Unnamed Tributary to Pembroke Creek Wetland and Stream Restoration

Chowan County, North Carolina, Project #D06102S

Final – Mitigation Plan

Prepared for:

North Carolina Department of the Environment and Natural Resources
Ecosystem Enhancement Program (NCDENR-EEP)
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Executive Summary

The restoration site contains an unnamed tributary to Pembroke Creek (UT Pembroke Creek) and was selected for wetland and stream restoration by the North Carolina Department of the Environmental and Natural Resources Ecosystem Enhancement Program (NCDENR-EEP). The purpose of the restoration project was to restore and enhance the headwater wetland/stream complex located within the Pasquotank River Basin.

The site is located 3.5 miles west-northwest of Edenton, Chowan County, North Carolina; specifically three miles west-northwest of the Route 17 Bypass and Route 32 interchange. The drainage area for this project, measured at the downstream end where the cell tower access road crosses the unnamed tributary to Pembroke creek is 0.4 square miles (265 acres). The drainage area at the northern portion of the project area is 0.08 square miles (50 acres).

Prior to construction the restoration site was evaluated for jurisdictional wetlands. This evaluation was based on the United States Army Corps of Engineers Wetland Delineation Manual 1987. In general, the investigator assessed the restoration site to determine which areas currently met the three (3) criteria listed in the delineation manual for wetland hydrology, hydric soils, and hydrophytic vegetation (USACE, 1987). The non-riparian wetlands within the restoration area were isolated into two (2) drainage features on the site which primarily existed along the western and eastern boundaries of the site and drained from north to south. The western drainage feature flowed through a small pond near the middle of the site before converging with the eastern drainage feature. Excluding the small pond, the jurisdictional wetlands within the restoration and enhancement areas were isolated to linear ditch features. The majority of the land within the restoration area was being used for agriculture. The linear maintained ditch features were effectively draining the field areas that were formerly wetlands.

The project goal for the restoration plan was to modify the ditch, based on reference conditions (e.g., reference cross-sections, hydrology, and vegetation), with the intent to restore its primary headwater wetland functions such as nutrient cycling, flood storage, and providing wildlife habitat. The ideal end product, once the wetland becomes established, will be a self maintaining vegetated corridor containing a diversity of native plant and animal species. The current base flow conditions have been modified to emulate reference conditions and to ensure that the necessary success criteria are met.

The restored wetland will function similarly to a bottomland hardwood forest (USACE, 2005), but will consist of Non-Riverine Wet Hardwood plant community, transitioning into a Coastal Plain Small Stream Swamp plant community, according to reference data. The wetland restoration will consists of two (2) communities within the wetland area and one community in transition areas as well as on hummocks within the restoration area. The two communities that will be represented within the wetland area will be the Non-Riverine Wet Hardwood Forest (Oak-Gum Slough Subtype) and the Coastal Plain Small Stream Swamp. The community type on hummocks and transition areas will consist of the Mesic Mixed Hardwood Forest (Coastal Plain Subtype). In general the project site will be restored as a bottomland hardwood wetland.

In addition to the restored areas, an area to the east of the restoration site will be preserved and left undisturbed. This area has no significant invasive species issues and includes Reference Wetland 1.

Six (6) acres of wetlands were enhanced and 17 acres of wetlands and 4,488 linear feet of headwater wetland corridor were restored. The headwater wetland corridor was created by filling in the eastern drainage feature north of the access road and creating microtopography throughout the site.

Table 1 – Restoration Summary Table

Post Project	
Headwater Wetland Valley	4,488 ft
Wetland Restoration	17.03 ac
Wetland Enhancement	5.99 ac
Preservation	26.67 ac

The ecological benefits of this project include improving water quality downstream by allowing nutrients and sediment to settle and be processed in the wetland. The natural terrestrial and aquatic habitats have been restored allowing for more diversity among plant and animal species. Non-native and invasive species have been removed which will create a more natural habitat for the animals living on the site.

The wetlands restored on this project site target establishing the water table near or at the surface. More specifically, the water table shall be within 12 inches of the soil surface continuously for greater than 5% of the growing season under normal rainfall conditions (USACE, 1987). The water table will be monitored by using 14 automated groundwater gauges within the restoration area and one (1) groundwater gauge in nearby Reference Area 1. Performance criteria may be defined more specifically based on long term reference data (USACE, 2002).

The restoration site was planted with species appropriate for the three (3) targeted community types on the site. For each community, the vegetation will be monitored on an annual basis to determine survival. This monitoring process will be conducted in an effort to show the survival of a diverse target community such that the restored site has survival at a density of 320 stems/acre after three (3) years. Data will be monitored using sample plots (USACE, 2003) and in accordance with the most recent version of the CVS-EEP document entitled “CVS-EEP Protocol for Recording Vegetation” (Lee et. al, 2007).

Some invasive species have been noted on the site. These include *Lonicera japonica*, *Microstegium vimineum*, *Ligustrum sinense*, and *Myriophyllum aquaticum*. These species were formerly isolated along or within the drainage ditches themselves. Weed seed sources were likely mobilized during construction; however, the increased saturation of the site should inhibit their growth. It will be important during monitoring site visits to check for any significant encroachment of invasive species and to develop a plan of action to control any such problem.

1.0 General Project Description

1.1 Location and Setting

The project site is approximately 3.5 miles west-northwest of Edenton, in Chowan County, North Carolina as depicted on **Figure 1**, Vicinity Map in **Section 1.0**. The site is specifically located approximately three (3) miles west-northwest of the Route 17 Bypass and Route 32 Interchange (exit 227). The project is located in USGS Cataloging Unit 03020105. To reach the site from the Route 17 Bypass, take Route 32 north approximately 1.2 miles then turn left onto Wildcat Road. Continue north on Wildcat Road for 1.8 miles. Approximately 1,000 feet before reaching the end of Wildcat Road where in intersects Macedonia Road, UT Pembroke Creek and the site will be on the left.

1.2 Restoration Summary

Several distinct conclusions can be drawn from analysis of the photographs and the information regarding historic land use. The 1927 tile drain schematic provided by the property owner and developed by the North Carolina Cooperative Extension Service indicates that circa 1927 the land was drained for the purposes of agriculture. The FSA information reviewed by Natural Systems Engineering (NSE) indicated that the majority of the site was designated as prior converted (PC) cropland. According to FSA records the PC call was made on June 12, 1990 (Form SCS CPA 026) farm serial number 1299 tract 204. Aerial photographs dating from 1948 until today indicate that the site has been used for agricultural purposes for at least the past 59 years, although it has likely been closer to 80 years. All of the facts reviewed for this site support the notion that the groundwater, vegetation, surface drainage, and potentially soil parameters have been modified. Soil structure and surface texture have been altered from intensive agricultural operations. Although most on-site soil series are classified as poorly drained, the ditching and lowering if the groundwater table on-site has caused these soils to be effectively drained. Further information regarding historical land use is presented in the Restoration Plan for this site (NSE, 2006).

The goal for the restoration project was to modify the channelized water features, based on reference conditions (e.g., reference cross-sections, hydrology, and vegetation), with the intent to restore the sites primary wetland functions such as nutrient cycling, flood storage, and providing wildlife habitat. The ideal end product, once the wetland becomes established, will be a self maintaining vegetated corridor containing a diversity of native plant and animal species. The current base flow conditions were modified to emulate reference conditions and to ensure that the necessary success criteria are met. The design was based on reference conditions, USACE guidance (USACE, 2005; USACE, 1987) and criteria that were developed during this project to achieve success. Reference conditions included reference cross-sections, hydrology, and vegetation. Physical restoration and the return of the overall biological and water quality functionality were accomplished by fulfilling the following objectives:

- Improve water quality in the basin by filtering nutrients through on-site wetlands
- Buffer flood flows downstream by increasing infiltration and storage areas
- Design a waterway through the wetland complex with the appropriate cross-section, slope, and pattern as to provide nutrient filtering, flood storage, and wildlife habitat while meeting the appropriate success criteria for the wetland
- Improve terrestrial and aquatic habitat diversity
- Establish a contiguous buffer along the project that can serve as a migration corridor for local fauna

- Ensure hydraulic stability of the restored waterway through the use of natural materials (i.e., log sills) to create the desired hydrology within the project site as guided by reference data
- Use natural materials and native vegetation into the proposed restoration design to the greatest extent possible
- Establish a native forested riparian plant community within the non-wetland buffer area
- Establish a headwater wetland community
- Provide an aesthetically pleasing landscape

Table 2 – Project Summary Table

Pre-Construction	
Channelized water feature (ditch)	5,391 ft
Wetlands[1]	1.6 ac
Post-Construction	**Mitigation Amount**
Headwater Wetland Valley	4,488 ft
Wetland Restoration	17.03 ac
Wetland Enhancement	5.99 ac
Preservation	26.67 ac

[1] – Pre project jurisdictional areas were confined to the ditch feature and pond area near station 21+00.

The Restoration Plan for the UT Pembroke Creek site outlined a method for restoring the existing heavily modified agricultural property into a natural headwater wetland feature. A pool and hummock complex was restored at the site to disrupt flow and retain water on-site to the greatest extent possible. Native vegetation was incorporated into the design using reference conditions as a guide. The existing ditches were filled and existing surface drainage was modified to promote the retention of water on site. Upon completion of grading activities the site was planted.

The restoration plan for the site will be described in two (2) parts to simplify discussion. The first portion of the site is extremely flat and begins where UT Pembroke Creek flows under Wildcat Road (SR 1208) and ends where the access road to the hog lagoon passes over UT Pembroke Creek. The second portion of the site has minor relief and begins at the east-west access road and ends where the cell tower access road crosses the ditch feature that is the UT to Pembroke Creek.

Near station 1+00 a wetland valley feature was used to divert the existing flow from the main ditch onto the site. The wetland valley dimensions are based on reference data and yielded a bottom width of 10 feet and side slopes of 1:8. The invert of the culvert under Wildcat Road is 17.0 feet, and the top of the pipe has an elevation of 19.0 feet. Setting the wetland valley invert at 18.0 feet allows 2.5 feet of water storage above the design invert, before water extends onto Wildcat Road. More importantly, the design elevation of 18.0 feet is based on measured water surface elevations therefore the project will not be creating a water surface increase for any upstream offsite properties or rights-of-way.

Filling the main ditch feature north of the access road required approximately 1,500 cubic yards of fill material. The wetland valley generated approximately 5,000 cubic yards of fill material. Placement of excess fill material outside of Area 1 or on areas above 21.0 feet within Area 1 ensured that a net gain of water storage capacity was achieved.

At station 11+00 the wetland valley transitions into the existing land surface. Small channels, hummock areas, and pools were created throughout the wetland area. Reference cross-sections indicated that approximately 30 percent of the "flat" wetted width had standing water or pools; therefore, approximately 30% of the project area was constructed to have standing water. Pool dimensions are based on reference data. Reference data used in the design was collected between April 13, 2006 and June 20, 2006. Material pushed aside to make pool areas were used for the creation of hummock areas.

At station 40+00 to 50+00 the surface was roughened and minor earthwork occurred to promote sheet flow. Small channels (6" to 12" deep by 6" to 12" wide) were created along the axis of Area 1B and also perpendicular across the valley. The conveyance of water across the valley will promote wetland hydrology near station 12+00 and possibly stations 11+00 and 10+00. The existing access road was modified to have a constant elevation with two (2) low areas that convey flow during large storm events. The elevation of these areas is 18.0 feet. Geoweb® material was used to reinforce the crossings and to also ensure the invert elevation of each crossing remains constant over time.

