MITIGATION PLAN

UT TO NEUSE RIVER (BIG DITCH)
STREAM RESTORATION SITE

Wayne County, North Carolina
Project ID No. 09-0776201

Prepared for:

NCDENR-Ecosystem Enhancement Program
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April 8, 2010

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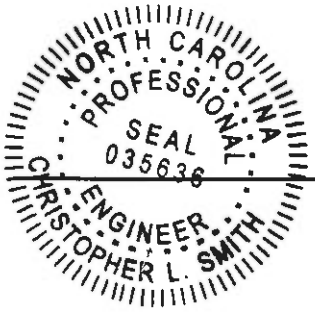
I HEREBY CERTIFY THAT THE DOCUMENTS CONTAINED HEREIN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 8TH DAY OF APRIL 2010.



Christopher L. Smith, PE

Florence & Hutcheson

CONSULTING ENGINEERS

EXECUTIVE SUMMARY

The UT to Neuse (Big Ditch) Stream Restoration Site (Site) is located within the City of Goldsboro in Wayne County, North Carolina (Figure 1). The properties included in this project are southeast of the intersection of South John Street and East Elm Street, and is adjacent to the City of Goldsboro's Willow Dale Cemetery (Lat 35.373 Long 77.995). The Site is located in the United States Geological Survey Hydrologic Unit 03020201200040 (North Carolina Division of Water Quality Subbasin 03-04-12) of the Neuse River Basin. The Site was identified to assist the North Carolina Ecosystem Enhancement Program (EEP) in meeting its stream and buffer mitigation goals.

This document details planned stream mitigation activities at the Site. A 9.94-acre conservation easement will be placed on the Site to incorporate all mitigation activities. The Site contains approximately 2,113 existing feet of jurisdictional stream in the form of an unnamed tributary to the Neuse River (UT), as well as associated floodplains and upland slopes.

The contributing watersheds are characterized primarily by forest/wetland (approximately 20 percent of the total area), cultivated cropland (approximately five percent of the total area), urban area (approximately 74 percent of the total area) and surface water (approximately 1 percent of the total area). The UT is located within a highly urbanized watershed. The large majority of the watershed is contained within the city limits of Goldsboro. Goldsboro is highly developed, with undeveloped lands comprising relatively small portions of land in the watershed. It is not anticipated that watershed conditions will be substantially altered within the foreseeable future.

The UT has been detrimentally impacted in the past due to channelization and deepening. Evidence of channelization includes the fact that the channel follows the fall line of the valley through the site with no natural meander geometry. The UT is highly entrenched which produces high stress on the channel banks which leads to mass wasting. Additionally, degradation of banks has decreased root growth which increases erodibility and promotes bank failure.

The primary goals of this stream restoration project focus on reducing sediment loading in the UT, improving water quality, providing/enhancing flood attenuation, and restoring and enhancing aquatic and riparian habitat. These goals will be accomplished through the following objectives:

- Restore a stable dimension, pattern and profile to the UT that will deter degradation of side slopes and mass wasting of banks. A newly designed channel cross-section with overbank flood relief and stream channel structures that reduce stress on channel banks and creates pools will ensure stability and reduce exiting sediment loading.
- Stabilize the UT by planting live stakes and bare roots along the channel banks to promote root growth. The proposed planting density along channel banks calls for

two foot spacing, which should assist in establishing a continuous, dense root mat through the Site.

- Enhancing the capacity of the Site to mitigate flood flows by excavating a 5 foot floodplain bench off of each channel bank and sloping terrace side slopes at a 5:1 angle. Additionally, a stormwater wetland BMP will be retrofitted on a contributing conveyance which should assist in mitigating flood flows during precipitation events.
- Enhancing in stream habitat by creating an undulating bedform (shallows/deeps) by placing woody structures in the channel that provide shading, natural food sources, and protective areas for propagation. Additionally, planting vegetation along the channel banks and within the riparian buffer will enhance shading and provide much needed biomass to fauna within the UT for cover, forage and propagation.
- Reducing sedimentation and nutrients from adjacent urban areas by establishing a native riparian buffer through existing open/grassed fields that are currently regularly maintained.
- Improve terrestrial habitat by restoring a forested riparian corridor through a highly urbanized environment which has historically experienced vegetation maintenance and forest segmentation. This corridor will provide a diversity of habitats such as mature forest, early successional forest, riparian wetlands (in the form of a stormwater wetland BMP) and uplands.
- Reduce nutrients and other pollutant inputs by retrofitting a contributing conveyance to a stormwater wetland BMP.

Project mitigation efforts will result in the following:

- Restore and stabilize 2,128 linear feet of Site streams.
- Restore and plant 9.13 acres of Neuse River Buffers in the floodplain, stream bank, and upland slopes.
- Impact zero (0) acres of existing wetlands during construction activities.
- Retrofit one contributing conveyance to a stormwater wetland BMP.

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

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1.0 PROJECT SITE IDENTIFICATION AND LOCATION

The UT to Neuse River (UT) Stream Restoration Site (Site) is located within the City of Goldsboro in Wayne County, North Carolina (Figure 1). The properties included in this plan are southeast of the intersection of South John Street and East Elm Street, and is adjacent to the City of Goldsboro's Willow Dale Cemetery (Lat 35.373 Long 77.995).

This document details planned stream mitigation activities at the Site. A 9.94-acre conservation easement will be placed on the Site to incorporate all restoration activities.

1.1 Directions to Project Site

Directions to the Site:

- From Raleigh, take I-40 East to US 70. Travel east on the US 70 towards Goldsboro.
- At Goldsboro, take Grantham Street (go straight) where US 70 veers off to the right (turns over a bridge)
- Take Grantham to George Street and turn right onto George Street
- Take George Street to Elm Street and turn left at Elm Street
- Site is located due southeast of the intersection of Elm Street and John Street
- Site Latitude and Longitude (35.373°N, 77.995°W)

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designation

The Site is located in Wayne County, North Carolina within USGS HU 03020201200040 (NCDWQ Subbasin 03-04-12) of the Neuse River Basin (USGS 1974, NCEEP 2009). The Site was identified to assist the North Carolina Ecosystem Enhancement Program (EEP) in meeting its stream and buffer mitigation goals.

1.3 Project Components, Restoration Type, and Approach

Proposed Site activities include the construction of a stable stream channel on the UT resulting in 2,128 linear feet of restored stream and the restoration of a vegetated riparian buffer along the restored reach of the stream channel.

Table 1. Project Components

Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Restoration Segment/ Reach ID	Existing LF/AC	Restoration Level	Approach	Designed LF/AC	Station Range	Buffer Acres	Comment
UT	2,113	R	PII	2,128	10+00 – 21+28	9.76	Restore pattern, dimension, profile, and riparian buffer.

Component Summations			
Restoration Level	**Stream (LF)**	**0-50 FT Buffer (AC)**	**50-200 FT Buffer (AC)**
Restoration	2,128	4.46	4.67
Totals	2,128	9.13	

BMP Summations			
	Size (AC)	**Nitrogen Treatment (lb/yr)**	**Phosphorus Treatment (lb/yr)**
Stormwater Wetland	0.25	49	6.8

1.4 Project History

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2 through 4.

Table 2. Project Activity and Reporting History
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Activity or Report	Data Collection Complete	Completion or Delivery
Mitigation Plan	January 2010	February 2010
Final Design – Construction Plans		
Construction		
Temporary S&E Mix Applied to Entire Project Area		
Permanent Seed Mix Applied to Entire Project Area		
Containerized and B&B plantings for Entire Project Area		
As-built (Year 0 Monitoring-Baseline)		
Year 1 Monitoring		
Year 2 Monitoring		
Structural maintenance (bench expansion, vane, etc.)		
Year 3 Monitoring		
Supplemental planting of containerized material		
Year 4 Monitoring		

Table 3. Project Contacts Table
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Designer Primary project design POC	Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Company Information/Address POC name and phone
Planting Contractor Planting Contractor POC	Company Information/Address POC name and phone
Seeding Contractor Seeding Contractor POC	Company Information/Address POC name and phone
Seed Mix Sources	Company and contact phone
Nursery Stock Suppliers	Company and contact phone
Monitoring Performers	Firm Information/address
Stream Monitoring POC	POC name and phone
Vegetation Monitoring POC	POC name and phone
Wetland Monitoring POC	POC name and phone

Table 4. Project Attributes Table
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Project County	Wayne County, North Carolina
Physiographic Region	Southeastern Plains
Ecoregion	Southeastern Floodplains and Low Terraces
Project River Basin	Neuse
USGS HUC for Project (14 digit)	03020201200040
NCDWQ Sub-basin for Project	03-04-12
Within extent of EEP Watershed Plan?	No
WRC Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	50% Currently / 100% Post Construction (Demarcated with signs/posts/fence)
Beaver activity observed during design phase?	No
Restoration Component Attributes	
	UT Neuse River
Drainage Area	2.27 sq mi (At End of Restoration Reach)
Stream Order (USGS topo)	2nd
Restored Length (feet)	2,128
Perennial (P) or Intermittent (I)	P
Watershed Type	Urban
Watershed impervious cover	~40%
NCDWQ AU/Index number	27-(56)
NCDWQ Classification	WS-IV, NSW, C
303d listed?	No
Upstream of a 303d listed	No
Reasons for 303d listed segment	N/A
Total acreage of easement	9.94 ac
Total vegetated acreage of easement	9.76 ac
Total planted restoration acreage	9.76 ac
Rosgen Classification of preexisting	B/G 5
Rosgen Classification of As-built	
Valley type	VIII
Valley slope	0.55%
Cowardin classification	N/A – Existing vegetation is primarily maintained grasses
Trout waters designation	N/A
Species of concern, endangered etc.	In County: Red-cockaded woodpecker, bald eagle
Dominant Soil Series	Bibb/Norfolk loamy sand

2.0 WATERSHED CHARACTERIZATION

2.1 Drainage Area

Onsite elevations range from a high of 84 feet above msl in the upstream extents of the Site to a low of 78 feet above msl at the downstream end of the site (Southeast Goldsboro, North Carolina USGS 7.5-minute topographic quadrangle). Drainage areas for site streams are listed in Table 4 (Project Attributes Table) and Figures 2 and 3.

- UT (entering Site): 2.05 sq mi (1310 ac)
- UT (exiting Site): 2.27 sq mi (1452 ac)

2.2 Surface Water Classification/Water Quality

Portions of the Neuse River adjacent to the Site (Stream Index Number/Assessment Unit Number 27 - (49.5, 55.5, and 56)) are classified as WS-IV, NSW and C downstream and south of the project (NCDWQ 2009). A classification of WS-IV signifies waters are used as sources of water supply for drinking, culinary or food processing purposes where a WS-I, II or III classification is not feasible. Fish consumption is impaired in those waters. WS-IV waters are generally in moderately to highly developed watersheds or Protected Areas. Waters with an NSW classification are waters needing additional nutrient management due to being subject to excessive growth of microscopic or macroscopic vegetation. Class C waters are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. None of these classifications qualified Project waters or waters adjacent to the project as high-quality waters (HQW). The following waters are HQW by definition:

- WS-I,
- WS-II,
- SA (commercial shell fishing),
- ORW,
- primary nursery areas (PNA) designated by the Marine Fisheries Commission, and
- Waters for which the DWQ has received a petition for reclassification to either WS-I or WS-II.

The UT is not on the North Carolina Impaired (303(d)) list. However, a portion of the Neuse River (Stream Index Number/Assessment Unit Number # 27 - 56) that the UT flows into is on the Draft 2008 303 (d) list. The Neuse River is listed as impaired both downstream and upstream of subbasin 03-04-12, which contains the UT. The reason for listing is a standard violation and suspect mercury levels leading to restricted fish consumption.

2.3 Physiography, Geology, and Soils

All lands within the Site are located within the Southeastern Floodplains and Low terraces Ecoregion. Elevations within the project area range from 84 feet above mean sea level where the UT enters the Site to 78 feet above mean sea level at the downstream end of the proposed restoration.

The Site is located within the Bibb and Norfolk loamy sand map units. The Bibb map unit consists of nearly level, poorly drained soils on the flood plains of natural drainage ways, with a surface layer of sandy loam, loamy sand, or loam. Norfolk loamy sand map unit consists of soils on gentle side slopes between nearly level soils and soils on drainage ways or bays (USDA 1978). Soils mapped within the Site in the *Soil Survey of Wayne County, North Carolina* are depicted in Figure 4 and described in the table below (USDA 1978).

Bibb soils are common along coastal plain streams and are typically inundated or saturated in a nondisturbed condition. The degree of incision exhibited by the UT effectively lowers the groundwater table and drains what would have been hydric soils.

Table 5. USDA Mapping Units within the Site
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Soil Series	Hydric Status	Family	Description
Bibb	Hydric A	*Typic Fluvaquents*	These soils consist of nearly level, poorly drained soils on floodplains. These soils formed in recent alluvium on the floodplains or natural drainage ways.
Norfolk loamy sand	Nonhydric	*Typic Paleudults*	These soils are on gentle side slopes between nearly level soils and soils on drainage ways or bays. This soil is on 2 to 6 percent slopes.

2.4 Historical Land Use and Development Trends

The Site is located in Wayne County, North Carolina within USGS HU 03020201200040 (NCDWQ Subbasin 03-04-12) of the Neuse River. The UT has a watershed drainage area of approximately 2.05 square miles (1310 acres) as it enters the Site and a watershed drainage area of approximately 2.27 square miles (1452 acres) at the downstream end of the Site (Figure 2).

The contributing watersheds are characterized primarily by forest/wetland (approximately 20 percent of the total area), cultivated cropland (approximately five percent of the total area), urban area (approximately 70 percent of the total area) and surface water (approximately 1 percent of the total area).

The UT is located within a highly urbanized watershed. The large majority of the watershed is contained within the city limits of Goldsboro. Goldsboro is highly developed, with undeveloped lands comprising relatively small portions of land in the watershed. It is not anticipated that watershed conditions will be substantially altered within the foreseeable future.

Table 6. Land Use of Watersheds
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Land Use of UT to Neuse (Big Ditch) Watershed		
Land Use	**Acres**	**Percentage**
Forest/Wetland	262	20
Cultivated Cropland	66	5
Urban Areas	969	74
Surface Water	13	1
Total	**1,310**	**100**

2.5 Watershed Planning

A local watershed plan has not been completed for the UT's ("Big Ditch") watershed.

2.6 Protected Species

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

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

Table 7. Federally Protected Species for Wayne County
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Common Name	**Scientific Name**	**Status***	**Habitat Present Within Site**	**Biological Conclusion**
Vertebrates				
Bald eagle	*Haliaeetus leucocephalus*	BGPA**	No	No Effect
Red-cockaded woodpecker	*Picoides borealis*	E	No	No Effect

*Endangered = a taxon "in danger of extinction throughout all or a significant portion of its range"; T(S/A) or Threatened due to similarity of appearance with another listed species and is listed for its protection. T(S/A) taxa are not biologically endangered or threatened and are not subject to Section & consultation;
**BGPA or Bald and Golden Eagle Protection Act = the bald eagle was declared recovered, and removed from the Federal List of Threatened and Endangered wildlife. After delisting, the BGPA became the primary law protecting bald eagle.

***Haliaeetus leucocephalus* (bald eagle) Bald and Golden Eagle Protection Act**

Adult bald eagles are identified by their large white head, short white tail, and dark-brown to chocolate-brown body plumage. Immature eagles lack the white head plumage and have brown to black body plumage. In flight bald eagles can be identified by their flat wing soar. Adults

average about three feet from head to tail, weigh approximately 10 to 20 pounds, and have a wingspan that can reach up to seven feet. Fish are the major food source for bald eagles although bald eagles also consume a variety of birds, mammals, and turtles when fish are not readily available.

Eagle nests are generally found in close proximity to water (within 0.5 miles) where the eagle has a clear flight path to the water. They generally nest in the largest living tree with an open view of the surrounding land. Human disturbance may cause an eagle to abandon otherwise suitable habitat.

Biological Conclusion: **NO EFFECT**
Potential habitat for the bald eagle does not occur within or adjacent to the Site. The nearest open water which may serve as habitat for the bald eagle is 3.8 miles to the west in Quaker Neck Lake. The Site may serve as a fly over corridor for the bald eagle; however, the proposed project will have no effect on the bald eagle. No known occurrences are documented by the NCNHP within or near the Site.

***Picoides borealis* (Red-cockaded woodpecker) Endangered**

Primary nest sites for red-cockaded woodpeckers (RCWs) include open pine stands greater than 60 years of age with little or no mid-story development. Foraging habitat is comprised of open pine or pine/mixed hardwood stands 30 years of age or older.

This small woodpecker (7.0 to 8.5 inches long) has a black head, prominent white cheek patches, and a black-and-white barred back. Males often have red markings (cockades) behind the eye, but the cockades may be absent or difficult to see. Primary habitat consists of mature to over-mature southern pine forests dominated by loblolly (*Pinus taeda*), long-leaf (*P. palustris*), slash (*P. elliottii*), and pond (*P. serotina*) pines. Nest cavities are constructed in the heartwood of living pines, generally older than 70 years that have been infected with red-heart disease. Nest cavity trees tend to occur in clusters, which are referred to as colonies. The woodpecker drills holes into the bark around the cavity entrance, resulting in a shiny, resinous buildup around the entrance that allows for easy detection of active nest trees. Pine flatwoods or pine-dominated savannas that have been maintained by frequent natural or prescribed fires serve as ideal nesting and foraging sites for this woodpecker. Development of a thick understory may result in abandonment of cavity trees.

Biological Conclusion: **NO EFFECT**
Habitat for red-cockaded woodpeckers includes mature, open pine stands 30 years (foraging habitat) and 60 years (nesting habitat) in age, or older. The Site area is comprised nearly entirely of maintained grass lands and low density residences and contains no habitat for this species. No known occurrences are documented by the NHP within or near the Site.

Designated Critical Habitat
No designated critical habitat is documented to occur within Wayne County.

2.7 Cultural Resources

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

2.8 Potential Constraints

Primary constraints on the project include the following:

- A box culvert at the upstream end of the project dictates proposed channel invert elevations.
- Adjacent sewer easements confine the horizontal alignment of the proposed channel.
- Sewer line crossings pose design constraints for invert elevations and proposed channel crossing alignments.
- Two stormwater pipe outfalls are located along the channel. These pipes dictate proposed channel elevations.
- Proposed conservation easement boundaries confine potential channel alignments and grading limits through the majority of the project limits.
- The channel has incised severely, which will require an immense amount of earthmoving to restore stability to side slopes.

Beaver activity has not been noticed during site visits and is not expected to be an issue at this point.

2.8.1 Property Ownership and Boundary

The Site contains 21 parcels that have three owners. The following list property ownership of each parcel:

- The City of Goldsboro (NC Parcel ID 2599913870, 2599913874, 2599913888, 2599914759, 2599914863, 2599914868, 2599914953, 2599914986, 2599915798, 2599916802, 2599916807, 2599916901, 2599916915, 2599916928, 2599924635, 2599926013, 2599926063, 2599929516, 3509030143)
- William H. Hodges and Trustee (NC Parcel ID 2599927144, 2599927184)
- Textilease Corporation (NC Parcel ID 2599819820)

A perpetual conservation easement and recordable map of the easement boundary will be signed by the owners and recorded in Wayne County prior to construction activities.

2.8.2 Project Access

Two access points to the Site will be designated: 1) Existing road at Odell Street on the eastern portion of the Site, and 2) a construction entrance along East Elm Street on the northern portion of the Site, at the crossing of East Elm Street over UT. A transportation plan, including the location of access routes and staging areas will be designed to minimize Site disturbance to the maximum extent feasible. The number of transportation access points into the floodplain will be maximized to avoid traversing long distances through the Site interior.

2.8.3 Utilities

Sanitary sewer lines are present within the site and cross the existing and proposed channel alignments. The pipes are currently aerial crossings. The proposed channel will bury the pipes below the channel invert.

2.8.4 FEMA/Hydrologic Trespass

The HEC-RAS analysis indicates that the restoration design will result in a no-rise in the 100-year floodplain water surface elevations upstream of the project area. The results of this analysis affirm that hydrologic trespass to adjacent properties will not occur. A more detailed discussion and HEC-RAS analysis can be found in section 7.3 and Appendix 5.

3.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

The Site contains one (1) jurisdictional stream channel (UT) that was studied for potential mitigation opportunities. The location of this channel and its reach is depicted on Sheets 1A and 1B.

Conformity with Stream Guidance

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

The UT's valley and natural watershed extends not only through the Site, but also well upstream (north) of the Site (Figures 2 and 3). This determination was made after reviewing elevations and contours obtained from the USGS Southeast Goldsboro, North Carolina 7.5-minute topographic quadrangle (USGS 1982), Wayne County LIDAR data, and a Digital Terrain Model that was prepared for the site using conventional surveying methods. These data confirmed that a natural drainage way/valley is present on-site for the UT to flow down. Additionally, the UT has a supporting drainage area greater than 100 acres (approximately 1,310 ac entering the Site). This data should be sufficient evidence that the UT supports a natural stream within the Site boundaries.

3.1 Existing Conditions Survey

A Rosgen Level II stream survey was conducted along the UT. The approximate location of the survey is shown on Sheet 1A. The survey included conducting a longitudinal profile, cross-sectional survey, measurement of plan form variables, determination of sediment size distributions, photographic logs, vegetation surveys, and general visual assessments of existing channel and watershed conditions.

3.2 Channel Classification

Data collected from the Level II survey revealed that the channel could be classified as a G or B 5 type stream. G and B type channels typically display moderately low to low width to depth ratios (approaching 12). The existing channel has a moderately low width to depth ratio of 8.9 and a slope of 0.55 percent. Additionally, G and B type channels typically display low or moderately low entrenchment ratios, with G type channels typically displaying an entrenchment ratio less than 1.4 and B type channels displaying entrenchment ratios between 1.4 and 2.2. The existing channel displays an entrenchment ratio that is typically 1.85. From a classification standpoint the channel is more typical of a G type channel in its width to depth ratio but more

typical of a B type channel in its entrenchment ratio. In practice however, it appears that the channel functions as a G type channel due to it incision (bank height ratio of 5.8), apparent bed scour, and mass wasting of channel side slopes throughout the entire site.

3.3 Valley Classification

The historic valley of the UT is broad with gentle slopes that can be classified as a Valley Type VIII. Topographic information obtained from a surveyor, LIDAR data, and the USGS survey all depict a natural drainage way through the site (Figures 2 and 3).

