RESTORATION PLAN

BROWN MARSH SWAMP STREAM AND WETLAND RESTORATION SITE

Robeson County, North Carolina
Contract No. 16-D06038

Prepared for:

NCDENR-Ecosystem Enhancement Program
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EXECUTIVE SUMMARY

The Brown Marsh Swamp Restoration Site (Site) is located one mile east of the North Carolina and South Carolina state line, and is approximately 15 miles southwest of the Town of Lumberton, in Robeson County. The Site is situated due east of the intersection of Cotton Valley Road and McCormick Road, approximately one mile south of Interstate Highway 95. The Site is located within United States Geological Survey (USGS) Hydrologic Unit and Targeted Local Watershed 03040204037010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-07-55) of the Lumber River Basin and will service the USGS 8-digit Cataloging Unit 03040204 (USGS 1974, NCWRP 2003). The Site was identified to assist the North Carolina Ecosystem Enhancement Program (EEP) in meeting its stream and wetland restoration goals.

This document details planned stream and wetland restoration activities at the Site. A 20.25-acre conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 5.0 acres of hydric soils, two unnamed tributaries (UTs) to Contrary Swamp (Northern UT and Southern UT), associated floodplain, and upland slopes. The purpose of this project is to restore a stable pattern, dimension, and profile to the UTs; restore hydrology to drained nonriverine wetlands; and revegetate streams, floodplains, wetlands, and upland slopes within the Site. The contributing watershed is characterized primarily by agricultural row crop production and pine plantation/forest land. Adjacent agricultural land uses, resulting in the removal of riparian vegetation, straightening and dredging of stream channels, and ditching of floodplain wetlands are responsible for the resulting degraded water quality and unstable channel characteristics (stream entrenchment, erosion, and bank collapse).

Project restoration efforts will result in the following.

- Restore 5,004 linear feet of two unnamed tributaries to Contrary Swamp (Northern UT and Southern UT).
- Restore 5.0 acres of nonriverine wetland within the interstream flat
- Reforest approximately 20.05 acres of floodplain, stream bank, upland slopes, and nonriverine wetlands with native forest species.

The primary goals of this stream and wetland restoration project focus on improving water quality, decreasing floodwater levels, and restoring aquatic and riparian habitat, which will be accomplished by:

- Reducing nonpoint sources of pollution associated with agricultural land uses by providing a forested buffer adjacent to streams to treat surface runoff.
- Reducing point sources of pollution associated with agricultural land uses by constructing a BMP at the convergence of a large drainage ditch and the Northern UT.
- Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring stable dimension, pattern, and profile.
- Promoting floodwater attenuation by;

  - excavating a floodplain at a new bankfull elevation;
  - restoring a secondary, entrenched tributary thereby reducing floodwater velocities within smaller catchment basins;
  - increasing storage capacity for floodwaters within the Site limits; and
  - revegetating floodplains to increase frictional resistance on floodwaters.
- Improving aquatic habitat by enhancing stream bed variability, restoring a ripple/dune-pool complex, and by incorporating grade control/habitat structures.
- Providing wildlife habitat including a forested riparian corridor within an area highly dissected by agricultural land uses.

A BMP in the form of a stormwater wetland will be placed in a large agricultural drainage ditch at its convergence with the Northern UT. The drainage ditch has a watershed area of approximately 50 acres, almost all of which is in agricultural (row crops) land. The stormwater wetland will help to enhance water quality by reducing the amount of nutrients, including phosphorous, nitrogen, and heavy metals from stormwater flows. Construction of the stormwater wetland is a voluntary effort on the part of Restoration Systems to improve water quality and habitat for waters within, and downstream of, the Site. No mitigation credits are expected to be received from this effort.

The United States Army Corps of Engineers and the North Carolina Department of Environment and Natural Resources developed a draft "Information Regarding Stream Restoration" document on April 4, 2007 which is to help guide compensatory mitigation providers in evaluating and planning stream mitigation projects. The objective of the document was to ensure that potential mitigation sites had streams that occur naturally, rather than streams that may have been ditched and intercepted groundwater causing intermittent or perennial flow. The primary tools used to assess if channels support natural drainage ways in the Coastal Plain include 1.) sufficient natural slope (drainage ways/valleys), drainage area (typically greater than 100 acres), soils in the drainage way with higher organic content than surrounding (upland) soils. Data collected on both the Northern and Southern UTs indicate that a natural stream may have been supported by slope (a natural valley), drainage area (watershed areas greater than 100 acres), and soils (organic content greater than in adjacent upland soils).

This document represents a detailed restoration plan summarizing activities proposed for the Site. The plan includes 1) descriptions of existing conditions; 2) reference stream, wetland, and forest studies; 3) restoration plans; and 4) monitoring and success criteria. Upon approval of this plan by the EEP, engineering construction plans will be prepared and activities implemented as outlined. Proposed restoration activities may be modified during the design stage to address constraints such as access issues, sediment-erosion control measures, drainage needs (floodway constraints), or other design considerations.

TABLE OF CONTENTS

TABLES

APPENDICES

FIGURES

1.0 PROJECT SITE IDENTIFICATION AND LOCATION

The Site is located one mile east of the North Carolina and South Carolina state line, and approximately 3.2 miles southeast of the town of Rowland (Figure 1, Appendix A). The center of the site has a latitude and longitude of 034º 29' 31.85 N and 079º 16' 26.87'' W. The Site is situated due east of the intersection of Cotton Valley Road (SR 2492) and McCormick Road (SR 2491), approximately one mile south of Interstate Highway 95

This document details planned stream and wetland restoration activities at the Site. A 20.25-acre conservation easement has been placed on the Site to incorporate all restoration activities. The Site contains 5.0 acres of hydric soil, two unnamed tributaries (UTs) to Contrary Swamp (Northern UT and Southern UT), associated floodplain, and upland slopes. The purpose of this project is to restore a stable pattern, dimension, and profile to the UTs; restore hydrology to drained nonriverine wetlands; and revegetate Site streams, floodplains, nonriverine wetlands, and upland slopes.

5,004 linear feet of stream, and 5.0 acres of nonriverine jurisdictional wetlands are expected to be restored at the Site. Table 1 describes the Site restoration structures and objectives.

Table 1. Site Restoration Structures and Objectives

Restoration Segment/ Reach ID	Station Range	Restoration Type	Existing Linear Footage/ Acreage	Designed Linear Footage/Acreage
Northern UT	10+00 – 54+65	Restoration PII	2700	4,465
Southern UT	10+00 – 15+39	Restoration PII	442	539
Nonriverine Wetlands	--	Restoration	5.0	5.0

1.1 Directions to Project Site

Directions to the Site from Raleigh, North Carolina, are as follows:

- Take Interstate 40 East for approximately 18 miles to Interstate Highway 95 (I-95) South
- Take I-95 South for approximately 80 miles to Exit 2, North Carolina Highway 130 (NC-130)
- Take a left/travel south on NC-130 for approximately 0.1 mile to Cotton Valley Road (SR 2492) and turn right
- Follow Cotton Valley Road for approximately 2 miles.
- The project is south of Cotton Valley Road and east of McCormick Road (SR 2491)

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designation

The Site is located in Robeson County, North Carolina within United States Geological Survey (USGS) Hydrologic Unit (HU) and **Targeted Local Watershed 03040204037010** (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-07-55) of the Lumber River Basin and will service the USGS 8-digit Cataloging Unit (CU) 03040204 (USGS 1974, NCWRP 2003).

Streams within the Site appear as perennial streams on the USGS 7.5-minute topographic quadrangle (Dillon East, North Carolina). In addition, NCDWQ stream data forms were completed for Site streams, which confirm a perennial flow regime on both the Northern and Southern UT's (NCDWQ form score of 27.5 and 25.5-See Appendix D).

2.0 WATERSHED CHARACTERIZATION

2.1 Drainage Area

The Northern UT's contributing drainage area at the downstream most end of the Site is 723 acres (1.13 square miles). The Southern UT's contributing drainage area at the downstream most end of the project is 117 acres (0.18 square miles) (Figure 2, Appendix A and Table 2). Onsite elevations are relatively flat, averaging approximately 140 feet National Geodetic Vertical Datum (NGVD) (Dillon East, North Carolina USGS 7.5-minute topographic quadrangle).

Table 2. Site Drainage Areas

Reach	Drainage Area	
	Acres	Square Mile(s)
Unnamed Tributary (Northern)	723	1.13
Unnamed Tributary (Southern)	117	0.18

2.2 Surface Water Classification/Water Quality

Contrary Swamp and its tributaries have been assigned Stream Index Number 14-35-2, a Best Usage Classification of **C Sw**, and are not rated for their intended uses (NCDWQ 2003, NCDWQ 2006a). Class C waters are suitable for aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. Sw (swamp waters) is a supplemental classification intended to recognize those waters that are characterized by very low velocities, low pH, and low dissolved oxygen.

Site streams are not included in the NCDWQ draft 2004 or 2006 Section 303(d) lists (NCDWQ 2004, 2006b) of impaired streams in the state.

2.3 Physiography, Geology, and Soils

The Site is located within the Southeastern Plains of North Carolina in the Atlantic Southern Loam Plains ecoregion. This ecoregion is characterized by dissected, smooth plains and irregular plains on broad, interstream divides with gentle slopes dissected by many small, low to moderate gradient sandy bottomed streams and Carolina bays (Griffith 2002). The Site is located on the Sunderland geomorphic surface in soils that have a very high content of very fine sand and silt (USDA 1978).

Soils within the Site are depicted in Figure 3 (Appendix A) and described in the table below (USDA 1978).

Table 3. USDA Mapping Units within the Site

Soil Series	Hydric Status*	Family	Description
Trebloc loam	Class A	*Typic Paleaquults*	This series consists of briefly ponded, poorly drained, moderately slow and slow permeable soils on broad plains and the lowest part of the landscape. The seasonal high water table generally occurs at the soil surface.
Nahunta very fine sandy loam	Class B	*Aeric Paleaquults*	This series consists of somewhat poorly drained, moderately permeable, nearly level soils on broad smooth plains in the lowest part of the landscape. Depth to the seasonal high water table is 1.5 feet.
Exum very fine sandy loam	Class B	*Aquic Paleudults*	This series consists of moderately well-drained, moderately permeable, nearly level soils on broad flats. Depth to the seasonal high water table is 2.5 feet.
Faceville fine sandy loam	Nonhydric	*Typic Kandiudults*	This series consists of very deep, well-drained, moderately permeable soils formed in red clayey Coastal Plain sediments on uplands.

* Class A = hydric soils; Class B = nonhydric soils, which may contain hydric soil inclusions

2.4 Historical Land Use and Development Trends

The Site watersheds are characterized primarily by row crop production (approximately 80 percent of the total area) and pine plantation/timbered land (approximately 19 percent of the total area). Low-density residential development near the Town of Echo occurs along Gerald Road (SR 2465) and McCormick Road (SR 2491) in the upper reaches of the watershed; however, impervious surfaces appear to account for approximately one percent of the watershed land surface (Figure 2, Appendix A and Table 4). It is anticipated that land uses will remain constant for the foreseeable future because there are currently no pressures from surrounding cities for development.

Table 4. Land Use of Watershed

Land Use	Acres	Percentage
Row-crops	674	80
Pine plantation/Forest land	160	19
Residential Development	8	1
Total	**842**	**100**

2.5 Protected Species

Species with a Federal classification of Endangered or Threatened are protected under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The term "Endangered species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range," and the term "Threatened species" is defined as "any species which is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C. 1532).

Based on the most recently updated county-by-county database of federally listed species in North Carolina as posted by the USFWS at http://nc-es.fws.gov/es/countyfr.html, three federally protected species are listed for Robeson County. The following table lists the federally protected species and indicates if potential habitat exists within the Site for each.

The state of North Carolina provides a measure of protection for species listed as Endangered, Threatened, and Special Concern. A review of element occurrences recorded for Robeson County at the North Carolina Natural Heritage Program confirms no known documents of federally listed or state protected species within 4 miles of the Site.

Potential habitat occurs within the Site for American alligator; however, this species is threatened due to similarity of appearance with another species and is not biologically endangered or threatened. Therefore, American alligators are not subject to Section 7 consultation and no further analysis is necessary.

The Site is almost entirely composed of disturbed vegetative communities and contains no open stands of pine that are suitable for red-cockaded woodpecker foraging (30 years or older) or roosting/nesting (60 years or older) habitat; therefore, no suitable habitat for the red-cockaded woodpecker occurs within the Site. Based on the absence of suitable habitat it is reasonable to conclude the proposed project will have **No Effect** on the red-cockaded woodpecker.

The Site contains suitable habitat for Michaux's sumac; therefore, plant-by-plant surveys were completed on October 31, 2006 within areas of suitable habitat including all stream, ditch, forest, and road margins. Prior to Site surveys, an existing population of Michaux's sumac was visited off of Poole Road in Raleigh, North Carolina. This visit was undertaken to fix a search image in the minds of those who would be conducting Site searches for the species. Sufficient plants were located at the Poole Road site to assure that plants would be recognizable to the investigators on the Site. No Michaux's sumac plants were found during scientifically sound plant-by-plant surveys; therefore, it is reasonable to conclude this project will have **No Effect** on Michaux's sumac.

No designated units of Critical Habitat occur in Robeson County.

In summary the project will have no effect on rare and protected species.

Table 5. Federally Protected Species for Robeson County

Common Name	Scientific Name	Status*	Habitat Present Within Site	Biological Conclusion
Vertebrates				
American alligator	*Alligator mississippiensis*	Threatened (due to Similarity of Appearance)	Yes	Not Applicable
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No	No Effect
Vascular Plants				
Michaux's sumac	*Rhus michauxii*	Endangered	Yes	No Effect

*Endangered = a taxon "in danger of extinction throughout all or a significant portion of its range"; Threatened = a taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range"; Threatened (due to Similarity of Appearance) = a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

2.6 Cultural Resources

Pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for compliance with Section 106 (36 CFR Part 800) comments were received for the Site from the North Carolina State Historic Preservation Office (NCSHPO). No documented archaeological sites or structures of historical or architectural importance occur within the Site. See the approved Categorical Exclusion document for more information concerning cultural resources.

2.7 Potential Constraints

The presence of conditions or characteristics that have the potential to hinder restoration activities within the Site was evaluated. The evaluation focused primarily on the presence of hazardous materials, utilities and restrictive easements, rare/threatened/endangered species or critical habitats, and the potential for hydrologic trespass. Existing information regarding constraints was acquired and reviewed. In addition, any Site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

No constraints that may hinder restoration activities have been identified for this Site.

2.7.1 Property Ownership and Boundary

The property is held in the estate of Mr. John W. Ward, Jr. (Robeson County Deed Book 812, Page 435). A perpetual conservation easement and recordable map of the easement boundary has been signed by the owner and recorded in Robeson County.

2.7.2 Project Access

An access easement has been obtained along the soil road that runs north from East McCormick Road (SR 2492) into the Site, and within the subject conservation easement. SR 2492 is located along the southern edge of the Ward Property.

2.7.3 Utilities

No utilities are located within or directly adjacent to the Project area.

2.7.4 FEMA/Hydrologic Trespass

The HEC-RAS analysis indicates that the restoration design will result in a no-rise in the 100-year floodplain water surface elevations outside of the project area. The results of this analysis affirms that hydrologic trespass to adjacent properties will not occur. A more detailed discussion and HEC-RAS analysis can be found in section 7.3 and Appendix G.

3.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

Site streams proposed for restoration includes two Unnamed Tributaries (UTs) to Contrary Swamp (Northern UT and Southern UT) (Figures 4, 5, Appendix A). Both UTs are depicted as second-order, perennial streams on the USGS Dillon East, South Carolina/North Carolina 7.5-minute topographic quadrangle. The Northern UT flows generally west and southwest for approximately 2700 linear feet until converging with the Southern UT at a tree line at the downstream end of the Site. The Southern UT flows generally northwest through agricultural fields for approximately 442 linear feet until converging with the Northern UT.

Conformity with Stream Guidance

The United States Army Corps of Engineers (USACE) and the DWQ developed a draft document titled "Information Regarding Stream Restoration" on April 4, 2007 which is to help guide compensatory mitigation providers in evaluating and planning stream mitigation projects. The objective of the document is to ensure that potential mitigation sites have streams that occur naturally, rather than streams that may have been ditched and intercepted groundwater causing intermittent or perennial flow. The primary tools used to assess if channels support natural drainage ways in the Coastal Plain include 1.) sufficient natural slope (drainage ways/valleys), drainage area (typically greater than 100 acres), and soils in the drainage way with higher organic content than surrounding (upland) soils.

The upstream most point of each UT within the Site appears to be the natural location of each system's headwaters. This conclusion was made after reviewing elevations and contours obtained from the USGS Dillon East, South Carolina/North Carolina 7.5-minute topographic quadrangle, Robeson County LIDAR data, and a Digital Terrain Model that was completed on the site using conventional surveying methods. These data confirmed that a natural drainage way/valley is present on-site for each stream to flow down. Additionally, both stream channels have supporting drainage areas greater than 100 acres, with the Northern UT draining approximately 1.1 square miles and the Southern UT draining approximately 0.2 square miles. Also, both streams display distinct linear soil boundaries within their valleys that contain much higher organic soils content than adjacent upland soils. This data should be sufficient evidence that the Northern and Southern UTs support a natural stream.

3.1 Channel Classification

Stream geometry and substrate data have been evaluated to classify existing stream conditions, utilizing fluvial geomorphic principles (Rosgen 1996). This classification stratifies streams into comparable groups based on pattern, dimension, profile, and substrate characteristics. Primary components of the classification include degree of entrenchment, width-depth ratio, sinuosity, channel slope, and stream substrate composition. Appendix B (Morphologic Tables) provide a summary of measured stream geometry attributes under existing conditions (considered to be unstable) in addition to stable stream attributes (reference and proposed).

Both the Northern and Southern UTs have been channelized in support of agricultural activities, as evidenced by the straightened channels following the fall line of their respective valleys with unnatural berms/spoil piles adjacent to the channel banks. Land use activities have resulted in numerous detrimental impacts to Site streams and floodplains including the removal of natural meanders, disconnection of bankfull and higher flows from historic floodplains, and denudation of riparian vegetation. Both the Northern and Southern UTs are classified as G5-type (gully) channels using the Rosgen classification system (Rosgen 1996). The channels are entrenched with very low to no sinuosity and a sand-dominated substrate. The Northern UT displays an entrenchment ratio of 2.0 which is slightly higher than normal in G type channels. However, the channel functions as a G type channel because of a lack of bed form diversity (pool to pool spacing is virtually nonexistent) and no meander pattern, which would help to reduce stream energy during high flows.

3.2 Discharge

Streams within the Site have drainage areas ranging from 0.2 square mile for the Southern UT to 1.1 square miles for the Northern UT, which corresponds to bankfull discharges of 4.9 and 18.1 cubic feet per second, respectively (Appendix B).

3.3 Channel Morphology

Channel cross-sections and stream profiles were measured for each of the existing reaches. The Morphological Stream Characteristics tables (Appendix B) include a summary of dimension, profile, and pattern data for each reach.

Data collected at the existing reaches indicate entrenchment ratios ranging from 1.3 (Southern UT) to 2.0 (Northern UT) and width-depth ratios of 5.8 (Southern UT) to 6.0 (Northern UT), typical of entrenched G-type (gully) channels. Straightening of the channels has resulted in a loss of pattern variables such as belt-width, meander wavelength, pool-to-pool spacing, and radius of curvature. The channel is currently characterized by a sinuosity of 1.00 (channel distance/valley distance) and no distinct repetitive pattern of riffles and pools is present. The channels are characterized by a channel substrate dominated by sand-sized particles.

3.4 Channel Stability Assessment

A visual assessment accompanied by a morphological assessment using data collected during a Rosgen Level II survey was used to determine channel stability. These data, which can be found in Appendix B (Morphological Tables) and in Appendix C and D (Project Site Photographs and Project Site NCDWQ Stream Classification Forms), confirmed that the channel attributes do not fall within acceptable ranges for a stable channel as evidenced by entrenchment, absence of sinuosity, absence of a repetitive sequence of riffle and pools, a lack of riparian vegetation on stream banks, and an inability of the channel to convey discharge and sediment loads without aggrading or degrading.

3.5 Bankfull Verification

Onsite data was compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* (regional curve) (Doll et al. 2006) and reference streams (discussed below) to verify the bankfull discharge. The bankfull discharge on the Northern UT is estimated to be 18.1 cubic feet per second and on the Southern UT is estimated to be 4.9 cubic feet per second.

3.6 Vegetation

Existing vegetation is sparse due to constant maintenance associated with agricultural row crops adjacent to the Northern and Southern UTs banks and riparian area. Existing channel banks are sparsely vegetated with various grass species, which are frequently mowed. The wetland restoration area is currently characterized by agricultural row crop fields that contain no natural vegetation due to constant tillage and planting of harvestable crops.

The loss of a forested riparian buffer has greatly increased nutrient runoff and sheet flow into streams within the Site, as evidenced by algal blooms. Additionally, the loss of forested riparian vegetation decreases the ability to regulate water temperatures within the streams due to a lack of overhanging vegetation to shade the channel. High water temperatures and nutrient inputs have lead to algal blooms and presumably low levels of dissolved oxygen in streams within the Site. Low levels of dissolved oxygen have a detrimental impact on aquatic fauna and flora, leading to fish kills and the absence of macrobenthos.

4.0 REFERENCE STREAMS

Four relatively undisturbed reaches (Mill Creek, UT to Wildcat Creek, UT to Hog Swamp, and UT to Ironhill Branch) were measured and characterized as E-type channels. Distinct bankfull variables were identifiable in the reaches and pattern/profile characteristics appear to have not been degraded, allowing for assistance with channel design. Reference site vicinity maps, reference site watershed maps, and reference site soil survey maps can be found for each reference stream in figures 6.1 A, B, and C (maps for Mill Creek), 6.2 A, B, and C (maps for UT to Wildcat Branch, 6.3 A, B, and C (maps for UT to Hog Swamp), and 6.4 A, B, and C (maps for UT to Ironhill Branch).

4.1 Channel Classification

The reference reaches are characterized by E-type, moderately sinuous (1.15 to 1.33) channels with sand-dominated substrates (Appendix B). E-type streams are characterized as slightly entrenched, riffle-pool channels with sinuous flow patterns. In North Carolina, E-type streams often occur in narrow to wide valleys with well-developed alluvial floodplains (Valley Type VIII).

4.2 Discharge

The reference reaches have drainage areas ranging from 1.92 square miles for Mill Creek, 0.44 square mile for the UT to Wildcat Branch, 0.08 square mile for the UT to Hog Swamp, and 1.61 square miles for the UT to Ironhill Branch. The reference reaches have bankfull discharges of 30.6, 8.5, 2.3, and 10.3 cubic feet per second, respectively (Appendix B).

4.3 Mill Creek

4.3.1 Watershed Characterization

The Mill Creek watershed is largely dominated by mature forest (approximately 80 percent of the watershed). Additional forest lands are experiencing impacts from timber harvests and minor residential development (approximately 10 percent of the watershed). The remainder of the watershed is comprised of agricultural land use practices (approximately 10 percent of the watershed).

4.3.2 Bankfull Verification

Onsite data was compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* [regional curve] (Doll et al. 2006) to verify the bankfull discharge. The bankfull discharge on Mill Creek at the point of the survey is estimated to be 30.6 cubic feet per second. The regional curve estimates the bankfull discharge to be 18.1 cubic feet per second. The high end of the 95 percent confidence interval of the curve however, is 30 cubic feet per second, which verifies the bankfull discharge for Mill Creek.

4.3.3 Vegetation

Mill Creek is surrounded by a mature (50 years or older) vegetated floodplain. The vegetated floodplain extends a minimum of 200 feet from both the left and right banks throughout the study area. Dominant vegetation within the floodplain includes giant cane (*Arundinaria gigantea*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), red bay (*Persea borbonia*), sweet bay (*Magnolia virginiana*), Chinese privet (*Ligustrum sinense*), yellow poplar (*Lirodendron tulipifera*), greenbrier (*Smilax rotundifolia*), Amerian holly (*Ilex opaca*), cinnamon fern (*Osmunda cinnamomea*), and black gum (*Nyssa sylvatica*).

4.4 UT to Wildcat Branch

4.4.1 Watershed Characterization

The UT to Wildcat Branch watershed is dominated by mature forests (approximately 60 percent of the watershed). Deforestation is occurring within the watershed; however, most cleared areas have been replanted with pine. The remainder of the watershed is comprised primarily of agricultural land use practices (approximately 40 percent of the watershed).

4.4.2 Bankfull Verification

Onsite data was compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* [regional curve] (Doll et al. 2006) to verify the bankfull discharge. The bankfull discharge on UT to Wildcat Branch at the point of the survey is estimated to be 8.2 cubic feet per second. The regional curve estimates the bankfull discharge to be 9.2 cubic feet per second, which verifies the estimated bankfull discharge found onsite.

4.4.3 Vegetation

The UT to Wildcat Branch is surrounded by a mature (50 years or older) vegetated floodplain. The vegetated floodplain extends a minimum of 250 feet from both the left and right banks throughout the study area. Dominant vegetation within the floodplain includes giant cane, red maple, sweet gum, red bay, sweet bay, Chinese privet, yellow poplar, greenbrier, Amerian holly, cinnamon fern, doghobble (*Leucothoe axilaris*), and black gum.

4.5 UT to Hog Swamp

4.5.1 Watershed Characterization

The UT to Hog Swamp watershed is dominated by agricultural practices (approximately 85 percent of the watershed). The remainder of the watershed is comprised of residential housing (approximately 5 percent of the watershed) and mature (over 50 years old) forest located adjacent to the UT to Hog Swamp (approximately 10 percent of the watershed).

4.5.2 Bankfull Verification

Onsite data was compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* [regional curve] (Doll et al.. 2006) to verify the bankfull discharge. The bankfull discharge on UT to Hog Swamp at the point of the survey is estimated to be 2.3 cubic

feet per second. The regional curve estimates the bankfull discharge to be 2.7 cubic feet per second, which verifies the estimated bankfull discharge found onsite.

4.5.3 Vegetation

The UT to Hog Swamp is surrounded by a mature (50 years or older) vegetated floodplain. The vegetated floodplain extends a minimum of 100 feet from both the left and right banks throughout the study area. Dominant vegetation within the floodplain includes giant cane, red maple, sweet gum, red bay, sweet bay, Chinese privet, yellow poplar, greenbrier, American holly, and doghobble.

4.6 UT to Ironhill Branch

4.6.1 Watershed Characterization

The UT to Ironhill Branch watershed is dominated by agricultural practices (approximately 65 percent of the watershed) and mature forest (approximately 30 percent of watershed). The remainder of the watershed is comprised of residential housing (approximately 5 percent of the watershed).

4.6.2 Bankfull Verification

Onsite data was compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* (regional curve) (Doll et al.. 2006) to verify the bankfull discharge. The bankfull discharge on UT to Ironhill Branch at the point of the survey is estimated to be 10.3 cubic feet per second. The regional curve estimates the bankfull discharge to be 23 cubic feet per second, which is considerably higher than the estimated discharge within the studied reach. However, bankfull is at top of bank and actual velocity measurements were conducted at near bankfull flows while surveying this reach, which gives credence to 10.3 cubic feet per seconds as the accurate bankfull discharge.

4.6.3 Vegetation

The UT to Ironhill Branch is surrounded by a mature (50 years or older) vegetated floodplain. The vegetated floodplain extends a minimum of 100 feet from both the left and right banks throughout the study area. Dominant vegetation within the floodplain includes giant cane, red maple, sweet gum, red bay, sweet bay, Chinese privet, yellow poplar, greenbrier, Amerian holly, and doghobble.

4.7 Channel Morphology

Channel cross-sections and stream profiles were measured for each of the three reference reaches. The Tables of Morphological Stream Characteristics (Appendix B) include a summary of dimension, profile, and pattern data for each reference reach to assist with the establishment of reconstruction parameters.

Data collected at the reference reaches indicate a width-to-depth ratio of 10.8 and bank-height ratio of 1.0. In addition, the width of the floodprone area is greater than 100 feet through the reach, giving the channel an entrenchment ratio well over 10, which is typical of stable E-type channels.

In-field measurements of the reference reaches have yielded an average sinuosity ranging from 1.15 to 1.33 (thalweg distance/straight-line distance). Accompanying this sinuosity are several channel attributes including pool-to-pool spacing ratio (L_{p-p}/W_{bkf}) of 1.0 to 6.3, meander wavelength ratio (L_m/W_{bkf}) of 2.7 to 7.0, and radius of curvature ratio (R_c/W_{bkf}) of 0.9 to 2.6. Meander geometry values for the reference reaches are acceptable. These variables were measured within stable reaches, which did not exhibit any indications of pattern instability such as shoot cutoffs, abandoned channels, or oxbows.

The channels are characterized by a channel substrate dominated by sand-sized particles.

4.8 Channel Stability Assessment

A visual assessment accompanied by a morphological assessment using data collected during a Rosgen Level II survey was used to determine channel stability. These data, which can be found in Appendix B (Morphological Tables) and in Appendix E and F (Reference Site Photographs and Reference Site NCDWQ Stream Classification Forms), confirmed that the channel fell within acceptable ranges for a stable reference channel.

Major components for stability include determining if the channel is conveying its discharge and sediment load without aggrading or degrading. Evidence that a channel does not fit this criteria includes, bank degradation, channel incision, channel widening, channel aggradation, massive amounts of sediment loading within and/or outside of the channel banks, channel armoring, and generally speaking no vegetation on the channel's banks.

5.0 SITE WETLANDS

5.1 Existing Jurisdictional Wetlands

Jurisdictional wetland limits are defined using criteria set forth in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987). As stipulated in this manual, the presence of three clearly defined parameters (hydrophytic vegetation, hydric soils, and evidence of wetland hydrology) are required for a wetland jurisdictional determination.

Hydric soil limits were mapped in the field during November 2006. Based on field surveys and groundwater models discussed below, **jurisdictional wetlands do not currently occur within the Site.** Areas within the Site which may have historically contained jurisdictional wetlands have been significantly disturbed by floodplain ditching of agriculture fields; relocation, dredging, straightening, and rerouting of onsite streams; removal of vegetation; and annual plowing. Due to those activities, any historical wetlands are currently effectively drained below jurisdictional wetland hydrology thresholds.

Historically, onsite wetlands may have supported communities similar to a Coastal Plain Small Stream Swamp and a Nonriverine Wet Hardwood Forest (Schafale and Weakley 1990). Coastal Plain Small Stream Swamp (Blackwater Subtype) communities typically occur on alluvial floodplains of small blackwater streams that are intermittently, temporarily, or seasonally flooded. Nonriverine Wet Hardwood Forests are typically located on poorly drained interstream flats not associated with a stream. Despite the landscape position difference between the riverine and nonriverine areas of the Site, vegetative communities are similar and historically may have been dominated by species contained within the reference forest (Figures 7, 8, 9, Appendix A). These species include water tupelo (*Nyssa biflora*), sweetgum, swamp chestnut oak (*Quercus michauxii*), tulip poplar, red maple, ironwood (*Carpinus caroliniana*), sweetbay, ash (*Fraxinus* sp.), water oak (*Quercus nigra*), American elm (*Ulmus americana*), and American holly with an understory of red bay, Carolina laurel cherry (*Prunus caroliniana*), red mulberry (*Morus rubra*), southern arrow-wood (*Viburnum dentatum*), possumhaw (*Viburnum nudum*), Virginia willow (*Itea virginica*), highbush blueberry (*Vaccinium corymbosum*), coastal doghobble (*Leucothoe axillaris*), poison ivy (*Toxicodendron radicans*), yellow jessamime (*Gelsemium sempervirens*), greenbriers (*Smilax rotundifolia, Smilax glauca,* and *Smilax laurifolia*), and several fern species. In the vicinity of these plots were several species that may have historically occurred within the Site such as bald cypress (*Taxodium distichum*), cottonwood (*Populus* sp.), box elder (*Acer negundo*), sweet pepperbush (*Clethra alnifolia*), and American beautyberry (*Callicarpa americana*). Onsite impacts may have reduced hydrologic functions, biogeochemical functions, and plant and animal habitat interactions of these communities.

5.2 Hydrological Characterization

5.2.1 Groundwater Modeling

Groundwater modeling was performed to characterize water table elevations under historic (reference), existing, and post-restoration conditions. Specifically, the study compared the output of two models (the Boussinesq Equation and DRAINMOD) to estimate the lateral effect of agricultural drainage ditches and downcutting stream channels within the Site on the depth to the groundwater table.

5.2.1.1 Groundwater Model Descriptions

Boussinesq Equation

The Boussinesq Equation represents a two-dimensional general flow equation for unconfined aquifers. The equation has been applied in the past to predict the decline in elevation of the water table near a pumping well as time progresses. The equation is based primarily on hydraulic conductivity, drainable porosity, and the saturated thickness of the aquifer. One form of the equation is as follows:

$$X = (K\, h_0\, t/f)^{½} / F(D,H)$$

where K = hydraulic conductivity (in/hr); h0 = depth to aquiclude (in); t = duration (hours); f = drainable porosity (dimensionless ratio); F(D,H) = profiles (graphs) relating ditch depth, water table depth, and depth to the aquiclude(h0); and X = wetland impact distance (in).

DRAINMOD

DRAINMOD was originally developed to simulate the performance of agricultural drainage and water table control systems on sites with shallow water table conditions. DRAINMOD predicts water balances in the soil-water regime at the midpoint between two drains of equal elevation. The model is capable of calculating hourly values for water table depth, surface runoff, subsurface drainage, infiltration, and actual evapotranspiration over long periods referenced to measured climatological data. The reliability of DRAINMOD has been tested for a wide range of soil, crop, and climatological conditions. Results of tests in North Carolina (Skaggs, 1982), Ohio (Skaggs et al. 1981), Louisiana (Gayle et al. 1985; Fouss et al. 1987), Florida (Rogers 1985), Michigan (Belcher and Merva 1987), and Belgium (Susanto et al. 1987) indicate that the model can be used to reliably predict water table elevations and drain flow rates. DRAINMOD has also been used to evaluate wetland hydrology by Skaggs et al. (1993). Methods for evaluating water balance equations and equation variables are discussed in detail in Skaggs (1980).

DRAINMOD was modified for application in wetland studies by adding a counter that accumulates the number of events wherein the water table rises above a specified depth and remains above that threshold depth for a given duration during the growing season. Important inputs into the DRAINMOD model include rainfall data, soil and surface storage parameters, evapotranspiration rates, ditch depth and spacing, and hydraulic conductivity values.

