FINAL
Stream Mitigation Plan
UT to Cane Creek Restoration Project

Alamance County, North Carolina

NCEEP Project ID No. 95729

Cape Fear River Basin: 03030002-050050

USACE Action ID No: SAW-2012-01907

Prepared for:

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

January 2014

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 01/06/14

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Prepared by:

Baker

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Phone: 919.463.5488
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January 2014

EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) proposes to restore 3,323 linear feet (LF) of perennial stream, and enhance 2,916 LF of stream along three unnamed tributaries (UTs) to Cane Creek. The UT to Cane Creek Restoration Project site (project) is located in Alamance County, North Carolina (NC) (Figure 2.1), approximately three miles south of the Town of Saxapahaw. The project is located in the NC Division of Water Resources (NCDWR) subbasin 03-06-04 and the NC Ecosystem Enhancement Program's (NCEEP) Targeted Local Watershed (TLW) 03030002-050050 of the Cape Fear River Basin. The purpose of the project is to restore and/or enhance the impaired stream and riparian buffer functions along the impaired stream channel at the site. A recorded conservation easement consisting of 19.9 acres (Figure 3.1) will protect all stream reaches and riparian buffers in perpetuity. Examination of the available hydrology and soil data indicate the project will potentially provide numerous water quality and ecological benefits within the Cane Creek and Haw River Watersheds, and the Cape Fear River Basin.

Based on the NCEEP 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the UT to Cane Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf), although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects which focus on developing creative strategies for improving water quality flowing to the Haw River in order to reduce NPS pollution to Jordan Lake.

The primary goals of the project are to improve ecologic functions and to manage nonpoint source inputs to the impaired areas as described in the NCEEP 2009 Cape Fear RBRP and are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters,
- Protect and improve water quality by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives have been identified:

- Restore existing incised, eroding, and channelized streams by providing them access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive stream bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

The proposed project aligns with overall NCEEP goals, which focus on restoring streams and riparian area values such as maintaining and enhancing water quality, increasing storage of floodwaters, and improving fish and wildlife habitat, as well as specific NCEEP RBRP goals including, but not limited to, nutrient and other non-point source pollutant management. The proposed natural channel design (NCD) approach will result in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Cane Creek sub-watershed, while improving water quality conditions that support terrestrial and aquatic species, including priority species identified in the Cape Fear River Basin.

This mitigation plan has been written in conformance with the requirements of the following:

- Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8, paragraphs (c)(2) through (c)(14).
- NCDENR Ecosystem Enhancement Program In-Lieu Fee Instrument signed and dated July 28, 2010.

These documents govern NCEEP operations and procedures for the delivery of compensatory mitigation.

Table ES.1 UT to Cane Creek Restoration Project Overview (Streams)
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Reach	Design Approach	Existing Reach Length (LF)	Design Reach Length (LF)	SMU Credit Ratio	Potential SMUs	Stationing	Comment
Unnamed Tributaries to Cane Creek (Reaches R1, R3, R4, R5, R5a)							
R1	R	944	1,043	1:1	1,043	10+00 to 20+43	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed.
R3	R	425	405	1:1	405	10+00 to 14+05	Restoration will follow a Rosgen Priority Level I and II approach. Work will involve a combination of raising a section of the streambed along the upstream portion of the reach, and grading a bankfull bench to provide floodplain connection.
R4 (upstream section)	E II	2,346	2,346	2.5:1	938	29+18 to 53+64	Enhancement Level II is proposed for a majority of the upper portion of the reach. Work will include stream bank sloping and stabilization, installation of in-stream structures, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
R4 (downstream section)	R	411	419	1:1	419	52+96 to 57+15	Restoration will follow a Rosgen Priority Level II approach. Work will include stream bank sloping and stabilization, installation of in-stream structures, grading a bankfull bench to provide floodplain connection, and planting native species vegetation.
R5 (upstream section)	R	1,386	1,456	1:1	1,456	10+00 to 24+56	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed.
R5 (downstream section)	E I	426	426	1.5:1	284	24+92 to 29+18	Enhancement Level I is proposed for a short portion of the downstream reach. Work will include minor stream bank sloping, stabilize active headcut, limited use of in-stream structures, improve existing stream crossing, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
R5a	E II	144	144	2.5:1	58	10+00 to 11+44	Enhancement Level II is proposed for the reach. Work will include minor stream bank sloping and stabilization, limited use of in-stream structures, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
Total		**6,082**	**6,239**	**-**	**4,603**		

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1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

The North Carolina Ecosystem Enhancement Program (NCEEP) develops River Basin Restoration Priorities (RBRPs) to guide its mitigation activities within each of the state's 17 major river basins and 54 cataloging units. RBRPs designate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds, designated as Targeted Local Watersheds (TLWs), receive priority for NCEEP planning and restoration project funds. The 2009 Cape Fear River Basin RBRP identified hydrologic cataloging unit (HUC) 03030002-050050 as a TLW (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf).

The Cane Creek sub-watershed is located in HUC 03030002-050050. The sub-watershed covers 70 square miles, including 213 miles of stream. Approximately 35 percent of stream reaches within the sub-watershed lack adequate riparian buffers. The sub-watershed is characterized by agricultural (46 percent of total area) and forested (49 percent of total area) land uses. Impervious surfaces constitute a small percentage of land use in the watershed (NCEEP, 2009). In addition to inadequate riparian buffers, there are 51 animal operations, 10 of which are permitted, in the sub-watershed. This leads to multiple opportunities to restore, enhance, or preserve streams and riparian buffers throughout this area.

The project will involve the restoration and enhancement of a Rural Piedmont Stream system (NC WAM 2010, Schafale and Weakley 1990) which has been impaired due to past agricultural conversion and cattle grazing. Due to the productivity and accessibility of these smaller stream systems, many have experienced heavy human and cattle disturbance. The middle portion of the main stem (Reaches R4 & R5) is mostly wooded, yet some sections have become highly unstable and are experiencing active widening and downcutting.

Restoration practices will involve raising the existing streambed and reconnecting the stream to the relic floodplain, and restoring natural flows to areas previously drained by ditching activities. The existing channels to be abandoned within the restoration areas will be partially filled to decrease surface and subsurface drainage and raise the local water table. Permanent cattle exclusion fencing will be provided around all proposed reaches and riparian buffers, with the exception of Reach R1, where cattle lack access. Vegetation buffers in excess of 50 feet will be established along both sides of the reaches and a recorded conservation easement consisting of 19.9 acres (AC) will protect the site in perpetuity. Additionally, Reach R2, a direct tributary to Cane Creek, immediately north of Reach R1, was submitted with the NCEEP proposal, however is not part of this mitigation plan. The reach designations have remained the same in order to be consistent throughout the document.

Animal operations, agricultural development, disturbance of natural riparian buffers (timber harvesting) and other various land-disturbing activities in the Cane Creek sub-watershed have negatively impacted both water quality and stream bank stability of the riparian buffers along Cane Creek and its various tributaries. To improve watershed health, one of the 2009 Cape Fear RBRP emphasized the need for increased implementation of agricultural best management practices (BMPs) in the Cane Creek watershed. Nutrients, sedimentation, stream bank erosion, livestock access to streams, channel modification and the loss of wetlands and riparian buffers were observed stressors within the watershed.

Additionally, the 2005 NCDWR Cape Fear River Basinwide Water Quality Plan states that all land uses and discharges of stormwater from subbasin 03-06-04 contribute nutrients to Jordan Reservoir. Jordan Reservoir has a total maximum daily load (TMDL) that was developed in 2007 for nitrogen and phosphorus to meet the chlorophyll *a* standard.

Based on the NCEEP 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the UT to Cane Creek Restoration Project area is located in an existing targeted local watershed (TLW) within the Cape Fear River Basin (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf), although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects which focus on developing creative strategies for improving water quality flowing to the Haw River in order to reduce NPS pollution to Jordan Lake.

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- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

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2.0 SITE SELECTION

2.1 Project Description and Directions to Project Site

The UT to Cane Creek Restoration Project site (site) is located in Alamance County, NC, approximately three miles south of the Town of Saxapahaw, as shown on the Project Site Vicinity Map (Figure 2.1). To access the site from Raleigh, take Interstate 40 and head west on US-64 towards Pittsboro, for approximately 25 miles. Take the exit ramp to NC 87 North towards Burlington and continue for 13 miles before turning left onto East Greensboro Chapel Hill Road. Once on East Greensboro Chapel Hill Road, travel west for approximately 1.2 miles before turning left onto Stockard Road. Then proceed 1.0 mile while heading south towards the end of the paved road. The site is located where the farm access road continues towards a farm pond crossing near an unnamed tributary to Cane Creek.

2.2 Site Selection

The site is located in the NC Division of Water Resources (NCDWR) subbasin 03-06-04 of the Cape Fear River Basin (Figure 2.2). The site includes three unnamed tributaries (UTs) to Cane Creek. Soils and topographic information (Figures 2.2, 2.3, 2.4, 2.5, and 2.6) indicate that the area contains well-drained upland soils and narrow historic valleys. The site soils primarily consist of Worham silt loam, Georgeville silty clay loam, and Tirzah silt loam.

Project Reaches R1 and R3 are shown as dashed blue-line streams on the USGS topographic quadrangle map (Figure 2.2). Project Reaches R4 and R5 are both shown as solid blue-line streams along their entire length within the project limits. Reaches R1, R3, R4, and R5a are shown as intermittent (unclassified) streams within the project limits on the 1960 Alamance County Soil Survey. The presence of historic valleys for each of the project stream systems can be seen from LIDAR imagery for the site (Figure 2.6), which was confirmed during field investigations.

Field evaluations of intermittent/perennial stream status were made in late March 2012. These evaluations were based on North Carolina Division of Water Resources (NCDWR) Methodology for Identification of Intermittent and Perennial Streams and Their Origins, (v 4.0) stream assessment protocols. Table 1 below presents the results of the field evaluations along with the assessed status of each project reach. Each of the project reaches scored as a perennial stream. Copies of the NCDWR classification forms can be found in Appendix B.

Table 1. Summary Information for Field Investigations to Determine Intermittent/Perennial Status

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Project Reach Designation	Existing Project Reach Length (ft)	NCDWR Stream Classification Form Score	Watershed Drainage Area (acres) [1]	Stream Status Based on Field Analyses
R1	944	30.5	77	Perennial
R3	425	36.0	95	Perennial
R4	2,757	42.5	472	Perennial
R5	1,812	38.5	306	Perennial
R5a	144	33.5	14	Perennial

Note 1: Watershed drainage area was approximated based on USGS topographic (NC Streamstats) and LIDAR information at the downstream end of each reach.

2.2.1 Historical Land Use and Development Trends

Land use in the watershed is approximately 49 percent forested, 46 percent agricultural, and approximately 35 percent of stream reaches lack adequate riparian buffers. Recent land use of the site includes active agricultural land managed as pasture for cattle grazing and crop production. Potential for land use change or future development in the area adjacent and upstream to the conservation easement is low, given the rural setting and proximity to the headwaters of the project location.

Over time, channels have incised and the UTs have become disconnected from their historic floodplain. Additionally, the riparian buffer has been cleared or narrowed in numerous locations to increase pastureland. These processes and practices have contributed excessive sediment and nutrient loading to the UTs and their receiving waters: Cane Creek, Jordan Reservoir, and the Cape Fear River.

2.2.2 Successional Trends

To convert the land for agricultural use, landowners historically cleared portions of the mature forest and manipulated site streams to increase land for grazing and agriculture. Over time, the stream channels became incised and floodplain connectivity was further reduced. More recently, landowners cleared portions of the remaining riparian buffer area within the site boundary to provide additional land for pasture (Figure 2.4). A historical aerial photograph from 1974 shows a more mature riparian buffer, particularly on Reaches R4, R5, and R5a, than what is present now.

Baker staff conducted field assessments that included an existing conditions survey and photographic documentation to evaluate and document the impacts of past land use management practices and current site conditions for each project stream reach. The following paragraphs briefly summarize these findings and the results were used to describe the geomorphic (Rosgen) stream classification for the project stream reaches. Sections 7 and 17 describe the restoration approaches proposed to achieve functional uplift and improve overall watershed health.

Reach R1 begins at the outfall pipe from an existing farm pond at the south end of the project site. Reach R1 flows from the pond outfall, eastward approximately 944 LF, to its confluence with Cane Creek. At several locations along its length, Reach R1 appears to have been moved away from the low point of the valley, likely to accommodate the adjacent row-cropping practices to the north. Cattle do not currently have access to this reach, however the upstream portions of Reach R1 appear to have been straightened and channelized, as evidenced by the spoil piles along the stream banks in this location. This portion of Reach R1 is moderately incised as a result of these modifications, and bank height ratios often exceed 1.5. The bank heights are slightly lower in middle portions of Reach R1, but increase again near an active headcut further downstream before the confluence with Cane Creek. This headcut will likely cause further channel incision, stream bank erosion, and subsequent channel widening if left unaddressed. Based on existing conditions, Reach R1 is classified as an incised "E" Rosgen stream type with portions evolving towards a more unstable "Gc" stream type.

Reach R3 begins just downstream from the confluence of two small tributaries on the northwest portion of the project site and extends approximately 425 LF to the confluence with Reach R5. The reach is actively incising, with typical bank height ratios of 2.0 or more, and is consequently experiencing significant degradation. Few mature buffer trees remain after recent timber harvesting and cattle now use this riparian buffer as a loafing area. Chinese privet (*Ligustrum sinense*) is prevalent along much of the existing buffer. Similar to Reach R1, the majority of the riffles along Reach R3 were observed to have their coarse gravel accumulations imbedded with fine sediment. This fining is likely due to stream bank erosion occurring along Reach R3. Based on existing

conditions, Reach R3 has a Rosgen stream type classification of "G" with a few stable riffles exhibiting a "Bc" stream type.

Reach R4 begins at the confluence of Reaches R3 and R5 and flows south to its confluence with Cane Creek. Reach R4 exhibits two distinctly different conditions along its reach. A majority of the reach is relatively stable with little to no floodplain alterations and bank height ratios ranging from 1.0 to 1.3, warranting enhancement activities only. However, from the existing crossing downstream to its confluence with Cane Creek, restoration is required due to significant instability and high stream bank erosion. The upstream, stable section of Reach R4 is bedrock controlled and is of near reference reach quality in several locations; however, cattle have total access throughout this area. Sections of the riparian buffer along this section of Reach R4 have recently been selectively timbered. Chinese privet (*Ligustrum sinense*), Tree-of-heaven (*Ailanthus altissima*), and Multi-flora rose (*Rosa multiflora*) are prevalent in many locations as well.

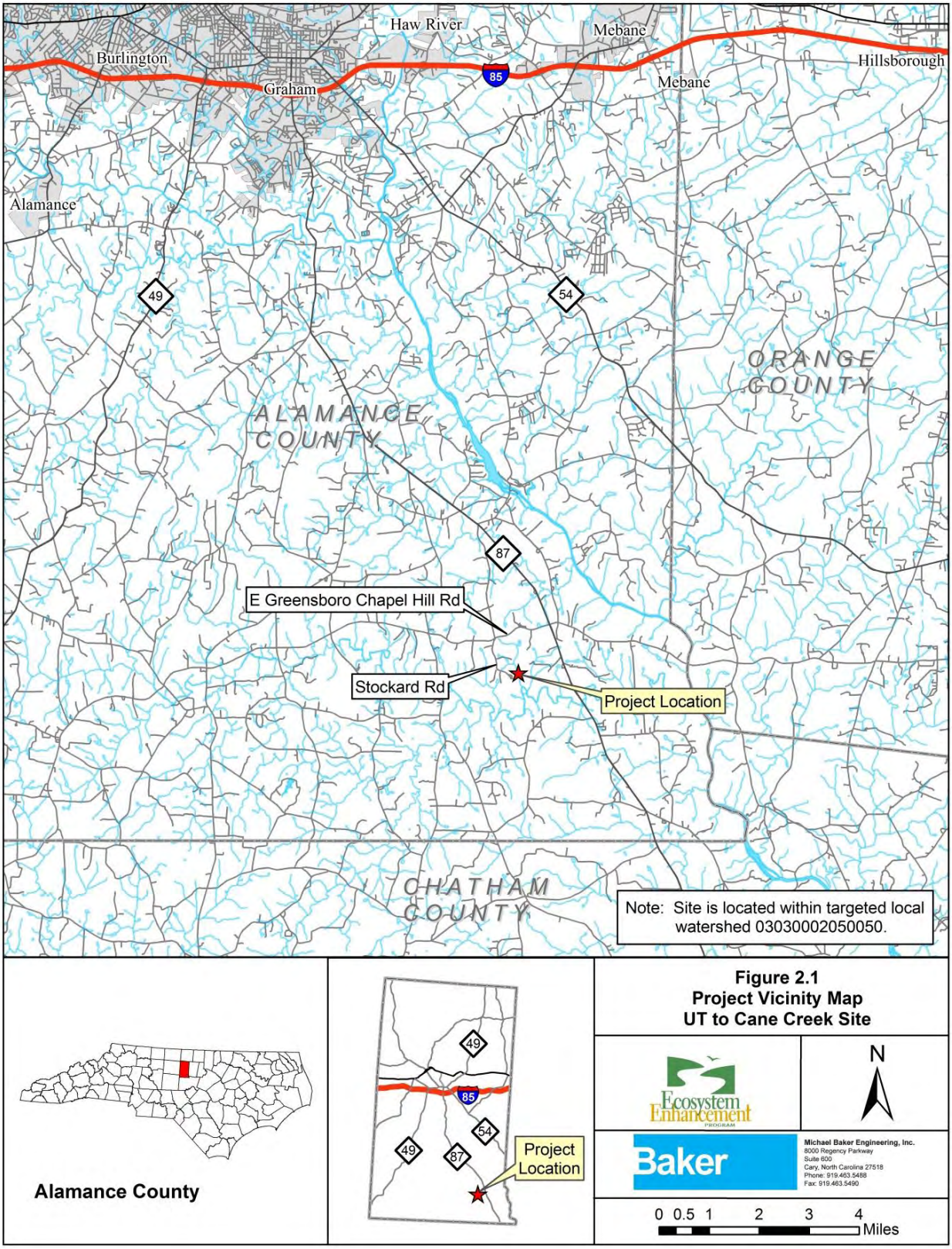
The buffer along the unstable section of Reach R4 consists mostly of herbaceous vegetation with frequent breaks in continuity of canopy of trees insufficient to form a definable single line of native trees along the top of the stream banks. Most of Reach R4 is subject to water quality stressors, in the form of an inadequate buffer with direct livestock access. The upstream, stable section of Reach R4 has a Rosgen stream type classification of "Bc". The downstream, unstable section of Reach R4 has a Rosgen stream type classification of "G".

Reach R5 begins at the northern property line and flows southward approximately 1,400 LF to an existing culverted crossing. The downstream portion of Reach R5 flows approximately 400 LF further to its confluence with Reach R3 and R4. The 1,400 LF of Reach R5 upstream of the culverted crossing is significantly degraded and appears to have been manipulated in the past, away from the low point of the valley (likely to expand the adjacent pastures). As a result of channelization and straightening, Reach R5 has downcut to existing bedrock in some locations, causing subsequent lateral instability. The reach is exhibiting moderate incision, with typical bank height ratios of 2.3 or more. A low percentage of the riffles along the degraded Reach R5 were observed to have coarse gravel accumulations imbedded with fine sediment.

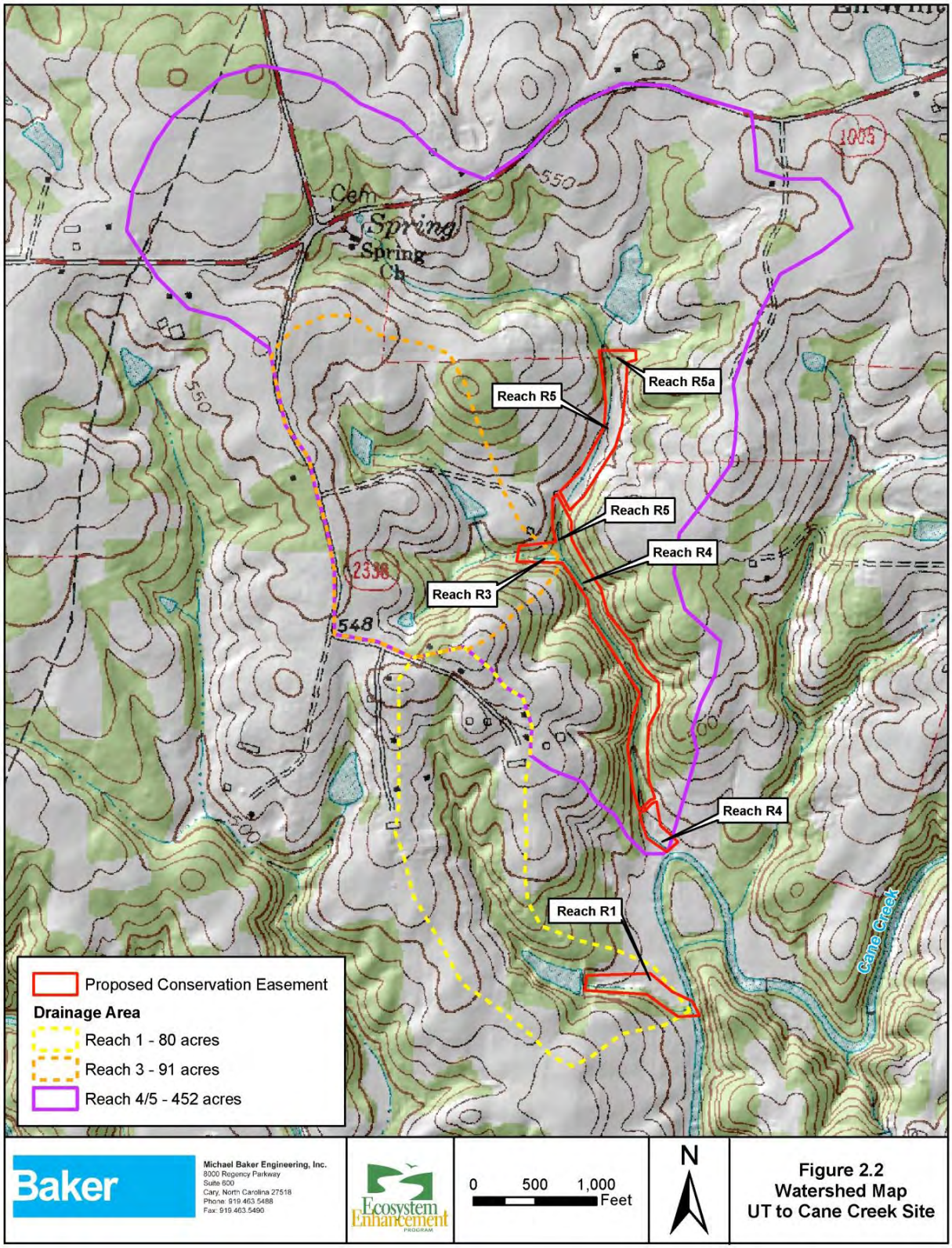
The condition of Reach R5 downstream of the culverted crossing is marginally stable in a few sections, however a headcut is actively migrating upstream and stream bank erosion is wide-spread due primarily to on-going cattle access. The buffer along this section of Reach R5 is best described as herbaceous with frequent breaks in continuity of canopy of trees insufficient to form a definable, single line of native trees along the top of the stream banks. Many of those trees are Tree-of-heaven (*Ailanthus altissima*), an exotic invasive. The uppermost end of Reach R5, near the property line exhibits a small area with a more "natural" buffer, though actively accessed by cattle. Over half of the degraded length of Reach R5 has experienced floodplain alteration, as evidenced by the obvious unnatural pattern of the reach. The longer, degraded stretch of Reach R5 has a Rosgen stream type classification of "G". The shorter, downstream section of is Reach R5 classifies as a Rosgen "B" stream type classification and evolving towards a more unstable condition.

Reach R5a begins near the northeastern property line and flows southwestward approximately 144 LF to its confluence with Reach R5. The reach is mostly stable and has exposed bedrock in a few locations, causing minor lateral instability. The reach is exhibiting slight to moderate incision, with typical bank height ratios of 1.3 or more. A low percentage of the riffles along Reach R5a were observed to have coarse gravel accumulations imbedded with fine sediment. Sections of the riparian buffer along Reach R5a have recently been selectively timbered and the left stream bank has minimal woody vegetation. Chinese privet (*Ligustrum sinense*) and Multi-flora rose (*Rosa multiflora*) are prevalent in a few locations as well.

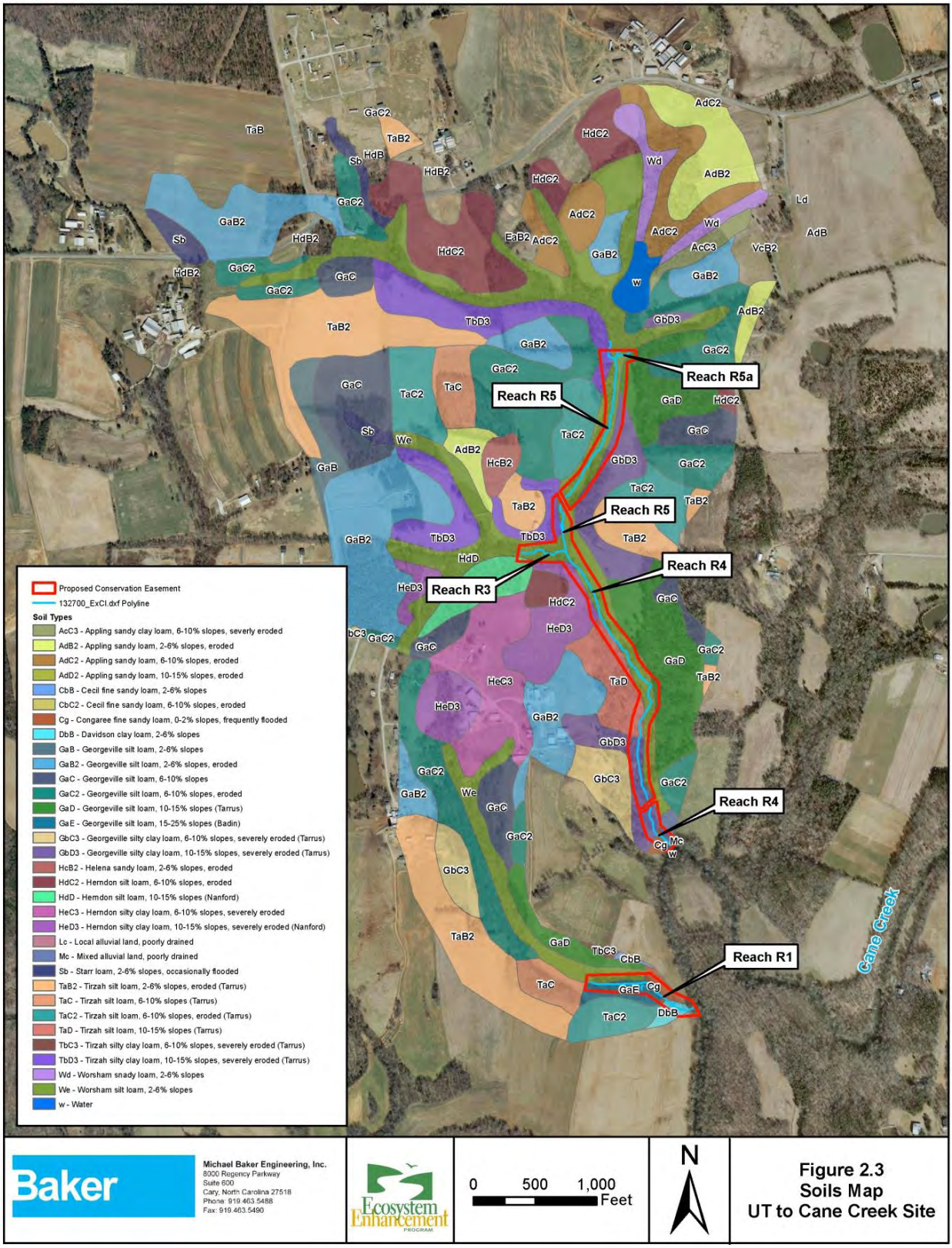
2.3 Vicinity Map



2.4 Watershed Map



2.5 Soils Map


Reach R5a
Reach R5
Reach R5
Reach R4
Reach R3
Reach R4
Reach R1
Cane Creek
Proposed Conservation Easement
132700_ExCl.dxf Polyline
Soil Types
AcC3 - Appling sandy clay loam, 6-10% slopes, severly eroded
AdB2 - Appling sandy loam, 2-6% slopes, eroded
AdC2 - Appling sandy loam, 6-10% slopes, eroded
AdD2 - Appling sandy loam, 10-15% slopes, eroded
CbB - Cecil fine sandy loam, 2-6% slopes
CbC2 - Cecil fine sandy loam, 6-10% slopes, eroded
Cg - Congaree fine sandy loam, 0-2% slopes, frequently flooded
DbB - Davidson clay loam, 2-6% slopes
GaB - Georgeville silt loam, 2-6% slopes
GaB2 - Georgeville silt loam, 2-6% slopes, eroded
GaC - Georgeville silt loam, 6-10% slopes
GaC2 - Georgeville silt loam, 6-10% slopes, eroded
GaD - Georgeville silt loam, 10-15% slopes (Tarrus)
GaE - Georgeville silt loam, 15-25% slopes (Badin)
GbC3 - Georgeville silty clay loam, 6-10% slopes, severely eroded (Tarrus)
GbD3 - Georgeville silty clay loam, 10-15% slopes, severely eroded (Tarrus)
HcB2 - Helena sandy loam, 2-6% slopes, eroded
HdC2 - Herndon silt loam, 6-10% slopes, eroded
HdD - Herndon silt loam, 10-15% slopes (Nanford)
HeC3 - Herndon silty clay loam, 6-10% slopes, severely eroded
HeD3 - Herndon silty clay loam, 10-15% slopes, severely eroded (Nanford)
Lc - Local alluvial land, poorly drained
Mc - Mixed alluvial land, poorly drained
Sb - Starr loam, 2-6% slopes, occasionally flooded
TaB2 - Tirzah silt loam, 2-6% slopes, eroded (Tarrus)
TaC - Tirzah silt loam, 6-10% slopes (Tarrus)
TaC2 - Tirzah silt loam, 6-10% slopes, eroded (Tarrus)
TaD - Tirzah silt loam, 10-15% slopes (Tarrus)
TbC3 - Tirzah silty clay loam, 6-10% slopes, severely eroded (Tarrus)
TbD3 - Tirzah silty clay loam, 10-15% slopes, severely eroded (Tarrus)
Wd - Worsham snady loam, 2-6% slopes
We - Worsham silt loam, 2-6% slopes
w - Water
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Ecosystem Enhancement Program
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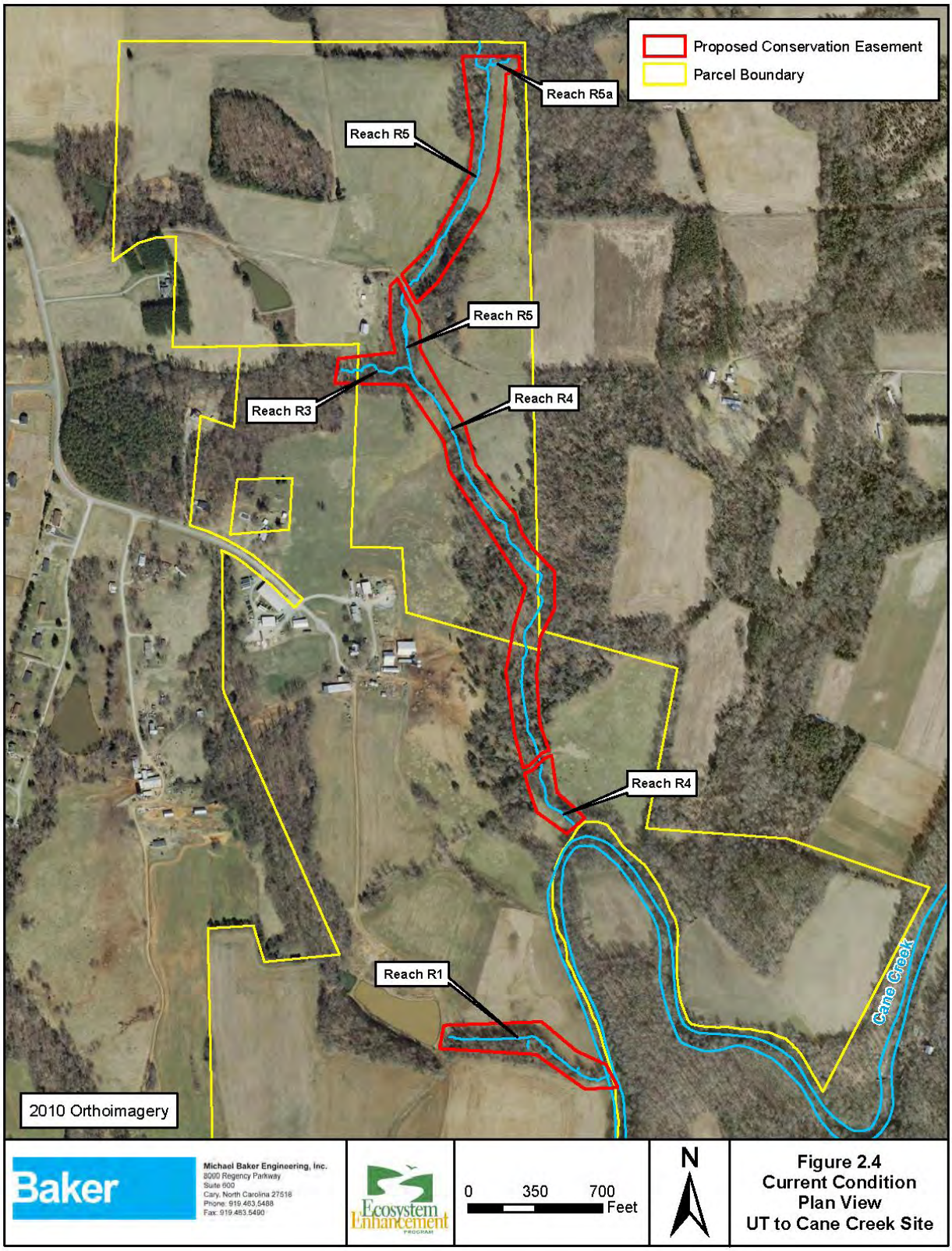
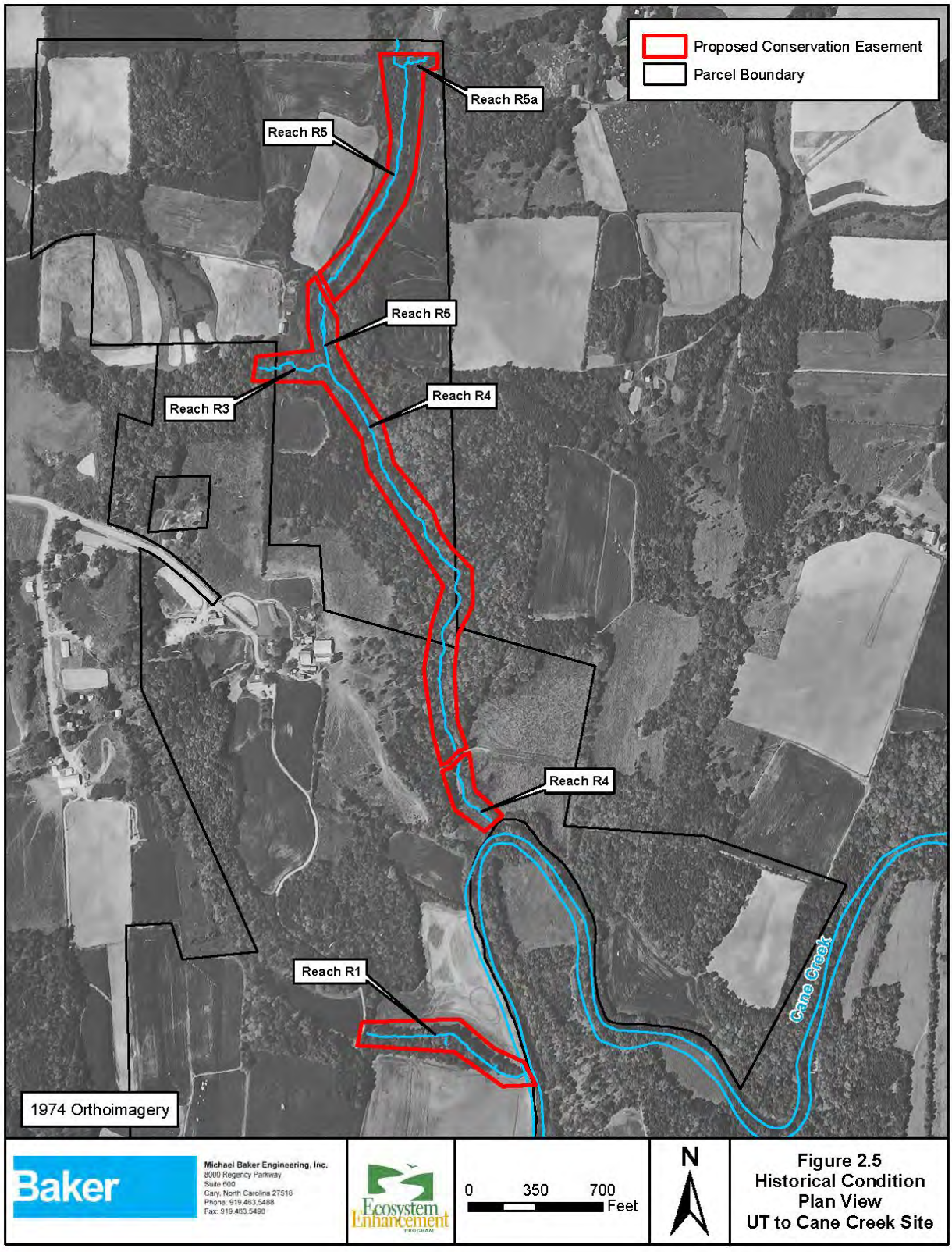
Figure 2.3
Soils Map
UT to Cane Creek Site

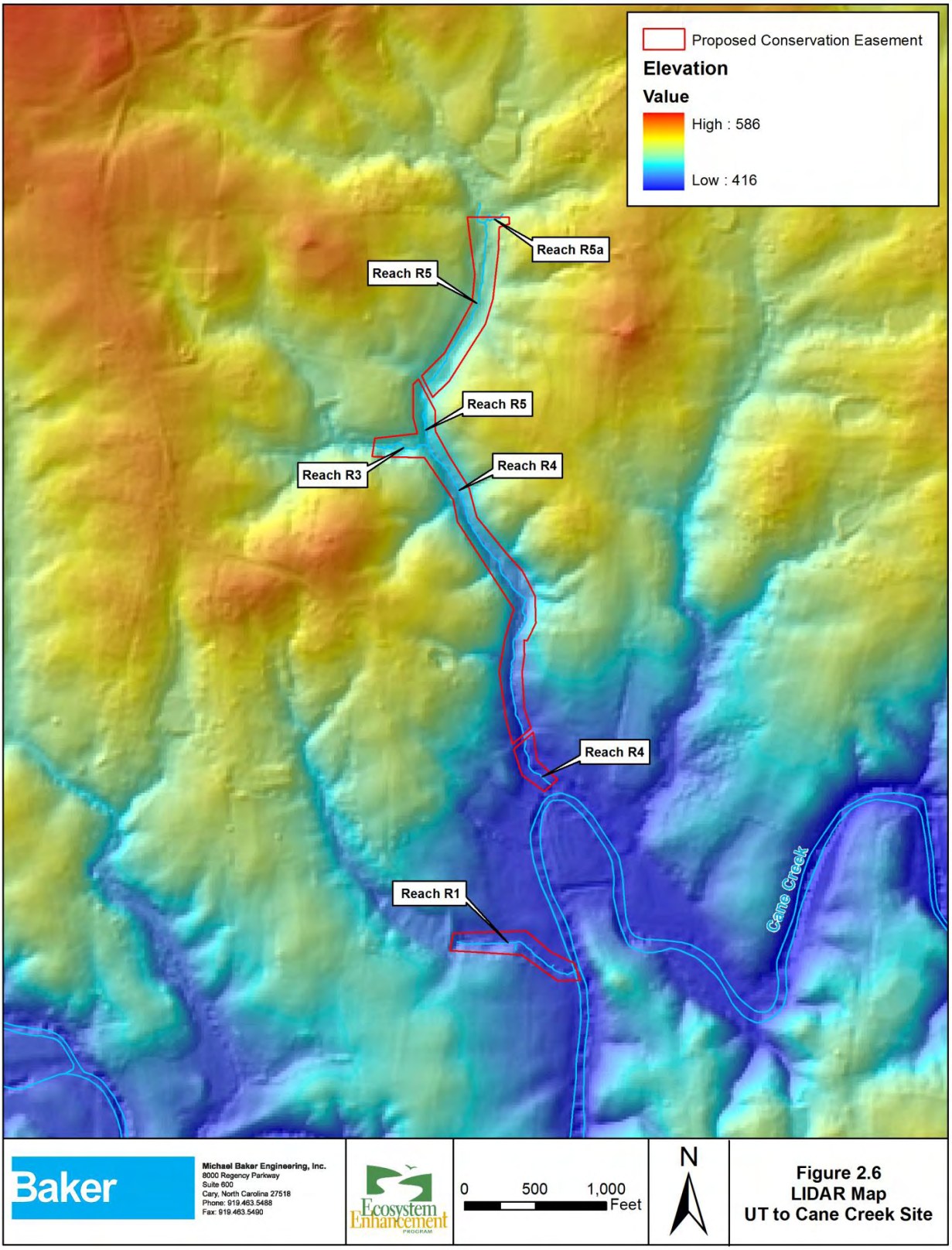
2.6 Current Conditions Map



2.7 Historical Conditions Map



2.8 LiDAR Map


Proposed Conservation Easement
Elevation
Value
High : 586
Low : 416
Reach R5a
Reach R5
Reach R5
Reach R3
Reach R4
Reach R4
Reach R1
Cane Creek
Baker
Michael Baker Engineering, Inc.
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Fax: 919.463.5490
Ecosystem Enhancement Program
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Figure 2.6
LIDAR Map
UT to Cane Creek Site

2.9 Site Photographs

2.9.1 Reach R1

View looking downstream at incised channel near beginning of Reach R1 (2/23/12)

View looking at 8" Dia. PVC inlet for draining man-made farm pond upstream of Reach R1 (1/2/13)

View looking down valley from man-made dam at Reach R1 restoration (12/10/12)

View looking upstream at minimal vegetation buffer along proposed restoration after recent rain event (1/2/13)

View looking upstream at channel incision near confluence with Cane Creek (10/28/12)

View looking downstream at bottom of Reach R1 at confluence with Cane Creek (1/2/13)

2.9.2 Reach R3

View looking downstream before confluence with Reach R4 (4/5/13)

View looking upstream at eroded stream banks, impacted riparian buffer, and hoof shear near middle of Reach R3 (3/29/12)

View looking upstream at stream bank erosion and channel incision near upstream end (3/29/12)

View looking at left stream bank erosion near existing crossing at beginning of proposed restoration (4/5/13)

View looking upstream at left stream bank erosion and abandoned floodplain along proposed restoration (3/29/12)

View looking upstream from downstream end of reach along proposed restoration (3/29/21)

2.9.3 Reach R4

View looking downstream at stable section with sparse riparian buffer vegetation on left stream bank (3/20/12)

View looking existing hillside seep (2/20/13)

View looking upstream at minor stream bank erosion/ channel incision (10/28/12)

View looking downstream at minimal buffer vegetation and invasive species (Chinese Privet) (10/28/12)

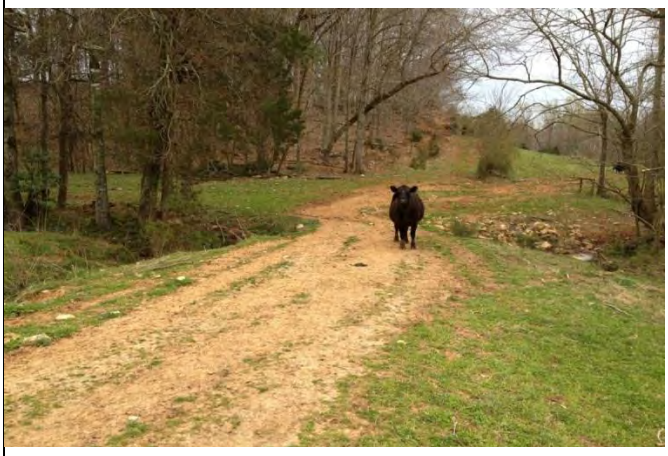
View looking at existing farm crossing to remain (10/28/12)

View looking downstream near bottom of Reach R4 confluence with Cane Creek (3/26/12)

2.9.4 Reach R5

View looking upstream at northern property line (2/20/13)

View looking at right stream bank erosion and channel incision (2/9/11)



View looking at existing culvert crossing to be improved (4/5/13)

View looking at right stream bank erosion/scour (4/5/13)

View looking downstream at stream bank erosion and hoof shear with minimal buffer vegetation (3/30/12)

View looking at cattle impacts and channel incision (3/15/12)

2.9.5 Reach R5a

View looking upstream at northeastern property line (2/20/13)

View looking downstream at left stream bank erosion and minimal buffer vegetation (2/20/13)

3.0 SITE PROTECTION INSTRUMENT

3.1 Site Protection Instrument Summary Information

The land required for the construction, management, and stewardship of this mitigation project includes portions of the following parcels. A copy of the land protection instrument is included in Appendix A.

Table 3.1 Site Protection Instrument Summary

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project 95729

Parcel Number	Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
CE-1	Paul E. and Shelby McBane	9708419476	Alamance	011578280018	3266 / 660-677	4.967
CE-2	Paul E. and Shelby McBane	9708419476	Alamance	011578280018	3266 / 660-677	7.361
CE-2A	Paul E. and Shelby McBane	9707574849	Alamance	011578280018	3266 / 660-677	2.052
CE-3	Paul E. and Shelby McBane	9707574849	Alamance	011578280018	3266 / 660-677	1.255
CE-4	Paul E. and Shelby McBane	9707574849	Alamance	011578280018	3266 / 660-677	3.161
CE-5	Dan B. and Cynthia S. Perry	9708606346	Alamance	011578320014	3266 / 684-697	0.691
CE-6	Paul E. and Shelby McBane	9707574849	Alamance	011578280018	3266 / 660-677	0.376

Baker has obtained a conservation easement from the current landowners for the entire project area. The easement and survey plat was reviewed and approved by NCEEP and State Property Office (SPO) and is now held by the State of North Carolina. The easement and survey plat (Deed Book 76 / Page 40-41) was recorded at the Alamance County Courthouse on September 27th, 2013. The secured conservation easement allows Baker to proceed with the restoration project and restricts the land use in perpetuity.

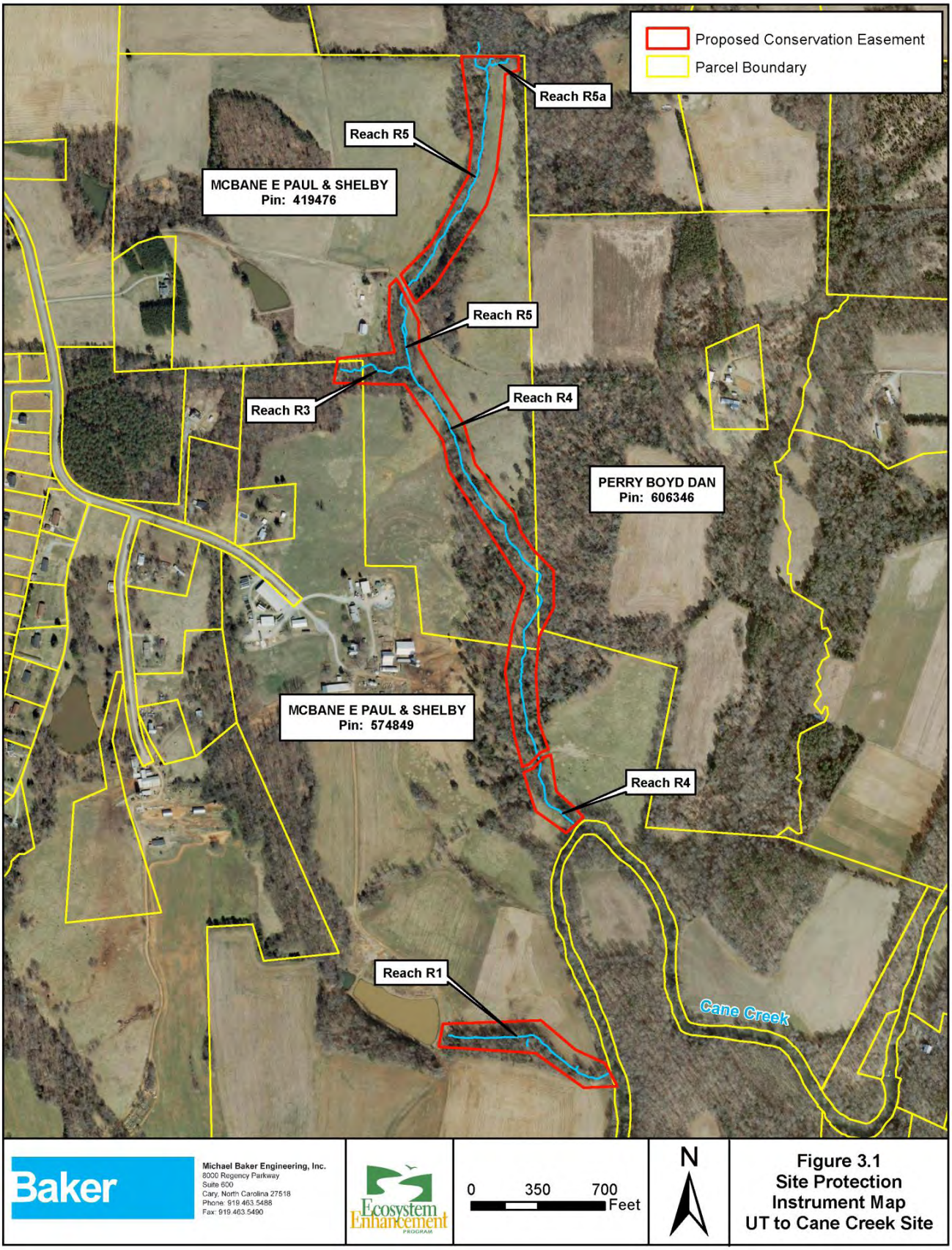
3.1.1 Potential Constraints

No fatal flaws have been identified at the time of this mitigation plan. Two existing farm crossings along Reach R4 and Reach R5 will be improved as part of this project. No existing or proposed easements for power and telephone utilities are located within the conservation easement. Riparian buffer widths will be at least 50 feet across along both stream banks (100 foot minimum total buffer width) for all of the proposed stream reaches. Although a portion of the project reaches are located in a FEMA regulated floodplain (("Zone AE") (Figure 16.1), hydraulic trespass will not result from the proposed project. Other regulatory factors discussed in Section 16, Appendix B were also not determined to pose potential site constraints. Construction access and staging areas have been identified and will be determined during final design.

