FINAL

UT to Sandy Creek Stream Mitigation Report

Randolph County, North Carolina

USGS HUC: 03030003020010

SCO No. 040611601A

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Prepared for:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
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Executive Summary

The Unnamed Tributary to Sandy Creek Stream Restoration project falls within the Williams (Williams Farm) and Henry (Rising Meadows Farm) Properties in Randolph County on Old Liberty Road, approximately 5.5 miles west of Liberty, North Carolina. The site streams lie within the USGS hydrologic unit **03030003**020010 in the Cape Fear River Basin.

Prior to restoration, the 28-acre Henry property contained the upper 1,000 feet of an unnamed tributary and two wetland seeps. The 20-acre Williams property contained the lower 870 feet of this unnamed tributary, 290 feet of another small unnamed tributary that flowed from a pond, and one wetland seep. The total existing length of the streams prior to restoration was 2,160 feet. The project watershed drains approximately 4.2 square miles of mostly agricultural and forest land of the southern piedmont. Pastures actively grazed by cattle and sheep dominate the landscape surrounding the project streams.

In areas where continuous woody buffers exist, the buffers extend only 5 to 10 feet beyond the tops of the left and right banks. Plants typically found within the buffers include Chinese privet (*Ligustrum sinese*), sycamore (*Platanus occidentalis*), hackberry (*Celtis* spp.) and black walnut (*Juglans nigra*). Active pastures featuring fescue (*Festuca* spp.), smartweed (*Polygonum* spp.), and cocklebur (*Xanthium strumarium*) dominate much of the riparian buffer. Pockets of soft-stem rush (*Juncus effuses*) and sedges (*Carex* spp.) also occur within the pasture.

Altered conditions of the streams and riparian buffer have reduced the water quality and impaired the habitat. Nutrients from the pasture flowing untreated through the riparian zone and fine silts sloughing from the incised banks have raised biological and chemical oxygen demand. This, combined with the lack of sufficient reoxygenating riffle features, reduced dissolved oxygen within the water column. Water quality also has diminished due to raised turbidity from bank erosion and elevated water temperatures caused by the lack of tree shading. Habitat potential has been impaired by the diminished water quality and loss of physical habitat such as bed features, undercut banks, and a well developed vegetative community.

The stream reaches were restored within the existing floodplain using a Priority I approach. The riparian buffer was replanted with native woody species to restore ecological function to the buffer.

This project resulted in the restoration of three impaired stream channels' dimension, pattern, and profile for approximately 2,680 linear feet of stream. Reconnecting the channel with its abandoned floodplain will improve stability by increasing the frequency of over-bank flooding, increasing hydrology to the riparian wetland seeps, and reducing shear stress. With the restoration, water quality should be improved due to a decrease in nutrients and turbidity, as well as a more moderate water temperature. Biological and chemical oxygen demand should be reduced through filtering in the riparian buffer and riverine wetlands. Potential habitats have been added through the creation of bed features, and reestablishment of a riparian vegetative community.

The monitoring process will assess the site's stream and riparian areas to determine restoration success. A monitoring plan has been set up based on guidance provided by *The Stream Mitigation Guidelines* disseminated by the United States Army Corps of Engineers – Wilmington District (McLendon, Scott, Fox, Becky et al. 2003) and the most current versions of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports".

Stream restoration will be considered successful through the achievement of stable channel geometry, appropriate channel materials, and lack of significant erosion. The riparian buffer will be investigated for survivability of planted vegetation and exclusion of invasive species.

The site will be maintained during the monitoring period to ensure that it upholds the success criteria. Repairs will be made as necessary to reestablish channel stability, and the site will be replanted if vegetation shows signs of significant failure.

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Narrative

The Unnamed Tributary to Sandy Creek Stream Restoration project falls within the Williams (Williams Farm) and Henry (Rising Meadows Farm) Properties in Randolph County on Old Liberty Road, approximately 5.5 miles west of Liberty, North Carolina. The site streams lie within the USGS hydrologic unit **03030003**020010 in the Cape Fear River Basin. The site is defined by the protective conservation easement surrounding the stream and riparian buffers covers approximately 10.2 acres.

Prior to restoration, the 28-acre Henry property contained the upper 1,000 feet of an unnamed tributary and two wetland seeps. The 20-acre Williams property contained the lower 870 feet of this unnamed tributary, 290 feet of another small unnamed tributary that flowed from a pond, and one wetland seep. The total existing length of the streams prior to restoration was 2,160 feet. The project watershed drains approximately 4.2 square miles of mostly agricultural and forest land of the southern piedmont.

Pasture land surrounded the project reach and the stream banks lacked strong rooted vegetation (e.g., woody or deep-rooted herbaceous vegetation). Most of the riparian buffer was dominated by pasture grasses with isolated specimens of hardwoods. In areas where continuous woody buffers exist, the buffers extend only 5 to 10 feet beyond the top of the left and right banks. Riparian zone woody vegetation included Chinese privet (*Ligustrum sinese*), sycamore (*Platanus occidentalis*), hackberry (*Celtis* spp.) and black walnut (*Juglans nigra*). Due to the lack of bank protection and developed watershed, the stream channel incised (bank height ratios of 1.2-1.6). In this condition and with regular impacts due to cattle traffic, bank erosion had accelerated and the variety of bed features diminished. With active cattle grazing in the area, the channel would have continued to receive impacts.

The goal of the restoration project is to improve the water quality and biological habitat of the site's streams, wetlands, and riparian buffers through the following:

- Restoration (pattern, dimension, and profile) of unstable streams using natural channel design techniques
- Reestablishment of riparian buffers

The design of the channel reaches employed a Priority I restoration approach. Morphological data from the reference reach, piedmont rural regional curves, regime equations, and the existing channel morphology were used in the design, and stable reaches of the existing channel were considered. These parameters were used in determining the proper dimension, pattern, and profile of the proposed channels.

The restored channels have banks constructed at a 3:1 slope to ensure stability until deep rooted vegetation can become established. To ensure proper bed width using these slopes, the channels for this project are Rosgen C type channels. Increasing sinuosity on all channels for restoration will decrease average stream slopes and will provide the proper pool and riffle sequencing found in natural reference stream systems. Bed material samples were taken, and sediment transport

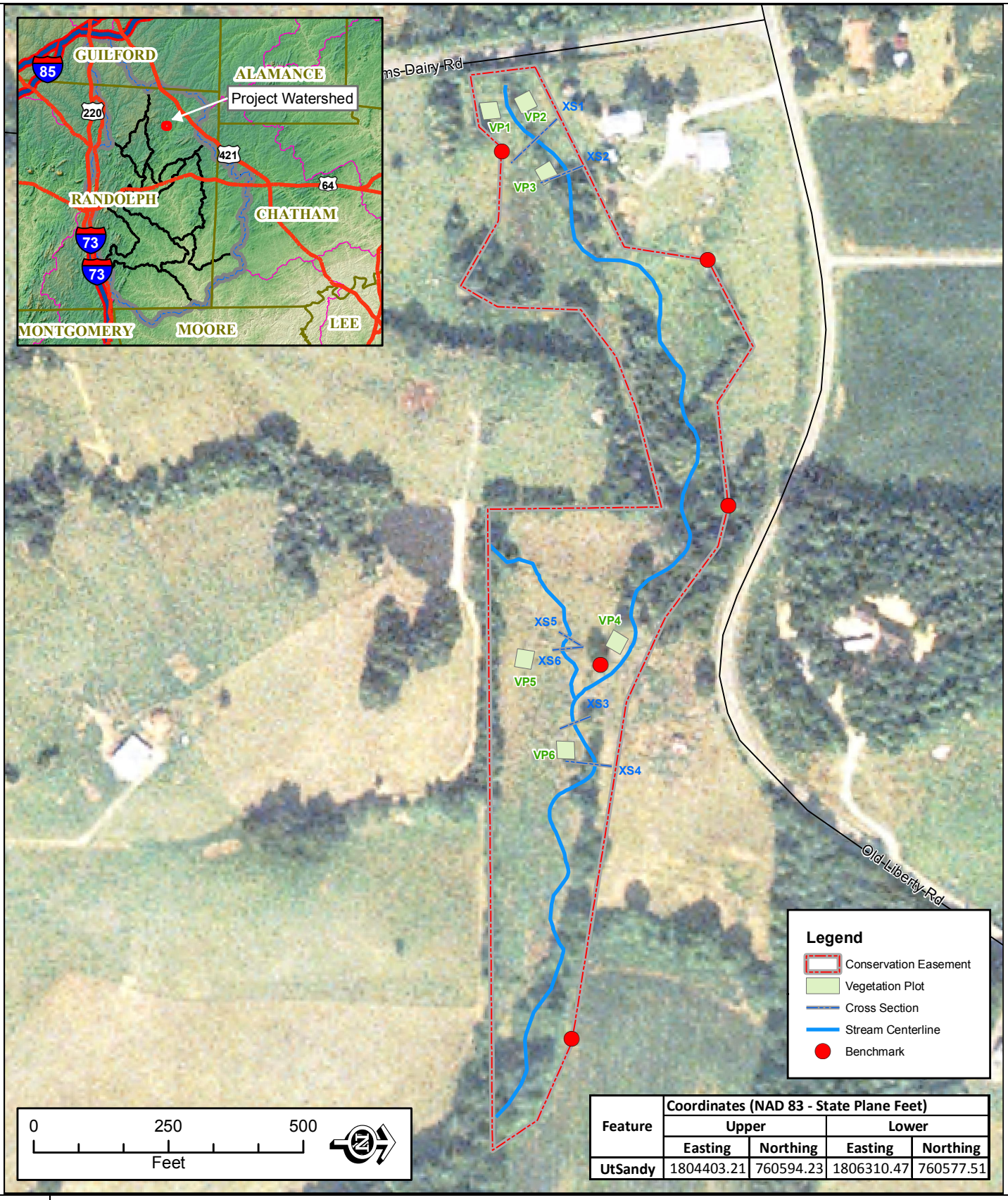
calculations were performed to ensure that the proper profile was designed for the channel dimensions.

