UT to Cane Creek Stream Restoration Site

2008 Annual Monitoring Report (Year 2)

Alamance County
EEP Project No. 69
Design Firm: Stantec Consulting Services, Inc.

May 2009

Prepared for:

NCDENR/ Ecosystem Enhancement Program
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I. Executive Summary

The UT to Cane Creek stream restoration project consists of 2,232 linear feet of stream restoration with just over 5 acres of buffer restoration. The property is in Alamance County north of Siler City, north of Old Dam Road (SR 2370) and west of Snow Camp Road (SR 1004). Construction of the site was completed in March of 2006. The planting was also completed in March of 2006. Four bankfull events occurred during construction. One bankfull event was recorded on September 6, 2008 as a result of Tropical Storm Hannah, which created a rain event of greater than four inches in Snow Camp.

The project contains a portion of an unnamed tributary (UT) to Cane Creek that drains to the Haw River of the greater Cape Fear River Basin and has a 2,003 acre drainage area. The North Carolina Wetland Restoration Program (NCWRP), now know as the North Carolina Ecosystem Enhancement Program (NCEEP), identified UT to Cane Creek as a potential stream mitigation site. Prior to restoration, UT to Cane Creek was incised with moderate habitat and an actively migrating unstable pattern. Sand bars were composed of erodable material that migrated frequently during small storm events. Sections of the channel that had been straightened for agricultural purposes contained mid channel bars indicating an overwidened channel. The mid channel bars were deflecting the stream flow into the banks accelerating stream bank erosion.

Currently the banks of UT to Cane Creek are holding up well with little erosion or bank failure. As a whole, the structures appear to be holding grade. The primary concern with this site is the aggradation that is occurring throughout the reach and backwater effects due to elevated fords and riffles. The aggradation is most likely a response to decrease the channel cross sectional area of the stream as opposed to a modification in channel slope which has remained consistent between monitoring years.

The aggradation is in the form of mid-channel bars, many of which have become vegetated. Mid-channel bar formation is an indicator of an overly widened channel. This is occurring in various locations along the entire reach and in all totals 600-700 feet, or about 25% of the restored reach.

The backwater impacts involve a significant length of stream. The first area is upstream of the ford crossing at station 19+12. The elevation of the ford, 570.5 feet, has backed water up approximately 360 feet to station 15+52. The structures and riffles in this area are not functioning as designed, as they are impacted by high water levels. A more appropriate level for this crossing based on the bankfull and water surface slopes is elevation 569.4 which is approximately 1.1 feet lower than the existing crossing.

Two consecutive areas with backwater, spanning a length of approximately 580 feet from station 26+63 to 32+46, are located near the bottom of the reach. The downstream backwater appears to be caused by an abandoned ford crossing at station 32+46, elevation 566.6 feet. The ford backs water up to a riffle at station 30+ 24, elevation 567 feet;

approximately 220 feet upstream. This riffle subsequently backs the water upstream approximately 360 feet to station 26+63. Both the ford and riffle are approximately 0.4 foot higher than the designed channel elevation. The structures and riffles within this reach are submerged by high water and not functioning as designed. The aggradation and deposition is most likely being accelerated by sediment dropping out of the slower moving water.

It is recommended that the three aforementioned causes of backwater effects be repaired to restore the lost function of the stream features and structures in those areas. Lowering the elevation of the stream fords and elevated riffle would alleviate the backwater effects and likely reduce the deposition of sediments throughout the affected areas.

The new CVS-EEP vegetation monitoring protocol was administered for monitoring year two. Four vegetation monitoring plots were added to the original plot (Plot 4) that was established during baseline data collection. Planted stems could not be distinguished from natural stems during the vegetation data collection, therefore stems were labeled as natural to err on the side of caution. The only plants that could positively be identified as planted stems were the black willow and silky willow livestakes within Plot 4. There are 2,145 stems/acre. The vegetation problem areas are mainly composed of bare benches, easement encroachment, and invasive exotics. Invasive exotics observed throughout the conservation easement believed to be a threat include tall fescue (*Schedonurus arundinaceus*), multiflora rose (*Rosa multiflora*), and Japanese stiltgrass (*Microstegium vimineum*). Other invasive exotics infrequently observed that did not seem to be threatening at this point include Japanese honeysuckle (*Lonicera japonica*) and Chinese privet (*Ligustrum sinense*).

II. Project Background

A. Project Objectives

The project goals for UT to Cane Creek include:

- Improving water quality
- Providing wildlife habitat through the creation of a riparian zone
- Improving aquatic habitat with the use of natural material stabilization structures and a riparian buffer
- Excluding cattle from the stream
- Reducing nutrient loads from entering the stream through a filtration buffer
- Increasing the streams access to its floodplain
- Reducing erosion and sedimentation

The UT to Cane Creek is a third order stream that flows generally from southwest to the northeast on the McPherson property and has a drainage area of 2,003 acres. The conservation easement is approximately 6.9 acres. Prior to construction, the 2,301 foot long stream was relatively sinuous near the upstream portion of the project area and became progressively wider downstream. There was also evidence of channelization. Cattle had full access to the stream resulting in bank erosion, vegetation degradation, and

reduced water quality. The channel was classified as a C4 channel type prior to construction.

The stream was restored in a C channel type using Priority 2 stream restoration techniques, which restores the pattern, dimension, and profile. Boulder structures and root wads were installed to provide further stability to the stream as well as to enhance aquatic wildlife habitat. Fencing was installed along the conservation easement boundaries to prevent cattle access to the stream and buffers. Streambanks, the floodplain, and upland areas within the easement were all planted with vegetation to stabilize the channel and providing shading, food, and habitat as well as a vegetated buffer to treat surrounding overland flows.

B. Project Structure

UT to Cane Creek was restored through Priority 2 restoration of the dimension, pattern, and profile to allow for adequate sediment transport within the stream. The natural meanders were restored through a combination of bedform transformation, channel dimension adjustments, and pattern alterations. Rock vane structures and rootwads were constructed to not only serve as bank protection and grade control,but to enhance aquatic habitat. The Priority 2 restoration converted the 2,301 feet of impaired channel into 2,277 linear feet of a restored meandering channel. Planting of the riparian buffer within the permanent conservation easement was completed in March of 2006.

Table I.a. Mitigation Structure and Objectives

Table 1.a. Project Components UT to Cane Creek /Project No. 69								
Project Component or Reach ID	**Existing Feet/Acres**	**Restoration Level**	**Approach**	**Footage or Acreage**	**Stationing**	**Buffer Acres**	**BMP Elements[1]**	**Comment**
Main Channel	2301	R	P2	2277lf	10+11-32+88	10.1	CF=5739lf	Instream Structure and Vegetated Buffers

1 = BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; Grassed Swale = S; LS = Level Spreader; NI = Natural Infiltration Area, O = Other CF = Cattle Fencing; WS = Watering System; CH = Livestock Housing

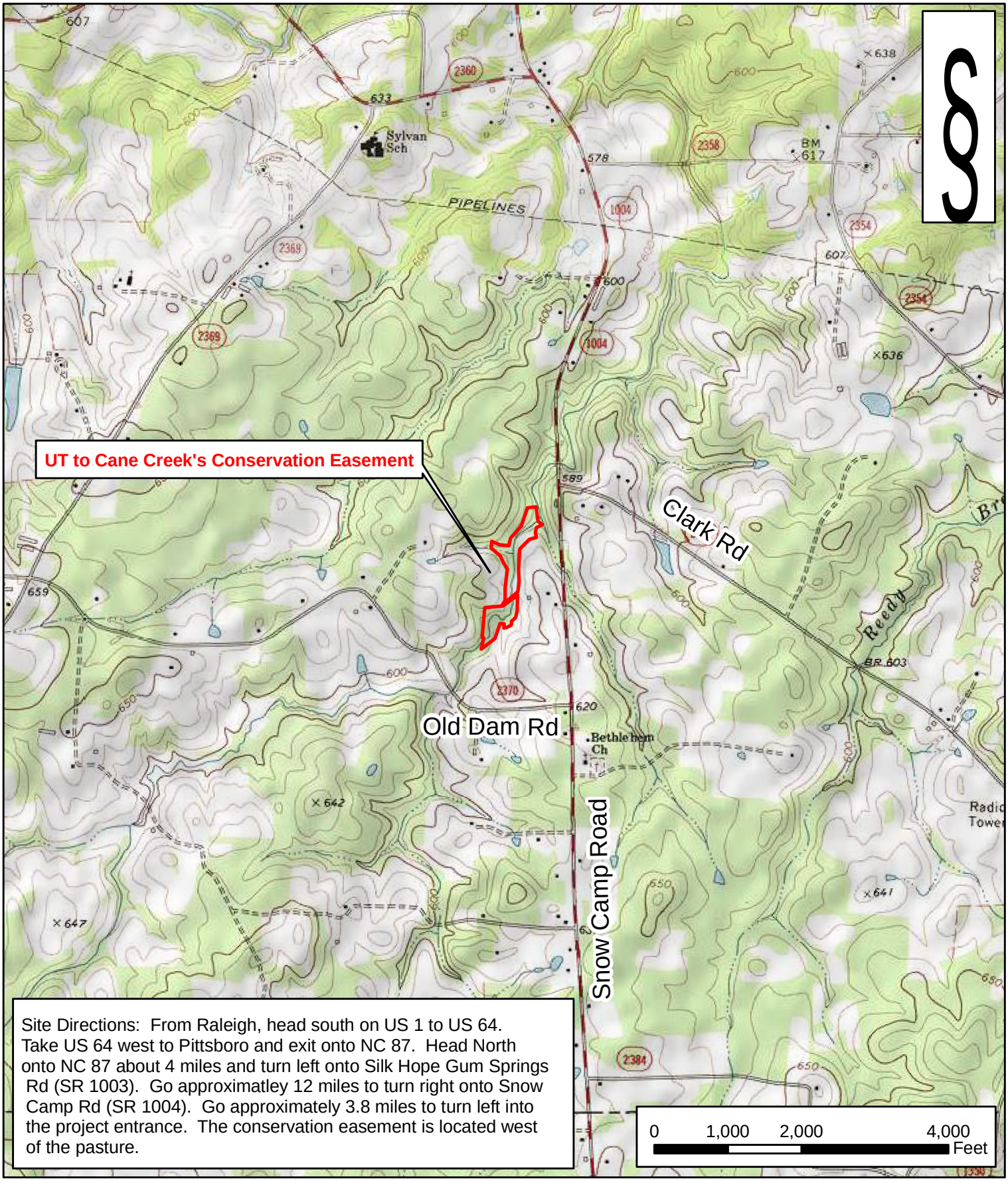
Table II.b. Component Summations

Table I.b. Component Summations UT to Cane Creek/Project No. 69							
Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration	2277					10.1	
Enhancement							
Enhancement I							
Enhancement II							
Creation							
Preservation							
HQ Preservation							
		0	0				
Totals	**2277**	**0**		**0**	**0**	**10.1**	**Count**
	Non-Applicable						

C. Location and Settings

UT to Cane Creek is located within a cattle pasture on the McPherson property off Snow Camp Road (SR 1004), north of Old Dam Road (SR 2370), north of Siler City in Alamance County, NC (Figure 1). It is in the Haw River Basin in Cape Fear 03030002 Cataloging Unit (CU) and North Carolina Division of Water Quality Subbasin 03-06-04.

Site Directions: From Raleigh, head south on US 1 to US 64. Take US 64 west to Pittsboro and exit onto NC 87. Head North onto NC 87 about 4 miles and turn left onto Silk Hope Gum Springs Rd (SR 1003). Go approximately 12 miles and turn right onto Snow Camp Rd (SR 1004). Go approximately 3.8 miles to turn left into the project entrance. The conservation easement is located west of the pasture.



Site Directions: From Raleigh, head south on US 1 to US 64. Take US 64 west to Pittsboro and exit onto NC 87. Head North onto NC 87 about 4 miles and turn left onto Silk Hope Gum Springs Rd (SR 1003). Go approximatley 12 miles to turn right onto Snow Camp Rd (SR 1004). Go approximately 3.8 miles to turn left into the project entrance. The conservation easement is located west of the pasture.

The Catena Group

UT to Cane Creek Stream Restoration Site

Site Location Map

Alamance County, North Carolina

USGS 7.5-Minute Topographic Quadrangle Map

EEP Project No. 69

Date: November 2008

Ecosystem Enhancement Program

Figure 1

D. History and Background

The North Carolina Wetland Restoration Program (NCWRP, now known as North Carolina Ecosystem Enhancement Program, NCEEP), identified UT to Cane Creek as having potential for stream restoration.

Prior to restoration, UT to Cane Creek consisted of an incised channel with moderate habitat and an unstable pattern that was actively migrating. Stream banks were steep with areas of active erosion, particularly along the outside of meander bends. Sand bars were composed of easily erodible material that migrated frequently during small storm events. Cattle had unlimited access to the stream and cattle crossings were observed throughout. The stream buffer was nearly absent. The channel was classified as a C channel type prior to restoration.