5.2.1.2 Groundwater Modeling Applications

Boussinesq Equation

In this study, the Boussinesq Equation was applied to agricultural field ditches and entrenched stream channels to predict where the linear distance of a drawdown in the groundwater exceeds 1 foot for 12.5 percent of the growing season. This percentage was selected based upon reference wetland groundwater modeling described below and guidance from the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). The equation is solved for the wetland impact distance with data for the following variables 1) equivalent hydraulic conductivity, 2) drainable porosity, 3) an estimated depth to the impermeable layer or aquiclude, 4) the time duration of the drawdown, 5) target water table depth (one foot below the soil surface), and 6) minimum ditch depth.

Hydraulic conductivity (K) values were estimated using published conductivity data in the Coastal Plain of North Carolina (Skaggs et al. 2002) and the Robeson County soil survey (USDA 1978). The soil layer depths were obtained from descriptions in the Robeson County soil survey and were verified in the field. Drainable porosity was determined using published data (Skaggs et al. 1986) and records maintained by the USDA-NRCS National STATSGO database (Map Unit User File [MUUF] computer program). The depth to aquiclude was obtained from published values for the Trebloc (Coxville) series (Skaggs et al. 1986).

The time variable, t, is based on 12.5 percent of the Robeson County growing season or 31 days. For the purpose of this study, the growing season is defined as the period between March 14 and November 14 (USDA 1978). Values for the function F(D,H), defined as a function of ditch depth, water table depth, and depth to the aquiclude, were taken from plotted numerical solutions to the Boussinesq Equation (Figure 2j, Skaggs 1976), where D = d/h0 and H = h/h0. The variable d is defined as the ditch elevation above the aquiclude. The variable h0 is the distance from the surface to the aquiclude. The variable h is equal to the height after drawdown for the water above the aquiclude at distance X from the ditch. For the purposes of this analysis, h was defined as the distance between the aquiclude and a point 1 foot below the surface. Minimum ditch depths were determined during cross-sectional analysis of agricultural field ditches.

DRAINMOD

DRAINMOD was used to model the zone of wetland loss resulting from the addition of the agricultural field ditches and channel incision. This zone was estimated by determining the threshold drain spacing of parallel ditches that would result in the area adjacent to the ditches meeting the wetland hydrology criterion in just over one-half of the years simulated. Ditches spaced any closer than this threshold distance would result in the entire area between the ditches experiencing a loss of wetland hydrology. If ditches were spaced further apart than the threshold distance, there would be a strip between the ditches which would still meet wetland hydrology criteria. One-half of this threshold spacing provides an estimate of the drainage effect on each side of a single agricultural field ditch. This application of the model recognizes that the water table midway between two ditches spaced at the threshold spacing will be lower (i.e., the soil at that point will be drier) than would be the case at the same distance from a single ditch (i.e., at a

distance of one-half the threshold spacing from a single ditch). This results in a conservative estimate of drainage impacts for a single ditch to the adjacent groundwater table. A second ditch parallel to the first ditch at the threshold distance would cut off seepage from the zone beyond the threshold distance and permit greater groundwater table drawdown at the midpoint than would occur if this second ditch were not present. Therefore, the width of the strip of land that would experience hydrologic conversion from wetland to upland hydraulic conditions would be less than a distance equal to one-half the threshold spacings.

Wetland hydrology is defined for DRAINMOD as groundwater within 12 inches of the ground surface for 31 consecutive days during the growing season in Robeson County (USDA 1978). Wetland hydrology is achieved in the model if target hydroperiods are met for one-half of the years modeled (i.e. 31 out of 62 years).

Additional inputs for soil parameters and relationships derived from soil water characteristic data such as the groundwater table depth/volume drained/upflux relationship, Green-ampt parameters, and the water content/matric suction relationship were obtained from published values (Skaggs et al. 1986). Hydraulic conductivities and ditch depths were calculated as described above. Surface depressional storage was estimated from published ranges (Skaggs et al. 1994 and Skaggs 1980) after visiting the Site. Drainage coefficients for the ditches were calculated based on formulas provided with DRAINMOD.

Weather data for a 62-year period was obtained for Plymouth, North Carolina in Washington County. Potential evapotranspiration rates were calculated based on Thornthwaite's method and adjusted using monthly factors derived from more reliable average values for crop evapotranspiration for the Coastal Plain known from Washington County. The DRAINMOD simulation was conducted for the time period from 1933 through 1994.

5.2.1.3 Groundwater Modeling Results

Reference Wetland Model

For development of reference wetland standards, modeling was performed to predict historic wetland hydroperiods (as a percentage of the growing season) in various undrained conditions. The reference model was developed by effectively eliminating the influence of ditching and forecasting the average hydroperiod over the number of years modeled. Two iterations were performed to evaluate changes in wetland hydroperiod between 1) old field (post-farmland) stages of wetland development and 2) forested stages of wetland development.

Old field stages of wetland development were simulated by modifying soil drainage characteristics such as rooting functions in proximity to the B (clay) horizon, A horizon (plow layer) hydraulic conductivity, and water storage capacity within the plow layer. The old field model provides a hypothetical approximation of the potential hydroperiod exhibited immediately after channel restoration is conducted and drainage networks are removed.

Forested stages were modeled to predict wetland hydroperiods that may occur within reference (relatively undisturbed) wetlands in the region. The reference forest model is expected to provide a projection of wetland hydroperiods and associated functions that may be achieved over the long term (10 or more years) as a result of wetland restoration activities and steady state forest conditions. The steady state model application assumes increases in rooting functions, organic matter content, and water storage capacity relative to post-farmland periods.

The reference model predicts that, in Trebloc soils, old field stages of wetland development exhibit an average wetland hydroperiod encompassing 17 percent of the growing season, respectively, over the years modeled (Table 6). This average hydroperiod translates to free water within 1 foot of the soil surface for a 42 day period. During the 62-year modeling period, reference wetland hydroperiods exhibited a range extending from less than 6 percent (61 out of 62 years) to more than 30 percent (1 out of 62 years) of the growing season, dependent upon rainfall patterns (Table 6).

Table 6. DRAINMOD Results for the Reference Wetland Hydroperiod

Duration of the Growing Season Wetland Hydrology Achieved		Number of Years Wetland Hydrology Achieved (62-year period)	
		Trebloc	
		Old Field Stage*	Forested Stage**
2 %	5 days	62	62
4 %	10 days	62	62
6 %	15 days	61	62
8 %	20 days	58	62
10 %	25 days	53	62
12 %	29 days	52	62
14 %	34 days	45	62
16 %	**39 days**	**36**	59
18 %	**44 days**	**27**	50
20 %	49 days	14	48
22 %	54 days	9	46
24 %	59 days	4	42
26 %	64 days	3	37
28 %	69 days	3	**32**
30 %	74 days	1	27

* Old Field Stage - immediately after backfilling and plugging ditches; relatively low surface water storage
** Forested Stage - 10 or more years after restoration; relatively high surface water storage

As surface topography, rooting, roughness, and storage variables increase during successional phases, the model predicts that hydroperiods will increase to steady state forest conditions with an average wetland hydroperiod of 28 percent in Trebloc soils over the 62 years modeled (Table 6). The average hydroperiod translates to free water within 1 foot of the soil surface for a 69-day period in Trebloc soils. The hydroperiod ranges from 14 percent to more than 30 percent during the 62 year period dependent upon rainfall patterns. Therefore, the reference model suggests that groundwater fluctuations must be tracked within a reference wetland site to accurately assess a target hydroperiod for any given year.

As described above, the average wetland hydroperiod in Trebloc soils is forecast to exhibit a gradual increase from approximately 14 percent of the growing season immediately after Site implementation to as much as 28 percent under steady state forest conditions. A gradual increase in hydroperiods may suggest that water storage capacity (rooting functions, organic materials/debris accumulation, microtopography, etc.) exhibits a significant effect on maintenance of wetland hydrology in on-Site wetlands. In old field stages of succession, accelerated runoff may occur within the compacted soil surfaces. For purposes of this preliminary model, runoff is assumed to occur at accelerated rates which reduce the influence of evapotranspiration on wetland hydrodynamics. This accelerated drainage would be expected to decrease as successional vegetation colonizes the Site.

Because wetland hydroperiods during old field stages of wetland development are projected to extend for approximately 14 percent of the growing season, wetland monitoring plans that extend for a five-year period after restoration should utilize a minimum 12.5 percent wetland hydrology criteria to substantiate restoration success. Alternatively, hydroperiods within the restored wetland area may be compared to the reference wetland, with success criteria stipulating that restored wetland hydroperiods must exceed 75 percent of the wetland hydroperiod exhibited by reference.

Methods may be employed to increase complexity in the soil surface (A-horizon plow layer) during restoration activities. These modifications, including woody debris deposition and soil scarification, may increase water storage capacity across the surface of relatively impermeable layers (B-horizon surface). If water storage is not adequately established during early stages of wetland development, marginal or non-wetland conditions may occur in elevated areas of the Site. Invariably, rooting influences on water storage capacity will require an extended period of forest development to establish (assumed to be greater than 10 years).

Existing Site Conditions

Groundwater models were utilized to forecast the maximum zone of ditch and incised stream influence on jurisdictional wetland hydroperiods. The maximum zone of influence may be used to predict the area of wetland hydrological restoration that may result due to Site implementation. In addition, the model provides an estimate of the area that may continue to be degraded in perpetuity by remaining ditches used to drain adjacent agricultural fields. Ditch depths and spacing were varied in the model until wetland hydroperiods were reduced relative to the reference groundwater model predictions.

Both the Boussinesq Equation and DRAINMOD have an ability to support different ditch morphology and features, suggesting that use of these methods in evaluation of drainage impacts from agricultural field ditches and stream channel incision is applicable with proper data inputs. Performing a comparison of output from both models is recommended due to output predictions typically within the lower limits (Boussinesq Equation) and upper limits (DRAINMOD) of the range of drainage influence likely to occur in real world conditions. Groundwater model results are presented in Table 7.

Table 7. Results for the Zone of Influence and Wetland Loss for Trebloc Soils

Ditch Depth (feet)	Zone of Influence (feet)		
	Boussinesq Equation	DRAINMOD Model*	Drainage Impact Used for this Study
2	52	159	105
3	83	193	138
5	86	238	162

*Zone of influence equal to half of the modeled ditch spacing.

The Boussinesq Equation and DRAINMOD model predict a range of influence on the jurisdictional wetland hydroperiod (12.5 percent of growing season) of 83 to 193 feet of lateral zone of influence for a 3-foot ditch (Table 5). The Boussinesq Equation value is expected to be at the low end of the drainage impact and the DRAINMOD model value is expected to be at the high end of the drainage impact. Therefore, an average value for drainage impact was calculated from the Boussinesq Equation and DRAINMOD results. As the Site succeeds towards steady state forest conditions, the zone of potential wetland loss is expected to be reduced due to projected, lower infiltration and runoff rates.

Groundwater model simulations for existing conditions indicate that approximately 5.0 acres of hydric Trebloc soils within the Site are below jurisdictional wetland hydrology criteria and are considered effectively drained due to the groundwater drawdown from relocation, dredging, straightening, and rerouting of onsite streams; ditching of fields; annual plowing; and removal of vegetation (Table 7 and Figure 11, Appendix A). Of these effectively drained areas, groundwater model simulations indicate that jurisdictional wetland hydrology will be restored as the result of Site restoration activities to approximately 5.0 acres of existing agricultural fields within the Site (Figure 12, Appendix A). Figure 12 depicts the area of nonriverine wetland restoration and the location of a relocated ditch, which will be required to be relocated.

Jurisdictional hydrology will be restored through groundwater. Surface water from the adjacent stream restoration on the Northern UT is not expected to influence hydrology with the wetland restoration aspect of the Site. Evidence of this can be found from analyzing bankfull and 100-year discharge elevations from the restored Northern UT to existing elevations within the wetland restoration area. Bankfull elevations of the Northern UT directly adjacent to the wetland restoration are between 135.4 and 136.4 feet above mean sea level (msl). 100-year flood elevations of the Northern UT in the same location are between 138.7 and 139.1 feet above msl. Elevations within the proposed non-riverine wetland restoration range from 138 to 139 feet above msl. So, as shown by these data, surface water flows from the Northern UT will only reach the proposed wetland restoration area when flood levels approach a 100-year storm.

It should be noted that construction activities will restore ground water hydrology to a minimum of 8.0 acres of existing agricultural fields. These lands, along with additional acreage of agricultural fields, will be preserved under a separate conservation easement and are not considered part of the conservation easement for this Site.

5.3 Soil Characterization

Onsite verification and ground-truthing of county soil survey map units were conducted in November 2006 by Grant Lewis, a licensed soil scientist, to refine soil map units and to locate inclusions. Verification of hydric soil limits within the Site can be found in Figures 11 and/or 12 (Appendix A). Systematic transects were established and sampled to ensure proper coverage. Soils were sampled for color, texture, consistency, and depth at each documented horizon.

5.3.1 Taxonomic Classification

Detailed soil mapping indicates that hydric soils of the Trebloc series encompass approximately 5.0 acres within the Site. Soils of the Trebloc series are characterized by light gray to dark gray with mottles consisting of silty loam textured surface soils underlain by loamy clay, clay loam, or sandy clay loam textured soils. In general, areas of hydric soils of the Trebloc series have been disturbed by ditching within agricultural fields, deforestation; and soil compaction due to annual plowing. Based on preliminary studies, onsite soils of the Trebloc series appear to have historically supported jurisdictional wetlands with groundwater hydrology driven primarily by lateral migration of groundwater and surface flows.

5.3.2 Profile Description

A typical soil profile from onsite verification and ground-truthing conducted by a licensed soil scientist for Trebloc soils within the Site proposed for nonriverine wetland restoration and enhancement is as follows.

- 0-5 inches 2.5Y 4/1 silt loam
- 5-11 inches 2.5Y 4/1 loamy clay
- 11-24 inches 2.5Y 6/1 sandy loam with mottles of 2.5Y 4/1
- 24+ inches 2.5Y 6/1 clay with mottles of 2.5Y 6/6

5.4 Plant Community Characterization

Existing vegetation within proposed nonriverine wetland restoration areas is composed entirely of agricultural row crops that contain no natural vegetation due to constant tillage and planting of harvestable crops.

6.0 REFERENCE FOREST ECOSYSTEM

According to Mitigation Site Classification (MiST) guidelines (USEPA 1990), a Reference Forest Ecosystem (RFE) must be established for restoration sites. RFEs are forested areas on which to model restoration efforts of the restoration site in relation to soils and vegetation. RFEs should be ecologically stable climax communities and should be a representative model of the Site forested ecosystem as it probably existed prior to human disturbances. Quantitative data describing plant community composition and structure should be collected at the RFEs and subsequently applied as reference data in an attempt to emulate a natural climax community.

Table 8. Reference Forest Ecosystem

Tree Species	Number of Individuals *	Relative Density (%)	Frequency * (%)	Relative Frequency (%)	Basal Area * (ft^2/acre)	Relative Basal Area (%)	Importance Value
Red maple (*Acer rubrum*)	9	17.6	67	10.6	27.7	16.8	0.15
Ironwood (*Carpinus caroliniana*)	6	11.8	67	10.6	2.4	1.4	0.08
Ash (*Fraxinus* sp.)	7	13.7	33	5.2	16.2	9.9	0.10
American holly (*Ilex opaca*)	1	2.0	33	5.2	0.5	0.3	0.02
Sweetgum (*Liquidambar styraciflua*)	2	3.9	67	10.6	4.2	2.6	0.06
Tulip poplar (*Liriodendron tulipifera*)	6	11.8	33	5.2	38.1	23.2	0.13
Water tupelo (*Nyssa biflora*)	11	21.6	100	15.8	37.6	22.8	0.20
Laurel oak (*Quercus laurifolia*)	1	2.0	33	5.2	2.3	1.4	0.03
Swamp chestnut oak (*Quercus nigra*)	2	3.9	67	10.6	18.5	11.2	0.09
Water oak (*Quercus nigra*)	1	2.0	33	5.2	5.8	3.5	0.04
American elm (*Ulmus americana*)	2	3.9	33	5.2	7.9	4.8	0.05
TOTALS	**51**	**100**	**633**	**100**	**165**	**100**	**1.00**

* Sum of three 0.1-acre plots

One RFE plot for this Site is located in the western end of the Site; two additional RFE plots were sampled along Ashpole Swamp near NC 130 approximately two miles southeast of the Site (Figure 8, Appendix A). The RFEs support plant community and landform characteristics that restoration efforts will attempt to emulate. The three circular plots described above were 0.1-acre in size and were randomly established within the two reference areas. Data collected within

each plot include 1) tree species composition; 2) number of stems for each tree species; 3) diameter at breast height (DBH) for each tree species; and 4) a list of understory species. Data for the three 0.1-acre plots were combined for the above table, which indicates importance values of dominant tree species calculated based on relative density, dominance, and frequency of tree species composition (Smith 1980). Hydrology, surface topography, and habitat features were also evaluated. Forest vegetation is dominated by water tupelo, red maple, and tulip poplar.

Understory species within the RFE include canopy species as well as red bay, American holly**,** Carolina laurel cherry, red mulberry, southern arrow-wood, possumhaw, Virginia willow, highbush blueberry, coastal doghobble, poison ivy, yellow jessamime, greenbriers, and several fern species. Several species in the vicinity of the reference plots, which may have historically occurred within the Site, include bald cypress, cottonwood, box elder, sweet pepperbush, and American beautyberry.

7.0 PROJECT SITE RESTORATION PLAN

7.1 Restoration Project Goals and Objectives

The primary goals of this restoration plan include 1) construction of a stable, riffle-pool stream channel; 2) enhancement of water quality functions within, upstream and downstream of the Site 3) creation of a natural vegetated buffer along restored stream channels; 4) restoration of jusrisdictional nonriverine wetlands in the Site; 5) improvement of aquatic habitat and species diversity by enhancing stream bed variability; and 6) restoration of wildlife functions associated with a riparian corridor/stable stream.

The proposed restoration plan is expected to restore 5,004 linear feet of stream using two UTs to Contrary Swamp (Northern UT and Southern UT), and restore 5.0 acres of nonriverine wetland. Components of this plan may be modified based on construction or access constraints.

Primary activities proposed at the Site include 1) stream restoration, 2) wetland restoration, 3) soil scarification, and 4) plant community restoration.

7.1.1 Stream Restoration

This stream restoration effort is designed to restore a stable, meandering stream on new location that approximates hydrodynamics, stream geometry, and local microtopography relative to reference conditions. Geomorphic attributes for the existing channels, proposed channels, and reference channels are listed in the Morphologic Tables (Appendix B). Proposed conditions for the Northern and Southern UT's (plan view and profile) are depicted on Figures 13 through 20 (Appendix A).

An erosion control plan and construction/transportation plan are expected to be developed during the next phase of this project. Erosion control will be performed locally throughout the Site and will be incorporated into construction sequencing. Exposed surficial soils at the Site are unconsolidated, alluvial sediments, which do not revegetate rapidly after disturbance; therefore, seeding with appropriate grasses and immediate planting with disturbance-adapted shrubs will be employed following the earth-moving process. In addition, onsite root mats (seed banks) and vegetation will be stockpiled and redistributed after disturbance.

A transportation plan, including the location of access routes and staging areas will be designed to minimize land disturbance to the maximum extent feasible. The number of transportation access points into the floodplain will be maximized to avoid traversing long distances through the Site's interior.

7.1.1.1 Channel Structures

Stream restoration using natural channel design techniques typically involves the use of in-stream structures for bank stabilization, grade control, and habitat enhancement. Two primary instream structures (rootwads and log sills) will be used for grade control and habitat enhancement.

Rootwads will be used to enhance aquatic cover and introduce woody material into the stream channel. Rootwads are also used on low energy systems to provide a natural, temporary means of bank protection.

Log sills will be used for grade control in both the Northern and Southern UT's. Log sills will provide a means of dropping stream channel inverts by 0.5 foot increments through the Site so that required bankfull slopes can be maintained. Log sills provide a secondary function of introducing woody material into the stream channel, while also providing minimal shading opportunities.

7.1.1.2 Culverted Channel Crossing

Landowner constraints will necessitate the installation of one culverted crossing across the Northern UT to allow access to portions of the property isolated by the conservation easement. The approximate location of the proposed crossing is depicted on Figure 15 (Appendix A).

7.1.2 Wetland Restoration/Enhancement

Alternatives for wetland restoration/enhancement are designed to restore a fully functioning nonriverine wetland system, which will provide surface water storage, nutrient cycling, removal of imported elements and compounds, and will create a variety and abundance of wildlife habitat. Restoration activities are expected to restore 5.0 acres of jurisdictional nonriverine wetlands (Figure 12, Appendix A).

Portions of the Site proposed for restoration are underlain by hydric soils and have been impacted by vegetative clearing, ditching of agricultural fields, and annual plowing of surficial soils. Wetland restoration options will focus on 1) the reestablishment of historic water table elevations, 2) excavation and grading of elevated spoil, and 3) reestablishment of hydrophytic vegetation.

<u>Reestablishment of Historic Groundwater Elevations</u>

Hydric soils within the interstream flat proposed for restoration/enhancement have been drained due to lowering of the groundwater tables and a lateral drainage effect from existing agricultural ditches. Filling of these agricultural ditches is expected to rehydrate and restore jurisdictional hydrology to 5.0 acres of nonriverine wetlands within the Site.

Excavation and Grading of Elevated Spoil
Any areas of elevated spoil will be removed from wetland restoration/enhancement areas.

Hydrophytic Vegetation
Onsite wetland areas have endured significant disturbance from land use activities such as land clearing, annual plowing, and other anthropogenic maintenance. Wetland areas will be revegetated with native forest species typical of wetland communities in the region. Emphasis will focus on developing a diverse plant assemblage.

7.2 Sediment Transport Analysis

7.2.1 Methodology

Both the Northern and Southern UTs are characterized by sand bed substrates mixed with detritus. A stream power analysis was used as the primary tool, rather than a shear stress analysis, to study the capacity of both stream channels to transport their respective sediment loads. To determine if the restoration design stream power will adequately convey sediment loads, analyses of existing stream powers, existing conditions that influence stream power, reference stream powers, and proposed conditions stream powers were completed.

7.2.2 Calculations and Discussion

Both the Northern and Southern UTs are classified as Rosgen G5-type streams. Typically, G5-type stream channels display both channel and bank scour due to increased shear stress and stream power (channel degradation). However, neither the Northern nor Southern UT exhibit natural channel degradation. As previously stated the channel is regularly maintained for agricultural practices, which seems to be the cause for most of the existing channel degradation.

A major concern for this project was to determine why the channel substrate contained detritus, which may indicate that the existing channel is aggrading, rather than degrading. It was found that detritus within the substrate is due to consistent blockages from beaver dams and massive amounts of debris, such as straw bails, within the channel. Both the beaver dams and other blockages are temporary, but cause backwater effects within the channel, even during low flows. This, in turn, decreases stream power even more so than under normal flowing conditions, which leads to the deposition of sticks and leaf litter.

Stream power values obtained from onsite may not provide accurate data to determine a stable stream power, due to channel obstructions. However, for documentation purposes, cross-sections from both the Northern and Southern UT's were completed and existing stream power determined. Existing channel cross-sections were taken in areas of the channel that seemed to exhibit the least amount of influence from downstream channel obstructions. However, both are influenced from backwater effects; therefore, calculated stream powers may not depict accurate existing conditions because of the effect of backwater during bankfull and higher flows. The existing unit stream power for the Northern UT is 0.10 pounds per foot-second and for the Southern is UT 0.01 pounds per foot-second.

The reference unit stream power was obtained from the UT to Ironhill Branch. The UT to Ironhill Branch, which has a slope similar to the design slope for both the Northern and Southern UTs, displays a unit stream power of 0.08 pounds per foot-second. The proposed unit stream power for the Northern UT is 0.10 pounds per foot-second and for the Southern UT is 0.12 pounds per foot-second. Both proposed unit stream powers are similar to the reference unit stream power obtained from the UT to Ironhill Branch. From this, it is discerned that the proposed unit stream power for both the Northern and Southern UT's will adequately convey sediment loads during bankfull and higher events.

7.3 HEC-RAS Analysis

Given that the project involves modifications to a stream channel, it is important to analyze the effect of these changes on flood elevations. Floodwater elevations were analyzed using HEC-RAS. HEC-RAS is a software package designed to perform one-dimensional, steady flow, analysis of water surface profiles for a network of natural and constructed channels.

HEC-RAS uses two equations, energy and/or momentum, depending upon the water surface profile. The model is based on the energy equation. The energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is used in situations where the water surface profile rapidly varies, such as hydraulic jumps and stream junctions.

Backwater analysis was performed for the existing and proposed conditions for both bankfull and 100-year discharges. In addition to steady flow data, geometric data is also required to run HEC-RAS. Geometric data consists of establishing the connectivity of the river system, which includes cross-section data, reach lengths, energy loss coefficients (friction losses, contraction, and expansion losses), and stream junction information.

7.3.1 Bankfull Discharge Analysis

Discharge rates for the design have been evaluated with data obtained from onsite conditions and compared with *Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams* [regional curve] (Doll et al. 2006). The bankfull discharge for the Northern UT is 18.1 cubic feet per second and for the Southern UT is 4.9 cubic feet per second. The existing and proposed geometries were evaluated at the bankfull discharge rates using HEC-RAS (USACE 2004). The analysis supports the field identification of the existing bankfull area within a close approximation and confirms the proposed channel will adequately carry the discharge at bankfull stage.

7.3.2 No-Rise

Analyses were performed for the existing and proposed conditions for the bankfull and 100-year discharges. Geometric data and steady flow data are both required to run HEC-RAS. The 100-year discharges were determined using the *USGS Coastal Plain Rural Regression Equations* (USGS et al. 1996). The bankfull discharge was determined using onsite indicators and

Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams [regional curve] (Doll et al. 2006).

Geometric data consists of establishing the connectivity of the river system. Such data includes: cross-sectional data, reach lengths, energy loss coefficients (friction losses, contraction and expansion losses), and stream junction information.

The analysis indicates that the proposed channel geometry would not increase the 100-year flood elevations outside of the project area (Appendix G).

7.3.3 Hydrologic Trespass

Hydrologic trespass is a term that describes hydrological consequences to properties outside the boundaries of the Site. Such issues as increased surface flooding frequency, or deprivation of surface or groundwater within adjacent parcels due to hydrological design modifications at the Site can take place if the design fails to address hydrological trespass. After studying the potential for hydrologic tress pass it has been determined that **onsite modifications associated with this project will not affect off site hydrology.**

7.4 Stormwater Best Management Practices

A BMP in the form of a stormwater wetland will be placed in a large agricultural drainage ditch at its convergence with the Northern UT. The drainage ditch has a watershed area of approximately 50 acres, almost all of which is in agricultural (row crops) land. The stormwater wetland will help to enhance water quality by reducing the amount of nutrients, including phosphorous, nitrogen, and heavy metals from stormwater flows. Construction of the stormwater wetland is a voluntary effort on the part of Restoration Systems to improve water quality and habitat for waters within, and downstream of, the Site. No mitigation credits are expected to be received from this effort.

7.5 Soil Restoration

7.5.1 Topsoil Stockpiling

Soil grading will occur during stream restoration activities. Topsoils may be stockpiled during construction activities and will be spread on the soil surface once critical subgrade has been established. The replaced topsoil will serve as a viable growing medium for community restoration to provide nutrients and aid in the survival of planted species.

7.5.2 Floodplain Soil Scarification

Microtopography and differential drainage rates within localized floodplain areas represent important components of floodplain functions. Reference forests in the region exhibit complex surface microtopography. Efforts to advance the development of characteristic surface microtopography will be implemented; in areas where soil surfaces have been compacted, ripping or scarification will be performed. After construction, the soil surface is expected to

exhibit complex microtopography ranging to one foot in vertical asymmetry. Subsequently, plant community restoration will be initiated.

7.6 Natural Plant Community Restoration

Restoration of the interstream flat (nonriverine wetland restoration), floodplain, side slopes and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife.

Reference Forest Ecosystem (RFE) data, onsite observations, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop primary plant community associations that will be promoted during community restoration activities. Community descriptions of the RFE closely resemble a Nonriverine Wet Hardwood Forest community (Schafale and Weakley 1990), which most closely resembles nonriverine areas within the Site. Nonriverine Wet Hardwood Forests are typically located on poorly drained interstream flats not associated with a stream that are seasonally saturated or flooded by high water tables, poor drainage, or sheet flow from adjacent areas.

Vegetative species present within the RFE also correspond with species of a Coastal Plain Small Stream Swamp (Blackwater Subtype) community, which occurs on alluvial floodplains of small blackwater streams that are intermittently, temporarily, or seasonally flooded such as riverine areas within the Site.

Nonriverine Wet Hardwood Forests of the interstream flat grade to Coastal Plain Small Stream Swamps at the head of drainages within the Site. Despite the landscape position difference between riverine and nonriverine areas of the Site, vegetative communities are similar and will be combined when developing the primary plant community associations. Community associations that will be utilized to develop primary plant community associations include 1) Coastal Plain Small Stream Swamp/Nonriverine Wet Hardwood Forest and 2) stream-side assemblage (Sheet 21, Appendix A). Planting elements are listed below.

Coastal Plain Small Stream Swamp/Nonriverine Wet Hardwood Forest

1. Swamp chestnut oak (*Quercus michauxii*)
2. Laurel oak (*Quercus laurifolia*)
3. Cherrybark oak (*Quercus pagoda*)
4. American elm (*Ulmus americana*)
5. Green ash (*Fraxinus pennsylvanica*)
6. Sweetbay (*Magnolia virginiana*)
7. Silky dogwood (*Cornus amomum*)

Stream-Side Assemblage

1. Black willow (*Salix nigra*)
2. Silky dogwood (*Cornus amomum*)
3. Buttonbush (*Cephalanthus occidentalis*)
4. Elderberry (*Sambucus canadensis*)

Stream-side assemblage trees and shrubs include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. Stream-side trees and shrubs will be planted from the toe of slope of the restored channel to the top of slope of the restored channel. Coastal Plain Small Stream Swamp/Nonriverine Wet Hardwood Forest is targeted for the majority of the Site including the floodplain, floodplain slopes, terrace, and nonriverine wetland restoration area.

7.6.1 Planting Plan

Species selected for planting will be dependent upon availability of local seedling sources. Bare-root seedlings of tree species will be planted within specified map areas at a density of approximately 680 stems per acre on 8-foot centers. Shrub species in the stream-side assemblage will be planted at a density of 2,720 stems per acre on 4-foot centers. Table 9 depicts the total number of stems and species distribution within each vegetation association. Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season. Approximately 12,900 bare-root seedlings and 2,850 shrub species will be planted during restoration.

Table 9. Planting Plan

Vegetation Association	Small Stream Swamp/Nonriverine Wet Hardwoods		Stream-side Assemblage		TOTAL
Area (acres)	**19.00**		**1.05**		**20.05**
Species	**Number planted***	**% of total**	**Number planted****	**% of total**	**Number planted**
Swamp chestnut oak	2,580	20	--	--	2,580
Laurel oak	2,580	20	--	--	2,580
Cherrybark oak	2,580	20	--	--	2,580
American elm	2,580	20	--	--	2,580
Green ash	903	7	--	--	903
Sweetbay	903	7	--	--	903
Silky dogwood	774	6	855	30	1,629
Black willow	--	--	855	30	855
Buttonbush	--	--	570	20	570
Elderberry	--	--	570	20	570
TOTAL	**12,900**	**100**	**2,850**	**100**	**15,750**

* Planted at a density of 680 stems/acre.
** Planted at a density of 2,720 stems/acre.

7.6.2 Invasive Species Management

Noxious species will be identified and controlled so that none become dominant or alter the desired community structure of the Site. If noxious plants are identified as a problem within the Site, the Restoration Systems Team will develop a species-specific control plan for approval by EEP prior to implementation.

Through coordination with EEP during the five-year monitoring period, the Restoration Systems Team, where necessary, will remove, treat, or otherwise manage undesirable plant or animal species, including physical removal, use of herbicides, live trapping, confining wires, or nets.

All vegetation removal from the Site shall be done by mechanical means only unless EEP has first authorized the use of herbicides or algaecides for the control of plants in or immediately adjacent to the Site.

8.0 PERFORMANCE CRITERIA

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring is proposed for the stream channel, wetland hydrology, and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the *Stream Mitigation Guidelines* (USACE et al. 2003).

8.1 Streams

The restored stream reaches are proposed to be monitored for geometric activity. Annual fall monitoring will include development of channel cross-sections on riffles and pools and a water surface profile of the channel. The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, 5) width-to-depth ratio, 6) meander wavelength, 7) belt-width, 8) water surface slope, and 9) sinuosity. The stream will subsequently be classified according to stream geometry and substrate (Rosgen 1996). Significant changes in channel morphology will be tracked and reported by comparing data in each successive monitoring year. A photographic record that will include preconstruction and postconstruction pictures has been initiated with current Site photographs (Appendix C).

8.1.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system.

The channel configuration will be measured on an annual basis in order to track changes in channel geometry, profile, or substrate. These data will be utilized to determine the success in restoring stream channel stability. Specifically, the width-to-depth ratio should characterize an E-type or borderline E-/C-type channel, bank-height ratios indicative of a stable or moderately unstable channel, and minimal changes in cross-sectional area, channel width, and/or bank erosion along the monitoring reach. In addition, channel abandonment and/or shoot cutoffs must not occur and sinuosity values must remain relatively constant. The field indicator of bankfull will be described in each monitoring year and indicated on a representative channel cross-section figure. If the stream channel is down-cutting or the channel width is enlarging due to bank erosion, additional bank or slope stabilization methods will be employed.

Stream substrate is not expected to coarsen over time; therefore, pebble counts are not proposed as part of the stream success criteria.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

8.1.2 Stream Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success, include 1) structure failure, 2) headcut migration through the Site, and/or 3) bank erosion.

Structure Failure

In the event that structures are compromised, the affected structure will be repaired, maintained, or replaced. Once the structure is repaired or replaced, it must function to stabilize adjacent stream banks and/or maintain grade control within the channel. Structures which remain intact, but exhibit flow around, beneath, or through the header/footer will be repaired by excavating a trench on the upstream side of the structure and reinstalling filter fabric in front of the pilings. Structures which have been compromised, resulting in shifting or collapse of header/footer, will be removed and replaced with a structure suitable for Site flows.

Headcut Migration Through the Site

In the event that a headcut occurs within the Site (identified visually or through measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

Bank Erosion

In the event that severe bank erosion occurs within the Site, resulting in elevated width-to-depth ratios, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of log-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated which will reduce shear stress to stable values.

