

Meadowbranch Swamp Wetland Restoration

SCO # 06-06731-01

EEP ID# 92351

Robeson County

FINAL

Baseline Monitoring Report



Prepared for:

North Carolina Department of the Environment and Natural Resources

Ecosystem Enhancement Program (NCDENR-EEP)

1652 Mail Service Center

Raleigh, NC 27699-1652

Submitted November 14, 2011

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1.0 Executive Summary

The Meadowbranch Swamp Wetland Restoration site was selected for wetland restoration, enhancement, and preservation by the North Carolina Department of the Environment and Natural Resources, Ecosystem Enhancement Program (NCDENR-EEP). The purpose of this restoration project was to restore, enhance, and preserve a low lying area adjacent to Meadowbranch Swamp. This was accomplished by restoring surface flow and groundwater elevations within the site area by removing a former logging road and modifying the canal access road. The intent of this project was to change these site features to restore the wetland functions as closely as possible to that of pre-disturbance conditions.

The project site is approximately one-half mile west-northwest of Lumberton, in Robeson County, North Carolina as depicted on **Figure 1 (Appendix 1)**, Project Site and Reference Site Vicinity Map. The site consists of a wooded parcel owned by the Lumber River Conservancy which encompasses approximately 55.4 acres. The site is located along Carthage Road which bounds the site to the south. Located immediately adjacent to the west of the site is a channelized water feature known as Meadowbranch Swamp canal. There is an access road, which is maintained by the City of Lumberton, along Meadowbranch Swamp canal which extends north from Carthage Road to SR 211. In addition, there was a former logging road located within the interior of the site which began approximately 100 feet from Meadowbranch Swamp canal. The former logging road began at Carthage Road and extended north, roughly paralleling Meadowbranch Swamp canal for a distance of approximately 2,000 feet. Along the eastern edge of the former logging road was a ditch feature.

Several approaches were used to restore the project site. The primary actions to restore the site included: removal of the former logging road, filling the ditch feature along the eastern edge of the former logging road, minor earthwork to modify the existing access road along Meadowbranch Swamp canal, removal of existing culverts within the former logging road and access road, treatment of the largest concentrations of Chinese privet (*Ligustrum sinese*), and replanting areas along the former logging road, filled in drainage feature, and areas with highest concentrations of Chinese privet. Removal of the former logging road involved excavating material from the logging road and placing it back into the ditch feature located along the eastern edge of the former logging road. In addition, there were five (5) culverts along the former logging road which were removed. Modifications to the access road along Meadowbranch Swamp canal involved designing several road crossings, or low areas built into the access road, to mimic the natural swale observed adjacent to the reference area. These road crossings will allow flood events onto the project parcel. In addition, there were six (6) culverts along the access road which were removed. This will hydrologically reconnect the site with Meadowbranch Swamp canal, allowing water from overbank flood events to be distributed and stored over the entire site. Within the highest concentrations of Chinese privet, the trunks and branches of the Chinese privet were removed, treated with aquatic safe herbicide, and were replanted.

Through these actions, the project has restored and enhanced 47.31 acres of riverine wetlands which had a disturbed surface flow regime. The project also included 0.35 acres of vegetative riverine wetland enhancement and the preservation of existing riverine wetlands (0.87 acres).

2.0 Project Goals, Background and Attributes

2.1 Location and Setting

The site is located approximately 2,500 feet to the west of Interstate 95 near Exit 19 in Lumberton, North Carolina. The project area encompasses 55.4 acres along Carthage Road which abuts the site to the south. The site is situated within the 100-year floodplain associated with Meadowbranch Swamp canal which is adjacent to the west. The site includes an access road along the canal which has been established by the City of Lumberton. From Carthage Road extending north, the canal road extends approximately 3,000 feet of the access road along the east side of Meadowbranch Swamp canal. From SR 211 extending south, the City primarily utilizes approximately 4,200 feet of the access road along the western side of Meadowbranch Swamp canal. Located within the interior of the site was a former logging road which roughly paralleled Meadowbranch Swamp canal. The former logging road began along Carthage Road approximately 100 feet east of Meadowbranch canal and extended north for approximately 2,000 feet. A ditch feature was located along the eastern edge of the former logging road.

The project site is almost entirely forested primarily with young hardwoods and some areas of young pine. This is due to the fact that the site was logged approximately 15 years ago. Due to the timing of the logging, the site is currently at a stage of succession where the vegetation is very dense. In general, the site is too disturbed to adequately assess the ultimate climax community types. Also, the increase in hydrology from the project may also adjust the community type boundary. Currently, there are a few small areas near the access road along Meadowbranch Swamp that still have stands of relatively older growth bald cypress (*Taxodium distichum*) and would be designated as Cypress-Gum Swamp. Other larger areas have some young bald cypress, but the areas are more dominated by red maple (*Acer rubrum*) and river birch (*Betula nigra*) and it is not clear what community will ultimately predominate. Besides those few areas of Cypress-Gum Swamp on the site, the remainder of the area could probably best be described as a disturbed site undergoing succession to a Coastal Plain Bottomland Hardwood (based on reference wetland conditions). In general, the majority of the site appears to have strong characteristics of bottomland hardwood. In general, large portions of the site are naturally regenerating with appropriate native vegetation and it would probably be counter-productive to intercede in this natural process. However, some portions of the site contained large concentrations of Chinese privet which have been removed, treated, and replanted.

The site is located in the Inner Coastal Plain Physiographic Region of North Carolina and lies within the USGS Hydrologic Unit Code 03040203 080010 (USGS, 1974), which falls within the Lumber River basin. The NC DWQ River Subbasin for the project area is listed as the Lumber 03-07-51 (NCDENR, 2003). The current State classification for Meadowbranch Swamp (Stream Index # 14-12) from its source to the Lumber River, is Class C and Swamp Waters (Sw) waters (NCDENR, 2006). Class C waters support aquatic life, wildlife, and

they can also be used for secondary recreation and agriculture. The Sw classification is intended for waters which have low velocities and other natural characteristics, different from adjacent streams.

2.2 Project Goals and Objectives

The goal of this project was to restore, enhance, and preserve the project area. This was achieved by creating low areas in the access road based on flood elevations, removing an existing former logging road and adjacent canal within the site, and planting native wetland vegetation in select areas. This has returned the site to a more natural hydrologic state which will:

- Store and treat runoff from 1.8 square miles of developed land, nearly half of Lumberton, which drains to the project site.
- Allow for retention and treatment of sediment, nutrients, and toxins to improve water quality of the Lumber River which is listed as impaired approximately six miles downstream of project site.
- Support the goals outlined in the 2003 Lumber River Basinwide Water Quality Plan by implementing a project within a watershed that has been identified by the NC Wetlands Restoration Program (NCWRP) as having the greatest need.
- Assist in the improvement of water quality; the Basinwide plan indicates 406 miles of waters within Subbasin 03-07-51 are impaired.
- Provide a more natural flood regime and flood storage for waters in Meadowbranch Swamp.
- Connect to surrounding wetland areas and enhance the wildlife habitat present in the wetland.

2.3 Project Structure, Restoration Type and Approach

The project area is located adjacent to Meadowbranch Swamp with a drainage area of 34.4 square miles. In addition, the site is located only about 1,000 feet upstream where Meadowbranch Swamp empties into the Lumber River. The drainage from Meadowbranch Swamp and the Lumber River contribute to the flood events at the site. As such, the project area regularly experiences hydrologic inputs from local rain events and more widespread “whole basin” events. The entire project area is located within a designated 100 year floodplain. Therefore, the type of wetland targeted for the project area was a palustrine riverine floodplain wetland system. Historically, alterations to the site associated with the maintenance of the access road along Meadowbranch Swamp canal and from the previous logging operations modified the hydrologic functions of the existing wetlands. The project will counteract these impacts to the wetlands by improving hydrologic connections to Meadowbranch Swamp and by removing a constructed logging road which is impeding surface water movement across the site.

The first modification was the installation of road crossings along the access road which are cuts in the access road to allow surface flow from Meadowbranch Swamp canal into the adjacent low lying areas. A total of nine (9) areas were lowered along the access road and consisted of a series of cuts along the canal to promote temporary flooding of the site during

overbank events. The City of Lumberton requires vehicle traffic along the eastern side of Meadowbranch Swamp. Therefore, five (5) crossings along the access road were reinforced and referred to as roadway crossings. The remaining four (4) crossings, located north of where the City of Lumberton requires vehicle traffic, were referred to as berm cuts. Additionally modifications to the access road included the removal of six (6) culverts.

The crossings and berm cuts constructed along the access road allow more frequent overbank flooding of the site which enhances the hydrologic wetland component of the project. Each of the nine (9) crossings or berm cuts has lowered the top of bank elevation by approximately two to three feet. Historical flooding information provided in Appendix 7 of the 2007 Restoration Plan for this project, showed the site (on average) flooding to an elevation of 113 five times per year and to an elevation of 115 only two times per year. Re-connecting the historic floodplain to the Meadowbranch Swamp canal at an elevation of 113 more than doubles the average flooding frequency and enhances the hydrologic regime on-site.

The second modification was the removal of the former logging road to allow surface flow across the site. The ditch located along the east side of the former logging road was filled in with soil material excavated from the former logging road. Additional modifications included the removal of five (5) culverts under the former logging road. The former logging road and filled in drainage feature were replanted.

The third modification was the removal of trunks and branches of the Chinese privet located within high concentration areas. The Chinese privet was treated with aquatic herbicide and replanted. The final action was the establishment of a conservation easement on the parcel owned by the Lumber River Conservancy which encompasses approximately 55.4 acres.

The actions of the project have restored and enhanced 47.31 acres of riverine wetlands which had a disturbed surface flow regime. The project also included 0.35 acres of vegetative riverine wetland enhancement and the preservation of existing riverine wetlands (0.87 acres). The preservation of existing uplands (1.59 acres) and areas associated with the access road, staging area, and utility easement (5.28 acres) round out the remainder of the conservation easement acreage.

Located in Appendix 2 are Table 1a (Project Components) and Table 1b (Component Summations).

2.4 Project History, Contact and Attribute Data

Located in Appendix 2 are Table 2 (Project Activity and Reporting History), Table 3 (Project Contacts), and Table 4 (Project Attributes).

3.0 Success Criteria

3.1 Vegetation

The project area has been planted in targeted areas with species appropriate for Coastal Plain Bottomland Hardwood and Cypress-Gum Swamp community types. Areas planted included the former logging road and adjacent drainage ditch, and the Chinese privet areas after their removal.

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 years and 288 at year 4. Final stem count criteria are 260 trees per acre at the end of the five (5) year monitoring. In addition, the areas being controlled for privet will be assessed during monitoring for the return of privet. If the privet returns in a quantity that threatens the targeted plants, then corrective actions will need to be taken.

In accordance to CVS-EEP Protocol for Recording Vegetation (CVS-EEP, v4.2), three (3) vegetation monitoring plots, which are 20 meter by 5 meter in size, have been established within the former logging road. Figure 2 As Built located in Appendix 1 shows the location of the vegetation plots. In addition, within the Chinese privet areas two (2) random transects, which were 50 meter by 2 meter in size, were assessed for planted stems (Appendix 1, Figure 2).

3.2 Hydrology

The restored wetlands have been designed to function as a bottomland hardwood forest, but will consist of Cypress-Gum Swamp and Coastal Plain Bottomland Hardwood communities (Schafale & Weakley, 1990) according to reference data. Therefore, the wetlands restored on this project site shall target establishing a wetland with water tables near or at the surface. Based on reference data collected, the performance criteria for the site shall consist of the water table being within 12 inches of the soil surface continuously for greater than 10% of the growing season under average rainfall conditions (USACE, 1987), as measured in the restored area of the former logging road. Groundwater table elevations within this area will be deemed successful if water tables meet these criteria. For this region, the growing season is 213 days; therefore, the water table must be within 12 inches of the soil for twenty four (21) consecutive days or more. To monitor the water table at the site, ten (10) automated groundwater gauges were installed in October, 2006.