Prior to planting the riparian buffer, efforts will be made to eradicate fescue. These efforts should include herbicide use during the spring and a follow-up spraying in early fall to eliminate any fescue not killed in the spring.

Vegetation planted within the floodplain and along the stream banks provide stability to the stream channels by reducing scour and runoff erosion. Pioneer species were planted along the stream bank to provide immediate bank stabilization and create an environment suitable for latter species common in mature riparian habitats. Live stakes and bare roots were planted around structure installations and the outside of meander bends to provide an area of high density root mass. Trees and shrubs were planted using live stakes, bare root, or container stock along the tops of the channel banks.

Table 1: Mitigation Summary Table

Reach	Pre-Construction Length (Feet)	Constructed Length (Feet)	Mitigation Type	Mitigation Ratio	SMUs
One	1,000	1,410	Restoration	1:1	1,410
Two	870	886	Restoration	1:1	886
Pond Tributary	290	384	Restoration	1:1	384
Total Credits					**2,680**



Feature	Coordinates (NAD 83 - State Plane Feet)			
	Upper		Lower	
	Easting	Northing	Easting	Northing
UtSandy	1804403.21	760594.23	1806310.47	760577.51

Title	Project Map		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Stream Restoration Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Figure** 1

Monitoring Plan

Upon completion of the restoration project, as-built surveys were conducted to document the dimension, pattern, and profile of all restored reaches. Any changes in the constructed channels' dimension, pattern, profile, vegetation plantings, and installed structures will be documented, along with any deviations from the proposed design.

The monitoring plan consists of reference photos, visual inspection of the channel, and plant survival analysis. Monitoring will be performed each year of the required 5-year monitoring period. All monitoring reports will be submitted to the United States Army Corps of Engineers, Raleigh Regulatory Field Office Project Manager. The mitigation success criteria and required remediation actions generally will be based on Appendix II of the *Stream Mitigation Guidelines* (April 2003) and recommendations from the Ecosystem Enhancement Program (EEP). The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports".

Stream Monitoring

Success Criteria

Judgments of success or failure of restoration activities using monitoring data will be qualitative. Changes in the channel dimension that may occur during the monitoring period will be evaluated to determine whether they represent a movement toward a less stable condition (e.g., down-cutting, deposition, erosion) or an increase in stability (e.g., settling, vegetative changes, decrease in width/depth ratio). Unstable conditions that require remediation will indicate failure of restoration activities.

Photographs will be used to quantitatively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal photos should indicate the absence of developing mid-channel bars or excessive bed scour in riffles or behind structures. Lateral photos should not indicate excessive erosion or continuing degradation of the bank. A series of photos over time should indicate successional maturation of riparian vegetation.

Assessment Methods

Generally, geomorphic assessment follows the Monitoring Level I procedures described in the *Stream Mitigation Guidelines (April 2003)*. The survey of channel dimension consists of one permanent riffle and one permanent pool cross-section for each constructed reach. Pebble counts will be conducted at the cross sections during subsequent monitoring years; however, based upon visual inspection during the baseline monitoring, the UT to Sandy Creek is a sand bed stream. There has been no coarsening of the bed material; however, the bed material may coarsen as the system has time to move the fines over time. A longitudinal profile was conducted based on topographic data. Monitoring will be conducted each year for the 5-year monitoring period. To

show success, the monitoring data for the channels should show no significant aggradation or degradation, nor any unexpected changes in morphology.

Riparian Buffer

Success Criteria

The success of riparian vegetation planting will be gauged by stem counts of planted species. Success of live stake plantings will require a 70% survival rate based on sample plots (see Appendix II, *Stream Mitigation Guidelines, April 2003*). Stem counts exceeding 320 trees per acre after 3 years and 260 trees per acre after 5 years will be considered successful. Successful herbaceous plants will be 75% ground cover. Photos taken at established photo points should indicate maturation of riparian vegetation community.

Assessment Methods

The success of vegetation plantings will be measured by stem counts during the growing season. During the counts, the health of the vegetation will be noted. Six permanent quadrants will be used to sample the riparian buffer. Each quadrant covers 100 square meters and includes permanent photo points.

References

McLendon, Scott, Becky Fox, et al. (2003). Stream Mitigation Guidelines. United States Army Corps of Engineers – Wilmington District, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, and North Carolina Department of Natural Resources – Division of Water Quality.

Rosgen, David L. (1997). A Geomorphic Approach to Restoration of Incised Rivers. Management of Landscapes Disturbed by Channel Incision.

Tuttle, John W. (1997). Soil Survey of Randolph County, North Carolina. Natural Resources Conservation Service, United States Department of Agriculture.

United States Army Corps of Engineers (1987). Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station, Environmental Laboratory.

Photograph 1: Plunge Pool. Head of UT-1.

Photograph 2: Cross Vane. STA: 100+12.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site, Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	1

Photograph 3: Cross Vane. STA: 100+73.

Photograph 4: Constructed Riffle. STA: 101+09.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 2

Photograph 5: Cross vane. STA: 101+40.

Photograph 6: Constructed Riffle. STA: 102+25.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	3

Photograph 7: Cross Vane. STA: 102+85.

Photograph 8: Constructed Riffle. STA: 103+15.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	4

Photograph 9: Armored Outlet Swale from Wetland.

Photograph 10: Constructed Riffle. STA: 103+88.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 5

Photograph 11: Crossing. STA: 104+23.

Photograph 12: Cross Vane. STA: 104+75.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	6

Photograph 13: Cross Vane. STA: 105+62.

Photograph 14: "A" Vane. STA: 106+60.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	7

Photograph 15: Armored Swale Entering Channel.

Photograph 16: Cross Vane. STA: 107+49.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
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Photograph 17: Cross Vane. STA: 108+11.

Photograph 18: Constructed Riffle. STA: 108+77.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
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Photograph 19: "A" Vane. STA: 109+14.

Photograph 20: Constructed Riffle. STA: 109+58.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 10

Photograph 21: Cross Vane. STA: 110+26.

Photograph 22: Constructed Riffle. STA: 110+58.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 11

Photograph 23: Crossing. STA: 111+32.

Photograph 24: Cross Vane. STA: 111+66.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	12

Photograph 25: Constructed Riffle. STA: 112+15.

Photograph 26: Cross Vane. STA: 112+70.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	13

Photograph 27: "A" Vane. STA: 113+80.

Photograph 28: Cross Vane. STA: 115+15.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 14

Photograph 29: "A" Vane. STA: 116+29.

Photograph 30: "A" Vane. STA: 117+58.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site, Randolph County, North Carolina

Date	Project Number	Photo Page
11/10/08	011795019	15

Photograph 31: "A" Vane. STA: 118+46.

Photograph 32: Cross Vane. STA: 119+07.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 16

Photograph 33: Constructed Riffle. STA: 120+00

Photograph 34: Armored Wetland Swale Outlet.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
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Photograph 35: Rip-Rap. Wetland drainage.

Photograph 36: Cross Vane. STA: 121+92

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 18

Photograph 37: Rip-Rap. Head of UT-2.

Photograph 38: Cross Vane. STA: 200+57.

Title	Monitoring Photo Pages (Pond Tributary)
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	19

Photograph 39: Cross Vane. STA: 201+16.

Photograph 40: Cross Vane. STA: 202+64.

Title	Monitoring Photo Pages (Pond Tributary)
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	Project Number	Photo Page
11/10/08	011795019	20

Photograph 41: Cross Vane. STA: 203+15.

Photograph 42: Cross Vane. STA: 203+58.

Title	Monitoring Photo Pages (Pond Tributary)

Prepared For:

Ecosystem Enhancement PROGRAM

Project	UT to Sandy Creek Site Randolph County, North Carolina		
Date	**Project Number**	**Photo Page**	
11/10/08	011795019	21	

Photograph 43: Cross Section 1 looking upstream.

