OAKLEY CROSSROADS
STREAM AND WETLAND RESTORATION

FINAL RESTORATION PLAN

Pitt County, North Carolina
SCO Project Number 050659701

Prepared for:
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
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Status of Plan: Final
Submission Date: August 25, 2006

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EXECUTIVE SUMMARY

The Oakley Crossroads Restoration Site is located approximately four miles south of Robersonville, North Carolina in northern Pitt County. The site is located on the right 2.5 miles from the intersection of Jim Taylor Road (SR 1547) and NC 903. This project is located in the Coastal Plain physiographic region and is in the 03020103090020 14-digit HUC of the Tar-Pamlico River basin. The 24.8-acre conservation easement consists of fallow agricultural fields in a natural valley. A channelized third order perennial stream flows from west to east through the easement before discharging into Tranters Creek.

The Oakley Crossroads Restoration Plan includes the following components: 1) restoration of a third order stream channel and associated riparian buffers, 2) restoration and enhancement of bottomland hardwood riparian wetlands, 3) preservation of the existing bottomland hardwood wetland, 4) expansion of two existing ponds within the conservation easement, and 5) construction of a road crossing near the midpoint of the project. Using Rosgen classification, the existing channel is classified as a G5c stream type, which is narrow and entrenched. Due to straightening and continued maintenance, the channel is much shorter than the natural condition and lacks the riffle-pool sequences that provide energy dissipation and habitat.

The stream channel will be restored using Priority 1 natural channel design. Riparian wetlands will be restored within the grading limits of the stream. The reconnection of the channel to its original floodplain will raise the water table at the site and likely restore hydrology to additional wetland areas within the conservation easement. The majority of the Oakley Crossroads project site is underlain with hydric soils, which are often indicative of the existence of wetlands prior to agricultural practices.

Riparian buffers will be replanted along the unnamed tributary on the project site creating a wildlife corridor from Tranters Creek south to Briery Swamp. Existing herbaceous wetlands within the conservation easement will be enhanced with the planting of bottomland hardwood tree species and wetland shrubs as appropriate. The existing forested wetlands will be preserved.

Restoration is part of a broad, watershed-based approach for the re-establishment of physical, chemical, and biological components of an aquatic ecosystem. This physiographic province has lost a significant portion of the historic wetland systems, including nonriverine wet flats and riparian wetlands, and stream habitat through intensive agricultural practices. Tranters Creek (28-103) is a major tributary to the Tar River [28-(102.5)]. The project site stream, Tranters Creek, and the Tar River are nutrient sensitive waters (NCDWQ, 2004). The restoration of the unnamed tributary and wetlands on the Oakley Crossroads site will improve physical, chemical and biological components of the Tranters Creek watershed and downstream waters.

Restoration of the stream channels and riparian buffers using the principles of natural channel design, will greatly benefit the stream system by improving biological integrity, increasing dissolved oxygen, and moderating the pH level and water temperature. The Oakley Crossroads Restoration Site may also provide future habitat for some ‘federal species of concern.’

The Oakley Site will be returned to a more natural state through stream and buffer restoration, wetland hydrology restoration where feasible, and installation of woody wetland vegetation. The Oakley Crossroads Restoration Site offers the potential to restore 3,800 linear feet of stream, 20.9 acres of riparian buffer, and 2.58 acres of riverine bottomland hardwood forest wetlands. Additionally, 1.11 acres

of bottomland hardwood forest wetland will be preserved and 2.60 acres will be enhanced. The following table provides acreages and footages for the project. For more information see Table 10.1

Before and After Area Lengths and Acreages for Oakley Crossroads Restoration Site

Area	Before	After
Stream Length	**2,950 feet**	**3,800 feet**
Buffer Restoration		20.86 acres
Buffer Preservation		1.52 acres
Total Buffer Acres		**22.38 acres**
Restoration of riverine bottomland hardwood wetlands		2.58 acres
Riverine Wetland Enhancement		2.60 acres
Wetland Preservation		1.11 acres
Total Wetland Acres		**6.3 acres**

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1.0 Project Site Location

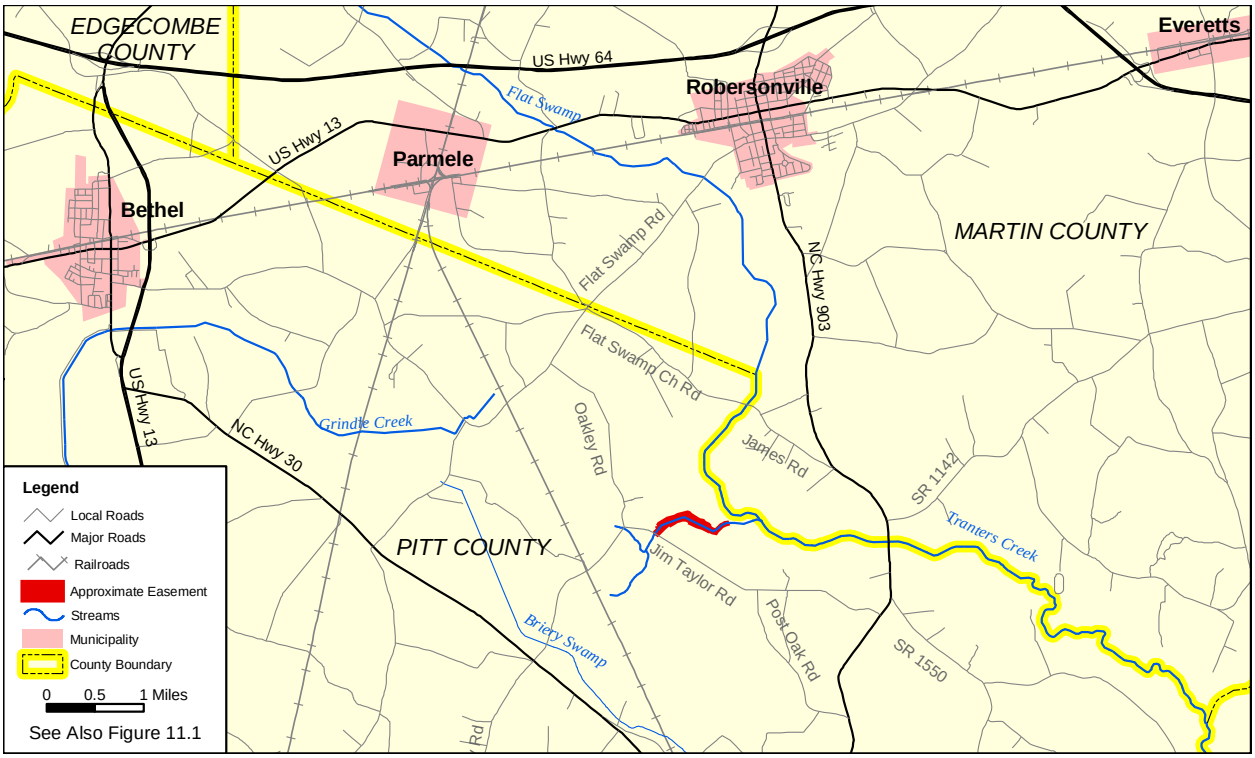
1.1 DIRECTIONS TO PROJECT SITE

The Oakley Crossroads Restoration Site is located approximately four miles south of Robersonville, North Carolina in northern Pitt County (Figure 11.1). From Tarboro, travel east on US 64 and take the NC 903 exit toward Robersonville. Travel 6.5 miles and take a right onto Jim Taylor Road (SR 1547 - the first road to the right after crossing into Pitt County). The site is located on the right 2.5 miles from the intersection of Jim Taylor Road and NC 903.

1.2 USGS HUC & NCDWQ RIVER BASIN DESIGNATIONS

The Site is within the Tar-Pamlico River Basin (NCDWQ Tranters Creek Subbasin 03-03-06) and the United States Geological Survey (USGS) 14-digit Hydrologic Unit Code 03020103090020. The project area includes an altered third order stream, flowing east for approximately 4,500 linear feet from the culvert at Jim Taylor Road (SR 1547) before discharging into Tranters Creek (Figure 11.2).

1.3 PROJECT VICINITY MAP



2.0 Watershed Characterization

2.1 DRAINAGE AREA

The Oakley Crossroads Site is located on an unnamed tributary to Tranters Creek with a watershed of approximately 1.59 square miles in size at the downstream end of the easement (Figure 11.2).

2.2 SURFACE WATER CLASSIFICATION / WATER QUALITY

The unnamed stream is a tributary of Tranters Creek, which is classified as C Sw NSW from its source to the Tar River. The 2004 "Use Support Rating" for this section of Tranters Creek is 'Supporting.'

2.3 PHYSIOGRAPHY, GEOLOGY AND SOILS

The project watershed is located in the eastern portion of the Coastal Plain Physiographic Province of North Carolina. Broad, flat interstream areas are the dominant topographic features of this province. Slopes are generally less than four percent. Elevations in the watershed range from approximately 38 to 66 feet above mean sea level. According to the soil survey for Pitt County (Soil Conservation Service, 1974) the majority of the easement is underlain by Bladen fine sandy loam and Pantego loam, both hydric soils. Other soils mapped within the easement include Coxville fine sandy loam, Craven fine sandy loam, Goldsboro sandy loam, Norfolk sandy loam, Ocilla loamy fine sand, Rains fine sandy loam and Wagram loamy sand (Figure 11.4). The watershed geology contains Tertiary Period material including the Yorktown Formation and Duplin Formation, Undivided. The Yorktown Formation is found primarily north of the Neuse River and is bluish gray fossiliferous clay with varying amounts of fine-grained sand. Shell material is commonly concentrated in lenses. The Duplin Formation is found primarily south of the Neuse River and is bluish gray shelly, medium- to coarse-grained sand, sandy marl, and limestone.

2.4 HISTORICAL LAND USE AND DEVELOPMENT TRENDS

More than 65% of the watershed consists of agricultural row crops and pasture. The remaining area is a mixture of forested lands, two-lane roadways, and scattered single-family homes (Table 10.2). Oakley Road (SR 1517) and Jim Taylor Road (SR 1547) bisect the watershed. The surrounding land use creates an ideal restoration site due to the lack of impervious surfaces and the unlikelihood of future development in the watershed. Although the downstream reach below the project area has been straightened in the past, it has since become a stable channel with a mature buffer. This buffer is protected by the Tar-Pamlico Buffer rules and should therefore remain intact. The upstream reach has not been disturbed and is surrounded by a mature riparian buffer, which will be similarly protected. This portion of Pitt County is zoned 'RA – Rural Agricultural' which is intended to accommodate very low density residential uses as well as associated public and institutional uses, low intensity commercial uses, and agricultural-related industrial uses. The various uses allowed under the 'RA' zone are interspersed throughout areas that are principally characterized as rural in nature (Pitt County, 2006). Land use within the watershed is not expected to change and development is not expected to increase enough to cause significant changes in the stream hydrograph.

2.5 PROTECTED SPECIES

Some populations of flora and fauna have been in, or are in, the process of decline either due to natural forces or their inability to coexist with human activities. Federal law (under the provisions of the Endangered Species Act of 1973, as amended) requires that any action, likely to adversely affect a species classified as federally protected, be subject to review by the US Fish and Wildlife Service (USFWS). Other species may receive additional protection under separate state laws.

Letters were sent to the USFWS and the NC Natural Heritage Program (NCNHP) on April 4, 2006 requesting comments on the project study area. A response letter dated April 10, 2006 was received from the NCNHP stating "The Natural Heritage Program has no record of rare species, significant natural communities, or significant natural areas at the site nor within a mile of the project area" (Appendix 10).

Plants and animals with federal classifications of 'endangered,' 'threatened,' 'proposed endangered,' and 'proposed threatened' are protected under the provisions of Section 7 and Section 9 of the Endangered Species Act of 1973, as amended. The USFWS lists four federally protected species for Pitt County, the bald eagle (*Haliaeetus leucocephalus*), the red-cockaded woodpecker (*Picoides borealis*), the West Indian manatee (*Trichechus manatus*), and the Tar River spinymussel (*Elliptio steinstansana*).

2.5.1 Bald eagle *(Haliaeetus leucocephalus)*

The federal and state status for the bald eagle is 'threatened.' A threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The bald eagle is a large raptor that requires large trees for nesting, roosting and perching. The trees must be in areas where human activity is limited. Bald eagles are opportunistic predator-scavengers that consume many different prey species. They eat fish when they are available, but shift to a variety of other birds, mammals and turtles, both live and as carrion, when fish are scarce. Ideal eagle habitat consists of mature shoreline forests with scattered openings and little human use, near water with abundant fish and waterfowl. No evidence of bald eagles in or near the project area was noted during field site visits. The unnamed tributary to Tranter's Creek does not provide sufficient aquatic resources to attract bald eagles or to support them in anything other than in a transient role. Therefore, the Oakley Crossroads restoration will have no effect on the bald eagle.

2.5.2 Red-cockaded woodpecker *(Picoides borealis)*

The federal and state status for the red cockaded woodpecker is 'endangered.' An endangered species is one whose continued existence as a viable component of the State's fauna is determined to be in jeopardy. Red-cockaded woodpeckers (RCW) are mostly black and white birds with barred backs and wings and a large white cheek patch. Its habitat preference is wet pine flatwoods and pine savannas. The project watershed does not have trees of suitable age and size to support RCW colonies. The majority of the watershed is agricultural row crops or pasture. There are small areas of pine plantation and mixed forest. These areas are not suitable for nesting due to the small size of the pine trees and/or the presence of hardwood species in the canopy or understory. Foraging is unlikely as there is no suitable nesting habitat within a half-mile of the watershed. A search of the NCNHP database does not indicate any occurrences of RCWs within the project watershed or its vicinity and no individuals were observed during field

surveys. Therefore, the Oakley Crossroads restoration will have no effect on the red-cockaded woodpecker.

2.5.3 West Indian manatee (*Trichechus manatus*)

The West Indian Manatee is a large gray or brown aquatic mammal. Adults average about 10 feet long and weigh 1,000 pounds. During summer months, manatees may migrate as far north as coastal Virginia. Manatees inhabit both salt and fresh water of sufficient depth (5 feet to usually less than 20 feet) throughout their range. The unnamed tributary to Tranters Creek does not provide appropriate habitat for the manatee. Therefore, the Oakley Crossroads restoration will have no effect on the West Indian manatee.

2.5.4 Tar River spinymussel (*Elliptio steinstansana*)

The Tar River spinymussel, one of only three freshwater mussels in the world with spines, is a medium-sized mussel reaching about 2.5 inches in length. In young specimens, the shell's outer surface (periostracum) is an orange-brown color with greenish rays; adults are darker with inconspicuous rays. The Tar River spinymussel lives in relatively silt-free uncompacted gravel and/or coarse sand in fast flowing, well oxygenated stream reaches. It is found in association with other mussels, but it is rarely numerous. It feeds by siphoning and filtering small food particles that are suspended in the water. The unnamed tributary to Tranters Creek is generally a sandbed stream, however, due to channelization and the past installation of a flashboard riser near the end of the project area as well as multiple beaver dams, the stream flow has been frequently ponded causing siltation. The project stream does not provide appropriate habitat for the mussel. Therefore, the Oakley Crossroads restoration will have no effect on the Tar River spinymussel.

2.5.5 Federal species of concern

'Federal species of concern' are not afforded federal protection under the Endangered Species Act and are not subject to any of its provisions, including Section 7, until they are formally listed or proposed as 'threatened' or 'endangered.' However, the status of these species is subject to change, and therefore should be included for consideration. A 'federal species of concern' is defined as a species that is under consideration for listing, but for which there is insufficient information to support its listing. In addition, organisms that are listed 'endangered,' 'threatened,' or of 'special concern' by the NCNHP list of Rare Plant and Animal Species, are afforded state protection under the N.C. State Endangered Species Act and the N.C. Plant Protection and Conservation Act of 1979.

As of March 29, 2006, there are ten 'federal species of concern' listed by the USFWS for Pitt County. There are six vertebrates, the American eel (*Anguilla rostrata*), the Carolina madtom (*Noturus furiosus*), the Eastern Henslow's sparrow (*Ammodramus henslowii susurrans*), the pinewoods shiner (*Lythrurus matutinus*), the Roanoke bass (*Ambloplites cavifrons*), and the southern hog-nosed snake (*Heterodon simus*); three invertebrates, the Atlantic pigtoe (*Fusconaia masoni*), the green floater (*Lasmigona subviridis*), and the yellow lampmussel (*Lampsilis cariosa*); and one vascular plant, grassleaf arrowhead (*Sagittaria weatherbiana*). None of these species were observed during site visits.

The restoration at the Oakley Crossroads Site may provide future habitat for a few of these 'federal species of concern' such as the southern hog-nosed snake.

2.6 CULTURAL RESOURCES

The Oakley Crossroads Restoration Site consists of former agricultural fields with no apparent historical or cultural significance. A letter was sent to the State Historic Preservation Office (SHPO) on April 3, 2006 requesting comments on the project study area. A response was received on April 21, 2006 that stated that SHPO was "aware of no historic resources that would be affected by the project. Therefore, we have no comment on the project as proposed" (Appendix 10).

2.7 POTENTIAL CONSTRAINTS

2.7.1 Property Ownership and Boundary

Four property owners are involved in this project: Ms. Lorraine Taylor, Ms. Janice Taylor Riley, Mr. Carl Briley, and Mr. Darrell Bullock. The associated parcels are shown on Figure 11.3. A conservation easement has been placed on each of these properties consistent with the areas required for the proposed mitigation. The conservation easements place mutually agreed upon restrictions on the property deed that guides the use and management of the stream, wetlands, and buffer areas. The property owners listed above will retain ownership, but agree to manage the property according to the restrictions. The easement will remain with the property if it is sold or transferred and the new owner will be required to honor the provisions of the conservation easement.

The original conservation easement acquisition agreement requires a stream crossing and an upgrade to an existing diversion structure. The ford stream crossing will be located at the Riley / Briley property boundary junction near the midpoint of the restoration reach (Sheet 12.2). The upgrade to the diversion structure will divert high stream flows into the Briley pond. The general location of the diversion structure is located on Sheet 12.2.

2.7.2 Site Access

The site is easily accessible by a farm road from the west from Jim Taylor Road. The dirt road originates on the Lorraine Taylor property and follows the easement along north side of the project area before returning back to Jim Taylor Road via the Briley property.

2.7.3 Utilities

No utilities are known to exist within the project area.

2.7.4 Irrigation

The existing land adjacent to the stream channel is used for agricultural production and crops are irrigated during dry months. Irrigation needs for the Taylor and Briley properties are currently met by two ponds

and the channel itself. The upstream pond (approximately 2,000 cubic yards) is on the Taylor property and the downstream pond (approximately 4,400 cubic yards) is on the Briley property (Figure 11.3).

The Taylor pond is supplied by groundwater and surface water runoff. Irrigation water is pumped from the pond to the adjacent agricultural fields. Agreements made with the property owner as part of the project development process include doubling the Taylor pond capacity (Sheets 12.6 and 12.7). A small agricultural ditch will be diverted from the main channel into the Taylor pond to provide additional water treatment.

In addition to groundwater and runoff, the stream channel supplies water to the Briley pond. Mr. Briley has a flashboard riser rack at the culvert inlet on the downstream end of his property (Sheet 12.2). Approximately 250 feet upstream of this structure, he has installed a pipe in the channel bank that connects the channel to the pond. When the water in the channel is raised to an elevation above the pipe inlet, water flows into the pond. Using the riser board allows Mr. Briley to control the stream level and the available water supply stored in the pond. Irrigation is accomplished by pumping from the pond and infrequently by pumping directly from the channel. As part of the stream restoration project, the control structure will be removed and Mr. Briley will no longer be able to impound water in the stream channel. As compensation, the State agreed to increase the storage capacity of his pond. The State also agreed to install a new diversion structure in the stream that will divert high flows into the pond. Sheets 12.8 and 12.9 depict the changes to the Briley pond as well as the general location of the diversion structure.

2.7.5 FEMA / Hydrologic Trespass

A check of FEMA flood zone mapping for Pitt County indicates that all of Tranters Creek and the lower reaches of the unnamed tributary on the Bullock property portion of the Oakley Crossroads site are within the 100-year flood hazard zone (http://www.ncfloodmaps.com/default_swf.asp). The HEC-RAS analysis indicates that the proposed channel geometry will not increase the 100-year flood elevations within the project area. In fact, the analysis indicates that the water surface elevation will be reduced by 0.05 feet at the upstream end (HEC-RAS Section 59) of the project. This analysis is discussed in Section 7.3.2 of this report.

3.0 Project Site Streams

A detailed topographic survey of the Oakley Crossroads Restoration Site was conducted by NC Department of Transportation (NCDOT) in May 2002. In addition, a field survey of existing channel conditions was completed on May 29, 2002. Field survey measurements were gathered using proper surveying techniques (Harrelson *et al.*, 1994). Measurements included, but were not limited to, longitudinal profile of the thalweg, water surface, bankfull, low bank, and terrace; cross section of riffle and pool including bank slope, water depth and width of flood-prone area; valley length; belt width; straight length; pool-to-pool spacing and channel material. A field verification of the watershed area delineated from the Robersonville West and Greenville NE USGS topographic quadrangles was conducted (Figure 11.2). The detailed stream survey and watershed data provide existing condition

information and identify design constraints, such as culvert elevations. Existing conditions are shown on Sheet 12.1. Photographs of the site are included in Appendix 1.

3.1 CHANNEL CLASSIFICATION

The unnamed tributary to Tranters Creek on the Oakley Crossroads Site is shown on both the USGS Robersonville West topographic quadrangle and the Soil Survey of Pitt County. The tributary is a third order stream that lies along the natural contours of the landscape. Regular maintenance (vegetation removal, channel bed material removal, and grade alteration) has created the current dimension, pattern, and profile. See Appendix 1 for photos of existing conditions.

The unnamed tributary originates to the southwest of Jim Taylor Road, and crosses the site from west to east before joining with Tranters Creek. The North Carolina Division of Water Quality (NCDWQ) method for determining ephemeral and perennial/intermittent channels was utilized to evaluate the project stream on May 1, 2003. NCDWQ Stream Classification forms are provided in Appendix 4.

Stream channels are classified using five criteria: width-to-depth ratio, entrenchment ratio, slope, sinuosity, and channel materials. Width-to-depth ratio is the ratio of the bankfull width to the mean depth of the bankfull channel, which is an indication of the channel's ability to dissipate energy and transport sediment. Entrenchment ratio is the vertical containment of the stream and the degree to which the channel is incised in the valley floor. Entrenchment ratio indicates if the stream is able to access its floodplain. Flood-prone width divided by the bankfull width yields the entrenchment ratio. The slope is the change in water surface elevation per unit of stream length. Slope can be analyzed over the entire reach, to determine if the slope is stable within the existing channel material, or over sections, to determine the condition of pools and riffles. Sinuosity is the ratio of stream length to valley length. Extremely low sinuosity channels in eastern North Carolina typically indicate a straightened channel. Channel bed and bank materials indicate the channel's resistance to hydraulic stress and ability to transport sediment (Rosgen, 1994). All five of the criteria are interrelated and were used as a set to determine the current condition of the channel.

According to the five criteria the existing channel is classified as a G5c. Moderate to high entrenchment, low width-to-depth ratio, and moderate sinuosity determines the 'G' classification. The '5' classification indicates a predominantly sand bed channel. The "c" classification represents the stream's flat slope, which does not fall under the "G" classification but rather the "C" stream classification. The existing channel data are provided in Table 10.4. The channel is approximately 15 to 20 feet wide and the bed is approximately 4 feet below the top of the bank. The existing channel can be characterized as having minimal riffle-pool sequence and very low sinuosity.

Due to straightening, the channel is much shorter than the natural condition. The slope of the streambed and the energy of the stream have been increased due to channelization. However, the installation of the flashboard riser system and the presence of beaver dams within the lower reach create a backwater effect in the channel. The streambanks are vegetated with black willow (*Salix nigra*) and American sycamore (*Platanus occidentalis*) saplings, rushes *(Juncus sp.),* sedges *(Carex sp.)* and a variety of herbaceous species. The channel is entrenched making it difficult for the flood flows to access the original floodplain. The existing channel data is presented in Table 10.4.

Beavers are located throughout the tributary and adjacent drainages and have caused some flooding. During site visits, two beaver dams were noted near the lower end of the tributary on the Oakley site. Beaver dams can create a backwater effect, raising waters levels in the tributary that can back up on the site. Although beavers are a natural part of the system, a beaver management plan will need to be developed to minimize damage to the stream restoration and the restored riparian buffer. This issue is discussed further in Section 7.6 of this document.

3.2 DISCHARGE

Bankfull discharge is defined as the dominant channel forming flow that moves the most sediment over time (Rosgen, 1994). This generally equates to a 1.2 to 1.5 year storm event in North Carolina. Bankfull discharge is estimated using various methods. Coastal Plain Regional Curves developed by the Stream Restoration Institute at North Carolina State University were reviewed (NCSRI, 2004). These curves provide a graphical representation of bankfull discharge to drainage area. USGS regional regression methods for determining peak discharge were also examined (Pope *et al.*, 2001). This method employs long-term gage data to develop equations based on hydro-physiographic region. Coastal plain regression equations were used to calculate various peak discharges for 2, 5, 10, 50 and 100-year events. A log-log plot of these discharged can then be extrapolated to determine a 1.2 to 1.5 year discharge. The third and final method is based on channel morphology. Once bankfull areas and bed roughness were determined from field surveys, Manning's equation is applied to calculate the mean velocity in the channel. This velocity is then multiplied by the channel area to determine the discharge. The existing bankfull velocity is approximately 1.9 ft/s equating to a bankfull discharge of approximately 30.0 ft^3/s. The calculated discharge compares moderately well to the NCSU regional curves and the USGS regression method.

3.3 CHANNEL MORPHOLOGY

Bankfull width of the existing stream channel at the Oakley Crossroads Site is approximately 10.4 feet and bankfull depth is approximately 1.8 feet. The stream has a sinuosity of 1.01; however, due to past straightening of the channel, there are no radii to measure for radius of curvature ratios or meander length ratios. The width-to-depth ratio of 6 and the entrenchment ratio of 1.4 are highly entrenched as expected for a G type stream. The Oakley Crossroads restoration site's streambed material is sand dominated. Photographs of the existing channel are presented in Appendix 1. A complete morphological table for the existing stream channel is presented in Table 10.4.

Bank height ratios note the difference between the bankfull elevation and the lowest stream bank. Commonly, stable channels exhibit bank height ratios between 1.0 and 1.3. The existing bank height ratio is greater than 2. Additional information including existing pattern data for the existing channels can be found with the morphological data in Table 10.4.

The composition of the streambed and banks is an important facet of stream character, influencing channel form and hydraulics, erosion rates and sediment supply. The streambed on the Oakley Crossroads Site was characterized using the modified Wolman Pebble Count (Rosgen, 1994). According to the modified Wolman Pebble Count procedure, the average d_{50} (50% of the sampled population is equal to or finer than the representative particle diameter) is less than 2.0 mm for the stream, which falls into the sand size category. Pebble counts were taken at representative locations along the reach. The locations included both riffle and pool cross sections.

3.4 CHANNEL STABILITY ASSESSMENT

The existing channel on the Oakley Crossroads Site was analyzed for overall stability. This analysis included the morphological assessment as mentioned above, and calculations of shear stress and stream power. The existing channel exhibited a bankfull shear stress of approximately 0.20 lb/sqft, which equates to a stream power of 0.38 lb/ft/s. In a relatively flat, sand bed system such as the Oakley Crossroads Site, the stream power is within an acceptable range. Field observations indicated no severe bank erosion or lateral migration of the channel. Existing herbaceous vegetation along the channel banks and within the channel also help channel stability. The proposed channel was designed to mimic or slightly reduce the bankfull shear and power of the existing channel.

The existing channel exhibited a top of bank shear stress of approximately 0.41 lb/sqft, which equates to a stream power of 1.22 lb/ft/s. The proposed channel was designed with a top of bank shear stress of approximately 0.14 lb/sqft, which equates to a stream power of 0.17 lb/ft/s.

3.5 BANKFULL VERIFICATION

In degraded systems bankfull indicators are often not present or are unreliable due to maintenance practices and the stream's degrading processes. There were no bankfull indicators located in the existing reach. The existing project reach is strongly influenced by beaver dams and a flashboard riser on the lower reach. The flashboard riser was removed as observed in May of 2006.