Table III. Project Activity and Reporting History

Table II. Project Activity and Reporting History UT to Cane Creek Stream Restoration Site-Project No.69

Activity or Reporting	Scheduled Completion	Data Collection Complete	Actual Completion Date
Restoration Plan	NA	NA	April 2003
Final Design-90%	NA	NA	October 2005
Construction	NA	NA	March 2006
Temporary S&E mix applied to entire project area	NA	NA	March 2006
Permanent seed mix applied to entire project area	NA	NA	March 2006
Containerized, B&B, and livestake planting	NA	NA	March 2006
Mitigation Plan/As-built (Year 0 Monitoring-baseline)	NA	May 2006	June 2006
Year 1 Monitoring	NA	February 2007	March 2007
Year 2 Monitoring	January 2009	October 2008	January 2009

Table IV. Project Contact Table

Table III. Project Contact Table UT to Cane Creek Stream Restoration Site-Project No. 69

Designer	Stantec Consulting Services Inc 801 Jones Franklin Road, Suite 300 Raleigh, North Carolina 27606 David Bidelspach - (919) 851-6866
Construction Contractor	Shamrock Environmental Corp. 6101 Corporate Park Drive Browns Summit, North Carolina 27699 Bill Wright - (800) 881-1098
Planting Contractor POC	Seal Brothers Contracting, LLC P.O.Box 86 Dobson, North Carolina 27017 Brian Seal

Seeding Contractor POC	Shamrock Environmental Corp. 6101 Corporate Park Drive Browns Summit, North Carolina 27699 Bill Wright - (800) 881-1098
Seed Mix Sources	contact Shamrock Environmental Corp.
Nursery Stock Suppliers	Hills Nursery Co., Inc. (931) 668-4364
Monitoring Performers	The Catena Group (TCG) 410-B Millstone Drive Hillsborough, North Carolina 27678
Stream Monitoring	Ward Consulting Engineers 8386 Six Forks Road, Suite 101 Raleigh, NC 27613-5088
Vegetation Monitoring	The Catena Group 410-B Millstone Dr. Hillsborough, NC 27278

Table IV. Project Background Table

Table IV. Project Background Table UT to Cane Creek Stream Restoration Site-Project No. 69	
Project County	Alamance
Drainage Area	
UT to Cane Creek	2003 acres
Drainage impervious surface cover estimate (%)	< 5%
Stream Order	
Main Channel	3rd
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-Built	C
Cowardin Classification Dominant Soil Types	Stream (R3UB1) Herndon Silt Loam
Reference Site ID	UT to Cabin Branch (CB) & Landrum Creek (LC)
USGS HUC for Project	03030002
USGS HUC for Reference-CB	03020201
USGS HUC for Reference-LC	03030003
NCDWQ Sub-basin for Project	03-06-04
NCDWQ Sub-basin for Reference Reach-CB	03-04-01
NCDWQ Sub-basin for Reference Reach-LC	03-06-12
NCDWQ Classification for Project	C, NSW
NCDWQ Classification for Reference -CB	WS-IV NSW
NCDWQ Classification for Reference -LC	C
Is any portion of any project segment 303D listed?	No
Is any portion of any project segment upstream of a 303D listed segment?	No
Reasons for 303D listing or stressor	N/A
% of project easement fenced	100%

E. Monitoring Plan View

The monitoring features are depicted in the Integrated Current Conditions Plan View in Appendix B.

III. Project Condition and Monitoring Results

A. Vegetation Assessment

The new CVS-EEP protocol was administered for monitoring year (MY)-02. By recommendation from EEP, four vegetation monitoring plots were added to the original one that was established during baseline data collection. Since distinguishing planted stems from natural stems was very difficult, it was agreed that Level II of the CVS-EEP protocol, which counts both planted and natural woody stems, should be followed to err on the side of caution. The only plants that could positively be identified as planted stems were the black willow and silky willow livestakes within Plot 4. There are 2,145 stems/acre including natural and planted stems. The CVS-EEP protocol was not followed for the MY-01. Level II of the CVS-EEP protocol will be used for the remainder of the monitoring period. The success criteria of the planted woody species are the survival of 320 stems/acre after MY-03. A mortality rate of ten percent will be allowed after MY-04 (288 stems/acre), with another ten percent mortality rate allowed after MY-05 requiring a minimum of 260 stems/acre.

The successional species dog fennel (*Eupatorium capillifolium*) along with horseweed (*Conyza canadensis)* was ubiquitous throughout the conservation easement. Other invasive exotics include tall fescue (*Schedonurus arundinaceus*), Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Chinese privet (*Ligustrum sinense*) with tall fescue and multiflora rose being the most common. According to the NC Native Plant Society, all of these species with the exception of tall fescue, are classified as Rank 1 “Severe Threat” species which is defined as exotic plant species that have invasive characteristics and spread readily into native plant communities, displacing native vegetation. Although these species have been given this rank, the functionality of the project is not expected to be impaired significantly. For additional information relating to vegetation see Appendix A.

1. Vegetation Problem Areas

The vegetation problem areas consist mainly of bare benches, eroding banks, and invasive exotic species encroachment of the conservation easement. Tall fescue is the most common plant species which is encroaching from the surrounding cattle pasture throughout the conservation easement. See Table 6 in Appendix A for locations of problem areas identified within the conservation easement. See Section 2 of Appendix A for representative photos of the vegetation problem areas.

2. Integrated Current Conditions Plan View (CCPV)

The vegetation and stream problem areas are integrated into the CCPV in Appendix B. The problem areas are color coded as severe, moderate, and minor with orange hatching, yellow hatching, and blue gray hatching, respectively.

B. Stream Assessment

1. Procedural Items

a) Morphological Criteria

The restoration site was surveyed by total station in November 21, 2008. The survey includes a profile of entire length of restored reach, 2,332 feet; and five cross-sections. Pebble counts, the visual stability assessment, the problem area assessment, and the photo points were conducted on December 2, 2008.

The existing cross-sections pins were located and marked with fiberglass poles and flagging tape. Three additional cross sections, two riffles and one pool, were established downstream of the stream crossing.

The permanent cross section locations are listed below:
Cross Section 1: Station 12+15, riffle.
Cross Section 2: Station 17+75, pool.
Cross Section 3: Station 23+18, riffle.
Cross Section 4: Station 25+15, pool.
Cross Section 5: Station 28+99, riffle.

b) Hydrological Criteria

Monitoring requirements state that at least two bankfull events are to be documented within the five year monitoring period. Currently, one crest gauge is present at UT to Cane Creek. One documented bankfull event occurred on 09/07/08.

Table VI. Verification of Bankfull Events

Table V. Verification of Bankfull Events UT to Cane Creek Stream Restoration Site-Project No. 69			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo #**
Late 2005/Early 2006	Late 2005/Early 2006	Visual during construction	N/A
October 23, 2008	September 7, 2008	wrack lines	None

2. Integrated Current Conditions Plan View

See Appendix B1 for the integrated problem area plan view including stream and vegetation problem areas.

3. Problem Areas Table Summary

The majority of the problem areas are due to the in-channel aggradation and backwater effects. There are areas of bank and structural failure, but these tend to be isolated as opposed to systemic. The backwater effects are apparent on the Longitudinal Profile plot in Appendix B. Problem area photos are also located in Appendix B.

4. Fixed Station Photos

Stream photos from the established photo stations were taken in October 2008 and can be viewed in Appendix B.

5. Stability Assessment

A visual morphological stability assessment was conducted on December 2, 2008. The MY-01 report only analyzed the upper 20 bankfull widths of the reach, from stations 10+00 to 17+85, approximately. Therefore, as-built quantities for the entire reach were not available and had to be determined by examination of the Restoration Plan design plan view and longitudinal profile. The as-built quantities of structures were also adjusted for the total reach length and were taken from the surveyed as-built drawings. The design and restoration quantities have been updated to reflect the entire reach of UT to Cane Creek in this MY-02 report.

The visual stability of the riffles and pools had a mean performance of 70% and 86%, respectively. The reduction in riffle performance stability is attributed to the loss of riffles in elongated pools or riffles that were too short. Backwater effects also resulted in submerged riffles loosing their function. The mean performance of the pools is greater than the riffles at 86%. The pool performance is based on the migration of pools into riffle areas, elongated pool lengths, and pools that have filled. The thalweg performance of 48% is primarily due to mid-channel deposition forcing the stream to one side of the channel.

The bank, meanders, and root wads all exhibited high scores of stability at 98%, 95%, and 100%, respectively, which reflects the stability of the stream pattern, bank height and establishment of vegetation. The cross vanes scored a 79% in performance mainly due to loss of function from sediment burying structures, backwater over structures, and gaps between boulders causing piping of water through the structure.

Table VII. Categorical Stream Feature Visual Stability Assessment

Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment
UT to Cane Creek Stream Mitigation Site/Project No. CMC/CPF/02
Main Channel: (2332 feet)

Feature	Initial	MY-01*	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	84%	70%			
B. Pools	100%	97%	86%			
C. Thalweg	100%	89%	48%			
D. Meanders	100%	93%	95%			
E. Bed General	100%	93%	87%			
F. Bank Condition	NA	95%	98%			
G. Vanes/J Hooks etc.	100%	89%	79%			
H. Wads and Boulders	100%	50%	100%			

*MY-01 monitoring reach did not include entire length of restoration project. MY-02 and subsequent monitoring shall.

6. Quantitative Measures Summary Tables Stability Assessment

The MY-01 report did not evaluate the entire reach, however, this MY-02 report does. As a result of this extended monitoring length some variation in the pattern and profile parameters has occurred.

Two cross sections, located upstream of the stream crossing, were able to be compared to MY-01 data. Three additional cross sections were added for MY-02 downstream of the crossing. Comparison of the two upstream sections, one riffle and one pool, shows that the cross sectional areas of the channel have changed by -2.5% and +5.7%, respectively; the bankfull widths of the riffle and pool increased by 4% and 8% respectively; while the mean depth of the riffle decreased by 8%, due to aggradation. With only one segment of the channel available for comparison, it is difficult to identify any overall trends for the project. Better comparisons will be possible next year with the additional cross sectional data.

The MY-02 pattern data shows a larger range and average for most of the parameters since it includes the entire channel length. The riffle and pool profile data shows larger ranges based on the larger sample size, however the median values are not that dissimilar between the two years. The channel slope is similar between MY-01 and MY-02, however, the riffle slope has increased by and order of magnitude, reflecting the shortening of the riffles. The d50 and d84 pebble counts have increased from MY-01 and is likely due to the increased rainfall and sediment available to the stream in this wetter monitoring year.

Table VIII. Baseline Morphology and Hydraulic Summary

Table VIII. Baseline Morphology and Hydraulics Summary																
Cane Creek Stream Restoration Project No. 69																
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Design**			**As-Built**			
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	
BF Width (ft)									44.5			24			26.6	
Flood Prone Width (ft)									88			72			72	
BF Cross Sectional Area (SF)									46.5			47.7			51	
BF Mean Depth (ft)									1			2			2.2	
Width/Depth Ratio									43			12			13.9	
Entrenchment Ratio									2			3			2.7	
Bank Height Ratio							0.8	4.3				1			1	
Wetted Perimeter (ft)															32	
Hydraulic Radius (ft)															0.67	
Pattern																
Channel Beltwidth (ft)									63			105			110	
Radius of Curvature (ft)									24	48	54	60	44	83	64	
Meander Wavelength (ft)									218	53	144	123	205	48	127	
Meander Width ratio									1.4			4.38			4.14	
Profile																
Riffle Length													48	60	54	
Riffle Slope									0.0162			0.0034	0.0023	0.004	0.032	
Pool Length													31	79	43	
Pool Spacing									355			82	77	160	100	
Substrate																
d50									18						2.3	
d84									180						11	
Additional Reach Parameters																
Valley Length (ft)									1960			1960			1960	
Channel Length (ft)									2301			2232			2232	
Sinuosity									1			1.14			1.14	
Water Surface Slope									0.0056			0.0023			0.0029	
BF Slope									0.0056			0.0023			0.0032	
Rosgen Classification									C4			C4			C4	
Habitat Index																
Macrobenthos																

Table IX. Morphology and Hydraulic Monitoring Summary

Exhibit Table IX. Morphology and Hydraulic Monitoring Summary
UT to Cane Creek Stream Mitigation Site/Project No. 69
Main Channel (2277 feet)

