Farrar Dairy Site
Stream & Wetland Restoration Plan

Harnett County, North Carolina

State Contract No. D06002

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Ecosystem Enhancement PROGRAM
NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699-165

May 2008

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KCI Project No. 12065438

Prepared for:
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Raleigh, NC 27699-1652

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EXECUTIVE SUMMARY

The Farrar Dairy Site (FDS) is a full-delivery project being developed for the North Carolina Ecosystem Enhancement Program (EEP). The site offers the opportunity to restore a heavily impacted wetland and stream system in order to improve water quality and aquatic and terrestrial habitat. The project proposes to restore approximately 6,693 linear feet of the North Prong of Anderson Creek (NPAC) as well as restore approximately 4,844 linear feet and enhance 1,420 linear feet of six tributary streams. Wetland restoration, enhancement and preservation will also occur along approximately 112 acres of the NPAC floodplain.

The NPAC is a Sand Hills stream with a contributing drainage area of 5.7 square miles (3,624 acres) at the downstream limits of the site. The downstream limit of the project site is approximately 5.1 river miles upstream of the confluence with the South Prong of Anderson Creek, which is the start of Anderson Creek. The NPAC drains into Anderson Creek, then the Little River to the south, and ultimately to the Cape Fear River. The surrounding area is predominately rural and has low to moderate development pressure at this time. Overall, the project watershed is about 71.9% forest, 20.9% agriculture, 5.2% wetland, 1.3% rangeland, and 0.6% water bodies.

The NPAC has been channelized and straightened beginning in the early 1900's. The entire site has been utilized for agricultural production to include row crops, cattle, and land application of animal wastes for at least 70 years. There are very few in-stream habitat features in the channel and the banks are nearly vertical in many areas. The channel can be characterized as having poor streambed variability and habitat diversity.

The FDS offers the opportunity to restore a significant headwater stream system within the Cape Fear River basin. By developing a healthy, interconnected riparian corridor, the site will also help to reduce nutrient and excess sediment inputs. The proposed project reaches were designed as restoration or enhancement based on the measured level of departure from a stable stream system. The NPAC stream will be restored to a C5 type channel, while the tributaries will be restored to C5/B5c, E5, and C5 type channels. Riparian vegetation at the FDS site will be restored using a variety of Coastal Plain Bottomland Hardwood and Coastal Plain Small Stream Swamp species in floodplain areas and Mixed Hardwood Forest species in the stream valleys and slopes leading away from floodplains.

There are approximately 46 acres of wetland preservation on the project site along with approximately 22 acres of wetland enhancement. Approximately 44 acres of drained wetlands will also be restored on the FDS. The bulk of the wetland restoration areas are located on the former floodplain of the NPAC. These areas have been altered through ditching or drain tile installation. Hydrology will be restored by abandoning existing tile and ditch features and restoring the NPAC and contributing tributaries to appropriately sized channels to reconnect these streams with their floodplains and reestablish a flooding regime.

The project goals are to:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish a functional Coastal Plain Small Swamp Stream wetland complex that creates terrestrial and aquatic habitat and connects to the existing floodplain corridor along the NPAC.

In order to meet these goals, the following objectives must be accomplished:

- Restore 11,517 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.

- Connect the streams to functioning floodplains.
- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions to the upper soil horizons.
- Plant the NPAC, its tributaries, riparian corridors, floodplains and upland habitats with herbaceous cover as well as trees and shrubs to create and restore appropriate habitats within the landscape.
- Eliminate existing nutrient source associated with land application of animal waste in proximity to project streams.

The following table summarizes the restoration plan activities proposed at the FDS:

Table 1: Mitigation Summary

Stream Restoration					
Reach	**Proposed Stationing**	**Mitigation Type**	**Priority Approach**	**Existing Linear Footage**	**Designed Linear Footage**
NPAC	10+00-77+24	Restoration	P1	4,565	6,693
T1.1	80+00-88+27	Restoration	P1	864	827
T1.2	90+00-99+86	Restoration	P1	995	986
T1	100+00-108+81	Restoration	P1	389	851
T2A	110+00-115+00	Restoration	P1	977	500
T2B	115+00-120+09	Restoration	P1		509
T3	130+00-141+51	Restoration	P1	1,335	1,151
T4	150+00-164+20	Enhancement II		1,420	1420
Total Stream Restoration					**11,517**
Total Stream Enhancement II					**1,420**
Wetland Enhancement					
Acreage	**Soil Type**	**Mitigation Type**	**Designed Community Type**		
22.3	Wehadkee	Enhancement	Coastal Plain Small Stream Swamp		
Wetland Restoration					
Acreage	**Soil Type**	**Mitigation Type**	**Designed Community Type**		
43.8	Wehadkee	Restoration	Coastal Plain Small Stream Swamp		
Wetland Preservation					
Acreage	**Soil Type**	**Mitigation Type**	**Designed Community Type**		
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1.0 INTRODUCTION

The Farrar Dairy Stream and Wetland Restoration Site (FDS) is a full-delivery project that is being developed for the North Carolina Ecosystem Enhancement Program (EEP) to mitigate stream and wetland impacts within the 8-digit hydrologic cataloging unit 03030004. The entire length of the North Prong of Anderson Creek (NPAC) within the project area will be restored or preserved. Where practical, the stream will be relocated to its historic floodplain position. In addition, six tributaries to the NPAC will be restored or enhanced. The project will also incorporate the restoration of approximately 44 acres of drained wetlands, the preservation of 46 acres of existing wetlands and the enhancement of approximately 22 acres of existing degraded wetlands. Upland species management will also be incorporated as a component of the restoration plan.

The work needed to meet the project goals will require the relocation of the NPAC, removal of ditches and underdrains, reforestation of bottomland hardwood forest communities, incorporation of supplemental planting in degraded forest and wetland communities, and the restoration of seeps and six tributary streams. Degraded wetlands and stream buffers will also be enhanced through supplemental planting and the removal of invasive species. This restoration plan presents the existing site and watershed conditions, the restoration design criteria, the design summary, and the proposed monitoring protocol.

2.0 PROJECT SITE IDENTIFICATION AND LOCATION

2.1 Directions to Project Site

The FDS occupies portions of three parcels owned by Sandra Pait, James and Angela Farrar, and Brigham and Kathleen Wilson. The site is located approximately 8.5 miles southwest of Lillington, North Carolina in Harnett County (Figure 1).

To reach the site from Raleigh:
Proceed south out of Raleigh on US 401/US-421/ Capital Drive towards Fuquay-Varina, continuing south from Fuquay-Varina on US-401/US-421 towards Lillington. Turn right onto NC-210 and continue south through Lillington for approximately 6.5 miles to Darroch Road. Turn right onto Darroch Road and continue approximately 3 miles to Powell Farm Road. Turn left onto Powell Farm Road, drive approximately 1.5 miles and the entrance to the site will be on the left through the driveway of the red ranch style home.

2.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The NPAC is a second and third order perennial stream that flows from northwest to southeast for approximately 7,750 linear feet through the project site.

The project site is situated within the 03030004 Watershed Cataloging Unit (8-digit HUC) and the Local Watershed Unit (14-digit HUC) 03030004110010 (Anderson Creek). It is within the North Carolina Division of Water Quality (NCDWQ) Subbasin 03-06-14. The FDS was not included in the area covered by North Carolina Ecosystem Enhancement Program's (EEP) most recent publication of excluded and targeted Local Watersheds/Hydrologic Units.

3.0 WATERSHED CHARACTERIZATION

The project watershed is predominantly forested with agricultural inclusions. Rural residential and suburban development is evident along the western edge of the project watershed. The project drainage is within the Sand Hills ecoregion of the Coastal Plain Physiographic Province and the surrounding topography is characterized as rolling to hilly (Figure 2). The site is mapped in close proximity to both the Rolling Coastal Plain and the Northern Outer Piedmont and displays characteristics of both

ecoregions. The elevation in the project watershed ranges from approximately 165 to 460 feet above mean sea level.

3.1 Drainage Area

The project watershed drains toward the southeast with a contributing area of approximately 5.7 square miles (3,624 acres) at the downstream limits of the site (Figure 3). The downstream limit of the project site is approximately 5.1 river miles upstream of the confluence with the South Prong Anderson Creek, which is the start of Anderson Creek. The NPAC drains into Anderson Creek, then the Little River to the south, and ultimately to the Cape Fear River. The project area is located in the United States Geological Survey (USGS) Anderson Creek Quadrangle.

3.2 Surface Water Classification/Water Quality

NCDWQ assigns surface water classifications in order to help protect, maintain, and preserve water quality. The NPAC is classified as Class C waters from its source to Anderson Creek. The DWQ categorized Anderson Creek as having a good bioclassification rating in 2003, which is an improvement from good-fair in 1998 (NCDENR, 2005).

- **Class C waters** are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. 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. There are no restrictions on watershed development or types of discharges. (NCDENR, 2006).

3.3 Geology and Soils

The underlying rocks of the site are Cretaceous sediments. The formation underlying the site is the Middendorf Formation, which is described as sand, sandstone and mudstone; gray to pale gray with an orange cast, mottled; clay balls and iron cemented concretions common; beds laterally discontinuous, cross-bedding common (NCGS, 1985).

The soils within the project site are defined by the Harnett County Soil Survey as Altavista, Augusta, Bibb, Blaney, Gilead, Roanoke and Wehadkee. According to the NRCS, Harnett County Soil Survey, Wehadkee loam is the dominant soil type in the project area (Figure 4). Altavista fine sandy loam consists of nearly level, very deep, moderately well drained soils on terraces. Augusta fine sandy loam consists of nearly level, very deep, somewhat poorly drained soils on stream terraces. Bibb loam consists of nearly level, very deep, poorly drained soils on floodplains and in small natural drainageways. Gilead loamy sand consists of gently sloping, very deep, moderately well drained soils on side slopes in the uplands. Roanoke loam consists mainly of nearly level, very deep, poorly drained soils on low flats and in depressions or drainageways. Wehadkee loam consists of nearly level, very deep, poorly drained soils on floodplains. The Bibb, Roanoke and Wehadkee soils are listed as hydric (federal, state and county hydric soils lists) due to prolonged saturation for a significant portion of the growing season (USDA, SCS 1984).

3.4 Historical Land Use and Development Trends

3.4.1 Historical Resources

Historical aerial photographs were obtained from the Harnett County Natural Resources Conservation Service (NRCS) office in order to enhance the assessment of existing site conditions. All available aerial photographs were reviewed in order to create a chronology of land disturbance and aid in the evaluation of the site. Aerial photographs of the site were obtained from 1938, 1949, 1955, 1972, 1981, 1988, 1993, 1998 and 2004 (Appendix A). Overall, the land use surrounding the site has not changed significantly since 1938. Forest and agricultural land dominate the landscape with scattered residential development

occurring within the general area. The historic aerial photographs elucidate several features pertinent to the proposed environmental improvements to the property. They are:

1. At some time before 1938 the mainstem of the NPAC was altered to maximize the use of an agricultural field adjacent to Powell Farm Road.
2. The headwaters of the NPAC west of Powell Farm Road have remained primarily undeveloped through the period of photographic record with the exception of two residential developments in the southwestern portion of the watershed. A significant portion of the watershed will remain undeveloped as Harnett County Economic Development has acquired approximately 1,000 acres of the NPAC headwaters.
3. Between 1955 and 1972, additional channel manipulations along the mainstem of the NPAC and three tributary systems are evident. These manipulations general appeared to have been completed to more efficiently convey water through the property. Several ponds were also constructed during this period.
4. Significant land clearing along the mainstem of the NPAC occurred between 1981 and 1988, apparently to expand production of pasture and commodity crop acreage.
5. Minor land use changes were apparent between 1988 and 2004. A pond (the largest on the property) was constructed and hydrologic manipulations were noted in the central portion of the site where shallow ponds and ditches were created for the purpose of attracting migratory waterfowl.
6. A dendritic channel pattern is apparent in the eastern portion of the 2004 photograph that is not evident in the 1988 photo. This is along the NPAC and is likely caused by beaver activity, as confirmed during site visits to the property.

3.4.2 Land Use and Development Potential

The project watershed is approximately 3,624 acres in size as seen in Figure 3. The land use in the project watershed consists of Forest Land (2,606 ac/71.9%), Agricultural (756 ac/20.9%), Wetland (189 ac/5.2%), Rangeland (47 ac/1.3%), Water Bodies (21 ac/0.6%) and Urban or Built-up (5 ac/0.2%). The approximate total impervious cover of the project watershed is 2.7% (98 ac). This estimate was developed using the following percent impervious estimates: Water (100%), Urban or Built-up (55%), Wetland (30%), Barren (10%), Rangeland (5%), Agricultural (2%), and Forest (0%). The surrounding area is rural with low to moderate development pressure. Land use was based on the North Carolina GAP land use classification using 1992 aerial photography (McKerrow, 2003).

3.5 Endangered/Threatened Species

KCI requested a formal review by the North Carolina Natural Heritage Program (NCNHP) in July 2006 to evaluate the presence of any rare species, critical habitats, and priority natural areas on the project site and to determine the potential impact of the proposed project on these resources. In their findings letter dated August 1, 2006 (Appendix B), the NCNHP indicated "no record of rare species, significant natural communities, or priority natural areas at the site." NCNHP did indicate that there is a County-significant natural area known as the Barbecue Pine Forest that is located to the west of the site. However, that site is located upstream of the FDS and no detrimental impacts are anticipated to occur to the County-significant parcel. In addition, no threatened or endangered species were identified in the project area during the existing conditions site assessment. Also, a formal review by the United States Fish and Wildlife Service (USFWS) was requested in July 2006, but no correspondence was returned.

3.6 Cultural Resources

To evaluate the presence of significant cultural resources on the subject property, KCI requested a formal review at the North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO). The formal SHPO review, dated August 23, 2006, found no historic properties within the project

area (See Appendix B). A formal review by the State Archeology Office identified no potential archeology sites on or around the subject property.

3.7 Potential Constraints

The site was evaluated for any constraints that could hinder the implementation of a successful mitigation project. In addition, any field conditions that could restrict the restoration design and implementation were documented during the field investigation.

3.7.1 Property Ownership and Boundary

The project site is located on three different parcels: James and Angela Farrar, 1395 Farrar Dairy Road, Lillington, NC 27546; Sandra Pait, 5407 Willington Drive, Fort Lawn, SC 29714; and Brigham and Kathleen Wilson, 300 Wilson Run, Bunnlevel, NC 28323. On the area identified for stream and wetland mitigation, KCI acquired a conservation easement that is now held by the State of North Carolina. The conservation easement boundary (plat with legal description) has been included in Appendix C.

3.7.2 Site Access

There will be one access point to the project site off of Powell Farm Road at the western corner of the project site. This is a legal access point guaranteed with an ingress/egress easement. During the restoration of the stream and wetland components, construction equipment will be able to maneuver up and down the site as necessary.

3.7.3 Utilities

There are no utilities located on the project site.

3.7.4 FEMA/Hydrologic Trespass

The NPAC and the wetland restoration site are both located within the 100-year floodplain (Zone AE) (Figure 6). As such, any modifications that would result in the increase of the 100-year flood elevation would require a Conditional Letter of Map Revision (CLOMR). It is the intent of the restoration design to maintain the existing 100-year flood elevations. A proposed hydrology and hydraulics (H&H) summary will be submitted with a letter indicating that an increase in the 100-year flood elevation is not anticipated (No-Rise Certification).

KCI has acquired the existing HEC-RAS model from FEMA for the FDS as shown on DFIRM Panels Number 0506J and 0526J. KCI has developed a conditional floodplain model by updating the published hydraulic data with the detailed topographic survey used to prepare the construction drawings for the NPAC. The proposed model represents the conditions following changes to the channel and floodplain as a result of the restoration. Following completion of the final design, the proposed model will be updated and submitted to Harnett County for approval. Preliminary indications are that the proposed project will not produce hydrologic trespass conditions on any of the three adjacent properties to the FDS.

4.0 PROJECT SITE STREAMS (EXISTING CONDITIONS)

A site field assessment was conducted in the fall of 2007 to document existing conditions and evaluate the potential for stream and wetland restoration. The existing site conditions and site assessment locations for cross-sections and longitudinal profiles are shown in Figure 7 and documented in the site photographs (Appendix D). Observations and collected data are summarized below. All the project streams receive perennial flow and the DWQ stream identification forms that were completed in March 2006 are included in Appendix F.

4.1 General Site Description

Livestock, crop production, vegetation removal, and other human induced disturbances have impacted all the project streams. The site has a documented history of disturbance beginning before the 1900's. In addition, the NPAC within the study area has been relocated to facilitate drainage and maximize use of the adjacent agricultural fields. The USGS quadrangle documents the radical movement of the NPAC to its current location. In its current condition, the site contributes significant nutrient loading from the land application of animal waste and offers limited terrestrial and aquatic wildlife habitat.

The FDS consists of approximately 4,565 existing linear feet of the NPAC and approximately 5,980 linear feet of six tributaries Tributary 1 (T1.1), Tributary 1 (T1.2), Tributary 1 (T1), Tributary 2 (T2A-T2B), Tributary 3 (T3), and Tributary 4 (T4) as shown in Figure 7. Four of these tributaries drain into the NPAC: T1 at existing Station 25+75, T2B at existing Station 35+50, T3 at existing Station 45+33, and T4 at the limits of the preservation area at existing Stations 150+00-164+20. Tributary 2 has been divided into two reaches as A (steep slope) and B (flat slope), according to the change in slope for each tributary.

- ***NPAC – 4,565 Linear Feet***

  The NPAC begins at Powell Farm Road on the western property boundary of the site at existing Station 10+00. The NPAC is a second-order stream that flows west to east for approximately 7,750 linear feet toward the project end at the property line at Station 58+00. The first 3,000 feet of the NPAC have been straightened over the past 80 years, showing significant variation from the alignment as identified on the USGS quadrangle and historic aerial photographs. The portion of the stream from Station 10+00 to 31+00 was excavated to follow a property line and is deeply incised. This section of channel was actually excavated through an existing drainage divide. The stream is bordered to the south by an agricultural field that contains three drainage features along with several tile drains that enter the NPAC. This section contains a gravel bottom with the banks consisting of sand and clay layers. The tops of the banks are heavily vegetated with dense roots. The majority of the banks along this reach have surface protection provided by a moderately dense herbaceous cover. Downstream at Station 28+00 to 31+00, cattle have access to the stream resulting in an absence of vegetation along the stream banks. This section of the stream is narrow with low banks. The stream flows into a corrugated metal culvert under a farm road near Station 28+50. Downstream of the farm road, the stream remains narrow with low banks until the confluence with T2 at Station 35+50, where the channel starts to widen and again becomes incised. An agricultural field borders the stream to the west. Further downstream at Station 45+33, T3 enters the NPAC and the stream remains overwidened and deeply incised. Downstream of the confluence with T3, there are three man-made ponds that border the NPAC to the north. These ponds were constructed as habitat for migratory waterfowl by the existing landowner. The NPAC then flows into a corrugated metal pipe under a farm road at Station 50+55. From Station 50+55 to Station 58+00, the stream has been channelized to drain the existing adjacent agricultural fields, and presumably to allow the construction of the adjacent ponds. Due to the presence of a 300-foot wide beaver dam downstream, the NPAC channel begins to braid at Station 58+00. The braided channel feature extends approximately 2,750 linear feet to the downstream limits of the project site. This area encompasses the wetland preservation portion of the project and contains a diverse vegetated mosaic of forested, scrub shrub and emergent wetlands that offer significant habitat and water quality benefits to the NPAC watershed.

- ***Tributary 1.1 (T1.1) – 864 Linear Feet***

  This tributary is located at the northern extent of the project site and flows south to join T1. T1.1 originates from a wetland seep located within a forested area that has been impacted by livestock grazing. The beginning of T1.1 has low banks and appears relatively stable. Downstream, the adjacent topography to the south slopes toward the stream where the channel becomes more

incised. Several mature trees exist within this riparian zone and the root systems have served as grade control in some areas. Headcuts have migrated to these roots systems from downgradient, causing several significant hydraulic drops. Uncontrolled cattle grazing are evident throughout this area, contributing to the destabilization of the banks within this tributary.

- ***Tributary 1.2 (T1.2) – 995 Linear Feet***
  This tributary parallels T1.1 approximately 300 feet to the northwest. T1.2 is a first-order hydrologic features that flow south for approximately 995 linear feet. T1.2 and T1.1 join together at the confluence of T1. The beginning of T1.2 starts at a culvert where the channel is approximately 5 feet incised. The stream is located in a cattle pasture and has undergone severe degradation with two significant headcuts.

- ***Tributary 1 (T1) – 389 Linear Feet***
  T1 is a second order hydrologic feature that begins at the confluence of T1.1 and T1.2. As a result of cattle activity, there are no defined banks where the two streams join, making it difficult to define a stream centerline. T1 flows south into a low-lying wetland area. The tributary joins the NPAC below the existing farm pond.

- ***Tributary 2A (T2A) – 977 Linear Feet***
  This tributary is located on the western edge of the project site and is a first-order hydrologic feature. T2A is a single-thread channel originating from a large seep on the adjacent valley wall. T2A flows east to a road crossing, where T2B begins as the slope changes. The channel has been ditched with spoil piles located along the banks.

- ***Tributary 2B (T2B) – 977 Linear Feet***
  This tributary is a continuation of T2. It begins at the culvert crossing and flows northeast before joining the NPAC. Two drainage features originating in the adjacent cattle pasture to the north enter T2B. The channel is ditched to its confluence with the NPAC and spoil piles exist along the banks.

- ***Tributary 3 (T3) – 1,335 Linear Feet***
  This tributary is located on the southwestern edge of the project site and is a first order hydrologic feature. T3 originates from seeps on the west side of NC 1126. The stream enters the FDS and flows northeast for approximately 1,335 linear feet before joining the NPAC. Two drainage features enter T3. The first feature joins T3 from the west, while the second feature joins T3 from the northwest. T3 has been extensively ditched and the downstream section experiences backwater from the NPAC.

- ***Tributary 4 (T4) – 1,420 Linear Feet***
  This tributary is located on the southeastern edge of the project site. T4 is a first order hydrologic feature that flows northeast for approximately 1,420 linear feet before joining an area that has been significantly altered by beaver activity. The tributary flows onto the property into a field that has been logged and is heavily overrun with common greenbrier. T4 has significant debris blockages from the logging activities; however, the channel itself is relatively stable with appropriate dimension and pattern. Downstream, the channel begins to braid into a small wetland just before flowing into an eight-inch (8") diameter pipe under a farm road crossing. The road embankment together with the small pipe impounds the stream upstream of the road. Downstream of the pipe crossing, the channel has been backwatered due to beaver activity approximately 800 feet downstream.

4.2 Channel Morphology (Pattern, Dimension, and Profile)

A Rosgen Level III assessment was conducted to gather existing stream dimension, pattern, and profile data and determine the degree of channel instability. Channel cross-sections were surveyed at eleven representative locations along the NPAC, two locations each along T1.1, T1.2, and T3, while one location each on T2A and T2B. Data developed from these surveys are presented in a channel morphology summary in Appendix E.

4.3 Channel Stability Assessment

A qualitative stability assessment was performed to estimate the level of departure and determine the likely causes of the channel disturbance. This assessment facilitates the decision-making process with respect to restoration alternatives and establishing goals for successful restoration.

Bank Erodibility Hazard Index (BEHI) rating forms were prepared for the NPAC and its tributaries (Appendix E). Two BEHI rating forms were performed on the NPAC, two forms were performed on T1.1, and one form each for T1.2, T2B, and T3.

The NPAC exhibits the characteristics typical of an unstable stream channel. Most notably, the stream has been channelized and is experiencing bank erosion along portions of the reach. The upstream portion of the NPAC exhibited a very high BEHI rating with bank height ratios ranging from 1.9 to 2.5. High bank height ratios (>1.2) are typical of incised and/or channelized streams. The steep banks and lack of vegetation in this reach creates a high potential erosion condition. Further downstream, there are areas where cattle are regularly crossing the stream. This has resulted in significant physical disturbance to the stream channel. This portion of the NPAC lacks stream bank vegetation and consequently lacks rooting strength and cover. This area exhibited a high BEHI rating with bank height ratios as high as 1.9. Of the two areas with lower bank heights, the first section is where the stream gauge was installed. It has been stabilized by rip rap backfilled in the channel. The second section consists is a local area with a narrower channel and lower banks. The downstream portion of NPAC is channelized and exhibits the same characteristics found in the upstream section. NPAC flows through a culvert that creates backwater for several hundred feet upstream and disrupts the normal baseflow. Due to the backwater, large amounts of fine sediment have deposited throughout this portion of the stream.

The tributaries draining to the NPAC all show signs of instability as well. T1.1 does not exhibit specific bed features, rather it consists of grass sporadically covering the channel bed and banks. Further downstream, the channel changes with the steeper topography, becoming severely incised as a result of poor grazing management and increased slope. Downstream, a 6-foot head cut is migrating upstream resulting in a narrow channel and steep banks. The stream remains unstable until the confluence with T1.2. There were two BEHI forms performed on T1.1, because the upstream portion of the stream varies considerably from the downstream portion. T1.1 upstream exhibited a low BEHI rating while the downstream section exhibited an extreme rating with bank height ratios ranging from 1.7 to 4.4. T1.2 is an unstable, incised channel. Sparse trees exist along the banks with minimal vegetation protecting the bank surface. The tributary remains unstable throughout the entire reach. T1.2 exhibited an extreme BEHI rating with bank height ratios ranging from 1.1 to 2.0.

T2 had a very high BEHI rating with bank height ratios ranging from 3.2 to 3.5. This tributary has been channelized, which has resulted in a deep and narrow channel with a constricted floodprone area. The tributary has a thin row of mature trees bordering the channel to the right. There is cattle pasture located adjacent to the left bank (northern side) of the stream and as a result, there is no riparian vegetation along the stream to stabilize the bank.

T3 flows onto the property from an upstream drainage. Approximately 270 linear feet downstream, the tributary flows into a culvert at a farm road crossing. Upstream of the crossing, the channel has high unstable banks and there is a deep, wide pool with a large amount of residual fine sediment. Downstream of the culvert, the tributary has a narrow channel with steep banks. A drainage feature enters the stream where the channel begins to widen. T3 exhibited a very high BEHI rating with bank height ratios up to 1.4. T3 flows through a second culvert just before it enters NPAC. The resulting backwater conditions deposits large amounts of fine sediment throughout this portion of the stream.

4.4 Bankfull Verification

The standard methodology used in natural channel design is based on the ability to select the appropriate bankfull discharge and generate the corresponding bankfull hydraulic geometry from a stable reference system(s). The determination of bankfull stage is the most critical component of the natural channel design process.

Bankfull can be defined as "the stage at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of the channels" (Dunne and Leopold, 1978). Several characteristics that commonly indicate the bankfull stage include: breaks in slope, changes in vegetation, highest depositional features (i.e. point bars), and highest scour line. Using these indicators to the extent practical in a degraded system, a bankfull stage height of 2.6 feet was identified on the NPAC.

Because the identification of bankfull stage in a degraded system can be difficult, verification measures were utilized to facilitate the correct identification of the bankfull stage on the NPAC. To validate bankfull stage at the site, a pressure transducer/data logger combination gauge monitored actual stream stage throughout the study period. Stream stage data were collected from a pressure transducer on the NPAC for twelve months (March 2007 through February 2008). The hydrograph events are included in Table 2. Water levels were correlated to an estimated discharge using a rating curve generated for the gauged cross-section. Based on the stream dimensions at the gauge, the discharge at which water accessed a bankfull elevation was approximately 100 cfs during a precipitation event on March 16, 2007. This event occurred at the same stage height (2.6 ft) identified as bankfull in the field. This storm produced 2.9 inches of rain over 12 hours. Using precipitation frequency estimates, the March event has an average reoccurrence interval of approximately 1 to 2 years using the published margins of error (NOAA, NWS 2007). Because of drought conditions beginning in May 2007 and extending into February 2008, there were no other large storm events that provided reliable stream hydrograph responses to evaluate bankfull discharge.

A regional curve has not been developed for the Sand Hills Ecoregion and therefore this verification method was not employed. In lieu of a published relationship describing drainage area and hydraulic geometry, KCI investigated the relationship between drainage area and discharge among available USGS gauge data in the Sand Hills Ecoregion (Level IV – 65c). Discharge data from 15 available gauges with at least 10 years of annual maximum discharges and drainage areas less than 350 square miles were used in the analysis. The annual maximum discharges were used with a Log-Pearson Type III Distribution to produce approximate discharges for 1.0, 1.2 and 1.5 year events. Unfortunately, no statistically valid relationships could be developed from the available data.

Other methods used to evaluate the bankfull determination included an ecoregion-based effective discharge calculation method put forth by Simon et al. (2003). This relationship looks at the effective discharge (channel-forming discharge) measured by the maximum suspended sediment transport and predicts that the project drainage area of this size in the Southeastern Plains Ecoregion (Level III) would have an effective discharge of 125 cfs with a 1.2 year frequency.

4.5 Vegetation

The existing riparian areas throughout the FDS are in pasture, agricultural fields, and wetlands. The cattle keep the vegetation to a minimum. There are no distinct community types present along the NPAC and its tributaries. Any vegetation along the stream channels is comprised mainly of small brushy shrubs sporadically interspersed with larger trees. Sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), tulip poplar (*Liriodendron tulipifera*), loblolly pine (*Pinus taeda*), southern red oak (*Quercus falcata*), swamp tupelo (*Nyssa biflora*), water oak (*Quercus nigra*), and common greenbrier (*Smilax rotundifolia*) are predominant species along the riparian corridor. Along the upstream section of the NPAC to the north, there is a young forest dominated by red maple, sweet gum, and American elm (*Ulmus americana*). The understory is dense and is dominated by American holly (*Ilex opaca)*, sweetgum and common greenbrier (*Smilax rotundifolia*). Along T4, the dominant species were similar with the exception that more blackgum were present.

5.0 REFERENCE STREAMS

A reference reach is a channel with a stable dimension, pattern, and profile within a particular valley morphology. The reference reach is used to develop dimensionless morphological ratios (based on bankfull stage) that can be extrapolated to disturbed/unstable streams to restore a stream of the same type and disposition as the reference stream (Rosgen, 1998). For this project, three reference reaches were used to design the proposed restored reaches for the NPAC and its tributaries: Little Rockfish Creek in Cumberland County, UT to Wilkinson Creek in Chatham County, and Still Creek in Wayne County (see Appendix G for detailed reference reach data).

5.1 Little Rockfish Creek Reference Site

A section of Little Rockfish Creek, located southwest of Fayetteville off of Gills Hills Road, was identified as a reference reach to use for the restoration design for the NPAC and T3. Little Rockfish Creek flows southeast through the southern portion of Cumberland County (Figure 8). The reference site selection was based on the location in the same physiographic province and watershed, similar valley morphology, and similar sediment regime to the project stream. The NPAC is a C5 stream while its reference Little Rockfish Creek is an E5 stream. The designed width to depth ratio for the NPAC is 12, which is a low width to depth ratio C5 classification. Earth Tech surveyed approximately 620 linear feet of Little Rockfish Creek in July 2002. This reach of Little Rockfish Creek was classified as a Rosgen E5 channel type and has a valley slope of approximately 0.2%.

Little Rockfish Creek is situated in the Coastal Plain physiographic province and the Atlantic Southern Loam Plains Ecoregion. The Little Rockfish Creek watershed is located within the NCDWQ Subbasin 03-06-15 of the Cape Fear River Basin and the (USGS 14-digit Hydrologic Unit 03030004150050). The reference reach watershed drains approximately 16.50 square miles of low-density residential and forested lands, including a military reservation (Figure 9). The headwaters of Little Rockfish Creek start north of US-401 and flow south/southeast toward the Town of Hope Mills and BUS-95 where the stream meets Rockfish Creek.

5.2 UT to Wilkinson Creek Reference Site

A section of an Unnamed Tributary to Wilkinson Creek, located southwest of Chapel Hill, was identified and surveyed as a reference reach for the T1.1, T1.2, T1, and T2A restoration. UT to Wilkinson Creek flows west through Chatham County towards its confluence with Wilkinson Creek (Figure 10). It drains approximately 105 acres of low-density residential, agriculture, and forested lands (Figure 11). The reference reach is situated within the southeastern portion of the Piedmont physiographic province and its watershed (USGS 14-digit Hydrologic Unit 03030002050100) is located within the NCDWQ sub-basin 03-06-04 of the Cape Fear River Basin. Approximately 205 linear feet of the UT to Wilkinson Creek were surveyed in May 2006. This reach of UT to Wilkinson Creek was classified as a “B4c” channel

type. The dimensionless hydraulic geometry relationships were developed from stable channel dimensions to facilitate the design of the proposed channel cross-sections for the restoration reaches.

5.3 Still Creek Reference Site

A section of Still Creek, located southeast of Goldsboro in Cliffs of the Neuse State Park, was identified as a reference reach to use for the restoration design for T2B. Still Creek flows south through the southern portion of Wayne County (Figure 12). The reference site selection was based on the location in the same physiographic province and watershed, similar valley morphology, and similar sediment regime to the project stream. Buck Engineering surveyed approximately 529 linear feet of Still Creek. This reach of Still Creek was classified as a Rosgen E5 channel type and has a valley slope of approximately 0.8%.

Still Creek is situated in the Coastal Plain physiographic province and the Southeastern Floodplains and Low Terraces Ecoregion. The watershed is located within the DWQ Subbasin 03-04-05 of the Neuse River Basin. The reference reach watershed drains approximately 0.35 square mile of forested lands including a state park (Figure 13). The headwaters of Still Creek originate from a small pond in the State Park and flow northwest crossing over NC-111 to join the Neuse River.

KCI spent considerable time searching for suitable reference reaches for the FDS. Finding a reference stream for the tributaries proved to be particularly hard. No stable B5c streams with the appropriate slope in the coastal area could be found. Even though the UT to Wilkinson site is not as close to the project site geographically, the desired stream type and valley slope is the same as the project tributaries.

5.4 Reference Vegetative Communities

A survey was conducted to identify and document the dominant plant communities associated with the different reference reaches. Several distinct communities were recognized and species lists were compiled. These lists were used to identify two communities described by Schafale and Weakley (1990) that are representative of the reference systems appropriate for the FDS.

The natural community identified as representative of the reference reach floodplain areas was the Coastal Plain Small Stream Swamp (Brownwater Subtype). This community type is described as being palustrine, intermittently, temporarily, or seasonally flooded. Generally this community will exist on alluvial soils such as Bibb and Wehadkee as is the case for the FDS. This community is generally limited to areas just below the Fall Zone, where small Piedmont streams flow into the Coastal Plain. Although the streams on the FDP originate in the Sand Hills, they closely fit the description of this community type. The canopy species that are typically found within a Coastal Plain Small Stream Swamp include black willow (*Salix nigra*), river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), sweetgum, sugarberry (*Celtis laevigata*), and various species of oak. Species that dominate the understory are ironwood (*Carpinus caroliniana*), American holly, and Carolina ash *(Fraxinus caroliniana)* (Schafale and Weakley, 1990).

The second community type identified was the Coastal Plain Semipermanent Impoundment. This community type covers areas on the property that have been manipulated by physical disturbance, whether that be from man induced disturbance (pond creation, dam installation) or by natural measures (beaver dams). These areas are permanently flooded, grading outward to the prevailing hydrology of the surrounding area. Vegetation is dominated by floating or submerged aquatics, with a canopy of tupelo or cypress around the periphery.

6.0 PROJECT SITE WETLANDS (EXISTING CONDITIONS)

There were twelve existing wetlands identified on the project site (Figure 7). The soils in the project area were delineated by using data from soil borings throughout the site. The jurisdictional wetland delineation for the project site was approved by the USACE on August 20, 2007 and is included in Appendix H.

6.1 Jurisdictional Wetlands

Existing wetlands were delineated in September 2006 using the methods outlined by the US Army Corps of Engineers (USACE, 1987). Twelve existing wetland communities were mapped on the Farrar Dairy Property (Appendix H). Many of these wetlands extend beyond the conservation easement limits of the FDS, as indicated by the acreages below. Wetland W1 is located in the southern portion of the project site on the floodplain of T4 and includes approximately 1.7 acres of forested wetlands dominated by red maple, sweet gum, water tupelo and loblolly pine. Wetland W2 is located in the southeastern corner of the property within and surrounding the braided channel portion of the NPAC. This wetland area is approximately 60.60 acres in size and contains a mixed mosaic of herbaceous, scrub shrub and forested wetlands along the floodplain of the NPAC. This area has been impounded by a series of beaver dams. Wetlands W3 and W4 comprise approximately 13.15 acres of palustrine forested wetlands that have been impacted by cattle grazing and sedimentation. Many of the trees within this wetland are dead, apparently because of excessive sedimentation and prolonged inundation. The herbaceous ground cover, consisting of a broad range of wetland sedges, rushes and grasses, thrives due to the lack of canopy cover. Unfortunately, a strong invasive component dominated by Japanese stilt grass (*Microstegium vimineum*) also is abundant throughout this wetland. Wetlands W6 and W7 are both small seep wetlands that provide hydrology to T1.1. These areas have also been impacted by cattle grazing. Wetland W8 is a 0.10-acre pond located on the northwestern portion where T1 enters the NPAC. Wetlands W9 and W10 are located on the western portion of the project near the confluence of the NPAC and T2 and are approximately 1.56 acres and 0.62 acre, respectively. These wetland areas were created through the installation of berms that were installed to create shallow water impoundments. Wetland W11 is located in the central portion of the project near the confluence of T3 and is approximately 2.28 acres in size. This is also a wetland that has been developed by the landowner using shallow berms to hold water. The area relies on floodwaters from the NPAC for hydrology. Wetlands P1 and P2 are located in the central portion of the project adjacent to the NPAC and are approximately 1.11 and 7.09 acres in size, respectively. Wetlands P1 and P2 are manipulated ponds that create a series of shallow impoundments intended to attract migratory waterfowl. The deepwater impoundments range in depth from 1 foot to 4 feet.

6.2 Hydrologic Characterization

6.2.1 Groundwater Modeling

The numerous modifications to the hydrology of the FDS have effectively drained significant areas of historic wetlands on-site. The development of a network of ditches up to three feet deep has significantly altered the influence and frequency of flooding in these areas. The effect of ditching on wetland hydrology was evaluated using DRAINMOD (Skaggs, North Carolina State University). The model simulates the hydrology of poorly drained, high water table soils on an hour-by-hour, day-by-day basis for long periods of climatological record (e.g. 50 years). DRAINMOD was used as a predictive tool for the FDS using the following data:

1. NRCS model Map Unit Users File (MUUF) for Wehadkee soils;
2. Daily rainfall and daily maximum and minimum temperatures for Fayetteville Public Works Commission and Smithfield Airport for the period from 1960 to 2000 (National Climatic Data Center);
3. Harnett County growing season (16 March to 11 November).

In addition to the data collected from available literature, soil borings were emplaced within the wetland restoration areas to determine the depth to a confining layer. These data showed an impermeable layer at a depth of approximately 90 cm (±3 ft) from the ground surface throughout the majority of the proposed wetland restoration area.

The DRAINMOD simulations were run based on the input data above. The site specific data suggest that jurisdictional wetland hydrology would occur only if the drain spacing was 125 m (410 ft) or more, but the existing drainage ditches on site are generally closer together than this. Additional simulations were run using the proposed conditions (restored channel depth and increased surface storage through the creation of microtopography). Based on this data, wetland hydrology is forecast to be achieved for post-restoration conditions at a drain spacing of 117 m (351 ft) or greater for the restored channel brought up to the floodplain with an effective depth of 75 cm (2.5 ft). The distance between the proposed tributary channels is significantly larger than 117 meters throughout the wetland restoration area. In addition to the drain spacing information, the results indicate that the drainage network has contributed to the removal of jurisdictional wetland hydrology. Restoration of these wetlands will be dependent on eliminating (filling) the existing field drains to the extent practical, maximizing the spacing of existing jurisdictional streams within the wetland area, increasing surface storage through the creation of microtopography and increasing the frequency of flooding between the restored jurisdictional tributaries and the adjacent wetland restoration areas.

The data output files for the existing conditions as well as proposed conditions are included in Appendix I. Excel charts of the analytical simulations that allowed the determination of the specific simulations to run are also included in Appendix I.

6.2.2 Surface Water Modeling

T2, T3, and the wetland restoration areas are all located within the 5-year floodplain of the NPAC (Figure 6). The 5-year floodplain extent serves to differentiate between riverine and non-riverine wetland restoration types. The discharge associated with a 0.20 (20%) exceedence probability or 5-year return period was calculated using the Rural Regression Equation published in the USGS Fact Sheet 007-00, January 2002. The rural peak discharge associated with a 0.01 (1%) exceedence probability or 100-year return period as published in FEMA's Flood Insurance Study (FIS) for Harnett County was computed using the Rural Regression Equations for the Sand Hills hydrologic region of the state. The drainage area of 3.7 square miles, as published in the FIS, began 0.05 miles downstream of Powell Farm Road. The drainage area for calculation of the peak discharge changes 1.04 miles downstream of Powell Farm Road. The project area lies within these boundaries.

KCI performed an analysis of surface water inputs in order to differentiate between riverine and nonriverine wetlands. HEC-GeoRAS was used to develop cross-sections through the project at the same locations as published in the Flood Insurance Study for Harnett County. The 2-foot LIDAR DEM was used to provide the elevations for the cross-sections. The cross-sections were exported to HEC-RAS and used to develop a model within the project area. The 5-year water surface elevations were generated and exported to HEC-GeoRAS, and the limits of the 5-year floodplain were converted into boundary limits. All of the areas within the boundary represent riverine wetland restoration, while those identified outside of the boundary represent the non-riverine wetland restoration portions of the FDS. For the FDS, all of the wetland restoration proposed will be riverine in nature.

6.2.3 Hydrologic Budget for Restoration Site

Existing Conditions

Existing site hydrology was modeled by developing an annual water budget that calculates hydrologic inputs and outputs in order to calculate the change in storage on a monthly time step (Appendix J).

In order to set up the water budget, historic climatic data were obtained from the North Carolina State Climatic Office. The weather station Fayetteville, Public Works Commission in Fayetteville, North Carolina was used, because it is the nearest station with daily precipitation and temperature records. The station is located approximately 25 miles to the south of FDS. Monthly precipitation totals from the

entire period of record (1960-2000) were reviewed and three years were selected to represent a range of precipitation conditions: dry year (1981), average year (1979), and wet year (2000).

Potential inputs to the water budget include precipitation, groundwater, and surface inputs. For precipitation, the data from the three selected years were used in the budget. Groundwater inputs likely exists, but were considered to be negligible for the purposes of this study. Surface water input was calculated using the USDA Soil Conservation Service (SCS) runoff curve number equation (USDA, SCS 1986).

Outputs from the site include potential evapotranspiration (PET), groundwater, and surface water outlets. PET was calculated by the Thornthwaite method using mean monthly temperatures determined from the chosen years of record: 1981, 1979, and 2000. On the FDS, a substantial amount of water is lost through the existing ditches. The DRAINMOD simulation above modeled the effect of the existing drainage network on wetland hydrology. The model results were used to determine the input parameter for annual surface water loss associated with the ditch network on site.

Once the inputs and outputs were determined, a net monthly total was calculated in inches and used to estimate a yearly water budget. The model assumes unsaturated conditions at the beginning of the year. A maximum wetland water volume of 5.4 inches was calculated based on the specific yield of 0.15 for 36 inches of Wehadkee soil. The resulting hydrographs for the average, dry, and wet years show a seasonal pattern. The model shows that the majority of hydrologic inputs to the site come during the rainy spring months. The site begins to lose saturation in the upper twelve inches in the late spring and early summer months. The late fall sees an increase in hydrologic inputs again. The dry year shows very little hydrology overall. A chart showing existing conditions for dry, wet and average years is included in Appendix J. It is clear from the existing model output that the ditches within the site are exerting a larger influence on the site than the water budget is accurately able to predict. The site is currently not achieving the wetland hydrology that the model predicts.

Proposed Conditions

A modified water budget was developed to analyze the effect of restoration actions on the site hydrology. Because the majority of the ditches on the site will be filled, reducing or eliminating surface water losses, the loss of water from the existing ditches was removed from the calculations. To estimate the impact from re-creating wetland microtopography, an additional two inches of hydrologic capacity was added to the calculations. Based on these changes, the budget shows a small increase in jurisdictional wetland hydrology in the spring for dry, average and wet years, when compared to the existing conditions. All three scenarios (dry, wet and average rainfall years) forecast that wetland hydrology will be met for the proposed wetland condition.

6.3 Soil Characterization

A soils investigation at the proposed wetland restoration site was conducted by a licensed soil scientist to determine the extent and distribution of the hydric soils and to classify the predominate soils to the soil series level. The investigation consisted of delineating the hydric soil boundaries with pink flagging in accordance with the US Army Corps of Engineers, Wetland Delineation Manual (1987). Areas that were identified as possible hydric soil mapping units were surveyed at a higher intensity until the edge of the mapping unit was identified. The boundary of the hydric and non-hydric soil mapping units were then followed by continual sampling and observations as the boundary line was identified and delineated.

Several soil borings were emplaced on the site in the general hydric soil areas identified by landscape position, vegetation and slope. Once the hydric soil borings were identified, the soil scientist marked the points and established a visual line to the next auger boring where again hydric soil conditions were confirmed by additional borings. The soil scientist moved along the edges of the mapping unit and

marked each point along the line. The soil profile descriptions identified the individual horizons in the topsoil and upper subsoil as well as the depth, color, texture, structure, boundary, and evidence of restrictive horizons and redoximorphic features. Delineated hydric soils boundaries were similar to those mapped in the Soil Survey of Harnett County, North Carolina, however, in several areas the hydric soil boundaries extended into areas that were mapped as being either Altavista fine sandy loam, Augusta fine sandy loam or Gilead loamy sand, all non-hydric soil types. The delineated hydric soil boundaries are shown in Figure 7.

6.3.1 Taxonomic Classification

The following soil types were found along the existing wetlands: Altavista fine sandy loam (Ata) and Bibb loam (Bb) with Gilead loamy sand (GaB) and Wehadkee loam (Wh) being the most dominant.

6.3.2 Profile Description

The Wehadkee series is described as very deep, poorly drained and very poorly drained soils typically found along floodplains. The soil is formed by loamy sediments with slopes ranging from 0 to 2 percent. The Gilead series is described as very deep, moderately well drained, firm, clayey soils in the Upper Coastal Plain. These soils are typically found on uplands with slopes ranging from 0 to 25 percent. The Wehadkee and Gilead series are listed by the Natural Resource Conservation Service (NRCS) as hydric soils.

6.4 Wetland Plant Community Characterization

The wetland restoration site is currently under seasonal agricultural production. There are some indications of wetland vegetation in the farmed area in the form of various wetland sedges and rushes, especially surrounding the man-made drainage features. The bottoms of the ditches do contain a few species typically found in wetlands such as cattail (*Typha latifolia),* water primrose *(Ludwigia spp.)* and knotweed *(Polygonum spp.)*, but in general, there are no woody species within the wetland restoration areas.

7.0 REFERENCE WETLAND

A suitable reference wetland was found along Tributary 4 on the site. A species list has been prepared based on the reference site condition. The site is consistent with a Coastal Plain Small Stream Swamp community type. A groundwater monitoring well has also been installed to document the reference wetland hydrology during the course of monitoring.

8.0 PROJECT SITE RESTORATION PLAN

8.1 Restoration Project Goals and Objectives

The NPAC and its tributaries have experienced degradation as a result of poor grazing management and channelization. These impacts have left the streams with large amounts of excess sediment, unstable banks, and incised streambeds.

The project goals are to:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish a functional Coastal Plain Small Swamp Stream wetland complex that creates terrestrial and aquatic habitat and connects to the existing floodplain corridor along the NPAC.

In order to meet these goals, the following objectives must be accomplished:

- Restore 11,517 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.

- Connect the streams to functioning floodplains.
- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions to the upper soil horizons.
- Plant the NPAC, its tributaries, riparian corridors, floodplains and upland habitats with herbaceous cover as well as trees and shrubs to create and restore appropriate habitats within the landscape.
- Eliminate existing nutrient source associated with land application of animal waste in proximity to project streams.

The ecological diversity and water quality values of the site are significantly limited under the existing conditions. This project aims to restore terrestrial and aquatic diversity and improve water quality through stream and wetland restoration. These goals will be accomplished through the reestablishment of fluvial geomorphic features, wetland hydrology, and reforestation. These activities will reduce both point source and nonpoint source nutrient and sediment inputs into the system and improve aquatic and terrestrial habitat. The restored stream and wetland will provide a buffer between the existing functioning wetlands along the NPAC and the agricultural activities in the local watershed.

8.1.1 Designed Channel Classification

The NPAC and its tributaries are divided into reaches based on the drainages entering the streams and the restoration or enhancement approach needed to design the proposed channels (Table 3 and Table 4). The morphological design criteria for each of the reaches are found in Table 5. The proposed reaches are identified in Figure 14.

The design for the NPAC proposes constructing approximately 6,693 linear feet of C5 channel. The restoration design for the upstream portion of the NPAC is based on a Priority 1 approach as described in Rosgen (1997). This Priority 1 reach will create a C5 channel and associated floodplain by re-establishing the channel on the existing floodplain and relocating the existing stream to its historic floodplain derived from existing and historic topography and field indicators (Figure 15). The new channel will be designed to an appropriate dimension, pattern and profile using data obtained from a stable reference stream system, while the existing channel will be abandoned and filled. At station 10+00 the channel begins online at the culvert on Powell Farm road. At Station 21+00 the channel meanders into the adjacent forest in the location of the historic channel. Due to the presence of existing wetlands and forested areas, disturbance in this area will be minimized to the extent practical. The new channel will again cross the existing channel at Station 45+00 where it remains offline through Station 73+41 where it crosses the existing NPAC. The new channel will come back online at the end of the restoration project reach at Station 77+00. Further downstream, the NPAC is a stable DA stream/wetland complex. No restoration actions are proposed for this braided channel section of the NPAC. The entire area will be encompassed within the conservation easement and be credited as wetland preservation.

The design for T1.1 and T1.2 proposes constructing approximately 827 linear feet and 986 linear feet of C5/B5c channel, respectively. The restoration design for T1.1 and T1.2 is based on a Priority 1 approach. The new planform for T1.1 and T1.2 will include more sinuosity than currently exists in these tributaries. T1.1 begins at Station 80+00 and meanders away from and then back along the existing channel, avoiding unstable areas when possible until Station 84+20. The new channel will meander to the north of the existing channel at Station 84+20 and remain there until the confluence with T1.

T2 has been divided into two different reaches each in order to develop the appropriate design as the slope decreases downstream. The design for T2 proposes constructing approximately 1,009 linear feet of C5/B5c for T2A and an E5 channel for T2B and is based on a Priority 1 approach. T2A begins at Station 110+00 approximately 70 feet to the north of the existing channel. The existing large seep will be the

hydrology source for the new channel. The new channel crosses the existing channel at Station 115+25 where it meanders to the south until the confluence with the NPAC at Station 120+09.

The design for T3 proposes constructing approximately 1,151 linear feet of C5 channel. The restoration design for T3 is based on a Priority 1 approach. T3 begins at Station 130+00 where it meanders through the floodplain south of the existing channel. T3 crosses over a drainage feature at Station 133+35. The new channel remains to the north of the existing channel and crosses a second drainage ditch at Station 135+62. Both drainage features will both be filled and graded during construction. T3 crosses the existing channel at Station 138+73 and meanders to south side of the channel to join the confluence with the NPAC at Station 141+50

Approximately 1,420 linear feet of T4 will be enhanced upstream of the road crossing at T4. Under Enhancement II, the stream banks and buffer areas will be modified where necessary and planted with vegetation to stabilize any erosion. Debris resulting from a recent logging operation will also be removed from the channel. Invasive species control will occur along T4 to remove invasive vines and multiflora rose.

In-stream structures, including log sills, log drops, riffle grade controls, and offset rock cross vanes, will be used to stabilize the restored channels (Refer to Plan Sheets 2 and 2A). These structures are designed to reduce bank erosion, influence secondary circulation in the near-bank region of stream bends, provide grade control and promote efficient sediment transport. The log sill and log drop structures will produce/enhance in-stream habitat for pools by creating a scouring obstruction, maintaining pool depths and providing habitat cover. Coir fiber matting, seeding, and mulching will be used to provide temporary stabilization on the newly graded stream banks and live stakes will be planted to provide long term rooting strength to the stream banks.

8.1.2 Target Plant Communities

The project will restore a Coastal Plain Small Stream Swamp (Brownwater subtype) along the floodplains of the NPAC as described by Schafale and Weakley (1990). This community will fit into the natural topography and setting created by the newly restored channel. The Coastal Plain Small Stream Swamp is characterized by a variable canopy, which can be dominated by combinations of bald cypress (*Taxodium distichum*), water tupelo, and various bottomland hardwoods such as swamp chestnut oak (*Quercus michauxii*), Shumard oak (*Q. shumardii*), cherrybark oak (*Q. pagoda (falcata var. pagodaefolia*)), laurel oak (*Q. laurifolia*), black oak (*Q. nigra*), willow oak (*Q. phellos*), sweetgum, sugarberry, sycamore, river birch (*Betula nigra*), green ash, black willow (*Salix nigra*), and swamp cottonwood (*Populus heterophylla*). Understory species include American hornbeam (*Carpinus caroliniana*), Carolina ash (*Fraxinus caroliniana*), American holly (*Ilex opaca*), and red maple (*Acer rubrum*).

The buffer areas outside of the stream floodplains will be planted as a variant of the Mesic Mixed Hardwood Forest (also described in Section 5.7). This community typically exists along lower slopes, north-facing slopes, ravines, and occasionally on well-drained small stream bottoms (Schafale and Weakley, 1990).

In addition to the community types listed above, two areas on the property have been identified as being suitable for restoring Northern bobwhite (*Colinus virginianus)* and early-succession songbird habitat in an agriculture-dominated landscape within the inner Coastal Plain. Early succession habitat—characterized by grasslands or herbaceous ground cover—is critically scarce in the Southeast due to the suppression of fire, agricultural conversion, and rural development (Gill *et al.*, 2006). As a consequence, wildlife and bird species found only in early-succession plant communities have dramatically declined over the past four decades (Riddle, 2007; Gill *et al.*, 2006). Analyses of breeding bird survey data gathered since 1965

show declines in most species associated with early-succession habitat (Smith, 2007). These areas will be replanted with a variety of native warm-season grasses using no-till drill methods.

In addition to restoring this important plant community, the inclusion of linear and nonlinear field borders will also be an important component in order to reverse the decline in early-succession species. The term 'field border' refers to areas of maintained herbaceous vegetation (grass and/or forbs, sometimes with a shrub component) along field margins, established specifically for wildlife, but also providing other environmental benefits (Smith *et al*., 2005). When field borders are managed for northern bobwhite and other early-succession bird species, they usually are disturbed with periodic selective herbicide application for woody vegetation control and/or with rotational mowing, rotational grazing, or prescribed fires every three years to keep them in a perpetual state of early-succession. A variety of field border practices for bobwhite and other early-succession birds currently are promoted and subsidized by federal and state programs, including the Conservation Reserve Program's (CRP) Upland Bird Habitat Buffer (CP-33; USDA 2004) and the North Carolina Wildlife Resources Commission's (NCWRC) Cooperative Upland Habitat Restoration and Enhancement (CURE) Program (Cobb *et al.,* 2002). Field borders have the potential to provide nesting habitat, movement corridors, and cover for bobwhite (Burger *et al.,* 1995; Puckett *et al*., 1995; Puckett *et al*., 2000) by providing usable space (Guthery, 1997).

The establishment of field borders is a proven restoration technique as it has nearly doubled the number of bobwhite coveys on farms in eastern North Carolina (Palmer *et al.,* 2005). The subsidization of field border practices, combined with their apparent high potential for increasing bobwhite populations, makes them a cost-effective conservation solution for private landowners. However, the CP-33 and CURE programs do not encourage or cost-share the establishment of field borders that average widths of less than 9.1 or 6.1 m, respectively (Riddle, 2007). As a result, in places where primary farm production functions will not be compromised, KCI proposes planting nonlinear field borders, which reduces negative edge effects by decreasing edge-to-area ratios (Johnson and Temple 1990), of up to 10 m, and narrow (~3 m) borders in other areas where they are the only option.

Two areas on the property that are best described as Coastal Plain Semipermanent Impoundments (Schafale and Weakley, 1990). These areas will be planted with wetland trees and shrubs such as buttonbush (*Cephalanthus occidentalis*), water tupelo, Atlantic white cedar, and bald cypress. The modified waterfowl impoundments and the periodically flooded area surrounding Tributary 1 will be planted with these species.

8.2 Sediment Transport Analysis

The NPAC and its tributaries comprise a sand-dominated system. Sand channels have a unique transport process where particles are suspended in the water column during turbulent flows. During fully turbulent flow, all of the sand can move, but this is rarely the case. In partial transport scenarios, there is a complex relationship between the sand being suspended and the sand slowly depositing back on the bed.

Sand bed streams contain smaller grain size particles, therefore the beds are highly mobile and can mould into different bedform shapes due to flow pattern conditions. During low flow conditions, sand streams have thick plane beds. Bed variations (pools) only result from scenarios (i.e., objects in the stream) that would induce local scour. At smooth flows, ripples form with small ridges in the bed and sharp crests. At rough flows, dunes form large rounded crests. Both ripples and dunes can migrate downstream by eroding their faces and re-depositing downstream. In the proposed restoration, this process provides the mechanism by which sediment transport will occur and provide bed heterogeneity. (Gordon, et al., 2004)

The NPAC has been extensively channelized resulting in an alteration of the channel bed. The NPAC channel bed has deeply incised and currently resides in a gravel layer. During the field assessment, the banks were observed for sediment transitional changes from sand to gravel. At a depth of 4.2 feet below

the existing top of bank, the stream bank begins to change from sand to gravel. No pebble counts were performed on the NPAC because the data would be extraneous to the restoration design, due to the current residence of the stream bed in gravel. A visual inspection of the tributaries was performed and it was concluded that all the channel beds were dominated by coarse sand. The stream restoration will raise the current incised bed elevation to the existing floodplain elevation, which is within the sand layer.

Sand channels must have adequate capacity to allow dunes to form and move. This design capacity is related to the available sediment supply. Observations of the existing condition, upstream of the NPAC, provide evidence of an adequate sand sediment supply to support the proposed restoration design. The adjoining upstream property is owned by the county and is under low pressure for any development that would impact the sediment regime. While much of the existing sediment produced by the site will become residual as a benefit of the restored wetlands, the low gradient of the proposed NPAC will allow for the continual transport and transition of sand-bed features through the restored reach stabilizing with time as the site becomes an integrated wetland and stream complex that is visible in others areas throughout the watershed.

The design channel for the NPAC will be a C5 type with sand banks while all tributaries will be C5/B5c with the exception of T2B (E5 channel). As has been previously discussed in Section 8.1.1, several rigid structures and wood have been designed to serve as grade control and compliment the sand-channel design by inducing scour to maintain deeper features as prescribed in certain locations throughout the NPAC. At bankfull stage, the designed channel has adequate transport competence to mobilize the entire bed. At intermediate high flows, the channel shape and dimension will create a transport capable of progressing features slowly through the reach, as discussed previously.

8.3 Wetland Hydrologic Modifications

Hydrologic modifications will focus on enhancing hydrology to the proposed wetland enhancement and restoration areas by improving the hydroperiod of the wetlands. Currently, ditches in the areas drain the surface water directly into the NPAC. The ditches prevent surface water from remaining on-site and recharging groundwater. These ditches will be filled and stabilized to allow longer retention times and reduce/eliminate shallow groundwater loss from the area. The proposed wetland restoration areas will exist on the floodplains of the NPAC.

In addition to blocking the major non-jurisdictional outlets from the site, KCI will also re-create wetland microtopography to reestablish a Coastal Plain Small Stream Swamp community. The site will be graded to form small depressions and rises throughout the site that will resemble the minor variations in elevation found in a natural wetland system. Seeps at the toe of slopes surrounding the floodplain will be re-developed to alleviate compaction and will be incorporated into the overall design to maximize available ecological niches.

8.3.1 Narrative of Modifications

The following modifications are planned within the designated wetland enhancement and preservation areas below. The wetlands are specifically identified in Figure 14.

Wetland Area 1 – 45.93 acres of preservation

Wetland 1 will preserve approximately 46 acres of palustrine forested, scrub shrub and emergent wetlands that are diverse and well vegetated along the floodplain of the NPAC. The preservation area is dominated by various wetland sedges, rushes and persistent emergent vegetation, but also contains large scrub-shrub alder thickets that are permanently inundated.

Wetland Area 2 – 6.88 acres of enhancement
Starting from the west and working east, the first enhancement area is located in the general vicinity of Tributary 1. This area, which includes jurisdictional wetlands W3 and W4, receives significant runoff contributions from the nearby pasture as well as the cattle feed lots and adjacent farm buildings. This area will be enhanced through planting of bare root material as per the project planting plan. Invasive species such as Japanese stilt grass (*Microstegium vimineum*) will be treated with a glyphosate herbicide, approved for use in aquatic environments.

Wetland Area 3 – 2.57 acres of enhancement
The second wetland enhancement area is located in the central portion of the site and includes jurisdictional wetland W9. The area includes a shallow man-made pond and adjacent overbank areas of the NPAC. This area is located adjacent to an area of the NPAC where existing overbank flows have regular access to the floodplain, providing the hydrology to wetland W9. This area will be planted with wetland trees and shrubs and graded to eliminate the man-made berms that serve to impound excess surface water.

Wetland Area 4 – 12.67 acres of enhancement
The third enhancement area is located in an area that was heavily manipulated by the landowner to create a series of shallow impoundments intended to attract migratory waterfowl. The impoundments contain water control structures that, prior to the purchase of the easement, allowed the landowner to manipulate water levels within the impoundments. This enhancement area is made up of jurisdictional wetlands W11, P1, P2, and W2. Wetland W2 is not an impoundment, but is a transitional area between the impounded features and the wetland preservation area. This area will be planted with bare root seedlings and treated to control invasive species.

Wetland Area 5 – 43.8 acres of restoration
Wetland Area 5 includes all the wetland areas within the floodplain of the NPAC and it's tributaries that have been hydrologically altered to allow for agricultural production. Four main construction techniques will be utilized to restore these wetland areas. They include:

1. Raising the elevation of the NPAC and its tributaries to re-establish an active floodplain.
2. Fill in existing ditches and remove existing tile drains to discourage rapid groundwater discharge to surface water receptors.
3. Scarify top 0.5'-1.0' of organic surface soil to re-establish soil structure and allow for increased surface storage (microtopography). This material will not be removed from the site, simply re-worked to maximize the ability of the surface soils to retain surface and groundwater hydrology.
4. Plant species of wetland plants and shrubs typically adapted to live in areas of saturated or periodically inundated soil.

8.4 Natural Plant Community Restoration

8.4.1 Stream Riparian Planting

On the restored stream banks, live stakes will be used in conjunction with the native herbaceous seed mix to provide natural stabilization. Appropriate species identified for live staking include:

Zone A (Stream Bank Stabilization-Live Stakes)

Common Name	**Scientific Name**	**Indicator Status (Region 2)**
Silky dogwood	*Cornus amomum*	FACW+
Silky willow	*Salix sericea*	OBL
Black willow	*Salix nigra*	OBL

Riverine plantings shall consist of native woody species planted at 436 stems per acre (10 feet by 10 feet spacing) to achieve a mature survivability of 320 stems per acre. Plant placement and groupings will be randomized during installation in order to develop a more naturalized appearance. Woody vegetation planting will be conducted during dormancy. Species to be planted in the lower floodplain area (50 feet from the top of bank) will consist of the following:

Zone B (Lower Riverine Planting Zone – Bare Root)

Common Name	**Scientific Name**	**Indicator Status (Region 2)**
Green ash	*Fraxinus pennsylvanica*	FACW
River Birch	*Betula nigra*	FACW
Silky Dogwood	*Cornus amomum*	FACW+
Swamp Tupelo	*Nyssa biflora*	OBL
Laurel Oak	*Quercus laurifolia*	FACW-
Sugarberry	*Celtis laevigata*	FACW
Buttonbush	*Cephalanthus occidentalis*	OBL

8.4.2 Wetland Planting

Plantings shall consist of native species commonly found in Coastal Plain Small Stream Swamp communities, Coastal Plain Bottomland Hardwood communities and Coastal Plain Semipermanent Impoundments. Trees and shrubs will be planted at a density of 436 trees per acre (10 feet by 10 feet spacing) to achieve a mature survivability of at least 320 trees per acre. Plant placement and groupings will be randomized during installation in order to develop a more naturalized appearance. Woody vegetation planting will be conducted during dormancy. Tree species to be planted within the wetland site will consist of the following species:

Zone C (Upper Riverine Planting Zone – Bare Root)

Common Name	**Scientific Name**	**Indicator Status (Region 2)**
Green ash	*Fraxinus pennsylvanica*	FACW
Pin Oak	*Quercus palustris*	FACW
Laurel oak	*Quercus laurifolia*	FACW
Swamp chestnut oak	*Quercus michauxii*	FACW-
Cherrybark oak	*Quercus pagoda*	FAC+
Willow oak	*Quercus phellos*	FACW-
Sweetbay	*Magnolia virginiana*	FACW+

Zone D (Seasonally Inundated Palustrine Forested Wetland)

Common Name	**Scientific Name**	**Indicator Status (Region 2)**
Black Willow (Cuttings)	*Salix nigra*	OBL
Atlantic White Cedar	*Chamaecyparis thyoides*	OBL
Bald Cypress	*Taxodium distichum*	OBL
Water Tupelo	*Nyssa aquatica*	OBL
Buttonbush	*Cephalanthus occidentalis*	OBL
Overcup Oak	*Quercus lyrata*	OBL

Zone E (Permanently Inundated Palustrine Forested Wetland)

Common Name	**Scientific Name**	**Indicator Status (Region 2)**
Bald Cypress	*Taxodium distichum*	OBL
Atlantic White Cedar	*Chamaecyparis thyoides*	OBL
Black Willow (Cuttings)	*Salix nigra*	OBL

8.4.3 Upland Early Successional Habitat Restoration

No-till drill methods will be used to plant a variety of USDA-recommended native warm season grasses. The seed mix represents a particular vegetation growth stature; quantities may be constrained by availability, but will consist of the following species:

Common Name	**Scientific Name**
Big Bluestem	*Andropogon gerardii*
Bushy Bluestem	*Andropogon glomeratus*
Eastern Gamagrass	*Tripsacum dactyloides*
Indiangrass	*Sorghastrum nutans*
Little Bluestem	*Schizachyrium scoparium*
Little Bluestem	*Schizachyrium scoparium*
Prairie Wildrye	*Elymus canadensis*
Virginia Wildrye	*Elymus virginicus*
Sideoats Grama	*Bouteloua curtipendula*
Switchgrass	*Panicum virgatum*
Purpletop	*Tridens flavus*

Seeding rates will range from 2 lbs pure live seed (PLS) per acre to 5 lbs PLS per acre, except for Switchgrass which should be planted no greater than 1.25 lbs PLS per acre, due to its ability to out compete other warm-season native grasses.