There were bankfull indicators identified in the reach downstream of the project area. The existing bankfull elevations and bankfull cross sectional areas were determined in the field by locating depositions or inner berms, scour lines, vegetation lines, or slope breaks in the bank. These bankfull dimensions were then compared to the Coastal Plain Regional Curves for verification (NCSRI, 2004).

3.6 VEGETATION

Vegetative communities present on the site include agricultural fields, pasture, herbaceous/shrub areas (including herbaceous wetlands), bottomland hardwood forest wetland, and mesic hardwood forest. The streambanks on the site are vegetated with grasses and weedy herbaceous species. The riparian buffer had been consistently mowed prior to the establishment of the conservation easement. The surrounding property has been planted in agricultural row crops each year, although the area within the conservation easement has been left fallow in recent years. Various grasses and saplings, including broomsedge (*Andropogon virginicus*), blackberries (*Rhubus* sp.), goldenrod (*Solidago* sp.), American sycamore, and red maple (*Acer rubrum*) have colonized these areas. Additional descriptions of site vegetation including onsite wetlands can be found in section 5.4.

4.0 Reference Streams

A reference reach provides natural channel design criteria that are based on measured morphological relationships from stable channels. A search was carried out for suitable reference reaches for the design

of the new channel using topographic maps followed by field investigations. Criteria used to identify a potential reference reach included: current land use, drainage area, stream order, absence of man-made alterations or beaver dams, stream classification, and stream condition. Visual inspections were conducted along the channel of each potential reference reach. Each reach was walked and notes were taken on the vegetative cover, bank stability, sinuosity, channel classification, and channel condition. The inspection was performed to ensure that the contributing watershed was not adversely affecting the condition of the reach.

Two streams were identified as reference reaches in 2002; Shepard Run in Greene County and an unnamed tributary to Tyson Creek in Pitt County, North Carolina (Figure 11.6). These reference reaches were both surveyed on June 11, 2002 and July 11, 2002, respectively and were revisited on May 18, 2006. Since 2002, the Shepard Run and Tyson Creek stream reaches have deteriorated with the influence of beaver activity and some bank stability. An additional reference reach was surveyed and was used as verification of the physical characteristics of the actual reference reaches detailed below. The data from this reach was not used in calculating the dimensionless ratios used for design. All of the surveys were performed using techniques outlined in the USDA Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson *et al.*, 1994), and Rosgen's Natural Channel Design (Rosgen, 1996).

Measurements taken included, but were not limited to, longitudinal profile, cross section of a riffle and a pool detailing the following data: thalweg, water surface, bankfull, low bank, and terrace elevation; bank slope; width of flood-prone area; belt width; valley length; straight length; pool-to-pool spacing and channel materials. The data were utilized to form dimensionless ratios for natural channel design. NCDWQ Stream Classification forms for each reference channel are included in Appendix 8.

The stream design was based on two reference reaches with different classifications. Shepherd Run is classified as an E5 and portrays the long-term goal of the restoration project. The unnamed tributary (UT) to Tyson Creek is classified as a C5 and portrays a stable channel and pattern that can be constructed. As vegetation matures within and around the constructed C5 channel, its cross-section will tighten and evolution will turn it into an E5 channel. Both a C5 and an E5 are stable stream types. The Oakley Site will have a low width-to-depth ratio of 8, due to constructability issues with the site's soils. The C5 channel that is built will naturally tighten into an E5 channel; thus the need for an E5 and C5 reference reach.

4.1 REFERENCE WATERSHED CHARACTERIZATION

Shepherd Run is a second order tributary flowing northeast into Contentnea Creek, which continues to the Tar River. Shepherd Run is shown as a blue-line stream on the USGS Snow Hill Quadrangle (Figure 11.7). The watershed is approximately 880 acres and is located south of Snow Hill in Greene County, North Carolina. The surrounding land use is predominantly forested, encompassing a few secondary roads (Figure 11.8). The watershed contains only the one small tributary and no impoundments. The reference reach surveyed begins upstream (south) of the NC 58 stream crossing. Soils in the watershed are predominantly Autryville and Cowarts (Figure 11.9).

The unnamed tributary to Tyson Creek reference reach is a first order tributary flowing southeast to the Tar River. The unnamed tributary to Tyson Creek is a blue-line stream on the USGS Falkland Quadrangle (Figure 11.10). The watershed is approximately 420 acres and is located south of Falkland in Pitt County,

North Carolina. The watershed is predominately forested with some agricultural practices and houses (Figure 11.11). The watershed has minimal roadway influence and no impoundments. The reference reach survey begins upstream (west) of the King's Crossroads (SR 1247) stream crossing. Soils in the watershed are predominantly Wagram (Figure 11.12).

4.2 CHANNEL CLASSIFICATION

The Shepherd Run reference reach was classified as an E5 stream type based upon the survey data (Table 10.4). The reach is transporting its sediment supply without aggrading or degrading while maintaining its dimension, pattern, and profile. The reach used for the detail survey totals 389 feet. The survey included a longitudinal profile, cross-sections, bed material evaluation, buffer establishment, and system stability evaluation

The unnamed tributary to Tyson Creek reference reach was characterized as a C5 stream type based on the 2002 survey (Table 10.4). The reach used for the survey totals 445 feet. The survey included a longitudinal profile, cross-sections, bed material evaluation, buffer establishment, and system stability evaluation. Historically, the reach was transporting its sediment supply without aggrading or degrading while maintaining its dimension, pattern, and profile. However, as observed in the May 2006 site visit, the reference reach has been flooded by beavers.

4.3 DISCHARGE

Bankfull discharge is defined as the dominant channel forming flow that moves the most sediment over time (Rosgen, 1994). This generally equates to a 1.2 to 1.5 year storm event in North Carolina. Bankfull discharge is estimated using various methods. Coastal Plain Regional Curves developed by the Stream Restoration Institute at North Carolina State University were reviewed (NCSRI, 2004). These curves provide a graphical representation of bankfull discharge to drainage area. A second method, based on channel morphology, was used to determine bankfull discharge. Once bankfull areas and bed roughness were determined from field surveys, Manning's equation is applied to calculate the mean velocity in the channel. This velocity is then multiplied by the channel area to determine the discharge. Shepard Run has an average bankfull velocity of 1.7 ft/s which equates to a discharge of 21.3 cfs. The unnamed tributary to Tyson Creek has an average velocity of 0.9 ft/s which equates to a bankfull discharge of 8.8 cfs. The calculated discharge compares well to the NCSU regional curves.

4.4 CHANNEL MORPHOLOGY

Bankfull width of the Shepard Run reference reach is approximately 7.8 feet and bankfull depth is approximately 1.6 feet. The reference reach has a sinuosity of 1.2 and a radius of curvature of 8.0 – 14.0. The width-to-depth ratio of 5 is low and the entrenchment ratio of 17.1 is slightly entrenched as expected for a C type stream. Both the reference reach and the mitigation Site's streambed material are dominated by sand. The completed NCDWQ stream form is located in Appendix 8. The stream classification form indicates that the stream is at least intermittent. Photographs of Shepherd Run are presented in Appendix 5 and the reference reach data are presented in Table 10.4.

Bankfull width of the unnamed tributary to Tyson Creek is approximately 14.6 feet and bankfull depth is approximately 0.6 feet. The reference reach has a sinuosity of 1.2 and a radius of curvature of 8 – 21. The

width-to-depth ratio of 22 is moderate to high and entrenchment ratio of 8.2 is slightly entrenched as expected for a C type stream. Both the reference reach and the mitigation site's streambed material are dominated by sand. The completed NCDWQ stream form is located in Appendix 8. The stream classification form indicates that the stream is at least intermittent. Photographs of the unnamed tributary to Tyson Creek are presented in Appendix 5 and the reference reach data are presented in Table 10.4.

4.5 CHANNEL STABILITY ASSESSMENT

Each reference reach was analyzed for overall stability. This analysis included the morphological assessment as mentioned above, and calculations of shear stress and stream power. Shepard Run exhibits a shear stress of 0.20 lb/sqft and a stream power of 0.34lb/ft/s. The unnamed tributary to Tyson Creek exhibits a shear stress of 0.08 lb/sqft and a stream power of 0.07 lb/ft/s. Field observations indicated no severe bank erosion or lateral migration of the channel. Heavy vegetation, which occurs over the majority of the stream banks, is providing valuable protection. The proposed channel design for the Oakley Crossroads Site utilizes lower shear stresses and stream power due to the lack of vegetation upon completion of construction.

4.6 BANKFULL VERIFICATION

In reference systems, bankfull is typically the top of bank or very near so. The existing bankfull elevations and bankfull cross sectional areas were determined in the field by locating the top of bank or back of point bars. These bankfull dimensions were then compared to the Coastal Plain Regional Curves for verification (NCSRI, 2004). The morphological data, including bankfull dimensions, for each reference reach is presented in Table 10.4.

4.7 VEGETATION

Although the stability of the two original reference stream channels has deteriorated, their riparian buffers remain good vegetative references for the proposed buffers at the Oakley site. Shepherd Run flows through a well-established buffer. The canopy is comprised of red maple, sweetgum (*Liquidambar styraciflua*), American holly (*Ilex opaca*), sweetbay magnolia (*Magnolia virginiana*), and green ash (*Fraxinus pennsylvanica*). Plants in the understory include Virginia chain fern (*Woodwardia virginica*), grapevine (*Vitis* sp.), greenbriar (*Smilax* sp.), jewelweed (*Impatiens* sp.), clearweed (*Pilea pumila*), lizards tail (*Saururus cernuus*), tag alder (*Alnus serrulta*), blackberry, arrowleaf tear thumb (*Polygonum sagittatum*), and various types of grasses.

The vegetative communities surrounding the unnamed tributary to Tyson Creek include a bottomland hardwood forest and a mesic hardwood forest. Dominant canopy and shrub vegetation in the bottomland hardwood forest included red maple, green ash, ironwood (*Carpinus caroliniana*), and Chinese privet (*Ligustrum sinenese*). Herbaceous species vary with the degree of flooding and include lizard's tail, arrowleaf tearthumb, sedges (*Carex* sp.), clearweed, water pennywort (*Hydrocotyle* sp.), giant cane (*Arundinaria gigantea*), cattails (*Typha* sp.), southern lady fern (*Athyrium asplenioides*), and netted chain fern (*Woodwardia areolata*). Although the NWI mapping indicates that no wetland areas are adjacent to the unnamed tributary to Tyson Creek, hydrophytic vegetation and wetland hydrology are present. The dominant upland vegetation in the mesic hardwood forest included beech (*Fagus grandifolia*), American

holly, and tulip poplar (*Liriodendron tulipifera*). Understory species included greenbriar, grapevine, poison ivy (*Toxicodendron radicans*), and trumpet creeper (*Campsis radicans*).

5.0 Project Site Wetlands

5.1 JURISDICTIONAL WETLANDS

The methods outlined in the US Army Corps of Engineers (USACE) Wetlands Delineation Manual (Environmental Laboratory, 1987) were used to delineate the jurisdictional wetlands within the Oakley Crossroads project area (Appendix 2). Approximately 3.7 acres of existing wetlands are located within the conservation easement along the unnamed tributary (Figure 11.5). Mike Bell of the USACE verified jurisdictional wetlands on April 1, 2004. The jurisdictional determination letter and wetland map is included in Appendix 2. The delineated wetlands include open herbaceous areas along the lower (Briley) portion of the site and an area of remnant bottomland hardwood forest around the Taylor pond. Wetland rating forms are included in Appendix 3.

Portions of the Taylor portion of the site were designated as prior converted (PC) cropland by the United States Department of Agriculture Farm Services Agency and were under cultivation as recently as 2002. Since acquisition of the conservation easement, the land has been left fallow and herbaceous wetland vegetation and saplings have begun to populate these areas. The PC land will be selectively planted with woody wetland vegetation and will likely be considered wetland enhancement.

Three areas of jurisdictional wetlands were delineated within the project area. The only forested wetland on the site is a 1.11-acre area of bottomland hardwood forest adjacent to the Taylor pond (Figure 11.5). Two herbaceous wetlands are located on the north and south sides of the stream on the Briley property. The 0.77-acre herbaceous wetland on the north side is separated from the bottomland hardwood wetland by fill for an old farm road. This area of wetland grasses and herbs extends east to the spoil pile present around the Briley pond. The one-acre wetland south of the stream channel also contains a few scattered areas of black willow.

Wetland data forms for the delineated wetlands are provided in Appendix 2 and demonstrate that the existing wetlands support hydrophytic vegetation, wetland hydrology, and display hydric soil conditions. Figure 11.5 shows the existing wetland areas.

5.2 HYDROLOGICAL CHARACTERIZATION

5.2.1 Hydrologic Budget for Restoration Site

Hydrology for the existing wetland areas has come from poor drainage of stormwater runoff from the adjacent fields, occasional overflow from the irrigation ponds, and occasional overflow from the stream channel being blocked by beaver dams or the flashboard risers. Spoil piles around the irrigation ponds and along lower portions of the stream channel also assist with the ponding of rainfall and runoff. The Priority 1 restoration of the stream channel will greatly enhance the overbank flooding within the stream valley

therefore enhancing the hydrology of the existing wetlands and potentially expanding the proposed riverine wetland areas.

5.3 SOIL CHARACTERIZATION

The soil survey for Pitt County (Karnowski et al., 1974) indicates that the majority of the easement is underlain by Bladen fine sandy loam and Pantego loam, both hydric soils. Other soils mapped within the easement include Coxville fine sandy loam, Craven fine sandy loam, Goldsboro sandy loam, Norfolk sandy loam, Ocilla loamy fine sand, Rains fine sandy loam and Wagram loamy sand (Figure 11.4). As discussed in Section 5.1, portions of the site are designated as prior converted (PC) cropland according to the United States Department of Agriculture Farm Services Agency.

5.3.1 Taxonomic Classification

Bladen fine sandy loam is a poorly drained soil found on level upland areas. The high water table is seasonally at or near the surface. Infiltration is moderate and runoff is slow to ponded. The shrink-swell potential of this soil is moderate and permeability is slow. Bladen soils are located in the southwestern section of the stream restoration project and buffer restoration area on the Lorraine and James Taylor properties. Bladen soils are clayey, mixed, thermic Typic Albaquults and are classified as hydric soils by the NRCS.

Pantego loam consists of very poorly drained soils on level upland areas. Infiltration is moderate, and surface runoff is very slow. The seasonal high water table is at or near the surface. Pantego soils are mapped in the northeast section of the conservation easement and underlie over half of the stream restoration segment. Pantego soils are fine-loamy, siliceous, thermic Umbric Paleaquults and are classified as hydric soils by the NRCS.

Coxville fine sandy loam is a poorly drained soil found on smooth flats or in depressions in uplands. Infiltration is moderate and runoff is slow to ponded. The seasonal high water table is at or near the surface. This soil is mapped on the eastern portion of the Bullock property underlying the stream area that is not being restored but joins the buffer preservation area. Coxville soils are also mapped on the Lorraine Taylor property in the proposed buffer restoration area. Coxville soils are clayey, kaolinitic, thermic Typic Paleaquults and are classified as hydric soils by the NRCS.

Craven fine sandy loam is a moderately well-drained soil found on nearly level to sloping upland areas. Infiltration is moderate and runoff is medium to rapid depending upon slope. Permeability is slow and shrink-swell potential is high. The water table is at a depth of about 2.5 feet. Gray mottles may be found in zones affected by the high water table. Craven soils are clayey, mixed, thermic Aquic Hapludults. These soils are mapped in the eastern section of the project where buffer restoration is proposed.

Goldsboro fine sandy loam consists of very deep, moderately permeable, moderately well drained soils that formed in unconsolidated stratified Coastal Plain sediments, dominantly of medium texture. These soils are located on uplands in broad interstream divides in the Coastal Plain and have slopes ranging from 0 to 10 percent. The water table is at a depth of 1.5 to 2.5 feet below the surface from December to April. Goldsboro soils are classified as fine-loamy, siliceous, thermic Aquic Paleudults. These soils are mapped in a small area on the southeastern section of the project where buffer restoration is proposed.

Norfolk sandy loam is a well-drained soil on nearly level to gently sloping upland areas. Infiltration is moderate and runoff is slow to medium. The seasonal high water table is below a depth of five feet. Permeability is moderately and shrink-swell potential is low. Norfolk soils are fine-loamy, siliceous, thermic Typic Paleudults and are mapped on the south and northwest edges of the project boundary within the buffer restoration area.

Ocilla loamy fine sand is a somewhat poorly drained soil on uplands and stream terraces. Infiltration is rapid and runoff is slow. The seasonal high water table is at a depth of approximately 2.5 feet. Permeability is moderate and shrink-swell potential is low. Ocilla soils are loamy, siliceous, thermic Aquic Arenic Paleudults. A small area of this soil type is mapped on northern side of the Taylor pond within the buffer restoration area.

Rains fine sandy loam consists of poorly drained soils on level upland areas. Infiltration is moderate, and surface runoff is slow or ponded. The seasonal high water table is at or near the surface. A small area of this soil type is mapped on northern side of the Taylor pond within the buffer restoration area. Rains soils are fine-loamy, siliceous, thermic Typic Paleaquults and are classified as hydric soils by the NRCS.

Wagram loamy sand is a well-drained soil on smooth wide divides and stream terraces. Infiltration is rapid and runoff is slow. The seasonal high water table is below a depth of five feet. Permeability is moderately rapid and shrink-swell potential is low. Wagram soils are loamy, siliceous, thermic Arenic Paleudults and are mapped on the northwest corner of the project boundary within the buffer restoration area.

5.3.2 Profile Description

Seven soil profiles were evaluated across the Oakley Crossroads Site on July 11, 2002 and May 18, 2006 (Figure 11.4 and Table 10.3). In general, the soils observed onsite exhibit low chroma matrices indicative of water movement in the pedon. Layering of various textured sediments was observed and is likely due to historical agricultural activities. In some areas (profiles 3, 5 and 6) muck is overlain by mineral soils. Profiles 1, 2, 6, and 7 are located within the area mapped as the Bladen soil series by the NRCS. The soils in this area were sandier textured and darker in color than the typical soil series. Profiles 3, 4, and 5 are located in the area mapped as the Pantego soil series. These soil profiles were more stratified than typical Pantego soils, likely due to past disturbance.

None of the soil samples indicated highly restrictive layers that may affect stream or wetland restoration. Water tables in the sampling locations outside the existing wetlands ranged from 20 to 32 inches below the surface while areas of surface water were present within the existing wetlands. The topsoil across the site ranges from 6 to 22 inches deep, and contains a fair amount of organic matter. No constraints for stream and wetland restoration were observed onsite.

5.4 PLANT COMMUNITY CHARACTERIZATION

Vegetative communities present on the project site include fallow fields, mesic hardwood forest, bottomland hardwood forest, and herbaceous wetlands (Figure 11.5). Agricultural row crops are located adjacent to the project site. The fallow fields contain various grasses and saplings, including broomsedge, blackberries, goldenrod, American sycamore, red maple, and sweetgum that have colonized these areas.

The herbaceous wetland areas are dominated by rush, seedbox (*Ludwigia altemifolia*), broomsedge, goldenrod, giant bristlegrass (*Setaria magna*), and arrowleaf tearthumb. Within the wetland south of the stream there are also scattered specimens of black willow and elderberry (*Sambucus canadensis*).

The existing bottomland hardwood (Schafale and Weakley, 1990) wetland includes red maple, sweetgum, black willow, tag alder, elderberry, lizard's tail, and clearweed. The more open area at the eastern end of this wetland also includes cattails, rushes, sedges, trumpet creeper, arrowleaf tearthumb, giant cane, and blackberries. Although this community seems to have been impacted by past agricultural activities, hydrophytic vegetation has re-colonized the area and the community appears to be stabilizing. Upland vegetation adjacent to the wetland area includes sweetgum, American sycamore, red maple, loblolly pine (*Pinus taeda*), black cherry (*Prunus serotina*), winged sumac (*Rhus copallina*), and goldenrod.

The mesic hardwood forest (Schafale and Weakley, 1990) located along the north side of the stream channel at the east end of the project is dominated by red maple, sycamore, elderberry, sweetgum, black cherry, winged sumac, and tulip poplar.

6.0 Reference Wetlands

Reference wetlands were used to provide guidance on re-establishing the bottomland hardwood forests at the Oakley site. A review of potential reference wetlands was conducted prior to beginning fieldwork. Suitable reference wetlands were identified based on a review of USGS Quadrangles, the Pitt County Soil Survey, land use activities, hydrologic regimes, and vegetation. One reference wetland was identified at the site. The other reference wetland was identified at the Shepherd Run reference stream site.

The on-site reference wetland is a small remnant bottomland hardwood forest adjacent to the unnamed tributary to Tranters Creek (Figure 11.5). A farm pond, agricultural fields, and the unnamed tributary to Tranters Creek bound this wetland. The Shepherd Run reference wetland is a bottomland hardwood forest associated with Shepherd Run and is located in Greene County (Figure 11.7). Photographs of the two reference wetlands are shown in Appendix 5 and the wetland data forms, which indicate that the sites support hydrophytic vegetation, hydrologic conditions, and hydric soils, are provided in Appendix 6. The wetland rating form is included in Appendix 7.

6.1 HYDROLOGICAL CHARACTERIZATION

According to National Wetlands Inventory (NWI) mapping, the project site wetland is designated a palustrine, emergent, broad-leaved deciduous, seasonally flooded, partially drained/ditched wetland (PEM1Cd). Hydrologic field indicators included surface soil saturation, inundation, drainage patterns, and drift lines. According to NWI mapping, the Shepherd Run wetland is designated a palustrine, forested, broad-leaved, deciduous wetland (PFO1). Hydrologic field indicators included surface soil saturation in the upper 12 inches, inundation, and drainage patterns in the wetlands.

6.1.1 Gauge Data Summary

Gauges have not been installed at the onsite or Shepherd Run reference wetlands.

6.2 SOIL CHARACTERIZATION

6.2.1 Taxonomic Classification

Trees in the onsite wetland displayed multiple trunks (which is a morphological adaptation in response to inundation or soil saturation) and oxidized root channels were observed in the soil. The onsite reference wetland is mapped as a Pantego loam (Figure 11.4). The Pantego series consists of very poorly drained soils on level upland areas. Infiltration is moderate, and surface runoff is very slow. The seasonal high water table is at or near the surface. Pantego soils are fine-loamy, siliceous, thermic Umbric Paleaquults and are classified as hydric soils by the NRCS.

Soils in the Shepherd Run reference wetland are mapped as Bibb loamy sands (Figure 11.9). The Bibb series consists of poorly drained, nearly level soils on floodplains. Infiltration is moderate, and surface runoff is slow. The seasonal high water table is at or near the surface. Bibb soils are coarse-loamy, siliceous, active, acid, thermic Typic Fluvaquents and are classified as hydric soils by the NRCS.

6.2.2 Profile Description

The onsite reference soils were examined during the wetland delineation. The surface layer was a very dark gray (10YR 3/1) loam from 0 to 12 inches followed by a black (10YR 3/1) sandy clay loam to beyond 18 inches. The soils at the Shepherd Run wetland reference site included a surface layer of very dark gray (7.5YR 3/1) sandy loam from 0 to 12 inches that transitioned to a very dark gray (7.5YR 3/1) loam to beyond 24 inches.

6.3 PLANT COMMUNITY CHARACTERIZATION

6.3.1 Community Description

The dominant vegetative species within the canopy of the Shepherd Run reference wetland include red maple, green ash, and sweetbay magnolia. Shrubs and vines include tag alder, swamp dogwood (*Cornus stricta*), Chinese privet, blackberry and greenbrier. Herbaceous species vary with the degree of flooding and include lizard's tail, tearthumb, rushes, sedges, clearweed and netted chain fern. A general vegetative community map for the Shepherd Run watershed is included in Figure 11.8.

The dominant vegetative species within the canopy of the onsite reference wetland include red maple, sweetgum, sycamore, and black willow. Shrubs and vines included tag alder, elderberry, trumpet creeper, and blackberry. Herbaceous species vary with the degree of flooding and include lizard's tail, tear thumb, rushes, sedges, clearweed, giant cane and cattails. The vegetative communities in and around the onsite reference wetland can be observed on Figure 11.5.

7.0 Project Site Restoration Plan

7.1 RESTORATION PROJECT GOALS AND OBJECTIVES

The health of a watershed is dependent on the quality of the headwater system(s), individual tributaries, and major channels. High quality tributaries with vegetated buffers filter contaminants, maintain moderate water temperatures, provide high quality aquatic and terrestrial habitat and regulate flows downstream. Land use practices in the Tranters Creek watershed have maximized available land for agricultural uses. The Oakley stream channel is a tributary to Tranters Creek, which flows into the Tar River just west of Washington, NC. The unnamed tributary, Tranters Creek, and the Tar River are all nutrient sensitive waters (NCDWQ, 2004). Agricultural land use practices have narrowed or removed many natural, vegetated buffers along streams within the Tar River watershed as well as draining and converting many wet hardwood forests to cropland. The restoration of the Oakley unnamed tributary and riparian wetlands will enhance structural and functional elements within the Tranters Creek watershed.

The goal of the Oakley restoration project is to improve water quality and wildlife habitat by restoring a stable stream and wetland system to the project site (Table 10.1). This involves the Priority 1 restoration of the stream channel and associated riparian buffers, as well as the restoration and enhancement of a bottomland hardwood wetland system along the restored stream channel. The restored site will provide a wildlife corridor between Tranters creek and forested areas along Briery Swamp to the south.

Priority 1 stream restoration will be carried out on the project reach of the Oakley site. This will involve reconnecting the stream channel to a floodplain which will allow overbank flooding to more easily access existing and restored riverine wetlands. Water quality functions will be improved due to floodplain processes, increased filtering of pollutants, and attenuation of floodwaters. The stream restoration will also improve the aquatic habitat in the channels by restoring riffle / pool sequences and adding structures such as cross vanes and root wads which will help stabilize the channel as well as add diversity to the instream habitat. Barring any outside water quality issues, the restoration should improve the aquatic species diversity and abundance in the stream channel.

Specific project goals:

- Provide a stable stream channel (3,800 linear feet of stream restoration)
- Restore 20.9 acres and preserve 1.52 acres of riparian buffers along stream channel
- Improve aquatic and terrestrial habitat along a tributary to Tranters Creek
- Establish a wildlife corridor between the Tranters Creek and Briery Swamp to the south
- Restore 2.58 acres, enhance 2.60 acres, and preserve 1.11 acres of riverine wetlands
- Improve water quality by diverting an existing agricultural ditch from the stream channel into the Taylor pond

7.1.1 Designed Channel Classification and Wetland Type

The proposed stream channels are designed using Rosgen's Natural Channel Design Methodology (Rosgen, 1996). Typical morphological characteristics were obtained from stable reference reaches, checked against the appropriate regional curves, and utilized as design dimension, pattern, and profile parameters. A combination of Priority 1 restoration techniques and floodplain grading are proposed for the restoration. The majority of the floodplain grading will occur on the upstream end of the project. As the restoration moves downstream, the need for floodplain grading will be reduced. The channel slope will be adjusted with the change in the existing floodplain slope.

Utilizing reference reach surveys, dimensionless ratios were calculated in order to determine stable channel dimension, pattern and profile ranges for the restoration. The stream design parameters also include the stream being able to transfer sediment through the reach without aggrading or degrading. Maintaining the parameters for the natural stable dimension, pattern and profile, the proposed stream design is located in the lowest part of the natural stream valley. The proposed alignment is also outside of the existing channel as much as practicable to ease construction. See Sheet 12.2 for a plan view of the stream reach. The longitudinal profile was designed in order to achieve bankfull elevations as close to the existing valley floor as possible (Sheet 12.12). Facet slopes for each feature are derived from reference reach ratios. To ensure the channel functions naturally, the proposed profile is tied into the existing channel below the restoration. At a minimum, grade control structures are added at the upper and lower limits of each reach. Additional structures will be added for habitat and stability. Flood analysis ensures that the stream restoration project will not increase flood stage following construction.