Parameter	Cross Section 1 Riffle						Cross Section 2 Pool						Cross Section 3 Riffle[1]						Cross Section 4 Pool[1]						Cross Section 5 Riffle[1]					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	27.20	28.31					24.20	26.17					NA	23.45					NA	31.21					NA	26.31				
Floodprone Width (ft)	72.00	72.00					72.00	72.00					NA	95.40					NA	92.00					NA	59.10				
BF Cross Sectional Area (sq.ft)	48.00	46.77					53.60	56.69					NA	45.79					NA	57.77					NA	43.42				
BF Mean Depth (ft)	1.80	1.65					2.20	2.17					NA	1.95					NA	1.85					NA	1.65				
BF Max Depth (ft)	3.10	2.90					3.60	3.55					NA	3.31					NA	4.26					NA	2.83				
Width/Depth Ratio	15.40	17.14					11.00	12.08					NA	12.01					NA	16.86					NA	15.95				
Entrenchment Ratio	2.65	2.54					2.97	2.75					NA	4.07					NA	2.95					NA	2.25				
Wetted Perimeter (ft)	32.00	29.25					26.00	27.46					NA	24.65					NA	32.90					NA	27.20				
Hydraulic Radius (ft)	1.50	1.60					2.00	2.06					NA	1.86					NA	1.76					NA	1.60				
Bank Height Ratio	1.00	0.86					1.00	1.07					NA	0.89					NA	0.87					NA	0.93				
Substrate																														
d50 (mm)	2.36	22.6					NA	N/A					NA	42					NA	N/A					NA	12.4				
d84 (mm)	8.72	63.1					NA	N/A					NA	108.2					NA	N/A					NA	70.2				

Parameter	MY-01 (2007)			MY-02 (2008)[2]			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)			MY+ (2013)			MY+ (2014)			MY+ (2015)			MY+ (2016)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)			110	38	193	67																								
Radius of Curvature (ft)	43	74	70	21	111	65																								
Meander Wavelength (ft)	167	205	185	88	215	155																								
Meander Width Ratio			4	1.46	7.42	2.57																								
Profile																														
Riffle length (ft)	55	43	49	9	73	27																								
Riffle slope (ft/ft)	0.004	0.008	0.006	0.002	0.052	0.020																								
Pool length (ft)	24	89	57	17	132	69																								
Pool spacing (ft)	55	257	129	34	212	103																								
Additional Reach parameters																														
Valley Length (ft)		1960			1960																									
Channel Length (ft)		2232			2288																									
Sinuosity		1.14			1.17																									
Water Surface Slope (ft/ft)		0.0030			0.0026																									
BF Slope (ft/ft)		0.0030			0.0026																									
Rosgen Classification		C4			C4																									
Habitat Index*																														
Macrobenthos*																														

1. These sections were added for MY-02 and subsequent monitoring, there is no data prior to MY-02.
2. Pattern and profile parameters for MY-02 were based on the entire restoration reach. MY-00 and MY-01 surveyed the upper 20 bankfull widths, or about 600 feet.

IV. Methodology

Methodologies follow the current EEP monitoring report template (Version 1.2-11/16/06) and the CVS-EEP protocol for recording vegetation (Lee et al 2006). All photos were taken with a digital camera. A Trimble Geo XT handheld unit with sub-meter accuracy was used to collect groundwater gauge locations, vegetation monitoring plot origins, and problem area locations.

A. Vegetation Methodologies

Four vegetation monitoring plots were added this year to the original plot (Plot 4) established during as built data collection, for a total of five plots. Level II of the EEP/CVS protocol Version 4.0 was used to collect data for MY-02, which includes natural stems. Since this is the first year for plots 1, 2, 3, and 5 and it is two years after initial planting, all stems recorded in these plots were classified as natural stems. Data collected for these plots are in Appendix A.

B. Stream Methodologies

Stream profile and cross-sections were surveyed using total station equipment and methods. The survey data was plotted using AutoCAD Civil3D. The longitudinal profile was generated using the monitoring baseline alignment provided by Stantec. This alignment, however, only covered the upper 740 feet of the reach. WCE generated the monitoring alignment for the balance of the project which included the original Stantec alignment for the upper reach. This hybrid alignment for the total reach will be used for subsequent monitoring years.

Cross sectional data was extracted based on a linear alignment between the end pins. Three additional cross sections were added, two riffles and one pool downstream of stream crossing.

V. References

Lee, Michael T. Peet, Robert K. Roberts, Steven D., Wentworth, Thomas R. (2006). *CVS-EEP Protocol for Recording Vegetation Version 4.0.*

Weakley, Alan (2007). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. http://www.herbarium.unc.edu/flora.htm.

Appendix A

Vegetation Raw Data

Appendix A. Table 1. Vegetation Metadata

Report Prepared By	The Catena Group
Date Prepared	11/11/2008 14:10
database name	cvs-eep-entrytool-v2.2.5.mdb
database location	
computer name	TOSHIBA-USER
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	69
project Name	UT to Cane Creek
Description	2096 lf of stream restoration; no wetlands
River Basin	Cape Fear
length(ft)	2232
stream-to-edge width (ft)	15-20
area (sq m)	5 acres
Required Plots (calculated)	
Sampled Plots	5

Appendix A. Table 2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing	Unknown
	Salix nigra*	3	10					
	Salix sericea		2					
TOT:	**2**	**3**	**12**					

* - This species was the only species confirmed to be planted within all vegetation plots on site.

Appendix A. Table 3. Vegetation Damage by Species

	Species	All Damage Categories	(No damage)	Flood	Insect
	Salix nigra*	13	4	1	8
	Salix sericea	2	1		1
TOT:	**2**	**15**	**5**	**1**	**9**

* - This species was the only species confirmed to be planted within all vegetation plots on site.

Appendix A. Table 4. Vegetation Damage by Plot

	Plot	All Damage Categories	(No damage)	Flood	Insect
	069-01-VP4-year:2	15	5	1	9
TOT:	**1**	**15**	**5**	**1**	**9**

* - *Salix nigra* was the only species confirmed to be planted within all vegetation plots on site.

Appendix A. Table 5. All Stem Counts by Plots and Species (Planted and Natural Stems)

	Species	Total Stems	# plots	avg# stems	069-01-VP1-year:2	069-01-VP2-year:2	069-01-VP3-year:2	069-01-VP4-year:2	069-01-VP5-year:2
	Baccharis halimifolia	1	1	1			1		
	Cornus amomum	3	2	1.5			1	2	
	Fraxinus pennsylvanica	17	4	4.25	1	2		13	1
	Ligustrum sinense	3	3	1	1		1	1	
	Liquidambar styraciflua	35	4	8.75	1		6	25	3
	Quercus lyrata	4	4	1	1	1	1		1
	Quercus michauxii	4	2	2	2	2			
	Rosa multiflora	9	1	9			9		
	Salix nigra	15	2	7.5			2	13	
	Salix sericea	2	1	2				2	
	Sambucus canadensis	8	4	2	4		1	2	1
	Rhus copallinum	1	1	1			1		
	Carpinus caroliniana	14	1	14	14				
	Juniperus virginiana	10	3	3.33		1	8	1	
	Prunus serotina	1	1	1			1		
	Acer negundo	17	1	17	17				
	Acer rubrum	62	5	12.4	23	1	19	6	13
	Ulmus sp.	59	4	14.75	5		1	44	9
TOT:	**18**	**265**	**18**		**69**	**7**	**52**	**109**	**28**

Appendix A. Table 6. Vegetation Problem Areas Table

Appendix A. Table 6. Vegetation Problem Areas			
VPA #	**Station #**	**Probable Cause**	**Photo #**
Bare Bench			
1	29+00	Bare bench/plantings absent on left descending bank	1
2	27+80	Bare bench/plantings absent on left descending bank	None
6	22+00	Bare bench/plantings absent on right descending bank	5
7	26+00	Bare bench/plantings absent on right descending bank	6
Eroding Bare Banks			
3	21+20	Bare bench/plantings absent on left descending bank	2
Invasive Exotics			
4	16+00	Tall fescue encroaching buffer throughout conservation easement	3
5	See integrated PAPV	Tall fescue encroaching buffer throughout conservation easement	4
8	See integrated PAPV	Tall fescue encroaching buffer throughout conservation easement	7
9	See integrated PAPV	Tall fescue encroaching buffer throughout conservation easement	8
12	26+50	Japanese stiltgrass stand along drainageway	10
13	23+00	Multiflora rose colonies	None
Encroachment Issues			
10	See integrated PAPV	20 feet of fence missing	None
11	19+00	fence washed out from flooding event on September 8, 2008	9

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

Photo 1. VPA 1

Photo 2. VPA 3

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

Photo 3. VPA 4

Photo 4. VPA 5

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

Photo 5. VPA 6

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

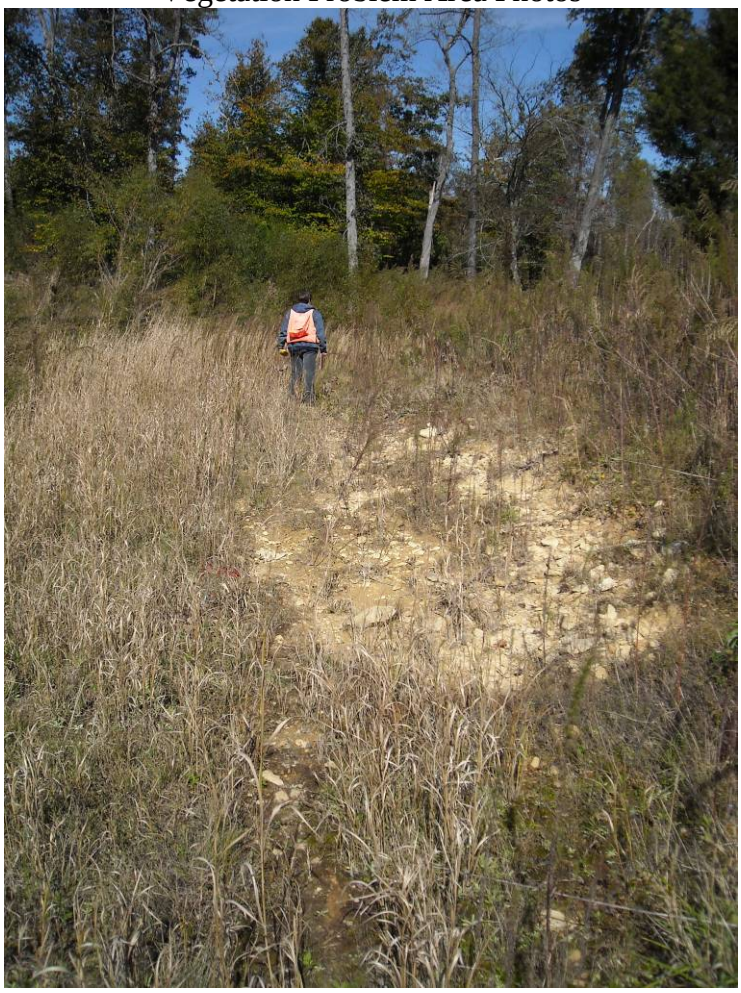


Photo 6. VPA 7

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

Photo 7. VPA 8

Photo 8. VPA 9

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Problem Area Photos

Photo 9. VPA 11

Photo 10. VPA 12

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Monitoring Plot Photos

Vegetation Plot 1

Vegetation Plot 2

UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Monitoring Plot Photos

Vegetation Plot 3

Vegetation Plot 4

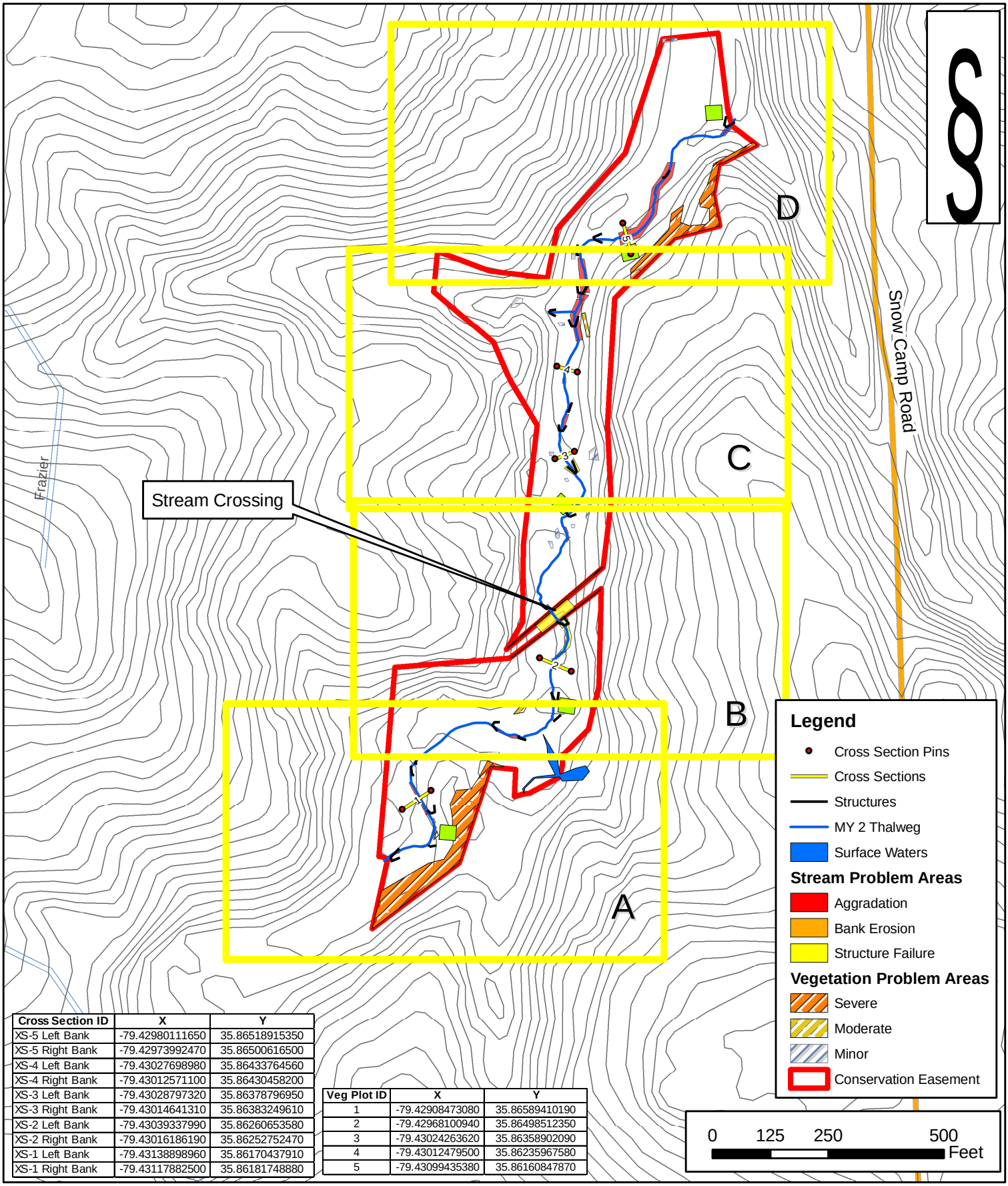
UT to Cane Creek Stream Restoration Site
Monitoring Year 2 Report
Vegetation Monitoring Plot Photos

