MITIGATION PLAN

Bear Creek Restoration Project
(Phillips Site)
Chatham County, North Carolina
EEP ID #26
DENR Contract D09050S
SCO Project Number: 090772601

Cape Fear River Basin
HUC 03030003

Prepared for:

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

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June 22, 2011

EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) proposes to restore 4,082 linear feet (LF) of perennial stream in Chatham County, NC (Table ES.1). The streams proposed for restoration include Bear Creek, a third order stream, as well as an unnamed second order tributary to Bear Creek (UT). The project is being completed to provide stream mitigation units (SMUs) in the Cape Fear River Basin. Buffer restoration will also take place but is not intended for mitigation credit at this time. The project streams ultimately flow into the Rocky River which is part of the Cape Fear River Basin.

Table ES.1 Project Components
Bear Creek Restoration Project

Project Reach	Existing Length (LF)	Mitigation Level	Approach	Proposed Length (LF)
Bear Creek Reach A	859	Restoration	Priority 2	966
Bear Creek Reach B	1050	Restoration	Priority 2	1,179
UT to Bear Creek	1,857	Restoration	Priority 1	1,937

Note: Easement breaks for stream crossings have been excluded from restoration lengths.

The Bear Creek Restoration Project is located in the Upper and Middle Rocky River Local Watershed planning area (http://www.nceep.net/services/lwps/Rocky_Cape_Fear/Summary_of_Findings_and_RecommendationsUpperRocky_CapeFear_.pdf). The Project Site's watershed includes Hydrologic Unit Code (HUC) 03030003070050 which was identified as a Targeted Local Watershed in NCEEP's 2009 Cape Fear River Basin Restoration Priority (RBRP) plan (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf). The Local Watershed Plan (LWP) identified the following major stressors in the watershed: nutrient loading from farming and urban runoff and sediment loading from overland runoff and streambank erosion. Specifically, cattle access to streams and insufficient bank vegetation were identified as prime causes of streambank erosion in the watershed. The LWP identified the Bear Creek as a stream restoration opportunity with the potential to improve water quality and habitat within the watershed.

The proposed project will provide numerous ecological benefits within the Cape Fear River Basin. While many of these benefits are limited to the Bear Creek project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat have more far-reaching effects. The design will not result in adverse impacts to wetlands.

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.

Bear Creek Restoration Project
(Phillips Site)
Mitigation Plan

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1.0 Restoration Project Goals and Objectives

The Bear Creek Restoration Project is located in the Upper and Middle Rocky River Local Watershed planning area (http://www.nceep.net/services/lwps/Rocky_Cape_Fear/ Summary_of_Findings_and_ RecommendationsUpperRocky_CapeFear_.pdf). The Project Site's watershed includes Hydrologic Unit Code (HUC) 03030003070050 which was identified as a Targeted Local Watershed in NCEEP's 2009 Cape Fear River Basin Restoration Priority (RBRP) plan (http://www.nceep.net/services/lwps/cape_fear/ RBRP%20Cape%20Fear%202008.pdf) and is identified in the Upper Rocky River Local Watershed Plan Detailed Assessment and Targeting of Management Report (http://www.nceep.net/services/lwps/ Rocky_Cape_Fear/Rocky_River_ DATMR_Final_6-27-05.pdf.).

EEP developed a local watershed plan (LWP) for the 177-square mile drainage area that included land use analysis, water quality monitoring and stakeholder input to identify problems with water quality, habitat and hydrology. The Bear Creek watershed is characterized as primarily forested and agricultural and has a history of sediment loading problems from overland runoff, disturbed and bare surfaces, and stream bank erosion. EEP completed the Upper Rocky River LWP in June 2005 (http://www.nceep.net/services/lwps/ Rocky_Cape_Fear/Rocky_River_ DATMR_Final_6-27-05.pdf.).

The Upper Rocky River LWP identified the following major stressors in the watershed: nutrient loading from farming and urban runoff and sediment loading from overland runoff and stream bank erosion. Specifically, cattle access to streams and insufficient bank vegetation were identified as prime causes of streambank erosion in the watershed. The LWP identified the Bear Creek Project as a stream restoration opportunity with the potential to improve water quality and habitat within the Upper Rocky River watershed.

The goals of the Bear Creek Restoration Project address stressors identified in the LWP and include the following:

- Remove harmful nutrients from creek flow;
- Reduce pollution of creek by excess sediment;
- Improve stream bank stability;
- Increase dissolved oxygen concentrations;
- Improve in-stream habitat;
- Restore terrestrial habitat; and
- Improve aesthetics.

The project goals will be addressed through the following project objectives:

- Cattle will be removed from streams and runoff will be filtered through buffer zones. Flood flows will be filtered through restored floodplain areas, where flood flow will spread through native vegetation. Vegetation uptakes excess nutrients.
- Stream bank erosion which contributes sediment load to the creek will be greatly reduced, if not eliminated in the project area. Eroding streambanks will be stabilized by increased woody root mass in banks and reducing channel incision. Storm flow containing grit and fine sediment will be filtered through restored floodplain areas, where flow will spread through native vegetation. The spreading flood flows will reduce velocity, allowing sediment to settle out.
- Eroding streambanks will be stabilized using bioengineering, natural channel design techniques, and grading to reduce bank angles and bank height.
- In-stream structures will promote aeration of water.
- In-stream structures will be constructed to improve habitat diversity and trap detritus. Wood structures will be incorporated into the stream as part of the restoration design. Such structures may include log drops and rock structures that incorporate woody debris.

- Adjacent buffer and riparian habitats will be restored with native vegetation as part of the project. Native vegetation will provide cover and food for terrestrial creatures.
- Native plant species will be planted, invasive species will be treated, and eroding and unstable areas will be stabilized as part of this project.

2.0 Site Selection

2.1 Directions

The proposed Bear Creek Restoration Project is located off of Siler City-Glendon Road (SR1006) in the southwest portion of Chatham County, NC. The site is approximately 2.3 miles north of NC Highway 902 at Harpers Crossroads. The proposed project is located in an active cattle pasture surrounded by woods and small agricultural operations.

2.2 Site Selection

The North Carolina Ecosystem Enhancement Program (NCEEP) proposes to restore 4,082 linear feet (LF) of perennial stream in Chatham County, NC. The streams proposed for restoration include Bear Creek, a third order stream, as well as an unnamed second order tributary to Bear Creek (UT). The project is being completed to provide stream mitigation units (SMUs) in the Cape Fear River Basin. Buffer restoration will also take place but is not intended for mitigation credit at this time. The project design will cause no adverse impacts to wetlands. The project streams ultimately flow into the Rocky River which is part of the Cape Fear River Basin.

The Bear Creek (Phillips) project site was originally identified for its restoration potential by the North Carolina Department of Transportation (NCDOT) on the Phillips property. A preliminary Stream Mitigation Plan was prepared for the site in January 2003 and a conservation easement was acquired on the project area by NCDOT in 2006 (Appendix A). The restoration design was never finalized and no restoration efforts have occurred on the site to date.

2.3 Vicinity Map

Bear Creek is located within the Deep River watershed (NCDWQ Subbasin 03-06-12) of the Cape Fear River Basin (USGS Hydrologic Unit Code 03030003070050) as shown in Figure 1. The North Carolina Division of Water Quality (NCDWQ) assigns best usage classifications to State Waters that reflect water quality conditions and potential resource usage. Bear Creek (NCDWQ Index No. 17-43-16) is the main tributary of the project and has been classified as Class C waters. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses. See Figure 1 for the Vicinity Map of the Bear Creek Restoration Project.

2.4 Watershed Map

The Bear Creek watershed is located in a rural area of Chatham County in the Cape Fear River Basin as shown in Figure 2. At the downstream limits of the project, the drainage area is 3,196 acres (5.0 square miles). The drainage area of each of the three project reaches is included in Table 1.

Table 1. Drainage Areas
Bear Creek Restoration Project

Project Reach	Existing Length (LF)	Drainage Area (acres)	Drainage Area (square miles)
Bear Creek Reach A	859	2,610	4.1
Bear Creek Reach B	1,050	3,196	5.0
UT to Bear Creek	1,857	565	0.9

2.5 Soil Survey

Soil mapping units are based on the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soil Survey for Chatham County. Soil types within the study area include Riverview (RvA), Callison-Lignum complex (CaB), and Callison-Misenheimer complex (CbC) as shown in Figure 3. Riverview soils are well-drained, found mainly in the floodplains of major rivers and streams, and exhibit moderate permeability and slow surface runoff. Callison-Lignum complex soils are found on ridges, broad inter-stream divides, drainage ways, and heads of drainage ways. The Callison portion of this complex exhibits moderately slow permeability, while Lignum soils have a very slow permeability. The overall Callison-Lignum complex is somewhat poorly to moderately well-drained. Callison-Misenheimer complex soils are found on ridges, broad inter-stream divides, drainage ways, and heads of drainage ways. The Misenheimer portion of this complex exhibits moderately rapid permeability, while the overall complex is somewhat poorly to moderately well-drained with medium surface runoff. Riverview, Callison-Lignum complex, and Callison-Misenheimer complex soil types are listed on the 2010 NRCS Hydric Soils list for Chatham County as having minor inclusions of hydric soils.

2.6 Current Condition Plan View

On September 25, 2009, WEI investigated on-site jurisdictional waters of the U.S. using the U.S. Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the 1987 Corps of Engineers Wetlands Delineation Manual. Determination methods included stream classification utilizing the NCDWQ Stream Identification Form and the USACE Stream Quality Assessment Worksheet. Potential jurisdictional wetland areas as well as typical upland areas were classified using the USACE Routine Wetland Determination Data Form. All USACE forms are included in Appendix B.

The results of the on-site field investigation indicate that there are three jurisdictional stream channels located within the proposed project area: Bear Creek and two unnamed tributaries (UT) (Figure 4). No jurisdictional wetland areas were identified within the proposed project area. Bear Creek and UT to Bear Creek were determined to be perennial streams. The second UT was determined to be intermittent. All NCDWQ Stream Classification Forms are included in Appendix B.

2.7 Historical Condition Plan View

Specifically, the Bear Creek Site has historically been forested or used for agricultural purposes. Historic aerial photos are included in Appendix B. Currently, the UT to Bear Creek watershed originates in a wooded headwater area and the channel flows through agricultural pasture. The headwaters of the Bear Creek watershed are a combination of agricultural and forested. According to the NCEEP 2005 Upper Rocky River Local Watershed Plan one of the primary stressors in the watershed was determined to be sediment loading from overland runoff, disturbed and bare surfaces, and stream bank erosion. Cattle access to streams and insufficient bank vegetation were cited as the primary causes of stream bank erosion in the watershed.

2.8 Site Photographs

See Appendix B for site photographs of the Bear Creek Restoration Project.

3.0 Site Protection Instrument

3.1 Site Protection Instruments Summary Information

The land required for construction, management, and stewardship of the mitigation project includes portions of the parcel(s) listed in Table 2. A copy of the land protection instrument is included in the Appendix A.

Table 2. Site Protection Instrument
Bear Creek Restoration Project

Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Number	Acreage Protected
Ina Jane and Gary Phillips	8667-03-0364	Chatham	Conservation Easement	01279 / 0470	14.42*

*The recorded conservation easement is proposed to be modified to provide a full 50-foot-wide buffer at all points along the restoration project.

All site protection instruments require 60-day advance notification to the Corps and the State prior to any action to void, amend, or modify the document. No such action shall take place unless approved by the State.

3.2 Site Protection Instrument Figure

See Figure 5 for the Site Protection Instrument Figure for the Bear Creek Restoration Project.

4.0 Baseline Information

Table 3 summarizes the attributes of the overall project and of the project reaches.

Table 3. Baseline Information
Bear Creek Restoration Project

Project Information	
Project Name	Bear Creek Restoration Project
County	Chatham County
Project Area (acres)	15.5*
Project Coordinates (latitude and longitude)	35° 36' 3.353"N, 79° 28' 4.711"W
Project Watershed Summary Information	
Physiographic Province	Carolina Slate Belt of the Piedmont
River Basin	Cape Fear
USGS Hydrologic Unit 8-digit	03030003
USGS Hydrologic Unit 14-digit	03030003070050
DWQ Sub-basin	Deep River Watershed, 03-06-12
Project Drainage Area (acres)	3,761
Project Drainage Area Percentage of Impervious Area	<1%
CGIA Land Use Classification	70% Forest Land and 30% Cultivated Land

Reach Summary Information			
Parameters	**Bear Creek Reach A**	**Bear Creek Reach B**	**UT to Bear Creek**
Length of reach (linear feet)	966	1,179	1,937
Valley classification	VIII	VIII	VIII
Drainage area (acres)	2,610	3,196	565
NCDWQ stream identification score	37.5	38	33.25
NCDWQ Water Quality Classification	C	C	C
Morphological Description (stream type)	Perennial	Perennial	Perennial
Evolutionary trend	Stage IV	Stage IV	Stage II to III
Underlying mapped soils	Callison-Lignum complex 2-6% slopes (CaB)	Riverview silt loam 0-3% slopes (RvA)	Callison-Misenheimer complex 6-10% slopes (CbC)
Drainage class	moderately well drained	well drained	moderately well drained
Soil Hydric status	No	No	No
Slope	0.0036	0.0018	0.0043
FEMA classfication	Zone AE	Zone AE	no regulated floodplain
Native vegetation community	Pasture	Bottomland forest	Pasture
Percent composition of exotic invasive vegetation	10%	10%	10%
Wetland Summary Information			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)	N/A	N/A	N/A
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	N/A	N/A	N/A
Mapped Soil Series	N/A	N/A	N/A
Drainage class	N/A	N/A	N/A
Soil Hydric status	N/A	N/A	N/A
Source of Hydrology	N/A	N/A	N/A
Hydrologic Impairment	N/A	N/A	N/A
Native vegetation community	N/A	N/A	N/A
Percent composition of exotic invasive vegetation	N/A	N/A	N/A
Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States - Section 404	X		
Waters of the United States - Section 401	X		

Endangered Species Act	X	X	See Appendix B
Historic Preservation Act	X	X	See Appendix B
Coastal Zone Management Act (CZMA) / Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	X		No rise certification to be completed.
Essential Fisheries Habitat	N/A	N/A	N/A

*A conservation easement has been recorded, but is proposed to be modified along Reach B. The larger number represents the easement modification.

4.1 Watershed Summary Information

Bear Creek is located within the Deep River watershed (NCDWQ Subbasin 03-06-12) of the Cape Fear River Basin (USGS Hydrologic Unit Code 03030003070050). Land use within the watershed is historically rural and is dominated by forestry, agriculture and livestock with approximately 70% of the watershed forested and 30% used for agriculture (Figure 2). While development is occurring in Chatham County along the US Highway 64 corridor between Siler City and Pittsboro, there is no evidence of increased development pressure in the Bear Creek watershed which is located approximately eight miles south of Siler City.

NCEEP developed a local watershed plan (LWP) for the Upper and Middle Rocky River Watershed that included land use analysis, water quality monitoring, and stakeholder input to identify problems with water quality, habitat, and hydrology. The 177-square mile watershed is characterized as primarily forested, but has a history of water quality problems due to agricultural and urban point source issues. NCEEP completed the Upper and Middle Rocky River LWP in June 2005 (http://www.nceep.net/services/lwps/Rocky_Cape_Fear/Rocky_River_ DATMR_ Final_6-27-05.pdf). The LWP identified the following major stressors in the watershed: nutrient loading from farming and urban runoff and sediment loading from overland runoff and streambank erosion. Specifically, cattle access to streams and insufficient bank vegetation were identified as prime causes of streambank erosion in the watershed. The LWP identified the Bear Creek as a stream restoration opportunity with the potential to improve water quality and habitat within the Rocky River watershed.

NCEEP also develops River Basin Restoration Priorities (RBRP) to guide its restoration activities within each of the state's 54 cataloging units. RBRPs delineate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds are called Targeted Local Watersheds (TLWs) and receive priority for NCEEP planning and restoration project funds. The 2009 Cape Fear River Basin RBRP identified HUC 03030003070050 and the Bear Creek Restoration Project site located within that HUC. The restoration of Bear Creek and its tributary will address the water quality issues identified in the RBRP and LWP by increasing bank stability, reducing erosion, and eliminating a direct nutrient source to the stream by excluding livestock from the stream.

4.2 Reach Summary Information

The existing conditions data were collected by HDR and Buck Engineering in 2003, and NCDOT in 2009.

Bear Creek has likely been historically channelized and straightened for agricultural purposes. Cattle access to the upstream portion of the channel (Reach A) has resulted in wide, trampled

banks. This reach is incised vertically and is also over-wide. Reach B of Bear Creek is more incised than Reach A. Tall, vertical banks on Reach B have limited cattle access to a few locations.

UT to Bear Creek has been straightened and cleared of bank vegetation. This is a small channel and cattle have continuous and unlimited access. Extensive bank trampling has led to an over-side channel section. Due to its small size, low flow rate, and gradual slope, the upstream portion of the channel has not incised vertically or worked to re-establish pattern horizontally. The downstream portion of the tributary between Siler City-Glendon Road and the confluence with Bear Creek has incised to meet the lower elevation of Bear Creek.

4.2.1 Channel Classification

Bear Creek Reach A classifies as a straightened Rosgen C4 stream. The channel is located in a wide valley and is not extremely incised, and so the entrenchment ratio is more than 2.2. Excess stream energy and cattle trampling has resulted in moderate vertical incision and widened banks. The shallow depth and wide banks provides a width-to-depth ratio close to 12. The channel has been maintained and straightened, so sinuosity cannot be used for classification. The bed material appears to be a bi-modal distribution dominated by large boulders as well as a small-grain fraction, rather than a dominant gravel substrate.

Bear Creek Reach B classifies as a Rosgen G4 stream. Reach B is more incised than Reach A, leading to a higher bank height ratios and lower entrenchment ratios. This reach is deeper and not as wide as Reach A, with a width-to-depth ratio close to 10. The channel has been maintained and not allowed to freely form its own pattern, so sinuosity cannot be used for classification. Like Reach A, there is a bi-modal sediment distribution of very large and very small particles.

UT to Bear Creek classifies as a straightened Rosgen E4 stream, with a low width-to-depth ratio and a high entrenchment ratio with extensive floodplain access. The reach has been channelized and straightened, so sinuosity cannot be used for classification. The channel contains sediment with a median diameter in the gravel fraction.

4.2.2 Valley Classification

The project reaches are located in a surrounding fluvial and morphological landform classified as Valley Type VIII (Rosgen, 1996). Alluvial terraces and broad floodplains are typically the predominant depositional features for this valley type. Slightly entrenched and meandering Rosgen C or E channels are the typical stream types found in Type VIII valleys, in addition to D, F, and G stream types (Rosgen, 1996).

4.2.3 Discharge

Several methods were used to evaluate bankfull discharge at the site. USGS regression equations were used to estimate a 2-year flow and to extrapolate a 1.2-year recurrence interval flow. Manning's equation was used to estimate a bankfull discharge with the existing cross-section dimensions. These estimations were plotted with the regional curve data to show the range of discharge estimations as shown in Figure 6. For the design, a bankfull discharge of 230 cfs was chosen for Reach A; 280 cfs was selected for Reach B; and 70 cfs for UT to Bear Creek.

4.2.4 Channel Morphology

Overall, Reach A of Bear Creek is over-wide in some locations, but not extremely vertically incised. Bank height ratios typically range from 1.1 to 1.4. Cattle trampling has destabilized the banks. The riparian buffer is narrow, typically a row of brushy growth with pasture extending across the floodplain. Baseflow appears to run subsurface through sediment deposits in some locations. The channel slope is fairly flat and flow is stagnant in many pools.

Reach B of Bear Creek has a larger cross-section and is more incised than Reach A, with bank height ratios typically between 1.2 and 1.8. Tall, vertical banks prevent cattle access except at a few locations. Several large trees that were located on the banks have now fallen into the channel. The left floodplain is pasture; the right floodplain is a wooded area. Few distinct riffles are present; the reach is primarily comprised of runs and stagnant pools.

UT to Bear Creek is a small channel draining through a pasture. The UT crosses under Siler City- Glendon Road via a CMP elliptical culvert. 1,497 LF of the UT is located upstream of the culvert and 360 LF is located downstream. The channel lacks distinct riffle and pool features; bed and banks have been continuously trampled by cattle.

4.2.5 Channel Evolution

Bear Creek Reach A is currently in Stage IV of Simon's channel evolution model, illustrated in Figure 7. The channel is being widened by flow and cattle trampling of the banks. The channel has historically been straightened; this maintenance of a straight-line channel has steepened the channel such that sediment transport calculations indicate the existing condition slope is steeper than needed to move the sediment load. This indicates that the channel is continuing to degrade. There is no evidence that aggradation indicative of Stage V is starting to occur. Removal of cattle and restoration of a woody vegetated buffer will help to stabilize the channel. Construction of a stable cross-section and meandering pattern is needed to reduce channel slope and allow energy to be dissipated through meander bends.

Bear Creek Reach B is currently in Stage IV also. Reach B has incised vertically as well as widened. There is little indication of aggradation in this reach, indicating that the channel has not progressed to Stage V.

UT to Bear Creek has been continuously trampled and disturbed, and is in Stage II to III of the Simon evolution model. The portion of the channel upstream of Siler City-Glendon Road is not extremely vertically incised, but lacks channel habitat diversity and bank-stabilizing vegetation. The downstream portion of the channel from Siler City-Glendon Road to the Bear Creek confluence is downcutting to meet the incised grade at Bear Creek. Due to its small size, these disturbances have not caused extensive stability problems but continuous and unlimited cattle trampling has not allowed the channel to stabilize itself.

4.2.6 Channel Stability Assessment

Bear Creek Reach A's primary destabilizing force is cattle access, incision, and widening. Bank height ratios range from 1.1 to 1.4. The removal of cattle access, creation of a stable channel cross-section and pattern, improved floodplain access, reduced channel slope, and the addition of woody vegetation for bank protection will help to protect this reach from further degradation.

Bear Creek Reach B is incised, over-wide, and will continue to have stability problems without corrective action. Vertical banks are eroding and the few mature trees at the top of bank are falling into the creek. Bank angles need to be sloped, a stable cross-section should be developed, and access should be provided to a floodplain. Establishment of bank vegetation will help to stabilize the banks.

UT to Bear Creek is currently horizontally unstable due to continuous and unlimited cattle trampling. The channel lacks bedform diversity, habitat, and riparian buffer. The culvert at Siler City- Glendon Road currently sets vertical grade at the middle of the reach. The downstream portion of the UT is vertically unstable as it downcuts to meet the grade of the Bear Creek confluence.

Table 4 summarizes total Bank Erosion Hazard Index (BEHI) values. BEHI condition locations of the project streams are shown in Figure 8.

Table 4. Pre-Construction BEHI and Sediment Export Estimates for Project Streams Bear Creek Restoration Project

	Left Bank			Right Bank		
	BEHI	**Linear Footage**	**Sediment Export Ft³/Yr**	**BEHI**	**Linear Footage**	**Sediment Export Ft³/Yr**
Bear Creek Reach A	V. High	29	29.07	V. High	114	410.40
	High	76	275.40	High	172	387.00
	Mod	299	232.72	Mod	410	386.79
	Low	455	53.96	Low	163	38.81
	Total Ft³/Yr		591.15			1223.00
	Tons/Yr		28.46			58.89
	Reach Total		**87 tons/year**			
Bear Creek Reach B	V. High	171	749.60	V. High	171	752.40
	High	193	657.40	High	379	1061.00
	Mod	337	379.37	Mod	372	330.03
	Low	349	76.81	Low	128	25.16
	Total Ft³/Yr		1863.18			2168.59
	Tons/Yr		89.71			104.41
	Reach Total		**194 tons/year**			
UT to Bear Creek	V. High	156	312	V. High	79	158
	High	568	741.8	High	415	495
	Mod	414	153.095	Mod	514	135.045
	Low	719	61.761	Low	849	68.136
	Total Ft³/Yr		1268.66			856.18
	Tons/Yr		61.08			41.22
	Reach Total		**102 tons/year**			

4.2.7 Bankfull Verification

Previous work included in HDR's Stream Mitigation Plan for NCDOT indicates that nearby USGS gages at Dutchman Creek and Rocky River in Chatham County have bankfull return intervals of 1.5 years. The selected design bankfull discharges for the Bear Creek site have a return interval between 1.2 years and 2 years, based on extrapolation from the USGS regression equations. The site bankfull flow return interval is consistent with the estimated bankfull return interval of nearby gaged Piedmont streams.

The effective FEMA hydraulic model was used to model the selected design discharge for Bear Creek. A range of flows from the 1-year discharge to the 2-year discharge was run through the model. The resulting stage for each flow was compared to the bankfull elevations estimated based on previous consultants' measurements. The hydraulic model indicated that a discharge of 200 to 270 cfs corresponds to the elevation of bankfull indicators observed in the field. Based on extrapolation from the USGS regression equations, the recurrence interval of this flow range is between 1.2 and 1.5 years.

4.2.8 Vegetation Community Types Descriptions

Vegetation habitats within the project area are primarily comprised of open pastures dominated by various graminoid species, in addition to a few small areas of mixed hardwood forest. The stream banks of Bear Creek and its unnamed tributary are dominated by riparian shrub and herbaceous species and exhibit few canopy trees. These areas are of moderate to poor quality as a result of active cattle grazing. Typical herbaceous vegetation includes: Canada goldenrod (*Solidago canadensis*), smartweed (*Polygonum pennsylvanicum*), cocklebur (*Xanthium strumarium*), soft stem rush (*Juncus effusus*), cardinal flower (*Lobelia cardinalis*), ragweed (*Ambrosia artemisiifolia*), and dogfennel (*Eupatorium capillifolium*). Riparian shrub and understory species include: common blackberry (*Rubus argutus*), Chinese privet (*Ligustrum sinense*), black willow (*Salix nigra*), hackberry (*Celtis occidentalis*), and winged elm (*Ulmus alata*).

Mixed hardwood forests are located throughout the downstream portion of Bear Creek and the upstream end of its unnamed tributary. These forested areas exhibit mature canopy tree species; however, understory shrub and herbaceous growth have been completely removed as a result of active cattle grazing. Canopy hardwood species include: American sycamore (*Platanus occidentalis*), red maple (*Acer rubrum*), ironwood (*Carpinus caroliniana*), sweet gum (*Liquidambar styraciflua*), and shagbark hickory (*Carya ovata*).

4.2.9 Subsurface Investigation

Due to concern over typical shallow bedrock of the local geology, a series of test pits were performed in the floodplain of Bear Creek along the proposed design alignment to ensure that the proposed vertical profile could be excavated as planned. On April 14, 2011, WEI conducted subsurface investigations at 20 locations along the proposed Bear Creek alignment. The test pits were excavated using a track hoe and extended up to 10 feet in depth or until bedrock refusal, whichever was less. Test pit locations were laid out approximately every 100 feet with a focus on outside bends where deeper grading for pools is proposed. Boring depths were recorded and soil types were noted. Bedrock was observed at each test pit within the 10 foot depth excavated. Proposed profile elevations will be designed with consideration for these depth limitations. Pool depths can still be constructed within the design parameter range at all locations. Refer to Figure 9 and Table 5 for the location and detailed test pit results.

Table 5. Subsurface Investigation Summary

Bear Creek Restoration Project

Stream Reach	Test Pit No.	Alignment Station (ft)	Existing Ground Surface Elevation (ft)	Bedrock Elevation (ft)	Depth to Bedrock (ft)	Soil Type Observed
Bear Creek	1	201+45	474.3	467.3	7.0	clay and saprolite
Reach A	2	201+96	474.8	468.2	6.6	clay and saprolite
	3	202+49	474.4	467.3	7.1	clay and saprolite
	4	203+45	473.9	465.2	8.7	clay and saprolite
	5	204+20	473.2	466.7	6.5	clay and saprolite
	6	205+67	473.0	466.4	6.6	clay
	7	206+22	473.6	467.0	6.6	clay
	8	206+87	473.1	465.9	7.2	clay and saprolite
	9	208+60	473.4	466.8	6.6	clay and saprolite
	10	209+10	472.6	466.0	6.6	clay
Bear Creek	11	213+25	472.5	465.5	7.0	clay and saprolite
Reach B	12	214+05	473.3	466.3	7.0	clay and saprolite
	13	214+74	473.3	465.4	7.9	clay and saprolite
	14	216+00	472.6	465.2	7.4	clay and saprolite
	15	218+75	472.4	464.2	8.2	clay and saprolite
	16	219+41	472.0	463.2	8.8	clay and saprolite
	17	220+41	472.0	462.1	9.9	clay and saprolite
UT to Bear	18	118+26	473.0	466.2	6.8	clay and saprolite
Creek	19	119+13	472.9	465.9	7.0	clay and saprolite
	20	120+19	472.0	465.0	7.0	clay and saprolite

4.3 Regulatory Considerations

4.3.1 Endangered and Threatened Species

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

WEI utilized the U.S. Fish and Wildlife Service (USFWS) and North Carolina Natural Heritage Program (NHP) databases in order to identify federally listed Threatened and Endangered plant and animal species for Chatham County, NC (USFWS, 2008 and NHP, 2009). Four federally listed species, the red-cockaded woodpecker (*Picoides borealis*), bald eagle (*Haliaeetus leucocephalus*), Cape Fear shiner (*Notropis mekistocholas*), and harperella (*Ptilimnium nodosum*) are currently listed in Chatham County (Table 5). A Categorical Exclusion Checklist for the project is included in Appendix B.

Table 6. Listed Threatened and Endangered Species in Chatham County, NC
Bear Creek Restoration Project

Species	Federal Status	Habitat
Vertebrate		
Red-cockaded woodpecker (*Picoides borealis*)	E	Open stands of mature pines
Bald eagle (*Haliaeetus leucocephalus*)	BGPA	Near large open water bodies: lakes, marshes, seacoasts, and rivers
Cape Fear shiner (*Notropis mekistocholas*)	E	Pools, riffles, and runs of rocky, clean freshwater streams
Vascular Plant		
Harperella (*Ptilimnium nodosum*)	E	Rocky or gravely shoals of clear swift-moving streams
E = Endangered; T=Threatened; BGPA=Bald & Golden Eagle Protection Act		

Based on observations from the on-site field investigation, the site does not provide potential habitat for any of the federally listed species. No stands of mature hardwood or pine tree species exist at the site and no individuals or potential nests were observed of red-cockaded woodpecker or bald eagle; it is therefore determined that the proposed restoration activities will not affect either of these bird species.

On-site stream channels exhibit heavily embedded substrate and very turbid and silty water, providing extremely poor habitat for the Cape Fear shiner. No individual species of Cape Fear shiner or any type of fish species were observed within the project stream channels; it is determined that proposed restoration activities will not likely negatively affect populations of the Cape Fear shiner.

The majority of on-site stream banks and low-water rocky areas are heavily impacted from active cattle grazing and trampling, providing no suitable habitat for populations of harperella throughout the site. No individuals of harperella were observed within the study area and it is determined that the proposed restoration activities will have no impact on this vascular plant species.

Habitat for the Cape Fear shiner includes water willow beds in flowing areas of creeks and rivers. Individuals can be found in pools, riffles, and slow runs of clean, rocky streams composed of gravel, cobble, and boulder substrates. According to the USFWS database, designated critical habitat for the Cape Fear shiner exists within Chatham County. These areas include approximately 4.1 miles of the Rocky River from the NC-902 Bridge downstream to the County Road 1010 bridge. Additional Critical Habitat includes 0.5 mile of Bear Creek from the County Road 2156 bridge downstream to the Rocky River and 4.2 miles downstream within the Rocky River to 2.6 miles of the Deep River. The Critical Habitat within Bear Creek is located approximately 19 river miles downstream of the proposed Bear Creek restoration project.

Habitat for the Cape Fear shiner is not likely to extend the 19 river miles upstream into the upper portions of the Bear Creek watershed based on the species distribution in this and the neighboring Rocky River watershed. It is determined that the proposed project is not likely to adversely affect the designated critical habitat and that the restoration activities may potentially improve this downstream habitat.

The USFWS was notified of the Bear Creek project via letter on September 17, 2009. The USFWS responded on October 2, 2009, and stated that the project is "not likely to adversely affect any

federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing." USFWS also stated that the requirements of section 7(a)(2) of the Clean Water Act "have been satisfied" for the project.

4.3.2 Cultural Resources

The National Historic Preservation Act (NHPA) of 1966, amended (16 U.S.C. 470), defines the policy of historic preservation to protect, restore, and reuse districts, sites, structures, and objects significant in American history, architecture, and culture. Section 106 of the NHPA mandates that federal agencies take into account the effect of an undertaking on any property, which is included in, or eligible for inclusion in, the National Register of Historic Places. A letter was sent to the North Carolina State Historic Preservation Office (SHPO) on September 17, 2009, requesting review and comment for the potential of cultural resources potentially affected by the Bear Creek project. The SHPO responded on October 5, 2009, and stated they were aware of no historic resources which would be affected by the project. A Categorical Exclusion Checklist for the project is included in Appendix B.

4.3.3 FEMA and Hydrologic Trespass

Reaches A and B of Bear Creek are mapped as a FEMA Zone AE floodplain on FIRM panel 8666 (Figure 4). Base flood elevations have been defined, but no floodway is mapped on the FIRM panel. Limited detailed methods were used to study Bear Creek and non-encroachment widths are published in the Chatham County Community 370299 Flood Insurance Study dated February 2, 2007.

A no-rise certification will be prepared as appropriate based on hydraulic modeling. The project is being designed so that no increase in flooding will occur on the project site and or upstream parcels.

5.0 Determination of Credits

Mitigation credits presented in Table 6 are projections based upon site design. Upon completion of site construction the project components and credits data will be revised to be consistent with the as-built condition.

Table 7. Determination of Credits
Bear Creek Restoration Project

Bear Creek Restoration Project (Phillips Site), Chatham County, DENR Contract D09050S									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	4,082								

Project Components						
Project Component or Reach ID	**Stationing / Location**	**Existing Footage / Acreage**	**Approach (PI, PII, etc.)**	**Restoration or Restoration Equivalent**	**Restoration Footage or Acreage**	**Mitigation Ratio**
Bear Creek Reach A	200+59 to 208+80; 209+04 to 209+66; 209+90 to 210+73	859	PII	Restoration	966	1:1
Bear Creek Reach B	210+73 to 217+77; 217+77 to 222+52	1,050	PII	Restoration	1,179	1:1
UT to Bear Creek	100+25 to 105+05; 105+25 to 116+17; 116+78 to 120+43	1,857	PI	Restoration	1,937	1:1

Component Summation						
		Riparian Wetland (acres)				
Restoration Level	**Stream (linear feet)**	**Riverine**	**Non-Riv.**	**Non-Riparian Wetland (acres)**	**Buffer (square feet)**	**Upland (acres)**
Restoration	4,082					
Enhancement						
Enhancement I						
Enhancement II						
Creation						
Preservation						
High Quality Preservation						

6.0 Mitigation Work Plan

6.1 Target Stream Types and Plant Communities

6.1.1 Target Stream Type(s)

As part of HDR's 2003 Stream Mitigation Plan, two reference reach sites were evaluated. The two sites selected are largely bedrock-controlled, and so dimension, pattern, and profile are not free to adjust to channel-forming flow influences. The riparian vegetation community species observed at these sites will be used in the development of riparian planting plan, but dimensionless design parameters will be developed from previously surveyed reference reaches in the area, such as Spencer Creek surveyed for the UT to Barnes Creek restoration design.

Data from the Spencer Creek reference site located in the Uwharrie National Forest will be used from the UT to Barnes Restoration Plan by Buck Engineering (2004). The data are summarized in Appendix C of this report.

This reference site is classified as Rosgen E4 channel. Bear Creek will be designed as a C channel type because the low width/depth ratio characteristic of E channels is difficult to stabilize immediately after construction. By building the channel as a C and using width/depth ratios in the

low range, close to an E range, if appropriate the channel will narrow over time as bank vegetation becomes established. Spencer Creek has a drainage area of 0.96 square miles at the reference survey site. This drainage area is within an order of magnitude of Bear Creek and the UT to Bear Creek drainage areas, which is generally accepted as an appropriate range for reference parameters. The site is located approximately 30 miles from the Bear Creek site, in the adjacent Yadkin River basin (03040103). Appendix C contains representative photographs.

6.1.2 Target Plant Communities

As a final stage of construction, riparian stream buffers will be planted and restored to the dominant natural plant community that exists within the project watershed. This natural community within and adjacent to the project easement is classified as Piedmont Bottomland Forest and was determined based on existing canopy and herbaceous species (Schafale and Weakley, 1990). Proposed plant and seed materials will be placed on stream banks and bench areas as well as from the tops of banks out to the projects easement limits. These areas will be planted with bare root trees, live stakes, and a seed mixture of permanent herbaceous vegetation ground cover.

A permanent seed mixture of native herbaceous and grass species will be applied to all disturbed areas within the project easement. An herbaceous seed mixture was chosen that would provide quicker stabilization of constructed stream banks, benches, and side slopes. These species will also provide early habitat value through rapid growth of ground cover to the tops of banks and floodplain areas. Proposed herbaceous species are shown in Appendix C.

Individual tree and shrub species will be planted throughout the project easement including stream banks, benches, tops of banks, and floodplains zones. These species will be planted as bare root and live stakes and will provide additional stabilization to the outsides of constructed meander bends and side slopes. Species planted as bare roots will spaced at an initial density of 680 plants per acre (8 feet on center). Live stakes will be planted at 4,840 stakes per acre (3 feet on center) on channel banks. Targeted densities after monitoring year 3 are 320 woody stems per acre. Proposed tree and shrub species are representative of existing on-site vegetation communities and are typical of Piedmont Bottomland Forests, shown in Appendix C.

6.2 Stream Project Design Parameters and Design Justification

The project site mitigation plan builds upon preliminary work completed by HDR in 2003 and Buck Engineering. Restoration of dimension, profile, and pattern is planned on Bear Creek Reaches A and B as well as on the UT to Bear Creek. The project site concept plan is shown in Figure 10. The proposed restoration work will improve channel stability and habitat throughout the project area. Restoration of a meandering pattern will reduce channel slope to better match the critical slope needed for sediment transport, rather than having a channel too steep that is prone to bank erosion, high shear stress, and degradation. The meandering pattern will also create and maintain pools for diversity of in-stream habitat. Establishment of a stable cross-section will allow for floodplain access, reduce bank slopes, shear stress, and rotational failures. Riffle-pool sequences will provide for habitat diversity, increased aeration and dissolved oxygen levels, and cool water storage. Establishment of a riparian buffer will provide shading to help control water temperatures, root mass to stabilize banks, and improve riparian habitat.

A site walk was conducted with NCEEP on May 19, 2009, during which the restoration approach published by HDR and Buck Engineering was discussed. Reach A of Bear Creek is not extremely incised, so a Rosgen Priority 1 restoration approach is feasible. This approach is the most physically effective and most cost-effective method for re-connecting the channel to a floodplain. However, after hydraulic modeling was completed, a Priority 1 raised channel bed cannot be constructed without causing a rise in the 100-year flood elevation on the upstream property. Instead, a Priority 2 restoration approach has been selected. The channel bed will remain at approximately the same elevation as the existing channel, but will be restored to a meandering channel with a stable cross-section. Floodplain benching

will be excavated at the bankfull elevation. A Rosgen C channel type will be constructed with a width/depth ratio of approximately 12.7, at the low end of this ratio range for a C channel classification. The channel will be allowed to narrow over time as bank vegetation is established. Gradual bank slopes of 2.5:1 are planned to provide adequate rooting area and stability for plant establishment. By keeping the top width of the channel at 24.5 feet and using gradual bank side slopes, the bottom width of the channel will be effectively narrowed. Base flow can be minimal in this low-slope channel, especially in Reach A where some water appears to flow subterraneously. The narrower channel bottom width will help to improve in-stream habitat that is currently dry or stagnant. Appendix C provides a summary of the design geomorphic values for Reach A.

Reach B will also be a Priority 2 restoration approach. The bankfull cross-sectional area increases slightly from Reach A since Reach B is downstream and has a slightly larger watershed size. The channel type selected for design is a Rosgen C type channel, consistent with the upstream reach. A width to depth ratio of 14.1 with 2.5:1 side slopes has been designed to improve cross-section stability and to provide adequate rooting area and stability for plant establishment. The floodplain bench width varies from 20 feet to 80 feet wide within the new meandering belt width. Pool depths were designed with consideration for the subsurface investigation conducted at the site to determine depth to bedrock. Appendix C provides a summary of the design geomorphic values for Reach B.

UT to Bear Creek will follow a Priority 1 restoration at the upstream end, where the channel will be constructed at a new, higher elevation so that bankfull stage corresponds to the existing floodplain elevation. After 1,300 LF, the channel begins to transition to a Priority 2 restoration with a floodplain bench excavation in order to match grade at the Siler-City Glendon Road culvert. The Priority 2 restoration continues through the Bear Creek floodplain into the confluence. A large step from the outfall sill of the tributary to the confluence with Bear Creek will need to be stabilized with rock. This step was designed to reduce the floodplain grading along the tributary. The confluence grading has been designed so that the bankfull elevation of the UT matches the bankfull elevation of Bear Creek. The design channel has a width to depth ratio of 12.5 with 2.5:1 side slopes. Appendix C provides a summary of the design geomorphic values for UT to Bear Creek. A Rosgen C channel was selected as the design channel type, but on the lower end of the width-to-depth ratio range so that the channel can narrow over time as vegetation becomes established. Conventional restoration design experience has shown that building a true E-type channel is difficult to stabilize in the immediate years following construction due to steep bank angles and low width-to-depth ratios.

Design alternatives to minimize floodplain excavation include a steeper transition to the tie-in at the Siler-City Glendon Road culvert. This design option was rejected due to the risk of instability of building a steep step structure immediately upstream of the culvert. Another alternative would be to raise the culvert or to raise the bed of the creek adjacent to the culvert, but either of these options would require an encroachment agreement with NC DOT. In the interest of project schedule, an encroachment agreement was not pursued. The tributary and floodplain grade were maintained as high as possible until the confluence of Bear Creek to minimize floodplain grading.

6.3 Data Analysis

6.3.1 Sediment Transport Analysis

Sediment transport analysis is based on data provided by Buck Engineering for Bear Creek. The sediment distribution in this reach is likely characterized by a bi-modal distribution, with large bedrock and cobble in addition to smaller sand-grain particles.

Bear Creek Reach B contains some larger boulders. Vertical incision is more active on this reach. The work in this reach consists of Priority 2 restoration with floodplain bench excavation. The existing channel lacks mid-channel bars, so aggradation is not a foreseeable concern. The existing channel is vertically incised, so grade control structures will help to prevent degradation, and the proposed floodplain bench will help to reduce shear stress and scour potential.

Appendix C provides a summary of the existing sediment characteristics and an analysis of the proposed design for Bear Creek Reach A and B. The analysis of Reach A indicates that the proposed design is very near to the critical slope and depth required to transport the existing sediment load. The shear stress analysis using the modified Shield's relationship of critical shear stress to the largest movable particle indicates that a 15 to 25 mm particle can be moved, and the largest subpavement particle size sampled was 28 mm. This analysis indicates that the design channel will have the shear stress needed to move the sediment load without aggradation or degradation.

Analysis of Reach B indicates that the proposed channel is very near to the critical slope and depth required to transport the existing sediment load. The shear stress analysis using the modified Shield's relationship of critical shear stress to the largest movable particle indicates that a 20 to 50 mm particle can be moved, and the largest subpavement particle size sampled was 49 mm. This analysis indicates that the design channel will have the shear stress needed to move the sediment load without aggradation or degradation.

UT to Bear Creek's sediment load is primarily gravel and sand. The existing channel is not overly incised, nor has it shown excessive aggradation. Critical depth and slope calculations could not be used; pavement and subpavement particle sizes were very homogenous in the fine-grain range and input parameters did not fall in the appropriate range for the empirical equations to be applicable. The shear stress analysis using the modified Shield's relationship of critical shear stress to the largest movable particle indicates that a 10 to 20 mm particle can be moved, and the largest subpavement particle size sampled was 25 mm. This analysis indicates that the design channel will have the shear stress needed to move the sediment load without aggradation or degradation. Log structures will help to provide grade control to prevent vertical incision. Steeper riffles and meandering geometry will help to continue to move sediment load. Floodplain access will allow excess sediment load to settle out on the floodplain rather than in the channel.

One area of concern is the relatively flat lower 360 LF portion of UT restoration from the Siler-City Glendon Road culvert to the confluence with Bear Creek. Due to the elevation of the road culvert, there is little vertical drop available from the culvert to the Bear Creek tie-in. This flat slope could encourage aggradation of sediment loads in the UT, or the UT channel could become silted in from floodplain sediment distributed by Bear Creek. The design expectation is that the channel will flush itself out during the receding limb of the hydrograph, but this area will need to be monitored.

6.3.2 HEC-RAS Analysis

Reaches A and B of Bear Creek are mapped as a FEMA Zone AE floodplain on FIRM panel 8666 (Figure 4). Base flood elevations have been defined, but no floodway is mapped on the FIRM panel. Limited detailed methods were used to study Bear Creek and non-encroachment widths are published in the Chatham County Community 370299 Flood Insurance Study dated February 2, 2007.

A Rosgen Priority 2 restoration approach is proposed for Reaches A and B of Bear Creek. The channel will remain at approximately the existing bed elevation, or will be raised slightly in some areas. A floodplain bench will be excavated at the bankfull elevation. This design was developed in order to tie-in to the existing 100-year base flood elevation at the upstream property line and to cause no flood rise on the project property or adjacent landowners. A no-rise certification will be prepared for submittal to the Chatham County local floodplain administrator and the NC Floodplain Mapping Program for approval prior to construction.

Appendix B contains the NCEEP Floodplain Requirements Checklist. The project has been designed so that there is no increase in flooding during the 100-year event on the project site or adjacent parcels.

6.4 Additional Property Improvements

In the interest of the stream restoration work to be performed, NCEEP has agreed to provide the following amenities for the on-going protection of the conservation easement and stream work.

- Fencing for livestock exclusion at the perimeter of the conservation easement- to be provided by NCEEP;
- Two (2) culverted crossings on Bear Creek- to be provided by NCEEP;
- One (1) ford crossing on UT to Bear Creek- to be provided by NCEEP.

7.0 Maintenance Plan

NCEEP shall monitor the site on a regular basis and shall conduct a physical inspection of the site a minimum of once per 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 should be expected most often in the first two years following site construction and may include the components listed in Table 8.

Table 8 Maintenance Plan Components
Bear Creek Restoration Project

Component / Feature	Maintenance Through Project Close-Out
Stream	Stream – Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, 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.
Utility Right-of-Way	Utility rights-of-way within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights-of-way, or corridor agreements.
Ford Crossing	Ford crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights-of-way, or corridor agreements.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights-of-way, or corridor agreements.

8.0 Performance Standards

The stream restoration success criteria for the project site will follow approved success criteria presented in the NCEEP Mitigation Plan Guidance (Version 2.0, 03/27/08) and the Interagency Stream Mitigation Guidelines issued April 2003 by the USACE, NCDWQ, WRC and the EPA. NCEEP will oversee annual monitoring of channel stability and vegetation to assess the condition of the finished project for five years, or until success criteria are met. Stream and vegetation success criteria are described in more detail below.

8.1 Streams

Post restoration monitoring of channel stability will include dimension (cross-sections), pattern and profile (longitudinal profile), and photo documentation of the project. Success criterion for the stream restoration also includes substrate analysis and the frequency of bankfull events. The methods used and any related success criteria are described below for each parameter.

8.1.1 Dimension

Riffle cross-sections on the restoration and enhancement reaches should be stable and should show little change in bankfull area, maximum depth ratio and width-to-depth ratio. Riffle cross-sections should generally fall within the parameters defined for channels of the appropriate Rosgen stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

8.1.2 Pattern and Profile

Longitudinal profile data for the stream reach should show that the bedform features are remaining stable. The riffles should be steeper and shallower than the pools, while the pools should be deep with flat water surface slopes. The relative percentage of riffles and pools should not change significantly from the design parameters.

8.1.3 Substrate

Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

8.1.4 Bankfull Events

Two bankfull flow events in separate years must be documented on the project within the five-year monitoring period.

