DETAILED BUFFER RESTORATION PLAN
TERRIBLE CREEK BUFFER RESTORATION
WAKE COUNTY, NORTH CAROLINA

(SCO Project Number 050667901)
NEUSE RIVER BASIN
CATALOGINC UNIT 03020201

Prepared for:

NCDENR

Ecosystem Enhancement PROGRAM

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

September 12,2006

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EXECUTIVE SUMMARY

This detailed restoration plan describes the **Terrible Creek Buffer Restoration Site** (Site) and is designed specifically to assist in fulfilling North Carolina Ecosystem Enhancement Program (EEP) restoration goals. The Site is located approximately 1 mile northeast of Willow Springs and 4 miles northeast of Fuquay-Varina, in Wake County. This portion of Wake County is located within Neuse River Basin Cataloging Unit 03020201120010.

This document details riparian buffer restoration procedures on the approximately 47.84-acre Site, which will result in a total of approximately 45.6 acres of riparian buffer restoration.

Site drainage features provide water quality function to an approximately 13.0-square mile watershed. The Site is located within a North Carolina Wetlands Restoration Program (NCWRP) targeted local watershed; however, Site streams and the receiving stream (Middle Creek) have not been placed on the state's 303(d) list by the North Carolina Division of Water Quality (NCDWQ). Terrible Creek has a Best Usage Classification of C, NSW (Nutrient Sensitive Waters) and supports its designated uses.

Site land use consists primarily of livestock pasture; however, cattle have been removed from the property. Terrible Creek is characterized by eroding stream banks and contains a riparian buffer dominated by fescue as well as other herbaceous vegetation. Residential development is currently under construction north of the Site and will continue to expand exacerbating runoff into the Site. Based on preliminary analyses, the Site appears best suited for removal of the existing fescue and restoration of a natural wooded riparian buffer in floodplains adjacent to Site streams.

Site reforestation, consisting of Piedmont/Mountain Levee Forest and Piedmont/Mountain Bottomland Forest communities, has been proposed within the Site. The primary goals of this buffer restoration project focus on reforestation of the floodplain with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering Terrible Creek; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to Site open waters; and 10) enhance characteristic macroinvertebrate species populations in the channel.

In addition, this will serve as a pilot project for outer bend treatments. The erosion status of each outer bend on Terrible Creek within the Site was evaluated and ranked on a qualitative scale. Three outer bend treatments consisting of 1) erosion control matting and livestakes, 2) brush mattresses, and 3) do nothing will be incorporated on bends throughout the Site in order to monitor the progression of each outer bend and compare treatments through the monitoring period.

A Monitoring Plan has been prepared that entails a detailed analysis of Site vegetation; success of the project will be based on criteria outlined in this document.

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TERRIBLE CREEK
DETAILED BUFFER RESTORATION PLAN

1.0 INTRODUCTION

The North Carolina Ecosystem Enhancement Program (EEP) is currently developing detailed buffer restoration plans at the Terrible Creek Buffer Restoration Site (Site) located approximately 1 mile northeast of Willow Spring and 4 miles northeast of Fuquay-Varina, in Wake County (Figure 1, Appendix A). The Site is located in United States Geological Survey (USGS) Hydrologic Unit (HU) 03020201120010 (North Carolina Division of Water Quality [NCDWQ] Subbasin 03-04-03) of the Neuse River Basin and will service the USGS 8-digit HU 03020201 (Figure 2, Appendix A) (USGS 1974).

The primary goals of this buffer restoration project focus on reforestation of the entire 47.84-acre Site with native species to 1) improve water quality; 2) enhance flood attenuation; 3) reduce sedimentation/siltation; 4) increase channel bank stability; 5) filter and reduce pollutants prior to entering Terrible Creek; 6) serve as a wildlife corridor by providing connectivity to forested areas adjacent to the Site; 7) provide increased habitat for aquatic and terrestrial wildlife; 8) increase organic matter, carbon export, and woody debris in the stream corridor; 9) restore shade to Site open waters; and 10) enhance characteristic macroinvertebrate species populations in the channel.

The purpose of this plan is to outline a detailed restoration plan for buffer restoration activities. The objectives of this project include the following.

- Classify on-Site streams as perennial, intermittent, or ephemeral.
- Identify jurisdictional wetlands within Site boundaries.
- Identify a suitable reference forest to model Site restoration attributes.
- Establish a baseline photographic record of each outer bend of Terrible Creek within the Site.
- Develop a detailed plan of buffer restoration activities within the approximately 47.84-acre conservation easement boundary.
- Establish success criteria and a method of monitoring the Site upon completion of restoration construction.

Site restoration efforts will result in the following.

- Restore approximately 45.6 acres of riparian buffer within the Site.
- Reforest or supplemental plant approximately 45.6 acres of the Site with native forest vegetation.
- Install outer bend treatments on Terrible Creek.

The primary goals of this buffer restoration project focus on improving water quality, enhancing flood attenuation, and restoring aquatic and riparian habitat and will be accomplished by:

- Removing nonpoint sources of pollution by providing a vegetative buffer adjacent to streams and wetlands to treat surface runoff.
- Reducing sedimentation within on-Site and downstream receiving waters by a) reducing bank erosion associated with vegetation maintenance and agricultural activities to Site streams, b) filtering surface runoff from adjacent developments and reduce particulate matter deposition into area waterways, and c) providing a forested vegetative buffer adjacent to Site streams and wetlands.

- Promoting floodwater attenuation and improving stream stability by a) enhancing depressional floodplain wetlands and the storage capacity for floodwaters within the Site and b) revegetating Site floodplains to reduce floodwater velocities and increase frictional resistance on floodwaters crossing Site floodplains.
- Providing wildlife habitat including a forested riparian corridor within a region of the state increasingly dissected by residential land use.

This document represents a detailed restoration plan summarizing activities proposed within the Site. The plan includes 1) descriptions of existing condition, 2) reference forest studies, 3) restoration plans, and 4) Site monitoring and success criteria. Upon approval of this plan by EEP, activities will be implemented as outlined. Proposed restoration activities may be modified due to constraints such as access issues or other design considerations.

2.0 METHODS

Natural resource information was obtained from available sources including USGS 7.5-minute topographic quadrangle (Angier, North Carolina), United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping, Soil Conservation Service (SCS) soils mapping for Wake County (USDA 1970), and recent Wake County aerial photography and shapefiles to evaluate existing landscape, stream, and soil information prior to Site inspections.

Characteristic and target natural community patterns were classified according to Schafale and Weakley's, *Classification of the Natural Communities of North Carolina* (1990).

Detailed field investigations were conducted in July 2006, including delineation of jurisdictional wetlands, stream determinations, collection of soil samples, establishment of photographic records, and mapping of on-Site resources. Hydrology, vegetation, and soil attributes were analyzed to determine the status of jurisdictional wetlands. Jurisdictional wetlands locations were recorded using Global Positioning System (GPS) technology with reported submeter accuracy. Recent aerial photography and hydrology information obtained from the Wake County Geographic Information Systems (GIS) Department, USGS 7.5-minute topographic quadrangle, and Wake County soil maps were used to make determinations on hydrologic features and to map relevant environmental features.

3.0 EXISTING CONDITIONS

3.1 Physiography, Topography, and Land Use

The Terrible Creek Site is located approximately 1 mile northeast of Willow Springs and 4 miles northeast of Fuquay-Varina, in Wake County (Figure 1, Appendix A). The Site is located in the Northern Outer Piedmont ecoregion of North Carolina within USGS HU 03020201120010 (NCDWQ Subbasin 03-04-03) of the Neuse River Basin and will service the USGS 8-digit HU 03020201 (Figure 2, Appendix A) (USGS 1974). Regional physiography is characterized by dissected irregegular plains, low rounded hills and ridges, and low to moderate gradient streams with mostly cobble, gravel, and sand substrate (Griffith 2002). This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 46.9 inches per year (USDA 1970).

The Site encompasses only the left bank of Terrible Creek, several unnamed tributaries to Terrible Creek, floodplains, and jurisdictional wetlands. The Site drains an approximately 13.0-square mile watershed at the Site outfall (Figure 3, Appendix A). The main tributary is a fourth-order or greater, bank-to-bank

stream system, which has been impacted by vegetative clearing, hoof shear from cattle and horses, and erosive flows.

The upstream drainage basin is characterized mainly by agricultural and forest land with interspersed low-density residential development; impervious surfaces appear to account for less than 10 percent of the drainage basin area (Figure 3, Appendix A). Residential development becomes more concentrated southwest of the watershed in the City of Fuquay-Varina and northeast of the watershed in the City of Raleigh. The Site was historically characterized by hardwood forest several decades ago; forest vegetation was cleared and the property was converted to livestock pasture. Livestock have been removed from the Site, which is currently characterized by fallow pasture (Figure 4, Appendix A). The Site contains an abundance of complex microtopography ranging to one foot in vertical symmetry across the landscape most likely remnant from logging operations. A beaver dam is currently located near the downstream end of the Site and has resulted in the mortality of mature hardwood trees in this area. Several residential developments are currently being constructed immediately north/upslope of the Site.

3.2 Soils

Soils that occur within the Site, according to the *Soil Survey of Wake County, North Carolina* are depicted in Figure 4 (Appendix A) and described in the following table (USDA 1970).

Table 1. USDA Soils Mapped within the Site

Soil Series	Hydric Status*	Family	Description
Appling	Nonhydric	*Typic Hapludults*	This series consists of well-drained, moderatly permeable, gently sloping to strongly sloping soils found on side slopes and rounded divides. Hard rock occurs at a depth of more than 60 inches.
Augusta	Class B	*Aeric Ochraquults*	This series consists of somewhat poorly drained, moderately slow permeable, nearly level to gently sloping soils on low stream terraces near large streams. Depth to the seasonal high water table occurs at 1.5 feet. Hard rock occurs at a depth of more than 60 inches.
Chewacla	Class B	*Aquic Fluventic Dystrochrepts*	This series consists of nearly level, somewhat poorly drained, moderately to moderately rapid permeable soils on floodplains. Depth to the seasonal high water table occurs at 1.5 feet. Hard rock occurs at a depth of more than 48 inches.
Wehadkee and Bibb	Class A	*Fluventic Haplaquepts/ Typic Haplaquents*	This series consists of nearly level, poorly drained, moderately to moderately rapid permeable soils on floodplains. The seasonal high water table generally occurs at the soil surface. Hard rock occurs at a depth of more than 36 inches.

* USDA 2005

Four soil samples were collected within the Site for analysis by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Agronomy Division to receive Site specific lime and fertilizer recommendations in order to protect the environment by minimizing the use of fertilizers. Each sample was collected following the protocol outlined by the NCDA&CS and recommendations are given for the establishment of hardwood forest vegetation and the maintenance of hardwood forest vegetation. The location of each soil sample is depicted on Figure 4 (Appendix A) and the full Soil Test Report can

be found in Appendix B. The following table summarizes the results of the four soil samples based on the results from NCDA&CS for the establishment of hardwood forest vegetation.

Table 2. NCDA&CS Soil Sample Results

Sample	pH	P-I	K-I	Recommended Application for the Establishment of Hardwood Forest Vegetation			
				Lime (tons/acre)	N (pounds/acre)	P_2O_5 (pounds/acre)	K_2O (pounds/acre)
1	6.2	12	11	0	0	40-60	70-90
2	6.7	7	11	0	0	50-70	70-90
3	5.4	29	17	0	0	10-30	60-80
4	5.9	8	18	0	0	50-70	60-80

P-I = phosphorus index; K-I = potassium index; N = nitrogen; P_2O_5 = phosphate; K_2O = potash

The target pH for hardwood seedlings is 6.0 according to the NCDA&CS; Site pH's range from 5.4 to 6.7 and no recommendations for the application of lime were made. In addition, for the establishment of hardwood trees no nitrogen application is recommended. However, phosphate and potash fertilizers were recommended for hardwood establishment at rates of 10 to 70 pounds per acre and 60 to 90 pounds per acre, respectively.

3.3 Plant Communities

Distribution and composition of plant communities reflect landscape-level variations in topography, soils, hydrology, and past or present land use practices. The entire Site is composed of fallow pasture (Figure 4, Appendix A).

Fallow pastureland is currently dominated by fescue (*Festuca* sp.) planted for grazing and maintains little vegetative diversity. Areas of the Site not dominated by fescue contain a variety of early successional wetland vegetation including soft rush (*Juncus effusus*), goldenrod (*Solidago* sp.), false nettle (*Boehmeria cylindrica*), arrowleaf tearthumb (*Polygonum sagittatum*), Nepalese browntop (*Microstegium vimineum*), jewelweed (*Impatiens capensis*), bedstraw (*Galium* sp.), ironweed (*Vernonia novaboracensis*), sedge (*Carex* sp.), lizard's tail (*Saururus cernuus*), blackberry (*Rubus* sp.), maypop (*Passiflora edulis*), and Carolina horsenettle (*Solanum carolinense).*

A few scattered trees remain within the pasture and adjacent to the stream including sweetgum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), cherrybark oak (*Quercus pagoda*), American holly (*Ilex opaca*), river birch (*Betula nigra*), black willow (*Salix nigra*), dogwood (*Cornus amomum*), sycamore (*Platanus occidentalis*), ironwood (*Carpinus caroliniana*), and black gum (*Nyssa* sp.).

3.4 Watershed Hydrology

Hydrology within the Site is defined by the presence of surface water flows, groundwater migration into open water conveyances, groundwater seepage onto floodplain surfaces, and, to a lesser extent, precipitation. Surface water flows result primarily from upstream drainage basin catchment, discharge into feeder tributaries, and surface water flows into and through the Site.

This region is considered characteristic of the Piedmont Physiographic Province and is characterized by dissected irregegular plains, low rounded hills and ridges, and low to moderate gradient streams with

mostly cobble, gravel, and sand substrate (Griffith 2002). This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 46.9 inches per year (USDA 1970). The Site occurs within USGS 14-digit HU 03020201120010 (NCDWQ Subbasin 03-04-03), a **Targeted Local Watershed** of the Neuse River Basin (Figure 2, Appendix A) (USGS 1974, NCWRP 2003). However, Terrible Creek and its tributaries are not listed on the NCDWQ draft 2004 or draft 2006 303(d) lists (NCDWQ 2004, 2006b).

The Site drainage area encompasses approximately 13.0 square miles at the downstream Site outfall (Figure 3, Appendix A). The drainage area is characterized by agricultural land, forest, and low-density residential development. Terrible Creek has been assigned Stream Index Number 27-43-15-8-(2) and a Best Usage Classification of **C NSW** (NCDWQ 2006a).

3.5 Stream Classification

Unnamed tributaries to Terrible Creek within the Site depicted on the Wake County GIS Department hydrology layer as intermittent and perennial were identified and classified in the field as perennial, intermittent, or ephemeral based on the NCDWQ Stream Identification Form Version 3.1. The stream classifications will aid in determining the Neuse River Riparian Buffer restoration acreage within the Site. The NCDWQ forms and United States Army Corps of Engineers (USACE) Stream Quality Assessment Worksheets are included in Appendix C. The approximate location that forms were completed for each stream is depicted on Figure 4 (Appendix A). The following table summarizes information for each stream. Fish were present in many of the stream reaches.

Table 3. Stream Classifications

Stream	Depicted on Topo	Depicted on Soil Survey	NCDWQ Form Score	USACE Form Score	Status
A	no	no	30.75	54	perennial
B	no	no	34.75	63	perennial
C	yes	yes	30	35	perennial
D	no	no	33.25	58	perennial
E	no	no	35.25	59	perennial
F	no	yes	39.25	61	perennial
G	no	no	23.75	46	intermittent
H	no	no	29.75	52	intermittent
I	yes	yes	34	45	perennial
J	no	no	27.75	49	intermittent
K	no	no	38.5	53	perennial

3.6 Jurisdictional Wetlands

Jurisdictional wetlands within the Site were delineated in the field following guidelines set forth in the *Corps of Engineers Wetlands Delineation Manual* and located using GPS technology with reported submeter accuracy during July 2006 (Environmental Laboratory 1987). Maps and dataforms for the jurisdictional wetland delineation are included in Appendix C of this document.

Historically, on-Site wetlands may have supported communities similar to a Piedmont/Mountain Levee Forest adjacent to Terrible Creek grading towards a Piedmont/Mountain Bottomland Forest within the remainder of the floodplain area (Schafale and Weakley 1990). Piedmont/Mountain Levee Forest communities typically occur on natural levee and point bar deposits on large floodplains that are palustrine and seasonally to intermittently flooded. Piedmont/Mountain Bottomland Forest communities typically occur on floodplain ridges and terraces other than active levees adjacent to the stream channel. Each of these communities are typically underlain by alluvial soils such as the Chewacla soils and Wehadkee and Bibb soils that comprise the majority of the Site.