Maximum Consecutive Days of Ground Water Within 12" of the Surface						
Monitoring Wells	Growing Season					
	2006*	2007	2008	2009	2010	2011**
1	24	30	23	22	25	n/a
2	15	34	55	40	42	50
3	24	116	n/a	n/a	n/a	n/a
4	14	29	24	20	22	8
5	24	113	120	59	50	55
6	23	87	120	113	64	73
7	23	89	122	112	65	83
8	9	2	15	39	11	13
9	14	31	49	40	26	50
REF	15	13	32	52	37	21

Notes:

Construction/earthwork completion around 9/15/2010

*Year 2006 data collection began on 10/27/2006

**Year 2011 data collection ended on 9/1/2011

During a site visit on September 1, 2011, Monitoring Well 8 was found protruding from the ground. The calibration point was a significant amount above the ground surface. It has yet to be determined if the well was originally installed above the calibration point or if the well has moved over time. The data from Monitoring Well 8 does not accurately represent the groundwater elevation.

Additionally, the site will experience overbank flooding events as an important part of its function. Specific performance criteria for the site indicating success shall consist of flood waters reaching the improved road crossings, at an elevation equal to the existing elevation of the adjacent wetlands, at least four (4) times per year. The flooding occurrence performance criteria are only valid if rainfall amounts are equal to or greater than historical averages. Table 3, below, provides a summary of rainfall data for Lumberton, NC.

Lumberton Yearly Total Rainfall							
	2006	2007	2008	2009	2010	2011	Average
Rainfall (in)	42.2	22.65	43.3	32.6	35.7	34.51*	46.85

Notes:

*Total rainfall from 01/01/2006 to 10/01/2011

The data obtained from the State Climate Office of North Carolina shows the annual rainfall amounts for Lumberton, NC from 2006 to present to be less than the historical average.

4.0 Monitoring Plan Guidelines

4.1 Hydrology

To monitor the water table at the site during the initial project investigation and design, ten (10) automated groundwater gauges, a stream gauge, and rainfall gauge were installed at the site during the initial project investigation and design. Three (3) additional automated groundwater gauges have been placed within the limits of the restored area of the former logging road to measure the groundwater table. All thirteen (13) automated groundwater gauges, the stream gauge, and rainfall gauge wells will be monitored at least three (3) times per year.

4.2 Vegetation Plan

Vegetation will be monitored on an annual basis to determine planted stem 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 years and 288 at year 4. Final stem count criteria are 260 trees per acre at the end of the five (5) year monitoring.

5.0 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.

6.0 Documenting the As Built Condition (Baseline)

6.1 As-Built/Record Drawings

As-built drawings are located in Appendix 1.

6.2 Baseline Data Collection

Baseline data was collected during the As-Built survey which was conducted from September 1 through 3, 2011. Year 1 monitoring data will be compared to 0-Year data to evaluate if there are any problem areas occurring at the site.

7.0 References

NC Department of Environment and Natural Resources (NCDENR). December 2003. 2003 Lumber River Basinwide Water Quality Plan. Division of Water Quality.

NC Department of Environment and Natural Resources (NCDENR), 2005. North Carolina Waterbodies Listed by Subbasin. Report Date 9/30/05.

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US Army Corps of Engineers (USACE), 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, January 1987.

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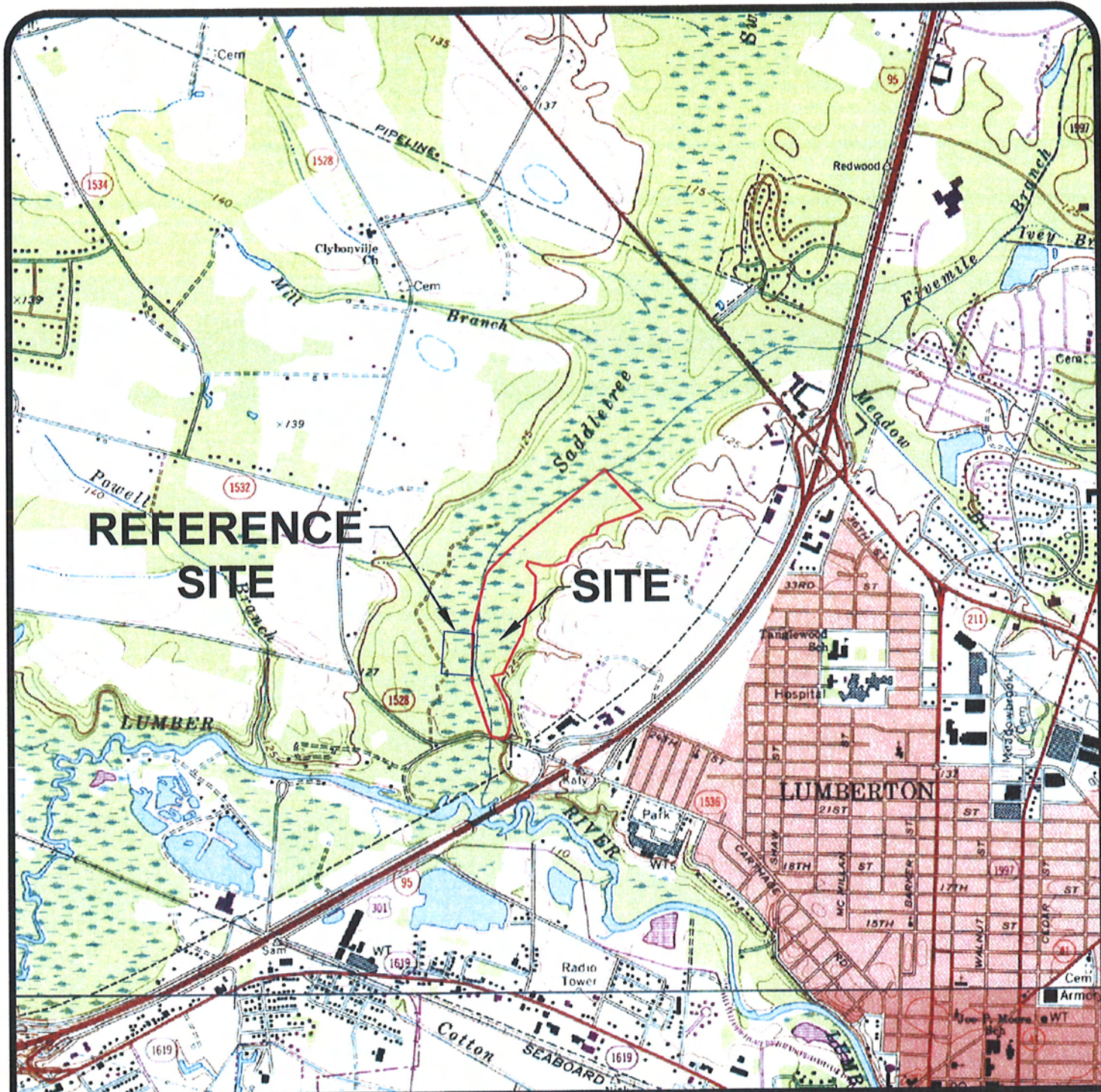
U.S. Department of Agriculture (USDA), 1997. Engineering Field Handbook. 210-EFH, Part 650, 1/92, revised 1997.

United States Geological Survey (USGS), 1974. North Carolina Hydrologic Unit Map.

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U.S. Fish and Wildlife Service, 2006. Robeson County Endangered Species, Threatened Species, and Federal Species of Concern. <http://www.fws.gov/nc-es/es/cntylist/robeson.html>

APPENDIX 1
GENERAL FIGURES AND AS-BUILT DRAWINGS

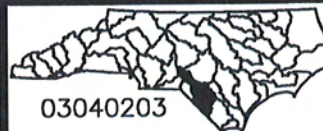


LEGEND:

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE REFERENCE AREA BOUNDARY

NOTES:

MAP SOURCE: 1982 USGS NW LUMBERTON QUAD
 PROJECT: MEADOWBRANCH, DENR #D07017S
 ROBESON COUNTY, NORTH CAROLINA



03040203

2000 0 1000 2000



SCALE: 1" = 2000'

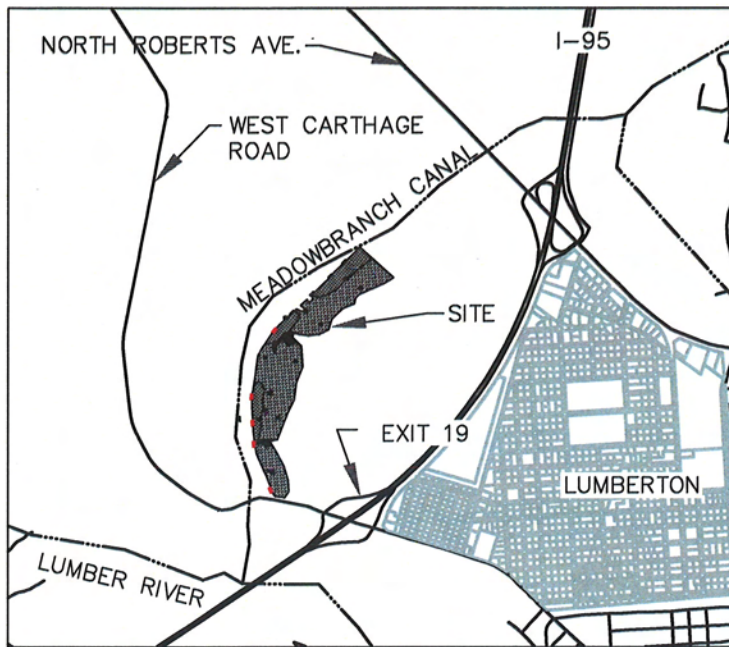
McADAMS	PROJECT NO.	EEP-06050
	FILENAME:	EEP06050
	SCALE:	1" = 2,000'
	DATE:	10-07-11



PROJECT SITE & REFERENCE
 SITE VICINITY MAP

FIGURE 1

EcoEngineering
 A division of The John R. McAdams Company, Inc.
 ENGINEERS • PLANNERS • SURVEYORS • ENVIRONMENTAL
 RESEARCH TRIANGLE PARK • CHARLOTTE
 2905 Meridian Parkway, Durham NC 27713
 800-733-5646 • www.johnrmcadams.com • License No.: C-0293



VICINITY MAP LUMBERTON, NC
NOT TO SCALE

GENERAL NOTES

1. PREPARED FOR NC ECOSYSTEM ENHANCEMENT PROGRAM, 1652 MAIL SERVICE CENTER, RALEIGH, NC 27699-1652.
2. AS-BUILT SURVEY PROVIDED BY TURNER LAND SURVEYING, DAVID S. TURNER, LICENSE NO.: L-4551.
3. EXACT RECORDS CAN BE FOUND ON FILE WITH ECOENGINEERING UNDER JOB NUMBER EEP-06050.
4. THE TOTAL EASEMENT ACREAGE FOR THIS PROJECT IS 56.66 ACRES. EASEMENT BOUNDARY WAS PROVIDED BY OTHERS.
5. NCGS MONUMENTS HOSPITAL AND KATY WERE USED AS CONTROL FOR SURVEY DATA.
6. THE SENIOR DESIGN CONTACT FOR THIS PROJECT IS JAMES M. HALLEY, PE OF ECOENGINEERING, 919-287-4262.
7. THE EEP PROJECT MANAGERS ARE TRACY STAPLETON AND HEATHER SMITH, 919-715-5590.
8. THE EEP REVIEW COORDINATOR IS LIN XU, PE, 919-715-7571.

