LITTLE TROUBLESOME CREEK MITIGATION SITE

Rockingham County, NC

DENR Contract 003267

Mitigation Plan

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Prepared for:

Ecosystem Enhancement PROGRAM

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LITTLE TROUBLESOME CREEK MITIGATION SITE
Restoration Plan

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EXECUTIVE SUMMARY

The North Carolina Ecosystem Enhancement Program (NCEEP) proposes to restore 5,340 linear feet (LF) of perennial and intermittent streams and 18.0 acres of wetlands in Rockingham County, NC. The streams proposed for restoration include Little Troublesome Creek, an unnamed tributary to Little Troublesome Creek that is locally referred to as Irvin Creek, and one additional unnamed tributary to Little Troublesome Creek (UT1). The wetland area is located approximately four miles southeast of the stream project area and is also adjacent to Little Troublesome Creek. The project streams ultimately flow into the Haw River which is part of the Cape Fear River Basin.

The Little Troublesome Creek Mitigation Project is located in the Troublesome and Little Troublesome Creeks Local Watershed planning area (http://www.nceep.net/ services/lwps/Troublesome_Creek/trouble-summ.pdf). The project site's watershed includes Hydrologic Unit Code (HUC) 03030002010030 which was identified as a Targeted Local Watershed in NCEEP's 2001 and 2009 Cape Fear River Basin Restoration Priority (RBRP) plans (http://www.nceep.net/ services /lwps/pull_down/by _basin/CapeFear_RB.html).

The Upper Cape Fear Basin Local Watershed Plan (LWP) identified urbanization and morphological stream alteration as having profound impacts on the health of Little Troublesome Creek. The LWP identified the stream restoration portion of the site as the top recommended site for stream restoration in the Upper Cape Fear Basin Local Watershed Plan - Targeting Management Report (http://www.nceep.net/services/lwps/ Troublesome_Creek/target.pdf).

The proposed project will provide numerous ecological benefits within the Cape Fear River Basin. While many of these benefits are limited to the Little Troublesome Creek project area, others, such as pollutant removal and improved aquatic and terrestrial habitat have more far-reaching effects. Expected improvements to water quality and ecological processes are outlined below in Table ES.1 as project goals.

Table ES.1. Project Goals and Objectives
Little Troublesome Creek Mitigation Project

Primary Goals (Measured)	
Project goal	**How project will seek to reach goal**
Stabilize stream dimensions	Riffle cross-sections of the restoration and enhancement reaches will be constructed to remain stable and will show little change in bankfull area, maximum depth ratio and width-to-depth ratio over time.
Stabilize stream pattern and profile	The project will be constructed so that the bedform features of the restoration reaches will remain stable overtime. This will include riffles that remain steeper and shallower than the pools and pools that are deep with flat water surface slopes. The relative percentage of riffles and pools will not change significantly over time. Banks will be constructed so that bank height ratios will remain very near to 1.0 for nearly all of the restoration reaches.

Establish proper substrate distribution throughout stream	Stream substrate will remain coarse in the riffles and finer in the pools.
Establish wetland hydrology for restored wetlands	A free groundwater surface be present within 12 inches of the ground surface for 7 percent of the growing season measured on consecutive days under typical precipitation conditions.
Restore native vegetation throughout wetlands and buffer zones	Native vegetation appropriate for the wetland and riparian buffer zones on the site will be planted throughout. The planted trees will become well established and survival criteria will be met.
Secondary Goals (Unmeasured)	
Project goal	**How project will seek to reach goal**
Decrease nutrient and urban runoff pollutant levels	Off-site nutrient input will be absorbed on-site by filtering flood flows through restored floodplain areas and wetlands, where flood flows can disperse through native vegetation and be captured in vernal pools. Increased surface water residency time will provide contact treatment time and groundwater recharge potential.
Decrease sediment input	Sediment input from eroding stream banks will be reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles. Sediment from off-site sources will be captured by deposition on restored floodplain areas where native vegetation will slow overland flow velocities.
Decrease water temperature and increase dissolved oxygen concentrations	Restored riffle/step-pool sequences where distinct points of re-aeration can occur will allow for oxygen levels to be maintained in the perennial reaches. Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.
Create appropriate in-stream habitat	By creating a channel form that includes riffle and pool sequences, gravel and cobble zones of macroinvertebrate habitat and deep pool habitat for fish. Introduction of large woody debris, rock structures, root wads, and native stream bank vegetation will substantially increase habitat value.
Create appropriate terrestrial habitat	Adjacent buffer areas will be restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular inundating flows. Riparian wetland areas will be restored and enhanced to provide wetland habitat.
Decrease channel velocities	By allowing for more overbank flooding and by increasing channel roughness, local channel velocities can be reduced. This will allow for less bank shear stress, formation of refuge zones during large storm events and zonal sorting of depositional material.

Table ES.2.a Project Components
Little Troublesome Creek Mitigation Project

Project Reach	Existing Length/Acres	Mitigation Level	Approach	Proposed Length (LF) or Area (ac)	Stationing	Proposed Length/Acres for Credit*	Mitigation Ratio	Mitigation Units	Buffer Area* (ac)
Streams									
Irvin Creek – Reach 1	1,640	R	Priority 1	2,056.6	102+10.4 to 122+67	1,712	1:1	1,712	13.1
Irvin Creek – Reach 2	1,505	R	Priority 1	1,918.6	122+67 to 141+85.6	1,883	1:1	1,883	12.2
Little Troublesome Creek	1,080	R	Priority 1	1,157.8	200+00.00 to 211+57.8	1,067	1:1	1,067	4.1
UT1 – UT to Little Troublesome Creek	184	R	Priority 1/2	239.9	400+00.00 to 402+39.9	240	1:1	240	0.5
Total	4,409	---	---	5,373	---	4,902	---	4,902	
Wetlands									
RW1	8.7	R	N/A	8.7	N/A	8.7	1:1	8.7	N/A
	5.6	C	N/A	5.6	N/A	5.6	3:1	1.9	
	3.7	E	N/A	3.7	N/A	3.7	1.3:1	2.8	
Total	18.0	---	N/A	18.0	---	18.0		13.4	

* Design lengths include portions of streams that will be reconstructed but for which mitigation credit may not be claimed

Table ES.2.b Summary of Mitigation Levels
Little Troublesome Creek Mitigation Project

Mitigation Level	Stream Length (LF)	SMUs	Wetland (acres)	WMUs	Upland (acres)	Buffer* (acres)
Restoration (R)	5,373	4,902	8.7	8.7	0	29.9
Enhancement (E)	0	0	3.7	2.8	0	0
Preservation (P)	0	0	0	0	0	0
Creation (C)	0	0	5.6	1.9	0	0
TOTAL	5,373	4,902	18.0	13.4	0	29.9*

*Buffer restoration will take place, but is not intended for mitigation credit.

This document is consistent with the requirements of the 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). Specifically the document addresses the following requirements of the federal rule:

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

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

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

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

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

(7) *Mitigation work plan.* Detailed written specifications and work descriptions for the compensatory mitigation project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as plan form geometry, channel form (e.g. typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

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

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

(10) *Monitoring requirements.* A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is needed. A schedule for monitoring and reporting on monitoring results to the district engineer must be included. (See §332.6)

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

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

(13) *Financial assurances.* A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with its performance standards (See §332.3(n))

1.0 Project Site Identification and Location

The North Carolina Ecosystem Enhancement Program (NCEEP) proposes to restore 5,340 linear feet (LF) of perennial and intermittent streams and 18.0 acres of wetlands in Rockingham County, NC. The streams proposed for restoration include Little Troublesome Creek, an unnamed tributary to Little Troublesome Creek that is locally referred to as Irvin Creek, and one additional unnamed tributary to Little Troublesome Creek (UT1). The wetland area is located approximately four miles southeast of the stream project area and is also adjacent to Little Troublesome Creek (Figure 1). The project streams ultimately flow into the Haw River which is part of the Cape Fear River Basin. Photographs of the project site are included in Appendix 1.

As a result of the proposed restoration activities, total stream length within the project area will be increased from approximately 4,435 linear feet to 5,340 linear feet. The proposed stream restoration designs will primarily include a Rosgen Priority Level 1 approach and the stream types for the restored streams will be Rosgen C channels with design dimensions based on those of reference reaches and past projects. The wetland areas consist of 8.7 acres of wetland restoration, 3.7 acres of wetland enhancement, and 5.6 acres of wetland creation. The wetlands will be restored to a Piedmont Bottomland Forest (Shafale and Weakley, 1990). Based on the proposed mitigation effort, the mitigation site will result in 4,900 stream mitigation units (SMUs) and 14.5 wetland mitigation units (WMUs). Certain sections of the 5,340 LF of proposed stream restoration do not have the mandatory 50-foot buffer on both sides of the stream; therefore these sections are not being claimed for mitigation credit at this time.

1.1 Directions to Project Site

The proposed stream mitigation project area is located south of Turner Road, east of the intersection of Turner Road and Way Street in the City of Reidsville, North Carolina (Figure 2). The subject site itself is forested, but is located in a highly urbanized watershed within the Cape Fear River Basin (HUC 03030002). A large shopping center is located immediately north of the site. An active railroad runs along the eastern edge of the project boundary.

The proposed wetland mitigation project area is located approximately 3,000 feet southwest of the intersection of NC Highway 150 and Mizpah Church Road, south of the City of Reidsville (Figure 2). The subject site is agricultural land and is surrounded by forested land. The site is also located within the Cape Fear River Basin (HUC 03030002) and is currently being used for corn production.

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

Little Troublesome Creek is located within the Haw River watershed (North Carolina Division of Water Quality (NCDWQ) Subbasin 03-06-01) of the Cape Fear River Basin (Hydrologic Unit 03030002010030) as shown in Figure 1.

The NCDWQ assigns best usage classifications to State Waters that reflect water quality conditions and potential resource usage. Little Troublesome Creek (NCDWQ Index No. 16-7) is the main tributary of the project and has been classified as Class C; NSW waters. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses. The Nutrient Sensitive Waters (NSW) classification is a supplemental classification for waters that are subject to excessive growth of microscopic or macroscopic vegetation and therefore need nutrient management.

Little Troublesome Creek is included on the NCDWQ 303d list of impaired water bodies for to habitat degradation and turbidity. This specific project reach was recommended for stream restoration in the NCEEP 2004 Upper Cape Fear Basin Local Watershed Plan but was never acquired by NCEEP.

1.3 Project Components and Structure

Table 1a. Project Components
Little Troublesome Creek Mitigation Project

Project Reach	Existing Length/Acres	Mitigation Level	Approach	Proposed Length (LF) or Area (ac)	Stationing	Proposed Length/Acres for Credit*	Mitigation Ratio	Mitigation Units	Buffer Area* (ac)
Streams									
Irvin Creek – Reach 1	1,640	R	Priority 1	2,056.6	102+10.4 to 122+67	1,712	1:1	1,712	13.1
Irvin Creek – Reach 2	1,505	R	Priority 1	1,918.6	122+67 to 141+85.6	1,883	1:1	1,883	12.2
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Total	4,409	---	---	5,373	---	4,902	---	4,902	

Wetlands									
RW1	8.7	R	N/A	8.7	N/A	8.7	1:1	8.7	N/A
	5.6	C	N/A	5.6	N/A	5.6	3:1	1.9	
	3.7	E	N/A	3.7	N/A	3.7	1.3:1	2.8	
Total	18.0	---	N/A	18.0	---	18.0		13.4	

* Design lengths include portions of streams that will be reconstructed but for which mitigation credit may not be claimed.

Table 1.b Summary of Mitigation Levels
Little Troublesome Creek Mitigation Project

Mitigation Level	Stream Length (LF)	SMUs	Wetland (acres)	WMUs	Upland (acres)	Buffer* (acres)
Restoration (R)	5,373	4,902	8.7	8.7	0	29.9
Enhancement (E)	0	0	3.7	2.8	0	0
Preservation (P)	0	0	0	0	0	0
Creation (C)	0	0	5.6	1.9	0	0
TOTAL	5,373	4,902	18.0	13.4	0	29.9*

*Buffer restoration will take place, but is not intended for mitigation credit.

2.0 Watershed Characterization

2.1 Drainage Area, Project Area, and Easement Acreage

The Little Troublesome Creek and Irvin Creek watersheds for the stream portion of the project drain approximately 3,245 acres (5.1 square miles) and 584 acres, respectively. The stream portion of the project's drainage area is located in a region southwest of the town of Reidsville, NC (Figure 3). The drainage area of each of the stream project reaches is included in Table 2.

Table 2. Drainage Areas
Little Troublesome Creek Mitigation Project

Project Reach	Existing Length (LF)	Drainage Area (acres)
Irvin Creek Reach 1	1,640	525
Irvin Creek Reach 2	1,533	584
Little Troublesome Creek	1,078	3,245
UT1- UT to Little Troublesome Creek	184	62

The stream portion of the Little Troublesome Creek project is located within a 34.5-acre tract owned by Wildlands Little Troublesome Creek Holdings, LLC. A conservation easement has been recorded on 33 acres of the tract (Deed Book 1411, Page Number 2458). The wetland portion of the Little Troublesome Creek project is located within a tract of land owned by Jerry Apple, south of Reidsville, NC. A conservation easement has been recorded on the 19-acre project area within the Apple tract (Deed Book 1412, Page Number 1685). The conservation easements allow for the restoration work to occur and protect the project area in perpetuity.

2.2 Surface Water Classification and Water Quality

On July 21, 2009, Wildlands Engineering investigated and assessed on-site jurisdictional Waters of the United States 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. On-site jurisdictional wetland areas were also assessed using the North Carolina Wetland Assessment Method (NCWAM). All USACE and NCWAM wetland forms are included in Appendix 2.

The results of the on-site field investigation indicate that there are six jurisdictional stream channels in the stream project area including: Little Troublesome Creek, Irvin Creek, and four unnamed tributaries. There are also four jurisdictional wetland areas on the stream site and two jurisdictional wetland areas on the wetland site (Figures 4 and 5). The proposed stream restoration project includes three of the jurisdictional stream channels: Little Troublesome Creek, Irvin Creek, and one of the unnamed tributaries (UT1) as shown in Figure 4. The wetland portion of the project is located adjacent to Little Troublesome Creek and includes 3.7 acres of existing jurisdictional waters (Figure 5). All tributaries and wetland areas are protected under the conservation easements that were placed on the project areas. All NCDWQ Stream Classification Forms are included in Appendix 2.

2.3 Physiography, Geology, and Soils

The Little Troublesome Creek Mitigation Site is located in the Inner Piedmont Belt of the Piedmont Physiographic Province. The Piedmont Province is characterized by gently rolling, well rounded hills and long low ridges, with elevations ranging anywhere from 300 to 1500 feet above sea level. The Inner Piedmont Belt is the most intensely deformed segment of the Piedmont with metamorphic rocks ranging from 500 to 750 million years in age. The belt consists of gneiss and schist that have been intruded by younger granite rock and is known for producing crushed stone that is commonly used for road aggregate and building construction. Specifically, the mitigation site is located within the CZbg region of the Inner Piedmont Belt. The CZbg region is characterized primarily of biotite gneiss and schist and consists of inequigranular, locally abundant potassic feldspar and garnet; interlayed and gradational with calc-silicate rock, sillimanite-mica schist, mica schist, and amphibolite. In addition, this region is known to contain small masses of granite rock (NCGS, 2009).

The floodplain areas of the proposed project are mapped by the Rockingham County Soil Survey (USDA, 2009). As shown in Figure 6, the soils found within the stream project include Clifford-Urban land complex, Codorus loam soils, and Fairview-Poplar Forest complex. Soils in the wetland project area are primarily mapped as Haw River silty clay loam, and Codorus loam. These four soils are described below in Table 3.

Table 3. Soil Types and Descriptions
Little Troublesome Creek Mitigation Project

Soil Name	Location	Description

Soil Name	Location	Description
Clifford-Urban land complex	Stream Area	Clifford-Urban land complex soils are located on urban land, interfluves, and uplands. The material is typically well-drained and consists of saprolite derived from granite and gneiss.
Fairview-Poplar Forest complex	Stream Area	The Fairview-Poplar Forest complex is comprised of approximately 50% Fairview components and 40% Poplar Forest. The Fairview component is well-drained and consists of saprolite derived from schist or gneiss, while the Poplar Forest consists of well-drained weathered residuals from mica schist.
Codorus loam, 0-2% slopes, frequently flooded	Stream and Wetland Areas	Codorus loam soils consist of nearly level, very deep, somewhat poorly drained soils. They are typically found in floodplain areas. Shrink swell potential is low. These soils are frequently flooded.
Haw River silty clay loam, 0-2% slopes, frequently flooded	Wetland Area	Haw River silty clay loam soils consist of nearly level, very deep, poorly drained soils. They are typically found in floodplain areas and river valleys. Shrink-swell potential is moderate. These soils are frequently flooded over a very long duration.
Source: Rockingham County Soil Survey, USDA-NRCS, http://efotg.nrcs.usda.gov		

2.4 Historical Land Use and Development Trends

The Cape Fear 0303002 includes developing areas such as the cities of Greensboro, Durham, Burlington and Chapel Hill as well as the I-40/ I-85 transportation corridor. Population growth and the associated development and infrastructure projects create the necessity for mitigation projects in this region. Approximately 28% of the land in the project watershed has been developed and approximately 17% of the land surface is impervious. Land uses within the watershed include: mixed hardwood/evergreen forests (54%), residential (20%), cultivated/managed herbaceous cover (17%), commercial/ industrial (8%), deciduous/ evergreen scrubland (>1%), and open water (>1%). The development in the area surrounding the stream site was mostly complete by the 1970s and is likely completely stabilized by now. There is no evidence of increased development immediately around the wetland component of the project. According to historical aerial photography, the surrounding lands have been used as farm land for decades and there is no indication of any changes in landuse in this rural area which is approximately 6.3 miles south of the City of Reidsville.

2.5 Watershed Planning

The Little Troublesome Creek Mitigation Project is located in the Troublesome and Little Troublesome Creeks Local Watershed planning area (http://www.nceep.net/ services/lwps/Troublesome_Creek/trouble-summ.pdf). The project site's watershed includes HUC 03030002010030 which was identified as a Targeted Local Watershed in NCEEP's 2001 and 2009 Cape Fear River Basin Restoration Priority plans (http://www.nceep.net/ services /lwps/pull_down/by _basin/CapeFear_RB.html).

The Upper Cape Fear Basin Local Watershed Plan (LWP) identified urbanization and morphological stream alteration as having profound impacts on the health of Little Troublesome

Creek. The LWP identified the stream restoration portion of the site as the top recommended site for stream restoration in the Upper Cape Fear Basin Local Watershed Plan - Targeting Management Report (http://www.nceep.net/services/lwps/ Troublesome_Creek/target.pdf).

2.6 Endangered and Threatened Species

2.6.1 Site Evaluation Methodology

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).

Wildlands 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 Rockingham County, NC (USFWS, 2008 and NHP, 2009). Three federally listed species, the Roanoke logperch (*Percina rex*), James spinymussel (*Pleurobema collina*), and smooth coneflower (*Echinacea laevigata*) are currently listed in Rockingham County (Table 4).

Table 4. Listed Threatened and Endangered Species in Rockingham County, NC
Little Troublesome Creek Mitigation Project

Species	Federal Status	Habitat
Vertebrate		
Roanoke logperch (*Percina rex*)	E	Medium to large warm water streams with relatively silt free substrates
Invertebrate		
James spinymussel (*Pleurobema collina*)	E	Free-flowing, silt free, fresh water streams
Vascular Plant		
Smooth coneflower (*Echinacea laevigata*)	E	Open woods, roadsides, clearcuts, dry limestone bluffs, and power line right-of-way
E = Endangered; T=Threatened		

2.6.2 Threatened and Endangered Species

2.6.2.1 Species Description

Percina rex

Roanoke logperch is typically found in medium to large warm water streams with moderate gradient. This species ranges from the Ridge and Valley province in Virginia to the Blue Ridge and lower Piedmont of North Carolina and is intolerant of moderate to heavily silted substrata. Current threats to this species include urban runoff containing silts, turbidity, oil, fertilizers, and channelization.

Pleurobema collina

The James spinymussel is typically found in small headwater tributaries of the upper James River basin in Virginia and West Virginia and the Upper Roanoke River basin of Virginia and North Carolina. This species is a filter-feeding freshwater mussel, requiring habitats of free-flowing streams with a variety of substrates that are free from silt. Threats to this species include siltation, water impoundments, sewage discharge, stream channelization, and discharge of chlorine. Known populations of the James spinymussel have been observed within Rockingham County over the past 20 years.

Echinacea laevigata

The smooth coneflower is a perennial herb that grows approximately 1.5 meters tall and has pink to purplish ray flowers. This herbaceous species is typically found in open woods, road sides, clear cut areas, dry limestone bluffs, and power line rights-of-way. Abundant sunlight, little competition within the herbaceous layer, and periodic natural disturbances offer the most favorable habitat conditions for this species. This species is currently listed as historic for Rockingham County.

2.6.2.2 Biological Conclusion

A pedestrian survey of the site was performed on July 21, 2009. No individual listed species were found to exist within the project area. It is determined that the proposed restoration activities will have no impact on any of the listed species.

2.6.3 Federal Designated Critical Habitat

2.6.3.1 Habitat Description

The results of the pedestrian survey performed on July 21, 2009, indicate that in-stream habitat exhibits poor conditions for the presence of Roanoke logperch and James spinymussel. In-stream habitat includes gravel and cobble; however these substrates are dominated by finer sands and silts as a result of heavy bank erosion throughout the project reach. Potential habitat for the smooth coneflower exists within the northern portion of the upstream project area, which includes the power line right-of-way. This right-of-way habitat is, however, unsuitable for the smooth coneflower due to heavy herbaceous dominance of blackberry and invasive honeysuckle. No critical habitat for the listed species exists in the project area.

2.6.3.2 Biological Conclusion

It is determined that the proposed restoration activities will have no impact on any of the listed species critical habitat.

2.6.4 USFWS Concurrence

Requests for records search were submitted on July 12, 2010, to the USFWS and July 16, 2009, to the NCNHP to determine the presence of any federally-listed, candidate endangered, threatened species, or critical habitat located within the project area. In a letter dated July 20, 2009, the NCNHP stated that they have "no record of rare species, significant natural communities, significant natural heritage areas, or conservation/managed areas at the site or within a mile of the project area." A further review of the NCNHP element occurrence GIS data layer shows that no natural heritage elements occur within four miles of the proposed

project area. In a letter dated July 28, 2010, the USFWS stated the proposed project "is not likely to adversely affect any federally listed endangered or threatened species, their formally designated critical habitats, or species currently proposed for listing." All correspondence is included in Appendix 3.

2.7 Cultural Resources

2.7.1 Site Evaluation Methodology

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 July 16, 2009, regarding the stream portion of the project and another on July 12, 2010, regarding the wetland portion of the project. Both letters requested review and comment for the potential of cultural resources potentially affected by the Little Troublesome Creek Project.

2.7.2 SHPO/THPO Concurrence

Requests for records search were submitted on July 16, 2009, and July 12, 2010, to the NC State Historic Preservation Office (SHPO) to determine the presence of any areas of architectural, historic, or archaeological significance that would be affected by the project. In a letter dated July 23, 2009, and another letter dated July 28, 2010, (see Appendix 3), the SHPO stated that they have reviewed the project and are "aware of no historic resources which would be affected by the project."

2.8 Physical Constraints

2.8.1 Property Ownership, Boundary, and Utilities

The stream portion of the project is located on a mostly forested parcel owned by Wildlands Little Troublesome Creek Holdings, LLC. A conservation easement held by the State of North Carolina has been recorded over 33 acres of the 34.5 acre parcel. The stream project site is bound by a sanitary sewer easement on the west side and a CSX railroad line on the east side. An existing gas line runs along the left top of bank of the existing channel for approximately 1,000 feet and is exposed in places due to bank erosion. The section of the gas line crossing Irvin Creek is scheduled to be relocated in June 2011. The new alignment of the gas line is shown on Figure 2.

The wetland portion of the project is located on a parcel owned by Jerry Apple. A conservation easement held by the State of North Carolina has been recorded over 19 acres of the parcel. An underground irrigation pipe from Little Troublesome Creek to the upland area of the property bisects the project area. There is a 15-foot break in the easement for the irrigation pipe as shown in Figure 2. An existing conservation easement held by the US Fish and Wildlife Service is located immediately adjacent to the State of North Carolina easement south of the wetland project area.

2.8.2 Site Access

The stream portion of the mitigation project is accessible from Turner Drive on the north side of the project area and Industrial Drive (SR 1798) on the west side of the project area (Figure 2). The wetland portion of the mitigation project is accessible from Cotton Road (SR 2603).

2.8.3 FEMA and Hydrologic Trespass

The flood study for the Little Troublesome Creek project is comprised of two separate parts: the stream portion and wetland portion of the site (Figure 7). The stream restoration portion of the site is mapped as a FEMA Zone AE floodplain on FIRM panels 8903 and 8904. Irvin Creek and the upper portion of Little Troublesome Creek were modeled as a detailed study including 100-year base flood elevations and mapped floodway. The wetland restoration site is also mapped as a FEMA Zone AE floodplain on FIRM panels 8911, 9812, 8921 and 9822. This lower portion of Little Troublesome Creek model was performed as a limited detail study. Base flood elevations have been defined, but no floodway is mapped on the FIRM panel. Non-encroachment widths are published in the Rockingham County Community 370350 Flood Insurance Study dated July 3, 2007.

A Conditional Letter of Map Revision (CLOMR) has been prepared for the stream portion of the site. The project has been designed so that any increase in flooding will be contained on the project site and will not extend upstream to the adjacent parcel. The minor grading proposed for the wetland portion of the site proved to have little or no affect on the conveyance of the stream and does not require a full flood study. The proposed work has been addressed in a technical memorandum approved by Rockingham County.

3.0 Project Site Streams – Existing Conditions

3.1 Existing Conditions Survey

Little Troublesome Creek, Irvin Creek and UT1 are located within relatively mature forested buffers; however these channels are located within a urbanized watershed. Heavy storm flows and lack of stabilizing vegetation along these reaches have resulted in severe bank erosion, channel incision, and over-widening. The on-site existing conditions data were collected by Wildlands Engineering, Inc. (Wildlands) in December 2009 and February 2011. Existing geomorphic survey data is included in Appendix 4 and cross-section locations are shown on Figure 4.

Tables 5a and 5b summarize the attributes of the overall project and of the project reaches.

Table 5a. Project Attributes
Little Troublesome Creek Mitigation Project

Project County	Rockingham County
Physiographic Region	Inner Piedmont Belt of the Piedmont Physiographic Province
Ecoregion	Piedmont
River Basin	Cape Fear
USGS HUC (14 digit)	03030002010030
NCDWQ Sub-basin	03-06-01
Within NCEEP Watershed Plan?	The project is within an NCEEP Targeted Watershed
WRC Class	Warm
Percent of Easement Fenced or Demarcated	The easement has been recorded but is proposed to be demarcated post construction. No fencing necessary for easement area.
Beaver Activity Observed During Design Phase?	No

Table 5b. Mitigation Component Attributes
Little Troublesome Creek Mitigation Project

	Irvin Creek Reach 1	Irvin Creek Reach 2	Little Troublesome Creek	UT1
Drainage Area (acres)	525	584	3245	62
Stream Order	1st	2nd	3rd	1st
Restored Length (LF)	2,014	1,917	1,169	240
Perennial or Intermittent	Perennial	Perennial	Perennial	Intermittent
Watershed Type	Urban			
Watershed Land Use				
Developed	28%			
Agricultural	17%			
Forested/Scrubland	55%			
Watershed Impervious Cover	17%			
NCDWQ Index Number	N/A	N/A	16-7a	N/A
NCDWQ Classification	C	C	C; NSW	C
303d Listed	No	No	Yes	N
Upstream of a 303d Stream	Yes	Yes	Yes	Yes
Reasons for 303d Listing	N/A	N/A	Ecological/Biological Integrity	N/A
Total Acreage of Easement	33 acres (stream site); 19 acres (wetland site)			
Total Vegetated Acreage within Easement	52 acres			
Total Planted Acreage as part of Restoration	33.7 acres			
Rosgen Classification of Pre-Existing	G4c	G4c	C5	G5

Rosgen Classification of Design	C	C	C	C
Valley Type	Valley Type VIII			
Valley Slope (feet/ foot)	0.0114	0.0044	0.0033	N/A*
Cowardin Classification	N/A	N/A	N/A	N/A
Trout Waters Designation	No	No	No	No
Endangered or Threatened Species	No	No	No	No
Dominant Soil Series and Characteristics	Codorus loam, 0-2% slopes (CsA)	Codorus loam, 0-2% slopes (CsA)	Fairview-Poplar Forest Complex	Codorus loam, 0-2% slopes (CsA)

**The valley of UT1 has been significantly altered by grading and piling of dredged material. An accurate valley slope for this reach is not available*

3.2 Channel Classification

Irvin Creek was divided into two separate reaches for classification due to differences in stream morphology and drainage area size: Reach 1 and Reach 2. Reach 1 of Irvin Creek includes approximately 1,640 LF of channel downstream of Turner Drive and a drainage area of 0.82 square mile. This upstream reach of Irvin Creek classifies as a relatively straight Rosgen G4c stream type (Rosgen, 1994). The channel is located in a moderately narrow portion of the valley and is highly incised with an entrenchment ratio of 1.2. The deep channel bed and narrow bankfull widths result in a low width-to-depth ratio of 11.5. According to an adjacent landowner, the channel was straightened in the 1930's or early 1940's for farming. Because the channel has been historical straightened (see aerial photo in Appendix 5) sinuosity cannot be used for classification. As seen below, this reach exhibits a very coarse gravel substrate throughout and is underlain at the downstream end by an exposed bedrock grade control point.

Gravel and sand substrate common throughout Irvin Creek

Irvin Creek Reach 2 is approximately 1,533 LF and includes the area downstream of the bedrock grade control point of Reach 1 to the confluence with Little Troublesome Creek. Reach 2 continues to be classified as a Rosgen G4c stream type with an increased watershed size of 0.91 square mile. Reach 2 is also highly incised with a comparable entrenchment ratio to Reach 1 of 1.2. This reach is deeper than Reach 1 with similar bankfull widths, resulting in a much lower width-to-depth ratio ranging from 8.0 to 8.6. As with Reach 1, Reach 2 is known to have been historically straightened and heavily managed, particularly in the area adjacent to natural gas line, so sinuosity cannot be used for classification. Substrate throughout this reach transitions from a coarse gravel and cobble upstream to a gravel and coarse sand downstream.

Little Troublesome Creek includes approximately 1,078 LF of the lower portion of the project area with a drainage area of 5.1 square miles. Little Troublesome Creek classifies as a

straightened Rosgen C5 channel type. This channel exhibits a significantly larger cross-sectional area than Irvin Creek and has bank height ratios ranging from 1.6 to 2.8 indicating moderate to severe incision. The relatively deep channel bed and narrow bankfull widths result in a somewhat low width-to-depth ratio of 11.2. According to NRCS personnel, this channel was historically straightened, so sinuosity cannot be used for classification. Substrate throughout Little Troublesome Creek includes a medium gravel substrate along with irregularly occurring areas of coarse sand deposition including side channel and mid channel bars.

UT1 is 184 LF in length and has a drainage area of 0.1 square miles. This straight channel begins at the outfall of a culvert under the railroad and has downcut through the Little Troublesome Creek floodplain so that its outlet is at the bed elevation of the receiving creek. Immediately downstream of the culvert the channel is relatively unincised with bank height ratios near 1. Incision increases greatly in the downstream direction so that near the confluence with Little Troublesome Creek, the bank height ratios become closer to three (attempts to identify true bankfull elevation in the lower sections of this channel would be unreliable). Due to low width to depth and entrenchment ratios most of the length of this channel is classified as a G5 stream type. The substrate in UT1 is almost completely comprised of sand. Existing geomorphic conditions for Irvin Creek, Little Troublesome Creek, and UT1 are summarized below in Table 6.

Table 6: Little Troublesome Creek & Irvin Creek Existing Conditions
Little Troublesome Creek Stream Mitigation Project

	Notation	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			Min	Max	Min	Max	Min	Max	Min	Max
stream type			G4c		G4c		C5		G5	
drainage area	DA	sq mi	0.67	0.82	0.82	0.91	4.95	5.07	0.1	
Q- NC Rural Regional Curve			67	72	72	83	283	288	14	
Q- NC Urban Regional Curve			238	255	255	288	830	842	58	
$Q_{2\text{-}yr}$ NFF regression			110		126		422		---	
Q- USGS extrapolation			45	91	48	99	215	365	---	
Q Mannings			122		99	102	237		---	
bankfull design discharge	Q_{bkf}	cfs	90		100		370		14	
Cross-Section Features										
bankfull cross-sectional area	A_{bkf}	SF	27.3		30.6	32.8	73.6		6.4	
average velocity during bankfull event	v_{bkf}	fps	3.3		3.0	3.3	5.0		4.4	
width at bankfull	w_{bkf}	feet	17.7		15.2	17.2	28.7		5.2	
maximum depth at bankfull	d_{max}	feet	1.8		2.4	2.6	3.3		1.9	
mean depth at	d_{bkf}	feet	1.5		1.9	2.0	2.6		1.2	

	Notation	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			Min	Max	Min	Max	Min	Max	Min	Max
bankfull										
bankfull width to depth ratio	w_{bkf}/d_{bkf}		11.5		8.0	8.6	11.2		4.3	
depth ratio	d_{max}/d_{bkf}		1.2		1.2	1.3	1.3		1.6	
low bank height			3.4	5.9	5.4	6.6	5.3	9.0	2.2	4.7
bank height ratio	BHR		1.9	3.3	2.3	2.5	1.6	2.8	1.2	2.5
floodprone area width	w_{fpa}	feet	21		18	21	93		8	
entrenchment ratio	ER		1.2		1.2	1.2	3.2		1.5	
Sinuosity										
valley slope	S_{valley}	feet/ foot	0.0114		0.0044		0.0033		N/A*	
channel slope	$S_{channel}$	feet/ foot	0.0107		0.0043		0.0030		0.0183*	
sinuosity	K		1.1		1.0		1.1		1.0*	
Riffle Features										
riffle slope	S_{riffle}	feet/ foot	0.001	0.025	0.0019	0.017	0.0007	0.011	0.0072	0.050
riffle slope ratio	$S_{riffle}/S_{channel}$		0.1	2.4	0.4	3.8	0.2	3.6	0.4	2.7
Pool Features										
pool slope	S_{pool}	feet/ foot	0.0005	0.0029	0.001	0.004	0.000	0.002	0.000	0.009
pool slope ratio	$S_{pool}l/S_{channel}$		0.0	0.3	0.1	0.9	0.0	0.8	0.0	0.5
pool-to-pool spacing	L_{p-p}	feet	39	60	27	76	46	127	29	42
pool spacing ratio	L_{p-p}/w_{bkf}		2.2	3.4	1.8	4.4	1.6	4.4	5.6	8.0
maximum pool depth at bankfull	d_{pool}	feet	2.09	3.65	2.27	3.33	3.19	5.25	2.24	3.31
pool depth ratio	d_{pool}/d_{bkf}		1.4	2.4	1.2	1.7	1.2	2.0	1.8	2.7
pool width at bankfull	w_{pool}	feet	25.4		15.6	16.6	31.8		4.1	
pool width ratio	w_{pool}/w_{bkf}		1.4		1.0	1.0	1.1		0.8	
pool cross-sectional area at bankfull	A_{pool}	SF	34.9		28.5	32.7	81.2		9.2	
pool area ratio	A_{pool}/A_{bkf}		1.3		0.9	1.0	1.1		1.4	
Pattern Features										

	Notation	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			Min	Max	Min	Max	Min	Max	Min	Max
belt width	W_{blt}	feet	39	81	46	94	119		---	
meander width ratio	W_{blt}/W_{bkf}		2.2	4.6	3.0	5.5	4.1		---	
meander length	L_m	feet	86	175	175	348	179	315	---	
meander length ratio	L_m/W_{bkf}		4.9	9.9	11.5	20.2	6.2	11.0	---	
radius of curvature	R_c	feet	57.0	114.0	100	251	103	313	---	
radius of curvature ratio	R_c/W_{bkf}		3.2	6.4	6.6	14.6	3.6	10.9	---	
Sediment										
Particle Size Distribution from Riffle 100-Count			X2		X3	X5	X8			
	d_{16}	mm	11.0		0.7	0.3	0.5		---	
	d_{35}	mm	23.6		17.8	0.5	1.1		---	
	d_{50}	mm	32.8		24.2	0.8	9.7		---	
	d_{84}	mm	67.7		55.6	11.4	21.9		---	
	d_{95}	mm	98.3		86.2	19.0	40.2		---	
	d_{100}	mm	180.0		256.0	32.0	>2048		---	
Particle Size Distribution from Subpavement Analysis										
Sub-pavement	d_{16}	mm	2.0		2.4	0.5	2.8		---	
	d_{35}	mm	8.9		8.1	0.9	8.3		---	
	d_{50}	mm	14.2		13.1	1.3	11.5		---	
	d_{84}	mm	28.5		31.5	5.1	20.5		---	
	d_{94}	mm	37.2		40.3	9.7	28.6		---	
	d_{99}	mm	45.0		45.0	16.0	45.0		---	
Particle Size Distribution from Reachwide Count										
	d_{50} particle		medium gravel		fine gravel		coarse sand			
	d_{16}	mm	0.1		0.1		0.2		---	
	d_{35}	mm	0.6		0.3		0.5		---	
	d_{50}	mm	14.8		4.5		1.0		0.062	
	d_{84}	mm	56.1		24.7		22.0		3.55	
	d_{95}	mm	98.3		31.3		30.2		13.3	
	d_{99}	mm	>2048		45.0		>2048		>2048	

*The valley of UT1 has been significantly altered by grading and piling of dredged material. An accurate valley slope for this reach is not available. Sinuosity was calculated as channel length over valley length.

3.3 Valley Classification

The Little Troublesome Creek project area is bound by broad valleys and gentle elevation relief. This surrounding fluvial and morphological landform is classified as Valley Type VIII (Rosgen, 1996). Alluvial terraces and broad floodplains are typically the predominant depositional

features for this valley type; however, due to extensive urban development these features are much less defined in the Little Troublesome Creek and Irvin Creek watersheds. 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). Historical straightening, dredging, adjacent utility line construction, and channel modifications of Little Troublesome Creek and Irvin Creek have resulted in alteration of the channel type.

3.4 Discharge

Multiple methods were used to approximate the bankfull discharge and choose a design discharge for each of the separate design reaches. Due to the amount of impervious cover within the watersheds of the three reaches, discharge estimates were made using methods intended for both urban and rural watersheds when available. Table 7 summarizes the results of each of the discharge analyses described in this section.

Table 7. Summary of Design Discharge Analysis
Little Troublesome Creek Mitigation Project

USGS NFF- Rural Watersheds

	Drainage Areas (sq mi)	% Impervious	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Std Error (%)
Irvin Creek - Reach 1	0.82	35%	117	212	293	41
Irvin Creek- Reach 2	0.91	32%	126	227	314	41 - 42
Little Troublesome Ck.	5.07	17%	422	726	978	41 - 42
UT1	0.1	41%	---	---	---	---

USGS NFF - Urban Watersheds

	Drainage Areas (sq mi)	% Impervious	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Std Error (%)
Irvin Creek - Reach 1	0.82	35%	330	527	669	41 - 42
Irvin Creek- Reach 2	0.91	32%	335	537	683	41 - 42
Little Troublesome Ck.	5.07	17%	772	1210	1520	41 - 42
UT1	0.1	41%	64.6	116	155	39 - 40

Regional Curves - Rural Piedmont

	Drainage Areas (sq mi)	A_{bkf} (SF)	Qbkf (cfs)	Vbkf (ft/s)	Lower 95%	Upper 95 %
Irvin Creek - Reach 1	0.82	18.74	77.1	4.12	32.31	219.42
Irvin Creek- Reach 2	0.91	20.11	83.2	4.14	34.88	236.27
Little Troublesome Ck.	5.07	64.22	287.6	4.48	123.07	800.75
UT1	0.1	3.82	14.1	3.69	5.75	41.23

Regional Curves - Urban Piedmont

	Drainage Areas (sq mi)	Abkf (SF)	Qbkf (cfs)	Vbkf (ft/s)
Irvin Creek - Reach 1	0.82	51.39	260.4	5.07
Irvin Creek- Reach 2	0.91	55.04	278.4	5.06
Little Troublesome Ck.	5.07	171.02	835.7	4.89
UT1	0.1	10.88	57.8	5.31

Manning's Equation

	Drainage Areas (sq mi)	A (SF)	Qbkf (cfs)	Vbkf (ft/s)
Irvin Creek - Reach 1a	0.82	27.3	69.7	2.55
Irvin Creek - Reach 1b	0.82	48.8	360.9	7.39

Regional curves relating bankfull discharge to drainage area for both rural (Harman, et al., 1999) and urban (Doll, et al., 2002) watersheds in the piedmont region of North Carolina were used to estimate the bankfull discharge for each reach. In addition, the U.S. Geological Survey (USGS) flood frequency equations for rural (Weaver, et al., 2009) and urban (Robbins and Pope, 1996) watersheds in the North Carolina piedmont were used to estimate peak discharges for floods with a recurrence interval of two years. The two-year discharge provides a reasonable approximation of bankfull discharge, but is generally slightly larger than the discharge predicted by the appropriate regional curve.

Another method used to estimate the bankfull discharge of Reach 1 involved using Manning's equation to estimate the discharge corresponding to a water surface elevation equal to potential bankfull features at two cross sections surveyed at the upper end of the reach. Cross section 1 had a stable left bank and the top of that bank (point of incipient flooding) was chosen to be a potential bankfull feature. Cross section 2, approximately 150 feet downstream of cross section 1, had a stable, vegetated bar feature at a lower elevation than the top of bank feature at cross section 1. The top break in slope of this bar was chosen as a potential bankfull feature at this cross section. No other cross sections were surveyed for this purpose due to the degraded condition of the channels and lack of potential bankfull features with the consistency necessary to make a bankfull determination. To determine how the potential bankfull features of each cross section compared to the regional curves, the surveyed bankfull cross-sectional area of each cross section was compared to both the urban and rural curves relating bankfull cross-sectional area to drainage area. The bankfull cross-sectional area surveyed for cross section 1 was very similar (8% lower) to the area predicted by the urban piedmont regional curve for the drainage area of that reach. The surveyed bankfull cross-sectional area for cross section 2 was 43% higher than the rural regional curve predicted but within the 95% confidence interval published with the rural curve.

The USGS gauging station nearest to the project site with a long-term, continuous record of discharge is located on the Haw River at Benaja. The Haw River at this location has a drainage

area of 168 square miles and, therefore, this gauge is not appropriate to estimate discharge at the project site even though it is within the Haw River watershed.

The lack of either reliable bankfull features along the project reach or an appropriate gauging station to estimate streamflow corresponding to bankfull discharge at the site make selection of a design discharge approximating the bankfull discharge difficult. The rationale for selecting the design discharges shown in Table 7 was developed based on the best available information and experience and professional judgments of the designers. The best estimates of a bankfull discharge are provided by the regional curves and USGS flood frequency equations for 2-year peak flows. Although the watersheds of the three reaches are somewhat developed (impervious surface estimates range from 17% to 35%), past projects in the North Carolina piedmont have shown that restored stream channels in developed watersheds tend to stabilize with cross-sectional areas closer to that estimated by the rural regional curve rather than the urban curve. Recent research by Annable et al. (2010a and 2010b) indicates that channel forming discharge occurs far more frequently in urban streams than rural, indicating a similar magnitude of bankfull discharge in urban and rural watersheds. In addition, the site provides an ample forested floodplain which will dissipate the energy of larger discharges. A design intended to allow streamflows to more frequently spread onto the forested floodplain and into existing wetlands and created vernal pool features will maximize the water quality and hydrologic benefits of the project. Therefore, the design discharges for the three reaches were selected between those predicted by the rural and urban regression models, but more similar to those predicted by the rural equations.

3.5 Channel Morphology

The existing conditions assessment of the project reaches of Irvin Creek and Little Troublesome Creek indicated that channelization of the streams and urbanization of the watersheds has resulted in incision and enlargement of the channels. The channels have downcut to elevations where local grade control will prevent further incision. Bank erosion, which is severe at many locations in these channels, is now causing lateral enlargement of the streams. Results from a bank erosion hazard index (BEHI) assessment indicate that the bank erosion along the project reaches of Irvin and Little Troublesome Creeks contributes approximately 2,400 tons of sediment to downstream waters per year. The BEHI results are discussed in more detail in Section 3.7.

Irvin Creek is a deeply incised stream channel with eroding banks, limited pool depth and classifies as a G-type stream. Parts of Irvin Creek have become over-widened due to excessive erosion and the beginnings of meander development. Short embedded riffles and long shallow pools dominate the bed form. The incision and lateral erosion have also resulted in degraded aquatic habitat, altered hydrology related to loss of floodplain connection and lowered water table, and have contributed to water quality problems such as lower dissolved oxygen levels due to wide channels with shallow flow. Similar conditions exist in UT1 where incision is especially severe. UT1 is a small, intermittent stream which has down cut to the incised bed level of Little Troublesome Creek.

The portion of Little Troublesome Creek included in the project classifies as a C-type channel but borders on a being a G- or F-type channel due to limited access to its floodplain. Little

Troublesome Creek is also lined by dredge spoil berms which further separate the channel from the floodplain. Incision appears to have ceased, so the width to depth ratios will likely never become low enough to warrant a G stream type classification. As lateral erosion continues, it will develop into an F-type channel and will likely continue to pollute downstream waters and cover bed substrate and habitat.

3.6 Channel Evolution

The project stream reaches are all currently laterally unstable. According the Simon channel evolution model (Simon, 1986), the project reaches of Irvin Creek, Little Troublesome Creek, and UT1 appear to be at *Stage 4 – Channel Widening* (Figure 8). They have passed *Stage 3 – Incision;* the down-cutting has been arrested by grade control or incision to local base level. In most areas bank erosion is actively widening the channels. In some locations bank erosion causes substantial widening and some transient deposition is beginning.

For Irvin Creek and UT1 this is evident by the classification of G according to the Rosgen system and related channel evolution models. According to the Rosgen channel type succession model, these streams have progressed from C or E streams (the likely natural condition of the streams given regional physiography) to G streams and appear to be moving towards the wider incised F-type streams. Little Troublesome Creek is moving from a C to an F channel through lateral erosion having never incised to a G stream type.

Once this stage of mass wasting is completed, the project streams would likely begin to experience increased sediment deposition caused by decreased depth of flow and shear stress in the wider channels. This depositional trend, known as *Stage 5* according to Simon's model, will eventually create a new floodplain within the over-widened channels and a small C type or E type channel will be formed (*Stage 6 – Quasi-Equilibrium*).

3.7 Channel Stability Assessment

The primary destabilizing force in Irvin Creek and Little Troublesome Creek is vertical stream banks; areas lacking in significant riparian vegetation and root depth are allowing for further instability. A small area of exposed bedrock at the downstream portion of Reach 1 provides some vertical stability to Irvin Creek; however the remainder of this reach exhibits moderate to large amounts of incision and vertical degradation along with unstable vertical banks. Examination of BEHI ratings for this reach reveals moderate and extreme levels of bank erosion potential for the majority of the reach (Figure 9). Sediment export was also determined for 902 linear feet of Reach 1 of Irvin Creek and is estimated at approximately 870 tons per year (Table 8). This portion of Irvin Creek exhibited bank heights typically ranging from 5 to 8 feet.

Reach 2 of Irvin Creek is equally affected by a lack of stabilizing bed features and bare vertical banks with similar incision and vertical degradation as Reach 1. Additionally, Reach 2 exhibits areas of mid-channel bars and heavy sediment deposition, indicative of channel over-widening. BEHI ratings for this reach range from low which is typical of smaller areas stabilized by tree roots, to extreme in which the channel banks exhibit severe undercutting and completely lack vegetation. Sediment export was determined for 2,470 linear feet of Reach 2 and is estimated at approximately 1,473 tons per year (Table 8). This large increase in sediment export over Reach

1 can most likely be attributed to the increase in reach length as well as a slight increase in bank height (6 to 10 feet) and channel incision.

The portion of the Little Troublesome Creek located within the project area exhibits large amounts of bank instability and areas of over-widening resulting in mid-channel deposition. BEHI ratings for Little Troublesome Creek range from moderate to extreme due to near vertical banks lacking stabilizing vegetation. Sediment export is estimated at approximately 2,404 tons per year for the reach (Table 8). The large amount of sediment export occurring in Little Troublesome Creek can be attributed to much higher bank heights along this section of the project; typically 15 to 20 feet in height.

Table 8. Pre-Construction BEHI and Sediment Export Estimates
Little Troublesome Creek Mitigation Project

	Left Bank			Right Bank		
	BEHI	Linear Footage	Sediment Export Ft³/Yr	BEHI	Linear Footage	Sediment Export Ft³/Yr
Irvin Creek Reach 1	Extreme	505	15150	Extreme	61	1830
	Mod	297	532	Mod	741	540
	Low	100	14	Low	100	14
	Total Ft³/Yr		15696			2384
	Tons/Yr		756			115
	Reach Total		**871 Tons/Yr**			
Irvin Creek Reach 2	Extreme	267	13212	Extreme	76	5320
	V. High	692	3433	V. High	499	2698
	High	419	1752	High	363	1796
	Mod	886	939	Mod	1430	1392
	Low	206	32	Low	102	14
	Total Ft³/Yr		19368			11218
	Tons/Yr		933			540
	Reach Total		**1473 Tons/Yr**			
Little Troublesome Creek	Extreme	549	42628	Extreme	80	2880
	V. High	209	2618	V. High	273	999
	High	61	110	High	196	353
	Mod	80	101	Mod	350	234
	Total Ft³/Yr		45457			4466
	Tons/Yr		2189			215
	Reach Total		**2404 Tons/Yr**			

3.8 Bankfull Verification

There were very few reliable indicators of bankfull stage throughout the project reaches. Based on the judgment of the field assessment team, a few potential bankfull stage indicators were selected throughout the reaches of Irvin Creek and Little Troublesome Creek. These features included either a break in slope on flat depositional features or scour lines on steep banks. These indicators are consistent with those identified on other, more stable NC piedmont streams. The limited data collected on bankfull geometry for the project reaches were compared with the NC urban and rural piedmont regional curves. Analysis of the estimated bankfull cross-sectional

areas for the project reaches consistently plotted at or just above the NC rural piedmont regional curve data (Figure 10). This provides some validation of the bankfull identification and indicates that, although the selected bankfull features along the project reaches remain questionable, that the best available information was used to estimate bankfull stage throughout the project area.

3.9 Vegetation Community Types Descriptions

Within the Little Troublesome Creek project corridor, a variety of vegetative habitats exist. The dominant community type is mesic mixed hardwood forest located throughout the floodplains and top of stream bank zones. These communities exhibited strong canopy layers as well as areas of thick shrub layer species. Canopy species throughout these areas include red maple (*Acer rubrum*), ironwood (*Carpinus caroliniana*), sweetgum (*Liquidambar styraciflua*), American sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), tulip poplar (*Liriodendron tulipifera*), southern red oak (*Quercus falcata*), and white oak (*Quercus alba*). Dominant sub-canopy species ranging in height from eight to 15 feet include red maple, ironwood, tulip tree, and box elder (*Acer negundo*). The shrub layer varies in thickness throughout the project area, but predominantly includes spicebush *(Lindera benzoin)*, multiflora rose (*Rosa multiflora*), common blackberry (*Rubus argutus*), pignut hickory (*Carya glabra*), and pawpaw (*Asimina triloba*). The herbaceous layer is relatively sparse other than areas where canopy coverage is minimal; species within this layer include false nettle (*Boehmeria cylindrica*), Nepalese browntop (*Microstegium vimineum*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and Christmas fern (*Polystichum acrostichoides*).

Several utility line rights-of-way intersect and run parallel to Irvin Creek and Little Troublesome Creek and include overhead utility lines, a natural gas pipeline, and a sanitary sewer line (Figure 2). Habitats within these areas range from moderately to heavily maintained. The overhead utility line right-of-way exhibits no canopy species and is completely dominated by shrub and herbaceous species including common blackberry, multiflora rose, invasive Japanese honeysuckle (*Lonicera japonica*), and pokeweed (*Phytolacca americana*). The natural gas pipeline exhibits minor adjacent canopy species including tulip tree, ironwood, black walnut, and green ash (*Fraxinus pennsylvanica*), while moderate maintenance of this right-of-way has allowed for domination of shrub and herbaceous species including common blackberry, box elder, wingstem (*Verbesina alternifolia*), Nepalese browntop, poison ivy, and false nettle. The sanitary sewer line is the most heavily maintained and is dominated by mowed species of Nepalese browntop, straw-colored flatsedge (*Cyperus strigosus*), narrowleaf lespedeza (*Lespedeza angustifolia*), and various grasses (*Festuca* spp.). Edge species found throughout this maintained corridor include sweetgum, ironwood, multiflora rose, tulip tree, black walnut, poison ivy, wingstem, red maple, and honey locust (*Gleditsia triacanthos*).

The eastern boundary of the project area is defined by an adjacent railroad right-of-way. Species along the forest edge and toe of slope are moderately maintained and include sweetgum, box elder, pokeweed, Nepalese browntop, red bud (*Cercis canadensis*), pin oak (*Quercus palustris*), post oak (*Quercus stellata*), Queen Anne's lace (*Daucus carota*), yellow foxtail (*Setaria pumila*), poison hemlock (*Conium maculatum*), flowering dogwood (*Cornus florida*), and bull thistle (*Cirsium vulgare*).

