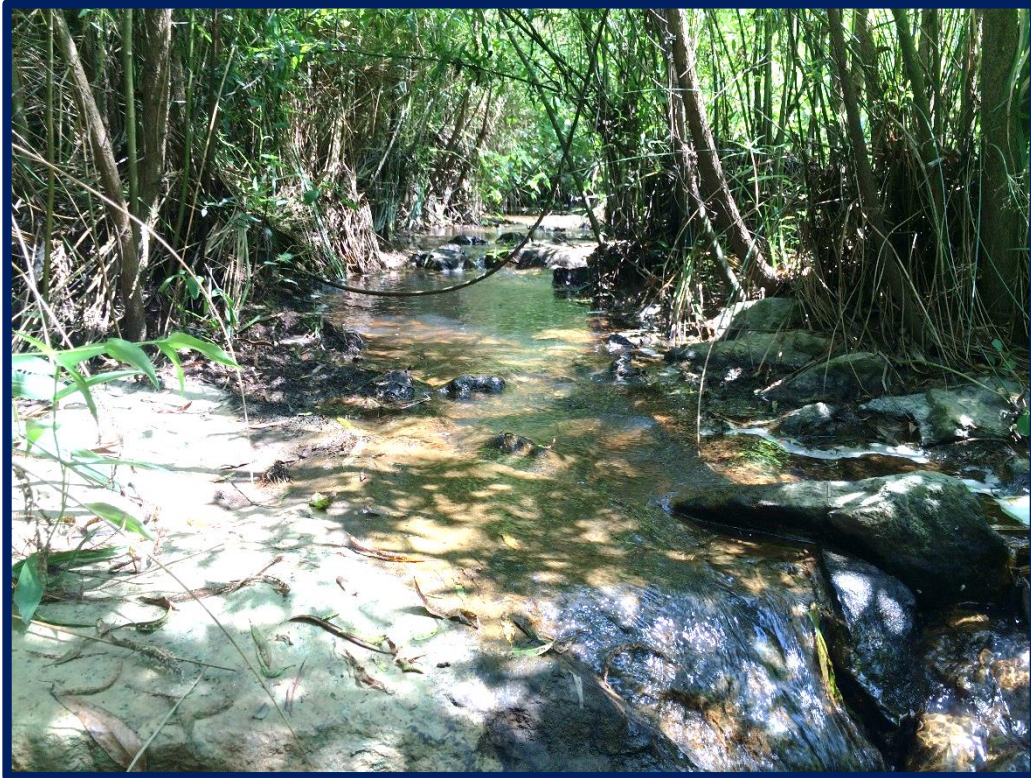


UT to Cane Creek Restoration Project Year 3 Final Monitoring Report

Alamance County, North Carolina

DMS Project ID Number – 95729, DEQ Contract No. 4951

Permits: SAW-2012-01907, DWR# 13-1177



Project Info:

Monitoring Year: 3 of 7

Year of Data Collection: 2016

Year of Completed Construction: 2014

Submission Date: December 2016

Submitted To:

NCDEQ - Division of Mitigation Services

1625 Mail Service Center

Raleigh, NC 27699

NC DEQ Contract ID No. 004951

UT to Cane Creek Restoration Project Year 3 Final Monitoring Report

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Report Prepared and Submitted by Michael Baker Engineering, Inc.

NC Professional Engineering License # F-1084



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1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored 3,314 linear feet (LF) of perennial and intermittent streams and enhanced 2,911 LF of channel for the Unnamed Tributary (UT) to Cane Creek Restoration Project (Site). Baker also planted approximately 14.0 acres (AC) of native riparian species vegetation within the recorded conservation easement areas along the restored and enhanced reaches (Reaches R1, R3, R4, R5 and R5a) for the Site. Table 1 summarizes project components and mitigation credits (Appendix A). The Site is located in Alamance County, approximately three miles south of the Town of Saxapahaw (Figure 1). The Site is located in the NC Division of Water Resources (NCDWR) Sub-basin 03-06-04 and the North Carolina Department of Environmental Quality ((NCDEQ) formerly Department of Environment and Natural Resources) - Division of Mitigation Services ((DMS) formerly Ecosystem Enhancement Program) Targeted Local Watershed (TLW) 03030002-050050 of the Cape Fear River Basin. The Project involved the restoration and enhancement of Rural Piedmont Streams (NC WAM 2010, Schafale and Weakley 1990) which had been impaired due to past agricultural conversion and cattle grazing.

Based on the DMS 2009 Cape Fear River Basin Restoration Priority (RBRP) Plan, the UT to Cane Creek Restoration Project area is located in an existing TLW within the Cape Fear River Basin, although it is not located in a Local Watershed Planning (LWP) area. The restoration strategy for the Cape Fear River Basin targets specific projects, which focus on developing creative strategies for improving water quality flowing to the Haw River in order to reduce non-point source (NPS) pollution to Jordan Lake.

The primary goals of the Project were to improve ecologic functions and to manage NPS inputs to the impaired areas as described in the DMS 2009 Cape Fear RBRP and as identified below:

- Create geomorphically stable conditions along the UTs across the Site,
- Implement agricultural best management practices (BMPs) to reduce NPS inputs to receiving waters,
- Protect and improve water quality by reducing stream bank erosion, and nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives were identified:

- Restore existing incised, eroding, and channelized streams by providing flood water access to the relic floodplains,
- Prevent cattle from accessing the conservation easement by installing permanent fencing thus reducing excessive stream bank erosion and nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment inputs from accelerated stream bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve stream bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and

- Treat invasive species vegetation within the Site area and, if necessary, continue treatments during the monitoring period.

During Year 3 monitoring, the planted acreage performance categories were functioning at 100 percent with no bare areas to report (Appendix B). The average density of total planted stems, based on data collected from the six monitoring plots following Year 3 monitoring in September 2016, was 634 stems per acre. The Year 3 vegetation data demonstrate that the Site has met the minimum success interim criteria of 320 trees per acre by the end of Year 3.

Two areas of invasive species vegetation were observed during Year 3 monitoring. Re-sprouts of *Ligustrum sinense* (Chinese privet) were noted along Reach 5 near the confluence with Reach 3, and along the right bank of Reach 4 just below the lower crossing. The total combined area of the observed privet plants is 0.103 acres and their locations are shown on the Current Condition Plan View (CCPV) maps in the Appendix B. In order to keep these areas of privet under control, the privet is scheduled to be treated in 2017.

Additionally, a previously documented easement issue regarding a buffer encroachment along the downstream portion of Reach 1 following Year 1 Monitoring has been resolved. This problem area was approximately 0.06 acre in size and encompassed 3.8% of the planted riparian buffer area of Reach R1. To demarcate the easement boundary, metal t-posts and 1-inch wire-mesh horse tape were installed and has prevented further encroachment. Following Year 3 monitoring, this former-encroachment area is now thick with herbaceous vegetation as well as tree stems. This area will continue to be periodically checked at future site visits.

The Year 3 monitoring survey data of twelve cross-sections indicates that the Site is geomorphically stable and performing at 100 percent for all the parameters evaluated. Certain cross-sections (located in Appendix D) have shown minor fluctuations in their geometry over Monitoring Year 3. These fluctuations do not represent and trend towards instability based off visual field evaluations. All reaches are stable and performing as designed. The data collected are within the lateral/vertical stability and in-stream structure performance categories.

During Year 3 monitoring, the Reach R5 crest gauge (crest gauge #1) documented at least three post-construction bankfull events, while the Reach R3 crest gauge (crest gauge #2) documented at least two bankfull events.

Summary information/data related to the Site and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report Appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan available on the DMS website. All raw data supporting the tables and figures in the Appendices is available from DMS upon request.

This report documents the successful completion of the Year 3 monitoring activities for the post-construction monitoring period.

2.0 METHODOLOGY

The seven-year monitoring plan for the Site includes criteria to evaluate the success of the stream and vegetation components of the Site. The methodology and report template used to evaluate these components adheres to the DMS monitoring report template document Version 1.4 (November 7, 2011), which will continue to serve as the template for subsequent monitoring years. The specific locations of monitoring features, such as vegetation plots, permanent cross-sections, reference photograph stations and crest gauges, are shown on the CCPV map found in Appendix B.

The Year 3 cross-section data was collected in October 2016, while the vegetation plot data was collected in September 2016. All visual site assessment data contained in Appendix B was also collected in September and October 2016.

2.1 Stream Assessment

The Project involved the restoration and enhancement of a Rural Piedmont Stream System (NC WAM 2010, Schafale and Weakley 1990) that had been impaired due to past agricultural conversion and cattle grazing. Restoration practices involved raising the existing streambed and reconnecting the stream to the relic floodplain, and restoring natural flows to areas previously drained by ditching activities. The existing channels abandoned within the restoration areas were partially to completely filled to decrease surface and subsurface drainage and raise the local water table. Permanent cattle exclusion fencing was provided around all proposed reaches and riparian buffers, with the exception of Reach R1, where cattle lack access.

Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal accuracy using Leica TS06 Total Station and was georeferenced to the NAD83 State Plane Coordinate System, FIPS3200 in US Survey Feet, which was derived from the As-built survey.

2.1.1 Morphological Parameters and Channel Stability

Survey data from the twelve permanent project cross-sections were collected and classified using the Rosgen Stream Classification System, and all monitored cross-sections fall within the quantitative parameters defined for channels of the design stream type. The Year 3 monitoring survey data for the cross-sections indicates that the Site is geomorphically stable and performing at 100 percent for all the parameters evaluated. The data collected are within the lateral/vertical stability and in-stream structure performance categories. All morphological survey data is presented in Appendix D.

A longitudinal profile was surveyed for the entire length of channel immediately after construction to document as-built baseline conditions for the first year of monitoring only. Annual longitudinal profiles will not be conducted during subsequent monitoring years unless channel instability has been documented or remedial actions/repairs are required by the U.S. Army Corps of Engineers (USACE) or DMS.

2.1.2 Hydrology

To monitor on-site bankfull events, crest gauges were installed along two of the restored reaches. One crest gauge was installed on the floodplain at the bankfull elevation along the left top of bank on Reach R5 (Crest gauge 1), approximately at Station 22+00. The second crest gauge was installed on the floodplain along the right top of bank along Reach R3 (Crest gauge 2), approximately at Station 13+50.

During Year 3 monitoring, three above-bankfull stage events were documented by Crest gauge 1, while two above-bankfull stage events were recorded by Crest gauge 2. The crest gauge readings are presented in Appendix E.

2.1.3 Photographic Documentation

Reference photograph transects were taken at each permanent cross-section. The survey tape was centered in the photographs of the bank. The water line was located in the lower edge of the frame, and as much of the bank as possible is included in each photograph.

Representative photographs also were taken of grade control structures and buffer areas along the restored stream. Selected stream photographs from Year 3 monitoring are shown in Appendix B.

2.1.4 Visual Stream Morphological Stability Assessment

The visual stream morphological stability assessment involves the qualitative evaluation of lateral and vertical channel stability, and the integrity and overall performance of in-stream structures throughout the Project reaches as a whole. Habitat parameters and pool depth maintenance are also measured and scored. During Year 3 monitoring, Baker staff walked the entire length of each of the Project reaches, noting geomorphic conditions of the stream bed profile (riffle/pool facets), both stream banks, and engineered in-stream structures. Representative photos were taken per the Site's Mitigation Plan. Locations of potential Stream Problem Areas (SPAs) are documented in the field for subsequent mapping on the CCPV figures (none were identified in Year 3). A detailed summary of the results for the visual stream stability assessment can be found in Appendix B, which includes all supporting figures, data tables, and SPA photos if applicable.

2.2 Vegetation Assessment

In order to determine if the success criteria are achieved, vegetation-monitoring quadrants were installed and are monitored across the restoration site in accordance with the Carolina Vegetation Survey (CVS)-DMS Protocol for Recording Vegetation, Version 4.1 (2007). The vegetation monitoring plots are a minimum of 2 percent of the planted portion of the Site with six plots established randomly within the planted riparian buffer areas per Monitoring Levels 1 and 2. No monitoring quadrants were established within the undisturbed wooded areas of Reach R4. The sizes of individual quadrants are 100 square meters for woody tree species.