The proposed channel design follows that of a stable E5 stream (Sheet 12.2). A typical E5 stream is a slightly entrenched, meandering, sand dominated, riffle-pool channel with a well-developed floodplain (Rosgen, 1996). The E5 stream type is typical of coastal plain areas such as the Oakley Site. E channels typically exhibit a width-to-depth ratio less than 12. The proposed width-to-depth ratio at the Oakley site is eight. Sod mats and brush mattresses will be used to keep adequate riparian vegetation, it is anticipated that the constructed channels will become narrower over time and morph into more of an E channel with a low width to depth ratio. E channels are low width to depth ratio streams that are extremely efficient in transporting their sediment. Typical riffle and pool cross sections are included on Sheet 12.4.

As part of the channel restoration, the flashboard riser system on the Briley portion of the stream will be removed. In accordance with the landowner agreements made by the State, a high water diversion will be incorporated into a vane structure to assist with maintaining water levels in the Briley pond. Also, a low water, ford stream crossing will be constructed at the Riley / Briley property line to replaced a failed concrete slab bridge. Existing farm roads and stream crossings on the Taylor and Briley properties will remain.

Wetlands on the Oakley project site will be significantly increased through the restoration of riverine bottomland hardwood forest along the restored stream channel and the enhancement of existing wetland areas through the selective planting of hardwood species (Sheet 12.3). Re-connecting the stream channel to its floodplain will allow more frequent overbank flooding to occur within the stream valley. This overbank flooding along with the stormwater runoff from the adjacent fields will provide the hydrology needed to support the bottomland hardwood forest wetland community within the project area. The construction of the lower portion of the stream restoration will temporarily impact 0.36 acres of the

wetland on the south side of the channel. All of the impacted area except the area that is being converted to the new stream channel will be restored to riverine bottomland hardwood forest.

7.1.2 Target Wetland and Buffer Communities

With a Priority 1 stream restoration, the stream will be reconnected with the existing floodplain allowing an increase in flooding across the project area and in time should raise the groundwater levels within the conservation easement. This increase in overbank flooding and groundwater should support wetland hydrology through much of the project area. The target wetland community for the area within the grading limits of the restored stream channel is a Coastal Plain Riverine Bottomland Hardwood Forest. Outside the grading limits the Bottomland Hardwood Forest will grade slowly up into a Coastal Plain Mesic Mixed Hardwood Forest. The existing herbaceous wetlands will be enhanced with plantings of hardwood trees. The final extent of the wetland coverage is difficult to predict and will depend on minute variations in the hydrology of the site.

The Bottomland Hardwood Forest will comprise the bulk of the riparian buffer along the restored channel. Mesic Mixed Hardwood Forest will be restored along the upper and lower portions of the conservation easement outside the stream restoration. Most of the conservation easement will be selectively planted as needed. Since the stream is being restored to the south side of the existing channel to minimize construction costs, the riparian buffer within the conservation easement will narrow to an average width of 25 feet off the outer meander bends through middle section of the south side of the project area. Outside this section the buffers expand back out to 70 to 100 feet in width. The riparian buffer within the conservation easement on the north side of the channel will range from 130 feet to over 200 feet in width between the ponds.

Existing forested areas outside of construction limits will be left as is and existing desirable saplings will be preserved as much as possible. Typical plant species identified in the reference wetlands, as well as those identified in Schafale and Weakley (1990) descriptions for the target wetlands were utilized as a guide in developing the planting scheme (Table 10.5).

7.2 SEDIMENT TRANSPORT ANALYSIS

7.2.1 Methodology

A stable stream has the ability to transfer its sediment load without aggrading (depositing sediment) or degrading (scouring sediment) over long periods of time. The stream design is based on a comparison with the existing channel's aggrading/degrading pattern and adjusting the proposed channel's shear stress and stream power such that the channel has the ability to transfer its sediment load in a stable manner. The geometry and profile of the proposed stream combine to provide a stream that will convey the bankfull discharge and transport the stream's sediment supply. Grade control devices will be installed to further reduce the possibility of degradation within the restored channel.

7.2.2 Calculations and Discussion

When working with a sandbed channel the standard practice is to evaluate the stream power of the channel. Stream power is the product of the shear stress and the bankfull flow velocity. The proposed channel plan, dimension, and profile are designed such that the stream power is close to or slightly less than the existing channel conditions (Table 10.4). As mentioned above, the existing channels exhibited bank stability and low stream power.

7.3 HEC-RAS ANALYSIS

7.3.1 No-rise, LOMR, CLOMR

The methodology used to evaluate the hydrologic analysis required the evaluation of the existing stream's bankfull elevation and corresponding bankfull area. Due to the severe alterations in the stream channels at the Oakley Crossroads site, bankfull indicators were not easily observed in the field. For this reason, the Coastal Plain Regional Curves were used to verify the bankfull dimensions surveyed (NCSRI, 2004). Also, bankfull discharge was verified with the regional curves equation below.

$$Q = 16.56 (A_{watershed})^{0.72} \quad R^2 = 0.90 \text{ (NCSRI, 2004)}$$

Hydrologic Engineering Center's River Analysis System (HEC-RAS) was used to evaluate how the discharge flows within the proposed channel geometry (USACE, 1997). This evaluation verifies that the proposed plan, dimension, and profile would adequately carry the discharge at the bankfull stage, the point where water begins to overflow onto the floodplain.

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 the HEC-RAS Version 3.1.3 software from the US Army Corps of Engineers Hydrologic Engineering Center (USACE, 1997).

HEC-RAS is a software package that is designed to perform one-dimensional, steady flow, hydraulic calculations for water surface profiles for a network of natural and constructed channels. The model is based on the energy equation, and 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. The HEC-RAS analysis was executed several times utilizing the USGS, and NCSRI discharge values.

The bankfull discharge for the Oakley site ranges between 23.0 and 30.0 ft^3/s based on evaluation of the design with the North Carolina Coastal Plain Regional Curve (Table 10.4). The existing bankfull velocity is approximately 1.9 ft/s. The proposed design will slightly reduce the bankfull velocity, and allow the proposed geometry, pattern and profile to reduce the shear stress and stream power from the existing stream condition. The existing and proposed geometries were evaluated at the bankfull discharge rates, using HEC-RAS. This evaluation verifies that the proposed plan, dimension, and profile would adequately carry the discharge at the bankfull stage, the point where water begins to overflow onto the floodplain.

7.3.2 Hydrologic Trespass

Geometric data and steady flow data are both required to run HEC-RAS. The 100-year discharges were determined using the USGS Rural Coastal Plain flood-frequency equations (Pope *et al.*, 2001).

The HEC-RAS model was used to evaluate the effect of the project on flood elevations. The analysis shows that the restored channel adequately carries the bankfull stage and flood elevations are not increased within the project area during the 100-year discharge and bankfull discharge. In fact, the analysis indicates that the water surface elevation will be reduced by 0.05 feet at the upstream end of the project (Appendix 9, HEC-RAS Section 59). The HEC-RAS plan sheet flooding limit layout is shown in Sheet 12.11.

7.4 HYDROLOGIC MODIFICATIONS

As described in section 7.2.1 the Priority 1 stream restoration will restore much of the hydrology within the conservation easement, which will support the restoration and enhancement of wetlands. Increased overbank flooding and higher groundwater levels should result from the stream restoration. Much of the old channel will be plugged and filled with material excavated from the new channel and the pond expansion.

The existing agricultural ditch currently entering the stream channel will be diverted into the Taylor pond (Sheet 12.6). This will help to maintain water levels in the pond as well as reuse and filter agricultural runoff before it enters the tributary. Both irrigation ponds will be enlarged to offset the loss of using the flashboard riser system in the stream. The existing diversion pipe from the stream channel to the Briley pond will be replaced with a similar diversion to allow high stream flows to continue to fill the pond.

7.5 SOIL RESTORATION

The recommended construction sequence will include removing the existing topsoil within the areas to be restored prior to construction. The excavated material will be stockpiled and then spread across the wetland restoration areas to help jumpstart the vegetation and provide a more nutrient rich substrate for the establishment of planted vegetation. Compacted areas of the subsoil will be “deep ripped” prior to planting.

7.6 NATURAL PLANT COMMUNITY RESTORATION

7.6.1 Narrative & Plant Community Restoration

As previously discussed, the target wetland community is a bottomland hardwood forest along the restored stream channel and mesic mixed hardwood forests at higher elevations in the extended buffer zone. It is anticipated with the Priority 1 restoration that much of the area within the conservation easement will revert to wetlands as the hydrology is restored. However, taking a conservative approach, only the area along the restored stream channel between the grading limits is being counted as wetland restoration at this time. The planting plan was designed to include species that would be found in the bottomland hardwood forest and mixed mesic hardwood forest (Coastal Plain subtype) communities as

described by Schafale and Weakley's Classification of the Natural Communities of North Carolina (1990).

Based on the grading plans, site elevations, predicted flooding, and best professional judgment, the Oakley Site has been divided into three planting zones (Table 10.5 and Sheet 12.5). Zone 1 is a streamside zone in which fast growing woody shrubs and trees will be live staked to quickly stabilize the newly created streambanks. Zone 2 will consist of the bottomland hardwood forest and will be include the projected wetland along the restored channel as well as the majority of the conservation easement including the herbaceous wetlands. Zone 3 is limited to the higher elevations to be left in the project area as well as riparian buffer along unrestored stream reaches. Zone 3 will be planted with drier species typically found in the mesic mixed hardwood forest.

Trees will be planted on average 8-foot centers, for a planting density of 680 stems per acre. Planting densities on streambanks will average 3 to 4 foot centers. Plantings will consist of bare root seedlings and live stakes. Since the establishment of the conservation easement, there has been considerable natural recruitment of trees, shrubs, and herbaceous vegetation. Desirable trees will be marked for preservation and the plantings adjusted around them. This should reduce planting costs and increase survivorship in the project area. Site modifications will attempt to provide adequate hydrology for those vegetative species proposed for planting. Based on additional soil and groundwater data and vegetative species availability, these grades and planting species may be modified.

It may be necessary to "deep rip" the disturbed portions of the Oakley Site in order to ensure proper root development and promote infiltration. Site modifications will help to provide adequate hydrology for those vegetative species proposed for planting.

7.6.2 On-site Invasive Species Management

It is not anticipated that invasive plant species will be a significant problem on the Oakley Restoration Site. During the first year of monitoring, any invasive species problems will be noted and specific management options will be proposed.

7.7 WILDLIFE MANAGEMENT

Historic and current beaver activity on the site may require future management. The presence or absence of beavers, especially in small headwater streams can result in dramatic differences in vegetation along the stream channel and in-stream habitat (diversity/composition) due to beaver modifications. Beaver activity can be a problem in certain areas of a watershed because the dams that are built flood areas and slow the water flow contributing to increased sedimentation. Benefits derived from beavers include their ability to maintain wetland systems in the landscape and create new habitats for plants, fish, and other wildlife. Beaver ponds are critical for slowing stormwater runoff, trapping sediments, and maintaining summer base flows among other ecological benefits.

To address some of the detrimental aspects of beavers, the North Carolina legislature in 1992 created the Beaver Damage Control Advisory Board with the charge to develop, implement, and oversee a program to manage beaver damage on public and private lands. The goal of the Beaver Management Assistance Program (BMAP) is to educate the public and participating landholders about the best strategies for

managing beaver damage including the pros and cons of removing beavers or using pond levelers, exclusion, or other non-lethal techniques. The BMAP program provides assistance to the NCDOT, city and county governments, soil and water conservation districts, private landholders, and others with beaver problems. The program is run by the USDA Wildlife Services through a cooperative agreement with the North Carolina Wildlife Resources Commission. Funding comes from state, county, federal, and private sources (http://www.ncwildlife.com/pg06_coexistingwildlife/pg6b2.htm).

Alternate beaver management options utilized by other states include fencing and flow control devices. Since beavers typically only fell trees within 200 feet of the shoreline, erecting temporary fencing around the plantings at the restoration site or wrapping trees with chicken wire or hardware cloth can act as an effective beaver deterrent. Flow control devices can alleviate flooding and damming problems by beavers. An example of a flow control device is the "beaver deceiver" which was developed by Skip Lisle, wildlife biologist with the Penobscot Nation in Maine (http://dnr.metrokc.gov/wlr/Dss/beavers/beaverintro.htm). The device reduces the noise of running water through a culvert by the installation of a receiver fence. The receiver fence and the round fence act as "filters" by diffusing the incoming water over a large area to prevent the beavers from determining where the water is leaving the system and it prevents them from blocking the pipe or culvert.

Beaver management should include an initial trapping program on the Oakley site, protection for tree seedlings planted in riparian areas, and removal of blockages in the restored stream channel during the monitoring period.

8.0 Performance Criteria

8.1 STREAMS

An as-built channel survey will be performed after construction. Permanent cross-sections will be established approximately one per 20 (bankfull-width) lengths representing pools and riffles. Profile surveys will be conducted along 3000 linear feet of the new channel as per NCEEP monitoring guidelines. Two crest-stage gauges will be installed in the restoration reach to verify that two bankfull events occur during the five-year monitoring period. Photo reference points will be established at each cross-section and located on the as-built plan. Three forms of monitoring will be used to evaluate the success of the project: photo documentation, ecological function, and channel stability measurements. During the monitoring phase photo documentation will be provided of channel aggradation or degradation if applicable, bank erosion if applicable, success of riparian vegetation, effectiveness of erosion control measures and presence or absence of developing instream bars. Ecological function will be evaluated by surveying the health and survival of vegetation. In addition the restoration reach should mimic reference reach conditions. The channel will be considered stable if there are little or insignificant changes from the as-built dimensions and longitudinal profile. In addition pool/riffle spacing should remain constant, pools should not aggrade or riffles degrade. Finally, pebble counts should show a change in the size of bed material toward a desired composition.

8.2 WETLANDS

The wetland restoration areas will be monitored annually for five years following construction or until success criteria are met, whichever comes first.

Eight shallow groundwater/surface water gauges will be installed within the grading limits along the restored channel as well as in some areas outside the these limits to monitor the hydrologic success in the bottomland hardwood forest (Sheet 12.10). One of the eight gauges will also be placed in the relic bottomland hardwood forest as a reference. These gauges will measure surface water and groundwater over a 40-inch vertical column on a daily basis. Data from each of the gauges will be downloaded on a bi-monthly basis.

Hydrologic success will be based on the Oakley Crossroads Site achieving saturated soil conditions for a period equivalent to 12.5 percent of the growing season for Pitt County. The growing season for Jones County as defined by the Pitt County Soil Survey occurs from March 15 to November 16, a total of 246 days. In order to attain conditions suitable for the formation of wetland vegetation and hydric soils, the Site should be saturated within 12 inches of the surface or inundated for a consecutive period equal to 31 days. Overbank flooding will also be noted during monitoring. The hydrologic conditions of the restored wetlands will also be compared with conditions in the reference wetlands over the same time period.

8.3 VEGETATION

Vegetative sample plots will be quantitatively monitored during the growing season. According to NCEEP guidance, 1-2% of the planted area should be sampled. Based on the approximate areas of the two restoration types (bottomland hardwood forest and mesic mixed hardwood forest), 11 100-meter square vegetation plots will be established on the Oakley Crossroads Site. Vegetation sampling plots will be proximal to hydrology monitoring gauges, wherever practical, to assist in correlating vegetation and hydrology parameters. In each plot, species composition, density, and survival will be monitored. The four plot corners will be located using a Global Positioning System (GPS), permanently located with metal conduit stakes, and included in the “as-built” report for the Oakley Crossroads Site.

The vegetative success of the bottomland hardwood forest and mesic mixed hardwood forest will be evaluated based on the species density and survival rates. Vegetation monitoring will be considered successful if at least 260 trees/acre are surviving at the end of five years for each planting zone.

8.4 SCHEDULE & REPORTING

1. Restoration Plan	August 2006
2. Final Design	August 2006
3. Bid Administration	
• Execute Contract	October 2006
4. Construction Management	
• Begin Construction	November 2006
• Complete Construction/Planting	January 2007 / Planting February 2007
5. Mitigation Plan	March 2007
6. First Year Monitoring Report	October 2007

9.0 References

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10.0 Tables

Table 10.1 Restoration Structure and Objectives Project Number 050659701 (Oakley Crossroads)				
Restoration Reach	**Restoration Type**	**Priority Approach**	**Existing Linear Footage or Acreage**	**Designed Linear Footage or Acreage**
Stream	**Restoration**	**Priority 1**	**2950 feet**	**3800 feet**
Buffer	Restoration			20.86 acres
	Preservation			1.52 acres
Total Buffer Acres				**22.38 acres**
Riverine Wetland	Restoration			2.58 acres
	Enhancement			2.60 acres
	Preservation			1.11 acres
Total Wetland Acres				**6.3 acres**

Table 10.2 Land Use of Watershed Project Number 050659701 (Oakley Crossroads)		
Land Use	**Acreage**	**Percentage**
Agriculture	684.1	67.6%
Forested	312.9	30.9%
Other (includes Urban, Barren Land, Herbaceous Wetland as well as Open Water)	14.5	1.4%

Table 10.3 Summary of Soil Profiles Project Number 050659701 Oakley Crossroads Stream and Wetland Restoration					
Sample Number	**Soil Depth (inches)**	**Matrix Color**	**Mottle Color**	**Texture**	**Notes**
1	0 - 6	10YR 3/1		sand	
	6 - 10	10YR 4/1		sandy loam	
	10 - 14	10YR 3/1	7.5YR 5/6	sandy clay loam	oxidized rhizospheres
	14 - 28	10YR 3/1	7.5YR 5/6 5YR 4/6	clay loam	oxidized rhizospheres
	28 - 32	10YR 3/1		sandy loam	layers of sand mixed with sandy loam
	32 - 39	10YR 3/2		sandy clay loam to sandy loam	old fine roots present; soil will not stay in auger past 39”
2	0 - 22	10YR 3/2		loam	
	22 - 28	10YR 3/2 10YR 2/1	7.5YR 4/6	mucky very fine sand	oxidized rhizospheres
3	0 - 10	2.5Y 2.5/1		clay loam	
	10 - 22	10YR 2/1		muck	
	22 - 27	10YR 5/2 10YR 2/1	5YR 5/8	sandy clay	
4	0 - 14	10YR 3/1		loam	
	14 - 18	10YR 5/3	7.5YR 5/6 5YR 4/6	sand	oxidized rhizospheres
	18 - 24	10YR 4/2	7.5YR 5/6	sandy clay loam	oxidized rhizospheres
	24 - 32	10YR 4/1		layers of sandy loam, loam, and sandy clay loam	
5	0 - 6	10YR 2/2		loam	
	6 - 12	10YR 7/3		sand	matrix color is primary base color of sand
	12 - 24	10YR 5/1	7.5YR 5/6 5YR 4/6	sandy clay loam to clay	
	24 - 32	10YR 2/1		muck	buried muck layer was dried out
	32 - 34	10YR 4/1		sandy clay loam	
	34 - 48+	10YR 2/1		muck	
6	0 - 10	10YR 3/1		loamy sand	
	10 - 20	10YR 2/1		sandy clay	
	20 - 23	10YR 2/1		muck	
	23+	10YR 6/1	10YR 6/8	coarse sand	
7	0 - 11	10YR 4/2		loam	
	11 - 24	10YR 4/2		loamy sand	
	24 - 34	10YR 4/2	10YR 3/3 10YR 2/1	sandy loam	faint mottling; more clay
	34 - 42	10YR 5/1		sand and loamy sand layered	sand is coarse grained

Table 10.4 Morphological Table: Project Number 050659701 Oakley Crossroads Stream and Wetland Restoration					
Variables		**Existing Channel**	**Design Reach**	**Reference Reach**	**Reference Reach**
				UT to Tyson Creek	**Shepherd Run**
1. Stream Type		G5c	E5	C5	E5
2. Drainage Area (sq. mi)		1.59	1.59	0.65	1.37
3. Bankfull Width (Wbkf) ft	Mean:	10.4	12.3	14.6	7.8
4. Bankfull Mean Depth (dbkf) ft	Mean:	1.8	1.5	0.7	1.6
5. Width/Depth Ratio (Wbkf/dbkf)	Mean:	5.7	8.0	22.4	4.8
6. Bankfull Cross-Sectional Area (Abkf) sq ft	Mean:	19.0	19.0	9.5	12.6
7a. Bankfull Mean Velocity (Vbkf) fps	Mean:	1.9	1.7	0.9	1.7
7b. Bankfull Mean Velocity (SRI-NCSU) fps	Mean:	1.2	1.2	1.3	1.7
7c. TOB Mean Velocity (Vtob) fps	Mean:	3.0	1.2	1.3	1.7
8a. Bankfull Discharge (Qbkf) cfs	Mean:	30	30	8.8	21.3
8b. Bankfull Discharge (SRI-NCSU) cfs	Mean:	23.2	23.2	12.1	20.8
8c. TOB Discharge (Qtob) cfs	Mean:	141.0	23.2	12.1	20.8
9. Maximum Bankfull Depth (dmax) ft	Mean:	2.7	2.4	1.6	2.1
10. Width of Flood Prone Area (Wfpa) ft	Mean:	15	240	120	133
11. Entrenchment Ratio (Wfpa/Wbkf)	Mean:	1.4	19.5	8.2	17.1
12. Meander Length (Lm) ft	Mean:	N/A	86	58	92
	Min:		111	17	27
	Max:		135	100	156
13. Ratio of Meander Length to Bankfull Width	Mean:	N/A	7.0	4.0	11.8
(Lm/Wbkf)	Min:		9.0	1.2	3.5
	Max:		11.0	6.8	20.0
14. Radius of Curvature (Rc) ft	Mean:	N/A	27	14.5	11.0
	Min:		22	8.0	8.0
	Max:		31	21.0	14.0
15. Ratio of Radius of Curvature to Bankfull	Mean:	N/A	2.2	1.0	1.4
Width (Rc/Wbkf)	Min:		1.8	0.5	1.0
	Max:		2.5	1.4	1.8
16. Belt Width (Wblt) ft	Mean:	N/A	74	100	45
	Min:		62		
	Max:		86		

Table 10.4 Continued					
Variables		**Existing Channel**	**Design Reach**	**Reference Reach**	**Reference Reach**
				UT to Tyson Creek	**Shepherd Run**
17. Meander Width Ratio (Wblt/Wbkf)	Mean:	N/A	6.0	6.8	5.8
	Min:		5.0		
	Max:		7.0		
18. Sinuosity (Stream length/valley distance)	Mean:	1.01	1.28	1.18	1.18
19. Valley Slope (ft/ft)	Mean:	0.0018	0.0018	0.0017	0.0017
20. Average Slope - Water Surface	Mean:	0.0018	0.0014	0.0020	0.0020
21. Pool to Pool Spacing (p-p) ft	Mean:	N/A	62	35	29
	Min:		43	5	11
	Max:		74	67	47
22. Ratio of Pool-to-Pool Spacing to Bankfull	Mean:	N/A	5.0	2.4	3.7
Width (p-p/Wbkf)	Min:		3.5	0.3	1.4
	Max:		6.0	4.6	6.0
23. Max Pool Depth ft	Mean:	N/A	4.0	1.7	2.9
24. Ratio of Max Pool Depth to Bankfull Depth	Mean:	N/A	2.6	2.6	1.8
25. Pool Width ft	Mean:	N/A	21.0	17.0	20.0
26. Pool Width to Bankfull Width	Mean:	N/A	1.7	1.2	2.6
27a. Shear Stress (τ) lb/sqft	Mean:	0.20	0.14	0.08	0.20
27b. TOB Shear Stress (τ) lb/sqft	Mean:	0.41	0.14	0.08	0.20
28a. Unit Stream Power (ω) lb/ft/s	Mean:	0.38	0.23	0.07	0.34
28b. Unit Stream Power (ω) (SRI-NCSU)	Mean:	0.25	0.17	0.10	0.33
28b. TOB Unit Stream Power (ω)	Mean:	1.22	0.17	0.10	0.33

Table 10.5 Designed Vegetative Communities by Zone Project Number 050659701 Oakley Crossroads Stream and Wetland Restoration		
Common Name	**Scientific Name**	**Southeast Region Indicator**
Zone 1 Streambank		
Tag alder	*Alnus serrulata*	Facultative Wetland +
River Birch	*Betula nigra*	Facultative Wetland
Virginia willow	*Itea virginica*	Facultative Wetland +
Zone 2 Riverine Bottomland Hardwood Forest		
Overcup Oak	*Quercus lyrata*	Obligate Wetland
Swamp Cottonwood	*Populus heterophylla*	Obligate Wetland
Swamp Chestnut Oak	*Quercus michauxii*	Facultative Wetland -
Swamp Black Gum	*Nyssa sylvatica var. biflora*	Obligate
Willow Oak	*Quercus phellos*	Facultative Wetland -
Dog-Hobble	*Leucothoe racemosa*	Facultative Wetland
Elderberry	*Sambucus Canadensis*	Facultative Wetland -
Zone 3 Mesic Mixed Hardwood Forest		
Cherrybark Oak	*Quercus alcate* var *pagodaefolia*	Facultative +
Green Ash	*Fraxinus pennsylvanica*	Facultative Wetland
Black gum	*Nyssa sylvatica*	Facultative
American Sycamore	*Platanus occidentalis*	Facultative Wetland -
Water Oak	*Quercus nigra*	Facultative
Sweet Bay	*Magnolia virginiana*	Facultative Wetland+
Wax myrtle	*Morella cerifera*	Facultative +

11.0 Figures

Figure 11.1. Project Site Vicinity Map

Figure 11.2. Project Site Watershed Map

Figure 11.3 Project Site Property Ownership Map

Figure 11.4. Project Site NRCS Soil Survey Map (includes onsite reference wetland)

Figure 11.5. Project Site Hydrological Features Map (includes onsite reference wetland)

Figure 11.6. Reference Site Vicinity Map

Figure 11.7. Shepherd Run Reference Site Watershed Map

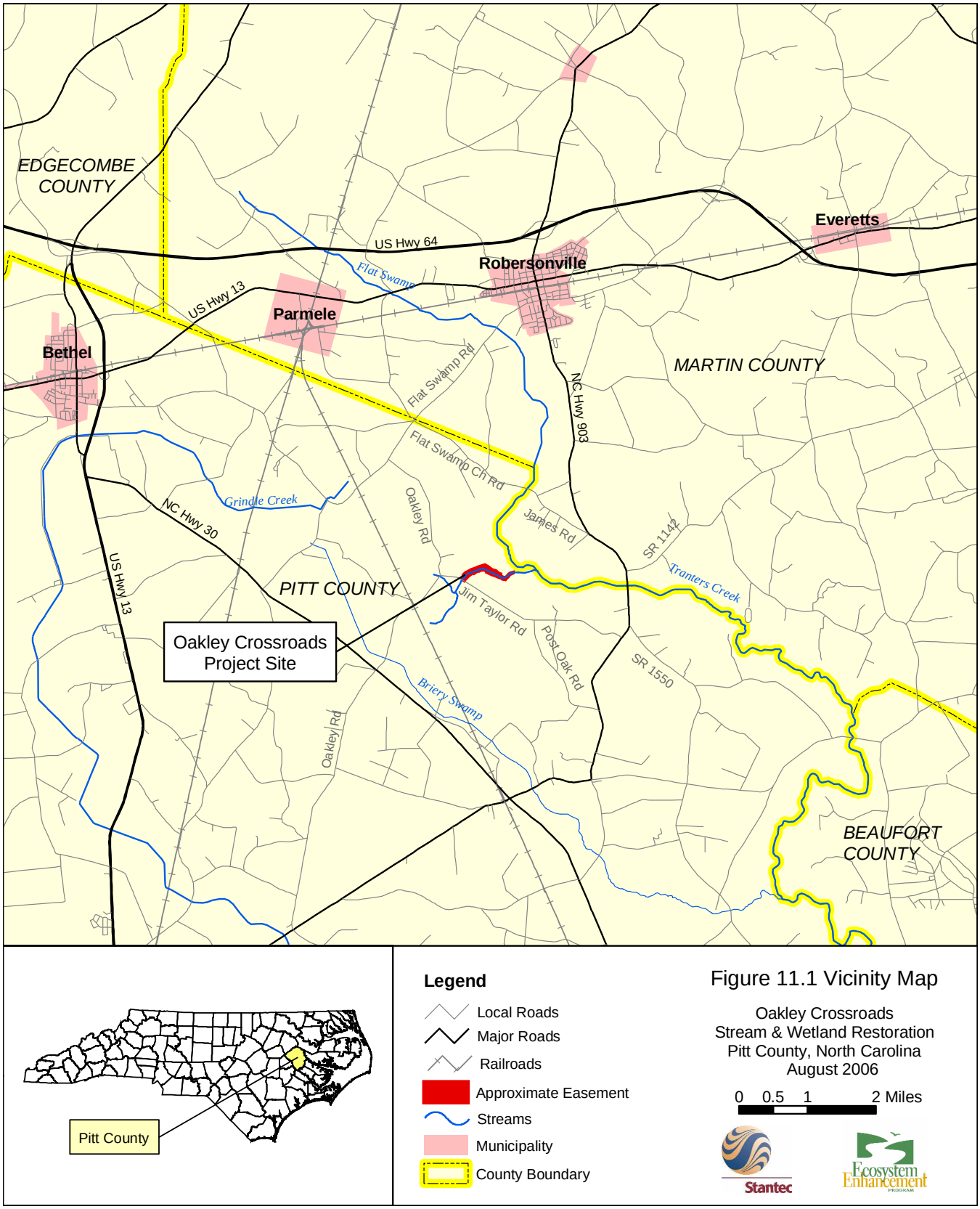
Figure 11.8. Shepherd Run Reference Site Vegetative Communities Map