4.0 Reference Streams

Identification of suitable reference reaches for urban projects can be problematic. It is well documented that streams in developed watersheds become destabilized and enlarged and have degraded habitat conditions due to altered hydrology (U.S. EPA, 1997). Therefore, it is often difficult to find reference quality streams in urban settings. In addition, reference reaches in rural, wooded areas, where reference streams are most often identified in the southeast, are not appropriate as the sole basis for designing urban stream restoration projects. For these reasons, appropriate reference reaches were not identified within the Little Troublesome Creek watershed and project-specific reference reaches in nearby rural settings were not sought. The design parameters were largely developed based on the design discharge and the designers' experience with dimensionless ratio values commonly used in successful restoration designs of streams in urban areas of the North Carolina Piedmont. Multiple naturally stable streams were identified to provide verification of design parameters, especially pattern and profile characteristics. The reference reach data for similar streams was obtained from existing data sets. The reference streams considered when developing design parameters for this project include Collins Creek, Spencer Creek, UT to Belews Creek, and UT to Rocky Creek (Figure 11). These reference streams were chosen because of similarities to the project streams including drainage area, valley slope and morphology, bed material, and location within the piedmont. Collins Creek was used as a reference reach for another NCEEP stream restoration project constructed downstream of the project site on Little Troublesome Creek in 2008. The UT to Rocky Creek, UT to Belews Creek, and Spencer Creek references were used for other stream designs near the project site.

4.1 Reference Streams Channel Morphology and Classification

According to the Little Troublesome Creek Restoration Plan (KCI Technologies, 2007), Collins Creek is located in the southern portion of Orange County near the confluence of the stream with the Haw River in Chatham County. The drainage area is 1.68 square miles and the land use within the drainage area is low-density residential and forest. The Collins Creek reference site was classified as an E4 channel type according to the Rosgen classification system (Rosgen, 1994). The channel has a width to depth ratio ranging from 4.4 to 12.1 and an entrenchment ratio of 2 to 3. The channel has a bank height ratio of 1 to 1.1 indicating vertical stability. However the channel is apparently straight and no planform feature information is available for the site.

Data from the UT to Rocky Creek and Spencer Creek reference sites were obtained from the Big Cedar Creek Restoration Plan by Baker Engineering (2007). The reference reaches are located in a mature forested area with 20-to 50-year-old forest growth. UT to Rocky Creek is classified as an E4b stream type in the Rosgen classification system and Spencer Creek is classified as an E4/C4. These reference reaches are vertically and horizontally stable, have moderate pattern with sinuosity measurements ranging from 1.1 to 2.3, have well-established pools at outside of channel bends, have several riffles, and have plentiful habitat features such as woody debris jams and tree roots. UT to Rocky Creek has a width to depth ratio of 6.0 and a slope of 2.6 percent. The Spencer Creek reach has a sinuosity of 1.1 and a slope of 1.3 percent.

The fourth reference site is a reach of UT to Belews Creek near the Town of Kernersville in Forsythe County. This reference reach data set was obtained from Brushy Fork Stream Restoration Plan (URS Corporation, 2007). The drainage area of the site is 3.4 square miles and the land use within the watershed includes residential development, forest, and areas of managed

herbaceous vegetation. The floodplain of this E5 stream is undeveloped bottomland hardwood forest. The width to depth ratio along this reach ranges from 6.3 to 9.1 and the entrenchment ratio is 34.7. The bank height ratio is 1.0 and the sinuosity of the reach is 1.2. The URS report stated that the reach appears to be maintaining stable cross section, pattern, and profile dimensions.

Summaries of geomorphic parameters for all of the reference reaches analyzed for this project are included in Table 9.

Table 9. Summary of Reference Reach Geomorphic Parameters
Little Troublesome Creek Mitigation Project

			Collins Creek		UT to Belews Creek		UT to Rocky Creek		Spencer Creek	
Parameter	Not-ation	Units	min	max	min	max	min	max	min	max
stream type			E4		E5		E4b		E4/C4	
drainage area	DA	sq mi	1.68		3.40		1.1		0.5	
bankfull discharge	Q_{bkf}	cfs	115-150		125.00		85		N/P	
bankfull cross-sectional area	A_{bkf}	SF	32.90		27.40		16.3		10.6	
average velocity during bankfull event	v_{bkf}	fps	3.90		4.80		5.5		N/P	
width at bankfull	w_{bkf}	feet	11.9-20.1		14.40		12.2		8.7	
maximum depth at bankfull	d_{max}	feet	3.3-4.2		2.70		1.8		1.9	
mean depth at bankfull	d_{bkf}	feet	1.6-2.7		1.95		1.3		1.2	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		4.4-12.1		7.60		9.1		7.3	
depth ratio	d_{max}/d_{bkf}		1.5-2.5		1.40		1.3		1.6	
bank height ratio	BHR		1-1.1		1.00		1.0		1.0	
floodprone area width	w_{fpa}	feet	60		200		72		229	
entrenchment ratio	ER		2.0-3.0		34.70		6.0		26.3	
valley slope	S_{valley}	feet/ foot	---		0.008		0.0261		0.0139	
channel slope	$S_{channel}$	feet/ foot	0.003		0.007		0.0235		0.0132	
sinuosity	K		---		1.20		1.1		1.05	
riffle slope	S_{riffle}	feet/ foot	0.003	0.008	---		0.0606	0.0892	0.0100	0.0670

			Collins Creek		UT to Belews Creek		UT to Rocky Creek		Spencer Creek	
Parameter	**Not-ation**	**Units**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**
riffle slope ratio	$S_{riffle}/S_{channel}$		---		---		2.6	3.8	0.8	5.1
pool slope	S_{pool}	feet/ foot	0.0		0.0		0.0000	0.0037	0.000	
pool slope ratio	$S_{poo}l/S_{channel}$		0.0		0.1		0.0	0.16	0.01	
pool-to-pool spacing	L_{p-p}	feet	32.0	80.0	75.0		26	81	13	47
pool spacing ratio	L_{p-p}/w_{bkf}		1.6	6.7	5.2		2.2	6.7	1.5	5.3
maximum pool depth at bankfull	d_{pool}	feet	2.4		4.6		2.2		2.5	
pool depth ratio	d_{pool}/d_{bkf}		---		2.4		1.6		2.1	
pool width at bankfull	w_{pool}	feet	24.3		13.1		10.9		8.4	
pool width ratio	w_{pool}/w_{bkf}		---		0.90		0.9		1.0	
pool cross-sectional area at bankfull	A_{pool}	SF	57.9		---		19.3		12.8	
pool area ratio	A_{pool}/A_{bkf}		---		0.90		1.2		1.2	
belt width	w_{blt}	feet	---		31.0	32.0	---		24	52
meander width ratio	w_{blt}/w_{bkf}		---		2.15	2.22	---		2.8	6.0
meander length	L_m	feet	---		74.0	101.0	---		54	196
meander length ratio	L_m/w_{bkf}		---		5.5	6.6	---		6.2	22.5
radius of curvature	R_c	feet	---		16.0	27.0	---		5	22
radius of curvature ratio	R_c/ w_{bkf}		---		1.11	1.93	---		0.6	2.5

4.2 Reference Streams Vegetation Community Types Descriptions

UT to Rocky Creek and Spencer Creek are both surrounded by mature hardwood forests composed of typical Piedmont bottomland riparian forest tree species. Dominant species include sweetgum, tulip tree, hackberry (*Celtis occidentalis*), red maple, and American elm (*Ulmus americana*). Common understory vegetation includes ironwood, American holly (*Ilex opaca*), paw paw (*Asimina triloba*), and flowering dogwood. The mature trees within the riparian buffers

provide significant bank reinforcement to keep the streams from eroding horizontally and maintain channels with small width to depth ratios (Baker Engineering, 2007).

The riparian vegetation community for Collins Creek was not used as a reference community and is not described in the previous Little Troublesome Creek Restoration Plan. That document describes a reference community called the Williamsburg Alluvial Forest located approximately one mile downstream of the project site. The canopy species in the Piedmont Alluvial Forest portion of the Williamsburg Alluvial Forest include box elder, red maple, slippery elm (*Ulmus rubra*), river birch (*Betula nigra*), and American sycamore. Understory species include Musclewood (*Carpinus caroliniana*), winged elm (*Ulmus alata*), black haw (*Viburnum prunifolium*), and sweet bay (*Magnolia virginiana*). The canopy species in the Mesic Mixed Hardwood Forest include American beech (*Fagus grandifolia*), various oaks (*Quercus spp*.), and tulip poplar. Understory species include ironwood, sourwood (*Oxydendrum arboretum*), hazel-nut (*Corylus americana*), deerberry (*Vaccinium stamineum*), and mapleleaf arrowwood (*Viburnum acerifolium*) (KCI Technologies, 2007).

The riparian community of the UT to Belews Creek site is described as Piedmont-Mountain bottomland forest community. Canopy species described include sweetgum, tulip poplar, red maple, and American sycamore. The understory includes ironwood, Chinese privet (*Ligustrum sinense*) and saplings of the canopy species along with vines such as grape, catbrier, poison ivy, and Japanese honeysuckle. The herb layer was sparse; however the exotic Japanese knotweed was identified.

5.0 Project Site Wetlands – Existing Conditions

5.1 Jurisdictional Wetlands

On November 23, 2010, and March 23, 2011, Wildlands Engineering investigated and delineated on-site jurisdictional waters of the U.S. using the USACE Routine On-Site Determination Method. This method is defined by the 1987 Corps of Engineers Delineation Manual and the Eastern Mountain and Piedmont Regional Supplement Guide. The results of the on-site jurisdictional determination for the southern wetland site indicate that there are two jurisdictional wetland areas located within the floodplain of Little Troublesome Creek. These wetlands (WL-1 and WL-2) are approximately 0.9 and 2.76 acres in size, respectively and are primarily located within an active agricultural area (Figure 5). These systems exhibited pockets of inundation from one to six inches, sediment deposits, oxidized root channels, drainage patterns, low-chroma soils (10YR 5/2 and 7.5YR 5/1), many distinct mottles (7.5YR 4/6 and 2.5YR 4/6), and saturation within the upper 12 inches of the soil profile. Vegetation within this area has been heavily managed, resulting in a dominant herbaceous strata layer with very few, sparse trees. Wetland Determination Data Forms representative of these jurisdictional wetland areas have been enclosed in Appendix 2 (DP1w, DP2w, and DP7w).

Based on an adjacent reference area, it was determined that these jurisdictional systems historically functioned as a Bottomland Hardwood Forest, prior to their conversion to cropland. An assessment of these wetlands was performed according to the recent North Carolina Wetland Assessment Method (NCWAM) in order to determine their level of hydrologic function, water quality, and habitat condition. Due to heavy agricultural activities over the past several decades

along with aggressive vegetation management, these wetland systems scored out as low functioning systems when compared to reference conditions. Particularly low scoring parameters include the effects from tilling, grading, and ditching on decreased surface and subsurface hydrology. Additionally, vegetation management has reduced aquatic and terrestrial habitat along with eliminating the systems' connection to adjacent natural habitats. An NCWAM Wetland Rating Sheet representative of these jurisdictional wetland areas is enclosed in Appendix 2 (WL-1 and WL-2).

5.2 Hydrological Characterization

In order to develop a wetland restoration, enhancement, and creation design for the Little Troublesome Creek Site, an analysis of the existing and proposed conditions for groundwater hydrology was necessary. DrainMod (version 6.0) was used to model existing and proposed groundwater hydrology at the site. DrainMod simulates water table depth over time and produces statistics describing long term water table characteristics and an annual water budget. DrainMod was selected for this application because it is a well documented modeling tool for assessing wetland hydrology (NCSU, 2010) and is commonly used in wetland creation and restoration projects. For more information on DrainMod and its application to high water table soils see Skaggs (1980).

5.2.1 Groundwater Modeling

For the Little Troublesome Creek wetland site, six total models were developed and calibrated to represent the existing and proposed conditions at three different gauge locations across the site. Resulting model output was used to validate and refine the proposed grading plan for wetland restoration and creation on site and to develop a water budget for the site. The modeling procedures are described below.

5.2.1.1 Data Collection

DrainMod models are built using site hydrology, soil, climate, and crop data. Prior to building the models, soil cores were taken to validate existing mapped soils across the site. Further explanation of the site soils can be found in section 5.3 of this report. Rainfall and temperature data were obtained from nearby weather station Reidsville 2 NW (Station No. 317202) operated by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service. The data set for this station was obtained from the North Carolina State Climate Office from May of 1962 through December of 2010. These data were used to calibrate the models and perform the long term simulations. Information to develop model inputs for crops previously grown on the site was obtained through interviews with the landowner.

5.2.1.2 Existing Conditions Base Model Set up and Calibration

Models were created to represent three monitoring gauge locations on the site at as shown on Figure 5. The models were developed using the conventional drainage water management option with contributing surface water runoff to best simulate the drainage of the site. Each of the three gauges was installed in late July, 2010 and recorded groundwater depth twice per day with In-situ Level TROLL® 100 or 300 pressure transducers through early December 2010. This period was used as the calibration period for the groundwater models.

The first step in developing the model was to prepare input files from various data sources. A soil input file obtained from N.C. State University, which has similar characteristics to the soils on the site, was used as a base soil input file for each model. The soil files were refined by adjusting the lateral saturated conductivity values for each of the mapped soils found on-site from published soil survey data (NRCS, 2010). Temperature and precipitation data from a nearby weather station, described above, were used to produce weather input files for each model. A crop file was also developed for this application because the site has previously been used for row crops including corn and soy beans. The crop file provides information used by the model to simulate the agricultural practices that have occurred on the site and is especially important for this project, because the site was used for agricultural production during the calibration period.

Once the necessary input files were created, the project settings were adjusted for this application and then calibration runs were conducted. To calibrate the model, parameters not measured in the field were adjusted within the limits typically encountered under similar soil and geomorphic conditions until model simulation results closely matched observed gauge data. After calibration of each of the models was complete, the calibrated models were used as the basis for the proposed conditions models. Plots showing the calibration results are included in Appendix 2. Trends in the observed data are well-represented by the calibration simulations. Although hydrograph peaks between plots of observed and simulated data do not match exactly, relative changes in water table hydrology as a result of precipitation events correspond well between observed data and model results.

5.2.1.3 Proposed Conditions Model Setup

The proposed conditions models were developed based on the existing conditions models to predict whether wetland criteria would be met over a long period of recorded climate data. Proposed plans for the site include grading portions of the site to lower elevations, removing an existing agricultural ditch that currently drains a portion of the site, planting native wetland plants, and roughing the surface soil through disking. These proposed plans were developed to increase the wetland hydrology on site. Settings for the proposed conditions model were altered to reflect these changes to the site. Filling of the existing agricultural ditch on the site was simulated by increasing the surface storage for the nearby gauge (gauge 2) rather than increasing ditch spacing. This method was used because the existing ditch is quite shallow and does not likely contribute to subsurface drainage. The ditch spacing values in the models were based on proximity of the gauges to Little Troublesome Creek. To account for proposed site grading conditions, the ground surface elevations were decreased by the depth of ground to be graded at gauge 1. Changes in the vegetation on the site were simulated by altering the rooting depth of plants on the site from variable shallow depths for crops (varying by time of year) to consistent and deeper values for hardwood tree species. Surface storage values were increased at all gauges to account for proposed disking to the site. Once the proposed conditions models were developed, each model was run for a 47-year period from May 1963 through 2009 using the weather data from the Reidsville 2 NW weather station to perform the long term simulation.

5.2.1.4 Modeling Results and Conclusions

DrainMod was used to compare calibrated existing conditions models with proposed conditions scenarios to determine the effect of proposed practices on site hydrology. Each

gauge location was evaluated to establish how often annual wetland criteria would be met over the 47-year simulation period. The wetland criteria are that the water table must be within 12 inches of the ground surface at each gauge for a minimum of 7% of the growing season (March 25 through November 10). The modeling results show that Gauges 2 and 3 would meet the criteria 47 years out of the 47-year period following restoration activities. Gauge 1 would not regularly meet criteria without grading the portion of the site represented by that gauge (the wetland creation zone) to a lower elevation. The model results show that if grading is performed to lower the ground surface at Gauge 1 by 4 to 6 inches, that portion of the site will meet criteria 38 years out of the 47-year period. The existing ground surface rises between Gauge 1 and Little Troublesome Creek. Portions of the site nearer to the creek will be graded up to 18 to 24 inches in order to lower the ground to the same elevation as that proposed for the area around Gauge 1.

5.2.2 Surface Water Modeling at Restoration Site

The only surface water modeling necessary for the wetland restoration, enhancement, and creation design was performed with DrainMod by simulating a contributing area runoff for the hillslope on the western edge of the project site. The runoff simulated for this hillslope provided one of the hydrologic inputs for the wetland restoration, enhancement, and creation areas. No other modeling of surface hydrology, other than the HEC-RAS-hydraulic flood study, was performed for this project.

5.2.3 Hydrologic Budget for Restoration Site

DrainMod computes daily water balance information and outputs summaries that describe the loss pathways for rainfall over the model simulation period. Tables 10a, 10b, and 10c summarize the average annual amount of rainfall, infiltration, drainage, runoff, and evapotranspiration estimated for the three modeled locations on site. Infiltration represents the amount of water that percolates into the soil. Drainage is the loss of infiltrated water that travels through the soil profile and is discharged to the drainage ditches or to underlying aquifers. Runoff is water that flows overland and reaches the drainage ditches before infiltration. Evapotranspiration is water that is lost by the direct evaporation of water from the soil or through the transpiration of plants. From the water balance results provided in Tables 10a, 10b, and 10c it is clear that most rainfall on the existing site is lost via evapotranspiration and runoff. Once the project is complete, less water will leave the site through these mechanisms and more will drain through subsurface drainage.

Table 10a. Water Balance for Gauge 1
Little Troublesome Creek Mitigation Project

Hydrologic Parameter	Existing Conditions		Proposed Conditions- 4" Excavation		Proposed Conditions- 6" Excavation	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)

Hydrologic Parameter	Existing Conditions		Proposed Conditions- 4" Excavation		Proposed Conditions- 6" Excavation	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)
Precipitation	113.35	67.7%	113.35	67.7%	113.35	67.7%
Runon from Upland	54.16	32.3%	54.16	32.3%	54.16	32.3%
Precip. + Runon	167.51	100.0%	167.51	100.0%	167.51	100.0%
Infiltration	111.49	66.6%	145.77	87.0%	145.28	86.7%
Evapotranspiration	72.76	43.4%	67.35	40.2%	67.63	40.4%
Drainage	40.12	24.0%	79.62	47.5%	78.93	47.1%
Runoff	56.02	33.4%	21.69	12.9%	22.18	13.2%

Table 10b. Water Balance for Gauge 2
Little Troublesome Creek Mitigation Project

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)	Average Annual Amount (cm of water)	Average Annual Amount (% of precipitation + runon)
Precipitation	113.35	71.5%	113.35	71.5%
Runon from Upland	45.13	28.5%	45.13	28.5%
Precip. + Runon	158.48	100.0%	158.48	100.0%
Infiltration	85.84	54.2%	146.77	92.6%
Evapotranspiration	67.92	42.9%	72.88	46.0%
Drainage	18.38	11.6%	74.34	46.9%
Runoff	72.63	45.8%	11.61	7.3%

Table 10c. Water Balance for Gauge 3
Little Troublesome Creek Mitigation Project

Hydrologic Parameter	Existing Conditions		Proposed Conditions	
	Average Annual Amount	Average Annual Amount	Average Annual Amount	Average Annual Amount

	(cm of water)	(% of precipitation + runon)	(cm of water)	(% of precipitation + runon)
Precipitation	113.35	71.5%	113.35	71.5%
Runon from Upland	45.13	28.5%	45.13	28.5%
Precip. + Runon	158.48	100.0%	158.48	100.0%
Infiltration	90.09	56.8%	92.63	58.4%
Evapotranspiration	63.8	40.3%	68.38	43.1%
Drainage	27.3	17.2%	25.11	15.8%
Runoff	68.39	43.2%	65.85	41.6%

5.3 Soil Characterization

An investigation of the existing soils on the wetland restoration/enhancement/creation site was performed by Wildlands staff on December 9, 2010. This investigation supplemented the soils analysis performed by a licensed soil scientist (LSS) on March 1, 2010. Soil cores were collected at locations across the site to provide data to refine NRCS soils mapping units, establish areas suitable for wetland restoration and creation, and aid in developing a wetland grading plan. Twenty-six soil cores were taken at approximately 100 to 200-foot grid spacing across the site at varying depths. Five soil cores were taken by the licensed soil scientist in March. The cores were taken to a depth at which either hydric soil features or groundwater was encountered. Soil texture; Munsell chart hue, chroma, and value; and hydric soil characteristics were recorded for each core. The depth to hydric indicators and groundwater table was then measured at each core. Soils were also evaluated at six additional locations around the site during the wetland delineation described above. The soil core data from these six locations were added to the 26 grid-spaced cores, and the five cores taken by the LSS for a total of 37 cores in the soil core data base for the site. The most recent 32 soil boring locations and mapped soil units are shown on Figure 12. The data for each core is included in Appendix 2 along with the soil core profiles and figure from the March investigation.

5.3.1 Taxonomic Classification

Two soils are mapped within the boundaries of the wetland project area in the Natural Resources Conservation Service (NRCS) Soil Survey (NRCS, 2009). Much of the site is mapped as the Haw River (HcA) silty clay loam while the northern, eastern, and western edges of the site are mapped as Codorus (CsA) loam. Analysis of the soil core samples collected from the project site along with consideration of site topography indicated that soils classifications at 32 core locations agreed with the mapped soil units. The Haw River silty clay loam is not on the NC hydric soil list; however, it is a poorly drained, frequently flooded soil that was previously mapped as Chewacla which is listed on the NC Hydric Soil list. The Codorus series is not listed on the NC hydric soil list. Analysis of the core data indicates that the soils on the site mapped as Haw River are on the wetter end of the range of the Haw River series as many of the cores included low chroma soils and other hydric indicators.

5.3.2 Profile Description

The Haw River series is described in the NRCS official series description as a piedmont floodplain soil that is very deep, poorly drained found on zero to two percent slopes. The typical texture profile of the Haw River is a silt loam at zero to five inches, a silty clay loam from five to 52 inches, and sand from 52 to 80 inches. The Codorus series is described as very deep, moderately well drained to somewhat poorly drained soils. Codorus is found on floodplains with zero to three percent slopes. The texture profile of the Codorus series is loam from zero to eight inches, silty clay loam from eight to 18 inches, loam from 18 to 30 inches, and silt loam from 30 to 80 inches.

5.3.3 Hydraulic Conductivity

The Haw River series has a moderately low to moderately high Ksat value ranging from 0.06 to 0.2 in/hr. It is poorly drained and typically has a water table depth of zero to 12 inches. The Codorus series has a moderately high to high Ksat value ranging from 0.57 to 1.98 in/hr. It is somewhat poorly drained and generally has a water table depth of six to 24 inches.

5.4 Vegetation Community Types Descriptions and Disturbance History

The existing vegetation communities within the on-site jurisdictional wetland area are representative of a stressed Palustrine Emergent system (Cowardin, 1979). Based on historical aerial photographs, farming and crop planting has been prevalent in this area since at least 1969 (Appendix 5). Due to heavy agricultural activities and vegetation management over the past several decades, several major strata are completely absent from this area resulting in a dominant herbaceous layer with few sparse mature trees. Dominant herbaceous species within this area include swamp rose (*Rosa palustris*), Nepalese browntop, stawcolored flatsedge, soft stem rush (*Juncus effuses*), and rice cutgrass (*Leersia oryzoides*). Sparse tree species include black willow (*Salix nigra*) and sweetgum.

6.0 Reference Wetlands

A reference wetland was identified immediately adjacent to the wetland restoration/ enhancement/creation site (Figure 13). The property is a pristine Piedmont Bottomland Forest (Shafale & Weakley, 1990) protected by a U.S. Fish and Wildlife Service conservation easement. Because the preservation site is immediately adjacent to the project, it offers the best opportunity to provide reference information to use in restoring and creating wetlands on the project site because it represents the most likely example of the original condition of the project site. The preservation site is primarily bottomland hardwood forest and the natural community present on the site will be used as a basis to develop the planting plan for the restoration/enhancement/creation project.

6.1 Hydrological Characterization

A groundwater monitoring gauge was installed on July 29, 2010 on the preservation site immediately adjacent to the project to document the reference wetland hydrology. However, after further analysis during the fall when local water tables began to rise, it was determined that this particular location represented wetter than average conditions for this wetland complex. This well will be moved to a more appropriate reference location prior to construction of the wetland mitigation site. This information will be used to provide a comparison for the restored and created wetland hydrology throughout the monitoring period.

6.2 Soil Characterization

The soils on the reference site are mapped the same as those on the project site according to the NRCS soil mapping. The wetland areas of the property are predominately Haw River series soils. The edges near Little Troublesome Creek and the Haw River are mapped as Codorus series. The areas mapped as Codorus series are not likely to be jurisdictional; the areas mapped as Haw River series will be the prime reference wetland.

6.2.1 Taxonomic Classification

The dominant soil on the site is Haw River silty clay loam which is generally considered a hydric soil. As described in Section 5.3.1 above, analysis of the soil cores taken on the adjacent project site which are mapped as Haw River are on the wetter end of the range of the Haw River series and have characteristics indicative of hydric soils.

6.2.2 Profile Description

A detailed profile description of the Haw River series is described in Section 5.3.2 above.

6.3 Vegetation Community Types Descriptions and Disturbance History

Historical aerials reveal no recent disturbances to this USFWS conservation area and no disturbances were observed in the field other than a minor cut trail. The existing vegetation communities are typical of a Bottomland Hardwood Forest and include mature canopy tree species, moderate subcanopy and shrub species, as well as a dense herbaceous layer. Dominant canopy species include sweetgum, cottonwood (*Populus deltoids*), red maple , sycamore , overcup oak (*Quercus lyrata*), willow oak (*Quercus phellos*), and swamp chestnut oak (*Quercus michauxii*). Typical subcanopy and shrub species include American elm, box elder , sweetgum, and red maple. The dense herbaceous layer is comprised of soft stem rush, rice cutgrass, strawcolored flatsedge, and river oats (*Chasmanthium latifolium*).

7.0 Project Site Mitigation Plan

7.1 Overarching Goals and Applications of Mitigation Plans

The following list provides the intended goals and applications of this mitigation plan:

7.1.1 The timely, cost effective delivery of sustainable ecological uplift for the purpose of meeting compensatory mitigation requirements.

7.1.2 Link project specific goals to watershed goals as provided in planning documents.

7.1.3 Articulate how the proposed approach or levels of intervention are proportional and optimized in terms of 7.1.1.

7.1.4 Demonstrate that the factors of influence and the data streams that are part of the design effort converge (or provide explanation when they don't) to justify the proposed level of intervention (7.1.3).

7.1.5 Define project level goals and objectives.

7.1.6 Provide a pre-restoration baseline to which monitoring data can be compared for the purpose of demonstrating attainment of goals and objectives.

7.1.7 Provide impact and other information necessary to obtain regulatory permits.

7.1.8 Document whether or not the project will result in a rise in flood elevations.

7.1.9 Address how does project goals and objectives address stressors identified in watershed characterization section of the plan.

7.2 Mitigation Project Goals and Objectives

The Little Troublesome Creek Mitigation Project has been designed to meet the over-arching goals described above. A technical assessment of the Troublesome and Little Troublesome Creeks watersheds was conducted in 2004 and development of a local watershed plan (LWP) for these watersheds was completed, based on the findings and recommendations of the technical assessment. The most significant watershed stressors identified during the technical assessment were stream erosion and instability. Others included declining aquatic habitat, loss of forest, degraded riparian buffers, loss of wetlands, lack of urban stormwater detention, and water quality problems related to increased sediment and nutrient loadings. The management recommendations to address these problems were stream restoration and implementation of stormwater best management practices, or BMPs (Tetra Tech, 2004). The stream restoration project described in this Mitigation Plan (referred to as Site 3 in that report) was identified as a top priority project to achieve the management goals described in the LWP documents. The project will address the key watershed stressor by reducing stream instability and erosion in the Little Troublesome Creek watershed. This project has been designed to offset the other key watershed stressors as well. The goals for this project include:

- Decrease nutrient and urban runoff pollutant levels;
- Decrease sediment input;
- Decrease water temperature and increase dissolved oxygen levels;
- Create appropriate in-stream habitat;
- Create appropriate terrestrial habitat; and
- Decrease channel velocities.

The project objectives to meet these goals are:

- Off-site nutrient input will be absorbed on-site by filtering flood flows through restored floodplain areas and wetlands, where flood flows can disperse through native vegetation and be captured in vernal pools. Increased surface water residency time will provide contact treatment time and groundwater recharge potential.
- Sediment input from eroding stream banks will be reduced by installing bioengineering and in-stream structures while creating a stable channel form using geomorphic design principles. Sediment from off-site sources will be captured by deposition on restored floodplain areas where native vegetation will slow overland flow velocities.
- Restored riffle/step-pool sequences where distinct points of re-aeration can occur will allow for oxygen levels to be maintained in the perennial reaches. Creation of deep pool zones will lower temperature, helping to maintain dissolved oxygen concentrations. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating.
- Creating a channel form that includes riffle -pool sequences and gravel and cobble zones of macroinvertebrate habitat for fish. Introduction of large woody debris, rock structures, root wads, and native stream bank vegetation will substantially increase habitat value.

- Adjacent buffer areas will be restored by removing invasive vegetation and planting native vegetation. These areas will be allowed to receive more regular and inundating flows. Riparian wetland areas will be restored and enhanced to provide wetland habitat.
- By allowing for more overbank flooding and by increasing channel roughness, local channel velocities can be reduced. This will allow for less bank shear stress, formation of refuge zones during large storm events and zonal sorting of depositional material.

7.2.1 Designed Channel Classification and Wetland Type

The design streams and wetlands will be restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but with also strong consideration to existing watershed conditions and trajectory. The specific proposed stream and wetland types are described below.

7.2.1.1 Designed Channel Classification

The stream restoration portion of this project includes four reaches (Figure 14):

Reach 1: Irvin Creek from Turner drive to the confluence with UT2 (design length = 2,014 LF)

Reach 2: Irvin Creek from the confluence with UT2 to the confluence with Little Troublesome Creek (design length = 1,917 LF)

Reach 3: Little Troublesome Creek from the confluence with Irvin Creek to the confluence with UT3 approximately 1,000 feet downstream of the confluence with Irvin Creek (design length = 1,169 LF)

UT1: A tributary to Little Troublesome Creek (design length = 240 LF).

All stream reaches included in the design for this project will be constructed as C type streams according to the Rosgen classification system (Rosgen, 1996). Type C streams are slightly entrenched, meandering streams with well developed floodplains and gentle gradients of 2% or less. They occur within a wide range of valley types and are common within valley type VIII, which is similar to the valleys of Little Troublesome Creek and Irvin Creek.

The morphologic design parameters for the design reaches fall within the ranges specified for C streams (Rosgen, 1996). However, the specific values for the design parameters were selected based on designer experience and judgment and were verified with sediment transport analyses and assessment of morphologic data from reference reach data sets. Each of the design reaches will be reconnected with the existing floodplain (Priority 1) except along portions of the design reaches where excavation of a new floodplain at a lower level is necessary due to stream and floodplain grade transitions (Priority 2). In either case, the restored channels will have entrenchment ratios of greater than 2. The sinuosity for the restored channels will range from 1.2 to 1.3.

7.2.1.2 Designed Wetland Type

The wetland elements of this project include the following (Figure 15):

RW1: The main wetland component of this project which is located at the lower end of the Little Troublesome Creek watershed and consists of 8.7 acres of wetland restoration, 3.7 acres of wetland enhancement, and 5.6 acres of wetland creation. This wetland area will be restored to a Piedmont Bottomland Forest (Shafale and Weakley, 1990).

Vernal Pools and Pocket Wetlands: The restoration of the streams described above will include reconnecting the stream to the natural floodplain in some sections and creating a new lower floodplain for other sections. This will provide opportunities for wetlands to be created or restored which will include the creation of vernal pool features where portions of the existing channel will be filled to an elevation lower than that of the surrounding floodplain. These features will generally be designed to intercept concentrated runoff from offsite to provide water quality treatment benefits. Other pocket wetlands are likely to be created or enhanced simply by raising the existing stream beds to a degree that the floodplain will be frequently inundated. No mitigation credit will be claimed for either of these conditions. Communities planted in these zones will be appropriate for Piedmont bottomland hardwood forests.

7.2.2 Target Wetland Communities and Buffer Communities

The target communities for the restored and created wetlands (including RW1 and the vernal pools and pocket wetlands) and riparian buffer zones will be based on reference conditions. The main reference site is combination of a Piedmont bottomland forest and Piedmont bottomland swamp adjacent to RW1. This reference site is within a conservation easement held by the U.S. Fish and Wildlife service. Because most of the wetland restoration, enhancement, and creation areas as well as the riparian buffer will have hydrology similar to the Piedmont bottomland forest, that community will be the primary target, although both communities share many of the same species. The species to be planted are described in Section 5.4.2.

7.3 Stream Project and Design Justification

The existing conditions assessment of the project reaches of Irvin Creek and Little Troublesome Creek indicated that channelization of the streams and urbanization of the watersheds has resulted in incision and enlargement of the channels. The channels have down cut to a point at which local grade control will prevent further incision. Bank erosion, which is severe at many locations in these channels, is now causing lateral enlargement of the streams. Results from a BEHI assessment indicate that the bank erosion along the project reaches of Irvin and Little Troublesome Creeks contributes approximately 2,400 tons of sediment to downstream waters per year. The incision and lateral erosion have also resulted in degraded aquatic habitat, altered hydrology (related to loss of floodplain connection and lowered water table), and have contributed to water quality problems such as lower dissolved oxygen levels (due to wide channels with shallow flow). Similar conditions exist in UT1 where incision is especially severe. UT1 is a small, intermittent stream which has down cut to the incised bed level of Little Troublesome Creek.

The project stream reaches are all currently unstable. According the Simon channel evolution model (Simon, 1989), the project reaches of Irvin Creek, Little Troublesome Creek, and UT1 are at *Stage 4 – Channel Widening*. They have passed *Stage 3 – Incision;* the down-cutting appears to have been arrested by grade control or incision to local base level. Bank erosion has begun and, in fact, has progressed quite far in many locations. It appears, based on visual observation and cross-sectional measurements, that the reaches have progressed to the point where depositional processes are beginning. For Irvin Creek and UT1, this is evident by the classification of G according to the Rosgen system and related channel evolution models. According to the Rosgen channel type succession model, these streams have progressed from C or E streams which is the likely natural condition of the streams given regional physiography, to G streams and appear to be moving towards the wider, incised F type.

The next stages in many streams would likely be increased sediment deposition caused by decreased depth of flow and shear stress in the wider channels (*Stage 5* according to Simon's model), eventually creating a small C type channel (or potentially a more narrow E type eventually) with a lower floodplain and base level (*Stage 6 – Quasi-Equilibrium*). However, with limited sediment supply from the developed watersheds, especially the case for Irvin Creek, the sediment accumulation necessary to reform a stable channel at a lower elevation will take a long time.

The portions of Little Troublesome Creek and UT1 included in the project have not incised enough to be classified as G channels with entrenchment ratios lower than 1.4. However both are incised and laterally eroding. Little Troublesome Creek is also lined by dredge spoil berms which further separate the channel from the floodplain. Local base level control appears to be preventing this stream from down-cutting further, so its entrenchment ratio will likely never become low enough to warrant a G stream type classification. However, this channel may continue to widen through bank erosion. On-going lateral erosion in these streams will continue to pollute downstream waters and cover bed substrate and habitat. They may eventually reach the same end point as Irvin Creek and UT 2, i.e. erosion will cease and depositional processes will rebuild a natural channel form at the current lower base level.

The objectives described in Section 7.2 were partially developed to deal with the issues described in the paragraphs above. The key factors driving the need for this intervention are:

- Without intervention, it is likely that lateral erosion in all of the project reaches will continue for some time contributing tons of sediment to downstream waters each year.
- Restoration of aquatic habitat is needed. Rates of recovery of alluvial channels after disturbance due to urbanization are not well understood or documented and, in theory, the disturbed reaches may remain unstable indefinitely (Arnold et al., 1982).
- Treatment and storage of urban runoff is needed. The restored floodplain and created and restored wetlands will provide both increased flood storage and treatment.
- The project offers an excellent opportunity to implement a stream restoration project along with restored and created wetlands that meet the goals of the local watershed plan extremely well.

An assessment of watershed trajectory further justifies intervention. The watersheds of Irvin Creek, Little Troublesome Creek, and UT1 are essentially built out. The development in this area includes downtown Reidsville, multiple shopping centers, and a hospital, as well as multiple single family subdivisions. The development in this area was mostly complete by the 1970s and is likely completely stabilized by now. This is important to the stream project because if further development were expected it could cause another disturbance to the fluvial system and result in additional channel adjustments after the mitigation project is constructed. Further, there is reason to believe that, due to the length of time that the watersheds have been stabilized and the fact that the channels have not yet reached a new equilibrium point, the stream reaches described in this document need intervention to be stabilized and to accomplish the other objective of this project.

Table 11. Design Geomorphic Data
Little Troublesome Creek Mitigation Project

	Notat-ion	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			min	max	min	max	min	max	min	max
stream type			C4		C4		C5		C5	
drainage area	DA	sq mi	0.82		0.91		5.07		0.1	
bankfull design discharge	Q_{bkf}	cfs	90		100		370		14	
Cross-Section Features										
bankfull cross-sectional area	A_{bkf}	SF	30.0		30.8		87.0		5.1	
average bankfull velocity	v_{bkf}	fps	3.0		3.3		4.3		2.7	
width at bankfull	w_{bkf}	feet	19		19.2		32.3		7.8	
maximum depth at bankfull	d_{max}	feet	1.9	2.0	1.9	2.2	3.2	3.8	0.8	0.9
mean depth at bankfull	d_{bkf}	feet	1.6		1.6		2.7		0.7	
bankfull width to depth ratio	w_{bkf}/d_{bkf}		12.0		12.0		12.0		12.0	
depth ratio	d_{max}/d_{bkf}		1.2	1.4	1.2	1.4	1.2	1.4	1.1	1.43
low bank height			1.9		1.9		3.2		0.6	
bank height ratio	BHR		1.0		1.0		1.0		1.0	

	Notat-ion	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			min	max	min	max	min	max	min	max
floodprone area width	w_{fpa}	feet	>80		>200		>285		>100	
entrenchment ratio	ER		≥4.2		≥10.4		≥8.8		≥16.4	
Sinuosity										
valley slope	S_{valley}	feet/ foot	0.00585		0.00588		0.00572		NA*	
channel slope	$S_{channel}$	feet/ foot	0.0045		0.0049		0.0044		0.012*	
sinuosity	K		1.3		1.2		1.3		1.3*	
Riffle Features										
riffle slope	S_{riffle}	feet/ foot	0.006	0.008	0.007	0.0147	0.0066	0.0088	0.01845	0.0369
riffle slope ratio	S_{riffle}/ $S_{channel}$		1.4	3.0	1.4	3.0	1.5	2.0	1.5	3.0
Pool Features										
pool slope	S_{pool}	feet/ foot	0.0005	0.0009	0.00049	0.00098	0.00044	0.00088	0.00123	0.00246
pool slope ratio	S_{pool}/ $S_{channel}$		0.1	0.02	0.1	0.2	0.1	0.2	0.1	0.2
pool-to-pool spacing	L_{p-p}	feet	76.1	133.1	76.9	134.6	129.2	226.1	24.3	42.5
pool spacing ratio	L_{p-p}/ w_{bkf}		4.0	7.0	4.0	7.0	4.0	7.0	4.0	7.0
maximum pool depth at bankfull	d_{pool}	feet	2.8	4.0	2.9	4.0	4.8	6.7	1.2	1.6
pool depth ratio	d_{pool}/ d_{bkf}		1.8	2.5	1.8	2.5	1.8	2.5	1.7	2.3
pool width at bankfull	w_{pool}	feet	22.8	28.5	23.1	28.8	38.8	48.5	9.4	11.7
pool width ratio	w_{pool}/ w_{bkf}		1.2	1.5	1.2	1.5	1.2	1.5	1.2	1.5
Pattern Features										
belt width	w_{blt}	feet	57	152	58	154	113	258	27	62
meander width ratio	w_{blt}/ w_{bkf}		3.0	8.0	3.0	8.0	3.5	8.0	3.5	8.0
meander length	L_m	feet	152	228	154	231	258	388	62	94
meander length ratio	L_m/ w_{bkf}		8.0	12.0	8.0	12.0	8.0	12.0	8.0	12.0
radius of curvature	R_c	feet	38	57	38	58	65	97	16	23

	Notat-ion	Units	Irvin Creek Reach 1		Irvin Creek Reach 2		Little Troublesome Creek		UT1	
			min	max	min	max	min	max	min	max
radius of curvature ratio	R_c/w_{bkf}		2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0

*The valley of UT1 has been significantly altered by grading and piling of dredged material. An accurate valley slope for this reach is not available. Sinuosity was calculated as channel length over valley length

7.3.1 Sediment Transport Analysis

A sediment transport analysis was performed for the design reaches of Irvin Creek and Little Troublesome Creek in order to evaluate the stability of the proposed channel. Two separate questions should be addressed with sediment transport studies:

1) What size bed material particles will become entrained at flows at or near the bankfull discharge (competence) and
2) Does the stream have the ability to pass the sediment load supplied to it (capacity)?

The analysis performed for this project addresses both the competence and capacity questions with the information available. Stream competence can be determined through calculations performed with data commonly collected for stream restoration projects. The issue of capacity is much more difficult to analyze due to lack of reliable data on sediment supply for a given stream and, therefore, must often be analyzed qualitatively – unless initial qualitative analysis warrants further field data collection.

The existing bed material matrix in Irvin Creek and Little Troublesome Creek is comprised of both gravel and sand. Multiple pebble counts and pavement and subpavement samples throughout the project reaches show similar bimodal distributions of particle size. In gravel bed streams, including bimodal systems, bedload is the dominant component of sediment transport (Wilcock, et al., 2009). Therefore bedload was the focus of this sediment transport analysis.

7.3.1.1 Methodology

The competence question was addressed by analyzing shear stresses at the design bankfull flows for each design reach and comparing that to the shear stress needed to move the bed material that will line the proposed channels (similar to existing bed material). The initial competence analysis was performed using standard equations for calculating critical dimensionless shear stress needed to move the bed material and the depth and slope combination needed to produce that stress. The equations are:

(1) $\tau_{ci} = 0.0834(d_{50}/ds_{50})^{-0.872}$
(2) $\tau_{ci} = ds/(\gamma s * Di)$
(3) $d_{bkf} = (\tau_{ci} * \gamma s * Di)/S$

where τ_{ci} is critical dimensionless shear stress, d_{50} is median diameter of pavement material, ds_{50} is median diameter of subpavement material, γs is specific weight of

sediment, Di is the largest diameter of subpavement material, d_{bkf} is mean bankfull depth of channel, and S is the water surface slope at bankfull stage. This analysis is only appropriate for gravel bed streams and therefore was only performed for Reaches 1 and 2 of Irvin Creek. In sand bed channels such as Little Troublesome Creek and UT1, the entire bed becomes mobile during bankfull events and other techniques must be used to analyze stability.

An additional analysis was performed with a HEC-RAS model of the proposed condition. The model was used to analyze all of the project streams, including the sand bed channels. As mentioned above, the Shields diagram methodology is not appropriate to analyze channels with bed material predominately comprised by sand – which is the case for Little Troublesome Creek and UT1. Little Troublesome Creek is classified as a sand bed channel but has a significant gravel component as well. The bed of UT 1 is almost entirely comprised of sand. The allowable velocity method is suggested by the Natural Resources Conservation Service (NRCS) National Engineering Handbook on stream restoration for analyzing stability in sand bed channels (NRCS, 2007). The allowable velocities for fine sand, coarse sand, and fine gravel according to that document are 2 ft/s, 4 ft/s, and 6 ft/s respectively. Therefore velocities were analyzed for Little Troublesome Creek and UT1 and shear stresses were analyzed for Irvin Creek in the HEC-RAS analysis described below.

The capacity question was addressed by performing a watershed assessment including an assessment of the existing reaches to determine the significance of the sediment supply on the design. In this case, the highly developed condition of the project reach watersheds indicated that sediment supply would be minimal and not likely to change as described below.

7.3.1.2 Calculations

The results of the critical dimensionless shear stress analysis were compared to the Irvin Creek design in order to predict whether or not the channel will move the bed material at design bankfull flow. A summary of the results of this analysis are included in Table 12. Table 12 also shows the critical shear stress in lbs/ft^2 required to move the largest particle from the subpavement samples derived from the modified Shield Diagram developed by Wildland Hydrology based on the original Shield's curve (ASCE, 1975). Examination of the results in Table 12 shows that all of the Irvin Creek reaches will be capable of mobilizing the largest subpavement particles at the design bankfull flows.

Table 12. Summary of Dimensionless Critical Shear Stress Calculations
Little Troublesome Creek Mitigation Project

	Irvin Creek -Reach 1	Irvin Creek-Reach 2	Little Troublesome Creek*	UT1
Calculated $D_{critical}$ (ft)	1.56	1.06	0.53	N/A
Design riffle mean depth (ft)	1.6	1.6	3.2 - 3.8	N/A
Calculated $S_{critical}$ (ft/ft)	0.0044	0.0033	0.0009	N/A

	Irvin Creek -Reach 1	Irvin Creek-Reach 2	Little Troublesome Creek*	UT1
Design channel slope (ft/ft)	0.0045	0.0050	0.0044	0.0123
Critical shear stress to move largest subpavement particle (lbs/ft2)**	0.18	0.17	0.15	N/A
Bankfull boundary shear stress (lbs/ft^2)	0.38	0.43	N/A	N/A

[1]*The critical shear stress analysis was not performed on the sand bed channels.
**From modified Shield's Diagram (Figure 16)

The HEC-RAS model of the proposed condition was developed to analyze shear stresses throughout Irvin Creek. Shear stresses were analyzed at locations every 100 feet throughout the entire length of the creek. Table 13 shows summary statistics of the results of the shear stress modeling for riffles and pools for both reaches of Irvin Creek. The summary statistics shown in Table 13 can be compared with the critical shear stresses obtained from the modified Shields Diagram (Table 12) to provide an estimate of stress on the channel bed and if deposition or scour is predicted. As expected, the shear stresses summarized in Table 13 are greater in riffles than pools. In most cases there is not enough shear stress in the pools to move the largest subpavement particle. However, the riffles appear to have enough shear stress to move the largest subpavement particle in every case. It appears that in some cases, the potential for degradation exists. As discussed below, measures will be taken to prevent channel degradation.

Table 13. Summary of Shear Stress in Design Reaches by Bed Feature Type
Little Troublesome Creek Mitigation Project - Irvin Creek

Shear Stress Statistic (lb/ft^2)	Riffle	Pool
Minimum	0.26	0.07
Maximum	1.08	0.34
Average	0.56	0.15

The HEC-RAS model of the proposed conditions was also used to analyze velocities throughout the Little Troublesome Creek and UT1 design reaches. The results (Table 14) can be compared to the permissible velocities listed above for the bed material of Little Troublesome (fine gravel and coarse sand) and UT1 (fine sand) to assess the potential for bed degradation. While the velocities are generally within the allowable range, the maximum values indicate that some locations will have velocities that somewhat exceed the allowable values. As discussed below, measures will be taken to prevent channel degradation.

Table 14. Summary of Channel Velocities in Design Reaches of Little Troublesome Creek and UT1
Little Troublesome Creek Mitigation Project

Velocity Statistic (ft/s)	Little Troublesome Creek	UT1
Minimum	2.18	0.10
Maximum	5.58	2.90
Average	3.61	1.01
Allowable Velocity	4 to 6 ft/s	2 ft/s

As mentioned above, the capacity of the design reaches to move the sediment load supplied from their respective watersheds must be analyzed qualitatively because no accurate data on sediment supply are available. A review of the land use within the watersheds for each of the design reaches was performed through GIS analysis and windshield surveys. The results of these assessments indicate that the watersheds were developed decades ago and are essentially built-out. Due to the developed nature of the watershed and the fact that urban watersheds tend to stabilize over time, the design reaches are not expected to have a large sediment supply coming from the watershed. Another important consideration when assessing sediment load from a watershed is the potential for future changes in load. Further development within these watersheds will be limited and thus no change in bedload supply is expected to occur. Finally, bed deposition observed along the existing reaches is mostly sandy material, a significant portion of which has come from erosion of upstream channel banks. Much of this supply will be eliminated as a result of this project.

Due to these considerations, the bedload supply of the design reaches has been considered small and the channels have been designed as threshold channels. A threshold channel is a channel that will remain stabile without depositing or evacuating sediment over time. With a low sediment load, grade control and bank stabilization and

reinforcement will prevent vertical and lateral movement of the channel. Adequate shear stresses in the proposed design condition will result in improved transport of the existing sediment load and will prevent aggradation of the bed over time. This is a common design approach for urban streams where channel adjustments over time are not desirable due to constraints such as adjacent properties and existing infrastructure.

7.3.1.3 Discussion

The shear stress values for the riffle features in some portions of the Irvin Creek design reach indicate excess shear stress but are not uncommonly high and a couple of qualifying statements are in order. First, the revised Shields diagram analysis does not directly predict scour but, rather, entrainment of particles. It provides information that may be used to estimate if and where scour might occur. Secondly, the Shields diagram was developed for gravel bed streams that have a consistent bed material particle size (i.e. not bimodal systems with large quantities of sand). Research has shown that bed material that is bimodal with large proportions of both gravel and sand (such as that of Irvin Creek) is more difficult to move than bed material that is uniform in size (Wilcock, et al., 2009). Therefore the revised Shields diagram analysis likely under-predicts the critical shear stress required to mobilize the bed within the design reaches. However, measures will be taken to prevent significant scour at key locations in the channel, especially riffles. Grade control structures including constructed riffles, reinforced constructed riffles, log and boulder sills, cross vanes, and others will be installed during construction at locations were bed scour potential is significant. Natural material revetments such as root wads and brush toe will be used along with bioengineering to prevent bank erosion. All in-stream structures and revetments are shown on the design plans. The grade control structures have been designed to withstand much greater shear stresses than those predicted through modeling for Irvin creek. In addition, the channel banks will be protected with revetments and erosion control matting to protect the banks until vegetation becomes established.

Similarly, some potential for degradation is predicted by the allowable velocity analysis for Little Troublesome Creek and UT1. Again, stout grade control structures capable of withstanding significantly higher velocities and shear stress than the model results indicate will occur in the channel have been designed to protect vulnerable locations.

7.3.2 HEC-RAS Analysis

7.3.2.1 No-rise, LOMR, CLOMR

The flood study for the Little Troublesome Creek project is comprised of two parts: the stream portion and wetland portion of the site. The stream portion of the site includes channel and floodplain grading of approximately 5,000 linear feet of Little Troublesome Creek and its unnamed tributary (mapped as Tributary A of Little Troublesome Creek and locally referred to as Irvin Creek). This area is mapped as a FEMA Zone AE floodplain on FIRM panels 8903 and 8904 (Figure 7). Irvin Creek and the upper portion of Little Troublesome Creek were performed as a detailed study including 100-year base flood elevations and mapped floodway.

The wetland portion of the site includes restoration of approximately 17.5 acres of riparian wetlands located within the Little Troublesome Creek floodplain near its confluence with the Haw River. This area is also mapped as a FEMA Zone AE floodplain on FIRM panels 8911, 9812, 8921 and 9822 (Figure 7). The lower portion of Little Troublesome Creek was performed as a limited detailed study. Base flood elevations have been defined, but no floodway is mapped on the FIRM panel. Non-encroachment widths are published in the Rockingham County Community 370350 Flood Insurance Study dated July 3, 2007.

A Rosgen Priority 1 restoration approach is proposed for the stream work performed on Little Troublesome and Irvin Creeks (Rosgen, 1997). The channel will tie into the existing adjacent floodplain elevation which hydraulic modeling indicates will result in an increase in the 100-year base flood and floodway elevations. The effective hydraulic models have been obtained from the NC Floodplain Mapping Program. Wildlands has modeled existing and proposed hydraulic conditions on the stream site for the 100-year flood event along the upper portion of Little Troublesome Creek as well as Irvin Creek. A Conditional Letter of Map Revision (CLOMR) has been prepared for submittal to the City of Reidsville, the NC Floodplain Mapping Program, and FEMA for approval prior to construction to document the increase in base flood and floodway elevations. Following construction completion, an as-built survey and Letter of Map Revision (LOMR) will be finalized and submitted to the City of Reidsville local floodplain administrator, the NC Floodplain Mapping Program, and FEMA.

The wetland portion of the site will require only minor floodplain grading to create wetland features on site. After thorough review of the existing stream data and proposed design plans, a hydrologic analysis is not necessary for minor floodplain work proposed for this project. The proposed plans and wetland evaluation have been addressed in a technical memo and approved by Rockingham County.

The EEP Floodplain Requirements Checklists are included in Appendix 6 and have been submitted to the Rockingham County and City of Reidsville floodplain administrators.

7.3.2.2 Hydrologic Trespass

The project will be designed so that any increase in flooding will be contained on the project site and will not extend upstream to adjacent parcels, so hydrologic trespass will not be a concern. The proposed restoration has been designed to transition back to the existing boundary conditions in a gradual manner.

7.4 Site Construction

7.4.1 Site Grading, Structure Installation and Other Project Related Construction

The majority of the stream restoration elements of the project will be constructed as Priority 1 restoration in which the stream bed is raised so that the bankfull elevation will coincide with the existing floodplain. Due to the degree of incision, portions of the stream restoration will be constructed as Priority 2 restoration or restoration where a new floodplain bench is excavated at an elevation below the existing floodplain. The Priority

2 sections of the design include the first section of the Irvin Creek portion of the project (approximately 900 feet), the lower 375 feet of Irvin Creek, and all of the UT1 restoration. Existing floodplain berms will be removed from the Little Troublesome Creek portion of the project to provide better floodplain access to that stream; however, that portion of the project is categorized as Priority 1. While some trees will be removed during construction and used for in-stream habitat and grade control, minimal mature canopy removal will occur. Trees to be protected will be marked prior to construction.

The stream reconstruction will result in an appropriately-sized channel that will meander across the floodplain. The cross-sectional dimensions of the design channels will be constructed to flood the adjacent floodplain, wetlands, and constructed vernal pools frequently. The reconstructed channel banks will be built with stable side slopes, armored with native materials, matted, and planted for long-term stability. The sinuous planform of the channel will be built to mimic a natural piedmont stream. Portions of the new channel will be less sinuous due to adjacent constraints but these irregularities will add a desirable variation to the planform.