3.2 Site Protection Instrument Figure

The conservation easement for the project area is shown in Figure 3.1 and copies of the recorded survey plat will be included in Section 15, Appendix A.

Figure 3.1 Site Protection Instrument Map



4.0 BASELINE INFORMATION

Table 4.1 Baseline Information
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Project Information					
Project Name	UT to Cane Creek Restoration Project				
County	Alamance				
Project Area (acres)	19.9				
Project Coordinates (latitude and longitude)	35.8934 N, -79.3187 W				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit and 14-digit	03030002 / 03030002050050				
NCDWR Sub-basin	03-06-04				
Project Drainage Area (acres)	452 (Reach R4 main stem at downstream confluence w/ Cane Creek)				
Project Drainage Area Percent Impervious	<1%				
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (49%) Agriculture (46%) Impervious Cover (1%)				
Reach Summary Information					
Parameters	**Reach R1**	**Reach R3**	**Reach R4**	**Reach R5**	**Reach R5a**
Length of Reach (linear feet)	944	425	2,750	1,823	144
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	80	91	452	290	14
NCDWR Stream Identification Score	30.5	36.0	42.5	38.5	33.5
NCDWR Water Quality Classification	WS V; NSW				
Morphological Description (Rosgen stream type)	Incised E	G	Bc (upstream)/ F (downstream)	G	B
Evolutionary Trend	Incised E→Gc→F	Bc→G→Fb	Bc→G→Fb	Bc→G→Fb	B→G
Underlying Mapped Soils	We, GaE, Cg, DbB	We	We, GbD3, Mc, Cg, TaD	We	We
Drainage Class	Poorly drained	Poorly drained	Poorly	Poorly drained	Poorly
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0127	0.0168	0.0169	0.0126	0.0223
FEMA Classification	N/A	Zone AE	Zone AE	N/A	N/A
Native Vegetation Community	Piedmont Small Stream				
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%	<5%	<5%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

5.0 DETERMINATION OF CREDITS

Table 5.1 Project Components and Mitigation Credits
UT to Cane Creek Restoration Project Stream Mitigation Plan, Alamance County - NCEEP Project No. 95729

Mitigation Credits								
	Stream	**Riparian Wetland**		**Non-riparian Wetland**		**Buffer**	**Nitrogen Nutrient Offset**	**Phosphorus Nutrient Offset**
Type	R, E1, E2	R	E					
Totals	4,673 SMU	0.0	0.0					

Project Components						
Project Component or Reach ID	**Stationing/ Location**	**Existing Footage/ Acreage**	**Approach**	**Restoration/ Restoration Equivalent**	**Restoration Footage or Acreage**	**Mitigation Ratio**
Reach R1	10+00 – 20+43	1,043 LF	Restoration	1,043 SMU	1,043 LF	1:1
Reach R3	10+00 – 14+05	425 LF	Restoration	405 SMU	405 LF	1:1
Reach R4 (upstream section)	29+18 – 53+64	2,346 LF	Enhancement Level II	938 SMU	2,346 LF	2.5:1
Reach R4 (downstream section)	52+96 – 57+15	419 LF	Restoration	419 SMU	419 LF	1:1
Reach R5 (upstream section)	10+00 – 24+56	1,386 LF	Restoration	1,456 SMU	1,456 LF	1:1
Reach R5 (downstream section)	24+92 – 29+18	426 LF	Enhancement Level I	284 SMU	426 LF	1.5:1
Reach R5a	10+00 – 11+44	144 LF	Enhancement Level II	58 SMU	144 LF	2.5:1

Component Summation						
Restoration Level	**Stream (LF)**	**Riparian Wetland (AC)**		**Non-riparian Wetland (AC)**	**Buffer (SF)**	**Upland (AC)**
		Riverine	Non-Riverine			
Restoration	3,323					
Enhancement I	426					
Enhancement II	2,490					
Creation						
Preservation						
High Quality Preservation						

BMP Elements			
Element	Location	Purpose/Function	Notes

BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area

6.0 CREDIT RELEASE SCHEDULE

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (DA) authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the NC Interagency Review Team (NCIRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described in Table 6.1 as follows:

Table 6.1 Credit Release Schedule

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Stream Credits			
Monitoring Year	**Credit Release Activity**	**Interim Release**	**Total Release**
0	Initial Allocation - see requirements below	30%	30%
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met	10%	50% (60%*)
3	Third year monitoring report demonstrates performance standards are being met	10%	60% (70%*)
4	Fourth year monitoring report demonstrates performance standards are being met	5%	65% (75%*)
5	Fifth year monitoring report demonstrates performance standards are being met.	10%	75% (85%*)
6	Sixth year monitoring report demonstrates performance standards are being met.	5%	80% (90%*)
7	Seventh year monitoring report demonstrates performance standards are being met and project has received closeout approval.	10%	90% (100%)

Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the NCEEP without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the Final Mitigation Plan

b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property

c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCEEP Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.

d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the NCIRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after two bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the NCIRT. As projects approach milestones associated with credit release, the NCEEP will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

7.0 MITIGATION WORK PLAN

7.1 Target Stream Type(s), Wetland Type(s), and Plant Communities

7.1.1 Target Stream Types

The primary goal when targeting a stream type was to select a site-specific design approach that would return rural piedmont stream functions to a stable state prior to past disturbances. Current assessment methods and data analyses were utilized for identifying lost or impaired functions at the site and to determine overall mitigation potential. Among these are reviewing existing hydrogeomorphic conditions, historical aerials and LiDAR (Light Detection and Ranging) mapping, evaluating stable reference reaches, and a comparison of results from similar past projects in rural piedmont stream systems.

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration of stream functions within the project area. Topography and soils on the site indicate that the project area most likely functioned in the past as small tributary stream system, eventually flowing downstream into the larger Cane Creek system. Assigning an appropriate stream type for the corresponding valley that accommodates the existing and future hydrologic conditions and sediment supply was considered prior to selecting the proposed design approach. This decision was based primarily on the range of the reference reach data available and the desired performance of the site.

7.1.2 Target Wetland Types

No wetland restoration or enhancement is included in this mitigation project.

7.1.3 Target Plant Communities

Native species riparian vegetation will be established in the riparian buffer throughout the site. Schafale and Weakley's (1990) guidance on vegetation communities as well as the USACE Wetland Research Program (WRP) Technical Note VN-RS-4.1 (1997) were referenced during the development of riparian and adjacent wetland planting lists for the site. In general, bare root vegetation will be planted at a target density of 684 stems per acre. Live stakes will be planted along the channels at a target density of 40 stakes per 1,000 square feet. Using triangular spacing along the stream banks, the live stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing. Invasive species vegetation, such as Chinese privet (*Ligustrum sinense*), Tree-of-heaven (*Ailanthus altissima*), Multiflora rose (*Rosa multiflora*), and Princess tree (*Paulownia tomentosa*), will be removed and to allow native species plants to become established within the conservation easement. Larger native tree species will be preserved and harvested woody material will be utilized to provide stream bank stabilization cover and/or nesting habitat. Hardwood species will be planted to provide the appropriate vegetation for the restored riparian buffer areas. Species will include River birch (*Betula nigra*), Green ash (*Fraxinus pennsylvanica*), Tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), and White oak (*Quercus alba*).

7.2 Design Parameters

Selection of design criteria is based on a combination of approaches, including review of reference reach data, regime equations, evaluation of monitoring results from past projects, and best professional judgment. Evaluating data from reference reach surveys and monitoring results from multiple Piedmont stream projects provided pertinent background information to determine the appropriate design parameters given the existing conditions and overall site potential. The design parameters for the site (shown in Section 17, Appendix C) also considered current guidelines from the USACE.

The restoration activities and structural elements are justified for the following reasons:

1. Many of the stream sections are incised (Bank Height Ratios greater than 1.5) and the cattle access has resulted in significant degradation throughout the site;
2. Past agricultural and silvicultural activities, such as timber production and channelization, have resulted in stream bank erosion, sedimentation and the loss of woody vegetation within the riparian zone;
3. Enhancement or preservation measures alone would not achieve the highest possible level of functional lift for many portions of the degraded stream system.

For design purposes, the stream channels were divided into five reaches labeled R1, R3, R4, R5 and R5a, as shown in Table 7.1. Selection of a general restoration approach was the first step in selecting design criteria for the project reaches. The approach was based on the potential for restoration as determined during the site assessment and the specific design parameters were developed so that plan view layout, cross-section dimensions, and profile could be described for developing construction documents. The design philosophy is to use these design parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods of time under the processes of flooding, re-colonization of vegetation, and watershed influences.

Table 7.1 Project Design Stream Types

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Reach	Proposed Stream Type	Approach/Rationale
R1	E/C	Restoration: Priority 1 Restoration will be implemented from the outlet of the existing pond. This approach is feasible because the pond outlet is significantly higher than the existing bed of the stream channel. The restored channel will be constructed off-line along the existing field edge, and will be designed as a Rosgen E/C type channel. The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel and bench grading as the channel ties into Cane Creek base level. Riparian buffers in excess of 50 feet will be restored or protected along both sides of Reach R1.
R3	Bc	Restoration: A combination of Priority Level I and II approaches will provide floodplain reconnection and long-term channel stability. Due to the short length of the reach before its confluence with Reach R4, it is not practical to only use Priority Level I approaches that would raise the stream back to its historic floodplain. Therefore, restoration will involve a combination of some raising of the streambed along the upstream portion of the reach, and benching along the right stream bank to provide floodplain connection. These techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from stream bank erosion. This reach will be designed as a Rosgen Bc type channel. The design width/depth ratio for the channel will be between 10 and 14, and over time, the channel will likely narrow to an E-type channel due to deposition of sediment and stream bank vegetation growth. Riparian buffers in excess of 50 feet will be restored along both sides of Reach R3.

Table 7.1 Project Design Stream Types

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Reach	Proposed Stream Type	Approach/Rationale
R4 (upstream/enhancement reach)	Bc	Enhancement: The primary source of impairment for Reach R4 is direct cattle access to the stream; therefore, Enhancement Level II approaches will be used on the upper section to exclude cattle permanently from the system. Due to the presence of bedrock along various sections of the reach, the stream shows little indication of channel incision or downcutting, or of having been channelized in the past. Only minor stream bank stabilization practices in isolated locations are proposed for the upper portion of the reach where the riparian buffer has been the most impacted and cattle access has been most detrimental to channel dimension. Portions of the riparian buffer along Reach R4 were recently thinned and/or cleared as a result of timber harvesting, increasing the importance of restoring appropriate riparian species vegetation to a width of 50 feet from the stream channel. A new, culverted crossing will be installed to provide access across the stream. The crossing will be designed to pass a 10 year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing. The new crossing will be fenced to exclude cattle from entering the restored stream.
R4 (downstream/restoration reach)	E/C	Restoration: Along the downstream portion of Reach R4, near the existing crossing, the channel condition is very poor due to channel incision and heavy use by cattle. This reach will be restored through the installation of grade control structures, to dissipate energies, and eliminate the potential for upstream channel incision. Channel banks will be graded to stable slopes, and bankfull benches will be incorporated to promote stability and the re-establishment of riparian vegetation to the confluence. This section of Reach R4 will be designed as a Rosgen E/C type channel. The design width/depth ratio for the channel will be between 10 and 14, and over time, the channel will likely narrow to an E-type channel due to deposition of sediment and stream bank vegetation growth. Riparian buffers in excess of 50 feet will be restored along both sides of all of Reach R4. There are currently two existing stream crossings on Reach R4. The upstream crossing will be abandoned and the downstream ford crossing will be improved.
R5 (upstream/ restoration reach)	Bc	Restoration: Moving downstream, Reach R5 becomes rapidly incised, with steeply eroding stream banks and limited floodplain access. Due to the rapid drop in grade after the reach enters the project property, a Priority Level I will be implemented for the upper portion of Reach R5. This approach involves constructing the restored channel off-line and along the low part of the adjacent valley (to the left side of the existing channel). The benefits of this approach are that floodplain connection is restored, limited impact to desirable native species trees along the existing channel, and the ability to provide full restoration of a natural channel pattern and appropriate stream functions. A Rosgen Bc type channel will be designed for the restoration reach, similar to the approach described for Reach R1. At the downstream end of the reach, above the stream crossing, some benching will likely be required to transition the restored reach back to the existing elevation of the stream at the proposed culvert crossing.

Table 7.1 Project Design Stream Types

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Reach	Proposed Stream Type	Approach/Rationale
R5 (downstream/enhancement reach)	Bc	Enhancement: Along the downstream portion of Reach R5 below the stream crossing, channel incision decreases and the primary source of impairment is direct cattle access. Because the stream is already connected to its floodplain along this reach, Enhancement Level I approaches are proposed for this section of Reach R5. These approaches include permanent exclusion of cattle, minor grading of isolated sections of the stream banks, limited use of structures to promote channel stability and bedform diversity, stabilize an active headcut, and restoration of an appropriate riparian buffer. Riparian buffers in excess of 50 feet will be restored or enhanced along both sides of Reach R5. The existing stream crossing near the downstream end of Reach R5 will be replaced and improved as part of the proposed project.
R5a	B	Enhancement: Along the downstream portion of Reach R5a near the confluence with the Reach R5 main stem, channel incision increases and the primary source of impairment is direct cattle access. Because the stream is already connected to its floodplain along most portions, Enhancement Level II approaches are proposed for Reach R5a. These approaches include permanent exclusion of cattle, minor grading of isolated sections of the stream banks, limited use of structures to promote channel stability and bedform diversity, and establishment of an appropriate riparian buffer. Riparian buffers in excess of 50 feet will be restored or enhanced along both sides of Reach R5a.

7.3 Data Analysis

Baker compiled and assessed watershed information such as drainage areas, historical land use, geologic setting, soil types, and terrestrial plant communities. The results of the existing condition analyses along with reference reach data from previous projects were used to develop a proposed stream restoration design for the project reaches. Numerous sections of the existing tributaries throughout the project have been straightened/channelized or moved in the past. This manipulation has impacted channels that are now overly wide and overly deep for the given drainage areas. The channel slopes within the main stem are consistent (0.014 ft/ft) until the valley widens and flattens towards the bottom portion the Cane Creek floodplain. Within the existing forested areas near the middle of the project, the main stem is mostly stable and likely existed prior to manipulation as a "Bc" stream type, or a gently meandering step-pool channel. This is evidenced by stable morphological features, the presence of bedrock knickpoints and valley morphology.

Additionally, detailed topographic surveys were conducted along the channel and floodplain to determine the elevation of the stream where it flows throughout property, and to validate the valley signatures shown on the LiDAR imagery (Figure 2.6). The valley slope flattens slightly (0.009 ft/ft) across the downstream section of Reach R4, south of the farm road crossing, before it eventually connects to the confluence with Cane Creek system.

The design approach follows the Rosgen "step-wise" methodology in which dimensionless ratios from the reference reach and successful past project experience are used to restore stable dimension, pattern, and profile, as well as proper bankfull sediment-transport competency for the proposed reaches. The stream channel design included analysis of the hydrology, hydraulics, shear stress, sediment transport, and

appropriate channel dimensions. The critical shear stress and boundary shear stress analysis was used verify that the design channels will not aggrade nor degrade.

Baker also performed representative pebble counts and collected subpavement samples in order to evaluate bed material characteristics and sediment transport. The results of the substrate analyses were used to classify the streams and to complete shear stress, sediment transport, and stability analyses.

Regional curve equations developed for the North Carolina Piedmont study (Harman et al., 1999) estimate a bankfull cross-sectional area of approximately 17 square feet for a 0.706 square mile watershed (see Appendix C, Table 17.5) for Reach R4 at the downstream terminus of the watershed. Rosgen's stream classification system (Rosgen, 1996) depends on the proper identification of the bankfull elevation. The upper and lower main stem (Reach R4 & R5) was classified as a channelized G5c-F5 stream type due to its calculated entrenchment ratio (based on an estimation of bankfull area from the published NC Piedmont regional curve), channel slope, and channel substrate (sand/gravel).

Additionally, feature formation and bedform diversity throughout the impaired reaches is poor with minimal habitat diversity or woody debris, except for trees along the stream banks. The riparian buffer vegetation is marginal throughout most the reaches areas. The streams display no measurable meander geometry due to their current channelized conditions and valley formation.

The existing conditions data indicates that proposed mitigation activities will result in re-establishment of functional stream and floodplain ecosystem. The restoration and enhancement efforts, including site protection from a conservation easement, will promote the greatest ecological benefit, a rapid recovery period, and a justifiable and reduced environmental impact over a natural recovery that would otherwise occur through erosional processes with associated impacts on water quality and flooding. Currently, excess nutrients and cattle excrement are entering the system from adjacent farm fields and pastures where existing riparian buffer widths are marginal or non-existent. Ecological uplift will come from removing the cattle and the restoration of diverse aquatic and terrestrial habitats that are appropriate for the piedmont ecoregion and landscape setting.

Additionally, by raising the stream bed and reconnecting the active floodplains, the maximum degree of potential uplift will be provided, restoring stream, buffer, and wetland functions whenever possible. Uplift will also be provided to the system by improving and extending wildlife corridors that connect with wooded areas near the upstream and downstream extents of the project reaches. The water quality of Cane Creek will be improved by reducing nutrient and sediment inputs, and providing cattle exclusion fencing along all tributaries. Approximately 19.9 acres of riparian buffer will be restored and/or protected by a perpetual conservation easement.

8.0 MAINTENANCE PLAN

The site will be monitored on a regular basis and a well as a physical inspection of the site at least once a year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance will be most likely in the first two years following site construction and may include the following components as described in Table 8.1:

Table 8.1 Routine Maintenance Components

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent stream bank failures and head-cutting until vegetation becomes established.
Wetland	N/A
Vegetation	Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, and fertilizing. Exotic invasive plant species will controlled by mechanical and/or chemical methods. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site Boundary	Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Farm Road Crossing	The farm road crossings within the site may be maintained only as allowed by the recorded Conservation Easement, deed restrictions, rights of way, or corridor agreements.
Beaver Management	Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dam breeching/dewatering and/or removal. Beaver management will be performed in accordance with US Department of Agriculture (USDA) rules and regulations using accepted trapping and removal techniques only within the project boundary.

9.0 PERFORMANCE STANDARDS

Baker has obtained regulatory approval for numerous stream mitigation plans involving NCDOT and NCEEP full-delivery projects. The success criteria for the project site will follow the mitigation plans developed for these projects, as well as the *Stream Mitigation Guidelines* (SMG) issued in April 2003 and October 2005 (USACE and NCDWR) and NCEEP's recent supplemental guidance document *Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* dated November 7, 2011. All monitoring activities will be conducted for a period of 7 years, unless the site demonstrates complete success by year 5 and no concerns have been identified. An early closure provision may be requested by the provider for some or all of the monitoring components. Early closure may only be obtained through written approval from the USACE in consultation with the NCIRT.

Based on the design approaches, different monitoring methods are proposed for the project reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Levels I and/or II) and Enhancement Level I (stream bed/bank stabilization) approaches, geomorphic monitoring methods will follow those recommended by the 2003 SMG and the 2011 NCEEP supplemental guidance. For reaches involving Enhancement Level II approaches, monitoring efforts will focus primarily on visual inspections, photo documentation, and vegetation assessments. The monitoring parameters shall be consistent with the requirements described in the Federal Rule for compensatory mitigation sites in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b). Specific success criteria components and evaluation methods are described below and report documentation will follow the NCEEP Baseline Monitoring Document template and guidance (v 2.0, dated 10/14/10).

9.1 Stream Monitoring

Geomorphic monitoring of the proposed restoration reaches will be conducted once a year for a minimum of seven years following the completion of construction to evaluate the effectiveness of the restoration practices. Monitored stream parameters include stream dimension (cross-sections), pattern (planimetric survey), profile (longitudinal profile survey), and visual observation with photographic documentation. The success criteria for the proposed Enhancement Level II reaches/sections will follow the methods described under Photo Reference Stations and Vegetation Monitoring. The methods used and related success criteria are described below for each parameter. Figure 9.1 shows approximate locations of the proposed monitoring devices throughout the project site.

9.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. The crest gauge will be installed on the floodplain within ten feet (horizontal) of the restored channel. The crest gauge will record the highest watermark between site visits, and the gauge will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Two bankfull flow events must be documented within a seven-year monitoring period. The two bankfull events must occur in separate years; otherwise, the monitoring will continue until two bankfull events have been documented during the seven-year post construction monitoring period.

9.1.2 Cross-sections

Permanent cross-sections will be installed at an approximate rate of one cross-section per twenty bankfull widths or an average distance interval (not to exceed 500 LF) of restored stream, with approximately eight (8) cross-sections located at riffles, and four (4) located at pools. Each cross-section will be marked on both stream banks with permanent monuments using rebar cemented in place to establish the exact transect used. A common benchmark will be used for cross-sections and

consistently used to facilitate easy comparison of year-to-year data. The cross-section surveys will occur in years one, two, three, five, and seven, and must include measurements of Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of stream banks, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System.

There should be little change in as-built cross-sections. If changes do take place, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the stream banks, or decrease in width/depth ratio). Using the Rosgen Stream Classification System, and all monitored cross-sections should fall within the quantitative parameters (i.e. BHR no more than 1.2 and ER no less than 2.2 for 'C' stream types) defined for channels of the design stream type. Given the smaller channel sizes and meander geometry of the proposed steams, bank pins will not be installed unless monitoring results indicate active lateral erosion.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the stream banks. Photographs will be taken of both stream banks at each cross-section. The survey tape will be centered in the photographs of the stream banks. The water line will be located in the lower edge of the frame, and as much of the stream bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

9.1.3 Pattern

The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline (year-0) only. Subsequent visual monitoring will be conducted twice a year, at least five months apart, to document any changes or excessive lateral movement in the plan view of the restored channel.

9.1.4 Longitudinal Profile

A longitudinal profile will be surveyed for the entire length of restored channel immediately after construction to document as-built baseline conditions for the first year of monitoring only. The survey will be tied to a permanent benchmark and measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. The longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary.

9.1.5 Bed Material Analyses

After construction, there should be minimal change in the pebble count data over time given the current watershed conditions and sediment supply regime. Significant changes in particle sizes or size distribution in otherwise stable riffles and pools could warrant additional sediment transport analyses and calculations. A substrate sample will be collected where constructed riffles are installed as part of the project. One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase and any significant changes (i.e.; aggradation, degradation) will be noted after stream bank vegetation becomes established and a minimum of two bankfull flows or greater have been documented.

9.1.6 Visual Assessment

Visual monitoring assessments of all stream sections will be conducted by qualified personnel twice per monitoring year with at least five months in between each site visit. Photographs will be used to visually document system performance and any areas of concern related to stream bank stability, condition of in-stream structures, channel migration, headcuts, live stake mortality, impacts from invasive plant species or animal species, and condition of pools and riffles. The photo locations and descriptions will be shown on a plan view map per NCEEP's monitoring report guidance (v1.5, June 2012).

The Photographs will be taken from a height of approximately five to six feet to ensure that the same locations (and view directions) at the site are documented in each monitoring period. A series of photos over time will be also be used to subjectively evaluate channel aggradation (bar formations) or degradation, stream bank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures.

9.2 Vegetation Monitoring

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, vegetation-monitoring quadrants will be installed and monitored across the restoration site in accordance with the CVS-NCEEP Protocol for Recording Vegetation, Version 4.1 (2007). The vegetation monitoring plots shall be a minimum of 2% of the planted portion of the site with a minimum of five (5) plots established randomly within the planted riparian buffer areas per Monitoring Levels 1 and 2. No monitoring quadrants will be established within the undisturbed wooded areas of Reaches R1 and R4. The size of individual quadrants will be 100 square meters for woody tree species.

Vegetation monitoring will occur in the fall, prior to the loss of leaves. Individual quadrant data will be provided and will include species diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first full growing season (from baseline/year 0) or after 180 days between March 1st and November 30th, species composition, stem density, and survival will be evaluated. For each subsequent year, vegetation plots shall be monitored for seven years in years 1, 2, 3, 5 and 7 or until the final success criteria are achieved. The restored site will be evaluated between March and November. The interim measure of vegetative success for the site will require the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. At year five, density must be no less than 260, 5-year old, planted trees per acre. The final vegetative success criteria will be the survival of 210, 7-year old, planted trees per acre at the end of the seven-year monitoring period, which must average 10 feet in height. However, if the performance standard is met by year 5 and stem densities are greater than 260, 5-year old stems/acre, vegetation monitoring may be terminated with approval by the USACE and the NCIRT.

While measuring species density and height is the current accepted methodology for evaluating vegetation success on mitigation projects, species density and height alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices, native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success.

Baker will provide required remedial action on a case-by-case basis, such as: replanting more wet/drought tolerant species vegetation, conducting beaver management/dam removal, and removing undesirable/invasive species vegetation, and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table, that negatively impact existing forest cover or favorable buffer vegetation.

Additionally, herbaceous vegetation, primarily native species grasses, will be seeded/planted throughout the site. During and immediately following construction activities, all ground cover at the project site must be in compliance with the NC Erosion and Sedimentation Control Ordinance.

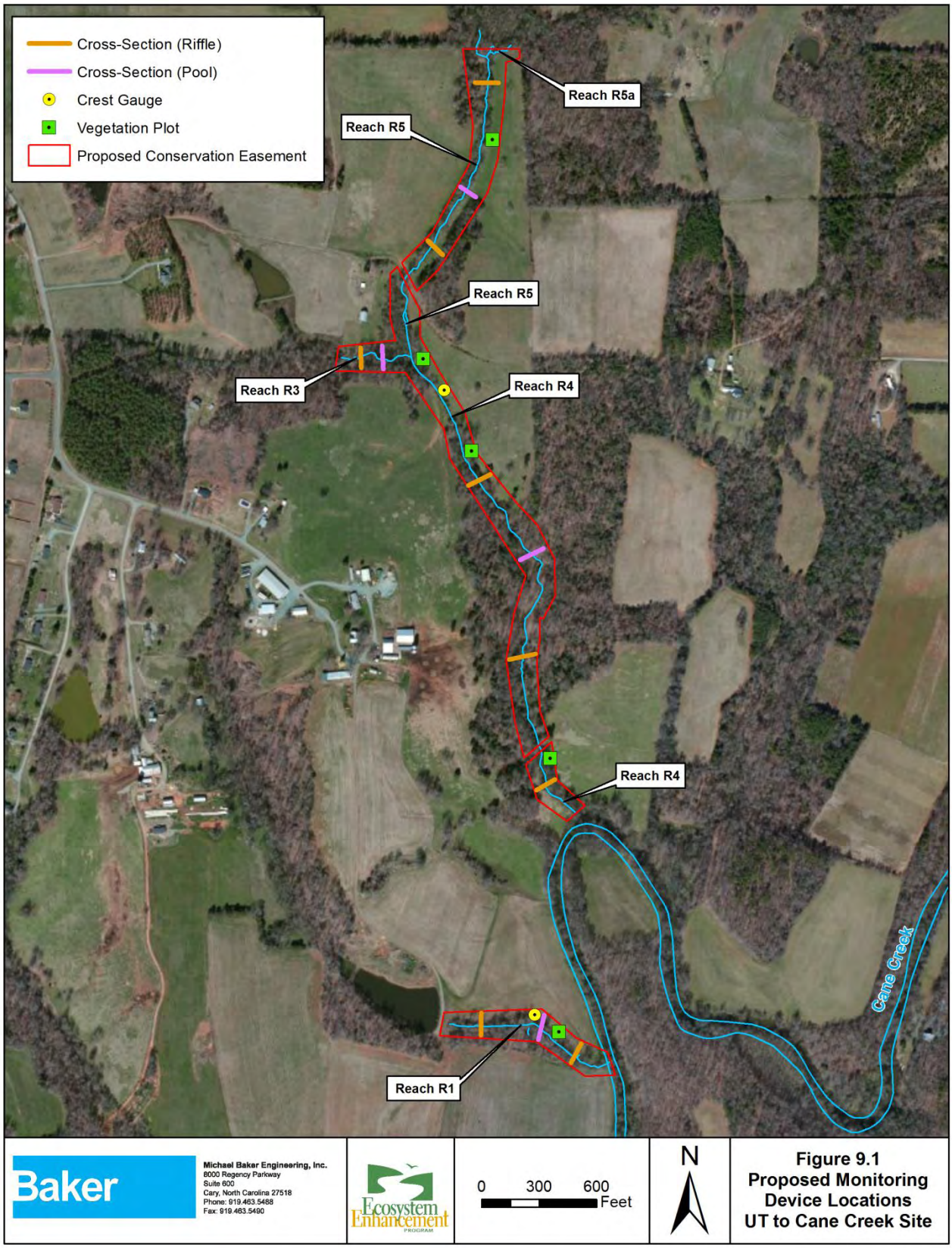
9.3 Wetland Monitoring

No wetlands are proposed at the site therefore no such monitoring will be included.

9.4 Stormwater Management Monitoring

No stormwater BMPs are proposed at the site therefore no such monitoring will be included.

Figure 9.1 Proposed Monitoring Device Locations



10.0 MONITORING REQUIREMENTS

Annual monitoring reports containing the information defined within Table 10.1 below will be submitted to NCEEP by December 31st of the each year during which the monitoring was conducted. The monitoring report shall provide a project data chronology for NCEEP to document the project status and trends, population of NCEEP databases for analysis, research purposes, and assist in decision making regarding project close-out. Project success criteria must be met by the final monitoring year prior to project closeout, or monitoring will continue until unmet criteria are successfully met.

Table 10.1 Monitoring Requirements

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Required	Parameter	Quantity	Frequency	Notes
X	Pattern	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	As-built Year and as needed	Pattern data, including bank erosion pins/arrays in pool cross-sections, will be collected only if there are indications through profile and dimensional data that significant geomorphological adjustments occurred.
X	Dimension	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCEEP Monitoring Requirements	Monitoring Years 1, 2, 3, 5 and 7	Cross-sections to be monitored over seven (7) years and shall include assessment of bank height ratio (BHR) and entrenchment ratio (ER).
X	Profile	As per November 2011 NCEEP Monitoring Requirements	As-built Year and as needed	For restoration or enhancement I components, 3,000 linear feet or less, the entire length will be surveyed. For mitigation segments in excess of this footage, 30% of the length or 3,000 feet will be surveyed, whichever is greater.
X	Substrate	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCEEP Monitoring Requirements	Annually	A substrate sample will be collected if constructed riffles are installed as part of the project. One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase.
X	Surface Water Hydrology	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	Annually	A Crest Gauge and/or Pressure Transducer will be installed on site; the device will be inspected on a quarterly/semi-annual basis to document the occurrence of bankfull events on the project.
X	Vegetation	NCEEP-CVS Guidance	Annually	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols.
X	Exotic and Nuisance Vegetation		Semi-Annually	Locations of exotic and nuisance vegetation will be visually assessed and mapped a minimum of 5 months apart.
X	Visual Assessment	As per November 2011 NCEEP Monitoring Requirements	Semi-Annually and as needed	Representative photographs will be taken to capture the state of the restored channel and vegetated buffer conditions. Stream photos will be preferably taken in the same location when the vegetation is minimal to document any areas of concern or to identify trends.
X	Project Boundary		Semi-Annually	Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped

11.0 LONG-TERM MANAGEMENT PLAN

Upon approval for close-out by the NCIRT, the site will be transferred to the NCDENR. This party shall be responsible for periodic inspection of the site to ensure that restrictions required in the conservation easement or the deed restriction document(s) are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to site transfer to the responsible party.

The NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program currently houses NCEEP stewardship endowments within the non-reverting, interest-bearing Conservation Lands Stewardship Endowment Account. The use of funds from the Endowment Account is governed by North Carolina General Statue GS 113A-232(d) (3). Interest gained by the endowment fund may be used only for the purpose of stewardship, monitoring, stewardship administration, and land transaction costs, if applicable. The NCDENR Stewardship Program intends manage the account as a non-wasting endowment. Only interest generated from the endowment funds will used to steward the compensatory mitigation sites. Interest funds not used for those purposes will be re-invested in the Endowment Account to offset losses due to inflation.

12.0 ADAPTIVE MANAGEMENT PLAN

Upon completion of site construction, NCEEP will implement the post-construction monitoring protocols previously defined in this document. Project maintenance will be performed as described previously in this document. If, during the course of annual monitoring it is determined the site's ability to achieve site performance standards are jeopardized, NCEEP will notify the USACE of the need to develop a Plan of Corrective Action. The Plan of Corrective Action may be prepared using in-house technical staff or may require engineering and consulting services. Once the Corrective Action Plan is prepared and finalized NCEEP will:

1. Notify the USACE as required by the Nationwide 27 permit general conditions.
2. Revise performance standards, maintenance requirements, and monitoring requirements as necessary and/or required by the USACE.
3. Obtain other permits as necessary.
4. Implement the Corrective Action Plan.
5. Provide the USACE a Record Drawing of Corrective Actions. This document shall depict the extent and nature of the work performed.

13.0 FINANCIAL ASSURANCES

Pursuant to Section IV H and Appendix III of the Ecosystem Enhancement Program's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural Resources has provided the USACE-Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCEEP. This commitment provides financial assurance for all mitigation projects implemented by the program.

14.0 OTHER INFORMATION

14.1 Definitions

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

(2) *Objectives.* A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.

(3) *Site selection.* A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation site. (See § 332.3(d).)

(4) *Site protection instrument.* A description of the legal arrangements and instrument, including site ownership, that will be used to ensure the long-term protection of the compensatory mitigation site (see § 332.7(a)).

(5) *Baseline information.* A description of the ecological characteristics of the proposed compensatory mitigation site and, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other site characteristics appropriate to the type of resource proposed as compensation. The baseline information should also include a delineation of waters of the United States on the proposed compensatory mitigation site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site, not the mitigation bank or in-lieu fee site.

(6) *Determination of credits.* A description of the number of credits to be provided, including a brief explanation of the rationale for this determination. (See § 332.3(f).)

(7) *Mitigation work plan.* Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as plan form geometry, channel form (e.g. typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

(8) *Maintenance plan.* A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

(9) *Performance standards.* Ecologically-based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives. (See § 332.5.)

(10) *Monitoring requirements.* A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is

needed. A schedule for monitoring and reporting on monitoring results to the district engineer must be included. (See § 332.6.)

(11) *Long-term management plan.* A description of how the compensatory mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management. (See § 332.7(d).)

(12) *Adaptive management plan.* A management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success. (See § 332.7(c).)

(13) *Financial assurances.* A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with its performance standards (see § 332.3(n)). 2) *Objectives.* A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.

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15.0 APPENDIX A - SITE PROTECTION INSTRUMENT

OWNER(S) CERTIFICATE

PIN: 9708419476
PIN: 9707574849

WE, ELWOOD PAUL MCBANE AND WIFE, SHELBY J. MCBANE, HEREBY CERTIFY THAT WE ARE THE OWNERS OF THE PROPERTIES SHOWN AND DESCRIBED HEREON, WHICH WERE CONVEYED TO US BY DEEDS RECORDED IN DEED BOOK 347, PAGE 488 (PIN: 9708419476), AND DEED BOOK 306, PAGE 221 (PIN: 9707574849), OF THE ALAMANCE COUNTY REGISTRY; AND THAT WE HEREBY ADOPT THIS PLAN OF SUBDIVISION AND GRANT AND CONVEY THE EASEMENTS HEREIN WITH FREE CONSENT. FURTHER, I HEREBY CERTIFY THAT THE LAND AS SHOWN HEREON IS WITHIN THE SUBDIVISION REGULATION JURISDICTIONS OF ALAMANCE COUNTY, NORTH CAROLINA.

Elwood Paul McBane — 9-27-2013
ELWOOD PAUL MCBANE — DATE

Shelby J. McBane — 9-27-13
SHELBY J. MCBANE — DATE

STATE OF NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr. A NOTARY PUBLIC FOR THE COUNTY AND STATE AFORESAID, DO HEREBY CERTIFY THAT ELWOOD PAUL MCBANE AND WIFE, SHELBY J. MCBANE PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE DUE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS 27th DAY OF September, 2013.

Robert H. Merritt
NOTARY PUBLIC

MY COMMISSION EXPIRES: 5-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

NOTES

1. THE PURPOSE OF THIS PLAT IS TO IDENTIFY THE LOCATION OF CONSERVATION EASEMENTS DEPICTED AS CE-1, CE-2, CE-2A, CE-3, CE-4, CE-5 ,AND CE-6 AS SHOWN HEREIN.

2. BOUNDARY INFORMATION IS DERIVED FROM FIELD SURVEY, DEEDS, PLATS, GIS DATA, AND TAX RECORDS OF THE ALAMANCE COUNTY REGISTRY AS SHOWN HEREON. SURVEYED BOUNDARY LINES ARE SHOWN AS SOLID LINES.

APPROXIMATELY 3900' OF STOCKARD ROAD(NCSR 2338) ADJACENT TO THE PARENT TRACT OF THE CONSERVATION EASEMENTS WAS FIELD LOCATED.

APPROXIMATELY 1200' OF OCCUPATIONAL CULTIVATION WAS FIELD LOCATED FOR VERIFICATION OF THE COMMON SOUTHERLY LINE OF PIN: 9708452108(BOONE & BRADSHAW), AND THE NORTHERLY LINE OF PIN: 9708419476(MCBANE) IN THE PROXIMITY OF THE NORTHERLY EXTENT OF CE-1.

3. NORTH CAROLINA GRID COORDINATES FOR GPS DERIVED CONTROL POINTS WERE ESTABLISHED BY MICHAEL BAKER ENGINEERING, INC. (COMBINED FACTOR=0.9991567)

4. ALL DISTANCES ARE HORIZONTAL GROUND UNLESS OTHERWISE NOTED.

5. THE BEARING BASIS FOR THIS PLAT IS NAD 83(NC GRID).

6. ALL AREAS SHOWN WERE CALCULATED BY COORDINATE COMPUTATION.

7. ALL CONSERVATION EASEMENT POINTS ARE MONUMENTED WITH REBAR AND CAP.

8. THE RIGHT(S) OF NON-EXCLUSIVE INGRESS, EGRESS, AND REGRESS OVER AND ALONG ANY AND ALL EXISTING PATHS/ROADS TRANSECTING SUBJECT PROPERTY, AS SHOWN ON SHEET 2 OF 2 OF THIS PLAT, ARE RESERVED BY THE GRANTOR(S) AND THE GRANTEE(S) OF THE CONSERVATION EASEMENTS FOR USES AND PURPOSES NOT INCONSISTENT WITH THE USES OF THE CONSERVATION EASEMENTS DESCRIBED HEREON.

THE LOCATION OF THE EXISTING SOIL PATHS FOR NON-EXCLUSIVE ACCESS SHOWN ON SHEET 2 OF 2 OF THIS PLAT WERE DERIVED FROM GIS BASED AERIAL PHOTOGRAPHY AND VERIFIED BY FIELD SURVEY.

OWNER(S) CERTIFICATE

PIN: 9708606346

WE, BOYD DAN PERRY AND SPOUSE, CYNTHIA SAX PERRY, HEREBY CERTIFY THAT WE ARE THE OWNERS OF THE PROPERTIES SHOWN AND DESCRIBED HEREON, WHICH WERE CONVEYED TO US BY DEED RECORDED IN DEED BOOK 3143, PAGE 794 (PIN: 9708606346) OF THE ALAMANCE COUNTY REGISTRY; AND THAT WE HEREBY ADOPT THIS PLAN OF SUBDIVISION AND GRANT AND CONVEY THE EASEMENTS HEREIN WITH FREE CONSENT. FURTHER, I HEREBY CERTIFY THAT THE LAND AS SHOWN HEREON IS WITHIN THE SUBDIVISION REGULATION JURISDICTIONS OF ALAMANCE COUNTY, NORTH CAROLINA.

Boyd Dan Perry — 9-27-13
BOYD DAN PERRY — DATE

Cynthia Sax Perry — 9-27-13
CYNTHIA SAX PERRY — DATE

STATE OF NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr. A NOTARY PUBLIC FOR THE COUNTY AND STATE AFORESAID, DO HEREBY CERTIFY THAT BOYD DAN PERRY AND SPOUSE, CYNTHIA SAX PERRY PERSONALLY APPEARED BEFORE ME THIS DAY AND ACKNOWLEDGED THE DUE EXECUTION OF THE FOREGOING INSTRUMENT.

WITNESS MY HAND AND OFFICIAL STAMP OR SEAL THIS 27th DAY OF September 2013

Robert H. Merritt
NOTARY PUBLIC

MY COMMISSION EXPIRES: 5-1-2017

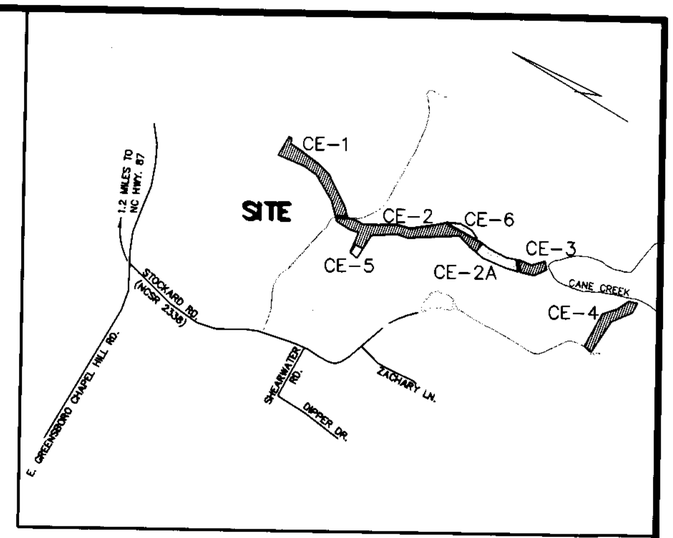
ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

CONSERVATION EASEMENT AREA SUMMARY

CE-1 PIN: 9708419476	4.967 Acres	(MCBANE)
CE-2 PIN: 9708419476	7.361 Acres	(MCBANE)
CE-2A PIN: 9707574849	2.052 Acres	(MCBANE)
CE-3 PIN: 9707574849	1.255 Acres	(MCBANE)
CE-4 PIN: 9707574849	3.161 Acres	(MCBANE)
CE-5 PIN: 9707574849	0.376 Acres	(MCBANE)
CE-6 PIN: 9708606346	0.691 Acres	(PERRY)

PIN: 9708419476(MCBANE): 12.328 Acres
PIN: 9707574849(MCBANE): 6.844 Acres
PIN: 9708606346(PERRY): 0.691 Acres

Doc ID: 011578260001 Type: CRP
Recorded: 09/27/2013 at 02:44:06 PM
Fee Amt: $21.00 Page 1 of 1
Alamance, NC
HUGH WEBSTER REGISTER OF DEEDS
BK 76 PG 40



VICINITY MAP
NTS

REFERENCES

ALAMANCE COUNTY REGISTRY

PB 67, PG 152
PB 65, PG 467
PB 73, PG 160
PB 70, PG 60
PB 45, PG 178
DB 347, PG 488
DB 306, PG 221
DB 3143, PG 794
DB 2778, PG 453
DB 6518, PG 301
DB 891, PG 638
DB 1971, PG 495
DB 2779, PG 80
DB 2738, PG 271
DB 4508, PG 578
DB 363, PG 279
DB 1000, PG 480

State of North Carolina
County of Alamance

I, Jason S. Martin Review Officer of Alamance County, certify that the map or plat to which this certification is affixed meets all Statutory requirements for recording.

Jason S. Martin — 9/27/13
Review Officer — Date

SURVEYOR'S CERTIFICATION

I, WILLIAM KENT, DO HEREBY CERTIFY THAT THIS SURVEY IS OF ANOTHER CATEGORY AND IS AN EXCEPTION TO THE DEFINITION OF SUBDIVISION.

William Kent
WILLIAM KENT, PLS L-3708

NORTH CAROLINA PROFESSIONAL SEAL L-3708 LAND SURVEYOR WILLIAM KENT — 9/18/13

I, WILLIAM KENT, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION USING REFERENCES SHOWN HEREON; THAT THE BOUNDARIES NOT SURVEYED ARE SHOWN AS BROKEN LINES PLOTTED FROM INFORMATION SHOWN HEREON; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000+; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 16th DAY OF Sept., 2013.