8.4.4 Early Successional Habitat Management

In order to establish and maintain an early successional upland habitat, integrative management protocols will be necessary (Appendix K). This will include mowing during establishment, rotational mowing or prescribed fire on a 3-year cycle, and the application of herbicides for invasive species control as needed. Rotational mowing is used to maintain native grassland communities in various stages of growth and vegetative diversity to promote the use of this habitat for wildlife. According to the NRCS (Smith, 2007), this management option is conducted by dividing an area into 15 to 25-foot wide strips that are separated from one another by another 50 to 85 feet. Wider strips may be used to provide larger habitat blocks. A single strip is mown to a height of 4 to 8 inches either once or twice a year, depending on the presence of wildlife in that area. The mowing cycle would be once in early spring (mid-March to mid-April) before nesting birds commence activities, and then again in the late summer after nesting activities are completed. The following year, the second strip would be mowed during the same months. The third strip would be mowed in year three, and so forth. Larger areas evenly divided into six or more strips can be rotationally mown in pairs so that strip one is worked with strip 4, strip 2 with strip 5, strip 3 with strip 6, and so forth. If it is possible to use prescribed fire to manage the site, it is recommended that burns be conducted on a rotational basis during the dormant season. Dividing the proposed burn area into strips or plots will leave undisturbed escape and nesting cover for wildlife adjacent to burned plots. Disked firebreaks would be incorporated into the proposed burn plots.

To create and manage a field border, approximately 50 feet of untilled field along any edge adjacent to woody growth should be cut (Smith, 2007). Every three years, this border should be mowed and disked lightly to maintain an early-succession state. A plan sheet showing the location proposed location and dimensions of the Early Successional Habitat Management area is included in Appendix K.

8.4.5 On-Site Invasive Species Management

Invasive species management within wetlands will occur during construction in conjunction with several areas on the property that contain a predominance of invasive species. These include the floodplain of

T1, the floodplain of T4 and scattered areas along the NPAC. Work will be conducted using a glyphosate herbicide formulated for use in aquatic environments. Mechanical removal during construction will also be used on woody material such as privet and multiflora rose.

9.0 PERFORMANCE CRITERIA

Both the stream and wetland restoration sites will be monitored to evaluate project success. For the stream, monitoring shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. Specifically, stream success will be assessed utilizing measurements of stream dimension, pattern, and profile, site photographs, and vegetation sampling. The wetland site will be deemed successful once hydrology is established and vegetation success criteria are met.

9.1 Stream Stability

The purpose of monitoring is to evaluate the stability of the restored stream. Following the procedures established in the USDA Forest Service Manual, *Stream Channel Reference Sites* (Harrelson et al.,1994) and the methodologies utilized in the Rosgen stream assessment and classification system (1994 and 1996), data collected will consist of detailed dimension and pattern measurements, longitudinal profiles, and bed materials sampling. Due to the project stream's sand bed channel, which is designed to undergo variation as sand moves through the channel in the form of ripples and dunes, typical riffles and pools will not be measured.

Dimension

Permanent cross-sections will be established 36 locations along the project reaches. The following cross-sections will be used to evaluate stream dimension:

- 14 cross-sections on NPAC
- 4 cross-sections each on T1.1, T1.2 and T1
- 5 cross-sections each on T2 and T3

Permanent monuments will be established by conventional survey. The cross-section surveys shall provide a detailed measurement of the stream and banks and will include points on the adjacent floodplain or valley, at the top of bank, bankfull, at all breaks in slope, the edge of water, and thalweg. Width/depth and entrenchment ratios will be calculated for each cross-section based on the survey data.

Profile – Longitudinal profiles will be conducted on approximately 5,500 linear feet of the project reaches as described below:

- 3,000 linear feet along NPAC
- 500 linear feet each along T1.1, T1.2, T1, T2, and T3 (2,500 linear feet total)

Cross-section measurements should also show little or no change from the as-built cross-sections. Annual slope measurements should indicate that bedform features are stable with little change from the as-built survey. The pools should maintain their depth with lower water surface slopes, while the riffles should remain shallower and steeper than the average values for the stream.

Sediment transport should remain relatively unchanged with respect to aggradation and deposition of sediments. Due to the nature of a sand channel, it is expected that the bed will vary due to the movement of dunes and anti-dunes along the profile. This will create variation in the yearly monitoring of the cross-sections and longitudinal profiles. If changes to occur, they will be evaluated to determine whether they are minor adjustments associated with the movement of the sand bed and increasing stability or whether they indicate movement toward an unstable condition.

Pattern
Measurements associated with the restored channel pattern shall be taken on the section of the stream included in the longitudinal profiles. These data will include belt width, meander length, and radius of curvature. Subsequently, sinuosity, meander width ratios, radius of curvature, and meander length/bankfull width ratios will be calculated.

Bed Materials
Pebble counts will be conducted at each representative cross-section for the purpose of repeated classification and to evaluate sediment transport.

Verification of Bankfull Events
During the monitoring period, a minimum of two bankfull events must be recorded within the five-year monitoring period. These two bankfull events must occur in separate monitoring years. A bankfull event will be verified using methods such as a crest gauge, a pressure transducer logger, or an on-site photograph during the actual event.

Photograph Reference Points
Thirty photograph reference points (PRP) will be established to assist in characterizing the site and to allow qualitative evaluation of the site conditions. The location and bearing/orientation of each photo point will be documented to allow for repeated use.

Cross-section Photograph Reference Points
Each cross-section will be photographed to show the form of the channel with the tape measure stretched over the channel for reference in each photograph. An effort will be made to consistently show the same area in each photograph.

Longitudinal Photograph Reference Points
Additional PRPs will be located, as needed, to document the condition of specific in-stream structures such as log sills, log drops, riffle grade controls, and offset rock cross vanes.

9.2 Stream Riparian Vegetation
The success of the riparian buffer plantings will be evaluated using fifteen ten by ten meter vegetative sampling plots and will use the CVS stream vegetation monitoring protocol set out by the EEP. The corners of each monitoring plot will be permanently marked in the field. The coordinates of the plot corners as well as the individual trees will be recorded using conventional survey. The monitoring will consist of the following data inventory: composition and number of surviving species, total number of stems per acre, diameter at decimeter height (DDH), diameter at breast height (DBH) for trees greater than 5 feet in height, and vigor. Additionally, a photograph will be taken of each plot that will be replicated each monitoring year. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will take place, which may include invasive species control, the removal of dead/dying plants and replanting.

9.3 Wetland Hydrology
Groundwater elevations will be monitored to evaluate the attainment of jurisdictional wetland hydrology. The reference wetland will also be monitored using the same procedures for comparative analysis.

Verification of wetland hydrology will be determined by automatic recording well data collected within the project area and reference wetland. Five automatic recording gauges will be established within the restoration areas. Daily data will be collected from the automatic gauges over the 5-year monitoring period following wetland construction.

Wetland hydrology will be considered established if well data from the site indicates that the water table is within 12 inches of the soil surface for a continuous 5% of the growing season (NRCS published or locally calculated) during normal weather conditions. A "normal" year is based on NRCS climatological data for Harnett County, and using the 30th to 70th percentile thresholds as the range of normal, as documented in the USACE Technical Report "Accessing and Using Meterological Data to Evaluate Wetland Hydrology, April 2000." According to the Harnett County Soil Survey, the growing season is considered to extend from March 16 to November 11, yielding 240 days. Therefore, success will be achieved if the water table is within 12 inches of the soil surface for at least 12 consecutive days during the growing season.

9.4 Wetland Vegetation

The success criteria for the planted species in the wetland restoration area will be based on survival and growth. Beginning at the end of the first growing season, KCI will monitor vegetation for five years following the planting.

Thirty permanent monitoring plots (10 by 10 meters) will be established in the wetland restoration area at a density that will ensure adequate coverage of the total restoration acreage. Plots will be systematically located to ensure even placement. Data will be collected at each plot for composition and number of surviving species, differentiation between planted individuals and volunteers, and total number of stems per acre.

Survival of planted species must be 320 stems/acre at the end of five years of monitoring. Non-target species must not constitute more than 20% of the woody vegetation based on permanent monitoring plots.

9.5 Schedule/Reporting

The first scheduled monitoring will be conducted during the first full growing season following project completion. Monitoring shall subsequently be conducted annually for a total period of five years or until the project meets its success criteria. Vegetation monitoring will be conducted as near to the end of the growing season as possible.

Annual monitoring reports will be prepared and submitted after all monitoring tasks for each year are completed. The report will document the monitored components of the restoration plan and include all collected data, analyses, and photographs. Each report will provide the new monitoring data and compare the most recent results against previous findings. The monitoring report format will be similar to that set out in the most recent EEP monitoring protocol.

Variations from the designed project reaches can be anticipated due to unknown site conditions, inputs from outside the restoration site, regional climatic variations, or acts of God, etc. Regular management activities will be implemented as necessary to ensure that the goals and objectives of the project are met. These activities will be conducted throughout the year and may include invasive species control or other management activities. If the monitoring identifies failures in the project site, a remedial action plan will be developed to investigate the causes of the failure and propose actions to rectify the problem.

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USDA., NRCS. Historical Aerial Photographs. 1938, 1949, 1955, 1981, 1988, 1993, 1998, and 2004.

USACE, 1987. Corps of Engineers Wetland Delineation Manual.

Tables

Table 2: Hydrograph Events

Farrar Dairy Site (March 2007-February 2008)														
Date	March 16		June 4		September 15		October 27		December 16		January 20		February 2	
Rainfall (in)	2.9		0.37		0.3		2.3		1.3		0.47		0.54	
	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)	Q (cfs)	Stage (ft)
Gauge 1 (NPAC)	158	2.6	85	1.9	6	0.5	53	3.0	45	1.3	17	0.8	14	0.7

Table 3: Project Drainage Areas

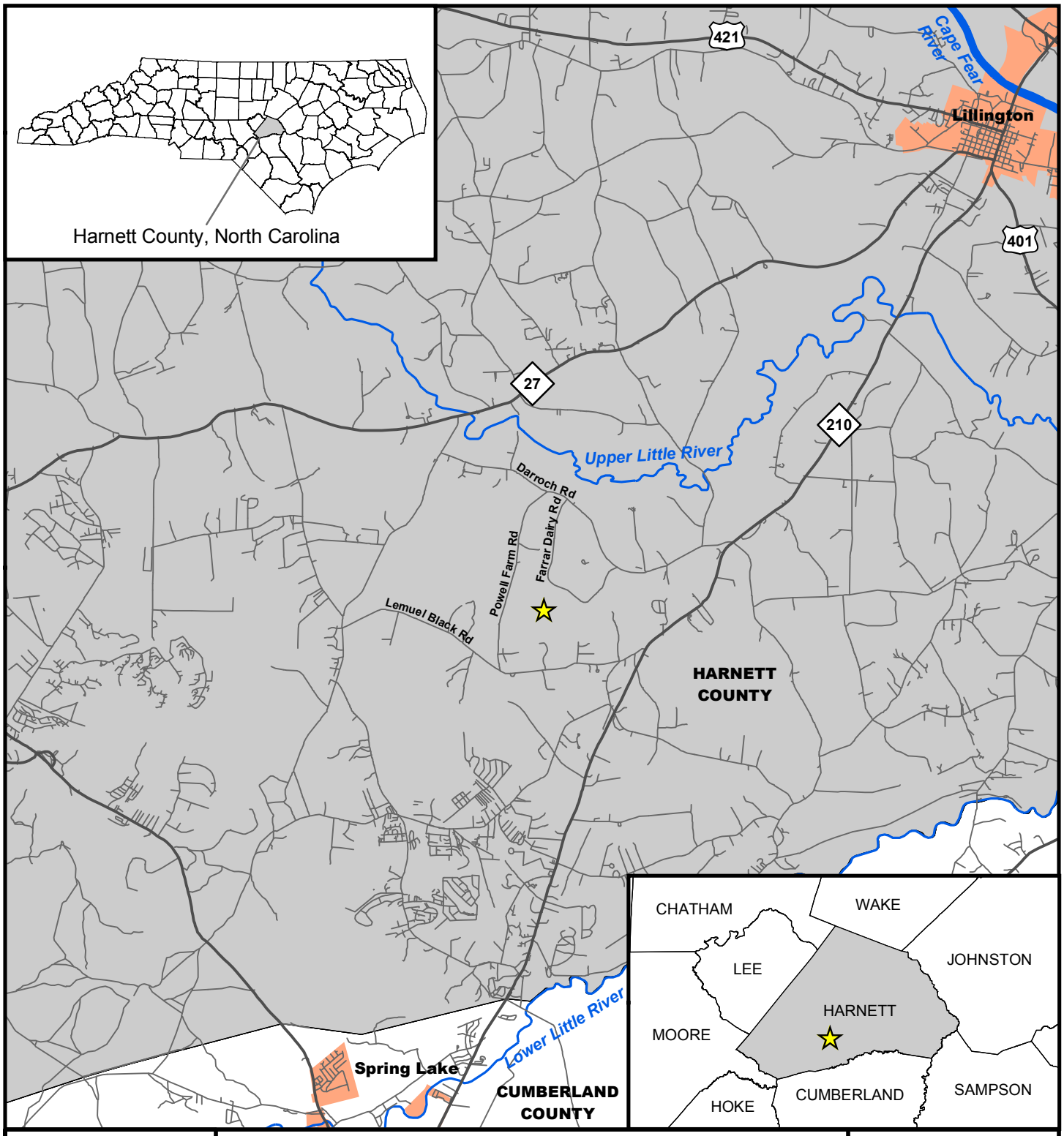
Reach	Drainage Area (Square Miles)
NPAC	3.92
T1.1-T1.2	0.18
T1	0.18
T2A-B	0.04
T3	0.39
T4	0.38

Table 4: Project Restoration Structure and Objectives

Reach	Station Range	Restoration Type	Priority Approach	Designed Linear Footage
NPAC	10+00-77+24	Restoration	P1	6,693
T1.1	80+00-88+27	Restoration	P1	827
T1.2	90+00-99+86	Restoration	P1	986
T1	100+00-108+81	Restoration	P3	*851
T2A	110+00-115+00	Restoration	P1	500
T2B	115+00-120+09	Restoration	P1	509
T3	130+00-141+51	Restoration	P1	1,151
T4	150+00-164+20	Enhancement	E II	418

*T1 designed linear footage excludes a 30' crossing, therefore Station range excludes 30 feet.

Figures



KCI TECHNOLOGIES

Figure 1. Vicinity Map

- Project Site Location
- Major Roads
- Other Roads
- Major Rivers
- Municipalities
- County Boundaries

1:126,720
1 inch equals 2 miles
2 1 0 2 Miles

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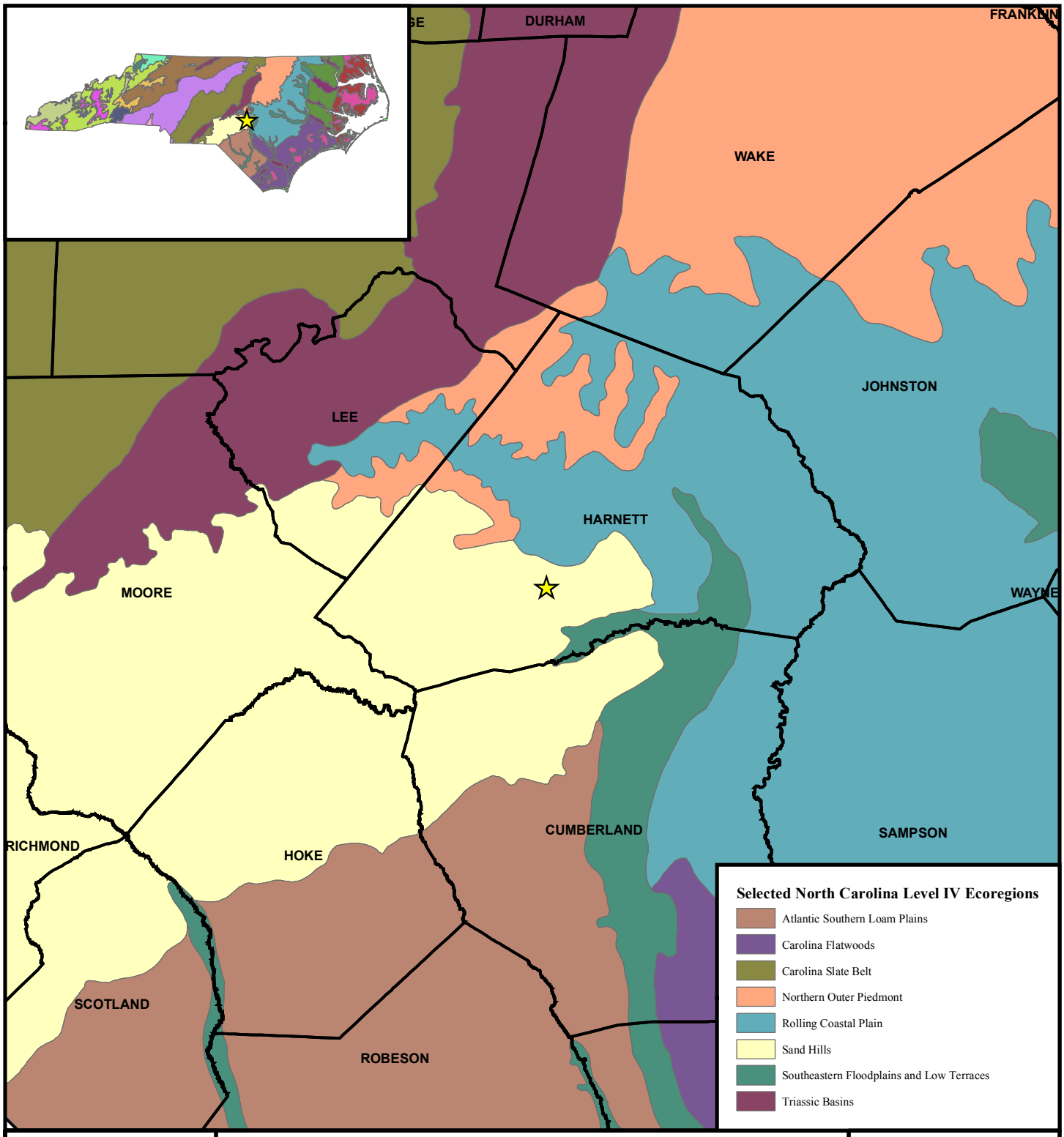
ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.



KCI TECHNOLOGIES

Figure 2. North Carolina Ecoregions

County Boundaries

Project Site Location

N
W E
S

1:633,600

1 inch equals 10 miles

10 5 0 10 Miles

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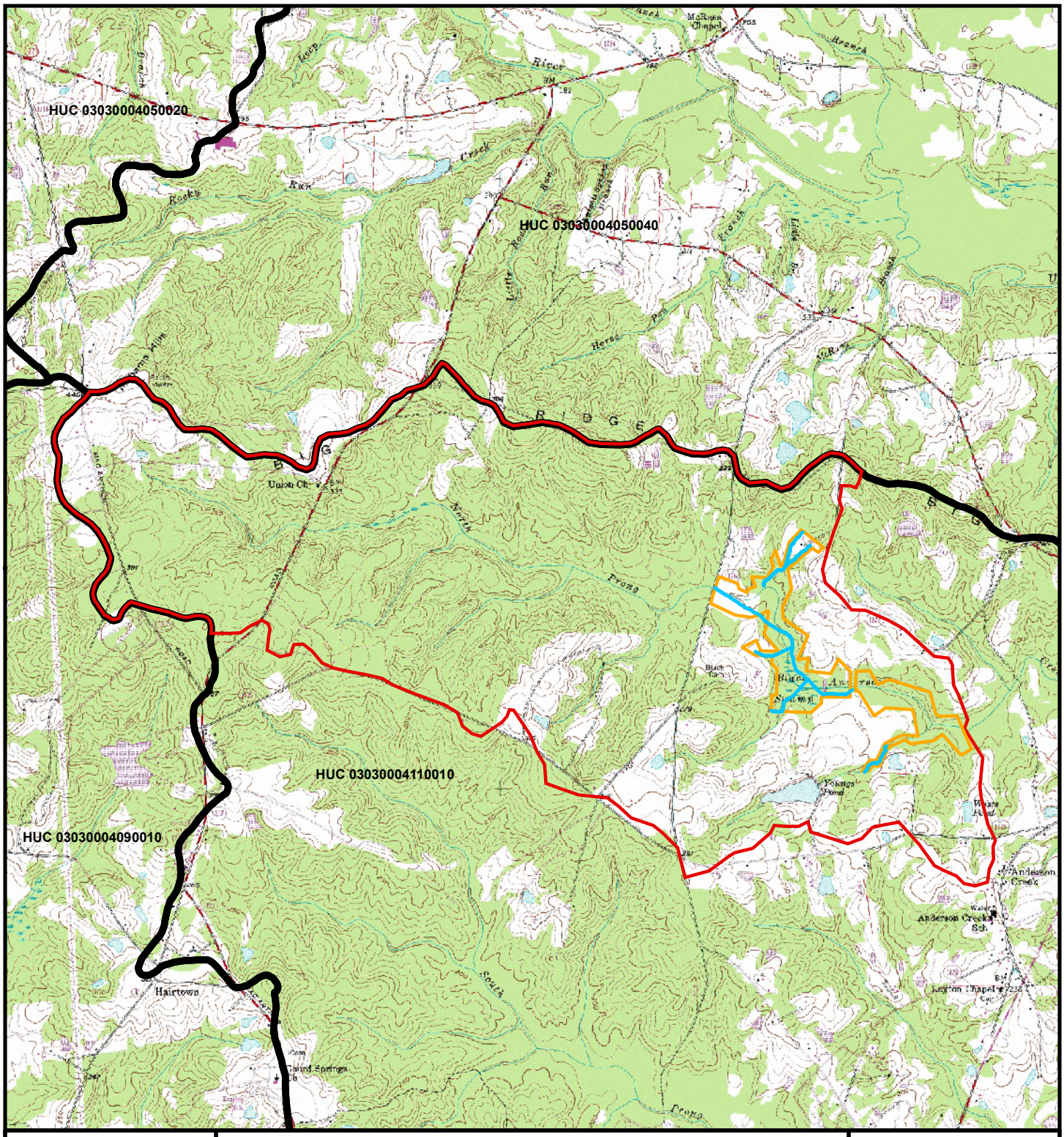

KCI TECHNOLOGIES

Figure 3. Project Watershed

Project Watershed (Approx. 5.7 sq. miles)

Project Streams

14-digit HUC Boundaries

Project Easement Boundary

N
W E
S

1:42,000

1 inch equals 3,500 feet

3,500 1,750 0 3,500 Feet

Source: USGS Topographic Quadrangle Anderson Creek, 1981

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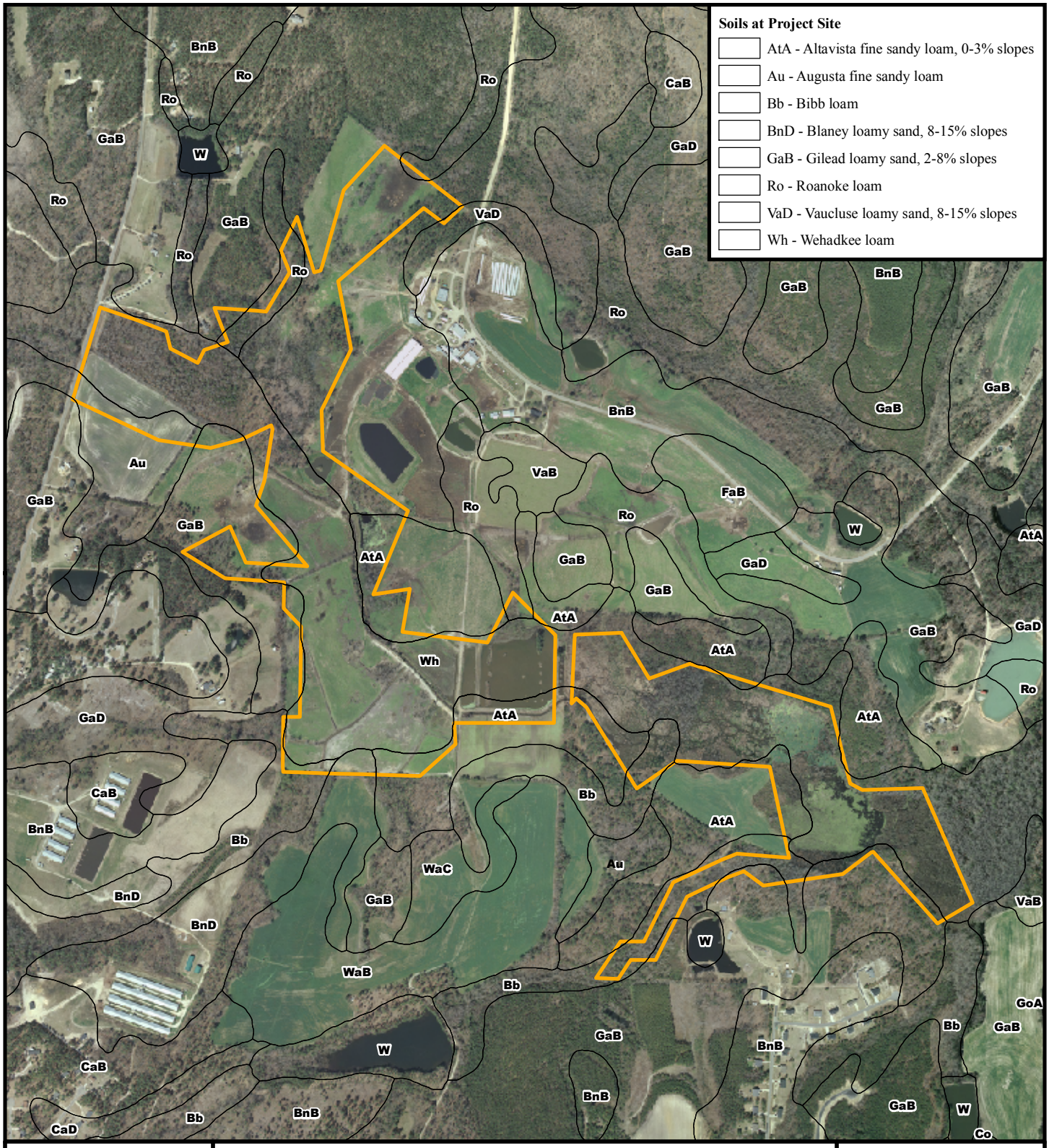

Figure 4. Project Site NRCS Soil Survey

Soils

Project Easement Boundary

1:12,000

1 inch equals 1,000 feet

1,000 500 0 1,000 Feet

Source: SSURGO Dataset from NRCS based on Soil Survey of Harnett County, North Carolina, USDA SCS 1994; 2005 Orthoimagery from Harnett County GIS/Land Records

KCI TECHNOLOGIES

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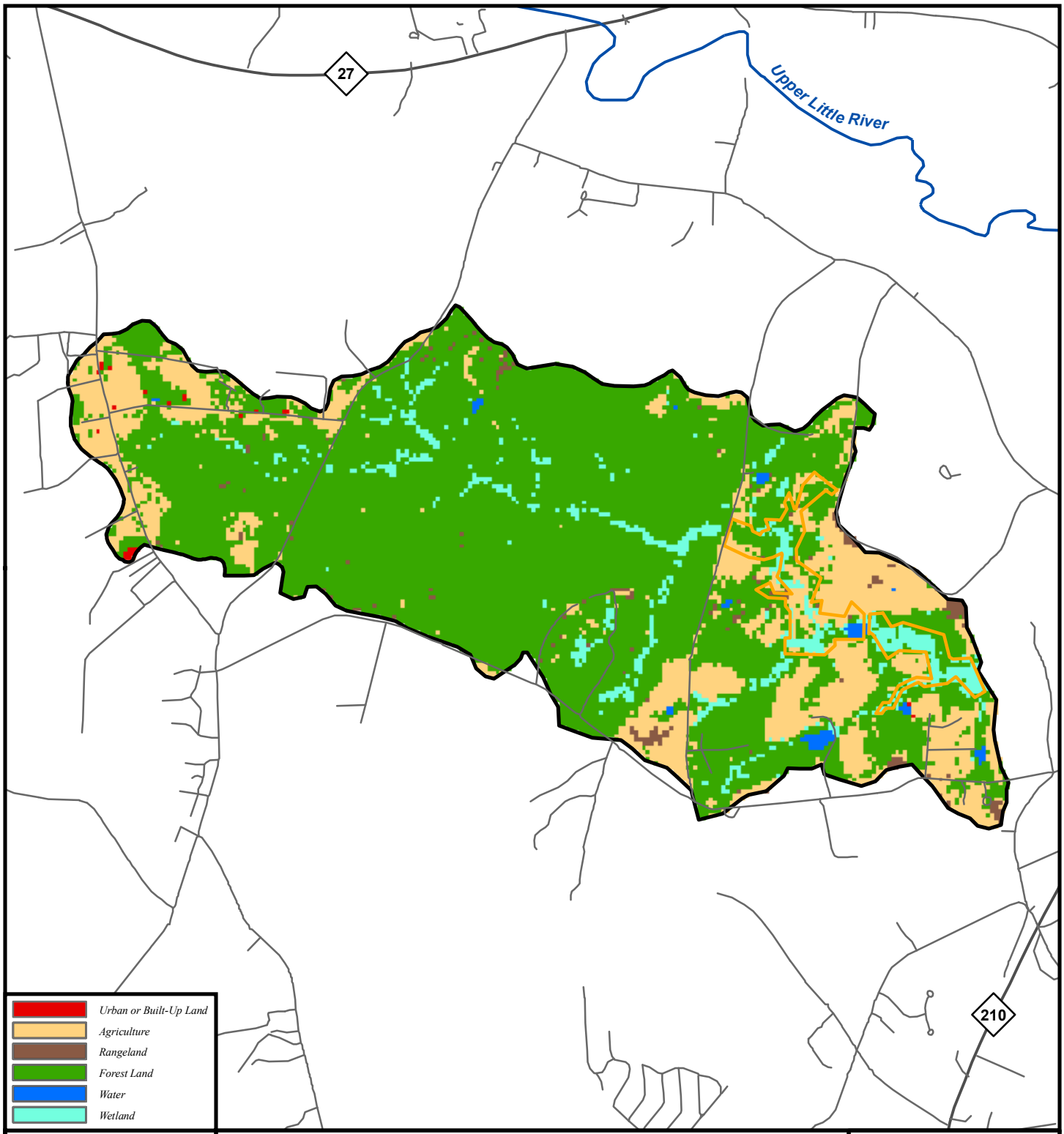

Figure 5. Project Watershed Land Use

Project Watershed

Project Easement Boundary

Major Rivers

Major Roads

Other Roads

Source: NC GAP Land Cover Dataset
Using Anderson I Classification Scheme

N
W E
S

1:42,000

1 inch equals 3,500 feet

3,500 1,750 0 3,500 Feet

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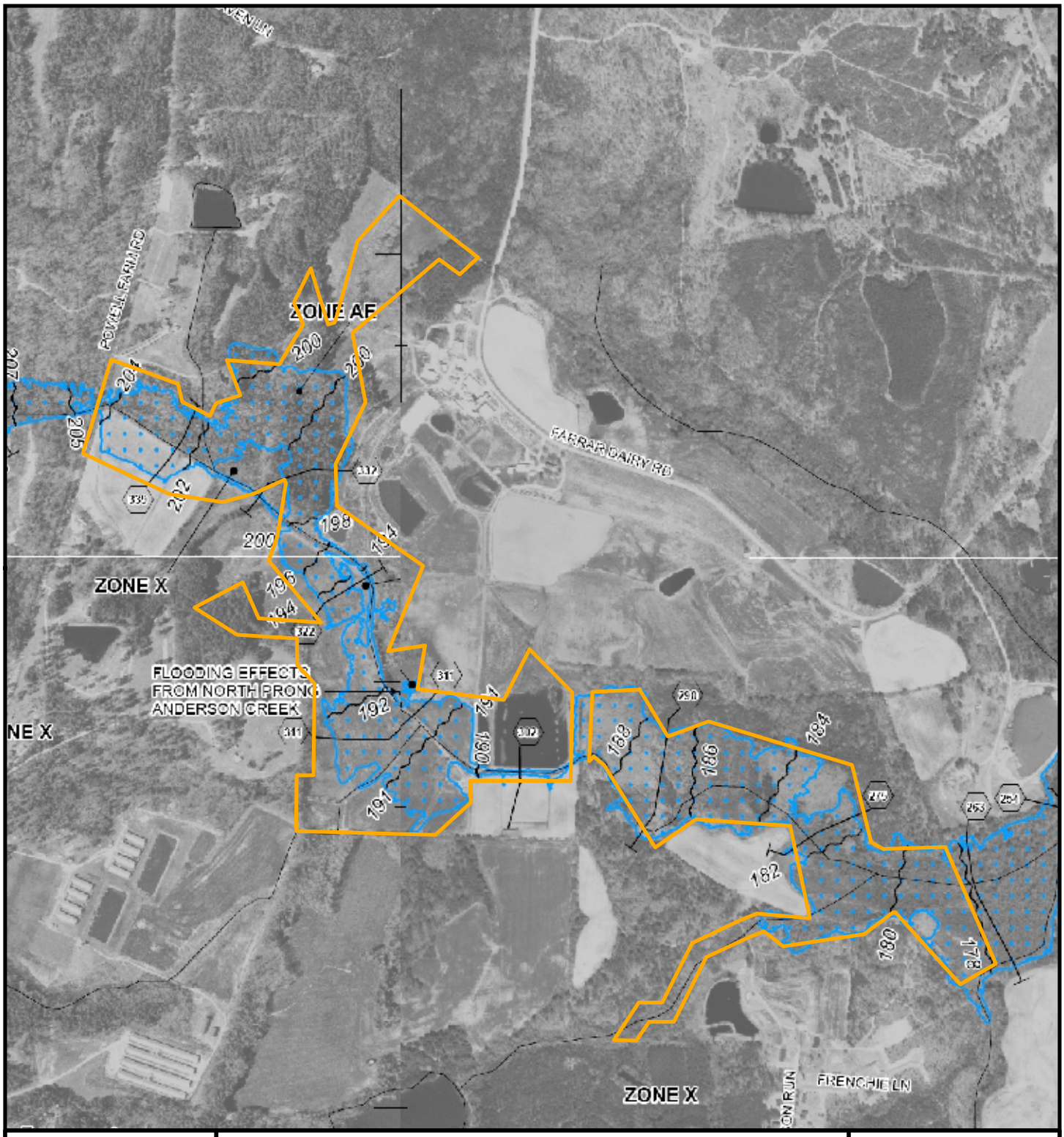

Figure 6. Project Site Floodplain Map

Project Easement Boundary

Special Flood Hazard Area
(Subject to inundation by the 1% annual chance flood)

1:12,000
1 inch equals 1,000 feet

1,000 500 0 1,000 Feet

Source: FEMA DFIRM Panels 0506J and 0526J
Harnett County FIS, Effective 10/3/06

KCI TECHNOLOGIES

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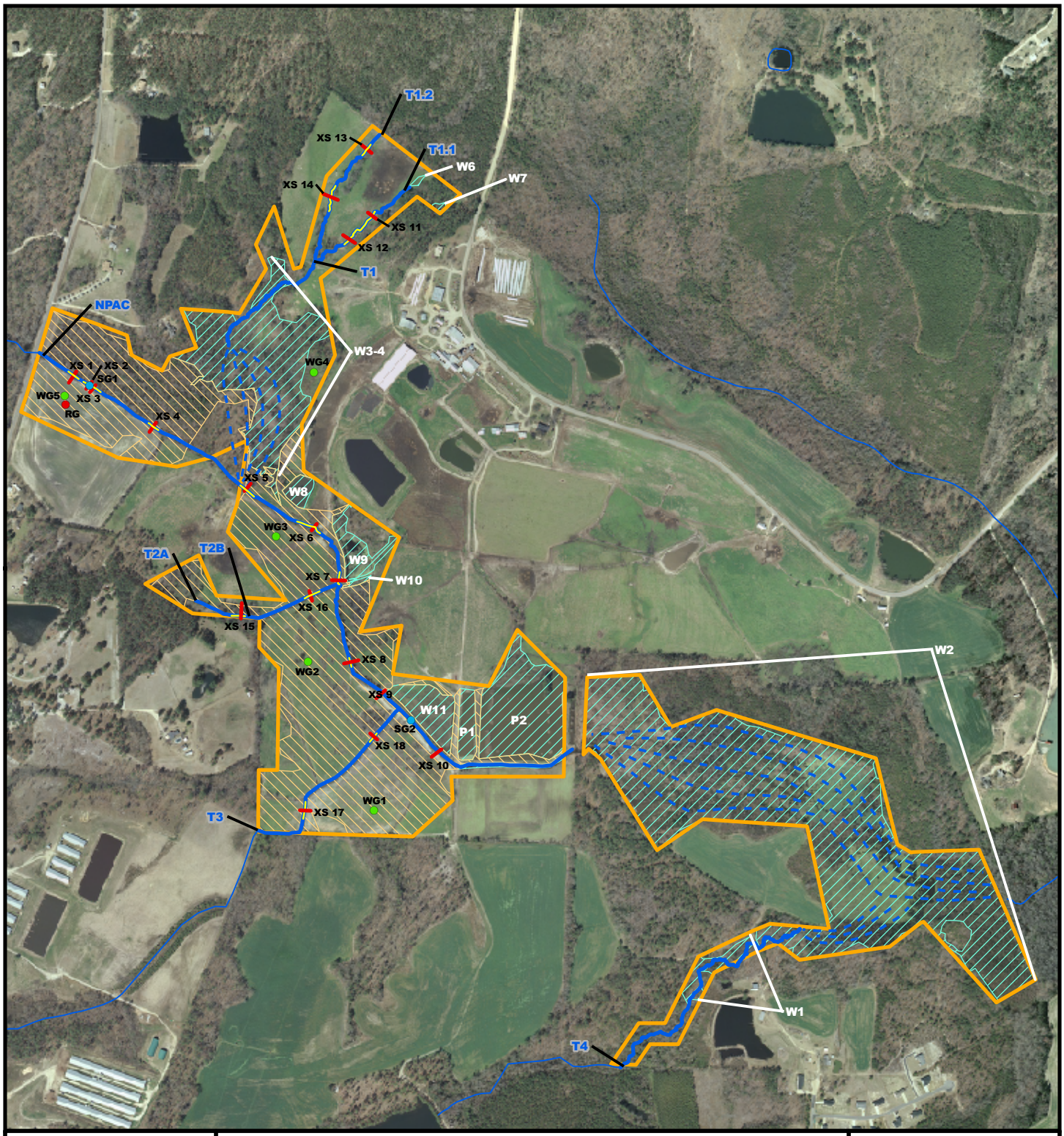

Figure 7. Existing Hydrologic Conditions

Project Streams
Diffuse Flow
Other Streams
Rain Gauge
Stream Gauge
Wetland Gauge
Project Easement Boundary
Surveyed Cross-Sections
Longitudinal Profiles
Drained Hydric Soils
Existing Wetlands

1:10,800
1 inch equals 900 feet

900 450 0 900 Feet

Source: Orthoimagery 2005, Harnett County GIS/Land Records

KCI TECHNOLOGIES

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

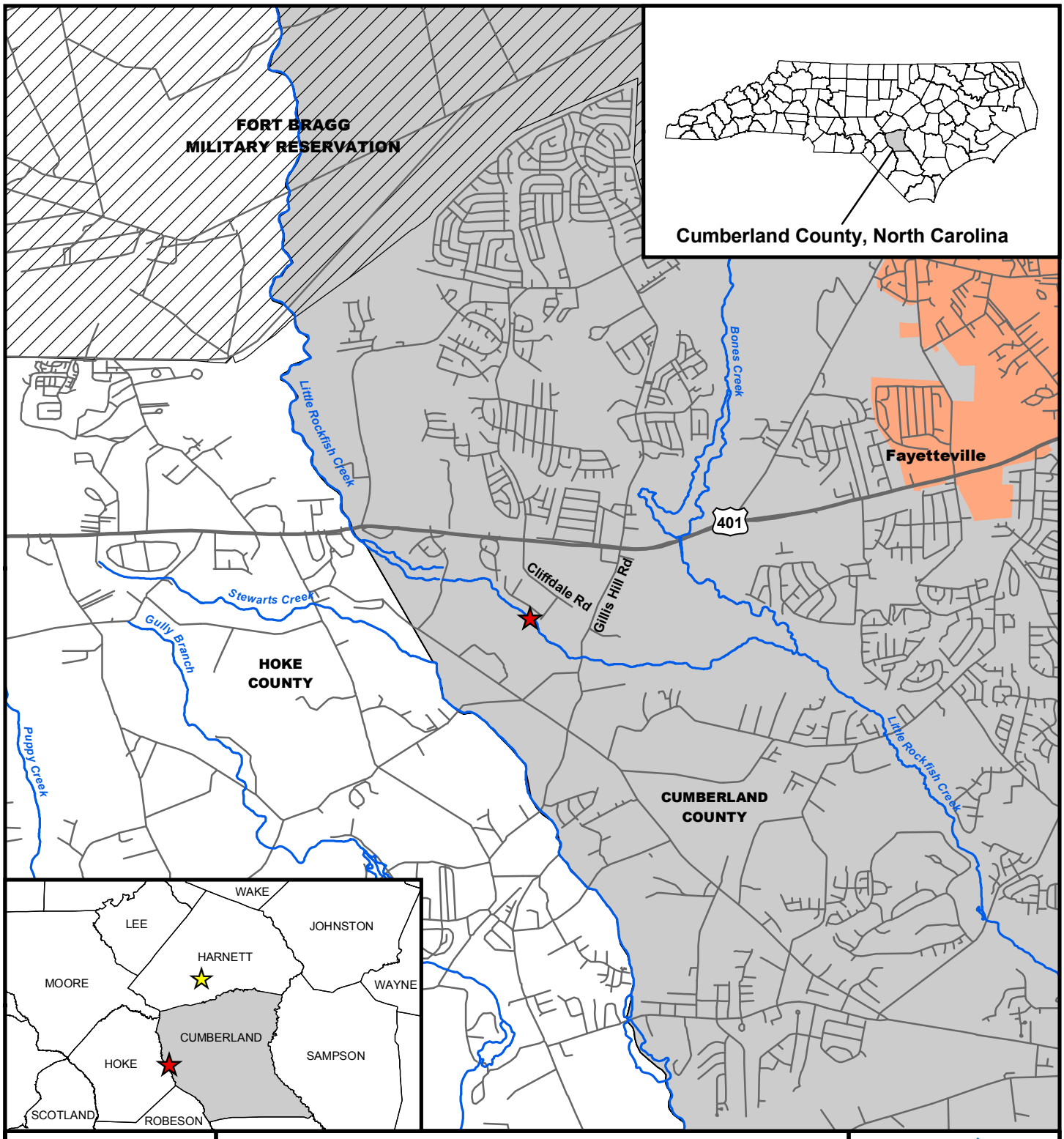

Figure 8. Reference Site Vicinity Map (Little Rockfish Creek)

- Project Site
- Reference Reach (Little Rockfish Creek)
- Major Streams
- Major Roads
- Other Roads
- Municipalities
- County Boundaries

1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

KCI TECHNOLOGIES

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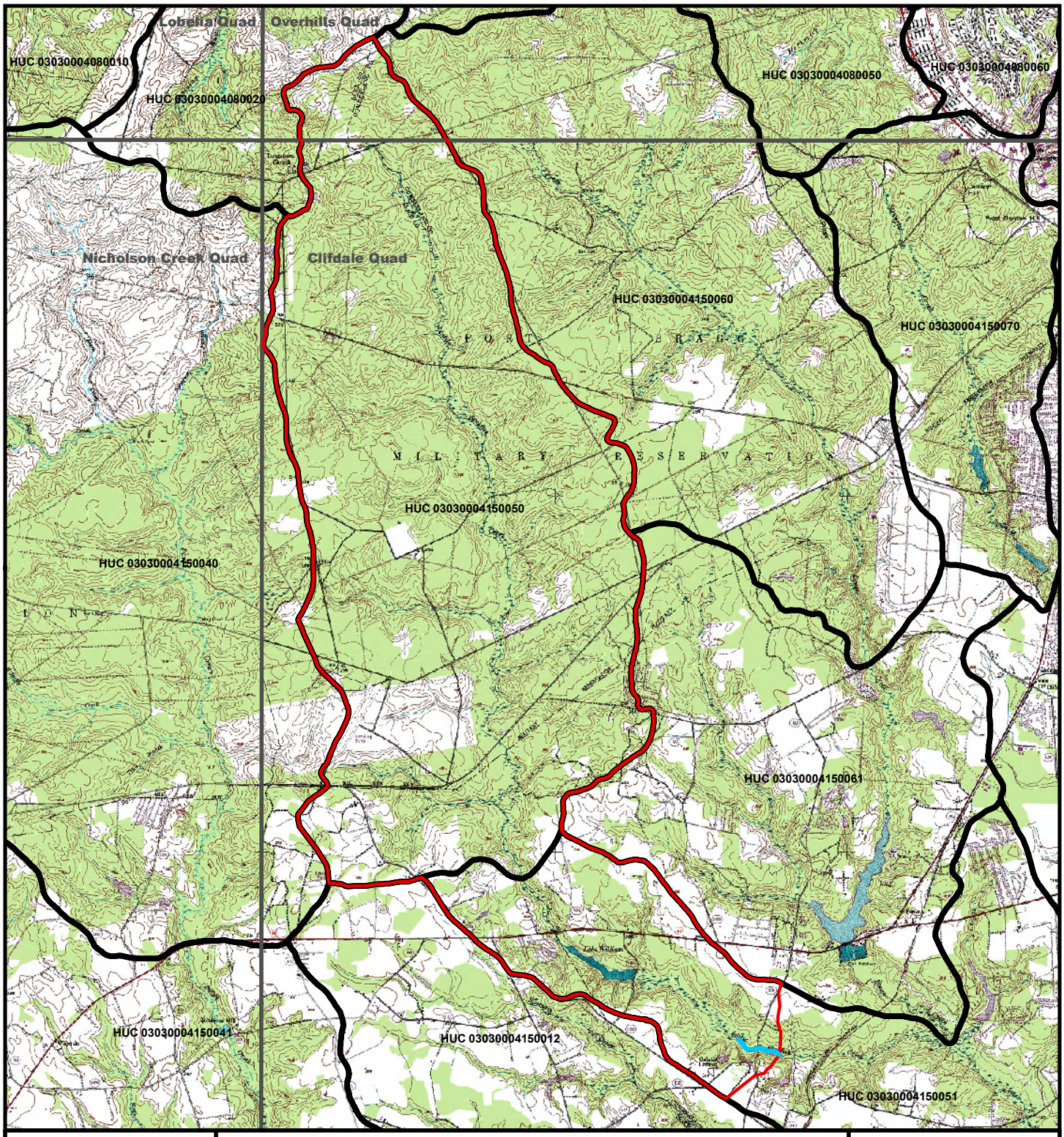
ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.



KCI TECHNOLOGIES

Figure 9. Reference Site Watershed (Little Rockfish Creek)

Reference Reach Watershed (Approx. 16.5 sq. miles)

14-digit HUC Boundaries

Reference Reach (Little Rockfish Creek)

Quadrangle Boundaries

N
W E
S

1:72,000
1 inch equals 6,000 feet

6,000 3,000 0 6,000 Feet

Source: USGS Topographic Quadrangles Clifdale (1971), Lobelia (1981), Nicholson Creek (1982), and Overhills (1971).

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

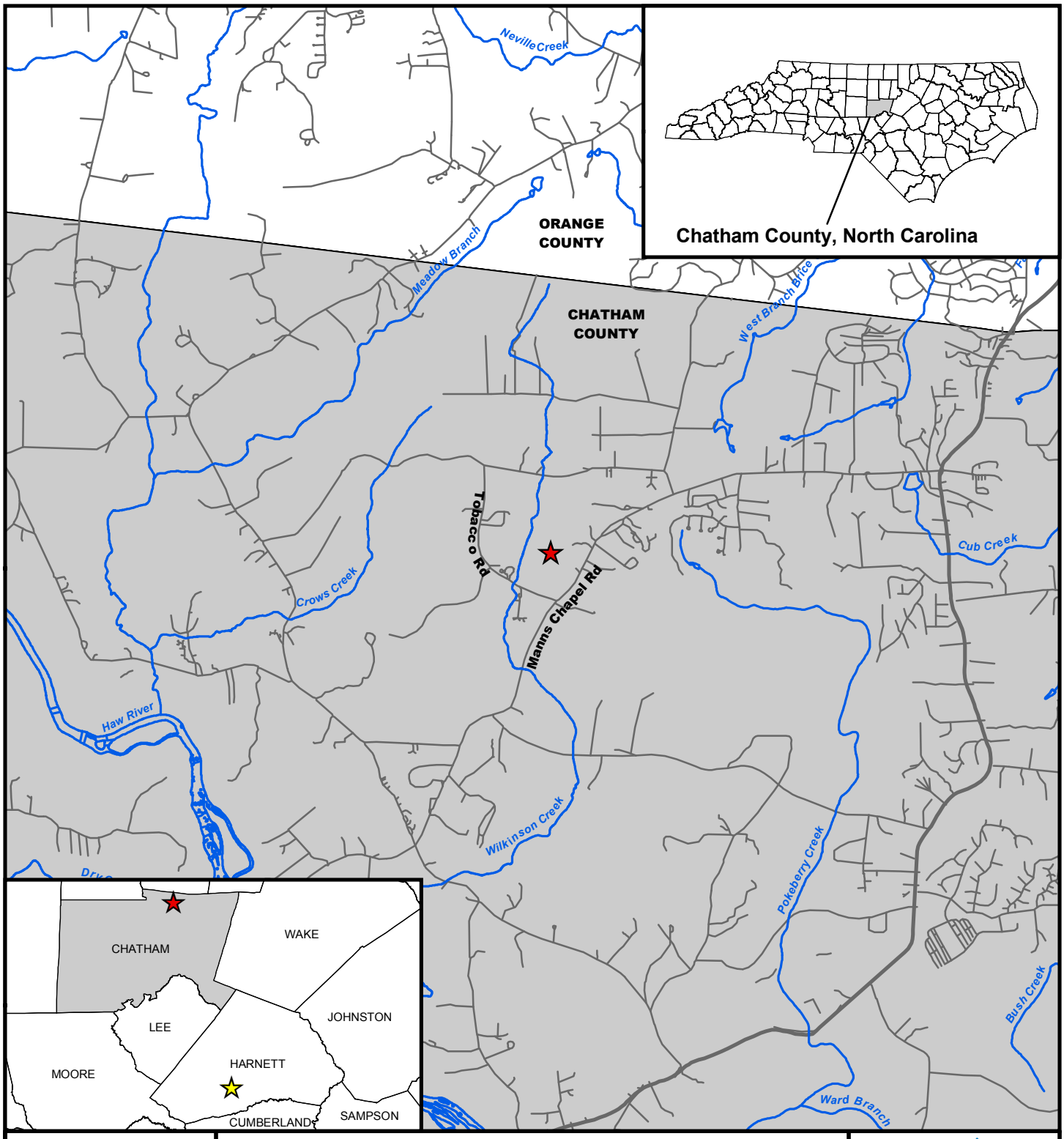

Figure 10. Reference Site Vicinity Map (UT to Wilkinson Creek)

- Project Site
- Reference Reach (UT to Wilkinson Creek)
- Major Streams
- Major Roads
- Other Roads
- County Boundaries

1:63,360
1 inch equals 1 miles
1 0.5 0 1 Miles

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

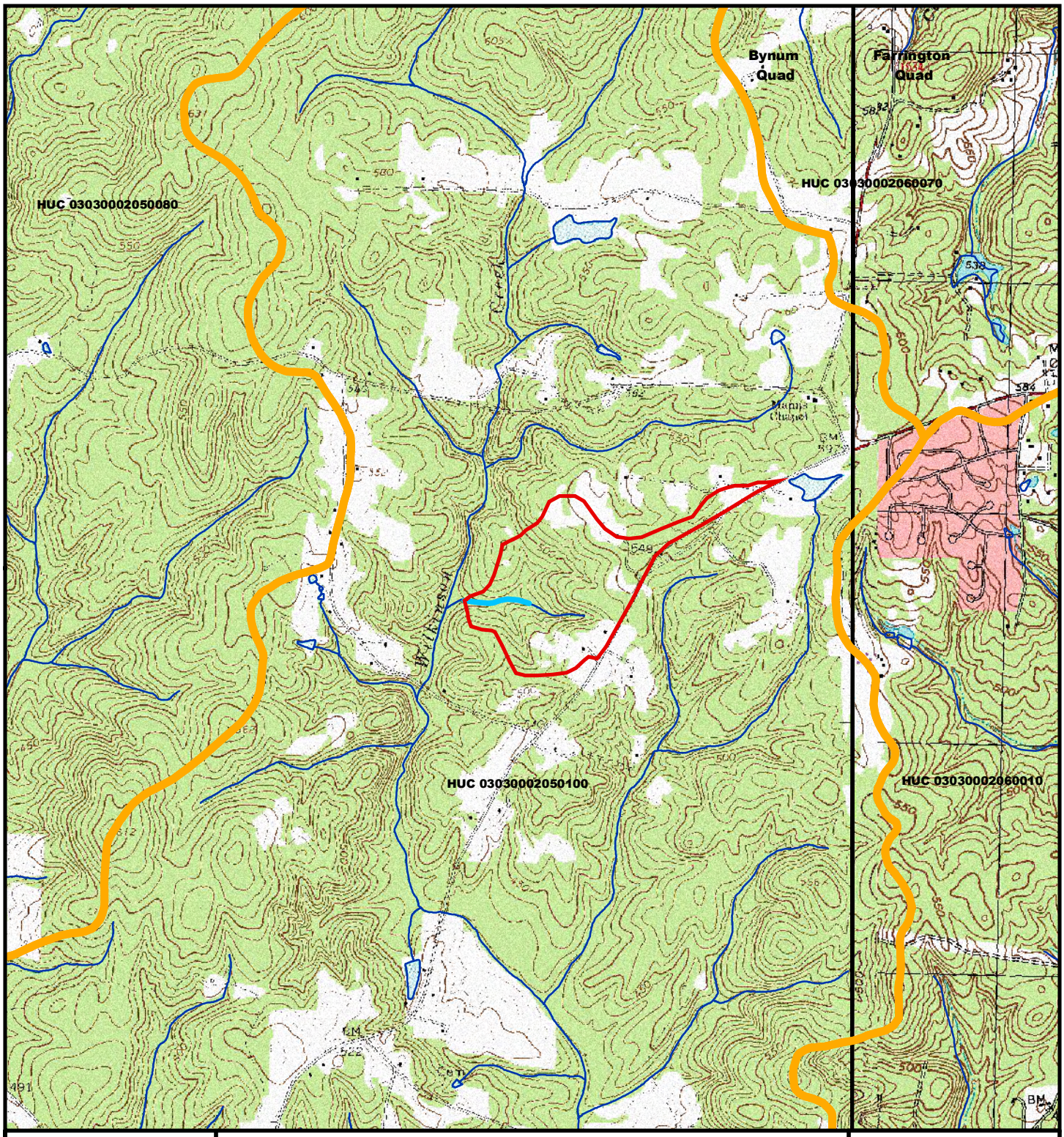

Figure 11. Reference Site Watershed (UT to Wilkinson Creek)

- Reference Reach Watershed (0.16 sq. mile)
- 14-digit HUC Boundaries
- Reference Reach (UT to Wilkinson Creek)
- Other Streams
- Quadrangle Boundaries

1:24,000

1 inch equals 2,000 feet

2,000 1,000 0 2,000 Feet

Source: USGS Topographic Quadrangles Bynum (1968) and Farrington (1981)

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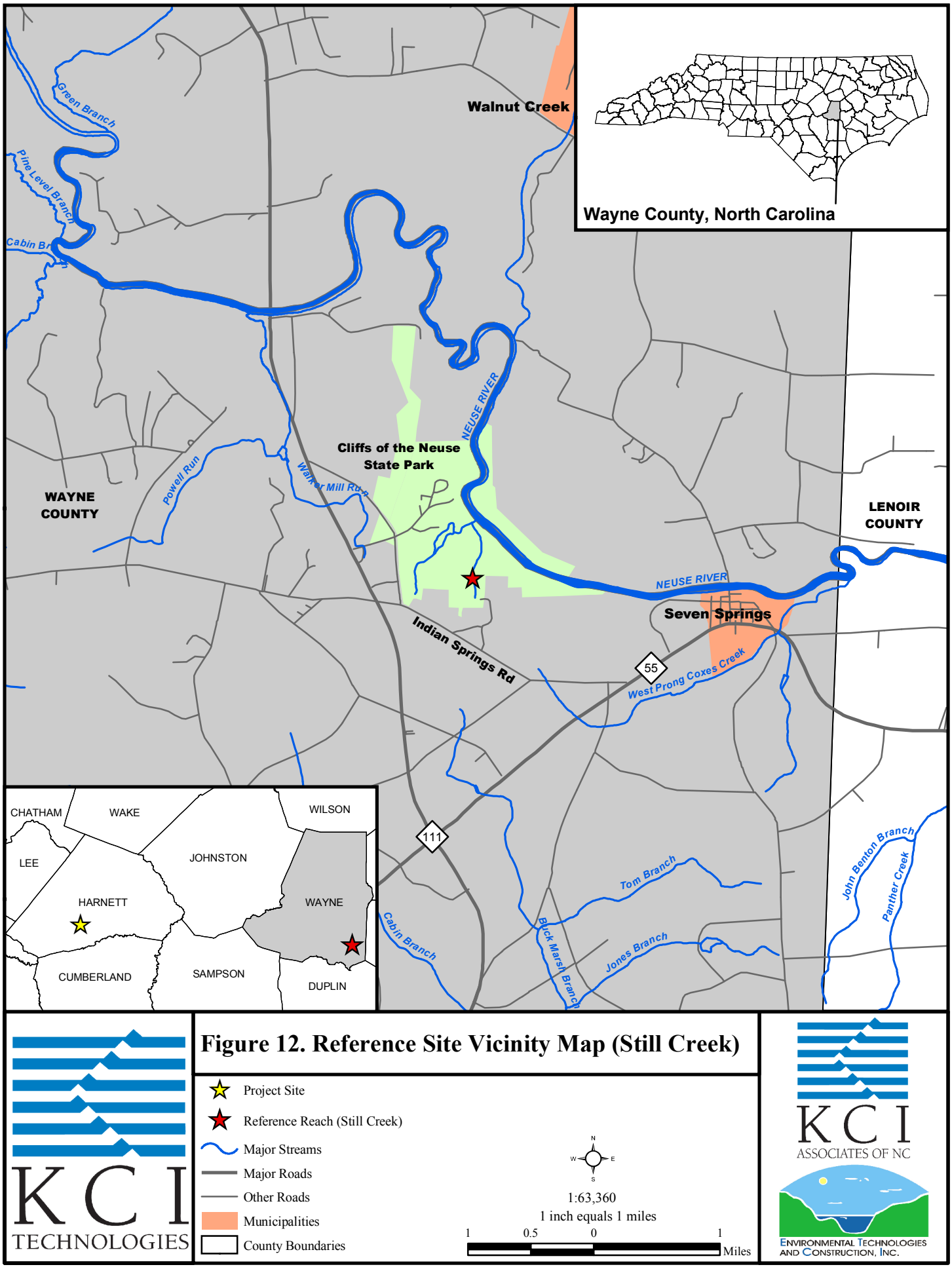

Figure 12. Reference Site Vicinity Map (Still Creek)

- Project Site
- Reference Reach (Still Creek)
- Major Streams
- Major Roads
- Other Roads
- Municipalities
- County Boundaries

N
W E
S

1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

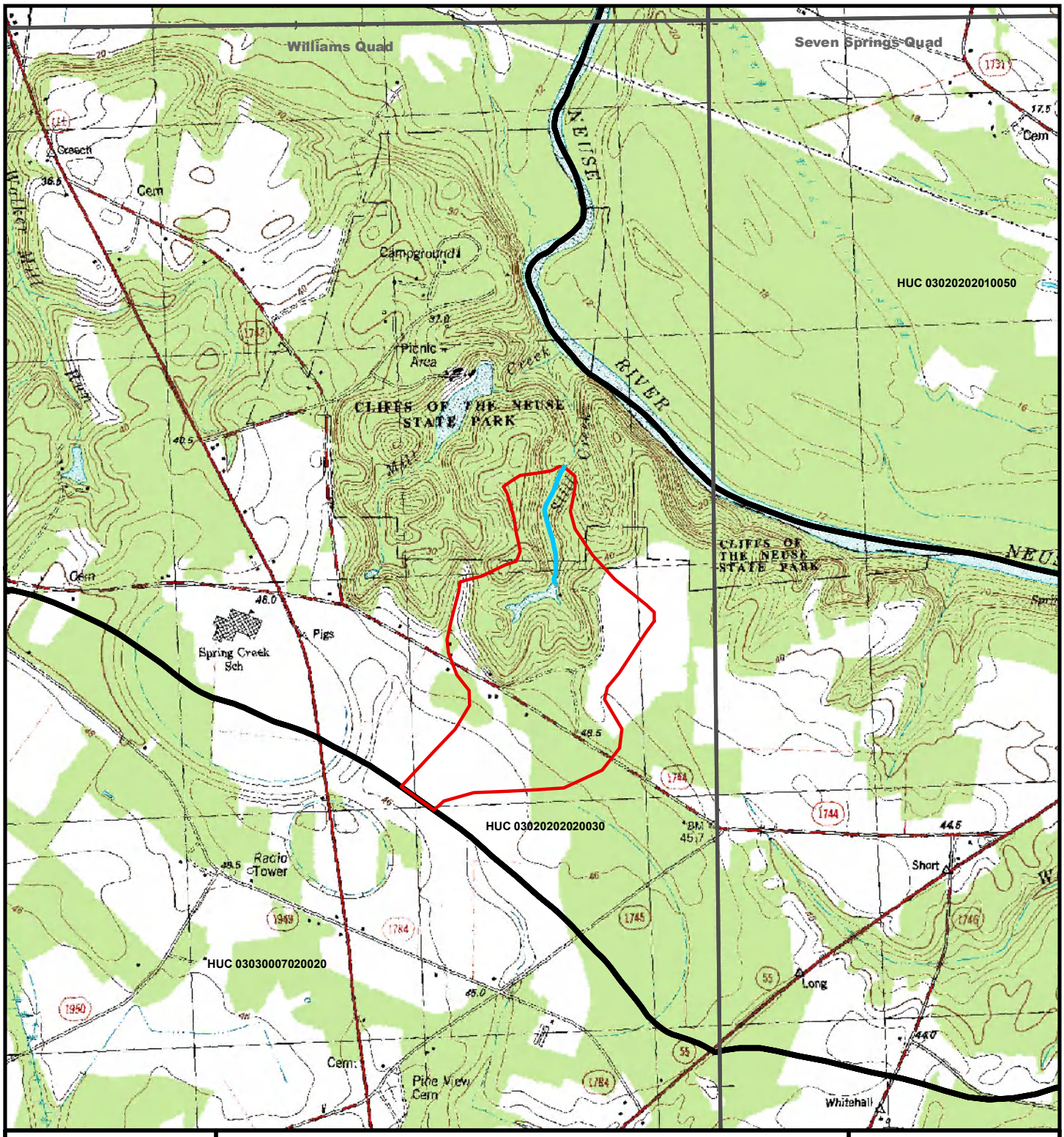

Figure 13. Reference Site Watershed (Still Creek)

Reference Reach Watershed (Approx. 0.35 sq. mile)

14-digit HUC Boundaries

Reference Reach (Still Creek)

Quadrangle Boundaries

1:24,000

1 inch equals 2,000 feet

2,000 1,000 0 2,000 Feet

Source: USGS Topographic Quadrangles Seven Springs (1980) and Williams (1980).