Downstream of the access road it is likely that the groundwater table will be at or near the surface during the majority of the year. The two (2) wetland valleys continue south until they combine near main ditch station 24+00. Once the two valleys combine, the easement area becomes narrow for the remainder of the project. Two (2) low areas in the road, similar in design to the areas along the access road, are located at the end of the project. The first low area in the road will allow flow from Reference Area 1 into the project site. The second low area will be higher than the first, and will assist in conveying large storm events.

A structure constructed of rock, logs, and coir matting was installed at the downstream end of the project site to transition flow from the restored headwater wetland area to the lower elevation of the existing ditch. The structure consists of four (4) pairs of logs and a small rock structure that forms a series of steps that transition flow from elevation 15.0 feet to elevation 10.0 feet. The steps were constructed within a 100-foot section of channel and the structure was designed to allow the establishment of vegetation so that over time, the vegetation will mask the structure and promote a more natural appearance.

2.0 Monitoring Plan

The methods, frequencies, and success criteria, for each monitoring element is listed below. A determination will be made regarding the success of the project following the collection and evaluation of ecological and physical monitoring data, photographs, site observations, and the performance of the restoration project during a five year period. Monitoring components that will be evaluated include wetland hydrology, vegetation, and stability of surface flow features. This report was prepared using the most recent EEP Mitigation Plan guidance document (EEP, 2005b) and also incorporated the relevant aspects of the monitoring guidelines (EEP, 2005a).

Headwater wetland systems have a variable water table. The restored wetland will function similarly to a bottomland hardwood forest (USACE, 2005), but consists of a Non-Riverine Wet Hardwood plant community, transitioning into a Coastal Plain Small Stream Swamp plant community, according to reference data (**Appendix 4**). Therefore, the wetlands restored on this project site shall target establishing the water table to be within 12 inches of the soil surface continuously for greater than 5% of the growing season under normal rainfall conditions (USACE, 1987). The water table will be monitored by using 14 automated groundwater gauges within the restoration area and one (1) groundwater gauge in nearby Reference Area 1. Performance criteria may be defined more specifically based on long term reference data (USACE, 2002).

The restoration site was planted with species appropriate for the three targeted community types on the site. For each community, the vegetation will be monitored on an annual basis to determine survival. This monitoring process will be conducted in an effort to show the survival of a diverse target community such that the restored site has survival at a density of 320 stems/acre after three (3) years. This data will be monitored using sample plots in accordance with the most recent version of the EEP document entitled "CVS-EEP Protocol for Recording Vegetation" (Lee et. al, 2007). Vegetative success criteria applies to wetland restoration, enhancement, and the headwater valley.

Natural channel erosion and sedimentation across the site will be monitored through observation and measurement of cross-sections. Four (4) permanent cross-sections were installed to record any aggradation or degradation within the site and to also show flow patterns and channel formation.

Four (4) road crossings were installed to allow occasional flow over the on-site roads during storm events. The crossings will be visually monitored during site visits to document any sediment deposition or other maintenance concerns.

Table 3 - Monitoring Summary

Parameter	Methodology	Frequency	Success Criteria	0 Year Data
Hydrology	Monitoring well readings Crest Gauges	Annually and as needed	Water table near or at the surface. The water table shall be within 12 inches of the soil surface for greater than 5% of the growing season.	Presented in Year 1 report
Vegetation	Stem counts within the 16 established vegetation plots	Annually between June and September	Stem survival greater than 320 stems/acre through year 3	681 stems/acre
Flow Features	Measurement of cross sections	Annually	No significant aggradation or degradation	See Cross-Section data

2.1 Hydrology

2.1.1 Methodology

Flooding events will be documented through on-site evidence such as wrack lines, crest gauges or through the measurement of flooding using monitoring wells. The water table will be monitored by using 14 automated groundwater gauges within the restoration area and one (1) groundwater gauge in nearby Reference Area 1. These monitoring wells have a sensor that is set to record groundwater depth every six (6) hours. Using a Meazura Rugged Digital Assistant the data is downloaded and stored in the field until it can be transferred onto a computer in the office where it can then be analyzed.

2.1.2 Frequency

Monitoring wells shall be inspected once a month during the growing season which begins in March and concludes in November. Site visits should be conducted, when possible, subsequent to known major rain events to ensure accuracy in well readings. The results of the inspection shall be documented for each well. Once documentation is complete, the wells will be reset to continue recording.

2.2.3 Success Criteria

The water table shall be within 12 inches of the soil surface continuously for greater than 5% of the growing season under normal rainfall conditions (USACE, 1987).

2.2.4 0-Year Data

Pre-construction monitoring was conducted in September 2007. The monitoring wells were removed prior to construction and were re-installed after construction was completed. The monitoring well data will be examined at the beginning of the growing season (March) and will be reported in the Year-1 monitoring report.

2.2 Vegetation

2.2.1 Methodology

Proposed vegetation monitoring will follow the criteria outlined in the NC EEP 2006 Monitoring Report Guidelines document (NC EEP, 2006) and the CVS-EEP 2007 vegetation monitoring training class. The taxonomic standard for vegetation that was applied was Flora of the Carolinas, Virginia, Georgia, northern Florida, and surrounding areas (Weakley, 2008). Based on discussions with EEP and the required plots spreadsheet set up by EEP, the project would normally require 11 vegetation plots along the stream/headwater wetland valley. To fully represent all plant community types in the project area, 16 vegetation plots were established with 11 inside the stream/headwater wetland valley and 5 in the restored wetland area. Monitoring will follow the CVS-EEP Protocol for Recording Vegetation Version 4.0 (Lee et al., 2006), Protocol Level 1, which stipulates measuring only planted stems. The taxonomic protocol used for identification must be documented so subsequent investigators will know how the identification was derived. All plots have dimensions of 10 by 10 meters. Each vegetation plot was monumented at all corners with recoverable markers made of galvanized pipe.

2.2.2 Frequency

The vegetation plots shall be inventoried and documented annually between June and September. This timeframe will ensure that the maximum number of characteristics will be present to properly identify each species within the plots.

2.2.3 Success Criteria

The vegetative success shall be based on the Wilmington District Army Corps of Engineers April 2003 mitigation guidelines. The survival rate for the planted woody species on the mitigation site should be greater than 320 stems per acre through year three (3). A ten (10) percent mortality rate will be acceptable in year four (4) (288 stems per acre) and an additional ten percent in year five (5) resulting in a required survival rate of 260 woody stems per acre through year five (5).

2.2.4 0-Year Data

Vegetation was established at the site after construction activities. Approximately 22,900 bare root seedlings were planted on the 33.5 acres in the project area during December 2007. This resulted in a density in excess of 681 stems per acre of woody vegetation. Plant species were selected based on geographic location, soil quality, existing local vegetation, and target plant communities. Perennial and annual seed mixes were broadcast in both of the established planting zones to aid in soil stabilization during construction and vegetation re-establishment. Temporary seed consisted of annual rye applied at a rate of 120 pounds per acre. Permanent seed consisted of a wetland seed mix. Wetland seed mix species and application rates were: Red Top (*Agrostis alba*, 2 pounds per acre), Wild Rye (*Elymus virginicus*, 5 pounds per acre), and Rush (*Juncus effuses*, 1/2 pound per acre).

Three vegetation zones were created within the project area. Zone 1 is located on the fridges of the wetlands and on larger hummocks. Zone 2 is located throughout the middle portion of the property excluding the eastern side of the project area. Zone 3 is located in the area below where Reference Wetland 1 drainage flows into the eastern drainage area. All of the zones were both planted with annual and perennial seed mixtures as indicated in the tables below.

Table 4 - Zone 1, Mesic Mixed Hardwood Forest

Common Name	Scientific Name	Description	Stems Planted
White Oak	*Quercus alba*	Bare Root	300
Swamp Chestnut Oak	*Quercus michauxxi*	Bare Root	400
Water Oak	*Quercus nigra*	Bare Root	400
Tulip Poplar	*Liriodendron tulipifera*	Bare Root	350
American Elm	*Ulmus Americana*	Bare Root	300
Common Elderberry	*Sambucus Canadensis*	Containerized	189
Red Top	*Agrostis alba*	Wetland Seed	Broadcast
Wild Rye	*Elymus virginicus*	Wetland Seed	Broadcast
Rush	*Juncus effuses*	Wetland seed	Broadcast
(Raeford et al., 1968)			

Table 5 - Zone 2, Non-Riverine Wet Hardwood Forest

Common Name	Scientific Name	Description	Stems Planted
Tulip Poplar	*Liriodendron tulipifera*	Bare Root	3,000
Swamp Tupelo	*Nyssa biflora*	Bare Root	3,050
Swamp Chestnut Oak	*Quercus michauxii*	Bare Root	3,100
Laural Oak	*Quercus laurifolia*	Bare Root	2,600
Water Oak	*Quercus nigra*	Bare Root	3,100
American Elm	*Ulmus americana*	Bare Root	3,100
Wax Myrtle	*Morella cerifera*	Containerized	3,100
Red Top	*Agrostis alba*	Wetland Seed	Broadcast
Wild Rye	*Elymus virginicus*	Wetland Seed	Broadcast
Rush	*Juncus effuses*	Wetland seed	Broadcast
(Raeford et al., 1968)			

Table 6 - Zone 3, Coastal Plain Small Stream Swamp

Common Name	Scientific Name	Description	Stems Planted
Tulip Poplar	*Liriodendron tulipifera*	Bare Root	250
Swamp Tupelo	*Nyssa biflora*	Bare Root	250
Overcup Oak	*Quercus lyrata*	Bare Root	200
Swamp Bay	*Persea palustris*	Bare Root	200
Virginia Sweetspire	*Itea virginica*	Containerized	101
Red Top	*Agrostis alba*	Wetland Seed	Broadcast
Wild Rye	*Elymus virginicus*	Wetland Seed	Broadcast
Rush	*Juncus effuses*	Wetland seed	Broadcast
(Raeford et al., 1968)			

2.3 Site Geomorphology

2.3.1 Methodology

Flow features will be monitored by measuring the four (4) established cross-sections. Cross section diagrams are included in **Appendix 2.0**.

2.3.2 Frequency

The cross-sections will be surveyed annually or as needed in cases where severe aggradation and/or degradation have been observed.

2.3.3 Success Criteria

The overland flow component shall be deemed successful if conditions become stable over time. This will be evaluated annually and will be documented through measurement of the established cross-sections.

2.3.4 0-Year Data

Baseline data was collected during the As-Built survey which was conducted on November 28-30, 2007. Year 1 monitoring data will be compared to 0-Year data to evaluate any problem areas and determine if aggradation or degradation is occurring at the site.

3.0 Maintenance and Contingency Plans

At least annually during monitoring and any problem areas will be noted by site personnel and the information will be provided to the Ecosystem Enhancement Program (EEP). EEP will evaluate the problem at that time and determine the best course of action. Site visits will also be conducted by the monitoring contractor and EEP on an occasional basis throughout the year to identify potential problem areas. This approach of frequent site visits will ensure that any developing problem can be addressed before it poses a major risk to the success of the project.