William Kent
WILLIAM KENT, PLS L-3708

EEP PROJECT NAME: 'UT to CANE CREEK'

Drawing No: UTtoCaneCreek_95729_CE_Baker_Final.dwg

Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
License: F-1084

UT to CANE CREEK CONSERVATION EASEMENT SURVEY

FOR

STATE OF NORTH CAROLINA — ECOSYSTEM ENHANCEMENT PROGRAM

ON THE PROPERTY OF

ELWOOD PAUL McBANE, SHELBY J. McBANE, BOYD DAN PERRY, & CYNTHIA S. PERRY

NEWLIN TOWNSHIP ALAMANCE COUNTY NORTH CAROLINA

SPO FILE No: 01-J & 01-N
EEP PROJECT No: 95729
Baker Project No. 132700
Date: April 22, 2013

NCGS "WHITNEY"
N=783,282.42 (Y)
E=1,909,673.86 (X)
PID: EZ3051
(NAD 83)

N/F
MELISSA ANN BOONE
&
FRANCES MARIE BRADSHAW
DB 2778, PG 0453
PIN: 9708452108

ELECTRIC CATTLE FENCE

TIE LINE
N72°52'20"E
4447.20'

IRON ROD (F)

OLD FENCE LINE

TIE LINE
N05°44'14"E
608.72'

CONTROL POINT No.8
N=781,972.70 (Y)
E=1,905,423.89 (X)

TIE LINE
N28°53'05"E
519.83'

CONTROL POINT No.7
N=781,517.54 (Y)
E=1,905,172.79 (X)

TIE LINE
S21°32'11"W
85.88'

TIE LINE
S35°27'26"W
466.18'

CONTROL POINT No.6
N=780,872.94 (Y)
E=1,905,506.00 (X)

CONTROL POINT No.5
N=780,415.40
E=1,905,674.48 (X)

N20°12'56"W
487.57'

EIP

EIP (DISTURBED)

STEEL ROD (F)

CONTROL POINT No.11
N=779,113.35 (Y)
E=1,905,977.40 (X)

TIE LINE
N08°18'02"W
485.27'

CONTROL POINT No.3
N=778,667.85 (Y)
E=1,906,118.53 (X)

TIE LINE
S16°49'41"W
143.30'

TIE LINE
N17°34'40"W
467.32'

TIE LINE
S05°12'57"E
53.49'

NAD 83

N/F
BOYD DAN PERRY
&
CYNTHIA SAX PERRY
DB 3143, PG 0794
PIN: 9708609839

SOIL PATH
(SEE NOTE 8, SHEET 1of2)

N/F
FREDDIE MICHAEL PERRY
&
LISA L. PERRY
DB 2660, PG 0010
PIN: 9707892806

Doc ID: 011578270001 Type: CRP
Recorded: 09/27/2013 at 02:44:18 PM
Fee Amt: $21.00 Page 1 of 1
Alamance, NC
HUGH WEBSTER REGISTER OF DEEDS
BK 76 PG 41

N/F
BOYD DAN PERRY
&
CYNTHIA SAX PERRY
DB 3143, PG 0794
PIN: 9708606346

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 306, PG 221
PIN: 9707574849

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 347, PG 488
PIN: 9708419476

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 347, PG 488
PIN: 9708419476

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 306, PG 221
PIN: 9707574849

N/F
DWAYNE CURTIS MARLEY
&
CATHY MCBANE MARLEY
DB 6518, PG 301
PIN: 9708318312

N/F
DAVID S. WELCH
&
DINAH P. WELCH
DB 2779, PG 080
PIN: 9708401628

N/F
PAUL STEVEN MCBANE
&
CHERYL STOUT MCBANE
DB 4508, PG 578
PIN: 9708404235

N/F
TRACY MCBANE COBB
DB 2738, PG 0271
PIN: 9708401487

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 891, PG 638
PIN: 9708323375

N/F
ELWOOD PAUL & SHELBY MCBANE
DB 1971, PG 495
PIN: 9708307637

N/F
GEORGE DOUGLAS ZACHARY
DB 1000, PG 480
PIN: 9707490443

N/F
GEORGE N. ZACHARY, JR.
DB 363, PG 279
PIN: 9707398675

N/F
GEORGE N. ZACHARY, JR.
DB 363, PG 279
PIN: 9707374435

SOIL PATH

SOIL PATH
(SEE NOTE 8, SHEET 1of2)

STOCKARD ROAD
(NCSR 2338)
(60' PUBLIC R/W)

CANE CREEK

CE-1

LINE	BEARING	DISTANCE
L1	N89°55'13"E	296.89'
L2	S01°24'04"E	46.36'
L3	S72°18'44"W	75.61'
L4	S01°58'03"W	163.20'
L5	S06°20'06"W	346.39'
L6	S16°26'07"W	184.32'
L7	S32°38'36"W	482.12'
L8	S46°02'48"W	156.94'
L9	N27°37'21"W	168.54'
L10	N45°10'57"E	222.07'
L11	N28°56'31"E	411.06'
L12	N05°04'43"E	200.60'
L13	N07°30'18"W	406.05'

AREA: 4.967 Acres
PIN: 9708419476

CE-2

LINE	BEARING	DISTANCE
L14	S27°37'21"E	249.32'
L15	S01°19'32"E	147.42'
L16	S29°01'03"E	204.68'
L17	S32°08'04"E	257.26'
L18	S15°21'53"E	214.68'
L19	S38°56'11"E	334.14'
L20	S42°34'28"E	166.00'
L21	S01°15'16"E	483.73'
L23	S01°15'16"W	105.66'
L60	N81°59'12"W	155.19'
L61	N09°30'40"E	104.31'
L31	N17°13'12"E	210.06'
L32	N33°01'10"W	731.17'
L33	N10°55'21"W	158.97'
L34	N34°26'19"W	357.43'
L35	N88°32'16"W	219.70'
L36	N00°51'56"W	120.47'
L37	S87°26'23"W	132.12'
L38	N08°56'16"E	16.86'
L39	N83°44'59"E	300.88'
L40	N14°06'17"W	122.16'
L41	N00°16'44"E	228.49'
L42	N45°10'57"E	53.74'

AREA: 7.361 Acres
PIN: 9708419476

CE-5

LINE	BEARING	DISTANCE
L61	N88°32'16"W	151.27'
L62	N08°56'16"E	112.06'
L37	N87°26'23"E	132.12'
L36	S00°51'56"E	120.47'

AREA: 0.376 Acres
PIN: 9707574849

CE-6

LINE	BEARING	DISTANCE
L22	N74°28'07"W	21.76'
L21	N01°15'16"W	483.73'
L57	S26°59'56"E	196.26'
L58	S00°59'47"E	191.33'
L59	S26°16'43"W	137.48'

AREA: 0.691 Acres
PIN: 9708606346

CE-2A

LINE	BEARING	DISTANCE
L27	S48°58'06"W	171.79'
L28	N14°44'34"W	189.40'
L29	N07°56'22"W	334.30'
L30	N09°30'40"E	139.61'
L60	S81°59'12"E	155.19'
L24	S07°39'31"W	128.39'
L25	S03°50'50"E	256.49'
L26	S19°19'21"E	142.41'

AREA: 2.052 Acres
PIN: 9707574849

CE-3

LINE	BEARING	DISTANCE
L46	S48°12'05"W	123.46'
L47	N34°31'15"W	194.03'
L48	N17°57'34"W	194.38'
L43	N48°58'06"E	180.78'
L44	S08°36'38"E	201.95'
L45	S46°53'01"E	196.40'

AREA: 1.255 Acres
PIN: 9707574849

CE-4

LINE	BEARING	DISTANCE
L50	N88°07'14"E	513.40'
L51	S49°48'39"E	236.55'
L52	S65°29'49"E	179.42'
L53	S19°15'59"E	125.17'
L54	S87°19'45"W	159.27'
L55	N54°25'17"W	313.77'
L56	N86°26'03"W	507.31'
L49	N10°21'16"E	123.71'

AREA: 3.161 Acres
PIN: 9707574849

CONTROL POINT No.2
N=777,531.48 (Y)
E=1,905,925.77 (X)

CONTROL POINT No.1
N=777,600.09 (Y)
E=1,905,466.21 (X)

S81°30'33"E
464.65'

TIE LINE
S49°13'47"W
106.46'

EASEMENT CORNERS

CORNER	NORTHING	EASTING
1	782578.37	1905484.74
2	782578.78	1905781.63
3	782532.44	1905782.77
4	782509.47	1905710.73
5	782346.36	1905705.12
6	782002.09	1905666.90
7	781825.30	1905614.75
8	781418.33	1905354.69
9	781310.40	1905241.71
10	781459.73	1905163.57
11	781516.26	1905321.10
12	781975.98	1905520.02
13	782175.80	1905537.78
14	781437.65	1905141.27
15	781216.35	1905257.07
16	781068.97	1905260.48
17	780889.98	1905359.77
18	780672.13	1905496.60
19	780465.12	1905553.49
20	780205.22	1905763.48
21	780075.50	1905884.50
22	779908.10	1905964.88
23	779716.80	1905968.21
24	779593.53	1905907.34
25	779558.40	1905890.00
26	779599.36	1905886.38
27	779493.68	1905889.00
28	779366.48	1905871.58
29	779110.57	1905888.79
30	778976.18	1905935.91
31	778863.41	1905806.32
32	779046.57	1905758.13
33	779377.66	1905711.95
34	779515.36	1905735.02
35	779618.24	1905752.26
36	779818.88	1905814.44
37	780431.95	1905416.01
38	780588.04	1905385.89
39	780882.83	1905183.75
40	780888.43	1904964.12
41	781008.89	1904962.30
42	781002.99	1904830.31
43	781019.64	1904832.93
44	780892.29	1904812.90
45	781052.40	1905132.02
46	781170.88	1905102.25
47	781399.37	1905103.36
48	778829.82	1905813.42
49	778948.49	1905949.79
50	778748.82	1905980.03
51	778614.58	1906123.39
52	778532.30	1906031.36
53	778644.91	1905873.36
54	777530.56	1905385.58
55	777547.40	1905898.70
56	777394.75	1906079.41
57	777320.34	1906242.67
58	777202.18	1906283.97
59	777194.76	1906124.87
60	777377.32	1905869.68
61	777408.87	1905363.35

LEGEND

PROPERTY LINE SURVEYED.....
PROPERTY LINE(R/W) NOT SURVEYED.....
CONSERVATION EASEMENT.....
EXISTING IRON PIPE/ROD(EIP).....
EASEMENT MONUMENT SET.....
CONTROL POINT SET.....
PIN..... PARCEL IDENTIFICATION NUMBER

GRAPHIC SCALE
0 250 500 750

NORTH CAROLINA PROFESSIONAL SEAL L-3708 LAND SURVEYOR WILLIAM KENT
9.18.13

EEP PROJECT NAME: 'UT to CANE CREEK'

Drawing No: UTtoCaneCreek_95729_CE_Baker_Final.dwg

Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway, Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
License: F-1084

UT to CANE CREEK CONSERVATION EASEMENT SURVEY
FOR
STATE OF NORTH CAROLINA — ECOSYSTEM ENHANCEMENT PROGRAM
ON THE PROPERTY OF
ELWOOD PAUL McBANE, SHELBY J. McBANE, BOYD DAN PERRY, & CYNTHIA S. PERRY
NEWLIN TOWNSHIP ALAMANCE COUNTY NORTH CAROLINA

SPO FILE No: 01-J & 01-N
EEP PROJECT No: 95729
Baker Project No. 132700
Date: April 22, 2013

Doc ID: 011578280018 Type: CRP
Recorded: 09/27/2013 at 02:48:08 PM
Fee Amt: $614.00 Page 1 of 18
Revenue Tax: $576.00
Alamance, NC
HUGH WEBSTER REGISTER OF DEEDS
BK 3266 PG 660-677

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

Excise Tax $ 576.00

STATE OF NORTH CAROLINA

ALAMANCE COUNTY

CONSERVATION EASEMENT PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT CONTRACT #004951

SPO# 01-J
EEP SITE ID#: 95729

THIS CONSERVATION EASEMENT DEED, made this 27th day of September, 2013, by ELWOOD PAUL McBANE and wife, SHELBY J. Mc BANE, (hereinafter "Grantor"), whose mailing address is 7542 Stockard Road, Snow Camp, NC 27439, to the State of North Carolina, ("Grantee"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. §143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources

19/38

for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc. and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources purchase and Services Contract Number 004951.

WHEREAS, the State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (the "MOA") duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and

the Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple a certain parcels of real property situated, lying and being in Newlin Township, Alamance County, North Carolina, which parcels are identified by Tax PN: 156585 (PIN: 9708-41-9476) containing approximately 111 acres having been conveyed to Grantor by deed recorded in Deed Book 347, Page 488, Alamance County Registry, North Carolina and another parcel identified by Tax PN: 156452 (PIN: 9707-57-4849) containing approximately 240 acres having been conveyed to Grantor by deeds recorded in Deed Book 306, Page 221 and Deed Book 306, Page 218, Alamance County Registry, North Carolina (collectively the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement (as hereinafter defined) over portions of the Property referred to above, thereby restricting and limiting the use of the included portions of the Property to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept such Conservation Easement for the protection and benefit of the waters and the other portions of the UT to Cane Creek Restoration Project, Alamance County, North Carolina;

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth and other good and valuable consideration, the receipt and legal sufficiency of which is hereby acknowledged, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

All of the land identified as follows:

Conservation Easements identified as CE-1, CE-2, CE-2A, CE-3, CE-4 and CE-5 as shown on a Plat entitled "UT to Cane Creek Conservation Easement Survey for State of North Carolina – Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry and Cynthia S. Perry, Newlin Township, Alamance County – North Carolina" dated April 22, 2013, prepared by Michael Baker Engineering, Inc. and recorded at Plat or Map Book 76, Page 40 - 41, Alamance County Registry.

TOGETHER WITH easements and rights for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of the Conservation Easement are to maintain, restore, enhance, create and preserve wetland and/or riparian resources in the Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with and be a continuing restriction upon the use of the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, lessees, agents and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor are hereby and have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Usage of motorized vehicles in the Easement Area is prohibited.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Easement Area not inconsistent with this Conservation Easement, and the right of access to the Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the Conservation Easement shall not alter vegetation, hydrology or topography of the site.

D. Vegetation Cutting. Except as related to the removal of non-native plants,

diseased or damaged trees, and vegetation that destabilizes or renders unsafe the Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Easement Area, including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Easement Area.

H. Roads and Trails. There shall be no construction of roads, trails, walkways, or paving in the Easement Area.

I. Signs. No signs shall be permitted in the Easement Area except interpretive signs describing restoration activities and the conservation values of the Easement Area, signs identifying the owner of the Property and the holder of the Easement Area, signs giving directions, or signs prescribing rules and regulations for the use of the Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or other material in the Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, removal of topsoil, sand, gravel, rock, peat, minerals, or other materials in the Easement Area.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or

permitting the diversion of surface or underground water in the Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticides or biocides in the Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Easement Area may temporarily be used for good cause shown as needed for the survival of livestock and agricultural production on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no subdivision, partitioning or dividing of the underlying Property owned by the Grantor in fee simple ('fee") that is subject to this Easement is allowed. Unless agreed to by the Grantee in writing, any future conveyance of the underlying fee and the rights conveyed herein shall be as a single block of property. Any future transfer of the fee is subject to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is consistent with the purposes of this Conservation Easement and the Grantor obtains advance written approval from the N. C. Ecosystem

Enhancement Program, whose mailing address is currently 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction and Inspection. The Grantee, its employees and agents, successors and assigns, receive the perpetual Right of Access to the Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, and monitor the stream, wetland and other riparian resources in the Easement Area in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities with the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to repair the fence, at its sole discretion.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach, and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law will be inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have

the right, with reasonable notice, to enter the Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Easement Area caused by third parties or resulting from causes beyond the Grantor's control, including , without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Conservation Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision

to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown above or to such other address(es) as such party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed shall be subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in a writing signed by all parties hereto, or their successors and/or assigns, and provided such amendment does not affect the qualification of this Conservation Easement or the status of the

Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property. Such notification shall be addressed to: Justin McCorkle, General Counsel, US Army Corps of Engineers, 69 Darlington Avenue, Wilmington, NC 28403.

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable; provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Easement Area, and the right of quiet enjoyment of the Easement Area.

TO HAVE AND TO HOLD the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes.

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same are free from encumbrances except the easements, leases, restrictions and rights-of-way reserved or granted herein or otherwise of record and described below and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever. The easements, leases, restrictions and rights-of-way reserved herein or of record constituting exceptions to title are as follows:

1. Reservation of rights as set forth in Article II, above.

IN TESTIMONY WHEREOF, the Grantor has hereunder set its hand and seal, the day and year first above written.

Elwood Paul McBane (SEAL)
Elwood Paul McBane

Shelby J. McBane (SEAL)
Shelby J. McBane

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr., do certify that **Elwood Paul McBane and wife, Shelby J. McBane**, personally appeared before me this day, each acknowledging that they voluntarily signed the foregoing document for the purposes therein expressed. I have received satisfactory evidence of the principals' identity in the form of NC Drivers Licence.

Witness my hand and official stamp or seal this 27 day of September, 2013.

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

Robert H Merritt
Notary Public
Robert H. Merritt, JR
Printed or typed notary name

My Commission Expires: 2-1-2017

00353755

Exhibit 1
Legal Description
Permanent Conservation Easements
UT to Cane Creek
Alamance County, NC

1. Permanent Conservation Easement (Ref: PIN: 9708419476) (CE-1)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry* dated April 22, 2013, and recorded in Plat Book 76, Page 40-41, of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9708419476), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,905423.89, Y=781,972.70, and identified as Control Point # 8 on the above referenced plat and running N 05° 44'14" E , 608.72' to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

N 89°55'13" E, 296.89', thence
S 01°24'04" E, 46.36', thence
S 72°18'44"W, 75.61, thence
S 01°58'03"W, 163.20', thence
S 06°20'06"W, 346.39', thence
S 16°26'07"W, 184.32', thence
S 32°38'36" W, 482.12', thence
S 46°02'48"W, 156.94", thence
N 27°37'21"W, 168.54', thence
N 45°10'57" E, 222.07', thence
N 28°56'31"E, 411.06', thence
N 05°04'43" E, 200.60', thence
N 07°30'18"W, 406.05' to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 4.967 acres, more or less.

2. Permanent Conservation Easement (Ref: PIN: 9708419476) (CE-2)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry,*

and Cynthia Sax Perry dated April 22, 2013, and recorded in Plat Book 76, Page 40-41 of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9708419476), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,905,172.79, Y=781,517.54, and identified as Control Point # 7 on the above referenced plat and running S 21°32'11"W , 85.88' to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

S 27°37'21" E, 249.32', thence
S 01°19'32" E, 147.42', thence
S 29°01'03" E, 204.68', thence
S 32°08'04" E, 257.26', thence
S 15°21'53" E, 214.68', thence
S 38°56'11" E, 334.14', thence
S 42°34'28" E, 166.00', thence
S 01°15'16" E, 483.73', thence
S 01°15'16" E, 105.66', thence
N 81°59'12" W, 155.19', thence
N 09°30'40" E, 104.31', thence
N 17°13'12" E, 210.06', thence
N 33°01'10" W, 731.17', thence
N 10°55'21" W, 158.97', thence
N 34°26'19" W, 357.43', thence
N 88°32'16" W, 219.70', thence
N 00°51'56" W, 120.47', thence
S 87°26'23" W, 132.12', thence
N 08°56'16" E, 16.86', thence
N 83°44'59" E, 300.88', thence
N 14°06'17" W, 122.16', thence
N 00°16'44" E, 228.49', thence
N 45°10'57" E, 53.74', to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 7.361 acres, more or less.

3. Permanent Conservation Easement (Ref: PIN: 9707574849) (CE-2A)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry* dated April 22, 2013, and recorded in Plat Book 76, Page 40-41, of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9707574849), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,905,977.40, Y=779,113.35, and identified as Control Point # 11 on the above referenced plat and running S16°49'41"W , 143.30', to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

S 48°58'06" W, 171.79', thence
N 14°44'34" W, 189.40, thence
N 07°56'22" W, 334.30', thence
N 09°30'40" E, 139.61', thence
S 81°59'12" E, 155.19', thence
S 07°39'31" W, 128.39', thence
S 03°50'50" E, 256.49', thence
S 19°19'21" E, 142.41', to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 2.052 acres, more or less.

4. Permanent Conservation Easement (Ref: PIN: 9707574849) (CE-3)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry* dated April 22, 2013, and recorded in Plat Book 76, Page 40-41, of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9707574849), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,906,118.53, Y=778,667.85, and identified as Control Point # 3 on the above referenced plat and running S 05°12'57" E , 53.49', to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

S 48°12'05" W, 123.46', thence
N 54°31'15" W, 194.03', thence
N 17°57'34" W, 194.38', thence
N 48°58'06" E, 180.78', thence
S 08°36'38" E, 201.95', thence
S 46°53'01" E, 196.40' , to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 1.255 acres, more or less.

4. Permanent Conservation Easement (Ref: PIN: 9707574849) (CE-4)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement*

Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry dated April 22, 2013, and recorded in Plat Book 76, Page 40 - 41, of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9707574849), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,905,466.21, Y=777,600.09, and identified as Control Point # 1 on the above referenced plat and running S 49°13'47" W , 106.46', to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

N 88°07'14" E, 513.40', thence
S 49°48'39" E, 236.55', thence
S 65°29'49" E, 179.42', thence
S 19°15'59" E, 125.17', thence
S 87°19'45" W, 159.27', thence
N 54°25'17" W, 313.77', thence
N 86°26'03" W, 507.31', thence
N 10°21'16" E, 123.71', to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 3.161 acres, more or less.

5. Permanent Conservation Easement (Ref: PIN: 9707574849) (CE-5)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry* dated April 22, 2013, and recorded in Plat Book 76, Page 40 - 41, of the Alamance County Registry, and being a portion of the parcel owned by *Elwood Paul McBane, and wife, Shelby J. McBane* (PIN: 9707574849), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,904,964.12, Y=780,888.43, and identified as Easement Corner # 40 on the above referenced plat, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

N 88°32'16" W, 151.27', thence
N 08°56'16" E, 112.06', thence
N 87°26'23" E, 132.12', thence
S 00°51'56" E, 120.47', to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 0.376 acres, more or less.

6. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easements described above and conveyed herein, shall be (1) as provided in this deed,(2) as provided on the Plat referenced above (see Note 8.,Sheet 1 of 2), and (3), from the 60' Public Right-of-Way of Stockard Road,(NCSR 2338), to provide ingress, egress, and regress for purposes of accessing the permanent conservation easements set forth above, and as shown on the aforesaid map recorded in Plat Book 76, Page 40 - 41, of the Alamance County Registry.

Doc ID: 011578320014 Type: CRP
Recorded: 09/27/2013 at 03:03:36 PM
Fee Amt: $28.00 Page 1 of 14
Revenue Tax: $2.00
Alamance, NC
HUGH WEBSTER REGISTER OF DEEDS
BK3266 PG684-697

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

Excise Tax $ 2.00

STATE OF NORTH CAROLINA

ALAMANCE COUNTY

CONSERVATION EASEMENT PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT CONTRACT #004951

SPO# 01-N
EEP SITE ID#: 95729

THIS CONSERVATION EASEMENT DEED, made this 27th day of September, 2013, by BOYD DAN PERRY and spouse, CYNTHIA SAX PERRY, (hereinafter "Grantor"), whose mailing address is P. O. Box 147, Pittsboro, NC 27312, to the State of North Carolina, ("Grantee"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. §143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources

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for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc. and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources purchase and Services Contract Number 004951.

WHEREAS, the State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (the "MOA") duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and

the Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple a certain parcels of real property situated, lying and being in Newlin Township, Alamance County, North Carolina, which parcel is identified by Tax PN: 156591 (PIN: 9708-60-6346) containing approximately 92.35 acres having been conveyed to Grantor by deed recorded in Deed Book 3143, Page 792, and Book 3143, Page 794 Alamance County Registry, North Carolina, (the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement (as hereinafter defined) over portions of the Property referred to above, thereby restricting and limiting the use of the included portions of the Property to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept such Conservation Easement for the protection and benefit of the waters and the other portions of the UT to Cane Creek Restoration Project, Alamance County, North Carolina;

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth and other good and valuable consideration, the receipt and legal sufficiency of which is hereby acknowledged, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

All of the land identified as follows:

Conservation Easement identified as CE-6 as shown on a Plat entitled "UT to Cane Creek Conservation Easement Survey for State of North Carolina – Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry and Cynthia S. Perry,

Newlin Township, Alamance County – North Carolina" dated April 22, 2013, prepared by Michael Baker Engineering, Inc. and recorded at Plat or Map Book 76, Page 40 - 41, Alamance County Registry.

TOGETHER WITH easements and rights for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of the Conservation Easement are to maintain, restore, enhance, create and preserve wetland and/or riparian resources in the Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with and be a continuing restriction upon the use of the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, lessees, agents and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Easement Area shall be restricted from any development or usage that would impair

or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor are hereby and have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Usage of motorized vehicles in the Easement Area is prohibited.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Easement Area not inconsistent with this Conservation Easement, and the right of access to the Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the Conservation Easement shall not alter vegetation, hydrology or topography of the site.

D. Vegetation Cutting. Except as related to the removal of non-native plants, diseased or damaged trees, and vegetation that destabilizes or renders unsafe the Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees

and vegetation in the Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Easement Area, including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Easement Area.

H. Roads and Trails. There shall be no construction of roads, trails, walkways, or paving in the Easement Area.

I. Signs. No signs shall be permitted in the Easement Area except interpretive signs describing restoration activities and the conservation values of the Easement Area, signs identifying the owner of the Property and the holder of the Easement Area, signs giving directions, or signs prescribing rules and regulations for the use of the Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or other material in the Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, removal of topsoil, sand, gravel, rock, peat, minerals, or other materials in the Easement Area.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored,

enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticides or biocides in the Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Easement Area may temporarily be used for good cause shown as needed for the survival of livestock and agricultural production on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no subdivision, partitioning or dividing of the underlying Property owned by the Grantor in fee simple ('fee") that is subject to this Easement is allowed. Unless agreed to by the Grantee in writing, any future conveyance of the underlying fee and the rights conveyed herein shall be as a single block of property. Any future transfer of the fee is subject to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is consistent with the purposes of this Conservation Easement and the Grantor obtains advance written approval from the N. C. Ecosystem Enhancement Program, whose mailing address is currently 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction and Inspection. The Grantee, its employees and agents, successors and assigns, receive the perpetual Right of Access to the Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, and monitor the stream, wetland and other riparian resources in the Easement Area in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities with the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to repair the fence, at its sole discretion.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement,

Grantee is allowed to prevent any activity within the Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach, and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law will be inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the

terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Easement Area caused by third parties or resulting from causes beyond the Grantor's control, including , without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Conservation Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown above or to such other address(es) as such party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed shall be subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in a writing signed by all parties hereto, or their successors and/or assigns, and provided such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the U.S. Army Corps of Engineers in writing

sixty (60) days prior to the initiation of any transfer of all or any part of the Property. Such notification shall be addressed to: Justin McCorkle, General Counsel, US Army Corps of Engineers, 69 Darlington Avenue, Wilmington, NC 28403.

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable; provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Easement Area, and the right of quiet enjoyment of the Easement Area.

TO HAVE AND TO HOLD the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes.

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same are free from

encumbrances except the easements, leases, restrictions and rights-of-way reserved or granted herein or otherwise of record and described below and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever. The easements, leases, restrictions and rights-of-way reserved herein or of record constituting exceptions to title are as follows:

1. Reservation of rights as set forth in Article II, above.

IN TESTIMONY WHEREOF, the Grantor has hereunder set its hand and seal, the day and year first above written.

_____(SEAL)
Boyd Dan Perry

_____(SEAL)
Cynthia Sax Perry

NORTH CAROLINA

COUNTY OF WAKE

I, Robert H. Merritt, JR, do certify that **Boyd Dan Perry and spouse, Cynthia Sax Perry**, personally appeared before me this day, each acknowledging that they voluntarily signed the foregoing document for the purposes therein expressed. I have received satisfactory evidence of the principals' identity in the form of NC Drivers License.

Witness my hand and official stamp or seal this 27th day of September, 2013.

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

_____
Notary Public
Robert H. Merritt, JR
Printed or typed notary name

My Commission Expires: 5-1-2017

00353757

Exhibit 1
Legal Description
Permanent Conservation Easement
UT to Cane Creek
Alamance County, NC

1. Permanent Conservation Easement (Ref: PIN: 9708606346) (CE-6)

A permanent conservation easement over a portion of land in Newlin Township, Alamance County, North Carolina, as shown on a map entitled *"UT to Cane Creek Conservation Easement Survey for State of North Carolina - Ecosystem Enhancement Program on the property of Elwood Paul McBane, Shelby J. McBane, Boyd Dan Perry, and Cynthia Sax Perry* dated April 22, 2013, and recorded in Plat Book 76, Page 40-41, of the Alamance County Registry, and being a portion of the parcel owned by *Boyd Dan Perry and spouse, Cynthia Sax Perry* (PIN: 9708606346), more particularly described as follows:

Commencing at an iron bar and cap with NC Grid coordinates of X=1,905,977.40 Y=779,113.35, and identified as Control Point # 11 on the above referenced plat and running N 08° 18'02" W , 485.27' to a point, which is the **POINT AND PLACE OF BEGINNING**; thence continuing the following courses and distances:

N 74°28'07" W, 21.76', thence
N 01°15'16" W, 483.73', thence
S 26°59'56" E, 196.26', thence
S 00°59'47" E, 191.33', thence
S 26°16'43" W, 137.48', to the **POINT AND PLACE OF BEGINNING**, said permanent conservation easement containing 0.691 acres, more or less.

6. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easements described above and conveyed herein, shall be (1) as provided in this deed,(2) as provided on the Plat referenced above (see Note 8.,Sheet 1 of 2), and (3), from the 60' Public Right-of-Way of Stockard Road,(NCSR 2338), to provide ingress, egress, and regress for purposes of accessing the permanent conservation easements set forth above, and as shown on the aforesaid map recorded in Plat Book 76, Page 40 - 41, of the Alamance County Registry.

16.0 APPENDIX B - BASELINE INFORMATION DATA

16.1 USACE Routine Wetland Determination Forms – per regional supplement to 1987 Manual

SUPPORTING DATA.

Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:
  .
- ☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: _____.
- ☐ Corps navigable waters' study: _____.
- ☐ U.S. Geological Survey Hydrologic Atlas: _____.
  - ☐ USGS NHD data.
  - ☐ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: 7.5' Saxapahaw, NC; 2013.
- ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Alamance.
- ☒ National wetlands inventory map(s). Cite name: Saxapahaw.
- ☐ State/Local wetland inventory map(s): _____.
- ☒ FEMA/FIRM maps: FIRM Panels 370012004021796, 3700120040217104.
- ☐ 100-year Floodplain Elevation is: _____ (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): 2010.
  or ☐ Other (Name & Date): _____.
- ☐ Previous determination(s). File no. and date of response letter: _____.
- ☐ Other information (please specify): _____.

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

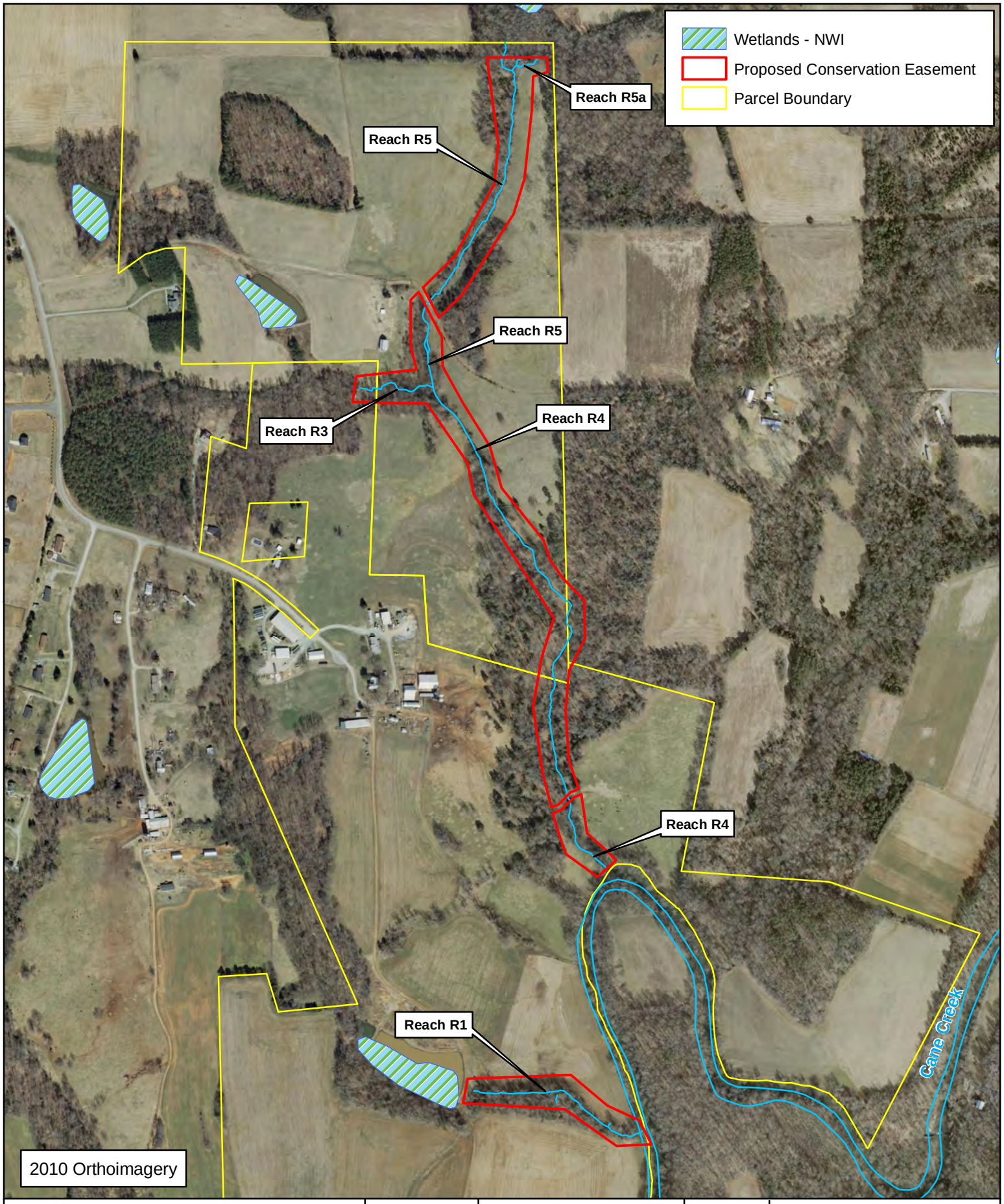
Signature and date of
Regulatory Project Manager
(REQUIRED)

Richard Darby 7/25/2013

Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining
the signature is impracticable)

MULTIPLE WATERBODIES

Waters_Name	Cowadin_Code	HGM_Code	Measurement_Type	Amount	Units	Waters_Types	Latitude	Longitude	Local_Waterway
Reach 1			Linear	943.000000	FOOT	RPW	35.88577170	-79.31930810	Perennial UT to Cane Creek
Reach 2			Linear		FOOT	UPLAND			Ephemeral UT to Reach 1
Reach 3			Linear	426.000000	FOOT	RPW	35.89535890	-79.32125830	Perennial UT to Reach 4
Reach 4			Linear	2752.000000	FOOT	RPW	35.89536860	-79.32002460	Perennial UT to Cane Creek
Reach 5			Linear	1804.000000	FOOT	RPW	35.89980770	-79.31888970	Perennial UT to Cane Creek
Reach 5a			Linear	144.000000	FOOT	RPW	35.89980970	-79.31833420	Perennial UT to Reach 5
Reach 5b			Linear	17.000000	FOOT	RPW	35.89980860	-79.31863510	Perennial UT to Reach 5a
Stream Total				6086.000000	FOOT				
Wetland 1	U		Area		ACRE	UPLAND			Upland
Wetland 2	RP1FO8	RIVERINE	Area	0.014000	ACRE	RPWWN	35.89907370	-79.31885590	Wetland adjacent to Reach 5
Wetland 3	RP1FO8	RIVERINE	Area	0.022000	ACRE	RPWWD	35.89704440	-79.31972180	Wetland abutting Reach 5
Wetland 4	RP1FO8	RIVERINE	Area	0.010000	ACRE	RPWWD	35.89654080	-79.31997650	Wetland abutting Reach 5
Wetland 5	RP1FO8	RIVERINE	Area	0.011000	ACRE	RPWWD	35.89650350	-79.32019580	Wetland abutting Reach 5
Wetland 6	RP1FO8	RIVERINE	Area	0.043000	ACRE	RPWWD	35.89614770	-79.32016110	Wetland abutting Reach 5
Wetland 7	RP1FO8	RIVERINE	Area	0.003000	ACRE	RPWWD	35.89504370	-79.31962740	Wetland abutting Reach 4
Wetland 8	RP1FO8	RIVERINE	Area	0.011000	ACRE	RPWWD	35.89475440	-79.31940280	Wetland abutting Reach 4
Wetland 9	RP1FO8	RIVERINE	Area	0.004000	ACRE	RPWWD	35.89409940	-79.31921400	Wetland abutting Reach 4
Wetland 10	RP1FO8	RIVERINE	Area	0.091000	ACRE	RPWWD	35.89278670	-79.31782960	Wetland abutting Reach 4
Wetland Total				0.209000	ACRE				



Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

Ecosystem Enhancement Program

0 350 700 Feet

N

NWI Wetlands Map
UT to Cane Creek Site

North Carolina Department of Environment and Natural Resources
Division of Water Quality

Pat McCrory
Governor

Thomas A Reeder
Acting Director

John E. Skvarla, III
Secretary

July 29, 2013

Mr. Richard Darling
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NC 27518

Subject Property: UT to Cane Creek Mitigation Site, Graham NC, Alamance County

On-Site Determination for Applicability to the Mitigation Rules (15A NCAC 2H .0506(h))
On-Site Determination for Applicability to the Jordan Lake Riparian Buffer Rules (15A NCAC 02B .0267)

Dear Mr. Darling:

On May 16, 2013, at your request and in your attendance, Sue Homewood conducted an on-site determination to review features located on the subject property for intermittent/perennial determinations with regards to the above noted state regulations. Andy Williams with the US Army Corps of Engineers (USACE) was also present at the site visit. The feature that was reviewed is identified on the attached map.

The Division acknowledges the areas and boundaries identified as jurisdictional wetlands by the USACE. The streams shown on the attached maps were determined to be perennial streams throughout the boundaries of the project as noted on the attached maps.

Please note that at the time of this letter, all intermittent and perennial stream channels and jurisdictional wetlands found on the property are subject to the mitigation rules cited above. These regulations are subject to change in the future.

The owner (or future owners) should notify the DWQ (and other relevant agencies) of this decision in any future correspondences concerning this property. This on-site determination shall expire five (5) years from the date of this letter.

Landowners or affected parties that dispute a determination made by the DWQ or Delegated Local Authority that a surface water exists and that it is subject to the buffer rule may request a determination by the Director. A request for a determination by the Director shall be referred to the Director in writing c/o Cyndi Karoly, DWQ, 401 Oversight/Express Review Permitting Unit, 2321 Crabtree Blvd., Suite 250, Raleigh, NC 27604-2260. Individuals that dispute a determination by the DWQ or Delegated Local Authority that "exempts" surface water from the buffer rule may ask for an adjudicatory hearing. You must act within 60 days of the date that you receive this letter. Applicants are hereby notified that the 60-day statutory appeal time does not start until the affected party (including downstream and adjacent landowners) is notified of this decision. DWQ recommends that the applicant conduct this notification in order to be certain that third party appeals are made in a timely manner. To ask for a hearing, send a written petition, which conforms to Chapter 150B of the North Carolina General Statutes to the Office of Administrative Hearings, 6714 Mail Service Center, Raleigh, N.C. 27699-6714. This determination is final and binding unless you ask for a hearing within 60 days.

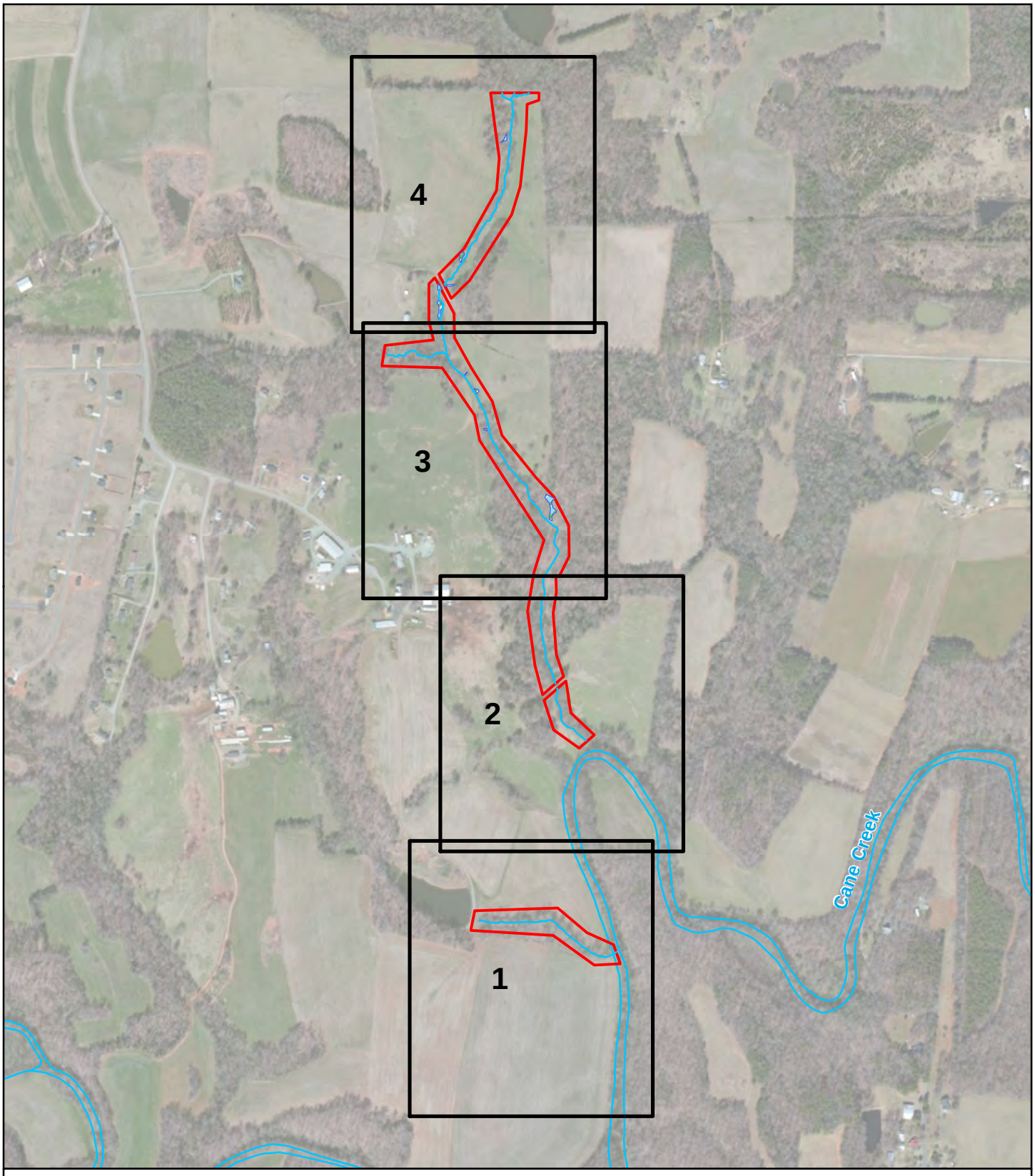
This letter only addresses the applicability to the mitigation rules and the buffer rules and does not approve any activity within Waters of the United States or Waters of the State or their associated buffers. If you have any additional questions or require additional information please contact me at 336-771-4964 or sue.homewood@ncdenr.gov

Sincerely,

Sue Homewood
DWQ Winston-Salem Regional Office

Enclosures: Baker provided Location Map
Baker provided Stream/Wetland Maps

cc: Paul & Shelby McBane, 7542 Stockard Rd, Snow Camp NC 27349
Andy Williams, USACE Raleigh Regulatory Office (via email)
DWQ, Winston-Salem Regional Office



Index Map

Jurisdictional Waters of the U.S. Including Wetlands for UT to Cane Creek Site Alamance County, NC

0 500 1,000 Feet

Ecosystem Enhancement Program

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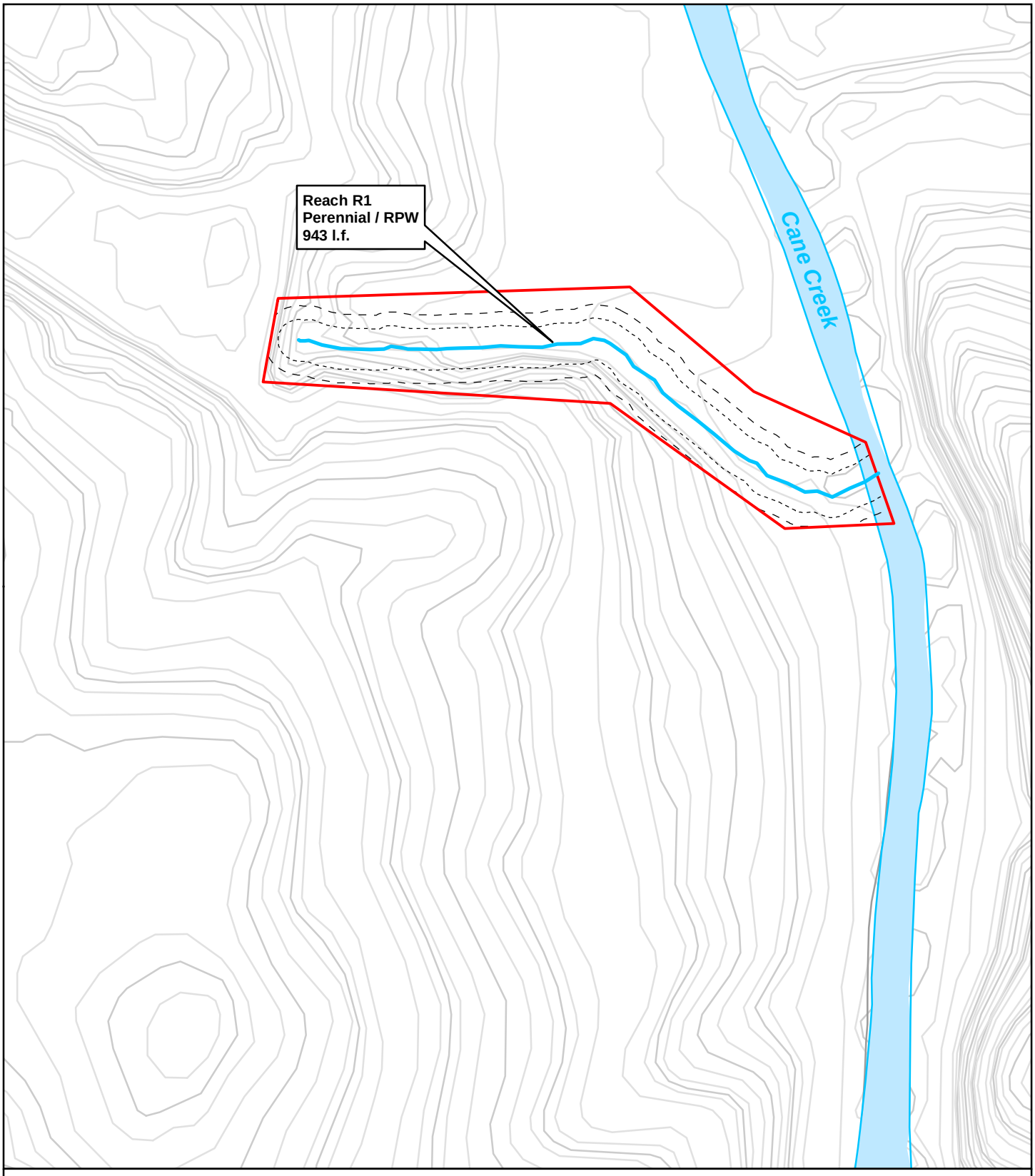

Map 1 of 4

Proposed Conservation Easement

50' Jordan Lake WSW Buffer

Zone 1

Zone 2

Ecosystem Enhancement Program

Baker

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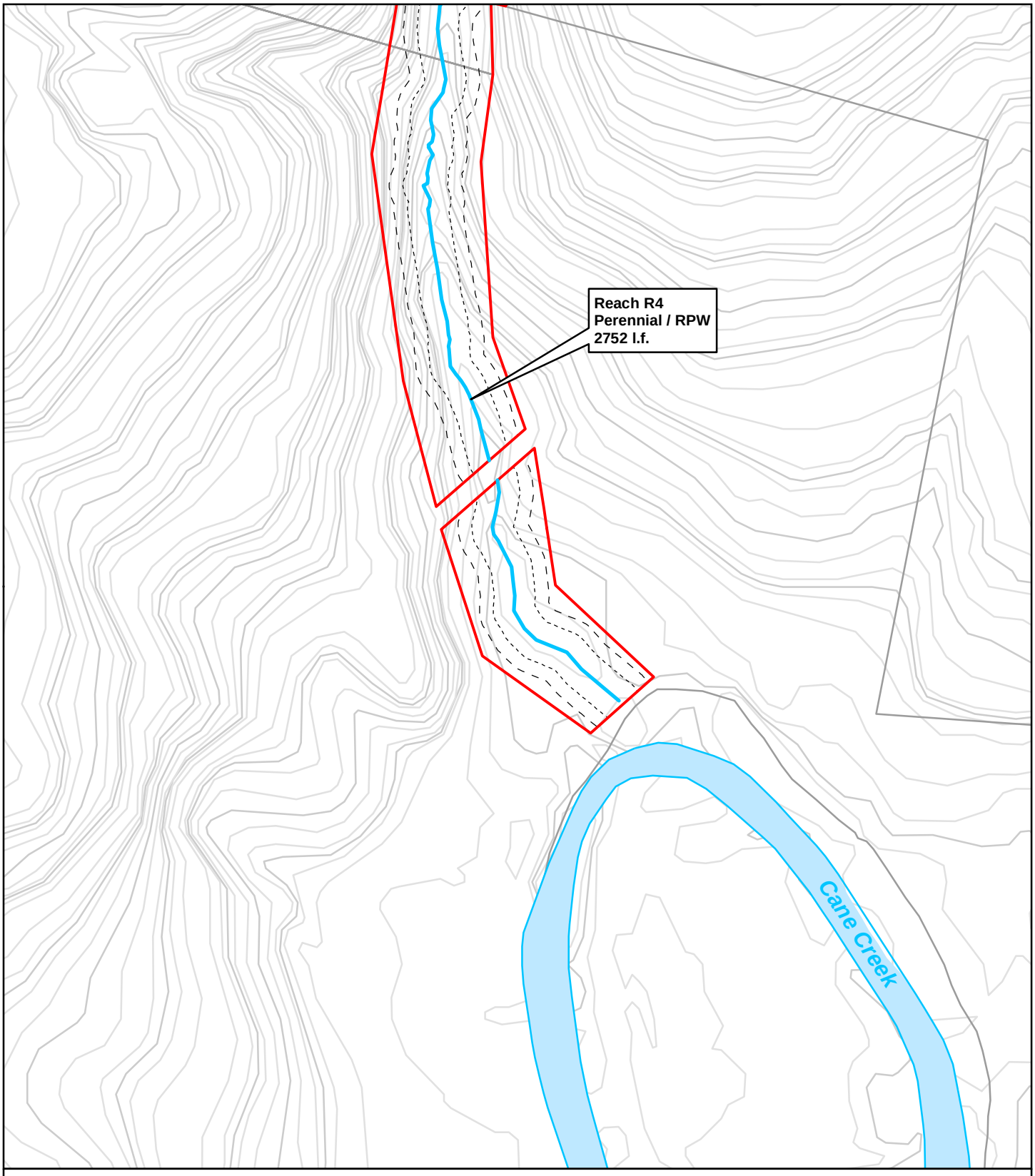
Fax: 919.463.5490

Jurisdictional Waters of the U.S. Including Wetlands for UT to Cane Creek Site Alamance County, NC

0 100 200 Feet



Map 2 of 4

Proposed Conservation Easement

50' Jordan Lake WSW Buffer

Zone 1

Zone 2

Ecosystem Enhancement Program

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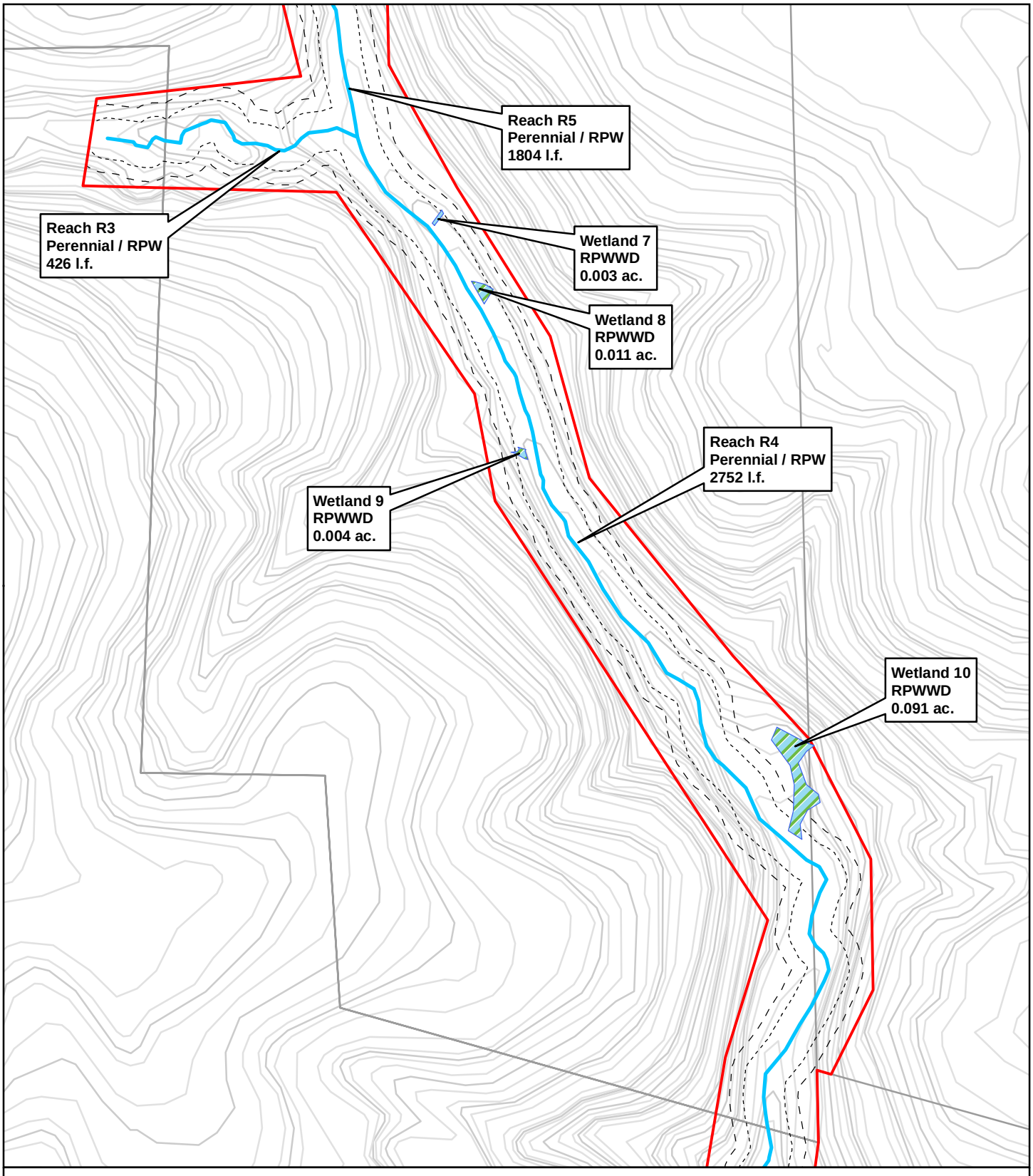
N