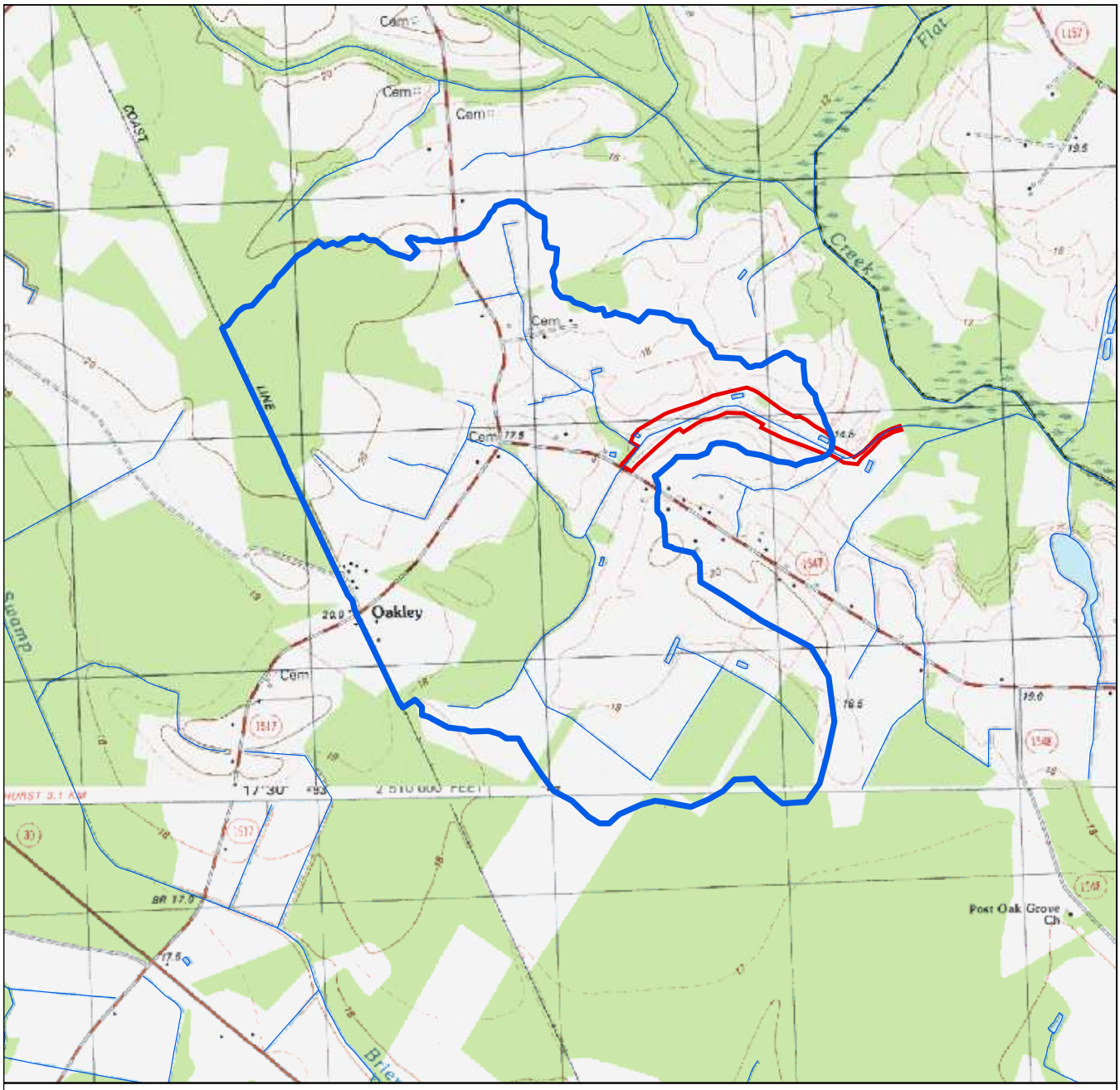
Figure 11.9. Shepherd Run Reference Site NRCS Soil Survey Map

Figure 11.10. UT to Tyson Creek Reference Site Watershed Map

Figure 11.11. UT to Tyson Creek Reference Site Vegetative Communities Map

Figure 11.12. UT to Tyson Creek Reference Site NRCS Soil Survey Map


EDGECOMBE COUNTY
MARTIN COUNTY
PITT COUNTY
BEAUFORT COUNTY
Everetts
Robersonville
Parmele
Bethel
US Hwy 64
US Hwy 13
NC Hwy 903
NC Hwy 30
Flat Swamp
Flat Swamp Rd
Flat Swamp Ch Rd
Grindle Creek
Oakley Rd
James Rd
SR 1142
Tranters Creek
Jim Taylor Rd
Post Oak Rd
SR 1550
Briery Swamp
Oakley Crossroads Project Site
Pitt County
Legend
Local Roads
Major Roads
Railroads
Approximate Easement
Streams
Municipality
County Boundary
Figure 11.1 Vicinity Map
Oakley Crossroads
Stream & Wetland Restoration
Pitt County, North Carolina
August 2006
0 0.5 1 2 Miles
Stantec
Ecosystem Enhancement Program



Legend

- Approximate Easement
- Streams
- Watershed

Robersonville West and Greenville NE USGS 7.5' Quads
Contours and Elevations in Meters

Figure 11.2 Project Site Watershed Map

Oakley Crossroads Stream & Wetland Restoration
Pitt County, North Carolina
August 2006

0 0.25 0.5 1 Miles

Stantec

Ecosystem Enhancement Program

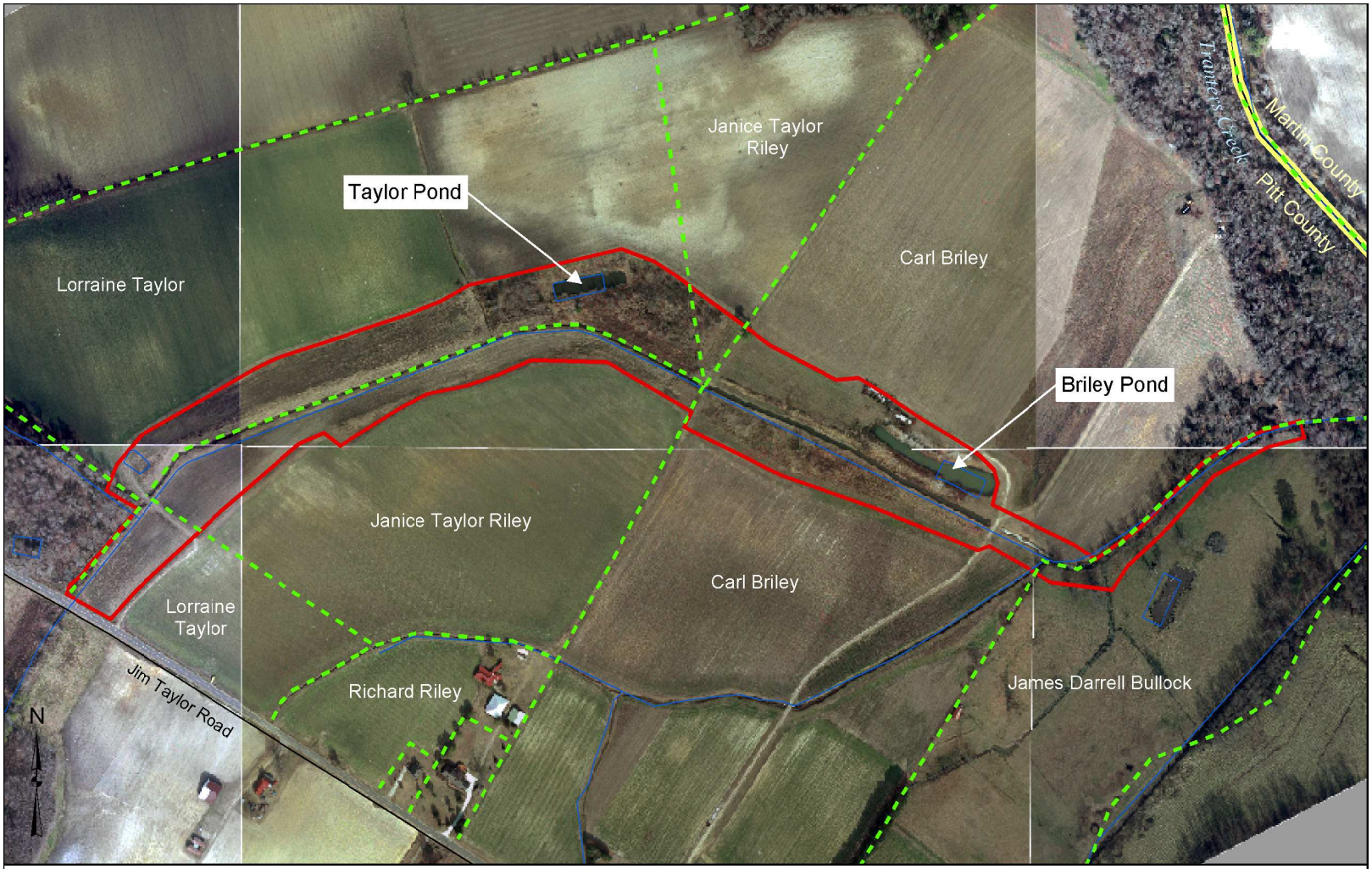
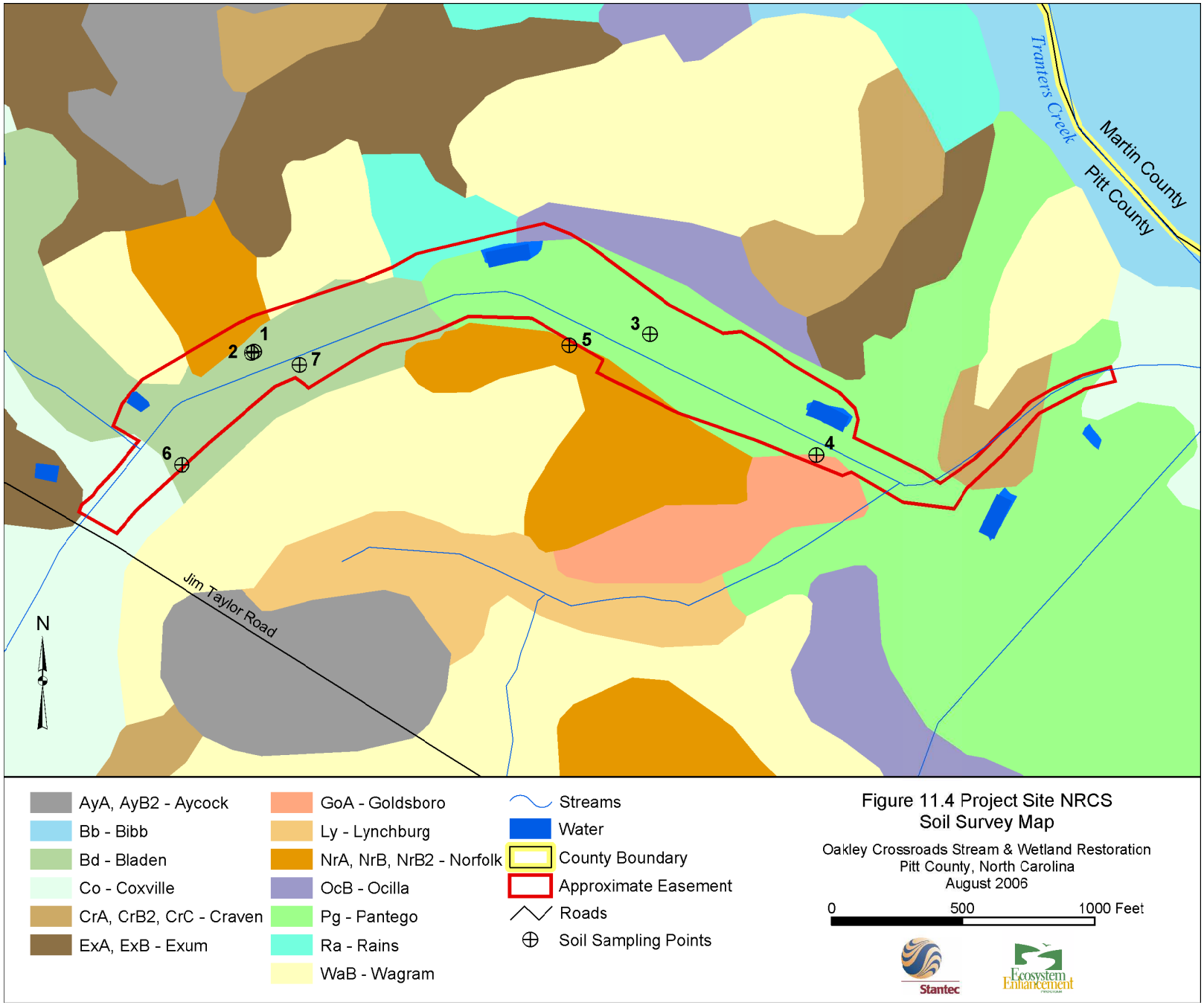


Figure 11.3 Project Site
Property Ownership Map

Oakley Crossroads Stream & Wetland Restoration
Pitt County, North Carolina
August 2006


Trantors Creek
Martin County
Pitt County
Jim Taylor Road
N
1
2
3
4
5
6
7
AyA, AyB2 - Aycock
Bb - Bibb
Bd - Bladen
Co - Coxville
CrA, CrB2, CrC - Craven
ExA, ExB - Exum
GoA - Goldsboro
Ly - Lynchburg
NrA, NrB, NrB2 - Norfolk
OcB - Ocilla
Pg - Pantego
Ra - Rains
WaB - Wagram
Streams
Water
County Boundary
Approximate Easement
Roads
Soil Sampling Points
Figure 11.4 Project Site NRCS Soil Survey Map
Oakley Crossroads Stream & Wetland Restoration
Pitt County, North Carolina
August 2006
0
500
1000 Feet
Stantec
Ecosystem Enhancement

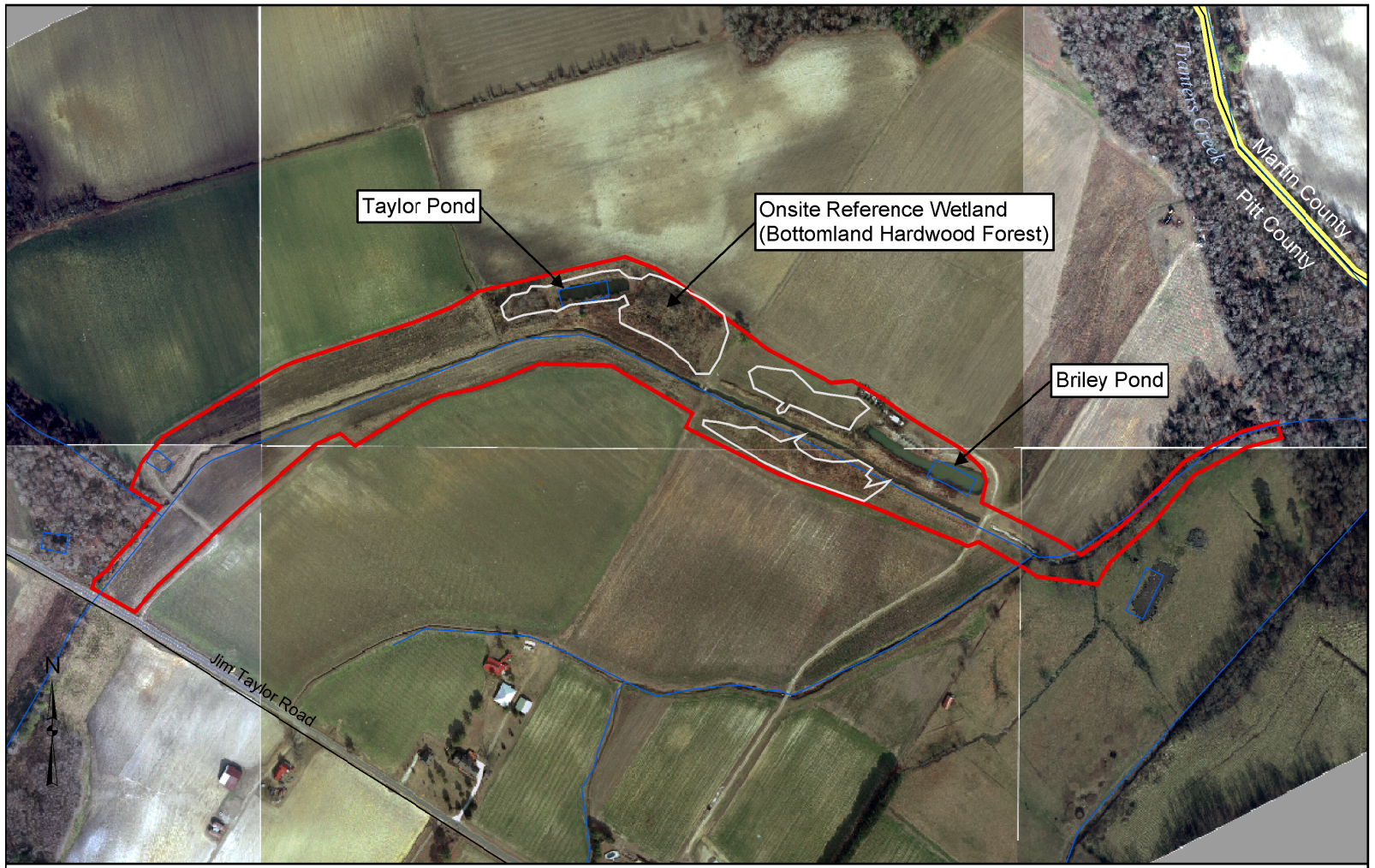


Figure 11.5 Project Site
Hydrologic Features Map

Oakley Crossroads Stream & Wetland Restoration
Pitt County, North Carolina
August 2006

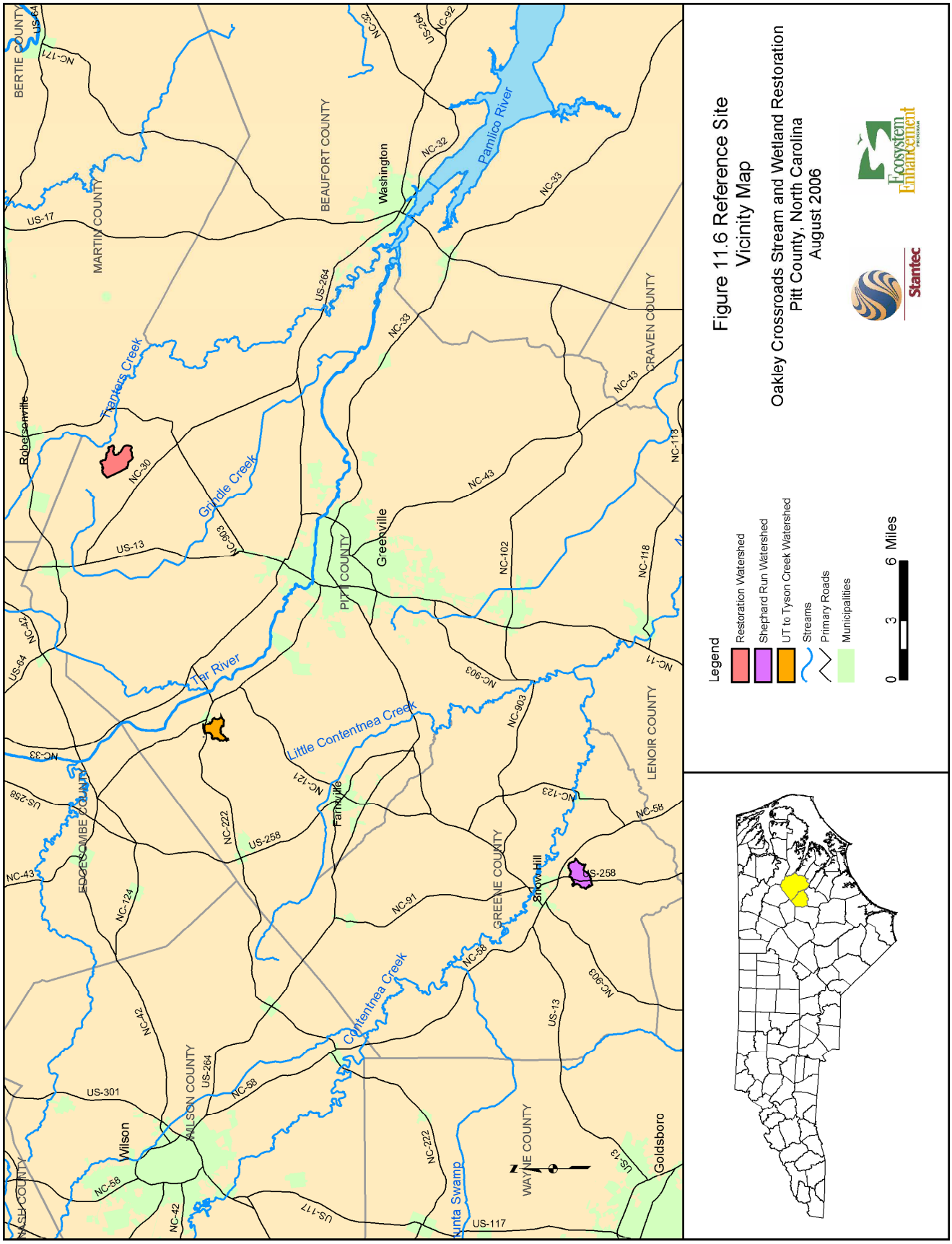


Figure 11.6 Reference Site
Vicinity Map
Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
August 2006
Legend
Restoration Watershed
Shephard Run Watershed
UT to Tyson Creek Watershed
Streams
Primary Roads
Municipalities
0
3
6 Miles
Ecosystem Enhancement Program
Stantec
Tranters Creek
Parrilico River
Greenville
Washington
Robersonville
Farmville
Snow Hill
Goldsboro
Wilson
Tar River
Little Contentnea Creek
Contentnea Creek
Grindle Creek
Hunta Swamp
PITT COUNTY
BEAUFORT COUNTY
MARTIN COUNTY
BERTIE COUNTY
CRAVEN COUNTY
LENOIR COUNTY
GREENE COUNTY
WAYNE COUNTY
WILSON COUNTY
EDGECOMBE COUNTY
NASH COUNTY
US-64
US-17
US-264
NC-32
NC-33
NC-43
NC-30
US-13
NC-903
NC-102
NC-118
NC-11
NC-121
NC-123
NC-58
US-258
NC-222
NC-124
NC-91
NC-42
US-301
US-117

Legend

Stream

Reference Watershed

Snow Hill USGS 7.5' Quad

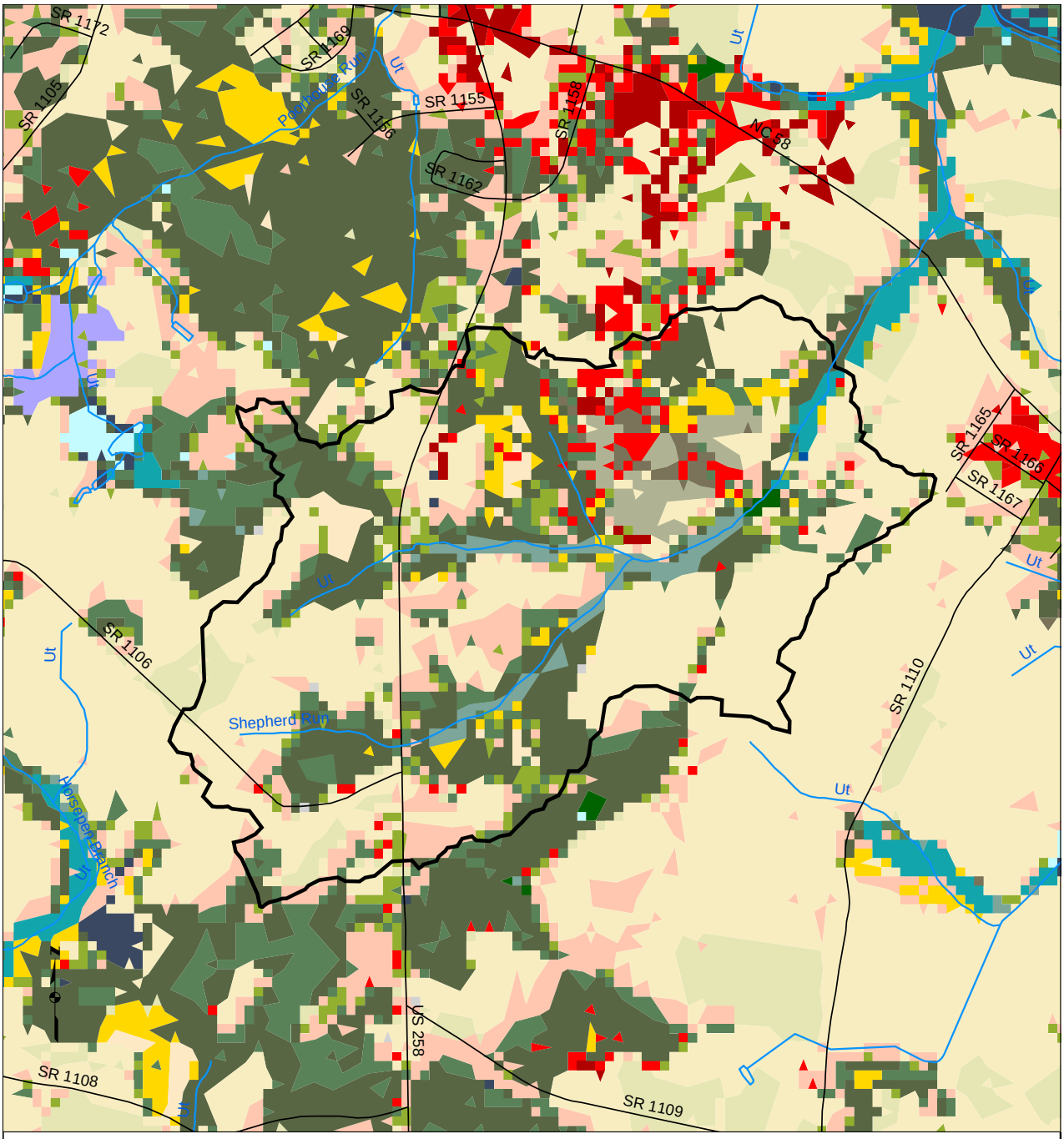
0 1500 3000 Feet

Figure 11.7 Shepherd Run
Reference Site Watershed Map

Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
June 2006

Stantec

Ecosystem Enhancement Program



Legend

- Stream
- Roads
- Watershed
- Coniferous Regeneration
- Coniferous Cultivated Plantation
- Cypress-Gum Floodplain Forest
- Successional Deciduous Forest
- Xeric Longleaf Pine
- Coastal Plain Oak Bottomland Forest
- Coastal Plain Mixed Bottomland
- Coastal Plain Mesic Hardwood
- Pocosin Woodlands and Shrublands
- Coastal Plain Dry to Dry-Mesic Oak Forest
- Coastal Plain Nonriverine Wet Flat Forests
- Agricultural Fields
- Residential Urban
- Urban High-Intensity Developed
- Agricultural Pasture/Hay/Herbaceous
- Barren (bare rock and sand)
- Dry Mesic Oak Pine Forests
- Piedmont Mixed Successional Forests