8.2 Wetlands

Groundwater monitoring gauges will be installed within the Site and on a reference site to monitor groundwater hydrology. Hydrological sampling will continue throughout the growing season at intervals necessary to satisfy the hydrology success criteria within each design unit (USEPA 1990).

8.2.1 Wetland Success Criteria

Target hydrological characteristics include saturation or inundation for at least 12.5 percent within Trebloc soils (nonriverine wetlands) of the growing season, during average climatic conditions. This value is based on DRAINMOD simulations for 62 years of rainfall data in an old field stage. These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed in these areas.

8.2.2 Wetland Contingency

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

8.3 Vegetation

Restoration monitoring procedures for vegetation will monitor plant survival and species diversity. After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional modifications will be implemented, if necessary. A photographic record of plant growth should be included in each annual monitoring report.

During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed between June 1 and September 30, after each growing season, until the vegetation success criteria are achieved.

During quantitative vegetation sampling in early fall of the first year, up to 41 sample plots (10 meters by 10 meters) will be randomly placed within the Site; however, best professional judgment may be necessary to establish vegetative monitoring plots upon completion of construction activities. In each sample plot, vegetation parameters to be monitored include species composition and species density.

8.3.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. Additional success criteria are dependent upon density and growth of “Character Tree Species.” Character Tree Species include planted species along with species identified through visual inventory of an approved reference (relatively undisturbed) forest community used to orient the Site design. All canopy tree species planted and identified in the reference forest will be utilized to define “Character Tree Species” as termed in the success criteria.

An average density of 320 stems per acre of Character Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Character Tree Species per acre must be surviving in year 4 and 260 Character Tree Species per acre in year 5.

8.3.2 Vegetation Contingency

If vegetation success criteria are not achieved based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

8.4 Scheduling and Reporting

A tentative phasing schedule for the proposed project is presented below; certain tasks may be dependant on seasonal conditions.

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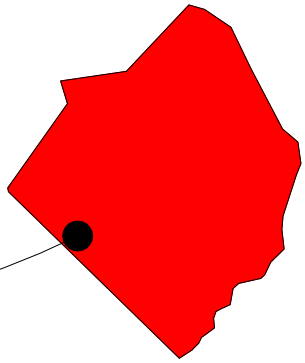
APPENDIX A
FIGURES AND DESIGN SHEETS

Robeson County
North Carolina



PROJECT AREA

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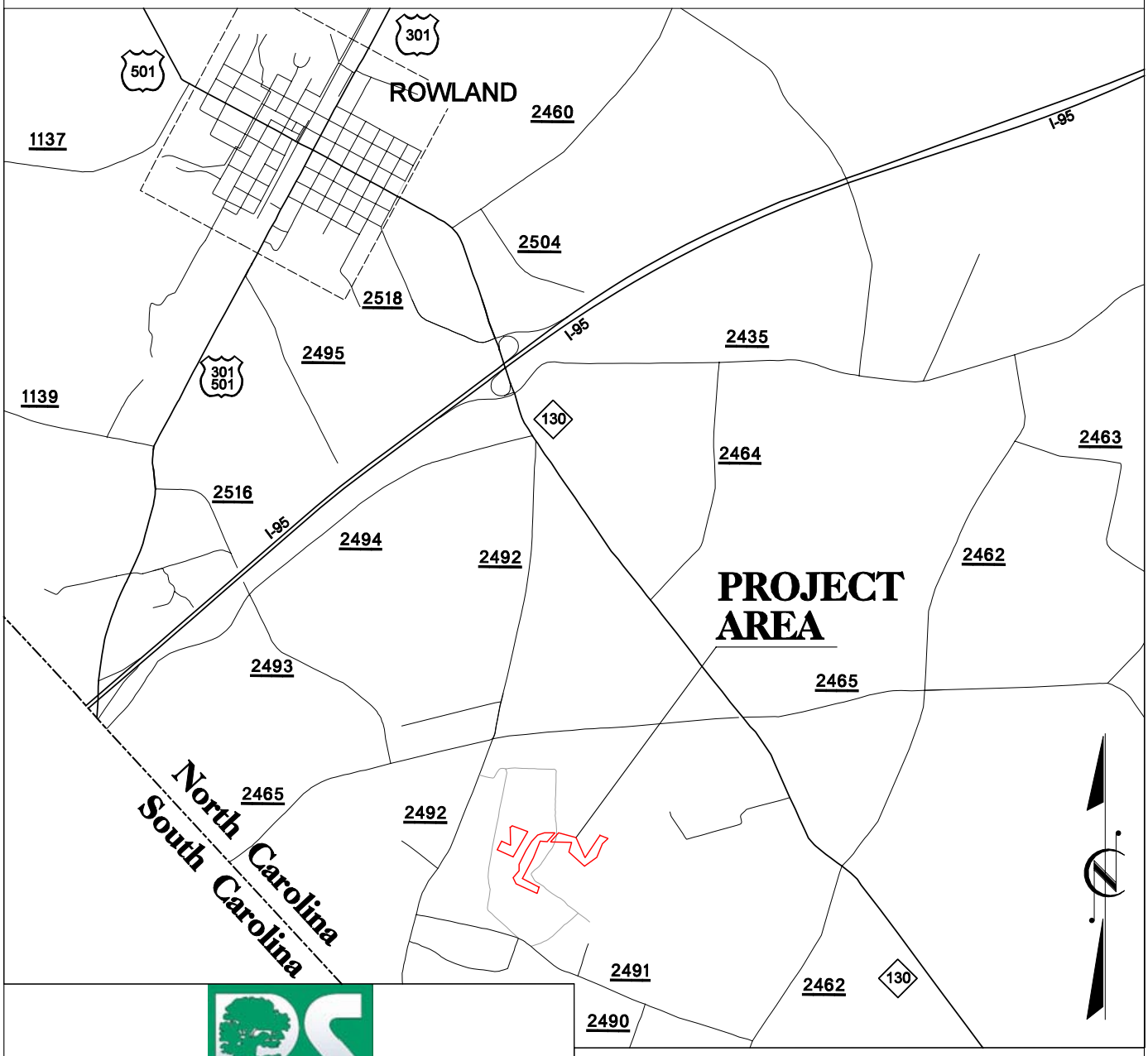

RESTORATION SYSTEMS, LLC

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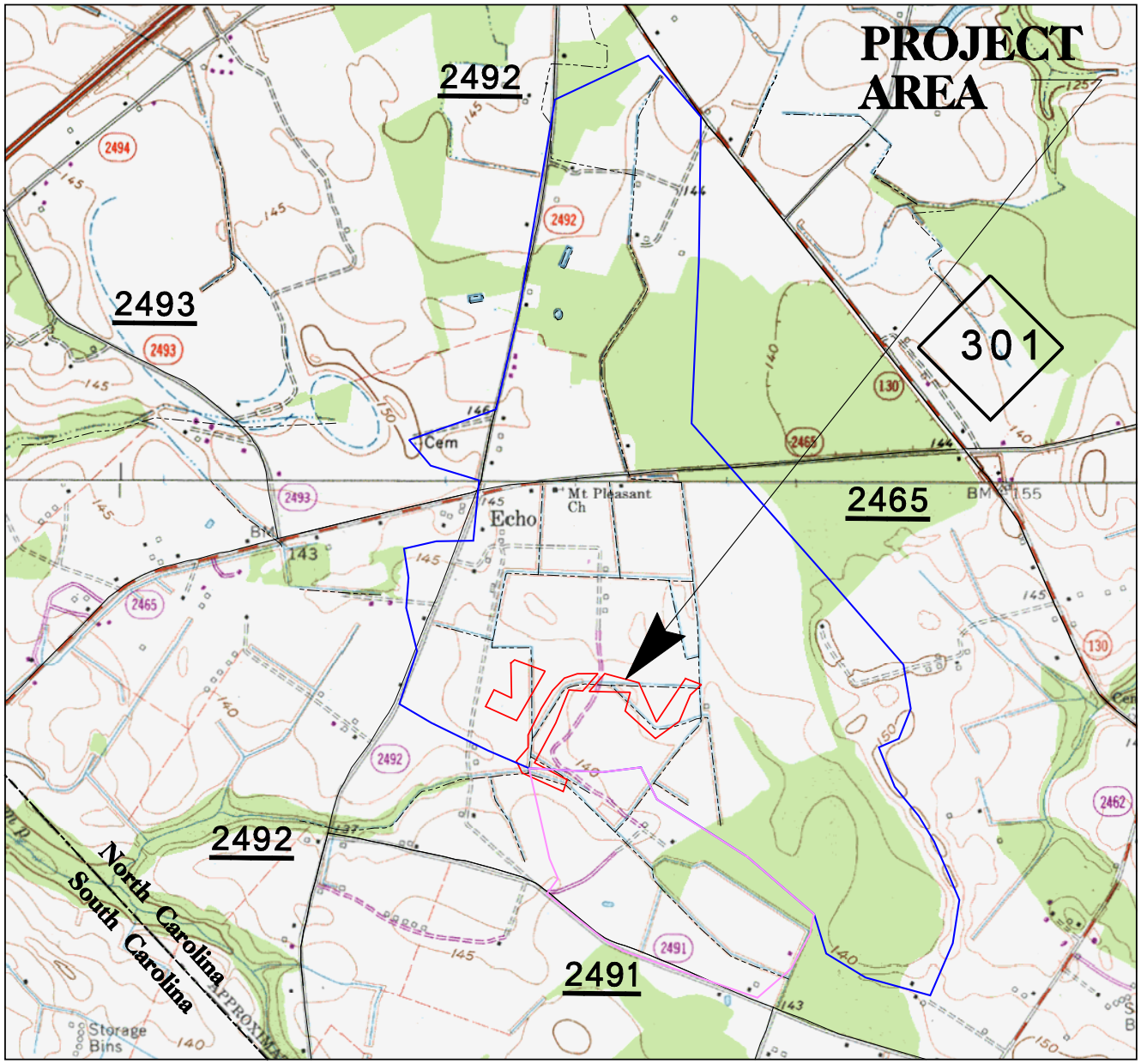
(919) 851-6066

Vicinity Map

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 1/08/07

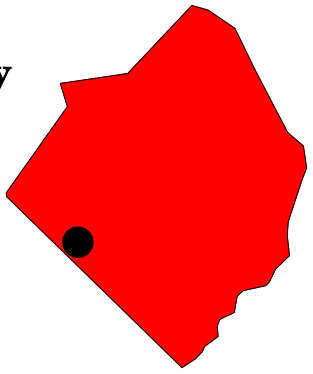
Figure: 1



LEGEND

- Northern UT Watershed (725 Ac.)
- Southern UT Watershed (117 Ac.)
- Project Area

Robeson County
North Carolina



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Watershed Map

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

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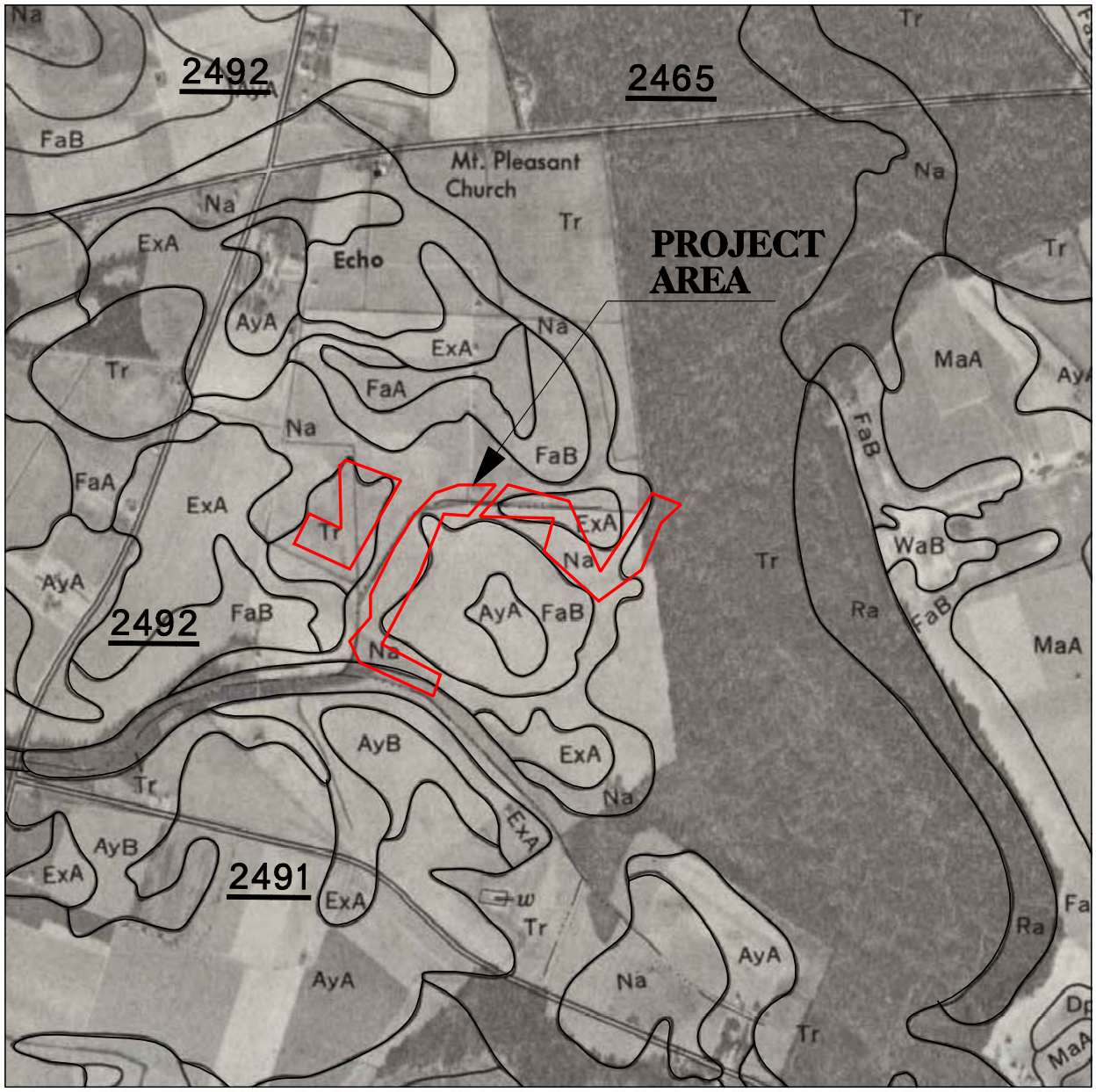
Date: 1/08/07

Figure: 2



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FEET

LEGEND

Symbol	Name
Na	- Nahunta
ExA	- Exum
Tr	- Trebloc
	- Project Area

Soil Survey Map

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

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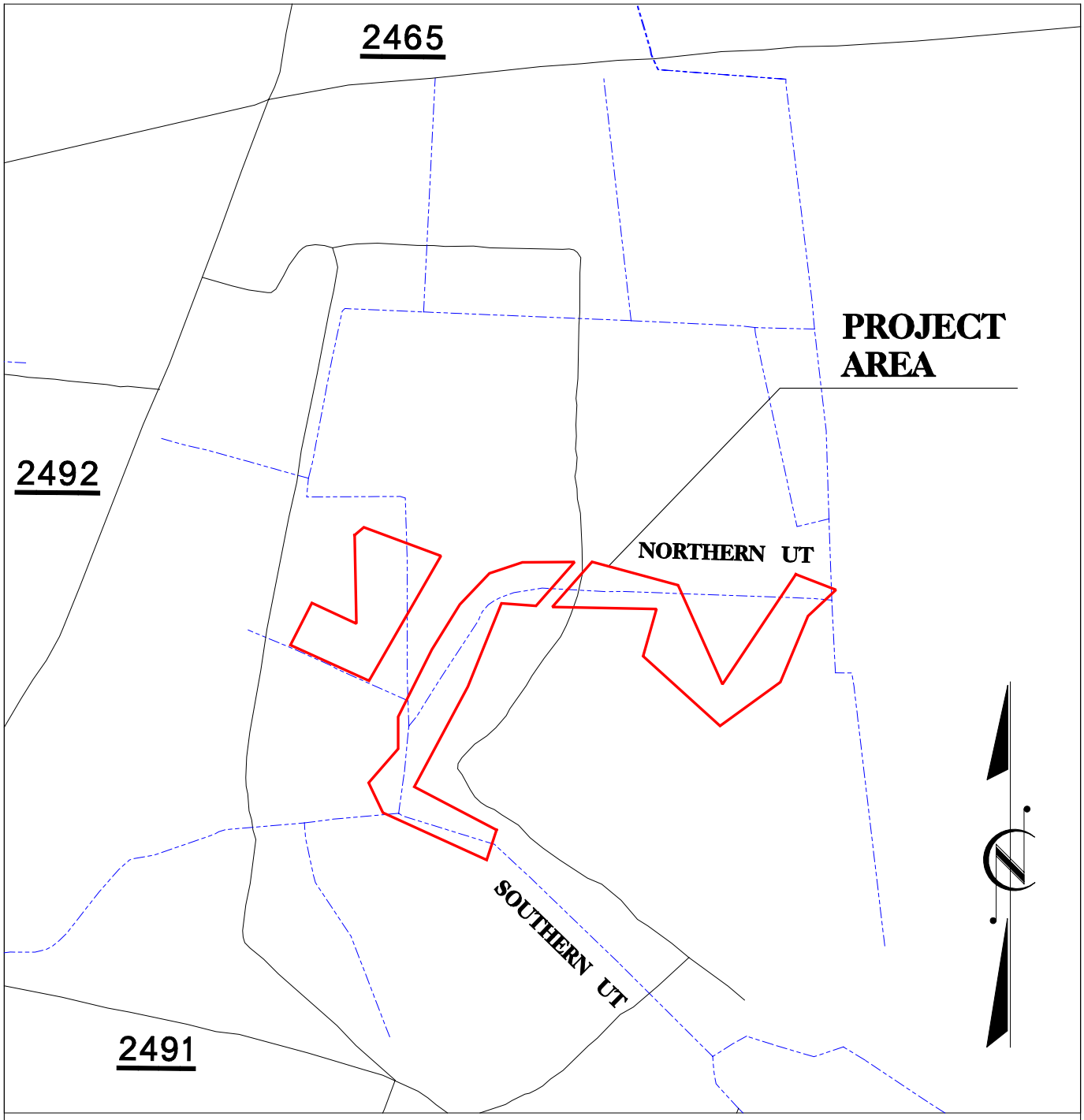
Date: 12/05/06

Figure: 3



Hydrological Map

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

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Date: 12/05/06

Figure: 4

8/17/99

EXISTING CONDITIONS

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125 0 250
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 5
PROJECT ENGINEER	

DRAINAGE DITCH

AGRICULTURAL FIELDS

48" CMP

NORTHERN UT

WOODS

PROPOSED NORTHERN UT

SOIL ROAD

AGRICULTURAL FIELDS

WOODS

PROPOSED SOUTHERN UT

SOUTHERN UT

AGRICULTURAL FIELDS

JOHN W. WARD, JR. ESTATE
DEED BOOK 812,PAGE 435

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

TIP NO.: COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 4/5/07

5/2/2007
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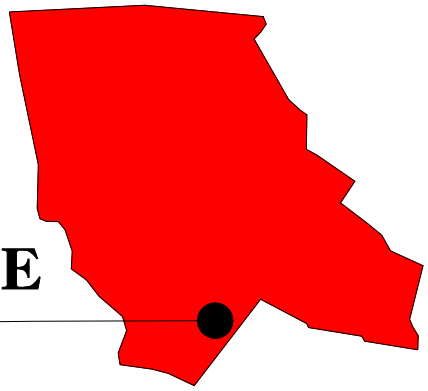
KO & Associates, P.C.

Moore County
North Carolina



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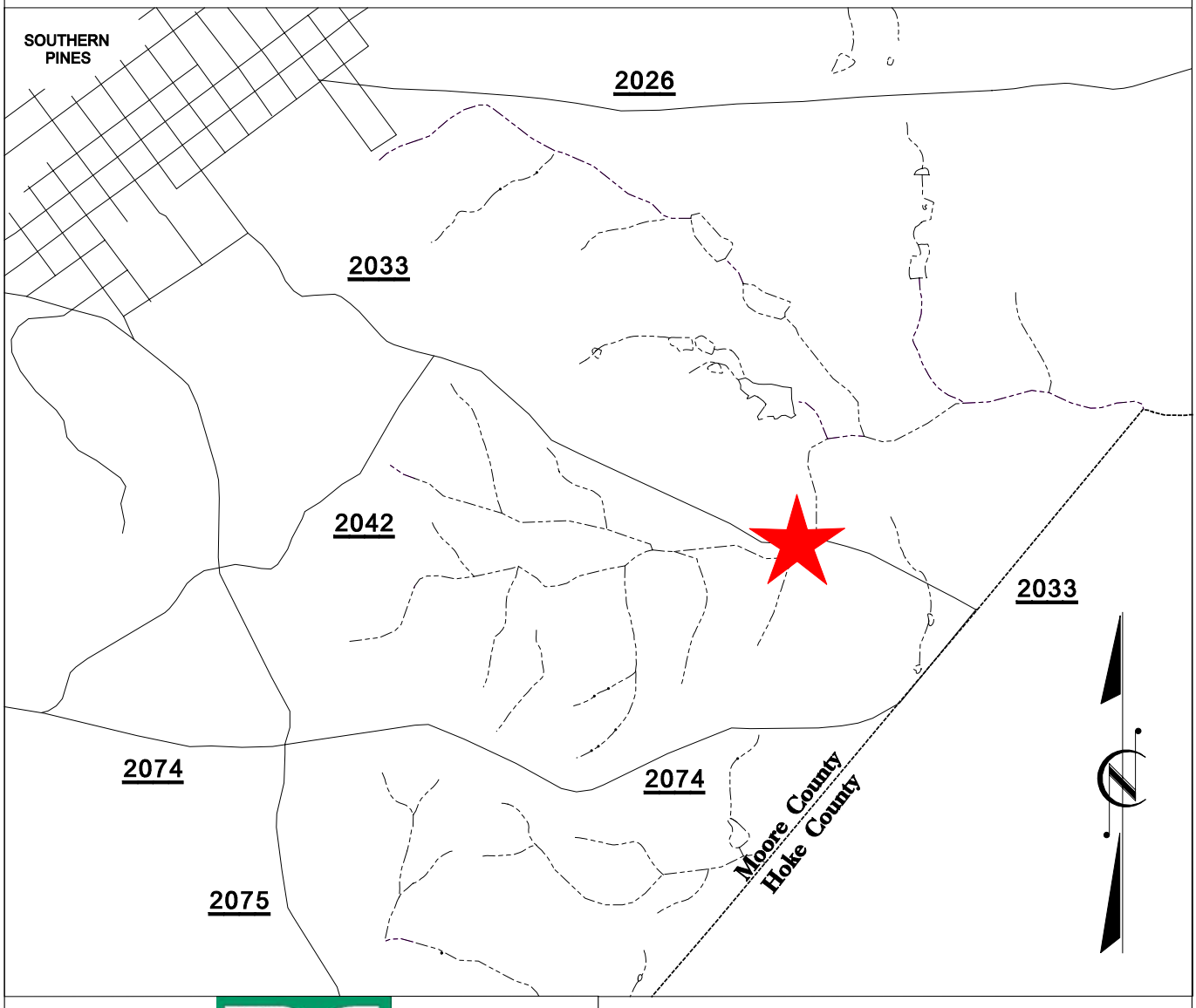
REFERENCE SITE



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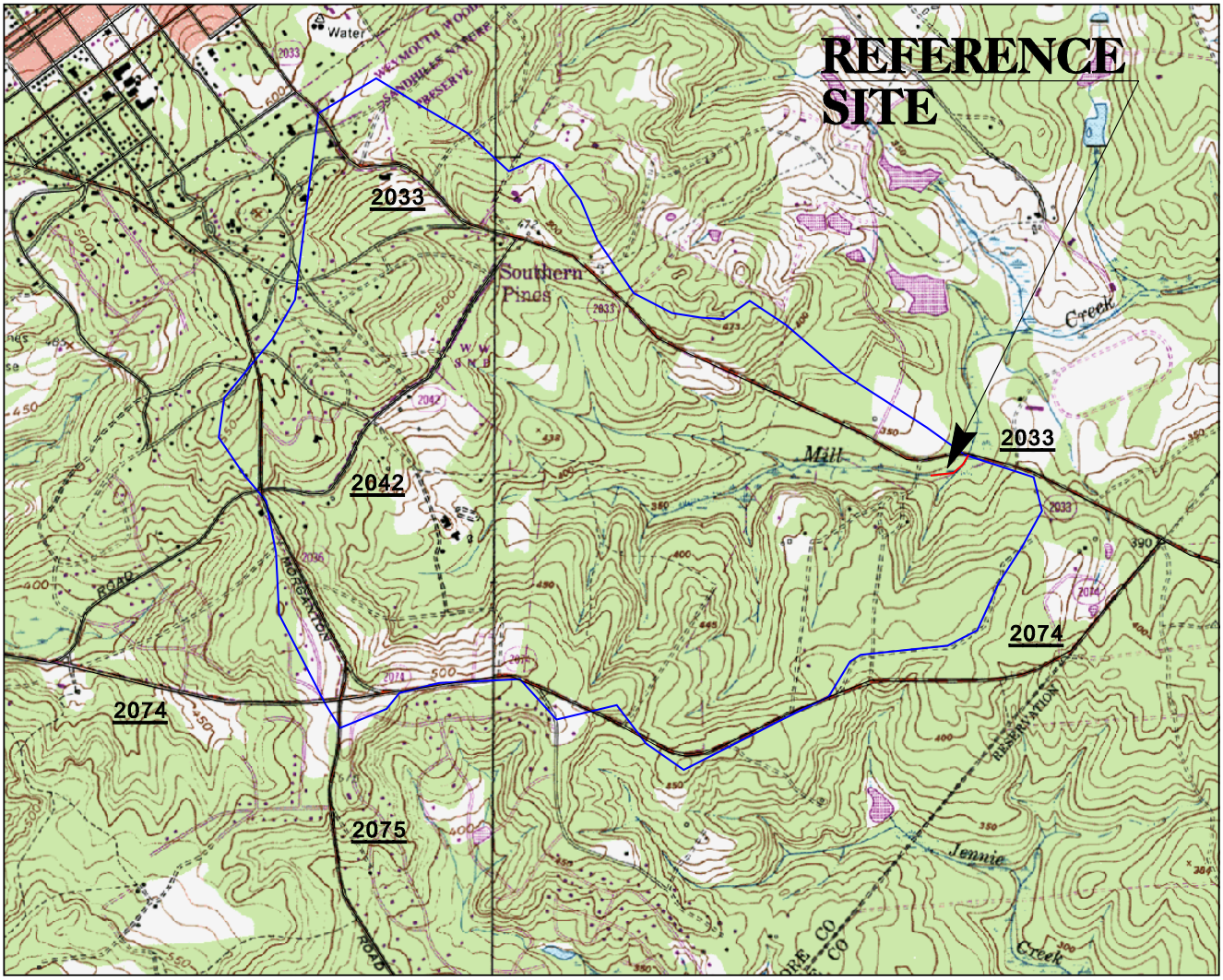
Reference Site Vicinity Map

Mill Creek

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 12/05/06

Figure: 6.1A



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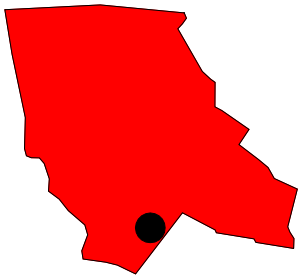
FEET

LEGEND

Watershed

Project Area

Reference Site Moore County North Carolina



RESTORATION SYSTEMS, LLC

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Consulting Engineers

1011 SCHAUB DR., SUITE #202 RALEIGH, N.C. 27606

(919) 851-6066

Reference Site Watershed Map

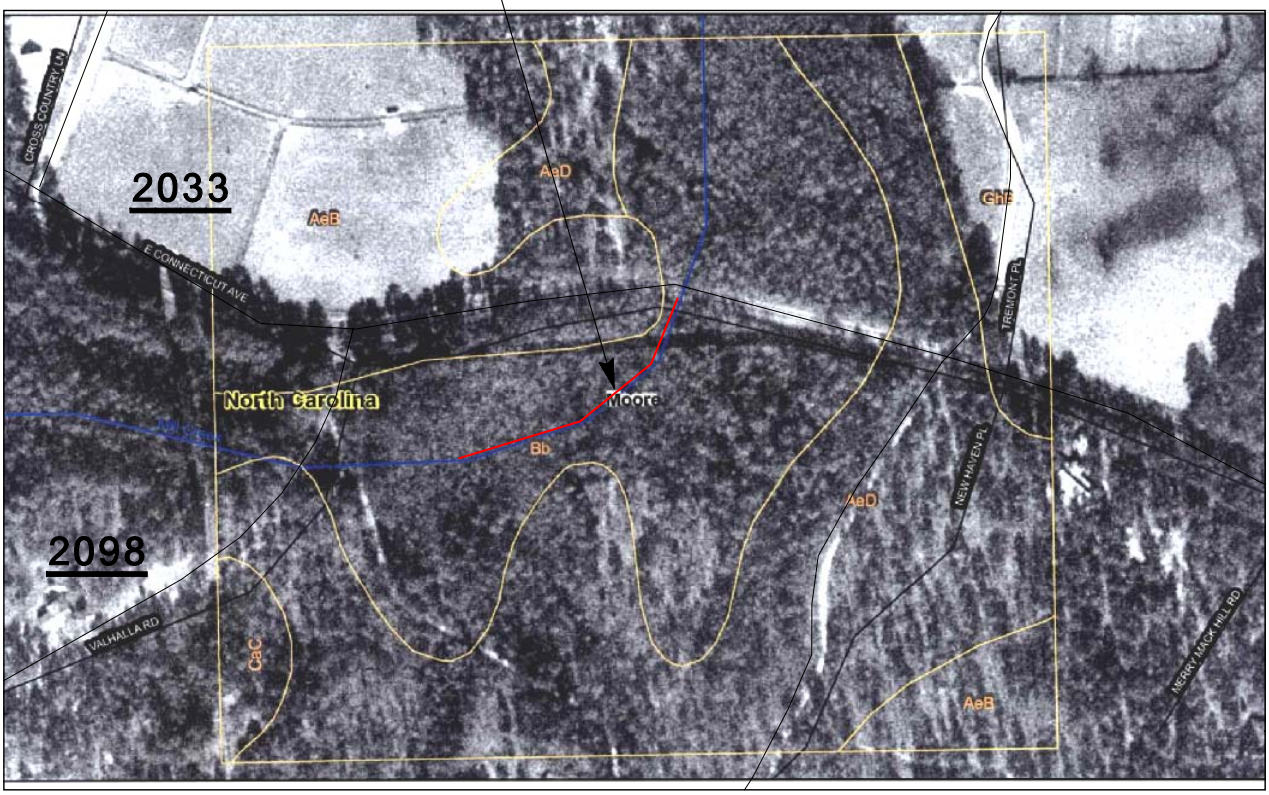
Mill Creek

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 10807

Figure: 6.1B

REFERENCE SITE



0 500 1000

FEET

LEGEND

Symbol	Name
Bb	Bibb
———	Project Area

Reference Site Soil Survey Map

Mill Creek

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

RESTORATION SYSTEMS, LLC

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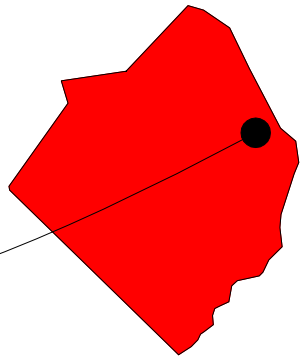
(919) 851-6066

Date: 12/05/06

Figure: 6.1C

Robeson County
North Carolina



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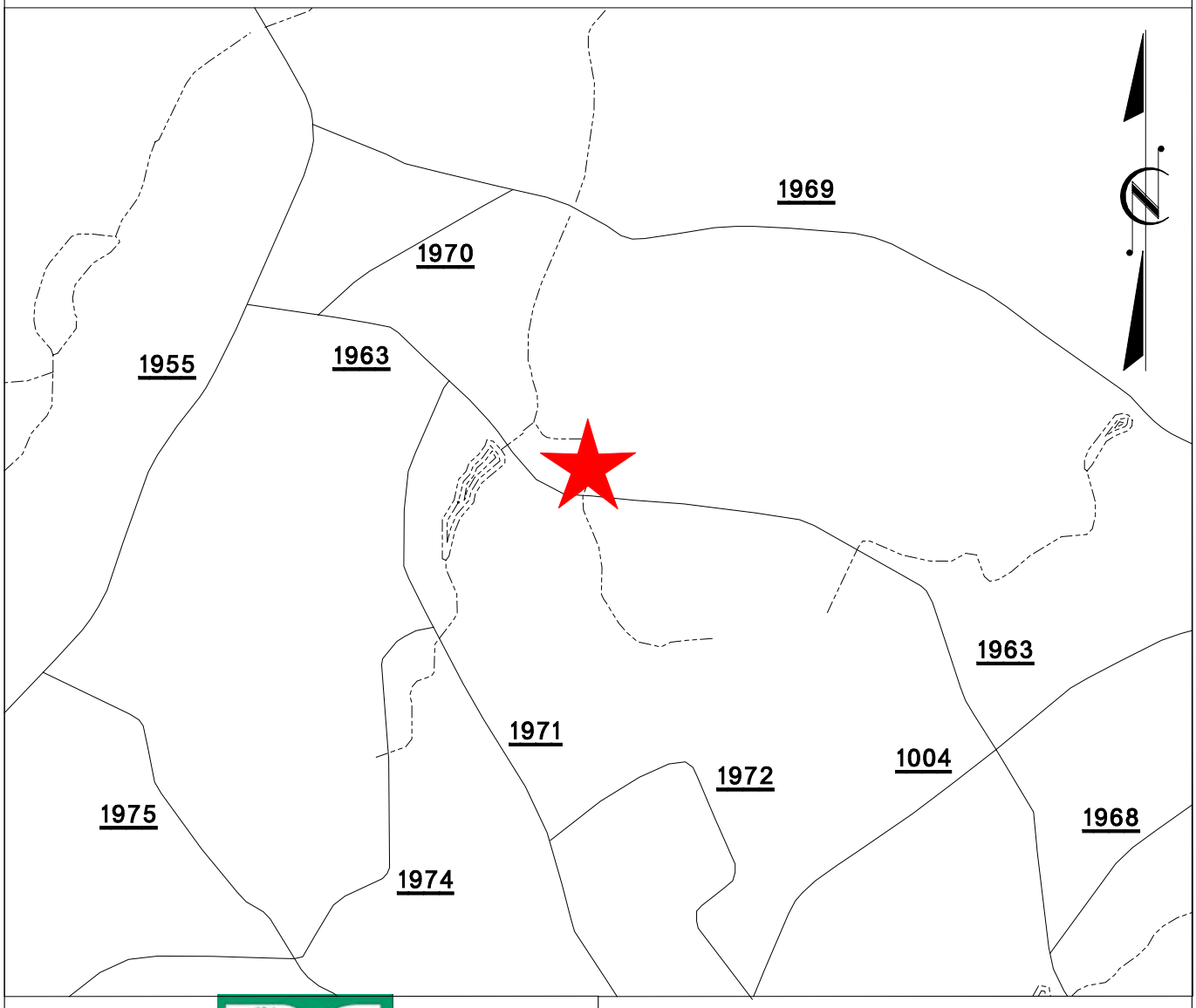
FEET



