DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

7 September, 2012

Regulatory Division

Re: NCIRT Review and USACE Approval of the Jacobs Ladder Mitigation Plan (SAW 2012-01007)

Ms. Suzanne Klimek
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Ms. Klimek:

The purpose of this letter is to provide the North Carolina Ecosystem Enhancement Program (NCEEP) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the Jacobs Ladder Mitigation Plan, which closed on 23 August, 2012. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan. However, the minor issues with the Draft discussed in the attached comments must be addressed in the Final Mitigation Plan.

The Final Mitigation Plan is to be submitted with the Preconstruction Notification (PCN) Application for Nationwide permit approval of the project along with a copy of this letter and a summation of the comments addressed. If it is determined that the project does not require a Department of the Army permit, you must still provide a copy of the Final Mitigation Plan, along with a copy of this letter, to the appropriate USACE field office at least 30 days in advance of beginning construction of the project. Please note that this approval does not preclude the inclusion of permit conditions in the permit authorization for the project, particularly if issues mentioned above are not satisfactorily addressed. Additionally, this letter provides initial approval for the Mitigation Plan, but this does not guarantee that the project will generate the requested amount of mitigation credit. As you are aware, unforeseen issues may arise during construction or monitoring of the project that may require maintenance or reconstruction that may lead to reduced credit.

Thank you for your prompt attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please call us at 919-846-2564.

Sincerely,

Tyler Crumbley
Regulatory Specialist

Enclosures

Electronic Copies Furnished:

NCIRT Distribution List
CESAW-RG/McLendon
CESAW-RG-A/Kichefski
Michael McDonald, NCEEP
Deborah Daniel, NCEEP

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WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

CESAW-RG/Crumbley August 24, 2012

MEMORANDUM FOR RECORD

SUBJECT: NCIRT Comments During 30-day Mitigation Plan Review

Purpose: The comments listed below were posted to the NCEEP Mitigation Plan Review Portal during the 30-day comment period in accordance with Section 332.8(g) of the 2008 Mitigation Rule.

NCEEP Project Name: Jacobs Ladder Stream Mitigation Site (EEP-IMS# 95023), Rowan County, NC

USACE AID#: SAW 2012-01007

30-Day Comment Deadline: August 23, 2012

1. 8/22/2012- N.C. Division of Water Quality; Eric Kulz:

   No comments or concerns regarding this property, pending a site visit by DWQ (Alan Johnson - MRO), along with a visit to Jacob's Landing.

2. 8/23/2012- U.S. Environmental Protection Agency; Jeffrey Garnett:

   I would like to reiterate comments that I made on the Jacob's Landing bank: The plan calls for some reconstructed culverted crossings. I request that the Provider submit detailed plans of culvert installations that adequately ensure that passage for aquatic life is achievable. Additionally, one of the goals of the project is to "reduce the sediment supply entering Irish Buffalo Creek." Monitoring channel forms over the first five years of the bank only serves as a surrogate that sediment loads are decreasing. The assumption is being made that improving the channel will reduce sediment loads, but no quantifiable way to test this is being presented. The Provider should develop a quantifiable plan to directly measure success of the project goal. For example, simple turbidity measurements could be taken on a regular basis (during base flows and bank full events) both upstream and downstream of the site. These measurements should be taken before restoration, during restoration, and for a minimum of five years post-restoration in order to document achievement of the goal.

3. 8/23/2012 - U.S. Army Corps of Engineers; Tyler Crumbley and Todd Tugwell:

    a. Please ensure that the performance standards for channel dimension [(as described in Sections 9 and 10 of the document (pgs. 35-38)], are in accordance with the 2003 Stream Mitigation Guidelines (1 cross-section per 20 bankfull width lengths) and that the performance standard for Bed Materials is instituted to show a change to a pre-determined desired composition, rather than purely an evaluation of sediment transport.
    b. Section 9.0, pg. 35 reads: “The purpose of monitoring…” please change to “The purpose of geomorphological monitoring …”
    c. Section 9.0, pg. 36, vegetation: Please add “planted, living stems per acre.” Also, please remove the year 4 performance standard of 288 stems per acre.
    d. Site Plan and Profile, (sheet 11 of 23), Sta. 119+25: A 50’ crossing is proposed. Please ensure that all crossings on the project are wide enough to allow for future planned uses on the property, including any municipal or DOT mandated road widths, if anticipated.

FINAL MITIGATION PLAN

Jacob's Ladder Stream Restoration Site
Rowan County, North Carolina
EEP Contract 003983

Yadkin-Pee Dee River Basin
Cataloging Unit 03040105

Prepared for:

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

September 2012

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Prepared for:

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

Prepared by:

KCI Associates of North Carolina, PA
4601 Six Forks Rd, Suite 220
Raleigh, NC 27609
(919) 783-9214

September 2012

EXECUTIVE SUMMARY

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

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

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

The Jacob's Ladder Stream Restoration Site is a full-delivery mitigation project being developed for the North Carolina Ecosystem Enhancement Program (EEP). The site offers the opportunity to restore and enhance a series of headwater tributaries to Irish Buffalo Creek. This project will return these tributaries to a stable stream ecosystem, lower the sediment supply entering Irish Buffalo Creek, and reduce incoming nutrients from livestock. This project also looks to expand aquatic and terrestrial habitat in the Rocky River Watershed (03040105). The project is located in the Irish Buffalo Creek Drainage (03040105020040), which the EEP has identified as a Targeted Local Watershed (TLW).

The project goals address stressors identified in the TLW and include the following:

- Restore a diverse riparian corridor that connects forested stream systems upstream and downstream of the project.
- Reduce the sediment supply entering Irish Buffalo Creek.

The project goals will be addressed through the following objectives:

- Restore stable channel planforms to streams that have been straightened and modified.
- Reshape and stabilize eroding stream banks.
- Plant the site with native trees to help reestablish a diverse riparian corridor.
- Install exclusion fencing and alternative watering options to keep livestock out of the project streams.

The majority of the site is currently used for pasture. Past anthropogenic modifications have involved logging, grazing, and channelization. Three separate streams make up the site: (T1) begins in the northwestern project corner, Tributary 1A (T1A) is a tributary to T1, joining T1 from the east; and Tributary 2 (T2) enters the site from the northeastern corner. Both T1 and T2 flow to the south and join Irish Buffalo Creek along the southern property boundary.

The mitigation approach for the Jacob's Ladder Stream Restoration Site will focus on repairing isolated sections of bed degradation and bank erosion in the enhancement reaches and restoring the unstable reaches that have been straightened or severely degraded by cattle. Once site grading is complete, the stream buffers will be planted as Piedmont Alluvial Forest (Schafale and Weakley 1990). The site will be monitored for five years or until the success criteria are met.

Table 1. Jacob's Ladder Stream Restoration Site - Mitigation Summary

Reach	Mitigation Type	Priority Approach	Existing Linear Footage	Designed Linear Footage	Mitigation Units
T1-1	Restoration	P1	587	739	739
T1-2	Restoration	P1	1,592	1,622*	1,622
T2-1	Enhancement I	-	837	750*	500
T2-2	Restoration	P1	1,246	1,334*	1,334
T1A-1	Enhancement I	-	306	306	204
T1A-2	Enhancement II	-	140	140	56
T1A-3	Restoration	P1	470	498	498
Total Stream Enhancement I			1,143	1,056	704
Total Stream Enhancement II			140	140	56
Total Stream Restoration			3,895	4,193	4,193
Total Mitigation Units					4,953

*Mitigation units have been calculated to exclude the easement exceptions and water utility easements.

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TABLES

APPENDICES

1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

EEP develops River Basin Restoration Priorities (RBRPs) to guide its restoration activities within each of the state's 54 Cataloging Units (CUs). RBRPs delineate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds are called Targeted Local Watersheds (TLWs) and receive priority for EEP planning and restoration project funds.

The 2009 Lower Yadkin Pee-Dee RBRP identified population growth, urban stormwater and agricultural activities as major stressors within the 8-digit Cataloging Unit (03040105). Overall watershed restoration goals for this CU include management of stormwater runoff and protection of aquatic habitat for rare species (NCDENR, EEP 2009).

The 2009 Lower Yadkin Pee-Dee RBRP identified HUC 03040105020040 (Irish Buffalo Creek) as a Targeted Local Watershed. Major stressors identified within the 46-square mile Irish Buffalo Creek TLW include animal operations and impervious cover. Reduction of sediment inputs and protection of Water Supply Waters serving the City of Kannapolis are primary goals of any stream restoration efforts undertaken within this TLW (NCDENR. EEP 2009). The Jacob's Ladder Stream was identified as a stream restoration opportunity to restore and enhance headwater streams within the TLW by addressing some of the local watershed stressors.

The project goals address stressors identified in the TLW and include the following:

- Restore a diverse riparian corridor that connects forested stream systems upstream and downstream of the project.
- Reduce sedimentation of Irish Buffalo Creek from the project site

The project goals will be addressed through the following objectives:

- Restore stable channel planforms to streams that have been straightened and modified.
- Reshape and stabilize eroding stream banks.
- Plant the site with native trees to help reestablish a diverse riparian corridor.
- Install exclusion fencing and alternative watering options to keep livestock out of the project streams.

2.0 SITE SELECTION

2.1 Directions

The Jacob's Ladder Stream Restoration Site is west of China Grove and north of Kannapolis, located off of Saw Road. To reach the site from Raleigh: proceed west on I-40 for approximately 62 miles. Then travel on I-85 south toward High Point/Charlotte for approximately 50 miles. Take Exit 68 toward China Grove on US-29 south. Turn right on NC-152 on East Church Street for approximately 5 miles and then turn left onto Saw Road. The site will be approximately 1-mile ahead on the left (shortly after passing Goodnight Lake Road) (See 2.3 Vicinity Map).

2.2 Site Selection

The site is part of the 03040105 Watershed Cataloging Unit (Rocky River). The Rocky River Watershed as a whole is experiencing a large amount of habitat alteration due to population growth from Charlotte and its surrounding metropolitan area. The drainage is expected to gain an estimated 950,000 new residents by 2030 (NCDENR, EEP 2009). As a result, the focus in this watershed is on mitigating impacts from stormwater and protecting existing habitat (NCDENR, EEP 2009).

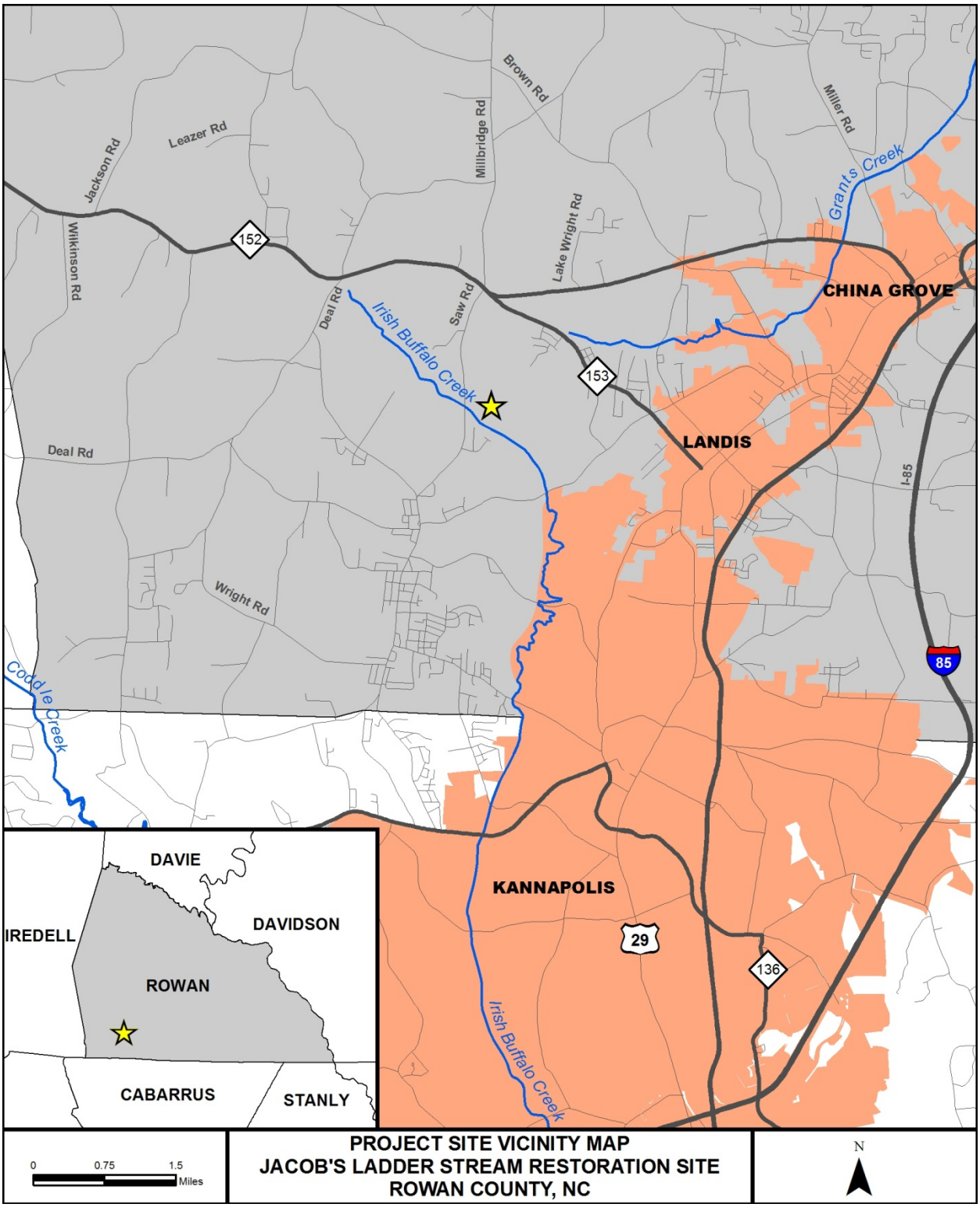
The North Carolina Division of Water Quality (NCDWQ) assigns surface waters a classification in order to help protect, maintain, and preserve water quality. The site is located in a water supply watershed; Irish Buffalo Creek flows into Kannapolis Lake, which is the primary water source for the City of Kannapolis. The section of Irish Buffalo Creek immediately below the project site (DWQ 13-17-9-(0.5)) is classified as a Class C, Water Supply III (WS-III) (NCDENR, DWQ 2012b).

- **Class C Waters** in North Carolina are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. There are no restrictions on watershed development or types of discharges.
- **Water Supply III (WS-III)** Waters used as sources of water supply for drinking, culinary, or food processing purposes where a more protective WS-I or II classification is not feasible. These waters are also protected for Class C uses. WS-III waters are generally in low to moderately developed watersheds.

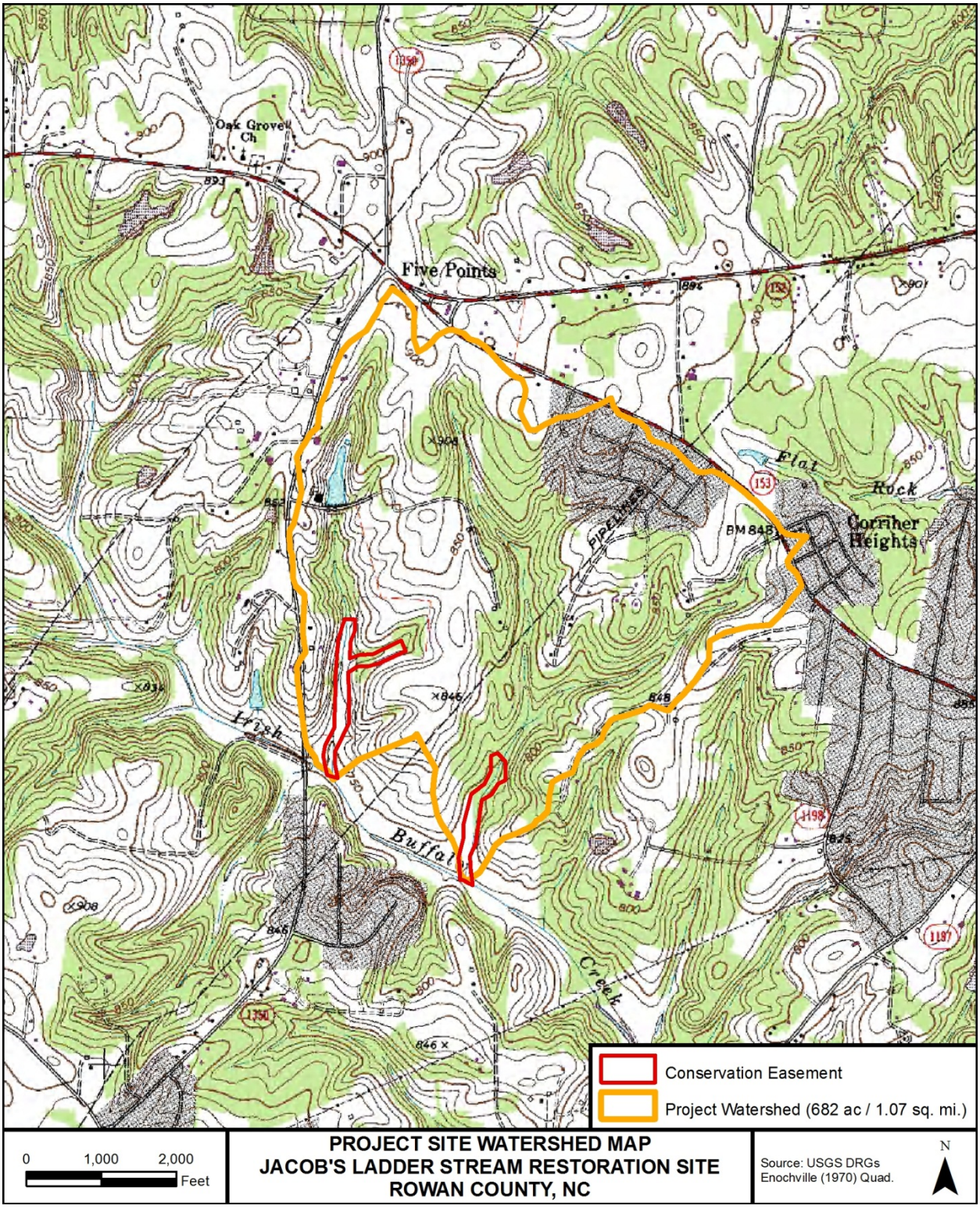
Downstream of Kannapolis Lake, Irish Buffalo Creek is listed as impaired on the 2012 North Carolina 303(d) list-Category 5 (Unit 13-17-9-(2)) listed for turbidity and copper violations (NCDENR, DWQ 2012a). The Lower Yadkin Pee-Dee River Basin Restoration Priorities 2009 report noted that several animal operations existed in the Irish Buffalo Creek watershed and that there was potential for future restoration projects to add to the ecological uplift in the watershed (NCDENR, EEP 2009).

Based on correspondence with the landowner, the site has been actively used for timber and cattle production for over five generations. Historic aerials were examined for any additional information about how the site hydrology and vegetation has changed over the last century. The reviewed aerials are included in 2.7 Historical Condition Plan View. Historic aerials were obtained from Rowan County NRCS and the USGS Earth Explorer for 1936, 1949, 1965, 1983, 1993, 1998, 2006, and 2009. The photographs confirm that the modifications to the project streams have been in place for quite some time; the aerial in 1936 indicates the lower reaches were likely straightened by that time and the aerial from 1949 shows that they certainly were by this later date. Tributary 1 on the western side and Tributary 1A coming from the northeastern portion of the project were both forested at this time, but the remainder of the site had little riparian vegetation. This photo also showed that the forest along the banks of Irish Buffalo Creek was cleared along the southern edge of the project. Photos from 1965 and 1983 show little change from the previous modifications that occurred at the Jacob's Ladder Stream Restoration Site. By 1993 and 1998, more of the forested cover at the site had been removed. The 2006 photo shows a large clear cut adjacent to Tributary 2 along the eastern side of the project.

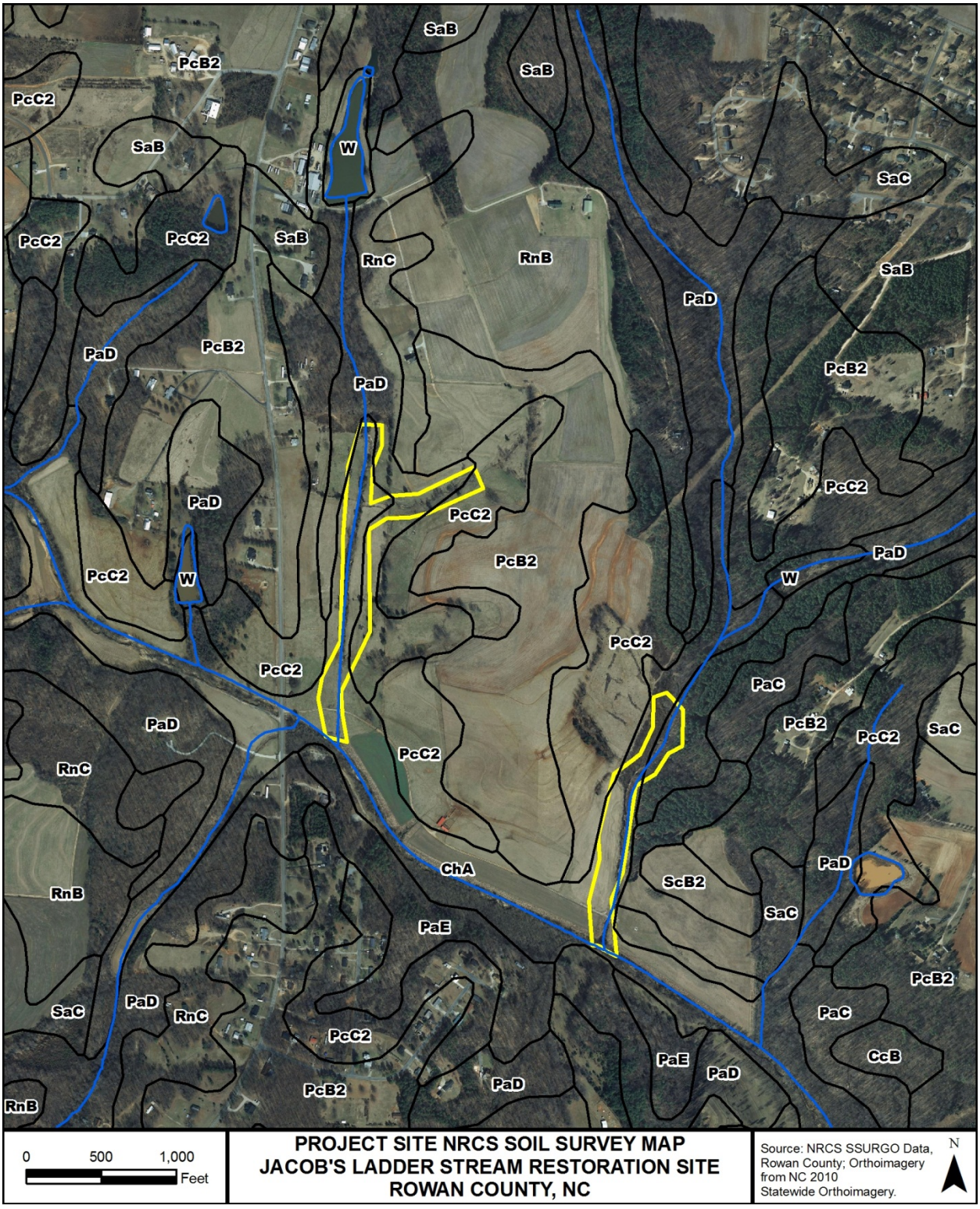
2.3 Vicinity Map



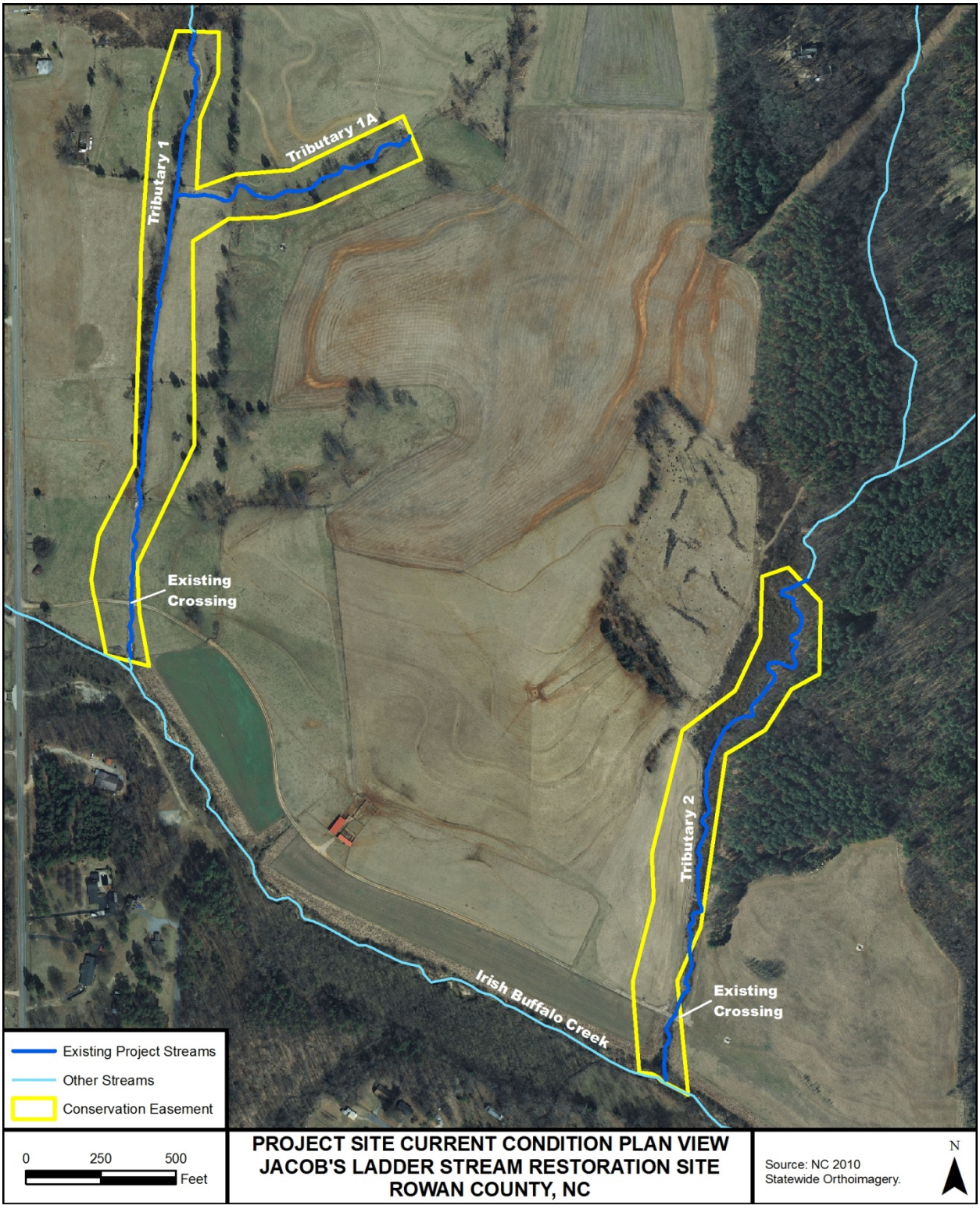
2.4 Watershed Map



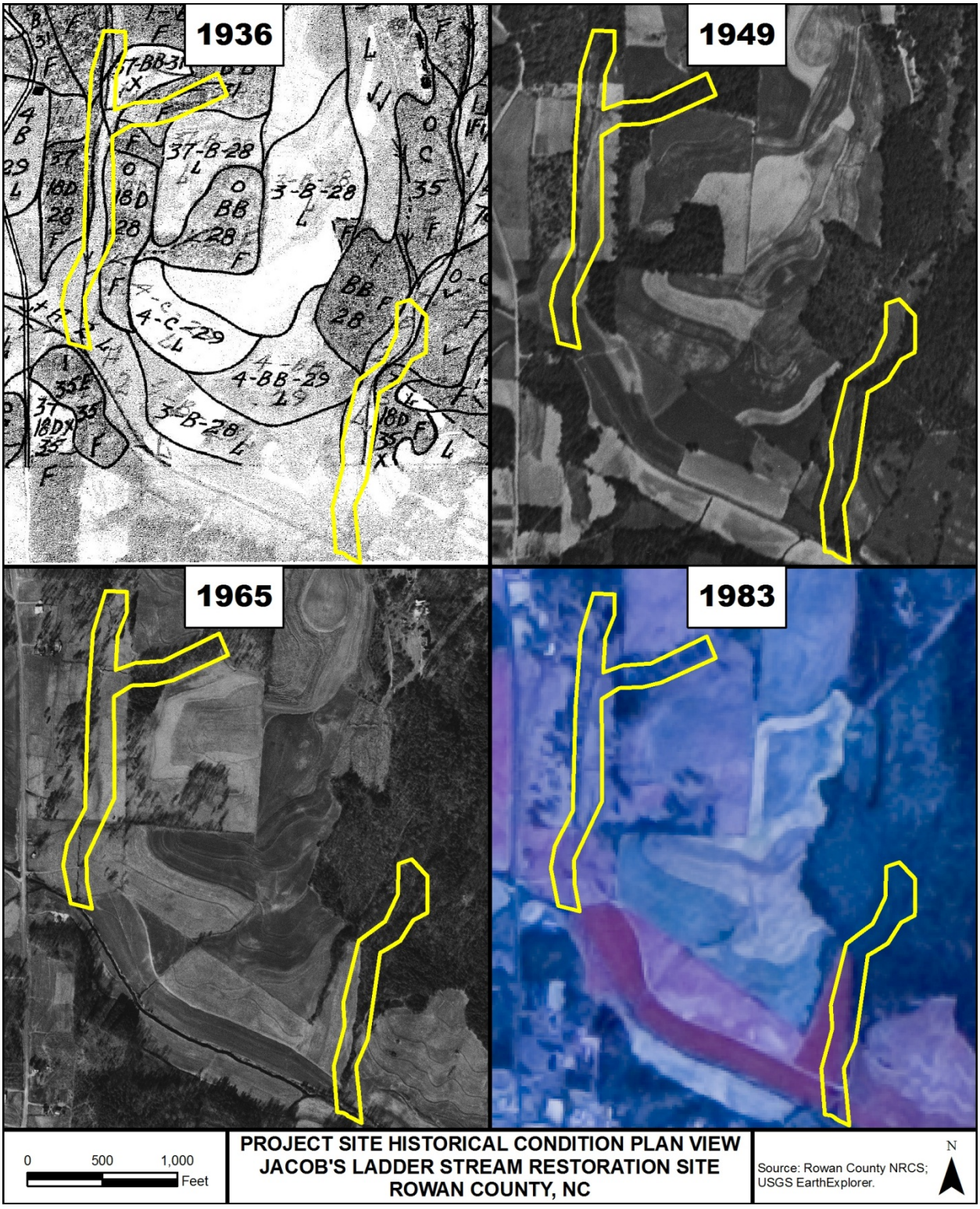
2.5 Soil Survey

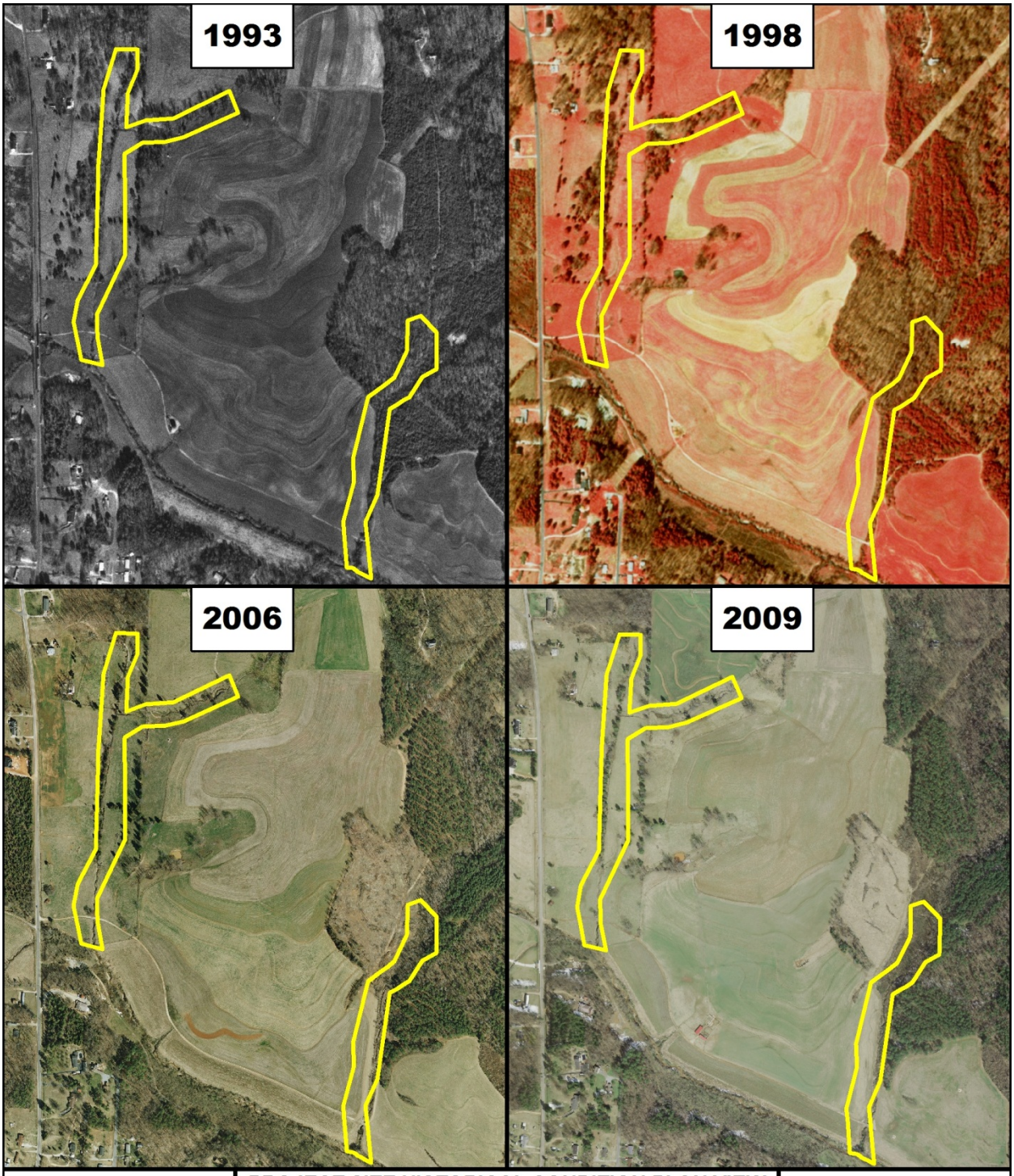


2.6 Current Condition Plan View



2.7 Historical Condition Plan View




1993
1998
2006
2009
0
500
1,000
Feet
PROJECT SITE HISTORICAL CONDITION PLAN VIEW
JACOB'S LANDING STREAM RESTORATION SITE
ROWAN COUNTY, NC
Source: USGS DOQs 1993 and 1998; Rowan County Orthoimagery 2006 and 2009.
N

2.8 Site Photographs

Looking upstream at cattle crossing located at the start of T1-1. 2/10/2012

Looking downstream at degraded bank on T1-1. 2/10/2012

Looking downstream at the start of T1A-1. 2/10/2012

Looking downstream at cattle damage on T1A-1. 2/10/2012

Looking downstream at T1A-1 transitioning into T1A-2. 2/10/2012

Looking downstream at the start of T1A-2. 2/10/2012

Looking downstream at T1A-2. 2/10/2012

Looking downstream at the ponded area on T1A-3. 2/10/2012

Looking downstream at the head cut section of T1A-3. 2/10/2012

Looking upstream at the head cut section of T1A-3. 2/10/2012

Looking downstream at T1-2. 2/10/2012

Looking upstream at degraded bank on T1-2. 2/10/2012

Looking downstream at culvert on T1-2. 2/10/2012

Looking downstream at end of reach after the culvert on T1-2. 2/10/2012

Looking downstream at the top of T2-1. 2/10/2012

Looking at an eroded bank on T2-1. 2/10/2012

Looking upstream at an eroded bank on T2-1. 2/10/2012

Looking downstream at T2-2. 2/10/2012


Looking downstream at eroded bank on T2-2. 2/10/2012


Looking at an eroded bank on T2-2. 2/10/2012


Looking downstream at culvert at the end of reach T2-2. 2/10/2012

3.0 SITE PROTECTION INSTRUMENT

3.1 Site Protection Instrument Summary Information

The project site will be placed in a permanent conservation easement held by the State of North Carolina and will consist of 17.2 acres.

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

3.2 Site Protection Instrument Figure

The land required for the construction, management, and stewardship of this mitigation project includes one parcel owned by the following entities in Rowan County; Martha Myers Deal Revocable Trust, Oscho Roy Deal, Oscho Roy Deal Revocable Trust, Roy Rhodes Trust. The preliminary conservation easement boundary has been included in Appendix A.

4.0 BASELINE INFORMATION

Table 2. Project Information

Project Name	Jacob's Ladder Stream Restoration Site				
County	Rowan County				
Project Area (acres)	17.2 acres				
Project Coordinates (lat. and long.)	35.552956 N, 80.653116 W				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Yadkin-Pee Dee				
USGS Hydrologic Unit 8-digit	03040105	USGS Hydrologic Unit 14-digit	03040105020040		
DWQ Sub-basin	13-17-09				
Project Drainage Area	682 acres/1.06 square miles				
Project Drainage Area Percentage of Impervious Area	1.1%/8 acres				
CGIA Land Use Classification	15.8% Cultivated, 35.1% Managed Herbaceous Cover, 41.6% Mixed Upland Hardwoods, 6.9% Mixed Hardwoods/Conifers, and 0.5% Southern Yellow Pine				
Reach Summary Information					
Parameters	**T1-1**	**T1-2**	**T1A-1, T1A-2, T1A-3**	**T2-1**	**T2-2**
Length of reach (linear feet)	587	1,592	916	837	1,246
Valley classification	VIII	VIII	VIII	VIII	VIII
Drainage area (acres)	136 acres	231.6 acres	34.5 acres	428.5 acres	450.1 acres
NCDWQ Water Quality Classification	Class C, WSIII	Class C, WSIII	Class C, WSIII	Class C, WSIII	Class C, WSIII
Morphological Description (stream type)	Modified	Modified	Modified	Modified	Modified
Evolutionary trend	Ditching and Pasture	Ditching and Pasture	Ditching and Pasture	Ditching and Pasture	Ditching and Pasture
Mapped Soil Series	Chewacla loam	Chewacla loam	Pacolet sandy loam	Pacolet sandy loam	Chewacla loam
Drainage class	Poorly drained	Poorly drained	Well drained	Well drained	Poorly drained
Soil Hydric status	Non hydric	Non hydric	Non hydric	Non hydric	Non hydric
Slope	0-2%	0-2%	0-2%	0-2%	0-2%
FEMA classification	N/A	AE (portion in backwater of Irish Buffalo Creek only)	N/A	N/A	AE (portion in backwater of Irish Buffalo Creek only)
Native vegetation community	Pasture	Pasture	Pasture	Mixed successional hardwoods	Pasture
Percent composition of exotic invasive vegetation	0%	0%	0%	15-25%	10%
Regulatory Considerations					
Regulation	**Applicable?**		**Resolved?**		**Supporting Documentation**
Waters of the United States – Section 404	Yes		Submitting NWP 27 following Mitigation Plan approval		N/A
Waters of the United States – Section 401	Yes		Submitting NWP 27 following Mitigation Plan approval		N/A
Endangered Species Act*	No		N/A		N/A
Historic Preservation Act*	No		N/A		N/A
Coastal Zone Management Act * (CZMA)/ Coastal Area Management Act (CAMA)	No		N/A		N/A
FEMA Floodplain Compliance	Yes		Floodplain development permit through Rowan County		N/A
Essential Fisheries Habitat*	No		N/A		N/A

* Items addressed in the Categorical Exclusion in Appendix B.

4.1 Watershed Summary Information

The site is within the 03040105 Rocky River Watershed Unit (Rocky River). The Rocky River Watershed as a whole is experiencing extensive habitat alteration due to population growth from Charlotte and its surrounding metropolitan area. The project drainage is comprised of 1.1 square miles (682 acres) that flow through the project floodplain before reaching Irish Buffalo Creek, which ultimately flows into the Kannapolis Lake downstream of the project site. Current land use in the project watershed (See 2.4 Watershed Map) consists of cultivated land (108 ac/15.8%), high intensity developed (1 ac/0.1%), managed herbaceous cover (240 ac/35.1%), mixed hardwoods/conifers (47 ac/6.9%), mixed upland hardwoods (284 ac/41.6%), and southern yellow pine (3 ac/0.5%) (NCCGIA Land Cover, 2006). The approximate total impervious cover of the project watershed is 1.1% (8 ac). This estimate was developed using the following percent impervious estimates: high intensity developed (100%), cultivated/managed (2%) and forest (0%). The project area is located in the United States Geological Survey (USGS) Enochville Quadrangle (1970).

According to the Rowan County Land Use Plan the Jacob's Ladder Stream Restoration Site is located in "Area 2" of their land use plan (Benchmark, 2009). This area of the county will encourage mixed use development and encourage connectivity through open space networks with surrounding development to promote walking and biking. Traditional and conservation subdivisions will be encouraged in this area. Current lot size minimums (1 acre) are proposed in this area. Based on this information, and the stormwater requirements for new development, it does not appear that the project will be significantly impacted by stormwater discharges, even if a full build-out scenario is implemented in the watershed.

4.2 Geology and Soils Information

The site lies within the Southern Outer Piedmont (Level IV 45b) ecoregion of the Piedmont physiographic province. This area is characterized by irregular plains with low rounded hills and ridges consisting of low to moderate gradient streams with mostly cobble, gravel and sandy substrates. The underlying rocks of the area consist of gneiss, schist and granite covered with deep saprolite and mostly red, clayey subsoils. According to the soil survey for Rowan County, the primary soils along the project streams are part of the Chewacla loam series as shown in 2.5 Soil Survey. There are also small mapped areas of Pacolet sandy loam and Pacolet sandy clay loam in the upper reaches of the project. Chewacla loam is described as a very deep, somewhat poorly drained soil that occurs within river or stream valleys and drainage ways of the piedmont. Pacolet sandy loam is a very deep and well-drained soil that occurs within narrow ridges and side slopes in piedmont uplands. (Soil Survey of Rowan County, NC, NRCS, 2004).

4.3 Reach Summary Information

Existing Streams

The streams at the Jacob's Ladder Stream Restoration Site have been impacted by a history of logging, grazing, and channelization (See 2.8 Site Photographs). Three separate streams make up the site: T1 begins in the northwestern project corner, T1A flows from the east to join T1; and T2 comes onto the site from the northeastern corner. Both T1 and T2 flow to the south and join Irish Buffalo Creek as it flows to the east along the southern property boundary (See 2.6. Current Condition Plan View).

T1 is a first-order stream that consists of project streams T1-1 and T1-2. The stream begins in the northwestern corner of the property and flows south for approximately 2,179 linear feet through the Jacob's Ladder Stream Restoration Site until it reaches Irish Buffalo Creek. T1-1 originates from a farm pond approximately 1,500 linear feet to the north and then travels through a forested drainage until it

comes onto the project site just upstream of a wooden fence across the channel. Once the stream leaves the wooded cover, it travels straight down the valley, along an alignment that is not in the lowest part of the valley, indicating that it was channelized at some time prior to 1936. The banks have been impacted by the removal of riparian vegetation and grazing along the entire length of the project stream. The stream also lacks distinct pool and riffle features; erosion from unstable banks and the upper slopes have contributed an excess amount of sediment that has impacted these features in addition to an unstable stream bed. The area right at the start of the project stream has been trampled by cattle and lacks distinct banks. Approximately 587 linear feet from the top of the project, T1-1 reaches the confluence with T1A-3. At this point, T1-2 enters a more incised reach with cedars along the top of the banks. The banks are more defined in this area, but they are experiencing erosion. Due to the straight, confined channel, distinct bedform features are infrequent in this section. After another 1,000 linear feet downstream, T1-2 goes under another wooden fence across the channel and enters into a broader valley as it approaches Irish Buffalo Creek. This section has also been straightened, and there is even less riparian vegetation, which has exacerbated the bank erosion. The stream goes through an existing road crossing with a culvert and flows for approximately 200 linear feet before reaching Irish Buffalo Creek.

T1A is a first-order, seep-driven stream that consists of project streams T1A-1, T1A-2, and T1A-3. T1A flows 916 linear feet toward the west before draining into T1-2. The project reach begins below a farm road crossing as a B-type channel and transitions from an intermittent channel to a perennial stream at the beginning of the project reach. The first 306 linear feet of T1A-1 have a stable channel pattern, but the stream is experiencing bed degradation as it flows down the valley. The lack of riparian vegetation has increased bank erosion due to lack of root material in the soils. After this first section, T1A-2 becomes less steep and has more mature trees along its banks. The pattern is stable, but there are still isolated areas of bank erosion. After 560 linear feet from the start of T1A, T1A-3 spreads out into a dispersed channel where a small farm pond exists with a breached berm. In this section of channel the banks and planform are poorly defined. After the stream flows through the old pond berm, it begins to quickly incise to reach the confluence with T1-2. It makes a sharp turn to the right and then the left as it downcuts. Approximately 60 linear feet upstream of the confluence with T1-2, there is a severe 4-foot head cut moving up from the base elevation of T1-2.

T2 is a second-order stream that consists of project streams T2-1 and T2-2. The stream begins from the northeastern corner of the project and flows south for approximately 2,083 linear feet until the confluence with Irish Buffalo Creek. T2-1 starts in a previously logged vegetative community with mixed successional growth. There is minimal riparian vegetation to stabilize the banks and there are invasive plant species present throughout the entire reach. The pattern is stable, but the banks show erosion along the outer meanders. T2-1 flows for 810 linear feet before it reaches a section of bedrock grade control in the channel, which begins T2-2. This feature protects the upstream reaches from the downstream bed degradation. As the stream continues to flow south, it immediately begins incising as it progresses toward Irish Buffalo Creek. After the bedrock grade control, the stream enters a confined channelized reach. The banks are high and riparian vegetation is limited to small trees and shrubs or herbaceous vegetation. There is limited bedform diversity in the channel. Similar to T1, this part of the reach has been channelized and does not flow through the lowest part of the valley. T2-2 continues to flow south to an existing crossing approximately 200 linear feet upstream of the confluence with Irish Buffalo Creek. The channel remains incised until the confluence.

All project reaches (existing) were evaluated using NCDWQ Stream Classification Forms in February 2012 (Appendix C). The NCDWQ forms were used to determine if the tributaries were classified as perennial or intermittent streams. A numerical value of at least 30 points is determined from the NCDWQ stream identification form to classify the stream as a perennial stream (NCDENR, 2010). All project reaches scored a numerical value of at least 30 points.

Channel Classification

As T1-1 comes onto the project site, it begins as an overwidened channel due to a cattle crossing. Downstream of the cattle crossing, the channel narrows and becomes a "G4" stream type with an entrenchment ratio of 1.3, a low width-to-depth ratio of 7.6 and a bank height ratio of 3.3. The bankfull width is 15.8 feet. Downstream, after the confluence with T1A-3, the channel still classifies as a "G4" stream type with a higher width-to-depth ratio of 8.8 and an entrenchment ratio of 1.7. The stream then continues downstream with an entrenchment ratio of 2.2 and a very low width-to-depth ratio of 4.6 before reaching Irish Buffalo Creek.

T1A-1 begins as a moderately incised channel with a low entrenchment ratio. Further downstream T1A-2 becomes a "C4" stream type with an entrenchment ratio of 2.4 and a bank height ratio of 1.0. From here, the stream spreads out into a dispersed channel and then flows through an old pond berm and becomes an "F4" stream type. The entrenchment ratio is 1.1, with a very high width-to-depth ratio of 20.1. The channel continues to incise as it flows toward the confluence of T1-2.

T2-2 begins as a "G4" stream type with a moderate entrenchment ratio of 1.9 and a very low width-to-depth ratio of 6.1. Further downstream, the channel continues to classify as a "G4" with a very low width-to-depth ratio. Downstream of the bedrock grade control, the stream continues to incise in its channelized reach with bank height ratios greater than 2.0.

Channel Morphology (Pattern, Dimension, and Profile)

A Rosgen Level III assessment was conducted to gather existing stream dimension, pattern, and profile data to determine the degree of channel instability. Channel cross-sections were surveyed at eight representative locations along the project; one location each on T1A-2, T1A-3, and T2-2, two locations on T2-1 and three locations on T1-2. Data developed from these surveys are presented in a channel morphology summary in Appendix C.