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ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

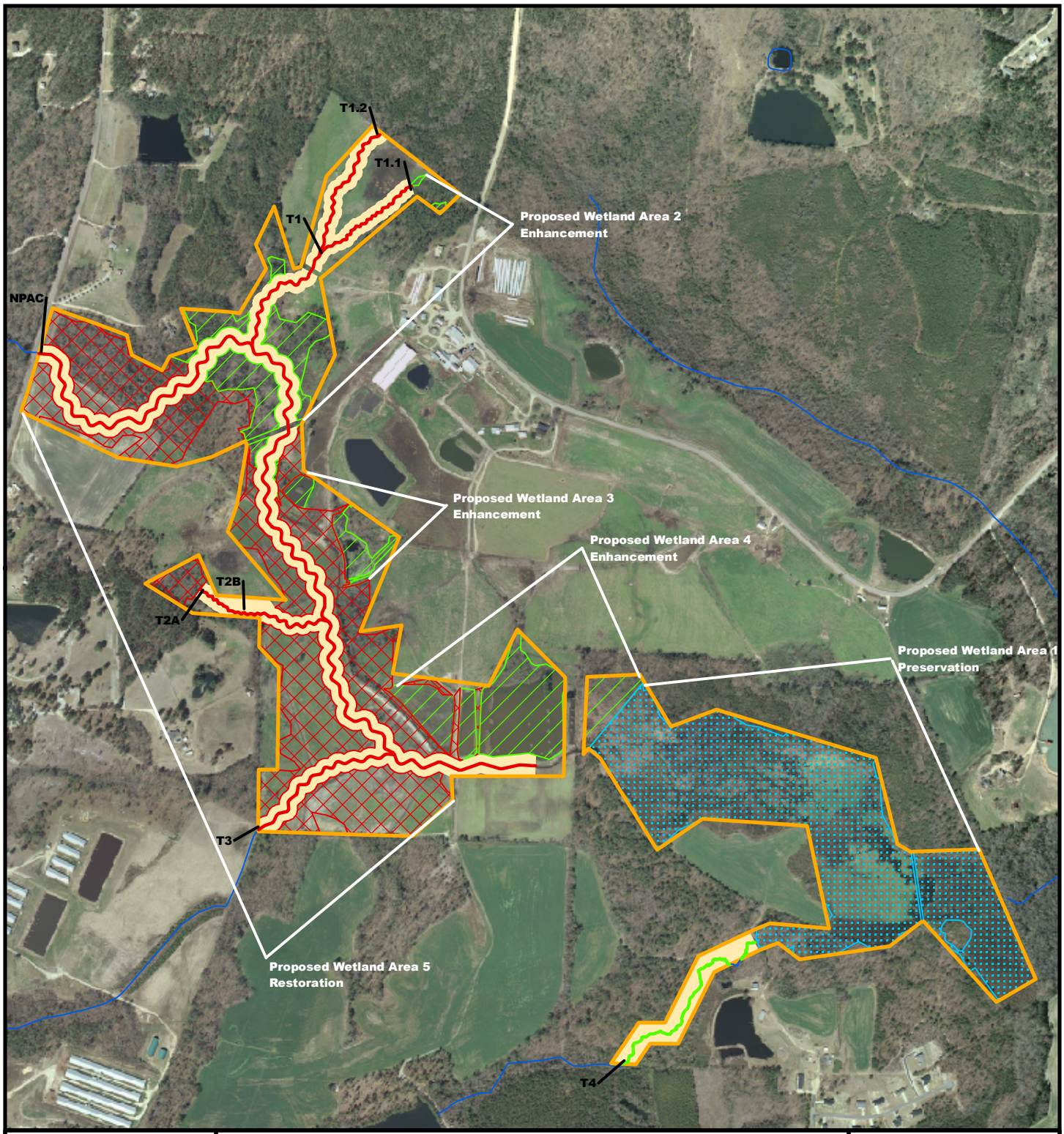

Figure 14. Proposed Site Plan

- Project Easement Boundary
- Stream Restoration (11,517 lf)
- Stream Enhancement II (1,420 lf)
- 50-ft Stream Buffer
- Other Streams
- Wetland Restoration (43.8 ac)
- Wetland Enhancement (22.3 ac)
- Wetland Preservation (45.9 ac)

1:10,800
1 inch equals 900 feet

900 450 0 900 Feet

Source: Orthoimagery 2005, Harnett County GIS/Land Records

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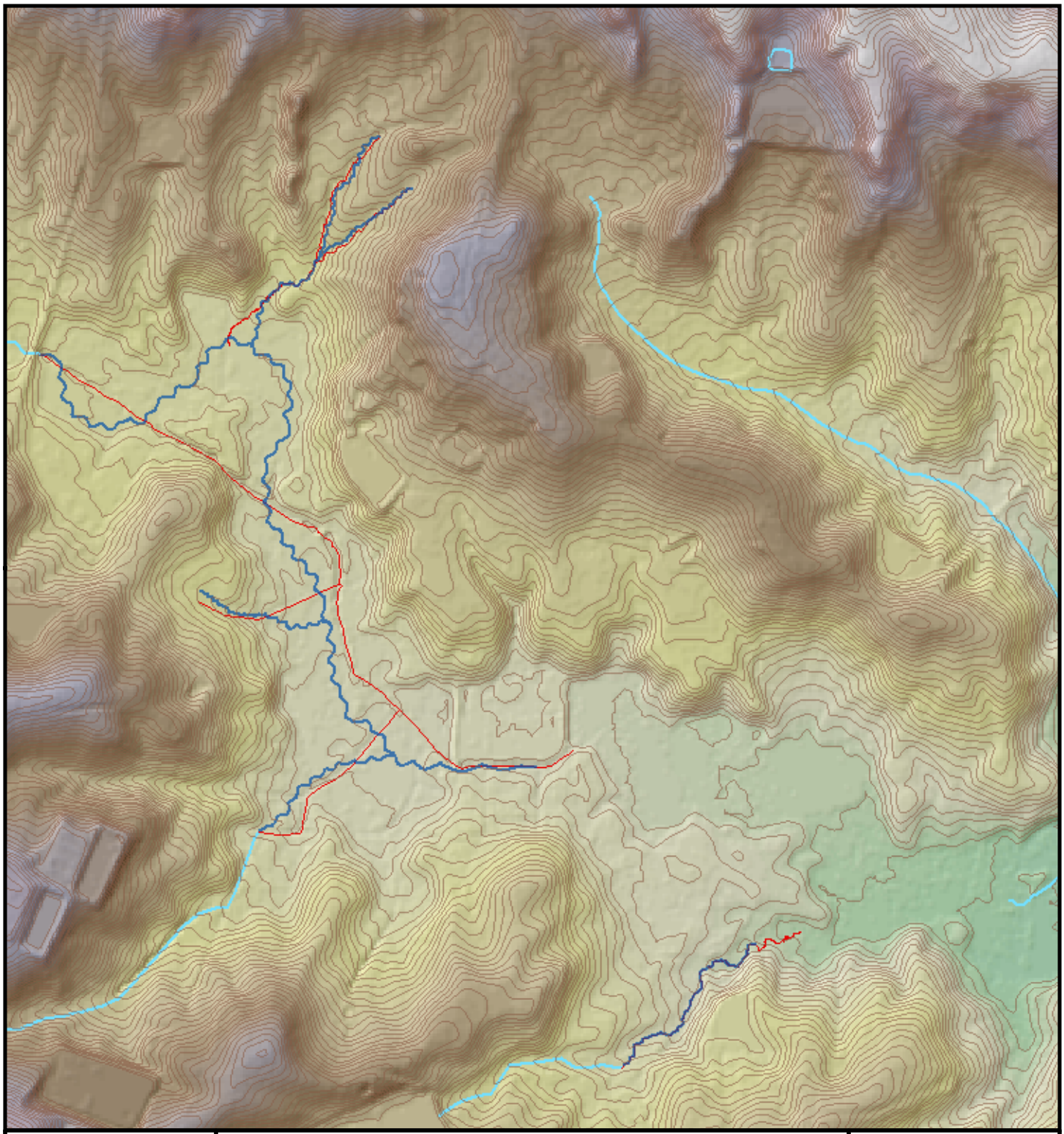


Figure 15. Project Site Topography

Proposed Project Streams
Existing Project Streams
Other Streams
2-ft Contours

Elevation

High: 300 ft

Low : 169 ft

1:10,800
1 inch equals 900 feet

900 450 0 900 Feet

Source: NCDOT LiDAR Data, 2007

KCI TECHNOLOGIES

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

Stream Plan Sheets

KCI JOB# : 12065438

CONTRACT #: D06002

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D06002	1	40

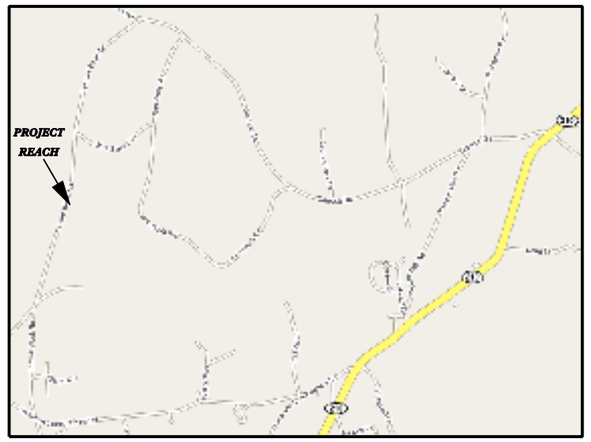
A	SUBMITTED WITH RESTORATION PLAN	APRIL 2008	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

HARNETT COUNTY

LOCATION: FARRAR DAIRY
1175 FARRAR DAIRY ROAD
LILLINGTON, NORTH CAROLINA 27546

TYPE OF WORK: STREAM AND WETLAND MITIGATION



VICINITY MAP
NOT TO SCALE

DIRECTIONS TO SITE

PROCEED SOUTH OUT OF RALEIGH ON US 401/ US-421/CAPITAL DRIVE TOWARDS FUQUAY-VARINA, CONTINUING SOUTH FROM FUQUAY-VARINA ON US-401/US-421 TOWARDS LILLINGTON. TURN RIGHT ONTO NC-210 AND CONTINUE SOUTH THROUGH LILLINGTON FOR APPROXIMATELY 6.5 MILES TO DARROCH ROAD. TURN RIGHT ONTO DARROCH ROAD AND CONTINUE APPROXIMATELY 3 MILES TO POWELL FARM ROAD. TURN LEFT ONTO POWELL FARM ROAD, DRIVE APPROXIMATELY 1.5 MILES AND THE ENTRANCE TO THE SITE WILL BE ON THE LEFT THROUGH THE DRIVEWAY OF THE RED RANCH STYLE HOME.

INDEX OF SHEETS

1	*TITLE SHEET*
1A	*GENERAL NOTES & PROJECT LEGEND*
2-2A	*DETAILS: STREAM RESTORATION*
2B-2C	*DETAILS: TYPICAL CROSS-SECTIONS*
3-15	*STREAM PLAN AND PROFILE*
16	*WETLAND OVERVIEW*
17-20	*WETLAND SITE PLAN*
21-24	*PLANTING PLAN*
25-36	*SEDIMENT & EROSION CONTROL PLAN*

GRAPHIC SCALES

PLANS: –40 –20 0 40 80

PROFILE (HORIZONTAL): –40 –20 0 40 80

PROFILE (VERTICAL): –4 –2 0 4 8

PROJECT DATA

STREAM RESTORATION LENGTH = 11,517 FEET

STREAM ENHANCEMENT LENGTH = 1,420 FEET

WETLAND RESTORATION = 43.8 ACRES

WETLAND ENHANCEMENT = 22.3 ACRES

WETLAND PRESERVATION = 45.9 ACRES

Prepared in the Office of:

KCI Associates of North Carolina, P.A.
SUITE 220 LANDMARK CENTER II, 4601 SIX FORKS RD., RALEIGH, NC
ENGINEERS • PLANNERS • ECOLOGISTS

TIM MORRIS — *WETLAND DESIGN*

TIM MORRIS / ALEX FRENCH — *NATURAL CHANNEL DESIGN*

PROJECT ENGINEER

GARY M. MRYNCZA, P.E.

P.E.

SIGNATURE:

Prepared for:

Ecosystem Enhancement Program

GUY PEARCE
CONTRACT ADMINISTRATOR

GENERAL NOTES

GENERAL NOTES:

BEARING AND DISTANCES:
ALL BEARINGS ARE NAD 1983 GRID BEARINGS.
ALL DISTANCES AND COORDINATES SHOWN ARE HORIZONTAL (GROUND) VALUES.
ALL INFORMATION IS BASED ON THE FOLLOWING KCI CONTROL POINTS.

GPS#1	N=922346.1638	E=1819828.0300	ELEV.=661.73′
GPS#2	N=922529.8350	E=1820356.7900	ELEV.=673.50′

GRADING:
-ALL EXCAVATED MATERIALS, INCLUDING NATURAL STONE MEETING SIZE LIMITATIONS, ARE TO BE SALVAGED FOR REUSE WITHIN THE PROJECT AT THE DISCRETION OF THE DESIGNER.
-ALL INFLECTION POINTS BETWEEN SLOPE ANGLES SHALL BE ROUNDED SLIGHTLY IN ORDER TO PROVIDE FOR SMOOTH TRANSITIONS AND A MORE NATURAL APPEARANCE.

UTILITY/SUBSURFACE PLANS:
-NO SUBSURFACE PLANS ARE AVAILABLE ON THIS PROJECT. EXISTING UNDERGROUND UTILITIES HAVE NOT BEEN VERIFIED. THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING A UTILITY LOCATOR AND ESTABLISHING THE EXACT LOCATION OF ANY AND ALL EXISTING UTILITIES IN THE PROJECT REACH.

PROJECT LEGEND

STREAM RESTORATION

Proposed Thalweg w/Approximate Bankfull Limits ..... 12+00 13+00

Proposed Offset Rock Cross Vane .....

Proposed Channel Block .....

Proposed Riffle Grade Control .....

Proposed Log Drop .....

Proposed Log Sill .....

SEDIMENT & EROSION CONTROL

Stabilized Construction Entrance ..... SCE

Silt Fence ..... SF

Limits of Disturbance ..... LOD

Rock Silt Screen (Std. Drawing 1636.01) .....

Temporary Mat Stream Crossing .....

Temporary Rock Ford Crossing .....

Silt Fence Rock Outlet .....

WETLAND MITIGATION

Proposed Microtopography .....

Proposed Deep Harrowing .....

Proposed Filled Ditches .....

Proposed Seep Stabilization .....

VEGETATION

Existing Woods Line .....

TOPOGRAPHY

Minor Contour Line .....

Major Contour Line 720

MISCELLANEOUS

Existing Barbed Wire Fencing .....

A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

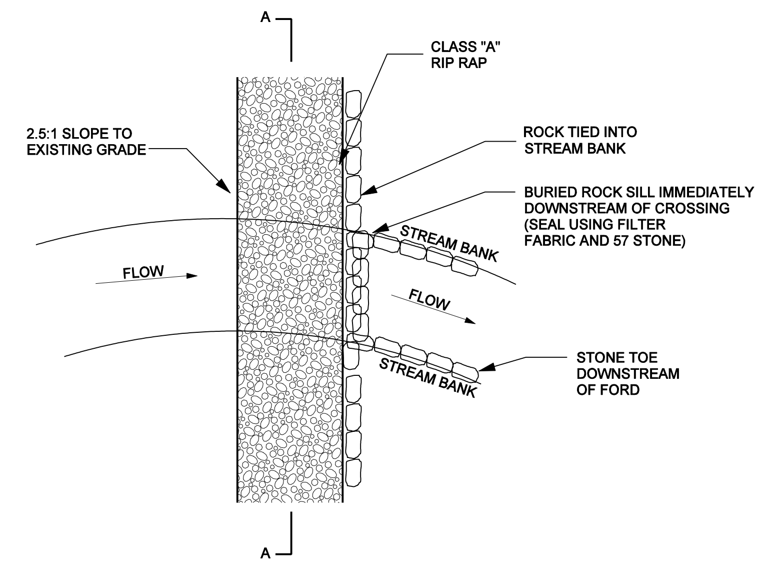
Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

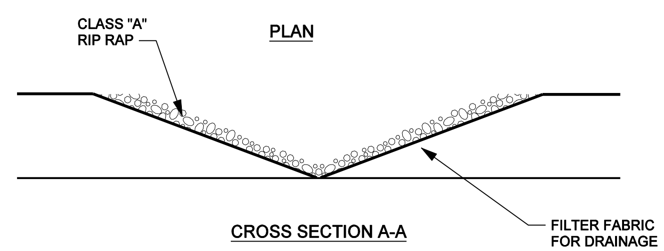
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: N.T.S.

GENERAL NOTES & PROJECT LEGEND



PLAN

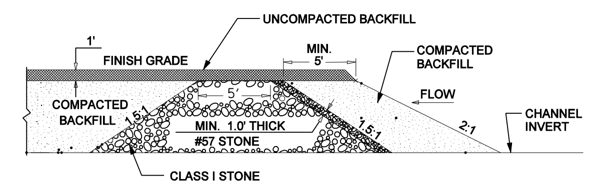


CROSS SECTION A-A

1. A STABILIZED PAD OF CLASS "A" RIP RAP, 18 INCHES THICK, LINED WITH FILTER FABRIC SHALL BE LOCATED WHERE FARM EQUIPMENT AND LIVESTOCK WILL BE CROSSING THE RESTORED STREAM CHANNEL.
2. EXCLUSION FENCING SHALL BE INSTALLED ON ALL APPROACHES TO AND ADJACENT TO THE CROSSING.
3. THE CROSSING SHALL BE BUILT TO THE DIMENSIONS SPECIFIED ON THE PLANS.
4. THE ENGINEER SHALL DETERMINE AN APPROPRIATE RAMP ANGLE FOR THE STREAM CROSSING ACCORDING TO THE CHANNEL MORPHOLOGY.
5. THE CROSSING LOCATIONS ARE DEPICTED IN THE PLANS.

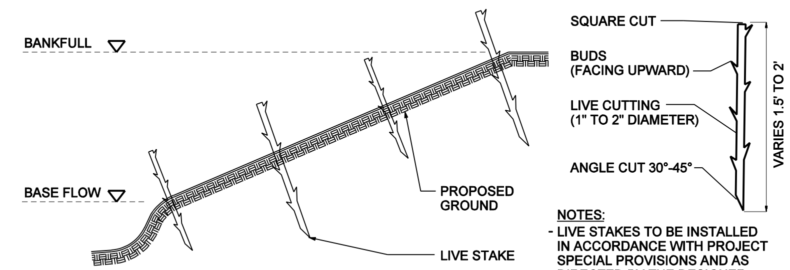
ROCK FORD CROSSING

SCALE: NTS



CHANNEL BLOCK

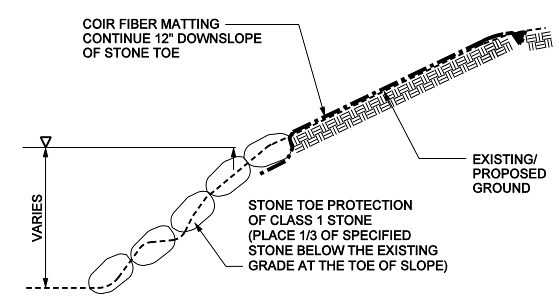
SCALE: NTS



NOTES:
- LIVE STAKES TO BE INSTALLED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS AND AS DIRECTED BY THE DESIGNER.
- LIVE STAKES SHALL BE REDUCED ON INNER BAR LOCATIONS (INSIDE MEANDER BENDS) AS DIRECTED BY THE DESIGNER.

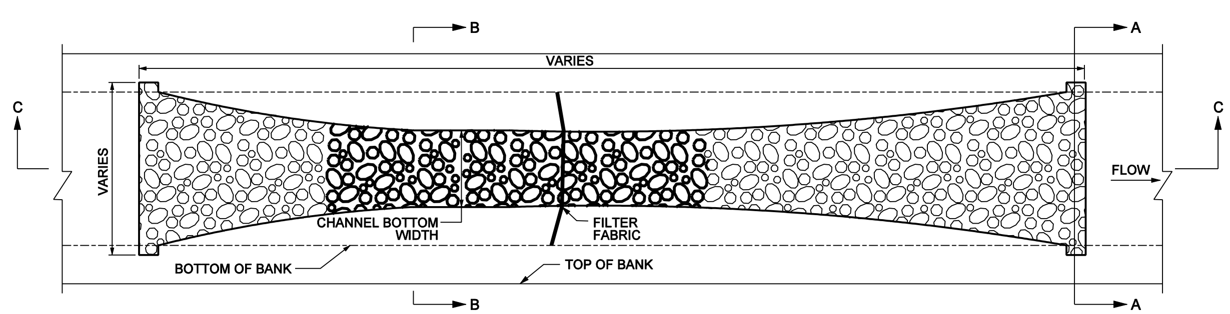
LIVE STAKES

SCALE: NTS

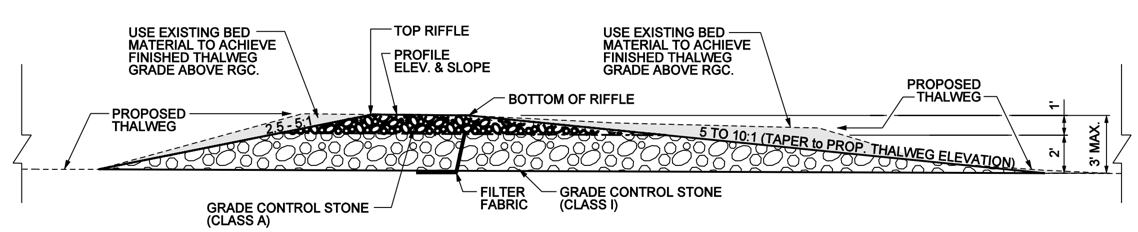


STONE TOE STABILIZATION

SCALE: NTS



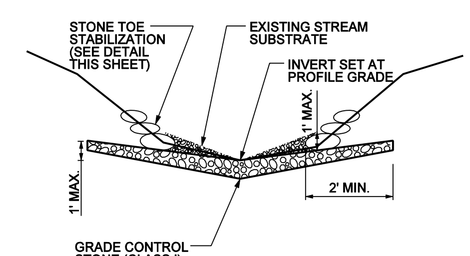
PLAN VIEW



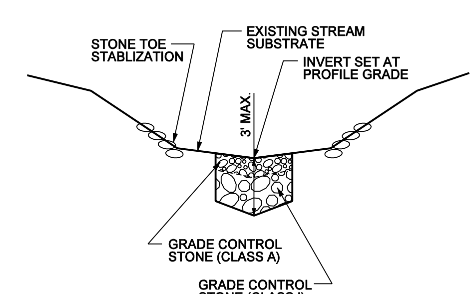
PROFILE - SECTION C-C

RIFFLE GRADE CONTROL

SCALE: NTS



SECTION A-A



SECTION B-B

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

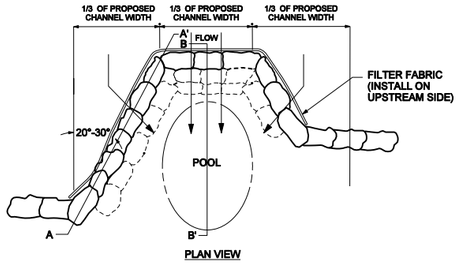
REVISIONS

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

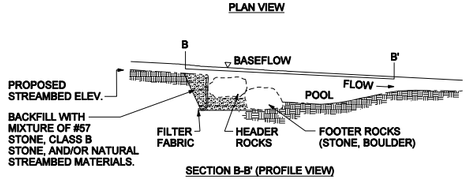
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: NTS

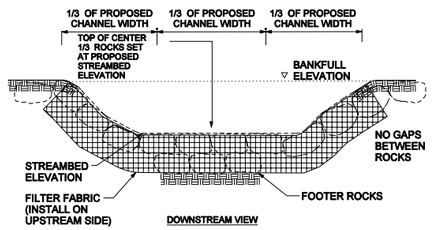
DETAILS:
STABILIZATION



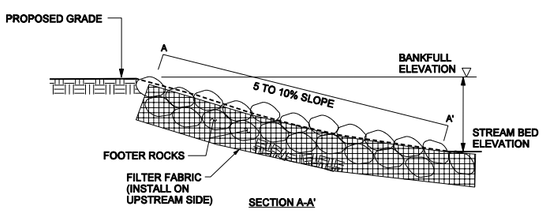
PLAN VIEW



SECTION B-B' (PROFILE VIEW)



DOWNSTREAM VIEW

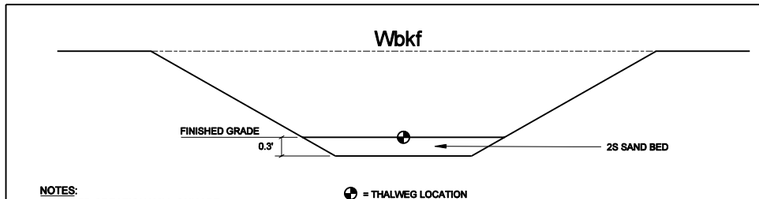


SECTION A-A'

NOTE: (1) ALL ROCKS OR STONES IN THE VANE STRUCTURE ARE STONE BOULDERS.
(2) SHORT CROSS VANE ARM TO BE HALF THE SLOPE OF THE FULL ARM SLOPE.

OFFSET ROCK CROSS VANE

SCALE: NTS

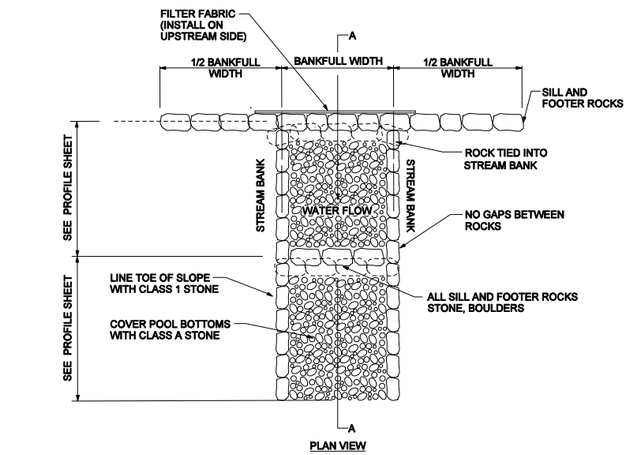


NOTES:
- SAND BED CREATION WILL ONLY BE CONDUCTED IN LOCATIONS WHERE CLAY LAYERS ARE FOUND.
- CONTRACTOR SHALL COORDINATE WITH DESIGNER TO DETERMINE APPLICABLE LOCATIONS.

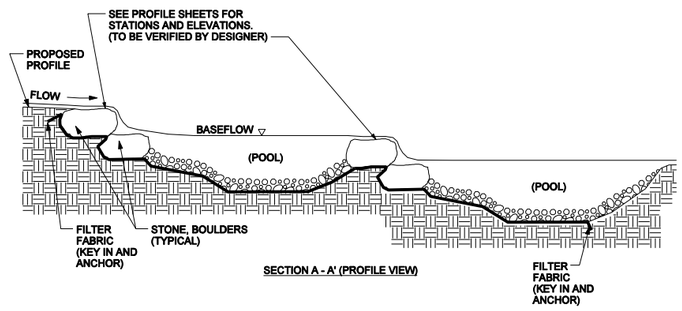
SAND BED CREATION

** ONLY USED IN CLAY MATERIAL LOCATIONS **

SCALE: NTS



PLAN VIEW

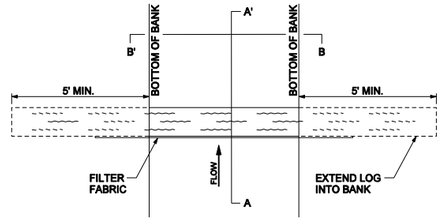


SECTION A - A' (PROFILE VIEW)

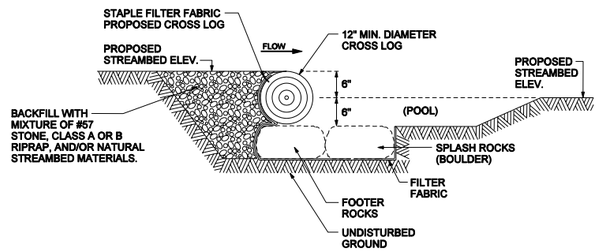
NOTES:
- ALL SILL OR FOOTER ROCKS ARE STONE, BOULDERS
- DETAIL SHOWN IS FOR A DOUBLE STEP POOL. ADJUST ACCORDINGLY FOR SINGLE AND TRIPLE STEP POOLS. (SEE PROFILE SHEET TO DETERMINE AMOUNT OF STEPS)

DOUBLE STEP POOL

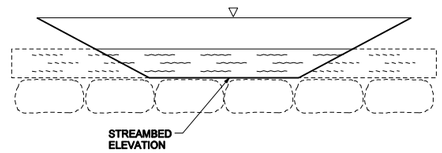
SCALE: NTS



PLAN VIEW



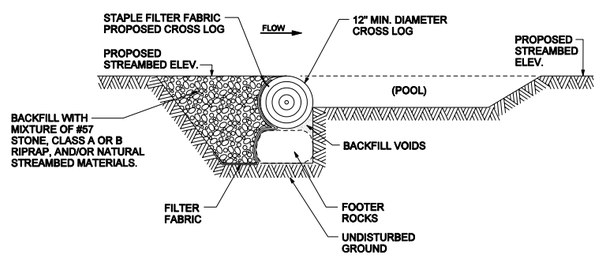
SECTION B-B' (PROFILE VIEW)



SECTION A-A' (CROSS SECTION VIEW)

LOG DROP DETAIL

SCALE: NTS



SECTION B-B' (PROFILE VIEW)

LOG SILL DETAIL

SCALE: NTS

A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008					
					STM.	DESCRIPTION	DATE

REVISIONS

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

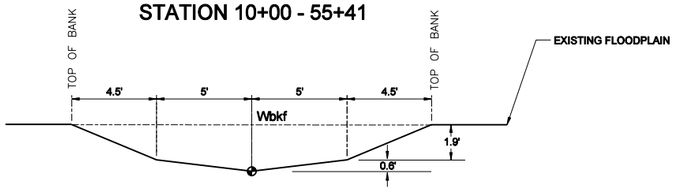
DATE: APRIL 2008
SCALE: NTS

DETAILS: STABILIZATION

SHEET 2A OF 36

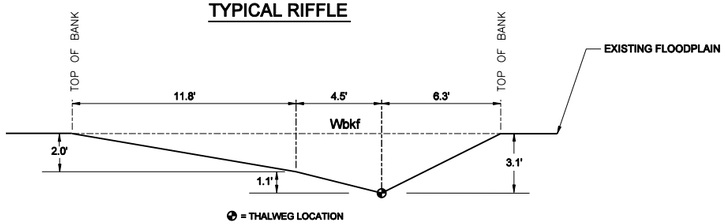
MAIN CHANNEL
TYPICAL CROSS-SECTIONS
"C5" STREAM TYPE

STATION 10+00 - 55+41



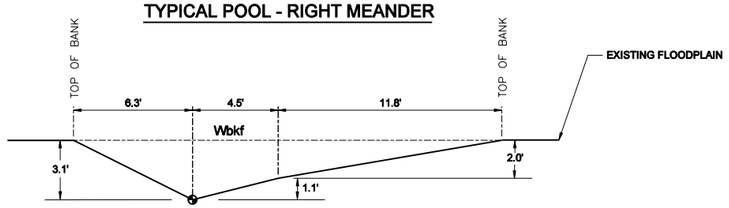
= THALWEG LOCATION

TYPICAL RIFFLE



= THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER

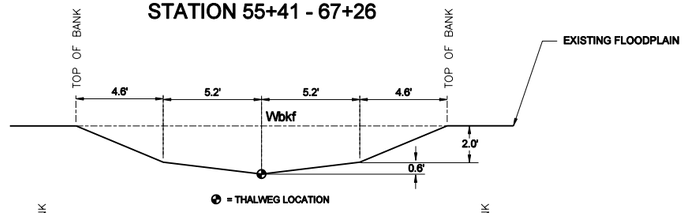


= THALWEG LOCATION

TYPICAL POOL - LEFT MEANDER

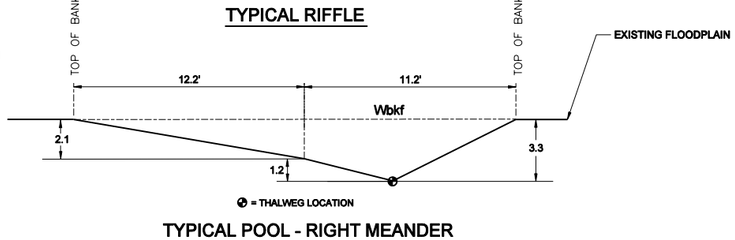
MAIN CHANNEL
TYPICAL CROSS-SECTIONS
"C5" STREAM TYPE

STATION 55+41 - 67+26



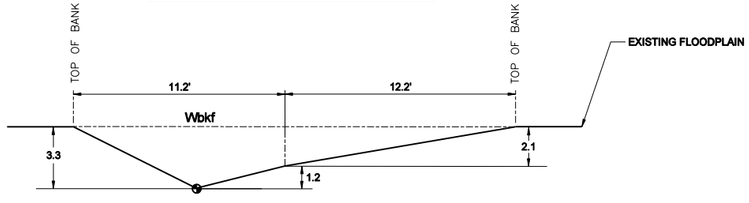
= THALWEG LOCATION

TYPICAL RIFFLE



= THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER

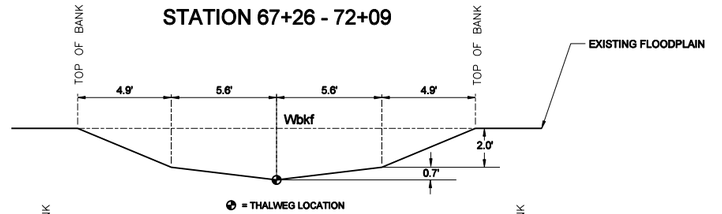


= THALWEG LOCATION

TYPICAL POOL - LEFT MEANDER

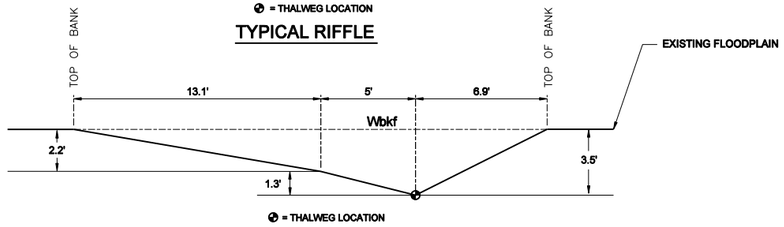
MAIN CHANNEL
TYPICAL CROSS-SECTIONS
"C5" STREAM TYPE

STATION 67+26 - 72+09



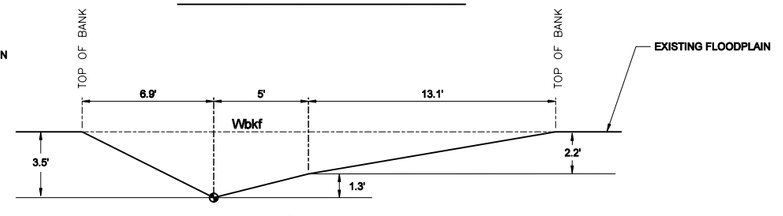
= THALWEG LOCATION

TYPICAL RIFFLE



= THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER

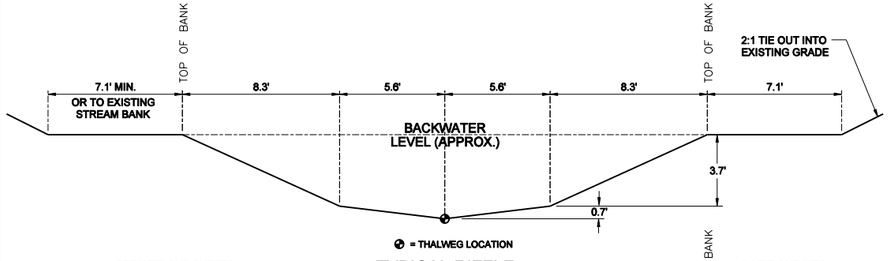


= THALWEG LOCATION

TYPICAL POOL - LEFT MEANDER

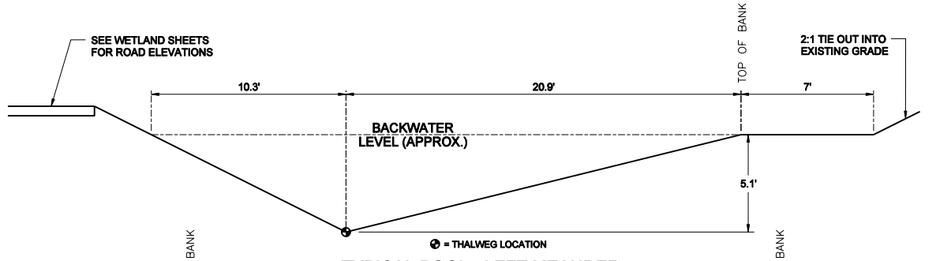
MAIN CHANNEL
TYPICAL CROSS-SECTIONS
"C5" STREAM TYPE

STATION 72+09 - 77+24



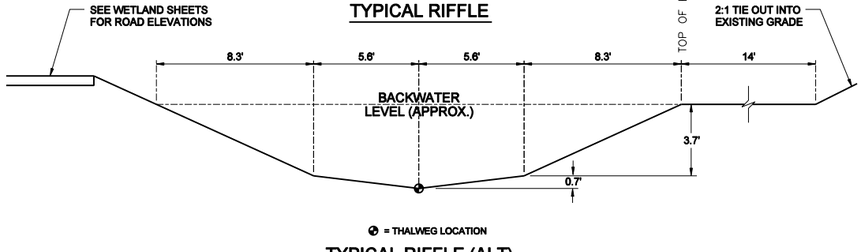
= THALWEG LOCATION

TYPICAL RIFFLE



= THALWEG LOCATION

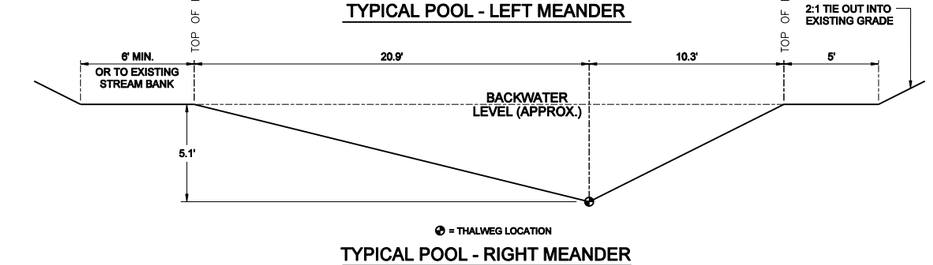
TYPICAL POOL - LEFT MEANDER



= THALWEG LOCATION

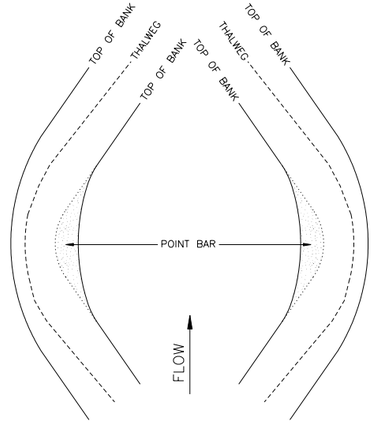
TYPICAL RIFFLE (ALT)

* ONLY FORM STATIONS 76+30-77+24 *



= THALWEG LOCATION

TYPICAL POOL - RIGHT MEANDER



LEFT MEANDER
NOT TO SCALE

RIGHT MEANDER
NOT TO SCALE

A	SUBMITTED WITH RESTORATION PLAN (60%)					APRIL 2008	
					DESCRIPTION	DATE	APPROVED
					REVISIONS		

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RALEIGH, NORTH CAROLINA 27609

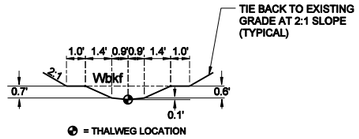
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: N.T.S.

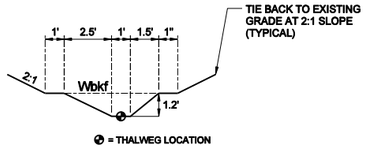
DETAILS:
TYPICAL XS

SHEET 2B OF 36

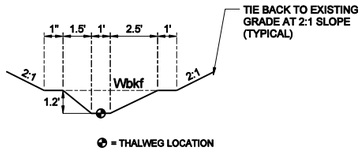
TRIBUTARY 1.1
TYPICAL CROSS-SECTIONS
"C5/B5c" STREAM TYPE



TYPICAL RIFFLE

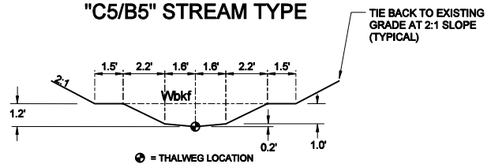


TYPICAL POOL - RIGHT MEANDER

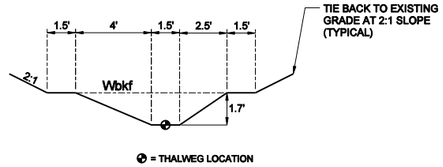


TYPICAL POOL - LEFT MEANDER

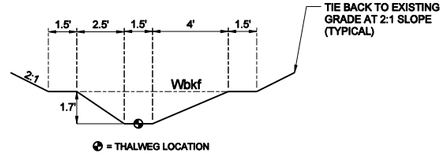
TRIBUTARY 1.2
TYPICAL CROSS-SECTIONS
"C5/B5" STREAM TYPE



TYPICAL RIFFLE

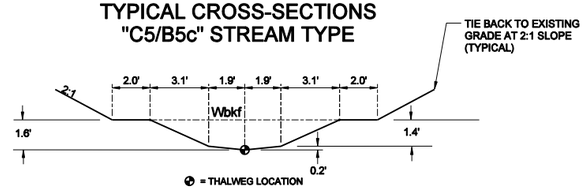


TYPICAL POOL - RIGHT MEANDER



TYPICAL POOL - LEFT MEANDER

TRIBUTARY 1
TYPICAL CROSS-SECTIONS
"C5/B5c" STREAM TYPE



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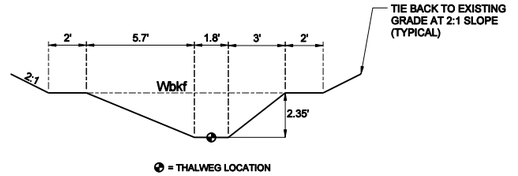
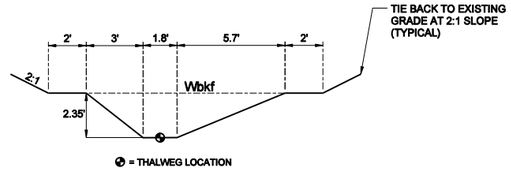
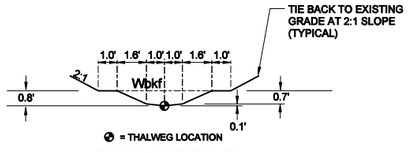


TYPICAL POOL - RIGHT MEANDER

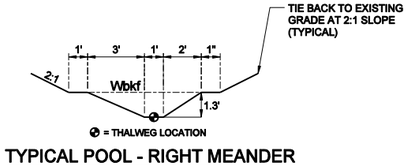


TYPICAL POOL - LEFT MEANDER

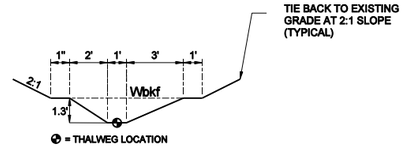
TRIBUTARY 2A
TYPICAL CROSS-SECTIONS
"C5/B5c" STREAM TYPE



TYPICAL RIFFLE

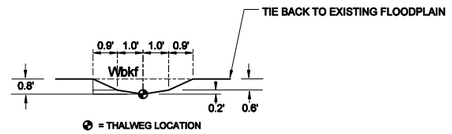


TYPICAL POOL - RIGHT MEANDER

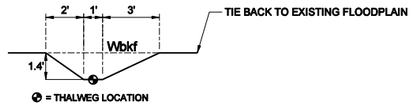


TYPICAL POOL - LEFT MEANDER

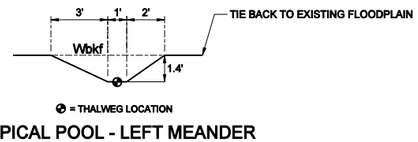
TRIBUTARY 2B
TYPICAL CROSS-SECTIONS
"E5" STREAM TYPE



TYPICAL RIFFLE

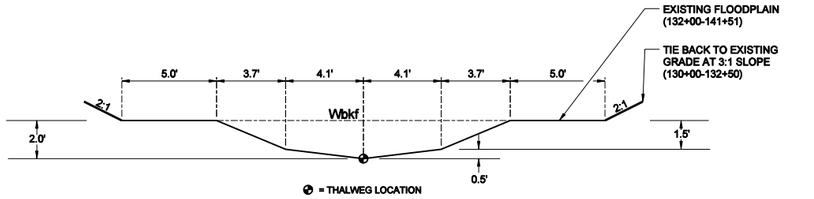


TYPICAL POOL - RIGHT MEANDER

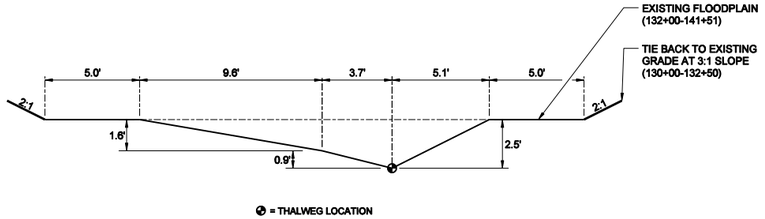


TYPICAL POOL - LEFT MEANDER

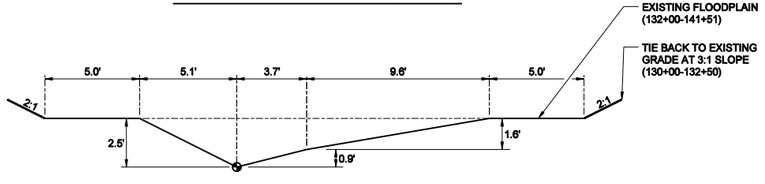
TRIBUTARY 3
TYPICAL CROSS-SECTIONS
"C5" STREAM TYPE



TYPICAL RIFFLE



TYPICAL POOL - RIGHT MEANDER



TYPICAL POOL - LEFT MEANDER

A	SUBMITTED WITH RESTORATION PLAN (60%)					APRIL 2008	
					DESCRIPTION	DATE	APPROVED
	REVISIONS						

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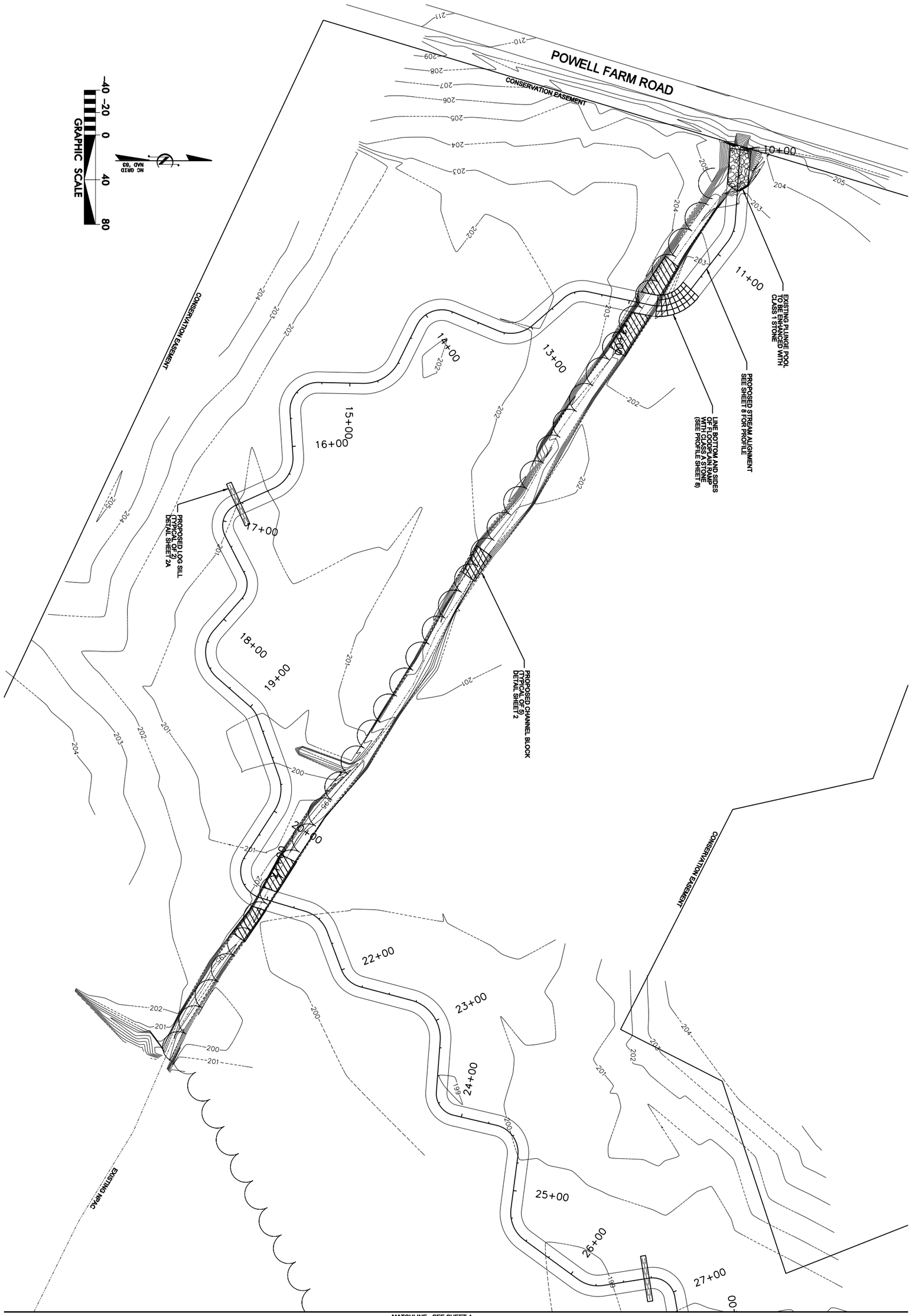
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: N.T.S.

DETAILS:
TYPICAL XS

SHEET 2C OF 36



MATCHLINE - SEE SHEET 4

SHEET 3 OF 36

SITE PLAN

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 10+00 TO STATION 27+17

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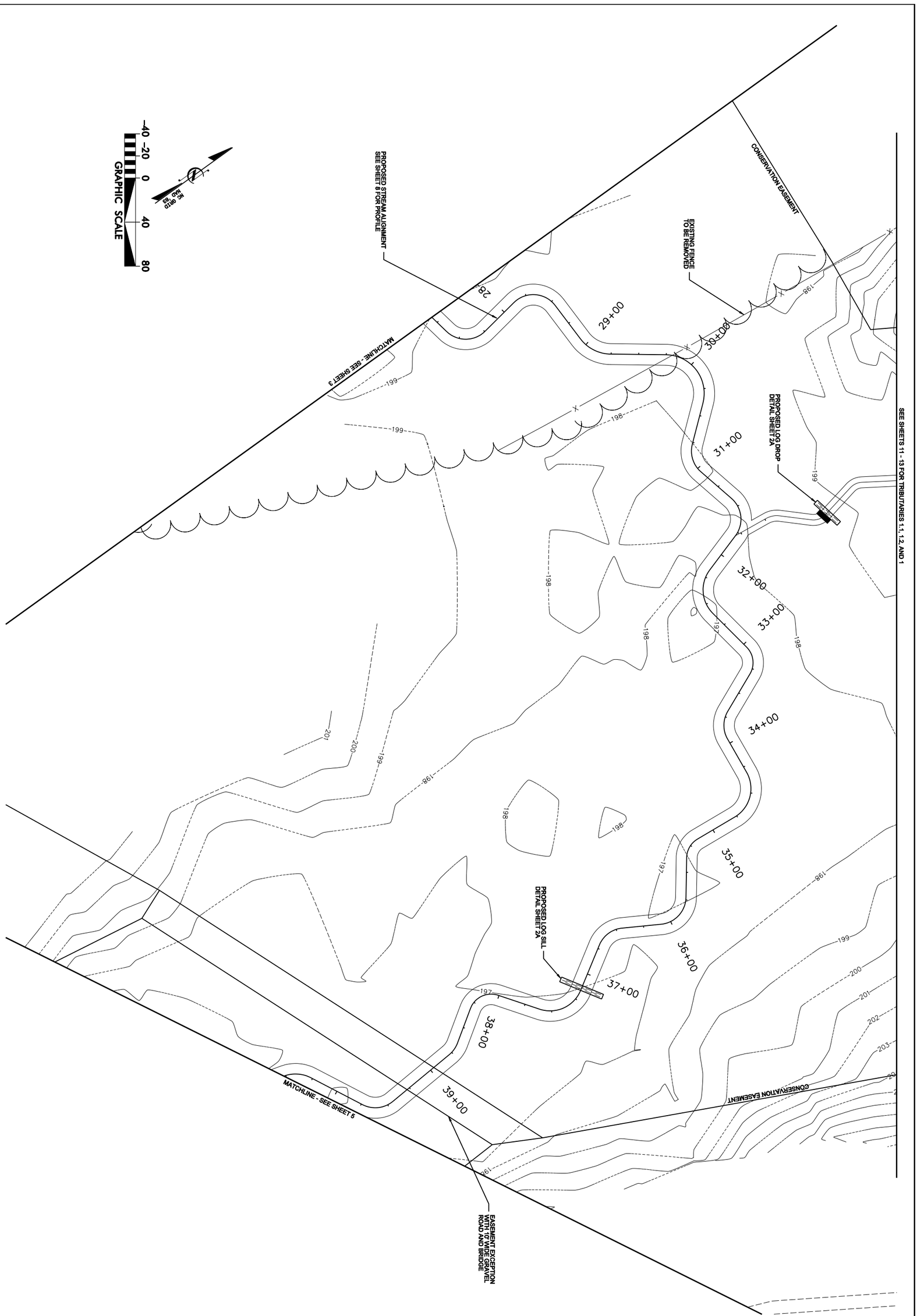
Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

REVISIONS



SHEET 4 OF 36

SITE PLAN

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 27+17 TO STATION 40+51

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Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

REVISIONS

SHEET 5 OF 36

SITE PLAN

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 40+51 TO STATION 55+39

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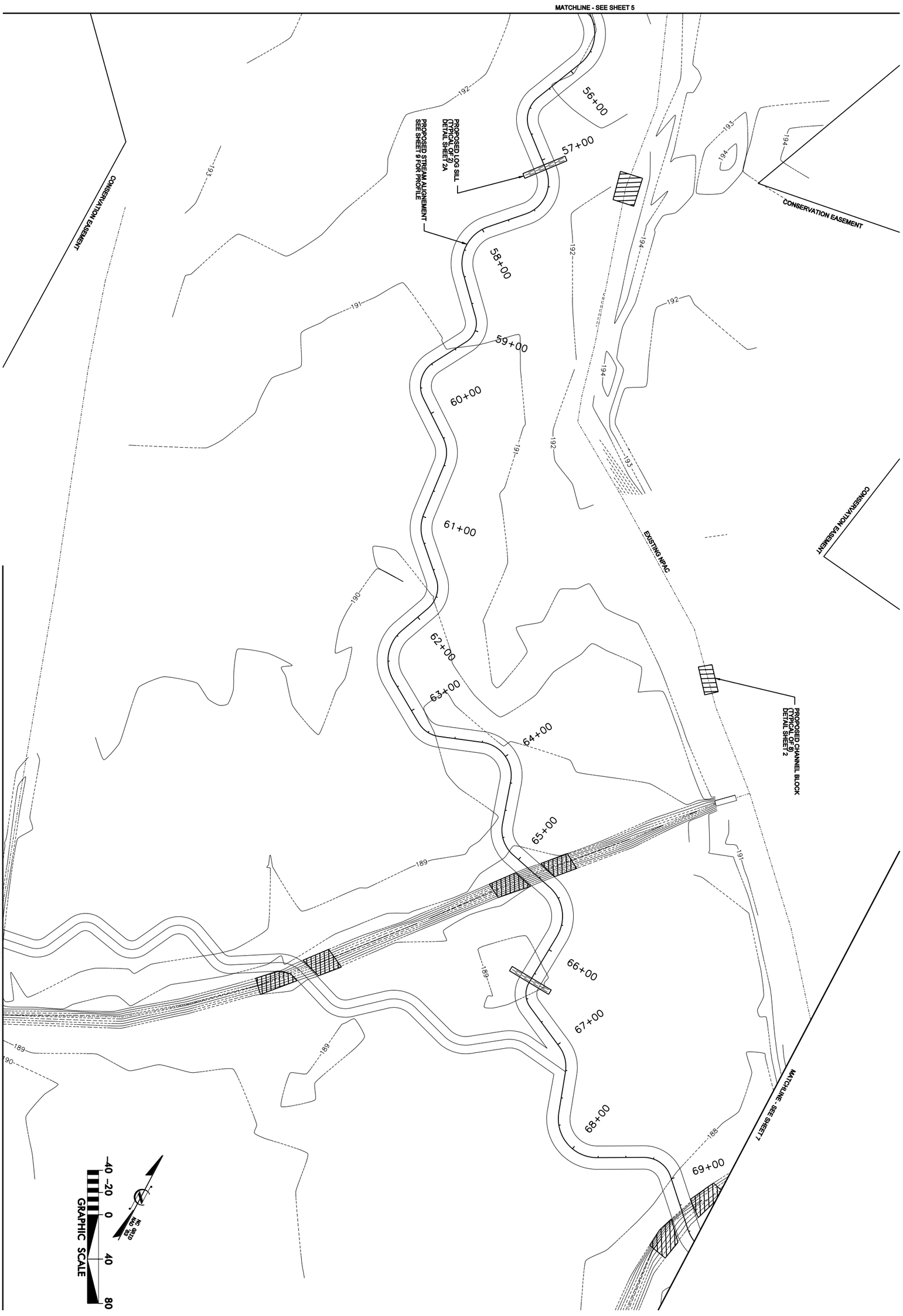
Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

REVISIONS



SHEET 6 OF 36

SITE PLAN

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 55+39 TO STATION 69+60

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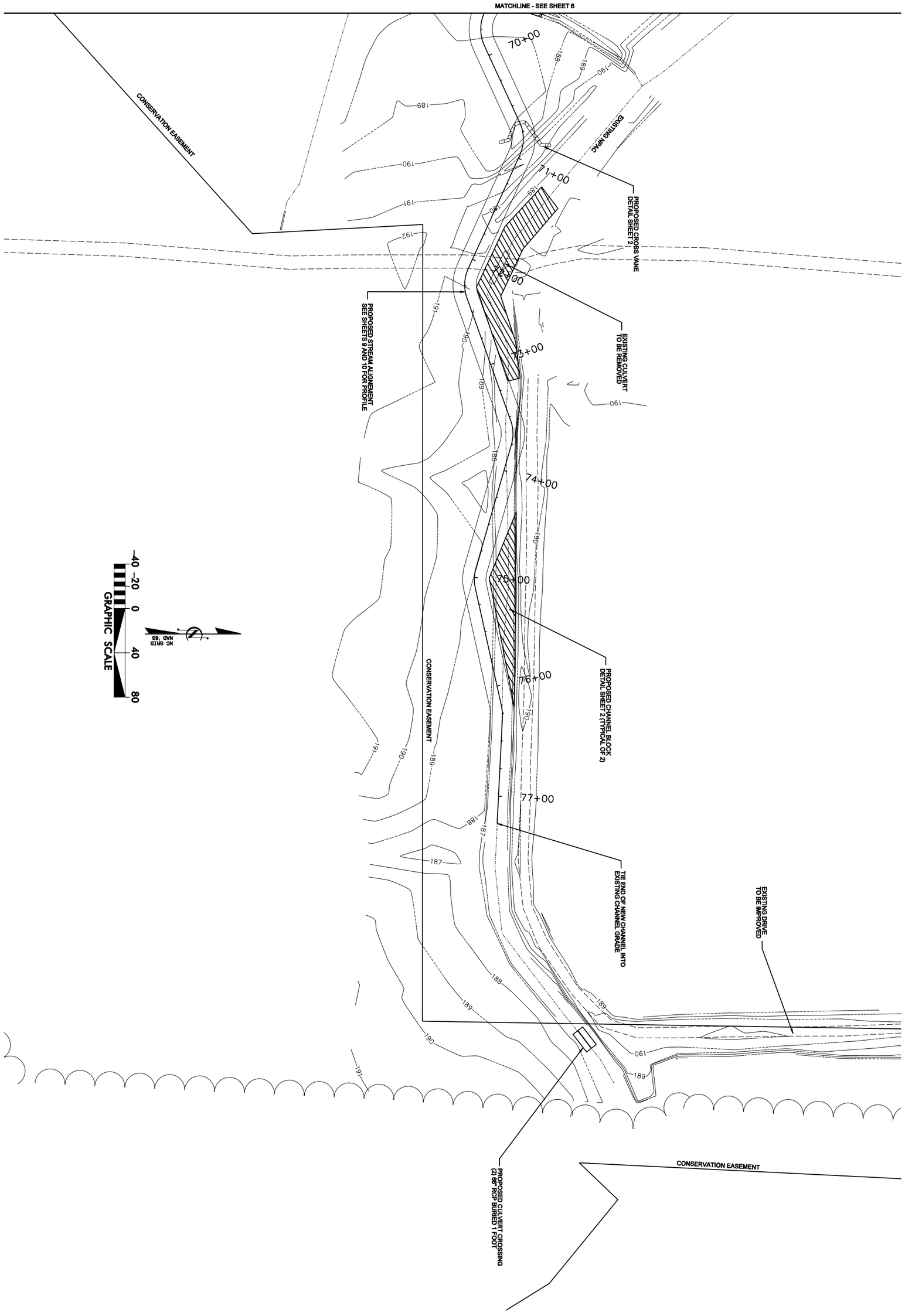
Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

REVISIONS



SHEET 7 OF 36

SITE PLAN

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 69+60 TO STATION 77+24

KCI ASSOCIATES OF NC

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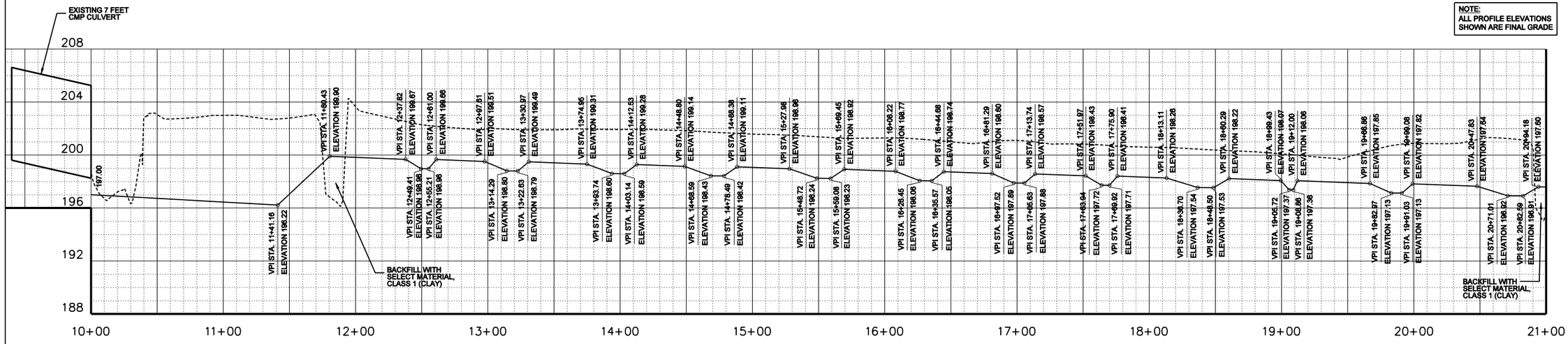
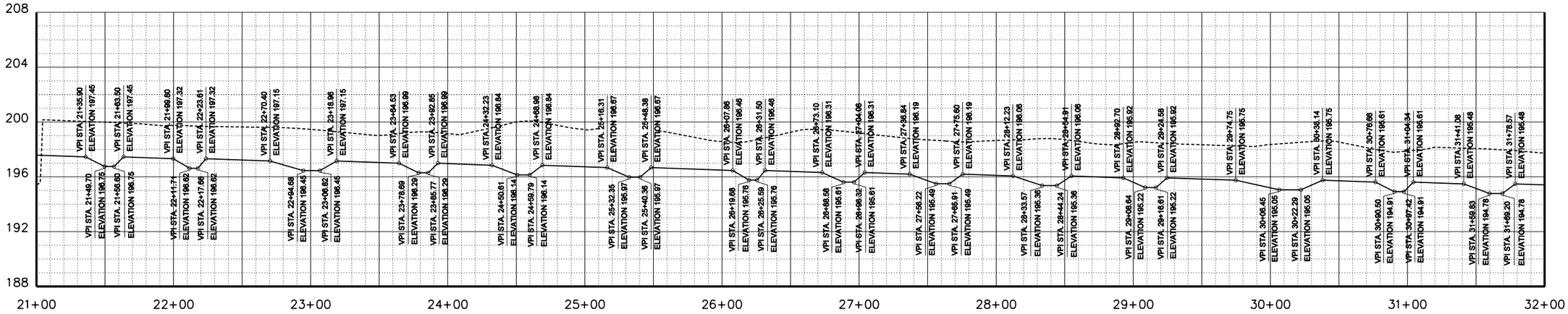
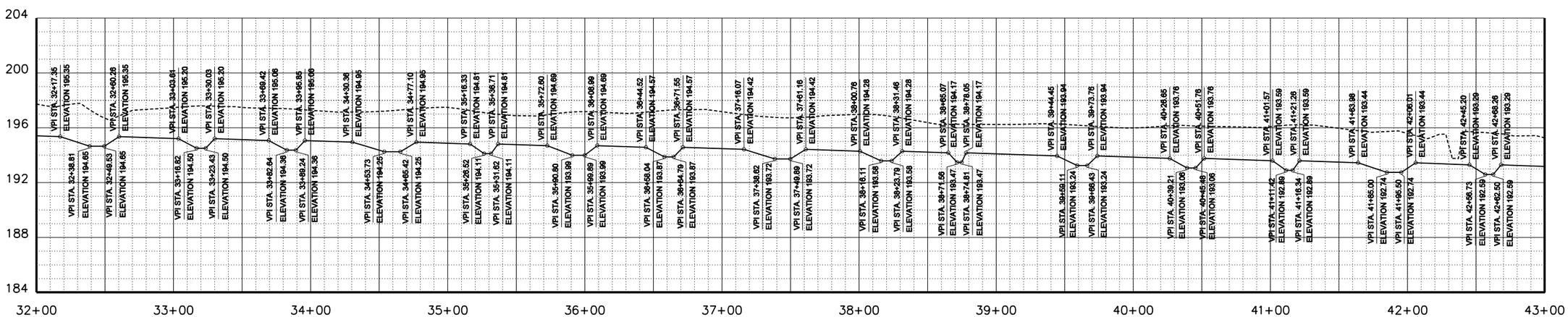
Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

REVISIONS







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SYM.	DESCRIPTION	DATE	APPROVED		

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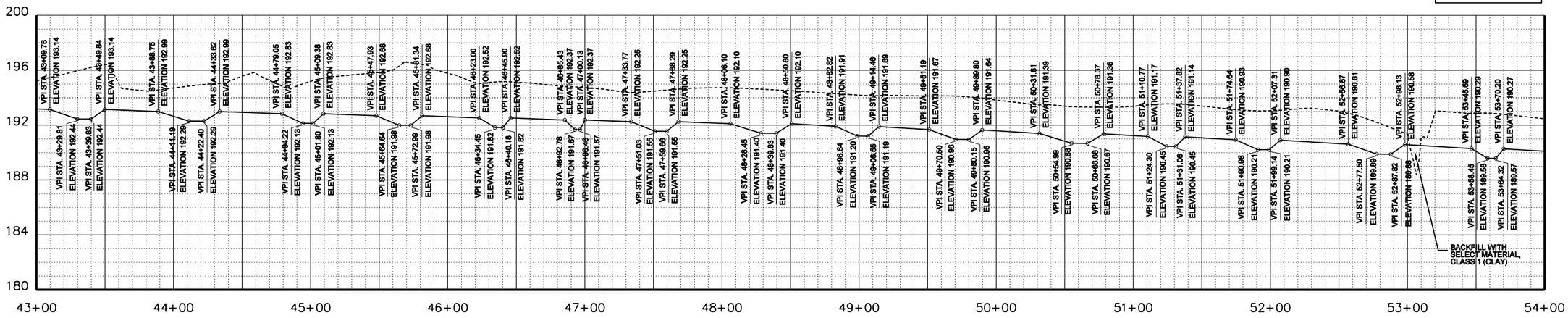
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 10+00 TO STATION 43+00