During Year 3 monitoring, the planted acreage performance categories were functioning at 100 percent with no bare areas to report (Appendix B). The average density of total planted stems, based on data collected from the six monitoring plots following Year 3 monitoring in September 2016, was 634 stems per acre. Thus, the Year 3 vegetation data demonstrate that the Site has met the minimum success interim criteria of 320 trees per acre by the end of Year 3.

Two areas of Chinese privet totaling a combined 0.103 acres were noted near Station 28+50 on the downstream portion of Reach 5, and along the right bank of Reach 4 just below the lower crossing near Station 53+50 as shown in Figure 4. In order to keep these areas of privet under control, the privet is scheduled to be treated in 2017.

Year 3 vegetation assessment information is provided in Appendices B and C.

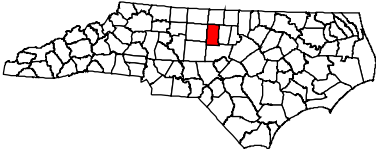
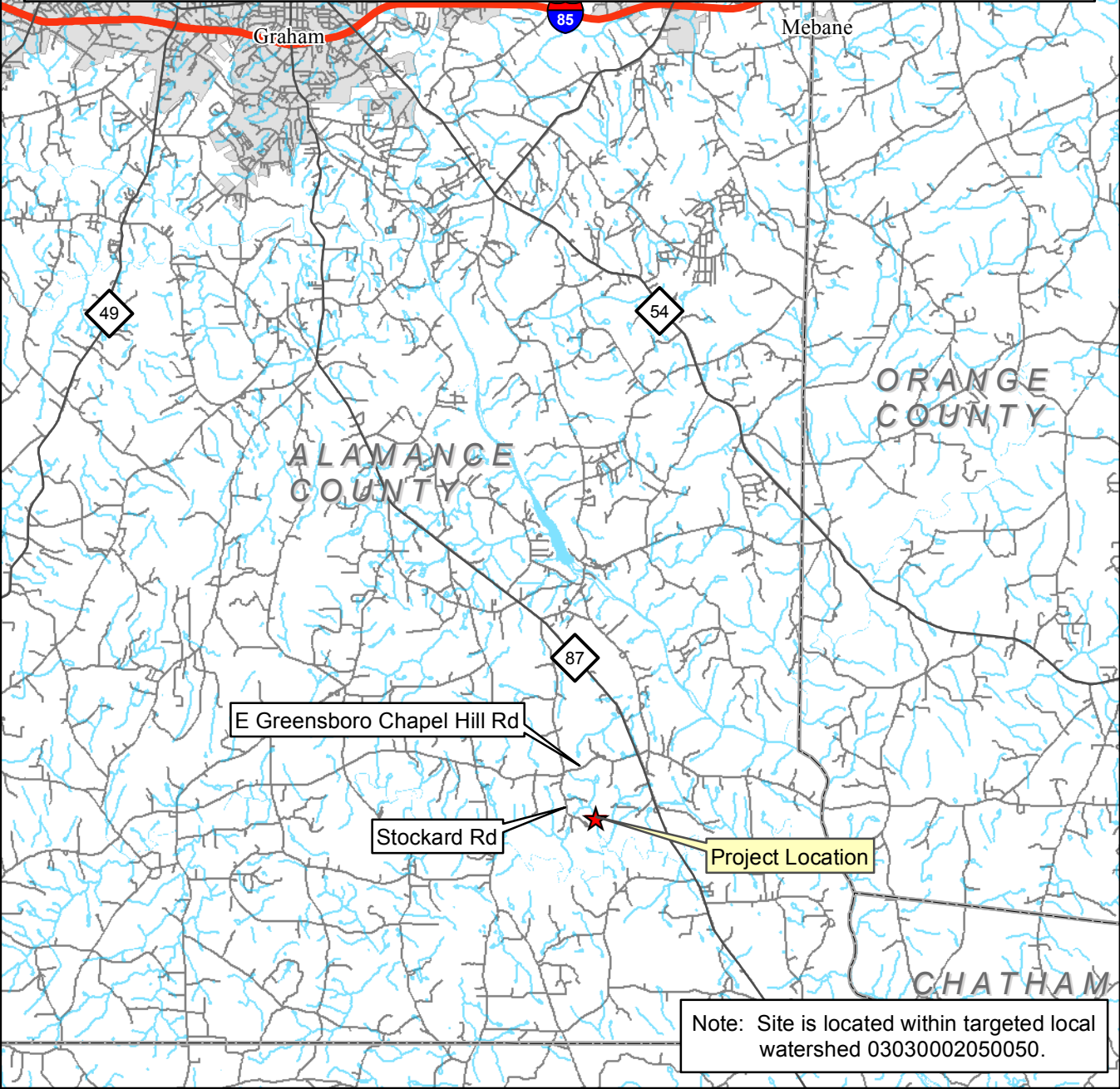
3.0 REFERENCES

- Carolina Vegetation Survey (CVS) and NC Division of Mitigation Services (DMS). CVS-DMS Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC.
- Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-DMS Protocol for Recording Vegetation, Version 4.1.
- North Carolina Division of Mitigation Services (DMS). 2011. Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation. Version 1.4, November 7, 2011.
- North Carolina Division of Mitigation Services (DMS). 2010. Baseline Monitoring Template and Guidance. Version 2.0, October 14, 2010.
- Rosgen, D. L. 1994. A Classification of Natural Rivers. *Catena* 22:169-199.
- Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third Approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDEQ. Raleigh, NC.
- U.S. Army Corps of Engineers. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers (USACE). Wilmington District.

Appendix A

Project Vicinity Map and Background Tables

The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with DMS.



Alamance County

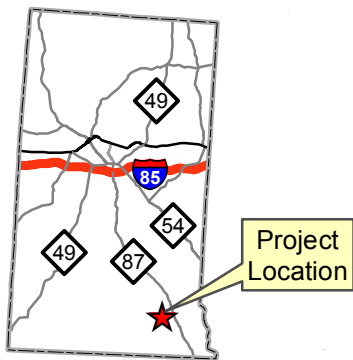
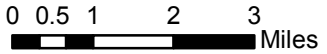


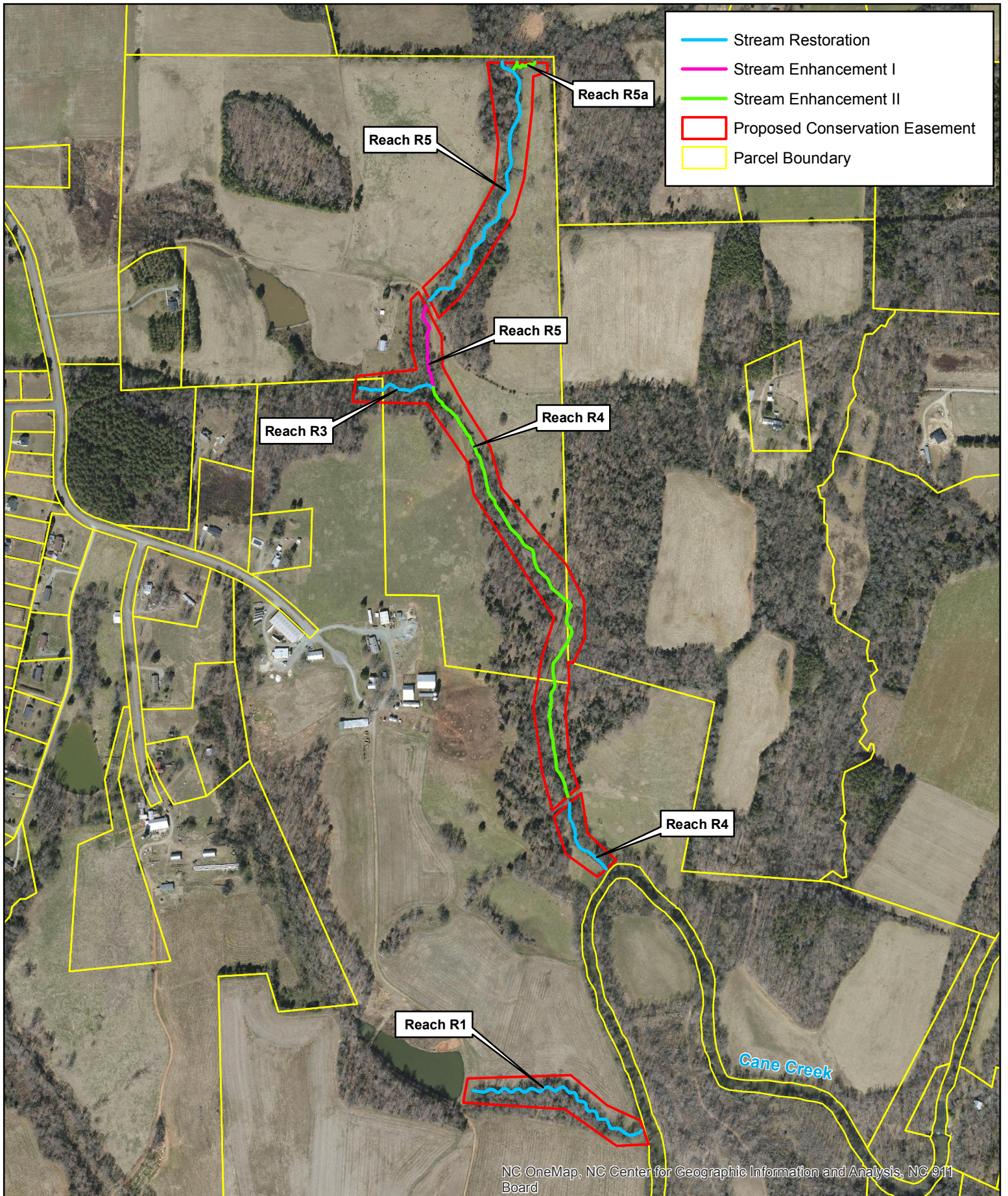
Figure 1
Project Vicinity Map
UT to Cane Creek Site

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Mitigation Services



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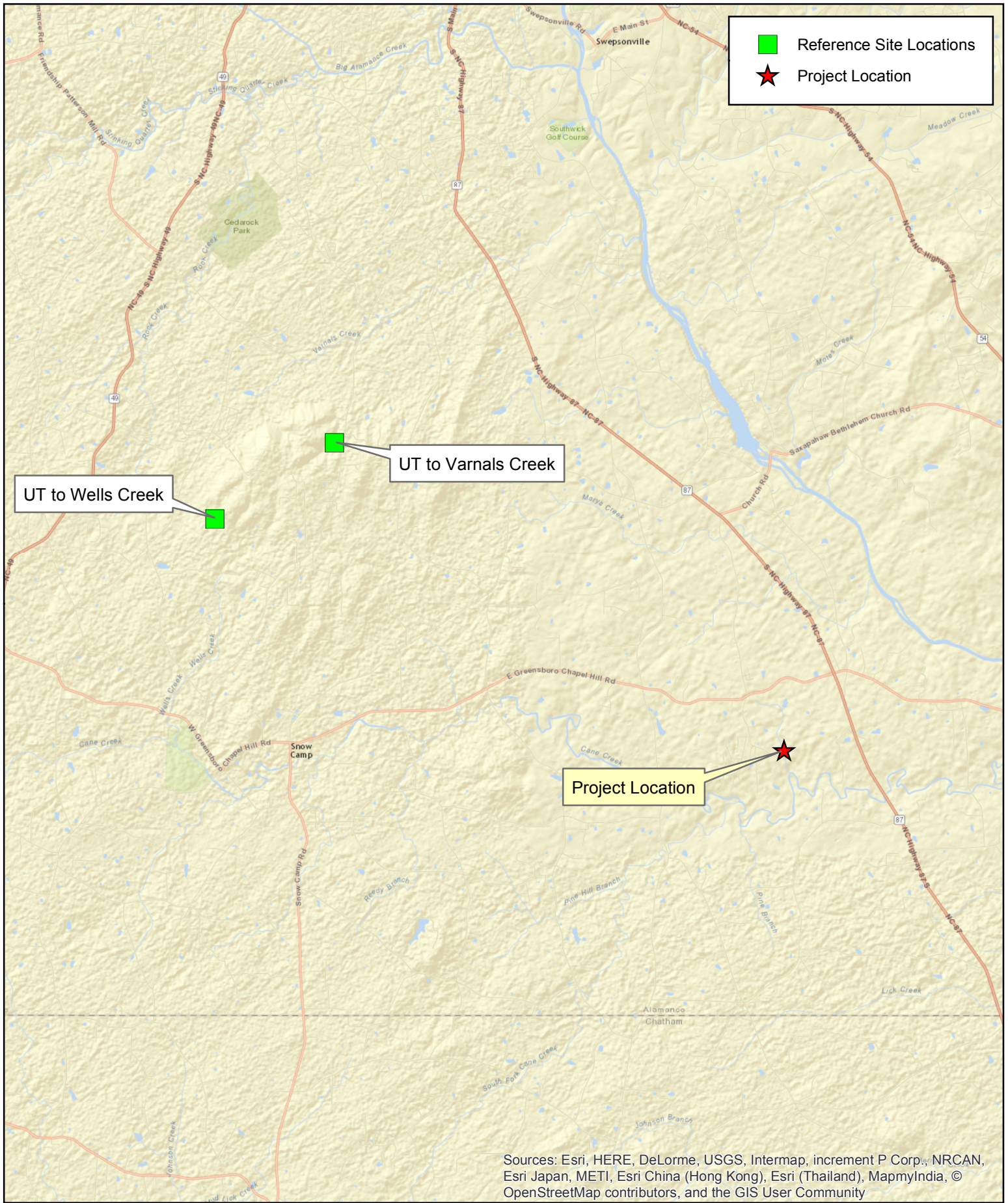