Photograph 44: Cross Section 1 looking downstream.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

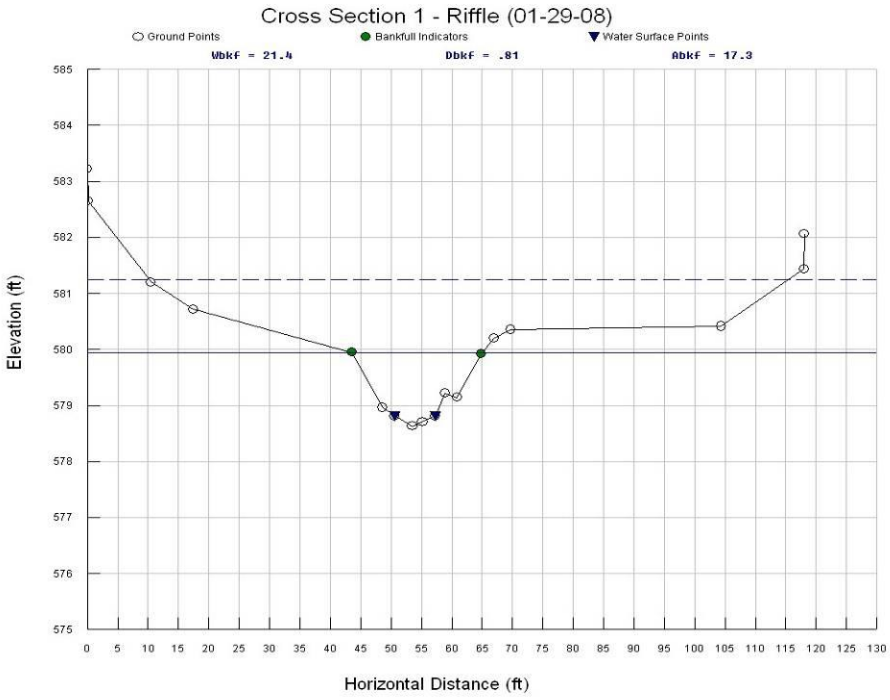
Date	**Project Number**	**Photo Page**
11/10/08	011795019	22

Photograph 45: Cross Section 1 looking at the left bank.

Photograph 46: Cross Section 1 looking at the right bank.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 23

Photograph 47: Cross Section 1 looking at the substrate composition.



Cross Section 1 Profile

Title	Monitoring Photo Pages
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
11/10/08	011795019	24

Photograph 48: Cross Section 2 looking upstream.

Photograph 49: Cross Section 2 looking downstream.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
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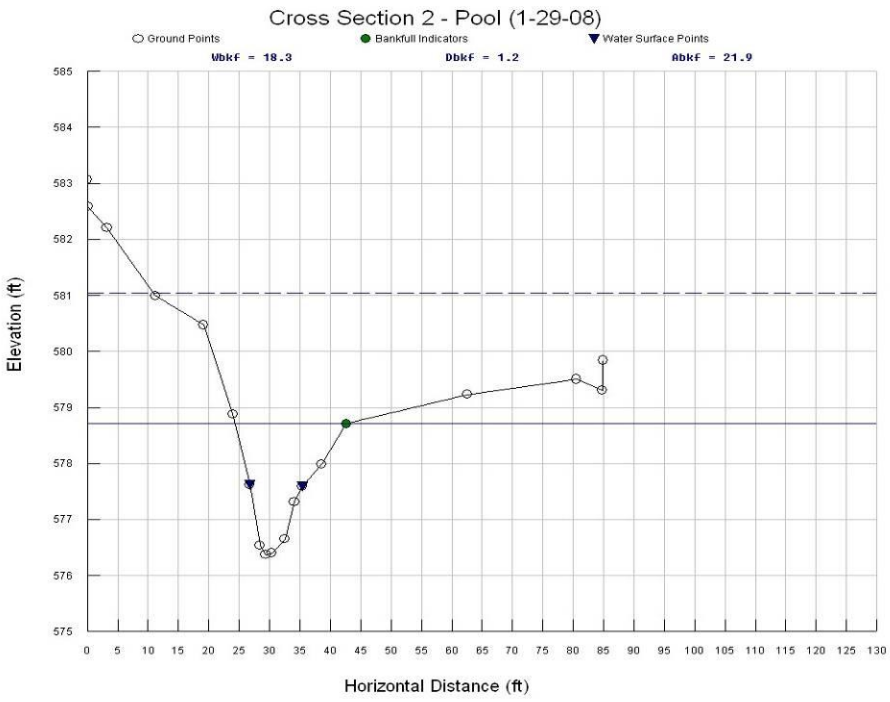
Photograph 50: Cross Section 2 looking at the left bank.

Photograph 51: Cross Section 2 looking at the right bank.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	26

Photograph 52: Cross Section 2 looking at the substrate composition.



Cross Section 2 Profile

Title	Monitoring Photo Pages
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
11/10/08	011795019	27

Photograph 53: Cross Section 3 looking upstream.

Photograph 54: Cross Section 3 looking downstream.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

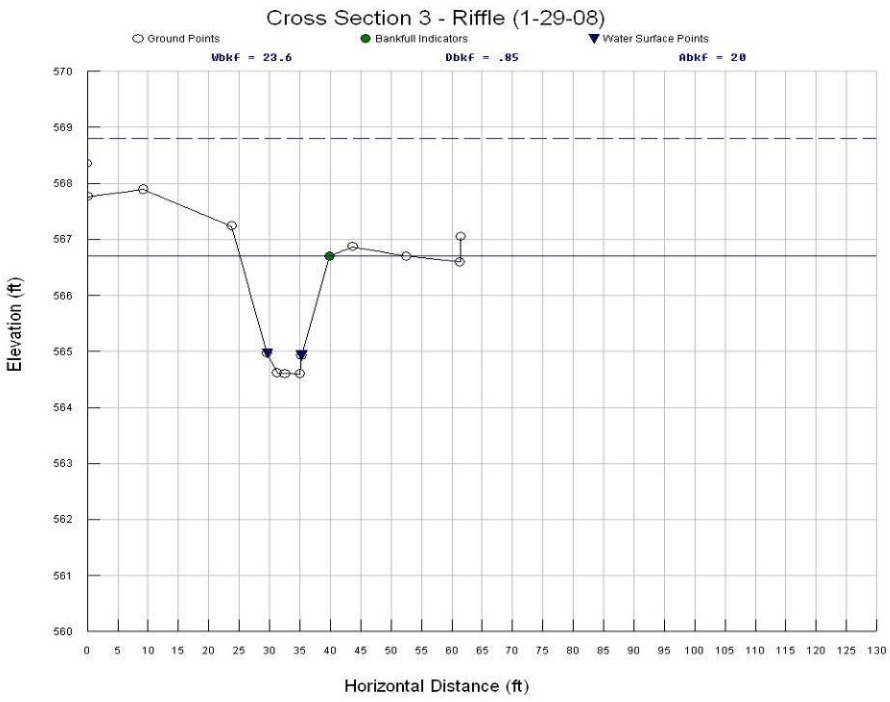
Date	**Project Number**	**Photo Page**
11/10/08	011795019	28

Photograph 55: Cross Section 3 looking at the left bank.

Photograph 56: Cross Section 3 looking at the right bank.

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 29

Photograph 57: Cross Section 3 looking at the substrate composition.



Cross Section 3 Profile

Title	Monitoring Photo Pages		
Prepared For: Ecosystem Enhancement Program	**Project**	UT to Sandy Creek Site Randolph County, North Carolina	
	Date 11/10/08	**Project Number** 011795019	**Photo Page** 30

Photograph 58: Cross Section 4 looking upstream.

Photograph 59: Cross Section 4 looking downstream.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site, Randolph County, North Carolina

Date	Project Number	Photo Page
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Photograph 60: Cross Section 4 looking at the left bank.

Photograph 61: Cross Section 4 looking at the right bank.

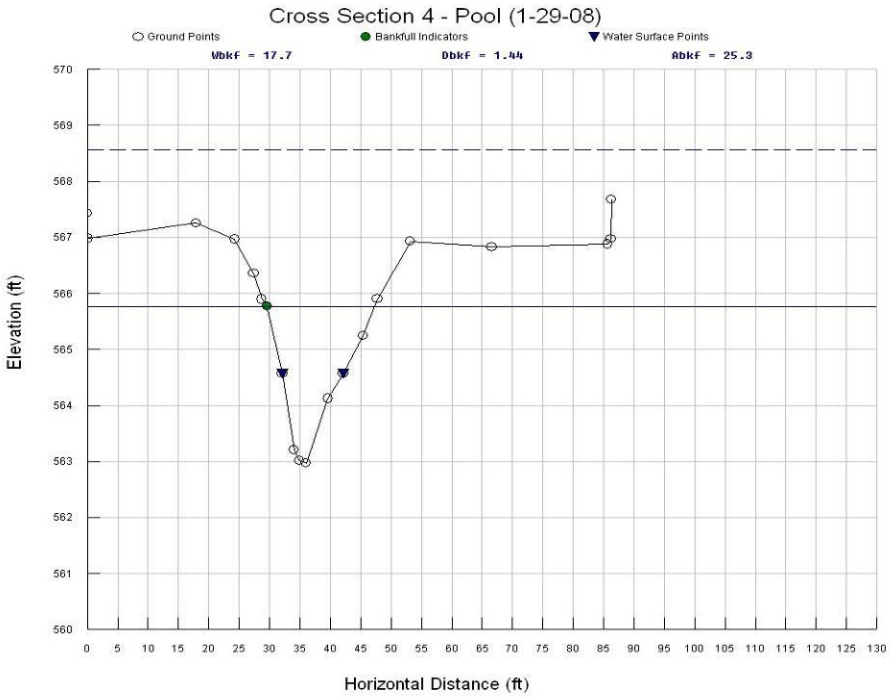
Title	Monitoring Photo Pages (Pond Tributary)

Prepared For:

Ecosystem Enhancement PROGRAM

Project	UT to Sandy Creek Site Randolph County, North Carolina		
	Date	**Project Number**	**Photo Page**
	11/10/08	011795019	32

Photograph 62: Cross Section 4 looking at the substrate composition.