4.0 References

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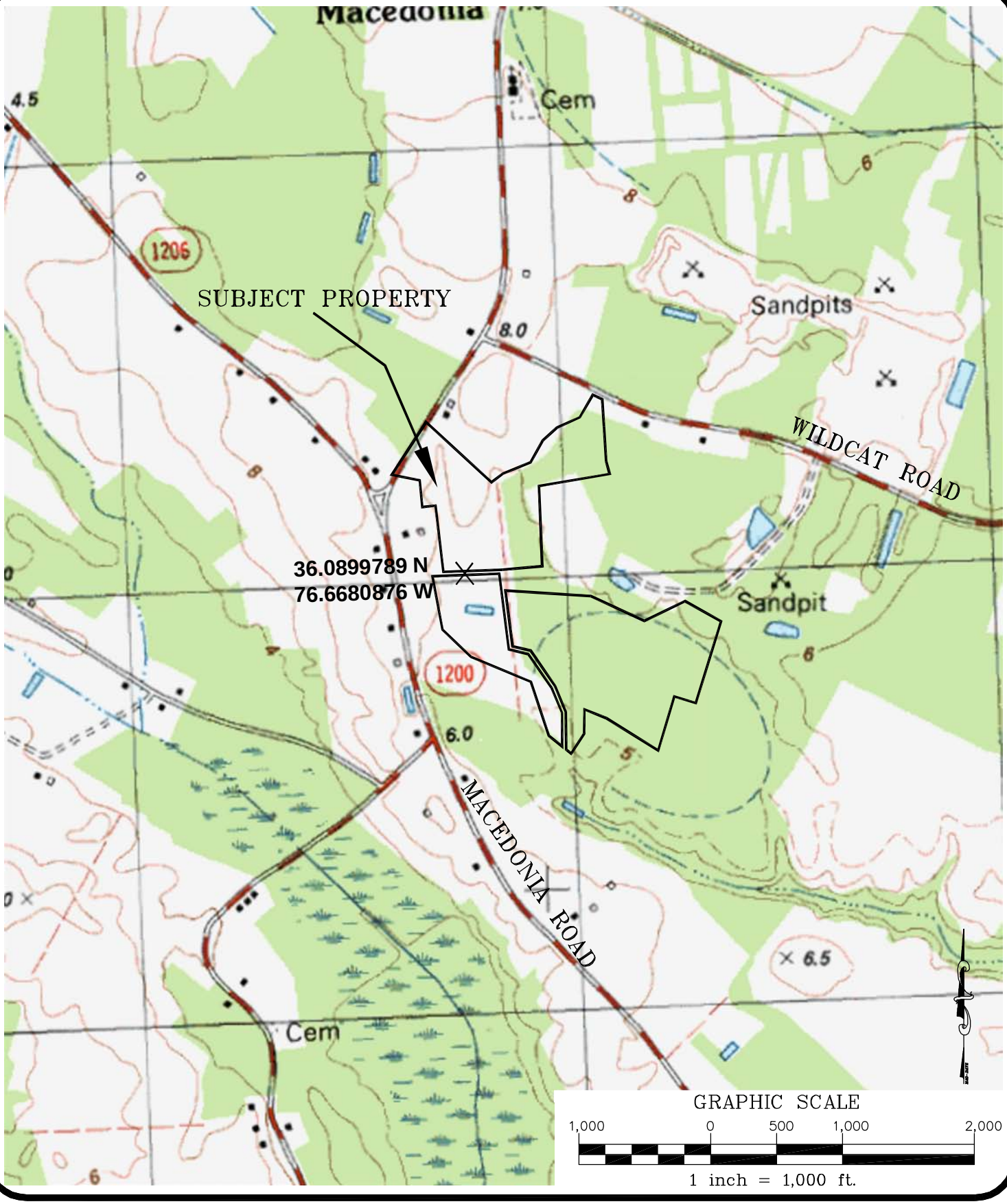
Section 1.0 Figures



PROJECT NO.	EEP-06010
FILENAME:	EEP06010X.DWG
SCALE:	1"=1,000'
DATE:	10-20-08

FIGURE 1 VICINITY MAP
UT PEMBROKE CREEK
EDENTON
CHOWAN COUNTY, NORTH CAROLINA
USGS HUC 03020105

McADAMS

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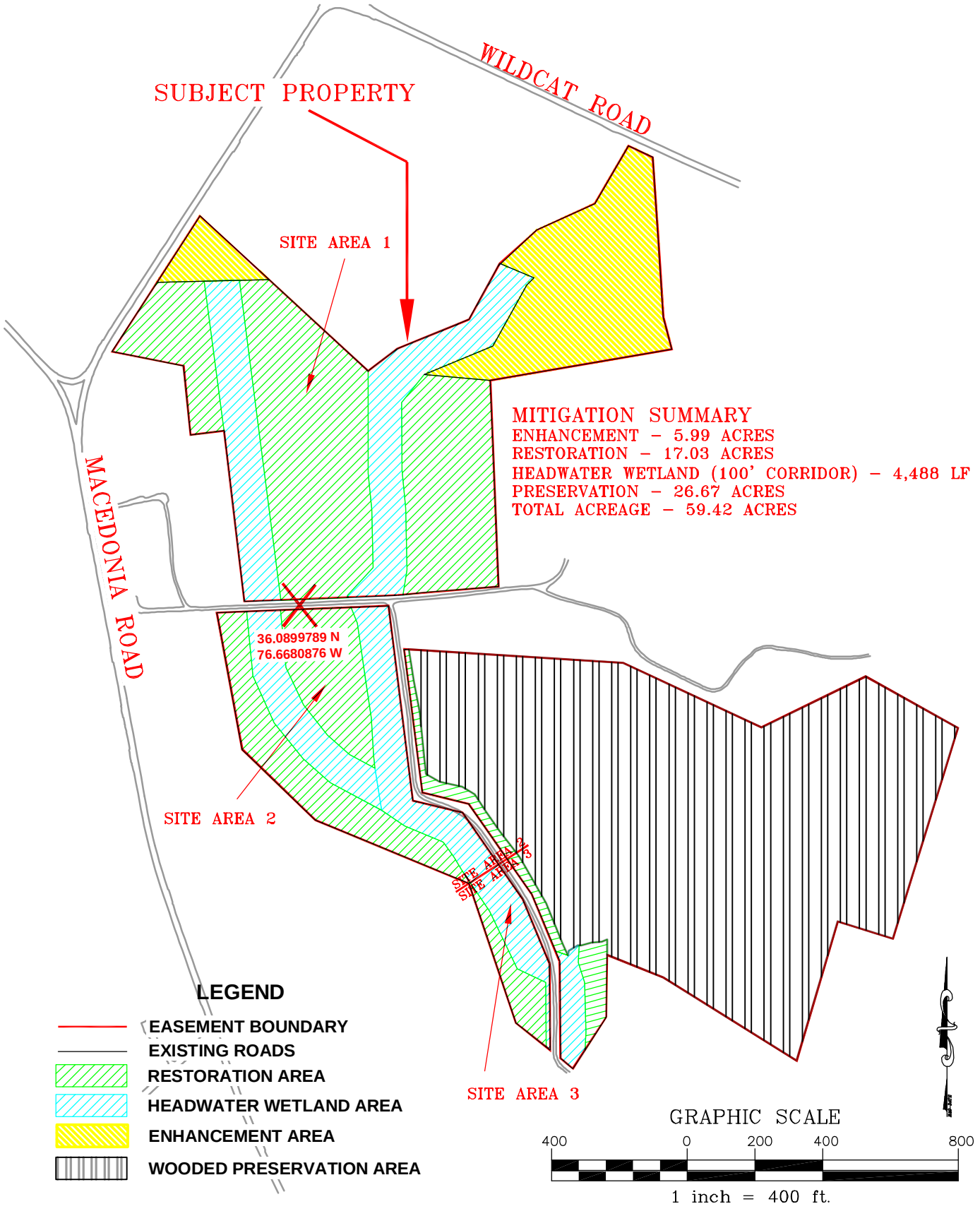

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DATE:	10–20–08

FIGURE 2 MITIGATION SUMMARY
UT PEMBROKE CREEK
EDENTON
CHOWAN COUNTY, NORTH CAROLINA
USGS HUC 03020105

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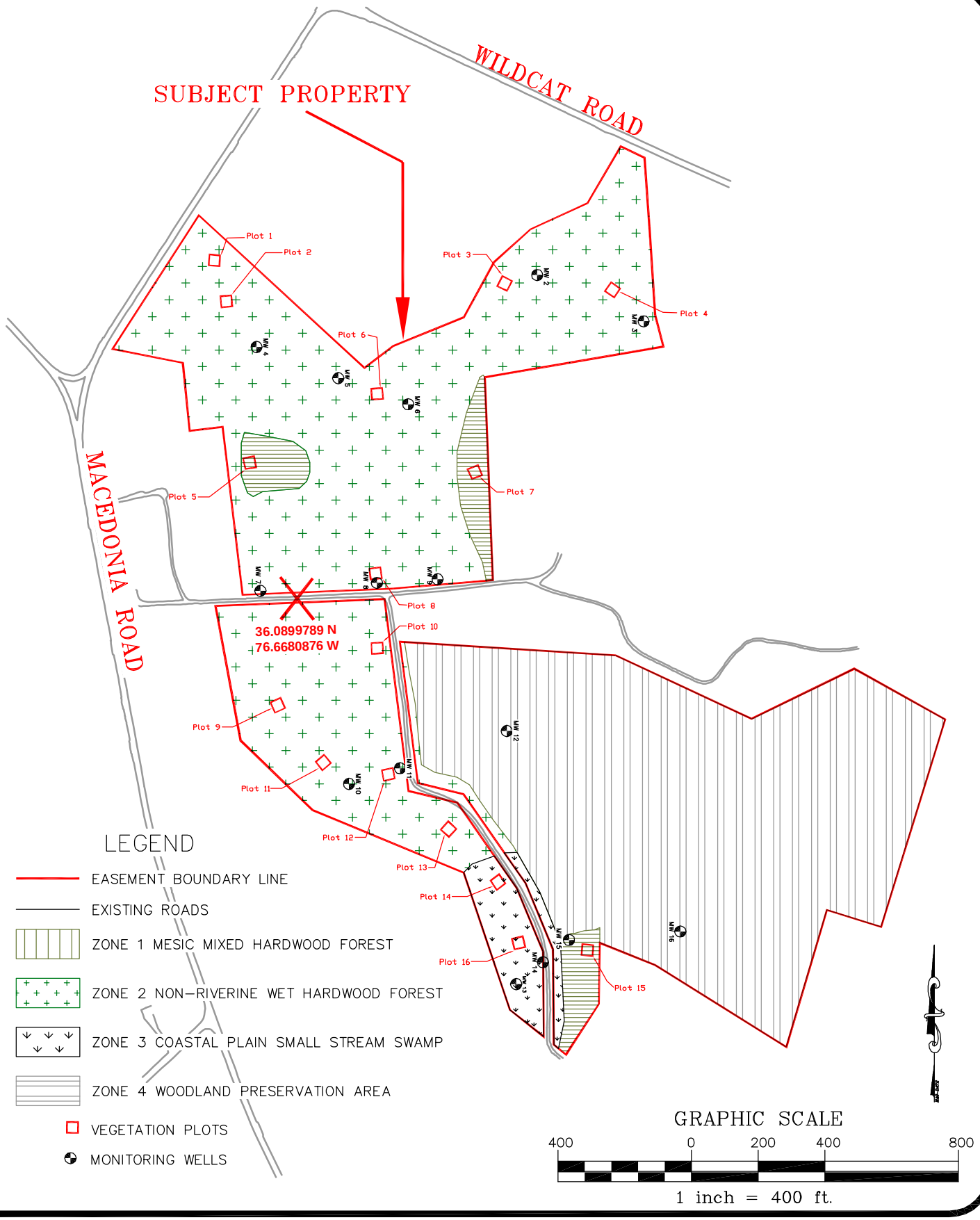

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FIGURE 3 VEGETATION PLOTS
UT PEMBROKE CREEK
EDENTON
CHOWAN COUNTY, NORTH CAROLINA
USGS HUC 03020105

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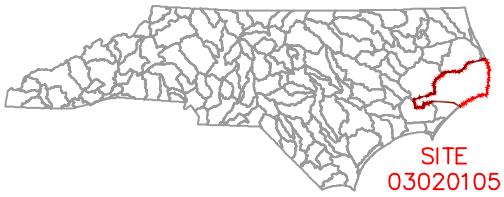

NOTE:
REFERENCE SITES LOCATED ON PRIVATE PROPERTY. NO ACCESS WITHOUT OWNER PERMISSION.