Because the UT's bankfull discharge is so incised the historic valley is no longer active, with the exception of massive flood events in excess of the 100 year storm event. The UT's valley in reality is now contained within the existing channel banks, and is very confined. The UT's valley slope is 0.55 percent.

3.4 Discharge

Bankfull discharge was estimated to be 25.0 cfs for the UT within the Site limits. Section 3.8 provides further detail on bankfull discharge determination

3.5 Channel Morphology

Morphological characteristics of the Site streams were collected during a Rosgen Level II survey. The Morphological Characteristics Table, shown below, includes a summary of existing dimension, profile, and pattern data for the Site streams and references.

Table 8. Morphological Characteristics of UT Neuse River and Reference
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Morphological Characteristics of UT Neuse River and Reference								
Restoration Plan:	UT Neuse River Stream Mitigation Site							
Reach:	UT Neuse River							
County:	Wayne County, NC							
Design by:	CLS							
Checked by:	RVS/RKW							
ITEM	**Existing Conditions**			**Reference Reach**			**Proposed Conditions**	
LOCATION	**UT Neuse River**			**Johnson Mill**			**UT Neuse River**	
STREAM TYPE	G/B 5			B5			B/E 5	
DRAINAGE AREA, Ac - Sq Mi	1312 Ac -	2.05 Sq Mi		8640 Ac -	13.5 Sq Mi		1312 Ac -	2.05 Sq Mi
BANKFULL DISCHARGE, cfs	25.0	cfs		80.9	cfs		25.0	cfs
BANKFULL X-SECTION AREA (A_{bkf}), ft^2	9.02	ft^2		47.59	ft^2		16.3	ft^2
BANKFULL MEAN VELOCITY, fps	2.77	fps		1.70	fps		1.5	fps
BANKFULL WIDTH (W_{bkf}), ft	8.9	ft		21.2	ft		14.0	ft
BANKFULL MEAN DEPTH (d_{bkf}), ft	1.01	ft		2.25	ft		1.17	ft
WIDTH/DEPTH RATIO (W_{bkf}/d_{bkf})	**8.9**			**9.4**			**12.0**	
BANKFULL MAX DEPTH (d_{max}), ft	1.43	ft		2.42	ft		1.75	ft
BANK HEIGHT RATIO	5.80			1.00			1.00	
TYPICAL BANK HEIGHT	8.30	ft		2.42	ft		1.75	ft
WIDTH Flood-Prone Area (W_{fpa}), ft	16.6	ft		34.9	ft		36.00 ft	
ENTRENCHMENT RATIO (ER)	**1.85**			**1.65**			**2.6**	
MEANDER LENGTH (Lm), ft	Stream has been channelized down the fall line of the valley and does not display any natural meanders in the bankfull channel.			250 -	400 ft		140.0 -	280.0 ft
RATIO OF Lm TO W_{bkf}				11.8 -	18.9		10.0 -	20.0
RADIUS OF CURVATURE, ft				43 -	235 ft		42.0 -	70.0 ft
RATIO OF Rc TO W_{bkf}				2.0 -	11.1		3.0 -	5.0
BELT WIDTH, ft				50.00 -	1500.00 ft		28.0 -	980.0 ft
MEANDER WIDTH RATIO				2.36 -	70.85 ft		2.0 -	70.0
SINUOSITY (K)	**1.01**			**1.10**			**1.01**	
VALLEY SLOPE, ft/ft	0.0055	ft/ft*		0.0011	ft/ft		0.0055	ft/ft
AVERAGE SLOPE (S), ft/ft	0.0055	ft/ft**		0.0010	ft/ft		0.0017	ft/ft
RIFFLE SLOPE, ft/ft	0.0100	ft/ft		0.0010	ft/ft		0.0021	ft/ft
RATIO OF RIFFLE SLOPE TO AVERAGE SLOPE	1.8			1.0			1.2	
POOL SLOPE, ft/ft	0.0026	ft/ft		0.0004	ft/ft		0.0000	ft/ft
RATIO OF POOL SLOPE TO AVERAGE SLOPE	0.5			0.4			0.0	
MAX POOL DEPTH, ft	1.50	ft		3.56	ft		2.33	ft
RATIO OF POOL DEPTH TO AVERAGE BANKFULL DEPTH	1.5			1.6			2.0	
POOL WIDTH, ft	17.2	ft		19.9	ft		16.80	ft
RATIO OF POOL WIDTH TO BANKFULL WIDTH	1.92			0.9			1.20	
POOL TO POOL SPACING, ft	23.14 -	86.74 ft		91.07 -	129.97 ft		56.0 -	84.0 ft
RATIO OF POOL TO POOL SPACING TO BANKFULL WIDTH	2.59 -	9.70		4.30 -	6.14		4.0 -	6.0

* Valley Slope, and Sinuosity were taken from topographical data obtained on the entire site for existing conditions (i.e. data was not taken along reach lengths).

** Average Slope was taken along a reach length for existing conditions.

3.6 Channel Evolution

Discussions with local landowners indicate that the channel has incised substantially over time due to continuous channel maintenance and natural incision. These conditions in Coastal Plain settings typically lead to a G type channel that may eventually build a small bankfull bench and stabilize into a B type channel. Another possibility is that the channel will build a large enough bench that it could be classified as an E type channel.

G→B

or

G→B→E

3.7 Channel Stability Assessment

The UT enters the Site as a second order stream as depicted on the Southeast Goldsboro, NC Quadrangle (USGS 1998). The UT flows generally north to south through the completely developed urban setting of Goldsboro. Lands surrounding the channel through the Site are continuously maintained grass fields and a cemetery off of the right bank of the channel. The existing channel length through the site is approximately 2,113 feet in length.

The UT has been detrimentally impacted in the past due to channelization and deepening. Evidence of channelization includes the fact that the channel follows the fall line of the valley through the Site with no natural meander geometry. Discussions with local landowners revealed that the channel was historically much smaller but past dredging and regular maintenance has deepened the channel over the years. The culvert at the upstream end of the Site set the channel grade to a point that bankfull flows are well below existing ground (historic floodplain).

Bank height ratios are typically near 5.8, which indicates that bankfull and much higher flows are entrenched within the existing banks. Maximum bankfull depth of the exiting channel is estimated to be 1.43 feet. Existing ground (top of terrace) is approximately 8.3 feet above the channel invert (6.9 feet above bankfull). The existing conditions HEC-RAS model that has been completed for the Site suggests that the 100 year flood is contained within the channel for much of the Site. Some sections of the channel appear to also contain up to the 500 year event. A resident near the site indicated that their house was not flooded during hurricane Floyd.

Such a highly entrenched system is expected to see higher stress on channel banks and terrace side slopes when compared with stable channels that have a floodplain to dissipate flood flows. Evidence of increased stress on channel banks and channel invert is evidenced in failing channel and terrace side slopes throughout the Site. Mass wasting of both the left and right banks is evident.

Destabilization of the banks from high flows contained within the terrace banks is only enhanced when coupled with the fact that most of the banks along the site are regularly maintained

throughout the year. Vegetative clearing throughout the Site appears to be a fairly routine practice. Denudation of channel banks has removed and repressed the ability of root growth, which would help to stabilize Site soils. Additionally, removal of vegetation decreases channel and overbank roughness, which is a primary means of slowing flood flows and reducing stress on channel side slopes.

Additional observations of channel and invert degradation include sections of the channel that have been "hardened" with bricks, concrete blocks and other materials in an attempt to deter lateral scour. One section of the right bank of the channel has expanded so far towards the cemetery that the boundary fence and trees are falling into the open channel. Finally, there are two sewer crossings that are now aerial crossings because the channel has incised well below the hanging pipes.

A bank erosion hazard index (BEHI) and near bank stress (NBS) evaluation was completed on the UT through the entire site to determine more exacting evidence of existing and potential future bank failure. The BEHI and NBS scores are summarized in Appendix 10. These scores appear to confirm general visual assumptions and morphological data that the channel is in a state of flux. The BEHI scores ranged from high to extreme through the entire site. NBS scores were estimated only in high erosion potential sections of the channel. NBS scores ranged from moderate to very high. Results suggest that the site may be loosing approximately 771 tons of sediment per year (0.35 tons per foot of channel) which would be considered a substantial loss of sediment on an annual basis

3.8 Bankfull Verification

Bankfull indicators were identified along all studied reaches during field inspections. Existing conditions surveys were conducted which included surveying representative riffle cross-sections, representative hydraulic (bankfull) slope, and determining an existing Manning's n coefficient for the surveyed reaches. Four representative cross sections and 235 feet of channel profile were surveyed. The surveyed data and calculated Manning's n coefficient were correlated with identified bankfull indicators to estimate bankfull cross-sectional area and velocity, and consequently bankfull discharge. The estimated bankfull cross-sectional area and discharge were compared with a calculated bankfull cross-sectional area and discharge using the published regional curve (Hydraulic Geometry Relationships for Rural North Carolina Coastal Plain Streams [regional curve] (Doll et al. 2006)).

Table 9. Site Stream Discharges and Areas
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

	Discharge BKF (cfs)		Area BKF (sq ft)	
	Coastal Plain Curve	Site Conditions	Coastal Plain Curve	Site Conditions
UT Neuse River	30.3	25.0	23.3	9.02

Discernable bankfull indicators were observed throughout the UT. Indicators include abrupt changes in slope on the existing banks and what appears to be a small bankfull bench that has formed through small sections of the channel.

3.9 Vegetation

Land adjacent to the UT is dominated by regularly maintained open areas. Vegetation within the maintained open areas is dominated by grasses. The cemetery has planted a row of crape myrtles (*Laburnum anagyroides*) along the right top of bank. The right bank of the channel displays a small row of young saplings that established themselves along some sections of the channel. The row of saplings averages approximately 5 feet in width and is bordered on the cemetery side by a fence that is falling into the channel in places. The cemetery is located on the opposite side of the fence and is also regularly maintained. The entire left bank of the channel and many areas of the right bank of the channel are regularly maintained through mowing and vegetation removal.

Vegetation that has survived on the right bank includes Chinese privet (*Ligustrum sinense*), black willow (*Salix nigra*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), Chinaberry (*Melia azedarach*), common rush (*Juncus effuses*), black cherry (*Prunus serotina*) and elderberry (*Sambucus Canadensis*).

4.0 REFERENCE STREAMS

A reference reach search for a B5c type channel with a sizeable drainage area was completed. A B5c type channel with a relatively large drainage area was not found near the site within the Neuse River Basin, so a search was conducted that covered the areas that would potentially yield a B5c type channel. This search was conducted through the Lumber, Cape Fear, Neuse, and Tar-Pamlico River Basins. Only one suitable reference (Johnsons Mill Run) that displayed B5c type characteristics with a relatively large drainage area was found. Johnsons Mill Run is located near Greenville in the Tar-Pamlico River Basin. The Johnsons Mill Run site vicinity, watershed, and soils are depicted in Figures 5 through 7.

Distinct bankfull variables were identifiable in the reference and pattern/profile characteristics appear to have not been degraded, allowing for assistance with proposed design characteristics.

4.1 Johnson Mill Run

4.1.1 Watershed Characterization

Land use within the Johnson Mill Run watershed can be characterized as rural and more specifically agricultural in nature. Pine plantations and row cropping dominate the watershed, consuming approximately 90 percent of the land area. Residential development, roads, and other impervious surfaces comprise the remaining 10 percent of the watershed land area.

4.2.2 Channel Classification

Johnsons Mill Run is characterized by a B-type, low sinuosity (1.10) channel with sand-dominated substrate (Table 8). B-type streams are characterized as slightly entrenched pool dominated channels exhibiting low sinuosity. In North Carolina, B-type streams often occur in narrow valleys that limit the development of a wide floodplain (Valley Types II and VI).

4.2.3 Discharge

The Johnsons Mill Run reference reach has a drainage area of 13.5 square miles and a bankfull discharge of 80.9 cubic feet per second (Table 8).

4.14 Channel Morphology

Channel cross-sections and stream profiles were measured along the reference reach. Four representative cross sections and 493 feet of channel profile were surveyed. Surveys included a plan form analysis, bed material evaluation, and buffer assessment. The reach is transporting its sediment supply while maintaining its dimension, pattern, and profile. The Table of Morphological Characteristics (Table 8) includes a summary of dimension, profile, and pattern data to assist with the establishment of design parameters. The channel streambed material is dominated by sand-sized particles.

4.1.5 Channel Stability Assessment

A visual assessment accompanied by a morphological assessment using data collected during a Rosgen Level II survey was used to determine channel stability. These data, which can be found in Table 8 (Morphological Stream Table) and in Appendix 3 and 4 (Reference Site Photographs and Reference Site NCDWQ Stream Classification Form), confirmed that the channel falls within acceptable ranges for a stable reference channel.

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

4.1.6 Bankfull Verification

Onsite data was compared with the regional curve to verify the bankfull discharge. The bankfull discharge on Johnson Mill Run at the point of the survey is estimated to be 80.9 cfs. The regional curve estimates the bankfull discharge to be 107.9 cubic feet per second. The reference's estimated discharge is within an acceptable level of confidence when compared with the regional curve.

5.0 REFERENCE FOREST ECOSYSTEM

A Reference Forest Ecosystem (RFE) is a forested area on which to model restoration efforts at the Site in relation to soils and vegetation. RFEs should be ecologically stable climax communities and should be a representative model of the Site forested ecosystem as it likely existed prior to human disturbances. Data describing plant community composition and structure should be collected at the RFEs and subsequently applied as reference data in an attempt to emulate a natural climax community.

The RFE for this project is located in a similar topographical setting adjacent to a highly incised stream channel. 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 within the following table 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.

Table 10. Reference Forest Ecosystem
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Tree Species	Number of Individuals *	Relative Density (%)	Frequency * (%)	Relative Frequency (%)	Basal Area * (ft^2/acre)	Relative Basal Area (%)	Importance Value
River birch (*Betula nigra*)	1	2.6	50	6.7	4.6	4.5	0.05
Ironwood (*Carpinus caroliniana*)	12	31.6	100	13.3	13.2	13.0	0.19
Mockernut hickory (*Carya tomentosa*)	1	2.6	50	6.7	2.5	2.4	0.04
Sweetgum (*Liquidambar styraciflua*)	2	5.3	50	6.7	1.3	1.3	0.04
Loblolly pine (*Pinus taeda*)	4	10.5	100	13.3	28.9	28.6	0.17
Black cherry (*Prunus serotina*)	2	5.3	50	6.7	1.8	1.8	0.05
Oak species (*Quercus* sp.)	1	2.6	50	6.7	1.8	1.8	0.04
Southern red oak (*Quercus falcata*)	1	2.6	50	6.7	7.3	7.2	0.06
Water oak (*Quercus nigra*)	8	21.1	100	13.3	34.3	33.8	0.23
Sassafras (*Sassafras albidum*)	4	10.5	100	13.3	4.2	4.2	0.09
Winged elm (*Ulmus alata*)	2	5.3	50	6.7	1.3	1.3	0.04
TOTALS	**38**	**100**	**750**	**100**	**101**	**100**	**1.00**

* Sum of two 0.1-acre plots

The RFE is located in the Coastal Plain physiographic region and mostly closely resembles the Schafale and Weakley community type of Coastal Plain Levee Forrest. The RFE contains predominantly Bibb soils. The stream within the RFE was approximately 21 feet wide by 2.25 feet deep.

Two 0.1-acre plots were established which best characterize expected steady-state forest composition. Forest vegetation was dominated by ironwood, water oak, loblolly pine, and sassafras. Understory species within the RFE include canopy species as well as flowering dogwood (*Cornus amomum*), black cherry (*Prunus serotina*), American holly (*Ilex opaca*), willow oak (*Quercus phellos*), eastern red cedar (*Juniperus virginiana*), Japanese honeysuckle (*Lonicera japonica*), muscadine (*Vitis rotundifolia*), and greenbrier (*Smilax rotundifolia*).

6.0 PROJECT SITE MITIGATION PLAN

6.1 Project Goals and Objectives

The primary goals of this stream restoration project focus on reducing sediment loading in the UT, improving water quality, providing/enhancing flood attenuation, and restoring and enhancing aquatic and riparian habitat. These goals will be accomplished through the following objectives:

- Restore a stable dimension, pattern and profile to the UT that will deter degradation of side slopes and mass wasting of banks. A newly designed channel cross-section with overbank flood relief and stream channel structures that reduce stress on channel banks and creates pools will ensure stability and reduce exiting sediment loading.
- Stabilize the UT by planting live stakes and bare roots along the channel banks to promote root growth. The proposed planting density along channel banks calls for two foot spacing, which should assist in establishing a continuous, dense root mat through the Site.
- Enhancing the capacity of the Site to mitigate flood flows by excavating a 5 foot floodplain bench off of each channel bank and sloping terrace side slopes at a 5:1 angle. Additionally, a stormwater wetland BMP will be retrofitted on a contributing conveyance which should assist in mitigating flood flows during precipitation events.
- Enhancing in stream habitat by creating an undulating bedform (shallows/deeps) by placing woody structures in the channel that provide shading, natural food sources, and protective areas for propagation. Additionally, planting vegetation along the channel banks and within the riparian buffer will enhance shading and provide much needed biomass to fauna within the UT for cover, forage and propagation.
- Reducing sedimentation and nutrients from adjacent urban areas by establishing a native riparian buffer through existing open/grassed fields that are currently regularly maintained.
- Improve terrestrial habitat by restoring a forested riparian corridor through a highly urbanized environment which has historically experienced vegetation maintenance and forest segmentation. This corridor will provide a diversity of habitats such as mature forest, early successional forest, riparian wetlands (in the form of a stormwater wetland BMP) and uplands.
- Reduce nutrients and other pollutant inputs by retrofitting a contributing conveyance to a stormwater wetland BMP.

Project mitigation efforts will result in the following:

- Restore and stabilize 2,128 linear feet of Site streams.
- Restore and plant 9.76 acres of Neuse River Buffers in the floodplain, stream bank, and upland slopes.
- Impact zero (0) acres of existing wetlands during construction activities.

- Retrofit one contributing conveyance to a stormwater wetland BMP.

6.2 Stream Project and Design Justification

Sheets 2A, 2B and 3A depict the proposed mitigation plan.

After reviewing the site several times and conducting on-site and watershed surveys it was determine that the proposed plan's main focus should be to stabilize the UT through the Site to deter further mass erosion of channel and terrace banks. Natural Channel Design methodologies are incorporated into the restoration design approach; however the primary goal is not to provide the landscape with a "naturally meandering" channel. Rather, the design approach works around site constraints and concentrates on providing a system that will convey flows through the Site without degrading channel banks.

The design was formulated around numerous constraints that dictated the approach. The primary constraints include extreme channel incision, a box culvert setting grade at the upstream end of the Site, easement boundary constraints, sewer line constraints, the site is located within a FEMA detailed study (cannot increase flood elevations) and the general fact that the UT's watershed is located in an densely urbanized area with flashy flows.

F&H has a wealth of experience with restoring and constructing highly urbanized sand bed systems that have numerous constraints. We have learned that creating sinuous channels in environments that display highly flashy flows with highly erodible soils (as seen on-site) may not always be conducive to long term channel stability. Our experience, observations, and "lessons learned" leads us to believe that a stream system such as the UT coupled with the numerous constraints posed is most suited to being restored without numerous meander bends. Energy dissipation in straighter stream systems would need to be primarily achieved through bedform (pools) rather than plan form (meanders).

Energy dissipation through plan form in urban sand systems can lead to higher rates of bank and structure failure because soils are not stabilized quickly (i.e. root establishment takes time). By dissipating energy through bed form the primary stress of high flows is concentrated on the channel invert (primarily pools) rather than on the channel banks (as seen in meandering channels). Pools are natural energy dissipaters and are typically formed from down welling due to centripetal force on outside bends in a meandering stream. So, rather than forcing flows against outside meander bends to create pools, we propose to dissipate energy through the use of structures such as log cross-vanes and log sills that help create deep, lasting pools that are able to maintain needed pool spacing.

Proposed pool to pool spacing is lower than what is typically found in meandering streams. The proposed pool to pool spacing ranges from four to six bankfull channel widths (56 feet to 84 feet) and typically approaches four bankfull widths. Closer pool spacing is preferred to ensure sufficient energy dissipation. As previously stated, the pools will have to be created using stream channel structures because there are only a few meander bends to assist in pool

development. A greater number of stream channel structures have been placed than may typically be found in a meandering channel, because the proposed pool to pool spacing is so close, and the structures are being relied on to create pools.

Another challenge for the proposed design is to provide overbank relief from above bankfull flood events. A wide floodplain is preferable to dissipate flood flows, however constraints such as extreme channel incision, sewers and their respective easements and the limits of the conservation easement constrain the width of a proposed floodplain. To provide some overbank relief a five foot bench has been proposed on each side of the channel. This would total 10 feet of bankfull elevation floodplain. Traditionally, three to one (3:1) side slopes have been used to transition from the bankfull floodplain to the top of terrace. The proposed design however, has five to one (5:1) side slopes proposed from the bankfull floodplain up to the top of terrace. This allows a gentler slope up to the terrace, which will substantially increase the flow area of floods when compared with 3:1 side slopes. The five foot bench and five to one side slopes allows for an average proposed entrenchment ratio of 2.6 through the Site. Another advantage of five to one side slopes in sandy soils is that rill and gully erosion should be less severe when compared with three to one side slopes.

The two existing ductile iron sewer crossings will be improved by restoring the channel. The ductile iron sewer pipes are currently aerial crossings approximately 3 feet above existing invert. These pipes collect debris in the channel and have caused lateral expansion and mass wasting of the banks at each of their locations. The proposed channel invert has been raised to the point that both pipes will be covered and situated in shallow ripple areas. This should not only stabilize the pipes, but also allow a more unobstructed flow through the Site.

A riparian buffer will be planted along both banks of the UT through the proposed easement area in the restored reach of channel. One primary aspect of the riparian buffer will be planting live stakes and bare root species along the channel banks. Typically, plantings along the channel banks have been spaced at four foot centers. The proposed plantings will be spaced at two foot centers. We strongly believe that a denser planting plan along the channel banks will increase the effectiveness of plantings and more efficiently stabilize channel bank soils. Root stabilization in all stream restoration projects is vital to success; however stabilization in urban sand systems is more vital for long term success. Additionally, plant establishment is a large component of channel and overbank roughness, which helps to slow flood flows and decrease stress on channel banks. To aid in quick buffer establishment, shading, habitat and roughness some containerized plants will be planted within the buffer as well. Additionally, ball and burlap trees will be planted along the easement boundary. The more vegetation that is established, the higher roughness that is achieved.