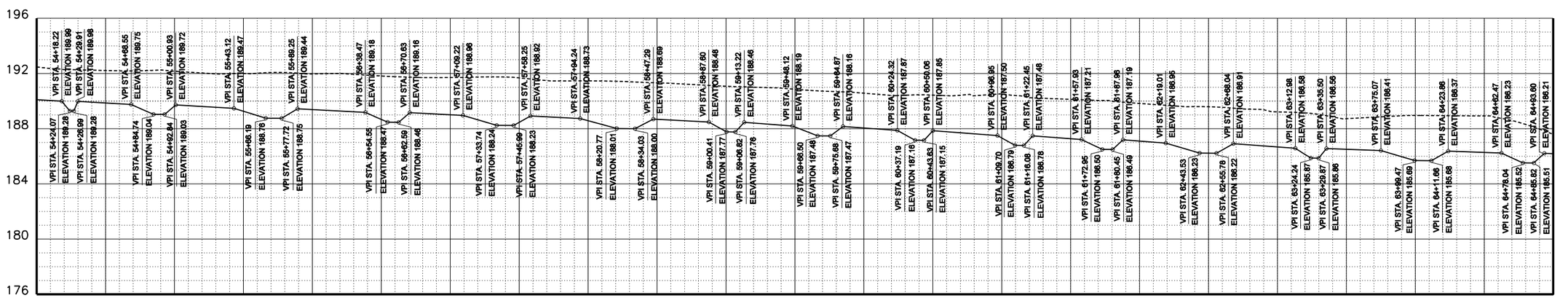
DATE: APRIL 2008

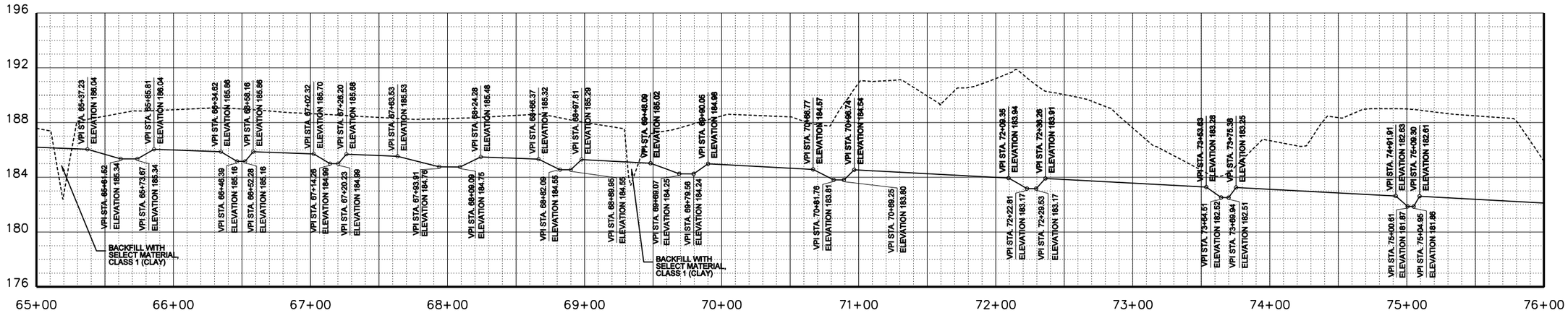
SCALE: 1"=40'

SITE PROFILE

NOTE:
ALL PROFILE ELEVATIONS SHOWN ARE FINAL GRADE







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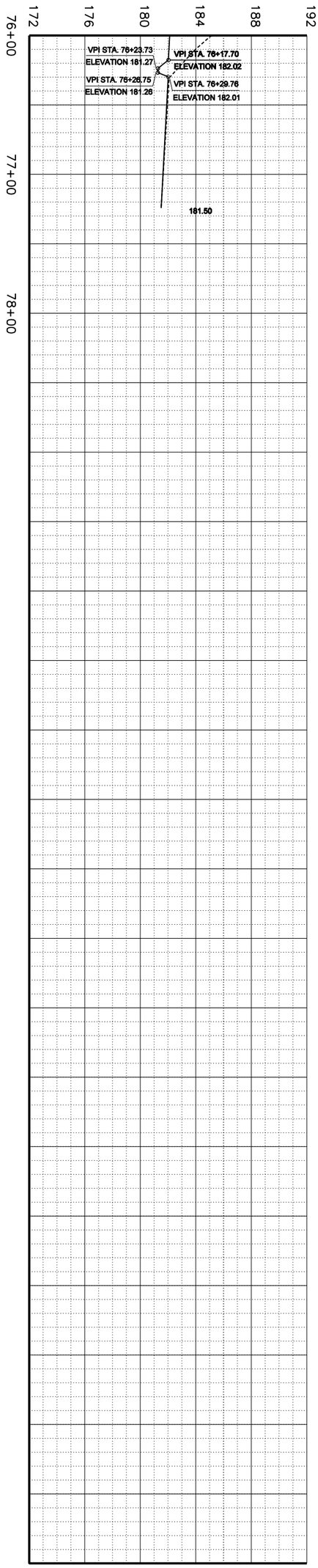
Ecosystem Enhancement Program

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 43+00 TO STATION 76+00

DATE: APRIL 2008
SCALE: 1"=40'

SITE PROFILE

SHEET 9 OF 36



NOTE:
ALL PROFILE ELEVATIONS SHOWN ARE FINAL GRADE

SHEET 10 OF 36

SITE PROFILE

DATE: APRIL 2008

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

STATION 76+00 TO STATION 77+24

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SYM.	DESCRIPTION	DATE	APPROVED
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REVISIONS

CONSERVATION EASEMENT

CONSERVATION EASEMENT

CONSERVATION EASEMENT

STABILIZE EXISTING HEADCUT WITH CLASS 1 STONE AND BACKFILL

PROPOSED CHANNEL BLOCK (TYPICAL OF 6) DETAIL SHEET 2

EASEMENT EXCEPTION WITH 15' WIDE FORD CROSSING (DETAIL SHEET 2)

PROPOSED DOUBLE STEP POOL (TYPICAL OF 3) DETAIL SHEET 2A

PROPOSED LOG DRIP (TYPICAL OF 3) DETAIL SHEET 2A

SEE SHEET 13 FOR TRIBUTARY 1

SEE SHEET 12 FOR TRIBUTARY 1.2

–40 –20 0 40 80

GRAPHIC SCALE

NC GRID NAD '83

NOTE:
ALL PROFILE ELEVATIONS SHOWN ARE FINAL GRADE

EXISTING GRADE

PROPOSED GRADE

228
224
220
216
212
208
204

80+00 81+00 82+00 83+00 84+00 85+00 86+00 87+00 88+00 89+00

REVISIONS				
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008		

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Ecosystem Enhancement Program

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 80+00 TO STATION 88+27

DATE: APRIL 2008
SCALE: 1"=40'

PLAN AND PROFILE

SHEET 11 OF 36

SEE SHEET 11 FOR TRIBUTARY 1.1

CONSERVATION EASEMENT

EXISTING PLUNGE POOL TO BE ENHANCED WITH CLASS 1 STONE

PROPOSED LOG DROP (TYPICAL OF 4) DETAIL SHEET 2A

PROPOSED DOUBLE STEP POOL (TYPICAL OF 3) DETAIL SHEET 2A

PROPOSED LOG SILL DETAIL SHEET 2A

EASEMENT EXCEPTION WITH 15' WIDE FORD CROSSING (DETAIL SHEET 2)

CONSERVATION EASEMENT

CONSERVATION EASEMENT

STABILIZE WITH CLASS I STONE AND BACKFILL

PROPOSED CHANNEL BLOCK DETAIL SHEET 2 (TYPICAL OF 8)

PROPOSED RIFFLE GRADE CONTROL DETAIL SHEET 2

SEE SHEET 13 FOR TRIBUTARY 1

GRAPHIC SCALE

–40 –20 0 40 80

NC 6R10 NAD 83

EXISTING GRADE

PROPOSED GRADE

BACKFILL WITH SELECT MATERIAL, CLASS 1 (CLAY)

NOTE:
ALL PROFILE ELEVATIONS SHOWN ARE FINAL GRADE

REVISIONS				
	DESCRIPTION	DATE	APPROVED	
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008		

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Ecosystem Enhancement Program

FARRAR DAIRY STREAM AND WETLAND MITIGATION

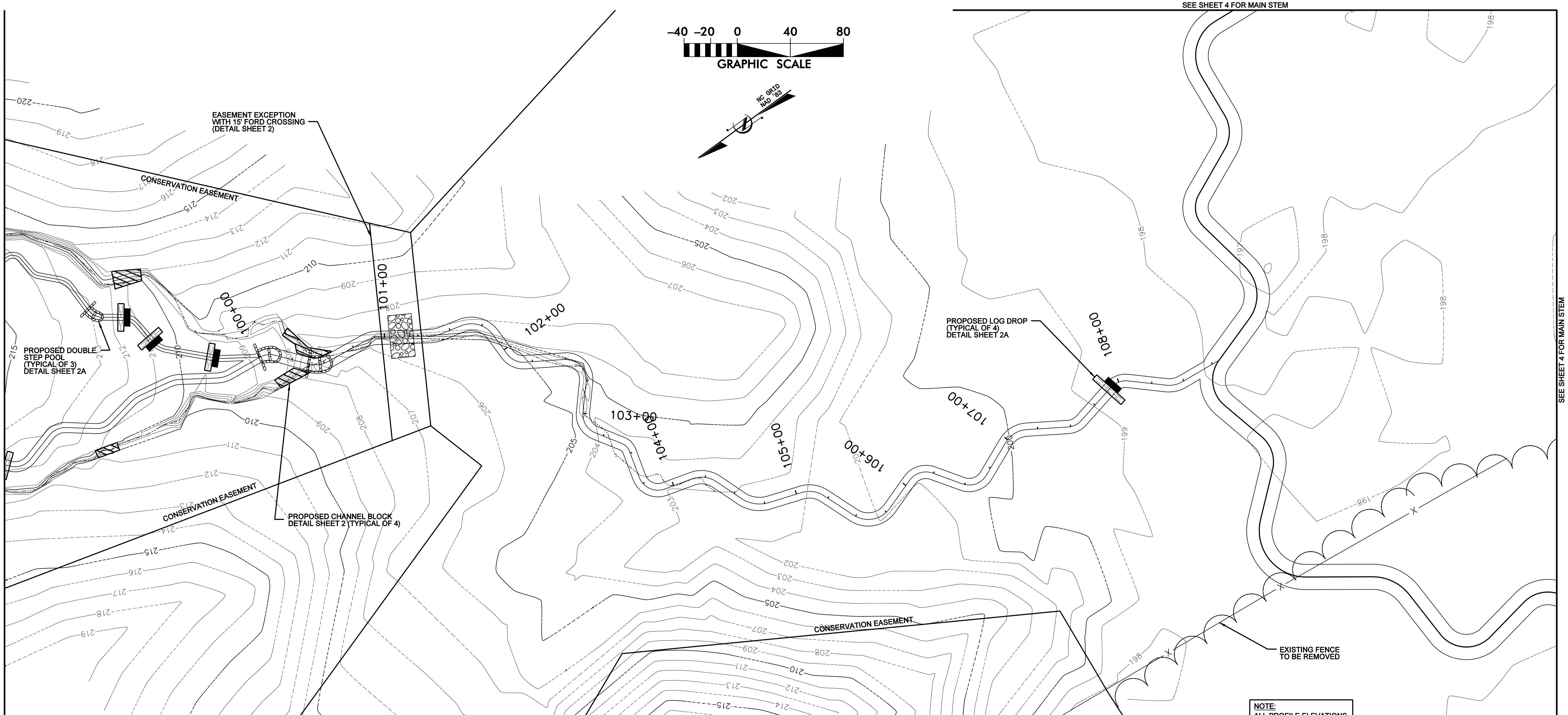
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

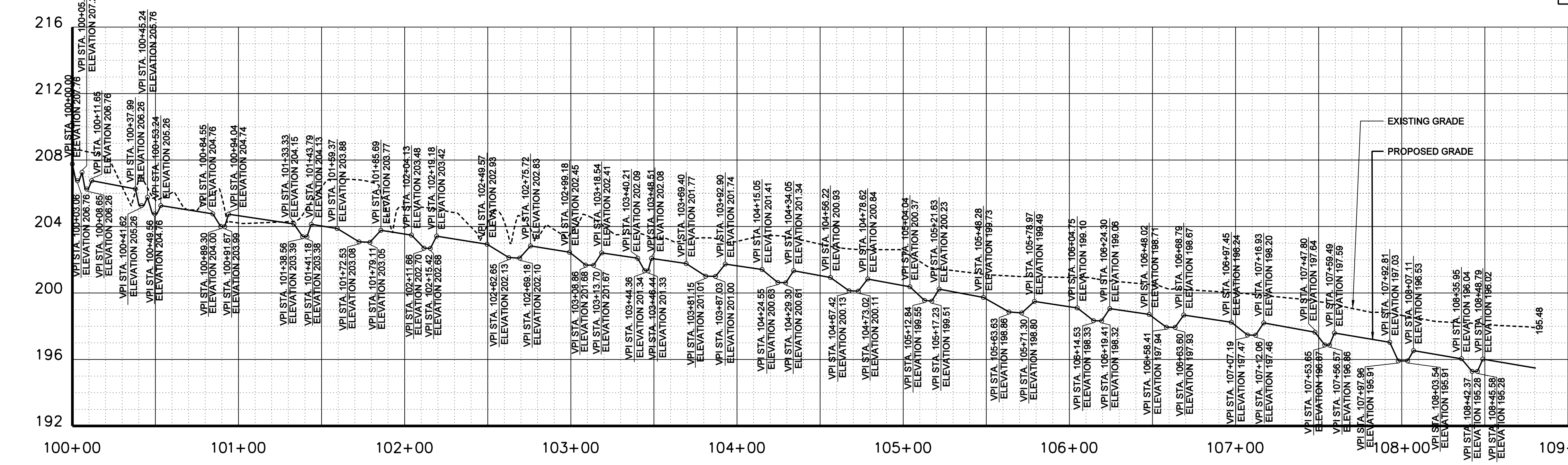
STATION 90+00 TO STATION 99+86

DATE: APRIL 2008

SCALE: 1"=40'

PLAN AND PROFILE





A SUBMITTED WITH RESTORATION PLAN (60%) APRIL 2008

SYM. DESCRIPTION DATE APPROVED

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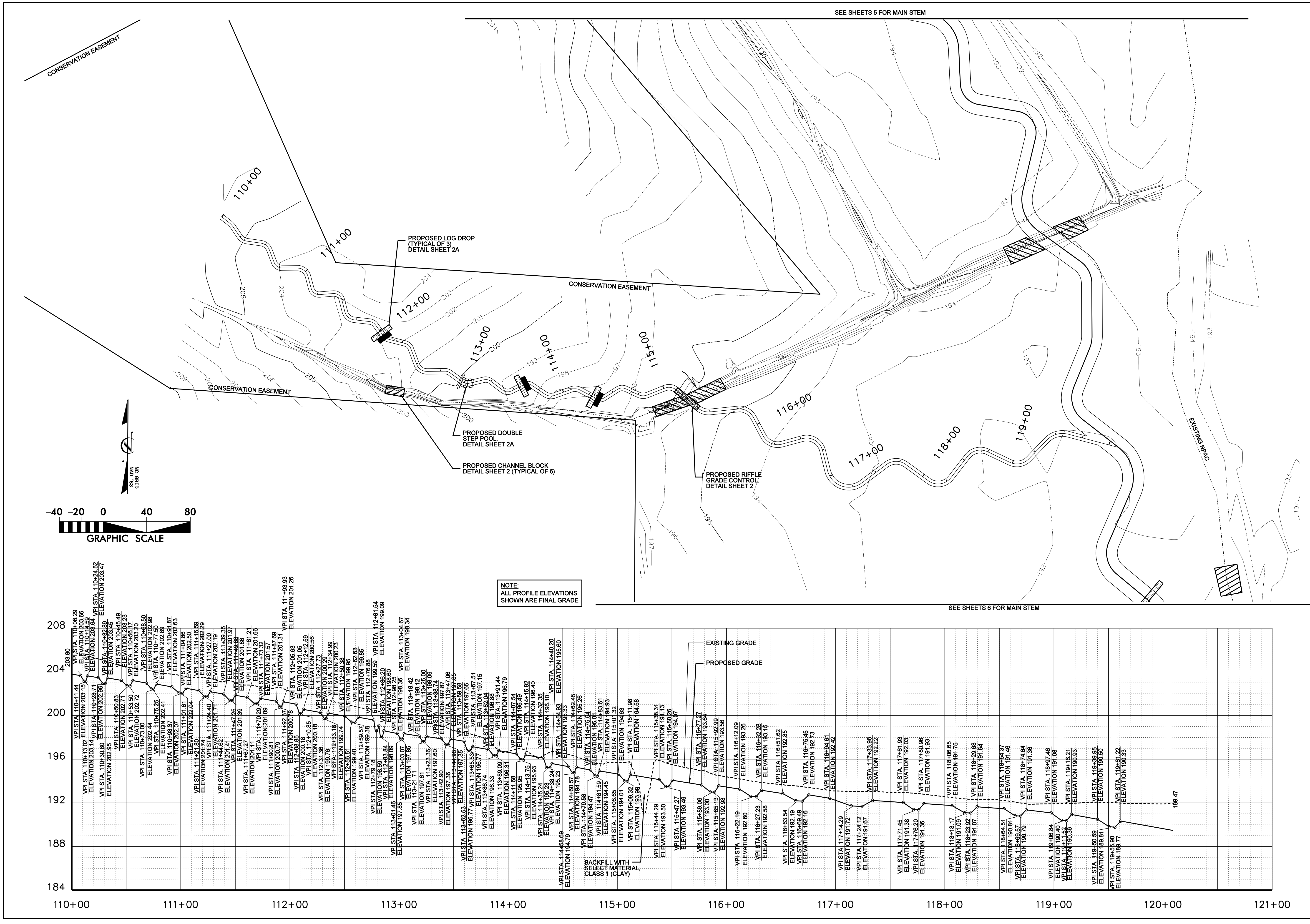
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 100+00 TO STATION 108+81

DATE: APRIL 2008
SCALE: 1"=40'

PLAN AND PROFILE

SHEET 13 OF 36



SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008	

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STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 110+00 TO STATION 120+09

DATE: APRIL 2008
SCALE: 1"=40'

PLAN AND PROFILE

SHEET 14 OF 36

SEE SHEET 6 FOR MAIN STEM

SEE SHEET 7 FOR MAIN STEM

CONSERVATION EASEMENT

PROPOSED CHANNEL BLOCK
DETAIL SHEET 2 (TYPICAL OF 6)

EXISTING CULVERT
TO BE REMOVED

CONSERVATION EASEMENT

NO GRID
GRID NO

-40 -20 0 40 80
GRAPHIC SCALE

NOTE:
ALL PROFILE ELEVATIONS
SHOWN ARE FINAL GRADE

EXISTING GRADE

PROPOSED GRADE

BACKFILL WITH
SELECT MATERIAL,
CLASS 1 (CLAY)

200
196
192
188
184
180
176

130+00 131+00 132+00 133+00 134+00 135+00 136+00 137+00 138+00 139+00 140+00 141+00 142+00

VPI STA. 141+09.32
ELEVATION 186.11

VPI STA. 141+03.99
ELEVATION 185.65

185.68

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SYM.	DESCRIPTION	DATE	APPROVED

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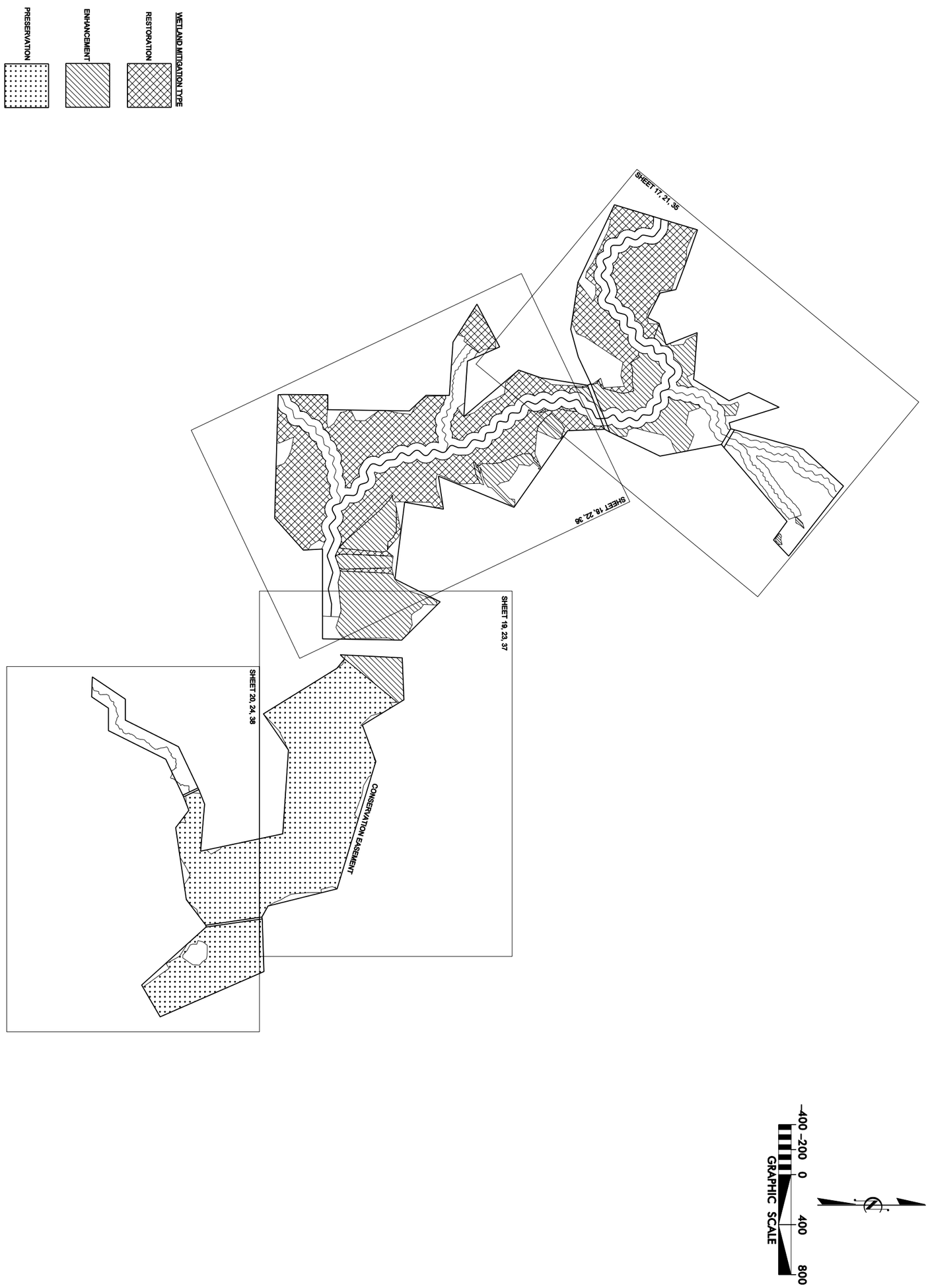
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
STATION 130+00 TO STATION 141+51

DATE: APRIL 2008
SCALES: 1"=40'

PLAN
AND
PROFILE

SHEET 15 OF 36



FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

WETLAND OVERVIEW

SHEET 16 OF 38

DATE: APRIL 2008

SCALE: 1"=400'

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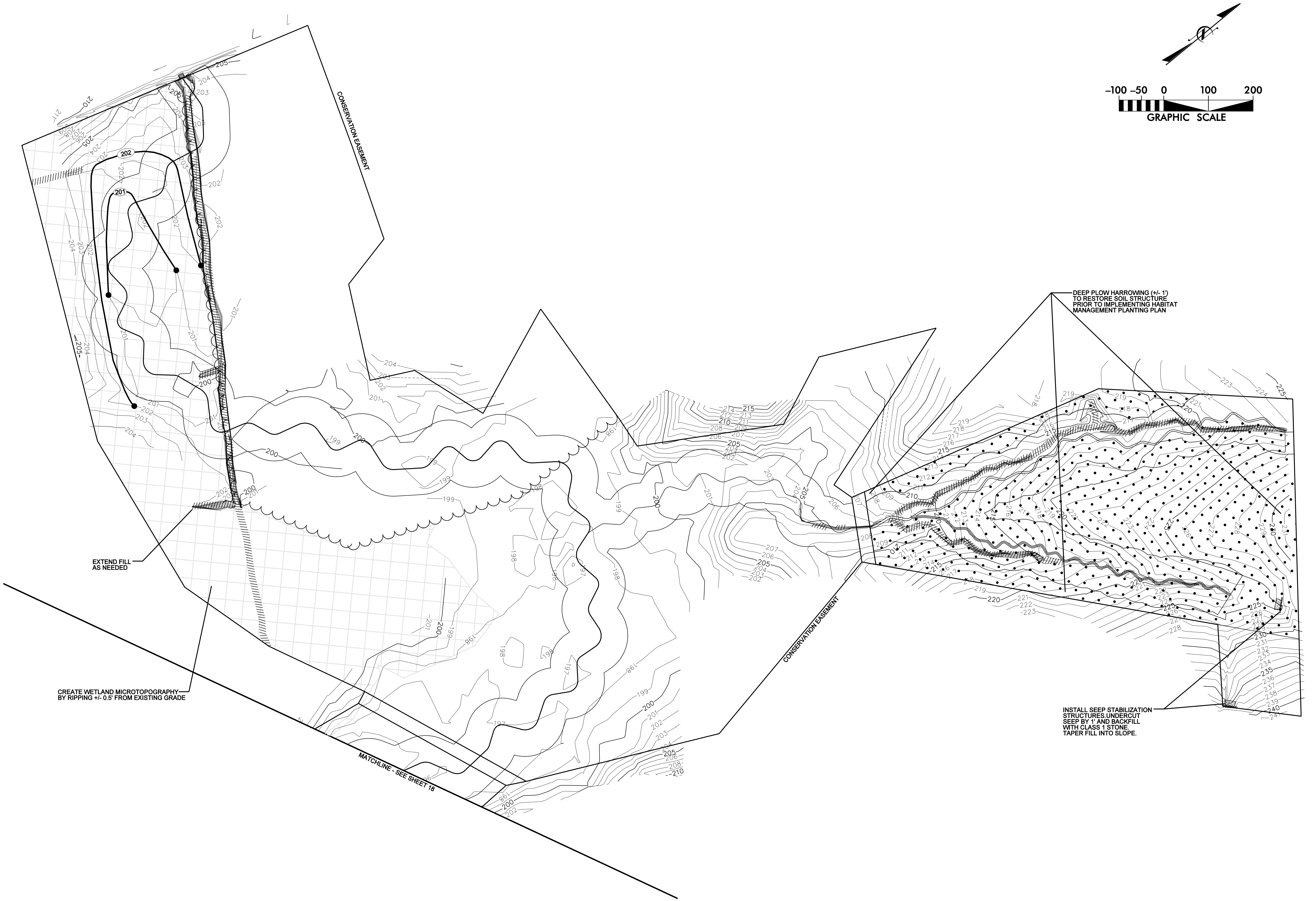

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

WETLAND SITE PLAN

MATCHLINE - SEE SHEET 19

MATCHLINE - SEE SHEET 17

CREATE NESTING ISLANDS 0.5 - 1.0' ABOVE HIGH WATER ELEVATION

DISPERSE EXISTING BERMS TO CREATE NESTING ISLANDS

REMOVE ROAD TO 0.5' ABOVE HIGH WATER ELEVATION

REMOVE ROAD TO DEPICTED SPOT ELEVATIONS ABOVE HIGH WATER ELEVATION

FILL IN EXISTING FARM POND USING MATERIAL FROM EXISTING POND BERM. GRADE TO MATCH ADJACENT WETLAND ELEVATIONS. HAUL ANY EXCESS MATERIAL OFF SITE.

REMOVE EXISTING BERM AND USE TO FILL OLD CHANNEL

CONSERVATION EASEMENT

REMOVE EXISTING BERM/ROAD AND USE TO FILL OLD CHANNEL AFTER TIE-IN

REMOVE EXISTING FARM ROAD AND USE TO FILL OLD CHANNEL

187.5

187.6

187.7

187.8

187.9

INSTALL SEEP STABILIZATION STRUCTURE. UNDERCUT SEEP BY 1' AND BACKFILLWITH CLASS 1 STONE. TAPER FILL INTO SLOPE.

CONSERVATION EASEMENT

CREATE WETLAND MICROTOPOGRAPHY BY RIPPING +/- 0.5' FROM EXISTING GRADE

-100 -50 0 100 200

GRAPHIC SCALE

A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008		
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		REVISIONS		

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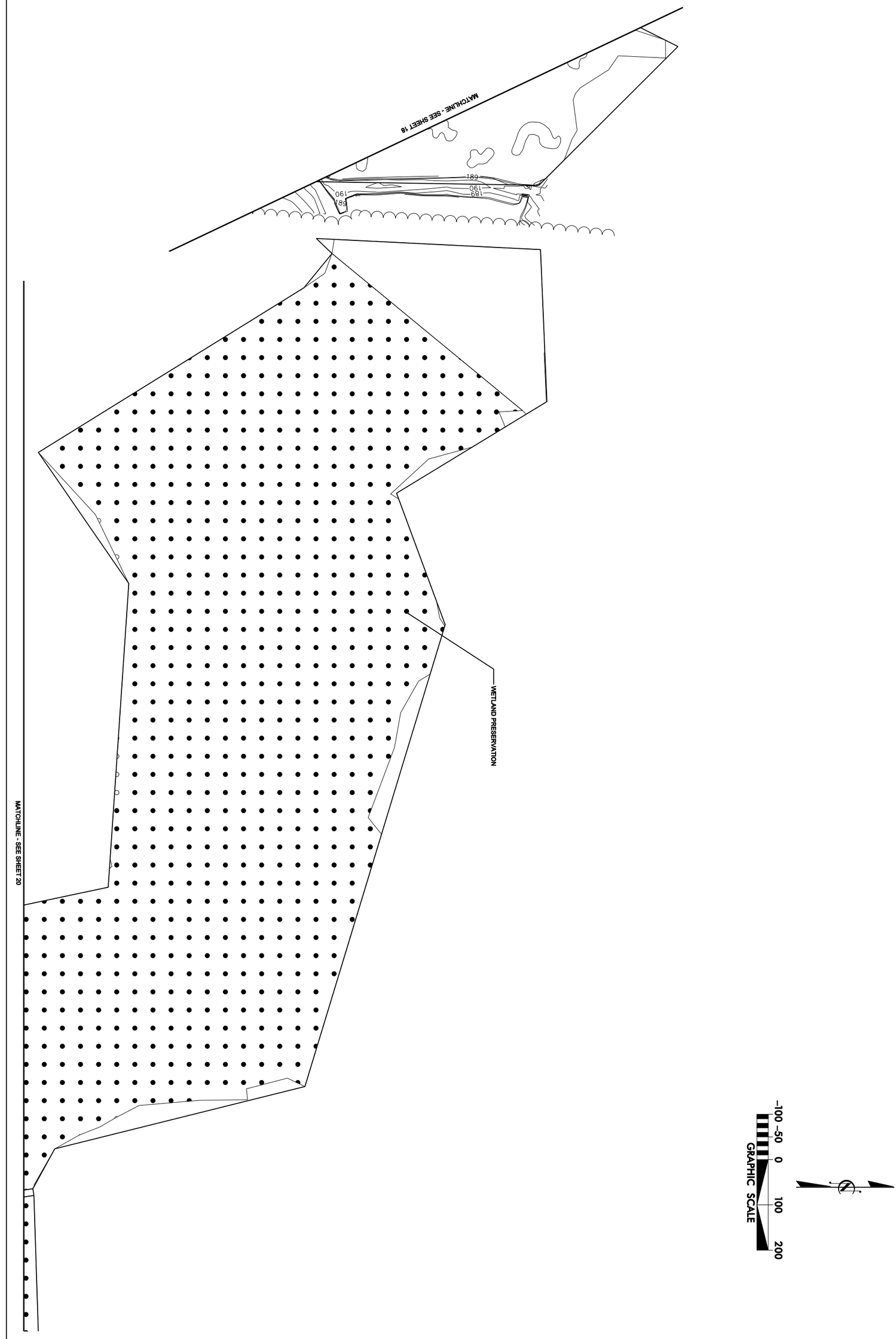
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

WETLAND SITE PLAN

SHEET 18 OF 36



SHEET 19 OF 36

WETLAND SITE PLAN

DATE: APRIL 2008

SCALE: 1"=100'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

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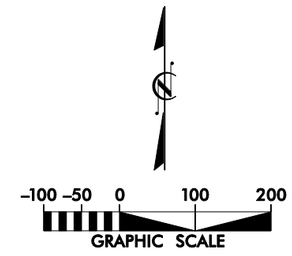
REVISIONS

MATCHLINE - SEE SHEET 19



A						SYM.	APPROVED
						DESCRIPTION	DATE
	SUBMITTED WITH RESTORATION PLAN (60%)						APRIL 2008

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STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

WETLAND
SITE PLAN

SHEET 20 OF 36

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

PLANTING PLAN

SHEET 21 OF 36

...\CADD\21_farCPL.dgn 6/16/2008 10:30:26 AM

ZONE B1/B2 — LOWER RIVERINE PLANTING AREA

ZONE C — UPPER RIVERINE PLANTING AREA

ZONE D — SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE E1/E2 — PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

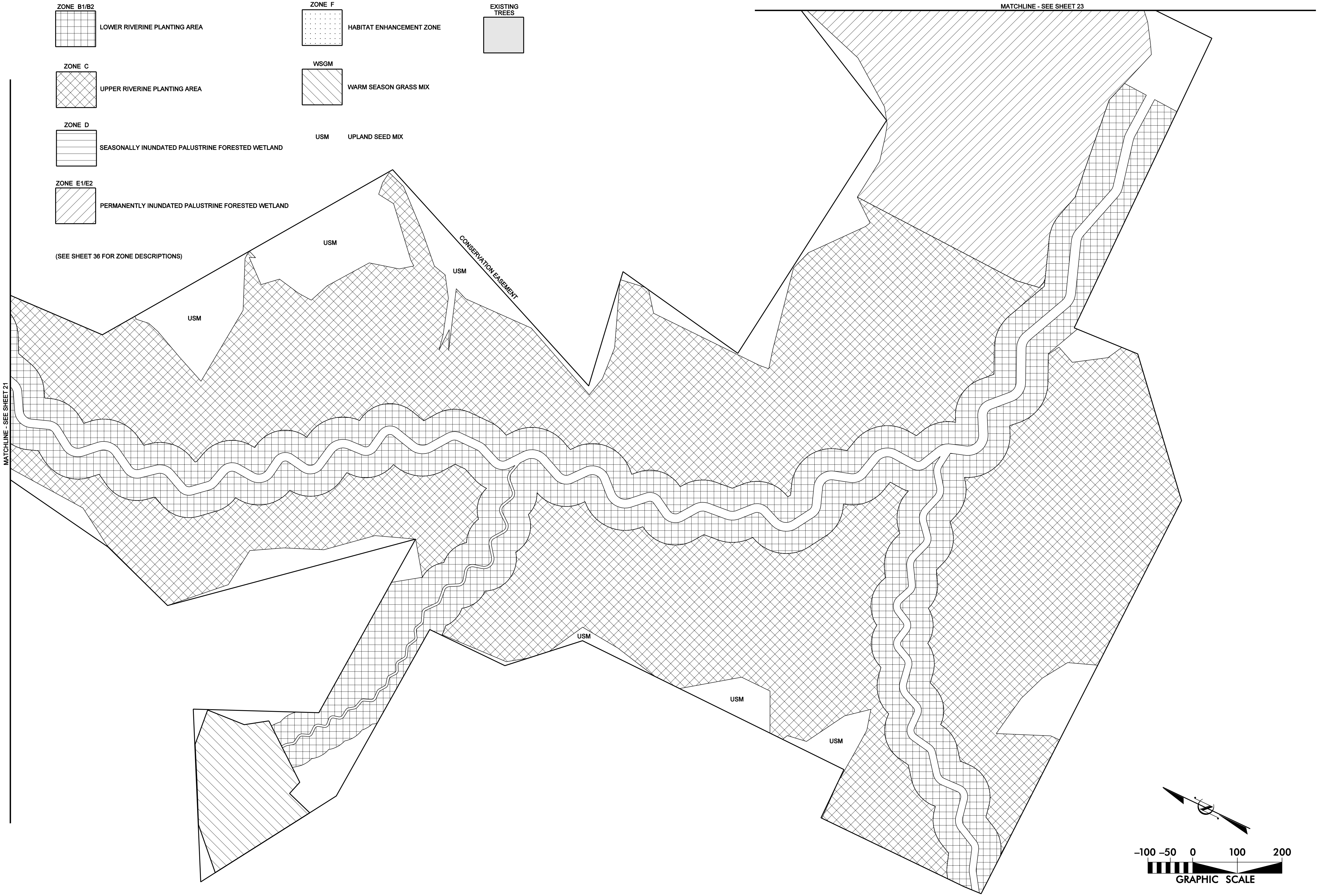
ZONE F — HABITAT ENHANCEMENT ZONE

WSGM — WARM SEASON GRASS MIX

USM — UPLAND SEED MIX

EXISTING TREES

(SEE SHEET 36 FOR ZONE DESCRIPTIONS)



SYM.	DESCRIPTION	DATE	APPROVED
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FARRAR DAIRY STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

PLANTING PLAN

ZONE B1/B2
LOWER RIVERINE PLANTING AREA

ZONE C
UPPER RIVERINE PLANTING AREA

ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

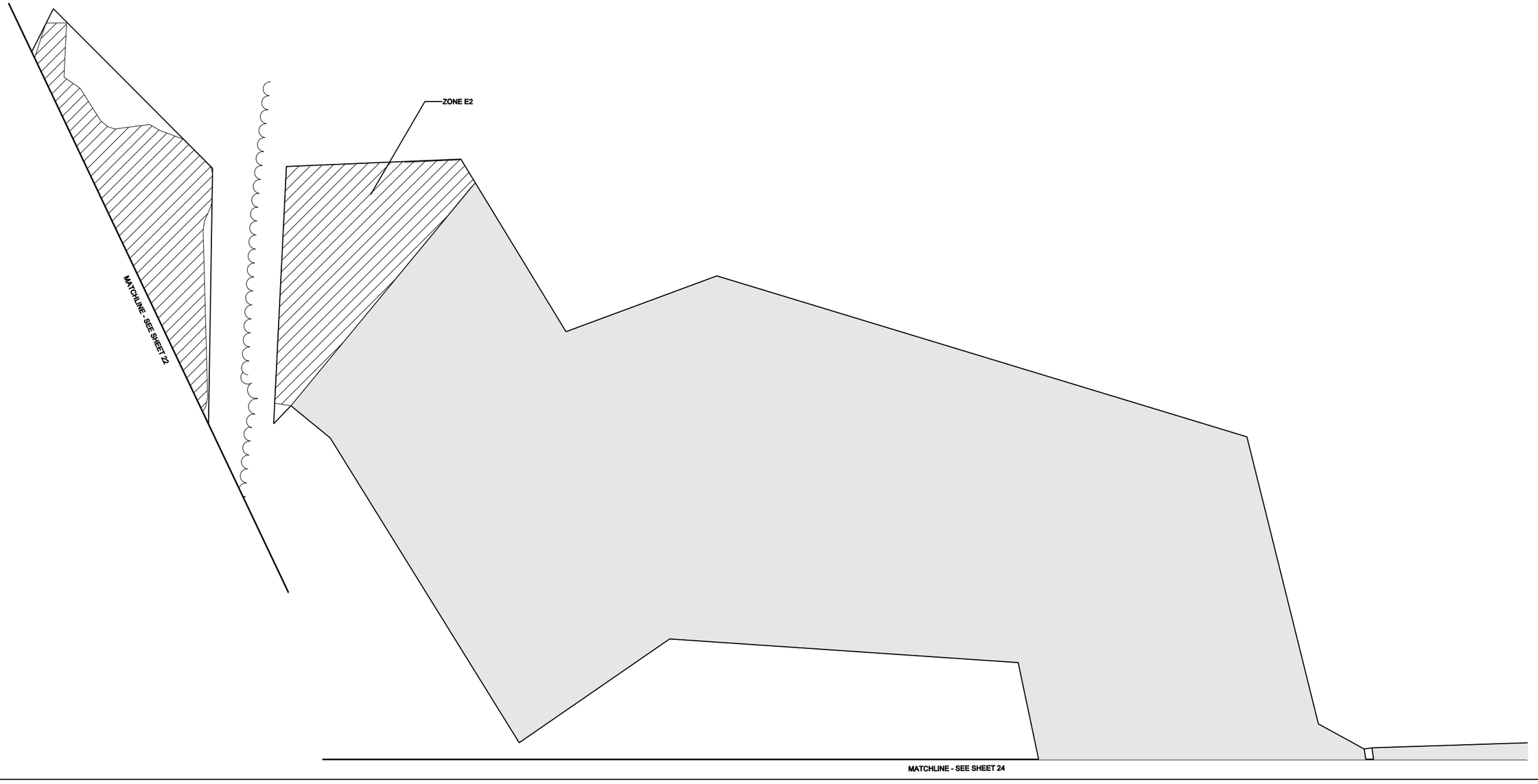
ZONE F
HABITAT ENHANCEMENT ZONE

WSGM
WARM SEASON GRASS MIX

USM
UPLAND SEED MIX

EXISTING TREES

(SEE SHEET 36 FOR ZONE DESCRIPTIONS)



–100 –50 0 100 200
GRAPHIC SCALE

A						STAL	APPROVED
SUBMITTED WITH RESTORATION PLAN (60%)						DESCRIPTION	DATE
APRIL 2008						REVISIONS	

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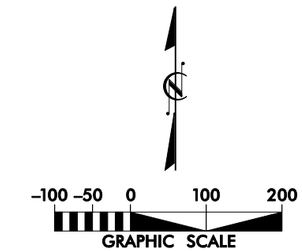
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

PLANTING PLAN

SHEET 23 OF 36

MATCHLINE - SEE SHEET 23



PLANTING PLAN AND SPECIES COMPOSITION

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONES WILL NOT BE PLANTED

ZONE A

STREAM ZONE = 2.07 ACRES (90,172 SQUARE FEET)
ZONE NOT DISPLAYED ON PLANS. INSTALL LIVE STAKES FROM BOTTOM BANK TO TOP OF BANK ON ALL STREAMS EXCEPT T4.

LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2' TO 2" DIAMETER
3' CENTER SPACING, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
SILKY DOGWOOD	CORNUS AMOMUM
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA

NOTE: NO SINGLE LIVE STAKING SPECIES SHALL COMPOSE MORE THAN 40% OF THE 11,542 TOTAL NUMBER OF LIVE STAKES TO BE INSTALLED

ZONE B1/B2

B1 - STREAM RESTORATION
LOWER RIVERINE PLANTING AREA = 21.13 ACRES
PLANT ALL OF ZONE B AS B1 UNLESS OTHERWISE MARKED

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	25	2,303
SUGARBERRY	CELTIS LAEVIGATA	10	921
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	10	921
SILKY DOGWOOD	CORNUS AMOMUM	15	1,382
GREEN ASH	FRAXINUS PENNSYLVANICA	20	1,843
SWAMP TUPELO	NYSSA BIFLORA	10	921
LAUREL OAK	QUERCUS LAURIFOLIA	10	921
			9,212

B2 - STREAM ENHANCEMENT
LOWER RIVERINE PLANTING AREA = 3.67 ACRES
PLANT B2 ONLY IN AREAS MARKED ON PLANS

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	25	92
SUGARBERRY	CELTIS LAEVIGATA	10	37
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	10	37
SILKY DOGWOOD	CORNUS AMOMUM	15	55
GREEN ASH	FRAXINUS PENNSYLVANICA	20	73
SWAMP TUPELO	NYSSA BIFLORA	10	37
LAUREL OAK	QUERCUS LAURIFOLIA	10	37
			368

ZONE C

UPPER RIVERINE PLANTING AREA = 42.41 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
GREEN ASH	FRAXINUS PENNSYLVANICA	20	3,699
SWEETBAY	MAGNOLIA VIRGINIANA	15	2,773
LAUREL OAK	QUERCUS LAURIFOLIA	15	2,773
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	20	3,699
CHERRYBARK OAK	QUERCUS PAGODA	10	1,849
PIN OAK	QUERCUS PALUSTRIS	10	1,849
WILLOW OAK	QUERCUS PHELLOS	10	1,849
			18,491

ZONE D

SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.95 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	15	193
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	15	193
WATER TUPELO	NYSSA AQUATICA	10	129
OVERCUP OAK	QUERCUS LYRATA	10	129
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	25	322
BALD CYPRESS	TAXODIUM DISTICHUM	25	322
			1,288

ZONE E1/E2

E1 - WETLAND RESTORATION
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 8.43 ACRES
PLANT ALL OF ZONE E AS E1 UNLESS OTHERWISE INDICATED

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	20	735
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	40	1,470
BALD CYPRESS	TAXODIUM DISTICHUM	40	1,470
			3,675

E2 - WETLAND ENHANCEMENT
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.25 ACRES
PLANT E2 ONLY AS MARKED ON PLANS.

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	20	45
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	40	90
BALD CYPRESS	TAXODIUM DISTICHUM	40	90
			225

ZONE F

HABITAT ENHANCEMENT ZONE = 4.03 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
SUGARBERRY	CELTIS LAEVIGATA	15	264
PERSIMMON	DIOSPYROS VIRGINIANA	15	264
YELLOW POPLAR	LIRODENDRON TULIPIFERA	25	439
SYCAMORE	PLATANUS OCCIDENTALIS	20	351
WHITE OAK	QUERCUS ALBA	25	439

WSGM

WARM SEASON GRASS MIX = 6.02 ACRES

PLANT AS SHOWN ON PLANS

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
0.8 LBS	BIG BLUESTEM	ANDROPOGON GERARDII
0.8 LBS	BUSHY BLUESTEM	ANDROPOGON GLOMERATUS
0.8 LBS	SIDEOATS GRAMA	BOUTELOUA CURTIPENDULA
0.8 LBS	PRAIRIE WILDRYE	ELYMUS CANADENSIS
0.8 LBS	VIRGINIA WILDRYE	ELYMUS VIRGINICUS
0.8 LBS	SWITCHGRASS	PANICUM VIRGATUM
0.8 LBS	LITTLE BLUESTEM	SCHIZACHYRIUM SCOPARIUM
0.8 LBS	INDIANGRASS	SORGHASTRUM NUTANS
0.8 LBS	PURPLETOP	TRIDENS FLAVUS
0.8 LBS	EASTERN GAMAGRASS	TRIPSACUM DACTYLOIDES
8 LBS/ACRE		

USM

UPLAND SEED MIX = 13.42 ACRES

PLANT IN UPLAND AREAS AS INDICATED ON PLANS AND IN ZONE F

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
5 LBS	BUCKWHEAT	FAGOPYRUM ESCULENTUM
5 LBS	SUNFLOWER	HELIANTHUS SPECIES
5 LBS	GRAIN SORGHUM	SORGHUM BICOLOR
5 LBS	BROWNTOP MILLET	UROCHLOA RAMOSA
20 LBS/ACRE		

WSM

WETLAND SEED MIX = 71.34 ACRES

PLANT IN ZONES B, C, D, AND E (IN ISLANDS ONLY FOR ZONE E)

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
1.25 LBS	AUTUMN BENTGRASS	AGROSTIS PERENNANS
1.25 LBS	BLADDER SEDGE	CAREX INTUMESCENS
1.25 LBS	AWL SEDGE	CAREX STIPATA
1.25 LBS	FOX SEDGE	CAREX VULPINOIDEA
1.25 LBS	SHOWY TICK TREFOIL	DESMODIUM CANADENSE
1.25 LBS	JAPANESE MILLET	ECHINOCHLOA CRUSGALLI VAR. FRUMENTACEA
1.25 LBS	VIRGINIA WILD RYE	ELYMUS VIRGINICUS
1.25 LBS	PATH RUSH	JUNCUS TENUIS
1.25 LBS	TIOGA DEER TONGUE	PANICUM CLANDESTINUM
1.25 LBS	SWITCH GRASS	PANICUM VIRGATUM
1.25 LBS	PENNSYLVANIA SMARTWEED	POLYGONUM PENSYLVANICUM
15 LBS/ACRE		

EXISTING TREES

DO NOT PLANT IN FORESTED AREAS UNLESS OTHERWISE INDICATED.

A	SUBMITTED WITH RESTORATION PLAN (60%)	APRIL 2008
SYM.	DESCRIPTION	DATE

REVISIONS

APPROVED

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement Program

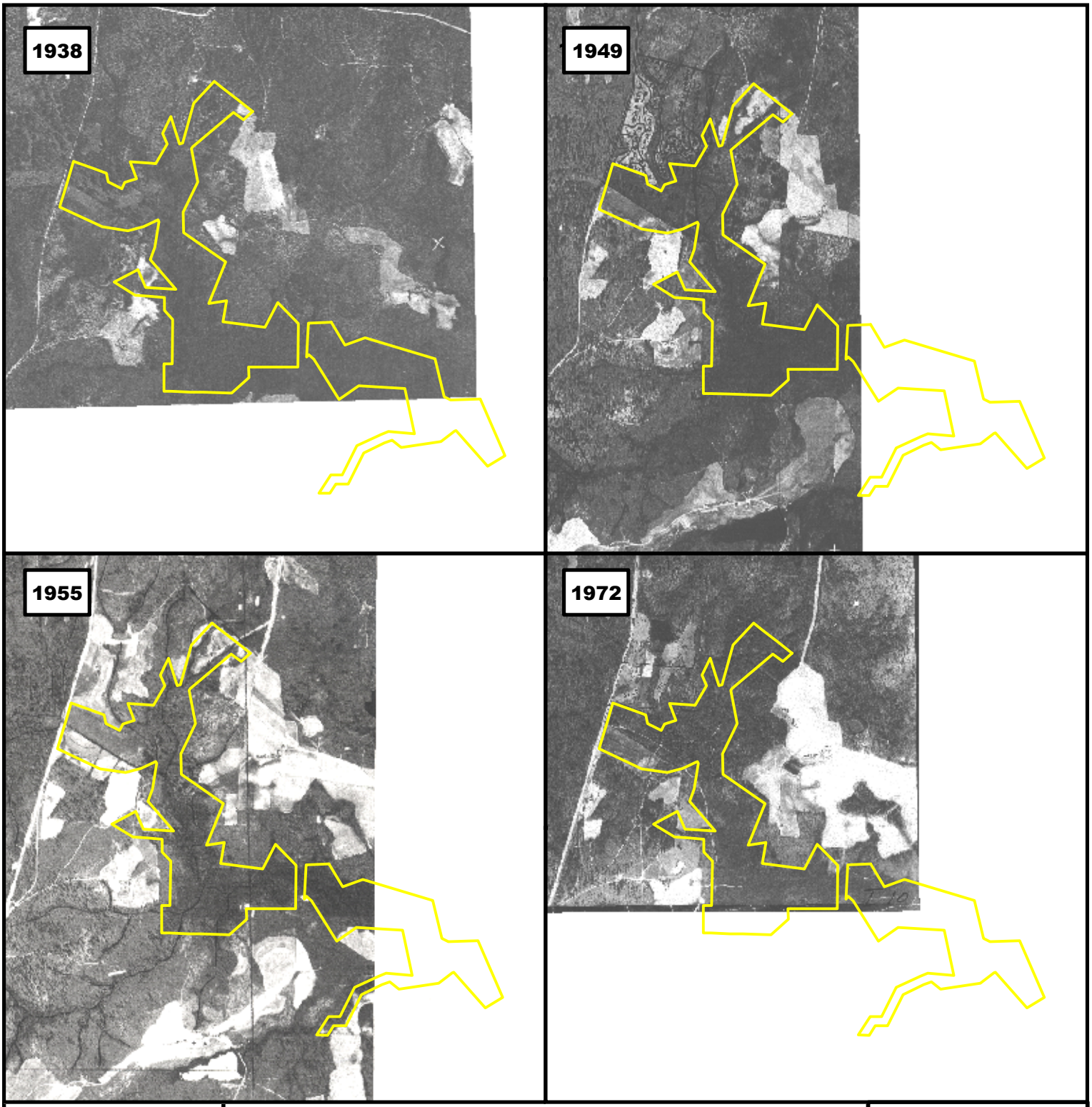
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: APRIL 2008
SCALE: 1"=100'

PLANTING PLAN

SHEET 24 OF 36

Appendix A
Historic Aerial Photographs



Historic Aerials 1938-1972

Project Easement

N
W E
S

1:24,000
1 inch equals 2,000 feet

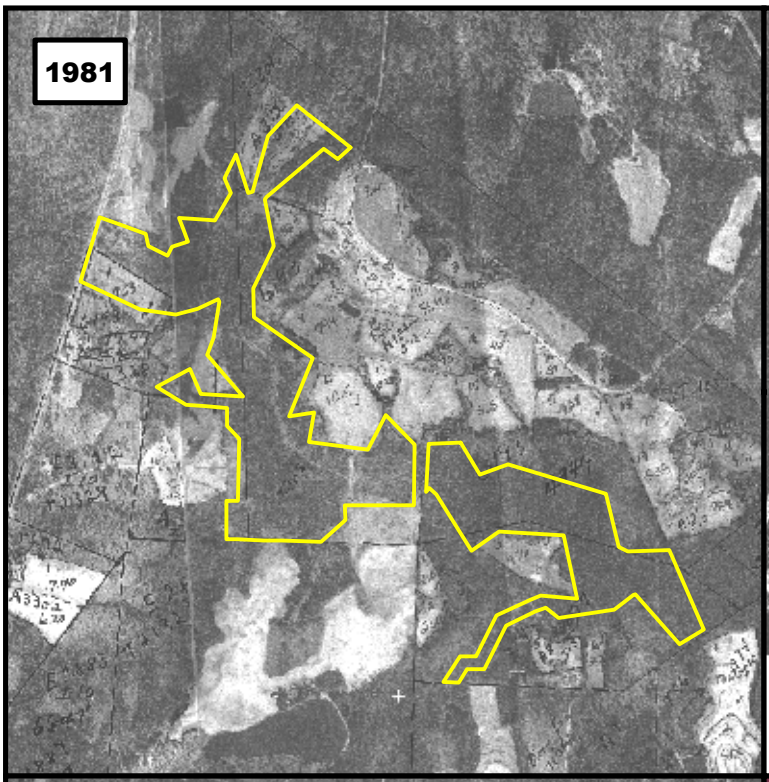
2,000 1,000 0 2,000 Feet

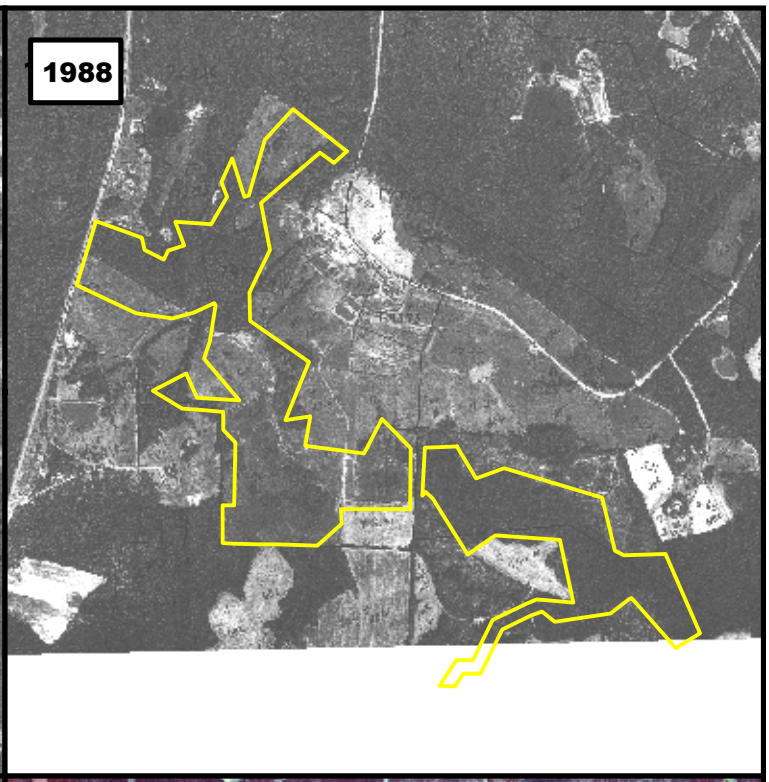
Source: Harnett County Natural Resources Conservation Service

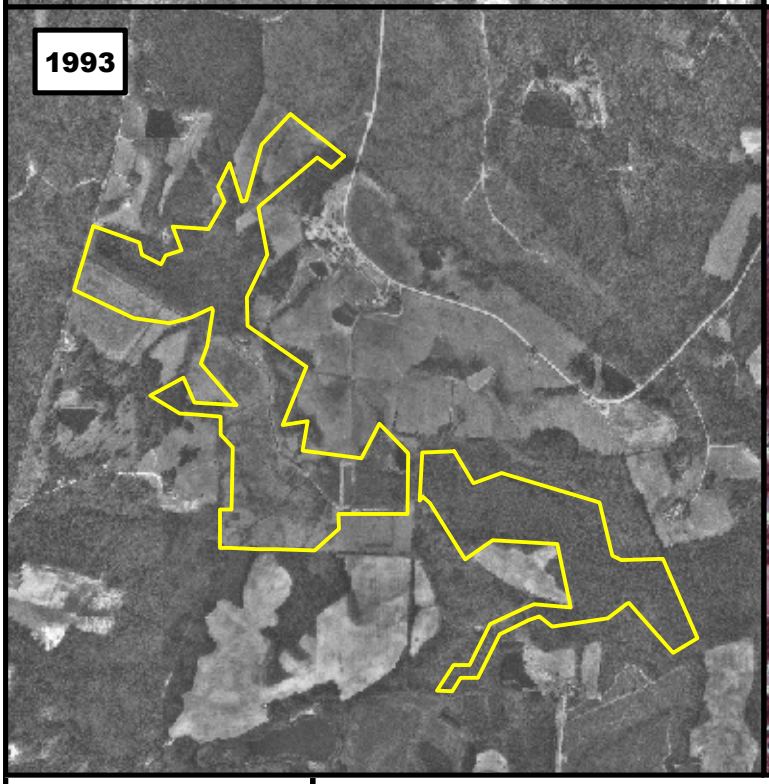
KCI TECHNOLOGIES

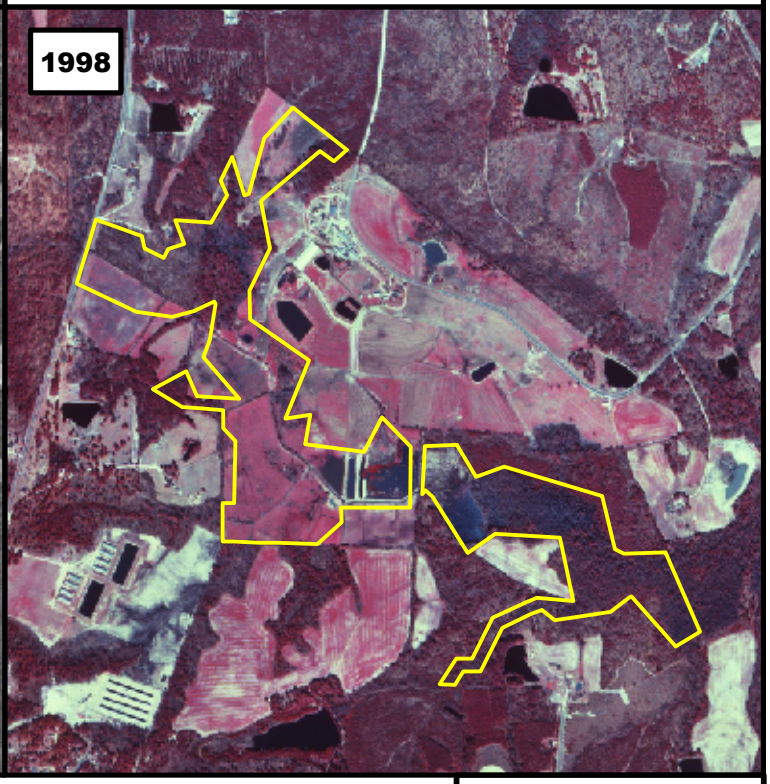
KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.









KCI TECHNOLOGIES

Historic Aerials 1981-1998

Project Easement

N
W E
S

1:24,000

1 inch equals 2,000 feet

2,000 1,000 0 2,000 Feet

Source: Harnett County Natural Resources Conservation Service 1981 and 1988; USGS DOQQs 1993 and 1998.

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

Appendix B
Agency Correspondence

North Carolina Wildlife Resources Commission

Richard B. Hamilton, Executive Director

MEMORANDUM

To: Elizabeth S. Solchik
KCI Technologies
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609

From: Steven H. Everhart, PhD
Southeastern Permit Coordinator
Habitat Conservation Program
127 Cardinal Drive Ext.
Wilmington, NC 28405

Date: August 11, 2006

RE: Farrar Creek EEP Stream and Wetland Restoration Site in Harnett County

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

The project is located west of NC 210, east of Powell Farm Rd., on Anderson Creek in Harnett County. A letter and vicinity map was submitted for review of fish and wildlife issues associated with the project.

The applicant proposes to restore approximately 1.5 mile of natural form stream on which several sections have been converted to pasture. Anderson Creek is a tributary of the Cape Fear River. The mitigation is intended to satisfy needs of the NC Ecosystem Enhancement Program (EEP).

There do not appear to be any threatened or endangered species that would be impacted by the project and we do not foresee any fish and wildlife issues that might arise from the project. Thank you for the opportunity to review and comment on this project. If you have any questions or require additional information regarding these comments, please call me at (910) 796-7217.

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

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

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

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

August 23, 2006

Elisabeth S. Solchik
KCI Technologies
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609

Re: EEP, Farrar Dairy Stream and Wetland Restoration, Intersection of Powell Farm and Lemuel Black Roads, Harnett County, ER 06-2009

Dear Ms. Solchik:

Thank you for your letter of July 19, 2006, concerning the above project.

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

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

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

Sincerely,

Peter B. Sandbeck

Peter Sandbeck by MPM

	Location	Mailing Address	Telephone/Fax
ADMINISTRATION	507 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-4763/733-8653
RESTORATION	515 N. Blount Street, Raleigh NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6547/715-4801
SURVEY & PLANNING	515 N. Blount Street, Raleigh, NC	4617 Mail Service Center, Raleigh NC 27699-4617	(919)733-6545/715-4801

United States
Department of
Agriculture

Natural Resources
Conservation
Service

530 West Innes Street
Salisbury, NC 28144
Telephone: 704-637-2400
Fax: 704-637-8077

August 3, 2006

Elisabeth S. Solchik
KCI Technologies
4601 Six Forks Road Suite 220
Raleigh, NC 27609

Dear Ms. Solchik;

Here is the Farmland Conversion Impact Rating, form AD1006 for the Farrar Dairy stream/wetland restoration project in Harnett Co, NC. If you need additional soils information, please contact either myself or Parks Blake at the Harnett County NRCS office in Lillington, NC.

Please send me a copy of both AD1006 forms after section VII has been completed. We keep track of the number of these we do and what the outcomes are.

Thanks,

Alan Walters
Resource Soil Scientist

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 7/19/06
Name Of Project Farrer Dairy Stream & Wetland Restoration Project	Federal Agency Involved USDOT-FHWA
Proposed Land Use Riparian Buffer and Wetlands	County And State Harnett County, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 8/1/06

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply – do not complete additional parts of this form).* Yes [X] No [ ]

Acres Irrigated: 0 | Average Farm Size: 157

Major Crop(s): CORN	Farmable Land In Govt. Jurisdiction Acres: 327789 % 85.1	Amount Of Farmland As Defined in FPPA Acres: 239304 % 75.5
Name Of Land Evaluation System Used: HARNETT CO LE	Name Of Local Site Assessment System: None	Date Land Evaluation Returned By NRCS: 8/14/06

PART III *(To be completed by Federal Agency)*	Alternative Site Rating: Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	176.2			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	176.2	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	57.9			
B. Total Acres Statewide And Local Important Farmland	4.28			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.026			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	85.1			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0 30	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	Site A	Site B	Site C	Site D
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	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

NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross Jr., Secretary

August 1, 2006

Ms. Elisabeth S. Solchik
KCI Technologies
Landmark Center II, Suite 220
4601 Six Forks Road
Raleigh, NC 27609

Subject: Farrar Dairy Stream and Wetland Restoration Project; Harnett County

Dear Ms. Solchik:

The Natural Heritage Program has no record of rare species, significant natural communities, or significant natural heritage areas at the site. Our program shows a County-significant natural area known as Barbecue Pine Forest across SR 1126 to the west of the project area. I have enclosed a map and brief text for the site, which is completely unprotected and probably heavily degraded, either by fire suppression or development, since the last site visit.

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

Please do not hesitate to contact me at 919-715-8697 if you have questions or need further information.

Sincerely,

Harry E. LeGrand, Jr.

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

Enclosures

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

Significant Natural Heritage Area Report

01 August 2006

Name Barbecue Pine Forest

IDENTIFIERS

Site ID 41

Site Alias

Macro Site Name

Mega Site Name

Site Relations

Owner Abbr.	Owner	Owner Comments
PRV	PRIVATE	

LOCATORS

County Harnett (NC)

Latitude 351829N **Longitude** 0785753W

Quad Anderson Creek **Watershed** Upper Cape Fear

Directions Both sides of Nursery Road (SR 1117), west to SR 1116 and east to SR 1126, north of SR 1125. Along North Prong Anderson Creek in central Harnett County.

SITE DESCRIPTION

Minimum Elevation: 200.00 **Feet** 61.00 **Meters** **Survey** R

Maximum Elevation: 400.00 **Feet** 122.00 **Meters**

Site Description Large area of typical Sandhills Region terrain, including broad upland ridgetops, slopes, and ravines. Communities include Xeric Sandhill Scrub, Pine/Scrub Oak Sandhill, and Sandhill Seep. Most of the site was cut over in 1992 and communities are in fair to poor condition. It remains signficant as a large expanse of typical sandhill communities on the edge of the region.