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0 500 1,000 Feet
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Project # 95729



Figure 2
Mitigation Work Plan
UT to Cane Creek Site



■ Reference Site Locations
★ Project Location

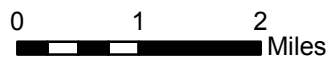
UT to Wells Creek

UT to Varnals Creek

Project Location

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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Project #95729



Figure 3
Reference Reach
Location Map
UT to Cane Creek Site

Table 1. Project Components and Mitigation Credits								
UT to Cane Creek Restoration Project: DMS Project ID No. 95729								
Mitigation Credits								
	Stream	Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R, E1, EII	R	E					
Totals	4,594 SMU	0	0					
Project Components								
Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage (LF)		Approach	Restoration/ Restoration Equivalent (SMU)	Restoration Footage or Acreage (LF)	Mitigation Ratio	
Reach 1	10+00 – 20+45	944		Restoration	1,045	1,045	1:1	
Reach 3	10+00 – 13+98	425		Restoration	398	398	1:1	
Reach 4 (Upstream section)	29+32 – 52+86	2,346		Enhancement Level II	933	2,333	2.5:1	
Reach 4 (Downstream section)	53+20 – 57+30	411		Restoration	410	410	1:1	
Reach 5 (Upstream section)	10+03 – 24+64	1,386		Restoration	1,461	1,461	1:1	
Reach 5 (Downstream section)	25+00 – 29+32	426		Enhancement Level I	289	433	1.5:1	
Reach 5a	10+02 – 11+47	144		Enhancement Level II	58	145	2.5:1	
Component Summation								
Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)		
		Riverine	Non-Riverine					
Restoration	3,314							
Enhancement I	433							
Enhancement II	2,478							
Creation	0							
Preservation	0							
High Quality Preservation	0							
BMP Elements								
Element	Location	Purpose/Function		Notes				
BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area								

Table 2. Project Activity and Reporting History
UT to Cane Creek Restoration Project: DMS Project ID No. 95729

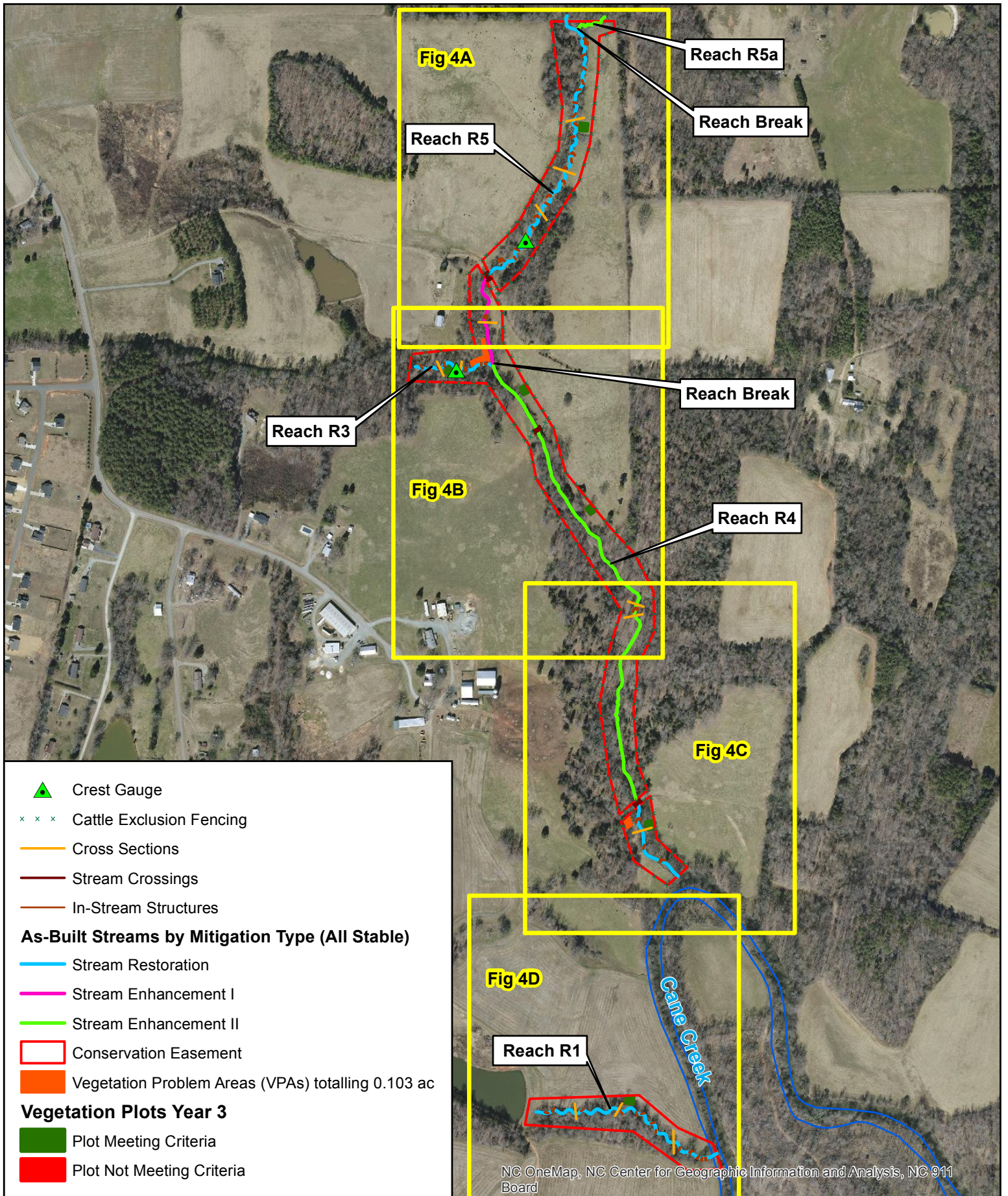
Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Mitigation Plan Prepared	N/A	N/A	Aug-13
Mitigation Plan Amended	N/A	N/A	Oct-13
Mitigation Plan Approved	May-13	N/A	Dec-13
Final Design – (at least 90% complete)	N/A	N/A	Feb-14
Construction Begins	Nov-13	N/A	Mar-14
Temporary S&E mix applied to entire project area	Feb-14	N/A	Jun-14
Permanent seed mix applied to entire project area	Feb-14	N/A	Jun-14
Planting of live stakes	Feb-14	N/A	Jun-14
Planting of bare root trees	Feb-14	N/A	Jun-14
End of Construction	Feb-14	N/A	Jun-14
Survey of As-built conditions (Year 0 Monitoring-baseline)	Apr-14	Jul-14	Aug-14
Year 1 Monitoring	Dec-14	Jan-15	Apr-15
Year 2 Monitoring	Dec-15	Oct-15	Nov-15
Year 3 Monitoring	Dec-16	Oct-16	Nov-16
Year 4 Monitoring	Dec-17	N/A	N/A
Year 5 Monitoring	Dec-18	N/A	N/A
Year 6 Monitoring	Dec-19	N/A	N/A
Year 7 Monitoring	Dec-20	N/A	N/A

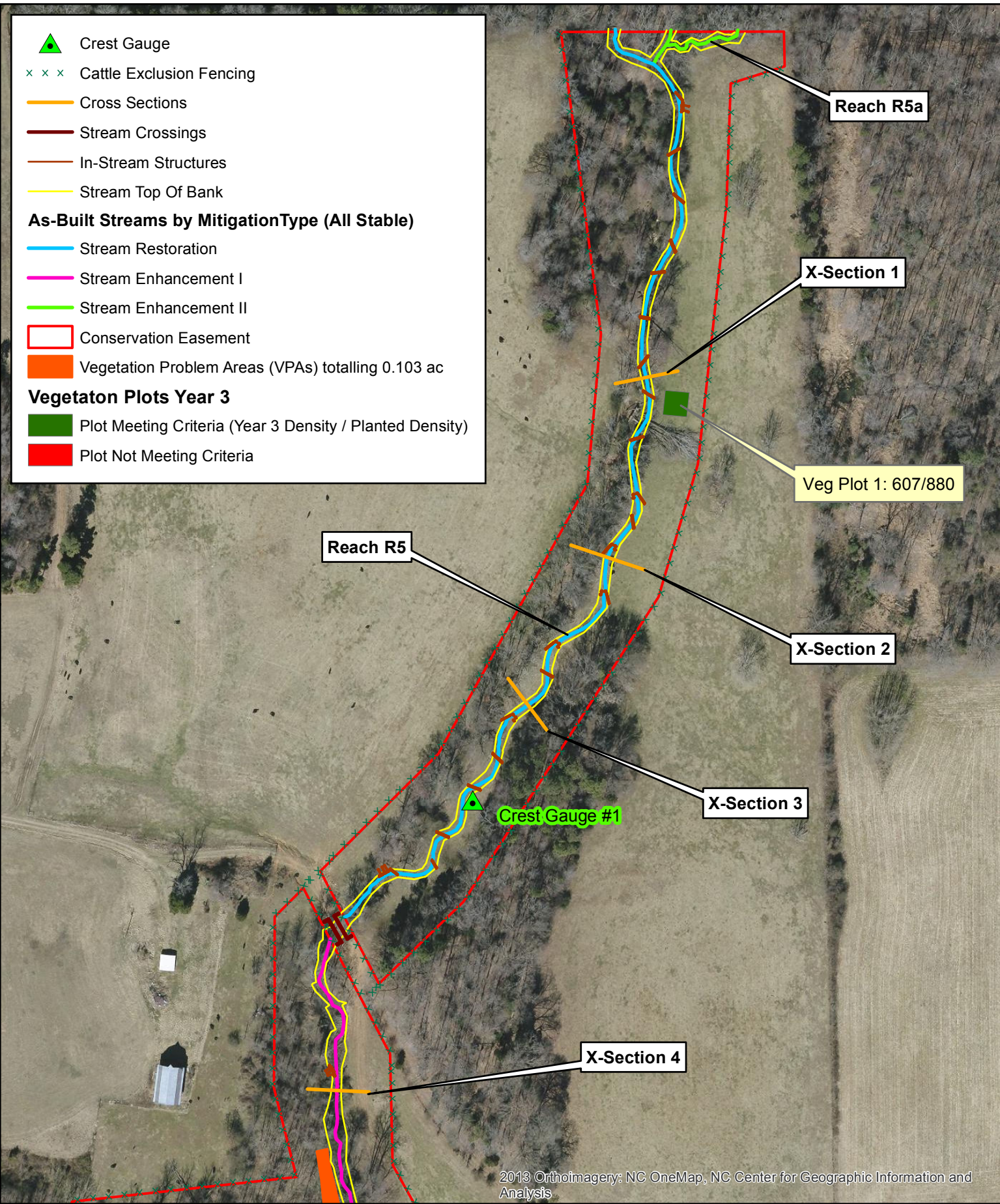
Table 3. Project Contacts	
UT to Cane Creek Restoration Project: DMS Project ID No. 95729	
Designer	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 <u>Contact:</u> Scott King, Telephone: 919-481-5731
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 <u>Contact:</u> Phillip Todd, Telephone: 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 <u>Contact:</u> Phillip Todd, Telephone: 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 <u>Contact:</u> Phillip Todd, Telephone: 919-582-3575
Seed Mix Sources	Green Resources, Telephone: 336-855-6363
Nursery Stock Suppliers	Mellow Marsh Farm, Telephone: 919-742-1200 ArborGen, Telephone: 843-528-3204
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 <u>Contact:</u>
Stream Monitoring Point of Contact	Dwayne Huneycutt, Tel. 919-481-5745
Vegetation Monitoring Point of Contact	Dwayne Huneycutt, Tel. 919-481-5745