Despite the slight landscape position difference between the Levee and Bottomland Forests, the vegetative communities are similar with the exception of species such as sycamore, river birch, and box elder (*Acer negundo*), which are generally distinguishing species of a Levee Forest. These species generally only occur within disturbed sections of a Bottomland Forest. The Site historically may have been dominated by species contained within the reference forest located south of Terrible Creek near the upstream/western end of the Site (Figure 3, Appendix A) such as green ash (*Fraxinus pennsylvanica*), cherrybark oak, sweetgum, red maple, ironwood, and river birch with an understory of American holly, spice bush (*Lindera benzoin*), southern lady fern (*Athyrium filix-femina* ssp. *asplenioides*), and greenbrier (*Smilax* sp.). Site impacts may have reduced hydrologic functions, biogeochemical functions, and plant and animal habitat interactions of these communities.

3.7 Surface Water Analysis and Hydrologic Trespass

This project is proposing riparian buffer restoration within the Site and no alterations to the stream channel are being proposed; therefore, no FEMA coordination is necessary and this project will result in no hydrologic trespass to adjacent properties. Revegetating the Site will promote floodwater attenuation and improve stream stability by:

- Enhancing depressional floodplain wetlands for floodwaters within the Site.
- Revegetating Site floodplains to reduce floodwater velocities and increase frictional resistance on floodwaters crossing Site floodplains.

4.0 REFERENCE FOREST STUDIES

According to Mitigation Site Classification (MiST) guidelines (USEPA 1990), a Reference Forest Ecosystem (RFE) must be established for restoration sites. RFEs are forested areas on which to model restoration efforts in relation to soils and vegetation. RFEs should be ecologically stable climax communities and should represent believed historical (predisturbance) conditions of the restoration site. Quantitative data describing plant community composition and structure are collected at the RFEs and subsequently applied as reference data for design of the restoration Site planting scheme.

The RFE for this project is located south of Terrible Creek near the upstream/western end of the Site (Figure 3, Appendix A). The RFE supports plant community and landform characteristics that restoration efforts will attempt to emulate. Two circular, 0.1-acre plots were randomly established within the reference area. Data collected within each plot include 1) tree species composition, 2) number of stems for each tree species, 3) diameter at breast height (DBH) for each tree species, and 4) a list of understory species. Field data (Table 4) indicates importance values of dominant tree species calculated based on relative density, dominance, and frequency of tree species composition (Smith 1980). Hydrology, surface topography, and habitat features were also evaluated.

Two 0.1-acre plots were established which best characterize expected steady-state forest composition. Forest vegetation was dominated by green ash and cherrybark oak. Understory species within the RFE

include canopy species as well as American holly, spice bush, Chinese privet (*Ligustrum sinense*), Nepalese browntop, lizard's tail, soft rush, false nettle, southern lady fern, poison ivy (*Toxicodendron tulipifera*), muscadine (*Vitis rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), greenbrier, and crossvine (*Bignonia capreolata*).

Table 4. Reference Forest Ecosystem

Tree Species	Number of Individuals[1]	Relative Density (%)	Frequency[1] (%)	Relative Frequency (%)	Basal Area[1] (ft^2/acre)	Relative Basal Area (%)	Importance Value
Red maple (*Acer rubrum*)	3	5.6	50	7.7	3.2	2.7	0.05
River birch (*Betula nigra*)	5	9.3	100	15.4	15.2	12.9	0.13
Ironwood (*Carpinus caroliniana*)	10	18.5	100	15.4	9.5	8.1	0.14
Green Ash (*Fraxinus pennsylvanica*)	16	29.6	100	15.4	32.4	27.6	0.24
Sweetgum (*Liquidambar styraciflua*)	8	14.8	100	15.4	13.0	11.1	0.14
Cherrybark oak (*Quercus pagoda*)	6	11.1	100	15.4	37.8	32.2	0.20
Winged elm (*Ulmus alata*)	5	9.3	50	7.7	5.9	5.1	0.07
American elm (*Ulmus americana*)	1	1.9	50	7.7	0.4	0.4	0.03
TOTALS	**54**	**100**	**650**	**100**	**117**	**100**	**1.00**

[1] Sum of two 0.1-acre plots

5.0 OUTER BEND EROSION STUDIES

A baseline photographic record of each Site outer bend of Terrible Creek was compiled and is included within Appendix E. In addition, the apex of each outer bend was located using GPS technology with reported submeter accuracy (Figure 4, Appendix A). In some cases up to three locations on the same outer bend were located with the GPS due to the length/overall size of the meander. The GPS points will serve as a baseline to monitor if erosion continues once the project has been implemented. The erosion status of each outer bend was evaluated and ranked on a qualitative scale with four erosion categories starting with the lowest extent of erosion consisting of 1) low erosion, 2) moderate erosion, 3) severe erosion, and 4) extreme erosion. The rankings of each outer bend can be found on the photographs in Appendix E or on Figure 4 in Appendix A. In addition, outer bends are discussed in more detail in Section 6.3 (Outer Bend Treatments).

6.0 RESTORATION PLAN

The primary goals of this restoration plan include 1) enhancement of water quality functions in the Site, upstream, and downstream segments of the channel; 2) creation of a natural forested buffer adjacent to Site streams; and 3) restoration of wildlife functions associated with a forested riparian corridor.

The complete restoration plan is depicted in Figure 5 (Appendix A). The proposed restoration plan is expected to restore approximately 45.6 acres of Neuse River Riparian Buffers within the Site boundaries. Components of this plan may be modified based on construction or access constraints.

Primary activities proposed at the Site include 1) herbicide treatment, 2) soil amendments, 3) outer bend treatments, and 4) plant community restoration. A monitoring plan and contingency plan are outlined in Section 7.0 (Monitoring Plan) of this document.

6.1 Herbicide Treatment Followed by Soil Discing

Currently the Site is dominated by fescue planted for livestock pasture in addition to large clumps of other herbaceous vegetation such as soft rush and various polygonum species, which if left uncontrolled will result in significant mortality of planted hardwood seedlings. Prior to planting the Site, growth of the herbaceous layer, most importantly the fescue, will be controlled to aid in the survival of planted hardwood seedlings.

A Certified Herbicide Applicator should apply the following herbicide treatment by ground application (skidder, bulldozer, or backpack sprayed) to the fallow pasture within the Site (approximately 43.7 acres, Figure 5 [Appendix A]) in the late summer to early fall prior to the first frost. However, prior to spraying, the entire treatment area should be bush hogged and allowed to green for two to three weeks. Bush hogging will ensure herbicide treatment of the entire herbaceous layer including plants that are currently overtopped. Please note that a one time herbicide application is considered an exempt use and is allowable within Neuse Riparian Buffer Zone 2 with spot spraying allowable in Zone 1 in accordance with NCDWQ Administrative Code 15A NCAC 02B .233 (Neuse River Basin, Protection and Maintenance of Riparian Buffers). Within Zone 1 (the first 30 feet from the top of the stream banks), the herbicide should be applied using a backpack sprayer; a 2-foot diameter circle should be sprayed at the desired spacing of the hardwood plantings. In addition, bush hogging within Neuse Riparian Buffer Zone 2 is considered an exempt use and is allowable; however, bush hogging within Zone 1 is prohibited (15A NCAC 02B .233).

Herbicide Treatment (sprayed at a rate of 20 gallons of total solution per acre):
4 quarts per acre of Accord Concentrate
0.25 percent total solution of non-ionic surfactant (Cide-kick or Induce)

The Accord Concentrate is used to kill existing vegetation while the surfactant is an oil-based additive that aids in the adherence of the herbicide to the leaf structure of the existing vegetation. Accord Concentrate is labeled (EPA Reg. No. 62719-324) as an herbicide that can be used in aquatic habitats including habitat restoration and management areas and may be sprayed over standing water or adjacent to flowing water. Spray operators should apply herbicides while traversing in an upstream direction to prevent concentration of herbicide in the water. Care should be taken when applying the treatment to avoid areas of standing water and streams where problem vegetation does not exist and to ensure that bankside applications do not overlap more than 1 foot into open water. The herbicide treatment should be applied when a minimum of six hours of dry time follows. Discing and planting of the Site should occur no sooner than two weeks after the herbicide treatment is complete. Discing of the Site to prepare the soils bed within Neuse Riparian Buffer Zone 2 is considered an exempt use and is allowable; however, discing within Zone 1 is prohibited (15A NCAC 02B .233). Following discing of the Site, a riparian seed mix will be spread for added structure within the buffer restoration area.

The goal of herbicide application for the use of Site preparation is to control current competing vegetation. While the recommended rates of herbicide application should control the majority of the existing competing vegetation within the Site, without the use of preemergent herbicides (Oust), annual and perennial weeds including the fescue will naturally regenerate in the spring due to seeds stored within the soil. In combination with the riparian seed mix utilized for erosion control, competing vegetation may cause high rates of mortality for the planted hardwood seedlings; therefore, seedlings should be reexamined periodically throughout the monitoring period. Follow up applications of herbicides may be needed to ensure the survivability of the seedlings planted, dependant upon the amount and severity of competing vegetation in the spring. Please note that ongoing herbicide application within Neuse Riparian Buffer Zones 1 and 2 is prohibited (15A NCAC 02B .233).

6.2 Soil Amendments

Site specific lime and fertilizer recommendations were given for the establishment and maintenance of hardwood forest vegetation based on the results of four soil samples collected within the Site and analyzed by the NCDA&CS Agronomy Division (Appendix B). Due to the existing pH of the soils, it is recommended that no lime be applied to the Site. In addition, for the establishment of hardwood seedlings, no application of nitrogen, magnesium, copper, or zinc is recommended. During planting, the following soil amendments may be added at the location of each newly planted hardwood seedling to aid in its establishment. A one time fertilizer application is considered an exempt use and is allowable within Neuse Riparian Buffer Zones 1 and 2 (the first 50 feet from the top of bank on all Site streams) in accordance with NCDWQ Administrative Code 15A NCAC 02B .233 (Neuse River Basin, Protection and Maintenance of Riparian Buffers).

Fertilizer Recommendations for the Establishment of Hardwood Trees:
50 pounds per acre P_2O_2 (phosphate)
70 pounds per acre K_2O (potash)

While ongoing fertilizer application within Neuse Riparian Buffer Zones 1 and 2 is prohibited (15A NCAC 02B .233), the following fertilizer recommendations may be used for maintenance of the hardwood trees 50 feet from the top of the stream bank and beyond on the Site.

Fertilizer Recommendations for the Maintenance of Hardwood Trees:
100 pounds per acre of N (nitrogen)
50 pounds per acre P_2O_2 (phosphate)
50 pounds per acre K_2O (potash)

6.3 Outer Bend Treatments

The erosion status of each outer bend on Terrible Creek within the Site was evaluated and ranked on a qualitative scale with four erosion categories starting with the lowest extent of erosion consisting of 1) low erosion, 2) moderate erosion, 3) severe erosion, and 4) extreme erosion. Three outer bend treatments consisting of 1) erosion control matting and livestakes, 2) brush mattresses, and 3) do nothing will be incorporated on bends throughout the Site in order to monitor the progression of each outer bend through the five-year monitoring period. Outer bend treatments were assigned at random within each of the four erosion categories. The outer bend treatments are depicted in Figure 5 (Appendix A), detailed in Figure 6 (Appendix A), and outlined in the following table. Please note that Outer Bends 1 through 3 are not located within the conservation easement and therefore, no treatments are recommended.

Table 5. Outer Bend Treatments

Outer Bend	Extent of Erosion	Treatment to be Installed
1	Low	Outside of easement, no treatment recommended
2	Low	Outside of easement, no treatment recommended
3	Low	Outside of easement, no treatment recommended
4	Moderate	Leave as is
5	Low	Leave as is
6	Moderate	Live stake with erosion control matting
7	Moderate	Brush mattress
8	Severe	Live stake with erosion control matting
9	Moderate	Brush mattress
10	Moderate	Leave as is
11	Severe	Brush mattress
12	Severe	Live stake with erosion control matting
13	Severe	Brush mattress
14	Severe	Leave as is
15	Moderate	Live stake with erosion control matting
16	Moderate	Brush mattress
17	Severe	Brush mattress
18	Extreme	Live stake with erosion control matting
19	Severe	Leave as is
20	Extreme	Brush mattress
21	Extreme	Leave as is
22	Severe	Live stake with erosion control matting
23	Severe	Brush mattress
24	Severe	Leave as is
25	Extreme	Brush mattress
26	Extreme	Leave as is
27	Severe	Brush mattress
28	Severe	Live stake with erosion control matting
29	Severe	Leave as is
30	Extreme	Live stake with erosion control matting

6.4 Plant Community Restoration

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

Reference Forest Ecosystem (RFE) data, onsite observations, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration

activities. Based on Schafale and Weakley (1990) community descriptions, the RFE most closely resembles a Piedmont/Mountain Levee Forest adjacent to Terrible Creek grading towards a Piedmont/Mountain Bottomland Forest for the remainder of the floodplain. Piedmont/Mountain Levee Forest communities typically occur on natural levee and point bar deposits on large floodplains that are palustrine and seasonally to intermittently flooded. Piedmont/Mountain Bottomland Forest communities typically occur on floodplain ridges and terraces other than active levees adjacent to the stream channel. Each of these communities are typically underlain by alluvial soils such as the Chewacla soils and Wehadkee and Bibb soils that comprise the majority of the Site and the RFE.

Community associations that will be utilized to develop primary plant community associations include 1) Piedmont/Mountain Bottomland Forest, 2) Piedmont/Mountain Levee Forest, and 3) stream-side assemblage (Figure 7, Appendix A). Planting elements are listed below.

Piedmont/Mountain Bottomland Forest

Overstory Species

1. Swamp chestnut oak (*Quercus michauxii*)
2. Cherrybark oak (*Quercus pagoda*)
3. Bitternut hickory (*Carya cordiformis*)
4. American elm (*Ulmus americana*)
5. Green ash (*Fraxinus pennsylvanica*)
6. Shagbark hickory (*Carya ovata*)
7. Hackberry (*Celtis laevigata*)

Understory Species

8. Silky dogwood (*Cornus amomum*)
9. Ironwood (*Carpinus caroliniana*)
10. American holly (*Ilex opaca*)
11. Painted buckeye (*Aesculus sylvatica*)

Piedmont/Mountain Levee Forest

Overstory Species

1. Sycamore (*Platanus occidentalis*)
2. River birch (*Betula nigra*)
3. Cherrybark oak (*Quercus pagoda*)
4. Bitternut hickory (*Carya cordiformis*)
5. American elm (*Ulmus americana*)
6. Green ash (*Fraxinus pennsylvanica*)
7. Black walnut (*Juglans nigra*)
8. Hackberry (*Celtis laevigata*)

Understory Species

9. Silky dogwood (*Cornus amomum*)
10. Ironwood (*Carpinus caroliniana*)
11. American holly (*Ilex opaca*)
12. Painted buckeye (*Aesculus sylvatica*)

Stream-Side Assemblage

1. Black willow (*Salix nigra*)
2. Silky dogwood (*Cornus amomum*)
3. Buttonbush (*Cephalanthus occidentalis*)
4. Elderberry (*Sambucus canadensis*)
5. Tag alder (*Alnus serrulata*)
6. Spicebush (*Lindera benzoin*)

Stream-side trees and shrubs include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. Stream-side trees and shrubs will be planted within 15 feet of Terrible Creek. Outer bend treatments for Terrible Creek were discussed previously in Section 6.3 (Outer Bend Treatments). The Piedmont/Mountain Levee Forest is targeted for the levee/berm area outside of the 15 feet immediately adjacent to Terrible Creek while the Piedmont/Mountain Bottomland Forest is targeted for the remainder of the floodplain area (Figure 7, Appendix A). The following planting plan is the blueprint for community restoration.

6.5 Planting Plan

The purpose of a planting plan is to reestablish vegetative community patterns across the landscape. The plan consists of 1) acquisition of available plant species, 2) implementation of proposed Site preparation, and 3) planting of selected species.

Species selected for planting will be dependent upon availability of local seedling sources. Advance notification to nurseries (1 year) will facilitate availability of various noncommercial elements.

Bare-root seedlings of tree species will be planted within specified map areas at a density of approximately 680 stems per acre on 8-foot centers. Species in the stream-side assemblage will be planted at a density of 2720 stems per acre on 4-foot centers. In addition, larger, containerized trees will be planted throughout the Site at a rate of 3 to 5 trees per acre to provide an additional seed source to the Site.

Table 6 depicts the total number of stems and species distribution within each vegetation association. Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season. A total of 35,088 diagnostic tree and shrub seedlings may be planted during restoration.

Table 6. Planting Plan

Vegetation Association	Piedmont/Mountain Bottomland Forest		Piedmont/Mountain Levee Forest		Stream-side Assemblage		TOTAL
Area (acres)	35.5		8.1		2.0		45.6
Species	Number planted*	% of total	Number planted*	% of total	Number planted**	% of total	Number planted
Swamp chestnut oak	2897	12	--	--	--	--	2897
Cherrybark oak	2897	12	661	12	--	--	3558
Bitternut hickory	2897	12	661	12	--	--	3558
American elm	2897	12	661	12	--	--	3558
Green ash	2414	10	551	10	--	--	2965
Shagbark hickory	2414	10	--	--	--	--	2414
Hackberry	2414	10	551	10	--	--	2965
Silky dogwood	1690	7	385	7	1088	20	3163
Ironwood	1690	7	385	7	--	--	2075
American holly	966	4	220	4	--	--	1186
Painted buckeye	966	4	220	4	--	--	1186
Sycamore	--	--	661	12	--	--	661
River birch	--	--	275	5	--	--	275
Black walnut	--	--	275	5	--	--	275
Black willow	--	--	--	--	1088	20	1088
Buttonbush	--	--	--	--	1088	20	1088
Elderberry	--	--	--	--	544	10	544
Tag alder	--	--	--	--	1088	20	1088
Spicebush	--	--	--	--	544	10	544
TOTAL	**24,142**	**100**	**5506**	**100**	**5440**	**100**	**35,088**

* Planted at a density of 680 stems/acre.