8.1.5 Bank Stability Assessments

For the BEHI assessment completed in Monitoring Year 5, no more than 20% of bank areas should score above a “low” BEHI ranking and no project areas should score above a “moderate” BEHI ranking.

8.2 Vegetation

The final vegetative success criteria will be the survival of 260 five-year-old planted trees and/or shrubs per acre in the riparian corridor along restored and enhanced reaches at the end of year five of the monitoring period. The interim measure of vegetative success for the site will be the survival of at least 320 three-year-old planted trees per acre at the end of year three of the monitoring period.

9.0 Monitoring Requirements

Annual monitoring data will be reported using the NCEEP Monitoring Report template (Version 1.2, 11/16/06). The monitoring report shall provide a project data chronology that will facilitate an understanding of project status and trends, population of EEP databases for analysis, research purposes, and assist in decision making regarding close-out. Project monitoring requirements are listed in more detail in Table 9.

Table 9. Monitoring Requirements
Bear Creek Restoration Project

Parameter	Monitoring Feature	Quantity		Frequency
		Bear Creek	Bear Creek	
Pattern	Pattern	entire reach	entire reach	Annual
Dimension	Riffle Cross-sections	3	3	Annual
	Pool Cross-sections	2	2	
Profile	Profile	entire reach	entire reach	Annual
Substrate	Substrate	entire reach	entire reach	Annual
Surface Water Hydrology	Crest Gauge	1	1	Annual
Vegetation (CVS Level I)	Vegetation (CVS Level I)	6 plots	6 plots	Annual
Project Boundary				Semi-annual
BEHI/NBS	BEHI/NBS	Entire reach	Entire reach	Year five only

9.1 Streams

The following characteristics will be monitored with respect to stream channels on site.

9.1.1 Dimension

In order to monitor the channel dimensions, five permanent cross-sections in Bear Creek (three in Reach A and two in Reach B) and five permanent cross-sections in the UT to Bear Creek will be installed. Each cross-section will be permanently marked with pins to establish its location. Cross-section surveys will be performed annually and will include points measured at all breaks in slope, including top of bank, bankfull, edge of water, and thalweg.

9.1.2 Pattern and Profile

A longitudinal profile will be completed for the entire lengths of Reaches A and B of Bear Creek and the entire length of UT to Bear Creek immediately after construction and annually throughout the remaining five year monitoring period. The initial survey will be used for year one baseline monitoring. Measurements in the survey will include thalweg, water surface, bankfull, and top of low bank. These profile measurements will be taken at the head of each riffle, run, pool, and glide, as well as at the maximum pool depth. The survey will be tied to a permanent benchmark and NC State Plane coordinates.

9.1.3 Photo Documentation

Lateral reference photos should show a stable cross-section with no excessive erosion or degradation of the banks. The reference photo transects will be taken of both banks at each permanent cross-section. A survey tape pulled across the section will be centered in the photographs of the bank. The photographer will make every effort to maintain the same area in each photo over time.

Longitudinal photos should indicate the absence of developing bars within the channel or vertical incision. The photographer will make every effort to consistently maintain the same area in each photo over time.

Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected. Photographs will be taken at each grade control structure along the restored stream. The photographer will make every effort to consistently maintain the same area in each photo over time.

Photographs will be taken once a year for five years following construction to visually document stability. Permanent markers will be established so that the same locations and view directions on the site are monitored each year.

9.1.4 Substrate

A reach-wide pebble count will be conducted on each of the three project reaches. Pebble counts will also be conducted on at least one riffle cross-section on each project reach, for a total of three cross-sections. The pebble counts will be done annually and compared with data from previous years.

9.1.5 Bankfull Events

Bankfull events will be documented using a crest gage and photographs. Two crest gages will be installed: one on Bear Creek and the other gage on UT to Bear Creek. The crest gage will be installed on the floodplain within 10 feet of the restored channel at a central site location. The gage 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.

9.1.6 Bank Stability Assessments

BEHI and NBS assessments will be performed in year five of the project monitoring. The entire project length will be classified into the BEHI erosion hazard categories and will include a NBS assessment. The data will be compared to the preconstruction BEHI and NBS assessment results.

9.2 Vegetation

The extent of invasive species coverage will also be monitored and controlled as necessary. At the end of the first growing season, species composition, density, and survival will be evaluated. The restoration site will then be evaluated each subsequent year until the final success criteria are achieved.

Vegetation monitoring plots will be installed across the restoration site to measure the survival of the planted trees. The number of monitoring plots required will be based on the NCEEP methodology for vegetation monitoring. The size of individual plots will be 100 square meters for woody tree species and shrubs and one square meter for herbaceous vegetation. Individual plot data will be provided each year and will include diameter, height, and density, and coverage quantities. Individual seedlings will be marked so 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.

Monitoring will begin at the end of the first growing season. Monitoring in each of the following years will be performed between July and November.

10.0 Long-Term Management Plan

Upon approval for close-out by the Interagency Review Team (IRT) the site will be transferred to the NCDENR Division of Natural Resource Planning and Conservation and Stewardship Program. 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 EEP 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 to manage the account as a non-wasting endowment. Only interest generated from the endowment funds will be 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.

11.0 Adaptive Management Plan

Upon completion of site construction EEP 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, EEP 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 EEP 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.

12.0 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 US Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by EEP. This commitment provides financial assurance for all mitigation projects implemented by the program.

13.0 References

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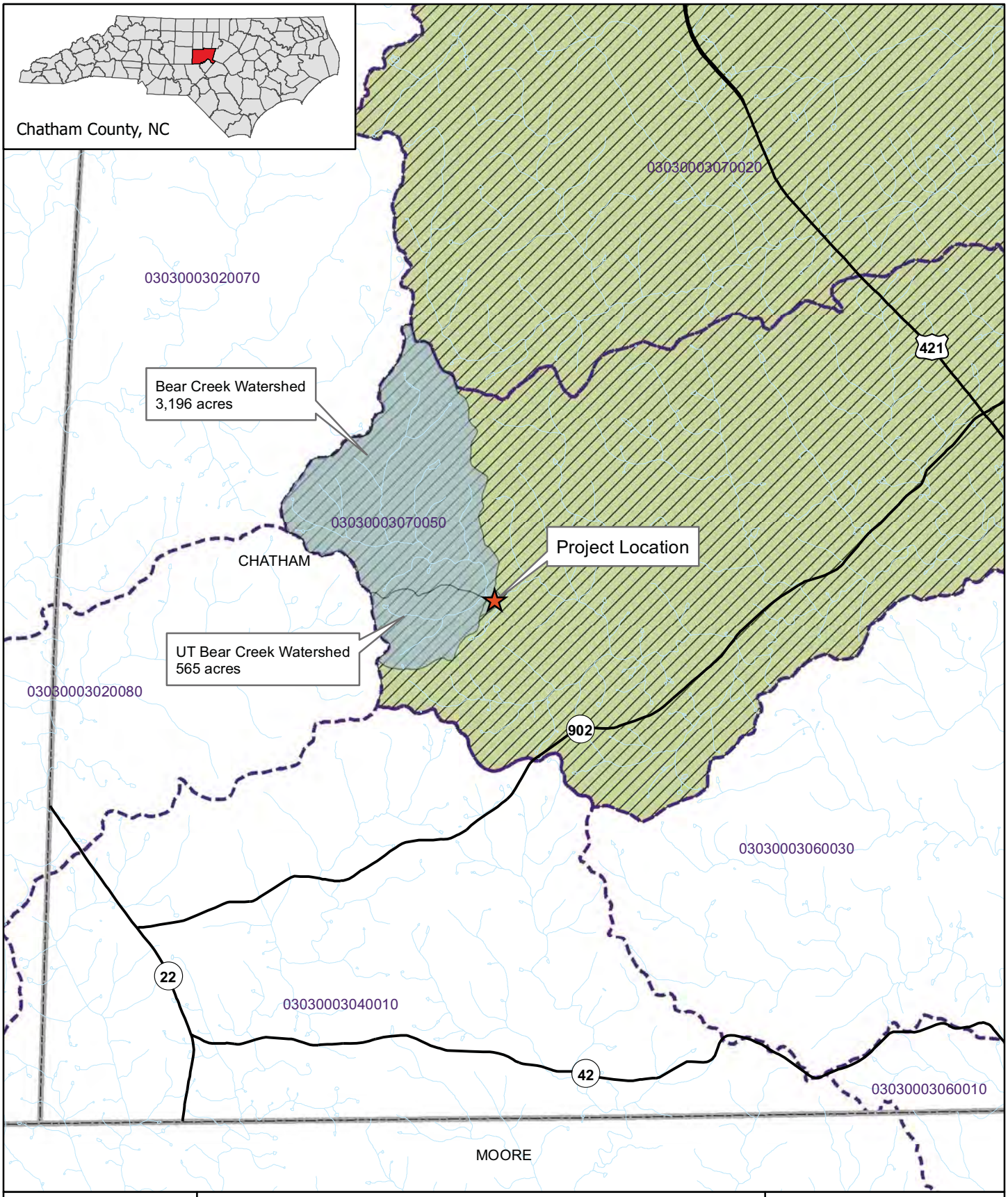
United States Geological Survey (USGS), 1998. North Carolina Geology. http:// http://www.geology.enr.state.nc.us/usgs/carolina.htm



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

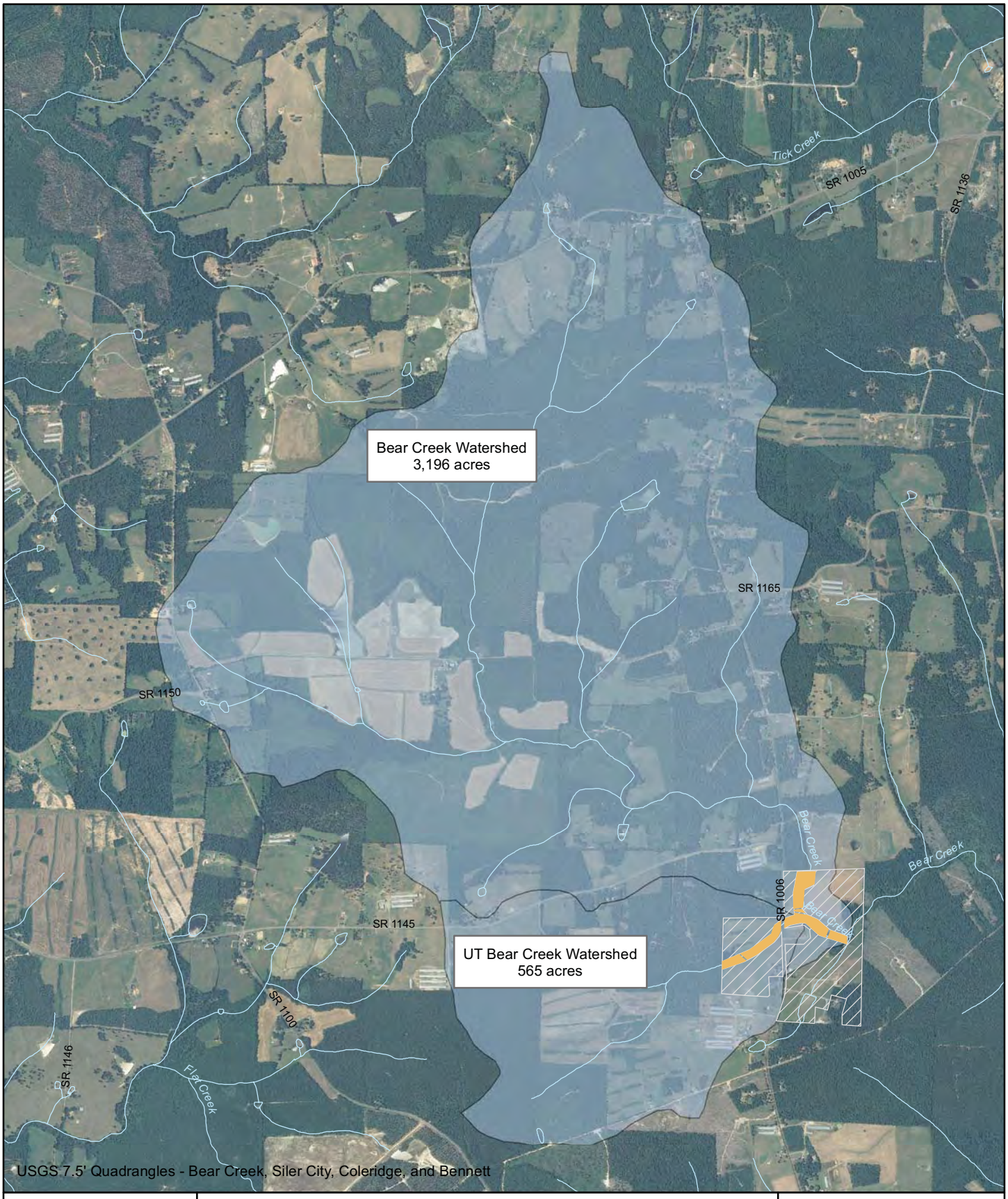
Bear Creek Project Watershed
Hydrologic Unit Code (14 Digit)
EEP Targeted Watersheds
Counties

0 0.75 1.5 Miles

N

Figure 1. Vicinity Map
Bear Creek
Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Bear Creek Project Watershed

Phillips Tract

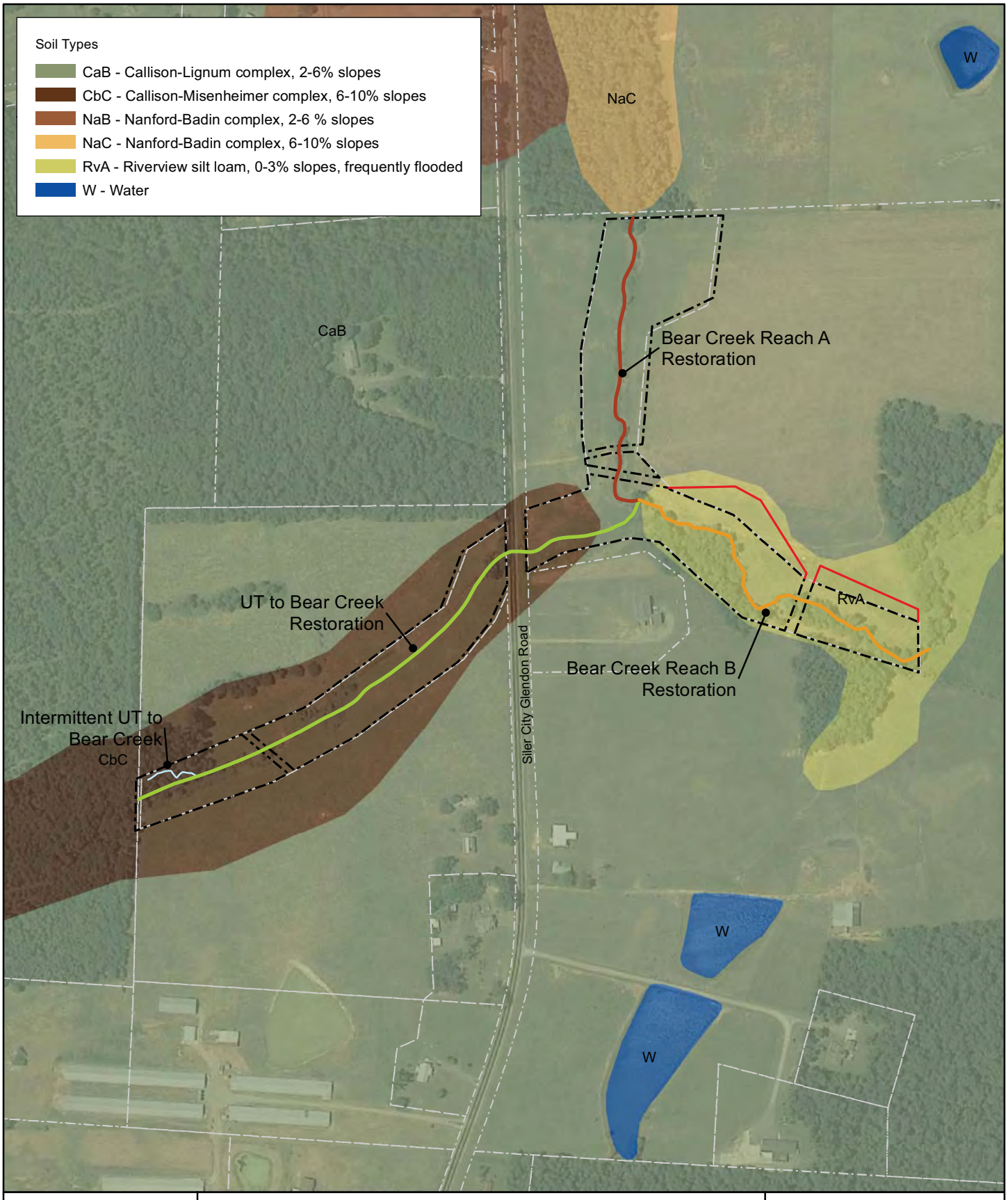
Project Area

0 1,250 2,500 Feet

N

Figure 2. Watershed Map
Bear Creek
Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Parcels
Bear Creek Reach A
Bear Creek Reach B
UT to Bear Creek
Recorded Conservation Easement
Proposed Modified Conservation Easement

0 200 400 Feet

N

Figure 3. Soils Map
Bear Creek
Restoration Project

Chatham County, NC

Ecosystem Enhancement Program

WILDLANDS ENGINEERING

FEMA Flood Zone AE
Bear Creek Reach A
Bear Creek Reach B
UT to Bear Creek
USACE Wetland Determination Point (DP)
NCDWQ Stream Classification Point (SCP)
Photo Locations
Recorded Conservation Easement
Proposed Modified Conservation Easement

0 200 400 Feet

N

Figure 4. Hydrological Features
Bear Creek
Restoration Project

Chatham County, NC

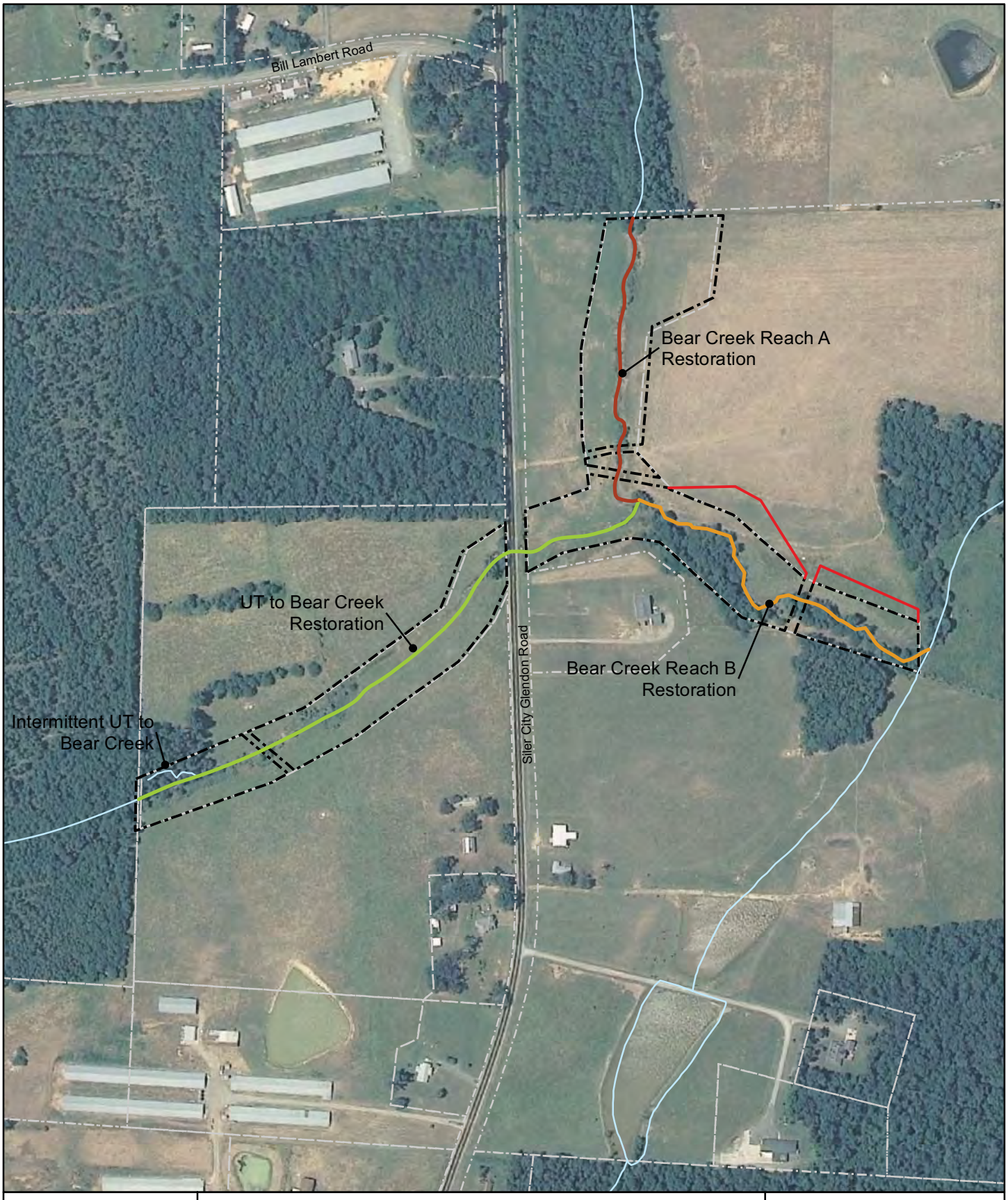
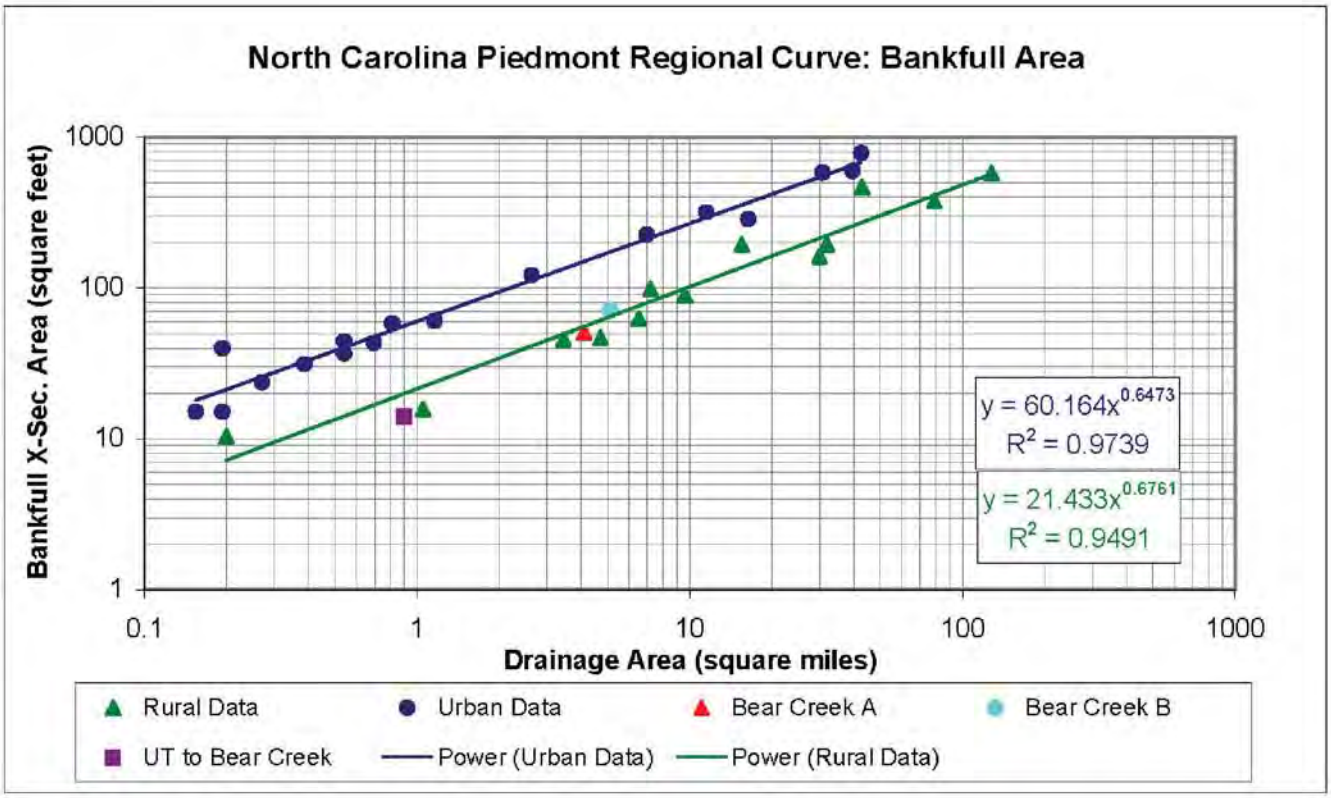
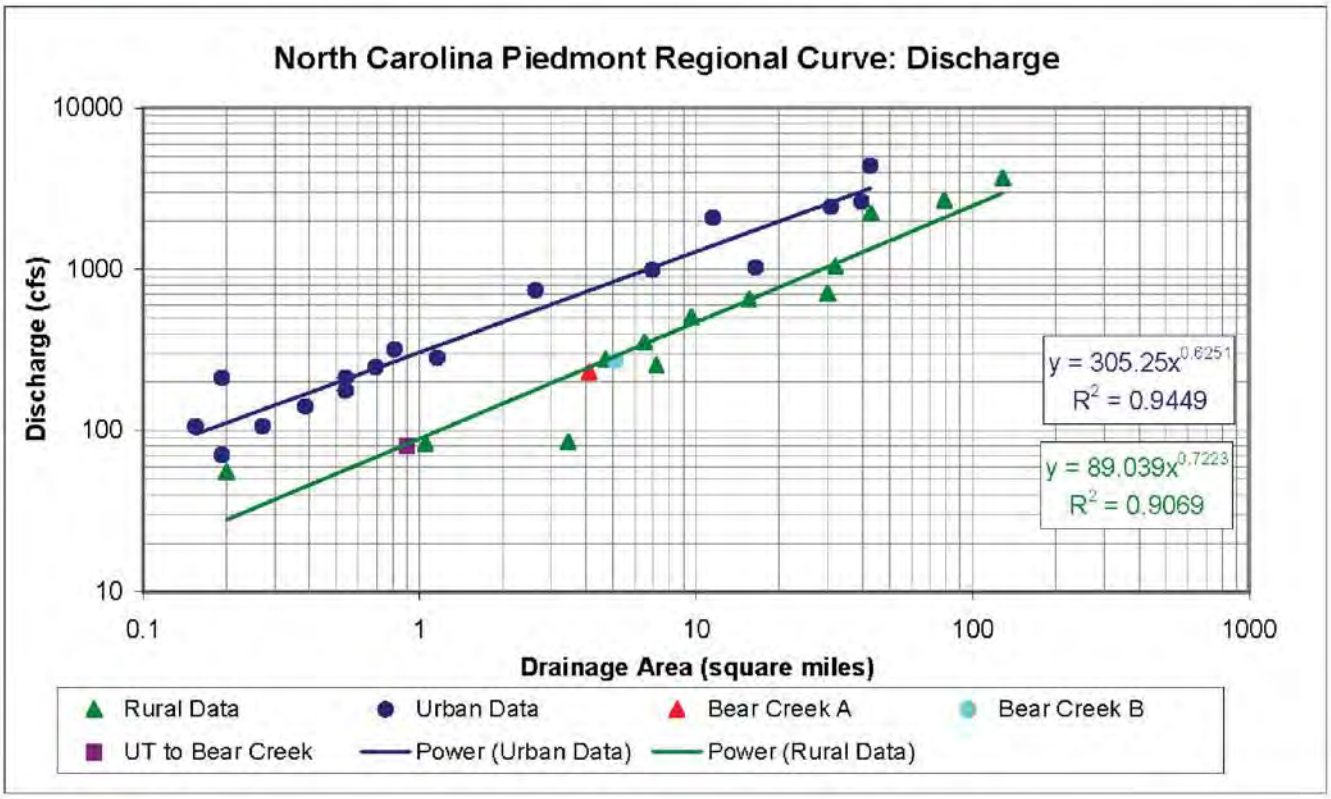


Figure 5. Site Protection Instrument
Bear Creek
Restoration Project

Chatham County, NC



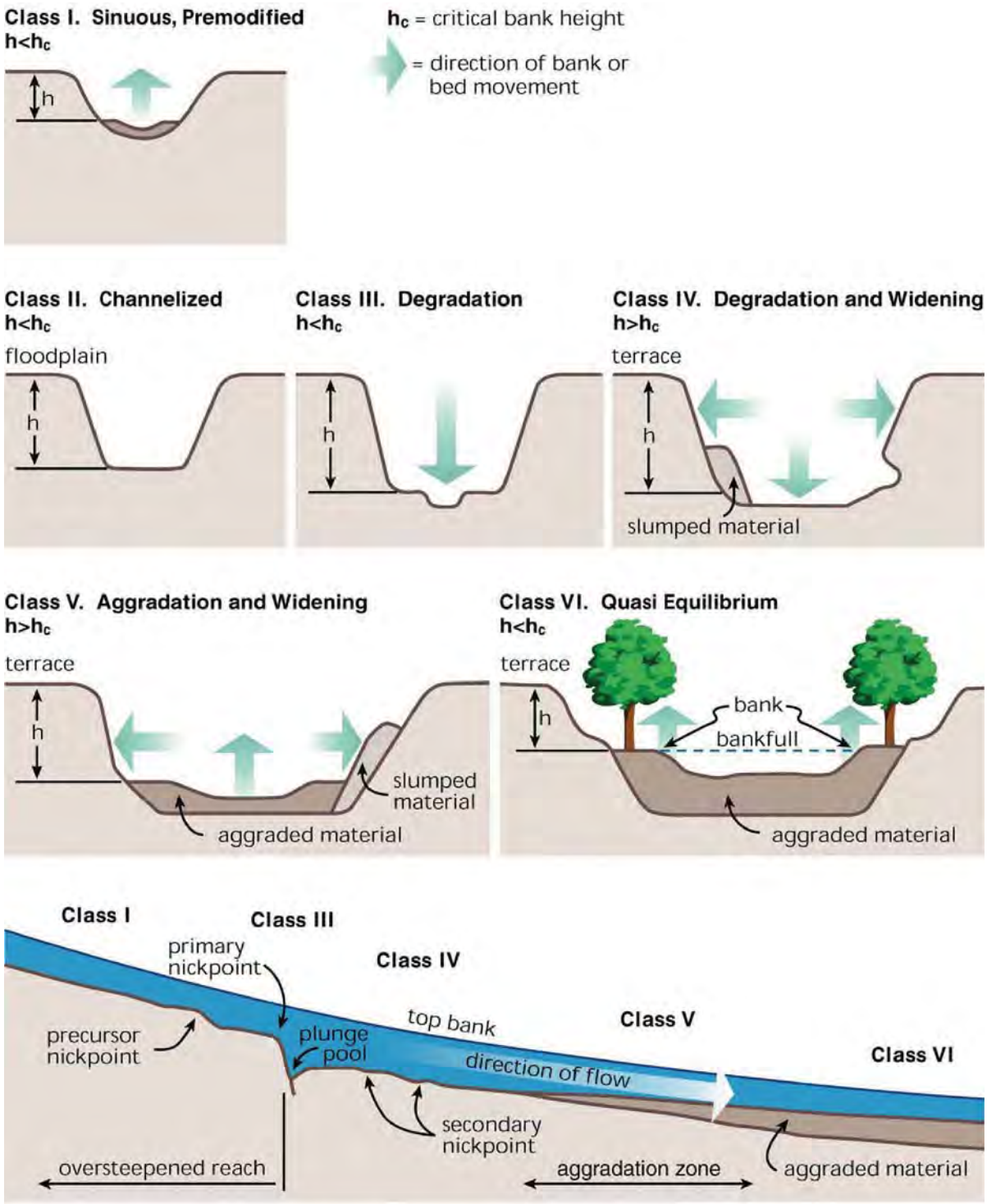


Ecosystem Enhancement Program

WILDLANDS ENGINEERING

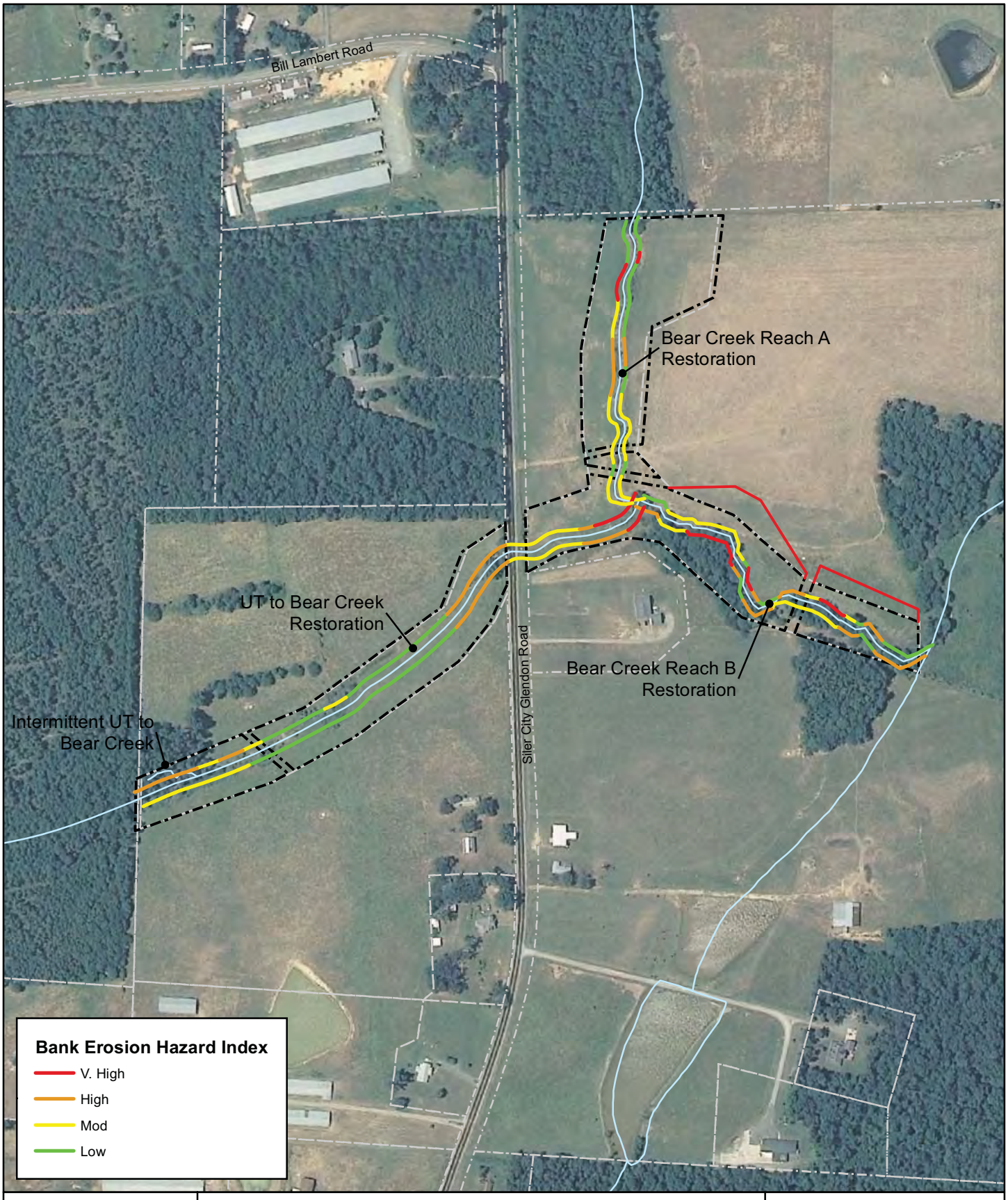
Figure 6. Piedmont Regional Curve Data
Bear Creek
Restoration Project

Chatham County, NC



Source: Simon, 1989; US Army Corps of Engineers, 1990.
Fig. 7.14 -- Channel evolution model..
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

Channel Evolution Model Six Stages (Simon & Hupp, 1986)



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

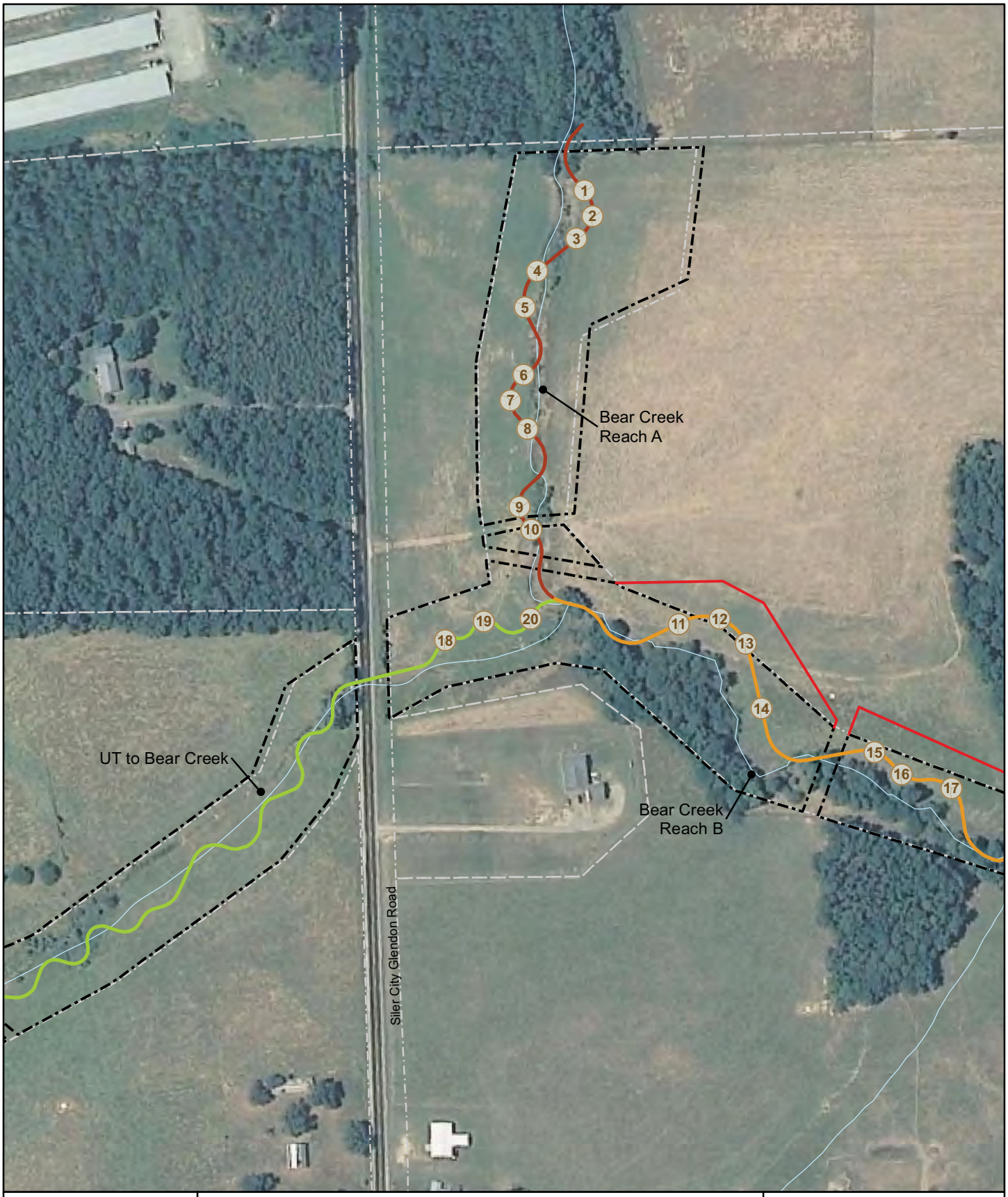
Parcels
Recorded Conservation Easement
Proposed Modified Conservation Easement
Streams

0 200 400 Feet

N

Figure 8. Bank Erosion Hazard Index
Bear Creek Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

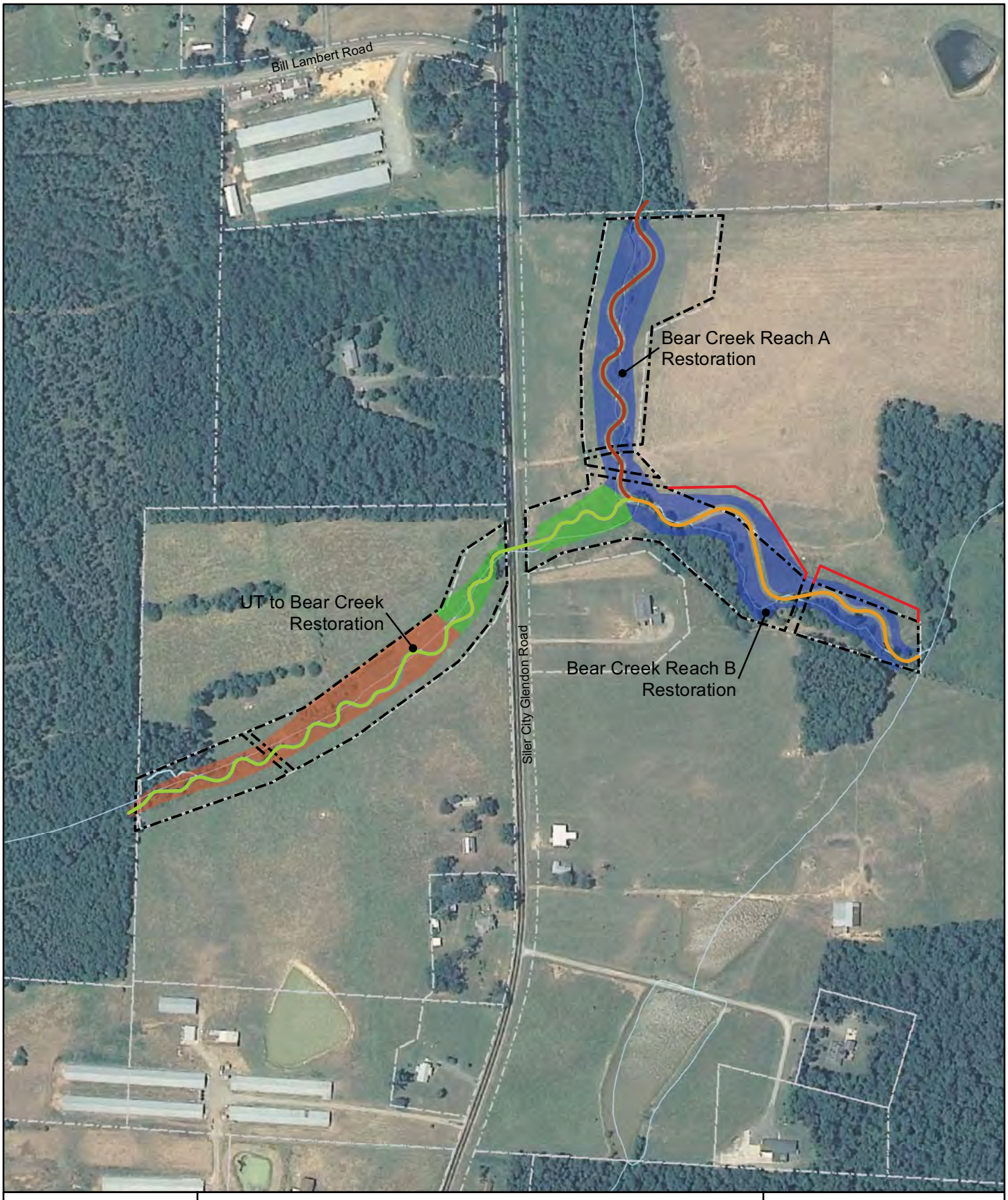
Bear Creek Reach A
Bear Creek Reach B
UT to Bear Creek
Test Pit Location
Modified Conservation Easement Area
Recorded Conservation Easement
Parcels

0 125 250 Feet

N

Figure 9. Test Pit Location Map
Bear Creek
Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Figure 10. Proposed Concept Plan
Bear Creek
Restoration Project

Chatham County, NC

Appendix A:
Site Protection Instrument

1279
0470

FILED
CHATHAM COUNTY
REBA G. THOMAS
REGISTER OF DEEDS

FILED	Aug 18, 2006
AT	03:51:21 pm
BOOK	01279
START PAGE	0470
END PAGE	0488
INSTRUMENT #	11013

BOOK 1279 PAGE 470

STATE OF NORTH CAROLINA P.I.N. #_____

COUNTY OF Chatham

PREPARED BY: Lisa Glover
Assistant Attorney General
North Carolina Department of Justice

RETURN TO: North Carolina Department of Transportation
Office of Natural Environment
1548 Mail Service Center
Raleigh, NC 27699-1548

Revenue # 0

CONSERVATION EASEMENT and
TEMPORARY CONSTRUCTION EASEMENT

This Conservation Easement and Easement of Ingress and Egress is granted on this 12 day of April, 2006, by GARY PHILLIPS and INA JANE PHILLIPS, having an address of 7796 Siler City Glendon Road, North Carolina, 27207 (hereinafter, "Grantor"), to THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, having an address of 1548 Mail Service Center, Raleigh, NC 27699-1548 (hereinafter, "NCDOT" or "Grantee").

The designation 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.

WHEREAS:

The Grantor is the sole owner in fee simple of certain real property more particularly described in Deed Book 418, Page 143, of the Chatham County Registry (hereinafter, the "Property"), which consists of approximately 129 acres, more or less, located in Bear Creek Township, Chatham County, North Carolina.

The Property provides natural wildlife habitat for a wide variety of land, air and aquatic species, because of the streams that run through the Property; many of these species, which rely on the streams, are of great importance to the Grantor and the people of North Carolina

The Grantor is willing to grant a perpetual Conservation Easement over 14.42 acres of the Property (hereinafter, the "Conservation Easement Area"), thereby restricting and limiting the use of land within the Conservation Easement Area to the terms and conditions and for the purposes hereinafter set forth, and to further grant a Temporary Construction Easement upon and along the Property as more particularly set forth hereinafter.

The NCDOT is an agency of the State of North Carolina whose purpose includes the construction of transportation projects for public use and who has the authority to acquire land for the purpose of mitigating environmental impacts of these transportation projects.

The NCDOT desires to restore, enhance or preserve stream and associated streamside wetlands in Chatham County on the Conservation Easement Area (hereinafter, the "Stream Mitigation Project"), and to hold a conservation easement over said length of stream and surrounding land and wetlands encompassing approximately 14.42 acres and referred to as the Conservation Easement Area;

The NCDOT, under a Section 404 permit granted by the United States Army Corps of Engineers (hereinafter, "USACE"), must conduct certain off-site stream and wetland mitigation work to compensate for impacts to streams and wetlands resulting from road construction;

The Stream Mitigation Project will be undertaken pursuant to a Stream Mitigation Plan developed by NCDOT, in coordination with the Grantor, for the restoration, enhancement and preservation of the streams and wetlands on the Conservation Easement Area, and kept on file with NCDOT;

The purposes of the Conservation Easement over the Conservation Easement Area are (1) to protect the mitigation activities performed by the NCDOT; (2) to preserve and protect the conservation values of the Conservation Easement Area,

which include natural resources; wildlife habitat for land, air and aquatic species; aquatic resources, including streams, rivers, ponds, and wetlands; and scenic resources of the Property; (3) to prevent any use of the Conservation Easement Area that will significantly impair or interfere with these purposes; and, (4) to maintain permanently the dominant woodland, scenic and natural character of the Conservation Easement Area.

The specific conservation values of the Conservation Easement Area and its current use and state of improvement are described in the Draft Stream Mitigation Study dated December 2002, prepared by HDR Engineering, Inc. and acknowledged by all parties to be accurate as of the date of this Conservation Easement. The Mitigation Study may be used by the Grantee to document any future changes in the use or character of the Conservation Easement Area in order to ensure the terms and conditions of this Conservation Easement are fulfilled. This Mitigation Study, however, is not intended to preclude the use of other evidence to establish the present condition of the Conservation Easement Area if there is a controversy over its use. The Grantor and Grantee have copies of the Mitigation Study, and said report will remain on file with the Office of Natural Environment of NCDOT.

