AS-BUILT MITIGATION PLAN
ANDERSON SWAMP WETLAND RESTORATION SITE
EDGECOMBE COUNTY, NORTH CAROLINA

(CONTRACT #16- D06048)
FULL DELIVERY PROJECT
TAR-PAMLICO RIVER BASIN
CATALOGING UNIT 03020102

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
RALEIGH, NORTH CAROLINA

Prepared by:

RESTORATION SYSTEMS, LLC
Natural Resources Restoration & Conservation

And

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April 2007

ANDERSON SWAMP WETLAND RESTORATION SITE
AS-BUILT MITIGATION REPORT
EDGECOMBE COUNTY

EXECUTIVE SUMMARY

Restoration Systems, LLC (Restoration Systems) has completed the restoration of nonriverine wetlands at the Anderson Swamp Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling wetland mitigation goals in the region. The Site is located approximately 6 miles north of Tarboro, in northern Edgecombe County (Figure 1, Appendix A). The Site encompasses 25 acres of land situated in an interstream flat that, prior to Site implementation, was characterized primarily by agriculture. The project consists of 12.9 acres of nonriverine wetland restoration and 8.4 acres of nonriverine wetland enhancement.

The Site is located within the Tar-Pamlico River Basin in 14-digit USGS Hydrologic Unit 03020102060010 of the South Atlantic/Gulf Region (North Carolina Division of Water Quality subbasin number 03-03-04 [Figure 2, Appendix A]). Two main drainage features, Maple Swamp and an unnamed tributary to Fishing Creek, surround the Site.

A Detailed Wetland Restoration Plan was completed for the Site in November 2006 and submitted to EEP in March 2007. The plan outlined methods designed to restore agricultural fields that had been ditched, drained, and cleared for row crop production. Prior to implementation, the 25-acre Site was underlain by approximately 12.9 acres of hydric soil that had been effectively drained and 8.4 acres of hydric soil with jurisdictional wetland hydrology. The Detailed Wetland Restoration Plan outlined restoration procedures including 1) ditch cleaning prior to backfill, 2) ditch rerouting, 3) depression construction, 4) impervious ditch plug construction, 5) ditch backfilling, 6) floodplain soil scarification, and 7) plant community restoration.

The primary goals of the nonriverine wetland restoration project focused on improving water quality, enhancing flood attenuation, and restoring wildlife habitat and were accomplished by the following.

1. Removing nonpoint sources of pollution associated with agricultural row crop production including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to Site drainage ditches, b) cessation of land application of area hog lagoon effluent, and c) preemption and treatment of agricultural runoff by providing a vegetative buffer adjacent to headwater streams and wetlands.
2. Restoring wetland hydroperiods that satisfy wetland jurisdictional requirements and approximate the Site's natural range of variation.
3. Promoting floodwater attenuation through removal of interfield ditches and enhancing groundwater storage capacity.
4. Restoring and reestablishing natural community structure, habitat diversity, and functional continuity.
5. Enhancing and protecting of the Site's full potential of wetland functions and values in perpetuity.

As constructed, the Site provides 12.9 acres of nonriverine wetland restoration and 8.4 acres of nonriverine wetland enhancement for a total of 17.1 Wetland Mitigation Units.

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EDGECOMBE COUNTY

1.0 INTRODUCTION

Restoration Systems, LLC (Restoration Systems) has completed the restoration of nonriverine wetlands at the Anderson Swamp Wetland Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program (EEP) in fulfilling wetland mitigation goals in the region. The Site is located approximately 6 miles north of Tarboro, in northern Edgecombe County (Figure 1, Appendix A). The Site encompasses 25 acres of land situated in an interstream flat that, prior to Site implementation, was characterized primarily by agriculture. The project consists of 12.9 acres of nonriverine wetland restoration and 8.4 acres of nonriverine wetland enhancement.

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A Detailed Wetland Restoration Plan was completed for the Site in November 2006. The plan outlined methods designed to restore agricultural fields that had been ditched, drained, and cleared for row crop production. Prior to implementation, the 25-acre Site was underlain by approximately 12.9 acres of hydric soil that had been effectively drained and 8.4 acres of hydric soil with jurisdictional wetland hydrology. The Detailed Wetland Restoration Plan outlined restoration procedures including 1) ditch cleaning prior to backfill, 2) ditch rerouting, 3) depression construction, 4) impervious ditch plug construction, 5) ditch backfilling, 6) floodplain soil scarification, and 7) plant community restoration.

The following objectives were proposed to provide mitigation credit requested under the EEP Request For Proposal (RFP) #16-D06048 dated October 26, 2005.

- Providing 15.5 nonriverine Wetland Mitigation Units, as calculated in accordance with the requirements stipulated in RFP #16-D06048.
    - Restoring approximately 12 acres of wetland through filling agricultural ditches, removal of spoil castings, eliminating row crop production activities, and planting with native forest vegetation.
    - Enhancing approximately 7 acres of wetland through eliminating row crop production activities and planting with native forest vegetation.
- Protecting the Site in perpetuity with a conservation easement.

The primary goals of the nonriverine wetland restoration project focused on improving water quality, enhancing flood attenuation, and restoring wildlife habitat and were accomplished by the following.

1. Removing nonpoint sources of pollution associated with agricultural row crop production including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to Site drainage ditches, b) cessation of land application of area hog lagoon effluent, and c) preemption and treatment of agricultural runoff by providing a vegetative buffer adjacent to headwater streams and wetlands.
2. Restoring wetland hydroperiods that satisfy wetland jurisdictional requirements and approximate the Site's natural range of variation.