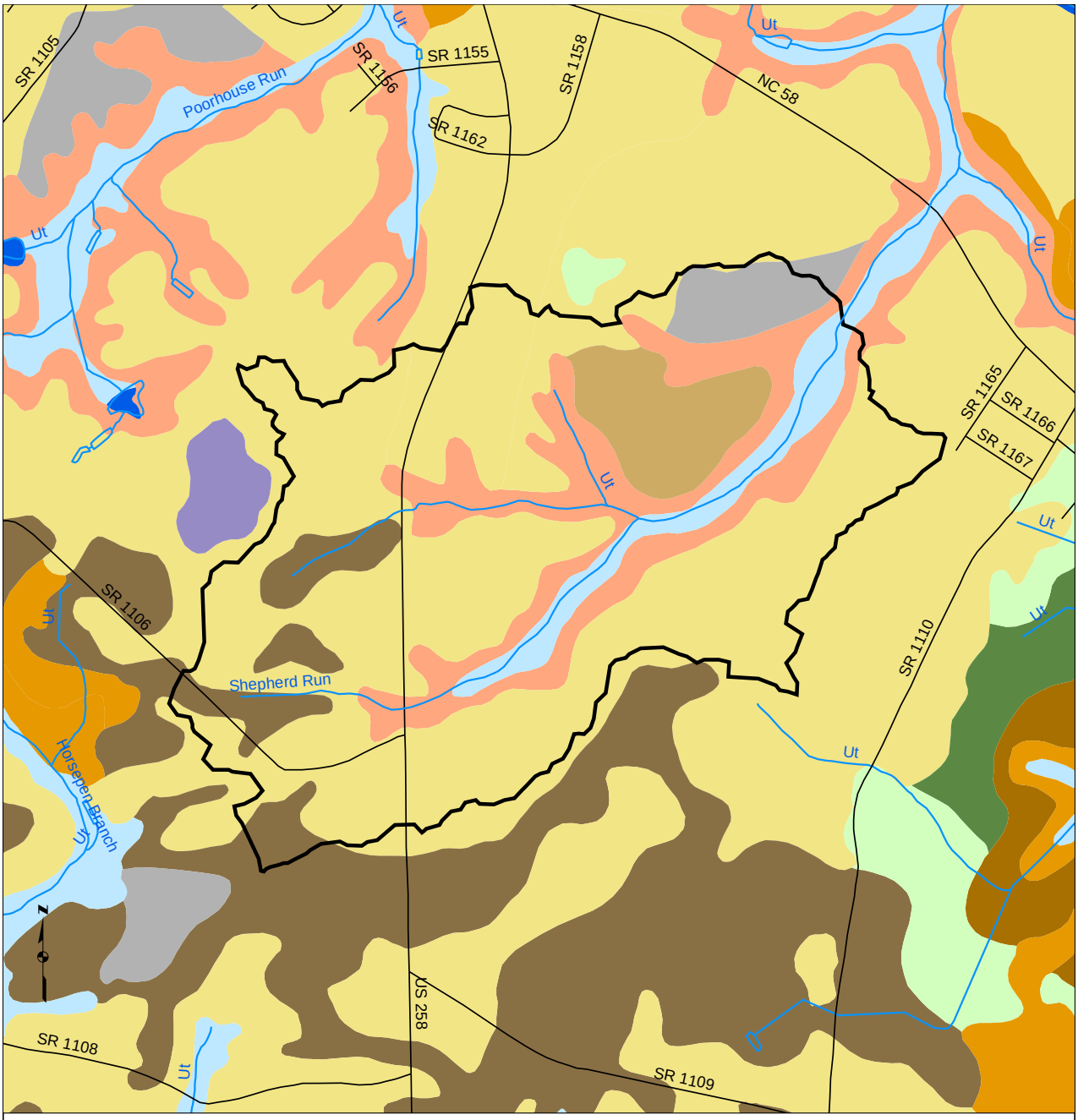
0 1500 3000 Feet

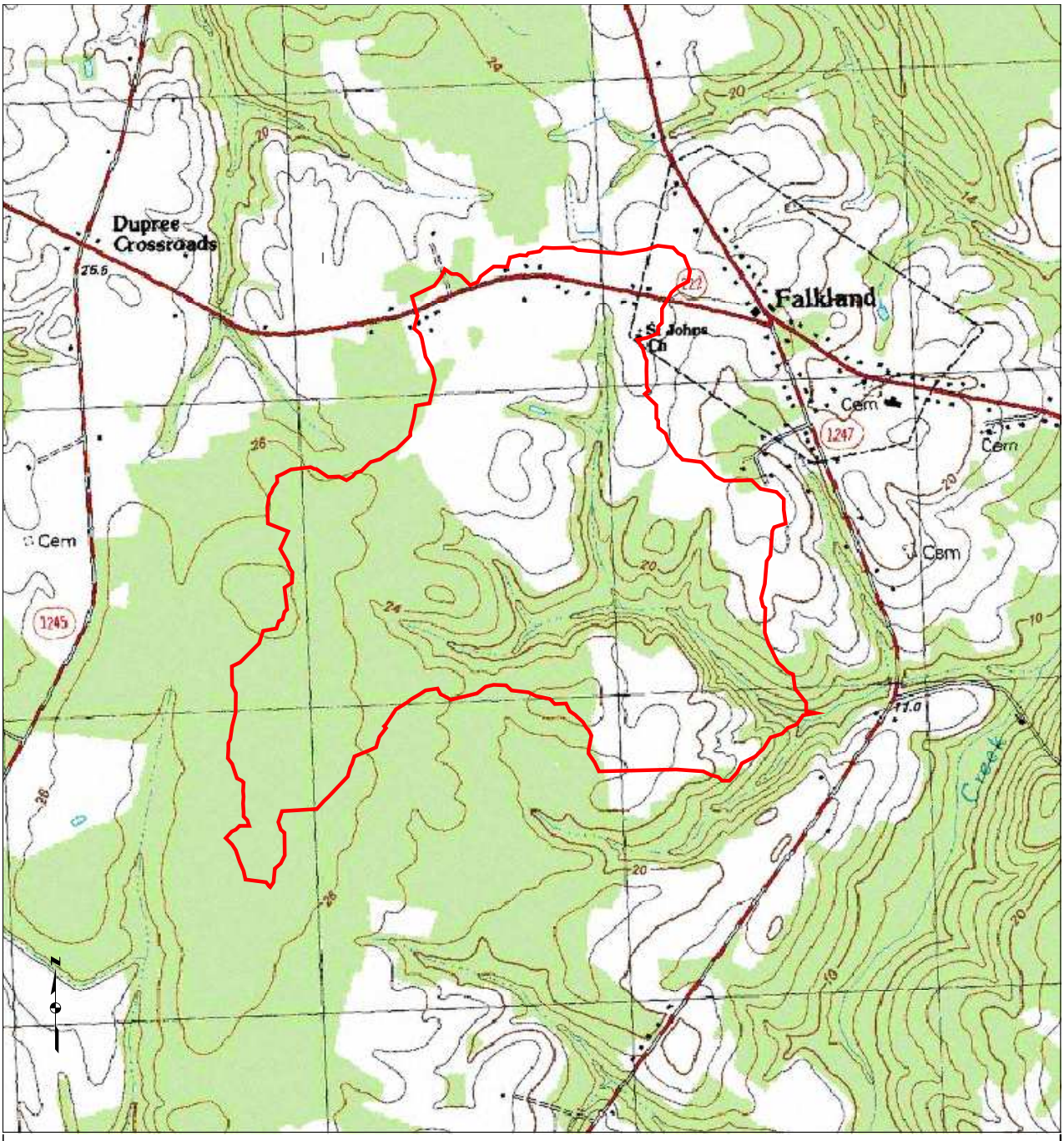
Figure 11.8 Shepherd Run
Reference Site Vegetative Communities Map

Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
June 2006

Stantec

Ecosystem Enhancement Program


SR 1105
Poorhouse Run
SR 1156
SR 1155
SR 1158
SR 1162
NC 58
Ut
SR 1165
SR 1166
SR 1167
SR 1106
Shepherd Run
SR 1110
Horsepen Branch
US 258
SR 1108
SR 1109
N
Legend
Stream
Roads
Watershed
AuB; AxB - Autryville
BB - Bibb
BnB - Blanton
CoC2 - Cowarts
GoA - Goldsboro
Ly - Lynchburg
NoA; NoB - Norfolk
Pa - Pactolus
Ra - Rains
St - Stallings
WaB - Wagram
water
Figure 11.9 Shepherd Run
Reference Site NRCS Soil Survey Map
Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
August 2006
0
1500
3000 Feet
Stantec
Ecosystem Enhancement Program



Legend

Stream

Reference Watershed

Falkland USGS 7.5' Quad

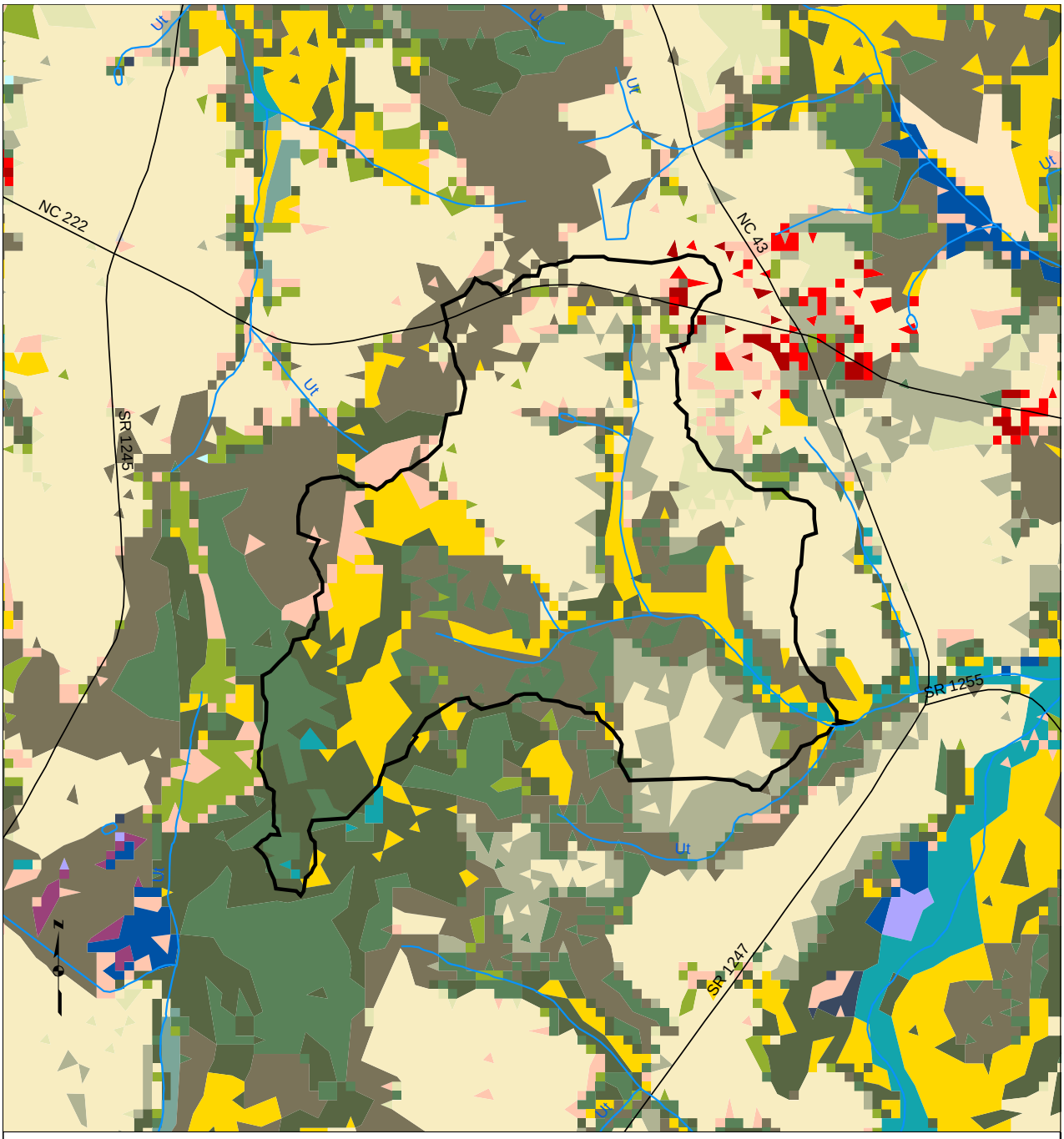
0 1500 3000 Feet

Figure 11.10 UT to Tyson Creek
Reference Site Watershed Map

Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
June 2006

Stantec

Ecosystem Enhancement Program



Legend

- Streams
- Roads
- Watershed
- Coniferous Regeneration
- Coniferous Cultivated Plantation
- Cypress-Gum Floodplain Forest
- Successional Deciduous Forest
- Xeric Longleaf Pine
- Mesic Longleaf Pine
- Coastal Plain Dry/Dry-Mesic Oak Forest
- Agricultural Fields
- Residential Urban
- Urban High-Intensity Developed
- Agricultural Pasture/Hay/Herbaceous
- Dry Mesic Oak Pine Forests
- Piedmont Mixed Successional Forests

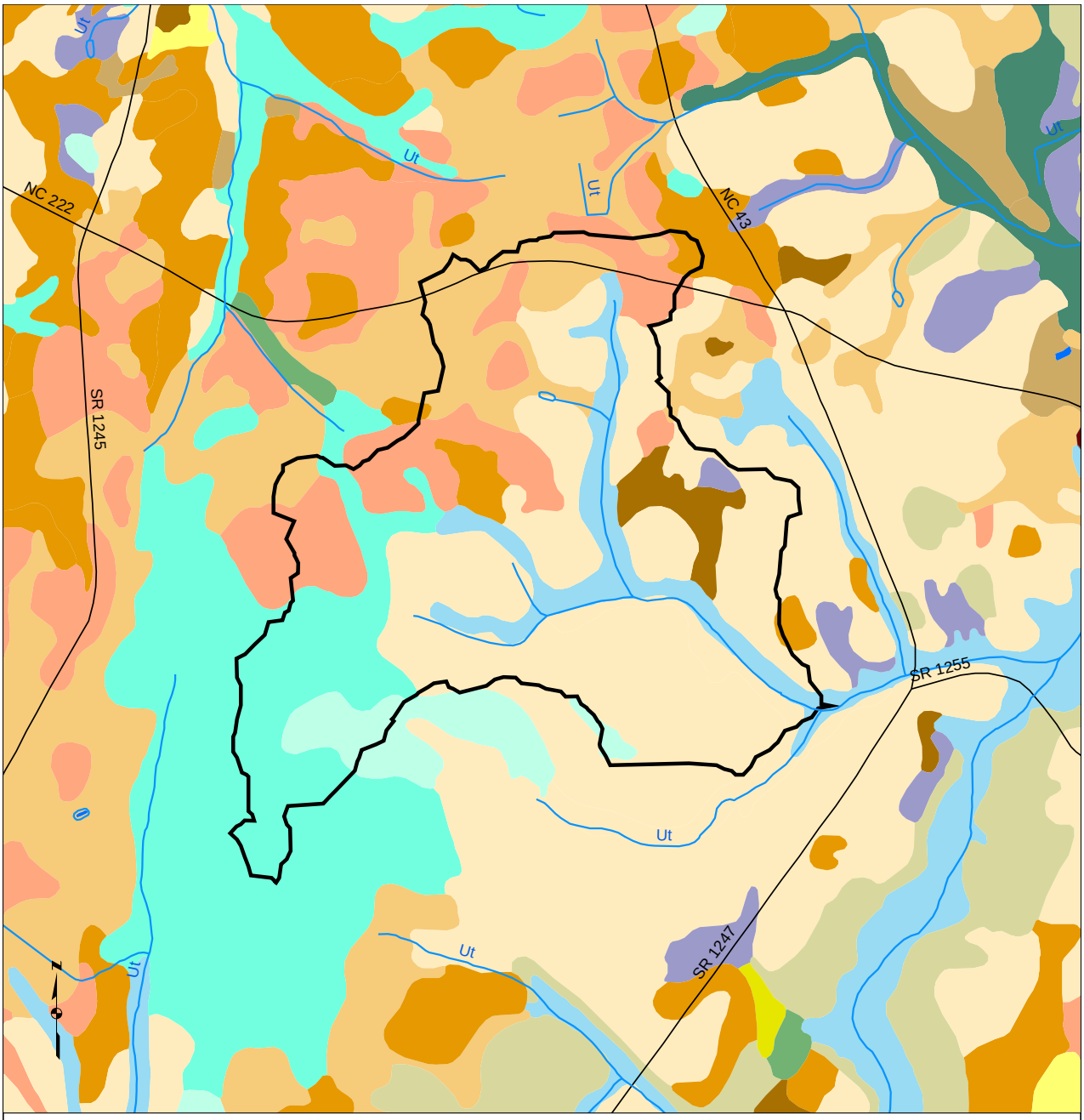
0 1500 3000 Feet

Figure 11.11 UT to Tyson Creek
Reference Site Vegetative Communities Map

Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
June 2006

Stantec

Ecosystem Enhancement Program



Legend

- Streams
- Roads
- Watershed
- AgB - Alaga
- AlB - Altavista
- AyA, AyB, AyB2 - Aycock
- Bb - Bibb
- Bd - Bladen
- Co - Coxville
- CrA, CrB, CrB2, CrC - Craven
- ExA, ExB - Exum
- GoA, GoB - Goldsboro
- Ly - Lynchburg
- NrA, NrB, NrB2 - Norfolk
- OcB - Ocilla
- Os - Osier
- Ra - Rains
- Tu - Tuckerman
- WaB, WaC - Wagram
- Water

Figure 11.12 UT to Tyson Creek
Reference Site NRCS Soil Survey Map

Oakley Crossroads Stream and Wetland Restoration
Pitt County, North Carolina
August 2006

0 1500 3000 Feet

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Ecosystem Enhancement Program

12.0 Designed Sheets

Sheet 12.1 Existing Conditions

Sheet 12.2 Plan View of Proposed Stream Restoration

Sheet 12.3 Proposed Wetland Restoration

Sheet 12.4 Typical Riffle and Pool Cross Sections

Sheet 12.5 Planting Plan

Sheet 12.6 Proposed Taylor Pond Excavation

Sheet 12.7 Proposed Typical Section for the Taylor Pond

Sheet 12.8 Proposed Briley Pond Excavation

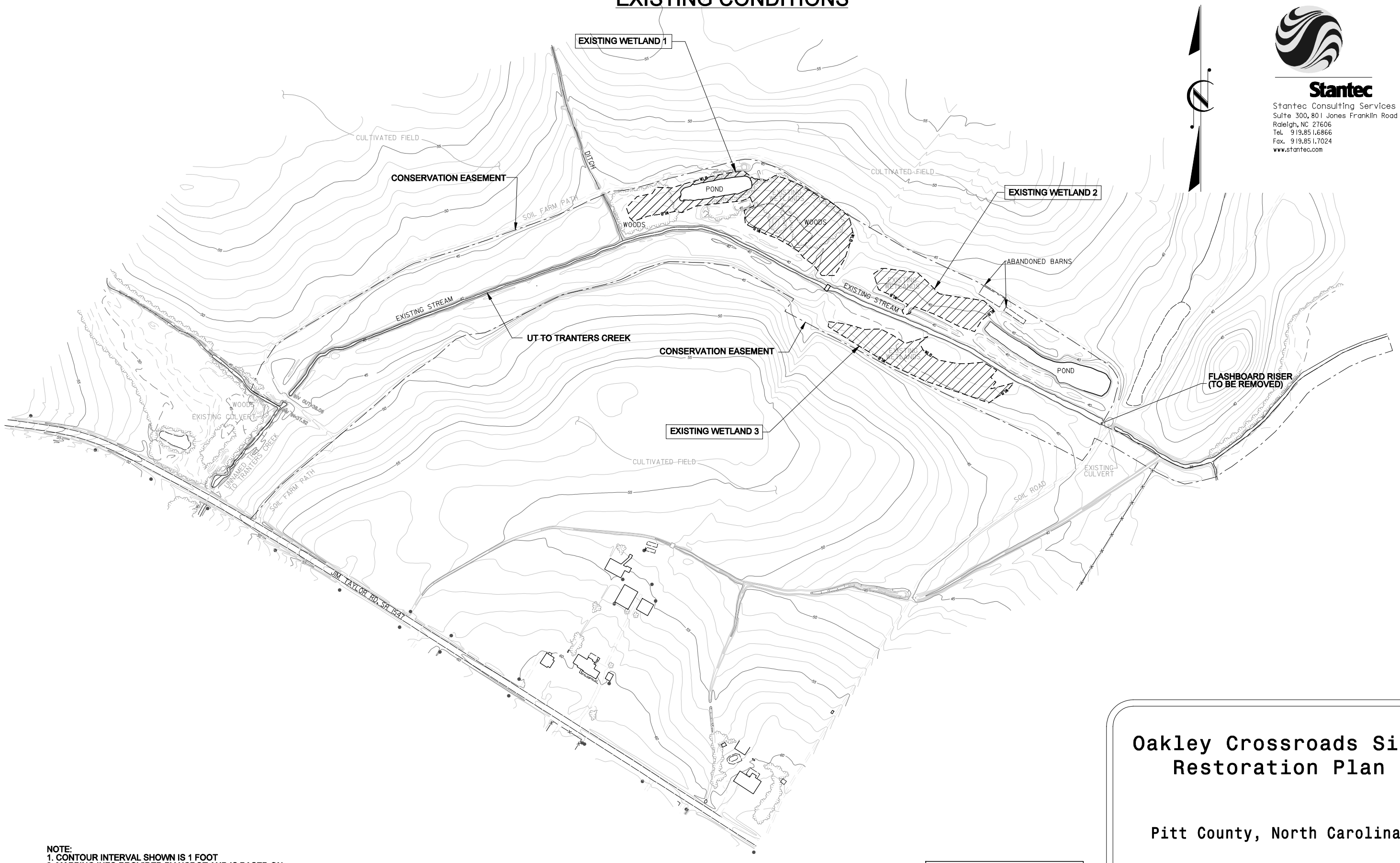
Sheet 12.9 Proposed Typical Section for the Briley Pond

Sheet 12.10 Proposed Hydrological Monitoring Plan

Sheet 12.11 HEC-RAS Analysis

Sheet 12.12 Longitudinal Profile

EXISTING CONDITIONS



NOTE:
1. CONTOUR INTERVAL SHOWN IS 1 FOOT
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

150 0 300
SCALE

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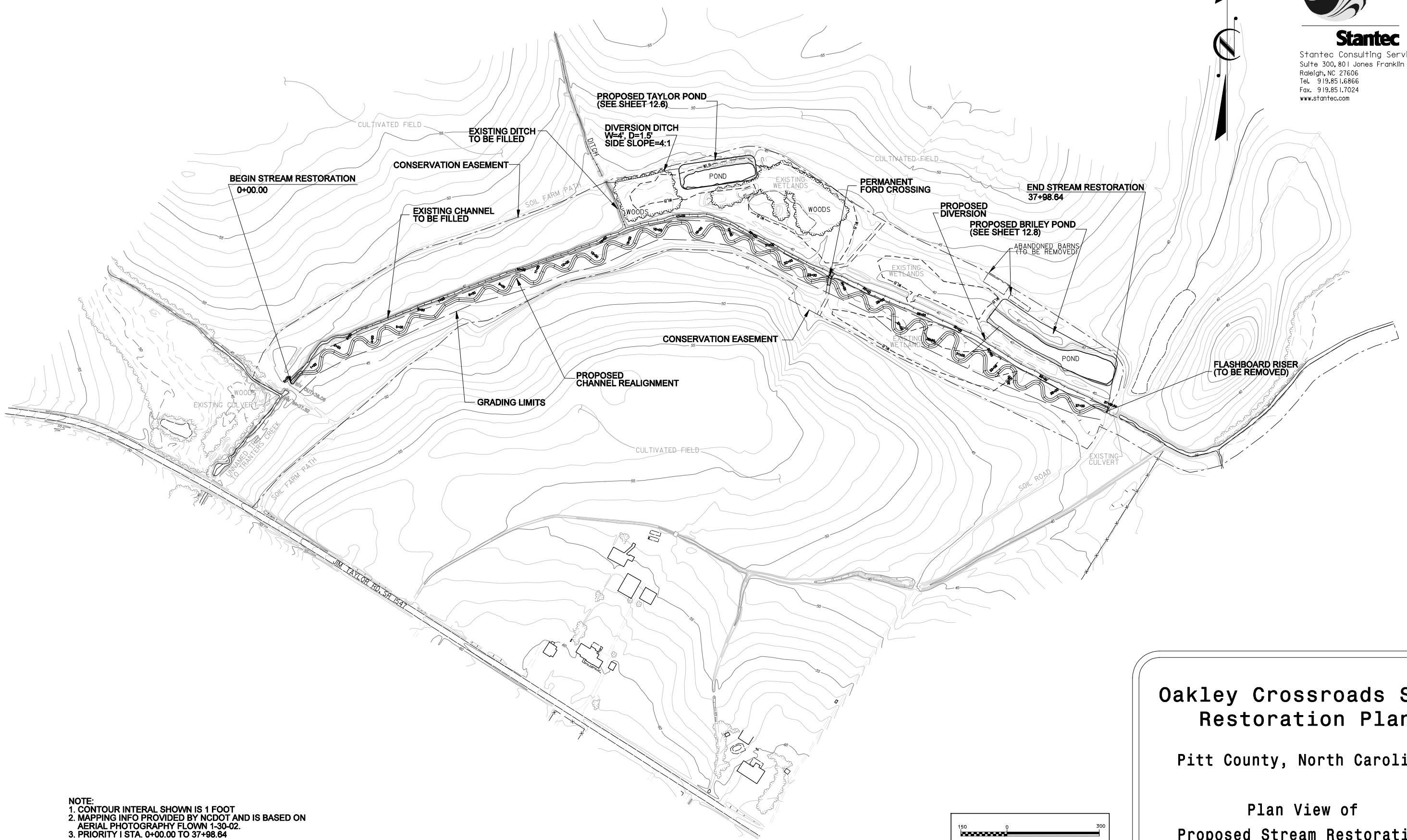
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Existing Conditions

SHEET 12.1

PLAN VIEW OF PROPOSED STREAM RESTORATION



NOTE:
1. CONTOUR INTERAL SHOWN IS 1 FOOT
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.
3. PRIORITY I STA. 0+00.00 TO 37+98.64