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Consulting Engineers
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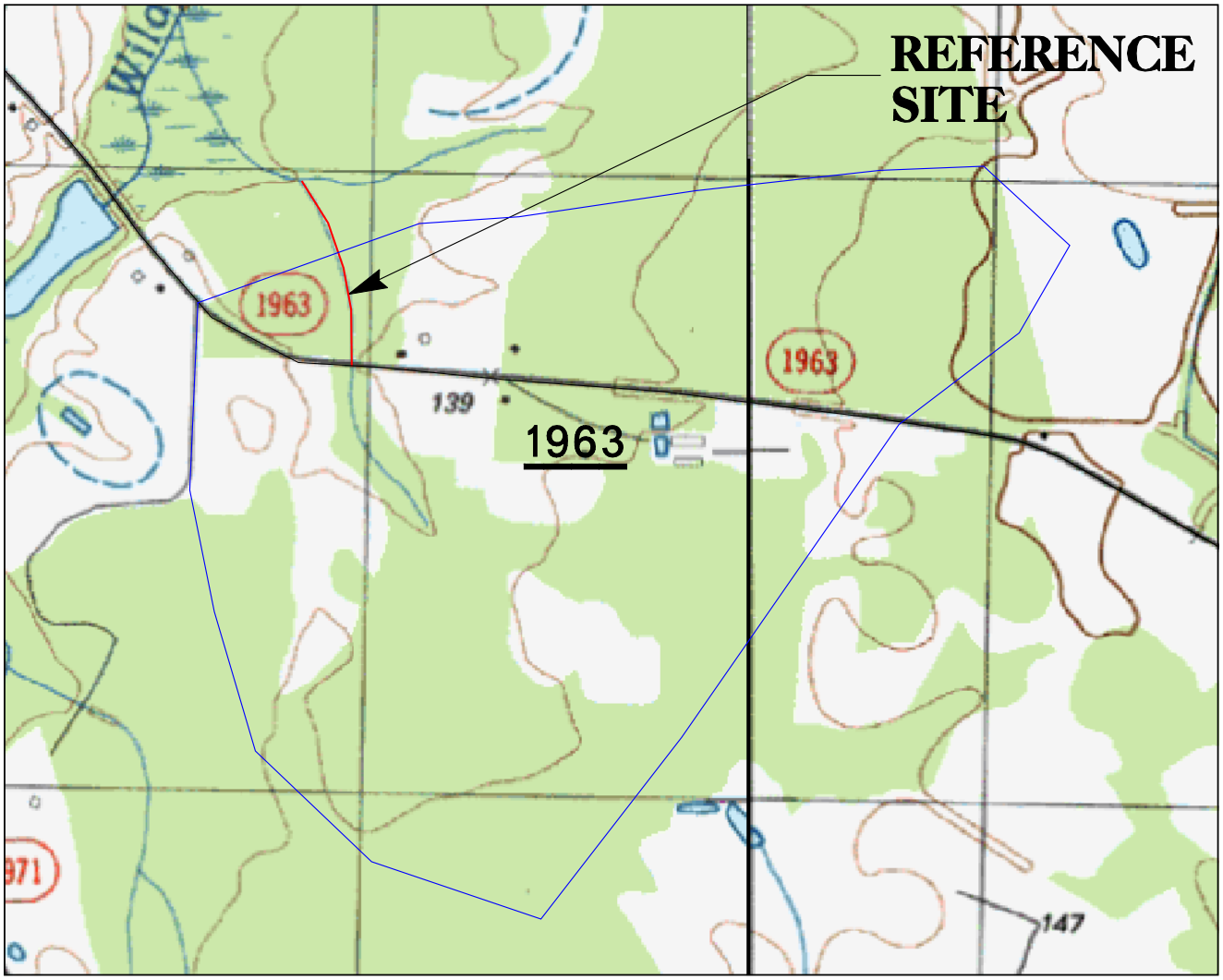
Reference Site Vicinity Map

UT to Wildcat Branch

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 12/05/06

Figure: 6.2A



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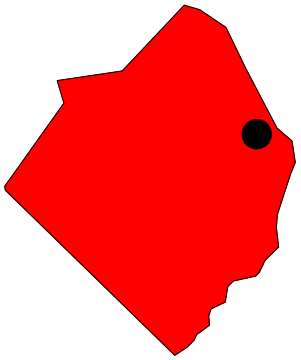
FEET

LEGEND

Watershed
Project Area

Reference Site Robeson County North Carolina



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Reference Site Watershed Map

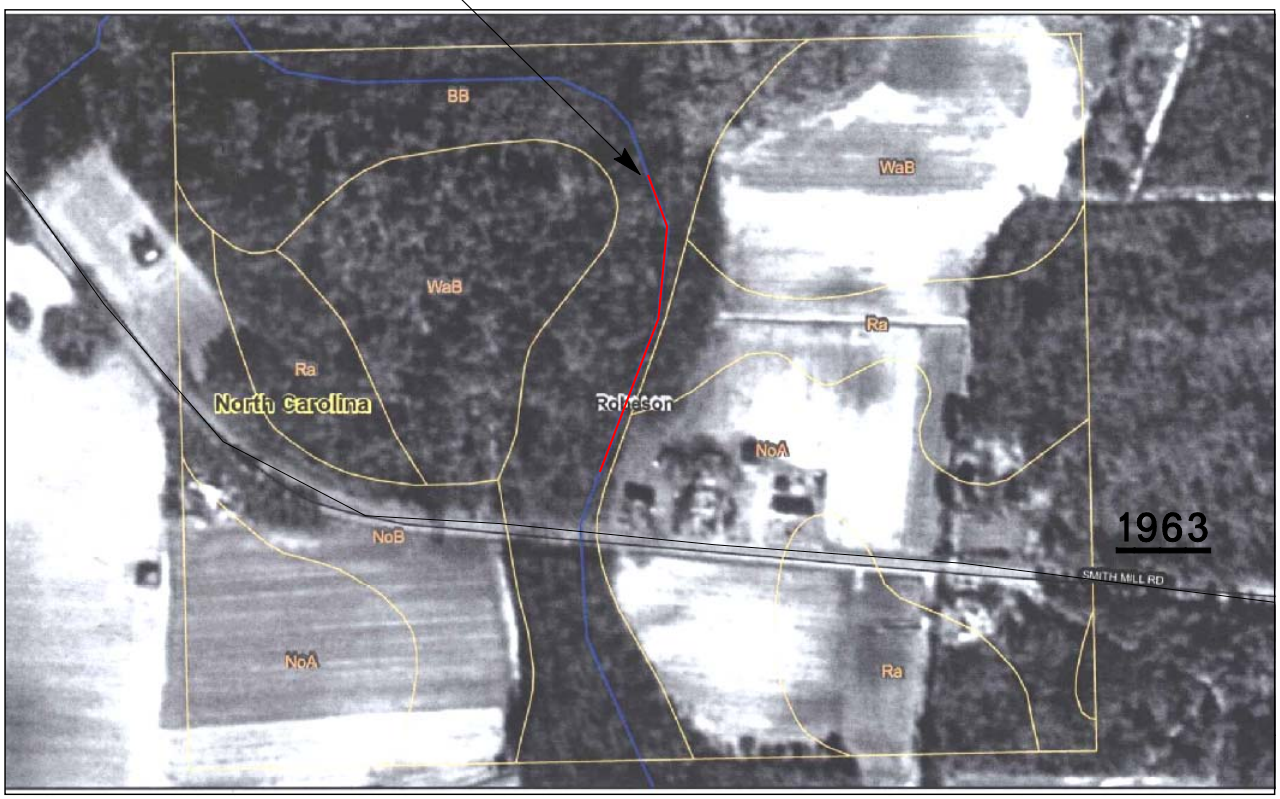
UT to Wildcat Branch

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 10807

Figure: 6.2B

REFERENCE SITE



0 1000 2000

FEET

LEGEND

Symbol	Name
BB	Bibb
———	Project Area

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Reference Site Soil Survey Map

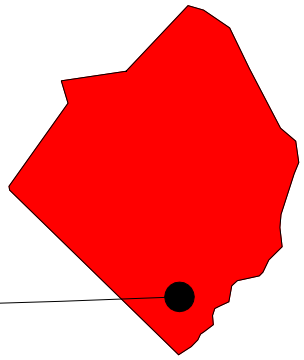
UT to Wildcat Branch

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 12/05/06

Figure: 6.2C

Robeson County
North Carolina



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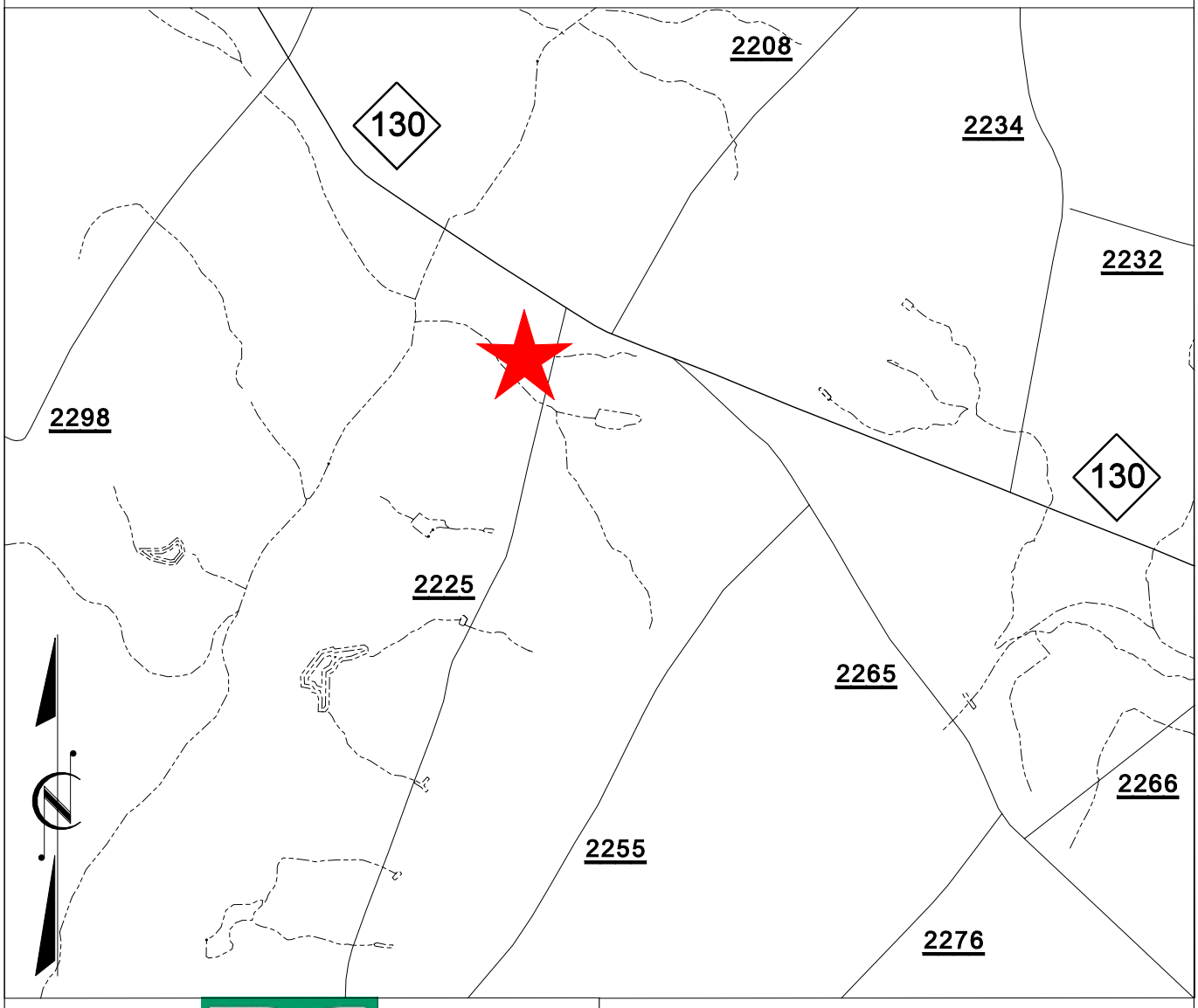

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(919) 851-6066

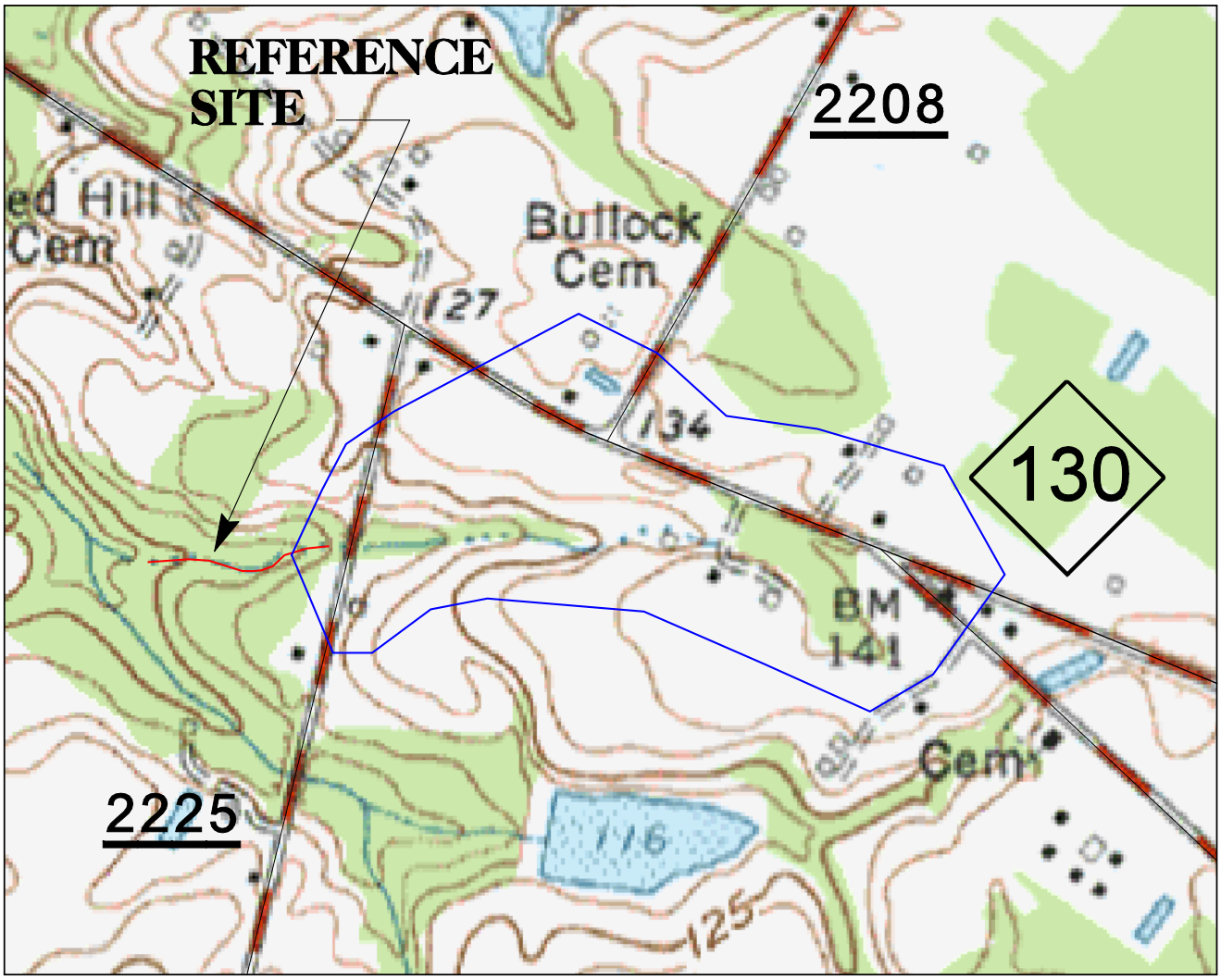
Reference Site Vicinity Map

UT to Hog Swamp

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 12/05/06

Figure: 6.3A



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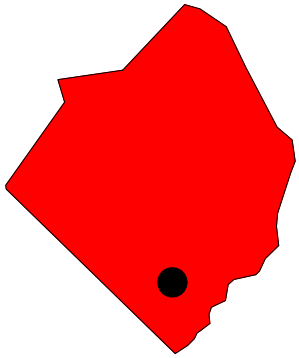
FEET

LEGEND

Watershed
Project Area

Reference Site Robeson County North Carolina



Reference Site Watershed Map

UT to Hog Swamp

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

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Consulting Engineers
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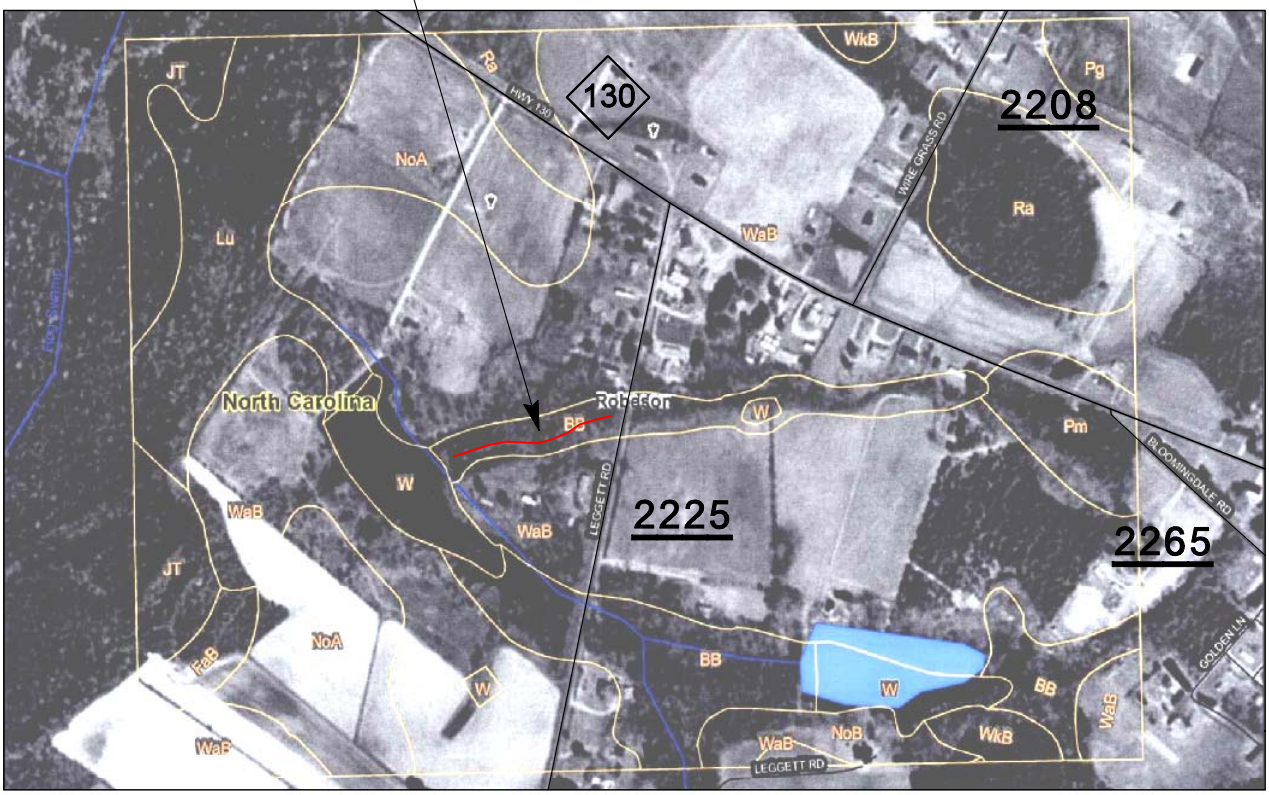
(919) 851-6066

Date: 10807

Figure: 6.3B

REFERENCE SITE



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FEET

LEGEND

Symbol	Name
BB	Bibb
———	Project Area

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Reference Site Soil Survey Map

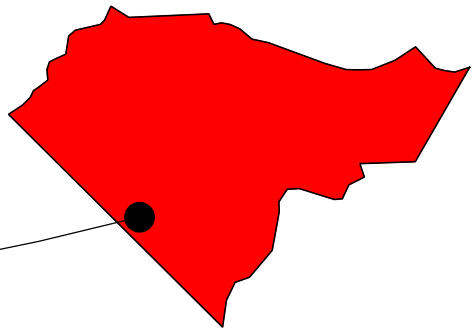
UT to Hog Swamp

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 12/05/06

Figure: 6.3C

Columbus County
North Carolina



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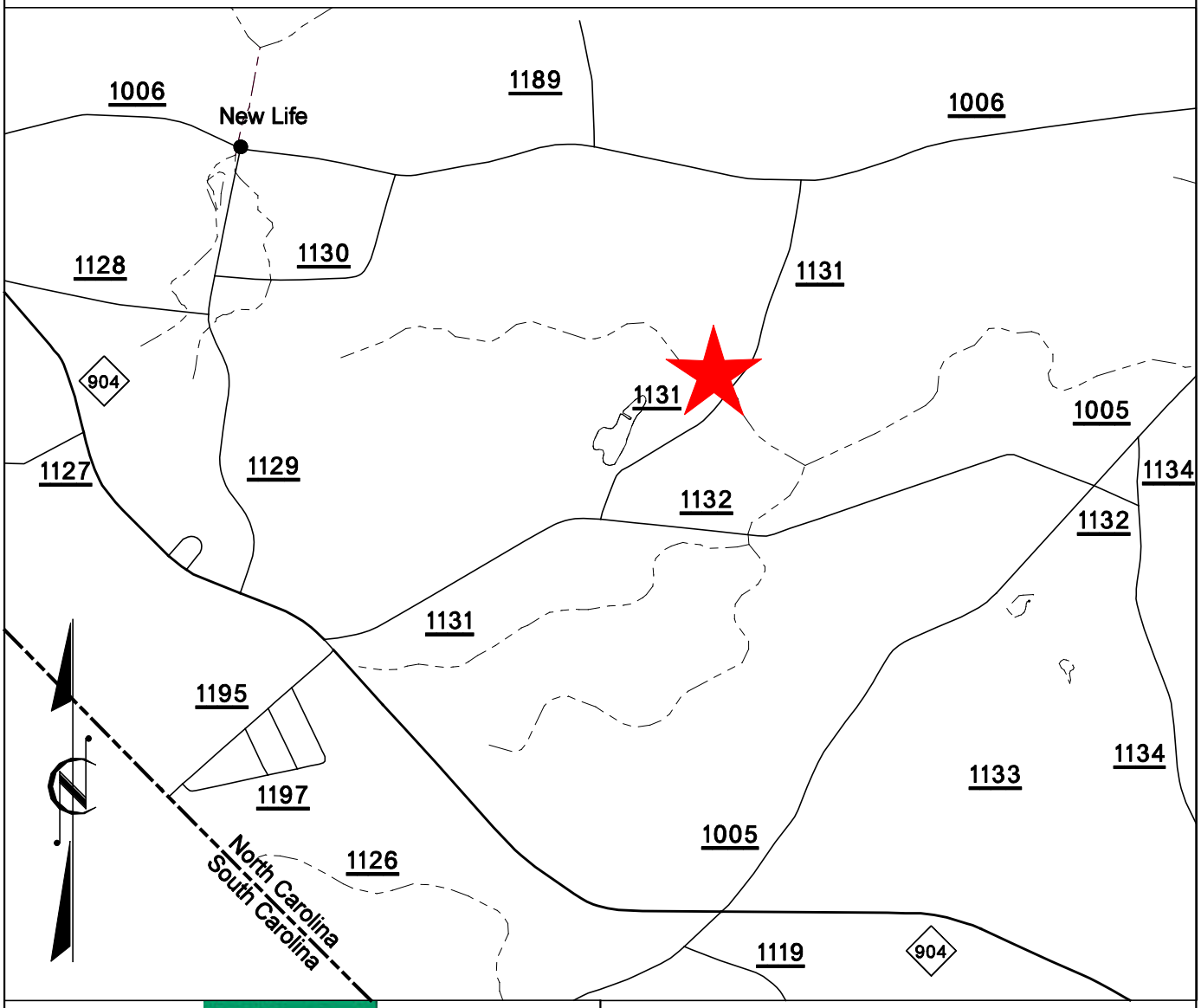
FEET

REFERENCE SITE



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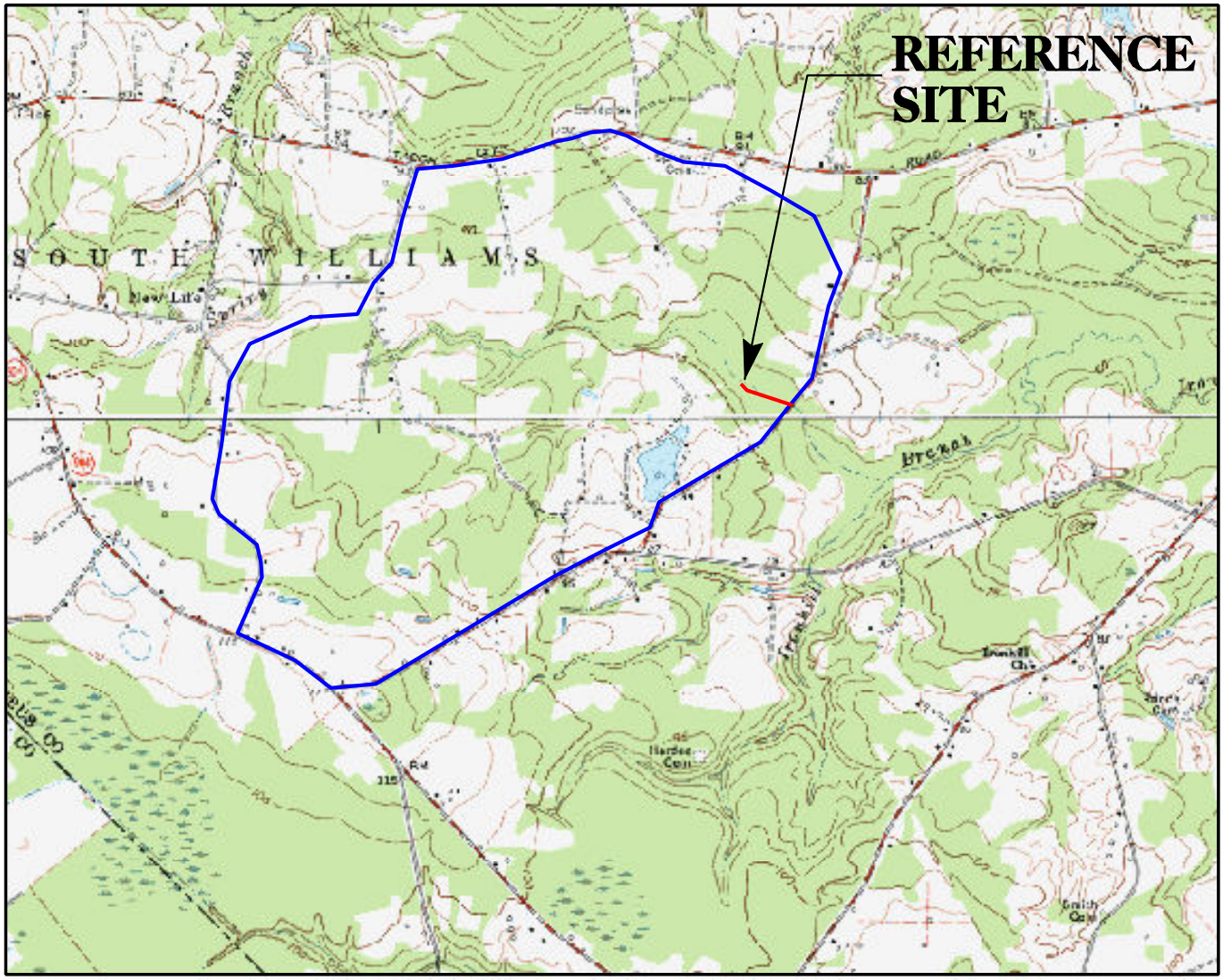
Ut to Ironhill Branch Vicinity Map

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 04/30/07

Figure: 6.4A



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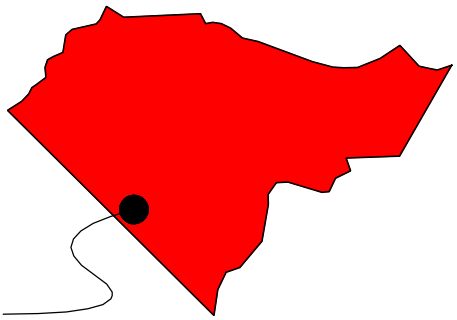
FEET

LEGEND

Watershed
Project Area

Reference Site Columbus County North Carolina



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Consulting Engineers
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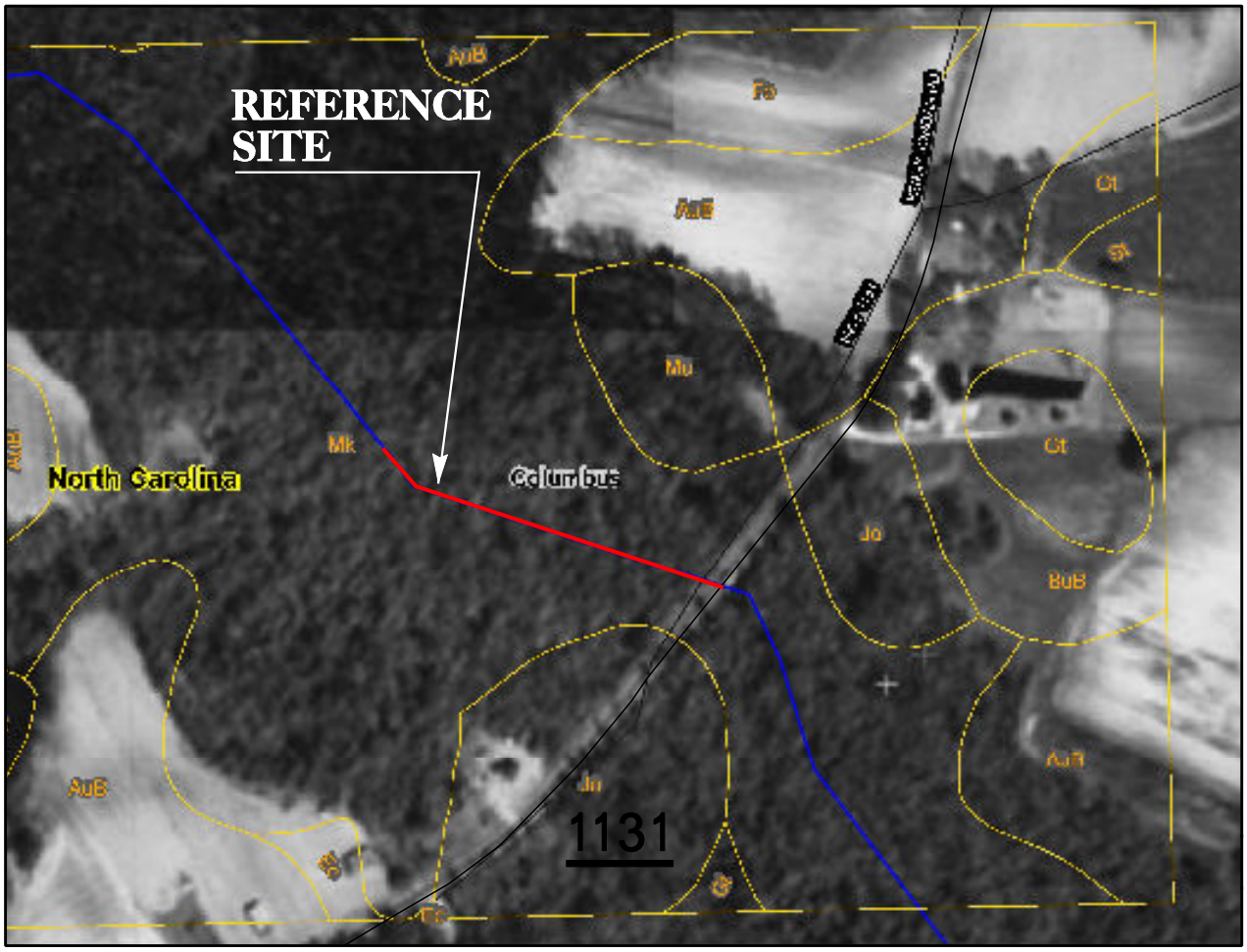
Reference Site Watershed Map