3. Promoting floodwater attenuation through removal of interfield ditches and enhancing groundwater storage capacity.
4. Restoring and reestablishing natural community structure, habitat diversity, and functional continuity.
5. Enhancing and protecting of the Site's full potential of wetland functions and values in perpetuity.

As constructed, the Site provides 12.9 acres of nonriverine wetland restoration and 8.4 acres of nonriverine wetland enhancement for a total of 17.1 Wetland Mitigation Units.

2.0 SUMMARY

2.1 Preconstruction Condition

The Site includes 25 acres of land located in a nonriverine interstream flat. Prior to construction, the entire tract was utilized for agricultural row crop production and land application of hog lagoon effluent. The Site was encompassed within one parcel utilized for agricultural row crop production and timber harvest. The Site is situated within a terrace on the western rim of the Fishing Creek floodplain between a headwater tributary to Maple Swamp and an Unnamed Tributary (UT) to Fishing Creek (Figure 3, Appendix A). An extensive ditch system had been excavated to drain the Site. These ditches were excavated to a depth of approximately 3 feet and drained towards Maple Swamp and UT to Fishing Creek, which removed hydrology from the Site. Both Maple Swamp and the UT to Fishing Creek drain for approximately 2 miles prior to converging with Fishing Creek, a major tributary of the Tar River.

Nonriverine Hydric Soils

Nonriverine areas of hydric Roanoke soils had been disturbed by ditching, deforestation, and plowing associated with agricultural row crop production. Site soils of the Roanoke series appeared to have historically supported jurisdictional nonriverine wetlands with groundwater hydrology driven primarily by precipitation.

Prior to Site implementation, soil surfaces had been leveled, graded, and compacted as a result of agricultural practices. Typical of crop land with clayey subsurface horizons (ex: Roanoke series), approximately 9 inches of the Site soil surface (A horizon or plow layer) was characterized by loamy soils with relatively high permeability that were plowed annually. Immediately below this plow layer, a compacted clay layer or "pan" (upper portion of the B horizon) exhibited low permeability. Precipitation that infiltrated to the clay pan migrated laterally through the permeable plow layer into Site and perimeter ditches.

Plant Communities

Prior to construction, three plant communities existed on the Site: 1) agricultural land utilized for row crop production, 2) fallow cropland, and 3) disturbed forest.

Crops harvested from the Site included corn, soybeans, and peanuts. The fallow fields were characterized by primary successional herbaceous vegetation including various goldenrods (*Solidago* spp.), common ragweed (*Ambrosia* sp.), broomsedge (*Andropogon* sp.), various species of knotweed (*Polygonum* spp.), Virginia buttonweed (*Diodia virginiana*), and cockle-burr (*Xanthium strumarium*). A few quickly establishing woody species were also identified within the fallow cropland including sweetgum (*Liquidambar styraciflua*) and river birch (*Betula nigra*).

Disturbed forest occurred along the western margins of the Site and was dominated by primary successional species approximately 5 to 10 years in age including loblolly pine (*Pinus taeda*), sweetgum, red maple (*Acer rubrum*), and other opportunistic species. The understory was relatively dense and characterized by blackberry (*Rubus* sp.), honeysuckle (*Lonicera japonica*), and river birch.

Drainage Area
The Site is located in a hydrophysiographic region that consists of relatively flat, Coastal Plain environment characterized by moderate rainfall, averaging approximately 48 inches of precipitation per year (USDA 1979). The Site is situated along the apex of a Coastal Plain interstream divide and includes groundwater slopes at the upper headwaters of UT to Fishing Creek and Maple Swamp. Therefore, historic wetlands were influenced primarily by precipitation and lateral migration of groundwater flows toward the upper reaches of the UT to Fishing Creek and Maple Swamp.

2.2 Project History

On June 26, 2006, the EEP entered into a contract with Restoration Systems to restore the Site. A Detailed Wetland Restoration Plan was completed for the project in November 2006. Upon completion of the detailed plan, construction schematics were developed and construction was initiated on February 26, 2007. Anderson Farms completed earthwork and grading at the Site on March 7, 2007. Carolina Silvics completed planting of the Site on February 27-28, 2007.

Information on project managers, owners, and contractors follows:

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Earthwork Contractor Information
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3.0 RESTORATION ACTIVITIES

Site alterations designed to restore characteristic wetland soil features and groundwater wetland hydrology included 1) ditch cleaning prior to backfill, 2) ditch rerouting, 3) depression construction, 4) impervious ditch plug construction, 5) ditch backfilling,6) floodplain soil scarification, and 7) plant community restoration (Figure 4, Appendix A). Implementation of restoration plans restored 12.9 acres and enhanced 8.4 acres of nonriverine, interstream flat wetland, and reforested the entire 25-acre Site.

3.1 Ditch Cleaning Prior to Backfill

Ditches identified for backfilling were cleaned, as needed, to remove unconsolidated sediments within the lower portion of the cross-section. Accumulated sediments within the ditches consisted of relatively high permeability material that could have acted as a conduit for continued drainage after restoration. The unconsolidated sediments were removed from the ditches to expose the underlying, relatively impermeable clay substrate along the ditch bottoms. The sediment material was placed on adjacent surfaces and later incorporated into top soils during soil preparation for planting.

3.2 Ditch Rerouting

A ditch at the northern extent of the Site was rerouted to avoid hydrologic trespass outside of the conservation easement. An interfield ditch that flowed into the Site was rerouted into a perimeter ditch located on the western property margin. The rerouted ditch and perimeter ditch have suitable slope and cross-section to adequately accommodate stormwater discharges.