The bedform of the reconstructed channel will vary between pools and riffles. Generally the pools will occur in the outside of the meander bends and the riffles in the straight sections of channel between meanders. Riffle-pool sequences such as those that will be built in the new channels are common for piedmont streams and provide energy dissipation and aquatic habitat. The straighter portions of the channel will also have irregularly-spaced pools scoured by hydraulics created by in-stream structures.

The floodplain will become wetter as a result of the project. Existing wetlands will be better hydrated and it is likely that additional wetlands will be created as a byproduct of raising the channel bed. In addition, vernal pools will be constructed at some locations along the existing channel alignment. These features will be depressions in the floodplain that will provide additional storage for flood waters and additional wetland acreage. The will be constructed so that they remain inundated after water on the majority of the floodplain has receded. Because the project area is currently forested, construction will be done in a way to minimize removal of any large, mature trees.

Grade control is an important element of the design and many riffles will be constructed with grade control features. These include native gravel/cobble material riffles harvested from the existing channel, native material riffles reinforced with larger quarry stone, boulder and log sills, and cross vanes. Log vanes, log and rock j-hook vanes, and constructed riffles with cross vanes will be among other in-stream structures constructed along the stream project. These structures will provide additional grade control and will deflect flows away from vulnerable banks and create habitat diversity. The channel banks will also be armored with native materials from the site including root wads and brush toe features. These structures and revetments are shown on the attached 60 percent design plans. A mix of log and rock structures will be used on this site due to the occurrence of woody debris and bedrock and large cobble features found in the existing channels and reference reaches.

The wetland restoration, enhancement, and creation areas for which mitigation credit will be generated are several miles downstream of the stream restoration site near the confluence of Little Troublesome Creek and the Haw River. Most of the site has been used for planting corn, soy beans, and wheat in rotation for several decades. The site is located between a relatively steep upland area to the west and Little Troublesome Creek to the east. The site is slightly lower along the center for much of the length of the project and the northern portion of this lower area is jurisdictional wetland. The lower elevation zone becomes much wider towards the southern end of the property. The southern portion of the site is drained by a shallow ditch that runs generally east to west across the site and discharges to another ditch off the south end of the property.

The plan for the wetland site is to restore, enhance, and create wetland functions by grading portions of the site to improve or create wetland hydrology and planting the site with native wetland vegetation. The preexisting wetland hydrology of the lower elevation portions of the site will be restored by filling the ditch to slow drainage from the site. The upland areas around the perimeter of the site will be graded to a lower elevation so that wetland hydrology will become established. In these areas, the ground surface will be lowered by approximately 4 inches in the restoration zone and up to 24 inches in the creation zone, depending on the existing elevation (see Figure 18). In addition to these activities, a berm that currently runs along Little Troublesome Creek on the eastern edge of the site will be notched to allow more frequent flooding of the site during storm flow events in the stream. These activities will result in 8.7 acres of wetland restoration, 3.7 acres of wetland enhancement, and 5.6 acres of wetland creation. The entire site will be protected by a permanent conservation easement.

7.4.2 Natural Plant Community Restoration

7.4.2.1 Narrative of Plant Community Restoration

As a final stage of construction, riparian stream buffers and wetland mitigation zones 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 the floodplain, for a total of 33.7 acres of planting. 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 quick stabilization of constructed stream banks, benches, and side slopes. These species will also provide early habitat value through rapid growth of ground cover on the tops of banks and floodplain areas. Proposed herbaceous species are listed in Table 15.

Table 15. Permanent Herbaceous Seed Mixture
Little Troublesome Creek Mitigation 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

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 Table 16.

Table 16. Riparian Woody Vegetation
Little Troublesome Creek Mitigation 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
Acer rubrum	Red maple
Corylus americana	Hazelnut
Symphoricarpos orbiculatus	Coralberry

**will not exceed 5% of live stakes*

7.4.2.2 Narrative of Invasive Species Management

During the on-site field investigation, occurrences of invasive species were identified throughout the project reaches. The abundance of these species differed across various habitats within the project area. Within the more heavily forested floodplain areas along Irvin Creek and Little Troublesome Creek, Chinese privet (*Ligustrum sinense*), multiflora rose, and Japanese honeysuckle were observed along the top of bank and floodplain zones. Chinese privet is a large evergreen shrub that aggressively encroaches and out-competes native vegetation. Multiflora rose is a medium-sized, deciduous, thorny shrub that forms dense thickets that can choke out native understory species. Japanese honeysuckle is a moderately invasive, perennial trailing or twining vine found in forest margins, rights-of-way, and disturbed areas. Mechanical extraction of these species 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.

The on-site and adjacent gas and sewer utility rights-of-way are dominated by heavily maintained herbaceous species including Nepalese browntop and lespedeza (*Lespedeza cuneata*). Nepalese browntop is an aggressive, low-growing grass that can dominate shaded, disturbed floodplains. Lespedeza is an aggressive perennial, drought-resistant species able to invade a variety of habitats including fields, meadows, marshes, open woodlands, and roadsides. Fruiting season for this species generally occurs from July through March. Although mechanical extraction of these species will be performed along with stream restoration activities, follow up treatment and long term management with herbicides will be required in order to prevent the spread of these species into newly restored areas. A late season herbicide application should be performed before these species set seed. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.

7.4.3 Mitigation Credit Summary

The stream restoration activities described above will result in 5,340 linear feet of stream restoration. Certain sections of the 5,340 LF of proposed stream restoration do not have the mandatory 50-foot buffer on both sides of the stream; therefore these sections are not being claimed for mitigation credit at this time. There will be other sections of stream that have substantially greater buffer than the minimum requirement of 50 feet and may generate additional mitigation credits. At a mitigation ratio of 1:1, the restoration activities will generate 4,900 stream mitigation units (SMUs).

The proposed wetland mitigation project includes restoration, enhancement, and creation of wetlands. The proposed mitigation ratios are 1:1 for restoration, 1.3:1 for enhancement, and 3:1 for creation. These are typical ratios for these types of mitigation activities except that the proposed enhancement ratio is somewhat higher than typical. The higher enhancement ratio was agreed to with Todd Tugwell with the USACE during a March 9, 2011 meeting for the following reasons: The higher ratio is warranted because of the low quality of the existing wetland enhancement zone. Currently the

enhancement zone, like the restoration and creation zones, is being used for farming. The hydrology of the site has been altered by a drainage ditch and a berm along Little Troublesome Creek. There is no vegetation on the site except for some areas of grasses and cultivated crops. Enhancement activities performed on the site will include improving the hydrology of the enhancement zone (as well as the creation and restoration zones) and restoring the native vegetation. Therefore the functional uplift of the enhancement portion of the project will be nearly the same as that of the restoration zone and, thus, a high ratio for enhancement is appropriate. The wetland mitigation work will result in a total of 13.4 WMUs as shown in Table 17. The wetland mitigation zones are shown in Figure 15.

Table 17. Wetland Mitigation Summary
Little Troublesome Creek Mitigation Project

Type of Mitigation	Acres	Ratio	WMUs
Restoration	8.7	1:1	8.7
Creation	5.6	3:1	1.9
Enhancement	3.7	1.3:1	2.8
Total Wetland Mitigation Units	18.0	**---**	13.4

8.0 Performance Criteria

The stream and wetland restoration performance criteria for the project site will follow approved performance criteria presented in the NCEEP Mitigation Plan Template (version 1.0, 11/20/2009) and the Stream Mitigation Guidelines issued in April 2003 by the USACE and NCDWQ. Annual monitoring and quarterly site visits will occur to assess the condition of the finished project. The stream restoration sections of the project will be assigned specific performance criteria components for stream morphology, hydrology, and vegetation. The wetland restoration, enhancement, and creation sections will be assigned specific performance criteria for hydrology and vegetation. An outline of the performance criteria components follows.

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 criteria for the stream restoration also include substrate analysis and the frequency of bankfull events. The 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 restoration reaches should show that the bedform features are remaining stable. Although the project reaches are naturally gravel and small coble bed channels, the bedload currently includes a large percentage of finer channel material. We anticipate this fine material to create transient bar features that will migrate with each large flow event throughout the project reaches. The riffles should remain steeper and shallower than the pools, while the pools should remain deeper with flat water surface slopes. Due to the fines in the bedload, some filling of the pools will occur over time. The relative percentage of riffles and pools should not change significantly from the design parameters. The longitudinal profile should show that the bank height ratio remains very near to 1.0 for nearly all of the restoration reach.

8.1.3 Photo Documentation

Lateral reference photos should show a stable cross-section with no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of developing bars within the channel or vertical incision. 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. .

8.1.4 Substrate

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

8.1.5 Bankfull Events

Two bankfull flow events must be documented on the restoration and enhancement reaches within the five-year monitoring period. The two bankfull events must occur in separate years.

8.2 Wetlands

The final performance criteria for wetland hydrology will be a free groundwater surface within 12 inches of the ground surface for 7 percent of the growing season which is measured on consecutive days under typical precipitation conditions. This success criteria was determined through model simulations of post restoration conditions and comparison to an immediately adjacent existing wetland system. If a particular well does not meet these criteria for a given monitoring year, rainfall patterns will be analyzed and the hydrograph will be compared to that of the reference well to assess whether atypical weather conditions occurred during the monitoring period.

8.3 Vegetation

The final vegetative success criteria will be the survival of 260, five-year-old, planted trees 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. The extent of invasive species coverage will also be monitored and controlled as necessary.

9.0 Preliminary Monitoring

Using the NCEEP Baseline Monitoring Plan Template (version 1.0, 11/19/2009), a baseline monitoring document and as-built record drawings of the project will be developed within 60 days of the planting completion and monitoring installation on the restored site. Monitoring reports will be prepared in the fall of each year of monitoring and submitted to NCEEP. These reports will be based on the NCEEP Monitoring Report Template (version 1.2.1, 12/01/2009). The monitoring period will extend five years beyond completion of construction or until performance criteria have been met. The project's activity and reporting history is included in Table 18.

Table 18. Project Activity and Reporting History
Little Troublesome Creek Mitigation Project

Activity or Report	Completion or Delivery
Mitigation Plan Report	June 2011
Final Design-Construction Plans	July 2011
Permanent Seed Mix Applied	March 2012
Bare Root Plantings	March 2012
Mitigation Plan / As-Built Report	May 2012
Year 1 Monitoring Report	December 2012
Year 2 Monitoring Report	December 2013
Year 3 Monitoring Report	December 2014
Year 4 Monitoring Report	December 2015
Year 5 Monitoring Report	December 2016

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 dimension, two permanent cross-sections will be installed per 1,000 linear feet of stream restoration work, with riffle and pool sections in proportion to EEP guidance. Each cross-section will be permanently marked with pins to establish its location. An annual cross-section survey 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 restoration reaches of the project each year of the monitoring period. For reaches greater than 3,000 feet in length, the profile will be conducted for at least 30% of the restoration length of the channel, per USACE and NCDWQ Stream Mitigation Guidance. For reaches less than 3,000 feet in length, the profile will be completed for the entire reach length. Measurements 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

Photographs will be taken once a year to visually document stability for five years following construction. Permanent markers will be established so that the same locations and view directions on the site are monitored each year. Photos will be used to monitor restoration and enhancement stream reaches as well as vegetation plots.

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 persistent 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 representative grade control structures along the restored stream. The photographer will make every effort to consistently maintain the same area in each photo over time.

9.1.4 Substrate

A reach-wide pebble count will be performed in each restoration reach each year for classification purposes. A pebble count will be performed at each surveyed riffle to characterize the pavement. Also, a subpavement sample will be taken at each surveyed riffle to characterize the subpavement particle size distribution.

9.1.5 Bankfull Events

Bankfull events will be documented using a crest gauge and photographs. The crest gauge will be installed on the floodplain within 10 feet of the restored channel at a central site location. The gauge will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition.

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 Wetlands

Groundwater monitoring gauges will be established throughout the wetland restoration, enhancement, and creation areas. Generally, the gauges will be installed at appropriate locations so that the data collected will provide an indication of groundwater levels throughout the wetland project area.

9.3 Vegetation

Monitoring will begin 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 between July and November until the final success criteria are achieved. The extent of invasive species coverage will also be monitored and controlled as necessary.

Vegetation-monitoring quadrants will be installed across the restoration site to measure the survival of the planted trees. The number of monitoring quadrants required will based on the NCEEP monitoring guidance documents (version 1.2, 11/16/06). The size of individual quadrants will be 100 square meters for woody tree species and shrubs and 1 square meter for herbaceous vegetation. Vegetation monitoring will occur in the fall. Individual quadrant data will be provided and will include diameter, height, density, and coverage quantities. Relative values will be calculated and importance values will be determined. 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.

10.0 Site Protection and Adaptive Management Strategy

The Little Troublesome Creek project is located within two tracts of land in Rockingham County, NC. One parcel is owned by Jerry D. Apple and the second parcel is owned by Wildlands Little Troublesome Creek Holdings, LLC. Conservation easements held by the State of North Carolina have been recorded with the Rockingham County Register of Deeds on the Little Troublesome Creek project study area within the two tracts (Apple - Deed Book 1412 Page Number 1685, Wildlands Holding LLC - Deed Book 1411, Page Number 2458). The conservation easements allow for the restoration work to occur and protect the project area in perpetuity. Signage will be placed along the easement boundary per NCEEP guidance that was current at the time the proposal was submitted.

Adaptive measures will be developed or appropriate remedial actions will be implemented in the event that the site or a specific component of the site fails to achieve the success criteria outlined in this report. Any actions implemented will be designed to achieve the success criteria specified previously, and will include a work schedule and updated monitoring criteria.

11.0 References

Annable, W.K., et al., 2010a. Estimating channel forming flow in urban watercourses. River Research and Applications 1-16. DOI: 10.002/rra.1391

Annable, W.K., et al., 2010b. Quasi-equilibrium conditions of urban gravel-bed stream channels in southern Ontario, Canada. River Research and Applications 1-23. DOI: 10.1002/rra.1457

Arnold, C.L., P.J. Boison, and P.C. Patton, 1982. Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization. Journal of Geology 90:155-166.

Baker Engineering NY, Inc., 2007. Big Cedar Creek Restoration Plan. Charlotte, NC.

Doll, B.A., et al. 2002. Analysis of Hydraulic Geometry Relationships for Urban Streams throughout the Piedmont of North Carolina. Journal of the American Water Resources Association. Vol. 27, No. 3, p 641-651.

EPA, 1997. Urbanization and Streams: Studies of Hydrologic Impacts. Office of Water, Washington, D.C., 841-R-97-009.

Harman, W.H., et al. 1999. Bankfull Hydraulic Geometry Relationships for North Carolina Streams. AWRA Wildland Hydrology Symposium Proceedings. Edited By: D.S. Olsen and J.P. Potyondy. AWRA Summer Symposium. Bozeman, MT.

KCI Technologies, 2007. Little Troublesome Creek Restoration Plan. Raleigh, NC.

Natural Resources Conservation Service (NRCS), 2009. Web Soil Survey. Retrieved from http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

North Carolina Geological Survey (NCGS), 2009. Mineral Resources. http://www.geology.enr.state.nc.us/Mineral%20resources/mineralresources.html

North Carolina Natural Heritage Program (NHP), 2009. Natural Heritage Element Occurrence Database, Rockingham County, NC. http://149.168.1.196/nhp/county.html

North Carolina State University (NCSU), 2010. DrainMod Related Publications. Accessed May 10, 2010, at: http://www.bae.ncsu.edu/soil_water/drainmod/drainmod_papers.html#wetland

Robbins, J.C., and Pope, B.F., 1996, Estimation of flood frequency characteristics of small urban streams in North Carolina: U.S. Geological Survey Water-Resources Investigations Report 96–4084, 21 p.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. Center For Computational Hydroscience and Bioengineering, Oxford Campus, University of Mississippi, Pages 12-22.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, 3rd approx. North Carolina Natural Heritage Program, Raleigh, North Carolina.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14(1):11-26.

Simon, A., Rinaldi, M. 2006. Disturbance, stream incision, and channel evolution: The roles of excess transport capacity and boundary materials in controlling channel response. Geomorphology 79: 361-383.

Skaggs, R. W. 1980. DrainMod Reference Report: Methods for design and evaluation of drainage-water management systems for soils with high water tables. U. S. Department of Agriculture, Soil Conservation Service. 329 pp.

Simon, A. 2006. Flow energy, time, and evolution of dynamic fluvial systems: implications for stabilization and restoration of unstable systems. In: Proceedings of the 2006 World Environmental and Water Resources Congress (R. Graham, Ed.), May 21-25, 2006, Omaha, Nebraska. CDROM.

Weaver, J.C., et al. 2009. Magnitude and Frequency of Rural Floods in the Southeastern United States, through 2006: Volume 2, North Carolina. U.S. Geological Survey Scientific Investigations Report 2009-5158, 111 p.

Wilcock, P., et al., 2009. Sediment Transport Primer: Estimating Bed-Material Transport in Gravel Bed Rivers. Gen. Tech. Rep. RMRS-GTR-226. Fort Collins, Co: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 78 p.

Tetra Tech, Inc., 2004. Upper Cape Fear Basin Targeting of Management Report. Durham, NC

United States Department of Agriculture (USDA), 2009. Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) database for Rockingham County, North Carolina. http://SoilDataMart.nrcs.usda.gov

United States Fish and Wildlife Service (USFWS), 2008. Endangered Species, Threatened Species, Federal Species of Concern and Candidate Species, Rockingham County, NC. http://www.fws.gov/nc-es/es/countyfr.html

URS Corporation, 2007. Brushy Fork Stream Restoration Plan. Morrisville, NC

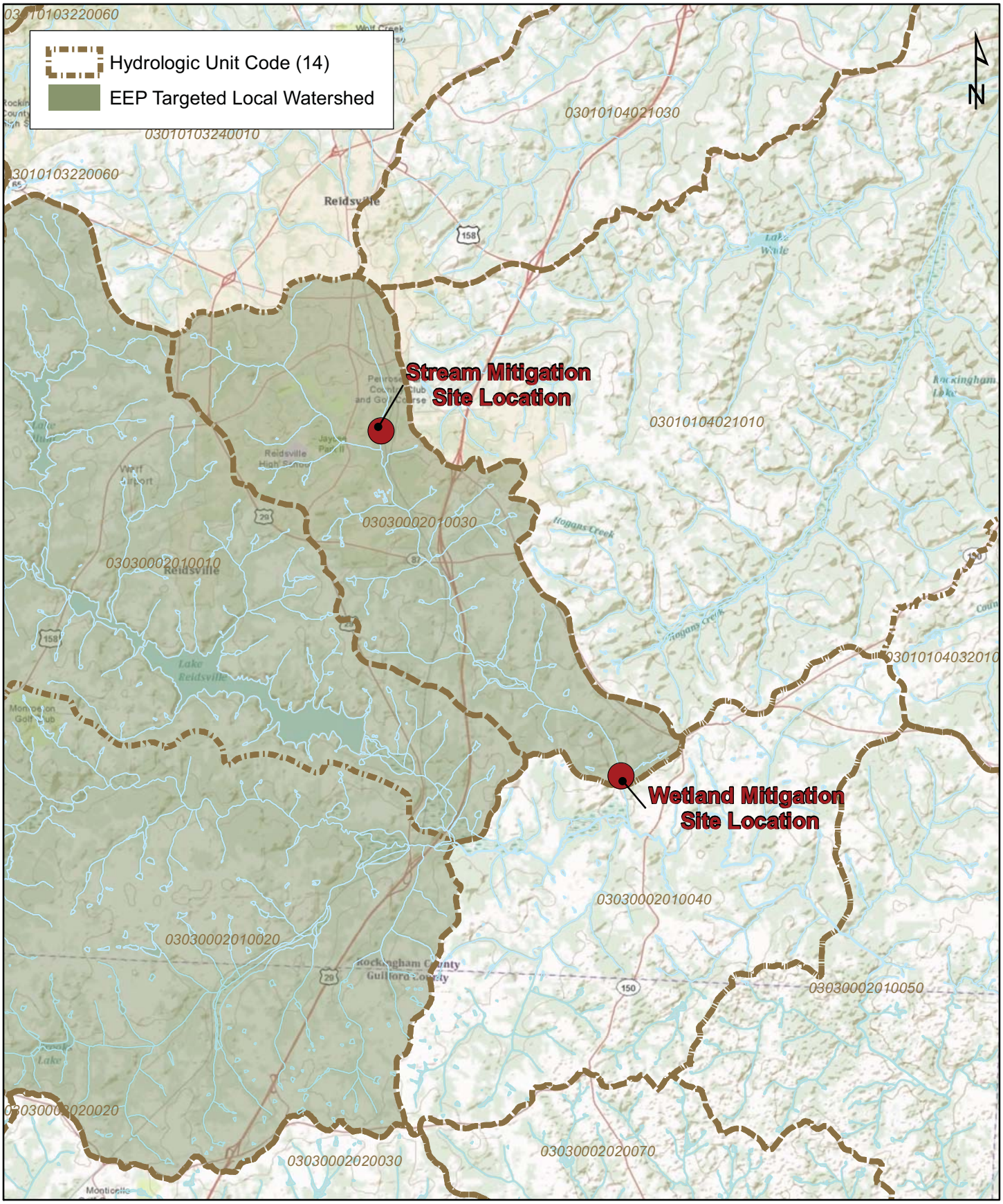

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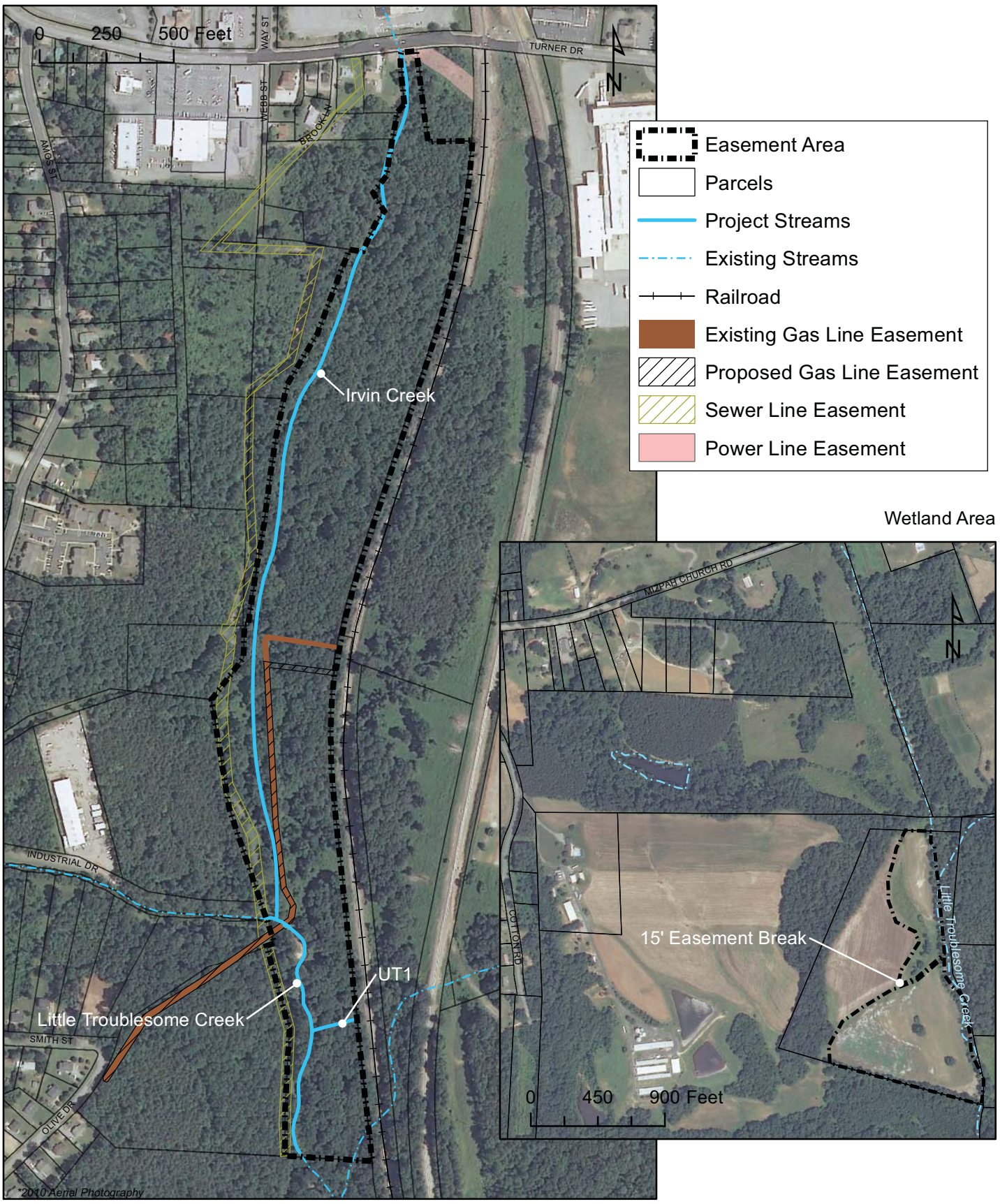
Figure 1. Vicinity Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

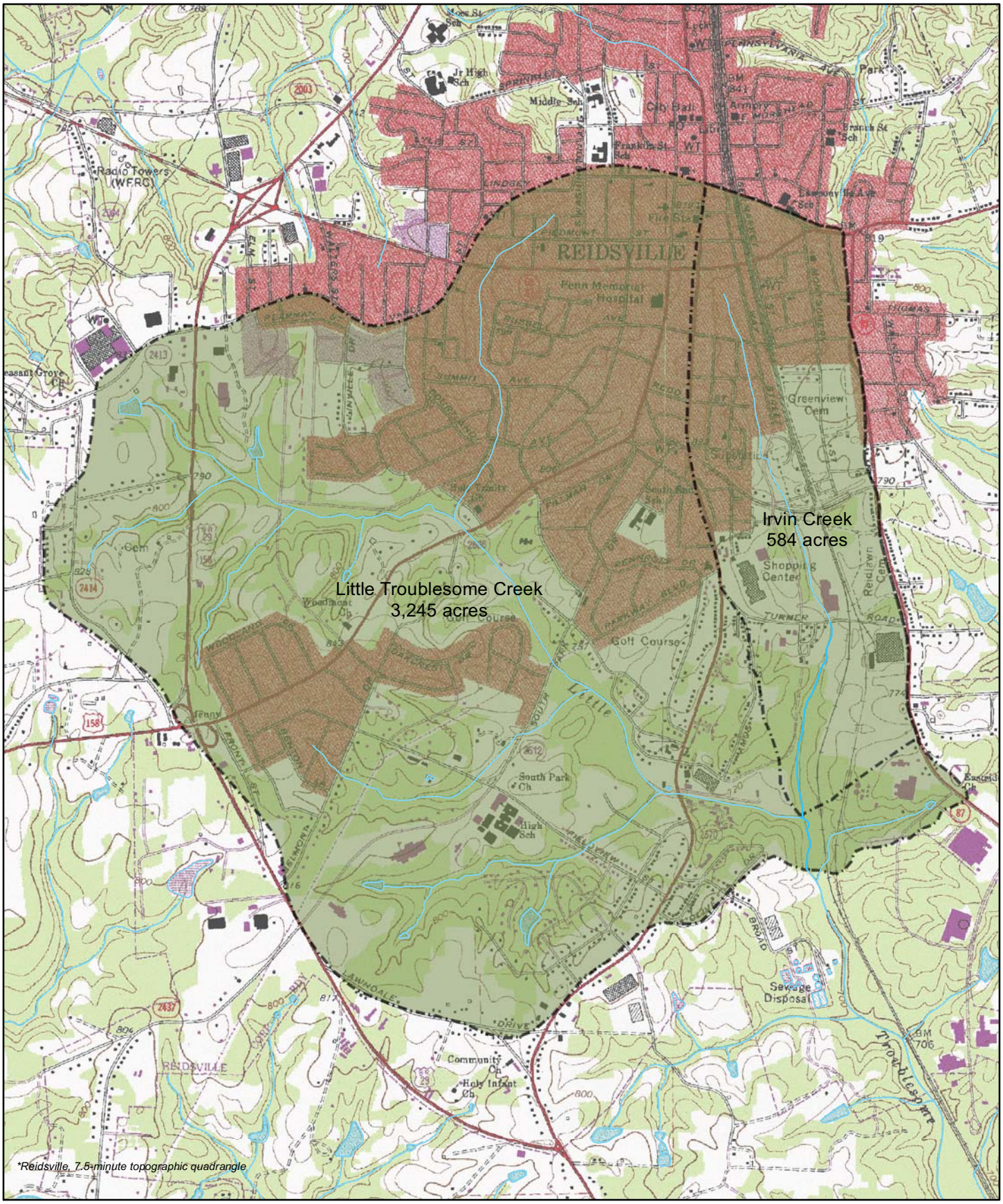
Rockingham County, NC



WILDLANDS ENGINEERING

Figure 2. Site Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

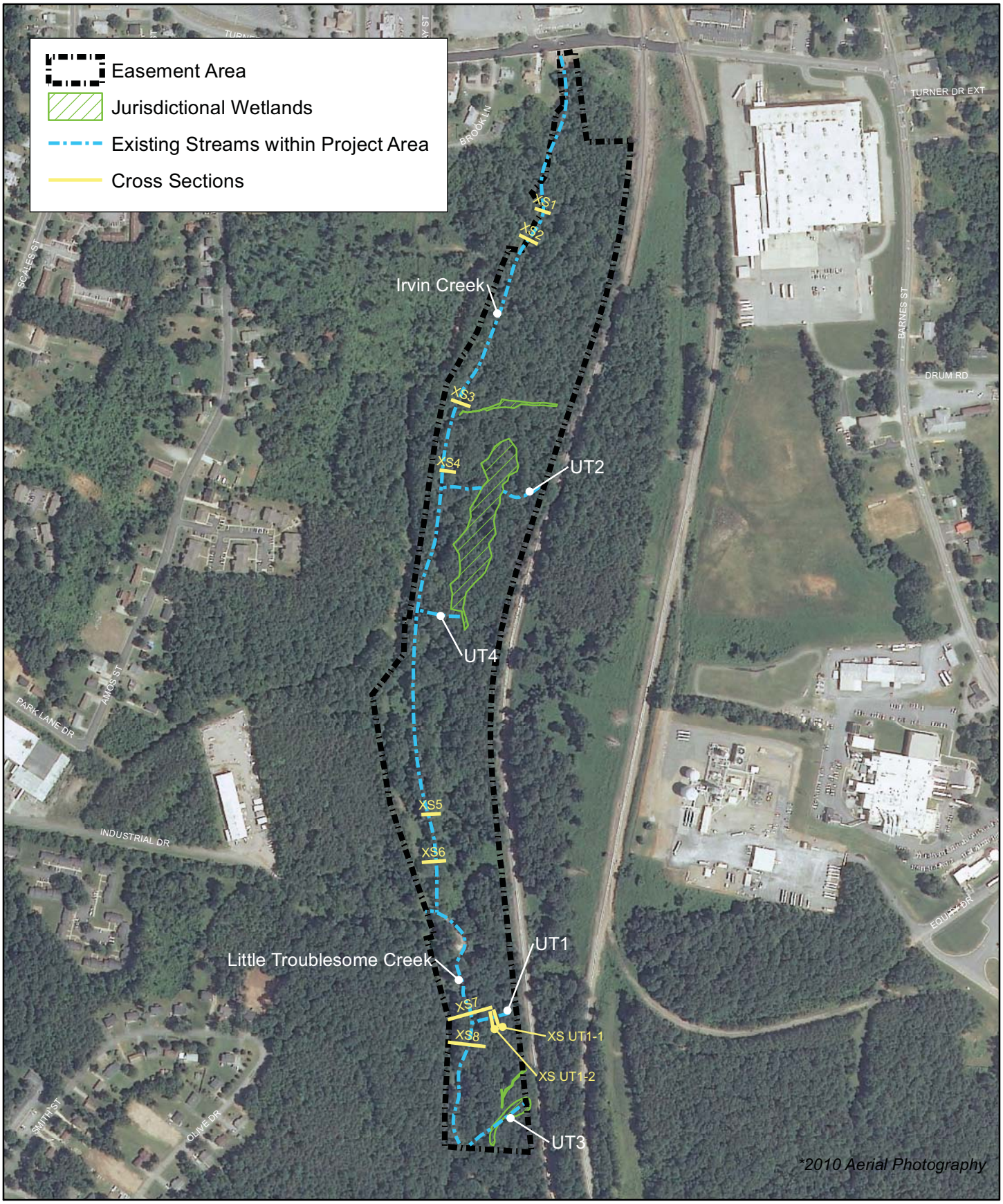


WILDLANDS ENGINEERING

0 1,100 2,200 Feet

N

Figure 3. Watershed Map - Stream Area
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)
Rockingham County, NC



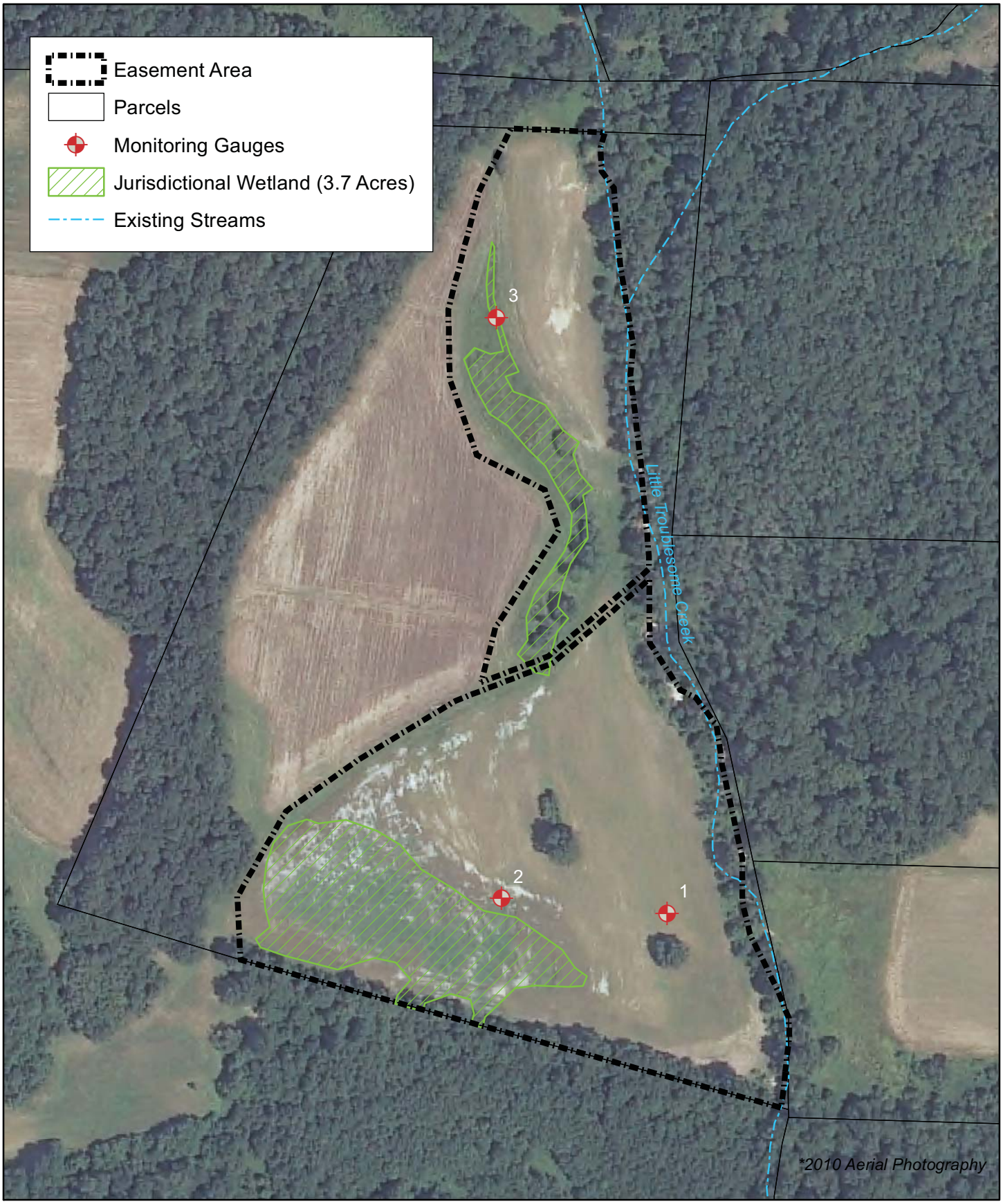
WILDLANDS ENGINEERING

0 250 500 Feet

N

Figure 4. Hydrologic Features - Stream Area
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

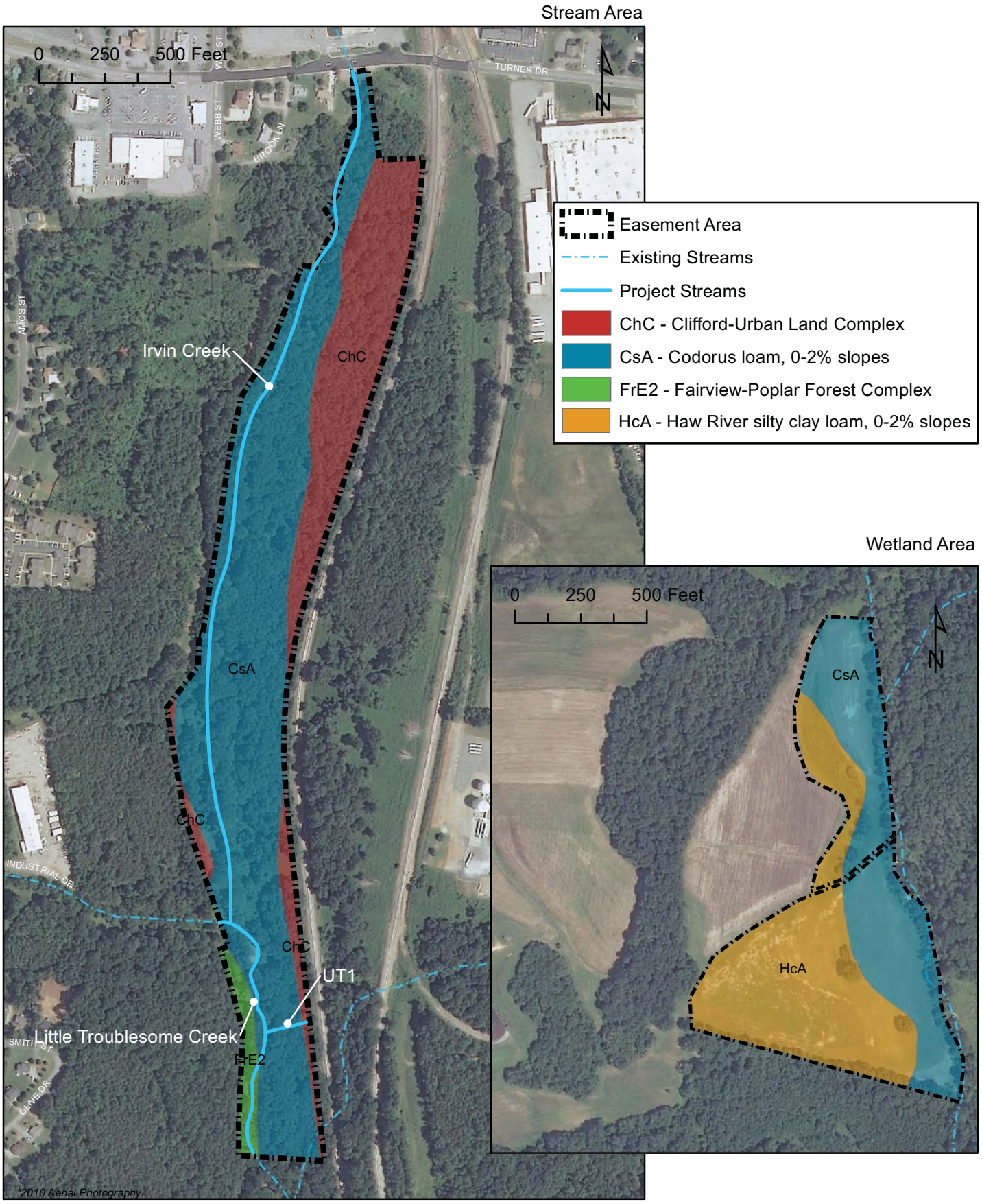


WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 5. Wetland Delineation - Wetland Area
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)
Rockingham County, NC



WILDLANDS ENGINEERING

Figure 6. Soils Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

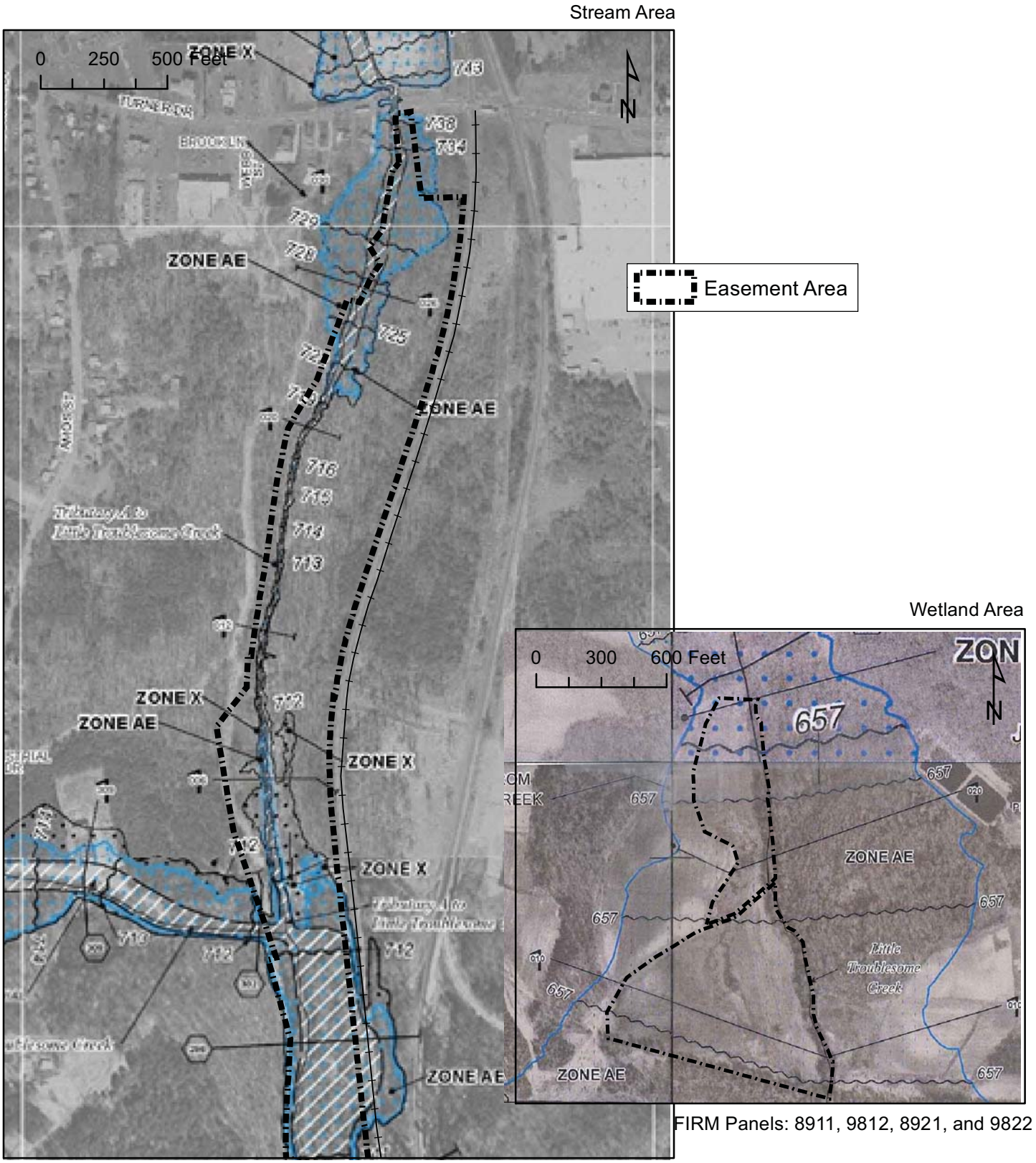
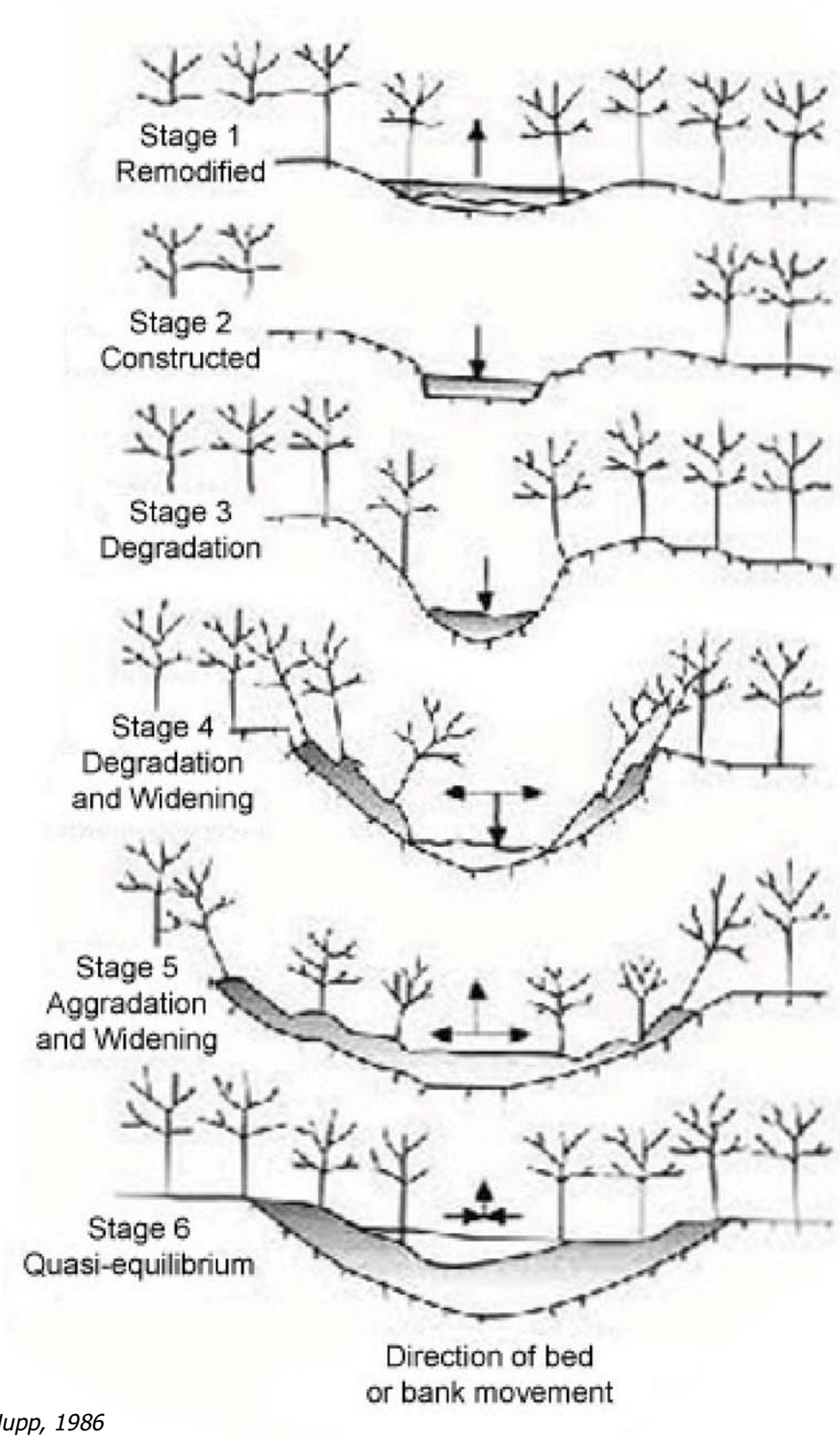


Figure 7. FEMA Flood Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

WILDLANDS ENGINEERING

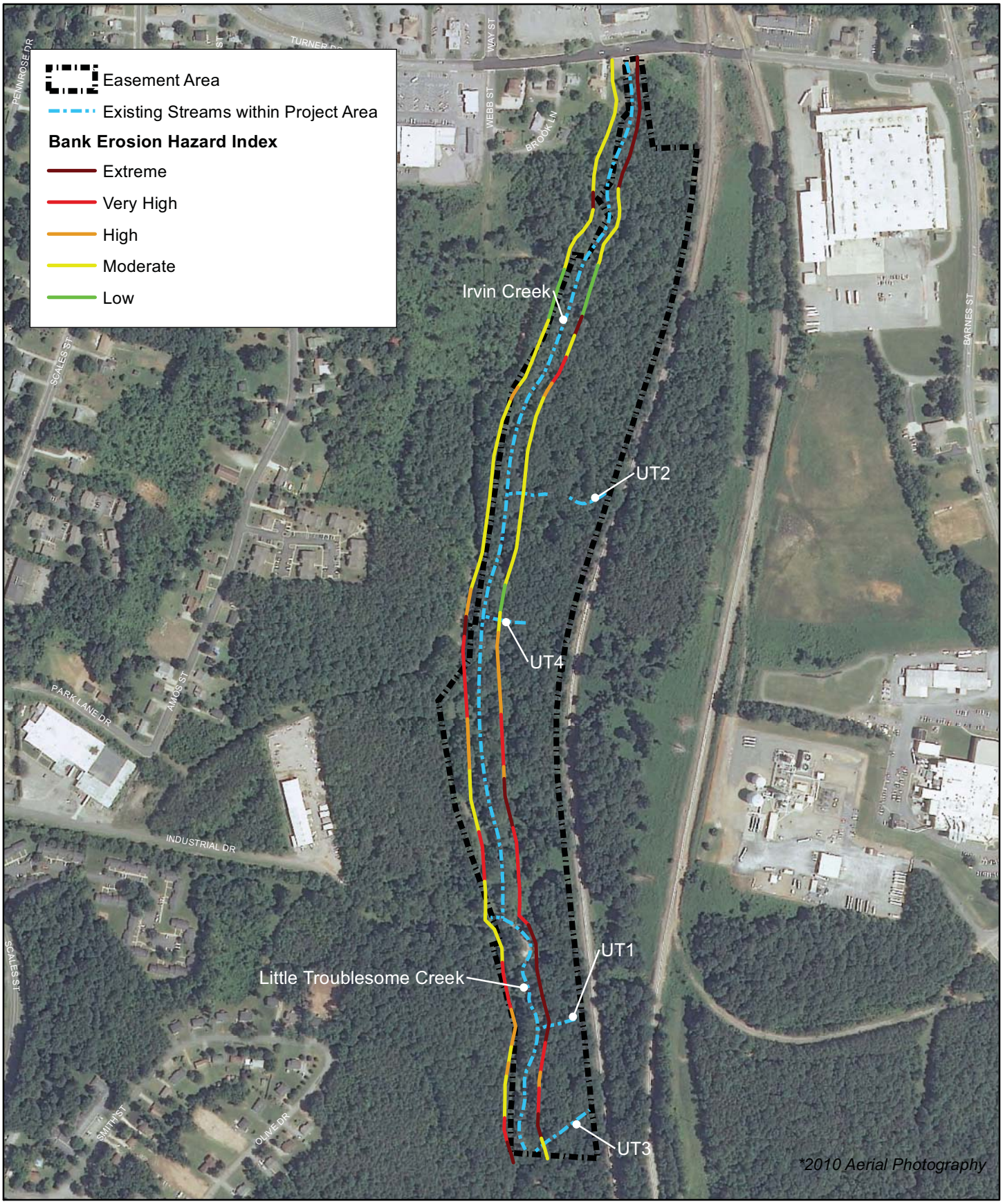


**Simon & Hupp, 1986*

Figure 8. Channel Evolution Model - Six Stages
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