UT to Ironhill Branch

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

Date: 04/30/07

Figure: 6.4B



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FEET

LEGEND

Symbol	Name
Mk	Muckalee
	Project Area

Reference Site Soil Survey Map

UT to Ironhill Branch

Restoration Plan
Brown Marsh Swamp
Robeson County, North Carolina

RESTORATION SYSTEMS, LLC

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Consulting Engineers
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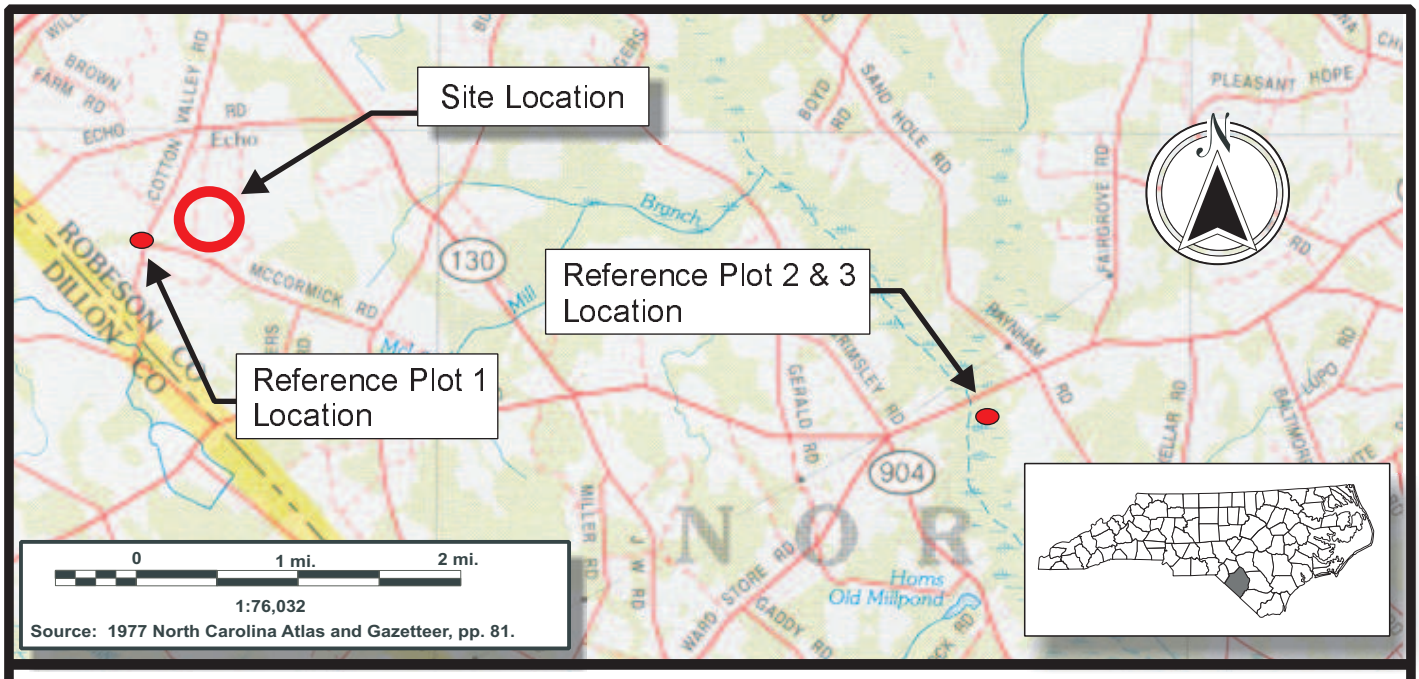
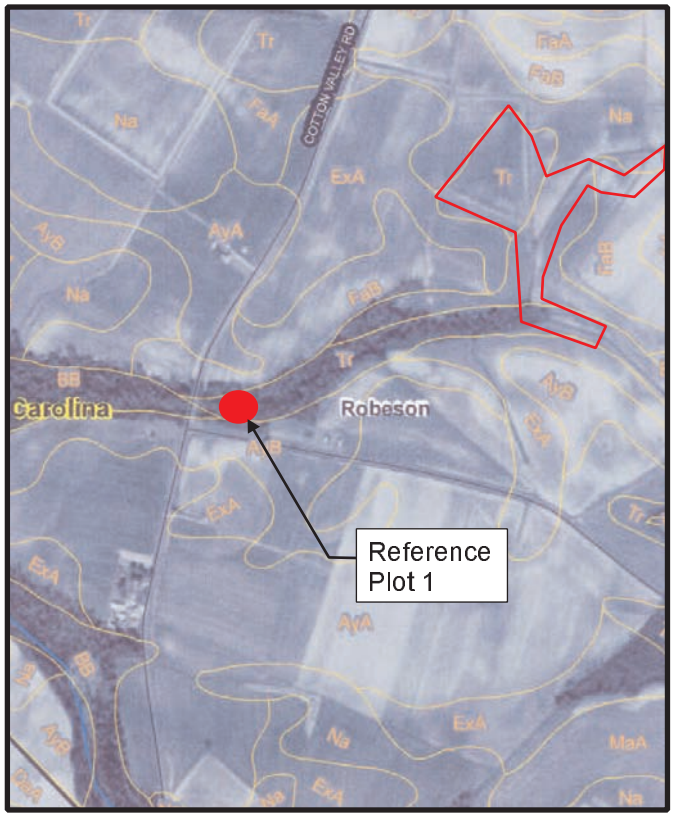
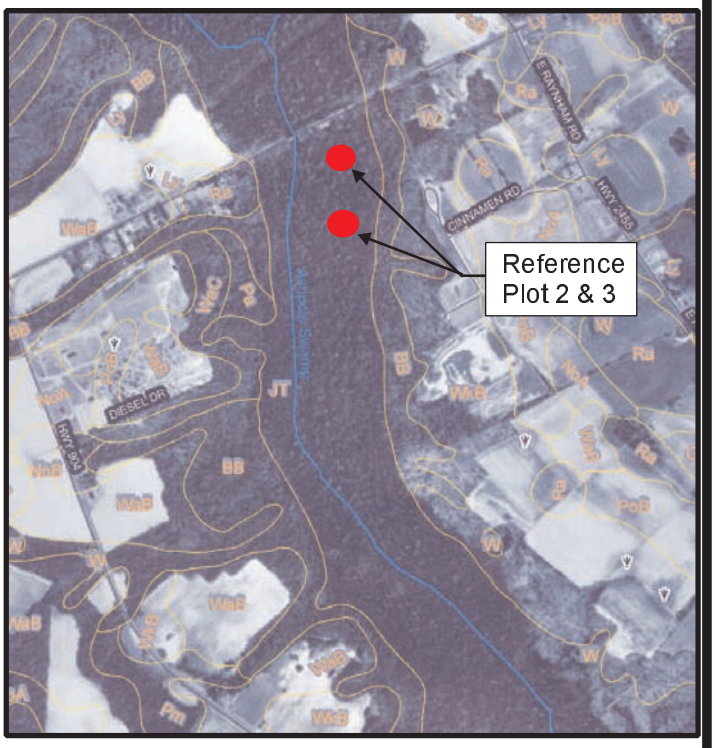
(919) 851-6066

Date: 04/30/07

Figure: 6.4C







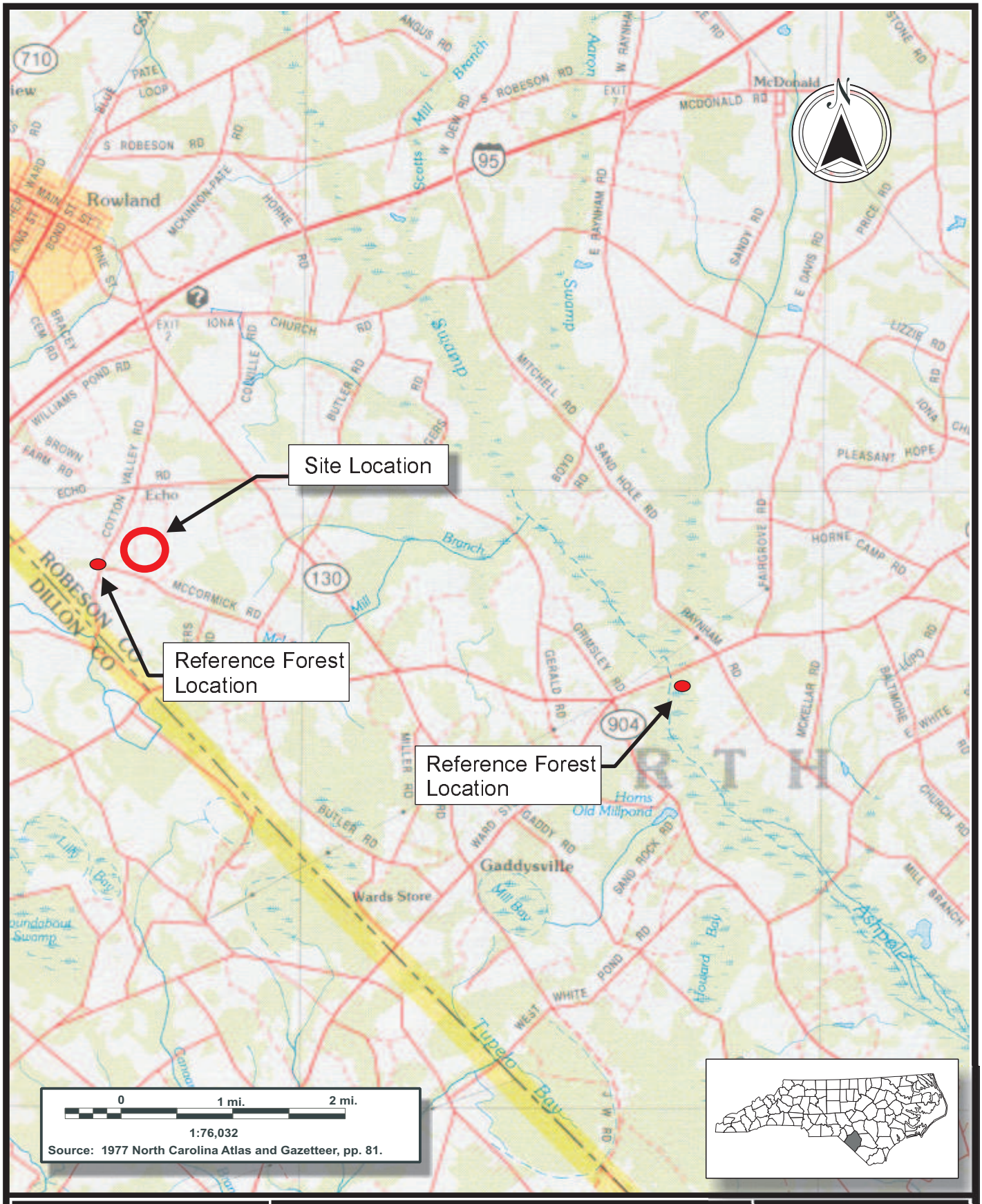
Legend
JT - Johnston Soil Series
BB - Bibb Soil Series
Tr - Trebloc Soil Series

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

WETLAND REFERENCE LOCATION AND SOIL MAP
BROWN MARSH SWAMP RESTORATION SITE
Robeson County, North Carolina

Dwn. by:	WGL
Ckd by:	WGL
Date:	Dec 2006
Project:	06-020

FIGURE
7



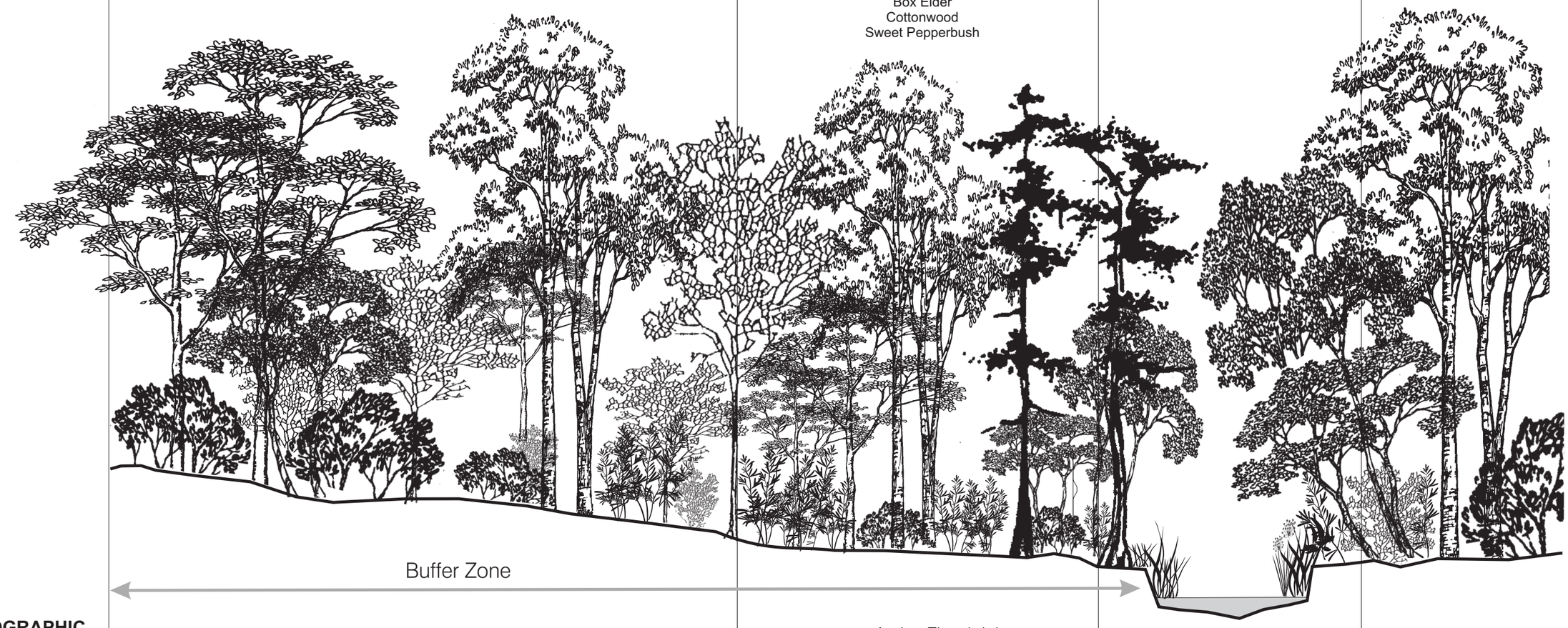
Axiom Environmental
2126 Rowland Pond Dr
Willow Spring, NC 27592
(919) 215-1693
(919) 341-3839 fax

REFERENCE SITE LOCATION
BROWN MARSH SWAMP RESTORATION SITE
Robeson County, North Carolina

Dwn. by:	WGL
Ckd by:	WGL
Date:	Dec 2006
Project:	06-020

FIGURE 8

VEGETATIVE ZONE	Nonriverine Wet Hardwood Forest	Coastal Plain Small Stream Swamp	Stream-Side Shrub Assemblage	Coastal Plain Small Stream Swamp
DIAGNOSTIC VEGETATION	Ash American Elm Laurel Oak Swamp Chestnut Oak Tulip Poplar Water Tupelo Water Oak Red Maple Sweetgum Sweetbay Ironwood American Holly	Ash American Elm Laurel Oak Swamp Chestnut Oak Tulip Poplar Water Tupelo Water Oak Red Maple Sweetgum Sweetbay Ironwood American Holly Bald Cypress Box Elder Cottonwood Sweet Pepperbush	Green Ash American Elm Black Willow Ironwood Possum-Haw Virginia Willow	See species list to left.



PHYSIOGRAPHIC LANDSCAPE UNIT	Secondary Floodplain	Active Floodplain	Riparian Zone	Active Floodplain
SOILS	Trebloc/Bibb Poorly Drained	Johnston/Bibb/Trebloc Soils Poorly to Very Poorly Drained		

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REFERENCE VEGETATIVE COMMUNITIES MAP
BROWN MARSH SWAMP RESTORATION SITE
ROBESON COUNTY, NORTH CAROLINA

Figure:	9
Project:	06-020
Date:	DEC 2006

8/17/99

FIGURE LOCATION MAP

KO & ASSOCIATES, P.C.
Consulting Engineers
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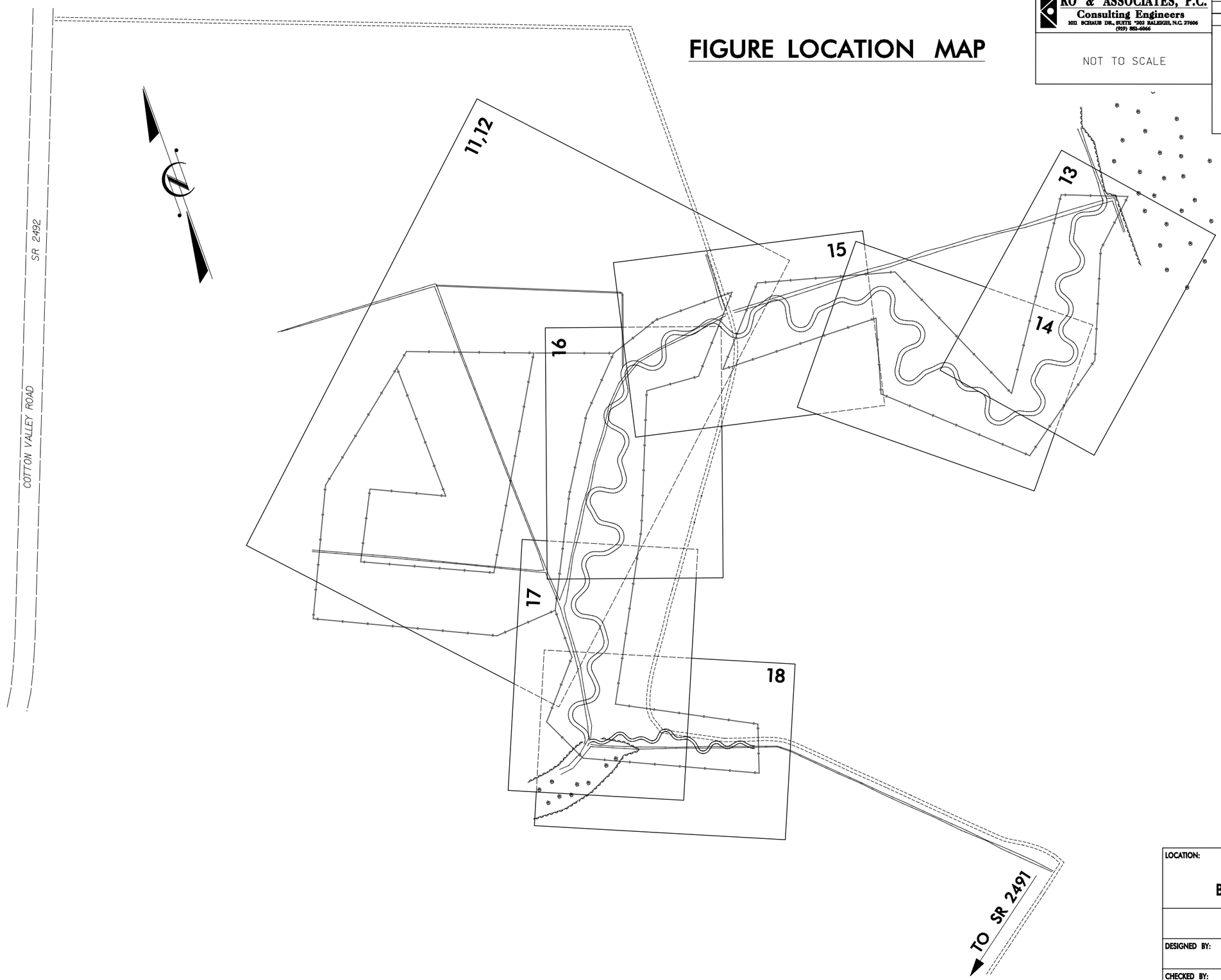
(919) 851-6066

NOT TO SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 10
PROJECT ENGINEER	



LOCATION:	RESTORATION PLAN BROWN MARSH SWAMP
COUNTY:	ROBESON
DESIGNED BY:	RVS
CHECKED BY:	RKW
DATE:	1/08/07

1/5/2007
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KO & Associates, P.C.

DRAWDOWN INFLUENCE OF EXISTING CONVEYENCES

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50 0 100
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 11
PROJECT ENGINEER	

EXISTING SOIL ROAD

EASEMENT LINE

EXISTING CHANNEL

EXISTING DITCH

EASEMENT LINE

EXISTING DITCH

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- CONFIRMED HYDRIC SOILS
- CONVEYENCE DRAWDOWN LIMITS

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 1/08/07

8/17/99

1/5/2007
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NONRIVERINE WETLANDS PROPOSED CONDITIONS

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50 0 100
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 12
PROJECT ENGINEER	

EXISTING SOIL ROAD

PROPOSED CHANNEL

EXISTING CHANNEL

EASEMENT LINE

SLOPE STAKE LINE

RELOCATED DITCH

EXISTING DITCH

RELOCATED DITCH

EASEMENT LINE

EASEMENT LINE

EXISTING DITCH

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- CONFIRMED HYDRIC SOILS
- CONVEYENCE DRAWDOWN LIMITS
- NONRIVERINE WETLAND RESTORATION

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 1/08/07

8/17/99

1/5/2007
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STREAM PROPOSED CONDITIONS

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25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 13
PROJECT ENGINEER	

WOODS

NORTHERN UT

EASEMENT LINE

SLOPE STAKE LINE

MATCHLINE- STATION 19+00

PROPOSED THALWEG

AGRICULTURAL FIELDS

EXISTING CHANNEL

EXISTING CHANNEL

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- ROOTWAD

LOCATION:	RESTORATION PLAN BROWN MARSH SWAMP
COUNTY:	ROBESON
DESIGNED BY:	RVS
CHECKED BY:	RKW
DATE:	1/08/07

1/5/2007
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STREAM PROPOSED CONDITIONS

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PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 14
PROJECT ENGINEER	

25 0 50
SCALE

AGRICUTURAL FIELDS

PROPOSED THALWEG

SLOPE STAKE LINE

NORTHERN UT

-MATCHLINE- STATION 19+00

EASEMENT LINE

-MATCHLINE- STATION 29+50

AGRICUTURAL FIELDS

EXISTING CHANNEL

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- ROOTWAD

LOCATION:	RESTORATION PLAN BROWN MARSH SWAMP
COUNTY:	ROBESON
DESIGNED BY:	RVS
CHECKED BY:	RKW
DATE:	1/07/08

1/5/2007
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STREAM PROPOSED CONDITIONS

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SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 15
PROJECT ENGINEER	

N

AGRICULTURAL FIELDS

NORTHERN UT

PROPOSED THALWEG

SLOPE STAKE LINE

EXISTING SOIL ROAD

RELOCATED SOIL ROAD

EASEMENT LINE

48" CMP

-MATCHLINE- STATION 29+50

-MATCHLINE- STATION 35+00

EXISTING CHANNEL

EASEMENT LINE

AGRICULTURAL FIELDS

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- ROOTWAD

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 1/08/07

1/5/2007
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STREAM PROPOSED CONDITIONS

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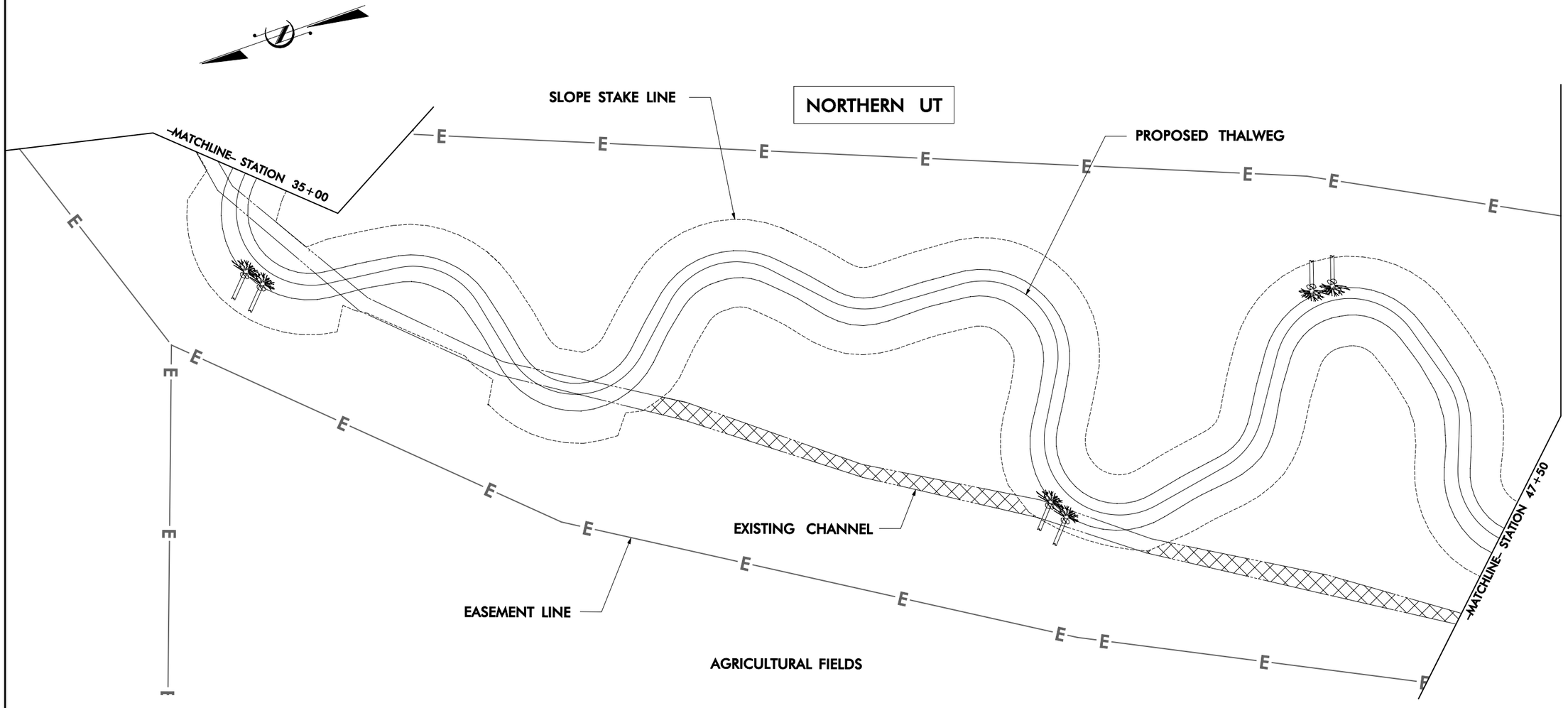
(919) 851-6066

25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 16
PROJECT ENGINEER	

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- ROOTWAD

LOCATION:	RESTORATION PLAN BROWN MARSH SWAMP
COUNTY:	ROBESON
DESIGNED BY:	RVS
CHECKED BY:	RKW
DATE:	1/08/07

1/5/2007
R:\Stream\Proj\Report Stuff\BMS_prop_psh_f16.dgn

8/17/99

STREAM PROPOSED CONDITIONS

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25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 17
PROJECT ENGINEER	

LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL
- LOG SILL

EXISTING SOIL ROAD

AGRICULTURAL FIELDS

SOUTHERN UT

NORTHERN UT

PROPOSED THALWEG

PROPOSED THALWEG

-MATCHLINE- STATION 14+00

SLOPE STAKE LINE

EXISTING CHANNEL

WOODS

-MATCHLINE- STATION 47+50

EXISTING CHANNEL

EASEMENT LINE

SLOPE STAKE LINE

AGRICULTURAL FIELDS

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 1/08/07

1/5/2007
K:\Stream\Proj\Report Stuff\BMS_prop_psh_f17.dgn
Ko & Associates, P.C.

8/17/99

STREAM PROPOSED CONDITIONS

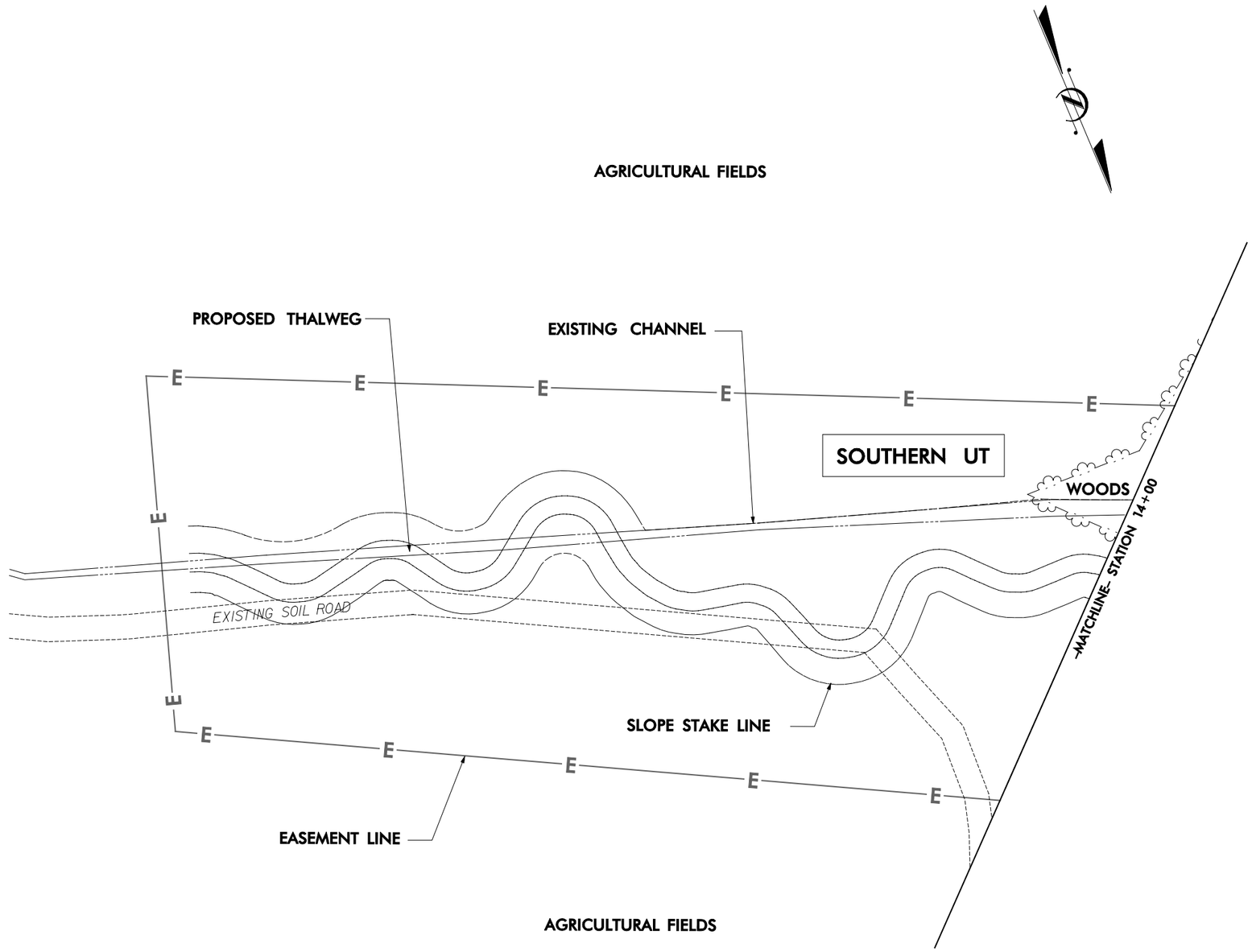
KO & ASSOCIATES, P.C.
Consulting Engineers
1011 SCHAUB DR., SUITE 202 RALEIGH, N.C. 27606
(919) 851-6066

25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 18
PROJECT ENGINEER	

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



LEGEND

- PROPOSED CHANNEL
- TREE LINE
- FILL

LOCATION:	RESTORATION PLAN BROWN MARSH SWAMP
COUNTY:	ROBESON
DESIGNED BY:	RVS
CHECKED BY:	RKW
DATE:	1/08/07

1/5/2007
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KO & Associates, P.C.

5/28/99

LONGITUDINAL PROFILE
NORTHERN UT

KO & ASSOCIATES, P.C.
Consulting Engineers
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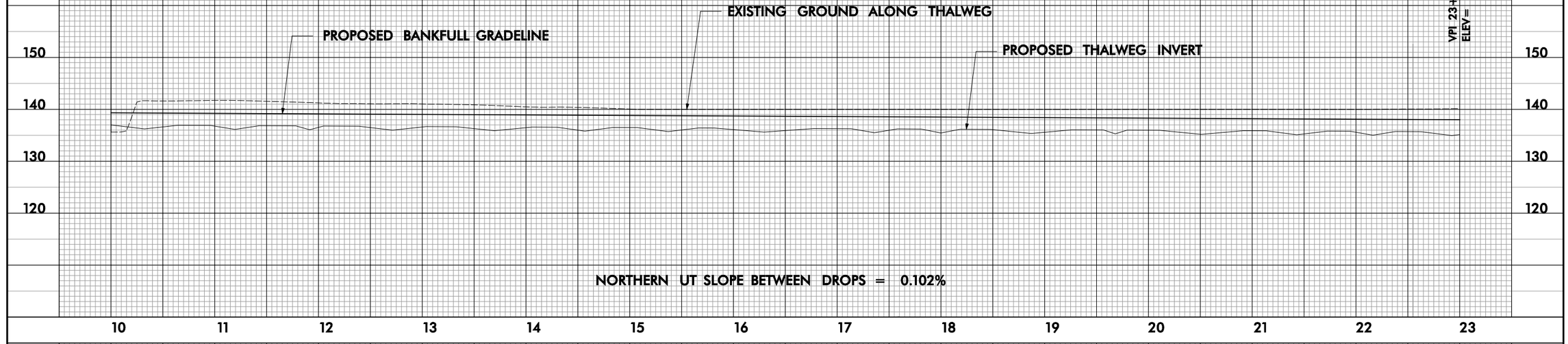
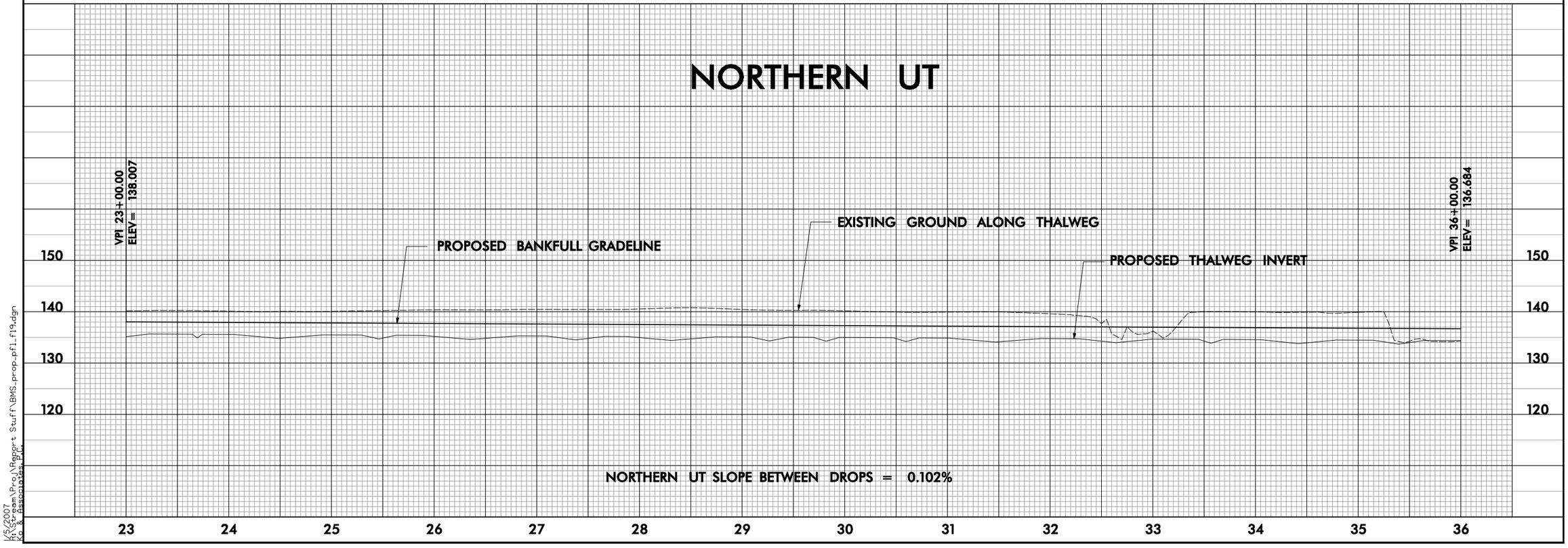
(919) 851-6066

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 19
PROJECT ENGINEER	





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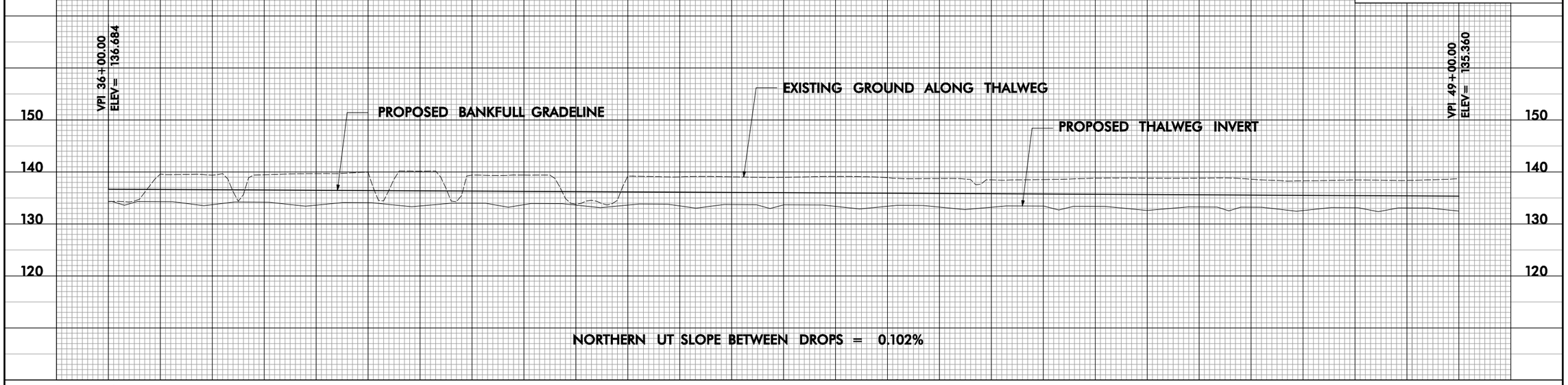
Ko & Associates, P.C.