Cross Section 4 Profile

Title	Monitoring Photo Pages (Pond Tributary)
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
11/10/08	011795019	33

Photograph 63: Cross Section 5 looking upstream.

Photograph 64: Cross Section 5 looking downstream.

Title	Monitoring Photo Pages (Pond Tributary)
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	Project Number	Photo Page
11/10/08	011795019	34

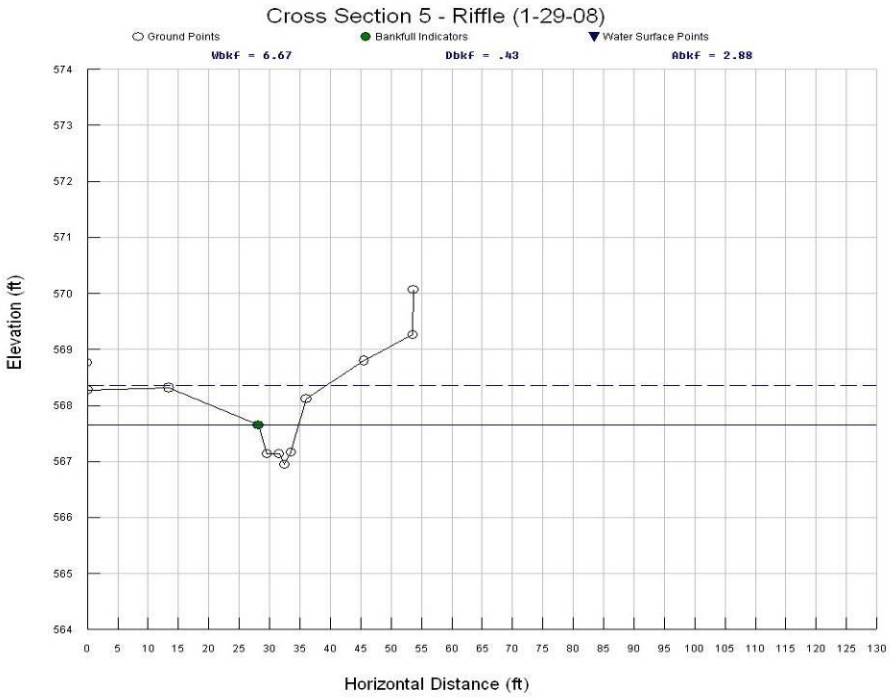
Photograph 65: Cross Section 5 looking at the left bank.

Photograph 66: Cross Section 5 looking at the right bank.

Title	Monitoring Photo Pages (Pond Tributary)
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	**Project Number**	**Photo Page**
11/10/08	011795019	35

Photograph 67: Cross Section 5 looking at the substrate composition.



Cross Section 5 Profile

Title	Monitoring Photo Pages (Pond Tributary)
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
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Photograph 68: Cross Section 6 looking upstream.

Photograph 69: Cross Section 6 looking downstream.

Title	Monitoring Photo Pages
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
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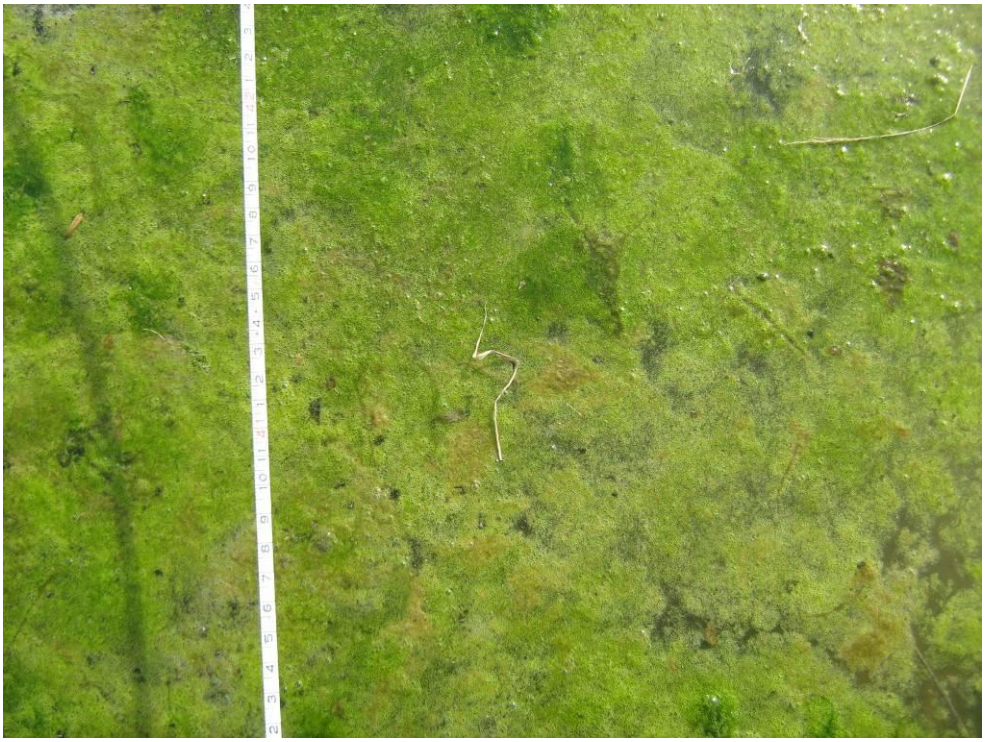
Photograph 70: Cross Section 6 looking at the left bank.

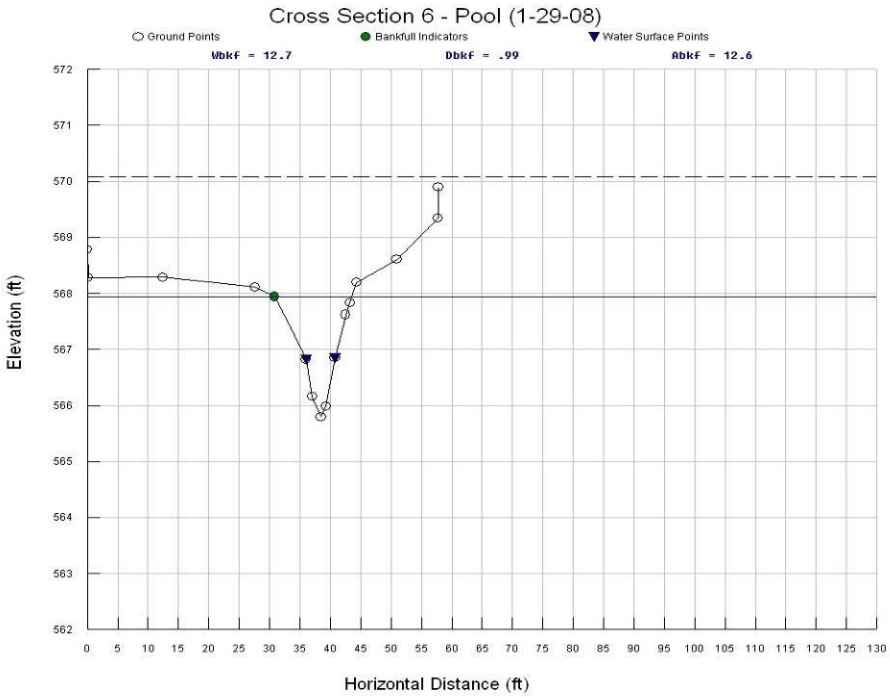
Photograph 71: Cross Section 6 looking at the right bank.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	Project Number	Photo Page
11/10/08	011795019	38



Photograph 72: Cross Section 6 looking at the substrate composition.



Cross Section 6 Profile

Title	Monitoring Photo Pages
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
11/10/08	011795019	39

Photograph 73: Vegetation Plot 1.

Photograph 74: Vegetation Plot 2.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project**: UT to Sandy Creek Site Randolph County, North Carolina

Date	Project Number	Photo Page
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Photograph 75: Vegetation Plot 3.

Photograph 76: Vegetation Plot 4.