Channel Stability Assessment

A qualitative stability assessment was performed to estimate the level of departure and determine the likely causes of the channel disturbance. This assessment facilitates the decision-making process with respect to restoration alternatives and establishing goals for successful restoration. Stream bank measurements were taken on the following characteristics; bank heights, bank angles, materials, presence of soil layers, rooting depth, rooting density and percent of bank protection. The data was used to develop the Bank Erodibility Hazard Rating (BEHI) forms for all reaches (Appendix C), (Rosgen, 2001).

A total of nineteen BEHI rating forms were performed and completed for all reaches. Table 3 summarizes total BEHI values for all reaches. T1-1 exhibited BEHI ratings of moderate 29.2, high 35.1, and very high 40.9 with a bank height ratio at 3.3. The T1-2 assessment exhibited a moderate 29.4, high 33.7, and very high 42.4 with bank height ratios in the project reach ranging from of 2.3 to 3.3. T1A-1 exhibited BEHI ratings of moderate 27.1, high 31.4, and very high 40.4 with a bank height ratio of 1.0. The T1A-2 assessment exhibited a BEHI rating of moderate 26.5 with a bank height ratio at 1.0. T1A-3 exhibited moderate 28.7, high 33.7, and very high 45.4 BEHI ratings with bank height ratio of 8.6. T2-1 assessment exhibited BEHI ratings of moderate 29.5, high 37.4, and very high 40.4 with bank height ratios in the reach ranging from 1.9 to 2.0. T2-2 exhibited moderate 29.8, high 36.1, and very high 47.1 BEHI ratings with a bank height ratio of 2.0.

The reaches exhibit characteristics of unstable stream channels. High bank height ratios (>1-2) are typical of incised and/or channelized streams. Most notably, the channels show evidence of bank erosion and undercutting along with channelization in portions of each reach. Furthermore, several sections do not have vegetation on the banks and consequently lack rooting strength and cover protection. The high bank

height ratio indicates the lack of a bankfull or floodplain feature along the stream to provide any access during high flow events.

Table 3. BEHI Data

	Left Bank		Right Bank		Total	
	BEHI	**Linear Footage**	**BEHI**	**Linear Footage**	**BEHI Rating**	**Linear Footage**
T1-1	Very High	50	Very High	110	40.9	160
	High	135	High	75	35.1	210
	Moderate	70	Moderate	70	29.2	140
Reach Total		**255**		**255**		
T1-2	Very High	220	Very High	85	42.4	305
	High	145	High	-	33.7	145
	Moderate	205	Moderate	160	29.4	365
Reach Total		**570**		**570**		
T1A-1	Very High	80	Very High	-	40.4	80
	High	25	High	70	31.4	95
	Moderate	35	Moderate	40	27.1	75
Reach Total		**140**		**110**		
T1A-2	Moderate	25	Moderate	20	26.5	45
Reach Total		**25**		**20**		
T1A-3	Very High	100	Very High	100	45.4	200
	High	-	High	35	33.7	35
	Moderate	40	Moderate	-	28.7	40
Reach Total		**140**		**135**		
T2-1	Very High	45	Very High	40	40.4	85
	High	63	High	75	37.4	138
	Moderate	80	Moderate	45	29.5	125
Reach Total		**188**		**160**		
T2-2	Very High	260	Very High	165	47.1	425
	High	65	High	195	36.1	260
	Moderate	150	Moderate	75	29.8	225
Reach Total		**475**		**435**		

Bankfull Verification

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

Bankfull can be defined as "the stage at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of the channels," (Dunne and Leopold, 1978). Several characteristics that commonly indicate the bankfull stage include: incipient point of flooding, breaks in slope, changes in vegetation, highest depositional features (i.e. point bars), and highest scour line. The identification of bankfull stage, especially in a degraded

system, can be difficult. Therefore, verification measures were undertaken to validate the correct identification of the bankfull stage on all project reaches.

Regional curves are typically utilized in ungauged areas to approximate bankfull discharge, area, width, and depth as a function of drainage area based on interrelated variables from other similar streams in the same hydrophysiographic province. Regional curves and corresponding equations from "Bankfull Hydraulic Geometry Relationships for North Carolina Streams" (Harman *et al*., 1999) were used to approximate bankfull in the project reaches. Based on the regional curves, a bankfull discharge and cross-sectional area were estimated for all reaches. For T1-1, the regional curve estimates a bankfull discharge of 31 ft^3/s and a cross-sectional area of 7.8 ft^2. For T1-2, the regional curve estimates a bankfull discharge of 45 ft^3/s and a cross-sectional area of 11.1 ft^2. For all three reaches of T1A, the values were estimated at 12 ft^3/s, and 3.1 ft^2. For T2-1, the regional curve estimates a bankfull discharge of 69 ft^3/s and a cross-sectional area of 16.8 ft^2, while T2-2 estimates a bankfull discharge of 71 ft^3/s and a cross-sectional area of 17.4 ft^2.

A similar reach of UT to Irish Buffalo Creek, located 400 linear feet upstream of an existing project reach on T1 of Jacob's Landing Stream Restoration Site, was surveyed for a reference stream by KCI in February 2012. KCI analyzed the relationship between drainage area and discharge to the NC rural piedmont regional curve data. The results indicated the bankfull cross-sectional area and discharge for the reference stream reveal consistent plotting of the regional curve data, demonstrating that bankfull stage is suitable at the reference stream. Since this stream is located in close proximity of Jacob's Ladder Stream Restoration Site, KCI feels that it is a suitable reference for the project reaches.

The method used to confirm bankfull stage at Jacob's Ladder Stream Restoration Site was bankfull field identification of UT to Irish Buffalo Creek Reference Reach (T1). For the reference reach cross-section, bankfull field indicators resulted in a discharge of 25 ft^3/s, which is similar to the piedmont regional curve bankfull discharge of 25 ft^3/s. After analyzing the bankfull verification results, the design discharges were set for the project reaches. The design bankfull discharges are shown in Table 4.

Table 4. Bankfull Discharge

Parameters	Reference XS	T1-1	T1-2	T1A-1	T1A-2	T1A-3	T2-1	T2-2
Regional Curve								
	25 ft^3/s	31 ft^3/s	45 ft^3/s	12 ft^3/s	12 ft^3/s	12 ft^3/s	69 ft^3/s	71 ft^3/s
UT to Irish Buffalo Creek Reference (T1) Discharge								
	25 ft^3/s							
Design Discharge								
		31 ft^3/s	44 ft^3/s	12 ft^3/s	12 ft^3/s	12 ft^3/s	63 ft^3/s	69 ft^3/s

Bankfull data for the project reaches were compared with the NC rural piedmont regional curve. The proposed cross-sectional areas and bankfull discharge for the reaches are shown overlaid with the NC rural regional curve in (4.4 Regional Curve Discharge). Analysis of the bankfull cross-sectional areas and discharge for the project reaches reveal consistent correlation with the NC rural piedmont regional curve data.

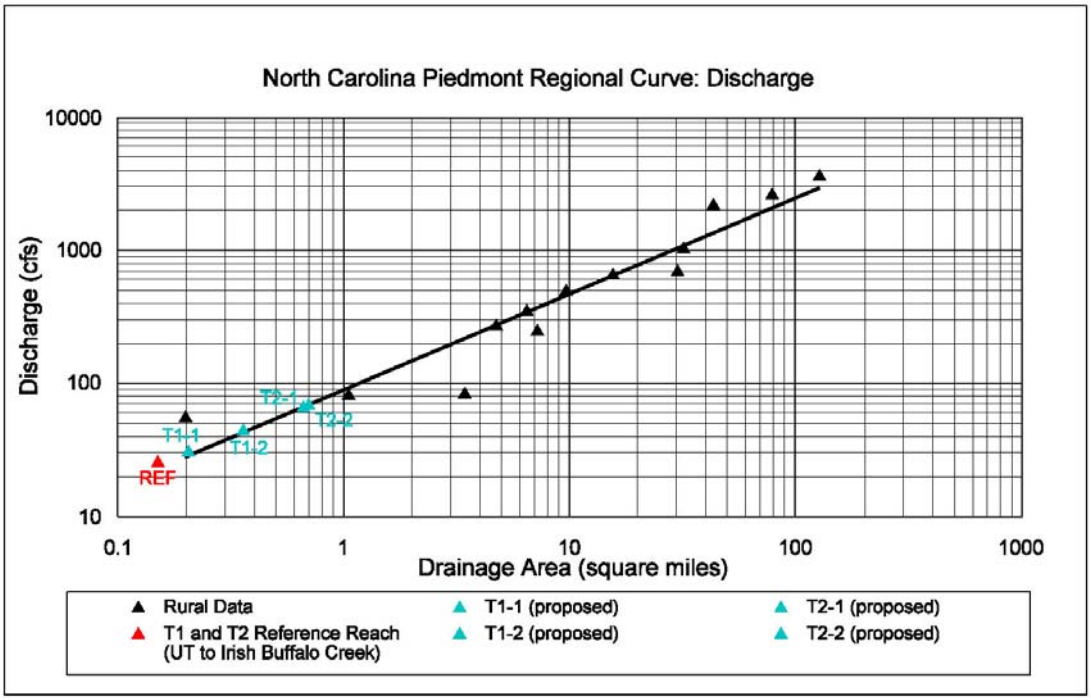
Vegetation

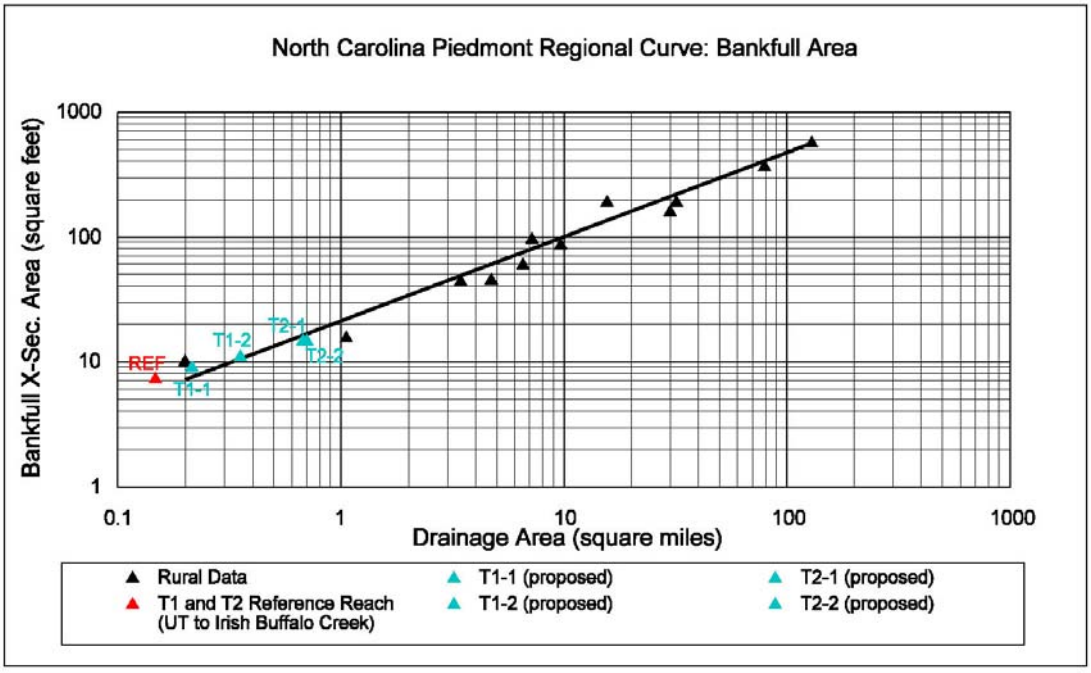
Because of previous cattle impacts at Jacob's Ladder Stream Restoration Site, no distinct vegetative communities exist on the site. The vegetation within the project area is primarily comprised of open pastures dominated by various grass species and small understory trees.

T1 consists of open pasture with little to no riparian species. The riparian corridor contains red cedar (*Juniperus virginiana*) and various grasses. The downstream portion of T1 has been affected by cattle grazing and consists of limited riparian species.

The start of T2 is in early successional growth with riparian vegetation limited to small trees and shrubs or herbaceous vegetation. The dominant species consist of tulip poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), and box elder (*Acer negundo*). Chinese privet (*Ligustrum sinense*) and multiflora rose (*Rosa multiflora*) are the invasive species that exist along T2. These species will be removed during the construction phase of the project and any remaining plants will be treated. Treatment techniques may vary based on seasonality, the concern for drift and the size of the plants and stems. Basal bark spray of Garlon 4 (triclopyr ester) and foliar spraying of Rodeo (glyphosate) or Escort XP (metsulfuron methyl) will be the preferred treatment methods. Treatments will be targeted in late summer, when possible. For large stems, stem injections using Garlon 3A (triclopyr) will be completed in the fall. In order to minimize the allelopathic influence of tall fescue (primarily Kentucky 31) along the stream banks and within the riparian zone, fescue will be mechanically removed and or treated with glyphosate herbicide. A chelated form of glyphosate (Rodeo, or similar) will be used in proximity to the stream, and a non-chelated form (Roundup, or similar) will be used in upland areas.

4.4 Regional Curve Discharge





Reference; Wildlands Engineering, Inc. 2010

4.5 Wetland Summary Information

Not applicable for this project.

4.6 Regulatory Considerations

The confluences of T1 and T2 with Irish Buffalo Creek are located in the 100-year floodplain (Zone AE). Modifications made to the tributaries in these locations are not anticipated to have any impact on the flood elevations of Irish Buffalo Creek. It is the intent of the restoration design to maintain the existing 100-year flood elevations. Per communication with the Rowan County floodplain administrator, no hydraulic modeling will be required. KCI submited a county floodplain development permit documenting that there will be no hydraulic impacts such as berms built or banks extended on the portion that is within the floodway (see FEMA Compliance in Appendix B).

5.0 DETERMINATION OF CREDITS

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

Table 5. Determination of Credits

Mitigation Credits								
	Stream			Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	EI	EII	-	-	-	-	-
Length	4,193	1,056	140	-	-	-	-	-
Credits	4,193	704	56	-	-	-	-	-
TOTAL CREDITS	4,953			-	-	-	-	-

Project Components					
Reach ID	Existing Footage	Approach (PI, PII etc.)	Restoration -or- Restoration Equivalent	Proposed Footage	Mitigation Ratio
T1-1	587	P1	Restoration	739	1:1
T1-2	1,592	P1	Restoration	1,622	1:1
T1A-1	306	-	Enhancement I	306	1:1.5
T1A-2	140	-	Enhancement II	140	1:2.5
T1A-3	470	P1	Restoration	498	1:1
T2-1	837	-	Enhancement I	750	1:1.5
T2-2	1,246	P1	Restoration	1,334	1:1

6.0 CREDIT RELEASE SCHEDULE

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

Stream Credits			
Monitoring Year	**Credit Release Activity**	**Interim Release**	**Total Released**
0	Initial Allocation – see requirements below	30%	30%
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met	10%	50% (65%*)
3	Third year monitoring report demonstrates performance standards are being met	10%	60% (75%*)
4	Fourth year monitoring report demonstrates performance standards are being met	10%	70% (85%*)
5	Fifth year monitoring report demonstrates performance standards are being met and project has received closeout approval	15%	100%

*If two bankfull events have been observed.

Initial Allocation of Released Credits

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

a. Approval of the final Mitigation Plan
b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCEEP Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.
d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 15% of a site's total stream credits shall be released after two bank-full events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bank-full events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, the NCEEP will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

7.0 MITIGATION WORK PLAN

7.1 Target Stream Type and Plant Communities

Target Streams
The design for the Jacob's Ladder Stream Restoration Site proposes the Restoration of approximately 4,193 linear feet, Enhancement I of approximately 1,056 linear feet, and Enhancement II of 140 linear feet. The Enhancement I will involve adjusting the stream to have the appropriate profile and dimension, while the Enhancement II will involve grading the stream banks, removing invasive vegetation and planting the buffer with native trees (USACE *et. al* 2003). The tributaries are divided into seven separate reaches based on the restoration or enhancement approach applied to the portions of the channels. The project reaches are identified in (7.6 Proposed Mitigation Plan View).

Target Plant Communities
The 50-foot buffer along the project streams will receive riparian plantings consisting of native woody species and will be incorporated as outlined in the planting plan. Six hundred and eighty (680) stems per acre (8' x 8' spacing) will be planted along project reaches to achieve a mature survivability of two hundred sixty (260) stems per acre. Woody vegetation planting will take place during dormancy. The riparian areas for T1-1, T1-2, T2-1, T2-2, and T1A-3 will be planted as a Piedmont Alluvial Forest and will consist of the following:

American Sycamore	*Platanus occidentalis*	River Birch	*Betula nigra*
Swamp Chestnut Oak	*Quercus michauxii*	Willow Oak	*Quercus phellos*
Green Ash	*Fraxinus pennsylvanica*	Tulip Poplar	*Liriodendron tulipifera*

The riparian areas of T1A-1 and T1A-2 will be planted as Mesic Mixed Hardwood Forest and may consist of the following species:

Tulip Poplar	*Liriodendron tulipifera*	White oak	*Quercus alba*
Southern Red Oak	*Quercus falcata*	American Persimmon	*Diospyros virginiana*
Willow Oak	*Quercus phellos*	Pin oak	*Quercus palustris*

On the restored stream banks, live stakes will be used to provide natural stabilization. Appropriate species identified for live staking include:

Silky Dogwood	*Cornus amomum*	Silky Willow	*Salix sericea*
Black Willow	*Salix nigra*	Common Elderberry	*Sambucus canadensis*

A herbaceous seed mix composed of appropriate native species will also be developed and used to further stabilize and restore the riparian and bank zones following construction.

In addition to planting the proposed community types, vegetative restoration will also include eliminating invasive species that have moved into portions of the site. The targeted species will be treated with an appropriate herbicide.

7.2 Design Parameters

The mitigation approach for the Jacob's Ladder Stream Restoration Site will aim to restore and protect the headwater tributaries to Irish Buffalo Creek. Mitigation actions will focus on repairing isolated sections of bed degradation and bank erosion and restoring the unstable reaches that have been straightened or severely degraded by cattle. The overall approach to the design of Jacob's Ladder Stream Restoration Site is a Priority 1 approach, which will involve creating an appropriate dimension, pattern, profile and reconnecting the floodplain to an elevation at or similar to the historic floodplain elevation, while the existing channel will be abandoned and filled (Rosgen, 1997). Grade control, habitat structures, and constructed riffles will all be utilized to maintain the riffle and pool sequence in the newly constructed channel. Where feasible, the native riffle material from the existing channel will be used to enhance the newly constructed riffles. The constructed and enhanced riffles will be installed to provide protection from bed scour associated with the unstable, erosive soils at the site.

Tributary T1-1 – 739 linear feet of Restoration
T1 will be restored to a C4-type channel using a Priority 1 approach. As the stream comes onto the project site, it is a straightened channel with unstable, eroding banks. A new channel planform will be constructed by moving the stream to the right (west) as it comes onto the Jacob's Ladder Stream Restoration Site. Pulling the stream away from the old channel and transitioning the stream to reconnect with the relic floodplain will allow for lower bank heights to be constructed and a wider floodprone area to attenuate flows. T1-1 will be restored as a moderately sinuous channel with a bankfull bench and will transition from the existing bed elevation to a floodplain reconnected to the broad valley.

Tributary T1-2 – 1,622 linear feet of Restoration
This reach of T1 will start at the confluence with T1A and continue the same design approach as in T1-1. The restoration will use a Priority 1 approach to develop a moderately sinuous C4-type channel. After the confluence with T1A, the planform of T1-2 will be brought out to the left (east) of the existing straightened channel. Since most of the existing channel will be abandoned, the cedar trees along the old channel will be kept wherever possible.

There will be two crossings excluded from the conservation easement on this reach. The first crossing will be located just below the T1-1/T1A-3 confluence. The second crossing is located just upstream of the confluence with Irish Buffalo Creek and will be replaced with a newly designed culvert.

Tributary T1A-1 – 306 linear feet of Enhancement I
At the beginning of T1A, the bed cuts down quickly and the banks are eroding. This reach will be enhanced by stabilizing the stream below the upstream road crossing, shaping the banks to creating a bankfull bench, and installing grade control structures to gradually drop the bed elevation down. Currently, the vegetation along this reach is primarily herbaceous, so the riparian buffer will be planted with native trees and shrubs at a full density.

Tributary T1A-2 – 140 linear feet of Enhancement II
The section of T1A-2 has developed a stable planform and is less steep than the upstream reach. Enhancement II will be used to stabilize the banks and develop a bankfull bench with an entrenchment

ratio of 2.0 or more. Supplemental riparian plantings will be used to increase the rooting strength on the banks and to create a diverse riparian buffer beyond the tops of the banks.

Tributary T1A-3 – 498 linear feet of Restoration
The restoration reach on T1A-3 will begin where the channel flows through a drained pond. At the beginning of the reach, there is no defined channel through this area, but then the stream quickly cuts down to the confluence with T1. Through most of the old pond area the channel will remain in its existing condition as requested by members of the IRT during a site walk on August 3, 2011. As the stream approaches the old pond berm a Priority 1 approach will be used to restore a B4c/C4-type stream that will distribute the elevation change evenly along the new channel. The planform of T1A-3 will be brought out to the left (south) of the existing straightened channel. The new channel will be a moderately sinuous step-pool stream and tie-in to T1 downstream of the current confluence. Grade control, habitat structures, and constructed riffles will all be utilized to maintain the bed morphology of the newly constructed channel

Tributary T2-1 – 750 linear feet of Enhancement I
Upstream of the project start at T2, the stream is a stable B4-type channel that flows through a mature forested area with a stable pattern. The project reach of T2-1 is in transition. The forest cover becomes less dense along the stream and the banks are beginning to experience bank erosion. However, the pattern and bed elevations have remained stable, likely due to the large bedrock feature at the end of the reach. This reach will benefit from Enhancement I actions to tie in the stable reach upstream and the newly restored reach downstream. Enhancement will include shaping the banks, creating a bankfull bench, creating a more stable and heterogeneous stream bed, and replanting the riparian buffer to achieve a mix of native tree species.

There will be one crossing excluded from the conservation easement on this reach. The crossing will be located at the downstream portion of T2-1 at the transition of T2-2.

Tributary T2-2 – 1,334 linear feet of Restoration
T2-2 begins immediately upstream of a bedrock feature. After this point, the existing stream moves into a straightened, highly constrained channel. A Priority 1 approach will be used to move the stream to the right (west) to develop a moderately sinuous C4-type channel that is reconnected to the relic floodplain and has a defined riffle and pool sequence. This new pattern will move the stream out of the existing incising channel and allow a more effective riparian buffer to develop. Constructed riffles, grade control, and habitat structures will be used to maintain the stream bedform while transitioning the stream down to the confluence with Irish Buffalo Creek.

There will be one crossing excluded from the conservation easement on this reach. There is a crossing already in place just upstream of the confluence with Irish Buffalo Creek. This crossing will be replaced with a new culvert.

7.3 Data Analysis

The streams at the Jacob's Ladder Stream Restoration Site will be restored using a combination of C4 and B4c/C4 Rosgen stream types. The project streams are divided into reaches based on the drainages entering the streams and the restoration or enhancement approach needed to design the proposed channels. The morphological design criteria for each of the reaches are found in Table 6. Morphological Design Criteria. Below is a description of the specific design approach used for all project reaches.

T1 has been divided into two reaches for design purposes and will be restored as C4 channels. T2 was also divided into separate reaches based on the restoration and enhancement approach. T2-1 and T2-2 will

be restored and enhanced as C4 channels. The pattern and profile for T1 and T2 were developed from detailed morphological criteria and hydraulic geometry relationships taken from stable sections of UT to Irish Buffalo Creek Reference Reach (T1) (See Table 6 and Appendix C Morphological Design Criteria).

T1A has been divided into three separate reaches based on the restoration and enhancement approach. The UTFR Reference Reach was used to develop the morphological criteria for T1A-3, which will be restored as a B4c/C4 stream type.

The remaining upstream portion of T1A-1 and T1A-2 will be enhanced by grading stable banks, enhancing bed form, restoring a native riparian buffer, and permanently fencing out cattle. The UT to Wilkinson Reference Reach was used to develop the morphological criteria.

The design discharges and cross-sectional areas for all project reaches compare closely to their values as predicted by the regional curve. The designed stream discharges were also evaluated using the channel hydraulics and sediment transport for the proposed cross-sectional areas.

In-stream structures, including step pools, riffle grade controls, soil lifts, and log drops will be used to stabilize the restored channels (Refer to Plan Sheets 3 and 4). These structures are designed to reduce bank erosion, influence secondary circulation in the near-bank region of stream bends, and provide grade control. The structures further promote efficient sediment transport and produce/enhance in-stream habitat. Riffle areas will also be enhanced with graded gravel material to mimic existing stable riffle features. Coir fiber matting and seeding will be used to stabilize the newly graded stream banks and live stakes will be planted to provide long-term rooting strength.

During construction, the number of mature trees removed from the existing riparian areas will be minimized as much as possible. Any valuable trees that may provide immediate shade to the restored channel will be left in place if feasible. In the enhancement areas, certain trees may be able to remain on one bank if the opposite bank can be reshaped to accommodate the appropriate dimension for the stream. Prior to construction, woven wire exclusion fencing (Stay Tuff, model 949-12) and alternative watering options will be installed along the easement boundary to keep livestock out of the project streams. All of T1 and T1A will have fence installed along the easement boundary. Along T2, the fence will be installed along the restoration reach and then tie into existing fence in the upper forested reaches. To ensure adequate cattle watering, a groundwater well and three, four-hole cattle waterers will be installed prior to construction.

7.4 Reference Streams

A reference reach is a channel with a stable dimension, pattern, and profile within a particular valley morphology. The reference reach is used to develop dimensionless morphological ratios (based on bankfull stage) that can be extrapolated to disturbed/unstable streams to restore a stream of the same type and disposition as the reference stream (Rosgen 1998). For this project, three reference reaches were used to design the proposed restoration reaches: an Unnamed Tributary to Fisher River (UTFR) in Surry County, Unnamed Tributary to Wilkinson Creek in Chatham County, and UT to Irish Buffalo Creek (T1) (see Appendix C for detailed reference reach data).

UT to Fisher River Reference Site

An unnamed tributary to Fisher River (UTFR), a first order rural stream in Surry County, was selected as a reference reach for the restoration of the project streams. The reference reach is located on Fisher Valley Road off of Exit 93 from Interstate 77. The valley slope is approximately 1.6%. The sediment distribution and transport are similar to the project streams. The local topography is characterized by rolling hills. Approximately 300 linear feet of UTFR was surveyed and was classified as a B4c channel.

UTFR flows northeast into Fisher River and drains approximately 0.38 square mile of predominantly forested land with a small section of rangeland. The reference reach watershed is within the Northern Inner Piedmont ecoregion in the Piedmont physiographic province. The site is in the 14-digit hydrologic unit 03040101090010 in the Yadkin Basin and is in the DWQ Subbasin 03-07-02. The reference reach watershed elevations range from 1,420 feet AMSL at the headwaters of the site to 1,210 at the bottom of the reference reach.

UT to Wilkinson Reference Site

A section of Unnamed Tributary to Wilkinson Creek, located southwest of Chapel Hill, was identified and surveyed as a reference reach. UT to Wilkinson Creek flows west through Chatham County towards its confluence with Wilkinson Creek. It drains approximately 105 acres of low-density residential, agriculture, and forested lands.

Approximately 205 linear feet of the UT to Wilkinson Creek were surveyed (Appendix C contains data from the field assessment). This reach of UT to Wilkinson Creek was classified as a "B4c" channel type. The dimensionless hydraulic geometry relationships were developed from stable channel dimensions to facilitate the design of the proposed channel cross-sections for T1A-1 and T1A-2 enhancement reaches. The water surface slope and dimensions at this reference reach made it suitable for developing dimensionless ratios for T1A-1 and T1A-2. UT to Wilkinson Creek also has a valley slope similar to the T1A-1 and T1A-2 (0.17% compared to 0.20% at the project site).

UT to Irish Buffalo Creek Reference Site (T1)

A short reach of a tributary to Irish Buffalo Creek, located approximately 400 linear feet upstream of an existing project reach on T1-1 of Jacob's Landing Stream Restoration Site, was surveyed by KCI in February 2012 (Appendix C). The sediment distribution and transport are the same as the project streams. A stable riffle cross-section was surveyed and classified as an E4 channel to be used as a dimensional reference. Although likely logged previously, historic aerial photos indicate that this upstream reach of T1 has been under mature forest for at least fifty years. The stream flows through a hardwood forest and has stable planform and banks. Small cobble/gravel riffles are present and there is no evidence of bed degradation. The forest cover becomes less mature as the stream travels downslope, but the channel remains stable with functional riffles and pools. The dimensionless hydraulic geometry relationships were developed from stable channel dimensions to facilitate the design of the proposed channel cross-section, planform, and pattern data for T1 and T2 restoration reaches.

Table 6. Morphological Design Criteria

Variables	Existing	Existing	Existing	Ref. Reach UT to Irish Buffalo	Proposed	Proposed	Proposed	Proposed
	T1-1, T1-2	T2-1	T2-2		T1-1	T1-2	T2-1	T2-2
Rosgen Stream Type	G4	G4	G4	E4	C4	C4	C4	C4
Mitigation Type	Restoration	Enh.I	Restoration	N/A	Restoration	Restoration	Enh.I	Restoration
Drainage Area (mi^2)	0.21, 0.36	0.67	0.70	0.16	0.21	0.36	0.67	0.70
Bankfull Width (W_{bkf}) (ft)	6.7-9.6	10.6-16.5	10.8	6.9	10.3	11.5	13.5	13.5
Bankfull Mean Depth (d_{bkf}) (ft)	1.1-1.5	1.2-1.7	2.3	1.1	0.9	1.0	1.1	1.1
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)	9.8-10.5	18.5-20.6	25	7.4	9.0	11.0	15.3	15.3
Width/depth Ratio (W_{bkf}/d_{bkf})	4.6-8.8	6.1-13.2	4.7	6.4	12.0	12.0	12.0	12.0
Maximum Depth (d_{mbkf}) (ft)	1.7-2.4	2.1-2.6	3.4	1.6	1.4	1.5	1.8	1.8
Width of flood prone area (W_{fpa}) (ft)	12-16	20-35	16	23	23-70	26-70	30	30-70
Entrenchment Ratio (ER)	1.3-2.2	1.9-2.1	1.5	3.4	2.2-6.0	2.2-6.0	2.2	2.2-5.2
Sinuosity (stream length/valley length) (K)	1.03	1.47	1.00	1.18	1.14	1.18	1.45	1.16
Bank Height Ratio (BHR)	2.3-3.3	1.9-2.0	2.0	1.0	1.0	1.0	1.0	1.0
Mean Bankfull Velocity (V) (fps)	4.3-4.6	3.2-3.7	2.8	3.3	3.4	4	4.1	4.5
Bankfull Discharge (Q) (cfs)	44.7-45.0	65.7-68.2	71.3	24.7	30.5	44.3	62.9	68.6
Average water surface slope	0.011	0.006	0.013	0.007	0.004	0.011	0.007	0.012

Variables	Existing	Ref. Reach UTFR	Proposed
	T1A-3		T1A-3
Rosgen Stream Type	F4	B4c	B4c/C4
Mitigation Type	Restoration	N/A	Restoration
Drainage Area (mi^2)	0.05	0.4	0.05
Bankfull Width (W_{bkf}) (ft)	9.3	9.0-10.0	6.0
Bankfull Mean Depth (d_{bkf}) (ft)	0.5	1.1-1.2	0.5
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)	4.3	10.4-10.7	3.2
Width/depth Ratio (W_{bkf}/d_{bkf})	20.1	8.0-10.0	11.2
Maximum Depth (d_{mbkf}) (ft)	0.7	1.3-1.5	0.9
Width of flood prone area (W_{fpa}) (ft)	10.0	13-21	14
Entrenchment Ratio (ER)	1.1	1.3-2.3	2.2
Sinuosity (stream length/valley length) (K)	1.06	1.20	1.09
Bank Height Ratio (BHR)	8.6	1.0	1.0
Mean Bankfull Velocity (V) (fps)	2.5	4.1-4.5	3.6
Bankfull Discharge (Q) (cfs)	10.8	42-46	11.6
Average water surface slope	0.018	0.013	0.017

Variables	Existing	Ref. Reach UT to Wilkinson	Proposed
	T1A-1, T1A-2		T1A-1, T1A-2
Rosgen Stream Type	C4	B4c	B4c/C4
Mitigation Type	Enh. I/Enh. II	N/A	Enh. I, Enh. II
Drainage Area (mi^2)	0.05	0.15	0.05
Bankfull Width (W_{bkf}) (ft)	12.7	7.7 - 10.8	7.0
Bankfull Mean Depth (d_{bkf}) (ft)	0.4	0.7 - 0.9	0.6
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)	4.5	6.1 - 8.8	3.9
Width/depth Ratio (W_{bkf}/d_{bkf})	35.8	8.5 - 11.4	12.5
Maximum Depth (d_{mbkf}) (ft)	0.9	1.3 - 1.7	0.9
Width of flood prone area (W_{fpa}) (ft)	30	13.0 - 16.0	15
Entrenchment Ratio (ER)	2.4	1.6 - 2.1	2.2
Sinuosity (stream length/valley length) (K)	1.11	1.20	1.11
Bank Height Ratio (BHR)	1.0	1.0	1.0
Mean Bankfull Velocity (V) (fps)	2.2	5.1-5.8	2.9
Bankfull Discharge (Q) (cfs)	10.6	31.0-49.0	11.5
Average water surface slope	0.015	0.012	0.012

7.5 Sediment Transport Analysis

In order to analyze the existing sediment conditions within the project streams, the bar sampling method was utilized at Jacob's Ladder Stream Restoration Site. In addition, the streams were sampled by the pebble count method at seven sites along all reaches for trend analysis. These data are provided in Appendix C. In order to analyze the existing sediment conditions within the project streams, bar samples were taken from the Jacob's Ladder Stream Restoration Site. In addition, the streams were sampled using the Wolman pebble count method at six sites along all reaches for trend analysis. These data are provided in Appendix C. Based on this analysis, the majority of the project reaches are dominated by gravel material with portions of sand in the smaller, headwater reaches.

After analyzing the existing sediment conditions, the site was studied with respect to proposed sediment transport. In active bed systems, there is a threshold level of bedload movement. At low flow levels, only the smallest particles will move, with the larger particles resisting the flow of the stream; this is the condition of partial sediment transport. As the stream flow increases, eventually every particle on the streambed will show threshold movement. This is the condition of full sediment transport. If the largest particle that moves during a bankfull event can be identified, then the flow conditions that produced this movement can be determined and this flow condition (channel competency) can be used in the design of the restored stream. Determinations of the design shear stresses were made based on the sediment distribution from the surface and subsurface sampling.

These shear stresses were validated for the proposed riffle cross-sections and channel gradient using the equation below. The shear stress values for the designed reaches were calculated and related to the movement of a particular grain size using Shield's threshold of motion curve (See Table 7.) (Shields *et al.* 1936). An approximate bedload transport rate was modeled using the Wilcock and Crowe model for mixed gravel-sand systems using the existing surface (pebble count) data.

$$\tau = \gamma R s$$

Where: τ = shear stress (lb/ft^2)
γ = specific gravity of water (62.4 lb/ft^3)
R = hydraulic radius (ft)
s = average water slope (ft/ft)

Table 7. Sediment Analysis

Project Reach	Shear Stress at Designed Reaches (lb/sq. ft)	Largest Grain Diameter Mobilized (mm)	Equivalent Grain Type	Bedload Transport Rate (lb/min)
T1-1	0.21	15	Medium Gravel	43
T1-2	0.63	48	Very Coarse Gravel	123
T1A-1	0.53	41	Very Coarse Gravel	N/A
T1A-2	0.33	25	Coarse Gravel	N/A
T1A-3	0.54	41	Very Coarse Gravel	N/A
T2-1	0.47	36	Very Coarse Gravel	106
T2-2	0.81	63	Very Coarse Gravel	478

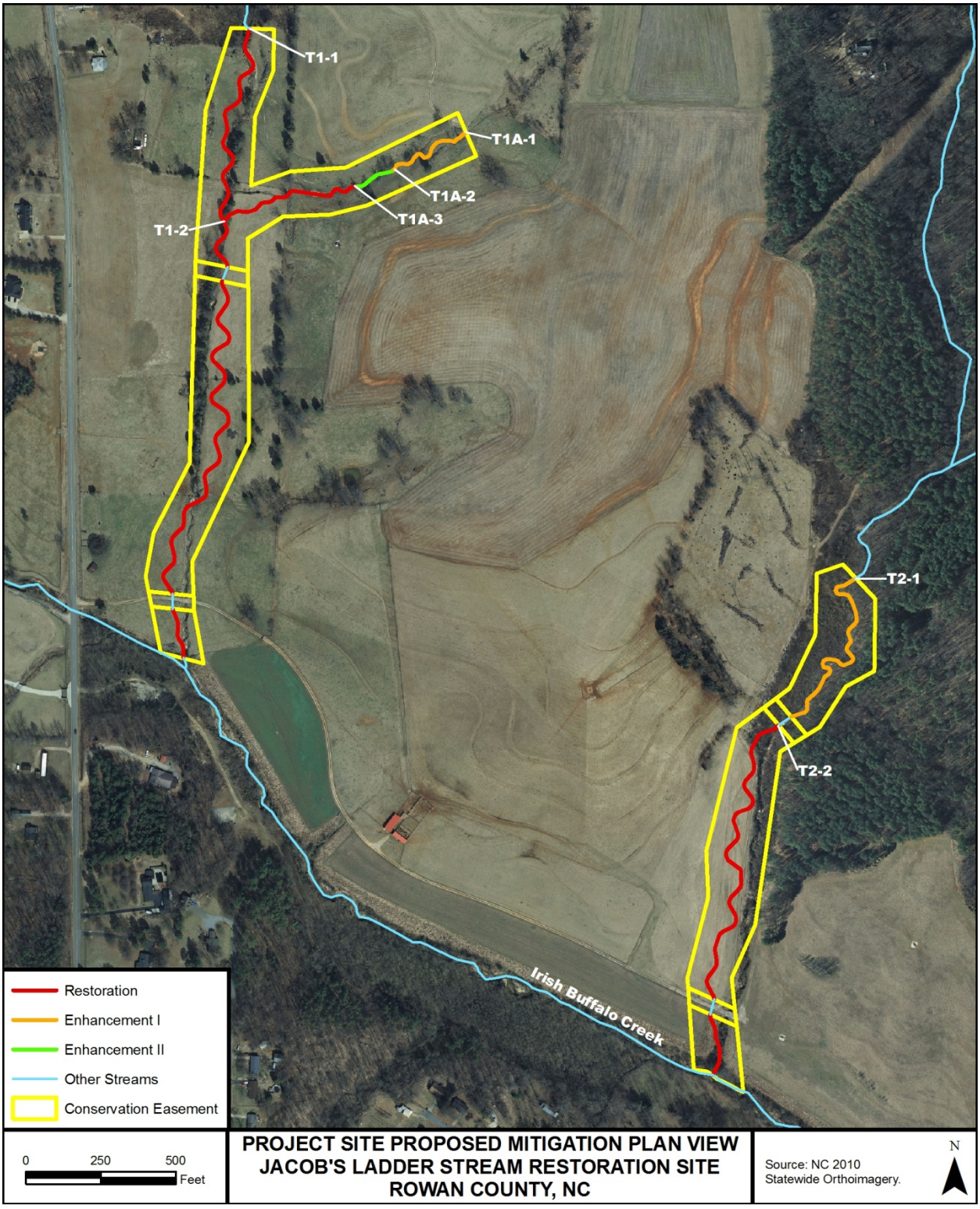
The predicted mobilized material size and bedload transport rates are appropriate for the gravel material existing within the project streams. The project streams all have small watershed areas that drain to them and the incoming sediment supply is limited. Currently, the smaller-sized sands and fine gravels within

the project streams are coming from active bank erosion. This source of sediment will be greatly reduced following the project restoration.

Tributary 1A is a threshold channel, which is defined as a stream where the bed material inflow is negligible and the channel boundary is immobile even at high flows (Shields *et al.* 2003). At the Jacob's Ladder Stream Restoration Site, this tributary is a threshold channel due to the lack of incoming bed material from the small surrounding watershed. Existing bed sediment in this channel was limited to silt introduced from eroding banks and underlain by a stable gravel layer. As opposed to an active bed system, a threshold channel never achieves full sediment transport; the system only achieves partial sediment transport. Therefore, the bedload rates provided for the other tributaries are not relevant for the reaches of T1A. The riffles installed in T1A will be constructed with stabilized rock material due to the lack of a mobile bed and the steep slope as the stream flows into the confluence with T1.

Based on this analysis, the designed channels provide sufficient competency for the type of streams proposed and are capable of transporting sediment during bankfull events.

7.6 Proposed Mitigation Plan View



8.0 MAINTENANCE PLAN

KCI shall monitor the site on a regular basis and shall conduct a physical inspection of the site a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

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

9.0 PERFORMANCE STANDARDS

Monitoring of the Jacob's Ladder Stream Restoration Site shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. Specifically, project success will be assessed utilizing measurements of stream dimension and profile; site photographs, and vegetation sampling.

The purpose of monitoring is to evaluate the stability of the restored stream. Following the procedures established in the USDA Forest Service Manual, *Stream Channel Reference Sites* (Harrelson *et al*. 1994) and the methodologies utilized in the Rosgen stream assessment and classification system (Rosgen D.L. 1994 and 1996), data collected will consist of detailed dimension measurements, longitudinal profiles, and bed materials sampling.

Dimension

Permanent cross-sections will be established along the restored and enhanced reaches and will be used to evaluate stream dimension stability. Permanent monuments will be established at the left and right extents of each cross-section by either conventional survey or GPS. The cross-section surveys shall provide a detailed measurement of the stream and banks and will include points on the adjacent floodplain or

valley, at the top of bank, bankfull, at all breaks in slope, the edge of water, and thalweg. Width/depth and entrenchment ratios will be calculated for each cross-section based on the survey data.

Cross-section measurements should show little or no change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increased stability or whether they indicate movement toward an unstable condition.

Profile
A 3,000 linear foot detailed longitudinal profile will be conducted along portions of T1, T2, and T1A. Measurements will include slopes (average, pool, and riffle) as well as calculations of pool-to-pool spacing. Annual measurements should indicate that bedform features are stable with little change from the as-built survey. The pools should maintain their depth with lower water surface slopes, while the riffles should remain shallower and steeper than the average values for the stream.

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

Verification of Bankfull Events
During the monitoring period, a minimum of two bankfull events must be recorded within the five-year monitoring period. These two bankfull events must occur in separate monitoring years. Bankfull events will be verified using automatic stream monitoring gauges to record daily stream depth readings.

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

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

Visual Assessment
An annual site walk will be conducted at the end of each monitoring period to document any stream problem areas. Specific problem areas that could arise include excessive bank erosion, bed deposition or aggradation, or problems with the installed structures. The findings of the visual assessment as well as any recommended corrective actions for problem areas will be summarized in the monitoring reports by way of a Current Conditions Plan View figure.

Vegetation
The success of the riparian buffer plantings will be evaluated using sixteen, ten-by-ten meter vegetative sampling plots and will use the CVS-EEP version 4.2, stream vegetation monitoring protocol (Lee *et al*. 2008). The corners of each monitoring plot will be permanently marked in the field. The coordinates of the plot corners will be recorded using conventional survey. The monitoring will consist of the following data inventory: composition and number of surviving species, total number of stems per acre, diameter at breast height for trees greater than 5 feet in height, and vigor. Additionally, a photograph will be taken of each plot that will be replicated each monitoring year. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after three years, 288 stems/acre after four years, and 260 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective

actions will take place, which may include invasive species control, the removal of dead/dying plants and replanting.

10.0 MONITORING REQUIREMENTS

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

Beginning at the end of the first growing season, KCI will monitor the planted vegetation for five years or until the success criterion is met. Annual monitoring reports will be prepared and submitted after all monitoring tasks for each year are completed. The report will document the monitored components and include all collected data, analyses, and photographs. Each report will provide the new monitoring data and compare the most recent results against previous findings. Monitoring will also include evaluating the site for potential maintenance needs, including but not limited to invasive species problems, stream channel instability, riparian vegetation survival, floodplain scour and easement violations or encroachments. If problems arise, maintenance will occur to address the problem area. Maintenance will occur throughout the monitoring period on an as-needed basis. Specific maintenance activities, including any easement violations or encroachments will be documented in yearly monitoring reports. The monitoring report format will be similar to that set out in the most recent EEP monitoring protocol.

Required	Parameter	Quantity	Frequency	Notes
Yes	Pattern		Once, during as-built survey	
Yes	Dimension	10 Cross-sections	annual	To be distributed throughout the project reaches.
Yes	Profile	3,000 linear feet	annual	Profile will include sections of all project reaches
Yes	Substrate	Pebble counts at permanent riffle cross-sections	annual	
Yes	Surface Water Hydrology	Two, one each on T1 and T2.	annual	Two pressure transducer gauges will be installed on site; the devices will be inspected every two months to document the occurrence of bankfull events on the project
Yes	Vegetation	A total of 16 plots will be distributed to ensure sufficient coverage of planted vegetation	annual	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols
Yes	Exotic and nuisance vegetation		annual	Locations of exotic and nuisance vegetation will be mapped
Yes	Project boundary		annual	Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped

11.0 LONG-TERM MANAGEMENT PLAN

Upon approval for close-out by the Interagency Review Team (IRT), the site will be transferred to the NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program. This party shall be responsible for periodic inspection of the site to ensure that restrictions required in the conservation easement are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to site transfer to the responsible party. Section III of the Conservation Easement allows perpetual Right of Access to the Grantee, its employees and agents at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance and monitor the site. Although the Conservation Easement does not restrict how the Grantee can access the site, the Conservation Easement plat shows the preferred access route into the site for the convenience of the Conservation Stewardship Program.