WILDLANDS ENGINEERING



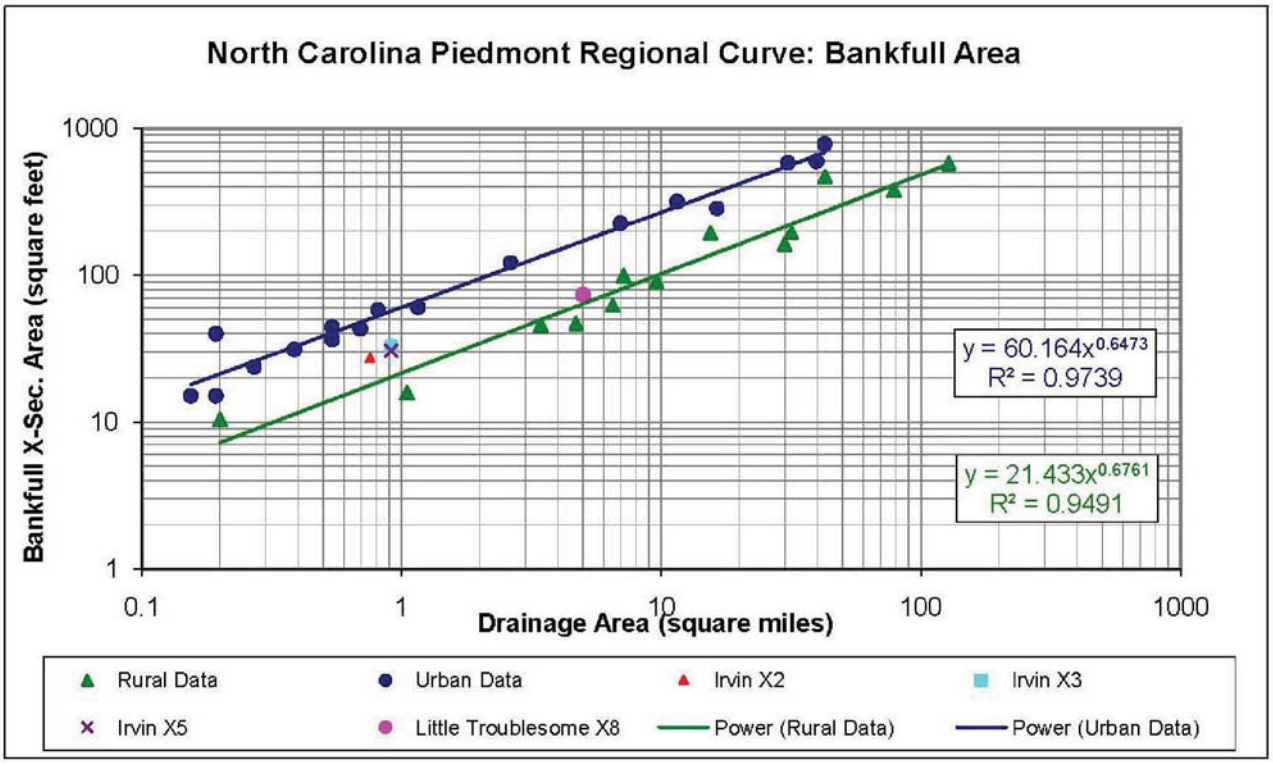
WILDLANDS ENGINEERING

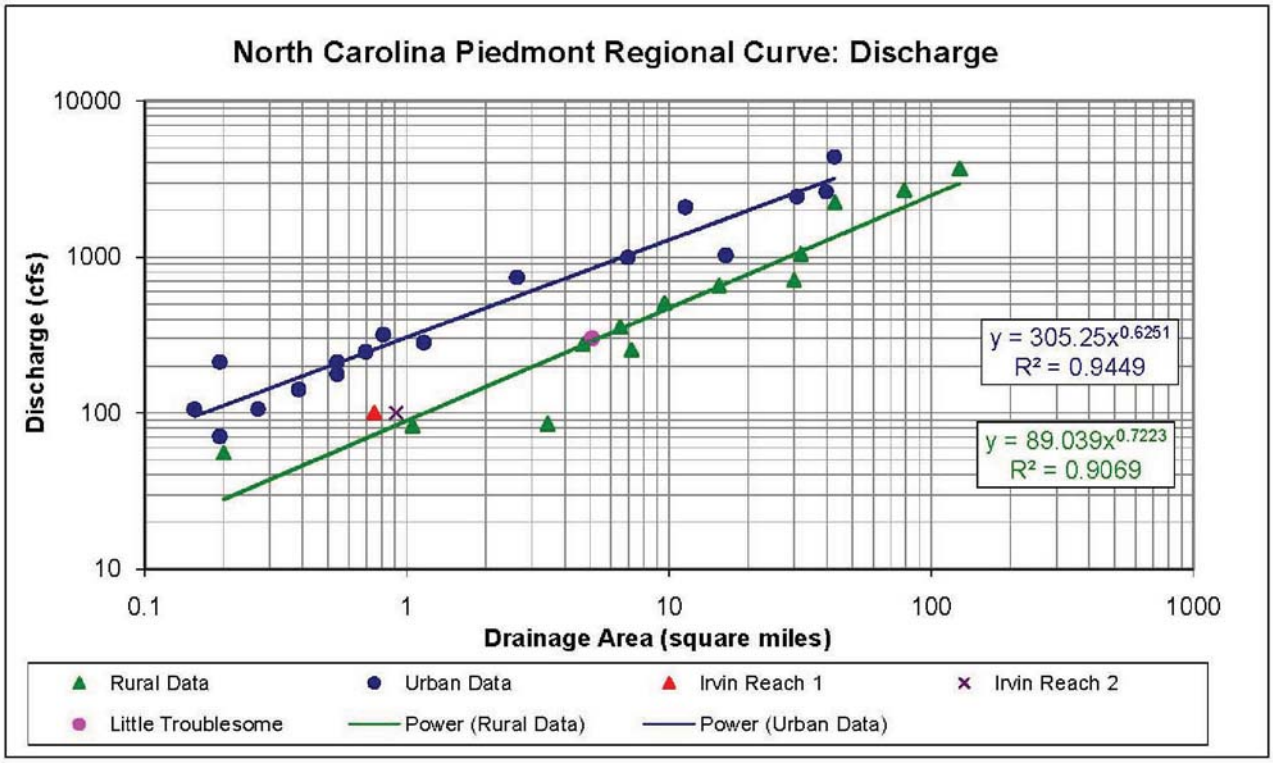
0 250 500 Feet

N

Figure 9. Bank Erosion Hazard Index
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC





WILDLANDS ENGINEERING

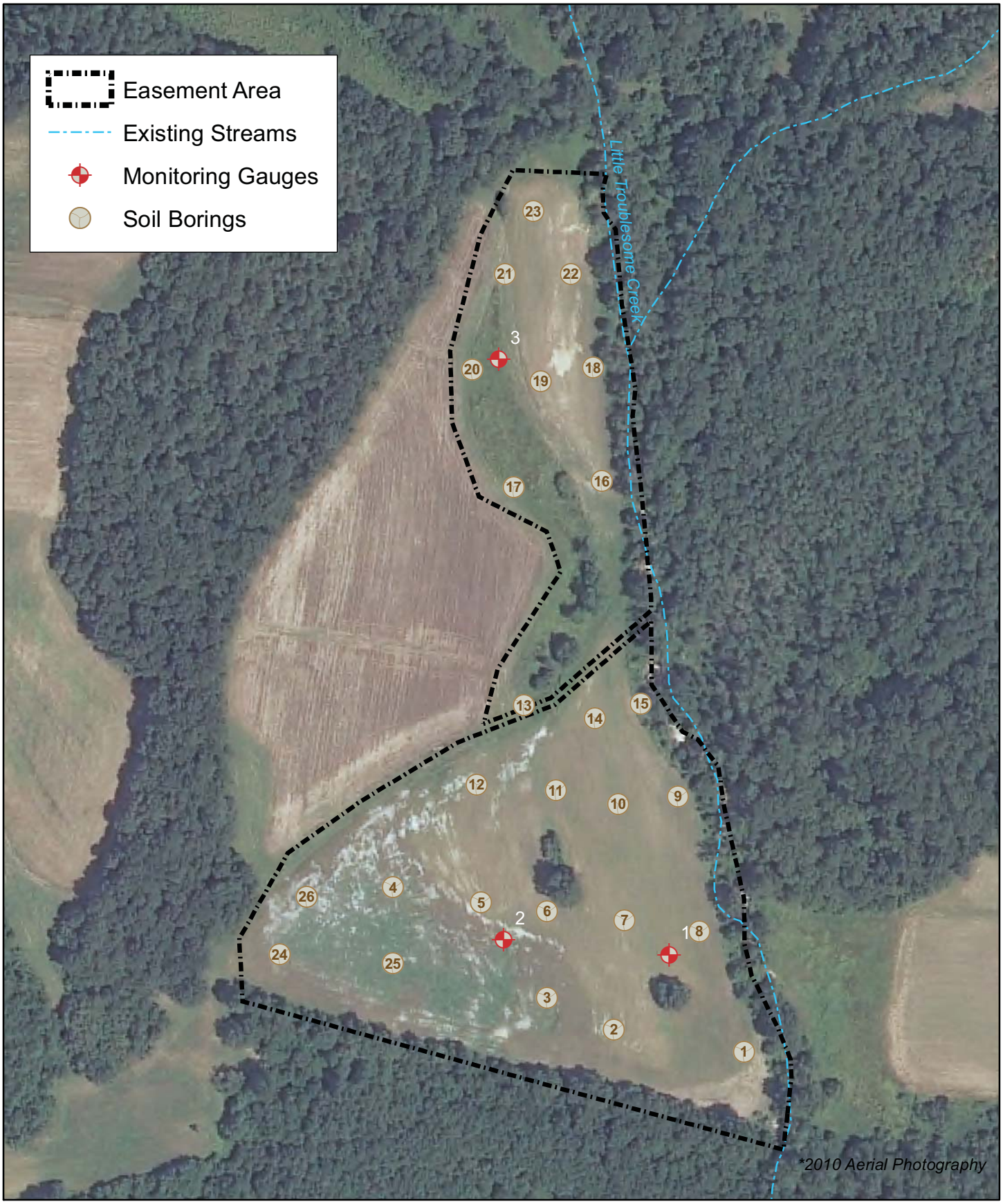
Figure 10. Regional Curve Data
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

WILDLANDS ENGINEERING

Figure 11. Stream Reference Site Vicinity Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC

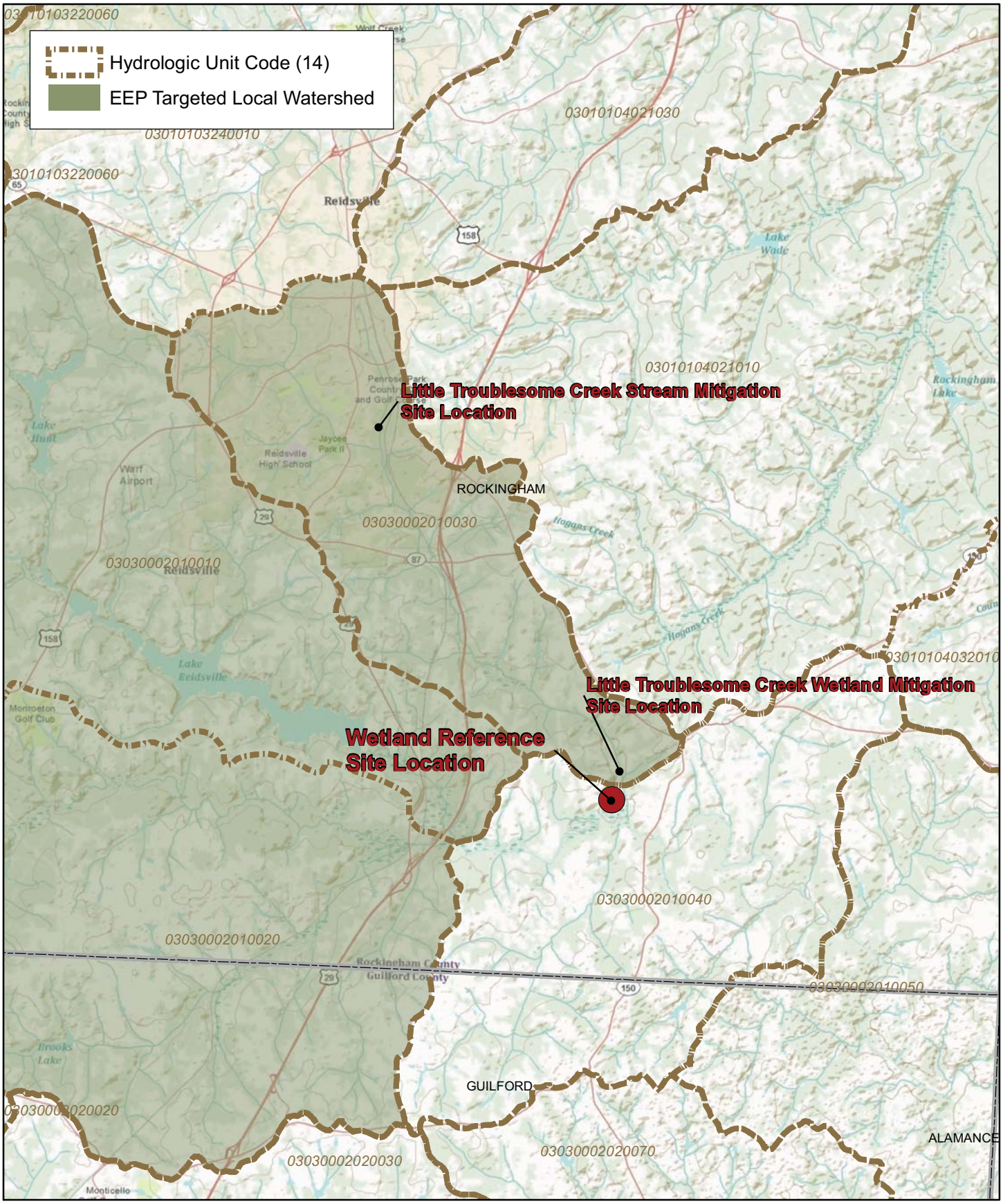


WILDLANDS ENGINEERING

0 125 250 Feet

Figure 12. Soil Borings - Wetland Area
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC



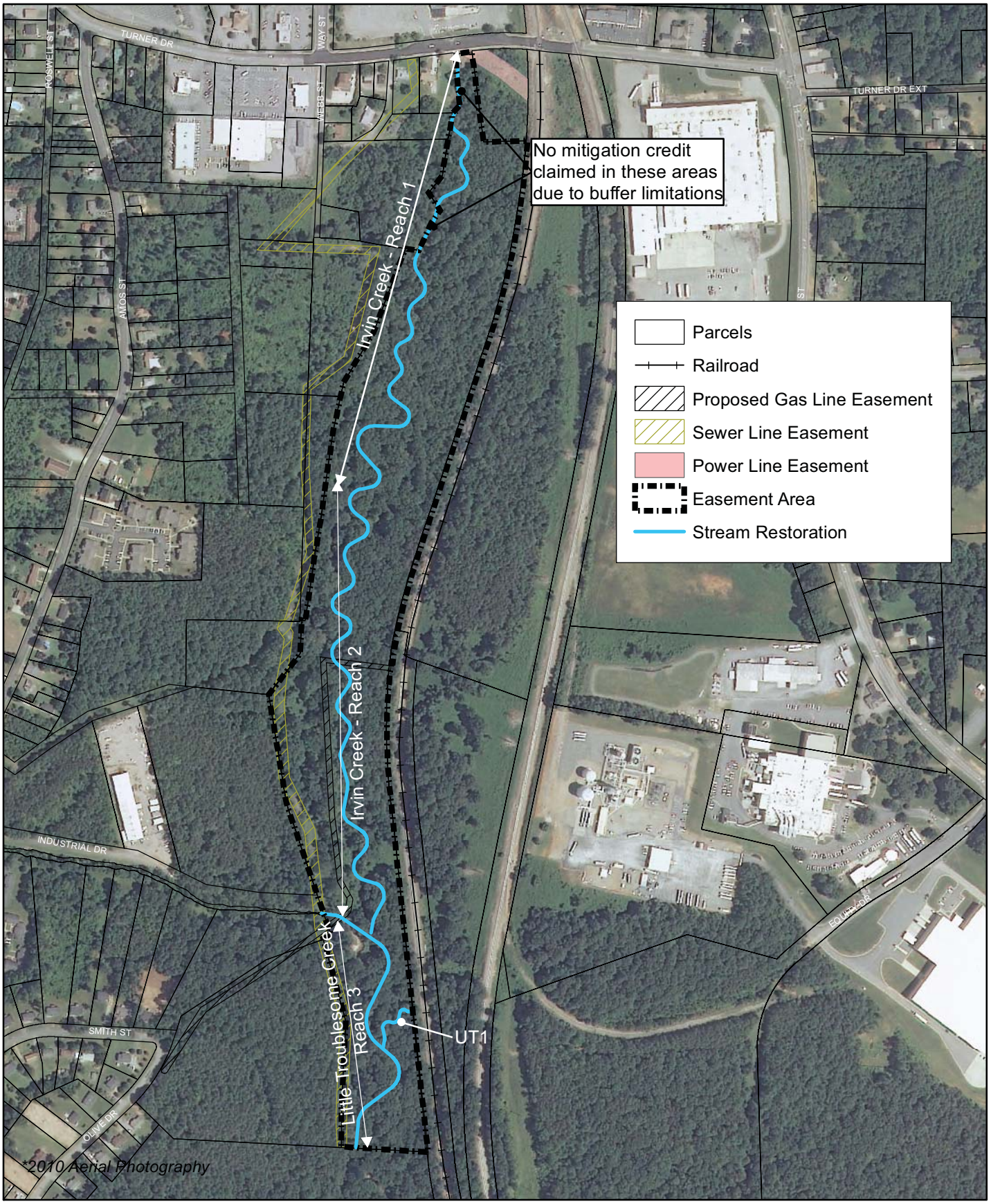
WILDLANDS ENGINEERING

0 0.75 1.5 Miles

N

Figure 13. Wetland Reference Site Vicinity Map
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC



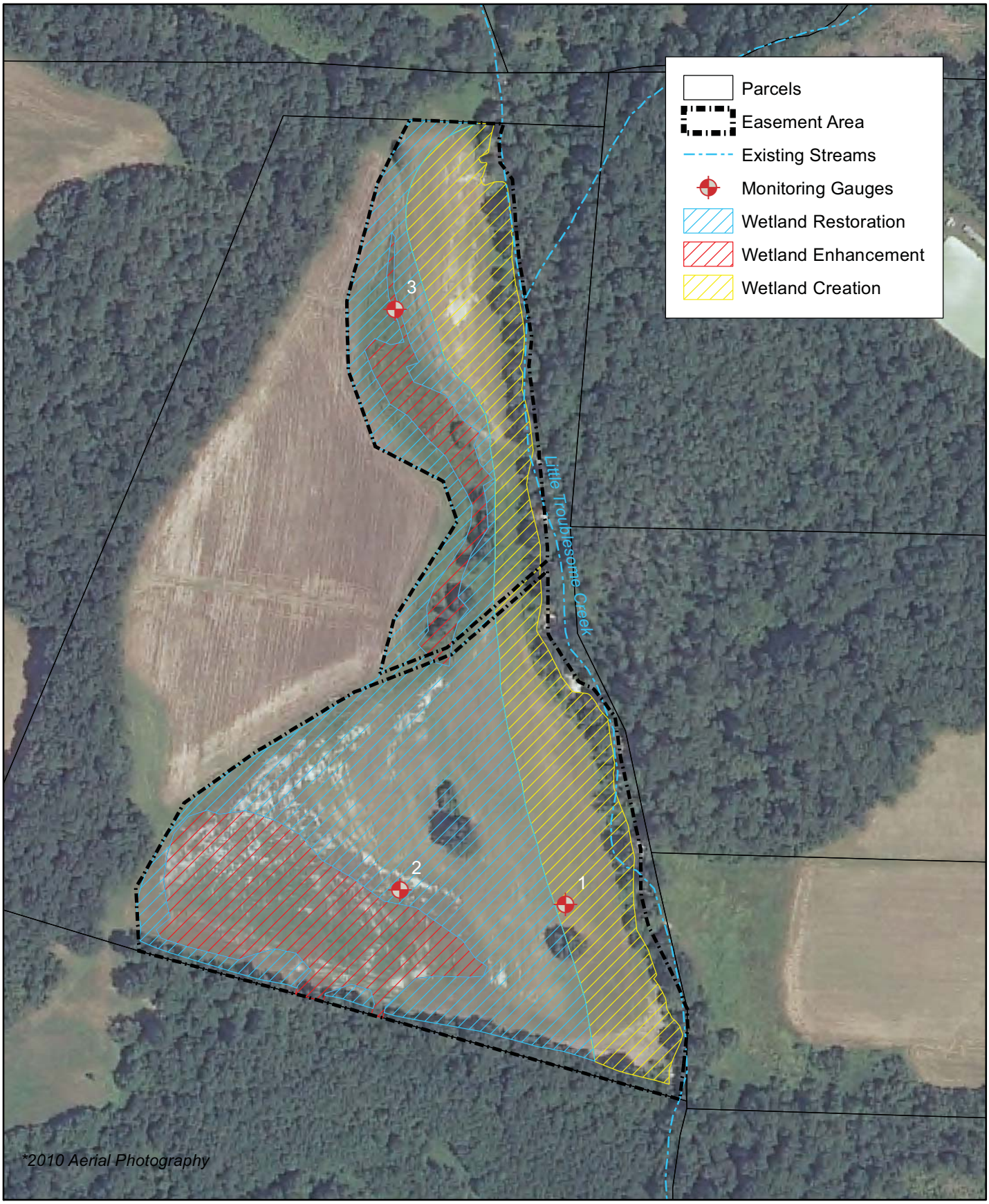
WILDLANDS ENGINEERING

0 250 500 Feet

N

Figure 14. Stream Design
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC



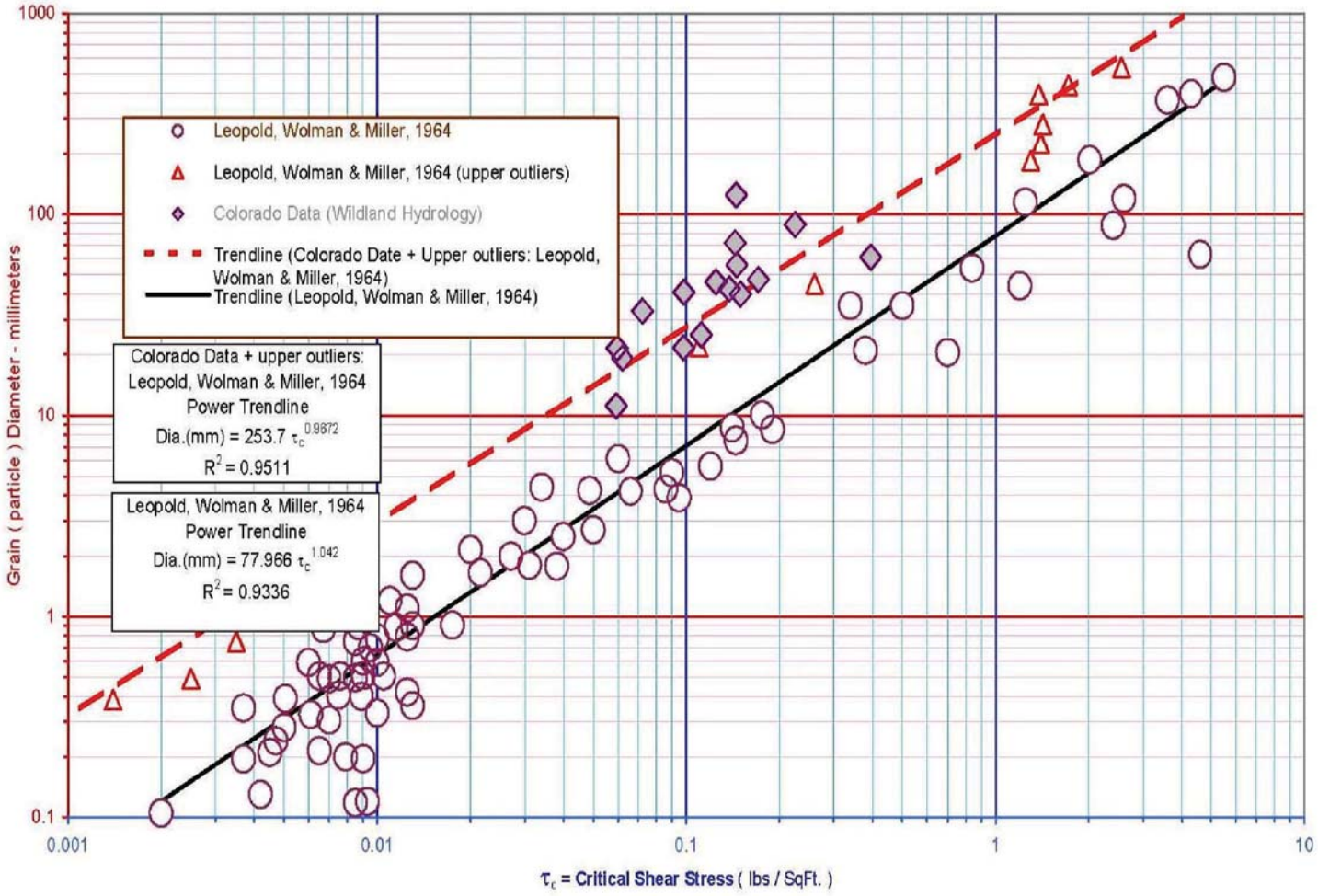
WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 15. Wetland Design
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

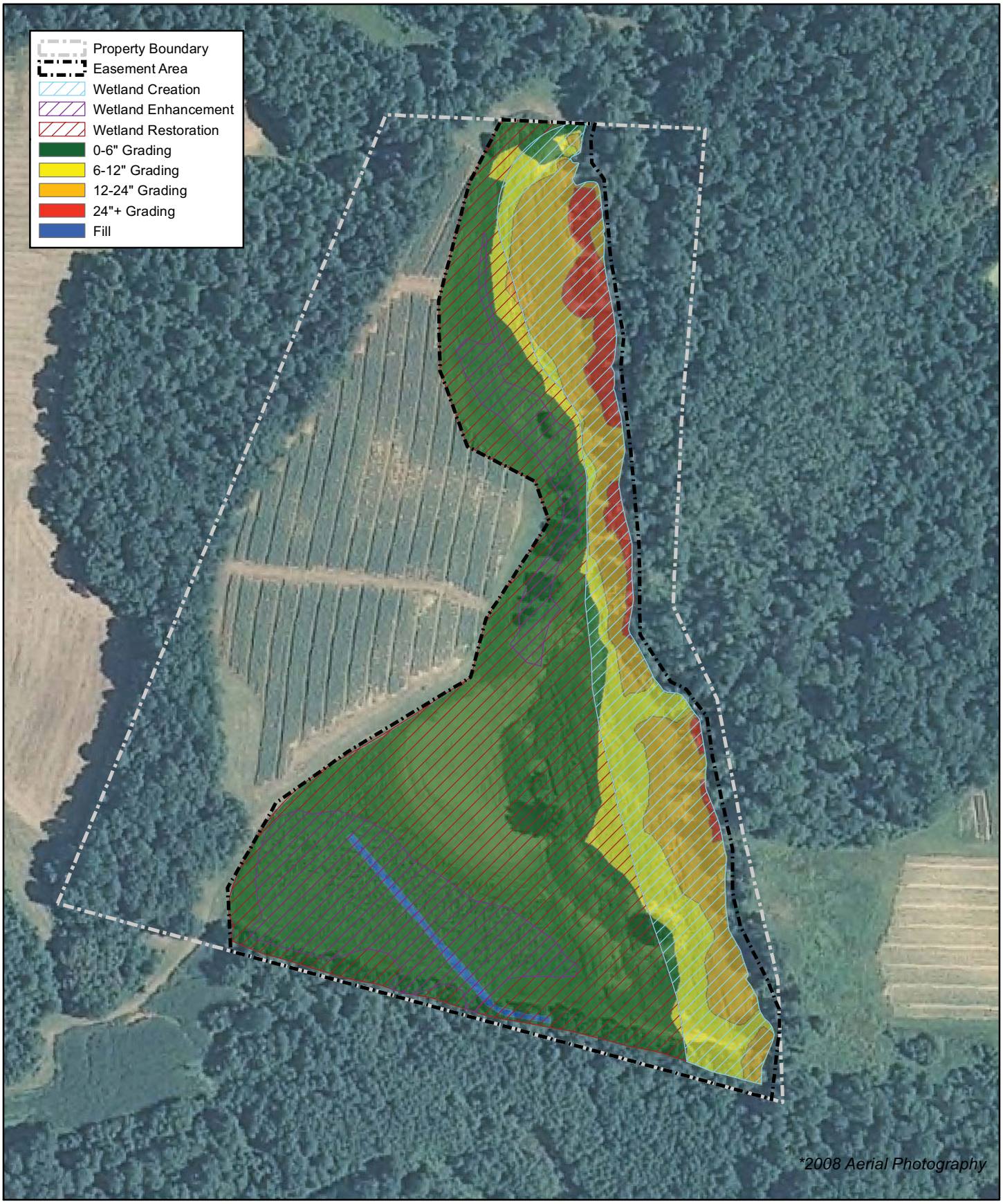
Rockingham County, NC



WILDLANDS ENGINEERING

Figure 16. Shield's Curve Modified
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

Rockingham County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 17 - Proposed Wetland Grading
Little Troublesome Creek Mitigation Site
Cape Fear River Basin (03030002)

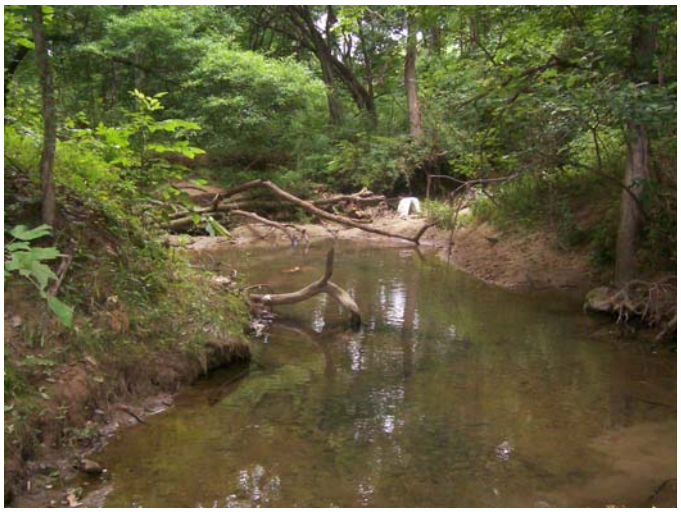
Rockingham County, NC

APPENDIX 1

Site Photographs

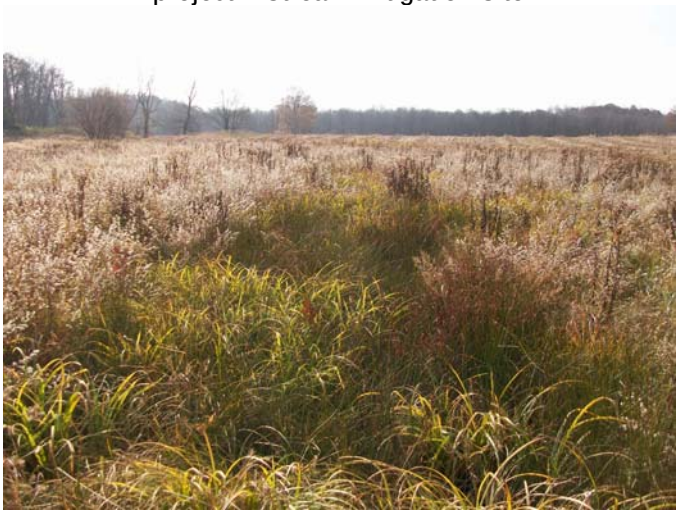
Little Troublesome Creek, facing downstream - Stream Mitigation Site

Irvin Creek, lower portion of project – Stream Mitigation Site



Irvin Creek, facing downstream at upper portion of project – Stream Mitigation Site

UT1, facing upstream to culvert crossing – Stream Mitigation Site



Wetland (WL-1) and adjacent agricultural field, facing south - Wetland Mitigation Site

Southern agricultural field, mapped as non-wetlands by NRCS – Wetland Mitigation Site

APPENDIX 2

Wetland and Stream Documentation

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW2009-02113** County: **Rockingham** U.S.G.S. Quad: **Reidsville, NC**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner/Agent: **Wildlands Engineering, Inc.**
Address: **1430 South Mint Street, Suite 104**
Charlotte, NC 28203

Telephone No.: **(704) 332-7754**

Property description:
Size (acres) **~23.9 and 17.6 acres** Nearest Town **Reidsville**
Nearest Waterway **Little Troublesome Creek** River Basin **Cape Fear**
USGS HUC **03030002** Coordinates N **36.3334** W **-79.6579**
Location description **The proposed stream mitigation portion of the Little Troublesome Creek Mitigation Project is located south of Turner Road, east of the intersection of Turner Road and Way Street in the City of Reidsville, Rockingham County, North Carolina. The proposed wetland mitigation portion of the project is located approximately 3,000 feet southwest of the intersection of NC Highway 150 and Mizpah Church Road, south of the City of Reidsville, Rockingham County, North Carolina.**

Indicate Which of the Following Apply:

A. Preliminary Determination

_ Based on preliminary information, there may be wetlands on the above described property. We strongly suggest you have this property inspected to determine the extent of Department of the Army (DA) jurisdiction. To be considered final, a jurisdictional determination must be verified by the Corps. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331).

B. Approved Determination

_ There are Navigable Waters of the United States within the above described property subject to the permit requirements of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

X There are waters of the U.S. including wetlands on the above described project area subject to the permit requirements of Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ We strongly suggest you have the waters of the U.S. on your project area delineated. Due to the size of your property and/or our present workload, the Corps may not be able to accomplish this wetland delineation in a timely manner. For a more timely delineation, you may wish to obtain a consultant. To be considered final, any delineation must be verified by the Corps.

X The waters of the U.S. including wetland on your project area have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

_ The wetlands have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on _____. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ There are no waters of the U.S., to include wetlands, present on the above described property which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

_ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Washington, NC, at (252) 946-6481 to determine their requirements.

Placement of dredged or fill material within waters of the US and/or wetlands without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Steve Kichefski** at **919-554-4884 ext. 35**.

C. Basis For Determination

There are six streams within this project area that are relatively permanent waters (RPW) and four of them are unnamed tributaries (UT) to Little Troublesome Creek. The fifth stream, Irving Creek, is also an RPW. These five RPW's flow into the sixth stream, Little Troublesome Creek, which is also an RPW. Little Troublesome Creek flows into the Haw River, a traditionally navigable water (TNW), which is a tributary to the Cape Fear River a navigable water of the United States. The Ordinary High Water Marks (OHWMs) of the streams were indicated by the following physical characteristics: Bed and banks, clear natural line impressed on the bank, shelving, scour and changes in the character of soil. There are five wetlands in the project area, three at the northern site location and two at the southern site location. The wetlands are adjacent with the unnamed tributaries or Little Troublesome Creek and meet the hydrophytic vegetation, wetland hydrology, and hydric soil criteria of the 1987 Corps of Engineers Wetland Delineation Manual .

D. Remarks

The project area is split into two separate locations. All five streams and 3 wetlands are associated with the northern location and two wetlands are associated with the southern location. The site locations are described above.

E. Appeals Information (This information applies only to approved jurisdictional determinations as indicated in B. above)

This correspondence constitutes an approved jurisdictional determination for the above described site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and request for appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the following address:

District Engineer, Wilmington Regulatory Division
Attn: Steve Kichefski, Project Manager,
Raleigh Regulatory Field Office
3331 Heritage Trade Drive, Suite 105
Wake Forest, North Carolina 27587

In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the District Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by **July 5, 2011**.

It is not necessary to submit an RFA form to the District Office if you do not object to the determination in this correspondence.

Corps Regulatory Official: S Kichefski

Date **May 5, 2011** Expiration Date **May 5, 2016**

The Wilmington District is committed to providing the highest level of support to the public. To help us ensure we continue to do so, please complete the Customer Satisfaction Survey located at our website at http://regulatory.usacesurvey.com/ to complete the survey online.

Copy furnished:

Sue Homewood
North Carolina Department of Natural Resources
Division of Water Quality
585 Waughtown Street
Winston-Salem, NC 27107

NC DWQ Stream Identification Form Version 4.11

Date: 7/21/2009	**Project/Site:** Little Troublesome	**Latitude:** N 36.329409°
Evaluator: MLJ	**County:** Rockingham	**Longitude:** W 79.658261°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 43	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP1 - Little Troublesome Creek *e.g. Quad Name:*

A. Geomorphology (Subtotal = 24.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	2	(3)
7. Recent alluvial deposits	0	1	2	(3)
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	No = 0		Yes = (3)	

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

B. Hydrology (Subtotal = 11)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	1	(1.5)
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

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

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 7/21/2009	**Project/Site:** Little Troublesome	**Latitude:** N 36.336561°
Evaluator: MLJ	**County:** Rockingham	**Longitude:** W 79.657671°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 41	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** SCP2 - Irvin Creek *e.g. Quad Name:*

A. Geomorphology (Subtotal = 24.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	(3)
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	2	(3)
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	No = 0		Yes = (3)	

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

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

C. Biology (Subtotal = 7)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 7/21/2009	**Project/Site:** Little Troublesome	**Latitude:** N 36.334299°
Evaluator: MLJ	**County:** Rockingham	**Longitude:** W 79.657851°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCP3 - UT2 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	2	(3)
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 7.5)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	0.5	1	(1.5)
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: This channel has been impacted by ATV activity, resulting in flows into the floodplain, creating Wetland BB; a portion of this system reconnects to Irvin Creek now via UT4.

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 7/21/2009	**Project/Site:** Little Troublesome	**Latitude:** N 36.329032°
Evaluator: MLJ	**County:** Rockingham	**Longitude:** W 79.657826°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCP4 - UT1 *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	~~(0.5)~~	(1)	1.5
11. Second or greater order channel	No = (0)		Yes = 3	

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

B. Hydrology (Subtotal = 9)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	(1.5)
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 7/21/2009	**Project/Site:** Little Troublesome	**Latitude:** N 36.327996°
Evaluator: MLJ	**County:** Rockingham	**Longitude:** W 79.657853°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 22.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCPS - UT3 *e.g. Quad Name:*

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

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

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

C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 4/1/2010	**Project/Site:** Little Troublesome	**Latitude:** N 36.334299°
Evaluator: MCJ	**County:** Rockingham	**Longitude:** W 79.657851°
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** SCP6 - UT4 *e.g. Quad Name:*

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

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

B. Hydrology (Subtotal = 8)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	(1.5)	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	(1.5)
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)	

C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: A portion of UT2 has been taken offline due to ATV activity and impacts, and allowed to flow along this ATV trail to connect to Irvin Creek via UT4.

Sketch:

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP1 – Little Troublesome Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 7/21/09
4. Time of Evaluation: 1:30pm
5. Name of Stream: Little Troublesome Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 3,198 acres
8. Stream Order: Second
9. Length of Reach Evaluated: 200 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.329409 °, W 79.658261°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 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 _X_ 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: 40 % Residential 5 % Commercial 5 % Industrial ___% Agricultural 50 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 20 feet
22. Bank Height (from bed to top of bank): 5-10 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): 57 **Comments:**_____

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP1 – Little Troublesome 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	2
	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	3
	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	3
	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	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	1
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
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	4
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	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	1
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						57

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP2 – Irvin Creek (Perennial RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 7/21/09
4. Time of Evaluation: 9:30 am
5. Name of Stream: Irvin Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 583 acres
8. Stream Order: Second
9. Length of Reach Evaluated: 200 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.336561 °, W 79.657671°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 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:_____
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: 10 % Residential 50 % Commercial 10 % Industrial ___% Agricultural 30 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 15-20 feet
22. Bank Height (from bed to top of bank): 5-8 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): 54 **Comments:**_____

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP2 – Irvin 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	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	3
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	3
	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	3
	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	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	3
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	1
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	1
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	2
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	3
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	4
	18	**Canopy coverage over streambed** (no shading vegetation = 0; continuous canopy = max points)	0 – 5	0 – 5	0 – 5	5
	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	0
	22	**Presence of fish** (no evidence = 0; common, numerous types = max points)	0 – 4	0 – 4	0 – 4	3
	23	**Evidence of wildlife use** (no evidence = 0; abundant evidence = max points)	0 – 6	0 – 5	0 – 5	2
Total Points Possible			100	100	100	
TOTAL SCORE (also enter on first page)						54

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP3 – UT2 (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 7/21/09
4. Time of Evaluation: 10:30 am
5. Name of Stream: UT to Irvin Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 42 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.336561 °, W 79.657671°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 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:_____
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 10 % Industrial ___% Agricultural 90 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 5-6 feet
22. Bank Height (from bed to top of bank): 2-3 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): 48 **Comments: This channel has been impacted by ATV activity, resulting in flows into the floodplain, creating Wetland BB; a portion of this system now reconnects to Irvin Creek via UT4.**

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP3 – UT2 (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	4
	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	4
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	1
	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	1
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	3
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	3
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
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	5
	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	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)						48

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP4 – UT1 (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 7/21/09
4. Time of Evaluation: 11:00 am
5. Name of Stream: UT to Little Troublesome Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 58 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.329032 °, W 79.657826°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 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:_____
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 60 % Industrial ___% Agricultural 40 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 3-4 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): 48 **Comments:**_____

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP4 – UT1 (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	1
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	4
	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	4
	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	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	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	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	3
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
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	5
	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	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)						48

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP5 – UT3 (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 7/21/09
4. Time of Evaluation: 1:00 pm
5. Name of Stream: UT to Little Troublesome Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 40 acres
8. Stream Order: First
9. Length of Reach Evaluated: 100 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.329032 °, W 79.657826°
13. Proposed Channel Work (if any): restoration
14. Recent Weather Conditions: no rain within the past 48 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:_____
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 50 % Industrial ___% Agricultural 50 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 4-6 feet
22. Bank Height (from bed to top of bank): 2-3 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): 53 **Comments:**_____

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP5 – UT3 (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	4
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	1
	6	**Presence of adjacent floodplain** (no floodplain = 0; extensive floodplain = max points)	0 – 4	0 – 4	0 – 2	4
	7	**Entrenchment / floodplain access** (deeply entrenched = 0; frequent flooding = max points)	0 – 5	0 – 4	0 – 2	4
	8	**Presence of adjacent wetlands** (no wetlands = 0; large adjacent wetlands = max points)	0 – 6	0 – 4	0 – 2	2
	9	**Channel sinuosity** (extensive channelization = 0; natural meander = max points)	0 – 5	0 – 4	0 – 3	2
	10	**Sediment input** (extensive deposition= 0; little or no sediment = max points)	0 – 5	0 – 4	0 – 4	2
	11	**Size & diversity of channel bed substrate** (fine, homogenous = 0; large, diverse sizes = max points)	NA*	0 – 4	0 – 5	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
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	5
	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	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)						53

* These characteristics are not assessed in coastal streams.

OFFICE USE ONLY: USACE AID#_____ DWQ #_____

SCP6 – UT4 (Intermittent RPW)

STREAM QUALITY ASSESSMENT WORKSHEET

1. Applicant's Name: Wildlands Engineering
2. Evaluator's Name: Matt Jenkins
3. Date of Evaluation: 4/1/10
4. Time of Evaluation: 11:30 am
5. Name of Stream: UT to Irvin Creek
6. River Basin: Cape Fear 03030002
7. Approximate Drainage Area: 42 acres
8. Stream Order: First
9. Length of Reach Evaluated: 50 lf
10. County: Rockingham
11. Location of reach under evaluation (include nearby roads and landmarks): From Greensboro, travel north on US-29 for approximately 21 miles to Exit 150 (Barnes St.) toward Reidsville. Turn left at Barnes St., travel approximately 1 mile and turn left onto Turner Dr. Travel approximately ¼ mile, the project corridor begins downstream of Turner Dr. across from K-Mart.
12. Site Coordinates (if known): N 36.336561 °, W 79.657671°
13. Proposed Channel Work (if any): preservation
14. Recent Weather Conditions: no rain within the past 48 hours
15. Site conditions at time of visit: sunny, 65°
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 10 % Industrial ___% Agricultural 90 % Forested ___% Cleared / Logged ___% Other (_____)
21. Bankfull Width: 3-4 feet
22. Bank Height (from bed to top of bank): 0.5-1 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): 51 **Comments:** A portion of UT2 has been taken offline due to ATV activity and impacts, and allowed to flow along this ATV trail (creating Wetland BB) and connect to Irvin Creek via UT4.

Evaluator's Signature_____ **Date**_____

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STREAM QUALITY ASSESSMENT WORKSHEET
SCP6 – UT4 (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	1
	2	**Evidence of past human alteration** (extensive alteration = 0; no alteration = max points)	0 – 6	0 – 5	0 – 5	2
	3	**Riparian zone** (no buffer = 0; contiguous, wide buffer = max points)	0 – 6	0 – 4	0 – 5	4
	4	**Evidence of nutrient or chemical discharges** (extensive discharges = 0; no discharges = max points)	0 – 5	0 – 4	0 – 4	4
	5	**Groundwater discharge** (no discharge = 0; springs, seeps, wetlands, etc. = max points)	0 – 3	0 – 4	0 – 4	1
	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	3
	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	1
STABILITY	12	**Evidence of channel incision or widening** (deeply incised = 0; stable bed & banks = max points)	0 – 5	0 – 4	0 – 5	4
	13	**Presence of major bank failures** (severe erosion = 0; no erosion, stable banks = max points)	0 – 5	0 – 5	0 – 5	4
	14	**Root depth and density on banks** (no visible roots = 0; dense roots throughout = max points)	0 – 3	0 – 4	0 – 5	4
	15	**Impact by agriculture or livestock production** (substantial impact =0; no evidence = max points)	0 – 5	0 – 4	0 – 5	4
HABITAT	16	**Presence of riffle-pool/ripple-pool complexes** (no riffles/ripples or pools = 0; well-developed = max points)	0 – 3	0 – 5	0 – 6	1
	17	**Habitat complexity** (little or no habitat = 0; frequent, varied habitats = max points)	0 – 6	0 – 6	0 – 6	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	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	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)						51

* These characteristics are not assessed in coastal streams.

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Stream Site City/County: Rockingham Sampling Date: 7/21/09

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP1

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.329409 Long: W 79.658261 Datum: _____

Soil Map Unit Name: Clifford-Urban land complex (ChC) NWI classification: N/A

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

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

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

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

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

Remarks:

Sampling point is representative of a non-jurisdictional upland area in the floodplain of Irvin Creek.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	30	Yes	FAC
2. Acer rubrum	10	Yes	FAC
3. Acer negundo	5	No	FACW
4.			
5.			
6.			
7.			
8.			
	45	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. Rubus argutus	30	Yes	FACU
2. Lindera benzoin	20	Yes	FACW
3. Asimina triloba	10	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	60	= Total Cover	
Herb Stratum (Plot size: 5')			
1. Rubus argutus	10	Yes	FACU
2. Fraxinus pennsylvanica	5	Yes	FACW
3. Acer rubrum	5	Yes	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	20	= Total Cover	
Woody Vine Stratum (Plot size: 30')			
1. Toxicodendron radicans	5	Yes	FAC
2.			
3.			
4.			
5.			
6.			
	5	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

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

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP1

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	5YR 4/4	100					sandy silt loam	
5-12	7.5YR 5/4	90	5YR 4/6	10	C	PL	clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Stream Site City/County: Rockingham Sampling Date: 7/21/09

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP2

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.329409 Long: W 79.658261 Datum: _____

Soil Map Unit Name: Codorus loam (CsA) NWI classification: N/A

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

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

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

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

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

Remarks:

Sampling point is representative of a non-jurisdictional upland area in the floodplain of Irvin Creek.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP2

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Acer rubrum	40	Yes	FAC
2. Carpinus caroliniana	15	Yes	FAC
3. Platanus occidentalis	10	No	FACW
4.			
5.			
6.			
7.			
8.			
	65	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')			
1. Rubus argutus	30	Yes	FACU
2. Acer rubrum	20	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	50	= Total Cover	

Herb Stratum (Plot size: 5')			
1. Polystichum acrostichoides	20	Yes	FAC
2. Rubus argutus	10	Yes	FACU
3. Acer rubrum	5	No	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	35	= Total Cover	

Woody Vine Stratum (Plot size: 30')			
1. Toxicodendron radicans	5	Yes	FAC
2.			
3.			
4.			
5.			
6.			
	5	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 71% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

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

SOIL

Sampling Point: DP2

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	10YR 4/4	100					sandy silt loam	
1-12	7.5YR 4/6	75	5YR 4/6	25	C	PL	silt loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Stream Site City/County: Rockingham Sampling Date: 7/21/09

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP3

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): none Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.329409 Long: W 79.658261 Datum: _____

Soil Map Unit Name: Codorus loam (CsA) NWI classification: N/A

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

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

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

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

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

Remarks:

Sampling point is representative of a non-jurisdictional upland area in the floodplain of Little Troublesome Creek.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present?	Yes _____	No ✔	Depth (inches): _____
Water Table Present?	Yes _____	No ✔	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No ✔	Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	35	Yes	FAC
2. Quercus phellos	10	Yes	FACW
3. Acer rubrum	5	No	FAC
4.			
5.			
6.			
7.			
8.			
	50	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
		= Total Cover	

Herb Stratum (Plot size: 5')			
1. Microstegium vimineum	80	Yes	FAC
2. Rubus argutus	10	No	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	90	= Total Cover	

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
		= Total Cover	

Dominance Test worksheet:

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

Total Number of Dominant Species Across All Strata: 3 (B)

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

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

SOIL

Sampling Point: DP3

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/3	100					silt loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Stream Site City/County: Rockingham Sampling Date: 7/21/09

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP4

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 1%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.329409 Long: W 79.658261 Datum: _____

Soil Map Unit Name: Codorus loam (CsA) NWI classification: PFO6

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

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

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

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

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

Remarks:

Sampling point is representative of a jurisdictional wetland area in the floodplain of Little Troublesome Creek, adjacent to UT3.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): 1-2"

Wetland Hydrology Present? Yes ✔ No _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP4

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Fraxinus pennsylvanica	50	Yes	FACW
2. Acer rubrum	20	Yes	FAC
3. Platanus occidentalis	5	No	FACW
4.			
5.			
6.			
7.			
8.			
	75	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. Lindera benzoin	30	Yes	FACW
2. Carpinus caroliniana	10	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	40	= Total Cover	
Herb Stratum (Plot size: 5')			
1. Peltandra virginica	5	Yes	OBL
2. Cyperus strigosus	1	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	5	= Total Cover	
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP4

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	5YR 4/4	100					silt loam	
3-12	7.5YR 4/1	90	5YR 4/4	10	C	PL	silt loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Stream Site City/County: Rockingham Sampling Date: 7/21/09

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP5

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 1%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.329409 Long: W 79.658261 Datum: _____

Soil Map Unit Name: Codorus loam (CsA) NWI classification: PFO6

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

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

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

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

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

Remarks:

Data point is representative of a jurisdictional wetland area. Inundation in this area is a result of impacts to UT1 from ATV traffic. UT1 now flows offline and follows the ATV trail and inundates the surrounding floodplain area; reconnecting to Irvin Creek via a former ephemeral drainage (now determined to be intermittent UT4).

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes ✔ No _____ Depth (inches): 2-6"

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): upper 12"

Wetland Hydrology Present? **Yes** ✔ **No** _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP5

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	25	Yes	FAC
2. Acer rubrum	10	Yes	FAC
3. Liriodendron tulipifera	5	No	FAC
4.			
5.			
6.			
7.			
8.			
	40	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. Rubus argutus	20	Yes	FACU
2. Carpinus caroliniana	5	No	FAC
3. Cornus amomum	5	No	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	30	= Total Cover	
Herb Stratum (Plot size: 5')			
1. Polystichum acrostichoides	10	Yes	FAC
2. Rubus argutus	5	Yes	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	15	= Total Cover	
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
		= Total Cover	

Dominance Test worksheet:

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

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 60% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP5

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1	10YR 4/2	90	5YR 4/6	10	C	PL	sandy silt loam	
1-12	7.5YR 5/2	90	5YR 4/6	10	C	PL	silt loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP1W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: PEM1

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

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

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

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

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

Remarks:

Sampling point is representative of a jurisdictional wetland area in the floodplain of Little Troublesome Creek. This area falls adjacent to an active agricultural crop field. Vegetation in this area has been extensively managed; herbaceous only.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes ✔ No _____ Depth (inches): 6-8"

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): at surface

Wetland Hydrology Present? **Yes** ✔ **No** _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP1W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Rosa palustris	50	Yes	OBL
2. Microstegium vimineum	30	Yes	FAC
3. Cyperus strigosus	10	No	FACW
4. Juncus effusus	5	No	-
5. Leersia oryzoides	5	No	OBL
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

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

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP1W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 5/2	95	7.5YR 4/6	5	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP2W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: PEM1

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

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

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

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

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

Remarks:

Sampling point is representative of a jurisdictional wetland area in the floodplain of Little Troublesome Creek. This area falls adjacent to an active agricultural crop field. Vegetation in this area has been extensively managed.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present?	Yes ✔	No _____	Depth (inches): 3-6"
Water Table Present?	Yes ✔	No _____	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes ✔	No _____	Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No _____

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP2W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1. Salix nigra	10	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	10 = Total Cover		
Herb Stratum (Plot size: 5')			
1. Typha latifolia	40	Yes	OBL
2. Cyperus strigosus	5	No	FACW
3. Microstegium vimineum	5	No	FAC
4. Juncus effusus	2	No	-
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	52 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

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

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

✔ 1 - Rapid Test for Hydrophytic Vegetation

✔ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP2W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 5/2	95	7.5YR 4/6	5	C	PL	silty loam	
6-12	7.5YR 5/1	90	2.5YR 4/6	10	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP3W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: _____

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

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

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

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

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

Remarks:

This area falls adjacent to an active agricultural crop field. Vegetation in this area has been extensively managed; herbaceous only.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP3W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Microstegium vimineum	30	Yes	FAC
2. Cyperus strigosus	15	Yes	FACW
3. Juncus effusus	10	No	-
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

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

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

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

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? **Yes** ✔ **No** ___

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

SOIL

Sampling Point: DP3W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	7.5YR 4/4	100					silt loam	
6-12	7.5YR 5/4	75	7.5YR 3/4	25	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP4W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: _____

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

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

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

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

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

Remarks:

This area falls adjacent to an active agricultural crop field. Vegetation in this area has been extensively managed; herbaceous only.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes _____ No ✔ Depth (inches): _____

Water Table Present? Yes _____ No ✔ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✔ Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP4W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Microstegium vimineum	30	Yes	FAC
2. Cyperus strigosus	15	Yes	FACW
3. Juncus effusus	10	No	-
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

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

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

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

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ___

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

SOIL

Sampling Point: DP4W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/4	100					silt loam	
8-12	10YR 5/4	90	7.5YR 4/4	10	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP5W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: _____

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

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

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

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

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

Remarks:

This area falls adjacent to an active agricultural crop field. Vegetation in this area has been extensively managed; grasses only.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present?	Yes _____	No ✔	Depth (inches): _____
Water Table Present?	Yes _____	No ✔	Depth (inches): _____
Saturation Present? (includes capillary fringe)	Yes _____	No ✔	Depth (inches): _____

Wetland Hydrology Present? **Yes** _____ **No** ✔

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

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP5W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1. Festuca subverticillata	95	Yes	FACU
2. Solidago canadensis	5	No	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

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

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes _____ No ✔

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

SOIL

Sampling Point: DP5W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	7.5YR 4/4	90	7.5YR 4/6	10	C	PL	silt loam	
6-12	10YR 4/4	90	7.5YR 3/4	10	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ **No** ✔

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 11/23/10

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP6W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: _____

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

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

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

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

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

Remarks:

Sampling area is located within an active crop field. Corn was recently harvested from this site and ditching has been performed. This portion of the site has been mapped by the NRCS as "Non Wetlands" - see attached SCS-CPA-026 Form, dated 11/28/94. This area is also determined to be "prior converted cropland" as defined by Regulatory Guidance Letter 90-07.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes ✔ No _____ Depth (inches): 1-12"

Water Table Present? Yes ✔ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): _____

Wetland Hydrology Present? **Yes** ✔ **No** _____

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

Remarks:

This area is an active agricultural field and hydrology has been affected by recent crop harvests and field ditching.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP6W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

Total Number of Dominant Species Across All Strata: 0 (B)

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes _____ No ✔

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

No vegetation strata were present in this lower agricultural field during the time of the site investigation.