Vegetation Plot 5

Appendix B

Geomorphologic Raw Data

1. Integrated Problem Current Conditions Plan View



Cross Section ID	X	Y
XS-5 Left Bank	-79.42980111650	35.86518915350
XS-5 Right Bank	-79.42973992470	35.86500616500
XS-4 Left Bank	-79.43027698980	35.86433764560
XS-4 Right Bank	-79.43012571100	35.86430458200
XS-3 Left Bank	-79.43028797320	35.86378796950
XS-3 Right Bank	-79.43014641310	35.86383249610
XS-2 Left Bank	-79.43039337990	35.86260653580
XS-2 Right Bank	-79.43016186190	35.86252752470
XS-1 Left Bank	-79.43138898960	35.86170437910
XS-1 Right Bank	-79.43117882500	35.86181748880

Veg Plot ID	X	Y
1	-79.42908473080	35.86589410190
2	-79.42968100940	35.86498512350
3	-79.43024263620	35.86358902090
4	-79.43012479500	35.86235967580
5	-79.43099435380	35.86160847870

The Catena Group

UT to Cane Creek Stream Restoration Site

Current Conditions Plan View

Alamance County, North Carolina

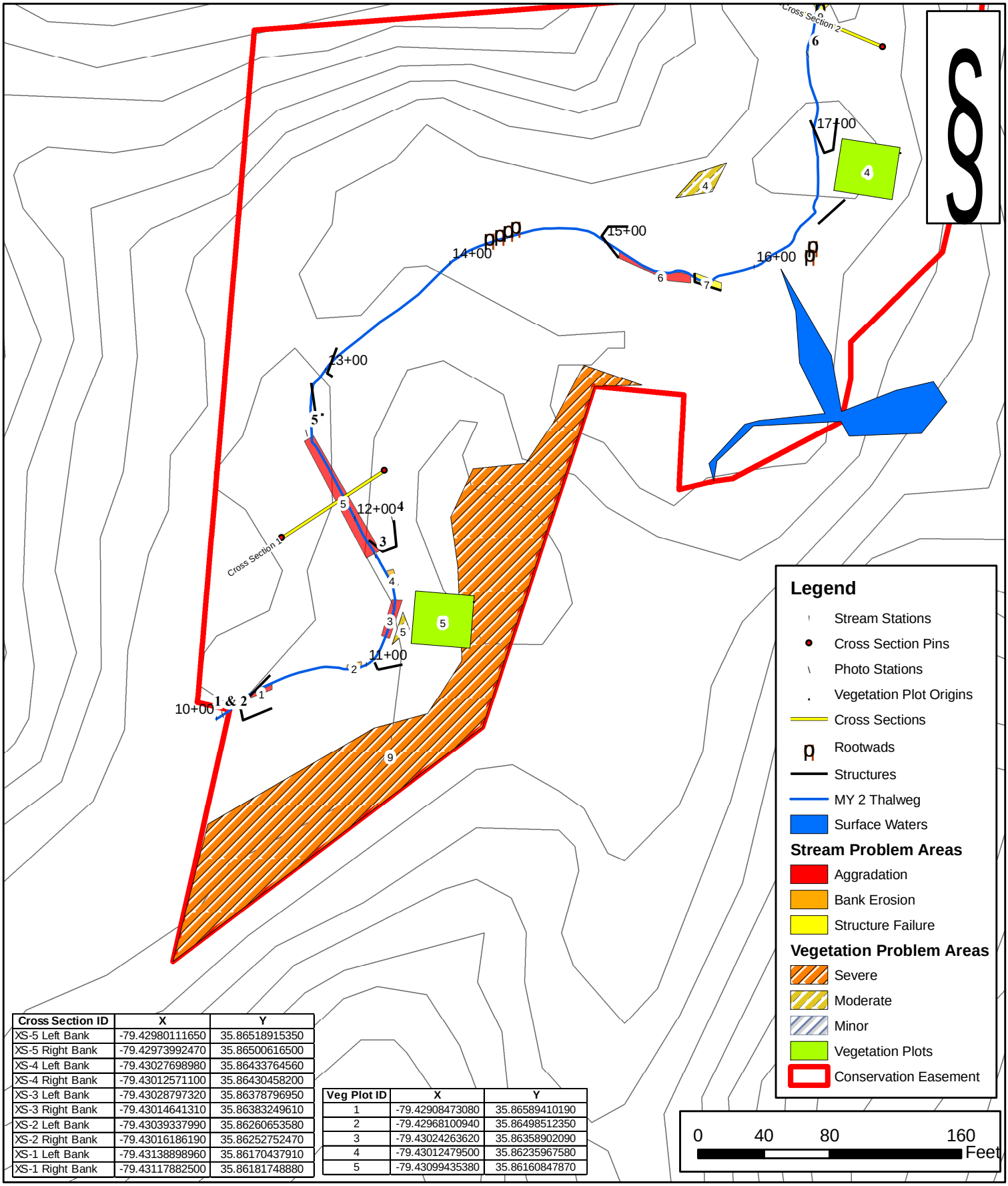
EEP Project No. 69

2 ft Topographic Contours
Source: Alamance County

Date:
March 2009

Ecosystem Enhancement Program

Figure
Key



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UT to Cane Creek Stream Restoration Site