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

12.0 ADAPTIVE MANAGEMENT PLAN

Upon completion of site construction, KCI will implement the post-construction monitoring protocols previously defined in this document. Project maintenance will be performed as described previously in this document. If, during the course of annual monitoring it is determined the site's ability to achieve site performance standards are jeopardized, KCI will notify the EEP and the USACE of the need to develop a Plan of Corrective Action. Once the Corrective Action Plan is prepared and finalized KCI will:

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

13.0 FINANCIAL ASSURANCES

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

14.0 OTHER INFORMATION

14.1 Definitions

Morphological description – the stream type; stream type is determined by quantifying channel entrenchment, dimension, pattern, profile, and boundary materials; as described in Rosgen, D. (1996), *Applied River Morphology, 2nd edition*

Native vegetation community – a distinct and reoccurring assemblage of populations of plants, animals, bacteria and fungi naturally associated with each other and their population; as described in Schafale, M.P. and Weakley, A. S. (1990), *Classification of the Natural Communities of North Carolina, Third Approximation*

Project Area - includes all protected lands associated with the mitigation project

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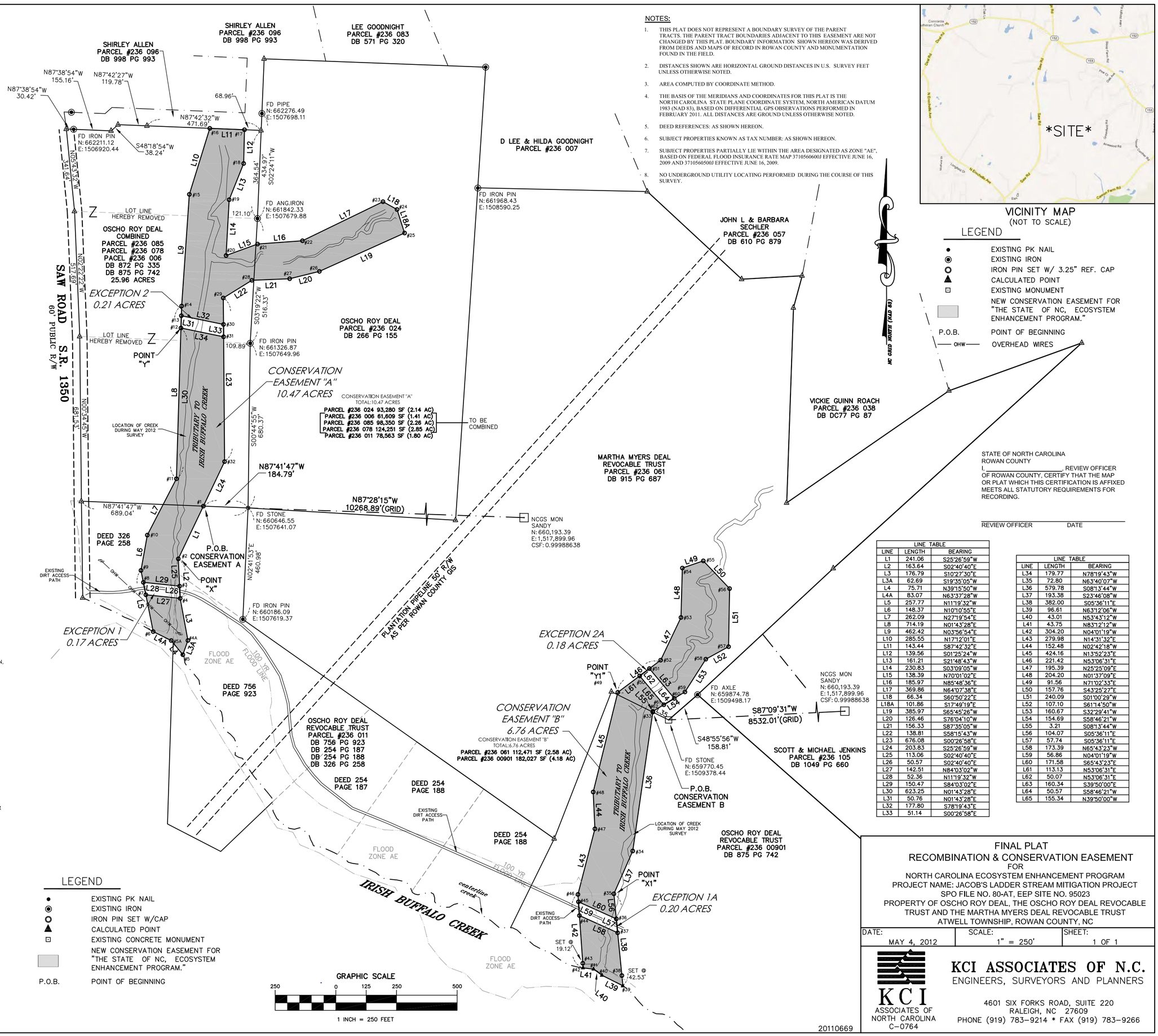
Appendix A

Conservation Easement (Preliminary)

POINT TABLE			
POINT	NORTHING	EASTING	DESCRIPTION
1	660653.98	1507456.43	ESMT CORNER
2	660436.31	1507352.84	ESMT CORNER
3	660323.37	1507358.13	ESMT CORNER
4	660272.85	1507360.49	ESMT CORNER
4A	660099.00	1507392.58	ESMT CORNER
5	660039.93	1507371.57	ESMT CORNER
5A	660098.55	1507323.65	ESMT CORNER
6	660135.46	1507249.23	ESMT CORNER
7	660287.63	1507218.75	ESMT CORNER
8	660338.97	1507208.47	ESMT CORNER
9	660388.21	1507198.61	ESMT CORNER
10	660534.24	1507224.83	ESMT CORNER
11	660767.07	1507345.17	ESMT CORNER
12	661390.04	1507363.92	ESMT CORNER
13	661440.78	1507365.45	ESMT CORNER
14	661480.94	1507366.66	ESMT CORNER
15	661942.26	1507398.50	ESMT CORNER
16	662215.04	1507482.94	ESMT CORNER
17	662209.31	1507626.27	ESMT CORNER
18	662069.79	1507622.80	ESMT CORNER
19	661920.12	1507562.90	ESMT CORNER
20	661689.64	1507550.21	ESMT CORNER
21	661736.93	1507680.27	ESMT CORNER
22	661750.52	1507865.74	ESMT CORNER
23	661911.91	1508198.52	ESMT CORNER
24	661879.59	1508256.46	ESMT CORNER
25	661782.62	1508287.63	ESMT CORNER
26	661624.14	1507935.70	ESMT CORNER
27	661593.69	1507812.96	ESMT CORNER
28	661587.11	1507656.77	ESMT CORNER
29	661514.09	1507538.72	ESMT CORNER
30	661404.81	1507539.58	ESMT CORNER
31	661353.67	1507539.98	ESMT CORNER
32	660838.03	1507544.02	ESMT CORNER
33	659802.74	1509313.19	ESMT CORNER
34	659228.93	1509230.21	ESMT CORNER
35	659051.95	1509152.27	ESMT CORNER
36	658948.37	1509162.43	ESMT CORNER
37	658890.91	1509168.07	ESMT CORNER
38	658714.10	1509185.41	ESMT CORNER
39	658671.78	1509189.56	ESMT CORNER
40	658715.33	1509103.33	ESMT CORNER
41	658740.78	1509068.66	ESMT CORNER
42	658745.96	1509025.21	ESMT CORNER
43	658765.04	1509023.87	ESMT CORNER
44	658962.20	1509010.01	ESMT CORNER
45	659018.92	1509006.02	ESMT CORNER
46	659049.41	1509003.88	ESMT CORNER
47	659320.44	1509074.10	ESMT CORNER
48	659472.75	1509066.90	ESMT CORNER
49	659884.54	1509168.61	ESMT CORNER
50	659952.45	1509259.09	ESMT CORNER
51	659982.51	1509299.13	ESMT CORNER
52	660017.45	1509345.69	ESMT CORNER
53	660193.92	1509429.56	ESMT CORNER
54	660398.04	1509435.33	ESMT CORNER
55	660427.79	1509521.92	ESMT CORNER
56	660313.21	1509630.37	ESMT CORNER
57	660073.15	1509626.14	ESMT CORNER
58	660021.64	1509532.25	ESMT CORNER
59	659886.12	1509445.93	ESMT CORNER
60	659859.38	1509401.83	ESMT CORNER
61	659833.16	1509358.59	ESMT CORNER
62	659805.92	1509313.65	ESMT CORNER



NOTES:

1. THIS PLAT DOES NOT REPRESENT A BOUNDARY SURVEY OF THE PARENT TRACTS. THE PARENT TRACT BOUNDARIES ADJACENT TO THIS EASEMENT ARE NOT CHANGED BY THIS PLAT. BOUNDARY INFORMATION SHOWN HEREON WAS DERIVED FROM DEEDS AND MAPS OF RECORD IN ROWAN COUNTY AND MONUMENTATION FOUND IN THE FIELD.
2. DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES IN U.S. SURVEY FEET UNLESS OTHERWISE NOTED.
3. AREA COMPUTED BY COORDINATE METHOD.
4. THE BASIS OF THE MERIDIANS AND COORDINATES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED IN FEBRUARY 2011. ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.
5. DEED REFERENCES: AS SHOWN HEREON.
6. SUBJECT PROPERTIES KNOWN AS TAX NUMBER: AS SHOWN HEREON.
7. SUBJECT PROPERTIES PARTIALLY LIE WITHIN THE AREA DESIGNATED AS ZONE "AE", BASED ON FEDERAL FLOOD INSURANCE RATE MAP 37105606000J EFFECTIVE JUNE 16, 2009 AND 37105605000J EFFECTIVE JUNE 16, 2009.
8. NO UNDERGROUND UTILITY LOCATING PERFORMED DURING THE COURSE OF THIS SURVEY.

VICINITY MAP
(NOT TO SCALE)

LEGEND

- EXISTING PK NAIL
- EXISTING IRON
- IRON PIN SET W/ 3.25" REF. CAP
- CALCULATED POINT
- EXISTING MONUMENT
- NEW CONSERVATION EASEMENT FOR "THE STATE OF NC, ECOSYSTEM ENHANCEMENT PROGRAM."
- P.O.B. POINT OF BEGINNING
- OHW OVERHEAD WIRES

STATE OF NORTH CAROLINA
ROWAN COUNTY

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

_____
REVIEW OFFICER DATE

LINE TABLE		
LINE	LENGTH	BEARING
L1	241.06	S25°26'59"W
L2	163.64	S02°40'40"E
L3	176.79	S10°27'30"E
L3A	62.69	S19°35'05"W
L4	75.71	N39°15'50"W
L4A	83.07	N63°37'28"W
L5	257.77	N11°19'32"W
L6	148.37	N10°10'55"E
L7	262.09	N27°19'54"E
L8	714.19	N01°43'28"E
L9	462.42	N03°56'54"E
L10	285.55	N17°12'01"E
L11	143.44	S87°42'32"E
L12	139.56	S01°25'24"W
L13	161.21	S21°48'43"W
L14	230.83	S03°09'05"W
L15	138.39	N70°01'02"E
L16	185.97	N85°48'36"E
L17	369.86	N64°07'38"E
L18	66.34	S60°50'22"E
L18A	101.86	S17°49'19"E
L19	385.97	S65°45'26"W
L20	126.46	S76°04'10"W
L21	156.33	S87°35'05"W
L22	138.81	S58°15'43"W
L23	676.08	S00°26'58"E
L24	203.83	S25°26'59"W
L25	113.06	S02°40'40"E
L26	50.57	S02°40'40"E
L27	142.51	N84°03'02"W
L28	52.36	N11°19'32"W
L29	150.47	S84°03'02"E
L30	623.25	N01°43'28"E
L31	50.76	N01°43'28"E
L32	177.80	S78°19'43"E
L33	51.14	S00°26'58"E

LINE TABLE		
LINE	LENGTH	BEARING
L34	179.77	N78°19'43"W
L35	72.80	N63°40'07"W
L36	579.78	S08°13'44"W
L37	193.38	S23°46'08"W
L38	382.00	S05°36'11"E
L39	96.61	N63°12'06"W
L40	43.01	N53°43'12"W
L41	43.75	N83°12'12"W
L42	304.20	N04°01'19"W
L43	279.98	N14°31'32"E
L44	152.48	N02°42'18"W
L45	424.16	N13°52'23"E
L46	221.42	N53°06'31"E
L47	195.39	N25°25'09"E
L48	204.20	N01°37'09"E
L49	91.56	N71°02'33"E
L50	157.76	S43°25'27"E
L51	240.09	S01°00'29"W
L52	107.10	S61°14'50"W
L53	160.67	S32°29'41"W
L54	154.69	S58°46'21"W
L55	3.21	S08°13'44"W
L56	104.07	S05°36'11"E
L57	57.74	S05°36'11"E
L58	173.39	N65°43'23"W
L59	56.86	N04°01'19"W
L60	171.58	S65°43'23"E
L61	113.13	N53°06'31"E
L62	50.07	N53°06'31"E
L63	160.34	S39°50'00"E
L64	50.57	S58°46'21"W
L65	155.34	N39°50'00"W

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

_____
NORTH CAROLINA REGISTRATION NUMBER L-3860
JAMES M. GELLENTHIN

I, JAMES M. GELLENTHIN, PROFESSIONAL LAND SURVEYOR, NO. L-3860 CERTIFY TO THE FOLLOWING AS REQUIRED IN G.S. 47-30 (F)(11):

THAT THE SURVEY IS OF ANOTHER CATEGORY, SUCH AS THE RECOMBINATION OF EXISTING PARCELS, A COURT ORDERED SURVEY, OR OTHER EXCEPTION TO THE DEFINITION OF SUBDIVISION.

_____
NORTH CAROLINA REGISTRATION NUMBER L-3860
JAMES M. GELLENTHIN

STATE OF NORTH CAROLINA
ROWAN COUNTY

PRESENTED FOR REGISTRATION AND RECORDED IN THIS OFFICE IN BOOK OF MAPS_____, PAGE _____ THIS THE _____DAY OF _____, 2012.

_____
REGISTER OF DEEDS

LEGEND

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

FINAL PLAT
RECOMBINATION & CONSERVATION EASEMENT
FOR
NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM
PROJECT NAME: JACOB'S LADDER STREAM MITIGATION PROJECT
SPO FILE NO. 80-AT, EEP SITE NO. 95023
PROPERTY OF OSCHO ROY DEAL, THE OSCHO ROY DEAL REVOCABLE TRUST AND THE MARTHA MYERS DEAL REVOCABLE TRUST
ATWELL TOWNSHIP, ROWAN COUNTY, NC

DATE:	SCALE:	SHEET:
MAY 4, 2012	1" = 250'	1 OF 1

KCI ASSOCIATES OF NORTH CAROLINA C-0764

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

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

20110669

Appendix B

Baseline Information Data

FHWA Categorical Exclusion Form

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

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

Part 1: General Project Information	
Project Name:	Jacob's Ladder Stream Restoration Project
County Name:	Rowan
EEP Number:	003983
Project Sponsor:	NC Ecosystem Enhancement Program (EEP) / KCI Technologies, Inc.
Project Contact Name:	Tim Morris
Project Contact Address:	4601 Six Forks Road, Suite 220, Raleigh NC 27609
Project Contact E-mail:	tim.morris@kci.com
EEP Project Manager:	Guy Pearce

Project Description

This project proposes to improve water quality and protect aquatic habitat in an agricultural area of Rowan County that has undergone degradation from unrestricted agricultural activities and human induced disturbances. This stream restoration project intends to restore approximately 4,935 linear feet of tributary stream draining to Irish Buffalo Creek in southwestern Rowan County.

For Official Use Only

Reviewed By:

Deborah a Dann

Date — EEP Project Manager

Conditional Approved By:

Date — For Division Administrator FHWA

☐ Check this box if there are outstanding issues

Final Approval By:

10-21-11

Date — For Division Administrator FHWA

RECEIVED
OCT - 5 2011
NC ECOSYSTEM ENHANCEMENT PROGRAM

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

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

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

FEMA Compliance

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:	Jacob's Ladder Stream Restoration Site
Name if stream or feature:	Tributaries to Irish Buffalo Creek
County:	Rowan
Name of river basin:	Lower Yadkin Pee-Dee River Basin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Rowan
DFIRM panel number for entire site:	5606 and 5605
Consultant name:	KCI Technologies/Kristin Knight-Meng
Phone number:	919-923-2854
Address:	4601 Six Forks Road Suite 220 Raleigh, NC 27609

Design Information

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

The Jacob's Ladder Stream Restoration Site involves the restoration of streams impacted by channelization, cattle, and riparian vegetation removal. The proposed project will restore three unnamed tributaries (T1, T1A, and T2) that flow into Irish Buffalo Creek. The restoration will return the streams to natural meander patterns and will involve planting riparian vegetation within the extent of the conservation easement. The confluences of T1 and T2 are in the backwater of the Irish Buffalo Creek floodplain. The restored channels of T1 and T2 will be tied into Irish Buffalo Creek at the same existing confluence locations.

Summarize stream reaches or wetland areas according to their restoration priority.

Reach	Length (Linear Feet)	Priority
T1-1	739	P1, Restoration
T1-2	1,622	P1, Restoration
T2-1	775	Enhancement I
T2-2	1,334	P1, Restoration
T1A-1	306	Enhancement I
T1A-2	140	Enhancement II
T1A-3	498	P1, 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: Zone AE

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:

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:
Phone Number:

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

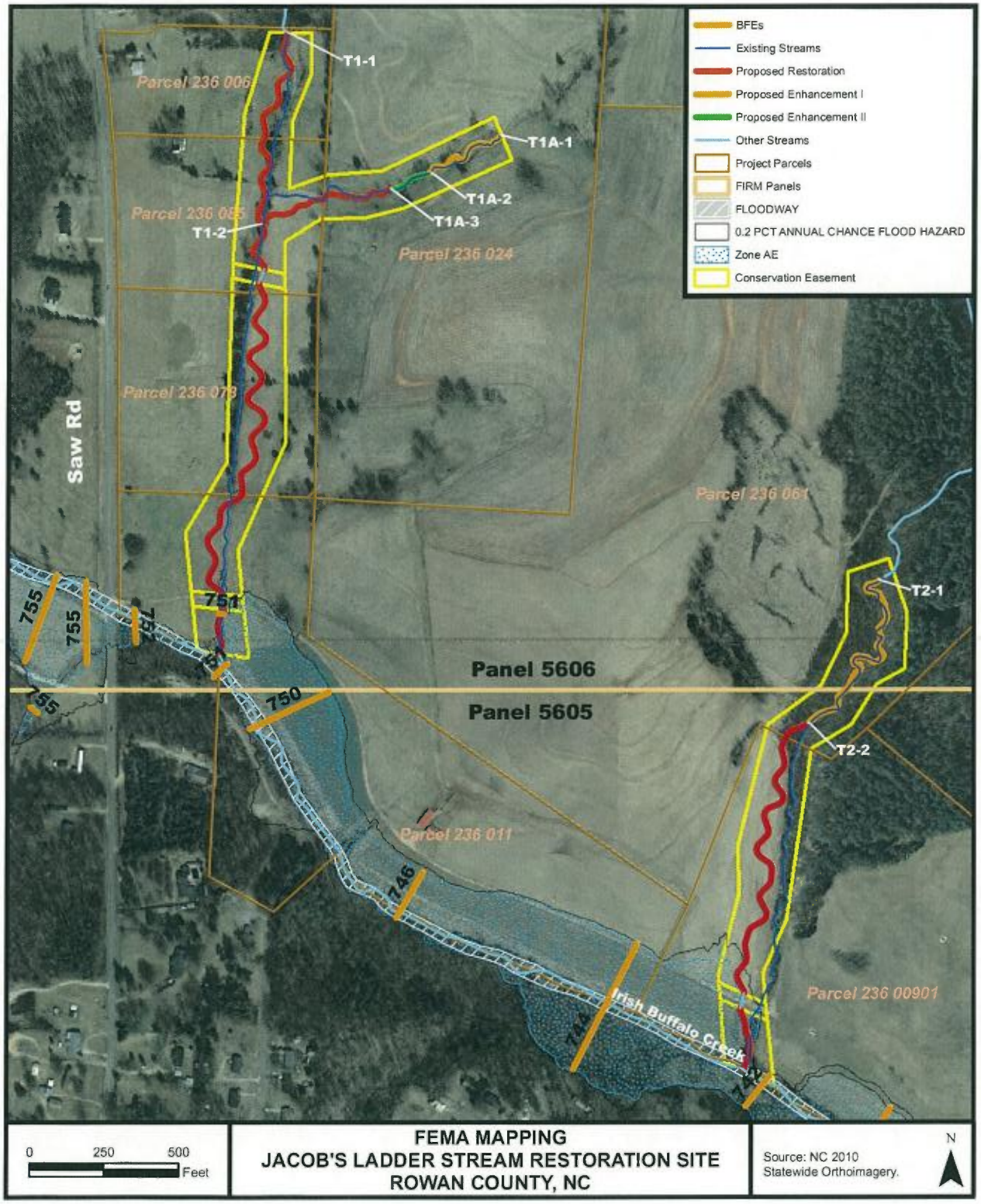
☑ Other Requirements

List other requirements: County floodplain development permit and a statement certified by a PE that there would be no hydraulic impacts such as berms built or banks extended on the portion that is within the floodway.

Comments:

Name: GARY M. MRYNCZA Signature:

Title: PROJECT ENGINEER Date: 06.21.12


BFEs
Existing Streams
Proposed Restoration
Proposed Enhancement I
Proposed Enhancement II
Other Streams
Project Parcels
FIRM Panels
FLOODWAY
0.2 PCT ANNUAL CHANCE FLOOD HAZARD
Zone AE
Conservation Easement
T1-1
T1A-1
T1A-2
T1A-3
T1-2
T2-1
T2-2
Parcel 236 006
Parcel 236 024
Parcel 236 078
Parcel 236 061
Parcel 236 011
Parcel 236 00901
Saw Rd
Panel 5606
Panel 5605
Irish Buffalo Creek
755
750
746
0
250
500
Feet
N
FEMA MAPPING
JACOB'S LADDER STREAM RESTORATION SITE
ROWAN COUNTY, NC
Source: NC 2010
Statewide Orthoimagery.

Rowan County Department of Planning & Development
402 North Main Street Salisbury, NC 28144
Phone (704) 216-8588 Fax (704) 638-3130
www.rowancountync.gov

FLOOD PLAIN DEVELOPMENT PERMIT

This permit is required prior to any development* within or adjacent to a regulated flood plain.

Owner Name: Oscho Deal / (Conserv. Esmt to be owned by State of NC) Phone #: N/A

Applicant Name: KCI Technologies, Inc. ATTN: Tim Morris, Project Manager Phone #: (919) 278-2511

Property Location: 350 Saw Rd, China Grove, NC 28023 Tax Parcel(s): 236 00901, 236 011

Zoning Jurisdiction: RR Application Date: June 21, 2012

* Development - means any man-made change to improved or unimproved real estate including, but not limited to, buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials.

Type of Development (check all that apply):
Residential: _____ Non-residential: _____ Addition: _____ Renovation: _____
Fill: _____ Grading: _____ Other (specify): Stream Restoration Project for State of North Carolina, Ecosystem Enhancement Program

Provide a plot plan prepared by a professional land surveyor or engineer containing the following information**:

☑ Location, dimensions, and elevations (to the 1/10 foot accuracy) of the area of development.

☑ Existing and proposed structures, utility systems, grading / pavement areas, fill materials, storage areas, drainage facilities, and any other development.

☑ Boundary of regulated flood plain, BFE (to the 1/10 foot accuracy), and floodway / non-encroachment area as indicated on the FIRM / FIS.

☑ Old and new location of any watercourse that will be altered or relocated as a result of the proposed development (if applicable).

** In lieu of this requirement, the Floodplain Administrator may provide necessary certifications for development adjacent to but not within the regulated flood plain.

FIRM Data: Flood Zone (check one): AE ☑ X ☐ Map Panel(s) #: 5605, 5606

Within Floodway/Non-encroachment Area? (check one): Yes ☐ No ☑ NA ☐

BFE at development site: 751; 742 **NAVD 88**

Regulatory Flood Protection Elevation (BFE plus 2 foot freeboard): 753; 744 **NAVD 88**

SUBMIT ELEVATION CERTIFIATE (FEMA FORM 81-31) OR FLOOD PROOFING CERTIFICATE (FEMA FORM 81-65) FOR DEVELOPMENT WITHIN THE REGULATED FLOODPLAIN.

If the development is proposed within a regulated flood plain, the following development standards apply:

1. Elevation which lowest floor (including basement) must be constructed at or above: N/A **NAVD 88** (measured from the bottom of the lowest horizontal structural member of the lowest floor).

2. Will garage (if applicable) be used for any purpose other than parking vehicles, building access, or limited storage as defined by Section 9-52 (4)? Yes ☐ No ☐ If yes, then the garage must be used in determining the lowest floor elevation. N/A

3. Elevation at or above which all supporting utilities (HVAC, electrical, plumbing, etc.) must be installed: N/A **NAVD 88**

4. Submit foundation plan, drawn to scale, indicating details of the foundation system including all information required by Section 9-32 (1)(d).

5. Elevation to which structure will be flood proofed (non-residential only) N/A **NAVD 88**

6. Other Restrictions: _____

_____

The following information, if indicated, is required after issuance of the development permit:

☐ If any portion of a proposed structure is within a regulated flood plain, an elevation certificate is required **within 7 calendar days** of establishment of the lowest floor elevation. A final as-built elevation certificate is also required **prior to issuing a certificate of occupancy**.

☐ If a structure will be flood proofed, the applicant shall provide a flood proofing certificate **within 7 calendar days** of completing the flood proofing.

☐ A survey prepared by a professional land surveyor showing the location of the regulated flood plain, BFE, and the structure location with elevations **after completing** _____.

☐ Contact the Floodplain Administrator **after completion of foundation** for inspection.

☐ _____

_____

Applicant acknowledgment: I the undersigned understand that the issuance of a floodplain development permit is contingent upon the above information being correct and that the plans and supporting data have been or shall be provided as required. I also understand that prior to occupancy of the structure being permitted, an elevation and/or flood proofing certificate signed by a professional engineer or professional land surveyor must be on file with the Planning Department indicating the "as built" elevations (for development within the regulated floodplain).

Applicant Signature: _____ Approved by: _____

Date: 06.21.12 Date: _____

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES: AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

MATCHLINE - SEE SHEET 6

22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00

FLOODPLAIN GRADING EXTENTS

CONSERVATION EASEMENT

100-YEAR FLOODPLAIN

ALL BARBED WIRE FENCING WITHIN CONSERVATION EASEMENT TO BE REMOVED

(1) 4' DIA., 20' LONG STREAM CULVERT (CONCRETE)
(2) 18" DIA., 20' LONG FLOODPLAIN CULVERTS (CMP)

50-FOOT WIDE EASEMENT EXCEPTION WITH A 16-FOOT WIDE CROSSING

OHP

IRISH BUFFALO CREEK

NC GRID NAD '83

-40' -20' 0' 40' 80'
GRAPHIC SCALE

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MRYNCZA
06.21.12

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012

REVISIONS

DESCRIPTION | DATE | APPROVED

Ecosystem Enhancement Program

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

JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACH T1-2

DATE: MAY 2012
SCALE: 1"=40'

SITE PLAN

SHEET 7 OF 23

07_ladGP\T1-1_T1-2\ dgn 6/20/2012 4:49:47 PM

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MYNCZA
06.21.12

MATCHLINE - SEE SHEET 10

CONSERVATION EASEMENT

ALL BARBED WIRE FENCING WITHIN CONSERVATION EASEMENT TO BE REMOVED

FLOODPLAIN GRADING EXTENTS

(1) 4' DIA., 20' LONG STREAM CULVERT (CONCRETE)
(2) 16' DIA., 20' LONG FLOODPLAIN CULVERTS (CMP)

50-FOOT WIDE EASEMENT EXCEPTION WITH A 16 FOOT WIDE CROSSING

100-YEAR FLOODPLAIN

IRISH BUFFALO CREEK

NC GRID NAD '83

-40' -20' 0' 40' 80'
GRAPHIC SCALE

PROPOSED PROFILE
EXISTING GRADE
PROPOSED STREAM CULVERT

750
746
742
738
734
730
726
111+00 112+00 113+00 114+00 115+00 116+00 117+00 118+00 119+00 120+00 121+00 122+00

REVISIONS

	DESCRIPTION	DATE	APPROVED
A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012	

Ecosystem Enhancement

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

JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACH T2-2

DATE: MAY 2012
SCALE: 1"=40'

SITE PLAN & PROFILE

SHEET 11 OF 23

April Helms

From: April Helms
Sent: Tuesday, June 26, 2012 12:55 PM
To: April Helms
Subject: RE: FEMA update - Jacob's Ladder

From: Stewart, Shane A. [mailto:Shane.Stewart@rowancountync.gov]
Sent: Wednesday, May 02, 2012 10:54 AM
To: Kristin Knight-Meng
Subject: RE: FEMA Compliance for Jacob's Ladder Stream Restoration Site

Kristen

In order to approve this project, we would need the attached development permit completed and a statement certified by a PE that there would be no hydraulic impacts such as berms built or banks extended on the portion that is within the floodway. The project would restore the banks to the natural condition on these tributaries with no work within Irish Buffalo Creek. This should not entail a full no-impact certification or hydraulic model to certify as such.

Let me know if you have any questions regarding this.

Shane Stewart, CFM
Senior Planner
Rowan County Department of Planning & Development
402 N Main St. Suite 204, Salisbury, NC 28144
Main Line: (704) 216-8588 www.rowancountync.gov

From: Kristin Knight-Meng [mailto:Kristin.Knight-Meng@kci.com]
Sent: Monday, April 16, 2012 3:11 PM
To: Stewart, Shane A.
Subject: FEMA Compliance for Jacob's Ladder Stream Restoration Site

Dear Mr. Stewart,
I was given your name as the floodplain administrator for Rowan County and I left you a voice mail earlier today, but wanted to send you some information in the meantime.

I am currently working on a proposed stream restoration project in the southwestern part of the county. It is a project for the NC Ecosystem Enhancement Program and they have a certain form for FEMA compliance (see attached). We are not working directly on a modeled stream, but our tributaries do come down to the Irish Buffalo Creek floodplain. Can you take a look at the attached checklist and maps and give me a call at your convenience to discuss the project?

Thanks very much,
Kristin

Kristin Knight-Meng
Environmental Scientist
KCI Technologies, Inc.
(919) 923-2854
kristin.knight-meng@kci.com
http://www.kci.com

Appendix C

Mitigation Work Plan Data and Analyses

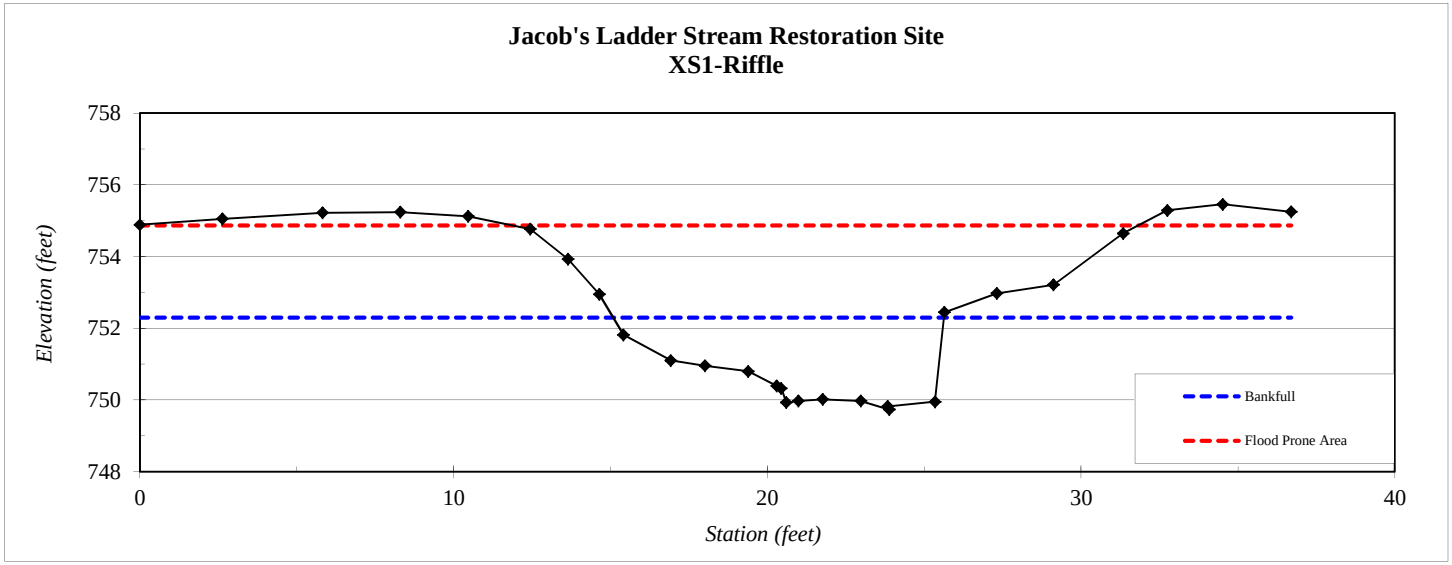
Existing Conditions

Cross-Sections

River Basin:	Yadkin-PeeDee
Watershed:	Jacobs Ladder Site, Existing Conditions, T2-1
XS ID	XS1-Riffle
Drainage Area (sq mi):	0.67
Date:	2/9/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	754.89
2.6	755.05
5.8	755.22
8.3	755.24
10.5	755.12
12.4	754.76
13.6	753.92
14.6	752.95
15.4	751.81
16.9	751.10
18.0	750.96
19.4	750.80
20.3	750.39
20.4	750.33
20.6	749.93
21.0	749.97
21.8	750.02
23.0	749.97
23.9	749.73
23.8	749.82
25.3	749.95
25.6	752.44
27.3	752.97
29.1	753.21
31.3	754.65
32.7	755.29
34.5	755.46
36.7	755.25

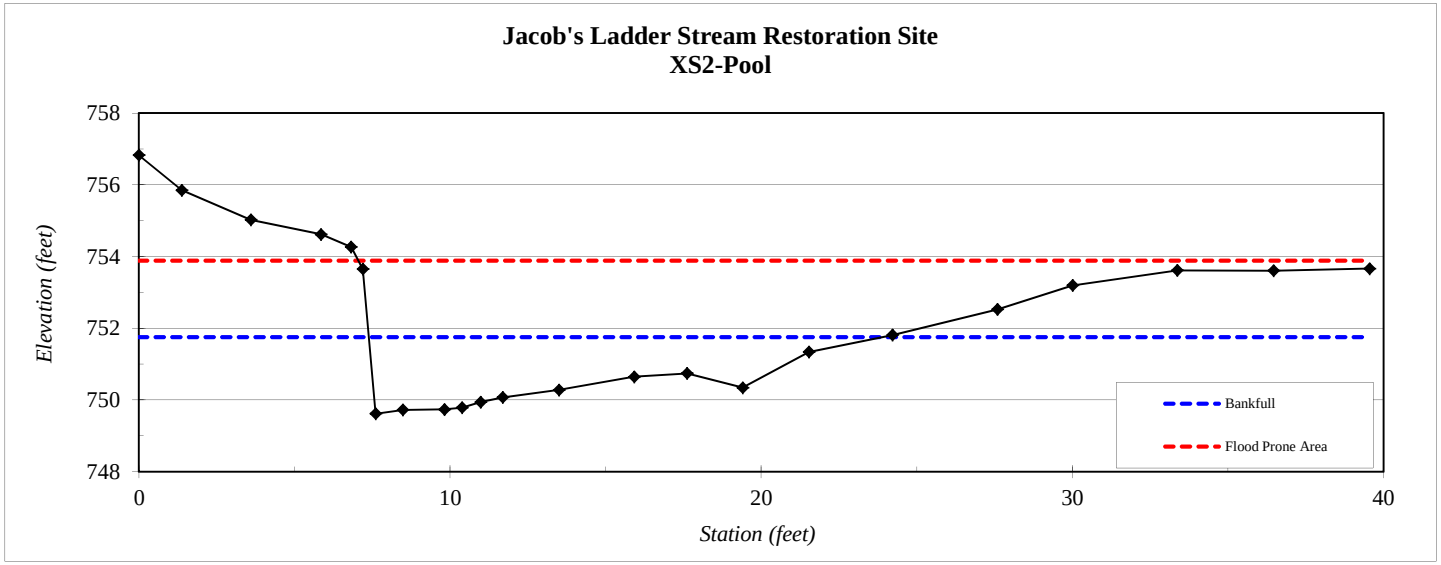
SUMMARY DATA	
Bankfull Elevation:	752.3
Bankfull Cross-Sectional Area:	18.5
Bankfull Width:	10.6
Flood Prone Area Elevation:	754.9
Flood Prone Width:	20
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.7
W / D Ratio:	6.1
Entrenchment Ratio:	1.9
Bank Height Ratio:	2.0



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T2-1
XS ID	XS2-Pool
Drainage Area (sq mi):	0.67
Date:	2/9/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	756.83
1.4	755.85
3.6	755.02
5.9	754.62
6.8	754.26
7.2	753.65
7.6	749.61
8.5	749.72
9.8	749.74
10.4	749.78
11.0	749.94
11.7	750.07
13.5	750.28
15.9	750.65
17.6	750.74
19.4	750.34
21.5	751.34
24.2	751.81
27.6	752.52
30.0	753.20
33.4	753.61
36.5	753.60
39.6	753.66

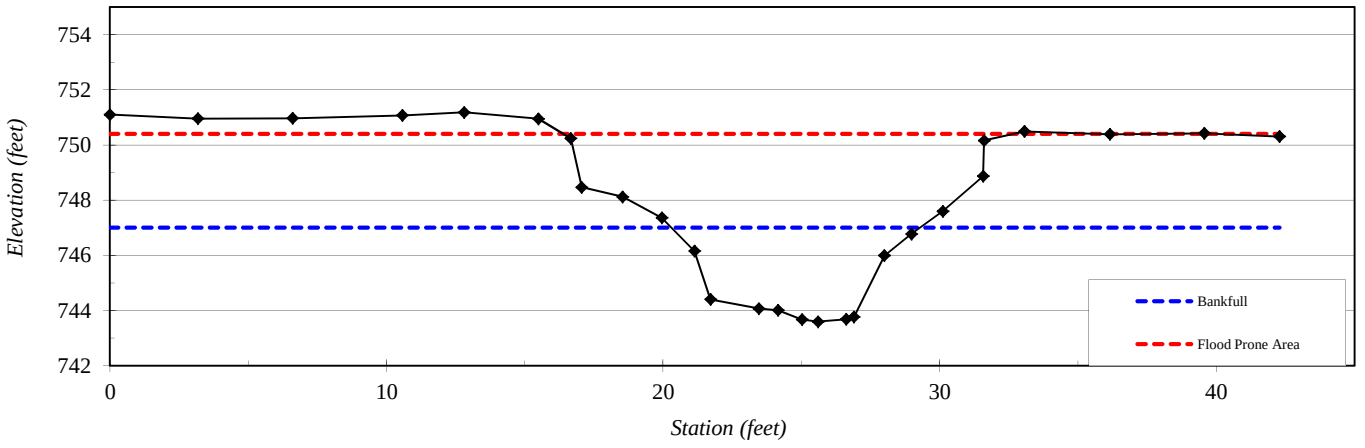
SUMMARY DATA	
Bankfull Elevation:	751.8
Bankfull Cross-Sectional Area:	20.6
Bankfull Width:	16.5
Flood Prone Area Elevation:	753.9
Flood Prone Width:	>35
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.2
W / D Ratio:	13.2
Entrenchment Ratio:	2.1
Bank Height Ratio:	1.9



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T2-2
XS ID	XS4-Riffle
Drainage Area (sq mi):	0.7
Date:	2/9/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	751.10
3.2	750.96
6.6	750.97
10.6	751.08
12.8	751.19
15.5	750.95
16.7	750.24
17.1	748.47
18.5	748.12
20.0	747.36
21.1	746.16
21.7	744.40
23.5	744.07
24.2	744.01
25.0	743.67
25.6	743.60
26.6	743.68
26.9	743.77
28.0	745.99
29.0	746.78
30.1	747.60
31.6	748.87
31.6	750.16
33.1	750.50
36.2	750.39
39.6	750.42
42.3	750.31

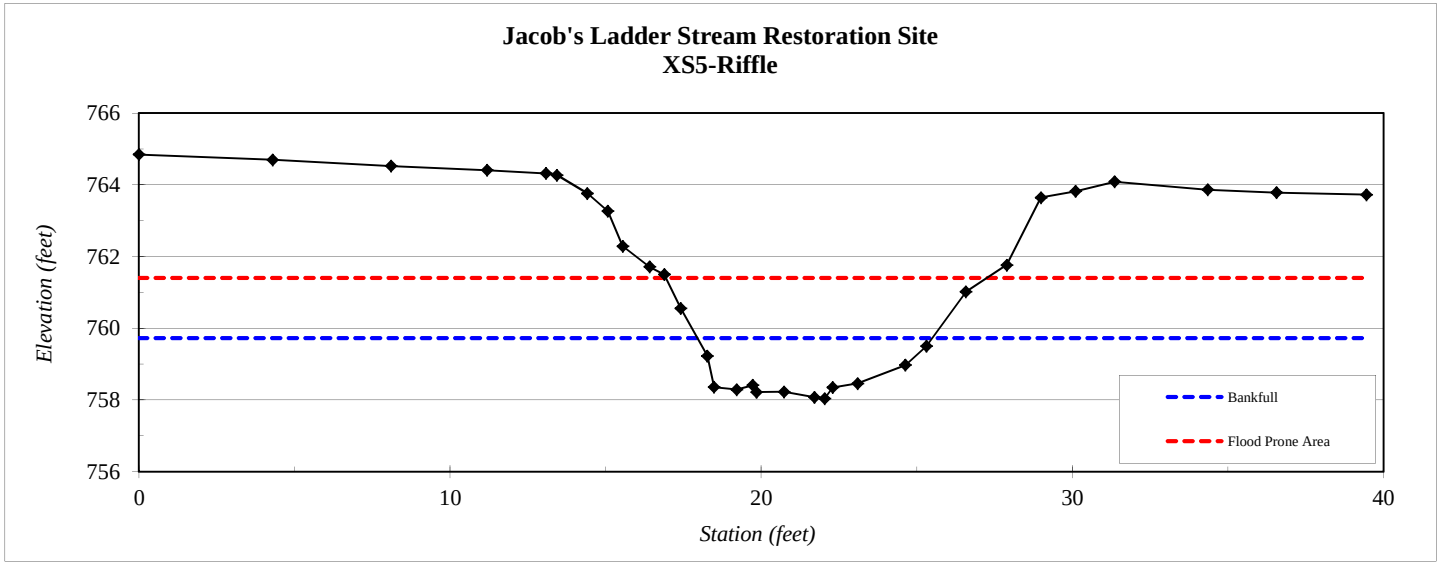
SUMMARY DATA	
Bankfull Elevation:	747.0
Bankfull Cross-Sectional Area:	25.0
Bankfull Width:	10.8
Flood Prone Area Elevation:	750.4
Flood Prone Width:	16
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.3
W / D Ratio:	4.7
Entrenchment Ratio:	1.5
Bank Height Ratio:	2.0



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T1-2
XS ID	XS5-Riffle
Drainage Area (sq mi):	0.36
Date:	2/10/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	764.85
4.3	764.70
8.1	764.52
11.2	764.41
13.1	764.32
13.4	764.27
14.4	763.76
15.1	763.27
15.6	762.29
16.4	761.71
16.9	761.50
17.4	760.55
18.3	759.23
18.5	758.36
19.2	758.29
19.7	758.41
19.9	758.22
20.7	758.23
21.7	758.07
22.0	758.03
22.3	758.35
23.1	758.46
24.6	758.97
25.3	759.50
26.6	761.01
27.9	761.76
29.0	763.64
30.1	763.82
31.4	764.09
34.3	763.86
36.6	763.78
39.5	763.73

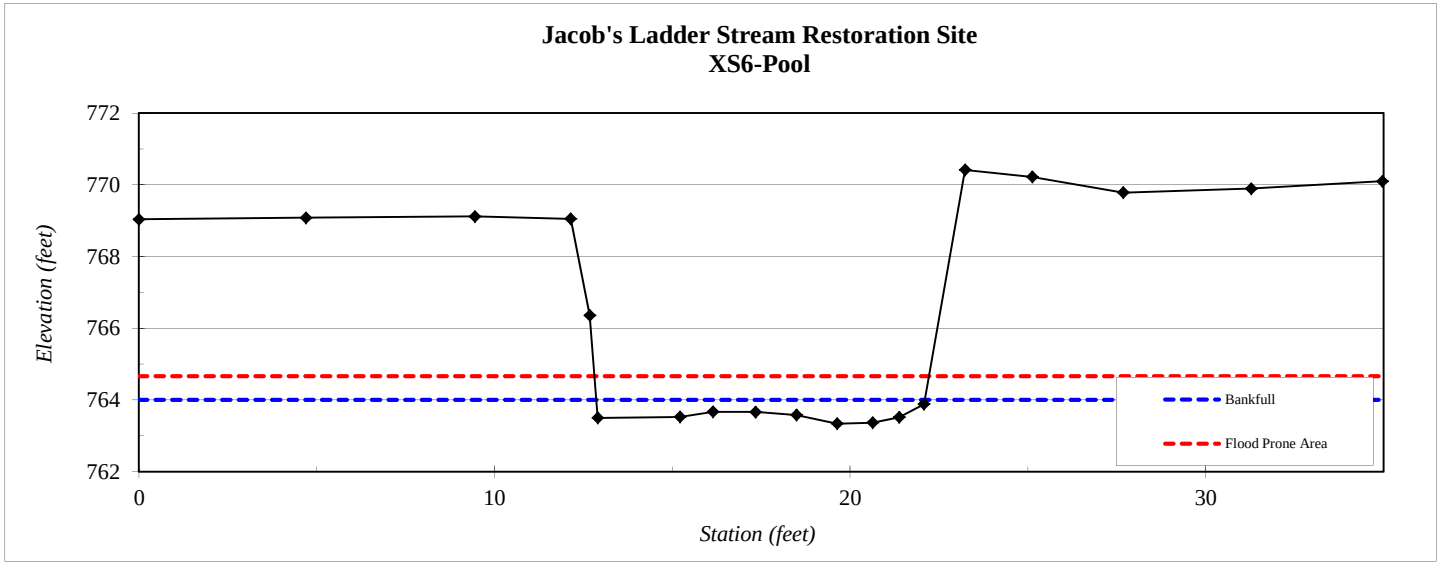
SUMMARY DATA	
Bankfull Elevation:	759.7
Bankfull Cross-Sectional Area:	10.2
Bankfull Width:	8.8
Flood Prone Area Elevation:	761.4
Flood Prone Width:	12
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.2
W / D Ratio:	7.6
Entrenchment Ratio:	1.3
Bank Height Ratio:	3.3



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T1A-3
XS ID	XS6
Drainage Area (sq mi):	0.05
Date:	2/10/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	769.04
4.7	769.08
9.4	769.12
12.1	769.05
12.7	766.36
12.9	763.50
15.2	763.53
16.1	763.67
17.3	763.66
18.5	763.58
19.6	763.34
20.6	763.37
21.4	763.52
22.1	763.89
23.2	770.42
25.1	770.22
27.7	769.78
31.3	769.89
35.0	770.10

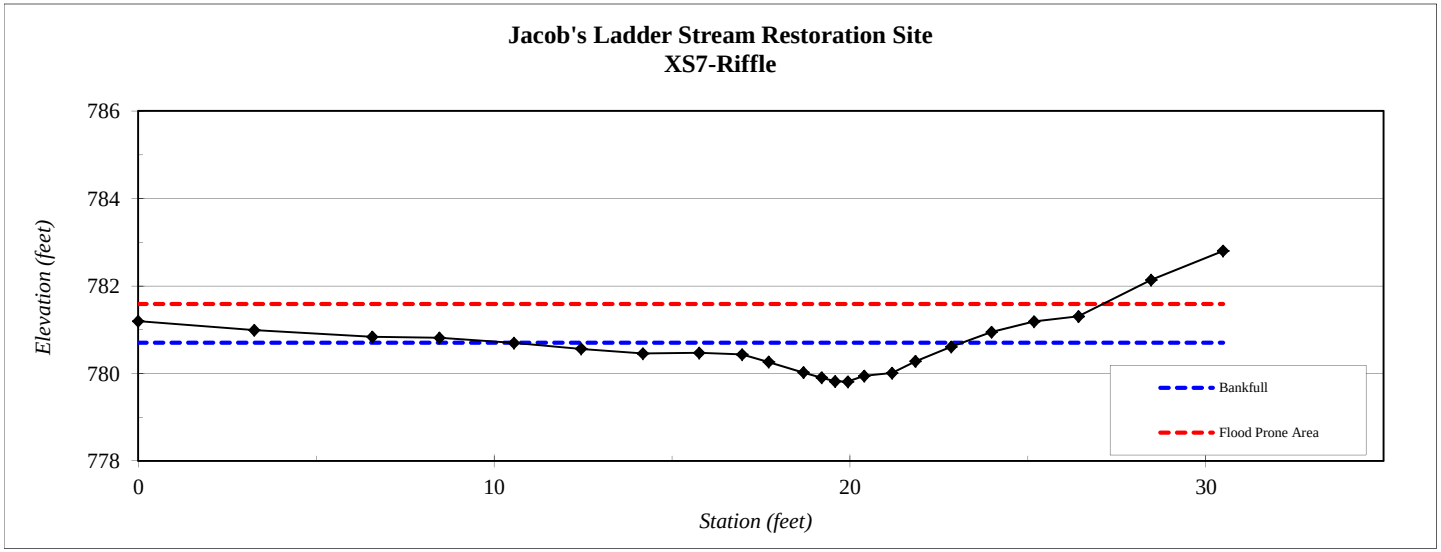
SUMMARY DATA	
Bankfull Elevation:	764.0
Bankfull Cross-Sectional Area:	4.3
Bankfull Width:	9.3
Flood Prone Area Elevation:	764.7
Flood Prone Width:	10
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.5
W / D Ratio:	20.1
Entrenchment Ratio:	1.1
Bank Height Ratio:	8.6



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T1A-2
XS ID	XS7-Riffle
Drainage Area (sq mi):	0.05
Date:	2/10/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	781.20
3.3	780.99
6.6	780.84
8.5	780.81
10.6	780.69
12.4	780.56
14.2	780.46
15.8	780.47
17.0	780.43
17.7	780.26
18.7	780.02
19.2	779.90
19.6	779.82
19.9	779.81
20.4	779.94
21.2	780.01
21.8	780.28
22.8	780.61
24.0	780.95
25.2	781.19
26.4	781.30
28.5	782.14
30.5	782.80