SOIL

Sampling Point: DP6W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-2	7.5YR 5/2	95	7.5YR 4/6	5	C	PL	silt loam	
2-12	7.5YR 4/1	90	5YR 4/6	10	C	PL	silty clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont

Project/Site: Little Troublesome Creek - Wetland Site City/County: Rockingham Sampling Date: 03/16/11

Applicant/Owner: Wildands Engineering State: NC Sampling Point: DP7W

Investigator(s): Matt Jenkins, PWS Section, Township, Range: Reidsville Township

Landform (hillslope, terrace, etc.): floodplain Local relief (concave, convex, none): None Slope (%): 0%

Subregion (LRR or MLRA): MLRA 136 Lat: N 36.275194 Long: W 79.609577 Datum: _____

Soil Map Unit Name: Haw River silty clay loam (HcA) NWI classification: _____

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

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

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

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

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

Remarks:

Sampling area is located within an active crop field. Corn was recently harvested from this site and ditching has been performed. Soil has also been extensively tilled in recent past.

HYDROLOGY

Wetland Hydrology Indicators:

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

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

Secondary Indicators (minimum of two required)

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

Field Observations:

Surface Water Present? Yes ✔ No _____ Depth (inches): 1-12"

Water Table Present? Yes ✔ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✔ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes ✔ No _____

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

Remarks:

This area is an active agricultural field and hydrology has been affected by recent crop harvests and field ditching.

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: DP7W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	= Total Cover		
Herb Stratum (Plot size: 5')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	= Total Cover		
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

Dominance Test worksheet:

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

Total Number of Dominant Species Across All Strata: 0 (B)

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

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

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

✔ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Four Vegetation Strata:

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

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

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

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

Hydrophytic Vegetation Present? Yes ✔ No ____

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

The site currently exhibits both hydric soil and wetland hydrology indicators, however due to recent tilling and planting, no hydrophytic vegetation exists within the site. Additionally, the site is located in a topographic setting (floodplain of Little Troublesome Creek) that is conducive to the creation and support of Bottomland Hardwood Forested wetland systems. The immediate adjacent property, however, is being used as a reference to this site and exhibits similar hydric soil and hydrology characteristics along with established, mature hydrophytic vegetation species. It is therefore determined that hydrophytic vegetation would naturally establish itself within subject area.

SOIL

Sampling Point: DP7W

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

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	7.5YR 5/2	100					silt loam	
3-12	7.5YR 4/1	90	5YR 4/6	10	C	PL	clay loam	

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

Hydric Soil Indicators:

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

Indicators for Problematic Hydric Soils[3]:

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

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

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ✔ **No** _____

Remarks:

NC WAM WETLAND ASSESSMENT FORM
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name Little Troublesome Creek Wetland AA | **Date** 5/25/2010

Wetland Type Bottomland Hardwood Forest | **Assessor Name/Organization** Matt Jenkins, PWS

Level III Ecoregion Piedmont | **Nearest Named Water Body** Little Troublesome Creek

River Basin Cape Fear | **USGS 8-Digit Catalogue Unit** 03030002

☐ Yes ◉ No **Precipitation within 48 hrs?** | **Latitude/Longitude (deci-degrees)** 36.328068°N, 79.657458°W

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note below if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, approximately within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ◉ No

Describe effects of stressors that are present.
Wetland adjacent to railroad right-of-way. Watershed includes industrial buildings.

Regulatory Considerations
Select all that apply to the assessment area.

- ☐ Anadromous fish
- ☐ Federally protected species or State endangered or threatened species
- ☐ NCDWQ riparian buffer rule in effect
- ☐ Abuts a Primary Nursery Area (PNA)
- ☐ Publicly owned property
- ☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
- ☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
- ☐ Designated NCNHP reference community
- ☑ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (Check all that apply)

- ☐ Blackwater
- ◉ Brownwater
- ☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ◉ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ◉ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric
Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence of an effect.

GS	VS	
◉ A	◉ A	Not severely altered
☐ B	☐ B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], artificial hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric
Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and ditch sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐ A	◉ A	Water storage capacity and duration are not altered.
◉ B	☐ B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐ C	☐ C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric
Check a box in each column for each group below. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

AA	WT	
☐ A	☐ A	Majority of wetland with depressions able to pond water > 1 foot deep
☐ B	☐ B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
☐ C	☐ C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
◉ D	◉ D	Depressions able to pond water < 3 inches deep

- ☐ A Evidence that maximum depth of inundation is greater than 2 feet
- ☐ B Evidence that maximum depth of inundation is between 1 and 2 feet
- ◉ C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

- ☐ A Sandy soil
- ☉ B Loamy or clayey soils exhibiting redoxymorphic features (concentrations, depletions, or rhizospheres)
- ☐ C Loamy or clayey soils not exhibiting redoxymorphic features
- ☐ D Loamy or clayey gleyed soil
- ☐ E Histosol or histic epipedon

- ☉ A Soil ribbon < 1 inch
- ☐ B Soil ribbon ≥ 1 inch

- ☉ A No peat or muck presence
- ☐ B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☉ A	☉ A	Little or no evidence of pollutants or discharges entering the assessment area
☐ B	☐ B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐ C	☐ C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M). Effective riparian buffers are considered to be 50 feet wide in the Coastal Plain and Piedmont ecoregions and 30 feet wide in the Blue Ridge Mountains ecoregion.

WS	5M	2M	
☑ A	☑ A	☑ A	≥ 10% impervious surfaces
☐ B	☐ B	☐ B	< 10% impervious surfaces
☐ C	☐ C	☐ C	Confined animal operations (or other local, concentrated source of pollutants)
☐ D	☐ D	☐ D	≥ 20% coverage of pasture
☐ E	☐ E	☐ E	≥ 20% coverage of agricultural land (regularly plowed land)
☑ F	☑ F	☑ F	≥ 20% coverage of maintained grass/herb
☐ G	☐ G	☐ G	≥ 20% coverage of silvicultural land characterized by a clear-cut < 5 years old
☐ H	☐ H	☐ H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?

☐ Yes ☉ No If Yes, continue to 7b. If No, skip to Metric 8.

Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of the wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is weltand? Descriptor E should be selected if ditches effectively bypass the buffer.

- ☐ A ≥ 50 feet
- ☐ B From 30 to < 50 feet
- ☐ C From 15 to < 30 feet
- ☐ D From 5 to < 15 feet
- ☐ E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.

☐ ≤ 15-feet wide ☐ > 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?

☐ Yes ☐ No

7e. Is tributary or other open water sheltered or exposed?

- ☐ Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
- ☐ Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex metric

Check a box in each column for riverine wetlands only. Select the appropriate width for the wetland type at the assessment area (WT) and the wetland complex at the assessment areas (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐ A	☐ A	≥ 100 feet
☐ B	☐ B	From 80 to < 100 feet
☐ C	☐ C	From 50 to < 80 feet
☐ D	☐ D	From 40 to < 50 feet
☉ E	☉ E	From 30 to < 40 feet
☐ F	☐ F	From 15 to < 30 feet
☐ G	☐ G	From 5 to < 15 feet
☐ H	☐ H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.

- (•) A Evidence of short-duration inundation (< 7 consecutive days)
- ( ) B Evidence of saturation, without evidence of inundation
- ( ) C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).

- (•) A Sediment deposition is not excessive, but at approximately natural levels.
- ( ) B Sediment deposition is excessive, but not overwhelming the wetland.
- ( ) C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
( ) A	( ) A	( ) A	≥ 500 acres
( ) B	( ) B	( ) B	From 100 to < 500 acres
( ) C	( ) C	( ) C	From 50 to < 100 acres
( ) D	( ) D	( ) D	From 25 to < 50 acres
( ) E	( ) E	( ) E	From 10 to < 25 acres
( ) F	( ) F	( ) F	From 5 to < 10 acres
( ) G	( ) G	( ) G	From 1 to < 5 acres
( ) H	( ) H	( ) H	From 0.5 to < 1 acre
(•) I	(•) I	(•) I	From 0.1 to < 0.5 acre
( ) J	( ) J	( ) J	From 0.01 to < 0.1 acre
( ) K	( ) K	( ) K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

- ( ) A Pocosin is the full extent (≥ 90%) of its natural landscape size.
- ( ) B Pocosin is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column). Involves a GIS effort with field adjustment.** This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, urban landscapes, maintained fields (pasture open and agriculture), or water > 300 feet wide.

Well	Loosely	
( ) A	( ) A	≥ 500 acres
(•) B	( ) B	From 100 to < 500 acres
( ) C	( ) C	From 50 to < 100 acres
( ) D	( ) D	From 10 to < 50 acres
( ) E	( ) E	< 10 acres
( ) F	( ) F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

( ) Yes ( ) No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include permanent features such as fields, development, two-lane or larger roads (≥ 40-feet wide), utility line corridors wider than a two-lane road, and clear-cuts < 10 years old. Consider the eight main points of the compass.

- ( ) A No artificial edge within 150 feet in all directions
- (•) B No artificial edge within 150 feet in four (4) to seven (7) directions
- ( ) C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

- (•) A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ( ) B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ( ) C Vegetation severely altered from reference in composition. Expected strata are unnaturally absent or dominated by exotic species or composed of planted stands of non-characteristic species or inappropriately composed of a single species.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

- ( ) A Vegetation diversity is high and is composed primarily of native species (<10% cover of exotics).
- ( ) B Vegetation diversity is low or has > 10% to 50% cover of exotics.
- ( ) C Vegetation is dominated by exotic species (>50% cover of exotics).

○

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?

● Yes ○ No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

● A ≥ 25% coverage of vegetation
● B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

AA	WT	
● A	● A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
○ B	○ B	Canopy present, but opened more than natural gaps
○ C	○ C	Canopy sparse or absent
○ A	○ A	Dense mid-story/sapling layer
● B	● B	Moderate density mid-story/sapling layer
○ C	○ C	Mid-story/sapling layer sparse or absent
● A	● A	Dense shrub layer
○ B	○ B	Moderate density shrub layer
○ C	○ C	Shrub layer sparse or absent
○ A	○ A	Dense herb layer
● B	● B	Moderate density herb layer
○ C	○ C	Herb layer sparse or absent

18. Snags – wetland type condition metric

○ A Large snags (more than one) are visible (> 12-inches DBH, or large relative to species present and landscape stability).
● B Not A

19. Diameter Class Distribution – wetland type condition metric

○ A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
● B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12-inch DBH.
○ C Majority of canopy trees are < 6 inches DBH or no trees.

20. Large Woody Debris – wetland type condition metric

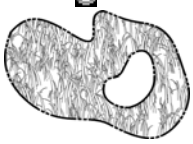
Include both natural debris and man-placed natural debris.

○ A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
● B Not A

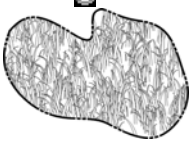
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

○ A 

○ B 

○ C 

○ D 

22. Hydrologic Connectivity – assessment area condition metric

Evaluate for riverine wetlands only. Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.

● A Overbank and overland flow are not severely altered in the assessment area.
○ B Overbank flow is severely altered in the assessment area.
○ C Overland flow is severely altered in the assessment area.
○ D Both overbank and overland flow are severely altered in the assessment area.

Notes

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name	Little Troublesome Creek Wetland AA	Date	5/25/2010
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Matt Jenkins, PWS

Presence of stressor affecting assessment area (Y/N)	YES
Notes on Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	NO
Assessment area is substantially altered by beaver (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**HIGH**
	Sub-Surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Particulate Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Soluble Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**YES**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
Habitat	Physical Structure	Condition	**MEDIUM**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**HIGH**

Function Rating Summary

Function	Metrics/Notes	Rating
Hydrology	Condition	**HIGH**
Water Quality	Condition	**HIGH**
	Condition/Opportunity	**HIGH**
	Opportunity Presence? (Y/N)	**YES**
Habitat	Conditon	**MEDIUM**

Overall Wetland Rating **HIGH**

NC WAM WETLAND ASSESSMENT FORM
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name Little Troublesome Creek Wetland BB | **Date** 5/25/2010

Wetland Type Bottomland Hardwood Forest | **Assessor Name/Organization** Matt Jenkins, PWS

Level III Ecoregion Piedmont | **Nearest Named Water Body** Irvin Creek

River Basin Cape Fear | **USGS 8-Digit Catalogue Unit** 03030002

○ Yes ◉ No **Precipitation within 48 hrs?** | **Latitude/Longitude (deci-degrees)** 36.3343°N, 79.657915°W

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note below if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, approximately within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ○ Yes ◉ No

Describe effects of stressors that are present.
Four-wheeler trails, sediment deposition from adjacent UT1 flows

Regulatory Considerations
Select all that apply to the assessment area.

- ☐ Anadromous fish
- ☐ Federally protected species or State endangered or threatened species
- ☐ NCDWQ riparian buffer rule in effect
- ☐ Abuts a Primary Nursery Area (PNA)
- ☐ Publicly owned property
- ☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
- ☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
- ☐ Designated NCNHP reference community
- ☑ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (Check all that apply)

- ○ Blackwater
- ◉ Brownwater
- ☐ Tidal (if tidal, check one of the following boxes) ○ Lunar ○ Wind ○ Both

Is the assessment area on a coastal island? ○ Yes ◉ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ○ Yes ◉ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric
Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence of an effect.

GS	VS	
◉ A	◉ A	Not severely altered
○ B	○ B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], artificial hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric
Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and ditch sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
○ A	◉ A	Water storage capacity and duration are not altered.
◉ B	○ B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
○ C	○ C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric
Check a box in each column for each group below. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

AA	WT	
○ A	○ A	Majority of wetland with depressions able to pond water > 1 foot deep
○ B	○ B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
○ C	○ C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
◉ D	◉ D	Depressions able to pond water < 3 inches deep

- ○ A Evidence that maximum depth of inundation is greater than 2 feet
- ○ B Evidence that maximum depth of inundation is between 1 and 2 feet
- ◉ C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

- ☐ A Sandy soil
- ☉ B Loamy or clayey soils exhibiting redoxymorphic features (concentrations, depletions, or rhizospheres)
- ☐ C Loamy or clayey soils not exhibiting redoxymorphic features
- ☐ D Loamy or clayey gleyed soil
- ☐ E Histosol or histic epipedon

- ☉ A Soil ribbon < 1 inch
- ☐ B Soil ribbon ≥ 1 inch

- ☉ A No peat or muck presence
- ☐ B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☉ A	☉ A	Little or no evidence of pollutants or discharges entering the assessment area
☐ B	☐ B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐ C	☐ C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M). Effective riparian buffers are considered to be 50 feet wide in the Coastal Plain and Piedmont ecoregions and 30 feet wide in the Blue Ridge Mountains ecoregion.

WS	5M	2M	
☑ A	☑ A	☑ A	≥ 10% impervious surfaces
☐ B	☐ B	☐ B	< 10% impervious surfaces
☐ C	☐ C	☐ C	Confined animal operations (or other local, concentrated source of pollutants)
☐ D	☐ D	☐ D	≥ 20% coverage of pasture
☐ E	☐ E	☐ E	≥ 20% coverage of agricultural land (regularly plowed land)
☑ F	☑ F	☑ F	≥ 20% coverage of maintained grass/herb
☐ G	☐ G	☐ G	≥ 20% coverage of silvicultural land characterized by a clear-cut < 5 years old
☐ H	☐ H	☐ H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?

☉ Yes ☐ No If Yes, continue to 7b. If No, skip to Metric 8.

Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of the wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is weltand? Descriptor E should be selected if ditches effectively bypass the buffer.

- ☐ A ≥ 50 feet
- ☐ B From 30 to < 50 feet
- ☐ C From 15 to < 30 feet
- ☐ D From 5 to < 15 feet
- ☉ E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.

☐ ≤ 15-feet wide ☉ > 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?

☐ Yes ☉ No

7e. Is tributary or other open water sheltered or exposed?

- ☉ Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
- ☐ Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex metric

Check a box in each column for riverine wetlands only. Select the appropriate width for the wetland type at the assessment area (WT) and the wetland complex at the assessment areas (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐ A	☐ A	≥ 100 feet
☉ B	☉ B	From 80 to < 100 feet
☐ C	☐ C	From 50 to < 80 feet
☐ D	☐ D	From 40 to < 50 feet
☐ E	☐ E	From 30 to < 40 feet
☐ F	☐ F	From 15 to < 30 feet
☐ G	☐ G	From 5 to < 15 feet
☐ H	☐ H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.

- ○ A Evidence of short-duration inundation (< 7 consecutive days)
- ○ B Evidence of saturation, without evidence of inundation
- ◉ C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).

- ○ A Sediment deposition is not excessive, but at approximately natural levels.
- ◉ B Sediment deposition is excessive, but not overwhelming the wetland.
- ○ C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
○ A	○ A	○ A	≥ 500 acres
○ B	○ B	○ B	From 100 to < 500 acres
○ C	○ C	○ C	From 50 to < 100 acres
○ D	○ D	○ D	From 25 to < 50 acres
○ E	○ E	○ E	From 10 to < 25 acres
○ F	○ F	○ F	From 5 to < 10 acres
◉ G	◉ G	◉ G	From 1 to < 5 acres
○ H	○ H	○ H	From 0.5 to < 1 acre
○ I	○ I	○ I	From 0.1 to < 0.5 acre
○ J	○ J	○ J	From 0.01 to < 0.1 acre
○ K	○ K	○ K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

- ○ A Pocosin is the full extent (≥ 90%) of its natural landscape size.
- ○ B Pocosin is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column). Involves a GIS effort with field adjustment.** This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, urban landscapes, maintained fields (pasture open and agriculture), or water > 300 feet wide.

Well	Loosely	
○ A	○ A	≥ 500 acres
◉ B	○ B	From 100 to < 500 acres
○ C	○ C	From 50 to < 100 acres
○ D	○ D	From 10 to < 50 acres
○ E	○ E	< 10 acres
○ F	○ F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

○ Yes ○ No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include permanent features such as fields, development, two-lane or larger roads (≥ 40-feet wide), utility line corridors wider than a two-lane road, and clear-cuts < 10 years old. Consider the eight main points of the compass.

- ○ A No artificial edge within 150 feet in all directions
- ◉ B No artificial edge within 150 feet in four (4) to seven (7) directions
- ○ C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

- ○ A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ◉ B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ○ C Vegetation severely altered from reference in composition. Expected strata are unnaturally absent or dominated by exotic species or composed of planted stands of non-characteristic species or inappropriately composed of a single species.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

- ○ A Vegetation diversity is high and is composed primarily of native species (<10% cover of exotics).
- ○ B Vegetation diversity is low or has > 10% to 50% cover of exotics.
- ○ C Vegetation is dominated by exotic species (>50% cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?

(•) Yes ( ) No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

( ) A ≥ 25% coverage of vegetation
( ) B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

AA	WT	
(•) A	(•) A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
( ) B	( ) B	Canopy present, but opened more than natural gaps
( ) C	( ) C	Canopy sparse or absent
( ) A	( ) A	Dense mid-story/sapling layer
(•) B	(•) B	Moderate density mid-story/sapling layer
( ) C	( ) C	Mid-story/sapling layer sparse or absent
(•) A	(•) A	Dense shrub layer
( ) B	( ) B	Moderate density shrub layer
( ) C	( ) C	Shrub layer sparse or absent
( ) A	( ) A	Dense herb layer
( ) B	( ) B	Moderate density herb layer
(•) C	(•) C	Herb layer sparse or absent

18. Snags – wetland type condition metric

(•) A Large snags (more than one) are visible (> 12-inches DBH, or large relative to species present and landscape stability).
( ) B Not A

19. Diameter Class Distribution – wetland type condition metric

(•) A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
( ) B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12-inch DBH.
( ) C Majority of canopy trees are < 6 inches DBH or no trees.

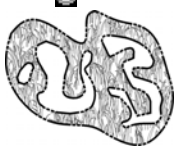
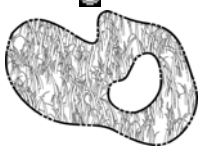
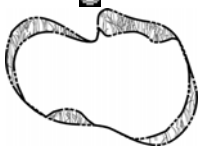
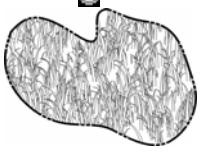
20. Large Woody Debris – wetland type condition metric

Include both natural debris and man-placed natural debris.

( ) A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
(•) B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

( ) A 
( ) B 
( ) C 
( ) D 

22. Hydrologic Connectivity – assessment area condition metric

Evaluate for riverine wetlands only. Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.

(•) A Overbank and overland flow are not severely altered in the assessment area.
( ) B Overbank flow is severely altered in the assessment area.
( ) C Overland flow is severely altered in the assessment area.
( ) D Both overbank and overland flow are severely altered in the assessment area.

Notes

Inundation in this system is a result of 4-wheeler activity impacts and excessive sediment deposits in UT1. Flows from this tributary have been taken off-line and allowed to flow through the floodplain.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name	Little Troublesome Creek Wetland BB	Date	5/25/2010
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Matt Jenkins, PWS

Presence of stressor affecting assessment area (Y/N)	YES
Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	YES
Assessment area is substantially altered by beaver (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-Surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence? (Y/N)	**YES**
	Particulate Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**YES**
	Physical Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence? (Y/N)	**YES**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
Habitat	Physical Structure	Condition	**HIGH**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics/Notes	Rating
Hydrology	Condition	**LOW**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence? (Y/N)	**YES**
Habitat	Conditon	**HIGH**

Overall Wetland Rating **LOW**

NC WAM WETLAND ASSESSMENT FORM
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name Little Troublesome Creek Wetland CC | **Date** 5/25/2010

Wetland Type Bottomland Hardwood Forest | **Assessor Name/Organization** Matt Jenkins, PWS

Level III Ecoregion Piedmont | **Nearest Named Water Body** Irvin Creek

River Basin Cape Fear | **USGS 8-Digit Catalogue Unit** 03030002

☐ Yes ◉ No **Precipitation within 48 hrs?** | **Latitude/Longitude (deci-degrees)** 36.335343°N, 79.657626°W

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note below if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, approximately within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☐ Yes ◉ No

Describe effects of stressors that are present.

Regulatory Considerations
Select all that apply to the assessment area.

- ☐ Anadromous fish
- ☐ Federally protected species or State endangered or threatened species
- ☐ NCDWQ riparian buffer rule in effect
- ☐ Abuts a Primary Nursery Area (PNA)
- ☐ Publicly owned property
- ☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
- ☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
- ☐ Designated NCNHP reference community
- ☑ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (Check all that apply)

- ☐ Blackwater
- ◉ Brownwater
- ☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ◉ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ◉ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric
Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence of an effect.

GS	VS	
◉ A	◉ A	Not severely altered
☐ B	☐ B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], artificial hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric
Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and ditch sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
◉ A	◉ A	Water storage capacity and duration are not altered.
☐ B	☐ B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐ C	☐ C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric
Check a box in each column for each group below. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

AA	WT	
☐ A	☐ A	Majority of wetland with depressions able to pond water > 1 foot deep
☐ B	☐ B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
◉ C	◉ C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
☐ D	☐ D	Depressions able to pond water < 3 inches deep

- ☐ A Evidence that maximum depth of inundation is greater than 2 feet
- ☐ B Evidence that maximum depth of inundation is between 1 and 2 feet
- ◉ C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

- ☐ A Sandy soil
- ☒ B Loamy or clayey soils exhibiting redoxymorphic features (concentrations, depletions, or rhizospheres)
- ☐ C Loamy or clayey soils not exhibiting redoxymorphic features
- ☐ D Loamy or clayey gleyed soil
- ☐ E Histosol or histic epipedon

- ☒ A Soil ribbon < 1 inch
- ☐ B Soil ribbon ≥ 1 inch

- ☒ A No peat or muck presence
- ☐ B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☒ A	☒ A	Little or no evidence of pollutants or discharges entering the assessment area
☐ B	☐ B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐ C	☐ C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M). Effective riparian buffers are considered to be 50 feet wide in the Coastal Plain and Piedmont ecoregions and 30 feet wide in the Blue Ridge Mountains ecoregion.

WS	5M	2M	
☑ A	☑ A	☑ A	≥ 10% impervious surfaces
☐ B	☐ B	☐ B	< 10% impervious surfaces
☐ C	☐ C	☐ C	Confined animal operations (or other local, concentrated source of pollutants)
☐ D	☐ D	☐ D	≥ 20% coverage of pasture
☐ E	☐ E	☐ E	≥ 20% coverage of agricultural land (regularly plowed land)
☑ F	☑ F	☑ F	≥ 20% coverage of maintained grass/herb
☐ G	☐ G	☐ G	≥ 20% coverage of silvicultural land characterized by a clear-cut < 5 years old
☐ H	☐ H	☐ H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?

☒ Yes ☐ No If Yes, continue to 7b. If No, skip to Metric 8.

Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of the wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is weltand? Descriptor E should be selected if ditches effectively bypass the buffer.

- ☐ A ≥ 50 feet
- ☒ B From 30 to < 50 feet
- ☐ C From 15 to < 30 feet
- ☐ D From 5 to < 15 feet
- ☐ E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.

☐ ≤ 15-feet wide ☒ > 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?

☐ Yes ☒ No

7e. Is tributary or other open water sheltered or exposed?

- ☒ Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
- ☐ Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex metric

Check a box in each column for riverine wetlands only. Select the appropriate width for the wetland type at the assessment area (WT) and the wetland complex at the assessment areas (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐ A	☐ A	≥ 100 feet
☐ B	☐ B	From 80 to < 100 feet
☐ C	☐ C	From 50 to < 80 feet
☐ D	☐ D	From 40 to < 50 feet
☐ E	☐ E	From 30 to < 40 feet
☐ F	☐ F	From 15 to < 30 feet
☒ G	☒ G	From 5 to < 15 feet
☐ H	☐ H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.

- ☐ A Evidence of short-duration inundation (< 7 consecutive days)
- ☐ B Evidence of saturation, without evidence of inundation
- ☉ C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).

- ☉ A Sediment deposition is not excessive, but at approximately natural levels.
- ☐ B Sediment deposition is excessive, but not overwhelming the wetland.
- ☐ C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐ A	☐ A	☐ A	≥ 500 acres
☐ B	☐ B	☐ B	From 100 to < 500 acres
☐ C	☐ C	☐ C	From 50 to < 100 acres
☐ D	☐ D	☐ D	From 25 to < 50 acres
☐ E	☐ E	☐ E	From 10 to < 25 acres
☐ F	☐ F	☐ F	From 5 to < 10 acres
☐ G	☐ G	☐ G	From 1 to < 5 acres
☐ H	☐ H	☐ H	From 0.5 to < 1 acre
☐ I	☐ I	☐ I	From 0.1 to < 0.5 acre
☉ J	☉ J	☉ J	From 0.01 to < 0.1 acre
☐ K	☐ K	☐ K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

- ☐ A Pocosin is the full extent (≥ 90%) of its natural landscape size.
- ☐ B Pocosin is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column). Involves a GIS effort with field adjustment.** This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, urban landscapes, maintained fields (pasture open and agriculture), or water > 300 feet wide.

Well	Loosely	
☐ A	☐ A	≥ 500 acres
☉ B	☐ B	From 100 to < 500 acres
☐ C	☐ C	From 50 to < 100 acres
☐ D	☐ D	From 10 to < 50 acres
☐ E	☐ E	< 10 acres
☐ F	☐ F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

☐ Yes ☐ No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include permanent features such as fields, development, two-lane or larger roads (≥ 40-feet wide), utility line corridors wider than a two-lane road, and clear-cuts < 10 years old. Consider the eight main points of the compass.

- ☐ A No artificial edge within 150 feet in all directions
- ☉ B No artificial edge within 150 feet in four (4) to seven (7) directions
- ☐ C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

- ☉ A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ☐ B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ☐ C Vegetation severely altered from reference in composition. Expected strata are unnaturally absent or dominated by exotic species or composed of planted stands of non-characteristic species or inappropriately composed of a single species.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

- ☐ A Vegetation diversity is high and is composed primarily of native species (<10% cover of exotics).
- ☐ B Vegetation diversity is low or has > 10% to 50% cover of exotics.
- ☐ C Vegetation is dominated by exotic species (>50% cover of exotics).

☐

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?

☒ Yes ☐ No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

☐ A ≥ 25% coverage of vegetation
☒ B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

AA	WT	
☒ A	☒ A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
☐ B	☐ B	Canopy present, but opened more than natural gaps
☐ C	☐ C	Canopy sparse or absent
☐ A	☐ A	Dense mid-story/sapling layer
☐ B	☐ B	Moderate density mid-story/sapling layer
☒ C	☒ C	Mid-story/sapling layer sparse or absent
☐ A	☐ A	Dense shrub layer
☐ B	☐ B	Moderate density shrub layer
☒ C	☒ C	Shrub layer sparse or absent
☐ A	☐ A	Dense herb layer
☐ B	☐ B	Moderate density herb layer
☒ C	☒ C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☒ A Large snags (more than one) are visible (> 12-inches DBH, or large relative to species present and landscape stability).
☐ B Not A

19. Diameter Class Distribution – wetland type condition metric

☒ A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐ B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12-inch DBH.
☐ C Majority of canopy trees are < 6 inches DBH or no trees.

20. Large Woody Debris – wetland type condition metric

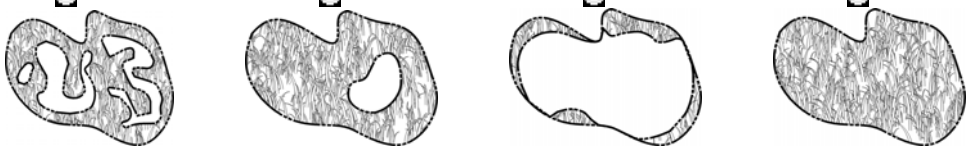
Include both natural debris and man-placed natural debris.

☐ A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒ B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐ A ☐ B ☐ C ☐ D



22. Hydrologic Connectivity – assessment area condition metric

Evaluate for riverine wetlands only. Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.

☒ A Overbank and overland flow are not severely altered in the assessment area.
☐ B Overbank flow is severely altered in the assessment area.
☐ C Overland flow is severely altered in the assessment area.
☐ D Both overbank and overland flow are severely altered in the assessment area.

Notes

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name	Little Troublesome Creek Wetland CC	Date	5/25/2010
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Matt Jenkins, PWS

Presence of stressor affecting assessment area (Y/N)	NO
Notes on Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	YES
Assessment area is substantially altered by beaver (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-Surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence? (Y/N)	**YES**
	Particulate Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**YES**
	Physical Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence? (Y/N)	**YES**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
Habitat	Physical Structure	Condition	**HIGH**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**HIGH**

Function Rating Summary

Function	Metrics/Notes	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence? (Y/N)	**YES**
Habitat	Conditon	**HIGH**

Overall Wetland Rating **MEDIUM**

NC WAM WETLAND ASSESSMENT FORM
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name Little Troublesome Creek Wetlands WL-1 & WL-2 **Date** 11/23/2010

Wetland Type Bottomland Hardwood Forest **Assessor Name/Organization** Matt Jenkins, PWS

Level III Ecoregion Piedmont **Nearest Named Water Body** Little Troublesome Creek

River Basin Cape Fear **USGS 8-Digit Catalogue Unit** 03030002

☐ Yes ◉ No **Precipitation within 48 hrs?** **Latitude/Longitude (deci-degrees)** 36.275194°N, 79.609577°W

Evidence of stressors affecting the assessment area (may not be within the assessment area)
Please circle and/or make note below if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, approximately within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ◉ Yes ☐ No

Describe effects of stressors that are present.
Vegetation is heavily managed, herbaceous strata layer only; located adjacent to active agricultural fields.

Regulatory Considerations
Select all that apply to the assessment area.

- ☐ Anadromous fish
- ☐ Federally protected species or State endangered or threatened species
- ☐ NCDWQ riparian buffer rule in effect
- ☐ Abuts a Primary Nursery Area (PNA)
- ☐ Publicly owned property
- ☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
- ☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
- ☐ Designated NCNHP reference community
- ☑ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (Check all that apply)

- ☐ Blackwater
- ◉ Brownwater
- ☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ◉ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ◉ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric
Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence of an effect.

GS	VS	
◉ A	☐ A	Not severely altered
☐ B	◉ B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], artificial hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric
Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. Refer to the current NRCS lateral effect of ditching guidance for North Carolina hydric soils (see USACE Wilmington District website) for the zone of influence of ditches in hydric soils. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and ditch sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐ A	◉ A	Water storage capacity and duration are not altered.
◉ B	☐ B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐ C	☐ C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric
Check a box in each column for each group below. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

AA	WT	
☐ A	☐ A	Majority of wetland with depressions able to pond water > 1 foot deep
☐ B	☐ B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
◉ C	◉ C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
☐ D	☐ D	Depressions able to pond water < 3 inches deep

- ☐ A Evidence that maximum depth of inundation is greater than 2 feet
- ☐ B Evidence that maximum depth of inundation is between 1 and 2 feet
- ◉ C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

- ☐ A Sandy soil
- ☉ B Loamy or clayey soils exhibiting redoxymorphic features (concentrations, depletions, or rhizospheres)
- ☐ C Loamy or clayey soils not exhibiting redoxymorphic features
- ☐ D Loamy or clayey gleyed soil
- ☐ E Histosol or histic epipedon

- ☉ A Soil ribbon < 1 inch
- ☐ B Soil ribbon ≥ 1 inch

- ☉ A No peat or muck presence
- ☐ B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☉ A	☉ A	Little or no evidence of pollutants or discharges entering the assessment area
☐ B	☐ B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐ C	☐ C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M). Effective riparian buffers are considered to be 50 feet wide in the Coastal Plain and Piedmont ecoregions and 30 feet wide in the Blue Ridge Mountains ecoregion.

WS	5M	2M	
☑ A	☐ A	☐ A	≥ 10% impervious surfaces
☐ B	☑ B	☑ B	< 10% impervious surfaces
☐ C	☐ C	☐ C	Confined animal operations (or other local, concentrated source of pollutants)
☐ D	☐ D	☑ D	≥ 20% coverage of pasture
☑ E	☑ E	☑ E	≥ 20% coverage of agricultural land (regularly plowed land)
☑ F	☑ F	☑ F	≥ 20% coverage of maintained grass/herb
☐ G	☐ G	☐ G	≥ 20% coverage of silvicultural land characterized by a clear-cut < 5 years old
☐ H	☐ H	☐ H	Little or no opportunity to improve water quality. Lack of opportunity may result from hydrologic alterations that prevent drainage or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area condition metric

7a. Is assessment area within 50 feet of a tributary or other open water?

☐ Yes ☉ No If Yes, continue to 7b. If No, skip to Metric 8.

Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of the wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is weltand? Descriptor E should be selected if ditches effectively bypass the buffer.

- ☐ A ≥ 50 feet
- ☐ B From 30 to < 50 feet
- ☐ C From 15 to < 30 feet
- ☐ D From 5 to < 15 feet
- ☐ E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.

☐ ≤ 15-feet wide ☐ > 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?

☐ Yes ☐ No

7e. Is tributary or other open water sheltered or exposed?

- ☐ Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
- ☐ Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex metric

Check a box in each column for riverine wetlands only. Select the appropriate width for the wetland type at the assessment area (WT) and the wetland complex at the assessment areas (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐ A	☐ A	≥ 100 feet
☐ B	☐ B	From 80 to < 100 feet
☉ C	☉ C	From 50 to < 80 feet
☐ D	☐ D	From 40 to < 50 feet
☐ E	☐ E	From 30 to < 40 feet
☐ F	☐ F	From 15 to < 30 feet
☐ G	☐ G	From 5 to < 15 feet
☐ H	☐ H	< 5 feet

9. Inundation Duration – assessment area condition metric

Answer for assessment area dominant landform.

- ☐ A Evidence of short-duration inundation (< 7 consecutive days)
- ☐ B Evidence of saturation, without evidence of inundation
- ☉ C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric

Consider recent deposition only (no plant growth since deposition).

- ☉ A Sediment deposition is not excessive, but at approximately natural levels.
- ☐ B Sediment deposition is excessive, but not overwhelming the wetland.
- ☐ C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐ A	☐ A	☐ A	≥ 500 acres
☐ B	☐ B	☐ B	From 100 to < 500 acres
☐ C	☐ C	☐ C	From 50 to < 100 acres
☐ D	☐ D	☐ D	From 25 to < 50 acres
☐ E	☐ E	☐ E	From 10 to < 25 acres
☐ F	☐ F	☐ F	From 5 to < 10 acres
☐ G	☐ G	☐ G	From 1 to < 5 acres
☉ H	☉ H	☐ H	From 0.5 to < 1 acre
☐ I	☐ I	☐ I	From 0.1 to < 0.5 acre
☐ J	☐ J	☐ J	From 0.01 to < 0.1 acre
☐ K	☐ K	☉ K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

- ☐ A Pocosin is the full extent (≥ 90%) of its natural landscape size.
- ☐ B Pocosin is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column). Involves a GIS effort with field adjustment.** This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, urban landscapes, maintained fields (pasture open and agriculture), or water > 300 feet wide.

Well	Loosely	
☐ A	☉ A	≥ 500 acres
☐ B	☐ B	From 100 to < 500 acres
☐ C	☐ C	From 50 to < 100 acres
☐ D	☐ D	From 10 to < 50 acres
☐ E	☐ E	< 10 acres
☉ F	☐ F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

☐ Yes ☐ No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include permanent features such as fields, development, two-lane or larger roads (≥ 40-feet wide), utility line corridors wider than a two-lane road, and clear-cuts < 10 years old. Consider the eight main points of the compass.

- ☐ A No artificial edge within 150 feet in all directions
- ☐ B No artificial edge within 150 feet in four (4) to seven (7) directions
- ☉ C An artificial edge occurs within 150 feet in more than four (4) directions or assessment area is clear-cut

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

- ☐ A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
- ☐ B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
- ☉ C Vegetation severely altered from reference in composition. Expected strata are unnaturally absent or dominated by exotic species or composed of planted stands of non-characteristic species or inappropriately composed of a single species.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

- ☐ A Vegetation diversity is high and is composed primarily of native species (<10% cover of exotics).
- ☐ B Vegetation diversity is low or has > 10% to 50% cover of exotics.
- ☐ C Vegetation is dominated by exotic species (>50% cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?

☒ Yes ☐ No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

☐ A ≥ 25% coverage of vegetation
☒ B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

AA	WT	
☐ A	☐ A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
☐ B	☐ B	Canopy present, but opened more than natural gaps
☒ C	☒ C	Canopy sparse or absent
☐ A	☐ A	Dense mid-story/sapling layer
☐ B	☐ B	Moderate density mid-story/sapling layer
☒ C	☒ C	Mid-story/sapling layer sparse or absent
☐ A	☐ A	Dense shrub layer
☐ B	☐ B	Moderate density shrub layer
☒ C	☒ C	Shrub layer sparse or absent
☒ A	☒ A	Dense herb layer
☐ B	☐ B	Moderate density herb layer
☐ C	☐ C	Herb layer sparse or absent

18. Snags – wetland type condition metric

☐ A Large snags (more than one) are visible (> 12-inches DBH, or large relative to species present and landscape stability).
☒ B Not A

19. Diameter Class Distribution – wetland type condition metric

☐ A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐ B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12-inch DBH.
☒ C Majority of canopy trees are < 6 inches DBH or no trees.

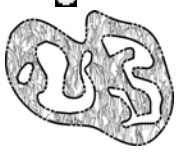
20. Large Woody Debris – wetland type condition metric

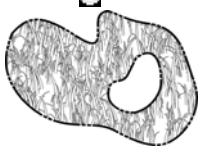
Include both natural debris and man-placed natural debris.

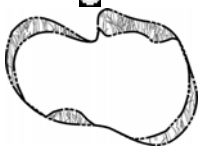
☐ A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒ B Not A

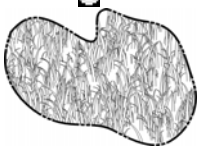
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐ A 

☐ B 

☐ C 

☐ D 

22. Hydrologic Connectivity – assessment area condition metric

Evaluate for riverine wetlands only. Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision.

☐ A Overbank and overland flow are not severely altered in the assessment area.
☐ B Overbank flow is severely altered in the assessment area.
☒ C Overland flow is severely altered in the assessment area.
☐ D Both overbank and overland flow are severely altered in the assessment area.

Notes

The lower crop field has been heavily ditched allowing for overland flow to drain more quickly from Wetland WL-1.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 3.0
Rating Calculator Version 3.0

Wetland Site Name	Little Troublesome Creek Wetland WL-1	Date	11/23/2010
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Matt Jenkins, PWS

Presence of stressor affecting assessment area (Y/N)	YES
Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Wetland is intensively managed (Y/N)	YES
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	NO
Assessment area is substantially altered by beaver (Y/N)	NO

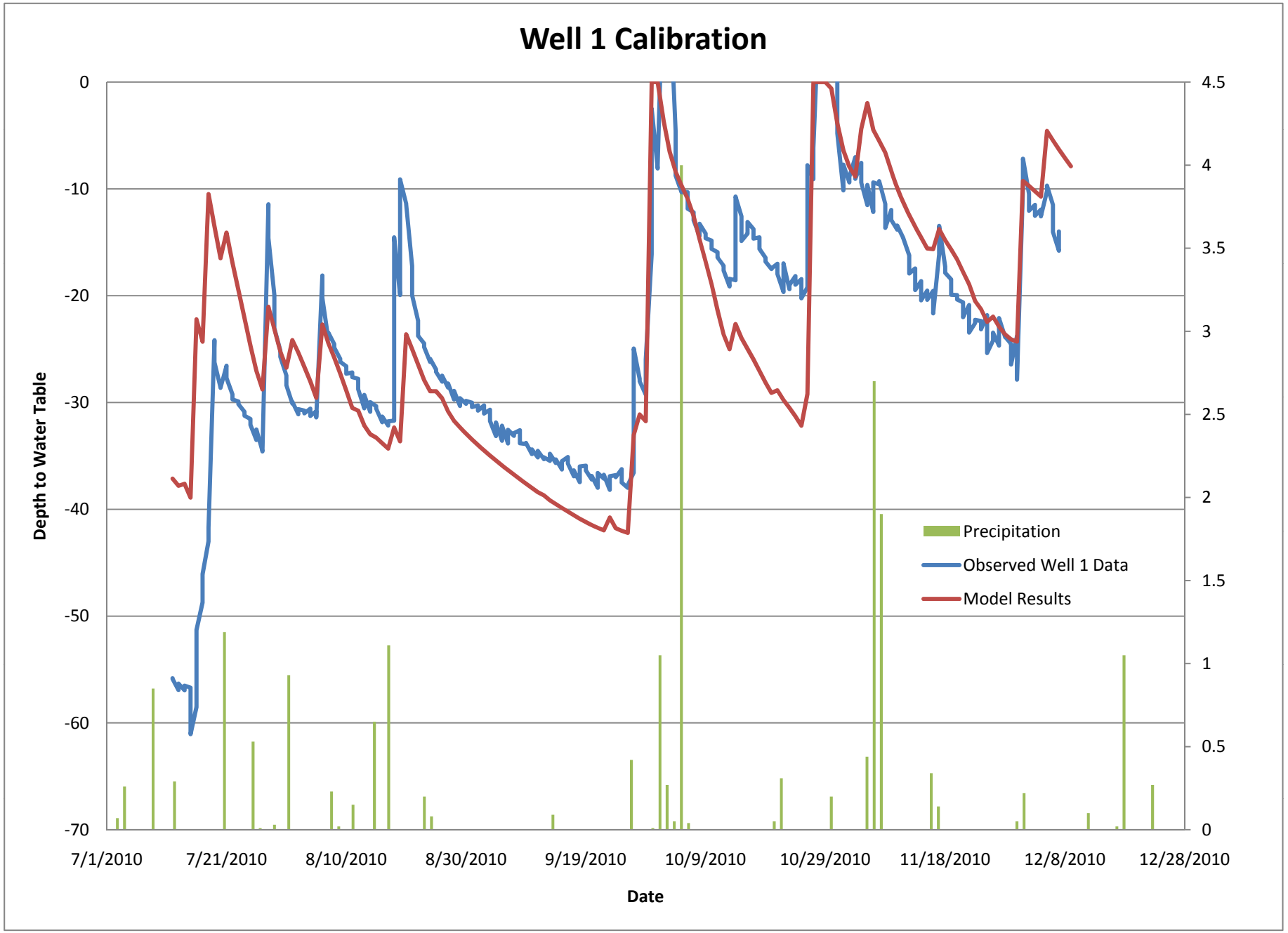
Sub-function Rating Summary

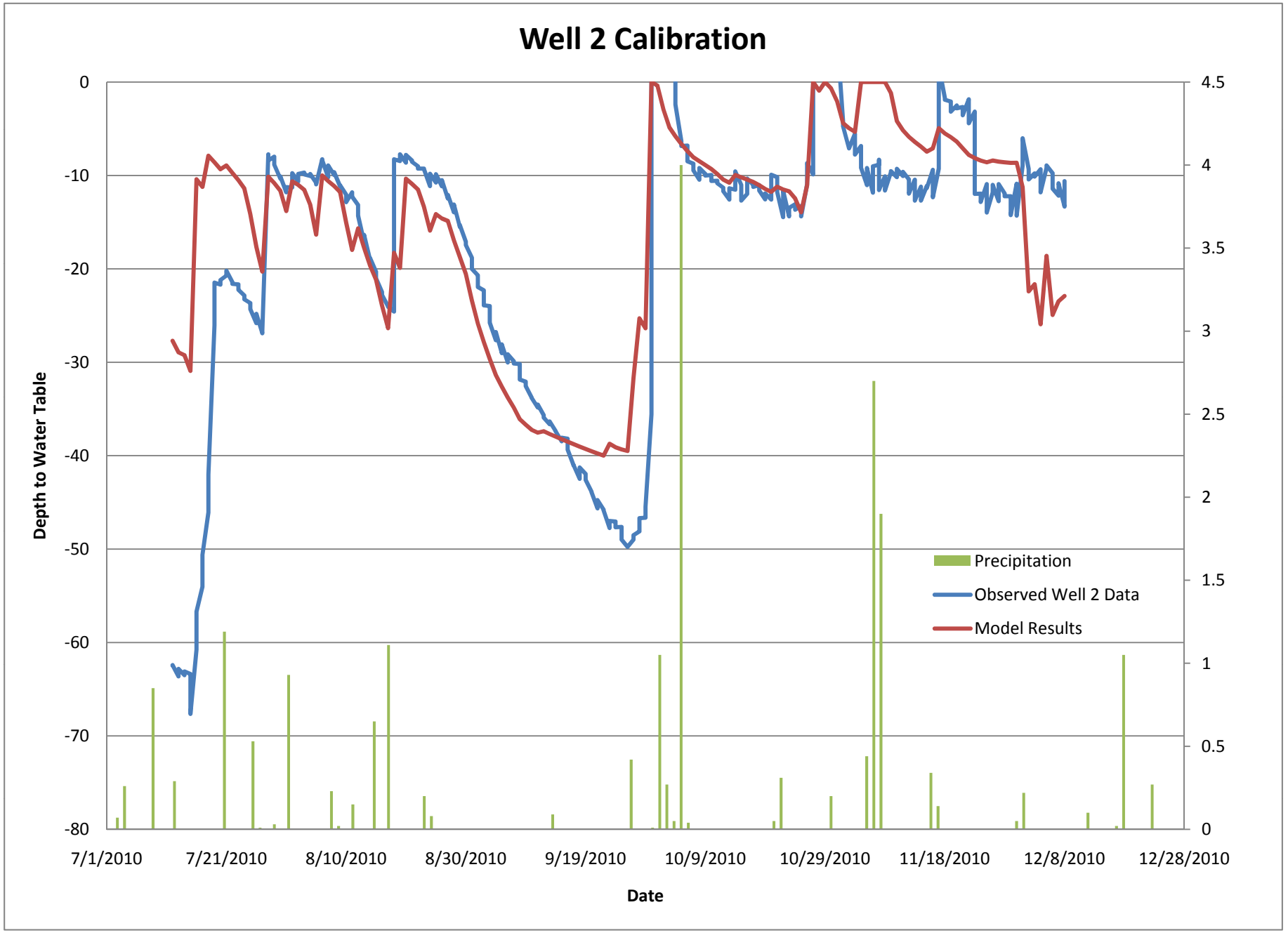
Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-Surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**NO**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**NO**
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence? (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

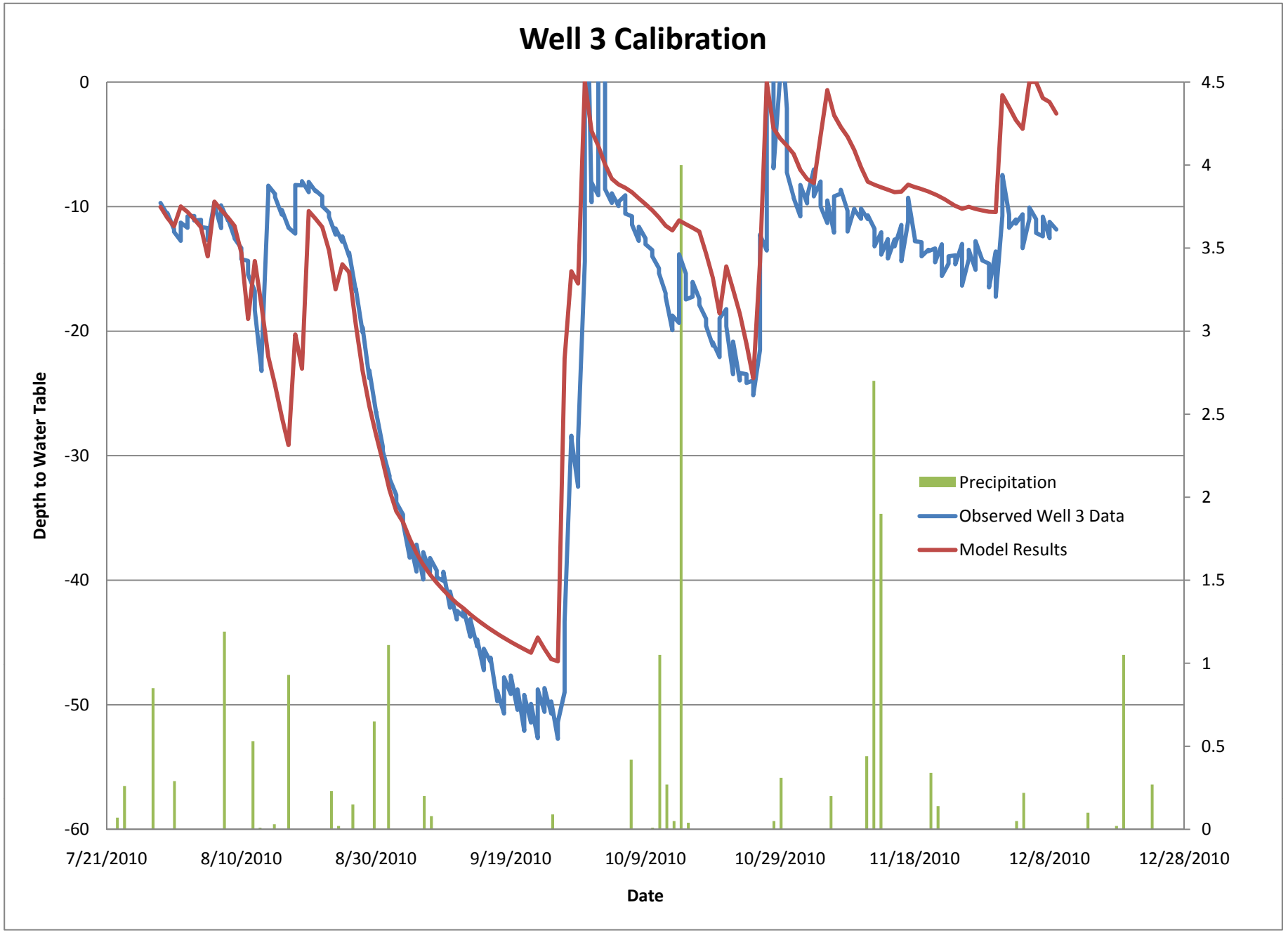
Function Rating Summary

Function	Metrics/Notes	Rating
Hydrology	Condition	**LOW**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence? (Y/N)	**YES**
Habitat	Conditon	**LOW**

Overall Wetland Rating **LOW**


Well 1 Calibration
Depth to Water Table
0
-10
-20
-30
-40
-50
-60
-70
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/1/2010
7/21/2010
8/10/2010
8/30/2010
9/19/2010
10/9/2010
10/29/2010
11/18/2010
12/8/2010
12/28/2010
Date
Precipitation
Observed Well 1 Data
Model Results


Well 2 Calibration
Depth to Water Table
0
-10
-20
-30
-40
-50
-60
-70
-80
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/1/2010
7/21/2010
8/10/2010
8/30/2010
9/19/2010
10/9/2010
10/29/2010
11/18/2010
12/8/2010
12/28/2010
Date
Precipitation
Observed Well 2 Data
Model Results


Well 3 Calibration
Depth to Water Table
0
-10
-20
-30
-40
-50
-60
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/21/2010
8/10/2010
8/30/2010
9/19/2010
10/9/2010
10/29/2010
11/18/2010
12/8/2010
12/28/2010
Date
Precipitation
Observed Well 3 Data
Model Results