** Planted at a density of 2720 stems/acre.

6.6 Nuisance Species Management

Potential for nuisance species including fescue and nonnative floral species may be monitored over the course of the 5-year monitoring period. Appropriate actions may be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis.

6.7 Common Mistakes Detrimental To New Plantings

Survival of new plantings can be difficult under the best of circumstances. The following is a list of common errors that should be avoided in order to give the new planting the best chance of survival.

Care Errors

Overheated from direct sun

Roots dry out from not planting soon enough

Wind exposed roots

Temporary storage covers blow away exposing seedlings

Planting Errors
Planting too deep or shallow
J-rooting
Second hole not closed behind first (planting bar problem)
Planting in duff rather than mineral soil
Failure to allow good root spread in hole
Soil packed too loosely
More than one tree per hole

Other Errors
Improper spacing (many potential long-term problems)
Failure to control competing vegetation, especially grasses
Incorrect match of species and site
Planting at the wrong time of the year
Failure to provide full sunlight (at least with most species)

7.0 MONITORING PLAN

Monitoring of Site restoration efforts will be performed for vegetation components of the Site until success criteria are fulfilled. In addition, the outer bends will be evaluated, photographed, and located with GPS as part of the monitoring effort. Vegetation monitoring and success criteria are discussed in more detail below. The establishment, collection, and summarization of monitoring data shall be conducted in accordance with the most current version of the EEP document entitled *Content, Format, and Data Requirements for EEP Monitoring Reports*.

7.1 Vegetation Monitoring

Restoration monitoring procedures for vegetation are designed in accordance with USEPA guidelines enumerated in Mitigation Site Type (MiST) documentation (USEPA 1990) and *Compensatory Hardwood Mitigation Guidelines* (DOA 1993). A general discussion of the restoration monitoring program is provided. A photographic record of plant growth should be included in each annual monitoring report.

After planting has been completed in winter or early spring, an initial evaluation will be performed to verify planting methods and to determine initial species composition and density. Supplemental planting and additional Site modifications will be implemented, if necessary.

During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed each fall, until vegetation success criteria are achieved.

During quantitative vegetation sampling in early fall of the first year, up to 25 sample plots (10 meters by 10 meters) will be randomly placed within the Site. However, best professional judgment may be necessary to establish vegetative monitoring plots upon completion of construction activities. In each sample plot, vegetation parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be recorded.

7.2 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth

of characteristic forest species. Additional success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species along with species identified through visual inventory of an approved reference (relatively undisturbed) forest community used to orient the project design. All canopy tree species planted and identified in the reference forest will be utilized to define "Characteristic Tree Species" as termed in the success criteria.

An average density of 320 stems per acre of Characteristic Tree Species must be surviving in the first three monitoring years. Subsequently, 290 Characteristic Tree Species per acre must be surviving in year 4 and 260 Characteristic Tree Species per acre in year 5. Planted species must represent a minimum of 30 percent of the required stems per acre total (96 stems/acre). Each naturally recruited Characteristic Tree Species may represent up to 10 percent of the required stems per acre total. In essence, seven naturally recruited Characteristic Tree Species may represent a maximum of 70 percent of the required stems per acre total. Additional stems of naturally recruited species above the 10 percent and 70 percent thresholds are discarded from the statistical analysis. The remaining 30 percent is reserved for planted Characteristic Tree Species as a seed source for species maintenance during midsuccessional phases of forest development.

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

8.0 REFERENCES

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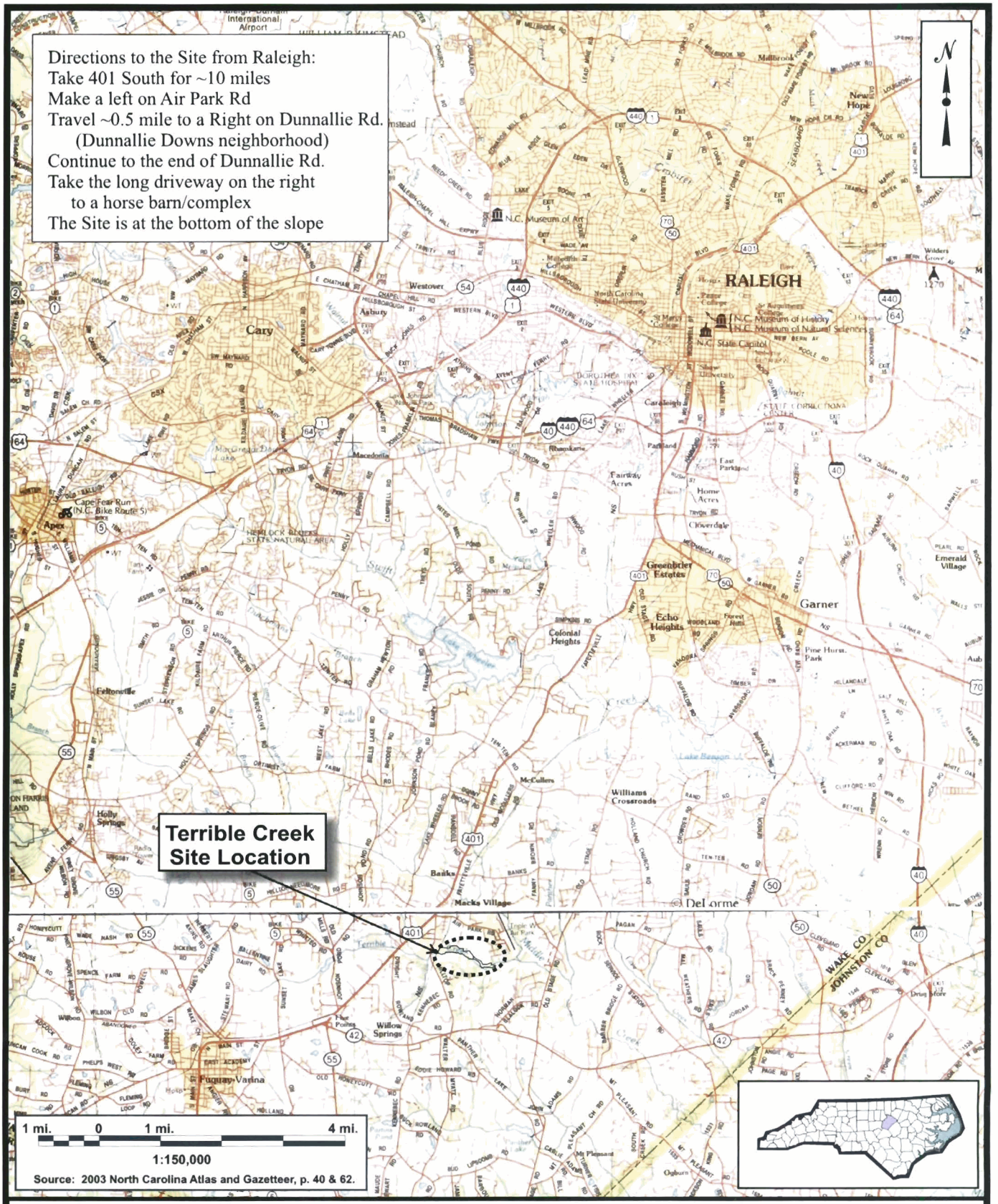
Appendix A.
Figures



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(919) 877-7413 fax

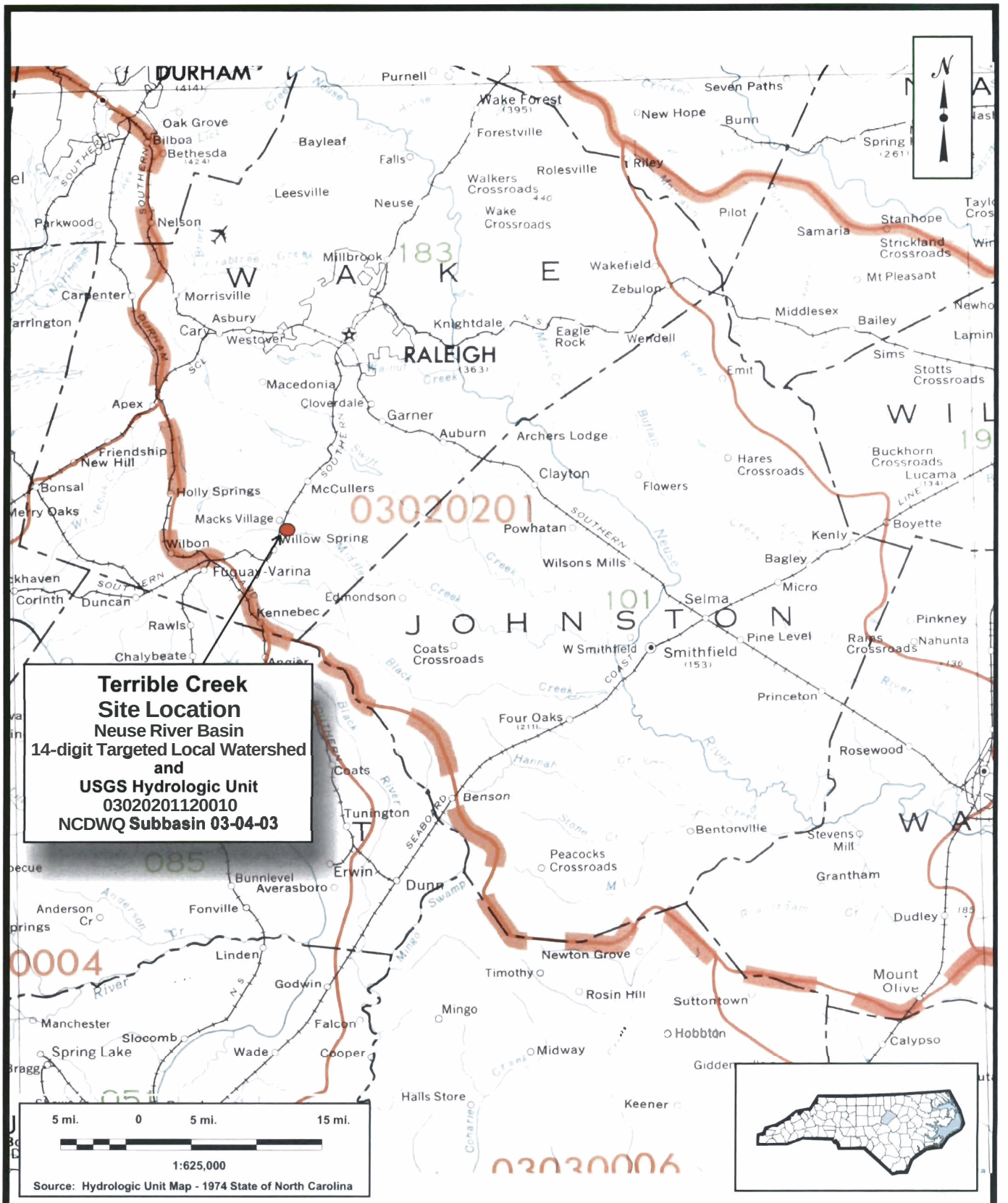
SITE LOCATION
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn. by: CLF

Date: August 2006

Project: 06-013

FIGURE 1



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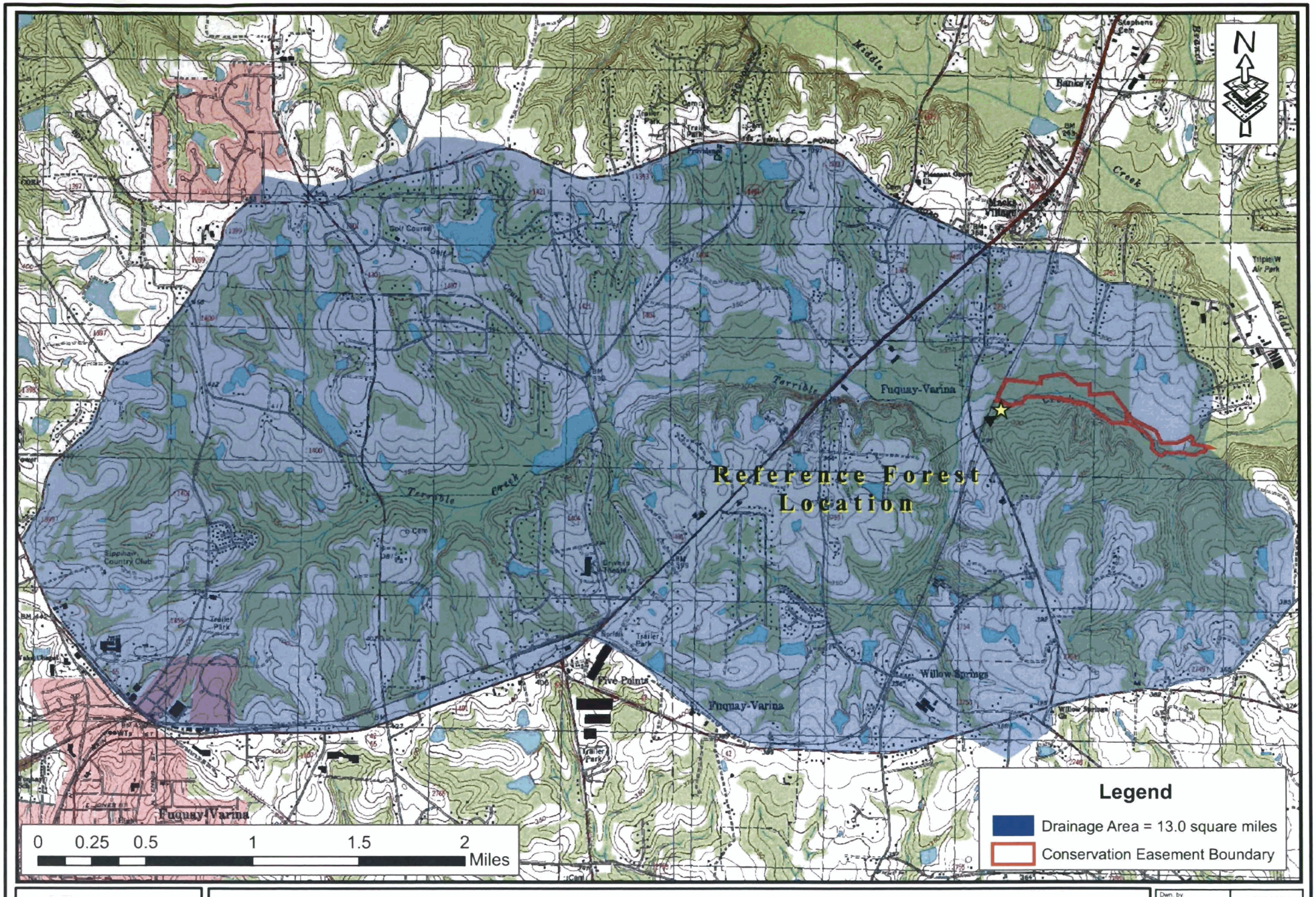
USGS HYDROLOGIC UNIT MAP
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn. by: CLF	FIGURE
Date: August 2006	2
Project: 06-013	