3.3 Depression Construction

Based on volume calculations for ditch-backfill material, approximately 5375 cubic yards of material were borrowed from the Site. Borrow material was generated through excavation of groundwater storage depressions throughout the Site landscape. The primary purpose of these depressions was to provide suitable, low permeability material for ditch plugs and backfilling, to increase water storage potential within the wetland restoration area, and to increase potential for biological diversity within the complex.

The depressions were constructed by excavating and stockpiling top soils overlying the B horizon (clay layer). Subsequently, clay from the B horizon was excavated as individual pockets approximately 2 to 3 feet in width and 2 to 3 feet in depth, such that the landscape was "pockmarked" with small, groundwater storage depressions. Clays excavated from the depressions were utilized as backfill material on adjacent ditch sections. Top soils and sediment removed from ditch cleaning efforts were utilized to backfill the depression to within 0.3 foot of the surface (Figure 5, Appendix A).

3.4 Ditch Plugs

Ditch plugs were installed along onsite ditches at locations depicted in Figure 4 (Appendix A). In addition, all Site outfall locations were effectively plugged to prevent migration of surface water to and from the Site. The plugs were constructed of low density material designed to withstand erosive forces associated with concentrated surface water or groundwater flows. Each plug consisted of earthen material backfilled in 2-foot lifts of vegetation free material and compacted into the bottom of the ditch. Earthen plugs were reinforced by incorporation of filter cloth into the plug to minimize preferential flow of groundwater through fill material. Earthen material was obtained from excavation of groundwater storage depressions within the Site.

3.5 Ditch Backfilling

Ditches were backfilled using on-Site, earthen material from excavated depressions. Based on cut-fill estimates for this project, approximately 5375 cubic yards of ditch backfill material was required to effectively fill all onsite ditches. Material excavated from the groundwater storage depressions was stockpiled adjacent to the ditches to be backfilled. Ditch backfill locations were filled, compacted, and graded to the approximate elevation of the adjacent wetland surface.

4.0 WETLAND COMMUNITY RESTORATION

On February 27-28, 2007, the Site was planted with native, wetland-adapted tree species. Onsite observations, a reference forest, and pertinent community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community association promoted during restoration efforts. The entire 25-acre Site was planted with species characteristic of a Nonriverine Wet Hardwoods Forest community.

Before wetland plant community restoration was implemented, the entire Site was scarified. Scarification was performed as linear bands directed perpendicular to the land slope. Subsequently, community restoration was initiated on scarified wetland surfaces.

Seven tree species were planted at the Site; they are as follows (with planted quantity).

Table 1. Planted Tree Species

Vegetation Association (Planting Area)	**Nonriverine Wet Hardwoods Forest**	
Area (acres)	**25**	
SPECIES	**Total Number Planted**	**Percentage of Total**
Swamp Black Gum (*Nyssa biflora*)	3600	14.3
Laurel Oak (*Quercus laurifolia*)	3600	14.3
Swamp Chestnut Oak (*Quercus michauxii*)	3600	14.3
Cherrybark Oak (*Quercus pagodaefolia*)	3600	14.3
Water Oak (*Quercus nigra*)	3600	14.3
Willow Oak (*Quercus phellos*)	3600	14.3
Sweetbay (*Magnolia virginiana*)	3600	14.3
TOTAL	**25,200**	**100**

Bare-root seedlings of canopy and understory tree species were planted within the Site at a density of 1008 stems per acre (6.6-foot centers). Planting was performed during February 2007 to allow plants to stabilize during the dormant period and set root during the spring season. Bare-root seedlings were hand planted to minimize wetland soil disturbance. A total of 25,200 diagnostic tree and shrub seedlings were planted in support of Site wetland restoration. The entire 25-acre restoration area was revegetated during implementation of this plan.

5.0 MONITORING PLAN

The Anderson Swamp Restoration Site monitoring plan consists of a comparison between reference and restoration areas along with evaluation of jurisdictional wetland criteria (Environmental Laboratory 1987). Monitoring will entail analysis of two primary parameters: hydrology and vegetation. Monitoring of restoration efforts will be performed for a minimum of 5 years or until success criteria are fulfilled. The detailed monitoring plan is depicted in Figure 6 (Appendix A).

5.1 Hydrology

After hydrological modifications were completed at the Site, continuously recording, surficial monitoring gauges were installed in accordance with specifications in *Installing Monitoring Wells/Piezometers in Wetlands* (NCWRP 1993). Monitoring gauges were set to a depth of approximately 24 inches below the soil surface. Screened portions of each gauge were surrounded by filter fabric, buried in screened well sand, and sealed with a bentonite cap to prevent siltation and surface flow infiltration during floods.

Five monitoring gauges were installed in wetland restoration areas to provide representative coverage of the Site. Two gauges were also placed in a reference wetland area in similar landscape positions for comparison with onsite conditions. Hydrological sampling will be performed in restoration and reference

areas during the growing season (March 21 through November 10) at daily intervals necessary to satisfy the hydrology success criteria within each physiographic landscape area.

5.2 Vegetation

Following Site planting, nine 10-meter by 10-meter vegetation monitoring plots were established within the Site (Figure 6, Appendix A). 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 each year using the EEP/CVS methods for vegetation sampling (Lee et al. 2006) between June 1 and September 30 until the vegetation success criteria are achieved.

A photographic record of plant growth will be included in each annual monitoring report.

6.0 SUCCESS CRITERIA

6.1 Hydrologic Success Criteria

Target hydrological characteristics include saturation or inundation for at least 5 percent of the growing season, during average climatic conditions. This value is based on DRAINMOD simulations for 60 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.