Currently landscaped fields abut the channel and there is little to no riparian buffer. The planted riparian buffer will establish a wildlife corridor through a currently dissected landscape. The buffer will allow cover and foraging habitat for terrestrial fauna that is currently non existent.

The buffer will also act as a filter strip to remove nutrients flowing from adjacent landscaped fields and impervious surfaces.

6.2.1 Designed Channel Classification

The UT was designed using Natural Channel Design principals. The Morphological Characteristics Table details channel classification and variables used to classify the design channel.

The UT is designed as B/E 5 type stream channel with a width-to-depth ratio of 12.0 and an typical entrenchment ratio of 2.6. The designed stream type combines principals of two different stream types (a B and E type channel) to accommodate site constraints. The design philosophy is that the channel will naturally form a low width to dept ratio (approaching 12) because it is in a sandy system in the Coastal Plain. B and E type channels can both display width to depth ratios approaching 12. Consequently, the proposed design width to depth ratio is 12. E type channels typically display entrenchment ratios greater than 2.2. The designed entrenchment ratio averages 2.6. Typically this would lead to a E type design channel classification. However, due to vertical, horizontal and watershed constraints the proposed channel displays little meander geometry. Because of this the pool to pool spacing is relatively close (averaging close to four channel widths) which is more consistent with B type channels. In conclusion, the design channel displays characteristics of both B and E type channels, but cannot be solely classified as either.

6.2.2 Sediment Transport Analysis

One of the primary goals of this project is to construct a stable channel on the UT that will transport its sediment and flow such that, over time, the stream system neither aggrades nor degrades. This stability is achieved when the sediment input to the design reach equals the sediment output. One of the primary functions of determining the capacity of the channel to transport its sediment load is stream power. Below is a discussion of both sediment concentration and stream power and their relation to stability in the design.

Sediment Concentration

The Engelund-Hansen function was used to analyze sediment transport capacity through the designed channels on-site. The basic principal of the Engelund-Hansen function is to determine if sediment input to the design stream equals the sediment output from the design stream. If sediment input equals or is adequately close to sediment output then the channel is considered a stable channel in equilibrium. Below is the Enguland-Hansen function:

$$g = 0.535\ D^{1/2}\ S^{3/2}\ V\ Q\ /\ d$$

where;

g = sediment discharge (lbs/s)
D = water depth (ft)

S = channel slope (ft/ft)
V = average velocity (ft/s)
Q = discharge (cubic ft/s)
d = median particle diameter of stream bed material (ft)

Stable reference reaches had to be used for sediment input calculations since the existing stream reach on the UT is unstable. The reference reach used (Johnson Mill Run) had a similar stream type as the proposed channel and a similar valley and geological setting as the UT, which allow for accurate comparisons. A stable reference reach can be used because the sediment input is in balance with sediment output over geologic time. In most cases, the bankfull discharge of a reference reach is different from that of the design reach so, instead of using sediment discharge (lbs/s) for the comparison, sediment concentration (lbs/ft^3.) is used in the analysis because the function of discharge is set equal per cubic foot (ft^3). Below is the equation for sediment concentration:

$$SC = g/Q$$

where;

SC = sediment concentration (lbs/ft^3)
g = sediment discharge (lbs/s)
Q = discharge (ft^3/s)

The sediment concentration output for Johnson Mill Run is in equilibrium (because it is a stable reach) and is calculated to be 0.044 lbs/ft^3. The sediment output for the proposed design of the UT is 0.067 lbs/ft^3. The design sediment concentration is very similar to those of the stable reference reach, therefore the design channel is considered stable and in equilibrium.

Stream Power

A stream power analysis was used as a tool to study the capacity of both stream channels to transport their respective sediment loads. To determine if the restoration design stream power will adequately convey sediment loads, analyses of reference stream powers and proposed conditions stream powers were completed.

Johnsons Mill has a unit stream power of 0.20 lbs/ft s. As previously stated, Johnsons Mill is a stable channel that is in equilibrium and adequately conveys it sediment load, so it can be assumed that Johnsons Mill's unit stream power is adequate to transport its sediment load. The UT's design displays a unit stream power of 0.19 lbs/ft s which corresponds closely to the Johnsons Mill unit stream power. Using Johnsons Mill as a reference, it is determined that the UT's design has an adequate capacity to transport its sediment load.

6.3 HEC-RAS Analysis

Given that the project involves modifications to a stream channel, it is important to analyze the effect of these changes on flood elevations. Floodwater elevations were analyzed using HEC-

RAS. HEC-RAS is a software package designed to perform one-dimensional, steady flow, analysis of water surface profiles for a network of natural and constructed channels.

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

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

6.3.1 Bankfull Discharge Analysis

Hydrologic Engineering Center's River Analysis System (HEC-RAS Version 4.0, see Section 7.4) was used to evaluate how the discharge of the restored channel flows within the proposed channel geometry. This evaluation verifies that the proposed plan, dimension, and profile would adequately convey the discharge at the bankfull stage; the point where water begins to overflow onto the floodplain.

Bankfull discharge estimates were determined using on-site conditions and using the regional curve. This is discussed further in Section 3.8.

6.3.2 LOMR (Letter of Map Revision)

A HEC-RAS analysis has been prepared and completed on both the existing and proposed conditions of the restored channel. The resulting data output has been analyzed to determine if the design channel is adequately conveying its bankfull discharge, and to determine if a rise, fall, or no-rise in water surface elevations during the 100 year flood event has occurred.

The City of Goldsboro requested that a LOMR (Letter of Map Revision) be prepared and submitted to the North Carolina Floodplain Mapping Program for review and approval. The revision is from the beginning of stream project just upstream of Elm Street, river station 9435 to river station 7200.

The Effective HEC-2 Model was obtained from FEMA on February 2, 2010 and was provided in hardcopy format only. The Effective FIS (Flood Insurance Study) HEC-2 model was imported into HECRAS 4.0 to produce the Duplicated Effective Model. The 100 year and 100 year floodway elevations from the Duplicate Effective model were compared with those in the Floodway Data Table within the effective FIS report dated December 2, 2005. It was determined that the elevations are within 0.1 foot of each other, which is within acceptable limits as per FEMA's LOMR instructions.

Eighteen (18) geometric cross-sections were modeled along the length of the existing channel, with 10 of those sections falling within the project limits. Three models, Duplicate Effective, Corrective Effective/Existing Conditions, and the Proposed Conditions model, were developed and executed to determine the water surface elevations for the 10, 50, 100, 500, and 100 year floodway events. The 100-year discharge varied between 1,140 cfs and 1,280 cfs along the project reach.

The Duplicate Effective model cross sections are very crude and do not contain the entire floodplain geometry that the Corrective Effective/Existing Conditions and Proposed Conditions models contain. With the more detailed survey data, the base flood elevations (100 year) for the Corrective Effective/Existing Conditions model are approximately 0.6' to 1.0' lower than the Duplicate Effective elevations. Since the proposed stream profile was raised approximately 3' (to bury sewer line) than existing channel elevation, the increase in 100 year flood elevation (proposed conditions vs existing conditions) just upstream of Elm Street (river station 9435) is approximately 0.3'. However, the proposed 100 year flood elevation just upstream of Elm Street (river station 9435) is approximately 0.2' lower than effective published elevation. According to FEMA's LOMR instructions, an effective tie-in is obtained when revised and effective elevations are within 0.5'. Therefore, we are proposing that a LOMR be prepared and submitted to FEMA and the NC Floodplain Mapping Program. Results are located within the HEC-RAS Summary Table in Appendix 5.

6.3.3 Hydrologic Trespass

Hydrologic trespass includes any issue which may affect hydrology outside of the property boundaries on which the Site is located. These issues were reviewed for this project. All on-site modifications should not affect offsite hydrology.

6.4 Stormwater Best Management Practices

One of the primary long term goals of this project is to enhance water quality within the UT and within the overall Neuse River water body. To accomplish this goal, groundwater and stormwater must be treated prior to entering the Neuse River. One ditch on-site will be utilized as a BMP to filter pollutants and sediments prior to entering the UT.

The proposed BMP for the site is a stormwater wetland. The primary goals of the stormwater wetland are to remove suspended solids, debris/trash, soil-bound phosphorus and pathogens by settling and filtration; remove dissolved metals and soluble phosphorous through adsorption to soil particles; remove nitrogen organics and pathogens using microbial processes such as nitrification and denitrification; and remove nutrients such as phosphorous and nitrogen through plant uptake (NRCS 2006).

Appendix 9 contains tables and graphs which show design calculations and expected pollutant removal rates of the proposed stormwater wetland.

6.5 Site Construction

Following approval of permits a detailed construction plan set will be completed for the Site. Sheets 2A and 2B show slope stake limits, which are the limits of proposed grading within the Site. Proposed structures and their placement are shown in Sheets 2A and 2B. Proposed in-stream structures include log cross vanes, log vanes with cross-sills, and log sills. Each of these structures have been designed to maintain pool spacing, provide consistent deep pools, provide grade stabilization, drop invert elevation and provide foraging and cover habitat for aquatic organisms. It is anticipated that spoil from construction activities will be wasted either on-site or on the cemetery's property. Initial disposal alternatives are to place spoil along the easement's perimeter and plant with native vegetation. Additionally, spoil may be wasted on the cemetery's property if they so agree to allow for more usable space. Construction access is plentiful with numerous access points available.

6.6 Native Plant Community Restoration

6.6.1 Soil Restoration

Soils will be amended after excavation activities and during the seeding/planting portions of the project to ensure proper soil stability and nutrient availability for proposed plants and seed.

6.6.2 Topsoil Stockpiling

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

6.6.3 Floodplain Soil Scarification

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

6.6.4 Planting Zones

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.

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. Community associations that will be utilized to develop primary plant community associations include 1) Coastal Plain Levee Forest (Brownwater subtype), 2) stream-side assemblage, and 3) stormwater wetland (Sheet 4). Planting elements are listed below.

Coastal Plain Levee Forest

1. River birch (Betula nigra)
2. Slippery elm (Ulmus rubra)
3. Winged elm (Ulmus alata)
4. Pignut hickory (Carya glabra)
5. Mockernut hickory (Carya tomentosa)
6. Southern red oak (Quercus falcata var. falcata)
7. Water oak (Quercus nigra)
8. Ironwood (Carpinus caroliniana)
9. Sassafras (Sassafras albidum)
10. Vaccinium Elliottii (Elliot's Blueberry)
11. Black cherry (Prunus serotina)

Stream-Side Assemblage (Channel Banks and Floodplain)

1. Black willow (Salix nigra)
2. Silky dogwood (Cornus amomum)
3. Buttonbush (Cephalanthus occidentalis)
4. Elderberry (Sambucus canadensis)
5. Tag alder (Alnus serrulata)
6. Common rush (Juncus effusus)

Stormwater Wetland

1. Bald Cypress (*Taxodium distichum*)
2. Swamp tupelo (*Nyssa biflora*)
3. Overcup oak (*Quercus lyrata*)
4. Green ash (*Fraxinus pennsylvanica*)
5. Water oak (*Quercus nigra*)
6. Willow oak (*Quercus phellos*)
7. Elderberry (*Sambucus canadensis*)
8. Buttonbush (*Cephalanthus occidentalis*)
9. Silky dogwood (*Cornus amomum*)
10. Arrow arum (*Peltandra virginicia*)
11. Arrowhead (*Sagittaria* spp.)
12. Lizards tail (*Saururus cernuus*)
13. Rose mallow (*Hibiscus moscheutos*)
14. Rush (*Juncus effuses*)
15. Water lily (*Nymphaea odorata*)
16. Cow lily (*Nuphar lutea*)

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 on channel side slopes and within the five foot wide bankfull bench.

Coastal Plain Levee Forest is targeted for the majority of the Project outside of the 15-feet immediately adjacent to the restored stream channels. These species were selected due to their ability to withstand drought conditions, due to the well-drained sandy soils present within the Site, as well as tolerate moderate amounts of moisture. The following planting plan is the blueprint for community restoration.

6.6.5 Planting Plan

Species selected for planting will be dependent upon availability of local seedling sources. Advance notification to nurseries (1 year) would 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. Vegetative species in the stream-side assemblage will be planted at a density of 10,890 stems per acre on 2-foot centers. Potted plants will be incorporated throughout the buffer at approximately 50-foot centers. Ball and burlap trees will be planted at 20-foot centers along the easement boundary.

Table 11 depicts the total number of stems and species distribution within each vegetation association, with the exception of the emergent seed mix outlined above. 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 12,074 native tree and shrub seedlings may be planted during restoration.

6.6.6 Neuse River Buffers

Neuse River Buffers will be both impacted and restored during construction of the proposed stream and BMPs. Stream restoration activities are exempt activities under the Neuse River Riparian Buffer Rules. The existing Neuse River Riparian Buffer on-site encompasses approximately 0.64 acres of forested buffer (> 100 trees per acre), and 9.12 acres of maintained grass/forest buffer (<100 trees per acre). The existing forested buffer of 0.64 acres has a substantial amount of invasive plants, dominated by Chinese privet. The buffer is primarily along the existing channel's right bank and extends to the existing fence line.

A vegetated riparian buffer will be established along both the left and right banks of the UT and throughout the project's easement area. Invasive species inside of the existing vegetated buffer will be removed and planted with native species. As a result the total restored Neuse River Riparian Buffer area following construction will encompass 9.67 acres (Sheet 4).

6.6.7 Invasive Species Management

Known invasive species include Chinese privet and Chinaberry. Additionally, a row of crape myrtles has been planted on the right top of bank of the existing channel by the cemetery. All invasives will be removed during construction as well as the crape myrtles that fall within the conservation easement. Noxious species will be identified and controlled so that none become dominant or alter the desired community structure of the Site. If noxious plants are identified as a problem within the Site, a species-specific control plan will be developed for approval by EEP prior to implementation.

During the five-year monitoring period, where necessary, undesirable plant or animal species will be removed, treated, or otherwise managed by means of physical removal, use of herbicides, live trapping, confining wires, or nets.

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

Table 11. Planting Plan
Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Coastal Plain Levee Forest							**Acres to be Planted**			**8.21**
Species	**Common Name**	**Max Spacing (Ft)**	**Unit Type***	**Size****	**Stratum**	**Indiv. Spacing (Ft)**	**% of Total**	**# of Stems**	**lbs per Acre**	**Total lbs**
Betual nigra	River birch	8	R	2 -3'	Canopy	8	13	726		
Ulmus rubra	Slippery elm	8	R	2 -3'	Subcanopy	8	5	279		
Ulmus alata	Winged elm	8	R	2 -3'	Subcanopy	8	5	279		
Carya glabra	Pignut hickory	8	R	2 -3'	Canopy	8	13	726		
Carya tomentosa	Mockernut hickory	8	R	2 -3'	Canopy	8	13	726		
Quercus falcata var. falcata	Southern red oak	8	R	2 -3'	Canopy	8	13	726		
Quercus nigra	water oak	8	R	2 -3'	Canopy	8	13	726		
Carpinus caroliniana	ironwood	8	R	2 -3'	Subcanopy	8	5	279		
Sassafras albidum	Sassafras	8	R	2 -3'	Shrub	8	5	279		
Vaccinium Elliottii	Elliott's Blueberry	8	R	2-3'	Shrub	8	5	279		
Prunus serotina	Black Cherry	8	R	2 -3'	Subcanopy	8	10	559		
						Total	**100**	**5584**		
Carya glabra	Pignut hickory	50	P	2-3'	Canopy	50	25	36		
Carya tomentosa	Mockernut hickory	50	P	2-3'	Canopy	50	25	36		
Quercus falcata var. falcata	Southern red oak	50	P	2-3'	Canopy	50	25	36		
Quercus nigra	water oak	50	P	2-3'	Canopy	50	25	36		
						Total	**100**	**144**		
							Permanent Seed Acres			**5**
Panicum virgatum	Switchgrass		S		Herb		15		30	23
Sorghastum nutans	Indiangrass		S		Herb		20		30	30
Andropogon gerardii	Big bluestem		S		Herb		15		30	23
Andropogon virginicius	Broomsedge bluestem		S		Herb		20		30	30
Tripsicum dactyloides	Gamagrass		S		Herb		20		30	30
Tridens flavus	Purpletop		S		Herb		10		30	15
						Total	**100**			**151**
Coastal Plain Levee Forest - Ball & Burlap							**Trees to be Planted**			**188.00**
Species	**Common Name**	**Max Spacing (Ft)**	**Unit Type***	**Size****	**Stratum**	**Indiv. Spacing (Ft)**	**% of Total**	**# of Stems**	**lbs per Acre**	**Total lbs**
Betual nigra	River birch	20	B	3-4"	Canopy	20	33	62		
Quercus falcata var. falcata	Southern red oak	20	B	3-4"	Canopy	20	33	63		
Prunus serotina	Black Cherry	20	B	3-4"	Subcanopy	20	33	63		
						Total	100	188		

Table 11. Planting Plan (cont.)

Project ID No. D09052S (UT Neuse (Big Ditch) Stream Restoration Project)

Streamside Assemblage - Channel Banks										**Acres to be Planted**	**0.51**
Species	**Common Name**	**Max Spacing (Ft)**	**Unit Type***	**Size****	**Stratum**	**Indiv. Spacing (Ft)**	**% of Total**	**# of Stems**	**lbs per Acre**	**Total lbs**
Cornus amomum	Silky dogwood	2	L	2'	Subcanopy	2	20	1111		
Sambucus canadensis	Elderberry	2	L	2'	Shrub	2	20	1111		
Cephalanthus occidentalis	Buttonbush	2	R	2	Shrub	2	20	1111		
Salix nigra	Black willow	2	L	2'	Subcanopy	2	40	2222		
						Total	**100**	**5555**		
							Permanent Seeding Acres			**0.51**
Carex vulpinoidea	Fox sedge		S		Herb		14		30	2
Andropogon gerardii	Big bluestem		S		Herb		14		30	2
Elymus virgatum	Virginia wildrye		S		Herb		14		30	2
Panicum virgatum	Switchgrass		S		Herb		14		30	2
Juncus effusus	Soft rush		S		Herb		30		30	5
Dichanthelium clandestinum	Deetrongue		S		Herb		14		30	2
						Total	**100**			**15**
Streamside Assemblage - Floodplain										**Acres to be Planted**	**0.49**
Species	**Common Name**	**Max Spacing (Ft)**	**Unit Type***	**Size****	**Stratum**	**Indiv. Spacing (Ft)**	**% of Total**	**# of Stems**	**lbs per Acre**	**Total lbs**
Cornus amomum	Silky dogwood	8	L	2'	Subcanopy	8	20	69		
Sambucus canadensis	Elderberry	8	L	2'	Shrub	8	20	69		
Cephalanthus occidentalis	Buttonbush	8	R	2	Shrub	2	20	278		
Salix nigra	Black willow	8	L	2'	Subcanopy	8	40	139		
						Total	**100**	**555**		
							Permanent Seeding Acres			**0.51**
Carex vulpinoidea	Fox sedge		S		Herb		14		30	2
Andropogon gerardii	Big bluestem		S		Herb		14		30	2
Elymus virgatum	Virginia wildrye		S		Herb		14		30	2
Panicum virgatum	Switchgrass		S		Herb		14		30	2
Juncus effusus	Soft rush		S		Herb		30		30	5
Dichanthelium clandestinum	Deetrongue		S		Herb		14		30	2
						Total	**100**			**15**
Stormwater Wetland										**Acres to be Planted**	**0.46**
Species	**Common Name**	**Max Spacing (Ft)**	**Unit Type***	**Size****	**Stratum**	**Indiv. Spacing (Ft)**	**% of Total**	**# of Stems**	**lbs per Acre**	**Total lbs**
Deep Water Zone (15% of total)										
	Bald cypress	8	R	2 -3'	Canopy	8	15	47		
Shallow Water Zone (50% of total)										
	Swamp tupelo	8	R	2 -3'	Canopy	8	15	47		
	Overcup oak	8	R	2 -3'	Canopy	8	15	47		
	Bald cypress	8	R	2 -3'	Canopy	8	20	63		
Shallow Land Zone (35 % of total)										
	Green ash	8	R	2 -3'	Canopy	8	5	16		
	Water oak	8	R	2 -3'	Canopy	8	5	16		
	Willow oak	8	R	2 -3'	Canopy	8	5	16		
	River birch	8	R	2 -3'	Canopy	8	5	16		
	Buttonbush	8	R	2 -3'	Shrub	8	5	16		
	Silky dogwood	8	R	2 -3'	Shrub	8	5	16		
	Elderberry	8	R	2 -3'	Shrub	8	5	16		
						Total	**100**	**316**		
							Permanent Seed Acres			**0.46**
Deep Water Zone (15% of total)										
	Cow lily		S		Herb		7.5		30	1
	Water lily		S		Herb		7.5		30	1
Shallow Water Zone (50% of total)										0
	Arrow arum		S		Herb		13		30	2
	Arrowhead		S		Herb		13		30	2
	Lizards tail		S		Herb		12		30	2
	Rush		S		Herb		12		30	2
Shallow Land Zone (35 % of total)										0
	Rose mallow		S		Herb		18		30	2
	Rush		S		Herb		17		30	2
						Total	**100**			**14**

* Unit Type choices inlcude: Transplant (T), Lives stake (L), Ball and Burlap (B), Pot (P), Tubling (T), Bare Root (R), Mechanically Planted (M), and Seed (S)
** Size units may vary, but must be stated.

7.0 PERFORMANCE CRITERIA

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

7.1 Streams

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

7.1.1 Stream Success Criteria

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

For Restoration or Enhancement I components, 3,000 linear feet or less, the entire length of channel will be surveyed on an annual basis in order to track changes in channel geometry, profile, or substrate. For segments in excess of 3,000 linear feet, 30 percent of the length or 3,000 linear feet (whichever is greater) shall be surveyed to track changes. The following table will be used to determine the amount of cross-sections to be surveyed per reach:

Segment/Reach			Segment/Reach		
Footage	# Riffle	# Pool	Footage	# Riffle	# Pool
500 or Less	Visual	Visual	4001 – 4500	5	3
501 – 1000	3	1	4501 – 5000	5	4
1001 – 1500	3	2	5001 – 5500	6	4
1501 – 2000	3	2	5501 – 6000	7	4
2001 – 2500	3	2	6001 – 6500	8	4
2501 – 3000	4	2	6501 – 7000	9	5
3001 – 3500	4	2	7001 – 10,000	10	5
3501 – 4000	4	3	10,000 or >	14	6

These data will be utilized to determine the success in restoring stream channel stability. Specifically, the width-to-depth ratio and bank-height ratios should be indicative of a stable or

moderately unstable channel with minimal changes in cross-sectional area, channel width, and/or bank erosion along the monitoring reach. In addition, channel abandonment and/or shoot cutoffs must not occur. Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

7.1.2 Stream Dimension

General maintenance of a stable cross-section and hydrologic access to the floodplain features over the course of the monitoring period will generally represent success in dimensional stability. Some changes in dimension (such as lowering of bankfull width) should be expected. Key parameters such as cross-sectional area and the channel's width to depth ratio should demonstrate modes overall change. Riffle sections should generally maintain a Bank Height ration approaching 1.0, with some variation in this ration naturally occurring. Pool sections naturally adjust based on recent flows and time between flows, therefore more leeway on pool section geometry is expected.