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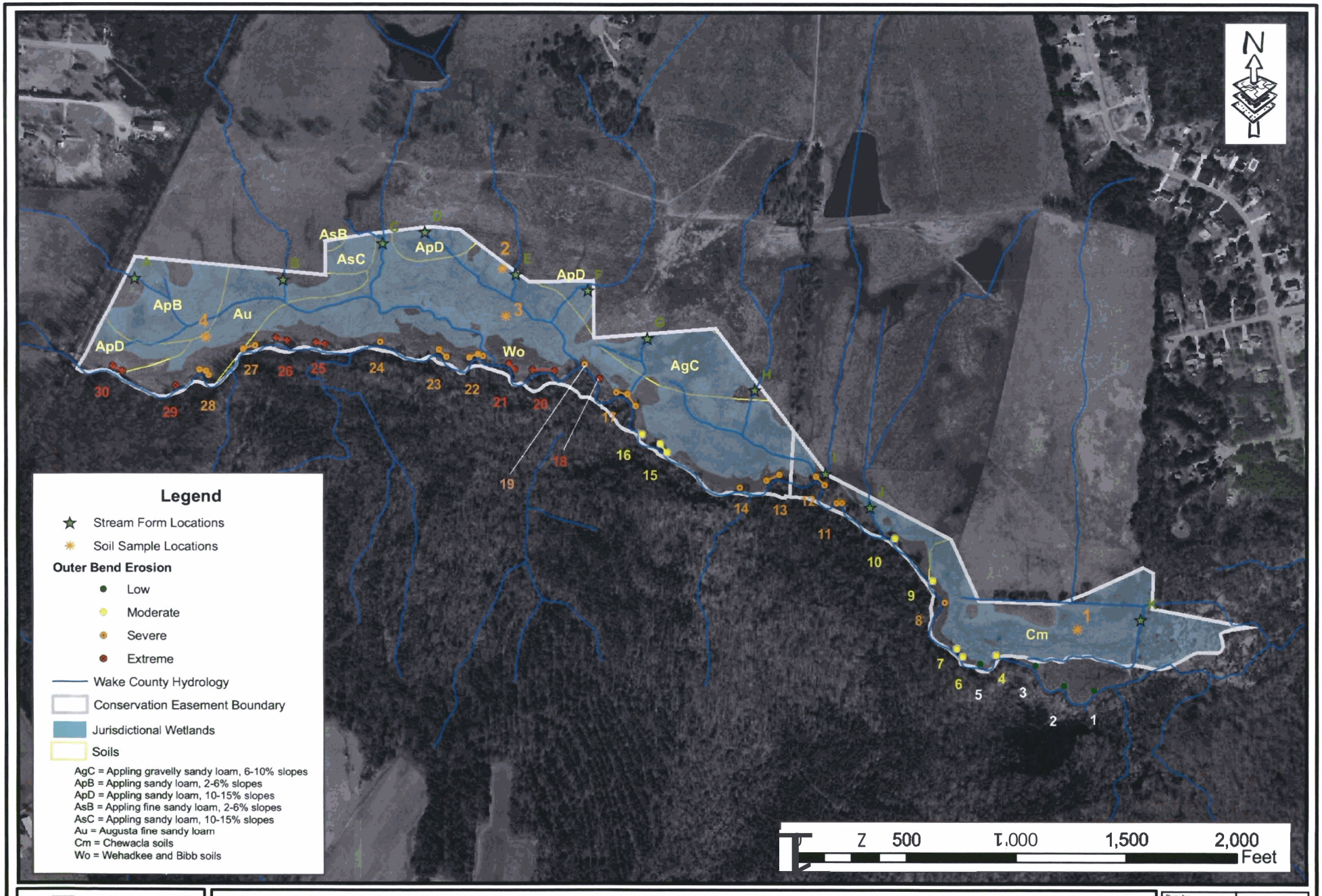
TOPOGRAPHY, DRAINAGE AREA, AND REFERENCE FOREST LOCATION
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn. by	CLF
Date	August 2006
Project	06-013

FIGURE 3



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EXISTING CONDITIONS AND SOILS
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn. by: CLF
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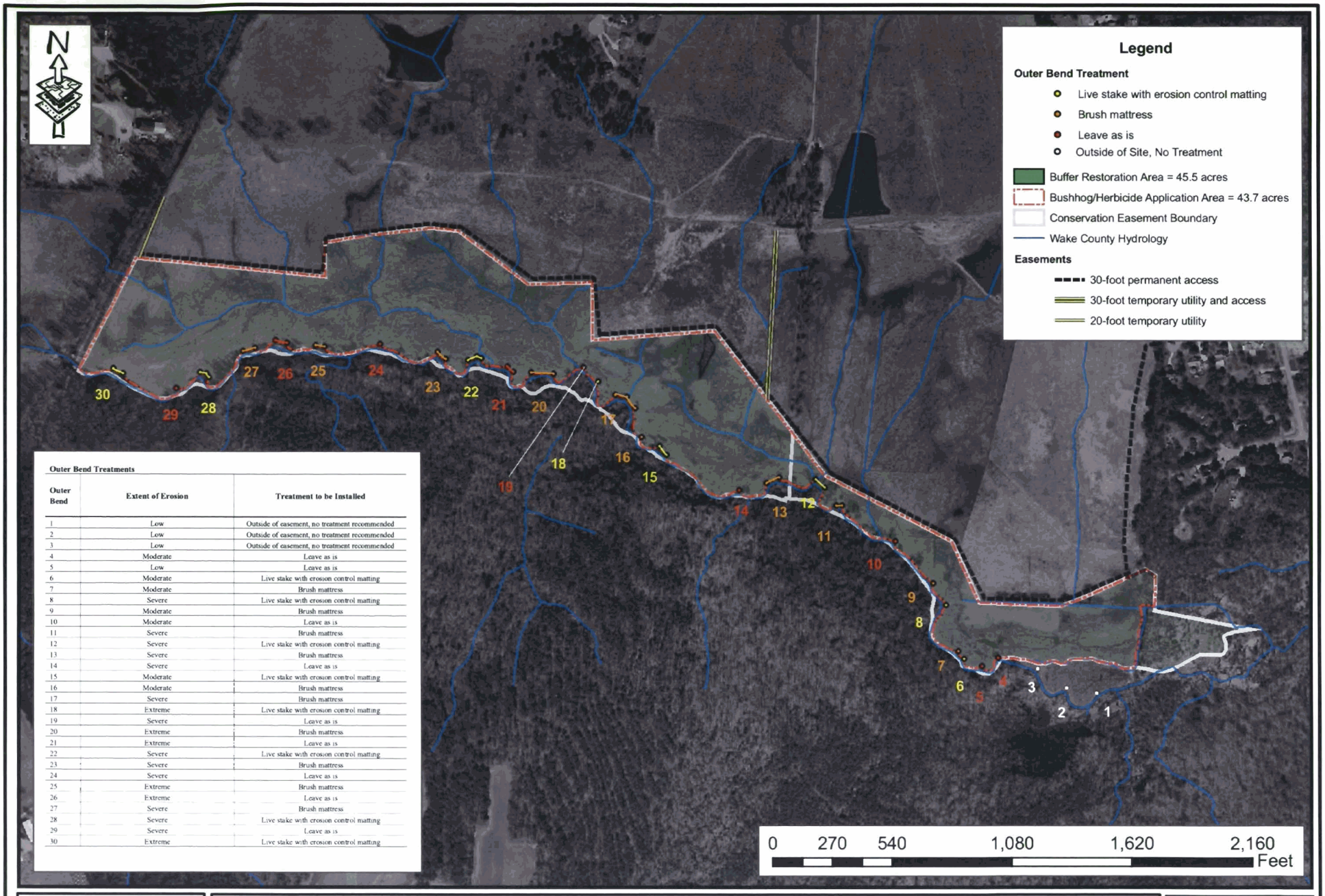
Project: 06-013

FIGURE 4



Outer Bend Treatments

Outer Bend	Extent of Erosion	Treatment to be Installed
1	Low	Outside of easement, no treatment recommended
2	Low	Outside of easement, no treatment recommended
3	Low	Outside of easement, no treatment recommended
4	Moderate	Leave as is
5	Low	Leave as is
6	Moderate	Live stake with erosion control matting
7	Moderate	Brush mattress
8	Severe	Live stake with erosion control matting
9	Moderate	Brush mattress
10	Moderate	Leave as is
11	Severe	Brush mattress
12	Severe	Live stake with erosion control matting
13	Severe	Brush mattress
14	Severe	Leave as is
15	Moderate	Live stake with erosion control matting
16	Moderate	Brush mattress
17	Severe	Brush mattress
18	Extreme	Live stake with erosion control matting
19	Severe	Leave as is
20	Extreme	Brush mattress
21	Extreme	Leave as is
22	Severe	Live stake with erosion control matting
23	Severe	Brush mattress
24	Severe	Leave as is
25	Extreme	Brush mattress
26	Extreme	Leave as is
27	Severe	Brush mattress
28	Severe	Live stake with erosion control matting
29	Severe	Leave as is
30	Extreme	Live stake with erosion control matting

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RESTORATION PLAN
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

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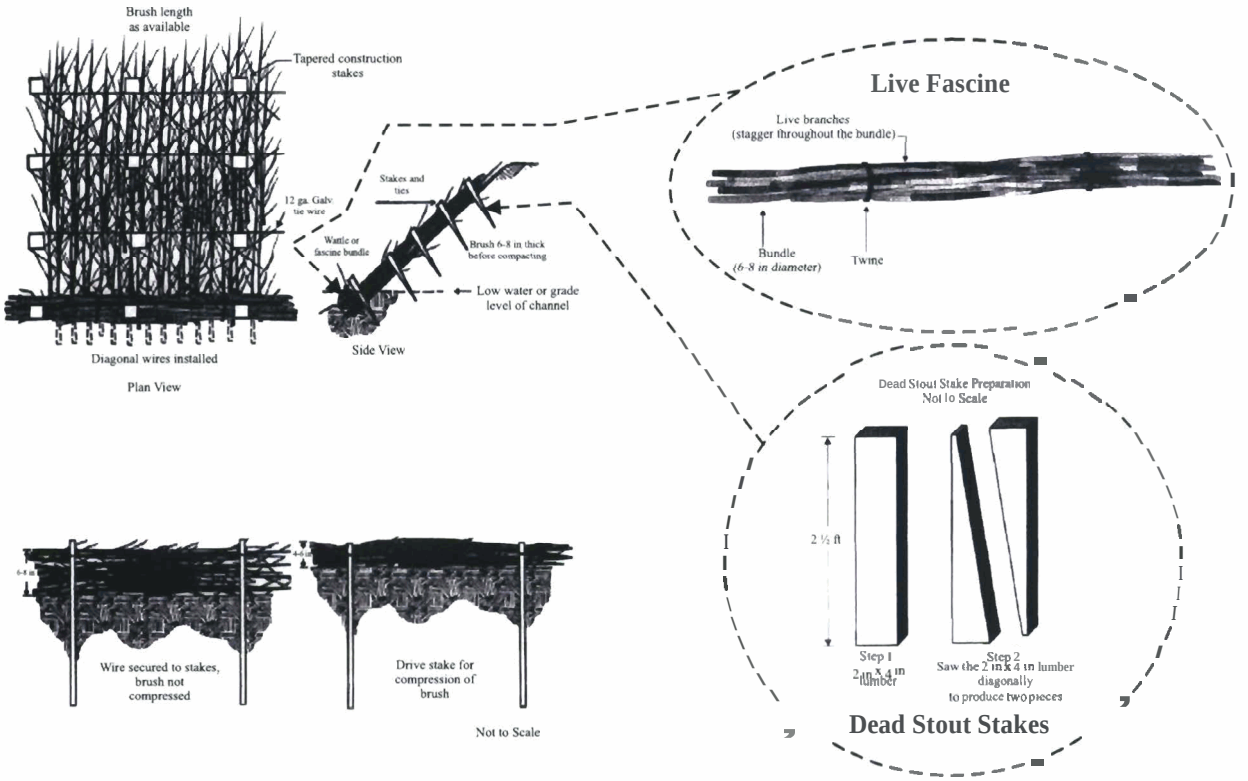
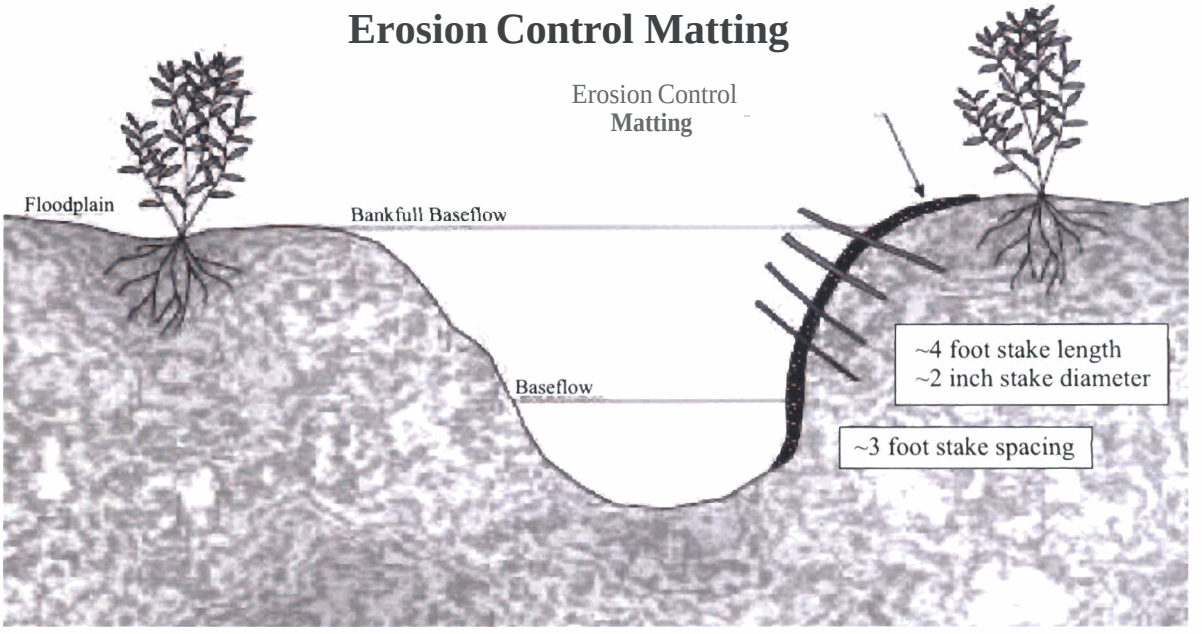
Date: August 2006
Project: 06-013

FIGURE 5

Brush Mattress



Live Stake Embankment with Erosion Control Matting



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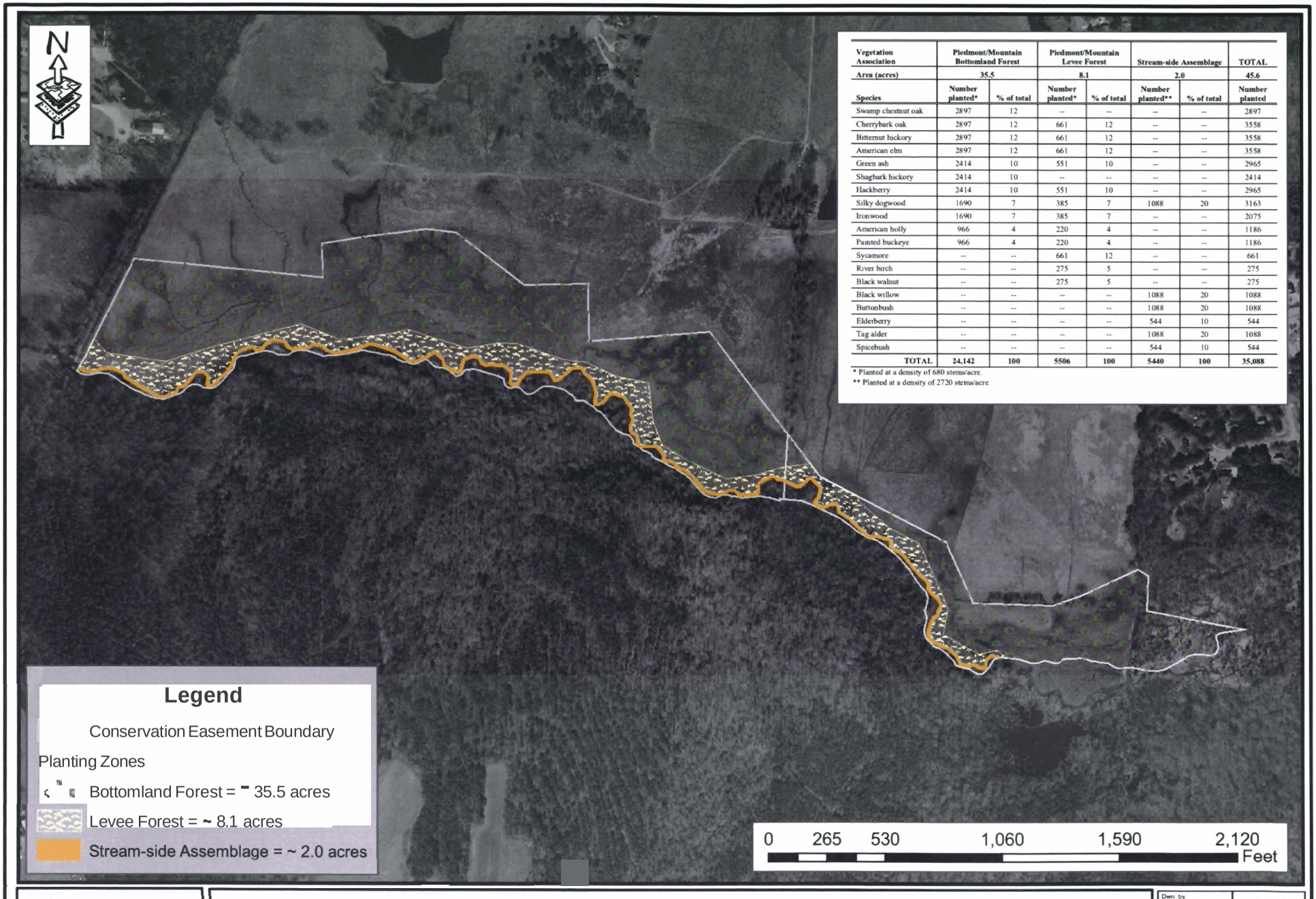
OUTER BEND TREATMENT DETAILS
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn by: CLF	FIGURE
Date: August 2006	6
Project: 06-013	