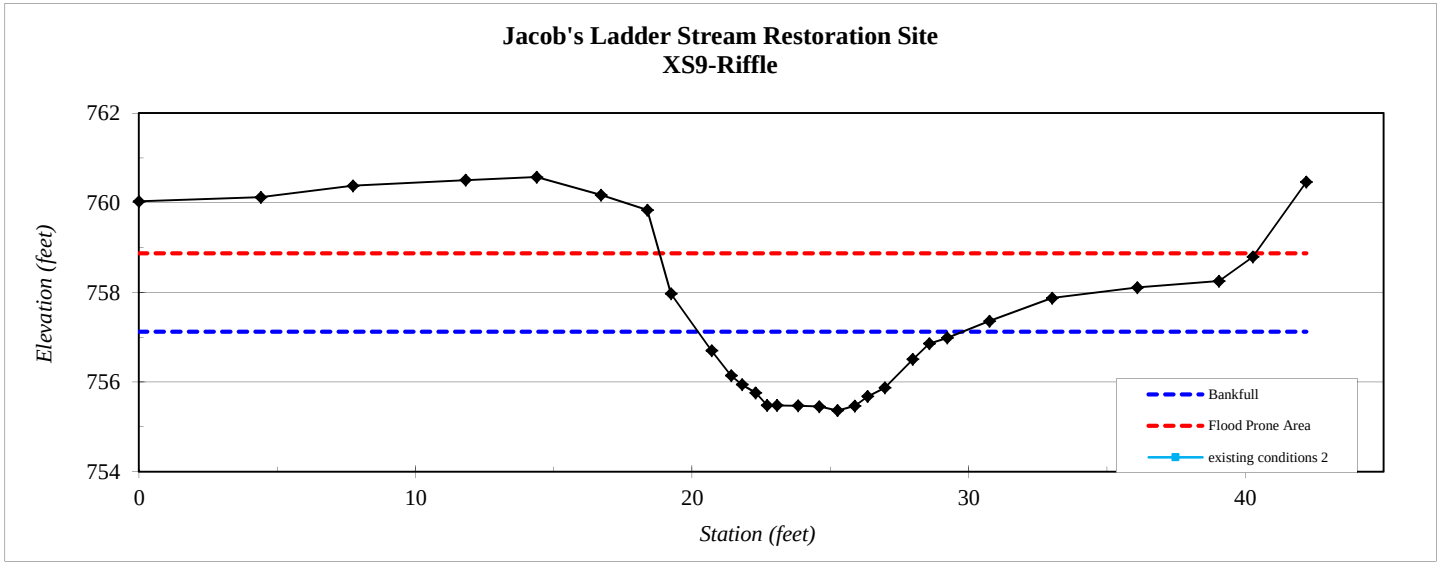
SUMMARY DATA	
Bankfull Elevation:	780.7
Bankfull Cross-Sectional Area:	4.5
Bankfull Width:	12.7
Flood Prone Area Elevation:	781.6
Flood Prone Width:	>30
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.4
W / D Ratio:	35.8
Entrenchment Ratio:	2.4
Bank Height Ratio:	0.7



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T1-2
XS ID	XS-9-Riffle
Drainage Area (sq mi):	0.36
Date:	2/10/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	760.03
4.4	760.12
7.7	760.38
11.8	760.50
14.4	760.57
16.7	760.17
18.4	759.84
19.2	757.97
20.7	756.70
21.4	756.14
21.8	755.94
22.3	755.76
22.7	755.48
23.1	755.48
23.8	755.47
24.6	755.45
25.3	755.37
25.9	755.47
26.4	755.68
27.0	755.87
28.0	756.51
28.6	756.86
29.2	756.99
30.8	757.36
33.0	757.87
36.1	758.11
39.1	758.25
40.3	758.79
42.2	760.46

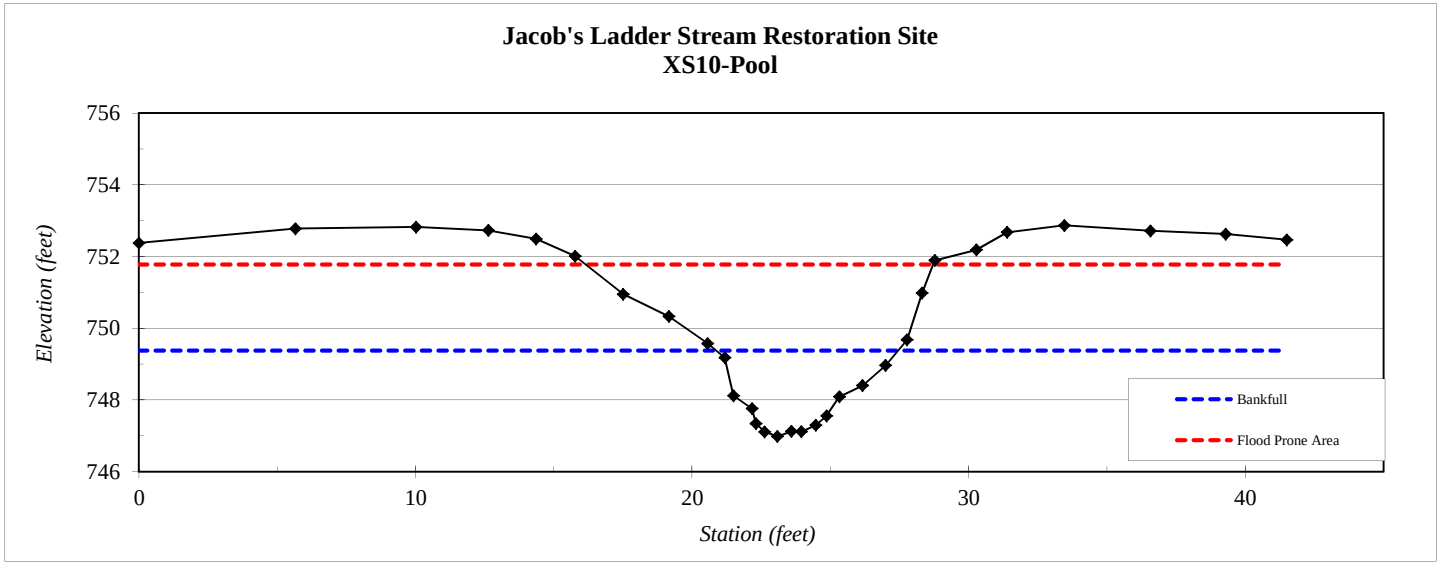
SUMMARY DATA	
Bankfull Elevation:	757.1
Bankfull Cross-Sectional Area:	10.5
Bankfull Width:	9.6
Flood Prone Area Elevation:	758.9
Flood Prone Width:	16
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	8.8
Entrenchment Ratio:	1.7
Bank Height Ratio:	2.9



River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, Existing Conditions, T1-2
XS ID	XS10-Pool
Drainage Area (sq mi):	0.36
Date:	2/10/2012
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	752.38
5.7	752.78
10.0	752.83
12.6	752.73
14.4	752.49
15.8	752.01
17.5	750.95
19.2	750.33
20.6	749.58
21.2	749.18
21.5	748.12
22.2	747.76
22.3	747.34
22.6	747.11
23.1	746.98
23.6	747.12
24.0	747.12
24.5	747.30
24.9	747.55
25.3	748.09
26.2	748.40
27.0	748.96
27.8	749.68
28.3	750.98
28.8	751.89
30.3	752.18
31.4	752.68
33.5	752.87
36.6	752.72
39.3	752.63
41.5	752.47

SUMMARY DATA	
Bankfull Elevation:	749.4
Bankfull Cross-Sectional Area:	9.8
Bankfull Width:	6.7
Flood Prone Area Elevation:	751.8
Flood Prone Width:	15
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.5
W / D Ratio:	4.6
Entrenchment Ratio:	2.2
Bank Height Ratio:	2.3



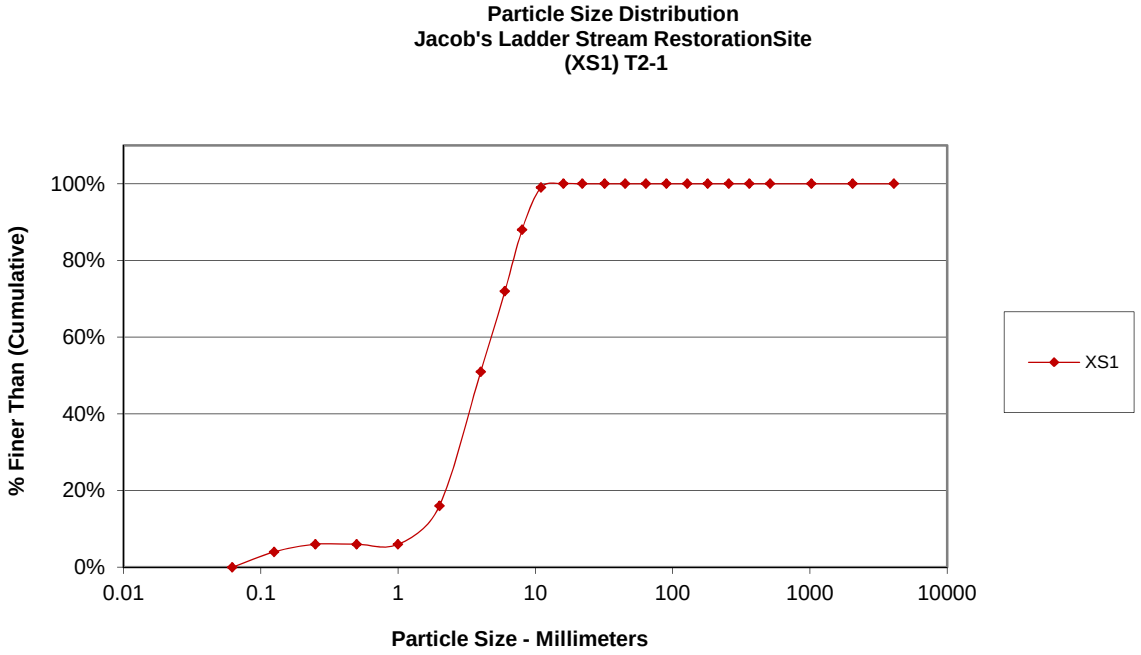
Existing Conditions

Sediment Data

Pebble Count Plots

Cross-Section 1			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	2
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		35
Fine	4 - 5.7	G	21
Fine	5.7 - 8	R	16
Medium	8 - 11.3	A	11
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



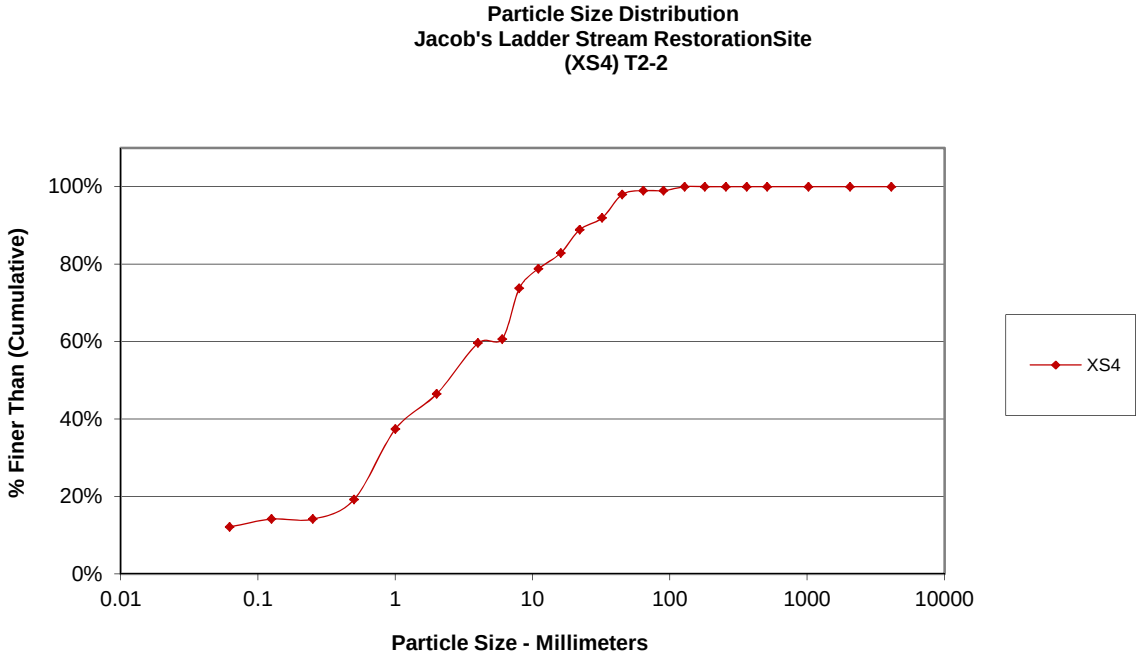
Size (mm)	
D16	2
D35	2.9
D50	3.9
D65	5.2
D84	7.4
D95	9.8

Size Distribution	
mean	3.8
dispersion	1.9
skewness	-0.01

Type	
silt/clay	0%
sand	16%
gravel	84%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	12
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	18
Very Coarse	1 - 2	S	9
Very Fine	2 - 4		13
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	13
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	4
Coarse	16 - 22.6	E	6
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		1
Small	64 - 90	C	
Small	90 - 128	O	1
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	99

Note:



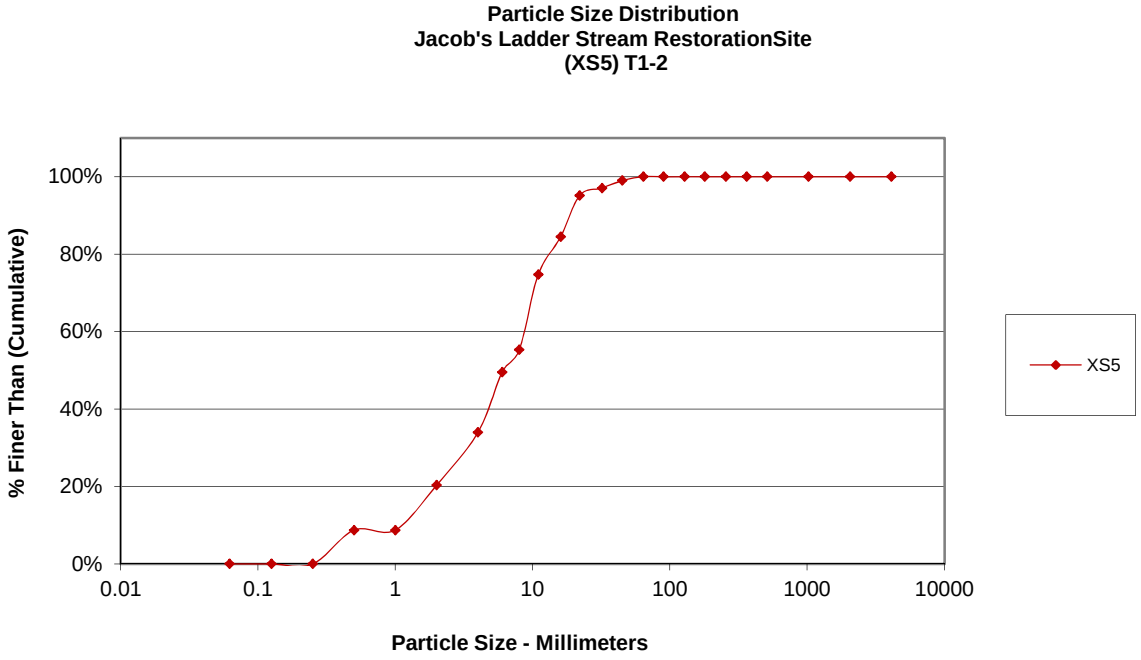
Size (mm)	
D16	0.32
D35	0.91
D50	2.4
D65	6.6
D84	17
D95	38

Size Distribution	
mean	2.3
dispersion	7.3
skewness	-0.01

Type	
silt/clay	12%
sand	34%
gravel	53%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	12
Very Fine	2 - 4		14
Fine	4 - 5.7	G	16
Fine	5.7 - 8	R	6
Medium	8 - 11.3	A	20
Medium	11.3 - 16	V	10
Coarse	16 - 22.6	E	11
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		1
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	103

Note:



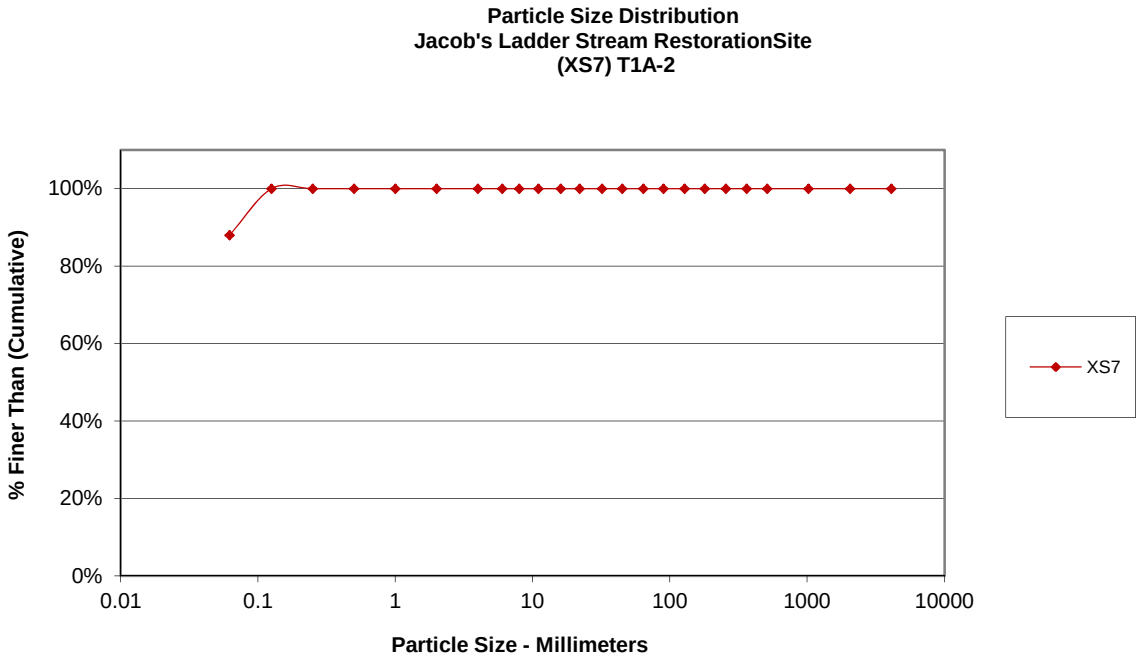
Size (mm)	
D16	1.5
D35	4.1
D50	6.1
D65	9.4
D84	16
D95	22

Size Distribution	
mean	4.9
dispersion	3.3
skewness	-0.09

Type	
silt/clay	0%
sand	20%
gravel	80%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	88
Very Fine	.062 - .125	S	12
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



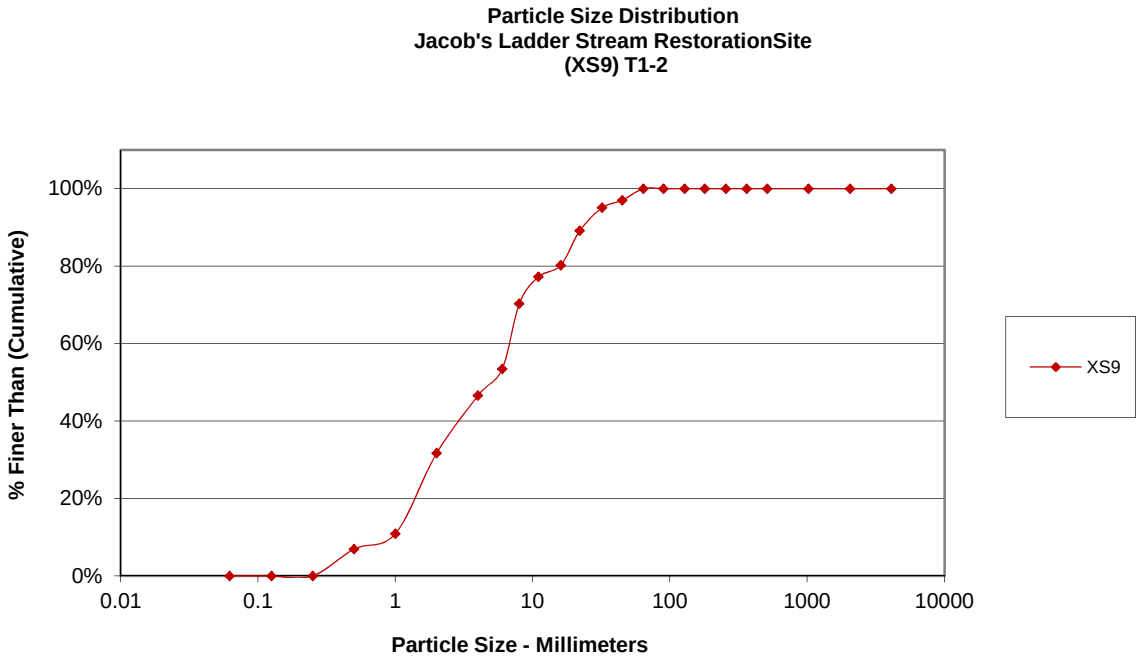
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.093

Size Distribution	
mean	0.1
dispersion	1.0
skewness	-

Type	
silt/clay	88%
sand	12%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	21
Very Fine	2 - 4		15
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	17
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		3
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



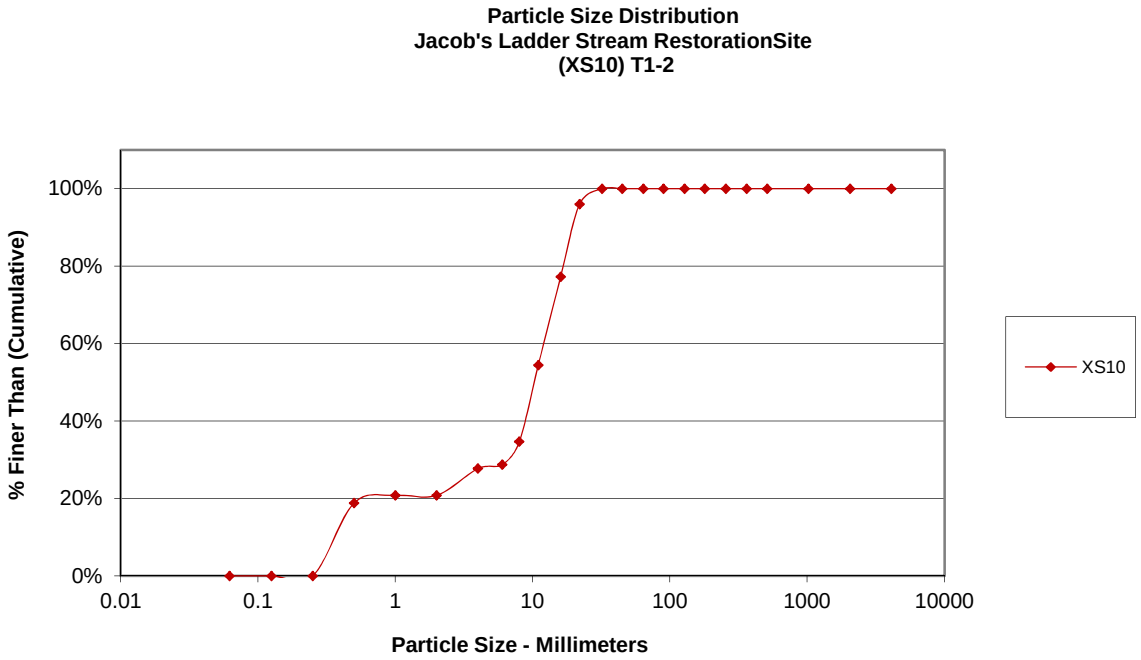
Size (mm)	
D16	1.2
D35	2.3
D50	4.9
D65	7.3
D84	18
D95	32

Size Distribution	
mean	4.6
dispersion	3.9
skewness	-0.02

Type	
silt/clay	0%
sand	32%
gravel	68%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 10			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	7
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	21
Very Fine	2 - 4		15
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	17
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		3
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



Size (mm)	
D16	0.45
D35	8
D50	10
D65	13
D84	18
D95	22

Size Distribution	
mean	2.8
dispersion	12.0
skewness	-0.43

Type	
silt/clay	0%
sand	21%
gravel	79%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis

Party: AF, AH

Location: Jacob's Ladder T1 | Date: 2-22-2012 | Notes: Bar sample 0-6 inches

SUB SAMPLES

Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)	Sieve Size (mm)
< 1.0	1.0	2.0	4.0	8.0	16.0	31.5	128.0	256.0	> 256.0		
Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)	Tare Weight (oz)		
30	31	43	45	47	48						
Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights	Sample Weights		
Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net
1	91.0	61.0	134.0	103.0	297.0	254.0	114.0	69.0	51.0	4.0										
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
Net Wt. Total	61.0		103.0		254.0		69.0		4.0		0.0		0.0		0.0		0.0		0.0	491.0
% Grand Tot.	12.4%		21.0%		51.7%		14.1%		0.8%		0.0%		0.0%		0.0%		0.0%		0.0%	
Accum. % =<	12.4%	→	33.4%	→	85.1%	→	99.2%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	

SURFACE MATERIALS DATA
(Two Largest Particles)

No.	Dia.	WT.
1	15mm	.5 oz
2	15mm	.5 oz

Bucket + Materials Weight_____

Bucket Tare Weight_____

Materials Weight_____
(Materials less than: _____mm.)

Be Sure to Add Separate Material Weights to Grand Total

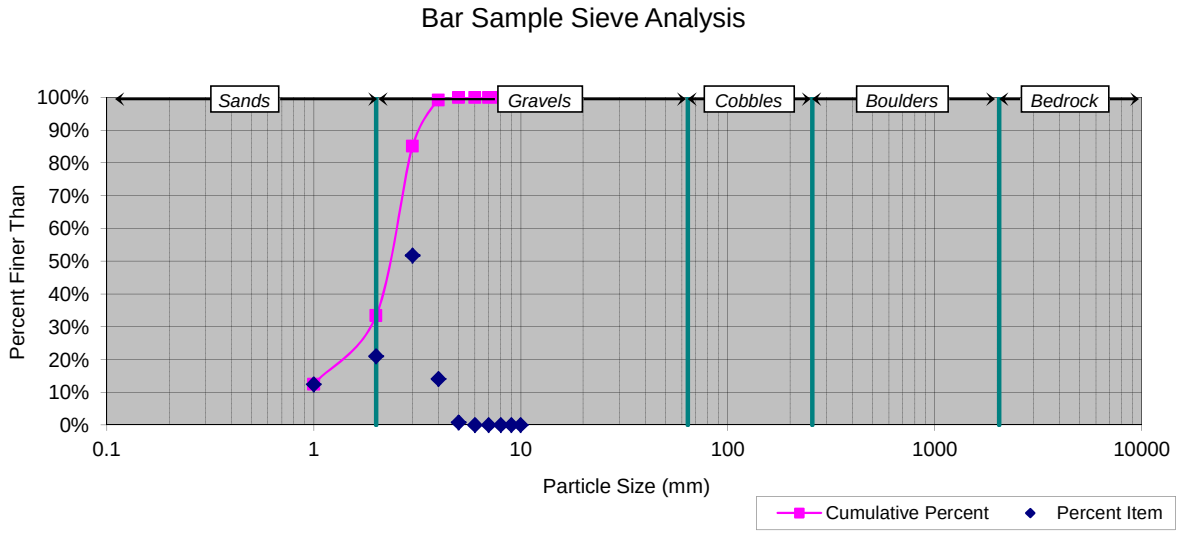
GRAND TOTAL SAMPLE WEIGHT

NOTES

Bar Sample Sieve Analysis

Smallest Sieve Passed (mm)	Weight (oz)	% Item	Percent Finer Than
<1	61	12.4%	12.4%
1.0	103.0	21.0%	33.4%
2.0	254.0	51.7%	85.1%
4.0	69.0	14.1%	99.2%
8.0	4.0	0.8%	100.0%
16.0	0.0	0.0%	100.0%
31.5	0.0	0.0%	100.0%
128.0	0.0	0.0%	100.0%
256.0	0.0	0.0%	100.0%
> 256.0	0.0	0.0%	100.0%
Total:	491.0	100%	

Stream:	Jacob's Ladder Stream Restoration Site T1
Watershed:	
Location:	
Note:	Bar Sample # 1 (0-6 inches)



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.0	1.0	1.2	2.0	3.3	0%	85%	15%	0%	---	---

SUB SAMPLES

Point / Side BAR-BULK MATERIALS SAMPLE DATA: Size Distribution Analysis

Party: AF, AH

Location: Jacob's Ladder T2

Date: 2-22-2012

Notes: Bar sample 0-6 inches

	Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)		Sieve Size (mm)	
	< 1.0		1.0		2.0		4.0		8.0		16.0		31.5		128.0		256.0		> 256.0	
	Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)		Tare Weight (oz)	
	30		31		43		45		47		48									
	Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights		Sample Weights	
	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net	Total	Net
1	152.0	122.0	92.0	61.0	88.0	45.0	71.0	26.0	62.0	15.0										
2			89.0	58.0	89.0	46.0	61.0	16.0												
3			108.0	77.0	98.0	55.0	76.0	31.0												
4			80.0	49.0	78.0	35.0														
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
Net Wt. Total	122.0			245.0		181.0		73.0		15.0		0.0		0.0		0.0		0.0		0.0	636.0
% Grand Tot.	19.2%			38.5%		28.5%		11.5%		2.4%		0.0%		0.0%		0.0%		0.0%		0.0%	
Accum. % =<	19.2%	→		57.7%	→	86.2%	→	97.6%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	→	100.0%	

SURFACE MATERIALS DATA
(Two Largest Particles)

No.	Dia.	WT.
1	23mm	1oz
2	22mm	1oz

Bucket
+ Materials
Weight_____

Bucket
Tare
Weight_____

Materials
Weight_____
(Materials less than:
_____mm.)

Be Sure to Add Separate Material Weights to Grand Total

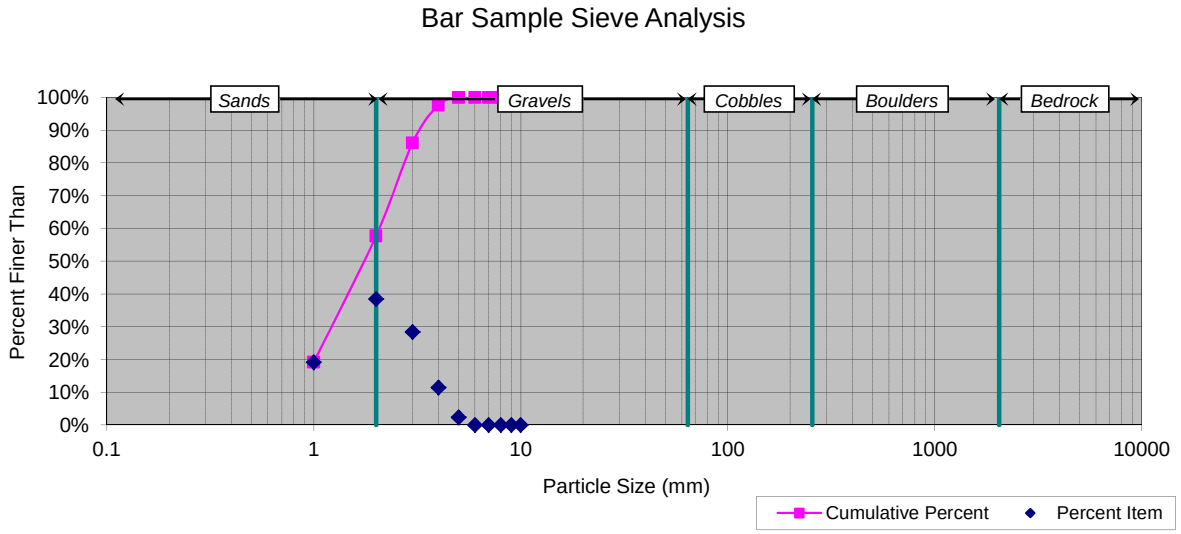
GRAND TOTAL SAMPLE WEIGHT

NOTES

Bar Sample Sieve Analysis

Smallest Sieve Passed (mm)	Weight (oz)	% Item	Percent Finer Than
<1	122	19.2%	19.2%
1.0	245.0	38.5%	57.7%
2.0	181.0	28.5%	86.2%
4.0	73.0	11.5%	97.6%
8.0	15.0	2.4%	100.0%
16.0	0.0	0.0%	100.0%
31.5	0.0	0.0%	100.0%
128.0	0.0	0.0%	100.0%
256.0	0.0	0.0%	100.0%
> 256.0	0.0	0.0%	100.0%
Total:	636.0	100%	

Stream:	Jacob's Ladder Stream Restoration Site T2
Watershed:	
Location:	
Note:	Bar Sample # 1 (0-6 inches)



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.9	1.9	1.9	1.9	3.4	0%	86%	14%	0%	---	---

BEHI

Ecosystem Enhancement PROGRAM

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS

JACOBS LADDER
STREAM MITIGATION PROJECT
[redacted]

DATE: APRIL 2012
SCALE: 1"=160'

BEHI
FIGURE [redacted]

SHEET 1 OF 2

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS

JACOBS LADDER
STREAM MITIGATION PROJECT
[redacted]

DATE: APRIL 2012
SCALE: 1"=160'

BEHI
FIGURE[redacted]

SHEET 2 OF 2

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-1) **Reach:** 140 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 85.0**	**I: 1.7**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 40.0**	**I: 2.9**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.2**	**I: 4.0**	**V: 0.50**	**I: 3.9**	**V: 45.0**	**I: 4.7**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index **SUB-TOTAL (Sum one index from each column)** 17.2

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-1 at representative bank features throughout.

GRAND TOTAL 29.2

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-1) **Reach:** 210 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential	Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
	VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
		Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
		Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
	LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
		Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
		Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 45.0**	**I: 3.2**	**V: 70.0**	**I: 2.7**
	MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
		Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
		Choice	**V:**	**I:**	**V: 0.37**	**I: 5.2**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
	HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
		Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
		Choice	**V: 1.6**	**I: 6.0**	**V:**	**I:**	**V: 29.0**	**I: 6.0**	**V:**	**I:**	**V:**	**I:**
	VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
		Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
		Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
	EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
		Index Range	10		10		10		10		10	
		Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
	V = value, I = index								**SUB-TOTAL (Sum one index from each column)**		**23.1**	

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-1 at representative bank features throughout.

GRAND TOTAL 35.1

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-1) **Reach:** 160 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 3.4**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 2.0**	**I: 7.9**	**V: 0.25**	**I: 6.5**	**V: 15.0**	**I: 7.9**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 28.9

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-1 at representative bank features throughout.

GRAND TOTAL 40.9

BEHI RATING Very High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-2) **Reach:** 365 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 95.0**	**I: 1.2**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 40.0**	**I: 2.9**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.3**	**I: 4.6**	**V: 0.41**	**I: 4.0**	**V: 45.0**	**I: 4.7**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 17.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 7

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-2 at representative bank features throughout.

GRAND TOTAL 29.4

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-2) **Reach:** 145 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 80.0**	**I: 1.9**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 45.0**	**I: 3.2**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V: 0.40**	**I: 4.9**	**V: 32.0**	**I: 5.7**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 1.6**	**I: 6.0**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 21.7

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 7

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-2 at representative bank features throughout.

GRAND TOTAL 33.7

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1-2) **Reach:** 305 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 3.4**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V: 0.20**	**I: 7.2**	**V: 15.0**	**I: 7.9**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V: 2.6**	**I: 8.7**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 30.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 7

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1-2 at representative bank features throughout.

GRAND TOTAL 42.4

BEHI RATING Very High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-1) **Reach:** 75 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 80.0**	**I: 1.9**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V: 0.70**	**I: 2.9**	**V: 56.0**	**I: 3.8**	**V: 45.0**	**I: 3.2**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.4**	**I: 5.3**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 17.1

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1A-1 at representative bank features throughout.

GRAND TOTAL 27.1

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-1) **Reach:** 95 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 70.0**	**I: 2.4**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V: 0.71**	**I: 2.9**	**V:**	**I:**	**V: 45.0**	**I: 3.2**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.5**	**I: 5.9**	**V:**	**I:**	**V: 42.0**	**I: 5.0**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 19.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1A-1 at representative bank features throughout.

GRAND TOTAL 31.4

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-1) **Reach:** 80 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 3.4**	**V: 60.0**	**I: 3.5**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V: 0.35**	**I: 5.4**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V: 21.0**	**I: 7.1**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V: 2.8**	**I: 9.0**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 28.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1A-1 at representative bank features throughout.

GRAND TOTAL 40.4

BEHI RATING Very High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-2) **Reach:** 45 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 80.0**	**I: 1.9**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V: 0.85**	**I: 2.2**	**V: 63.0**	**I: 3.3**	**V: 45.0**	**I: 3.2**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.5**	**I: 5.9**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 2.0**	**I: 7.9**	**V: 0.25**	**I: 6.5**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 16.5

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at one location on T1A-2 at a representative bank feature.

GRAND TOTAL 26.5

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-3) **Reach:** 40 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 80.0**	**I: 1.9**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 45.0**	**I: 3.2**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.3**	**I: 4.6**	**V: 0.50**	**I: 3.9**	**V: 40.0**	**I: 5.1**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 18.7

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several ocations on T1A-3 at representative bank features throughout.

GRAND TOTAL 28.7

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-3) **Reach:** 35 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 45.0**	**I: 3.2**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V: 0.50**	**I: 3.9**	**V: 35.0**	**I: 5.5**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 2.0**	**I: 7.9**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 23.7

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 5

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1A-3 at representative bank features throughout.

GRAND TOTAL 33.7

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T1A-3) **Reach:** 200 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 65.0**	**I: 2.8**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V: 0.30**	**I: 5.9**	**V:**	**I:**	**V: 65.0**	**I: 4.4**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V: 19.5**	**I: 7.3**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V: 7.1**	**I: 10.0**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 30.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 7

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 8

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T1A-3 at representative bank features throughout.

GRAND TOTAL 45.4

BEHI RATING Very High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-1) **Reach:** 125 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 90.0**	**I: 1.5**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 40.0**	**I: 2.9**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.2**	**I: 4.0**	**V: 0.50**	**I: 4.0**	**V: 40.0**	**I: 5.1**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 17.5

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-1 at representative bank features throughout.

GRAND TOTAL 29.5

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-1) **Reach:** 138 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 80.0**	**I: 1.9**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 40.0**	**I: 2.9**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 1.6**	**I: 6.0**	**V: 0.20**	**I: 7.2**	**V: 18.7**	**I: 7.4**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 25.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-1 at representative bank features throughout.

GRAND TOTAL 37.4

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-1) **Reach:** 85 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 3.4**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 1.8**	**I: 7.0**	**V: 0.22**	**I: 7.0**	**V: 15.4**	**I: 7.8**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index **SUB-TOTAL (Sum one index from each column)** 28.4

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-1 at representative bank features throughout.

GRAND TOTAL 40.4

BEHI RATING Very High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-2) **Reach:** 225 Linear Feet **Date:** 2/21/12 **Crew:** AH

Moderate Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 90.0**	**I: 1.5**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 40.0**	**I: 2.9**	**V:**	**I:**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V: 1.3**	**I: 4.6**	**V: 0.50**	**I: 3.9**	**V: 43.0**	**I: 4.9**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 17.8

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-2 at representative bank features throughout.

GRAND TOTAL 29.8

BEHI RATING Moderate

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-2) **Reach:** 260 Linear Feet **Date:** 2/21/12 **Crew:** AH

High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 60.0**	**I: 3.9**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V: 0.46**	**I: 4.3**	**V: 32.2**	**I: 5.7**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 1.8**	**I: 7.0**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 24.1

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-2 at representative bank features throughout.

GRAND TOTAL 36.1

BEHI RATING High

Bank Erodibility Hazard Rating Guide

Stream: Jacob's Ladder (T2-2) **Reach:** 425 Linear Feet **Date:** 2/21/12 **Crew:** AH

Very High Rating

Bank Erosion Potential

Bank Height (ft): / Bankfull Height (ft):		Bank Height/ Bankfull Ht		Root Depth/ Bank Height		Root Density %		Bank Angle (Degrees)		Surface Protection%	
VERY LOW	Value Range	1.0	1.1	1.0	0.9	100	80	0.0	20.0	100	80
	Index Range	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9	1.0	1.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
LOW	Value Range	1.11	1.19	0.9	0.50	79	55	21.0	60.0	79	55
	Index Range	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9	2.0	3.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V: 50.0**	**I: 3.4**	**V: 70.0**	**I: 3.2**
MODERATE	Value Range	1.2	1.5	0.5	0.30	54	30	61.0	80.0	54	30
	Index Range	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9	4.0	5.9
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
HIGH	Value Range	1.6	2.0	0.29	0.15	29	15	81.0	90.0	29	15
	Index Range	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9	6.0	7.9
	Choice	**V: 2.0**	**I: 7.9**	**V: 0.20**	**I: 7.2**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**
VERY HIGH	Value Range	2.1	2.8	0.14	0.05	14	5	91.0	119.0	14	10
	Index Range	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0	8.0	9.0
	Choice	**V:**	**I:**	**V:**	**I:**	**V: 14.0**	**I: 8.0**	**V:**	**I:**	**V:**	**I:**
EXTREME	Value Range	>2.8		<0.05		<5		>119		<10	
	Index Range	10		10		10		10		10	
	Choice	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**	**V:**	**I:**

V = value, I = index

SUB-TOTAL (Sum one index from each column) 29.7

Bank Material Description:

Mostly smaller gravel mixed with sand

Bank Materials

Bedrock (Bedrock banks have very low bank erosion potential)

Boulders (Banks composed of boulders have low bank erosion potential)

Cobble (Subtract 10 points. If sand/gravel matrix greater than 50% of bank material, then do not adjust)

Gravel (Add 5-10 points depending percentage of bank material that is composed of sand)

Sand (Add 10 points)

Silt Clay (+ 0: no adjustment)

Bank Sketch

BANK MATERIAL ADJUSTMENT 5

Stratification Comments:

Few stratified layers were observed

Stratification

Add 5-10 points depending on position of unstable layers in relation to bankfull stage

STRATIFICATION ADJUSTMENT 7

VERY LOW	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
5-9.9	10-19.9	20-29.9	30-39.9	40-45.9	46-50

Bank location description (check one)

The BEHI was conducted at several locations on T2-2 at representative bank features throughout.