Table 4. Project Attributes					
UT to Cane Creek Restoration Project: DMS Project ID No. 95729					
Project Information					
Project Name	UT to Cane Creek Restoration Project				
County	Alamance				
Project Area (acres)	19.9				
Project Coordinates (latitude and longitude)	35.8934 N, -79.3187 W				
Project Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Cape Fear				
USGS Hydrologic Unit 8-digit and 14-digit	03030002 / 03030002050050				
NCDWR Sub-basin	03-06-04				
Project Drainage Area (acres)	452 (Reach R4 main stem at downstream confluence w/ Cane Creek)				
Project Drainage Area Percent Impervious	<1%				
CGIA Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (49%) Agriculture (46%) Impervious Cover (1%)				
Reach Summary Information					
Parameters	Reach R1	Reach R3	Reach R4	Reach R5	Reach R5a
Length of Reach (linear feet)	1,052	400	2,731	1,925	145
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	80	91	452	290	14
NCDWR Stream Identification Score	30.5	36	42.5	38.5	33.5
NCDWR Water Quality Classification	WS V; NSW				
Morphological Description (Rosgen stream type)	Incised E	G	Bc (upstream)/ F (downstream)	G	B
Evolutionary Trend	Incised E→Gc→F	Bc→G→Fb	Bc→G→Fb	Bc→G→Fb	B→G
Underlying Mapped Soils	We, GaE, Cg, DbB	We	We, GbD3, Mc, Cg, TaD	We	We
Drainage Class	Poorly drained	Poorly drained	Poorly	Poorly drained	Poorly
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0127	0.0168	0.0169	0.0126	0.0223
FEMA Classification	N/A	Zone AE	Zone AE	N/A	N/A
Native Vegetation Community	Piedmont Small Stream				
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%	<5%	<5%
Regulatory Considerations					
Regulation	Applicable	Resolved	Supporting Documentation		
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion		
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion		
Endangered Species Act	No	N/A	Categorical Exclusion		
Historic Preservation Act	No	N/A	Categorical Exclusion		
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion		
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion		
Essential Fisheries Habitat	No	N/A	Categorical Exclusion		

Appendix B

Visual Assessment Data





- ▲ Crest Gauge
- x x x Cattle Exclusion Fencing
- Cross Sections
- Stream Crossings
- In-Stream Structures
- Stream Top Of Bank
- As-Built Streams by MitigationType (All Stable)**
- Stream Restoration
- Stream Enhancement I
- Stream Enhancement II
- Conservation Easement
- Vegetation Problem Areas (VPAs) totalling 0.103 ac
- Vegetation Plots Year 3**
- Plot Meeting Criteria (Year 3 Density / Planted Density)
- Plot Not Meeting Criteria

Reach R5

Reach R5a

X-Section 1

Veg Plot 1: 607/880

X-Section 2

X-Section 3

Crest Gauge #1

X-Section 4

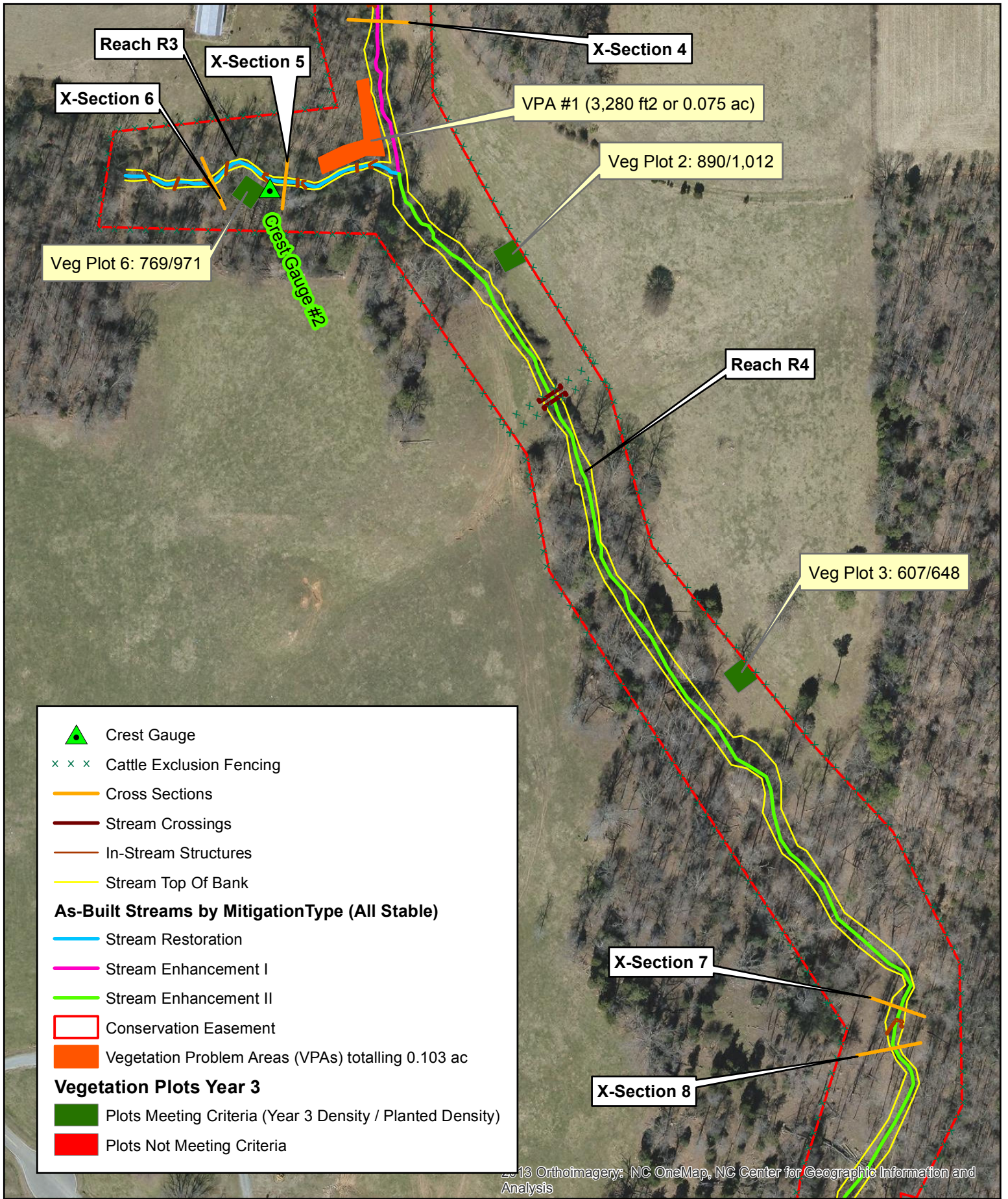
2013 Orthoimagery: NC OneMap, NC Center for Geographic Information and Analysis

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0 100 200 Feet
DEQ - Division of Mitigation Services
Project # 95729



**Current Condition
Plan View - Figure 4A
Monitoring Year 3
UT to Cane Creek Site**



- Crest Gauge
- Cattle Exclusion Fencing
- Cross Sections
- Stream Crossings
- In-Stream Structures
- Stream Top Of Bank

As-Built Streams by MitigationType (All Stable)

- Stream Restoration
- Stream Enhancement I
- Stream Enhancement II

- Conservation Easement
- Vegetation Problem Areas (VPAs) totalling 0.103 ac

Vegetation Plots Year 3

- Plots Meeting Criteria (Year 3 Density / Planted Density)
- Plots Not Meeting Criteria

VPA #1 (3,280 ft² or 0.075 ac)

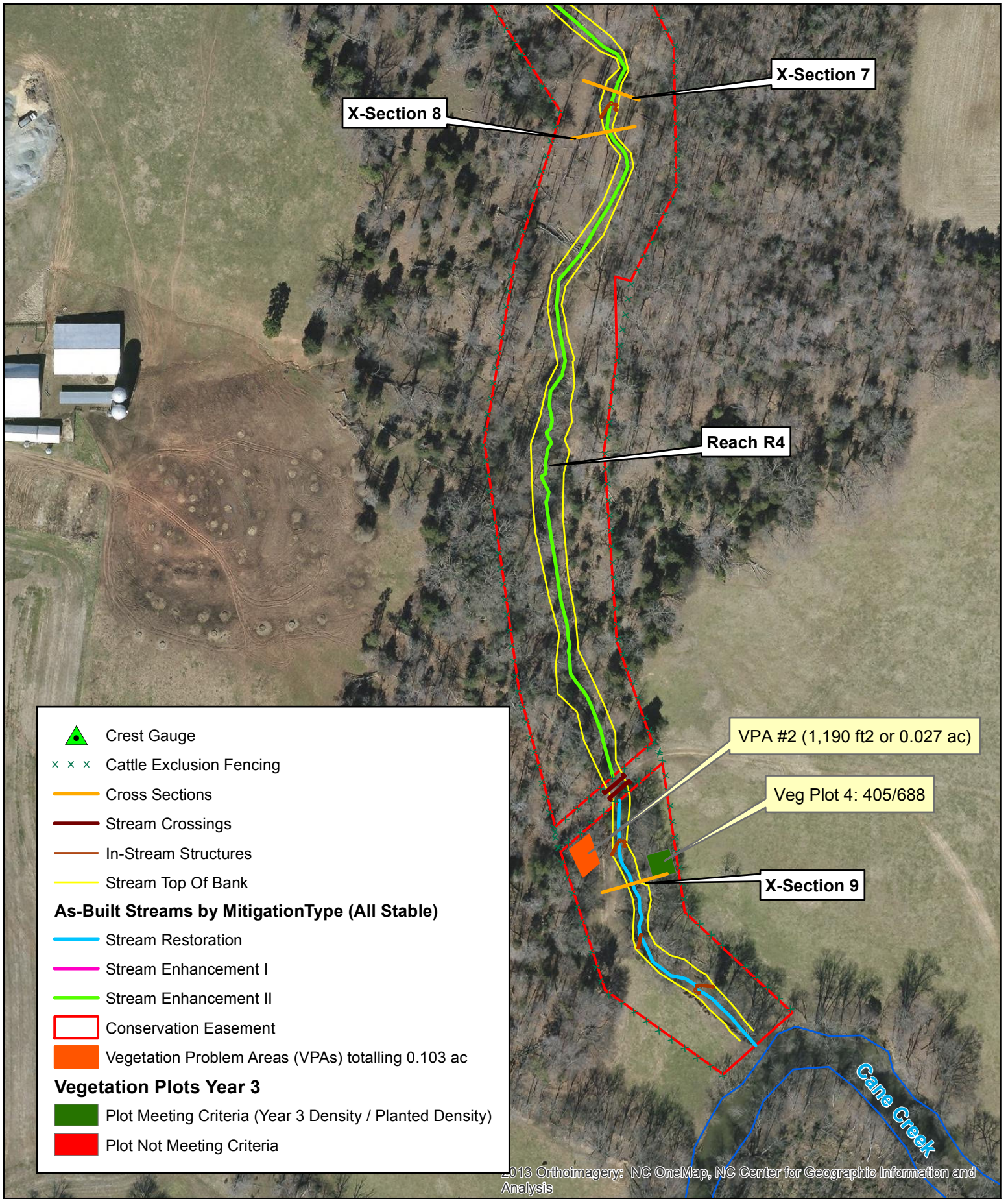
Veg Plot 2: 890/1,012














Veg Plot 6: 769/971

Veg Plot 3: 607/648

2013 Orthoimagery: NC OneMap, NC Center for Geographic Information and Analysis





-  Crest Gauge
-  Cattle Exclusion Fencing
-  Cross Sections
-  Stream Crossings
-  In-Stream Structures
-  Stream Top Of Bank
- As-Built Streams by MitigationType (All Stable)**
-  Stream Restoration
-  Stream Enhancement I
-  Stream Enhancement II
-  Conservation Easement
-  Vegetation Problem Areas (VPAs) totalling 0.103 ac
- Vegetation Plots Year 3**
-  Plot Meeting Criteria (Year 3 Density / Planted Density)
-  Plot Not Meeting Criteria