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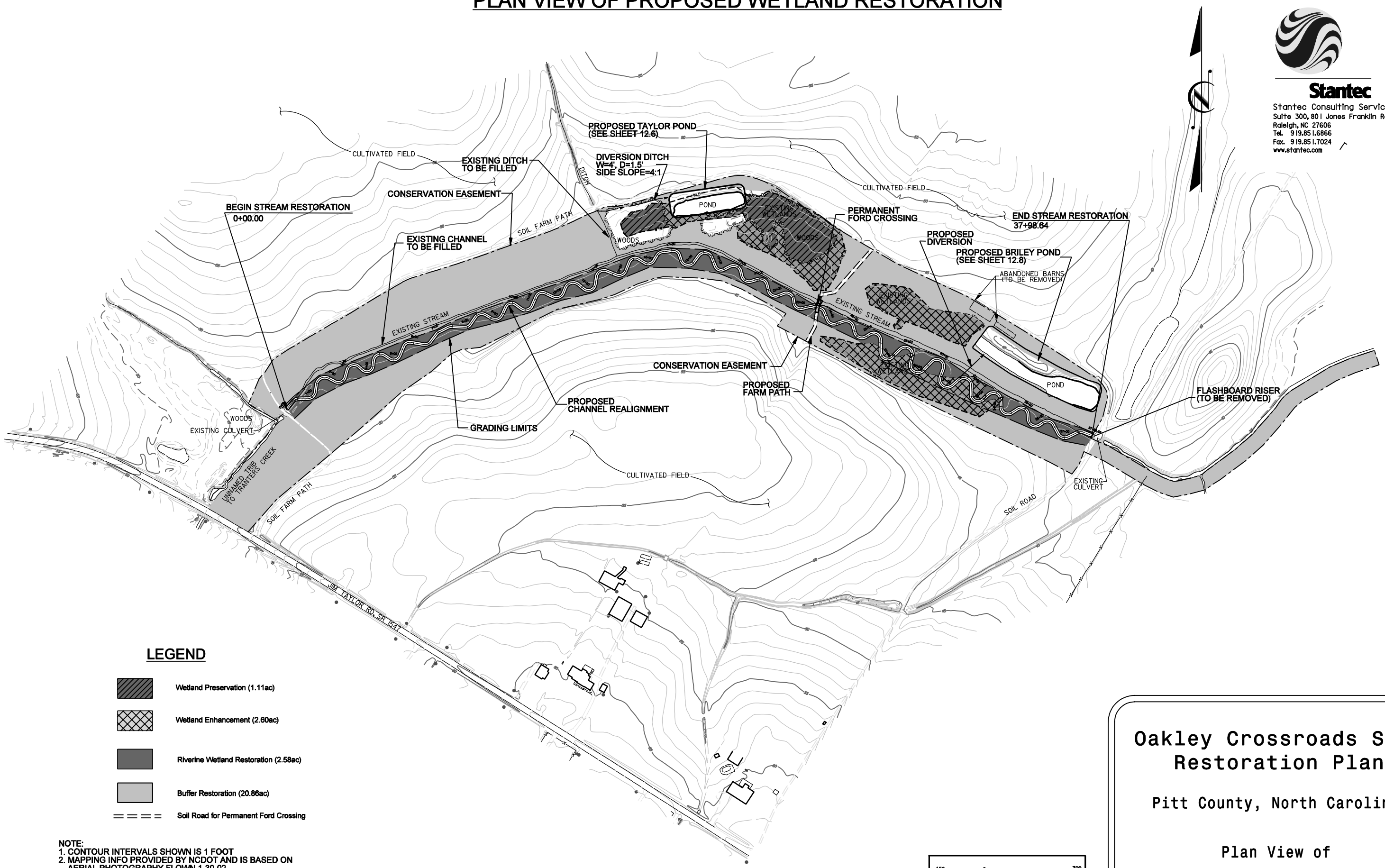
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Plan View of
Proposed Stream Restoration

SHEET 12.2

PLAN VIEW OF PROPOSED WETLAND RESTORATION



LEGEND

- Wetland Preservation (1.11ac)
- Wetland Enhancement (2.60ac)
- Riverine Wetland Restoration (2.58ac)
- Buffer Restoration (20.86ac)
- Soil Road for Permanent Ford Crossing

NOTE:
1. CONTOUR INTERVALS SHOWN IS 1 FOOT
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

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Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Plan View of
Proposed Wetland Restoration

SHEET 12.3

TYPICAL RIFFLE AND POOL CROSS SECTION

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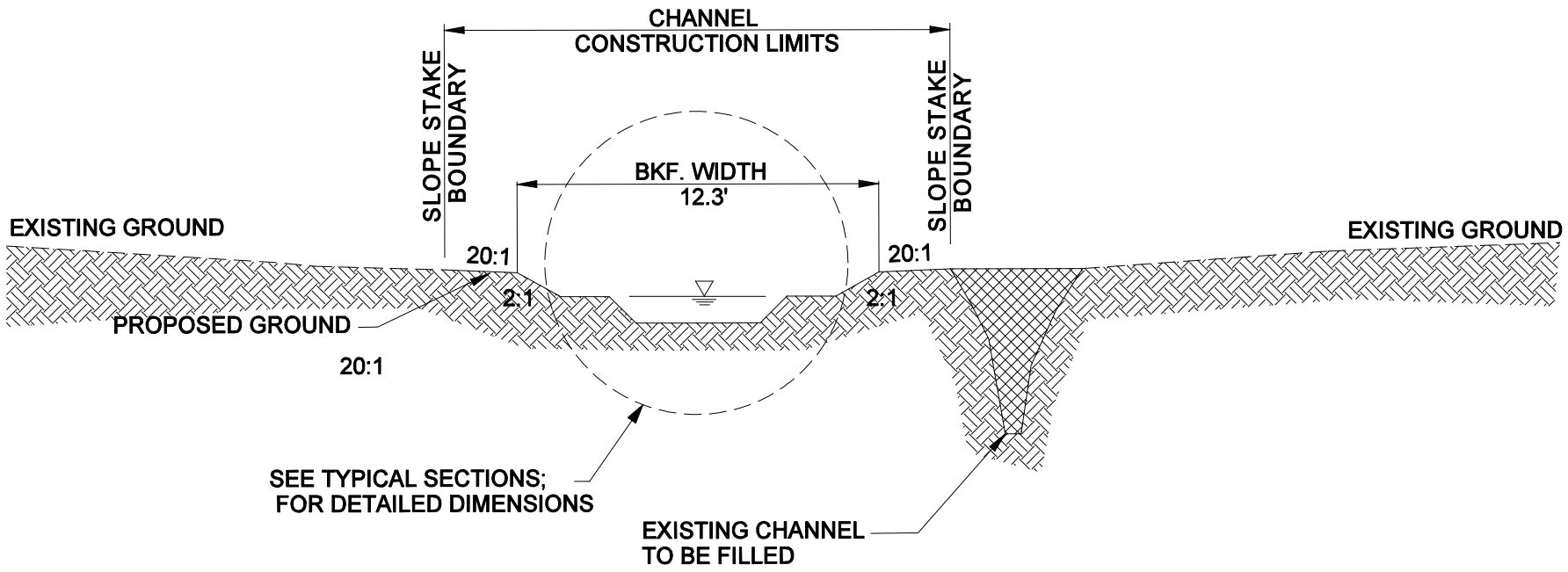
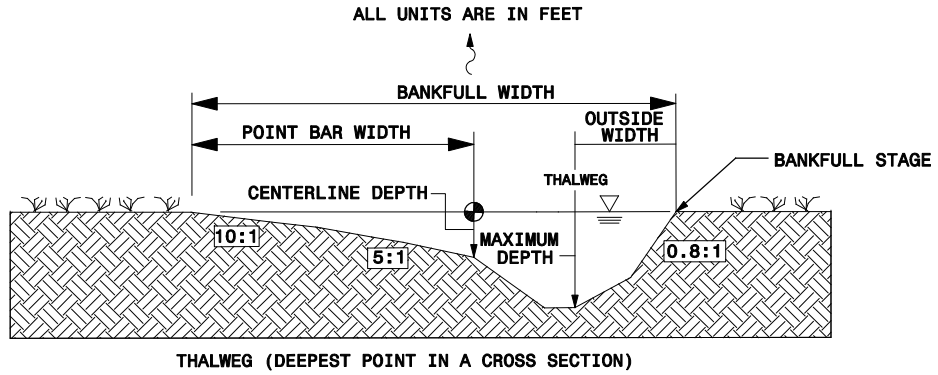
PRIORITY I TYPICAL CHANNEL SECTION



TYPICAL SECTION - POOL RIGHT

MIRROR ABOUT CENTERLINE FOR POOL LEFT

BANKFULL WIDTH	12.3'
POINT BAR WIDTH	10.7
MAX DEPTH (THALWEG)	4.0
OUTSIDE WIDTH	3.4
CENTERLINE DEPTH	1.2



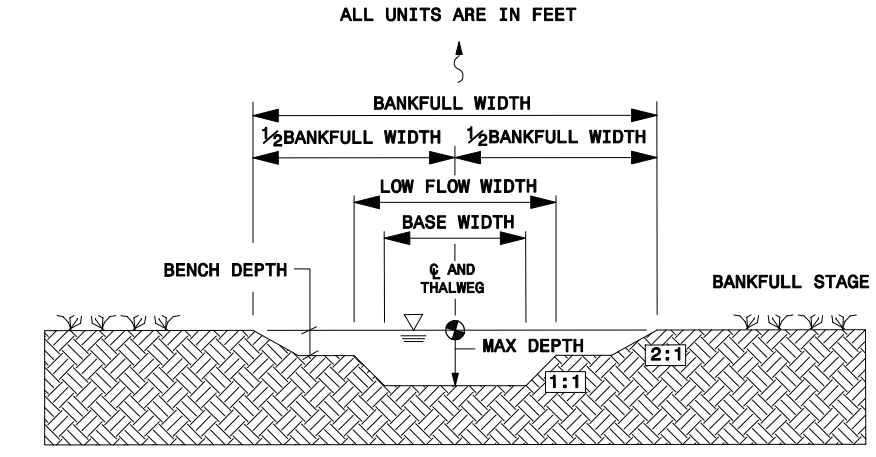
THALWEG (DEEPEST POINT IN A CROSS SECTION)
IS LOCATED IN THE MIDDLE OF THE BASE WIDTH.

NOTES: - ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE DOWNSTREAM DIRECTION
- ⊕ - GRADE POINT IS THE CENTERLINE OF THE STREAM
- ALL SHARP CORNERS SHOULD BE ROUNDED

SCALE: NTS

TYPICAL SECTION - RIFFLE

BANKFULL WIDTH	12.3
BASE WIDTH	3.4
MAXIMUM DEPTH	2.5
LOW FLOW	5.6
BENCH DEPTH	1.4



THALWEG (DEEPEST POINT IN CROSS SECTION) IS LOCATED IN CENTER OF CHANNEL IN A RIFFLE.

NOTES: - ALL CROSS SECTIONS ARE SHOWN LOOKING IN THE DOWNSTREAM DIRECTION
- ⊕ - GRADE POINT IS THE CENTERLINE OF THE STREAM
- ALL SHARP CORNERS SHOULD BE ROUNDED

SCALE: NTS

Scale: NTS

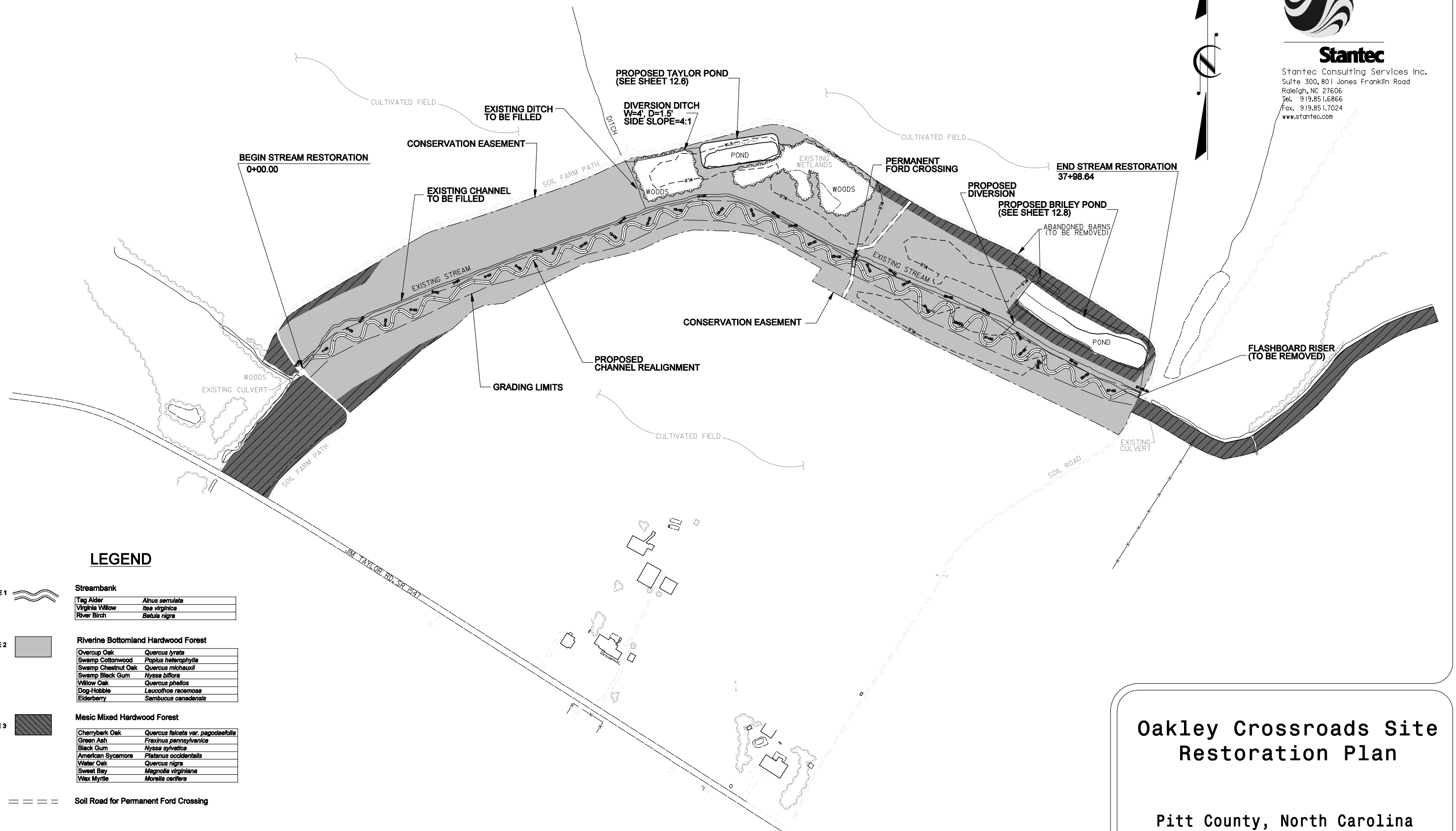
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed Riffle
and Pool Cross-Sections

SHEET 12.4

PLANTING PLAN



LEGEND

ZONE 1 — Streambank

Tag Alder	*Alnus serrulata*
Virginia Willow	*Itea virginica*
River Birch	*Betula nigra*

ZONE 2 — Riverine Bottomland Hardwood Forest

Overcup Oak	*Quercus lyrata*
Swamp Cottonwood	*Populus heterophylla*
Swamp Chestnut Oak	*Quercus michauxii*
Swamp Black Gum	*Nyssa biflora*
Willow Oak	*Quercus phellos*
Dog-Hobble	*Leucothoe racemosa*
Elderberry	*Sambucus canadensis*

ZONE 3 — Mesic Mixed Hardwood Forest

Cherrybark Oak	*Quercus falcata var. pagodaefolia*
Green Ash	*Fraxinus pennsylvanica*
Black Gum	*Nyssa sylvatica*
American Sycamore	*Platanus occidentalis*
Water Oak	*Quercus nigra*
Sweet Bay	*Magnolia virginiana*
Wax Myrtle	*Morella cerifera*

Soil Road for Permanent Ford Crossing

NOTE:
1. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.
2. POND AREAS ARE NOT PART OF PLANTING.

150 0 300
SCALE

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Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Planting Plan

SHEET 12.5

PROPOSED TAYLOR POND EXCAVATION

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PROPOSED TOP OF POND ELEV= 40.0'

DIVERSION DITCH W=4' D=1.5' SIDE SLOPE = 4:1

TIE TO EXISTING GROUND

CONSERVATION EASEMENT

EXISTING POND

EXISTING DITCH TO BE FILLED

EXISTING CHANNEL TO BE FILLED

PROPOSED BASE OF POND ELEV= 31.0'

PROPOSED CHANNEL REALIGNMENT

CONSERVATION EASEMENT

27'
81'
27'
27'
POND
A
A
WOODS
WOODS
45
45
15+00
16+00
17+00
18+00
19+00
20+00
21+00

NOTE:
1. CONTOUR INTERAL SHOWN 1 FT.
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

25 0 50
SCALE

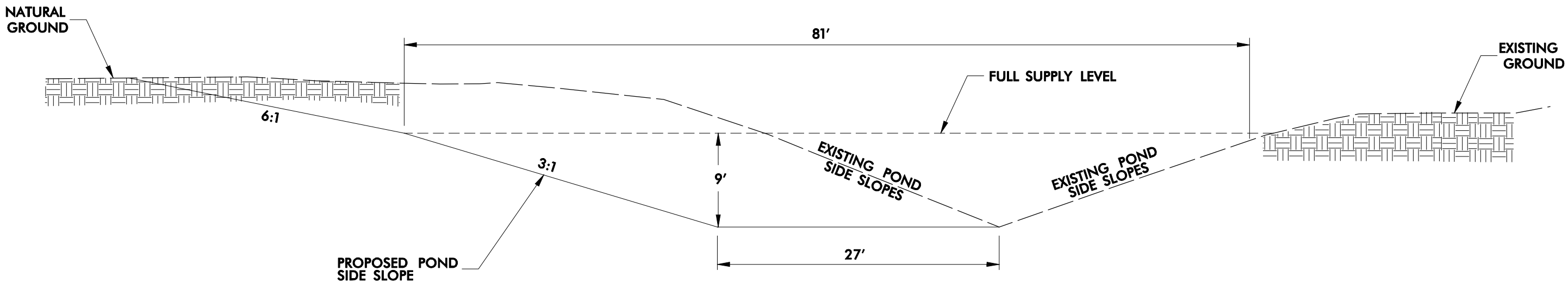
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed Taylor Pond Excavation

SHEET 12.6

PROPOSED TYPICAL SECTION FOR THE TAYLOR POND



SECTION A-A

NOTE:
MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

5 0 10
SCALE

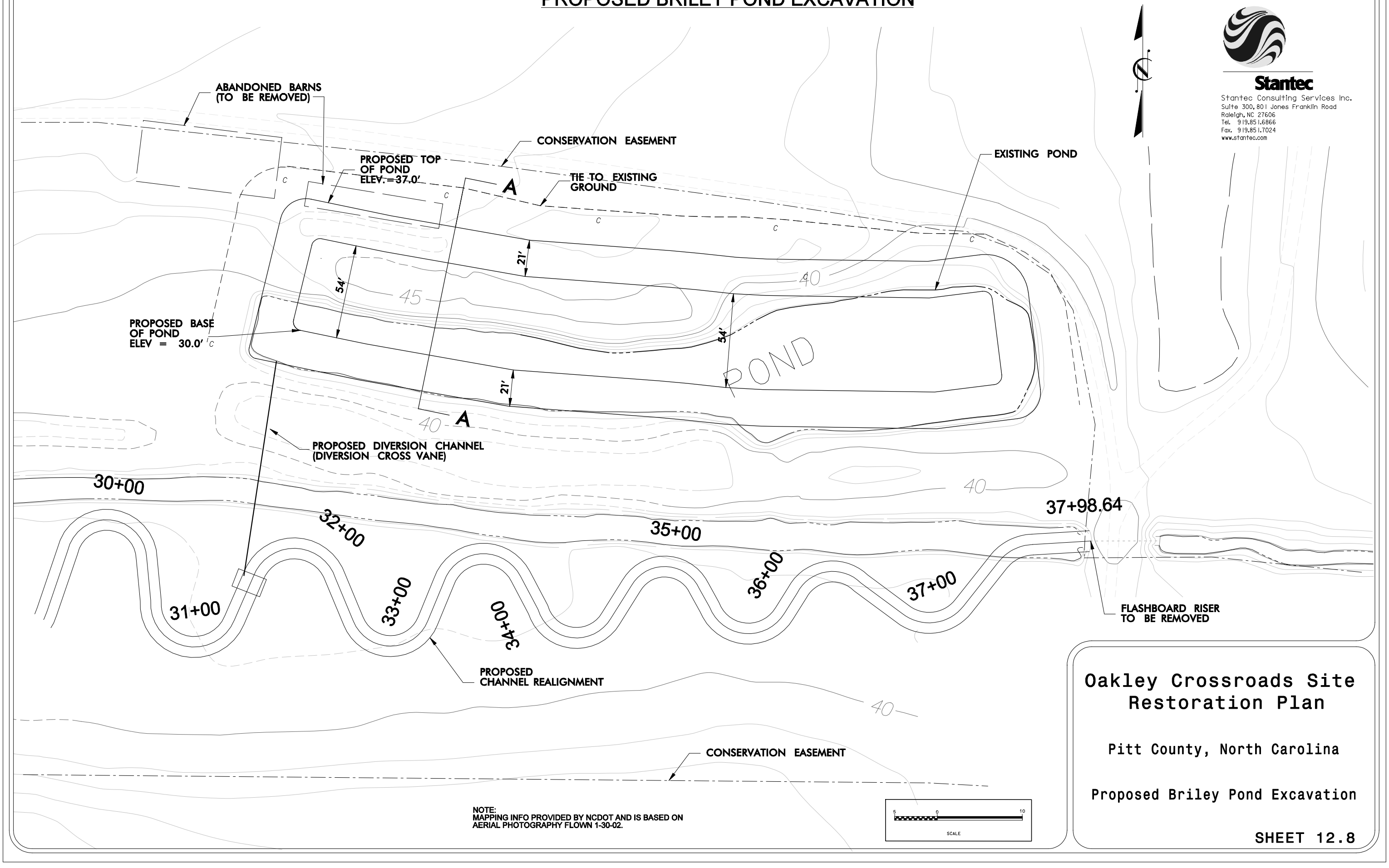
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed Typical Section for the Taylor Pond

SHEET 12.7

PROPOSED BRILEY POND EXCAVATION



NOTE:
MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON
AERIAL PHOTOGRAPHY FLOWN 1-30-02.

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Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed Briley Pond Excavation

SHEET 12.8

PROPOSED TYPICAL SECTION FOR THE BRILEY POND

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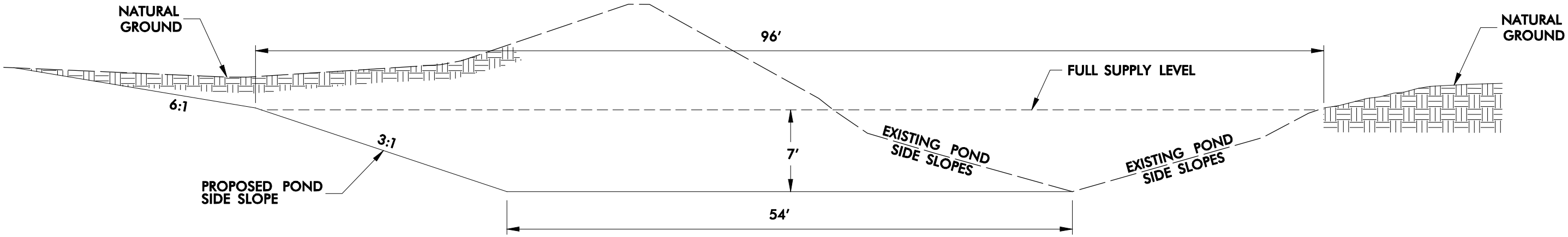


SECTION A-A

NOTE:
MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

5 0 10
SCALE

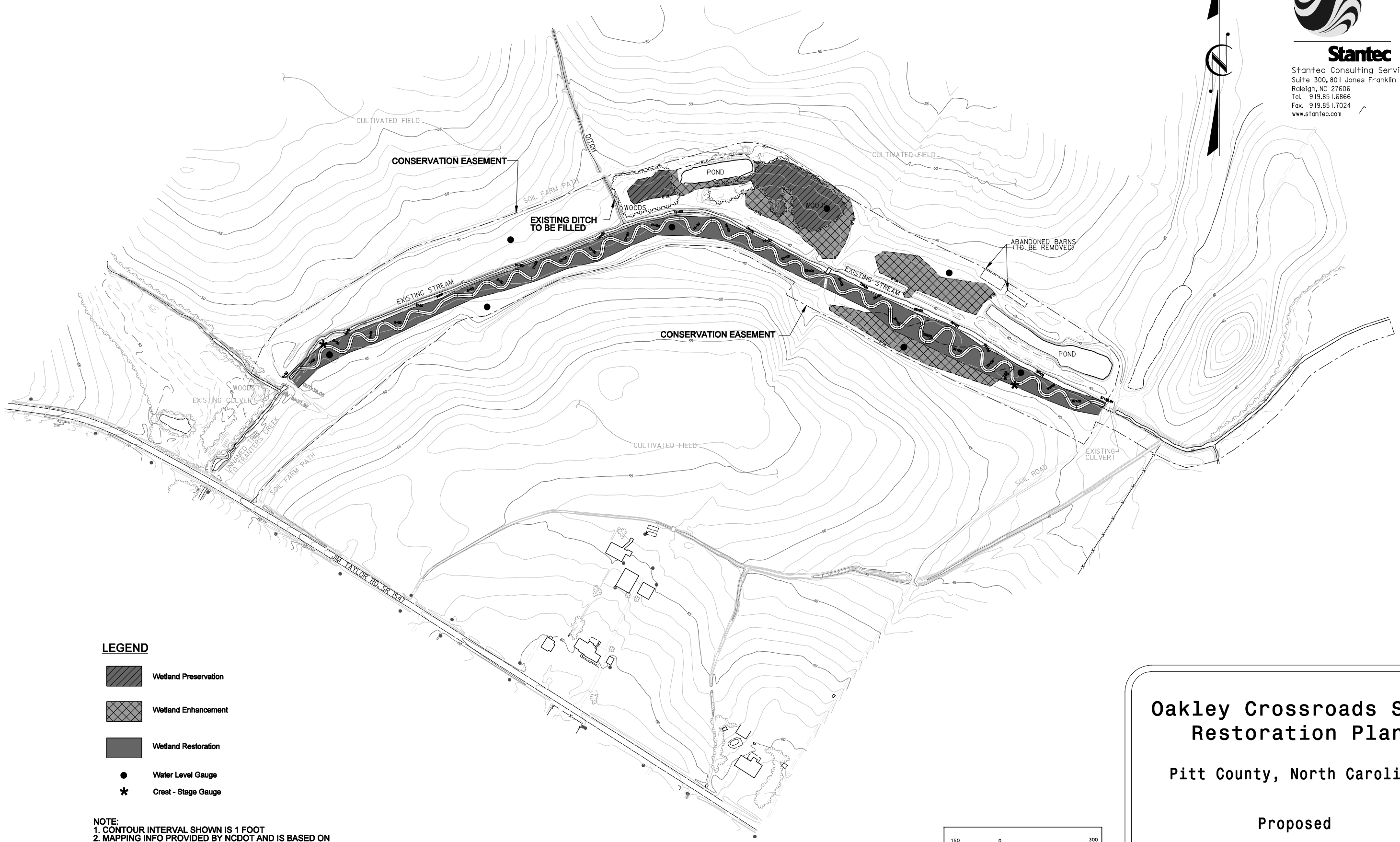
Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed Typical Section for the Briley Pond

SHEET 12.9

PROPOSED HYDOLOGIC MONITORING PLAN



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LEGEND

- Wetland Preservation
- Wetland Enhancement
- Wetland Restoration
- ● Water Level Gauge
- ✱ Crest - Stage Gauge

NOTE:
1. CONTOUR INTERVAL SHOWN IS 1 FOOT
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

150 0 300
SCALE

Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

Proposed
Hydrological Monitoring Plan

SHEET 12.10

HEC-RAS ANALYSIS

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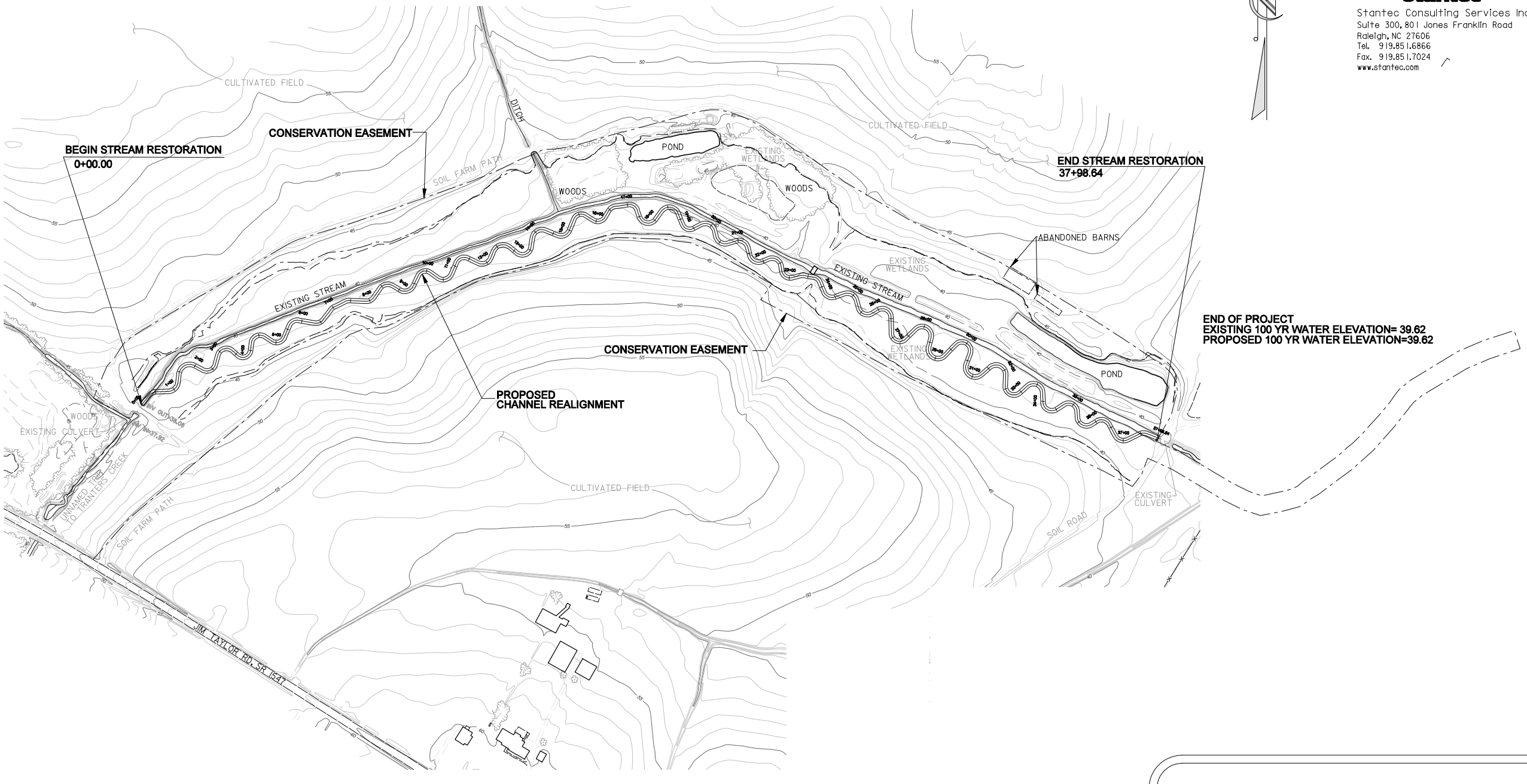


LEGEND

EXISTING 100 YEAR WATER SURFACE

PROPOSED 100 YEAR WATER SURFACE

NOTE:
1. CONTOUR INTERVALS SHOWN 1 FT.
2. MAPPING INFO PROVIDED BY NCDOT AND IS BASED ON AERIAL PHOTOGRAPHY FLOWN 1-30-02.