In atypical dry years, the hydroperiod must exceed 75 percent of the hydroperiod exhibited by the reference gauges. Reference gauge data will be used to compare wetland hydroperiods between the restoration areas and relatively undisturbed reference wetlands. This data will supplement regulatory evaluation of success criteria and also provide information that shall allow interpretation of mitigation success in years not supporting “normal” rainfall conditions.

6.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for floodplain 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 "Characteristic Tree Species." Characteristic Tree Species include planted species and species identified through inventory of a reference (relatively undisturbed) forest community used to orient the planting plan. All canopy tree species planted and identified in the reference forest will be utilized to define “Characteristic Tree Species” as termed in the success criteria.

An average density of 320 stems per acre of Characteristic Tree Species must be surviving at the end of the third monitor year. Subsequently, 290 Characteristic Tree Species per acre must be surviving at the end of year 4 and 260 Characteristic Tree Species per acre at the end of year 5.

Table 2. Characteristic Tree Species

PLANTED SPECIES	REFERENCE SPECIES
Swamp Black Gum (*Nyssa biflora*)	Willow Oak (*Quercus phellos*)
Laurel Oak (*Quercus laurifolia*)	Swamp Chestnut Oak (*Quercus michauxii*)
Swamp Chestnut Oak (*Quercus michauxii*)	Water Oak (*Quercus nigra*)
Cherrybark Oak (*Quercus pagodaefolia*)	Sweet Gum (*Liquidambar styraciflua*)
Water Oak (*Quercus nigra*)	Loblolly Pine (*Pinus taeda*)
Willow Oak (*Quercus phellos*)	Red Maple (*Acer rubrum*)
Sweetbay (*Magnolia virginiana*)	River Birch (*Betula nigra*)
	Swamp Black Gum (*Nyssa biflora*)
	Highbush Blueberry (*Vaccinium corymbosum*)
	Elderberry (*Sambucus canadensis*)
	Sweetbay (*Magnolia virginiana*)
	Horse Sugar (*Symplocos tinctoria*)
	Sweet Pepperbush (*Clethra alnifolia*)
	Ironwood (*Carpinus caroliniana*)
	Spicebush (*Lindera benzoin*)
	American Holly (*Ilex opaca*)

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.

7.0 MONITORING REPORT SUBMITTAL

An Annual Wetland Monitoring Report will be prepared at the end of each monitoring year (growing season). The monitoring report will depict the sample plot and quadrant locations and include photographs which illustrate Site conditions. Data compilation and analyses will be presented including graphic and tabular format, where practicable.

8.0 CONTINGENCY

In the event that success criteria are not fulfilled, a mechanism for contingency will be implemented.

Hydrology

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.

Vegetation

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.

9.0 REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

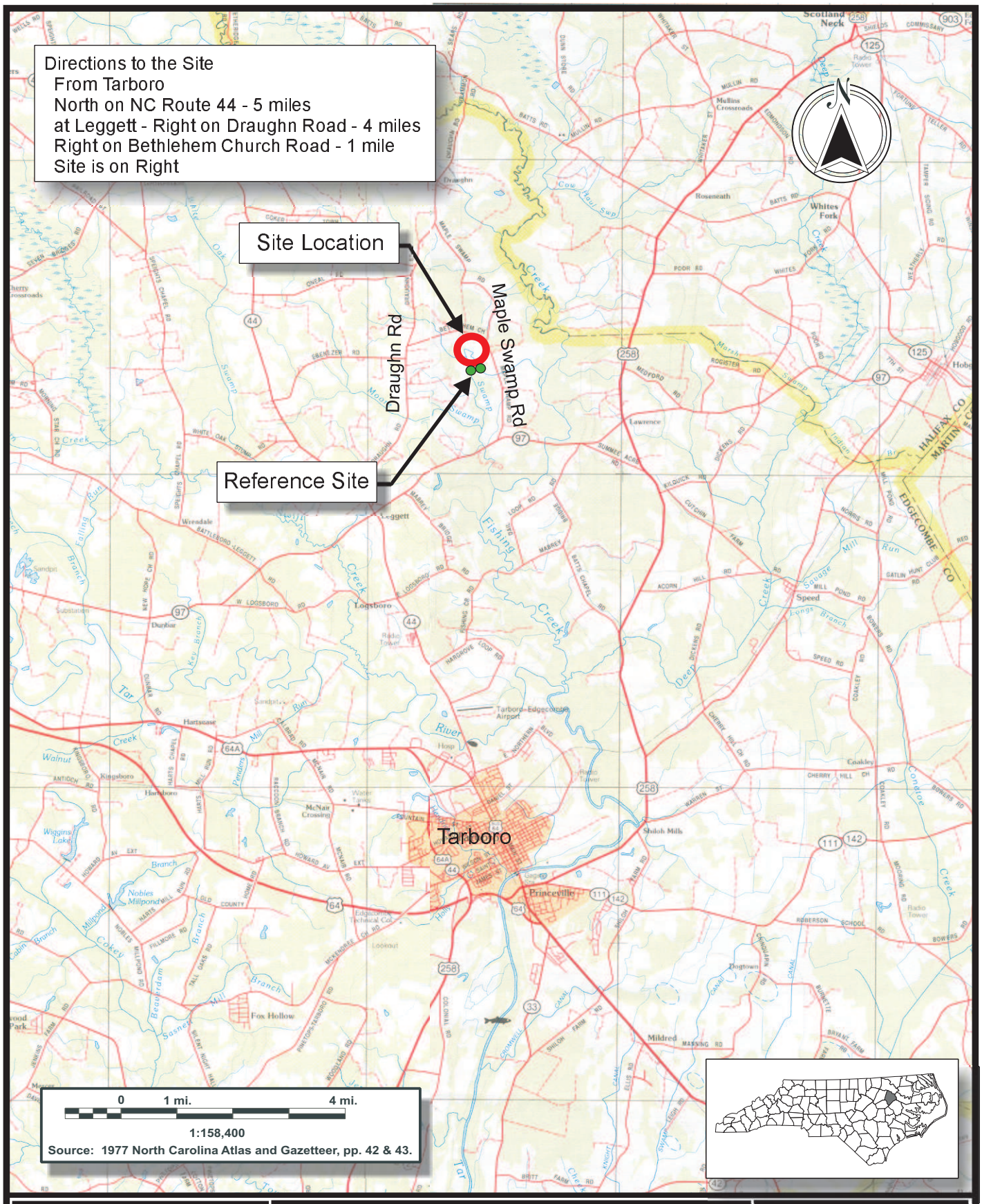
Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation. Version 4.0. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Wetlands Restoration Program (NCWRP). 1993. Installing Monitoring Wells/Piezometers in Wetlands (WRP Technical Note HY-IA-3.1). North Carolina Department of Environment, Health, and Natural Resources, Raleigh, North Carolina