Key Enviro Factors

Climate Description

Land Use History

Cultural Features

Additional Topics W1

SITE DESIGN

Site Mapped Y - Yes **Mapped Date**

Designer Schafale

Boundary Justification Boundary on NHP map very rough. Includes substantial degraded area.

Primary and Secondary Area 1,792.75 **Acres** **Primary Area** 1,753.37 **Acres**

Site Comments

Last Visit 1992-06-16

SITE SIGNIFICANCE

Site Significance D

Site Significance Comments Natural communities

Biodivsig rating B4 - Moderate

Biodivsig Comments CD-ranked Xeric Sandhill Scrub

Other Values V3 - Moderate values

Other Values Comments

Significant Natural Heritage Area Report

01 August 2006

Name Barbecue Pine Forest

Protection Urgency P3 - Definable threat/opportunity but not within 5 years

Protection Urgency Comments

Management Urgency M2 - Essential within 5 years to prevent loss

Management Urgency Comments Communities are continuing to deteriorate in the absence of fire.

REAL ESTATE/PROTECTION

Conservation Intentions Registry

Number of Tracts

Designation

Protection Comments No protection status

MANAGEMENT

Land Use Comments The area was heavily timbered in 1992, but was apparently not site prepped. Several old home sites and a couple of old fields occur on the site.

Natural Hazard Comments

Exotics Comments

Offsite Most of surrounding area is farm land or rural housing.

Information Needs

Management Needs

Managed Area Relations

ELEMENT OCCURRENCES

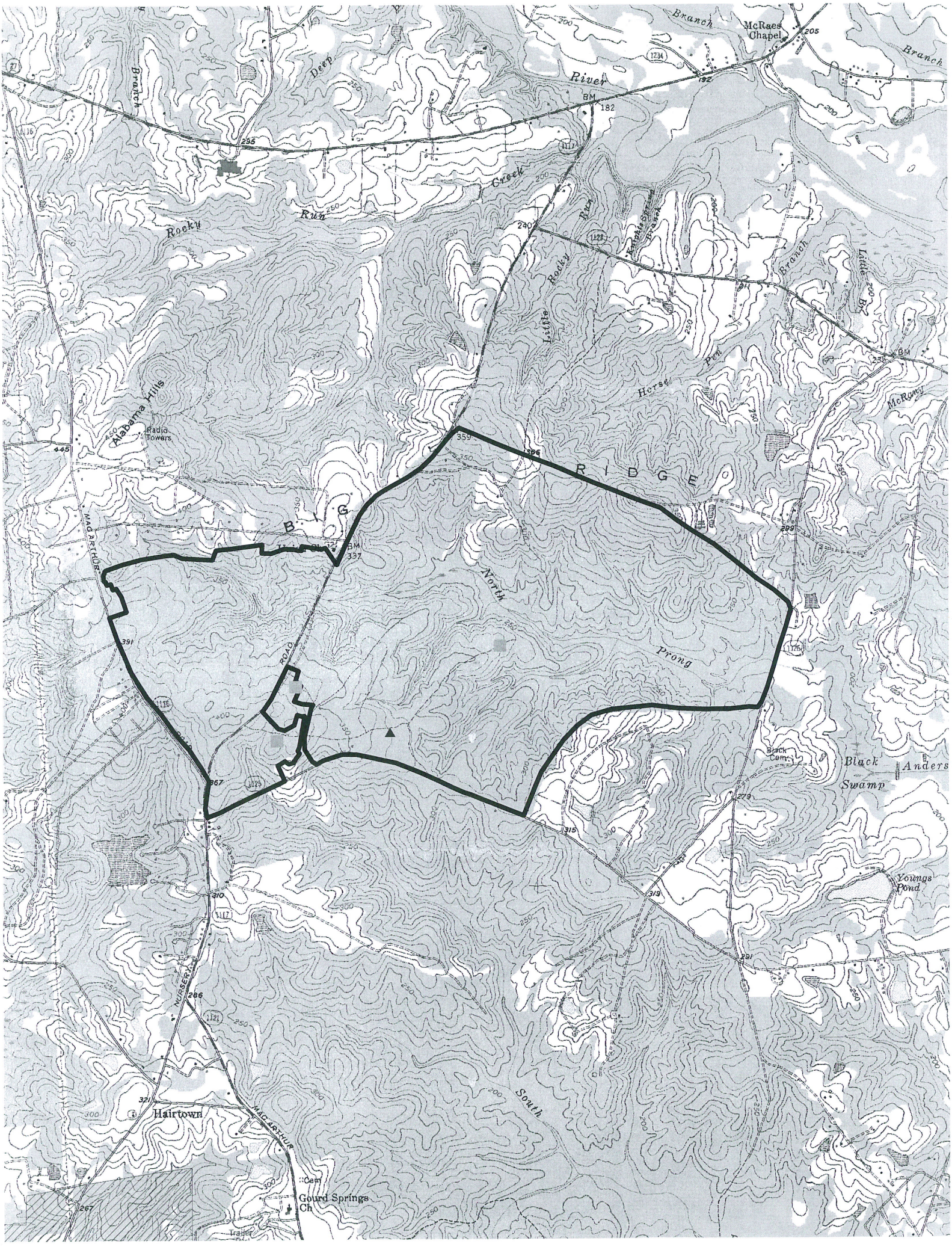
Scientific Name	Common Name	G Rank	S Rank	EO Rank	EO ID
Pyxidanthera barbulata var. brevifolia	Sandhills Pyxie-moss	G4T3	S3	D	3242
Pine/scrub oak sandhill		G4	S3	D	10434
Sandhill seep		G2	S2S3	D	1698

REFERENCES

Reference Code	Full Citation
U91CAR01NCUS	Carter, J.H. III. 1991. Longleaf Pine Survey of the Sandhills and Southwestern Coastal Plain of North Carolina, 1989-1990.

VERSION

Version Date 1993-09-29
Version Author Schafale


McRaes Chapel
Deep River
Rocky Run Creek
Little Rocky Run
Horse Pen Branch
Little Horse Pen Br
McRary
Alabama Hills
Radio Towers
BIG RIDGE
North Prong
MacARTHUR ROAD
Black Swamp
Black Cem.
Anders
Youngs Pond
South
NURSERY
Hairtown
MacARTHUR
Gourd Springs Ch
Cem
Trailer

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 7/19/06
Name Of Project Farrar Dairy Stream & Wetland Restoration	Federal Agency Involved USDOT-FHWA
Proposed Land Use Riparian Buffer and Wetlands	County And State Harnett County, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 8/1/06

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☑	No ☐	Acres Irrigated 0	Average Farm Size 157
Major Crop(s) Corn	Farmable Land In Govt. Jurisdiction Acres: 327,789	% 85.1	Amount Of Farmland As Defined in FPPA Acres: 239,304	% 75.5
Name Of Land Evaluation System Used Harnett County LE	Name Of Local Site Assessment System None		Date Land Evaluation Returned By NRCS 8/4/06	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	176.2			
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	176.2	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	57.9			
B. Total Acres Statewide And Local Important Farmland	4.28			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.026			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	85.1			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	30	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	0			
2. Perimeter In Nonurban Use	10	0			
3. Percent Of Site Being Farmed	20	10			
4. Protection Provided By State And Local Government	20	20			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	5			
7. Size Of Present Farm Unit Compared To Average	10	10			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	15			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	80	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	30	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	80	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	110	0	0	0

Site Selected: Farrar Dairy	Date Of Selection 8/8/06	Was A Local Site Assessment Used? Yes ☐ No ☒

Reason For Selection: This site offers a valuable opportunity to restore a portion of the North Prong of Anderson Creek and surrounding wetlands. Widespread ditching across the site combined with years of dairy production have degraded the natural stream and wetland conditions. The project will create buffers to protect water quality from surrounding agricultural drainage and restore functioning aquatic and wetland habitat to the site.

Appendix C
Conservation Easement

FARRAR TRACT
CONSERVATION EASEMENT

A parcel of land to be used for Conservation Easement purposed located on lands now or formerly owned by James Farrar (Deed Book 1055 Page 324, Deed Book 1088 Page 933, Deed Book 47 Page 30, and Deed Book 471, Page 27) in Anderson Creek Township, Harnett County, North Carolina and being more particularly described as follows:

Commencing at a found pk nail in the centerline of Powell Farm Road (60 foot public right of way), said point being the Southwest corner of lands now or formerly owned by Sandra Womack Pait (Deed Book 794 Page 970);
Thence South 87° 05' 23" East a distance of 30.90 feet to the intersection with the Easterly line of Powell Farm Road;
Thence on the centerline of a creek the follow 17 calls:

1. South 87°05'23" East, a distance of 12.50 feet to a point;
2. South 72°50'25" East, a distance of 15.65 feet to a point;
3. South 53°38'07" East, a distance of 116.84 feet to a point;
4. South 56°27'34" East, a distance of 160.88 feet to a point;
5. South 61°52'10" East, a distance of 89.01 feet to a point;
6. South 56°11'47" East, a distance of 121.17 feet to a point;
7. South 65°46'42" East, a distance of 51.27 feet to a point;
8. South 56°23'03" East, a distance of 77.51 feet to a point;
9. South 50°09'18" East, a distance of 92.91 feet to a point;
10. South 60°22'34" East, a distance of 47.80 feet to a point;
11. South 61°00'02" East, a distance of 54.78 feet to a point;
12. South 48°41'16" East, a distance of 35.15 feet to a point;
13. South 58°54'31" East, a distance of 70.82 feet to a point;
14. South 66°30'13" East, a distance of 94.75 feet to a point;
15. South 58°14'33" East, a distance of 93.52 feet to a point;
16. South 64°07'56" East, a distance of 3.30 feet to a point;
17. South 66°14'29" East, a distance of 147.64 feet to a found concrete monument;

Thence North 07°05'01" East, a distance of 927.57 feet to an iron pin set;
Thence South 83°54'45" East, a distance of 71.12 feet to an iron pin set;
Thence North 31°05'59" East, a distance of 331.13 feet to an iron pin set;
Thence North 22°44'28" West, a distance of 170.26 feet to an iron pin set;
Thence North 25°44'34" East, a distance of 270.25 feet to an iron pin set;
Thence South 17°21'31" East, a distance of 419.09 feet to an iron pin set;
Thence North 74°42'49" East, a distance of 48.68 feet to an iron pin set, being also known as Point "P";
Thence North 15°46'33" East, a distance of 31.04 feet to an iron pin set;
Thence North 15°46'32" East, a distance of 572.41 feet to an iron pin set;
Thence North 42°35'02" East, a distance of 435.24 feet to an iron pin set;
Thence South 51°57'09" East, a distance of 710.71 feet to an iron pin set;
Thence North 46°42'56" West, a distance of 176.60 feet to an iron pin set;
Thence North 53°57'21" West, a distance of 183.57 feet to an iron pin set;
Thence North 49°32'34" West, a distance of 808.76 feet to an iron pin set;
Thence North 10°42'01" East, a distance of 499.74 feet to an iron pin set;
Thence North 25°39'36" West, a distance of 444.70 feet to an iron pin set, being also known as Point "Q";
Thence North 28°00'51" West, a distance of 46.08 feet to an iron pin set;
Thence South 02°09'02" East, a distance of 296.70 feet to an iron pin set;
Thence North 55°01'49" East, a distance of 747.64 feet to an iron pin set;
Thence North 22°25'42" West, a distance of 653.45 feet to an iron pin set;
Thence North 81°19'14" East, a distance of 267.12 feet to an iron pin set;
Thence North 10°04'21" West, a distance of 315.25 feet to an iron pin set;
Thence North 82°50'31" East, a distance of 619.04 feet to an iron pin set;
Thence North 26°46'48" East, a distance of 404.35 feet to an iron pin set;
Thence North 44°55'54" East, a distance of 433.49 feet to an iron pin set, being also known as Point "R";
Thence North 88°34'51" East a distance of 91.86 feet to the West line of lands now or formerly owned by Brigham and Kathleen Wilson (Deed Book 903 Page 983);
Thence South 02°50'22" West, on the West line of said lands owned by Brigham and Kathleen Wilson, a distance of 553.27 feet to a point;
Thence South 42°04'30" West a distance of 111.32 feet to an iron pin set;
Thence South 89°58'34" West, a distance of 717.98 feet to an iron pin set;
Thence South 03°05'07" East, a distance of 153.71 feet to an iron pin set;
Thence South 47°59'24" West, a distance of 342.98 feet to an iron pin set;
Thence North 88°23'13" West, a distance of 987.90 feet to an iron pin set;
Thence North 02°49'51" West, a distance of 41.97 feet to an iron pin set;
Thence North 00°19'31" East, a distance of 354.78 feet to an iron pin set;
Thence North 89°59'54" East, a distance of 119.53 feet to an iron pin set;
Thence North 00°51'36" East, a distance of 652.31 feet to an iron pin set;
Thence North 43°12'28" West, a distance of 182.38 feet to an iron pin set;
Thence North 00°19'31" East, a distance of 186.60 feet to an iron pin set;
Thence North 86°05'03" West, a distance of 427.57 feet to an iron pin set;
Thence North 57°44'38" West, a distance of 359.16 feet to an iron pin set;
Thence North 62°08'53" East, a distance of 387.17 feet to an iron pin set;
Thence South 23°45'56" East, a distance of 281.16 feet to an iron pin set;
Thence North 86°15'53" East, a distance of 444.82 feet to an iron pin set;
Thence North 40°22'13" West, a distance of 574.61 feet to an iron pin set;
Thence North 19°08'46" East, a distance of 186.73 feet to an iron pin set;
Thence North 09°09'28" East, a distance of 378.92 feet to an iron pin set;
Thence North 22°12'04" West, a distance of 30.00 feet to an iron pin set;
Thence South 64°52'59" West, a distance of 237.41 feet to an iron pin set;
Thence North 74°40'44" West, a distance of 230.19 feet to an iron pin set;
Thence North 81°16'42" West, a distance of 381.08 feet to an iron pin set;
Thence North 64°46'06" West, a distance of 683.47 feet to an iron pin set;
Thence North 16°47'02" East, a distance of 390.76 feet to the POINT OF BEGINNING.

LESS AND EXCEPT THE FOLLOWING 3 PARCELS;

EXCEPTION 1
Beginning at said Point "P";
Thence North 15°46'32" East a distance of 31.04 feet to a point;
Thence South 59°19'17" East a distance of 164.62 feet to a point;
Thence South 49°32'34" West a distance of 31.70 feet to a point;
Thence North 59°19'17" West a distance of 146.39 feet to the Point of Beginning, containing 0.11 acres, more or less.

EXCEPTION 2
Beginning at said Point "Q";
Thence South 28°00'51" West a distance of 46.08 feet to a point;
Thence South 68°38'09" West a distance of 378.24 feet to a point;
Thence North 22°12'04" West a distance of 30.00 feet to a point;
Thence North 68°38'09" East a distance of 413.65 feet to the Point of Beginning, containing 0.27 acres, more or less.

EXCEPTION 3
Beginning at said Point "R";
Thence North 88°34'51" East a distance of 91.86 feet to a point;
Thence South 02°50'22" West a distance of 553.27 feet to a point;
Thence South 42°04'30" West a distance of 111.32 feet to a point;
Thence North 00°55'13" East a distance of 633.02 feet to the Point of Beginning, containing 1.11 acres, more or less.

Residual Acreage of easement is 99.86 acres, more or less.

I HEREBY CERTIFY THAT I AM THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED HEREON, WHICH IS LOCATED IN HARNETT COUNTY; THAT I HEREBY ACCEPT AND ADOPT THIS PLAN OF EASEMENT, WITH MY FREE CONSENT, ESTABLISH AND DEDICATE THE CONSERVATION EASEMENT(S), AS DEPICTED HEREON, TO THE STATE OF NORTH CAROLINA.

SIGNATURE

PRINTED NAME DATE

NOTES:

THIS PLAN HAS BEEN PREPARED WITHOUT THE BENEFIT OF A REPORT OF TITLE.

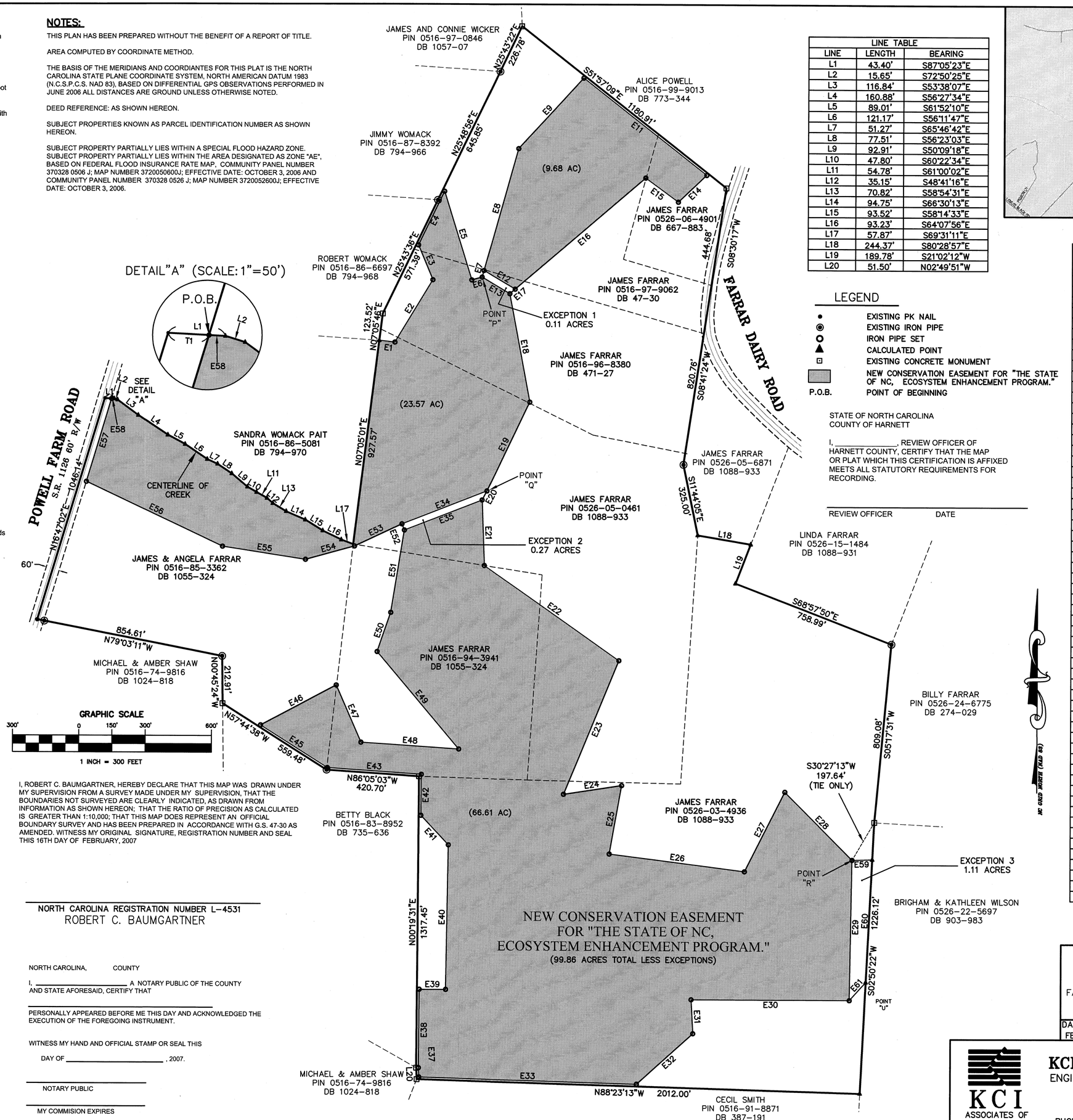
AREA COMPUTED BY COORDINATE METHOD.

THE BASIS OF THE MERIDIANS AND COORDIANTES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (N.C.S.P.C.S. NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED IN JUNE 2006 ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.

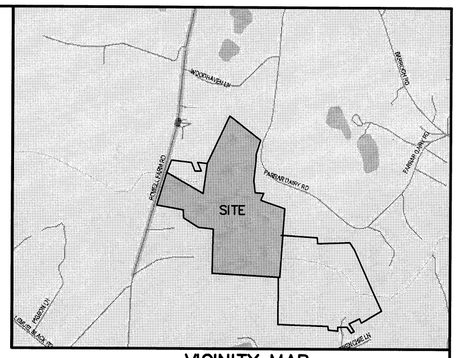
DEED REFERENCE: AS SHOWN HEREON.

SUBJECT PROPERTIES KNOWN AS PARCEL IDENTIFICATION NUMBER AS SHOWN HEREON.

SUBJECT PROPERTY PARTIALLY LIES WITHIN A SPECIAL FLOOD HAZARD ZONE. SUBJECT PROPERTY PARTIALLY LIES WITHIN THE AREA DESIGNATED AS ZONE "AE", BASED ON FEDERAL FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NUMBER 370328 0506 J; MAP NUMBER 3720050600J; EFFECTIVE DATE: OCTOBER 3, 2006 AND COMMUNITY PANEL NUMBER 370328 0526 J; MAP NUMBER 3720052600J; EFFECTIVE DATE: OCTOBER 3, 2006.



LINE TABLE		
LINE	LENGTH	BEARING
L1	43.40'	S87°05'23"E
L2	15.65'	S72°50'25"E
L3	116.84'	S53°38'07"E
L4	160.88'	S56°27'34"E
L5	89.01'	S61°52'10"E
L6	121.17'	S56°11'47"E
L7	51.27'	S65°46'42"E
L8	77.51'	S56°23'03"E
L9	92.91'	S50°09'18"E
L10	47.80'	S60°22'34"E
L11	54.78'	S61°00'02"E
L12	35.15'	S48°41'16"E
L13	70.82'	S58°54'31"E
L14	94.75'	S66°30'13"E
L15	93.52'	S58°14'33"E
L16	93.23'	S64°07'56"E
L17	57.87'	S69°31'11"E
L18	244.37'	S80°28'57"E
L19	189.78'	S21°02'12"W
L20	51.50'	N02°49'51"W



VICINITY MAP
(NOT TO SCALE)

EASEMENT LINE TABLE		
LINE	LENGTH	BEARING
E1	71.12'	S83°54'45"E
E2	331.13'	N31°05'59"E
E3	170.26'	N22°44'28"W
E4	270.25'	N25°44'34"E
E5	419.09'	S17°21'31"E
E6	48.68'	N74°42'49"E
E7	31.04'	N15°46'32"E
E8	572.41'	N15°46'32"E
E9	435.24'	N42°35'02"E
E10	138.84'	S51°57'09"E
E11	710.72'	S51°57'09"E
E12	164.62'	S59°19'17"E
E13	146.39'	N59°19'17"W
E14	176.60'	S46°42'56"W
E15	183.57'	N53°57'21"W
E16	777.06'	S49°32'34"W
E17	31.70'	S49°32'34"W
E18	499.74'	S10°42'01"E
E19	444.70'	S25°39'36"W
E20	46.08'	S28°00'51"W
E21	296.70'	S02°09'02"E
E22	747.64'	S55°01'49"E
E23	653.45'	S22°25'42"W
E24	267.12'	N81°19'14"E
E25	315.25'	S10°04'21"W
E26	619.04'	S82°50'31"E
E27	404.35'	N26°46'48"E
E28	433.49'	S44°55'54"E
E29	633.02'	S00°55'13"W
E30	717.98'	N89°58'34"W
E31	153.71'	S03°05'07"E
E32	342.98'	S47°59'24"W
E33	987.91'	N88°23'13"W
E34	413.65'	N68°38'09"E
E35	378.24'	S68°38'09"W
E37	41.97'	N02°49'51"W
E38	354.78'	N00°19'31"E
E39	119.53'	S89°59'54"E
E40	652.31'	N00°51'36"E
E41	182.38'	N43°12'28"W
E42	186.60'	N00°19'31"E
E43	427.57'	N86°05'03"W
E45	359.16'	N57°44'38"W
E46	387.17'	N62°08'53"E
E47	281.16'	S23°45'56"E
E48	444.82'	S86°15'53"E
E49	574.61'	N40°22'13"W
E50	186.73'	N19°08'46"E
E51	378.92'	N09°09'28"E
E52	30.00'	N22°12'04"W
E53	237.41'	S64°52'59"W
E54	230.19'	S74°40'44"W
E55	381.08'	N81°16'42"W
E56	683.47'	N64°46'06"W
E57	390.76'	N16°47'02"E
E58	12.50'	S87°05'23"E
E59	91.86'	N88°34'51"E
E60	553.27'	S02°50'22"W
E61	111.32'	S42°04'30"W
T1	30.90'	S87°05'23"E

LEGEND

- EXISTING PK NAIL
- EXISTING IRON PIPE
- IRON PIPE SET
- CALCULATED POINT
- EXISTING CONCRETE MONUMENT
- NEW CONSERVATION EASEMENT FOR "THE STATE OF NC, ECOSYSTEM ENHANCEMENT PROGRAM."
- P.O.B. POINT OF BEGINNING

STATE OF NORTH CAROLINA
COUNTY OF HARNETT

I, _____, REVIEW OFFICER OF HARNETT COUNTY, CERTIFY THAT THE MAP OR PLAT WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

REVIEW OFFICER DATE

I, ROBERT C. BAUMGARTNER, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED, AS DRAWN FROM INFORMATION AS SHOWN HEREON; THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS BEEN PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY OWNER SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 16TH DAY OF FEBRUARY, 2007

NORTH CAROLINA REGISTRATION NUMBER L-4531
ROBERT C. BAUMGARTNER

NORTH CAROLINA, COUNTY

I, _____ A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT

_____ PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS

DAY OF _____, 2007.

NOTARY PUBLIC

MY COMMISION EXPIRES

FINAL PLAT
CONSERVATION EASEMENT
FOR
JAMES FARRAR
FARRAR DAIRY FARM STREAM RESTORATION
ANDERSON CREEK TOWNSHIP
HARNETT COUNTY, NORTH CAROLINA

DATE:	SCALE:	SHEET:
FEB. 16, 2007	1" = 300'	1 OF 1

KCI ASSOCIATES OF NORTH CAROLINA

KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS

4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

12065438

NOTES:

THIS PLAN HAS BEEN PREPARED WITHOUT THE BENEFIT OF A REPORT OF TITLE.

AREA COMPUTED BY COORDINATE METHOD.

THE BASIS OF THE MERIDIANS AND COORDIANTES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (N.C.S.P.C.S. NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED IN JUNE 2006 ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.

DEED REFERENCE: DEED BOOK 794, PAGE 970.

SUBJECT PROPERTIES KNOWN AS PARCEL IDENTIFICATION NUMBER: 0516-86-5081.

SUBJECT PROPERTY PARTIALLY LIES WITHIN A SPECIAL FLOOD HAZARD ZONE. SUBJECT PROPERTY PARTIALLY LIES WITHIN THE AREA DESIGNATED AS ZONE "AE", BASED ON FEDERAL FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NUMBER 370328 0506 J; MAP NUMBER 3720050600J; EFFECTIVE DATE: OCTOBER 3, 2006.

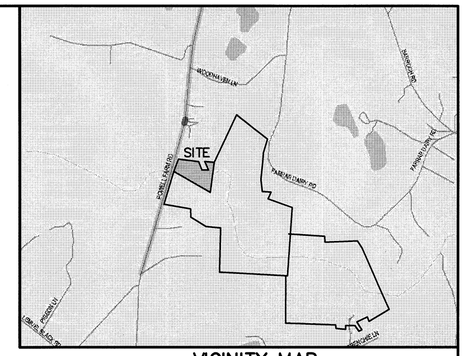
STATE OF NORTH CAROLINA
COUNTY OF HARNETT

I, _____, REVIEW OFFICER OF HARNETT COUNTY, CERTIFY THAT THE MAP OR PLAT WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

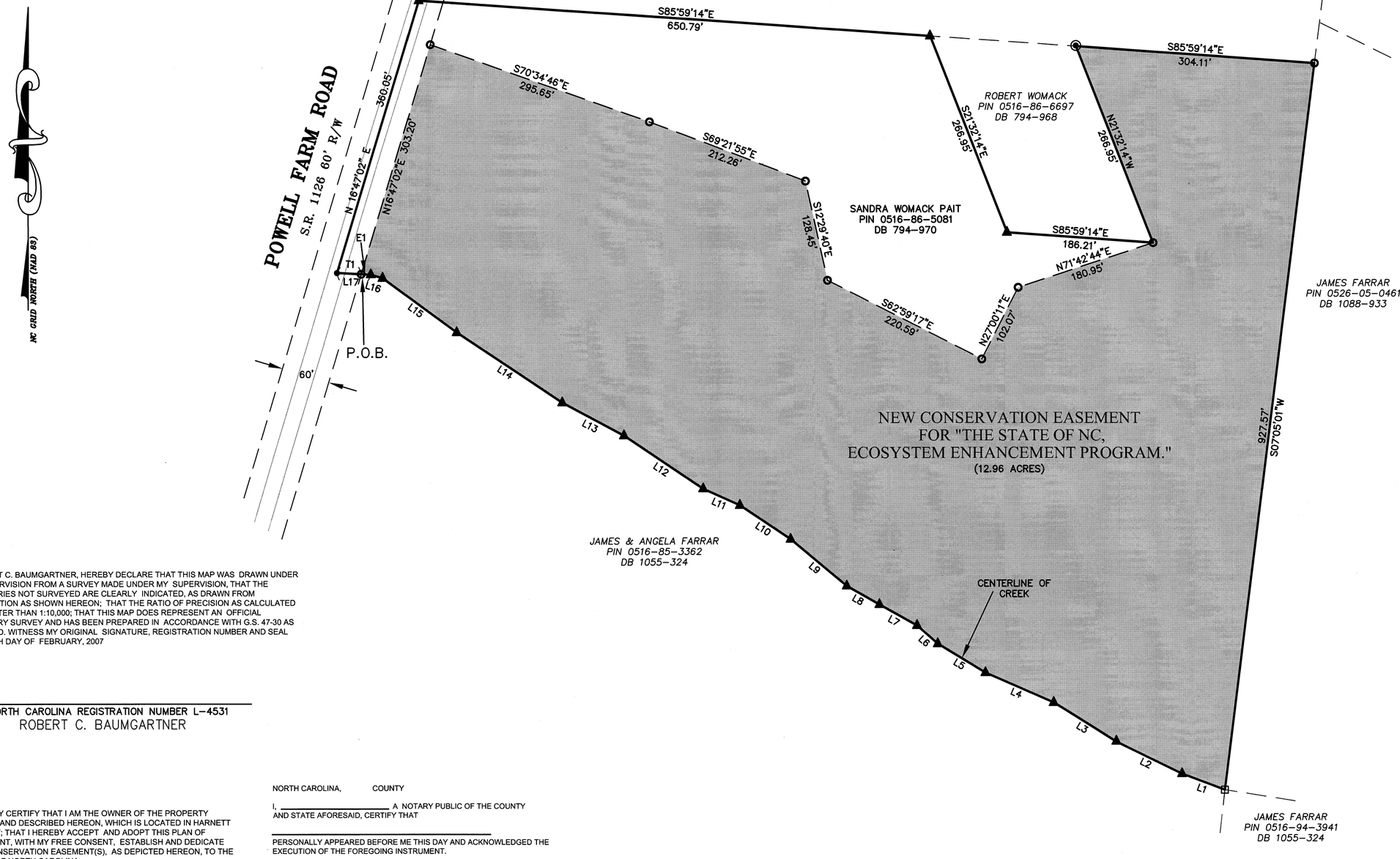
_____
REVIEW OFFICER DATE

LEGEND

- EXISTING PK NAIL
- EXISTING IRON PIPE
- IRON PIPE SET
- CALCULATED POINT
- EXISTING CONCRETE MONUMENT
- NEW CONSERVATION EASEMENT FOR "THE STATE OF NC, ECOSYSTEM ENHANCEMENT PROGRAM."
- P.O.B. POINT OF BEGINNING



VICINITY MAP
(NOT TO SCALE)



LINE TABLE		
LINE	LENGTH	BEARING
L1	57.87'	N69°31'11"W
L2	93.23'	N64°07'56"W
L3	93.52'	N58°14'33"W
L4	94.75'	N66°30'13"W
L5	70.82'	N58°54'31"W
L6	35.15'	N48°41'16"W
L7	54.78'	N61°00'02"W
L8	47.80'	N60°22'34"W
L9	92.91'	N50°09'18"W
L10	77.51'	N56°23'03"W
L11	51.27'	N65°46'42"W
L12	121.17'	N56°11'47"W
L13	89.01'	N61°52'10"W
L14	160.88'	N56°27'34"W
L15	116.84'	N53°38'07"W
L16	15.65'	N72°50'25"W
L17	43.40'	N87°05'23"W
T1	30.90'	S87°05'23"E

EASEMENT LINE TABLE		
LINE	LENGTH	BEARING
E1	12.50'	N87°05'23"W

PAIT TRACT
CONSERVATION EASEMENT

A parcel of land to be used for Conservation Easement purposes located on lands now or formerly owned by Sandra Womack Pait (Deed Book 794 Page 970) in Anderson Creek Township, Harnett County, North Carolina and being more particularly described as follows:

Commencing at a found pk nail in the centerline of Powell Farm Road (60 foot public right of way), said point being the Southwest corner of said lands owned by Sandra Womack Pait;

Thence South 87° 05' 23" East a distance of 30.90 feet to the intersection with the Easterly line of Powell Farm Road;

Thence North 16°47'02" East, on the Easterly line of Powell Farm Road, a distance of 303.20 feet to an iron pin set;
Thence South 70°34'46" East, a distance of 295.65 feet to an iron pin set;
Thence South 69°21'55" East, a distance of 212.26 feet to an iron pin set;
Thence South 12°29'40" East, a distance of 128.45 feet to an iron pin set;
Thence South 62°59'17" East, a distance of 220.59 feet to an iron pin set;
Thence North 27°00'11" East, a distance of 102.07 feet to an iron pin set;
Thence North 71°42'44" East, a distance of 180.95 feet to the Southeast corner of lands now or formerly owned by Robert Womack (Deed Book 764 Page 968);
Thence North 21°32'14" West, on the Easterly line of said lands owned by Robert Womack, a distance of 266.95 feet to an iron pin set on the South line of lands now or formerly owned by John Stephenson (Deed Book 1360 Page 560);
Thence South 85°59'14" East, on the South line of said lands owned by John Stephenson, a distance of 304.11 feet to an iron pin set;
Thence South 07°05'01" West, on the East line of said lands owned by Sandra Womack Pait, a distance of 927.57 feet to a found concrete monument in the centerline of a creek;
Thence along the centerline of a creek the following 17 calls:

1. North 69°31'11" West, a distance of 57.87 feet to a point;
2. North 64°07'56" West, a distance of 93.23 feet to a point;
3. North 58°14'33" West, a distance of 93.52 feet to a point;
4. North 66°30'13" West, a distance of 94.75 feet to a point;
5. North 58°54'31" West, a distance of 70.82 feet to a point;
6. North 48°41'16" West, a distance of 35.15 feet to a point;
7. North 61°00'02" West, a distance of 54.78 feet to a point;
8. North 60°22'34" West, a distance of 47.80 feet to a point;
9. North 50°09'18" West, a distance of 92.91 feet to a point;
10. North 56°23'03" West, a distance of 77.51 feet to a point;
11. North 65°46'42" West, a distance of 51.27 feet to a point;
12. North 56°11'47" West, a distance of 121.17 feet to a point;
13. North 61°52'10" West, a distance of 89.01 feet to a point;
14. North 56°27'34" West, a distance of 160.88 feet to a point;
15. North 53°38'07" West, a distance of 116.84 feet to a point;
16. North 72°50'24" West, a distance of 15.65 feet to a point;
17. North 87°05'23" West, a distance of 12.50 feet to the POINT OF BEGINNING, containing 12.96 acres, more or less.

I, ROBERT C. BAUMGARTNER, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED, AS DRAWN FROM INFORMATION AS SHOWN HEREON; THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS BEEN PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 16TH DAY OF FEBRUARY, 2007

_____
NORTH CAROLINA REGISTRATION NUMBER L-4531
ROBERT C. BAUMGARTNER

I HEREBY CERTIFY THAT I AM THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED HEREON, WHICH IS LOCATED IN HARNETT COUNTY; THAT I HEREBY ACCEPT AND ADOPT THIS PLAN OF EASEMENT, WITH MY FREE CONSENT, ESTABLISH AND DEDICATE THE CONSERVATION EASEMENT(S), AS DEPICTED HEREON, TO THE STATE OF NORTH CAROLINA.

_____
SIGNATURE

_____
PRINTED NAME DATE

NORTH CAROLINA, COUNTY

I, _____ A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT

_____
PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS

DAY OF _____, 2007.

_____
NOTARY PUBLIC

_____
MY COMMISION EXPIRES

GRAPHIC SCALE
100' 0 50' 100 200'
1 INCH = 100 FEET

12065438

KCI ASSOCIATES OF NORTH CAROLINA

KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS

4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

FINAL PLAT
CONSERVATION EASEMENT
FOR
SANDRA WOMACK PAIT
FARRAR DAIRY FARM STREAM RESTORATION
ANDERSON CREEK TOWNSHIP
HARNETT COUNTY, NORTH CAROLINA

DATE:	SCALE:	SHEET:
FEB. 16, 2007	1" = 100'	1 OF 1

WILSON TRACT
CONSERVATION EASEMENT

A parcel of land to be used for Conservation Easement purposed located on lands now or formerly owned by Brigham and Kathleen Wilson (Deed Book 903 Page 983) in Anderson Creek Township, Harnett County, North Carolina and being more particularly described as follows:

Commencing at a found concrete monument at the Northwest corner of said lands owned by Brigham and Kathleen Wilson, said point having North Carolina Grid Coordinates of N:564203.74 and E:2021331.52;
Thence South 14° 03' 34" East a distance of 172.01 feet to the a set iron pin being the **Point of Beginning**;
Thence North 87°35'34" East, a distance of 335.85 feet to an iron pin set;
Thence South 31°19'18" East, a distance of 388.75 feet to an iron pin set;
Thence North 69°41'01" East, a distance of 309.52 feet to an iron pin set;
Thence South 73°05'37" East, a distance of 1,065.36 feet to an iron pin set;
Thence South 13°58'44" East, a distance of 569.23 feet to an iron pin set;
Thence South 61°18'35" East, a distance of 100.55 feet to an iron pin set, being also known as Point "S";
Thence North 81°09'20" East, a distance of 15.00 feet to an iron pin set;
Thence North 88°08'47" East, a distance of 421.09 feet to an iron pin set;
Thence South 23°35'44" East, a distance of 904.86 feet to an iron pin set;
Thence South 59°41'51" West, a distance of 294.08 feet to an iron pin set;
Thence North 42°00'34" West, a distance of 693.73 feet to an iron pin set;
Thence South 78°55'43" West, a distance of 15.02 feet to an iron pin set;
Thence South 52°44'18" West, a distance of 256.11 feet to an iron pin set;
Thence South 81°33'40" West, a distance of 582.37 feet to an iron pin set;
Thence North 52°48'44" West, a distance of 174.49 feet to an iron pin set;
Thence South 68°37'37" West, a distance of 115.67 feet to an iron pin set, being also known as Point "T";
Thence South 64°37'55" West, a distance of 15.00 feet to an iron pin set
Thence South 64°37'55" West, a distance of 317.52 feet to an iron pin set;
Thence South 26°33'54" West, a distance of 512.43 feet to an iron pin set;
Thence South 90°00'00" West, a distance of 179.69 feet to an iron pin set;
Thence South 33°50'15" West, a distance of 161.12 feet to an iron pin set;
Thence North 88°06'57" West, a distance of 159.97 feet to an iron pin set;
Thence North 33°58'09" East, a distance of 317.81 feet to an iron pin set;
Thence North 90°00'00" East, a distance of 168.28 feet to an iron pin set;
Thence North 26°33'54" East, a distance of 475.57 feet to an iron pin set;
Thence North 64°37'55" East, a distance of 379.09 feet to an iron pin set;
Thence North 68°28'36" East, a distance of 125.17 feet to an iron pin set;
Thence North 85°09'44" East, a distance of 377.44 feet to an iron pin set;
Thence North 11°55'03" West, a distance of 670.99 feet to an iron pin set;
Thence North 86°06'58" West, a distance of 671.89 feet to an iron pin set;
Thence South 55°23'40" West, a distance of 351.52 feet to an iron pin set;
Thence North 31°47'19" West, a distance of 690.05 feet to an iron pin set;
Thence North 50°43'27" West, a distance of 97.62 feet to an iron pin set;
Thence South 43°45'49" West, a distance of 48.03 feet to an iron pin set, also known as Point "U";
Thence South 42°04'30" West a distance of 79.05 feet to a point on the West line of said lands owned by Brigham and Kathleen Wilson;
Thence North 02°50'22" East, on the West line of said lands owned by Brigham and Kathleen Wilson, a distance of 553.27 feet to a point;
Thence North 88°34'51" East, a distance of 50.14 feet to the **Point of Beginning**.

LESS AND EXCEPT THE FOLLOWING 3 PARCELS;

DESCRIPTION OF EXCEPTION 1
Beginning at said Point "S";
Thence North 81°09'20" East a distance of 15.00 feet to a point;
Thence South 08°13'55" East a distance of 453.18 feet to a point;
Thence South 78°55'43" West a distance of 15.02 feet to a point;
Thence North 08°13'55" West a distance of 453.76 feet to the Point of Beginning, containing 0.16 acres, more or less.

DESCRIPTION OF EXCEPTION 2
Beginning at said Point "T";
Thence South 64°37'55" West a distance of 15.00 feet to a point;
Thence North 25°22'08" West a distance of 135.00 feet to a point;
Thence North 64°37'55" East a distance of 15.00 feet to a point;
Thence South 25°22'08" East a distance of 135.00 feet to the Point of Beginning, containing 0.05 acres, more or less.

DESCRIPTION OF EXCEPTION 3
Beginning at said Point "U";
Thence South 42°04'30" West a distance of 79.05 feet to a point;
Thence North 02°50'22" East a distance of 553.27 feet to a point;
Thence North 88°34'51" East a distance of 91.86 feet to a point;
Thence South 02°50'22" West a distance of 633.02 feet to the Point of Beginning, containing 0.60 acres, more or less.

Residual Acreage of easement is 54.10 acres, more or less.

I HEREBY CERTIFY THAT I AM THE OWNER OF THE PROPERTY SHOWN AND DESCRIBED HEREON, WHICH IS LOCATED IN HARNETT COUNTY; THAT I HEREBY ACCEPT AND ADOPT THIS PLAN OF EASEMENT, WITH MY FREE CONSENT, ESTABLISH AND DEDICATE THE CONSERVATION EASEMENT(S), AS DEPICTED HEREON, TO THE STATE OF NORTH CAROLINA.

_____
SIGNATURE

_____
PRINTED NAME **DATE**

NORTH CAROLINA,_____COUNTY

I, _____ A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT

_____
PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS

DAY OF_____, 2007.

_____
NOTARY PUBLIC

_____
MY COMMISION EXPIRES

_____
SIGNATURE

_____
PRINTED NAME **DATE**

NORTH CAROLINA,_____COUNTY

I,_____ A NOTARY PUBLIC OF THE COUNTY AND STATE AFORESAID, CERTIFY THAT

_____
PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS

DAY OF_____, 2007.

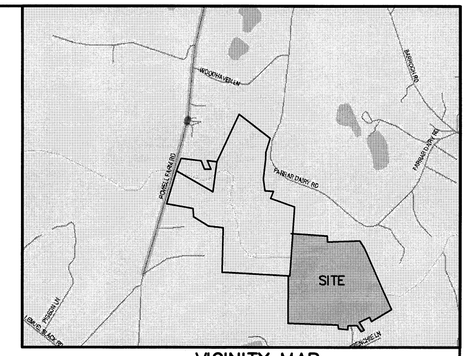
_____
NOTARY PUBLIC

_____
MY COMMISION EXPIRES

STATE OF NORTH CAROLINA
COUNTY OF HARNETT

I, _____, REVIEW OFFICER OF HARNETT COUNTY, CERTIFY THAT THE MAP OR PLAT WHICH THIS CERTIFICATION IS AFFIXED MEETS ALL STATUTORY REQUIREMENTS FOR RECORDING.

_____
REVIEW OFFICER DATE



VICINITY MAP
(NOT TO SCALE)

NOTES:

THIS PLAN HAS BEEN PREPARED WITHOUT THE BENEFIT OF A REPORT OF TITLE.

AREA COMPUTED BY COORDINATE METHOD.

THE BASIS OF THE MERIDIANS AND COORDIANTES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (N.C.S.P.C.S. NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED IN JUNE 2006 ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.

DEED REFERENCE: DEED BOOK 903, PAGE 983.

SUBJECT PROPERTIES KNOWN AS PARCEL IDENTIFICATION NUMBER 0526-22-5697.

SUBJECT PROPERTY PARTIALLY LIES WITHIN A SPECIAL FLOOD HAZARD ZONE. SUBJECT PROPERTY PARTIALLY LIES WITHIN THE AREA DESIGNATED AS ZONE "AE", BASED ON FEDERAL FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NUMBER 370328 0526 J; MAP NUMBER 3720052600J; EFFECTIVE DATE: OCTOBER 3, 2006.

LINE TABLE		
LINE	LENGTH	BEARING
L1	137.14'	N30°10'55"W
L2	309.15'	S60°59'54"W
L3	130.00'	S24°06'36"E
L4	130.00'	S24°07'03"E
L5	50.00'	S65°52'44"W
L6	138.55'	N24°05'13"W
L7	335.76'	N88°01'48"W
L8	123.03'	S03°53'12"W
L9	206.57'	N87°13'57"W
L10	65.30'	S70°42'41"W
L11	143.62'	N03°56'38"E
L12	202.18'	N88°00'37"W

EASEMENT LINE TABLE								
LINE	LENGTH	BEARING	LINE	LENGTH	BEARING	LINE	LENGTH	BEARING
E1	335.85'	N87°35'34"E	E18	317.52'	S64°37'55"W	E35	48.03'	S43°45'49"W
E2	388.75'	S31°19'18"E	E19	512.43'	S26°33'54"W	E36	495.76'	N02°50'22"E
E3	309.52'	N69°41'01"E	E20	179.69'	N90°00'00"W	E37	453.18'	S08°13'55"E
E4	1065.36'	S73°05'37"E	E21	161.12'	S33°50'15"W	E38	453.76'	N08°13'55"W
E5	569.23'	S13°58'44"E	E22	159.97'	N88°06'57"W	E39	135.00'	N25°22'08"E
E6	100.55'	S61°18'35"E	E23	317.81'	N33°58'09"E	E40	135.00'	S25°22'08"E
E7	15.00'	N81°09'20"E	E24	168.28'	N90°00'00"E	E41	79.05'	S42°04'30"W
E8	421.09'	N88°08'47"E	E25	475.57'	N26°33'54"E	E42	553.27'	N02°50'22"E
E9	904.86'	S23°35'44"E	E26	364.09'	N64°37'55"E	E43	50.14'	N88°34'51"E
E10	294.08'	S59°41'51"W	E27	15.00'	N64°37'55"E			
E11	693.73'	N42°00'34"W	E28	125.17'	N68°28'36"E			
E12	15.02'	S78°55'43"W	E29	377.44'	S85°09'44"E			
E13	256.11'	S52°44'18"W	E30	670.99'	N11°55'03"W			
E14	582.37'	S81°33'40"W	E31	671.89'	N86°06'58"W			
E15	174.49'	N52°48'44"W	E32	351.52'	S55°23'40"W			
E16	115.67'	S68°37'37"W	E33	690.05'	N31°47'19"W			
E17	15.00'	S64°37'55"W	E34	97.62'	N50°43'27"W			

LEGEND

- EXISTING IRON PIPE
- IRON PIPE SET
- CALCULATED POINT
- EXISTING CONCRETE MONUMENT
- NEW CONSERVATION EASEMENT FOR "THE STATE OF NC, ECOSYSTEM ENHANCEMENT PROGRAM."
- P.O.B. POINT OF BEGINNING

I, ROBERT C. BAUMGARTNER, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED, AS DRAWN FROM INFORMATION AS SHOWN HEREON; THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS BEEN PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 16TH DAY OF FEBRUARY, 2007

NORTH CAROLINA REGISTRATION NUMBER L-4531
ROBERT C. BAUMGARTNER

revised on 02/27/2007 12065438

KCI ASSOCIATES OF NORTH CAROLINA

KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS
4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

FINAL PLAT
CONSERVATION EASEMENT
FOR
BRIGHAM & KATHLEEN WILSON
FARRAR DAIRY FARM STREAM RESTORATION
ANDERSON CREEK TOWNSHIP
HARNETT COUNTY, NORTH CAROLINA

DATE:	SCALE:	SHEET:
FEB. 16, 2007	1" = 200'	1 OF 1

Appendix D
Project Site Photographs

PROJECT SITE PHOTOGRAPHS
NPAC

NPAC- Start of project looking upstream at Powell Farm Road

NPAC

NPAC

NPAC

NPAC

NPAC

PROJECT SITE PHOTOGRAPHS
NPAC

NPAC- Bedrock

NPAC

NPAC

NPAC

NPAC- Cattle have access to stream to the left

NPAC- Stream banks eroding downstream from culvert crossing

PROJECT SITE PHOTOGRAPHS
NPAC

NPAC

NPAC- T2B entering NPAC

NPAC

NPAC

NPAC

NPAC

PROJECT SITE PHOTOGRAPHS
NPAC

NPAC- View of T3 joining NPAC

NPAC

NPAC- View of stream at culvert crossing

NPAC- View of culvert crossing

NPAC

NPAC- End of NPAC restoration reach

PROJECT SITE PHOTOGRAPHS
Tributary 1.1

Tributary 1.1– Start of stream looking downstream

Tributary 1.1– Large seep (existing Wetland 1) that feeds the tributary

Tributary 1.1

Tributary 1.1

Tributary 1.1

Tributary 1.1– Headcut 1 approximately 6-7 feet in depth

PROJECT SITE PHOTOGRAPHS
Tributary 1.1 and 1.2

Tributary 1.1– Headcut 2 further downstream

Tributary 1.1

Tributary 1.1

Confluence of T1.1 and T1.2

Tributary 1.2– Start of Tributary 1.2. Channel depth is approximately 5 feet.

Tributary 1.2

PROJECT SITE PHOTOGRAPHS
Tributary 1.2

Tributary 1.2

Tributary 1.2

Tributary 1.2– Headcut 1

Tributary 1.2– Cattle crossing

Tributary 1.2– Headcut 2

Tributary 1.2

PROJECT SITE PHOTOGRAPHS
Tributary 1

Tributary 1– Start of T1

Tributary 1– Stream flowing in existing Wetland 2

Tributary 1– Braided stream channel

Tributary 1– NPAC is located beyond the far left tree line

PROJECT SITE PHOTOGRAPHS
Tributary 2A and 2B

Tributary 2A– Large seep providing groundwater to the tributary

Tributary 2A

Tributary 2A

Tributary 2A– Culvert

Tributary 2B– Cattle pasture to the left

Tributary 2B

PROJECT SITE PHOTOGRAPHS
Tributary 3

Tributary 3– Beginning of T3

Tributary 3- Tributary at culvert

Tributary 3– Channel is narrow

Tributary 3– A drainage feature entering T3 to the left

Tributary 3

Tributary 3– End of Tributary

PROJECT SITE PHOTOGRAPHS
Tributary 4

Tributary 4– Start of Tributary 4

Tributary 4

Tributary 4

Tributary 4

Tributary 4– Tributary flows through culvert under road crossing

Tributary 4– T4 downstream of road crossing, where it flows into existing Wetland 2

PROJECT SITE PHOTOGRAPHS
Tributary 4

Tributary 4– End of Tributary 4, where it flows into the NPAC braided wetland area

PROJECT SITE PHOTOGRAPHS
Existing Jurisdictional Wetlands

View of Wetland 7, which is a seep that provides hydrology to T1.1

Beginning of Wetlands 3 and 4

Wetlands 3 and 4

Wetlands 3 and 4

Wetlands 3 and 4 with a view of T1 in the background

Wetlands 3 and 4

PROJECT SITE PHOTOGRAPHS
Existing Jurisdictional Wetlands

View of Wetland 8 to the far left

Wetland 9

Wetland 9

Wetland 9

Wetland 11

Wetland P1

PROJECT SITE PHOTOGRAPHS
Existing Jurisdictional Wetlands

Wetlands P1 and P2

Wetland 1

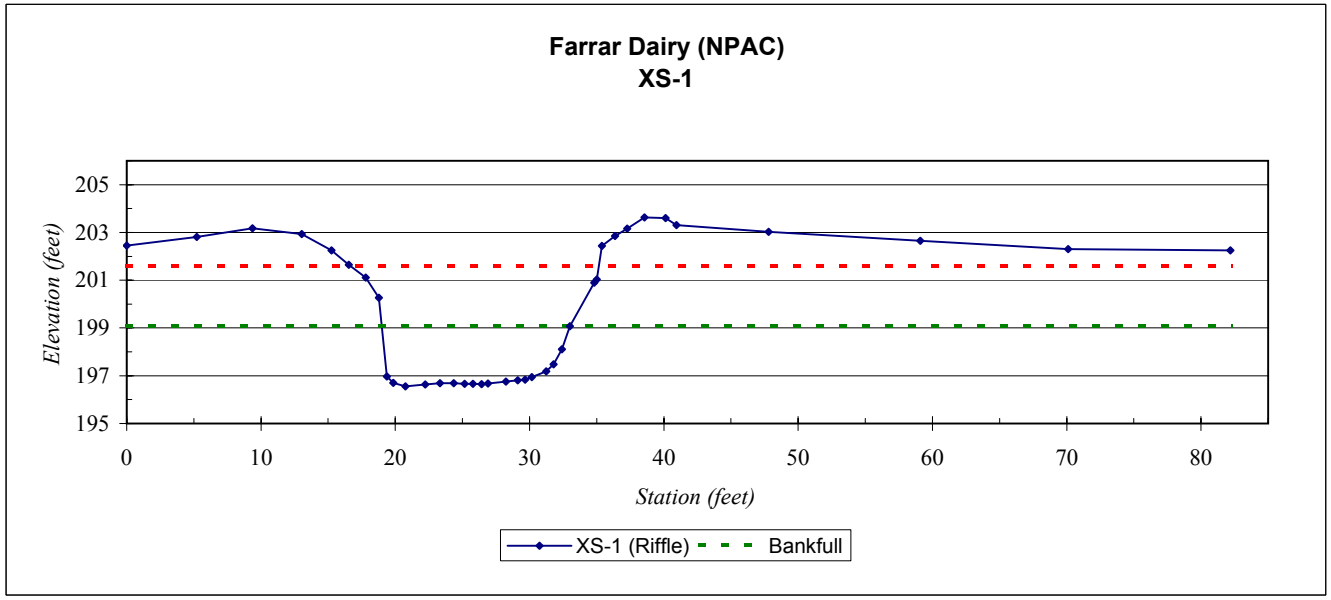
Appendix E
Existing Conditions Data

NPAC

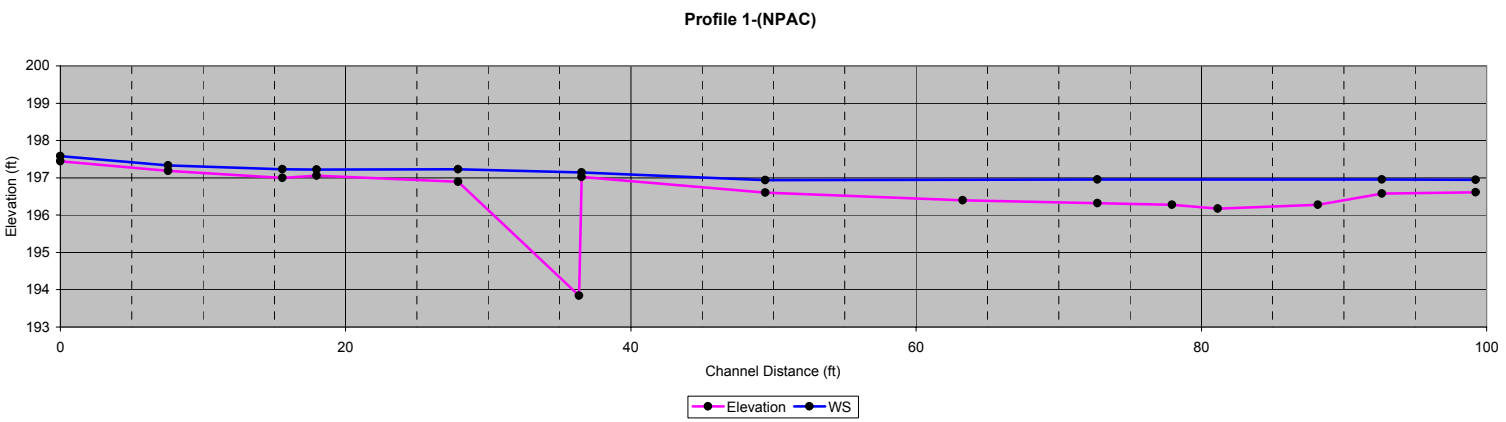
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-1 (Riffle)
Drainage Area (sq mi):	3.92
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	202.45
5.2	202.82
9.4	203.17
13.0	202.93
15.3	202.25
16.5	201.64
17.8	201.11
18.8	200.26
19.4	196.97
19.8	196.70
20.8	196.55
22.2	196.64
23.3	196.68
24.3	196.69
25.2	196.66
25.8	196.67
26.4	196.65
26.9	196.67
28.2	196.75
29.1	196.81
29.7	196.83
30.2	196.94
31.2	197.19
31.8	197.48
32.4	198.10
33.0	199.07
34.8	200.89
35.0	201.03
35.4	202.44
36.4	202.85
37.3	203.15
38.6	203.62
40.1	203.61
40.9	203.31
47.8	203.03
59.1	202.65
70.1	202.30
82.2	202.24

SUMMARY DATA	
Bankfull Elevation:	199.1
Bankfull Cross-Sectional Area:	30.2
Bankfull Width:	14.0
Flood Prone Area Elevation:	201.6
Flood Prone Width:	20.0
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	2.2
W / D Ratio:	6.5
Entrenchment Ratio:	1.4
Bank Height Ratio:	2.5
Water Surface Slope (ft/ft):	0.006



Slope Profile

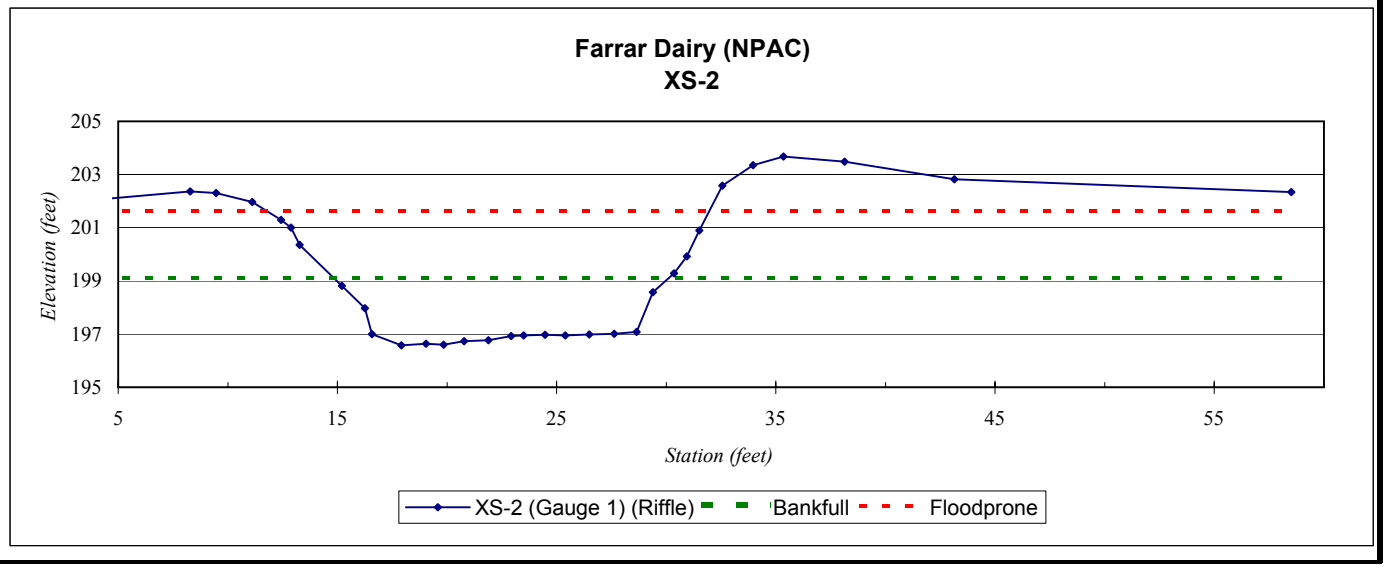


		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
pro1_bri		0.0		100									197.44					197.58
pro1_ri	7.6	7.6		100									197.18					197.33
pro1_ri	8.0	15.6		100									197.00					197.23
pro1_ri	2.4	18.0		100									197.06					197.22
pro1_ri	9.9	27.9		100									196.90					197.23
pro1_ri	8.5	36.4		100									193.84					
pro1_ri	0.2	36.5		100									197.03					197.14
pro1_eri	12.9	49.4		100									196.60					196.94
pro1_tw	13.8	63.3		100									196.40					
pro1_tw	9.5	72.7		100									196.32					196.96
pro1_tw	5.2	78.0		100									196.27					
pro1_tw	3.2	81.1		100									196.18					
pro1_tw	7.0	88.2		100									196.28					
pro1_tw	4.5	92.7		100									196.58					196.95
pro1_tw	6.6	99.2		100									196.61					196.95

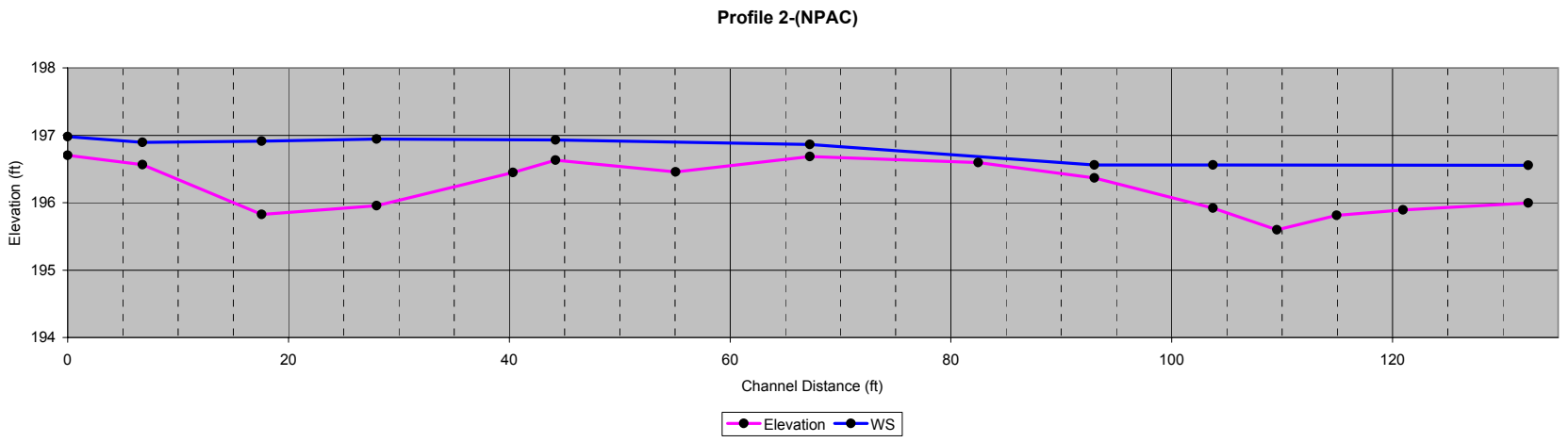
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-2 (Gauge 1) (Riffle)
Drainage Area (sq mi):	3.92
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	201.86
3.0	201.98
8.3	202.36
9.5	202.31
11.1	201.96
12.4	201.29
12.9	201.01
13.3	200.36
15.2	198.81
16.2	197.97
16.6	197.00
17.9	196.57
19.0	196.64
19.8	196.60
20.8	196.73
21.9	196.76
22.9	196.92
23.5	196.95
24.5	196.97
25.4	196.95
26.5	196.99
27.6	197.01
28.6	197.08
29.4	198.57
30.4	199.28
30.9	199.93
31.5	200.89
32.6	202.58
34.0	203.35
35.4	203.67
38.1	203.48
43.1	202.82
58.5	202.34

SUMMARY DATA	
Bankfull Elevation:	199.1
Bankfull Cross-Sectional Area:	30.0
Bankfull Width:	15.5
Flood Prone Area Elevation:	201.6
Flood Prone Width:	20.0
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.9
W / D Ratio:	8.0
Entrenchment Ratio:	1.3
Bank Height Ratio:	2.3
Water Surface Slope (ft/ft):	0.003