Jurisdictional Waters of the U.S. Including Wetlands for UT to Cane Creek Site Alamance County, NC

0 100 200 Feet



Map 3 of 4

Proposed Conservation Easement

50' Jordan Lake WSW Buffer

Zone 1

Zone 2

Ecosystem Enhancement Program

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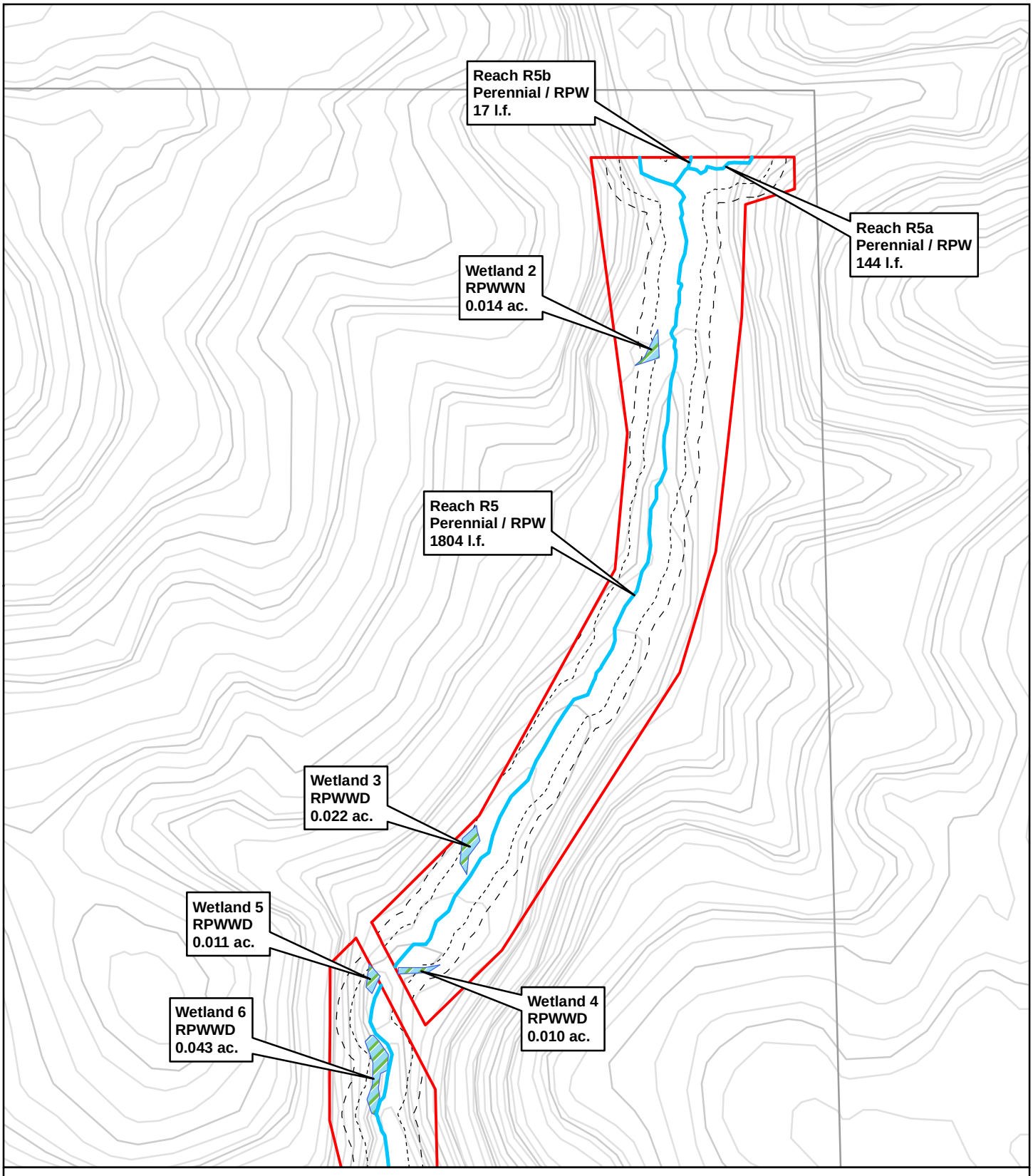
Jurisdictional Waters of the U.S. Including Wetlands for UT to Cane Creek Site Alamance County, NC

0 100 200 Feet



Map 4 of 4

Proposed Conservation Easement

50' Jordan Lake WSW Buffer

Zone 1

Zone 2

Ecosystem Enhancement Program

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N

Jurisdictional Waters of the U.S. Including Wetlands for UT to Cane Creek Site Alamance County, NC

0 100 200 Feet

WETLAND-2
WETLAND FORM

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: UT to Cane Creek City/County: Stanly County/Ala. Sampling Date: 4-8-2013
Applicant/Owner: NC EEP/Baker Eng. State: NC Sampling Point: WTLD-2 WET
Investigator(s): D. Hunegnett Section, Township, Range: NA
Landform (hillslope, terrace, etc.): toe of slope/floodplain Local relief (concave, convex, none): concave Slope (%): 1%
Subregion (LRR or MLRA): 136 of P Lat: 35.899151 Long: -79.318812 Datum: NA
Soil Map Unit Name: Tirzah silty clay loam NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation Y, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks:
- Datapoint is within a wetland
- Veg is impacted by cattle in wetland and adjacent areas

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ✓ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✓ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ✓ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No ____ Depth (inches): 1"
Water Table Present? Yes ✓ No ____ Depth (inches): 7"
Saturation Present? (includes capillary fringe) Yes ✓ No ____ Depth (inches): 3"

Wetland Hydrology Present? Yes ✓ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Hydrology present at datapoint

Sampling Point: WTLD-2 WEST

VEGETATION (Four Strata) – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30' ✓)			
1. Salix nigra	20%	Y	OBL
2. Platanus occidentalis	10%	N	FACW
3. Acer rubrum	25%	Y	FAC
4.			
5.			
6.			
7.			
8.			
	60% = Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	20%	Y	FAC
2. Lagerstroemia sinensis	15%	N	FAC
3. red cedar	10%	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	45% = Total Cover		
Herb Stratum (Plot size: 5')			
1. Impatiens capensis	30%	Y	FACW
2. other species not yet mature			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	30% = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1. Rosa multiflora	25%	Y	UP
2. Toxicodendron radicans (poison ivy)	10%	N	FAC
3.			
4.			
5.			
6.			
	35% = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	40	x 2 =	80
FAC species	70	x 3 =	210
FACU species	10	x 4 =	40
UPL species	–	x 5 =	–
Column Totals:	140 (A)		350 (B)

Prevalence Index = B/A = 2.5

Hydrophytic Vegetation Indicators:

- ✓ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks: (include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present at datapoint

WTLND-2

Sampling Point: WET

SOIL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3"	10YR 3/3	100					clay loam	
3"-8"	7.5yr 6/3	75	7.5yr 4/3	25	RM	M	Loamy clay	
8"-15"	10yr 6/2	40	10yr 5/6	60	C	M	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

Hydric soils present at data point

WETLAND-2 upland form

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: UT to Cane Creek City/County: Snow Camp / Ala. Sampling Date: 4/8

Applicant/Owner: EEP / Baker Eng. State: _____ Sampling Point: WETD2-UP

Investigator(s): D. Hunegnaw Section, Township, Range: NA

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): concave Slope (%): 5%

Subregion (LRR or MLRA): 136 or P Lat: 35.999157 Long: -79.318812 Datum: —

Soil Map Unit Name: Georgeville silt loam, 6-10% NWI classification: NA

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Aroa within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks: Data point is not within a wetland

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes _____	No ✓	Depth (inches): 7-24"
Water Table Present?	Yes _____	No ✓	Depth (inches): 7-24"
Saturation Present? (includes capillary fringe)	Yes _____	No ✓	Depth (inches): 7-24"

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland hydrology not present at data point

WETLAND - 2

Sampling Point: UP

VEGETATION (Four Strata) – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30')			
1. L. guidambar styraciflua	10%	N	FAC
2. Liriodendron tulipifera	10%	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	20	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. red cedar	60%	Y	FACU
2. ligustrum sinense	10%	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	70	= Total Cover	
Herb Stratum (Plot size: 5')			
1. none observed	NA	–	–
2. leaf layer observed			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
		= Total Cover	
Woody Vine Stratum (Plot size: 30')			
1. Toxicodendron radicans	10%	N	FAC
2.			
3.			
4.			
5.			
6.			
	10	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	–
FACW species	0	x 2 =	–
FAC species	40	x 3 =	120
FACU species	60	x 4 =	240
UPL species	0	x 5 =	–
Column Totals:	100 (A)		360 (B)

Prevalence Index = B/A = 3.6

Hydrophytic Vegetation Indicators:

N 1 - Rapid Test for Hydrophytic Vegetation

N 2 - Dominance Test is >50%

N 3 - Prevalence Index is ≤3.0[1]

__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation not present at datapoint

WETLAND 2

SOIL

Sampling Point: DP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-9"	10YR 4/6	100					Loam	
9-	10YR 3/4	100					clay loam	very tasty!!!

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

Hydric soil not present at data point

WETLAND-10
WETLAND FORM

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: UT to Cane Creek City/County: Snow Camp / Alamance Sampling Date: 4/8/2013
Applicant/Owner: NC EEP / Baker Eng. State: NC Sampling Point: WTLD-10 WET
Investigator(s): P. Hunnycutt Section, Township, Range: NA
Landform (hillslope, terrace, etc.): toeslope Local relief (concave, convex, none): concave Slope (%): 1%
Subregion (LRR or MLRA): 136 of P Lat: 35.892842 Long: -79.318252 Datum: NA
Soil Map Unit Name: Mixed Alluvial land, poorly drained NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes Y No _____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks: Datapoint is within a wetland

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ✓ Surface Water (A1)
- ___ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ✓ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ✓ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ✓ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ✓ Microtopographic Relief (D4)
- ✓ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ✓	No _____	Depth (inches): +2"
Water Table Present?	Yes ✓	No _____	Depth (inches): -1"
Saturation Present? (includes capillary fringe)	Yes ✓	No _____	Depth (inches): 0"

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: wetland hydrology present at datapoint

WTLD 10

Sampling Point: WET

VEGETATION (Four Strata) – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30')			
1. Liriodendron tulipifera	20%	Y	FAC
2. Quercus rubra	5%	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
	30% = Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	15%	N	FAC
2. Ligustrum sinense	20%	Y	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	35% = Total Cover		
Herb Stratum (Plot size: 5')			
1. no IDable yet	NA	—	
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	NA = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1. Smilax rotundifolia	15%	N	FAC
2.			
3.			
4.			
5.			
6.			
	15% = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	
FACW species	0	x 2 =	
FAC species	70	x 3 =	210
FACU species	5	x 4 =	20
UPL species	0	x 5 =	
Column Totals:	80 (A)		230 (B)

Prevalence Index = B/A = 2.875

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ✓ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present at datapoint

SOIL

Sampling Point: WTLD-10 Inlet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-7"	10YR 2/2	40	10 YR 7/2	60	RM	M	Loam sand	
7"-15"	10 YR 2/2	70	10 YR 7/2	30	RM	M	Loam/sand/Gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ✓ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

WETLAND - 10
UPLAND FORM

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: UT to Cane Creek City/County: Snow Camp/Alamance Sampling Date: 4/9/2013
Applicant/Owner: NC EEP / Baker Eng. State: NC Sampling Point: WETLD 10 - UP
Investigator(s): D. Hungerford Section, Township, Range: N/A
Landform (hillslope) terrace, etc.): hillslope Local relief (concave, convex, none): concave Slope (%): 7-9%
Subregion (LRR or MLRA): 136 of P Lat: 35.892842 Long: -79.518232 Datum: —
Soil Map Unit Name: Georgeville silt loam 10-15% slopes NWI classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No ____	**Is the Sampled Area within a Wetland?** Yes ____ No ✓
Hydric Soil Present?	Yes ____	No ✓	
Wetland Hydrology Present?	Yes ____	No ✓	

Remarks: Datapoint is not within a wetland

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ✓	Depth (inches): >15"
Water Table Present?	Yes ____	No ✓	Depth (inches): >15"
Saturation Present? (includes capillary fringe)	Yes ____	No ✓	Depth (inches): >15"

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Hydrology not present at datapoint

WTLD 1P

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: UP

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Liriodendron tulipifera	10%	N	FAC
2. Fagus grandifolia	50%	Y	FACU
3. Red cedar	10%	N	FACU
4. Carpinus caroliniana	10%	N	FAC
5. Ilex opaca	20%	Y	FAC
6. Acer rubrum	20%	Y	FAC
7. Pinus taeda	10%	Y	FAC
8.			
	130% = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1. Acer rubrum	10%	N	FAC
2. Fagus grandifolia	10%	N	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	20% = Total Cover		

Herb Stratum (Plot size: 5')			
1. leaf layer none observed in sample plot	NA		
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	NA = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1. leaf layer none observed in plot	NA		
2.			
3.			
4.			
5.			
6.			
	NA = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	–
FACW species	0	x 2 =	–
FAC species	80	x 3 =	240
FACU species	70	x 4 =	280
UPL species	0	x 5 =	–
Column Totals:	150 (A)		520 (B)

Prevalence Index = B/A = 3.5

Hydrophytic Vegetation Indicators:

N 1 - Rapid Test for Hydrophytic Vegetation

Y 2 - Dominance Test is >50%

N 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation not present at data point

WTLO-10

SOIL

Sampling Point: UP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4"	10YR 5/3	100					Loam	
4-10"	10YR 5/4	100					Clay Loam	
10"-15"	10YR 6/6	100					Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

Hydric soil not present at datapoint

16.2 NCWAM Forms – Existing Wetlands

NC Wetland Assessment Method (NCWAM) Forms were not included for this project, as the NC Division of Water Resources and the USACE did not require them at the time this project was evaluated.

16.3 NCDWR Stream Classification Forms

R1

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	Project/Site: MCBANE R1 ENTIRE R. 1234	Latitude: 35.885758°
Evaluator: R. BARLING	County: ALAMANCE	Longitude: -79.319215°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30.5	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other e.g. Quad Name: SWEPSONVILLE

A. Geomorphology (Subtotal = 15)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		(Yes = 3)	

[a] artificial ditches are not rated; see discussions in manual

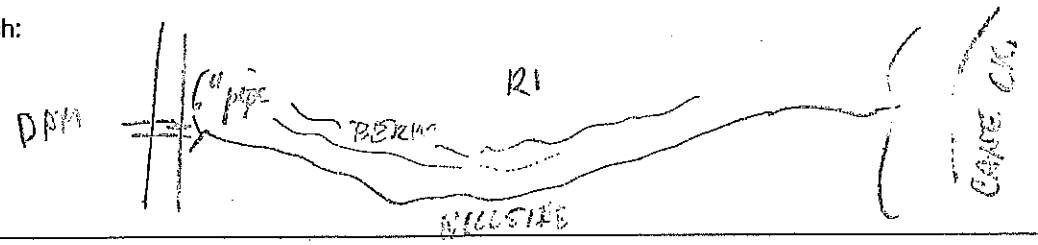
B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	1	(2)	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 4.5)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			N/A

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



DAM UPSTREAM END ⇒ PERENNIAL FLOW

A2

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	**Project/Site:** MC BANE R2 spring to Cane Ck.	**Latitude:** 35.888411°
Evaluator: R. DARLING	**County:** ALAMANCE	**Longitude:** -79.319456°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 11	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** SAXAPAHAW *e.g. Quad Name*

A. Geomorphology (Subtotal = 4.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	(1)	2	3
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	(0)	1	2	3
4. Particle size of stream substrate	(0)	1	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

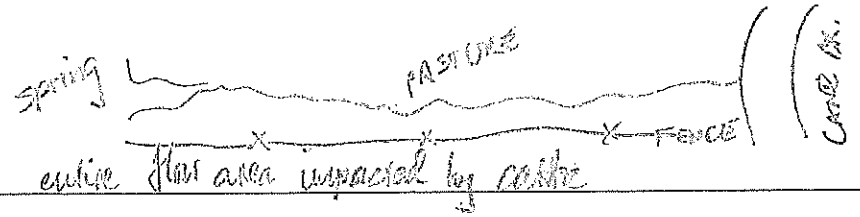
B. Hydrology (Subtotal = 5)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	1	(2)	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 1.5)				
18. Fibrous roots in streambed	3	2	1	(0)
19. Rooted upland plants in streambed	3	2	1	(0)
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) NONE			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



channel is ephemeral but persistent cattle activity & constant flow may not be mutually exclusive

Maybe 40' of actual discernible channel at end.

R3A (IMMEDIATELY U/S OF PROJECT REAC

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	Project/Site: MCBANE R3A CONFL to CROSSING	Latitude: 35.895363°
Evaluator: R. DARLING	County: ALAMANCE	Longitude: -79.321956
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 41.5	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other SAXAPAHAW *e.g. Quad Name:*

A. Geomorphology (Subtotal = 22.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	2	(3)
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	1	(2)	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

[a] artificial ditches are not rated; see discussions in manual

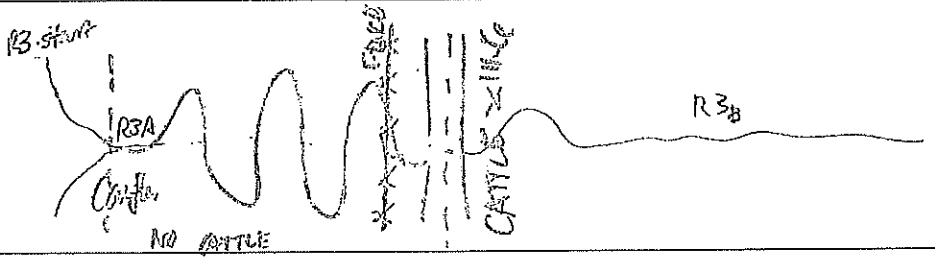
B. Hydrology (Subtotal = 16)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 8)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	0	1	(2)	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = (0)			N/A

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:
Macros: Amphipods + Mayfly



R3B

(PROJECT REACH)

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	Project/Site: McGEE R3 CROSSING - RESTORE	Latitude: 35.895264°
Evaluator: R. DARLING	County: ALAMANCE	Longitude: -79.320958°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 36	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other SAXAPAHAW *e.g. Quad Name:*

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	2	(3)
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		(Yes = 3)	

[a] artificial ditches are not rated; see discussions in manual

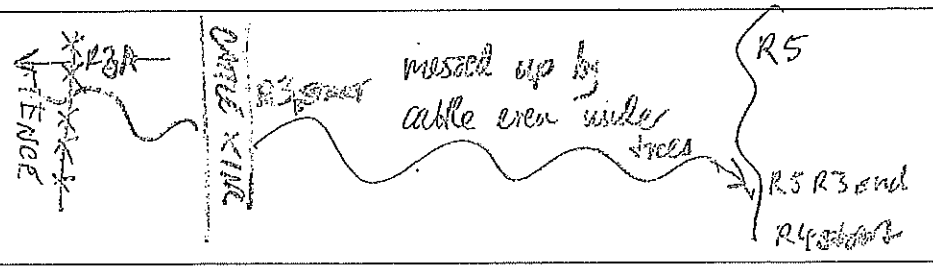
B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	(1.5)
16. Organic debris lines or piles	0	0.5	1	(1.5)
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) NA			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



R4

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	Project/Site: MCGANE Rep start to end	Latitude: 35.895220
Evaluator: R. DARLING	County: ALAMANCE	Longitude: -79.320083
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 42.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other SAXAPAHAW *e.g. Quad Name:*

A. Geomorphology (Subtotal = 25)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	1	(2)	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	No = 0		(Yes = 3)	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 9)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	(0.5)	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) N/A			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

Macros = amphipods, midges

MAIN TRIB.

CATTLE THROUGHOUT

ROCKY

R5

NC DWQ Stream Identification Form Version 4.11

Date: 3/29/2012	Project/Site: MCBANE PROPERTY REACH R-5	Latitude: 35.899683°
Evaluator: R. DARLING	County: ALAMANCE	Longitude: -79.318862°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 38.5	Stream Determination (circle one) Ephemeral Intermittent (Perennial)	Other SAXAPAHAW *e.g. Quad Name*

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	No = 0		(Yes = 3)	

[a] artificial ditches are not rated; see discussions in manual

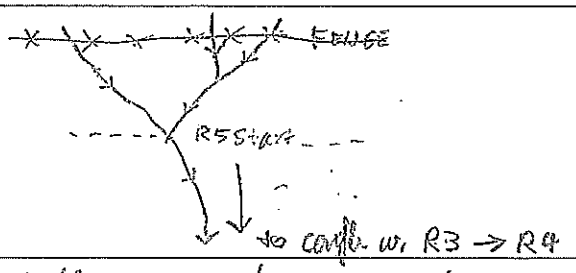
B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 7.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0) n/a			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: Heavily impacted by cattle even in upper section under trees.

Sketch:



Macrobenthos - Black flys, water beetle, amphipods

NC DWQ Stream Identification Form Version 4.11

Date: 4/8/2013	**Project/Site:** SA	**Latitude:** 35.899805
Evaluator: D. Honeycutt	**County:** Alamance	**Longitude:** -79.318372
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 33.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:* East of Snow Camp

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 11)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	(3)
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	0.5	(1)	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: 2 amphipod (may Ply 1 isopod

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 4/8/2013	**Project/Site:** JB	**Latitude:** 35.899817
Evaluator: D. Hunnycutt	**County:** Alamance	**Longitude:** -79.318557
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30.25	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** East of Snow Camp *e.g. Quad Name:*

A. Geomorphology (Subtotal = 7)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	(1)	2	3
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	(0)	1	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	1	(2)	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 13.25)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	(3)
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	0.5	1	(1.5)
24. Amphibians	0	0.5	1	(1.5)
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75	OBL = 1.5	Other = 0	

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes: many amphipods & isopods, 1 salamander

Sketch:

16.4 FHWA Categorical Exclusion Form

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	UT to Cane Creek
County Name:	Alamance
EEP Number:	95729
Project Sponsor:	Michael Baker Engineering, Inc.
Project Contact Name:	Ken Gilland
Project Contact Address:	8000 Regency Parkway, Suite 600, Cary NC 27518
Project Contact E-mail:	kgilland@mbakercorp.com
EEP Project Manager:	Perry Sugg

Project Description

The UT to Cane Creek restoration site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and/or wetland impacts. Several sections of channel have been identified as significantly degraded by past channelization and agricultural practices. The proposed project would involve a combination of Priority Level I restoration of approximately 3,300 linear feet of stream and Enhancement II of approximately 2,920 linear feet of stream.

Reviewed By:

3-7-13

Date

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator FHWA

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

Final Approval By:

3-20-13

Date

For Division Administrator FHWA

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

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

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

16.5 FEMA Compliance - NCEEP Floodplain Requirements Checklist

The topography of the site supports the design without creating the potential for hydrologic trespass. The site is located in a FEMA mapped area and therefore a hydraulic analysis is required to obtain a "No-Rise/No-Impact" certification. Baker will submit a floodplain development permit application, including the hydraulic analysis, to the Alamance County Floodplain Manager. The project will likely require a Letter of Map Revision (LOMR) following construction in order to document any changes (reductions) to Base Flood Elevations (BFEs). The NCEEP Floodplain Checklist was provided to the Alamance County Floodplain Manager along with this report.

Baker

March 7, 2013

Perry Sugg
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center,
Raleigh, NC 27699-1652

Subject: NCEEP Floodplain Requirements Checklist: UT to Cane Creek Stream Restoration Project, Alamance County, North Carolina. NCDWQ sub-basin 03-06-04, USGS hydrologic unit 03030002, NCEEP Project Number 95729

Dear Mr. Sugg:

Please find enclosed one copy of the NCEEP Floodplain Requirements Checklist for the UT to Cane Creek Stream Restoration Project in Alamance County, North Carolina (see Figure 1). The project site is located three miles south of the Town of Saxapahaw, NC, within cataloging unit 03030002 and NC Division of Water Quality (NCDWQ) subbasin 03-06-04 of the Cape Fear River Basin.

Currently, the project reaches are impacted by on-going agricultural use, cattle access, and the lack of adequate riparian buffers. Project goals include the Priority Level I restoration of approximately 3,300 linear feet (LF) of stream and the Enhancement II of approximately 2,920 LF of stream for the purpose of obtaining stream mitigation credit in the Cape Fear River Basin. A topographic map of the project area is shown in Figure 2, the soils in the project area are shown in Figure 3, LiDAR mapping in Figure 4, and area floodplains in Figure 5. The proposed restoration plan for the site is shown in Figure 6b.

Project activities will include filling drainage ditches, raising the existing stream bed, establishing riparian buffers, stabilizing degraded stream channels, and installing in-stream structures. As per our previous discussion with the Local Floodplain Manager about the project, Baker has prepared the following checklist to summarize the potential floodplain impacts of the project.

Sincerely,

Ken Gilland

Ken Gilland, P.G.
Enclosures

Cc: Edward Curtis, NC Floodplain Mapping Program
John Gerber, NC Floodplain Mapping Unit
Jason Martin, MPA, Floodplain Manager, Alamance County

March 7, 2013

Mr. Edward Curtis
NC Floodplain Mapping Program
NC Division of Emergency Management
Hazard Mitigation Section
1830-B Tillery Place, Raleigh, NC 27604

Subject: NCEEP Floodplain Requirements Checklist: UT to Cane Creek Stream Restoration Project, Alamance County, North Carolina. NCDWQ sub-basin 03-06-04, USGS hydrologic unit 03030002, NCEEP Project Number 95729

Dear Mr. Curtis:

Please find enclosed one copy of the NCEEP Floodplain Requirements Checklist for the UT to Cane Creek Stream Restoration Project in Alamance County, North Carolina (see Figure 1). The project site is located three miles south of the Town of Saxapahaw, NC, within cataloging unit 03030002 and NC Division of Water Quality (NCDWQ) subbasin 03-06-04 of the Cape Fear River Basin.

Currently, the project reaches are impacted by on-going agricultural use, cattle access, and the lack of adequate riparian buffers. Project goals include the Priority Level I restoration of approximately 3,300 linear feet (LF) of stream and the Enhancement II of approximately 2,920 LF of stream for the purpose of obtaining stream mitigation credit in the Cape Fear River Basin. A topographic map of the project area is shown in Figure 2, the soils in the project area are shown in Figure 3, LiDAR mapping in Figure 4, and area floodplains in Figure 5. The proposed restoration plan for the site is shown in Figure 6b.

Project activities will include filling drainage ditches, raising the existing stream bed, establishing riparian buffers, stabilizing degraded stream channels, and installing in-stream structures. As per our previous discussion with the Local Floodplain Manager about the project, Baker has prepared the following checklist to summarize the potential floodplain impacts of the project.

Sincerely,

Ken Gilland

Enclosures

Cc: Perry Sugg, North Carolina Ecosystem Enhancement Program
John Gerber, NC Floodplain Mapping Unit
Jason Martin, MPA, Floodplain Manager, Alamance County

Baker

March 7, 2013

Jason Martin, MPA,
Alamance County Floodplain Administrator
Planning Department
217 College Street, Suite C.
Graham, NC 27253

Subject: NCEEP Floodplain Requirements Checklist: UT to Cane Creek Stream Restoration Project, Alamance County, North Carolina. NCDWQ sub-basin 03-06-04, USGS hydrologic unit 03030002, NCEEP Project Number 95729

Dear Mr. Martin:

Please find enclosed one copy of the NCEEP Floodplain Requirements Checklist for the UT to Cane Creek Stream Restoration Project in Alamance County, North Carolina (see Figure 1). The project site is located three miles south of the Town of Saxapahaw, NC, within cataloging unit 03030002 and NC Division of Water Quality (NCDWQ) subbasin 03-06-04 of the Cape Fear River Basin.

Currently, the project reaches are impacted by on-going agricultural use, cattle access, and the lack of adequate riparian buffers. Project goals include the Priority Level I restoration of approximately 3,300 linear feet (LF) of stream and the Enhancement II of approximately 2,920 LF of stream for the purpose of obtaining stream mitigation credit in the Cape Fear River Basin. A topographic map of the project area is shown in Figure 2, the soils in the project area are shown in Figure 3, LiDAR mapping in Figure 4, and area floodplains in Figure 5. The proposed restoration plan for the site is shown in Figure 6b.

Project activities will include filling drainage ditches, raising the existing stream bed, establishing riparian buffers, stabilizing degraded stream channels, and installing in-stream structures. As per Kevin Higgins' previous discussion with you about the project, Baker has prepared the following checklist to summarize the potential floodplain impacts of the project.

Sincerely,

Ken Gilland

Ken Gilland, P.G.

Enclosures

Cc: Edward Curtis, NC Floodplain Mapping Program
Perry Sugg, North Carolina Ecosystem Enhancement Program
John Gerber, NC Floodplain Mapping Unit

EEP Floodplain Requirements Checklist

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

Project Location

Name of project:	UT to Cane Creek Restoration Project
Name if stream or feature:	UT to Cane Creek
County:	Alamance
Name of river basin:	Cape Fear
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Alamance County
DFIRM panel number for entire site:	9707J
Consultant name:	Ken Gilland, PG Michael Baker Engineering, Inc.
Phone number:	919-463-5488
Address:	8000 Regency Parkway, Suite 600 Cary, NC 27518

Design Information

Michael Baker Engineering, Inc. proposes to restore 3,293 linear feet (LF) of perennial stream, and enhance 2,923 LF of stream along three unnamed tributaries (UTs) to Cane Creek. The project site is located approximately three miles south of the Town of Saxapahaw, NC (see Figure 1). The project site is located in the NC Division of Water Quality subbasin 03-06-04 and the NC Ecosystem Enhancement Program's Targeted Local Watershed 03030002-050050 of the Cape Fear River Basin. The purpose of the project is to restore and/or enhance stream and riparian buffer functions and improve area water quality where impaired stream channel flows through the site. The project will potentially provide numerous water quality and ecological benefits within the Cane Creek and Haw River watersheds, and the Cape Fear River Basin. A recorded conservation easement consisting of approximately 19.6 acres will protect all stream reaches and riparian buffers in perpetuity.

Reach	**Length**	**Priority**
Reach 1	*1,052 LF*	*Restoration*
Reach 3	*369 LF*	*Restoration*
Reach 4	*222 LF (downstream) and 2,490 LF (upstream)*	*Restoration and Enhancement II*
Reach 5	*1,650 LF and 433 LF*	*Restoration and Enhancement II*

Floodplain Information

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

◉ Yes ○ No

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

☐ Redelineation

☑ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation:

Check if applies:

☑ AE Zone

○ Floodway

○ Non-Encroachment

◉ None ☐ A Zone ○ Local Setbacks Required ○ No Local Setbacks Required
If local setbacks are required, list how many feet:
Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? ○ Yes ◉ No
Land Acquisition (Check) ☐ State owned (fee simple) ☐ Conservation easment (Design Bid Build) ☑ Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? ◉ Yes ○ No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, (919) 715-8000)
Name of Local Floodplain Administrator: Jason Martin Phone Number: 336-570-4052

Floodplain Requirements

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

☐ No Action

☑ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision (CLOMR)

☐ Other Requirements

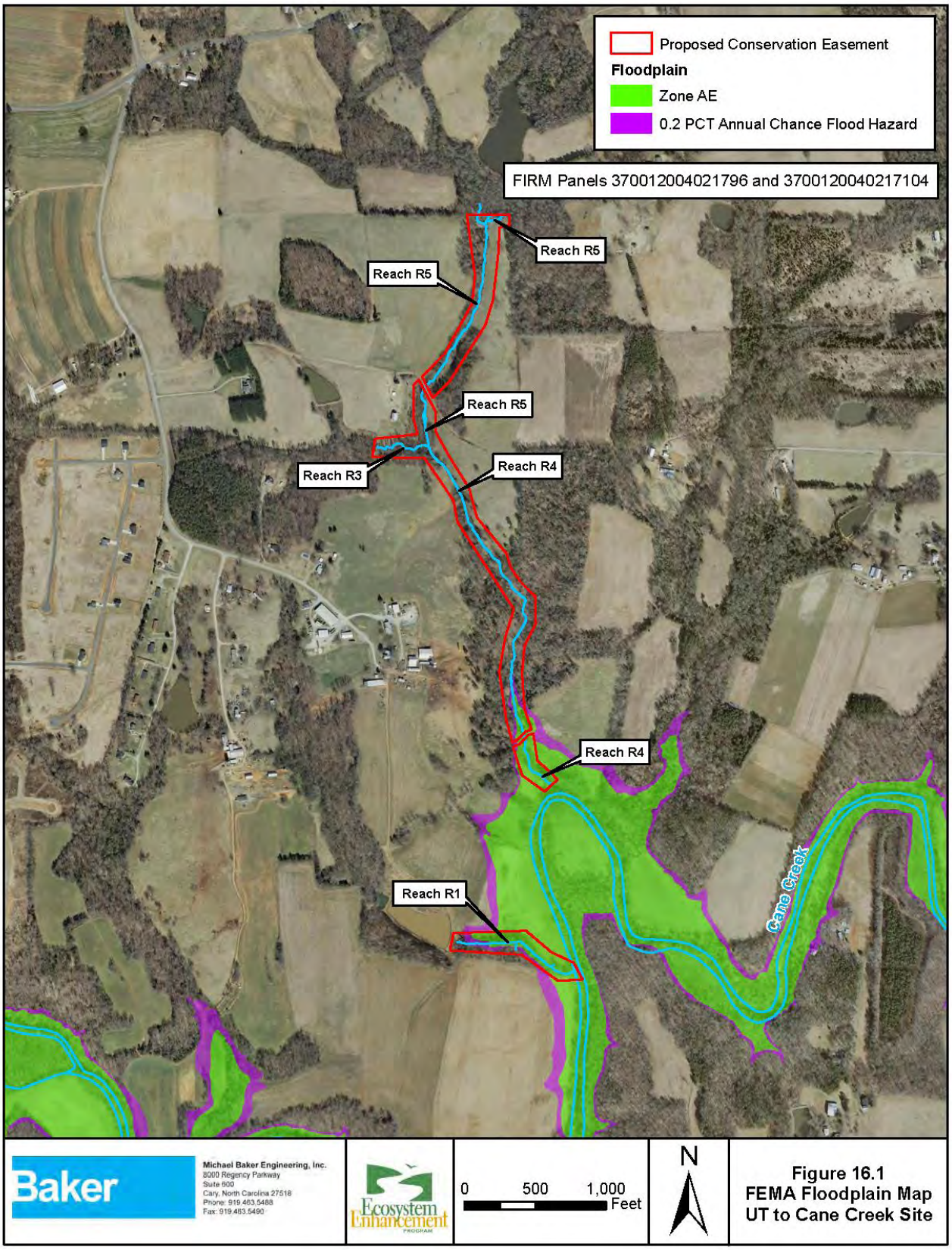
List other requirements:

Comments:

Name: Ken Gilland_ Signature: _____

Title: _Professional Geologist Date: ___3/7/13____

Figure 16.1 FEMA Floodplain Map



17.0 APPENDIX C - MITIGATION WORK PLAN DATA AND ANALYSES

17.1 Channel Morphology (Rosgen Analysis)

17.1.1 Existing Conditions

17.1.1.1 Channel Classification

The UTs to Cane Creek are small, perennial streams with a total drainage area of approximately 0.706 square miles for Reaches R3, R4, R5, and R5a and 0.125 square miles for Reach R1 (Figure 2.2). Historically, the project streams have been impacted due to agricultural conversion and cattle grazing. The main stem (Reaches R4 & R5) is mostly wooded, yet some sections have become extremely unstable and are experiencing active widening and downcutting.

For analysis purposes, Baker labeled the existing unnamed tributaries Reach R1, R3, R4, R5 and R5a respectively. The existing UT reach locations are shown on Figures 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 17.2, and 17.4. The main stem (Reach R5) begins at the northernmost project boundary and flows south towards a farm access road where it was disconnected from its historical flow path towards the confluence with Cane Creek. During field verification with the USACE of intermittent or perennial status and subsequent site visits with NCEEP, Reach R5 was determined to be a perennial stream based on a minimum score of 30 for perennial streams and/or the presence of biological indicators using the NCDENR and NCDWR Determination of the Origin of Perennial Streams stream assessment protocols and guidelines (see NCDWR stream forms in Appendix B).

Reach R1

Reach R1 begins at the outfall pipe from an existing farm pond at the south end of the project site. The reach flows from the existing pond outfall, eastward approximately 970 linear feet (LF), to its confluence with Cane Creek. Cattle do not currently have access to this reach, however the upstream portions of Reach R1 appear to have been straightened and channelized, as evidenced by the spoil piles along the stream banks in this location. This portion of Reach R1 is moderately incised as a result of these modifications, and bank height ratios often exceed 1.5. The stream bank heights are slightly lower in downstream portions of Reach R1, but increase again at a headcut near the reach's confluence with Cane Creek. This headcut will likely cause further channel incision, stream bank erosion, and subsequent channel widening if left unaddressed.

At several locations along its length, Reach R1 appears to have been relocated south from the low point of the valley, likely to accommodate the adjacent row-cropping practices to the north. A majority of the riffles along Reach R1 were observed to have coarse gravel accumulations with imbedded fine sediment. Additionally, Baker hand augered through the fine material and found underlying coarse/gravel bed materials. This fining of the bed material is likely due to the active stream bank erosion occurring along Reach R1. Reach R1 is exhibiting significant incision, with an average bank height ratio (BHR) of 1.5 or more.

Evidence of active stream bank erosion along Reach R1 was observed along more than 40 percent of the existing footage, predominantly in the form of surficial scour. Reach R1 has some sections of mature buffer along the right stream bank, with most of the buffer along the left stream bank consisting of either a single tree line or active agricultural field. Approximately 50 percent of the length of left stream bank of Reach

R1 has longitudinal breaks or interruption of the existing tree line greater than 20 feet in length. A majority Reach R1 has experienced floodplain alteration, as evidenced by the spoil piles/levees along the reach.

Approximately 50 percent of Reach R1 is actively subject to water quality stressors, predominantly the active row crop agriculture along the left stream bank. Based on existing conditions, Reach R1 is classified as an incised "E" Rosgen stream type.

Reach R2

Reach R2, a direct tributary to Cane Creek, immediately north of Reach R1, was submitted by Baker with our original proposal, however is not part of this mitigation plan. The reach designations have remained the same in order to be consistent throughout the document.

Reach R3

Reach R3 begins just downstream from the confluence of two small tributaries on the northwest portion of the project site and extends to the confluence with Reach R5, a distance of more than 400 LF. Reach R3 is incised and used by cattle as a loafing area, and is consequently experiencing significant degradation. The mature timber along much of the reach has recently been selectively harvested. Chinese privet (*Ligustrum sinense*) is prevalent along much of the existing buffer. A majority of the riffles along Reach R3 were observed to have coarse gravel accumulations imbedded with fine sediment. This fining is likely due to the active incision and stream bank erosion occurring along Reach R3. A majority of Reach R3 is exhibiting significant incision, with typical BHRs of 2.1 or more. Evidence of active stream bank erosion along Reach R3 was observed along approximately 60 percent of the existing footage, predominantly in the form of surficial scour and mass wasting. Reach R3 has few mature buffer trees remaining after the recent harvesting. The floodplain along Reach R3 does not appear to have been altered, however most of the reach is actively subject to water quality stressors, in the form of buffer limitations and direct livestock access. Based on existing conditions, Reach R3 has a Rosgen stream type classification of "G".

Reach R4

Reach R4 begins at the confluence of Reaches R3 and R5. Reach R4 flows from this location south to its confluence with Cane Creek. Reach R4 exhibits two distinctly different conditions along its reach. A majority of the reach, beginning at the confluence with Reaches R3 and R5, approximately 2,300 feet to the existing at-grade stream crossing near the Cane Creek floodplain, is relatively stable, warranting enhancement activities only. From this crossing, downstream approximately 400 feet, to its confluence with Cane Creek, restoration is necessary due to significant instability. The upstream, stable section of Reach R4 is bedrock controlled and is near reference reach quality in several locations; however, cattle have total access to this reach. Sections of the buffer along this section of Reach R4 have recently been selectively timbered. Chinese privet (*Ligustrum sinense*) and multi-flora rose (*Rosa multiflora*) are prevalent in many locations as well. These conditions present an exceptional opportunity for successful enhancement activities. The downstream, unstable section of the reach is an uncontrolled cattle loafing area. This reach is abutted by active cattle pasture along both stream banks, with only a single row of mature trees, many of which are in imminent danger of falling into the stream channel due to stream incision and subsequent stream bank erosion.

A low percentage of the riffles along the entire length of Reach R4 were observed to have the coarse gravel accumulations imbedded with fine sediment. The majority of upper Reach R4 was exhibiting minimal incision, with a typical bank height ratio closer to 1.0. The unstable, downstream section of Reach R4 is exhibiting significant incision, with

typical BHRs of 3.2 or more. Active stream bank erosion along the unstable section of Reach R4 was observed throughout most of the reach, predominantly in the form of surficial scour and mass wasting. Stream bank erosion here is wide-spread due primarily to on-going cattle access. The stable, upstream length of Reach R4 has some significant sections of mature buffer along both stream banks, with some areas less intact and contiguous.

The existing riparian buffer along the unstable section of Reach R4 is best described as herbaceous with frequent breaks in continuity of canopy of trees insufficient to form a definable single line of native trees along the top of the stream banks. This section of Reach R4 has active cattle pasture along both stream banks, with only a single line of trees in some locations. No portion of Reach R4 appears to have experienced floodplain alteration, however most of Reach R4 is actively subject to water quality stressors, in the form of an inadequate buffer with direct livestock access. The upstream, stable section of Reach R4 has a Rosgen stream type classification of "B". The downstream, unstable section of Reach R4 has a Rosgen stream type classification of "F".

Reach R5

Reach R5 begins at the north end of the project site at the property line and flows southward approximately 1,400 LF to an existing culverted crossing. Reach R5 flows approximately 400 linear feet further to its confluence with Reaches R3 and R4. The condition of Reach R5 downstream of the culverted crossing is similar to the stable, upstream section of Reach R4 as described above. The 1,400 LF of Reach R5 upstream of the culverted crossing is significantly degraded. The degraded section of Reach R5 appears to have been straightened and channelized at some point in the past. This section of Reach R5 appears to have been relocated west, away from the low point of the valley (likely to expand the adjacent pastures). Along this section, Reach R5 is significantly incised, and often entrenched, as a result of channelization and straightening. The altered section of Reach R5 appears to have incised down to bedrock in some locations, causing subsequent lateral instability. A few of the riffles along the degraded Reach R5 were observed to have coarse gravel accumulations imbedded with fine sediment. Most of this section of Reach R5 is exhibiting significant incision, with typical BHRs of 2.3 or more. Evidence of active stream bank erosion along the degraded Reach R5 was observed along more than half of the existing footage, predominantly in the form of surficial scour and mass wasting. Stream bank erosion is wide-spread due primarily to on-going cattle access.

The buffer along this section of Reach R5 can be described as herbaceous with frequent breaks in continuity of canopy of trees insufficient to form a definable, single line of native trees along the top of the stream banks. Many tree species are Tree-of-heaven (*Ailanthus altissima*), an exotic invasive. The uppermost end of Reach R5, near the property line exhibits a small area with a more "natural" buffer, though actively accessed by cattle. More than half of the degraded length of Reach R5 has experienced some floodplain alteration, as evidenced by the obvious unnatural pattern of the reach. A majority of Reach R5 is actively subject to water quality stressors in the form of buffer with direct livestock herd access. The longer, degraded stretch of Reach R5 has a Rosgen stream type classification of "G". The shorter, stable section of Reach R5 classifies the same as upstream, stable section of Reach R4, as described above: a Rosgen "B" stream type classification.

Reach R5a

Reach R5a begins at the northeastern end of the project site at the property line and flows southwestward approximately 144 LF to the confluence with Reach R5. Reach R5a is only slightly degraded, and appears to have incised down to bedrock in some locations, causing minor lateral instability. A few of the riffles along the degraded Reach R5a were observed to have exposed bedrock and coarse gravel accumulations imbedded with fine sediment. Most of Reach R5a is exhibiting moderate incision, with typical BHRs of 1.3 or more.

The buffer along this section of Reach R5a can be described as wooded with frequent breaks in continuity of canopy of trees insufficient to form a definable, single line of native trees along the top of the stream banks. The uppermost end of Reach R5a, near the property line exhibits a small area with a more "natural" buffer, though actively accessed by cattle. A majority of Reach R5a is actively subject to water quality stressors in the form of buffer with direct livestock herd access. Reach R5a has a Rosgen stream type classification of "B" given the steeper slopes (> 2%) and lower entrenchment value (ER = 1.3).

Baker performed an existing conditions survey of the stream channels and floodplain, which included longitudinal profiles of all project reaches and seven (7) representative cross-sections. The total current length of the existing streams on the site is approximately 6,000 LF based on the field survey. Table 17.1 represents geomorphic data compiled from the existing condition survey.

Table 17.1 Representative Existing Conditions Geomorphic Data for Project Reaches: Stream Channel Classification Level II
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Parameter	Reach R1		Reach R3	
	XS1	XS2	XS6	-
Existing Reach Length (ft)	943		425	
Drainage Area (sq. mi.)	0.125		0.142	
Bankfull Discharge, Q_{bkf} (cfs)*	19.8		21.7	
Feature Type	Riffle	Riffle	Riffle	-
Rosgen Stream Type	G5c	E5	B4c	-
Bankfull Width (W_{bkf}) (ft)	5.6	7.3	7.6	-
Bankfull Mean Depth, (d_{bkf}) (ft)	0.9	0.7	0.8	-
Width to Depth Ratio (W_{bkf}/d_{bkf})	6.1	10.5	9.9	-
Cross-Sectional Area, A_{bkf} (sq ft)	5.2	5.1	5.6	-
Bankfull Max Depth (d_{mbkf}) (ft)	1.2	1.1	1.2	-
Floodprone Width (W_{fpa}) (ft)	6.8	>30	16.3	-
Entrenchment Ratio (W_{fpa}/W_{bkf}) (ft)	1.2	9.5	2.2	-
Bank Height Ratio**	4.3	1.6	1.5	-
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	11+64	15+69	12+00	-
Bankfull Mean Velocity, $V_{bkf}= (Q_{bkf}/A_{bkf})$ (ft/s)	3.8	3.9	3.8	-
Channel Materials (Particle Size Index – d50)***				
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	-		-	

Average Valley Slope (ft/ft)	0.0135	0.0195
Average Water Surface Slope (S)	0.0127	0.0168
Average Channel Sinuosity (K)****	1.09	1.16

*Bankfull discharge estimated using published NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate systemwide self-recovery is unlikely)
***Sediment samples taken along main stem only (Reaches R4 & R5) given shorter reach lengths, proximity to upstream impoundments, and similar substrate material.
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured. The channel exhibits minimal pattern since it has been straightened/channelized, and/or is classified as a step-pool channel.

Parameter	Reach R4		Reach R5	Reach R5a
	XS4	XS5	XS3	XS7
Existing Reach Length (ft)	2,783		1,848	144
Drainage Area (sq. mi.)	0.706		0.450	0.025
Bankfull Discharge, Q_{bkf} (cfs)*	69.2		50.0	7.1
Feature Type	Riffle	Riffle	Riffle	Riffle
Rosgen Stream Type	B3c	F5	G4	B4
Bankfull Width (W_{bkf}) (ft)	16.7	15.4	8.9	13.6
Bankfull Mean Depth, (d_{bkf}) (ft)	0.9	1.0	1.2	0.3
Width to Depth Ratio (W_{bkf}/d_{bkf})	19.0	15.4	7.2	45.0
Cross-Sectional Area, A_{bkf} (sq ft)	14.8	15.5	10.9	4.2
Bankfull Max Depth (d_{mbkf}) (ft)	1.3	1.6	1.5	0.5
Floodprone Width (W_{fpa}) (ft)	26.2	18.4	11.8	16.9
Entrenchment Ratio (W_{fpa}/W_{bkf}) (ft)	1.6	1.2	1.3	1.3
Bank Height Ratio**	1.3	2.8	2.6	2.3
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	36+17	52+96	14+57	10+62
Bankfull Mean Velocity, $V_{bkf}= (Q_{bkf}/A_{bkf})$ (ft/s)	4.6	4.4	4.5	1.7
Channel Materials (Particle Size Index – d50)***				
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	24.2 / 50.6 / 69.4 / 139.7 / 179.8	0.19 / 0.35 / 0.5 / 1.5 / 3.2	16.6 / 31.2 / 47.0 / 85.3 / 116.1	-
Average Valley Slope (ft/ft)	0.0169		0.0144	0.0236
Average Water Surface Slope (S)	0.0148		0.0128	0.0224
Average Channel Sinuosity (K)****	1.04		1.07	1.19

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate systemwide self-recovery is unlikely)
***Sediment samples were taken at representative riffles along main stem (Reaches R4 & R5)
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured. The channel exhibits minimal pattern since it has been straightened/channelized, and/or is classified as a step-pool channel.