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

United States Department of Agriculture (USDA). 1979. Soil Survey of Edgecombe County, North Carolina. United States Department of Agriculture.

Appendix A.
Figures



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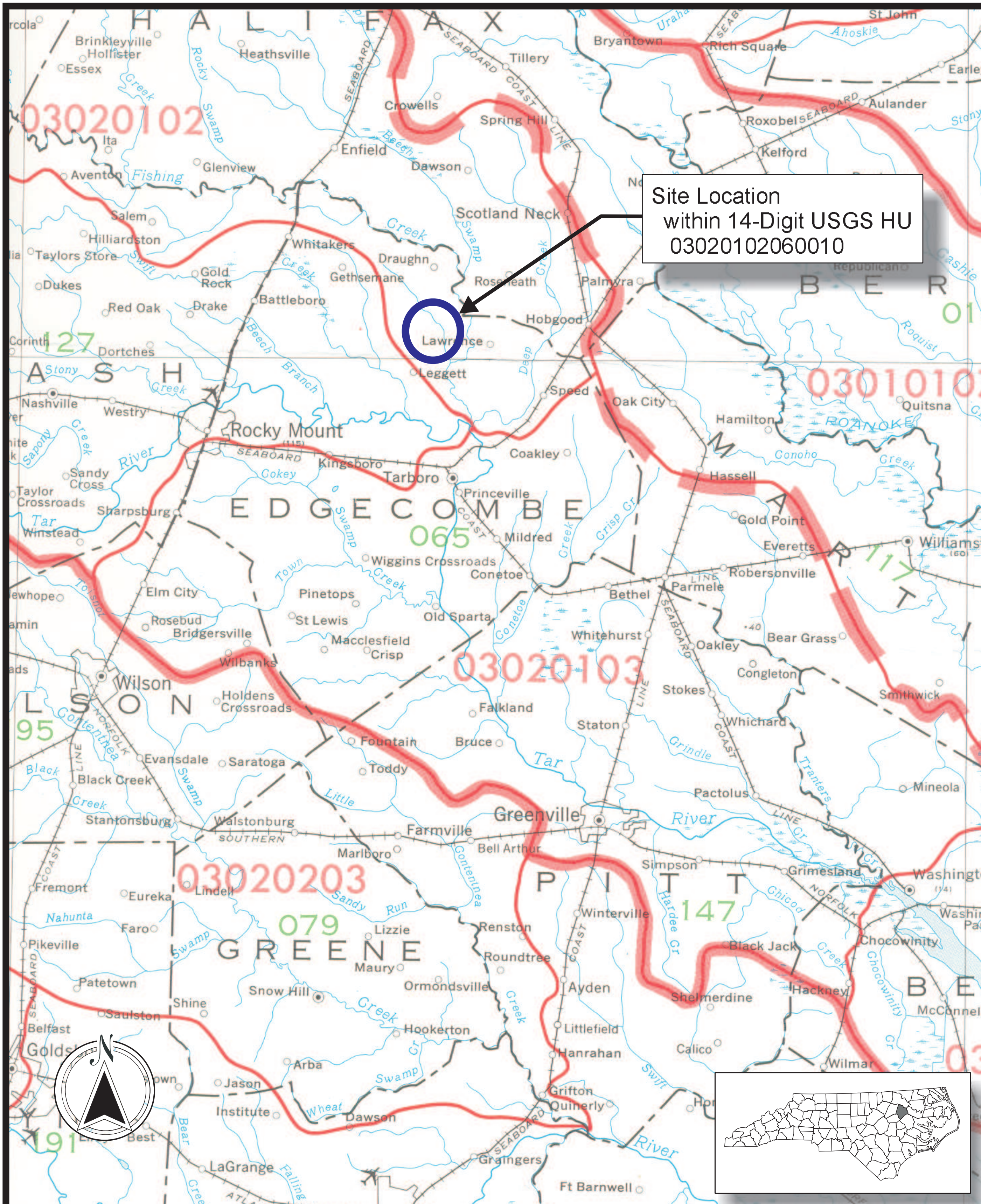
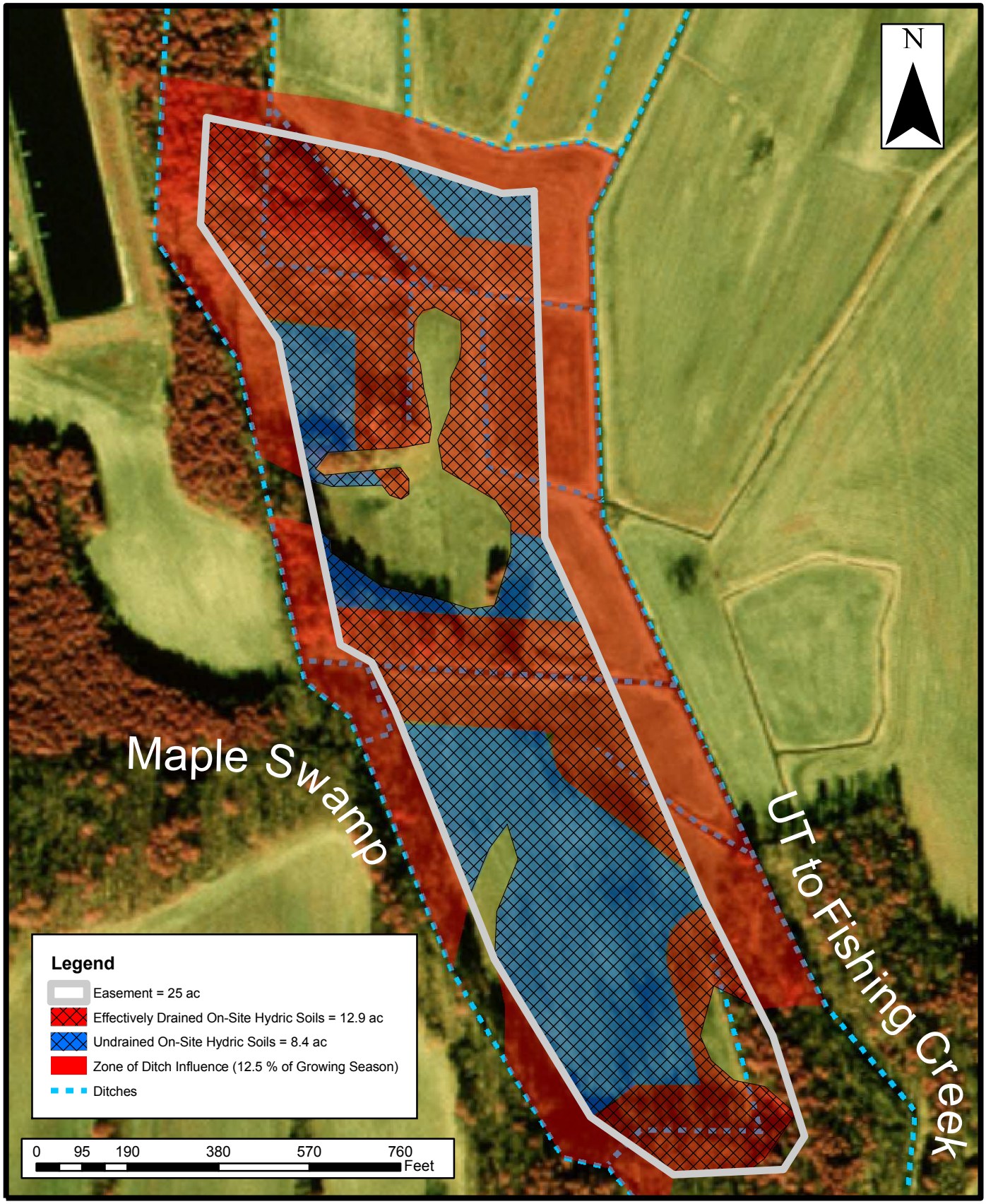
SITE LOCATION
ANDERSON SWAMP RESTORATION SITE
Edgecombe County, North Carolina