2013 Orthoimagery: NC OneMap, NC Center for Geographic Information and Analysis

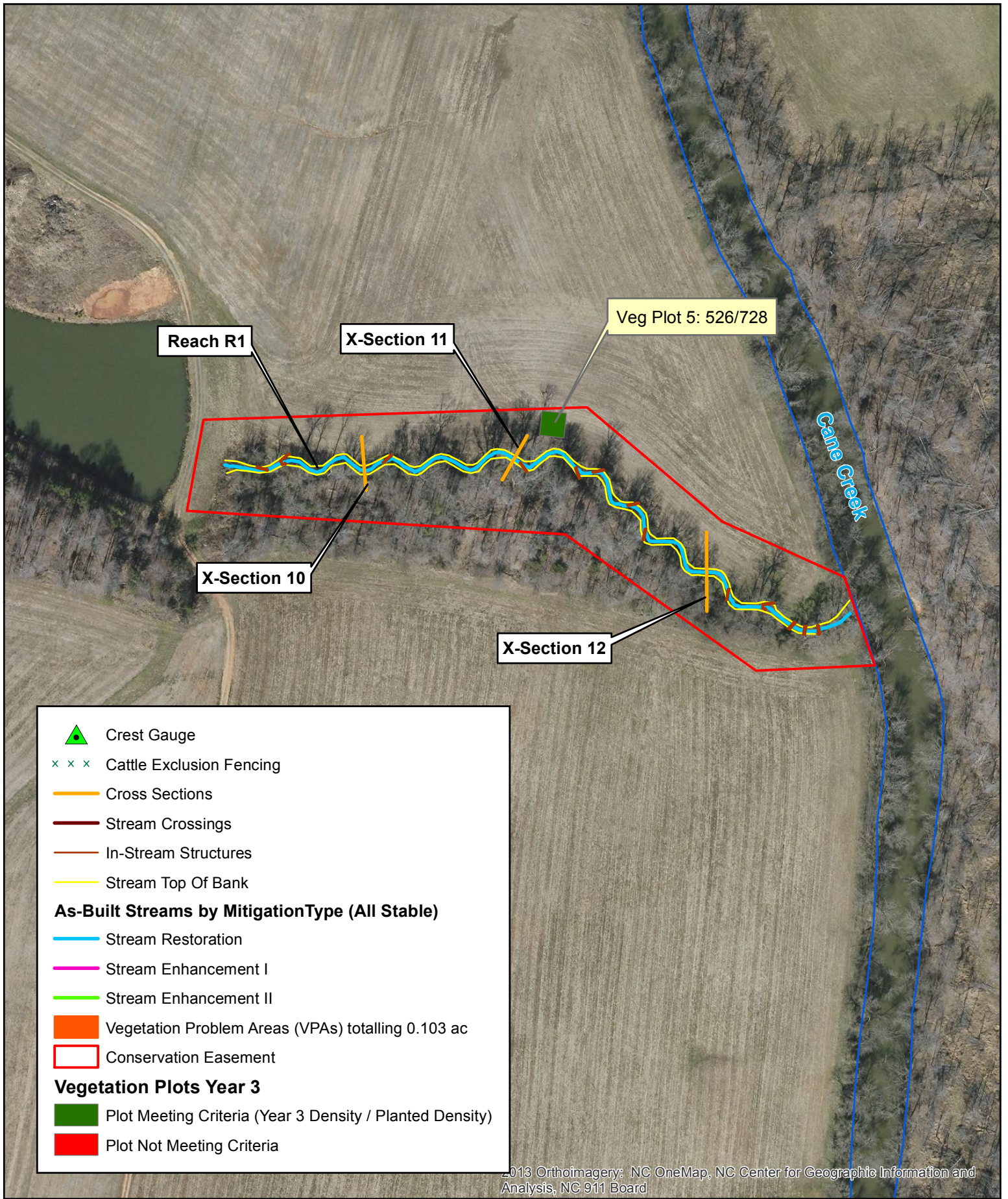
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0 100 200 Feet

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Project # 95729








**Current Condition
Plan View - Figure 4C
Monitoring Year 3
UT to Cane Creek Site**





-  Crest Gauge
-  Cattle Exclusion Fencing
-  Cross Sections
-  Stream Crossings
-  In-Stream Structures
-  Stream Top Of Bank

As-Built Streams by MitigationType (All Stable)

-  Stream Restoration
-  Stream Enhancement I
-  Stream Enhancement II

-  Vegetation Problem Areas (VPAs) totalling 0.103 ac
-  Conservation Easement

Vegetation Plots Year 3

-  Plot Meeting Criteria (Year 3 Density / Planted Density)
-  Plot Not Meeting Criteria

2013 Orthoimagery: NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board



Table 5a. Visual Stream Morphology Stability Assessment										
UT to Cane Creek Restoration Project: DMS Project ID No. 95729										
Reach ID: Reach 1										
Assessed Length (LF): 1,045										
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0%	100%			
	2. Riffle Condition	1. Texture Substrate	9	9			100%			
	3. Meander Pool Condition	1. Depth	21	21			100%			
		2. Length	21	21			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	21	21			100%			
2. Thalweg centering at downstream of meander bend (Glide)		20	20			100%				
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely			0	0	100%	0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%	0	0	100%
				Totals		0	0	100%	0	0
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	4	4			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	4	4			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth	4	4			100%			

Table 5a. Visual Stream Morphology Stability Assessment										
UT to Cane Creek Restoration Project: DMS Project ID No. 95729										
Reach ID: Reach 3										
Assessed Length (LF): 398										
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%			
		2. Degradation			0	0%	100%			
	2. Riffle Condition	1. Texture Substrate	6	6			100%			
	3. Meander Pool Condition	1. Depth	3	3			100%			
		2. Length	3	3			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	3	3			100%			
2. Thalweg centering at downstream of meander bend (Glide)		3	3			100%				
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely			0	0	100%	0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%	0	0	100%
				Totals		0	0	100%	0	0
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	4	4			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	4	4			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth	4	4			100%			

Table 5a. Visual Stream Morphology Stability Assessment											
UT to Cane Creek Restoration Project: DMS Project ID No. 95729											
Reach ID: Reach 4											
Assessed Length (LF): 2,743											
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.	
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%				
		2. Degradation			0	0%	100%				
	2. Riffle Condition	1. Texture Substrate	7	7			100%				
	3. Meander Pool Condition	1. Depth	2	2			100%				
		2. Length	2	2			100%				
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	2	2			100%				
		2. Thalweg centering at downstream of meander bend (Glide)	2	2			100%				
	2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
2. Undercut		Banks undercut/overhanging to the extent that mass wasting appears likely			0	0	100%	0	0	100%	
3. Mass Wasting		Banks slumping, caving or collapse			0	0	100%	0	0	100%	
			Totals			0	0	100%	0	0	100%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	3	3			100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	3	3			100%				
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	3	3			100%				
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	3	3			100%				
	4. Habitat	Pool forming structures maintaining - Max Pool Depth	3	3			100%				

Table 5a. Visual Stream Morphology Stability Assessment											
UT to Cane Creek Restoration Project: DMS Project ID No. 95729											
Reach ID: Reach 5											
Assessed Length (LF): 2,039											
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Veg.	Footage with Stabilizing Woody Veg.	Adjusted % for Stabilizing Woody Veg.	
1. Bed	1. Vertical Stability	1. Aggradation			0	0	100%				
		2. Degradation			0	0%	100%				
	2. Riffle Condition	1. Texture Substrate	15	15			100%				
	3. Meander Pool Condition	1. Depth	19	19			100%				
		2. Length	19	19			100%				
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	19	19			100%				
		2. Thalweg centering at downstream of meander bend (Glide)	18	18			100%				
	2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
2. Undercut		Banks undercut/overhanging to the extent that mass wasting appears likely			0	0	100%	0	0	100%	
3. Mass Wasting		Banks slumping, caving or collapse			0	0	100%	0	0	100%	
			Totals			0	0	100%	0	0	100%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	17	17			100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	17	17			100%				
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	17	17			100%				
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	17	17			100%				
	4. Habitat	Pool forming structures maintaining - Max Pool Depth	17	17			100%				

Table 5b. Stream Problem Areas (SPAs)			
UT to Cane Creek Restoration Project: DMS Project ID No. 95729			
Feature Issue	Station Number	Suspected Cause	Photo Number
None Observed	N/A	N/A	N/A

Table 6a. Vegetation Conditions Assessment						
UT to Cane Creek Restoration Project: DMS Project ID No. 95729						
Reach ID: Reach 1						
Planted Acreage: 3.1						
Vegetation Category	Defintions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover both woody and herbaceous material.	0.1	NA	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4 or 5 stem count criteria.	0.1	NA	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems or a size class that are obviously small given the monitoring year.	0.25	NA	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
Easement Acreage: 3.1						
Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
5. Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale)	1000 ft ²	NA	0	0.00	0.0%
6. Easement Encroachment Areas	Easement area shown was encroached into by use of farm equipment and will need to be replanted.	none	NA	0	0.00	0.0%
Reach ID: Reach 3 and 4						
Planted Acreage: 8.4						
Vegetation Category	Defintions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover both woody and herbaceous material	0.1	NA	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4 or 5 stem count criteria.	0.1	NA	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems or a size class that are obviously small given the monitoring year.	0.25	NA	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
Easement Acreage: 8.4						
Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
5. Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale)	1000 ft ²	Yes, Fig. 4C	1	0.027	0.32%
6. Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale)	none	NA	0	0.00	0.0%
Reach ID: Reach 5						
Planted Acreage: 5.0						
Vegetation Category	Defintions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover both woody and herbaceous material	0.1	NA	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4 or 5 stem count criteria.	0.1	NA	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems or a size class that are obviously small given the monitoring year.	0.25	NA	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
Easement Acreage: 5.0						
Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
5. Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale)	1000 ft ²	Yes, Fig. 4B	1	0.075	1.5%
6. Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale)	none	NA	0	0.00	0.0%

Table 6b. Vegetation Problem Areas (VPAs)			
UT to Cane Creek Restoration Project: DMS Project ID No. 95729			
Feature Issue	Station Number *	Suspected Cause	Photo Number
Chinese privet (<i>Ligustrum sinense</i>)	Reach 5, Station ~28+50	Re-sprout	VPA Photo 1
Chinese privet (<i>Ligustrum sinense</i>)	Reach 4, Station ~53+50	Re-sprout	VPA Photo 2

* See Figure 4 for location of invasive species



Reach R5 – View upstream of culvert, Station 24+75



Reach R5 – View upstream from crest gauge, Station 22+00



Reach R5 – View upstream, Station 20+00



Reach R5 – View upstream, Station 17+25



Reach R5 – View upstream, Station 16+50



Reach R5 – View upstream, Station 13+75



Reach R5 – View upstream, Station 12+00



Reach R5 – View upstream, Station 11+50



Reach R5 – View upstream, Station 28+50



Reach R3 – View upstream, at cross-section 6



Reach R4 – View upstream, Station 31+50



Reach R4 – View of upstream, Station 35+00



Reach R4 – View upstream, enhancement area,
Station 38+50



Reach R4 – View upstream, enhancement area
(Log J-Hook), Station 43+50



Reach R4 – View upstream, enhancement area,
Station 49+00



Reach R4 – View upstream, stream crossing,
Station 53+00



Reach R4 – View upstream, Station 54+75



Reach R4 – View upstream, Station 56+50



Reach R1 – View upstream, Station 10+50



Reach R1 – View downstream, Station 14+75



Reach R1 View upstream, Station 15+00



Reach R1 – View downstream, Station 17+00



Reach R1 – View upstream, Station 19+25



Reach R1 – View upstream, Station 20+00



Reach R5: Crest Gauge #1, 1.21 feet. July 21, 2016



Reach R5: Crest Gauge #1, 1.31 feet. Sept. 30, 2016



Reach R3: Crest Gauge #2, 1.12 feet. Sept. 30, 2016



Reach R5 upper – Bankfull evidence, Sept. 30, 2016



Reach R5: Crest Gauge #1, 0.75 feet, Nov. 7, 2016



Reach R3: Crest Gauge #2, 0.66 feet, Nov. 7, 2016



Vegetation Plot 1 – September 2016



Vegetation Plot 2 – September 2016



Vegetation Plot 3 – September 2016



Vegetation Plot 4 – September 2016



Vegetation Plot 5 – September 2016



Vegetation Plot 6 – September 2016



1) Vegetation Problem Area #1 – Right bank of Reach 5 near Station 28+50, October 2016



2) Vegetation Problem Area #2 – Right bank of Reach 4 near Station 53+50, Sept. 2016

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment			
UT to Cane Creek Restoration Project: DMS Project ID No. 95729			
Plot ID	Vegetation Survival Threshold Met?	September 2016 Total/Planted Stem Count	Tract Mean
1	Y	607/880	634
2	Y	890/1,012	
3	Y	607/648	
4	Y	405/688	
5	Y	526/728	
6	Y	769/971	
Notes:			
* Total/Planted Stem Count reflects the change in stem density based on the current total density of planted stems (Total), over the density of stems at the time of the As-Built Survey (Planted).			