7.1.3 Stream Pattern and Profile

The profile should not demonstrate significant trends towards degradation or aggradation over a significant portion of a reach. Additionally, bed form variables should remain noticeably intact and consistent with original design parameters that were based off of reference conditions.

Pattern features should show little adjustment over the standard 5 year monitoring period and will be monitored to ensure adjustment is minor prior to close out.

7.1.4 Substrate

Substrate measurements should indicate the progression towards or the maintenance of the known distributions from the design phase.

7.1.5 Sediment Transport

There should be an absence of any significant trend in the aggradational or depositional potential of the channel.

7.1.6 Hydraulics

A minimum of two bankfull events must be documented within the standard 5 year monitoring period. The two bankfull events shall occur within separate years.

7.1.7 Stream Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented. Stream contingency may include, but may not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that

are not in compliance with success criteria. Primary concerns, which may jeopardize stream success include 1) structure failure, 2) headcut migration through the Site, and/or 3) bank erosion.

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

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

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

7.2 Vegetation

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

During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) in September of the first monitoring year

and annually between June 1 and September 30 for the remainder of the monitoring period until vegetation success criteria are achieved.

Within thirty (30) days after planting, sample plots (10 meters by 10 meters) will be randomly placed within the restored buffer on-site; however, best professional judgment may be necessary to establish vegetative monitoring plots upon completion of construction activities. The amount of vegetation plots to be determined will be calculated using the CVS protocol based on the final acreage of vegetation plantings. In each sample plot, vegetation parameters to be monitored include species composition and species density.

7.2.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon the density and growth of characteristic forest species. An average density of 320 stems per acre of planted stems must be surviving in the first five monitoring years.

7.2.2 Vegetation Contingency

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

7.3 Stormwater Management Devices

Plant coverage within the stormwater wetland should be assessed and documented each growing season. If a minimum of 70 percent coverage is not achieved after the second growing season, supplemental planting should be completed. Plant coverage of 90 to 95 percent is desirable. Maintenance guidelines are as follows (NCDWQ 2007):

Wetland should be inspected annually after a rain event, and after all large (mean annual or greater) storm events to ensure the basin is operating as designed. At a minimum the following items should be corrected if observed.

- Remove excess sediment
- Maintain free flowing orifice
- Remove trash and debris
- Remove invasive vegetation
- Remove muskrats and beavers

Sediment should only be selectively removed; sediment removal disturbs stable vegetation cover and disrupts flow paths through the wetland.

7.4 Scheduling and Reporting

The first year monitoring report will be submitted at the end of December after Site implementation. Monitoring will continue for five years or until agreed upon success criteria are achieved, with a report submitted by the end of December for each monitoring year.

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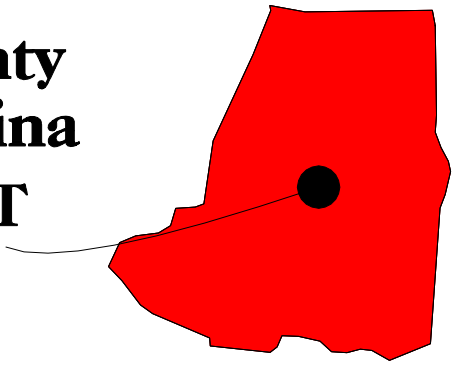
Wayne County North Carolina

PROJECT AREA



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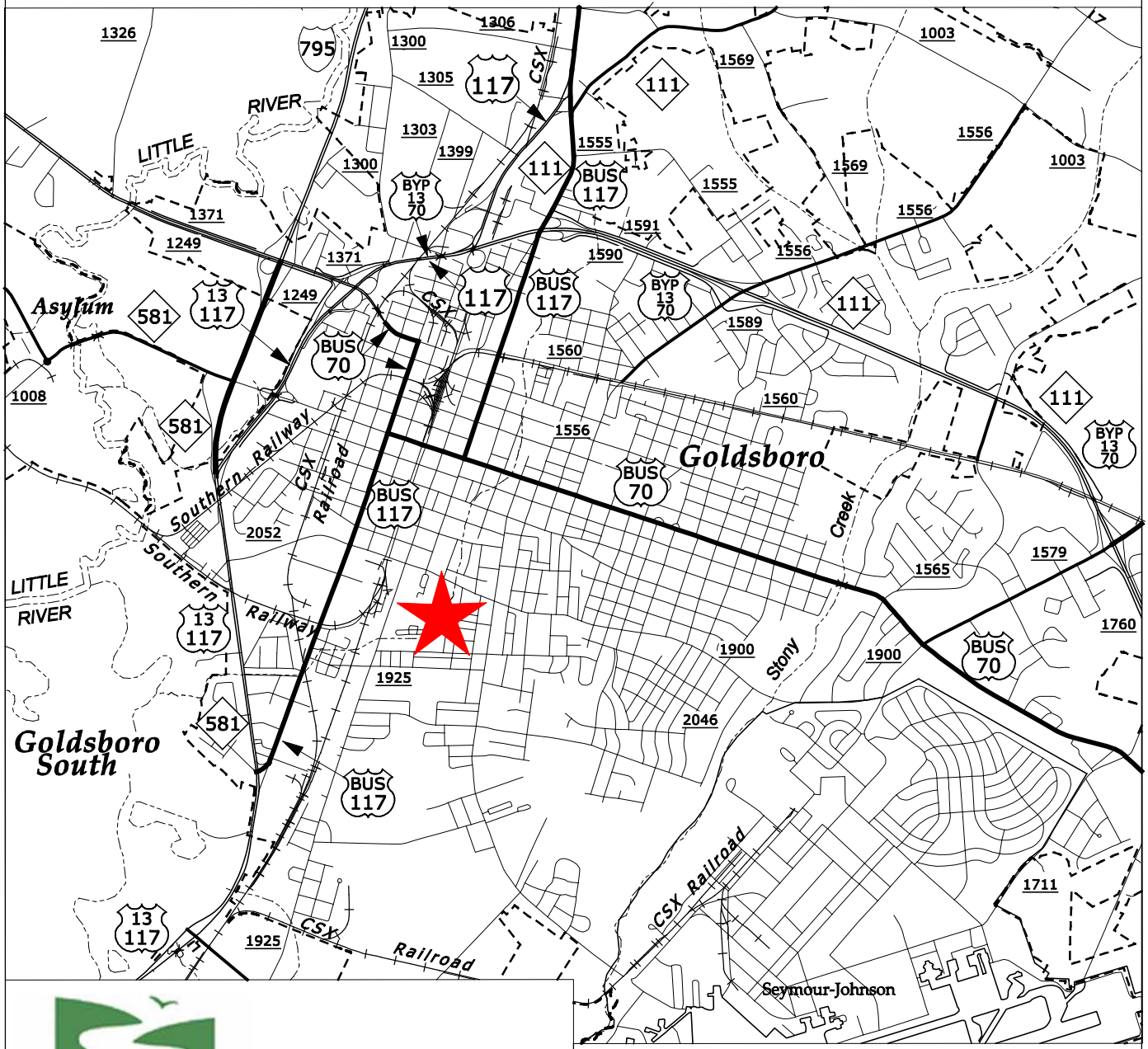
FEET



Ecosystem Enhancement Program

LEGEND

★ PROJECT AREA

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CONSULTING ENGINEERS
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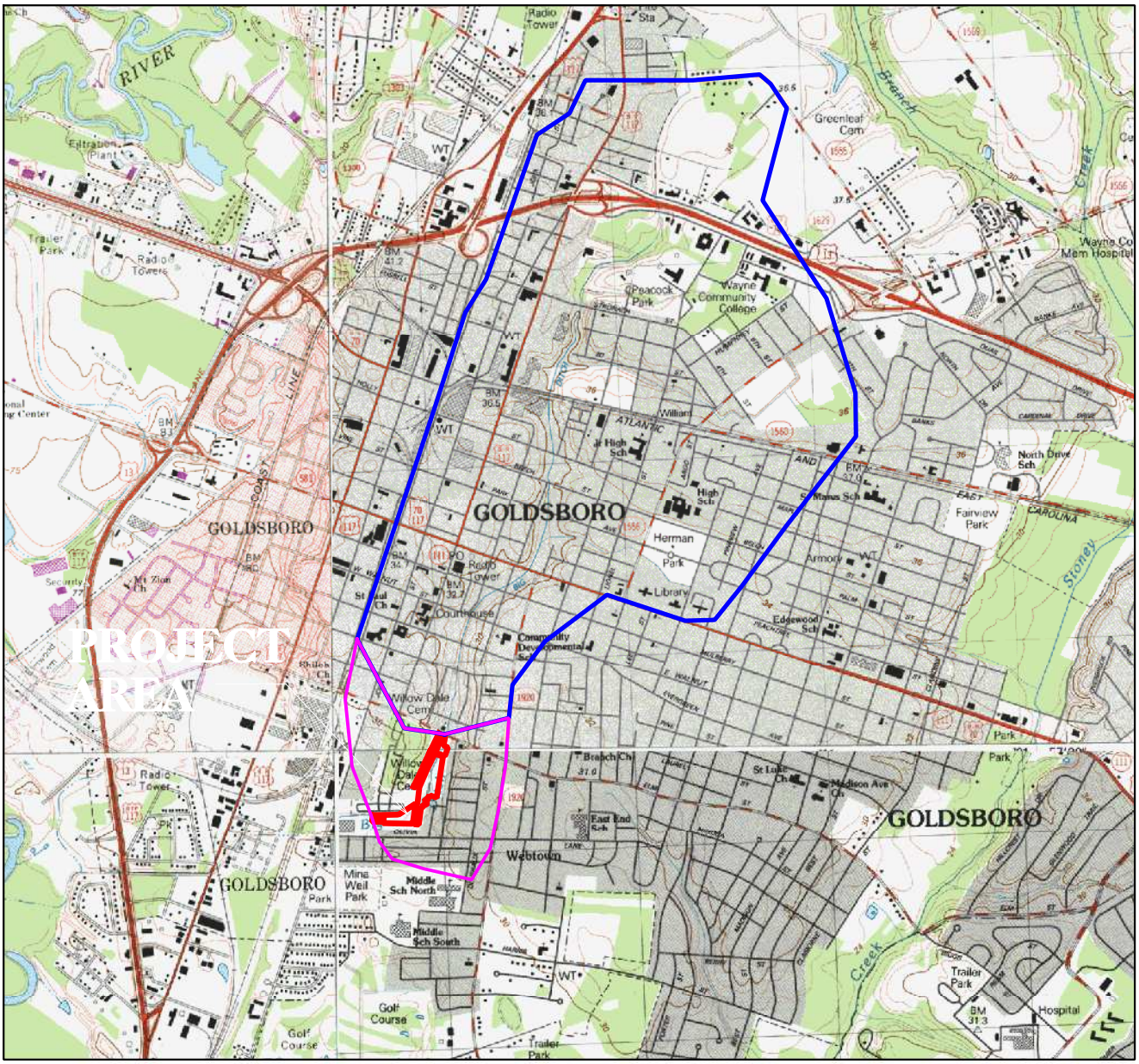
License No: F-0258

Vicinity Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/12/10	Figure: 1



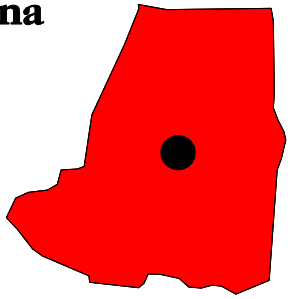
LEGEND

- UT to Neuse Upstream Watershed (2.05 Sq. Miles)
- UT to Neuse Downstream Watershed (2.27 Sq. Miles)
- Proposed Easement

N

0 1000 2000
FEET

Wayne County
North Carolina



Watershed Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Ecosystem Enhancement Program

Florence & Hutcheson
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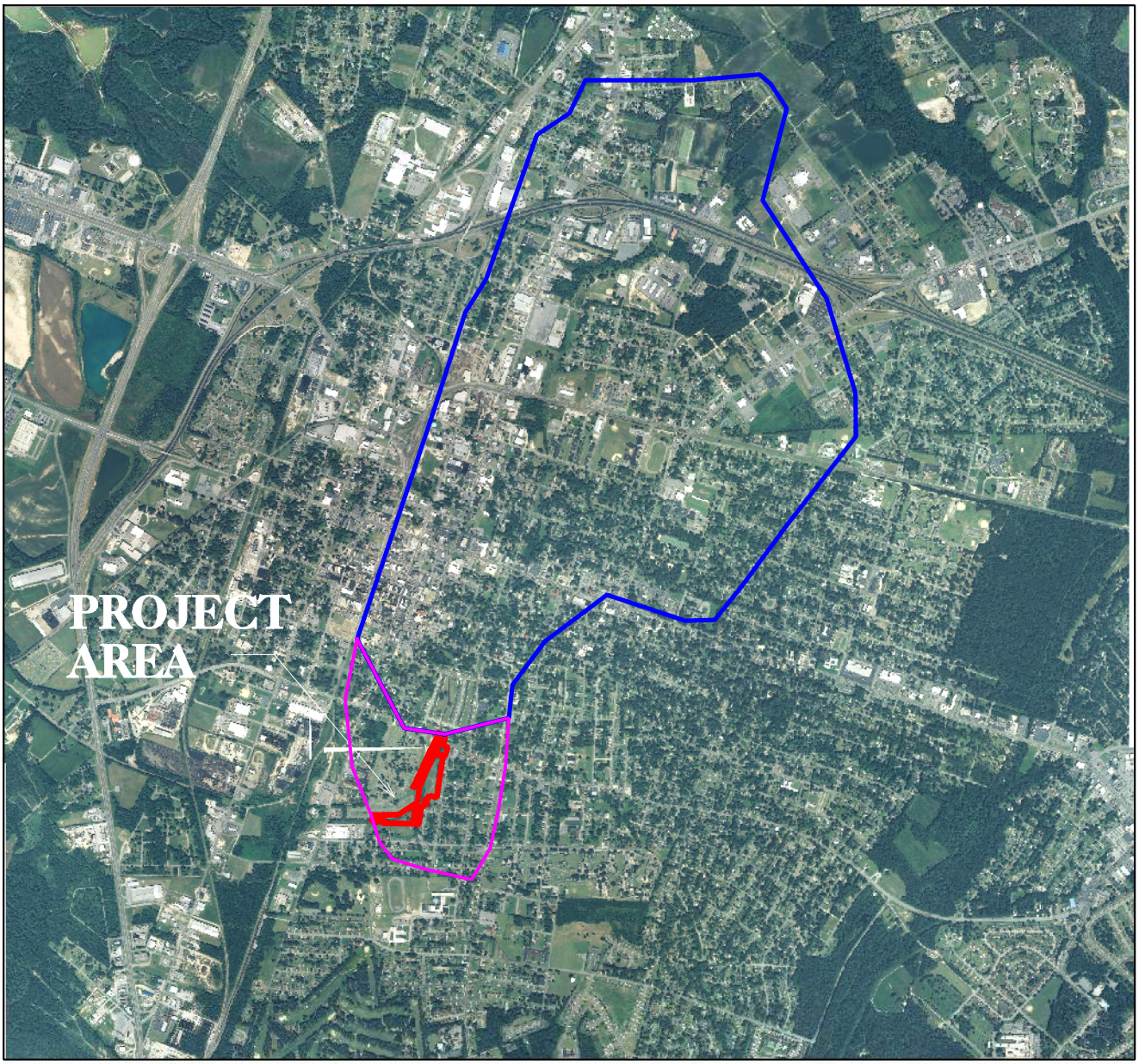
Date: 01/12/10

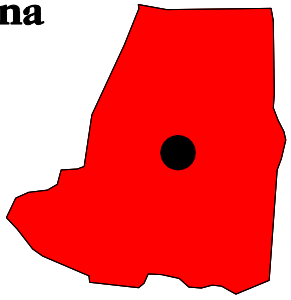
Figure: 2



LEGEND

- UT to Neuse Upstream Watershed (2.05 Sq. Miles)
- UT to Neuse Downstream Watershed (2.27 Sq. Miles)
- Proposed Easement

Wayne County
North Carolina



0 1000 2000
FEET

Ecosystem Enhancement PROGRAM

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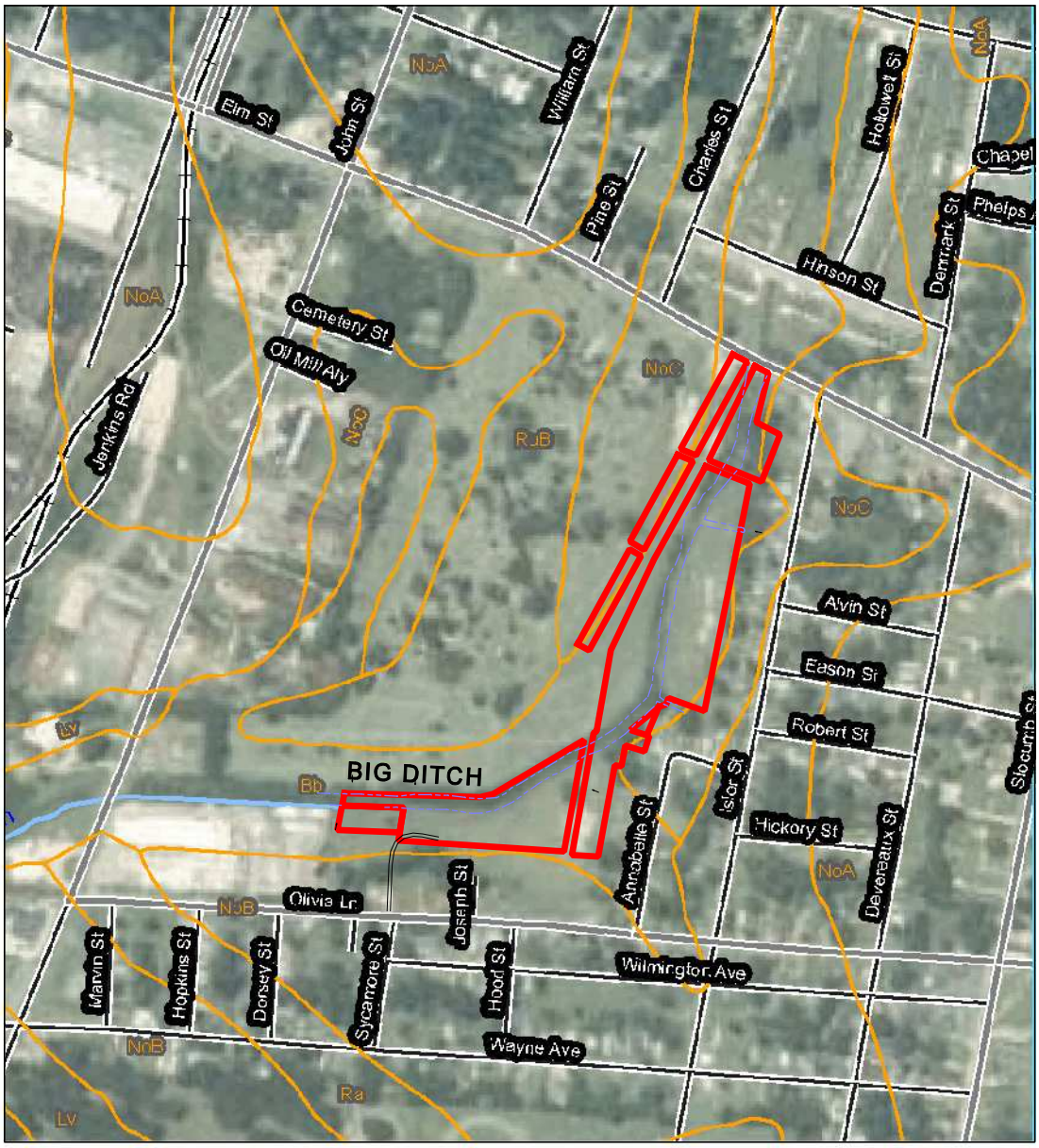
Watershed Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/12/10	Figure: 3



LEGEND

Symbol	Name
Bb	Bibb
NoC	Norfolk loamy sand (6 to 10 % slopes)
	Proposed Easement

Ecosystem Enhancement Program

0 500 1000

FEET

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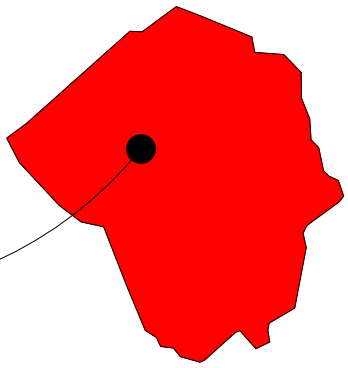
Soil Survey Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/12/10