Dwn. by:	WGL
Ckd by:	WGL
Date:	April 2007
Project:	06-017

FIGURE 1



2126 Rowland Pond Dr Willow Spring, NC 27592 (919) 215-1693 (919) 341-3839 fax Axiom Environmental	USGS HYDROLOGIC UNIT MAP ANDERSON SWAMP RESTORATION SITE Edgecombe County, North Carolina	Dwn. by: WGL Ckd by: WGL Date: April 2007 Project: 06-017	FIGURE 2



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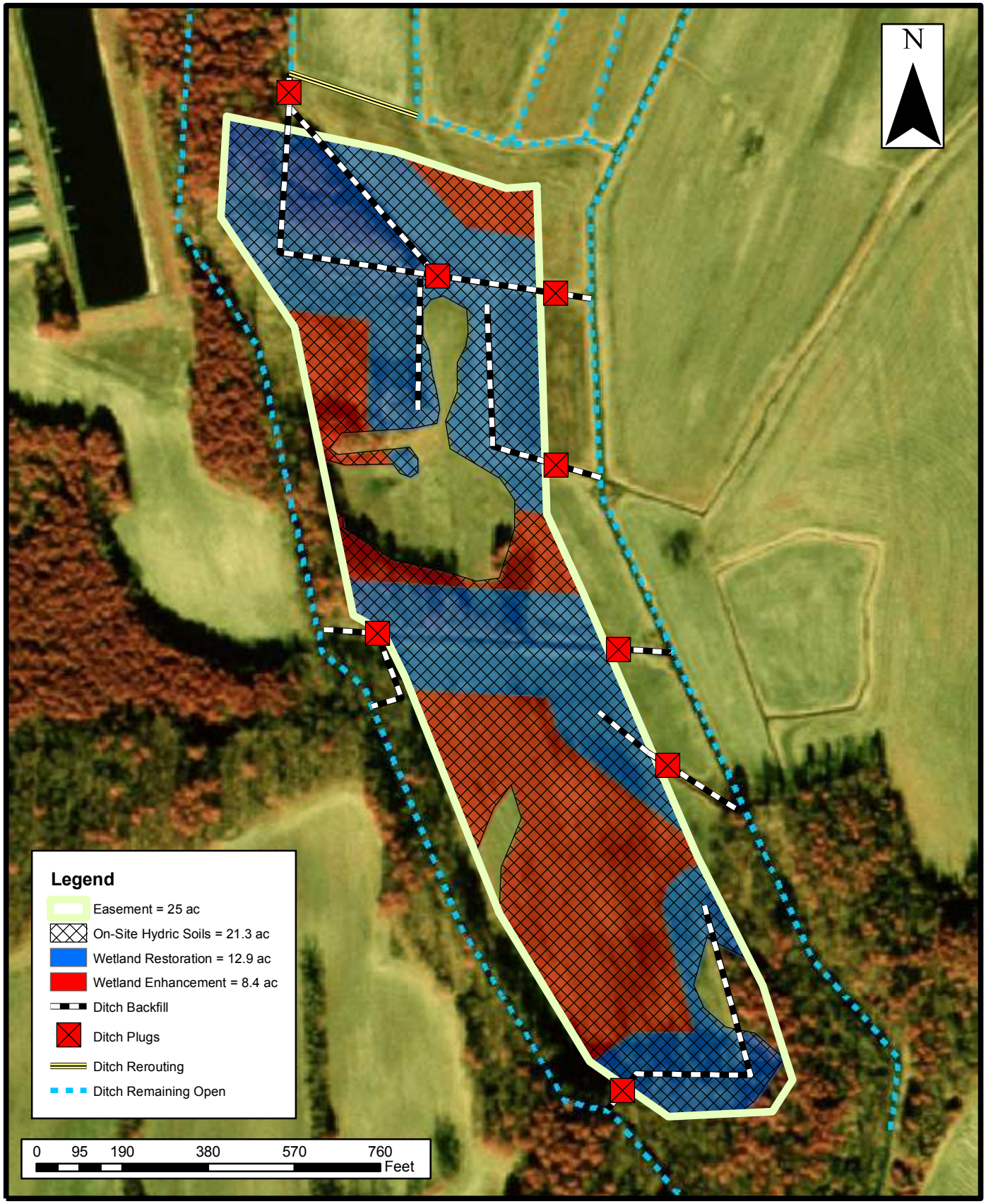