GRAPHIC SCALE

10,000 0 5,000 10,000 20,000

1 inch = 10,000 ft.

PROJECT NO.	EEP-06010
FILENAME:	EEP06010X.DWG
SCALE:	1"=10,000'
DATE:	10-20-08

FIGURE 4 REFERENCE SITE LOCATIONS
UT PEMBROKE CREEK
EDENTON
CHOWAN COUNTY, NORTH CAROLINA
USGS HUC 03020105

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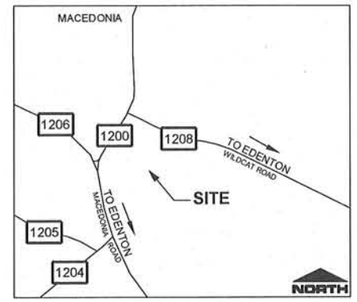
Section 2.0 Appendices

Appendix 1
Record Drawings
UT to Pembroke Wetland and Stream Restoration Project

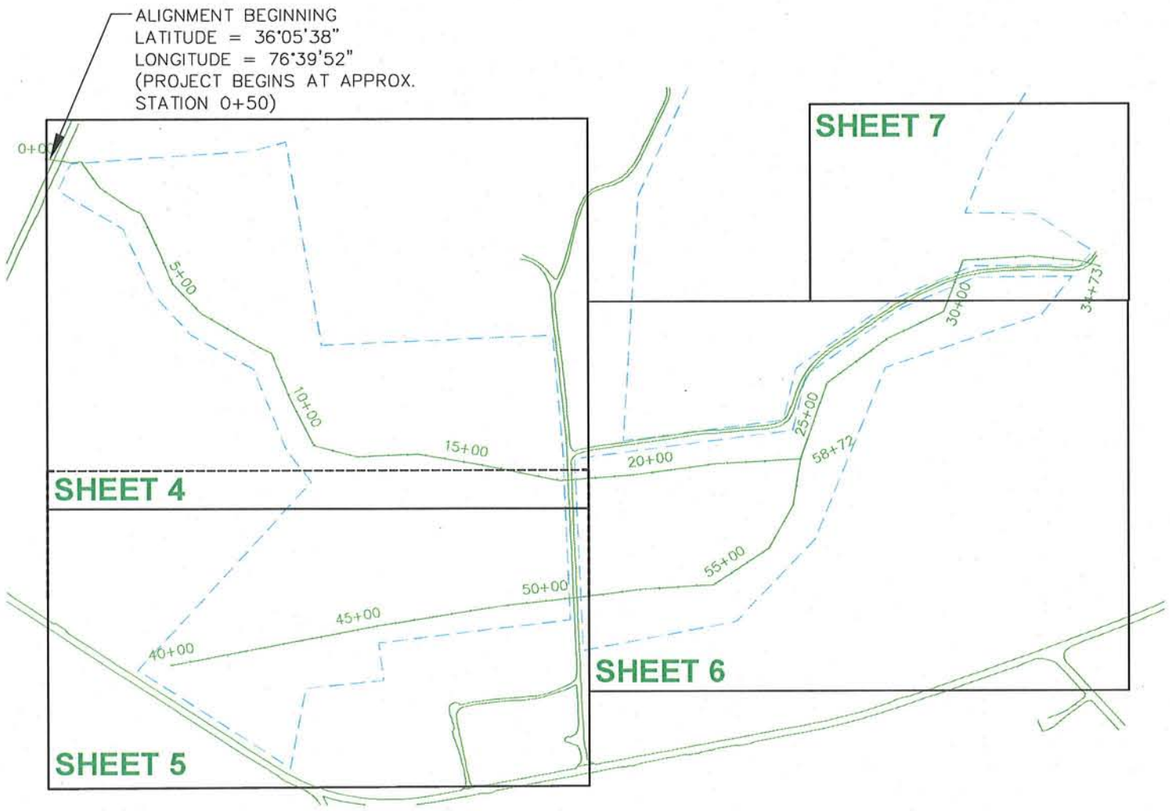
RECORD DRAWINGS - UT TO PEMBROKE CREEK STREAM AND WETLAND RESTORATION PROJECT EDENTON, CHOWAN COUNTY, NORTH CAROLINA

NC ECOSYSTEM ENHANCEMENT PROGRAM PROJECT

SCO# 050658801



VICINITY MAP EDENTON, NC
NOT TO SCALE



GENERAL NOTES

1. PREPARED FOR NC ECOSYSTEM ENHANCEMENT PROGRAM, 1652 MAIL SERVICE CENTER, RALEIGH, NC 27699-1652.
2. THE TOTAL EASEMENT ACREAGE FOR THIS PROJECT IS 59.42 ACRES.
3. THE SENIOR DESIGN CONTACT FOR THIS PROJECT IS JAMES M. HALLEY, PE OF THE JOHN R. MCADAMS COMPANY, 919-361-5000.
4. THE EEP PROJECT MANAGER IS TRACY MORRIS, 919-715-1658.
5. THE EEP REVIEW COORDINATOR IS LIN XU, PE, 919-715-7571.
6. THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES PROJECT NUMBER IS D06102S.
7. A BOUNDARY SURVEY WAS NOT PERFORMED WHILE OBTAINING THE FIELD SURVEYED DATA SHOWN HEREON AND THIS SET OF RECORD DRAWINGS WAS PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT AND IS SUBJECT TO ANY FACTS AND EASEMENTS WHICH MAY BE DISCLOSED BY A FULL AND ACCURATE TITLE SEARCH.
8. BOUNDARY INFORMATION SHOWN HEREON BASED ON A CONSERVATION EASEMENT SURVEY PREPARED BY NATURAL SYSTEMS ENGINEERING AND RECORDED IN PLAT CABINET NUMBER 2, SLIDE 34G OF THE CHOWAN COUNTY REGISTER OF DEEDS.
9. PHYSICAL FEATURES SHOWN HEREON SUCH AS BUILDINGS AND ROADWAYS ARE BASED ON AN AERIAL TOPOGRAPHIC SURVEY PREPARED BY GEODATA CORPORATION UNDER THE SUPERVISION OF JAMES M. SALMONS, PLS, PPS, LICENSE NUMBER L-4041 FROM MARCH 24, 2006 AERIAL PHOTOGRAPHY.
10. FIELD SURVEYED SPOT ELEVATIONS AND THE TOPOGRAPHIC DATA SHOWN HEREON OBTAINED BY GPS METHOD. THE DATA WAS DERIVED BY KINEMATIC GPS OBSERVATIONS USING A TRIMBLE R8 RECIEVER ON-SITE AND THE NCGS NETWORK RTK SYSTEM FROM 11-28-2007 TO 11-30-2007. THE DERIVED HORIZONTAL PRECISION ON POINTS ESTABLISHED ON-SITE IS 0.031'. THE ELEVATIONS ARE BASED ON THE NAVD 88 VERTICAL DATUM AND THE NC GRID (NAD 83) HORIZONTAL DATUM.
11. PLANTING WAS COMPLETED ON DECEMBER 18, 2007 - DECEMBER 19, 2007. THE VEGETATION PLOTS WERE LOCATED USING A TRIMBLE GEO XT SUBMETER GPS UNIT ON THESE DATES.

BASIS OF BEARINGS:
NC GRID, NAD 83

400 0 200 400

SCALE: 1" = 400'

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY 10-23-08

SHEET INDEX:

SHEET 1 OF 10

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TITLE AND INDEX SHEET
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO: EEP-06010
FILENAME: AS-BUILTS
SCALE: 1" = 400'
DATE: 10-20-08

McADAMS

DETAIL KEY

LEGEND

- EASEMENT BOUNDARY LINE
- ROADS
- FENCE
- 21.0 DESIGN CONTOUR
- 20.0 EXISTING CONTOUR
- HUMMOCK CREATION LINE
- FINE GRADING LIMIT
- OVERHEAD UTILITIES
- HEADWATER VALLEY CENTERLINE
- TREE LINES / WOODS
- UTILITY POLE
- MW 1 MONITORING WELL
- +16.5 SPOT GROUND ELEVATION
- RUINS STRUCTURES
- ROAD CROSSING
- DESIGN SURFACE FLOW DIRECTION
- GRADE TRANSITION
- RIP RAP

SHEET 2 OF 10

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LEGEND

UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	NOT TO SCALE
DATE:	10-20-08

McADAMS

NOTE: BOUNDARY INFORMATION SHOWN HEREON BASED ON A CONSERVATION EASEMENT SURVEY PREPARED BY NATURAL SYSTEMS ENGINEERING AND RECORDED IN PLAT CABINET NUMBER 2, SLIDE 34G OF THE CHOWAN COUNTY REGISTER OF DEEDS.

NOTE: FEATURES SHOWN IN GREEN ARE BASED ON AN AERIAL TOPOGRAPHIC SURVEY PREPARED BY GEODATA CORPORATION UNDER THE SUPERVISION OF JAMES M. SALMONS, PLS, PPS, LICENSE NUMBER L-4041 FROM MARCH 24, 2006 AERIAL PHOTOGRAPHY.

NOTE: FIELD SURVEYED SPOT ELEVATIONS AND THE TOPOGRAPHIC DATA SHOWN HEREON OBTAINED BY GPS METHOD. THE DATA WAS DERIVED BY KINEMATIC GPS OBSERVATIONS USING A TRIMBLE R8 RECIEVER ON-SITE AND THE NCGS NETWORK RTK SYSTEM FROM 11-28-2007 TO 11-30-2007. THE DERIVED HORIZONTAL PRECISION ON POINTS ESTABLISHED ON-SITE IS 0.031'. THE ELEVATIONS ARE BASED ON THE NAVD 88 VERTICAL DATUM AND THE NC GRID (NAD 83) HORIZONTAL DATUM.