5/28/99

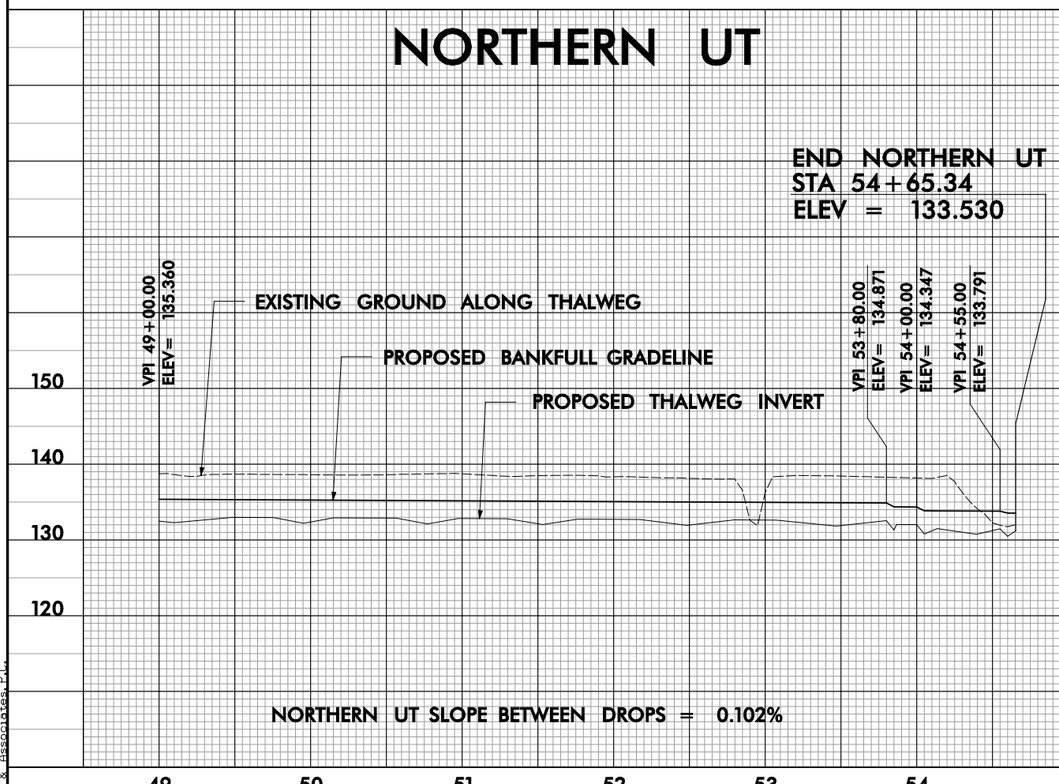
KO & ASSOCIATES, P.C.
Consulting Engineers
1011 SCHAUB DR., SUITE 202 RALEIGH, N.C. 27606
(919) 851-6066

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 20
PROJECT ENGINEER	

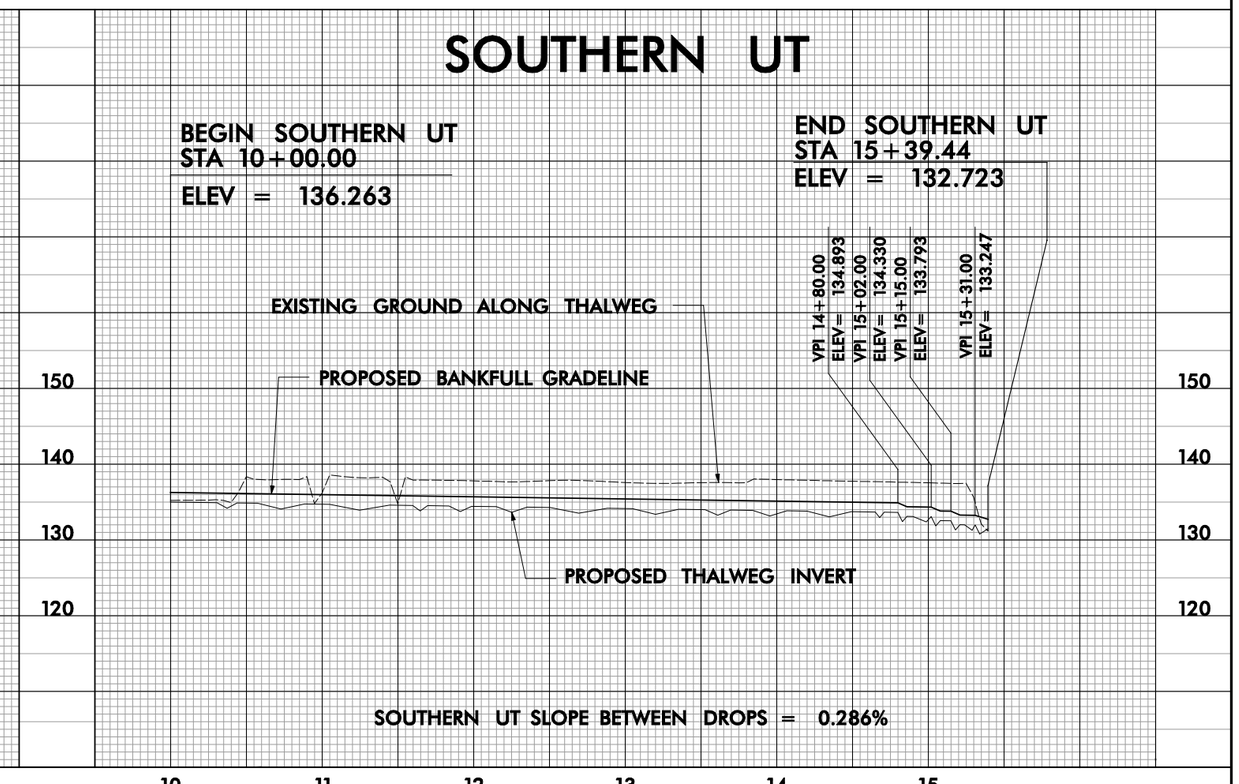
LONGITUDINAL PROFILE
NORTHERN UT



NORTHERN UT



SOUTHERN UT



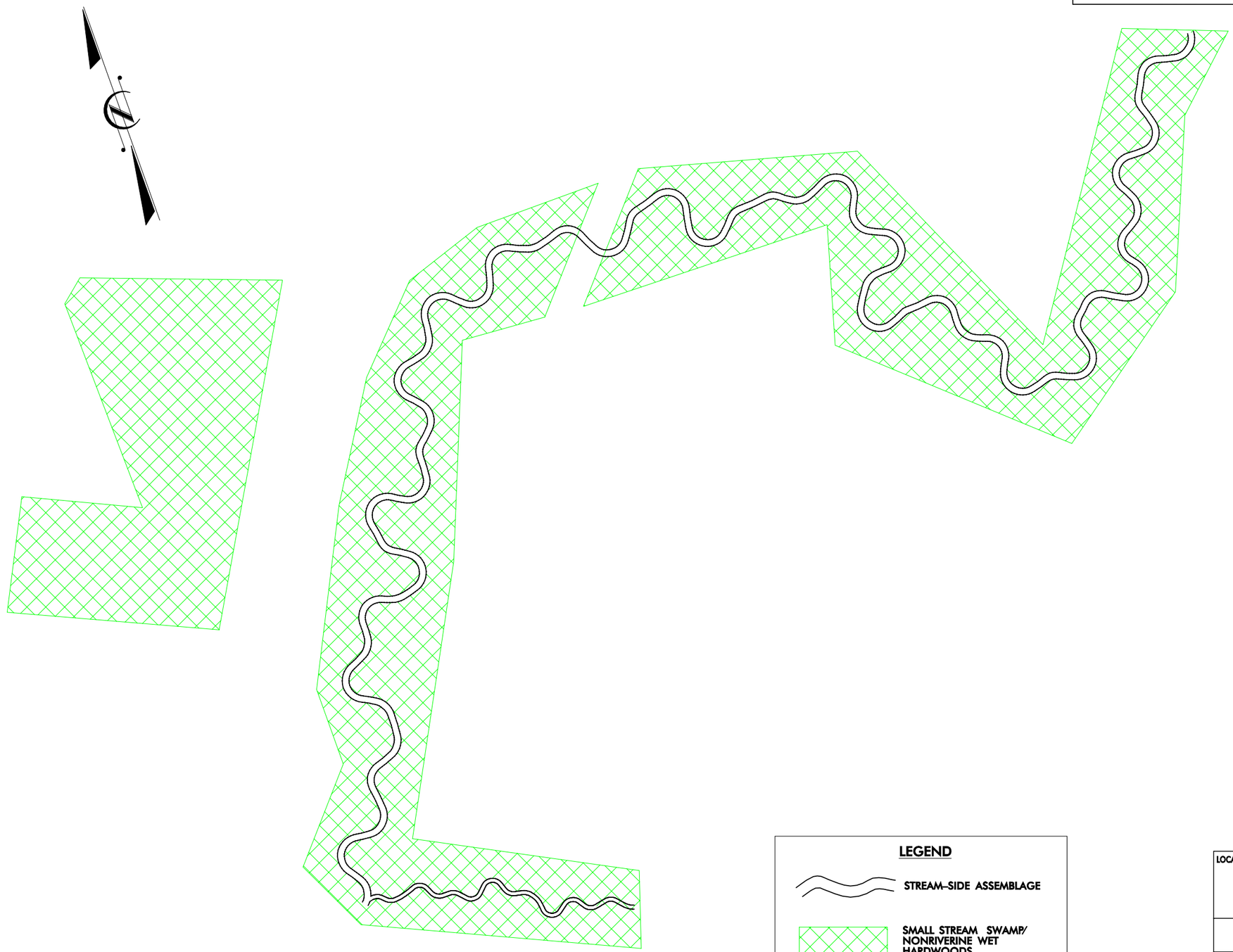
8/17/99

PLANTING PLAN

KO & ASSOCIATES, P.C.
Consulting Engineers
1011 SCHAUB DR., SUITE 202 RALEIGH, N.C. 27606
(919) 851-6066

100 0 200
SCALE

PROJECT REFERENCE NO.	SHEET NO.
BMS	Figure 21
PROJECT ENGINEER	



LEGEND

STREAM-SIDE ASSEMBLAGE

SMALL STREAM SWAMP/ NONRIVERINE WET HARDWOODS

LOCATION:
RESTORATION PLAN
BROWN MARSH SWAMP

COUNTY: ROBESON

DESIGNED BY: RVS

CHECKED BY: RKW DATE: 12/05/06

1/6/2007
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KO & Associates, P.C.

APPENDIX B
MORPHOLOGIC TABLES

Morphological Characteristics: Northern UT

Restoration Plan: **Brown Marsh Swamp Stream and Wetland Restoraiton Site**
County: **Robeson County, NC**
Design by: **RVS**
Checked by: **RKW**

ITEM	Existing Conditions	Proposed Conditions	Reference Reach	Reference Reach	Reference Reach
LOCATION	Existing Northern UT	Northern UT	UT to Ironhill Branch	Mill Creek	UT to WildCat Branch
STREAM TYPE	G5	E5	E5	E5	E5
DRAINAGE AREA, Ac - Sq Mi	723.20 Ac - 1.13 Sq Mi	723.20 Ac - 1.13 Sq Mi	1030.40 Ac - 1.61 Sq Mi	1228.80 Ac - 1.92 Sq Mi	281.60 Ac - 0.44 Sq Mi
BANKFULL WIDTH (W_{bkf}), ft	11.0 ft	11.5 ft	10.3 ft	11.3 ft	8.2 ft
BANKFULL MEAN DEPTH (d_{bkf}), ft	1.85 ft	1.53 ft	0.95 ft	1.85 ft	1.03 ft
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	5.9	7.5	10.8	6.1	8.0
BANKFULL X-SECTION AREA (A_{bkf}), ft^2	19.7 ft^2	17.6 ft^2	9.8 ft^3	21.0 ft^2	8.5 ft^2
BANKFULL MEAN VELOCITY, fps	0.9 fps	1.1 fps	1.1 fps	1.5 fps	1.0 fps
BANKFULL DISCHARGE, cfs	18.1 cfs	18.1 cfs	10.3 cfs	30.6 cfs	8.5 cfs
BANKFULL MAX DEPTH (d_{max}), ft	2.86 ft	1.52 ft	1.58 ft	2.58 ft	1.57 ft
WIDTH Flood-Prone Area (W_{fpa}), ft	21.73 ft	35.00 ft	290.0 ft	300.0 ft	130.0 ft
ENTRENCHMENT RATIO (ER)	2.0	3.0	28.2	26.5	15.9
MEANDER LENGTH (Lm), ft	1500.0	34.5 - 115.0 ft	42.0 - 72.0 ft	37.7 - 72.6 ft	22.5 - 29.0 ft
RATIO OF Lm TO W_{bkf}	136.4	3.0 - 10.0	4.1 - 7.0	3.3 - 6.4	2.7 - 3.5
RADIUS OF CURVATURE, ft	150.0	23.0 - 34.5 ft	13.7 - 20.8 ft	9.7 - 29.8 ft	10.9 - 15.3 ft
RATIO OF Rc TO W_{bkf}	13.6	2.0 - 3.0	1.3 - 2.0	0.9 - 2.6	1.3 - 1.9
BELT WIDTH, ft	600.0	23.0 - 69.0 ft	30.0 - 59.0 ft	15.1 - 27.0 ft	13.8 - 19.4 ft
MEANDER WIDTH RATIO	54.5	2.0 - 6.0	2.9 - 5.7	1.3 - 2.4	1.7 - 2.4
SINUOSITY (K)	1.00	1.39	1.33	1.18	1.15
VALLEY SLOPE, ft/ft	0.0010 ft/ft	0.0018 ft/ft	0.0017 ft/ft	0.0031 ft/ft	0.0027 ft/ft
AVERAGE SLOPE (S), ft/ft	0.0010 ft/ft	0.0010 ft/ft	0.0013 ft/ft	0.0026 ft/ft	0.0024 ft/ft
POOL SLOPE, ft/ft	0.0000 ft/ft	0.0004 ft/ft	0.0015 - 0.0065 ft/ft	0.0000 - 0.0080 ft/ft	0.0000 - 0.0000 ft/ft
RATIO OF POOL SLOPE TO AVERAGE SLOPE	0.0	0.4	1.2 - 5.0	0.0 - 3.0	0.0 - 0.0
MAX POOL DEPTH, ft	2.61 ft	3.07 ft	1.50 ft	3.12 ft	1.75 ft
RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.4	2.0	1.6	1.7	1.7
POOL WIDTH, ft	10.66 ft	12.65 ft	16.10 ft	11.85 ft	8.83 ft
RATIO OF POOL WIDTH TO BANKFULL WIDTH	0.97	1.10	1.57	1.05	1.08
POOL TO POOL SPACING, ft	5.5 - 140.0 ft	27.6 - 70.3 ft	40.0 - 65.0 ft	11.4 - 61.0 ft	14.0 - 16.6 ft
RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	5.5 - 12.7	2.4 - 6.1	3.9 - 6.3	1.0 - 5.4	1.7 - 2.0

Note: Existing Conditions data are collected on a typical reach within the studied channel, not the enitre channel with the project area. Some data, such as valley slope and average slope, may not deptic the actual average slope for the entire channel.

Morphological Characteristics: Southern UT

Restoration Plan: **Brown Marsh Swamp Stream and Wetland Restoraiton Site**
County: **Robeson County, NC**
Design by: **RVS**
Checked by: **RKW**

ITEM	Existing Conditions	Proposed Conditions	Reference Reach	Reference Reach
LOCATION	Existing Southern UT	Southern UT	UT to WildCat Branch	UT to Hog Swamp
STREAM TYPE	E5	E5	E5	E5
DRAINAGE AREA, Ac - Sq Mi	115.20 Ac - 0.18 Sq Mi	115.20 Ac - 0.18 Sq Mi	281.60 Ac - 0.44 Sq Mi	48.00 Ac - 0.08 Sq Mi
BANKFULL WIDTH (W_{bkf}), ft	5.6 ft	7.5 ft	8.2 ft	3.8 ft
BANKFULL MEAN DEPTH (d_{bkf}), ft	0.91 ft	0.79 ft	1.03 ft	0.48 ft
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	6.1	9.5	8.0	7.9
BANKFULL X-SECTION AREA (A_{bkf}), ft^2	3.0 ft^2	5.9 ft^2	8.5 ft^2	1.8 ft^3
BANKFULL MEAN VELOCITY, fps	1.6 fps	0.9 fps	1.0 fps	1.3 fps
BANKFULL DISCHARGE, cfs	4.9 cfs	4.8 cfs	8.5 cfs	2.3 cfs
BANKFULL MAX DEPTH (d_{max}), ft	1.24 ft	1.60 ft	1.57 ft	0.72 ft
WIDTH Flood-Prone Area (W_{fpa}), ft	7.21 ft	23.00 ft	130.0 ft	100.0 ft
ENTRENCHMENT RATIO (ER)	1.3	3.1	15.9	26.6
MEANDER LENGTH (Lm), ft	800.0	22.5 - 75.0 ft	22.5 - 29.0 ft	12.0 - 70.0 ft
RATIO OF Lm TO W_{bkf}	143.9	3.0 - 10.0	2.7 - 3.5	3.2 - 18.6
RADIUS OF CURVATURE, ft	65.0	15.0 - 22.5 ft	10.9 - 15.3 ft	4.4 - 45.6 ft
RATIO OF Rc TO W_{bkf}	11.7	2.0 - 3.0	1.3 - 1.9	1.2 - 12.1
BELT WIDTH, ft	100.0	15.0 - 45.0 ft	13.8 - 19.4 ft	5.7 - 16.0 ft
MEANDER WIDTH RATIO	18.0	2.0 - 6.0	1.7 - 2.4	1.5 - 4.2
SINUOSITY (K)	1.00	1.20	1.15	1.24
VALLEY SLOPE, ft/ft	0.0003 ft/ft	0.0071 ft/ft	0.0027 ft/ft	0.0084 ft/ft
AVERAGE SLOPE (S), ft/ft	0.0003 ft/ft	0.0026 ft/ft	0.0024 ft/ft	0.0068 ft/ft
POOL SLOPE, ft/ft	0.0000 ft/ft	0.0010 ft/ft	0.0000 - 0.0000 ft/ft	0.0000 - 0.0060 ft/ft
RATIO OF POOL SLOPE TO AVERAGE SLOPE	0.0	0.4	0.0 - 0.0	0.0 - 0.9
MAX POOL DEPTH, ft	0.94 ft	1.97 ft	1.75 ft	1.10 ft
RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.0	2.5	1.7	2.3
POOL WIDTH, ft	4.96 ft	7.50 ft	8.83 ft	3.80 ft
RATIO OF POOL WIDTH TO BANKFULL WIDTH	0.89	1.00	1.08	1.01
POOL TO POOL SPACING, ft	4.7 - 54.1 ft	18.0 - 45.8 ft	14.0 - 16.6 ft	9.0 - 23.0 ft
RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	4.7 - 9.7	2.4 - 6.1	1.7 - 2.0	2.4 - 6.1

Note: Existing Conditions data are collected on a typical reach within the studied channel, not the enitre channel with the project area. Some data, such as valley slope and average slope, may not deptic the actual average slope for the entire channel.

APPENDIX C
PROJECT SITE
PHOTOGRAPHS

Northern UT looking downstream at recently mowed banks.

Northern UT looking downstream from crossing. Notice stream has been channelized and regularly maintained.

View of algal blooms growing in Northern UT from nutrient loading.

Northern UT looking downstream at maintained banks, algal blooms, and agricultural practices adjacent to stream banks

Southern UT looking downstream at recently mowed banks.

Southern UT looking upstream. Notice stream has been channelized and regularly maintained.

Southern UT looking downstream towards convergence with Northern UT. Notice agricultural practices adjacent to steam banks.

Southern UT looking upstream. Notice algal blooms and vegetation choking channel flow.

APPENDIX D
PROJECT SITE
NCDWQ STREAM CLASSIFICATION FORMS

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2-27-06	**Project:** UT to Contrary Swamp	**Latitude:**
Evaluator: RVS / RKW	**Site:** Northern UT	**Longitude:**
Total Points: 27.5 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**County:** Robeson	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	(0)	1	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 5.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; (OBL = 1.5) SAV = 2.0; Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Extreme algal blooms are causing low levels of DO which may be killing much of the biological indicators that may have naturally occured in the channel.

Sketch:

North Carolina Division of Water Quality – Stream Identification Form; Version 3.1

Date: 2-27-06	**Project:** UT to Contary Swamp	**Latitude:**
Evaluator: RVS/RKW	**Site:** Southern UT	**Longitude:**
Total Points: 25.5 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**County:** Robeson	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	(0)	1	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		(Yes = 3)	

[a] Man-made ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	1	(0.5)	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	(1.5)
19. Hydric soils (redoximorphic features) present?	No = 0		(Yes = 1.5)	

C. Biology (Subtotal = 5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	3	2	(1)	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 (SAV = 2.0); Other = 0			

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)

Algal Blooms are causing low levels of DO which may be killing much of the biological indicators that may have naturally occured in the channel.

Sketch:

APPENDIX E
REFERENCE SITE
PHOTOGRAPHS

Mill Creek looking upstream. Notice mature vegetated riparian buffer and gently meandering pattern.

Mill Creek looking upstream. Notice roots along the banks which help to stabilize soils.

UT to Wildcat Branch looking upstream. Notice mature vegetated riparian buffer.

UT to Wildcat Branch looking upstream. Notice stable meandering pattern.

UT to Hog Swamp looking downstream. Notice vegetation on banks which help to stabilize soils.

UT to Hog Swamp looking upstream at stable channel with consistent riffle-pool sequence.

UT to Ironhill Branch looking downstream.

UT to Ironhill Branch looking upstream.

APPENDIX F
REFERENCE SITE
NCDWQ STREAM CLASSIFICATION FORMS

NCDWQ Stream Classification Form **S500**

Project Name: Mill Creek River Basin: Cape Fear County: Moore Evaluators: R. Smith

DWQ Project Number: N/A Nearest Named Stream: Mill Creek Latitude: Signature:

Date: 2/23/04 USGS QUAD: Niagra Longitude:

Location/Directions: Southern Pines, NC

PLEASE NOTE:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Riffle-Pool Sequence?	0	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1	2	3
3) Are Natural Levees Present?	0	1	2	3
4) Is The Channel Sinuous?	0	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	3
6) Is The Channel Braided?	0	1	2	3
7) Are Recent Alluvial Deposits Present?	0	1	2	3
8) Is There A Bankfull Bench Present?	0	1	2	3
9) Is A Continuous Bed & Bank Present?	0	1	2	3

*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*

10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map *And/Or* In Field) Present? *Yes*=3 *No*=0

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 23

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	3

PRIMARY HYDROLOGY INDICATOR POINTS: 3

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fibrous Roots Present In Streambed?	3	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	1	0
3) Is Periphyton Present?	0	1	2	3
4) Are Bivalves Present?	0	1	2	3

PRIMARY BIOLOGY INDICATOR POINTS: 6

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Head Cut Present In Channel?	0	.5	1	1.5
2) Is There A Grade Control Point In Channel?	0	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	1.5

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 3

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	0
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	1.5
3) Are Wrack Lines Present?	0	.5	1	1.5
4) Is Water In Channel *And* >48 Hrs. Since Last *Known* Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions *Or* In Growing Season)?	0	.5	1	1.5

6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)? *Yes=1.5* *No*=0

SECONDARY HYDROLOGY INDICATOR POINTS: 8.5

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are AquaticTurtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macrobenthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed? N/A	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	2	1	.75	.5	0	0

SECONDARY BIOLOGY INDICATOR POINTS: 5

TOTAL POINTS (Primary + Secondary)= 48.5 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

NCDWQ Stream Classification Form **S500**

Project Name: UT to Wildcat Branch River Basin: Lumber County: Robeson Evaluators: R. Smith

DWQ Project Number: N/A Nearest Named Stream: Wildcat Branch Latitude: 34°42'36.63"N Signature:

Date: 8/2/04 USGS QUAD: Northeast Lumberton Longitude: 78°52'55.14''W

Location/Directions:

PLEASE NOTE:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgment of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Riffle-Pool Sequence?	0	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1	2	3
3) Are Natural Levees Present?	0	1	2	3
4) Is The Channel Sinuous?	0	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	3
6) Is The Channel Braided?	0	1	2	3
7) Are Recent Alluvial Deposits Present?	0	1	2	3
8) Is There A Bankfull Bench Present?	0	1	2	3
9) Is A Continuous Bed & Bank Present?	0	1	2	3

*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*

10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map *And/Or* In Field) Present? *Yes*=3 *No*=0

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 21

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	3

PRIMARY HYDROLOGY INDICATOR POINTS: 2

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fibrous Roots Present In Streambed?	3	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	1	0
3) Is Periphyton Present?	0	1	2	3
4) Are Bivalves Present?	0	1	2	3

PRIMARY BIOLOGY INDICATOR POINTS: 6

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Head Cut Present In Channel?	0	.5	1	1.5
2) Is There A Grade Control Point In Channel?	0	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	1.5

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	0
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	1.5
3) Are Wrack Lines Present?	0	.5	1	1.5
4) Is Water In Channel *And* >48 Hrs. Since Last *Known* Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions *Or* In Growing Season)?	0	.5	1	1.5

6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)? *Yes=1.5* *No*=0

SECONDARY HYDROLOGY INDICATOR POINTS: 9

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are AquaticTurtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macrobenthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed? N/A	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	2	1	.75	.5	0	0

SECONDARY BIOLOGY INDICATOR POINTS: 7

TOTAL POINTS (Primary + Secondary)= 46 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

NCDWQ Stream Classification Form **S500**

Project Name: Hog Swamp River Basin: Lumber County: Robeson Evaluators: R. Smith, N. Daly, K. McKeithan

DWQ Project Number: N/A Nearest Named Stream: Hog Swamp Latitude: 34°28'19.39"N Signature:

Date: 3/9/04 USGS QUAD: Farimont Longitude: 79°04'40.54W

Location/Directions: UT to Hog Swamp located west of SR 2225

PLEASE NOTE:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Riffle-Pool Sequence?	0	1	2	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1	2	3
3) Are Natural Levees Present?	0	1	2	3
4) Is The Channel Sinuous?	0	1	2	3
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	3
6) Is The Channel Braided?	0	1	2	3
7) Are Recent Alluvial Deposits Present?	0	1	2	3
8) Is There A Bankfull Bench Present?	0	1	2	3
9) Is A Continuous Bed & Bank Present?	0	1	2	3
*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map *And/Or* In Field) Present?	*Yes*=3		*No*=0	

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: 18

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	3

PRIMARY HYDROLOGY INDICATOR POINTS: 2

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fibrous Roots Present In Streambed?	3	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	1	0
3) Is Periphyton Present?	0	1	2	3
4) Are Bivalves Present?	0	1	2	3

PRIMARY BIOLOGY INDICATOR POINTS: 6

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Head Cut Present In Channel?	0	.5	1	1.5
2) Is There A Grade Control Point In Channel?	0	.5	1	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	1.5

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: 2

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	1	.5	0
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	1.5
3) Are Wrack Lines Present?	0	.5	1	1.5
4) Is Water In Channel *And* >48 Hrs. Since Last *Known* Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	1	1.5
5) Is There Water In Channel During Dry Conditions *Or* In Growing Season)?	0	.5	1	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?	*Yes=1.5*		*No*=0	

SECONDARY HYDROLOGY INDICATOR POINTS: 6.5

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fish Present?	0	.5	1	1.5
2) Are Amphibians Present?	0	.5	1	1.5
3) Are AquaticTurtles Present?	0	.5	1	1.5
4) Are Crayfish Present?	0	.5	1	1.5
5) Are Macrobenthos Present?	0	.5	1	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	.5	1	1.5
7) Is Filamentous Algae Present?	0	.5	1	1.5

8) Are Wetland Plants In Streambed? N/A	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	2	1	.75	.5	0	0

SECONDARY BIOLOGY INDICATOR POINTS: 6

TOTAL POINTS (Primary + Secondary)= 40.5 *(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

NCDWQ Stream Classification Form **S500**

Project Name: Ironhill Branch River Basin: Lumber County: Columbus Evaluators: R. Smith, N. Daly, K. McKeithan

DWQ Project Number: N/A Nearest Named Stream: Ironhill Branch Latitude: 34°07'33.18" Signature:

Date: 2/20/03 USGS QUAD: Tabor City East Longitude: 78°48'55.13"W

Location/Directions: UT to Ironhill Branch located West of SR 1131

PLEASE NOTE:** ***If evaluator and landowner agree that the feature is a man-made ditch, then use of this form is not necessary. Also, if in the best professional judgement of the evaluator, the feature is a man-made ditch and not a modified natural stream—this rating system should not be used*

Primary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Riffle-Pool Sequence?	0	1	**2**	3
2) Is The USDA Texture In Streambed Different From Surrounding Terrain?	0	1	2	**3**
3) Are Natural Levees Present?	**0**	1	2	3
4) Is The Channel Sinuous?	0	1	2	**3**
5) Is There An Active (Or Relic) Floodplain Present?	0	1	2	**3**
6) Is The Channel Braided?	0	**1**	2	3
7) Are Recent Alluvial Deposits Present?	0	1	2	**3**
8) Is There A Bankfull Bench Present?	0	1	2	**3**
9) Is A Continuous Bed & Bank Present?	0	1	2	**3**
*(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*				
10) Is A 2nd Order Or Greater Channel (As Indicated On Topo Map *And/Or* In Field) Present?	*Yes*=3		*No*=**0**	

PRIMARY GEOMORPHOLOGY INDICATOR POINTS: **21**

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Groundwater Flow/Discharge Present?	0	1	2	**3**

PRIMARY HYDROLOGY INDICATOR POINTS: **3**

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fibrous Roots Present In Streambed?	**3**	2	1	0
2) Are Rooted Plants Present In Streambed?	3	2	**1**	0
3) Is Periphyton Present?	**0**	1	2	3
4) Are Bivalves Present?	0	**1**	2	3

PRIMARY BIOLOGY INDICATOR POINTS: **5**

Secondary Field Indicators: *(Circle One Number Per Line)*

I. Geomorphology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is There A Head Cut Present In Channel?	**0**	.5	1	1.5
2) Is There A Grade Control Point In Channel?	0	.5	**1**	1.5
3) Does Topography Indicate A Natural Drainage Way?	0	.5	1	**1.5**

SECONDARY GEOMORPHOLOGY INDICATOR POINTS: **2.5**

II. Hydrology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Is This Year's (Or Last's) Leaf litter Present In Streambed?	1.5	**1**	.5	0
2) Is Sediment On Plants (Or Debris) Present?	0	.5	1	**1.5**
3) Are Wrack Lines Present?	0	.5	1	**1.5**
4) Is Water In Channel *And* >48 Hrs. Since Last *Known* Rain? *(*NOTE: If Ditch Indicated In #9 Above Skip This Step And #5 Below*)*	0	.5	**1**	1.5
5) Is There Water In Channel During Dry Conditions *Or* In Growing Season)?	0	.5	**1**	1.5
6) Are Hydric Soils Present In Sides Of Channel (Or In Headcut)?	*Yes*=**1.5**		*No*=0	

SECONDARY HYDROLOGY INDICATOR POINTS: **7.5**

III. Biology	**Absent**	**Weak**	**Moderate**	**Strong**
1) Are Fish Present?	0	.5	**1**	1.5
2) Are Amphibians Present?	0	.5	**1**	1.5
3) Are AquaticTurtles Present?	0	**.5**	1	1.5
4) Are Crayfish Present?	0	.5	**1**	1.5
5) Are Macrobenthos Present?	0	.5	**1**	1.5
6) Are Iron Oxidizing Bacteria/Fungus Present?	0	**.5**	1	1.5
7) Is Filamentous Algae Present?	0	**.5**	1	1.5

8) Are Wetland Plants In Streambed? N/A	SAV	Mostly OBL	Mostly FACW	Mostly FAC	Mostly FACU	Mostly UPL
(NOTE: If Total Absence Of All Plants In Streambed As Noted Above Skip This Step UNLESS SAV Present*).*	2	**1**	.75	.5	0	0