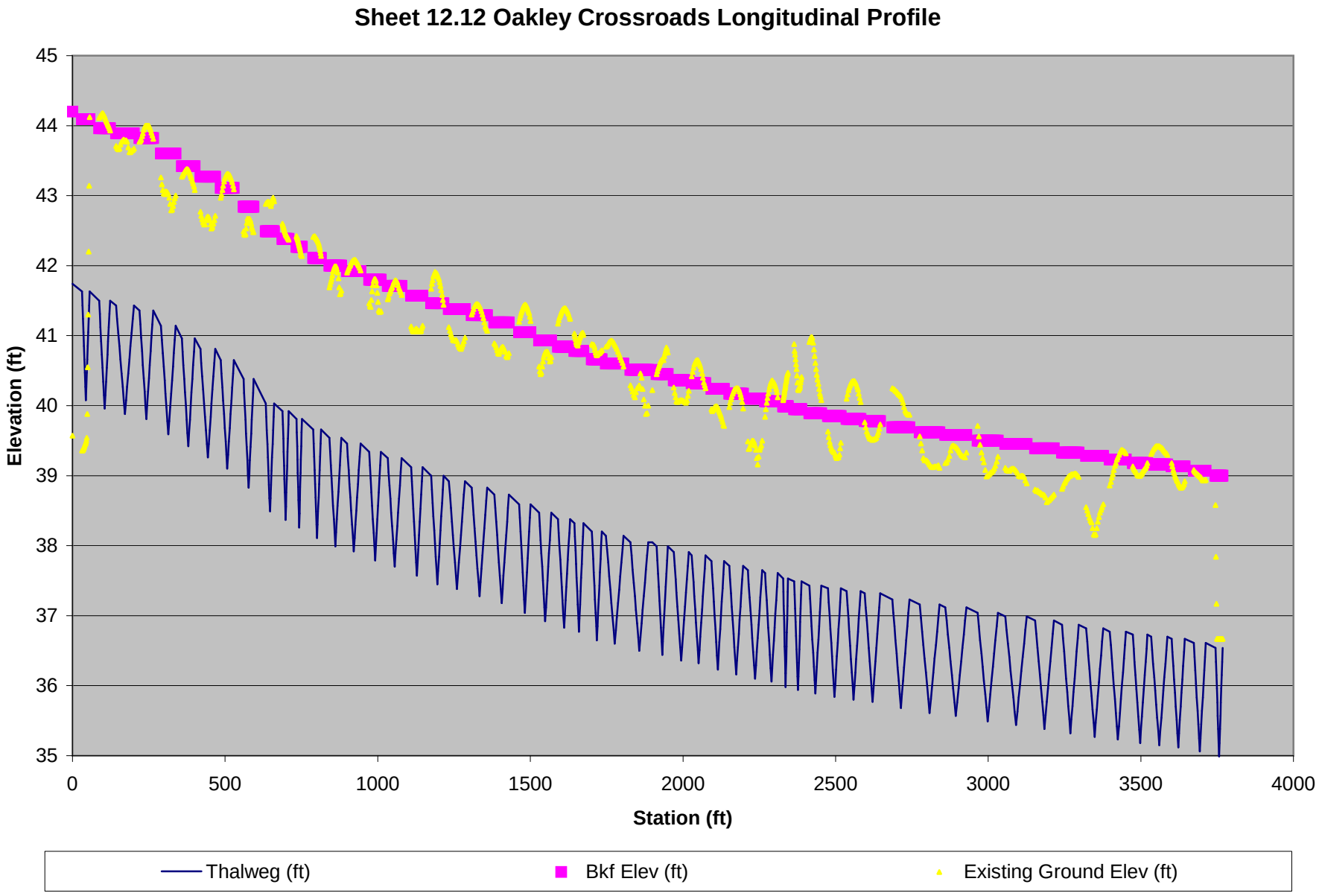
150 0 300
SCALE

Oakley Crossroads Site Restoration Plan

Pitt County, North Carolina

HEC-RAS Analysis

SHEET 12.11


Sheet 12.12 Oakley Crossroads Longitudinal Profile
Elevation (ft)
45
44
43
42
41
40
39
38
37
36
35
0
500
1000
1500
2000
2500
3000
3500
4000
Station (ft)
Thalweg (ft)
Bkf Elev (ft)
Existing Ground Elev (ft)

13.0 Appendices

Appendix 1. Project Site Photographs

Appendix 2. Project Site USACE Jurisdictional Wetland Determination and Data Forms

Appendix 3. Project Site Wetland Rating Forms

Appendix 4. Project Site NCDWQ Stream Classification Forms

Appendix 5. Reference Site Photographs

Appendix 6. Reference Site USACE Routine Wetland Determination Data Forms

Appendix 7. Reference Site Wetland Rating Form

Appendix 8. Reference Site NCDWQ Stream Classification Forms

Appendix 9. HEC–RAS Analysis

Appendix 10. Correspondence

Appendix 1. Project Site Photographs

Photo 1. UT Tranter's Creek (Upstream Reach)
Showing Narrow and Deep G5c Channel.

Photo 2. UT Tranter's Creek (Downstream Reach) Showing Backwater Influence of Flashboard Riser Weir and Aggradation Processes

Appendix 2. Project Site USACE Jurisdictional Wetland Determination and Data Forms

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **200411286** County: **Pitt** U.S.G.S. Quad: **35.6498 N/77.1835 W**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner/Agent: **Stantec Consulting Service**
Address: **801 Jones Franklin Road, Suite 300**
Raleigh, North Carolina 27606
Telephone No.: **919-851-6866**
Size and location of property (waterbody, road name/number, town, etc.) **Oakley Crossroads Mitigation Site, SR 1547 (Jim Taylor Road), for the North Carolina Department of Transportation.**

Indicate Which of the Following Apply:

_ Based on preliminary information, there may be wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps.

X There are wetlands on the above described property subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ We strongly suggest you have the wetlands on your property delineated. Due to the size of your property and/or our present workload, the Corps may not be able to accomplish this wetland delineation in a timely manner. For a more timely delineation, you may wish to obtain a consultant. To be considered final, any delineation must be verified by the Corps.

_ The wetland on your property have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

X The wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on **4/1/2004**. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are no waters of the U.S., to include wetlands, present on the above described property which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Washington, NC, at (252) 946-6481 to determine their requirements.

Remarks: ____

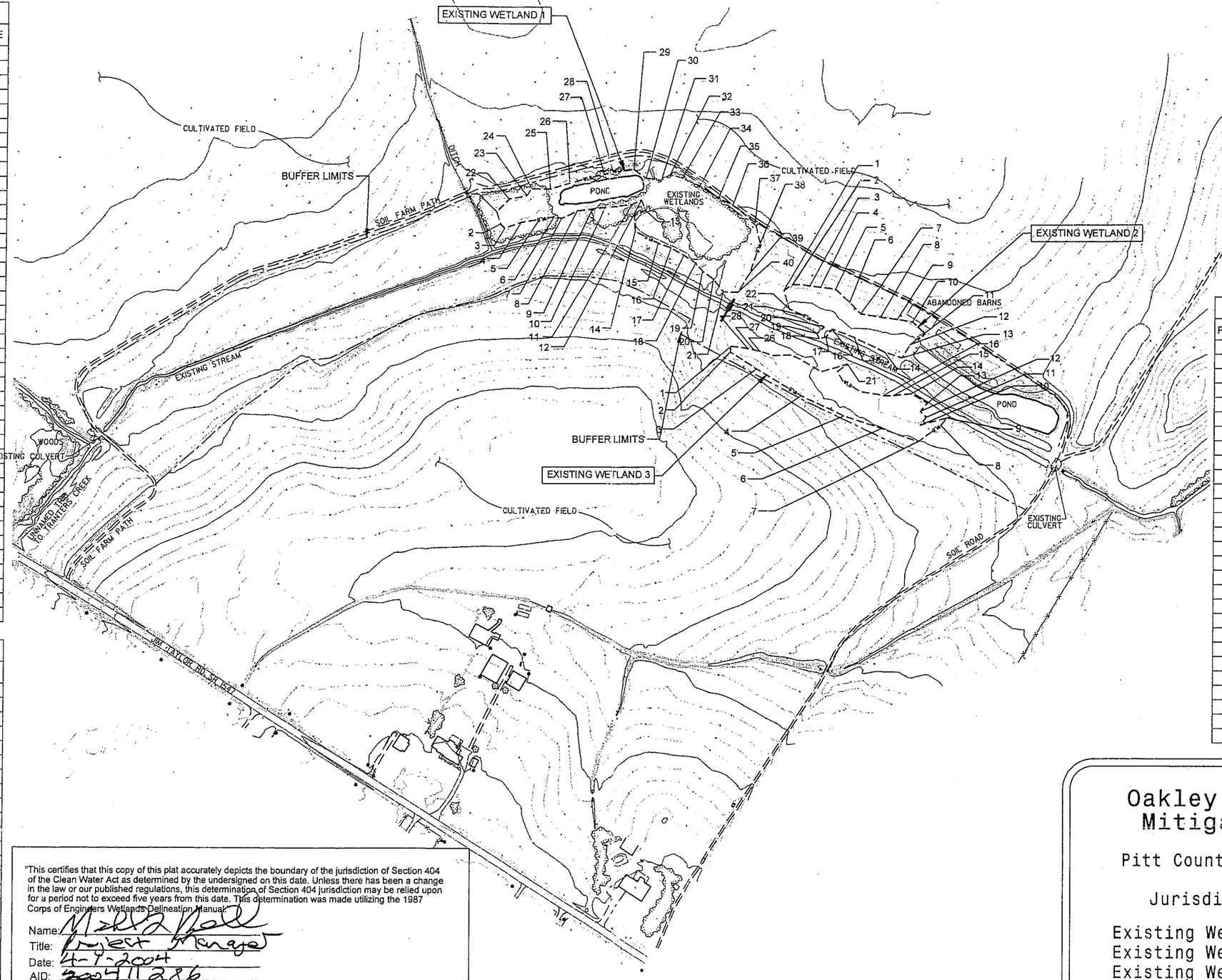
Corps Regulatory Official: Mitchell Bell

Date **04/01/2004** Expiration Date **04/01/2004**

EXISTING CONDITIONS

EXISTING WETLAND 1		
POINT	X COORDINATE	Y COORDINATE
1	1929972810	2951875990
2	1929972821	2951875957
3	1929972833	2951875945
4	1929972880	2951875962
5	1929972929	2951875970
6	1929972970	2951875978
7	1929972992	2951875974
8	1929973035	2951875995
9	1929973076	2951876001
10	1929973113	2951876006
11	1929973188	2951876013
12	1929973214	2951876025
13	1929973226	2951875996
14	1929973198	2951875938
15	1929973263	2951875905
16	1929973299	2951875892
17	1929973336	2951875872
18	1929973370	2951875850
19	1929973390	2951875827
20	1929973421	2951875805
21	1929973448	2951875770
22	1929972845	2951876026
23	1929972894	2951876036
24	1929972908	2951876056
25	1929972959	2951876055
26	1929973013	2951876072
27	1929973109	2951876097
28	1929973135	2951876103
29	1929973193	2951876110 EXISTING CULVERT
30	1929973227	2951876085
31	1929973269	2951876080
32	1929973295	2951876096
33	1929973330	2951876086
34	1929973380	2951876064
35	1929973433	2951876032
36	1929973474	2951876012
37	1929973537	2951875964
38	1929973551	2951875906
39	1929973522	2951875821
40	1929973490	2951875770

EXISTING WETLAND 2		
POINT	X COORDINATE	Y COORDINATE
1	1929973618	2951875776
2	1929973643	2951875793
3	1929973690	2951875789
4	1929973720	2951875785
5	1929973761	2951875780
6	1929973801	2951875743
7	1929973832	2951875711
8	1929973886	2951875702
9	1929973934	2951875696
10	1929973978	2951875689
11	1929974012	2951875658
12	1929973971	2951875625
13	1929973948	2951875588
14	1929973899	2951875604
15	1929973815	2951875645
16	1929973752	2951875669
17	1929973736	2951875646
18	1929973717	2951875642
19	1929973711	2951875656
20	1929973731	2951875675
21	1929973675	2951875706
22	1929973634	2951875724



EXISTING WETLAND 3		
POINT	X COORDINATE	Y COORDINATE
1	1929973472	2951875619
2	1929973470	2951875603
3	1929973544	2951875556
4	1929973668	2951875482
5	1929973787	2951875426
6	1929973892	2951875391
7	1929973995	2951875355
8	1929974059	2951875400
9	1929974077	2951875421
10	1929974001	2951875401
11	1929974018	2951875423
12	1929974001	2951875439
13	1929974021	2951875462
14	1929973976	2951875488
15	1929973925	2951875483
16	1929973896	2951875483
17	1929973832	2951875494
18	1929973791	2951875520
19	1929973781	2951875526
20	1929973768	2951875550
21	1929973796	2951875571
22	1929973723	2951875549
23	1929973681	2951875575
24	1929973641	2951875596
25	1929973590	2951875594
26	1929973553	2951875605
27	1929973536	2951875609
28	1929973519	2951875613

"This certifies that this copy of this plat accurately depicts the boundary of the jurisdiction of Section 404 of the Clean Water Act as determined by the undersigned on this date. Unless there has been a change in the law or our published regulations, this determination of Section 404 jurisdiction may be relied upon for a period not to exceed five years from this date. This determination was made utilizing the 1987 Corps of Engineers Wetlands Delineation Manual."

Name: Mark A Ball
Title: Project Manager
Date: 4-7-2004
AID: 200411286

Scale: NTS

Stantec

Stantec Consulting Services Inc.
Suite 300/801 Jones Franklin Road
Raleigh, NC
27606
Tel. 919.851.6866
Fax. 919.851.7024
www.stantec.com

Oakley Crossroads Mitigation Site

Pitt County, North Carolina

Jurisdictional Waters

Existing Wetland 1 = 2.07 AC
Existing Wetland 2 = 0.78 AC
Existing Wetland 3 = 1.11 AC

Exhibit 5.1.1

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Oakley Crossroads Restoration Site			Date: 01/22/04
Applicant / Owner: NC EEP			County: Pit
Investigator: P Colwell, A. Dvorak-Grantz			State: NC
Do Normal Circumstances exist on the site?	**YES**	NO	Community ID: Wetland
Is the site significantly disturbed (Atypical Situation)?	YES	**NO**	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: Wetland A (WA 001-042)

VEGETATION

Dominant Plant Species	Scientific Name	Stratum	Indicator
1 Sweetgum	*Liquidambar styraciflua*	Tree	FAC+
2 Red maple	*Acer rubrum*	Tree	FAC
3 Sycamore	*Platanus occidentalis*	Tree	FACW-
4 Elderberry	*Sambucus canadensis*	Shrub	FACW-
5 River cane	*Arundinaria gigantea*	Herb	FACW
6			
7			
8			
9			
10			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100%

Remarks: Remnant Bottomland Hardwood Forest. Herbaceous species identified during a previous site visit included lizard's tail, tear thumb, cattail, clearweed, and a variety of rushes and sedges.

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other

[X] No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	-	(in)
Depth of Free Water in Pit	8	(in)
Depth to Saturated Soil	4	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- [ ] Inundated
- [X] Saturated in Upper 12 Inches
- [X] Water Marks
- [X] Drift Lines
- [ ] Sediment Deposits
- [X] Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required)
- [X] Oxidized Root Channels in Upper 12 inches
- [X] Water-stained Leaves
- [X] Local Soil Survey Data
- [X] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Pantego loam					Drainage Class: poorly drained
Taxonomy (Subgroup): Umbric Paleaquults				Field Observations Confirm Mapped Type? YES NO	
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-15	A1	10YR 3/1			Fine sandy loam
15-24	A2	10YR 4/1			Loamy sand

HYDRIC SOIL INDICATORS:

[ ] Histosol	[ ] Concretions
[ ] Histic Epipedon	[ ] High Organic Content in Surface Layer in Sandy Soils
[X] Sulfidic Odor	[ ] Organic Streaking in Sandy Soils
[ ] Aquic Moisture Regime	[X] Listed on Local Hydric Soils List
[X] Reducing Conditions	[X] Listed on National Hydric Soils List
[X] Gleyed or Low-Chroma Colors	[ ] Other (Explain in Remarks)

Remarks: Mucky modifiers in the upper 15 inches of soil.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**YES** NO	Is this Sampling Point Within a Wetland? **YES** NO
Wetland Hydrology Present?	**YES** NO	
Hydric Soil Present?	**YES** NO	

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Oakley Crossroads Site			Date: January 24, 2004
Applicant / Owner: NCDOT			County: Pitt
Investigator: Andrea Dvorak-Grantz, Pete Colwell			State: North Carolina
Do Normal Circumstances exist on the site?	YES	**NO**	Community ID: wetland B
Is the site significantly disturbed (Atypical Situation)?	**YES**	NO	Transect ID: WB001-WB018
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: Plot

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
10) *Juncus sp.*	Rush	FACW-OBL			
2) *Ludwigia sp.*	Grass	OBL			
3) *Solidago sp.*	Herb	OBL-WACU			
4) *Scirpus sp.*	Sedge	OBL			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): > 100%

Remarks:
Herbaceous wetland – area has been regularly mowed

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other

[X] No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water		(in)
Depth of Free Water in Pit	12	(in)
Depth to Saturated Soil	9	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- [ ] Inundated
- [**X**] Saturated in Upper 12 Inches
- [ ] Water Marks
- [**X**] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required)
- [**X**] Oxidized Root Channels in Upper 12 inches
- [ ] Water-stained Leaves
- [**X**] Local Soil Survey Data
- [**X**] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

SOILS

Map Unit Name (Series and Phase): Pantego					Drainage Class: Poor
Taxonomy (Subgroup): Umbric Paleaquults				Field Observations Confirm Mapped Type? YES NO	
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-15		10YR 3/1	--	--	Fine sandy loam
15-24		10YR4/1	--	--	Loamy sand

HYDRIC SOIL INDICATORS:

[ ] Histosol	[ ] Concretions
[ ] Histic Epipedon	[ ] High Organic Content in Surface Layer in Sandy Soils
[X] Sulfidic Odor	[ ] Organic Streaking in Sandy Soils
[ ] Aquic Moisture Regime	[X] Listed on Local Hydric Soils List
[X] Reducing Conditions	[X] Listed on National Hydric Soils List
[X] Gleyed or Low-Chroma Colors	[ ] Other (Explain in Remarks)

Remarks:
Mucky modifiers in the upper 15 inches of soil

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**YES**	NO	Is this Sampling Point Within a Wetland? **YES** NO
Wetland Hydrology Present?	**YES**	NO	
Hydric Soil Present?	**YES**	NO	

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Oakley Crossroads Restoration Site			Date: 01/22/2004
Applicant / Owner: NC EEP			County: Pitt
Investigator: P. Colwell, A. Dvorak-Grantz			State: NC
Do Normal Circumstances exist on the site?	YES	**NO**	Community ID: Wetland
Is the site significantly disturbed (Atypical Situation)?	**YES**	NO	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: Wetland C (WC 001-026)

VEGETATION

Dominant Plant Species	Scientific Name	Stratum	Indicator
1 Black willow	*Salix nigra*	Tree	OBL
2 Elderberry	*Sambucus Canadensis*	Shrub	FACW-
3 Soft rush	*Juncus* sp.	Herb	FACW-OBL
4 Smartweed	*Polygonum* sp.	Herb	FAC-OBL
5 Seedbox	*Ludwigia* sp.	Herb	OBL
6			
7			
8			
9			
10			
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100%			
Remarks: Area has been mowed in the past.			

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
[ ] Stream, Lake, or Tide Gauge
[ ] Aerial Photographs
[ ] Other

[X] No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	-	(in)
Depth of Free Water in Pit	10	(in)
Depth to Saturated Soil	0	(in)

WETLAND HYDROLOGY INDICATORS
Primary Indicators:
[ ] Inundated
[X] Saturated in Upper 12 Inches
[ ] Water Marks
[X] Drift Lines
[ ] Sediment Deposits
[X] Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required)
[X] Oxidized Root Channels in Upper 12 inches
[ ] Water-stained Leaves
[X] Local Soil Survey Data
[X] FAC-Neutral Test
[ ] Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Pantego loam	Drainage Class: poorly drained
Taxonomy (Subgroup): Umbric Paleaquults	Field Observations Confirm Mapped Type? YES NO

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-8	A1	10YR 3/1			Fine sandy loam
8-16	A2	10YR 2/1			Fine sandy loam

HYDRIC SOIL INDICATORS:

[ ] Histosol
[ ] Histic Epipedon
[X] Sulfidic Odor
[ ] Aquic Moisture Regime
[X] Reducing Conditions
[X] Gleyed or Low-Chroma Colors
[ ] Concretions
[ ] High Organic Content in Surface Layer in Sandy Soils
[ ] Organic Streaking in Sandy Soils
[X] Listed on Local Hydric Soils List
[X] Listed on National Hydric Soils List
[ ] Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**YES** NO	Is this Sampling Point Within a Wetland? **YES** NO
Wetland Hydrology Present?	**YES** NO	
Hydric Soil Present?	**YES** NO	

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Oakley Crossroads Restoration Site			Date: 01/22/2004
Applicant / Owner: NC EEP			County: Pitt
Investigator: P. Colwell, A. Dvorak-Grantz			State: NC
Do Normal Circumstances exist on the site?	YES	**NO**	Community ID: Upland
Is the site significantly disturbed (Atypical Situation)?	**YES**	NO	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: WC

VEGETATION

Dominant Plant Species	Scientific Name	Stratum	Indicator
1 Dog fennel	*Eupatorium capillifolium*	Shrub	FACU
2 Fescue	*Vulpia* sp.	Herb	FACU
3 Upland cotton	*Gossypium hirsutum*	Herb	NI
4			
5			
6			
7			
8			
9			
10			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 0%

Remarks: Upland located at edge of agricultural field.

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other

[X] No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water		(in)
Depth of Free Water in Pit	>24	(in)
Depth to Saturated Soil		(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- [ ] Inundated
- [X] Saturated in Upper 12 Inches
- [ ] Water Marks
- [X] Drift Lines
- [ ] Sediment Deposits
- [ ] Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required)
- [X] Oxidized Root Channels in Upper 12 inches
- [ ] Water-stained Leaves
- [X] Local Soil Survey Data
- [X] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Norfolk loamy sand	Drainage Class: well drained
Taxonomy (Subgroup): Typic Kandiudults	Field Observations Confirm Mapped Type? YES NO

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-7	A1	10YR 5/4			Fine sandy loam
7-20	A2	10YR 6/3			Sandy loam
20+	B	10YR 6/6			Sandy loam

HYDRIC SOIL INDICATORS:

[ ] Histosol
[ ] Histic Epipedon
[ ] Sulfidic Odor
[ ] Aquic Moisture Regime
[ ] Reducing Conditions
[X] Gleyed or Low-Chroma Colors
[ ] Concretions
[ ] High Organic Content in Surface Layer in Sandy Soils
[ ] Organic Streaking in Sandy Soils
[X] Listed on Local Hydric Soils List
[ ] Listed on National Hydric Soils List
[ ] Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES **NO**	Is this Sampling Point Within a Wetland? YES **NO**
Wetland Hydrology Present?	YES **NO**	
Hydric Soil Present?	YES **NO**	

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Oakley Crossroads Restoration Site			Date: 01/24/2004
Applicant / Owner: NC EEP			County: Pitt
Investigator: P. Colwell, A. Dvorak-Grantz			State: NC
Do Normal Circumstances exist on the site?	YES	**NO**	Community ID: Upland
Is the site significantly disturbed (Atypical Situation)?	YES	**NO**	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: WA & WB

VEGETATION

Dominant Plant Species	Scientific Name	Stratum	Indicator
1 Loblolly pine	*Pinus taeda*	Tree	FAC
2 Sweetgum	*Liquidambar styraciflua*	Tree	FAC+
3 Fescue	*Vulpia* sp.	Herb	FACU
4 Dog fennel	*Eupatorium capillifolium*	Herb	FACU
5 Grass	*Andropogon* sp.	Herb	FAC-FAC-
6 Japanese honeysuckle	*Lonicera japonica*	Vine	FAC-
7			
8			
9			
10			
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 33%			
Remarks: Upland area located at edge of agricultural field.			