The Grantor intends that the conservation values of the Conservation Easement Area be preserved and maintained, and further, the Grantor intends to convey to the Grantee the right to preserve and protect the conservation values of the Conservation Easement Area in perpetuity.

The conservation purposes of this Conservation Easement are recognized by the Uniform North Carolina Conservation and Historic Preservation Agreements Act, N.C.G.S. § 121-34 *et seq.*, which provides for the enforceability of restrictions, easements, covenants or conditions "appropriate to retaining land or water areas predominantly in their natural, scenic, or open condition or in agricultural, horticultural, farming or forest use," N.C.G.S. § 121-35(1); and which provides for tax assessment of lands subject to such agreements "on the basis of the true value of the land and improvement less any reduction in value caused by the agreement," N.C.G.S. § 121-40.

NOW, THEREFORE, in consideration of the sum of **Sixty-Seven Thousand Seven Hundred and Seventy-Seven Dollars ($67,777.00)** and for other valuable considerations to the Grantor, and in consideration of the mutual covenants, terms, conditions and restrictions contained herein, the Grantor hereby grants and conveys unto the Grantee and its successors or assigns forever and in perpetuity a Conservation Easement of the nature and character and to the extent hereinafter set forth, in respect to the Conservation Easement Area of the Property of the Grantor situated in Chatham County, North Carolina; together with a Temporary Construction Easement; both as more particularly described below and in the plat entitled "Conservation Project U-2524WM Phillips Tract," dated October 28, 2004, prepared by Level Cross Surveying, PLLC, and recorded in Plat Book 2004, Page 371, of the Chatham County Registry. A reduced-size copy of the plat is attached hereto as Exhibit A and incorporated by reference. All subsequent references to the Conservation Easement shall include, where appropriate, reference to the Temporary Construction Easement.

The terms, conditions and restrictions of the Conservation Easement and Temporary Construction Easement are as hereinafter set forth:

1. Grant of Conservation Easement and Temporary Construction Easement

The Grantor hereby voluntarily grants and conveys to the Grantee, and the Grantee hereby voluntarily accepts, a perpetual Conservation Easement, which is an immediately vested interest in real property of the nature and character described herein. The Grantor agrees that it will not perform, nor knowingly allow others to perform, any act on or affecting the Conservation Easement Area that is inconsistent with the covenants herein. The Grantor authorizes the Grantee to enforce these covenants in the manner described below.

The Grantor hereby voluntarily grants and conveys to the Grantee all development rights for the Conservation Easement Area, except as otherwise reserved and provided by the terms of this Conservation Easement, that are now or hereafter inherent in the Conservation Easement Area. The parties agree that such rights are terminated and extinguished, and may not be used on or transmitted to any portion of the Property, as it now or hereafter may be bounded or described, or to any other property.

The Grantor hereby further grants and conveys to the Grantee a Temporary Construction Easement, in order that NCDOT, or its authorized representatives, including the Ecosystem Enhancement Program of the North Carolina Department of Environment and Natural Resources, may conduct the mitigation activities. NCDOT and its authorized representatives shall have the right to place equipment and materials on the Temporary Construction Easement as necessary. The Temporary Construction Easement will be valid until the completion of the construction and monitoring of the Stream Mitigation Project. Upon final approval by the USACE of the Stream Mitigation Project, the Temporary Construction Easement will dissolve and no longer be a part of this Conservation Easement. NCDOT will return any land in the Temporary Construction Easement that is disturbed as a result of the mitigation activities to its pre-disturbance state, if requested by the Grantor, after completion of the mitigation activities and final approval by the USACE.

2. Statement of Purpose, Duration

The primary purpose of the Conservation Easement is to protect the NCDOT's mitigation activities within the Conservation Easement Area, including the restored, enhanced, and preserved stream areas. Except as specifically permitted herein, no activity that shall significantly impair the condition of the restored, enhanced or preserved stream areas on the Conservation Easement Area shall be permitted.

This Conservation Easement shall be perpetual. It is an easement in gross, runs with the land and is enforceable by the Grantee against the Grantor, its representatives, heirs, successors and assigns, lessees, agents, and licensees.

3. Conservation Easement Area; Temporary Construction Easement

The Conservation Easement Area encompasses perennial streams, wetlands and surrounding land located on the Property, as more particularly depicted in Exhibit A, and is comprised of 14.42 total acres in two tracts labeled "Conservation Easement Area 1," consisting of 4.906 acres; and "Conservation Easement Area 2," consisting of 9.514 acres.

The Temporary Construction Easement consists of three areas, labeled on Exhibit A as "Staging Area 1," "Staging Area 2," and "Staging Area 3."

4. Access

The NCDOT and its authorized representatives, including the USACE and the Ecosystem Enhancement Program of the North Carolina Department of Environment and Natural Resources, at all reasonable times and continuing in perpetuity, shall have the right to access the Conservation Easement Area (1) in order to conduct and monitor the Stream Mitigation Project; and (2) for the purpose of inspecting the Conservation Easement Area to determine if the Grantor is complying with the terms, conditions, restrictions, and purposes of this Conservation Easement. This permanent access will be by way of State Road 1006 (Siler City Glendon Road), which is adjacent to the Conservation Easement Area. The NCDOT or its authorized representative will notify the Grantor by phone, email, or other correspondence before entering the Property for the purpose of determining compliance. However, if the NCDOT or its authorized representative in its sole discretion determines that circumstances require immediate entry, such party is not required to notify the Grantor prior to entry but will notify the Grantor within two business days of such entry.

5. Rights and Responsibilities Retained by the Grantor

Subject to the terms and restrictions contained herein, the Grantor reserves to and for itself and its successors all customary rights and privileges of ownership, including without limitation the right to quiet enjoyment of the Conservation Easement Area; the rights to sell, lease, encumber, impose restrictions on and devise the Conservation Easement Area, provided such transaction is subject to the terms of this Conservation Easement and written notice is provided to the Grantee; together with any rights not specifically prohibited by or limited by this Conservation Easement, and not inconsistent with the purposes of this Conservation Easement. Unless otherwise specified below, nothing in this Conservation Easement shall require the Grantor to take any action to restore the condition of the Conservation Easement Area after any Act of God or other event over which it had no control. The Grantor understands that nothing in this Conservation Easement relieves it of any obligation or restriction on the use of the Conservation Easement Area imposed by law.

6. Right to Privacy

The Grantor retains the right to privacy and the right to exclude any member of the public from trespassing on the Conservation Easement Area. This Conservation Easement does not create any rights of the public in, on or to the Conservation Easement Area, although the public

has the right to view the Conservation Easement Area from any adjacent publicly accessible areas.

7. Subdivision

The Conservation Easement Area may not be subdivided, partitioned nor conveyed from the Property, except in its current configuration as an entity or block of the Property.

8. Passive Recreational Use

The Grantor retains the right to engage in passive recreational uses of the Conservation Easement Area (requiring no surface alteration of the land and posing no threat to the conservation values set forth herein), including, without limitation, walking, fishing, hunting or animal and plant observation as long as such activity is consistent with the purposes of this Conservation Easement and is not prohibited by Paragraph 9 below.

9. Permitted and Restricted Activities

Any activity on, or use of, the designated Conservation Easement Area inconsistent with the purposes of this Conservation Easement is prohibited. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of the Conservation Easement. The Conservation Easement Area shall be maintained in its natural, scenic and open condition and restricted from any development that would significantly impair or interfere with the conservation values of this Conservation Easement Area, and any use or activity that causes or is likely to cause significant soil degradation or erosion or significant pollution of any surface or sub-surface waters is prohibited. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee.

Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited, restricted or reserved as indicated hereunder:

A. *Disturbance of Natural Features*

Any changes, disturbance, alteration or impairment of the natural, scenic and aesthetic features of the Conservation Easement Area or any introduction of non-native plants and/or animal species is prohibited unless the NCDOT gives its prior written consent or unless otherwise expressly permitted herein.

B. *Agricultural, Grazing, and Horticultural Use and Fencing*

Agricultural, grazing and horticultural use, including landscaping, of the Conservation Easement Area is prohibited. No herbicides, insecticides, fungicides, fertilizers or other potentially harmful substances may be used in the Conservation Easement Area without advance written permission from the NCDOT. No agricultural products or by-products may be disposed

of in the Conservation Easement Area or within 100 feet of the streambank, whichever is greater, or result in or cause discharge or runoff directly into the Conservation Easement Area. Existing fences may be repaired and replaced. After completion of the Stream Mitigation Project, Grantor will be responsible for maintenance of all fences.

C. *Silvicultural Use and Land Clearing*

There may be no destruction or cutting of trees or plants in the Conservation Easement Area, except upon written approval of NCDOT. The gathering of firewood in the Conservation Easement Area shall be limited to dead trees, such that the gathering is consistent with the purposes of this Conservation Easement. Removal of large live trees, or thinning of the forest or removal of brush for fire management, may be allowed in some cases provided that any such request is consistent with the purposes of this Conservation Easement and the Grantor obtains prior written approval from the NCDOT.

D. *Dumping and Storage*

Dumping or storage of soil, trash, refuse, debris, ashes, garbage, waste, abandoned vehicles or parts, appliances, machinery, or hazardous substances, or toxic or hazardous waste, or any placement of underground or aboveground storage tanks or other materials on the Conservation Easement Area is prohibited. No agricultural products or by-products, or agricultural equipment, may be dumped or stored in the Conservation Easement Area.

E. *Mineral Use, Excavation, and Dredging*

There shall be no filling, excavation, dredging, mining or drilling; no removal of topsoil, sand, gravel, rock, peat, minerals or other materials, and no change in the topography of the land in any manner on the Conservation Easement Area, or on adjacent property if owned by the Grantor or his successors, which would cause erosion or siltation on the Conservation Easement Area.

F. *Industrial Use*

Industrial activities on the Conservation Easement Area are prohibited.

G. *Residential Use*

Residential use of the Conservation Easement Area is prohibited.

H. *Commercial Use*

Commercial activities in the Conservation Easement Area are prohibited.

I. *Construction, Roads and Road Building, Motorized Vehicles*

There shall be no building, shed, facility, mobile home, or other structure constructed or placed in the Conservation Easement Area. No new roads, either paved or unpaved, may be constructed in the Conservation Easement Area except as allowed and described in the Stream Mitigation Plan. Motorized vehicles, including off-road vehicles, are prohibited in the Conservation Easement Area. However, the NCDOT expressly reserves the right to install, operate, and maintain structures or unpaved roads, and to use motorized vehicles in any manner necessary, for the purpose of reestablishing, protecting, and enhancing stream functional values, including those described in the Stream Mitigation Plan, for the Conservation Easement Area. All structures allowed under this paragraph, but not necessary for maintenance of the stream mitigation activities, will be removed once the USACE has given final approval of the Stream Mitigation Project. NCDOT, or its authorized representatives, will construct ford crossings or culverts at the four locations labeled "I/E Area" on Exhibit A. These crossings will not be removed after the Stream Mitigation Project is approved. Grantor is authorized to use these crossings, but may not improve or enlarge them without advance written consent from NCDOT. Grantor will be responsible for maintenance of the crossings after completion of the Stream Mitigation Project.

J. *Signs*

No signs shall be permitted in the Conservation Easement Area except interpretive signs describing activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, and signs giving directions or prescribing rules and regulations for the use of the Conservation Easement Area, which shall specifically include "No Trespassing," "No Hunting," and "Posted" signs, if applicable.

K. *Utilities*

The installation of utility systems, including, without limitation, water, sewer, power, fuel, and communication lines and related facilities, is prohibited. If there are existing utility easements located in the Conservation Easement Area or affecting the Conservation Easement Area, the Grantor shall notify the NCDOT if right-of-way clearing or other work in the Conservation Easement Area is scheduled by the utility. Any such clearing should be in keeping with the intent of the Conservation Easement.

L. *Water Quality and Drainage Patterns*

The Grantor shall conduct no activities in the Conservation Easement Area that would be detrimental to water quality or to any of the plants or habitats within the Conservation Easement Area, or that would alter natural water levels, drainage, sedimentation and/or flow in or over the Conservation Easement Area, or cause soil degradation or erosion. Diking, dredging, alteration, draining, filling or removal of wetlands or stream by the Grantor is prohibited. In addition, the Grantor is prohibited from diverting or causing or permitting the diversion of surface or

underground water into, within or out of the Conservation Easement Area by any means; polluting or discharging into waters, springs, seeps, or wetlands; or using pesticides or biocides in the Conservation Easement Area unless agreed to in writing by the NCDOT.

M. *NCDOT's Rights*

The NCDOT reserves the right to use the Conservation Easement Area in any way necessary, consistent with the terms herein, to undertake any activities to protect, restore, manage, maintain, or enhance stream or wetland functional values, and monitor the mitigation work, as described in the Stream Mitigation Plan, in order to mitigate for impacts to streams or wetlands resulting from road construction. These mitigation activities include, but are not limited to, construction of new stream channels; restoration/stabilization of existing stream channels; installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow; construction and maintenance of fences; planting of trees, shrubs and herbaceous vegetation; and utilization of heavy equipment to grade, fill, and prepare the soil. The NCDOT further reserves the right to monitor the results of the mitigation activities in perpetuity and to repair or restore any damage to the Conservation Easement Area occurring after initial completion of the construction associated with mitigation activities.

N. *Authorized Representatives*

For purposes of this Conservation Easement, NCDOT's authorized representatives include, but are not limited to, the United States Army Corps of Engineers and the Ecosystem Enhancement Program of the North Carolina Department of Environment and Natural Resources.

10. Ongoing Responsibilities of the Grantor

Other than as specified herein, this Conservation Easement is not intended to impose any legal or other responsibility on the Grantee, or in any way to affect any existing obligation of the Grantor as owner of the Property. Among other things, this shall apply to:

A. *Taxes*

The Grantor shall continue to be solely responsible for payment of all taxes and assessments levied against the Property. If the Grantee is ever required to pay any taxes or assessments on its interest in the Property, the Grantor will reimburse the Grantee for the same.

B. *Upkeep and Maintenance*

The Grantor retains all responsibilities and shall bear all costs and liabilities of any kinds related to the ownership, operation, upkeep and maintenance of the Property, including the maintenance of adequate comprehensive general liability insurance coverage. The Grantee shall have no obligation for the upkeep or maintenance of the Property.

C. *Liability and Indemnification*

The Grantor agrees to indemnify and hold the Grantee harmless from any and all costs, claims or liability, including but not limited to reasonable attorney's fees arising from any personal injury, accidents, negligence or damage relating to the Property, or any claim thereof, unless due to the intentional misconduct or negligence of the Grantee or their agents, in which case liability shall be apportioned accordingly.

11. Enforcement

The NCDOT shall have the right to prevent violations and remedy violations of the terms of this Conservation Easement through judicial action, which shall include, without limitation, the right to bring proceedings in law or in equity against any party or parties attempting to violate the terms of this Conservation Easement. Except when an ongoing or imminent violation could irreversibly diminish or impair the conservation values of the Conservation Easement Area, the NCDOT shall give the Grantor written notice of the violation and thirty (30) days to cure the violation, before commencing any legal proceedings. If a court with jurisdiction determines that a violation may exist or has occurred, the NCDOT may obtain an injunction to stop the violation, temporarily or permanently. The parties agree that a court may issue an injunction or order requiring the Grantor to restore the Conservation Easement Area to its condition prior to the violation as restoration of the Conservation Easement Area may be the only appropriate remedy. In any case where a court finds that a violation has occurred, the Grantor shall reimburse the NCDOT for all its expenses incurred in stopping and correcting the violation, including but not limited to court costs, attorneys' fees, and any other costs incurred with onsite remediation. If legal action is brought by the NCDOT and the court finds that no violation has occurred, each party shall bear its own costs. The failure of the NCDOT to discover a violation or to take immediate legal action shall not bar it from doing so at a later time for that violation or any subsequent violations.

12. Transfer of Easements

The Grantee shall have the right to transfer this Conservation Easement and Temporary Construction Easement to the Ecosystem Enhancement Program of the North Carolina Department of Environment and Natural Resources; or to any public agency or to a private nonprofit organization that, at the time of transfer, is a qualified organization under §170(h) of the U.S. Internal Revenue Code, as amended and under NCGS §121-34 *et seq.*, provided the agency or organization expressly agrees to assume the responsibility imposed on the transferring party or parties by this Conservation Easement. As a condition of such transfer, the Grantee shall require that the conservation purposes intended to be advanced hereunder shall be continued to be carried out.

13. Transfer of Property

The Grantor agrees to incorporate by reference the terms of this Conservation Easement and Temporary Construction Easement in any deed or other legal instrument by which it transfers or divests itself of any interests, including leasehold interests, in all or a portion of the Conservation Easement Area. Failure of the Grantor to comply with this section shall not impair the validity of this Conservation Easement and Temporary Construction Easement as to successor owners or limit their enforceability in any way, nor shall the Grantor's failure to comply with this section constitute a default under this Conservation Easement.

14. Amendment of Easements

This Conservation Easement and Temporary Construction Easement may be amended by a written instrument executed by the Grantee and the Grantor. Any such amendment shall be consistent with the purpose of this Conservation Easement and its terms, and shall comply with Section 170(h) of the Internal Revenue Code or any regulations promulgated in accordance with that section. Any such amendment shall be duly recorded.

15. Procedure in the Event of Changed Conditions

The grant or donation of this Conservation Easement gives rise to a property right immediately vested in the Grantee, with a fair market value equal to the proportionate value that the Conservation Easement bears to the value of the Property as a whole. That proportionate value of the Grantee's property rights shall remain constant. If a change in conditions occurs, which makes impossible or impractical any continued protection of the Conservation Easement Area for conservation purposes, the restrictions contained herein may only be extinguished by judicial proceeding. Any proceeds recovered in such actions shall be divided in accordance with the proportionate value of the Grantor's and Grantee's interests as specified herein; all expenses including attorneys' fees incurred by the Grantor and Grantee in such action shall be paid out of the recovered proceeds. The Grantee, its successors and assigns, shall be entitled to a portion of the proceeds of such sale, exchange, involuntary conversion of the Property, or any damage award with respect to any judicial proceeding. Upon such proceedings, such portion shall be equal to the proportionate value that the Grantee's, its successor's and assign's, interest in the Conservation Easement Area bears to the value of the Property as a whole as of the date of the recording of this Conservation Easement. "Proceeds of Sale" shall mean the cash value of all money and property paid, transferred or contributed in consideration for, or as otherwise required as a condition to the sale, exchange or involuntary conversion of the Conservation Easement Area, or any damages otherwise awarded as a result of judicial proceeding, minus the Grantor's expenses from such transaction or proceeding.

16. Procedure in the Event of Condemnation or Eminent Domain

Whenever all or part of the Property is taken by exercise of eminent domain by public, corporate or other authority, or by negotiated sale in lieu of condemnation, so as to abrogate the restrictions imposed by this Conservation Easement, the Grantor shall immediately give notice to

the Grantee and shall take all appropriate actions at the time of such taking or sale to recover the full value of the taking and all incidental or direct damages resulting from the taking. Any proceeds recovered in such actions shall be divided in accordance with the proportionate value of the Grantor's and Grantee's interests as specified herein; all expenses including attorneys' fees incurred by the Grantor and Grantee in such action shall be paid out of the recovered proceeds to the extent not paid by the condemning authority. The Grantee, its successors and assigns, shall be entitled to a portion of the proceeds of such sale, exchange, involuntary conversion of the Property, or any damage award with respect to any judicial proceeding. Such portion shall be equal to the proportionate value that the Grantee's, its successor's and assign's interest in the Conservation Easement Area bears to the value of the Property as a whole as of the date of the recording of this Conservation Easement. "Proceeds of Sale" shall mean the cash value of all money and property paid, transferred or contributed in consideration for, or as otherwise required as a condition to the sale, exchange or involuntary conversion of the Conservation Easement Area, or any damages otherwise awarded as a result of judicial proceeding, minus the Grantor's expenses from such transaction or proceeding.

17. Interpretation

This Conservation Easement shall be interpreted under the laws of the State of North Carolina, resolving any ambiguities and questions of the validity of specific provisions so as to give maximum effect to its conservation purposes.

18. Perpetual Duration; Severability

This Conservation Easement shall be a servitude running with the land in perpetuity. Every provision of this Conservation Easement that applies to the Grantor or the Grantee shall also apply to their respective agents, heirs, executors, administrators, assigns, and all other successors as their interests may appear. Invalidity of any of the covenants, terms or conditions of this Conservation Easement, or any part thereof, by court order or judgment shall in no way affect the validity of any of the other provisions hereof, which shall remain in full force and effect.

19. Notices

Any notices required by this Conservation Easement shall be in writing and shall be personally delivered or sent by first class mail to the parties respectively at the following addresses, unless a party has been notified in writing by the other of a change of address:

To the Grantor:
Gary Phillips and Ina Jane Phillips
7796 Siler City Glendon Road
Siler City, NC 27207

To NCDOT:
Natural Environment Unit
1548 Mail Service Center
Raleigh, NC 27699-1548

In any provision of this Conservation Easement in which the Grantor is required to provide advance notice to the Grantee of any activity on the Property, such notice shall be given not less than thirty days prior to the planned commencement of the activity. If the Grantee's approval is required, such approval shall be deemed withheld unless the Grantee provides to the Grantor written notice of approval within 30 days of receipt of said request. If the Grantor has received no response after said 30 days, the Grantor may send a second written notice to the Grantee requesting a statement of the reasons for the disapproval and the Grantee shall respond within 30 days with an explanation for the specific reasons and basis for its decision to disapprove.

20. Grantor's Title Warranty

The Grantor covenants and represents that the Grantor is the sole owner and is seized of the Property in fee simple and has good right to grant and convey the aforesaid Conservation Easement and Temporary Construction Easement; that the Conservation Easement Area and Temporary Construction Easement are free and clear of any and all encumbrances, except easements and leases of record or in effect by prescriptive rights as of the date hereto; and that there is legal access to the Property; and the Grantor covenants that the Grantee shall have the use of and enjoy all of the benefits derived from and arising out of the aforesaid easements conveyed.

21. Subsequent Liens

No provisions of this Conservation Easement should be construed as impairing the ability of the Grantor to use the Conservation Easement Area as collateral for subsequent borrowing. Any such liens shall be subordinated to this Conservation Easement.

22. Subsequent Easements/Restrictions

The grant of any easements or use restrictions that might diminish or impair the conservation values of the Conservation Easement Area are prohibited. Any such easements or restrictions shall be subordinated to this Conservation Easement.

23. Grantor's Environmental Warranty

The Grantor warrants that it has no actual knowledge of a release or threatened release of hazardous substances or wastes on the Property, as such substances and wastes are defined by applicable federal and state law, and hereby promises to defend and indemnify the Grantee against all litigation, claims, demands, penalties and damages, including reasonable attorneys' fees, arising from or connected with any release of hazardous waste caused by the intentional or

negligent act of the Grantor or violation of federal, state or local environmental laws caused by the negligent or intentional act of the Grantor. Without limiting the generality of the foregoing, nothing in this Conservation Easement shall be construed as giving rise to any right or ability in the Grantee, nor shall the Grantee have any right or ability, to exercise physical or managerial control over the day-to-day operations of the Property, or otherwise to become an operator with respect to the Property within the meaning of The Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended.

24. Entire Agreement

This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and Temporary Construction Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the said easements.

25. Recording

The Grantee shall record this instrument and any amendment hereto in timely fashion with the Office of the Register of Deeds of Chatham County, North Carolina, and may re-record it at any time as may be required to preserve its rights under this Conservation Easement.

26. Merger

The Parties agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interest in the Property.

TO HAVE AND TO HOLD this Conservation Easement unto the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, the Grantor and Grantee, intending to legally bind themselves, have set their hands on the date first written above.

GRANTORS:

_____ (Seal)
Gary Phillips

_____ (Seal)
Ina Jane Phillips

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NORTH CAROLINA
Chatham COUNTY

I, William Blair Schell, a Notary Public of Richmond County, North Carolina do hereby certify that Gary Phillips and Ina Jane Phillips personally appeared before me this day and executed the foregoing instrument.

Witness my hand and official stamp or seal this the 12 day of April, 2006.

William Blair Schell
Notary Public (SEAL)
My commission expires: 3-29-11

Accepted:

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GRANTEE:

THE NORTH CAROLINA DEPARTMENT
OF TRANSPORTATION

By: A.D. Allison, II
Assistant Manager, Right of Way Branch

NORTH CAROLINA
Wake COUNTY

I, Tracey C Humphries a Notary Public of Johnston County, North Carolina do hereby certify that A.D. Allison, II personally came before me this day and acknowledged that he is the Assistant Manager of the Right of Way Branch of the North Carolina Department of Transportation, an agency of the State of North Carolina, and that by authority duly given he executed the foregoing instrument.

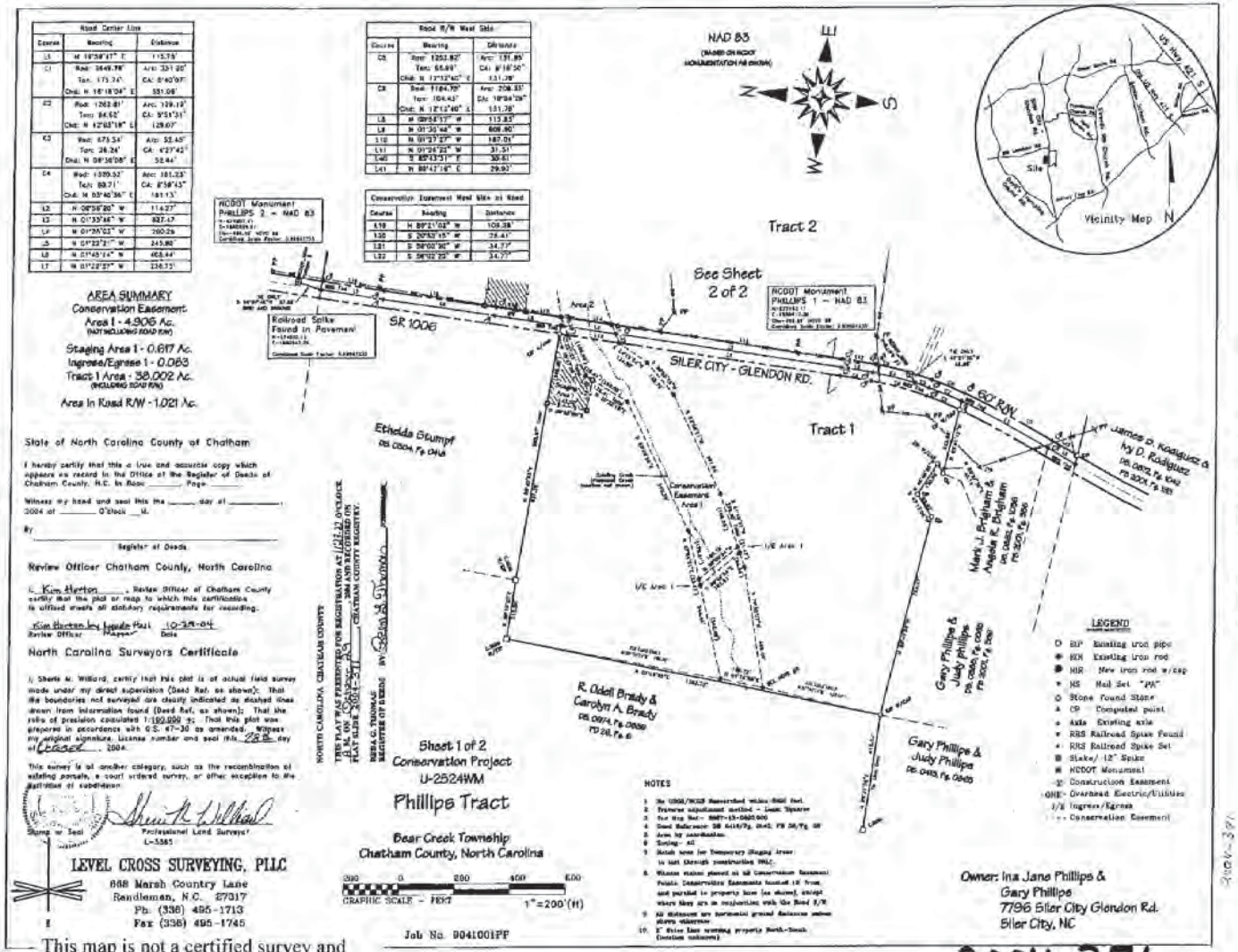
Witness my hand and official stamp or seal this the 29th day of June, 2006.

TRACEY C. HUMPHRIES
NOTARY
PUBLIC
JOHNSTON COUNTY, N.C.

Notary Public (SEAL)
My commission expires: 08-14-2010

EXHIBIT A

REDUCED-SIZE PLAT OF CONSERVATION EASEMENT AREA



This map is not a certified survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.

2004-371

(Box)

1279
0488

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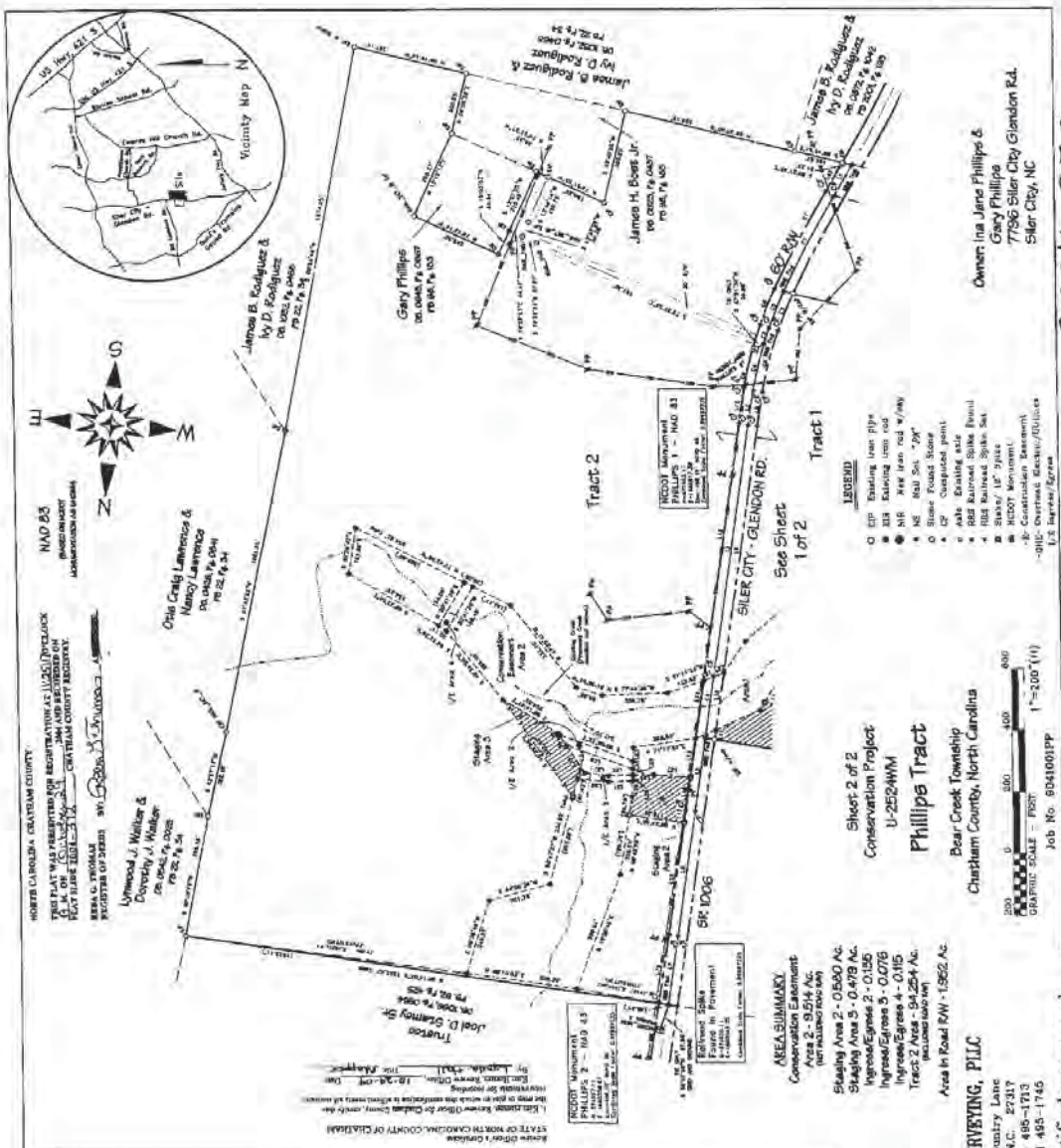
COE-none



This map is not a certified survey and has not been reviewed by a local government agency for compliance with any applicable land development regulations.

Appendix B:
Baseline Information Data

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

Project/Site:	**Bear Creek Stream Restoration Project**			Date:	**09/25/09**
Applicant/Owner:	**Wildlands Engineering**			County:	**Chatham**
Investigator(s):	**Matt Jenkins, PWS**			State:	**NC**
Do Normal Circumstances exist on the site?		(Yes)	No	Community ID:	**upland**
Is the site significantly disturbed (Atypical Situation)?		Yes	(No)	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)		Yes	(No)	Plot ID:	**DP1**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 *Rubus argutus*	shrub	FACU+	9		
2 *Xanthium strumarium*	herb	FAC	10		
3 *Ulmus alata*	tree	FACU+	11		
4 *Solidago canadensis*	herb	FACU	12		
5 *Ligustrum sinense*	shrub	FAC	13		
6 *Acer rubrum*	tree	FAC	14		
7 *Carya ovata*	tree	FACU	15		
8 *Festuca spp.*	herb	-	16		

Percent of Dominant Species that are OBL, FACW or FAC

43%

Remarks:

Less than 50% of the dominant species are FAC or wetter.

HYDROLOGY

Recorded Data (Describe in remarks):
- ____ Stream, Lake or Tide Gauge
- ____ Aerial Photographs
- ____ Other
- **X** No Recorded Data Available

Field Observations:

Depth of Surface Water:	**N/A**	(in.)
Depth to Free Water in Pit:	**N/A**	(in.)
Depth to Saturated Soil:	**>12**	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ____ Inundated
- ____ Saturated in Upper 12 Inches
- ____ Water Marks
- ____ Drift Lines
- ____ Sediment Deposits (on leaves)
- ____ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ____ Oxidized Root Channels in Upper 12 Inches
- ____ Water-Stained Leaves
- ____ Local Soil Survey Data
- ____ FAC-Neutral Test
- ____ Other (Explain in Remarks)

Remarks:

No indicators of wetland hydrology are present.

SOILS

Map Unit Name
(Series and Phase): **Riverview silt loam (RvA)** Drainage Class **well-drained**
Field Observations

Taxonomy (Subgroup): **thermic Fluventic Dystrudepts** Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12	**B**	**10YR 5/4**	**7.5YR 4/6**	**few/faint**	**silt loam**

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

Remarks:

No indicators of hydric soils are present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	(No) (Circle)	
Wetland Hydrology Present?	Yes	(No)	(Circle)
Hydric Soils Present?	Yes	(No)	Is this Sampling Point Within a Wetland? Yes (No)

Remarks:

Data point is representative of a non-jurisdictional upland area.

Approved by HQUSACE 2/92

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

Project/Site:	**Bear Creek Stream Restoration Project**			Date:	**09/25/09**
Applicant/Owner:	**Wildlands Engineering**			County:	**Chatham**
Investigator(s):	**Matt Jenkins, PWS**			State:	**NC**
Do Normal Circumstances exist on the site?		(Yes)	No	Community ID:	**upland**
Is the site significantly disturbed (Atypical Situation)?		Yes	(No)	Transect ID:	
Is the area a potential Problem Area? (If needed, explain on reverse.)		Yes	(No)	Plot ID:	**DP2**

VEGETATION

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1 *Rubus argutus*	shrub	FACU+	9		
2 *Ambrosia artemisiifolia*	herb	FACU	10		
3 *Ulmus alata*	tree	FACU+	11		
4 *Solidago canadensis*	herb	FACU	12		
5 *Ligustrum sinense*	shrub	FAC	13		
6 *Eupatorium capillifolium*	herb	FACU	14		
7 *Carya ovata*	tree	FACU	15		
8 *Festuca spp.*	herb	-	16		

Percent of Dominant Species that are OBL, FACW or FAC

14%

Remarks:

Less than 50% of the dominant species are FAC or wetter.

HYDROLOGY

Recorded Data (Describe in remarks):
- ____ Stream, Lake or Tide Gauge
- ____ Aerial Photographs
- ____ Other
- **X** No Recorded Data Available

Field Observations:

Depth of Surface Water:	**N/A**	(in.)
Depth to Free Water in Pit:	**N/A**	(in.)
Depth to Saturated Soil:	**>12**	(in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ____ Inundated
- ____ Saturated in Upper 12 Inches
- ____ Water Marks
- ____ Drift Lines
- ____ Sediment Deposits (on leaves)
- ____ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ____ Oxidized Root Channels in Upper 12 Inches
- ____ Water-Stained Leaves
- ____ Local Soil Survey Data
- ____ FAC-Neutral Test
- ____ Other (Explain in Remarks)

Remarks:

No indicators of wetland hydrology are present.

SOILS

Map Unit Name
(Series and Phase): **Callison-Misenheimer complex (CbC)** Drainage Class **mod. well-drained**
Field Observations

Taxonomy (Subgroup): **shallow Aquic Dystrudepts** Confirm Mapped Type? Yes (No)

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12	**B**	**10YR 4/4**	**N/A**	**N/A**	**silt loam**

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

Remarks:

No indicators of hydric soils are present.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	(No) (Circle)	
Wetland Hydrology Present?	Yes	(No)	(Circle)
Hydric Soils Present?	Yes	(No)	Is this Sampling Point Within a Wetland? Yes (No)

Remarks:

Data point is representative of a non-jurisdictional upland area.

Approved by HQUSACE 2/92

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

Date:	09/24/2009	Project:	Bear Creek Restoration	Latitude:	N 35.601944°
Evaluator:	MLJ	Site:	SCP1	Longitude:	W 79.467989°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**37.50**	County:	Chatham	Other *e.g. Quad Name:*	Bear Creek Reach A (Perennial RPW)

A. Geomorphology (Subtotal = 18.5)		Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	3.0	0	1	2	3
2. Sinuosity	1.0	0	1	2	3
3. In-channel structure: riffle-pool sequence	1.0	0	1	2	3
4. Soil texture or stream substrate sorting	2.0	0	1	2	3
5. Active/relic floodplain	3.0	0	1	2	3
6. Depositional bars or benches	1.0	0	1	2	3
7. Braided channel		0	1	2	3
8. Recent alluvial deposits	2.0	0	1	2	3
9[a]. Natural levees		0	1	2	3
10. Headcuts		0	1	2	3
11. Grade controls	1.0	0	0.5	1	1.5
12. Natural valley or drainageway	1.5	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	3.0	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 10.0)					
14. Groundwater flow/discharge	3.0	0	1	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	3.0	0	1	2	3
16. Leaflitter	1.5	1.5	1	0.5	0
17. Sediment on plants or debris	0.5	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0.5	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	1.5	No = 0		Yes = 1.5	

C. Biology (Subtotal = 9.00)					
20[b]. Fibrous roots in channel	2.0	3	2	1	0
21[b]. Rooted plants in channel	3.0	3	2	1	0
22. Crayfish		0	0.5	1	1.5
23. Bivalves		0	1	2	3
24. Fish		0	0.5	1	1.5
25. Amphibians	1.5	0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)		0	0.5	1	1.5
27. Filamentous algae; periphyton	1.0	0	1	2	3
28. Iron oxidizing bacteria/fungus.		0	0.5	1	1.5
29[b]. Wetland plants in streambed	1.50	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Strong presence of tadpoles. Water appears very turbid and silty, shows evidence of tannins.

Sketch:

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

Date:	09/24/2009	Project:	Bear Creek Restoration	Latitude:	N 35.600063°
Evaluator:	MLJ	Site:	SCP2	Longitude:	W 79.466563°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	**38.00**	County:	Chatham	Other *e.g. Quad Name:*	Bear Creek Reach B (Perennial RPW)

A. Geomorphology (Subtotal = 19.5)		Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	3.0	0	1	2	3
2. Sinuosity	1.0	0	1	2	3
3. In-channel structure: riffle-pool sequence	1.0	0	1	2	3
4. Soil texture or stream substrate sorting	3.0	0	1	2	3
5. Active/relic floodplain	3.0	0	1	2	3
6. Depositional bars or benches	1.0	0	1	2	3
7. Braided channel		0	1	2	3
8. Recent alluvial deposits	1.0	0	1	2	3
9[a]. Natural levees	1.0	0	1	2	3
10. Headcuts		0	1	2	3
11. Grade controls	1.0	0	0.5	1	1.5
12. Natural valley or drainageway	1.5	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	3.0	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 10.0)					
14. Groundwater flow/discharge	3.0	0	1	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season	3.0	0	1	2	3
16. Leaflitter	1.5	1.5	1	0.5	0
17. Sediment on plants or debris	0.5	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0.5	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	1.5	No = 0		Yes = 1.5	

C. Biology (Subtotal = 8.50)					
20[b]. Fibrous roots in channel	3.0	3	2	1	0
21[b]. Rooted plants in channel	3.0	3	2	1	0
22. Crayfish		0	0.5	1	1.5
23. Bivalves		0	1	2	3
24. Fish		0	0.5	1	1.5
25. Amphibians	1.5	0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)		0	0.5	1	1.5
27. Filamentous algae; periphyton	1.0	0	1	2	3
28. Iron oxidizing bacteria/fungus.		0	0.5	1	1.5
29[b]. Wetland plants in streambed		FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Channel exhibits increased incision and bank erosion from cattle activity. Strong presence of tadpoles. Water appears very turbid and silty, shows evidence of tannins.

Sketch:

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

Date:	09/24/2009	Project:	Bear Creek Restoration	Latitude:	N 35.599531°
Evaluator:	MLJ	Site:	SCP3	Longitude:	W 79.470262°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30*	33.25	County:	Chatham	Other *e.g. Quad Name:*	UT to Bear Creek (Perennial RPW)

A. Geomorphology (Subtotal = 16.5)		Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	2.0	0	1	2	3
2. Sinuosity	1.0	0	1	2	3
3. In-channel structure: riffle-pool sequence	1.0	0	1	2	3
4. Soil texture or stream substrate sorting	1.0	0	1	2	3
5. Active/relic floodplain	3.0	0	1	2	3
6. Depositional bars or benches	1.0	0	1	2	3
7. Braided channel	2.0	0	1	2	3
8. Recent alluvial deposits	1.0	0	1	2	3
9[a] Natural levees		0	1	2	3
10. Headcuts		0	1	2	3
11. Grade controls	0.5	0	0.5	1	1.5
12. Natural valley or drainageway	1.0	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	3.0	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 9.0)					
14. Groundwater flow/discharge	3.0	0	1	2	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	3.0	0	1	2	3
16. Leaflitter	1.5	1.5	1	0.5	0
17. Sediment on plants or debris		0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)		0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	1.5	No = 0		Yes = 1.5	

C. Biology (Subtotal = 7.75)					
20[b]. Fibrous roots in channel	2.0	3	2	1	0
21[b]. Rooted plants in channel	3.0	3	2	1	0
22. Crayfish		0	0.5	1	1.5
23. Bivalves		0	1	2	3
24. Fish		0	0.5	1	1.5
25. Amphibians	1.0	0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)		0	0.5	1	1.5
27. Filamentous algae; periphyton	1.0	0	1	2	3
28. Iron oxidizing bacteria/fungus.		0	0.5	1	1.5
29[b]. Wetland plants in streambed	0.75	FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

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

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

In-channel herbaceous species include *Polygonum pennsylvanicum* and *Juncus effusus*

Sketch:

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

Date: 09/24/2009	Project: Bear Creek Restoration	Latitude:	N 35.598709°
Evaluator: MLJ	Site: SCP4	Longitude:	W 79.472521°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30* **21.50**	County: Chatham	Other *e.g. Quad Name:*	UT to UT Bear Creek (Intermittent RPW)

A. Geomorphology (Subtotal = 10.0)		Absent	Weak	Moderate	Strong
1[a]. Continuous bed and bank	1.0	0	1	2	3
2. Sinuosity	2.0	0	1	2	3
3. In-channel structure: riffle-pool sequence		0	1	2	3
4. Soil texture or stream substrate sorting	1.0	0	1	2	3
5. Active/relic floodplain	3.0	0	1	2	3
6. Depositional bars or benches		0	1	2	3
7. Braided channel		0	1	2	3
8. Recent alluvial deposits	2.0	0	1	2	3
9[a] Natural levees		0	1	2	3
10. Headcuts		0	1	2	3
11. Grade controls	0.5	0	0.5	1	1.5
12. Natural valley or drainageway	0.5	0	0.5	1	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.		No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 5.5)					
14. Groundwater flow/discharge	1.0	0	1	2	3
15. Water in channel and > 48 hrs since rain, **or** Water in channel -- dry or growing season		0	1	2	3
16. Leaflitter	1.5	1.5	1	0.5	0
17. Sediment on plants or debris	1.0	0	0.5	1	1.5
18. Organic debris lines or piles (Wrack lines)	0.5	0	0.5	1	1.5
19. Hydric soils (redoximorphic features) present?	1.5	No = 0		Yes = 1.5	

C. Biology (Subtotal = 6.00)					
20[b]. Fibrous roots in channel	3.0	3	2	1	0
21[b]. Rooted plants in channel	3.0	3	2	1	0
22. Crayfish		0	0.5	1	1.5
23. Bivalves		0	1	2	3
24. Fish		0	0.5	1	1.5
25. Amphibians		0	0.5	1	1.5
26. Macrobenthos (note diversity and abundance)		0	0.5	1	1.5
27. Filamentous algae; periphyton		0	1	2	3
28. Iron oxidizing bacteria/fungus.		0	0.5	1	1.5
29[b]. Wetland plants in streambed		FAC = 0.5; FACW = 0.75; OBL = 1.5 SAV = 2.0; Other = 0			

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

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

Stream is a small channel in the wooded floodplain of UT to Bear Creek. Sandy substrate, hydric soils, active cattle grazing.