CROSS-SECTION 1

CROSS-SECTION 2

CROSS-SECTION 3

CROSS-SECTION 4

AREA 1A1

AREA 1A2

AREA 1

AREA 1B

AREA 2

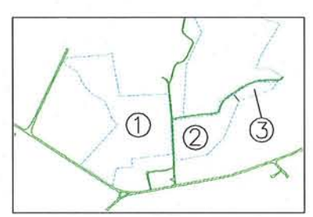
AREA 3

FINE GRADING LIMITS

HUMMOCK CREATION INSIDE LIMIT LINE

NORTH CAROLINA PROFESSIONAL SEAL L-4163 LAND SURVEYOR JOSEPH N. GRADY, JR
10/21/2008

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY
10-23-08



AREA INDEX MAP

GRAPHIC SCALE

200 0 100 200 400

1 inch = 200 ft.

SHEET 3 OF 10

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POST-CONSTRUCTION CONDITIONS

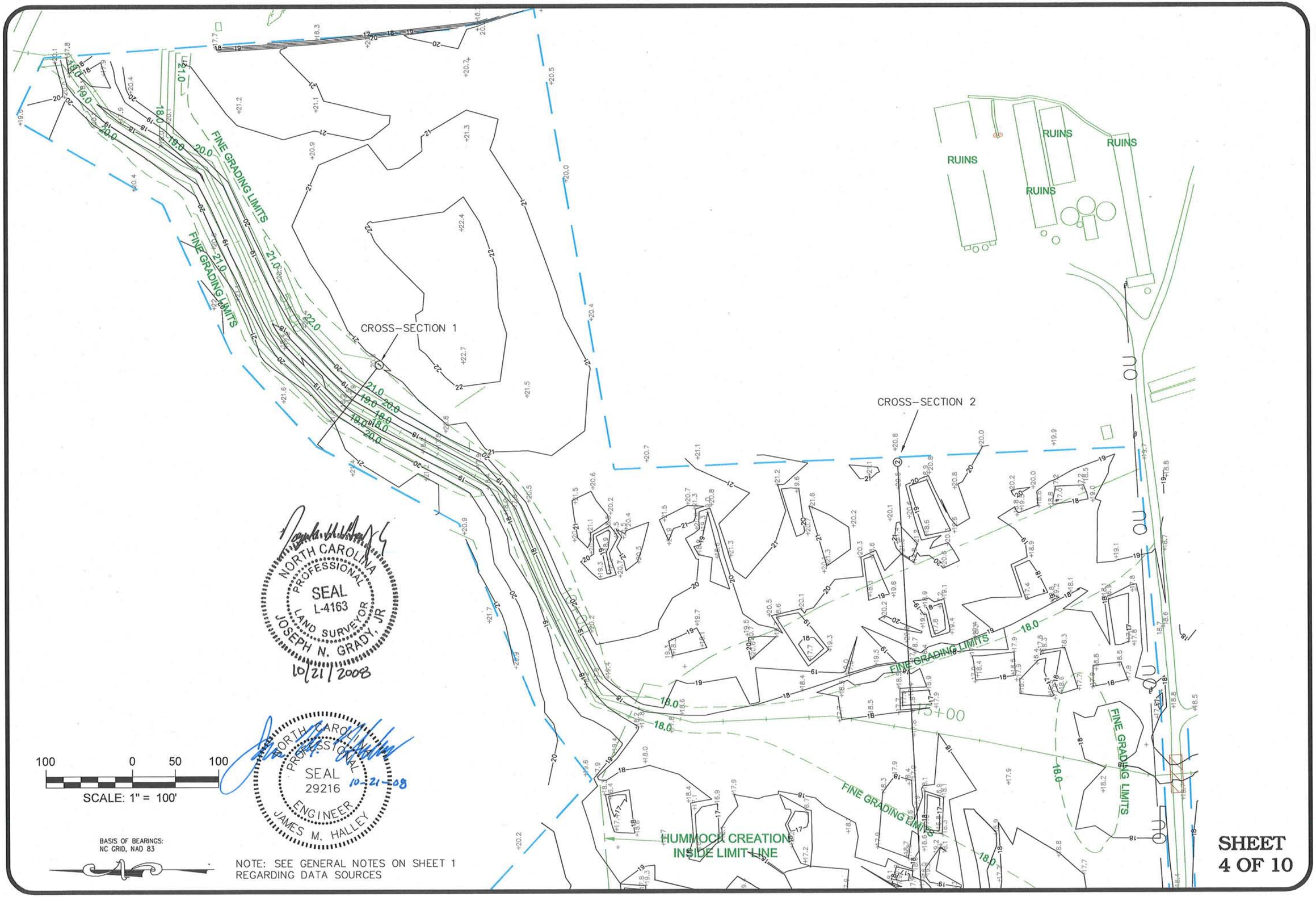
UT to PEMBROKE CREEK

STREAM AND WETLAND RESTORATION

CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1"= 200'
DATE:	10-20-08

McADAMS



NORTH CAROLINA PROFESSIONAL SEAL L-4163 LAND SURVEYOR JOSEPH N. GRADY, JR 10/21/2008

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY 10-21-08

NOTE: SEE GENERAL NOTES ON SHEET 1 REGARDING DATA SOURCES

SHEET 4 OF 10

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AREAS 1A1 & 1A2
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1" = 100'
DATE:	10-20-08

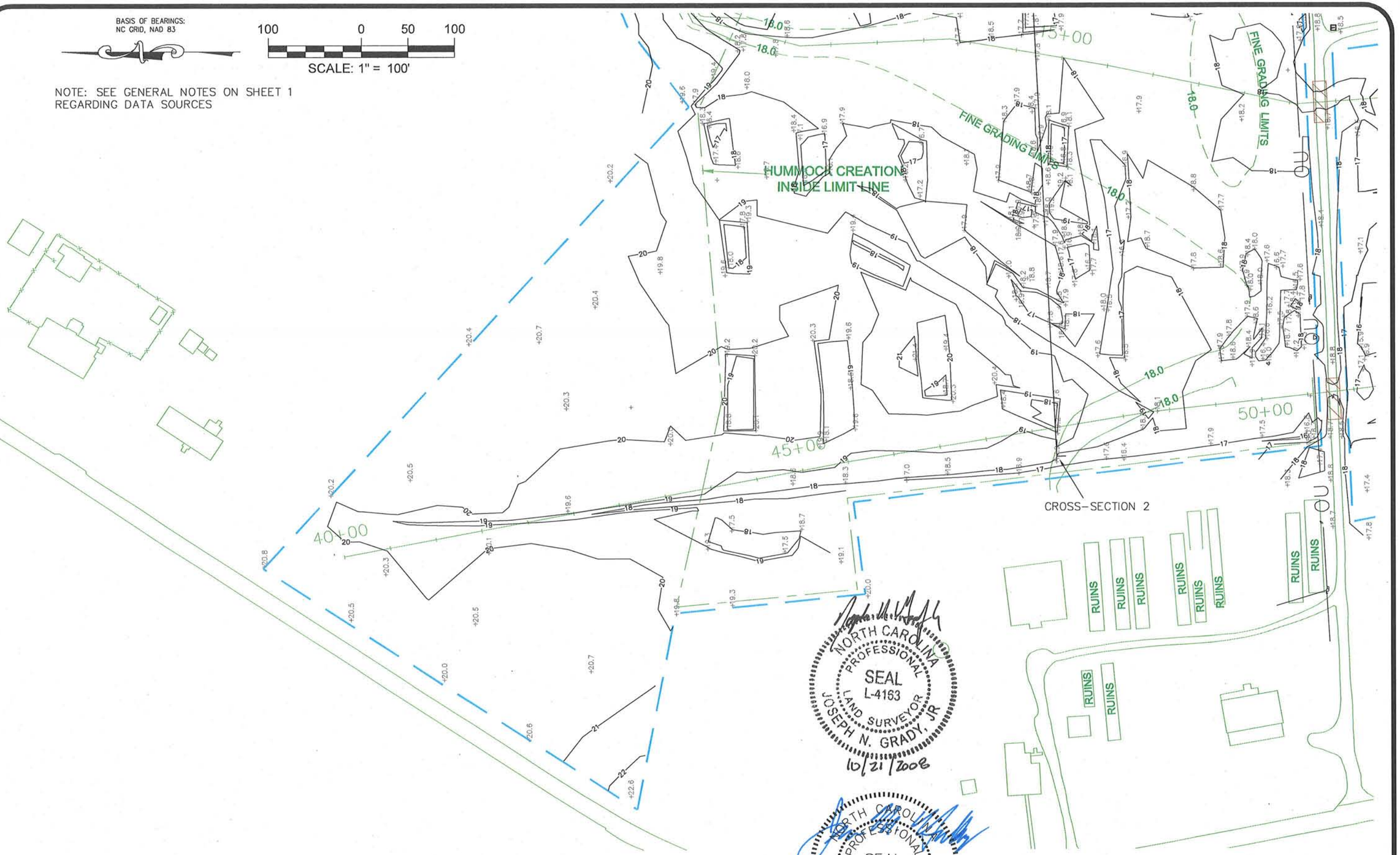
McADAMS

BASIS OF BEARINGS:
NC GRID, NAD 83

100 0 50 100

SCALE: 1" = 100'

NOTE: SEE GENERAL NOTES ON SHEET 1
REGARDING DATA SOURCES



NORTH CAROLINA PROFESSIONAL SEAL L-4163 LAND SURVEYOR JOSEPH N. GRADY, JR
10/21/2008

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY
10-21-08

SHEET 5 OF 10

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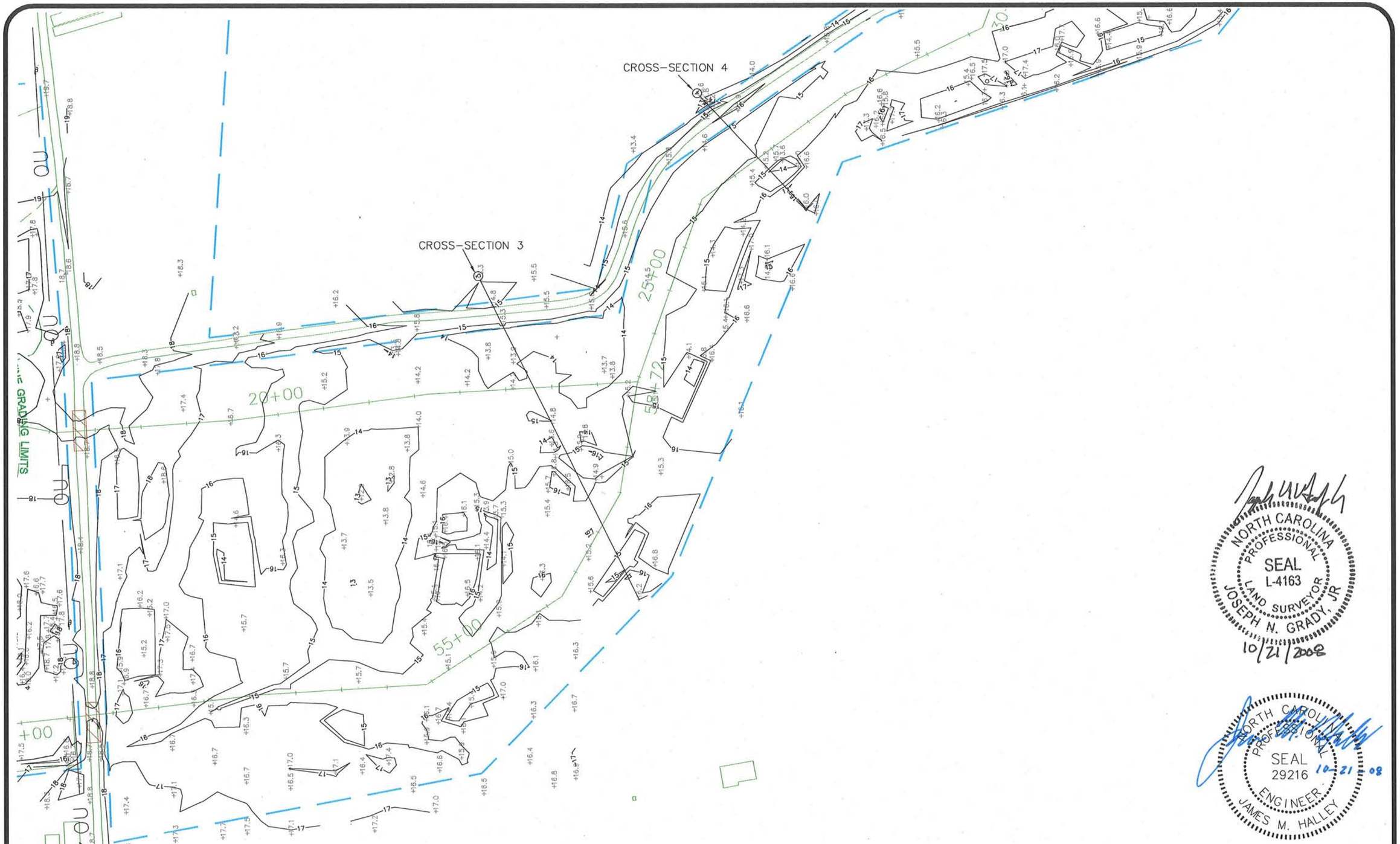
AREA 1B
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1" = 100'
DATE:	10-20-08