GRAND TOTAL 41.7

BEHI RATING Very High

NCDWQ Stream Forms

NC DWQ Stream Identification Form Version 4.11

Date: February 10, 2012	**Project/Site:** Ladder (T1-1)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 31	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 18.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

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

B. Hydrology (Subtotal = 5.5)				
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: February 10, 2012	**Project/Site:** Ladder(T1-2)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 31.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

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

C. Biology (Subtotal = 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: February 10, 2012	**Project/Site:** Ladder (T1A-1)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 36.5	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** Enochville *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 = 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: February 10, 2012	**Project/Site:** Ladder (T1A-2)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19)	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 = 4.5)				
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: February 10, 2012	**Project/Site:** Ladder (T1A-3)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 19)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	0	1	2	(3)
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes (= 3)	

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

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

C. Biology (Subtotal = 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: February 10, 2012	**Project/Site:** Ladder (T2-1)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 35.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 23)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	2	(3)
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	2	(3)
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = (3)	

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

B. Hydrology (Subtotal = 5.5)				
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 = 37)				
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: February 10, 2012	**Project/Site:** Ladder (T2-2)	**Latitude:**
Evaluator: AH	**County:** Rowan	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** Enochville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 21.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	1	(2)	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	(2)	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	1	2	(3)
6. Depositional bars or benches	0	1	(2)	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	1	(1.5)
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 5.5)				
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:

Reference Reach Data

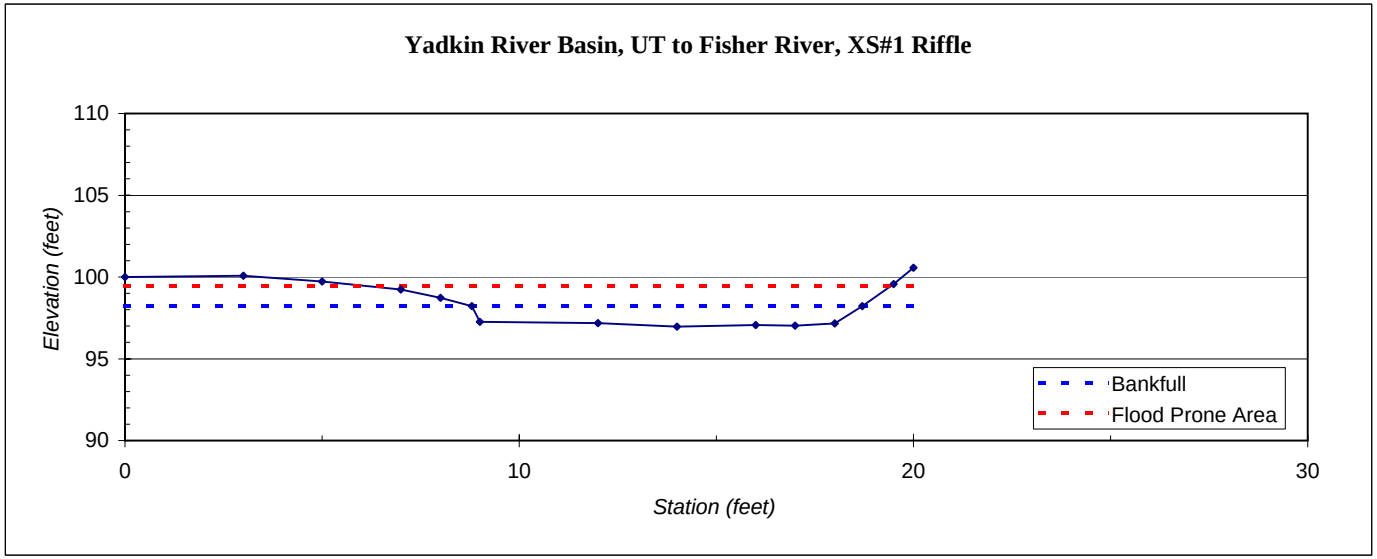
UT to Fisher River Reference Site

River Basin:	Yadkin
Watershed:	UT to Fisher River
XS ID	XS#1 Riffle
Drainage Area (sq mi):	0.38
Date:	6/9/2005
Field Crew:	G. Mryncza, A. Spiller

Station	Rod Ht.	Elevation
0.0	2.22	100.00
3.0	2.15	100.07
5.0	2.50	99.72
7.0	2.98	99.24
8.0	3.49	98.73
8.8	4.00	98.22
9.0	4.96	97.26
12.0	5.03	97.19
14.0	5.25	96.97
16.0	5.16	97.06
17.0	5.20	97.02
18.0	5.06	97.16
18.7	4.00	98.22
19.5	2.65	99.57
20.0	1.66	100.56

SUMMARY DATA	
Bankfull Elevation:	98.22
Bankfull Cross-Sectional Area:	10.40
Bankfull Width:	10.00
Flood Prone Area Elevation:	99.47
Flood Prone Width:	13.10
Max Depth at Bankfull:	1.25
Mean Depth at Bankfull:	1.04
W / D Ratio:	9.6
Entrenchment Ratio:	1.30
Bank Height Ratio:	2.08
Slope (ft/ft):	0.013
Discharge (cfs)	42

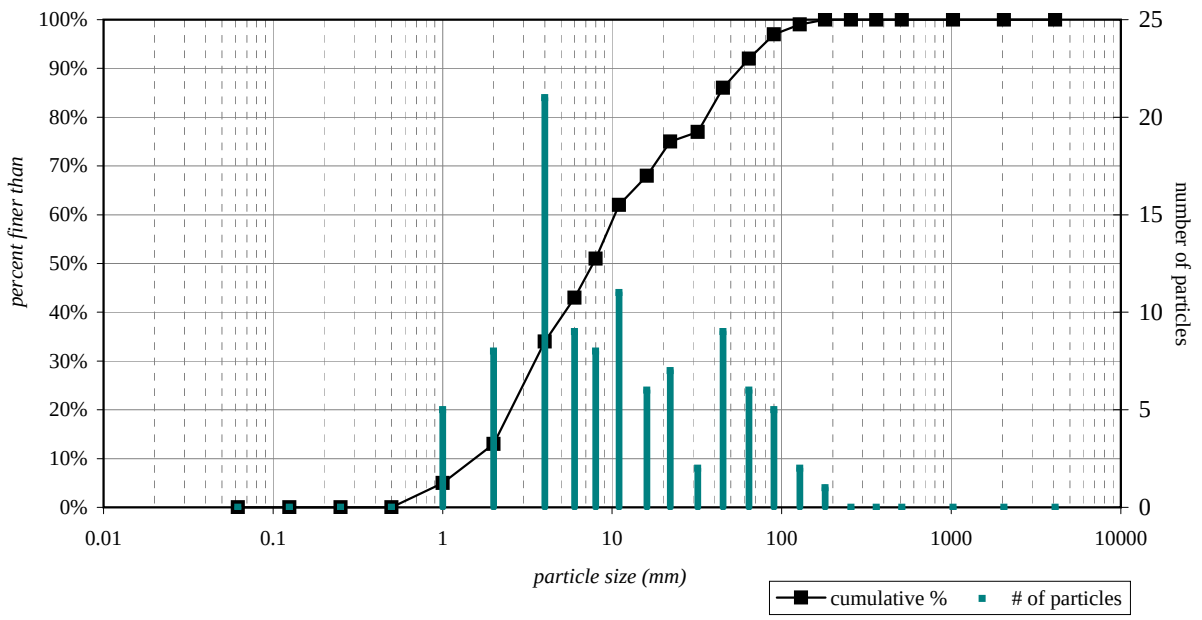
Stream Type:	B4c



Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**0**
very fine sand	0.062	0.13	**0**
fine sand	0.13	0.25	**0**
medium sand	0.25	0.5	**0**
coarse sand	0.5	1	**5**
very coarse sand	1	2	**8**
very fine gravel	2	4	**21**
fine gravel	4	6	**9**
fine gravel	6	8	**8**
medium gravel	8	11	**11**
medium gravel	11	16	**6**
coarse gravel	16	22	**7**
coarse gravel	22	32	**2**
very coarse gravel	32	45	**9**
very coarse gravel	45	64	**6**
small cobble	64	90	**5**
medium cobble	90	128	**2**
large cobble	128	180	**1**
very large cobble	180	256	**0**
small boulder	256	362	**0**
small boulder	362	512	**0**
medium boulder	512	1024	**0**
large boulder	1024	2048	**0**
very large boulder	2048	4096	**0**
		total particle count:	100

	UT to Fsher River
	Surry County, NC
	Riffle #1 (Sta. 01+00)
Note:	



bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	2.208	4.18	7.7	13	42	79	4.5	9.6	4.3

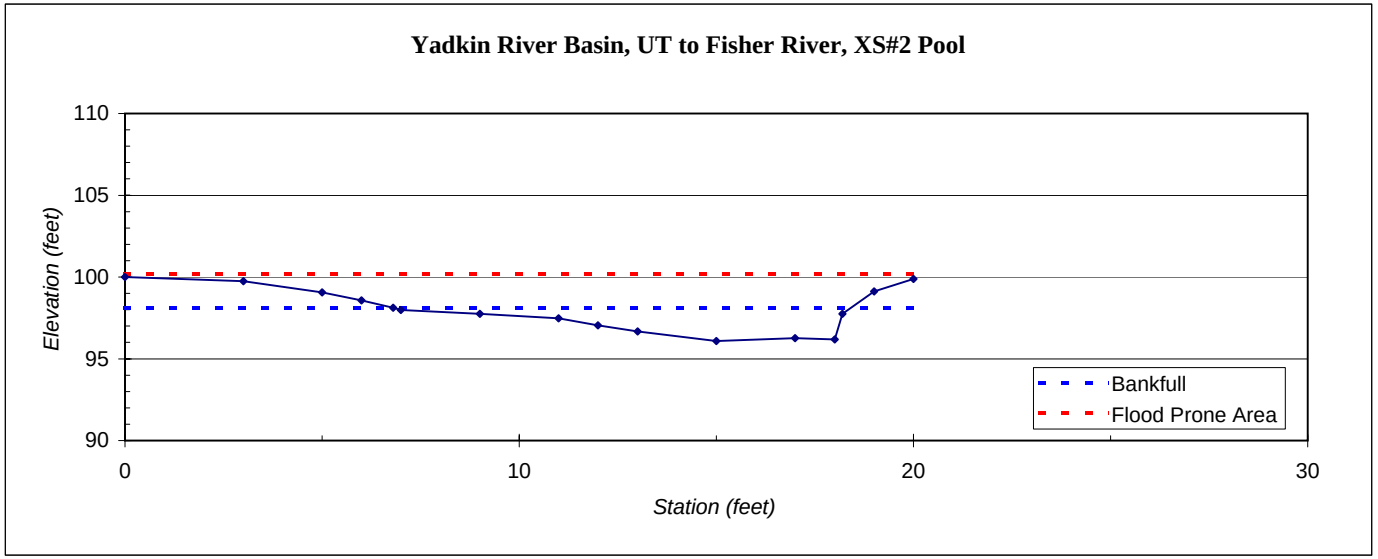
based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	13%	79%	8%	0%	0%	0%	0%	0%

River Basin:	Yadkin
Watershed:	UT to Fisher River
XS ID	XS#2 Pool
Drainage Area (sq mi):	0.38
Date:	6/9/2005
Field Crew:	G. Mryncza, A. Spiller

Station	Rod Ht.	Elevation
0.0	2.68	100.00
3.0	2.94	99.74
5.0	3.61	99.07
6.0	4.10	98.58
6.8	4.56	98.12
7.0	4.70	97.98
9.0	4.94	97.74
11.0	5.21	97.47
12.0	5.64	97.04
13.0	6.00	96.68
15.0	6.59	96.09
17.0	6.42	96.26
18.0	6.50	96.18
18.2	4.93	97.75
19.0	3.56	99.12
20.0	2.80	99.88

SUMMARY DATA	
Bankfull Elevation:	98.12
Bankfull Cross-Sectional Area:	13.40
Bankfull Width:	11.62
Flood Prone Area Elevation:	100.15
Flood Prone Width:	
Max Depth at Bankfull:	2.03
Mean Depth at Bankfull:	1.15
W / D Ratio:	10.1
Entrenchment Ratio:	
Bank Height Ratio:	0.81
Slope (ft/ft):	0.001
Discharge (cfs)	56

Stream Type:	B4c

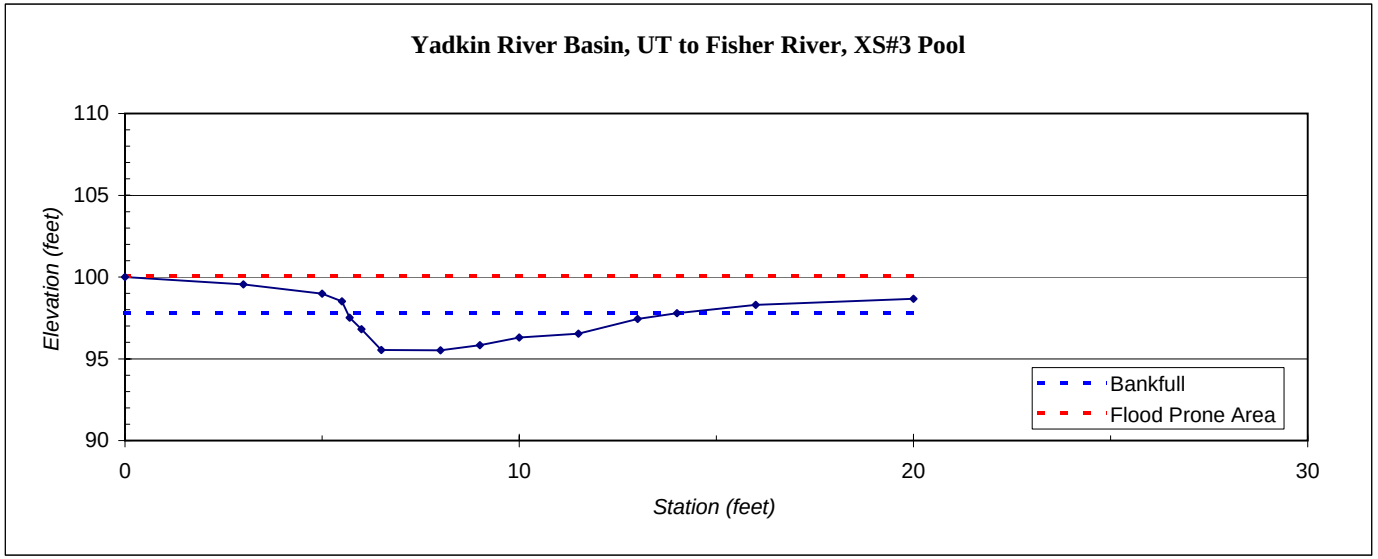


River Basin:	Yadkin
Watershed:	UT to Fisher River
XS ID	XS#3 Pool
Drainage Area (sq mi):	0.38
Date:	6/9/2005
Field Crew:	G. Mryncza, A. Spiller

Station	Rod Ht.	Elevation
0.0	1.33	100.00
3.0	1.78	99.55
5.0	2.35	98.98
5.5	2.82	98.51
5.7	3.81	97.52
6.0	4.52	96.81
6.5	5.79	95.54
8.0	5.82	95.51
9.0	5.50	95.83
10.0	5.02	96.31
11.5	4.80	96.53
13.0	3.90	97.43
14.0	3.55	97.78
16.0	3.03	98.30
20.0	2.66	98.67

SUMMARY DATA	
Bankfull Elevation:	97.78
Bankfull Cross-Sectional Area:	11.60
Bankfull Width:	8.35
Flood Prone Area Elevation:	100.05
Flood Prone Width:	
Max Depth at Bankfull:	2.27
Mean Depth at Bankfull:	1.39
W / D Ratio:	6.0
Entrenchment Ratio:	
Bank Height Ratio:	0.85
Slope (ft/ft):	0.001
Discharge (cfs)	52

Stream Type:	B4c

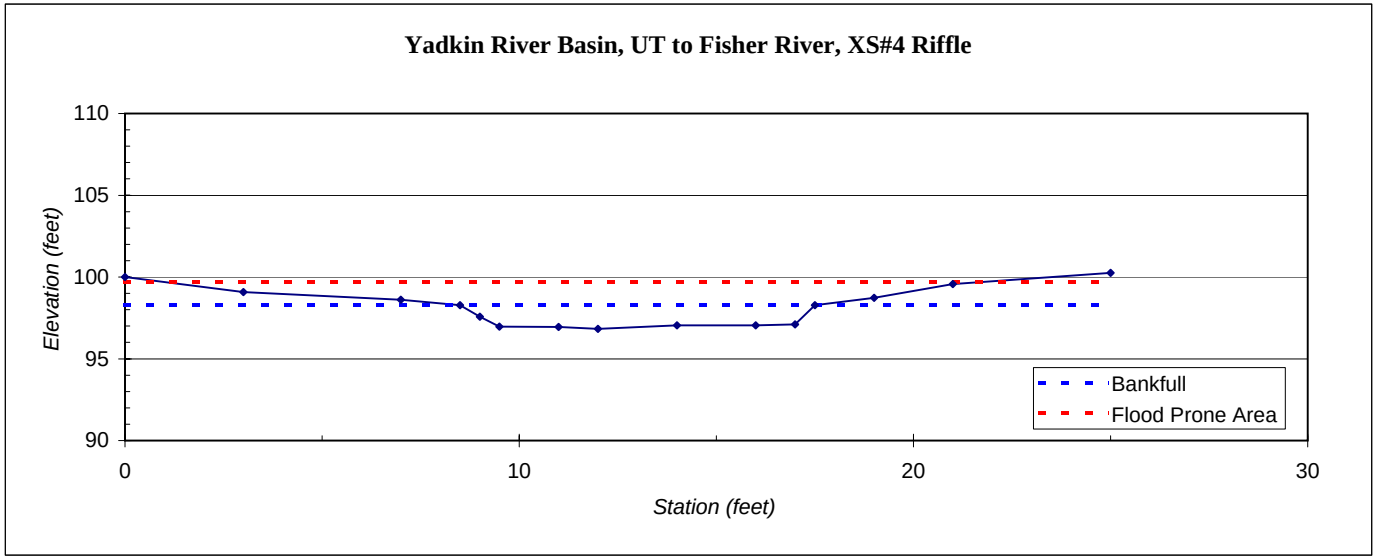


River Basin:	Yadkin
Watershed:	UT to Fisher River
XS ID	XS#4 Riffle
Drainage Area (sq mi):	0.38
Date:	6/9/2005
Field Crew:	G. Mryncza, A. Spiller

Station	Rod Ht.	Elevation
0.0	4.62	100.00
3.0	5.54	99.08
7.0	6.01	98.61
8.5	6.34	98.28
9.0	7.04	97.58
9.5	7.66	96.96
11.0	7.67	96.95
12.0	7.79	96.83
14.0	7.58	97.04
16.0	7.57	97.05
17.0	7.51	97.11
17.5	6.34	98.28
19.0	5.90	98.72
21.0	5.06	99.56
25.0	4.37	100.25

SUMMARY DATA	
Bankfull Elevation:	98.28
Bankfull Cross-Sectional Area:	10.70
Bankfull Width:	9.00
Flood Prone Area Elevation:	99.73
Flood Prone Width:	20.50
Max Depth at Bankfull:	1.45
Mean Depth at Bankfull:	1.19
W / D Ratio:	7.6
Entrenchment Ratio:	2.30
Bank Height Ratio:	1.00
Slope (ft/ft):	0.013
Discharge (cfs)	46

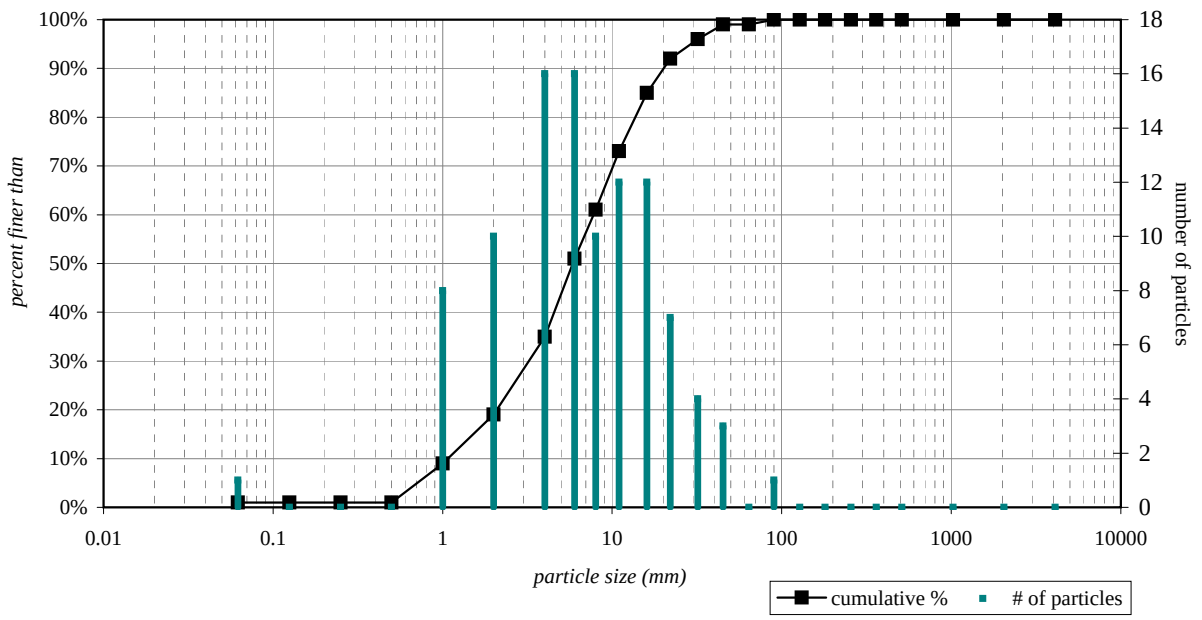
Stream Type:	B4c



Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**1**
very fine sand	0.062	0.13	**0**
fine sand	0.13	0.25	**0**
medium sand	0.25	0.5	**0**
coarse sand	0.5	1	**8**
very coarse sand	1	2	**10**
very fine gravel	2	4	**16**
fine gravel	4	6	**16**
fine gravel	6	8	**10**
medium gravel	8	11	**12**
medium gravel	11	16	**12**
coarse gravel	16	22	**7**
coarse gravel	22	32	**4**
very coarse gravel	32	45	**3**
very coarse gravel	45	64	**0**
small cobble	64	90	**1**
medium cobble	90	128	**0**
large cobble	128	180	**0**
very large cobble	180	256	**0**
small boulder	256	362	**0**
small boulder	362	512	**0**
medium boulder	512	1024	**0**
large boulder	1024	2048	**0**
very large boulder	2048	4096	**0**
	total particle count:		100

UT to Fsher River
Surry County, NC
Riffle #2 (Sta. 02+55)
Note:



bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:	100	

based on sediment particles only	size percent less than (mm) D16	D35	D50	D65	D84	D95	particle size distribution gradation	geo mean	std dev
	1.625	4.00	5.8	9	16	29	3.1	5.0	3.1

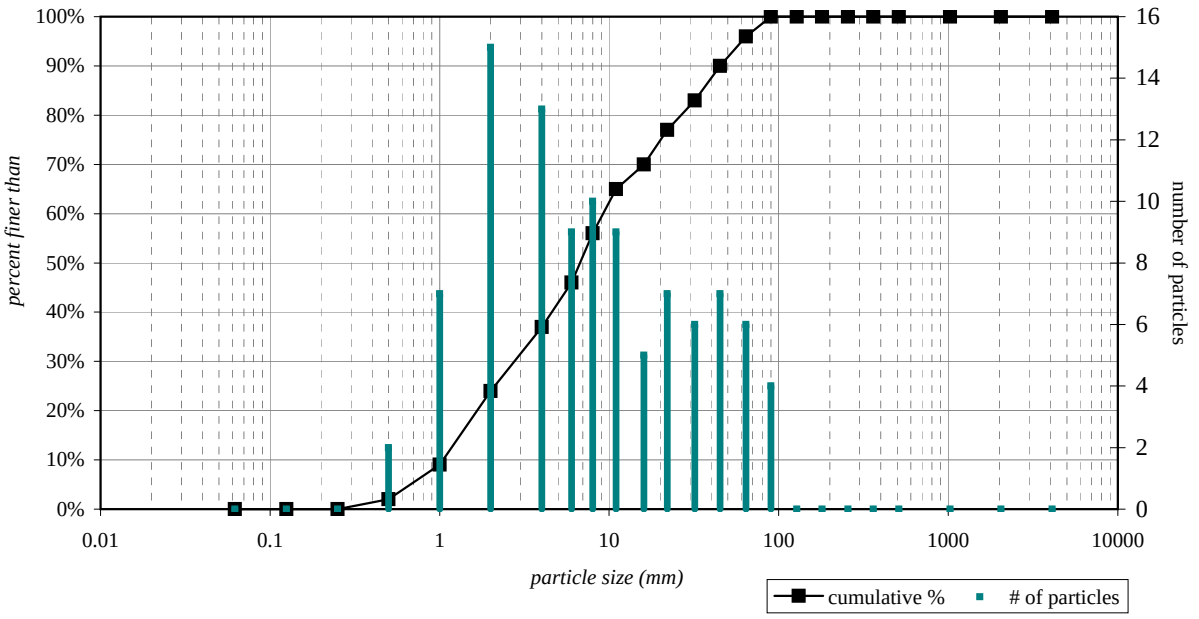
based on total count	percent by substrate type silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	1%	18%	80%	1%	0%	0%	0%	0%	0%

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**0**
very fine sand	0.062	0.13	**0**
fine sand	0.13	0.25	**0**
medium sand	0.25	0.5	**2**
coarse sand	0.5	1	**7**
very coarse sand	1	2	**15**
very fine gravel	2	4	**13**
fine gravel	4	6	**9**
fine gravel	6	8	**10**
medium gravel	8	11	**9**
medium gravel	11	16	**5**
coarse gravel	16	22	**7**
coarse gravel	22	32	**6**
very coarse gravel	32	45	**7**
very coarse gravel	45	64	**6**
small cobble	64	90	**4**
medium cobble	90	128	**0**
large cobble	128	180	**0**
very large cobble	180	256	**0**
small boulder	256	362	**0**
small boulder	362	512	**0**
medium boulder	512	1024	**0**
large boulder	1024	2048	**0**
very large boulder	2048	4096	**0**
	total particle count:		100

UT to Fsher River
Surry County, NC

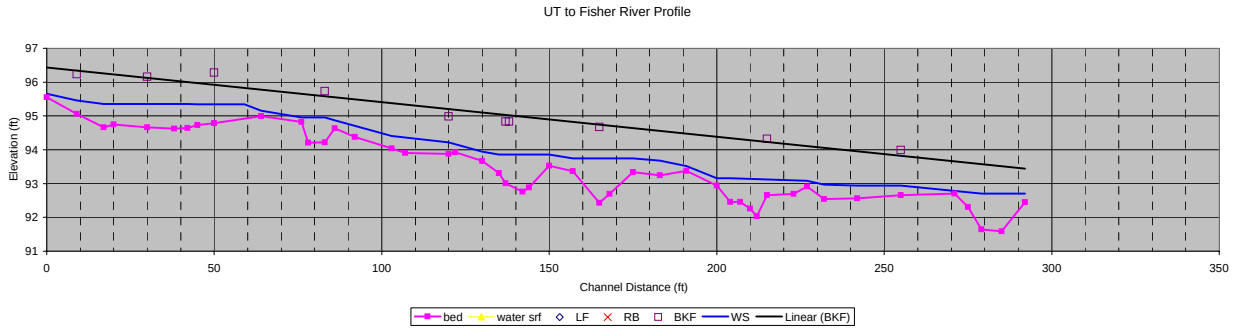
Note: **Reach Pebble Count**



bedrock		
clay hardpan		
detritus/wood		
artificial		
total count:	100	

based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.382	3.60	6.7	11	34	60	4.9	6.8	4.9

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	24%	72%	4%	0%	0%	0%	0%	0%



Elevation BM: 100

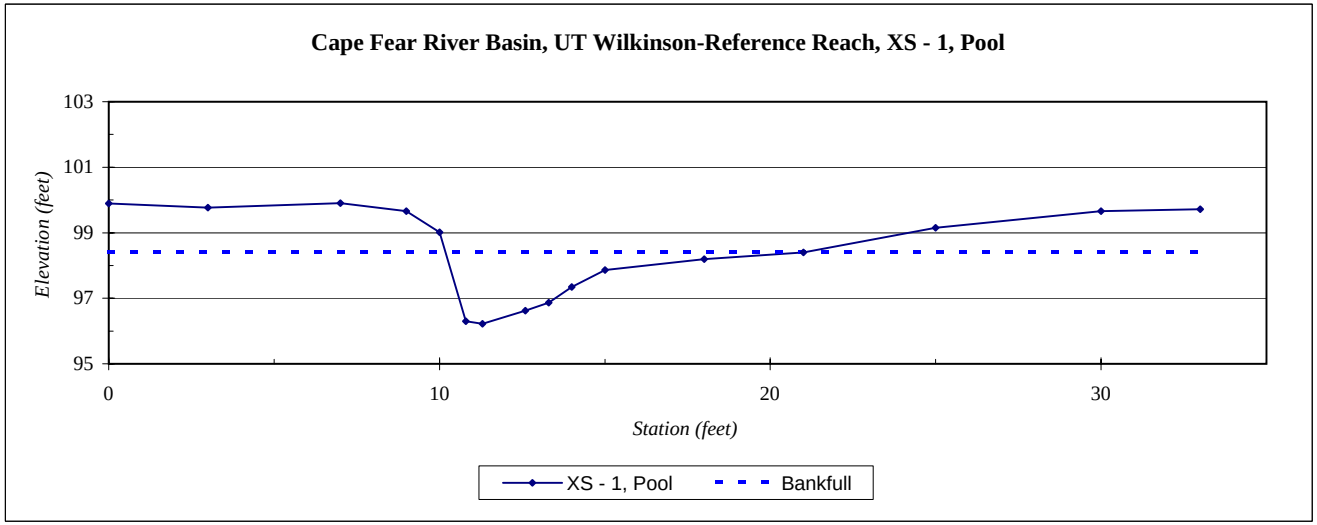
notes	inc distance	station	BS	HI	FS TP	FS bed	depth water	FS LB	FS RB	FS BKF	FS WS	AZ azimuth	ELEV bed	ELEV water srf	ELEV LF	ELEV RB	ELEV BKF	ELEV WS
		5		100		4.45					4.34		95.55					95.66
	9	14		100		4.94				3.77	4.54		95.06				96.23	95.46
	8	22		100		5.34					4.65		94.66					95.35
	3	25		100		5.25							94.75					
	10	35		100		5.34				3.84	4.65		94.66				96.16	95.35
	8	43		100		5.38							94.62					
	4	47		100		5.36					4.65		94.64					95.35
	3	50		100		5.27					4.66		94.73					95.34
	5	55		100		5.21				3.72			94.79				96.28	
	9	64		100							4.66							95.34
	5	69	-0.53	99.47		4.48					4.32		94.99					95.15
	12	81		99.47		4.65					4.51		94.82					94.96
	2	83		99.47		5.26							94.21					
	5	88		99.47		5.25				3.74	4.51		94.22				95.73	94.96
	3	91		99.47		4.84					4.6		94.63					94.87
	6	97		99.47		5.09							94.38					
	11	108		99.47		5.43					5.06		94.04					94.41
	4	112		99.47		5.56							93.91					
	13	125		99.47		5.59				4.49	5.25		93.88				94.98	94.22
	18	143		99.47						4.64							94.83	
	-16	127		99.47		5.55							93.92					
	8	135		99.47		5.8					5.53		93.67					93.94
	5	140		99.47		6.16					5.61		93.31					93.86
	2	142		99.47		6.46				4.64			93.01				94.83	
	5	147		99.47		6.71							92.76					
	2	149		99.47		6.59					5.61		92.88					93.86
	6	155		99.47		5.94					5.61		93.53					93.86
	7	162		99.47		6.1					5.73		93.37					93.74
	8	170		99.47		7.04				4.8	5.73		92.43				94.67	93.74
	3	173		99.47		6.78							92.69					
	7	180		99.47		6.13					5.73		93.34					93.74
	8	188	-1.56	97.91		4.67					4.23		93.24					93.68
	8	196		97.91		4.53					4.39		93.38					93.52
	9	205		97.91		4.97					4.75		92.94					93.16
	4	209		97.91		5.45					4.75		92.46					93.16
	3	212		97.91		5.45							92.46					
	3	215		97.91		5.65							92.26					
	2	217		97.91		5.88							92.03					
	3	220		97.91		5.25				3.59			92.66				94.32	
	8	228		97.91		5.22							92.69					
	4	232		97.91		5					4.83		92.91					93.08
	5	237		97.91		5.37					4.94		92.54					92.97
	10	247		97.91		5.35					4.97		92.56					92.94
	13	260	2.46	100.37		7.71				6.38	7.43		92.66				93.99	92.94
	16	276		100.37		7.67							92.7					
	4	280		100.37		8.06							92.31					
	4	284		100.37		8.73					7.67		91.64					92.7
	6	290		100.37		8.78					7.67		91.59					92.7
	7	297		100.37		7.92					7.67		92.45					92.7

UT to Wilkinson Creek Reference Site

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

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

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



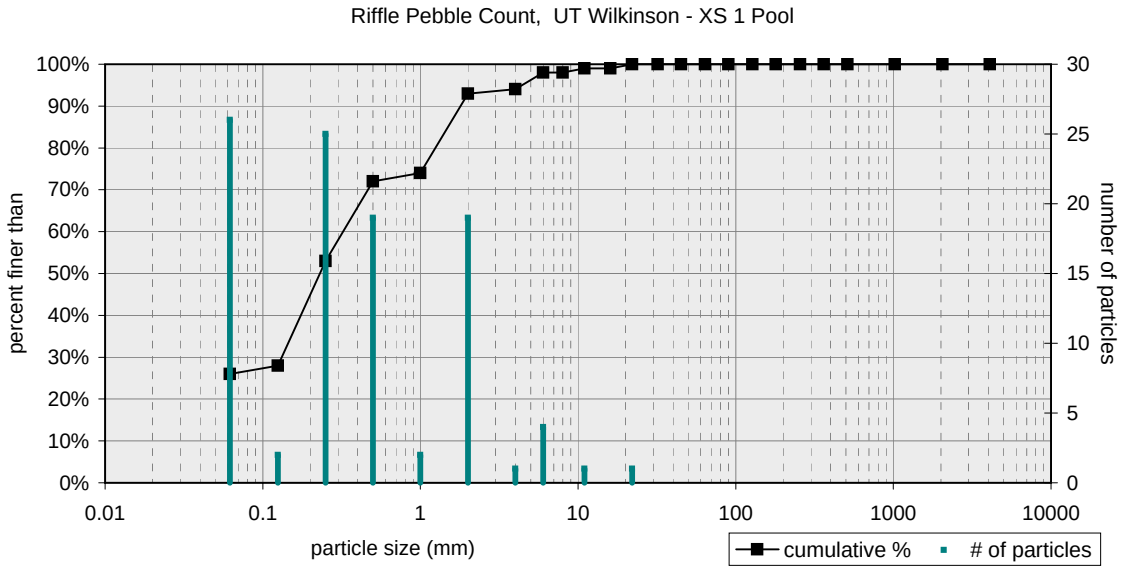
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062	**26**	#
very fine sand	0.062	0.13	**2**	#
fine sand	0.13	0.25	**25**	#
medium sand	0.25	0.5	**19**	#
coarse sand	0.5	1	**2**	#
very coarse sand	1	2	**19**	#
very fine gravel	2	4	**1**	#
fine gravel	4	6	**4**	#
fine gravel	6	8		#
medium gravel	8	11	**1**	#
medium gravel	11	16		#
coarse gravel	16	22	**1**	#
coarse gravel	22	32		#
very coarse gravel	32	45		#
very coarse gravel	45	64		#
small cobble	64	90		#
medium cobble	90	128		#
large cobble	128	180		#
very large cobble	180	256		#
small boulder	256	362		#
small boulder	362	512		#
medium boulder	512	1024		#
large boulder	1024	2048		#
very large boulder	2048	4096		#
		total particle count:	100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

	UT Wilkinson - XS 1 Pool
	Cape Fear
Note:	**XS 1**



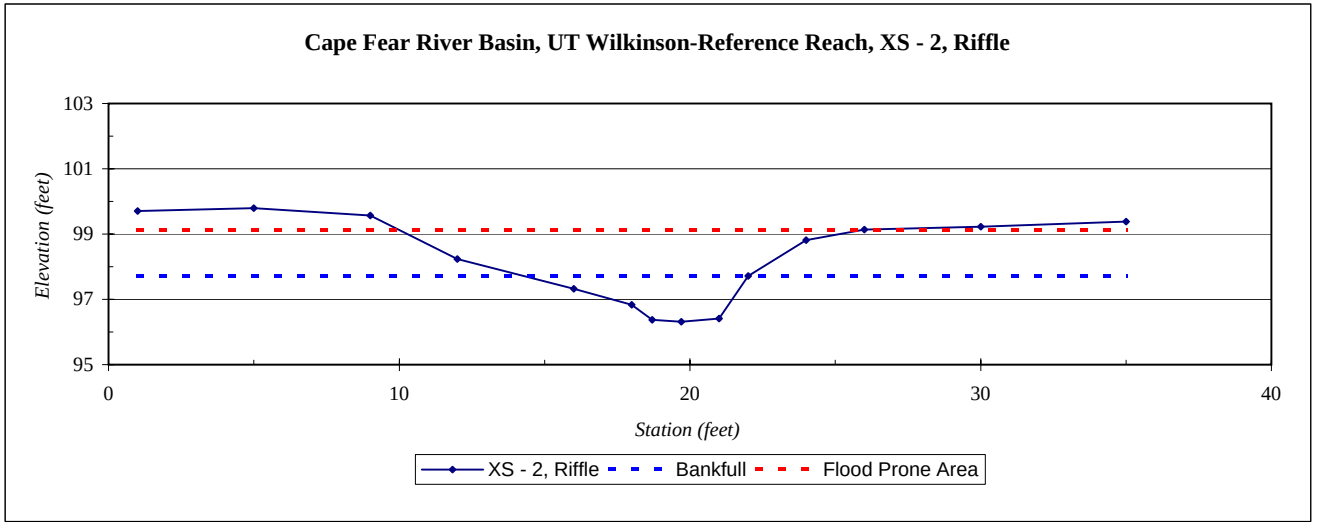
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.062	0.15	0.2	0	1	4	5.0	0.3	4.8

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	26%	67%	7%	0%	0%	0%	0%	0%	0%

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

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

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



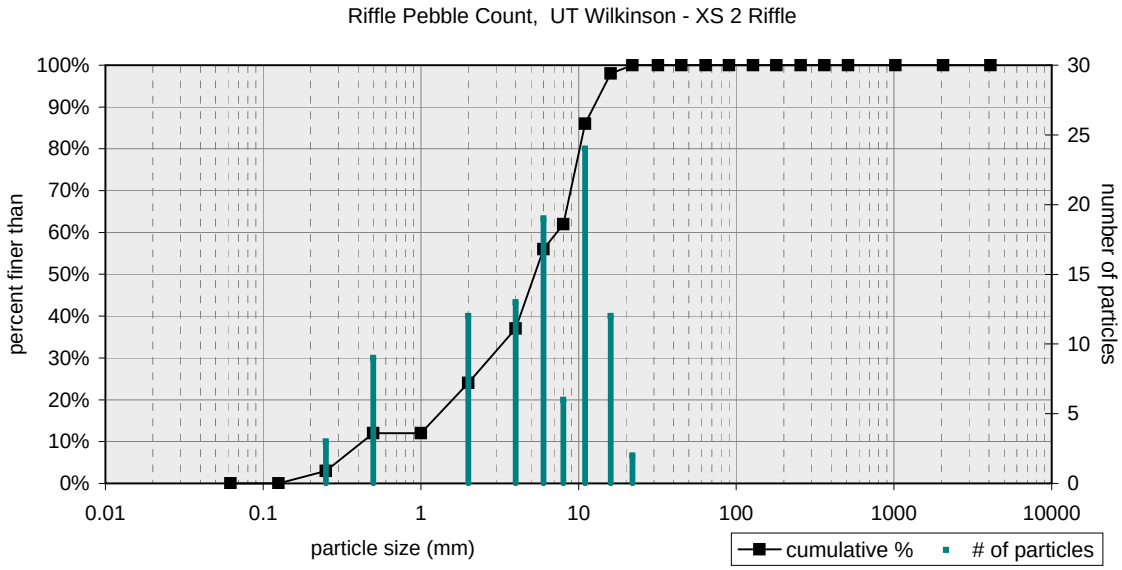
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		#
very fine sand	0.062	0.13		#
fine sand	0.13	0.25	**3**	#
medium sand	0.25	0.5	**9**	#
coarse sand	0.5	1		#
very coarse sand	1	2	**12**	#
very fine gravel	2	4	**13**	#
fine gravel	4	6	**19**	#
fine gravel	6	8	**6**	#
medium gravel	8	11	**24**	#
medium gravel	11	16	**12**	#
coarse gravel	16	22	**2**	#
coarse gravel	22	32		#
very coarse gravel	32	45		#
very coarse gravel	45	64		#
small cobble	64	90		#
medium cobble	90	128		#
large cobble	128	180		#
very large cobble	180	256		#
small boulder	256	362		#
small boulder	362	512		#
medium boulder	512	1024		#
large boulder	1024	2048		#
very large boulder	2048	4096		#
		total particle count:	100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

	UT Wilkinson - XS 2 Riffle
	Cape Fear
Note:	**XS 2**



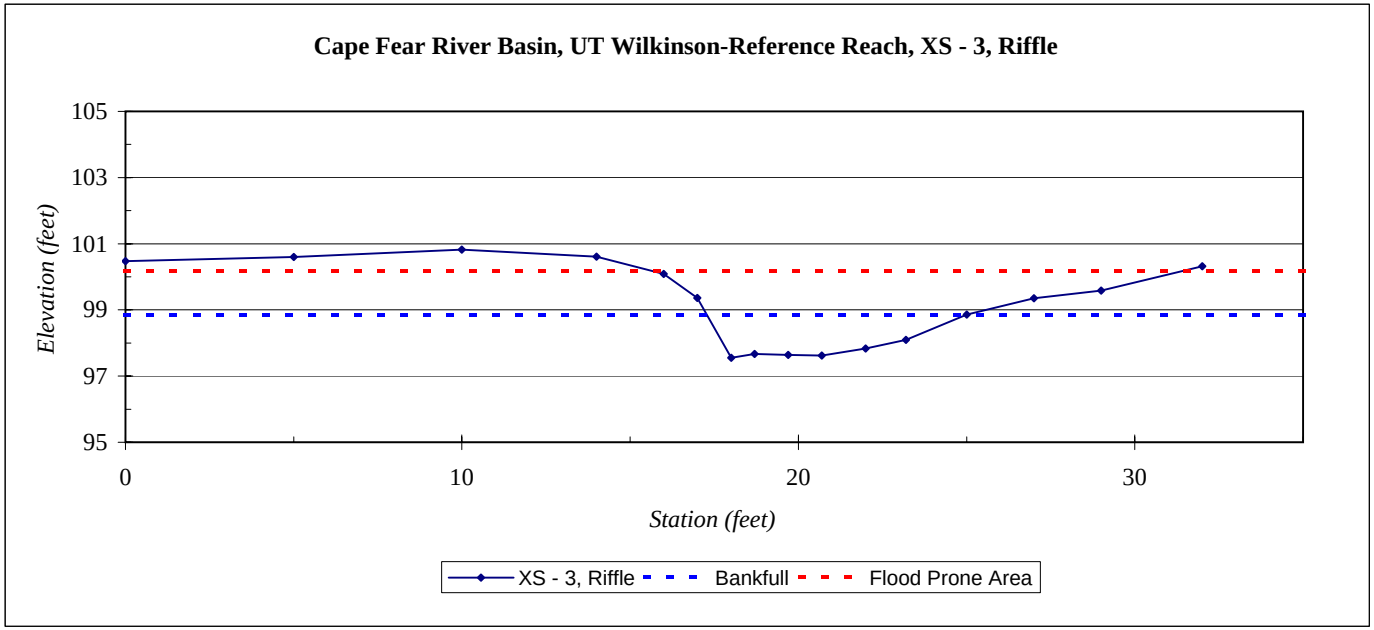
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	1.260	3.60	5.3	8	11	15	3.1	3.7	2.9

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	24%	76%	0%	0%	0%	0%	0%	0%

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

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

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



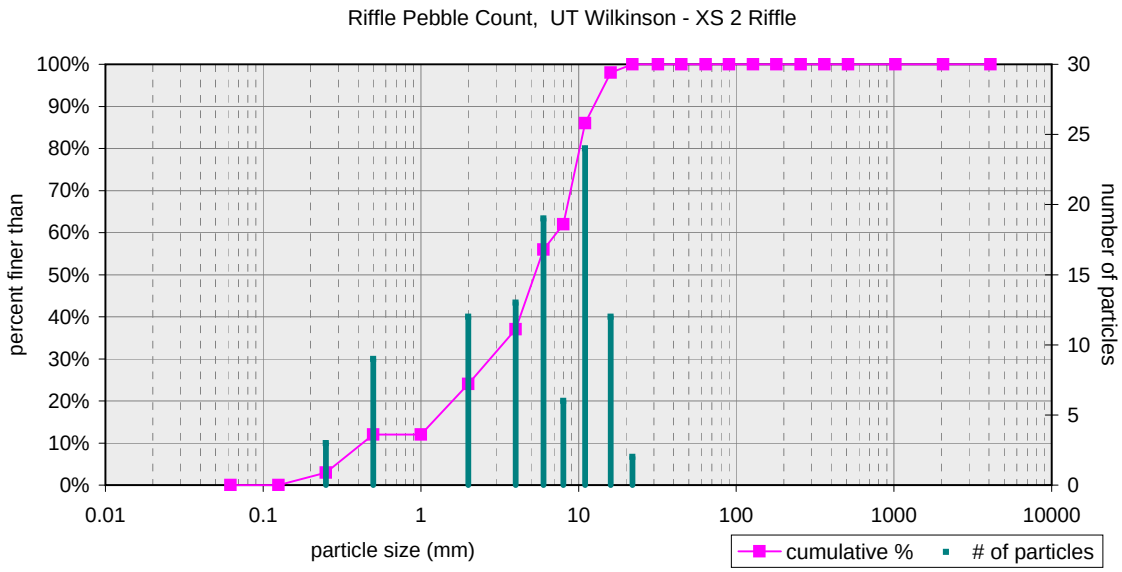
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	3
very fine sand	0.062	0.13	1
fine sand	0.13	0.25	4
medium sand	0.25	0.5	
coarse sand	0.5	1	1
very coarse sand	1	2	
very fine gravel	2	4	10
fine gravel	4	6	10
fine gravel	6	8	7
medium gravel	8	11	22
medium gravel	11	16	22
coarse gravel	16	22	16
coarse gravel	22	32	4
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
		total particle count:	100

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

UT Wilkinson - XS 3 Riffle
Cape Fear

Note: XS 3



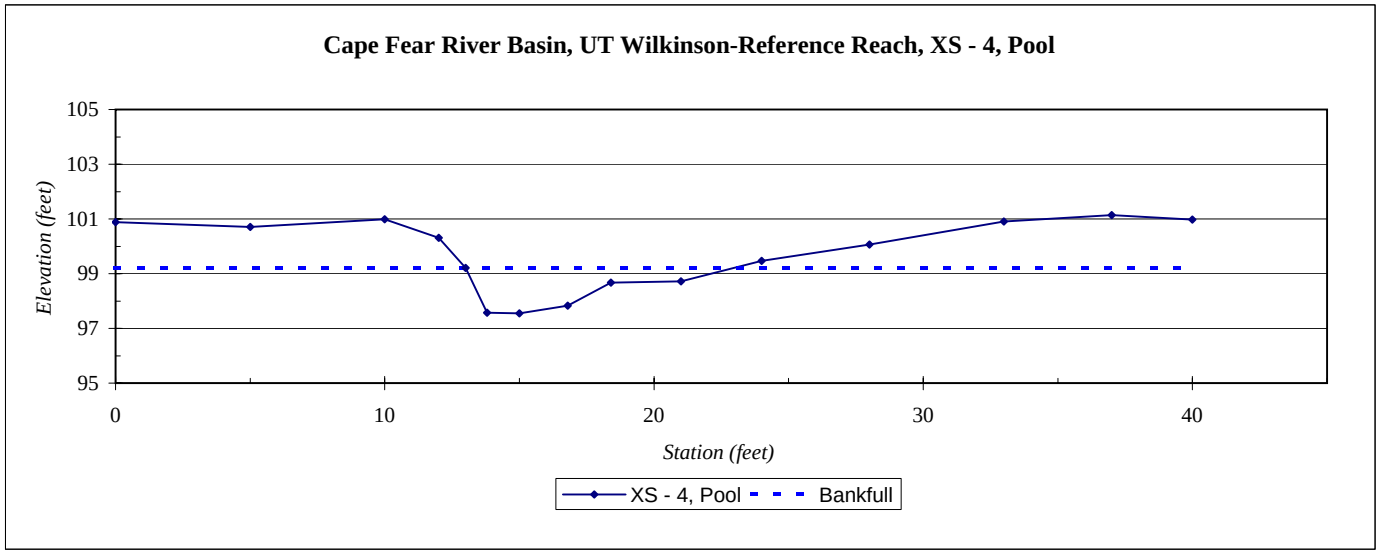
based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	5.102	10.32	13.3	17	23	35	2.2	10.9	2.1

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	12%	87%	1%	0%	0%	0%	0%	0%

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

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

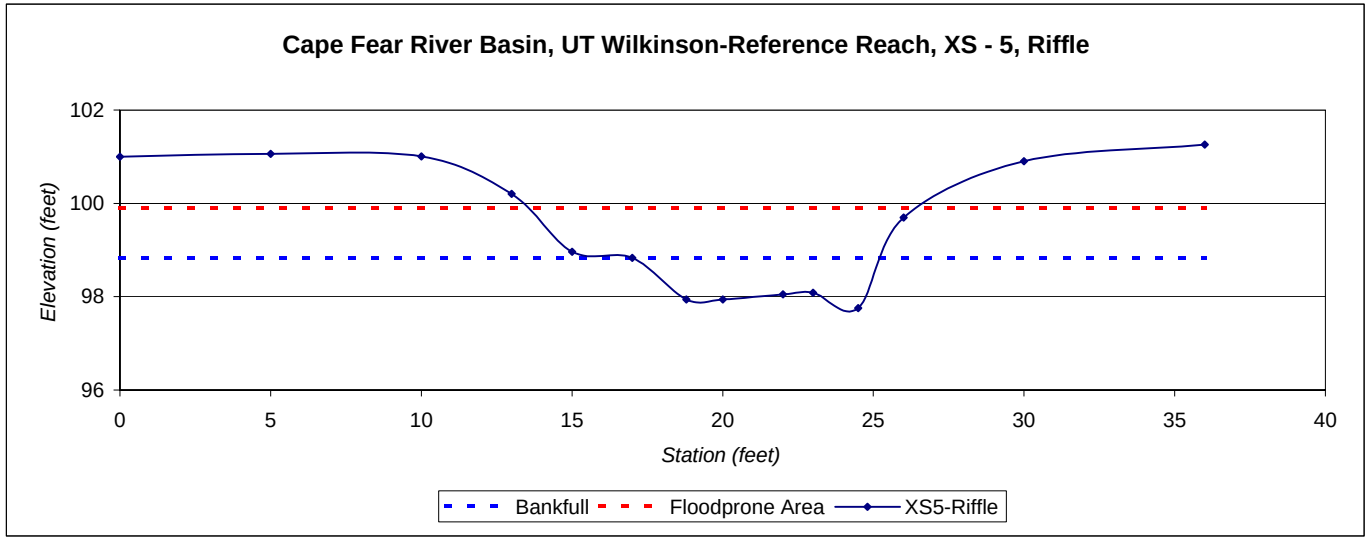
SUMMARY DATA	
Bankfull Elevation:	99.2
Bankfull Cross-Sectional Area:	8.8
Bankfull Width:	10.0
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-
Water Surface Slope (ft/ft):	0.018



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

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

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



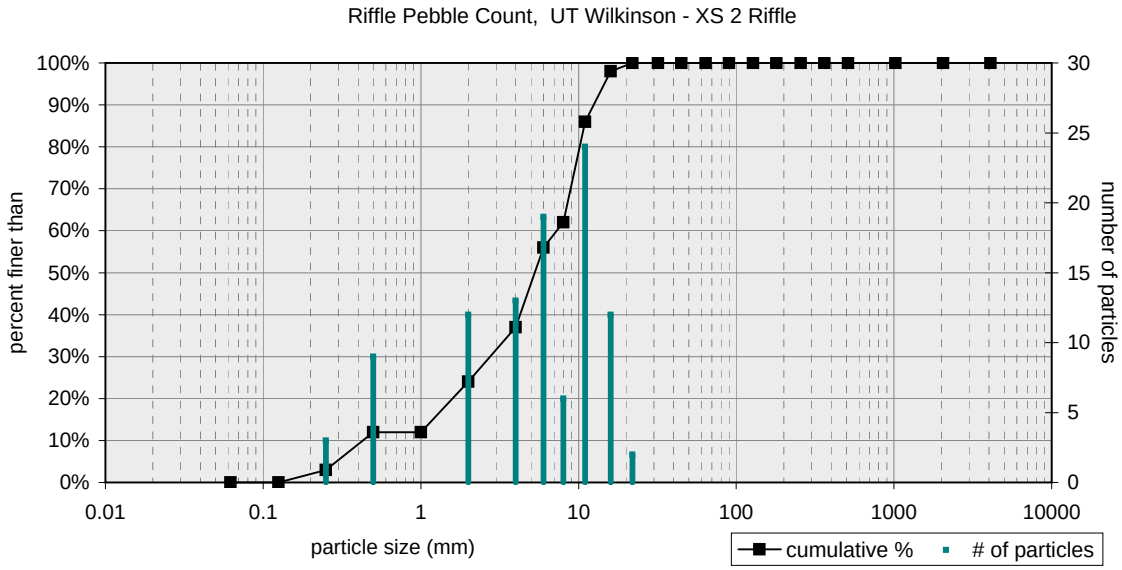
Riffle Pebble Count

Riffle Pebble Count,

Material	Size Range (mm)		Count	
silt/clay	0	0.062		#
very fine sand	0.062	0.13	**10**	#
fine sand	0.13	0.25	**17**	#
medium sand	0.25	0.5	**8**	#
coarse sand	0.5	1	**7**	#
very coarse sand	1	2	**9**	#
very fine gravel	2	4	**8**	#
fine gravel	4	6	**4**	#
fine gravel	6	8	**3**	#
medium gravel	8	11	**5**	#
medium gravel	11	16	**2**	#
coarse gravel	16	22	**4**	#
coarse gravel	22	32		#
very coarse gravel	32	45		#
very coarse gravel	45	64		#
small cobble	64	90	**1**	#
medium cobble	90	128	**3**	#
large cobble	128	180	**10**	#
very large cobble	180	256	**5**	#
small boulder	256	362	**4**	#
small boulder	362	512		#
medium boulder	512	1024		#
large boulder	1024	2048		#
very large boulder	2048	4096		#
		total particle count:	100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100