Sketch:

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP1 – Bear Creek Reach A (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 9/25/09
4. Time of Evaluation: 10:15am
5. Name of Stream: Bear Creek
6. River Basin: Cape Fear 03030003
7. Approximate Drainage Area: 4 sq. miles
8. Stream Order: Second
9. Length of Reach Evaluated: 400 lf
10. County: Chatham
11. Location of reach under evaluation (include nearby roads and landmarks): From downtown Greensboro, NC, travel south on US-421 for approximately 34 miles. Turn right onto Foust Road/NC-2118, continue on Mount Vernon Springs Road. Travel approximately 2 miles and turn left at Petty Road; travel approximately 1 miles and take first right onto Bonlee Bennett Road. After approximately 1 mile, take first left onto Siler City Glendon Road and continue approximately 2.5 miles to Bear Creek Site.
12. Site Coordinates (if known): N 35.601944°, W 79.467989 °
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: rain within the past 24 hours
15. Site conditions at time of visit: overcast, 75°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~10acres
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: 1 % Residential ___% Commercial ___% Industrial 30 % Agricultural 70 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 10-20 feet
22. Bank Height (from bed to top of bank): 3-4 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

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

Total Score (from reverse): 34 **Comments: Channel is heavily impacted from active cattle grazing.**

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP1 – Bear Creek Reach A (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	1
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	0
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	2
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	1
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	2
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	1
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	1
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	0
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						34

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP2 – Bear Creek Reach B (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 9/25/09
4. Time of Evaluation: 11:00am
5. Name of Stream: Bear Creek
6. River Basin: Cape Fear 03030003
7. Approximate Drainage Area: 4.99 sq. miles
8. Stream Order: Third
9. Length of Reach Evaluated: 500 lf
10. County: Chatham
11. Location of reach under evaluation (include nearby roads and landmarks): From downtown Greensboro, NC, travel south on US-421 for approximately 34 miles. Turn right onto Foust Road/NC-2118, continue on Mount Vernon Springs Road. Travel approximately 2 miles and turn left at Petty Road; travel approximately 1 miles and take first right onto Bonlee Bennett Road. After approximately 1 mile, take first left onto Siler City Glendon Road and continue approximately 2.5 miles to Bear Creek Site.
12. Site Coordinates (if known): N 35.600063°, W 79.466563°
13. Proposed Channel Work (if any): enhancement
14. Recent Weather Conditions: rain within the past 24 hours
15. Site conditions at time of visit: overcast, 75°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~10acres
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: 1 % Residential ___% Commercial ___% Industrial 30 % Agricultural 70 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 20-25 feet
22. Bank Height (from bed to top of bank): 5-6 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight X Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

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

Total Score (from reverse): 42 **Comments: Channel exhibits vertical, eroding banks, some areas heavily trampled from active cattle grazing.**

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP2 – Bear Creek Reach B (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	2
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	1
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	4
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	0
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	0
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	2
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	3
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	2
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	4
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	0
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						42

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP3 – UT to Bear Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 9/25/09
4. Time of Evaluation: 12:30pm
5. Name of Stream: UT to Bear Creek
6. River Basin: Cape Fear 03030003
7. Approximate Drainage Area: 565 acres
8. Stream Order: Second
9. Length of Reach Evaluated: 400 lf
10. County: Chatham
11. Location of reach under evaluation (include nearby roads and landmarks): From downtown Greensboro, NC, travel south on US-421 for approximately 34 miles. Turn right onto Foust Road/NC-2118, continue on Mount Vernon Springs Road. Travel approximately 2 miles and turn left at Petty Road; travel approximately 1 miles and take first right onto Bonlee Bennett Road. After approximately 1 mile, take first left onto Siler City Glendon Road and continue approximately 2.5 miles to Bear Creek Site.
12. Site Coordinates (if known): N 35.599531°, W 79.470262°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: rain within the past 24 hours
15. Site conditions at time of visit: partly cloudy, 80°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? (YES) NO If yes, estimate the water surface area: ~2acres
18. Does channel appear on USGS quad map? (YES) NO 19. Does channel appear on USDA Soil Survey? (YES) NO
20. Estimated Watershed Land Use: ___% Residential ___% Commercial ___% Industrial 60 % Agricultural 30 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 8-10 feet
22. Bank Height (from bed to top of bank): 1-2 feet
23. Channel slope down center of stream: X Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: X Straight ___Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

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

Total Score (from reverse): 33 **Comments:** _____

Evaluator's Signature _____ **Date** _____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP3 – UT to Bear Creek (Perennial RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	4
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	1
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	0
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	1
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	4
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	3
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	0
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	2
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	2
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	0
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	1
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	0
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						33

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP4 – UT to UT Bear Creek (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 9/25/09
4. Time of Evaluation: 1:00pm
5. Name of Stream: UT to UT Bear Creek
6. River Basin: Cape Fear 03030003
7. Approximate Drainage Area: 25 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Chatham
11. Location of reach under evaluation (include nearby roads and landmarks): From downtown Greensboro, NC, travel south on US-421 for approximately 34 miles. Turn right onto Foust Road/NC-2118, continue on Mount Vernon Springs Road. Travel approximately 2 miles and turn left at Petty Road; travel approximately 1 miles and take first right onto Bonlee Bennett Road. After approximately 1 mile, take first left onto Siler City Glendon Road and continue approximately 2.5 miles to Bear Creek Site.
12. Site Coordinates (if known): N 35.598709°, W 79.472521°
13. Proposed Channel Work (if any): N/A
14. Recent Weather Conditions: rain within the past 24 hours
15. Site conditions at time of visit: partly cloudy, 80°
16. Identify any special waterway classifications known: ___Section 10 ___Tidal Waters ___Essential Fisheries Habitat ___Trout Waters ___Outstanding Resource Waters ___ Nutrient Sensitive Waters ___Water Supply Watershed ____(I-IV)
17. Is there a pond or lake located upstream of the evaluation point? YES (NO) If yes, estimate the water surface area:_____
18. Does channel appear on USGS quad map? YES (NO) 19. Does channel appear on USDA Soil Survey? YES (NO)
20. Estimated Watershed Land Use: ___% Residential ___% Commercial ___% Industrial ___% Agricultural 100 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 4-6 feet 22. Bank Height (from bed to top of bank): 6-12 inches
23. Channel slope down center of stream: _X_Flat (0 to 2%) ___Gentle (2 to 4%) ___Moderate (4 to 10%) ___Steep (>10%)
24. Channel Sinuosity: ____Straight _X_Occasional Bends ___Frequent Meander ___Very Sinuous ___Braided Channel

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

Total Score (from reverse): 38 **Comments:**_____

Evaluator's Signature_____ **Date**_____

This channel evaluation form is intended to be used only as a guide to assist landowners and environmental professionals in gathering the data required by the United States Army Corps of Engineers in order to make a preliminary assessment of stream quality. The total score resulting from the completion of this form is subject to USACE approval and does not imply a particular mitigation ratio or requirement. Form subject to change – version 05/03. To Comment, please call 919-876-8441 x 26.

STREAM QUALITY ASSESSMENT WORKSHEET
SCP4 – UT to UT Bear Creek (Intermittent RPW)

	#	CHARACTERISTICS	ECOREGION POINT RANGE			SCORE
			Coastal	Piedmont	Mountain	
PHYSICAL	1	**Presence of flow / persistent pools in stream** (no flow or saturation = 0; strong flow = max points)	0 – 5	0 – 4	0 – 5	0
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	3
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	2
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	2
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	0
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	3
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	0
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	3
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	1
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	0
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	0
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	1
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	19	**Substrate embeddedness** (deeply embedded = 0; loose structure = max)	NA*	0 – 4	0 – 4	0
BIOLOGY	20	**Presence of stream invertebrates** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 5	0 – 5	0
	21	**Presence of amphibians** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	0
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	0
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						38

* These characteristics are not assessed in coastal streams.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): October 1, 2009

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:Raleigh Regional Office

C. PROJECT LOCATION AND BACKGROUND INFORMATION: Bear Creek Stream Restoration Project, Bear Creek, NC - Bear Creek

State:NC County/parish/borough: Chatham City: Bear Creek
Center coordinates of site (lat/long in degree decimal format): Lat. 35.601944° **N**, Long. 79.467989° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: Bear Creek

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Deep River
Name of watershed or Hydrologic Unit Code (HUC): Cape Fear 03030003

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: September 28, 2009
☒ Field Determination. Date(s): September 25, 2009

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☐ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:
Non-wetland waters: 1,900 linear feet: 10-20width (ft) and/or 0.65 acres.
Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: **1987 Delineation Manual**
Elevation of established OHWM (if known): .

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW
Identify TNW: .

Summarize rationale supporting determination: .

2. Wetland adjacent to TNW
Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:
Watershed size: **Pick List**
Drainage area: **Pick List**
Average annual rainfall: inches
Average annual snowfall: inches

(ii) Physical Characteristics:
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☐ Tributary flows through **Pick List** tributaries before entering TNW.

Project waters are **Pick List** river miles from TNW.
Project waters are **Pick List** river miles from RPW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Project waters are **Pick List** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: .
Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):

☐ Silts	☐ Sands	☐ Concrete
☐ Cobbles	☐ Gravel	☐ Muck
☐ Bedrock	☐ Vegetation. Type/% cover:	
☐ Other. Explain: .		

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):

☐ clear, natural line impressed on the bank	☐ the presence of litter and debris
☐ changes in the character of soil	☐ destruction of terrestrial vegetation
☐ shelving	☐ the presence of wrack line
☐ vegetation matted down, bent, or absent	☐ sediment sorting
☐ leaf litter disturbed or washed away	☐ scour
☐ sediment deposition	☐ multiple observed or predicted flow events
☐ water staining	☐ abrupt change in plant community
☐ other (list):	

☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☐ High Tide Line indicated by:	☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects	☐ survey to available datum;
☐ fine shell or debris deposits (foreshore)	☐ physical markings;
☐ physical markings/characteristics	☐ vegetation lines/changes in vegetation types.
☐ tidal gauges	
☐ other (list):	

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

- ☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: Bear Creek was determined to be a perennial channel and exhibited a strong bed and bank, strong perennial flow, and an average ordinary high water width of 10-20 feet. This channel exhibited weakly-defined riffle-pool sequences and substrate consisting of coarse sand to large cobbles. Biological sampling within this channel revealed a strong presence of amphibians. Heavy turbidity and silt in the water yielded poor habitat for benthic macroinvertebrate species. Scores for Bear Creek on the USACE Stream Quality Assessment Worksheet ranged from 34 to 42 out of a possible 100 points and from 37.5 to 38 out of a possible 71 points on the NCDWQ Stream Classification Form, indicating perennial status (SCP1 & SCP2, enclosed).

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: **1,900** linear feet **10-20** width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. Non-RPWs[8] that flow directly or indirectly into TNWs.
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. Impoundments of jurisdictional waters.[9]
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall 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:Bear Creek, NC; 1:2000.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation:NRCS soils GIS data layer.
☐ National wetlands inventory map(s). Cite name: .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): .
or ☒ Other (Name & Date):see attached report.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): October 1, 2009

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:Raleigh Regional Office

C. PROJECT LOCATION AND BACKGROUND INFORMATION: Bear Creek Stream Restoration Project, Bear Creek, NC - UT to Bear Creek

State:NC County/parish/borough: Chatham City: Bear Creek
Center coordinates of site (lat/long in degree decimal format): Lat. 35.601944° **N**, Long. 79.467989° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: Bear Creek

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Deep River
Name of watershed or Hydrologic Unit Code (HUC): Cape Fear 03030003

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: September 28, 2009
☒ Field Determination. Date(s): September 25, 2009

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☐ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:
Non-wetland waters: 1,780 linear feet: 5-8width (ft) and/or 0.27 acres.
Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: **1987 Delineation Manual**
Elevation of established OHWM (if known): .

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW
Identify TNW: .

Summarize rationale supporting determination: .

2. Wetland adjacent to TNW
Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:
Watershed size: **Pick List**
Drainage area: **Pick List**
Average annual rainfall: inches
Average annual snowfall: inches

(ii) Physical Characteristics:
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☐ Tributary flows through **Pick List** tributaries before entering TNW.

Project waters are **Pick List** river miles from TNW.
Project waters are **Pick List** river miles from RPW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Project waters are **Pick List** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: .

Identify flow route to TNW[5]: .
Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):

☐ Silts	☐ Sands	☐ Concrete
☐ Cobbles	☐ Gravel	☐ Muck
☐ Bedrock	☐ Vegetation. Type/% cover:	
☐ Other. Explain: .		

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):

☐ clear, natural line impressed on the bank	☐ the presence of litter and debris
☐ changes in the character of soil	☐ destruction of terrestrial vegetation
☐ shelving	☐ the presence of wrack line
☐ vegetation matted down, bent, or absent	☐ sediment sorting
☐ leaf litter disturbed or washed away	☐ scour
☐ sediment deposition	☐ multiple observed or predicted flow events
☐ water staining	☐ abrupt change in plant community
☐ other (list):	

☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☐ High Tide Line indicated by:	☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects	☐ survey to available datum;
☐ fine shell or debris deposits (foreshore)	☐ physical markings;
☐ physical markings/characteristics	☐ vegetation lines/changes in vegetation types.
☐ tidal gauges	
☐ other (list):	

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

- ☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: UT to Bear Creek was determined to be a perennial channel and exhibited a strong bed and bank, strong perennial flow, and an average ordinary high water width of 8-10 feet. This channel exhibited weakly-defined riffle-pool sequences and substrate consisting of coarse sand to large gravel. Biological sampling within this channel revealed a strong presence of amphibians. Heavy turbidity in the water and embedded substrate yielded poor habitat for benthic macroinvertebrate species. UT to Bear Creek scored 33 out of 100 possible points on the USACE Stream Quality Assessment Worksheet and 33.25 out of a possible 71 points on the NCDWQ Stream Classification Form, indicating perennial status (SCP3, enclosed).

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: **1,780** linear feet**5-8**width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. Non-RPWs[8] that flow directly or indirectly into TNWs.
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: **.**

4. Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **.**

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. Impoundments of jurisdictional waters.[9]
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.

[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall 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:Bear Creek, NC; 1:2000.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation:NRCS soils GIS data layer.
☐ National wetlands inventory map(s). Cite name: .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): .
or ☒ Other (Name & Date):see attached report.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): October 1, 2009

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:Raleigh Regional Office

C. PROJECT LOCATION AND BACKGROUND INFORMATION: Bear Creek Stream Restoration Project, Bear Creek, NC - UT to UT Bear Creek

State:NC County/parish/borough: Chatham City: Bear Creek
Center coordinates of site (lat/long in degree decimal format): Lat. 35.601944° **N**, Long. 79.467989° **W**.
Universal Transverse Mercator:
Name of nearest waterbody: Bear Creek

Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Deep River
Name of watershed or Hydrologic Unit Code (HUC): Cape Fear 03030003

☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: September 28, 2009
☒ Field Determination. Date(s): September 25, 2009

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

☐ TNWs, including territorial seas
☐ Wetlands adjacent to TNWs
☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
☐ Non-RPWs that flow directly or indirectly into TNWs
☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
☐ Impoundments of jurisdictional waters
☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:
Non-wetland waters: 174 linear feet: 3-4width (ft) and/or 0.01 acres.
Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: **1987 Delineation Manual**
Elevation of established OHWM (if known): .

2. Non-regulated waters/wetlands (check if applicable):[3]

☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. TNW
Identify TNW: .

Summarize rationale supporting determination: .

2. Wetland adjacent to TNW
Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. Characteristics of non-TNWs that flow directly or indirectly into TNW

(i) General Area Conditions:
Watershed size: 25 **acres**
Drainage area: 469 **acres**
Average annual rainfall: 40 inches
Average annual snowfall: 6 inches

(ii) Physical Characteristics:
(a) Relationship with TNW:
☐ Tributary flows directly into TNW.
☒ Tributary flows through **3** tributaries before entering TNW.

Project waters are **15-20** river miles from TNW.
Project waters are **1 (or less)** river miles from RPW.
Project waters are **10-15** aerial (straight) miles from TNW.
Project waters are **1 (or less)** aerial (straight) miles from RPW.
Project waters cross or serve as state boundaries. Explain: N/A.

Identify flow route to TNW[5]: Intermittent UT flows to perennial UT Bear Creek, to Bear Creek, to Rocky River.
Tributary stream order, if known: First.

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☒ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: 3-4 feet
Average depth: .5-1 feet
Average side slopes: **2:1.**

Primary tributary substrate composition (check all that apply):

☒ Silts	☒ Sands	☐ Concrete
☐ Cobbles	☐ Gravel	☐ Muck
☐ Bedrock	☐ Vegetation. Type/% cover:	
☐ Other. Explain: .		

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: channel heavily trampled from active cattle grazing.

Presence of run/riffle/pool complexes. Explain: weak to none, poor substrate.
Tributary geometry: **Relatively straight**
Tributary gradient (approximate average slope): 0.001 %

(c) Flow:
Tributary provides for: **Intermittent but not seasonal flow**
Estimate average number of flow events in review area/year: **11-20**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Confined.** Characteristics: ordinary high water marks are visible, relatively shallow channel.

Subsurface flow: **Yes**. Explain findings: sandy hydric soils.
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☒ Bed and banks
☒ OHWM[6] (check all indicators that apply):

☒ clear, natural line impressed on the bank	☒ the presence of litter and debris
☒ changes in the character of soil	☐ destruction of terrestrial vegetation
☐ shelving	☐ the presence of wrack line
☐ vegetation matted down, bent, or absent	☐ sediment sorting
☐ leaf litter disturbed or washed away	☐ scour
☒ sediment deposition	☐ multiple observed or predicted flow events
☒ water staining	☐ abrupt change in plant community
☐ other (list):	

☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):

☐ High Tide Line indicated by:	☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects	☐ survey to available datum;
☐ fine shell or debris deposits (foreshore)	☐ physical markings;
☐ physical markings/characteristics	☐ vegetation lines/changes in vegetation types.
☐ tidal gauges	
☐ other (list):	

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: Channel is located in a forested floodplain of an adjacent perennial channel. This reach is heavily trampled from active cattle grazing. Channel maintains a weak bed & bank.
Identify specific pollutants, if known: general agricultural runoff from cattle.

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

☒ Riparian corridor. Characteristics (type, average width): forested canopy cover, no supported vegetation adjacent to or within the channel, however.

☐ Wetland fringe. Characteristics: .

☐ Habitat for:

- ☐ Federally Listed species. Explain findings: .
- ☐ Fish/spawn areas. Explain findings: .
- ☐ Other environmentally-sensitive species. Explain findings: .
- ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: acres

Wetland type. Explain: .

Wetland quality. Explain: .

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Pick List**. Explain: .

Surface flow is**: Pick List**

Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .

☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

☐ Directly abutting

☐ Not directly abutting

- ☐ Discrete wetland hydrologic connection. Explain: .
- ☐ Ecological connection. Explain: .
- ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **Pick List** river miles from TNW.

Project waters are **Pick List** aerial (straight) miles from TNW.

Flow is from: **Pick List.**

Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

☐ Riparian buffer. Characteristics (type, average width): .

☐ Vegetation type/percent cover. Explain: .

☐ Habitat for:

- ☐ Federally Listed species. Explain findings: .
- ☐ Fish/spawn areas. Explain findings: .
- ☐ Other environmentally-sensitive species. Explain findings: .
- ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **Pick List**

Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   - ☒ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: This UT was determined to be an intermittent channel due to indications of seasonal flow including, weak sandy substrate, hydric soil indicators, water staining, and bank impressions indicating an average ordinary high water width of 3-4 feet. This channel is located in the forested floodplain of perennial channel and receives higher flow regimes during storm events from its 25-acre watershed. UT to UT Bear Creek scored 38 out of 100 possible points on the USACE Stream Quality

Assessment Worksheet and 21.5 out of a possible 71 points on the NCDWQ Stream Classification Form, indicating intermittent status (SCP4, enclosed).

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: **174** linear feet **3-4** width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. Non-RPWs[8] that flow directly or indirectly into TNWs.
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: **.**

4. Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **.**

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. Impoundments of jurisdictional waters.[9]
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall 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:Bear Creek, NC; 1:2000.
☒ USDA Natural Resources Conservation Service Soil Survey. Citation:NRCS soils GIS data layer.
☐ National wetlands inventory map(s). Cite name: .
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): .
or ☒ Other (Name & Date):see attached report.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

Bear Creek
7796 Siler City Glendon Road
Bear Creek, NC 27207

Inquiry Number: 2602386.4
September 30, 2009

The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDRs professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Date EDR Searched Historical Sources:

Aerial Photography September 30, 2009

Target Property:

7796 Siler City Glendon Road

Bear Creek, NC 27207

Year	*Scale*	*Details*	*Source*
1961	Aerial Photograph. Scale: 1"=1000'	Panel #: 2435079-E4/Flight Date: October 27, 1961	EDR
1973	Aerial Photograph. Scale: 1"=1000'	Panel #: 2435079-E4/Flight Date: March 01, 1973	EDR
1983	Aerial Photograph. Scale: 1"=1000'	Panel #: 2435079-E4/Flight Date: April 12, 1983	EDR
1993	Aerial Photograph. Scale: 1"=750'	Panel #: 2435079-E4/Flight Date: January 30, 1993	EDR
1999	Aerial Photograph. Scale: 1"=750'	Panel #: 2435079-E4/Flight Date: February 14, 1999	EDR
2006	Aerial Photograph. 1" = 604'	Flight Year: 2006	EDR


INQUIRY #: 2602386.4
YEAR: 1961
= 1000'
N


INQUIRY #: 2602386.4
YEAR: 1973
= 1000'
N


INQUIRY #: 2602386.4
YEAR: 1983
= 1000'
N


INQUIRY #: 2602386.4
YEAR: 1993
= 750'
N


INQUIRY #: 2602386.4
YEAR: 1999
= 750'
N


INQUIRY #: 2602386.4
YEAR: 2006
= 604'
N

Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Bear Creek Reach A
Bear Creek Reach B
UT to Bear Creek
Photo Locations
Recorded Conservation Easement
Proposed Modified Conservation Easement

0 200 400 Feet

N

Figure B-1. Site Photos
Bear Creek
Restoration Project

Chatham County, NC

Photo 1-View of left bank erosion along Bear Creek Reach A, facing downstream.

Photo 2-View of severe bank erosion along right bank of Bear Creek Reach, facing downstream.

Photo 3-View of existing equipment crossing over Bear Creek Reach A, facing upstream.

Photo 4-View of Bear Creek Reach B, facing upstream.

Photo 5- View of erosion along right bank of Bear Creek Reach B, facing downstream.

Photo 6-View of right bank erosion on Bear Creek Reach B, facing downstream.

Photo 7-View of sediment deposition and vertical banks, downstream portion of Bear Creek.

Photo 8-View of over-wide section of UT to Bear Creek at Siler City Glendon Road.

Photo 9-View of UT to Bear Creek, facing upstream from Siler City Glendon Road.

Photo 10-View of UT to Bear Creek, facing upstream.

Photo 11-View of upstream portion of UT to Bear Creek, facing downstream.

Photo 12-View of small intermittent channel located in the western portion of the project easement.

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:	Bear Creek Restoration Project
County Name:	Chatham County
EEP Number:	
Project Sponsor:	Wildlands Engineering, Inc.
Project Contact Name:	Andrea Spangler
Project Contact Address:	1430 S. Mint Street, Suite 104, Charlotte, NC 28203
Project Contact E-mail:	aspangler@wildlandsinc.com (704)332-7754
EEP Project Manager:	Melonie Allen

Project Description

The Bear Creek Restoration Project is a stream restoration project located off Siler City Glendon Road on a section of Bear Creek and its tributary southwest of the Siler City in Chatham County, NC. The project will provide stream mitigation units to NCEEP in the Cape Fear River Basin (HUC 03030003, NCDWQ Subbasin 03-06-12). The mitigation project involves a combination of restoration and enhancement on over 3,000 linear feet of stream.

For Official Use Only

Reviewed By:

1-19-10
Date

Melonie Allen
EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

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

Final Approval By:

1-19-10
Date

David Stilwell
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

EEP Floodplain Requirements Checklist

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

Project Location

Name of project:	Bear Creek (Phillips Site) Stream Restoration
Name of stream or feature:	Bear Creek (FEMA mapped) and UT to Bear Creek (not FEMA-mapped)
County:	Chatham
Name of river basin:	Cape Fear
Is project urban or rural?	rural
Name of Jurisdictional municipality/county:	Chatham County
DFIRM panel number for entire site:	Community: Chatham County (Unincorporated) Community No. 370299 FIRM Panel: 8666 Map Number: 3710866600J
Consultant name:	Wildlands Engineering, Inc. Emily Reinicker, PE, CFM
Phone number:	704-332-7754
Address:	1430 S. Mint Street, Suite 104 Charlotte, NC 28203

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500'.
Please see attached figure.

Summarize stream reaches or wetland areas according to their restoration priority.
The construction of Bear Creek will be comprised of Rosgen Priority 2 restoration of dimension, pattern, and profile. A stable cross-section will be designed to flood onto an excavated floodplain bench at flows greater than the 1.5-year bankfull event. A meandering pattern will be restored. The unnamed tributary (UT) to Bear Creek will also be restored to a meandering channel. No wetland work is proposed.

Example

Reach	Length	Priority
Bear Creek Reach A	996 LF	Priority 2 Restoration
Bear Creek Reach B	1,156 LF	Priority 2 Restoration
UT to Bear Creek	1,992 LF	Priority 1 Restoration

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?
YES- Bear Creek Reaches A and B only; UT to Bear Creek is not located in SFHA

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

☐ 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

Name of Local Floodplain Administrator: Mr. Fred Royal
Phone Number: 919-542-8268

Floodplain Requirements

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

☐ No Action

☐ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☐ Other Requirements

List other requirements:

Comments:

Name: Emily G. Reinicker, PE, CFM Signature: _____

Title: Water Resources Engineer Date: 11/10/2010

Appendix C:
Mitigation Work Plan
Data and Analysis

Target Stream Type - Reference Reaches Consulted for Design

Data from the Spencer Creek reference site located in the Uwharrie National Forest will be used from the UT to Barnes Restoration Plan by Buck Engineering (2004).

> The reference reach is located on Spencer Creek in a mature forested area with 20- to 50-year-old forest growth. The reference reach is vertically and horizontally stable, has excellent pattern with a sinuosity measurement greater than 2.2, has deep pools at outside of bends, has several points of aeration in the form of both riffles and woody debris jams, and shows excellent habitat potential. The reference reach data were useful in evaluating the evolutionary endpoint of the project with the realization that without the mature vegetation observed on the reference reach, the extreme dimensionless ratios are not appropriate for a newly-restored stream with little or no bank and floodplain vegetation.

This reference site is classified as Rosgen E4 channel. Spencer Creek has a drainage area of 0.96 square miles at the reference survey site. This drainage area is within an order of magnitude of Bear Creek and the UT to Bear Creek drainage areas, which is generally accepted as an appropriate range for reference parameters. The site is located approximately 30 miles from the Bear Creek site, in the adjacent Yadkin River basin (03040103). Overall, the Spencer Creek site is vertically and horizontally stable; has stable, natural dimension, pattern, and profile; and has excellent habitat value. Figures C-1, C-2, and C-3 illustrate the location, watershed, and soils mapping for the reference site. Representative photographs are attached.

Target Plant Communities - Reference Sites Consulted for Design

HDR's 2003 Stream Mitigation Plan evaluated vegetation at the UT to Bear Creek site, located several miles downstream from the project site at NC 902 in Chatham County:

> The stream is surrounded by a mature hardwood forest that is composed of typical Piedmont riparian/ upland forest tree species. Species include tulip poplar (*Liriodendron tulipfera*), sweet gum, American elm, red maple (*Acer rubrum*), oaks and hackberry. The understory also includes flowering dogwood (*Cornus florida*), ironwood (*Carpinus caroliniana*) and paw paw (*Asimina triloba*).

An additional reference site, UT to Sandy Creek in Randolph County north of Old Liberty Road, had a narrow riparian buffer including sweet gum, hackberry, oaks, and ironwood.

Narrative of Invasive Species Management

During the on-site field investigation, few occurrences of invasive species were identified throughout the project reaches. Lespedeza (*Lespedeza cuneata*) and Chinese privet (*Ligustrum sinense*) were sporadically observed along the top of bank of the entire reach of Bear Creek and the lower portion of UT to Bear Creek. Lespedeza is an aggressive warm-season perennial legume originally utilized for wildlife and livestock forage and hay. This drought resistant species is able to invade a variety of habitats including fields, meadows, marshes, open woodlands, and roadsides. Chinese privet is an aggressive, invasive shrub that encroaches and out-competes native vegetation. Fruiting season for this species generally occurs from July through March. Mechanical extraction of privet and lespedeza will be performed in tandem with stream restoration activities. Long term management of these species with herbicide should be applied prior to the fruiting season of adjacent native shrubs and trees to avoid minimal damage. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

Photo 1-Spencer Creek meander pattern.

Photo 2-Spencer Creek riffle structure.

Photo 3-Spencer Creek natural log structures.

Photo 4-Spencer Creek riffle-pool sequence and meander pattern.

Photo 5-Spencer Creek riffle-pool sequence.

Photo 6-Spencer Creek riffle structures.

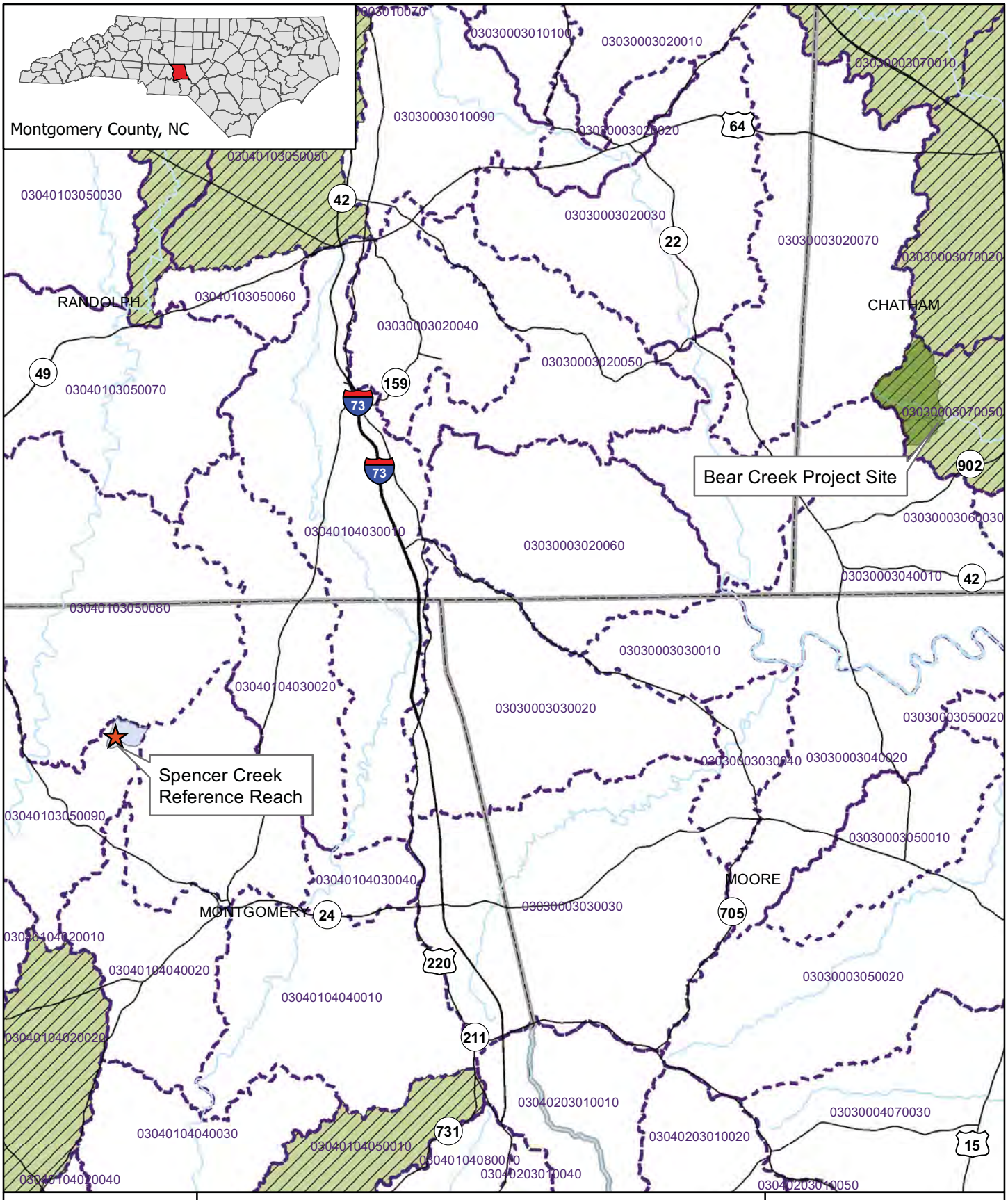
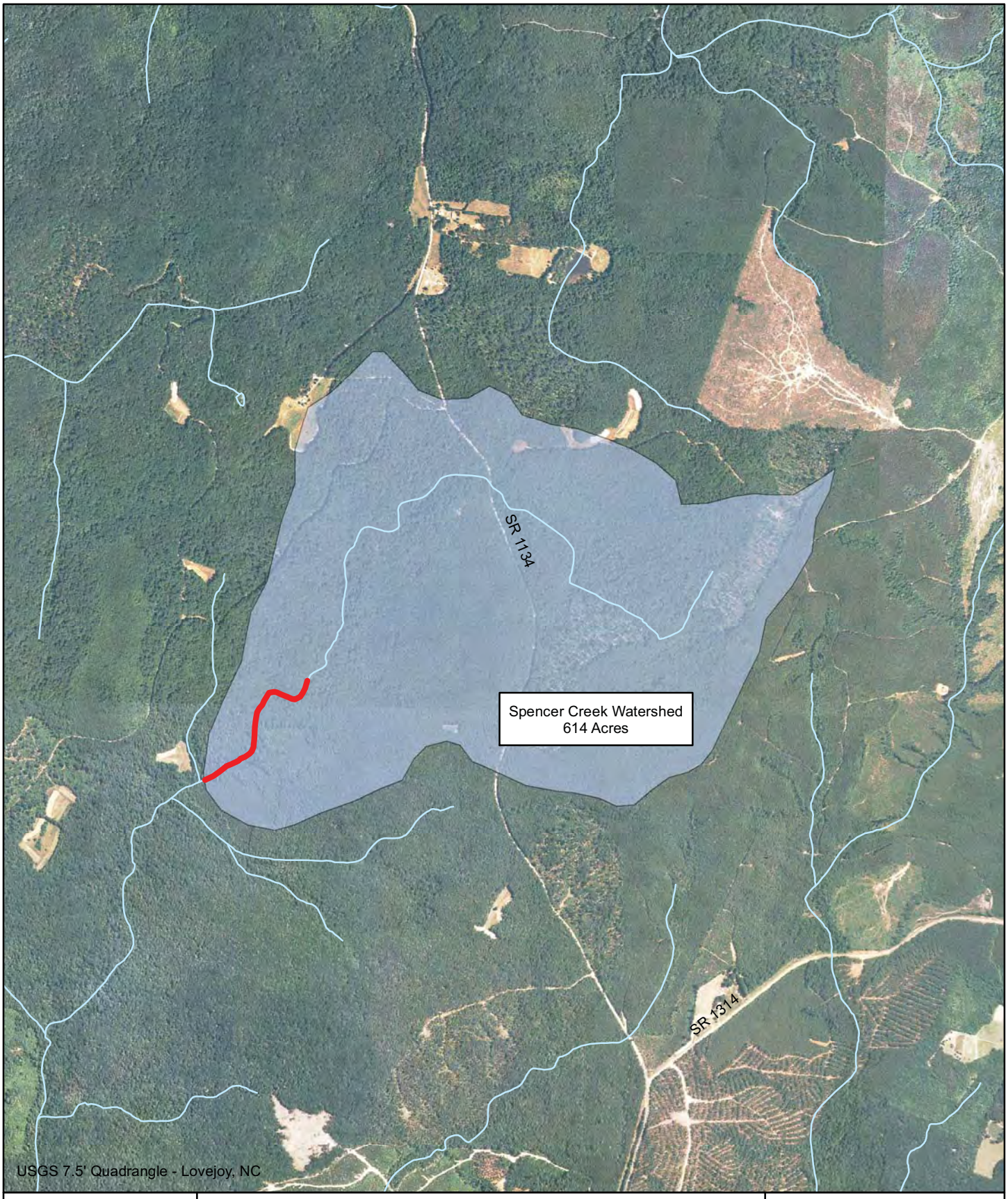


Figure C-1. Reference Reach Vicinity Map
Bear Creek Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Spencer Creek Reference Reach

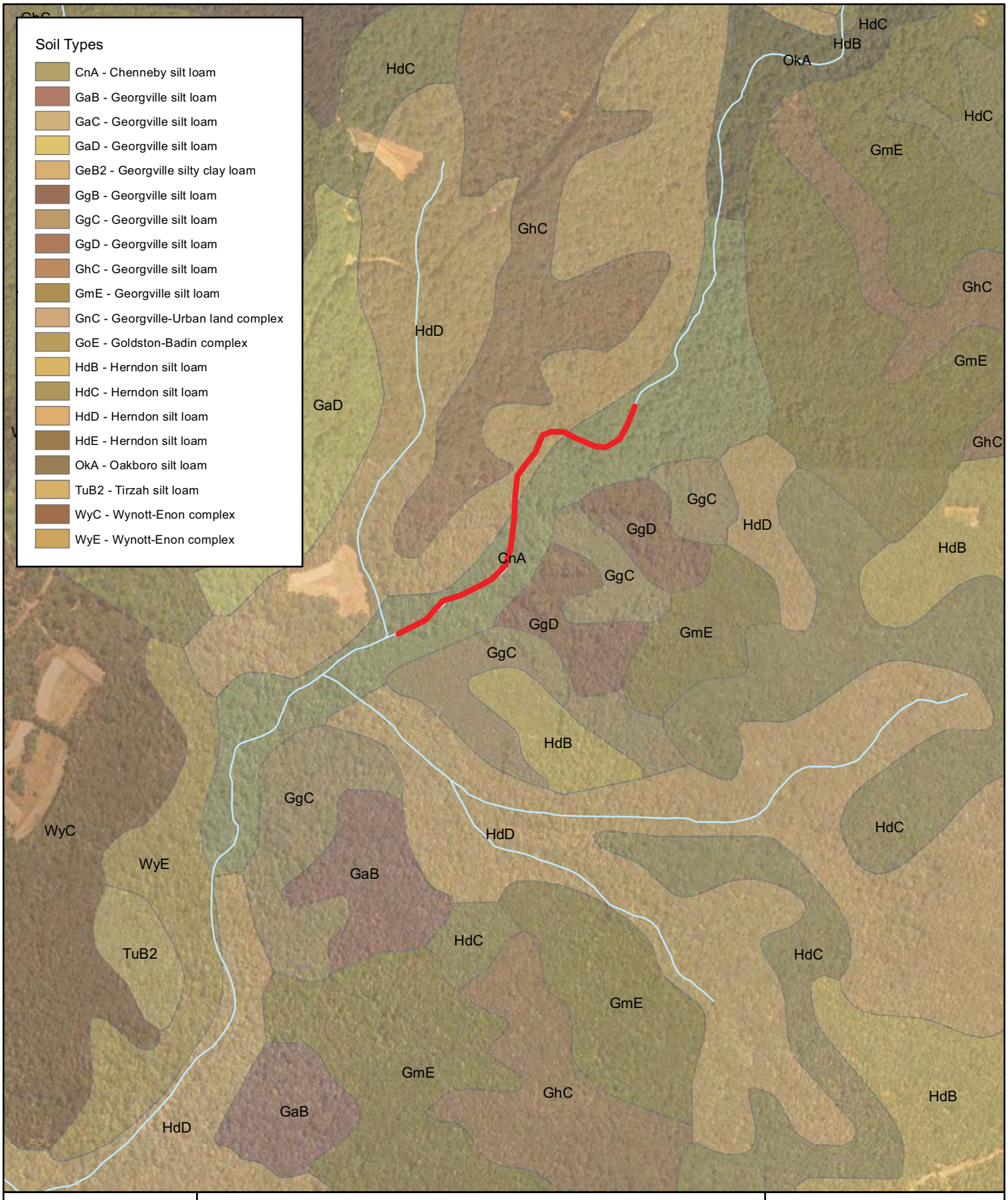
Spencer Creek Watershed

0 750 1,500 Feet

N

Figure C-2. Reference Reach Watershed Map
Bear Creek
Restoration Project

Chatham County, NC



Ecosystem Enhancement Program

WILDLANDS ENGINEERING

Spencer Creek Reference Reach

Streams

0 350 700 Feet

N

Figure C-3. Reference Reach Soils Map
Bear Creek
Restoration Project

Chatham County, NC

Bear Creek Reach A Geomorphic Data

Bear Creek Restoration Project

	Notation	Units	Existing Conditions		Designed Conditions		Reference Reach (Spencer Creek)	
			min	max	min	max	min	max
stream type			C4		C4		E4	
drainage area	DA	sq mi	4.1		4.1		0.96	
bankfull design discharge	Q_{bkf}	cfs	230		230		97	
Cross-Section Features								
bankfull cross-sectional area	A_{bkf}	SF	50.8		47.1		17.8	19.7
average bankfull velocity	v_{bkf}	fps	4.5		4.9		4.9	5.4
width at bankfull	w_{bkf}	feet	24.4		24.5		10.7	11.2
maximum depth at bankfull	d_{max}	feet	3.2		2.75		2.1	2.6
mean depth at bankfull	d_{bkf}	feet	2.1		1.9		1.6	1.8
bankfull width to depth ratio	w_{bkf}/d_{bkf}		11.7		12.7		5.8	7.1
depth ratio	d_{max}/d_{bkf}		1.5		1.4		1.3	1.4
low bank height			3.5		2.75			
bank height ratio	BHR		1.1		1		1	
floodprone area width	w_{fpa}	feet	310		126	394	60	114+
entrenchment ratio	ER		12.7		5.1	16.1	5.5	10.2+
Sinuosity								
valley slope	S_{valley}	feet/ foot	0.0036		0.0031		0.0109	
channel slope	$S_{channel}$	feet/ foot	0.0034		0.0026		0.0047	
sinuosity	K		1.1		1.2		2.3	
Riffle Features								
riffle slope	S_{riffle}	feet/ foot	*N/A		0.004	0.006	0.013	
riffle slope ratio	$S_{riffle}/S_{channel}$		*N/A		1.5	2.3	2.8	
Pool Features								
pool slope	S_{pool}	feet/ foot	0.001		0	0.0004	0.001	0.001
pool slope ratio	$S_{pool}/S_{channel}$		0.3		0	0.2	0.1	0.2
pool-to-pool spacing	L_{p-p}	feet	*N/A		91	147	71	
pool spacing ratio	L_{p-p}/w_{bkf}		*N/A		3.7	6	6.3	6.6
maximum pool depth at bankfull	d_{pool}	feet	3.8		2.5 – 6.0		3.3	
pool depth ratio	d_{pool}/d_{bkf}		1.8		1.3 – 3.2		1.8	2
pool width at bankfull	w_{pool}	feet	27.7		36.5		17.5	
pool width ratio	w_{pool}/w_{bkf}		1.1		1.5		1.6	
pool cross-sectional area at bankfull	A_{pool}	SF	50		93.4		24.5	
pool area ratio	A_{pool}/A_{bkf}		1		2		1.2	1.4
Pattern Features								
belt width	w_{blt}	feet	*N/A		144		38	41
meander width ratio	w_{blt}/w_{bkf}		*N/A		5.9		3.4	3.6
meander length	L_m	feet	*N/A		154	286	46	48
meander length ratio	L_m/w_{bkf}		*N/A		6.3	11.7	4.1	4.4
radius of curvature	R_c	feet	*N/A		44	70	11	15
radius of curvature ratio	R_c/w_{bkf}		*N/A		1.8	2.9	1.3	1.4
Sediment								
Particle Size Distribution from Riffle 100-Count			From Buck Engineering Survey,					
	d_{50}		Medium Gravel		N/A		Fine Gravel	
	d_{16}	mm	5.94		N/A	N/A	N/A	
	d_{35}	mm	11.47		N/A	N/A	N/A	
	d_{50}	mm	14.06		N/A	N/A	N/A	
	d_{84}	mm	27.3		N/A	N/A	N/A	
	d_{95}	mm	57.67		N/A	N/A	N/A	
Particle Size Distribution from Subpavement Analysis								
	d_{16}	mm	0.77	0.97	N/A	N/A	N/A	
	d_{35}	mm	1.97	3.64	N/A	N/A	N/A	
	d_{50}	mm	4	6.25	N/A	N/A	N/A	
	d_{84}	mm	11.18	17.33	N/A	N/A	N/A	
	d_{95}	mm	15.04	28.1	N/A	N/A	N/A	
Particle Size Distribution from Reachwide Count								
	d_{16}	mm	N/A		N/A	N/A	<0.062	
	d_{35}	mm	0.33		N/A	N/A	3	
	d_{50}	mm	7.67		N/A	N/A	8.8	
	d_{84}	mm	28.24		N/A	N/A	42	
	d_{95}	mm	133.64		N/A	N/A	90	

Notes

* The existing reach has minimal pattern.

** A typical section was designed in order to reshape a bend in the lower reach of Bear Creek. The overall pattern does not significantly change when compared to the existing conditions.

Existing conditions data provided by Buck Engineering.

Bear Creek Reach B Geomorphic Data

Bear Creek Restoration Project

	Notation	Units	Existing Conditions		Designed Conditions		Reference Reach (Spencer Creek)	
			min	max	min	max	min	max
stream type			G4		C4		E4	
drainage area	DA	sq mi	5.1		5.1		0.96	
bankfull design discharge	Q_{bkf}	cfs	270		270		97	
Cross-Section Features								
bankfull cross-sectional area	A_{bkf}	SF	70.8		57.6		17.8	19.7
event	v_{bkf}	fps	3.8		4.7		4.9	5.4
width at bankfull	w_{bkf}	feet	26		28.5		10.7	11.2
maximum depth at bankfull	d_{max}	feet	4.1		2.75		2.1	2.6
mean depth at bankfull	d_{bkf}	feet	2.7		2		1.6	1.8
bankfull width to depth ratio	w_{bkf}/d_{bkf}		9.7		14.1		5.8	7.1
depth ratio	d_{max}/d_{bkf}		1.5		1.4		1.3	1.4
low bank height			4.5		2.75		2.1	2.6
bank height ratio	BHR		1.1		1		1	
floodprone area width	w_{fpa}	feet	250		233	256	60	114+
entrenchment ratio	ER		9.4		8.2	9	5.5	10.2+
Sinuosity								
valley slope	S_{valley}	feet/ foot	0.0018		0.0018		0.0109	
channel slope	$S_{channel}$	feet/ foot	0.0016		0.0041 ŧ		0.0047	
sinuosity	K		1.1		1.2 ŧ		2.3	
Riffle Features								
riffle slope	S_{riffle}	feet/ foot	*N/A		0.0017	0.0028	0.013	
riffle slope ratio	$S_{riffle}/S_{channel}$		*N/A		0.7	1.2	2.8	
Pool Features								
pool slope	S_{pool}	feet/ foot	0.001		0	0.0002	0.001	0.001
pool slope ratio	$S_{poo}l/S_{channel}$		0.6		0	0.1	0.1	0.2
pool-to-pool spacing	L_{p-p}	feet	100	250	82	203	71	
pool spacing ratio	L_{p-p}/w_{bkf}		3.8	9.6	2.9	7.1	6.3	6.6
maximum pool depth at bankfull	d_{pool}	feet	4.7		2.5 – 6.0		3.3	
pool depth ratio	d_{pool}/d_{bkf}		1.7		1.3 – 3.0		1.8	2
pool width at bankfull	w_{pool}	feet	29.4		38.5		17.5	
pool width ratio	w_{pool}/w_{bkf}		1.1		1.4		1.6	
pool cross-sectional area at bankfull	A_{pool}	SF	80.6		102.4		24.5	
pool area ratio	A_{pool}/A_{bkf}		1.1		1.8		1.2	1.4
Pattern Features								
belt width	w_{blt}	feet	110	180	176		38	41
meander width ratio	w_{blt}/w_{bkf}		4.2	6.9	6.2		3.4	3.6
meander length	L_m	feet	300	480	158	374	46	48
meander length ratio	L_m/w_{bkf}		11.5	18.5	5.5	13.1	4.1	4.4
radius of curvature	R_c	feet	80	200	55	85	11	15
radius of curvature ratio	R_c/ w_{bkf}		3.1	7.7	1.9	3	1.3	1.4
Sediment								
Particle Size Distribution from Riffle 100-Count			From Buck Engineering Survey					
	d_{50}		Medium Gravel		N/A		Fine Gravel	
	d_{16}	mm	6.08		N/A	N/A	N/A	
	d_{35}	mm	12.17		N/A	N/A	N/A	
	d_{50}	mm	13.98		N/A	N/A	N/A	
	d_{84}	mm	20.95		N/A	N/A	N/A	
	d_{95}	mm	30.66		N/A	N/A	N/A	
Particle Size Distribution from Subpavement Analysis								
	d_{16}	mm	0.45	0.64	N/A	N/A	N/A	
	d_{35}	mm	1.18	1.84	N/A	N/A	N/A	
	d_{50}	mm	3.1	3.98	N/A	N/A	N/A	
	d_{84}	mm	11.46	14.23	N/A	N/A	N/A	
	d_{95}	mm	15.78	21.85	N/A	N/A	N/A	
Particle Size Distribution from Reachwide Count								
	d_{16}	mm	N/A		N/A	N/A	<0.062	
	d_{35}	mm	5.76		N/A	N/A	3	
	d_{50}	mm	8.5		N/A	N/A	8.8	
	d_{84}	mm	20.69		N/A	N/A	42	
	d_{95}	mm	2052.69		N/A	N/A	90	

Notes

* The existing reach has minimal pattern.

ŧ Channel slope is steeper than valley slope because channel grade drops with respect to valley to satisfy flood study requirements.
Sinuosity calculated using channel versus valley length.
Existing conditions data provided by Buck Engineering.