Slope Profile

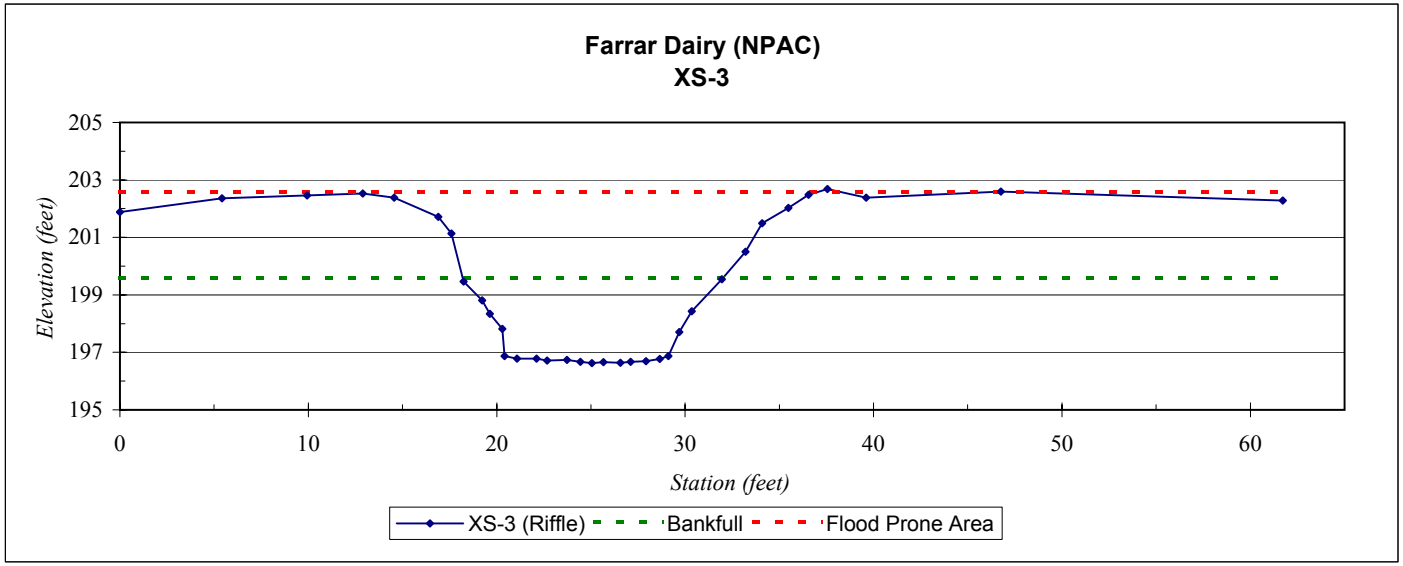


		Elevation BM:	100														
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO2&3_BRI		0		100									196.70					196.98
PRO2&3_ERI	6.8	6.8		100									196.56					196.90
PRO2&3_TW	10.8	17.6		100									195.82					196.91
PRO2+3_TW	10.4	28.0		100									195.96					196.95
PRO2+3_GLIDE	12.3	40.3		100									196.45					
PRO2+3_BRI	3.9	44.2		100									196.63					196.93
PRO2+3_RI	10.9	55.1		100									196.46					
PRO2+3_RI	12.2	67.2		100									196.68					196.86
PRO2+3_RI	15.3	82.5		100									196.60					
PRO2+3_ERI	10.5	93.0		100									196.37					196.56
PRO2+3_TW	10.8	103.7		100									195.92					196.56
PRO2+3_TW	5.8	109.5		100									195.60					
PRO2+3_TW	5.4	114.9		100									195.81					
PRO2+3_TW	6.0	120.9		100									195.89					
PRO2+3_TW	11.3	132.3		100									195.99					196.55

River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-3 (Riffle)
Drainage Area (sq mi):	3.92
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	201.88
5.4	202.36
9.9	202.47
12.9	202.53
14.6	202.38
16.9	201.72
17.6	201.13
18.2	199.46
19.2	198.81
19.6	198.34
20.3	197.82
20.4	196.88
21.1	196.79
22.1	196.79
22.7	196.71
23.7	196.74
24.4	196.67
25.0	196.62
25.7	196.66
26.6	196.64
27.1	196.67
27.9	196.70
28.6	196.77
29.1	196.88
29.7	197.71
30.4	198.43
31.9	199.54
33.2	200.50
34.1	201.50
35.5	202.03
36.5	202.49
37.5	202.68
39.6	202.39
46.8	202.59
61.7	202.29

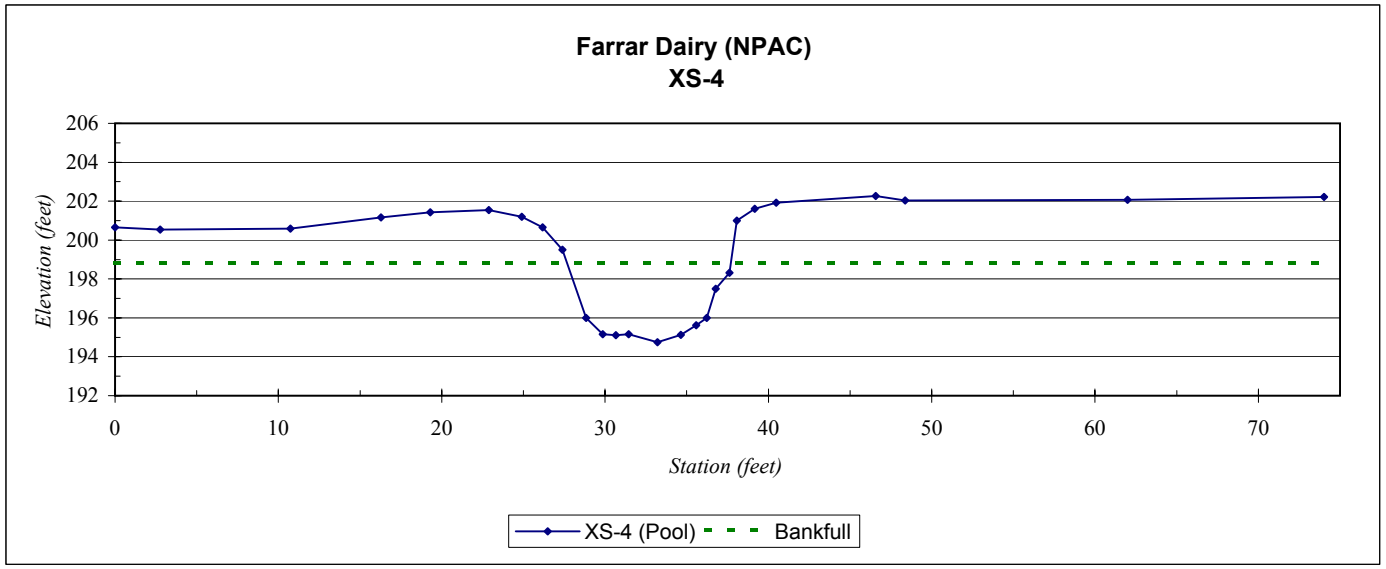
SUMMARY DATA	
Bankfull Elevation:	199.60
Bankfull Cross-Sectional Area:	30.2
Bankfull Width:	13.9
Flood Prone Area Elevation:	202.6
Flood Prone Width:	27.0
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	2.2
W / D Ratio:	6.4
Entrenchment Ratio:	4.3
Bank Height Ratio:	1.9
Water Surface Slope (ft/ft):	0.003



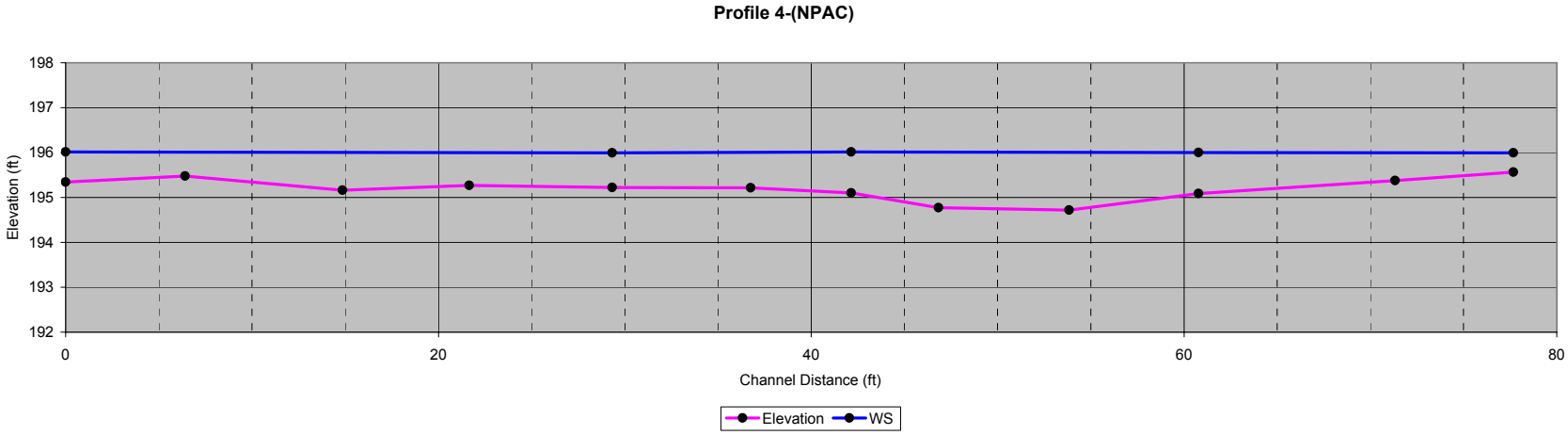
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-4 (Pool)
Drainage Area (sq mi):	3.92
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	200.65
2.8	200.54
10.7	200.59
16.3	201.17
19.3	201.42
22.9	201.55
24.9	201.20
26.2	200.65
27.4	199.51
28.8	196.00
29.8	195.16
30.7	195.12
31.5	195.15
33.2	194.75
34.6	195.13
35.6	195.62
36.2	196.00
36.8	197.50
37.6	198.32
38.1	201.00
39.2	201.61
40.5	201.91
46.6	202.26
48.4	202.03
62.0	202.06
74.0	202.21

SUMMARY DATA	
Bankfull Elevation:	198.8
Bankfull Cross-Sectional Area:	30.4
Bankfull Width:	10.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	4.1
Mean Depth at Bankfull:	3.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.003



Slope Profile

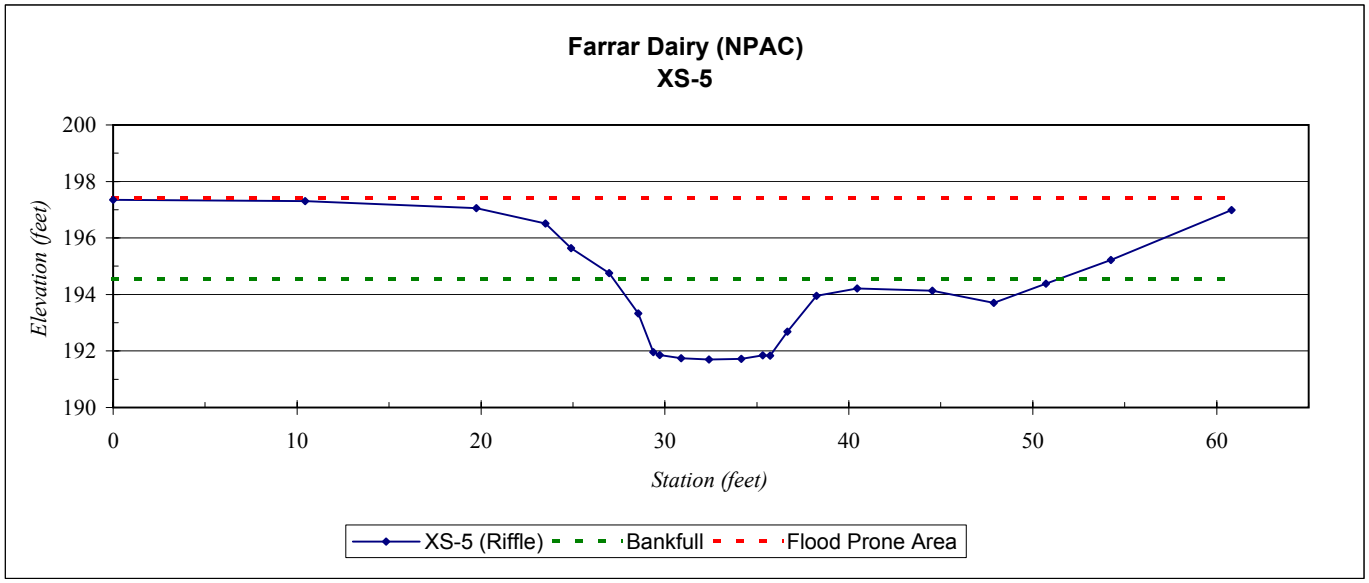


		Elevation BM:	100														
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
Pro4_tw		0		100									195.34					196.01
Pro4_tw	6.4	6.4		100									195.48					
Pro4_tw	8.4	14.8		100									195.16					
Pro4_tw	6.8	21.7		100									195.27					
Pro4_tw	7.7	29.3		100									195.22					195.99
Pro4_tw	7.4	36.8		100									195.22					
Pro4_tw	5.4	42.1		100									195.10					196.01
Pro4_tw	4.7	46.8		100									194.77					
Pro4_tw	7.0	53.8		100									194.72					
Pro4_tw	6.9	60.8		100									195.08					196.00
Pro4_tw	10.5	71.3		100									195.37					
Pro4_tw	6.4	77.7		100									195.57					195.99

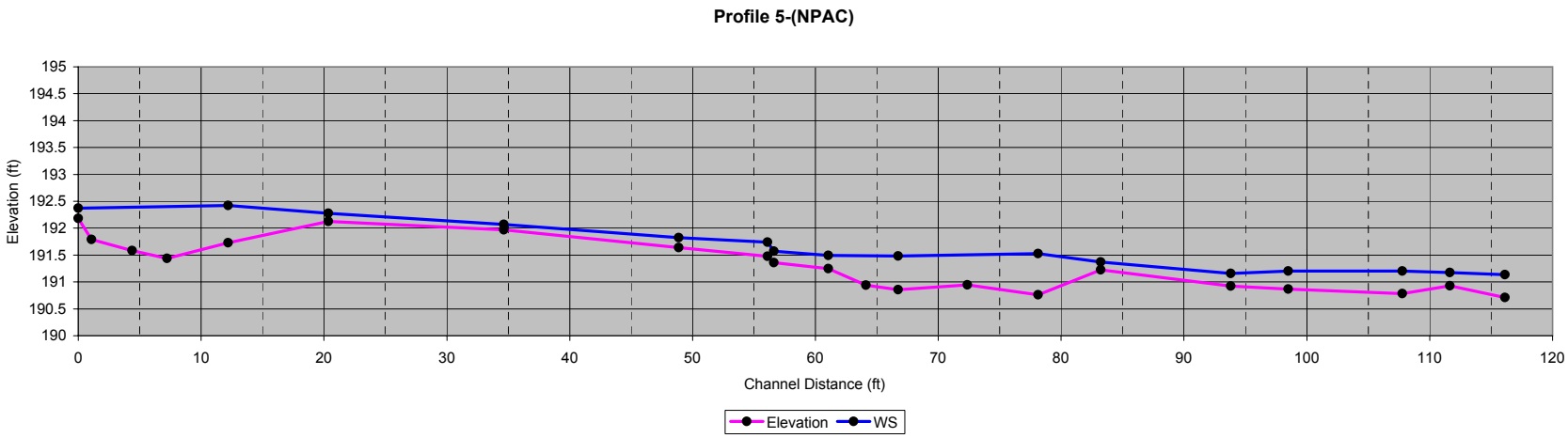
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-5 (Riffle)
Drainage Area (sq mi):	4.21
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	197.35
10.4	197.30
19.7	197.05
23.5	196.52
24.9	195.64
27.0	194.75
28.5	193.33
29.4	191.96
29.7	191.86
30.9	191.74
32.4	191.70
34.2	191.72
35.3	191.85
35.7	191.84
36.7	192.68
38.2	193.95
40.4	194.22
44.5	194.13
47.9	193.71
50.7	194.39
54.3	195.22
60.8	196.99

SUMMARY DATA	
Bankfull Elevation:	194.55
Bankfull Cross-Sectional Area:	30.2
Bankfull Width:	24.3
Flood Prone Area Elevation:	197.4
Flood Prone Width:	>50
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	19.6
Entrenchment Ratio:	2.1
Bank Height Ratio:	1.0
Water Surface Slope (ft/ft):	0.011



Slope Profile

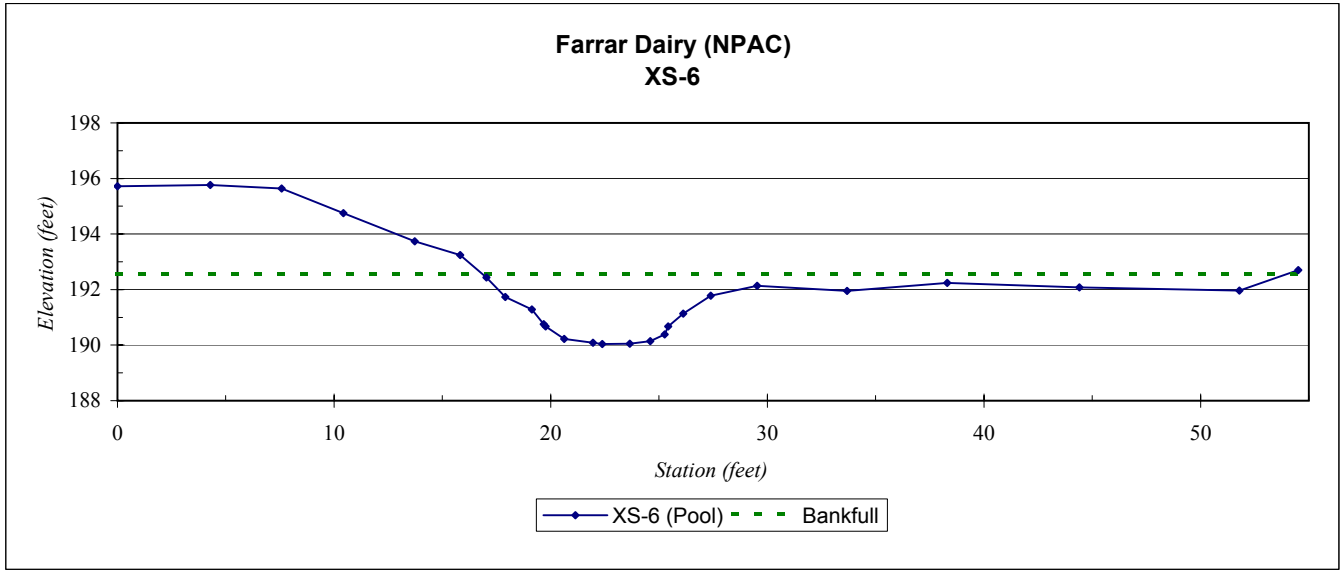


		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO5_GC		0		100									192.18					192.37
PRO5_tw	1.1	1.1		100									191.79					
PRO5_bpo	3.3	4.4		100									191.58					
PRO5_po	2.8	7.2		100									191.44					
PRO5_epo	5.0	12.2		100									191.73					192.42
PRO5_eri	8.2	20.4		100									192.13					192.28
PRO5_ri	14.3	34.6		100									191.97					192.07
PRO5_ri	14.2	48.9		100									191.64					191.82
PRO5_ri	7.2	56.1		100									191.48					191.74
PRO5_ri	0.5	56.6		100									191.36					191.57
PRO5_ri	4.4	61.1		100									191.25					191.49
PRO5_tw	3.0	64.1		100									190.94					
PRO5_bpo	2.6	66.7		100									190.86					191.48
PRO5_po	5.6	72.4		100									190.94					
PRO5_epo	5.8	78.1		100									190.76					191.53
PRO5_bri	5.1	83.2		100									191.23					191.37
PRO5_eri	10.6	93.8		100									190.92					191.16
PRO5_tw	4.7	98.5		100									190.87					191.20
PRO5_tw	9.3	107.8		100									190.78					191.20
PRO5_tw	3.9	111.7		100									190.93					191.17
PRO5_tw	4.5	116.1		100									190.71					191.14

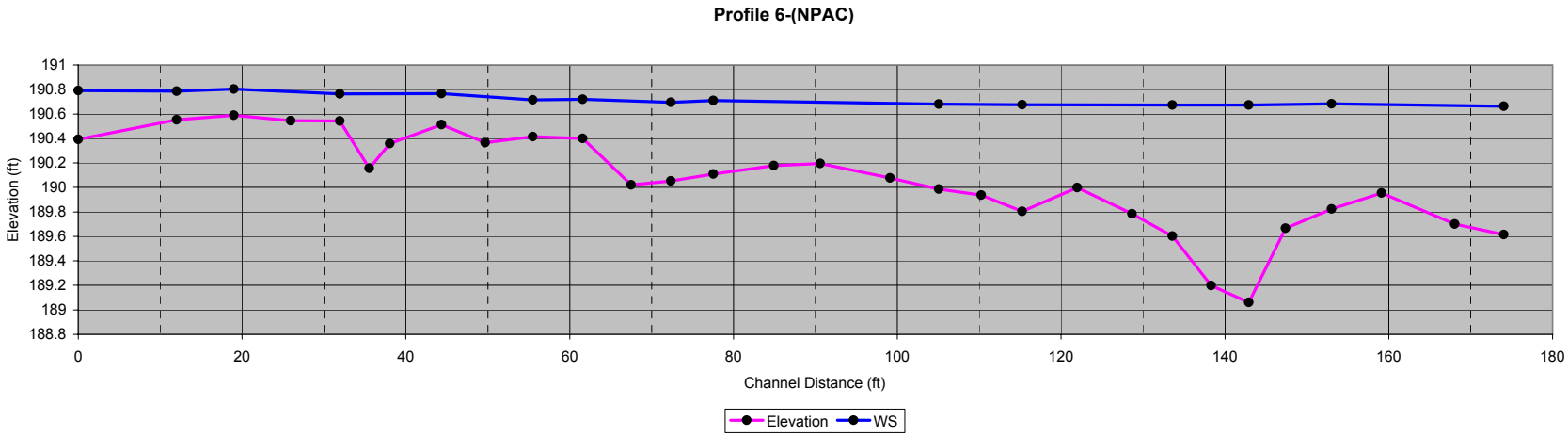
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-6 (Pool)
Drainage Area (sq mi):	4.21
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	195.72
4.3	195.77
7.6	195.63
10.4	194.76
13.7	193.74
15.8	193.24
17.0	192.43
17.9	191.74
19.1	191.29
19.7	190.75
19.8	190.67
20.6	190.23
21.9	190.09
22.4	190.03
23.6	190.05
24.6	190.15
25.3	190.38
25.4	190.67
26.1	191.14
27.4	191.77
29.5	192.14
33.7	191.95
38.3	192.25
44.4	192.08
51.8	191.97
54.5	192.70

SUMMARY DATA	
Bankfull Elevation:	192.6
Bankfull Cross-Sectional Area:	30.5
Bankfull Width:	37.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	0.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.001



Slope Profile

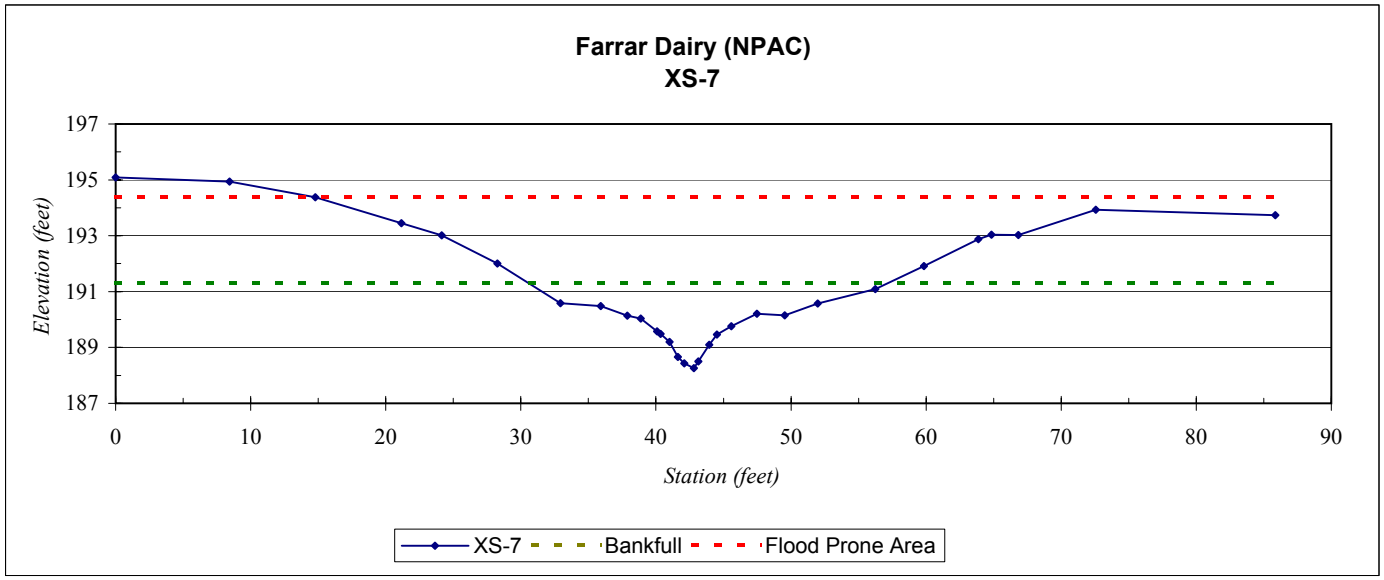


		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO6_TW		0.0											190.39					190.79
PRO6_TW	12.0	12.0											190.55					190.78
PRO6_BRI	7.0	19.0											190.59					190.80
PRO6_RI	6.9	26.0											190.54					
PRO6_ERI	6.0	31.9											190.54					190.76
PRO6_TW	3.6	35.5											190.16					
PRO6_TW	2.5	38.0											190.36					
PRO6_BRI	6.3	44.4											190.51					190.77
PRO6_TW	5.3	49.7											190.37					
PRO6_TW	5.8	55.5											190.42					190.72
PRO6_ERI	6.1	61.6											190.40					190.72
PRO6_TW	5.9	67.5											190.02					
PRO6_BPO	4.9	72.4											190.05					190.70
PRO6_EPO	5.2	77.5											190.11					190.71
PRO6_TW	7.4	84.9											190.18					
PRO6_TW	5.7	90.6											190.20					
PRO6_TW	8.5	99.1											190.08					
PRO6_BPO	5.9	105.1											189.99					190.68
PRO6_PO	5.2	110.3											189.94					
PRO6_PO	5.0	115.3											189.80					190.68
PRO6_PO	6.7	122.0											190.00					
PRO6_PO	6.7	128.7											189.78					
PRO6_PO	4.9	133.6											189.60					190.67
PRO6_PO	4.8	138.3											189.20					
PRO6_PO	4.6	142.9											189.06					190.67
PRO6_PO	4.5	147.4											189.67					
PRO6_TW	5.6	153.0											189.82					190.68
PRO6_TW	6.1	159.1											189.95					
PRO6_TW	8.9	168.1											189.70					
PRO6_TW	6.0	174.0											189.61					190.66

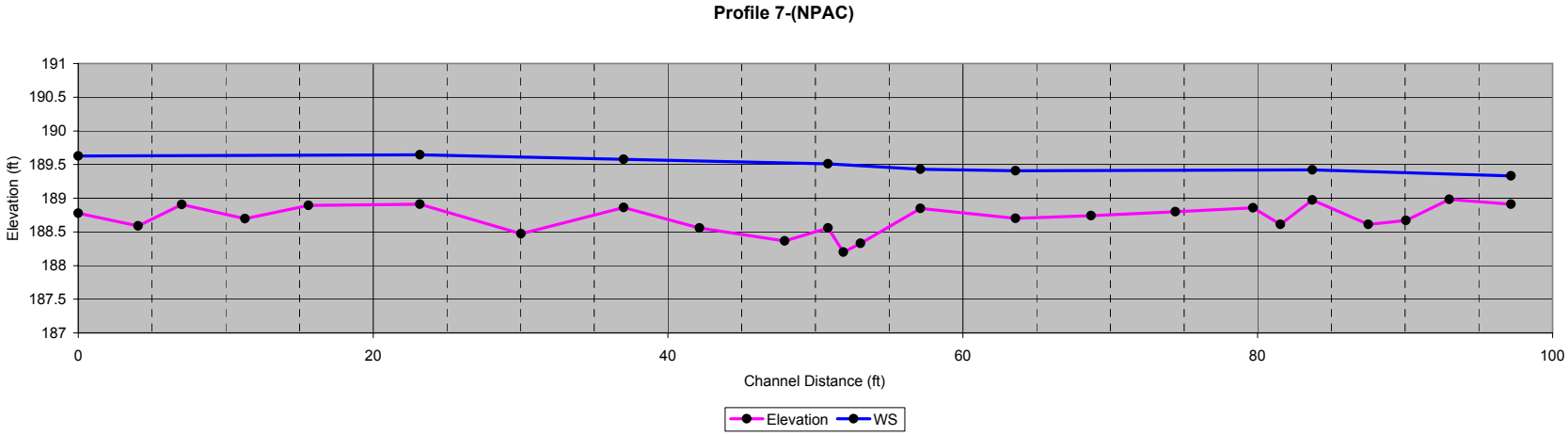
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-7
Drainage Area (sq mi):	4.21
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	195.08
8.4	194.93
14.8	194.37
21.2	193.45
24.1	193.01
28.3	192.01
32.9	190.59
35.9	190.48
37.9	190.14
38.9	190.03
40.1	189.58
40.3	189.49
41.0	189.20
41.6	188.66
42.1	188.43
42.8	188.26
43.1	188.50
43.9	189.10
44.5	189.47
45.6	189.76
47.5	190.21
49.5	190.15
52.0	190.58
56.2	191.08
59.8	191.92
63.9	192.87
64.8	193.04
66.8	193.02
72.6	193.93
85.9	193.73

SUMMARY DATA	
Bankfull Elevation:	191.32
Bankfull Cross-Sectional Area:	30.3
Bankfull Width:	26.7
Flood Prone Area Elevation:	194.4
Flood Prone Width:	>80
Max Depth at Bankfull:	3.1
Mean Depth at Bankfull:	1.1
W / D Ratio:	23.5
Entrenchment Ratio:	3.0
Bank Height Ratio:	1.9
Water Surface Slope (ft/ft):	0.002



Slope Profile

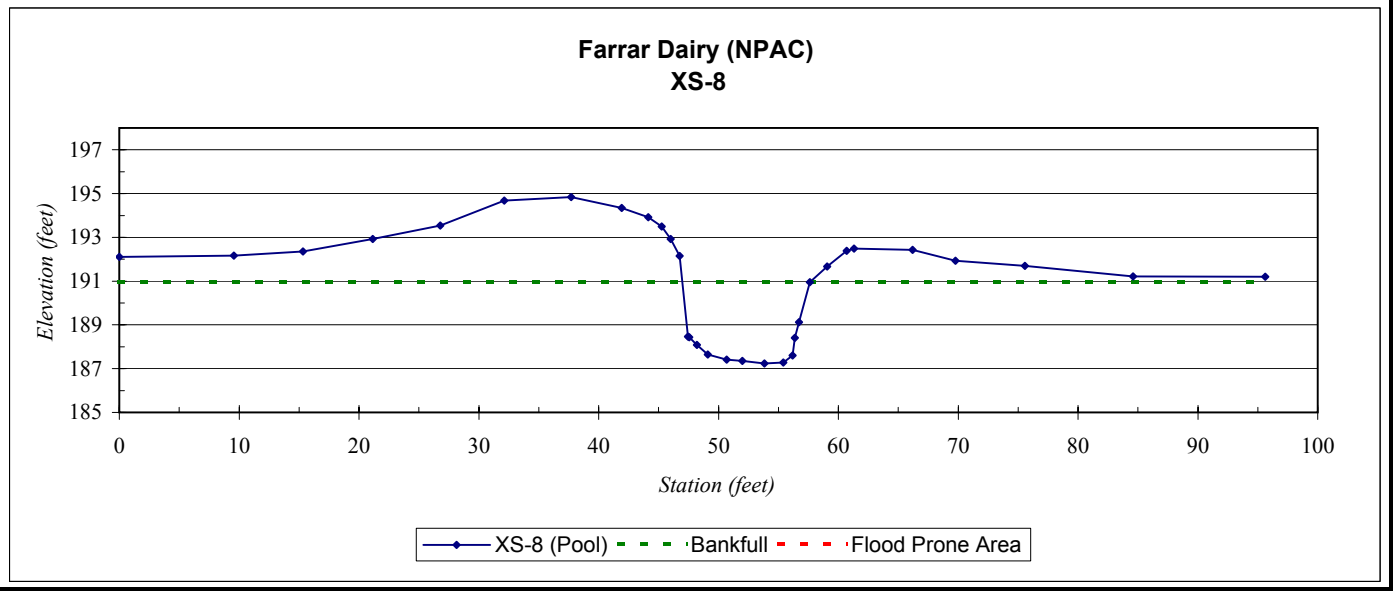


		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO7_tw		0											188.77					189.63
PRO7_tw	4.1	4.1											188.59					
PRO7_tw	3.0	7.0											188.91					
PRO7_tw	4.3	11.3											188.69					
PRO7_tw	4.3	15.6											188.89					
PRO7_tw	7.5	23.2											188.91					189.64
PRO7_tw	6.9	30.0											188.47					
PRO7_tw	7.0	37.0											188.86					189.58
PRO7_tw	5.1	42.1											188.56					
PRO7_tw	5.8	47.9											188.37					
PRO7_tw	2.9	50.9											188.56					189.51
PRO7_tw	1.0	51.9											188.20					
PRO7_tw	1.2	53.1											188.33					
PRO7_tw	4.1	57.1											188.85					189.43
PRO7_tw	6.4	63.6											188.70					189.41
PRO7_tw	5.1	68.7											188.74					
PRO7_tw	5.7	74.4											188.80					
PRO7_tw	5.3	79.7											188.86					
PRO7_tw	1.8	81.5											188.61					
PRO7_tw	2.2	83.7											188.97					189.42
PRO7_tw	3.8	87.5											188.61					
PRO7_tw	2.6	90.1											188.67					
PRO7_tw	2.9	93.0											188.98					
PRO7_tw	4.2	97.2											188.91					189.33

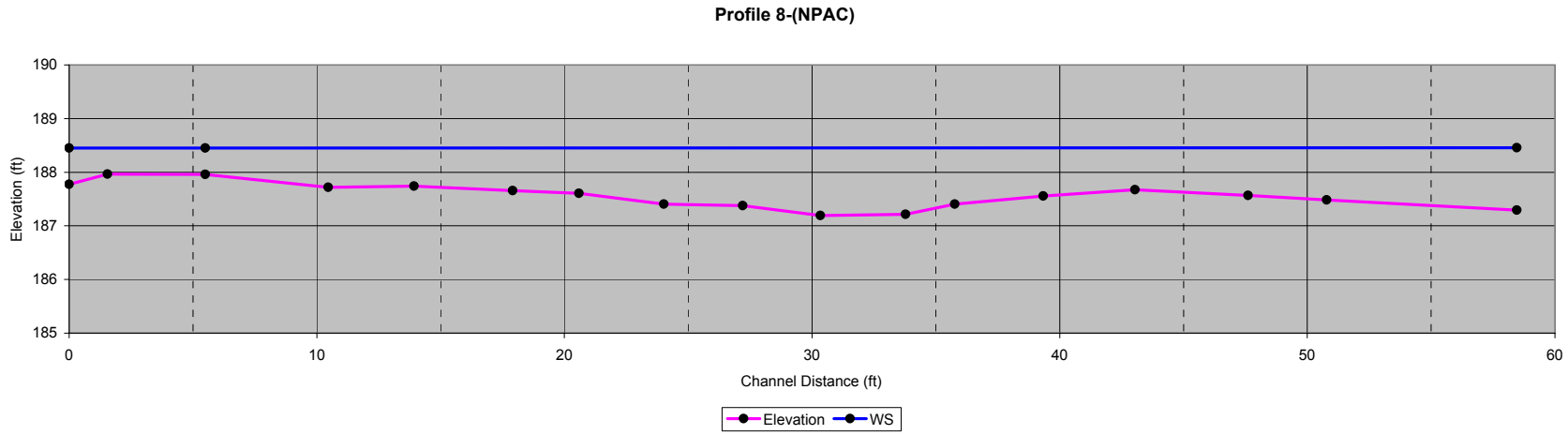
River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-8 (Pool)
Drainage Area (sq mi):	4.26
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	192.10
9.6	192.16
15.3	192.35
21.1	192.92
26.8	193.54
32.1	194.68
37.7	194.84
41.9	194.35
44.1	193.92
45.3	193.50
46.0	192.92
46.8	192.15
47.5	188.46
47.6	188.44
48.2	188.08
49.1	187.65
50.7	187.41
52.0	187.35
53.8	187.23
55.4	187.29
56.2	187.61
56.4	188.41
56.7	189.13
57.6	190.95
59.1	191.67
60.7	192.38
61.3	192.49
66.2	192.43
69.8	191.93
75.6	191.70
84.6	191.21
95.6	191.21

SUMMARY DATA	
Bankfull Elevation:	190.95
Bankfull Cross-Sectional Area:	32.3
Bankfull Width:	10.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	3.0
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.0001



Slope Profile

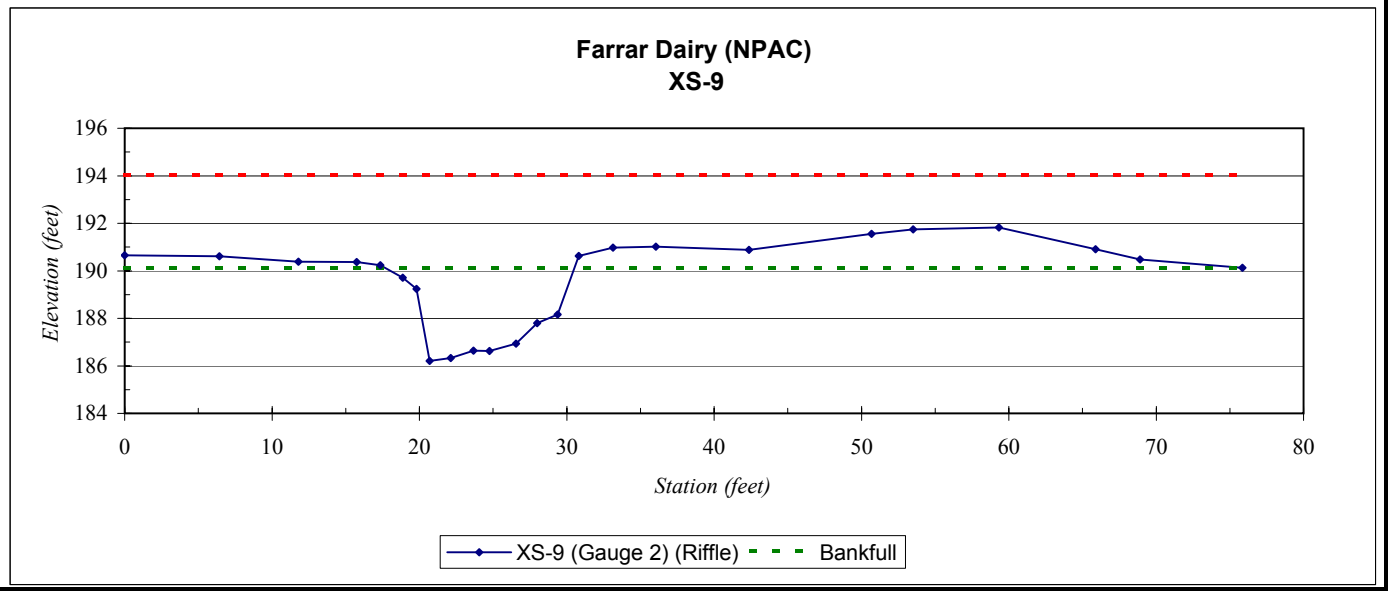


		Elevation BM:	100														
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO8_tw		0		100									187.77					188.45
PRO8_tw	1.6	1.6		100									187.96					
PRO8_eri	3.9	5.5		100									187.96					188.45
PRO8_tw	5.0	10.5		100									187.72					
PRO8_tw	3.5	13.9		100									187.74					
PRO8_tw	4.0	17.9		100									187.66					
PRO8_tw	2.7	20.6		100									187.61					
PRO8_tw	3.4	24.0		100									187.40					
PRO8_tw	3.2	27.2		100									187.37					
PRO8_tw	3.1	30.3		100									187.19					
PRO8_tw	3.4	33.8		100									187.21					
PRO8_tw	2.0	35.8		100									187.40					
PRO8_tw	3.6	39.3		100									187.56					
PRO8_tw	3.7	43.0		100									187.67					
PRO8_tw	4.6	47.6		100									187.57					
PRO8_tw	3.2	50.8		100									187.48					
PRO8_tw	7.7	58.5		100									187.29					188.46

River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-9 (Gauge 2) (Riffle)
Drainage Area (sq mi):	4.26
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	190.66
6.4	190.61
11.8	190.38
15.7	190.37
17.3	190.24
18.9	189.72
19.8	189.24
20.7	186.21
22.1	186.33
23.7	186.64
24.8	186.62
26.6	186.94
28.0	187.80
29.4	188.16
30.8	190.62
33.1	190.98
36.1	191.02
42.4	190.89
50.7	191.56
53.5	191.75
59.3	191.83
65.9	190.92
68.9	190.47
75.9	190.13

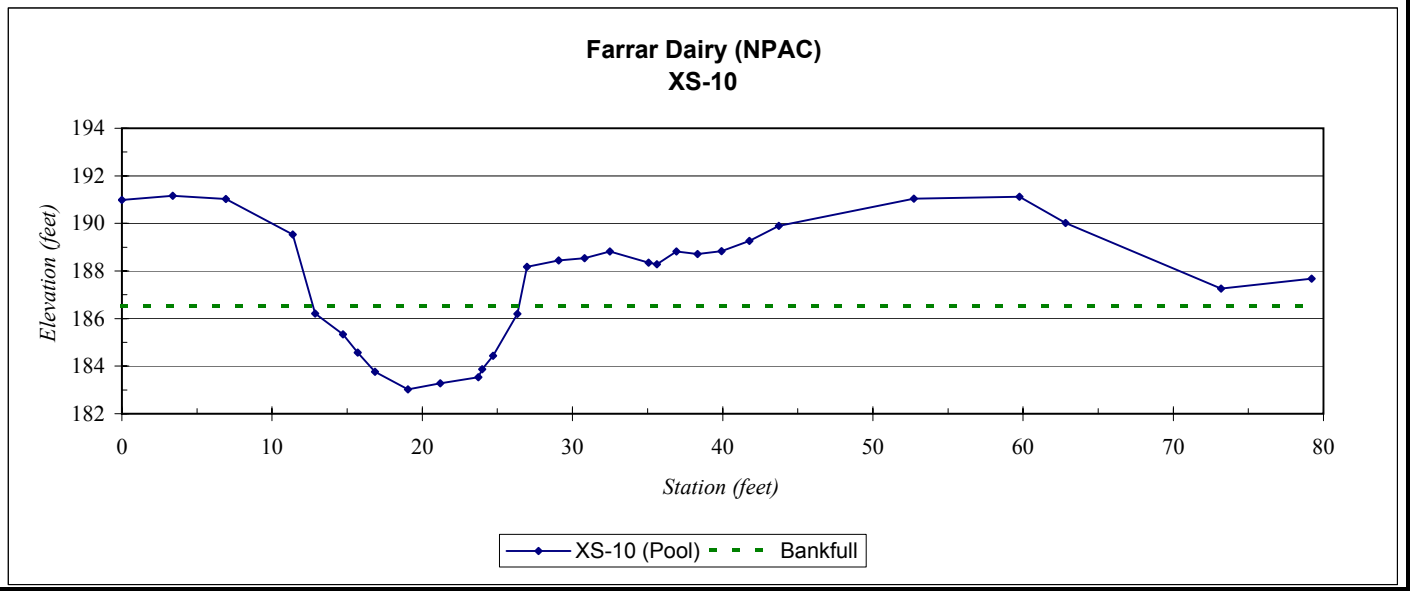
SUMMARY DATA	
Bankfull Elevation:	190.1
Bankfull Cross-Sectional Area:	31.2
Bankfull Width:	13.2
Flood Prone Area Elevation:	194.1
Flood Prone Width:	>75
Max Depth at Bankfull:	3.9
Mean Depth at Bankfull:	2.4
W / D Ratio:	5.6
Entrenchment Ratio:	5.7
Bank Height Ratio:	1.0
Water Surface Slope (ft/ft):	0.008



River Basin:	Cape Fear
Watershed:	Farrar Dairy (NPAC)
XS ID	XS-10 (Pool)
Drainage Area (sq mi):	4.81
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	190.98
3.4	191.16
6.9	191.03
11.4	189.54
12.9	186.21
14.7	185.33
15.7	184.56
16.8	183.76
19.0	183.02
21.2	183.27
23.7	183.54
24.0	183.87
24.7	184.43
26.3	186.20
27.0	188.17
29.1	188.45
30.8	188.54
32.5	188.82
35.1	188.35
35.6	188.28
36.9	188.83
38.3	188.71
39.9	188.84
41.8	189.26
43.7	189.90
52.7	191.04
59.8	191.12
62.8	190.02
73.2	187.26
79.2	187.68

SUMMARY DATA	
Bankfull Elevation:	186.6
Bankfull Cross-Sectional Area:	32.1
Bankfull Width:	13.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.5
Mean Depth at Bankfull:	2.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.002



Additional BEHI and NBS worksheets

Stream: NPAC Location: Farrar Site

Station: Gauge 1 Location Observers: AD, BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	6.5 (A)	Bankfull Height (ft) =	2.2 (B)	(A) / (B) =	2.9 (C)	9
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	4.0 (D)	Study Bank Height (ft) =	6.5 (A)	(D) / (A) =	.62 (E)	3.5
Weighted Root Density (G)						
Root Density as % =	55 (F)			(F) x (E) =	34 (G)	5.8
Bank Angle (H)						
Bank Angle as *Degrees* =	80 (H)					6
Surface Protection (I)						
Surface Protection as % =	30 (I)					6

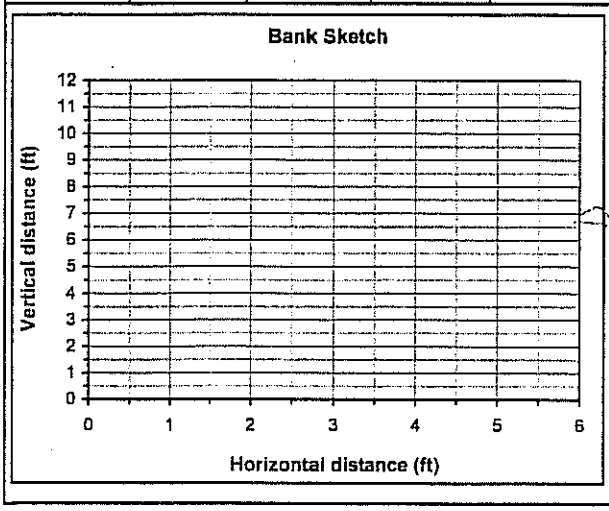
Bank Material Adjustment:

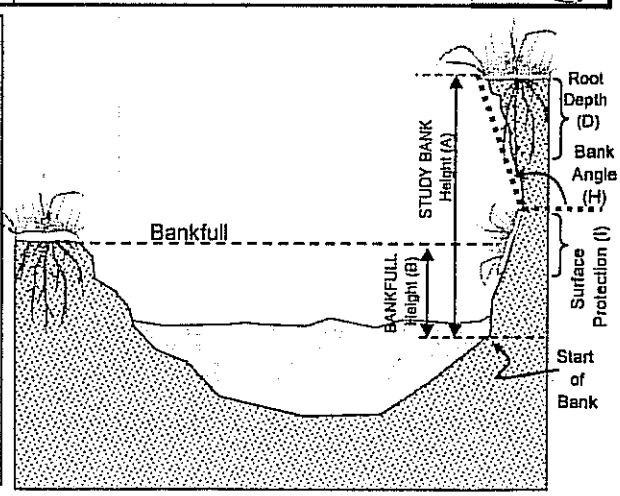
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40.3





Additional BEHI and NBS worksheets

Stream: NPAC Location: Farrar Dairy Site

Station: after confluence with T1 Observers: AD, BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.5 (A)	Bankfull Height (ft) =	3.0 (B)	(A)/(B) =	1.1 (C)	2
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1 (D)	Study Bank Height (ft) =	3.5 (A)	(D)/(A) =	.28 (E)	6.2
Weighted Root Density (G)						
Root Density as % =	30 (F)			(F)x(E) =	8.4 (G)	8.5
Bank Angle (H)						
Bank Angle as *Degrees* =	45 (H)					3
Surface Protection (I)						
Surface Protection as % =	35 (I)					6

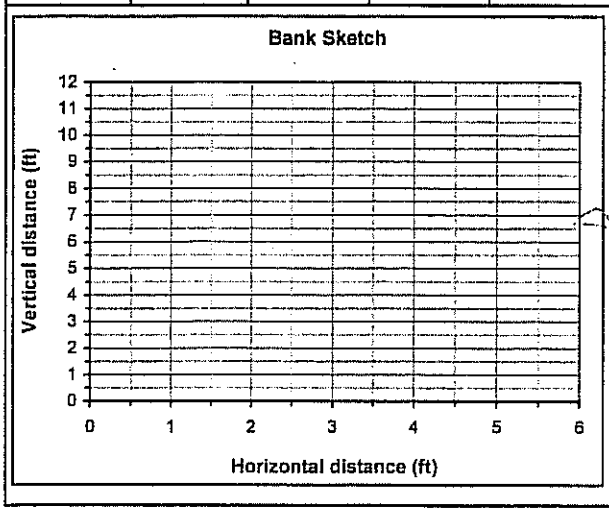
Bank Material Adjustment:

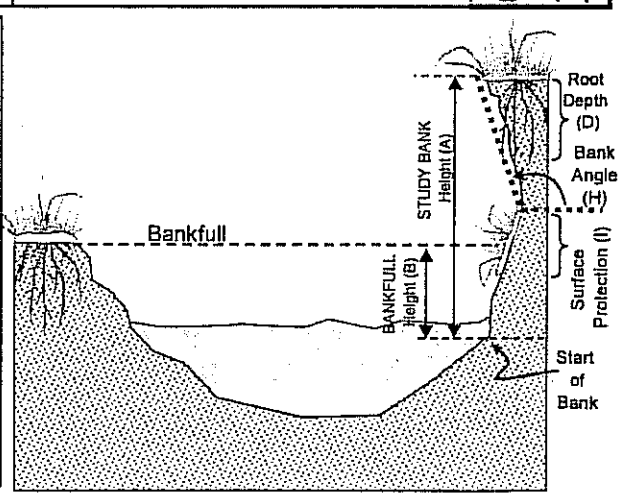
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: –

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	30.7





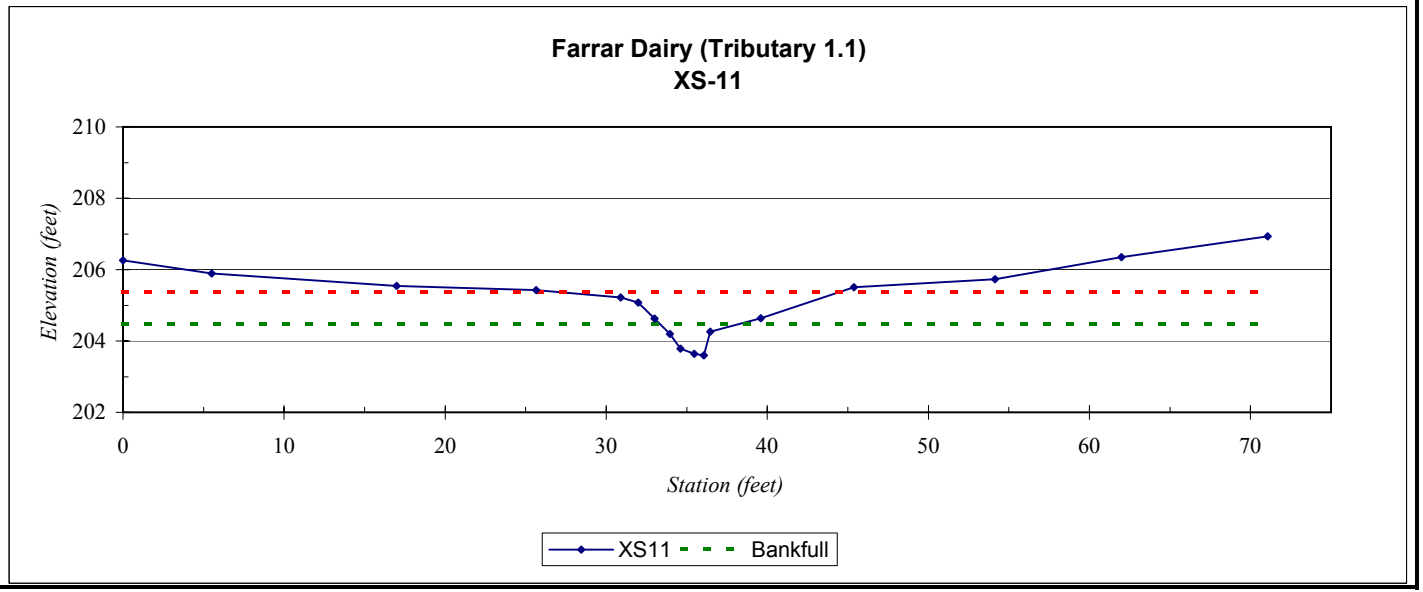
T1.1

River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 1.1)
XS ID	XS11
Drainage Area (sq mi):	0.18
Date:	November 2007
Field Crew:	A. French, A. Davis

Station	Elevation
0.0	206.26
5.5	205.89
17.0	205.54
25.7	205.43
30.9	205.22
32.0	205.07
33.0	204.63
34.0	204.20
34.6	203.78
35.5	203.64
36.1	203.59
36.5	204.26
39.6	204.63
45.4	205.51
54.1	205.73
62.0	206.35
71.1	206.94

SUMMARY DATA	
Bankfull Elevation:	204.5
Bankfull Cross-Sectional Area:	2.0
Bankfull Width:	5.0
Flood Prone Area Elevation:	205.4
Flood Prone Width:	15.0
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.4
W / D Ratio:	12.5
Entrenchment Ratio:	13.0
Bank Height Ratio:	1.7
Water Surface Slope (ft/ft):	0.026

Stream Type:	**C5**

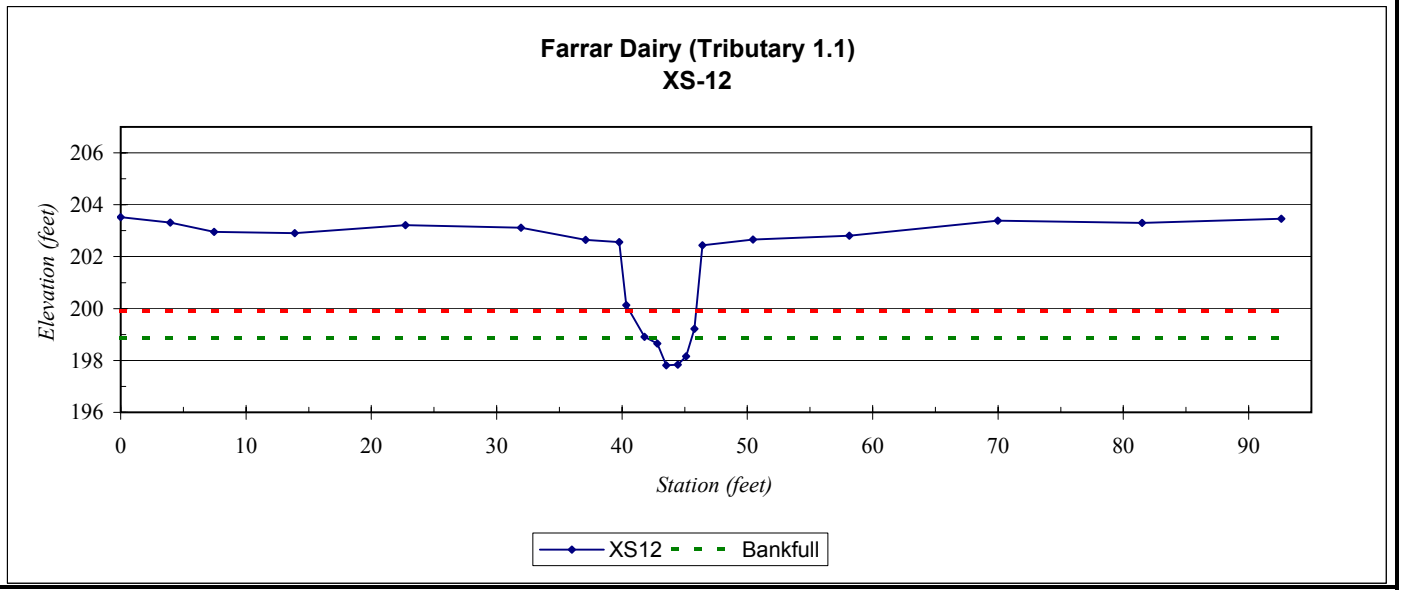


River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 1.1)
XS ID	XS12
Drainage Area (sq mi):	0.18
Date:	November 2007
Field Crew:	A. French, A. Davis

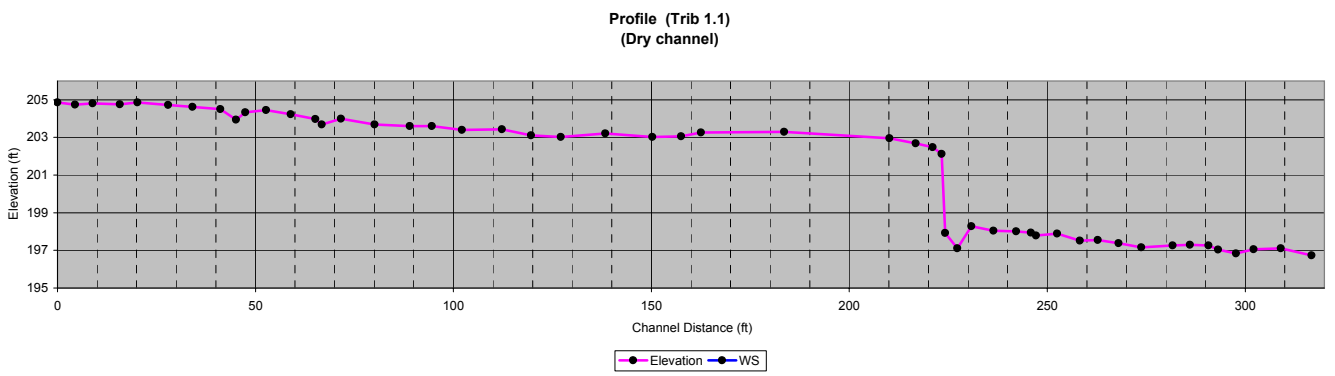
Station	Elevation
0.0	203.53
4.0	203.31
7.4	202.96
13.9	202.90
22.7	203.21
32.0	203.11
37.1	202.65
39.8	202.57
40.3	200.13
41.8	198.91
42.8	198.65
43.5	197.81
44.5	197.84
45.1	198.15
45.8	199.22
46.4	202.44
50.5	202.66
58.1	202.80
70.0	203.38
81.5	203.31
92.6	203.45

SUMMARY DATA	
Bankfull Elevation:	198.9
Bankfull Cross-Sectional Area:	2.0
Bankfull Width:	3.5
Flood Prone Area Elevation:	199.9
Flood Prone Width:	6.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	6.2
Entrenchment Ratio:	1.7
Bank Height Ratio:	4.4
Water Surface Slope (ft/ft):	0.026

Stream Type:	**G5**



Slope Profile



		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO3-4-TW		0											204.87					
PRO3-4-TW	4.4	4.4											204.75					
PRO3-4-TW	4.4	8.9											204.81					
PRO3-4-TW	6.9	15.8											204.75					
PRO3-4-TW	4.4	20.2											204.85					
PRO3-4-TW	7.8	28.0											204.72					
PRO3-4-TW	6.2	34.1											204.62					
PRO3-4-TW	7.0	41.2											204.50					
PRO3-4-TW	3.9	45.1											203.94					
PRO3-4-TW	2.4	47.5											204.33					
PRO3-4-TW	5.2	52.7											204.46					
PRO3-4-TW	6.2	58.9											204.23					
PRO3-4-TW	6.3	65.1											203.98					
PRO3-4-TW	1.6	66.8											203.69					
PRO3-4-TW	4.8	71.6											203.99					
PRO3-4-TW	8.5	80.1											203.69					
PRO3-4-TW	9.0	89.0											203.60					
PRO3-4-TW	5.6	94.6											203.60					
PRO3-4-TW	7.6	102.2											203.41					
PRO3-4-TW	10.1	112.3											203.43					
PRO3-4-TW	7.3	119.6											203.11					
PRO3-4-TW	7.6	127.2											203.03					
PRO3-4-TW	11.2	138.4											203.21					
PRO3-4-TW	11.9	150.3											203.02					
PRO3-4-TW	7.3	157.6											203.07					
PRO3-4-begin cattle crossin	4.9	162.5											203.26					
PRO3-4-cattle crossing	21.1	183.6											203.30					
PRO3-4-end crossing	26.6	210.1											202.95					
PRO3-4-TW	6.6	216.7											202.68					
PRO3-4-TW	4.3	221.0											202.48					
PRO3-4-HEADCUT	2.3	223.3											202.12					
PRO3-4-HEADCUT	0.9	224.2											197.93					
PRO3-4-HEADCUT	3.0	227.3											197.11					
PRO3-4-TW	3.6	230.8											198.27					
PRO3-4-TW	5.6	236.4											198.05					
PRO3-4-TW	5.8	242.2											198.01					
PRO3-4-TW	3.7	245.9											197.93					
PRO3-4-TW	1.3	247.2											197.79					
PRO3-4-TW	5.3	252.5											197.90					
PRO3-4-TW	5.7	258.2											197.52					
PRO3-4-TW	4.5	262.7											197.55					
PRO3-4-TW	5.3	268.0											197.38					
PRO3-4-TW	5.8	273.8											197.17					
PRO3-4-TW	7.9	281.7											197.26					
PRO3-4-TW	4.4	286.1											197.30					
PRO3-4-TW	4.7	290.7											197.26					
PRO3-4-TW	2.4	293.1											197.04					
PRO3-4-TW	4.5	297.7											196.84					
PRO3-4-TW	4.5	302.2											197.06					
PRO3-4-TW	6.8	309.0											197.11					
PRO3-4-TW	7.8	316.8											196.73					

Additional BEHI and NBS worksheets

Stream: T1.1 - US Location: Farrar Site

Station: Observers: AD, BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	1.5 (A)	Bankfull Height (ft) =	1.1 (B)	(A)/(B) =	1.3 (C)	4
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	1.8 (D)	Study Bank Height (ft) =	2.0 (A)	(D)/(A) =	.9 (E)	2
Weighted Root Density (G)						
Root Density as % =	100 (F)			(F)x(E) =	90 (G)	1
Bank Angle (H)						
Bank Angle as *Degrees* =	75 (H)					8
Surface Protection (I)						
Surface Protection as % =	100 (I)					0

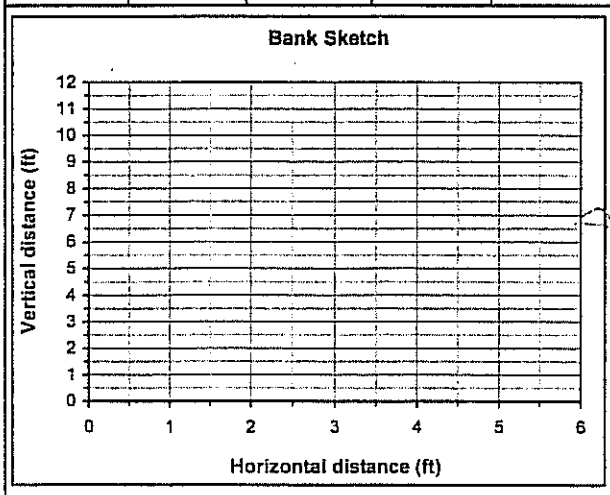
Bank Material Adjustment:

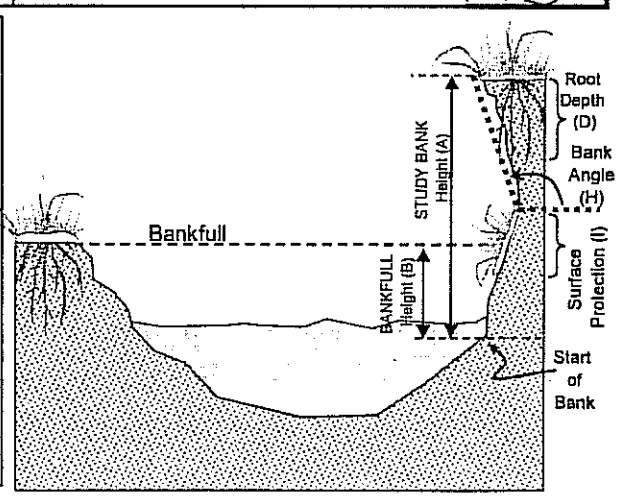
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment —

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage —

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	15





Additional BEHI and NBS worksheets

Stream: T1.1 - DS Location: Farrar Site

Station: Observers: AD BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	4.7 (A)	Bankfull Height (ft) =	1.5 (B)	(A)/(B) =	3.1 (C)	9.8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.5 (D)	Study Bank Height (ft) =	4.7 (A)	(D)/(A) =	.11 (E)	8.5
Weighted Root Density (G)						
Root Density as % =	5 (F)			(F)×(E) =	.55 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	90 (H)					8
Surface Protection (I)						
Surface Protection as % =	0 (I)					10

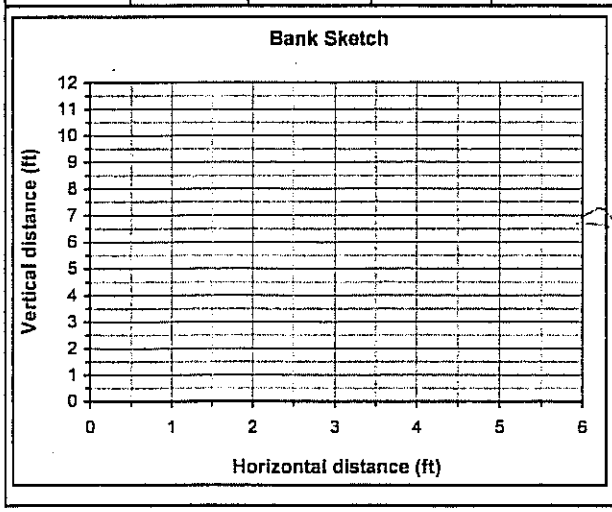
Bank Material Adjustment:

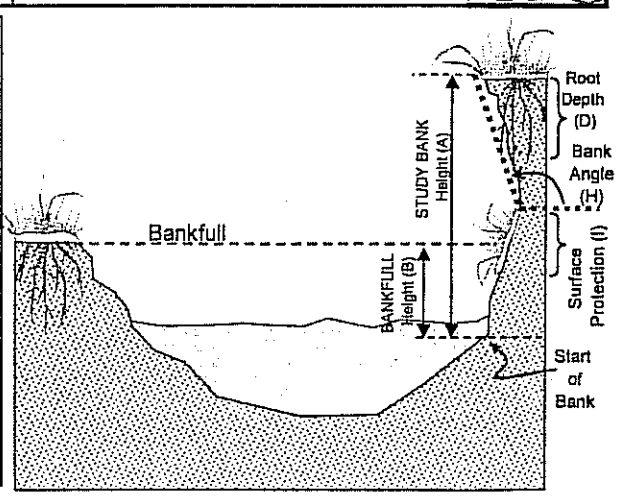
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	56.3