McADAMS



NOTE: SEE GENERAL NOTES ON SHEET 1
REGARDING DATA SOURCES

BASIS OF BEARINGS:
NC GRID, NAD 83

100 0 50 100
SCALE: 1" = 100'

NORTH CAROLINA PROFESSIONAL SEAL L-4163 LAND SURVEYOR JOSEPH N. GRADY, JR
10/21/2008

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY
10-21-08

SHEET 6 OF 10

AREA 2
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

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PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1" = 100'
DATE:	10-20-08

McADAMS

BASIS OF BEARINGS:
NC GRID, NAD 83

GRAPHIC SCALE

50 0 25 50 100

1 inch = 50 ft.

NOTE: SEE GENERAL NOTES ON SHEET 1
REGARDING DATA SOURCES

CROSS-SECTION 4

SEE INSET MAP FOR
GRADE CONTROL
ELEVATIONS

30+00

34+

NORTH CAROLINA
PROFESSIONAL
SEAL
L-4163
LAND SURVEYOR
JOSEPH N. GRADY, JR
10/21/2008

NORTH CAROLINA
PROFESSIONAL
SEAL
29216
ENGINEER
JAMES M. HALLEY
10-21-08

SHEET
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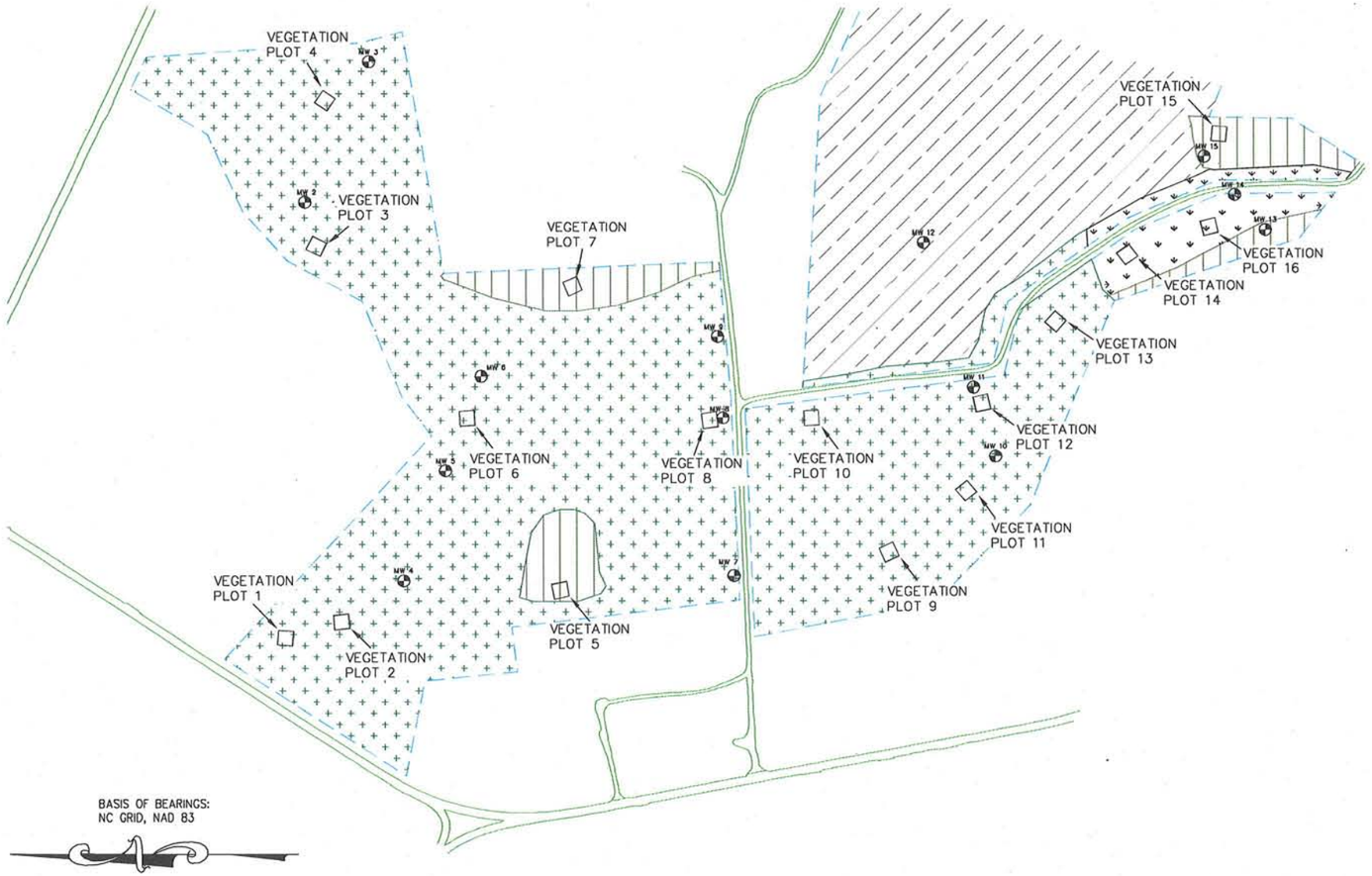
AREA 3
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1" = 50'
DATE:	10-20-08

McADAMS



NOTE: SEE GENERAL NOTES ON SHEET 1
REGARDING DATA SOURCES

GRAPHIC SCALE

300 0 150 300 600

1 inch = 300 ft.

ZONE 1
VEGETATION

COMMON NAME	SCIENTIFIC NAME	DESCRIPTION	STEMS PLANTED
WHITE OAK	QUERCUS ALBA	BARE ROOT	300
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	BARE ROOT	400
WATER OAK	QUERCUS NIGRA	BARE ROOT	400
TULIP POPLAR	LIRIODENDRON TULIPIFERA	BARE ROOT	350
AMERICAN ELM	ULMUS AMERICANA	BARE ROOT	300
COMMON ELDERBERRY	SAMBUCUS CANADENSIS	CONTAINERIZED	189
RED TOP	AGROSTIS ALBA	WETLAND SEED	BROADCAST
WILD RYE	ELYMUS VIRGINICUS	WETLAND SEED	BROADCAST
RUSH	JUNCUS EFFUSES	WETLAND SEED	BROADCAST

ZONE 2
VEGETATION

COMMON NAME	SCIENTIFIC NAME	DESCRIPTION	STEMS PLANTED
TULIP POPLAR	LIRIODENDRON TULIPIFERA	BARE ROOT	3,000
SWAMP TUPELO	NYSSA BIFLORA	BARE ROOT	3,050
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	BARE ROOT	3,100
LAURAL OAK	QUERCUS LAURIFOLIA	BARE ROOT	2,600
WATER OAK	QUERCUS NIGRA	BARE ROOT	3,100
AMERICAN ELM	ULMUS AMERICANA	BARE ROOT	3,100
WAX MYRTLE	MORELLA CERIFERA	CONTAINERIZED	3,100
RED TOP	AGROSTIS ALBA	WETLAND SEED	BROADCAST
WILD RYE	ELYMUS VIRGINICUS	WETLAND SEED	BROADCAST
RUSH	JUNCUS EFFUSES	WETLAND SEED	BROADCAST

ZONE 3
VEGETATION

COMMON NAME	SCIENTIFIC NAME	DESCRIPTION	STEMS PLANTED
TULIP POPLAR	LIRIODENDRON TULIPIFERA	BARE ROOT	250
SWAMP TUPELO	NYSSA BIFLORA	BARE ROOT	250
OVERCUP OAK	QUERCUS LYRATA	BARE ROOT	200
SWAMP BAY	PERSEA PALUSTRIS	BARE ROOT	200
VIRGINIA SWEETSPIRE	ITEA VIRGINICA	CONTAINERIZED	101
RED TOP	AGROSTIS ALBA	WETLAND SEED	BROADCAST
WILD RYE	ELYMUS VIRGINICUS	WETLAND SEED	BROADCAST
RUSH	JUNCUS EFFUSES	WETLAND SEED	BROADCAST

*NOTE: PLANTING WAS COMPLETED ON DECEMBER 18, 2007 – DECEMBER 19, 2007. THE VEGETATION PLOTS WERE LOCATED USING A TRIMBLE GEO XT SUBMETER GPS UNIT ON THESE DATES.