Vegetation Association	Piedmont/Mountain Bottomland Forest		Piedmont/Mountain Levee Forest		Stream-side Assemblage		TOTAL
Area (acres)	35.5		8.1		2.0		45.6
Species	Number planted*	% of total	Number planted*	% of total	Number planted**	% of total	Number planted
Swamp chestnut oak	2897	12	--	--	--	--	2897
Cherrybark oak	2897	12	661	12	--	--	3558
Bitternut hickory	2897	12	661	12	--	--	3558
American elm	2897	12	661	12	--	--	3558
Green ash	2414	10	551	10	--	--	2965
Shagbark hickory	2414	10	--	--	--	--	2414
Hackberry	2414	10	551	10	--	--	2965
Silky dogwood	1690	7	385	7	1088	20	3163
Ironwood	1690	7	385	7	--	--	2075
American holly	966	4	220	4	--	--	1186
Painted buckeye	966	4	220	4	--	--	1186
Sycamore	--	--	661	12	--	--	661
River birch	--	--	275	5	--	--	275
Black walnut	--	--	275	5	--	--	275
Black willow	--	--	--	--	1088	20	1088
Buttonbush	--	--	--	--	1088	20	1088
Elderberry	--	--	--	--	544	10	544
Tag alder	--	--	--	--	1088	20	1088
Spicebush	--	--	--	--	544	10	544
TOTAL	24,142	100	5506	100	5440	100	35,088

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

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PLANTING PLAN
TERRIBLE CREEK BUFFER RESTORATION
Wake County, North Carolina

Dwn. by: CLF
Date: August 2006
Project: 06-013

FIGURE 7

Appendix B.
NCDA&CS Soil Test Report

Soil Test Report

7/28/2006 SERVING N.C. RESIDENTS FOR OVER 60 YEARS

Grower: **Axiom Environmental**
2126 Rowland Pond Dr
Willow Springs, NC 27592

Farm: GRANT LEWIS

Wake County

Copies To:

Agronomist Comments I -- 11, $

Field Information		Applied Lime			Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	S	Cu	Zn	B	Mn	See Note
TCRK1					1st Crop: Hardwood,E	0	0.0	40-60	70-90	0	15-20	0	0			11
					2nd Crop: Hardwood,M	0	80-120	40-60	50-70	0	15-20	0	0			11

Test Results

Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI(1)	Mn-AI(2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.6	1.04	6.8	87.0	0.9	6.2	12	11	59.0	27.0	545			62	62	132	25				0.2

Field Information		Applied Lime			Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	S	Cu	Zn	B	Mn	See Note
TCRK2					1st Crop: Hardwood,E	0	0.0	50-70	70-90	0	0	0	$			11
					2nd Crop: Hardwood,M	0	80-120	50-70	50-70	0	0	0	$			11

Test Results

Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI(1)	Mn-AI(2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.36	1.12	8.7	93.0	0.6	6.7	7	11	81.0	11.0	121			24	24	30	55				0.4

Field Information		Applied Lime			Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	S	Cu	Zn	B	Mn	See Note
TCRK3					1st Crop: Hardwood,E	0	0.0	10-30	60-80	0	0	0	0			11
					2nd Crop: Hardwood,M	0	80-120	10-30	30-50	0	0	0	0			11

Test Results

Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI(1)	Mn-AI(2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.81	0.91	7.9	76.0	1.9	5.4	29	17	65.0	10.0	338			150	150	69	73				0.2

Field Information		Applied Lime			Recommendations											
Sample No.	Last Crop	Mo	Yr	T/A	Crop or Year	Lime	N	P_2O_5	K_2O	Mg	S	Cu	Zn	B	Mn	See Note
TCRK4					1st Crop: Hardwood,E	0	0.0	50-70	60-80	0	0	0	0			11
					2nd Crop: Hardwood,M	0	80-120	50-70	30-50	0	0	0	0			11

Test Results

Soil Class	HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	Mn-I	Mn-AI(1)	Mn-AI(2)	Zn-I	Zn-AI	Cu-I	S-I	SS-I	NO_3-N	NH_4-N	Na
MIN	0.76	0.94	7.9	84.0	1.3	5.9	8	18	73.0	10.0	130			99	99	176	51				0.2

NCDA&CS Agronomic Division 1040 Mail Service Center, Raleigh NC 27699-1040 (919) 733-2655 www.ncagr.com/agronomi/

Understanding the Soil Test Report

www.ncagr.com/agronomi/ustr.htm

Steve Troxler, Commissioner of Agriculture

FORESTRY, TREES / SEED

(Crop Codes 133, 134, 137, 142–146)

The current soil pH and the amount of lime required for optimum tree and seed production are crucial parts of your soil test report. The target pH for crops in this category is 5.5, except for hardwood seed, which have a target pH of 6.0. The lime recommendation depends on soil acidity, soil class and target pH.

Rates for lime and fertilizer are given in tons per acre and pounds per acre, respectively. Lime and phosphorus are most beneficial when incorporated into the soil prior to planting. Surface application is appropriate on established sites when recommended. Under extremely acid conditions, applying lime is just as important as applying appropriate amounts of fertilizer.

Local agricultural advisors can help you select a fertilizer grade that fits report recommendations. *Note 11: Nursery Crops—Container and Field*, which accompanies this report, contains additional information regarding lime and fertilizer.

Recommendations for phosphorus and potassium decrease as P-I and/or K-I values increase. Use the following guidelines to evaluate the relationship between soil test index and expected crop response to applied nutrients.

Soil Test Index		Crop Response to Nutrient Application				
Range	*Rating*	*Phosphorus*	*Potassium*	*Manganese*	*Zinc*	*Copper*
0–10	Very Low	Very High	Very High	Very High	Very High	Very High
11–25	Low	High	High	High	High	High
26–50	Medium	Medium *	Medium *	None	None	None
51–100	High	None	Low-None	None	None	None
100+	Very High	None	None	None	None	None

* Response decreases as soil test index increases.

Soil Test Report Abbreviations

MIN	mineral soil class
M-O	mineral-organic soil class
ORG	organic soil class
HM%	percent humic matter
W/V	weight per volume of soil
CEC	cation exchange capacity
BS%	percent of CEC occupied by bases
Ac	acidity (decreases as pH increases)
pH	current soil pH
P-I	phosphorus index
K-I	potassium index
Ca%	percent of CEC occupied by calcium
Mg%	percent of CEC occupied by magnesium
Mn-I	manganese index
Mn-AI	manganese availability index
Zn-I	zinc index
Zn-AI	zinc availability index
Cu-I	copper index
S-I	sulfur index
SS-I	soluble salt index
NO_3-N	nitrate nitrogen (ppm)
NH_4-N	ammonium nitrogen (ppm)
Na	sodium
P_2O_5	phosphate
K_2O	potash
B	boron
M	lb/1000 ft^2

July 2006

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Table 1. Micronutrient application rates (lb element/acre)*

Soil Class	Banded Mn	Banded Zn	Broadcast Mn	Broadcast Zn	Broadcast Cu	Foliar Spray Mn	Foliar Spray Zn	Foliar Spray Cu
Mineral (MIN)	3	3	10	6	2	0.5	0.5	0.25
Mineral-Organic (M-O)	3	3	10	6	4	0.5	0.5	0.25
Organic (ORG)	3	3	10	6	6	0.5	0.5	0.25

* Once a micronutrient need has been established by soil testing, a choice of the material to use must be made. Under the soil and climatic conditions in North Carolina, sulfates of the particular element and liquids formulated with ammonia, chlorides and nitrates are the most effective. Chelates and organic complexes used at equivalent elemental rates of the materials listed above are effective, but quite expensive. Oxides and most oxysulfates, except under special conditions, are not effective.
Premium fertilizers, which contain an array of micronutrients in very small quantities, may not correct a deficiency.

Additional information can be obtained from an NCDA&CS regional agronomist or the local Cooperative Extension office.

North Carolina Department of Agriculture and Consumer Services

Steve Troxler, Commissioner of Agriculture

NCDA&CS Agronomic Division

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$ NOTE: Secondary Nutrients & Micronutrients

This note gives advice for eliminating or preventing specific soil fertility problems. The $ on your soil test report indicates actual or potential deficiencies of magnesium, copper, zinc and/or manganese. Additionally, potential toxicities are noted for copper and zinc at certain soil test levels. Recommendation codes for each of these elements are explained below.

Magnesium (Mg) Recommendation

0 Additional Mg is not needed.

$ Mg levels in the soil are low.
- If lime is recommended, use dolomitic lime, which contains a minimum of 120 lb Mg per ton. Dolomitic lime is the most economical source of Mg.
- If no lime is needed, add 20–30 lb/acre of readily soluble Mg to your fertilizer. Annual applications of Mg may be required until subsequent soil tests show adequate levels in the soil.

Copper (Cu) Recommendation

0 Additional Cu is not needed.

Any number other than 0
This number is a suggested broadcast application rate for Cu, expressed in lb/acre. In this case, the Cu index (Cu-I) is low (< 25), and the crop will respond to Cu fertilization. Applying the suggested rate should correct the deficiency for several years. Incorporate

broadcast applications into the plow layer for maximum benefit. Foliar application is effective if the Cu deficiency occurs during the growing season.

$ Monitor Cu levels in your crop. The *Cu-I* is low (< 25), but the indicated crop may not respond to Cu fertilization. If an application rate is given for *1st Crop*, a *$* in the *Cu* column for *2nd Crop* reminds you that the second crop may still need Cu if it was not applied to the first crop.

C The *Cu-I* is greater than 2000. The critical toxic level is 3000. See the narrative printed on the soil test report for further advice.

Zinc (Zn) Recommendation

0 Additional Zn is not needed.

Any number other than 0
This number is a suggested broadcast application rate for Zn, expressed in lb/acre. In this case, the Zn-availability index (*Zn-AI*) is low (≤ 25), and the crop indicated will respond to Zn. The recommended amount should correct the deficiency and be adequate for several years.

$ Monitor Zn levels in your crop. The *Zn-AI* is low (≤ 25), but the indicated crop may not respond to Zn fertilization. If an application rate is given for *1st Crop*, a *$* in the *Zn* column for *2nd Crop* reminds you that the second crop may still need Zn if it was not applied to the first crop.

Z The *Zn-I* is greater than 2000. The critical toxic level is 3000. See the narrative printed on the soil test report for further advice.

Peanuts are very sensitive to zinc, and toxicity may occur at soil levels well below 2000. The risk of toxicity is greater with low soil pH and has been seen at a *Zn-I* as low as 300. A critical toxic level has been set at 500 for peanuts.

Zn-AI is an availability index related to soil class. *Zn-AI* will be greater that the *Zn-I* for mineral-organic (M-O) and organic (ORG) soils due to a lower target pH for these soil classes.

When Zn deficiencies occur due to high pH and phosphorus levels, a foliar application of Zn is required. The decision to apply Zn in this manner should be based on current soil tests and plant analyses. Some limestone sources contain enough Zn to build soil test levels above the critical point.

Manganese (Mn) Recommendation

0 Additional Mn is not needed.

10 Apply Mn at the rate of 10 lb/acre broadcast. The Mn-availability index (*Mn-AI*) is low (≤ 25), and the indicated crop is known to respond to Mn application.

$ Monitor your crop closely for Mn problems. In this case, the *Mn-AI* is ≤ 25, but the crop indicated may not respond to addition of Mn. Monitoring the crop through plant tissue analysis is a good way to track Mn levels in the crop. If tissue levels are low, application of Mn may be warranted.

$pH There is an existing or potential Mn deficiency due to *pH* ≥ 6.2 and *Mn-AI* ≤ 25. The recommendations outlined here can correct or prevent this problem:

- For currently growing crops, apply a totally water-soluble source of Mn to the foliage. Depending on the severity of the deficiency and the crops's stage of growth, a second application may be required.
- Under preplant conditions and with *Mn-I* > 25, band acid-forming starter fertilizers that do not contain Mn. If *Mn-I* ≤ 25, use an acid-forming starter fertilizer containing Mn.
- If *pH* ≥ 6.2, do not soil broadcast a Mn fertilizer. If overliming is the principal cause of Mn deficiency, apply acid-forming fertilizers or till deeply to lower the soil pH. Foliar applications and/or acid banded treatments are remedial and may be required for each crop until the *pH* falls below 6.2.

pH$ Mn levels are high (*Mn-AI* > 25), but there is potential for deficiency since soil pH is also high (> 6.4). Use a foliar spray of Mn fertilizer to correct a deficiency if it occurs.

Manganese deficiency is commonly observed throughout the coastal plain. It can be due to either overliming (*pH* ≥ 6.2) or inherently low levels of soil Mn. Although less frequently observed, Mn deficiencies can also occur in piedmont and mountain regions.

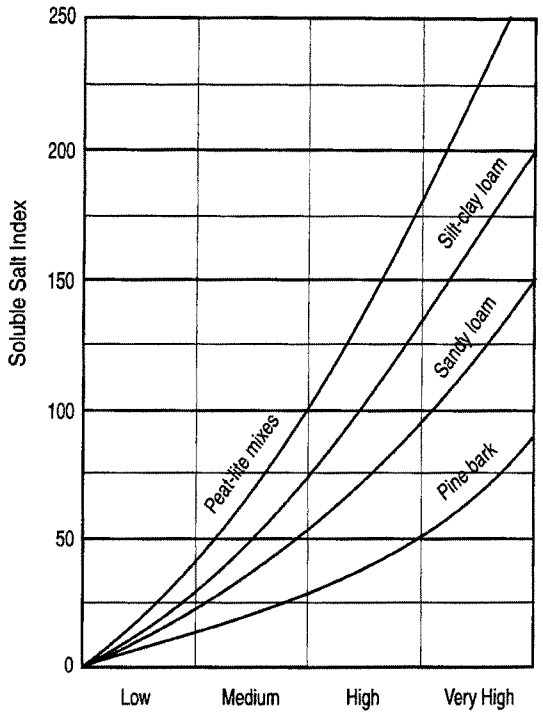
Mn availability is influenced by soil pH. As pH increases, Mn availability decreases. Some crops show Mn deficiency more readily than others.

On the soil test report, three values relate to Mn levels: *Mn-I*, an index correlated with the actual amount of Mn in the soil; *Mn-AI(1)*, the Mn-availability index for the first crop; and *Mn-AI(2)*, the Mn-availability index for the second crop.

Med: Fertilizer can be applied at the lower end but should be adequate near the top.

High: Germination and seedling growth affected as salt index increases within this range.

V.High: Apply no fertilizer and water enough to cause salts to leach.



Additional information on lime and fertilizer requirements for nursery crops is available from local agricultural advisors. If there is reason to suspect a nutritional problem, collect matching soil and plant samples. Send them to the laboratory for analysis.

North Carolina
Department of Agriculture

AGRONOMIC DIVISION
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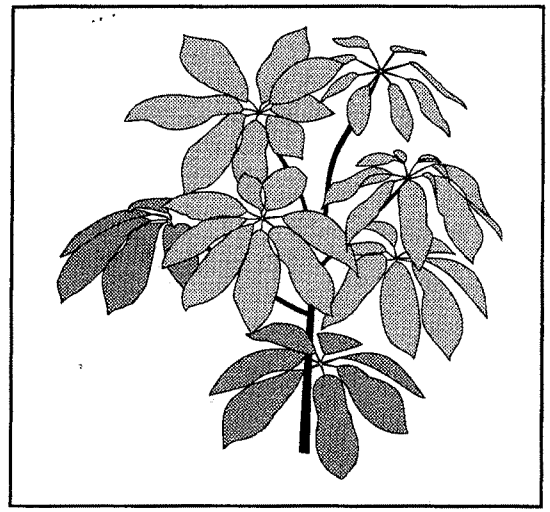
NOTE 11. NURSERY CROPS: CONTAINER and FIELD



The goal of plant production is to grow vigorous and healthy plants in the shortest period of time. Attaining this objective depends on application of proper amounts of lime and essential nutrients. Soil testing provides a means for deter mining lime and fertilizer rates.

Lime Requirement

A proper soil or media pH is essential for successful plant growth. Lime neutralizes soil acidity and provides the calcium and magnesium essential for plant growth. There is no substitute for lime for neutralizing soil acidity. Lime also provides a better environment for microbial activity required for transforming nutrients to forms that plants can utilize.

There are two types of lime, calcitic and dolomitic. Calcitic lime is composed of calcium carbonate and contains little or no magnesium. Dolomitic lime is composed of a mixture of calcium and magnesium carbonates and contains a minimum of 120 lbs of magnesium per ton. For maximum benefit, mix recommended

Appendix C.
USACE and NCDWQ Stream Forms

lime into the soil or media prior to planting. Surface application of lime should not exceed 1.0 ton per acre (50 lbs/1000 ft ^{2} or 50M) on established field plantings. Wait 6 months before applying additional lime.

The pH requirement for container and field-grown crops varies widely. The formula below provides a means to calculate the lime rate necessary to achieve the desired pH. Soil pH and acidity (Ac) appear on the soil test report.

$$\left[\frac{\text{desired pH - soil pH}}{\text{6.6 - soil pH}}\right] \text{acidity} = \text{tons lime/acre}$$

Conversion Factors

M = lbs / 1000 ft ^{2}
(tons lime /acre) x 46 = lbs lime / 1000 ft ^{2}
(lbs lime /1000 ft^2) / 24 = lbs lime / yd ^{3}
(tons lime /acre) x 1.92 = lbs / yd ^{3}

Micronutrients

A "$"appears under "SUGGESTED TREATMENT" when the soil test index for manganese (Mn), zinc (Zn) and copper (Cu) is below 25. The "$"note that comes with your soil test report provides information on correcting low micronutrient levels. Most field soils contain an adequate amount of micronutrients. Pine bark mixes generally contain adequate levels of manganese and zinc but are usually low in copper. Broad spectrum applications of micronutrients can be unnnecessary as well as harmful. Therefore, base micronutrient applications on soil test recommendations. If using a composite micronutrient source, apply the lowest rate necessary to meet plant requirements.