HYDROLOGY

[ ] Recorded Data (Describe in Remarks) [ ] Stream, Lake, or Tide Gauge [ ] Aerial Photographs [ ] Other [X] No Recorded Data Available		WETLAND HYDROLOGY INDICATORS Primary Indicators: [ ] Inundated [ ] Saturated in Upper 12 Inches [ ] Water Marks [ ] Drift Lines [ ] Sediment Deposits [ ] Drainage Patterns in Wetlands
FIELD OBSERVATIONS		
Depth of Surface Water	(in)	Secondary Indicators (2 or more Required) [ ] Oxidized Root Channels in Upper 12 inches [ ] Water-stained Leaves [ ] Local Soil Survey Data [ ] FAC-Neutral Test [ ] Other (Explain in Remarks)
Depth of Free Water in Pit	> 24 (in)	
Depth to Saturated Soil	(in)	
Remarks:		

SOILS

Map Unit Name (Series and Phase): Ocilla loamy sand					Drainage Class: somewhat poorly
Taxonomy (Subgroup): Aquic Arenic Paleudults				Field Observations Confirm Mapped Type? YES NO	
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6	A	10YR 4/2			Fine sandy loam
6-14	B	10YR 6/3			Sandy loam
14+	B2	10YR 6/6			Sandy loam

HYDRIC SOIL INDICATORS:

[ ] Histosol
[ ] Histic Epipedon
[ ] Sulfidic Odor
[ ] Aquic Moisture Regime
[ ] Reducing Conditions
[ ] Gleyed or Low-Chroma Colors
[ ] Concretions
[ ] High Organic Content in Surface Layer in Sandy Soils
[ ] Organic Streaking in Sandy Soils
[ ] Listed on Local Hydric Soils List
[ ] Listed on National Hydric Soils List
[ ] Other (Explain in Remarks)

Remarks:
No hydric indicators

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES **NO**	Is this Sampling Point Within a Wetland? YES **NO**
Wetland Hydrology Present?	YES **NO**	
Hydric Soil Present?	YES **NO**	

Remarks:

Appendix 3. Project Site Wetland Rating Forms

WETLAND RATING WORKSHEET Fourth Version

Project Name: Oakley Crossroads – Wetland A **Nearest Road:** Jim Taylor Road
County Pitt **Wetland Area:** 3 **acres Wetland Width** 100 **feet**
Name of evaluator P. Colwell, A. Dvorak-Grantz **Date** 1/22/2004

Wetland Location

X **on pond or lake**
X **on perennial stream**
_____ **on intermittent stream**
_____ **within interstream divide**
X **other** - Remnant of old floodplain wetland; lies adjacent to irrigation pond

Soil Series – Pantego loam

_____ **predominantly organic-humus, muck, or peat**
X **predominantly mineral – non-sandy**
_____ **predominantly sandy**

Hydraulic factors

_____ **steep topography**
_____ **ditched or channelized**
_____ **total wetland width >= 100 feet**

Adjacent land use
(within ½ mile upstream, upslope, or radius)

X **forested/natural vegetation 20 %**
X **agriculture, urban/suburban 80 %**
_____ **impervious surface ___ %**

Dominant Vegetation
(1) Sweetgum
(2) Red maple
(3) Tag alder

Flooding and wetness

_____ **semipermanently to permanently flooded or inundated**
_____ **seasonally flooded or inundated**
X **intermittently flooded or temporary surface water**
_____ No evidence of flooding or surface water

Wetland type (select one)*

X **Bottomland hardwood forest**
_____ **Headwater forest**
_____ **Swamp forest**
_____ **Wet flat**
_____ **Pocosin**
_____ **Bog forest**
_____ **Pine savanna**
_____ **Freshwater marsh**
_____ **Bog/fen**
_____ **Ephemeral wetland**
_____ **Carolina Bay**
X **Other** Wet Flat

***the rating system cannot be applied to salt or brackish marshes or stream channels**

Water storage	**2**	**x 4.00 =**	**8**
Bank/Shoreline stabilization	**1**	**x 4.00 =**	**4**
Pollutant removal	**3 ***	**x 5.00 =**	**15**
Wildlife Habitat	**3**	**x 2.00 =**	**6**
Aquatic life value	**3**	**x 4.00 =**	**12**
Recreation/Education	**0**	**x 1.00 =**	**0**

WETLAND RATING

45

* Add 1 point if in sensitive watershed and >10% nonpoint disturbance within ½ mile upstream, upslope, or radius

WETLAND RATING WORKSHEET Fourth Version

Project Name: Oakley Crossroads – Wetland B **Nearest Road:** Jim Taylor Road
County Pitt **Wetland Area:** 1 **acres Wetland Width** 70 **feet**
Name of evaluator P. Colwell, A. Dvorak-Grantz **Date** 1/22/2004

Wetland Location

_____ **on pond or lake**
__X__ **on perennial stream**
_____ **on intermittent stream**
_____ **within interstream divide**
__X__ **other –** Herbaceous wetland within old floodplain

Soil Series Pantego loam

_____ **predominantly organic-humus, muck, or peat**
__X__ **predominantly mineral – non-sandy**
_____ **predominantly sandy**

Hydraulic factors

_____ **steep topography**
_____ **ditched or channelized**
_____ **total wetland width >= 100 feet**

Adjacent land use
(within ½ mile upstream, upslope, or radius)

__X__ **forested/natural vegetation 20 %**
__X__ **agriculture, urban/suburban 80 %**
_____ **impervious surface ___ %**

Dominant Vegetation
(1) Soft rush
(2) Seedbox
(3) Sedge

Flooding and wetness

_____ **semipermanently to permanently flooded or inundated**
_____ **seasonally flooded or inundated**
__X__ **intermittently flooded or temporary surface water**
_____ No evidence of flooding or surface water

Wetland type (select one)*

_____ **Bottomland hardwood forest**
_____ **Headwater forest**
_____ **Swamp forest**
_____ **Wet flat**
_____ **Pocasin**
_____ **Bog forest**
_____ **Pine savanna**
__X__ **Freshwater marsh**
_____ **Bog/fen**
_____ **Ephemeral wetland**
_____ **Carolina Bay**
__X__ **Other** Disturbed (mowed) old BLH

***the rating system cannot be applied to salt or brackish marshes or stream channels**

Water storage	**1**	**x 4.00 =**	**4**
Bank/Shoreline stabilization	**0.5**	**x 4.00 =**	**2**
Pollutant removal	**2 ***	**x 5.00 =**	**10**
Wildlife Habitat	**1**	**x 2.00 =**	**2**
Aquatic life value	**1**	**x 4.00 =**	**4**
Recreation/Education	**0**	**x 1.00 =**	**0**

WETLAND RATING

22

* Add 1 point if in sensitive watershed and >10% nonpoint disturbance within ½ mile upstream, upslope, or radius

WETLAND RATING WORKSHEET Fourth Version

Project Name: Oakley Crossroads – Wetland C **Nearest Road:** Jim Taylor Road
County Pitt **Wetland Area:** 1.5 **acres Wetland Width** 80 **feet**
Name of evaluator P. Colwell, A. Dvorak-Grantz **Date** 1/22/2004

Wetland Location

_____ **on pond or lake**
__X__ **on perennial stream**
_____ **on intermittent stream**
_____ **within interstream divide**
__X__ **other –** Herbaceous wetland within old floodplain

Soil Series Pantego loam

_____ **predominantly organic-humus, muck, or peat**
__X__ **predominantly mineral – non-sandy**
_____ **predominantly sandy**

Hydraulic factors

_____ **steep topography**
_____ **ditched or channelized**
_____ **total wetland width >= 100 feet**

Adjacent land use
(within ½ mile upstream, upslope, or radius)

__X__ **forested/natural vegetation 20 %**
__X__ **agriculture, urban/suburban 80 %**
_____ **impervious surface ___ %**

Dominant Vegetation
(1) Black willow
(2) Soft Rush
(3) Smartweed

Flooding and wetness

_____ **semipermanently to permanently flooded or inundated**
_____ **seasonally flooded or inundated**
__X__ **intermittently flooded or temporary surface water**
_____ No evidence of flooding or surface water

Wetland type (select one)*

_____ **Bottomland hardwood forest**
_____ **Headwater forest**
_____ **Swamp forest**
_____ **Wet flat**
_____ **Pocasin**
_____ **Bog forest**
_____ **Pine savanna**
__X__ **Freshwater marsh**
_____ **Bog/fen**
_____ **Ephemeral wetland**
_____ **Carolina Bay**
__X__ **Other** Disturbed (mowed) old BLH

***the rating system cannot be applied to salt or brackish marshes or stream channels**

Water storage	**2**	**x 4.00 =**	**8**
Bank/Shoreline stabilization	**1**	**x 4.00 =**	**4**
Pollutant removal	**2 ***	**x 5.00 =**	**10**
Wildlife Habitat	**1**	**x 2.00 =**	**2**
Aquatic life value	**1**	**x 4.00 =**	**4**
Recreation/Education	**0**	**x 1.00 =**	**0**

WETLAND RATING

28

* Add 1 point if in sensitive watershed and >10% nonpoint disturbance within ½ mile upstream, upslope, or radius

Appendix 4. Project Site NCDWQ Stream Classification Form

NCDWQ Stream Classification Form

Stream Name: UT to Tranter's Creek Project Name: Oakley Crossroads River Basin: Tar-Pamlico

County: Pitt Evaluator: ADG DWQ Project Number: N/A Nearest Named Stream: Tranter's Creek

Latitude: 35° 45' 49" N Longitude: 77° 16' 23" W Signature: Date: 5/1/03

USGS QUAD: Robersonville West Location/Directions: Off of Highway 58 in Greene County

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	***1-Receives other "main ditches"***	

***PRIMARY GEOMORPHOLOGY INDICATOR POINTS*: 13**

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:* 1.5**

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: **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: **6.75**

TOTAL POINTS *(*Primary + Secondary*)*= 37.75 (If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)

Appendix 5. Reference Site Photographs

Photo 1. Shepherd Run Reference Reach (Looking Upstream)
E5 Stream Type with a Well-established Riparian Buffer

Photo 2. Shepherd Run Reference Reach (Looking Downstream)

Photo 3. UT to Tyson Creek Reference Reach (Looking Upstream) with C5 Stream Type with Well-established Buffer and Meandering Pattern

Photo 4. UT to Tyson Creek Reference Reach (Looking Downstream)

Photo 5. Onsite Reference Wetland (Bottomland Hardwood Forest)

Photo 6. Onsite Reference Wetland (Bottomland Hardwood Forest)

Photo 7. Shepherd Run Reference Wetland (Bottomland Hardwood Forest)

Photo 8. Shepherd Run Reference Wetland Vegetation

Appendix 6. Reference Site USACE Routine Wetland Determination Data Forms

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Shepherd Run Wetland Reference Site			Date: 06/17/02
Applicant / Owner: NC EEP			County: Greene
Investigator: A. Dvorak-Grantz			State: NC
Do Normal Circumstances exist on the site?	**YES**	NO	Community ID: Bottomland Hardwood
Is the site significantly disturbed (Atypical Situation)?	YES	**NO**	Transect ID:
Is the area a potential Problem Area? (If needed, explain on reverse)	YES	**NO**	Plot ID: Wetland Plot #1

VEGETATION

Dominant Plant Species	Scientific Name	Stratum	Indicator
1 Red maple	*Acer rubrum*	Tree	FAC
2 Green ash	*Fraxinus pennsylvanica*	Tree	FACW
3 Sweetbay magnolia	*Magnolia virginiana*	Shrub	FACW+
4 Tag alder	*Alnus serrulata*	Shrub	FACW
5 Tearthumb	*Polygonum sagittatum*	Herb	OBL
6 Clearweed	*Pilea pumila*	Herb	FACW
7 Lizard's tail	*Saururus cernuus*	Herb	OBL
8 Netted chain fern	*Woodwardia areolata*	Herb	OBL
9 Rush	*Juncus* sp.	Herb	FACW-OBL
10 Sedge	*Carex* sp.	Herb	FAC-OBL
11 Jewelweed	*Impatiens capensis*	Herb	FACW
12 Chinese privet	*Ligustrum sinense*	Shrub	FAC
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100%			
Remarks:			

HYDROLOGY

[ ] Recorded Data (Describe in Remarks)
- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other

[X] No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	2	(in)
Depth of Free Water in Pit	12	(in)
Depth to Saturated Soil	0	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- [X] Inundated
- [X] Saturated in Upper 12 Inches
- [ ] Water Marks
- [X] Drift Lines
- [ ] Sediment Deposits
- [X] Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required)
- [ ] Oxidized Root Channels in Upper 12 inches
- [X] Water-stained Leaves
- [X] Local Soil Survey Data
- [X] FAC-Neutral Test
- [ ] Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name (Series and Phase): Bibb sandy loam	Drainage Class: poorly
Taxonomy (Subgroup): Typic Fluvaquents	Field Observations Confirm Mapped Type? YES NO

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12	A	7.5YR 3/1			Sandy loam
12-24+	B	7.5YR 3/1			Loam

HYDRIC SOIL INDICATORS:

[ ] Histosol
[ ] Histic Epipedon
[X] Sulfidic Odor
[ ] Aquic Moisture Regime
[ ] Reducing Conditions
[X] Gleyed or Low-Chroma Colors
[ ] Concretions
[ ] High Organic Content in Surface Layer in Sandy Soils
[ ] Organic Streaking in Sandy Soils
[X] Listed on Local Hydric Soils List
[X] Listed on National Hydric Soils List
[ ] Other (Explain in Remarks)

Remarks:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**YES** NO	Is this Sampling Point Within a Wetland? **YES** NO
Wetland Hydrology Present?	**YES** NO	
Hydric Soil Present?	**YES** NO	

Remarks:

Appendix 7. Reference Site Wetland Rating Form

WETLAND RATING WORKSHEET Fourth Version

Project Name: Oakley Crossroads - Shepherd Run Site **Nearest Road:** Highway 58
County Greene **Wetland Area:** ____ **acres Wetland Width** ___ **feet**
Name of evaluator A. Dvorak-Grantz **Date** 6/17/2002

Wetland Location

_____ **on pond or lake**
__X__ **on perennial stream**
_____ **on intermittent stream**
_____ **within interstream divide**
_____ **other –** Herbaceous wetland within old floodplain

Soil Series Bibb

_____ **predominantly organic-humus, muck, or peat**
__X__ **predominantly mineral – non-sandy**
_____ **predominantly sandy**

Hydraulic factors

_____ **steep topography**
_____ **ditched or channelized**
_____ **total wetland width >= 100 feet**

water

Adjacent land use
(within ½ mile upstream, upslope, or radius)
__X__ **forested/natural vegetation 80 %**
__X__ **agriculture, urban/suburban 10 %**
__X__ **impervious surface 10 %**

Dominant Vegetation
(1) Tag alder
(2) Swamp dogwood
(3) Clearweed

Flooding and wetness

_____ **semipermanently to permanently flooded or inundated**
__X__ **seasonally flooded or inundated**
_____ **intermittently flooded or temporary surface water**
_____ **No evidence of flooding or surface**

Wetland type (select one)*

__X__ **Bottomland hardwood forest**	_____ **Pine savanna**
_____ **Headwater forest**	_____ **Freshwater marsh**
_____ **Swamp forest**	_____ **Bog/fen**
_____ **Wet flat**	_____ **Ephemeral wetland**
_____ **Pocasin**	_____ **Carolina Bay**
_____ **Bog forest**	_____ **Other** _____

***the rating system cannot be applied to salt or brackish marshes or stream channels**

Water storage	**3**	**x 4.00 =**	**12**
Bank/Shoreline stabilization	**3**	**x 4.00 =**	**12**
Pollutant removal	**4 ***	**x 5.00 =**	**20**
Wildlife Habitat	**4**	**x 2.00 =**	**8**
Aquatic life value	**4**	**x 4.00 =**	**16**
Recreation/Education	**0**	**x 1.00 =**	**0**

WETLAND RATING

68

* Add 1 point if in sensitive watershed and >10% nonpoint disturbance within ½ mile upstream, upslope, or radius

Appendix 8. Reference Site NCDWQ Stream Classification Forms

NCDWQ Stream Classification Form

Stream Name: Shepherds Run Project Name: Oakley Crossroads River Basin: Neuse County: Greene

Evaluator: ADG DWQ Project Number: N/A Nearest Named Stream: Shepherds Run Latitude: 35° 25' 49" N

Signature: Date: 06/17/02 USGS QUAD: Snow Hill, N.C. Longitude: 77° 38' 57" W

Location/Directions: South of Highway 58 in Greene County

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? *(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*	0	1	**2**	3
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*: 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: 7

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: 7.25

TOTAL POINTS *(*Primary + Secondary*)*= 46.25 (If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)

NCDWQ Stream Classification Form

Stream Name: UT to Tysons Creek Project Name: Oakley Crossroads River Basin: Tar-Pamlico County: Pitt

Evaluator: ADG DWQ Project Number: N/A Nearest Named Stream: Tysons Creek Latitude: 35° 41' 13" N

Signature: Date: 06/17/02 USGS QUAD: Falkland, N.C. Longitude: 77° 30' 50" W

Location/Directions: West of SR 1247, southwest of Falkland.

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? *(*NOTE: If Bed & Bank Caused By Ditching And WITHOUT Sinuosity Then Score=0*)*	0	1	2	**3**
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*: 1**

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*: 9**

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: **7**

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: **8.5**

TOTAL POINTS *(*Primary + Secondary*)*= 50.5 (If Greater Than Or Equal To 19 Points The Stream Is At Least Intermittent)

Appendix 9. HEC–RAS Analysis

Appendix 9. Oakley Crossroads Stream and Wetland Restoration
HEC-RAS / Backwater Comparison

HEC-RAS Station	Storm	Discharge (cfs)	Proposed WSEL (ft)	Existing WSEL (ft)	Rise in Water Surface (ft)
36	100 yr	610	45.34	45.39	-0.05
678	100 yr	610	44.33	43.99	0.34
1064	100 yr	610	43.41	43.29	0.12
1577	100 yr	610	42.72	42.74	-0.02
2027	100 yr	610	42.32	42.27	0.05
2412	100 yr	610	41.96	41.93	0.03
2798	100 yr	610	41.59	41.54	0.05
3183	100 yr	610	41.27	41.22	0.05
3761	100 yr	610	39.62	39.62	0.00

Appendix 10. Correspondence

Stantec Consulting Services Inc.
801 Jones Franklin Road Suite 300
Raleigh NC 27606
Tel: (919) 851-6866 Fax: (919) 851-7024
stantec.com

Stantec

April 3, 2006

Rene Gledhill-Early
State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 28516

RE: EEP Wetland and Stream restoration project in Pitt County.

Dear Ms. Gledhill-Early:

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential wetland and stream restoration project at Oakley Crossroads in Pitt County (see attached vicinity map).

The Oakley Crossroads site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Portions of the unnamed tributary to Tranters Creek have been identified as significantly degraded. A few of the agricultural fields on the site are classified as prior converted wetlands.

Remnants of two farm storage buildings are located in the northern portion of the easement. These buildings were observed during preliminary surveys of the site (see Site map). The buildings are slated for removal due to the likelihood that restoration activities will occur in that area. Two farm ponds are also located on the northern side of the channel. As part of the landowner agreement, these ponds will be expanded for irrigation purposes. The majority of the site has historically been disturbed due to agricultural purposes such as tilling. Enclosed are current photos (photo 1-4) of the site and the buildings. We ask that you review this site based on the attached information to determine the presence or absence of any historic properties.

We thank you in advance for your timely response and cooperation. Please feel free to contact me at (919) 851-6866 ext. 258 with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,

Amber Coleman, LSS
Scientist, Environmental Management

cc:
Julia Hunt,
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

Enclosed: Site photos, Project Vicinity and Project Site maps

Photo 1: Oakley Crossroads Project Site - Unnamed Tributary to Tranters Creek

Photo 2: Project Site Riparian Area

Photo 3: Farm Buildings to be Removed

Photo 4: Farm Pond on the Project Site

stantec.com

Memo

Stantec

To:	John Mintz NC Office of State Archaeology	From:	Amber Coleman Stantec Consulting Ltd.
File:		Date:	April 13, 2006

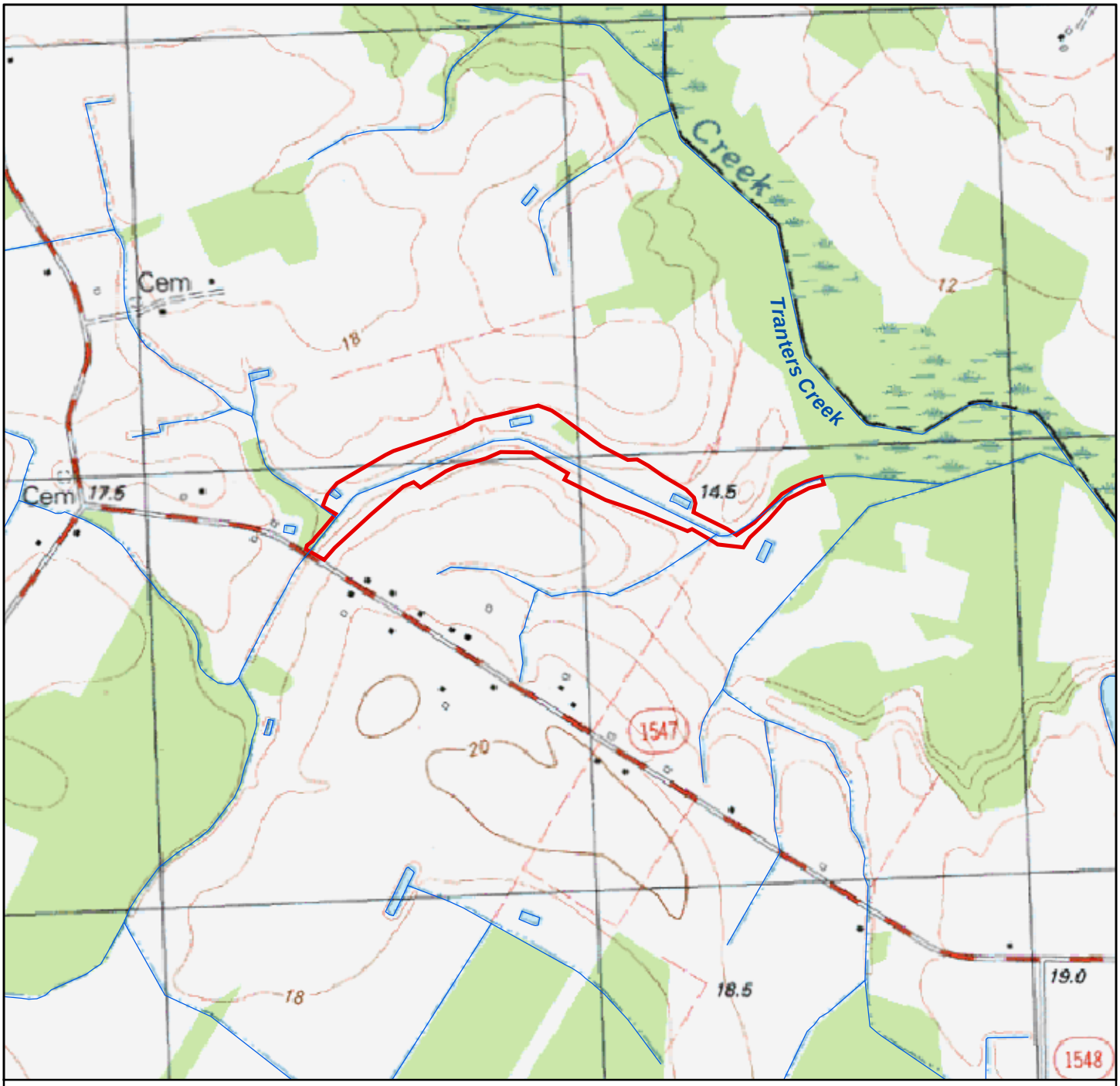
Reference: Oakley Crossroads Stream and Wetland Restoration Project – Additional Information

As discussed, I have attached a site map containing the approximate easement area overlain on the topographic quadrangle. The easement varies from approximately 50' to 250' on each side of the centerline of the channel. The project will involve construction of a wider and deeper floodplain and more sinuous channel as well as expansion of two irrigation ponds. Preliminary designs indicate that the new floodplain will be excavated approximately 3-4' below the existing land surface with an average width of 30' on either side of the existing channel. The irrigation ponds are within the easement on the middle and eastern portions of the project. Both ponds will be expanded northward, please see the attached Pond Excavation Maps for more details. The Taylor pond is the central pond while the Briley Pond is the eastern pond. The remainder of the easement is to be planted with wetland species and other riparian vegetation. Do not hesitate to call me if you have additional questions (919)851-6866 ext. 258.

Amber Coleman, LSS
Scientist
acoleman@stantec.com

Attachment: Topographic Quadrangle Map, Proposed Pond Excavation Maps

c. Julia Hunt, NCEEP



Legend

Approximate Easement

Streams

Robersonville West USGS 7.5' Quad
Contours and Elevations in Meters

Easement Varies from Approximately
50' to 250' from Stream Centerline

Project Site Topographic Map

Oakley Crossroads Stream & Wetland Restoration
Pitt County, North Carolina
April 2006

0 0.25 0.5 Miles

Stantec

Ecosystem Enhancement Program

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

April 21, 2006

Amber Coleman
Stantec Consulting Services
801 Jones Franklin Road
Raleigh, NC 27606

Re: EEP Wetland Restoration, Oakley Crossroads, Pitt County, ER 06-0992

Dear Ms. Coleman:

Thank you for your letter of April 3, 2006, concerning the above project.

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

Renee Gledhill-Earley

Peter Sandbeck

Stantec Consulting Services Inc.
801 Jones Franklin Road Suite 300
Raleigh NC 27606
Tel: (919) 851-6866 Fax: (919) 851-7024
stantec.com

Stantec

April 4, 2006

Mr. Harry E. LeGrand
NC Natural Heritage Program
1601 Mail Service Center
Raleigh, NC 27569-1601

RE: EEP Wetland and Stream restoration project in Pitt County.

Dear Mr. LeGrand:

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to endangered species and migratory birds from a potential wetland and stream restoration project located in Pitt County (see attached site maps).

The Oakley Crossroads 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. Areas of the agricultural fields on site are classified as prior converted wetlands.

We have reviewed the information on your website and provided a letter to the US Fish and Wildlife Service. Any comments and/or recommendations that you may have for the site would be greatly appreciated. If you have any questions concerning this project, or need additional information, please do not hesitate to call me at (919) 851-6866 ext. 258. We greatly appreciate your assistance in this matter.

Sincerely,

Amber Coleman, LSS
Scientist, Environmental Management

cc:
Julia Hunt,
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

Enclosed: Project Vicinity and Project Site maps

NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary

April 10, 2006

Ms. Amber Coleman
Stantec Consulting Services, Inc.
801 Jones Franklin Road Suite 300
Raleigh, NC 27606

Subject: EEP Wetland and Stream Restoration Project; Pitt County
Oakley Crossroads Site

Dear Ms. Coleman:

The Natural Heritage Program has no record of rare species, significant natural communities, or significant natural heritage areas at the site nor within a mile of the project area. Although our maps do not show records of such natural heritage elements in the project area, it does not necessarily mean that they are not present. It may simply mean that the area has not been surveyed. The use of Natural Heritage Program data should not be substituted for actual field surveys, particularly if the project area contains suitable habitat for rare species, significant natural communities, or priority natural areas.

You may wish to check the Natural Heritage Program database website at www.ncnhp.org for a listing of rare plants and animals and significant natural communities in the county and on the topographic quad map. Alternatively, the NC Center for Geographic Information and Analysis (CGIA) provides digital Natural Heritage data online on a cost recovery basis. Subscribers can get site specific information on GIS layers with Natural Heritage Program rare species occurrences and Significant Natural Heritage Areas. The CGIA website provides Element Occurrence (EO) ID numbers (instead of species name), and the data user is then encouraged to contact the Natural Heritage Program for detailed information. This service allows the user to quickly and efficiently get site specific NHP data without visiting the NHP workroom or waiting for the Information Request to be answered by NHP staff. For more information about data formats, pricing structure and ordering procedures, visit http://www.cgia.state.nc.us/cgdb/datalist.html, or call CGIA Production Services at (919) 733-2090.

Sincerely,

Harry E. LeGrand, Jr.

Harry E. LeGrand, Jr., Zoologist
Natural Heritage Program

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 • FAX: 919-715-3060 • Internet: www.enr.state.nc.us

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Stantec

April 4, 2006

Mr. Gary Jordan
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636-3726

RE: EEP Wetland and Stream restoration project in Pitt County.

Dear Mr. Jordan:

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to endangered species and migratory birds from a potential wetland and stream restoration project located in Pitt County (see attached site maps).

The Oakley Crossroads 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. Areas of the agricultural fields on site are classified as prior converted wetlands.

We have reviewed the information on your website and provided a letter to the North Carolina Natural Heritage Program. Any comments and/or recommendations that you may have for the site would be greatly appreciated. If you have any questions concerning this project, or need additional information, please do not hesitate to call me at (919) 851-6866 ext. 258. We greatly appreciate your assistance in this matter.

Sincerely,

Amber Coleman, LSS
Scientist, Environmental Management

cc:
Julia Hunt,
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

Enclosed: Project Vicinity and Project Site maps