	UT Wilkinson - XS 5 Riffle
	Cape Fear
Note:	**XS 5**



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	5.102	10.32	13.3	17	23	35	2.2	10.9	2.1

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	0%	12%	87%	1%	0%	0%	0%	0%	0%

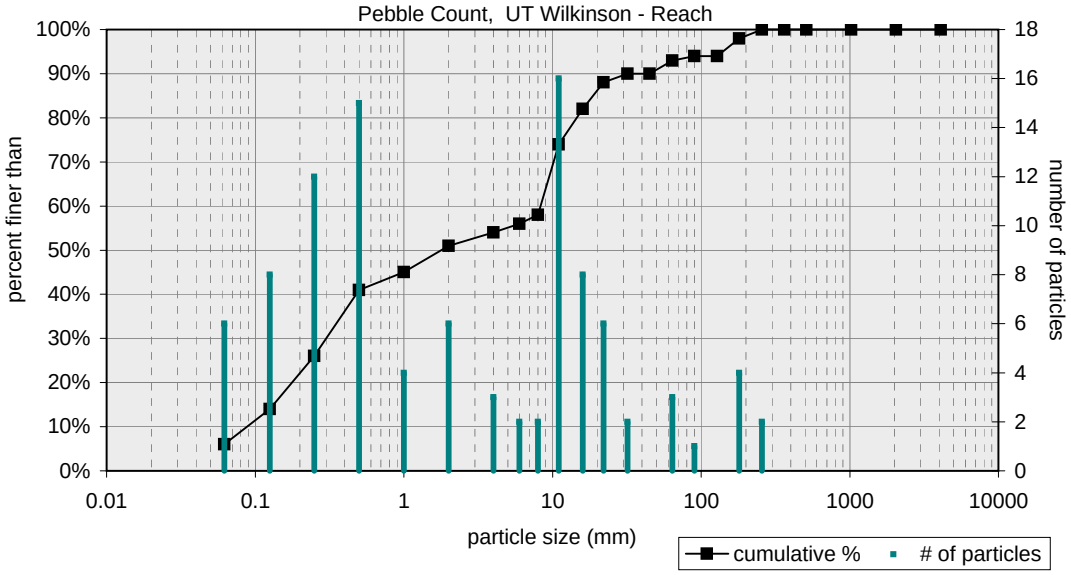
Pebble Count of Channel Reach

Pebble Count,
UT Wilkinson - Reach
Cape Fear

Note: **Reach**

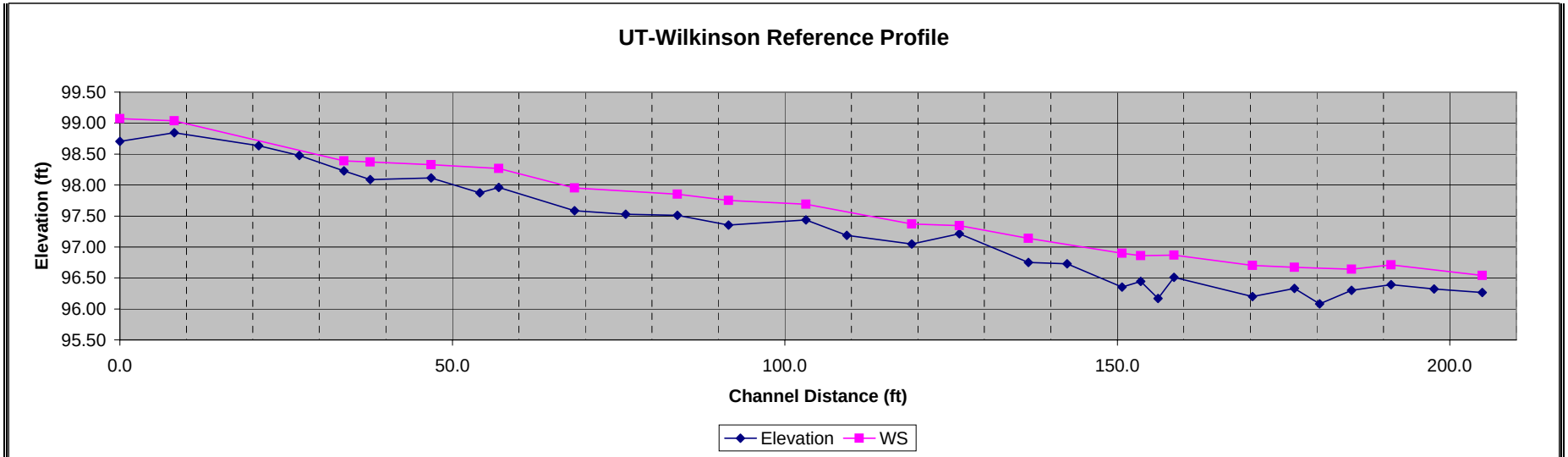
Material	Size Range (mm)		Count	
silt/clay	0	0.062	**6**	##
very fine sand	0.062	0.13	**8**	##
fine sand	0.13	0.25	**12**	##
medium sand	0.25	0.5	**15**	##
coarse sand	0.5	1	**4**	##
very coarse sand	1	2	**6**	##
very fine gravel	2	4	**3**	##
fine gravel	4	6	**2**	##
fine gravel	6	8	**2**	##
medium gravel	8	11	**16**	##
medium gravel	11	16	**8**	##
coarse gravel	16	22	**6**	##
coarse gravel	22	32	**2**	##
very coarse gravel	32	45		##
very coarse gravel	45	64	**3**	##
small cobble	64	90	**1**	##
medium cobble	90	128		##
large cobble	128	180	**4**	##
very large cobble	180	256	**2**	##
small boulder	256	362		##
small boulder	362	512		##
medium boulder	512	1024		##
large boulder	1024	2048		##
very large boulder	2048	4096		##
		total particle count:	100	

bedrock		
clay hardpan		
detritus/wood		
artificial		
	total count:	100



based on sediment particles only	size percent less than (mm)						particle size distribution		
	D16	D35	D50	D65	D84	D95	gradation	geo mean	std dev
	0.140	0.38	1.8	9	18	139	11.3	1.6	11.3

based on total count	percent by substrate type								
	silt/clay	sand	gravel	cobble	boulder	bedrock	hardpan	wood/det	artificial
	6%	45%	42%	7%	0%	0%	0%	0%	0%



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

Reference Reach UT to Wilkinson

01.JPG

02.JPG

03.JPG

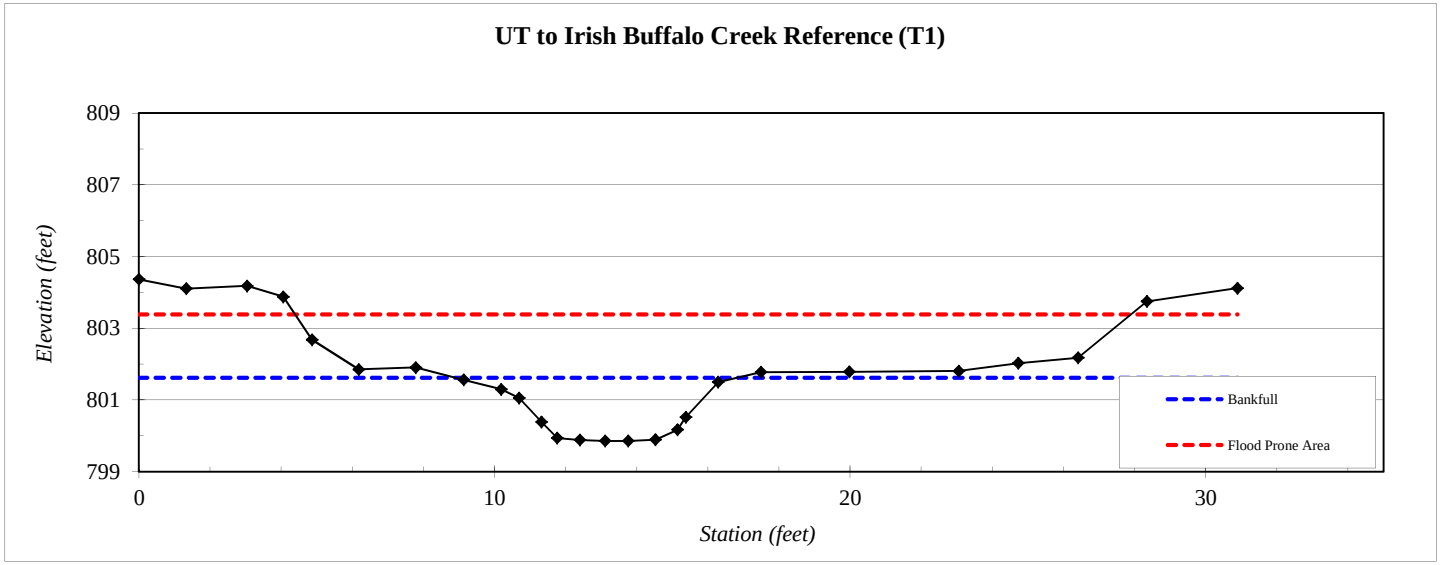
04.JPG

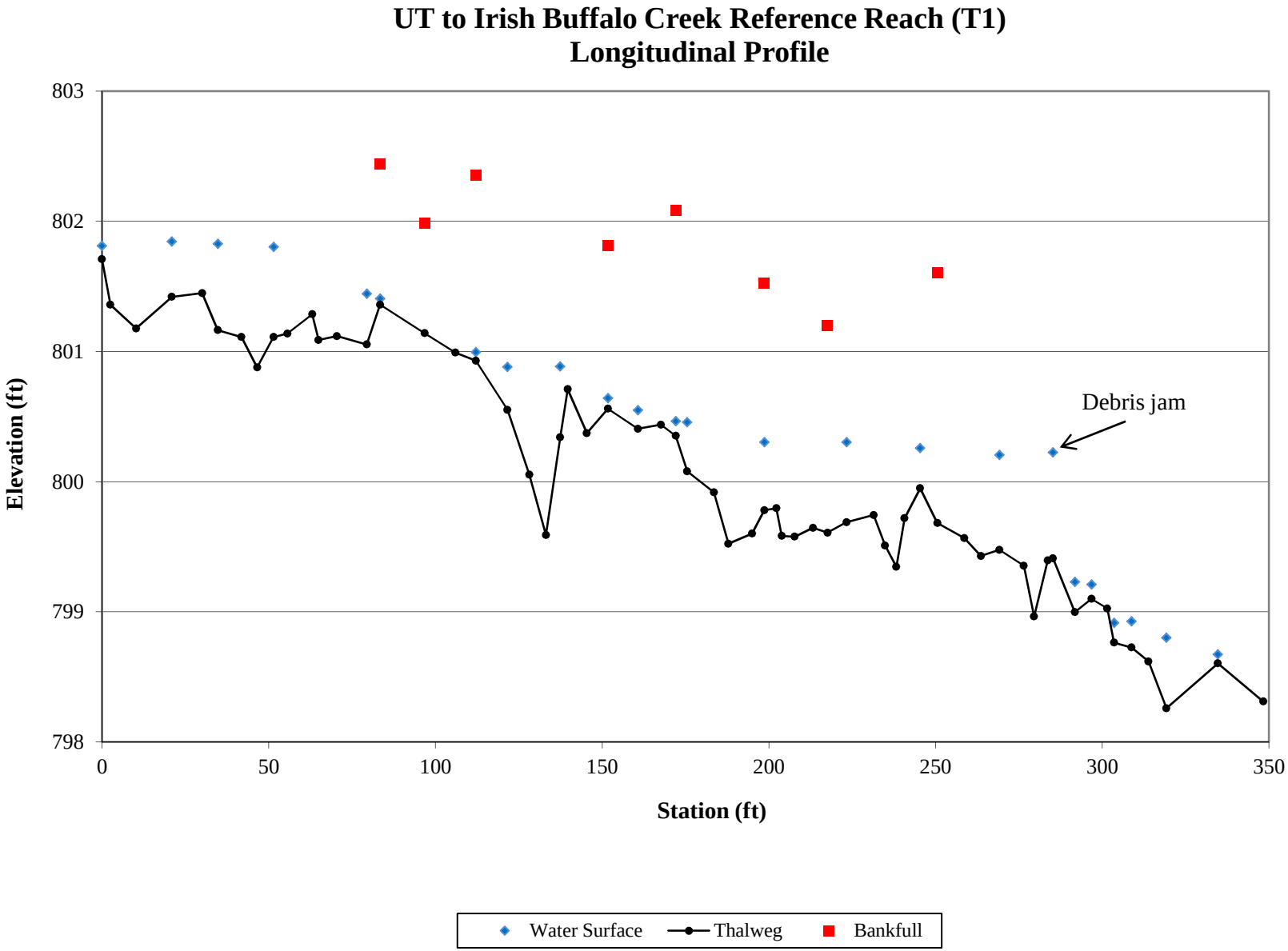
UT to Irish Buffalo Creek Reference Site

River Basin:	Yadkin-PeeDee
Watershed:	Irish Buffalo Creek, T1
XS ID	XS-Riffle (REFERENCE)
Drainage Area (sq mi):	0.16
Date:	2/17/2012
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	804.36
1.3	804.11
3.0	804.18
4.1	803.88
4.9	802.68
6.2	801.85
7.8	801.91
9.1	801.56
10.2	801.30
10.7	801.05
11.3	800.38
11.8	799.94
12.4	799.89
13.1	799.86
13.8	799.86
14.5	799.89
15.2	800.17
15.4	800.52
16.3	801.50
17.5	801.77
20.0	801.79
23.1	801.81
24.7	802.02
26.4	802.18
28.3	803.75
30.9	804.12

SUMMARY DATA	
Bankfull Elevation:	801.6
Bankfull Cross-Sectional Area:	8.4
Bankfull Width:	8.0
Flood Prone Area Elevation:	803.4
Flood Prone Width:	23
Max Depth at Bankfull:	1.8
Mean Depth at Bankfull:	1.1
W / D Ratio:	7.6
Entrenchment Ratio:	2.9
Bank Height Ratio:	1.0




UT to Irish Buffalo Creek Reference Reach (T1)
Longitudinal Profile
Elevation (ft)
803
802
801
800
799
798
0
50
100
150
200
250
300
350
Station (ft)
Debris jam
Water Surface
Thalweg
Bankfull

UT to Irish Buffalo Creek Reference Stream Photos

Looking downstream on reference reach. 2-17-2012

Looking downstream on reference reach. 2-17-2012

Looking downstream on reference reach. 2-17-2012

Morphological Design Criteria

Morphological Design Criteria

Variables		Existing T1-1, T1-2	Existing T2-1	Existing T2-2	Ref. Reach UT to Irish Buffalo	Proposed T1-1	Proposed T1-2	Proposed T2-1	Proposed T2-2
Rosgen Stream Type		G4	G4	G4	E4	C4	C4	C4	C4
Mitigation Type		Restoration	Enh.I	Restoration	N/A	Restoration	Restoration	Enh.I	Restoration
Drainage Area (mi^2)		0.21, 0.36	0.67	0.70	0.16	0.21	0.36	0.67	0.70
Bankfull Width (W_{bkf}) (ft)		6.7-9.6	10.6-16.5	10.8	6.9	10.3	11.5	13.5	13.5
Bankfull Mean Depth (d_{bkf}) (ft)		1.1-1.5	1.2-1.7	2.3	1.1	0.9	1.0	1.1	1.1
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)		9.8-10.5	18.5-20.6	25	7.4	9.0	11.0	15.3	15.3
Width/depth Ratio (W_{bkf}/d_{bkf})		4.6-8.8	6.1-13.2	4.7	6.4	12.0	12.0	12.0	12.0
Maximum Depth (d_{mbkf}) (ft)		1.7-2.4	2.1-2.6	3.4	1.6	1.4	1.5	1.8	1.8
Width of flood prone area (W_{fpa}) (ft)		12-16	20-35	16	23	23-70	26-70	30	30-70
Entrenchment Ratio (ER)		1.3-2.2	1.9-2.1	1.5	3.4	2.2-6.0	2.2-6.0	2.2	2.2-5.2
Sinuosity (stream length/valley length) (K)		1.03	1.47	1.00	1.18	1.14	1.18	1.45	1.16
Dimension	Pool Depth (ft)	1.5	1.2	*	1.6	1.3	1.4	1.5	1.6
	Riffle Mean Depth (ft)	1.1-1.5	1.2-1.7	2.3	1.1	0.9	1.0	1.1	1.1
	Max Pool Depth (ft)	2.4	2.1	*	2.7	2.6	2.8	3.1	3.2
	Pool Width (ft)	6.7	16.5	*	**	15.0	15.0	18.0	18.0
	Riffle Width (ft)	6.7-9.6	10.6-16.5	10.8	6.9	10.3	11.5	13.5	13.5
	Pool XS Area (sf)	9.8	20.6	*	**	19.5	20.6	27.5	28.4
	Riffle XS Area (sf)	9.8-10.5	18.5-20.6	25	7.4	9.0	11.0	15.3	15.3
	Pool depth/mean riffle depth	0-1.0	0-0.7	*	**	1.4	1.4	1.4	1.4
	Pool width/riffle width	0.7-1.0	1.0-1.6	*	**	1.5	1.3	1.3	1.3
	Pool area/riffle area	0.9-1.0	1.0-1.1	*	**	2.2	1.9	1.8	1.9
	Max pool depth/d_{bkf}	0-1.6	0-1.2	*	**	2.9	2.8	2.8	2.9
	Bank Height Ratio (BHR)	2.3-3.3	1.9-2.0	2.0	1.0	1.0	1.0	1.0	1.0
	Mean Bankfull Velocity (V) (fps)	4.3-4.6	3.2-3.7	2.8	3.3	3.4	4	4.1	4.5
	Bankfull Discharge (Q) (cfs)	44.7-45.0	65.7-68.2	71.3	24.7	30.5	44.3	62.9	68.6
Pattern	Meander length (L_m) (ft)	*	23-150	*	43 - 102	65-120	65-140	58-100	70-140
	Radius of curvature (R_c) (ft)	*	5-15	*	12 - 25	20-40	23-45	20-50	27-54
	Belt width (W_{blt}) (ft)	*	20-60	*	14 - 38	25-60	30-70	20-60	30-70
	Meander width ratio (W_{blt}/W_{bkf})	*	1.8-5.8	*	2.0 - 5.5	2.4-5.8	2.6-5.7	2.2-5.2	2.2-5.2
	Radius of curvature/bankfull width	*	0.5-1.4	*	1.7-3.6	2-4	2-4	2-4	2-4
	Meander length/bankfull width	*	2.2-14.1	*	6.2 - 14.8	6.3-11.7	5.7-12.2	4.3-7.4	5.2-10.4
Profile	Valley slope	0.010	0.011	0.008	0.009	0.005	0.013	0.009	0.014
	Average water surface slope	0.011	0.006	0.013	0.007	0.004	0.011	0.007	0.012
	Riffle slope	0.010-0.035	0.004-0.008	0.004-0.018	0.011-0.025	0.004-0.017	0.014-0.017	0.006-0.014	0.005-0.017
	Pool slope	*	*	*	0.001-0.007	0.000-0.001	0.000-0.001	0.000-0.007	0.000-0.001
	Pool to pool spacing	*	*	*	28 - 57	47-72	44-95	28-75	33-89
	Pool length	*	*	*	16 - 23	20-30	12-40	10-24	10-36
	Riffle slope/avg water surface slope	0.9-3.2	0.7-1.3	0.3-1.4	1.6 - 3.6	1.0-4.2	1.3-1.6	0.9-2.0	0.4-1.4
	Pool slope/avg water surface slope	*	*	*	0.2 - 1.0	0.0-0.3	0.0-0.9	0.0-1.0	0.00-0.08
	Pool length/bankfull width	*	*	*	2.3 - 3.4	1.9-2.9	1.0-3.5	0.7-1.8	0.7-2.7
	Pool to pool spacing/bankfull width	*	*	*	4.1 - 8.3	4.6-7.0	3.8-8.3	2.1-5.6	2.4-6.6

* T1-1, T1-2 and T2-2 are not meandering channels and are mostly composed of riffles and runs; therefore no pattern data or pool data was shown.

** No pool cross-section were surveyed for Ref. Reach UT to Irish Buffalo.

Variables		Existing	Ref. Reach UTFR	Proposed
		T1A-3		T1A-3
Rosgen Stream Type		F4	B4c	B4c/C4
Mitigation Type		Restoration	N/A	Restoration
Drainage Area (mi^2)		0.05	0.4	0.05
Bankfull Width (W_{bkf}) (ft)		9.3	9.0-10.0	6.0
Bankfull Mean Depth (d_{bkf}) (ft)		0.5	1.1-1.2	0.5
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)		4.3	10.4-10.7	3.2
Width/depth Ratio (W_{bkf}/d_{bkf})		20.1	8.0-10.0	11.2
Maximum Depth (d_{mbkf}) (ft)		0.7	1.3-1.5	0.9
Width of flood prone area (W_{fpa}) (ft)		10.0	13-21	14
Entrenchment Ratio (ER)		1.1	1.3-2.3	2.2
Sinuosity (stream length/valley length) (K)		1.06	1.20	1.09
Dimension	Pool Depth (ft)	*	1.2-1.4	0.9
	Riffle Depth (ft)	0.5	1.1-1.2	0.5
	Max Pool Depth (ft)	*	2.1-2.4	1.9
	Pool Width (ft)	*	8.4-11.6	8.0
	Riffle Width (ft)	9.3	9.0-9.9	6.0
	Pool XS Area (sf)	*	11.6-13.4	7.4
	Riffle XS Area (sf)	4.3	10.4-10.7	3.2
	Pool depth/mean riffle depth	*	1.0-1.3	1.9
	Pool width/riffle width	*	0.8-1.3	1.3
	Pool area/riffle area	*	1.1-1.3	2.3
	Max pool depth/d_{bkf}	*	1.9-2.0	3.8
	Bank Height Ratio (BHR)	8.6	1.0	1.0
	Mean Bankfull Velocity (V) (fps)	2.5	4.1-4.5	3.6
	Bankfull Discharge (Q) (cfs)	10.8	42-46	11.6
Pattern	Meander length (L_m) (ft)	*	93-136	50-80
	Radius of curvature (R_c) (ft)	*	13-42	12-27
	Belt width (W_{blt}) (ft)	*	45	15-30
	Meander width ratio (W_{blt}/W_{bkf})	*	4.5-5.0	2.5-5.0
	Radius of curvature/bankfull width	*	1.3-4.4	2.0-4.5
	Meander length/bankfull width	*	9.0-15.0	8.3-13.3
Profile	Valley slope	0.025	0.016	0.025
	Average water surface slope	0.018	0.013	0.017
	Riffle slope	*	0.013-0.028	0.020-0.030
	Pool slope	*	0-0.0010	0-0.008
	Pool to pool spacing	*	30-59	20-40
	Pool length	*	3-25	6-12
	Riffle slope/avg water surface slope	*	1.00-2.20	1.2-1.8
	Pool slope/avg water surface slope	*	0	0.0-0.5
	Pool length/bankfull width	*	0.3-2.5	1.0-2.0
	Pool to pool spacing/bankfull width	*	3.3-6.0	3.3-6.7

* T1A-3 is not meandering channel and is mostly composed of riffles and runs;
therefore no pattern data is shown.

Variables		Existing	Ref. Reach UT to Wilkinson	Proposed
		T1A-1, T1A-2		T1A-1, T1A-2
Rosgen Stream Type		C4	B4c	B4c/C4
Mitigation Type		Enh. I/Enh. II	N/A	Enh. I, Enh. II
Drainage Area (mi^2)		0.05	0.15	0.05
Bankfull Width (W_{bkf}) (ft)		12.7	7.7 - 10.8	7.0
Bankfull Mean Depth (d_{bkf}) (ft)		0.4	0.7 - 0.9	0.6
Bankfull Cross-Sectional area (A_{bkf}) (ft^2)		4.5	6.1 - 8.8	3.9
Width/depth Ratio (W_{bkf}/d_{bkf})		35.8	8.5 - 11.4	12.5
Maximum Depth (d_{mbkf}) (ft)		0.9	1.3 - 1.7	0.9
Width of flood prone area (W_{fpa}) (ft)		30	13.0 - 16.0	15
Entrenchment Ratio (ER)		2.4	1.6 - 2.1	2.2
Sinuosity (stream length/valley length) (K)		1.11	1.20	1.11
Dimension	Pool Depth (ft)	-	0.8-0.9	1.0
	Riffle Depth (ft)	0.4	0.7-0.9	0.6
	Max Pool Depth (ft)	-	2.2	1.9
	Pool Width (ft)	-	10.0-10.8	9.3
	Riffle Width (ft)	12.7	7.7-10.8	7.0
	Pool XS Area (sf)	-	8.6-8.8	8.9
	Riffle XS Area (sf)	4.5	6.1-8.8	3.9
	Pool depth/mean riffle depth	-	0.9-1.3	1.6
	Pool width/riffle width	-	0.9-1.4	1.3
	Pool area/riffle area	-	1.0-1.4	2.3
	Max pool depth/d_{bkf}	-	2.4-3.1	3.2
	Bank Height Ratio (BHR)	1.0	1.0	1.0
	Mean Bankfull Velocity (V) (fps)	2.2	5.1-5.8	2.9
	Bankfull Discharge (Q) (cfs)	10.6	31.0-49.0	11.5
Pattern	Meander length (L_m) (ft)	55-95	49-59	55-95
	Radius of curvature (R_c) (ft)	7-20	11-23	12-25
	Belt width (W_{blt}) (ft)	10-30	22	10-30
	Meander width ratio (W_{blt}/W_{bkf})	4.3-7.5	2.0-2.9	1.4-4.3
	Radius of curvature/bankfull width	0.6-2.4	1-3	2-4
	Meander length/bankfull width	0.8-2.4	4.5-7.7	7.9-13.6
Profile	Valley slope	0.020	0.017	0.014
	Average water surface slope	0.015	0.012	0.012
	Riffle slope	0.013-0.018	0.012-0.028	0.006-0.020
	Pool slope	-	0.000-0.003	0.003-0.006
	Pool to pool spacing	-	-	22-63
	Pool length	-	5-9	7-11
	Riffle slope/avg water surface slope	0.9-1.2	1.00-2.30	0.5-1.7
	Pool slope/avg water surface slope	-	0.16-0.24	0.3-0.5
	Pool length/bankfull width	-	0.46-1.80	1.0-1.6
	Pool to pool spacing/bankfull width	-	-	3.1-9.0

- T1A-1 and T1A-2 are mostly composed of riffles and runs; therefore no pool data was shown.

Appendix D

Project Plan Sheets

KCI JOB# : 20110669

CONTRACT #: 003983

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

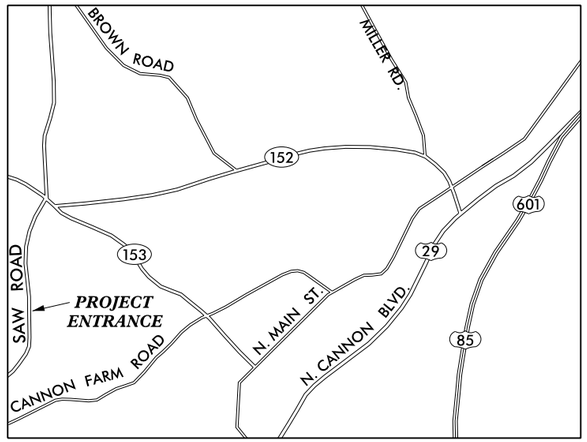
STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	003983	1	23

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012	
C	EDITS PER IRT COMMENTS	SEPT 2012	
SYM.	DESCRIPTION	DATE	APPROVED
REVISIONS			

ROWAN COUNTY

LOCATION: JACOB'S LADDER
CHINA GROVE, NORTH CAROLINA

TYPE OF WORK: STREAM MITIGATION

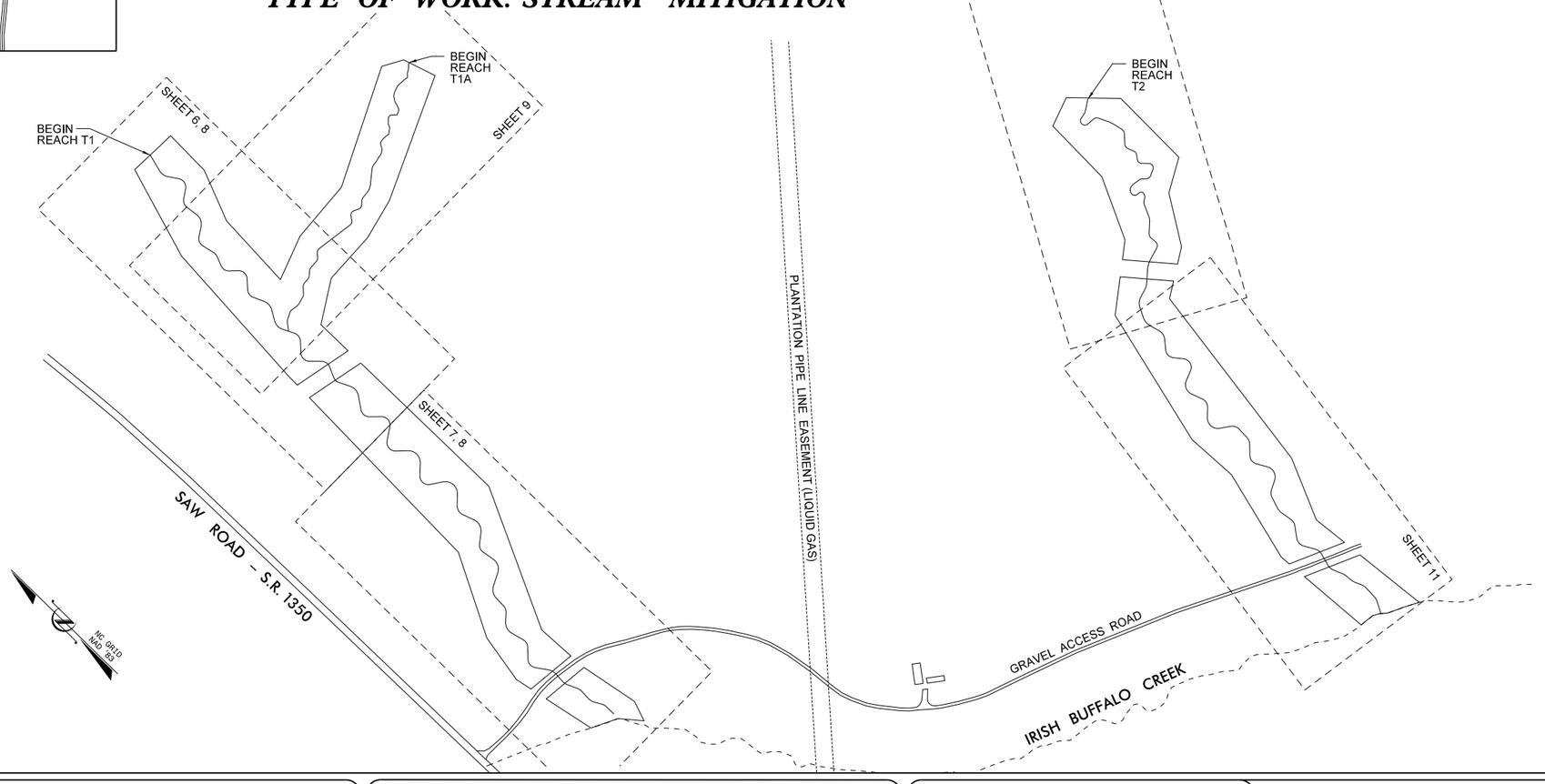


VICINITY MAP
NOT TO SCALE

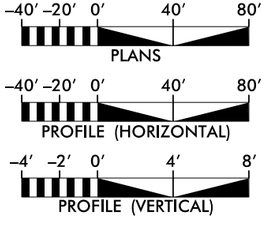
DIRECTIONS TO SITE

FROM RALEIGH, TAKE I–40 WEST. SLIGHT LEFT ONTO I–85 BUS S/US–29 S/US–70 W (signs for High Point/Charlotte). FOLLOW I–85 SOUTH TO EXIT 68. MERGE ONTO US–29 CONNECTOR SOUTH. TURN RIGHT ONTO NORTH CAROLINA 152 W/CHURCH STREET. TURN LEFT ONTO SAW ROAD. THE SITE WILL BE ON THE LEFT IN APPROX 1.5 MILES, JUST BEFORE THE IRISH BUFFALO CREEK BRIDGE.

INDEX OF SHEETS



GRAPHIC SCALES



PROJECT DATA

STREAM RESTORATION LENGTH = 4,193 FEET

STREAM ENHANCEMENT I LENGTH = 1,056 FEET

STREAM ENHANCEMENT II LENGTH = 140 FEET

Prepared in the Office of:

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

ALEX FRENCH
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

GARY M. MRYNCZA, P.E.

P.E.

SIGNATURE:

Prepared for:

Ecosystem Enhancement PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

GENERAL NOTES:

BEARINGS AND DISTANCES:
ALL BEARINGS ARE NAD 1983 GRID BEARINGS.
ALL DISTANCES AND COORDINATES SHOWN ARE HORIZONTAL (GROUND) VALUES.

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

IT IS BROUGHT TO THE CONTRACTOR'S ATTENTION THAT AN OVERHEAD POWER LINE IS LOCATED ON THIS PROJECT (SEE SHEET 7). EXACT LOCATION TO BE DETERMINED BY CONTRACTOR.

IT IS BROUGHT TO THE CONTRACTOR'S ATTENTION THAT A GAS LINE EASEMENT IS LOCATED ON THIS PROJECT (SEE TITLE SHEET). EXACT LOCATION TO BE DETERMINED BY CONTRACTOR.

CONTRACTOR IS RESPONSIBLE FOR PROVIDING TEMPORARY ACCESS ACROSS STREAMS FOR LAND OWNER DURING CULVERT REPLACEMENT.

CONTROL POINTS

POINT	NORTHING	EASTING	ELEV
KCI#01	660166.6530	1507419.0150	749.9200
KCI#02	660561.5714	1507483.8642	760.4151
KCI#03	661126.4985	1507505.2811	762.8247
KCI#04	661581.3128	1507565.8405	769.8388
KCI#05	661165.6119	1507163.4532	805.7027
KCI#06	662066.1646	1507619.2198	782.7055
KCI#07	662168.8809	1507726.7350	791.6899
KCI#08	661736.5136	1507898.2760	790.2148
KCI#09	661887.8459	1508251.3061	791.1339
KCI#10	659005.5578	1509000.5631	742.3300
KCI#11	659359.9904	1508911.6989	760.6932
KCI#12	658827.8391	1509265.0106	749.6684
KCI#13	659776.4506	1509245.0112	752.1122
KCI#14	659961.2182	1509393.9052	753.6455
KCI#15	660081.4788	1509488.2127	755.2711
KCI#16	660163.6570	1509558.2222	755.9459
KCI#17	660354.0435	1509550.1486	757.9904
KCI#18	660466.6157	1509620.0168	759.6410
KCI#19	660628.1248	1509730.0588	759.0129
KCI#20	659339.8103	1509268.3486	755.1816
KCI#21	659656.6209	1509321.0114	754.0829
KCI#22	660103.9096	1509262.7715	762.6000

PROJECT LEGEND:

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

Proposed Log Drop .....

Proposed Step Pool .....

Proposed Riffle Grade Control .....

Proposed Live Lift .....

Proposed Riffle Enhancement .....

RIFFLE ENHANCEMENT MATERIAL:
MINIMUM OF 6" DEPTH OF SURGE STONE, WASHED IN WITH NATIVE BED MATERIAL.
EXTEND INTO 'RUN' SECTION OF POOL AREA.

Proposed Stone Toe Stabilization .....

Proposed Channel Block .....

Existing Channel to be Filled .....

Existing Woods Line .....

Single Tree .....

Minor Contour Line .....

Major Contour Line 720

Existing Barbed Wire Fencing .....

Existing Overhead Power Line ..... OHP

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012	
C	EDITS PER IRT COMMENTS	SEPT 2012	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

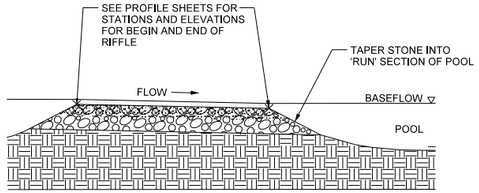
Ecosystem Enhancement Program

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

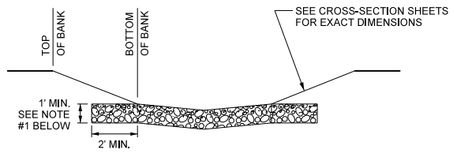
JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MAY 2012
SCALE: N.T.S.

PROJECT LEGEND & NOTES



SECTION (PROFILE VIEW)



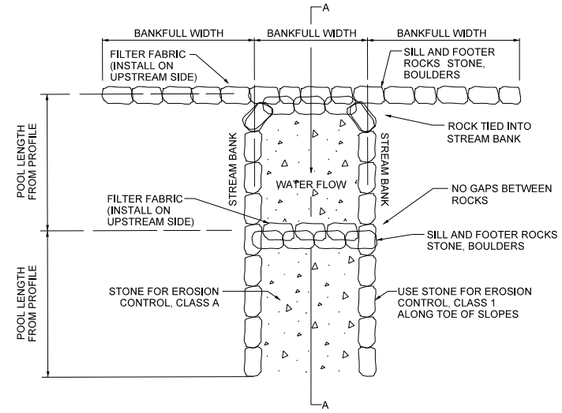
CROSS-SECTION VIEW

RIFFLE GRADE CONTROL

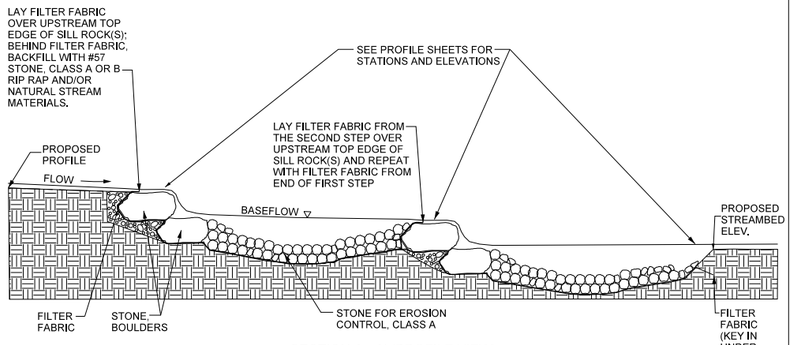
SCALE: NTS

NOTE:

1. START BY INSTALLING CLASS I STONE, THEN ADD SURGE STONE TO FILL IN VOIDS. FINISH BY WASHING IN NATURAL STREAM MATERIAL TO OBTAIN FINAL GRADE.



PLAN VIEW

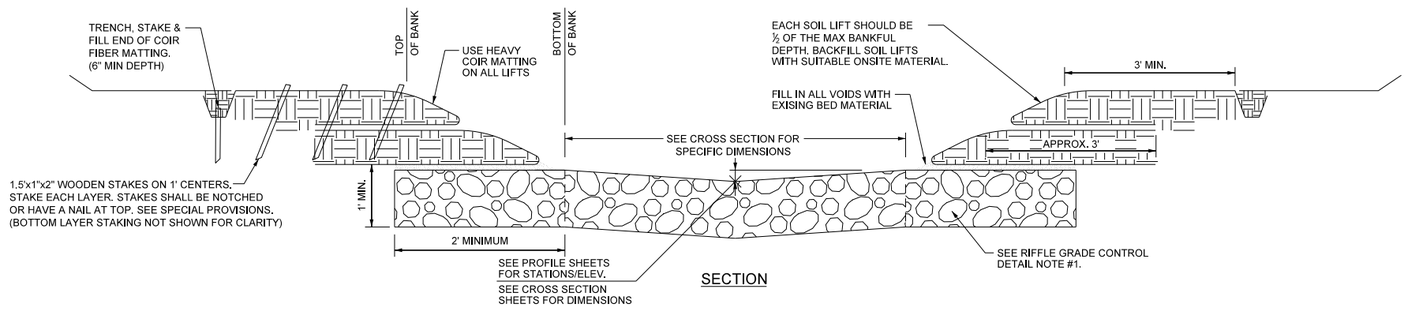


SECTION A - A' (PROFILE VIEW)

DOUBLE STEP POOL

SCALE: NTS

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



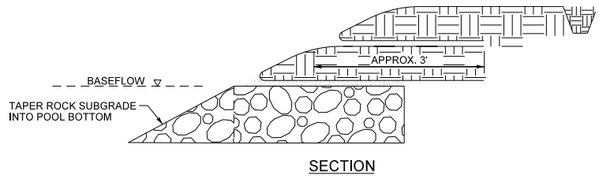
SECTION

SOIL LIFT / RIFFLE GRADE CONTROL

NOT TO SCALE

NOTE:

CERTAIN CIRCUMSTANCES MAY REQUIRE FOR ONLY ONE, THICK LAYER SOIL LIFT TO BE INSTALLED. TO BE DETERMINED BY DESIGN REPRESENTATIVE IN THE FIELD.



SECTION

NOTE:
MATCH ALL SPECS FROM "SOIL LIFT / RIFFLE GRADE CONTROL" DETAIL.

SOIL LIFT DETAIL FOR OUTER BENDS / POOLS

NOT TO SCALE

SYM.	DESCRIPTION	DATE
A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012
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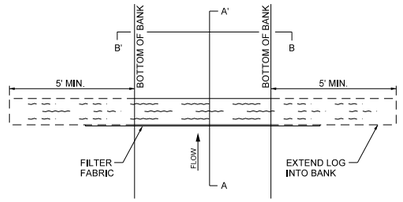
JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

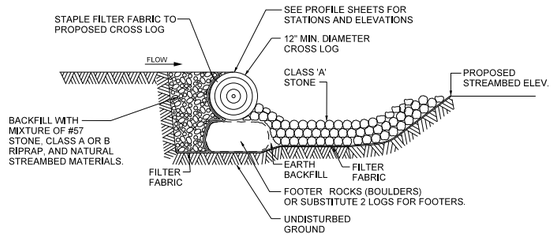
DATE: MAY 2012
SCALE: N.T.S.

DETAILS: STABILIZATION

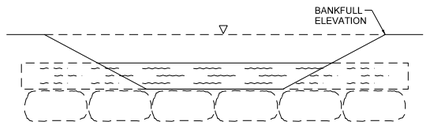
SHEET 3 OF 23



PLAN VIEW

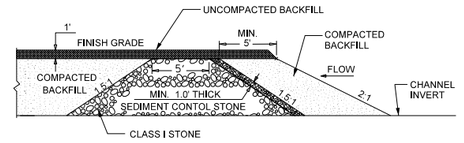


SECTION B-B' (PROFILE VIEW)

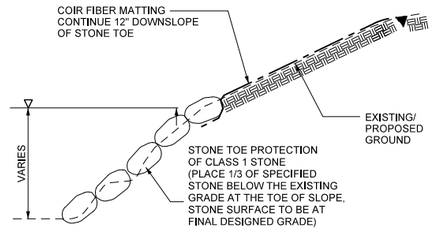


SECTION A-A' (CROSS-SECTION VIEW)

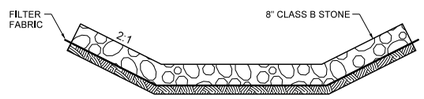
LOG DROP DETAIL
SCALE: NTS



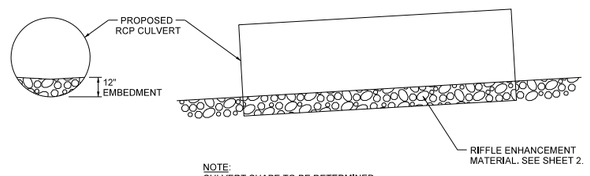
CHANNEL BLOCK
SCALE: NTS



STONE TOE STABILIZATION
SCALE: NTS



STABILIZED DRAINAGE OUTFALL
SCALE: NTS



EMBEDDED CULVERT
SCALE: NTS

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
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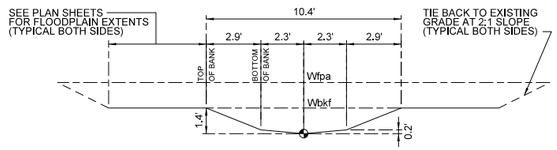
JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MAY 2012
SCALE: N.T.S.

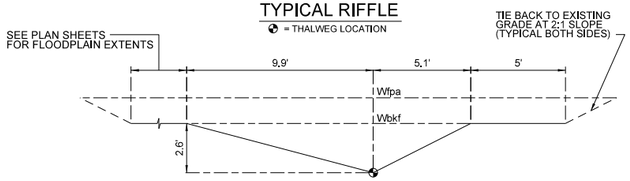
DETAILS:
STABILIZATION

SHEET 4 OF 23

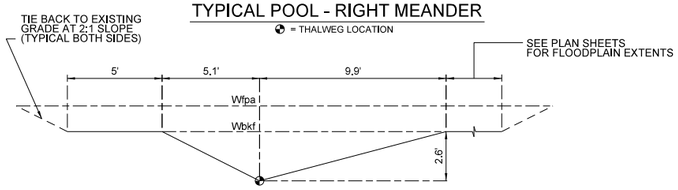
REACH T1-1
STATION 10+00 TO 17+39 = RESTORATION
"C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION

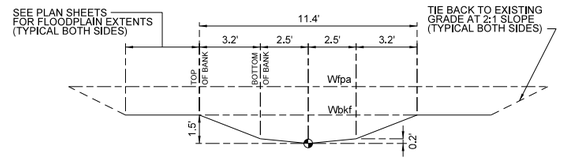


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

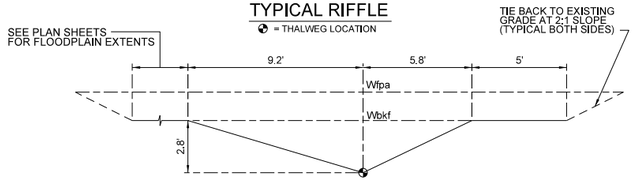


TYPICAL POOL - LEFT MEANDER
= THALWEG LOCATION

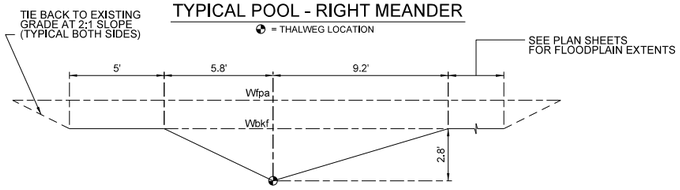
REACH 1-2
STATION 17+39 TO 34+62 = RESTORATION
"C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION

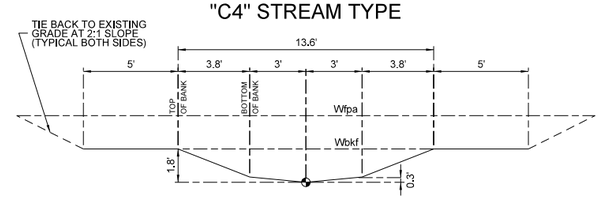


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

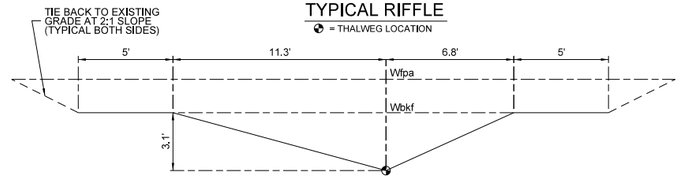


TYPICAL POOL - LEFT MEANDER
= THALWEG LOCATION

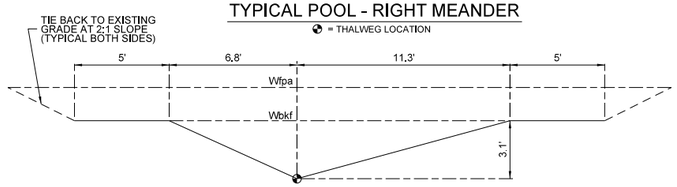
REACH T2-1
STATION 99+75 TO 107+75 = ENHANCEMENT I
"C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION

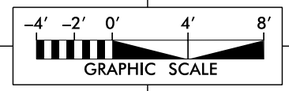


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

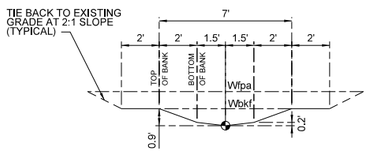


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

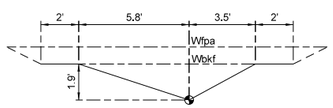
NOTE:
DUE TO STEEP VALLEY BANKS AT STATIONS 103+25 TO 103+75 AND 106+50 TO 108+00, FLOODPLAIN GRADING WILL BE MINIMIZED WHERE APPROPRIATE. EXACT WIDTHS TO BE DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.