UT to Bear Creek Geomorphic Data

Bear Creek Restoration Project

	Notation	Units	Existing Conditions		Designed Conditions		Reference Reach (UT Spencer Creek)	
			min	max	min	max	min	max
stream type			E5/C5		C5		E4/C4	
drainage area	DA	sq mi	0.9		0.9		0.014	
bankfull design discharge	Q_{bkf}	cfs	80		80		25	
Cross-Section Features								
bankfull cross-sectional area	A_{bkf}	SF	14	17.6	14.6		7.7	
event	v_{bkf}	fps	5.7		5.5		3.2	
width at bankfull	w_{bkf}	feet	11.9	20.3	13.5		7	
maximum depth at bankfull	d_{max}	feet	1.8	2.2	1.5		2	
mean depth at bankfull	d_{bkf}	feet	0.8	1.2	1.08		1.1	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		9.9	24.7	12.5		6.4	
depth ratio	d_{max}/d_{bkf}		1.5	2.2	1.4		1.8	
low bank height			2.1	3.5	1.5		2	
bank height ratio	BHR		1.0	1.6	1		1	
floodprone area width	w_{fpa}	feet	79	114	92	236	81+	
entrenchment ratio	ER		4.3	9.6	6.8	17.5	11.6+	
Sinuosity								
valley slope	S_{valley}	feet/ foot	0.0043		0.0054		0.0081	
channel slope	$S_{channel}$	feet/ foot	0.0041		0.0045		0.0033	
sinuosity	K		1		1.2		2.5	
Riffle Features								
riffle slope	S_{riffle}	feet/ foot	*N/A		0.007	0.0125	0.014	
riffle slope ratio	$S_{riffle}/S_{channel}$		*N/A		1.6	2.8	4.2	
Pool Features								
pool slope	S_{pool}	feet/ foot	0.001		0	0.0008	0.001	0.001
pool slope ratio	$S_{pool}/S_{channel}$		0.2		0	0.2	0.4	0.4
pool-to-pool spacing	L_{p-p}	feet	*N/A		51	106	19	42
pool spacing ratio	L_{p-p}/w_{bkf}		*N/A		3.8	7.9	2.7	6
maximum pool depth at bankfull	d_{pool}	feet	2.5		2.5		2.5	
pool depth ratio	d_{pool}/d_{bkf}		2.1	3.1	2.3		2.3	
pool width at bankfull	w_{pool}	feet	14.8		19		6.5	
pool width ratio	w_{pool}/w_{bkf}		0.7	1.2	1.4		0.9	
bankfull	A_{pool}	SF	20.9		28.75		8.8	
pool area ratio	A_{pool}/A_{bkf}		1.2	1.5	2		1.1	
Pattern Features								
belt width	w_{blt}	feet	*N/A		68	77	11	27
meander width ratio	w_{blt}/w_{bkf}		*N/A		5	5.7	2.8	6
meander length	L_m	feet	*N/A		79	165	38	43
meander length ratio	L_m/w_{bkf}		*N/A		5.9	12.2	5.4	6.1
radius of curvature	R_c	feet	*N/A		27	47	6	16
radius of curvature ratio	R_c/w_{bkf}		*N/A		2	3.5	0.8	2.3
Sediment								
Particle Size Distribution from Reachwide Count			From Buck Engineering Survey					
	d_{50}		Medium Sand				Coarse Sand	
	d_{16}	mm	N/A		N/A	N/A	<0.062	
	d_{35}	mm	0.07		N/A	N/A	0.1	
	d_{50}	mm	0.25		N/A	N/A	1	
	d_{84}	mm	10.64		N/A	N/A	16	
	d_{95}	mm	18.64		N/A	N/A	22.3	

Notes

* The existing reach has minimal pattern.

Existing conditions data provided by Buck Engineering.

Permanent Herbaceous Seed Mixture
Bear Creek Restoration Project

Scientific Name	Common Name
Ludwigia alternifolia	Bushy seedbox
Schizachyrium scoparium	Little bluestem
Scirpus cyperinus	Wool grass
Uniola latifolia	River oats
Trifolium repens	White clover
Carex crinita	Fringed sedge
Juncus effusus	Soft stem rush
Elymus virginica	Virginia wild rye
Panicum virgatum	Switchgrass

Riparian Woody Vegetation
Bear Creek Restoration Project

Scientific Name	Common Name
Stream Bank Live Stakes	
Salix nigra	Black willow
Cornus amomum	Silky dogwood
Sambucus canadensis	Elderberry
Salix sericea	Silky willow
Stream Benches/ Upper Banks Bare Roots	
Quercus michauxii	Swamp chestnut oak
Quercus nigra	Water oak
Acer negundo	Box elder
Betula nigra	River birch
Platanus occidentalis	Sycamore
Alnus serrulata	Tag alder
Carpinus caroliniana	Ironwood
Cornus amomum	Silky dogwood
Lindera benzoin	Spicebush
Viburnum dentatum	Arrowwood
Quercus falcata	Southern red oak
Corylus americana	Hazelnut
Symphoricarpos orbiculatus	Coralberry

COMPETENCY CALCULATION WORKSHEET

Project Name:	**Bear Creek**	**Data Collected By:**	**Buck Engineering, prov by EEP**
Location:	**Chatham County, NC**	**Data Collected On:**	**8/28/2003**
Job #:	**005-02120**	**Reach:**	**Bear Creek Reach 1 and Reach 2**
Designer:	**EGR**	**Cross Section #:**	
Date:	**7/27/2010**		

Shear Stress Analysis	Units	Notes	Bear Creek Reach A X3 Pave/Subpave	Bear Creek Reach B X6 Pave/Subpave	Bear Creek Reach A Proposed	Bear Creek Reach B Proposed
Bankfull Xsec Area, A_{bkf}	sq. ft.		72.4	71.0	47.13	57.63
Bankfull Width, W_{bkf}	ft.		49.7	26.3	24.5	28.5
Bankfull Mean Depth, D_{bkf}	ft.		1.5	2.7	1.9	2.0
S_{chan}	ft./ft.		0.0035	0.0013	0.002322	0.003208
D_{50}	mm	Median Diameter of the Riffle Bed (From 100 Pebble Count In Riffle Or Pavement Sample)	14	14	14	14
$D^{\wedge}_{50}$	mm	Median Diameter of the Bar Sample (Or Subpavement Sample)	3.9	3.9	3.9	3.9
D_i	mm	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	28	49	28	49
D_i	ft.	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	0.09	0.16	0.09	0.16
$D_{50}/D^{\wedge}_{50}$	dimensionless		3.59	3.59	3.59	3.59
D_i/D_{50}	dimensionless		2.00	3.50	2.00	3.50
Wetted Perimeter, WP	ft.	$WP=W_{bkf}+2(D_{bkf})$	52.6	31.7	28.3	32.5
Hydraulic Radius, R	ft.	$R=A_{bkf}/WP$	1.4	2.2	1.7	1.8
Boundary/Bankfull Shear Stress, t^*	lbs/sq. ft.	$t^*=62.4(R)(S_{chan})$	0.30	0.18	0.24	0.35
t^*_{ci} (Equation #1)	lbs/sq. ft.	$t^*_{ci}=0.0834[(D_{50}/D^{\wedge}_{50})^{-0.872}]$ Use When $3.0<D_{50}/D^{\wedge}_{50}<7.0$	0.0274	0.0274	0.0274	0.0274
t^*_{ci} (Equation #2)	lbs/sq. ft.	$t^*_{ci}=0.0384[(D_i/D_{50})^{-0.887}]$ Use When $1.3<d_i/d_{50}<3.0$	NA	NA	NA	NA
D_{crit}	ft.	Required Bankfull Mean Depth $D_{crit}=[(1.65)(t^*_{ci(Di)})]/S_{chan}$	1.2	5.6	1.8	2.3
S_{crit}	ft./ft.		0.00285	0.00269	0.00216	0.00359
Largest movable particle (Shield's/CO curves)	mm		50 - 75	40 - 50	50 - 70	75 - 100
Largest movable particle (modified Shield's curve)			15 - 20	7 - 10	15 - 25	15 - 30

Spreadsheet developed from Dave Rosgen - River Assessment and Monitoring 2002

COMPETENCY CALCULATION WORKSHEET

Project Name:	**Bear Creek**	**Data Collected By:**	**KG, JK**
Location:	**Chatham County, NC**	**Data Collected On:**	**4/14/2011**
Job #:	**005-02120**	**Reach:**	**UT1**
Designer:	**EGR**	**Cross Section #:**	**X1 and X2**
Date:	**5/5/2011**		

Shear Stress Analysis	Units	Notes	UT to Bear Creek X1 Pave/Subpave	UT to Bear Creek X2 Pave/Subpave	UT to Bear Creek X1 Proposed	UT to Bear Creek X2 Proposed
Bankfull Xsec Area, A_{bkf}	sq. ft.		16.7	17.6	14.6	14.6
Bankfull Width, W_{bkf}	ft.		20.3	14.9	13.5	13.5
Bankfull Mean Depth, D_{bkf}	ft.		0.8	1.2	1.1	1.1
S_{chan}	ft./ft.		0.0041	0.0041	0.004500	0.004500
D_{50}	mm	Median Diameter of the Riffle Bed (From 100 Pebble Count In Riffle Or Pavement Sample)	6.2	7.2	6.2	7.2
$D^{\wedge}_{50}$	mm	Median Diameter of the Bar Sample (Or Subpavement Sample)	6.6	5.4	6.6	5.4
D_i	mm	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	25	24	25	24
D_i	ft.	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	0.08	0.08	0.08	0.08
$D_{50}/D^{\wedge}_{50}$	dimensionless		0.94	1.33	0.94	1.33
D_i/D_{50}	dimensionless		4.03	3.33	4.03	3.33
Wetted Perimeter, WP	ft.	$WP=W_{bkf}+2(D_{bkf})$	20.9	16.4	15.7	15.7
Hydraulic Radius, R	ft.	$R=A_{bkf}/WP$	0.8	1.1	0.9	0.9
Boundary/Bankfull Shear Stress, t^*	lbs/sq. ft.	$t^*=62.4(R)(S_{chan})$	0.20	0.27	0.26	0.26
t^*_{ci} (Equation #1)	lbs/sq. ft.	$t^*_{ci}=0.0834[(D_{50}/D^{\wedge}_{50})^{-0.872}]$ Use When $3.0<D_{50}/D^{\wedge}_{50}<7.0$	NA	NA	NA	NA
t^*_{ci} (Equation #2)	lbs/sq. ft.	$t^*_{ci}=0.0384[(D_i/D_{50})^{-0.887}]$ Use When $1.3<d_i/d_{50}<3.0$	0.0111	0.0132	0.0111	0.0132
D_{crit}	ft.	Required Bankfull Mean Depth $D_{crit}=[(1.65)(t^*_{ci(Di)})]/S_{chan}$	0.4	0.4	0.3	0.4
S_{crit}	ft./ft.		0.00183	0.00145	0.00140	0.00159
Largest movable particle (Shield's/CO curves)	mm		40-60	50 - 75	50 - 75	50 - 75
Largest movable particle (modified Shield's curve)			10-15	10-20	10-20	10-20

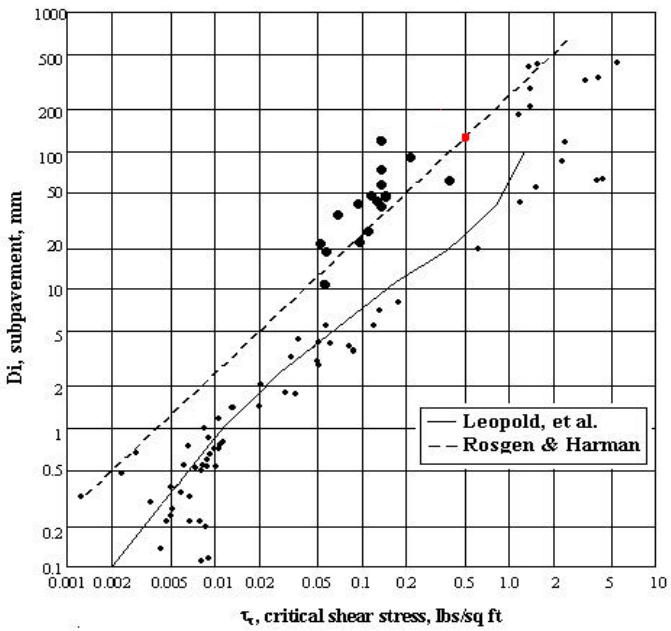
Spreadsheet developed from Dave Rosgen - River Assessment and Monitoring 2002

COMPETENCY CALCULATION WORKSHEET			
Project Name:	**Bear Creek**	**Data Collected By:**	**KG, JK**
Location:	**Chatham County, NC**	**Data Collected On:**	**4/14/2011**
Job #:	**005-02120**	**Reach:**	**UT1**
Designer:	**EGR**	**Cross Section #:**	**X1 and X2**
Date:	**5/5/2011**		

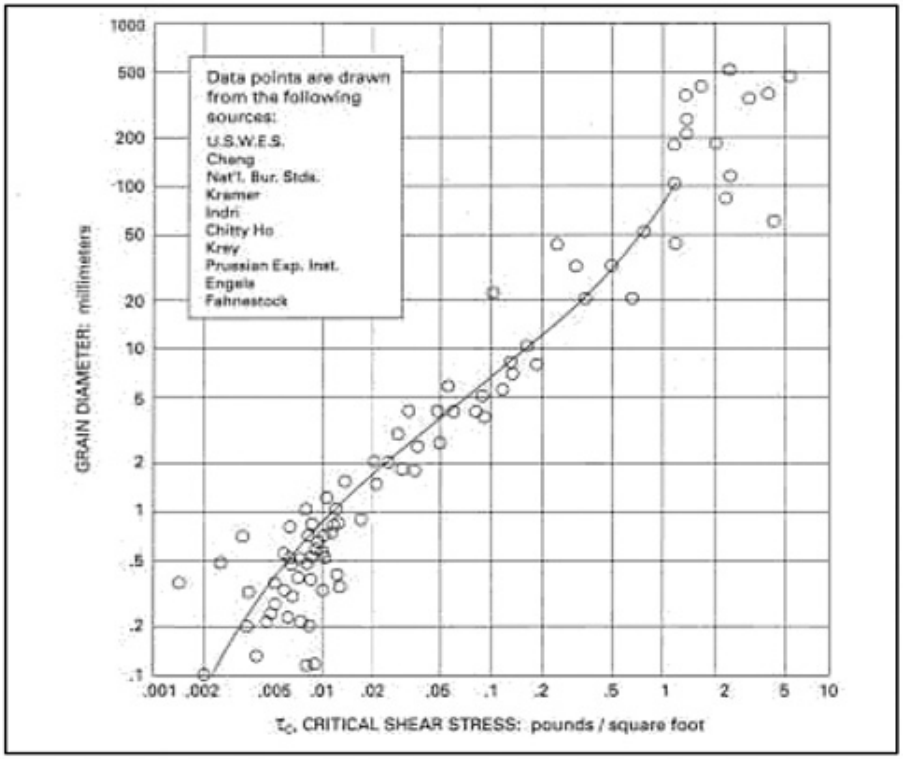
Shear Stress Analysis	Units	Notes	UT to Bear Creek X3 Pave/Subpave	UT to Bear Creek X4** Pave/Subpave	UT to Bear Creek X3 Proposed	UT to Bear Creek X4** Proposed
Bankfull Xsec Area, A_{bkf}	sq. ft.		14.3	14.1	14.6	14.6
Bankfull Width, W_{bkf}	ft.		11.9	13	13.5	13.5
Bankfull Mean Depth, D_{bkf}	ft.		1.2	1.1	1.1	1.1
S_{chan}	ft./ft.		0.0041	0.0041	0.004500	0.004500
D_{50}	mm	Median Diameter of the Riffle Bed (From 100 Pebble Count In Riffle Or Pavement Sample)	5.6	42.0	5.6	42
$D^{\wedge}_{50}$	mm	Median Diameter of the Bar Sample (Or Subpavement Sample)	5.5	14.6	5.5	14.6
D_i	mm	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	24	54	24	54
D_i	ft.	D_{100}, Largest Particle From Bar Sample (Or Subpavment Sample)	0.08	0.18	0.08	0.18
$D_{50}/D^{\wedge}_{50}$	dimensionless		1.02	2.88	1.02	2.88
D_i/D_{50}	dimensionless		4.29	1.29	4.29	1.29
Wetted Perimeter, WP	ft.	$WP=W_{bkf}+2(D_{bkf})$	12.9	15.1	15.7	15.7
Hydraulic Radius, R	ft.	$R=A_{bkf}/WP$	1.1	0.9	0.9	0.9
Boundary/Bankfull Shear Stress, t^*	lbs/sq. ft.	$t^*=62.4(R)(S_{chan})$	0.28	0.24	0.26	0.26
t^*_{ci} (Equation #1)	lbs/sq. ft.	$t^*_{ci}=0.0834[(D_{50}/D^{\wedge}_{50})^{-0.872}]$ Use When $3.0<D_{50}/D^{\wedge}_{50}<7.0$	NA	NA	NA	NA
t^*_{ci} (Equation #2)	lbs/sq. ft.	$t^*_{ci}=0.0384[(D_i/D_{50})^{-0.887}]$ Use When $1.3<d_i/d_{50}<3.0$	0.0106	0.0307	0.0106	0.0307
D_{crit}	ft.	Required Bankfull Mean Depth $D_{crit}=[(1.65)(t^*_{ci(Di)})]/S_{chan}$	0.3	2.2	0.3	2.0
S_{crit}	ft./ft.		0.00114	0.00828	0.00127	0.00831
Largest movable particle (Shield's/CO curves)	mm		50 - 75	50 - 75	50 - 75	50 - 75
Largest movable particle (modified Shield's curve)			10-20	10-20	10-20	10-20

Spreadsheet developed from Dave Rosgen - River Assessment and Monitoring 2002

**X4 located downstream of culvert at Siler City Glendon Road where stabilizing riprap has been placed- sediment samples may be skewed high due to artificial armoring.



(Data from: Leopold, Wolman, and Miller 1964; Rosgen, personal commun.; and Harman, personal commun.)



HEC-RAS River: Bear Creek Reach: Reach-1 Profile: 100-year

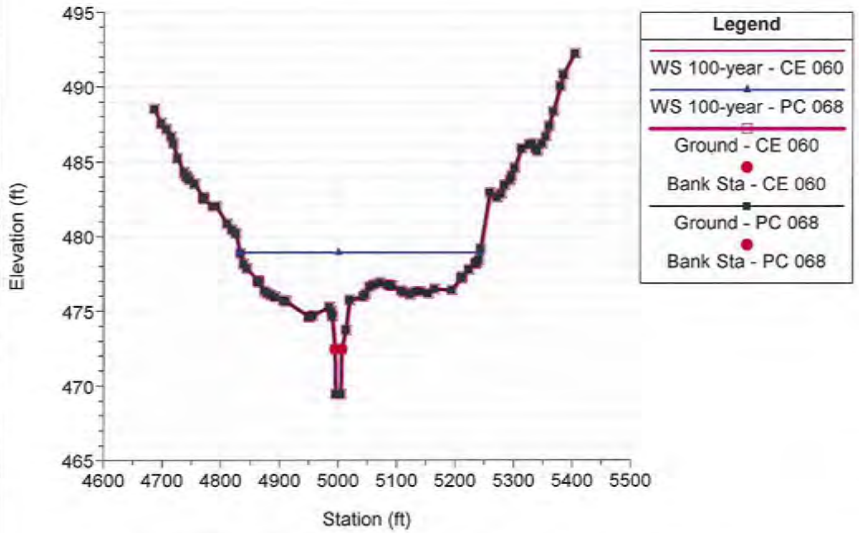
Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	119474	100-year	PC 068	2116.00	465.31	474.77	472.52	474.79	0.000334	2.04	2044.17	743.99	0.12
Reach-1	119474	100-year	CE 060	2116.00	465.31	474.77	472.52	474.79	0.000334	2.04	2044.17	743.99	0.12
Reach-1	119731	100-year	PC 068	2116.00	466.52	474.87		474.88	0.000388	1.86	2296.15	660.75	0.12
Reach-1	119731	100-year	CE 060	2116.00	465.18	474.87		474.89	0.000474	1.68	1897.30	660.80	0.12
Reach-1	119946	100-year	PC 068	2116.00	467.10	474.99		475.08	0.001686	3.71	1205.94	441.67	0.25
Reach-1	119946	100-year	CE 060	2116.00	465.35	474.98		475.08	0.001406	3.71	1096.95	441.23	0.22
Reach-1	119966			Culvert									
Reach-1	119986	100-year	PC 068	2116.00	467.50	475.02	473.09	475.11	0.001762	3.66	1215.68	424.34	0.25
Reach-1	119986	100-year	CE 060	2116.00	465.38	475.05		475.13	0.001304	3.54	1120.83	425.57	0.22
Reach-1	120007	100-year	PC 068	2116.00	467.60	475.09		475.15	0.001234	3.05	1393.51	426.31	0.21
Reach-1	120007	100-year	CE 060	2116.00	465.40	475.09		475.16	0.001305	2.86	1139.81	426.35	0.20
Reach-1	120312	100-year	PC 068	2116.00	467.80	475.50		475.60	0.001867	3.83	1094.93	294.28	0.26
Reach-1	120312	100-year	CE 060	2116.00	466.83	475.54		475.67	0.002055	3.89	849.65	295.26	0.25
Reach-1	120501	100-year	PC 068	2116.00	467.90	475.90		476.01	0.001905	3.98	1018.69	268.54	0.26
Reach-1	120501	100-year	CE 060	2116.00	467.33	475.92		476.06	0.002015	3.83	820.59	269.19	0.25
Reach-1	120730	100-year	PC 068	1798.00	468.50	476.23		476.26	0.000556	2.01	1712.14	511.09	0.14
Reach-1	120730	100-year	CE 060	1798.00	468.43	476.27		476.29	0.000523	1.74	1505.97	511.84	0.13
Reach-1	120750			Culvert									
Reach-1	120770	100-year	PC 068	1798.00	468.60	476.23	473.59	476.27	0.000930	2.58	1367.31	445.11	0.18
Reach-1	120770	100-year	CE 060	1798.00	468.53	476.29		476.32	0.000783	2.10	1255.12	446.87	0.16
Reach-1	120818	100-year	PC 068	1798.00	468.80	476.28		476.34	0.001272	3.10	1151.45	417.27	0.21
Reach-1	120818	100-year	CE 060	1798.00	468.38	476.32	474.50	476.38	0.001212	2.68	1049.14	419.23	0.20
Reach-1	120848	100-year	PC 068	1798.00	468.90	476.30		476.39	0.001781	3.64	992.18	364.60	0.25
Reach-1	120848	100-year	CE 060	1798.00	467.98	476.38	474.67	476.47	0.001622	3.45	901.71	368.66	0.23
Reach-1	120977	100-year	PC 068	1798.00	469.00	476.55		476.67	0.002163	4.06	855.77	245.71	0.28
Reach-1	120977	100-year	CE 060	1798.00	467.70	476.58		476.72	0.002086	3.69	701.60	246.83	0.26

HEC-RAS River: Bear Creek Reach: Reach-1 Profile: 100-year (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	121106	100-year	PC 068	1798.00	469.21	476.85		476.99	0.002402	4.32	815.42	241.05	0.29
Reach-1	121106	100-year	CE 060	1798.00	468.63	476.89		477.04	0.003033	3.99	643.62	242.79	0.30
Reach-1	121359	100-year	PC 068	1798.00	469.86	477.42		477.49	0.001411	3.29	1215.53	437.97	0.22
Reach-1	121359	100-year	CE 060	1798.00	469.24	477.56		477.62	0.001716	3.03	983.09	440.46	0.22
Reach-1	121532	100-year	PC 068	1798.00	469.25	477.64		477.74	0.001269	3.86	1036.66	403.87	0.24
Reach-1	121532	100-year	CE 060	1798.00	469.25	477.78		477.86	0.001115	3.66	1089.69	407.54	0.22
Reach-1	121562	100-year	PC 068	1798.00	469.50	477.55		477.87	0.003378	6.13	874.09	415.02	0.39
Reach-1	121562	100-year	CE 060	1798.00	469.50	477.70		477.97	0.002905	5.75	936.69	423.73	0.36
Reach-1	121971	100-year	PC 068	1798.00	469.46	478.92		479.08	0.002535	5.39	1178.16	409.74	0.32
Reach-1	121971	100-year	CE 060	1798.00	469.46	478.93		479.08	0.002510	5.37	1182.52	409.85	0.31

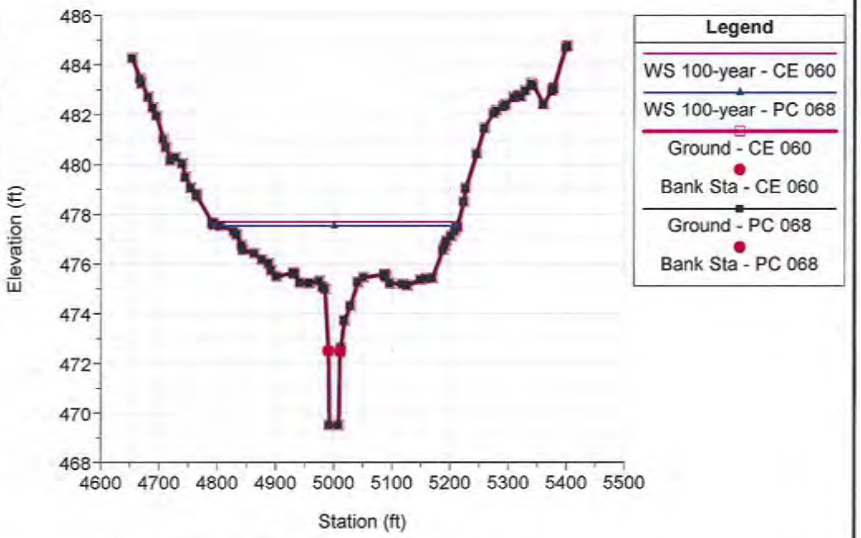
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 121971 Bear Creek 244.0



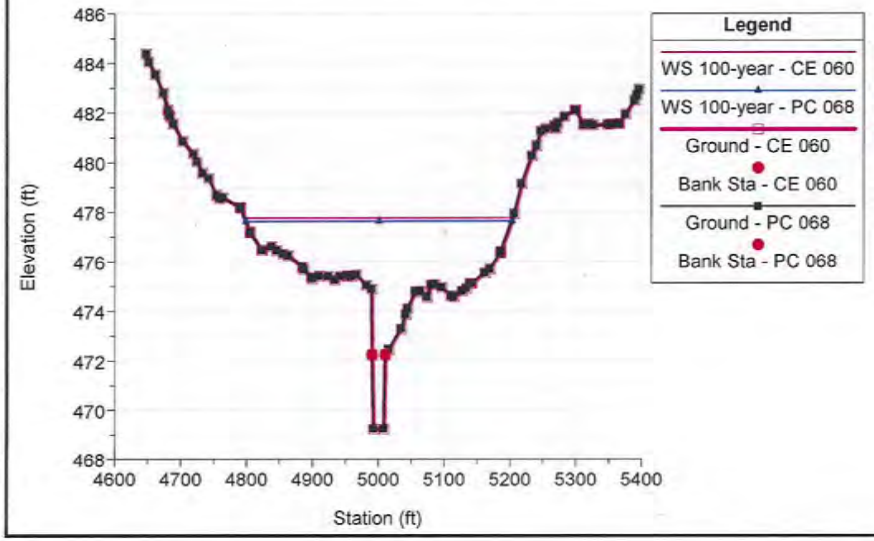
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 121562 Unnamed Rd 4 (BC) U



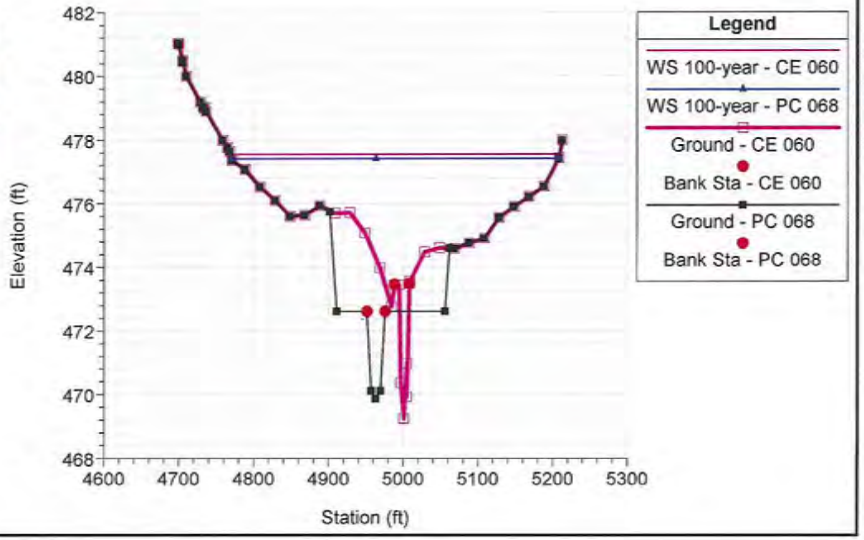
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 121532 Unnamed Rd 4 (BC) D



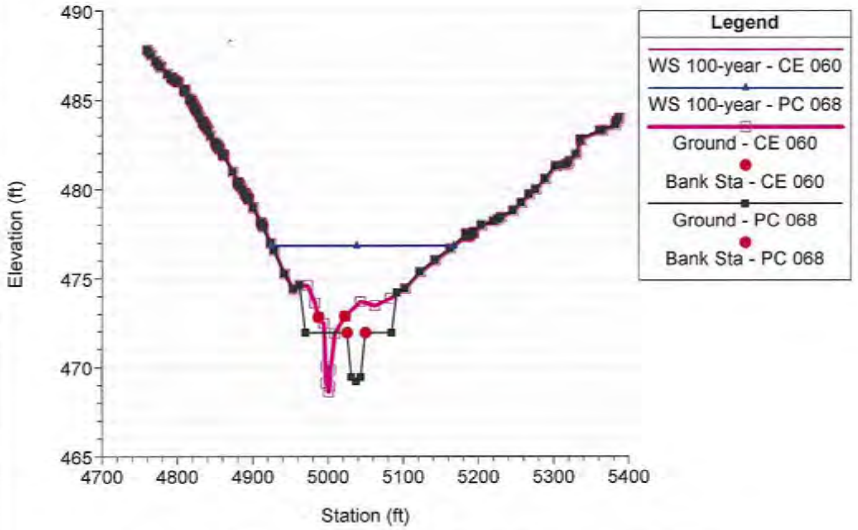
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 121359 supplemental section from DOT survey



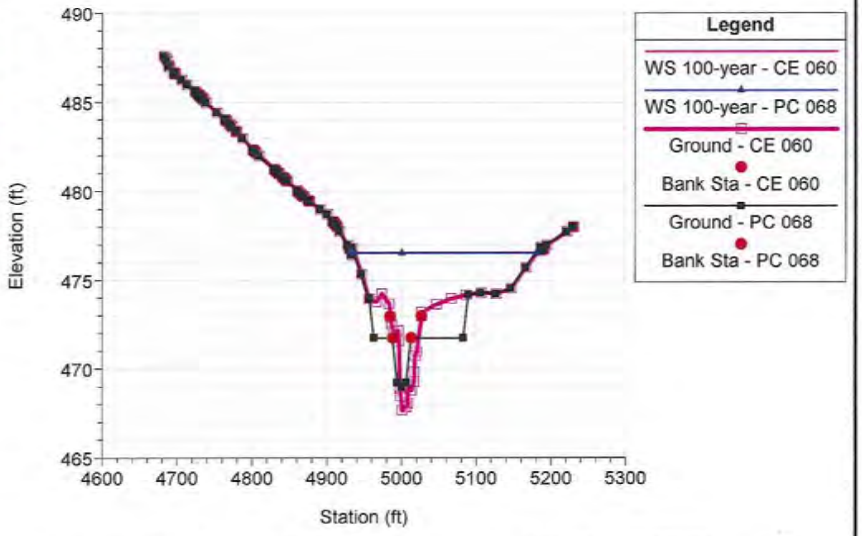
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 121106 Bear Creek 242.0 updated with DOT survey



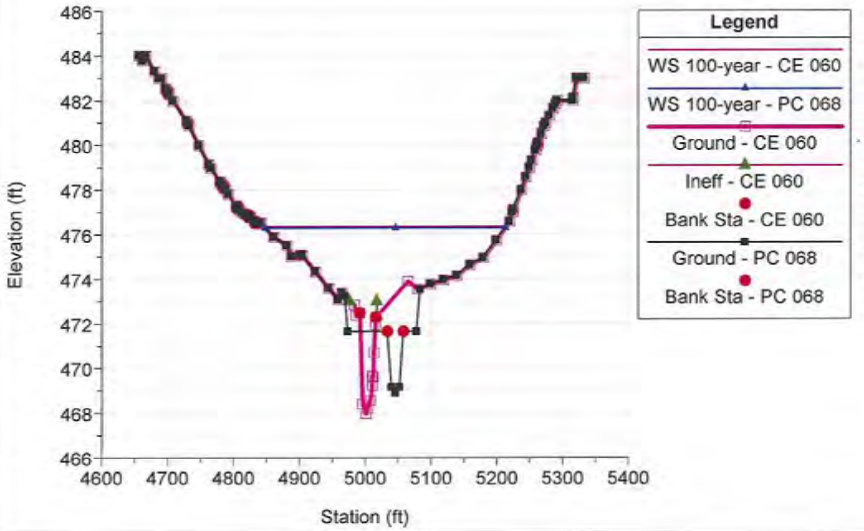
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 120977 supplemental section from DOT survey



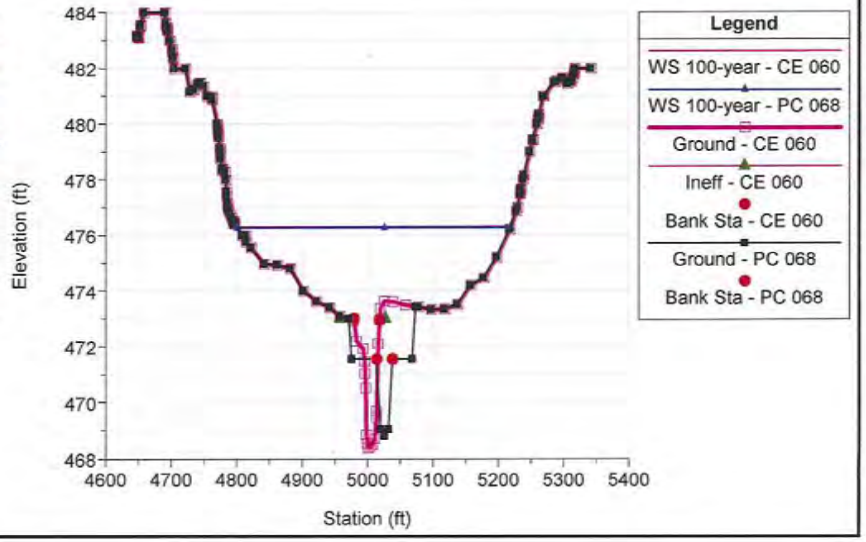
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 120848 Unnamed Rd 3 (BC) U updated with DOT survey



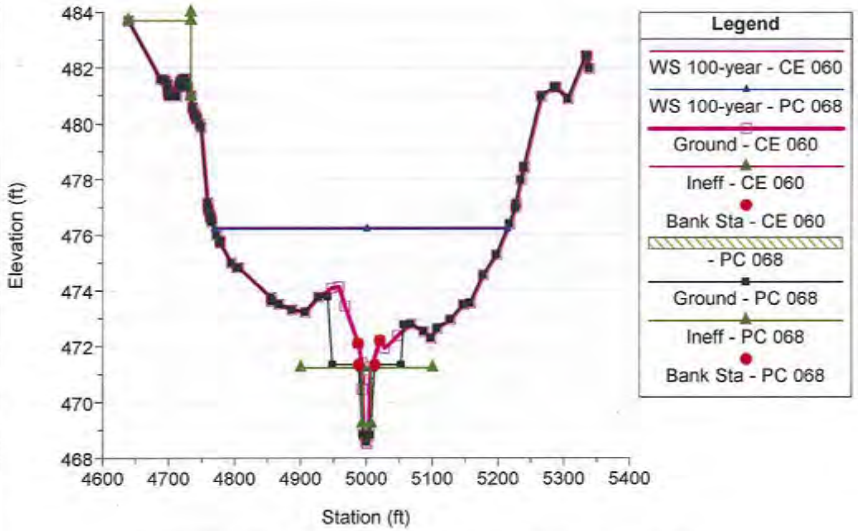
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 120818 Unnamed Rd 3 (BC) D updated with DOT survey



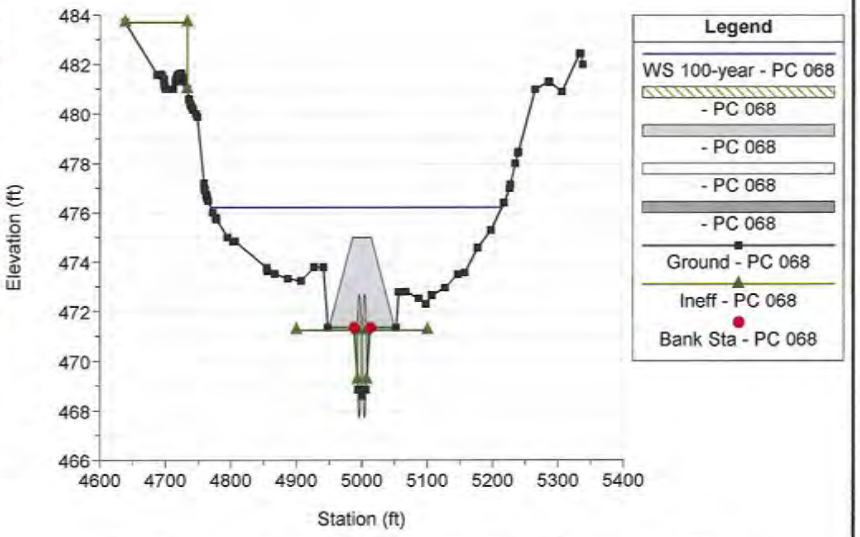
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 120770 supplemental section from DOT survey u/s xing



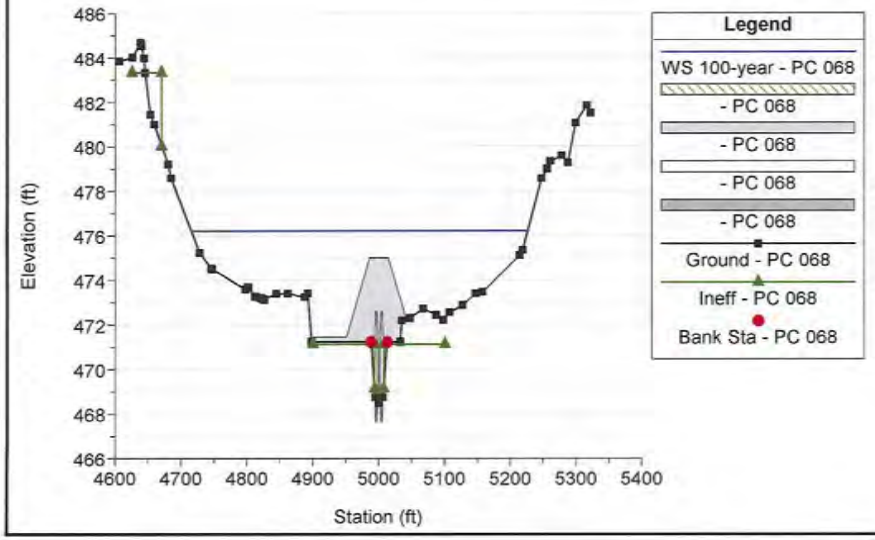
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 120750 Culv Unnamed Rd 3 (BC) TORStructure ID: Unnamed Rd 3 Approximate Su



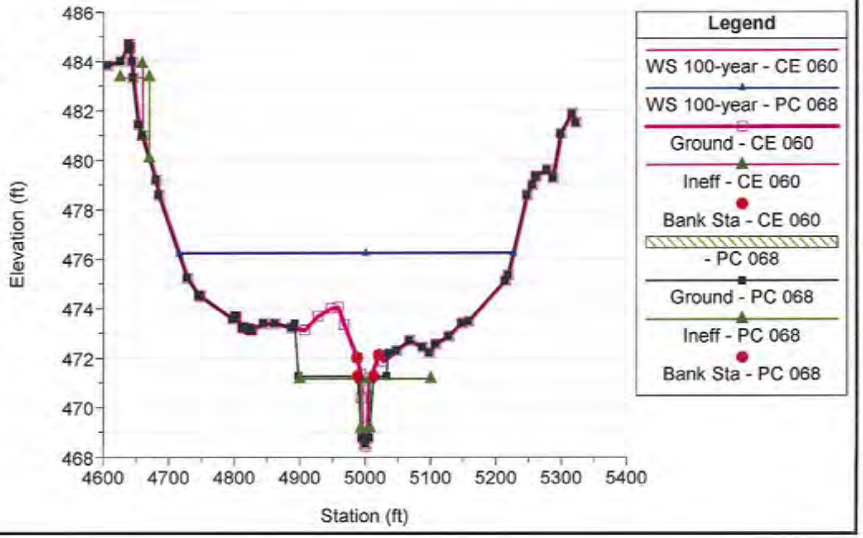
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

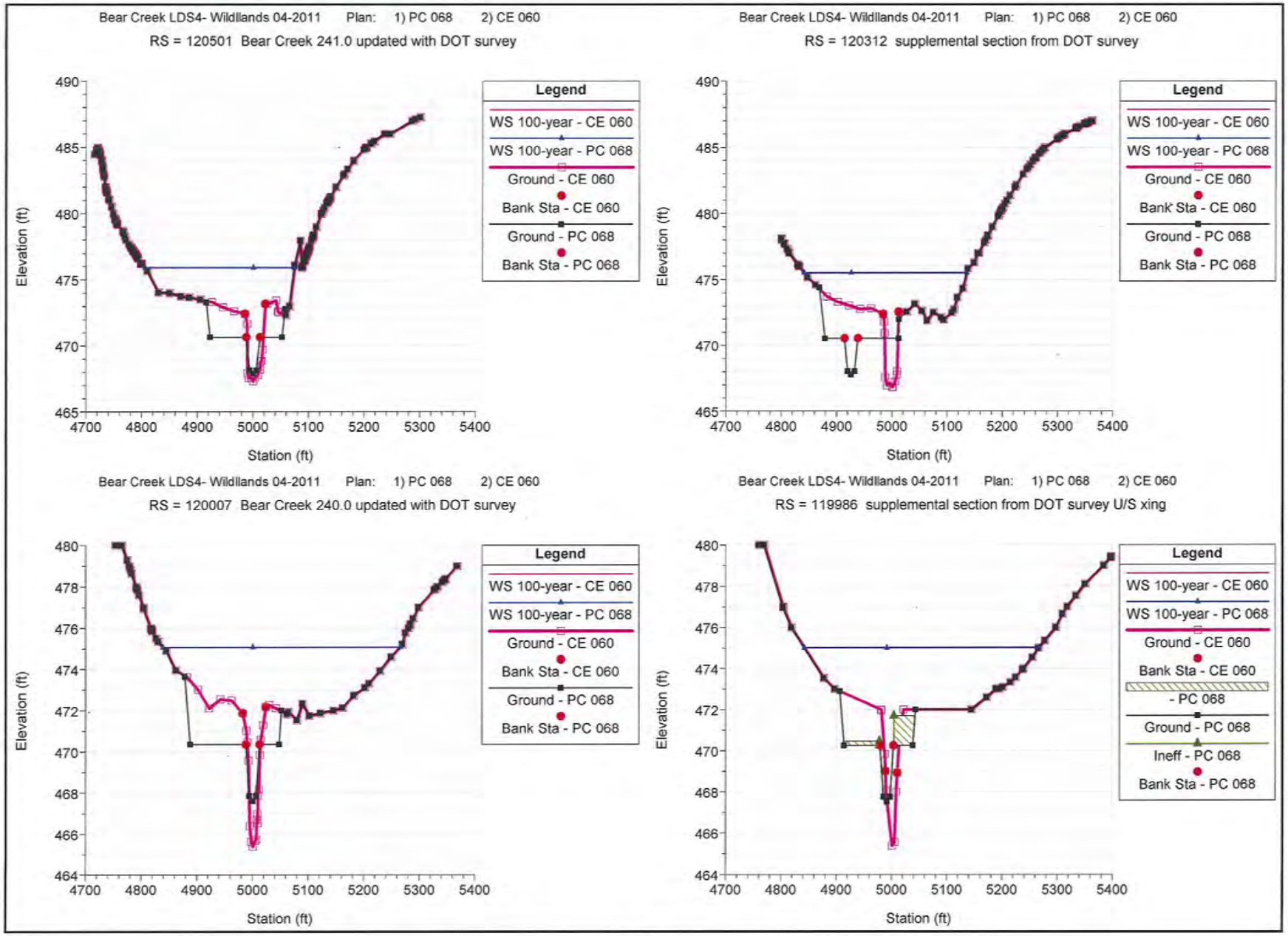
RS = 120750 Culv Unnamed Rd 3 (BC) TORStructure ID: Unnamed Rd 3 Approximate Su



Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

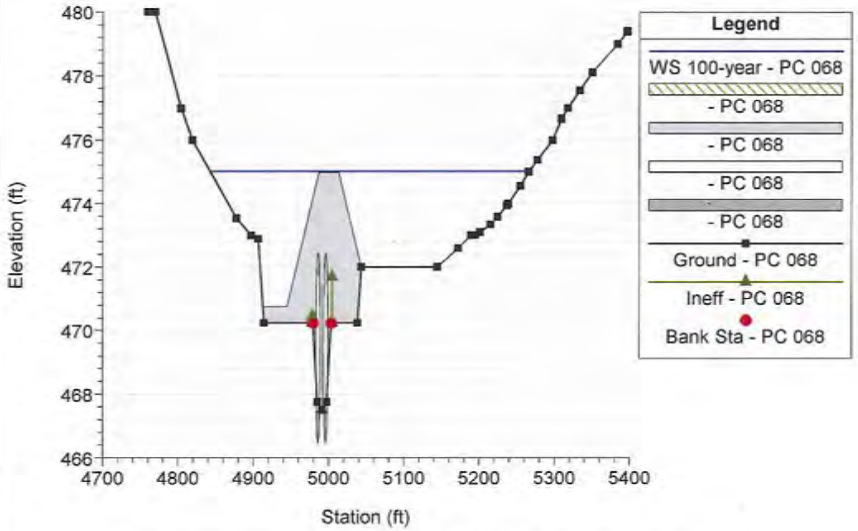
RS = 120730 supplemental section from DOT survey d/s xing




Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060
RS = 120501 Bear Creek 241.0 updated with DOT survey
Elevation (ft)
Station (ft)
Legend
WS 100-year - CE 060
WS 100-year - PC 068
Ground - CE 060
Bank Sta - CE 060
Ground - PC 068
Bank Sta - PC 068
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060
RS = 120312 supplemental section from DOT survey
Elevation (ft)
Station (ft)
Legend
WS 100-year - CE 060
WS 100-year - PC 068
Ground - CE 060
Bank Sta - CE 060
Ground - PC 068
Bank Sta - PC 068
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060
RS = 120007 Bear Creek 240.0 updated with DOT survey
Elevation (ft)
Station (ft)
Legend
WS 100-year - CE 060
WS 100-year - PC 068
Ground - CE 060
Bank Sta - CE 060
Ground - PC 068
Bank Sta - PC 068
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060
RS = 119986 supplemental section from DOT survey U/S xing
Elevation (ft)
Station (ft)
Legend
WS 100-year - CE 060
WS 100-year - PC 068
Ground - CE 060
Bank Sta - CE 060
- PC 068
Ground - PC 068
Ineff - PC 068
Bank Sta - PC 068