Figure: 4

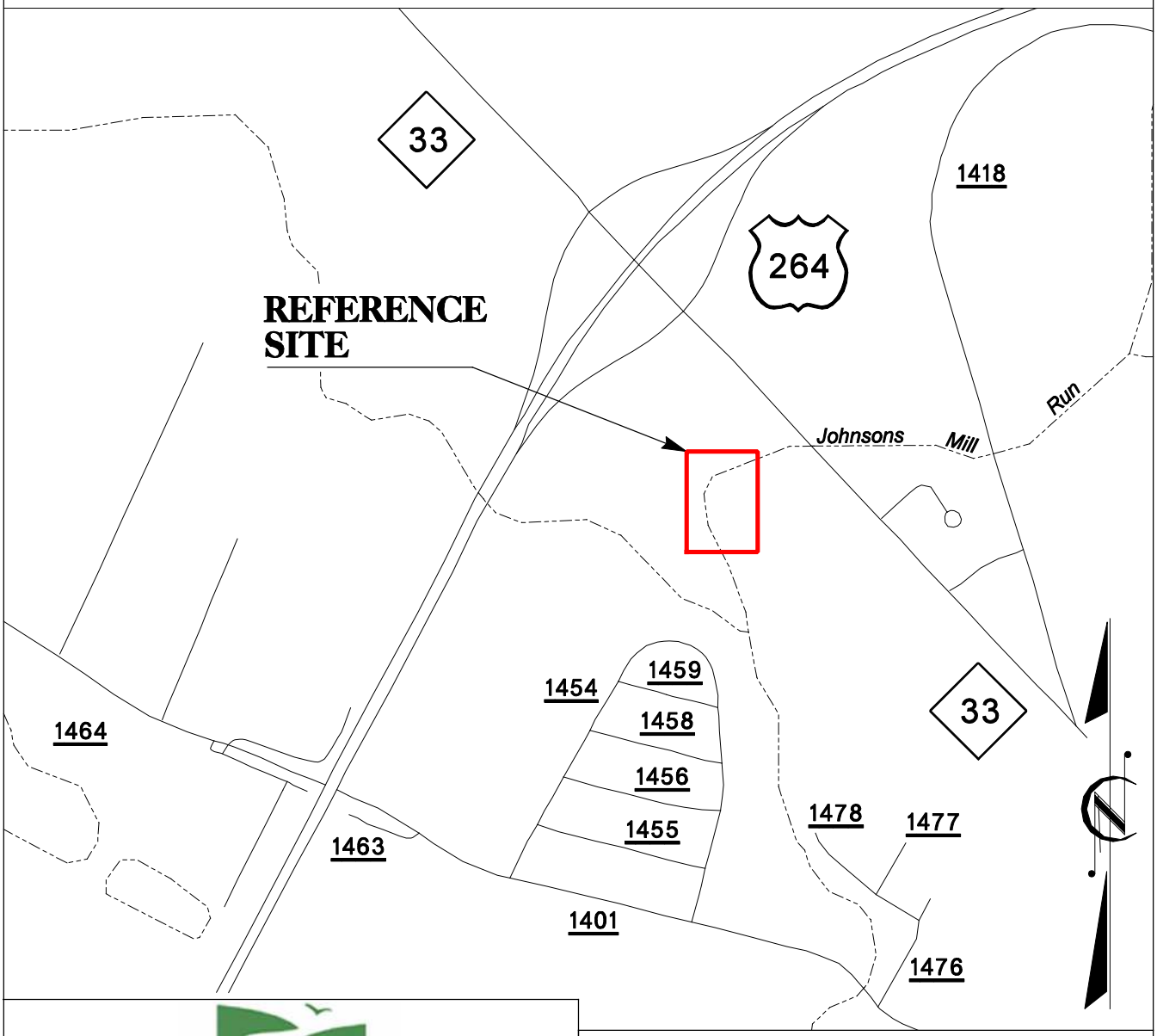
Pitt County
North Carolina



REFERENCE SITE

0 1000 2000

FEET



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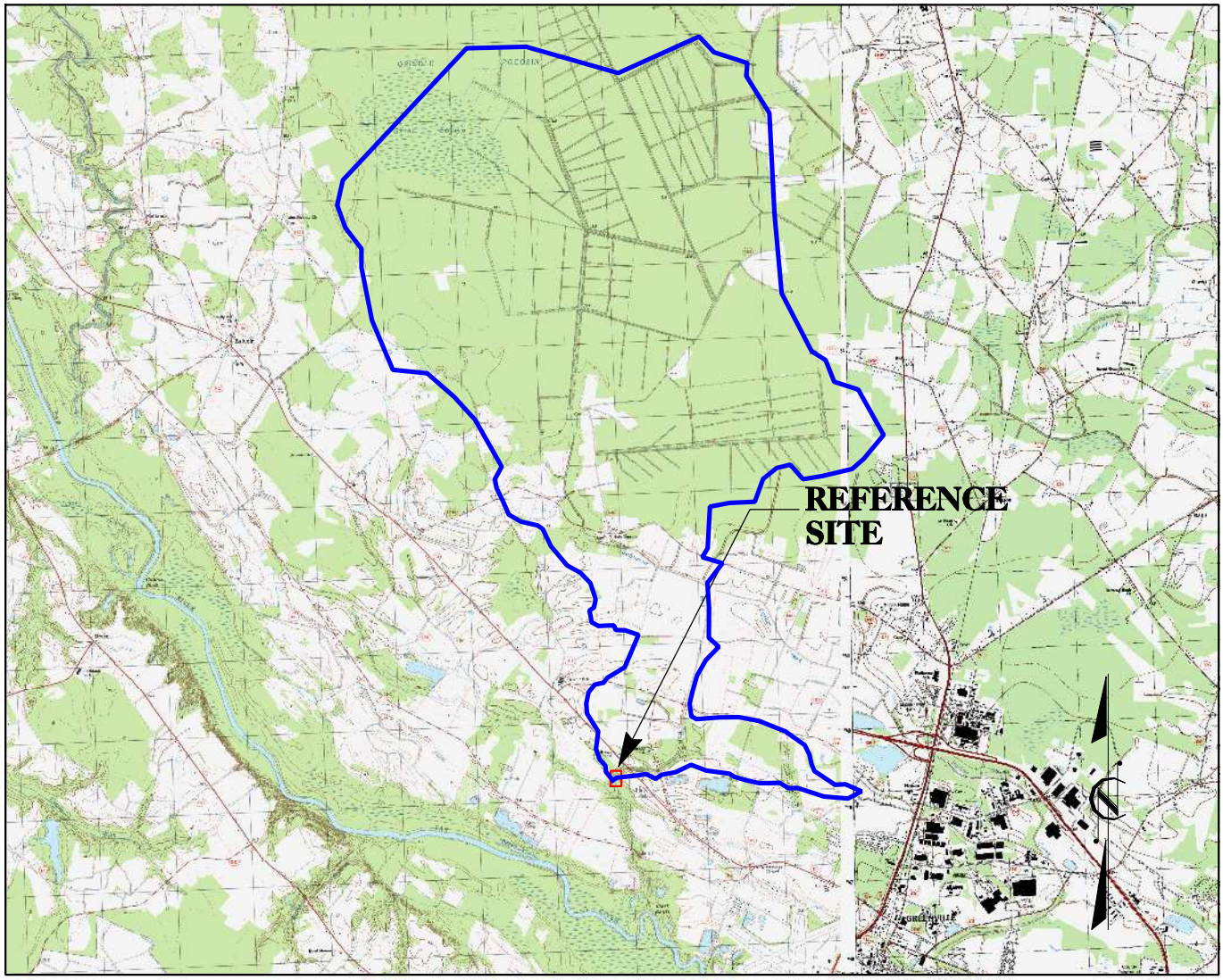
Johnsons Mill Run Vicinity Map

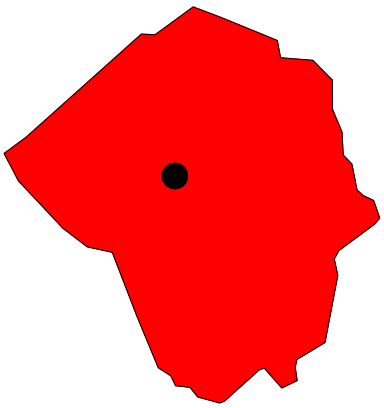
UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/20/10

Figure: 5



Reference Site
Pitt County
North Carolina



0 4000 8000
FEET

LEGEND

Watershed
Project Area

Ecosystem Enhancement Program

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Johnsons Mill Run Watershed Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/2010

Figure: 6

REFERENCE SITE

LEGEND

Symbol	Name
Bb	Bibb
	Project Area

0 500 1000

FEET

Ecosystem Enhancement Program

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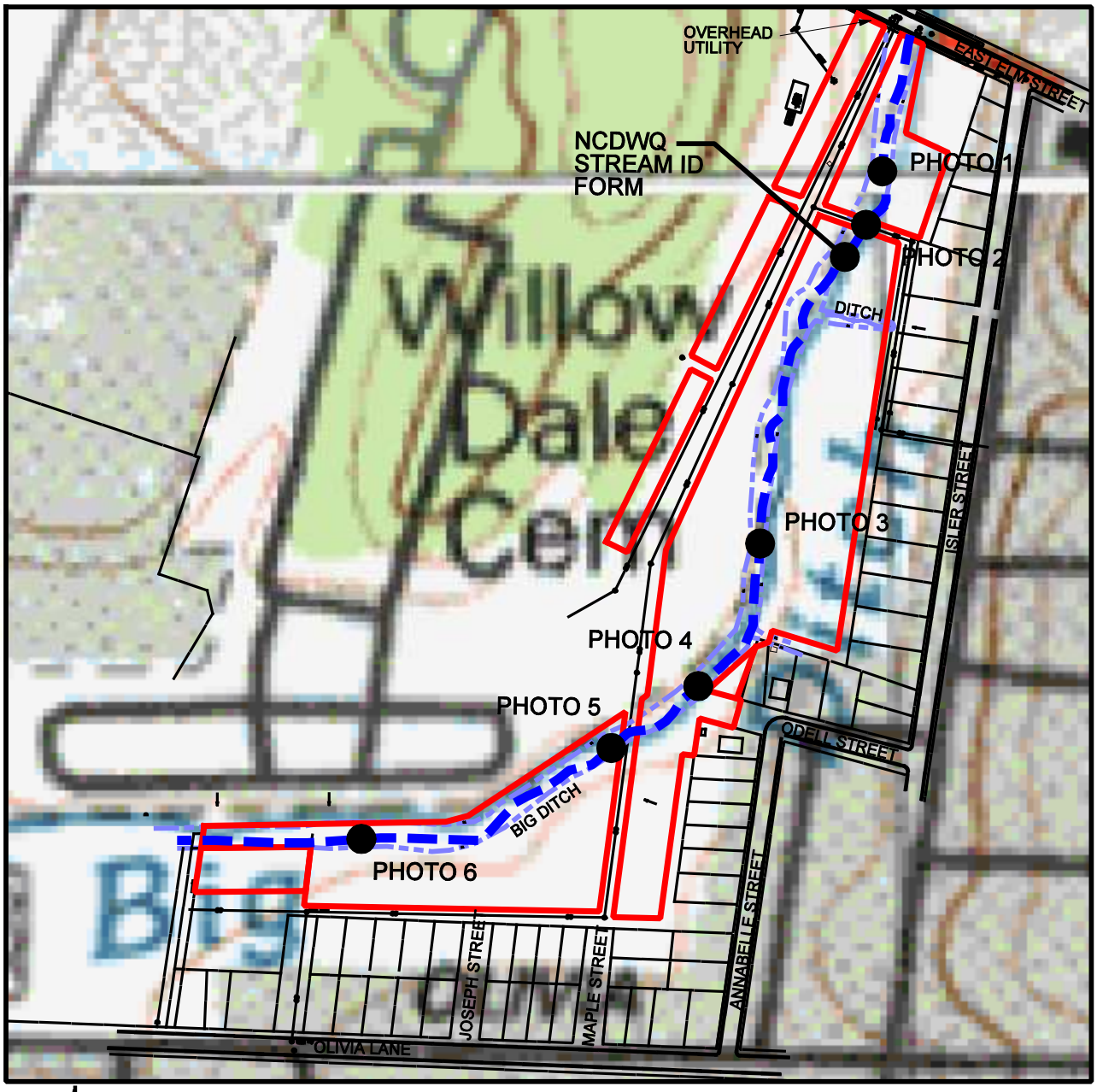
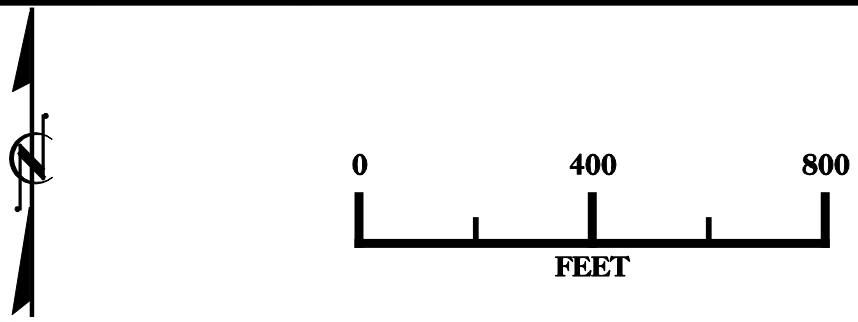
Johnsons Mill Run Soil Survey Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/20/10 **Figure:** 7





LEGEND

- Proposed Easement

Photograph & Stream Form Location Map

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Ecosystem Enhancement Program

Florence & Hutcheson
Consulting Engineers
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License No: F-0258

Date: 01/12/10

Figure: 8

Ecosystem Enhancement Program

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Consulting Engineers
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ISLER STREET

ODELL STREET

ANNABELLE STREET

EAST ELM STREET

8" DIP SEWERLINE EXPOSED IN CHANNEL

Flow Direction

UT NEUSE (BIG DITCH)

-MATCHLINE- STATION 22+00 SEE SHEET 1B

METAL BLDG

CONC

WILLOWDALE CEMETERY

SS

OHE

OHU

E

LEGEND

- CONSERVATION EASEMENT
- EXISTING CONDITIONS SURVEY

50 0 50 100

SCALE

Existing Conditions

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 02/10

Sheet 1A

Ecosystem Enhancement Program

Florence & Hutcheson, Inc.
Consulting Engineers
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(919) 851-6066

OLIVIA LANE

ANNABELLE STREET

MAPLE STREET

JOSEPH STREET

EMH #9

EMH #10

SS

60" RCP

Flow Direction

UT NEUSE (BIG DITCH)

30" DIP SEWERLINE EXPOSED IN CHANNEL

WILLOWDALE CEMETERY

-MATCHLINE- STATION 22+00 SEE SHEET 1A

N

LEGEND

CONSERVATION EASEMENT

50 0 50 100

SCALE

Existing Conditions

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 01/10

Sheet 1B

LEGEND

- CONSERVATION EASEMENT
- PROPOSED FENCE
- LIMITS OF CONSTRUCTION
- LOG SILL
- LOG VANE W/SILL
- LOG CROSS VANE

Ecosystem Enhancement Program

Florence & Hutcheson, Inc.
Consulting Engineers
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(919) 851-6066

ISLER STREET

ODELL STREET

ANNABELLE STREET

PROPOSED STORMWATER WETLAND BMP

PROPOSED THALWEG

PROPOSED BANKFULL

8" DIP SEWERLINE TO BE BURIED IN CHANNEL

10+00

15+00

20+00

UT NEUSE (BIG DITCH)

LIMITS OF CONSTRUCTION

Flow Direction

EAST ELM STREET

METAL BLDG

CONC

PROPOSED FENCE

WILLOWDALE CEMETERY

-MATCHLINE- STATION 22+00 SEE SHEET 2B

BEGIN UT TO NEUSE (BIG DITCH)
STA 10+00.00
N=593228.4042
E=2300042.5588

50 0 50 100
SCALE

Proposed Conditions

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 02/10 | Sheet 2A

Ecosystem Enhancement PROGRAM

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS
5121 KINGDOM WAY, SUITE 100 RALEIGH, N.C. 27607
(919) 851-6066

OLIVIA LANE

ANNABELLE STREET

MAPLE STREET

JOSEPH STREET

LIMITS OF CONSTRUCTION

PROPOSED THALWEG

Flow Direction

PROPOSED BANKFULL

UT NEUSE (BIG DITCH)

PROPOSED FENCE

30" DIP SEWERLINE TO BE BURIED IN CHANNEL

-MATCHLINE- STATION 22+00 SEE SHEET 2A

WILLOWDALE CEMETERY

HOUSE

BLDG

YARD INLET

48" PIPE

18" PIPE

10' DIRT PATH

60' RCP

EMH #9

EMH #10

25+00

30+00

END UT TO NEUSE (BIG DITCH)
STA 31+27.78
N=591859.2300
E=2298843.5313

LEGEND
- CONSERVATION EASEMENT
- PROPOSED FENCE
- LOG SILL
- LOG VANE W/SILL
- LOG CROSS VANE

50 0 50 100
SCALE

Proposed Conditions

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 02/10

Sheet 2B

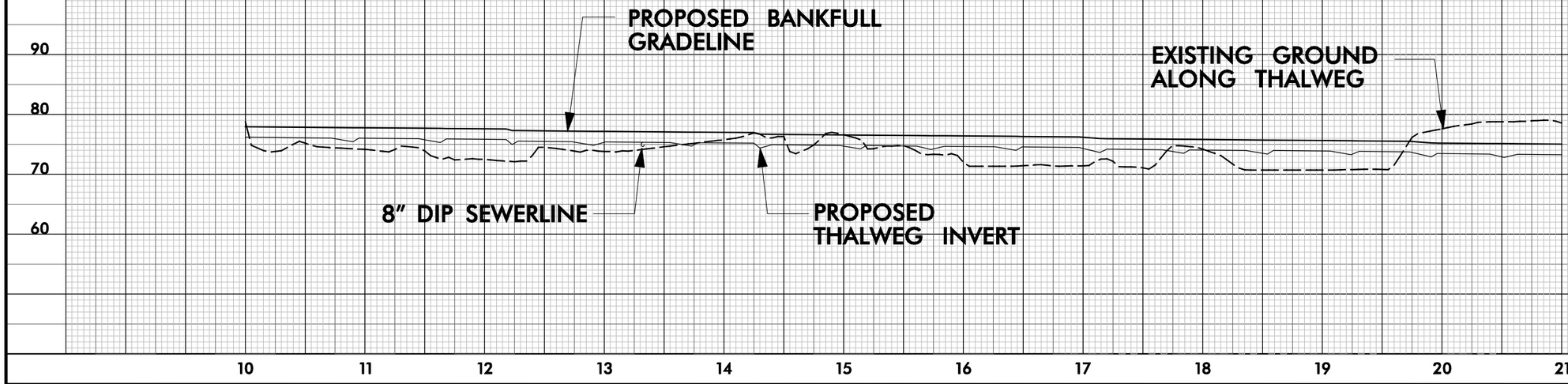
5/28/99

LONGITUDINAL PROFILE

Florence & Hutcheson
Consulting Engineers
5121 Kingdom Way, Suite 100
Raleigh, N.C. 27607
(919) 851-6066
License No: F-0258

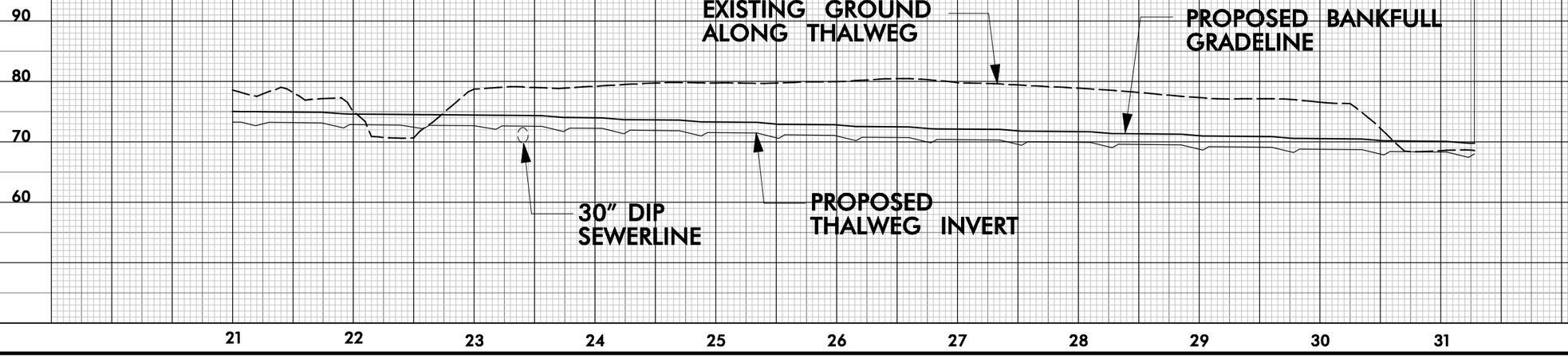
PROJECT REFERENCE NO.	SHEET NO.
UT TO NEUSE (BIG DITCH)	3A
PROJECT ENGINEER	

BEGIN UT TO NEUSE
(BIG DITCH)
STA 10+00.00
ELEV = 77.93



LONGITUDINAL PROFILE

END UT TO NEUSE
(BIG DITCH)
STA 31+27.78
ELEV = 69.75



2/15/2010
R:\stream\Proj\Restoration Plans\UTNeuse_Profile_sht_3a.dgn
Florence & Hutcheson, Inc.