BASELINE PROJECT DRAWINGS

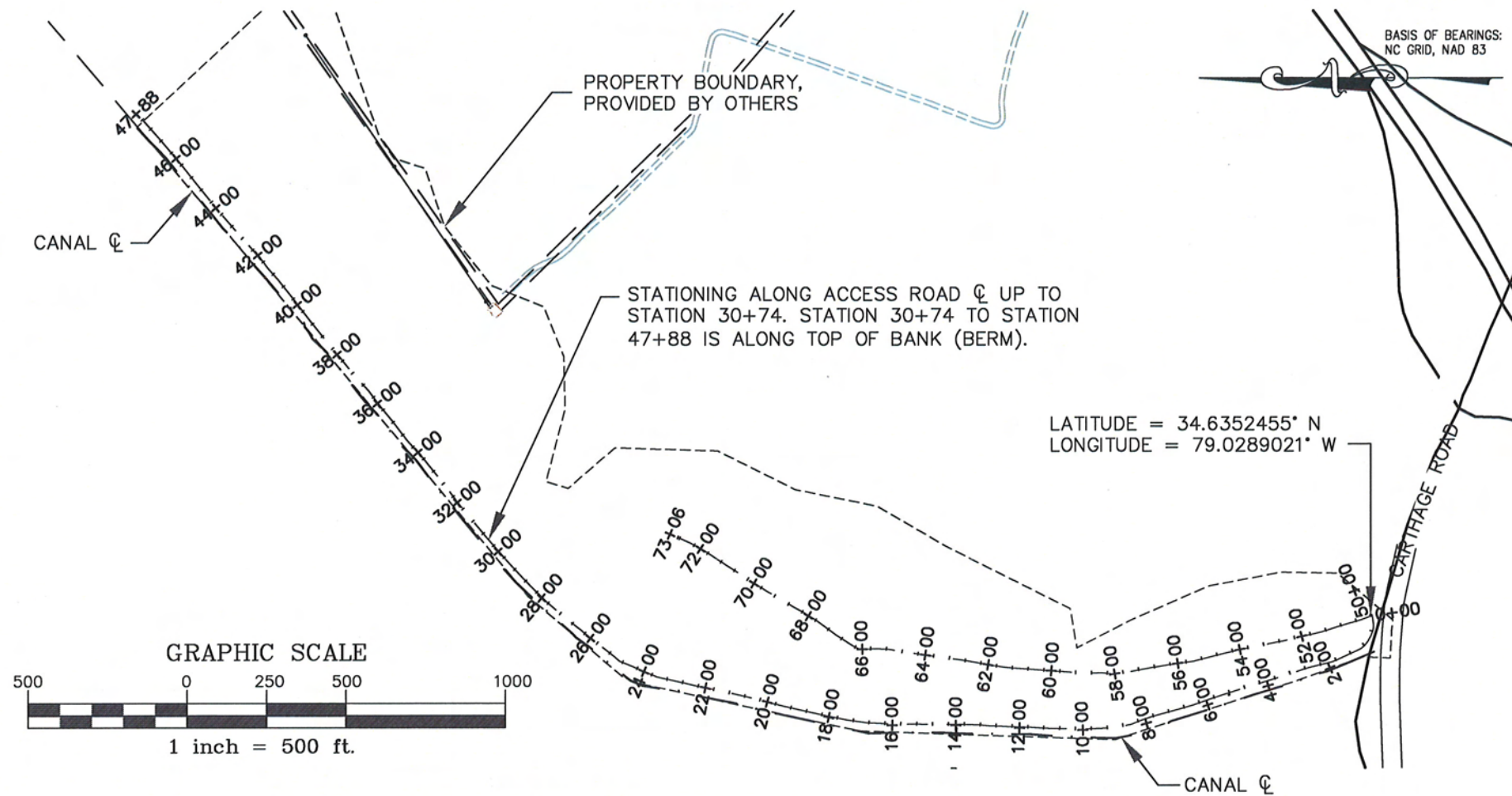
MEADOWBRANCH SWAMP WETLAND RESTORATION PROJECT

ROBESON COUNTY, NORTH CAROLINA

NC ECOSYSTEM ENHANCEMENT PROGRAM PROJECT

SCO# 06-06731-01

EEP ID# 92351



AS-BUILT OVERLAY SHEET INDEX:









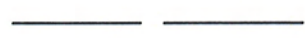
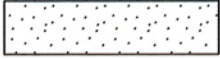

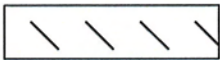

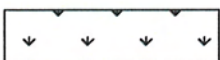


SHEET 1	TITLE/COVER SHEET
SHEET 2	LEGEND
SHEET 3	PLAN VIEW
SHEET 4	PLANTED AREAS
SHEET 5	MITIGATION SUMMARY

AS-BUILT SHEET INDEX:


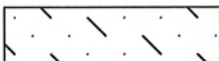



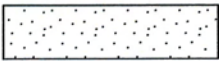

SHEET AB-1	TITLE, VICINITY MAP, SHEET INDEX, AND GENERAL NOTES
SHEET AB-2	ROADWAY CUTS
SHEET AB-3	BERM CUTS
SHEET AB-4	REMOVED LOGGING ROAD

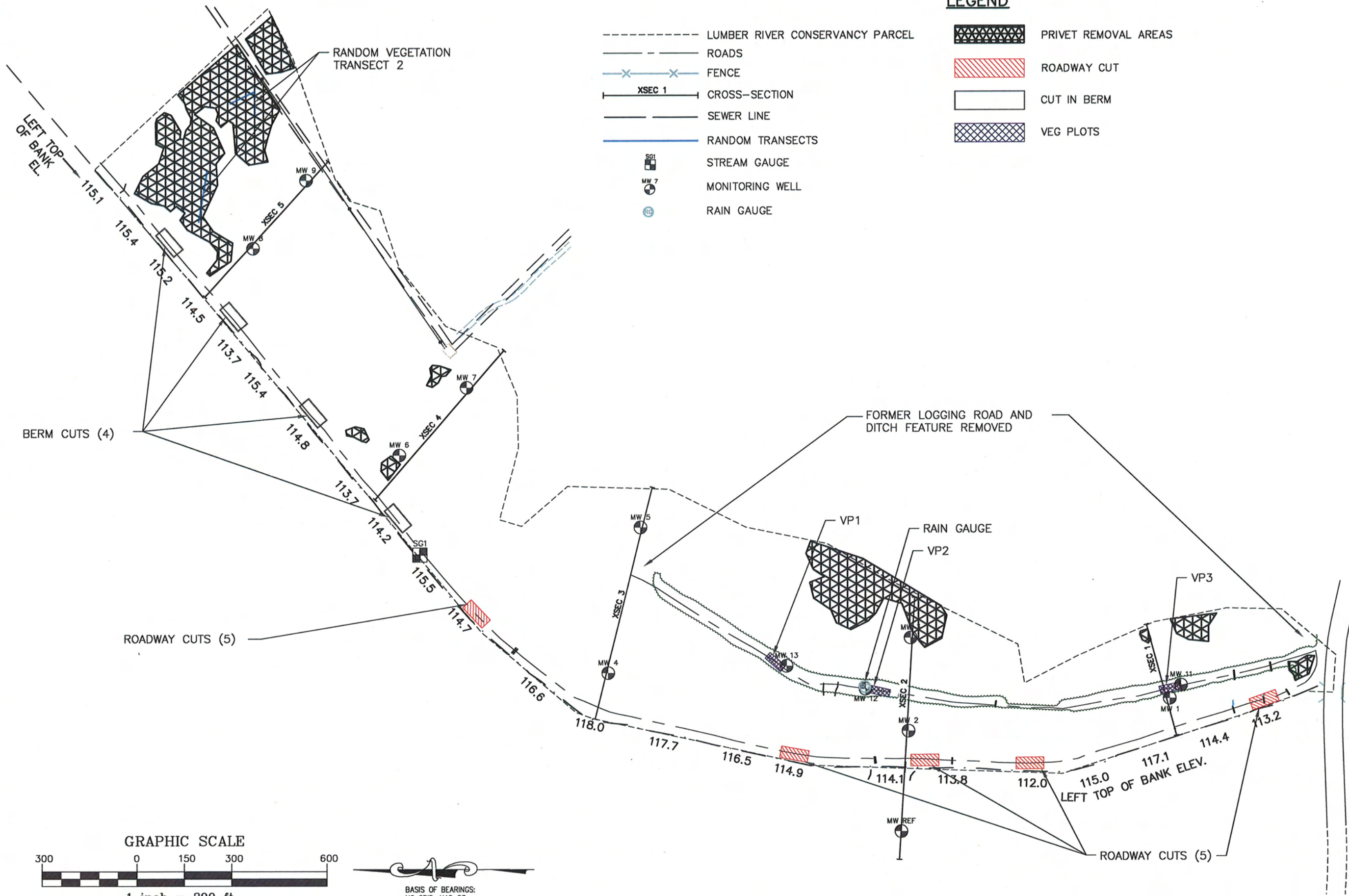
SHEET 1

LEGEND

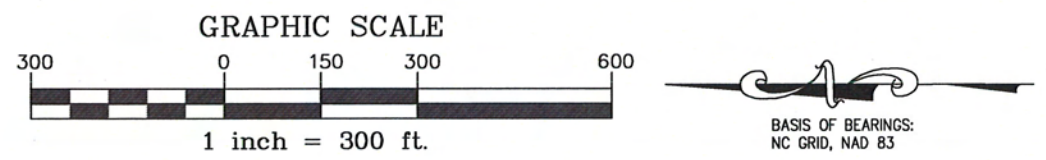
	LUMBER RIVER CONSERVANCY PARCEL		PRIVET REMOVAL AREAS
	ROADS		ROADWAY CUT
	FENCE		CUT IN BERM
	CROSS-SECTION		VEG PLOTS
	SEWER LINE		UPLAND AREAS
	RANDOM TRANSECTS		BOTTOMLAND HARDWOOD
	STREAM GAUGE		CYPRESS GUM SWAMP
	MONITORING WELL		
	RAIN GAUGE		

MITIGATION SUMMARY LEGEND

	FORMER LOGGING ROAD
	ENHANCEMENT OF WETLANDS (HYDROLOGICAL)
	ENHANCEMENT OF WETLANDS (HYDROLOGICAL & VEGETATIVE)
	ENHANCEMENT OF WETLANDS (VEGETATIVE)
	PRESERVATION (WETLANDS)
	PRESERVATION (UPLANDS)
	ACCESS ROAD, STAGING AREA, & UTILITY EASEMENT