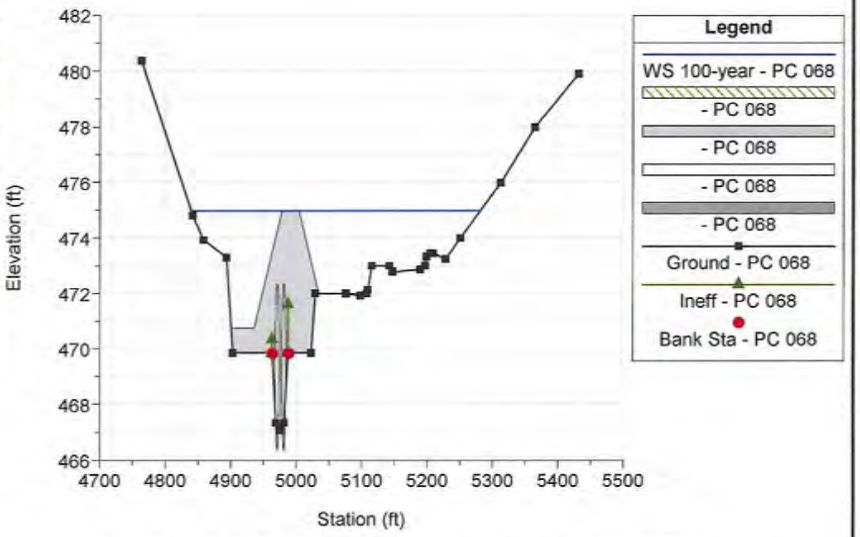
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 119966 Culv Unnamed Rd 3 (BC) TORStructure ID: Unnamed Rd 3 Approximate Su



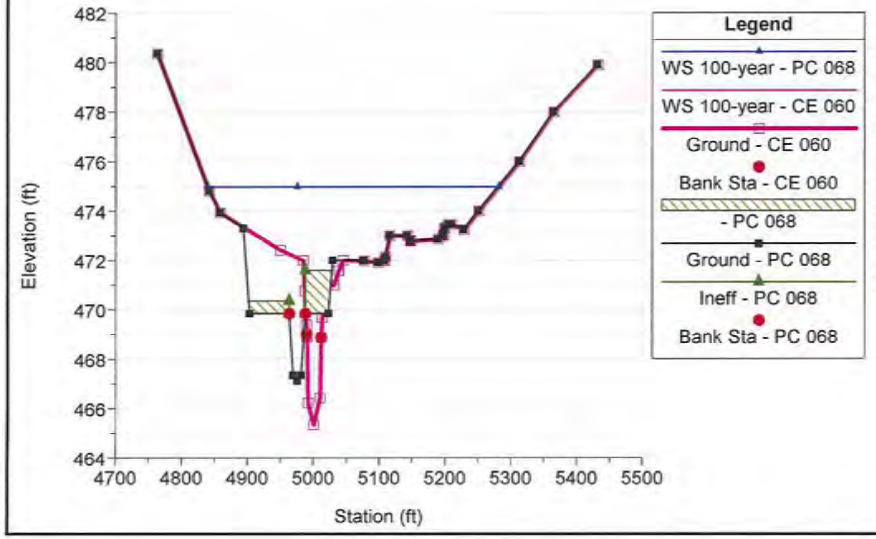
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 119966 Culv Unnamed Rd 3 (BC) TORStructure ID: Unnamed Rd 3 Approximate Su



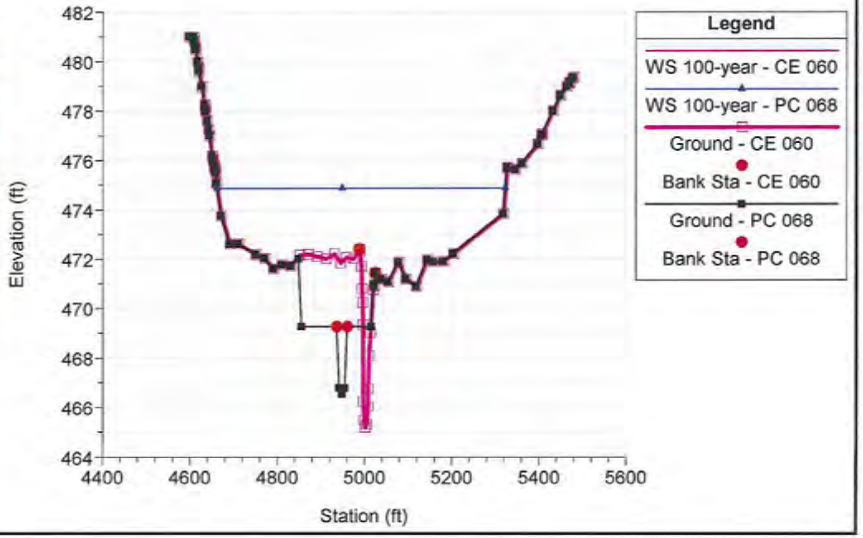
Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

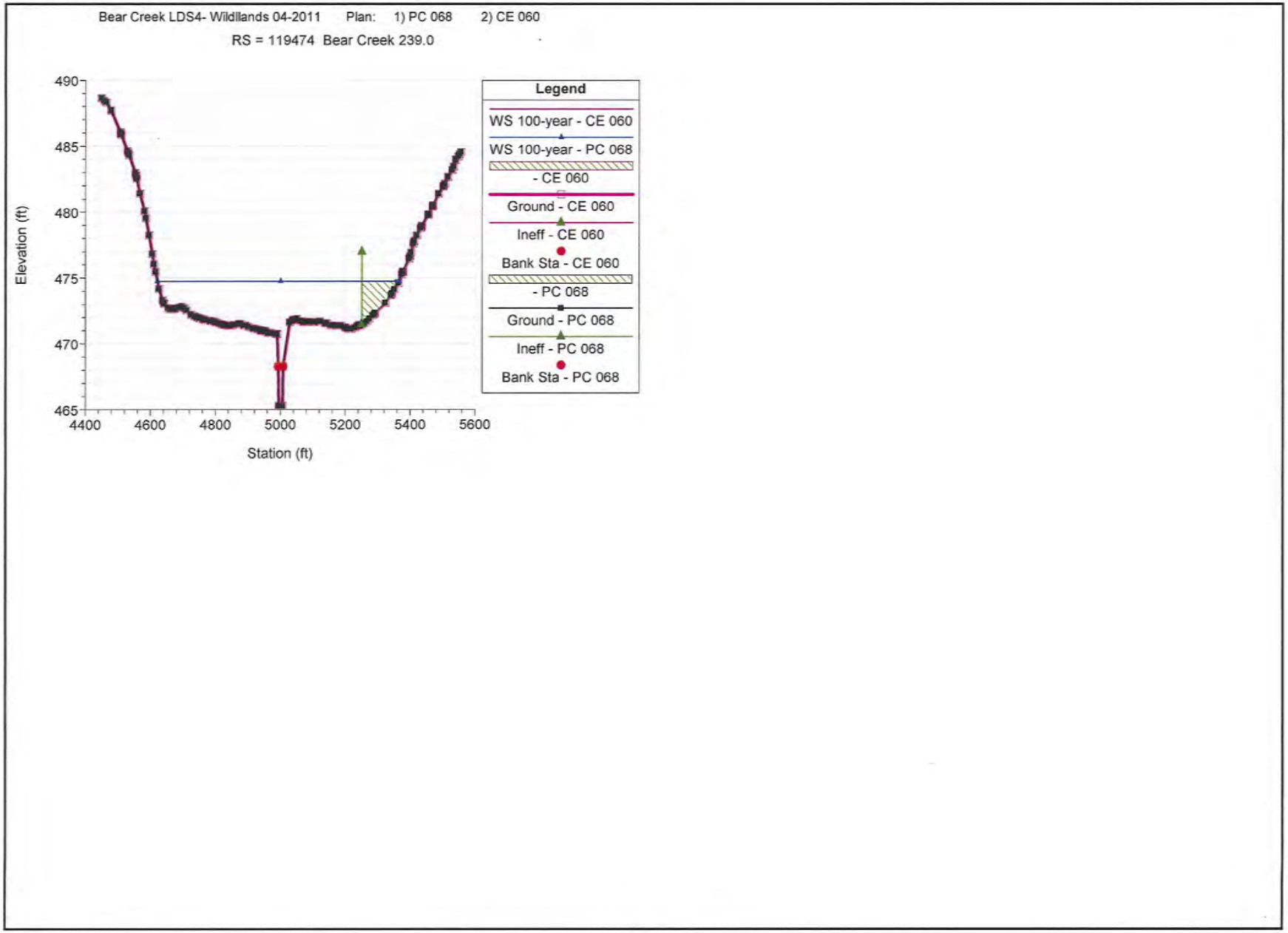
RS = 119946 supplemental section from DOT survey D/S xing

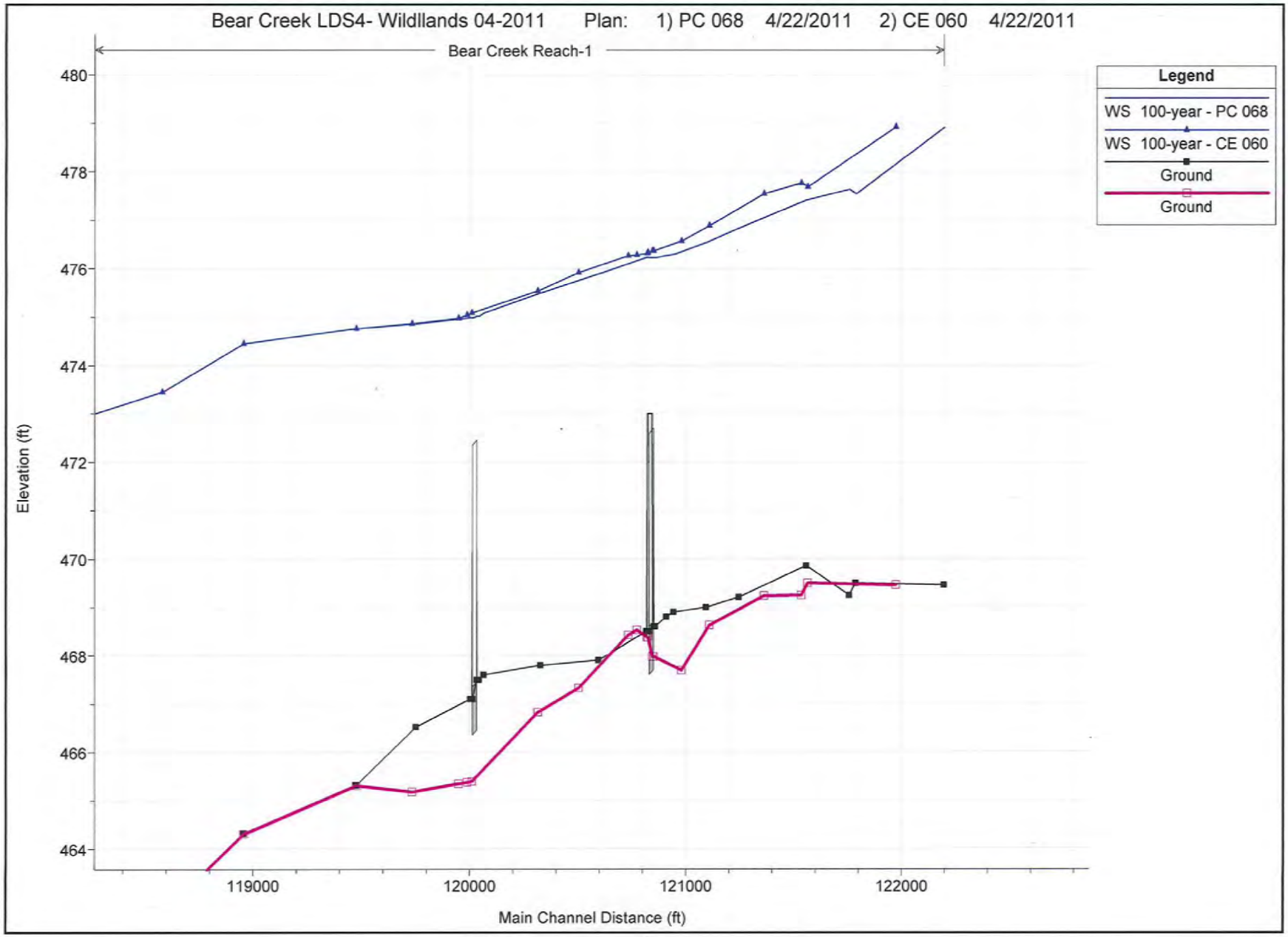


Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 2) CE 060

RS = 119731 supplemental section from DOT survey




Bear Creek LDS4- Wildlands 04-2011 Plan: 1) PC 068 2) CE 060
RS = 119474 Bear Creek 239.0
Elevation (ft)
490
485
480
475
470
465
4400
4600
4800
5000
5200
5400
5600
Station (ft)
Legend
WS 100-year - CE 060
WS 100-year - PC 068
- CE 060
Ground - CE 060
Ineff - CE 060
Bank Sta - CE 060
- PC 068
Ground - PC 068
Ineff - PC 068
Bank Sta - PC 068


Bear Creek LDS4- Wildllands 04-2011 Plan: 1) PC 068 4/22/2011 2) CE 060 4/22/2011
Bear Creek Reach-1
Legend
WS 100-year - PC 068
WS 100-year - CE 060
Ground
Ground
Elevation (ft)
480
478
476
474
472
470
468
466
464
119000
120000
121000
122000
Main Channel Distance (ft)

HEC-RAS Plan: CE 060 River: Bear Creek Reach: Reach-1

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Reach-1	119474	100-year	474.77		474.79	629.40	1016.03	268.63	831.34		4992.80	5007.20	
Reach-1	119474	100-FW	475.42	0.65	475.46	348.56	937.31	340.73	837.96	4825.75	4992.80	5007.20	5174.31
Reach-1	119731	100-year	474.87		474.89	660.80	889.36	376.91	849.73		4986.01	5022.90	
Reach-1	119731	100-FW	475.54	0.67	475.58	347.28	845.40	481.62	788.98	4803.59	4986.01	5022.90	5150.87
Reach-1	119946	100-year	474.98		475.08	441.23	430.72	712.92	972.35		4989.37	5011.06	
Reach-1	119946	100-FW	475.65	0.67	475.79	180.27	275.88	809.17	1030.95	4954.09	4989.37	5011.06	5134.36
Reach-1	119986	100-year	475.05		475.13	425.57	448.34	631.42	1036.24		4987.93	5009.41	
Reach-1	119986	100-FW	475.71	0.66	475.85	180.27	282.70	757.81	1075.48	4954.09	4987.93	5009.41	5134.36
Reach-1	120007	100-year	475.09		475.16	426.35	410.18	736.52	969.29		4981.52	5022.95	
Reach-1	120007	100-FW	475.78	0.69	475.88	204.15	338.05	870.81	907.14	4929.89	4981.52	5022.95	5134.04
Reach-1	120312	100-year	475.54		475.67	295.26	540.69	823.21	752.10		4983.25	5011.51	
Reach-1	120312	100-FW	476.23	0.69	476.46	140.34	814.72	1076.56	224.72	4894.00	4983.25	5011.51	5034.34
Reach-1	120501	100-year	475.92		476.06	269.19	813.03	989.63	313.34		4985.31	5021.75	
Reach-1	120501	100-FW	476.71	0.79	476.86	151.77	688.70	1082.70	344.60	4909.15	4985.31	5021.75	5060.92
Reach-1	120730	100-year	476.27		476.29	511.84	736.31	322.79	738.90		4986.92	5019.87	
Reach-1	120730	100-FW	477.05	0.78	477.10	252.09	647.60	427.92	722.47	4861.64	4986.92	5019.87	5113.73
Reach-1	120770	100-year	476.29		476.32	446.87	599.09	385.22	813.69		4986.92	5019.87	
Reach-1	120770	100-FW	477.08	0.79	477.12	253.43	642.81	430.01	725.19	4860.89	4986.92	5019.87	5114.32
Reach-1	120818	100-year	476.32		476.38	419.23	472.74	598.79	726.47		4978.06	5016.83	
Reach-1	120818	100-FW	477.09	0.77	477.19	169.60	218.66	775.61	803.73	4952.45	4978.06	5016.83	5122.05
Reach-1	120832 BR D	100-year	476.34		476.39	420.08	581.26	323.56	893.18		4978.06	5016.83	
Reach-1	120832 BR D	100-FW	477.10	0.76	477.20	169.60	283.89	464.05	1050.07	4952.45	4978.06	5016.83	5122.05
Reach-1	120832 BR U	100-year	476.37		476.44	368.59	549.20	307.98	940.82		4990.90	5015.27	
Reach-1	120832 BR U	100-FW	477.14	0.77	477.25	169.60	424.67	342.14	1031.19	4952.45	4990.90	5015.27	5122.05
Reach-1	120848	100-year	476.38		476.47	368.66	442.88	596.60	758.53		4990.90	5015.27	
Reach-1	120848	100-FW	477.15	0.78	477.26	169.60	344.01	633.70	820.29	4952.45	4990.90	5015.27	5122.05
Reach-1	120977	100-year	476.58		476.72	246.83	182.64	969.42	645.94		4984.02	5025.83	
Reach-1	120977	100-FW	477.30	0.72	477.50	111.95	15.98	1183.92	598.10	4981.25	4984.02	5025.83	5093.20

HEC-RAS Plan: CE 060 River: Bear Creek Reach: Reach-1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Reach-1	121106	100-year	476.89		477.04	242.79	276.75	743.76	777.49		4986.81	5021.74	
Reach-1	121106	100-FW	477.63	0.73	477.87	98.15		799.13	998.87	4992.30	4986.81	5021.74	5090.45
Reach-1	121359	100-year	477.56		477.62	440.46	645.86	360.63	791.51		4987.73	5007.40	
Reach-1	121359	100-FW	478.36	0.81	478.47	165.85	578.97	432.15	786.89	4925.89	4987.73	5007.40	5091.74
Reach-1	121532	100-year	477.78		477.86	407.54	395.36	602.29	800.35		4990.00	5010.00	
Reach-1	121532	100-FW	478.58	0.81	478.70	182.76	299.03	693.05	805.92	4927.85	4990.00	5010.00	5110.61
Reach-1	121562	100-year	477.70		477.97	423.73	441.71	908.86	447.43		4990.00	5010.00	
Reach-1	121562	100-FW	478.51	0.81	478.79	182.76	412.28	973.18	412.54	4927.85	4990.00	5010.00	5110.61
Reach-1	121971	100-year	478.93		479.08	409.85	684.39	555.50	558.11		4994.30	5005.70	
Reach-1	121971	100-FW	479.62	0.69	479.81	237.78	649.56	627.77	520.67	4891.84	4994.30	5005.70	5129.62

HEC-RAS Plan: PC 068 River: Bear Creek Reach: Reach-1

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Reach-1	119474	100-year	474.77		474.79	629.40	1016.03	268.63	831.34		4992.80	5007.20	
Reach-1	119474	100-FW	475.42	0.65	475.46	348.56	937.31	340.73	837.96	4825.75	4992.80	5007.20	5174.31
Reach-1	119731	100-year	474.87		474.88	660.75	782.06	341.90	992.05		4934.75	4959.25	
Reach-1	119731	100-FW	475.55	0.68	475.57	347.28	675.56	432.01	1008.43	4803.59	4934.75	4959.25	5150.87
Reach-1	119946	100-year	474.99		475.08	441.67	573.83	641.90	900.27		4962.75	4987.25	
Reach-1	119946	100-FW	475.66	0.67	475.88	180.27	78.62	967.66	1069.72	4954.09	4962.75	4987.25	5134.36
Reach-1	119966		Culvert										
Reach-1	119986	100-year	475.02		475.11	424.34	621.06	600.45	894.49		4978.75	5003.25	
Reach-1	119986	100-FW	475.75	0.73	475.95	180.27	272.19	893.59	950.22	4954.09	4978.75	5003.25	5134.36
Reach-1	120007	100-year	475.09		475.15	426.31	713.62	498.39	903.99		4987.75	5012.25	
Reach-1	120007	100-FW	475.92	0.83	476.02	204.15	550.52	670.98	894.50	4929.89	4987.75	5012.25	5134.04
Reach-1	120312	100-year	475.50		475.60	294.28	312.19	645.82	1157.99		4913.75	4938.25	
Reach-1	120312	100-FW	476.39	0.89	476.55	140.34	214.88	840.84	1060.28	4894.00	4913.75	4938.25	5034.34
Reach-1	120501	100-year	475.90		476.01	268.54	954.35	699.65	462.01		4987.75	5012.25	
Reach-1	120501	100-FW	476.83	0.93	476.94	151.77	833.23	767.12	515.65	4909.15	4987.75	5012.25	5060.92
Reach-1	120730	100-year	476.23		476.26	511.09	831.89	320.80	645.31		4987.75	5012.25	
Reach-1	120730	100-FW	477.16	0.92	477.19	252.09	772.45	435.34	590.21	4861.64	4987.75	5012.25	5113.73
Reach-1	120750		Culvert										
Reach-1	120770	100-year	476.23		476.27	445.11	635.39	404.28	758.32		4987.75	5012.25	
Reach-1	120770	100-FW	477.17	0.93	477.21	253.43	681.71	469.92	646.37	4860.89	4987.75	5012.25	5114.32
Reach-1	120818	100-year	476.28		476.34	417.27	685.65	504.21	608.13		5012.75	5037.25	
Reach-1	120818	100-FW	477.19	0.91	477.29	169.60	525.65	670.80	601.56	4952.45	5012.75	5037.25	5122.05
Reach-1	120848	100-year	476.30		476.39	364.60	747.12	585.68	465.21		5032.75	5057.25	
Reach-1	120848	100-FW	477.23	0.93	477.34	169.60	709.02	676.07	412.91	4952.45	5032.75	5057.25	5122.05
Reach-1	120977	100-year	476.55		476.67	245.71	256.64	669.16	872.20		4987.75	5012.25	
Reach-1	120977	100-FW	477.43	0.89	477.61	111.95	53.56	823.81	920.63	4981.25	4987.75	5012.25	5093.20
Reach-1	121106	100-year	476.85		476.99	241.05	596.02	720.96	481.02		5024.75	5049.25	
Reach-1	121106	100-FW	477.73	0.89	477.94	98.15	398.04	893.96	506.00	4992.30	5024.75	5049.25	5090.45

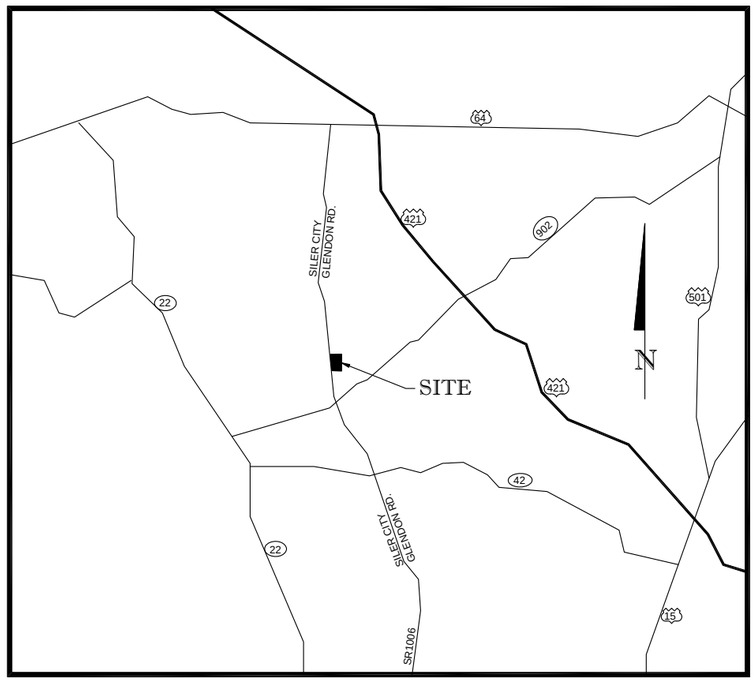
HEC-RAS Plan: PC 068 River: Bear Creek Reach: Reach-1 (Continued)

Reach	River Sta	Profile	W.S. Elev	Prof Delta WS	E.G. Elev	Top Wdth Act	Q Left	Q Channel	Q Right	Enc Sta L	Ch Sta L	Ch Sta R	Enc Sta R
			(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)
Reach-1	121359	100-year	477.42		477.49	437.97	351.34	542.80	903.86		4950.75	4975.25	
Reach-1	121359	100-FW	478.35	0.93	478.44	165.85	213.59	646.30	938.11	4925.89	4950.75	4975.25	5091.74
Reach-1	121532	100-year	477.64		477.74	403.87	377.12	625.60	795.28		4990.00	5010.00	
Reach-1	121532	100-FW	478.55	0.90	478.67	182.76	297.31	696.16	804.53	4927.85	4990.00	5010.00	5110.61
Reach-1	121562	100-year	477.55		477.87	415.02	415.66	949.44	432.90		4990.00	5010.00	
Reach-1	121562	100-FW	478.48	0.93	478.77	182.76	409.96	977.60	410.44	4927.85	4990.00	5010.00	5110.61
Reach-1	121971	100-year	478.92		479.08	409.74	683.82	557.22	556.96		4994.30	5005.70	
Reach-1	121971	100-FW	479.60	0.68	479.80	237.78	649.22	629.15	519.63	4891.84	4994.30	5005.70	5129.62

Appendix D:
Project Plan Sheets

Bear Creek Restoration

Phillips Site
Chatham County, NC
for
North Carolina Ecosystem Enhancement Program



Vicinity Map
Not to Scale

BEFORE YOU DIG!
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW!

Mitigation Plan Submittal
June 22, 2011

Sheet Index

Project Directory

Engineering:
Wildlands Engineering, Inc
License No. F-0831
1430 South Mint Street
Suite 104
Charlotte, NC 28203
Emily G. Reinicker, PE
704-332-7754

Owner:
NC Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652
Melonie Allen
919.368.9352

DENR Contract: D09050S
SCO ID No.: 09-0772601
EEP ID No.: 26

Project Summary

Bear Creek Restoration - Reach A	966 LF
Bear Creek Restoration - Reach B	1,179 LF
UT to Bear Creek Restoration	1,937 LF
River Basin	Cape Fear
HUC	03030003

WILDLANDS ENGINEERING

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Ecological Restoration Services
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Tel: 704.332.7754
Fax: 704.332.3306
Firm License No. F-0831

Preliminary Plans - Not for Construction

Bear Creek Restoration
Chatham County, NC

Title Sheet

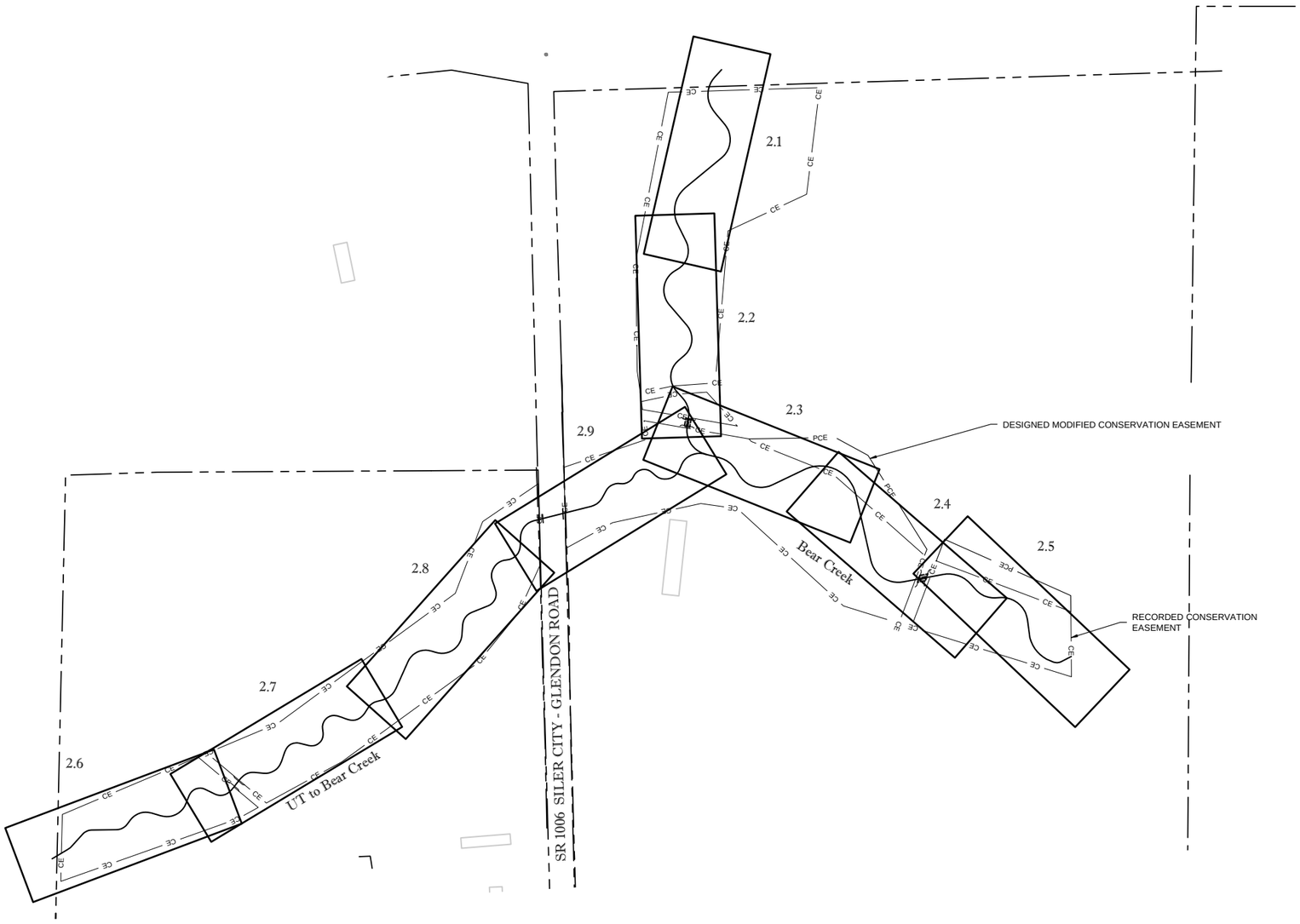
Date:	June 22, 2011
Job Number:	005-02120
Project Engineer:	EGR
Drawn By:	ICK
Checked By:	SDW

Revisions
Plan and Profile 5.12.2011

TITLE SHEET

Sheet

0.1



N

0' 150' 300' 450'
(HORIZONTAL)

Preliminary Plans - Not for Construction

WILDLANDS ENGINEERING

WILDLANDS ENGINEERING, INC.
Ecological Restoration Services
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Tel: 704.332.7754
Fax: 704.332.3306
Firm License No. F-0831

Bear Creek Restoration Site
Chatham County, NC

Project Overview

Date:	June 22, 2011
Job Number:	005-02120
Project Engineer:	EGR
Drawn By:	ICK
Checked By:	SDW

Revisions

PROJECT OVERVIEW

Sheet

0.2

NOTES:
1. Topographic data provided by NCDOT. Vertical datum NAVD88.
2. Conservation easement and temporary construction easement shown on this plan set per plat recorded on August 18, 2006, prepared by Level Cross Surveying, PLLC, in Chatham County Deed Book 1279, on pages 487-488.

Existing Property Line

Existing Thalweg

Existing Major Contour (100)

Existing Minor Contour

Existing Paved Road

Recorded Conservation Easement (CE)

Existing Fence (X)

Designed Channel Centerline (10+00)

Designed Bankfull

Designed Major Contour (100)

Designed Minor Contour

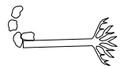
Designed Modified Conservation Easement (PCE)

Designed Silt Fence ([x])

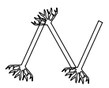
Designed Safety Fence (SAF)

Designed Temporary Fence

Designed Permanent Fence



Designed Log J-Hook
See Detail 4, Sheet 4.1



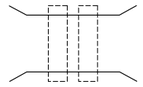
Designed Angled Log Step Pool
See Detail 1, Sheet 4.2
Designed Log Vane
See Detail 2, Sheet 4.1

Designed Log Sill
See Detail 1, Sheet 4.1

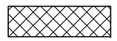
Designed Boulder Sill
See Detail 3, Sheet 4.1

Designed Constructed Riffle

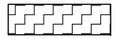
Designed Constructed Riffle with Boulder Sills
See Detail 2, Sheet 4.2



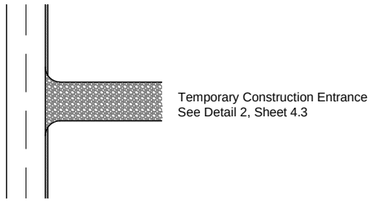
Designed Culverted Crossing



Designed Channel Plug
See Detail 3, Sheet 4.2



Designed Brush Mattress
See Detail 3, Sheet 4.4



Temporary Construction Entrance
See Detail 2, Sheet 4.3

WILDLANDS ENGINEERING

WILDLANDS ENGINEERING, INC.
Ecological Restoration Services
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Charlotte, NC 28203
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Firm License No. F-0831

Preliminary Plans - Not for Construction

Bear Creek Restoration Site
Chatham County, NC

General Notes and Symbols

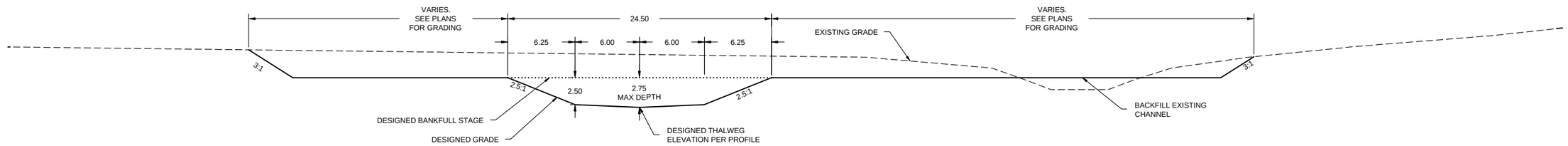
Date:	June 22, 2011
Job Number:	005-02120
Project Engineer:	EGR
Drawn By:	ICK
Checked By:	SDW

Revisions

NOTES AND SYMBOLS

Sheet

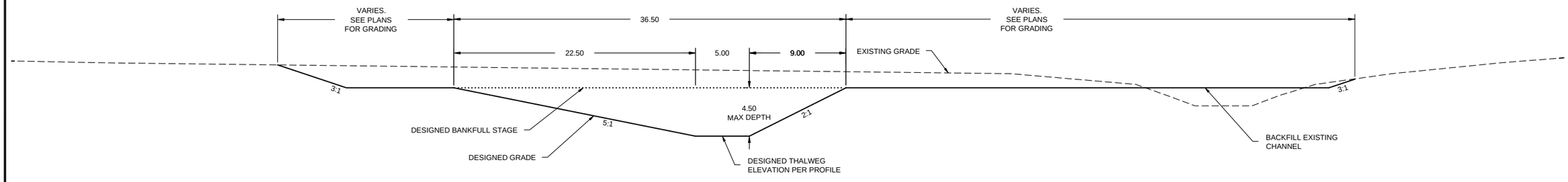
0.3



Bear Creek Reach A Typical Cross Section: Riffle

STA: 200+60 TO 210+50

Not to Scale



Bear Creek Reach A Typical Cross Section: Pool

STA: 200+60 TO 210+50

Not to Scale

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Fax: 704.332.3306
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Preliminary Plans - Not for Construction

Bear Creek Restoration Site
Chatham County, NC

Bear Creek
Typical Sections

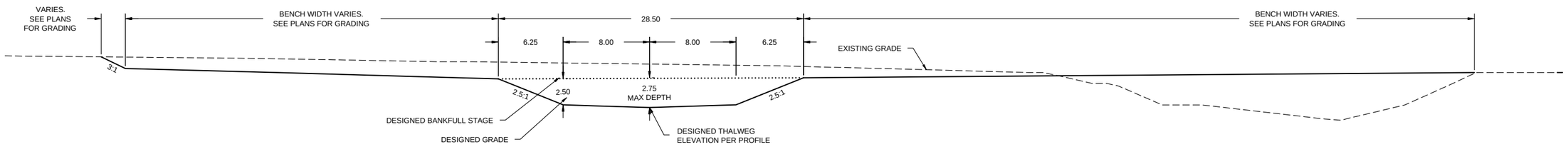
Date:	June 22, 2011
Job Number:	005-02120
Project Engineer:	EGR
Drawn By:	ICK
Checked By:	SDW

Revisions

TYPICAL SECTIONS

Sheet

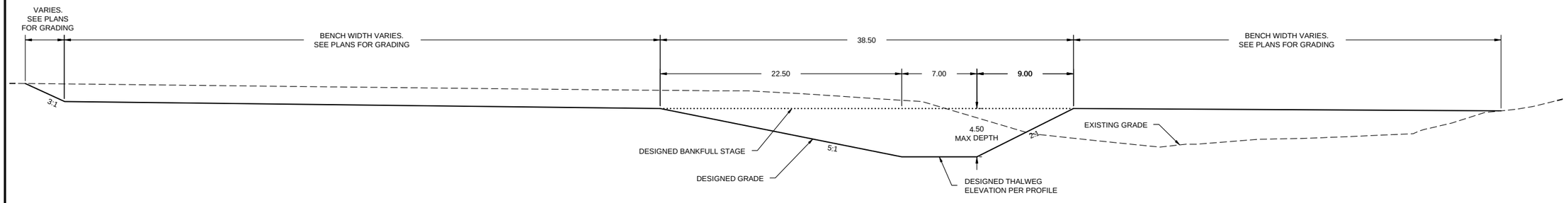
1.1



Bear Creek Reach B Typical Cross Section: Riffle

STA: 210+50 to STA: 222+06

Not to Scale



Bear Creek Reach B Typical Cross Section: Pool

STA: 210+50 TO 222+06

Not to Scale

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Chatham County, NC

Bear Creek
Typical Sections

Date:	June 22, 2011
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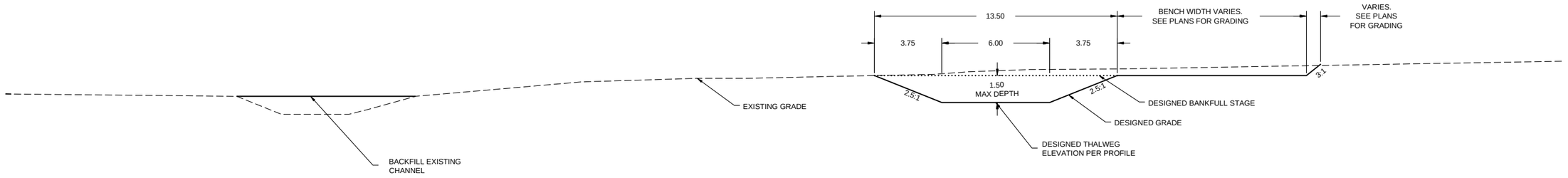
Drawn By:	ICK
Checked By:	SDW

Revisions

TYPICAL SECTIONS

Sheet

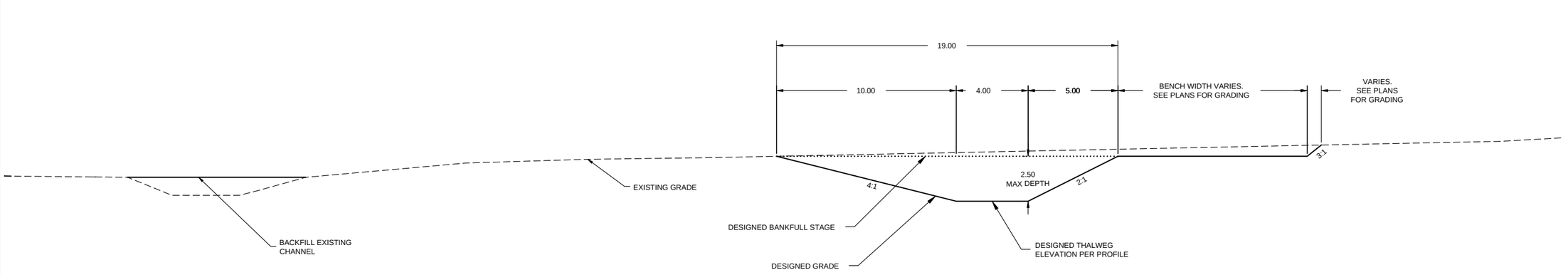
1.2



UT Typical Cross Section: Riffle

STA: 100+25 TO 112+50

Not to Scale



UT Typical Cross Section: Pool

STA: 100+25 TO 112+50

Not to Scale

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Bear Creek Restoration
Chatham County, NC

UT
Typical Sections

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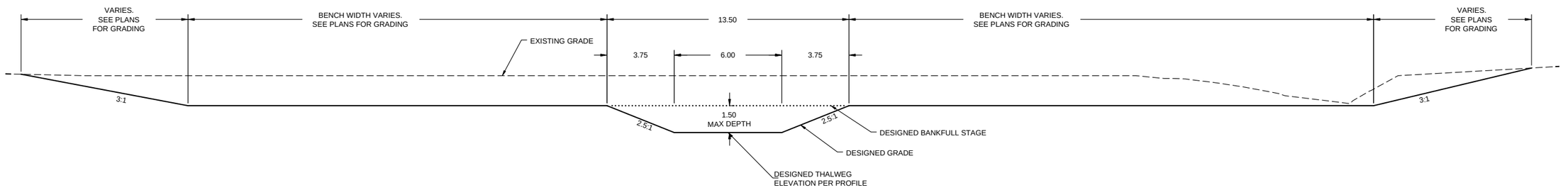
Checked By:	SDW

Revisions

TYPICAL SECTIONS

Sheet

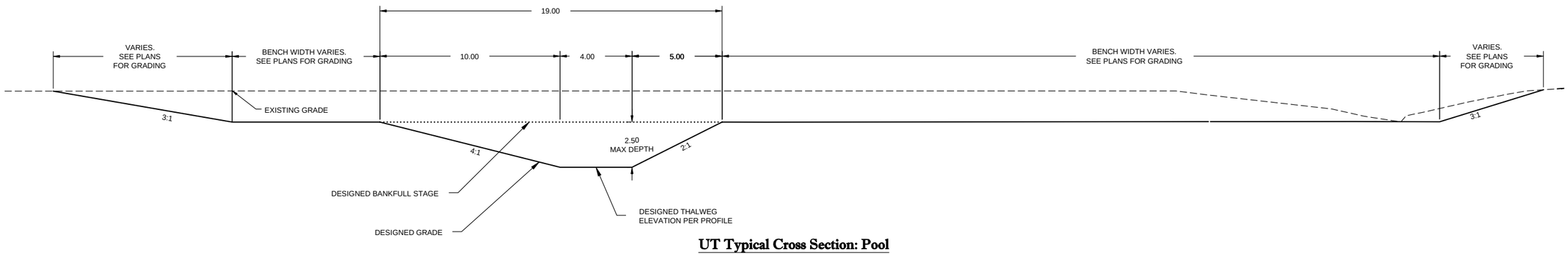
1.3



UT Typical Cross Section: Riffle

STA: 112+50 TO 120+57

Not to Scale



UT Typical Cross Section: Pool

STA: 112+50 TO 120+57

Not to Scale

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Chatham County, NC

UT
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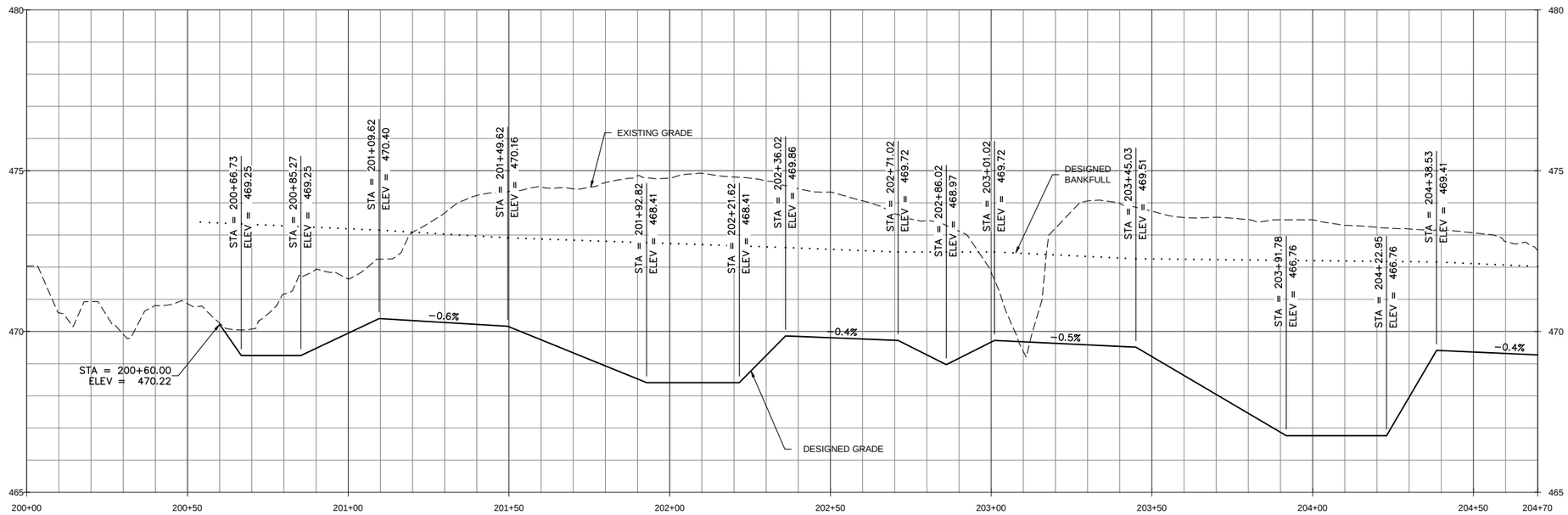
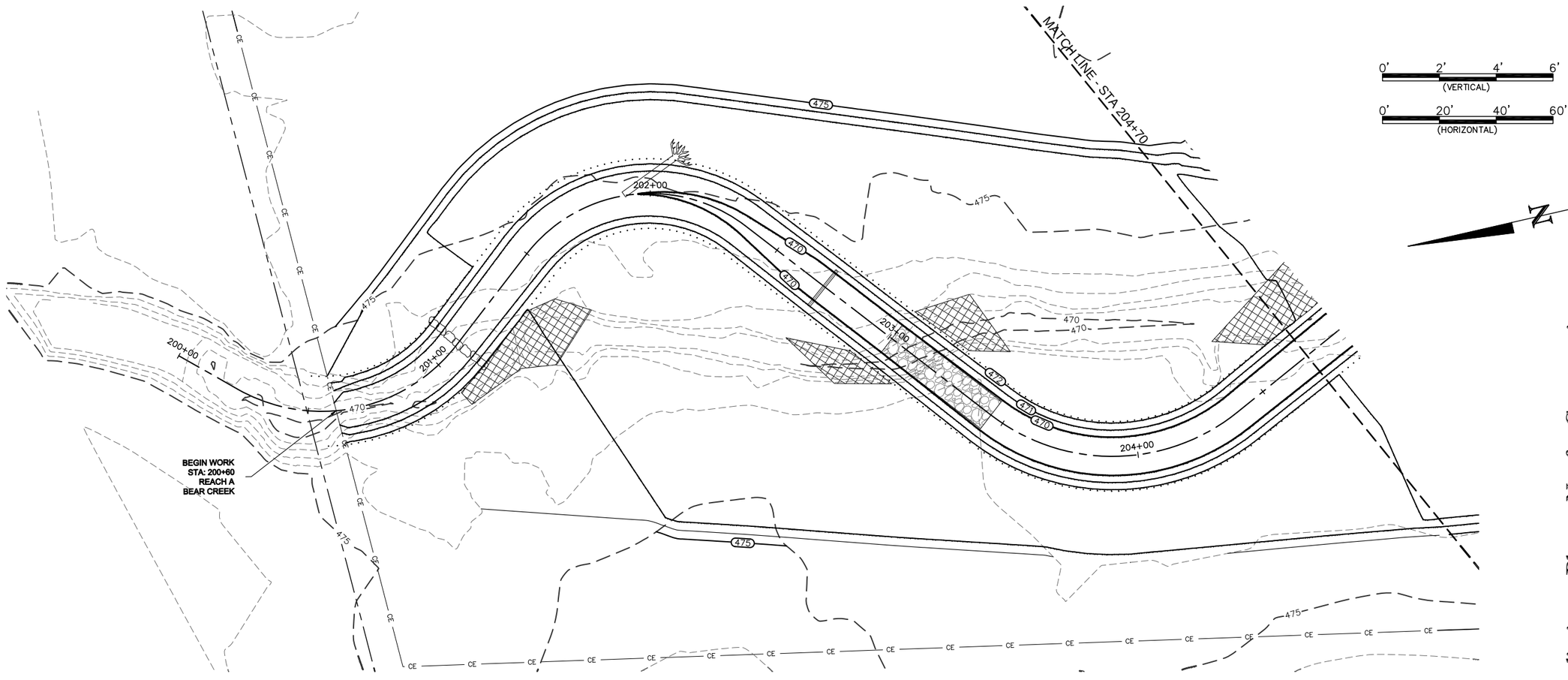
TYPICAL SECTIONS