LEGEND

- EASEMENT BOUNDARY LINE
- EXISTING ROADS
- ZONE 1 MESIC MIXED HARDWOOD FOREST
- ZONE 2 NON-RIVERINE WET HARDWOOD FOREST
- ZONE 3 COASTAL PLAIN SMALL STREAM SWAMP
- ZONE 4 WOODLAND PRESERVATION AREA

NORTH CAROLINA PROFESSIONAL SEAL 29216 ENGINEER JAMES M. HALLEY 10-21-08

SHEET 8 OF 10

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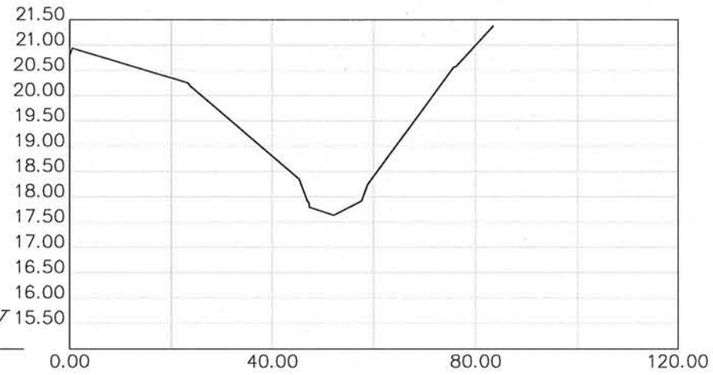
SITE VEGETATION

UT to PEMBROKE CREEK
WETLAND AND STREAM RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

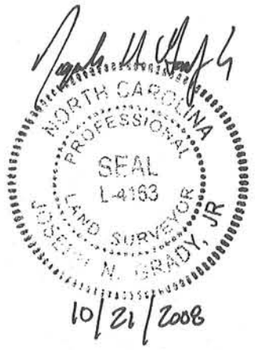
PROJECT NO. EEP-06010
FILENAME: AS-BUILTS
SCALE: 1" = 300'
DATE: 10-20-08

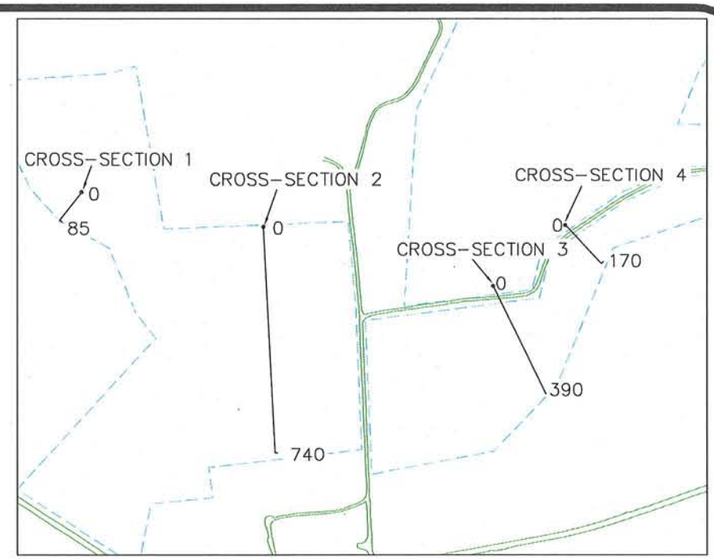
McADAMS

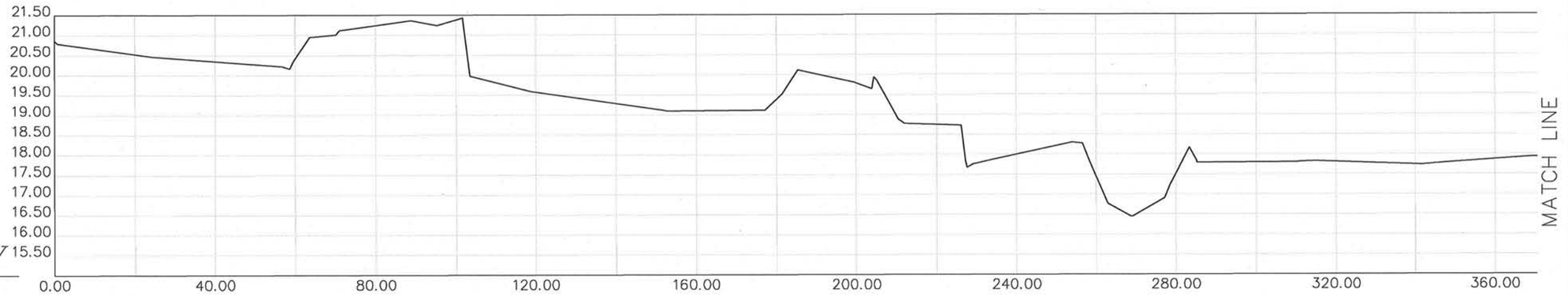


DATUM ELEV
15.00

GROUP AS-BUILT
SECTION 1 0-YEAR DATA







DATUM ELEV
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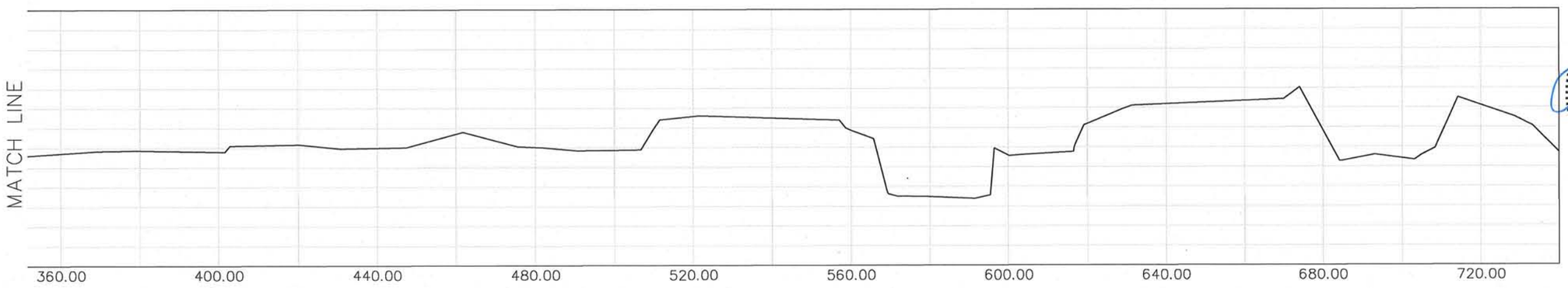
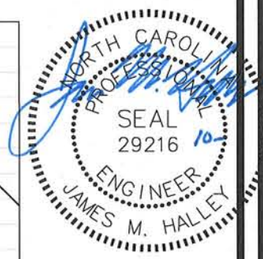
GROUP AS-BUILT
SECTION 2 0-YEAR DATA





SHEET 9 OF 10

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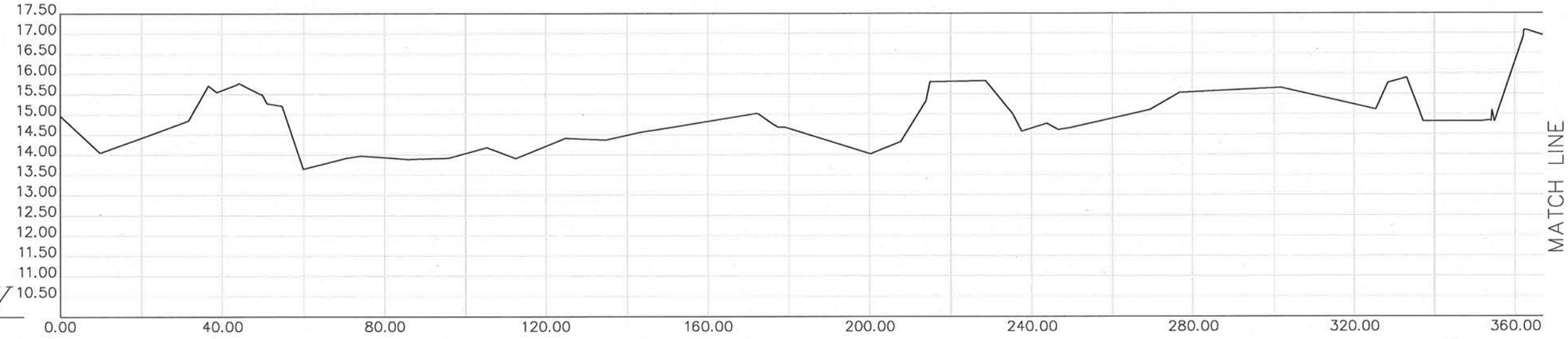
CROSS-SECTIONS
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

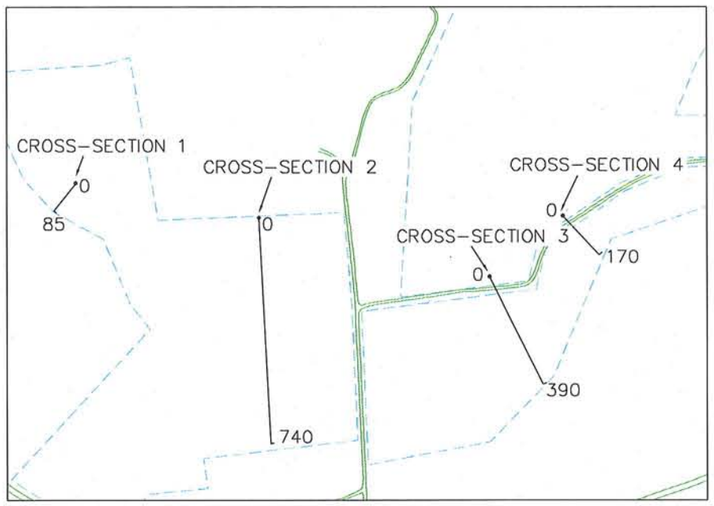
PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1"= 30'
DATE:	10-20-08

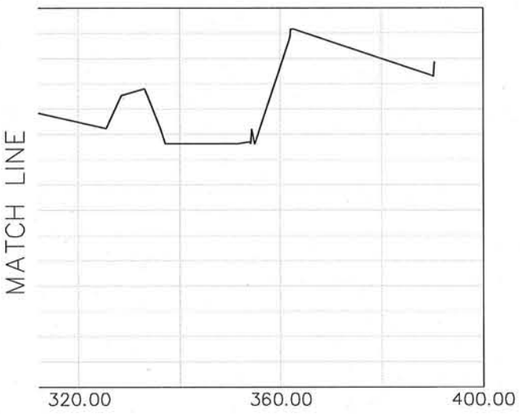
McADAMS

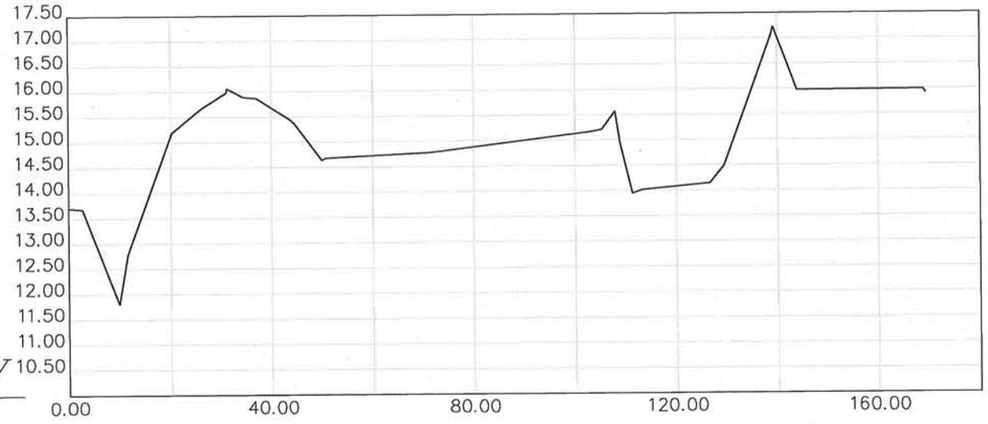


DATUM ELEV
10.00

GROUP AS-BUILT
SECTION 3 0-YEAR DATA







DATUM ELEV
10.00

GROUP AS-BUILT
SECTION 4 0-YEAR DATA

SHEET
10 OF 10

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CROSS-SECTIONS
UT to PEMBROKE CREEK
STREAM AND WETLAND RESTORATION
CHOWAN COUNTY, NORTH CAROLINA