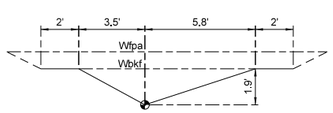
REACH T1A-1
STATION 50+00 TO 53+06 = ENHANCEMENT I
REACH T1A-2
STATION 53+06 TO 54+46 = ENHANCEMENT II
"B4c / C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION

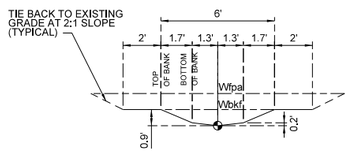


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

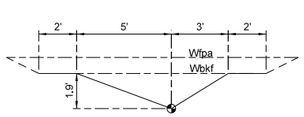


TYPICAL POOL - LEFT MEANDER
= THALWEG LOCATION

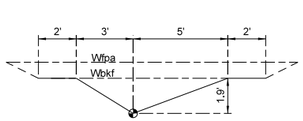
REACH T1A-3
STATION 54+46 TO 59+44 = RESTORATION
"B4c / C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION

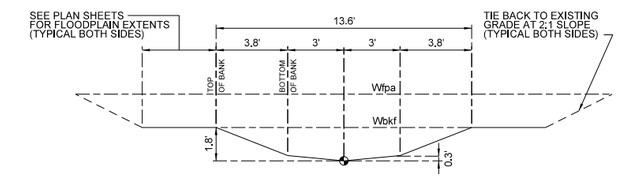


TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

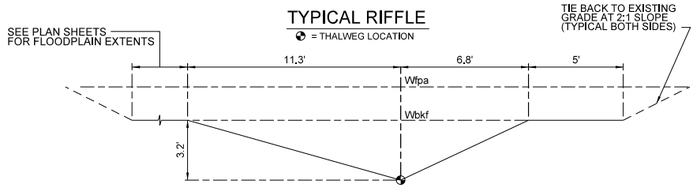


TYPICAL POOL - LEFT MEANDER
= THALWEG LOCATION

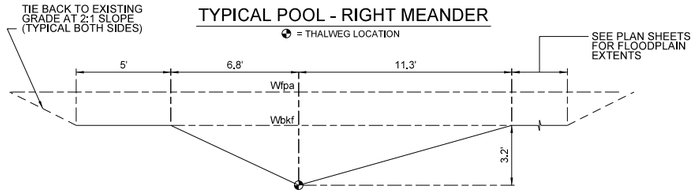
REACH T2-2
STATION 107+75 TO 121+60 = RESTORATION
"C4" STREAM TYPE



TYPICAL RIFFLE
= THALWEG LOCATION



TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION



TYPICAL POOL - RIGHT MEANDER
= THALWEG LOCATION

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN			MAY 2012	
B	SUBMITTED FOR LAND QUALITY PERMIT			JUNE 2012	
C	EDITS PER IRT COMMENTS			SEPT 2012	
SYM.	DESCRIPTION			DATE	APPROVED

REVISIONS

Ecosystem Enhancement Program

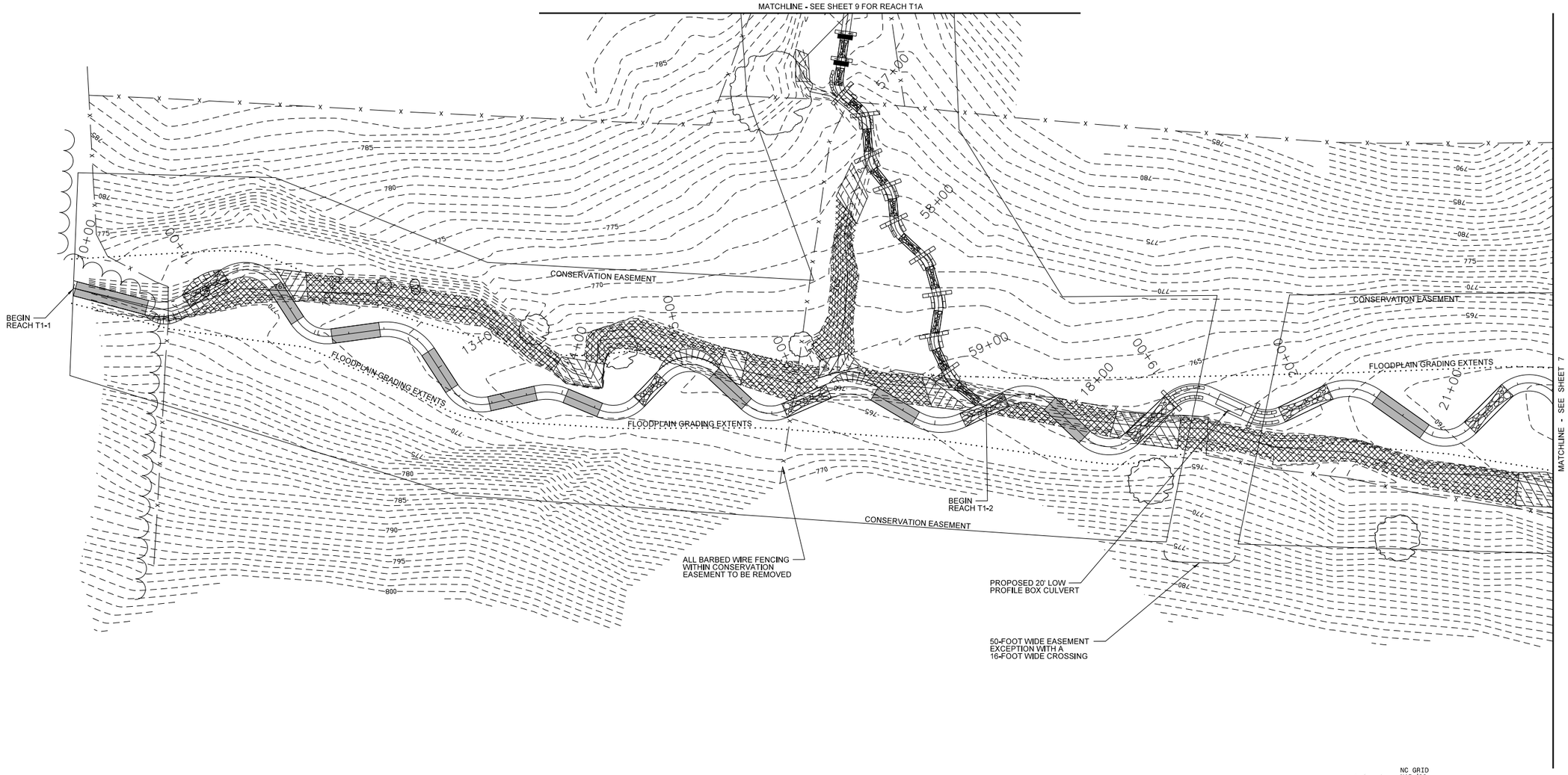
KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MAY 2012
SCALE: SEE SHEET

TYPICAL CROSS SECTIONS

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.



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		SYM.		

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JACOB'S LADDER STREAM MITIGATION PROJECT

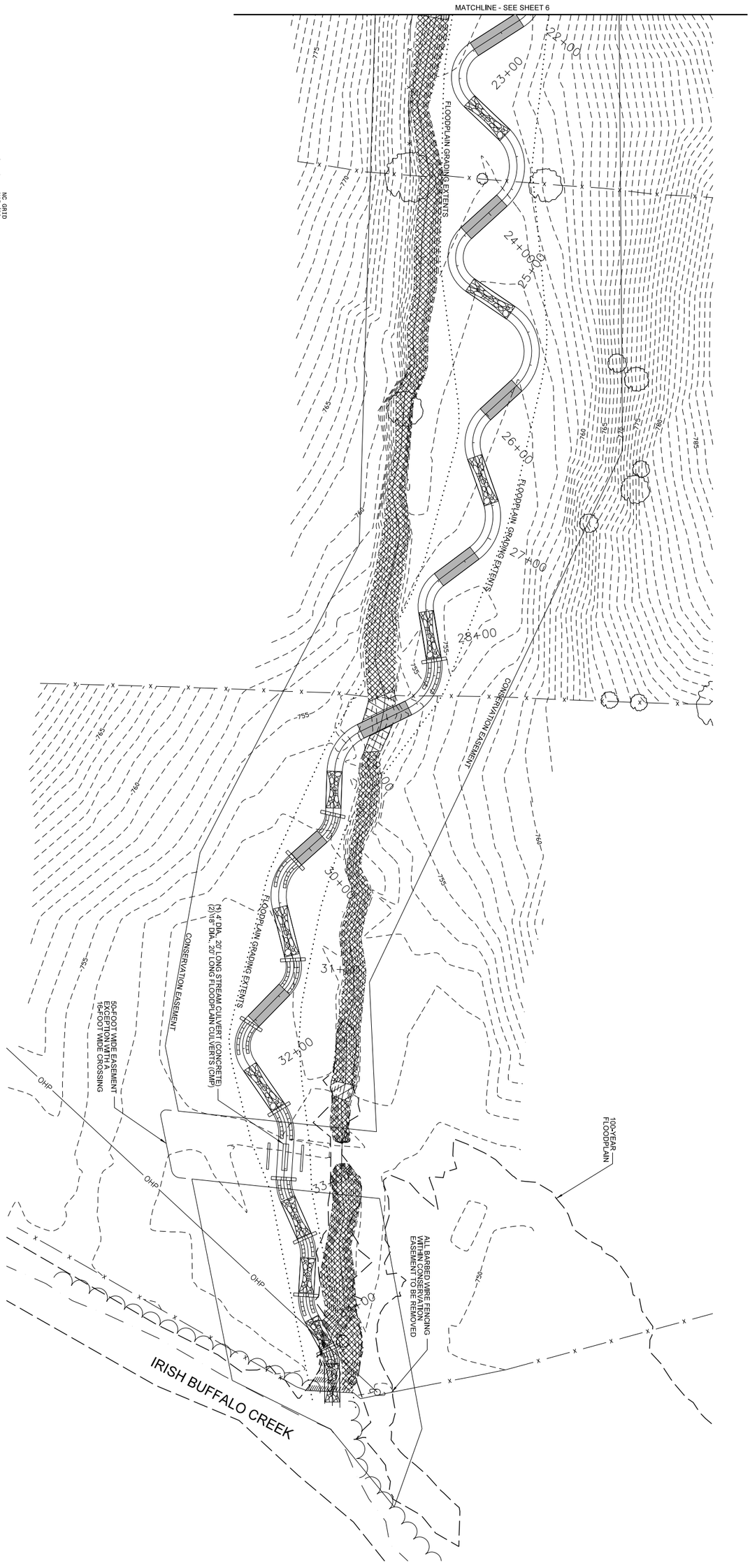
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1-1 AND T1-2

DATE: MAY 2012

SCALE: 1"=40'

SITE PLAN



SHEET 7 OF 23

SITE PLAN

DATE: MAY 2012
SCALE: 1"=40'

JACOB'S LADDER
STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T1-2

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Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
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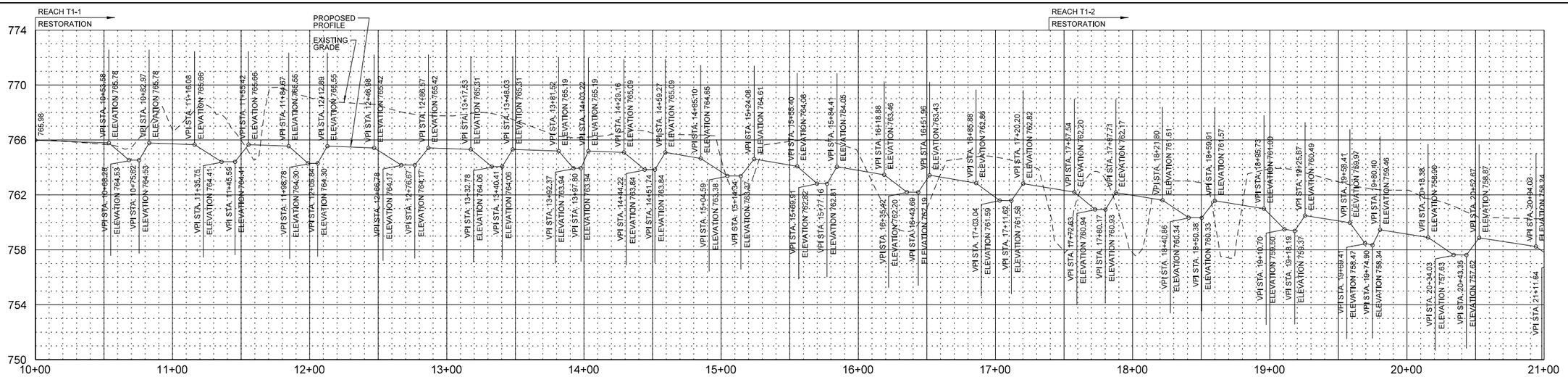
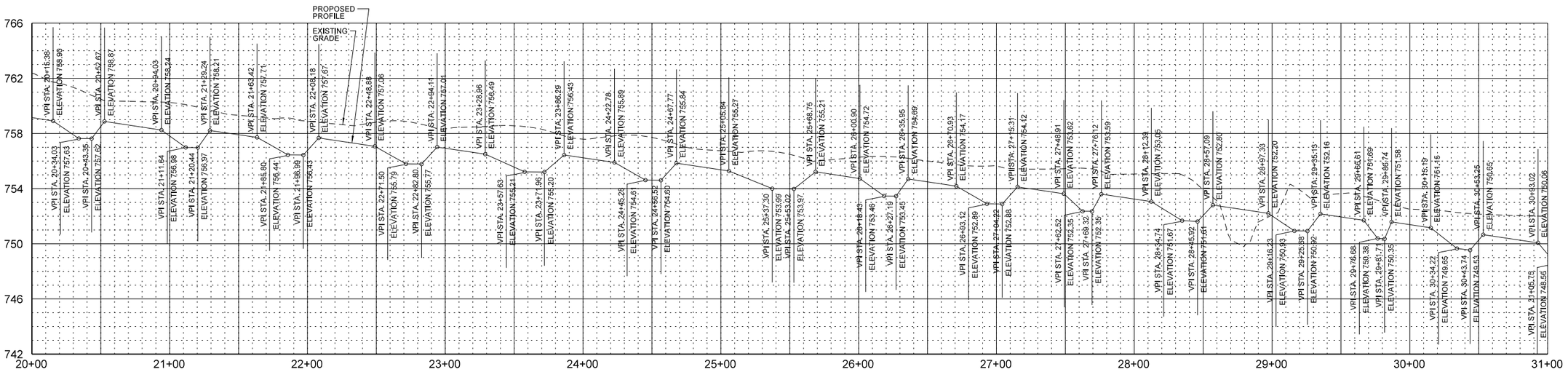
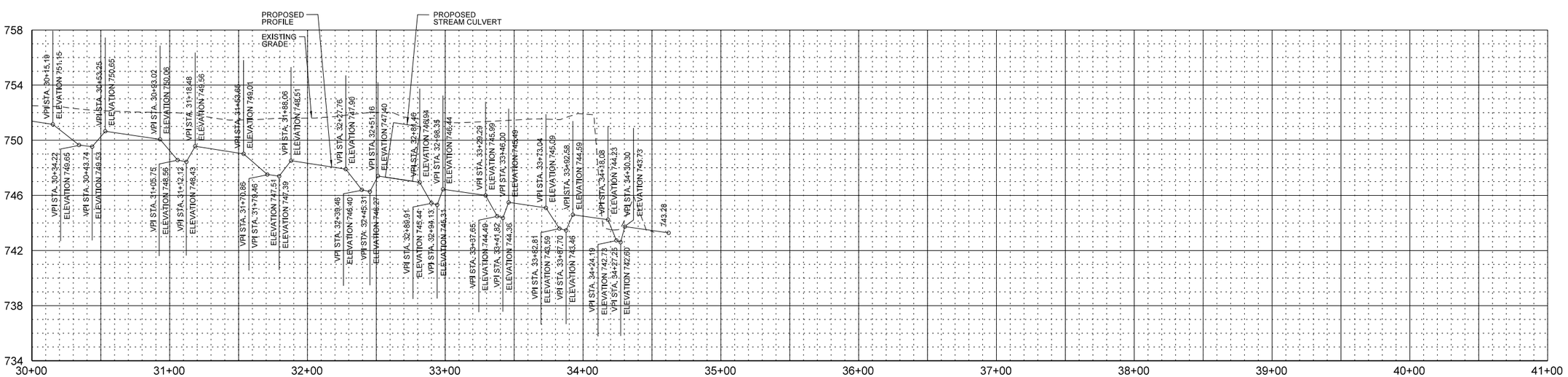
REVISIONS







A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012
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SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1-1 AND T1-2

DATE: MAY 2012

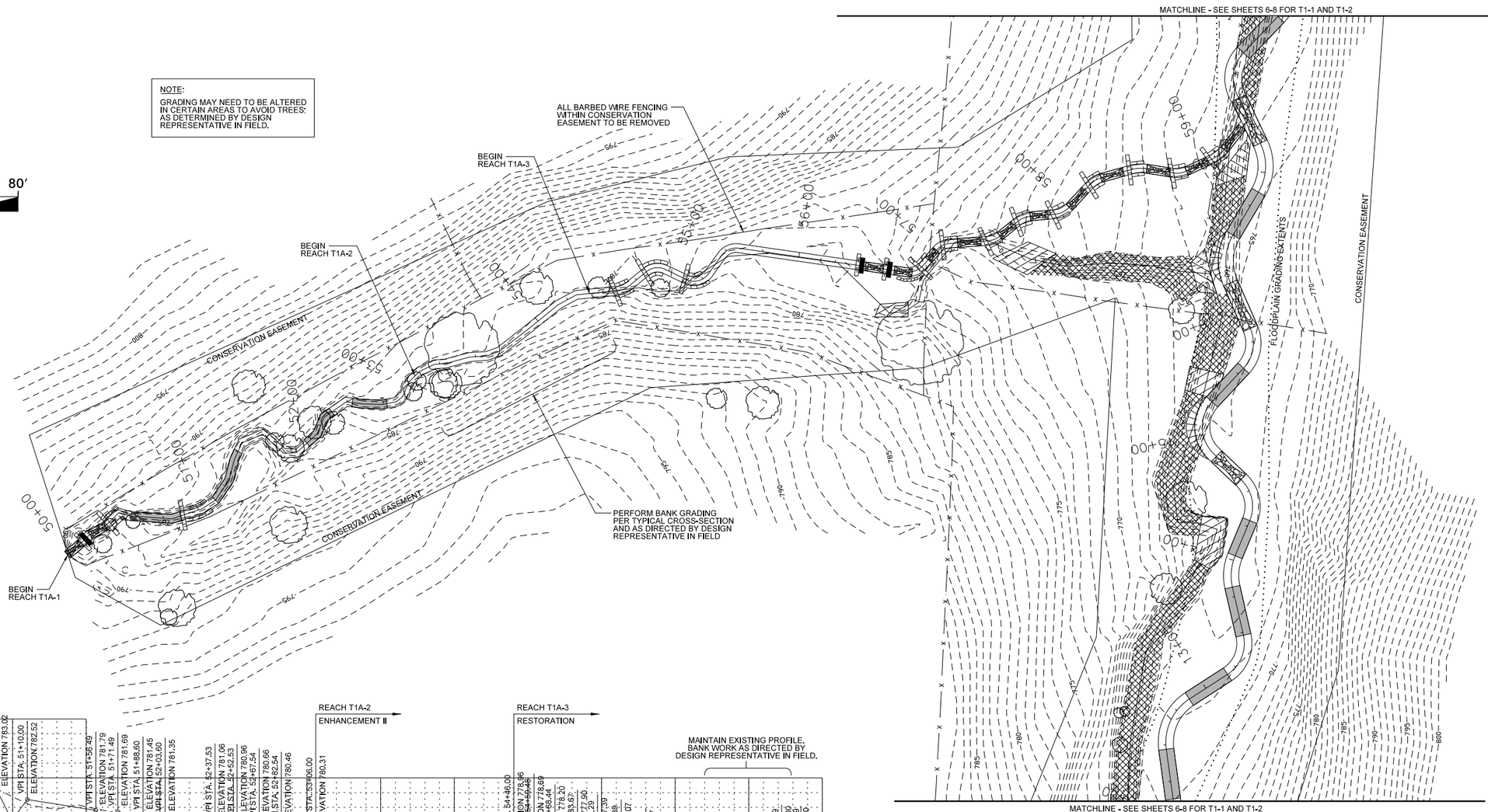
SCALE: 1"=40'

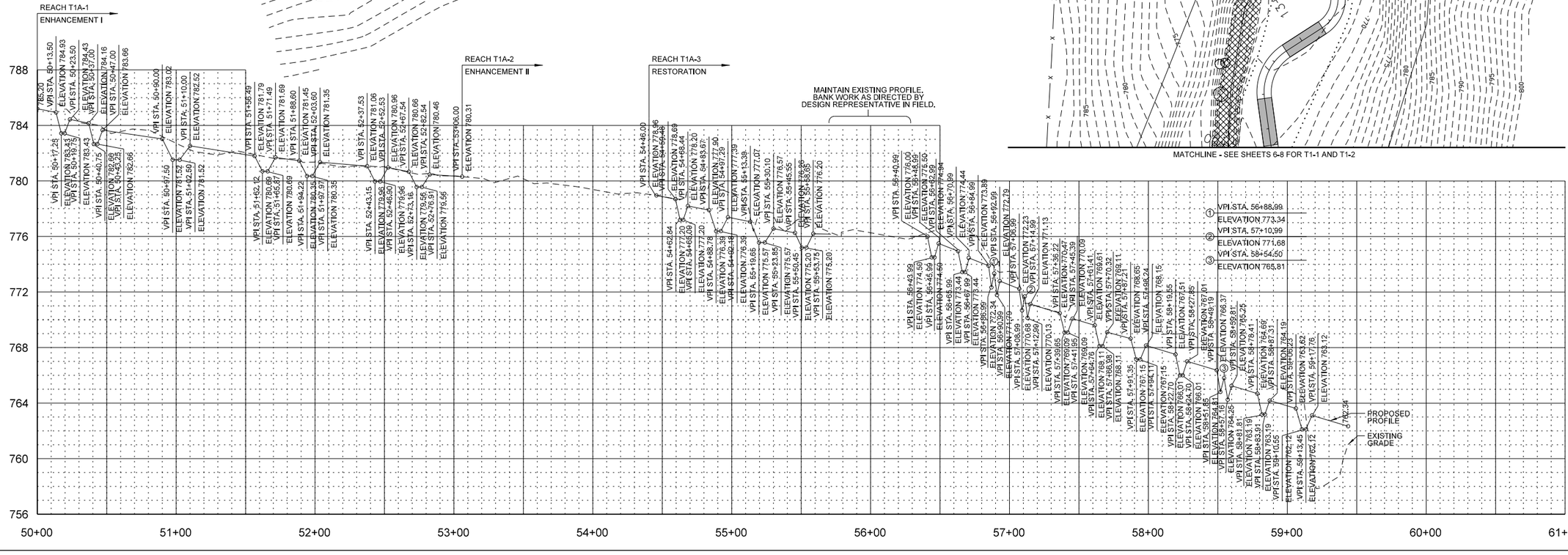
PROFILES (T1-1 & T1-2)

NC GRID
NAD '83

–40′ –20′ 0′ 40′ 80′
GRAPHIC SCALE

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.





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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1A-1, T1A-2, T1A-3

DATE: MAY 2012
SCALE: 1"=40'

SITE PLAN & PROFILE

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

DUE TO STEEP VALLEY WALL BANKS FROM STATIONS 103+25 TO 103+75 AND 106+50 TO 108+00, FLOODPLAIN GRADING WILL BE MINIMIZED WHERE APPROPRIATE. EXACT WIDTHS TO BE DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

CONSERVATION EASEMENT

50-FOOT WIDE EASEMENT EXCEPTION

BEGIN REACH T2-1

BEGIN REACH T2-2. MAINTAIN EXISTING BEDROCK ELEVATION.

FLOODPLAIN GRADING EXTENTS

STABILIZED INCOMING DITCH WITH CLASS B STONE. SEE DETAIL SHEET 4.

ALL BARBED WIRE FENCING WITHIN CONSERVATION EASEMENT TO BE REMOVED

MATCHLINE - SEE SHEET 11

NC GRID NAD 83

–40′ –20′ 0′ 40′ 80′
GRAPHIC SCALE

REACH T2-1
ENHANCEMENT I

REACH T2-2
RESTORATION

PROPOSED PROFILE

EXISTING GRADE

762
758
754
750
746
742
738

100+00 101+00 102+00 103+00 104+00 105+00 106+00 107+00 108+00 109+00 110+00 111+00

	DESCRIPTION	DATE	APPROVED
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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T2-1 AND T2-2

DATE: MAY 2012
SCALE: 1"=40'

SITE PLAN & PROFILE

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

MATCHLINE - SEE SHEET 10

CONSERVATION EASEMENT

ALL BARBED WIRE FENCING WITHIN CONSERVATION EASEMENT TO BE REMOVED

FLOODPLAIN GRADING EXTENTS

(1) 4' DIA., 20' LONG STREAM CULVERT (CONCRETE)
(2) 16" DIA., 20' LONG FLOODPLAIN CULVERTS (CMP)

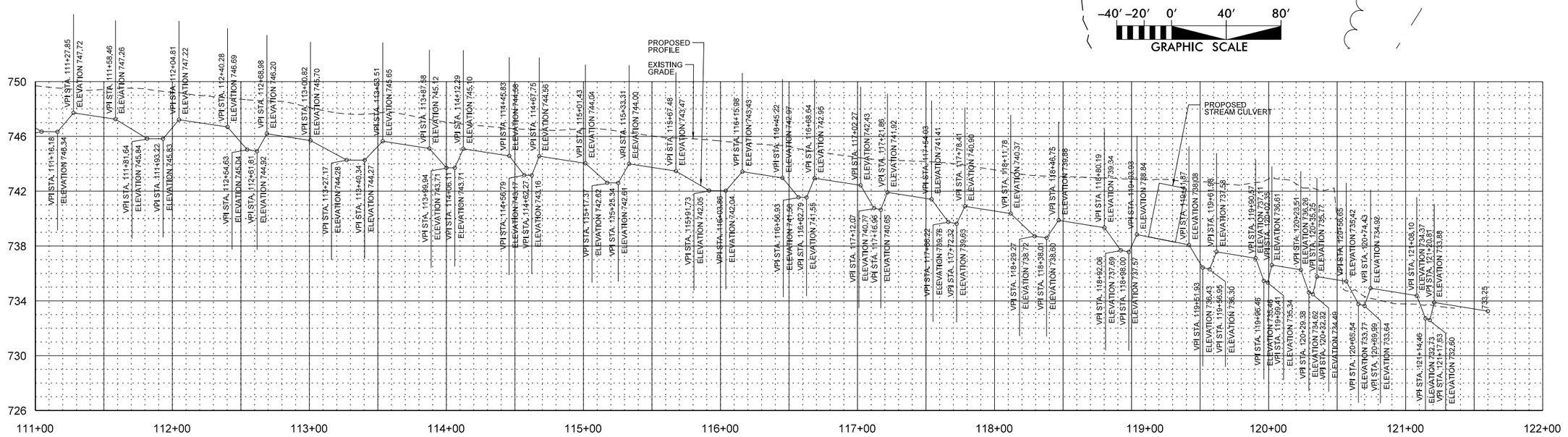
50-FOOT WIDE EASEMENT EXCEPTION WITH A 16 FOOT WIDE CROSSING

100-YEAR FLOODPLAIN

IRISH BUFFALO CREEK

NC GRID NAD '83

–40' –20' 0' 40' 80'
GRAPHIC SCALE



	DESCRIPTION	DATE
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SYM.	REVISIONS	APPROVED

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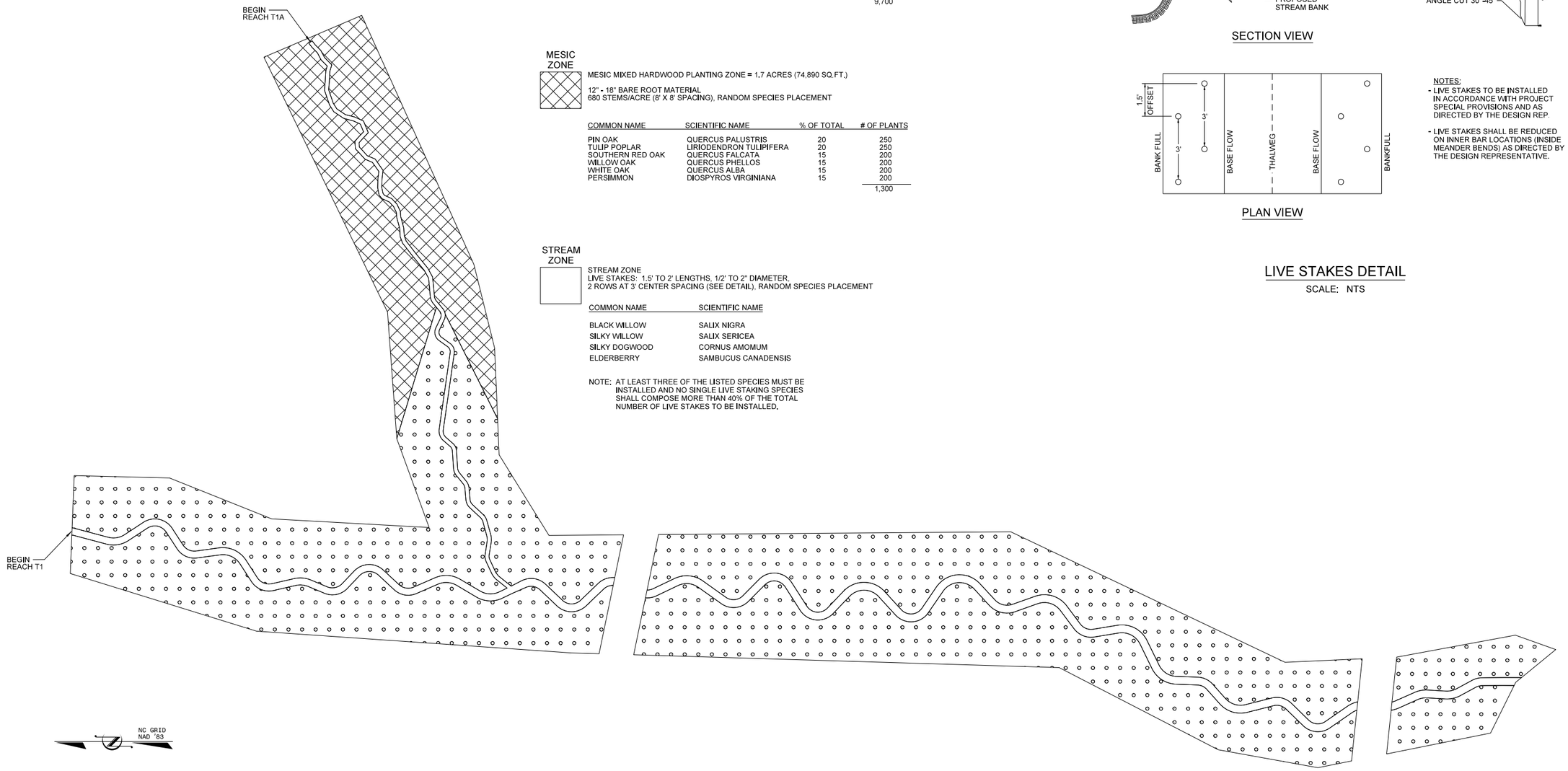
JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2-2

DATE: MAY 2012
SCALE: 1"=40'

SITE PLAN & PROFILE



RIPARIAN ZONE

PIEDMONT ALLUVIAL PLANTING ZONE = 14.2 ACRES (617,579 SQ.FT.)

12" - 18" BARE ROOT MATERIAL
680 STEMS/ACRE (8' X 8' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	25	2,400
GREEN ASH	FRAXINUS PENNSYLVANICA	15	1,450
TULIP POPLAR	LIRIODENDRON TULIPIFERA	15	1,450
SYCAMORE	PLATANUS OCCIDENTALIS	20	1,950
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	15	1,450
WILLOW OAK	QUERCUS PHELLOS	10	1,000
			9,700

MESIC ZONE

MESIC MIXED HARDWOOD PLANTING ZONE = 1.7 ACRES (74,890 SQ.FT.)

12" - 18" BARE ROOT MATERIAL
680 STEMS/ACRE (8' X 8' SPACING), RANDOM SPECIES PLACEMENT

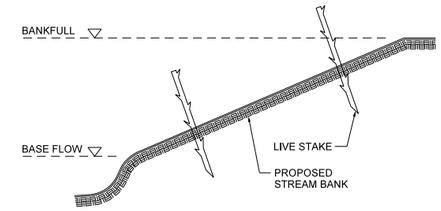
COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
PIN OAK	QUERCUS PALUSTRIS	20	250
TULIP POPLAR	LIRIODENDRON TULIPIFERA	20	250
SOUTHERN RED OAK	QUERCUS FALCATA	15	200
WILLOW OAK	QUERCUS PHELLOS	15	200
WHITE OAK	QUERCUS ALBA	15	200
PERSIMMON	DIOSPYROS VIRGINIANA	15	200
			1,300

STREAM ZONE

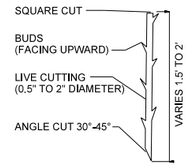
STREAM ZONE
LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2" TO 2" DIAMETER,
2 ROWS AT 3' CENTER SPACING (SEE DETAIL), RANDOM SPECIES PLACEMENT

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

NOTE: AT LEAST THREE OF THE LISTED SPECIES MUST BE INSTALLED AND NO SINGLE LIVE STAKING SPECIES SHALL COMPOSE MORE THAN 40% OF THE TOTAL NUMBER OF LIVE STAKES TO BE INSTALLED.



SECTION VIEW



PLAN VIEW

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

LIVE STAKES DETAIL

SCALE: NTS

	DESCRIPTION	DATE
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B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012
C	EDITS PER IRT COMMENTS	SEPT 2012
	STM.	APPROVED

REVISIONS

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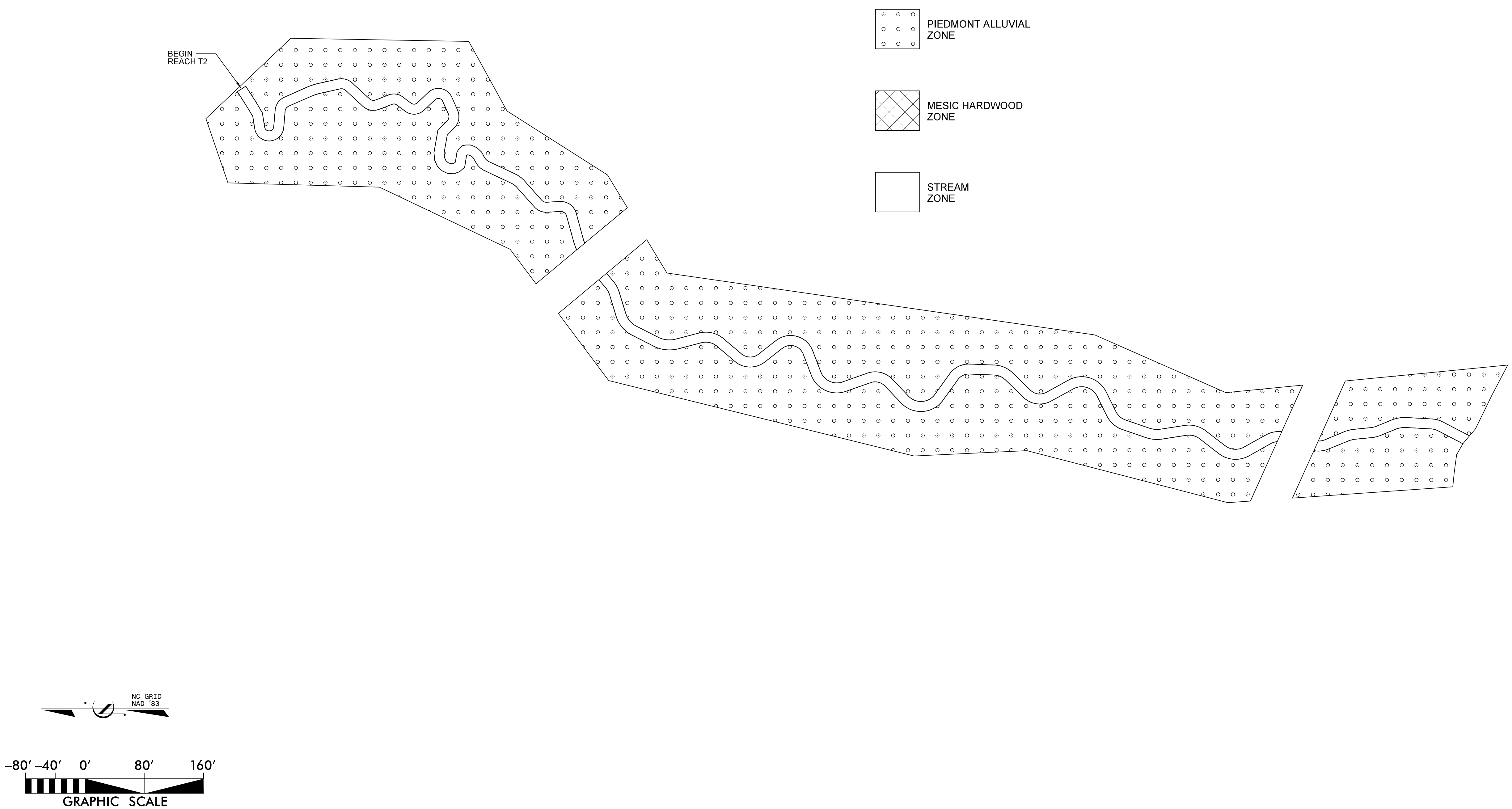
RALEIGH, NORTH CAROLINA 27609

JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACHES T1-1, T1-2, T1A-1, T1A-2, AND T1A-3

DATE: MAY 2012
SCALE: 1"=80'

PLANTING PLAN

SHEET 12 OF 23



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JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACHES T2-1 AND 2-2

DATE: MAY 2012
SCALE: 1"=80'

PLANTING PLAN

SHEET 13 OF 23

LEGEND:

STABILIZED CONSTRUCTION ENTRANCE ..... SCE

LIMITS OF DISTURBANCE ..... LOD

SILT FENCE ..... SF

STRAW WADDLE .....

ROCK SILT SCREEN .....

TEMPORARY STREAM CROSSING .....

TEMPORARY STOCKPILE .....

PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS ..... (2+00, 3+00)

EXISTING STREAM THALWEG .....

LIMITS OF DISTURBANCE = 19.8 AC

JOHN L & BARBARA SECHLER
PARCEL #236 057
DB 610 PG 879

SHEET 18

SCOTT & MICHAEL JENKINS
PARCEL #236 105
DB 1049 PG 660

OSCHO ROY DEAL
REVOCABLE TRUST
PARCEL #236 00901
DB 875 PG 742
PARCEL 2

BEGIN REACH T2

SHEET 19

MARTHA MYERS DEAL
PARCEL #236 061
DB 915 PG 687

D LEE & HILDA GOODNIGHT
PARCEL #236 007

PLANTATION PIPE LINE EASEMENT (LIQUID GAS)

GRAVEL ACCESS ROAD

254-188(1)

254-188(2)

254-187

IRISH BUFFALO CREEK

BEGIN REACH T1A

SHEET 17

LEE GOODNIGHT
PARCEL #236 083
DB 571 PG 320

OSCHO ROY DEAL
PARCEL #236 024
DB 266 PG 155

OSCHO ROY DEAL
PARCEL #236 024
DB 266 PG 155

MARTHA MYERS DEAL
PARCEL #236 061
DB 915 PG 687

OSCHO ROY DEAL
REVOCABLE TRUST
PARCEL #236 011
DB 756 PG 923
DB 254-PG 187
DB 254 PG 188
DB 326 PG 258

SHEET 15

SHEET 16

SHIRLEY ALLEN
PARCEL #236 096
DB 998 PG 993

BEGIN REACH T1

SHIRLEY ALLEN
PARCEL #236 096
DB 998 PG 993

ROY RHODES
C/O OSCHO DEAL
PARCEL #236 006
DB 872 PG 335

OSCHO ROY DEAL
REVOCABLE TRUST
PARCEL #236 085
DB 875 PG 742

OSCHO ROY DEAL
REVOCABLE TRUST
PARCEL #236 078
DB 875 PG 742
PARCEL 3

SCE

SAW ROAD - S.R. 1350

NC GRID
NAD '83

–150′ –75′ 0′ 150′ 300′
GRAPHIC SCALE

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SYM.	DESCRIPTION	DATE	APPROVED

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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1-1 AND T1-2

DATE: MAY 2012

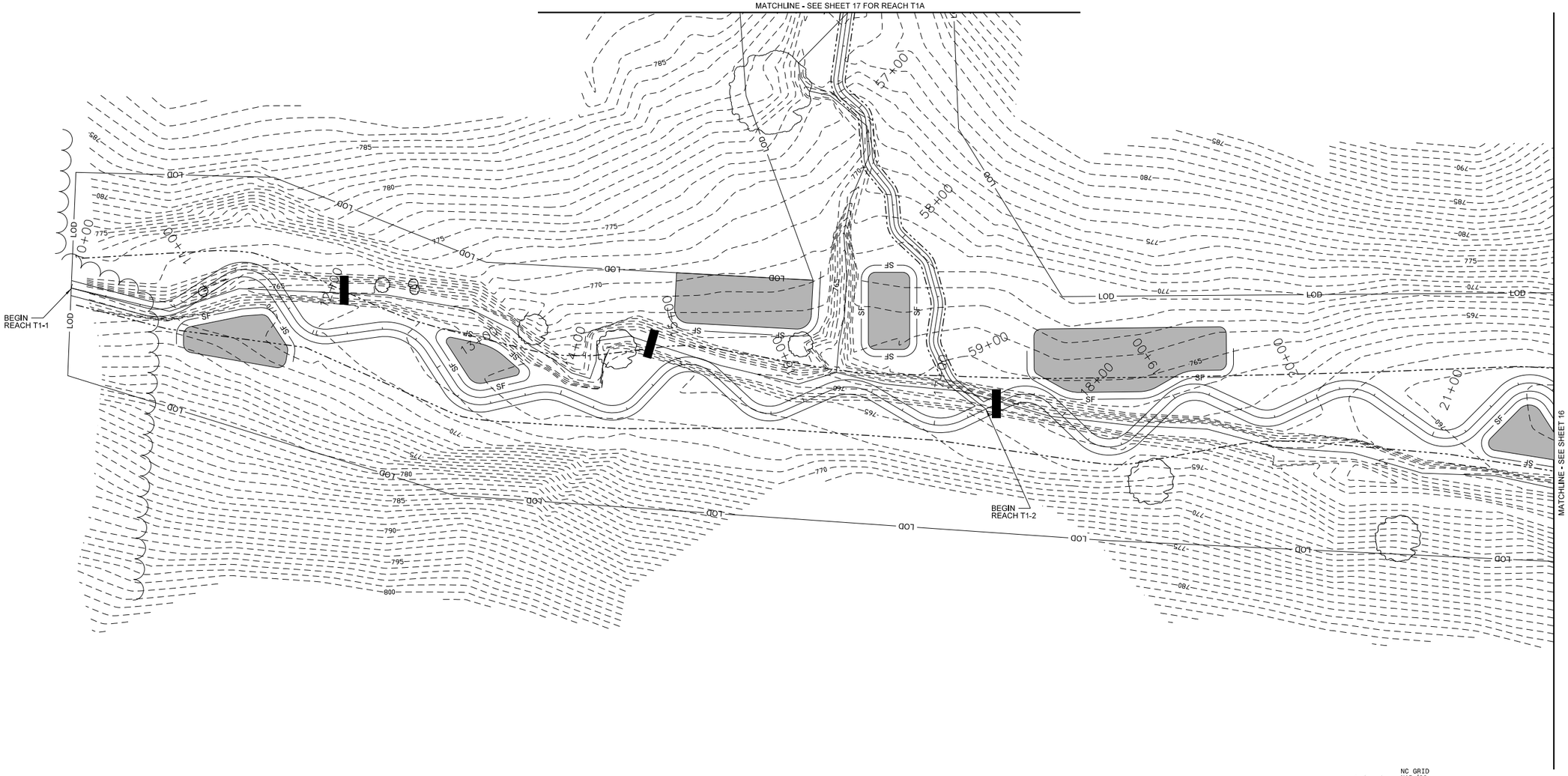
SCALE: 1"=150'

SEDIMENTATION AND EROSION CONTROL PLAN

LEGEND:

- STABILIZED CONSTRUCTION ENTRANCE . . . . . SCE
- LIMITS OF DISTURBANCE . . . . . LOD
- SILT FENCE . . . . . SF
- STRAW WADDLE . . . . .
- ROCK SILT SCREEN . . . . .
- TEMPORARY STREAM CROSSING . . . . .
- TEMPORARY STOCKPILE . . . . .
- PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS . . . . . 12+00 13+00
- EXISTING STREAM THALWEG . . . . .

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES: AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.



NC GRID
NAD '83

–40′ –20′ 0′ 40′ 80′
GRAPHIC SCALE

A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012	
C	EDITS PER IRT COMMENTS	SEPT 2012	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC
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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1-1 AND T1-2

DATE: MAY 2012
SCALE: 1"=40'

SEDIMENTATION AND EROSION CONTROL PLAN

LEGEND:

- STABILIZED CONSTRUCTION ENTRANCE ..... SCE
- LIMITS OF DISTURBANCE ..... LOD
- SILT FENCE ..... SF
- STRAW WADDLE .....
- ROCK SILT SCREEN .....
- TEMPORARY STREAM CROSSING .....
- TEMPORARY STOCKPILE .....
- PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS ..... (2+00, 3+00)
- EXISTING STREAM THALWEG .....

NOTE:
GRADING MAY NEED TO BE ALTERED IN CERTAIN AREAS TO AVOID TREES; AS DETERMINED BY DESIGN REPRESENTATIVE IN FIELD.

MATCHLINE - SEE SHEET 15

STAGING AREA

IRISH BUFFALO CREEK

SAW ROAD - S.R. 1350

NC GRID NAD '83

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GRAPHIC SCALE

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CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T1-2

DATE: MAY 2012
SCALE: 1"=40'

SEDIMENTATION AND EROSION CONTROL PLAN

SHEET 16 OF 23

LEGEND:

STABILIZED CONSTRUCTION ENTRANCE ..... SCE

LIMITS OF DISTURBANCE ..... LOD

SILT FENCE ..... SF

STRAW WADDLE .....