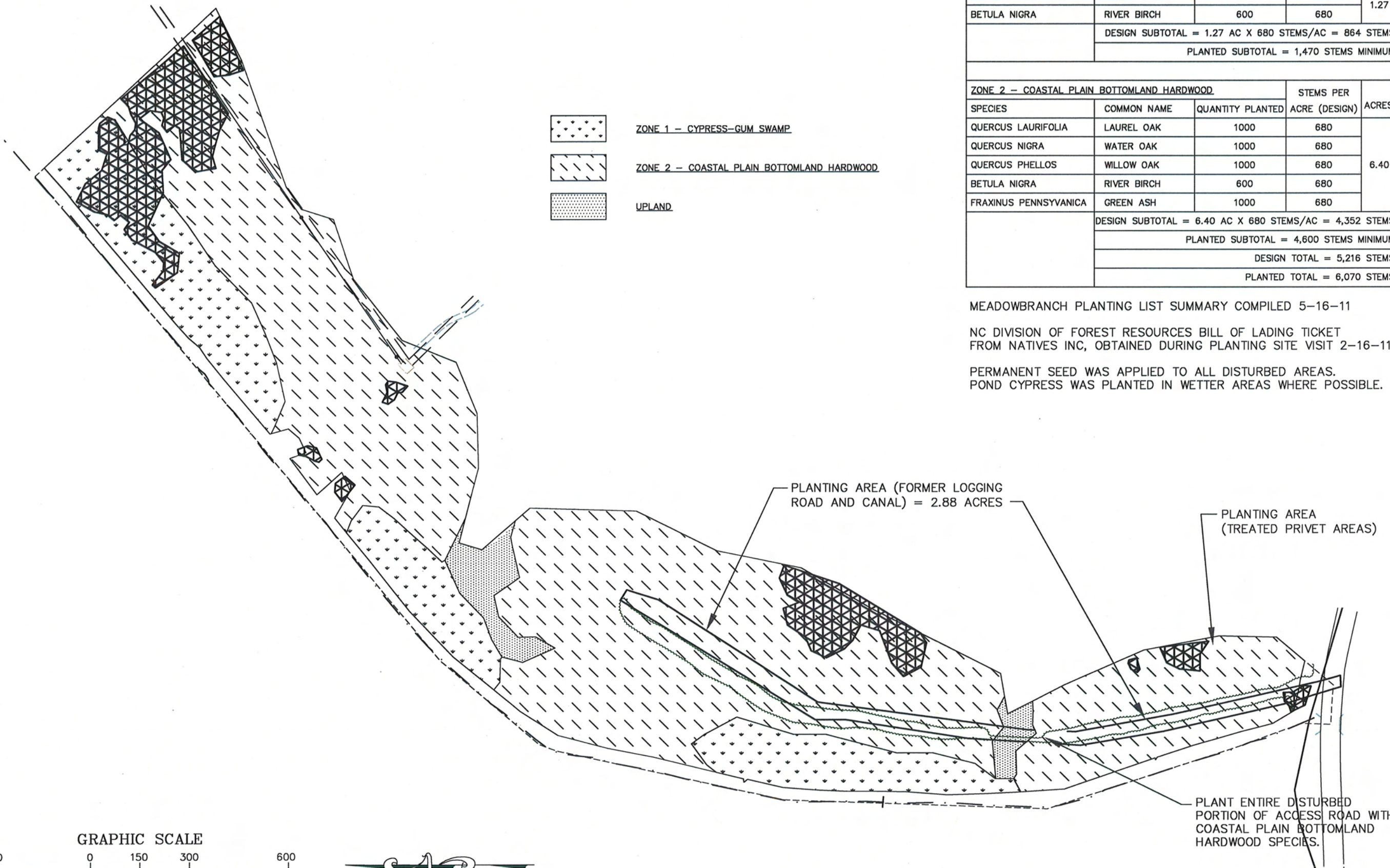


- LEGEND**
- LUMBER RIVER CONSERVANCY PARCEL
 - ROADS
 - x---x--- FENCE
 - XSEC 1 CROSS-SECTION
 - SEWER LINE
 - RANDOM TRANSECTS
 - SG1 STREAM GAUGE
 - MW 7 MONITORING WELL
 - RG RAIN GAUGE
 - [Cross-hatched box] PRIVET REMOVAL AREAS
 - [Red hatched box] ROADWAY CUT
 - [White box] CUT IN BERM
 - [Grid hatched box] VEG PLOTS



BASELINE PROJECT DRAWING
MEADOWBRANCH SWAMP WETLAND RESTORATION PROJECT
 PLAN VIEW

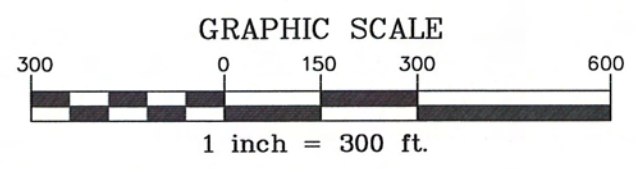
PROJECT NO. EEP-06050
FILENAME: BASELINE DRAWINGS
SCALE: 1" = 300'
DATE: 10-31-2011



- ZONE 1 - CYPRESS-GUM SWAMP
- ZONE 2 - COASTAL PLAIN BOTTOMLAND HARDWOOD
- UPLAND

ZONE 1 - CYPRESS-GUM SWAMP			STEMS PER	ACRES
SPECIES	COMMON NAME	QUANTITY PLANTED	ACRE (DESIGN)	
TAXODIUM DISTICHUM	BALD CYPRESS	870	680	1.27
BETULA NIGRA	RIVER BIRCH	600	680	
DESIGN SUBTOTAL = 1.27 AC X 680 STEMS/AC = 864 STEMS				
PLANTED SUBTOTAL = 1,470 STEMS MINIMUM				
ZONE 2 - COASTAL PLAIN BOTTOMLAND HARDWOOD			STEMS PER	ACRES
SPECIES	COMMON NAME	QUANTITY PLANTED	ACRE (DESIGN)	
QUERCUS LAURIFOLIA	LAUREL OAK	1000	680	6.40
QUERCUS NIGRA	WATER OAK	1000	680	
QUERCUS PHELLOS	WILLOW OAK	1000	680	
BETULA NIGRA	RIVER BIRCH	600	680	
FRAXINUS PENNSYVANICA	GREEN ASH	1000	680	
DESIGN SUBTOTAL = 6.40 AC X 680 STEMS/AC = 4,352 STEMS				
PLANTED SUBTOTAL = 4,600 STEMS MINIMUM				
DESIGN TOTAL = 5,216 STEMS				
PLANTED TOTAL = 6,070 STEMS				

MEADOWBRANCH PLANTING LIST SUMMARY COMPILED 5-16-11
 NC DIVISION OF FOREST RESOURCES BILL OF LADING TICKET
 FROM NATIVES INC, OBTAINED DURING PLANTING SITE VISIT 2-16-11:
 PERMANENT SEED WAS APPLIED TO ALL DISTURBED AREAS.
 POND CYPRESS WAS PLANTED IN WETTER AREAS WHERE POSSIBLE.



BASIS OF BEARINGS:
 NC GRID, NAD 83

ENHANCEMENT OF WETLANDS
(HYDROLOGICAL & VEGETATIVE)

ENHANCEMENT OF WETLANDS
(VEGETATIVE)

PRESERVATION (WETLANDS)

UTILITY EASEMENT

PRESERVATION (UPLAND)

ENHANCEMENT OF WETLANDS
(HYDROLOGICAL)

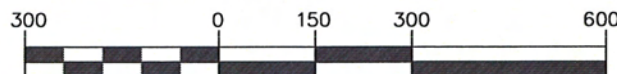
FORMER LOGGING ROAD

ENHANCEMENT OF WETLANDS
(HYDROLOGICAL & VEGETATIVE)

ENHANCEMENT OF WETLANDS
(HYDROLOGICAL)

ACCESS ROAD & STAGING AREA

MITIGATION SUMMARY TABLE	
PROJECT COMPONENT	ACREAGE
FORMER LOGGING ROAD	2.88
ENHANCEMENT OF WETLANDS (HYDROLOGICAL)	39.50
ENHANCEMENT OF WETLANDS (HYDROLOGICAL & VEGETATIVE)	4.93
ENHANCEMENT OF WETLANDS (VEGETATIVE)	0.35
PRESERVATION (WETLANDS)	0.87
PRESERVATION (UPLANDS)	1.59
OTHER: ACCESS ROAD & STAGING AREA	4.66
UTILITY EASEMENT	0.62
TOTAL	55.40



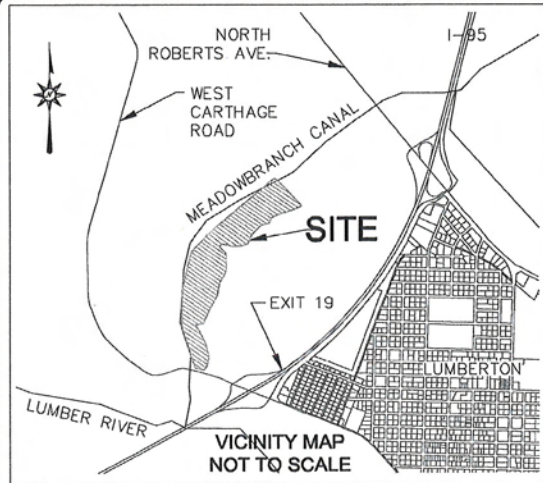
GRAPHIC SCALE

1 inch = 300 ft.



BASIS OF BEARINGS:
NC GRID, NAD 83

SHEET 5



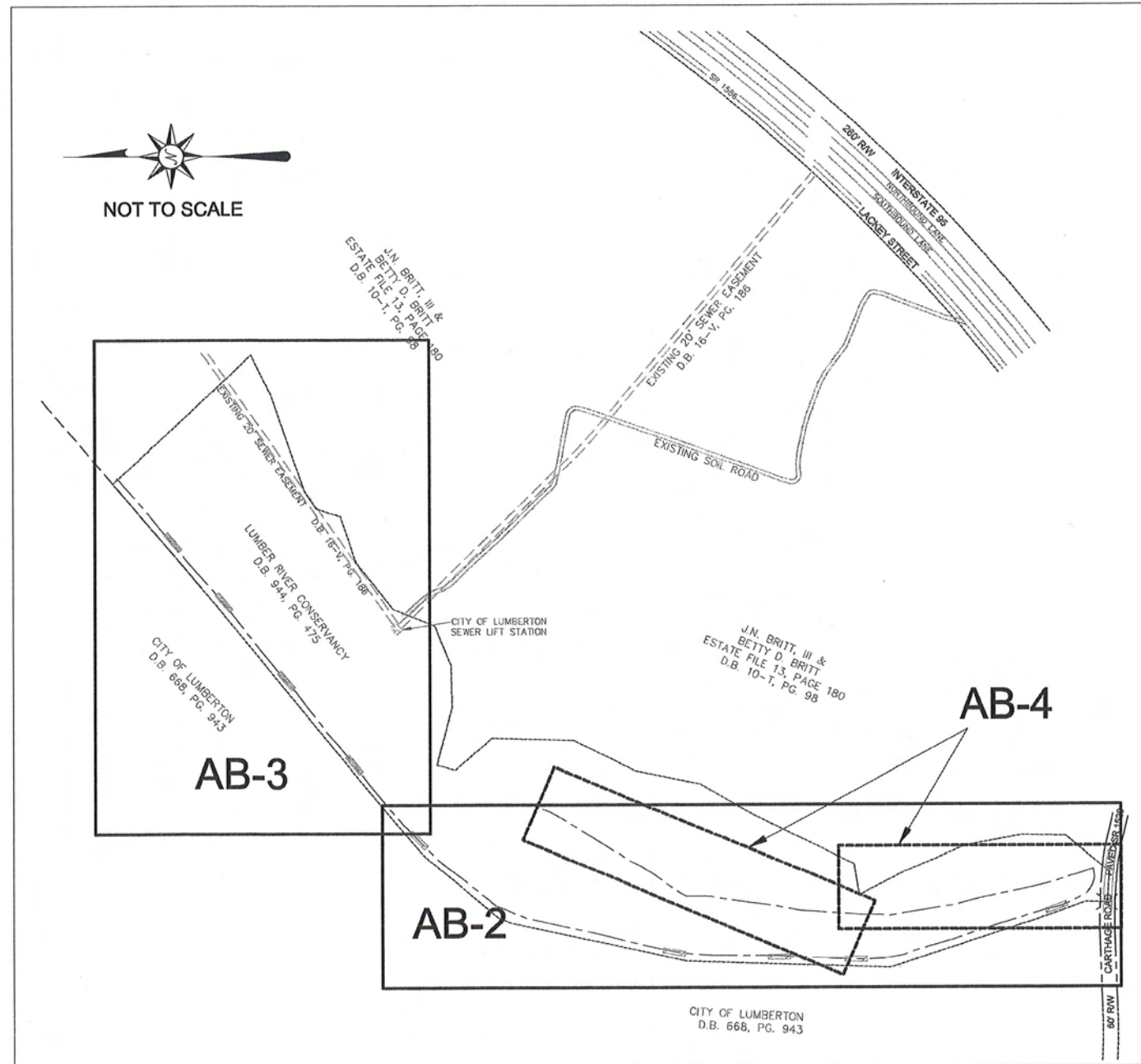
AS-BUILT SURVEY OF MEADOWBRANCH SWAMP WETLAND RESTORATION SCO# 06-06731-01 ROBESON COUNTY