Container-Grown Plants

A mixture of pine bark and sand is the media used for most container grown plants. Native pine bark, which is the major component, has a relatively low nutrient content. Successful production in this media requires supplementing with fertilizers. The challenge is to maintain adequate nutrient levels without creating a potential soluble salt problem.

The target pH for most field and container-grown plants ranges from pH 5.5 to 6.0. Nursery crops grow well in a pine bark and sand mixture at pH 5.5. The pH of native pine bark, however, ranges from 4.0 to 5.0. Application of dolomitic lime raises the pH to a more suitable level and provides the calcium and magnesium essential for plant growth. Native bark generally contains low phosphorus, calcium, and magnesium with appreciable amounts of potassium, manganese and zinc.

Leaching of nitrogen, phosphorus and potassium is a common problem associated with pine bark and sand media. Nutrient leaching is most prevalent during periods of heavy rainfall or high irrigation demand. Sand that is coated with clay reduces loss of phosphorus and potassium. The clay fraction provides sites that attract and hold nutrients against leaching. Slow-release fertilizers also reduces leaching of nitrogen, phosphorus and potassium. The release of these nutrients depends on nutrient source, temperature, moisture, and method of encapsulation. Rates of application depend on manufacturer guidelines and grower experience.

Field-Grown Plants

Lime and phosphorus do not move readily through the soil. Therefore, it is best to broadcast and mix them into the soil prior to planting. Incorporation enhances soil reaction and nutrient uptake by plants.

Nitrogen and potassium are mobile in soils. Therefore, surface applications are effective. Apply fertilizers 6 to 8 inches from plants to reduce the risk of salt injury. Split applications of nitrogen and potassium also minimizes the effects of leaching on sandy soils. Nitrogen recommendations are as follows.

First Year: Apply 50 lbs N /acre prior to bud swell (approximately 0.5 oz N /plant).

Second and Subsequent Years: Apply 80 - 120 lbs N/acre/year. Apply 2/3 prior to bud swell and 1/3 in early June. Do not apply nitrogen after July 1 since late growth may be more subject to winter injury.

Nitrogen rates may vary from rates shown above for high population plantings. Factors for converting nitrogen from lbs/acre to oz/tree are as follows...

lbs N /acre divided by 43.56 = lbs N / 1000 ft^2
lbs N / 1000 ft^2 divided by ft^2/tree= lbs N / tree
lbs N /tree x 16 = oz N / tree.

Nursery Seedling Beds

Mix recommended lime, phosphorus and potassium into the soil before planting. Apply lime several weeks in advance to allow time for soil acidity to be neutralized.

Apply nitrogen after plants emerge to prevent damage from soluble salts. Use 25 to 30 lbsN/acre and follow by irrigation if soil moisture is low. Use split applications for the remaining nitrogen depending on rainfall and plant growth.

On established plants, apply fertilizer in early spring before growth begins. On sandy soils, split applications of nitrogen and potassium reduce leaching losses. On sandy soils, sulfur-containing fertilizers are often beneficial.

Soluble Salts (SS-I) Interpretation

Over application of fertilizers or inadequate watering can cause salt injury. Salt damage depends on the type of media, moisture content, temperature,and plant tolerance. Ratings for different media are shown in Figure 1 and can be interpreted as follows;

Low: Needs additional fertilizer, no effect of salt on plant growth.

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream A

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 10:00 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~20 acres
8. Stream order: 1st (Wake Co. hydro)
9. Length of reach evaluated: ~ 100 feet
10. County: Wake
11. Site coordinates (if known): 35.6159°N 78.7215°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream A
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within past 24 hours
16. Site conditions at time of visit: sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 90 % Agricultural 5 % Forested ___% Cleared / Logged 5 % Other (railroad bed
22. Bankfull width: ~ 5 feet
23. Bank height (from bed to top of bank): ~ 1 foot
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 54 **Comments:** This stream reach enters the site from a culvert beneath the railroad bed fill. The channel had a defined bed and bank with an abundance of iron-oxidizing bacteria and wetland/hydrophytic vegetation (FACW to OBL) present.

Evaluator's Signature Coni L. Fuqua **Date** 7/20/06

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCOR
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	1
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						54

* These characteristics are not assessed in coastal streams.

Stream A

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

Date: 7/20/06	**Project:** Terrible creek	**Latitude:** 35.6159°N
Evaluator: AXE	**Site:** Stream A	**Longitude:** 78.7215°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30.75	**County:** Wake	**Other** *e.g. Quad Name:* Angier

A. Geomorphology (Subtotal = 13.5)

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

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

B. Hydrology (Subtotal = 9.5)

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

C. Biology (Subtotal = 7.75)

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

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

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

Abundance of iron-oxidizing bacteria and hydrophytic vegetation (FACW to OBL) in channel. Lots of sediment made it difficult to find benthics

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream B

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 10:30 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~80 acres
8. Stream order: 2nd (Wake Co. hydro)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6168°N 78.7199°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream B
14. Proposed channel work (if any): none
15. Recent weather conditions: Small amount of rain within the past 24 hours
16. Site conditions at time of visit: Sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ___(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: 5 % Residential ___% Commercial ___% Industrial 55 % Agricultural 40% Forested ___% Cleared / Logged ___% Other (
22. Bankfull width: ~5 feet
23. Bank height (from bed to top of bank): ~1 foot
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 63 **Comments:** An abundance of minnows were present within the stream reach.

Evaluator's Signature Cori L. Fgui Date 7/20/06

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				63

* These characteristics are not assessed in coastal streams.

Stream B

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

Date: 7/20/06	**Project:** Terrible Creek	**Latitude:** 35.6168° N	
Evaluator: AXE	**Site:** Stream B	**Longitude:** 78.7199° W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 34.75	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		(No = 0)	Yes = 3	

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

B. Hydrology (Subtotal = 11)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	(1)	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5	

C. Biology (Subtotal = 9.25)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	1	(1.5)
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	(1)	1.5
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

Sketch:

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

Abundance of minnows present in channel.

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream C

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 11:00 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: 70 acres
8. Stream order: 1st (topo), 2nd (Wake Co. hydr
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6169°N 78.7178°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream C
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within the past 24 hrs
16. Site conditions at time of visit: Sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~1.2 acre
19. Does channel appear on USGS quad map? (YES) NO
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100% Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~5 feet
23. Bank height (from bed to top of bank): 1-8 feet
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ____Straight ✓ Occasional bends ___Frequent meander ____Very sinuous ____Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 35 **Comments:** Within the site streams drains through wetland; however, at top of site and further upstream the channel drains along the edge of a slope and becomes increasingly entrenched with erosion and bare banks present. An abundance of minnows were present within the channel.

Evaluator's Signature Cori L. Fain **Date** 7/20/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	2
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	0
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	1
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	0
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						35

* These characteristics are not assessed in coastal streams.

Stream C

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

Date: 7/20/06	**Project:** Terrible Creek	**Latitude:** 35.6169°N
Evaluator: AXE.	**Site:** Stream C	**Longitude:** 78.7178°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30	**County:** Wake	**Other** *e.g. Quad Name:* Angier

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	(0)	1	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

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

C. Biology (Subtotal = 8.5)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	1	(1.5)
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	(1)	1.5
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = (0)			

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

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

Stream becomes highly entrenched upstream with bare banks. An abundance of minnows present in channel.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream D

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 11:30 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~5 acres
8. Stream order: 1st (Wake Co. hydro)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.10141°N 78.7173°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream D
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within the past 24 hours
16. Site conditions at time of visit: sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ___(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100% Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~6 feet
23. Bank height (from bed to top of bank): ~0.5 feet
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 58 **Comments:** This stream originates as a braided channel at the toe of a steep slope from a seep. An abundance of wetland/hydrophytic vegetation (FACW to OBL) present within channel.

Evaluator's Signature Corri L Flynn **Date** 7/20/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	2
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				58

* These characteristics are not assessed in coastal streams.

Stream D

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

Date: 7/20/04	**Project:** Terrible creek	**Latitude:** 35.6161°N	
Evaluator: AXE	**Site:** Stream D	**Longitude:** 78.7173°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 33.25	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 14)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	(1)	2	3
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	0	1	2	(3)
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	(1)	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 10)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	(0.5)	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 9.25)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	0.5	(1)	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	(1)	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	0.5	1	1.5
28. Iron oxidizing bacteria/fungus.	0	0.5	1	(1.5)
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Braided channel at toe of slope.

Sketch:

Stream E

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

Date: 7/20/06	**Project:** Terrible Creek	**Latitude:** 35.6167°N	
Evaluator: AXE	**Site:** Stream E	**Longitude:** 78.7160°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 35.25	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 10.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 10.25)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	(1)	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	(1.5)
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

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

A few minnows in channel and an abundance of snails on gravel/cobble sized substrate.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream E

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 12:00 am
5. Name of stream: UT to Terrible creek
6. River basin: Neuse
7. Approximate drainage area: ~10 acres
8. Stream order: 1st (wake co. hydro)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6167°N 78.7160°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream E
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within the past 24 hours
16. Site conditions at time of visit: Sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100% Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~2 feet
23. Bank height (from bed to top of bank): ~1 foot
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ____Straight ✓ Occasional bends ___Frequent meander ____Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 59 **Comments:** A few fish present within channel and an abundance of snails on gravel/cobble sized substrate.

Evaluator's Signature Cori L. Tquin **Date** 7/20/06

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	3
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	3
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				59

* These characteristics are not assessed in coastal streams.

Stream E

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

Date: 7/20/00	**Project:** Terrible Creek	**Latitude:** 35.6167°N
Evaluator: AXE	**Site:** Stream E	**Longitude:** 78.7160°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 35.25	**County:** Wake	**Other** *e.g. Quad Name:* Angier

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	(2)	3
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 10.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 10.25)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	3	(2)	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	(1)	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	(1.5)
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

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

A few minnows in channel and an abundance of snails on gravel/cobble sized substrate.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream F

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 12:30 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~60 acres
8. Stream order: 2nd (Wake Co. hydro)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6157°N 78.7139°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream F
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within the past 24 hours
16. Site conditions at time of visit: sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: 30% Residential ___% Commercial ___% Industrial 65% Agricultural 5% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~2 feet
23. Bank height (from bed to top of bank): ~2-4 feet
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 61 **Comments:** Several fish present within channel and an abundance of snails on gravel/cobble sized substrate.

Evaluator's Signature Con L. Fgun **Date** 7/20/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	3
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	2
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	3
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	2
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	3
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				61

* These characteristics are not assessed in coastal streams.

Stream F

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

Date: 7/20/06	**Project:** Terrible creek	**Latitude:** 35.6157°N
Evaluator: AXE	**Site:** Stream F	**Longitude:** 78.7139°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 39.25	**County:** Wake Co.	**Other** *e.g. Quad Name:* Angier

A. Geomorphology (Subtotal = 17.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	(2)	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	1	2	(3)
5. Active/relic floodplain	0	1	(2)	3
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	(0)	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 10)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	1.5	(1)	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 11.75)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	0	0.5	(1)	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	(1)	1.5
27. Filamentous algae; periphyton	0	0.5	1	(1.5)
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

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

An abundance of minnows in channel and snails on gravel/cobble sized substrate.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream G

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/20/06
4. Time of evaluation: 1:00 pm
5. Name of stream: UT to Terrible creek
6. River basin: Neuse
7. Approximate drainage area: ~10 acres
8. Stream order: 1st (field/Wake Co. hydro)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6150°N 78.7136°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream G
14. Proposed channel work (if any): none
15. Recent weather conditions: small amount of rain within the past 24 hours
16. Site conditions at time of visit: sunny, hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100 % Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~3 feet
23. Bank height (from bed to top of bank): ~3 feet
24. Channel slope down center of stream: ✓ Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ____Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 46 **Comments:** Originates from a seep in slope. Channel has a defined bed and bank with an abundance of hydrophytic vegetation (FACW to OBL) present within the bed.

Evaluator's Signature Coni L. Tquin **Date** 7/20/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	2
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	0
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	2
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	3
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	0
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				46

*These characteristics are not assessed in coastal streams.

Stream 6

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

Date: 7/20/06	**Project:** Terrible Creek	**Latitude:** 35.6150°N
Evaluator: AXE	**Site:** Stream 6	**Longitude:** 78.7136°W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 23.75	**County:** Wake	**Other** *e.g. Quad Name:* Angier

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

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

B. Hydrology (Subtotal = 6.5)				
14. Groundwater flow/discharge	0	(1)	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	(1)	2	3
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 6.25)				
20[b]. Fibrous roots in channel	3	2	(1)	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	0	0.5	(1)	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	0.5	1	1.5
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

Sketch:

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

Defined bed and bank with an abundance of hydrophytic vegetation (FACW to OBL). Sediment in channel made it difficult to find benthics.

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream H

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/26/06
4. Time of evaluation: 9:00 am
5. Name of stream: UT to Terrible creek
6. River basin: Neuse
7. Approximate drainage area: ~18 acres
8. Stream order: 2nd (wake county hydrology)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6144°N 78.7122°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream H
14. Proposed channel work (if any): none
15. Recent weather conditions: rain approximately 24 hours previous
16. Site conditions at time of visit: hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area: _____
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100 % Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~2 feet
23. Bank height (from bed to top of bank): ~0.5-2 feet
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 52 **Comments:** An abundance of frog eggs present on water surface.

Evaluator's Signature Cori L. Fquin **Date** 7/26/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	2
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				52

* These characteristics are not assessed in coastal streams.

Stream H

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

Date: 7/26/06	**Project:** Terrible Creek	**Latitude:** 35.6144°N	
Evaluator: A.X.E	**Site:** Stream H	**Longitude:** 78.7122°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 29.75	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 14)

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

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

B. Hydrology (Subtotal = 10)

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

C. Biology (Subtotal = 5.75)

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

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

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

An abundance of frog eggs present on water surface.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream I

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/12/06
4. Time of evaluation: 1:00 pm
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~80 acres
8. Stream order: 1st (topo)
9. Length of reach evaluated: ~25 feet
10. County: Wake
11. Site coordinates (if known): 35.6134°N 78.7117°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream I
14. Proposed channel work (if any): none
15. Recent weather conditions: dry, hot
16. Site conditions at time of visit: dry, hot, sunny
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~1.3 acres
19. Does channel appear on USGS quad map? (YES) NO
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: 5 % Residential ___% Commercial ___% Industrial 95 % Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~3-5 feet
23. Bank height (from bed to top of bank): ~3-5 feet
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ✓ Straight ___Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 45 **Comments:** Stream enters the site from a small culvert (road crossing). There is an ~1.0 foot drop from the culvert to the stream bed.

Evaluator's Signature Cori L. Fagan **Date** 7/12/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	3
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	2
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture, livestock, or timber production** (substantial impact = 0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	2
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				45

* These characteristics are not assessed in coastal streams.

Stream I

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

Date: 7/12/06	**Project:** Terrible Creek	**Latitude:** 35.6134°N	
Evaluator: AXE	**Site:**	**Longitude:** 78.7117°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 34	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	(1)	2	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	(0)	1	2	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 10.5)				
14. Groundwater flow/discharge	0	1	2	(3)
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	2	(3)
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	0	0.5	(1)	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 9)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	0	0.5	(1)	1.5
25. Amphibians	0	(0.5)	1	1.5
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	0	(0.5)	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = (0)			

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

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

Stream enters site from culvert (road crossing) with an approximate 1 foot drop to bed.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream J

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/26/06
4. Time of evaluation: 9:30 am
5. Name of stream: UT to Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: ~23 acres
8. Stream order: 2nd (Wake County hydrology)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6136°N 78.7102°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream J
14. Proposed channel work (if any): none
15. Recent weather conditions: rain approximately 24 hrs prevous
16. Site conditions at time of visit: hot, humid
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~0.5 acres
19. Does channel appear on USGS quad map? YES (NO)
20. Does channel appear on USDA Soil Survey? YES (NO)
21. Estimated watershed land use: ___% Residential ___% Commercial ___% Industrial 100 % Agricultural ___% Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~2 feet
23. Bank height (from bed to top of bank): ~0.5-1 foot
24. Channel slope down center of stream: ___Flat (0 to 2%) ✓ Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ___Straight ✓ Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 49 **Comments:** An abundance of hydrophytic vegetation (FACW to OBL) present within channel especially in riffle areas.

Evaluator's Signature Corri L Faglon **Date** 7/26/06

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STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	3
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	3
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	2
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
STABILITY	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	5
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture, livestock, or timber production** (substantial impact = 0; no evidence = max points)	0 – 5	0 – 4	0 – 5	1
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	1
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				49

* These characteristics are not assessed in coastal streams.