17.1.1.2 Valley Classification

The UT to Cane Creek Site is located in southeast Alamance County within the Piedmont hydrophysiographic region of North Carolina. Undisturbed Piedmont valleys in this region are generally classified as Valley Type 'VII' (Rosgen, 2006) and the province is characterized by broad, rolling, interstream divides across variable steep slopes along well-defined drainage ways. The underlying geologic unit of the project area consists of the Felsic Metavolvanic Rock (CZfv) within the Carolina Slate Belt geologic formation and Level III Ecoregion. (Geologic Map of North Carolina, NC Geological Survey, 1998). The area receives moderately high rainfall amounts with precipitation averaging 46.6 inches per year (NRCS Alamance County Soil Survey, 1960).

17.1.1.3 Channel Morphology and Stability Assessment

Baker performed general topographic and planimetric surveying of the project site and produced a 1-foot contour map based on survey data in order to create plan set base mapping (see Section 18.0, Appendix D). Six representative cross-sections and a longitudinal profile survey were also surveyed to assess the current condition and overall stability of the stream channels. The existing riffle cross-section data and locations are shown in Figure 17.1 and compared with the Rosgen Channel Stability Assessment shown in Table 17.2.

With exception to cross-section #2, #4 and #6 (Reaches R1, R3 & R4), consistent bankfull indicators could not be identified in the field. Therefore, bankfull cross-sectional areas were estimated using the NC Rural Piedmont Regional Curve to compare stability ratings. The representative riffle cross-sections have a typical Bank Height Ratio (BHR) greater than 1.5. Some of the cross-section data illustrate the presence of existing berms or overburden from channelization and the lack of natural floodplain deposits.

The longitudinal profiles show the channel slopes vary from 0.0127 to 0.0168 ft/ft and have average valley slopes of 0.0144 to 0.0195 ft/ft with several long riffle sections and infrequently spaced pools, except for the middle section of Reach R4. The sinuosity for the reaches is approximately 1.1, a result of prior straightening/channelization and valley morphology. Large sections of the project reaches are moderately to severely entrenched and highly unstable as shown on the cross-section data. This likely indicates a movement toward a more unstable condition (e.g., downcutting, stream bank erosion), especially in portions of the reach where numerous active headcuts are present (vertical instability) or stream banks are actively eroding (lateral instability).

Table 17.2 Rosgen Channel Stability Assessment

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Stability Rating	Bank Height Ratio (BHR)
Stable (low risk of degradation)	1.0-1.05
Moderately unstable	1.06-1.3
Unstable (high risk of degradation)	1.3-1.5
Highly unstable	>1.5

Notes: Rosgen, D. L. (2001) A stream channel stability assessment methodology. Proceedings of the Federal Interagency Sediment Conference. Reno, NV. March, 2001.

Figure 17.1 Existing Cross-Section Locations for Project Reaches

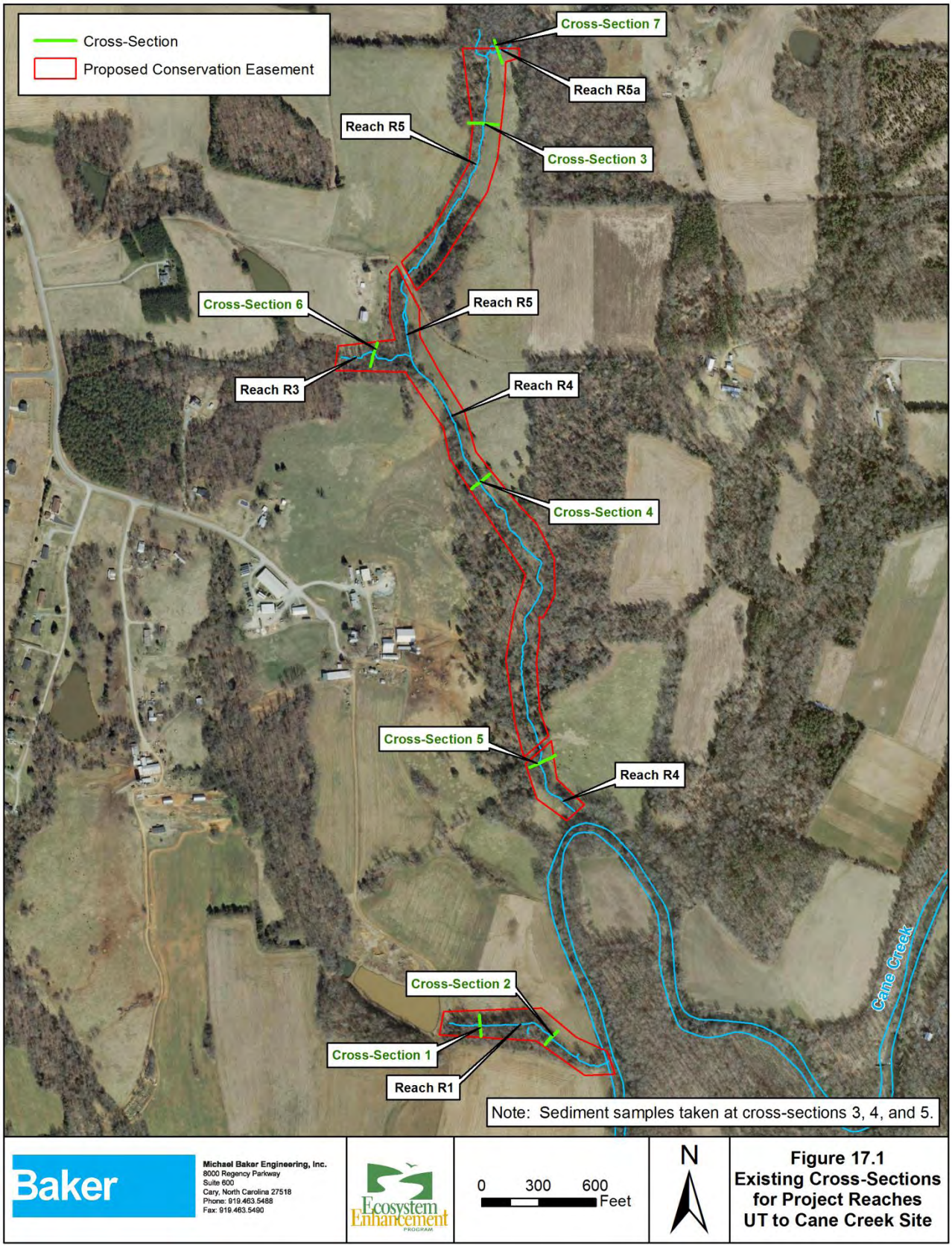
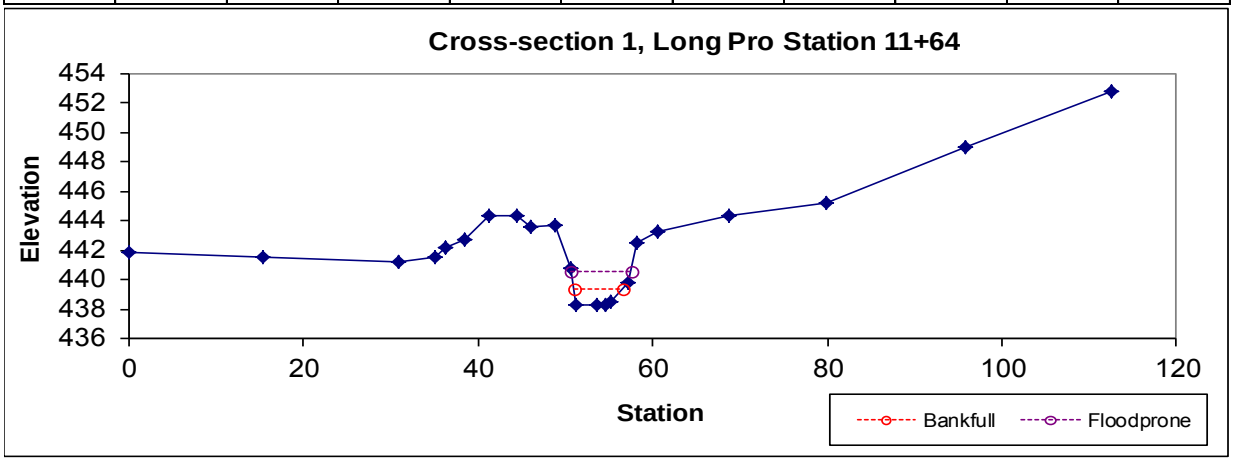
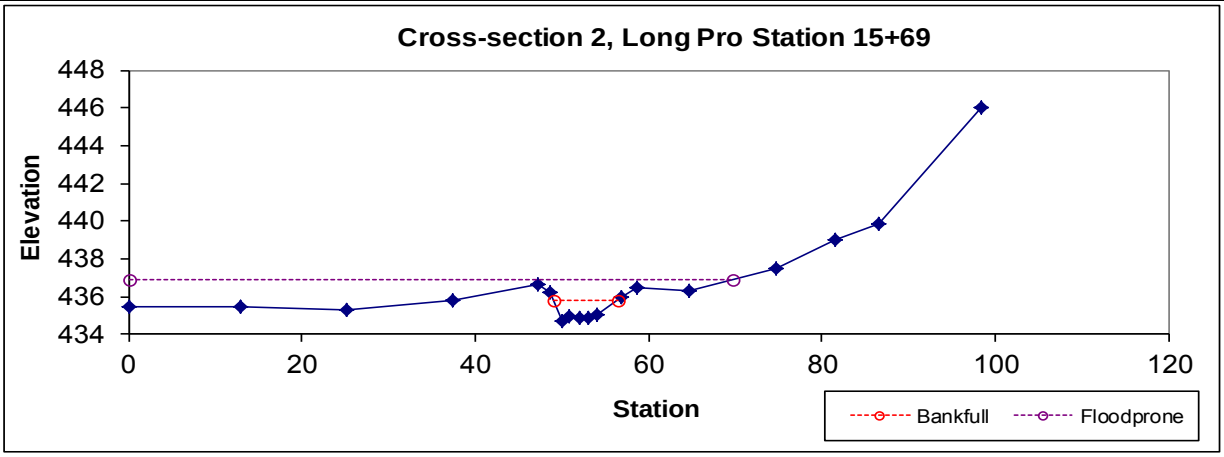


Figure 17.2 Existing Cross-Section Data for Project Reaches

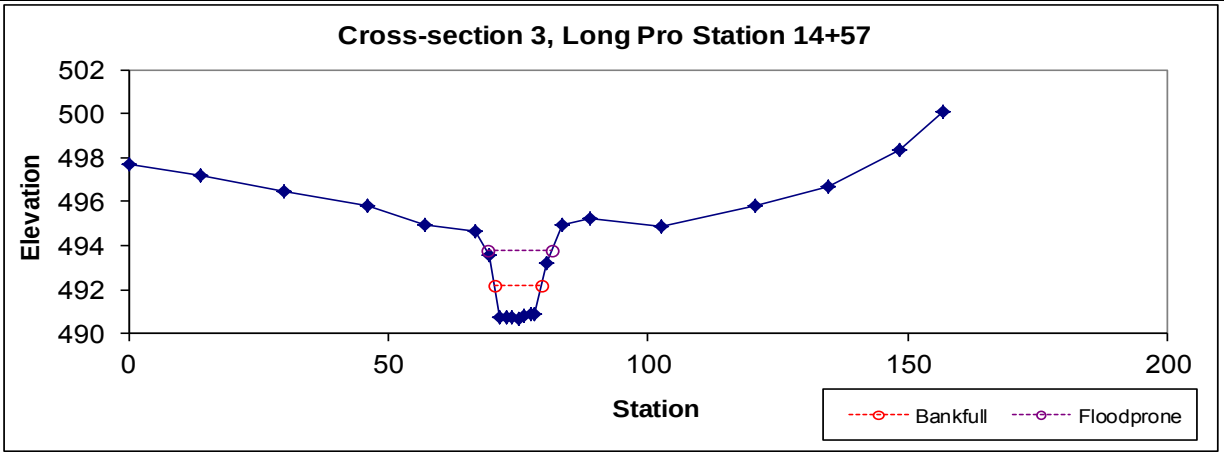
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	5.2	5.62	0.92	1.17	6.1	4.3	1.2	439.4	443.27



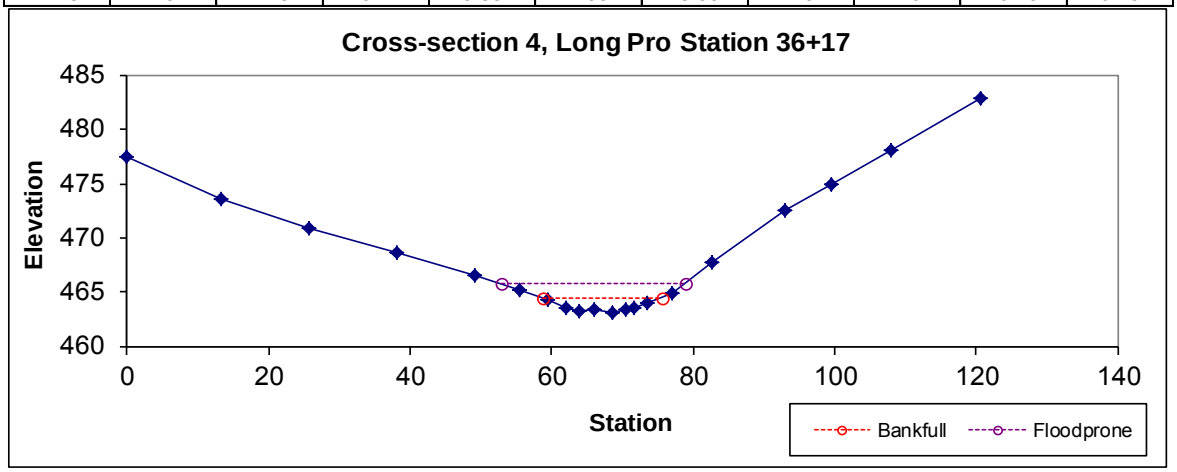
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	5.1	7.35	0.7	1.08	10.52	1.6	9.5	435.8	436.48



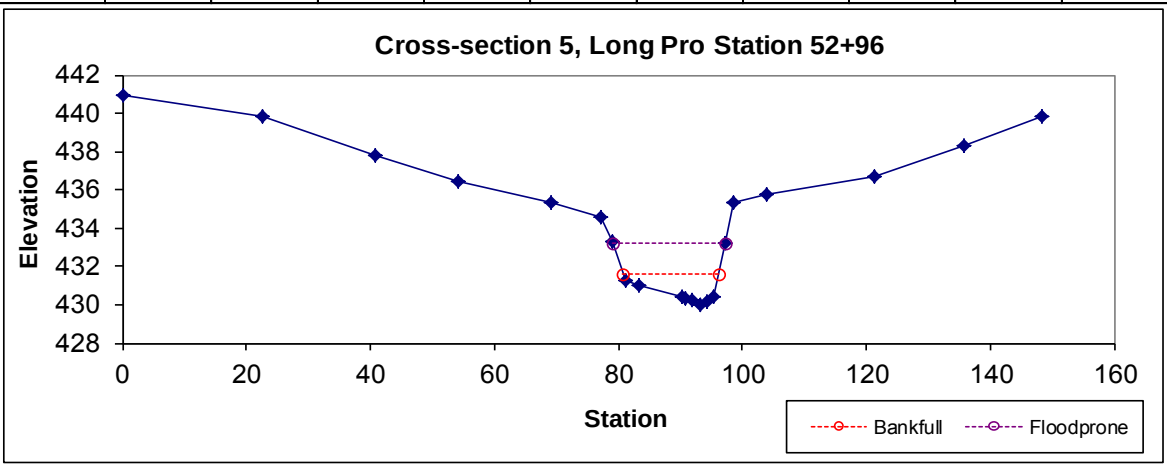
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	10.9	8.87	1.23	1.55	7.2	2.6	1.3	492.2	494.64



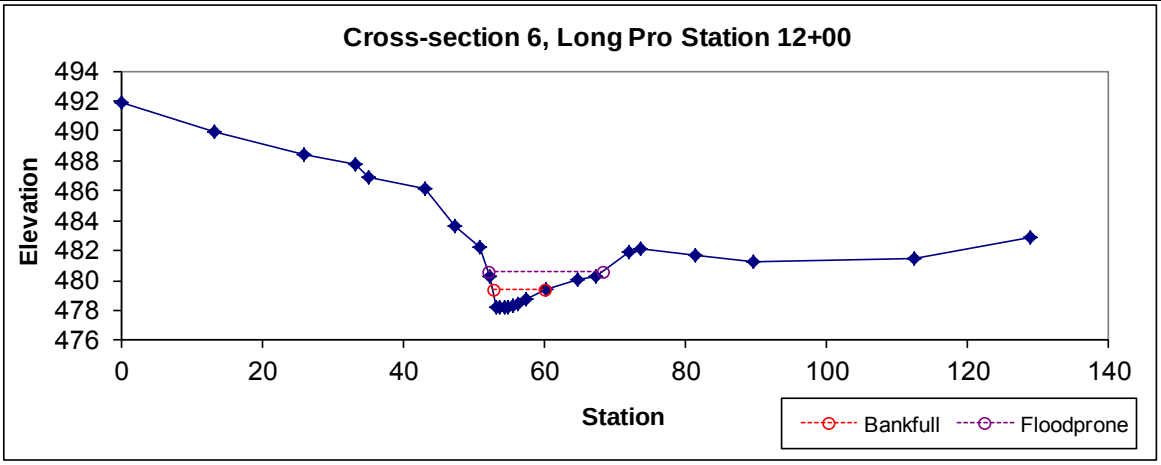
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	14.8	16.74	0.88	1.33	18.99	1.3	1.6	464.5	464.84



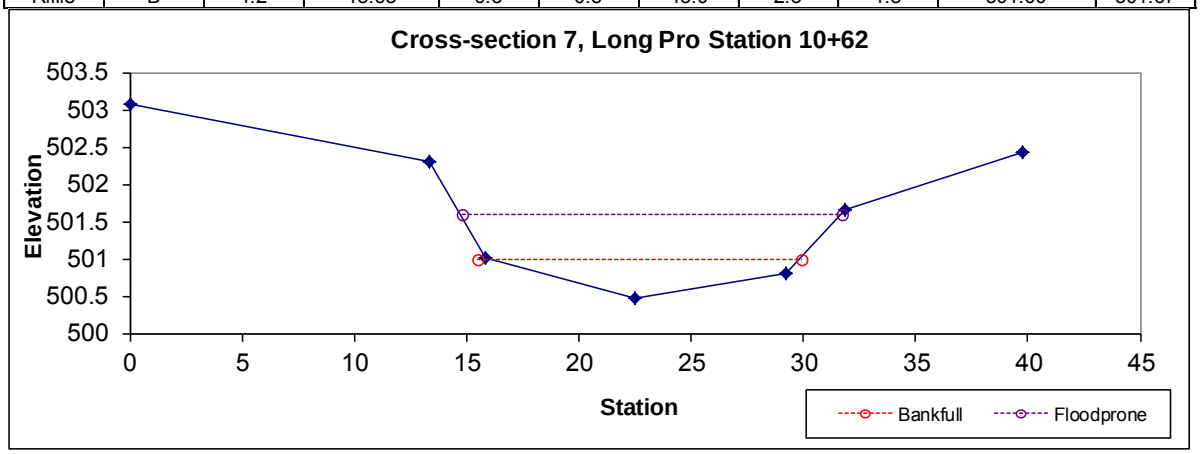
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F	15.52	15.46	1.0	1.62	15.4	2.8	1.2	431.65	434.55



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	5.6	7.45	0.76	1.21	9.85	1.5	2.2	479.4	480.04



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B	4.2	13.68	0.3	0.5	45.0	2.3	1.3	501.00	501.67



17.1.1.4 Bank Erosion Prediction (BEHI/NBS)

Sedimentation from stream bank erosion is a significant pollutant to water quality and aquatic habitat. Predicting stream bank erosion rates and annual sediment yields using the Bank Assessment for Non-point source Consequences of Sediment (BANCS) method (Rosgen 1996, 2001a) considers two stream bank erodibility estimation tools: the Bank Erosion Hazard Index (BEHI), and Near Bank Stress (NBS). This rating method is used to describe existing stream bank conditions and statistically quantify the erosion potential of a stream reach in feet/year. Since it is an estimation/prediction method, the intent is to be used as a relative comparison for pre- and post-restoration conditions.

Published curve data were initially developed from sites in Colorado with varying sediment sources, vegetation, and fluvial geomorphic processes characteristic of that region. Although the published BEHI/NBS curve is not directly applicable to piedmont streams in North Carolina, it can provide a framework to develop similar relations in other hydrophysiographic regions. Therefore, Baker used local unpublished NC piedmont BEHI and NBS ratings (obtained through personal communication with NRCS, A. Walker, 2011) to estimate sediment loss and support field observations and stream bank height measurements taken during existing conditions assessment.

The BEHI/NBS estimates for the existing conditions (pre-construction) suggests that the project reaches contribute approximately 61 tons of sediment per year to the Cane Creek system. The majority of BEHI ratings varied from 'low' to 'moderate' with a few middle sections rating on the 'very low' category based changes in the velocity gradient and shear stress, and stream bed/bank stability. This is typical of a partially degraded stream system with active stream bank erosion in localized areas. After stabilizing stream banks using the proposed restoration measures, post-construction BEHI/NBS estimates typically predict a significant decrease in sediment loading throughout the entire project area, especially considering the limited sediment supply entering the system from the upstream drainages and impoundments (farm ponds).

17.1.1.5 Channel Evolution

Channel stability is defined as the stream's ability to transport incoming flows and sediment loads supplied by the watershed without undergoing significant changes over a geologically short time-scale. A generalized relationship of stream stability was proposed by Lane (1955); it states that the product of sediment load and sediment size is in balance with the product of stream slope and discharge, or stream power. A change in

any one of these variables induces physical adjustment of one or more of the other variables to compensate and maintain the proportionality.

Longitudinally, the water and sediment flows delivered to each subsequent section are the result of the watershed and upstream or backwater (downstream) conditions. Water and sediment pass through the channel, which is defined by its shape, material, and vegetative condition. Flow and sediment are either stored or passed through at each section along the reach. The resulting physical changes are a balancing act between gravity, friction, and the sediment and water being delivered into the system (Leopold et al., 1964).

Observed stream response to induced instability, as described by Simon's (1989) Channel Evolution Model, involve extensive modifications to channel form resulting in profile, cross-sectional, and plan form changes, which often take decades or longer to achieve resolution. The Simon (1989) Channel Evolution Model characterizes typical evolution in six steps:

1. Pre-modified
2. Channelized
3. Degradation
4. Degradation and widening
5. Aggradation and widening
6. Quasi-equilibrium.

The channel evolution process is initiated once a stable, well-vegetated stream that interacts frequently with its floodplain is disturbed. Channelization, dredging, changing land use, removal of streamside vegetation, upstream or downstream channel modifications, and/or change in other hydrologic variables result in adjustments in channel morphology to compensate for the new condition(s). Disturbance commonly results in an increase in stream power that can cause degradation, often referred to as channel incision (Lane, 1955). Incision eventually leads to over-steepening of the stream banks and, when critical stream bank heights are exceeded, the stream banks begin to fail and mass wasting of soil and rock leads to channel widening. Incision and widening continue moving upstream in the form of a head-cut. Eventually the mass wasting slows, and the stream begins to aggrade. A new, low-flow channel begins to form in the sediment deposits. By the end of the evolutionary process, a stable stream with dimension, pattern, and profile similar to those of undisturbed channels forms in the deposited alluvium. The new channel is at a lower elevation than its original form, with a new floodplain constructed of alluvial material (FISRWG, 1998).

The channel stability assessment incorporated qualitative and quantitative site observations using detailed topographic data collected for the project. Conclusions reached from these methods were used to define overall channel stability and determine appropriate restoration approaches for the site. The UTs were identified as perennial streams that originate from a watershed that is predominantly forested with low density housing and agricultural land comprising much the remaining land use. Due to past channel manipulation, a majority of the UTs are moderately to severely incised as evidenced by an entrenchment ratios greater than 1.5.

All of the UTs have existing buffer widths less than 50 feet along both stream banks, with exception to the middle section of Reach R4. The UTs are predominantly transitioning from Step 3 to Step 4 of the Simon Channel Evolution Model and a Rosgen Bc-G-F stream type succession scenario (Rosgen 2001b). Most sections of the UTs are becoming overly-wide and laterally unstable, and transitioning into Step 5 of the model. This indicates that the floodplain connection has been severely compromised by channelization and vertical degradation. The system overall is in a degradational phase

of channel evolutionary sequence and would continue to degrade and widen further in order to reach Stage 6 (Quasi-equilibrium) since it lacks access to its relic floodplain. All but Reach R1 has been heavily impacted by cattle grazing and the lower portions of Reach R1 and Reach R5 are incised and unstable as a result of active headcutting. Reach R5a is closer to Step 3, and although the shorter reach is slightly incised near the confluence with Reach R5, it is mostly stable due to bedrock and larger coarse material providing grade control.

17.1.2 Proposed Morphological Conditions

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration and enhancement of stream functions within the project area while minimizing disturbance to existing wooded areas and protecting and/or enhancing existing jurisdictional wetlands. Prior to impacts from past channel manipulation, topography and soils on the site indicate that the project area most likely functioned in the past as a small tributary stream system with associated hillslope seep wetlands, eventually flowing into the larger Cane Creek system.

Therefore, a design approach was formulated to restore and/or enhance this type of system. First, an appropriate stream type for the valley type, slope, and desired stream functions was selected and designed to improve historic flow patterns within the project area. Then a design plan was developed in order improve the floodplain hydrology and base flow interaction impaired by current cattle impacts, active degradation, and other agricultural land manipulations.

17.1.2.1 Proposed Design Approach and Criteria Selection

For design purposes, the stream channels were divided into five reaches labeled R1, R3, R4, R5 and R5a (see Figure 17.3). Selection of a general restoration approach was the first step in selecting design criteria for all reaches. The approach was based on the potential for restoration as determined during the site assessment. Next, specific design parameters were developed so that plan view layout, cross-section dimensions, and a longitudinal profile could be described for developing construction documents. The design philosophy is to use these parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods of time under the processes of flooding, re-colonization of vegetation, and local watershed influences.

After selecting an appropriate design approach for the site based on field assessments and functional lift potential, proposed stream design values and design criteria were selected using common reference ratios and guidelines (Harman, Starr, 2011). Table 17.3 presents the design parameters used for the proposed reaches. Following initial application of the design criteria, detailed refinements were made to accommodate the existing valley type and channel morphology. This was done to minimize unnecessary disturbance of the riparian area, and to allow for some natural channel adjustment following construction. The design plans have been tailored to produce a cost and resource efficient design that is constructible, using a level of detail that corresponds to the tools of construction.

Reach R1 Restoration

Due to the degraded nature of Reach R1, and the ability to fully restore stream functions and floodplain connection, a Priority Level I restoration approach is proposed for the reach. The low part of the stream valley runs along the field edge to the north of the existing stream channel. Starting at the outlet of the upstream pond dam, the restored

channel will be raised to provide reconnection to the floodplain. This approach is feasible because the pond outlet is significantly higher than the existing bed of the stream channel. The restored channel will be constructed off-line along the existing field edge, and will be designed as a Rosgen E/C type channel. This approach will minimize the number of existing trees that will need to be removed during construction. The design width/depth ratio for the channel will be 13, and over time, the channel will narrow slightly to an E-type channel due to deposition of sediment and stream bank vegetation growth. In-stream structures will include constructed riffles for grade control and aquatic habitat (bed material for the existing stream is sand/gravel), log vanes, and log step pools for stream bed/bank stability, and habitat diversity.

At the downstream end of the reach, the restored channel must transition down to the elevation of Cane Creek; therefore, rock and log step pools and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, channel banks will be graded to stable slopes, and bankfull benches will be incorporated to further promote stability and re-establishment of riparian vegetation to the confluence.

The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel. Vernal pools will be incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff.

Riparian buffers in excess of 50 feet will be restored or protected along all of Reach R1. No stream crossing or breaks in the easement are proposed along this reach. As cattle do not have access to the reach, fencing will not be required.

Reach R3 Restoration

Work along Reach R3 will involve a combination of Priority Level I and II restoration approaches to provide floodplain reconnection and promote long-term channel stability. In its existing condition, the reach is incised and eroding. Much of the adjacent timber has recently been harvested; therefore, restoration activities can be conducted with minimal impact to existing trees. Due to the short length of the reach (~400 LF) before its confluence with Reach R4, it is not practical to only use Priority Level I approaches that would raise the stream back to its historic floodplain. Therefore, restoration will involve a combination of some raising of the streambed along the upstream portion of the reach, and benching along the reach to provide floodplain connection. These techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from stream bank erosion.

This reach will be designed as a Rosgen Bc type channel. The design width/depth ratio for the channel will be 12, and over time, the channel will likely narrow some due to deposition of sediment and stream bank vegetation growth.

Riparian buffers in excess of 50 feet will be restored along all of Reach R3. No stream crossings or breaks in the easement are proposed along Reach R3.

Reach R4 Enhancement and Restoration

Work on Reach R4 will primarily involve enhancement approaches on the majority of the upstream portion of the reach, and restoration approaches on a short section of the downstream end near its confluence with Cane Creek. The primary source of impairment

for Reach R4 is direct cattle access to the stream; therefore, Enhancement Level II approaches will be incorporated along the upper 2,380 LF of Reach R4 to permanently exclude cattle from the system. Due to the presence of bedrock along much of this reach, the stream shows little indication of channel incision or downcutting, or of having been channelized in the past. Only minor channel bank stabilization is proposed for the upper most portion of the reach where the riparian buffer has been the most impacted and cattle access has been most detrimental to channel dimension and stream bank erosion. Portions of the riparian buffer along Reach R4 were recently thinned and cleared as a result of timber harvest, increasing the importance of restoring appropriate riparian species.

Along the downstream 400 LF of Reach R4, the channel condition is very poor due to channel incision and heavy use by cattle. This reach section will be restored through the use of log vane/or constructed riffle structures to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Channel banks will be graded to stable slopes, and bioengineering measures as well as bankfull benches, will be incorporated to further promote stability and re-establishment of riparian vegetation to the confluence. This section of Reach R4 will be designed as a Rosgen E/C type channel. The design width/depth ratio for the channel will be 14, and over time, the channel will narrow to an E-type channel due to deposition of sediment and stream bank vegetation growth.

Riparian buffers in excess of 50 feet will be restored along all of Reach R4. There are currently two existing stream crossings on Reach R4. The upstream crossing will be abandoned and the downstream crossing will be replaced and improved. A new, culverted crossing will be installed to provide access across the stream. The crossing will be designed to pass a 10-year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing. The new crossings will be fenced to exclude cattle from entering the restored stream.

Reach R5 Enhancement and Restoration

Work on Reach R5 will involve full restoration of the upstream portion of the reach down to the culverted stream crossing, and enhancement approaches on a short section of the downstream end below the existing crossing. The primary source of impairment for Reach R5 is its incised and unstable condition, although direct cattle access to the stream is also a major contributor to its degraded condition. From the northern property line and moving downstream, Reach R5 becomes rapidly incised, with steeply eroding stream banks and limited to no floodplain access. Due to the rapid drop in grade after the reach enters the project property, a Priority Level I restoration approach is feasible for the upper portion of Reach R5. This approach will involve constructing the restored channel off-line and along the low part of the adjacent valley (to the left side of the existing channel). The benefits of this approach are that floodplain connection is restored, limited impact to desirable native species trees along the existing channel, and the ability to provide full restoration of a natural channel pattern and appropriate stream functions. Many of the existing trees along Reach R5 are Tree-of-heaven (*Ailanthus altissima*), which is an invasive exotic species; therefore, removal of these particular trees is proposed to encourage establishment of native species.

A Rosgen C type channel will be designed for the restoration reach, similar to the approach described for Reach R1. At the downstream end of the reach, above the culverted stream crossing, some benching will likely be required to transition the restored reach back to the existing bed elevation at the crossing. Along the downstream 420 LF of Reach R5 below the stream crossing, channel incision decreases and the primary source

of impairment is direct cattle access. Because the stream is already connected to its floodplain along this reach, Enhancement Level II approaches are proposed for this section of Reach R5. These approaches include permanent exclusion of cattle, minor grading of isolated sections of the stream banks, and limited use of structures to promote channel stability, bedform diversity, stabilize an active headcut, and establish an appropriate riparian buffer.

Riparian buffers in excess of 50 feet will be restored along all of Reach R5. The existing stream crossing near the downstream end of Reach R5 will be replaced and improved as part of the proposed project. A new, culverted crossing will be installed to provide access across the stream. The crossing will be designed to pass a 10-year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing. The new crossing will be fenced to exclude cattle from entering the restored stream.

Reach R5a Enhancement

Work on Reach R5a will primarily involve enhancement approaches on the unstable portions of the reach. The primary source of impairment for Reach R5a is direct cattle access to the stream; therefore, Enhancement Level II approaches will be incorporated along the 144 LF of Reach R5a to permanently exclude cattle from the system. Due to the presence of bedrock along this reach, the stream shows little indication of channel incision or downcutting, or of having been channelized in the past. Only minor channel bank stabilization is proposed for the reach where the riparian buffer has been the most impacted and cattle access has been most detrimental to channel dimension and stream bank erosion. Portions of the riparian buffer along Reach R5a have been cleared and maintained, increasing the importance of planting the appropriate riparian species. Reach R5a design values (dimensionless ratios) will be consistent with comparable stream types (Bc) for the project. However, they are not included in Table 17.3 for clarity, since only Enhancement Level II approaches will be considered throughout this shorter reach section and dimension, pattern, and profile will have little to no adjustments.

Table 17.3 Natural Channel Design Criteria for Project Reaches

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Parameter	Composite Reference Values		Design Values		Rationale
	Reach R1	Reach R3	Reach R1	Reach R3	
Stream Type (Rosgen)	C4	B4c	E4/C4	B4c	Note 1
Bankfull Discharge, Qbkf (cfs)	--	--	13.0	15.5	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	3.5 – 5.0	4.0 – 6.0	3.5	3.9	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	--	--	3.7	4.0	Note 7
Bankfull Riffle Width, Wbkf (ft)	--	--	6.9	7.2	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	--	--	0.5	0.6	d=A/W
Width to Depth Ratio, W/D (ft/ft)	10 - 15	12 – 18	13	13	Note 3
Width Floodprone Area, Wfpa (ft)	--	--	>20	12 - 20	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	>2.2	1.4 – 2.2	>2.2	1.8 - 2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	--	--	0.7	0.7	

Riffle Max Depth Ratio, Dmax/Dbkf	1.2 – 1.5	1.2 – 1.4	1.4	1.2	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	--	N/a	50 – 80	N/a	Note 7
Meander Length Ratio, Lm/Wbkf	7 – 14	N/a	7.2 – 11.5	N/a	Note 7
Radius of Curvature, Rc (ft)	--	N/a	14 – 21	N/a	Note 7
Rc Ratio, Rc/Wbkf *	2 – 3	N/a	2 – 3	N/a	Note 7
Belt Width, Wblt (ft)	--	N/a	25 – 45	N/a	Note 7
Meander Width Ratio, Wblt/Wbkf	3.5 – 8.0	N/a	3.6 – 6.5	N/a	Note 7
Sinuosity, K (TW length/ Valley length)	1.2 – 1.4	1.1 – 1.3	1.2	1.18	Note 7
Valley Slope, Sval (ft/ft)	0.0050 – 0.0150	0.005 – 0.015	--	--	Sval / K
Channel Slope, Schan (ft/ft)	--	--	0.012	0.016	
Average Slope Riffle, Srif (ft/ft)	--	--	0.015	0.018	
Riffle Slope Ratio, Srif/Schan	1.2 – 1.5	1.1 – 1.8	1.3	1.1	Note 8
Slope Pool, Spool (ft/ft)	--	--	0 – 0.003	0.001 – 0.003	
Pool Slope Ratio, Spool/Schan	0.0 – 0.2	0.0 – 0.4	0.1 – 0.2	0.1 – 0.2	Note 8
Pool Max Depth, Dmaxpool (ft)	--	--	1.5	1.5	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.5 – 3.5	2.0 – 3.5	3.0	2.5	Note 7
Pool Width, Wpool (ft)	--	--	9.0	9.2	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.5	1.3	1.3	Note 9
Pool-Pool Spacing, Lps (ft)	--	--	28 – 42	11 - 36	
Pool-Pool Spacing Ratio, Lps/Wbkf	3 – 7	2 – 6	4 – 6	1.5 - 5	Note 7

Notes:

1 A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning's equation (n = 0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

6 A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7 Design Values were chosen based on small piedmont stream reference reach data and past project evaluation.

8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Parameter	Composite Reference Values		Design Values		Rationale
	Reach R4	Reach R5	Reach R4	Reach R5	
Stream Type (Rosgen)	B3c	B4c	B3c	B4c	Note 1
Bankfull Discharge, Qbkf (cfs)	--	--	56.0	40.0	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	4.0 – 6.0	4.0 – 6.0	4.0	4.4	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	--	--	14.0	9.0	Note 7
Bankfull Riffle Width, Wbkf (ft)	--	--	14.0	10.8	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	--	--	1.0	0.8	d=A/W
Width to Depth Ratio, W/D (ft/ft)	12 – 18	12 – 18	14	13	Note 3
Width Floodprone Area, Wfpa (ft)	--	--	>30	>25	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.4 – 2.2	1.4 – 2.2	>2.2	>2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	--	--	1.2	1.1	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2 – 1.4	1.2 – 1.4	1.2	1.3	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 – 1.1	1.0 – 1.1	1.0	1.0	Note 6
Meander Length, Lm (ft)	N/a	N/a	N/a	N/a	Note 7
Meander Length Ratio, Lm/Wbkf	N/a	N/a	N/a	N/a	Note 7
Radius of Curvature, Rc (ft)	N/a	N/a	N/a	N/a	Note 7
Rc Ratio, Rc/Wbkf *	N/a	N/a	N/a	N/a	Note 7
Belt Width, Wblt (ft)	N/a	N/a	N/a	N/a	Note 7
Meander Width Ratio, Wblt/Wbkf	N/a	N/a	N/a	N/a	Note 7

Sinuosity, K (TW length/ Valley length)	1.1 – 1.3	1.1 – 1.3	1.1	1.18	Note 7
Valley Slope, Sval (ft/ft)	0.005 – 0.015	0.005 – 0.015	--	--	Sval / K
Channel Slope, Schan (ft/ft)	--	--	0.015	0.014	
Average Slope Riffle, Srif (ft/ft)	--	--	0.017	0.017	
Riffle Slope Ratio, Srif/Schan	1.1 – 1.8	1.1 – 1.8	1.1	1.2	Note 8
Slope Pool, Spool (ft/ft)	--	--	0.001 – 0.003	0.001 – 0.003	
Pool Slope Ratio, Spool/Schan	0.0 – 0.4	0.0 – 0.4	0.1 – 0.2	0.1 – 0.2	Note 8
Pool Max Depth, Dmaxpool (ft)	--	--	2.2	2.0	
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.0 – 3.5	2.0 – 3.5	2.2	2.5	Note 7
Pool Width, Wpool (ft)	--	--	17.0	13.0	
Pool Width Ratio, Wpool/Wbkf	1.1 – 1.5	1.1 – 1.5	1.2	1.2	Note 9
Pool-Pool Spacing, Lps (ft)	--	--	42 – 84	32 - 65	
Pool-Pool Spacing Ratio, Lps/Wbkf	2 – 6	2 – 6	1.5 – 5	2 - 6	Note 7

Notes:

1 A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2 Bankfull discharge analysis was estimated using Manning's equation (n = ~0.04) to represent post-construction conditions.

3 The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4 Required for Rosgen stream classification.

5 Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

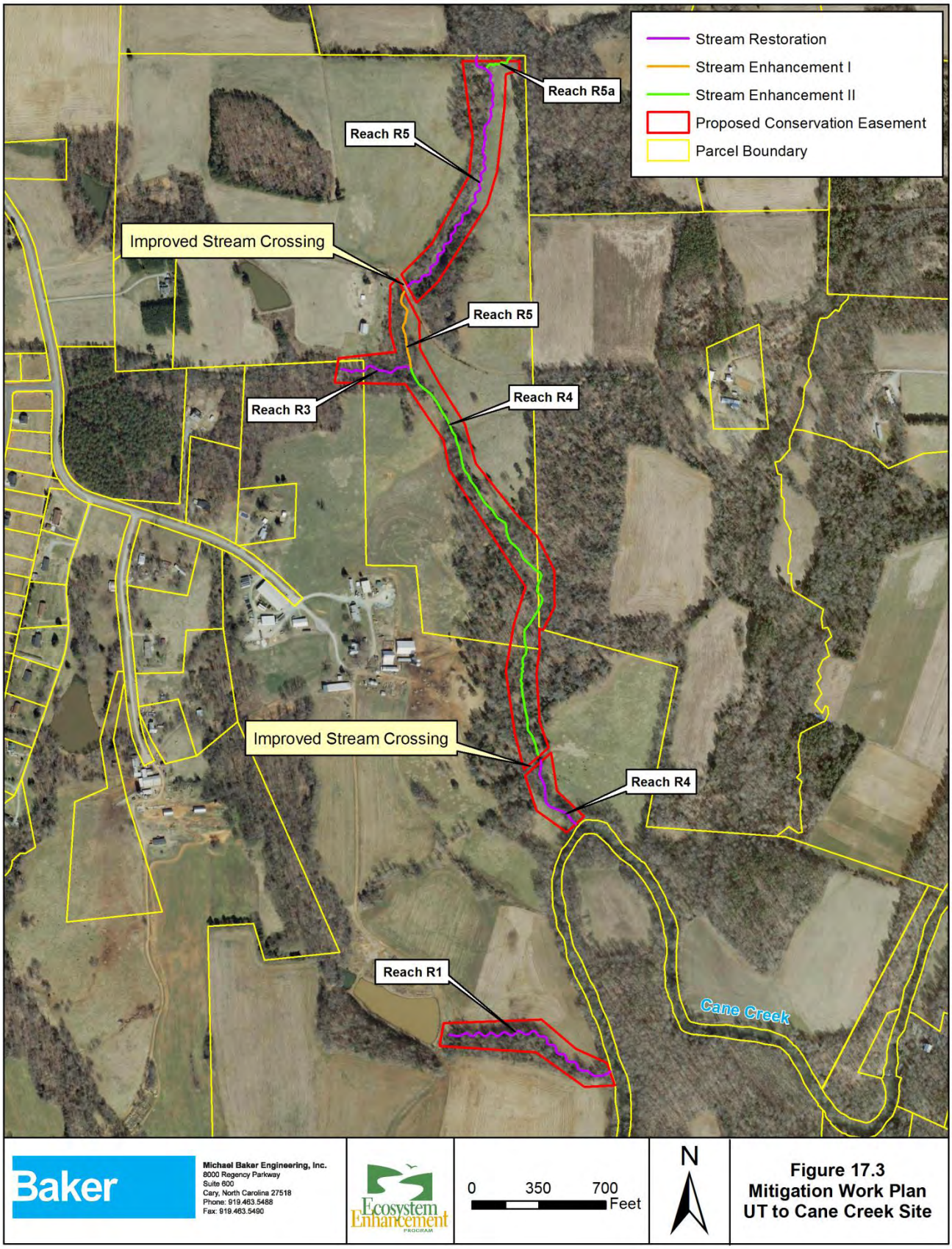
6 A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7 Design Values were chosen based on small piedmont stream reference reach data and past project evaluation.

8 Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9 Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

Figure 17.3 Mitigation Work Plan



17.1.3 Reference Reach Data Indicators

Reference reach surveys are valuable tools used for comparison. The morphologic data obtained such as dimension, pattern, and profile can be used as a template for design of a stable stream in a similar valley type with similar bed material. In order to extract the morphological relationships observed in a stable system, dimensionless ratios are developed from the surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type.

While reference reach data can be a useful aid in designing channel dimension, pattern, and profile, there are limitations in smaller stream systems. The flow patterns and channel formation for most reference reach quality streams is often controlled by slope, drainage areas and large trees and/or other deep rooted vegetation. Some meander geometry parameters, such as radius of curvature, are particularly affected by vegetation control. Pattern ratios observed in reference reaches may not be applicable or are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction, before the permanent vegetation is established. Often the best reference data is from adjacent stable stream reaches, or reaches within the same watershed.

Baker selected two nearby reference reaches, unnamed tributaries to Wells Creek and Varnals Creek, as shown on Figure 17.5. Wells Creek is a tributary to Cane Creek and Varnals Creek is just north of Wells Creek, also draining to the Haw River in Alamance County. The reference sites are located approximately seven miles northwest of the project site (see Figure 17.5) and originally identified as a reference site by ARCADIS, and previously used as a reference site for their stream mitigation project. These data helped to provide a basis for evaluating the valley slope and topography of the project site and determining the stream systems that may have been present historically and/or how they may have been influenced by changes within the watershed.

The tributaries are an example of a small "Rural Piedmont Stream," and fall within the same climatic, topographical, physiographic and ecological region as the UT to Cane Creek restoration site. These systems exist as the floodplains of smaller intermittent/perennial streams in which flows tend to be relatively steady, with floods of short duration, and seasonal periods of low flow.

The plant community is a mature Piedmont Mesic Mixed Hardwood Forest (Piedmont Subtype) as described by Schafale and Weakley (1990). The dominant canopy vegetation includes native species such as American beech (*Fagus grandifolia*), Yellow poplar (*Liriodendron tulipifera*), White oak (*Quercus alba*), Green ash (*Fraxinus pennsylvanica*), and Sweetgum (*Liquidambar styraciflua*). Understory trees consist of Red maple (*Acer rubrum),* Flowering dogwood (*Cornus florida*) and Black cherry (*Prunus serotina*).

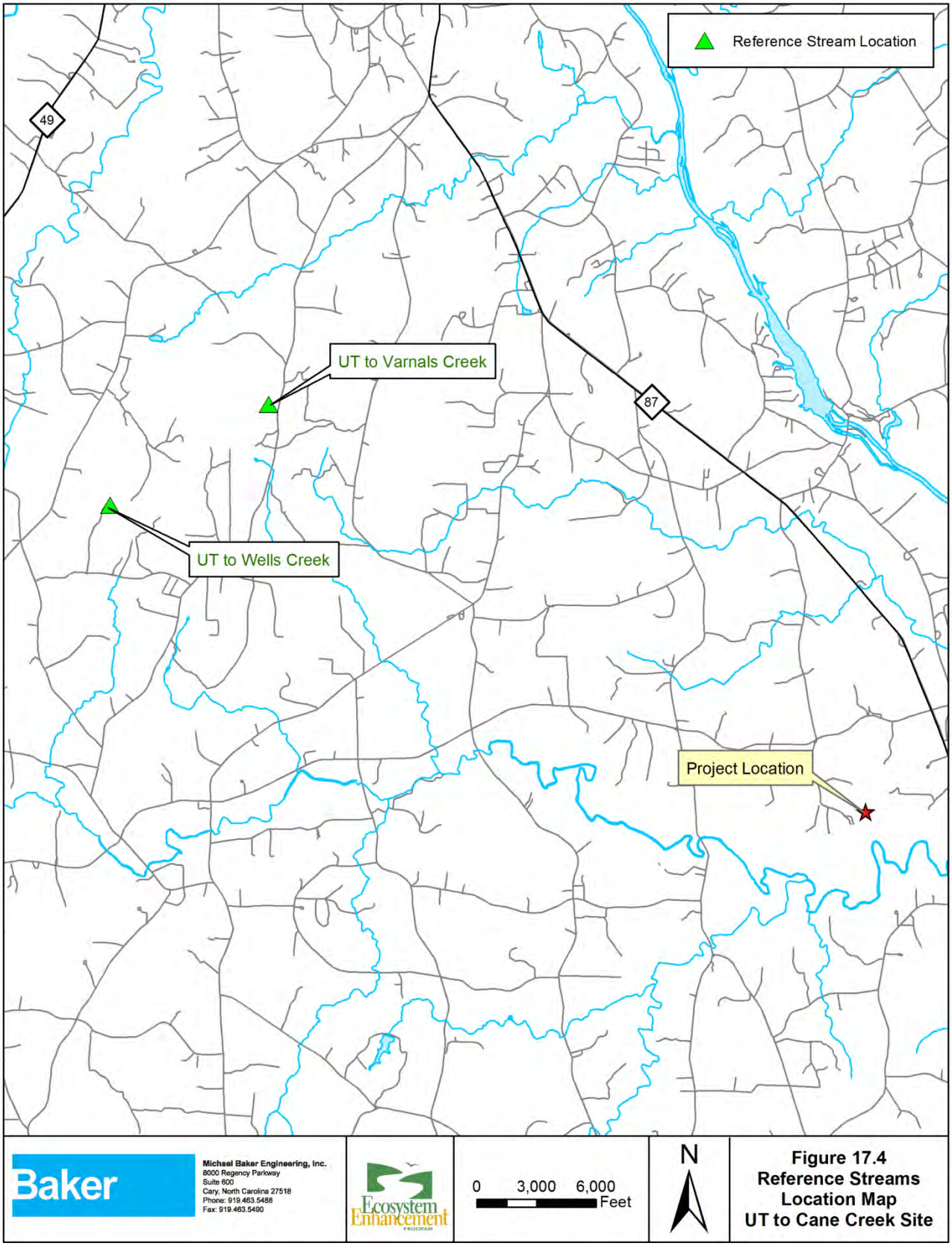
The primary series mapped at the reference sites are Cecil-Appling-Durham and can be generally described as silty loam/medium sand found on steeper slopes typically ranging from 2-15 percent (NRCS Alamance County Soil Survey, 1960). The Appling series is the dominant soil series found in the valley areas of the reference sites, and soil descriptions are similar to the soils evaluated on the project site. The Appling series consists of very deep, well drained, moderately permeable soils on ridges and side slopes of the Piedmont uplands. They are deep to saprolite and very deep to bedrock, and are formed in residuum weathered from felsic igneous and metamorphic rocks of the Piedmont uplands.