REFERENCES:

OWNER:
NORTH CAROLINA ECOSYSTEM
ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27099-1652
(919)715-0476
EEP PROJ. MGR.: TRACY MORRIS
EEP REVIEW COORDINATOR: LIN XU

CONTRACTOR:
ENVIRONMENTAL QUALITY RESOURCES, LLC
ARBUTUS, MD
(443)304-3310

DESIGNER:
ECO ENGINEERING
A DIVISION OF THE JOHN R. McADAMS
COMPANY, INC.
RESEARCH TRIANGLE PARK, NC
(919)361-5000



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David S. Turner
DAVID S. TURNER, P.L.S. #L-4551



SHEET INDEX

- SHEET AB-1 - TITLE, VICINITY MAP, SHEET INDEX, AND GENERAL NOTES
- SHEET AB-2 - ROADWAY CUTS
- SHEET AB-3 - BERM CUTS
- SHEET AB-4 - REMOVED LOGGING ROAD

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REVISIONS, DATE AND INITIAL:

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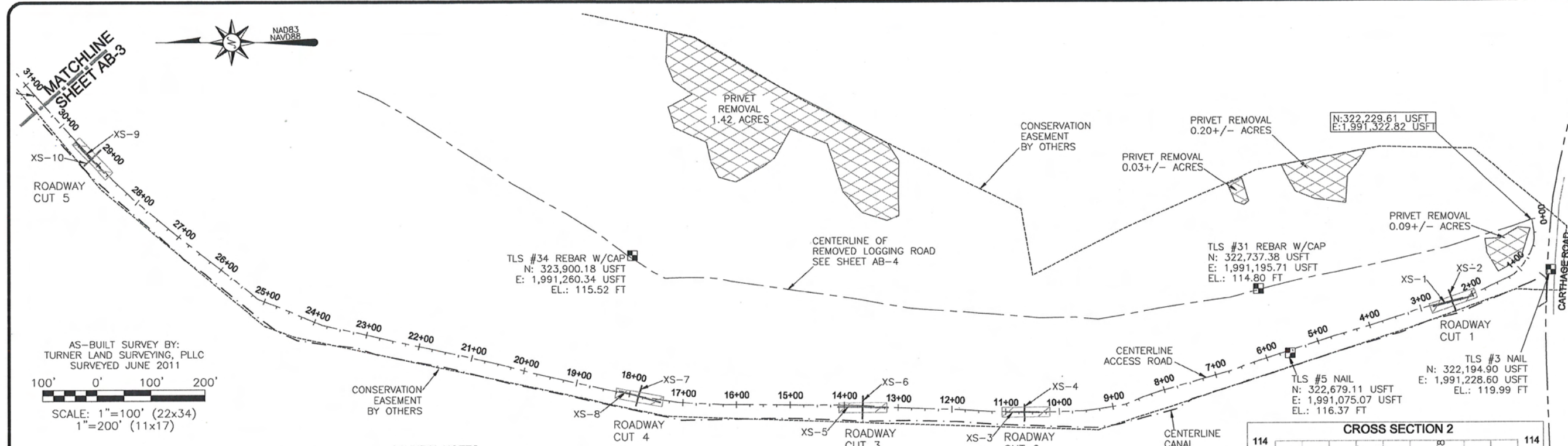


TITLE
AS-BUILT SURVEY OF
MEADOWBRANCH SWAMP
WETLAND RESTORATION
SCO# 06-06731-01

ROBESON COUNTY
NORTH CAROLINA

DATE: 6/10/2011
SURVEYED BY: DST/EGT
DRAWN BY: DST/EGT
REVIEWED BY: DST/EGT
PROJECT: TLS-10-012
FILE: MEADOWBRANCH_92351_AB_TLS_F
SCALE: AS SHOWN

SHEET
AB-1



AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED JUNE 2011

100' 0' 100' 200'

SCALE: 1"=100' (22x34)
1"=200' (11x17)

GENERAL NOTES

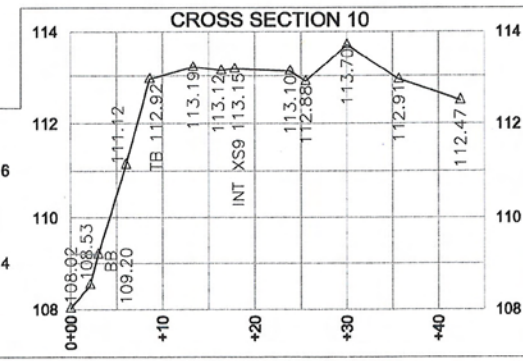
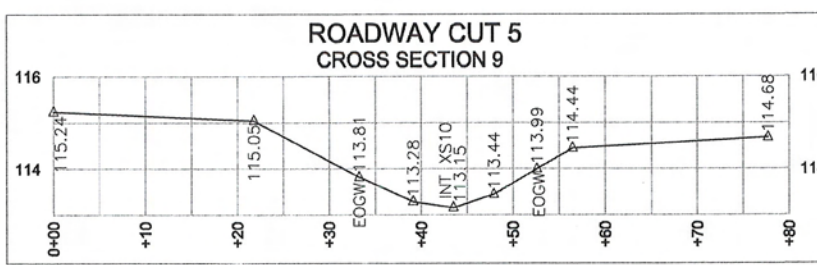
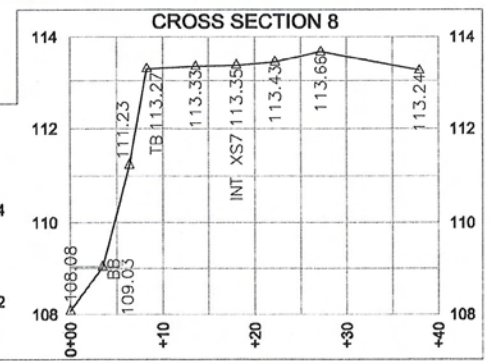
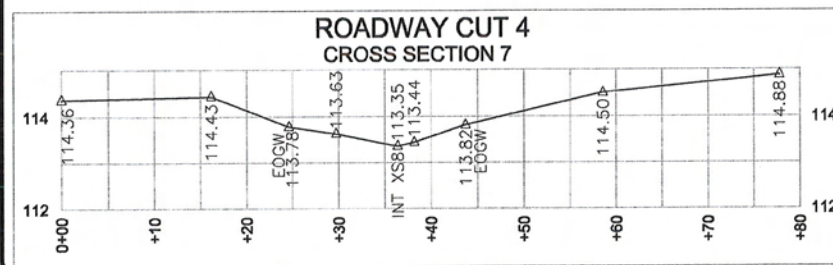
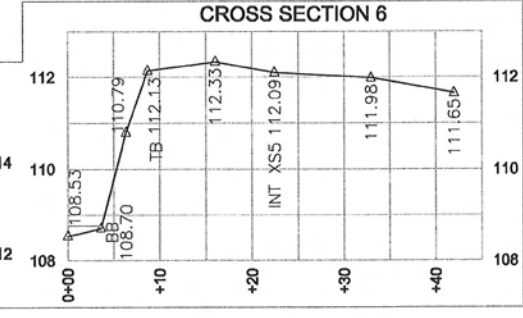
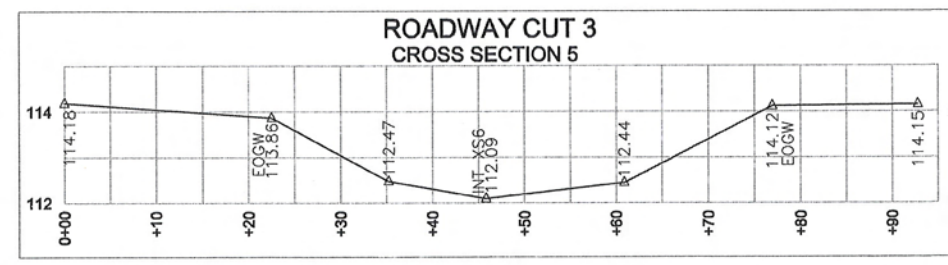
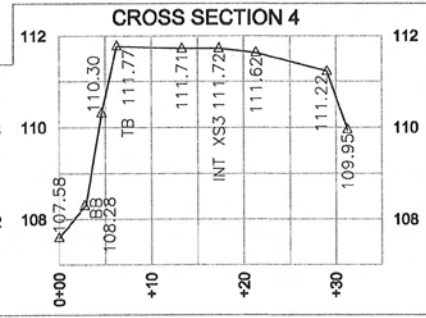
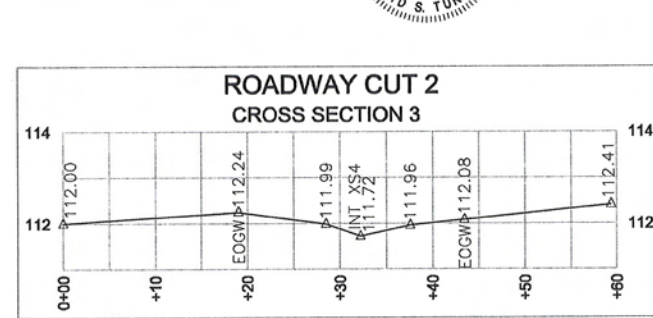
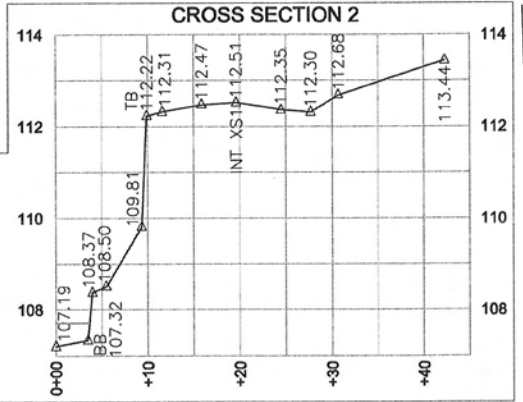
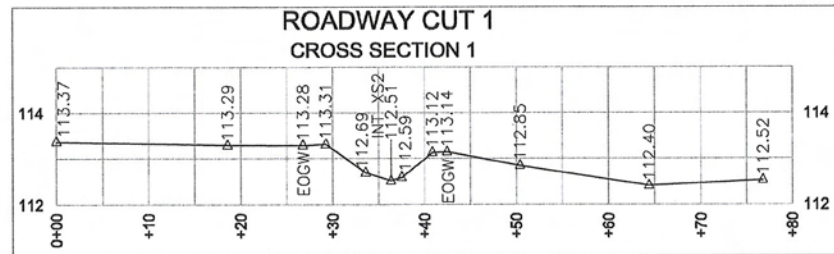
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CROSS SECTION SCALE
HORIZONTAL: 1"=10' (22x34)
VERTICAL: 1"=2' (22x34)
1"=4' (11x17)

EOGW-EDGE OF GEOWEB
BB-BOTTOM OF BANK
TB-TOP OF BANK
INT-INTERSECTION

I, DAVID S. TURNER, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THIS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 5th DAY OF JULY, 2011.