Title	Monitoring Photo Pages
Project	UT to Sandy Creek Site Randolph County, North Carolina

Prepared For: Ecosystem Enhancement Program

Date	Project Number	Photo Page
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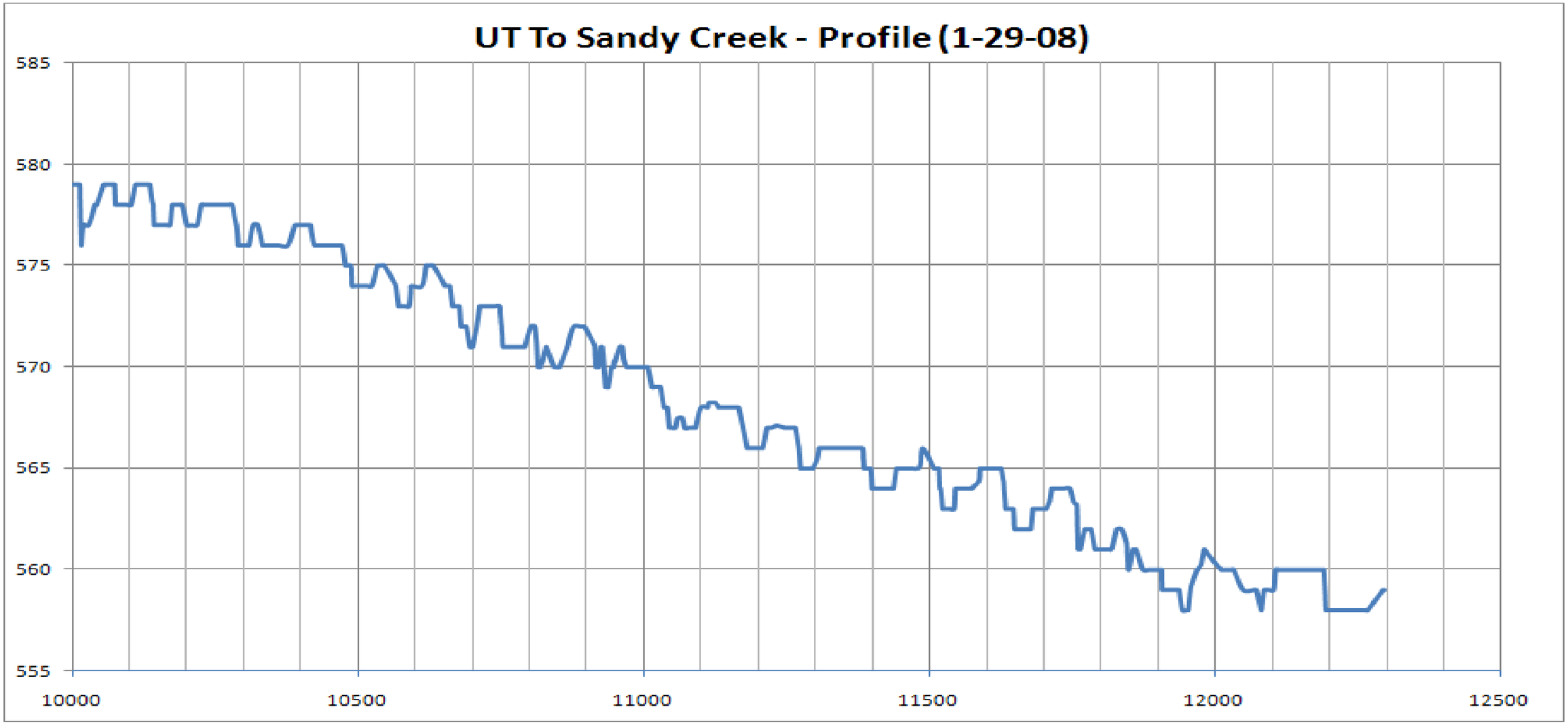
Photograph 77: Vegetation Plot 5.

Photograph 78: Vegetation Plot 6.

Title	Monitoring Photo Pages
Prepared For: Ecosystem Enhancement Program	**Project** UT to Sandy Creek Site Randolph County, North Carolina

Date	Project Number	Photo Page
11/10/08	011795019	42

Figure 1



Title	Longitudinal Profile		
Prepared For	**Project**	Randolph County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	10/24/08	011795019	

UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
10000.0	579.0	10119.5	579.0	10282.4	577.5	10441.4	576.0
10000.3	579.0	10129.7	579.0	10285.8	577.0	10444.8	576.0
10004.8	579.0	10134.3	579.0	10286.1	577.0	10445.3	576.0
10007.0	579.0	10138.0	578.3	10286.8	577.0	10445.3	576.0
10010.1	579.0	10138.6	578.2	10289.5	576.0	10446.4	576.0
10012.0	579.0	10140.0	578.1	10289.8	576.0	10446.6	576.0
10012.1	579.0	10140.6	578.0	10291.2	576.0	10446.9	576.0
10012.6	578.4	10141.9	577.1	10292.2	576.0	10456.0	576.0
10012.9	578.0	10142.1	577.0	10295.1	576.0	10462.4	576.0
10013.4	577.3	10142.3	577.0	10300.4	576.0	10467.6	576.0
10013.7	577.0	10142.4	577.0	10305.2	576.0	10467.7	576.0
10014.5	576.0	10142.9	577.0	10305.7	576.0	10468.2	576.0
10014.5	576.0	10145.6	577.0	10305.8	576.0	10471.4	576.0
10014.5	576.0	10158.5	577.0	10308.4	576.0	10475.3	575.4
10014.5	576.0	10158.7	577.0	10309.6	576.2	10478.1	575.0
10014.7	576.0	10158.8	577.0	10315.5	577.0	10487.0	575.0
10014.9	576.0	10158.9	577.0	10323.7	577.0	10488.7	574.0
10018.4	577.0	10160.2	577.0	10331.3	576.1	10493.0	574.0
10027.4	577.0	10162.8	577.0	10332.0	576.0	10495.9	574.0
10038.3	578.0	10163.5	577.0	10333.1	576.0	10496.0	574.0
10038.5	578.0	10163.7	577.0	10334.5	576.0	10496.5	574.0
10038.6	578.0	10166.1	577.0	10334.8	576.0	10496.6	574.0
10038.7	578.0	10170.0	577.0	10335.5	576.0	10498.1	574.0
10039.8	578.0	10171.4	577.3	10341.8	576.0	10504.3	574.0
10041.4	578.0	10173.6	578.0	10347.9	576.0	10504.8	574.0
10053.8	579.0	10173.8	578.0	10357.7	576.0	10506.7	574.0
10055.7	579.0	10176.9	578.0	10357.9	576.0	10507.4	574.0
10063.3	579.0	10185.6	578.0	10358.1	576.0	10507.6	574.0
10065.3	579.0	10191.2	578.0	10361.5	576.0	10515.8	574.0
10065.4	579.0	10194.9	577.6	10376.4	576.0	10523.7	574.0
10066.9	579.0	10199.9	577.0	10388.5	577.0	10533.0	575.0
10068.1	579.0	10208.1	577.0	10388.5	577.0	10534.6	575.0
10073.1	579.0	10208.2	577.0	10388.6	577.0	10536.5	575.0
10073.4	579.0	10217.4	577.0	10393.1	577.0	10537.0	575.0
10074.7	578.0	10221.4	577.5	10396.7	577.0	10537.5	575.0
10075.9	578.0	10225.0	578.0	10408.2	577.0	10545.3	575.0
10076.3	578.0	10231.3	578.0	10416.2	577.0	10562.3	574.2
10084.1	578.0	10241.7	578.0	10416.2	577.0	10562.9	574.2
10091.9	578.0	10247.8	578.0	10420.2	576.3	10565.4	574.0
10093.9	578.0	10248.3	578.0	10423.0	576.0	10568.9	573.3
10095.8	578.0	10248.9	578.0	10424.0	576.0	10569.6	573.2
10095.8	578.0	10250.1	578.0	10431.4	576.0	10570.3	573.0
10101.8	578.0	10251.2	578.0	10432.6	576.0	10570.4	573.0
10109.4	579.0	10258.1	578.0	10432.7	576.0	10571.4	573.0
10111.3	579.0	10269.9	578.0	10433.3	576.0	10572.8	573.0
10111.6	579.0	10278.7	578.0	10438.3	576.0	10574.9	573.0

UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
10580.5	573.0	10750.1	572.2	10894.0	572.0	11006.5	570.0
10582.4	573.0	10750.9	572.0	10896.4	572.0	11006.5	570.0
10582.6	573.0	10752.6	571.2	10911.6	571.2	11007.2	570.0
10582.6	573.0	10753.0	571.0	10914.2	571.0	11010.9	569.5
10588.9	573.0	10753.3	571.0	10914.4	571.0	11013.1	569.2
10591.9	573.8	10753.4	571.0	10915.8	570.3	11014.6	569.0
10592.8	574.0	10754.5	571.0	10916.4	570.0	11017.8	569.0
10611.6	574.0	10759.1	571.0	10917.7	570.0	11017.8	569.0
10618.8	575.0	10770.1	571.0	10920.5	570.0	11021.7	569.0
10622.7	575.0	10770.4	571.0	10924.9	571.0	11023.0	569.0
10623.1	575.0	10770.5	571.0	10926.4	571.0	11023.2	569.0
10631.0	575.0	10770.7	571.0	10927.3	571.0	11026.1	569.0
10650.2	574.1	10791.5	571.0	10930.3	570.0	11026.3	569.0
10651.3	574.0	10791.9	571.0	10933.3	569.0	11026.7	569.0
10652.1	574.0	10792.2	571.0	10934.1	569.0	11026.8	569.0
10657.4	574.0	10802.1	572.0	10934.2	569.0	11027.0	569.0
10657.8	574.0	10808.9	572.0	10935.0	569.0	11029.5	569.0
10659.7	574.0	10811.4	571.5	10938.0	569.0	11031.1	568.7
10660.3	574.0	10811.8	571.4	10943.3	570.0	11035.3	568.0
10660.6	574.0	10812.8	571.0	10943.6	570.0	11036.0	568.0
10664.9	573.0	10814.1	570.2	10945.5	570.0	11036.1	568.0
10666.2	573.0	10814.5	570.0	10947.3	570.0	11036.2	568.0
10667.9	573.0	10815.1	570.0	10948.6	570.3	11037.6	568.0
10670.0	573.0	10815.2	570.0	10949.5	570.2	11041.4	568.0
10673.3	573.0	10816.3	570.0	10951.0	570.4	11041.6	568.0
10675.5	573.0	10818.9	570.0	10958.0	571.0	11045.1	567.0
10677.1	573.0	10819.2	570.0	10962.0	571.0	11045.8	567.0
10680.0	572.0	10819.7	570.2	10964.1	570.6	11046.0	567.0
10681.8	572.0	10821.4	570.2	10965.1	570.4	11050.0	567.0
10682.3	572.0	10829.1	571.0	10969.7	570.0	11050.5	567.0
10686.4	572.0	10829.1	571.0	10973.0	570.0	11050.6	567.0
10689.3	572.0	10829.1	571.0	10977.4	570.0	11054.9	567.0
10695.4	571.0	10829.2	571.0	10981.3	570.0	11058.7	567.4
10699.2	571.0	10829.3	571.0	10983.4	570.0	11058.7	567.4
10699.9	571.0	10840.1	570.2	10983.5	570.0	11061.9	567.5
10699.9	571.0	10842.9	570.0	10985.8	570.0	11067.7	567.5
10700.5	571.0	10843.2	570.0	10989.5	570.0	11071.7	567.0
10707.3	572.0	10845.8	570.0	10991.0	570.0	11078.1	567.0
10712.3	573.0	10847.8	570.0	10995.8	570.0	11078.8	567.0
10712.5	573.0	10847.9	570.0	10996.0	570.0	11079.0	567.0
10716.7	573.0	10852.1	570.0	10996.9	570.0	11079.0	567.0
10719.9	573.0	10866.3	571.0	10998.3	570.0	11080.2	567.0
10737.1	573.0	10869.1	571.3	10999.1	570.0	11080.4	567.0
10747.4	573.0	10877.2	572.0	11000.6	570.0	11080.7	567.0
10748.5	572.7	10888.9	572.0	11004.5	570.0	11085.8	567.0
10749.4	572.4	10893.5	572.0	11005.9	570.0	11090.8	567.0

UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
11090.8	567.0	11200.8	566.0	11275.0	565.0	11410.6	564.0
11090.8	567.0	11201.4	566.0	11276.0	565.0	11410.7	564.0
11090.8	567.0	11201.6	566.0	11280.0	565.0	11413.7	564.0
11090.9	567.0	11204.7	566.0	11285.8	565.0	11414.4	564.0
11100.0	568.0	11205.7	566.0	11286.1	565.0	11415.6	564.0
11111.2	568.0	11206.4	566.0	11287.1	565.0	11417.1	564.0
11112.2	568.0	11206.7	566.0	11287.1	565.0	11420.6	564.0
11113.7	568.2	11206.7	566.0	11289.5	565.0	11422.0	564.0
11117.2	568.2	11208.6	566.0	11294.4	565.0	11425.3	564.0
11124.7	568.2	11210.3	566.2	11295.3	565.0	11425.3	564.0
11126.3	568.2	11213.0	566.6	11296.5	565.0	11425.6	564.0
11127.9	568.2	11215.8	567.0	11304.1	565.5	11427.4	564.0
11131.2	568.0	11216.4	567.0	11307.0	566.0	11429.7	564.0
11131.8	568.0	11219.4	567.0	11307.5	566.0	11431.3	564.0
11131.9	568.0	11219.7	567.0	11308.4	566.0	11432.4	564.0
11132.5	568.0	11220.0	567.0	11310.8	566.0	11436.8	564.0
11142.3	568.0	11222.7	567.0	11311.6	566.0	11437.4	564.0
11152.4	568.0	11226.5	567.0	11311.8	566.0	11437.9	564.0
11156.5	568.0	11231.5	567.1	11315.1	566.0	11442.4	565.0
11157.2	568.0	11232.0	567.1	11332.2	566.0	11442.6	565.0
11159.8	568.0	11235.4	567.1	11332.2	566.0	11446.8	565.0
11160.1	568.0	11236.4	567.1	11339.3	566.0	11447.3	565.0
11160.3	568.0	11239.3	567.1	11361.7	566.0	11447.4	565.0
11161.2	568.0	11241.4	567.1	11365.5	566.0	11448.7	565.0
11165.7	568.0	11243.2	567.0	11370.0	566.0	11449.6	565.0
11166.4	568.0	11246.4	567.0	11373.3	566.0	11452.3	565.0
11166.5	568.0	11246.7	567.0	11380.8	566.0	11454.3	565.0
11171.6	567.3	11247.2	567.0	11383.5	566.0	11455.3	565.0
11174.0	567.0	11250.2	567.0	11384.9	565.5	11456.7	565.0
11176.4	566.7	11251.5	567.0	11385.3	565.3	11457.3	565.0
11181.1	566.0	11252.3	567.0	11386.3	565.0	11461.2	565.0
11181.3	566.0	11254.1	567.0	11388.1	565.0	11462.3	565.0
11181.4	566.0	11254.9	567.0	11388.7	565.0	11462.9	565.0
11186.5	566.0	11256.5	567.0	11391.1	565.0	11467.3	565.0
11187.0	566.0	11258.1	567.0	11395.9	565.0	11468.3	565.0
11187.0	566.0	11261.1	567.0	11397.3	565.0	11470.2	565.0
11187.6	566.0	11261.2	567.0	11397.8	565.0	11470.4	565.0
11189.0	566.0	11264.8	567.0	11400.1	564.0	11470.5	565.0
11191.3	566.0	11266.0	567.0	11400.6	564.0	11471.4	565.0
11192.0	566.0	11266.2	567.0	11400.6	564.0	11480.3	565.0
11192.1	566.0	11268.0	566.6	11401.0	564.0	11484.6	565.2
11192.8	566.0	11270.3	566.2	11402.2	564.0	11488.3	566.0
11194.1	566.0	11270.6	566.2	11405.1	564.0	11502.9	565.3
11196.2	566.0	11271.7	566.0	11405.6	564.0	11505.5	565.2
11196.7	566.0	11273.6	565.3	11406.4	564.0	11508.6	565.0
11198.3	566.0	11274.4	565.0	11408.0	564.0	11510.4	565.0

UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
11515.5	565.0	11629.5	564.5	11696.2	563.0	11798.7	561.0
11517.1	565.0	11630.7	564.3	11700.6	563.0	11798.7	561.0
11518.6	564.0	11631.3	564.0	11703.5	563.0	11799.4	561.0
11520.3	564.0	11633.4	563.3	11704.0	563.0	11803.7	561.0
11523.6	563.0	11634.1	563.0	11705.7	563.0	11803.9	561.0
11524.7	563.0	11635.7	563.0	11705.7	563.0	11804.3	561.0
11526.2	563.0	11635.8	563.0	11705.7	563.0	11804.7	561.0
11526.4	563.0	11637.1	563.0	11705.7	563.0	11808.3	561.0
11528.7	563.0	11637.4	563.0	11710.3	563.3	11808.5	561.0
11534.9	563.0	11639.0	563.0	11711.4	563.4	11808.7	561.0
11535.8	563.0	11643.3	563.0	11714.7	564.0	11809.1	561.0
11536.3	563.0	11646.1	563.0	11714.8	564.0	11813.9	561.0
11536.6	563.0	11647.6	563.0	11718.5	564.0	11815.6	561.0
11543.8	563.0	11649.7	562.0	11735.0	564.0	11819.5	561.0
11545.9	564.0	11651.1	562.0	11746.3	564.0	11828.0	562.0
11546.7	564.0	11652.1	562.0	11753.2	563.3	11828.2	562.0
11547.7	564.0	11652.3	562.0	11758.0	563.2	11837.3	562.0
11557.4	564.0	11653.1	562.0	11758.6	563.2	11845.8	561.3
11557.6	564.0	11656.1	562.0	11758.9	563.1	11846.3	561.2
11558.0	564.0	11657.3	562.0	11759.2	563.0	11846.9	561.0
11560.1	564.0	11658.3	562.0	11759.8	562.4	11848.3	560.1
11566.8	564.0	11661.5	562.0	11760.2	562.0	11848.4	560.0
11567.8	564.0	11662.7	562.0	11760.9	561.2	11848.5	560.0
11568.0	564.0	11663.3	562.0	11761.1	561.0	11848.5	560.0
11575.0	564.0	11666.8	562.0	11761.5	561.0	11848.7	560.0
11575.9	564.1	11667.5	562.0	11761.6	561.0	11849.0	560.0
11576.4	564.1	11667.8	562.0	11763.6	561.0	11850.1	560.0
11576.7	564.1	11668.7	562.0	11764.9	561.0	11857.3	561.0
11576.8	564.1	11672.3	562.0	11772.6	562.0	11858.5	561.0
11582.2	564.2	11672.7	562.0	11774.3	562.0	11859.9	561.0
11582.5	564.2	11673.0	562.0	11774.6	562.0	11862.1	561.0
11584.8	564.3	11678.5	562.0	11775.1	562.0	11862.2	561.0
11585.2	564.3	11678.5	562.0	11777.7	562.0	11862.3	561.0
11588.0	564.5	11678.5	562.0	11779.4	562.0	11862.9	561.0
11589.5	565.0	11678.5	562.0	11780.2	562.0	11867.1	560.6
11591.4	565.0	11678.5	562.0	11782.0	562.0	11874.7	560.0
11593.7	565.0	11681.7	563.0	11782.6	562.0	11885.4	560.0
11597.9	565.0	11683.8	563.0	11783.8	562.0	11889.3	560.0
11605.7	565.0	11684.9	563.0	11787.8	561.4	11889.4	560.0
11617.7	565.0	11685.3	563.0	11790.6	561.0	11892.1	560.0
11617.7	565.0	11686.6	563.0	11792.9	561.0	11896.1	560.0
11620.9	565.0	11687.9	563.0	11793.4	561.0	11903.1	560.0
11623.1	565.0	11688.6	563.0	11793.4	561.0	11907.3	560.0
11623.8	565.0	11691.1	563.0	11793.8	561.0	11907.4	560.0
11623.9	565.0	11694.5	563.0	11795.0	561.0	11907.9	559.4
11626.3	565.0	11696.2	563.0	11797.7	561.0	11908.2	559.0