Current Conditions Plan View

Alamance County, North Carolina

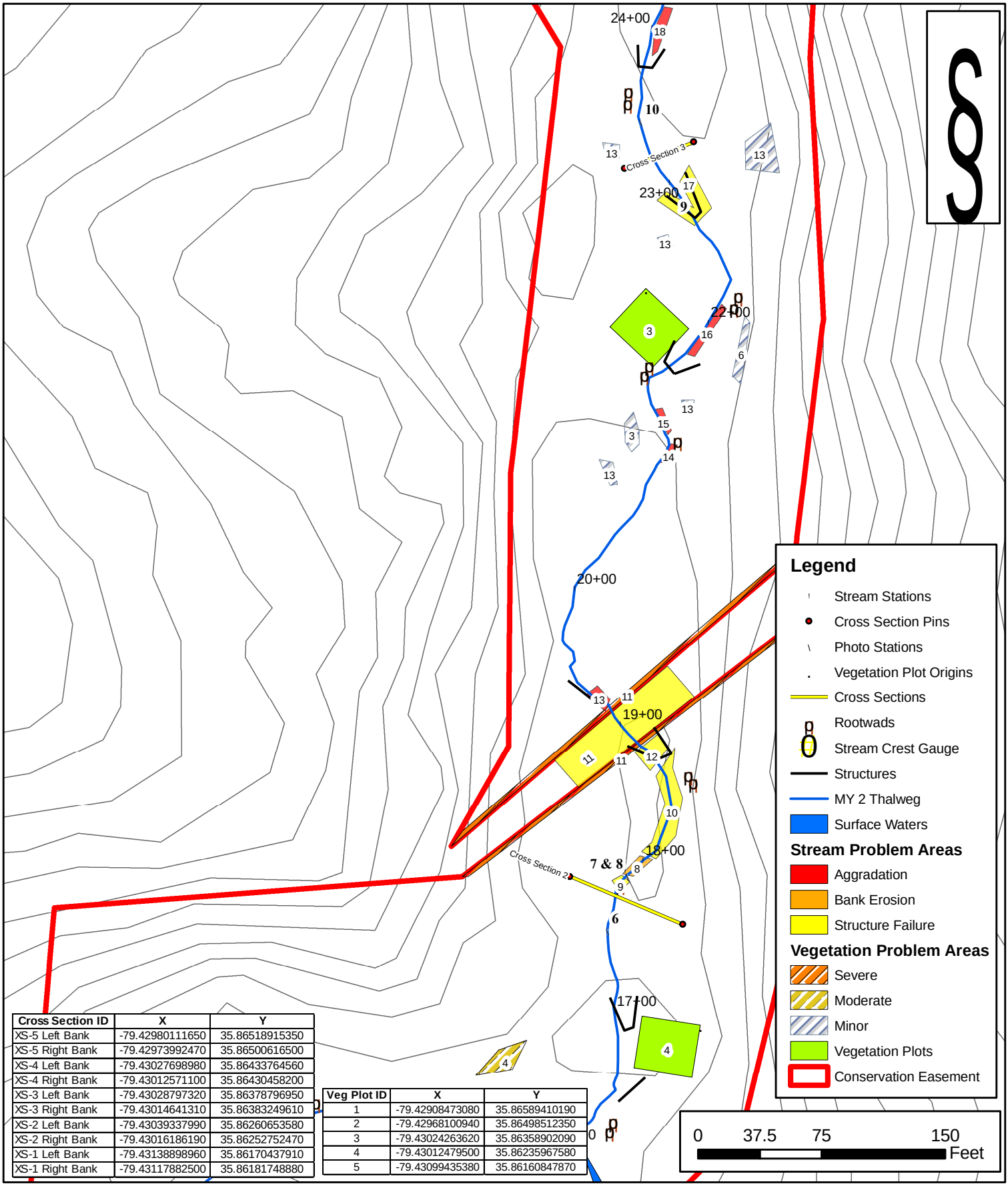
EEP Project No. 69

2 ft Topographic Contours
Source: Alamance County

Date:
March 2009

Ecosystem Enhancement Program

Figure
A



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The Catena Group

UT to Cane Creek Stream Restoration Site

Current Conditions Plan View

Alamance County, North Carolina

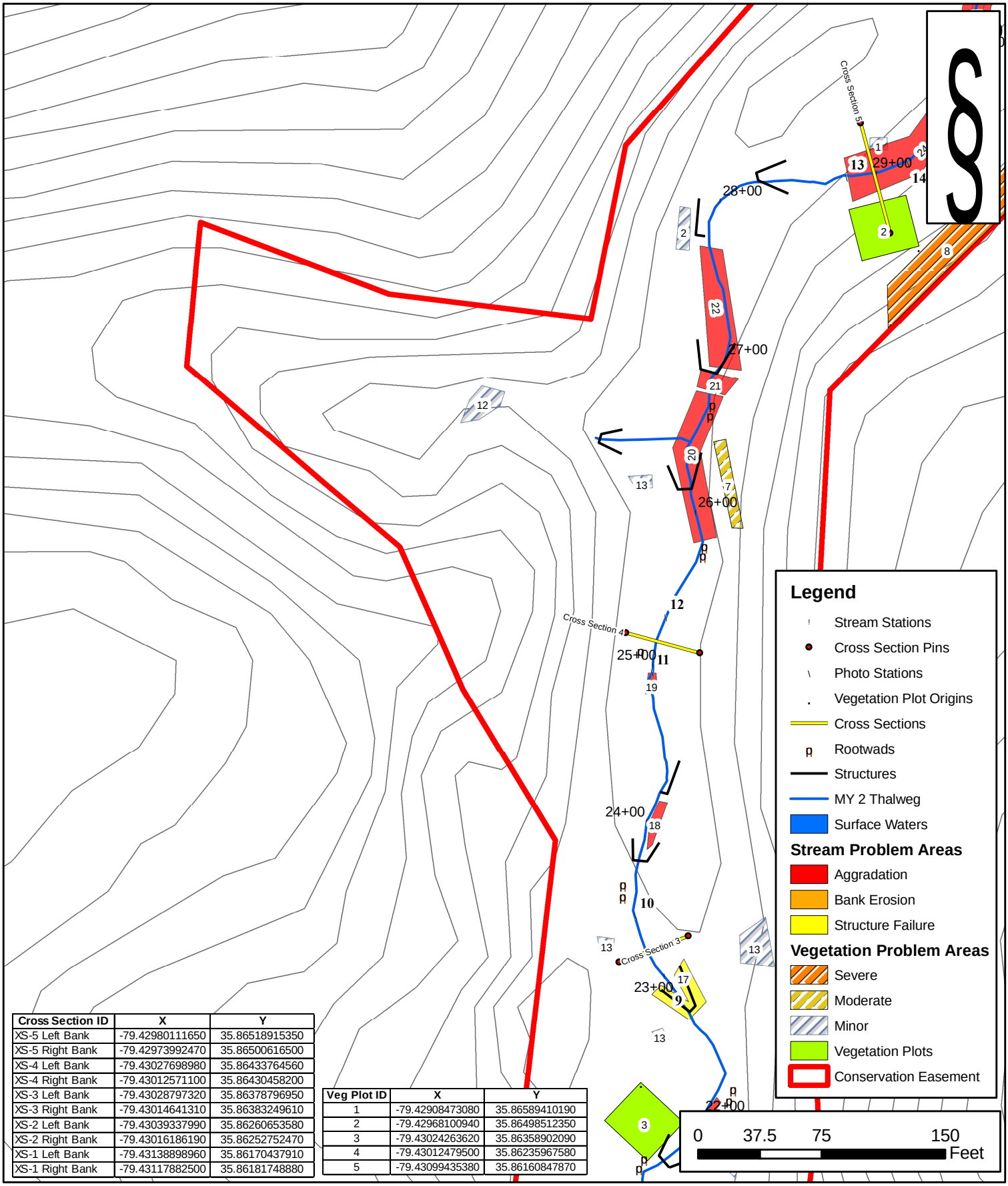
EEP Project No. 69

2 ft Topographic Contours
Source: Alamance County

Date:
March 2009

Ecosystem Enhancement Program

Figure
B



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UT to Cane Creek Stream Restoration Site

Current Conditions Plan View

Alamance County, North Carolina

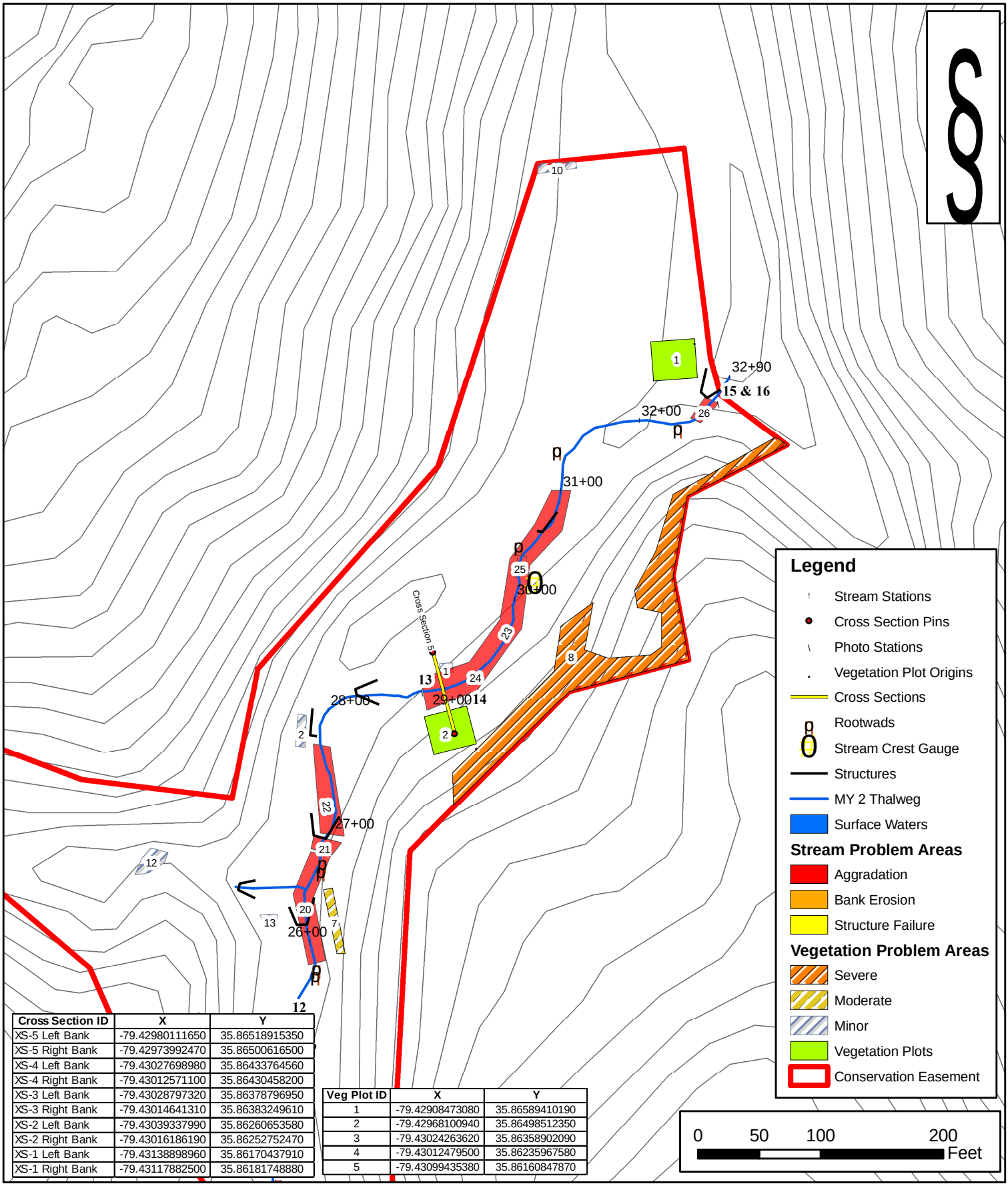
EEP Project No. 69

2 ft Topographic Contours
Source: Alamance County

Date:
March 2009

Ecosystem Enhancement Program

Figure
C



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The Catena Group

UT to Cane Creek Stream Restoration Site

Current Conditions Plan View

Alamance County, North Carolina

EEP Project No. 69

2 ft Topographic Contours
Source: Alamance County

Date:
March 2009

Ecosystem Enhancement Program

Figure
D

2. Stream Problem Areas Table

Exhibit Table B.1 Stream Problem Areas UT to Cane Creek Stream Restoration- Project No. 69			
Feature Issue	**Station Numbers**	**Suspected Cause**	**Photo Number**
Aggradation			
Bank Aggradation: Right Bank	10+25 10+40	Upstream debris and sediment being introduced into the constructed project section.	PA 1
Bank Aggradation: Right Bank	20+95 21+10	Pool filling in on right descending bank due to upstream scour.	PA 14
Bank Aggradation: Right Bank	21+15 21+35	High point bar causing aggradation on the right descending bank.	PA 15
Bank Aggradation: Right Bank	21+70 22+10	Aggradation of the right bank most likely due to the angle of upstream structure, which is stable and functioning.	PA 16
Bank Aggradation: Right Bank	24+00 24+40	Aggradation due to the angle of the upstream structure, which is stable and functioning.	PA 18
Bank Aggradation: Left Bank	24+75 24+90	Aggradation due to upstream eroding banks and channel scour.	PA 19
Centerline Aggradation	11+20 11+50	Aggradation of pool, due to upstream undercutting and aggradation.	PA 3
Centerline Aggradation	26+25 26+75	Center line aggradtion due to overly wide channel.	PA 21
Centerline Aggradation	30+20 30+60	Center line aggradtion due to overly wide channel and upstream bank erosion.	PA 25
Centerline Aggradation	32+50 32+65	Center line aggradation due to riffle material deposition adjacent to boulder structure.	PA 26
Centerline Aggradation	26+75 27+75	Center line aggradtion due to overly wide channel.	PA 22
Overwidening Channel, aggradation	11+80 12+55	Overwidening channel causing aggradation and instream vegetation.	PA 5
Overwidening Channel, aggradation	15+10 15+60	Overwidening channel causing aggradation and instream vegetation on the right bank.	PA 6
Overwidening Channel, aggradation	25+75 26+25	Overwidening channel causing aggradation.	PA 20
Scour Pool and Aggradation	19+20 19+35	Pool scour and aggradation due to higher elevation of the stream crossing.	PA 13
Backwater	See Long Pro	Downstream aggradation causing backwater effect.	PA 23
Bank Erosion			
Bank Erosion: Left Bank	10+80 10+90	Left bank undercutting due to upstream aggradation has caused a thalweg shift.	PA 2
Bank Erosion: Right	11+60	Overland flow undermining erosion control matting	PA 4

Bank	11+70	resulting in bank erosion.	
Bank Erosion: Right Bank	17+80 18+10	Undercutting bank due to rootwad failure.	PA 8
Bank Erosion: Left and Right Bank	18+90 19+00	Right and left banks scouring.	PA 12
Bank Erosion: Right Bank	25+15 25+35	Erosion of right bank resulting from backwater effects.	PA 24
Structure Failure			
Structure Failure	15+60 15+60	Structure failure due to piping, channel migration towards left descending bank causing bank erosion.	PA 7
Structure Failure	17+80 17+80	Rootwad failure most likely due to backwater caused by stream crossing.	PA 9
Structure Failure	18+70 18+70	Structure failure due to backwater caused by stream crossing. Inundation of the structure prevents intended function.	PA 10
Structure Failure	19+00 19+00	Crossings high grade causing backwater within the channel.	PA 11
Structure Failure	22+70 22+70	Structure piping due to the size of boulders used, gaps do not appear to be chinked properly.	PA 17

3. Representative Stream Problem Area Photos

SPA 1

SPA 2

SPA 3

SPA 4

SPA 5

SPA 6

SPA 7

SPA 8

SPA 9

SPA 10

SPA 11

SPA 12

SPA 13

SPA 14

SPA 15

SPA 16

SPA 17

SPA 18

SPA 19

SPA 20

SPA 21

SPA 22

SPA 23

SPA 24

SPA 25

SPA 26

4. Stream Photo Station Photos

Cane Photo Point 1, Looking upstream project start

Cane Photo Point 2, Looking downstream project start

Cane Photo Point 3, Looking downstream at XS-1

Cane Photo Point 4, Looking downstream at XS-1 from right bank

Cane Photo Point 5, Looking upstream at XS-1 from left bank

Cane Photo Point 6, Looking downstream at XS-2

Cane Photo Point 7, Looking upstream at XS-2

Cane Photo Point 8, Looking downstream, end point of monitoring year 1

Cane Photo Point 9, Looking downstream at XS-3

Cane Photo Point 10, Looking upstream at XS-3

Cane Photo Point 11, Looking downstream at XS-4

PHOTO NOT AVAILABLE

Cane Photo Point 12, Looking upstream at XS-4

Cane Photo Point 13, Looking downstream at XS-5

Cane Photo Point 14, Looking upstream at XS-5

Cane Photo Point 15, Looking downstream at project end

Cane Photo Point 16, Looking upstream at project end

5. Exhibit Table B2. Qualitative Visual Assessment

Table B2. Visual Morphological Stability Assessment
UT to Cane Creek Stream Mitigation Site/Project No. CMC/CPF/02
Main Channel: (2232 feet)

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform Mean or Total
A. Riffles	1. Present?	19	22	NA	86%	
	2. Armor stable (e.g.no displacement?)	13	22	NA	59%	
	3. Facet grade appears stable?	15	22	NA	68%	
	4. Minimal evidence of embedding/fining?	18	22	NA	82%	
	5. Length appropriate?	12	22	NA	55%	**70%**
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	22	23	NA	96%	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	22	23	NA	96%	
	3. Length appropriate?	15	23	NA	65%	**86%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	9	22	NA	41%	
	2. Downstream of meander (glide/inflection) centering?	12	22	NA	55%	**48%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	22	23	NA	96%	
	2. Of those eroding, # w/concomitant point bar formation?	1	1	NA	100%	
	3. Apparent Rc within spec?	23	23	NA	100%	
	4. Sufficient floodplain access and relief?	19	23	NA	83%	**95%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	15/570	74%	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	0	100%	**87%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	NA	NA	4/68	98%	**98%**
G. Cross vanes, sills, single wing vanes	1. Free of back or arm scour?	17	21	NA	81%	
	2. Height appropriate?	17	21	NA	81%	
	3. Angle and geometry appear appropriate?	16	21	NA	76%	
	4. Free of piping or other structural failures?	16	21	NA	76%	**79%**
H. Wads/ Boulders	1. Free of scour?	11	11	NA	100%	
	2. Footing stable?	11	11	NA	100%	**100%**