Table 8. CVS Vegetation Plot Metadata	
UT to Cane Creek Restoration Project: DMS Project ID No. 95729	
Report Prepared By	Dwayne Huneycutt
Date Prepared	10/4/2016 13:08
database name	MichaelBaker_2016_UTCaneCrk_95729.mdb
database location	L:\Monitoring\Veg Plot Info\CVS Data Tool\UT to Cane Creek
computer name	CARYLDHUNEYCUTT
file size	48762880
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.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	95729
project Name	UT to Cane Creek
Description	
River Basin	Cape Fear
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	6

Table 9a. CVS Stem Count of Planted Stems by Plot and Species

UT to Cane Creek Restoration Project: DMS Project ID No. 95729

Comment	Species	Species Type	Common Name	Total Planted Stems	# plots	Avg# stems	Plot 95729-01-0001	Plot 95729-01-0002	Plot 95729-01-0003	Plot 95729-01-0004	Plot 95729-01-0005	Plot 95729-01-0006
	<i>Betula nigra</i>	Tree	river birch	10	3	3.33	6				1	3
	<i>Carpinus caroliniana</i>	Shrub Tree	American hornbeam	7	5	1.4		1	1	1	1	3
	<i>Diospyros virginiana</i>	Tree	common persimmon	6	5	1.2	2	1	1	1	1	
	<i>Fraxinus pennsylvanica</i>	Tree	green ash	24	6	4	1	9	5	2	3	4
	<i>Liriodendron tulipifera</i>	Tree	tuliptree	1	1	1				1		
	<i>Nyssa sylvatica</i>	Tree	blackgum	2	1	2				2		
	<i>Platanus occidentalis</i>	Tree	American sycamore	11	5	2.2	4	2	2		1	2
	<i>Quercus alba</i>	Tree	white oak	5	3	1.67	2	2	1			
	<i>Quercus laurifolia</i>	Tree	laurel oak	3	2	1.5	1				2	
	<i>Quercus lyrata</i>	Tree	overcup oak	11	4	2.75		6	1		2	2
	<i>Quercus michauxii</i>	Tree	swamp chestnut oak	11	5	2.2		1	2	2	1	5
	<i>Quercus nigra</i>	Tree	water oak	3	3	1	1		1		1	
TOT:	0	14	14	94	12		15	22	15	10	13	19

**Table 9b. Stem Count for Each Species Arranged by Plot
UT to Cane Creek Restoration Project: DMS Project ID No. 95729**

Botanical Name	Common Name	Plots						
		1	2	3	4	5	6	
Tree Species								
<i>Betula nigra</i>	river birch	6				1	3	
<i>Fraxinus pennsylvanica</i>	green ash	1	9	5	2	3	4	
<i>Liriodendron tulipifera</i>	tulip poplar				1			
<i>Nyssa sylvatica</i>	black gum				2			
<i>Platanus occidentalis</i>	American sycamore	4	2	2		1	2	
<i>Quercus alba</i>	white oak		2	2	1			
<i>Quercus laurifolia</i>	laurel oak	1				2		
<i>Quercus lyrata</i>	overcup oak		6	1		2	2	
<i>Quercus michauxii</i>	swamp chestnut oak		1	2	2	1	5	
<i>Quercus nigra</i>	water oak	1		1		1		
Shrub Species								
<i>Asimina triloba</i>	paw paw							
<i>Carpinus caroliniana</i>	ironwood		1	1	1	1	3	
<i>Diospyros virginiana</i>	persimmon	2	1	1	1	1		
<i>Hamamelis virginiana</i>	witch hazel							
<i>Itea virginica</i>	Virginia sweetspire							
<i>Lindera benzoin</i>	spicebush							
<i>Viburnum dentatum</i>	arrowwood viburnum							
Total Stems Per Plot for Year 3 (September 2016)		15	22	15	10	13	19	Average Stems Per Acre
Density Per Plot for Year 3 (September 2016)		607	890	607	405	526	769	634
Density Per Plot for Year 2 (October 2015)		607	890	728	486	607	769	681
Density Per Plot for Year 1 (After Supplemental Planting Mar. 2015)		728	1012	648	688	728	971	796
Total Stems/ Acre for Year 1 (Before Supplemental Dec. 2014)		728	405	121	364	202	567	398
Total Stems/ Acre for Year 0 As-Built (Baseline Data)		880	680	640	680	760	520	693

Table 9c. CVS Density Per Plot

UT to Cane Creek Restoration Project: DMS Project ID No. 95729

Scientific Name	Common Name	Species Type	Current Plot Data (MY3 2016)																		Annual Means														
			95729-01-0001			95729-01-0002			95729-01-0003			95729-01-0004			95729-01-0005			95729-01-0006			MY3 (2016)			MY2 (2015)			MY1 (2014)								
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T			
<i>Betula nigra</i>	river birch	Tree	6	6	6													1	1	1	3	3	3	10	10	10	10	10	10	10	10	10	13	13	13
<i>Carpinus caroliniana</i>	American hornbeam	Tree				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	7	7	7	7	7	7	7	7	7	5	5	5
<i>Diospyros virginiana</i>	common persimmon	Tree	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				6	6	6	5	5	5	5	5	5	1	1	1
<i>Fraxinus pennsylvanica</i>	green ash	Tree	1	1	1	9	9	9	5	5	5	2	2	2	3	3	3	4	4	4	4	4	4	24	24	24	27	27	27	27	27	27	15	15	15
<i>Liriodendron tulipifera</i>	tuliptree	Tree										1	1	1										1	1	1	1	1	1	1	1	1			
<i>Nyssa sylvatica</i>	blackgum	Tree										2	2	2										2	2	2	3	3	3	3	3	3	4	4	4
<i>Platanus occidentalis</i>	American sycamore	Tree	4	4	4	2	2	2	2	2	2							1	1	1	2	2	2	11	11	11	11	11	11	11	11	11	7	7	7
<i>Quercus spp.</i>	oak	Tree																									1	1	1						
<i>Quercus alba</i>	white oak	Tree				2	2	2	2	2	2	1	1	1										5	5	5	5	5	5						
<i>Quercus laurifolia</i>	laurel oak	Tree	1	1	1													2	2	2				3	3	3	3	3	3	3	3	3	3	3	3
<i>Quercus lyrata</i>	overcup oak	Tree				6	6	6	1	1	1				2	2	2	2	2	2	2	2	2	11	11	11	11	11	11						
<i>Quercus michauxii</i>	swamp chestnut oak	Tree				1	1	1	2	2	2	2	2	2	1	1	1	5	5	5	11	11	11	13	13	13	13	13	13	9	9	9	9	9	9
<i>Quercus nigra</i>	water oak	Tree	1	1	1				1	1	1							1	1	1				3	3	3	3	3	3	3	3	3	1	1	1
<i>Unknown</i>	unk	unk																									2	2	2	2	2	2	1	1	1
Stem count			15	15	15	22	22	22	15	15	15	10	10	10	13	13	13	19	19	19	19	19	19	94	94	94	102	102	102	59	59	59	59	59	59
size (ares)			1			1			1			1			1			1			6			6			6								
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.15			0.15			0.15								
Species count			6	6	6	7	7	7	8	8	8	7	7	7	9	9	9	6	6	6	6	6	6	12	12	12	14	14	14	14	14	14	10	10	10
Stems per ACRE			607.0	607.0	607.0	890.3	890.3	890.3	607.0	607.0	607.0	404.7	404.7	404.7	526.1	526.1	526.1	768.9	768.9	768.9	634.0	634.0	634.0	688.0	688.0	688.0	397.9	397.9	397.9	397.9	397.9	397.9			

Exceeds requirements, by greater than 10%

Table 9d. CVS Vegetation Summary and Totals							
UT to Cane Creek Restoration Project: DMS Project ID No. 95729							
UT to Cane Creek Restoration Project: DMS Project ID No. 95729							
Year 3 (September 2016)							
Vegetation Plot Summary Information							
Plot #	Riparian Buffer Stems ¹	Stream/Wetland Stems ²	Live Stakes	Invasives	Volunteers ³	Total ⁴	Unknown Growth Form
1	n/a	15	0	0	0	15	0
2	n/a	22	0	0	0	22	0
3	n/a	15	0	0	0	15	0
4	n/a	10	0	0	0	10	0
5	n/a	13	0	0	0	13	0
6	n/a	19	0	0	0	19	0
Wetland/Stream Vegetation Totals							
(per acre)							
Plot #	Stream / Wetland Stems ²	Volunteers ³	Total ⁴	Success Criteria Met?			
1	607	0	607	Yes			
2	890	0	890	Yes			
3	607	0	607	Yes			
4	405	0	405	Yes			
5	526	0	526	Yes			
6	769	0	769	Yes			
Project Average	634	0	634	Yes			
Riparian Buffer Vegetation Totals							
(per acre)							
Plot #	Riparian Buffer Stems ¹	Success Criteria Met?					
1	n/a						
2	n/a						
3	n/a						
4	n/a						
5	n/a						
6	n/a						
Project Average	n/a						
Stem Class	Characteristics						
¹ Buffer Stems	Native planted hardwood trees. Does NOT include shrubs. No pines. No vines.						
² Stream/ Wetland Stems	Native planted woody stems. Includes shrubs, does NOT include live stakes. No vines						
³ Volunteers	Native woody stems. Not planted. No vines.						
⁴ Total	Planted + volunteer native woody stems. Includes live stakes. Excl. exotics. Excl. vines.						

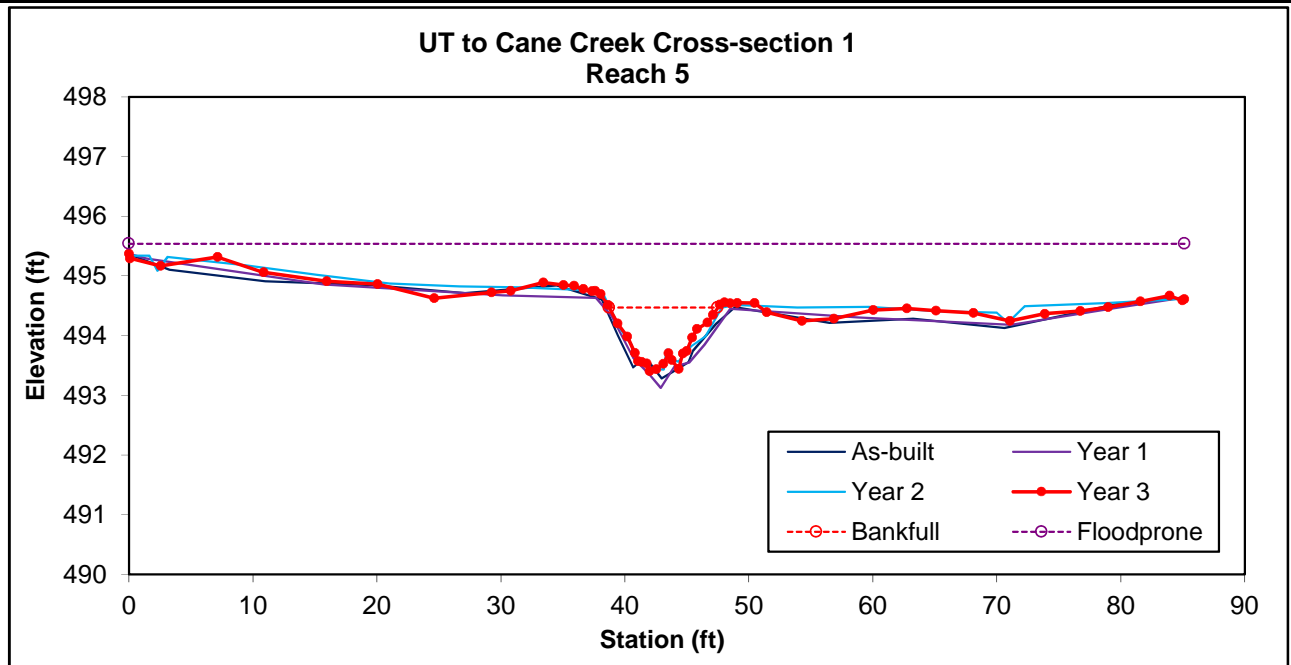
Appendix D

Stream Survey Data

Permanent Cross-section 1, Reach 5
 (Year 3 Data - Collected October 2016)