Table 17.4 Reference Reach Parameters Used to Inform Design Ratios

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Parameter	UT to Wells Creek		UT to Varnals Creek	
	MIN	MAX	MIN	MAX
Drainage Area, DA (sq mi)	0.13		0.24	
Stream Type (Rosgen)	C4/1		B4/1a	
Bankfull Discharge, Qbkf (cfs)	25.2		46.6	
Bankfull Width, Wbkf (ft)	8.0		9.7	
Bankfull Riffle Cross-Sectional Area, Abkf (sq ft)	5.3		7.9	
Bankfull Mean Velocity, Vbkf (ft/s)	5.3			
Width to Depth Ratio, W/D (ft/ft)	7	26	8	18
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	2.0	3.4	1.9	3.9
Riffle Max Depth Ratio, Dmax/Dbkf	1.4	2.2	1.1	1.5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.4	2.5	1.1	1.5
Meander Length Ratio, Lm/Wbkf	4.4	8.8	4.8	6.9
Rc Ratio, Rc/Wbkf	0.3	4.0	0.8	2.3
Meander Width Ratio, Wblt/Wbkf	1.3	4.4	1.2	1.8
Sinuosity, K	1.4		1.2	
Valley Slope, Sval (ft/ft)	0.028		0.0458	
Channel Slope, Schan (ft/ft)	0.0197		0.0405	
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.3	2.7	1.6	2.3
Pool Width Ratio, Wpool/Wbkf	0.7	1.2	0.9	1.5
Pool-Pool Spacing Ratio, Lps/Wbkf	2.1	7.9	2.9	5.0
d16 (mm)	0.1		0.2	
d35 (mm)	0.6		2.5	
d50 (mm)	4.5		8.0	
d84 (mm)	53		92	
d95 (mm)	96		1,536	

Figure 17.4 Reference Streams Location Map



17.2 Bankfull Verification Analysis

17.2.1 Bankfull Stage and Discharge

Bankfull stage and its corresponding discharge are the primary variables used to develop a natural channel design. However, the correct identification of the bankfull stage in the field can be difficult and subjective (Williams, 1978; Knighton, 1984; and Johnson and Heil, 1996). Numerous definitions exist of bankfull stage and methods for its identification in the field (Wolman and Leopold, 1957; Nixon, 1959; Schumm, 1960; Kilpatrick and Barnes, 1964; and Williams, 1978). The identification of bankfull stage in the humid Southeast can be especially difficult because of dense understory vegetation and a long history of channel modification and subsequent adjustment in channel morphology.

It is generally accepted that bankfull stage corresponds with the discharge that fills a channel to the elevation of the active floodplain and represents a breakpoint between processes of channel formation and floodplain development. The bankfull discharge, which also corresponds with the dominant discharge or effective discharge, is thought to be the flow that moves the most sediment over time in stable alluvial channels.

Field indicators include the back of point bars, significant breaks in slope, changes in vegetation, the highest scour line, or the top of the stream bank (Leopold, 1994). The most consistent bankfull indicators for streams in the Piedmont of North Carolina are the backs of point bars, breaks in slope at the front of flat bankfull benches, or the top of the stream banks (Harman et al., 1999).

Upon completion of the field survey, accurate identification of bankfull stage could not be made in all reach sections throughout the site due to incised/impaired channel conditions. Although some indicators were apparent in portions of Reaches R1, R3 and R4, with lower stream bank heights and discernible scour features, the reliability of the indicators was inconsistent due to the altered condition of the stream channels. For this reason, bankfull stage was estimated using regional curve information.

17.2.2 Bankfull Hydraulic Geometry Relationships (Regional Curves)

Hydraulic geometry relationships are often used to predict channel morphology features and their corresponding dimensions. The stream channel hydraulic geometry theory developed by Leopold and Maddock (1953) describes the interrelations between dependent variables such as width, depth, and area as functions of independent variables such as watershed area or discharge. These relationships can be developed at a single cross-section or across many stations along a reach (Merigliano, 1997). Hydraulic geometry relationships are empirically derived and can be developed for a specific river or extrapolated to a watershed in the same physiographic region with similar rainfall/runoff relationships (FISRWG, 1998).

Regional curves developed by Dunne and Leopold (1978) relate bankfull channel dimensions to drainage area. A primary purpose for developing regional curves is to aid in identifying bankfull stage and dimension in un-gaged watersheds, as well as to help estimate the bankfull dimension and discharge for natural channel designs (Rosgen, 1994). Gage station analyses throughout the United States have shown that the bankfull discharge has an average return interval of 1.5 years or 66.7% annual exceedence probability on the maximum annual series (Dunne and Leopold, 1978; Leopold, 1994).

Regional curves are available for a range of stream types and physiographic provinces. The NC Rural Piedmont Regional Curve (Harman et al., 1999) and an unpublished NC Piedmont Regional Curve developed by the Natural Resources Conservation Service (A. Walker private communication, 2012) were used for comparison with other site-specific methods of estimating bankfull discharge. Baker has successfully implemented a large number of stream

restoration projects in North Carolina using the published curve data and has produced "mini-curves" specific to many these projects. The NC Rural Piedmont Regional curve equations developed from the study are shown below in Table 17.5.

Table 17.5 NC Rural Piedmont Regional Curve Equations

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

NC Piedmont Rural Regional Curve Equations (Harman et al., 1999)		**NC Piedmont Rural Regional Curve Equations (Unpublished Revised NC Rural Piedmont Regional Curve (NRCS, 2008)**	
$Q_{bkf} = 66.57\ A_w^{0.89}$	$R^2=0.97$	$Q_{bkf} = 58.26\ A_w^{0.78}$	$R^2=0.99$
$A_{bkf} = 21.43\ A_w^{0.68}$	$R^2=0.95$	$A_{bkf} = 15.65 A_w^{0.69}$	$R^2=0.99$
$W_{bkf} = 11.89\ A_w^{0.43}$	$R^2=0.81$	$W_{bkf} = 11.64\ A_w^{0.46}$	$R^2=0.98$
$D_{bkf} = 1.50\ A_w^{0.32}$	$R^2=0.88$	$D_{bkf} = 1.15\ A_w^{0.28}$	$R^2=0.96$

Based on observations made in small rural piedmont streams, the growing number of data points provides supporting evidence for the selection of bankfull indicators that produce smaller dimensions and flow rates than the published regional data. As a comparison of a representative stable cross-section (#4) identified within Reach R4, the NC Piedmont Regional Curve estimates a bankfull cross-sectional area (A_{bkf}) of approximately 17.4 sf and a bankfull discharge (Q_{bkf}) of approximately 71.5 cfs for a 0.706 mi^2 watershed. The unpublished revised rural piedmont regional curve estimates the A_{bkf} of 12.7 sf and the Q_{bkf} of 46.0 cfs. The existing surveyed channel dimension has cross-sectional area at the top-of-stream-bank/bankfull indicator of 14.8 sf. Similarly, for the representative stable cross-section (#6) in Reach R3, the NC Piedmont Regional Curve estimates a bankfull cross-sectional area (A_{bkf}) of approximately 5.9 sf and a bankfull discharge (Q_{bkf}) of approximately 22.5 cfs for a 0.142 mi^2 watershed. The unpublished piedmont regional curve estimates the A_{bkf} of 4.1 sf and the Q_{bkf} of 13.2 cfs. The existing surveyed channel dimension has cross-sectional area at the top-of- stream-bank/bankfull indicator of 5.6 sf.

17.2.3 Conclusions for Channel Forming Discharge

As described above in Section 17.2.1, Rosgen's stream classification system (Rosgen, 1996) depends on the proper field identification of consistent geomorphic features related to the active floodplain. Although bankfull stage verification was not possible in the field for all reaches under current conditions, the cross-section data used for the above regional curve comparison are within an acceptable range of values.

Table 17.6 provides a bankfull discharge analyses based on the bankfull regional curves, the Manning's equation discharges calculated from the representative cross-sections for each reach, and the bankfull design discharge calculated based on the proposed design cross-sections for all project reaches.

Table 17.6 Bankfull Discharge Analysis

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Estimating Method	Bankfull Velocity (ft/sec)	Bankfull Discharge (cfs)
Reach R1		
NC Rural Piedmont Regional Curve[1]	3.8	19.8
NRCS NC Rural Piedmont Regional Curve[2]	2.3	11.6
Friction Factor to Relative Roughness Ratio method[3]	3.2	17.1
Manning's "n" from friction factor and relative roughness[3]	3.3	16.6
Manning's "n" from stream type[3]	2.5	12.8
Baker Design Estimate	3.5	13.0
Reach R3		
NC Rural Piedmont Regional Curve[1]	3.9	21.7
NRCS NC Rural Piedmont Regional Curve[2]	2.3	12.8
Friction Factor to Relative Roughness Ratio method[3]	3.9	21.8
Manning's "n" from friction factor and relative roughness[3]	3.8	21.4
Manning's "n" from stream type[3]	2.6	14.4
Baker Design Estimate	3.8	15.5
Reach R4		
NC Rural Piedmont Regional Curve[1]	4.6	69.2
NRCS NC Rural Piedmont Regional Curve[2]	3.0	44.4
Friction Factor to Relative Roughness Ratio method[3]	2.9	42.4
Manning's "n" from friction factor and relative roughness[3]	3.5	51.0
Manning's "n" from stream type[3]	3.1	46.4
Baker Design Estimate	4.0	56.0
Reach R5		
NC Rural Piedmont Regional Curve[1]	4.5	50.0
NRCS NC Rural Piedmont Regional Curve[2]	2.9	31.3
Friction Factor to Relative Roughness Ratio method[3]	3.7	40.2
Manning's "n" from friction factor and relative roughness[3]	4.3	47.1
Manning's "n" from stream type[3]	3.0	32.5
Baker Design Estimate	4.4	40.0

Notes:
[1] NC Piedmont Regional Curve (Harman et al., 1999).
[2] Unpublished Revised NC Rural Piedmont Regional Curve developed by NRCS (A. Walker personal communication, 2008).
[3] WARSSS, 2006 spreadsheet. Bankfull discharge estimates vary based on Manning's Equation for the riffle cross-section. Bankfull stage roughness estimates (*n*-values) ranged from approximately 0.035 to 0.055 based on channel slopes, depth, bed material size, and vegetation influence.

17.3 Sediment Transport Analysis

17.3.1 Background and Methodology

The purpose of a sediment transport analysis is to ensure that the stream restoration design creates a stable channel that does not aggrade or degrade over time. The overriding assumption is that the site should be transporting the total sediment load delivered from upstream sources, thereby being a "transport" reach and classified as a stable Rosgen "B", "C" or "E" type channel. The ability of the stream to transport its total sediment load can be quantified through two measures: sediment transport

competency (force) and sediment transport capacity (power). Lane (1955) describes a generalized relationship of stream stability and dynamic equilibrium wherein the product of sediment load and sediment size is proportional to the product of stream slope and discharge.

Sediment Transport Capacity is a stream's ability to move a mass of sediment through a cross-section dimension, and is a measurement of stream power, often expressed in units of watts/square meter (Watts/meter^2). Sediment Transport Competency is a stream's ability to move particles of a given size and is a measurement of force, often expressed as units of pounds per square foot (lbs/ft^2). A streams competency is estimated in terms of the relationship between critical and actual depth, at a given slope, and occurs when the critical depth produces enough shear stress to move the largest (d100) sub pavement particle. The prediction calculations shown on Table 17.7 include shear stress, tractive force, and critical dimensionless shear stress, which help to determine a particle size class (e.g., sand, gravel, cobble) that is mobile, or entrained, under various flow conditions (WARSS, 2006).

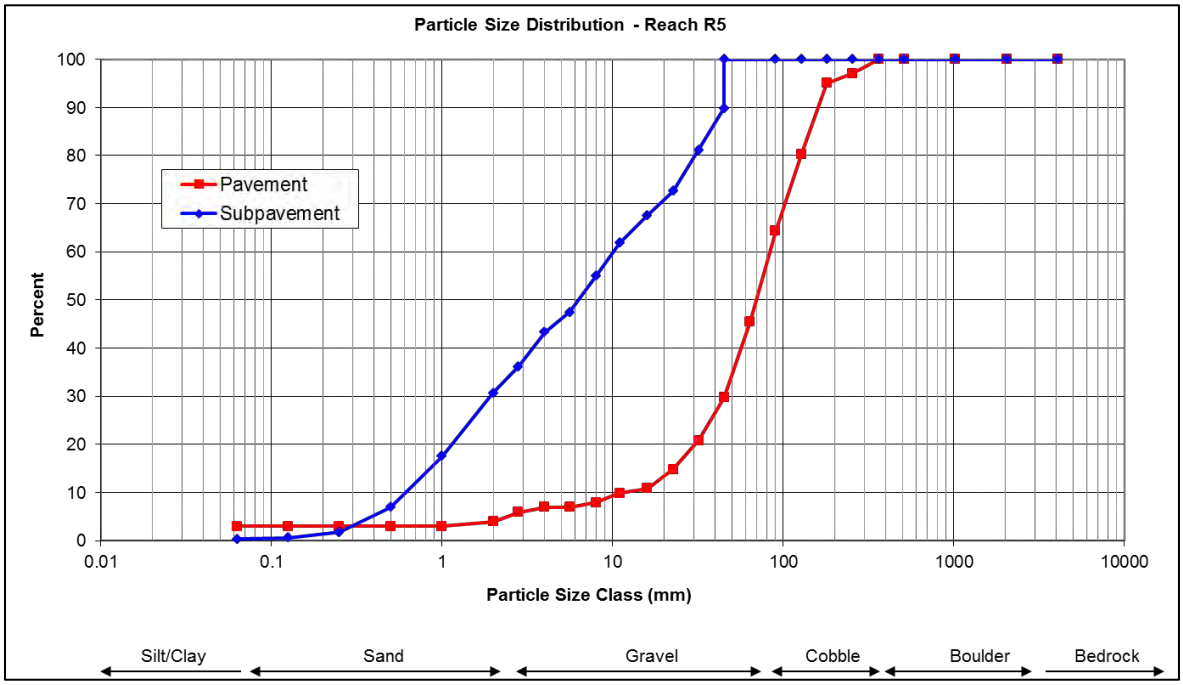
In sand bed streams, sediment transport capacity is a critical analysis, whereas in gravel/cobble bed streams, sediment transport competency is a critical analysis. The total volume of sediment transported through a cross-section consists of bedload plus suspended load fractions. Suspended load is normally composed of fine sand, silt, and clay particles transported in the water column. Bedload is generally composed of larger particles, such as course sand, gravels, and cobbles, which are transported by rolling, sliding, or hopping (saltating) along the bed.

17.3.2 Sampling Data Results

Sediment samples, including pebble counts and pavement/subpavement, were collected along the main stem tributary and dry sieved in a lab to obtain a sediment size distribution, determine dimensionless critical shear stress, and calculate/predict corresponding slope and depth required to move the d100 largest particle class size. The sample locations are shown on Figure 17.1. The sieve data shown in Figure 17.5 show that samples have a pavement d50 range of 47.0-69.4 mm and subpavement layer d50 range 6.9-6.3 mm, indicating that the dominant bed material in the stream channel is large gravel/small cobble under current conditions.

It should be noted that the modified Wolman pebble count (Rosgen, 1994) is not appropriate for sand-bed systems; therefore, a bulk sample procedure was only used to characterize the bed material for the downstream section of Reach R4 near the confluence with Cane Creek. The majority of this shorter reach contains a sand, silt, and muck stream bottom due to the parent soil and cattle impacts. A bulk sample was collected to confirm these initial observations, but was not used for the sediment transport analyses. Sediment transport in this area is not anticipated to be a concern given the backwater effects near the confluence of the larger Cane Creek system.

Figure 17.5 Sediment Particle Size Distribution



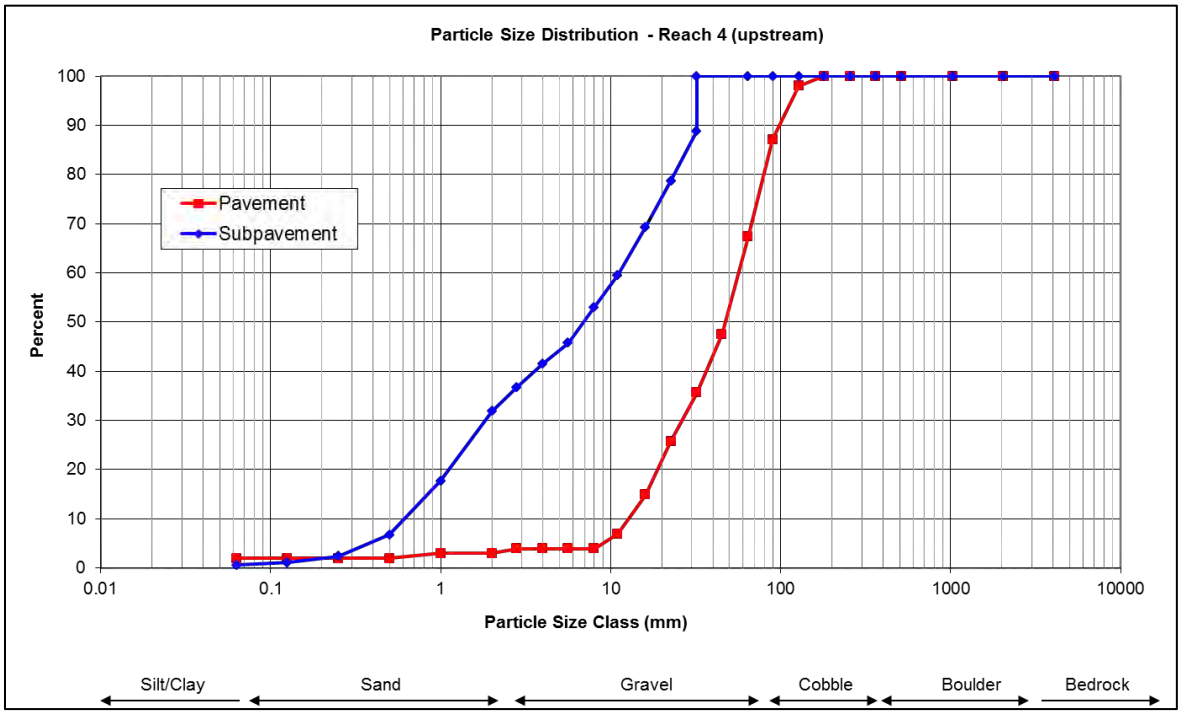
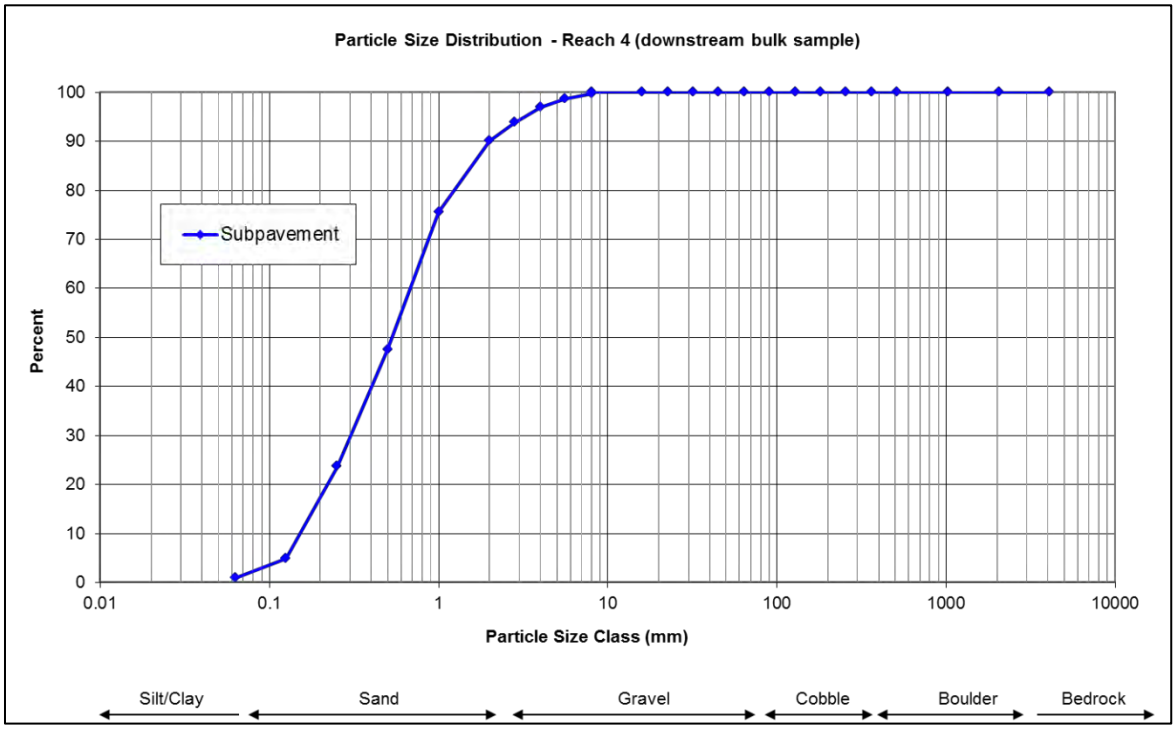


Figure 17.5 Sediment Particle Size Distribution (Continued)



17.3.3 Predicted Channel Response

The existing streams are predominantly gravel/cobble, with a few localized sections of coarse material and bedrock that control grade, as well as a sandier substrate in some flatter channel sections. Based on field observations from the project area and upper watershed, the streams receive mostly fine materials from stream bank erosion and contributions from the upstream drainage. However, further investigations confirmed that the sediment supply from upstream sources are limited during larger storm events due to impoundments (farm ponds), smaller headwater drainages, and vegetation cover. While it is predicted that the restoration and enhancement efforts will reduce localized stream bed/bank erosion, the channels still must transport smaller bedload material from upstream sources while maintaining stream bed/bank stability.

Sediment transport competency/entrainment and capacity were compared for the existing channels and the design conditions for restored stream systems. Table 17.7 shows bankfull boundary shear stress and stream power values for existing and design conditions. Bankfull boundary shear stress and stream power values are similar for the existing and design values for Reach R4 (upstream section), likely because the channel bedform is mostly stable and actively transporting sediment through the system. Currently, the upstream Reach R5 has a slightly higher bankfull boundary shear stress and stream power values than the proposed design. This is likely due to channel degradation, as the system is in the process of transitioning from an B to a G type channel; meaning that the channel has abandoned its active floodplain and deepening/widening to form a new channel that can appropriately move the required sediment load.

Using another sediment transport competency comparison, boundary shear stress was plotted on Shield's Curve to estimate the largest moveable particle. In both reaches, as shown in Table 17.7, the Shield's Curve predicts the mobility of particles larger than the d100 observed in the subpavement.

Both of these sediment transport competency analyses confirm the ability of the proposed design channel to transport a coarser sediment load.

As a design consideration, the proposed substrate material mix (riffle armor) will contain particle sizes larger than the d100 to achieve vertical stability immediately after construction. The site has both steep (>2%) and flatter channel slopes throughout the tributaries and the main stem (<2%). In general, the proposed design channels with riffle slopes greater than 1% will be constructed using larger colluvial-size particles in order to mimic the natural armoring present in the stable channel section along Reach 4. Any concerns regarding further channel degradation and vertical stability will be addressed by installing a combination of grade control structures such as constructed riffles and log/rock step pools.

Table 17.7 Boundary Shear Stress and Stream Power for Existing and Proposed Conditions

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Parameter	Reach R4 Existing Conditions	Reach R4 Proposed Conditions[1]	Reach R5 Existing Conditions	Reach R5 Proposed Conditions
Bankfull Discharge Estimate, Q (cfs)	56.0	56.0	40.0	40.0
Bankfull XSC Area (square feet)	14.8	14.0	10.9	9.0
Mean Bankfull Velocity (cfs)	4.0	4.0	4.4	4.4
Bankfull Width, W (feet)	16.7	14.0	8.9	10.8
Bankfull Mean Depth, D (feet)	0.9	1.0	1.2	0.8
Width to Depth Ratio, w/d (feet/ foot)	19.0	14.0	7.2	13.0
Wetted Perimeter (feet)	18.5	16.0	11.4	12.5
Hydraulic Radius, R (feet)	0.8	0.9	1.0	0.7
Channel Slope (feet/ foot)	0.0145	0.015	0.0128	0.013
Boundary Shear Stress, τ (lbs/ft^2)	0.79	0.55	0.98	0.50
Subpavement d_{100} (mm)	45	45	32	32
Largest Moveable Particle (mm) per Modified Shield's Curve	190	140	180	130
Predicted Critical Depth (feet)	0.2	0.6	0.3	0.7
Predicted Critical Slope (feet/ foot)	0.003	0.004	0.002	0.007
Stream Power (W/m^2)	44.2	52.7	52.3	43.7

Note:

[1] Reach R4 (upstream section) is a relatively stable enhancement reach and will not involve greater channel modifications to dimension, pattern and profile.

17.4 Existing Vegetation Assessment

The riparian areas within and adjacent to the proposed project area consists of successional forest, pasture, agricultural fields, and disturbed pine forest, as described by Schafale and Weakley (1990). Historic land management surrounding the project area has been primarily for agricultural and

silvicultural purposes through the alteration of drainage patterns and the significant removal of native species vegetation in the riparian zone. The wooded portions of the site consist of a combination of basic Mesic Forest in the uplands with Piedmont/Mountain Alluvial Forests and Bottomland Forest in the lower areas and floodplains on the site (Schafale and Weakley, 1990). Some of these areas lack understory vegetation due to extensive livestock use and grazing. The riparian buffer areas overall ranged from somewhat disturbed to very disturbed and a general description of each community follows.

17.4.1 Maintained/Disturbed

This community is primarily located along upper portions of the project area. Other perimeter areas near the middle of project contain some successional deciduous vegetation which are periodically mowed for hay production. Species such as Sweetgum (*Liquidambar styraciflua*), Pines (*Pinus spp*), Tulip poplar (*Liriodendron tulipifera*) and Red maple (*Acer rubrum*) are the dominant regenerating deciduous trees located in these areas. In some areas, small ditches, spoil piles, ruts, and other evidence of land disturbance suggest portions of the forested areas were harvested in the past for timber production.

17.4.2 Agricultural Fields and Pasture Areas

This community covers approximately 50-60 percent of the project area perimeter. Currently, the majority of pasture areas are used as grazing for cattle production. The vegetation within open fields and pasture areas is primarily comprised of fescues, clovers, and some dog fennel (*Eupatorium capillifolium*). In smaller wooded riparian areas within the pastures and fields, the canopy is dominated by Red maple (*Acer rubrum*), Loblolly pine (*Pinus taeda*), and understory species consist of Red cedar (*Juniperus virginiana*), Black willow (*Salix nigra*), Sweetgum (*Liquidambar styraciflua*). Woody shrub and vine species include Muscadine (*Vitis rotundifolia*), Chinese privet (*Ligustrum sinense*) and Greenbrier (*Smilax rotundifolia*). Herbaceous species consist of Dog fennel (*Eupatorium capillifolium*) and Soft rush (*Juncus effusus*).

17.4.3 Mesic Mixed Hardwood Forest

These forested areas comprise approximately 25-35 percent of the project area, mostly near the middle of the project area. The mature canopy is dominated by Northern Oak (*Quercus rubra*), Sycamore (*Liquidambar styraciflua*), Loblolly pine (*Pinus taeda*), American Beech (*Fagus grandifolia*), but also includes White Oak (*Quercus alba*), Sweetgum (*Liquidambar styraciflua*), Red cedar (*Juniperus virginiana*), Tulip poplar (*Liriodendron tulipifera*), Back willow (*Salix nigra*), American hornbeam (*Carpinus caroliniana*), Red maple (*Acer rubrum*), American holly (*Ilex opaca*), and River birch (*Betula nigra*). Woody shrub and vine species include Poison ivy (*Toxicodendron radicans*), Greenbrier (*Smilax rotundifolia*), and Blackberry (*Rubus spp*.). Herbaceous species include Jewelweed (*Woodwardia areolata*) and Common juncus (*Juncus effuses*).

17.4.4 Invasive Species Vegetation

The primary invasive species vegetation present on the project site are primarily Chinese privet (*Ligustrum sinense*), Tree-of-heaven (*Ailanthus altissima*), Princess Tree (*Paulownia tomentosa*) and Multiflora rose (*Rosa multiflora*) which were found interspersed primarily throughout the riparian buffer areas and a few areas along the stream banks. Invasive species vegetation will be sprayed, cut and painted, or grubbed in areas infested within the easement. Treatments will be conducted to control the invasive species vegetation with the easement during the monitoring period as needed.

17.5 Site Wetlands

17.5.1 Jurisdictional Wetland Assessment

The proposed project area was reviewed for the presence of wetlands and waters of the United States in accordance with the provisions on Executive Order 11990, the Clean Water Act, and subsequent federal regulations. Wetlands have been defined by the USACE as “those areas that are inundated or saturated

by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3(b) and 40 CFR 230.3 (t)). The areas in the project boundaries that displayed one or more wetland characteristics were reviewed to determine the presence of wetlands. The wetland characteristics included:

1. Prevalence of hydrophytic vegetation.
2. Permanent of periodic inundation or saturation.
3. Hydric soils.

On June 5, 2007, the USACE and US Environmental Protection Agency (USEPA) issued joint guidance for their field offices for Clean Water Act jurisdictional determinations in response to the Supreme Court's decision in the consolidated cases of Rapanos v. United States and Carabell v. United States (USEPA and USACE, 2007). Based on this guidance, the agencies will assert jurisdiction over the following waters:

- Traditional navigable waters (TNWs)
- Wetlands adjacent to TNWs
- Non-navigable tributaries of TNWs that are considered relatively permanent waters (RPWs). Such tributaries flow year-round or exhibit continuous flow for at least 3 months.
- Wetlands that directly abut RPWs.

The agencies will decide jurisdiction over the following waters based on a standardized analysis to determine whether they have a significant nexus with a traditional navigable water:

- Non-navigable tributaries that are not relatively permanent waters (non-RPWs)
- Wetlands adjacent to non-RPWs
- Wetlands that are adjacent to but do not directly abut an RPW.

The significant nexus analysis is fact-specific and assesses the flow characteristics of a tributary and the functions performed by all its adjacent wetlands to determine if they significantly affect the physical, chemical, and biological integrity of downstream TNWs. A significant nexus exists when a tributary, in combination with its adjacent wetlands, has more than a speculative or insubstantial effect on the physical, chemical, or biological integrity of a TNW.

The USACE and USEPA will apply the significant nexus standard within the limits of jurisdiction specified by the Supreme Court decision in the case of Solid Waste Agency of Northern Cook County (SWANCC) v. US Army Corps of Engineers. Under the SWANCC decision, the USACE and USEPA cannot regulate isolated wetlands and waters that lack links to interstate commerce sufficient to serve as a basis for jurisdiction under the Clean Water Act. Though isolated wetlands and waters are not regulated by the USACE, within the state of North Carolina isolated wetlands and waters are considered "waters of the state" and are regulated by the NCDWR under the isolated wetlands rules (15A NCAC 2H .1300).

Following a desktop review of the National Wetland Inventory (NWI), NRCS soil survey and USGS quadrangle maps, the project area was evaluated for potential impacts to jurisdictional wetlands. Baker wetland scientists conducted a field survey of the project area in February 2013 to investigate potential wetlands within hydric soils areas and confirm perennial and intermittent streams in the project area. In total, the field survey identified nine separate wetland areas containing hydric soil indicators and a predominance of hydrophytic vegetation and wetland hydrology. These areas were identified, flagged, and mapped, as described in Section 16.1. Wetland data forms are also provided in Section 16.1. Most of the identified areas exhibited marginal hydrologic indicators, dominated by herbaceous species that is currently subject to cattle grazing. All wetland areas are located within depressional areas and/or hill slope seeps adjacent to the stream channels. These areas were verified by the USACE and NCDWR in

May 2013, and the proposed mitigation plan for the site will seek to enhance and avoid disturbance of these wetland areas, if possible, to restore a stable stream system.

17.5.2 Wetland Impacts and Considerations

It is likely that small wetland seeps were historically present in some of these locations after evaluating existing topography, soils, hydrology and hydrophytic vegetation within the project reaches. The original plant community located in these wetlands was most likely indicative of other wetlands in the region, but past and current agricultural land use practices have altered the composition of the plant community currently present. Wetland stressors, such as man-made dams and ditching, have altered the hydrological connections within the project area. The main stem was likely moved and/or deepened to capture various sources of seepage in this portion of the project area to increase land available for agricultural use, which exacerbated channel incision and exerts a drainage effect on the adjacent fields.

After completing the proposed stream restoration practices, these areas will likely experience a more natural hydrology and flooding regime, and the riparian buffer area will be planted with native woody vegetation species that is more tolerant of wetter conditions. The design approach will also enhance any potential areas of adjacent fringe or marginal wetlands through higher water table conditions (elevated stream profile) and a more frequent over-bank flooding regime. Stream profiles will be raised along various reach sections, which will lead to higher water table conditions adjacent to the channels and more frequent out-of-bank flooding of adjacent wetland areas.

17.5.3 Climatic Conditions

The average growing season (defined as the period in which air temperatures are maintained above 28° Fahrenheit at a frequency of 5 years in 10) for the project locale is 243 days, beginning on April 17th and ending October 22nd (NRCS Alamance County Soil Survey, Weather Station: Moncure, NC, 1960). The area experiences an average annual rainfall of 46.60 inches (Graham, NC, NRCS Alamance County Soil Survey 1960) as shown on Table 17.8. During 2012, weather station (Graham 2 Ene, COOP 313555) recorded 42.47 inches of rain. In much of the southeastern US, average rainfall exceeds average evapotranspiration losses and these areas experience a moisture excess during most years. Excess water leaves a site by groundwater flow, surface runoff, channelized surface flow, or deep seepage. Annual losses due to deep seepage, or percolation of water to confined aquifer systems, are usually small and are not considered a significant loss pathway for excess water. Although groundwater flow can be significant in some systems, most excess water is lost via surface and shallow subsurface flow.

Table 17.8 Comparison of Monthly Rainfall Amounts for Project Site vs. Long-term Averages

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Month-Year	Observed Monthly Precipitation (in)	WETS Table Average Monthly Precipitation (in)	Deviation of Observed from Average (in)
Jan-2012	1.22	3.70	-2.48
Feb-2012	2.04	3.80	-1.76
Mar-2012	3.85	4.20	-.35
Apr-2012	2.03	4.00	-1.97
May-2012	5.52	3.60	1.92
Jun-2012	2.45	4.20	-1.75
Jul-2012	7.04	5.40	1.64

Table 17.8 Comparison of Monthly Rainfall Amounts for Project Site vs. Long-term Averages

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Month-Year	Observed Monthly Precipitation (in)	WETS Table Average Monthly Precipitation (in)	Deviation of Observed from Average (in)
Aug-2012	3.55	5.00	-1.45
Sept-2012	9.89	3.20	6.69
Oct-2012	1.64	2.90	-1.26
Nov-2012	0.58	2.40	-1.82
Dec-2012	2.66	4.20	-1.54
Sum	**42.47**	**46.60**	**-4.13**

17.5.4 Soil Characterization

Soils at the project site were initially determined using NRCS soil survey data for Alamance County. The areas proposed for stream restoration and enhancement are mapped as Worsham, Georgeville, Tirzah, and Davison soils. Worsham soils are hydric soils and all others are non-hydric. Reach R1 is underlain by Georgeville and Davidson soils. Reach R3 is underlain by Worsham soils. Reach R4 is underlain by Tirzah and Georgeville soils. Reach R5 is mostly underlain by Worsham soils. Figure 2.3 shows soil conditions throughout the project area and the soil descriptions are shown on Table 17.9.

Table 17.9 NRCS Soil Series (Alamance County Soil Survey, USDA-SCS, 1960)

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Soil Name	Landform	Hydric Soil	Description
Worsham	Depressions	Yes	Poorly drained soils formed in upland depressions. Slope ranges from 0 to 3%. Permeability is low.
Georgeville	Hillslopes	No	Well drained soils formed on hillslopes of ridges. Slope ranges from 10 to 25%. Permeability varies from very low to high.
Tirzah	Hillslopes	No	Well drained soils formed on hillslopes of ridges. Slopes range from 10 to 15%. Permeability varies from very low to high.
Davidson	Interfluves	No	Well drained soils formed in summit interfluves. Slopes range from 2 to 6%. Permeability is moderately high to high.

17.5.5 Plant Community Characterization

Based on historical aerials and the landowner's verification, a majority of the proposed stream restoration area is comprised of pasture land, narrow tree canopy and successional vegetation. Historically, the surrounding pasture areas have been used for cattle production. Current canopy vegetation within the existing delineated wetlands is dominated by Red maple (*Acer rubrum*), Black willow (*Salix nigra*), Sycamore (*Platanus occidentalis*), Green ash (*Fraxinus pennsylvanica*). Understory and woody shrub species include Black willow (*Salix nigra*), Chinese privet (*Ligustrum*

sinense), Tag alder (*Alnus serrulata*). Herbaceous and vine species consist of false nettle (*Boehmeria cylindrical*), broadleaf arrowhead (*Sagittaria latifolia*) and jewelweed (*Impatiens capensis*) and greenbrier (*Smilax rotundifolia*).

17.5.6 Proposed Riparian Vegetation Plantings

The vegetative components of this project include stream bank, floodplain, and transitional upland planting and described as the riparian buffer zone. These planting boundaries are shown on the revegetation plan sheets in Section 18, Appendix D. In addition to riparian buffer zone, any areas of the site that lack diversity, are disturbed or adversely impacted by the construction process, will be planted.

Bare-root trees, live stakes, and permanent seedlings will be planted within designated areas of the conservation easement. A minimum 50-foot buffer will be established along both stream banks (100 foot total minimum width) for all of the proposed stream reaches within the project boundary. In many areas, the buffer width will be in excess of 50 feet along one or both stream banks (more than 100 foot total width) and will encompass adjacent jurisdictional wetland areas. In general, bare-root vegetation will be planted at a total target density of 680 stems per acre. Planting will be conducted during the dormant season, with all trees installed between the last week of November and the third week of March.

Selected species for hardwood revegetation planting are presented in Table 17.10. Tree species selected for restoration and enhancement areas will be weak to tolerant of flooding. Weakly tolerant species are able to survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species are able to survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species are able to survive on sites in which the soil is saturated or flooded for extended periods during the growing season (WRP, 1997).

Observations will be made during construction of the site regarding the relative wetness of areas to be planted as compared to the revegetation plan. The planting zone will be determined based on these comparisons, and planted species will be matched according to their wetness tolerance and the anticipated wetness of the planting area.

Once trees are transported to the site, they will be planted within two days. Disturbed soils across the site will be prepared by sufficiently loosening to a depth of three inches prior to planting as described in the technical specifications. In any areas where excavation depths exceed ten inches, topsoil shall be separated from rocks, brush, or foreign materials, stockpiled, and placed back over these areas to a depth of eight inches to achieve design grades and create a soil base for vegetation. Trees will be planted by manual labor using a dibble bar, mattock, planting bar, or other approved method. Planting holes for the trees will be sufficiently deep to allow the roots to spread out and down without "J-rooting." Soil will be loosely compacted around trees once they have been planted to prevent roots from drying out.

Live stakes will be installed at a minimum of 40 stakes per 1,000 square feet and stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections using triangular spacing along the stream banks between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing.

Permanent seed mixtures will be applied to all disturbed areas of the project site. Table 17.11 lists the species, mixtures, and application rates that will be used. A mixture is provided that is suitable for stream bank, floodplain, and adjacent wetland areas. Mixtures will also include temporary seeding (rye grain or browntop millet) to allow for application with mechanical broadcast spreaders. To provide rapid growth of herbaceous ground cover and biological habitat value, the permanent seed mixture specified will be applied to all disturbed areas outside the stream banks of the restored stream channel. The species provided are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability.

Temporary seeding will be applied to all disturbed areas of the site that are susceptible to erosion. These areas include constructed stream banks, access roads, side slopes, and spoil piles. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre.

Table 17.10 Proposed Bare-Root and Live Stake Species
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Riparian Buffer Plantings - Overstory 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	9%	FACW
Betula nigra	River Birch	9%	FACW
Liriodendron tulipifera	Tulip Poplar	6%	FAC
Quercus phellos	Willow Oak	6%	FACW-
Quercus michauxii	Swamp Chestnut Oak	9%	FACW-
Carpinus caroliniana	American Hornbeam	6%	FAC
Platanus occidentalis	American Sycamore	9%	FACW-
Quercus alba	White Oak	6%	FACU
Riparian Buffer Plantings - Understory 8' x 8' spacing - 680 stems/Acre			
Diospyros virginiana	Persimmon	6%	FAC
Lindera benzoin	Spicebush	8%	FACW
Hamamelis virginiana	Witch hazel	6%	FAC-
Viburnum dentatum	Arrowwood Viburnum	6%	FAC
Itea virginica	Virginia sweetspire	8%	FACW+
Asimina triloba	Paw paw	6%	FAC
Riparian Live Stake Plantings			
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

Table 17.11 Proposed Permanent Seed Mixture
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Botanical Name	Common Name	% Planted by Species	Density (lbs/ac)	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	100%	15	

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting Contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

17.6 Site Construction

17.6.1 Site Grading, Structure Installation, and Other Project Related Construction

A general construction sequence is provided below and included on the plan set for the UT to Cane Creek Restoration Project.

1. Contractor shall contact North Carolina "One Call" Center (1.800.632.4949) before any excavation.
2. Contractor shall prepare stabilized construction entrances and haul roads as indicated on the plans.
3. The Contractor shall mobilize equipment, materials, prepare staging area(s) and stockpile area(s) as shown on the plans.
4. Construction traffic shall be restricted to the area denoted as "Limits of Disturbance" or "Haul Roads" on the plans.
5. The Contractor shall install temporary rock dams at locations indicated on the plans.
6. The Contractor shall install temporary silt fence around the staging area(s). Temporary silt fencing will also be placed around the temporary stockpile areas as material is stockpiled throughout the construction period.
7. The Contractor shall install all temporary and permanent stream crossings as shown on the plans in accordance with the NC Erosion and Sediment Control Planning and Design Manual. The existing channel and ditches on site will remain open during the initial stages of construction to allow for drainage and to maintain site accessibility.

8. The Contractor shall construct only the portion of channel that can be completed and stabilized within the same day.
9. The Contractor shall apply temporary seed and mulch to all disturbed areas at the end of each work day.
10. The Contractor shall clear and grub an area adequate to construct the stream channel and grading operations after all Sedimentation and Erosion Control practices have been installed and approved. In general, the Contractor shall work from upstream to downstream and in-stream structures and channel fill material shall be installed using a pump-around or flow diversion measure as shown on the plans.
11. The Contractor will begin construction by excavating channel fill material in areas for Reach R5. The Contractor may fill ditches which do not contain any water during the grading operations. Along ditches with water or stream reaches, excavated material should be stockpiled in areas shown on the plans. In any areas where excavation depths will exceed 10 inches, topsoil shall be separated, stockpiled and placed back over these areas to a depth of eight inches to achieve design grades and create a soil base for vegetation according to the plans and specifications.
12. Contractor shall begin construction on stream Reaches R5 and R5a at Station 10+00 and proceed in a downstream direction until the upstream portion of Reach R4. This section of design channel will be constructed offline and in the dry, since it will be excavated through the field areas. The Contractor shall excavate the channel to design grades in all areas except within 10 feet of the top of existing stream banks.
13. After excavating the channel to design grades, install in-stream structures, grassing, matting, and transplants in this section, and ready the channel to accept flow per approval by the Engineer.
14. Water will be turned into the constructed channel once the area in and around the new channel has been stabilized. Immediately begin plugging, filling, and grading the abandoned channel, as indicated on plans, moving in a downstream direction to allow for drainage of the old channels. No water shall be turned into any section of channel prior to the channel being completely stabilized with all structures installed.
15. The new channel sections shall remain open on the downstream end to allow for drainage during rain events.
16. Any grading activities adjacent to the stream channel shall be completed prior to turning water into the new stream channel segments. Grading activities shall not be performed within 10 feet of the new stream channel banks. The Contractor shall NOT grade or roughen any areas where excavation activities have not been completed.
17. Once a stream work phase is complete, apply temporary seeding, permanent seeding, and mulching to any areas disturbed during construction. Apply permanent seeding mixtures, as shown on the vegetation plan. Temporary seeding shall be applied in all areas susceptible to erosion (i.e. disturbed ditch banks, steep slopes, and spoil areas) such that ground cover is established within 15 working days following completion of any phase of grading. Permanent ground cover shall be established for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following completion of construction.
18. Contractor shall improve and construct the existing farm road crossings (Reach R5 near station 24+70 and Reach R4 near station 52+70) by installing permanent culverts and a ford crossing, stabilizing side slopes, and modifying the farm road bed elevations according to the plans and specifications.
19. All disturbed areas should be seeded and mulched before leaving the project. Remove temporary stream crossings and any in-stream temporary rock dams. All waste material must be removed from the project site.

20. The Contractor shall treat areas of invasive species vegetation throughout the project area according to the plans and specifications prior to demobilization.
21. The Contractor shall plant woody vegetation and live stakes, according to planting details and specifications. The Contractor shall complete the reforestation (bare-root planting) phase of the project and apply permanent seeding at the appropriate time of the year.
22. The Contractor shall ensure that the site is free of trash and leftover materials prior to demobilization of equipment from the site.

17.6.2 In-stream Structures and Other Construction Elements

A variety of in-stream structures are proposed for the UT to Cane Creek Restoration Project site. Structures such as log vanes, rock cross vanes, constructed riffles, root wads, log weirs, and cover logs will be used to stabilize the newly-restored stream and improve habitat functions. Woody debris will be harvested through the construction of this project and incorporated whenever possible. Table 17.12 summarizes the use of in-stream structures at the site.

Table 17.12 Proposed In-Stream Structure Types and Locations
UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Structure Type	Location
Root Wads	In locations along outside of meander bends or against one stream bank in straight reaches to increase pool diversity and provide refugium for fish.
Grade Control J-Hook Vanes	In locations where grade control is necessary to prevent to prevent possible downcutting or headcut migration, and stream bed/bank erosion.
Log Vanes	Located throughout various meander bends to prevent to prevent possible stream bank erosion.
Log Weirs / Step Pools	In locations where grade control is necessary to prevent to prevent possible downcutting or headcut migration, and bed erosion.
Cover Logs / Toe Wood	Located along outside bends or against one stream bank in straight reaches to increase pool diversity and provide refugium for fish.
Constructed Riffles	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.
Ditch Plug / Channel Block	Installed along some or all of remnant channel segments to prevent subsurface flow.
Vegetation Transplants	In locations outside of meander bends to increase stream bank stability and cover.
Vegetated Geolift	In locations outside of meander bends to create and/or increase stream bank stability and reduce near bank stress.

Root Wads

Root wads are placed at the toe of the stream bank along the outside of meander bends for the creation of habitat and for stream bank protection. Root wads include the root mass or root ball of a tree plus a portion of the trunk. They are used to armor a stream bank and reduce near bank stress by deflecting stream flows away from the stream bank. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. They also serve as a food source for aquatic insects. Root wads will be placed throughout the project reaches primarily to improve aquatic habitat and provide cover.

Grade Control J-Hook Vanes

Grade control j-hook vanes are utilized to provide grade control and protect the stream banks. These vanes may be constructed out of logs and/or rock boulders. The structure arms turn water away from the

stream banks and re-direct flow energies toward the center of the channel. In addition to providing stability to stream banks, grade control j-hook vanes also promote pool scour and provide structure within the pool habitat. Grade control j-hooks have two to three boulders placed in a hook shape at the upstream end of the vane. The primary difference between regular j-hooks and grade control j-hooks is the way that the "hook" part of the structure is constructed. Regular j-hooks are constructed to have gaps between the header boulders in the hook to promote flow convergence. Grade control j-hooks do not have gaps between the header boulders in the hook and also have a boulder sill built from the outside of the hook over to the opposite stream bank such that the structure can serve as a grade control feature. Grade control j-hooks still promote scour in the downstream pool, thus providing habitat benefit.

Log Vanes

A log vane is used to provide cover for aquatic organisms in the downstream scour pool and with a potential secondary benefit of protecting stream banks by reducing near-bank stress and redirecting flow away from the stream bank. The length of a single vane structure can span one-half to two-thirds the bankfull channel width. Vanes are located just downstream of the point where the stream flow intersects the stream bank at an acute angle in a meander bend.

Log Weirs / Step Pools

Log weirs and step pools are used to provide grade control as well as provide a secondary pool habitat benefit for aquatic organisms. A log weir consists of two logs stacked (a header log and a footer log) and installed perpendicular to the direction of flow. This center structure sets the invert elevation of the streambed. A step pool sequence or log/rock "rollers" are also commonly used in confined settings where sinuosity is less than 1.2 and in drainage areas less than 3 square miles, and located based on pool-to-pool spacing ratios. They can be used as floodplain interceptors to intercept concentrated floodplain flows from swales, ditches, low points, oxbow pond or vernal pool drains, etc. and to drain such flow to the restored channel in a stable and natural manner.