SECONDARY BIOLOGY INDICATOR POINTS: **6.5**

TOTAL POINTS (Primary + Secondary)= **45.5***(If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)*

APPENDIX G
HEC-RAS ANALYSIS

BROWN MARSH SWAMP
NORTHERN UT
HEC-RAS ANALYSIS

River Station	Storm Event	Discharge (cfs)	Existing WSEL (ft)	Proposed WSEL (ft)	Backwater (ft)
Upstream End of Project					
3657.97	Bankfull	18.1	137.84	139.24	1.40
3657.97	Q100	160	141.70	141.36	-0.34
3566.67	Bankfull	18.1	137.79	139.18	1.39
3566.67	Q100	160	141.62	141.10	-0.52
3495.11	Bankfull	18.1	137.76	139.01	1.25
3495.11	Q100	160	141.55	141.09	-0.46
3390.77	Bankfull	18.1	137.69	138.59	0.90
3390.77	Q100	160	141.43	141.03	-0.40
3271.52	Bankfull	18.1	137.61	138.34	0.73
3271.52	Q100	160	141.29	140.99	-0.30
3196.1	Bankfull	18.1	137.54	138.24	0.70
3196.1	Q100	160	141.18	140.96	-0.22
3084.74	Bankfull	18.1	137.43	137.82	0.39
3084.74	Q100	160	141.04	140.87	-0.17
2971.38	Bankfull	18.1	137.34	137.32	-0.02
2971.38	Q100	160	140.89	140.58	-0.31
2880.47	Bankfull	18.1	137.28	137.25	-0.03
2880.47	Q100	160	140.75	140.52	-0.23
2785.45	Bankfull	18.1	137.21	137.14	-0.07
2785.45	Q100	160	140.65	140.44	-0.21
2734.88	Bankfull	18.1	137.17	137.09	-0.08
2734.88	Q100	160	140.59	140.42	-0.17
2640.76	Bankfull	18.1	137.04	136.93	-0.11
2640.76	Q100	160	140.47	140.35	-0.12
2570.79	Bankfull	18.1	136.92	136.89	-0.03
2570.79	Q100	160	140.32	140.31	-0.01
2520.16	Bankfull	18.1	136.62	136.70	0.08
2520.16	Q100	160	140.19	139.76	-0.43
2413.55	Bankfull	18.1	136.53	136.55	0.02
2413.55	Q100	160	140.05	139.61	-0.44
2344.4	Bankfull	18.1	136.48	136.44	-0.04
2344.4	Q100	160	139.98	139.52	-0.46

BROWN MARSH SWAMP
NORTHERN UT
HEC-RAS ANALYSIS

River Station	Storm Event	Discharge (cfs)	Existing WSEL (ft)	Proposed WSEL (ft)	Backwater (ft)
2239.26	Bankfull	18.1	136.32	136.30	-0.02
2239.26	Q100	160	139.77	139.38	-0.39
2066.76	Bankfull	18.1	135.89	136.07	0.18
2066.76	Q100	160	139.36	139.12	-0.24
2001.89	Bankfull	18.1	135.77	136.00	0.23
2001.89	Q100	160	139.29	139.05	-0.24
1919.01	Bankfull	18.1	135.65	135.83	0.18
1919.01	Q100	160	139.19	138.90	-0.29
1850.35	Bankfull	18.1	135.55	135.71	0.16
1850.35	Q100	160	139.12	138.84	-0.28
1799.08	Bankfull	18.1	135.46	135.64	0.18
1799.08	Q100	160	139.08	138.83	-0.25
1694.92	Bankfull	18.1	135.25	135.48	0.23
1694.92	Q100	160	139.02	138.77	-0.25
1654.19	Bankfull	18.1	135.17	135.36	0.19
1654.19	Q100	160	139.00	138.73	-0.27
1568.92	Bankfull	18.1	134.92	135.23	0.31
1568.92	Q100	160	138.95	138.66	-0.29
1489.2	Bankfull	18.1	134.68	135.17	0.49
1489.2	Q100	160	138.84	138.59	-0.25
1391.82	Bankfull	18.1	134.51	135.09	0.58
1391.82	Q100	160	138.74	138.53	-0.21
1316.85	Bankfull	18.1	134.33	134.94	0.61
1316.85	Q100	160	138.62	138.43	-0.19
1194	Bankfull	18.1	133.99	134.46	0.47
1194	Q100	160	138.42	138.29	-0.13
1089.37	Bankfull	18.1	133.79	133.70	-0.09
1089.37	Q100	160	138.28	138.19	-0.09
1021.67	Bankfull	18.1	133.70	133.70	0.00
1021.67	Q100	160	138.20	138.20	0.00
Downstream End of Project					

BROWN MARSH SWAMP
SOUTHERN UT
HEC-RAS ANALYSIS

River Station	Storm Event	Discharge (cfs)	Existing WSEL (ft)	Proposed WSEL (ft)	Backwater (ft)
Upstream End of Tributary Restoration					
1494.75	Bankfull	4.9	136.30	136.25	-0.05
1494.75	Q100	90	139.26	138.53	-0.73
1439.76	Bankfull	4.9	136.15	136.11	-0.04
1439.76	Q100	90	139.11	138.40	-0.71
1400.05	Bankfull	4.9	136.05	135.90	-0.15
1400.05	Q100	90	139.01	138.25	-0.76
1351.56	Bankfull	4.9	135.92	135.71	-0.21
1351.56	Q100	90	138.82	138.02	-0.80
1297.47	Bankfull	4.9	135.67	135.43	-0.24
1297.47	Q100	90	138.62	137.72	-0.90
1240.59	Bankfull	4.9	135.08	135.27	0.19
1240.59	Q100	90	138.18	137.48	-0.70
1178.51	Bankfull	4.9	134.30	135.03	0.73
1178.51	Q100	90	137.67	137.16	-0.51
1136.11	Bankfull	4.9	133.82	134.83	1.01
1136.11	Q100	90	137.48	136.88	-0.60
1112.41	Bankfull	4.9	133.63	134.67	1.04
1112.41	Q100	90	137.42	136.68	-0.74
1098.94	Bankfull	4.9	133.51	134.45	0.94
1098.94	Q100	90	137.37	136.37	-1.00
1047.51	Bankfull	4.9	132.81	133.30	0.49
1047.51	Q100	90	137.19	135.75	-1.44
1027.43	Bankfull	4.9	132.71	133.01	0.30
1027.43	Q100	90	137.14	135.73	-1.41
Confluence with the Northern UT					

APPENDIX H
AGENCY COORDINATION

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Brown Marsh Swamp Stream and Wetland Restoration Site
County Name:	Robeson
EEP Number:	Contract # D06038-A
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	Paul Parker
Project Contact Address:	1101 Haynes Street, Suite 107, Raleigh, NC 27604
Project Contact E-mail:	paul@restorationsystems.com
EEP Project Manager:	Guy Pearce

Project Description

The Brown Marsh Swamp Site is located approximately two miles east of I-95 in Robeson County within EEP Targeted Local Watershed 03040204037010, approximately three miles to the southeast of Rowland. The project will restore approximately 5,000 linear feet of channelized unnamed tributaries to the Brown Marsh Swamp and approximately five acres of former wetlands. The site is currently in row-crop agricultural production.

For Official Use Only

Reviewed By:

Date — EEP Project Manager

Conditional Approved By:

Date — For Division Administrator FHWA

☐ Check this box if there are outstanding issues

Final Approval By:

1-22-06 — Date

For Division Administrator FHWA

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☑ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☑ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☐ Yes ☑ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

Environmental Documentation
for
Brown Marsh Swamp Wetland Restoration Site

EEP Contract Number D06038-A

Categorical Exclusion Form Items

CZMA
Not applicable, as the project is not located in a CAMA county.

CERCLA
See the attached Executive Summary of the limited Phase 1 Site Assessment.

National Historic Preservation Act (Section 106)
See the attached letter from the State Historic Preservation Office.

Uniform Act
See the attached letter that was sent to the landowner.

American Indian Religious Freedom Act
Not applicable, as the project is not located in a county claimed by the Eastern Band of Cherokee Indians.

Antiquities Act
Not applicable, as the project is not located on Federal lands.

Archaeological Resources Protection Act
Not applicable, as the project is not located on Federal or Indian lands.

Endangered Species Act
See the attached internal memo with the Biological Conclusion of No Effect. There is no suitable habitat on the site for the two Federally Endangered species known to occur in Robeson County.

Executive Order 13007
Not applicable, as the project is not located in a county claimed by the Eastern Band of Cherokee Indians.

Farmland Protection Policy Act
See the attached USDA Form AD-1006

Fish and Wildlife Coordination Act
See the attached letter from the NC Wildlife Resources Commission, who had no comment on the project.

The USFWS did not provide comments.

Land and Water Conservation Fund Act
Not applicable. The project will not convert recreation lands.

Magnuson-Stevens Fishery Conservation and Management Act
Not applicable. The project is not located in an estuarine system.

Migratory Bird Treaty Act
Neither the USFWS nor the NCWRC provided comments.

Wilderness Act
Not applicable. The project is not located in a Wilderness area.

Other Miscellaneous Items

Public Notice
See the attached Affidavit of Publication of a Public Notice in the Robesonian, the local paper. We received no comments or questions about the project.

EDR® Environmental
Data Resources Inc

The EDR Radius Map
with GeoCheck®

Brown Marsh Swamp Restoration Site
Robeson County
Rowland, NC 28383

Inquiry Number: 01718882.10r

July 20, 2006

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06461

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

FORM-BPK-ERN

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

ROBESON COUNTY
ROWLAND, NC 28383

COORDINATES

Latitude (North):	34.493300 - 34° 29' 35.9"
Longitude (West):	79.274100 - 79° 16' 26.8"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	658468.2
UTM Y (Meters):	3818010.2
Elevation:	136 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	34079-D3 DILLON EAST, SC
Most Recent Revision:	1982
North Map:	34079-E3 ROWLAND, NC
Most Recent Revision:	1982

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL ..... National Priority List
Proposed NPL ..... Proposed National Priority List Sites
Delisted NPL ..... National Priority List Deletions
NPL RECOVERY ..... Federal Superfund Liens
CERCLIS ..... Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP ..... CERCLIS No Further Remedial Action Planned

EXECUTIVE SUMMARY

CORRACTS	Corrective Action Report
RCRA-TSDF	Resource Conservation and Recovery Act Information
RCRA-LQG	Resource Conservation and Recovery Act Information
RCRA-SQG	Resource Conservation and Recovery Act Information
ERNS	Emergency Response Notification System
HMIRS	Hazardous Materials Information Reporting System
US ENG CONTROLS	Engineering Controls Sites List
US INST CONTROL	Sites with Institutional Controls
DOD	Department of Defense Sites
FUDS	Formerly Used Defense Sites
US BROWNFIELDS	A Listing of Brownfields Sites
CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
UMTRA	Uranium Mill Tailings Sites
ODI	Open Dump Inventory
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
SSTS	Section 7 Tracking Systems
ICIS	Integrated Compliance Information System
PADS	PCB Activity Database System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
FINDS	Facility Index System/Facility Registry System
RAATS	RCRA Administrative Action Tracking System

STATE AND LOCAL RECORDS

SHWS	Inactive Hazardous Sites Inventory
NC HSDS	Hazardous Substance Disposal Site
IMD	Incident Management Database
SWF/LF	List of Solid Waste Facilities
OLI	Old Landfill Inventory
LUST	Regional UST Database
LUST TRUST	State Trust Fund Database
UST	Petroleum Underground Storage Tank Database
AST	AST Database
INST CONTROL	No Further Action Sites With Land Use Restrictions Monitoring
VCP	Responsible Party Voluntary Action Sites
DRYCLEANERS	Drycleaning Sites
BROWNFIELDS	Brownfields Projects Inventory
NPDES	NPDES Facility Location Listing

TRIBAL RECORDS

INDIAN RESERV	Indian Reservations
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land

EDR PROPRIETARY RECORDS

Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants
EDR Historical Auto Stations	EDR Proprietary Historic Gas Stations
EDR Historical Cleaners	EDR Proprietary Historic Dry Cleaners

EXECUTIVE SUMMARY

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

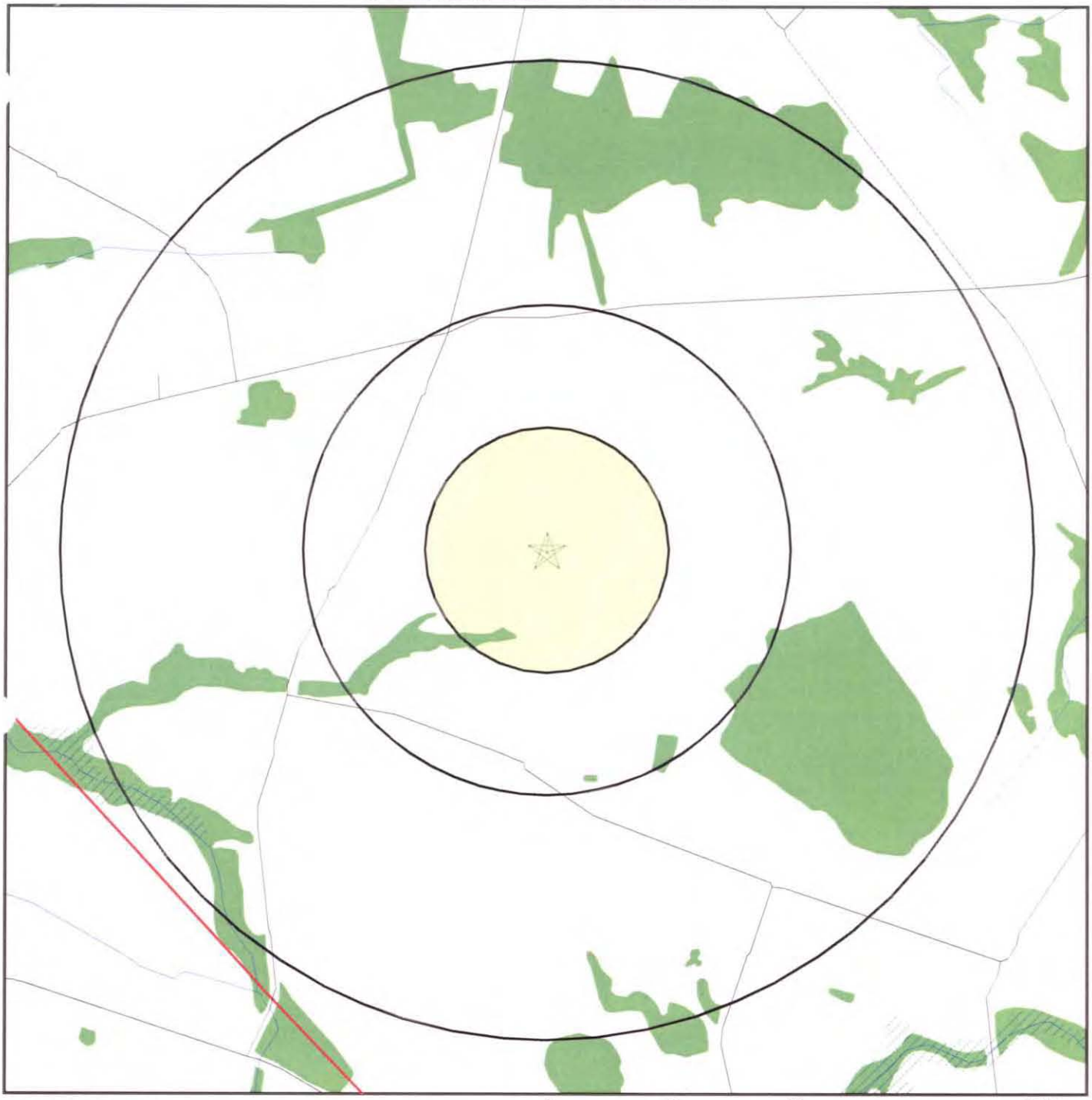
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
SHELL AT SOUTH OF THE BORDER	GWCI, LUST, UST
ROWLAND TRUCKING, INC.	LUST, IMD
BORDERLINE AMOCO	LUST, IMD
EXXON #4-7236	LUST TRUST
WHITTINGTON AGR-AIR SERV.	UST
Z U PATE FARMS	UST
DAVIS FARMS	UST
G. & L. FOOD MART	UST
WILTON SHOOTER SONS FARM INC	UST
DIXIE CARPET SERVICE	UST
BORDER TEXACO	UST
PURVIS COMMUNITY CENTER	UST
UNION ELEMENTARY SCHOOL	UST
ROWLAND TRUCKING CO.. INC.	UST
ROWLAND MOTOR CO.. INC.	UST
KARMA INC.	UST
S & H GROC.	UST
ODOM GROC.	UST
FLOYDS GROCERY	GWCI

OVERVIEW MAP - 01718882.10r

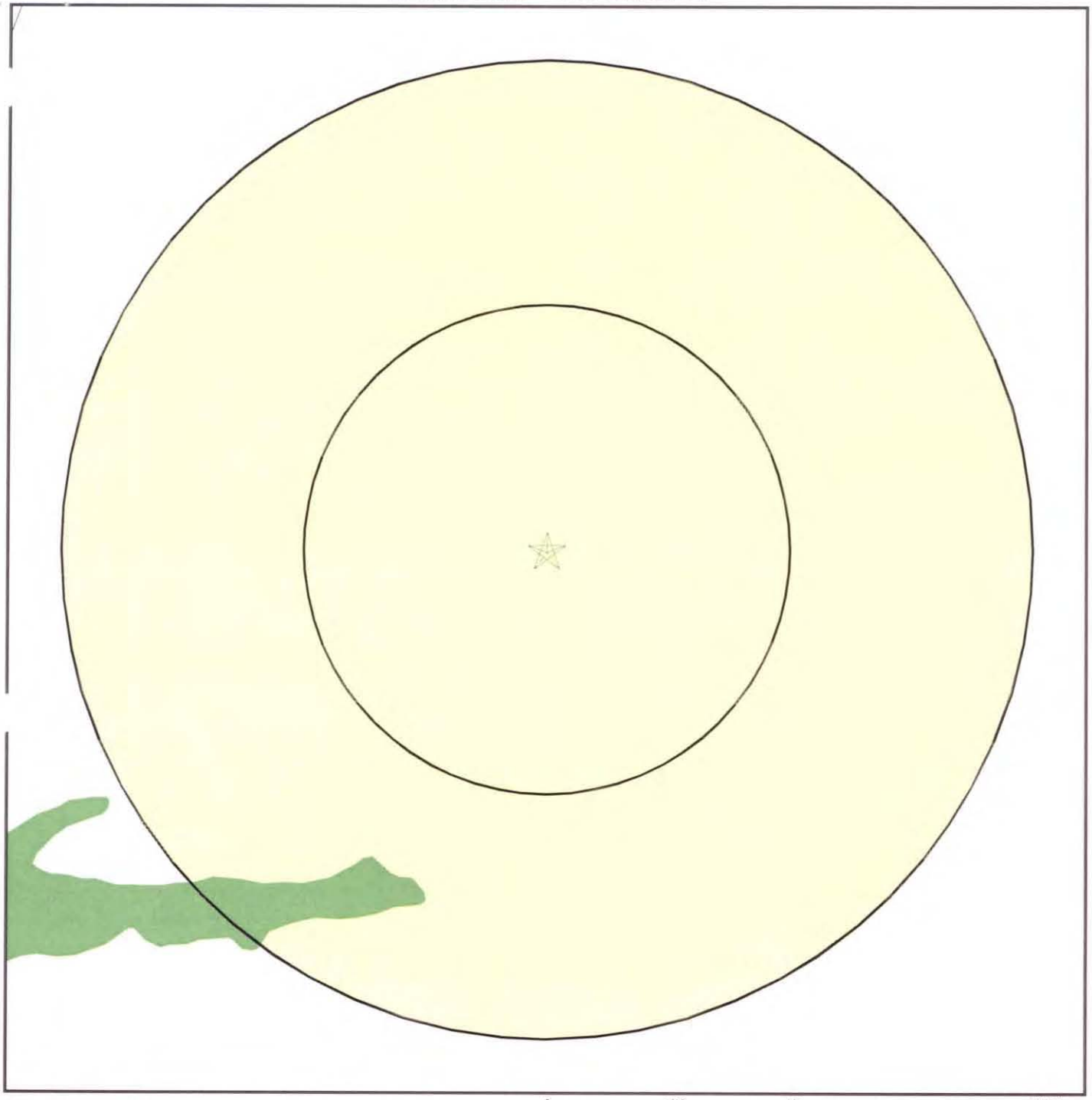


- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Brown Marsh Swamp Restoration Site ADDRESS: Robeson County Rowland NC 28383 LAT/LONG: 34.4933 / 79.2741	CLIENT: Restoration Systems, LLC CONTACT: Dave Schiller INQUIRY #: 01718882.10r DATE: July 20, 2006

DETAIL MAP - 01718882.10r



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites
- Dept. Defense Sites

0 1/16 1/8 1/4 Miles

- Indian Reservations BIA
- Oil & Gas pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

Hazardous Substance Disposal Sites

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SITE NAME: Brown Marsh Swamp Restoration Site ADDRESS: Robeson County Rowland NC 28383 LAT/LONG: 34.4933 / 79.2741	CLIENT: Restoration Systems, LLC CONTACT: Dave Schiller INQUIRY #: 01718882.10r DATE: July 20, 2006

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
NPL RECOVERY		TP	NR	NR	NR	NR	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA TSD		0.500	0	0	0	NR	NR	0
RCRA Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRA Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.000	0	0	0	0	NR	0
NC HSDS		1.000	0	0	0	0	NR	0
IMD		0.500	0	0	0	NR	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
BROWNFIELDS		0.500	0	0	0	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
TRIBAL RECORDS								
INDIAN RESERV		1.000	0	0	0	0	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0
EDR Historical Auto Stations		TP	NR	NR	NR	NR	NR	0
EDR Historical Cleaners		TP	NR	NR	NR	NR	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

Tuesday, August 01, 2006

North Carolina Wildlife Resources Commission
Division of Inland Fisheries
Falls Lake Office
1142 I-85 Service Road
Creedmore, NC 27522

ATTN: David Cox, Technical Guidance Supervisor

SUBJECT: Coordination with the North Carolina Wildlife Resources Commission on Behalf of the Fish and Wildlife Coordination Act for the Brown Marsh Swamp Site.

Mr. Cox:

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for the 5000' of Stream (SMU's), 16 acres of Riverine wetland restoration and 5 acres of Non-Riverine wetland restoration in the Lumber 04 , Cataloging Unit 03040204. Restoration Systems, LLC (RS), of Raleigh, NC was awarded a contract by the EEP to provide 5000' SMU's and 5 WMU's to be provided by RS at the Brown Marsh Swamp Site. KO & Associates, P.C Consulting Engineers is under contract to RS to provide technical environmental consulting and design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

In order for the project to proceed, RS is obligated to coordinate with your office on behalf of the Fish and Wildlife Coordination Act (FWCA). This letter provides you with certain details of the Brown Marsh Swamp Site, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. You are encouraged to determine if the actions proposed by RS may be inimical to any resources embraced by the FWCA, and provide comments to RS based on your evaluation. It is reasonable to assume that you will comment if the actions proposed by RS are, in your opinion, likely to result in harm to resources embraced by the FWCA .

Project Location & Description

The Brown Marsh Swamp Restoration Site is located approximately 2.0 miles east of I-95 and the North Carolina/South Carolina boarder in Robeson County within the EEP Targeted local Watershed 03030204037010 (Figure X). The site is boarded by East McCormick Road (S.R. (2491) on its southern boundary and by Cotton Valley Road (S.R. 2492 on its western boundary. The closest city is Rowland, which is located approximately 3.0 miles northwest of the site. The centerline coordinates of the Site is approximately Latitude 34.493276 and Longitude -79.274067. The site is located in an agricultural field that is approximately 350 acres in size. The field is used for row crops that are cultivated for economic benefit. Numerous ditches are located in the field to facilitate the drainage of groundwater and surface water flows. Existing vegetation on-site is sparse due to the row cropping and consistent maintenance.

Proposed activities designed to restore the stream and wetland complex include excavation of a bank-full floodplain bench and subsequent restoration of stream channels, wetlands, and vegetative communities within the site boundaries.

Restoration Means & Methods

The primary goals of this stream and non-riverine wetland restoration project focus on **improving water quality, enhancing flood attenuation, and restoring aquatic and riparian wildlife habitat.** These goals will be accomplished by:

- Restoring the existing degraded channels with a natural channel able to transport its sediment and flow without aggrading or degrading;
- Enhancing the capacity of the Site to mitigate flood flows by reconnecting the stream to its historic floodplain.
- Reducing non-point source sedimentation and nutrient inputs through the elimination of constant channel maintenance, the reestablishment of a native riparian buffer greater than 50', and the restoration of riparian wetlands in the agricultural fields;
- Enhancing in-stream habitat by restoring a riffle-pool complex to the channel and by placing structures in the channel that provide shading and habitat for the development of healthy benthic communities.
- Enhancing the entire ecosystem by reestablishing two habitat corridors through open agricultural fields.

Specific actions proposed to achieve these restoration goals will be further refined during restoration planning and design phases of the project based upon findings developed during detailed site assessments, data derived from reference reaches and referenced wetlands, permitting requirements, and input from the EEP.

Summary of Anticipated Effects

The long term effects of this project (post construction) will result in an overall enhancement to the integrity of the immediate ecosystems and result in long term beneficial effects to fish or wildlife. This site will also be protected in perpetuity with a conservation easement.

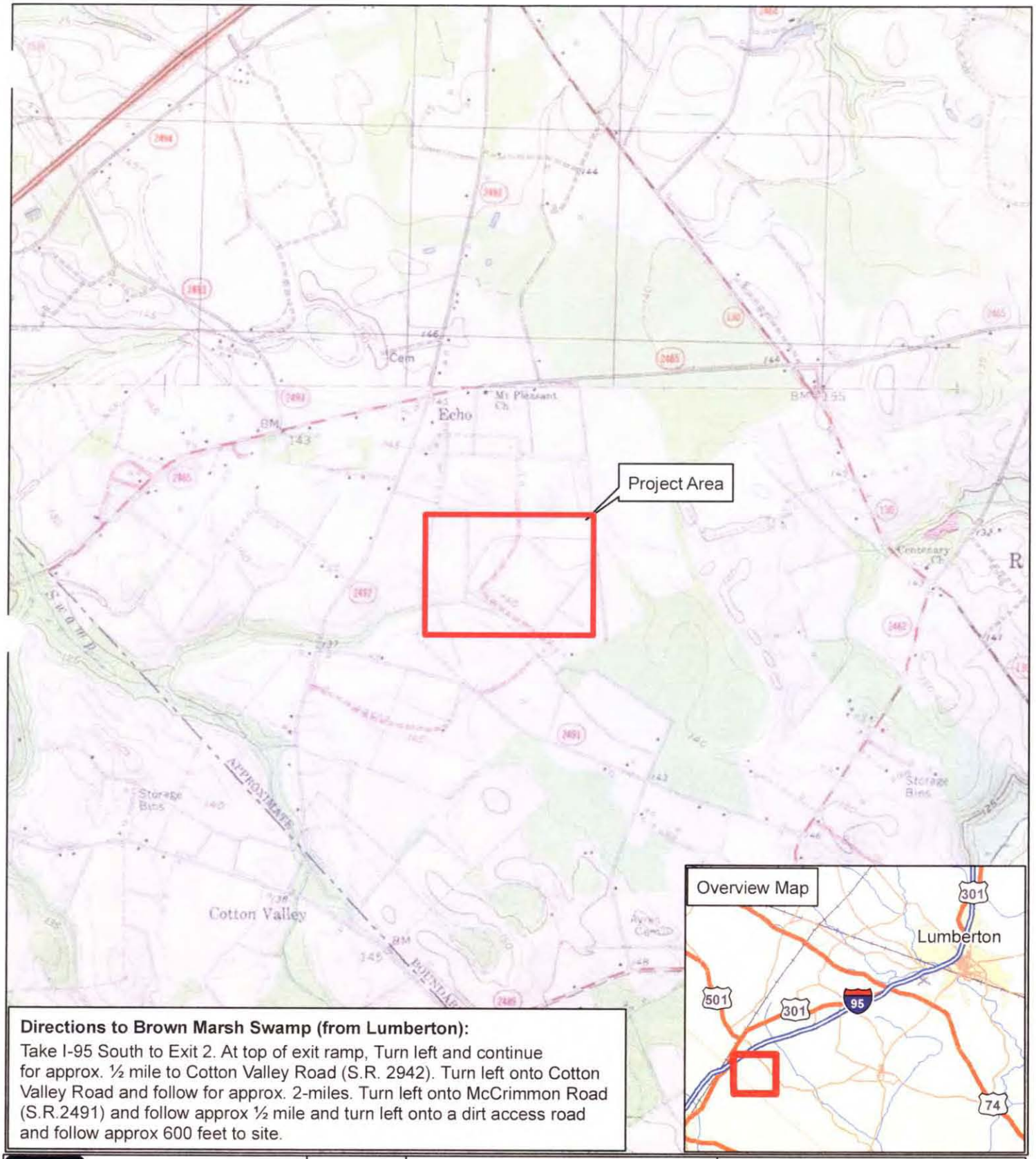
Should you have any questions or if any additional information is needed to complete your review, please feel free to contact me at (919) 755-9490 (o) or (919) 369-4328 Mobile. Your valuable time and cooperation are much appreciated.

Sincerely,

Paul Parker, Project Manager

Attachments

cc: Mr. Dave Schiller, Restoration Systems, LLC



Directions to Brown Marsh Swamp (from Lumberton):
Take I-95 South to Exit 2. At top of exit ramp, Turn left and continue for approx. ½ mile to Cotton Valley Road (S.R. 2942). Turn left onto Cotton Valley Road and follow for approx. 2-miles. Turn left onto McCrimmon Road (S.R.2491) and follow approx ½ mile and turn left onto a dirt access road and follow approx 600 feet to site.

Restoration Systems, LLC
1101 Haynes St. Suite 107
Raleigh, NC 27604
919.755.9490

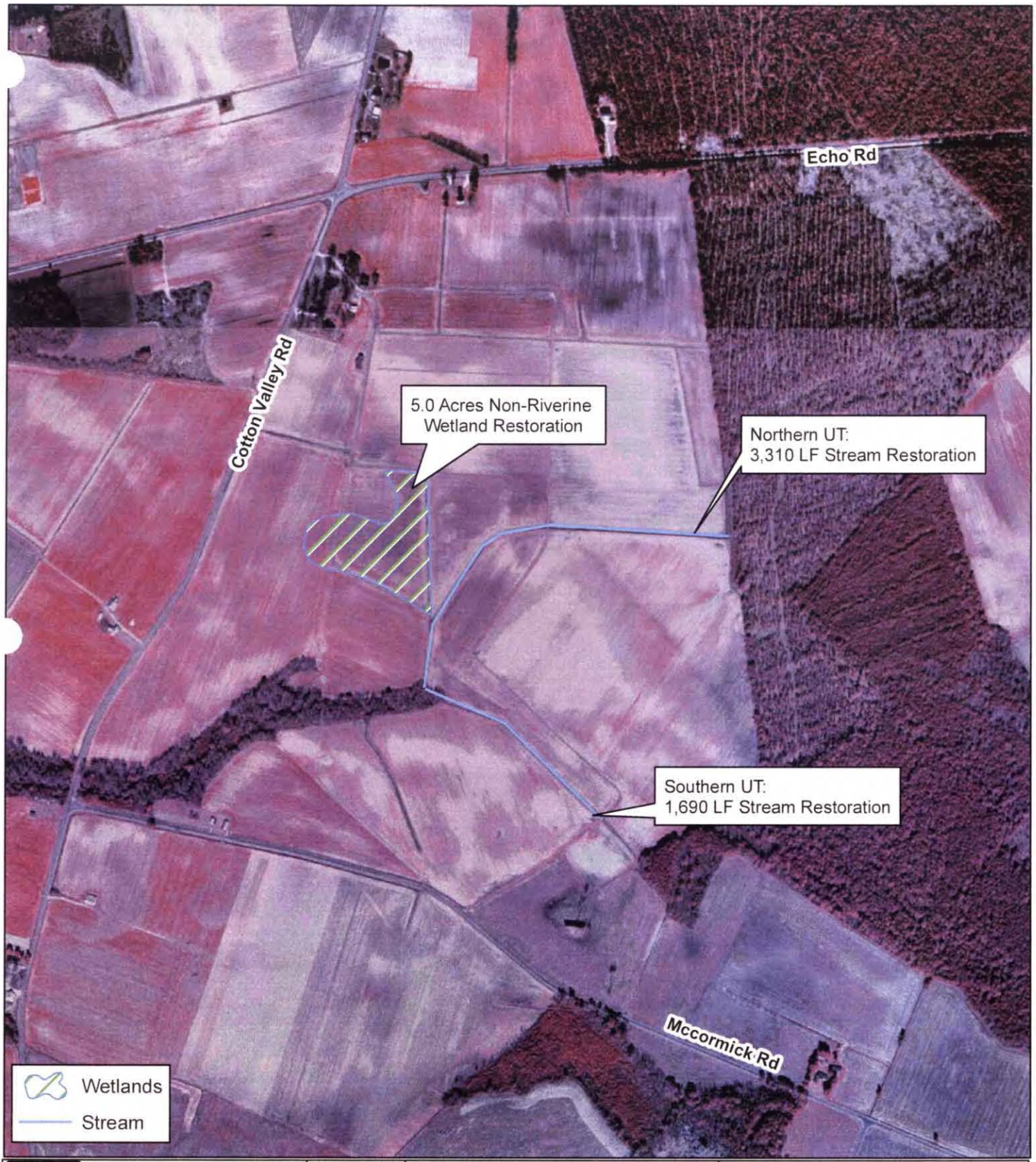
Figure 1: Project Location

Brown Marsh Swamp Stream & Wetland Restoration Project
Robeson County, NC

1:24,000

N

0 500 1,000 2,000 3,000 4,000 Feet



Restoration Systems, LLC 1101 Haynes St. Suite 107 Raleigh, NC 27604 919.755.9490	**Figure 2:** Project Description	**Brown Marsh Swamp Stream & Wetland Restoration Project** **Robeson County, NC**	1:10,000 N 0 200 400 800 1,200 1,600 Feet

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation

Tuesday, August 01, 2006

U. S. Department of the Interior
Fish and Wildlife Service
C/o Dale Suiter

ATTN: Dale Suiter, Fish and Wildlife Biologist

SUBJECT: Coordination with the U.S. Fish and Wildlife Service on Behalf of (1) Fish and Wildlife Coordination Act and (2) Migratory Bird Treaty Act for the Brown Marsh Swamp.