Ecosystem Enhancement PROGRAM

Florence & Hutcheson, Inc.
Consulting Engineers
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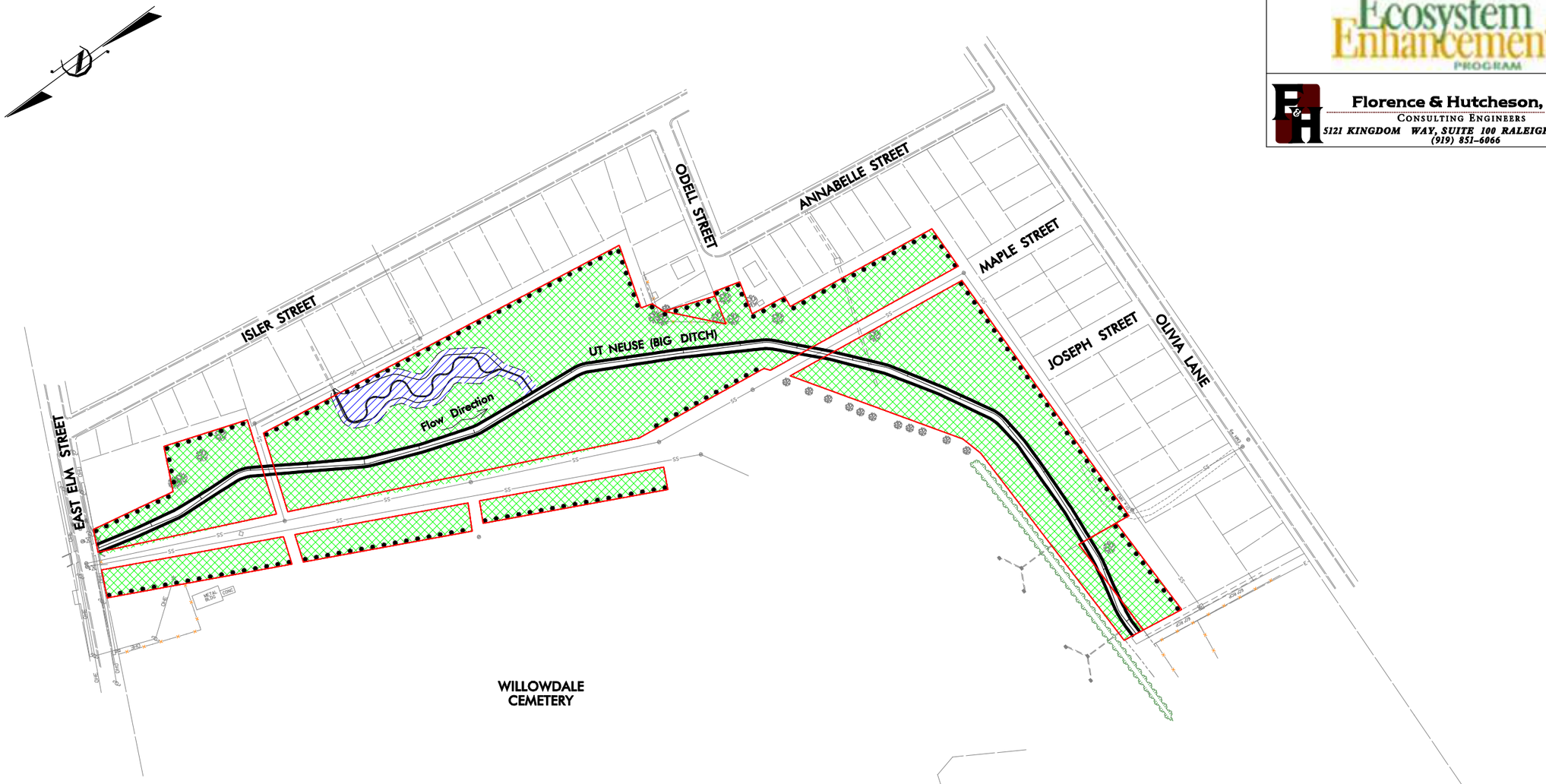
(919) 851-6066



LEGEND

- Ball and Burlap Trees
- Conservation Easement
- Stream Side Assemblage
- Coastal Plain Levee Forest
- Stormwater Wetland

100 0 100 200

SCALE

Planting Plan

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 04/10

Sheet 4

APPENDIX 1
RESTORATION SITE PHOTOGRAPHS

Photo 1 - Sewer service line within channel

Photo 2 – Sewer line within incised channel, steep channel banks with erosion

Photo 3 – Incised channel with eroding side slopes and undermined chain link fence

Photo 4 – Eroding banks stabilized with scrap concrete and brick material

Photo 5 – Perched culvert with scrap concrete dissipator to prevent further erosion

Photo 6 – Incised channel with steep and sloughing channel banks

APPENDIX 2
PROJECT SITE
NCDWQ STREAM CLASSIFICATION FORM

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

Date: 12/30/09	**Project:** UT NEUSE STREAM RESTOR.	**Latitude:** 35.373
Evaluator: CHRIS SMITH	**Site:** UT NEUSE (BIG DITCH)	**Longitude:** 77.995
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 36	**County:** WAYNE	**Other** *e.g. Quad Name:*

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 = 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 = 7.5)				
20[b]. Fibrous roots in channel	(3)	2	1	0
21[b]. Rooted plants in channel	(3)	2	1	0
22. Crayfish	(0)	0.5	1	1.5
23. Bivalves	(0)	(1)	2	3
24. Fish	0	(0.5)	1	1.5
25. Amphibians	(0)	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)	(0)	0.5	1	1.5
27. Filamentous algae; periphyton	(0)	1	2	3
28. Iron oxidizing bacteria/fungus.	(0)	0.5	1	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; (Other = 0)			

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

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

Sketch:

APPENDIX 3
REFERENCE SITE PHOTOGRAPHS

Johnson Mill Run Reference Site – Looking Downstream

Johnson Mill Run Reference Site – Looking Upstream

Johnson Mill Run Reference Site – Looking Downstream

Johnson Mill Run Reference Site - Looking Upstream

APPENDIX 4
REFERENCE SITE
NCDWQ STREAM CLASSIFICATION FORMS

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

Date: 1/20/10	**Project:** Johnsons Mill Run	**Latitude:** 35° 39' 23"
Evaluator: RVS	**Site:** Johnsons Mill Run	**Longitude:** 77° 24' 36"
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 42.5	**County:** Pitt	**Other** *e.g. Quad Name:* Greenville NW

A. Geomorphology (Subtotal = 22.5)	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 = 7)				
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	(1)	2	3
28. Iron oxidizing bacteria/fungus.	0	0.5	(1)	1.5
29[b]. Wetland plants in streambed	(FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Sketch:

APPENDIX 5
HEC-RAS ANALYSIS

Big Ditch: HEC-RAS SUMMARY TABLE

			DUPLICATE EFFECTIVE FEMA MODEL			CORRECTED/EXISTING MODEL			DIFFERENCE (Existing - Duplicate)		REVISED/PROPOSED MODEL			DIFFERENCE (Proposed - Existing)	
	SECNO	Q	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID
10-yr	9725	520	83.48	156.00		83.59	156.00		0.11	0.00	83.57	156.00		-0.02	0.00
50-yr	9725	910	84.76	156.00		84.88	156.00		0.12	0.00	84.98	156.00		0.10	0.00
100-yr	9725	1140	85.51	156.00		85.46	156.00		-0.05	0.00	85.51	156.00		0.05	0.00
500-yr	9725	1740	87.09	156.00		87.71	156.00		0.62	0.00	87.50	156.00		-0.21	0.00
100-yr floodway	9725	1140	85.81	70.00	0.30	85.86	70.00	0.40	0.05	0.00	86.01	70.00	0.50	0.15	0.00
10-yr	9675	520	83.32	110.00		83.33	110.00		0.01	0.00	83.43	110.00		0.10	0.00
50-yr	9675	910	84.55	110.00		84.65	110.00		0.10	0.00	84.81	110.00		0.16	0.00
100-yr	9675	1140	85.31	110.00		85.22	110.00		-0.09	0.00	85.31	110.00		0.09	0.00
500-yr	9675	1740	86.88	110.00		87.55	110.00		0.67	0.00	87.33	110.00		-0.22	0.00
100-yr floodway	9675	1140	85.70	70.00	0.39	85.67	70.00	0.45	-0.03	0.00	85.91	70.00	0.60	0.24	0.00
	Hinson St.														
10-yr	9625	520	81.64	37.46		82.01	58.90		0.37	21.44	82.74	87.19		0.73	28.29
50-yr	9625	910	84.06	110.00		84.27	110.00		0.21	0.00	84.61	110.00		0.34	0.00
100-yr	9625	1140	85.15	110.00		85.07	110.00		-0.08	0.00	85.21	110.00		0.14	0.00
500-yr	9625	1740	86.70	110.00		87.47	110.00		0.77	0.00	87.24	110.00		-0.23	0.00
100-yr floodway	9625	1140	85.33	70.00	0.18	85.28	70.00	0.21	-0.05	0.00	85.73	70.00	0.52	0.45	0.00
10-yr	9560	520	81.34	27.01		81.67	40.80		0.33	13.79	82.58	61.54		0.91	20.74
50-yr	9560	910	83.87	90.00		84.10	90.00		0.23	0.00	84.48	90.00		0.38	0.00
100-yr	9560	1140	84.97	90.00		84.90	90.00		-0.07	0.00	85.05	90.00		0.15	0.00
500-yr	9560	1740	86.47	90.00		87.31	90.00		0.84	0.00	87.07	90.00		-0.24	0.00
100-yr floodway	9560	1140	85.18	70.00	0.21	85.13	70.00	0.23	-0.05	0.00	85.62	70.00	0.57	0.49	0.00
10-yr	9435	520	81.05	28.89		80.88	18.00		-0.17	-10.89	82.11	33.77		1.23	15.77
50-yr	9435	910	83.68	88.00		83.21	93.13		-0.47	5.13	83.91	157.85		0.70	64.72
100-yr	9435	1140	84.80	88.00		84.14	179.21		-0.66	91.21	84.47	222.39		0.33	43.18
500-yr	9435	1740	86.27	88.00		87.24	404.39		0.97	316.39	86.97	395.09		-0.27	-9.30
100-yr floodway	9435	1140	85.02	60.00	0.22	84.39	60.00	0.25	-0.63	0.00	85.09	60.00	0.62	0.70	0.00
10-yr	9418	520				80.79	18.00				82.07	18.68		1.28	0.68
50-yr	9418	910				83.03	19.75				83.63	101.67		0.60	81.92
100-yr	9418	1140				83.40	66.22				83.87	150.08		0.47	83.86
500-yr	9418	1740				82.08	18.70				82.64	19.31		0.56	0.61
100-yr floodway	9418	1140			0.00	84.01	60.00	0.61			84.87	60.00	1.00	0.86	0.00
	Elm St.														
10-yr	9386	520	80.53	18.00											
50-yr	9386	910	82.95	50.91											
100-yr	9386	1140	84.22	73.89											
500-yr	9386	1740	85.66	80.00											
100-yr floodway	9386	1140	84.54	60.00	0.32										
10-yr	9361	520				80.35	24.79				81.73	49.27		1.38	24.48
50-yr	9361	910				81.83	39.89				82.79	81.29		0.96	41.40
100-yr	9361	1140				82.37	43.07				83.29	108.86		0.92	65.79
500-yr	9361	1740				83.46	119.19				84.41	238.50		0.95	119.31
100-yr floodway	9361	1140			0.00	82.77	60.00	0.40			84.13	60.00	0.84	1.36	0.00
	End Stream Project														
10-yr	9334	520	80.33	43.88											
50-yr	9334	910	81.92	61.86											
100-yr	9334	1140	82.73	63.34											
500-yr	9334	1740	83.88	90.00											
100-yr floodway	9334	1140	83.08	60.00	0.35										

Big Ditch: HEC-RAS SUMMARY TABLE

			DUPLICATE EFFECTIVE FEMA MODEL			CORRECTED/EXISTING MODEL			DIFFERENCE (Existing - Duplicate)		REVISED/PROPOSED MODEL			DIFFERENCE (Proposed - Existing)	
	SECNO	Q	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID	WSEL NAVD 88	TOPWID	Surcharge	WSEL NAVD 88	TOPWID
10-yr	9280	580	80.36	45.00		80.23	73.57		-0.13	28.57	81.59	154.41		1.36	80.84
50-yr	9280	1020	82.06	62.14		81.74	155.89		-0.32	93.75	82.64	174.44		0.90	18.55
100-yr	9280	1280	82.72	63.32		82.31	165.89		-0.41	102.57	83.13	185.46		0.82	19.57
500-yr	9280	1940	83.89	105.69		83.42	199.12		-0.47	93.43	84.25	253.22		0.83	54.10
100-yr floodway	9280	1280	83.07	63.00	0.35	82.67	63.00	0.36	-0.40	0.00	83.32	63.00	0.19	0.65	0.00
10-yr	9005	580				79.42	34.68				80.91	123.15		1.49	88.47
50-yr	9005	1020				80.98	124.58				81.79	139.26		0.81	14.68
100-yr	9005	1280				81.55	134.07				82.17	150.13		0.62	16.06
500-yr	9005	1940				82.60	168.04				83.03	205.16		0.43	37.12
100-yr floodway	9005	1280			0.00	82.02	77.00	0.47			82.63	97.00	0.46	0.61	20.00
10-yr	8770	580	79.61	122.96		78.91	44.19		-0.70	-78.77	80.14	199.29		1.23	155.10
50-yr	8770	1020	81.52	306.02		80.57	253.97		-0.95	-52.05	81.08	286.74		0.51	32.77
100-yr	8770	1280	82.24	346.77		81.23	296.15		-1.01	-50.62	81.53	309.46		0.30	13.31
500-yr	8770	1940	83.48	399.65		82.40	334.77		-1.08	-64.88	82.68	342.96		0.28	8.19
100-yr floodway	8770	1280	82.48	100.00	0.24	81.73	100.00	0.50	-0.75	0.00	82.19	150.00	0.66	0.46	50.00
10-yr	8450	580				78.58	121.79				79.17	177.44		0.59	55.65
50-yr	8450	1020				80.40	360.56				80.49	364.87		0.09	4.31
100-yr	8450	1280				81.08	385.64				81.08	385.58		0.00	-0.06
500-yr	8450	1940				82.27	406.91				82.40	420.22		0.13	13.31
100-yr floodway	8450	1280			0.00	81.57	127.00	0.49			81.72	127.00	0.64	0.15	0.00
10-yr	8040	580	78.45	35.18		77.95	32.80		-0.50	-2.38	77.56	68.95		-0.39	36.15
50-yr	8040	1020	80.36	105.20		79.72	60.13		-0.64	-45.07	79.32	93.44		-0.40	33.31
100-yr	8040	1280	81.01	134.54		80.37	273.87		-0.64	139.33	79.96	102.43		-0.41	-171.44
500-yr	8040	1940	82.06	263.00		81.74	436.20		-0.32	173.20	81.43	412.00		-0.31	-24.20
100-yr floodway	8040	1280	81.45	100.00	0.44	81.03	100.00	0.66	-0.42	0.00	80.69	100.00	0.73	-0.34	0.00
10-yr	7695	580				77.63	38.55				77.37	93.05		-0.26	54.50
50-yr	7695	1020				79.25	44.30				79.11	104.44		-0.14	60.14
100-yr	7695	1280				79.81	54.96				79.72	108.41		-0.09	53.45
500-yr	7695	1940				80.93	102.08				80.99	145.85		0.06	43.77
100-yr floodway	7695	1280			0.00	80.67	60.00	0.86			80.53	80.00	0.81	-0.14	20.00
10-yr	7360	580	77.22	31.49		77.23	51.05		0.01	19.56	77.20	91.90		-0.03	40.85
50-yr	7360	1020	78.90	46.76		78.94	309.65		0.04	262.89	78.93	308.42		-0.01	-1.23
100-yr	7360	1280	79.53	288.80		79.55	347.87		0.02	59.07	79.53	347.33		-0.02	-0.54
500-yr	7360	1940	80.85	325.00		80.83	534.08		-0.02	209.08	80.82	537.08		-0.01	3.00
100-yr floodway	7360	1280	80.39	100.00	0.86	80.37	100.00	0.82	-0.02	0.00	80.37	100.00	0.84	0.00	0.00
10-yr	7200	580				77.05	150.17				77.05	151.61		0.00	1.44
50-yr	7200	1020				78.80	409.24				78.79	408.80		-0.01	-0.44
100-yr	7200	1280				79.42	437.84				79.41	437.01		-0.01	-0.83
500-yr	7200	1940				80.73	639.93				80.72	640.57		-0.01	0.64
100-yr floodway	7200	1280			0.00	80.22	100.00	0.80			80.20	100.00	0.79	-0.02	0.00
	Begin Stream Project														
10-yr	7000	580	76.95	285.84		76.95	285.84		0.00	0.00	76.95	285.84		0.00	0.00
50-yr	7000	1020	78.72	287.95		78.72	287.95		0.00	0.00	78.72	287.95		0.00	0.00
100-yr	7000	1280	79.33	288.68		79.33	288.68		0.00	0.00	79.33	288.68		0.00	0.00
500-yr	7000	1940	80.63	325.00		80.63	325.00		0.00	0.00	80.63	325.00		0.00	0.00
100-yr floodway	7000	1280	80.07	100.00	0.74	80.07	100.00	0.74	0.00	0.00	80.07	100.00	0.74	0.00	0.00
	BEGIN HECRAS MODEL														

APPENDIX 6
CATEGORICAL EXCLUSION FORM

Florence & Hutcheson

CONSULTING ENGINEERS

January 25, 2010

Tracy Morris
EEP Project Manager
2728 Capital Boulevard, Suite 1H103
Raleigh, NC 27604

Subject: UT to Neuse (Big Ditch) Stream Restoration
EEP Contract # 090776201
Categorical Exclusion

Dear Ms. Morris,

The UT to Neuse (Big Ditch) Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Attached is the Categorical Exclusion, all supporting documentation and any relevant correspondence for the UT to Neuse (Big Ditch) Site in Wayne County, North Carolina. The purpose of Categorical Exclusion documentation is to assist the North Carolina Ecosystem Enhancement Program (EEP) in satisfying the Federal Highway Administration's (FHWA) obligation to ensure compliance with various federal environmental laws and regulations.

Correspondence between Florence & Hutcheson and any federal or state agency is included within the supporting documentation of the Categorical Exclusion, with the intent of providing justification for satisfied compliance with each regulation. This includes correspondence and/or responses from: the US Fish and Wildlife Service; the North Carolina Wildlife Resources Commission; the North Carolina State Historic Preservation Office; the Natural Resources Conservation Service; and the National Oceanic and Atmospheric Administration.

We thank you in advance for your timely response and cooperation.

Sincerely,
Florence & Hutcheson

R. Kevin Williams, PE, PLS

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: kwilliams@flohut.com

Environmental Documentation
for
UT to Neuse Stream Restoration Site

EEP Contract Number 090776201

Categorical Exclusion Form Items

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

- CERCLA
  - Not applicable, as the project is not a full-delivery project.

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

- Uniform Act
  - Not applicable, as the project is not a full-delivery project.

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

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

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

- Endangered Species Act
  - See the attached letter to the US Fish and Wildlife Service, who had no comment on the project.
  - There are two Federally Endangered species (red-cockaded woodpecker, bald eagle) known to occur in Wayne County. There is no suitable habitat for either of the species within the Site, resulting in a biological conclusion of No Effect for either of the relevant species.
  - Letters were mailed on January 8th, 2010; initial follow-up phone calls were made on January 25th, 2010 with no response.
  - The USFWS did not provide comments.

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

- Farmland Protection Policy Act
    - The NRCS determined that there was no prime, unique, statewide or locally important farmland within the Site.
    - See the attached letter from the NRCS.

- Fish and Wildlife Coordination Act
    - See the attached letter to the USFWS and the NC Wildlife Resources Commission, who had no comment on the project.
    - Letters were mailed on January 8th, 2010; initial follow-up phone calls were made on January 25th, 2010 with no response.
    - The USFWS and the NCRWC did not provide comments.
- Land and Water Conservation Act
    - Not applicable. The project will not convert recreation lands.

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

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

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

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	UT to Neuse (Big Ditch) Stream Restoration
County Name:	Wayne
EEP Number:	Contract # 090776201
Project Sponsor:	Florence & Hutcheson
Project Contact Name:	Kevin Williams, PE, PLS, CPESC, CPSWQ
Project Contact Address:	5121 Kingdom Way, Suite 100, Raleigh, NC 27607
Project Contact E-mail:	kwilliams@flohut.com
EEP Project Manager:	Tracy Morris

Project Description

The UT to Neuse Stream Restoration Site (Site) is located on parcels within the City of Goldsboro in Wayne County, North Carolina. The project is located immediately south of East Elm Street and is adjacent to the City of Goldsboro's Willow Dale Cemetery (Lat 35.373 Long 77.995) in Wayne County. The project site is adjacent to a cemetery and a vacant field within the floodplain of the UT Neuse (Big Ditch). Vegetation is sparse with only 2-5 year old trees lining the cemetery side of the existing channel.

For Official Use Only

Reviewed By:

Date | **EEP Project Manager**

Conditional Approved By:

Date | **For Division Administrator FHWA**

☐ **Check this box if there are outstanding issues**

Final Approval By:

Date | **For Division Administrator FHWA**

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

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

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

Florence & Hutcheson
CONSULTING ENGINEERS

January 8, 2010

Richard H. Brooks
Resource Soil Scientist
NRCS, 2736 NC Hwy 210
Smithfield, NC 27577

Subject: UT to Neuse (Big Ditch) Stream Restoration Site, Wayne County.

Dear Mr. Brooks,

The purpose of this letter is to request your assistance in completing the Farmland Conversion Impact Rating USDA Form AD-1006, along with review and comment on any possible issues that might emerge with respect to the Farmland Protection Policy Act (FPPA) from the proposed UT to Neuse (Big Ditch) Stream Restoration project. The project location, watershed area, and soil survey are depicted on the attached maps.

The UT to Neuse (Big Ditch) Stream Restoration Site includes approximately 2,100 linear feet of UT to Neuse River located within the city of Goldsboro in Wayne County, North Carolina (see attached figures). The Site stream is characterized by areas of degradation. The primary restoration activities at the Site include 1) construction of a stable, riffle-pool stream channel, 2) reconnect Site streams with the historic floodplain or excavated floodplain, 3) eliminate invasive vegetative species, 4) minimize disturbance to existing mature vegetation, 5) creation of a natural vegetative buffer along Site streams, and 6) establishment of a conservation easement.

We thank you in advance for your timely response concerning the completion of USDA Form AD-1006 from your office for the FPPA. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with this project.

Sincerely,
Florence & Hutcheson, Inc.

Nathan Lamb

cc:
Tracy Morris
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: nlamb@flohut.com

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 1/5/10
Name Of Project UT to Neuse Stream Restoration Site	Federal Agency Involved Federal Highway Administration
Proposed Land Use Stream restoration	County And State Robeson, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☐	No ☐	Acres Irrigated	Average Farm Size
Major Crop*(s)*	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined in FPPA Acres: %	
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	0.4			
B. Total Acres To Be Converted Indirectly	12.4			
C. Total Acres In Site	12.9	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		0	0	0

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

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

Reason For Selection:

(See Instructions on reverse side) **Form AD-1006 (10-83)**

This form was electronically produced by National Production Services Staff

United States Department of Agriculture

Natural Resources Conservation Service

2736 NC Hwy 210
Smithfield, NC 27577
919-934-7156, ext 139
(919) 989-5659 (FAX)

Subject: Farmland Conversion Impact Rating (Form AD1006) **Date:** January 14, 2010

To: Florence & Hutchenson **File Code:** 310-11-11

Nathan Lamb

5121 Kingdom Way, Suite 100

Raleigh, North Carolina 27607

The following information is in response to your request asking for information on farmlands in the project are for the Neuse Stream Restoration Project, also known as Big Ditch.

Prime farmland does not include land already in or committed to urban development or water storage. Other Prime Farmland "already in" urban development includes all land that has been designated for commercial or industrial use or residential use that is not intended at the same time to protect farmland in a,

1. Zoning code or ordinance adopted by the state or local unit of government or,

2. A comprehensive land use plan which has expressly been either adopted or reviewed in its entirety by the unit of local government in whose jurisdiction it is operative within 10 years preceding the implementation of the project or,

3. When funds have already been committed for utilities, water lines, and road replacement and widening, the land is committed to development and can be exempt from having to make determination.

The area in question meets the above criteria. You will NOT need to complete a Farmland Conversion Impact Rating form (AD1006), according to Federal Register 7CFR Part 658, Farmland Protection Policy Act; 1-1-99 Edition.