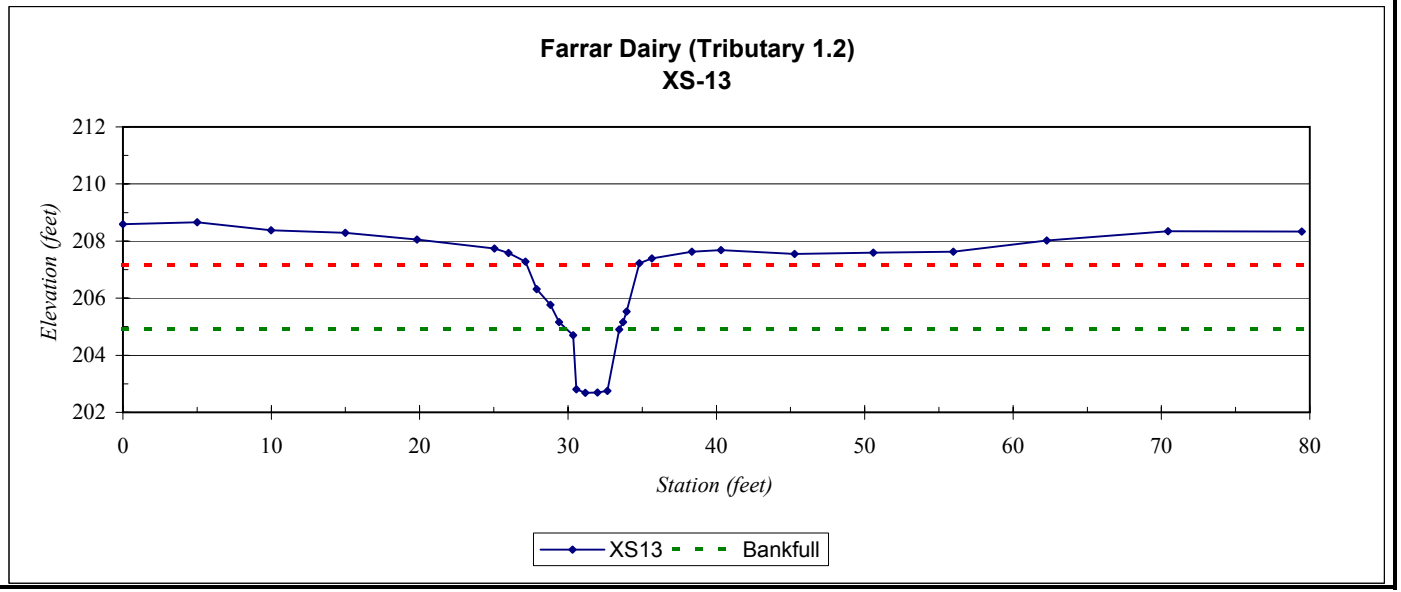
T1.2

River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 1.2)
XS ID	XS13
Drainage Area (sq mi):	0.18
Date:	November 2007
Field Crew:	A. French, A. Davis

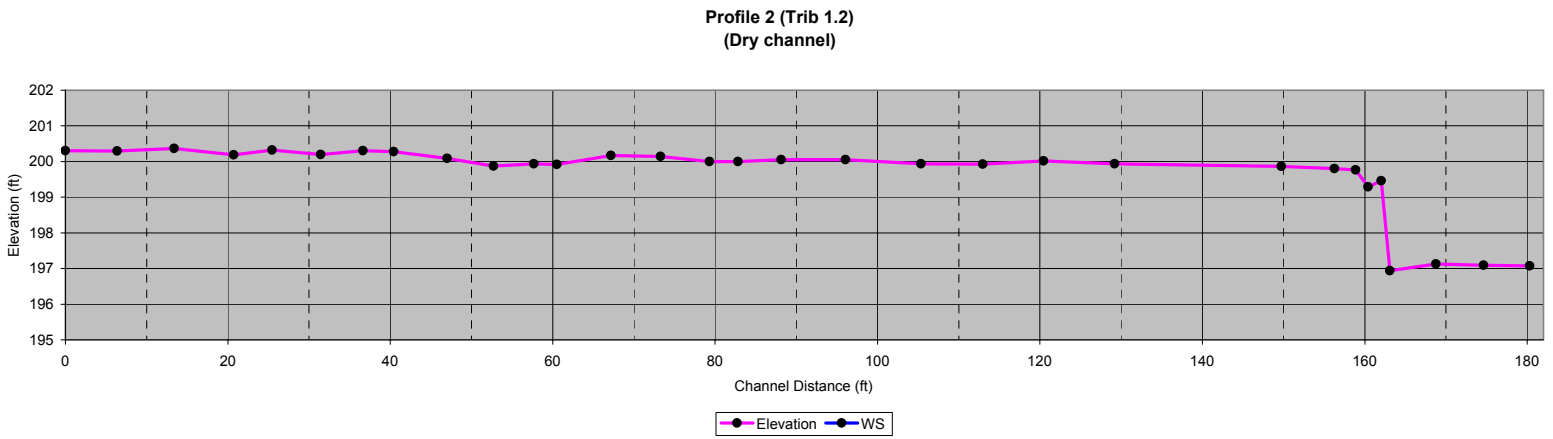
Station	Elevation
0.0	208.59
5.0	208.66
10.0	208.37
15.0	208.29
19.8	208.05
25.0	207.74
26.0	207.58
27.1	207.28
27.9	206.31
28.8	205.76
29.4	205.16
30.3	204.70
30.6	202.80
31.2	202.69
32.0	202.69
32.7	202.75
33.4	204.90
33.7	205.16
34.0	205.53
34.8	207.23
35.6	207.40
38.4	207.62
40.3	207.68
45.3	207.54
50.6	207.60
56.0	207.63
62.3	208.01
70.4	208.34
79.5	208.33

SUMMARY DATA	
Bankfull Elevation:	204.9
Bankfull Cross-Sectional Area:	5.8
Bankfull Width:	3.6
Flood Prone Area Elevation:	207.2
Flood Prone Width:	7.0
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.6
W / D Ratio:	2.2
Entrenchment Ratio:	2.0
Bank Height Ratio:	2.0
Water Surface Slope (ft/ft):	0.012

Stream Type:	**G5**



Slope Profile



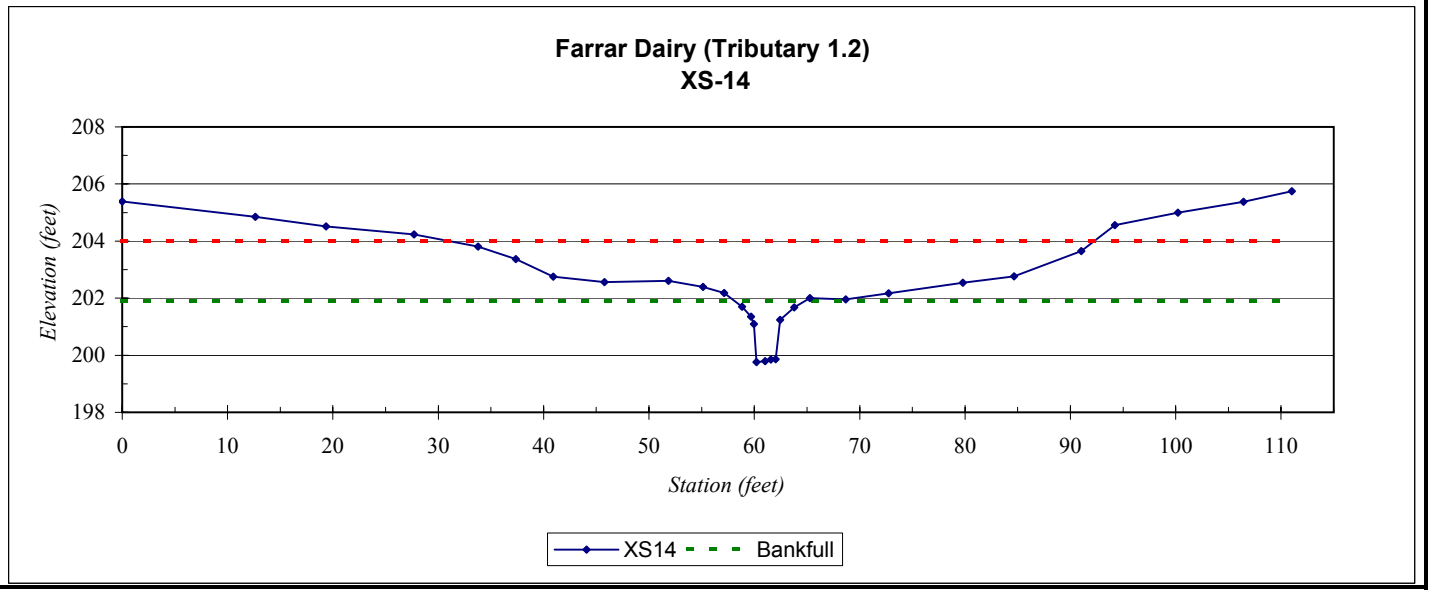
		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO2-TW		0											200.3003					
PRO2-TW	6.4	6.4											200.2931					
PRO2-TW	7.0	13.4											200.3636					
PRO2-TW	7.3	20.7											200.1834					
PRO2-TW	4.7	25.4											200.3177					
PRO2-TW	6.0	31.4											200.1956					
PRO2-TW	5.2	36.6											200.302					
PRO2-TW	3.8	40.4											200.277					
PRO2-TW	6.6	47.0											200.0882					
PRO2-TW	5.7	52.7											199.8755					
PRO2-TW	5.0	57.7											199.935					
PRO2-TW	2.8	60.5											199.917					
PRO2-TW	6.7	67.2											200.1735					
PRO2-TW	6.1	73.3											200.14					
PRO2-TW	6.0	79.3											200.00					
PRO2-TW	3.5	82.8											200.00					
PRO2-TW	5.3	88.1											200.06					
PRO2-TW	7.9	96.0											200.06					
PRO2-TW	9.3	105.4											199.94					
PRO2-TW	7.6	113.0											199.93					
PRO2-TW	7.5	120.5											200.0178					
PRO2-TW	8.7	129.2											199.9332					
PRO2-TW	20.6	149.7											199.8675					
PRO2-TW	6.5	156.3											199.7985					
PRO2-TW	2.6	158.9											199.7612					
PRO2-TW	1.5	160.4											199.2896					
begin headcut	1.6	162.0											199.4607					
PRO2-TW	1.1	163.1											196.9344					
PRO2-TW	5.7	168.8											197.1288					
PRO2-TW	5.9	174.6											197.0907					
PRO2-TW	5.7	180.3											197.0739					

River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 1.2)
XS ID	XS14
Drainage Area (sq mi):	0.18
Date:	November 2007
Field Crew:	A. French, A. Davis

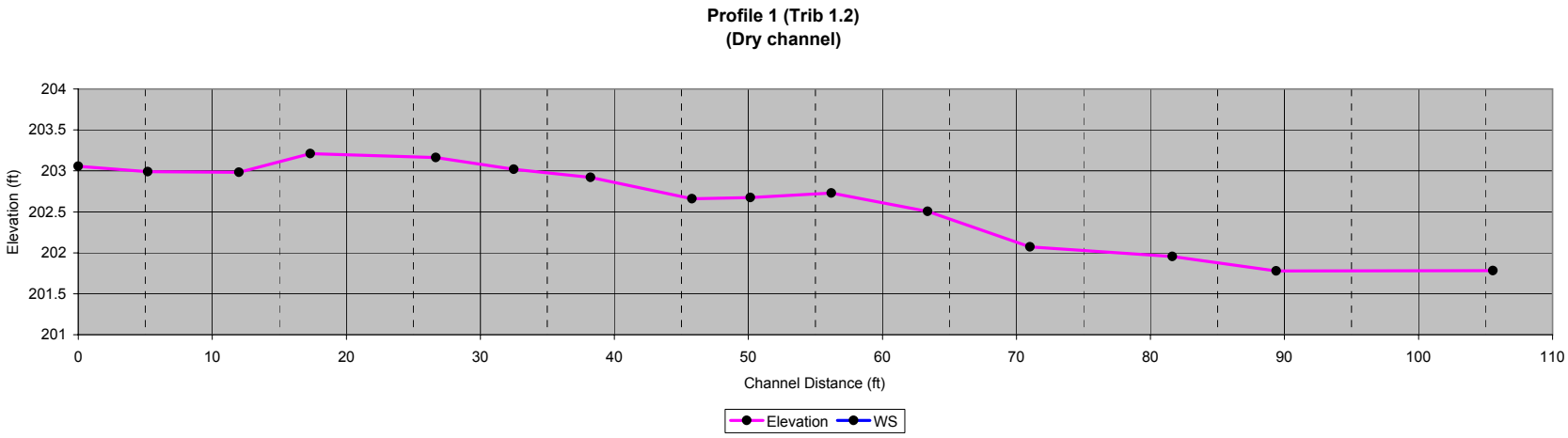
Station	Elevation
0.0	205.39
12.6	204.85
19.4	204.52
27.7	204.23
33.8	203.81
37.4	203.37
40.9	202.75
45.8	202.56
51.9	202.60
55.1	202.39
57.1	202.19
58.8	201.70
59.7	201.35
60.0	201.09
60.2	199.76
61.0	199.79
61.6	199.85
62.0	199.87
62.5	201.24
63.8	201.68
65.3	202.00
68.7	201.96
72.7	202.17
79.8	202.54
84.6	202.76
91.0	203.65
94.2	204.56
100.2	204.99
106.4	205.38
111.0	205.75

SUMMARY DATA	
Bankfull Elevation:	201.9
Bankfull Cross-Sectional Area:	5.8
Bankfull Width:	6.4
Flood Prone Area Elevation:	204.0
Flood Prone Width:	60.0
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	7.1
Entrenchment Ratio:	9.4
Bank Height Ratio:	1.1
Water Surface Slope (ft/ft):	0.018

Stream Type:	**E5**



Slope Profile



		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO1-TW		0											203.06					
PRO1-TW	5.2	5.2											202.99					
PRO1-TW	6.8	12.0											202.98					
PRO1-TW	5.3	17.3											203.21					
PRO1-TW	9.4	26.7											203.16					
PRO1-TW	5.8	32.5											203.02					
PRO1-TW	5.7	38.2											202.92					
PRO1-TW	7.6	45.8											202.66					
PRO1-TW	4.4	50.2											202.67					
PRO1-TW	6.0	56.2											202.73					
PRO1-TW	7.2	63.4											202.51					
PRO1-TW	7.6	71.0											202.07					
PRO1-TW	10.6	81.6											201.95					
PRO1-TW	7.8	89.4											201.78					
PRO1-TW	16.2	105.6											201.78					

Additional BEHI and NBS worksheets

Stream: T1.2 Location: Farrar Site

Station: Observers: AD, BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	5.0 (A)	Bankfull Height (ft) =	2.0 (B)	(A)/(B) =	2.5 (C)	8.5
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.5 (D)	Study Bank Height (ft) =	5.0 (A)	(D)/(A) =	0.1 (E)	8.5
Weighted Root Density (G)						
Root Density as % =	10 (F)			(F)×(E) =	1.1 (G)	10
Bank Angle (H)						
Bank Angle as *Degrees* =	80 (H)					6
Surface Protection (I)						
Surface Protection as % =	15 (I)					9

Bank Material Adjustment:

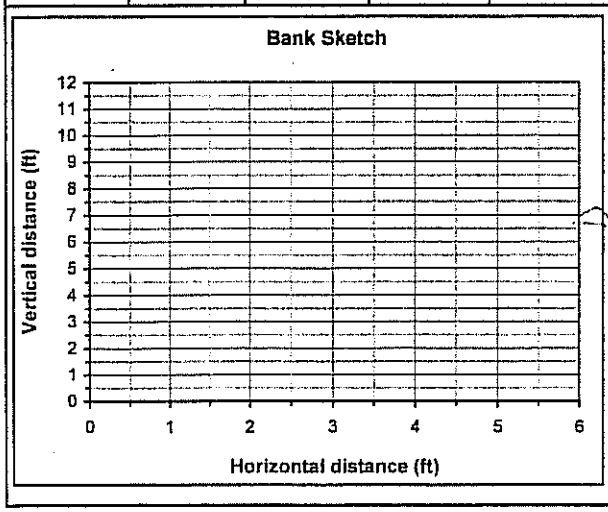
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

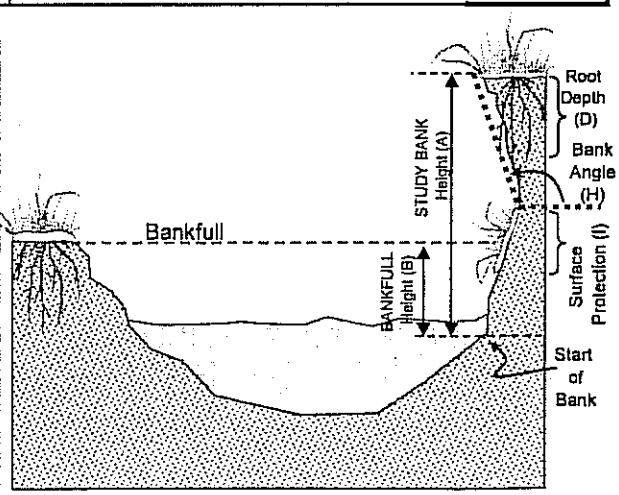
Bank Material Adjustment: 5

Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: 5

Very Low	Low	Moderate	High	Very High	Extreme
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50

Adjective Rating and Total Score: 52



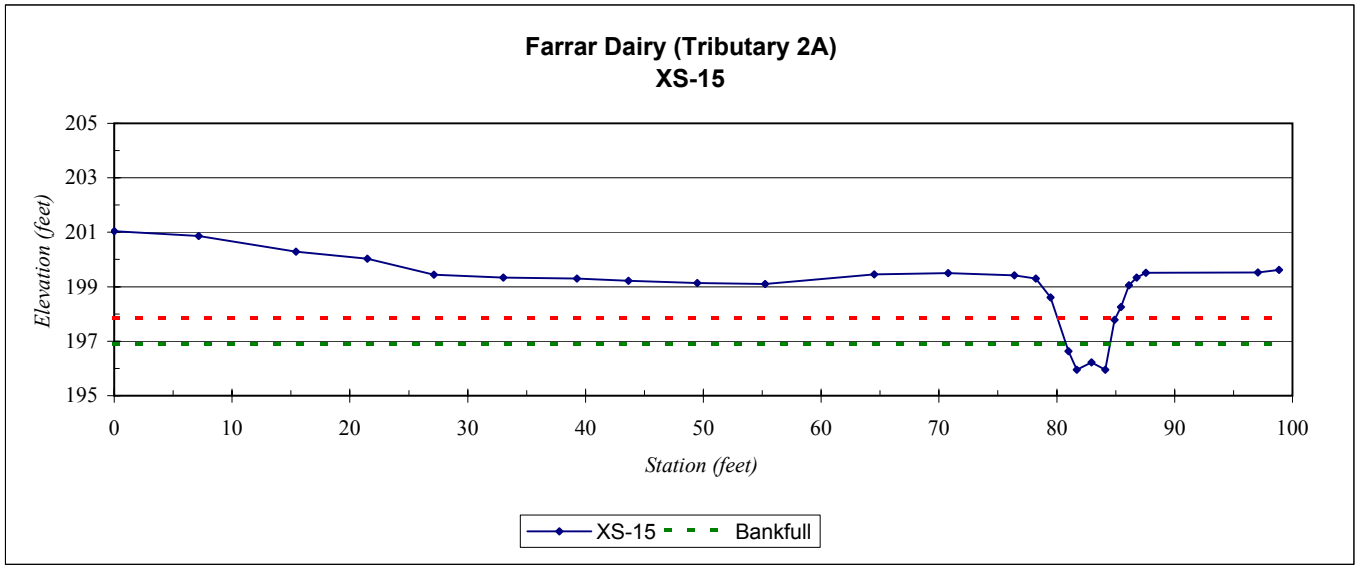


T2

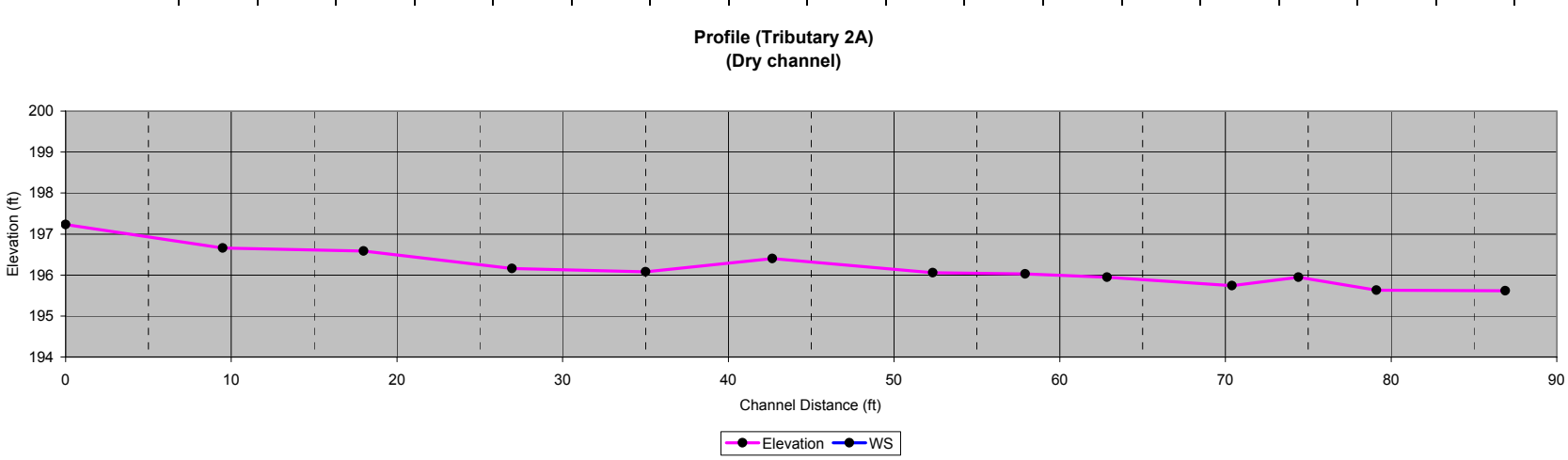
River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 2A)
XS ID	XS-15
Drainage Area (sq mi):	0.03
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	201.04
7.2	200.87
15.4	200.28
21.5	200.03
27.1	199.45
33.0	199.34
39.3	199.30
43.6	199.22
49.5	199.13
55.3	199.10
64.5	199.46
70.8	199.50
76.4	199.42
78.2	199.30
79.5	198.60
81.0	196.64
81.7	195.95
83.0	196.22
84.1	195.95
84.9	197.78
85.4	198.26
86.1	199.05
86.8	199.34
87.5	199.52
97.1	199.52
98.9	199.61

SUMMARY DATA	
Bankfull Elevation:	196.9
Bankfull Cross-Sectional Area:	2.5
Bankfull Width:	3.6
Flood Prone Area Elevation:	197.9
Flood Prone Width:	4.0
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.7
W / D Ratio:	5.2
Entrenchment Ratio:	1.1
Bank Height Ratio:	3.5
Water Surface Slope (ft/ft):	0.02



Slope Profile

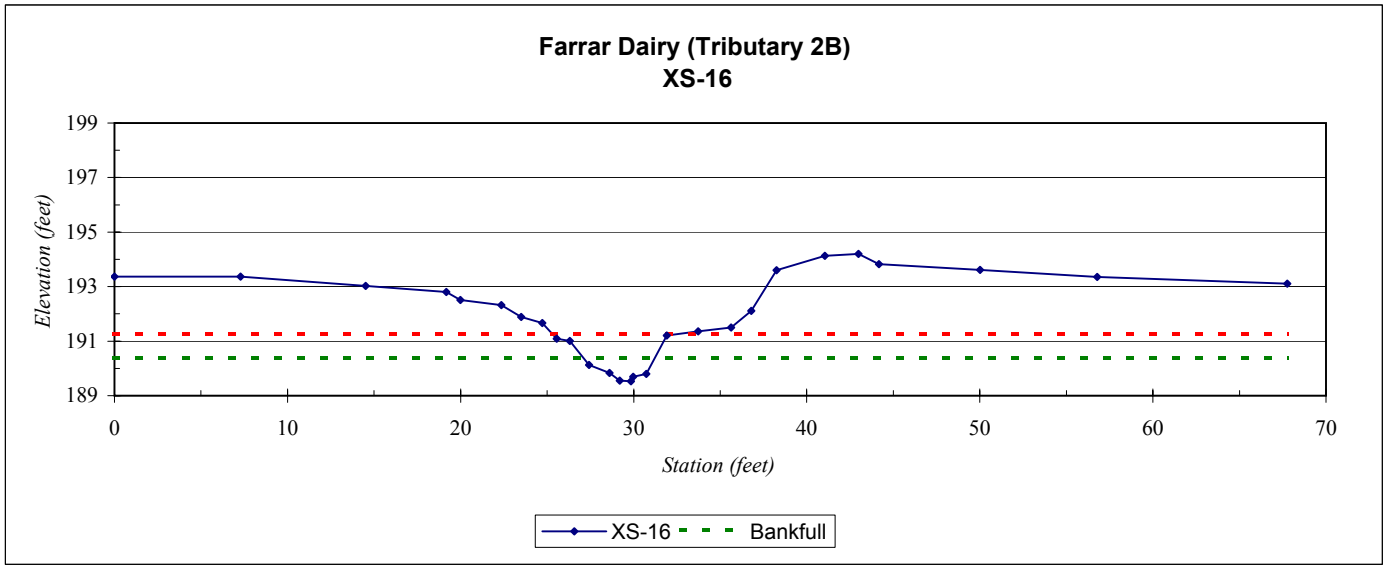


		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0		TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO15		0											197.2294					
PRO15_tw	9.5	9.5											196.6609					
PRO15_tw	8.5	18.0											196.5848					
PRO15_tw	9.0	26.9											196.16					
PRO15_tw	8.1	35.0											196.0788					
PRO15_tw	7.6	42.7											196.4033					
PRO15_tw	9.7	52.3											196.0582					
PRO15_tw	5.6	57.9											196.029					
PRO15_tw	4.9	62.9											195.9482					
PRO15_tw	7.5	70.4											195.7392					
PRO15_tw	4.0	74.4											195.9431					
PRO15_tw	4.7	79.1											195.6293					
PRO15_tw	7.8	86.9											195.6157					

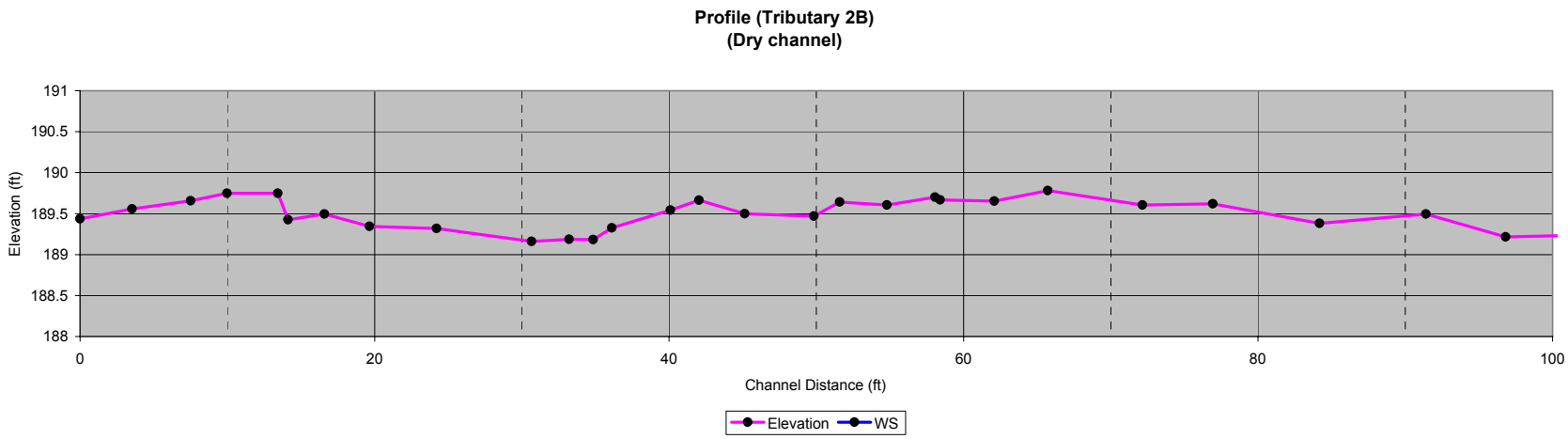
River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 2B)
XS ID	XS-16
Drainage Area (sq mi):	0.03
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	193.36
7.3	193.37
14.5	193.03
19.2	192.80
20.0	192.51
22.3	192.32
23.5	191.88
24.7	191.66
25.6	191.09
26.3	191.00
27.4	190.12
28.6	189.83
29.2	189.55
29.8	189.53
30.0	189.69
30.7	189.80
31.9	191.21
33.7	191.36
35.6	191.50
36.8	192.11
38.3	193.60
41.0	194.13
43.0	194.20
44.2	193.82
50.0	193.62
56.8	193.35
67.8	193.10

SUMMARY DATA	
Bankfull Elevation:	190.4
Bankfull Cross-Sectional Area:	2.5
Bankfull Width:	4.5
Flood Prone Area Elevation:	191.3
Flood Prone Width:	8.0
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	8.1
Entrenchment Ratio:	1.8
Bank Height Ratio:	3.2
Water Surface Slope (ft/ft):	0.002



Slope Profile



		Elevation BM:		100														
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO14_tw		0		100									189.4356					
PRO14_tw	3.5	3.5		100									189.5568					
PRO14_tw	4.0	7.5		100									189.6562					
PRO14_tw	2.5	10.0		100									189.7488					
PRO14_tw	3.4	13.4		100									189.7468					
PRO14_tw	0.7	14.1		100									189.426					
PRO14_tw	2.5	16.6		100									189.4936					
PRO14_tw	3.1	19.7		100									189.3454					
PRO14_tw	4.5	24.2		100									189.3198					
PRO14_tw	6.5	30.7		100									189.1592					
PRO14_tw	2.6	33.2		100									189.1844					
PRO14_tw	1.6	34.9		100									189.1811					
PRO14_tw	1.3	36.1		100									189.3248					
PRO14_tw	4.0	40.1		100									189.544					
PRO14_tw	1.9	42.0		100									189.6631					
PRO14_tw	3.1	45.1		100									189.4986					
PRO14_tw	4.7	49.8		100									189.4691					
PRO14_tw	1.8	51.6		100									189.6423					
PRO14_tw	3.2	54.8		100									189.604					
PRO14_tw	3.3	58.1		100									189.7006					
PRO14_tw	0.3	58.4		100									189.6664					
PRO14_tw	3.7	62.1		100									189.6539					
PRO14_tw	3.6	65.7		100									189.7803					
PRO14_tw	6.4	72.2		100									189.6053					
PRO14_tw	4.8	76.9		100									189.6205					
PRO14_tw	7.2	84.2		100									189.3792					
PRO14_tw	5.4	89.6		100									189.4929					
PRO14_tw	4.5	94.1		100									189.2138					
PRO14_tw	3.8	97.9		100									189.2333					

Additional BEHI and NBS worksheets

Stream: T2 Location: Farrar Site

Station: Observers: AD, BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.2 (A)	Bankfull Height (ft) =	0.60 (B)	(A)/(B) =	5.3 (C)	10
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.5 (D)	Study Bank Height (ft) =	3.2 (A)	(D)/(A) =	.16 (E)	8
Weighted Root Density (G)						
Root Density as % =	15 (F)			(F)x(E) =	2.4 (G)	9.5
Bank Angle (H)						
Bank Angle as *Degrees* =	60 (H)					4
Surface Protection (I)						
Surface Protection as % =	60 (I)					3.8

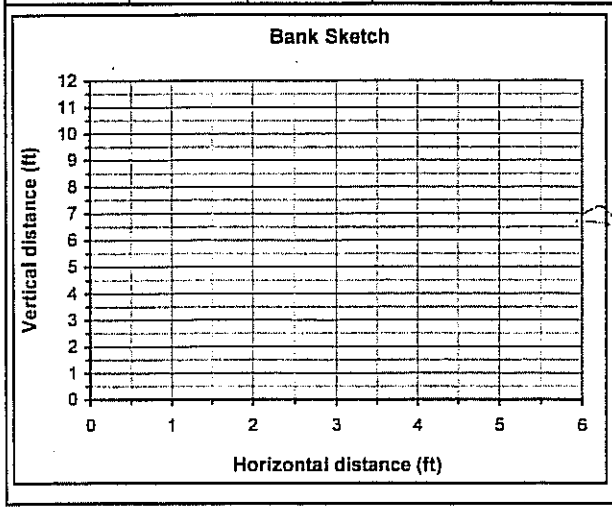
Bank Material Adjustment:

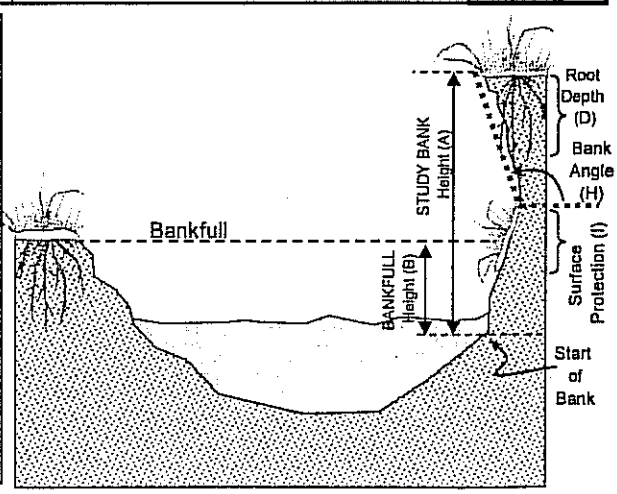
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: -

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40.3



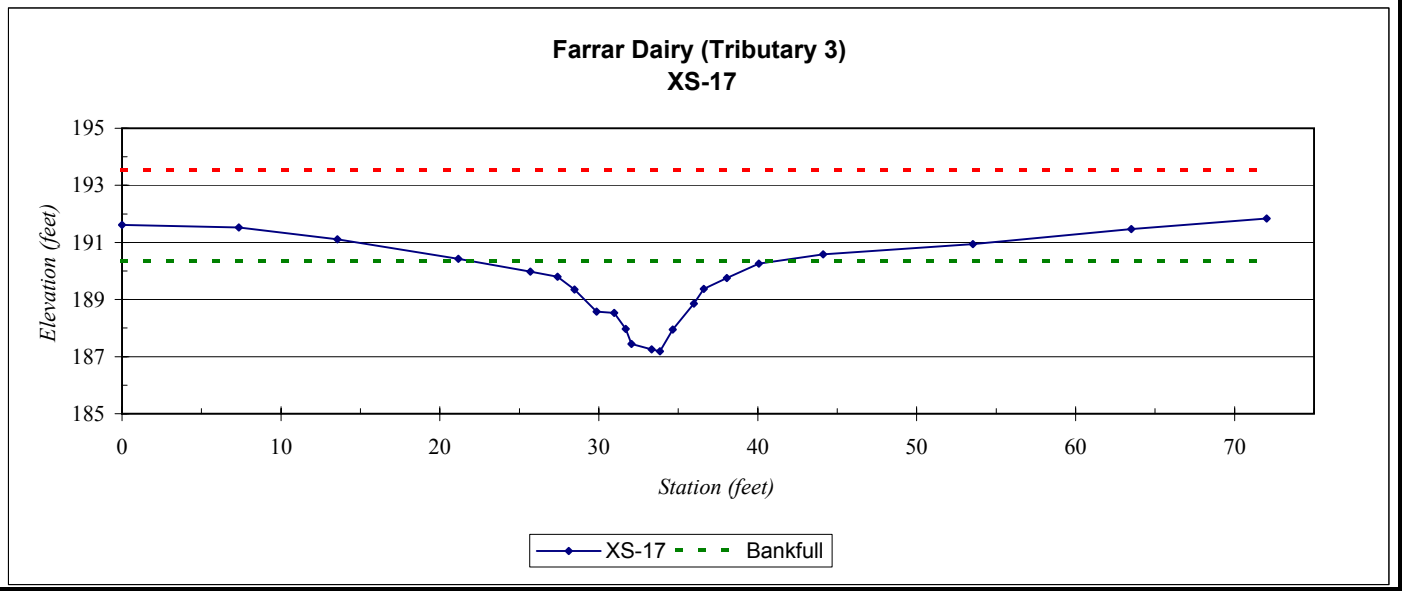


T3

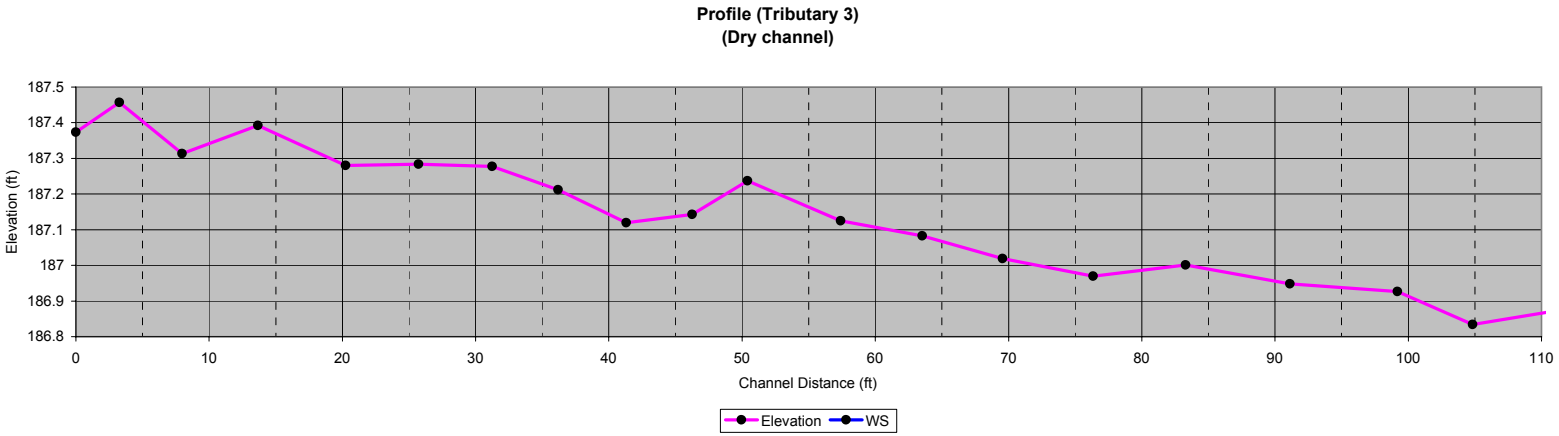
River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 3)
XS ID	XS-17
Drainage Area (sq mi):	0.38
Date:	September 2007
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	191.62
7.4	191.52
13.6	191.11
21.2	190.43
25.7	189.98
27.4	189.80
28.5	189.35
29.9	188.58
31.0	188.53
31.7	187.97
32.0	187.44
33.3	187.25
33.8	187.18
34.6	187.95
36.0	188.86
36.6	189.37
38.1	189.75
40.1	190.26
44.1	190.58
53.5	190.94
63.5	191.46
72.0	191.83

SUMMARY DATA	
Bankfull Elevation:	190.4
Bankfull Cross-Sectional Area:	20.1
Bankfull Width:	19.5
Flood Prone Area Elevation:	193.5
Flood Prone Width:	>70
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	1.0
W / D Ratio:	18.9
Entrenchment Ratio:	3.6
Bank Height Ratio:	0.8
Water Surface Slope (ft/ft):	0.005



Slope Profile

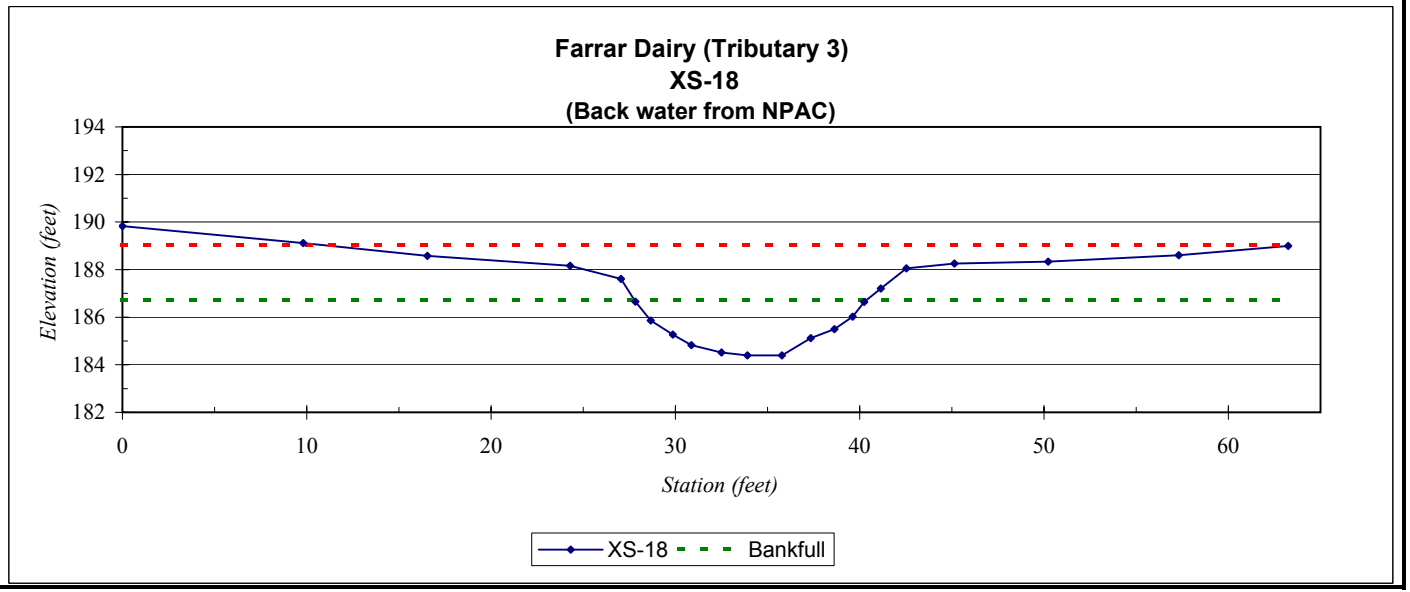


		Elevation BM:	100														
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO13		0		100									187.37					
PRO13	3.3	3.3		100									187.46					
PRO13	4.7	8.0		100									187.31					
PRO13	5.7	13.7		100									187.39					
PRO13	6.6	20.2		100									187.28					
PRO13	5.5	25.7		100									187.28					
PRO13	5.5	31.3		100									187.28					
PRO13	4.9	36.2		100									187.21					
PRO13	5.1	41.3		100									187.12					
PRO13	4.9	46.2		100									187.14					
PRO13	4.2	50.4		100									187.24					
PRO13	7.0	57.4		100									187.12					
PRO13	6.1	63.5		100									187.08					
PRO13	6.0	69.5		100									187.02					
PRO13	6.8	76.3		100									186.97					
PRO13	7.0	83.3		100									187.00					
PRO13	7.8	91.11235		100									186.95					
PRO13	8.1	99.18843		100									186.93					
PRO13	5.6	104.8243		100									186.83					
PRO13_TW=WS	5.7	110.5274		100									186.87					

River Basin:	Cape Fear
Watershed:	Farrar Dairy (Tributary 3)
XS ID	XS-18
Drainage Area (sq mi):	0.38
Date:	September 2007
Field Crew:	A. French, B. Roberts

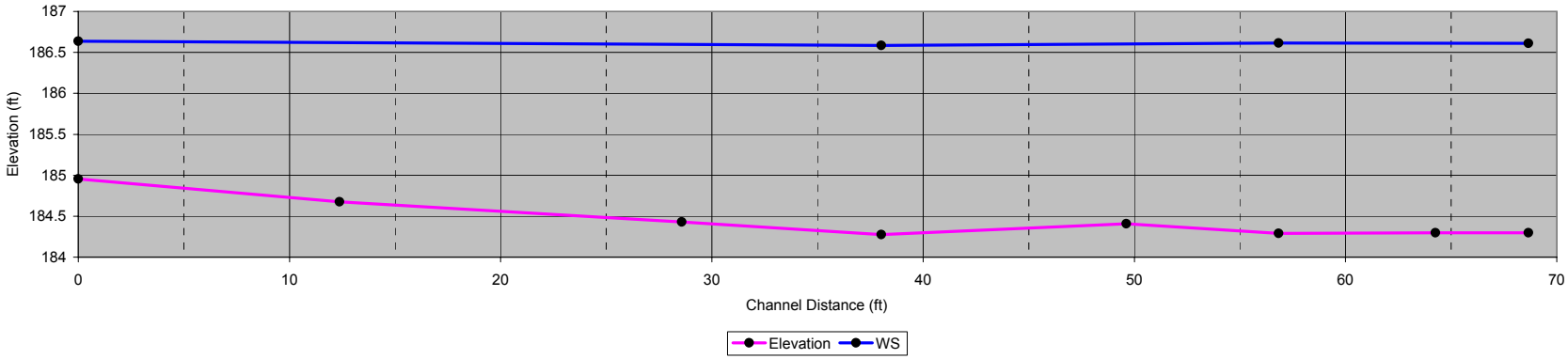
Station	Elevation
0.0	189.83
9.8	189.12
16.6	188.58
24.3	188.17
27.1	187.61
27.8	186.65
28.7	185.86
29.9	185.27
30.9	184.82
32.5	184.52
33.9	184.39
35.8	184.39
37.3	185.12
38.6	185.49
39.6	186.03
40.2	186.64
41.1	187.21
42.5	188.06
45.1	188.25
50.2	188.33
57.3	188.60
63.3	189.00

SUMMARY DATA	
Bankfull Elevation:	186.7
Bankfull Cross-Sectional Area:	20.0
Bankfull Width:	12.3
Flood Prone Area Elevation:	189.0
Flood Prone Width:	50.0
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.6
W / D Ratio:	7.6
Entrenchment Ratio:	4.1
Bank Height Ratio:	1.4
Water Surface Slope (ft/ft):	0.0004



Slope Profile

Profile (Tributary 3)
(Surface water is a result of backwater from NPAC)



		Elevation BM:	100															
	inc		BS	HI	FS	FS	depth	FS	FS	FS	FS	AZ	ELEV	ELEV	ELEV	ELEV	ELEV	ELEV
notes	distance	station	0	100	TP	bed	water	LB	RB	BKF	WS	azimuth	bed	water srf	LF	RB	BKF	WS
PRO12_TW		0		100									184.96					186.64
PRO12_TW	12.4	12.4		100									184.68					
PRO12_TW	16.2	28.6		100									184.43					
PRO12_TW	9.4	38.0		100									184.28					186.59
PRO12_TW	11.6	49.6		100									184.41					
PRO12_TW	7.2	56.8		100									184.29					186.61
PRO12_TW	7.4	64.3		100									184.30					
PRO12_TW	4.4	68.7		100									184.30					186.61

Additional BEHI and NBS worksheets

Stream: T3 Location: Farrar Site

Station: Observers: AD. BR

Date: 1-8-08 Stream Type: Valley Type:

						BEHI Score (Fig. A-9)
Study Bank Height / Bankfull Height (C)						
Study Bank Height (ft) =	3.3 (A)	Bankfull Height (ft) =	1.8 (B)	(A) / (B) =	1.8 (C)	8.8
Root Depth / Study Bank Height (E)						
Root Depth (ft) =	0.6 (D)	Study Bank Height (ft) =	3.3 (A)	(D) / (A) =	.18 (E)	7.2
Weighted Root Density (G)						
Root Density as % =	25 (F)			(F) x (E) =	4.5 (G)	9.5
Bank Angle (H)						
Bank Angle as *Degrees* =	40 (H)					3
Surface Protection (I)						
Surface Protection as % =	20 (I)					7

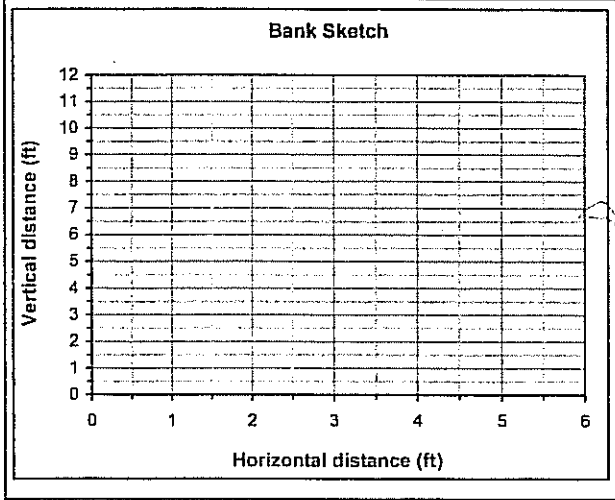
Bank Material Adjustment:

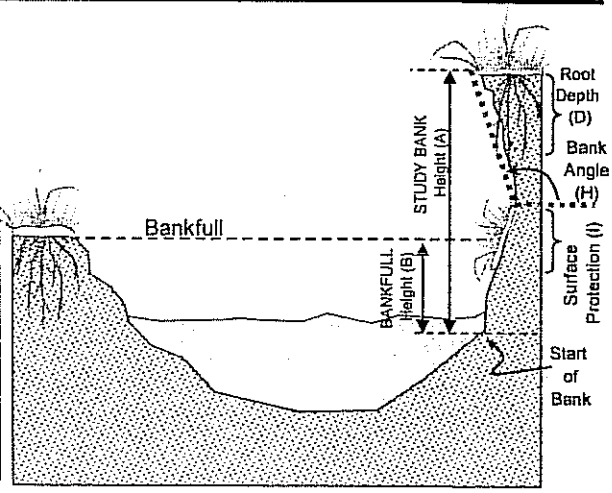
Bedrock (Overall Very Low BEHI)
Boulders (Overall Low BEHI)
Cobble (Subtract 10 points if uniform medium to large cobble)
Gravel or Composite Matrix (Add 5–10 points depending on percentage of bank material that is composed of sand)
Sand (Add 10 points)
Silt/Clay (no adjustment)

Bank Material Adjustment: 5

Stratification Adjustment
Add 5–10 points, depending on position of unstable layers in relation to bankfull stage: –

Very Low	Low	Moderate	High	Very High	Extreme	Adjective Rating and Total Score
5 – 9.5	10 – 19.5	20 – 29.5	30 – 39.5	40 – 45	46 – 50	40.5





Appendix F
NCDWQ Stream Identification Forms

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

Date: 3-10-06	Project: Farrar	Latitude:
Evaluator: SS	Site: T1	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 42	County: Harnett	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 23)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	1	2	(3)
3. In-channel structure: riffle-pool sequence	0	1	2	(3)
4. Soil texture or stream substrate sorting	0	1	(2)	3
5. Active/relic floodplain	0	(1)	2	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	1	(2)	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	2	(3)
11. Grade controls	0	0.5	1	(1.5)
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

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

C. Biology (Subtotal = 9)				
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:

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

Date: 3-10-06	Project: Farrar	Latitude:
Evaluator: SS	Site: Trib2	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 30.5	County: Harnett	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 15.5)	Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	0	1	2	(3)
2. Sinuosity	0	(1)	2	3
3. In-channel structure: riffle-pool sequence	0	1	(2)	3
4. Soil texture or stream substrate sorting	0	(1)	2	3
5. Active/relic floodplain	(0)	1	2	3
6. Depositional bars or benches	0	1	2	(3)
7. Braided channel	(0)	1	2	3
8. Recent alluvial deposits	0	(1)	2	3
9[a] Natural levees	(0)	1	2	3
10. Headcuts	0	1	(2)	3
11. Grade controls	0	0.5	(1)	1.5
12. Natural valley or drainageway	0	0.5	1	(1.5)
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = (0)		Yes = 3	

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

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

C. Biology (Subtotal = 6)				
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:

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

Date: 3-10-06	Project: Farrar	Latitude:
Evaluator: SS	Site: Trib 3	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 33.5	County: Harnett	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 18)

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

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

B. Hydrology (Subtotal = 8.5)

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

C. Biology (Subtotal = 7)

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:

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

Date: 3-10-06	Project: Farrar	Latitude:
Evaluator: SS	Site: Trib4	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* 43.5	County: Harnett	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 22)	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 = 10.5)				
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 G
Reference Reach Data

Reference Stream
Little Rockfish Creek

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

EARTH TECH
tyco / Earth Tech

Stream ID	41
Stream Name	Little Rockfish Creek
Contact	Ben Goetz
Organization	EarthTech
Email	Ben.Goetz@earthtech.com
Date Surveyed	7/2/2002

Location

River Basin	Cape Fear	
8-digit HUC	03030004	
Location	Gillis Farm	
Reach Description		
State	NC	
Latitude		(decimal degrees)
Longitude		(decimal degrees)
County	Cumberland	
Physio. Region	Coast	(coast, Piedmont, mtns)
Ecoregion		
Public/Private	V	
Right of Entry	☐	(check for yes)
USGS Quad	Clifdale	

Hydraulics

Bankfull Discharge		(cfs)
Bankfull Velocity		(ft/s)
Manning's n		
Method of Calculating Manning's n		

Channel Materials

Percent Silt/Clay	6%	
Percent Sand	81%	
Percent Gravel	15%	
Percent Cobble		
Percent Boulder		
Percent Bedrock		
D16		(mm)
D35	0.18	(mm)
D50	0.25	(mm)
D84	1.8	(mm)
D95	9	(mm)

Note: 2,049 mm corresponds to BEDROCK

Data Standards

No survey data provided	☐	No material analysis provided	☐
No pattern data provided	☐	Data do not align with regional curve	☐
No profile data provided	☐	No location information provided	☐
No hydraulics data provided	☐		

Description

Rosgen Stream Type	E5	Soils Type	
Reach Length	620 (ft)	BEHI Score	
Watershed Drainage Area	16.50 (sq. mi)	Avg Water Surface Slope	0.1600
Watershed % Impervious		Valley Slope	0.0020
Valley Type	(C- colluvial or A- alluvial)	Valley Length	477 (ft)
Land Use	(U- urban or R- rural)	Sinuosity	1.30
Site Description		DWQ Index No.	18-31-24-(1)
		DWQ Reference Reach	☐ (check for yes)
		DWQ Benthic Monitoring	☐ (check for yes)

Description of any Associated Wetlands

Description of Vegetative Communities

Watershed Description

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID 41

Stream Name Little Rockfish Creek

X-Section

X-Sec Station	Feature	Bankfull Width (ft)	Bankfull Depth (ft)	Bankfull Area (ft2)	BKF Max Depth (ft)	Width FPA (ft)	Low Bank Ht (ft)
1+53	Riffle	21	2.3	49.1	3	300	
3+73	Pool	16	3.4	55.1	5.4		
4+49	Riffle	19.5	2.3	45.4	3.5	300	

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID 41

Stream Name Little Rockfish Creek

Sinuosity 1.3

Pattern

Meander Length (ft)	Radius of Curvature (ft)	Meander Belt Width (ft)	Pool to Pool Spacing (ft)
325	35		79
119	30	36	68
184	27		123
220	36	27	74
	22		114

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID 41

Stream Name Little Rockfish Creek

Profile

Avg Water Surface Slope	0.16
Avg Valley Slope	0.002
Valley Length	477
Sinuosity	1.3

X-Sec Stationing	Run Slope	Pool Slope	Riffle Slope	Glide Slope
1+53			0.0042	
4+49			0.0028	

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID	41
Stream Name	Little Rockfish Creek

Dimension Ratios	**Mean**	**Minimum**	**Maximum**
Bankfull Width: Depth Ratio	8.80	8.48	9.13
Entrenchment Ratio	14.84	14.29	15.38
Bank Height Ratio			
Pool width: Bankfull width*	0.79	0.79	0.79
Max pool depth: Bankfull depth*	2.35	2.35	2.35
Mean pool depth: Bankfull depth*	1.48	1.48	1.48
Pool area: Riffle area*	1.17	1.17	1.17

*** Ratio denominators are the riffle mean bankfull value.**

Pattern Ratios	**Mean**	**Minimum**	**Maximum**
Pool to pool Spacing: Bkfl width	4.38	3.36	6.07
Meander length ratio	10.47	5.88	16.05
Radius of curvature ratio	1.47	1.09	1.78
Meander width ratio	1.45	1.23	1.78

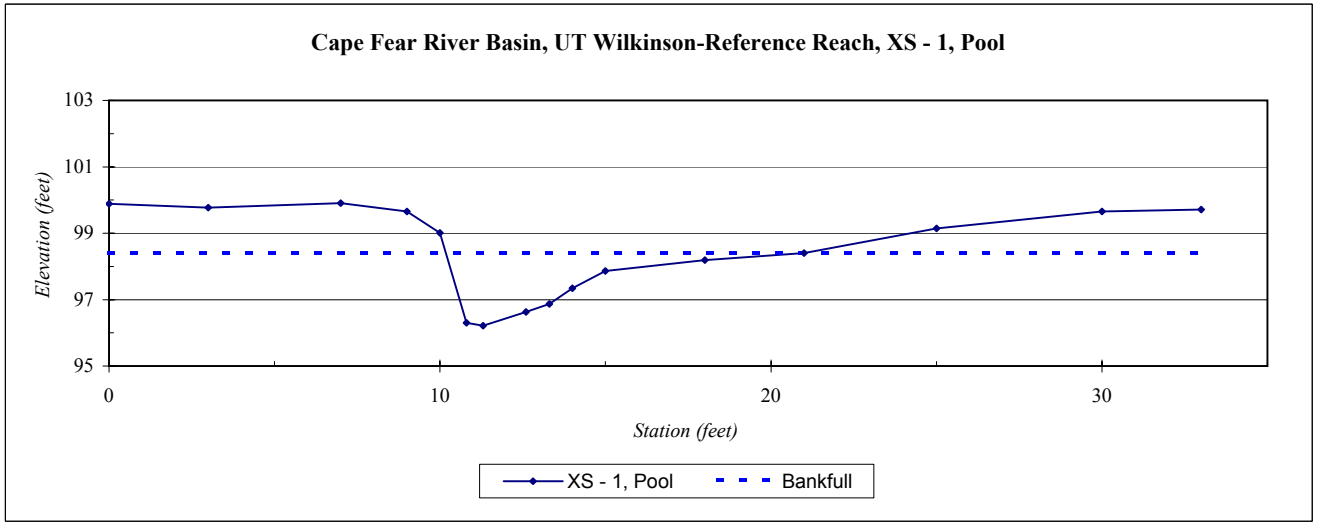
Profile Ratios	**Mean**	**Minimum**	**Maximum**
Pool slope: Avg WS slope			
Riffle slope: Avg WS slope	0.02	0.02	0.03
Glide slope: Avg WS slope			
Run slope: Avg WS slope			

Reference Stream
UT to Wilkinson Creek

River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 1, Pool
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	99.89
3	99.77
7	99.90
9	99.66
10	99.01
10.8	96.30
11.3	96.22
12.6	96.62
13.3	96.87
14	97.34
15	97.86
18	98.19
21	98.40
25	99.15
30	99.66
33	99.72

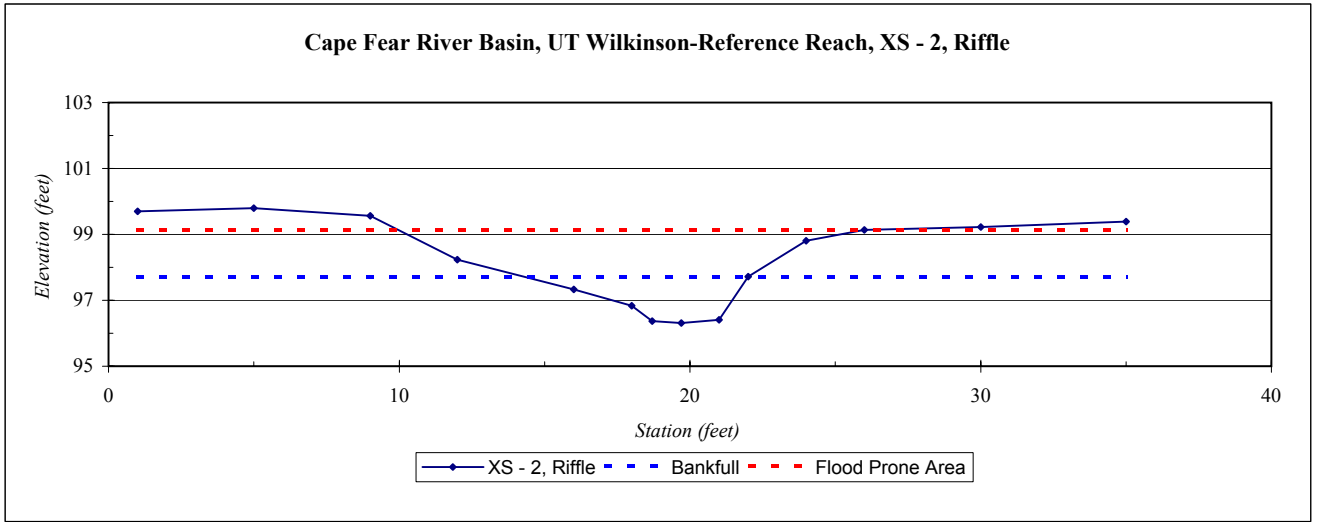
SUMMARY DATA	
Bankfull Elevation:	98.4
Bankfull Cross-Sectional Area:	8.6
Bankfull Width:	10.8
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.018



River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 2, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
1	99.70
5	99.80
9	99.57
12	98.23
16	97.33
18	96.84
18.7	96.37
19.7	96.32
21	96.41
22	97.72
24	98.81
26	99.13
30	99.22
35	99.38

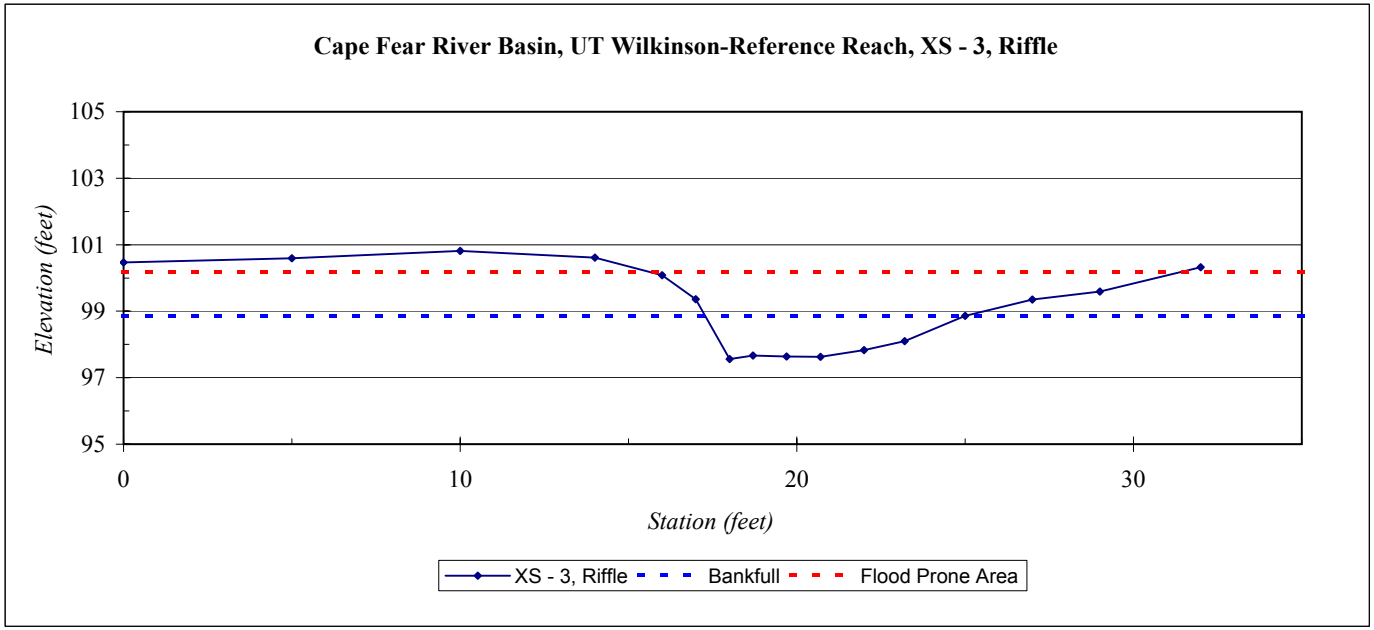
SUMMARY DATA	
Bankfull Elevation:	97.7
Bankfull Cross-Sectional Area:	6.2
Bankfull Width:	7.7
Flood Prone Area Elevation:	99.1
Flood Prone Width:	16.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.8
W / D Ratio:	9.6
Entrenchment Ratio:	2.1
Bank Height Ratio:	2.0
Water Surface Slope (ft/ft):	0.018



River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	100.47
5	100.60
10	100.82
14	100.61
16	100.09
17	99.36
18	97.56
18.7	97.67
19.7	97.64
20.7	97.63
22	97.83
23.2	98.10
25	98.86
27	99.35
29	99.59
32	100.32
35	100.97
39	101.20

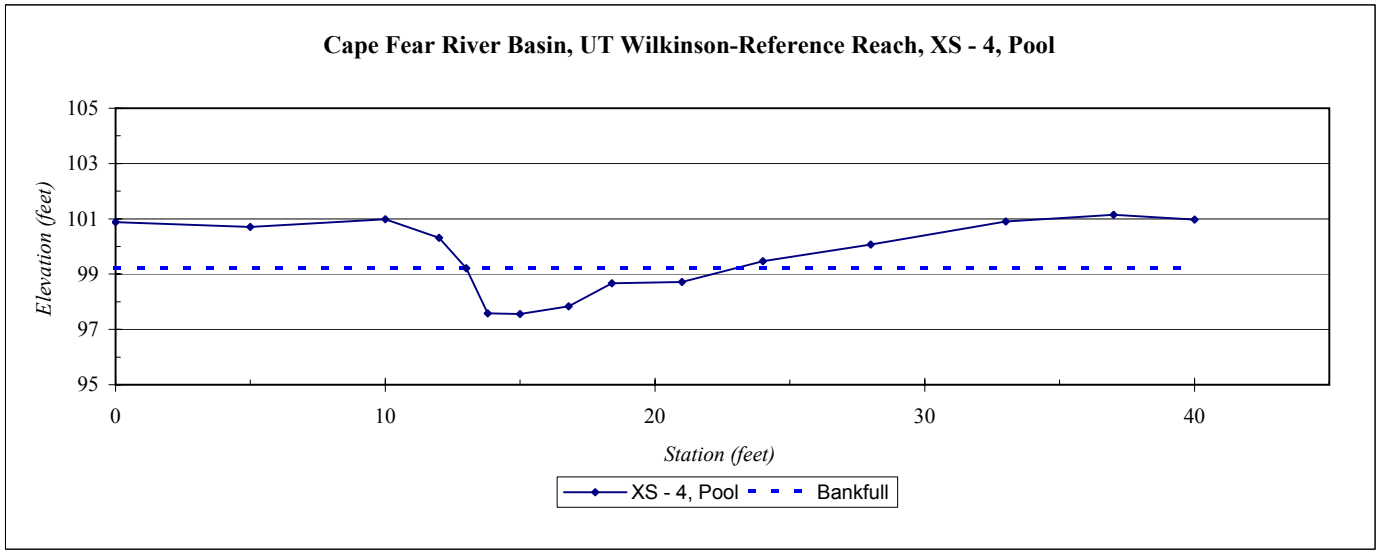
SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	7.0
Bankfull Width:	7.7
Flood Prone Area Elevation:	100.2
Flood Prone Width:	16.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	8.5
Entrenchment Ratio:	2.1
Bank Height Ratio:	2.3
Water Surface Slope (ft/ft):	0.018