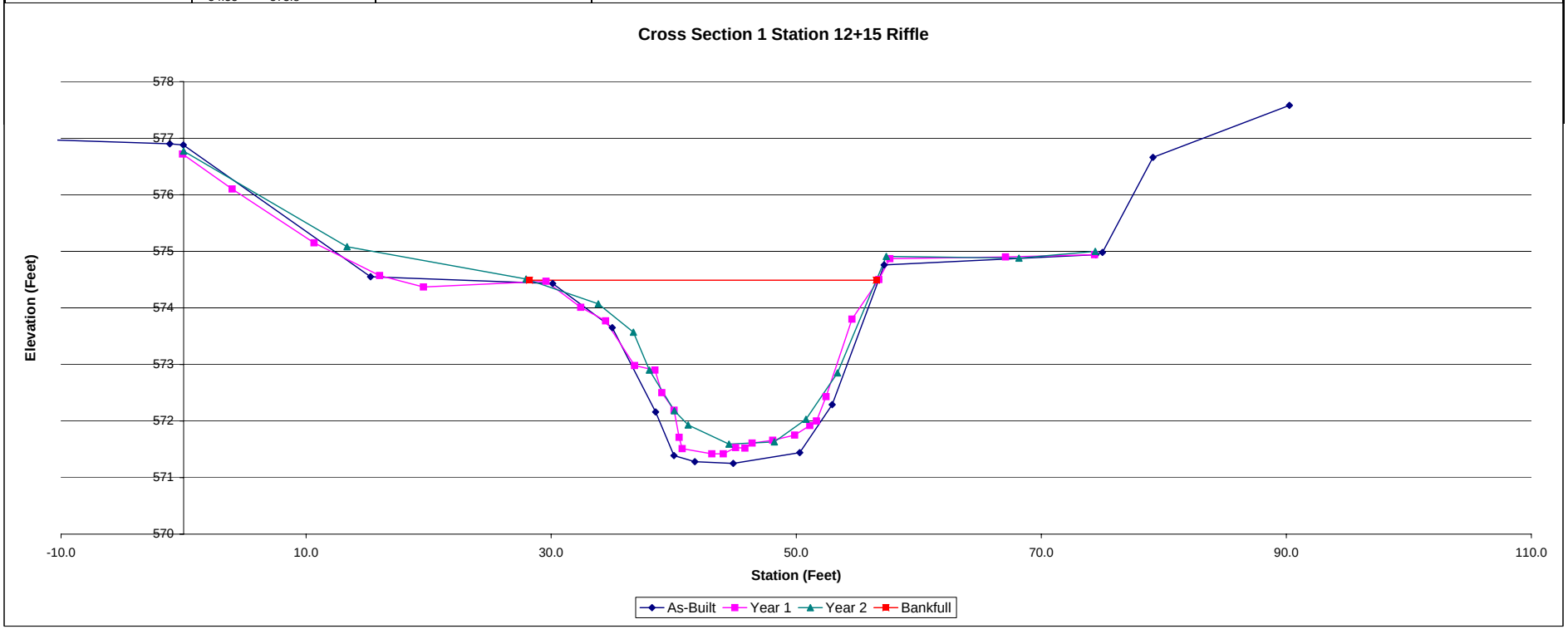
6. Cross Sections

Project:	UT to Cane Creek
Cross Section:	Cross Section 1
Feature	Riffle
Station:	12+15
Date:	10/31/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	51.0	48.0	46.8
W (BKF)	26.6	27.2	28.3
Max d	3.2	3.1	2.9
Mean d	1.9	1.8	1.7
W/D	13.9	15.4	17.1

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
-10.9	576.97		-0.08	576.72	LPIN	0.00	576.77	CS 1 LP
-1.1	576.9		3.97	576.1		13.34	575.08	CS 1
0.0	576.88	LPIN	10.65	575.15		27.96	574.51	CS 1
15.3	574.55		16	574.57		33.85	574.07	Bankfull Left
30.1	574.43	LBKF	19.58	574.37		36.71	573.57	CS 1
35.0	573.65		29.58	574.47	LBKF	38.01	572.90	CS 1
38.5	572.16		32.42	574.01		40.05	572.18	CS 1 TOE L
40.0	571.39		34.44	573.77		41.18	571.93	CS 1
41.7	571.28		36.81	572.98		44.51	571.59	CS 1 TW
44.9	571.25		38.47	572.9		48.21	571.63	CS 1
50.3	571.44		39.03	572.5		50.80	572.03	CS 1 TOE R
52.9	572.29		40.03	572.19		53.37	572.85	CS 1
56.7	574.5	RBKF	40.45	571.71		57.35	574.91	Bankfull Right
57.2	574.76		40.69	571.51		68.18	574.88	CS 1
74.5	574.94	RPIN	43.11	571.42		74.41	575.00	CS 1 RP
75.0	574.98		44.05	571.42				
79.1	576.66		45.06	571.53				
90.3	577.58		45.82	571.52				
			46.4	571.61				
			48.09	571.66				
			49.88	571.75				
			51.11	571.92				
			51.65	572				
			52.44	572.43				
			54.55	573.8				

Photo of XS-1, looking in the downstream direction

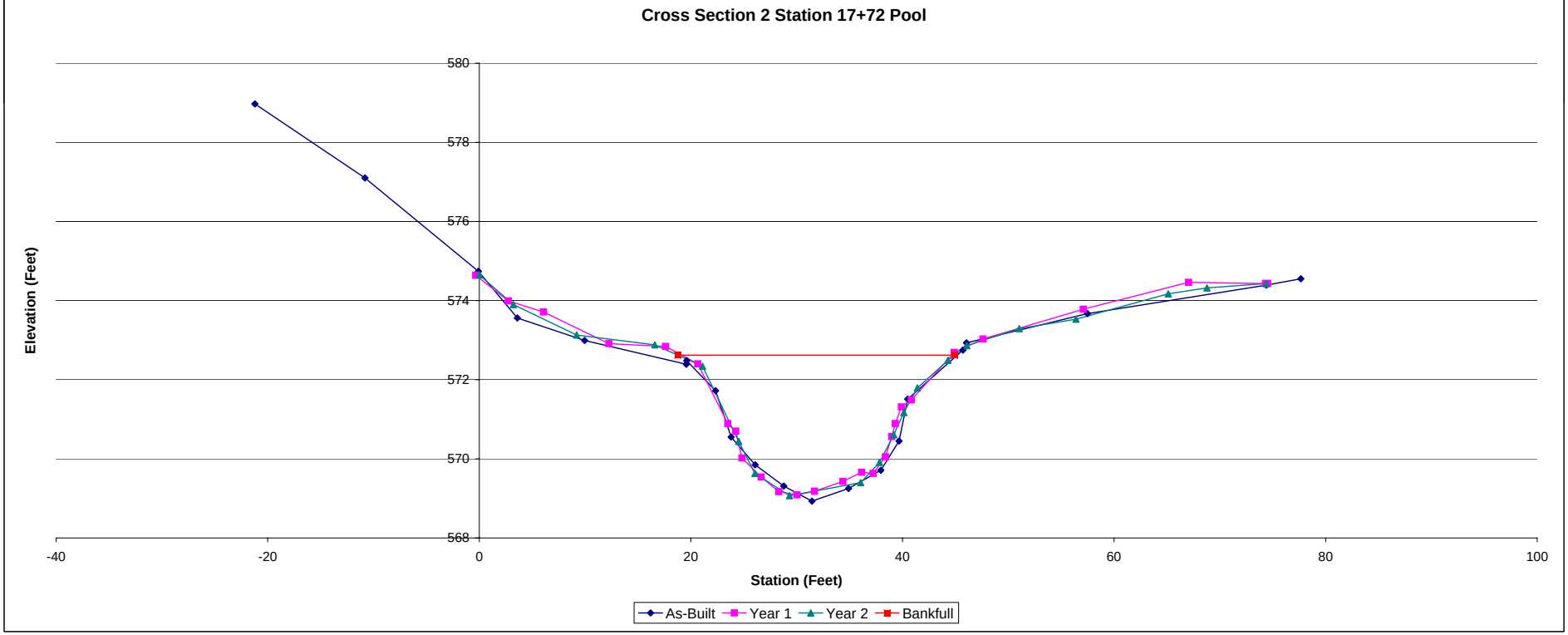


Project:	UT to Cane Creek
Cross Section:	Cross Section 2
Feature	Pool
Station:	17+72
Date:	10/31/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	56.5	53.6	56.7
W (BKF)	26.2	24.2	26.2
Max d	3.7	3.6	3.5
Mean d	2.2	2.2	2.2
W/D	12.1	11.0	12.1

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
-21.21	578.97		-0.34	574.64	LPIN	0	574.65	CS 2 LP
-10.81	577.1		2.75	573.99		3.22	573.9	CS 2
-0.08	574.74	LPIN	6.07	573.71		9.2	573.13	CS 2
3.59	573.56		12.26	572.91		16.59	572.88	Bankfull left
9.95	572.99		17.62	572.84		21.1	572.34	CS 2
19.57	572.39	LBKF	20.65	572.4	LBKF	24.52	570.44	CS 2 TOE L
19.61	572.48		23.49	570.89		26.06	569.63	CS 2
22.34	571.72		24.25	570.7		29.32	569.07	CS 2 TW
23.8	570.55		24.84	570.02		36.04	569.4	CS 2
26.08	569.85		26.65	569.54		37.83	569.91	CS 2 POOL
28.78	569.31		28.31	569.17		39.18	570.61	CS 2 TOE R
31.44	568.93		30.02	569.09		40.13	571.17	CS 2
34.9	569.25		31.69	569.18		41.41	571.79	CS 2
37.96	569.71		34.37	569.43		44.3	572.49	CS 2
39.68	570.45		36.14	569.66		46.09	572.86	Bankfull right
40.49	571.51		37.23	569.63		51.04	573.29	CS 2
45.72	572.75	RBKF	38.39	570.05		56.4	573.53	CS 2
46.05	572.93		38.99	570.56		65.12	574.17	CS 2
57.49	573.67		39.32	570.89		68.78	574.32	CS 2
74.4	574.39	RPIN	39.9	571.31		74.38	574.43	CS 2 RP
77.65	574.55		40.83	571.49				
			44.89	572.69	RBKF			
			47.62	573.03				
			57.09	573.78				
			67.05	574.46				

Photo of XS-2, looking in the downstream direction

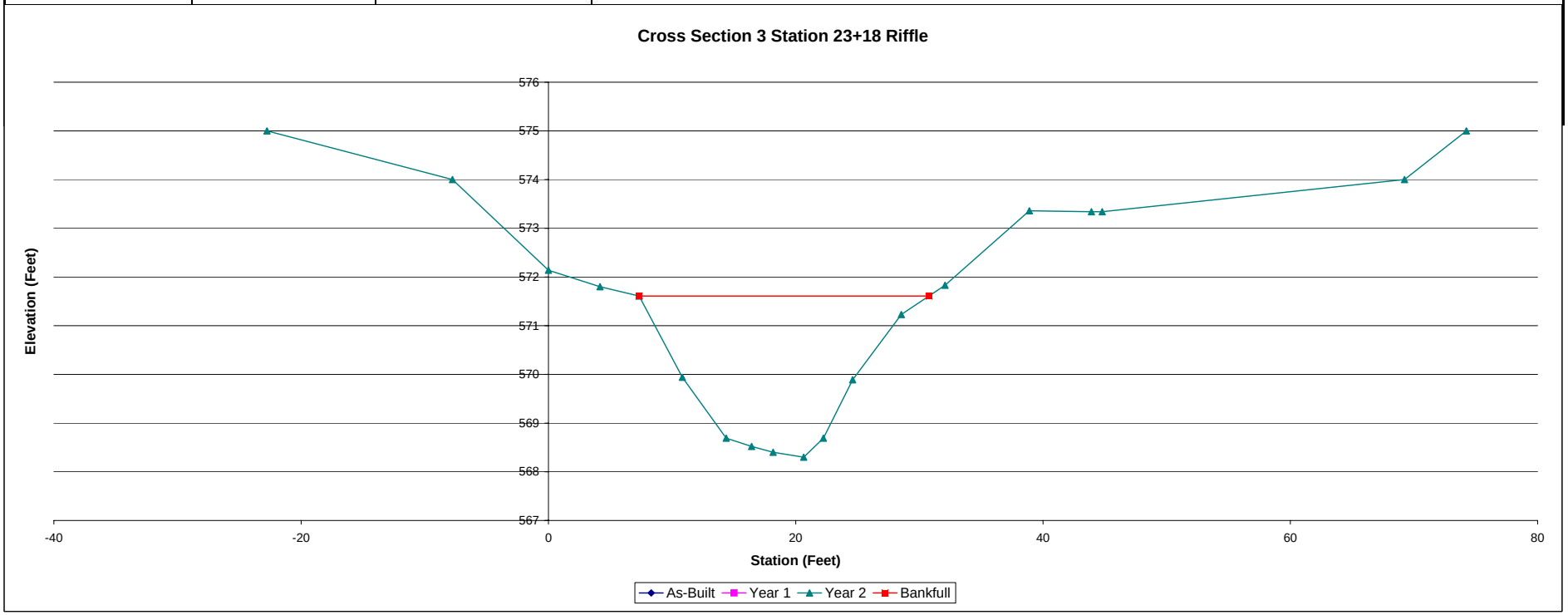


Project:	UT to Cane Creek
Cross Section:	Cross Section 3
Feature	Riffle
Station:	23+18
Date:	10/31/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	NA	NA	45.8
W (BKF)	NA	NA	23.5
Max d	NA	NA	3.3
Mean d	NA	NA	2.0
W/D	NA	NA	12.0