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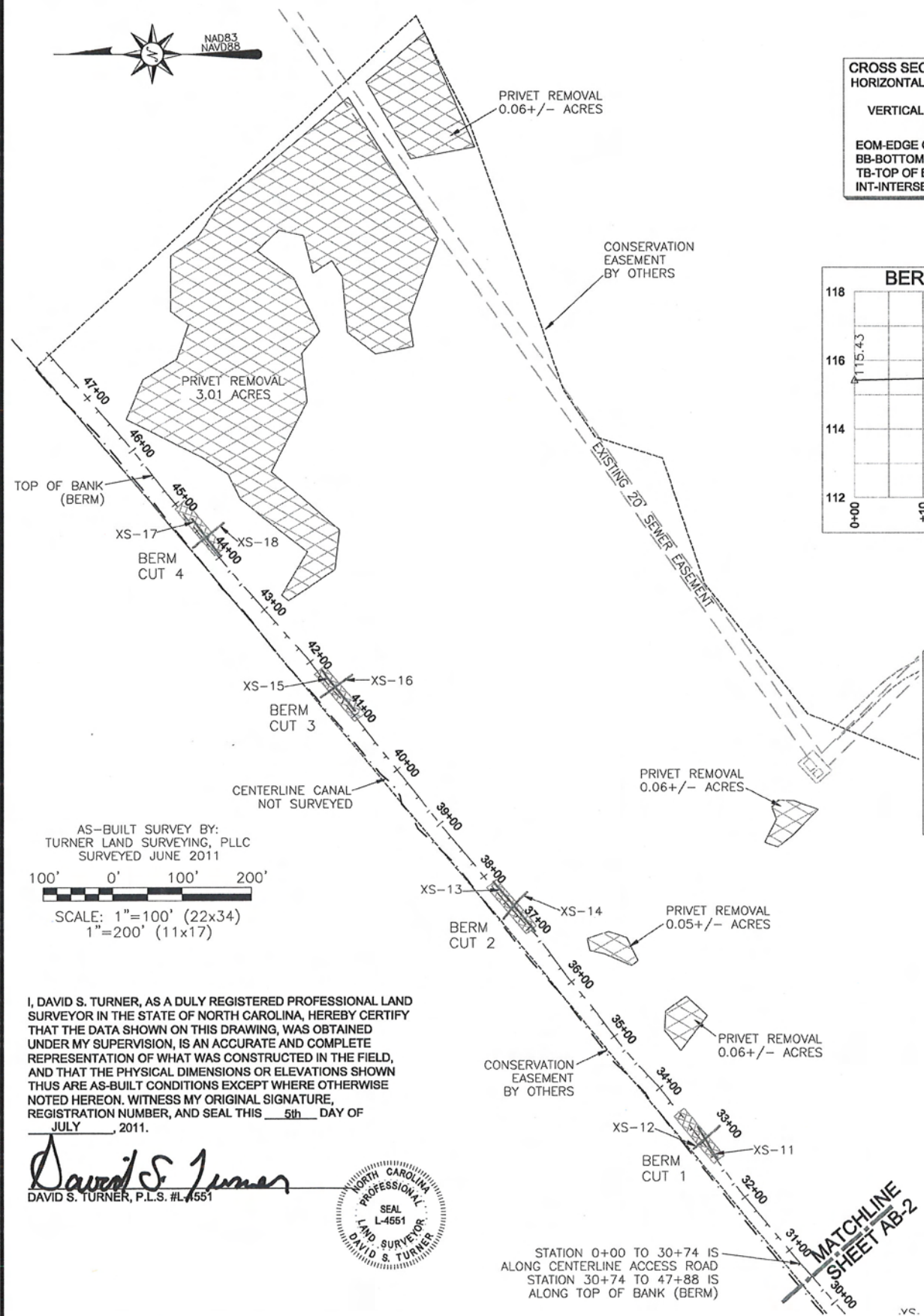
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ROADWAY CUTS
AS-BUILT SURVEY OF
MEADOWBRANCH SWAMP
WETLAND RESTORATION
SCO# 06-06731-01

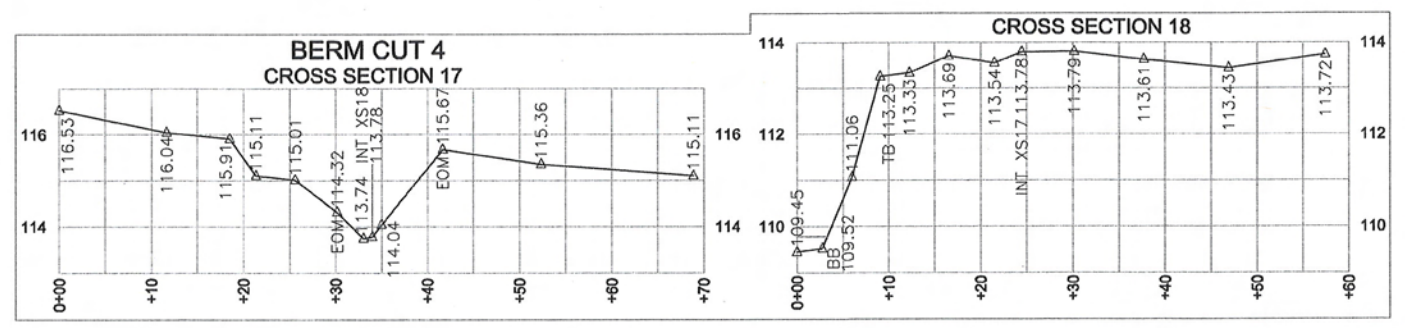
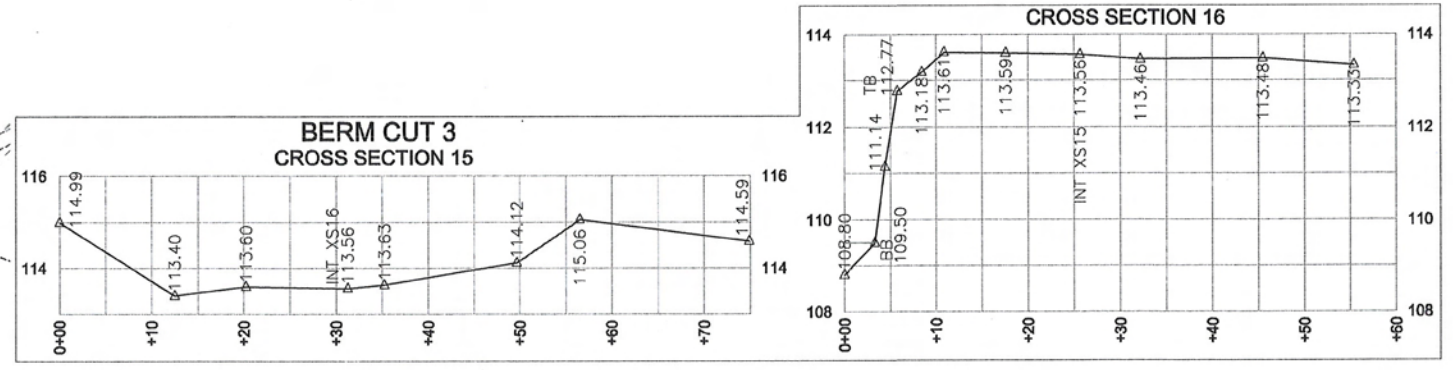
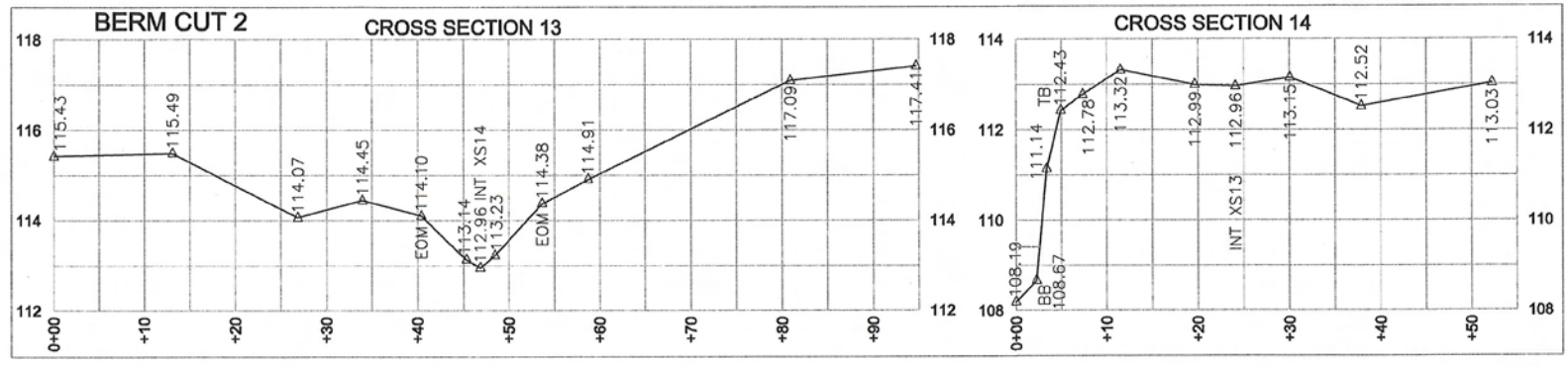
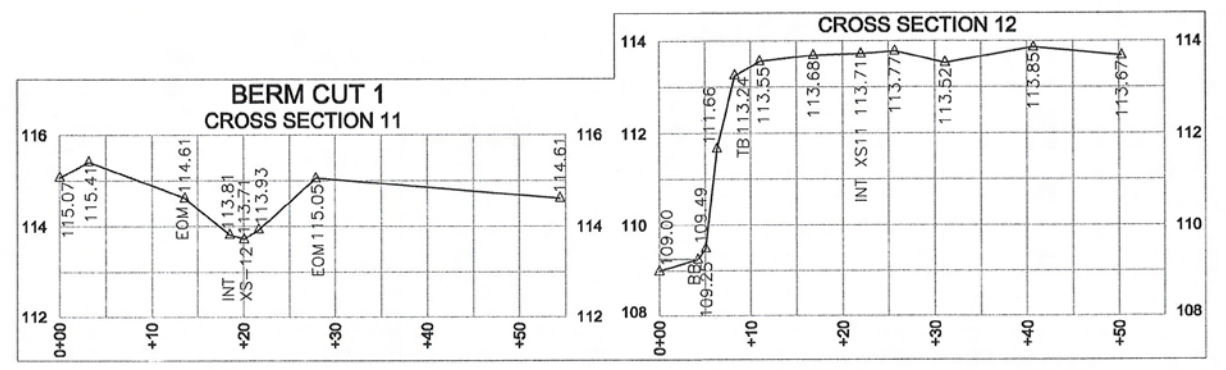
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PROJECT: TLS-10-012
FILE: MEADOWBRANCH_92351_AB_TLS_F
SCALE: AS SHOWN

SHEET
AB-2

NORTH CAROLINA
ROBESON COUNTY



CROSS SECTION SCALE
 HORIZONTAL: 1"=10' (22x34)
 1"=20' (11x17)
 VERTICAL: 1"=2' (22x34)
 1"=4' (11x17)
 EOM-EDGE OF MATTING
 BB-BOTTOM OF BANK
 TB-TOP OF BANK
 INT-INTERSECTION