Sheet

1.4





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Chatham County, NC

Bear Creek
Plan and Profile

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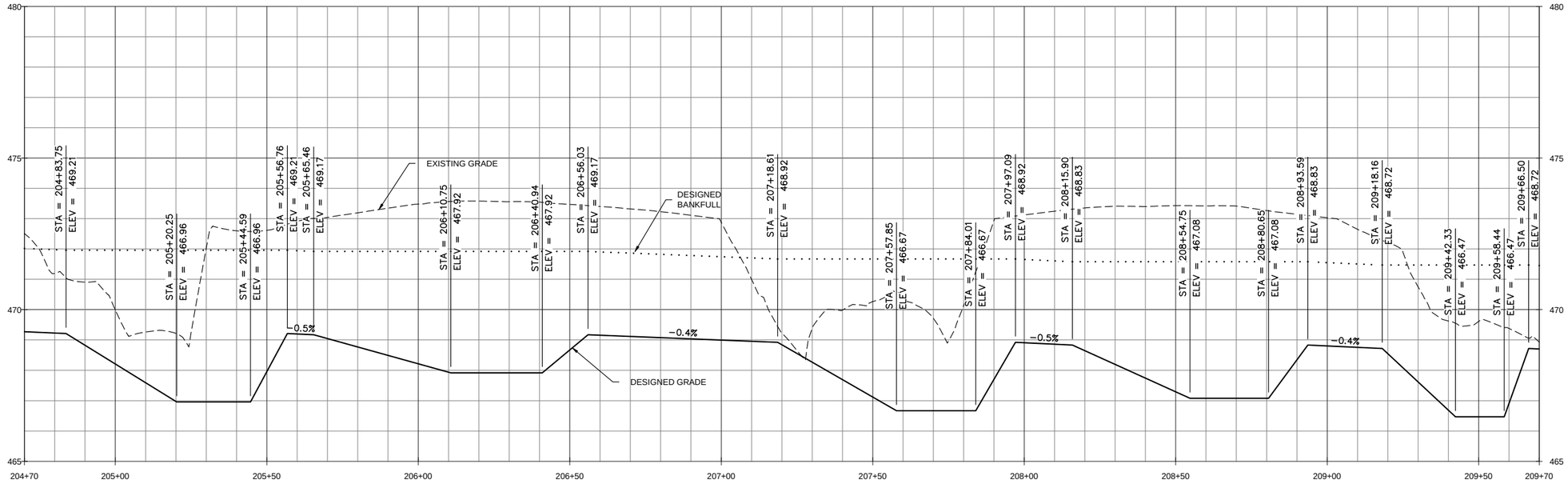
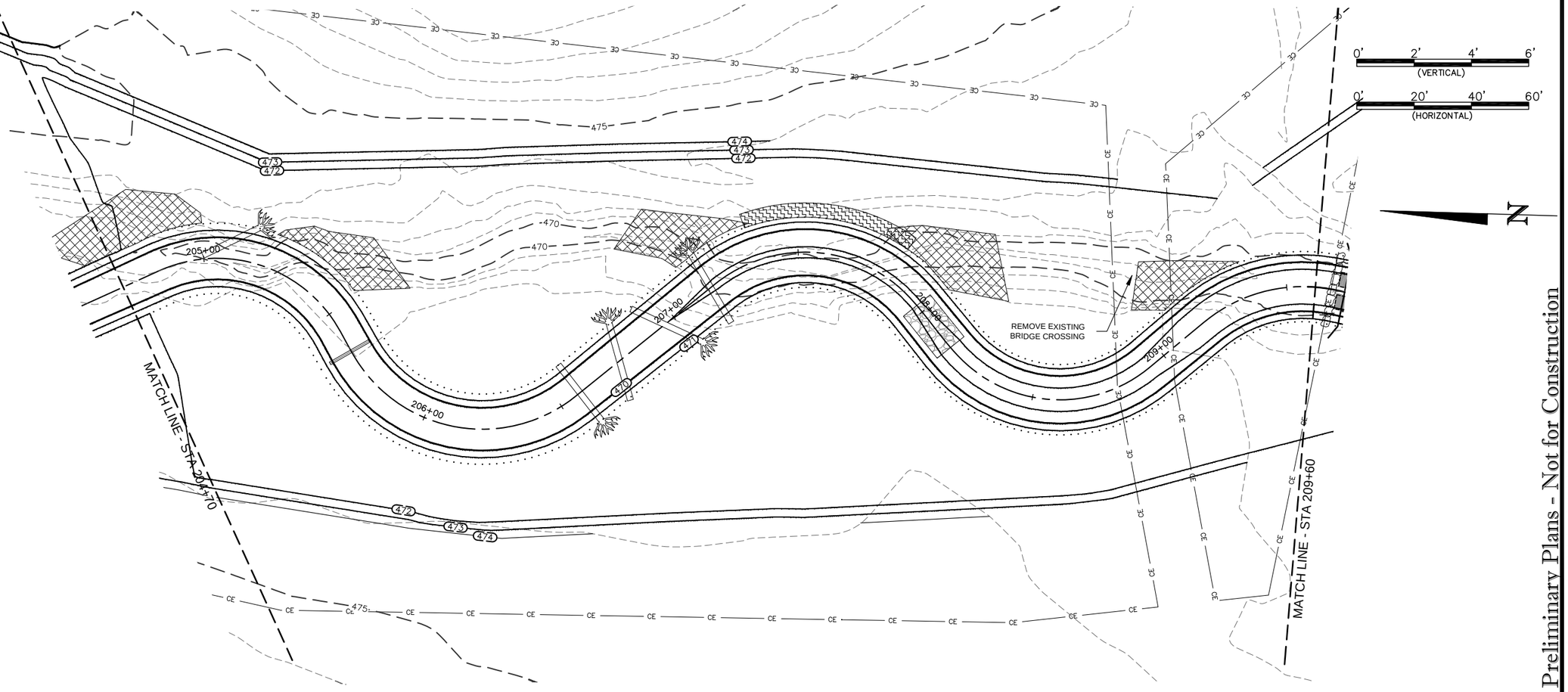
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.1**





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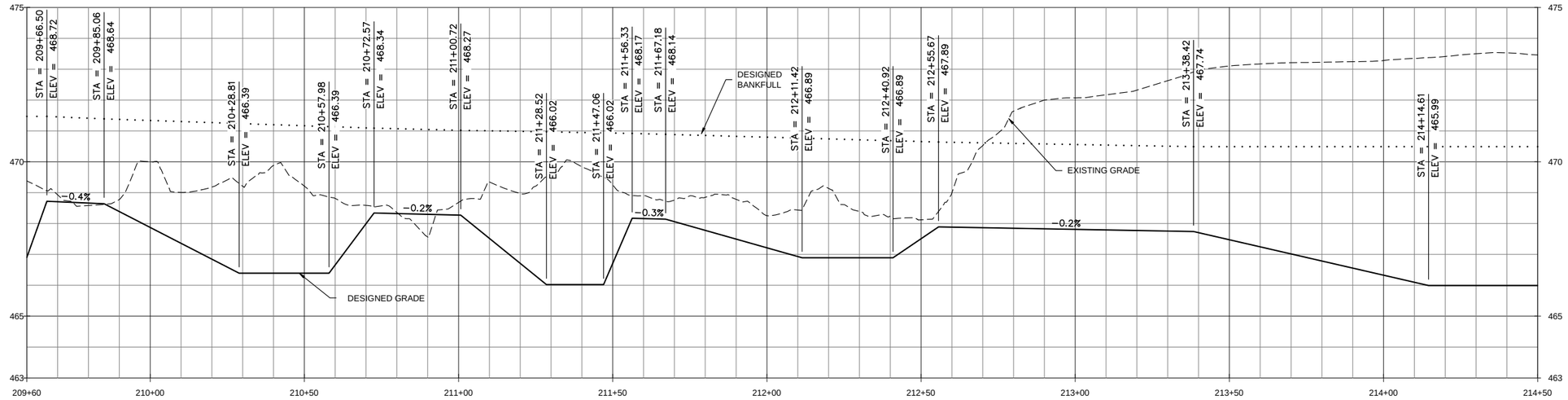
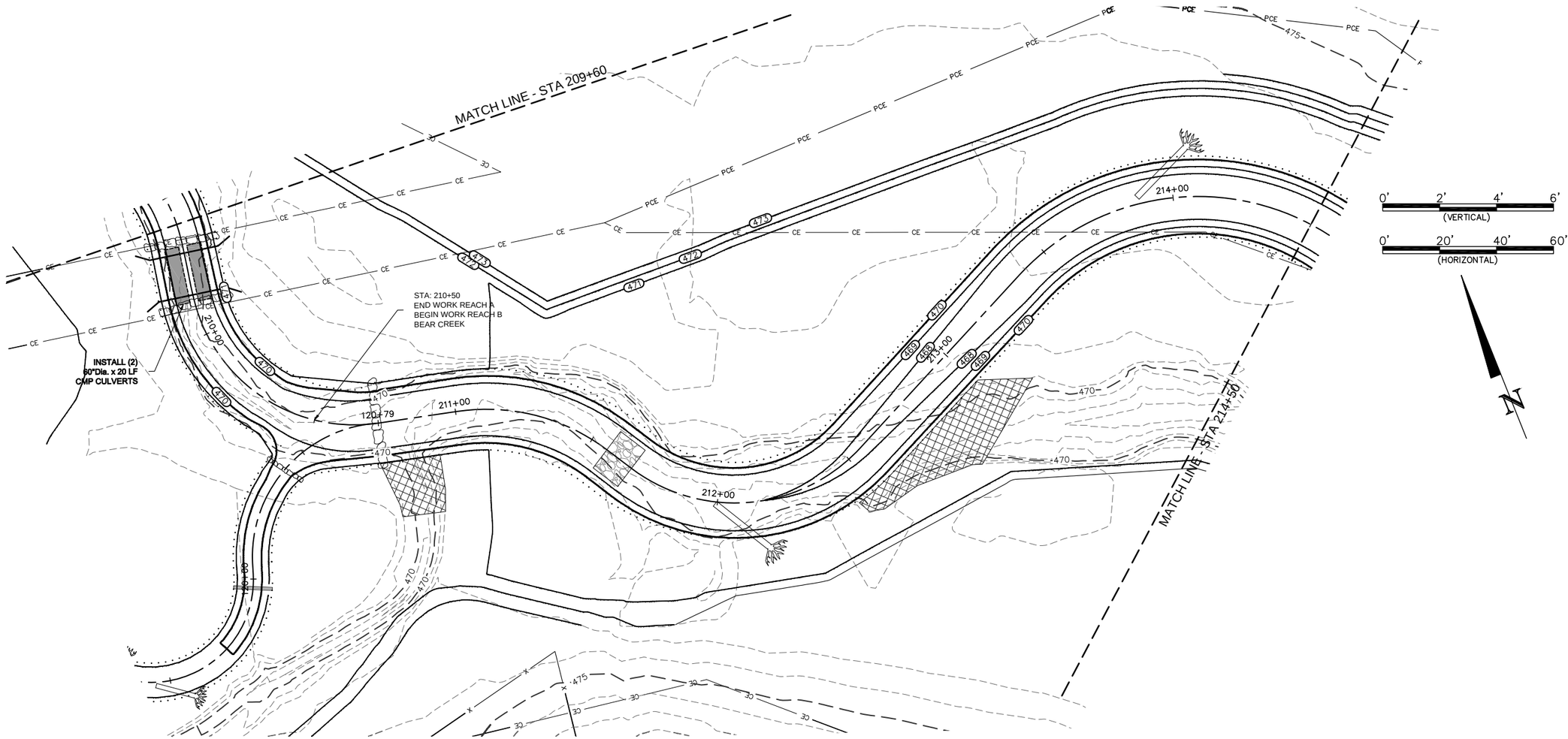
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.2**





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Bear Creek
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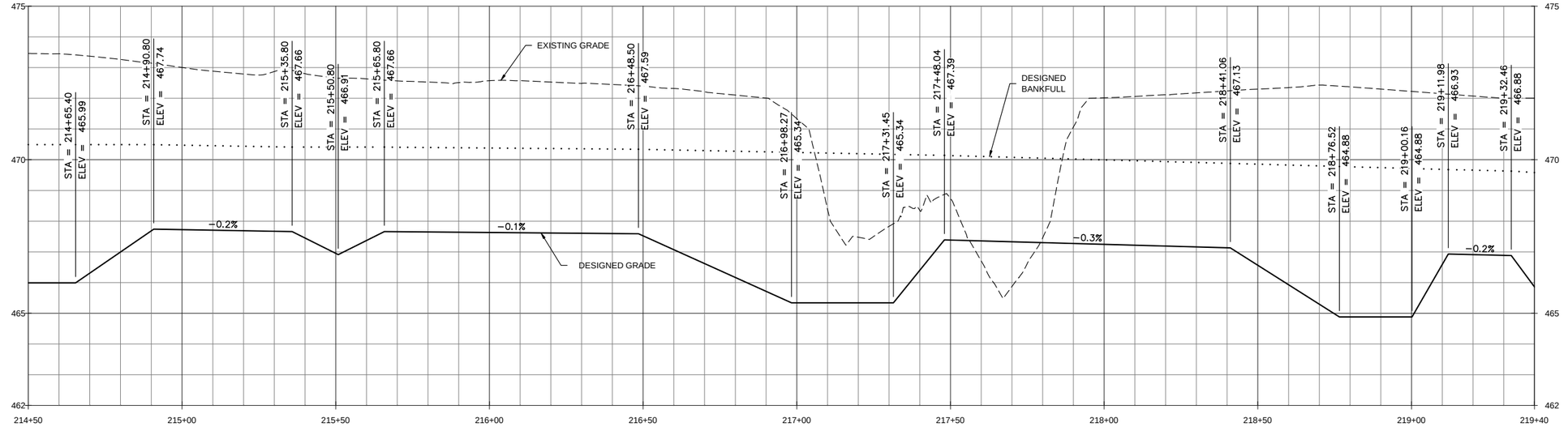
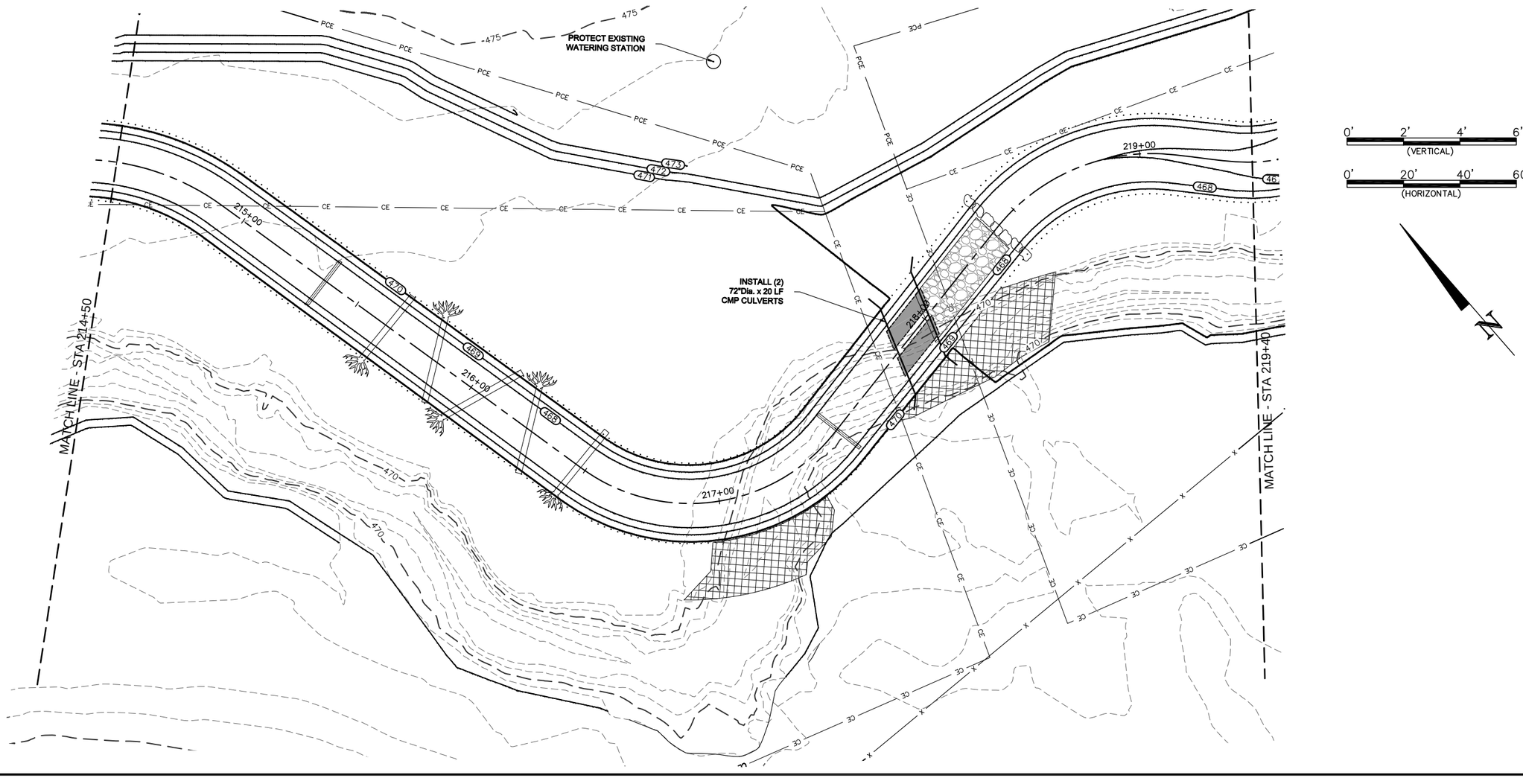
Revisions

Plan and Profile	5.12.2011

PLAN AND PROFILE

Sheet **2.3**





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Chatham County, NC

Bear Creek
Plan and Profile

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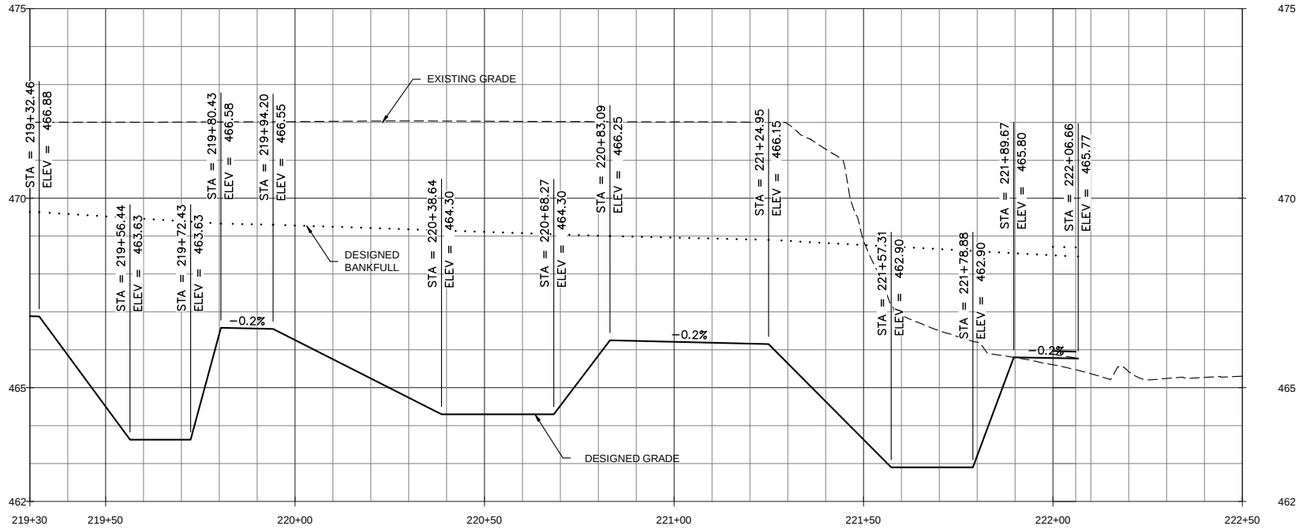
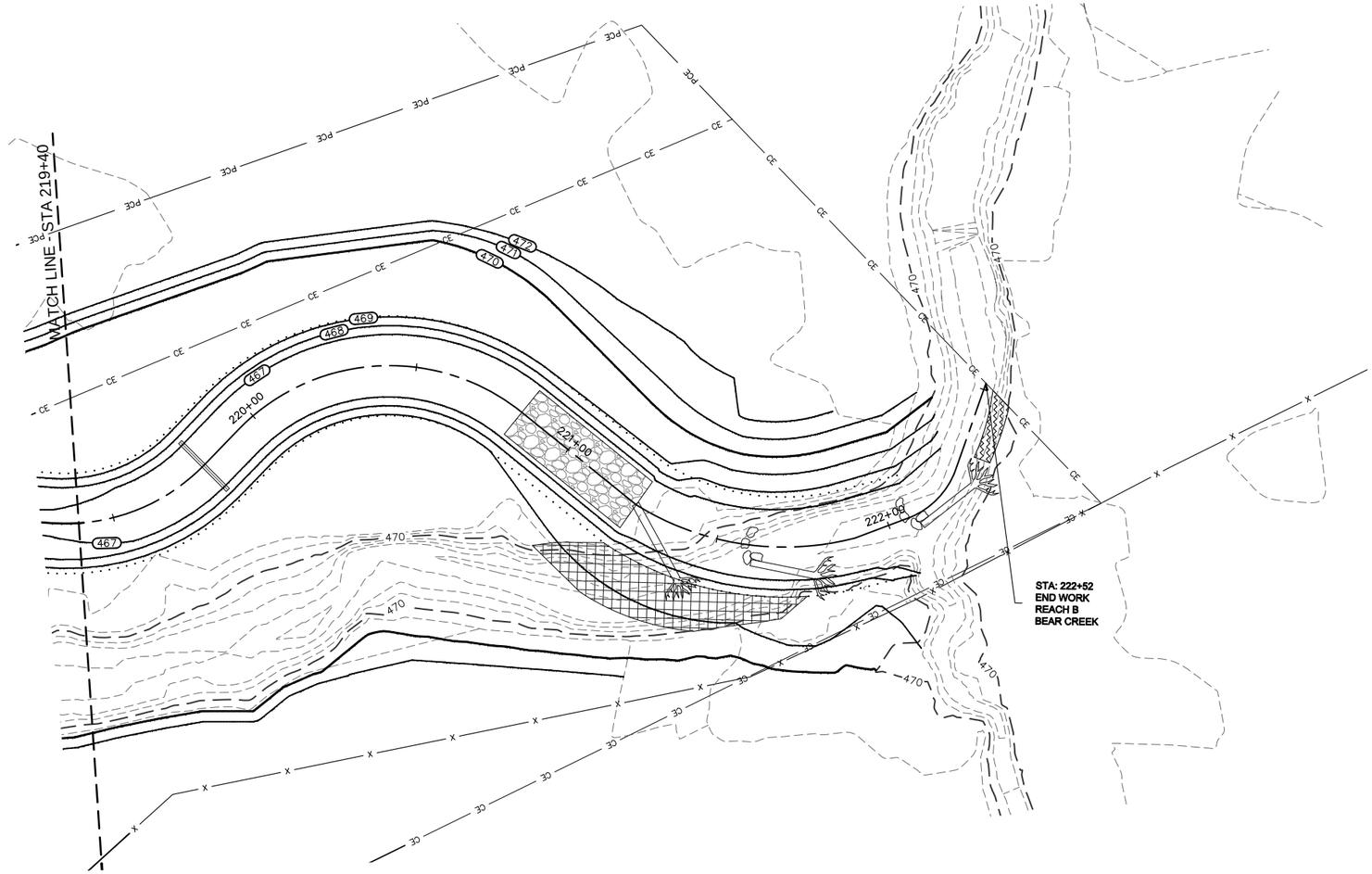
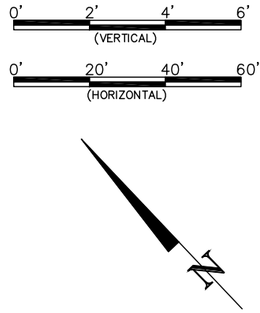
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.4**







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Chatham County, NC

Bear Creek
Plan and Profile

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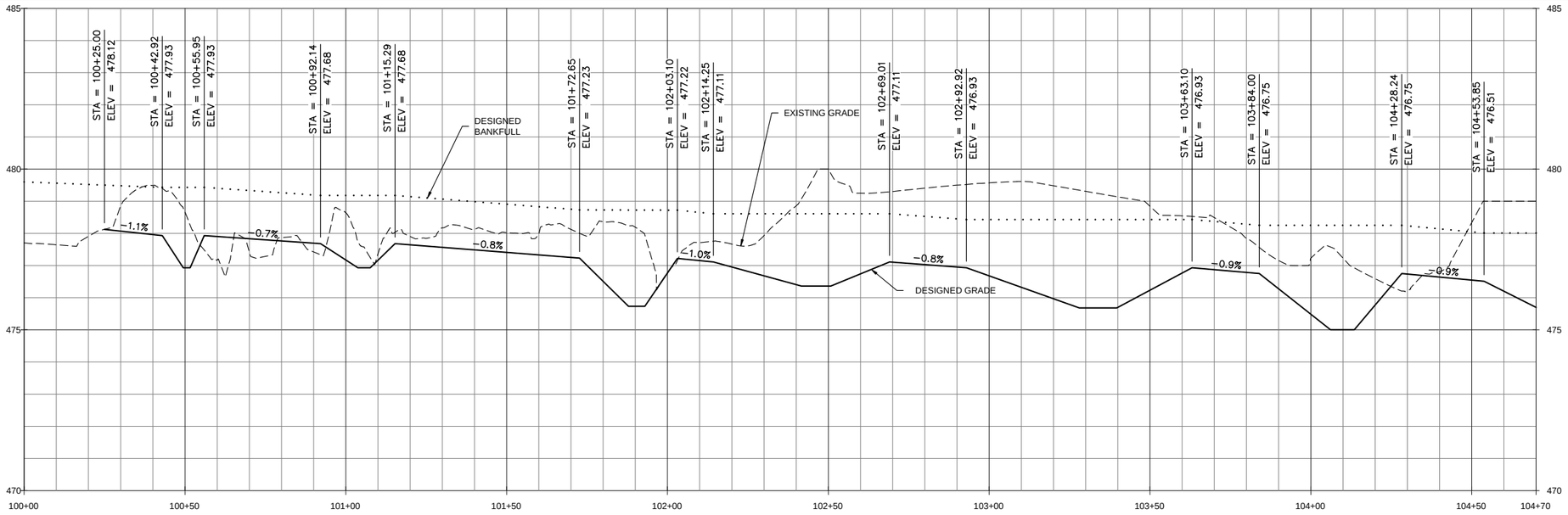
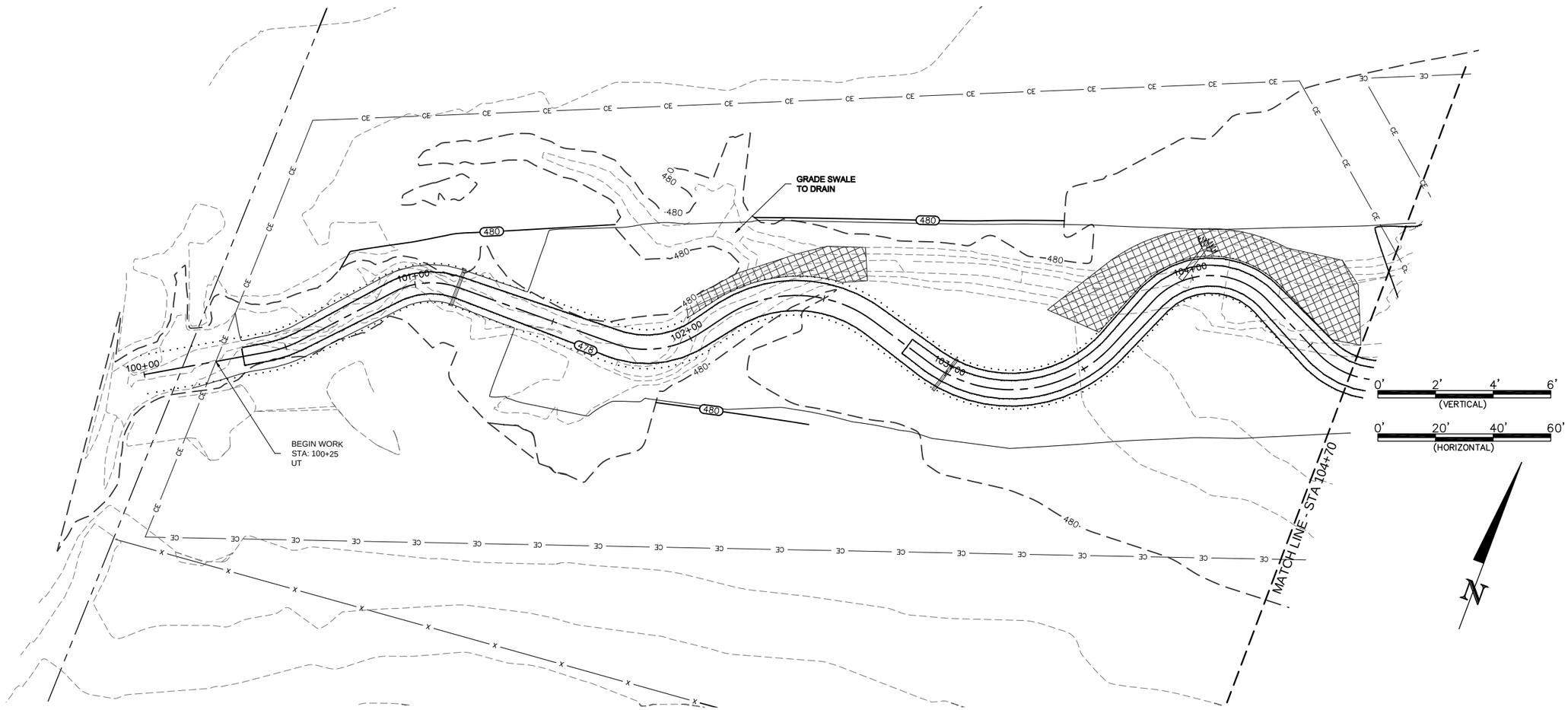
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.5**





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Bear Creek Restoration Site
Chatham County, NC
UT
Plan and Profile

Date:	June 22, 2011
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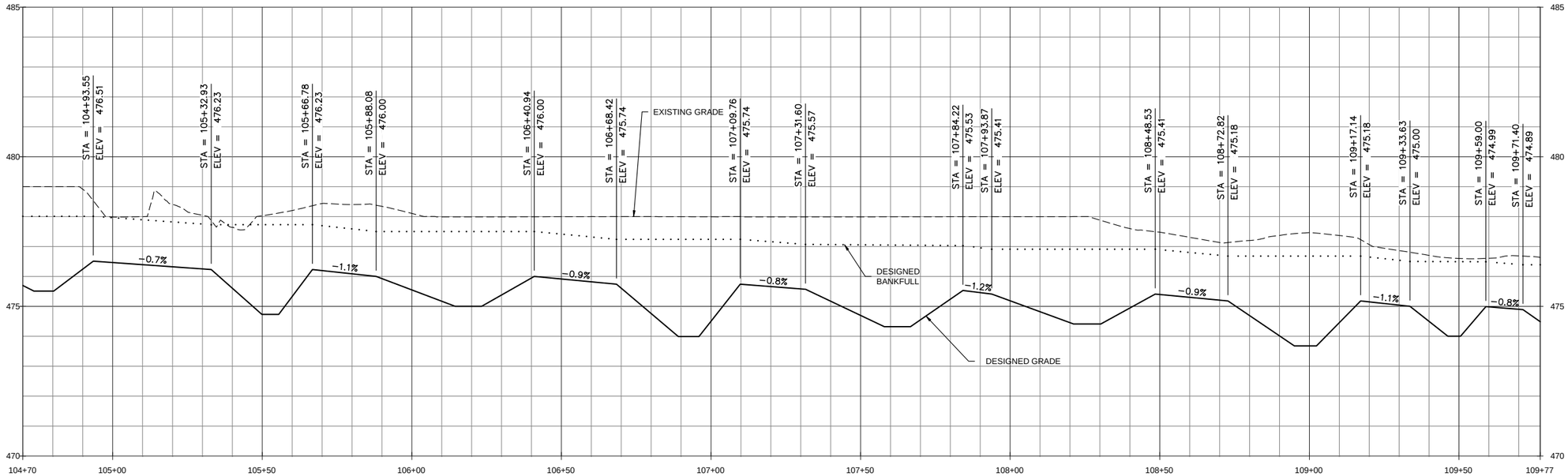
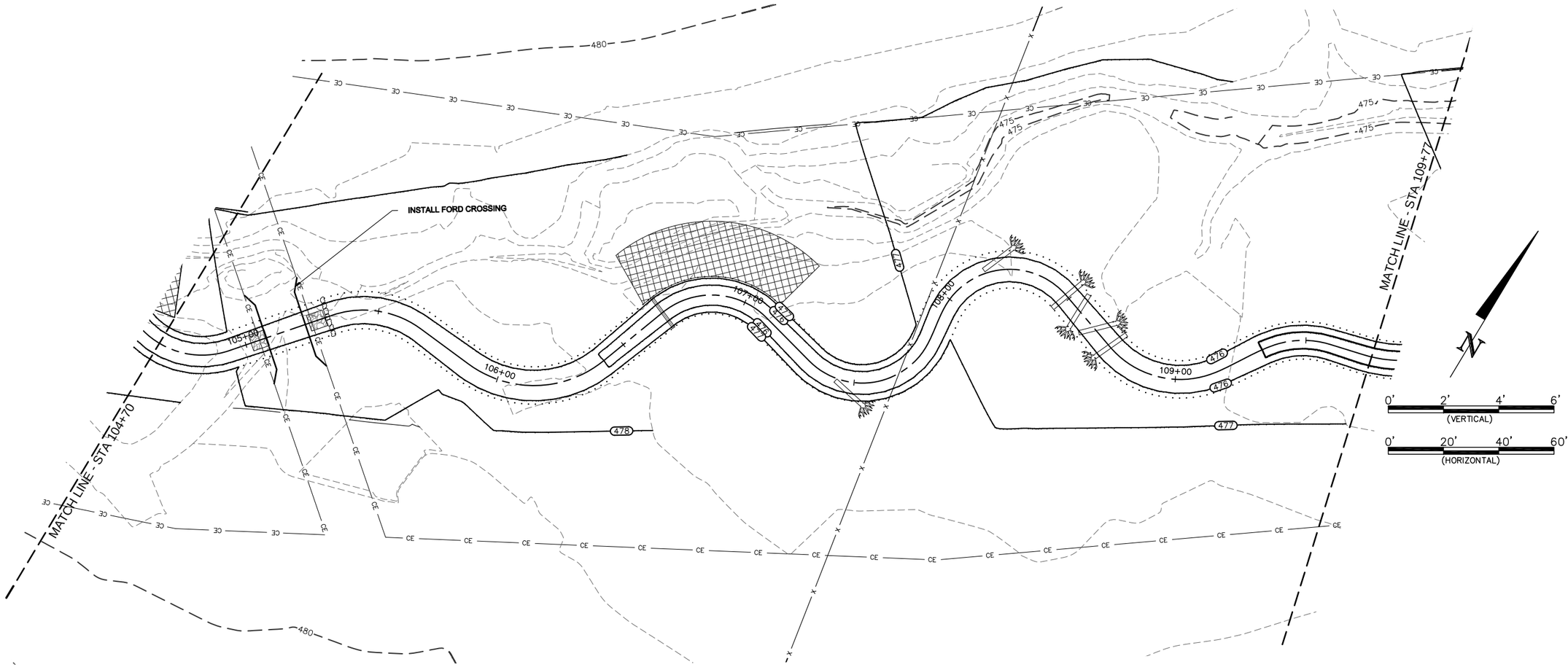
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.6**





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Chatham County, NC

UT
Plan and Profile

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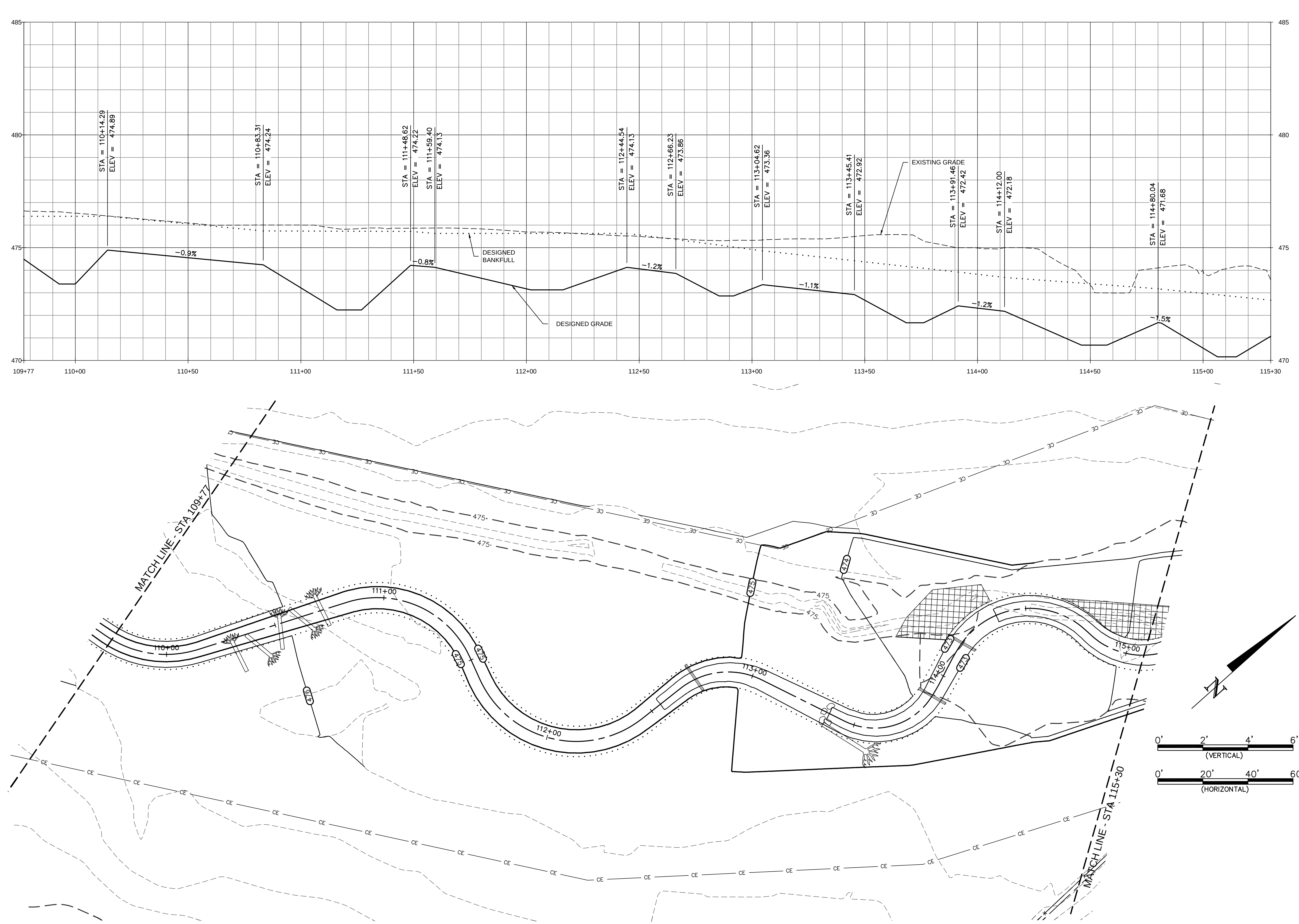
Revisions
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.7**



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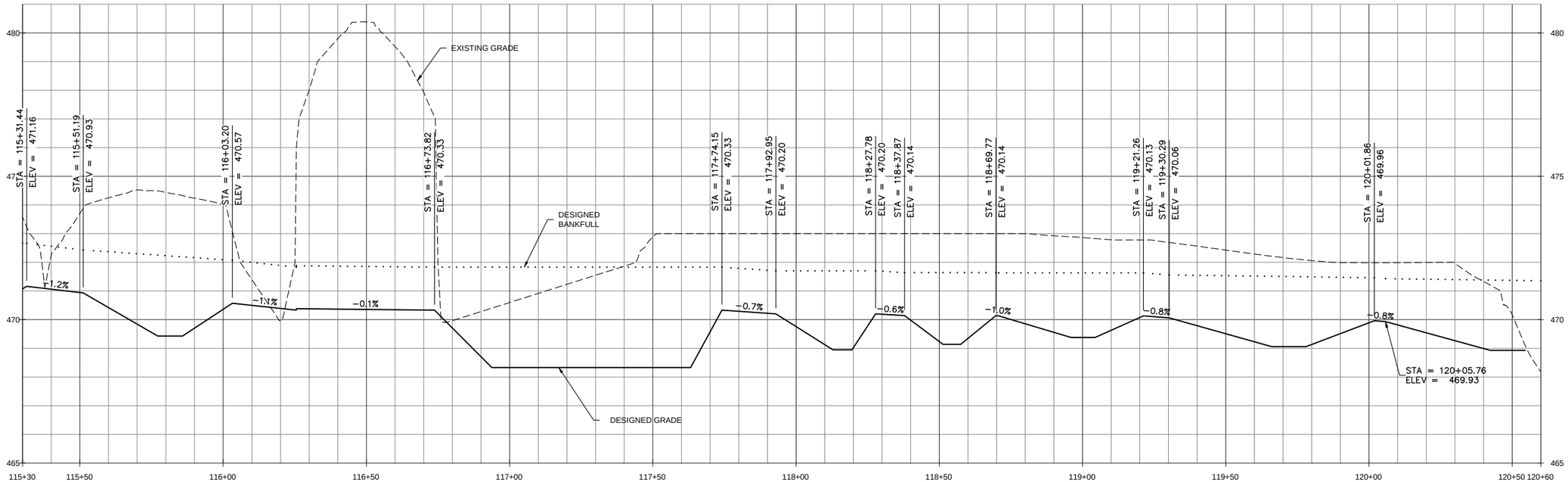
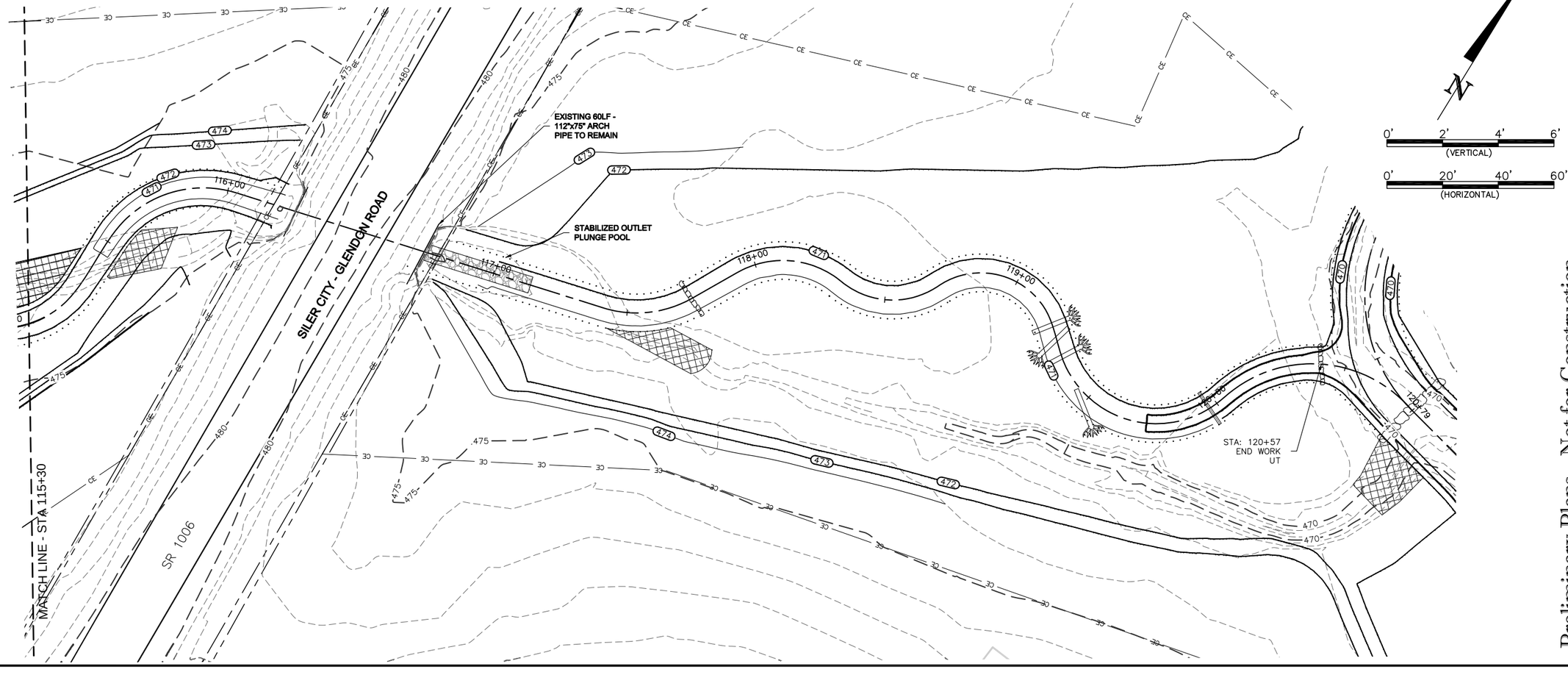
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet 2.8





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Chatham County, NC

UT
Plan and Profile

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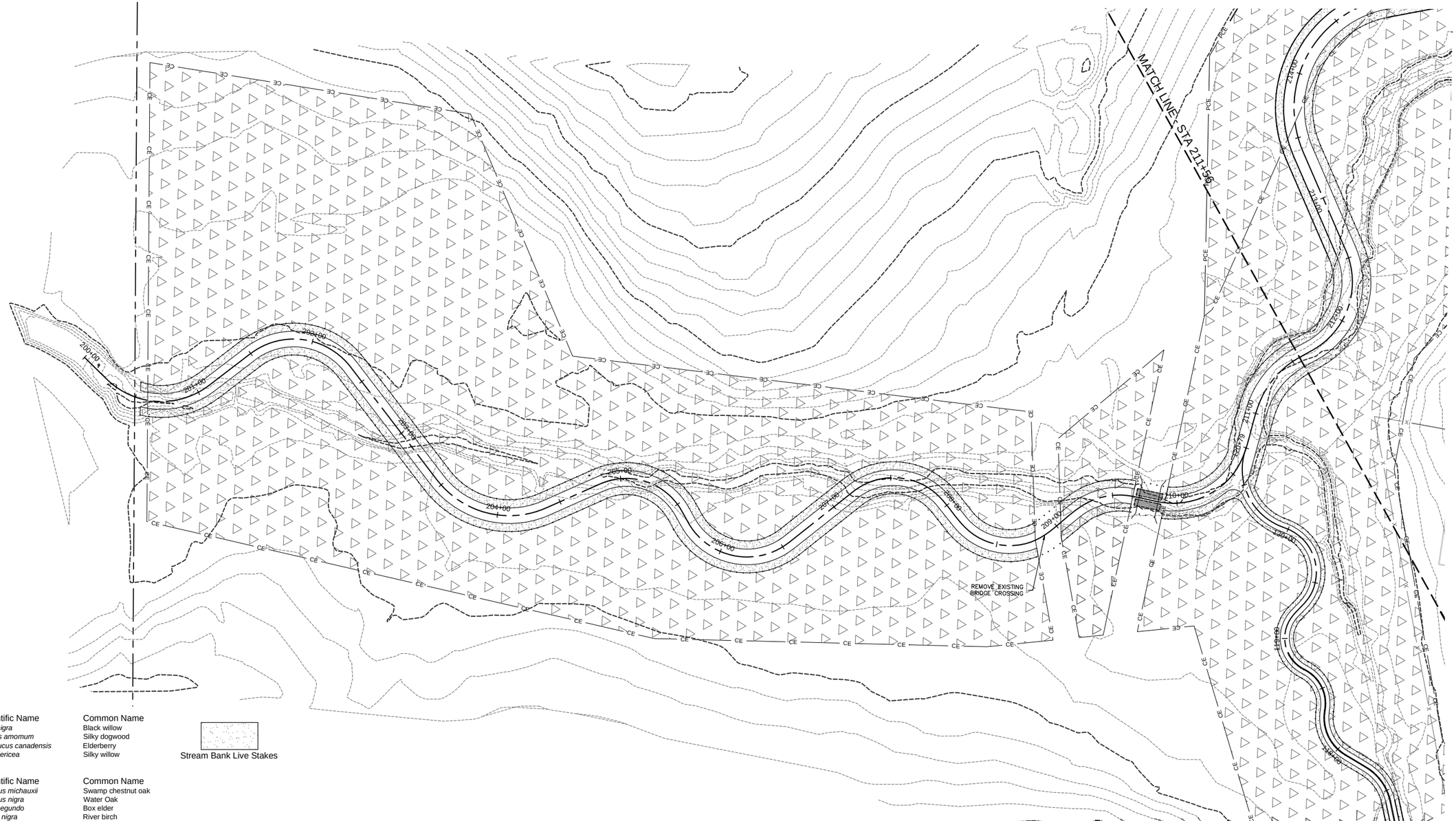
Plan and Profile 5.12.2011

PLAN AND PROFILE

Sheet **2.9**



Scientific Name	Common Name
Salix nigra	Black willow
Cornus amomum	Silky dogwood
Sambucus canadensis	Elderberry
Salix sericea	Silky willow

Stream Bank Live Stakes

Scientific Name	Common Name
Quercus michauxii	Swamp chestnut oak
Quercus nigra	Water Oak
Acer negundo	Box elder
Betula nigra	River birch
Platanus occidentalis	Sycamore
Alnus serrulata	Tag alder
Carpinus caroliniana	Ironwood
Cornus amomum	Silky dogwood
Lindera benzoin	Spicebush
Viburnum dentatum	Arrowwood
Quercus falcata	Southern red oak
Corylus americana	Hazelnut
Symphoricarpos orbiculatus	Coralberry

Stream Benches/
Upper Banks Bare Roots

Scientific Name	Common Name
Ludwigia alternifolia	Bushy seedbox
Schizachyrium scoparium	Little bluestem
Scirpus cyperinus	Wool grass
Uniola latifolia	River oats
Trifolium repens	White clover
Carex crinita	Fringed sedge
Juncus effusus	Soft stem rush
Elymus virginica	Viginia wild rye
Panicum virgatum	Switchgrass

Permanent Herbaceous
Seed Mixture
To Be Applied
Throughout Easement.