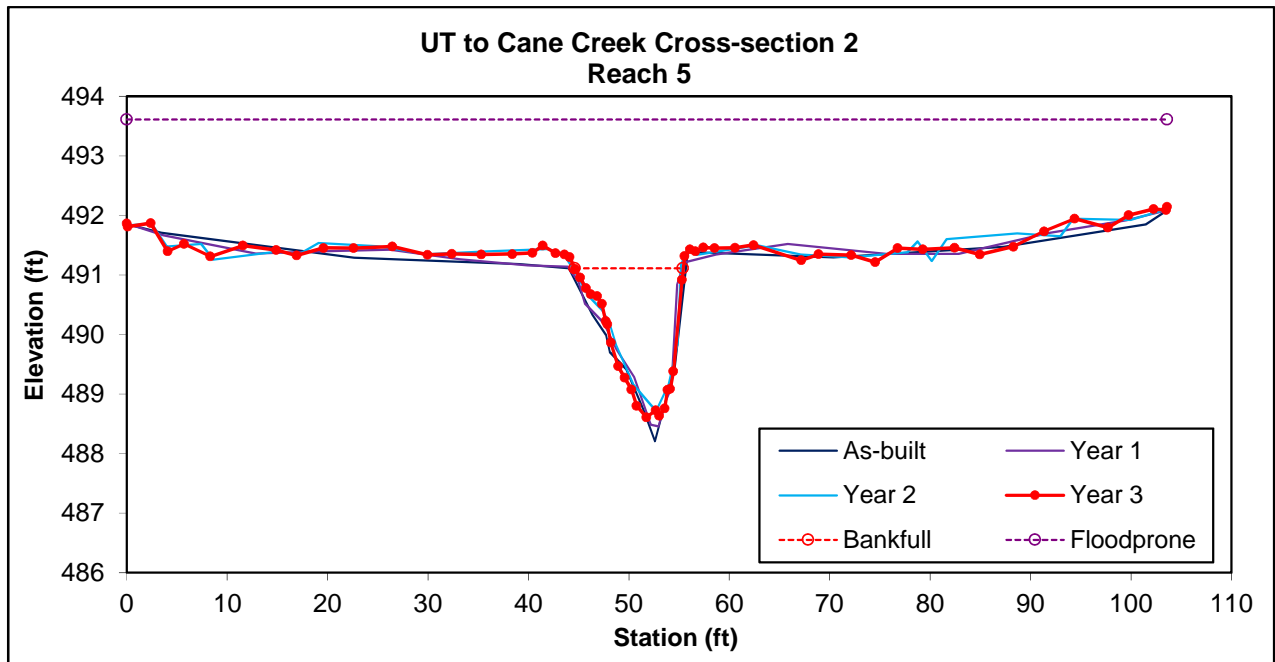
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	5.4	8.75	0.62	1.07	14.13	1.1	9.7	494.47	494.56



Permanent Cross-section 2, Reach 5
(Year 3 Data - Collected October 2016)



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		15.7	10.79	1.45	2.5	7.42	1.1	9.6	491.11	491.34

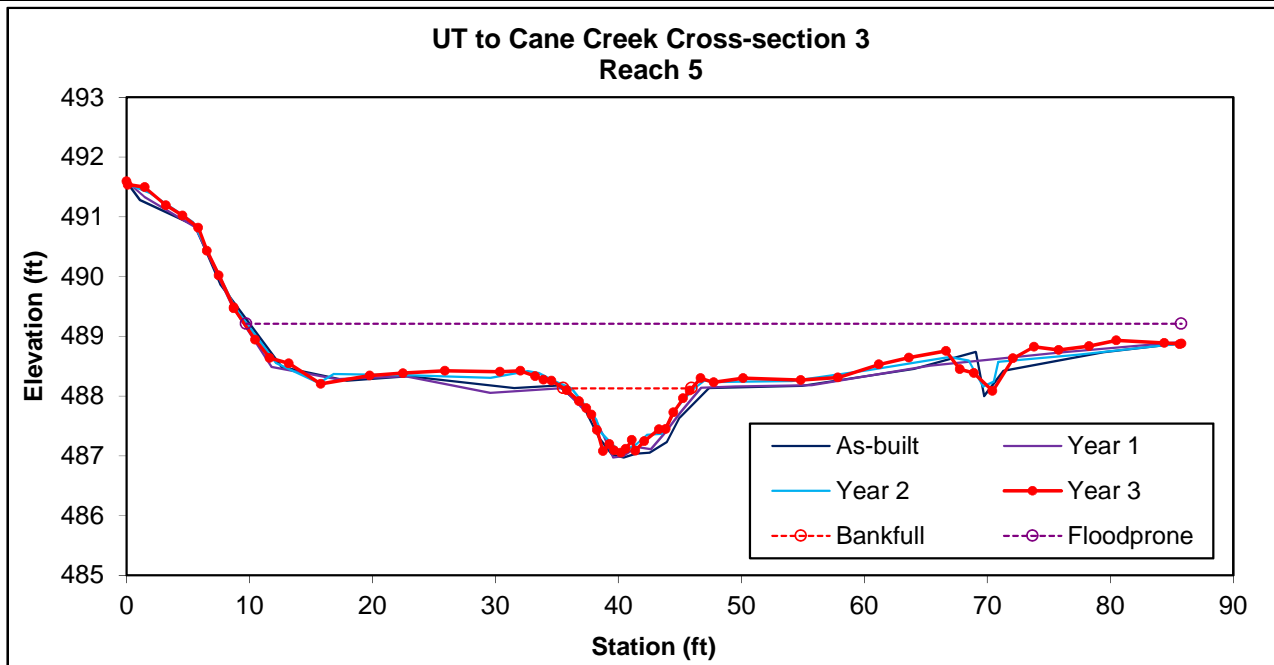


Permanent Cross-section 3, Reach 5

(Year 3 Data - Collected October 2016)



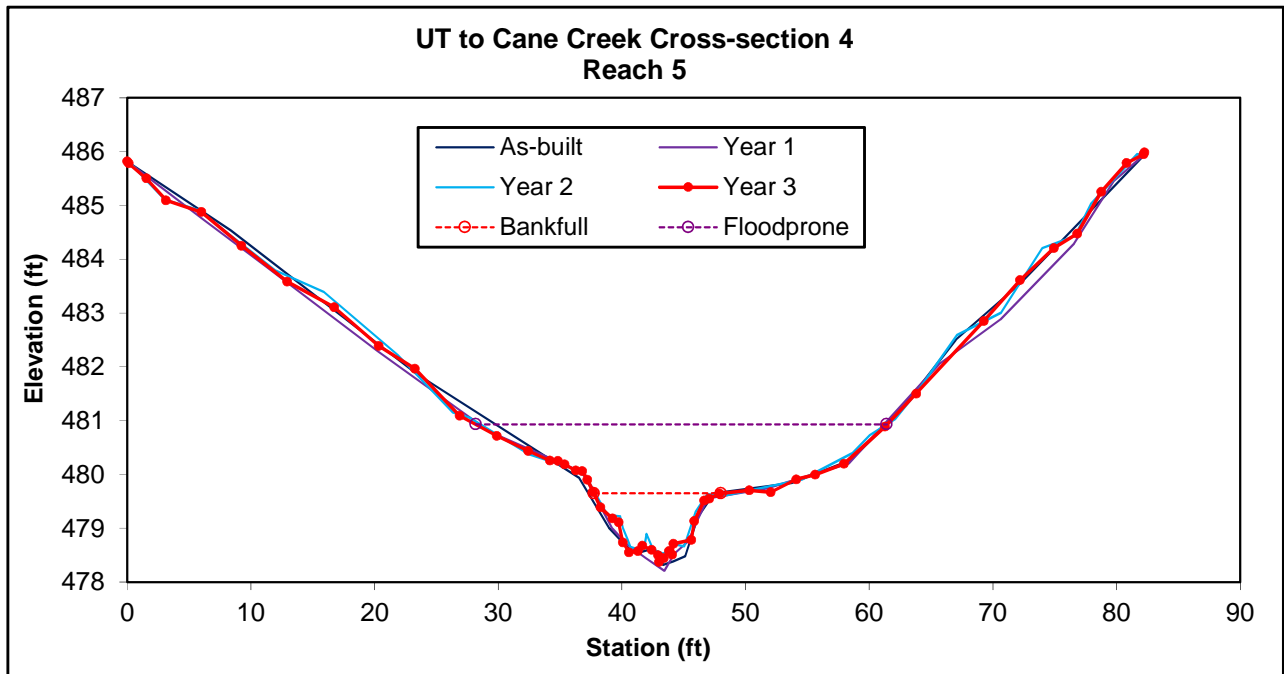
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	6.4	10.43	0.61	1.08	17	1.1	7.3	488.13	488.26



Permanent Cross-section 4, Reach 5
 (Year 3 Data - Collected October 2016)



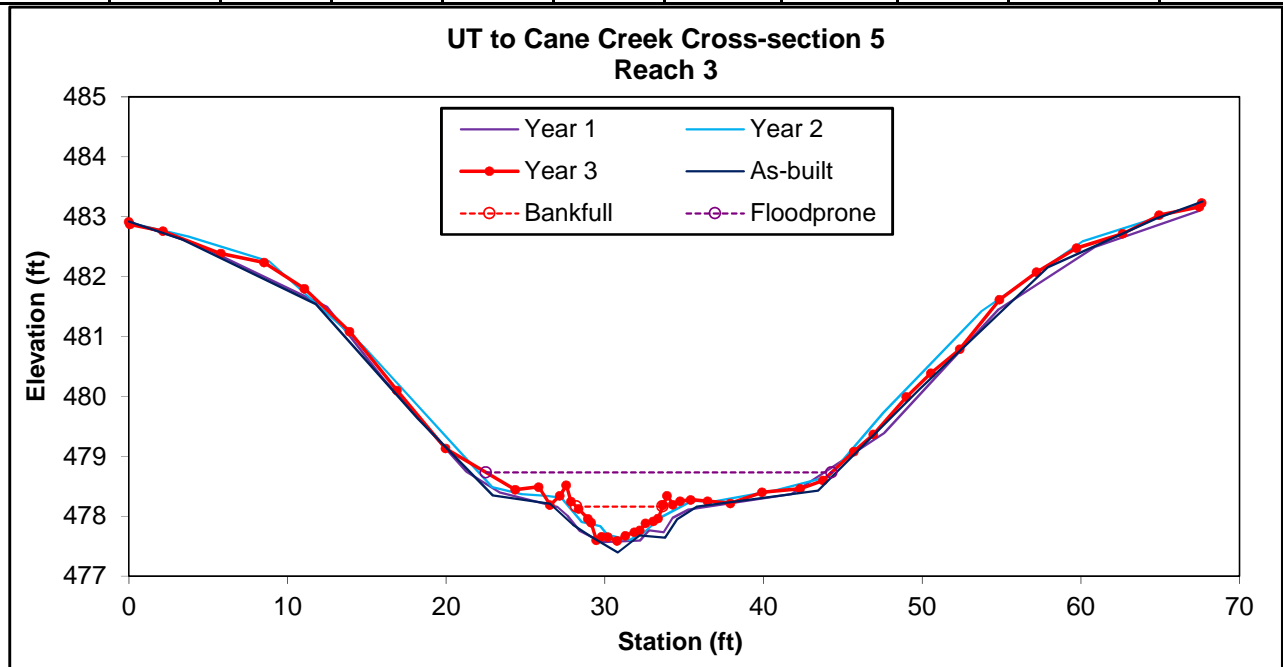
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	7.2	10.27	0.7	1.28	14.7	1	3.2	479.65	479.65