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
						-22.76	575.00	CS 3
						-7.76	574.00	CS 3
						0.00	572.14	CS 3 LP
						4.17	571.80	CS 3
						7.33	571.61	Bankfull left
						10.83	569.94	CS 3
						14.38	568.69	CS 3 TOE L
						16.43	568.52	CS 3
						18.17	568.40	CS 3
						20.65	568.30	CS 3 TW
						22.24	568.69	CS 3 TOE R
						24.60	569.89	CS 3
						28.54	571.23	Bankfull Right
						32.08	571.83	CS 3
						38.89	573.36	CS 3
						43.91	573.34	CS 3
						44.78	573.34	CS 3 RP
						69.24	574.00	CS 3
						74.24	575.00	CS 3

Photo of XS-3, looking in the downstream direction

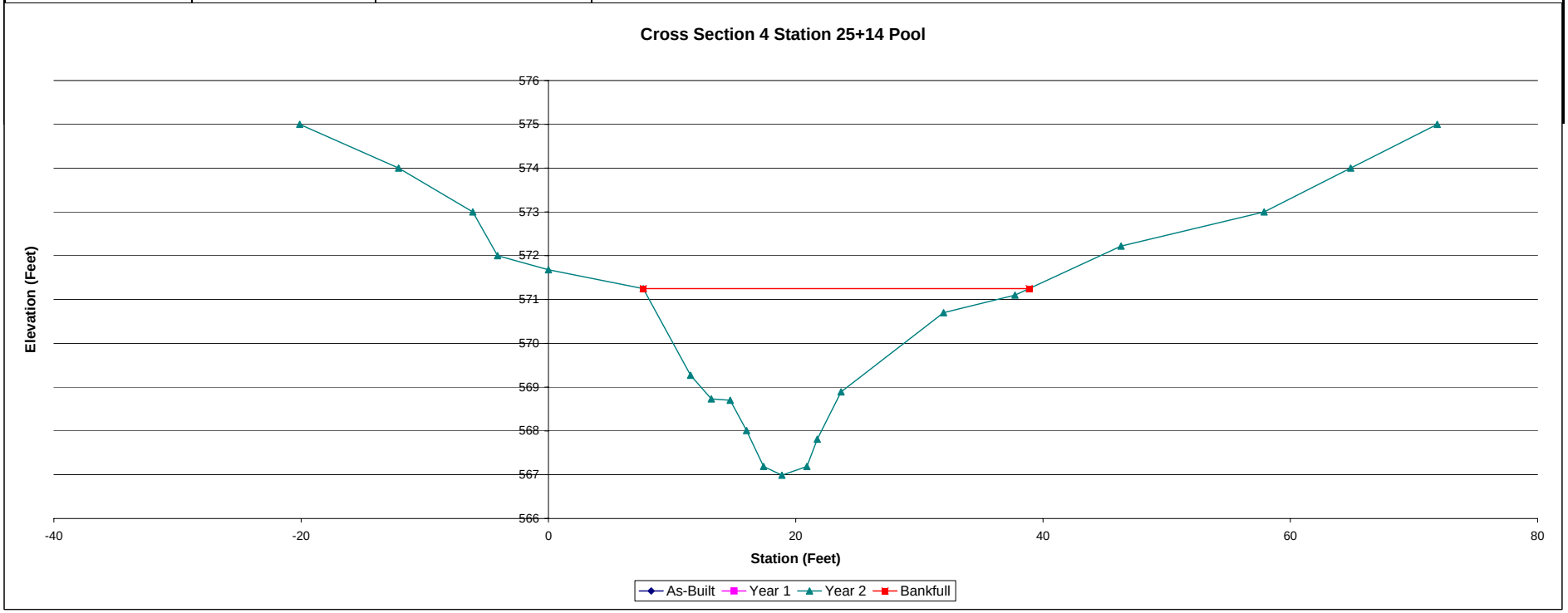


Project:	UT to Cane Creek
Cross Section:	Cross Section 4
Feature	Pool
Station:	25+14
Date:	10/31/08
Crew:	RL, JW, ZP

Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	NA	NA	57.8
W (BKF)	NA	NA	31.2
Max d	NA	NA	4.3
Mean d	NA	NA	1.9
W/D	NA	NA	16.9

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
						-20.12	575.00	CS 4
						-12.12	574.00	CS 4
						-6.12	573.00	CS 4
						-4.12	572.00	CS 4
						0.00	571.68	CS 4 LP POOL
						7.67	571.25	Bankfull left
						11.49	569.27	CS 4
						13.17	568.73	CS 4
						14.70	568.70	CS 4
						16.02	568.01	CS 4 TOE L
						17.40	567.19	CS 4
						18.88	566.99	CS 4 TW
						20.90	567.19	CS 4
						21.74	567.81	CS 4 TOE R
						23.67	568.89	CS 4
						31.96	570.70	Bankfull Right
						37.73	571.10	CS 4
						46.31	572.22	CS 4 RP
						57.88	573.00	CS 4
						64.88	574.00	CS 4
						71.88	575.00	CS 4

Photo of XS-4, looking in the downstream direction

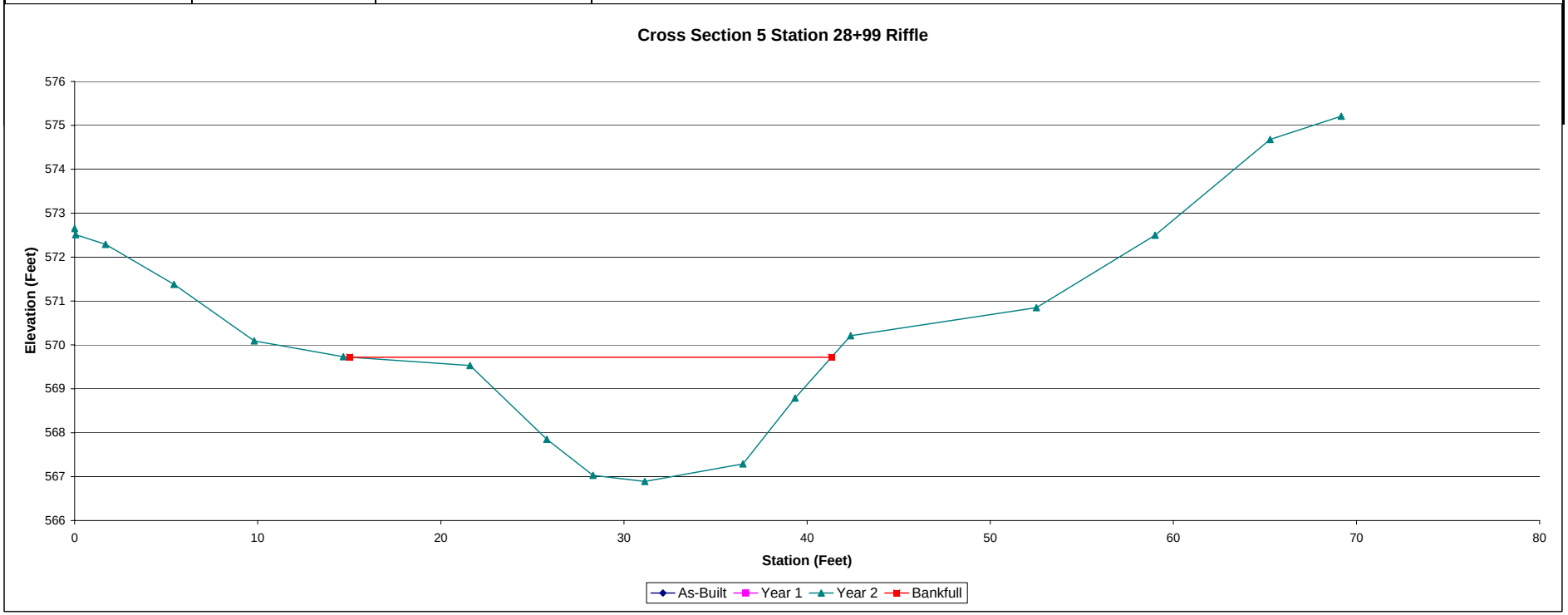


Project:	UT to Cane Creek
Cross Section:	Cross Section 5
Feature	Riffle
Station:	28+99
Date:	10/31/08
Crew:	RL, JW, ZP

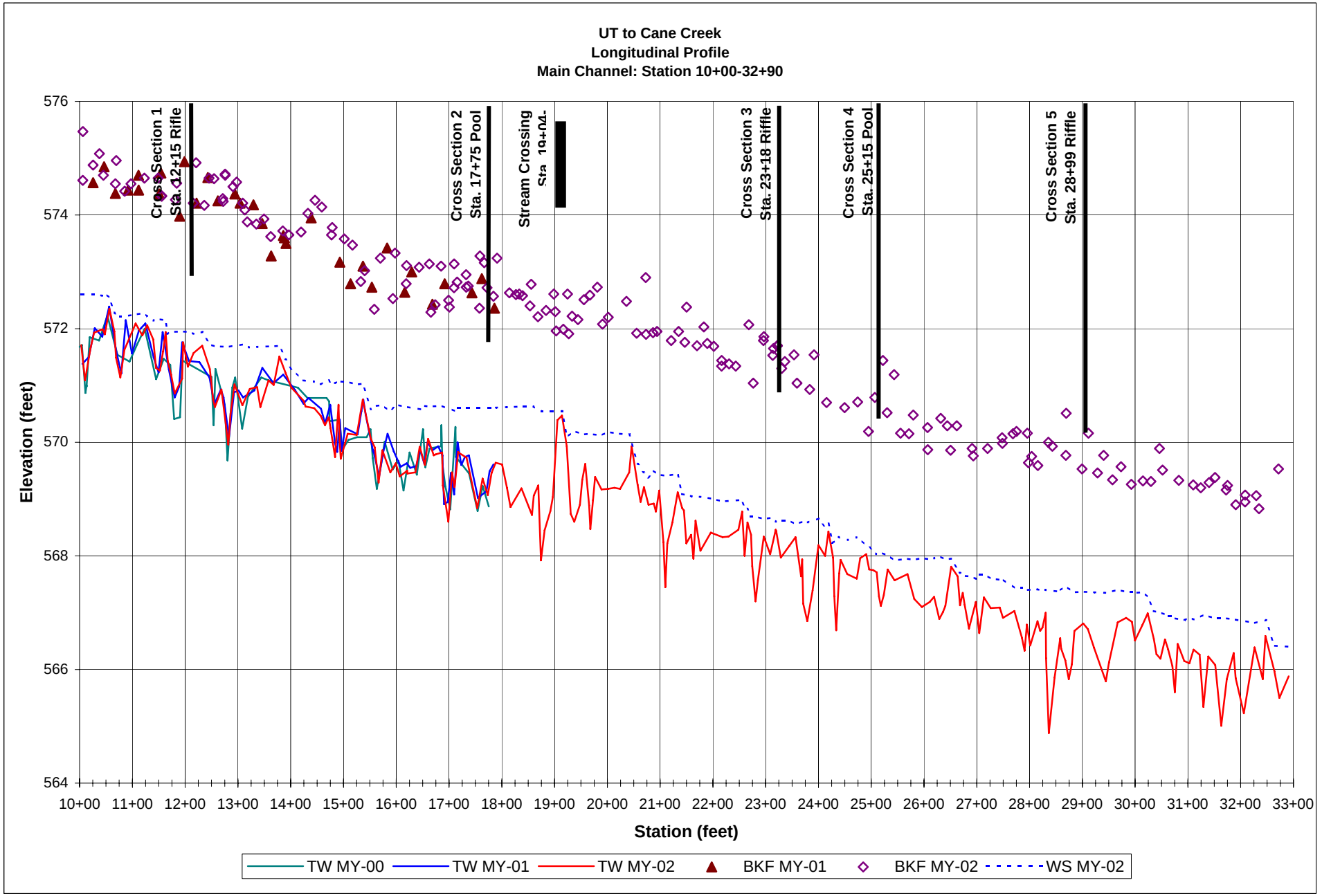
Summary (bankfull)			
	MY0	MY1	MY2
A (BKF)	NA	NA	43.4
W (BKF)	NA	NA	26.3
Max d	NA	NA	2.8
Mean d	NA	NA	1.7
W/D	NA	NA	15.9