Stream J

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

Date: 7/26/06	**Project:** Terrible Creek	**Latitude:** 35.6130°N	
Evaluator: AXE.	**Site:** Stream J	**Longitude:** 78.7102°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 27.75	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

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

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

B. Hydrology (Subtotal = 7.5)				
14. Groundwater flow/discharge	0	1	(2)	3
15. Water in channel and > 48 hrs since rain, or Water in channel – dry or growing season	0	1	(2)	3
16. Leaflitter	(1.5)	1	0.5	0
17. Sediment on plants or debris	(0)	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0	(0.5)	1	1.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = (1.5)	

C. Biology (Subtotal = 8.25)				
20[b]. Fibrous roots in channel	3	(2)	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	1	2	3
24. Fish	(0)	0.5	1	1.5
25. Amphibians	0	0.5	1	(1.5)
26. Macrobenthos (note diversity and abundance)	0	(0.5)	1	1.5
27. Filamentous algae; periphyton	0	(0.5)	1	1.5
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = (0.75); OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Abundance of FACW to OBL plants present in channel especially in riffle areas.

Sketch:

USACE AID#_____ DWQ #_____ Site #____ (indicate on attached map)

Stream K

STREAM QUALITY ASSESSMENT WORKSHEET

Provide the following information for the stream reach under assessment:

1. Applicant's name: EEP
2. Evaluator's name: Axiom Environmental
3. Date of evaluation: 7/12/06
4. Time of evaluation: 9:30 am
5. Name of stream: Terrible Creek
6. River basin: Neuse
7. Approximate drainage area: 11.6 sq. miles
8. Stream order: 4th or greater (topo)
9. Length of reach evaluated: ~100 feet
10. County: Wake
11. Site coordinates (if known): 35.6126°N 78.7077°W
12. Subdivision name (if any): NA
13. Location of reach under evaluation (note nearby roads and landmarks and attach map identifying stream(s) location): Stream K
14. Proposed channel work (if any): none
15. Recent weather conditions: dry, hot
16. Site conditions at time of visit: dry, hot, sunny
17. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ✓ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
18. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area: _____
19. Does channel appear on USGS quad map? (YES) NO
20. Does channel appear on USDA Soil Survey? (YES) NO
21. Estimated watershed land use: 30 % Residential ___% Commercial ___% Industrial 35 % Agricultural 35 % Forested ___% Cleared / Logged ___% Other (_____)
22. Bankfull width: ~15 feet
23. Bank height (from bed to top of bank): ~5-8 feet
24. Channel slope down center of stream: ✓ Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
25. Channel sinuosity: ✓ Straight ___Occasional bends ___Frequent meander ___Very sinuous ___Braided channel

Instructions for completion of worksheet (located on page 2): Begin by determining the most appropriate ecoregion based on location, terrain, vegetation, stream classification, etc. Every characteristic must be scored using the same ecoregion. Assign points to each characteristic within the range shown for the ecoregion. Page 3 provides a brief description of how to review the characteristics identified in the worksheet. Scores should reflect an overall assessment of the stream reach under evaluation. If a characteristic cannot be evaluated due to site or weather conditions, enter 0 in the scoring box and provide an explanation in the comment section. Where there are obvious changes in the character of a stream under review (e.g., the stream flows from a pasture into a forest), the stream may be divided into smaller reaches that display more continuity, and a separate form used to evaluate each reach. The total score assigned to a stream reach must range between 0 and 100, with a score of 100 representing a stream of the highest quality.

Total Score (from reverse): 53 **Comments:** This section of stream appears to have been dug, is very straight and wide. The majority of the flow from Terrible Creek travels through this section of channel.

Evaluator's Signature Corin L Gqui **Date** 7/12/06

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 06/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	0
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	4
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition = 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture, livestock, or timber production** (substantial impact = 0; no evidence = max points)	0 – 5	0 – 4	0 – 5	2
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	0
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	3
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (see page 4) (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	2
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	3
		Total Points Possible	100	100	100	
		TOTAL SCORE (also enter on first page)				53

* These characteristics are not assessed in coastal streams.

Stream K

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

Date: 7/12/06	**Project:** Terrible Creek	**Latitude:** 35.6126°N	
Evaluator: AXE	**Site:**	**Longitude:** 78.7077°W	
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30.5	**County:** Wake	**Other** *e.g. Quad Name:* Angier	

A. Geomorphology (Subtotal = 15.5)

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

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

B. Hydrology (Subtotal = 11)

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

C. Biology (Subtotal = 12)

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

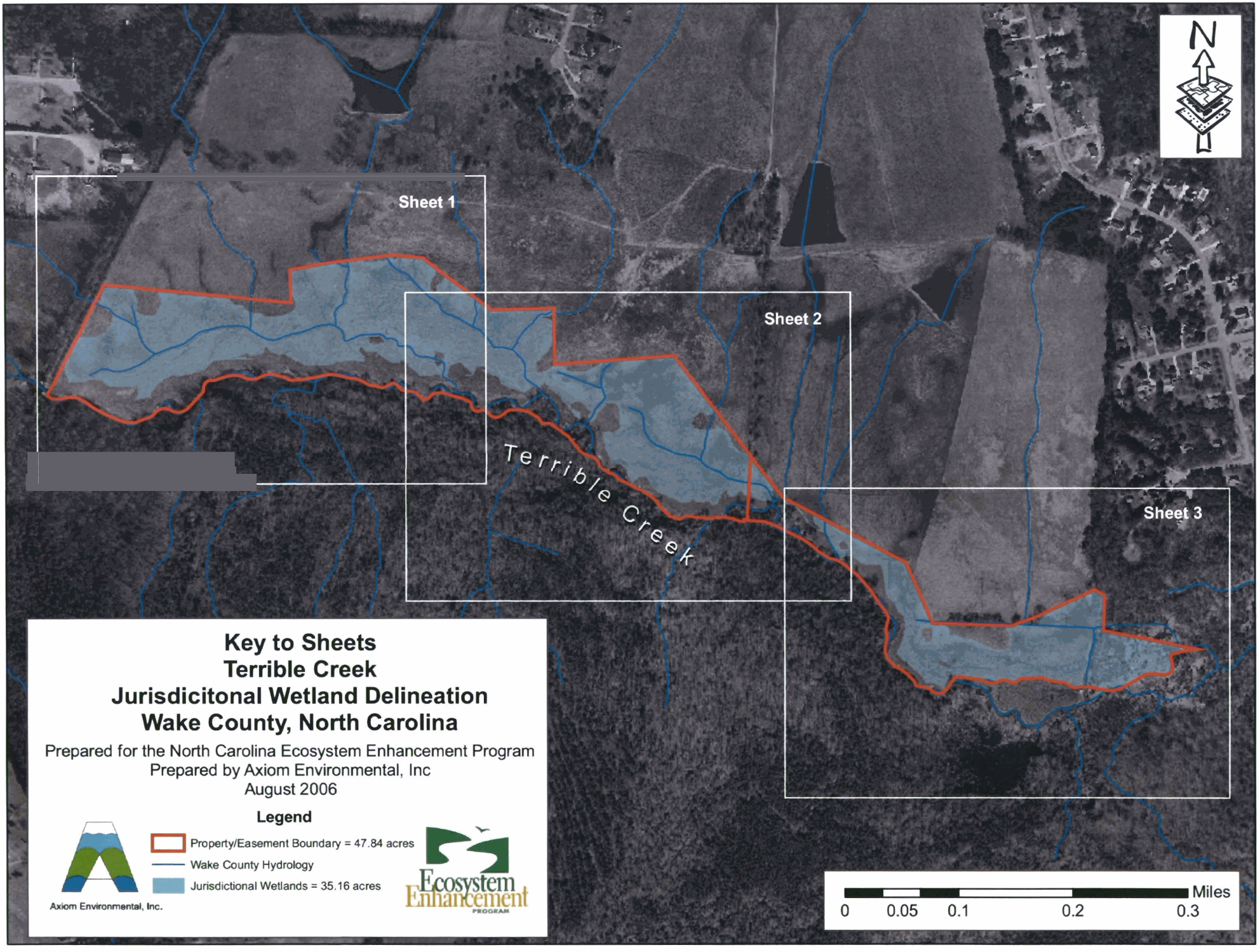
[b]Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

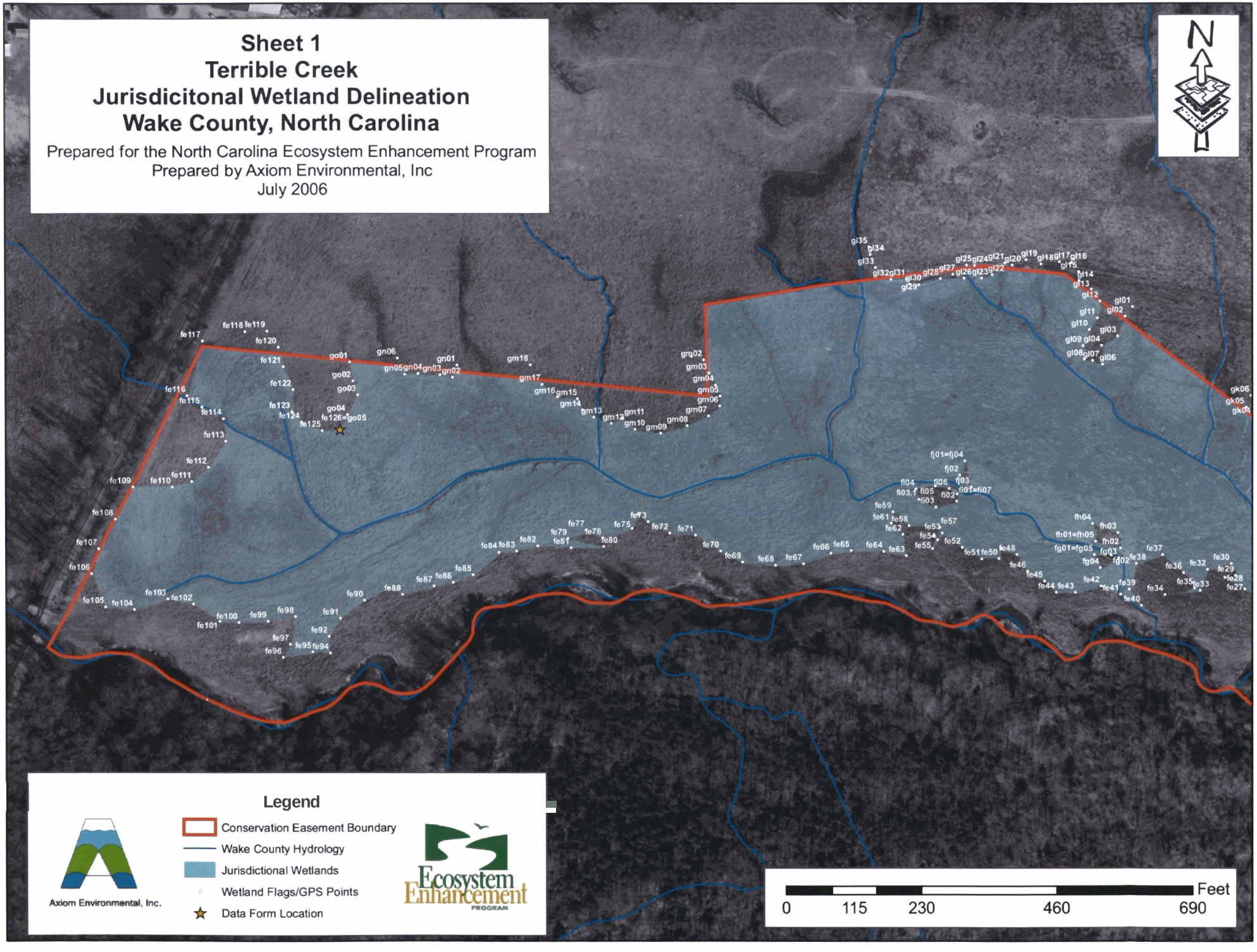
Notes: (use back side of this form for additional notes.)

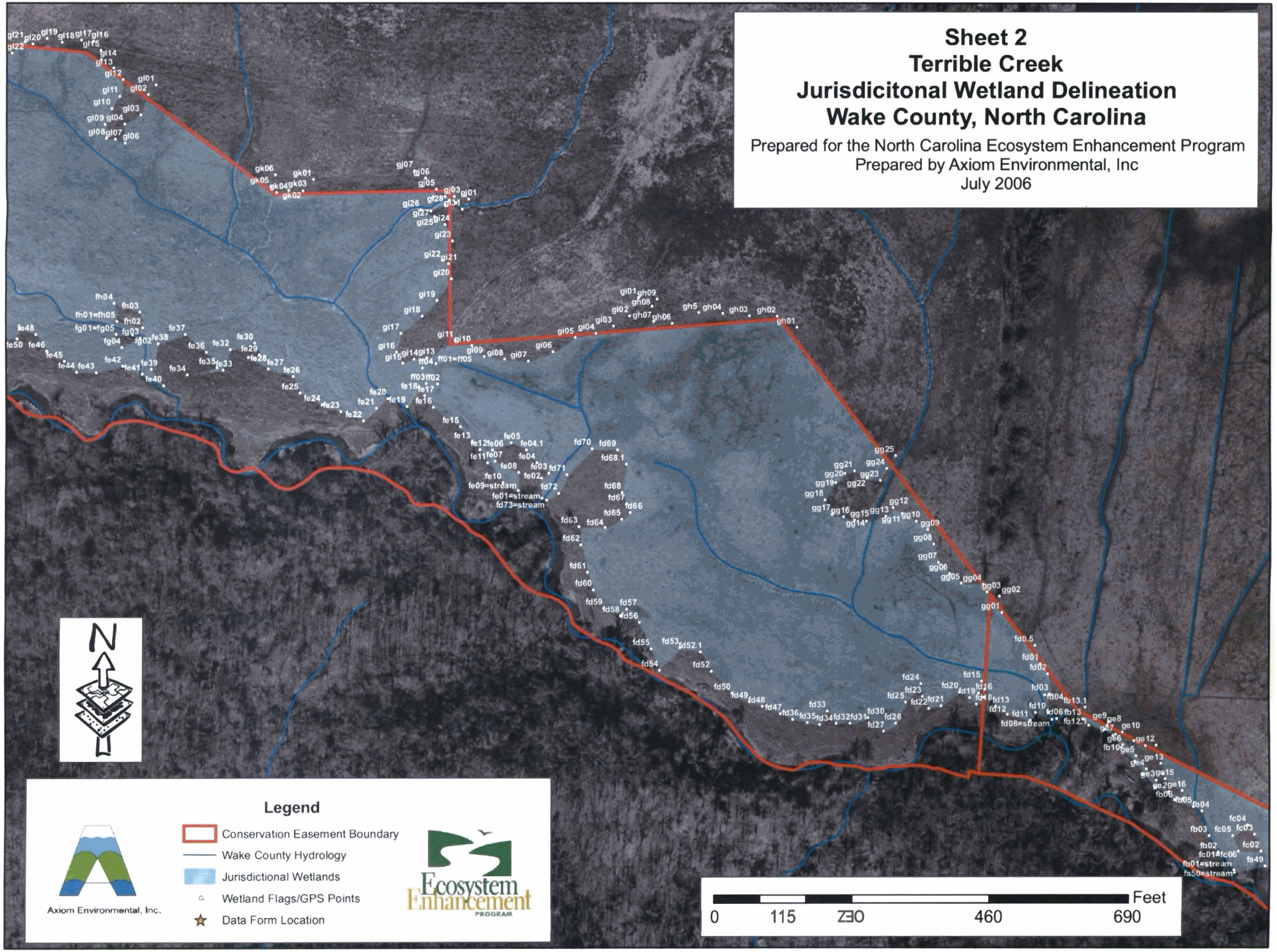
This section of stream appeared to be dug and the majority of the flow from Terrible Creek travels through this drainage.