If you have any other concern please feel free to call me at (919) 934-7156, ext. 139.

Richard Brooks
Resource Soil Scientist
Richard.brooks@nc.nrcs.usda.gov

Florence & Hutcheson
CONSULTING ENGINEERS

January 8, 2010

Ron Sechler
NOAA-Fisheries
Beaufort Field Office
101 Pivers Island Road
Beaufort, NC 28516

Subject: EEP stream mitigation project in Wayne County.

Dear Mr. Sechler,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to endangered species and essential fish habitat issues associated with a potential stream restoration project on the attached site (USGS site maps with approximate proposed easement boundaries and areas of potential ground disturbance are enclosed).

The UT to Neuse (Big Ditch) Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded.

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

Sincerely,
Florence & Hutcheson

Nathan Lamb

cc:
Tracy Morris
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: nlamb@flohut.com

Florence & Hutcheson
CONSULTING ENGINEERS

January 8, 2010

Shannon Deaton
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Subject: EEP stream mitigation project in Wayne County.

Dear Ms. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential stream restoration project on the attached site (USGS site maps with approximate proposed easement boundaries and areas of potential ground disturbance are enclosed).

The UT to Neuse (Big Ditch) Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded.

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

Sincerely,
Florence & Hutcheson

Nathan Lamb

cc:
Tracy Morris
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: nlamb@flohut.com

Florence & Hutcheson
CONSULTING ENGINEERS

January 8, 2010

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

Subject: EEP stream mitigation project in Wayne County.

Dear Ms. Gledhill-Earley,

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream restoration project on the attached site (USGS site maps with approximate proposed easement boundaries and areas of potential ground disturbance are enclosed)

The UT to Neuse (Big Ditch) Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded.

No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. In addition, the majority of the site has historically been disturbed due to agricultural purposes such as tilling. Enclosed are current photos of the site.

We ask that you review this site based on the attached information to determine the presence of any historic properties.

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

Sincerely,
Florence & Hutcheson

Nathan Lamb

cc:
Tracy Morris
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: nlamb@flohut.com

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

Beverly Eaves Perdue, Governor
Linda A. Carlisle, Secretary
Jeffrey J. Crow, Deputy Secretary

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

January 19, 2010

Nathan Lamb
Florence & Hutcheson
5121 Kingdom Way
Suite 100
Raleigh, NC 27607

Re: Unnamed Tributary to Neuse Stream Restoration, Wayne County, ER 10-0091

Dear Mr. Lamb:

Thank you for your letter of January 8, 2010, concerning the above project.

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

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

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

Florence & Hutcheson
CONSULTING ENGINEERS

January 8, 2010

Dale Suiter
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726

Subject: EEP stream mitigation project in Wayne County.

Dear Mr. Suiter,

The UT to Neuse (Big Ditch) Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Several sections of channel have been identified as significantly degraded.

We have already obtained an updated species list for Wayne County from your web site (http://nc-es.fws.gov/es/countyfr.html). The threatened or endangered species for this county are: bald eagle and red-cockaded woodpecker. We are requesting that you please provide any known information for each species in the county. Suitable habitat (pine stands over 60 years of age; large, living trees) for either species does not exist within the Site.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of a stream restoration project on the subject property. A USGS map showing the approximate proposed easement boundary and areas of potential ground disturbance is enclosed.

If we have not heard from you in 30 days we will assume that our species list is correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

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

Sincerely,
Florence & Hutcheson

Nathan Lamb

cc:
Tracy Morris
EEP Project Manager
1652 Mail Service Center
Raleigh, NC 27699

5121 Kingdom Way, Suite 100 • Raleigh, North Carolina 27607 • (919) 851-6066 • fax (919) 851-6846
e-mail: nlamb@flohut.com

APPENDIX 7
EEP FLOODPLAIN REQUIREMENTS CHECKLIST

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. Edward Curtis), NC Floodplain Mapping Unit (attn. John Gerber) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Big Ditch Stream Restoration
Name if stream or feature:	Big Ditch
County:	Wayne
Name of river basin:	Neuse
Is project urban or rural?	Urban
Name of Jurisdictional municipality/county:	City of Goldsboro and Wayne County
DFIRM panel number for entire site:	3720258800J and 3720350900J
Consultant name:	Ko/Florence & Hutcheson
Phone number:	(919) 851-6066
Address:	5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607

Design Information

The project site is located on parcels within the City of Goldsboro. The project is located immediately south of East Elm Street and is adjacent to the City of Goldsboro's Willow Dale Cemetery (Lat 35.373 Long 77.995) in Wayne County. The project site is adjacent to a cemetery and a vacant field within the floodplain of the Big Ditch. Vegetation is sparse with only 2-5 year old trees lining the cemetery side of the existing channel. The primary goal of the project is to restore the existing stream with a stable pattern, dimension and profile. The estimated restored stream length will be approximately 2,120 linear feet (2,100 feet existing).

Restoration Segment/ Reach ID	Station Range	Restoration Type	Priority Approach	Existing Linear Footage/ Acreage	Designed Linear Footage/ Acreage	Comment
UT to the Neuse	--	Stream, Riparian Buffer and Nutrient Offset Buffer Restoration	PII	2,100	2,120	

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

☑ Yes ☐ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☑ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: AE & X

Check if applies:

- [x] AE Zone
  - [x] Floodway
  - [ ] Non-Encroachment
  - [ ] None
- [ ] A Zone
  - [ ] Local Setbacks Required
  - [ ] No Local Setbacks Required

If local setbacks are required, list how many feet:

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

- [x] Yes
- [ ] No

Land Acquisition (Check)

- [ ] State owned (fee simple)
- [x] Conservation easment (Design Bid Build)
- [ ] Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

- [x] Yes
- [ ] No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)

Name of Local Floodplain Administrator: Marty Anderson
Phone Number: (919) 580-4377

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

- ☐ No Action
- ☐ No Rise
- ☑ Letter of Map Revision
- ☐ Conditional Letter of Map Revision
- ☐ Other Requirements

List other requirements:

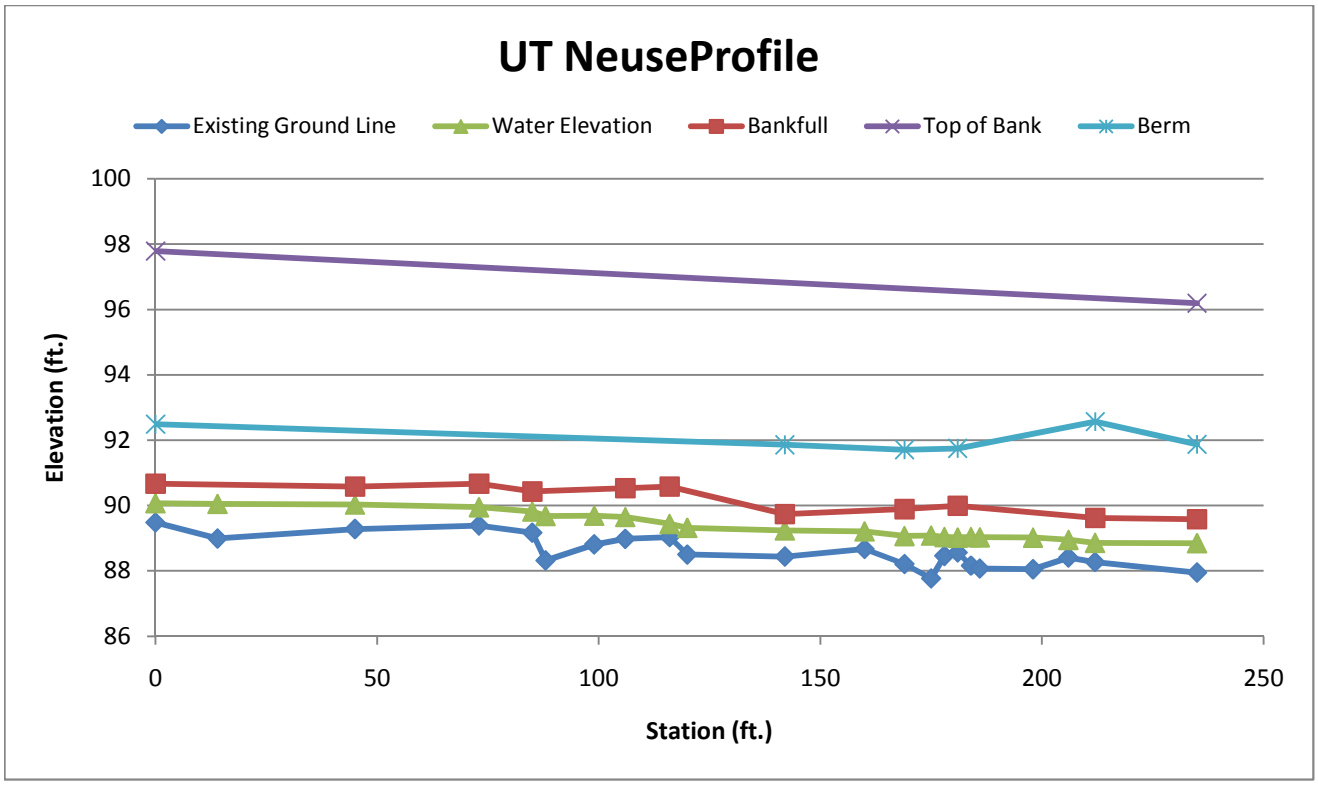
Marty Anderson, City of Goldsboro Director of Engineering and Floodplain Manager, stated that the process would be similar as that of Stoney Creek. He would like for a LOMR to be prepared and submitted after construction. However, He would like for the modeling and documentation to be prepared during the restoration stage and submitted to the City of Goldsboro for review and informational purposes.

Comments:

Name: R. Kevin Williams, PE, PLS_____ Signature: _____

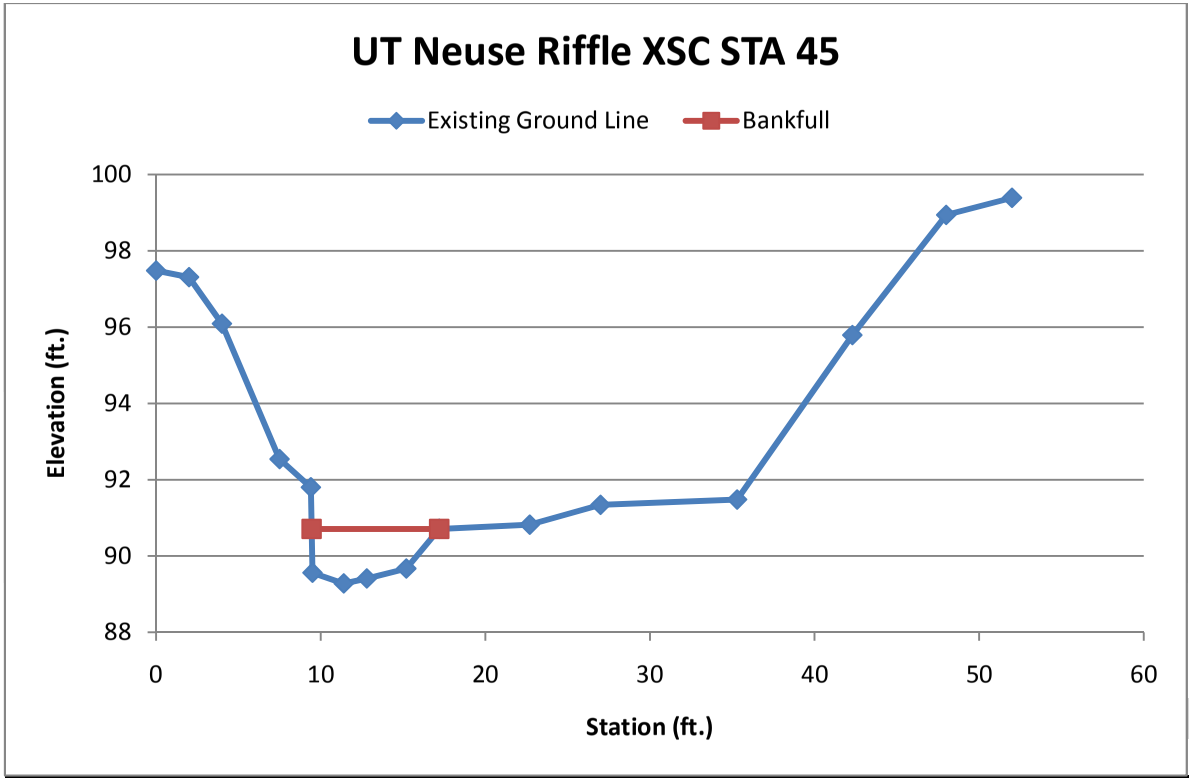
Title: Project Engineer/Manager_____ Date: _____

APPENDIX 8
EXISTING CONDITIONS CROSS SECTIONS AND PROFILES



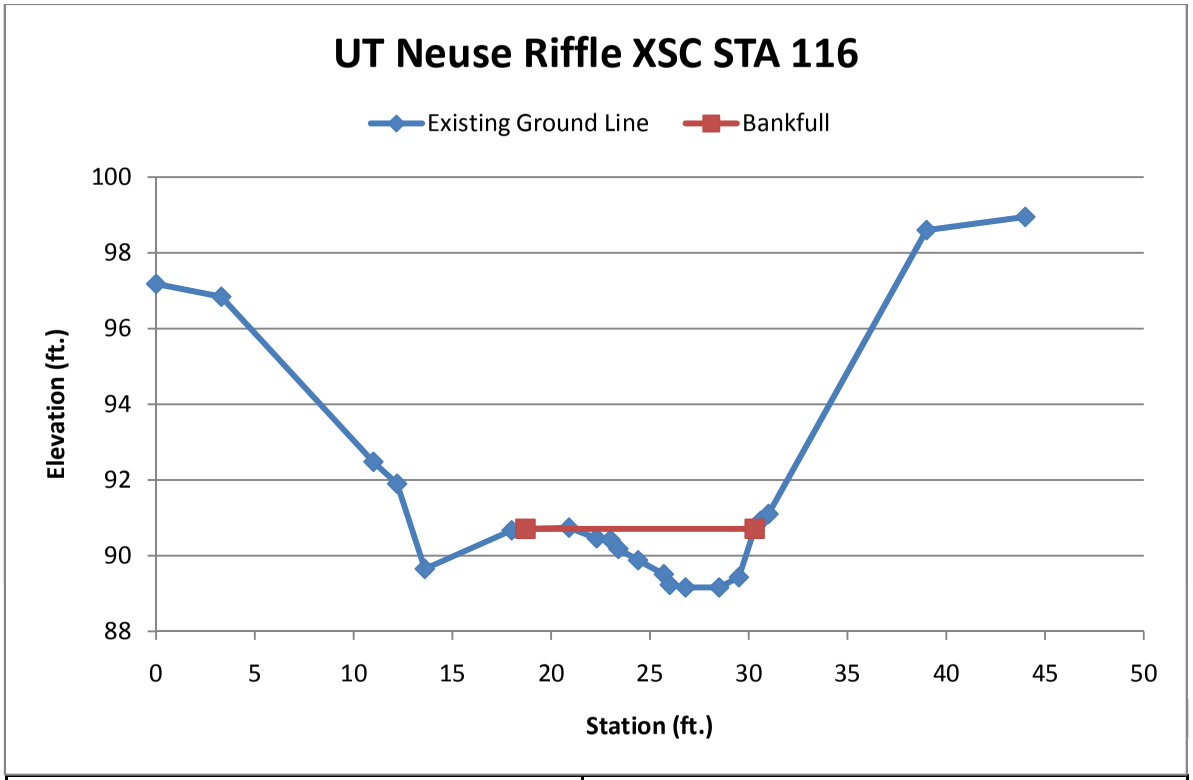
UT Neuse Profile					
STA (ft.)	*Channel Elev. (ft.)*	*Water Elev. (ft.)*	*BKF Elev. (ft.)*	*Top Bank Elev. (ft.)*	*Berm Elev. (ft.)*
0	89.48	90.07	90.67	97.79	92.49
14	88.99	90.05			
45	89.28	90.03	90.58		
73	89.39	89.95	90.67		
85	89.17	89.82	90.43		
88	88.32	89.68			
99	88.81	89.69			
106	88.98	89.65	90.53		
116	89.03	89.44	90.58		
120	88.5	89.32			
142	88.44	89.24	89.74		91.86
160	88.67	89.21			
169	88.21	89.07	89.89		91.71
175	87.77	89.08			
178	88.46	89.04			
181	88.56	89.02	89.99		91.75
184	88.16	89.04			
186	88.07	89.03			
198	88.05	89.02			
206	88.41	88.95			
212	88.27	88.86	89.62		92.57
235	87.95	88.85	89.58	96.19	91.87

UT Neuse Pool XSC STA 45		
Station (ft.)	*Elevation (ft.)*	*Feature*
0	97.48	
2	97.31	
4	96.09	
7.5	92.54	
9.4	91.8	
9.5	89.56	
11.4	89.28	
12.8	89.41	
15.2	89.67	
17.2	90.71	BKF
22.7	90.82	
27	91.34	
35.3	91.48	
42.3	95.79	
48	98.94	
52	99.39	



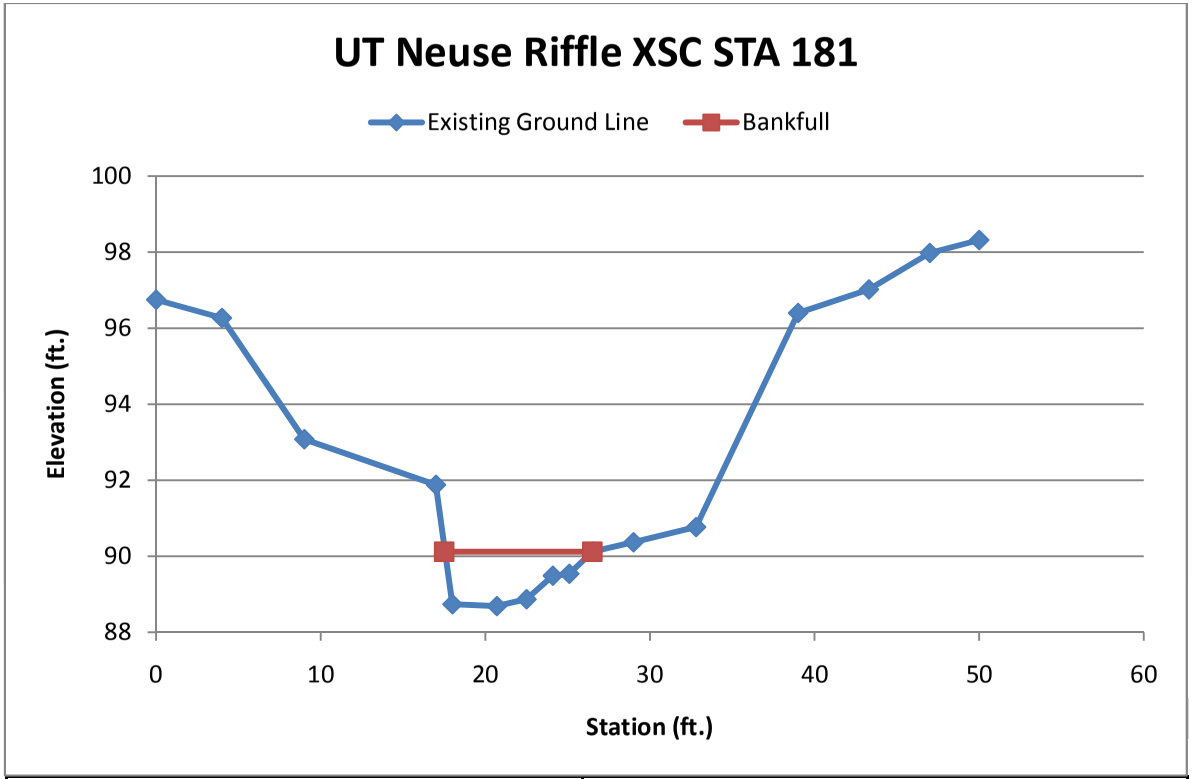
Bankfull Width (ft.):	17.5	*Mean Depth (ft.):*	0.99
Bankfull Area (ft. ²)	17.24	*Max Depth (ft.):*	2.05
Entrenchment Ratio (ft.):	1.81	*Width/Depth Ratio (ft.):*	17.68

UT Neuse Riffle XSC STA 116		
Station (ft.)	*Elevation (ft.)*	*Feature*
0	97.18	
3.3	96.84	
11	92.48	
12.2	91.9	
13.6	89.65	
18	90.67	
18.7	90.71	
20.9	90.74	
22.3	90.46	
23	90.42	
23.4	90.18	
24.4	89.88	
25.7	89.51	
26	89.23	
26.8	89.16	
28.5	89.16	
29.5	89.43	
30.3	90.71	BKF
30.6	90.92	
31	91.1	
39	98.6	
44	98.95	



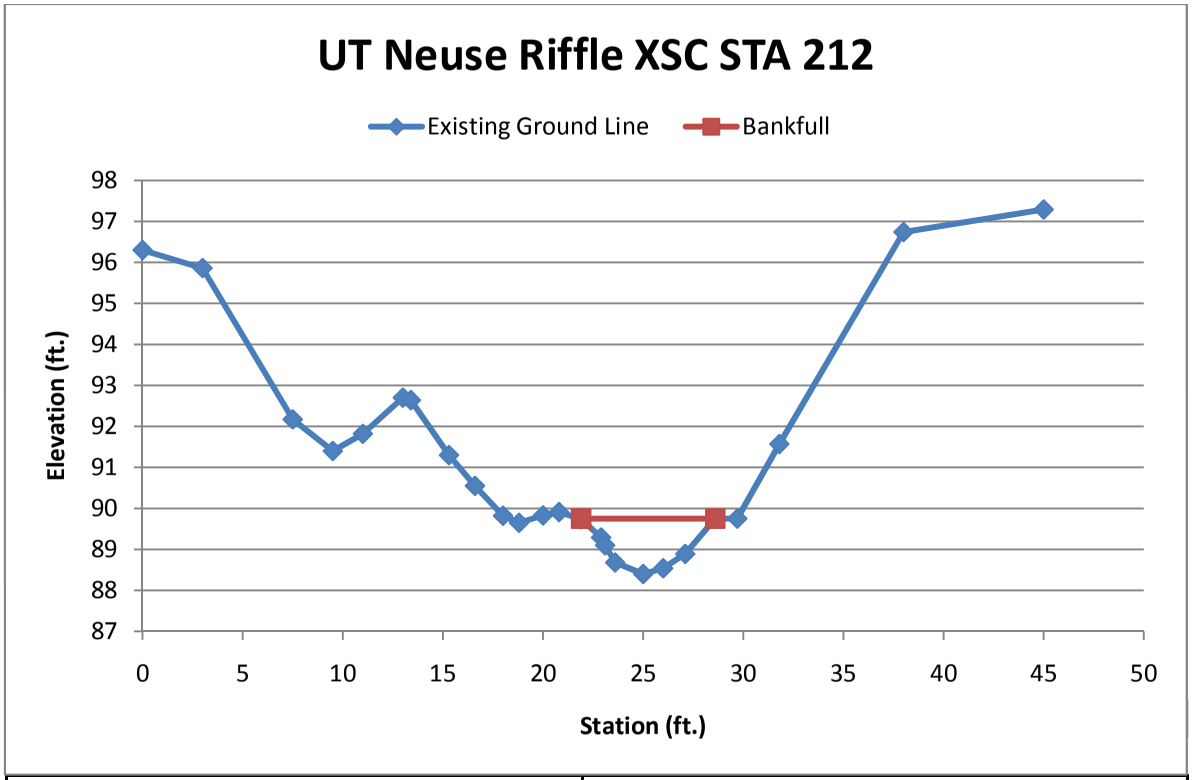
Bankfull Width (ft.):	15.01	*Mean Depth (ft.):*	0.76
Bankfull Area (ft.²)	11.47	*Max Depth (ft.):*	1.55
Entrenchment Ratio (ft.):	1.38	*Width/Depth Ratio (ft.):*	19.75