MY0-2006			MY1-2007			MY2-2008		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
						0.00	572.65	CS 5 LP
						0.06	572.51	CS 5
						1.69	572.29	CS 5
						5.43	571.38	CS 5
						9.81	570.09	CS 5
						14.67	569.73	CS 5
						21.59	569.53	Bankfull Left
						25.79	567.85	CS 5
						28.31	567.03	CS 5 TOE L
						31.14	566.89	CS 5 TW
						36.50	567.29	CS 5 TOE R
						39.34	568.79	CS 5
						42.38	570.21	Bankfull Right
						52.52	570.85	CS 5
						59.00	572.50	CS 5
						65.28	574.68	CS 5 RIFFLE
						69.17	575.21	CS 5 RP

Photo of XS-5, looking in the downstream direction

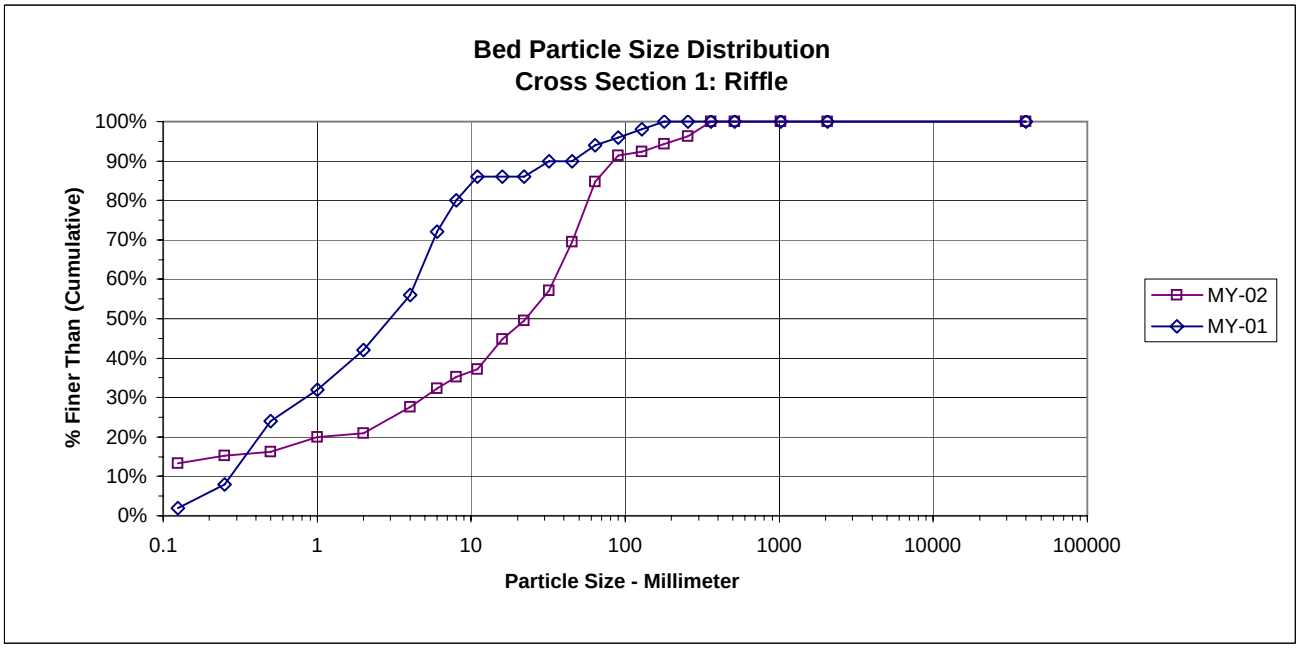


7. Longitudinal Profiles

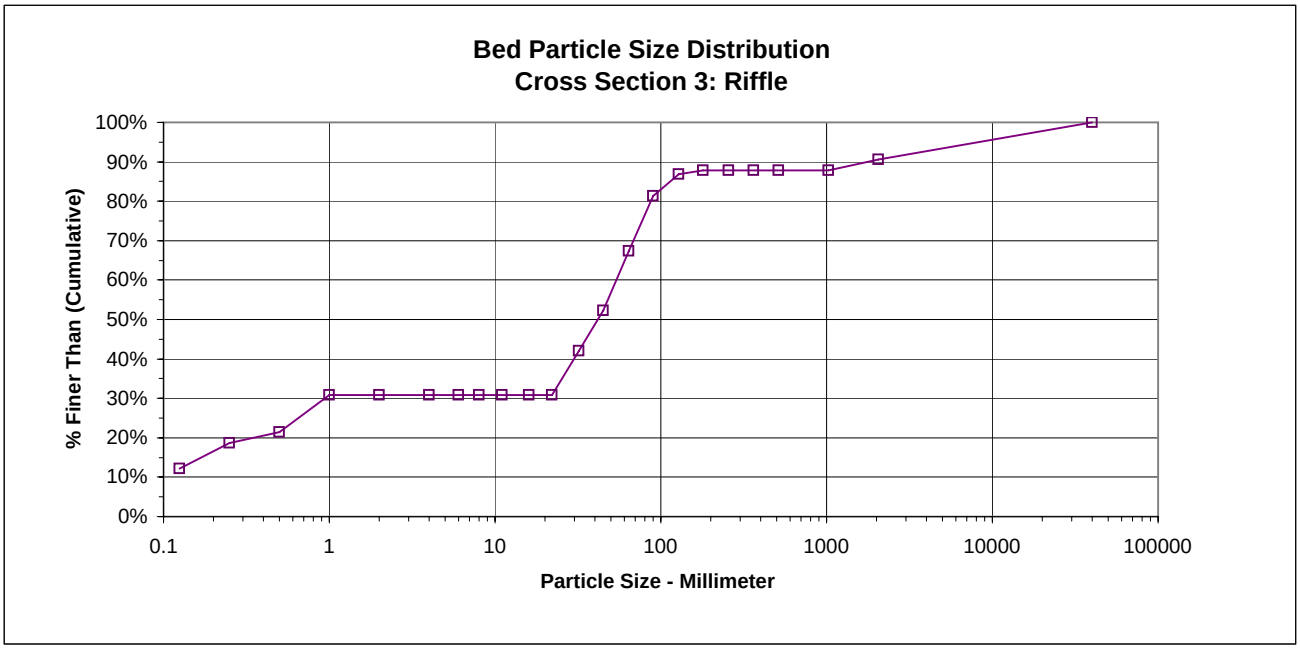

UT to Cane Creek
Longitudinal Profile
Main Channel: Station 10+00-32+90
Cross Section 1
Sta. 12+15 Riffle
Cross Section 2
Sta. 17+75 Pool
Stream Crossing
Cross Section 3
Sta. 23+18 Riffle
Cross Section 4
Sta. 25+15 Pool
Cross Section 5
Sta. 28+99 Riffle
Elevation (feet)
576
574
572
570
568
566
564
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
29+00
30+00
31+00
32+00
33+00
Station (feet)
TW MY-00
TW MY-01
TW MY-02
BKF MY-01
BKF MY-02
WS MY-02

8. Pebble Counts

PEBBLE COUNT								
Project:	UT to Cane Creek MY-02					**Date:**	12/9/2008	
Location:	Cross Section #1							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	8	0	8	8%	8%
	Very Fine	.062 - .125	S	6	0	6	6%	13%
	Fine	.125 - .25	A	2	0	2	2%	15%
	Medium	.25 - .50	N	1	0	1	1%	16%
	Coarse	.50 - 1.0	D	4	0	4	4%	20%
.04 -.08	Very Coarse	1.0 - 2.0	S	1	0	1	1%	21%
.08 - .16	Very Fine	2.0 - 4.0		7	0	7	7%	28%
.16 - .22	Fine	4.0 - 5.7	G	5	0	5	5%	32%
.22 - .31	Fine	5.7 - 8.0	R	3	0	3	3%	35%
.31 - .44	Medium	8.0 - 11.3	A	2	0	2	2%	37%
.44 - .63	Medium	11.3 - 16.0	V	8	0	8	8%	45%
.63 - .89	Coarse	16.0 - 22.6	E	5	0	5	5%	50%
.89 - 1.26	Coarse	22.6 - 32.0	L	8	0	8	8%	57%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	13	0	13	12%	70%
1.77 - 2.5	Very Coarse	45.0 - 64.0		16	0	16	15%	85%
2.5 - 3.5	Small	64 - 90	C	7	0	7	7%	91%
3.5 - 5.0	Small	90 - 128	O	1	0	1	1%	92%
5.0 - 7.1	Large	128 - 180	B	2	0	2	2%	94%
7.1 - 10.1	Large	180 - 256	L	2	0	2	2%	96%
10.1 - 14.3	Small	256 - 362	B	4	0	4	4%	100%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	100%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	100%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	100%
	Bedrock		BDRK	0	0	0	0%	100%
			Totals	**105**	**0**	**105**	**100%**	**100%**



PEBBLE COUNT								
Project:	UT to Cane Creek MY-02					**Date:**	12/9/2008	
Location:	Cross Section #3							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	3	0	3	3%	3%
	Very Fine	.062 - .125	S	10	0	10	9%	12%
	Fine	.125 - .25	A	7	0	7	7%	19%
	Medium	.25 - .50	N	3	0	3	3%	21%
	Coarse	.50 - 1.0	D	10	0	10	9%	31%
.04 -.08	Very Coarse	1.0 - 2.0	S	0	0	0	0%	31%
.08 - .16	Very Fine	2.0 - 4.0		0	0	0	0%	31%
.16 - .22	Fine	4.0 - 5.7	G	0	0	0	0%	31%
.22 - .31	Fine	5.7 - 8.0	R	0	0	0	0%	31%
.31 - .44	Medium	8.0 - 11.3	A	0	0	0	0%	31%
.44 - .63	Medium	11.3 - 16.0	V	0	0	0	0%	31%
.63 - .89	Coarse	16.0 - 22.6	E	0	0	0	0%	31%
.89 - 1.26	Coarse	22.6 - 32.0	L	12	0	12	11%	42%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	11	0	11	10%	52%
1.77 - 2.5	Very Coarse	45.0 - 64.0		16	0	16	15%	67%
2.5 - 3.5	Small	64 - 90	C	15	0	15	14%	81%
3.5 - 5.0	Small	90 - 128	O	6	0	6	6%	87%
5.0 - 7.1	Large	128 - 180	B	1	0	1	1%	88%
7.1 - 10.1	Large	180 - 256	L	0	0	0	0%	88%
10.1 - 14.3	Small	256 - 362	B	0	0	0	0%	88%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	88%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	88%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	3	0	3	3%	91%
	Bedrock		BDRK	10	0	10	9%	100%
			Totals	**107**	**0**	**107**	**100%**	**100%**



PEBBLE COUNT								
Project:	UT to Cane Creek MY-02					**Date:**	12/9/2008	
Location:	Cross Section #5							
				Particle Counts				
Inches	Particle	Millimeter		Riffles	Pools	Total No.	Item %	% Cumulative
	Silt/Clay	< 0.062	S/C	2	0	2	2%	2%
	Very Fine	.062 - .125	S	0	0	0	0%	2%
	Fine	.125 - .25	A	3	0	3	3%	5%
	Medium	.25 - .50	N	5	0	5	5%	10%
	Coarse	.50 - 1.0	D	6	0	6	6%	15%
.04 -.08	Very Coarse	1.0 - 2.0	S	1	0	1	1%	16%
.08 - .16	Very Fine	2.0 - 4.0		11	0	11	10%	27%
.16 - .22	Fine	4.0 - 5.7	G	7	0	7	7%	33%
.22 - .31	Fine	5.7 - 8.0	R	8	0	8	8%	41%
.31 - .44	Medium	8.0 - 11.3	A	7	0	7	7%	48%
.44 - .63	Medium	11.3 - 16.0	V	9	0	9	9%	56%
.63 - .89	Coarse	16.0 - 22.6	E	5	0	5	5%	61%
.89 - 1.26	Coarse	22.6 - 32.0	L	9	0	9	9%	70%
1.26 - 1.77	Very Coarse	32.0 - 45.0	S	9	0	9	9%	78%
1.77 - 2.5	Very Coarse	45.0 - 64.0		5	0	5	5%	83%
2.5 - 3.5	Small	64 - 90	C	5	0	5	5%	88%
3.5 - 5.0	Small	90 - 128	O	0	0	0	0%	88%
5.0 - 7.1	Large	128 - 180	B	0	0	0	0%	88%
7.1 - 10.1	Large	180 - 256	L	2	0	2	2%	90%
10.1 - 14.3	Small	256 - 362	B	2	0	2	2%	91%
14.3 - 20	Small	362 - 512	L	0	0	0	0%	91%
20 - 40	Medium	512 - 1024	D	0	0	0	0%	91%
40 - 80	Lrg- Very Lrg	1024 - 2048	R	0	0	0	0%	91%
	Bedrock		BDRK	9	0	9	9%	100%
			Totals	**105**	**0**	**105**	**100%**	**100%**