Sample Number	Depth (in)	Munsell Color	Texture	Mottle %	Mottle Munsell Color	Mottle %	Mottle Munsell Color	Free Water Surface Depth (in)	Recorded Soil Type	Confirmed Soil Type	Transect	Notes
SC1	0-24	7.5 YR 5/6	sandy loam						Codorus		1	
	24+	7.5 YR 6/1	clay loam	30%	7.5 YR 5/6							
SC2	0-14	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6				Haw River		1	
	14+	7.5 YR 6/1	clay loam	35%	7.5 YR 5/6							
SC3	0-20+	7.5 YR 6/6	clay loam	20%	7.5 YR 5/6				Haw River		1	10 ft off ditch
SC4	0-14	7.5 YR 5/2	clay loam	35%	7.5 YR 5/6				Haw River		2	
	14+	7.5 YR 6/1	clay loam	10%	7.5 YR 5/6							
SC5	0-20+	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6				Haw River		2	10% blackened mn
SC6	0-6	7.5 YR 5/3	clay loam						Haw River		2	
	6-20	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6							
	20+	7.5 YR 6/1	clay loam	20%	7.5 YR 3/2	10%	7.5 YR 5/6					
SC7	0-8	7.5 YR 5/3	clay loam						Codorus		2	
	8-20	7.5 YR 5/2	clay loam	30%	7.5 YR 5/6							
	20+	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6							
SC8	0-18	7.5 YR 5/6	sandy loam						Codorus		2	
	18-30	7.5 YR 5/4	sandy loam	20%	7.5 YR 5/6	20%	7.5 YR 5/2					
SC9	0-30	7.5 YR 5/5	sandy loam						Codorus		3	
SC10	0-16	7.5 YR 5/4	sandy loam	20%	7.5 YR 5/6				Codorus			
	16+	7.5 YR 5/2	sandy loam	20%	7.5 YR 5/6							
SC11	0-4	7.5 YR 5/4	clay loam	20%	7.5 YR 5/6				Haw River			
	4+	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6							blackened mn (no % noted)
SC12	0-16	7.5 YR 5/2	clay loam	10%	7.5 YR 5/6				Haw River			blackened mn (no % noted)
	16-24	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6							
SC13	0-24	7.5 YR 5/1	clay loam	30%	7.5 YR 5/6			0	Haw River		4	blackened mn (no % noted); within mapped wetland
SC14	0-6	7.5 YR 5/2	clay loam	30%	7.5 YR 5/6			12	Codorus		4	
	6-12	7.5 YR 5/5	sandy loam									
	12+	7.5 YR 5/1	clay loam	30%	7.5 YR 5/6							
SC15	0-24	7.5 YR 5/4	loam	10%	7.5 YR 5/2				Codorus		4	
	24+	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6							
SC16	0-24	7.5 YR 5/4	loam	10%	7.5 YR 5/2				Codorus		5	
	24+	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6							
SC17	0-24+	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6				Haw River		5	within mapped wetland
SC18	0-18	7.5 YR 5/5	loam						Codorus		6	
	18-24+	7.5 YR 5/1	sandy loam	20%	7.5 YR 5/6							
SC19	0-6	7.5 YR 5/3	clay loam	20%	7.5 YR 4/6				Codorus		6	
	6-24	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6							
SC20	0-12	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6			6	Haw River		6	
	12-24	7.5 YR 5/1	clay loam									
SC21	0-24+	7.5 YR 5/2	loam	30%	7.5 YR 5/6				Codorus		7	
SC22	0-24	7.5 YR 5/5	loam						Codorus		7	
	24+	7.5 YR 5/2	loam	20%	7.5 YR 5/6							
SC23	0-8	7.5 YR 5/4	loam					12	Codorus		8	
	8-12	7.5 YR 5/4	sandy loam									
	12-24+	7.5 YR 5/1	sandy loam	10%	7.5 YR 5/6							
SC24	0-10	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6			10	Haw River		1	
	10+	7.5 YR 5/1	clay loam	20%	7.5 YR 5/6							
SC25	0-24+	7.5 YR 5/1	clay loam	10%	7.5 YR 5/6				Haw River		1	
SC26	0-10	7.5 YR 5/2	clay loam	20%	7.5 YR 5/6			10	Haw River			
	10-24	7.5 YR 5/1	clay loam	10%	7.5 YR 5/6							
DP1	0-12	7.5 YR 5/2	silt loam		7.5 YR 4/6			12	Haw River			
DP2	0-6	7.5 YR 5/2	silt loam		7.5 YR 4/6			10	Codorus			
	6-12	7.5 YR 5/1	silt loam		7.5 YR 4/6							
DP3	0-6	7.5 YR 4/4	silt loam						Haw River			concretions
	6-12	7.5 YR 5/4	silt loam		7.5 YR 3/4							
DP4	0-8	10 YR 3/4	silt loam						Haw River			
	8-12	10 YR 5/4	silt loam		7.5YR 4/4							
DP5	0-6	7.5 YR 4/4	silt loam		7.5YR 4/6				Haw River			
	6-12	7.5 YR 5/7	silt loam		7.5YR 3/4							concretions
DP6	0-2	7.5 YR 5/2	silt loam		7.5YR 4/6				Haw River			
	2-12	7.5 YR 5/1	silt loam		5YR 4/6			12				

Note: SC data collected in a grid across the site on December 9, 2010; DP data collected during wetland delineation on X/X/2010

Soils Descriptions performed by **Mike Ortosky** (NC Licensed Soil Scientist # 1075)

Apple Property - 3/1/10

Profile #1

Depth	Color (Munsell)	Mottles	Texture	Notes
0-4	7.5 YR 5/4	C2D 10YR 5/2 & 5/6	Clay Loam	
4-12	10 YR 5/2	C2D 7.5 YR 5/6	Clay Loam	
12-16	10 YR 4/2	C2D 7.5 YR 5/6	Clay	
16-20	10 YR 6/1	7.5 YR 5/6 (50%)	Clay	

Profile #2 (same characteristics as #1)

Depth	Color (Munsell)	Mottles	Texture	Notes
0-4	7.5 YR 5/4	C2D 10YR 5/2 & 5/6	Clay Loam	
4-12	10 YR 5/2	C2D 7.5 YR 5/6	Clay Loam	
12-16	10 YR 4/2	C2D 7.5 YR 5/6	Clay	
16-20	10 YR 6/1	7.5 YR 5/6 (50%)	Clay	

Profile #3 (same characteristics as # 1 & 2)

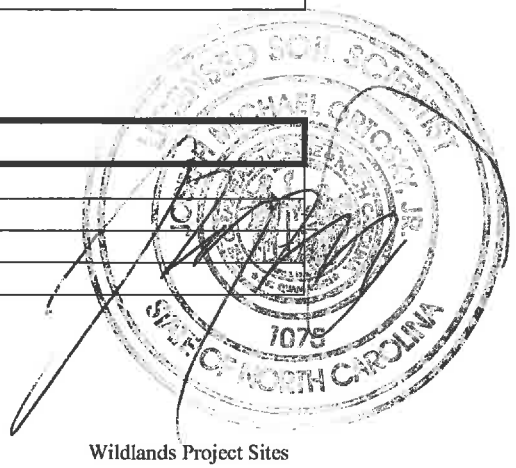
Depth	Color (Munsell)	Mottles	Texture	Notes
0-4	7.5 YR 5/4	C2D 10YR 5/2 & 5/6	Clay Loam	
4-12	10 YR 5/2	C2D 7.5 YR 5/6	Clay Loam	
12-16	10 YR 4/2	C2D 7.5 YR 5/6	Clay	
16-20	10 YR 6/1	7.5 YR 5/6 (50%)	Clay	

Profile #4

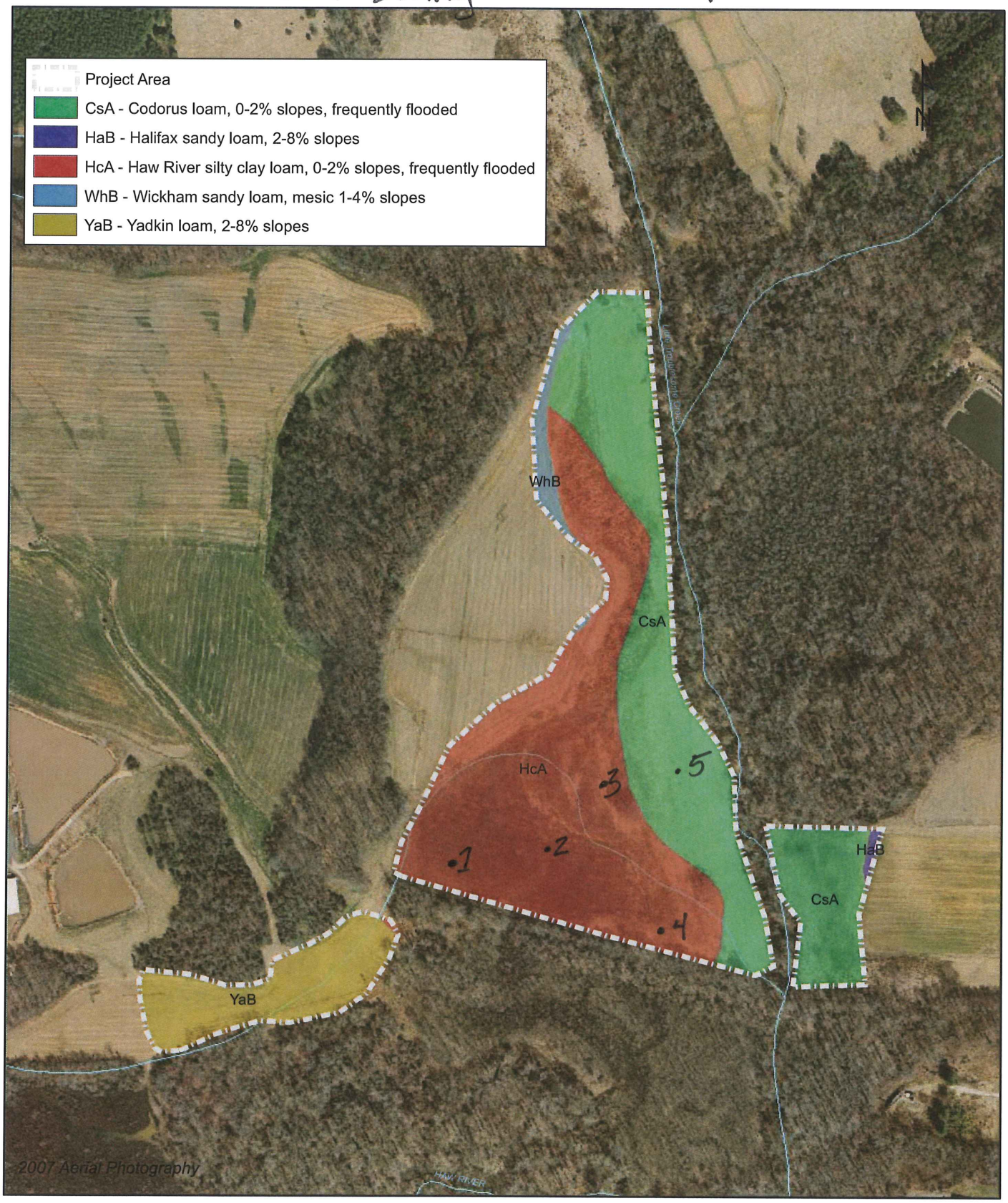
Depth	Color (Munsell)	Mottles	Texture	Notes
0-10	10 YR 4/4		Clay Loam	
10-14	7.5 YR 5/4	C2D 10YR 5/2 & 5/6	Clay Loam	
14-22	10 YR 5/2	C2D 7.5 YR 5/6	Clay	

Profile #5

Depth	Color (Munsell)	Mottles	Texture	Notes
0-8	7.5YR 4/3		Loam	
8-16	7.5 YR 4/4	C2D 10 YR 5/3	Clay Loam	
16-20	7.5 YR 4/2	F2D 10 YR 5/6	Clay Loam	
20+	10 YR 5/1	C2D 10 YR 5/6	Clay	



Soil Boring Location Map



WILDLANDS

0 175 350 Feet

Soils Map
Little Troublesome Creek
Mitigation Site

Rockingham County, NC

APPENDIX 3

Agency Communication and Approved Categorical Exclusion

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:	Little Troublesome Creek Mitigation Site
County Name:	Rockingham County
EEP Number:	003267
Project Sponsor:	Wildlands Engineering, Inc.
Project Contact Name:	Andrea M. Spangler
Project Contact Address:	1430 S. Mint Street, Suite 104, Charlotte, NC 28203
Project Contact E-mail:	aspangler@wildlandsinc.com
EEP Project Manager:	Guy Pearce

Project Description

The Little Troublesome Creek Mitigation Site is a stream and wetland mitigation project located in Rockingham County, NC. The project consists of two non-adjacent areas: stream mitigation area located on Little Troublesome Creek and Irvin Creek in the City of Reidsville and wetland mitigation area located on Little Troublesome Creek south of the City of Reidsville. The project as a whole will provide stream and wetland mitigation units to NCEEP in the Cape Fear River Basin (03030002).

For Official Use Only

Reviewed By:

Guy C Pearce — 9/20/2010

Date — **EEP Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

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

Final Approval By:

9-17-10 — [signature]

Date — **For Division Administrator FHWA**

July 16, 2009

Mr. Peter Sandbeck
Deputy State Historic Preservation Officer
North Carolina State Historic Preservation Office
4617 Mail Service Center
Raleigh, North Carolina 27699-4617

Subject: **Request for Records Search**
Little Troublesome Creek Mitigation Bank
Reidsville, North Carolina

Dear Mr. Sandbeck:

We are hereby contacting the North Carolina State Historic Preservation Office regarding the presence of any historic properties or cultural resources within the referenced project corridor. The project is located along Little Troublesome Creek, south of Turner Road in Reidsville, NC (Figure 1). The attached USGS Site Location Map illustrates the approximate location of the project area. Figure 1 was prepared from the Reidsville Quadrangle, North Carolina.

This project is located within a mixed use, low density commercial and residential area with adjacent roadways, wooded areas, and parking lots. The purpose of this project is to perform stream restoration and enhancement activities. Construction of this project will cause unavoidable impacts to jurisdictional waters of the U.S. and require Section 404/401 permitting.

Please provide a written response concerning your determination regarding the presence of any historic properties or cultural resources within the project area. Thank you for your attention to this matter.

Sincerely,

Matt L. Jenkins, PWS
Environmental Scientist

Attachment:
Figure 1. USGS Site Location Map

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

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

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

July 23, 2009

Matt Jenkins
Wildlands Engineering, Inc.
1430 South Mint Street
Suite 104
Charlotte, NC 28203

Re: Little Troublesome Creek Mitigation Bank, Reidsville, Rockingham County, ER 09-1682

Dear Mr. Jenkins:

Thank you for your letter of July 16, 2009, concerning the above project.

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

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

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

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

July 12, 2010

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

Subject: EEP Wetland and Stream mitigation project in Rockingham County.
Little Troublesome Creek Mitigation Project

Dear Ms. Gledhill-Earley,

The Ecosystem Enhancement Program (EEP) requests review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential wetland and stream restoration project on the attached site (USGS site map with approximate property lines and areas of potential ground disturbance is enclosed).

The Little Troublesome Creek site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. The majority of the site has historically been disturbed due to agricultural purposes such as tilling.

In addition, Wildlands contracted New South Associates to perform an "in-office" historical screening of the area. Maps from 1926 and 1938 showed no buildings in the site. The archaeological site files at the North Carolina Office of State Archaeology (OSA) were not reviewed. Due to the site's location in an active floodplain with poorly drained soils, New South Associates' professional opinion was that more detailed surveys would not be required. Enclosed are current photos of the site.

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

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

Sincerely,

Andrea M. Spangler
Senior Environmental Planner

cc:
Donnie Brew, EEP
1652 Mail Service Center
Raleigh, NC 27699

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

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

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

July 28, 2010

Andrea Spangler
Wildlands Engineering, Inc.
1430 South Mint Street, #104
Charlotte, NC 28203

Re: Little Troublesome Creek Mitigation Project, Rockingham County, ER 10-1314

Dear Ms. Spangler:

Thank you for your letter of July 12, 2010, concerning the above project.

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

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

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

Sincerely,

Renee Gledhill-Earley

for Peter Sandbeck

July 12, 2010

Dale Suiter
US Fish and Wildlife Service
Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636

Subject: **Little Troublesome Creek Mitigation Site**
Rockingham County, North Carolina

Dear Mr. Suiter,

The Little Troublesome Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel throughout the site have been identified as significantly degraded. Additionally, a downstream area has been identified for wetland creation and restoration.

We have already obtained an updated species list for Rockingham County from your web site (http://nc-es.fws.gov/es/countyfr.html). The threatened or endangered species for this county are: the Roanoke logperch (*Percina rex*), James spinymussel (*Pleurobema collina*), and smooth coneflower (*Echinacea laevigata*). We are requesting that you please provide any known information for each species in the county. The USFWS will be contacted if suitable habitat for any listed species is found or if we determine that the project may affect one or more federally listed species or designated critical habitat.

Please provide comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of a stream and wetland restoration project on the subject properties. A USGS map (Figure 1) showing the approximate property lines and areas of potential ground disturbance is enclosed. Figure 1 was prepared from the Reidsville, NC 7.5-Minute Topographic Quadrangle.

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

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

Sincerely,

Matt L. Jenkins, PWS
Environmental Scientist

Attachment:
Figure 1. USGS Topographic Map

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

July 28, 2010

Matt Jenkins
Wildlands Engineering, Inc.
1430 South Mint Street Suite 104
Charlotte, NC 28203

Re: Little Troublesome Creek Mitigation Site- Rockingham County, NC

Dear Mr. Jenkins:

This letter is to inform you that a list of all federally-protected endangered and threatened species with known occurrences in North Carolina is now available on the U.S. Fish and Wildlife Service's (Service) web page at http://www.fws.gov/raleigh. Therefore, if you have projects that occur within the Raleigh Field Office's area of responsibility (see attached county list), you no longer need to contact the Raleigh Field Office for a list of federally-protected species.

Our web page contains a complete and frequently updated list of all endangered and threatened species protected by the provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act), and a list of federal species of concern[1] that are known to occur in each county in North Carolina.

Section 7 of the Act requires that all federal agencies (or their designated non-federal representative), in consultation with the Service, insure that any action federally authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. In addition to the federally-protected species list, information on the species' life histories and habitats and information on completing a biological assessment or evaluation and can be found on our web page at http://www.fws.gov/raleigh. Please check the web site often for updated information or changes.

[1] The term "federal species of concern" refers to those species which the Service believes might be in need of concentrated conservation actions. Federal species of concern receive no legal protection and their designation does not necessarily imply that the species will eventually be proposed for listing as a federally endangered or threatened species. However, we recommend that all practicable measures be taken to avoid or minimize adverse impacts to federal species of concern.

If your project contains suitable habitat for any of the federally-listed species known to be present within the county where your project occurs, the proposed action has the potential to adversely affect those species. As such, we recommend that surveys be conducted to determine the species' presence or absence within the project area. The use of North Carolina Natural Heritage program data should not be substituted for actual field surveys.

If you determine that the proposed action may affect (i.e., likely to adversely affect or not likely to adversely affect) a federally-protected species, you should notify this office with your determination, the results of your surveys, survey methodologies, and an analysis of the effects of the action on listed species, including consideration of direct, indirect, and cumulative effects, before conducting any activities that might affect the species. If you determine that the proposed action will have no effect (i.e., no beneficial or adverse, direct or indirect effect) on federally listed species, then you are not required to contact our office for concurrence (unless an Environmental Impact Statement is prepared). However, you should maintain a complete record of the assessment, including steps leading to your determination of effect, the qualified personnel conducting the assessment, habitat conditions, site photographs, and any other related articles.

With regard to the above-referenced project, we offer the following remarks. Our comments are submitted pursuant to, and in accordance with, provisions of the Endangered Species Act.

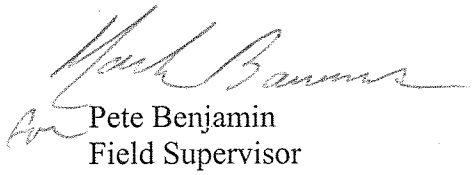
Based on the information provided and other information available, it appears that the proposed action is not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act at these sites. We believe that the requirements of section 7(a)(2) of the Act have been satisfied for your project. Please remember that obligations under section 7 consultation must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

However, the Service is concerned about the potential impacts the proposed action might have on aquatic species. Aquatic resources are highly susceptible to sedimentation. Therefore, we recommend that all practicable measures be taken to avoid adverse impacts to aquatic species, including implementing directional boring methods and stringent sediment and erosion control measures. An erosion and sedimentation control plan should be submitted to and approved by the North Carolina Division of Land Resources, Land Quality Section prior to construction. Erosion and sedimentation controls should be installed and maintained between the construction site and any nearby down-gradient surface waters. In addition, we recommend maintaining natural, vegetated buffers on all streams and creeks adjacent to the project site.

The North Carolina Wildlife Resources Commission has developed a Guidance Memorandum (a copy can be found on our website at (http://www.fws.gov/raleigh) to address and mitigate secondary and cumulative impacts to aquatic and terrestrial wildlife resources and water quality. We recommend that you consider this document in the development of your projects and in completing an initiation package for consultation (if necessary).

We hope you find our web page useful and informative and that following the process described above will reduce the time required, and eliminate the need, for general correspondence for species' lists. If you have any questions or comments, please contact Mark Bowers of this office at (919) 856-4520 ext. 19.

Sincerely,



Pete Benjamin
Field Supervisor

July 12, 2010

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

Subject: **Little Troublesome Creek Mitigation Site**
Rockingham County, North Carolina

Dear Mr. Deaton,

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a potential stream and wetland restoration project on the attached sites. A USGS map (Figure 1) showing the approximate property lines and areas of potential ground disturbance is enclosed. Figure 1 was prepared from the Reidsville, NC 7.5-Minute Topographic Quadrangle.

The Little Troublesome Creek Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel throughout the site have been identified as significantly degraded. Additionally, a downstream area has been identified for wetland creation and restoration.

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

Sincerely,

Matt L. Jenkins, PWS
Environmental Scientist

Attachment:
Figure 1. USGS Topographic Map

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

28 July 2010

Matt L. Jenkins, PWS
Wildlands Engineering, Inc.
1430 South Mint Street
Suite 104
Charlotte, NC 28203

Subject: Little Troublesome Creek Mitigation Site – Rockingham County, North Carolina.

Dear Mr. Jenkins:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject information. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and North Carolina General Statutes (G.S. 113-131 et seq.).

The proposed project includes restoration of a degraded stream channel and downstream wetland creation and restoration in Little Troublesome Creek. Little Troublesome Creek is a tributary to Haw River in the Cape Fear River basin. There are records for the state significantly rare Carolina ladle crayfish (*Cambarus davidi*) in Little Troublesome Creek.

Stream and wetland restoration projects often improve water quality and aquatic habitat. We recommend establishing native, forested buffers in riparian areas to protect water quality, improve terrestrial habitat, and provide a travel corridor for wildlife species. Provided natural channel design methods are used and measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this project. If we can provide further assistance, please contact our office at (336) 449-7625.

Sincerely,

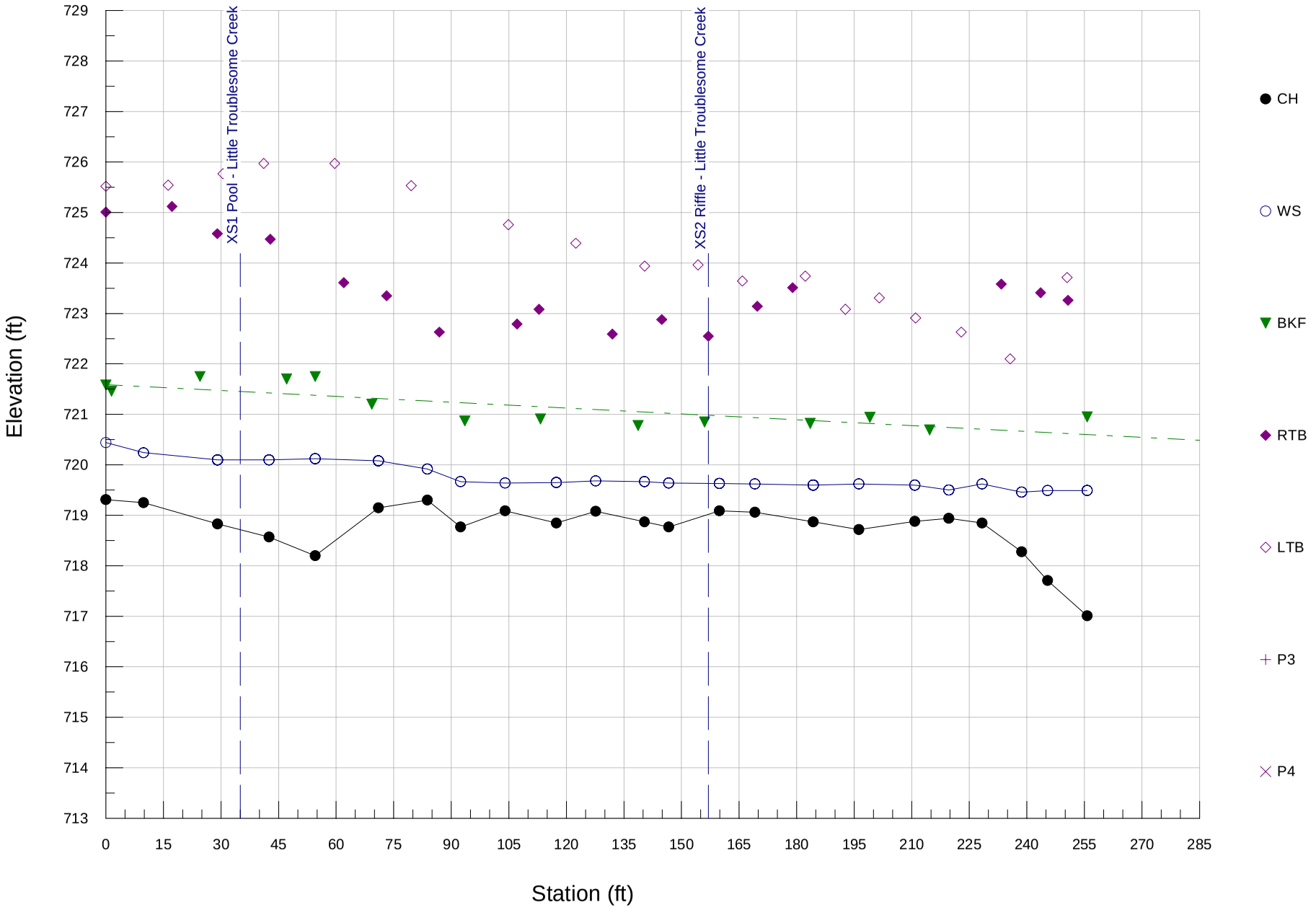
Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

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

APPENDIX 4

Existing Conditions Data

Reach 1 Profile - Little Troublesome Creek



Reach 1 Profile
RIVERMORPH PROFILE SUMMARY

River Name: Little Troublesome
Reach Name: Reach 1
Profile Name: Reach 1 Profile - Little Troublesome Creek
Survey Date: 12/09/09

Survey Data

DIST	CH	WS	BKF	RTB	LTB
0	719.31	720.44	721.58	725.01	725.52
1.424			721.46		
9.832	719.25	720.24			
16.239					725.54
17.224				725.12	
24.494			721.75		
29.05				724.58	
29.083	718.83	720.1			
30.518					725.77
41.145					725.97
42.52	718.57	720.1			
42.801				724.47	
47.088			721.7		
54.562	718.2	720.12			
54.562			721.75		
59.634					725.97
61.969				723.61	
69.319			721.2		
71.02	719.15	720.08			
73.14				723.35	
79.54					725.53
83.785	719.3	719.92			
86.903				722.63	
92.461	718.77	719.67			
93.523			720.87		
104.054	719.09	719.64			
104.886					724.76
107.118				722.79	
112.865				723.08	
113.222			720.91		
117.371	718.85	719.65			
122.485					724.39
127.671	719.08	719.68			
131.982				722.59	
138.692			720.78		
140.37	718.87	719.67			
140.378					723.94
144.875				722.88	
146.696	718.77	719.64			
154.286					723.96
155.999			720.85		
157.014				722.55	
159.862	719.09	719.63			
165.875					723.64
169.147	719.06	719.62			
169.732				723.14	
178.937				723.51	

Reach 1 Profile

182.241					723.74
183.563			720.82		
184.348	718.87	719.6			
192.724					723.08
196.23	718.72	719.62			
199.089			720.94		
201.555					723.31
210.82	718.88	719.6			
211.005					722.91
214.67			720.69		
219.643	718.94	719.5			
222.894					722.63
228.313	718.85	719.62			
233.356				723.58	
235.681					722.1
238.641	718.28	719.46			
243.61				723.41	
245.419	717.71	719.49			
250.46					723.71
250.709				723.26	
255.718	717.01	719.49	720.95		

Cross Section Locations

Cross Section Name	Type	Profile Station
XS1 Pool - Little Troublesome Creek	Pool	34.92
XS2 Riffle - Little Troublesome Creek	Riffle	156.53

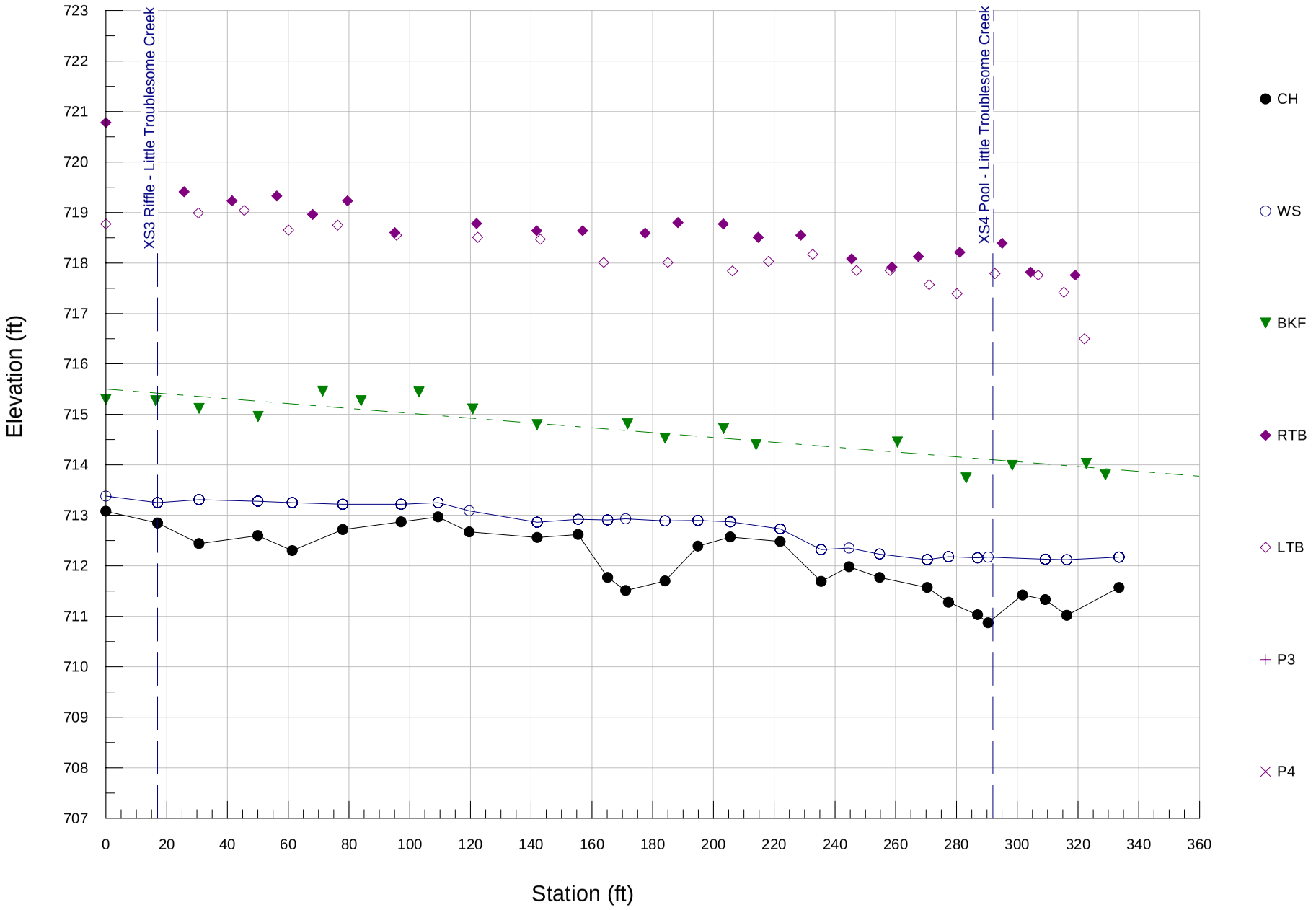
Measurements from Graph

Bankfull Slope: 0.00397

Variable	Min	Avg	Max
S riffle	0.00063	0.01113	0.02518
S pool	0.00053	0.00171	0.00287
S run	0.00108	0.00779	0.02329
S glide	0.0015	0.003	0.00437
P - P	39.49	50.82	59.93
P length	16.29	30.54	52.75
Dmax riffle	1.81	1.93	2.25
Dmax pool	2.09	2.45	3.65
Dmax run	1.93	2.26	3
Dmax glide	1.87	1.95	2.05
Low Bank Ht	3.43	4.44	5.9

Length and depth measurements in feet, slopes in ft/ft.

Reach 2 Profile - Little Troublesome Creek



Reach 2 Profile
RIVERMORPH PROFILE SUMMARY

River Name: Little Troublesome
Reach Name: Reach 2
Profile Name: Reach 2 Profile - Little Troublesome Creek
Survey Date: 12/08/09

Survey Data

DIST	CH	WS	BKF	RTB	LTB
0	713.08	713.38	715.3	720.78	718.77
13.992				719.51	
15.181					718.56
16.384			715.27		
17.025	712.85	713.25			
25.735				719.41	
30.418					718.99
30.663	712.44	713.31			
30.663			715.12		
41.533				719.23	
45.546					719.04
50.014	712.6	713.28			
50.124			714.96		
56.234				719.33	
60.103					718.65
61.375	712.3	713.25			
68.048				718.96	
71.38			715.46		
76.297					718.75
78.009	712.72	713.22			
79.536				719.23	
83.976			715.27		
95.081				718.6	
95.622					718.55
97.217	712.87	713.22			
103.015			715.44		
109.329	712.97	713.25			
119.626	712.67	713.09			
120.801			715.11		
122.031				718.78	
122.384					718.51
141.822				718.64	
141.988	712.56	712.86			
141.988			714.8		
143.006					718.47
155.471	712.62	712.92			
156.952				718.64	
163.887					718.01
165.135	711.77	712.91			
171.108	711.51	712.93			
171.74			714.81		
177.523				718.59	
184.058	711.7	712.89			
184.058			714.53		
184.954					718.01
188.268				718.8	
194.882	712.39	712.9			

Reach 2 Profile

203.269				718.77	
203.303			714.72		
205.531	712.57	712.87			
206.24					717.84
214.052			714.4		
214.749				718.51	
218.121					718.03
222.003	712.48	712.73			
228.747				718.55	
232.653					718.17
235.476	711.69	712.32			
244.603	711.98	712.354			
245.465				718.08	
247.103					717.85
254.695	711.77	712.23			
258.152					717.85
258.707				717.92	
260.552			714.45		
267.468				718.13	
270.36	711.57	712.12			
271.032					717.57
277.425	711.28	712.18			
280.206					717.39
281.128				718.21	
283.207			713.74		
286.919	711.03	712.16			
290.398	710.87	712.17			
292.656					717.79
295.026				718.39	
298.391			713.99		
301.737	711.42				
304.382				717.82	
306.882					717.76
309.236	711.33	712.13			
315.319					717.42
316.347	711.02	712.12			
319.086				717.76	
322.114					716.5
322.747			714.03		
329.051			713.8		
333.512	711.57	712.17			

Cross Section Locations

Cross Section Name	Type	Profile Station
XS3 Riffle - Little Troublesome Creek	Riffle	17.02
XS4 Pool - Little Troublesome Creek	Pool	292.29
XS5 Riffle - Little Troublesome Creek	Riffle	0
XS6 Pool - Little Troublesome Creek	Pool	0

Measurements from Graph

Bankfull Slope: 0.00479

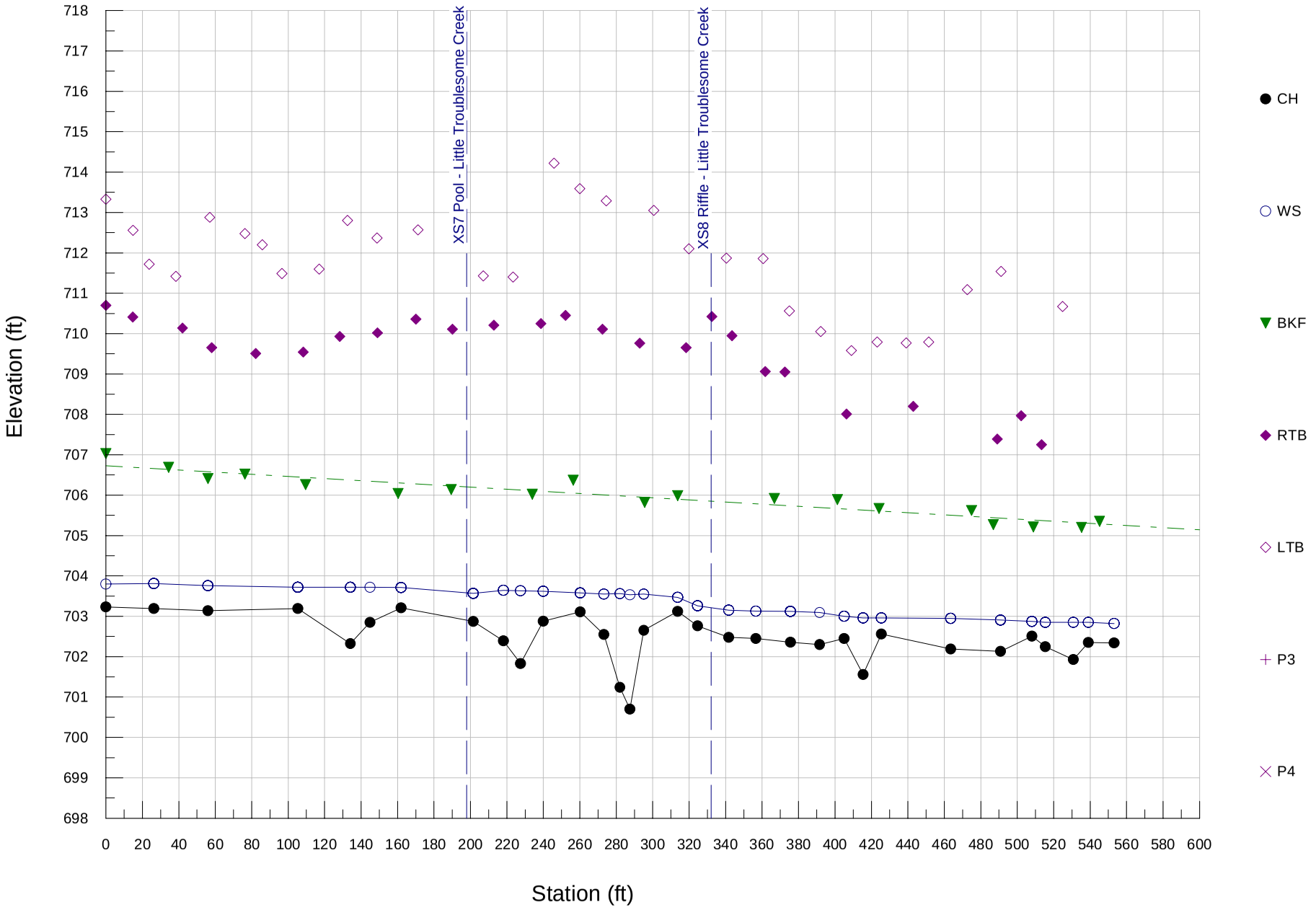
Variable	Min	Avg	Max
S riffle	0.00188	0.00839	0.01652
S pool	0.00051	0.00166	0.00401
S run	0.00215	0.00881	0.02411
S glide	0	0.00167	0.00485
P - P	26.86	51.49	76.05

Reach 2 Profile

P length	15.7	35.87	57.21
Dmax riffle	2.05	2.29	2.56
Dmax pool	2.27	2.9	3.33
Dmax run	2.33	2.57	2.78
Dmax glide	2.29	2.5	2.84
Low Bank Ht	5.44	6.05	6.57

Length and depth measurements in feet, slopes in ft/ft.

Reach 3 Profile - Little Troublesome Creek



Reach 3 Profile
RIVERMORPH PROFILE SUMMARY

River Name: Little Troublesome
Reach Name: Reach 3
Profile Name: Reach 3 Profile - Little Troublesome Creek
Survey Date: 12/07/09

Survey Data

DIST	CH	WS	BKF	RTB	LTB
0	703.23	703.8	707.03	710.7	713.33
14.781				710.41	
14.91					712.56
23.748					711.72
26.257	703.19	703.81			
34.454			706.69		
38.419					711.42
42.043				710.14	
55.958	703.14	703.76			
55.958			706.41		
56.951					712.88
57.986				709.65	
76.254					712.48
76.305			706.52		
82.172				709.51	
85.748					712.2
96.608					711.49
105.283	703.19	703.72			
108.28				709.54	
109.505			706.26		
116.978					711.6
128.362				709.93	
132.524					712.8
134.156	702.32	703.72			
144.913	702.85	703.72			
148.721					712.37
149.052				710.02	
160.323			706.04		
161.984	703.21	703.71			
170.037				710.36	
171.254					712.57
189.431			706.14		
190.1				710.11	
192.239					712.95
201.581	702.87	703.57			
207.034					711.43
212.818				710.21	
218.14	702.39	703.64			
223.33					711.4
227.521	701.83	703.63			
233.914			706.02		
238.723				710.25	
240.002	702.88	703.62			
245.899					714.22
252.203				710.45	
256.449			706.37		
259.957					713.59

Reach 3 Profile

260.278	703.11	703.58			
272.404				710.11	
273.238	702.55	703.55			
274.546					713.29
282.022	701.24	703.56			
287.521	700.7	703.53			
292.924				709.76	
295.125	702.65	703.55			
295.556			705.82		
300.645					713.05
313.665	703.12	703.47			
313.665			705.99		
318.342				709.65	
319.903					712.1
324.66	702.76	703.26			
332.396				710.42	
340.396					711.87
341.653	702.48	703.15			
343.537				709.95	
356.628	702.45	703.13			
360.572					711.86
361.731				709.06	
366.736			705.92		
372.554				709.05	
374.923					710.56
375.658	702.36	703.12			
391.604	702.3	703.09			
392.22					710.05
401.366			705.89		
405.014	702.45	703			
406.333				708.01	
409.006					709.58
415.412	701.56	702.96			
423.123					709.79
424.211			705.67		
425.485	702.56	702.96			
439.128					709.77
442.927				708.2	
451.411					709.79
463.475	702.19	702.95			
472.592					711.09
474.865			705.62		
486.878			705.27		
489.091				707.39	
490.858	702.13	702.91			
491.081					711.54
502.202				707.97	
508.112	702.51	702.87			
508.824			705.21		
513.325				707.25	
515.382	702.25	702.85			
524.873					710.67
530.776	701.93	702.85			
535.232			705.2		
539.018	702.35	702.85			
545.128			705.35		
553.141	702.34	702.82			

Cross Section Locations

Cross Section Name	Type	Profile Station
XS7 Pool - Little Troublesome Creek	Pool	197.56

Reach 3 Profile

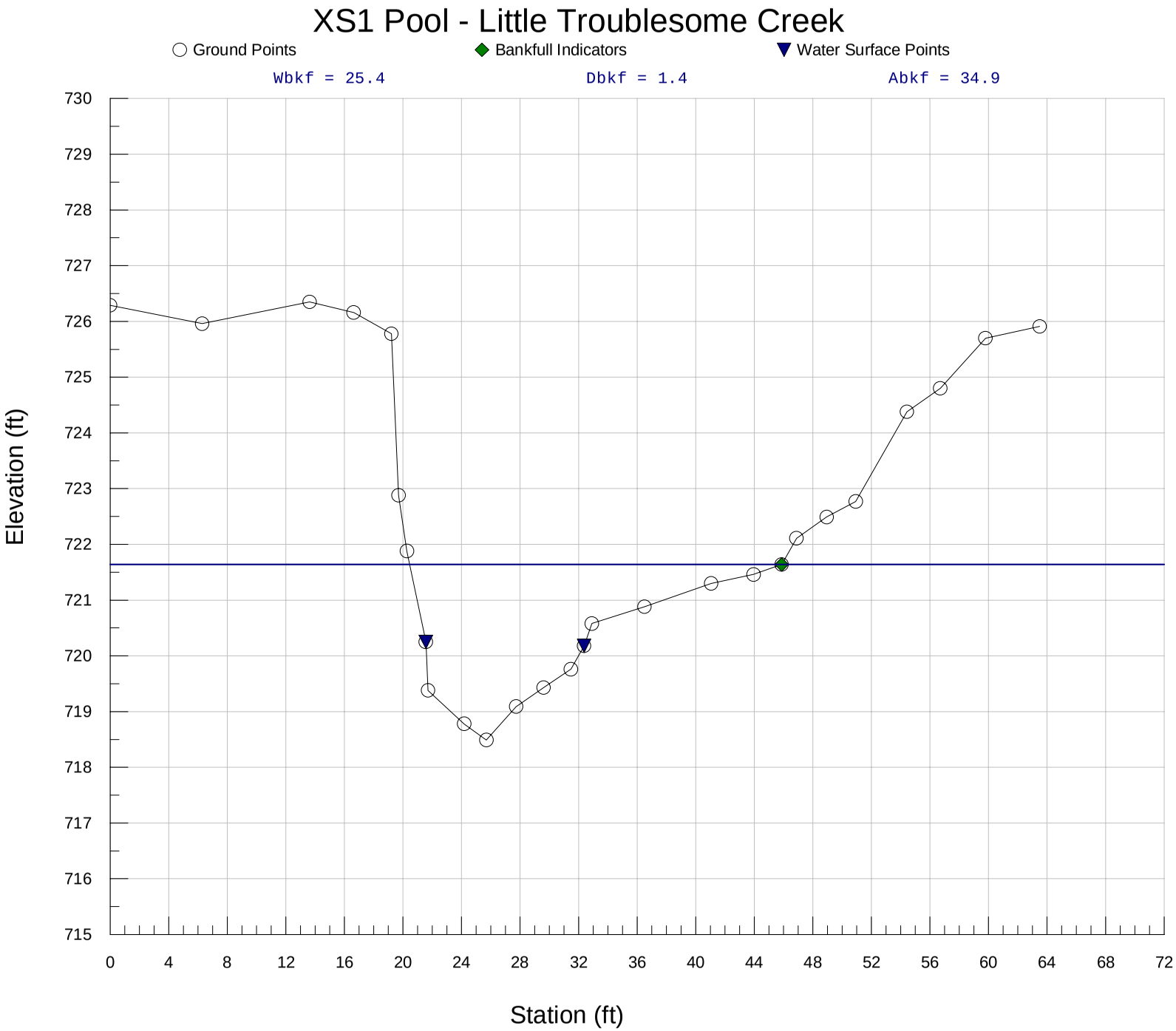
XS8 Riffle - Little Troublesome CreekRiffle 331.96

Measurements from Graph

Bankfull Slope: 0.00263

Variable	Min	Avg	Max
S riffle	0.00066	0.00348	0.01068
S pool	0	0.00092	0.0023
S run	0	0.00214	0.00503
S glide	0	0.00237	0.00589
P - P	45.93	79.77	127.33
P length	21.51	47.01	66.86
Dmax riffle	2.66	3.06	3.52
Dmax pool	3.19	4	5.25
Dmax run	3.02	3.36	3.7
Dmax glide	2.97	3.19	3.45
Low Bank Ht	5.27	6.81	9.03

Length and depth measurements in feet, slopes in ft/ft.