Cover Logs

A cover log is placed along the outside of a meander bend to provide habitat in the pool area. It is most often installed in conjunction with root wads. The log is buried into the outside stream bank of the meander bend; the opposite end extends through the deepest part of the pool and may be buried in the inside of the meander bend, in the bottom of the point bar. The placement of the cover log near the bottom of the stream bank slope on the outside of the bend encourages scour in the pool. This increased scour provides a deeper pool for bedform variability.

Constructed Riffles

A constructed riffle is installed by placing coarse bed material (gravel, cobble, and small boulders) in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial grade control and establish riffle habitat within the restored channel, prior to the natural establishment of an armored streambed. Wood material can also be incorporated with rock for these structures, and function in a similar way as natural riffles; the surfaces and interstitial spaces are crucial to the life cycles of many aquatic macroinvertebrate species.

Ditch Plug / Channel Block

A compacted earth plug will be installed by filling the existing ditch to prevent subsurface flows and improve site hydrology. The fill material used for ditch plugs shall come from a nearby borrow area and be free of debris, rocks, trash, etc. and shall consist of compactable soil material.

Vegetation Transplants

Vegetation transplants will be identified before starting construction as viable candidates (species and size) for uprooting and relocation. Areas that must be cleared will maximize the harvesting of

transplants; transplants will be taken from other areas as suitable to enhance the rapid development of vegetative growth along the constructed channel.

Vegetated Geolift

Geolifts are a bioengineering measure used to stabilize stream banks. Geolifts are most commonly used along the outside of stream meander bends. They are essentially a series of large overlapping soil "burritos," or "lifts", constructed using coir fiber erosion control matting and native soils. Live cutting materials, or whips, from specific woody native species plants are planted in the layers between the lifts. A stone or woody brush toe base is typically installed to provide protection at the toe of the stream bank and to provide a foundation for the geolifts. The geolifts are installed on top of the base material to comprise the entire restored stream bank up to the bankfull channel elevation. Geolifts can be used to effectively stabilize restored stream banks for all sizes of streams simply by varying the number of lifts required to form the stream bank.

18.0 APPENDIX D - PROJECT PLAN SHEETS

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	132700	1	22
	EEP ID No. 95729		

NORTH CAROLINA
ECOSYSTEM · ENHANCEMENT PROGRAM

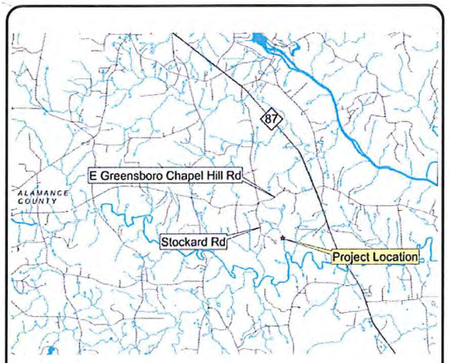
ALAMANCE COUNTY

LOCATION: APPROXIMATELY 3 MILES SOUTH OF THE TOWN OF SAXAPAHAW

TYPE OF WORK: STREAM RESTORATION AND ENHANCEMENT

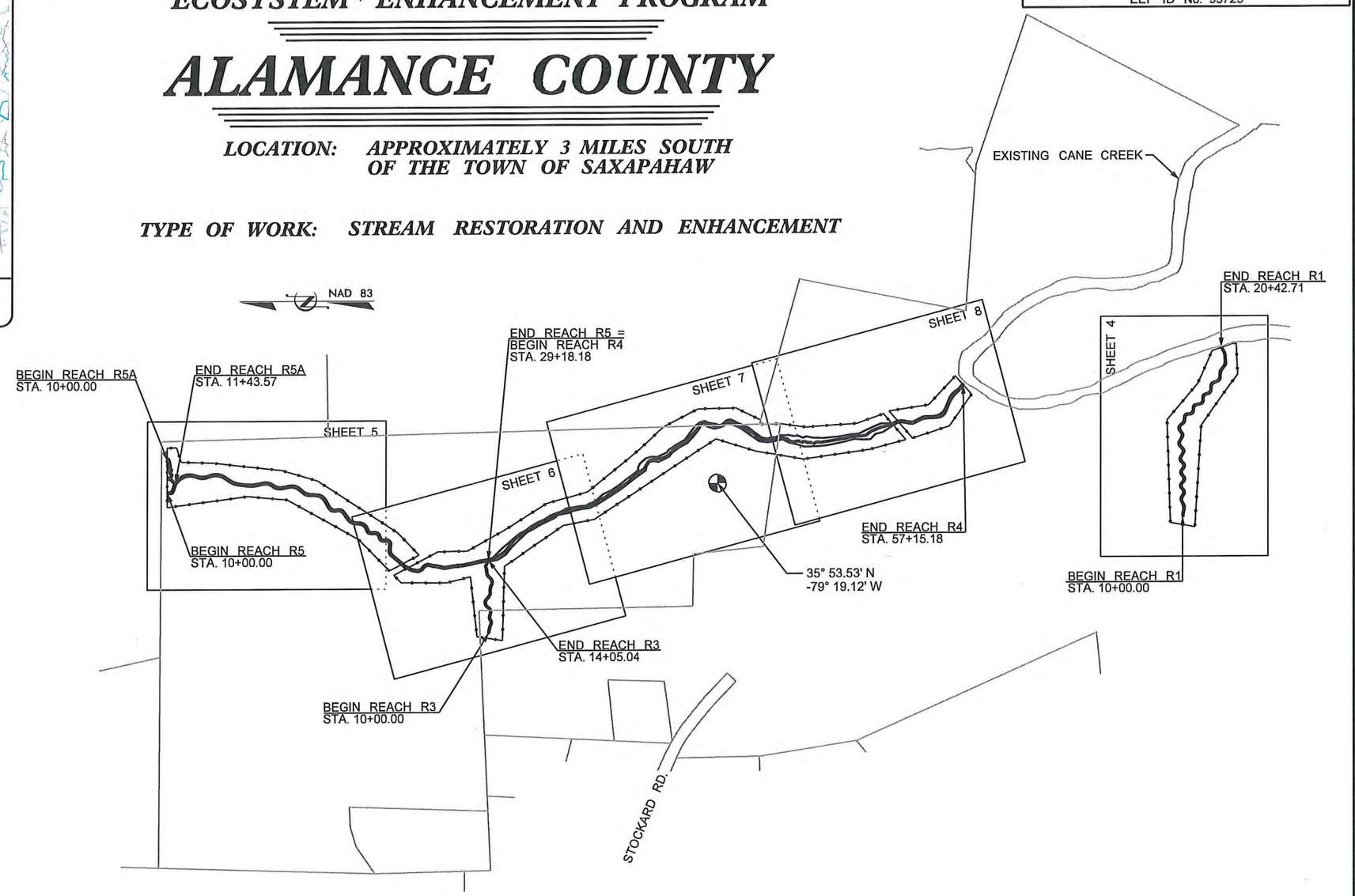
UT TO CANE CREEK

PROJECT: 132700

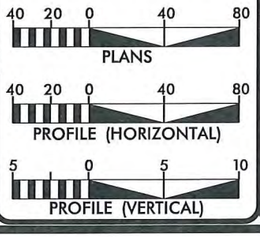


VICINITY MAP

INDEX OF SHEETS



GRAPHIC SCALES



DESIGN DATA

PROPOSED RESTORATION LENGTH REACH R1	=	1,043 FEET
PROPOSED RESTORATION LENGTH REACH R3	=	405 FEET
PROPOSED RESTORATION LENGTH REACH R4	=	419 FEET
PROPOSED ENHANCEMENT LENGTH REACH R4	=	2,346 FEET
PROPOSED RESTORATION LENGTH REACH R5	=	1,456 FEET
PROPOSED ENHANCEMENT LENGTH REACH R5	=	426 FEET
PROPOSED ENHANCEMENT LENGTH REACH R5A	=	144 FEET

PREPARED FOR THE OFFICE OF:

Ecosystem Enhancement PROGRAM

NCDENR
ECOSYSTEM ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652

NCEEP CONTACT: PERRY SUGG, PROJECT MANAGER

PREPARED IN THE OFFICE OF:

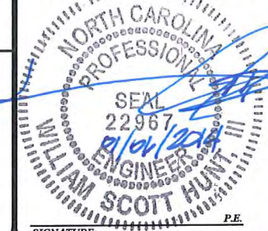
Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

LETTING DATE:

WILLIAM SCOTT HUNT, III, PE
PROJECT ENGINEER

KAYNE VAN STELL
PROJECT MANAGER

PROJECT ENGINEER



SIGNATURE: P.E.

2/25/03

STREAM CONVENTIONAL SYMBOLS
SUPERCEDES SHEET 1-B

- ROCK J-HOOK
- ROCK VANE
- OUTLET PROTECTION
- ROCK CROSS VANE
- DOUBLE DROP ROCK CROSS VANE
- SINGLE WING DEFLECTOR
- DOUBLE WING DEFLECTOR
- TEMPORARY SILT CHECK
- ROOT WAD
- LOG J-HOOK
- LOG VANE
- LOG WEIR
- LOG CROSS VANE
- CONSTRUCTED RIFFLE
- BOULDER CLUSTER
- ROCK STEP POOL
- LOG STEP POOL
- SAFETY FENCE
- TAPE FENCE
- 100 YEAR FLOOD PLAIN
- CONSERVATION EASEMENT
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- LIMITS OF DISTURBANCE
- FOOT BRIDGE
- TEMPORARY STREAM CROSSING
- PERMANENT STREAM CROSSING
- TRANSPLANTED VEGETATION
- TREE REMOVAL
- TREE PROTECTION
- DITCH PLUG
- CHANNEL FILL
- BRUSH MATTRESS
- GEOLIFT

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL IN-STREAM STRUCTURES USING A TRACK HOE WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE LOGS AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONSTRUCTION IS SCHEDULED TO BEGIN WINTER OF 2014.
4. CONTRACTOR SHOULD CALL NORTH CAROLINA "ONE-CALL" BEFORE EXCAVATION STARTS. (1-800-632-4949)
5. ENGINEER WILL FLAG TREES TO BE SAVED PRIOR TO CONSTRUCTION.

PROJECT REFERENCE NO.	SHEET NO.
132700	1-A

PROJECT ENGINEER

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
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Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

EEP ID No. 95729

STANDARD SPECIFICATIONS

NORTH CAROLINA
EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL
MARCH 2009

6.06	TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
6.60	TEMPORARY SEDIMENT TRAP
6.62	TEMPORARY SILT FENCE
6.63	TEMPORARY ROCK DAM
6.70	TEMPORARY STREAM CROSSING

VEGETATION SELECTION

The following table lists the bare root vegetation selection for the project site. Total planting area is approximately 14 acres and will vary based on areas denuded during construction. Species shall be planted at density of 680 stems per acre and a minimum of 50 feet from the stream banks to the revegetation limits. Exact placement of species will be determined prior to site planting and based on apparent wetness of planting locations and per the vegetation specialist. Refer to the Revegetation Plan Sheets & Construction Specifications for vegetation planting locations and riparian buffer requirements.

Riparian Buffer - Trees (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**	**Approx. Number of Stems**
Fraxinus pennsylvanica	Green Ash	9%	FACW	857
Betula nigra	River Birch	9%	FACW	857
Liriodendron tulipifera	Tulip Poplar	6%	FAC	571
Quercus phellos	Willow Oak	6%	FACW-	571
Quercus michauxii	Swamp Chestnut Oak	9%	FACW-	857
Carpinus caroliniana	American Hornbeam	6%	FAC	571
Platanus occidentalis	American Sycamore	9%	FACW-	857
Quercus alba	White Oak	6%	FACU	571
	Sub-total	60%		**5,712**
Riparian Buffer - Understory (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**			
Diospyros virginiana	Persimmon	6%	FAC	571
Lindera benzoin	Spicebush	8%	FACW	762
Hamamelis virginiana	Witch hazel	6%	FAC-	571
Viburnum dentatum	Arrowwood Viburnum	6%	FAC	571
Itea virginica	Virginia sweetspire	8%	FACW+	762
Asimina triloba	Paw paw	6%	FAC	571
	Sub-total	40%		**3,808**
	Total Bare-roots			**9,520**

Live staking will be applied to all restored streambanks following the details in this plan set and according to the construction specifications.

Scientific Name	Common Name	% Planted By Species	Wetland Tolerance
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

Permanent herbaceous seed mixtures for the project site shall be planted throughout the floodplain and riparian buffer areas. Permanent seed mixtures shall be applied with temporary seed, as defined in the construction specifications.

Scientific Name	Common Name	% Planted By Species	Total lbs per Acre	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	**100%**	**15.0**	

The following table lists temporary seed mix for the project site. All disturbed areas will be stabilized using mulch and temporary seed as defined in the construction specifications.

Planting Dates	Species Name	Rate (lbs./acre)
September to March	Rye Grain (Cool Season)	130
April to August	Browntop Millet (Warm Season)	40

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 01/06/2014

1/6/2014
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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
132700	1-B
EEP ID No. 95729	

*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III
01/06/2004

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin — EIP
- Property Corner
- Property Monument — ECM
- Parcel/Sequence Number — 23
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary — WLB
- Proposed Wetland Boundary — WLB
- Existing Endangered Animal Boundary — EAB
- Existing Endangered Plant Boundary — EPB

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign — S
- Well — W
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream — JS
- Buffer Zone 1 — BZ 1
- Buffer Zone 2 — BZ 2
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch — FLOW
- False Sump

RAILROADS:

- Standard Gauge — CSX TRANSPORTATION
- RR Signal Milepost — MILEPOST 35
- Switch — SWITCH
- RR Abandoned
- RR Dismantled

RIGHT OF WAY:

- Baseline Control Point
- Existing Right of Way Marker
- Existing Right of Way Line
- Proposed Right of Way Line — RW
- Proposed Right of Way Line with Iron Pin and Cap Marker — RW
- Proposed Right of Way Line with Concrete or Granite Marker — RW
- Existing Control of Access — CA
- Proposed Control of Access — CA
- Existing Easement Line — E
- Proposed Temporary Construction Easement — E
- Proposed Temporary Drainage Easement — TDE
- Proposed Permanent Drainage Easement — PDE
- Proposed Permanent Utility Easement — PUE
- Proposed Temporary Utility Easement — TUE
- Proposed Permanent Easement with Iron Pin and Cap Marker

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut — C
- Proposed Slope Stakes Fill — F
- Proposed Wheel Chair Ramp — WCR
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard — Vineyard

EXISTING STRUCTURES:

MAJOR:
- Bridge, Tunnel or Box Culvert — CONC
- Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR:
- Head and End Wall — CONC HW
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB — CB
- Paved Ditch Gutter
- Storm Sewer Manhole — S
- Storm Sewer — S

UTILITIES:

POWER:
- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole — P
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole — HH
- H-Frame Pole
- Recorded U/G Power Line — P
- Designated U/G Power Line (S.U.E.*) — P

TELEPHONE:
- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole — T
- Telephone Booth
- Telephone Pedestal — T
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole — HH
- Recorded U/G Telephone Cable — T
- Designated U/G Telephone Cable (S.U.E.*) — T
- Recorded U/G Telephone Conduit — TC
- Designated U/G Telephone Conduit (S.U.E.*) — TC
- Recorded U/G Fiber Optics Cable — T FO
- Designated U/G Fiber Optics Cable (S.U.E.*) — T FO

WATER:
- Water Manhole — W
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line — W
- Designated U/G Water Line (S.U.E.*) — W
- Above Ground Water Line — A/G Water

TV:
- TV Satellite Dish
- TV Pedestal — C
- TV Tower
- U/G TV Cable Hand Hole — HH
- Recorded U/G TV Cable — TV
- Designated U/G TV Cable (S.U.E.*) — TV
- Recorded U/G Fiber Optic Cable — TV FO
- Designated U/G Fiber Optic Cable (S.U.E.*) — TV FO

GAS:
- Gas Valve
- Gas Meter
- Recorded U/G Gas Line — G
- Designated U/G Gas Line (S.U.E.*) — G
- Above Ground Gas Line — A/G Gas

SANITARY SEWER:
- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer
- Recorded SS Forced Main Line — FSS
- Designated SS Forced Main Line (S.U.E.*) — FSS

MISCELLANEOUS:
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box — S
- Utility Unknown U/G Line — PUTL
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- U/G Test Hole (S.U.E.*)
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2

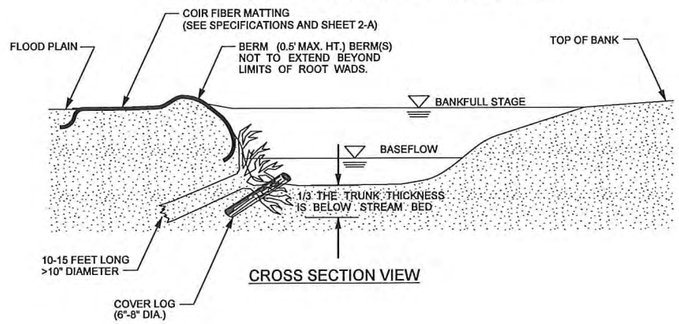
PROJECT ENGINEER

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

EEP ID No. 95729

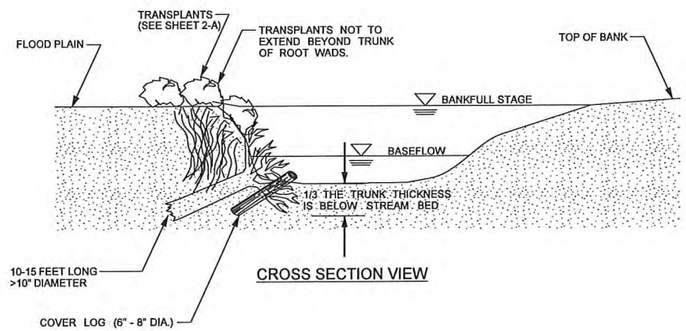
ROOT WADS

ROOT WADS WITHOUT TRANSPLANTS
USE IF TRANSPLANTS ARE NOT AVAILABLE ON-SITE



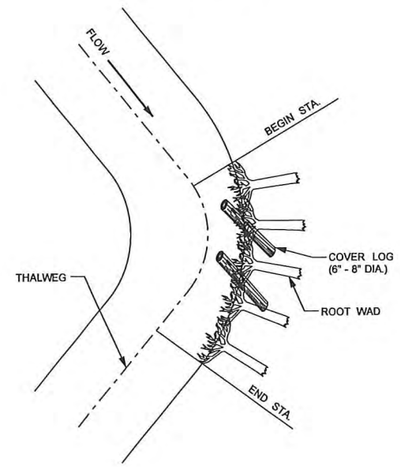
CROSS SECTION VIEW

ROOT WADS WITH TRANSPLANTS
USE IF TRANSPLANTS ARE AVAILABLE ON-SITE



CROSS SECTION VIEW

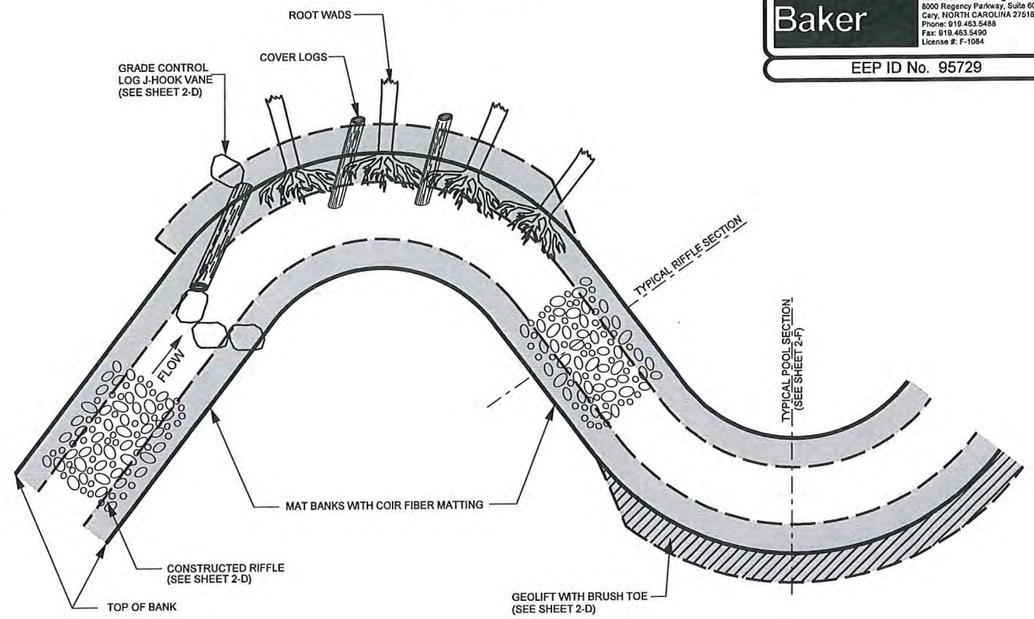
PLAN VIEW



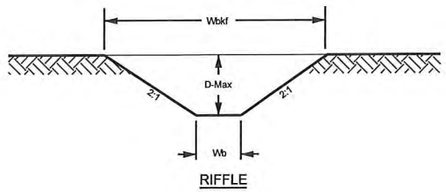
NOTES:
1. INSTALLATION USING THE TRENCHING METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS OR CHANNEL BOTTOM.
2. THE NUMBER OF ROOTWADS ESTIMATED MAY VARY DEPENDING ON THE ROOTMASS SIZE. IN GENERAL, ROOTWADS SHOULD PROTECT THE OUTER MEANDER BEND AS SHOWN. SEE STRUCTURE TABLE FOR APPROXIMATE STATION AND LOCATION.
3. INSTALL COVER LOGS BETWEEN ROOTWADS TO PROVIDE HABITAT ONLY WHEN AVAILABLE FROM ON-SITE HARVESTING.

TYPICAL STRUCTURE PLACEMENT

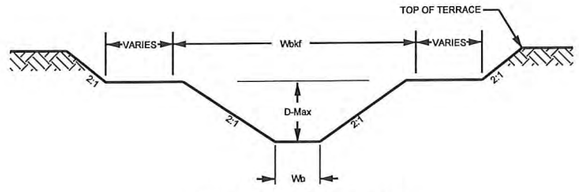
STRUCTURE NOTES:
1. GENERALLY CONSTRUCTED RIFFLES, ROOT WADS, LOG VANES AND COIR FIBER MATTING WILL BE INSTALLED IN THE LOCATION AND SEQUENCE AS SHOWN.
2. ANY CHANGES TO NUMBER OR LOCATION OF STRUCTURES DURING CONSTRUCTION MUST BE APPROVED BY THE DESIGN ENGINEER.
3. COIR FIBER MATTING TO BE INSTALLED ON ALL RESTORED STREAMBANKS, FLOODPLAIN BENCHING, AND TERRACE SLOPES AS DESCRIBED IN THE TECHNICAL SPECIFICATIONS.



TYPICAL RIFFLE, POOL, AND BANKFULL BENCH CROSS-SECTIONS

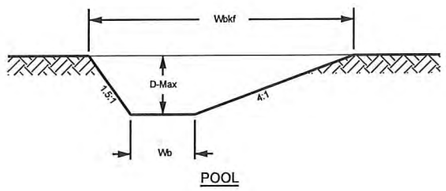


RIFFLE

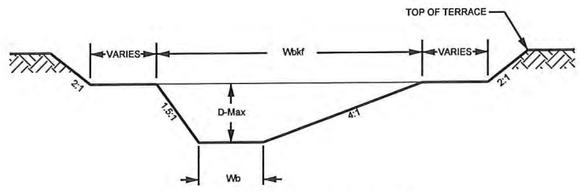


RIFFLE WITH BANKFULL BENCH

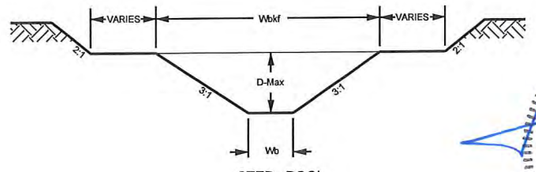
R1		R3		R4		R5		R5A		
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	
6.9	9.0	7.2	9.2	14.0	17.0	10.8	13.0	3.2	5.0	WIDTH OF BANKFULL (Wbkf)
0.7	1.5	0.7	1.3	1.2	2.2	1.1	2.0	0.4	1.0	MAXIMUM DEPTH (D-Max)
13.0	11.1	13.0	12.3	14.0	12.6	13.0	12.1	12.0	10.0	WIDTH TO DEPTH RATIO (Wbkf / D)
3.7	7.3	4.0	6.9	14.0	22.9	9.0	14.0	0.9	2.5	BANKFULL AREA (Abkf)
4.3	0.8	4.5	1.4	9.2	3.8	5.2	1.0	1.3	0.1	BOTTOM WIDTH (Wb)



POOL



POOL WITH BANKFULL BENCH



STEP - POOL

NOTES:
1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOLS SHOWN ABOVE ARE LEFT POOLS FOR MEANDER CHANNELS.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

1/6/2014
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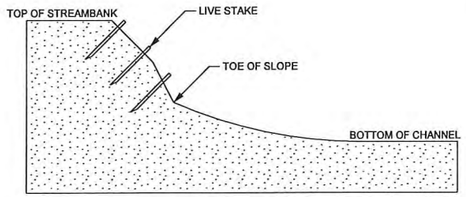
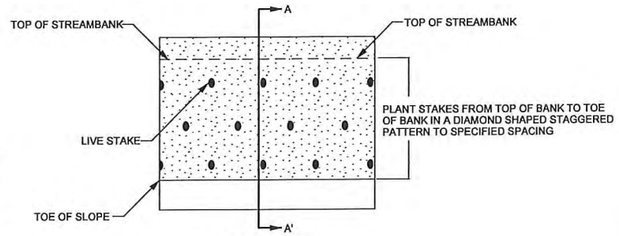
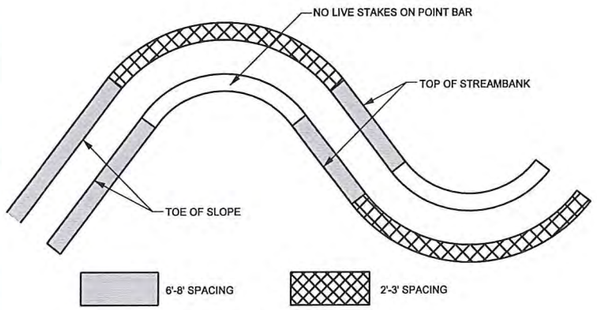
LIVE STAKING



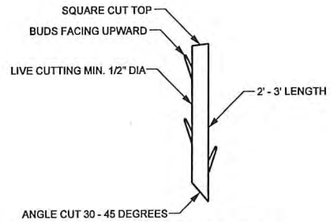
SECTION A - A'



PLAN VIEW



LIVE STAKE SPACING PLAN VIEW

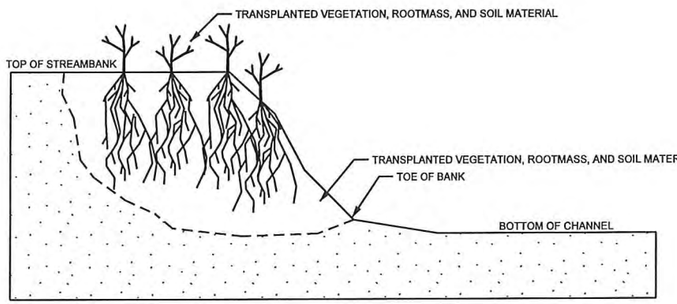


LIVE STAKE DETAIL

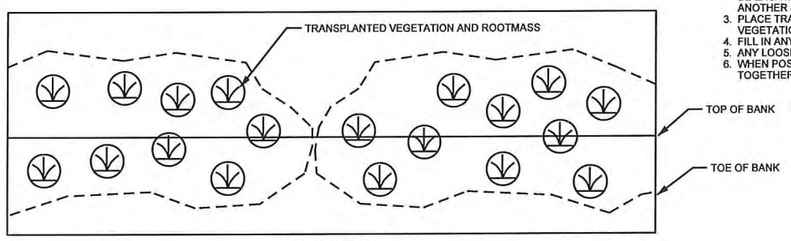
NOTES:

1. STAKES SHOULD BE CUT AND INSTALLED ON THE SAME DAY.
2. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
3. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
4. STAKES SHOULD BE INSTALLED PERPENDICULAR TO BANK.
5. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT LONG.
6. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.

TRANSPLANTED VEGETATION



CROSS SECTION VIEW

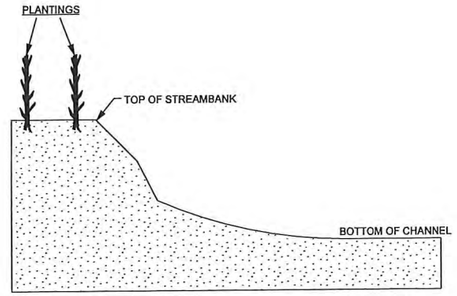


PLAN VIEW

NOTES:

1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED AT ONCE, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLACE TRANSPLANT IN THE BANK TO BE STABILIZED SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. WHEN POSSIBLE, PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

PLANTING SPECIFICATIONS



CROSS SECTION VIEW OF BARE ROOT PLANTING

NOTES:

1. PLANT BARE ROOT SHRUBS AND TREES TO THE WIDTH OF THE BUFFER/PLANTING ZONE AS SHOWN ON THE PLANS.
2. ALLOW FOR 6-10 FEET BETWEEN PLANTINGS, DEPENDING ON SIZE.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR, OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP, OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO PROJECT SITE.

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2-A

PROJECT ENGINEER

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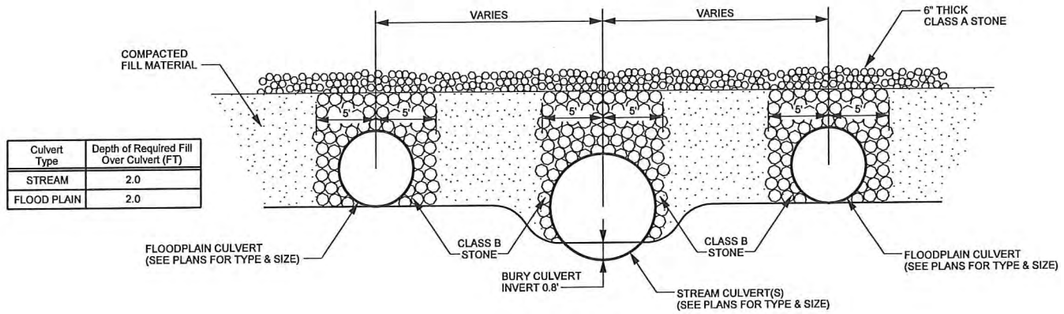
EEP ID No. 95729

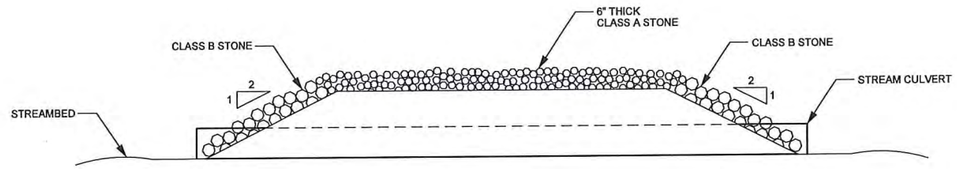
NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 01/06/2014

PERMANENT ROAD CULVERT CROSSING



Culvert Type	Depth of Required Fill Over Culvert (FT)
STREAM	2.0
FLOOD PLAIN	2.0

PROFILE VIEW ALONG ROAD



CROSS SECTION

NOTES:

1. APPLY SUFFICIENT FILL OVER CULVERTS TO PREVENT CULVERT COLLAPSE.
2. STABILIZE FILL AROUND CULVERTS WITH CLASS B STONE. STABILIZE REMAINING ROAD SIDE SLOPES WITH EROSION MATTING ACCORDING TO SPECIFICATIONS.

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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2-B

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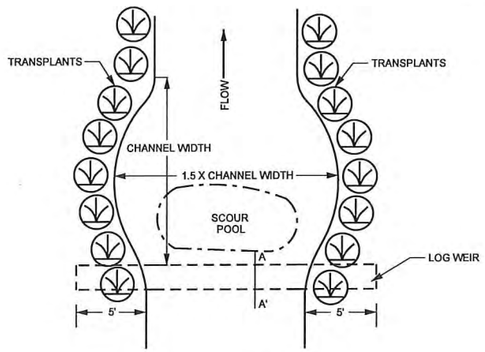
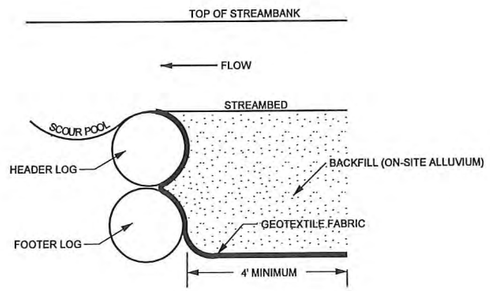
EEP ID No. 95729

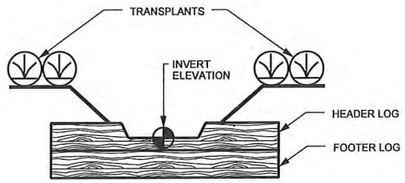
LOG WEIR



PLAN VIEW



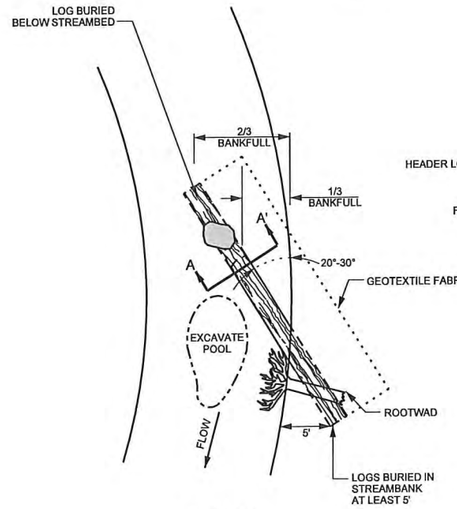
SECTION A-A'



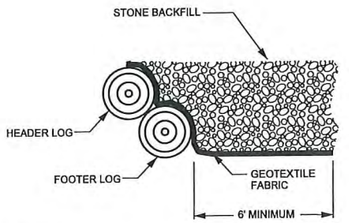
CROSS SECTION VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG. GEOTEXTILE FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG
3. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG APPROXIMATLEY 3 INCHES ABOVE THE INVERT ELEVATION.
4. CUT A NOTCH IN THE HEADER LOG APPROXIMATLEY 50 PERCENT OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION.
5. USE GEOTEXTILE FABRIC TO SEAL GAPS BETWEEN LOGS.
6. PLACE TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.

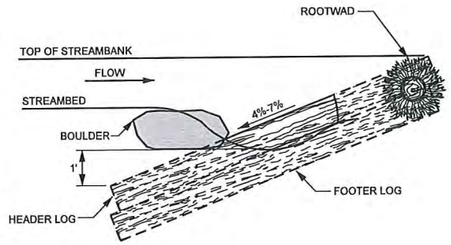
LOG VANE



PLAN VIEW



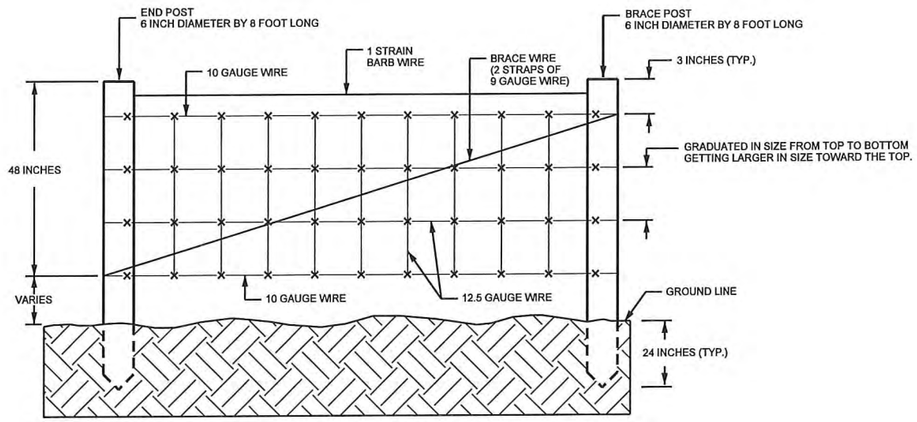
SECTION A - A'



PROFILE VIEW

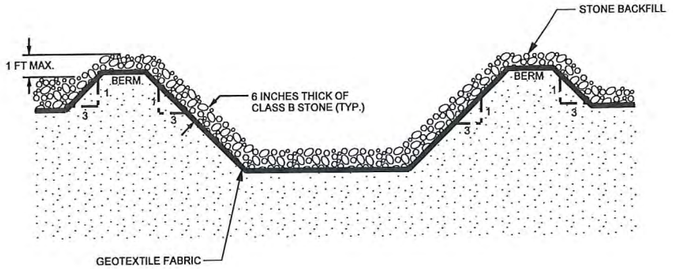
NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE OF SUFFICIENT SIZE TO ANCHOR LOGS.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDER SHOULD BE PLACED ON TOP OF HEADER LOG FOR ANCHORING.
6. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
7. TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

WOVEN FIELD FENCE



NOTE:
1. END POSTS SHALL BE INSTALLED AT A SPACING OF 10-15 FEET.

PERMANENT FORD STREAM CROSSING



NOTES:
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 3:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF STONE BACKFILL, 6 INCHES THICK, LINED WITH GEOTEXTILE FABRIC. SHALL BE USED OVER THE BERM AND ACCESS SLOPES.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
9/04/2014

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BAKER PROJECT REFERENCE NO.	SHEET NO.
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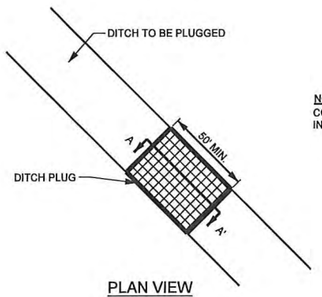
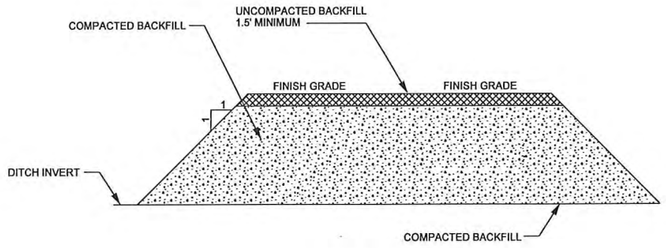
DITCH PLUG



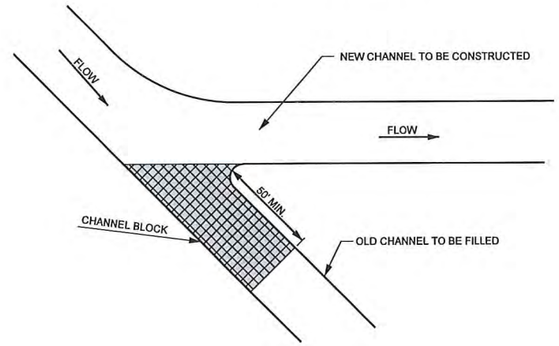
NOTE:
COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.

PLAN VIEW

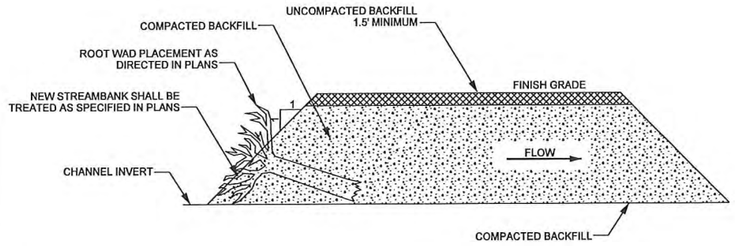


SECTION A - A'

CHANNEL BLOCK

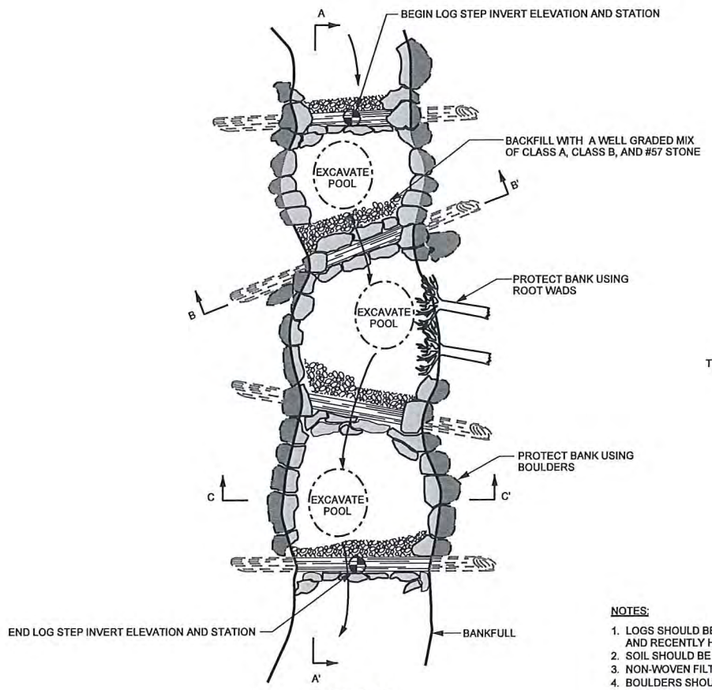


PLAN VIEW

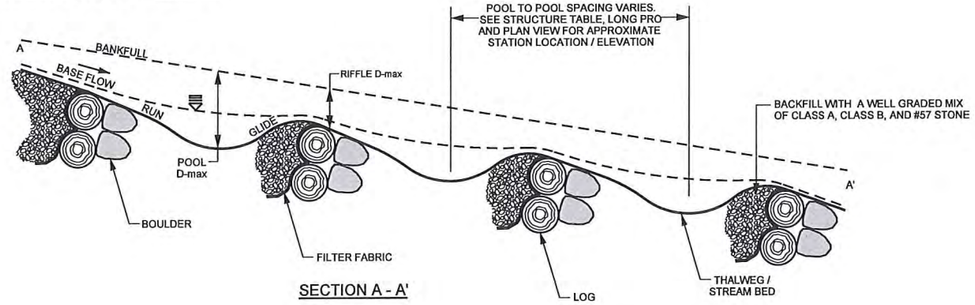


PROFILE VIEW

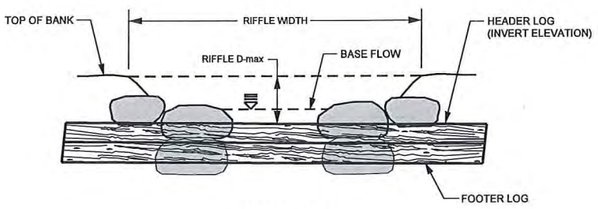
LOG AND ROCK STEP-POOL



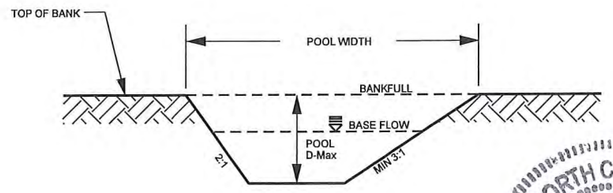
PLAN VIEW



SECTION A - A'



SECTION B - B'



SECTION C - C'

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. NON-WOVEN FILTER FABRIC SHOULD BE NAILED/STAPLED TO THE LOG BELOW THE BACKFILL.
4. BOULDERS SHOULD BE 3' X 2' X 2' AND PLACED ON TOP OF HEADER LOG FOR ANCHORING.
5. LOGS SHOULD BE ANGLED 60° - 70° FROM THE STREAM BANK AND CROSS SLOPES SHOULD NOT EXCEED 2%.
6. STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.4 FT AND POOL DEPTHS NOT TO EXCEED 1.8 FT.
7. THE NUMBER LOG STEPS MAY VARY BETWEEN BEGIN AND END STATIONING DEPENDING ON LOG DIAMETER SIZE. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR STATION AND ELEVATION.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/06/2014

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BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	2-D

PROJECT ENGINEER

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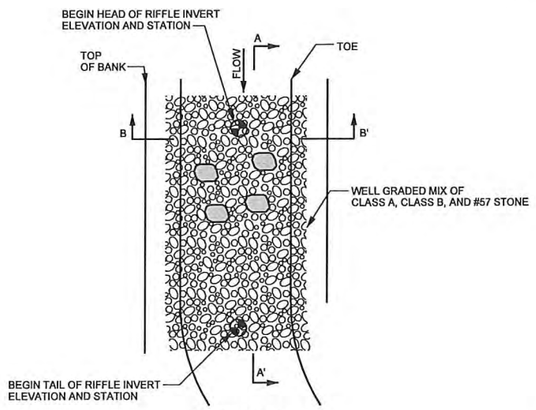
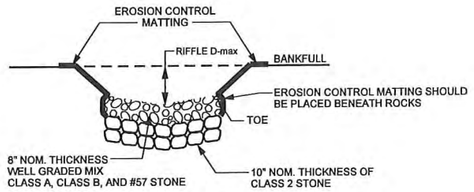
EEP ID No. 95729

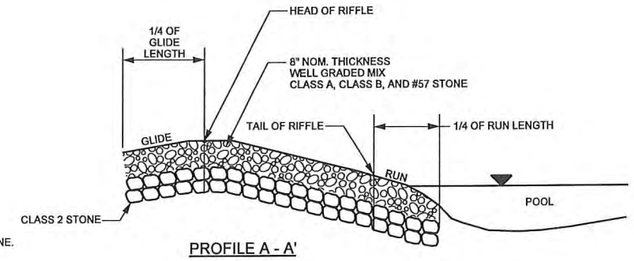
CONSTRUCTED RIFFLE



PLAN VIEW



SECTION B - B'

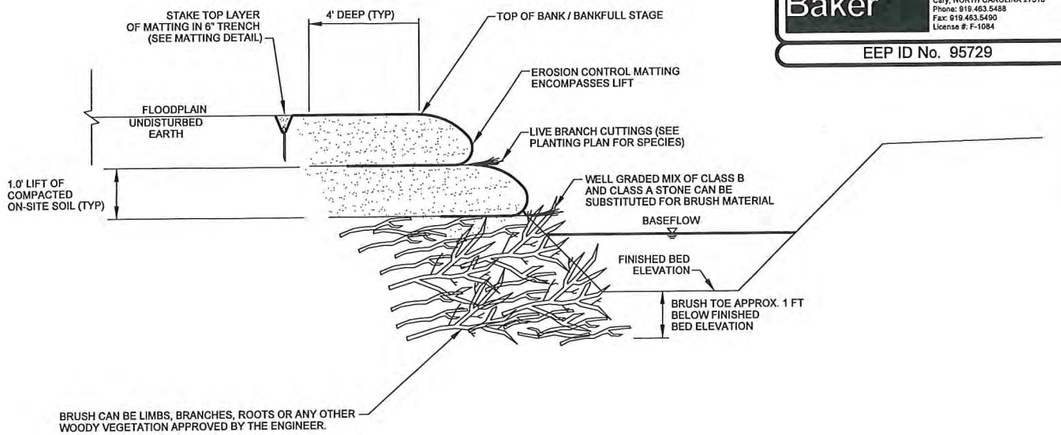


PROFILE A - A'

NOTES:
1. UNDERCUT CHANNEL BED ELEVATION 18 INCHES TO ALLOW FOR LAYERS OF STONE.
2. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
3. INSTALL SUB LAYER OF CLASS 2 STONE.
4. INSTALL A WELL GRADED MIX OF SPECIFIED STONE, COMPACTED TO GRADE.
5. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.
6. RIFFLE LENGTHS WILL VARY. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR BEGINNING AND ENDING STATIONS AND ELEVATIONS.

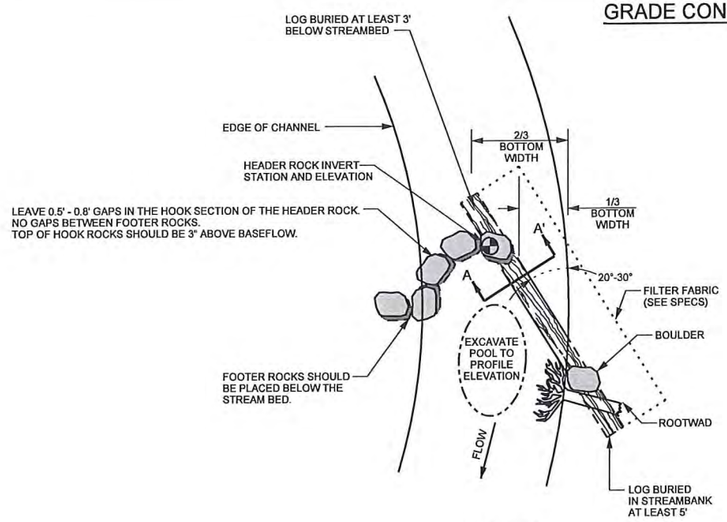
GEOLIFT WITH BRUSH TOE

NOTES:
1. LIVE BRANCH CUTTINGS SHALL BE THE SAME SPECIES AS THE LIVE STAKES AND SHALL BE INSTALLED DURING VEGETATION DORMANCY.
2. LIVE BRANCH CUTTINGS SHALL BE INSTALLED AT A DENSITY OF 20-30 CUTTINGS PER LINEAR FOOT AND A MAXIMUM DIAMETER OF 2.5 INCHES.
3. NUMBER OF SOIL LIFTS MAY VARY, IN GENERAL LIFTS SHALL EXTEND TO THE TOP OF BANK OR BANKFULL STAGE.
4. GEOLIFTS TO BE INSTALLED IN CHANNEL SECTIONS ALONG SIDE SLOPES STEEPER THAN 2:1 AND/OR ADJACENT TO HILL SLOPES.