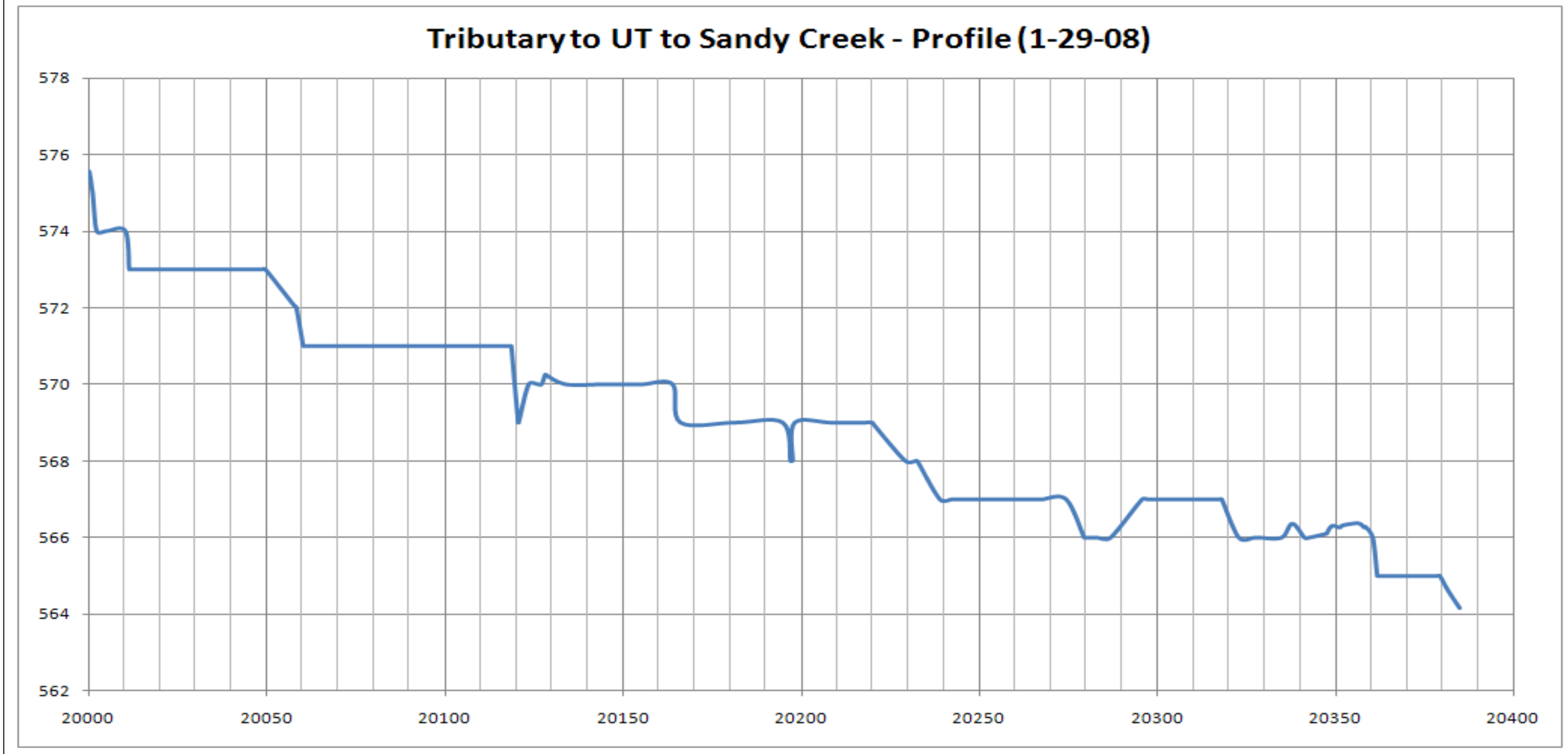
UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation
11908.5	559.0
11908.7	559.0
11909.4	559.0
11914.0	559.0
11925.2	559.0
11932.7	559.0
11938.1	559.0
11938.2	559.0
11943.6	558.0
11950.0	558.0
11951.1	558.0
11951.2	558.0
11953.9	558.0
11953.9	558.0
11957.8	559.0
11959.3	559.2
11969.3	560.0
11970.5	560.0
11975.2	560.2
11976.2	560.2
11976.6	560.3
11976.6	560.3
11982.1	561.0
11982.1	561.0
11982.1	561.0
11997.7	560.4
12012.0	560.0
12014.9	560.0
12017.7	560.0
12027.1	560.0
12028.7	560.0
12028.9	560.0
12029.2	560.0
12033.7	560.0
12050.0	559.0
12068.6	559.0
12073.2	559.0
12081.6	558.0
12082.0	558.0
12082.0	558.0
12082.0	558.0
12082.1	558.0
12082.3	558.0
12082.4	558.0
12086.8	559.0
12089.6	559.0

Station	Elevation
12095.6	559.0
12103.9	559.0
12106.9	560.0
12112.2	560.0
12118.1	560.0
12122.3	560.0
12125.1	560.0
12125.1	560.0
12125.4	560.0
12128.9	560.0
12134.6	560.0
12136.6	560.0
12136.6	560.0
12143.6	560.0
12152.8	560.0
12153.7	560.0
12163.9	560.0
12172.5	560.0
12172.8	560.0
12177.3	560.0
12182.3	560.0
12183.1	560.0
12184.3	560.0
12190.2	560.0
12191.6	560.0
12192.5	559.6
12192.6	559.5
12193.4	559.0
12194.5	558.2
12194.7	558.0
12194.9	558.0
12195.1	558.0
12195.1	558.0
12195.4	558.0
12196.8	558.0
12198.8	558.0
12205.7	558.0
12216.8	558.0
12219.6	558.0
12221.0	558.0
12221.4	558.0
12221.8	558.0
12235.2	558.0
12248.0	558.0
12261.3	558.0
12263.2	558.0

Station	Elevation
12263.3	558.0
12263.5	558.0
12263.6	558.0
12265.3	558.0
12268.4	558.0
12295.3	559.0
12296.9	559.0
12297.3	559.0

Figure 2



Title	Longitudinal Profile		
Prepared For	**Project**	Randolph County, North Carolina	**Prepared By**
Ecosystem Enhancement Program	**Date**	**Project Number**	Kimley-Horn and Associates, Inc.
	10/24/08	011795019	

Tributary to UT to Sandy Creek Profile Raw Survey Data (1-29-08)

Station	Elevation
20000.0	575.5
20000.1	575.6
20001.0	575.0
20002.2	574.0
20004.9	574.0
20010.2	574.0
20011.3	573.0
20011.5	573.0
20012.1	573.0
20012.1	573.0
20012.2	573.0
20013.5	573.0
20014.1	573.0
20021.6	573.0
20021.9	573.0
20024.8	573.0
20029.6	573.0
20035.7	573.0
20037.8	573.0
20044.6	573.0
20045.2	573.0
20048.6	573.0
20049.5	573.0
20057.5	572.1
20058.2	572.0
20060.1	571.0
20060.3	571.0
20060.3	571.0
20062.3	571.0
20067.2	571.0
20067.6	571.0
20067.7	571.0
20067.8	571.0
20069.1	571.0
20076.3	571.0
20088.7	571.0
20094.3	571.0
20095.1	571.0
20098.8	571.0
20110.7	571.0
20116.4	571.0
20116.6	571.0
20117.3	571.0
20118.4	571.0
20118.5	571.0
20119.5	570.0

Station	Elevation
20120.4	569.0
20120.4	569.0
20120.5	569.0
20120.5	569.0
20120.6	569.0
20120.6	569.0
20120.7	569.0
20123.4	570.0
20126.1	570.0
20127.0	570.0
20128.0	570.3
20128.1	570.3
20133.7	570.0
20144.5	570.0
20151.2	570.0
20151.4	570.0
20155.4	570.0
20163.8	570.0
20166.0	569.0
20181.2	569.0
20194.8	569.0
20196.9	568.0
20197.0	568.0
20197.2	568.0
20197.2	568.0
20197.3	568.0
20197.5	568.0
20197.5	568.0
20198.1	569.0
20208.4	569.0
20217.2	569.0
20219.9	569.0
20220.5	568.9
20229.1	568.0
20232.1	568.0
20232.5	568.0
20238.8	567.0
20242.3	567.0
20245.1	567.0
20246.0	567.0
20247.6	567.0
20252.5	567.0
20258.4	567.0
20263.1	567.0
20263.9	567.0
20264.3	567.0