PROJECT NO.	EEP-06010
FILENAME:	AS-BUILTS
SCALE:	1" = 30'
DATE:	10-20-08

McADAMS

Appendix 2
Vegetation Data

Table 1: Plots

Plot	Plot Level	Year	Northing	Easting	Datum	Date Sampled	Planted Living Stems	Planted Living Stems (excluding Live Stakes)	Dead/Missing Stems	Natural Stems	Total Living Stems	Total Living Stems (excluding Live Stakes)	Plated Living Stems per Acre	Planted Living Stems (excluding Live Stakes per Acre)	Total Living Stems per Acre	Total Living Stems (excluding Live Stakes per Acre)	# Species
Plot 1	1	0	860817.88	2688648.83	NAD83/WGS84	1/7/2008	14	14	0	0	14	14	566.5599002	566.5599002	566.5599002	566.5599002	4
Plot 2	1	0	860695.5	2688684.07	NAD83/WGS84	1/7/2008	11	11	0	0	11	11	445.1542073	445.1542073	445.1542073	445.1542073	3
Plot 3	1	0	860748.71	2689518.60	NAD83/WGS84	1/7/2008	17	17	0	0	17	17	687.9655931	687.9655931	687.9655931	687.9655931	6
Plot 4	1	0	860730.32	2689841.77	NAD83/WGS84	1/7/2008	14	14	0	0	14	14	566.5599002	566.5599002	566.5599002	566.5599002	2
Plot 5	1	0	860212.3	2688754.21	NAD83/WGS84	1/7/2008	15	15	0	0	15	15	607.0284645	607.0284645	607.0284645	607.0284645	4
Plot 6	1	0	860418.21	2689135.64	NAD83/WGS84	1/7/2008	12	12	0	0	12	12	485.6227716	485.6227716	485.6227716	485.6227716	5
Plot 7	1	0	860182.80	2689429.38	NAD83/WGS84	1/7/2008	13	13	0	0	13	13	526.0913359	526.0913359	526.0913359	526.0913359	5
Plot 8	1	0	859880.43	2689131.2	NAD83/WGS84	1/7/2008	14	14	0	0	14	14	566.5599002	566.5599002	566.5599002	566.5599002	5
Plot 9	1	0	859485.41	2688837.86	NAD83/WGS84	1/7/2008	18	18	0	0	18	18	728.4341574	728.4341574	728.4341574	728.4341574	5
Plot 10	1	0	859656.25	2689136.73	NAD83/WGS84	1/7/2008	12	12	0	0	12	12	485.6227716	485.6227716	485.6227716	485.6227716	5
Plot 11	1	0	859313.66	2688974.63	NAD83/WGS84	1/7/2008	15	15	0	0	15	15	607.0284645	607.0284645	607.0284645	607.0284645	6
Plot 12	1	0	859278.04	2689169.08	NAD83/WGS84	1/7/2008	14	14	0	0	14	14	566.5599002	566.5599002	566.5599002	566.5599002	5
Plot 13	1	0	859114.35	2689350.17	NAD83/WGS84	1/7/2008	15	15	0	0	15	15	607.0284645	607.0284645	607.0284645	607.0284645	7
Plot 14	1	0	858955.49	2689498.78	NAD83/WGS84	1/7/2008	14	14	0	0	14	14	566.5599002	566.5599002	566.5599002	566.5599002	5
Plot 15	1	0	858751.7	2689766.42	NAD83/WGS84	1/7/2008	12	12	3	0	12	12	485.6227716	485.6227716	485.6227716	485.6227716	5
Plot 16	1	0	858773.83	2689560.16	NAD83/WGS84	1/7/2008	15	15	0	0	15	15	607.0284645	607.0284645	607.0284645	607.0284645	4

Table 2: Vigor		
Vigor	**Count**	**Percent**
2 - Weak	10	4.4
3 - Good	138	60.5
4 - Excellent	77	33.8
Missing*	3	1.3

Table 3: Vigor by Species Type							
	Species	**4**	**3**	**2**	**1**	**0**	**Missing***
	Itea virginica	5					
	Nyssa biflora		31	3			
	Persea palustris	6		1			
	Quercus alba		4				
	Quercus laurifolia	32	1	1			
	Quercus lyrata		6				
	Quercus michauxii	1	16	2			1
	Quercus nigra	19	4				
	Sambucus nigra		9				
	Morella cerifera	14	1	2			
	Liriodendron tulipifera		35	1			
	Ulmus americana		31				2
TOT:	**12**	**77**	**138**	**10**			**3**

* Note: Trees were planted at the site in a 8-foot by 8-foot grid spacing. The comment “missing” was used to describe the scenario where a planted stem was expected but not found at the regular grid spacing.

Table 4: Damage to Stems		
Damage	**Count**	**Percent Of Stems**
No Damage	218	95.6
Site Too Wet	5	2.2
Removal	5	2.2

Table 5: Damage by Species Type					
	Species	All Damage Categories	No Damage	Removal	Site Too Wet
	Itea virginica	5	5		
	Liriodendron tulipifera	36	35		1
	Morella cerifera	17	15	2	
	Nyssa biflora	34	31		3
	Persea palustris	7	6	1	
	Quercus alba	4	4		
	Quercus laurifolia	34	33	1	
	Quercus lyrata	6	6		
	Quercus michauxii	20	18	1	1
	Quercus nigra	23	23		
	Sambucus nigra	9	9		
	Ulmus americana	33	33		
TOT:	**12**	**228**	**218**	**5**	**5**

Table 7: Planted Stems by Plot and Species Type

	Species	Total Planted Stems	# plots	Average Number of Stems	Plot1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16
	Itea virginica	5	1	5														5		
	Liriodendron tulipifera	36	12	3			4	3	5	5	4	1	1			6	2	1	1	3
	Morella cerifera	17	7	2	2		3			2		2		4	3		1			
	Nyssa biflora	34	10	3		1	5					7	5	3	1	2	3	2		5
	Persea palustris	7	2	4														3		4
	Quercus alba	4	1	4															4	
	Quercus laurifolia	34	10	3	7	8	1			1		3	6	1	1	3	3			
	Quercus lyrata	6	2	3														3		3
	Quercus michauxii	19	8	2	3		2			3	2				1	1	2		5	
	Quercus nigra	23	12	2	2		2		3	1	1	1	1	2	6	2	1		1	
	Sambucus nigra	9	3	3					4		4								1	
	Ulmus americana	31	8	4		2		11	3		2		5	2	3		3			
TOT:	**12**	**225**	**12**		**14**	**11**	**17**	**14**	**15**	**12**	**13**	**14**	**18**	**12**	**15**	**14**	**15**	**14**	**12**	**15**

Appendix 3
Vegetation Plot and Site Photos

Plot 1 - Facing Macedonia Road on the northwestern portion of the subject property

Plot 2- Facing Macedonia Road on the northwestern portion of the subject property

Plot 3- Facing intersection of Macedonia Road and Wildcat Road

Plot 4- Facing intersection of Macedonia Road and Wildcat Road on northeastern portion of subject property

Plot 5- Facing Macedonia Road on western portion of the subject property

Plot 6- Facing Macedonia Road on central portion of the subject property

Plot 7- Facing Macedonia Road on western portion of subject property

Plot 8- Facing Macedonia Road on central portion of subject property just north of main road

Plot 9- Facing Macedonia Road on western portion of property near pond

Plot 10- Facing Macedonia Road just southwest of intersection of main road and dirt access road

Plot 11- Facing Macedonia Road just south of Plot 9 near pond

Plot 12- Facing main road just south of pond

Plot 13- Facing Macedonia Road on southwestern portion of subject property

Plot 14- Facing Macedonia Road on southwestern portion of subject property

Plot 15- Facing east on southeastern portion of subject property

Plot 16- Facing Macedonia Road on southwestern portion of subject property

First Road Crossing Type A – Station 50+75 - Facing east toward Macedonia Rd.

Second Road Crossing Type A – Station 17+75 – Facing east toward Macedonia Rd.

Road Crossing Type B – Station 30+50 – Immediately after completion

Road Crossing Type C – Station 32+50 – In background, immediately after completion

Grade Transition – Facing downstream

Grade Transition – Facing upstream

Appendix 4
Site and Reference Sites
Data Summary

Appendix 4 - Site and Reference Sites Data Summary
UT to Pembroke Creek - D06102S

	Site Area 1A1			Site Area 1A2		Site Area 1B		Site Area 2		Site Area 3			Reference 1	Reference 2	Reference 3
Station	1+00	11+00		11+00	17+50	40+00	50+50	Drainage area for both tributaries	60+00	34+74			---	---	---
Drainage Area (ac)	Start 50	B/t Start and Access Road 96		1A2 Start 96	Upstream of Access Road 112	Start 19	Upstream of Access Road 42	Downstream of access Road 161	Before Conf. Ref 1 209	End 254			45	279	30
Land Surface Slope	0.1%			0.2%		0.3%		0.2%		0%			0.5%	0.5%	1.6%
Water Surface Slope	0.2%			0.2%		0.4%		0.3%		0.04%			0.2%	0.5%	NA
Average Depth-to-Groundwater (in) (+ values above ground, - values below ground)	MW 1	MW 2	MW 3	MW 8	MW 9	MW 4	MW 7	MW 10	MW 11	MW 13	MW 14	MW 15	MW 16	MW 17	MW 18
High	4	2	4	5	5	1	6	3	6	4	-3	6	6	5	3
Average	-27	-34	-28	-23	-24	-23	-11	-12	-10	-26	-36	-13	0	-4	-7
Low	-40	-40	-34	-37	-40	-34	-20	-22	-19	-37	-40	-27	-17	-9	-16
Range for Valley Width (ft)	Available 170			Available 420		230 – 120 upper lower		350 – 200 upper lower		75			133 – 143	87 - 133	(Values assume flow in observed channels) 14 – 47
Measured to existing Top of bank Cross-Sectional Area (ft.^{2})	27.5			15.6		7.3		9.1		46.1			23 – 28	6 - 20	(Values assume flow in observed channels) 4 – 8
Vegetative Community Types	Disturbed Woody			Disturbed Woody		Disturbed Woody		Disturbed		Disturbed Woody			Coastal Plain Small Stream Swamp, Non-Riverine Wet Hardwood Forest	Coastal Plain Small Stream Swamp, Mesic Mixed Hardwood Forest	Non-Riverine Wet Hardwood Forest, Mesic Mixed Hardwood Forest
Dominant Soil Series	Portsmouth			Roanoke		Tomotley		Roanoke		Roanoke			Portsmouth	Chowan	Roanoke
Hydrologic Soil Group	D			D		D		D		D			D	D	D

Comments/Notes:

--- indicates no data

Note: Monitoring Well Data represents data collected during the following dates: MW1 through MW16 represents data collected between 4-13-06 and 6-20-06. MW17 and MW18 represents data collected between 6-1-06 and 6-20-06.

	Reference 1	Reference 2	Reference 3
Average Pool Depth (ft)	0.3 – 0.9	0.2 – 0.7	0.4 – 0.6
Average Hummock Height (ft)	0.3 – 0.8	0.4 – 1.0	0.3 – 0.6
Stump Height (ft)	2.3 – 5.8	3.6 – 5.0	2.42
Stump Hole - Long Axis (ft)	6.0 – 20.0	7.0 – 9.0	
Stump Hole - Short Axis (ft)	3.6 – 9	3.7	2
Stump Hole - Depth (ft)	0.7 – 0.9	0.6 – 0.7	0.7
Max Pool Depth in Reference area (ft)	1.09	0.7	0.6