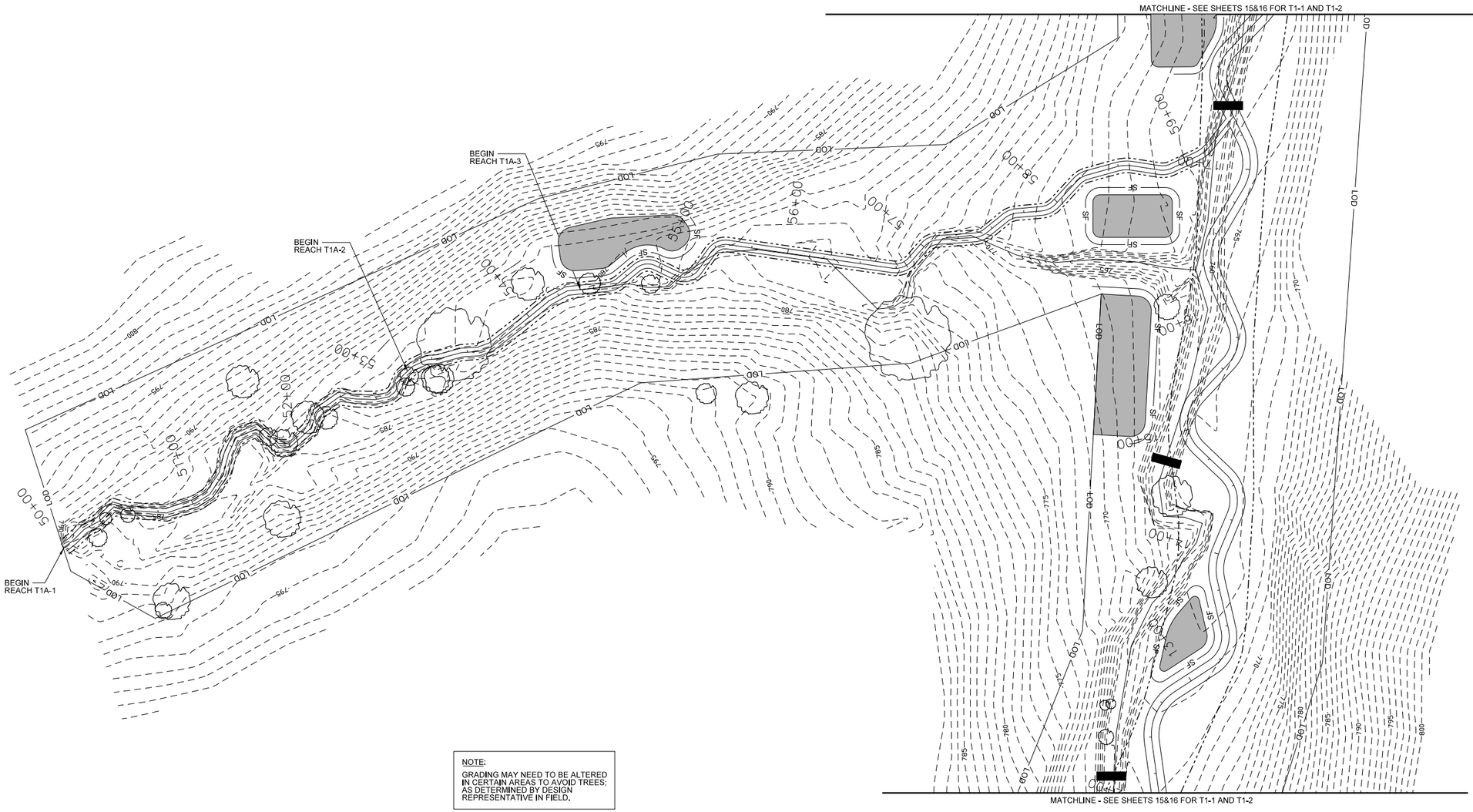
ROCK SILT SCREEN .....

TEMPORARY STREAM CROSSING .....

TEMPORARY STOCKPILE .....

PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS ..... 2+00 3+00

EXISTING STREAM THALWEG .....



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NC GRID NAD 83

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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1A-1, T1A-2, T1A-3

DATE: MAY 2012

SCALE: 1"=40'

SEDIMENTATION AND EROSION CONTROL PLAN

LEGEND:

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- LIMITS OF DISTURBANCE . . . . . LOD
- SILT FENCE . . . . . SF
- STRAW WADDLE . . . . .
- ROCK SILT SCREEN . . . . .
- TEMPORARY STREAM CROSSING . . . . .
- TEMPORARY STOCKPILE . . . . .
- PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS . . . . . (2+00, 3+00)
- EXISTING STREAM THALWEG . . . . .

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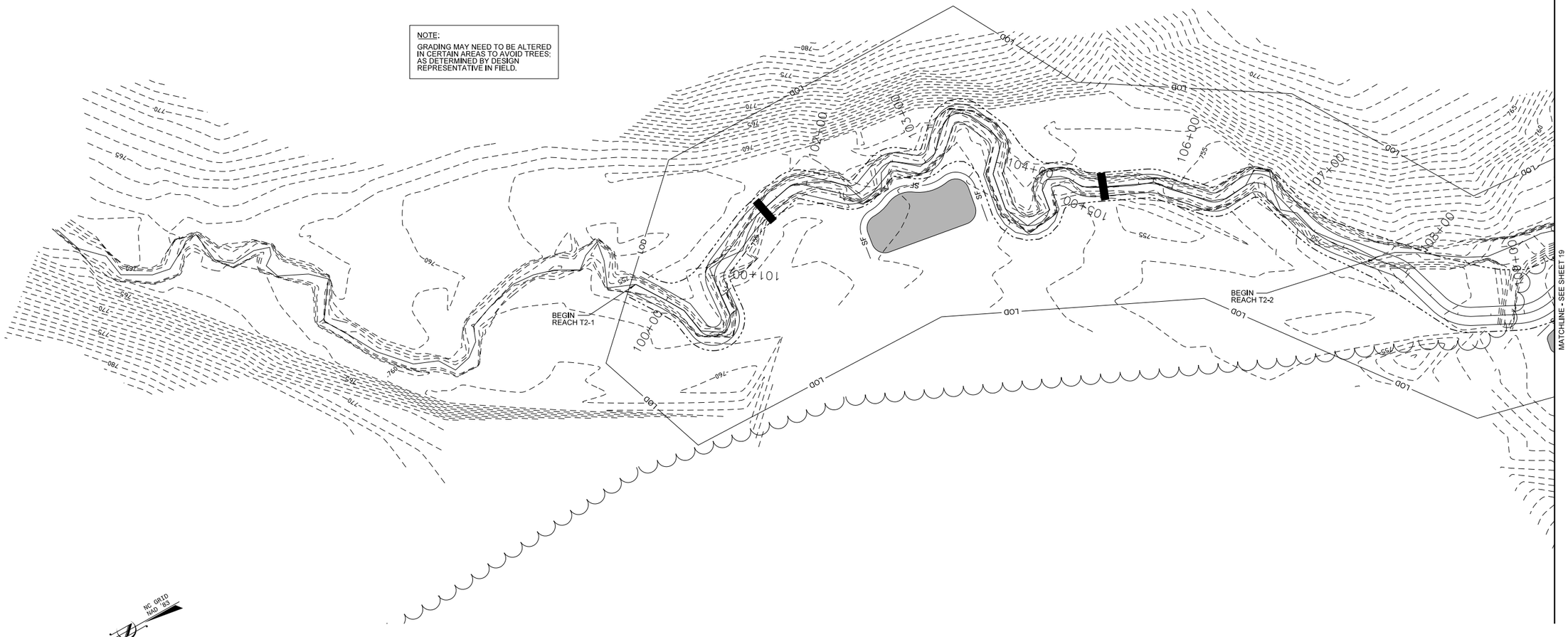

NC GRID NAD '83

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GRAPHIC SCALE

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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T2-1 AND T2-2

DATE: MAY 2012

SCALE: 1"=40'

SEDIMENTATION AND EROSION CONTROL PLAN

LEGEND:

- STABILIZED CONSTRUCTION ENTRANCE ..... SCE
- LIMITS OF DISTURBANCE ..... LOD
- SILT FENCE ..... SF
- STRAW WADDLE .....
- ROCK SILT SCREEN .....
- TEMPORARY STREAM CROSSING .....
- TEMPORARY STOCKPILE .....
- PROPOSED STREAM THALWEG W/ APPROX. BANKFULL LIMITS ..... (2+00, 3+00)
- EXISTING STREAM THALWEG .....

NOTE:
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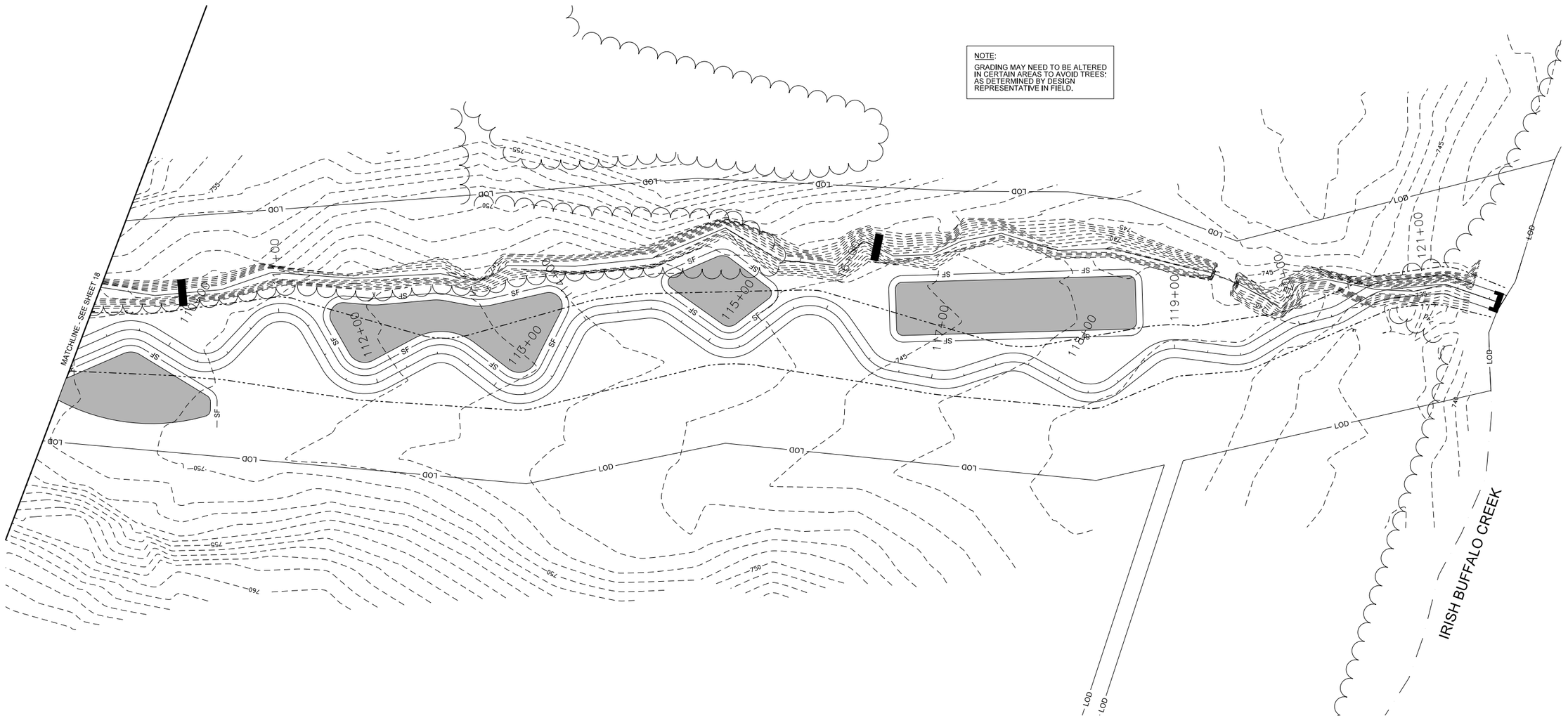

NC GRID NAD 83

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JACOB'S LADDER STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACH T2-2

DATE: MAY 2012
SCALE: 1"=40'

SEDIMENTATION AND EROSION CONTROL PLAN

SHEET 19 OF 23

SEEDBED PREPARATION

THE SEEDBED SHALL BE COMPRISED OF LOOSE UNCOMPACTED SOIL. THIS MAY REQUIRE MECHANICAL LOOSENING OF THE SOIL. SOIL AMENDMENTS SHOULD FOLLOW THE FERTILIZER AND LIMING DESCRIPTION IN THE FOLLOWING SECTIONS. FOLLOWING SEEDING, MULCHING SHALL FOLLOW THE BELOW APPLICATION METHODS AND AMOUNTS.

MULCHING

SEEDED AREAS ARE TO BE PROTECTED BY SPREADING STRAW MULCH UNIFORMLY TO FORM A CONTINUOUS BLANKET (75% COVERAGE = 2 TONS/ACRE) OVER SEEDED AREAS. CONTRACTOR MAY PROPOSE ALTERNATE METHODS OF SEED, FERTILIZER AND LIMING (HYDRO-SEEDING) UPON SUBMISSION TO THE DESIGNER OF CALCULATIONS SHOWING THE EQUIVALENCY OF THE PROPOSED METHOD.

TEMPORARY SEED MIX

THE CONTRACTOR SHALL UTILIZE THE FOLLOWING SEED/FERTILIZER MIX IN SEEDING ALL DISTURBED AREAS WITHIN THE PROJECT LIMITS:

WINTER MIX (AUG.15-MAY 1)
- RYE GRAIN · · · · · · · · SECALE CEREALE · · · · · 20 LBS / ACRE
- WHEAT · · · · · · · · · · · TRITICUM AESTIVUM · · · 10 LBS / ACRE

SUMMER MIX (MAY 1-AUG.15)
- GERMAN MILLET · · · · · SETARIA ITALICA · · · · · 5 LBS / ACRE
- BROWNTOP MILLET · · · UROCHLOA RAMOSA · · · 5 LBS / ACRE

FERTILIZER · 500 LBS / ACRE
LIMESTONE · 4000 LBS / ACRE

FERTILIZER SHALL BE 10-20-20 ANALYSIS. UPON WRITTEN APPROVAL OF THE SITE SUPERVISOR, A DIFFERENT ANALYSIS OF FERTILIZER MAY BE USED PROVIDED THE 1-2-2 RATIO IS MAINTAINED AND THE RATE OF APPLICATION ADJUSTED TO PROVIDE THE SAME AMOUNT OF PLANT FOOD AS A 10-20-20 ANALYSIS.

PERMANENT SEED MIX

THE CONTRACTOR SHALL UTILIZE THE FOLLOWING SEED MIX AND FERTILIZER SPECIFICATION IN ALL AREAS INSIDE THE RIPARIAN BUFFER ZONES, INCLUDING THE STREAM BANKS:

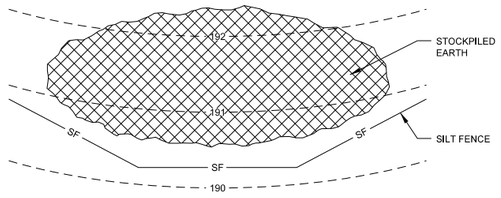
FERTILIZER AND LIMESTONE SHALL BE APPLIED AT THE RATE OF 500 LBS / ACRE AND 4000 LBS / ACRE, RESPECTIVELY. FERTILIZER SHALL BE 10-20-20 ANALYSIS. UPON WRITTEN APPROVAL OF THE DESIGN REPRESENTATIVE, A DIFFERENT ANALYSIS OF FERTILIZER MAY BE USED BASED ON SOIL TESTING RESULTS AND AS APPROVED BY THE DESIGN REPRESENTATIVE.

SUMMER MIX (MAY 15 – AUGUST 15)

SPECIES	APPLICATION RATE (IN MIX) % OF MIX	LBS / ACRE
ORCHARDGRASS – DACTYLIS GLOMERATA	5	1.5
BLUESTEM – ANDROPOGON GLOMERATUS	5	1.5
VIRGINIA WILDRYE -- ELYMUS VIRGINICUS	5	1.5
RIVER OATS -- CHASMANTHIUM LATIFOLIUM	5	1.5
PURPLE LOVE GRASS -- ERAGROSTIS SPECTABILIS	5	1.5
DEERTONGUE -- PANICUM CLANDESTINUM	25	7.5
SWITCHGRASS -- PANICUM VIRGATUM	25	7.5
PEARL MILLET -- PENNISETUM GLAUCOMA	25	7.5
TOTALS	100	30

WINTER MIX (AUGUST 15 -- MAY 15)

SPECIES	APPLICATION RATE (IN MIX) % OF MIX	LBS / ACRE
ORCHARDGRASS – DACTYLIS GLOMERATA	5	1.5
BLUESTEM – ANDROPOGON GLOMERATUS	5	1.5
VIRGINIA WILDRYE -- ELYMUS VIRGINICUS	5	1.5
RIVER OATS – CHASMANTHIUM LATIFOLIUM	5	1.5
PURPLE LOVE GRASS -- ERAGROSTIS SPECTABILIS	5	1.5
DEERTONGUE – DICHANTHELIUM CLANDESTINUM	25	7.5
SWITCHGRASS – PANICUM VIRGATUM	25	7.5
RYE GRAIN -- SECALE CEREALE	25	7.5
TOTALS	100	30



NOTES:

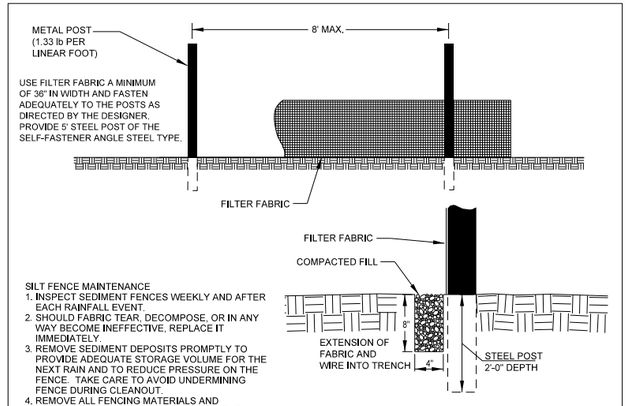
STOCKPILE LOCATIONS DEPICTED ON SITE PLANS ARE APPROXIMATE AND ARE SUBJECT TO CHANGE AT THE DISCRETION OF THE DESIGN REPRESENTATIVE.

TEMPORARY SEEDING MUST BE APPLIED TO STOCKPILES IF NOT RELOCATED WITHIN 7 DAYS.

ALL STOCKPILES SHALL BE WITHIN LIMITS OF DISTURBANCE.

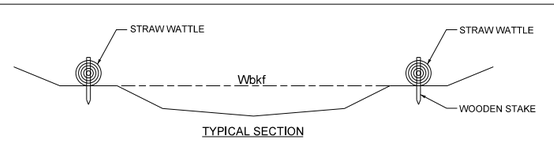
SILT FENCE SHALL BE INSTALLED DOWN GRADIENT OF ALL STOCK-PILES. ANY STOCKPILE LOCATED BETWEEN BOTH THE EXISTING AND PROPOSED STREAM CENTERLINES WILL REQUIRE SILT FENCE TO BE INSTALLED COMPLETELY AROUND THE STOCKPILE.

STOCKPILE DETAIL
NOT TO SCALE



SILT FENCE MAINTENANCE
1. INSPECT SEDIMENT FENCES WEEKLY AND AFTER EACH RAINFALL EVENT.
2. SHOULD FABRIC TEAR, DECOMPOSE, OR IN ANY WAY BECOME INEFFECTIVE, REPLACE IT IMMEDIATELY.
3. REMOVE SEDIMENT DEPOSITS PROMPTLY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING FENCE DURING CLEANOUT.
4. REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED, INSPECTED AND APPROVED. BRING THE DISTURBED AREA TO GRADE AND STABILIZE AS SHOWN IN THE VEGETATION PLAN.

SILT FENCE DETAIL
NOT TO SCALE



TYPICAL SECTION

NOTES:

WATTLES SHALL BE INSTALLED ACCORDING TO THE MANUFACTURERS SPECIFICATIONS.

WATTLES SHALL BE INSTALLED AS SHOWN ON PLANS FOLLOWING CHANNEL GRADING. SEE PLAN SHEETS 15-19 FOR EXACT LOCATIONS.

WATTLES SHALL BE INSTALLED ADJACENT TO THE TOP OF THE STREAM BANKS IN ANY OTHER LOCATIONS WHERE SOIL DISTURBANCE WILL OCCUR IN PROXIMITY OF THE STREAM CHANNEL.

STRAW WATTLE
NOT TO SCALE

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STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MAY 2012
SCALE: NTS

SEDIMENTATION AND EROSION CONTROL PLAN

SHEET 20 OF 23

NOTES:

-MATTING SHALL BE INSTALLED PRIOR TO THE INTRODUCTION OF WATER TO A STREAM SECTION.

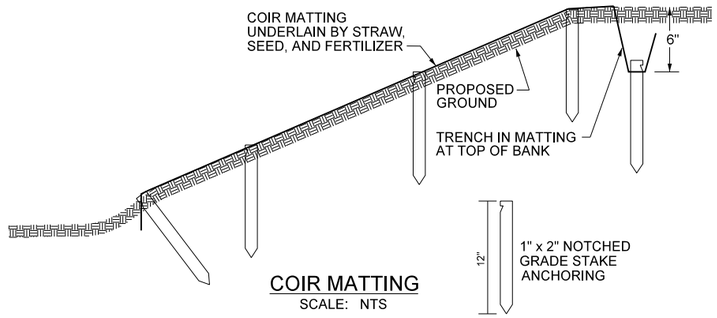
-ALL DISTURBED AREAS INSIDE FLOOD-PLAIN EXTENTS SHALL BE SEEDED DAILY.

-GROUND SHALL BE PREPARED AND SEED & FERTILIZER APPLIED ACCORDING TO PROJECT SPECIAL PROVISIONS.

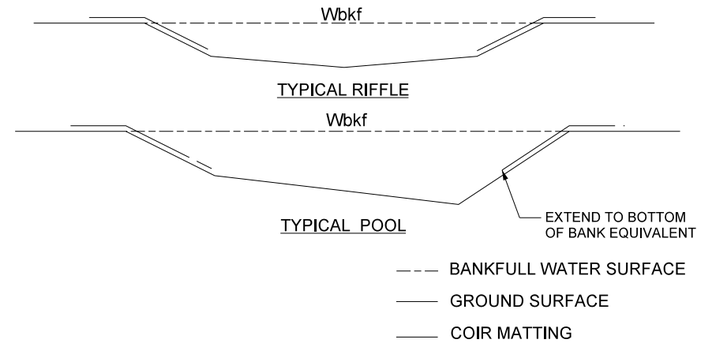
-MATTING SHALL BE INSTALLED ALONG BOTH SIDES OF NEW STREAM LENGTH.

-MATTING SHALL EXTEND FROM TOE OF SLOPE TO THE TOP OF BANK.

-MATTING SHALL BE APPLIED AND STAKED IN ACCORDANCE WITH PROJECT SPECIAL PROVISIONS.

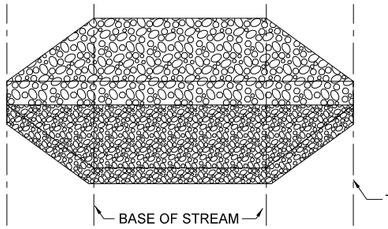


COIR MATTING
SCALE: NTS



EXAMPLE COIR MATTING PLACEMENT
NOT TO SCALE

ROCK SILT SCREEN MAINTENANCE:
1. REMOVE SEDIMENT WHEN IT ACCUMULATES TO ONE-HALF THE DESIGN VOLUME.
2. CHECK STRUCTURE AND ABUTMENTS FOR EROSION, PIPING, OR ROCK DISPLACEMENT. REPAIR IMMEDIATELY.
3. REPLACE AGGREGATE ON INSIDE FACE OF STRUCTURE WHEN SEDIMENT POOL DOES NOT DRAIN BETWEEN STORMS.
4. ADD FINE GRAVEL TO UPSTREAM FACE OF SCREEN IF SEDIMENT POOL DRAINS TOO RAPIDLY FOLLOWING A STORM.
5. REMOVE SILT SCREEN WHEN CONTRIBUTING DRAINAGE AREA HAS BEEN PERMANENTLY STABILIZED, INSPECTED AND APPROVED. REMOVE ALL WATER AND SEDIMENT PRIOR TO REMOVING SCREEN. DISPOSE OF WASTE MATERIAL IN DESIGNATED DISPOSAL AREA.



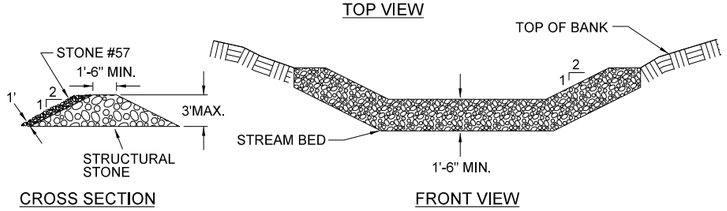
TOP VIEW

NOTES:

USE CLASS I STONE FOR STRUCTURAL STONE.

USE STONE NO. 57 STONE FOR SEDIMENT CONTROL.

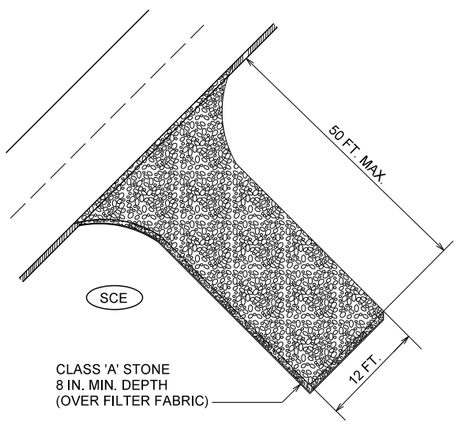
CONSTRUCT DAM A MAXIMUM OF 1 FT. ABOVE NORMAL FLOW DEPTH.



CROSS SECTION

FRONT VIEW

TEMPORARY ROCK SILT SCREEN
NOT TO SCALE

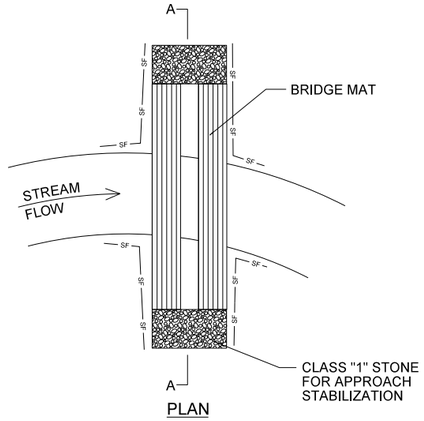


NOTES:
1. TURNING RADIUS SUFFICIENT TO ACCOMODATE LARGE TRUCKS SHALL BE PROVIDED.
2. ENTRANCE(S) SHOULD BE LOCATED TO PROVIDE FOR UTILIZATION BY ALL CONSTRUCTION VEHICLES.
3. MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO STREETS. PERIODIC TOPDRESSING WITH STONE WILL BE NECESSARY.
4. ANY MATERIAL TRACKED ONTO THE ROADWAY MUST BE CLEANED UP IMMEDIATELY.
5. GRAVEL CONSTRUCTION ENTRANCE SHALL BE LOCATED AT ALL POINTS OF INGRESS AND EGRESS UNTIL SITE IS STABILIZED. FREQUENT CHECKS OF THE DEVICE AND TIMELY MAINTENANCE MUST BE PROVIDED.

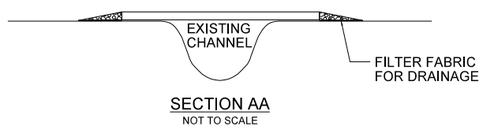
SCE MAINTENANCE:
1. INSPECT ENTRANCE/EXIT PAD AND SEDIMENT DISPOSAL AREA WEEKLY AND AFTER HEAVY RAINS OR HEAVY USE.
2. RESHAPE PAD AS NEEDED FOR DRAINAGE AND RUNOFF CONTROL.
3. TOPDRESS WITH CLEAN STONE, AS NEEDED.
4. IMMEDIATELY REMOVE MUD AND SEDIMENT TRACKED OR WASHED ONTO PUBLIC ROAD.

STABILIZED CONSTRUCTION ENTRANCE / ACCESS ROAD
SCALE: NTS

STREAM CROSSING MAINTENANCE:
1. INSPECT TEMPORARY CROSSING AFTER EACH RAINFALL EVENT FOR ACCUMULATION OF DEBRIS, BLOCKAGE, EROSION OF ABUTMENTS AND OVERFLOW AREAS, CHANNEL SCOUR, RIPRAP DISPLACEMENT, OR PIPING ALONG CULVERTS.
2. REMOVE DEBRIS, REPAIR AND REINFORCE DAMAGED AREAS IMMEDIATELY TO PREVENT FURTHER DAMAGE TO THE INSTALLATION.



PLAN



SECTION AA
NOT TO SCALE

1. BRIDGE LOCATIONS DEPICTED ON SITE PLANS ARE APPROXIMATE AND ARE SUBJECT TO CHANGE DEPENDING ON THE AREA THAT IS BEING WORKED UPON.
2. WIDTH OF EACH MAT IS DEPENDENT ON THE SIZE OF THE EQUIPMENT MEANT TO CROSS IT.
3. DISTANCE BETWEEN MATS IS DEPENDENT ON THE DISTANCE BETWEEN TRACKS ON THE EQUIPMENT MEANT TO CROSS IT.
4. APPROACH STABILIZATION, COMPOSED OF CLASS 1 STONE, WILL BE REQUIRED FOR EACH SECTION OF THE BRIDGE.

BRIDGE MAT STREAM CROSSING
PLACE AS SPECIFIED IN THE PLANS AND APPROVED BY THE DESIGNER

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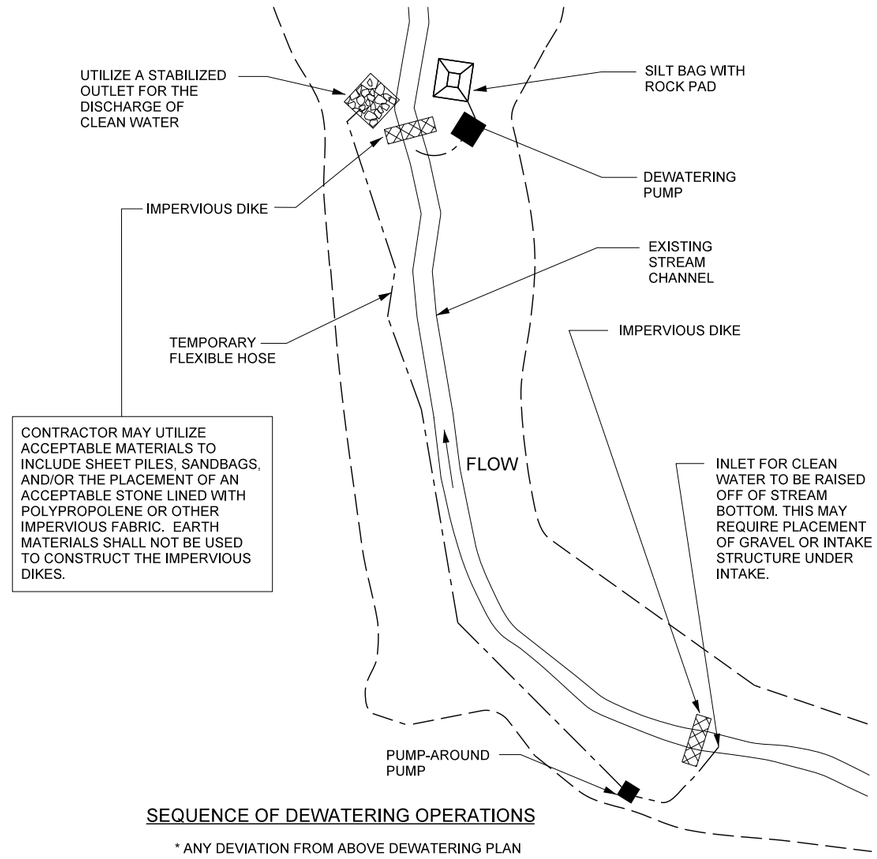
SEDIMENTATION AND EROSION CONTROL PLAN

EXAMPLE OF PUMP-AROUND OPERATION

NOT TO SCALE



CONTRACTOR MAY UTILIZE ACCEPTABLE MATERIALS TO INCLUDE SHEET PILES, SANDBAGS, AND/OR THE PLACEMENT OF AN ACCEPTABLE STONE LINED WITH POLYPROPOLENE OR OTHER IMPERVIOUS FABRIC. EARTH MATERIALS SHALL NOT BE USED TO CONSTRUCT THE IMPERVIOUS DIKES.

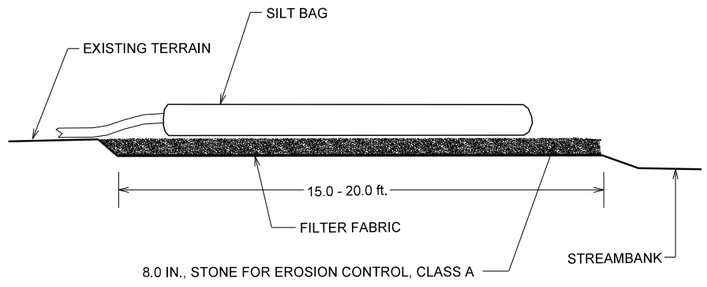
SEQUENCE OF DEWATERING OPERATIONS

* ANY DEVIATION FROM ABOVE DEWATERING PLAN WILL REQUIRE DESIGNER AND NCDLQ APPROVAL.

1. INSTALL SILT BAGS(S) AND ROCK PAD(S).
2. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
3. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS. DEWATER ENTRAPPED AREA.
5. PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLANS.
6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE (DOWNSTREAM IMPERVIOUS DIKES FIRST).
7. REMOVE SILT BAG(S) AND STABILIZE DISTURBED AREA WITH SEED AND MULCH.

STILLING BASIN MAINTENANCE:

1. SEDIMENT BAGS SHOULD BE REPLACED WHEN THE CAPACITY OF THE SEDIMENT BAG HAS EXCEEDED 50%.
2. ACCUMULATED SEDIMENT SHOULD BE DISPOSED OF IN A DESIGNATED DISPOSAL AREA.
3. SPENT BAGS SHOULD BE DISPOSED OF PROPERLY AND NOT BURIED.
4. GRAVEL PADS SHOULD BE CHECKED DAILY DURING USE TO ENSURE THAT GRAVEL HAS NOT BEEN WASHED AWAY OR BEEN CHOKED BY EXCESSIVE SEDIMENTATION.
5. REPLACE PAD WITH CLEAN GRAVEL, AS NEEDED.



NOTE: PROVIDE STABILIZED OUTLET DOWN BANK TO STREAM

SPECIAL STILLING BASIN (SILT BAG) WITH ROCK PAD

NOT TO SCALE

SYM.	DESCRIPTION	DATE
A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012
B	SUBMITTED FOR LAND QUALITY PERMIT	JUNE 2012
C	EDITS PER IRT COMMENTS	SEPT 2012

REVISIONS

APPROVED

Ecosystem Enhancement Program

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

JACOB'S LADDER
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MAY 2012
SCALE: NTS

SEDIMENTATION AND EROSION CONTROL PLAN

SEQUENCE OF CONSTRUCTION:

THE CONTRACTOR IS RESPONSIBLE FOR FOLLOWING THE SEQUENCE OF CONSTRUCTION IN ACCORDANCE WITH THE PLANS AND THE FOLLOWING PROVISIONS, AS DIRECTED BY THE DESIGNER. CONSTRUCTION SHALL PROCEED IN THE SPECIFIED MANNER UNLESS OTHERWISE DIRECTED OR APPROVED BY THE DESIGNER. THE FOLLOWING PROVISIONS, ALONG WITH THE INSTRUCTIONS CONTAINED IN THE PLANS, CONSTITUTE THE SEQUENCE OF CONSTRUCTION.

GENERAL SITE NOTES:

I. THE CONTRACTOR SHALL ONLY CONDUCT STREAM WORK, INCLUDING ALL IN-STREAM STRUCTURES, GRADING, STABILIZATION MEASURES, AND SEEDING, MULCHING, AND MATTING WORK, ON A SECTION OF STREAM THAT SHALL BE ENTIRELY COMPLETED WITHIN A SINGLE DAY. EACH SECTION OF COMPLETED STREAM MUST BE STABILIZED AND MATTED BEFORE FLOW CAN BE RETURNED INTO THE CHANNEL

II. IF APPROVED BY THE DESIGNER, THE CONTRACTOR MAY WORK SIMULTANEOUSLY ON MORE THAN ONE PHASE OR CHANGE THE ORDER OF PHASES 2-4.

III. WHEN WORKING IN STREAMS WITH NO ACTIVE FLOW THE CONTRACTOR IS REQUIRED TO HAVE APPROPRIATELY SIZED PUMPS AND MATERIALS TO INSTALL AND MAINTAIN A TEMPORARY STREAM DIVERSION IN ANTICIPATION OF PENDING STORM EVENTS. WORKING IN A DRY CHANNEL DOES NOT PRECLUDE THE CONTRACTOR FROM HAVING TO COMPLY WITH NOTE I ABOVE.

PHASE 1: INITIAL SITE PREPARATION

A. IDENTIFY PROJECT BOUNDARY, LIMITS OF DISTURBANCE, SENSITIVE AREAS, STAGING AREAS, STABILIZED ENTRANCES, AND ACCESS POINTS WITH THE DESIGNER.
B. CONSTRUCT ENTRANCES AND STAGING AREAS AND THEIR ASSOCIATED SEDIMENT AND EROSION CONTROL DEVICES IN A MANNER TO SUPPORT EXECUTION OF THE STREAM RESTORATION IN PHASES AS INDICATED IN THE PLANS AND AS DIRECTED BY THE DESIGNER.

PHASE 2: REACH T1 STA. 10+00 TO STA. 34+62

A. COMPLETE STREAM RESTORATION IN ACCORDANCE WITH THE FOLLOWING PROCEDURES:
   i. CLEAR VEGETATION AS NEEDED TO INSTALL SEDIMENT AND EROSION CONTROL MEASURES. INSTALL SEDIMENT AND EROSION CONTROL MEASURES ALONG EXISTING CHANNEL AS DEPICTED ON THE PLANS.
   ii. CONDUCT CLEARING NECESSARY TO COMPLETE CHANNEL WORK, PROTECTING EXISTING TREES WHEREVER POSSIBLE OR AS INDICATED BY THE DESIGNER.
   iii. ESTABLISH AN ISOLATED WORK AREA BY INSTALLING IMPERVIOUS DIKES AND TEMPORARY STREAM DIVERSION AND DIVERT STREAM FLOWS AROUND THE DESIGNATED WORK AREA (LENGTH OF ISOLATED WORK AREA IS LEFT TO THE DISCRETION OF THE CONTRACTOR).
   iv. COMPLETE CHANNEL GRADING AS DIRECTED IN THE PLANS. INSTALL ANY BANK STABILIZATION TREATMENTS AND IN-STREAM STRUCTURES
   v. SEED AND MULCH COMPLETED WORK AREAS.

PHASE 3: REACH T2 STA. 99+75 TO STA. 121+60

A. COMPLETE STREAM ENHANCEMENT-I FROM STA. 99+75 TO STA. 107+75 IN ACCORDANCE WITH PROCEDURES ESTABLISHED IN PHASE 2A.

B. COMPLETE STREAM RESTORATION FROM STA. 107+75 TO STA. 121+60 IN ACCORDANCE WITH PROCEDURES ESTABLISHED IN PHASE 2A.

PHASE 4: T1A STA. 40+00 TO STA. 59+44

A. COMPLETE STREAM ENHANCEMENT-I FROM STA. 50+00 TO STA. 53+06 IN ACCORDANCE WITH PROCEDURES ESTABLISHED IN PHASE 2A.
B. COMPLETE STREAM ENHANCEMENT-II FROM STA. 53+06 TO STA. 54+46 IN ACCORDANCE WITH PROCEDURES ESTABLISHED IN PHASE 2A.
C. COMPLETE STREAM RESTORATION FROM STA. 54+46 TO STA. 59+44 IN ACCORDANCE WITH PROCEDURES ESTABLISHED IN PHASE 2A.

PHASE 5: RIPARIAN BUFFER PLANTING

A. PHASE 6 CAN BE INITIATED AFTER THE STREAM WORK IS COMPLETED IN EACH SECTION OF THE PROJECT.
B. PLANTS SHOULD BE PLANTED DURING THE DORMANT SEASON (OCTOBER 20 - APRIL 13).
C. PREPARE AND PLANT BANK AND RIPARIAN VEGETATION IN ACCORDANCE WITH PLAN SHEET 12 AND AS DIRECTED BY THE DESIGNER.

PHASE 6: COMPLETION OF PROJECT SITE

A. REMOVE ALL REMAINING WASTE MATERIALS AND RESTORE THE REMAINING STAGING AND STOCKPILING AREAS AND CONSTRUCTION ENTRANCES TO THEIR PRIOR CONDITION. REMOVE TEMPORARY CROSSINGS AND INSTALL BANK STABILIZATION TREATMENTS, AND PLANT, SEED AND MULCH DISTURBED AREAS. SEED AND MULCH ALL DISTURBED AREAS UTILIZING THE SEED/MULCH MIXES SPECIFIED IN THE PLANS.

GROUND STABILIZATION	
SITE AREA DESCRIPTION	STABILIZATION TIME FRAME
PERIMETER DIKES, SWALES, DITCHES AND SLOPES	7 DAYS
HIGH QUALITY WATER (HQW) ZONES	7 DAYS
SLOPES STEEPER THAN 3:1	7 DAYS
SLOPES 3:1 OR FLATTER	7 DAYS
ALL OTHER AREAS WITH SLOPES FLATTER THAN 4:1	7 DAYS

NOTES:
1. ALL DISTURBED AREAS INSIDE FLOODPLAIN EXTENTS SHALL BE SEEDED DAILY.
2. ALL DISTURBED AREAS OUTSIDE OF FLOODPLAIN EXTENTS SHALL BE SEEDED WITHIN 7 DAYS.

Soil Amendments:

Due to erosion caused by surrounding agricultural activities, many areas within the limits of disturbance currently contain unproductive soils with low organic content. Many of these areas are characterized by rill and sheet erosion, exposing inorganic soils. Other areas where Priority 2 restoration will occur will expose these unproductive soils to the surface. In order to ensure appropriate growing media for furnished seed mixes as well as trees and shrubs that will be planted as part of the restoration plan, furnished topsoil or organic amendments will be required on this project at the direction of the designer.

Furnished Topsoil: Furnished topsoil shall be natural, friable surface soil uniform in color and texture. Topsoil shall have an organic content between 3 and 10 percent by weight. Furnished topsoil shall have a corrected pH value of not less than 6 nor more than 7.5. Textural analysis (by weight) shall be as follows: Sand (2.0 to 0.050mm) 20-75%, Silt (0.05 to 0.002mm) 10-60%, Clay (less than 0.002mm) 5-30%.

Furnished Compost: Furnished compost can be used to amend the soil. It should be mixed with existing inorganic sub-soils to enhance soil texture and minimize the potential for soil mobilization. Furnished compost should meet the requirements in the table below:

Parameter	Unit Measure	Product Range
pH	pH units	7.0-8.7
Soluble Salts	mmhos per centimeter	2.0-5.0
Bulk Density	lbs per cubic yard	900-1,000
Moisture Content	% wet wt basis	45%-55%
Organic Matter Content	% dry wt basis	70%-80%
Particle Size	inches	3/8 minus
Growth Screening	% germination	100%
Stability Rating	Mature-Very Mature	Very Mature

Biosolids Compost (Class A): Type A biosolids can be used with the permission of NC DENR Division of Water Quality. They cannot be applied within 25 feet of the top of bank of any perennial or intermittent stream. This material must be mechanically mixed with existing inorganic soils to minimized the potential for runoff.

NOTES:

1. THE LENGTH OF STREAM THAT IS ISOLATED AS A DAILY WORK AREA IS LEFT TO CONTRACTOR'S DISCRETION IN ACCORDANCE WITH THE FOLLOWING PROVISIONS. IT IS THE INTENT OF THIS CONTRACT THAT:

   A. ALL PROJECT OPERATIONS WILL COMPLY WITH THE PROVIDED SEDIMENT AND EROSION CONTROL PLAN.
   B. AT THE END OF EACH WORK DAY, EACH PORTION OF STREAM MUST BE A COMPLETED WORK PRODUCT, I.E. ALL BANK AND CHANNEL MODIFICATIONS INCLUDING EXCAVATION, GRADING, FILL, AND ALL STABILIZATION TREATMENTS (WITH THE EXCEPTION OF LIVE STAKING, WHICH MAY BE DEFERRED UNTIL ALL BANK AND CHANNEL WORK IS COMPLETED) MUST BE FINISHED AS CALLED FOR IN THE PLANS AND AS DIRECTED BY THE DESIGNER.
   C. DUE TO THE ANTICIPATED DURATION AND SEQUENCE OF THE CONSTRUCTION ACTIVITIES, THE CONTRACTOR IS REQUIRED TO MINIMIZE, AS MUCH AS POSSIBLE, THE AMOUNT 0F THE AREA THAT IS DISTURBED AT ONE TIME.

2. THE CONTRACTOR SHALL EXERCISE EVERY REASONABLE PRECAUTION THROUGHOUT THE CONSTRUCTION OF THE PROJECT TO PREVENT EROSION AND SEDIMENTATION. EROSION CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE PROJECT PLANS, NORTH CAROLINA SEDIMENT AND EROSION CONTROL GUIDELINES AND AS DIRECTED BY THE DESIGNER.

3. THE CONTRACTOR SHALL ONLY CONDUCT STREAM WORK, INCLUDING ALL IN-STREAM STRUCTURES, GRADING, STABILIZATION MEASURES, AND SEEDING AND MULCHING WORK, ON A SECTION OF STREAM THAT CAN BE ENTIRELY COMPLETED WITHIN A SINGLE DAY.

4. ALL EXCAVATION SHALL BE PERFORMED IN DRY OR ISOLATED SECTIONS OF THE CHANNEL.

5. ALL EXCAVATED MATERIAL SHALL BE STOCKPILED WITHIN THE LIMITS OF DISTURBANCE FOR LATER USE AS EMBANKMENT MATERIAL OR DISPOSAL. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING APPROPRIATE STABILIZATION MEASURES AROUND THE STOCKPILE AREA(S) TO PREVENT EROSION AND SEDIMENTATION.

6. A TEMPORARY PUMP-AROUND SHALL BE UTILIZED BY THE CONTRACTOR IN ALL PORTIONS OF THE STREAM TO DIVERT FLOW FROM AND DEWATER THE DESIGNATED AREA IN ORDER TO WORK. THE PUMP-AROUND USED BY THE CONTRACTOR SHALL MEET ALL REQUIREMENTS SPECIFIED IN THESE PLANS. THE PUMP-AROUND SHALL BE INSTALLED AND REMOVED IN ACCORDANCE WITH THE MANUFACTURER'S GUIDELINES. TWENTY-FOUR (24) HOURS PRIOR TO THE INITIATION OF PUMP-AROUND ACTIVITIES, THE CONTRACTOR SHALL MEASURE THE APPROXIMATE FLOW RATE IN THE EXISTING STREAM AT THE PUMP-AROUND LOCATION. THE FLOW RATE SHALL BE SUBMITTED TO THE DESIGNER FOR APPROVAL. THE CONTRACTOR SHALL, THEREAFTER, UTILIZE A PUMP(S) SUFFICIENT TO ACCOMODATE 120% (1.2 TIMES) THE APPROVED FLOW RATE.

7. IN THE EVENT OF A STORM, THE CONTRACTOR WILL BE RESPONSIBLE FOR REMOVAL OR PROTECTION OF ANY EQUIPMENT, TOOLS, MATERIALS OR OTHER ITEMS NEEDED TO COMPLETE THE WORK THAT COULD BE AFFECTED BY STORM FLOWS.

8. AFTER THE STREAM CHANNEL IS DEWATERED AND INITIAL STREAM GRADING CALLED FOR IN THE PLANS IS COMPLETED, THE CONTRACTOR SHALL IMMEDIATELY INSTALL APPROPRIATE STABILIZATION MATERIALS AS CALLED FOR IN THE PLANS TO STABILIZE SLOPES AND PROVIDE IMMEDIATE SEDIMENT/EROSION CONTROL.

9. WITH THE EXCEPTION OF STRAW WATTLES, EACH SEDIMENT CONTROL DEVICE WILL BE REMOVED AFTER ALL WORK IN THE CORRESPONDING CONSTRUCTION PHASE HAS BEEN COMPLETED AND THE AREAS HAVE BEEN STABILIZED.

10. THE CONSTRUCTION ENTRANCES AND STAGING AREAS IDENTIFIED ON THE PLANS PROVIDE THE ONLY ACCESS POINTS INTO THE LIMITS OF DISTURBANCE. NO ADDITIONAL ACCESS POINTS SHALL BE USED WITHOUT APPROVAL OF THE DESIGN REPRESENTATIVE.

11. SILT FENCE SHALL BE INSTALLED ON THE LOW SIDE OF ANY TEMPORARY OR PERMANENT SPOIL AND TOPSOIL PILES.

12. ALL DISTURBED SOILS WILL BE SEEDED FOR VEGETATIVE STABILIZATION IMMEDIATELY AFTER DISTURBANCE ACTIVITIES, FOLLOWING THE GUIDELINES DESCRIBED ON SHEET 20 OF THESE PLANS.

13. BRIDGE MATS WILL BE USED FOR ALL STREAM CROSSINGS. SUGGESTED LOCATIONS FOR THE CROSSINGS ARE SHOWN ON THE PLANS. HOWEVER, THE LOCATIONS CAN BE MODIFIED UPON CONSULTATION WITH THE DESIGNER. THE NUMBER OF CROSSING LOCATIONS SHOULD BE MINIMIZED TO THE EXTENT PRACTICAL.

14. THE CONSTRUCTION MANAGER AND EROSION CONTROL CONTACT FOR THIS SITE IS TIM MORRIS. OFFICE PHONE - 919-783-9214 CELL PHONE - 919-793-6886

REVISIONS			
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A	PRELIMINARY DESIGN - SUBMITTED WITH MITIGATION PLAN	MAY 2012	
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