PRECONSTRUCTION CONDITIONS
ANDERSON SWAMP RESTORATION SITE
Edgecombe County, North Carolina

Dwn. By:	CLF
Date:	April 2007
Project:	06-017
FIGURE	3



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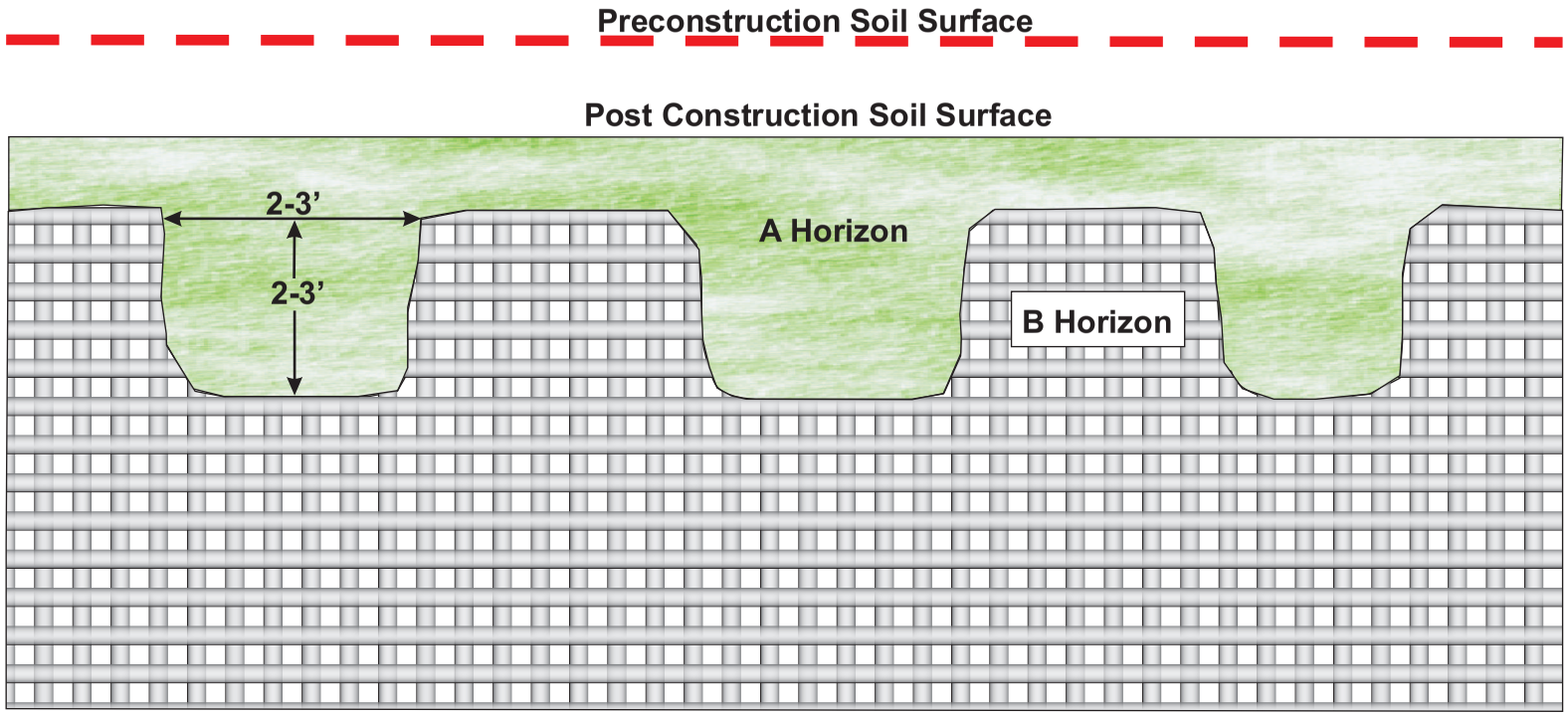
WETLAND RESTORATION PLAN
ANDERSON SWAMP RESTORATION SITE
Edgecombe County, North Carolina