XS1 Pool - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 25.4
Dbkf = 1.4
Abkf = 34.9
Elevation (ft)
730
729
728
727
726
725
724
723
722
721
720
719
718
717
716
715
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
Station (ft)

XS1 Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 1
Cross Section Name: XS1 Pool - Little Troublesome Creek
Survey Date: 12/09/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	726.29	POOL
6.28	0	725.96	
13.62	0	726.35	
16.63	0	726.16	
19.21	0	725.78	LTB
19.7	0	722.88	
20.27	0	721.88	
21.56	0	720.25	LEW
21.71	0	719.38	
24.18	0	718.78	
25.7	0	718.49	
27.73	0	719.09	
29.6	0	719.43	
31.47	0	719.76	
32.37	0	720.18	REW
32.9	0	720.58	
36.5	0	720.88	
41.05	0	721.3	
43.95	0	721.46	
45.87	0	721.64	BKF
46.88	0	722.11	
48.94	0	722.49	
50.93	0	722.77	
54.42	0	724.38	
56.7	0	724.8	RTB
59.79	0	725.7	
63.49	0	725.91	

Cross Sectional Geometry

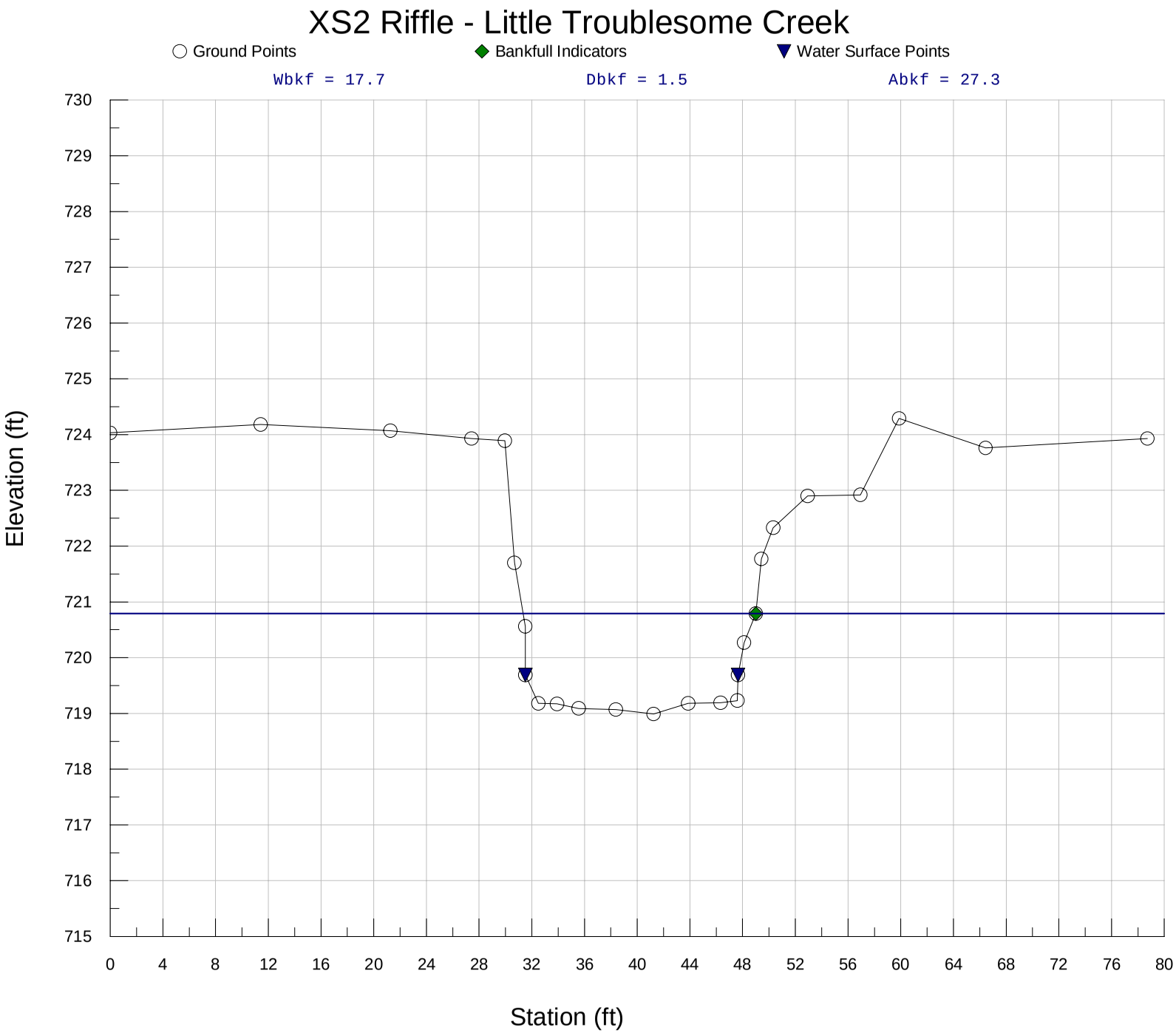
	Channel	Left	Right
Floodprone Elevation (ft)	724.79	724.79	724.79
Bankfull Elevation (ft)	721.64	721.64	721.64
Floodprone Width (ft)	37.27	-----	-----
Bankfull Width (ft)	25.41	12.7	12.71
Entrenchment Ratio	1.47	-----	-----
Mean Depth (ft)	1.37	2.24	0.51
Maximum Depth (ft)	3.15	3.15	1.04
Width/Depth Ratio	18.52	5.67	25.11
Bankfull Area (sq ft)	34.87	28.43	6.43
Wetted Perimeter (ft)	27.33	15.62	13.79
Hydraulic Radius (ft)	1.28	1.82	0.47
Begin BKF Station	20.46	20.46	33.16

		XS1 Pool	
End BKF Station	45.87	33.16	45.87

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS2 Riffle - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.7
Dbkf = 1.5
Abkf = 27.3
Elevation (ft)
730
729
728
727
726
725
724
723
722
721
720
719
718
717
716
715
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
Station (ft)

XS2 Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 1
Cross Section Name: XS2 Riffle - Little Troublesome Creek
Survey Date: 12/09/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	724.03	RIFFLE
11.42	0	724.18	
21.26	0	724.07	
27.43	0	723.93	
29.95	0	723.89	LTB
30.68	0	721.7	
31.5	0	720.56	
31.51	0	719.69	LEW
32.5	0	719.18	
33.91	0	719.17	
35.56	0	719.09	
38.38	0	719.07	
41.24	0	718.99	
43.87	0	719.18	
46.33	0	719.19	
47.6	0	719.23	
47.65	0	719.69	REW
48.11	0	720.27	
49	0	720.79	BKF
49.42	0	721.77	
50.32	0	722.33	
52.94	0	722.9	RTB
56.94	0	722.92	
59.87	0	724.29	
66.44	0	723.76	
78.72	0	723.93	

Cross Sectional Geometry

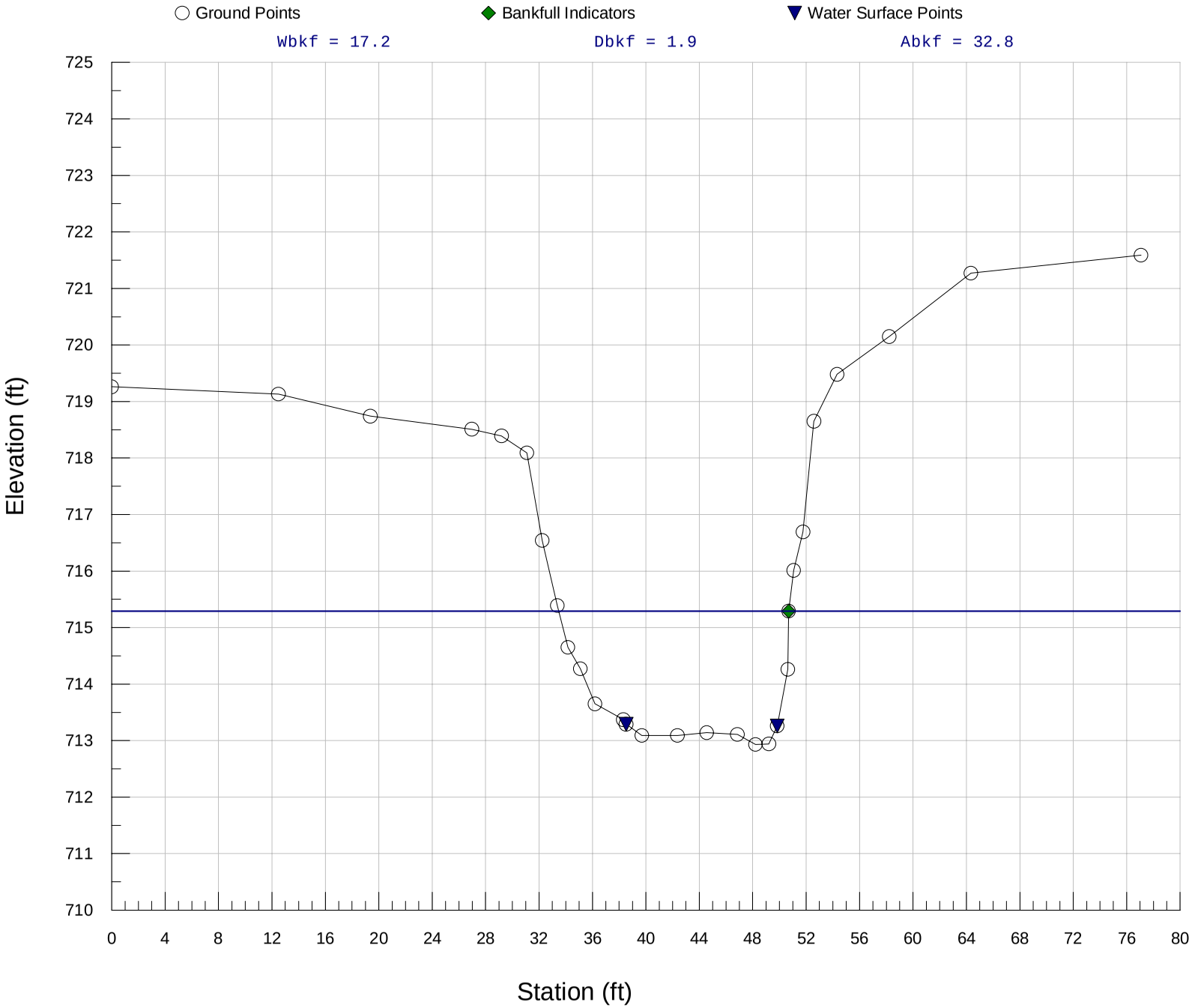
	Channel	Left	Right
Floodprone Elevation (ft)	722.59	722.59	722.59
Bankfull Elevation (ft)	720.79	720.79	720.79
Floodprone Width (ft)	21.13	-----	-----
Bankfull Width (ft)	17.67	8.84	8.83
Entrenchment Ratio	1.2	-----	-----
Mean Depth (ft)	1.55	1.62	1.47
Maximum Depth (ft)	1.8	1.77	1.8
Width/Depth Ratio	11.41	5.45	5.99
Bankfull Area (sq ft)	27.35	14.33	13.02
Wetted Perimeter (ft)	19.61	11.71	11.44
Hydraulic Radius (ft)	1.39	1.22	1.14
Begin BKF Station	31.33	31.33	40.17
End BKF Station	49	40.17	49

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

XS3 Riffle - Little Troublesome Creek



XS3 Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 2
Cross Section Name: XS3 Riffle - Little Troublesome Creek
Survey Date: 12/08/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	719.26	RIFFLE
12.49	0	719.13	
19.37	0	718.74	
26.97	0	718.51	
29.19	0	718.39	LTB
31.09	0	718.09	
32.24	0	716.54	
33.37	0	715.39	
34.16	0	714.65	
35.09	0	714.27	
36.19	0	713.65	
38.32	0	713.37	
38.52	0	713.29	LEW
39.7	0	713.09	
42.37	0	713.09	
44.56	0	713.14	
46.85	0	713.11	
48.21	0	712.93	
49.21	0	712.94	
49.84	0	713.26	REW
50.63	0	714.26	
50.69	0	715.29	BKF
51.07	0	716.01	
51.77	0	716.69	
52.58	0	718.65	
54.32	0	719.48	RTB
58.23	0	720.15	
64.34	0	721.27	
77.08	0	721.59	

Cross Sectional Geometry

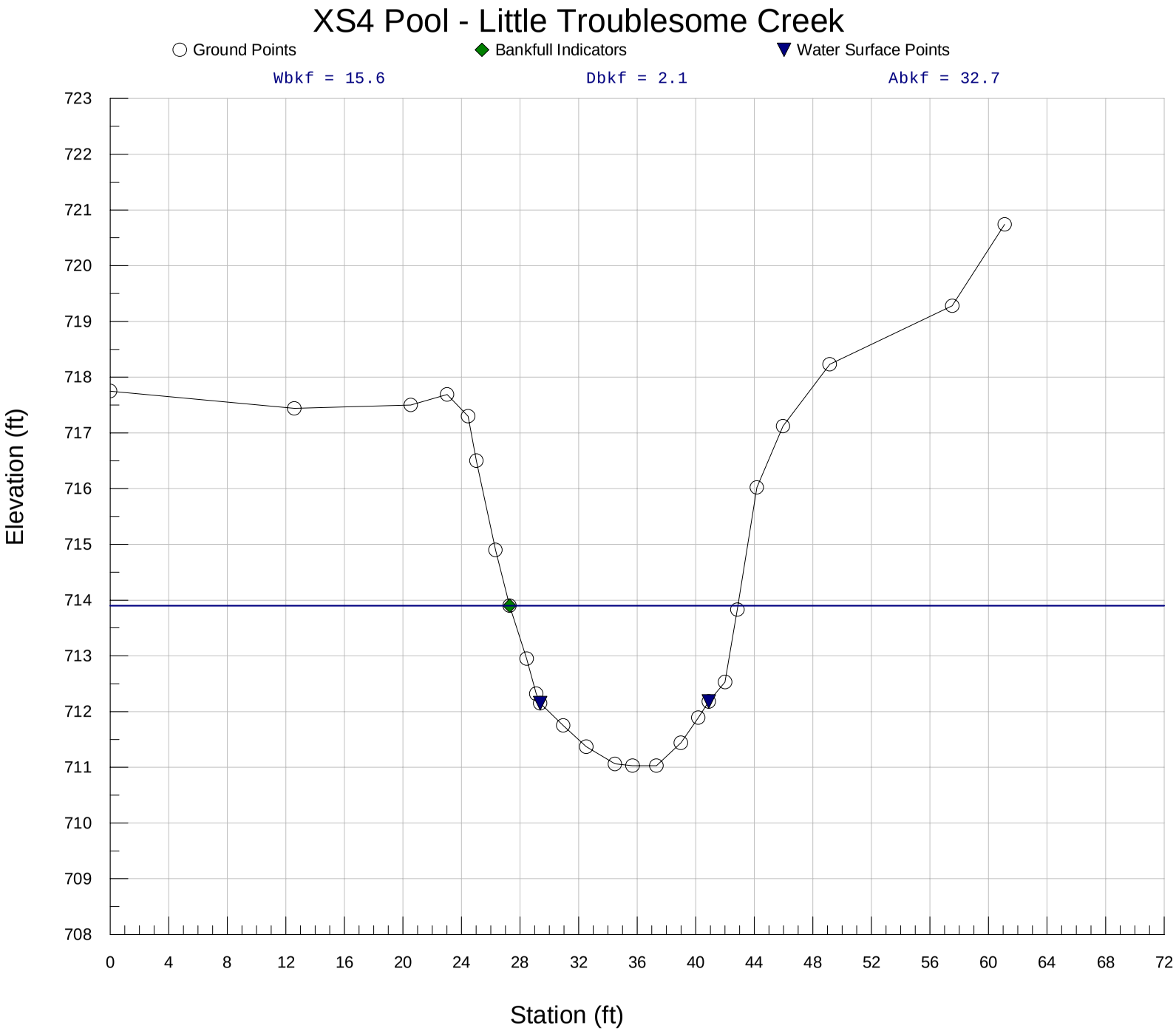
	Channel	Left	Right
Floodprone Elevation (ft)	717.65	717.65	717.65
Bankfull Elevation (ft)	715.29	715.29	715.29
Floodprone Width (ft)	20.75	-----	-----
Bankfull Width (ft)	17.21	8.6	8.61
Entrenchment Ratio	1.21	-----	-----
Mean Depth (ft)	1.9	1.67	2.14
Maximum Depth (ft)	2.36	2.2	2.36
Width/Depth Ratio	9.04	5.16	4.02
Bankfull Area (sq ft)	32.77	14.35	18.42
Wetted Perimeter (ft)	19.3	11.34	12.36

		XS3 Riffle	
Hydraulic Radius (ft)	1.7	1.27	1.49
Begin BKF Station	33.48	33.48	42.08
End BKF Station	50.69	42.08	50.69

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS4 Pool - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 15.6
Dbkf = 2.1
Abkf = 32.7
Elevation (ft)
723
722
721
720
719
718
717
716
715
714
713
712
711
710
709
708
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
Station (ft)

XS4 Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 2
Cross Section Name: XS4 Pool - Little Troublesome Creek
Survey Date: 12/08/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	717.75	POOL
12.58	0	717.44	
20.53	0	717.5	
23.01	0	717.69	RTB
24.45	0	717.3	
25.01	0	716.5	
26.32	0	714.9	
27.28	0	713.9	BKF
28.45	0	712.95	
29.1	0	712.32	
29.37	0	712.15	LEW
30.94	0	711.75	
32.52	0	711.37	
34.48	0	711.06	
35.68	0	711.03	
37.31	0	711.03	
38.99	0	711.44	
40.17	0	711.89	
40.89	0	712.18	REW
42	0	712.53	
42.84	0	713.83	
44.17	0	716.02	
45.96	0	717.12	
49.15	0	718.23	RTB
57.52	0	719.28	
61.1	0	720.74	

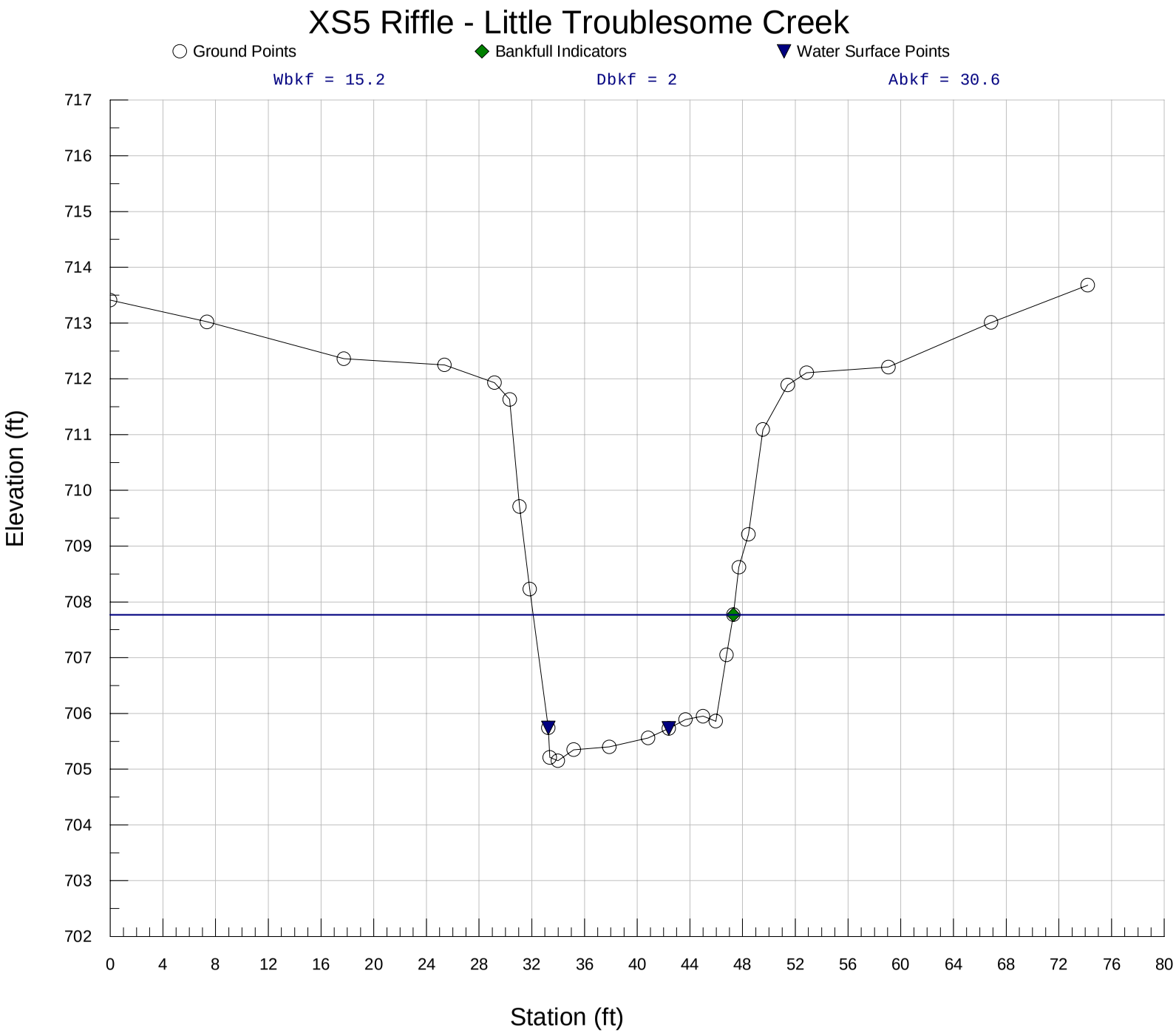
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	716.77	716.77	716.77
Bankfull Elevation (ft)	713.9	713.9	713.9
Floodprone Width (ft)	20.57	-----	-----
Bankfull Width (ft)	15.6	7.8	7.8
Entrenchment Ratio	1.32	-----	-----
Mean Depth (ft)	2.1	1.99	2.2
Maximum Depth (ft)	2.87	2.86	2.87
Width/Depth Ratio	7.44	3.91	3.54
Bankfull Area (sq ft)	32.73	15.56	17.17
Wetted Perimeter (ft)	17.35	11.42	11.65
Hydraulic Radius (ft)	1.89	1.36	1.47
Begin BKF Station	27.28	27.28	35.08
End BKF Station	42.88	35.08	42.88

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS5 Riffle - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 15.2
Dbkf = 2
Abkf = 30.6
Elevation (ft)
717
716
715
714
713
712
711
710
709
708
707
706
705
704
703
702
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
Station (ft)

XS5 Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 2
Cross Section Name: XS5 Riffle - Little Troublesome Creek
Survey Date: 12/08/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	713.41	RIFFLE
7.35	0	713.02	
17.73	0	712.36	
25.37	0	712.25	
29.17	0	711.93	LTB
30.32	0	711.63	
31.07	0	709.71	
31.84	0	708.23	
33.25	0	705.74	LEW
33.36	0	705.21	
33.98	0	705.15	
35.18	0	705.35	
37.88	0	705.4	
40.83	0	705.56	
42.39	0	705.73	REW
43.66	0	705.89	
44.99	0	705.95	
45.97	0	705.86	
46.78	0	707.05	
47.3	0	707.77	BKF
47.72	0	708.62	
48.44	0	709.21	
49.54	0	711.09	
51.43	0	711.89	
52.86	0	712.11	RTB
59.07	0	712.21	
66.86	0	713.01	
74.19	0	713.68	

Cross Sectional Geometry

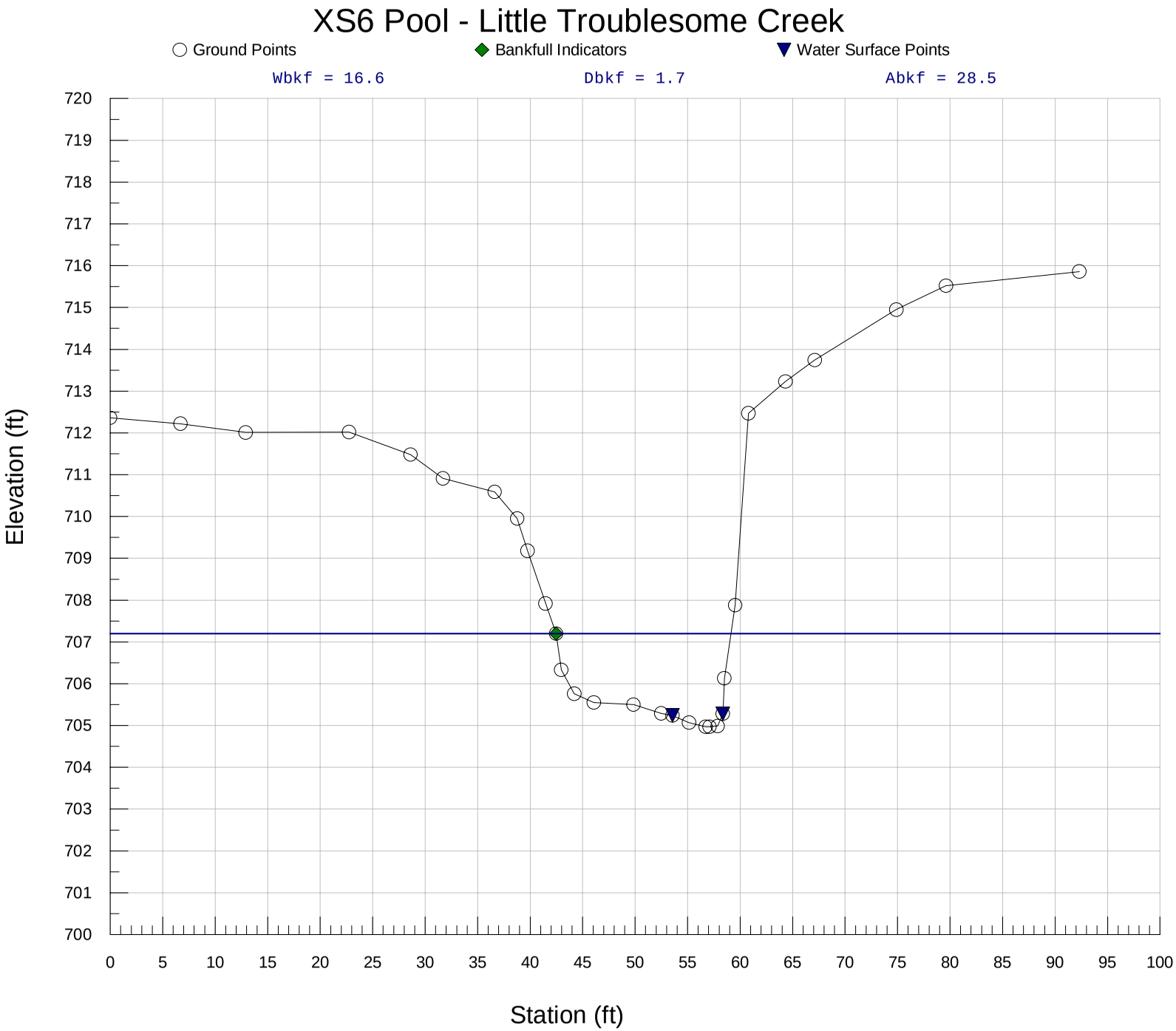
	Channel	Left	Right
Floodprone Elevation (ft)	710.39	710.39	710.39
Bankfull Elevation (ft)	707.77	707.77	707.77
Floodprone Width (ft)	18.33	-----	-----
Bankfull Width (ft)	15.2	7.6	7.6
Entrenchment Ratio	1.21	-----	-----
Mean Depth (ft)	2.01	2.2	1.83
Maximum Depth (ft)	2.62	2.62	2.27
Width/Depth Ratio	7.55	3.45	4.16
Bankfull Area (sq ft)	30.62	16.74	13.88
Wetted Perimeter (ft)	17.86	11.51	10.9
Hydraulic Radius (ft)	1.71	1.45	1.27

		XS5 Riffle	
Begin BKF Station	32.1	32.1	39.7
End BKF Station	47.3	39.7	47.3

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS6 Pool - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 16.6
Dbkf = 1.7
Abkf = 28.5
Elevation (ft)
720
719
718
717
716
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Station (ft)

XS6 Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 2
Cross Section Name: XS6 Pool - Little Troublesome Creek
Survey Date: 12/08/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	712.36	POOL
6.7	0	712.22	
12.91	0	712.01	
22.76	0	712.02	
28.61	0	711.48	
31.69	0	710.91	
36.62	0	710.59	LTB
38.77	0	709.95	
39.75	0	709.18	
41.47	0	707.92	
42.48	0	707.2	BKF
42.96	0	706.33	
44.2	0	705.76	
46.07	0	705.55	
49.84	0	705.5	
52.48	0	705.29	
53.55	0	705.24	LEW
55.13	0	705.07	
56.71	0	704.97	
57.09	0	704.97	
57.86	0	704.99	
58.35	0	705.28	REW
58.5	0	706.13	
59.53	0	707.88	
60.79	0	712.47	RTB
64.32	0	713.23	
67.11	0	713.74	
74.88	0	714.95	
79.61	0	715.52	
92.31	0	715.86	

Cross Sectional Geometry

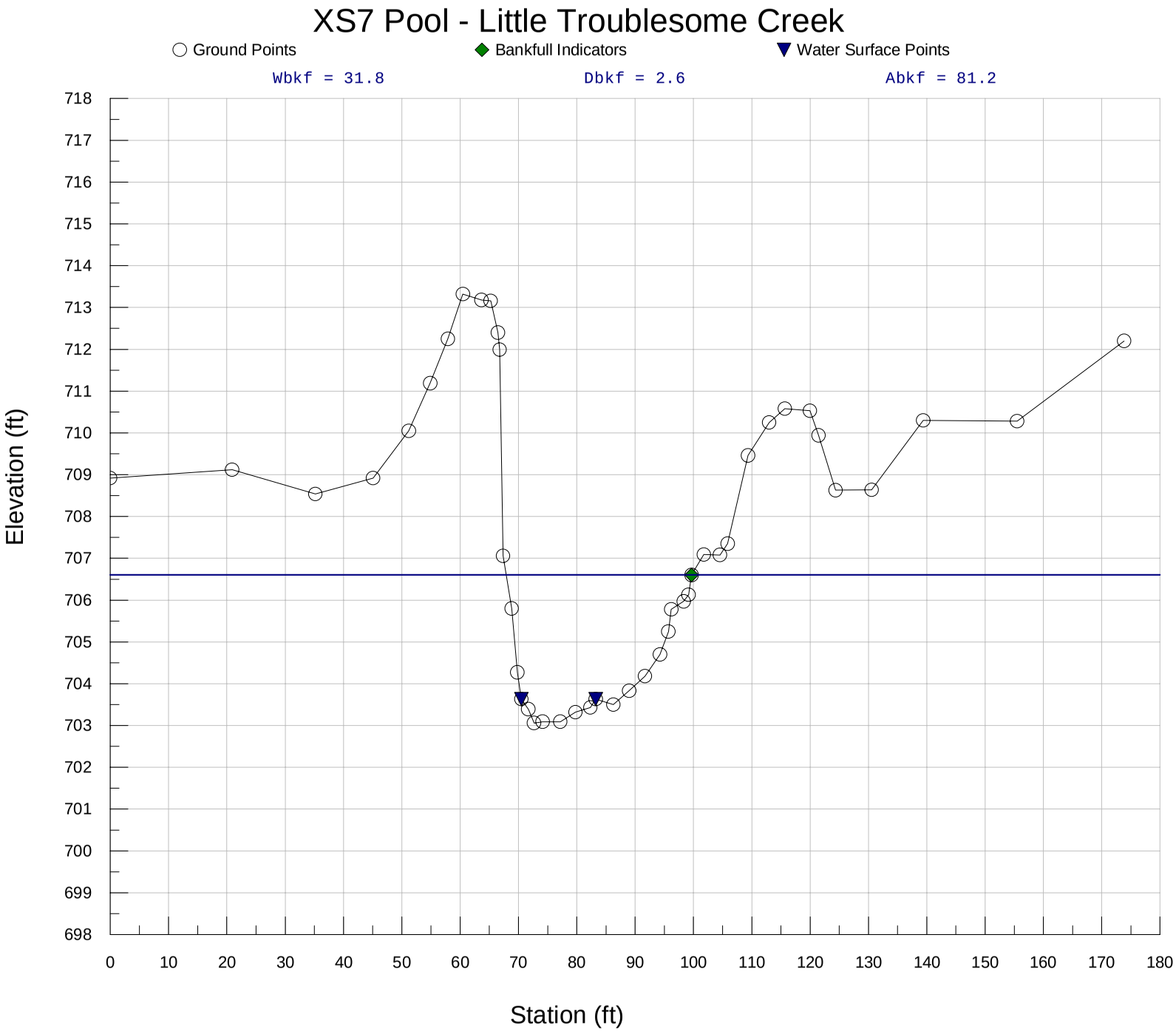
	Channel	Left	Right
Floodprone Elevation (ft)	709.51	709.51	709.51
Bankfull Elevation (ft)	707.24	707.24	707.24
Floodprone Width (ft)	20.65	-----	-----
Bankfull Width (ft)	16.73	8.37	8.36
Entrenchment Ratio	1.23	-----	-----
Mean Depth (ft)	1.74	1.53	1.95
Maximum Depth (ft)	2.27	1.82	2.27
Width/Depth Ratio	9.6	5.46	4.28
Bankfull Area (sq ft)	29.15	12.83	16.32

		XS6 Pool	
Wetted Perimeter (ft)	18.84	10.85	11.62
Hydraulic Radius (ft)	1.55	1.18	1.4
Begin BKF Station	42.42	42.42	50.79
End BKF Station	59.15	50.79	59.15

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS7 Pool - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 31.8
Dbkf = 2.6
Abkf = 81.2
Elevation (ft)
718
717
716
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
699
698
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Station (ft)

XS7 Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 3
Cross Section Name: XS7 Pool - Little Troublesome Creek
Survey Date: 12/07/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	708.92	POOL
20.9	0	709.12	
35.18	0	708.54	
45.06	0	708.92	
51.19	0	710.05	
54.87	0	711.19	
57.9	0	712.25	
60.47	0	713.32	
63.66	0	713.18	
65.23	0	713.16	LTB
66.48	0	712.4	
66.76	0	711.99	
67.36	0	707.06	
68.84	0	705.8	
69.8	0	704.27	
70.48	0	703.63	LEW
71.68	0	703.39	
72.67	0	703.06	
74.14	0	703.09	
77.17	0	703.09	
79.77	0	703.32	
82.32	0	703.43	
83.24	0	703.63	REW
86.27	0	703.5	
88.97	0	703.83	
91.7	0	704.18	
94.26	0	704.7	
95.71	0	705.25	
96.19	0	705.78	
98.33	0	705.97	
99.16	0	706.13	
99.69	0	706.6	BKF
101.78	0	707.09	
104.54	0	707.08	
105.87	0	707.35	
109.37	0	709.46	
112.98	0	710.25	
115.67	0	710.58	
119.96	0	710.53	
121.44	0	709.94	
124.36	0	708.63	
130.54	0	708.64	
139.4	0	710.3	
155.5	0	710.28	
173.84	0	712.2	

XS7 Pool

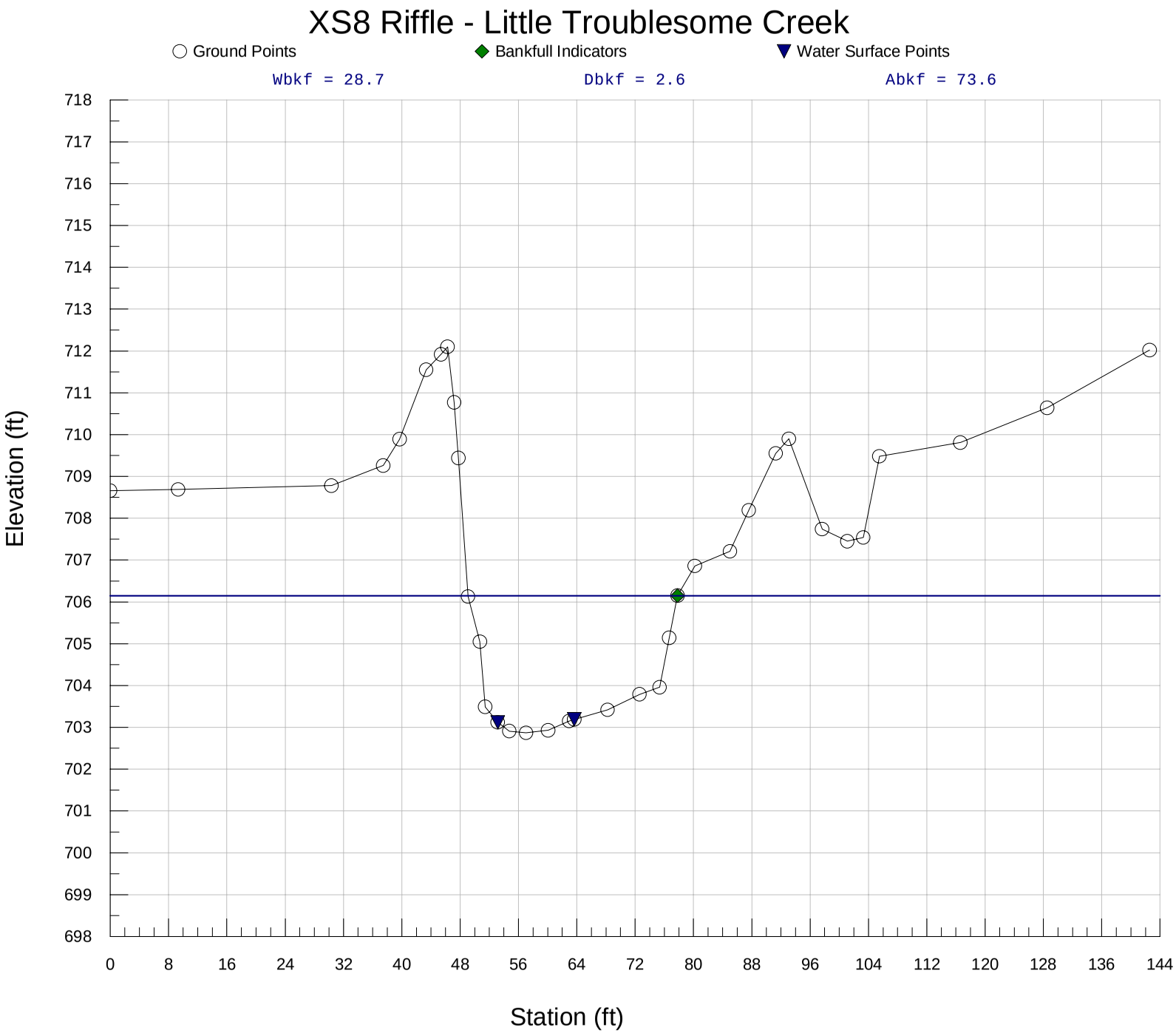
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	710.14	710.14	710.14
Bankfull Elevation (ft)	706.6	706.6	706.6
Floodprone Width (ft)	114.58	-----	-----
Bankfull Width (ft)	31.79	15.91	15.88
Entrenchment Ratio	3.6	-----	-----
Mean Depth (ft)	2.55	3.02	2.08
Maximum Depth (ft)	3.54	3.54	3.1
Width/Depth Ratio	12.45	5.26	7.63
Bankfull Area (sq ft)	81.17	48.12	33.04
Wetted Perimeter (ft)	33.93	20.41	19.51
Hydraulic Radius (ft)	2.39	2.36	1.69
Begin BKF Station	67.9	67.9	83.81
End BKF Station	99.69	83.81	99.69

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS8 Riffle - Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 28.7
Dbkf = 2.6
Abkf = 73.6
Elevation (ft)
718
717
716
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
699
698
0
8
16
24
32
40
48
56
64
72
80
88
96
104
112
120
128
136
144
Station (ft)

XS8 Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: Little Troublesome
Reach Name: Reach 3
Cross Section Name: XS8 Riffle - Little Troublesome Creek
Survey Date: 12/07/09

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	708.66	RIFFLE
9.32	0	708.69	
30.35	0	708.78	
37.45	0	709.26	
39.7	0	709.89	
43.34	0	711.55	
45.39	0	711.92	
46.27	0	712.1	LTB
47.18	0	710.77	LTB
47.77	0	709.44	
49.07	0	706.13	
50.71	0	705.05	
51.43	0	703.49	
53.15	0	703.12	LEW
54.74	0	702.91	
57.04	0	702.87	
60.07	0	702.93	
62.96	0	703.15	
63.65	0	703.19	REW
68.22	0	703.42	
72.59	0	703.79	
75.36	0	703.96	
76.67	0	705.14	
77.81	0	706.15	BKF
80.19	0	706.86	
85	0	707.21	
87.58	0	708.19	
91.29	0	709.55	
93.09	0	709.9	RTB
97.65	0	707.74	
101.1	0	707.45	
103.29	0	707.54	
105.5	0	709.48	
116.62	0	709.81	
128.52	0	710.64	
142.57	0	712.02	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	709.43	709.43	709.43
Bankfull Elevation (ft)	706.15	706.15	706.15
Floodprone Width (ft)	92.61	-----	-----

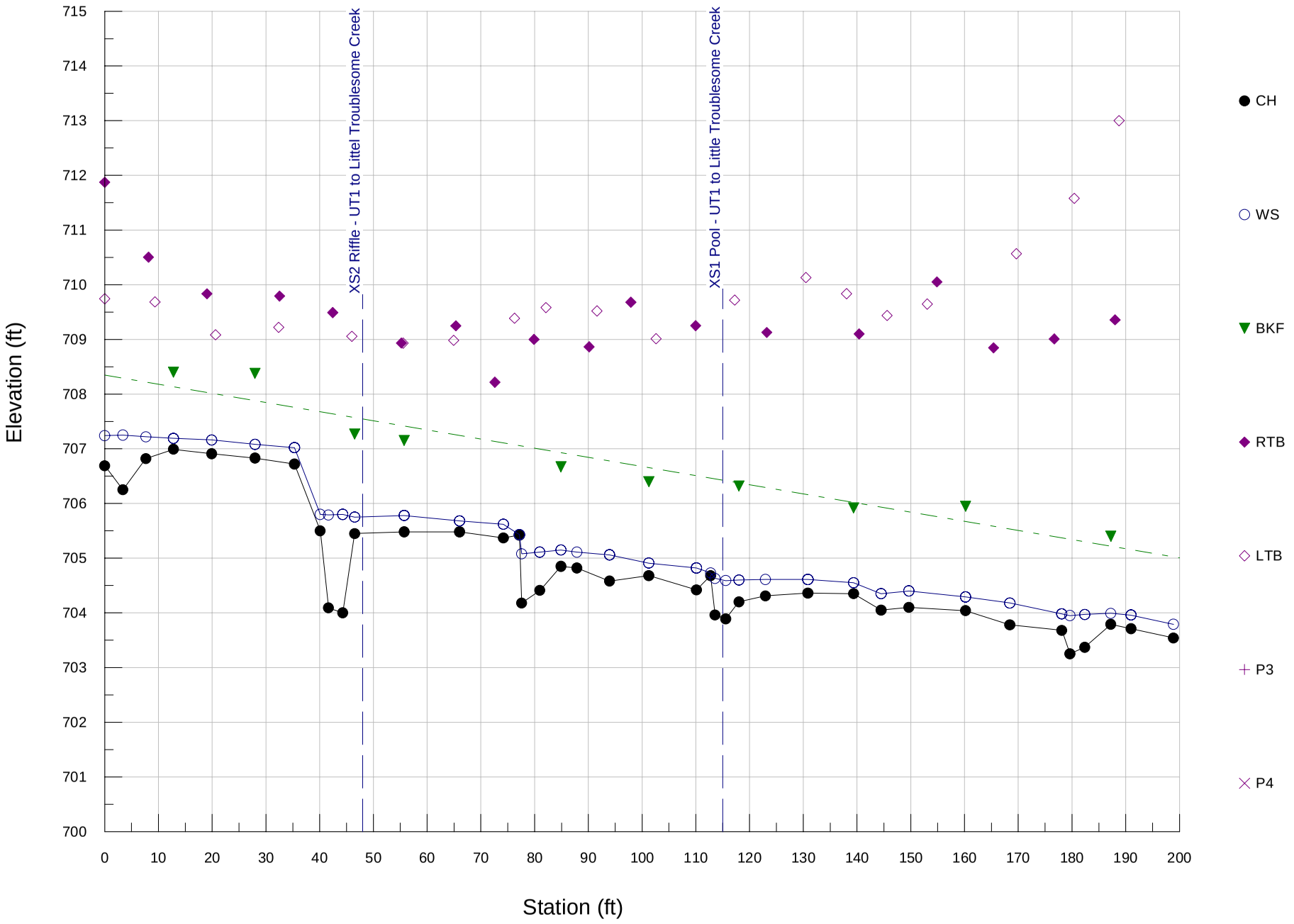
		XS8 Riffle	
Bankfull Width (ft)	28.75	14.38	14.37
Entrenchment Ratio	3.22	-----	-----
Mean Depth (ft)	2.56	2.78	2.35
Maximum Depth (ft)	3.28	3.28	2.97
Width/Depth Ratio	11.22	5.18	6.12
Bankfull Area (sq ft)	73.64	39.92	33.72
Wetted Perimeter (ft)	31.01	18.75	18.21
Hydraulic Radius (ft)	2.37	2.13	1.85
Begin BKF Station	49.06	49.06	63.44
End BKF Station	77.81	63.44	77.81

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

UT1 To Little Troublesome Creek Profile



UT1 Profile
RIVERMORPH PROFILE SUMMARY

River Name: UT1
Reach Name: Reach 1
Profile Name: UT1 Profile
Survey Date: 03/24/11

Survey Data

DIST	CH	WS	BKF	RTB	LTB
0	706.69	707.24		711.873	709.743
3.38	706.25	707.25			
7.66	706.82	707.22			
8.144				710.504	
9.355					709.685
12.8	706.99	707.19	708.4		
19.021				709.835	
19.93	706.91	707.16			
20.628					709.085
27.96	706.83	707.08	708.38		
32.379					709.22
32.55				709.792	
35.32	706.72	707.02			
40.11	705.5	705.8			
41.65	704.09	705.79			
42.433				709.491	
44.31	704	705.8			
45.99					709.057
46.51	705.45	705.75	707.27		
55.216				708.933	
55.535					708.932
55.72	705.48	705.78	707.15		
64.936					708.983
65.334				709.249	
66.04	705.48	705.68			
72.613				708.217	
74.19	705.37	705.62			
76.272					709.387
77.18	705.42	705.43			
77.59	704.18	705.08			
79.888				709.001	
80.97	704.41	705.11			
82.121					709.582
84.91	704.85	705.15	706.67		
87.87	704.82	705.11			
90.149				708.864	
91.604					709.52
93.94	704.58	705.06			
97.919				709.68	
101.26	704.68	704.91	706.4		
102.595					709.013
109.971				709.251	
110.13	704.42	704.82			
112.75	704.68	704.73			
113.58	703.96	704.63			
115.57	703.89	704.59			
117.231					709.719

UT1 Profile

118.02	704.2	704.6	706.32		
122.96	704.31	704.61			
123.21				709.128	
130.486					710.131
130.86	704.36	704.61			
138.048					709.836
139.36	704.35	704.55	705.92		
140.391				709.1	
144.49	704.05	704.35			
145.589					709.437
149.66	704.1	704.4			
153.075					709.646
154.866				710.052	
160.2	704.04	704.29	705.95		
165.417				708.847	
168.44	703.78	704.18			
169.646					710.567
176.687				709.009	
178.1	703.68	703.98			
179.62	703.25	703.95			
180.427					711.579
182.38	703.37	703.97			
187.23	703.79	703.99	705.4		
188.02				709.358	
188.761					713
190.98	703.71	703.96			
198.89	703.54	703.79			

Cross Section Locations

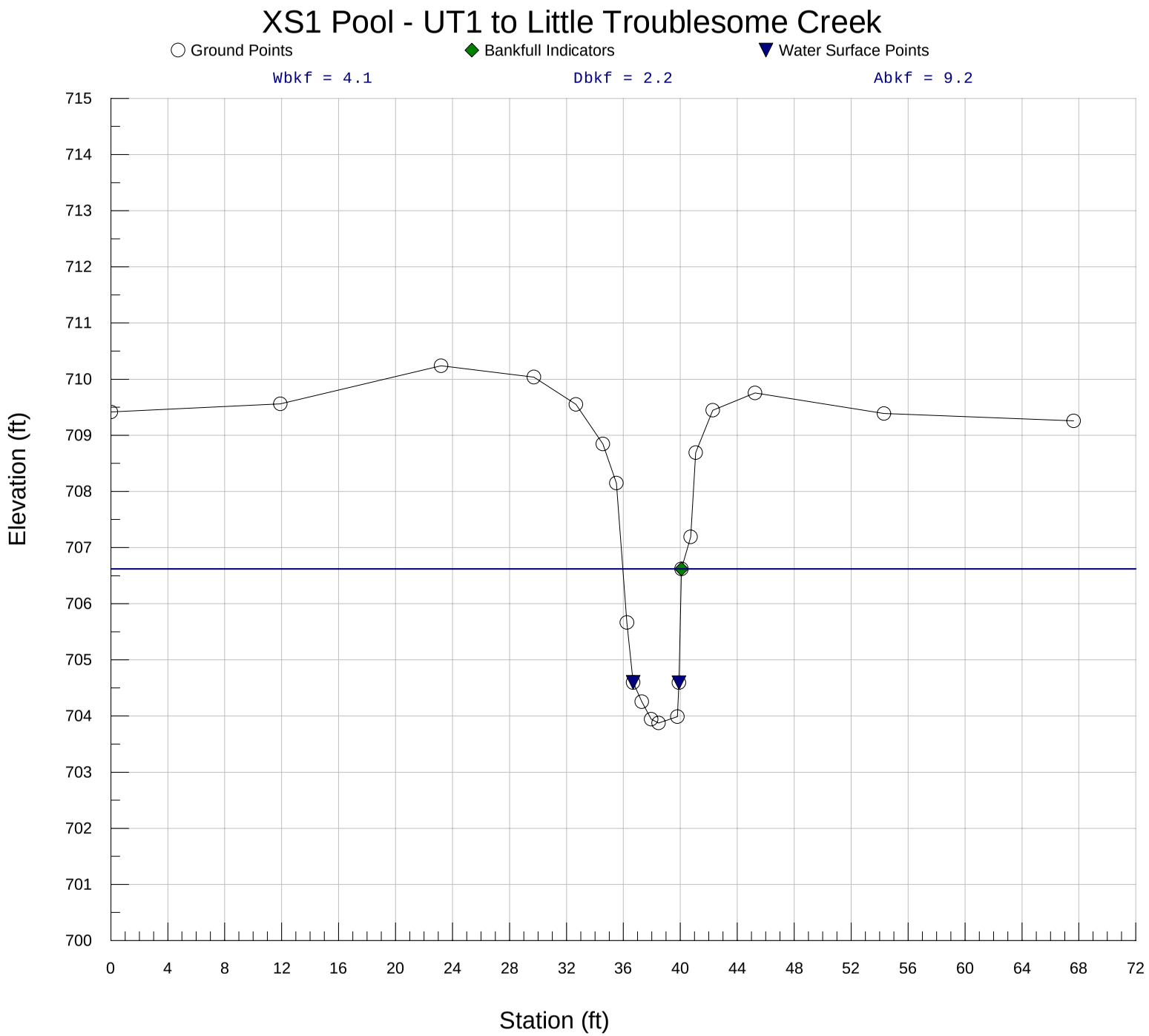
Cross Section Name	Type	Profile Station
XS1 Pool - UT1 to Little Troublesome Creek	Pool	115
XS2 Riffle - UT1 to Littel Troublesome Creek	Riffle	48

Measurements from Graph

Bankfull Slope: 0.0175

Variable	Min	Avg	Max
S riffle	0.00717	0.02375	0.04965
S pool	0	0.00389	0.00895
S run	0.00655	0.0136	0.01767
S glide	0.00301	0.02007	0.03613
P - P	29.1	35.52	41.73
P length	5.44	7.7	10.39
Dmax riffle	1.45	1.66	1.85
Dmax pool	2.24	2.62	3.31
Dmax run	1.57	1.63	1.68
Dmax glide	1.68	1.72	1.78
Low Bank Ht	2.23	3.29	4.65

Length and depth measurements in feet, slopes in ft/ft.


XS1 Pool - UT1 to Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 4.1
Dbkf = 2.2
Abkf = 9.2
Elevation (ft)
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
Station (ft)

UT1 XS1 Pool
RIVERMORPH CROSS SECTION SUMMARY

River Name: UT1
Reach Name: Reach 1
Cross Section Name: XS1 Pool - UT1 to Little Troublesome Creek
Survey Date: 03/28/11

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	709.413595	POOL
11.9	0	709.557552	
23.19	0	710.23958	
29.72	0	710.036341	
32.67	0	709.548397	
34.56	0	708.84521	
35.51	0	708.147253	
36.25	0	705.666295	
36.69	0	704.596426	LEW
37.3	0	704.255827	
37.96	0	703.941985	
38.48	0	703.875441	
39.79	0	703.986681	
39.9	0	704.59337	REW
40.09	0	706.61912	BKF
40.73	0	707.188861	
41.08	0	708.690093	
42.28	0	709.445026	
45.24	0	709.753853	
54.31	0	709.387523	
67.63	0	709.255355	

Cross Sectional Geometry

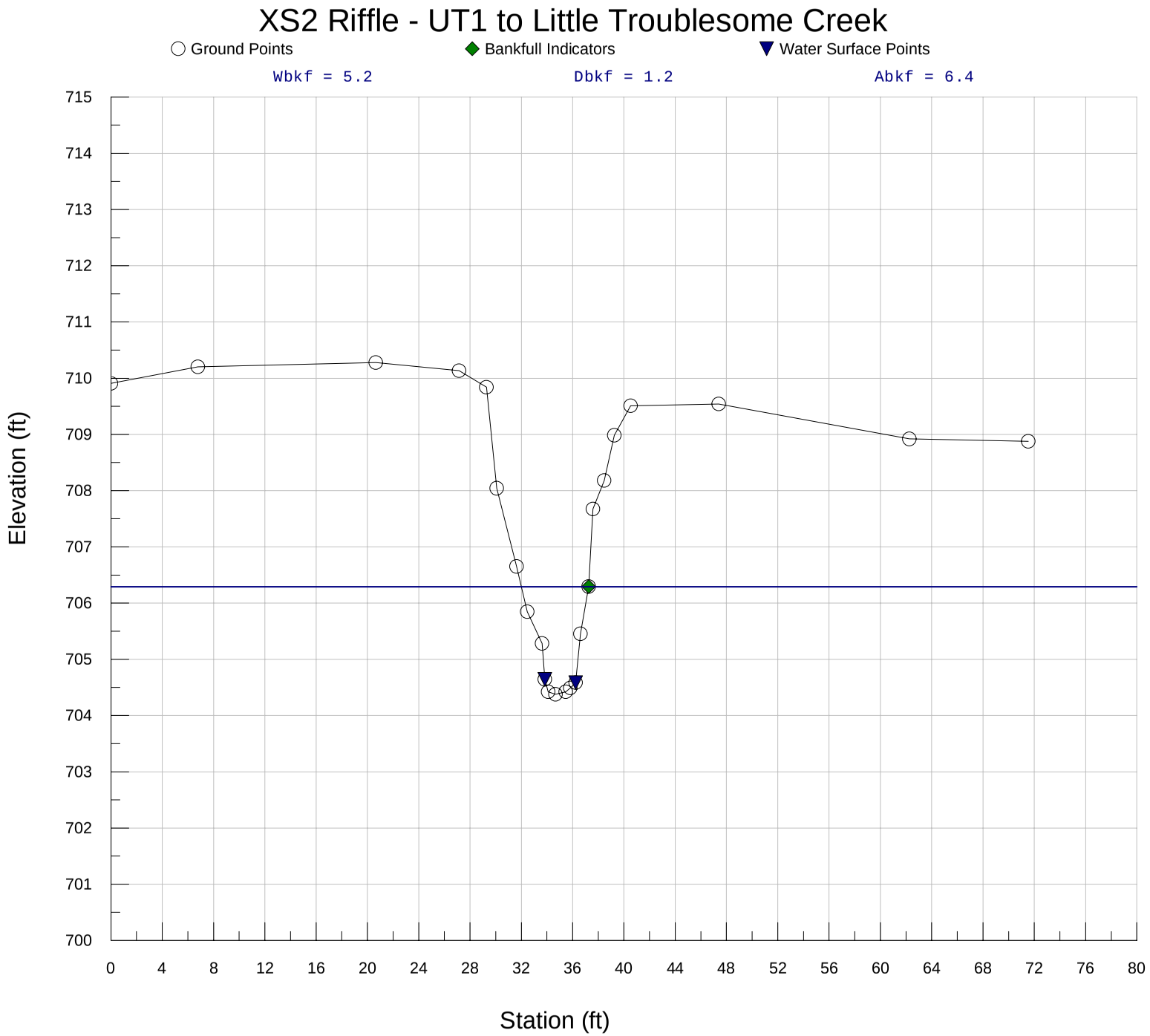
	Channel	Left	Right
Floodprone Elevation (ft)	709.36	709.36	709.36
Bankfull Elevation (ft)	706.62	706.62	706.62
Floodprone Width (ft)	19.99	-----	-----
Bankfull Width (ft)	4.13	2.06	2.06
Entrenchment Ratio	4.85	-----	-----
Mean Depth (ft)	2.22	1.93	2.52
Maximum Depth (ft)	2.74	2.69	2.74
Width/Depth Ratio	1.86	1.07	0.82
Bankfull Area (sq ft)	9.17	3.98	5.19
Wetted Perimeter (ft)	8.07	6.34	7.11
Hydraulic Radius (ft)	1.14	0.63	0.73
Begin BKF Station	35.97	35.97	38.03
End BKF Station	40.09	38.03	40.09

Entrainment Calculations

UT1 XS1 Pool

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


XS2 Riffle - UT1 to Little Troublesome Creek
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.2
Dbkf = 1.2
Abkf = 6.4
Elevation (ft)
715
714
713
712
711
710
709
708
707
706
705
704
703
702
701
700
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
Station (ft)

UT1 XS2 Riffle
RIVERMORPH CROSS SECTION SUMMARY

River Name: UT1
Reach Name: Reach 1
Cross Section Name: XS2 Riffle - UT1 to Littel Troublesome Creek
Survey Date: 03/28/11

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	709.907011	RIFFLE
6.77	0	710.200607	
20.65	0	710.279364	
27.14	0	710.132748	
29.28	0	709.838397	
30.08	0	708.042379	
31.64	0	706.650092	
32.47	0	705.845089	
33.61	0	705.279492	
33.83	0	704.641892	LEW
34.09	0	704.422656	
34.67	0	704.376734	
35.47	0	704.423008	
35.83	0	704.490751	
36.24	0	704.585854	REW
36.62	0	705.454883	
37.25	0	706.294323	BKF
37.58	0	707.67286	
38.46	0	708.181916	
39.26	0	708.986441	
40.53	0	709.509616	
47.39	0	709.541082	
62.27	0	708.919634	
71.53	0	708.877072	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	708.2	708.2	708.2
Bankfull Elevation (ft)	706.29	706.29	706.29
Floodprone Width (ft)	8.47	-----	-----
Bankfull Width (ft)	5.24	2.62	2.62
Entrenchment Ratio	1.62	-----	-----
Mean Depth (ft)	1.22	1.03	1.42
Maximum Depth (ft)	1.91	1.91	1.91
Width/Depth Ratio	4.27	2.54	1.85
Bankfull Area (sq ft)	6.41	2.7	3.71
Wetted Perimeter (ft)	7.09	5.38	5.53
Hydraulic Radius (ft)	0.9	0.5	0.67
Begin BKF Station	32.01	32.01	34.63
End BKF Station	37.25	34.63	37.25