Mr. Suiter,

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for the 5000' of Stream (SMU's), 16 acres of Riverine wetland restoration and 5 acres of Non-Riverine wetland restoration in the Lumber 04, Cataloging Unit 03040204. Restoration Systems, LLC (RS), of Raleigh, NC was awarded a contract by the EEP to provide 5000' SMU's and 5 WMU's to be provided by RS at the Brown Marsh Swamp Site. KO & Associates, P.C Consulting Engineers is under contract to RS to provide technical environmental consulting and design services.

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In order for the project to proceed, RS is obligated to coordinate with your office on behalf of the Fish and Wildlife Coordination Act (FWCA) and the Migratory Bird Treaty Act (MBTA). This letter provides you with certain details of the Brown Marsh Swamp, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. You are encouraged to determine if the actions proposed by RS may be inimical to any resources embraced by the FWCA, or the MBTA and provide comments to RS based on your evaluation. It is reasonable to assume that the Service will comment if the actions proposed by RS are, in the Service's opinion, likely to result in harm to resources embraced by the FWCA or the MBTA.

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Summary of Anticipated Effects

The long term effects of this project (post construction) will result in an overall enhancement to the integrity of the immediate ecosystems and result in long term beneficial effects to fish or wildlife. This site will also be protected in perpetuity with a conservation easement.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent o site disturbance associated with this project.

Should you have any questions or if any additional information is needed to complete your review, please feel free to contact me at (919) 755-9490 (o) or (919) 369-4328 Mobile. Your valuable time and cooperation are much appreciated.

Sincerely,

Paul Parker, Project Manager

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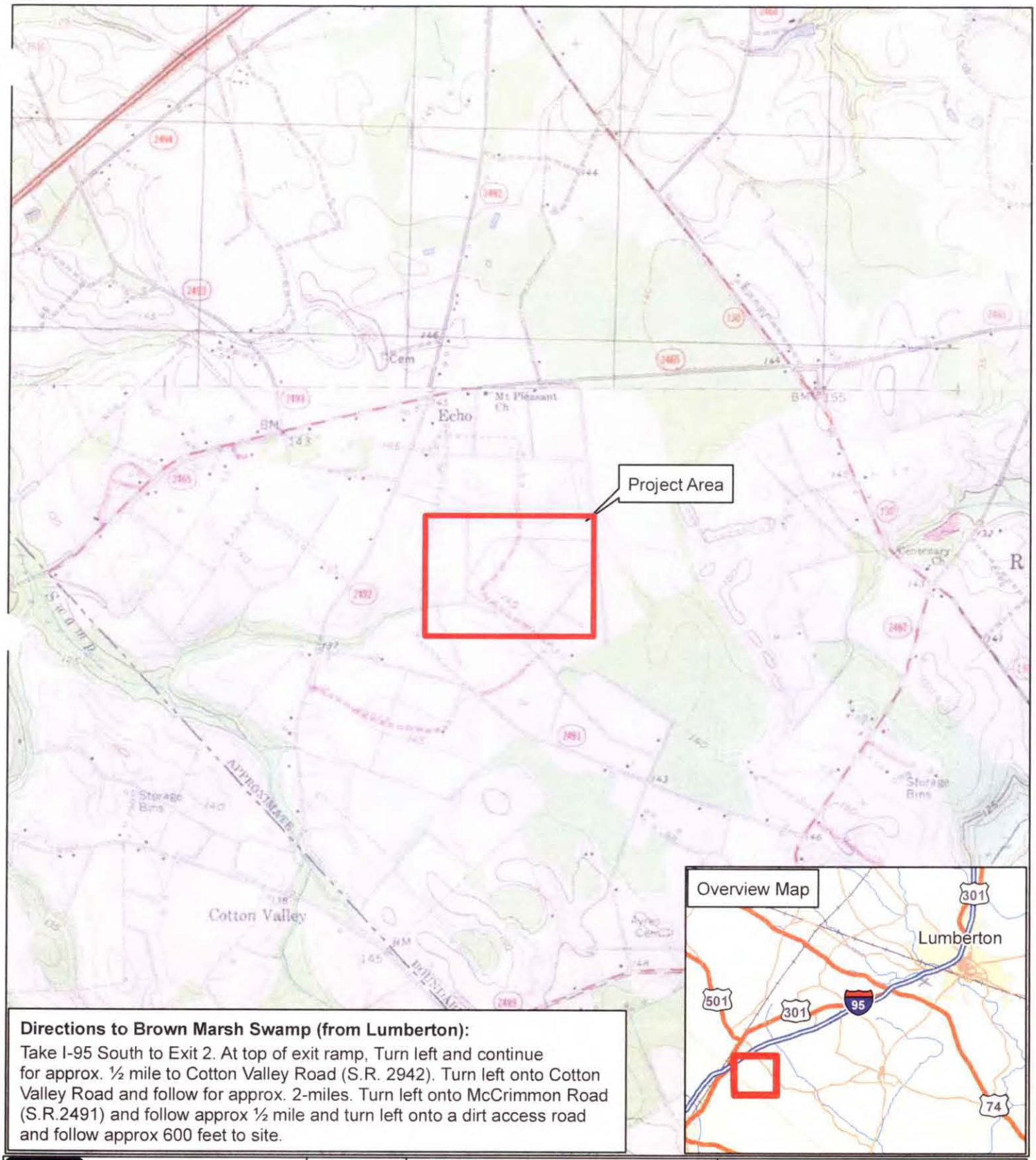
cc: Mr. Dave Schiller, Restoration Systems, LLC



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Restoration Systems, LLC
1101 Haynes St. Suite 107
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919.755.9490

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Brown Marsh Swamp Stream & Wetland Restoration Project
Robeson County, NC

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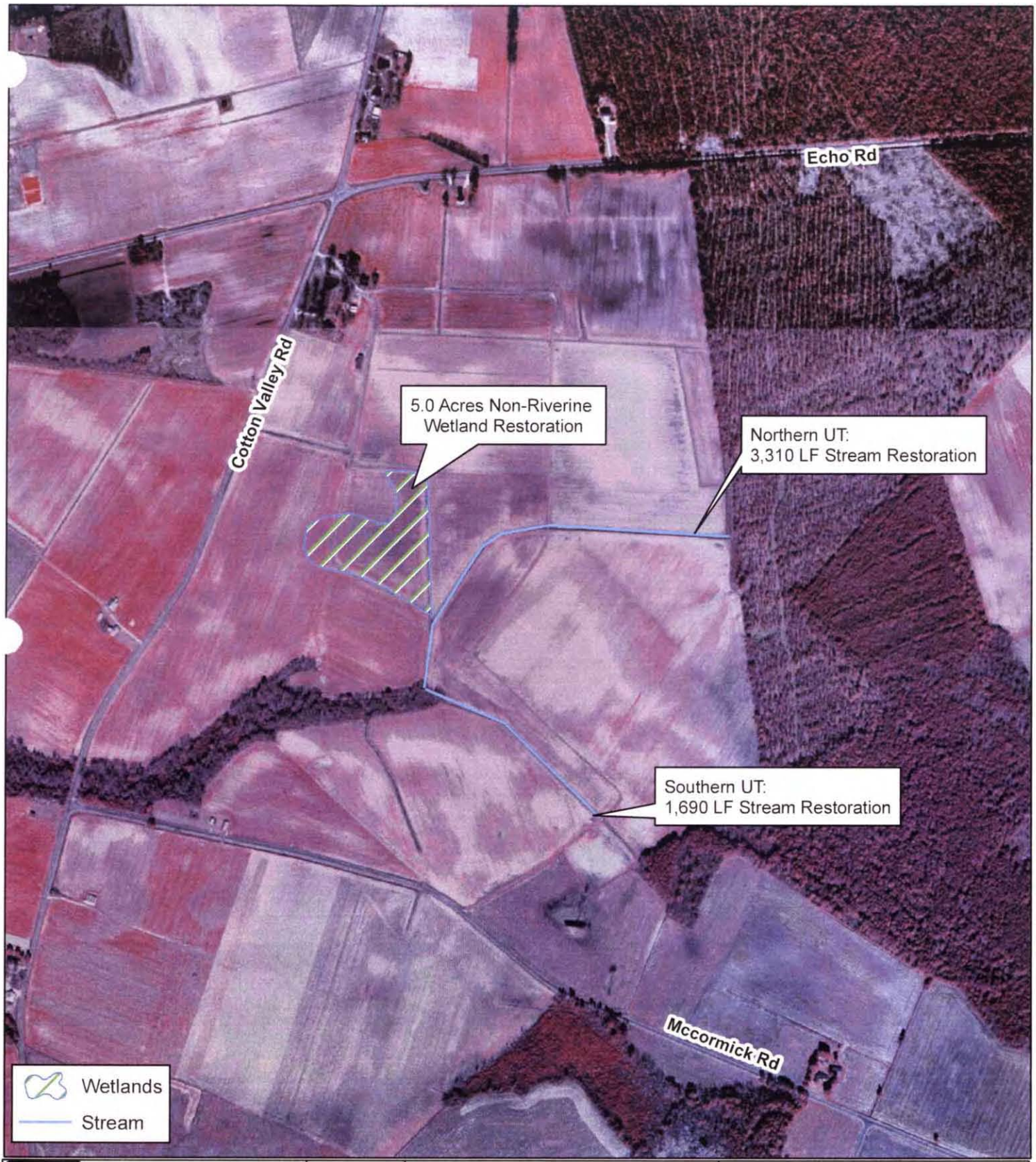


Restoration Systems, LLC 1101 Haynes St. Suite 107 Raleigh, NC 27604 919.755.9490	**Figure 2:** Project Description	**Brown Marsh Swamp Stream & Wetland Restoration Project** **Robeson County, NC**	1:10,000 N 0 200 400 800 1,200 1,600 Feet

North Carolina Wildlife Resources Commission

Richard B. Hamilton, Executive Director

MEMORANDUM

To: Paul Parker
Restoration Systems
1101 Hayes St., Ste. 107
Raleigh, NC 27604

From: Steven H. Everhart, PhD, CWB
Southeastern Permit Coordinator
127 Cardinal Drive
Wilmington, NC 28405

Date: August 21, 2006

RE: Browns Marsh Swamp Wetland Restoration in Robeson County

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) have reviewed the subject project for impacts to wildlife and fishery resources. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.), and Sections 401 and 404 of the Clean Water Act (as amended).

The project is located approximately 660 ft north of McCrimmon (or McCormick) Rd. (SR 2491), approximately one-half mile east of its intersection with Cotton Valley Rd. (SR 2492), in Robeson County. A letter and a vicinity map were submitted for review of fish and wildlife issues associated with the project.

The applicant proposes to restore natural form stream and associated wetlands in an agricultural field. The stream(s) is a tributary of the Lumber River. The mitigation site will satisfy needs for the NC Ecosystem Enhancement Program (EEP).

There do not appear to be any threatened or endangered species that would be impacted by the project. The Lumber River and the streams to be restored are classified as C-Swamp by the NC Division of Water Quality (NCDWQ).

The Wildlife Resources Commission does not object to this project as proposed. Thank you for the opportunity to review and comment on this project. If you have any questions or require additional information regarding these comments, please call me at (910) 796-7217.

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

ROBESON COUNTY
NORTH CAROLINA

Linda Barnes ~~Manager-Editor~~ Associate Editor, of THE ROBESONIAN, a newspaper published in Robeson County, N. C., being duly sworn, says that at the time the attached notice was published in THE ROBESONIAN, said newspaper met all of the requirements and qualifications prescribed by North Carolina General Statute 1-597; that said newspaper had a general circulation to actual paid subscribers and, was admitted to the United States mail as second class matter in Robeson County, N. C.; and further, that the attached notice was published in THE ROBESONIAN once a week for ____ consecutive weeks on the following issue dates:

July 23, 2006.

Linda Barnes
~~Manager-Editor~~-Associate Editor

Sworn to and subscribed before me
this the 25th day of July 2006.

Marybeth Mayers
NOTARY PUBLIC

My commission expires: May 7, 2008

MARYBETH MAYERS NOTARY PUBLIC ROBESON COUNTY, N.C.

NOTICE OF AN OPPORTUNITY FOR AN INFORMATIONAL PUBLIC MEETING ON THE PURCHASE AND OR USE OF PROPERTY FOR THE RESTORATION OF STREAMS AND WETLAND

ROBESON COUNTY

Restoration Systems, LLC proposes to purchase and use a 20 acre tract of land in Robeson County, North Carolina. The purpose of acquiring this property is to provide mitigation for impacts to stream and wetland restoration that will result from exiting or future development in this area. Anyone desiring that an informal public meeting be held for this proposed action may make such a request by registered letter to Restoration Systems, LLC at 1101 Haynes St., Suite 107; Raleigh, NC 27604. Request must be made by 8-23-06. If additional information is required, please contact Paul Parker at 919-755-9490. The Ecosystem Enhancement Program reserves the right to determine if a public meeting will be held.

RESTORATION SYSTEMS, LLC
Natural Resources
Restoration & Conservation
Monday, July 31, 2006

Renee Gledhill-Earley
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: EEP- Brown Marsh Swamp Stream & Wetland Restoration Project in Robeson County.

Dear Ms. Gledhill-Earley,

Restoration Systems, LLC (RS) has been awarded a contract by the Ecosystem Enhancement Program (EEP) to implement a stream and wetland restoration project in Robeson County. As required by the contract, RS requests your review of the project and any comments that you may have with respect to archaeological or historical resources associated with it. The location of the project is shown on the attached map.

The Brown Marsh Swamp Stream and Wetland Restoration site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel have been identified as significantly degraded. No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. In addition, the majority of this site has historically been disturbed due to agricultural purposes such as tobacco production. The ground disturbance activities required to complete this project will only impact those areas that have previously been impacted due to these agricultural practices.

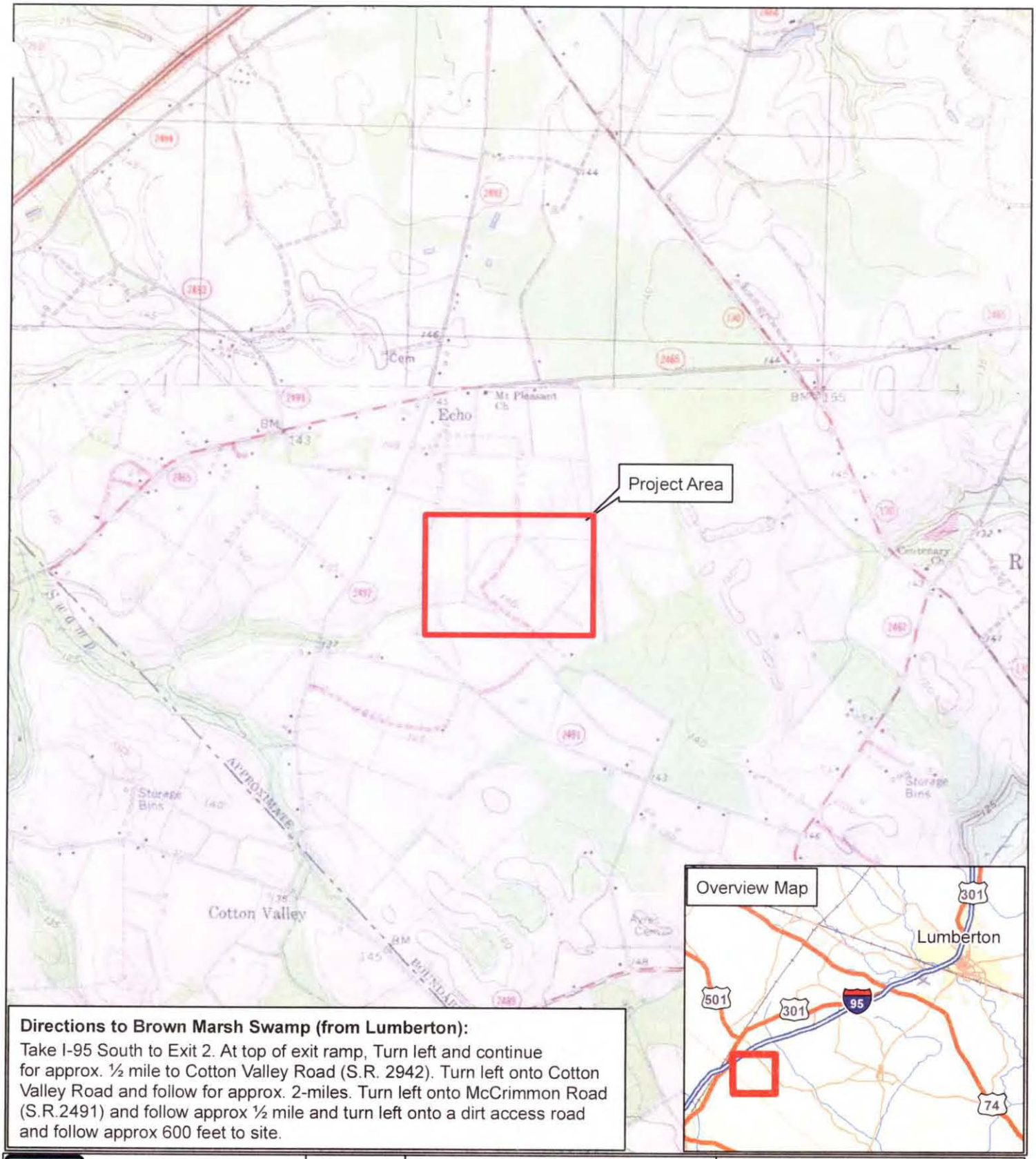
The project involves the restoration of approximately 5,000 feet of two unnamed tributaries and (5) five acres of wetlands. It is located on the Ward Farm, located approximately 2.0 miles east of I-95 and the North Carolina/South Carolina boarder in Robeson County. The site is boarded by East McCormick Road (S.R. (2491) on its southern boundary and by Cotton Valley Road (S.R. 2492 on its western boundary. The closest city to the Site is Rowland, which is located approximately 3.0 miles northwest of the Site. The centerline coordinates of the Site is approximately Latitude 34.493276 and Longitude -79.274067.

We request that you review this site based on the information provided to determine if you know of any existing resources that we need to know about. In addition, please provide us with your comments regarding the proposed project.

Thank you in advance for your timely response and cooperation. Please feel free to contact me at the office (919) 755-9490 or on my cell phone (919) 369-4328 if you have any questions.

Sincerely,

Paul Parker, Project Manager
Attachments: 2 maps



Directions to Brown Marsh Swamp (from Lumberton):
Take I-95 South to Exit 2. At top of exit ramp, Turn left and continue for approx. ½ mile to Cotton Valley Road (S.R. 2942). Turn left onto Cotton Valley Road and follow for approx. 2-miles. Turn left onto McCrimmon Road (S.R.2491) and follow approx ½ mile and turn left onto a dirt access road and follow approx 600 feet to site.

Restoration Systems, LLC
1101 Haynes St. Suite 107
Raleigh, NC 27604
919.755.9490

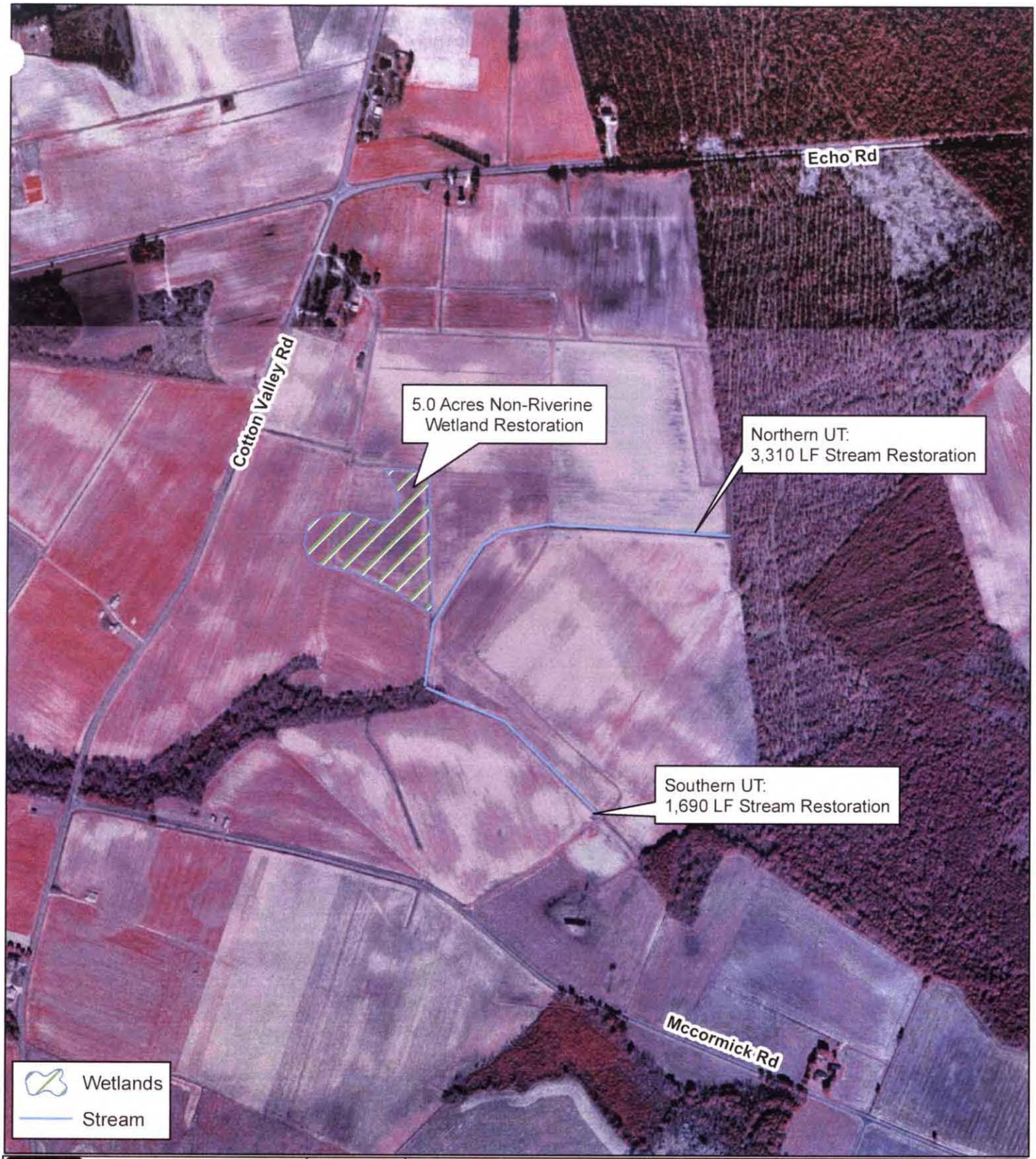
Figure 1: Project Location

Brown Marsh Swamp Stream & Wetland Restoration Project
Robeson County, NC

1:24,000

N

0 500 1,000 2,000 3,000 4,000 Feet



Restoration Systems, LLC 1101 Haynes St. Suite 107 Raleigh, NC 27604 919.755.9490	**Figure 2:** Project Description	**Brown Marsh Swamp Stream & Wetland Restoration Project** **Robeson County, NC**	1:10,000 N 0 200 400 800 1,200 1,600 Feet

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

August 23, 2006

Paul Parker
Restoration Systems, LLC
Pilot Mill
1101 Haynes Street, Suite 107
Raleigh, NC 27604

Re: EEP, Brown Marsh Stream & Wetland Restoration, Robeson County, ER 06-2122

Dear Mr. Parker:

Thank you for your letter of July 31, 2006, concerning the above project.

We have conducted a review of the proposed undertaking and are aware of no historic resources that would be affected by the project. Therefore, we have no comment on the undertaking as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Peter B. Sandbeck

Peter Sandbeck by MPM

RESTORATION SYSTEMS, LLC

Natural Resources
Restoration & Conservation

February 27, 2006

Mr. John Wes Ward
PO Box 3493
Myrtle Beach, SC

Dear Mr. Ward:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Robeson County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-369-4328.

Sincerely,

Paul Parker
Project Manager

Pilot Mill • 1101 Haynes St., Suite 107 • Raleigh, NC 27604 • www.restorationsystems.com • Phone 919.755.9490 • Fax 919.755.9492

Tuesday, August 01, 2006

MEMO

RE: Brown Marsh Swamp Stream & wetland Restoration Site; Robeson County, NC

To: David Schiller
Restoration Systems, LLC

From: Paul Parker, Project Manger

ATTN: David Schiller

SUBJECT: Coordination with the U.S. Fish and Wildlife Service on Behalf of Section 7 of the Endangered Species Act (ESA) for the Brown Marsh Swamp Restoration Site in Robeson County.

On October 26, 2005, the North Carolina Ecosystem Enhancement Program (EEP) issued a Request for Proposals for 5000' of stream (SMU's), 16 acres of riverine wetland restoration and 5 acres of non-riverine wetland restoration in the Lumber River Basin , Cataloging Unit 03040204. Restoration Systems, LLC (RS), of Raleigh, NC was subsequently awarded a contract by the EEP to provide 5000' SMU's and 5 WMU's to be provided by RS at the Brown Marsh Swamp Site. KO & Associates, P.C Consulting Engineers is under contract to RS to provide technical environmental consulting and design services.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. The EEP must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

Since financial support of certain EEP operational budgets derives, in part, from federal authorizations, it is necessary to conduct a Section 7 consultation with the U.S. Fish and Wildlife Service (Service). This letter provides you with certain details about the Brown Marsh Swamp Restoration Site, including the project's location, a general description of its physiography, hydrography and existing land uses, as well as the intended modifications to the site proposed by RS. In addition, should the project be located in a geographic area in which federally-listed species may be present (based on element

occurrences, as reflected in Service listings), and if scientifically-sound practices have been used to confirm the presence of suitable habitat for any listed species within the project area, the results of appropriate surveys for each listed species and separate biological conclusions for each will be provided for your review and consideration. You are asked to review the information provided and determine if it is sufficient to enable you to concur with our biological conclusions.

Project Location & Description

The Brown Marsh Swamp Restoration Site is located approximately 2.0 miles east of I-95 and the North Carolina/South Carolina boarder in Robeson County within the EEP Targeted local Watershed 03030204037010 (Figure X). The site is boarded by East McCormick Road (S.R. (2491) on its southern boundary and by Cotton Valley Road (S.R. 2492 on its western boundary. The closest city is Rowland, which is located approximately 3.0 miles northwest of the site. The centerline coordinates of the Site is approximately Latitude 34.493276 and Longitude -79.274067. The site is located in an agricultural field that is approximately 350 acres in size. The field is used for row crops that are cultivated for economic benefit. Numerous ditches are located in the field to facilitate the drainage of groundwater and surface water flows. Existing vegetation on-site is sparse due to the row cropping and consistent maintenance.

Proposed activities designed to restore the stream and wetland complex include excavation of a bank-full floodplain bench and subsequent restoration of stream channels, wetlands, and vegetative communities within the site boundaries.

Restoration Means & Methods

The primary goals of this stream and non-riverine wetland restoration project focus on **improving water quality, enhancing flood attenuation, and restoring aquatic and riparian wildlife habitat.** These goals will be accomplished by:

- Restoring the existing degraded channels with a natural channel able to transport its sediment and flow without aggrading or degrading;
- Enhancing the capacity of the Site to mitigate flood flows by reconnecting the stream to its historic floodplain.
- Reducing non-point source sedimentation and nutrient inputs through the elimination of constant channel maintenance, the reestablishment of a native riparian buffer greater than 50', and the restoration of riparian wetlands in the agricultural fields;
- Enhancing in-stream habitat by restoring a riffle-pool complex to the channel and by placing structures in the channel that provide shading and habitat for the development of healthy benthic communities.
- Enhancing the entire ecosystem by reestablishing two habitat corridors through open agricultural fields.

Specific actions proposed to achieve these restoration goals will be further refined during restoration planning and design phases of the project based upon findings developed during detailed site assessments, data derived from reference reaches and referenced wetlands, permitting requirements, and input from the EEP.

Federally Listed Species

Three species are listed by the Service for Robeson County—they are:

Table 1. Federally Protected Species for Robeson County

SPECIES	COMMON NAME	FEDERAL STATUS
Alligator mississippiensis	American alligator	T (S/A)
Picoides borealis	red-cockaded woodpecker	E
Rhus michauxii	Michaux`s sumac	E

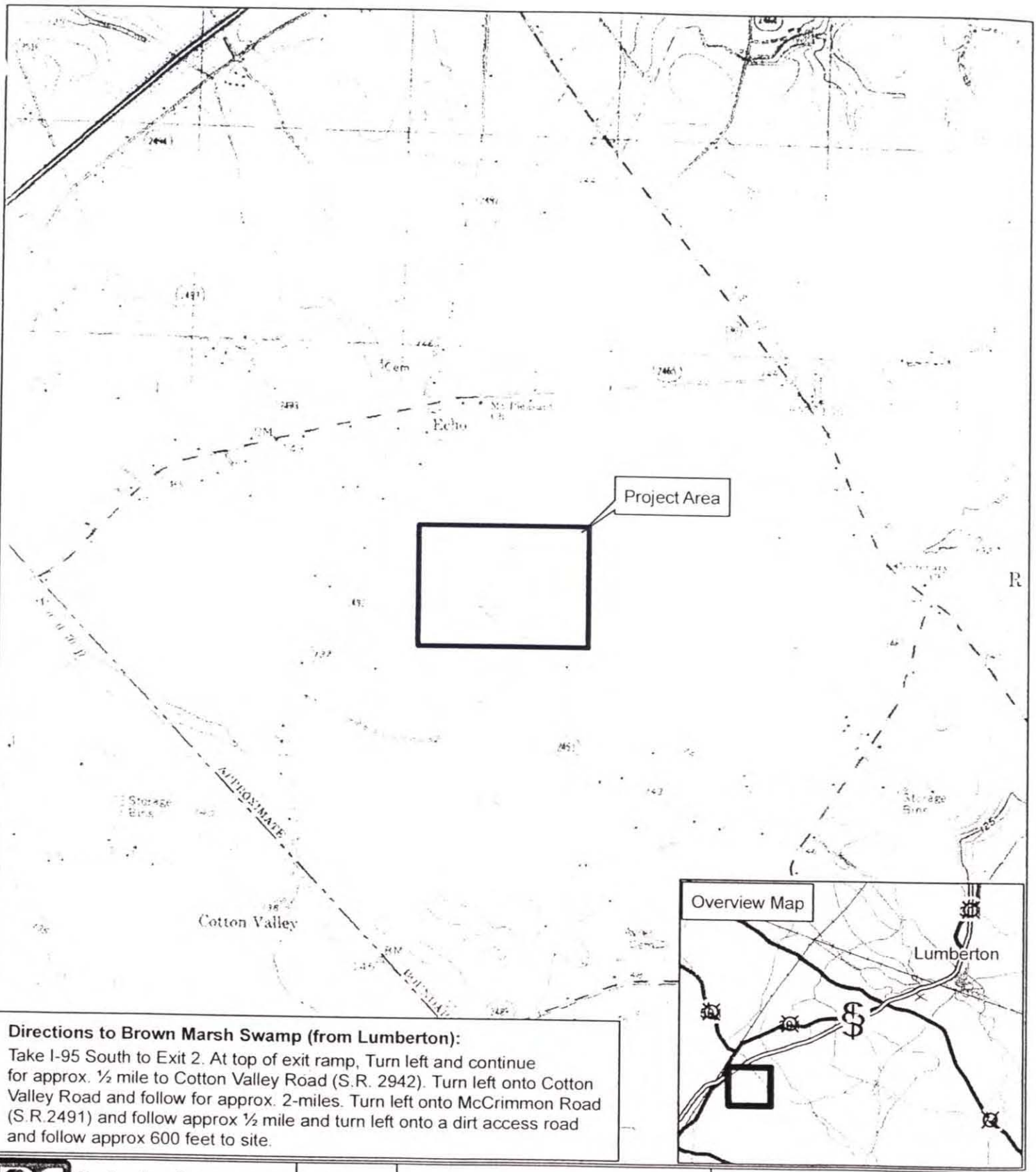
Note: "T (S/A)" and "E" denote Threatened due to similarity of appearance and Endangered. T (S/A) species are not biologically endangered or threatened and are not subject to Section 7 consultation. Endangered species are "taxa " in danger of extinction throughout all or a significant portion of their range."

Summary of Anticipated Effects

Although the above referenced endangered species are listed for Robeson County, proposed work at the site will not impact suitable habitat for either species. Field observations determined that there is no suitable habitat that exists within the site for any of the species.

Biological Conclusion: It is reasonable to conclude the project, as proposed, will have No Effect on either of the listed species based upon the absence of suitable habitat.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent o site disturbance associated with this project. Please feel free to contact me at (919) 755-9490 or (919) 369-4328. Your valuable time and cooperation are much appreciated.



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Restoration Systems, LLC
1101 Haynes St. Suite 107
Raleigh, NC 27604
919.755.9490

Figure 1: Project Location

Brown Marsh Swamp Stream & Wetland Restoration Project
Robeson County, NC

1:24,000

0 500 1,000 2,000 3,000 4,000 Feet

Restoration Systems, LLC 1101 Haynes St. Suite 107 Raleigh, NC 27604	Figure 2 Project Description	Brown Marsh Swamp Stream & Wetland Restoration Project Robeson County, NC	1:10,000

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*		Date Of Land Evaluation Request	
Name Of Project	Brown Marsh Swamp	Federal Agency Involved	Federal Highway Administration
Proposed Land Use	Stream & wetland Restoration	County And State	Robeson, North Carolina

PART II *(To be completed by NRCS)*			Date Request Received By NRCS 9/1/06	
Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☒	No ☐	Acres Irrigated NONE	Average Farm Size 328
Major Crop(s) ~~Tobacco~~ CORN	Farmable Land In Govt. Jurisdiction Acres: 493,220	% 81.2	Amount Of Farmland As Defined in FPPA Acres: 469,352	% 77.3
Name Of Land Evaluation System Used Robeson LE	Name Of Local Site Assessment System NONE		Date Land Evaluation Returned By NRCS 9-16-06	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	20			
B. Total Acres To Be Converted Indirectly	0			
C. Total Acres In Site	20	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	20			
B. Total Acres Statewide And Local Important Farmland	0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	< 0.01			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	57			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	70.9	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	0			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	20			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	10			
6. Distance To Urban Support Services	15	0			
7. Size Of Present Farm Unit Compared To Average	10	2			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	3			
10. On-Farm Investments	20	10			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	55	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	70.9	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	55	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	125.9	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐
Reason For Selection:		

(See Instructions on reverse side)

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Form AD-1006 (10-83)