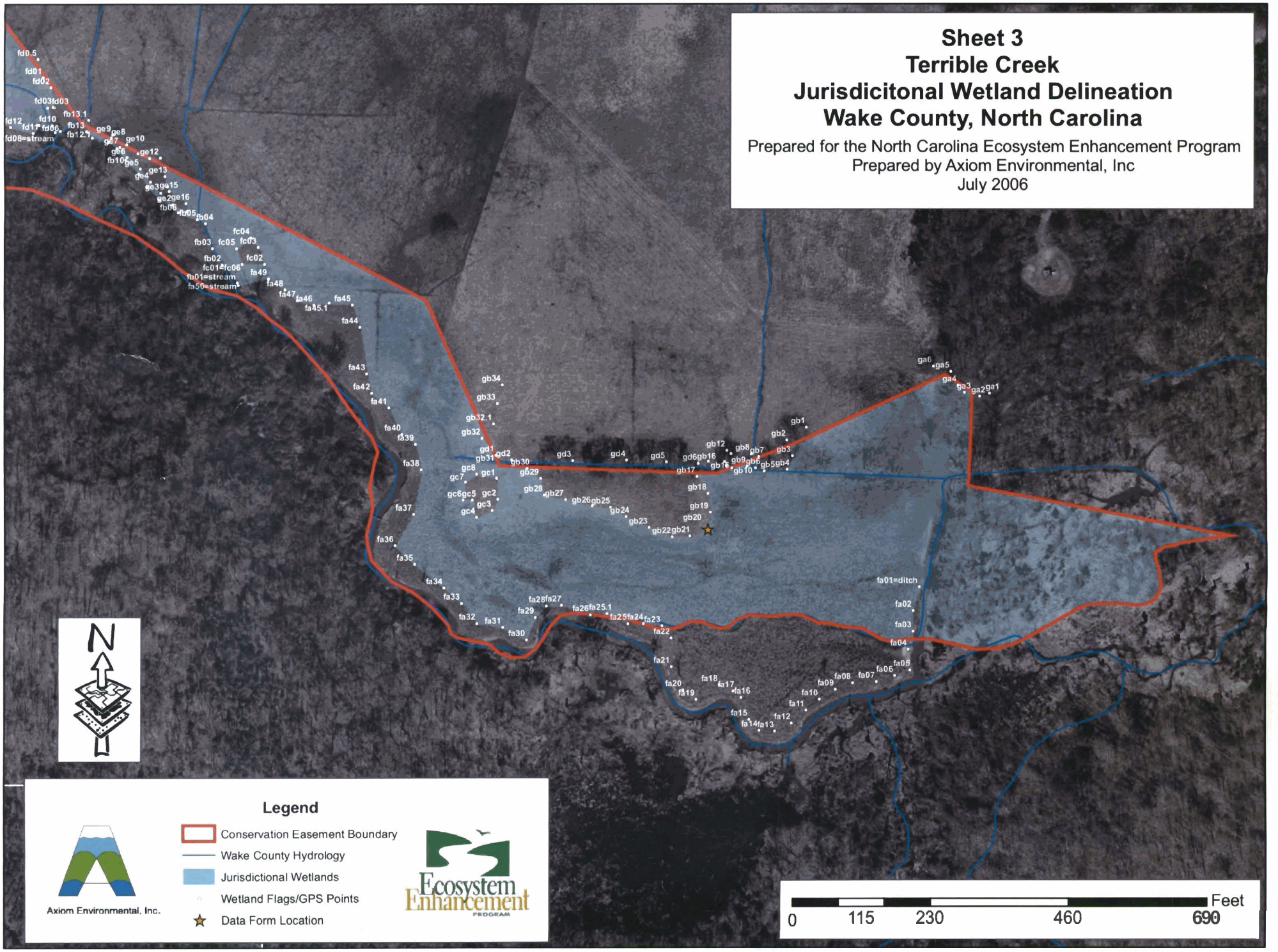
Sketch:

Appendix D.
USACE Routine Wetland Determination Data Forms
and
Jurisdictional Wetland Maps


N
Sheet 1
Sheet 2
Sheet 3
Terrible Creek
Key to Sheets
Terrible Creek
Jurisdicitonal Wetland Delineation
Wake County, North Carolina
Prepared for the North Carolina Ecosystem Enhancement Program
Prepared by Axiom Environmental, Inc
August 2006
Legend
Property/Easement Boundary = 47.84 acres
Wake County Hydrology
Jurisdictional Wetlands = 35.16 acres
Axiom Environmental, Inc.
Ecosystem Enhancement PROGRAM
Miles
0
0.05
0.1
0.2
0.3


Sheet 1
Terrible Creek
Jurisdicitonal Wetland Delineation
Wake County, North Carolina
Prepared for the North Carolina Ecosystem Enhancement Program
Prepared by Axiom Environmental, Inc
July 2006
N
Legend
Conservation Easement Boundary
Wake County Hydrology
Jurisdictional Wetlands
Wetland Flags/GPS Points
Data Form Location
Axiom Environmental, Inc.
Ecosystem Enhancement PROGRAM
0
115
230
460
690
Feet


Sheet 2
Terrible Creek
Jurisdicitonal Wetland Delineation
Wake County, North Carolina
Prepared for the North Carolina Ecosystem Enhancement Program
Prepared by Axiom Environmental, Inc
July 2006
N
Legend
Conservation Easement Boundary
Wake County Hydrology
Jurisdictional Wetlands
Wetland Flags/GPS Points
Data Form Location
Axiom Environmental, Inc.
Ecosystem Enhancement PROGRAM
0
115
230
460
690
Feet


Sheet 3
Terrible Creek
Jurisdicitonal Wetland Delineation
Wake County, North Carolina
Prepared for the North Carolina Ecosystem Enhancement Program
Prepared by Axiom Environmental, Inc
July 2006
N
Legend
Conservation Easement Boundary
Wake County Hydrology
Jurisdictional Wetlands
Wetland Flags/GPS Points
Data Form Location
Axiom Environmental, Inc.
Ecosystem Enhancement Program
0
115
230
460
690
Feet

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

Project / Site: Terrible Creek **Applicant / Owner:** EEP **Investigator:** Axiom Environmental	**Date:** 7/20/06 **County:** Wake **State:** NC
Do normal circumstances exist on the site? Yes ✓ No ___ **Is the site significantly disturbed (Atypical situation)?** Yes ___ No ✓ **Is the area a potential problem area?** Yes ___ No ✓ **(explain on reverse if needed)**	**Community ID:** FE1206=6005 **Transect ID:** maint./dist. **Plot ID:** wetland

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Juncus effusus	herb	FACW+	9.		
2. Saururus cernuus	herb	OBL	10.		
3. Eleocharis sp.	herb	FACW to OBL	11.		
4. Vernonia noveboracensis	shrub	FAC+	12.		
5. Phragmites australis	shrub	FACW	13.		
6.			14.		
7.			15.		
8.			16.		

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

___ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: ___ (in.)

Depth to Free Water in Pit: ___ (in.)

Depth to Saturated Soil: ___ (in.)

Wetland Hydrology Indicators

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12"
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ✓ Drainage Patterns in Wetlands

Secondary Indicators:
- ✓ Oxidized Roots Channels in Upper 12"
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ✓ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

SOILS

Map Unit Name (Series and Phase): Augusta fine sandy loam **Drainage Class:** somewhat poorly drained

Taxonomy (Subgroup): Aeric Ochraquults **Confirm Mapped Type? Yes** ___ **No** ✓

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6		2.5Y 3/1	10YR 4/6	2%	Sandy clay loam
6-12+		10YR 3/1	10YR 4/6	10%	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:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes** ✓	**No** ___	**Is the Sampling Point Within a Wetland?**	**Yes** ✓ **No** ___
Wetland Hydrology Present?	**Yes** ✓	**No** ___		
Hydric Soils Present?	**Yes** ✓	**No** ___		

Remarks:

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

Project / Site: Terrible Creek **Applicant / Owner:** EEP **Investigator:** Axiom Environmental	**Date:** 7/20/06 **County:** Wake **State:** NC
Do normal circumstances exist on the site? Yes ✓ No ___ **Is the site significantly disturbed (Atypical situation)?** Yes ___ No ✓ **Is the area a potential problem area?** Yes ___ No ✓ **(explain on reverse if needed)**	**Community ID:** FE126 = 6085 **Transect ID:** maint./dist. **Plot ID:** upland

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Rubus argutus	shrub	FACU+	9.		
2. Festuca sp.	herb.	FACU to FAC-	10.		
3. Solanum carolinense	herb	FACU	11.		
4. Passiflora edulis	vine	FACU	12.		
5.			13.		
6.			14.		
7.			15.		
8.			16.		

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

Remarks:

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12"
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators:
- ___ Oxidized Roots Channels in Upper 12"
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks: No wetland hydrology indicators.

SOILS

SOILS

Map Unit Name (Series and Phase): Appling gravelly sandy loam **Drainage Class:** well-drained

Taxonomy (Subgroup): Typic Hapludults **Confirm Mapped Type? Yes** ___ **No** ✓

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12+		10 YR 5/3 }	50%		fine sandy loam
		10 YR 4/3 }	each		(very gravelly)

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 soil indicators

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes** ___	**No** ✓	**Is the Sampling Point**	
Wetland Hydrology Present?	**Yes** ___	**No** ✓	**Within a Wetland?** **Yes** ___	**No** ✓
Hydric Soils Present?	**Yes** ___	**No** ✓		

Remarks:

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

Project / Site: Terrible Creek **Applicant / Owner:** EEP **Investigator:** Axiom Environmental	**Date:** 7/12/06 **County:** Wake **State:** NC
Do normal circumstances exist on the site? Yes ✓ No ___ **Is the site significantly disturbed (Atypical situation)?** Yes ___ No ✓ **Is the area a potential problem area?** Yes ___ No ✓ **(explain on reverse if needed)**	**Community ID:** 6B20 **Transect ID:** maint./dist. **Plot ID:** wetland

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Juncus effusus	herb	FACW+	9.		
2. Polygonum Sp.	herb.	FACW to OBL	10.		
3. Carex Sp.	herb	FACW to OBL	11.		
4. Acer rubrum	shrub	FAC	12.		
5. Boehmeria cylindrica	herb	FACW+	13.		
6. Hibiscus moscheutos	shrub	OBL	14.		
7.			15.		
8.			16.		

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

___ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: — (in.)

Depth to Free Water in Pit: — (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators

Primary Indicators:
- ___ Inundated
- ✓ Saturated in Upper 12"
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ✓ Drainage Patterns in Wetlands

Secondary Indicators:
- ✓ Oxidized Roots Channels in Upper 12"
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ✓ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

SOILS

SOILS

Map Unit Name (Series and Phase): Wehadkee and Bibb **Drainage Class:** poorly drained

Taxonomy (Subgroup): Fluvaquentic Haplaquepts / Typic Haplaquents **Confirm Mapped Type? Yes** ___ **No** ✓

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-6		2.5Y 3/2	—	—	silt loam
6-12+		2.5Y 4/2	10YR 4/6	5%	sandy loam
			10YR 5/6	5%	

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:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes** ✓	**No** ___	**Is the Sampling Point**		
Wetland Hydrology Present?	**Yes** ✓	**No** ___	**Within a Wetland?**	**Yes** ✓	**No** ___
Hydric Soils Present?	**Yes** ✓	**No** ___			

Remarks:

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

Project / Site: Terrible Creek **Applicant / Owner:** EEP **Investigator:** Axiom Environmental	**Date:** 7/12/06 **County:** Wake **State:** NC
Do normal circumstances exist on the site? Yes ✓ No ___ **Is the site significantly disturbed (Atypical situation)?** Yes ___ No ✓ **Is the area a potential problem area?** Yes ___ No ✓ **(explain on reverse if needed)**	**Community ID:** GB20 **Transect ID:** maint/dist. **Plot ID:** upland

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. Asclepias Sp.	shrub	FAC to OBL	9.		
2. Carya tomentosa	Shrub	UPL	10.		
3. Fraxinus Sp.	Shrub	FACU to FACW	11.		
4. Festuca sp.	herb	FACU to FAC	12.		
5. Campsis radicans	herb	FAC	13.		
6. Liquidambar styraciflua	Shrub	FAC+	14.		
7. Solanum carolinense	herb	FACU	15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC excluding FAC-). 43%

Remarks:

HYDROLOGY

___ **Recorded Data (Describe In Remarks):**
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ **No Recorded Data Available**

Field Observations:

Depth of Surface Water: _____(in.)

Depth to Free Water in Pit: _____(in.)

Depth to Saturated Soil: _____(in.)

Wetland Hydrology Indicators

Primary Indicators:
- ___ Inundated
- ___ Saturated in Upper 12"
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators:
- ___ Oxidized Roots Channels in Upper 12"
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

No wetland hydrology indicators.

SOILS

SOILS

Map Unit Name (Series and Phase): Altavista fine sandy loam **Drainage Class:** moderately well-drained

Taxonomy (Subgroup): Aquic Hapludults **Confirm Mapped Type? Yes** ___ **No** ✓

Profile Description:

Depth (inches)	Horizon	Matrix Colors (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-5		10YR 3/2	—	—	sandy loam
5-12+		2.5Y 4/3	10YR 3/2	10%	sandy loam (lots of gravel)

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:

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes** ___	**No** ___	**Is the Sampling Point**		
Wetland Hydrology Present?	**Yes** ___	**No** ✓	**Within a Wetland?**	**Yes** ___	**No** ✓
Hydric Soils Present?	**Yes** ___	**No** ✓			

Remarks:

Appendix E.
Outer Bend Erosion Photographs

Outer Bend #1 - Looking Upstream
at beaver dam.
(Low Erosion)

Outer Bend #2 - looking upstream
approximately 150 feet upstream from beaver dam.
(Low Erosion)

Outer Bend #3 - Looking Upstream
approximately 400 ft upstream from beaver dam,
still in impounded reach.
(Low Erosion)

Outer Bend #4 - Looking Upstream
approximately 500 ft upstream from beaver dam,
still in impounded reach.
(Moderate Erosion)

Outer Bend #5 - Looking Upstream
a bend with a larger radius.
(Low Erosion)

Outer Bend #6 - Looking Upstream
in a double outer bend.
(Moderate Erosion)

Outer Bend #7 - Looking Upstream
Privet on opposite bank may causing erosion on Site bank.
(Moderate Erosion)

Outer Bend #8 - Looking Upstream
(Severe Erosion)

Outer Bend #9 - Looking Upstream
at outer bend in a straight, immediately upstream from a tight radius.
(Moderate Erosion)

Outer Bend #10 - Looking Upstream
at tight radius below a large river birch.
Moderate Erosion)

Outer Bend #**11** - Looking Upstream
at tight radius. A fallen tree has cause
a hole in the bank.
(Severe Erosion)

Outer Bend #11 - Looking Downstream
at fallen tree causing a hole in the bank.
(Severe Erosion)

Outer Bend #**12** - Looking Upstream
(Severe Erosion)

Outer Bend #**12** - Looking Upstream
(Severe Erosion)

Outer Bend #**13** - Looking Upstream
A fallen tree may be causing erosion
on Site stream banks.
(Severe Erosion)

Outer Bend #**13** - Looking Upstream
A fallen tree may be causing erosion
on Site stream banks.
(Severe Erosion)

Outer Bend #14 - Looking Upstream
at tight radius caused by point bar and
transverse bar.
(Severe Erosion)

Outer Bend #15 - Looking Upstream
at a long bend with two stumps extending
into the stream.
(Moderate Erosion)

Outer Bend #16 - Looking Upstream
at tight bends. This is not a good reach for
bank stabilization comparisons.
(Moderate Erosion)

Outer Bend #16 - Looking Upstream
at tight bends. This is not a good reach for
bank stabilization comparisons.
(Moderate Erosion)

Outer Bend #17 - Looking Upstream
(Severe Erosion)

Outer Bend #17 - Looking Downstream
(Severe Erosion)

Outer Bend #18 - Looking Upstream
(Extreme Erosion)

Outer Bend #19 - Looking Upstream
(Severe Erosion)

Outer Bend #20 - Looking Upstream
at a long bend with a tight radius in the
middle of the bend.
(Extreme Erosion)

Outer Bend #20 - Looking Downstream
at a long bend with a tight radius in the
middle of the bend.
(Extreme Erosion)

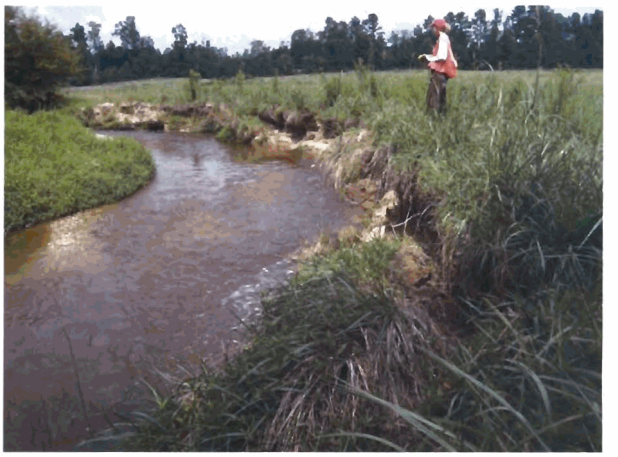
Outer Bend #21 - Looking Upstream
at bank sloughing
(Extreme Erosion)

Outer Bend #**22** - Looking Upstream
at lateral migration of outer bend with
point bar extension into the stream bed.
(Severe Erosion)

Outer Bend #**23** - Looking Upstream
at root balls in channel and bank sloughing
(Severe Erosion)

Outer Bend #**24** - Looking Upstream
at a short reach of erosion.
(Severe Erosion)

Outer Bend #**25** - Looking Upstream
at transverse bar and tight radius at upper
reach of the bend.
(Extreme Erosion)



Outer Bend #**26** - Looking Upstream
at migrating outer bend and extension of
point bar/transverse bar at lower
reach of bend.
(Extreme Erosion)

Outer Bend **#27 -** Looking Upstream
at erosion on low slope reach.
(Severe Erosion)

Outer Bend #28 - Looking Upstream
at potential shoot cutoff development.
(Severe Erosion)

Outer Bend **#28 -** Looking Downstream
at potential shoot cutoff development.
(Severe Erosion)

Outer Bend **#29 -** Looking Upstream
at shoot cutoff. Not a good bank erosion
treatment comparison area.
(Severe Erosion)

Outer Bend #30 - Looking Upstream
at lateral migration of out bend with extension
of point bar into the stream bed.
(Extreme Erosion)

Appendix F.
Preconstruction Photographs