NOTE:
EXOTIC INVASIVE PLANT SPECIES SHALL BE CONTROLLED BY MECHANICAL AND/OR CHEMICAL METHODS. ANY VEGETATION CONTROL REQUIRING HERBICIDE APPLICATION WILL BE PERFORMED IN ACCORDANCE WITH NC DEPARTMENT OF AGRICULTURE (NCDA) RULES AND REGULATIONS.

N

0' 40' 80' 120'
(HORIZONTAL)

Preliminary Plans - Not for Construction

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Bear Creek Restoration Project
Chatham County, NC

Bear Creek
Planting

Date:	June 22, 2011
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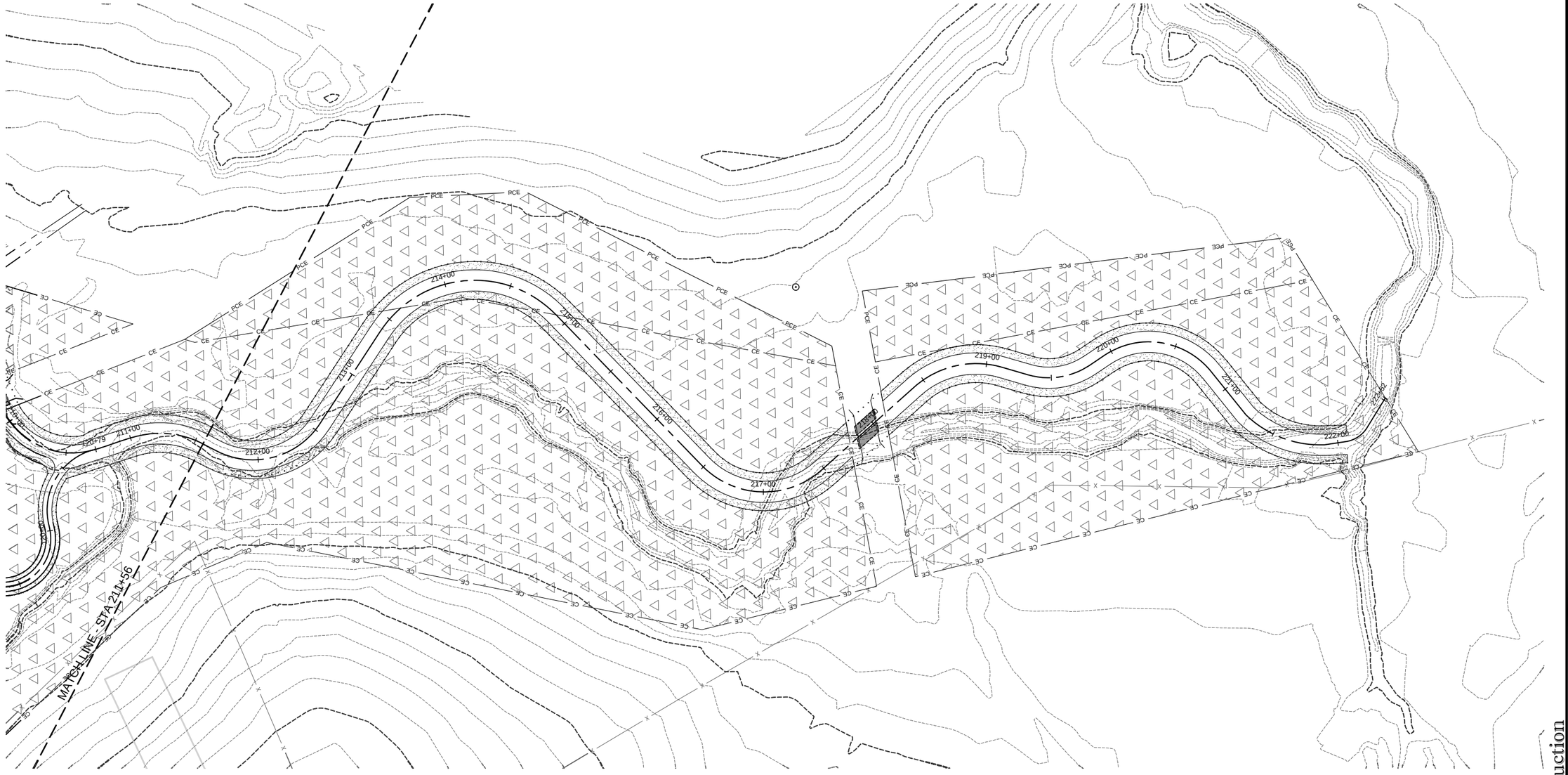
Revisions

PLANTING

Sheet
3.1



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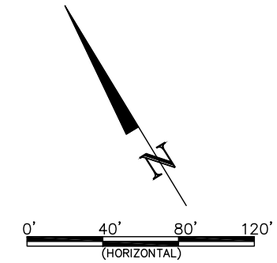

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Bear Creek Restoration Site
Chatham County, NC

Bear Creek
Planting

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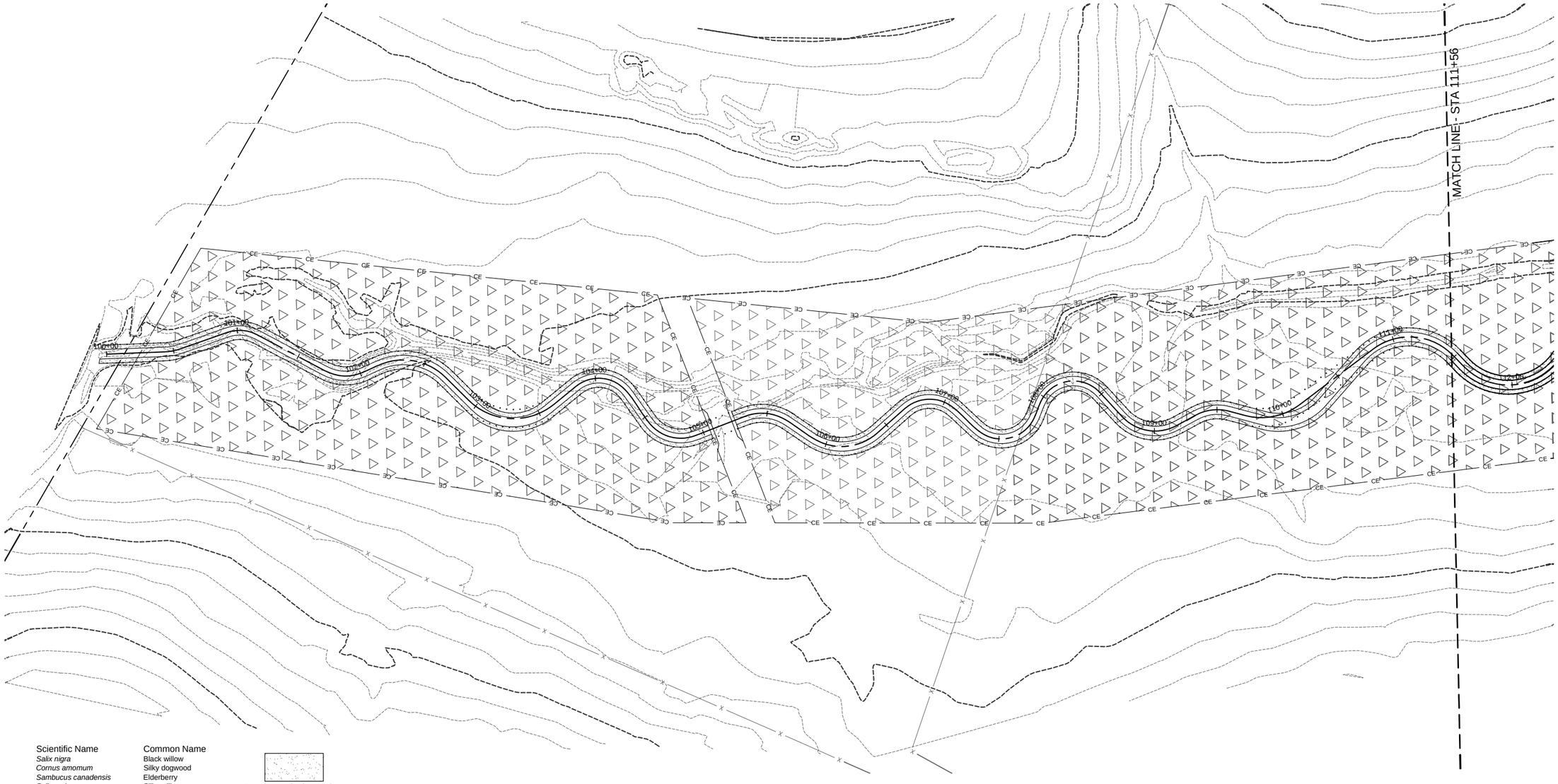
PLANTING

Sheet
3.2



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Permanent Herbaceous
Seed Mixture
To Be Applied
Throughout Easement

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Charlotte, NC 28203
Tel: 704.332.7754
Fax: 704.332.3306
Firm License No. F-0831

Preliminary Plans - Not for Construction

Bear Creek Restoration
Chatham County, NC

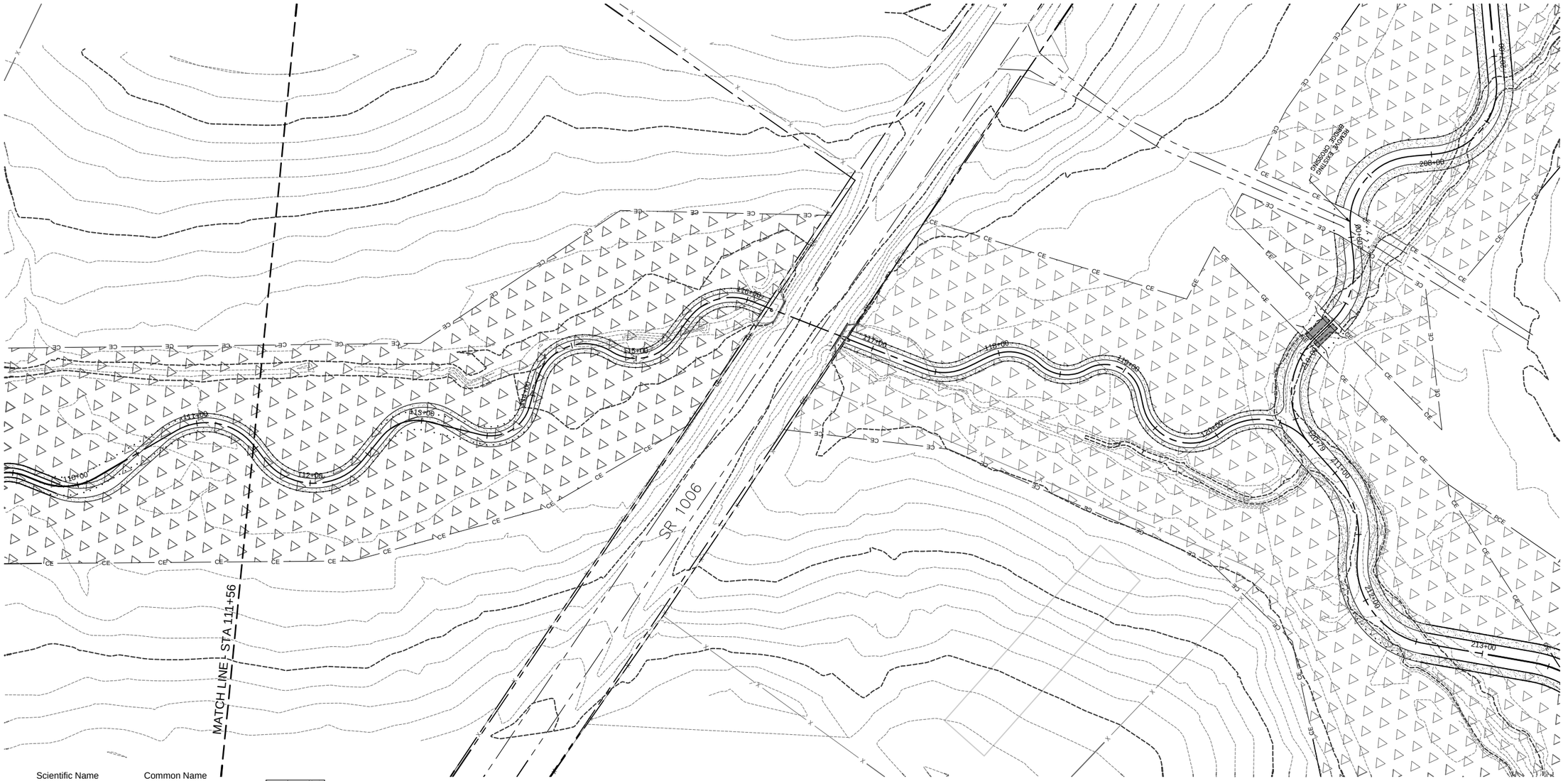
UT
Planting

Date:	June 22, 2011
Job Number:	005-02120
Project Engineer:	EGR
Drawn By:	ICK
Checked By:	SDW

Revisions

PLANTING

Sheet
3.3



Scientific Name	Common Name
Salix nigra	Black willow
Cornus amomum	Silky dogwood
Sambucus canadensis	Elderberry
Salix sericea	Silky willow

Stream Bank Live Stakes

Scientific Name	Common Name
Quercus michauxii	Swamp chestnut oak
Quercus nigra	Water Oak
Acer negundo	Box elder
Betula nigra	River birch
Platanus occidentalis	Sycamore
Alnus serrulata	Tag alder
Carpinus caroliniana	Ironwood
Cornus amomum	Silky dogwood
Lindera benzoin	Spicebush
Viburnum dentatum	Arrowwood
Quercus falcata	Southern red oak
Corylus americana	Hazelnut
Symphoricarpos orbiculatus	Coralberry

Stream Benches/
Upper Banks Bare Roots

Scientific Name	Common Name
Ludwigia alternifolia	Bushy seedbox
Schizachyrium scoparium	Little bluestem
Scirpus cyperinus	Wool grass
Uniola latifolia	River oats
Trifolium repens	White clover
Carex crinita	Fringed sedge
Juncus effusus	Soft stem rush
Elymus virginica	Viginia wild rye
Panicum virgatum	Switchgrass

Permanent Herbaceous
Seed Mixture
To Be Applied
Throughout Easement

NOTE:
EXOTIC INVASIVE PLANT SPECIES SHALL BE CONTROLLED BY MECHANICAL AND/OR CHEMICAL METHODS. ANY VEGETATION CONTROL REQUIRING HERBICIDE APPLICATION WILL BE PERFORMED IN ACCORDANCE WITH NC DEPARTMENT OF AGRICULTURE (NCDA) RULES AND REGULATIONS.

N

0' 40' 80' 120'
(HORIZONTAL)

Preliminary Plans - Not for Construction

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UT
Planting

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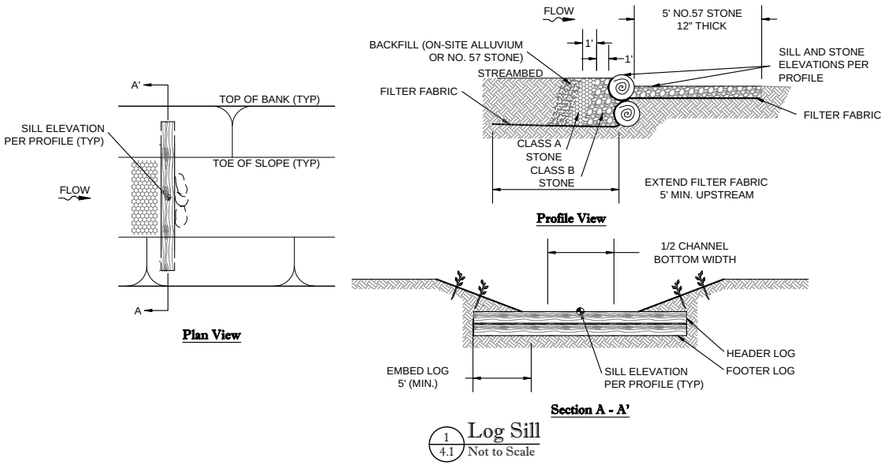
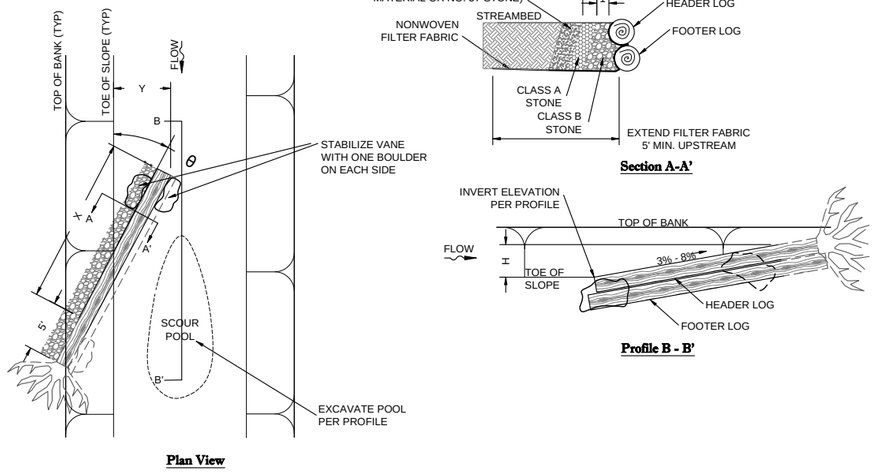
3.4

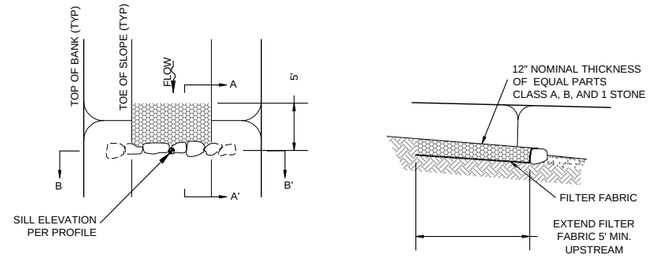


1 / 4.1 Log Sill
Not to Scale

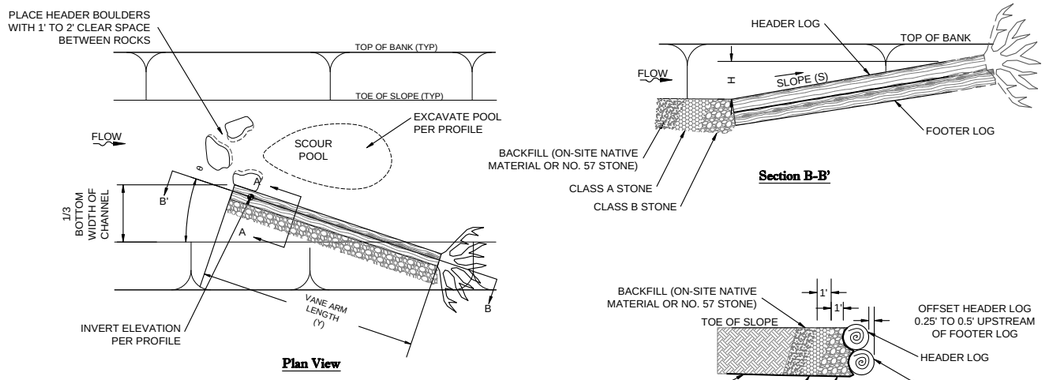


NOTE: DIMENSIONAL VALUES
LISTED ON SHEET 4.8.

2 / 4.1 Log Vane
Not to Scale



3 / 4.1 Boulder Sill
Not to Scale



NOTE: DIMENSIONAL VALUES
LISTED ON SHEET 4.8.

4 / 4.1 Log J-Hook
Not to Scale

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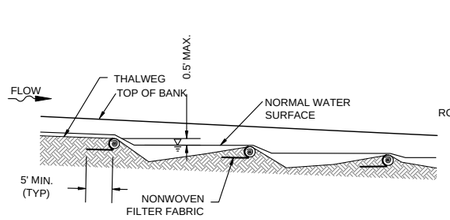
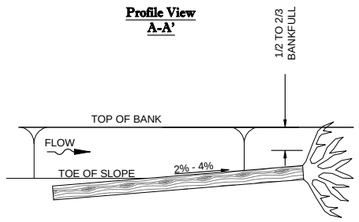
DETAILS

Sheet

4.1



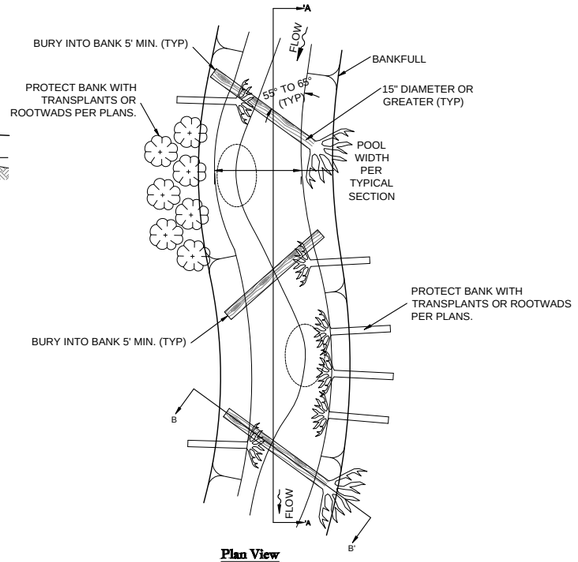
Profile View A-A'



Log Profile B-B'

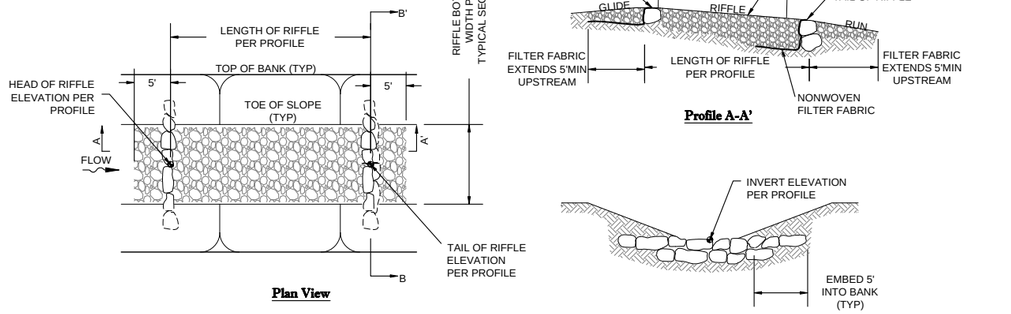
NOTE:

1. LOGS WITHOUT ROOT MASS MAY BE USED ONLY IF APPROVED BY THE PROJECT ENGINEER.
2. BOULDER MATERIAL CAN BE SUBSTITUTED IN PLACE OF ANGLED LOGS WITH APPROVAL OF ENGINEER.



Plan View

1 / 4.2 Angled Log Step Pool
Not to Scale

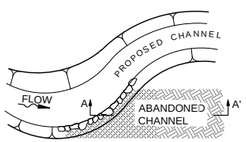


Plan View

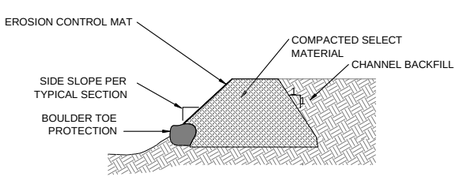
Profile A-A'

Section B-B'

2 / 4.2 Constructed Riffle with Boulder Sills
Not to Scale



Plan View



Section A-A'

3 / 4.2 Channel Plug
Not to Scale

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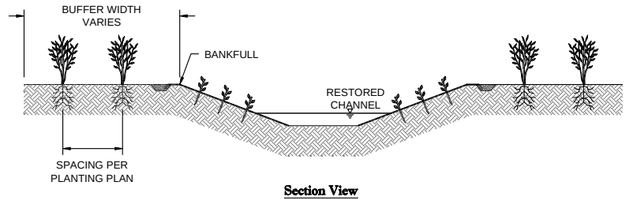
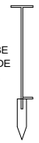


Section View

DIBBLE BAR

PLANTING BAR SHALL HAVE A BLADE WITH A TRIANGULAR CROSS-SECTION, AND SHALL BE 12 INCHES LONG, 4 INCHES WIDE AND 1 INCH THICK AT CENTER.

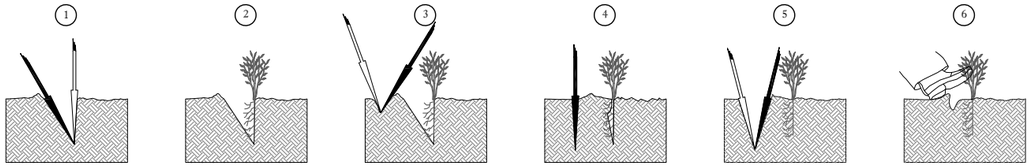


ROOTING PRUNING

ALL ROOTS SHALL BE PRUNED TO AN APPORIATE LENGTH TO PREVENT J-ROOTING.

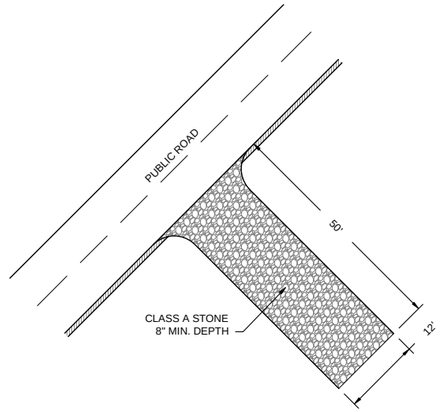
NOTES:

1. ALL SOILS WITHIN THE BUFFER PLANTING AREA SHALL BE DISKED, AS REQUIRED, PRIOR TO PLANTING.
2. ALL PLANTS SHALL BE PROPERLY HANDLED PRIOR TO INSTALLATION TO INSURE SURVIVAL.



1. INSERT THE DIBBLE, OR SHOVEL, STRAIGHT DOWN INTO THE SOIL TO THE FULL DEPTH OF THE BLADE AND PULL BACK ON THE HANDLE TO OPEN THE PLANTING HOLE. (DO NOT ROCK THE SHOVEL BACK AND FORTH AS THIS CAUSES SOIL IN THE PLANTING HOLE TO BE COMPACTED, INHIBITING ROOT GROWTH.
2. REMOVE THE DIBBLE, OR SHOVEL, AND PUSH THE SEEDLING ROOTS DEEP INTO THE PLANTING HOLE. PULL THE SEEDLING BACK UP TO THE CORRECT PLANTING DEPTH (THE ROOT COLLAR SHOULD BE 1 TO 3 INCHES BELOW THE SOIL SURFACE). GENTLY SHAKE THE SEEDLING TO ALLOW THE ROOTS TO STRAIGHTEN OUT. DO NOT TWIST OR SPIN THE SEEDLING OR LEAVE THE ROOTS J-ROOTED.
3. INSERT THE DIBBLE, OR SHOVEL, SEVERAL INCHES IN FRONT OF THE SEEDLING AND PUSH THE BLADE HALFWAY INTO THE SOIL. TWIST AND PUSH THE HANDLE FORWARD TO CLOSE THE TOP OF THE SLIT TO HOLD THE SEEDLING IN PLACE.
4. PUSH THE DIBBLE, OR SHOVEL, DOWN TO THE FULL DEPTH OF THE BLADE.
5. PULL BACK ON THE HANDLE TO CLOSE THE BOTTOM OF THE PLANTING HOLD. THEN PUSH FORWARD TO CLOSE THE TOP, ELIMINATING AIR POCKETS AROUND THE ROOT.
6. REMOVE THE DIBBLE, OR SHOVEL, AND CLOSE AND FIRM UP THE OPENING WITH YOUR HEEL. BE CAREFUL TO AVOID DAMAGING THE SEEDLING.

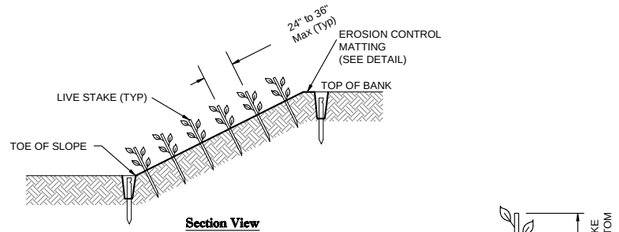
1/4.3 Bare Root Planting
Not to Scale



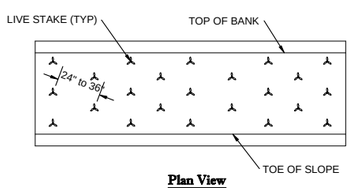
NOTES:

1. PROVIDE TURNING RADIUS SUFFICIENT TO ACCOMMODATE LARGE TRUCKS.
5. LOCATE CONSTRUCTION ENTRANCE AT ALL POINTS OF INGRESS AND EGRESS UNTIL SITE IS STABILIZED. PROVIDE FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE.
6. MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOP DRESSING WITH STONE WILL BE NECESSARY.
7. ANY MATERIAL TRACKED ONTO THE ROADWAY MUST BE CLEANED IMMEDIATELY.
8. USE CLASS A STONE OR OTHER COARSE AGGREGATE APPROVED BY THE ENGINEER.
9. PLACE FILTER FABRIC BENEATH STONE.

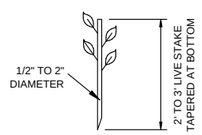
2/4.3 Construction Entrance
Not to Scale



Section View



Plan View

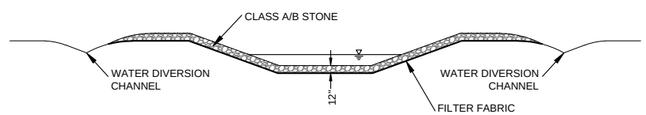


Live Stake Detail

NOTE:

1. LIVE STAKES TO BE PLANTED IN AREAS AS SHOWN ON PLANS AND DIRECTED BY THE ENGINEER.

3/4.3 Live Staking
Not to Scale



NOTES:

1. FORD CROSSING SHALL BE INSTALLED PERPENDICULAR TO CHANNEL BANKS.
2. MAINTAIN DIVERSION CHANNEL TO INSURE RUNOFF DOES NOT ENTER CHANNEL.
3. CONTRACTOR SHALL DETERMINE APPROPRIATE FORD DIMENSIONS.

4/4.3 Ford Crossing
Not to Scale

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Chatham County, NC

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Revisions

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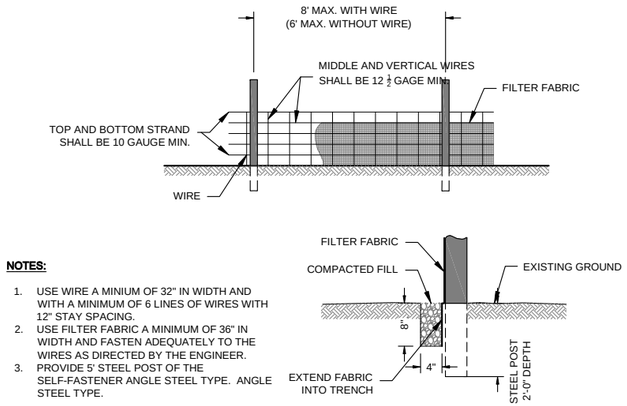
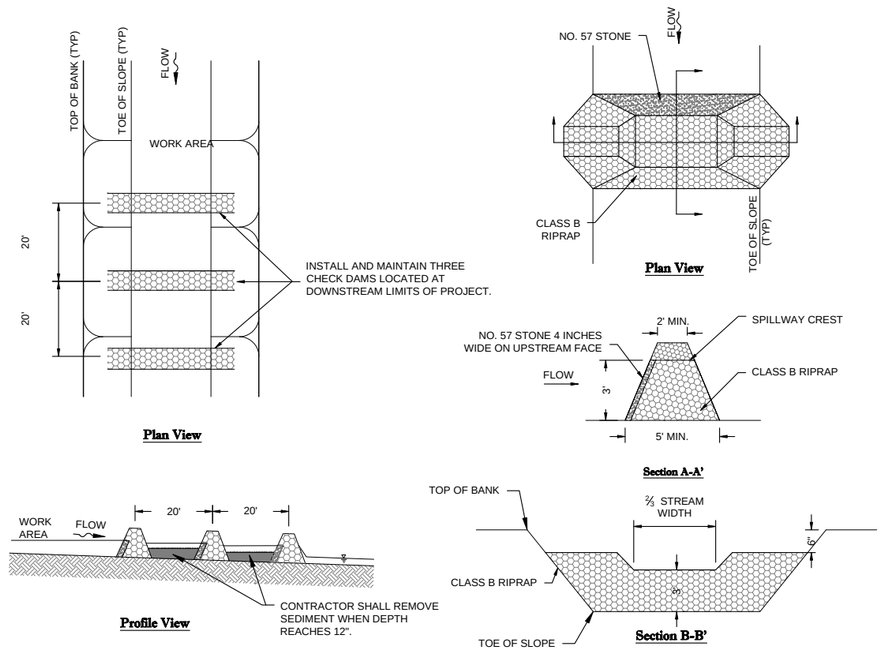
4.3



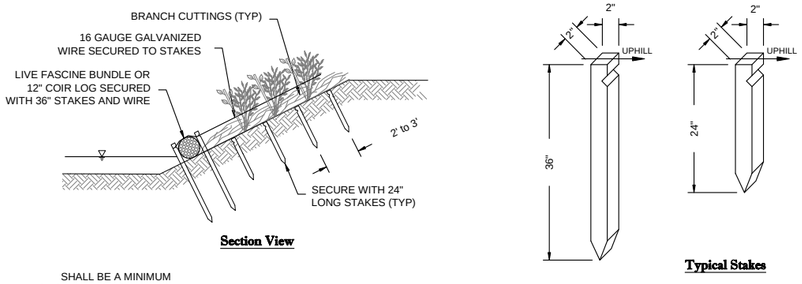
NOTES:

1. USE WIRE A MINIUM OF 32" IN WIDTH AND WITH A MINIMUM OF 6 LINES OF WIRES WITH 12" STAY SPACING.
2. USE FILTER FABRIC A MINIMUM OF 36" IN WIDTH AND FASTEN ADEQUATELY TO THE WIRES AS DIRECTED BY THE ENGINEER.
3. PROVIDE 5' STEEL POST OF THE SELF-FASTENER ANGLE STEEL TYPE. ANGLE STEEL TYPE.

1/4.4 Temporary Silt Fence
Not to Scale



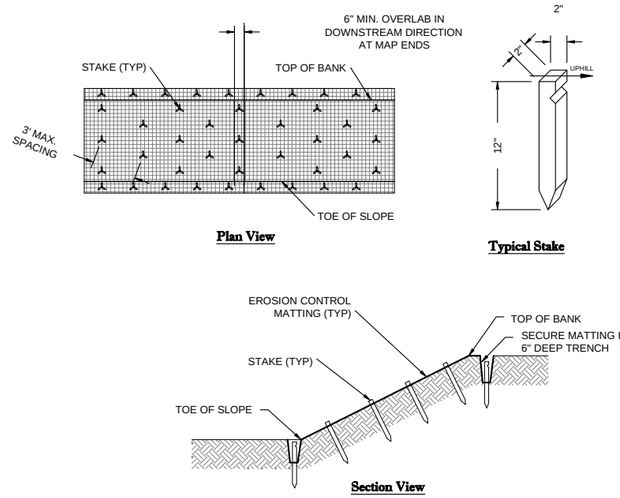
2/4.4 Temporary Rock Sediment Dam
Not to Scale



NOTE:

1. BOARD FOR STAKES SHALL BE 2" X 2" X 24" OR 2" X 2" X 36" AS DIRECTED BY THE ENGINEER.
2. ROOTED/LEAFED CONDITIONS OF THE LIVING PLANT MATERIAL IS NOT REPRESENTATIVE AT THE TIME OF INSTALLATION.

3/4.4 Brush Mattress with Coir Log
Not to Scale



4/4.4 Erosion Control Matting
Not to Scale

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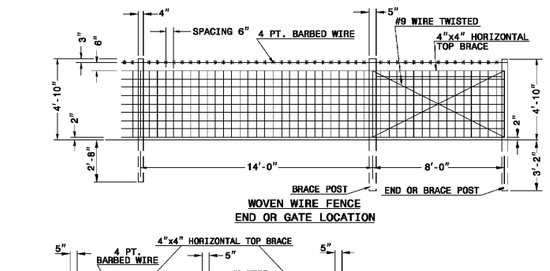
4.4

STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

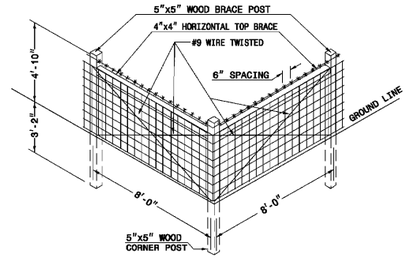
7-06

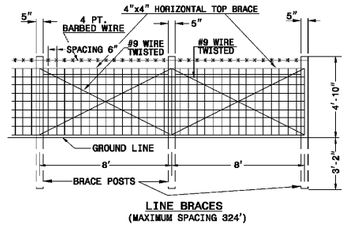
ENGLISH STANDARD DRAWING FOR
WOVEN WIRE FENCE
WITH WOOD POST

SHEET 1 OF 3
866.02



WOVEN WIRE FENCE
END OR GATE LOCATION

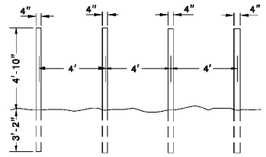




LINE BRACES
(MAXIMUM SPACING 324')

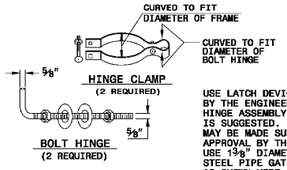
ERECT LINE BRACES BETWEEN END, CORNER OR GATE POSTS AT INTERVALS NOT EXCEEDING 324 FEET.
THIS MAXIMUM INTERVAL MAY BE REDUCED BY THE ENGINEER ON CURVES WHERE THE DEGREE OF CURVATURE IS GREATER THAN 3 DEGREES.
PLACE LINE BRACES AT THE END OF EACH ROLL OR PIECE OF WOVEN WIRE.

FENCE CORNER
USE WHEN CORNER ANGLE IS 15° OR GREATER

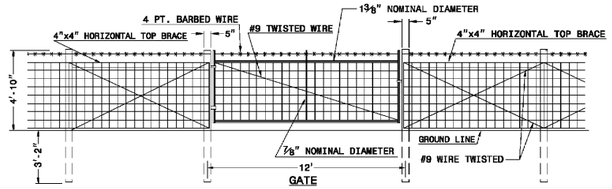


POST FOR BLOCKING DRIVEWAYS
OR OTHER ENTRANCES
INSTALL IN ADDITION TO FENCE WHERE SHOWN IN PLANS OR WHERE DIRECTED BY THE ENGINEER

PLACE THE BRACE WIRE AROUND THE POST. DRAW WIRE TAUT BY TWISTING BETWEEN EACH POST. THIS APPLIES TO ALL BRACE WIRES. NOTCH POSTS FOR BRACES. PLACE TWO GALVANIZED 12d OR THREE GALVANIZED 10d ON ALL BRACES AT EACH END.



USE LATCH DEVICE APPROVED BY THE ENGINEER. HINGE ASSEMBLY, AS DETAILED, IS SUGGESTED. SUBSTITUTION MAY BE MADE SUBJECT TO APPROVAL BY THE ENGINEER. USE 1 3/8" DIAMETER GALVANIZED STEEL PIPE GATE FRAME EXCEPT AS SHOWN HERE.



GATE

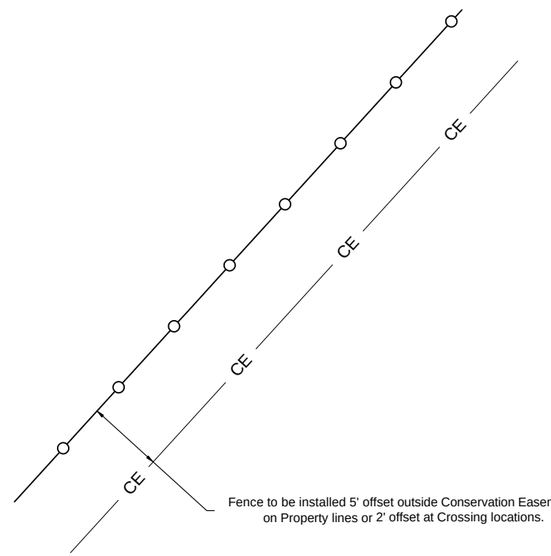
STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

7-06

ENGLISH STANDARD DRAWING FOR
WOVEN WIRE FENCE
WITH WOOD POST

SHEET 1 OF 3
866.02

1/4.5 Woven Wire Fence
Not to Scale



Fence to be installed 5' offset outside Conservation Easement, on Property lines or 2' offset at Crossing locations.

2/4.5 Fence Line Offset
Not to Scale

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NOTE:
DO NOT CONSTRUCT PERMANENT FENCE IN STAGING AREAS UNTIL FINAL PHASE.

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Chatham County, NC

Bear Creek
Fencing & Staging

Date:	June 22, 2011
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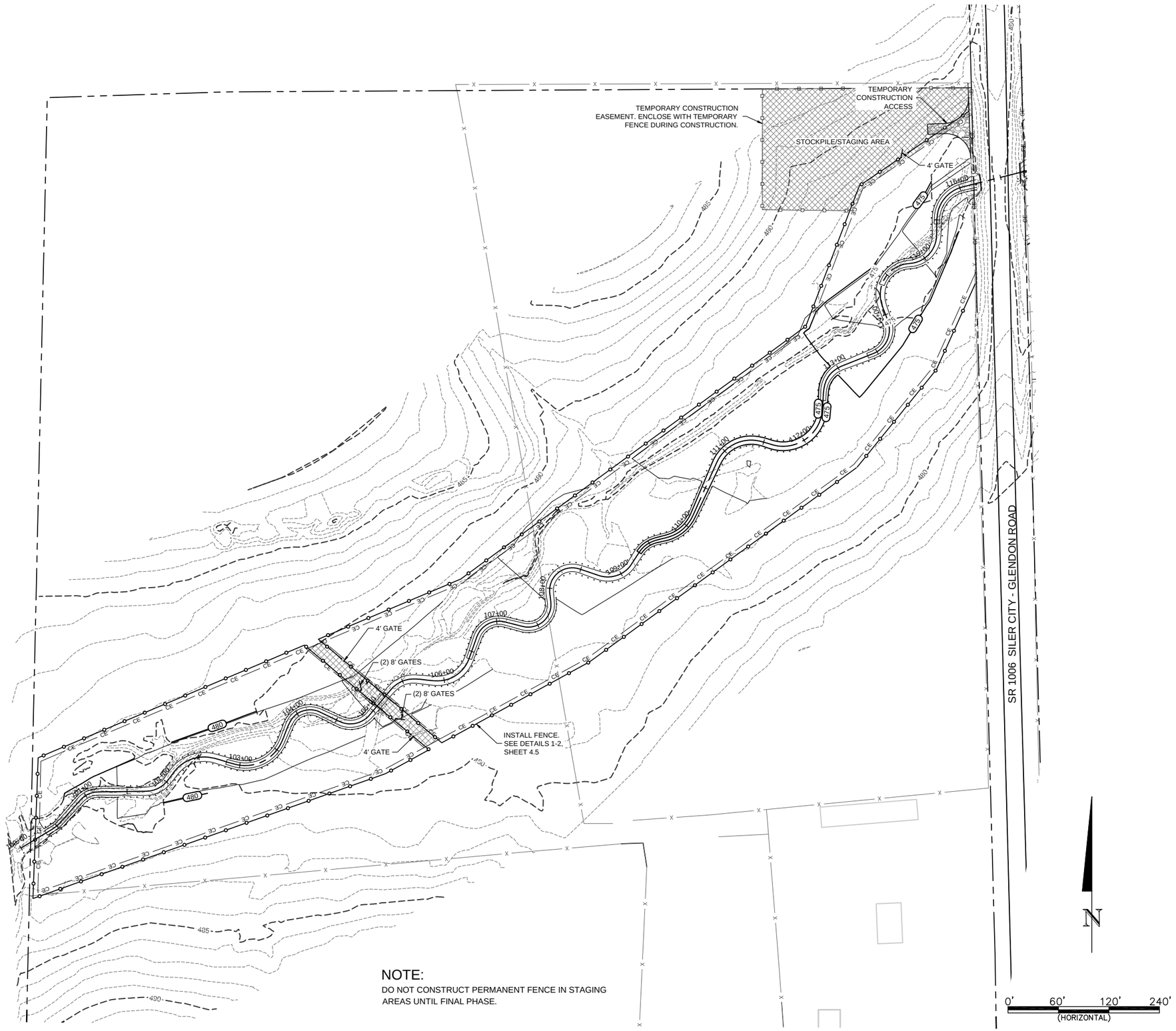
Fencing & Staging

Sheet
5.1



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Chatham County, NC

UT1
Fencing & Staging

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Checked By:	SDW

Revisions

Fencing & Staging

Sheet
5.2