UT Neuse Riffle XSC STA 181		
Station (ft.)	*Elevation (ft.)*	*Feature*
0	96.75	
4	96.27	
9	93.08	
17	91.88	
18	88.74	
20.7	88.69	
22.5	88.87	
24.1	89.49	
25.1	89.54	
26.5	90.12	BKF
29	90.37	
32.8	90.77	
39	96.4	
43.3	97.02	
47	97.98	
50	98.32	



Bankfull Width (ft.):	8.94	*Mean Depth (ft.):*	1.01
Bankfull Area (ft. ²)	9.02	*Max Depth (ft.):*	1.43
Entrenchment Ratio (ft.):	1.85	*Width/Depth Ratio (ft.):*	8.85

UT Neuse Riffle XSC STA 212		
Station (ft.)	*Elevation (ft.)*	*Feature*
0	96.3	
3	95.86	
7.5	92.17	
9.5	91.4	
11	91.82	
13	92.70	
13.4	92.64	
15.3	91.30	
16.6	90.55	
18	89.82	
18.8	89.65	
20	89.83	
20.8	89.91	
21.9	89.74	
22.9	89.29	
23.1	89.1	
23.6	88.68	
25	88.4	
26	88.54	
27.1	88.89	
28.6	89.75	BKF
29.7	89.75	
31.8	91.57	
38	96.74	
45	97.29	



Bankfull Width (ft.):	10.49	*Mean Depth (ft.):*	0.61
Bankfull Area (ft. ²)	6.37	*Max Depth (ft.):*	1.43
Entrenchment Ratio (ft.):	1.53	*Width/Depth Ratio (ft.):*	17.2

APPENDIX 9
STORMWATER WETLAND DESIGN

UT TO THE NEUSE STREAM RESTORATION

Stormwater Wetland UTNeuse

Soil Hydrologic Groups (% of Site Area)	
Group A	0.00%
Group B	7.90%
Group C	92.10%
Group D	0.00%

Stormwater Wetland at Top of UT Neuse

Precipitation= 0.50

Land Use Entry	Proposed Land Use			
	Area (ft2)	CN	S	R/O
Pervious Areas				
Row Crops	0			
A Soils		67	4.9	0.0
B Soils	0	78	2.8	0.0
C Soils	0	85	1.8	0.0
D Soils		89	1.2	0.0
Pasture	0			
A Soils		49	10.4	0.0
B Soils	0	69	4.5	0.0
C Soils	0	79	2.7	0.0
D Soils		84	1.9	0.0
Forest	188,738			
A Soils		36	17.8	0.0
B Soils	14,910	60	6.7	147.9
C Soils	173,828	73	3.7	240.7
D Soils		79	2.7	0.0
Wetland	0			
A Soils		36	17.8	0.0
B Soils	0	60	6.7	0.0
C Soils	0	73	3.7	0.0
D Soils		79	2.7	0.0
Meadow	0			
A Soils		30	23.3	0.0
B Soils	0	58	7.2	0.0
C Soils	0	71	4.1	0.0
D Soils		78	2.8	0.0
Lawn	363,329			
A Soils		39	15.6	0.0
B Soils	28,703	61	6.4	258.3
C Soils	334,626	74	3.5	346.1
D Soils		80	2.5	0.0
Impervious Areas				
Residential & Light Industrial				
Rooftops	90,843	98.0	0.2	2406.6
Driveways & Parking Lots	181,245	98.0	0.2	4801.4
Other Impervious Area	0	98.0	0.2	0.0
Road	0	98.0	0.2	0.0
Sidewalk	0	98.0	0.2	0.0
Commercial & Heavy Industrial				
Rooftops	0	98.0	0.2	0.0
Parking Lots	0	98.0	0.2	0.0
Other Impervious Area	0	98.0	0.2	0.0
Road	0	98.0	0.2	0.0
Sidewalk	0	98.0	0.2	0.0
Storm Water Management Facilities				
Pond/Wetland Surface Area	0	98.0	0.2	0.0
Permeable Pavement	0	98.0	0.2	0.0
Green Roof	0	98.0	0.2	0.0
All Other BMPs (except Forested Buffer)	0	73.0	3.7	0.0

Site Totals:

824155.00 SF

18.92 Ac

Weighted Curve Number 81.01

Volume to Treat 8,201 CF

UT TO THE NEUSE STREAM RESTORATION

Stormwater Wetland UTNeuse

Curve Numbers (assuming fair condition)		Rational C's		
Pervious Areas		slope < 2%	slope 2%-6%	slope > 6%
Row Crops				
A Soils	**67**	**0.20**	**0.25**	**0.30**
B Soils	**78**	**0.26**	**0.30**	**0.34**
C Soils	**85**	**0.30**	**0.35**	**0.40**
D Soils	**89**	**0.35**	**0.40**	**0.45**
Pasture				
A Soils	**49**	**0.07**	**0.12**	**0.17**
B Soils	**69**	**0.13**	**0.20**	**0.27**
C Soils	**79**	**0.19**	**0.26**	**0.33**
D Soils	**84**	**0.22**	**0.32**	**0.42**
Forest				
A Soils	**36**	**0.07**	**0.10**	**0.13**
B Soils	**60**	**0.10**	**0.13**	**0.16**
C Soils	**73**	**0.12**	**0.15**	**0.18**
D Soils	**79**	**0.14**	**0.18**	**0.22**
Wetland				
A Soils	**36**	**0.07**	**0.10**	**0.13**
B Soils	**60**	**0.10**	**0.13**	**0.16**
C Soils	**73**	**0.12**	**0.15**	**0.18**
D Soils	**79**	**0.14**	**0.18**	**0.22**
Meadow				
A Soils	**30**	**0.07**	**0.10**	**0.14**
B Soils	**58**	**0.11**	**0.14**	**0.17**
C Soils	**71**	**0.17**	**0.20**	**0.23**
D Soils	**78**	**0.21**	**0.24**	**0.27**
Lawn				
A Soils	**39**	**0.15**	**0.20**	**0.25**
B Soils	**61**	**0.20**	**0.25**	**0.30**
C Soils	**74**	**0.25**	**0.30**	**0.35**
D Soils	**80**	**0.28**	**0.35**	**0.42**
Impervious Areas				
Residential & Light Industrial				
Rooftops	**98**	**0.94**	**0.95**	**0.96**
Driveways & Parking Lots	**98**	**0.94**	**0.95**	**0.96**
Other Impervious Area	**98**	**0.94**	**0.95**	**0.96**
Road	**98**	**0.94**	**0.95**	**0.96**
Sidewalk	**98**	**0.94**	**0.95**	**0.96**
Commercial & Heavy Industrial				
Rooftops	**98**	**0.94**	**0.95**	**0.96**
Parking Lots	**98**	**0.94**	**0.95**	**0.96**
Other Impervious Area	**98**	**0.94**	**0.95**	**0.96**
Road	**98**	**0.94**	**0.95**	**0.96**
Sidewalk	**98**	**0.94**	**0.95**	**0.96**
Storm Water Management Facilities				
Pond/Wetland Surface Area	**98**	**0.95**	**0.95**	**0.95**
Permeable Pavement	**98**	**0.95**	**0.95**	**0.95**
Green Roof	**98**	**0.95**	**0.95**	**0.95**
All Other BMPs (except Forested Buffer)				
A Soils	**39**	**0.15**	**0.20**	**0.25**
B Soils	**61**	**0.20**	**0.25**	**0.30**
C Soils	**74**	**0.25**	**0.30**	**0.35**
D Soils	**80**	**0.28**	**0.35**	**0.42**

Design of Stormwater Wetlands
Bill Hunt Method August 2006 Workshop

Calculate Surface Area

Volume to Treat =	8,201 CF
Allowable Depth =	9 inches
Surface Area =	**10934.61 SF**
	0.25 Ac

Deep Water Zone 18-36" Depth	**15% of SA**	**1640 Square Feet**
Shallow Water 3-4" Depth	**50% of SA**	**5467 Square Feet**
Shallow Land Wet Only When Raining	**35% of SA**	**3827 Square Feet**

Forebay Design

Required Forebay Surface Area is 15% of SA

15% of SA	**1640 Square Feet**

Upper Neuse Site Evaluation Tool - Site Performance Analysis

UT to the Neuse
Goldsboro, NC
Stormwater Wetland

Land Use Summary

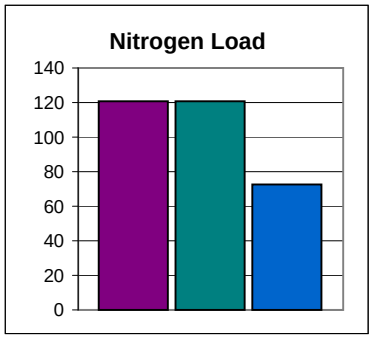
Total Site Area (acres)	**18.92**
Pre-development impervious percentage	**33.0%**
Post-development impervious percentage	**33.0%**

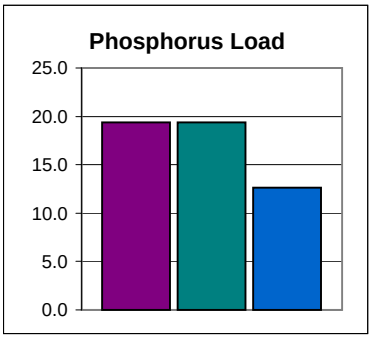
Annual Hydrology Summary

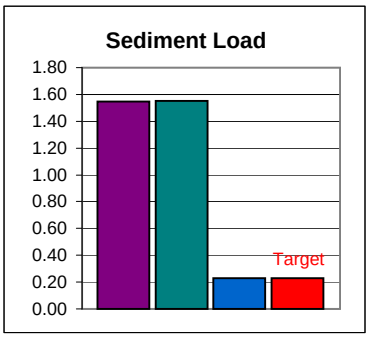
	Existing Landuse	Design without BMPs	Design with BMPs
Annual Surface Runoff (inches/yr)	**13.98**	**13.98**	**12.58**
Annual Infiltration (inches/yr)	**3.77**	**3.77**	**3.77**

Annual Pollutant Load and Target Summary

Total Site Annual Load	Existing Landuse	Design without BMPs	Design with BMPs	Target	Meets Goal?
Total Nitrogen (lb/yr)	**121**	**121**	**72**		
Total Phosphorus (lb/yr)	**19.4**	**19.4**	**12.6**		
Sediment (ton/yr)	**1.55**	**1.55**	**0.23**	**0.23**	**Yes**

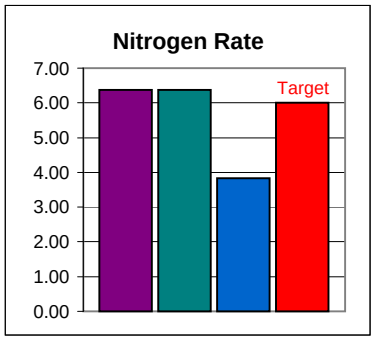


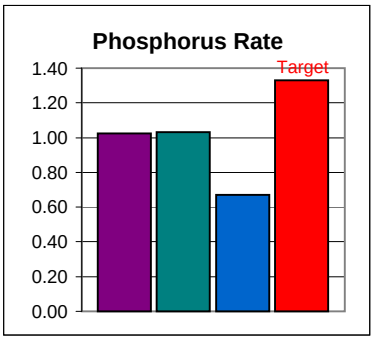


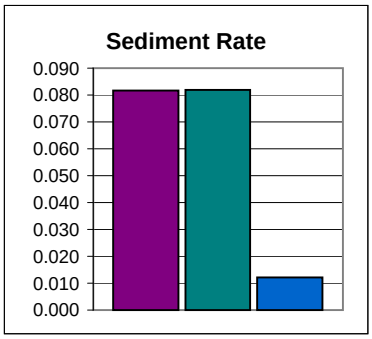


Areal Loading Rates	Existing Landuse	Design without BMPs	Design with BMPs	Target	Meets Goal?
Total Nitrogen (lb/ac/yr)	**6.38**	**6.38**	**3.83**	**6.00**	**Yes**
Total Phosphorus (lb/ac/yr)	**1.03**	**1.03**	**0.67**	**1.33**	**Yes**
Sediment (ton/ac/yr)	**0.082**	**0.082**	**0.012**		

Site is located in Urban Residential Nutrient Zone
TN loading rate is within the buy-down range of 3.6 to 6 lb/ac/yr







UT TO THE NEUSE STREAM RESTORATION

Model Output

Storm Event Runoff Volume and Target Summary

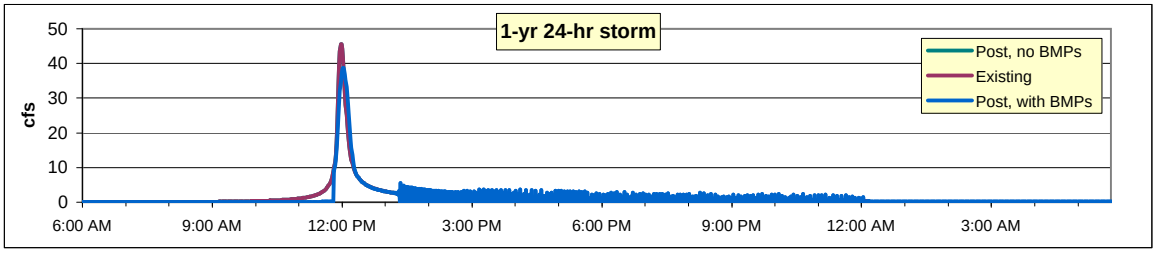
Runoff Volume (ac-ft)	Existing Landuse	Design without BMPs	BMP Storage Volume
No storm events selected			

Storm Event Not Selected	Storm Event Not Selected	Storm Event Not Selected	Storm Event Not Selected

Peak Flow and Hydrograph Summary

Estimated Peak Flows, Rational and SCS Unit Hydrograph Methods	Existing Landuse		Design without BMPs	
	Rational	Unit Hyd	Rational	Unit Hyd
1-yr 24-hr storm (cfs)	39.62	45.66	39.62	45.66

Comparison of SCS peak to Design with BMPs	Design without BMPs	Design with BMPs	Source	Target	Meets Goal?
1-yr 24-hr storm (cfs)	45.66	20.99	User-defined	45.66	Yes



APPENDIX 10
BEHI AND NBS ASSESSMENT

UT Neuse: Sediment Loss Along Banks							
Stream:		UT Neuse	Total Bank Length:	2205'	Stream Type:	B5	
Observers:		CLS/NGL	Date:	2/3/2010	Graph Used:	North Carolina	
	NBS	**BEHI**	**Erosion Rate (ft/yr)**	**Length of Bank (ft)**	**Bank Height (ft)**	**Erosion Sub-total (ft^3/yr)**	**Tons/yr/ft**
1	MODERATE	HIGH	0.15	70	7	74	0.05
2	HIGH	VERY HIGH	1	300	7	2100	0.34
3	MODERATE	VERY HIGH	0.7	40	7	196	0.24
4	VERY HIGH	EXTREME	5	50	7	1750	1.69
5	MODERATE	VERY HIGH	0.7	40	7	196	0.24
6	MODERATE	HIGH	0.15	100	6	90	0.04
7	VERY HIGH	VERY HIGH	1.25	35	6	263	0.36
8	VERY HIGH	EXTREME	5	15	6	450	1.44
9	MODERATE	HIGH	0.15	15	6	14	0.04
10	MODERATE	HIGH	0.15	20	6	18	0.04
11	MODERATE	HIGH	0.15	25	6	23	0.04
12	MODERATE	HIGH	0.15	70	8	84	0.06
13	MODERATE	HIGH	0.15	75	8	90	0.06
14	MODERATE	VERY HIGH	0.7	90	8	504	0.27
15	HIGH	EXTREME	4	50	8	1600	1.54
16	MODERATE	VERY HIGH	0.7	10	8	56	0.27
17	HIGH	EXTREME	4	25	8	800	1.54
18	MODERATE	HIGH	0.15	30	8	36	0.06
19	HIGH	VERY HIGH	1	75	8	600	0.39
20	HIGH	EXTREME	4	40	9	1440	1.73
21	MODERATE	VERY HIGH	0.7	40	9	252	0.30
22	MODERATE	HIGH	0.15	40	9	54	0.07
23	HIGH	VERY HIGH	1	65	9	585	0.43
24	MODERATE	HIGH	0.15	65	9	88	0.07
25	MODERATE	HIGH	0.15	110	7	116	0.05
26	HIGH	VERY HIGH	1	190	7	1330	0.34
27	HIGH	HIGH	0.2	105	7	147	0.07
28	MODERATE	VERY HIGH	0.7	50	7	245	0.24
29	MODERATE	VERY HIGH	0.7	85	6	357	0.20
30	HIGH	EXTREME	4	30	6	720	1.16
31	VERY HIGH	HIGH	0.275	45	6	74	0.08
32	EXTREME	EXTREME	8	25	7	1400	2.70
33	MODERATE	HIGH	0.15	55	7	58	0.05
34	HIGH	HIGH	0.2	125	8	200	0.08
35							
I. Sum erosion sub-totals for each BEHI/NBS combination					**Total Erosion (ft3/yr)**	16007	
II. Divide total erosion (ft^3) by 27 ft^3/yd^3					**Total Erosion (yd3/yr)**	593	
III. Multiply total erosion (yd^3) by 1.3 (conversion of yd^3 to tons for average material type)					**Total Erosion (tons/yr)**	771	
IV. Divide tons/yr by total length of bank					**Tons/yr/ft**	0.35	

LEGEND

NBS	BEHI	
Moderate	High	
Moderate	Very High	
High	High	
High	Very High	
High	Extreme	
Very High	High	
Very High	Very High	
Very High	Extreme	
Extreme	Extreme	

Ecosystem Enhancement Program

Florence & Hutcheson, Inc.
Consulting Engineers
5121 KINGDOM WAY, SUITE 100 RALEIGH, N.C. 27607
(919) 851-6066

ISLER STREET

ODELL STREET

ANNABELLE STREET

EAST ELM STREET

CONSERVATION EASEMENT

UT NEUSE (BIG DITCH)

Flow Direction

8" DIP SEWERLINE EXPOSED IN CHANNEL

METAL BLDG

CONC

WILLOWDALE CEMETERY

CONSERVATION EASEMENT

-MATCHLINE- STATION 22+00 SEE SHEET 1B

SCALE: 50 0 50 100

BEHI and NBS

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 02/10

Sheet 1A

Ecosystem Enhancement PROGRAM

Florence & Hutcheson, Inc.
CONSULTING ENGINEERS
5121 KINGDOM WAY, SUITE 100 RALEIGH, N.C. 27607
(919) 851-6066

OLIVIA LANE

ANNABELLE STREET

MAPLE STREET

JOSEPH STREET

EMH #9

EMH #10

SS

60" RCP

CONSERVATION EASEMENT

Flow Direction

UT NEUSE (BIG DITCH)

30" DIP SEWERLINE EXPOSED IN CHANNEL

WILLOWDALE CEMETERY

-MATCHLINE- STATION 22+00 SEE SHEET 1A

N

LEGEND

NBS	BEHI
Moderate	High
Moderate	Very High
High	High
High	Very High
High	Extreme
Very High	High
Very High	Very High
Very High	Extreme
Extreme	Extreme

50 0 50 100
SCALE

BEHI and NBS

UT to Neuse (Big Ditch)
Stream Mitigation Plan
Wayne County, North Carolina

Date: 02/10

Sheet 1B

APPENDIX 11
FEDERAL REGISTER TITLE 33 REQUIREMENTS

This document is consistent with the requirements of the federal rule for compensatory mitigation project sites as described in the Federal RegisterTitle 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8 paragraphs (c)(2) through (c)(14). Specifically the document addresses the following requirements of the federal rule:

- (2) *Objectives.* A description of the resource type(s) and amount(s) that will beprovided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.
- (3) *Site selection.* A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation project site. (See § 332.3(d).)
- (4) *Site protection instrument.* A description of the legal arrangements and instrument, including site ownership, that will be used to ensure the long-term protection of the compensatory mitigation project site (see § 332.7(a)).
- (5) *Baseline information.* A description of the ecological characteristics of the proposed compensatory mitigation project site and, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other site characteristics appropriate to the type of resource proposed as compensation. The baseline information should also include a delineation of waters of the United States on the proposed compensatory mitigation project site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site, not the mitigation bank or in-lieu fee project site.
- (6) *Determination of credits.* A description of the number of credits to be provided, including a brief explanation of the rationale for this determination. (See § 332.3(f).)
- (7) *Mitigation work plan.* Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as plan form geometry, channel form (e.g. typical channel cross-sections), watershed size, design discharge, and riparian area plantings.
- (8) *Maintenance plan.* A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

- (9) *Performance standards.* Ecologically-based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives. (See § 332.5.)
- (10) *Monitoring requirements.* A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting on monitoring results to the district engineer must be included. (See § 332.6.)
- (11) *Long-term management plan.* A description of how the compensatory mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management. (See § 332.7(d).)
- (12) *Adaptive management plan.* A management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success. (See § 332.7(c).)
- (13) *Financial assurances.* A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with its performance standards (see § 332.3(n)).“