UT1 XS2 Riffle

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

PEBBLE COUNT ANALYSIS WORKSHEET

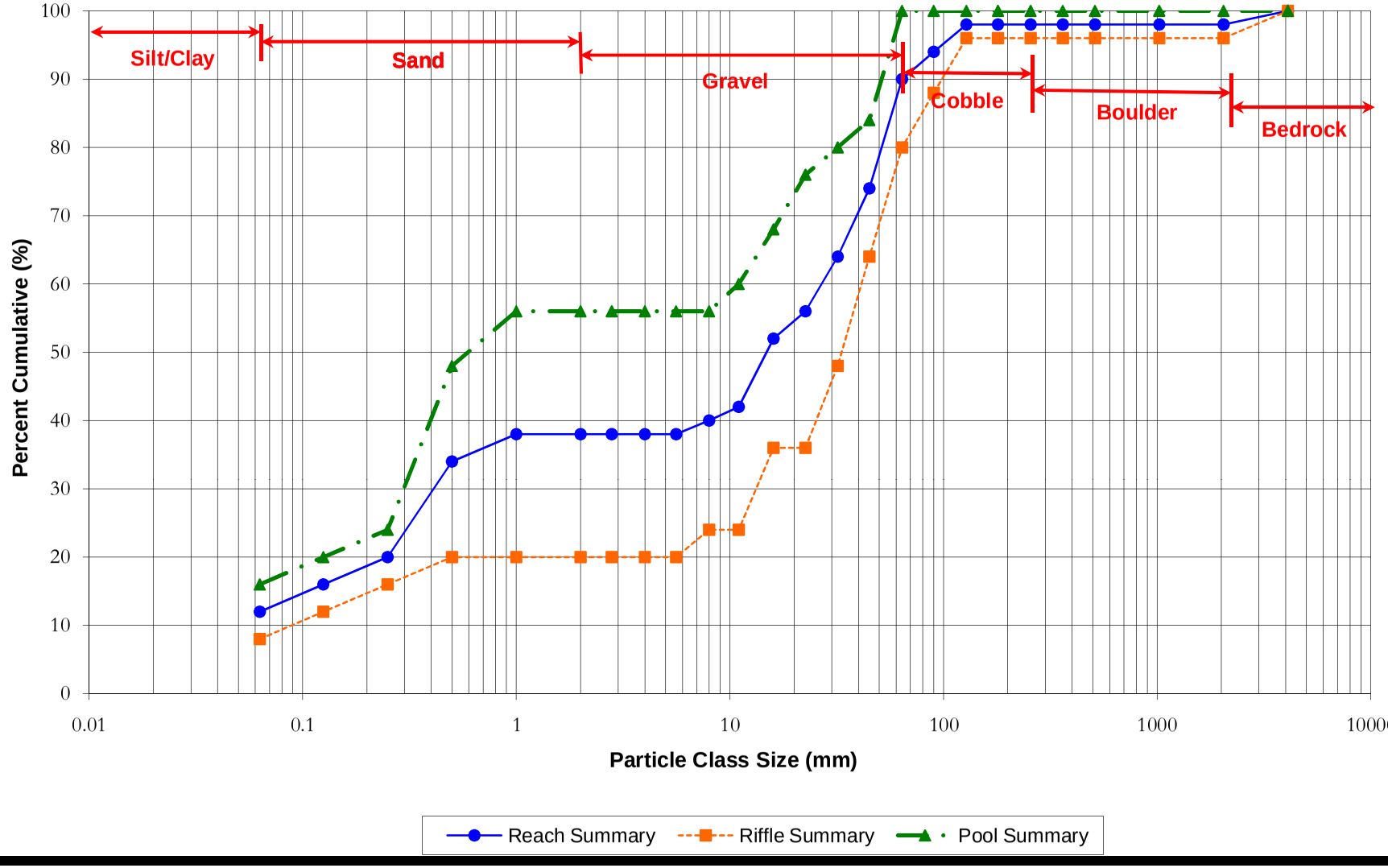
Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 1 (Irvin Creek to Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 1
Date:	12/10/2009	**Cross Section #:**	Reachwide

Particle Class		Diameter (mm)		Particle Count			Riffle Summary		Pool Summary		Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	8	12	8.0	8	16	16	12	12
SAND	Very fine	0.062	0.125	2	2	4	4.0	12	4	20	4	16
	Fine	0.125	0.250	2	2	4	4.0	16	4	24	4	20
	Medium	0.250	0.500	2	12	14	4.0	20	24	48	14	34
	Coarse	0.5	1.0		4	4		20	8	56	4	38
	Very Coarse	1.0	2.0					20		56		38
GRAVEL	Very Fine	2.0	2.8					20		56		38
	Very Fine	2.8	4.0					20		56		38
	Fine	4.0	5.7					20		56		38
	Fine	5.7	8.0	2		2	4.0	24		56	2	40
	Medium	8.0	11.3		2	2		24	4	60	2	42
	Medium	11.3	16.0	6	4	10	12.0	36	8	68	10	52
	Coarse	16.0	22.6		4	4		36	8	76	4	56
	Coarse	22.6	32	6	2	8	12.0	48	4	80	8	64
	Very Coarse	32	45	8	2	10	16.0	64	4	84	10	74
	Very Coarse	45	64	8	8	16	16.0	80	16	100	16	90
COBBLE	Small	64	90	4		4	8.0	88		100	4	94
	Small	90	128	4		4	8.0	96		100	4	98
	Large	128	180					96		100		98
	Large	180	256					96		100		98
BOULDER	Small	256	362					96		100		98
	Small	362	512					96		100		98
	Medium	512	1024					96		100		98
	Large/Very Large	1024	2048					96		100		98
BEDROCK	Bedrock	2048	>2048	2		2	4.00	100		100	2	100
			Total	**50**	**50**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): _____

Riffle Channel materials (mm)		Pool Channel materials		Cumulative Channel materials	
D_{16} =	0.25	D_{16} =	0.06	D_{16} =	0.13
D_{35} =	15.51	D_{35} =	0.34	D_{35} =	0.59
D_{50} =	33.39	D_{50} =	0.59	D_{50} =	14.84
D_{84} =	75.89	D_{84} =	45.00	D_{84} =	56.08
D_{95} =	122.49	D_{95} =	57.33	D_{95} =	98.28
D_{100} =	>2048	D_{99} =	64	D_{99} =	>2048

Reach 1 Little Troublesome Creek - Reach-Wide Pebble Count Particle Distribution



PEBBLE COUNT ANALYSIS WORKSHEET

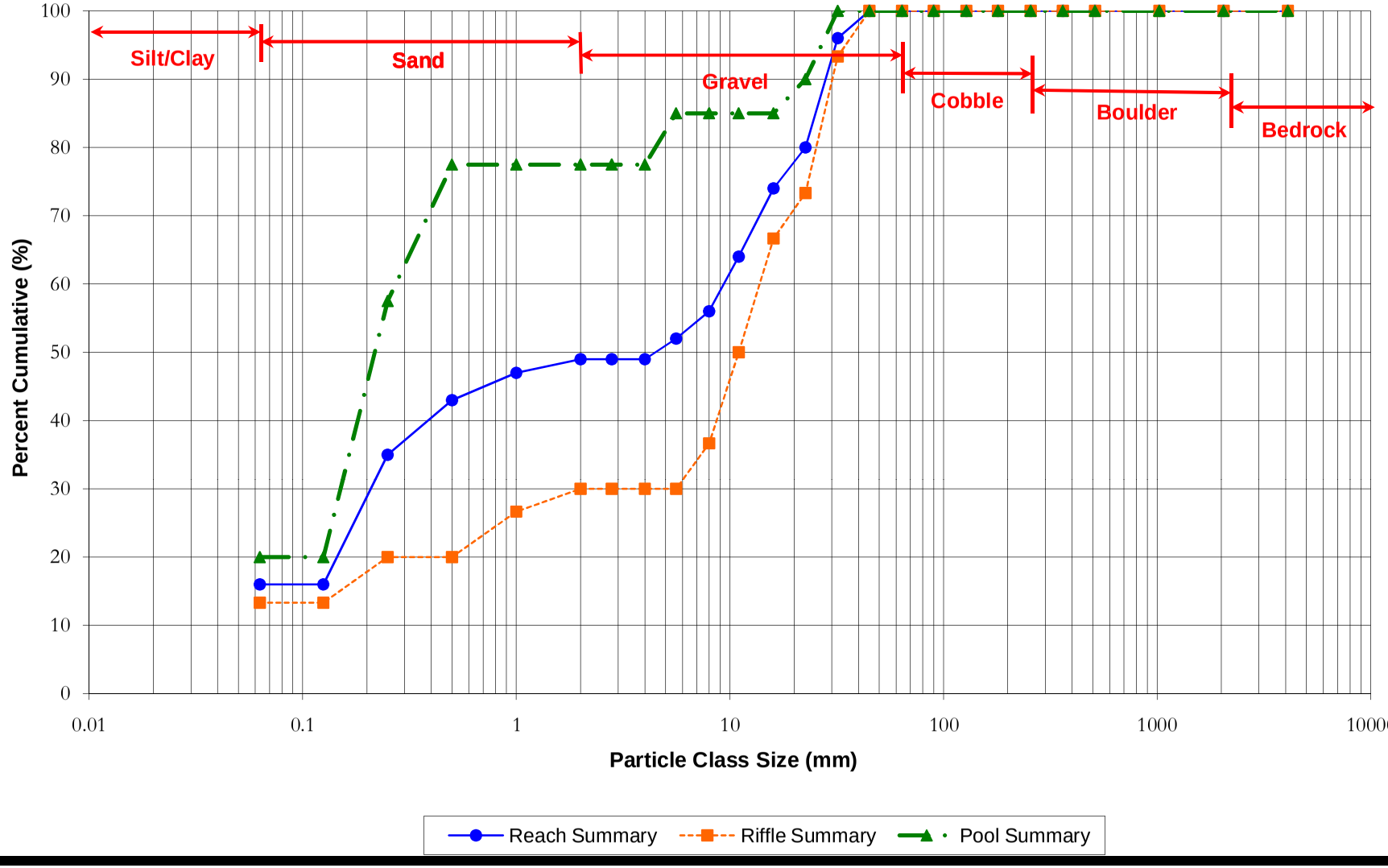
Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 2 (Irvin Creek to Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 2
Date:	12/10/2009	**Cross Section #:**	Reachwide

Particle Class		Diameter (mm)		Particle Count			Riffle Summary		Pool Summary		Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	8	8	16	13.3	13	20	20	16	16
SAND	Very fine	0.062	0.125					13		20		16
	Fine	0.125	0.250	4	15	19	6.7	20	38	58	19	35
	Medium	0.250	0.500		8	8		20	20	78	8	43
	Coarse	0.5	1.0	4		4	6.7	27		78	4	47
	Very Coarse	1.0	2.0	2		2	3.3	30		78	2	49
GRAVEL	Very Fine	2.0	2.8					30		78		49
	Very Fine	2.8	4.0					30		78		49
	Fine	4.0	5.7		3	3		30	8	85	3	52
	Fine	5.7	8.0	4		4	6.7	37		85	4	56
	Medium	8.0	11.3	8		8	13.3	50		85	8	64
	Medium	11.3	16.0	10		10	16.7	67		85	10	74
	Coarse	16.0	22.6	4	2	6	6.7	73	5	90	6	80
	Coarse	22.6	32	12	4	16	20.0	93	10	100	16	96
	Very Coarse	32	45	4		4	6.7	100		100	4	100
	Very Coarse	45	64					100		100		100
COBBLE	Small	64	90					100		100		100
	Small	90	128					100		100		100
	Large	128	180					100		100		100
	Large	180	256					100		100		100
BOULDER	Small	256	362					100		100		100
	Small	362	512					100		100		100
	Medium	512	1024					100		100		100
	Large/Very Large	1024	2048					100		100		100
BEDROCK	Bedrock	2048	>2048					100		100		100
			Total	**60**	**40**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): _____

Riffle Channel materials (mm)		Pool Channel materials		Cumulative Channel materials	
D_{16} =	0.16	D_{16} =	#N/A	D_{16} =	0.13
D_{35} =	7.32	D_{35} =	0.16	D_{35} =	0.25
D_{50} =	11.00	D_{50} =	0.22	D_{50} =	4.47
D_{84} =	27.21	D_{84} =	5.35	D_{84} =	24.65
D_{95} =	34.85	D_{95} =	26.89	D_{95} =	31.31
D_{100} =	45	D_{99} =	32	D_{99} =	45

Reach 2 Little Troublesome Creek - Reach-Wide Pebble Count Particle Distribution



PEBBLE COUNT ANALYSIS WORKSHEET

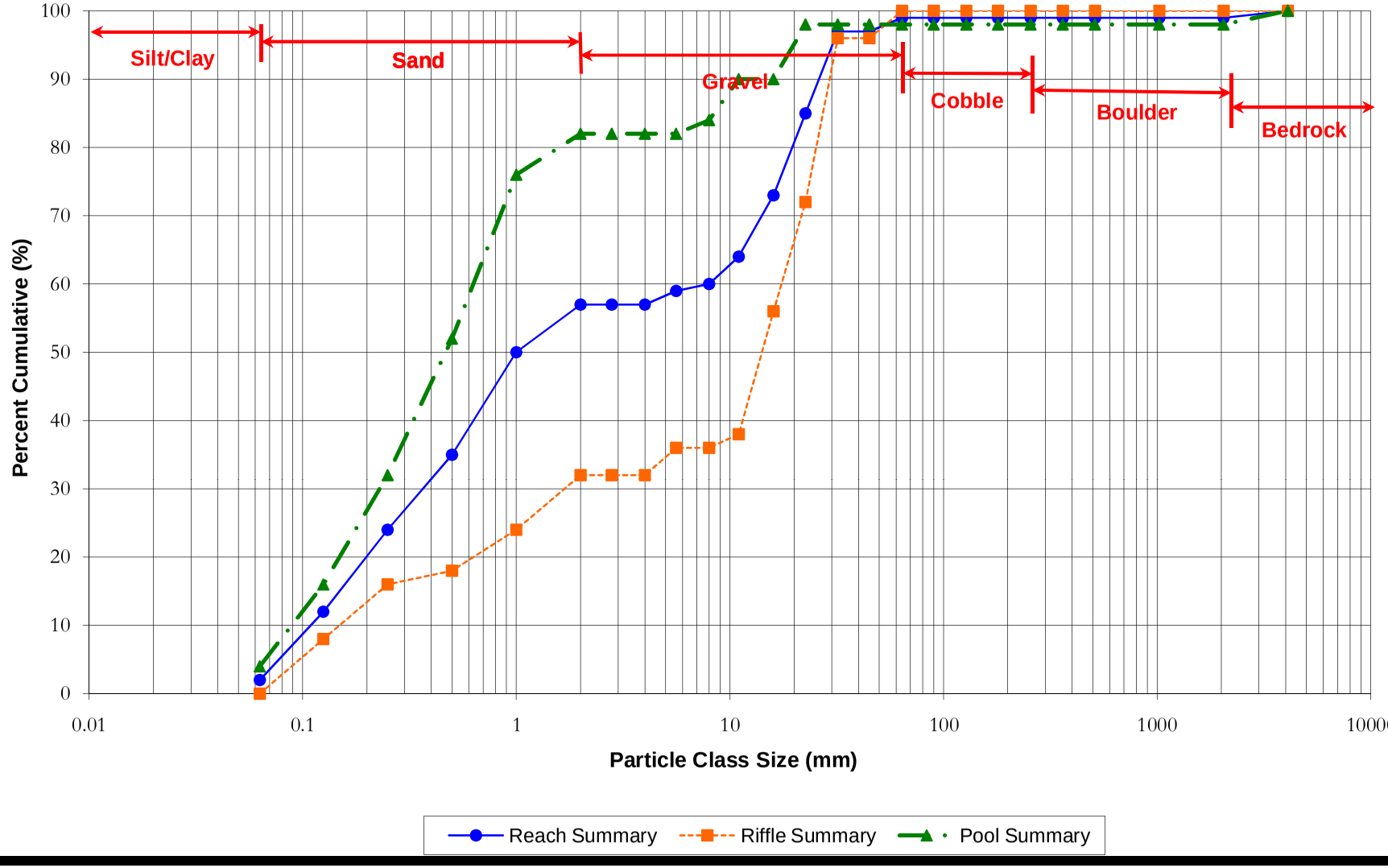
Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 3 (Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 3
Date:	12/10/2009	**Cross Section #:**	Reachwide

Particle Class		Diameter (mm)		Particle Count			Riffle Summary		Pool Summary		Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		2	2		0	4	4	2	2
SAND	Very fine	0.062	0.125	4	6	10	8.0	8	12	16	10	12
	Fine	0.125	0.250	4	8	12	8.0	16	16	32	12	24
	Medium	0.250	0.500	1	10	11	2.0	18	20	52	11	35
	Coarse	0.5	1.0	3	12	15	6.0	24	24	76	15	50
	Very Coarse	1.0	2.0	4	3	7	8.0	32	6	82	7	57
GRAVEL	Very Fine	2.0	2.8					32		82		57
	Very Fine	2.8	4.0					32		82		57
	Fine	4.0	5.7	2		2	4.0	36		82	2	59
	Fine	5.7	8.0		1	1		36	2	84	1	60
	Medium	8.0	11.3	1	3	4	2.0	38	6	90	4	64
	Medium	11.3	16.0	9		9	18.0	56		90	9	73
	Coarse	16.0	22.6	8	4	12	16.0	72	8	98	12	85
	Coarse	22.6	32	12		12	24.0	96		98	12	97
	Very Coarse	32	45					96		98		97
	Very Coarse	45	64	2		2	4.0	100		98	2	99
COBBLE	Small	64	90					100		98		99
	Small	90	128					100		98		99
	Large	128	180					100		98		99
	Large	180	256					100		98		99
BOULDER	Small	256	362					100		98		99
	Small	362	512					100		98		99
	Medium	512	1024					100		98		99
	Large/Very Large	1024	2048					100		98		99
BEDROCK	Bedrock	2048	>2048		1	1		100	2	100	1	100
			Total	**50**	**50**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): _____

Riffle Channel materials (mm)		Pool Channel materials		Cumulative Channel materials	
D_{16} =	0.25	D_{16} =	0.13	D_{16} =	0.16
D_{35} =	5.15	D_{35} =	0.28	D_{35} =	0.50
D_{50} =	14.12	D_{50} =	0.47	D_{50} =	1.00
D_{84} =	26.89	D_{84} =	8.00	D_{84} =	21.96
D_{95} =	31.54	D_{95} =	19.85	D_{95} =	30.20
D_{100} =	64	D_{99} =	>2048	D_{99} =	>2048

Reach 3 Little Troublesome Creek - Reach-Wide Pebble Count Particle Distribution



PEBBLE COUNT ANALYSIS WORKSHEET

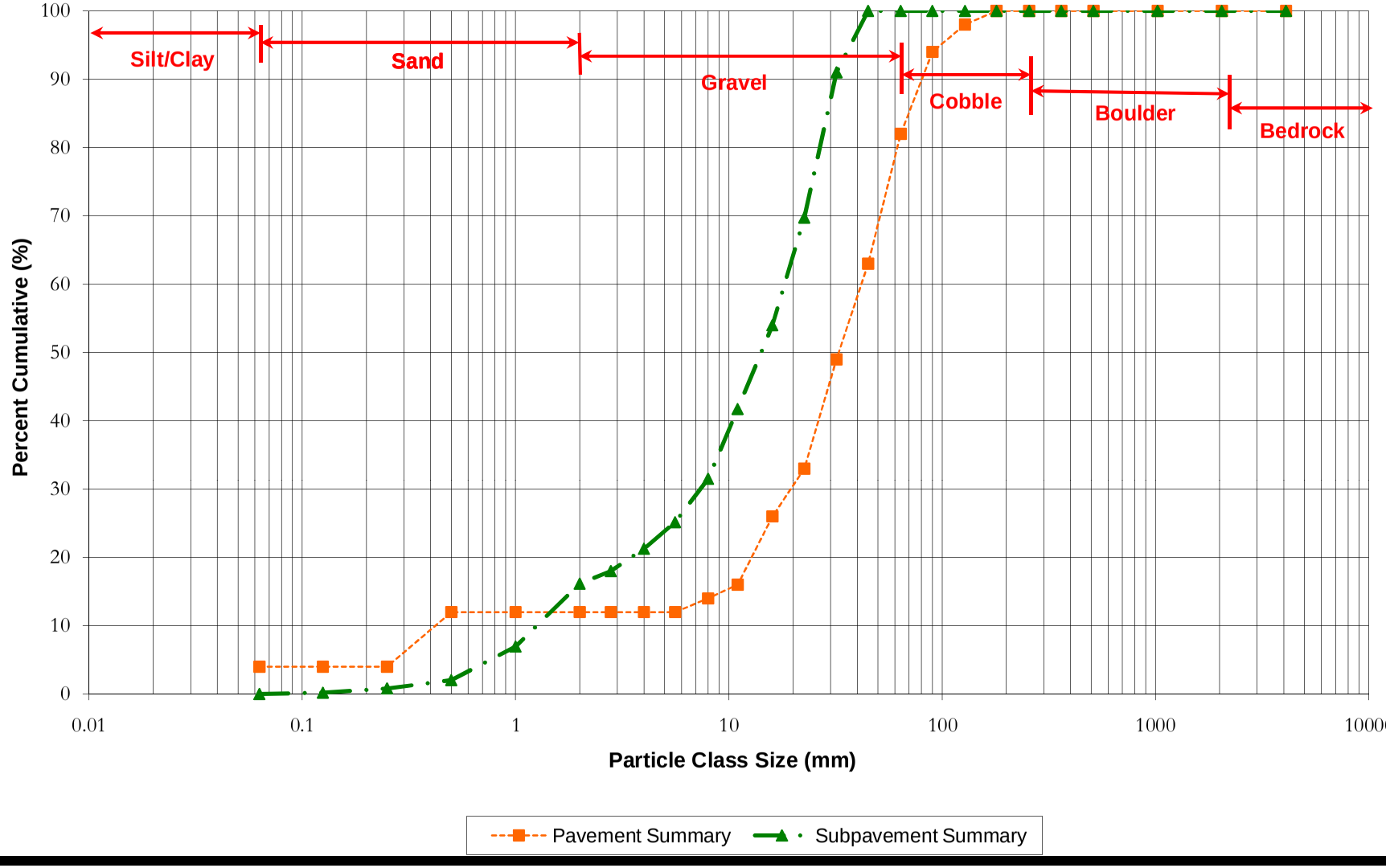
Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 1 (Irvin Creek to Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 1
Date:	12/10/2009	**Cross Section #:**	XS 2 Riffle

Particle Class		Diameter (mm)		Particle Count			Pavement Summary		Subpavement Summary		Reach Summary	
		min	max	Pavement	Subpavement	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4		4	4.0	4		0	0	0
SAND	Very fine	0.062	0.125		5.0	5		4	0	0	0	0
	Fine	0.125	0.250		15.0	15		4	1	1	1	1
	Medium	0.250	0.500	8	30.0	38	8.0	12	1	2	1	2
	Coarse	0.5	1.0		120.0	120		12	5	7	5	7
	Very Coarse	1.0	2.0		225.0	225		12	9	16	9	16
GRAVEL	Very Fine	2.0	2.8		45.0	45		12	2	18	2	18
	Very Fine	2.8	4.0		80.0	80		12	3	21	3	21
	Fine	4.0	5.7		95.0	95		12	4	25	4	25
	Fine	5.7	8.0	2	155.0	157	2.0	14	6	31	6	31
	Medium	8.0	11.3	2	250.0	252	2.0	16	10	42	10	41
	Medium	11.3	16.0	10	300.0	310	10.0	26	12	54	12	53
	Coarse	16.0	22.6	7	385.0	392	7.0	33	16	70	15	68
	Coarse	22.6	32	16	520.0	536	16.0	49	21	91	21	89
	Very Coarse	32	45	14	220.0	234	14.0	63	9	100	9	99
	Very Coarse	45	64	19		19	19.0	82		100	1	99
COBBLE	Small	64	90	12		12	12.0	94		100	0	100
	Small	90	128	4		4	4.0	98		100	0	100
	Large	128	180	2		2	2.0	100		100	0	100
	Large	180	256					100		100		100
BOULDER	Small	256	362					100		100		100
	Small	362	512					100		100		100
	Medium	512	1024					100		100		100
	Large/Very Large	1024	2048					100		100		100
BEDROCK	Bedrock	2048	>2048					100		100		100
			Total	**100**	**2445**	**2545**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): 42

Pavement Channel materials (mm)		Subpavement Channel materials	
D_{16} =	11.00	D_{16} =	1.98
D_{35} =	23.60	D_{35} =	8.92
D_{50} =	32.79	D_{50} =	14.17
D_{84} =	67.74	D_{84} =	28.54
D_{95} =	98.28	D_{95} =	37.23
D_{100} =	180	D_{99} =	45

XS 2 Riffle - Little Troublesome Creek
Pavement & Subpavement Particle Distribution



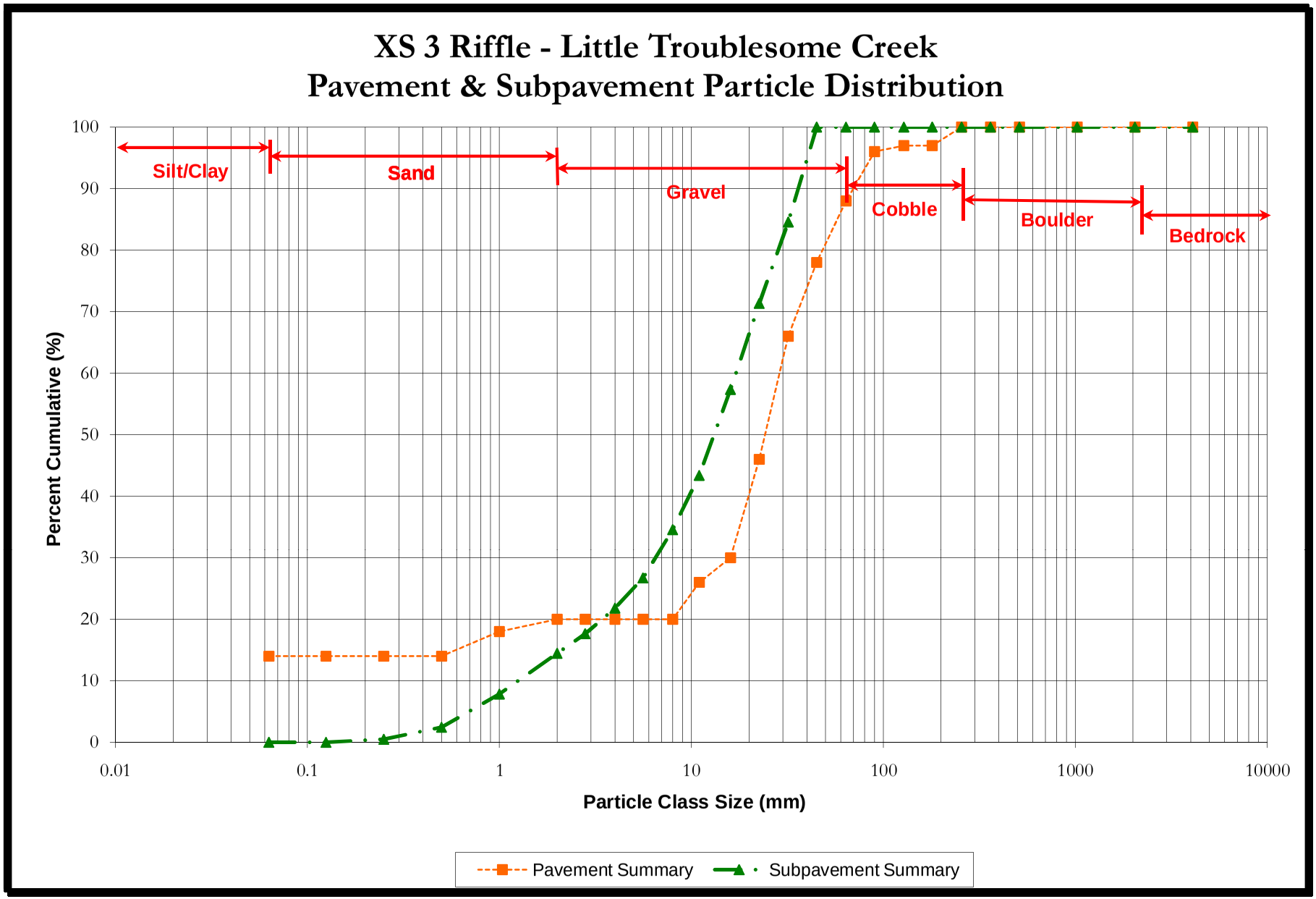
PEBBLE COUNT ANALYSIS WORKSHEET

Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 2 (Irvin Creek to Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 2
Date:	12/10/2009	**Cross Section #:**	XS 3 Riffle

Particle Class		Diameter (mm)		Particle Count			Pavement Summary		Subpavement Summary		Reach Summary	
		min	max	Pavement	Subpavement	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	14		14	14.0	14		0	1	1
SAND	Very fine	0.062	0.125					14		0		1
	Fine	0.125	0.250		10.0	10		14	0	0	0	1
	Medium	0.250	0.500		40.0	40		14	2	2	2	3
	Coarse	0.5	1.0	4	110.0	114	4.0	18	5	8	5	8
	Very Coarse	1.0	2.0	2	135.0	137	2.0	20	7	14	6	15
GRAVEL	Very Fine	2.0	2.8		65.0	65		20	3	18	3	18
	Very Fine	2.8	4.0		85.0	85		20	4	22	4	22
	Fine	4.0	5.7		100.0	100		20	5	27	5	26
	Fine	5.7	8.0		160.0	160		20	8	35	7	34
	Medium	8.0	11.3	6	180.0	186	6.0	26	9	43	9	43
	Medium	11.3	16.0	4	285.0	289	4.0	30	14	57	14	56
	Coarse	16.0	22.6	16	285.0	301	16.0	46	14	71	14	70
	Coarse	22.6	32	20	270.0	290	20.0	66	13	85	14	84
	Very Coarse	32	45	12	315.0	327	12.0	78	15	100	15	99
	Very Coarse	45	64	10		10	10.0	88		100	0	99
COBBLE	Small	64	90	8		8	8.0	96		100	0	100
	Small	90	128	1		1	1.0	97		100	0	100
	Large	128	180					97		100		100
	Large	180	256	3		3	3.0	100		100	0	100
BOULDER	Small	256	362					100		100		100
	Small	362	512					100		100		100
	Medium	512	1024					100		100		100
	Large/Very Large	1024	2048					100		100		100
BEDROCK	Bedrock	2048	>2048					100		100		100
			Total	**100**	**2040**	**2140**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): 37

Pavement Channel materials (mm)		Subpavement Channel materials	
D_{16} =	0.71	D_{16} =	2.35
D_{35} =	17.82	D_{35} =	8.13
D_{50} =	24.23	D_{50} =	13.14
D_{84} =	55.59	D_{84} =	31.53
D_{95} =	86.25	D_{95} =	40.30
D_{100} =	256	D_{99} =	45


XS 3 Riffle - Little Troublesome Creek
Pavement & Subpavement Particle Distribution
Silt/Clay
Sand
Gravel
Cobble
Boulder
Bedrock
Percent Cumulative (%)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Class Size (mm)
Pavement Summary
Subpavement Summary

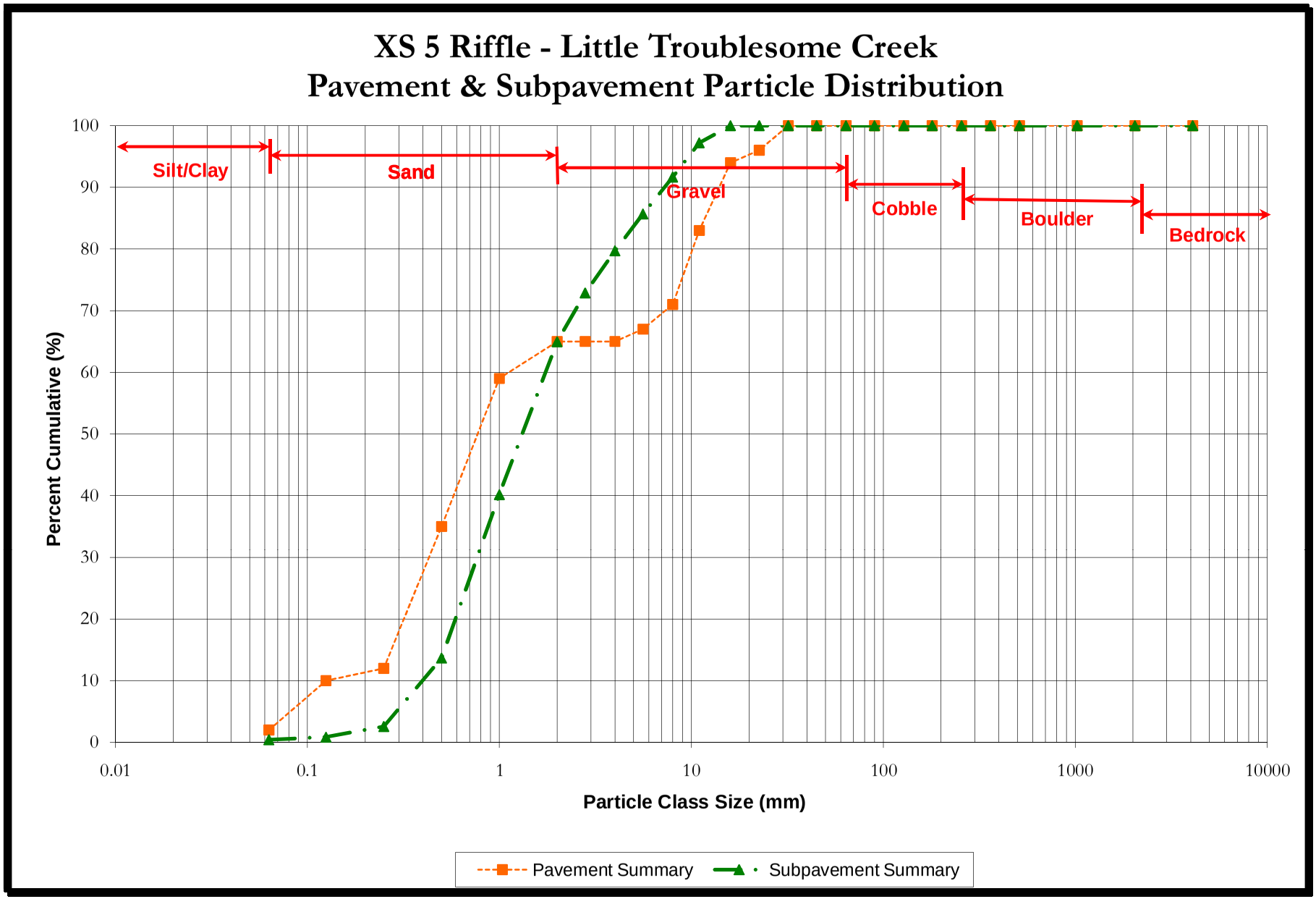
PEBBLE COUNT ANALYSIS WORKSHEET

Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 2 (Irvin Creek to Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 2
Date:	12/10/2009	**Cross Section #:**	XS 5 Riffle

Particle Class		Diameter (mm)		Particle Count			Pavement Summary		Subpavement Summary		Reach Summary	
		min	max	Pavement	Subpavement	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	10.0	12	2.0	2	0	0	0	0
SAND	Very fine	0.062	0.125	8	10.0	18	8.0	10	0	1	1	1
	Fine	0.125	0.250	2	40.0	42	2.0	12	2	3	2	3
	Medium	0.250	0.500	23	260.0	283	23.0	35	11	14	12	15
	Coarse	0.5	1.0	24	620.0	644	24.0	59	26	40	26	41
	Very Coarse	1.0	2.0	6	580.0	586	6.0	65	25	65	24	65
GRAVEL	Very Fine	2.0	2.8		185.0	185		65	8	73	8	73
	Very Fine	2.8	4.0		160.0	160		65	7	80	7	79
	Fine	4.0	5.7	2	140.0	142	2.0	67	6	86	6	85
	Fine	5.7	8.0	4	140.0	144	4.0	71	6	92	6	91
	Medium	8.0	11.3	12	130.0	142	12.0	83	6	97	6	97
	Medium	11.3	16.0	11	65.0	76	11.0	94	3	100	3	100
	Coarse	16.0	22.6	2		2	2.0	96		100	0	100
	Coarse	22.6	32	4		4	4.0	100		100	0	100
	Very Coarse	32	45					100		100		100
	Very Coarse	45	64					100		100		100
COBBLE	Small	64	90					100		100		100
	Small	90	128					100		100		100
	Large	128	180					100		100		100
	Large	180	256					100		100		100
BOULDER	Small	256	362					100		100		100
	Small	362	512					100		100		100
	Medium	512	1024					100		100		100
	Large/Very Large	1024	2048					100		100		100
BEDROCK	Bedrock	2048	>2048					100		100		100
			Total	**100**	**2340**	**2440**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): 12

Pavement Channel materials (mm)		Subpavement Channel materials	
D_{16} =	0.28	D_{16} =	0.53
D_{35} =	0.50	D_{35} =	0.87
D_{50} =	0.77	D_{50} =	1.32
D_{84} =	11.38	D_{84} =	5.09
D_{95} =	19.02	D_{95} =	9.68
D_{100} =	32	D_{99} =	16


XS 5 Riffle - Little Troublesome Creek
Pavement & Subpavement Particle Distribution
Silt/Clay
Sand
Gravel
Cobble
Boulder
Bedrock
Percent Cumulative (%)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Class Size (mm)
Pavement Summary
Subpavement Summary

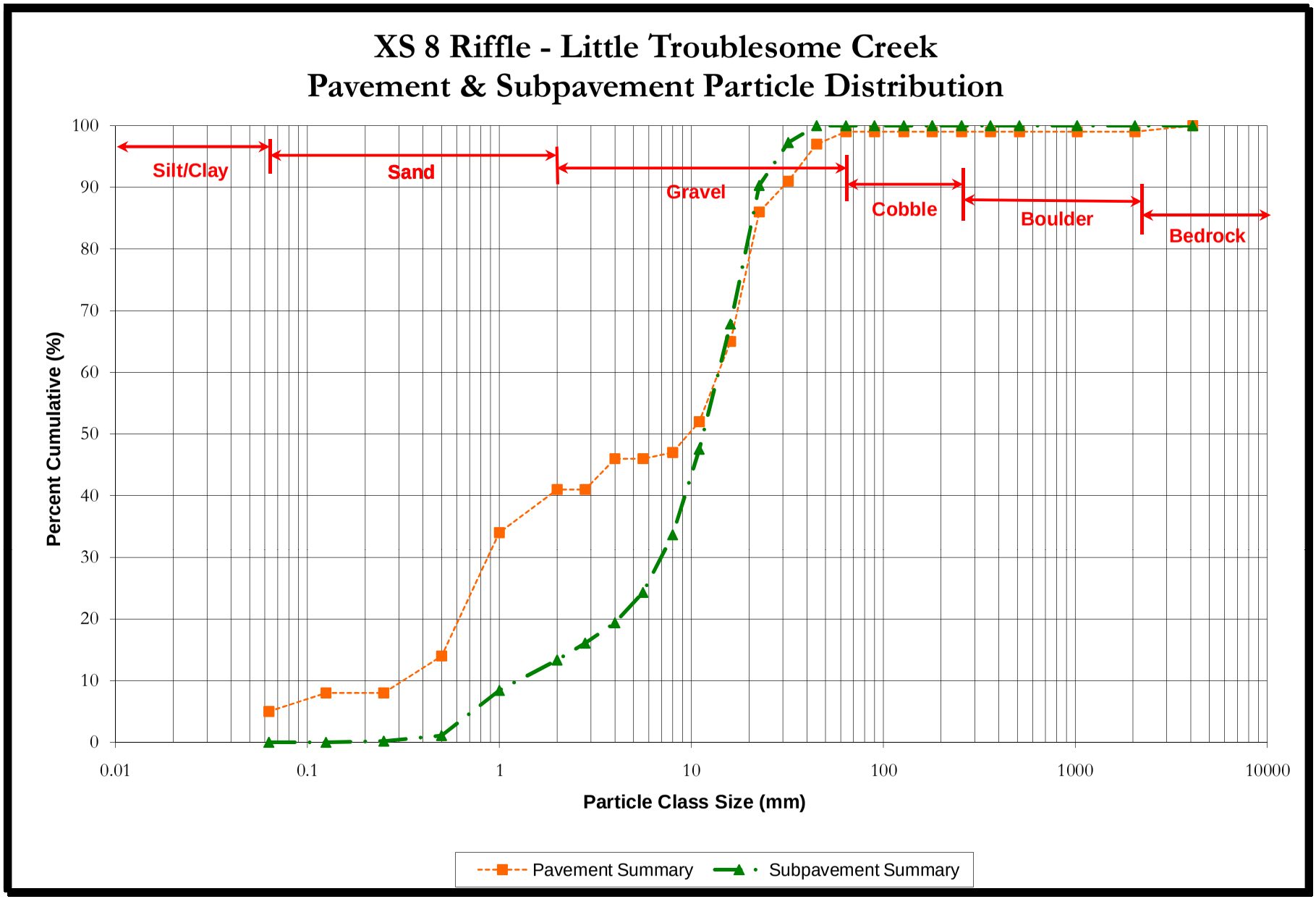
PEBBLE COUNT ANALYSIS WORKSHEET

Project Name:	Little Troublesome Creek	**Data Collected By:**	MJ, JK
Location:	Reach 3 (Little Troublesome)	**Data Collected On:**	12/10/2009
Job #:	005-12700	**Reach:**	Reach 3
Date:	12/10/2009	**Cross Section #:**	XS 8 Riffle

Particle Class		Diameter (mm)		Particle Count			Pavement Summary		Subpavement Summary		Reach Summary	
		min	max	Pavement	Subpavement	Total	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	5		5	5.0	5		0	0	0
SAND	Very fine	0.062	0.125	3		3	3.0	8		0	0	0
	Fine	0.125	0.250		5.0	5		8	0	0	0	0
	Medium	0.250	0.500	6	25.0	31	6.0	14	1	1	1	2
	Coarse	0.5	1.0	20	200.0	220	20.0	34	7	8	8	9
	Very Coarse	1.0	2.0	7	135.0	142	7.0	41	5	13	5	14
GRAVEL	Very Fine	2.0	2.8		75.0	75		41	3	16	3	17
	Very Fine	2.8	4.0	5	90.0	95	5.0	46	3	19	3	20
	Fine	4.0	5.7		135.0	135		46	5	24	5	25
	Fine	5.7	8.0	1	255.0	256	1.0	47	9	34	9	34
	Medium	8.0	11.3	5	380.0	385	5.0	52	14	48	14	48
	Medium	11.3	16.0	13	555.0	568	13.0	65	20	68	20	68
	Coarse	16.0	22.6	21	615.0	636	21.0	86	22	90	22	90
	Coarse	22.6	32	5	190.0	195	5.0	91	7	97	7	97
	Very Coarse	32	45	6	75.0	81	6.0	97	3	100	3	100
	Very Coarse	45	64	2		2	2.0	99		100	0	100
COBBLE	Small	64	90					99		100		100
	Small	90	128					99		100		100
	Large	128	180					99		100		100
	Large	180	256					99		100		100
BOULDER	Small	256	362					99		100		100
	Small	362	512					99		100		100
	Medium	512	1024					99		100		100
	Large/Very Large	1024	2048					99		100		100
BEDROCK	Bedrock	2048	>2048	1		1	1.00	100		100	0	100
			Total	**100**	**2735**	**2835**	**100**	**100**	**100**	**100**	**100**	**100**

Largest Particle (mm): 34

Pavement Channel materials (mm)		Subpavement Channel materials	
D_{16} =	0.54	D_{16} =	2.77
D_{35} =	1.10	D_{35} =	8.25
D_{50} =	9.68	D_{50} =	11.51
D_{84} =	21.87	D_{84} =	20.51
D_{95} =	40.17	D_{95} =	28.58
D_{100} =	>2048	D_{99} =	45


XS 8 Riffle - Little Troublesome Creek
Pavement & Subpavement Particle Distribution
Silt/Clay
Sand
Gravel
Cobble
Boulder
Bedrock
Percent Cumulative (%)
100
90
80
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
1000
10000
Particle Class Size (mm)
Pavement Summary
Subpavement Summary

APPENDIX 5

Historical Aerial Photographs

Little Troublesome Creek
Turner Road
Reidsville, NC 27320

Inquiry Number: 2542336.5
July 15, 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 July 15, 2009

Target Property:

Turner Road

Reidsville, NC 27320

Year	***Scale***	***Details***	***Source***
1971	Aerial Photograph. Scale: 1"=750'	Panel #: 2436079-C6/Flight Date: March 14, 1971	EDR
1977	Aerial Photograph. Scale: 1"=1000'	Panel #: 2436079-C6/Flight Date: March 09, 1977	EDR
1982	Aerial Photograph. Scale: 1"=1000'	Panel #: 2436079-C6/Flight Date: April 23, 1982	EDR
1993	Aerial Photograph. Scale: 1"=750'	Panel #: 2436079-C6/Flight Date: January 30, 1993	EDR
2006	Aerial Photograph. 1" = 604'	Flight Year: 2006	EDR


INQUIRY #: 2542336.5
YEAR: 1971
= 750'
N


INQUIRY #: 2542336.5
YEAR: 1977
= 1000'
N


INQUIRY #: 2542336.5
YEAR: 1982
= 1000'
N


INQUIRY #: 2542336.5
YEAR: 1993
= 750'
N


INQUIRY #: 2542336.5
YEAR: 2006
= 604'
N
EDR Environmental Data Resources Inc

Little Troublesome Creek Wetland
Mizpah Church Road
Reidsville, NC 27320

Inquiry Number: 2827687.4
July 29, 2010

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. EDR's 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 July 29, 2010

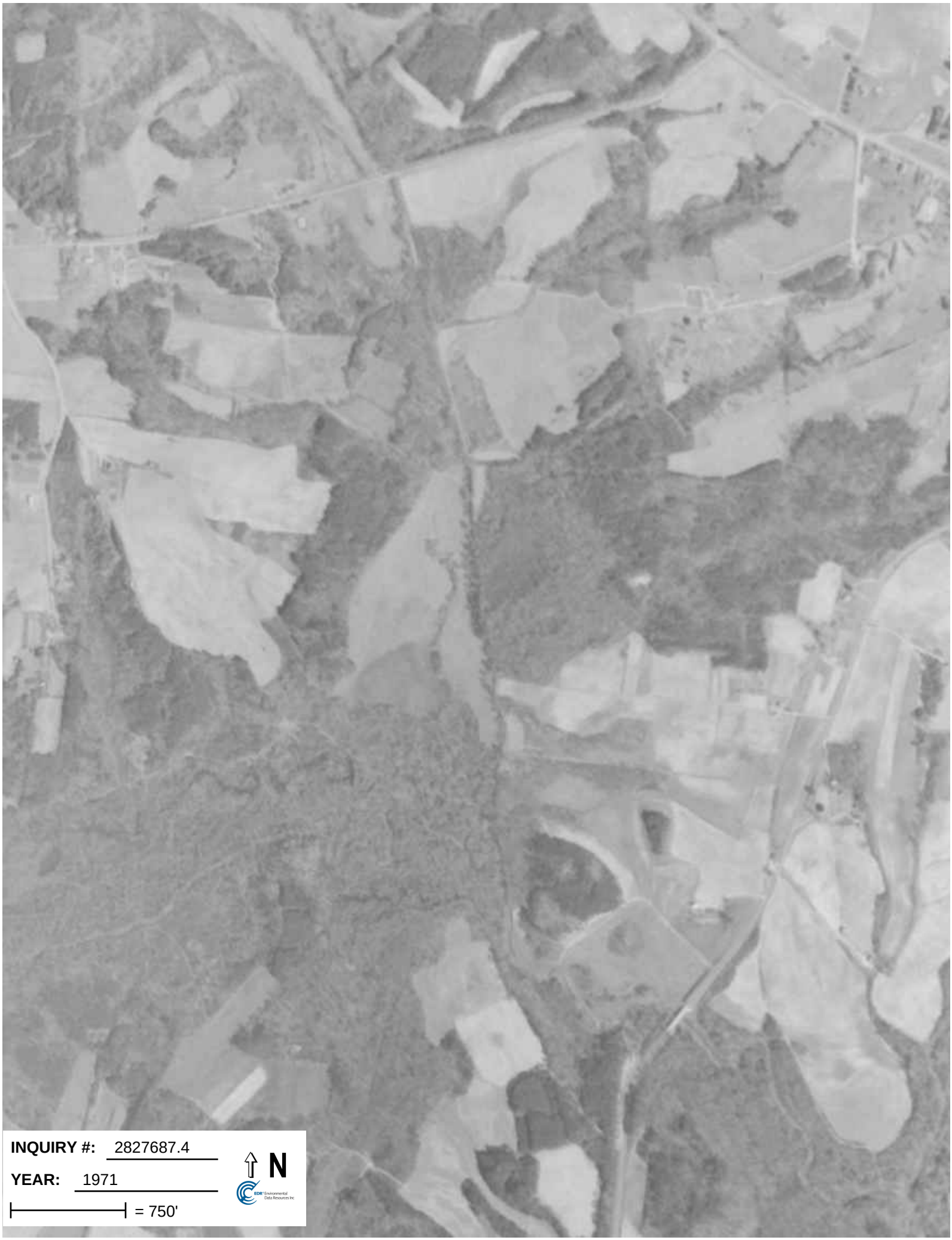
Target Property:

Mizpah Church Road

Reidsville, NC 27320

Year	***Scale***	***Details***	***Source***
1969	Aerial Photograph. Scale: 1"=500'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: March 13, 1969	EDR
1971	Aerial Photograph. Scale: 1"=750'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: March 16, 1971	EDR
1977	Aerial Photograph. Scale: 1"=750'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: March 26, 1977	EDR
1982	Aerial Photograph. Scale: 1"=1000'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: April 23, 1982	EDR
1999	Aerial Photograph. Scale: 1"=750'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: February 14, 1999	EDR
2006	Aerial Photograph. Scale: 1"=604'	Panel #: 36079-C5, Williamsburg, NC;/Flight Date: January 01, 2006	EDR


INQUIRY #: 2827687.4
YEAR: 1969
= 500'
N
EDR Environmental Data Resources Inc


INQUIRY #: 2827687.4
YEAR: 1971
= 750'
N

INQUIRY #: 2827687.4

YEAR: 1977

= 750'

N

EDR Environmental Data Resources Inc


INQUIRY #: 2827687.4
YEAR: 1982
= 1000'
N
EDR Environmental Data Resources Inc


INQUIRY #: 2827687.4
YEAR: 1999
= 750'
N


INQUIRY #: 2827687.4
YEAR: 2006
= 604'
N

APPENDIX 6

FEMA Floodplain Checklist

EEP Floodplain Requirements Checklist

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

Project Location

Name of project:	Little Troublesome Creek Stream & Wetland Mitigation Site
Name if stream or feature:	Little Troublesome Creek, Tributary A to Little Troublesome Creek
County:	Rockingham County, NC
Name of river basin:	Cape Fear River Basin
Is project urban or rural?	Urban
Name of Jurisdictional municipality/county:	City of Reidsville, NC
DFIRM panel number for entire site:	Firm Panels 8903 and 8904 Community No.: 370209, 370350 Map Numbers: 3710890300E and 3710890400E Effective Map Date: July 3, 2007
Consultant name:	Wildlands Engineering, Inc. Nicole Macaluso, PE
Phone number:	(919) 851-9986
Address:	5605 Chapel Hill Road, Suite 122 Raleigh, NC 27607

Design Information

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

Wildlands Engineering is designing a stream and wetland restoration project to provide stream and wetland mitigation units (SMUs and WMUs) for the NC Ecosystem Enhancement Program. The stream restoration work includes channel and floodplain grading for approximately 5,000 linear feet (LF) of Little Troublesome Creek and its unnamed tributary (mapped as Tributary A to Little Troublesome Creek and locally referred to as Irvin Creek). Little Troublesome Creek and its Tributary A are located within the Upper Cape Fear watershed (NCDWQ Subbasin 03-06-01) of the Cape Fear River Basin (USGS Hydrologic Unit 03030002). The wetland portion of the site will be addressed in a separate study and checklist.

Summarize stream reaches or wetland areas according to their restoration priority.

Example

Reach	Length	Priority
Little Troublesome Creek	*1,169*	*One (Restoration)*
Tributary A to Little Troublesome Creek	*3,931*	*One (Restoration)*
UT1 – UT to Little Troublesome Creek	*240*	*One (Restoration)*

Floodplain Information

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

(•) Yes ( ) No

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

- [ ] Redelineation
- [x] Detailed Study
- [ ] Limited Detail Study
- [ ] Approximate Study
- [ ] Don't know

List flood zone designation:

Check if applies:

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

If local setbacks are required, list how many feet: N/A
Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? ◉ Yes ○ No
Land Acquisition (Check) ☐ State owned (fee simple) ☐ Conservation easment (Design Bid Build) ☑ Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? ◉ Yes ○ No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: Edward Curtis, (919) 715-8000 x369)
Name of Local Floodplain Administrator: Donna Setliff Phone Number: (336) 349-1065

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: Nicole Macaluso, PE Signature:

Title: Project Engineer Date: 4/5/2011

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:	Little Troublesome Creek Stream & Wetland Mitigation Site
Name if stream or feature:	Little Troublesome Creek
County:	Rockingham County, NC
Name of river basin:	Cape Fear River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Rockingham County, NC
DFIRM panel number for entire site:	Firm Panels 8911, 9812, 8921 and 9822 Community No.: 370350 Map Numbers: 3710891100J, 3710891200J, 3710892100J, and 3710892200J Effective Map Date: July 3, 2007
Consultant name:	Wildlands Engineering, Inc. Nicole Macaluso, PE
Phone number:	(919) 851-9986
Address:	5605 Chapel Hill Road, Suite 122 Raleigh, NC 27607

Design Information

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

Wildlands Engineering is designing a stream and wetland restoration project to provide stream and wetland mitigation units (SMUs and WMUs) for the NC Ecosystem Enhancement Program. The wetland portion of the site includes the restoration of approximately 17.5 acres of riparian wetlands located within the Little Troublesome Creek floodplain near its confluence with the Haw River. Little Troublesome Creek is located within the Upper Cape Fear watershed (NCDWQ Subbasin 03-06-01) of the Cape Fear River Basin (USGS Hydrologic Unit 03030002). The stream portion of the site will be addressed in a separate study and checklist.

Summarize stream reaches or wetland areas according to their restoration priority.

Example

Reach	Area	Priority
RW1, adjacent to Little Troublesome Creek	*17.5 acres*	*N/A*

Floodplain Information

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

(•) Yes ( ) No

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

- [ ] Redelineation
- [ ] Detailed Study
- [x] Limited Detail Study
- [ ] Approximate Study
- [ ] Don't know

List flood zone designation:

Check if applies:

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

If local setbacks are required, list how many feet: N/A

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

○ Yes ◉ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

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

Is community/county participating in the NFIP program?

◉ Yes ○ No

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

Name of Local Floodplain Administrator: Frankie Legaux
Phone Number: (336) 342-8137

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:
A technical memo was prepared for Rockingham County according to guidance received from the NC Floodplain Mapping Program. The technical report included detailed construction plans and an explanation of the proposed affects on hydrology. Based on our evaluation, a full flood study was not required. Following construction, an as-built survey and engineer's certification will also be provided to the County.

Comments:

Name: Nicole Macaluso, PE Signature:

Title: Project Engineer Date: 4/5/2011