Station	Elevation
20264.4	567.0
20264.8	567.0
20266.9	567.0
20267.2	567.0
20267.7	567.0
20274.3	567.0
20279.3	566.0
20279.4	566.0
20279.9	566.0
20283.1	566.0
20283.1	566.0
20286.7	566.0
20295.6	567.0
20297.0	567.0
20297.3	567.0
20302.0	567.0
20306.6	567.0
20313.8	567.0
20315.8	567.0
20316.8	567.0
20317.5	567.0
20318.0	567.0
20322.7	566.0
20327.1	566.0
20328.5	566.0
20328.6	566.0
20334.8	566.0
20337.8	566.4
20341.2	566.0
20342.5	566.0
20347.3	566.1
20347.4	566.1
20348.9	566.3
20351.1	566.3
20352.0	566.3
20356.3	566.4
20358.0	566.3
20358.3	566.3
20360.3	566.0
20361.6	565.0
20361.7	565.0
20362.0	565.0
20362.3	565.0
20370.5	565.0
20370.8	565.0
20370.8	565.0

Station	Elevation
20370.9	565.0
20378.3	565.0
20379.2	565.0
20381.4	564.6
20384.8	564.2

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 1 - Riffle
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	583.2255	pin
0.14	0	582.6482	fp
10.49	0	581.2011	fp
17.42	0	580.7158	fp
43.54	0	579.9484	bkfl
48.6	0	578.9623	
50.6	0	578.8108	lew
53.53	0	578.6285	
55.21	0	578.7085	
57.3	0	578.8126	rew
58.88	0	579.2169	
60.87	0	579.143	
64.91	0	579.9276	bkfr
66.93	0	580.1996	fp
69.69	0	580.3557	fp
104.36	0	580.4154	fp
118.02	0	581.4349	fp
118.07	0	582.0661	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	581.25	581.25	581.25
Bankfull Elevation (ft)	579.94	579.94	579.94
Floodprone Width (ft)	105.43	-----	-----
Bankfull Width (ft)	21.42	10.71	10.71
Entrenchment Ratio	4.92	-----	-----
Mean Depth (ft)	0.81	0.85	0.77
Maximum Depth (ft)	1.31	1.31	1.28
Width/Depth Ratio	26.44	12.6	13.91
Bankfull Area (sq ft)	17.35	9.12	8.23
Wetted Perimeter (ft)	21.66	12.09	12.12
Hydraulic Radius (ft)	0.8	0.75	0.68
Begin BKF Station	43.58	43.58	54.29
End BKF Station	65	54.29	65

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 2 - Pool
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	583.0678	pin
0.09	0	582.5889	fp
3.22	0	582.2067	fp
11.17	0	580.9995	fp
19.11	0	580.4745	fp
23.93	0	578.884	fp
26.75	0	577.623	lew
28.41	0	576.5412	
29.38	0	576.3719	
30.39	0	576.4026	
32.48	0	576.6528	
34.08	0	577.3186	
35.39	0	577.5951	rew
38.6	0	577.9891	
42.65	0	578.7101	bkfr
62.56	0	579.2324	fp
80.54	0	579.5057	fp
84.82	0	579.3052	fp
84.91	0	579.8422	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	581.05	581.05	581.05
Bankfull Elevation (ft)	578.71	578.71	578.71
Floodprone Width (ft)	74.06	-----	-----
Bankfull Width (ft)	18.33	9.16	9.17
Entrenchment Ratio	4.04	-----	-----
Mean Depth (ft)	1.2	1.63	0.76
Maximum Depth (ft)	2.34	2.34	1.64
Width/Depth Ratio	15.27	5.62	12.07
Bankfull Area (sq ft)	21.92	14.97	6.96
Wetted Perimeter (ft)	19.16	11.47	10.98
Hydraulic Radius (ft)	1.14	1.3	0.63
Begin BKF Station	24.32	24.32	33.48
End BKF Station	42.65	33.48	42.65

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			

Movable Particle (mm)

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 3 - Riffle
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	568.3534	pin
0.09	0	567.768	
9.21	0	567.8926	
23.76	0	567.2368	
29.6	0	564.9669	lew
31.28	0	564.6136	
32.56	0	564.6054	
35.05	0	564.5959	
35.31	0	564.9306	rew
39.92	0	566.7011	bkfr
43.7	0	566.8708	
52.54	0	566.6996	
61.36	0	566.6011	
61.5	0	567.0457	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	568.8	568.8	568.8
Bankfull Elevation (ft)	566.7	566.7	566.7
Floodprone Width (ft)	61.5	-----	-----
Bankfull Width (ft)	23.65	11.83	24.42
Entrenchment Ratio	2.6	-----	-----
Mean Depth (ft)	0.85	1.51	0.18
Maximum Depth (ft)	2.1	2.1	1.13
Width/Depth Ratio	27.82	7.83	135.67
Bankfull Area (sq ft)	19.99	17.89	2.11
Wetted Perimeter (ft)	24.57	13.6	13.23
Hydraulic Radius (ft)	0.81	1.31	0.16
Begin BKF Station	25.14	25.14	36.97
End BKF Station	61.39	36.97	61.39

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 4 - Pool
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	567.4321	pin
0.07	0	566.9852	
17.84	0	567.2569	
24.27	0	566.9697	
27.39	0	566.3542	
28.73	0	565.8974	
29.6	0	565.7744	bkfl
32.11	0	564.5761	lew
34.04	0	563.2075	
34.88	0	563.0193	
36.03	0	562.9712	
39.56	0	564.1239	
42.14	0	564.5688	rew
45.37	0	565.2442	
47.74	0	565.9015	
53.16	0	566.9251	
66.62	0	566.8291	
85.71	0	566.8813	
86.21	0	566.9801	
86.29	0	567.6847	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	568.57	568.57	568.57
Bankfull Elevation (ft)	565.77	565.77	565.77
Floodprone Width (ft)	86.29	-----	-----
Bankfull Width (ft)	17.66	8.63	9.03
Entrenchment Ratio	4.89	-----	-----
Mean Depth (ft)	1.44	1.85	1.04
Maximum Depth (ft)	2.8	2.8	2.08
Width/Depth Ratio	12.26	4.66	8.68
Bankfull Area (sq ft)	25.35	15.93	9.42
Wetted Perimeter (ft)	18.75	11.55	11.35
Hydraulic Radius (ft)	1.35	1.38	0.83
Begin BKF Station	29.61	29.61	38.24
End BKF Station	47.27	38.24	47.27

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0

Shear Stress (lb/sq ft)
Movable Particle (mm)

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 5 - Riffle
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	568.7644	pin
0.09	0	568.2778	rf
13.42	0	568.3146	rf
28.15	0	567.6495	bkfl
29.56	0	567.1367	
31.6	0	567.1375	
32.47	0	566.9478	
33.55	0	567.1697	
36.06	0	568.1237	
45.5	0	568.7985	
53.56	0	569.2658	
53.69	0	570.0691	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	568.35	568.35	568.35
Bankfull Elevation (ft)	567.65	567.65	567.65
Floodprone Width (ft)	39.18	-----	-----
Bankfull Width (ft)	6.67	0.99	5.68
Entrenchment Ratio	5.87	-----	-----
Mean Depth (ft)	0.43	0.18	0.48
Maximum Depth (ft)	0.7	0.36	0.7
Width/Depth Ratio	15.51	5.5	11.83
Bankfull Area (sq ft)	2.88	0.18	2.7
Wetted Perimeter (ft)	6.9	1.41	6.2
Hydraulic Radius (ft)	0.42	0.12	0.44
Begin BKF Station	28.14	28.14	29.13
End BKF Station	34.81	29.13	34.81

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Sandy Creek
Reach Name: Reach 1
Cross Section Name: Cross Section 6 - Pool
Survey Date: 01/29/2008

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	568.7801	pin
0.18	0	568.282	
12.39	0	568.291	
27.62	0	568.1144	
30.84	0	567.9406	bkfl
36.04	0	566.8228	lew
36.99	0	566.155	
38.48	0	565.7954	
39.32	0	565.9866	
40.79	0	566.8455	rew
42.58	0	567.6203	
43.26	0	567.8343	
44.3	0	568.1976	
50.96	0	568.6046	
57.75	0	569.3471	
57.8	0	569.8949	pin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	570.08	570.08	570.08
Bankfull Elevation (ft)	567.94	567.94	567.94
Floodprone Width (ft)	57.8	-----	-----
Bankfull Width (ft)	12.72	6.62	6.1
Entrenchment Ratio	4.54	-----	-----
Mean Depth (ft)	0.99	0.78	1.22
Maximum Depth (ft)	2.14	1.9	2.14
Width/Depth Ratio	12.85	8.49	5
Bankfull Area (sq ft)	12.6	5.15	7.45
Wetted Perimeter (ft)	13.56	8.86	8.49
Hydraulic Radius (ft)	0.93	0.58	0.88
Begin BKF Station	30.84	30.84	37.46
End BKF Station	43.56	37.46	43.56

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			