AS-BUILT SURVEY BY:
 TURNER LAND SURVEYING, PLLC
 SURVEYED JUNE 2011
 100' 0' 100' 200'
 SCALE: 1"=100' (22x34)
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David S. Turner
 DAVID S. TURNER, P.L.S. #L-4551



STATION 0+00 TO 30+74 IS
 ALONG CENTERLINE ACCESS ROAD
 STATION 30+74 TO 47+88 IS
 ALONG TOP OF BANK (BERM)

MATCHLINE
 SHEET AB-2

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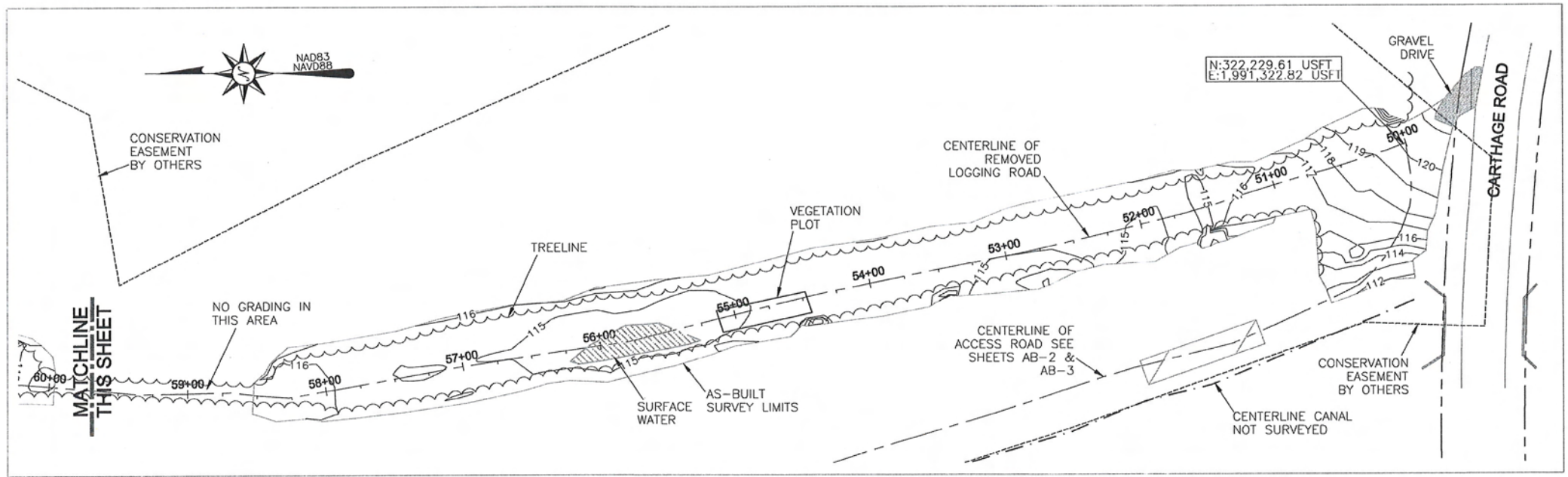
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BERM CUTS
 AS-BUILT SURVEY OF
 MEADOWBRANCH SWAMP
 WETLAND RESTORATION
 SCO# 06-06731-01

DATE: 6/10/2011
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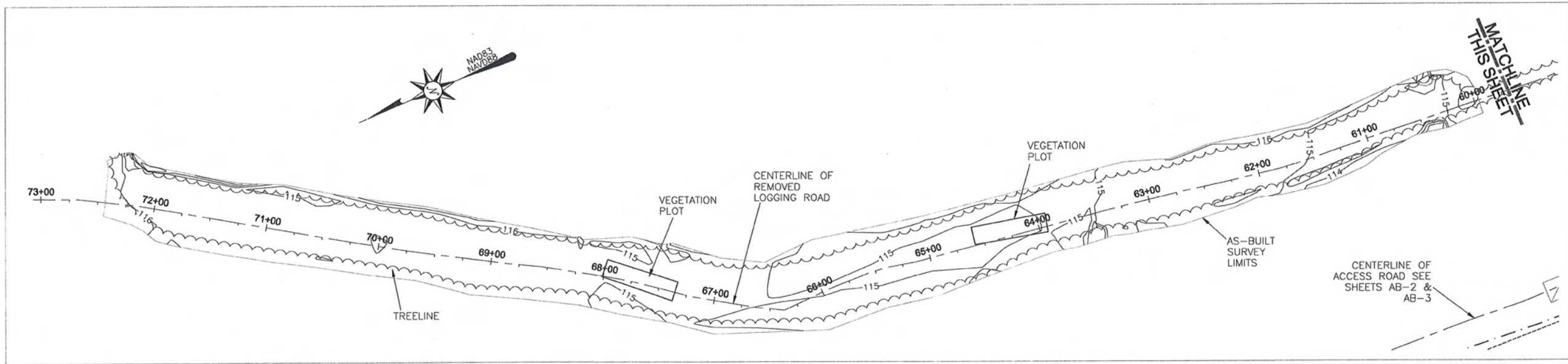
SHEET
AB-3



AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED JUNE 2011

50' 0' 50' 100'

SCALE: 1"=50' (22x34)
1"=100' (11x17)
CONTOUR INTERVAL = 1'



CENTERLINE OF ACCESS ROAD SEE SHEETS AB-2 & AB-3

I, DAVID S. TURNER, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THIS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 5th DAY OF JULY, 2011.

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REMOVED LOGGING ROAD
AS-BUILT SURVEY OF
MEADOWBRANCH SWAMP
WETLAND RESTORATION
SCO# 06-06731-01

ROBESON COUNTY NORTH CAROLINA

DATE: 6/10/2011
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SCALE: AS SHOWN

SHEET
AB-4

APPENDIX 2
GENERAL PROJECT TABLES

**Table 1a. Project Components
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Project Component	Existing Acres	Restoration Level	Approach	Acreage	Stationing	Mitigation Ratio	Mitigation Units	BMP Elements ¹	Comment
Former Logging Road	2.88	R1	Grading of Road, Removal of Ditch Feature, & Replanting	2.88	50+00 – 72+50	1:1	2.88		
Enhancement of Wetlands (Hydrological)	39.5	E	Improved Hydrologic Connections from Berm Cuts & Road Crossings	39.5		2:1	19.75		
Enhancement of Wetlands (Hydrological & Vegetative)	4.93	E	Improved Hydrologic Connections from Berm Cuts & Road Crossings, Privet Removal, Herbicide Treatment, & Replanting	4.93		2:1	2.47		
Enhancement of Wetlands (Vegetative)	0.35	E	Privet Removal, Herbicide Treatment, & Replanting	0.35		2:1	0.18		
Preservation (Wetlands)	0.87	P	Preservation of Existing Wetlands	0.87		5:1	0.17		
Preservation (Uplands)	1.59		Preservation of Existing Uplands	1.59					
Access Road & Staging Area	4.66			4.66					
Utility Easement	0.62			0.62					
Road Crossings					2+00 – 30+00				5 Total
Berm Cuts					32+00 – 44+00				4 Total

1 = BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond;
 FS = Filter Strip; Grassed Swale = S; LS = Level Spreader; NI = Natural Infiltration Area, O = Other
 CF = Cattle Fencing; WS = Watering System; CH = Livestock Housing

Non-Applicable

**Table 1b. Component Summations
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration		2.88					
Enhancement (Hydrological)		39.5					
Enhancement (Hydrological & Vegetative)		4.93					
Enhancement (Vegetative)		0.35					
Preservation (Wetlands)		0.87					
Preservation (Uplands)					1.59		
		48.53					
Totals (Acres)	0	48.53		0	1.59	0	0
MU Totals	0	25.45		0	0	0	0

 Non-Applicable

**Table 2. Project Activity and Reporting History
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Elapsed Time Since Grading Complete: 1 yr 0 months
Elapsed Time Since Planting Complete: 0 yr 7 Months
Number of Reporting Years¹: 0

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	Apr-07	Jun-07
Final Design – Construction Plans	Oct-10	Dec-10
Construction	NA	Feb-11
Containerized, bare root and B&B plantings for reach/segments 1&2	NA	Feb-11
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	Sep-11	Oct-11
Year 1 Monitoring		
Year 2 Monitoring		
Structural maintenance (bench expansion, vane) Reach 1		
Year 3 Monitoring		
Supplemental planting of containerized material reach/segment 1		
Year 4 Monitoring		

Bolded items are examples of those items that are not standard, but may come up and should be included
 Non-bolded items represent events that are standard components over the course of a typical project.
 The above are obviously not the extent of potential relevant project activities, but are just provided as example as part of this exhibit.
 If planting and morphology are on split monitoring schedules that should be made clear in the table
¹ = Equals the number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351

Designer EcoEngineering - A Division of The John R. McAdams Co. Primary project design POC	Firm Information / Address 2905 Meridian Parkway, Durham, NC 27713 POC name and phone: George Buchholz (919)287-4262
Construction Contractor EQR, LLC Construction contractor POC	Firm Information / Address 1405 Benson Court, Suite C, Arbutus, MD 21227 POC name and phone: James Walker (443)304-3314
Survey Contractor Turner Land Surveying Survey contractor POC	Firm Information / Address P.O. Box 41023, Raleigh, NC 27629 POC name and phone: David Turner (919)623-5095
Planting Contractor Natives Inc. Planting contractor POC	Firm Information / Address 550 East Westinghouse Boulevard, Charlotte, NC 28273 POC name and phone: Gregg Antemann (866)527-1177
Seeding Contractor EQR, LLC Contractor point of contact	Company Information / Address 1405 Benson Court, Suite C, Arbutus, MD 21227 POC name and phone: James Walker (443)304-3314
Seed Mix Sources ERNST Seeds	Company and Contact Phone 9066 Mercer Pike, Meadville, PA 16335; (800)873-3321
Nursery Stock Suppliers Cumberland Mountain Nursery	Company and Contact Phone 357 Middle Ridge Road, Beersheba Springs TN 37305 (931)692-2324
Nursery Stock Suppliers NC Division of Forest Resources	Company and Contact Phone 1616 Mail Service Center, Raleigh, NC 27699; (919)733-2162
Nursery Stock Suppliers NC Division of Forest Resources	Company and Contact Phone 1616 Mail Service Center, Raleigh, NC 27699; (919)733-2162
Monitoring Performers EcoEngineering - A Division of The John R. McAdams Co. Stream Monitoring POC	Firm Information / Address 2905 Meridian Parkway, Durham, NC 27713 POC name and phone
Vegetation Monitoring POC	POC name and phone: George Buchholz (919)287-4262
Wetland Monitoring POC	POC name and phone: George Buchholz (919)287-4262

**Table 4. Project Attribute Table
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Project County	Robeson
Physiographic Region	Inner Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terrace
Project River Basin	Lumber
USGS HUC for Project (14 digit)	03040203080010
NCDWQ Sub-basin for Project	03-07-51
Within extent of EEP Watershed Plan?	N/A
WRC Hab Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100%; by canal & by EEP markers
Beaver activity observed during design phase?	yes

Restoration Component Attribute Table

	PROJECT SITE
Meadow Branch Canal Drainage area	34.4
Stream order	3rd
Restored length (feet)	N/A
Perennial or Intermittent	N/A
Watershed type (Rural, Urban, Developing etc.)	Dvlping
Watershed LULC Distribution (e.g.)	N/A
Residential	N/A
Ag-Row Crop	N/A
Ag-Livestock	N/A
Forested	N/A
Etc.	N/A
Watershed impervious cover (%)	N/A
NCDWQ AU/Index number	14-12
NCDWQ classification	C, SW
303d listed?	No
Upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
Total acreage of easement	55.4
Total vegetated acreage within the easement (wetland & privet areas)	50.61
Total planted acreage as part of the restoration (former logging road & privet areas)	8.16
Rosgen classification of pre-existing	N/A
Rosgen classification of As-built	N/A
Valley type	N/A
Valley slope	N/A
Valley side slope range (e.g. 2-3.%)	N/A
Valley toe slope range (e.g. 2-3.%)	N/A
Cowardin classification	N/A
Trout waters designation	N/A
Species of concern, endangered etc.? (Y/N)	N/A
Dominant soil series and characteristics	
Series	Bibb
Depth	N/A
Clay%	N/A
K	N/A
T	N/A