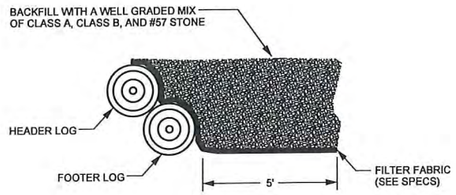


NOTES:
1. WHEN GEOLIFTS ARE BUILT ABOVE ROOTWAD CLUSTER, USE LARGE STONE BACKFILL BEHIND ROOT MASS TO BUILT FOUNDATION.

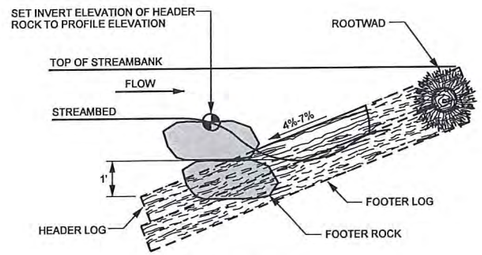
GRADE CONTROL LOG J-HOOK VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE 3' x 2' x 2'.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT SECURES THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ACHORING.
6. HEADER BOULDERS TO BE PLACED 0.5 TO 0.8 FEET APART.
7. NON-WOVEN FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
8. FOOTERS SHALL BE INSTALLED SUCH THAT 1/4 TO 1/3 OF THE LENGTH IS DOWNSTREAM OF THE HEADER.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/ar/04

1/6/2004
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2/26/03

PROJECT REFERENCE NO.	SHEET NO.
132700	3

PROJECT ENGINEER

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EEP ID No. 95729

GENERAL CONSTRUCTION SEQUENCE

MICHAEL BAKER ENGINEERING, INC. WILL PROVIDE CONSTRUCTION OBSERVATION DURING THE CONSTRUCTION PHASE OF THIS PROJECT. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE USED DURING IMPLEMENTATION OF THE PLAN. CONTRACTOR SHALL REFER TO THE APPROVED SEDIMENTATION AND EROSION CONTROL PLAN FOR SPECIFIC CONSTRUCTION SEQUENCE ITEMS AND SHALL BE RESPONSIBLE FOR FOLLOWING THE APPROVED PLANS AND PERMIT CONDITIONS.

1. CONTRACTOR SHALL CONTACT NORTH CAROLINA "ONE CALL" CENTER (1.800.632.4949) BEFORE ANY EXCAVATION.
2. CONTRACTOR SHALL PREPARE STABILIZED CONSTRUCTION ENTRANCES AND HAUL ROADS AS INDICATED ON THE PLANS.
3. THE CONTRACTOR SHALL MOBILIZE EQUIPMENT, MATERIALS, PREPARE STAGING AREA(S) AND STOCKPILE AREA(S) AS SHOWN ON THE PLANS.
4. CONSTRUCTION TRAFFIC SHALL BE RESTRICTED TO THE AREA DENOTED AS "LIMITS OF DISTURBANCE" OR "HAUL ROADS" ON THE PLANS.
5. THE CONTRACTOR SHALL INSTALL TEMPORARY ROCK DAMS AT LOCATIONS INDICATED ON THE PLANS.
6. THE CONTRACTOR SHALL INSTALL TEMPORARY SILT FENCE AROUND THE STAGING AREA(S). TEMPORARY SILT FENCING WILL ALSO BE PLACED AROUND THE TEMPORARY STOCKPILE AREAS AS MATERIAL IS STOCKPILED THROUGHOUT THE CONSTRUCTION PERIOD.
7. THE CONTRACTOR SHALL INSTALL ALL TEMPORARY AND PERMANENT STREAM CROSSINGS AS SHOWN ON THE PLANS IN ACCORDANCE WITH THE NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. THE EXISTING CHANNEL AND DITCHES ON SITE WILL REMAIN OPEN DURING THE INITIAL STAGES OF CONSTRUCTION TO ALLOW FOR DRAINAGE AND TO MAINTAIN SITE ACCESSIBILITY.
8. THE CONTRACTOR SHALL CONSTRUCT ONLY THE PORTION OF CHANNEL THAT CAN BE COMPLETED AND STABILIZED WITHIN THE SAME DAY.
9. THE CONTRACTOR SHALL APPLY TEMPORARY SEED AND MULCH TO ALL DISTURBED AREAS AT THE END OF EACH WORK DAY.
10. THE CONTRACTOR SHALL CLEAR AND GRUB AN AREA ADEQUATE TO CONSTRUCT THE STREAM CHANNEL AND GRADING OPERATIONS AFTER ALL SEDIMENTATION AND EROSION CONTROL PRACTICES HAVE BEEN INSTALLED AND APPROVED. IN GENERAL, THE CONTRACTOR SHALL WORK FROM UPSTREAM TO DOWNSTREAM AND IN-STREAM STRUCTURES AND CHANNEL FILL MATERIAL SHALL BE INSTALLED USING A PUMP-AROUND OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLANS.
11. THE CONTRACTOR WILL BEGIN CONSTRUCTION BY EXCAVATING CHANNEL FILL MATERIAL IN AREAS FOR REACH R5. THE CONTRACTOR MAY FILL DITCHES WHICH DO NOT CONTAIN ANY WATER DURING THE GRADING OPERATIONS. ALONG DITCHES WITH WATER OR STREAM REACHES, EXCAVATED MATERIAL SHOULD BE STOCKPILED IN AREAS SHOWN ON THE PLANS. IN ANY AREAS WHERE EXCAVATION DEPTHS WILL EXCEED 10 INCHES, TOPSOIL SHALL BE STOCKPILED AND PLACED BACK OVER THESE AREAS TO A DEPTH OF EIGHT INCHES TO ACHIEVE DESIGN GRADES AND CREATE A SOIL BASE FOR VEGETATION.
12. CONTRACTOR SHALL BEGIN CONSTRUCTION ON STREAM REACHES R5 AND R5A AT STATION 10+00 AND PROCEED IN A DOWNSTREAM DIRECTION UNTIL THE UPSTREAM PORTION OF REACH R4. THIS SECTION OF DESIGN CHANNEL WILL BE CONSTRUCTED OFFLINE AND IN THE DRY, SINCE IT WILL BE EXCAVATED THROUGH THE FIELD AREAS. THE CONTRACTOR SHALL EXCAVATE THE CHANNEL TO DESIGN GRADES IN ALL AREAS EXCEPT WITHIN 10 FEET OF THE TOP OF EXISTING STREAM BANKS.
13. AFTER EXCAVATING THE CHANNEL TO DESIGN GRADES, INSTALL IN-STREAM STRUCTURES, GRASSING, MATTING, AND TRANSPLANTS IN THIS SECTION, AND READY THE CHANNEL TO ACCEPT FLOW PER APPROVAL BY THE ENGINEER.
14. WATER WILL BE TURNED INTO THE CONSTRUCTED CHANNEL ONCE THE AREA IN AND AROUND THE NEW CHANNEL HAS BEEN STABILIZED. IMMEDIATELY BEGIN PLUGGING, FILLING, AND GRADING THE ABANDONED CHANNEL, AS INDICATED ON PLANS, MOVING IN A DOWNSTREAM DIRECTION TO ALLOW FOR DRAINAGE OF THE OLD CHANNELS. NO WATER SHALL BE TURNED INTO ANY SECTION OF CHANNEL PRIOR TO THE CHANNEL BEING COMPLETELY STABILIZED WITH ALL STRUCTURES INSTALLED.
15. THE NEW CHANNEL SECTIONS SHALL REMAIN OPEN ON THE DOWNSTREAM END TO ALLOW FOR DRAINAGE DURING RAIN EVENTS.
16. ANY GRADING ACTIVITIES ADJACENT TO THE STREAM CHANNEL SHALL BE COMPLETED PRIOR TO TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS. GRADING ACTIVITIES SHALL NOT BE PERFORMED WITHIN 10 FEET OF THE NEW STREAM CHANNEL BANKS. THE CONTRACTOR SHALL NOT GRADE OR ROUGHEN ANY AREAS WHERE EXCAVATION ACTIVITIES HAVE NOT BEEN COMPLETED.
17. ONCE A STREAM WORK PHASE IS COMPLETE, APPLY TEMPORARY SEEDING, PERMANENT SEEDING, AND MULCHING TO ANY AREAS DISTURBED DURING CONSTRUCTION. APPLY PERMANENT SEEDING MIXTURES, AS SHOWN ON THE VEGETATION PLAN. TEMPORARY SEEDING SHALL BE APPLIED IN ALL AREAS SUSCEPTIBLE TO EROSION (I.E. DISTURBED DITCH BANKS, STEEP SLOPES, AND SPOIL AREAS) SUCH THAT GROUND COVER IS ESTABLISHED WITHIN 15 WORKING DAYS FOLLOWING COMPLETION OF ANY PHASE OF GRADING. PERMANENT GROUND COVER SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF CONSTRUCTION.
18. CONTRACTOR SHALL IMPROVE AND CONSTRUCT THE EXISTING FARM ROAD CROSSINGS (REACH R5 NEAR STATION 24+70 AND REACH R4 NEAR STATION 52+70) BY INSTALLING PERMANENT CULVERTS AND A FORD CROSSING, STABILIZING SIDE SLOPES, AND MODIFYING THE FARM ROAD BED ELEVATIONS ACCORDING TO THE PLANS AND SPECIFICATIONS.
19. ALL DISTURBED AREAS SHOULD BE SEEDED AND MULCHED BEFORE LEAVING THE PROJECT. REMOVE TEMPORARY STREAM CROSSINGS AND ANY IN-STREAM TEMPORARY ROCK DAMS. ALL WASTE MATERIAL MUST BE REMOVED FROM THE PROJECT SITE.
20. THE CONTRACTOR SHALL TREAT AREAS OF INVASIVE SPECIES VEGETATION THROUGHOUT THE PROJECT AREA ACCORDING TO THE PLANS AND SPECIFICATIONS PRIOR TO DEMOBILIZATION.
21. THE CONTRACTOR SHALL PLANT WOODY VEGETATION AND LIVE STAKES, ACCORDING TO PLANTING DETAILS AND SPECIFICATIONS. THE CONTRACTOR SHALL COMPLETE THE REFORESTATION (BARE-ROOT PLANTING) PHASE OF THE PROJECT AND APPLY PERMANENT SEEDING AT THE APPROPRIATE TIME OF THE YEAR.
22. THE CONTRACTOR SHALL ENSURE THAT THE SITE IS FREE OF TRASH AND LEFTOVER MATERIALS PRIOR TO DEMOBILIZATION OF EQUIPMENT FROM THE SITE.

1/6/2004
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	4

PROJECT ENGINEER

Baker
Michael Baker Engineering Inc.
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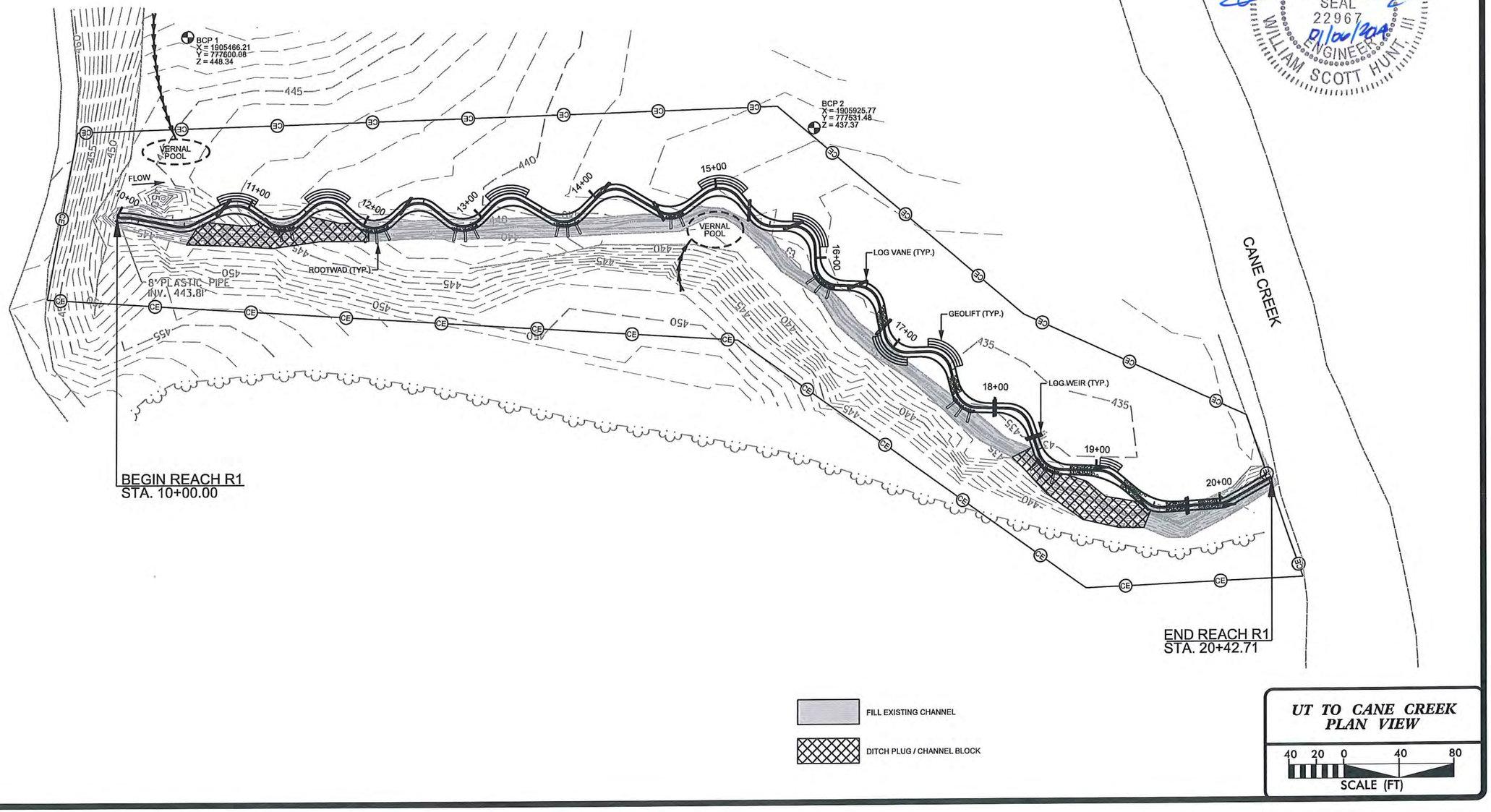
Fax: 919.463.5490
License #: F-1084

EEP ID No. 95729

NAD 83



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
9/10/2014

UT TO CANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

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6/6/2014

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	5

PROJECT ENGINEER

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EEP ID No. 95729

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/24/24

NAD 83

TIE INTO EXISTING FENCE

BEGIN REACH R5A
STA. 10+00.00

INSTALL WALK GATE (TYP.)

BCP 9
X = 1905705.3060
Y = 782379.1797
Z = 502.16

TRANSPLANTS (TYP.)

FLOW

LOG AND ROCK STEP-POOL ROLLER (TYP.)

LOG WEIR (TYP.)

GEOLIFT (TYP.)

CONSTRUCTED RIFFLE (TYP.)

ROOTWAD (TYP.)

GRADE CONTROL LOG J-HOOK (TYP.)

BCP 10

END REACH R5A
STA. 11+43.57 =
REACH R5
STA. 10+73.78

BEGIN REACH R5
STA. 10+00.00

DO NOT DISTURB EXISTING WETLANDS (TYP.)

INSTALL WOVEN FIELD FENCE (TYP.)

TIE INTO EXISTING FENCE

MATCH LINE STA 22+00
SEE SHEET 6

FILL EXISTING CHANNEL

DITCH PLUG / CHANNEL BLOCK

UT TO CANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

1/6/2014
R:\132700\Design\Plans\132700_PSH_05.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	6

PROJECT ENGINEER

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EEP ID No. 95729

NAD 83

MATCH LINE STA. 23+00
SEE SHEET 5

MATCH LINE STA. 34+50
SEE SHEET 7

INSTALL WALK GATE (TYP.)

GEOLIFT (TYP.)

INSTALL LARGE GATE AT EASEMENT CROSSING (TYP.)

ROOTWAD (TYP.)

36" RCP
INV. IN = 480.63'
INV. OUT 480.33'

INSTALL WALK GATE (TYP.)

INSTALL WOVEN FIELD FENCE (TYP.)

END REACH R5 =
BEGIN REACH R4
STA. 29+18.18

REMOVE WOODY DEBRIS AND INVASIVE SPECIES VEGETATION WITHIN CONSERVATION EASEMENT

EXISTING FARM CROSSING TO BE REMOVED
REGRADE BANKS, SLOPE, SEED, AND MAT

RESHAPE THALWEG AND SLOPE BANK 2:1, SEED AND MAT

LOG AND ROCK STEP-POOL (TYP.)

36" RCP
INV. IN = 480.97'
INV. OUT = 480.47'

INSTALL LARGE GATE AT EASEMENT CROSSING (TYP.)

CONSTRUCTED RIFFLE (TYP.)

INSTALL PERMANENT CULVERT STREAM CROSSING
REMOVE AND REUSE EXISTING CULVERTS
REINSTALL 36" (2) DIA. RCP AT FLOODPLAIN ELEVATION
INSTALL (2) 48" RCP AT 0.8 FT BELOW STREAMBED ELEV.
(SEE DETAIL SHEET 2-A)
INV. IN = 479.50'
INV. OUT = 479.10'

DO NOT DISTURB EXISTING WETLAND (TYP.)

INSTALL WOVEN FIELD FENCE (TYP.)

END REACH R3
STA. 14+05.04

GRADE CONTROL
LOG J-HOOK (TYP.)

LOG WEIR (TYP.)

BENCH LIMITS

FLOW

BCP 14
X = 1904997.1060
Y = 780896.6697
Z = 485.3887

BEGIN REACH R3
STA. 10+00.00

FILL EXISTING CHANNEL

DITCH PLUG / CHANNEL BLOCK

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
09/01/2014

UT TO CANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

I:\6\2014
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	7

PROJECT ENGINEER

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EEP ID No. 95729

NAD 83

DO NOT DISTURB EXISTING WETLAND (TYP.)

INSTALL WALK GATE (TYP.)

INSTALL WOVEN FIELD FENCE (TYP.)

BCP 9
X = 1905729.8150
Y = 780202.7025
Z = 470.7399

GEOLIFT WITH BRUSH TOE (TYP.)

LOG GRADE CONTROL J-HOOK (TYP.)

BCP 16
X = 1905875.2660
Y = 779769.5570
Z = 458.8155

INSTALL WOVEN FIELD FENCE (TYP.)

REMOVE WOODY DEBRIS AND INVASIVE SPECIES VEGETATION WITHIN CONSERVATION EASEMENT

MATCH LINE STA. 34+50 SEE SHEET 6

MATCH LINE STA. 46+50.00 SEE SHEET 8

NORTH CAROLINA PROFESSIONAL SEAL 22964 ENGINEER WILLIAM SCOTT HUNT

01/06/2004

UT TO CANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

K:\6/2004
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	8

PROJECT ENGINEER

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EEP ID No. 95729

NAD 83

MATCH LINE STA. 46+50.00
SEE SHEET 7

BCP 12
X = 1905876.2560
Y = 779372.7483
Z = 466.13

INSTALL WOVEN FIELD FENCE (TYP.)

BCP 11
X = 1905977.3990
Y = 779113.3505
Z = 452.89

INSTALL WALK GATE (TYP.)

INSTALL LARGE GATE AT EASEMENT CROSSING (TYP.)

INSTALL PERMANENT FORD STREAM CROSSING

CANE CREEK

BENCH LIMITS

CONSTRUCTED RIFFLE (TYP.)

GRADE CONTROL LOG J-HOOK (TYP.)

LOG VANE (TYP.)

GEOLIFT (TYP.)

END REACH R4
STA. 57+15.18

INSTALL LARGE GATE AT EASEMENT CROSSING (TYP.)

INSTALL WALK GATE (TYP.)

INSTALL WOVEN FIELD FENCE (TYP.)

FILL EXISTING CHANNEL

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
11/21/2003

UT TO CANE CREEK
PLAN VIEW

40 20 0 40 80
SCALE (FT)

1/6/2004
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BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	9

PROJECT ENGINEER

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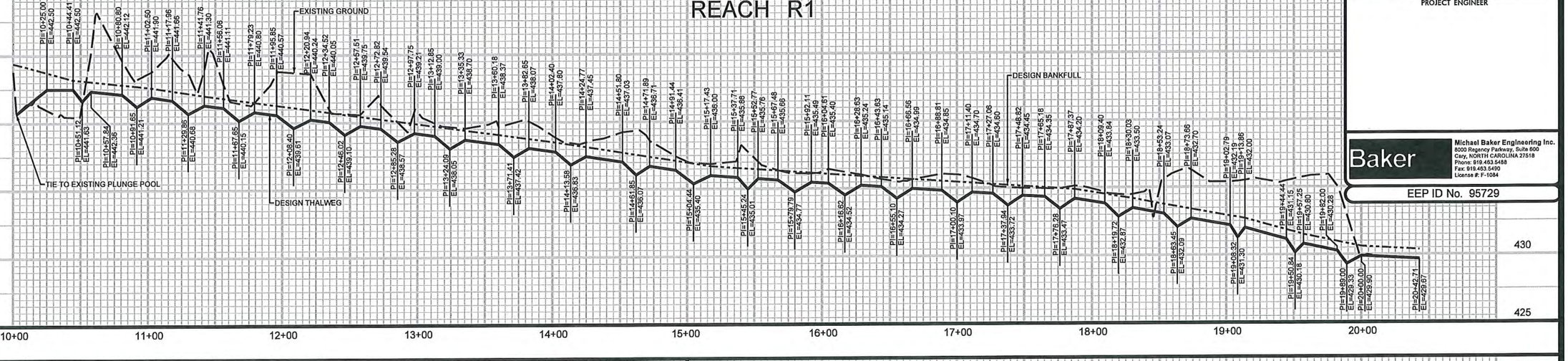
License #: F-1084

EEP ID No. 95729

REACH R1



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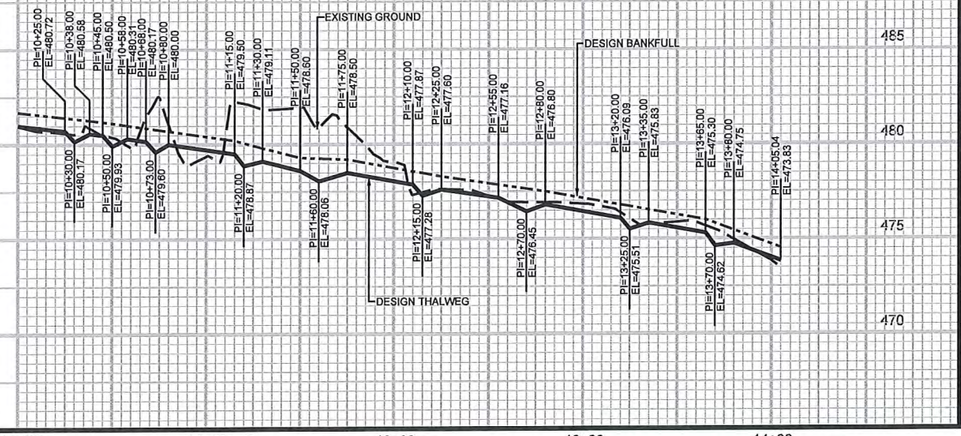

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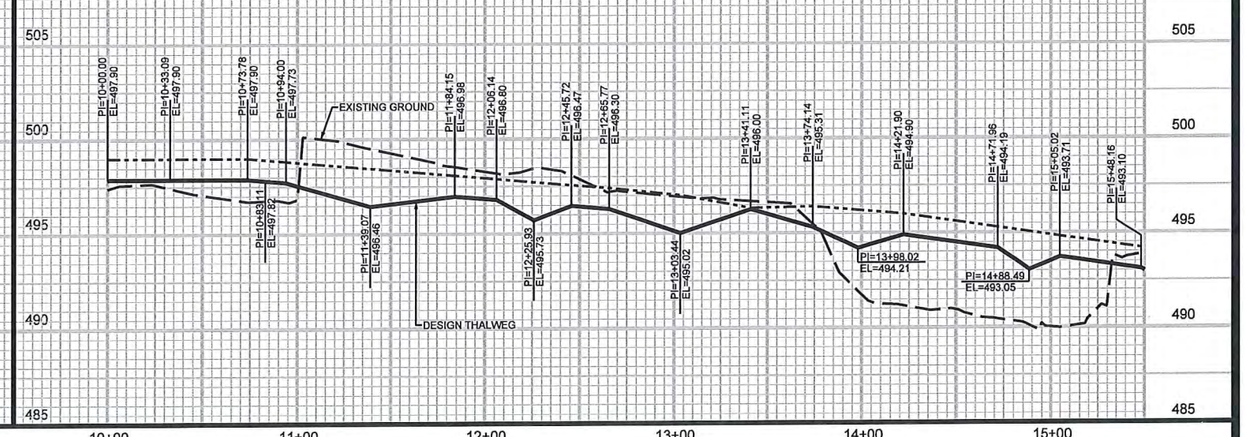

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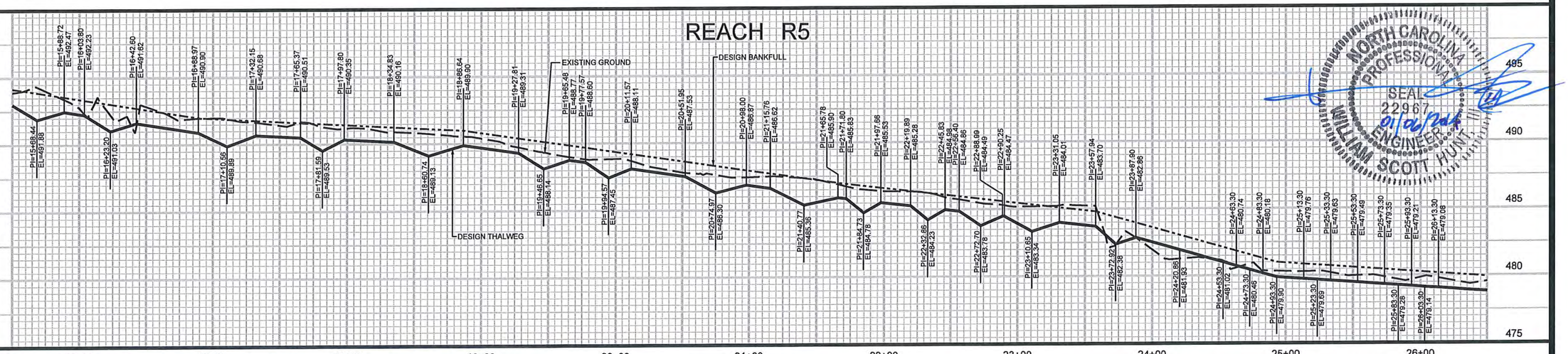

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT

01/06/2014

2/26/03

1/6/2014
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BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	10

PROJECT ENGINEER

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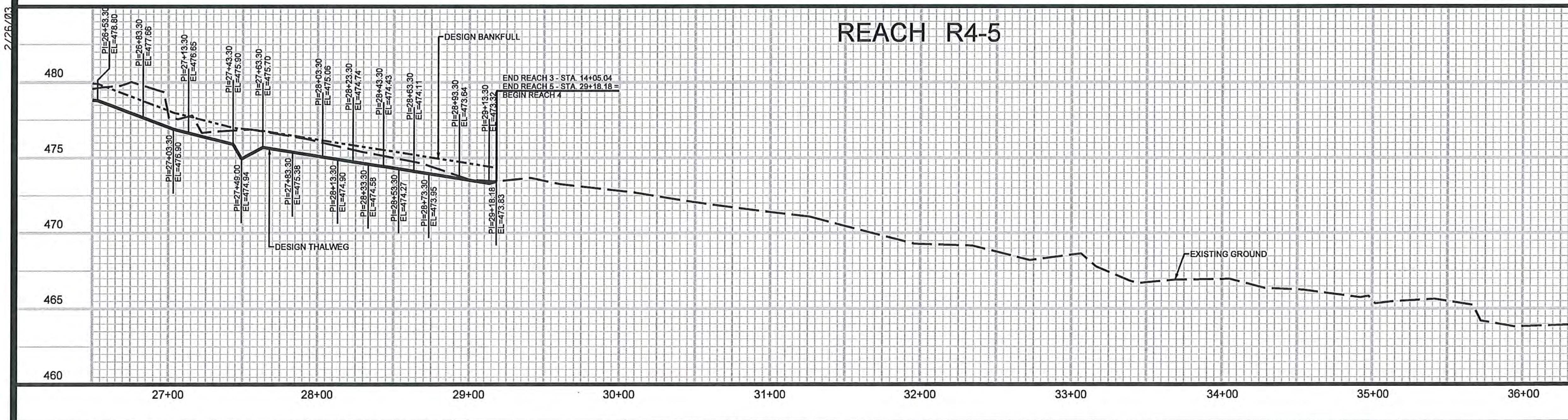
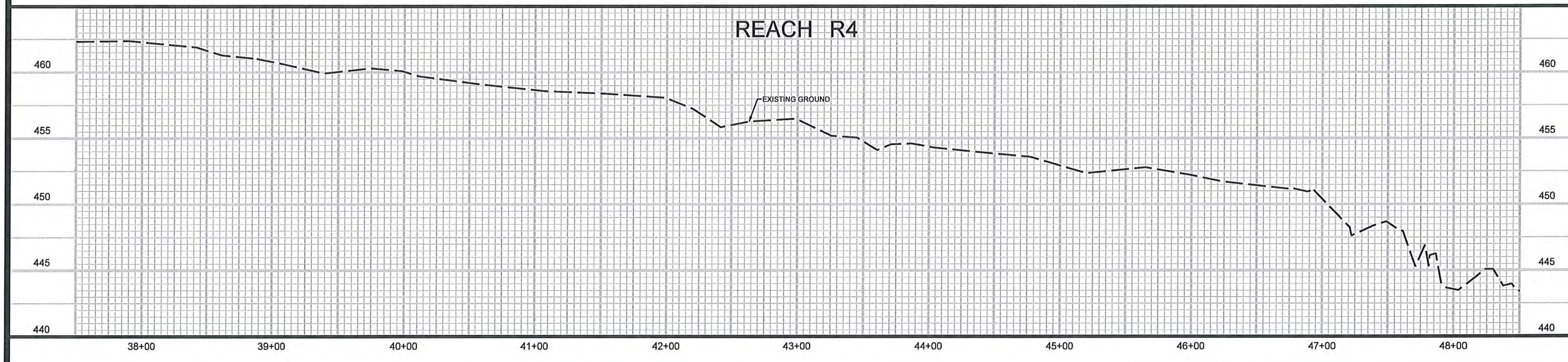
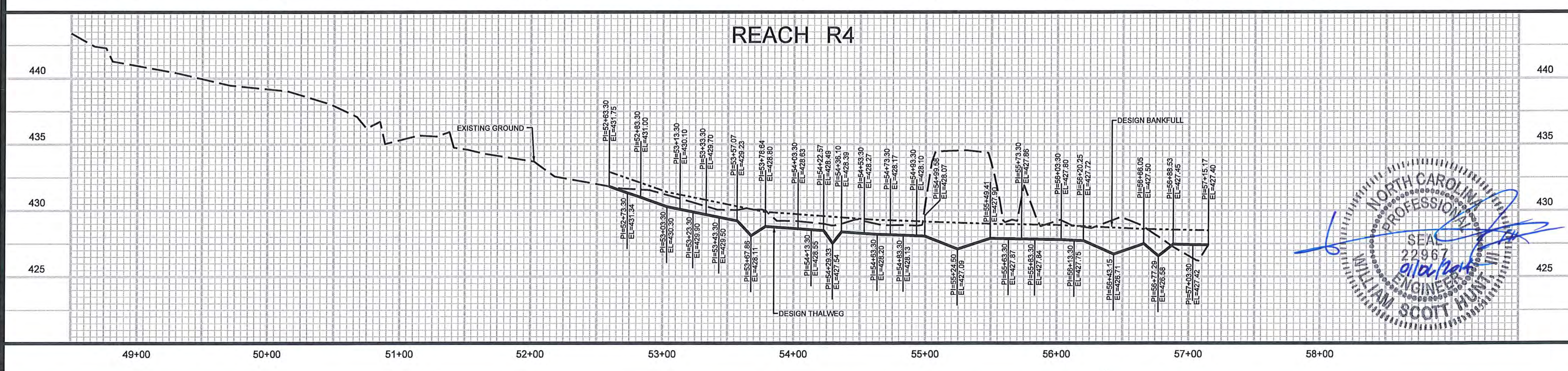


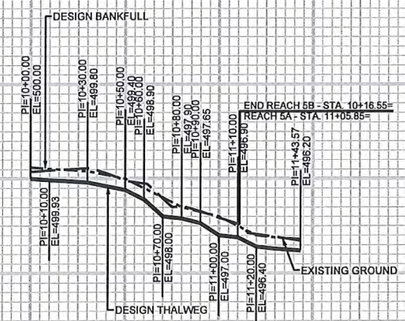




NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT III

2/26/03

REACH R5A



510
505
500
495
490

10+00
11+00
12+00

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	11

PROJECT ENGINEER

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

01/06/2014

1/6/2014
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	12

PROJECT ENGINEER

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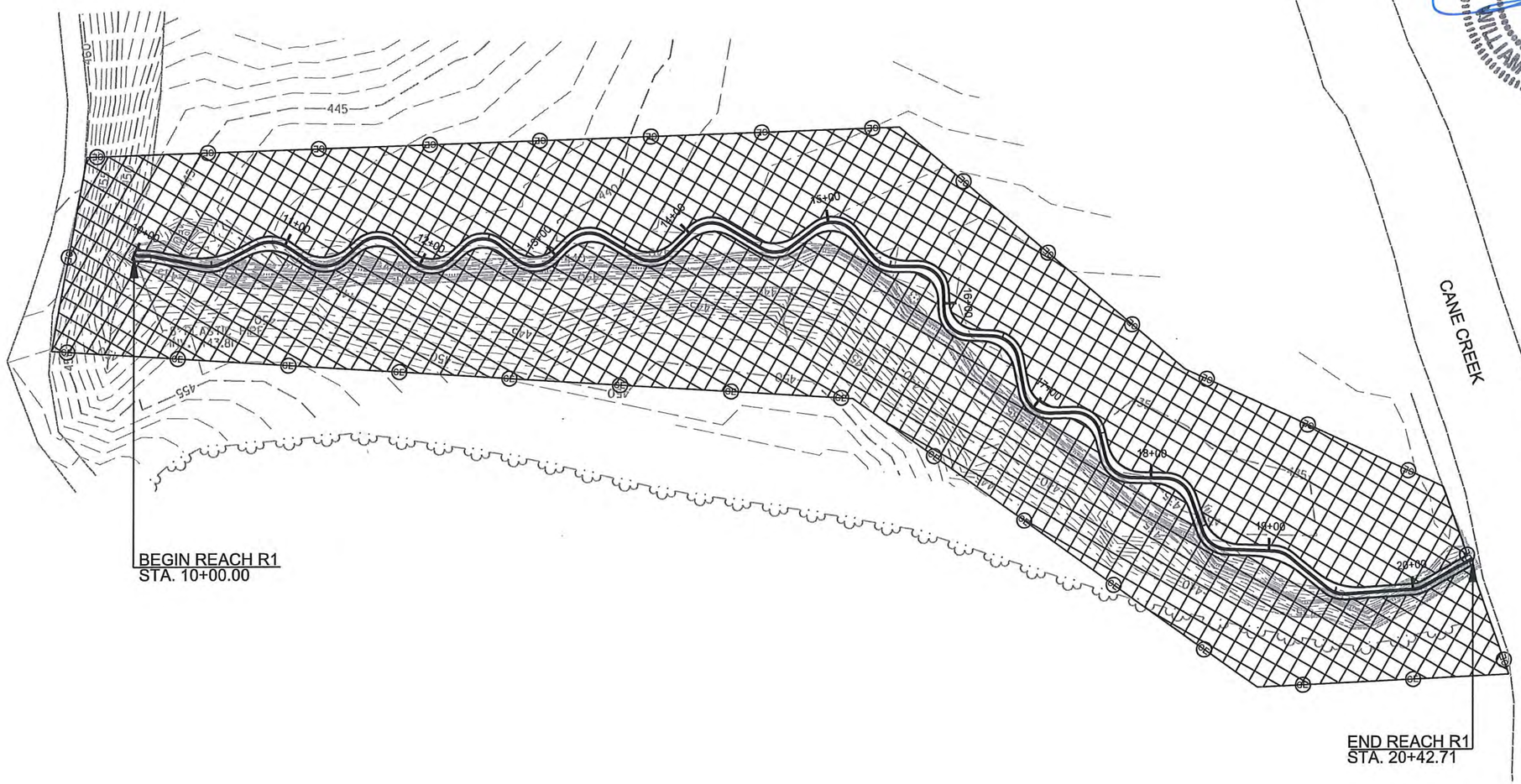
EEP ID No. 95729

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/06/04

NAD 83



RIPARIAN BUFFER PLANTING = APPROX. 14.0 AC.

NOTE:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT TO CANE CREEK VEGETATION PLAN

40 20 0 40 80
SCALE (FT)

1/5/2004
K:\132700\Design\Plans\132700_PSH_12.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	13

PROJECT ENGINEER

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EEP ID No. 95729

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/06/2014

NAD 83

BEGIN REACH R5A
STA. 10+00.00

BEGIN REACH R5
STA. 10+00.00

END REACH R5A
STA. 11+43.57 =
REACH R5
STA. 10+73.78

MATCH LINE STA. 22+00
SEE SHEET 14

RIPARIAN BUFFER PLANTING = APPROX. 14.0 AC.

NOTE:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT TO CANE CREEK
VEGETATION PLAN

40 20 0 40 80
SCALE (FT)

1/6/2014
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	14

PROJECT ENGINEER

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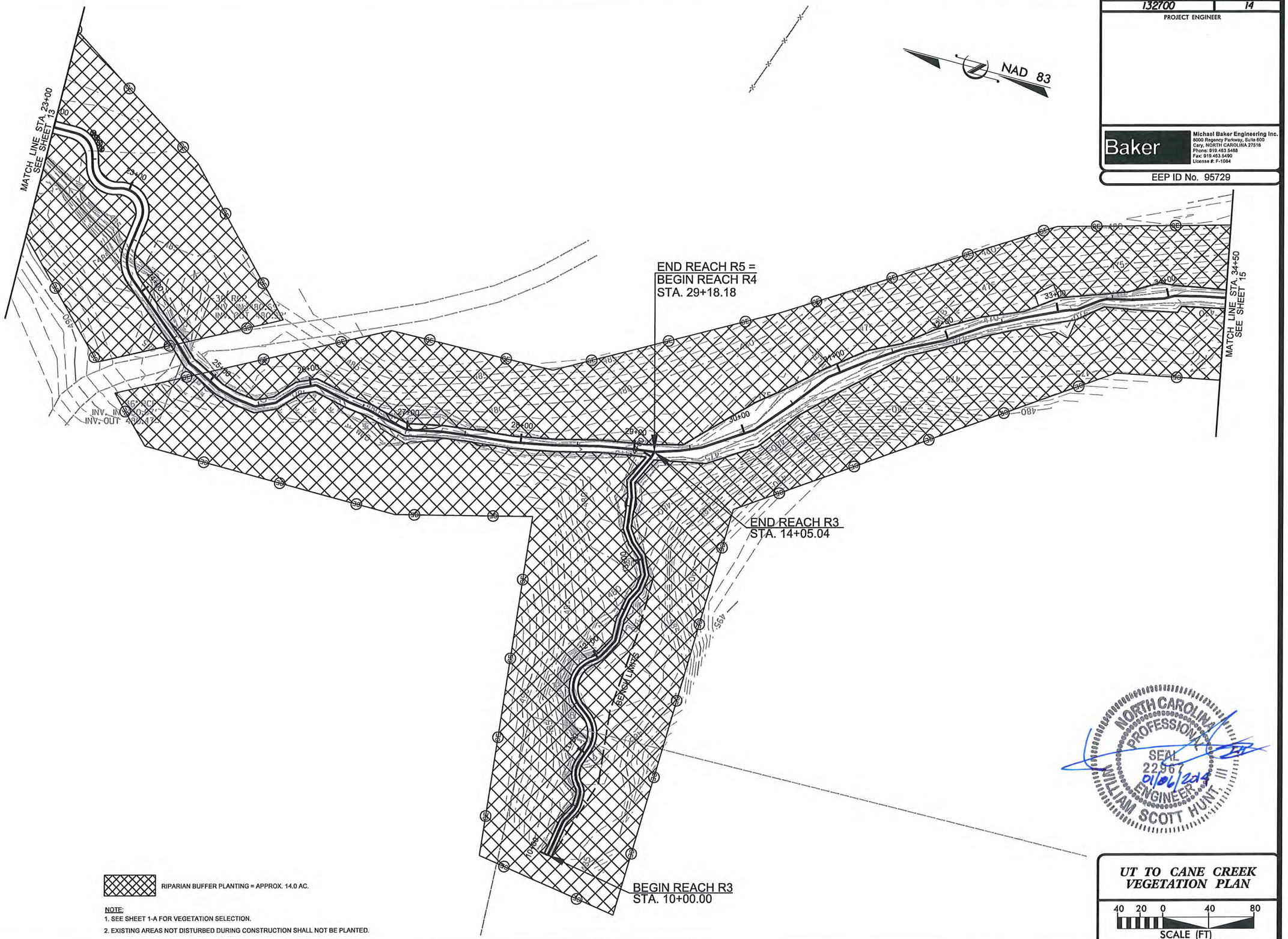
EEP ID No. 95729



RIPARIAN BUFFER PLANTING = APPROX. 14.0 AC.

NOTE:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
01/06/2004

UT TO CANE CREEK VEGETATION PLAN

40 20 0 40 80
SCALE (FT)

1/6/2004
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2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	15

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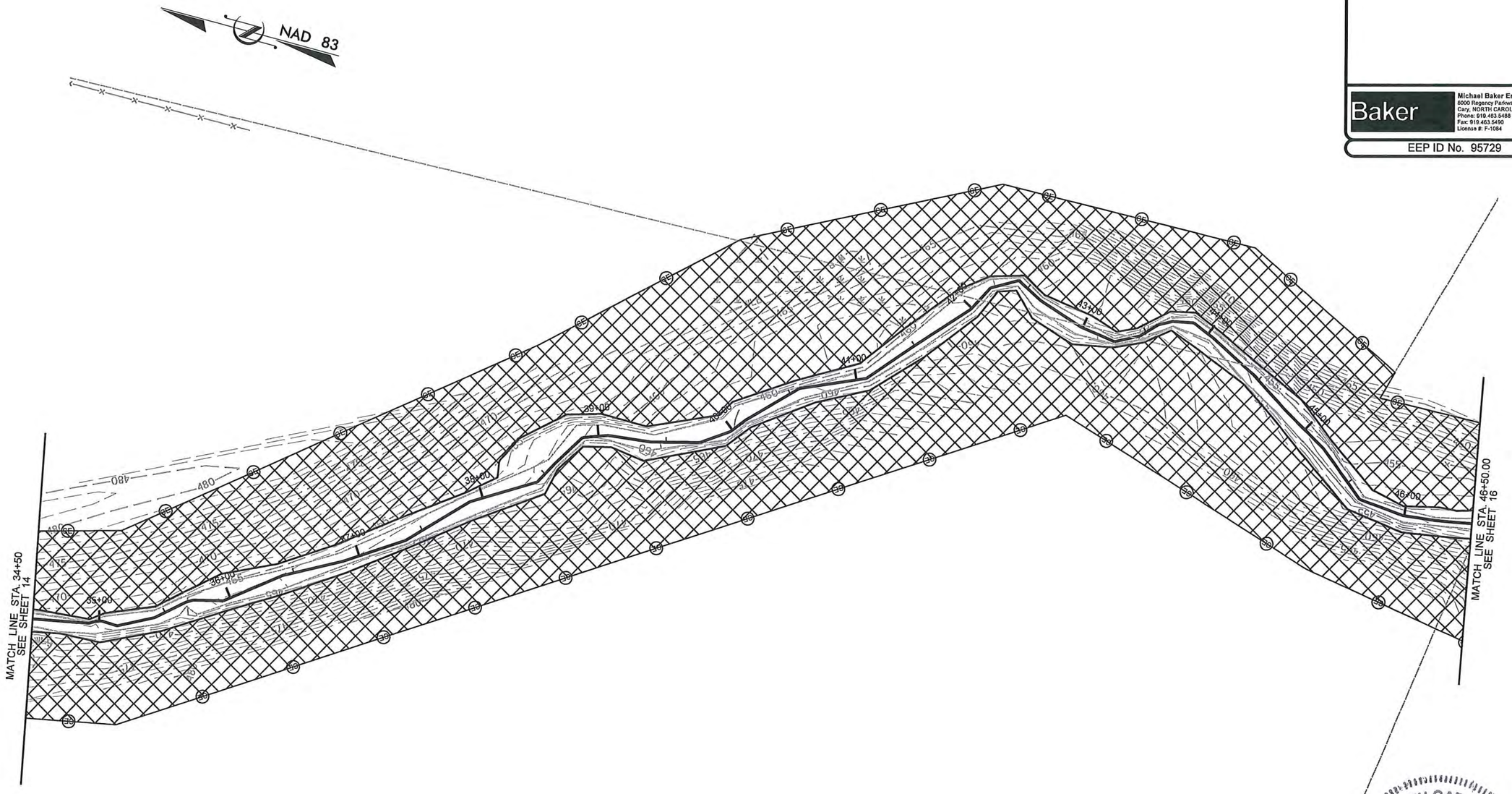
EEP ID No. 95729

NAD 83



NORTH CAROLINA PROFESSIONAL SEAL 2296 ENGINEER WILLIAM SCOTT HUNT, III
01/06/2014

RIPARIAN BUFFER PLANTING = APPROX. 14.0 AC.

NOTE:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT TO CANE CREEK VEGETATION PLAN

40 20 0 40 80
SCALE (FT)

K:\2014\132700\Design\Plans\132700_PSH_15.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
132700	16

PROJECT ENGINEER

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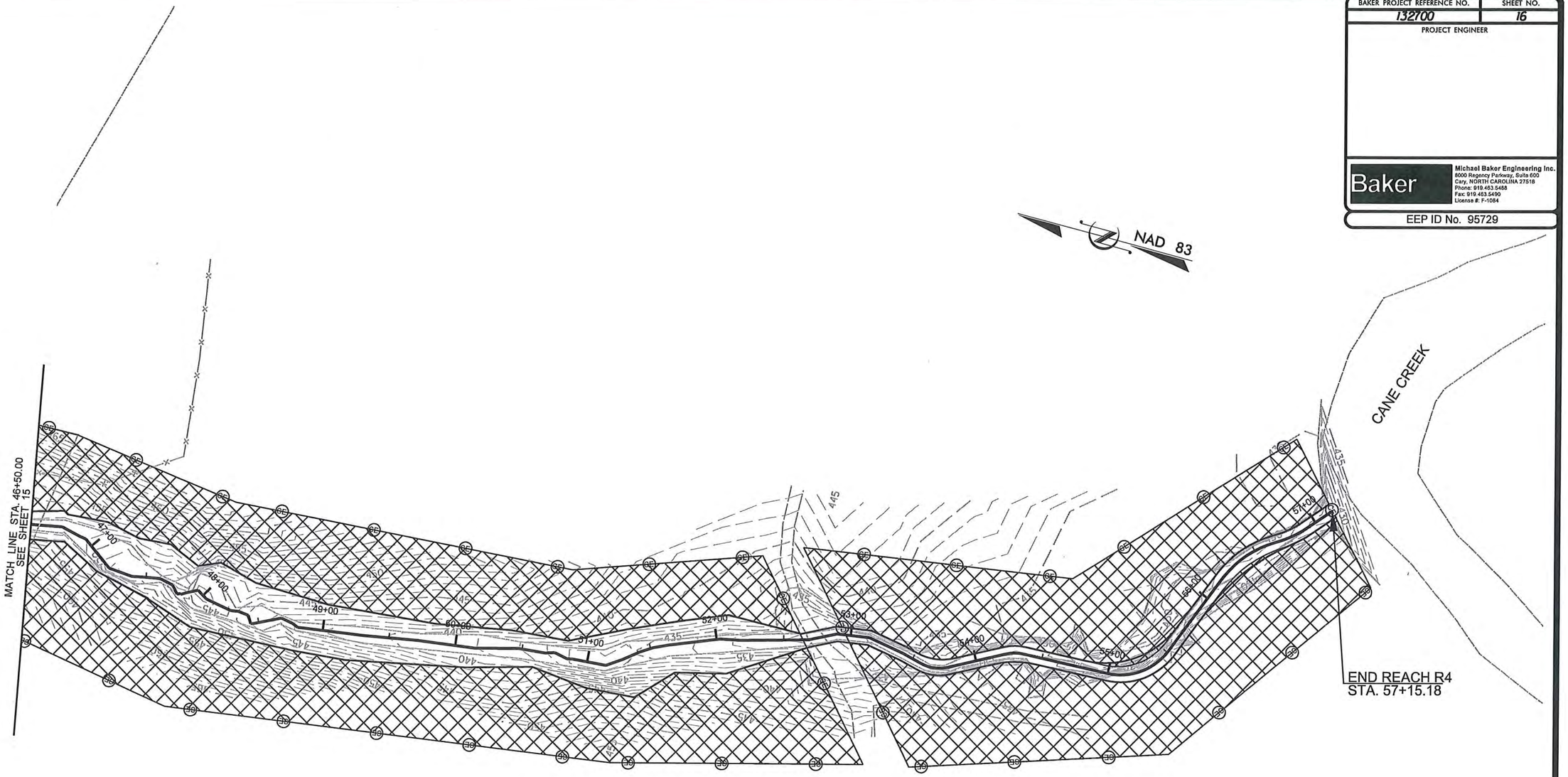
EEP ID No. 95729

NAD 83



NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
9/06/04

RIPARIAN BUFFER PLANTING = APPROX. 14.0 AC.

NOTE:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT TO CANE CREEK VEGETATION PLAN

40 20 0 40 80
SCALE (FT)

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