Dwn. By:	CLF
Date:	April 2007
Project:	06-017

FIGURE
4



2126 Rowland Pond Dr
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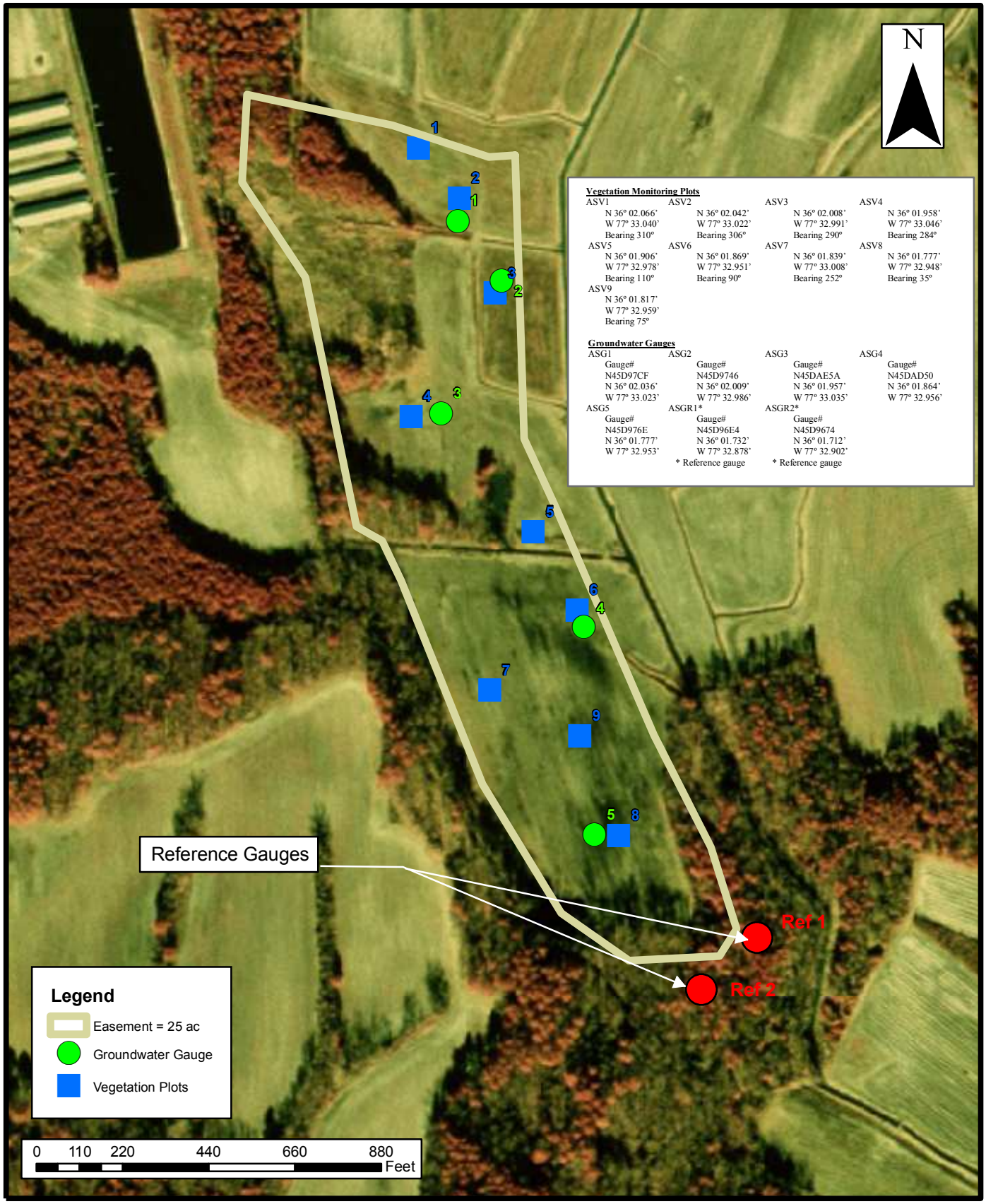
DEPRESSION CONSTRUCTION
ANDERSON SWAMP RESTORATION SITE
Edgecombe County, North Carolina

Dwn. by:	WGL
Ckd by:	WGL
Date:	April 2007
Project:	06-017

FIGURE
5



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MONITORING PLAN
ANDERSON SWAMP RESTORATION SITE
Edgecombe County, North Carolina

Dwn. By: CLF
Date: April 2007
Project: 06-017

FIGURE 6