Use N/A for items that may not apply. Use "-" for items that are unavailable and "U" for items that are unknown

Table 5. Vegetation Plot Mitigation Success Summary Table			
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351			
Tract	Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
Meadowbranch	VP1	Y	100%
	VP2	Y	
	VP3	Y	

Table 6. Vegetation Metadata	
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351	
Report Prepared By	George Buchholz
Date Prepared	9/13/2011 13:43
database name	cvs-cep-entrytool-v2.2.7.mdb
database location	X:\Projects\EEP\EEP-06050\Storm\Project Phases\Baseline Monitoring\CVS Monitoring Plots
computer name	BUCHHOLZ
file size	49336320
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	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.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	92351
project Name	Meadowbranch Swamp Wetland Restoration
Description	restore surface flow and groundwater elevations within the site area by removing the former logging road and modifying the canal access road
River Basin	Lumber
length(ft)	4788
stream-to-edge width (ft)	7
area (sq m)	6226.85
Required Plots (calculated)	3
Sampled Plots	3

Table 7. Stem Count Total and Planted by Plot Species
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351

Scientific Name	Common Name	Species Type	Baseline Monitoring Data (MY0, 2011)												Annual Means	
			92351-01-0001			92351-01-0002			92351-01-0003			MY0 (2011)				
			P-noLS	P-all	T	P-noLS	P-all	T	P-noLS	P-all	T	P-noLS	P-all	T		
Betula nigra	river birch	Tree	6	6	6	5	5	5	5	5	5	16	16	16		
Fraxinus pennsylvanica	green ash	Tree	2	2	2	1	1	1	4	4	4	7	7	7		
Quercus sp.	oak	Tree				1	1	1	2	2	2	3	3	3		
Quercus laurifolia	laurel oak	Tree	1	1	1	3	3	3				4	4	4		
Quercus lyrata	overcup oak	Tree	4	4	4	2	2	2				6	6	6		
Quercus nigra	water oak	Tree							3	3	3	3	3	3		
Quercus pagoda	cherrybark oak	Tree							1	1	1	1	1	1		
Quercus phellos	willow oak	Tree	1	1	1	7	7	7	7	7	7	15	15	15		
Taxodium distichum	bald cypress	Tree	1	1	1							1	1	1		
Stem count			15	15	15	19	19	19	22	22	22	56	56	56		
size (ares)			1						1			3				
size (ACRES)			0.02			0.02			0.02			0.07				
Species count			6	6	6	6	6	6	4	4	4	9	9	9		
Stems per ACRE			607.03	607.03	607.03	768.90	768.90	768.90	890.31	890.31	890.31	755.4132	755.4132	755.4132		

Notes:

- a) Data presented in table was provided to EcoEngineering from the Carolina Vegetation Survey. Data was not manipulated by EcoEngineering. Formatting of table was performed by EcoEngineering.
- b) P-noLS = Planted Excluding Live Stakes, P-all = All Planted Stems, T = Total Planted and Volunteer Stems
- c) Cells highlighted in VIOLET indicate the presence of volunteers

Color for Density of Planted Excluding Live Stakes	Exceeds requirements by 10%
Color for Density of Total Planted and Volunteer Stems	Exceeds requirements by 10%
Exceeds requirements, but by less than 10%	Exceeds requirements by 10%
Fails to meet requirements, by less than 10%	Fails to meet requirements by less than 10%
Fails to meet requirements by more than 10%	Fails to meet requirements by more than 10%

**Table 8. Vegetation Condition Assessment
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Planted Acreage 8.16

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	----	0	0	0.00%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	----	0	0	0.0%
Total						
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	----	0	0	0.0%
Cumaltive Total						0.00%

Easement Acreage 55.4

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	netting, black	9	5.28	9.50%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	----	0	0	0.00%

**Table 9. Stem Count Total by Random Transect Plot
Meadowbranch Swamp Wetland Restoration/EEP ID# 92351**

Scientific Name	Common Name	Species Type	Baseline Monitoring Data (MY0, 2011)	
			Random Transect 1	Random Transect 2
			Total	Total
Betula nigra	river birch	Tree	1	
Fraxinus pennsylvanica	green ash	Tree		4
Quercus sp.	oak	Tree		
Quercus laurifolia	laurel oak	Tree		
Quercus lyrata	overcup oak	Tree		
Quercus nigra	water oak	Tree		1
Quercus pagoda	cherrybark oak	Tree		
Quercus phellos	willow oak	Tree		
Taxodium distichum	bald cypress	Tree	9	1
Stem count			10	6
size (ACRES)			0.02	0.02
Species count			2	3
Stems per ACRE			404.69	242.81

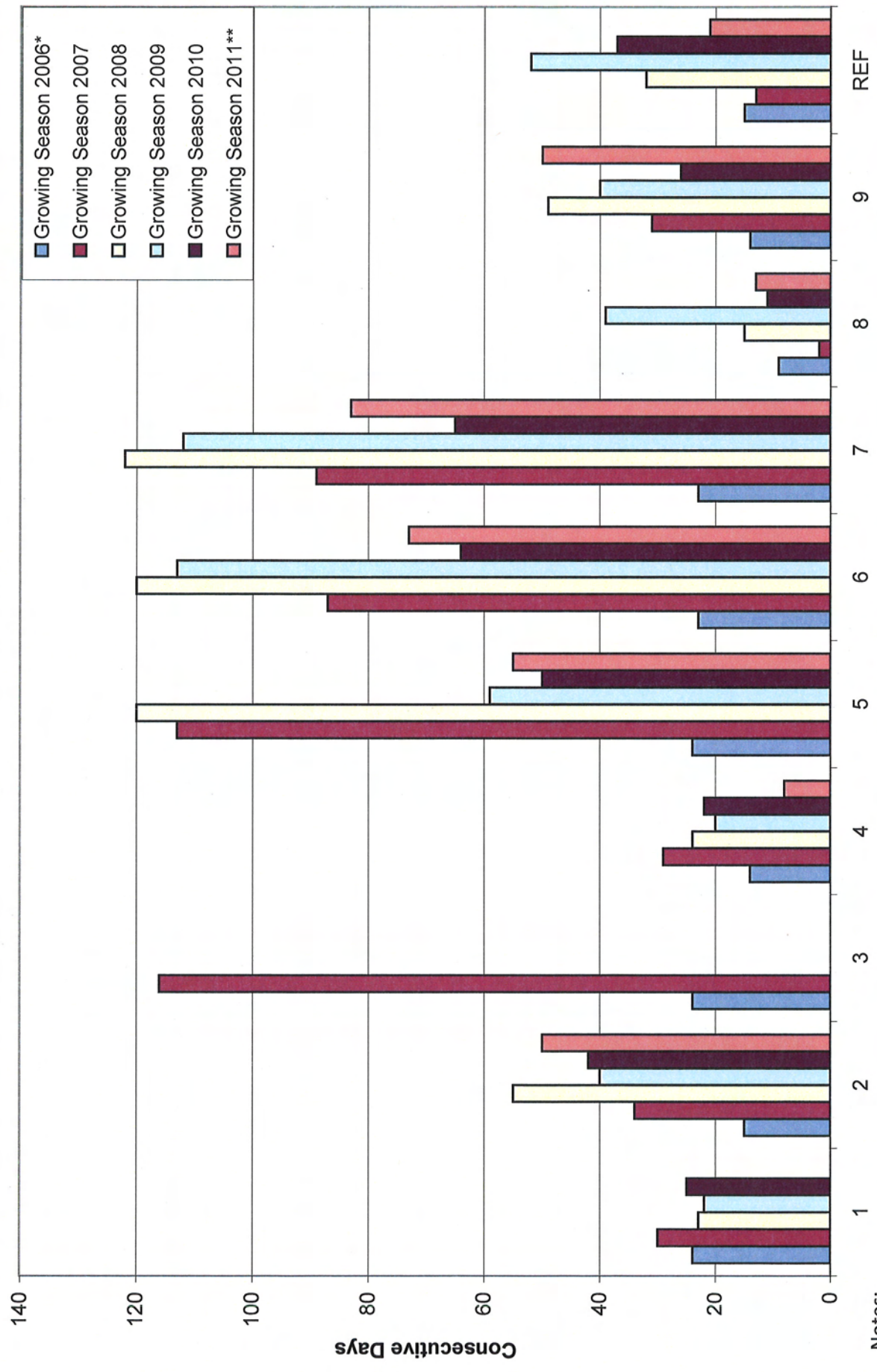
Notes:

a) Two vegetation plots consisting of 50 meter by 2 meter transects were randomly located within the Chinese privet areas. Visual identification of planted stems occurred along the transects. No measurements were taken of planted stems.

b) Total = Total planted stems along transect.

Color for Density of Planted Excluding Live Stakes
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

**Chart 1:
Consecutive Days with Ground Water Elevations within 12" of Ground Surface**



Notes:
 Construction/earthwork completion around 9/15/2010
 *Year 2006 data collection began on 10/27/2011
 **Year 2011 data collection ended on 9/1/2010

APPENDIX 4
PROJECT SITE PHOTOGRAPHS



PHOTO 1: VEGETATION PLOT 1.



PHOTO 2: VEGETATION PLOT 2.

McADAMS

PROJECT NO. EEP-06050
FILENAME: EEP06050.DWG
SCALE: AS SHOWN
DATE: 09-13-2011

BASELINE PHOTOS
**MEADOWBRANCH WETLAND
RESTORATION SITE**
ROBESON COUNTY, NORTH CAROLINA



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PHOTO 3: VEGETATION PLOT 3.



PHOTO 4: RANDOM TRANSECT 1 WITHIN THE CHINESE PRIVET AREA.

McADAMS

PROJECT NO. EEP-06050

FILENAME: EEP06050.DWG

SCALE: AS SHOWN

DATE: 09-13-2011

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PHOTO 5: RANDOM TRANSECT 2 WITHIN THE CHINESE PRIVET AREA.

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PROJECT NO. EEP-06050

FILENAME: EEP06050.DWG

SCALE: AS SHOWN

DATE: 09-13-2011

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PHOTO 6: BERM CUT 1.



PHOTO 7: BERM CUT 2.

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PROJECT NO.	EEP-06050
FILENAME:	EEP06050.DWG
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DATE:	09-13-2011

BASELINE PHOTOS
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PHOTO 8: BERM CUT 3.



PHOTO 9: BERM CUT 4.

PROJECT NO. EEP-06050

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PHOTO 10: ROAD CROSSING 1.



PHOTO 11: ROAD CROSSING 2.

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 PROJECT NO. EEP-06050
 FILENAME: EEP06050.DWG
 SCALE: AS SHOWN
 DATE: 09-13-2011

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PHOTO 12: ROAD CROSSING 3.



PHOTO 13: ROAD CROSSING 4.

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PROJECT NO. EEP-06050

FILENAME: EEP06050.DWG

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DATE: 09-13-2011

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PHOTO 14: ROAD CROSSING 5.

PROJECT NO. EEP-06050

FILENAME: EEP06050.DWG

SCALE: AS SHOWN

DATE: 09-13-2011

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