River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 4, Pool
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0	100.88
5	100.71
10	100.98
12	100.31
13	99.22
13.8	97.58
15	97.55
16.8	97.84
18.4	98.67
21	98.72
24	99.47
28	100.07
33	100.90
37	101.15
40	100.98

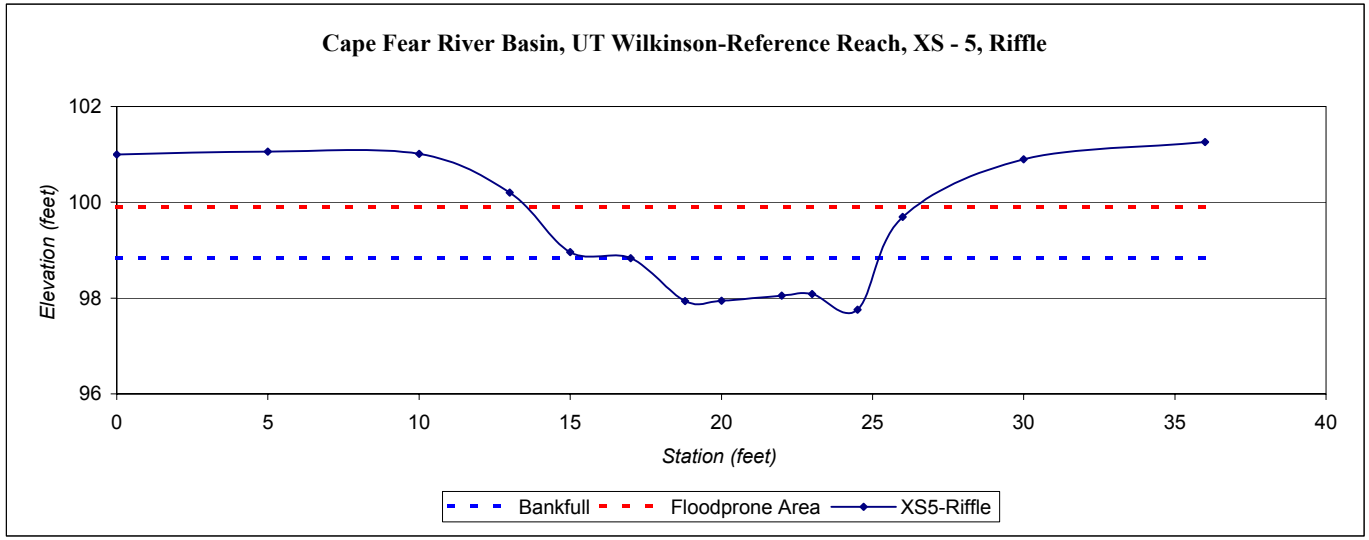
SUMMARY DATA	
Bankfull Elevation:	99.2
Bankfull Cross-Sectional Area:	8.8
Bankfull Width:	10.0
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.018



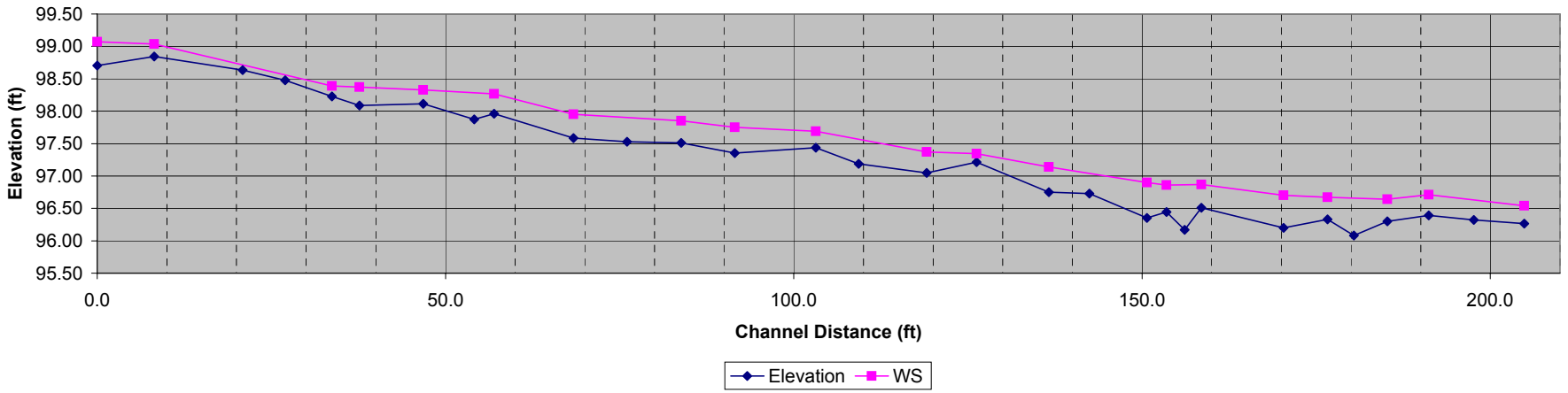
River Basin:	Cape Fear
Watershed:	UT Wilkinson-Reference Reach
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	0.145
Date:	5/9/2006
Field Crew:	A. Helms, A. French

Station	Elevation
0.00	101.00
5.00	101.06
10.00	101.01
13.00	100.20
15.00	98.96
17.00	98.83
18.80	97.94
20.00	97.94
22.00	98.05
23.00	98.08
24.50	97.75
26.00	99.70
30.00	100.90
36.00	101.26

SUMMARY DATA	
Bankfull Elevation:	98.8
Bankfull Cross-Sectional Area:	6.1
Bankfull Width:	8.3
Flood Prone Area Elevation:	99.9
Flood Prone Width:	13.0
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.7
W / D Ratio:	11.4
Entrenchment Ratio:	1.6
Bank Height Ratio:	2.7
Water Surface Slope (ft/ft):	0.018



UT-Wilkinson Reference Profile



Elevation BM: 100

notes	inc distance	station	BS 0	HI 100	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
				100														
TW	0	0.0		100									98.70					99.07
RIFF-start	8.18	8.2		100									98.85					99.04
RI	12.69	20.9		100									98.63					
RI	6.10	27.0		100									98.48					
RIFF-end	6.72	33.7		100									98.23					98.39
TW	3.93	37.6		100									98.09					98.37
TW	9.17	46.8		100									98.12					98.33
TW	7.32	54.1		100									97.87					
RIFF-start	2.85	57.0		100									97.96					98.27
RIFF-end	11.38	68.4		100									97.59					97.95
TW	7.69	76.0		100									97.53					
TW	7.78	83.8		100									97.51					97.85
TW	7.69	91.5		100									97.36					97.75
TW	11.66	103.2		100									97.44					97.69
TW	6.14	109.3		100									97.19					
TW	9.79	119.1		100									97.05					97.37
RIFF-start	7.15	126.2		100									97.21					97.34
RIFF-end	10.36	136.6		100									96.75					97.14
TW	5.82	142.4		100									96.73					
TW	8.26	150.7		100									96.35					96.90
POOL-start	2.81	153.5		100									96.45					96.86
POOL	2.63	156.1		100									96.17					
POOL-end	2.41	158.5		100									96.51					96.87
TW	11.78	170.3		100									96.20					96.70
POOL-start	6.31	176.6		100									96.33					96.67
POOL	3.81	180.4		100									96.08					
POOL-end	4.80	185.2		100									96.30					96.64
RIFF-start	5.96	191.2		100									96.39					96.71
RI	6.43	197.6		100									96.32					
RIFF-end	7.27	204.9		100									96.27					96.54

Reference Stream
Still Creek

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

BUCK ENGINEERING

Stream ID	9
Stream Name	Still Creek
Contact	Kevin Tweedy
Organization	Buck Engineering
Email	ktweedy@buckengineering.com
Date Surveyed	

Location

River Basin	Neuse
8-digit HUC	03020202
Location	Cliffs of the Neuse State Park
Reach Description	Visitors should check in at the Ranger Station before conducting surveys.
State	NC
Latitude	(decimal degrees)
Longitude	(decimal degrees)
County	Wayne
Physio. Region	Coast (coast, Piedmont, mtns)
Ecoregion	
Public/Private	U
Right of Entry	☐ (check for yes)
USGS Quad	Williams

Hydraulics

Bankfull Discharge	7.3	(cfs)
Bankfull Velocity	1.2	(ft/s)
Manning's n	0.04	
Method of Calculating Manning's n	Observation	

Channel Materials

Percent Silt/Clay		
Percent Sand		
Percent Gravel		
Percent Cobble		
Percent Boulder		
Percent Bedrock		
D16	0.28	(mm)
D35	0.37	(mm)
D50	0.44	(mm)
D84	0.82	(mm)
D95	0.97	(mm)

Note: 2,049 mm corresponds to BEDROCK

Data Standards

No survey data provided	☐	No material analysis provided	☐
No pattern data provided	☐	Data do not align with regional curve	☐
No profile data provided	☐	No location information provided	☐
No hydraulics data provided	☑		

Description

Rosgen Stream Type	E5	Soils Type	
Reach Length	529 (ft)	BEHI Score	
Watershed Drainage Area	0.35 (sq. mi)	Avg Water Surface Slope	0.0066
Watershed % Impervious		Valley Slope	0.0088
Valley Type	A (C- colluvial or A- alluvial)	Valley Length	399 (ft)
Land Use	R (U- urban or R- rural)	Sinuosity	1.33
Site Description	Single-thread small stream which flows into a small wetland system (DA)	DWQ Index No.	27-69
		DWQ Reference Reach	☐ (check for yes)
		DWQ Benthic Monitoring	☐ (check for yes)

Description of any Associated Wetlands

Most floodplain areas adjacent to stream are wetland. Reference reach flows into a small multithread wetland system (DA) at downstream end.

Description of Vegetative Communities

Watershed Description

Watershed is entirely within state park. There is a small pond at the top of the watershed.

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID 9

Stream Name Still Creek

X-Section

X-Sec Station	Feature	Bankfull Width (ft)	Bankfull Depth (ft)	Bankfull Area (ft2)	BKF Max Depth (ft)	Width FPA (ft)	Low Bank Ht (ft)
1+73.5	Riffle	7.07	0.95	6.73	1.36	34.29	1.36
2+39.5	Riffle	6.79	0.85	5.8	1.14	88.36	1.15
2+55.0	Pool	9.04	0.81	7.32	1.45	70.41	1.45
2+86.2	Riffle	7.99	0.71	5.7	1.11	68.6	1.11

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID 9

Stream Name Still Creek

Sinuosity 1.33

Pattern

Meander Length (ft)	Radius of Curvature (ft)	Meander Belt Width (ft)	Pool to Pool Spacing (ft)
43	21	15	45
84	47	48	45

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID	9	**Avg Water Surface Slope**	0.0066
Stream Name	Still Creek	**Avg Valley Slope**	0.0088
Profile		**Valley Length**	399
		Sinuosity	1.33

X-Sec Stationing	Run Slope	Pool Slope	Riffle Slope	Glide Slope
		0.0001		

Reference Reach Database

LeiLani Paugh, NCDOT
(919) 733-1194
lpaugh@dot.state.nc.us

Stream ID	9
Stream Name	Still Creek

Dimension Ratios	**Mean**	**Minimum**	**Maximum**
Bankfull Width: Depth Ratio	8.89	7.44	11.25
Entrenchment Ratio	8.82	4.85	13.01
Bank Height Ratio	1.00	1.00	1.01
Pool width: Bankfull width*	1.24	1.24	1.24
Max pool depth: Bankfull depth*	1.73	1.73	1.73
Mean pool depth: Bankfull depth*	0.97	0.97	0.97
Pool area: Riffle area*	1.20	1.20	1.20

* Ratio denominators are the riffle mean bankfull value.

Pattern Ratios	**Mean**	**Minimum**	**Maximum**
Pool to pool Spacing: Bkfl width	6.18	6.18	6.18
Meander length ratio	8.72	5.90	11.53
Radius of curvature ratio	4.67	2.88	6.45
Meander width ratio	4.32	2.06	6.59

Profile Ratios	**Mean**	**Minimum**	**Maximum**
Pool slope: Avg WS slope	0.02	0.02	0.02
Riffle slope: Avg WS slope			
Glide slope: Avg WS slope			
Run slope: Avg WS slope			

Appendix H
Jurisdictional Wetland Map

"THIS CERTIFIES THAT THIS COPY OF THIS PLAT ACCURATELY DEPICTS THE BOUNDARY OF THE JURISDICTION OF SECTION 404 OF THE CLEAN WATER ACT AS DETERMINED BY THE UNDERSIGNED ON THIS DATE. UNLESS THERE IS A CHANGE IN THE LAW OR OR OUR PUBLISHED REGULATIONS, THIS DETERMINATION OF SECTION 404 JURISDICTION MAY BE RELIED UPON FOR A PERIOD NOT TO EXCEED FIVE YEARS FROM THIS DATE. THIS DETERMINATION WAS MADE UTILIZING THE 1987 CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL."

NAME: _____

TITLE: Regulatory Specialist

DATE: 8/20/07

AID: 2006-40970

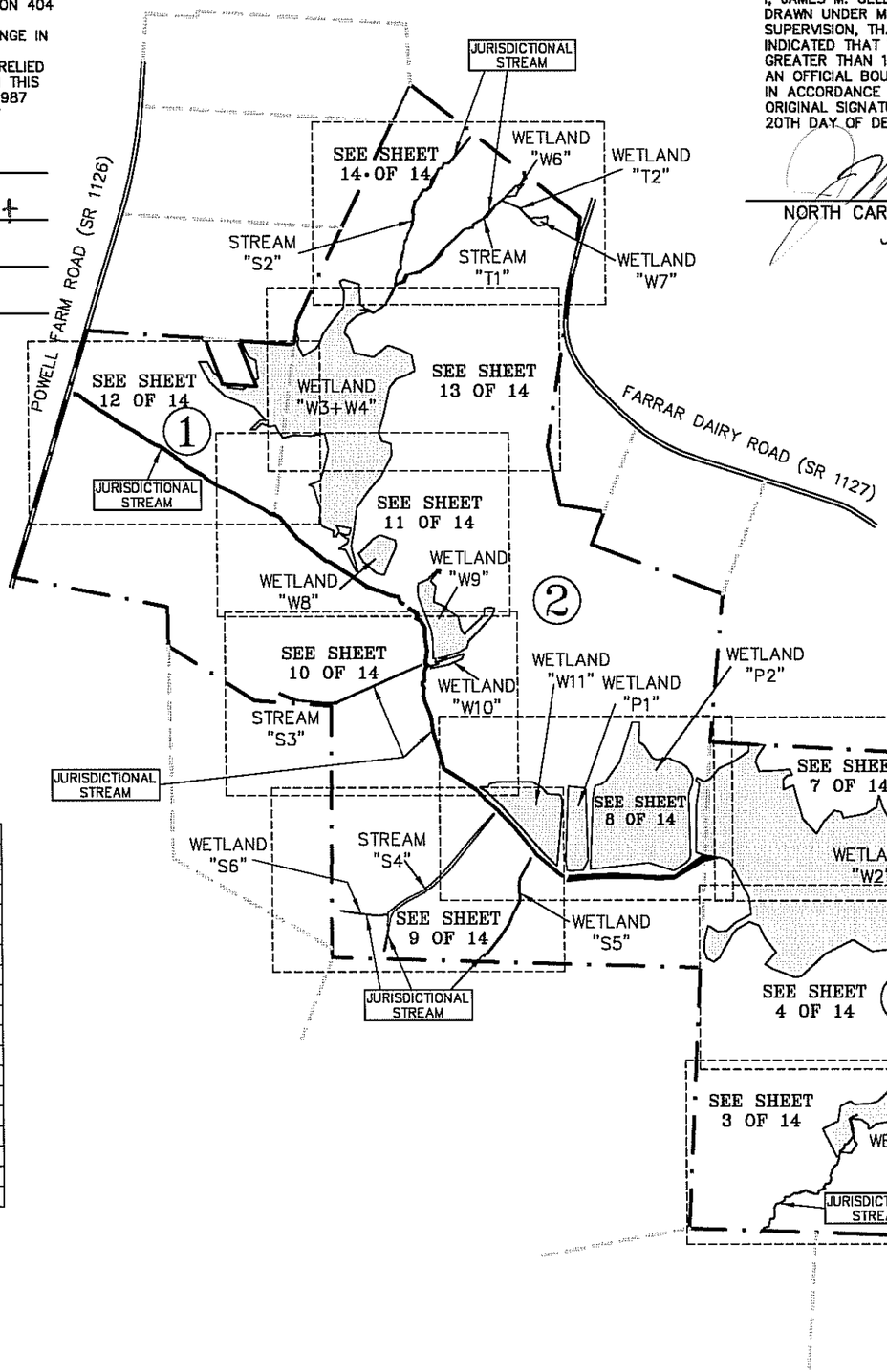
The above signature applies to sheets 1-14.

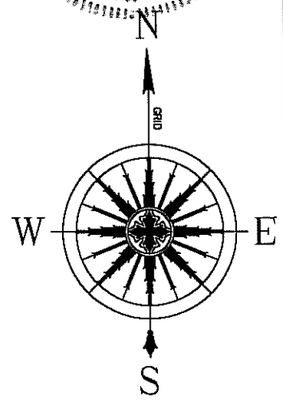
I, JAMES M. GELLENTHIN, HEREBY DECLARE THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION, THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED THAT THE RATIO OF PRECISION AS CALCULATED IS GREATER THAN 1:10,000; THAT THIS MAP DOES NOT REPRESENT AN OFFICIAL BOUNDARY SURVEY AND HAS NOT BEEN PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 20TH DAY OF DECEMBER, 2005.

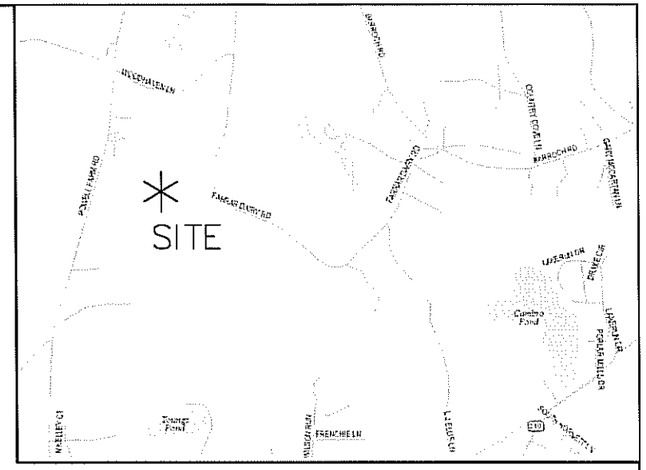
NORTH CAROLINA REGISTRATION NUMBER L-3860

JAMES M. GELLENTHIN

NORTH CAROLINA REGISTERED SEAL L-3860 SURVEYOR JAMES M. GELLENTHIN







VICINITY MAP
(NOT TO SCALE)

GENERAL NOTES:

THE BASIS OF THE COORDINATES SHOWN HEREON IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983.

ALL WETLAND FLAGS AND DATA POINTS WERE LOCATED IN THE FIELD BY CONVENTIONAL SURVEY METHODS BETWEEN JULY AND OCTOBER 2006.

WETLAND AREA TABLE

WETLAND/STREAM	ACREAGE
W1	1.70 AC
W2	60.60 AC
W3+W4	13.15 AC
W6	0.06 AC
W7	0.07 AC
W8	0.10 AC
W9	1.56 AC
W10	0.62 AC
W11	2.28 AC
T1	0.15 AC
T2	0.02 AC
S2	0.21 AC
S3	0.16 AC
S4	0.32 AC
S5	0.04 AC
S6	0.13 AC
P1	1.11 AC
P2	7.09 AC

(1) SANDRA WOMACK PAIT
PIN 0516-86-5081
DB 794-970

(2) JAMES FARRAR
PIN 0516-94-3941, PIN 0516-96-8380,
PIN 0526-05-0461, PIN 0526-03-4936
DB 471-27, DB 1055-324,
DB 1088-933

(3) BRIGHAM & KATHLEEN WILSON
PIN 0526-22-5697
DB 903-983

LEGEND:

- WETLANDS
- STREAM
- SURVEY BOUNDARY LIMITS
- PROPERTY LINE

12065438

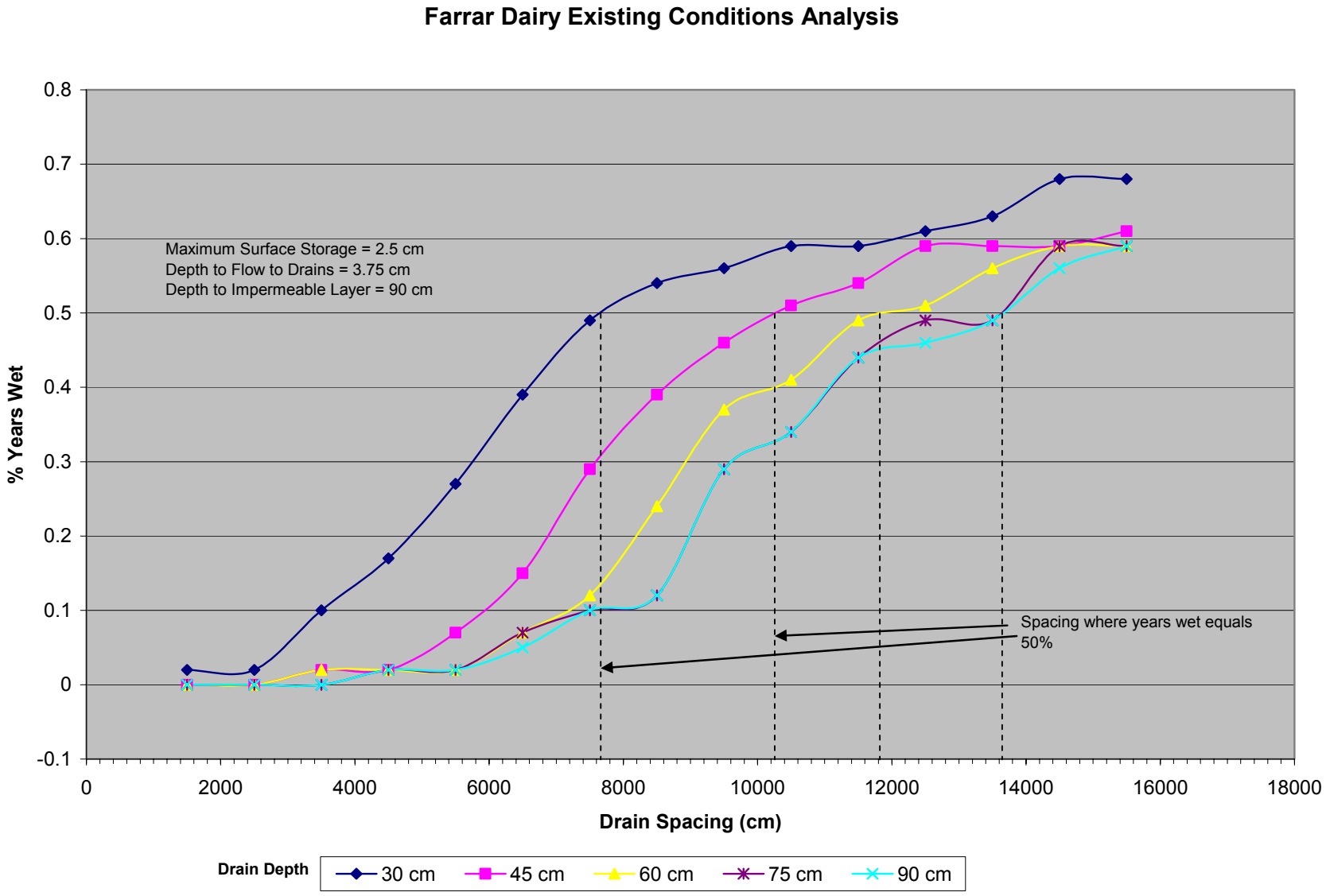
KCI ASSOCIATES OF NORTH CAROLINA

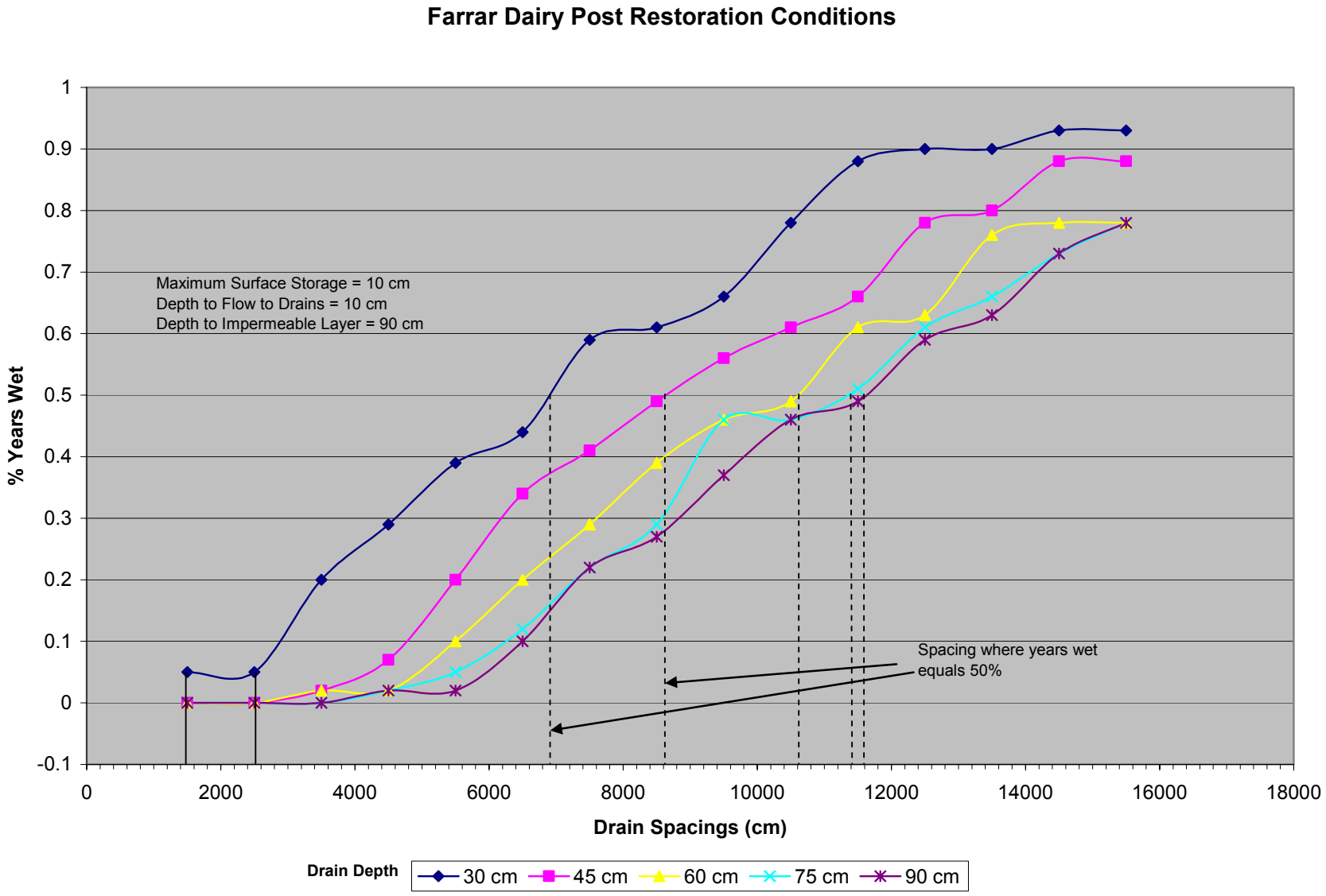
KCI ASSOCIATES OF N.C.
ENGINEERS, SURVEYORS AND PLANNERS
4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NC 27609
PHONE (919) 783-9214 * FAX (919) 783-9266

WETLAND DELINEATION PLAT
FOR
FARRAR SITE
@ STATE ROADS 1126 AND 1127
ANDERSON CREEK TOWNSHIP
HARNETT COUNTY, NORTH CAROLINA

DATE:	SCALE:	SHEET:
OCT 31, 2006	1" = 800'	1 OF 14

Appendix I
Groundwater Modeling


Farrar Dairy Existing Conditions Analysis
Maximum Surface Storage = 2.5 cm
Depth to Flow to Drains = 3.75 cm
Depth to Impermeable Layer = 90 cm
Spacing where years wet equals 50%
% Years Wet
Drain Spacing (cm)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Drain Depth
30 cm
45 cm
60 cm
75 cm
90 cm


Farrar Dairy Post Restoration Conditions
% Years Wet
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
Maximum Surface Storage = 10 cm
Depth to Flow to Drains = 10 cm
Depth to Impermeable Layer = 90 cm
Spacing where years wet equals 50%
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Drain Spacings (cm)
Drain Depth
30 cm
45 cm
60 cm
75 cm
90 cm

Existing Conditions for Farrar Dairy DRAINMOD Simulations

```
          ------------------------------------------------------
          *              DRAINMOD version 5.1                  *
          * Copyright 1980-99 North Carolina State University *
          ------------------------------------------------------

ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Wehadkee soil at Harnett Co, N.C.
for Ag field:15.2 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.80, 2.78,
*******************************************************************************


  ----------RUN STATISTICS ----------          time:  3/ 5/2008  @ 17:11
 input file:   C:\DRAINMOD\inputs\FARA60115.PRJ
 parameters:    free drainage              and yields not calculated
               drain spacing =   12500. cm   drain depth =   60.0 cm
-------------------------------------------------------------------------
```

YEAR	RAINFALL	INFILTRATION	ET	DRAINAGE	RUNOFF	SEW	TWLOSS	PUMPV
1960	120.73	120.24	88.18	4.45	.49	184.07	5.01	.00
1961	123.06	122.02	101.43	17.01	1.04	519.17	18.14	.00
1962	117.32	113.42	92.38	17.98	1.70	186.95	19.71	.00
1963	104.24	101.06	87.66	15.59	5.39	.00	21.00	.00
1964	147.90	127.34	99.06	26.70	20.56	980.00	47.31	.00
1965	117.91	103.67	98.73	17.45	14.23	184.38	31.74	.00
1966	106.91	103.13	84.30	7.85	3.78	.00	11.71	.00
1967	127.76	114.75	92.84	19.77	11.28	601.11	31.09	.00
1968	96.60	92.78	84.16	10.78	5.55	.00	16.35	.00
1969	128.32	117.46	93.20	23.35	10.86	730.37	34.26	.00
1970	104.77	104.18	96.74	14.01	.59	86.40	14.64	.00
1971	115.19	104.36	96.26	14.44	10.83	103.62	25.30	.00
1972	130.51	128.54	98.02	16.36	.81	.05	17.26	.00
1973	123.37	106.56	93.34	18.31	17.96	204.02	36.31	.00
1974	148.54	131.74	106.07	20.57	16.64	914.36	37.32	.00
1975	136.60	124.52	104.35	20.17	11.10	48.05	31.34	.00
1976	103.05	99.64	86.86	12.78	3.66	.00	16.46	.00
1977	117.22	111.15	97.09	14.07	6.04	.00	20.17	.00
1978	118.44	110.83	92.30	21.77	8.52	440.45	30.37	.00
1979	119.94	117.49	92.79	22.00	2.45	123.86	24.51	.00
1980	117.04	113.91	92.17	21.20	2.26	190.54	23.49	.00
1981	82.37	83.24	84.31	7.58	.00	.00	7.60	.00
1982	115.39	111.51	96.83	13.99	3.88	.00	17.93	.00
1983	126.09	109.26	83.14	18.16	15.35	528.81	33.52	.00
1984	117.20	113.30	98.70	26.46	5.38	754.54	31.90	.00
1985	112.98	109.99	97.18	7.03	2.99	.00	10.03	.00
1986	92.61	92.54	81.73	6.00	.07	220.77	6.13	.00
1987	106.15	87.01	79.74	15.45	19.14	.26	34.62	.00
1988	125.04	119.28	93.42	19.91	5.77	1241.03	25.77	.00
1989	162.05	133.85	103.55	27.44	28.20	1575.99	55.71	.00
1990	104.98	104.98	103.37	5.87	.00	.00	5.95	.00
1991	110.62	110.62	108.70	5.96	.00	.00	6.01	.00
1992	95.17	95.17	88.36	1.85	.00	.00	1.96	.00
1993	99.87	94.55	75.31	18.32	5.33	269.60	23.67	.00
1994	120.27	117.38	101.57	16.10	2.89	.00	19.05	.00

1995	149.99	121.08	96.35	23.28	28.90	978.41	52.23	.00
1996	135.05	122.29	94.18	27.97	12.76	1407.66	40.74	.00
1997	99.57	98.14	85.91	11.58	1.42	.00	13.02	.00
1998	122.99	97.42	91.51	18.10	25.56	397.07	43.68	.00
1999	137.08	120.65	94.97	15.49	16.43	1050.18	31.97	.00
2000	162.86	100.32	78.02	20.58	62.54	1541.35	83.16	.00
AVG	119.60	110.03	93.04	16.19	9.57	377.15	25.81	.00

```
          ------------------------------------------------------
          *              DRAINMOD version 5.1                  *
          * Copyright 1980-99 North Carolina State University *
          ------------------------------------------------------

ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Wehadkee soil at Harnett Co, N.C.
for Ag field:15.2 m D/SPACING, STMAX=2.5cm, thwtd=30cm/12days, Ksat=8.80, 2.78,
********************************************************************************


  ----------RUN STATISTICS ----------          time:  3/ 5/2008  @ 17:11
 input file:   C:\DRAINMOD\inputs\FARA60115.PRJ
 parameters:    free drainage              and yields not calculated
               drain spacing =   12500. cm   drain depth =   60.0 cm
--------------------------------------------------------------------------


                  D R A I N M O D --- HYDROLOGY EVALUATION
                  ****** INTERIM EXPERIMENTAL RELEASE ******

          Number of periods with water table closer than  30.00 cm
                for at least   12 days.  Counting starts on day
                 75 and ends on day  315 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   12 days or           Period in Days
                          more with WTD
                              < 30.00 cm
                        ------------------      --------------------

          1960                  0.                      7.
          1961                  1.                     23.
          1962                  0.                      9.
          1963                  0.                      5.
          1964                  2.                     27.
          1965                  1.                     21.
          1966                  0.                      0.
          1967                  1.                     15.
          1968                  0.                      1.
          1969                  3.                     13.
          1970                  0.                      9.
          1971                  1.                     19.
          1972                  0.                      1.
```

1973	1.	17.
1974	1.	26.
1975	1.	22.
1976	0.	0.
1977	0.	9.
1978	1.	12.
1979	0.	6.
1980	1.	21.
1981	0.	0.
1982	0.	4.
1983	1.	43.
1984	1.	27.
1985	0.	0.
1986	0.	9.
1987	0.	3.
1988	2.	18.
1989	4.	25.
1990	0.	0.
1991	0.	3.
1992	0.	0.
1993	2.	19.
1994	0.	3.
1995	1.	35.
1996	1.	30.
1997	0.	2.
1998	2.	18.
1999	2.	22.
2000	2.	43.

Number of Years with at least one period = 21. out of 41 years.

Proposed Post Restoration Conditions Farrar Dairy DRAINMOD simulations

```
 ------------------------------------------------------
 *              DRAINMOD version 5.1                  *
 * Copyright 1980-99 North Carolina State University *
 ------------------------------------------------------
```

ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Wehadkee soil at Harnett Co, N.C.
for Ag field:15.2 m D/SPACING, STMAX=10cm, thwtd=30cm/12days, Ksat=8.80, 2.78,
****

```
  ----------RUN STATISTICS ----------          time:  3/ 5/2008  @  8:37
 input file:   C:\DRAINMOD\inputs\FAPT60105.PRJ
 parameters:    free drainage              and yields not calculated
               drain spacing =   10700. cm   drain depth =   60.0 cm
-------------------------------------------------------------------------
```

YEAR	RAINFALL	INFILTRATION	ET	DRAINAGE	RUNOFF	SEW	TWLOSS	PUMPV
1960	120.73	120.73	88.06	5.54	.00	164.73	5.61	.00

1961	123.06	123.06	101.43	18.41	.00	335.33	18.50	.00
1962	117.32	115.79	91.79	20.10	.00	159.17	20.13	.00
1963	104.24	105.78	87.41	20.91	.00	.00	20.93	.00
1964	147.90	144.92	99.36	43.02	2.65	1499.24	45.70	.00
1965	117.91	118.24	99.97	29.66	.00	617.06	29.71	.00
1966	106.91	106.91	85.34	12.75	.00	.00	12.81	.00
1967	127.76	126.14	92.84	30.73	.00	1242.38	30.74	.00
1968	96.60	98.22	84.08	16.80	.00	.00	16.82	.00
1969	128.32	128.32	93.20	33.73	.00	967.38	33.79	.00
1970	104.77	104.78	96.04	15.32	.00	37.94	15.36	.00
1971	115.19	114.38	96.87	23.85	.81	344.05	24.67	.00
1972	130.51	130.25	98.02	18.04	.00	.00	18.14	.00
1973	123.37	120.93	95.53	30.49	2.69	569.24	33.24	.00
1974	148.54	143.83	106.07	32.99	4.71	1678.32	37.76	.00
1975	136.60	136.12	105.22	30.59	.00	287.68	30.66	.00
1976	103.05	102.34	86.70	15.64	.00	.00	15.65	.00
1977	117.22	118.05	96.99	21.05	.00	.00	21.12	.00
1978	118.44	118.81	92.30	30.66	.00	362.28	30.73	.00
1979	119.94	119.94	92.25	24.69	.00	122.86	24.74	.00
1980	117.04	116.98	91.41	24.62	.00	139.91	24.65	.00
1981	82.37	82.43	83.30	7.52	.00	.00	7.54	.00
1982	115.39	115.39	96.28	18.40	.00	.00	18.47	.00
1983	126.09	121.66	86.28	27.51	3.36	889.77	30.89	.00
1984	117.20	118.26	98.70	32.02	.00	734.41	32.06	.00
1985	112.98	112.98	97.47	9.40	.00	.00	9.41	.00
1986	92.61	92.61	81.36	7.06	.00	194.79	7.13	.00
1987	106.15	99.86	80.40	26.71	6.29	98.45	33.03	.00
1988	125.04	125.04	93.42	26.42	.00	1452.51	26.51	.00
1989	162.05	153.01	103.55	46.14	9.05	2797.83	55.22	.00
1990	104.98	104.98	102.64	6.72	.00	.00	6.81	.00
1991	110.62	110.62	107.89	6.38	.00	.00	6.42	.00
1992	95.17	95.17	88.29	2.30	.00	.00	2.41	.00
1993	99.87	99.87	76.00	22.91	.00	474.28	22.93	.00
1994	120.27	120.27	101.53	19.41	.00	.00	19.47	.00
1995	149.99	141.20	99.50	39.49	8.79	1491.03	48.34	.00
1996	135.05	133.72	93.36	40.62	1.33	2134.36	41.97	.00
1997	99.57	99.57	85.29	13.56	.00	.00	13.58	.00
1998	122.99	111.51	91.93	31.53	11.48	815.96	43.02	.00
1999	137.08	131.40	94.40	25.47	5.68	1740.12	31.19	.00
2000	162.86	116.92	78.59	37.54	45.94	2344.54	83.51	.00
AVG	119.60	117.10	93.20	23.09	2.51	577.94	25.64	.00

```
          ------------------------------------------------------
          *              DRAINMOD version 5.1                  *
          * Copyright 1980-99 North Carolina State University *
          ------------------------------------------------------

ANALYSIS OF WETLAND HYDROLOGIC CRITERIA for Wehadkee soil at Harnett Co, N.C.
for Ag field:15.2 m D/SPACING, STMAX=10cm, thwtd=30cm/12days, Ksat=8.80, 2.78,
*******************************************************************************



 ----------RUN STATISTICS ----------          time:  3/ 5/2008  @  8:37
 input file:   C:\DRAINMOD\inputs\FAPT60105.PRJ
```

parameters: free drainage and yields not calculated
drain spacing = 10700. cm drain depth = 60.0 cm

D R A I N M O D --- HYDROLOGY EVALUATION
****** INTERIM EXPERIMENTAL RELEASE ******

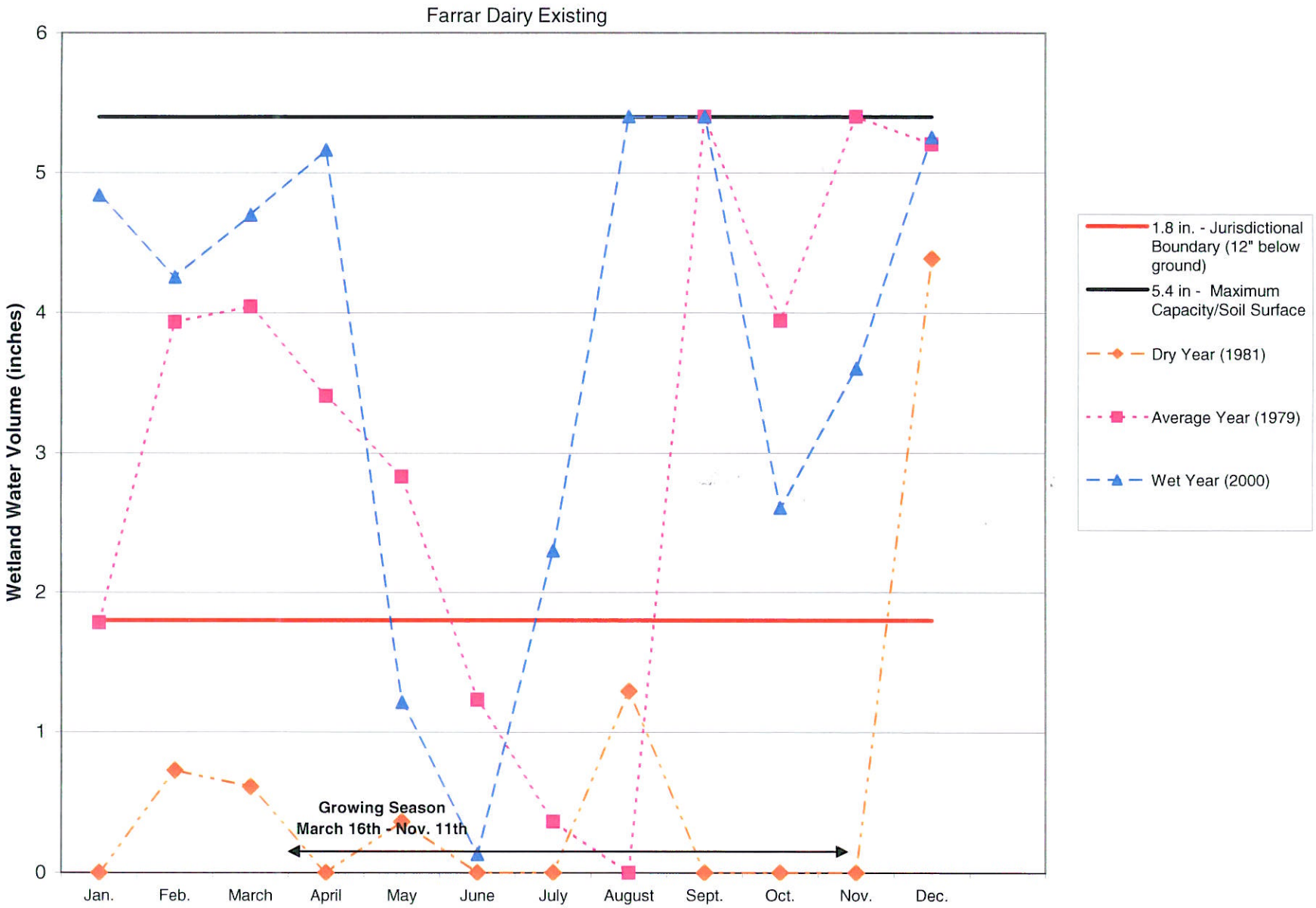
Number of periods with water table closer than 30.00 cm
for at least 12 days. Counting starts on day
75 and ends on day 315 of each year

YEAR	Number of Periods of 12 days or more with WTD < 30.00 cm	Longest Consecutive Period in Days
1960	0.	7.
1961	1.	22.
1962	0.	9.
1963	0.	6.
1964	2.	41.
1965	2.	34.
1966	0.	5.
1967	1.	44.
1968	0.	3.
1969	3.	19.
1970	0.	6.
1971	1.	34.
1972	0.	0.
1973	2.	27.
1974	1.	58.
1975	1.	36.
1976	0.	0.
1977	1.	12.
1978	0.	11.
1979	0.	5.
1980	1.	18.
1981	0.	0.
1982	0.	3.
1983	1.	56.
1984	1.	27.
1985	0.	0.
1986	0.	8.
1987	1.	23.
1988	1.	44.
1989	3.	45.
1990	0.	0.
1991	0.	0.
1992	0.	0.
1993	2.	20.
1994	0.	4.
1995	2.	47.
1996	1.	66.

1997	0.	2.
1998	1.	54.
1999	1.	52.
2000	1.	80.

Number of Years with at least one period = 22. out of 41 years.

Appendix J
Water Budget

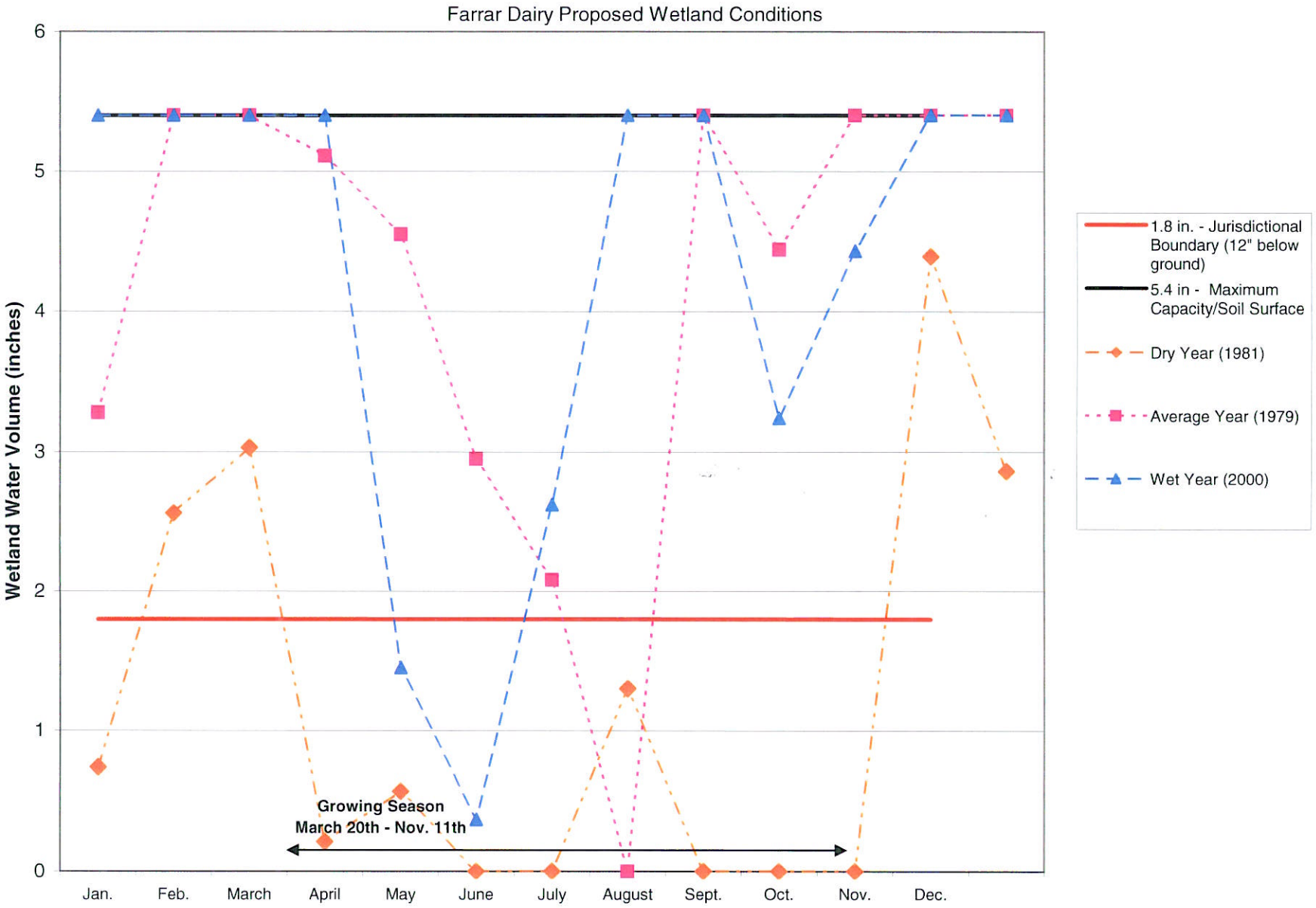

Farrar Dairy Existing
Wetland Water Volume (inches)
6
5
4
3
2
1
0
Jan.
Feb.
March
April
May
June
July
August
Sept.
Oct.
Nov.
Dec.
Growing Season
March 16th - Nov. 11th
1.8 in. - Jurisdictional Boundary (12" below ground)
5.4 in - Maximum Capacity/Soil Surface
Dry Year (1981)
Average Year (1979)
Wet Year (2000)

Farrar Dairy Water Budget - Existing Conditions

Dry Year	*Water Inputs*			*Water Outputs*				Change in Storage	Excess Water	Wetland Volume
1981	P	Si *	Gi	PET	So	Go	Infiltration/Loss to Ditches			
Jan-81	0.80	0.00	0.00	0.06	0.00	0.00	1.22	-0.48	0.00	0.00
Feb-81	2.46	0.00	0.00	0.64	0.00	0.00	1.09	0.73	0.00	0.73
Mar-81	1.53	0.00	0.00	1.06	0.00	0.00	0.58	-0.11	0.00	0.61
Apr-81	0.35	0.00	0.00	3.17	0.00	0.00	0.08	-2.90	0.00	0.00
May-81	4.05	0.01	0.00	3.69	0.01	0.00	0.00	0.36	0.00	0.36
Jun-81	1.89	0.00	0.00	6.54	0.00	0.00	0.00	-4.65	0.00	0.00
Jul-81	6.16	0.12	0.00	6.44	0.12	0.00	0.00	-0.28	0.00	0.00
Aug-81	6.72	0.34	0.00	5.42	0.34	0.00	0.01	1.29	0.00	1.29
Sep-81	1.24	0.00	0.00	3.95	0.00	0.00	0.00	-2.71	0.00	0.00
Oct-81	2.02	0.00	0.00	2.16	0.00	0.00	0.00	-0.14	0.00	0.00
Nov-81	0.68	0.00	0.00	1.17	0.00	0.00	0.00	-0.49	0.00	0.00
Dec-81	4.50	0.01	0.00	0.11	0.01	0.00	0.00	4.39	0.00	4.39
Annual Totals	32.40	0.48	0.00	34.41	0.48	0.00	2.98	-4.99	0.00	0.00

Avg. Year	*Water Inputs*			*Water Outputs*				Change in Storage	Excess Water	Wetland Volume
1979	P	Si *	Gi	PET	So	Go	Infiltration			
Jan-79	3.60	0.00	0.00	0.32	0.00	0.00	1.50	1.78	0.00	1.78
Feb-79	4.11	0.02	0.00	0.26	0.02	0.00	1.70	2.15	0.00	3.93
Mar-79	3.41	0.06	0.00	1.52	0.06	0.00	1.78	0.11	0.00	4.04
Apr-79	2.65	0.02	0.00	2.94	0.02	0.00	0.35	-0.64	0.00	3.41
May-79	3.54	0.00	0.00	4.10	0.00	0.00	0.02	-0.58	0.00	2.83
Jun-79	3.26	0.10	0.00	4.86	0.10	0.00	0.00	-1.60	0.00	1.23
Jul-79	4.97	0.27	0.00	5.84	0.27	0.00	0.00	-0.87	0.00	0.36
Aug-79	1.46	0.17	0.00	5.77	0.17	0.00	0.00	-4.31	0.00	0.00
Sep-79	11.32	0.40	0.00	4.21	0.40	0.00	0.06	7.05	2.37	5.40
Oct-79	1.09	0.00	0.00	2.05	0.00	0.00	0.50	-1.46	0.00	3.94
Nov-79	6.16	0.01	0.00	1.27	0.01	0.00	1.23	3.66	2.92	5.40
Dec-79	1.74	0.04	0.00	0.41	0.04	0.00	1.53	-0.20	0.00	5.20
Annual Totals	47.31	1.09	0.00	33.55	1.09	0.00	8.66	5.10	5.62	5.40

Wet Year	*Water Inputs*			*Water Outputs*				Change in Storage	Excess Water	Wetland Volume
2000	P	Si *	Gi	PET	So	Go	Infiltration			
Jan-00	5.79	0.11	0.00	0.02	0.11	0.00	0.93	4.84	0.16	4.84
Feb-00	1.73	0.01	0.00	0.70	0.01	0.00	1.61	-0.58	0.00	4.25
Mar-00	2.18	0.00	0.00	1.52	0.00	0.00	0.22	0.44	0.02	4.70
Apr-00	2.65	0.02	0.00	2.18	0.02	0.00	0.00	0.47	0.48	5.16
May-00	0.54	0.00	0.00	4.49	0.00	0.00	0.00	-3.95	0.00	1.21
Jun-00	4.88	0.01	0.00	5.96	0.01	0.00	0.00	-1.08	0.00	0.13
Jul-00	8.11	0.27	0.00	5.86	0.27	0.00	0.08	2.17	0.00	2.30
Aug-00	26.61	0.17	0.00	5.52	0.17	0.00	2.23	18.86	16.48	5.40
Sep-00	7.31	0.40	0.00	4.01	0.40	0.00	1.63	1.67	2.39	5.40
Oct-00	0.00	0.00	0.00	2.16	0.00	0.00	0.63	-2.79	0.00	2.61
Nov-00	2.00	0.01	0.00	0.81	0.01	0.00	0.19	1.00	0.00	3.60
Dec-00	2.31	0.04	0.00	0.09	0.04	0.00	0.57	1.65	0.57	5.25
Annual Totals	64.11	1.04	0.00	33.32	1.04	0.00	8.11	22.68	23.26	5.40


Farrar Dairy Proposed Wetland Conditions
Wetland Water Volume (inches)
6
5
4
3
2
1
0
Jan.
Feb.
March
April
May
June
July
August
Sept.
Oct.
Nov.
Dec.
Growing Season
March 20th - Nov. 11th
1.8 in. - Jurisdictional Boundary (12" below ground)
5.4 in - Maximum Capacity/Soil Surface
Dry Year (1981)
Average Year (1979)
Wet Year (2000)

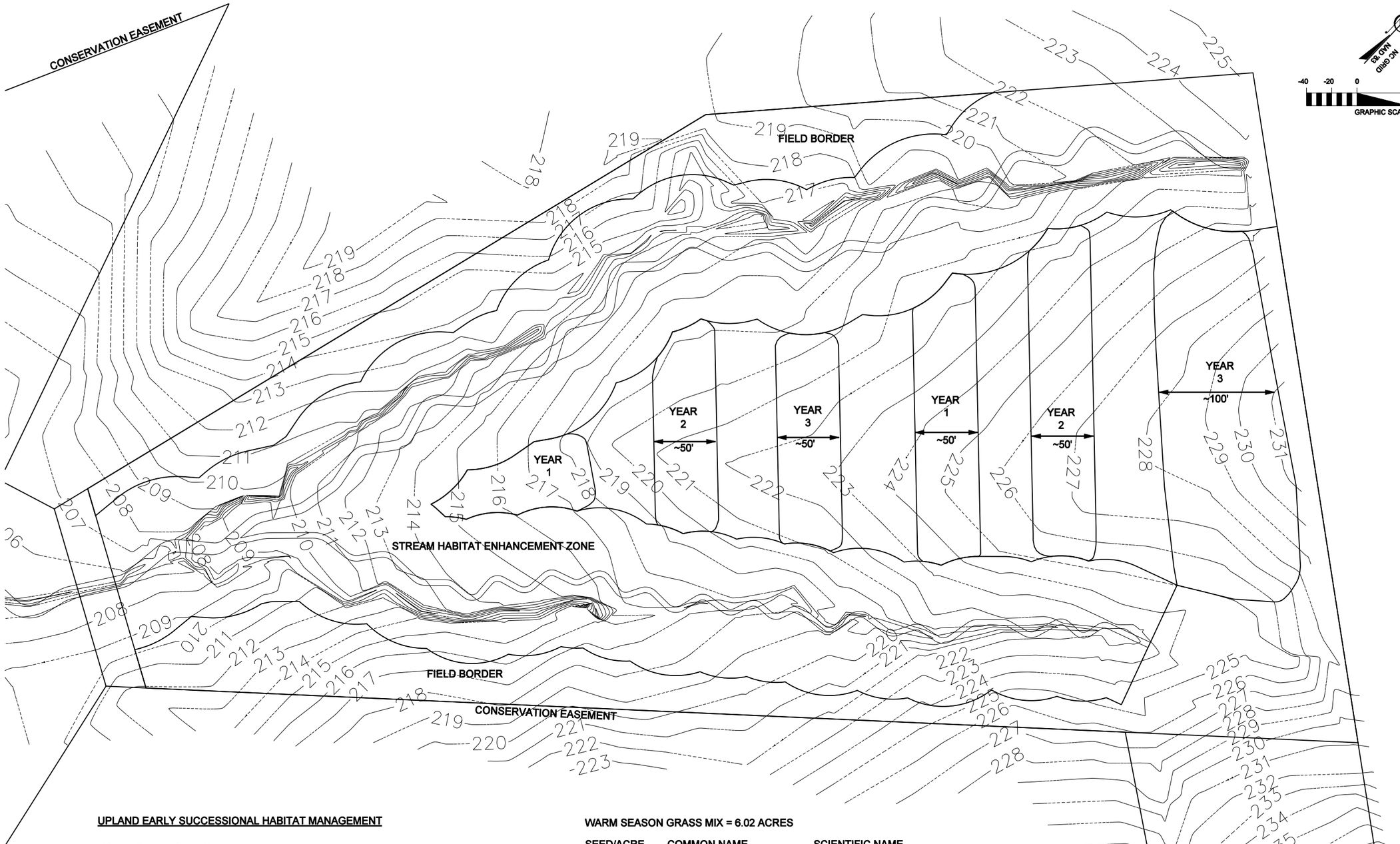
Farrar Dairy Water Budget - Proposed Conditions

Dry Year	Water Inputs			Water Outputs				Change in Storage	Excess Water	Wetland Volume
1981	P	Si *	Gi	PET	So	Go	Infiltration/Loss to Ditches			
Jan-81	0.80	0.00	0.00	0.06	0.00	0.00	0.00	0.74	0.00	0.74
Feb-81	2.46	0.00	0.00	0.64	0.00	0.00	0.00	1.82	0.00	2.56
Mar-81	1.53	0.00	0.00	1.06	0.00	0.00	0.00	0.47	0.00	3.03
Apr-81	0.35	0.00	0.00	3.17	0.00	0.00	0.00	-2.82	0.00	0.21
May-81	4.05	0.01	0.00	3.69	0.00	0.00	0.00	0.37	0.00	0.58
Jun-81	1.89	0.00	0.00	6.54	0.00	0.00	0.00	-4.65	0.00	0.00
Jul-81	6.16	0.12	0.00	6.44	0.00	0.00	0.00	-0.16	0.00	0.00
Aug-81	6.72	0.34	0.00	5.42	0.00	0.00	0.00	1.64	0.00	1.64
Sep-81	1.24	0.00	0.00	3.95	0.00	0.00	0.00	-2.71	0.00	0.00
Oct-81	2.02	0.00	0.00	2.16	0.00	0.00	0.00	-0.14	0.00	0.00
Nov-81	0.68	0.00	0.00	1.17	0.00	0.00	0.00	-0.49	0.00	0.00
Dec-81	4.50	0.01	0.00	0.11	0.00	0.00	0.00	4.40	0.00	4.40
Annual Tota	32.40	0.48	0.00	34.41		0.00		-1.53	0.00	2.87

Avg. Year	Water Inputs			Water Outputs				Change in Storage	Excess Water	Wetland Volume
1979	P	Si *	Gi	PET	So	Go	Infiltration			
Jan-79	3.60	0.00	0.00	0.32	0.00	0.00	0.00	3.28	0.00	3.28
Feb-79	4.11	0.02	0.00	0.26	0.00	0.00	0.00	3.87	2.47	5.40
Mar-79	3.41	0.06	0.00	1.52	0.00	0.00	0.00	1.95	2.67	5.40
Apr-79	2.65	0.02	0.00	2.94	0.00	0.00	0.00	-0.27	0.45	5.13
May-79	3.54	0.00	0.00	4.10	0.00	0.00	0.00	-0.56	0.00	4.57
Jun-79	3.26	0.10	0.00	4.86	0.00	0.00	0.00	-1.50	0.00	3.07
Jul-79	4.97	0.27	0.00	5.84	0.00	0.00	0.00	-0.60	0.00	2.47
Aug-79	1.46	0.17	0.00	5.77	0.00	0.00	0.00	-4.14	0.00	0.00
Sep-79	11.32	0.40	0.00	4.21	0.00	0.00	0.00	7.51	2.83	5.40
Oct-79	1.09	0.00	0.00	2.05	0.00	0.00	0.00	-0.96	0.00	4.44
Nov-79	6.16	0.01	0.00	1.27	0.00	0.00	0.00	4.90	4.66	5.40
Dec-79	1.74	0.04	0.00	0.41	0.00	0.00	0.00	1.37	2.09	5.40
Annual Tota	47.31	1.09	0.00	33.55		0.00	0.00	14.85	15.57	5.40

Wet Year	Water Inputs			Water Outputs				Change in Storage	Excess Water	Wetland Volume
2000	P	Si *	Gi	PET	So	Go	Infiltration			
Jan-00	5.79	0.11	0.00	0.02	0.00	0.00	0.00	5.88	1.20	5.40
Feb-00	1.73	0.01	0.00	0.70	0.00	0.00	0.00	1.04	1.76	5.40
Mar-00	2.18	0.00	0.00	1.52	0.00	0.00	0.00	0.66	1.38	5.40
Apr-00	2.65	0.02	0.00	2.18	0.00	0.00	0.00	0.49	1.21	5.40
May-00	0.54	0.00	0.00	4.49	0.00	0.00	0.00	-3.95	0.00	1.45
Jun-00	4.88	0.01	0.00	5.96	0.00	0.00	0.00	-1.07	0.00	0.38
Jul-00	8.11	0.27	0.00	5.86	0.00	0.00	0.00	2.52	0.00	2.90
Aug-00	26.61	0.17	0.00	5.52	0.00	0.00	0.00	21.26	19.48	5.40
Sep-00	7.31	0.40	0.00	4.01	0.00	0.00	0.00	3.70	4.42	5.40
Oct-00	0.00	0.00	0.00	2.16	0.00	0.00	0.00	-2.16	0.00	3.24
Nov-00	2.00	0.01	0.00	0.81	0.00	0.00	0.00	1.20	0.00	4.44
Dec-00	2.31	0.04	0.00	0.09	0.00	0.00	0.00	2.26	2.02	5.40
Annual Tota	64.11	1.04	0.00	33.32	0.00	0.00	0.00	31.83	32.55	5.40

Appendix K
Upland Early Successional Habitat Management



UPLAND EARLY SUCCESSIONAL HABITAT MANAGEMENT

ROTATIONAL MOWING
ROTATE MOWING AREAS ANNUALLY AS INDICATED ABOVE.
MOW TO HEIGHT OF APPROXIMATELY 4-8" TWO TIMES A YEAR.
MID-MARCH TO MID-APRIL - 1ST MOWING
LATE AUGUST TO SEPTEMBER - 2ND MOWING

FIELD BORDERS
MAINTAIN FIELD BORDERS APPROXIMATELY 30-120' WIDE WITH 50' OPTIMAL WIDTH ADJACENT TO WOODY GROWTH AND AGRICULTURAL FIELD. ONCE EVERY 3 YEARS, MOW AND LIGHTLY DISK FIELD BORDERS.

WARM SEASON GRASS MIX = 6.02 ACRES

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
0.8 LBS	BIG BLUESTEM	ANDROPOGON GERARDII
0.8 LBS	BUSHY BLUESTEM	ANDROPOGON GLOMERATUS
0.8 LBS	SIDEOATS GRAMA	BOUTELOUA CURTIPENDULA
0.8 LBS	PRAIRIE WILDRYE	ELYMUS CANADENSIS
0.8 LBS	VIRGINIA WILDRYE	ELYMUS VIRGINICUS
0.8 LBS	SWITCHGRASS	PANICUM VIRGATUM
0.8 LBS	LITTLE BLUESTEM	SCHIZACHYRIUM SCOPARIUM
0.8 LBS	INDIANGRASS	SORGHASTRUM NUTANS
0.8 LBS	PURPLETOP	TRIDENS FLAVUS
0.8 LBS	EASTERN GAMAGRASS	TRIPSACUM DACTYLOIDES
8 LBS/ACRE		

REVISIONS				
	DESCRIPTION	DATE	APPROVED	
A	SUBMITTED WITH RESTORATION PLAN (60%)	MARCH 2008		

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: MARCH 2008
SCALE: 1"=80'

UPLAND EARLY SUCCESSIONAL HABITAT MANAGEMENT PLAN

SHEET 1