Permanent Cross-section 5, Reach 3
 (Year 3 Data - Collected October 2016)



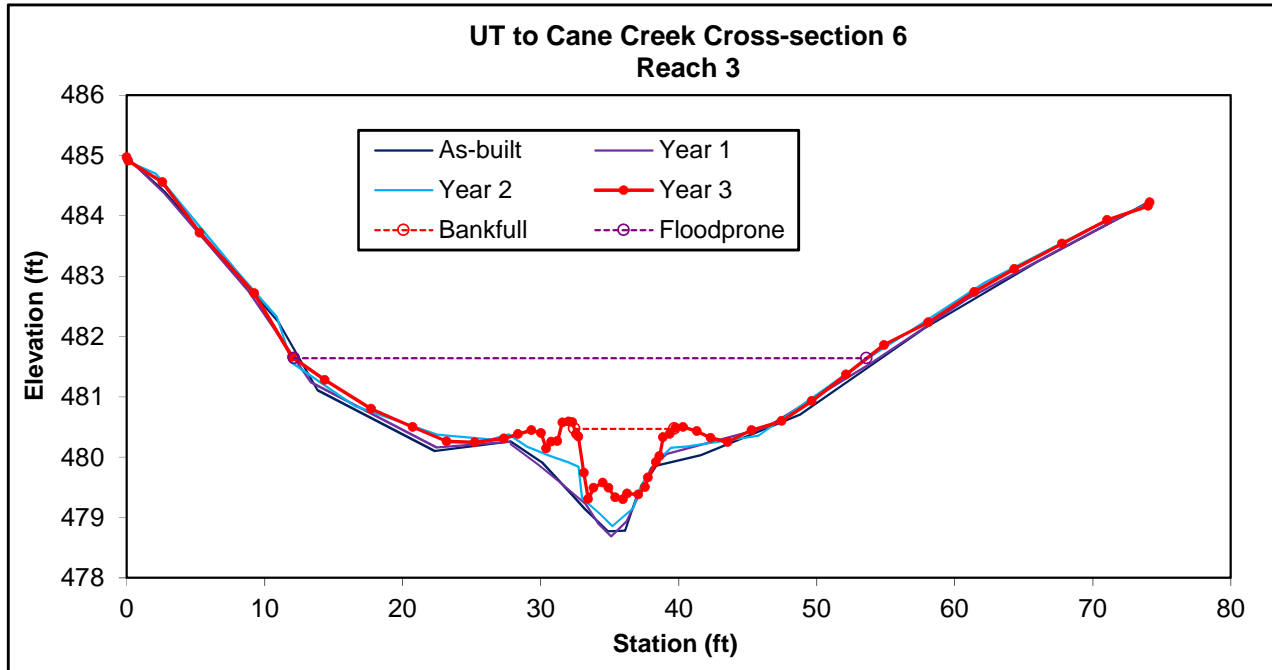
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	2	5.43	0.36	0.57	14.97	1	4	478.16	478.19



Permanent Cross-section 6, Reach 3
 (Year 3 Data - Collected October 2016)



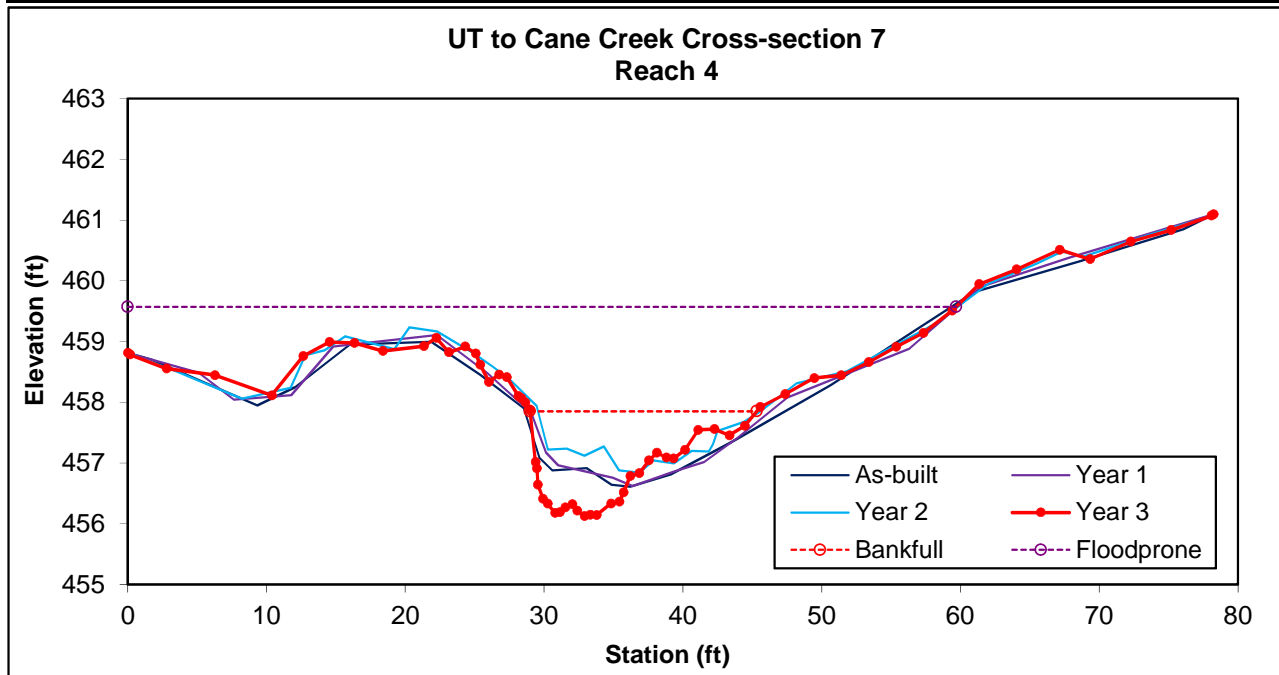
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		5.7	7.25	0.78	1.17	9.29	1	5.7	480.47	480.49



Permanent Cross-section 7, Reach 4
 (Year 3 Data - Collected October 2015)



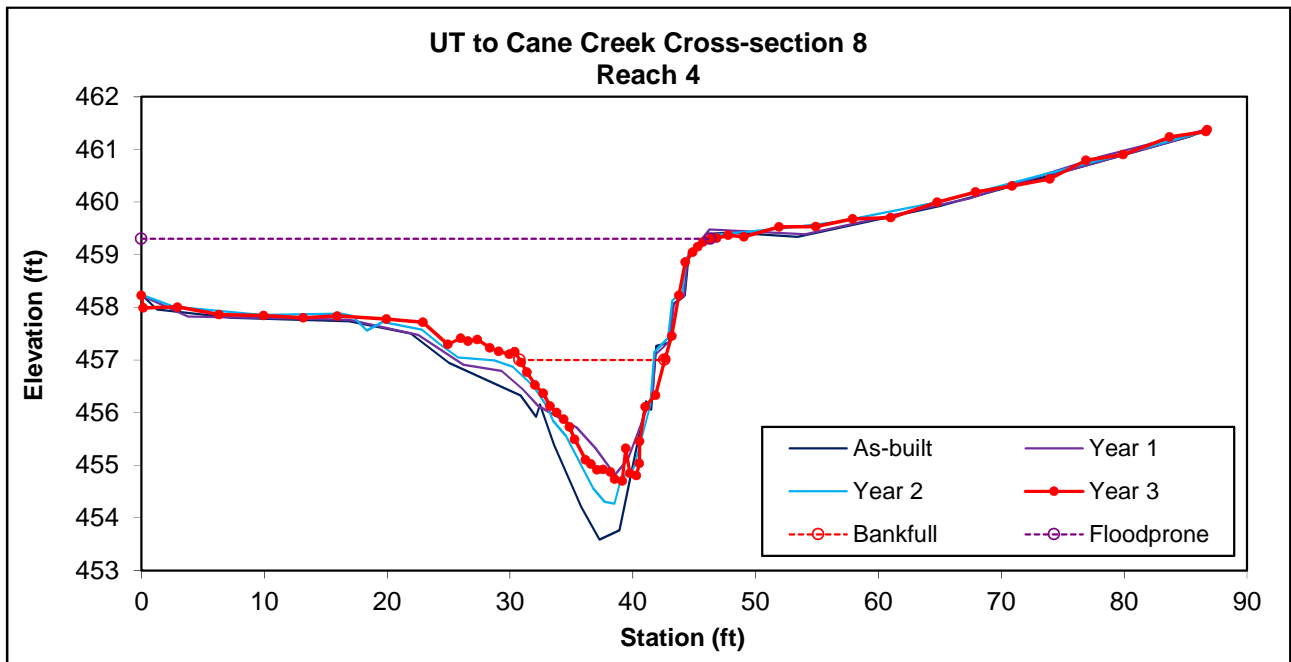
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	15.5	16.34	0.95	1.72	17.2	1	3.7	457.85	457.87



Permanent Cross-section 8, Reach 4
 (Year 3 Data - Collected October 2016)



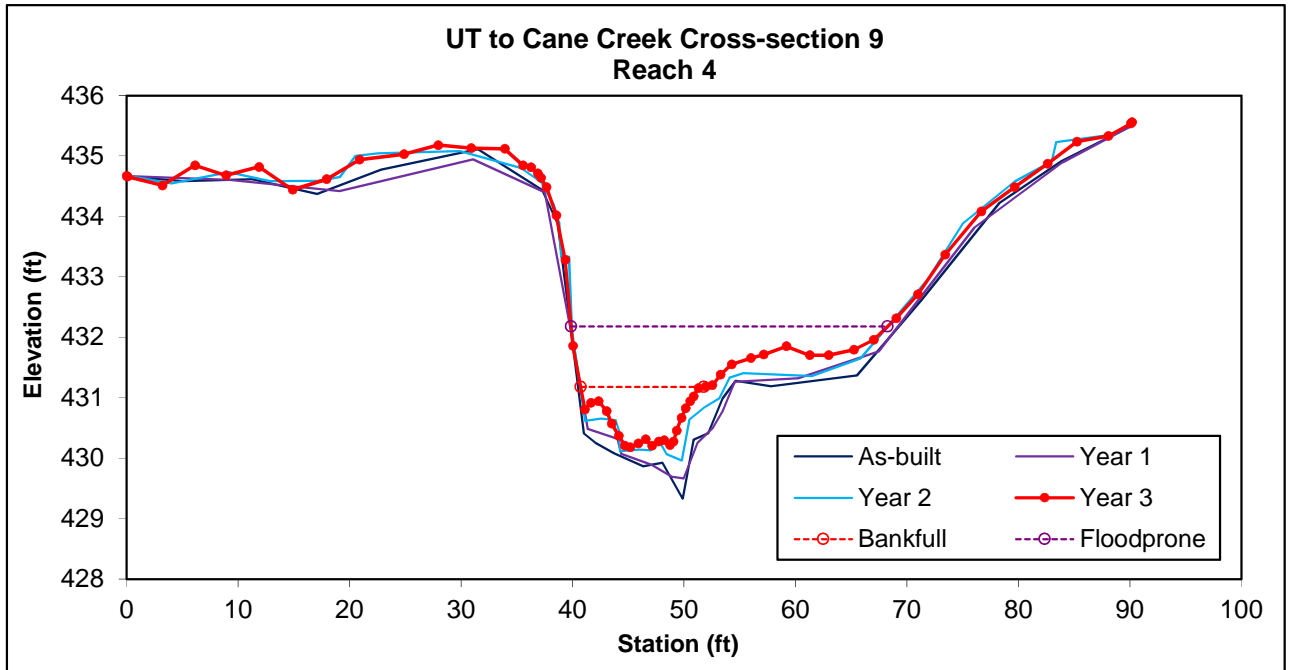
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		15.5	11.82	1.31	2.3	8.99	1.1	3.9	457	457.16



Permanent Cross-section 9, Reach 4
 (Year 3 Data - Collected October 2016)



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	6.8	11.06	0.61	1	18.08	1	2.6	431.18	431.21

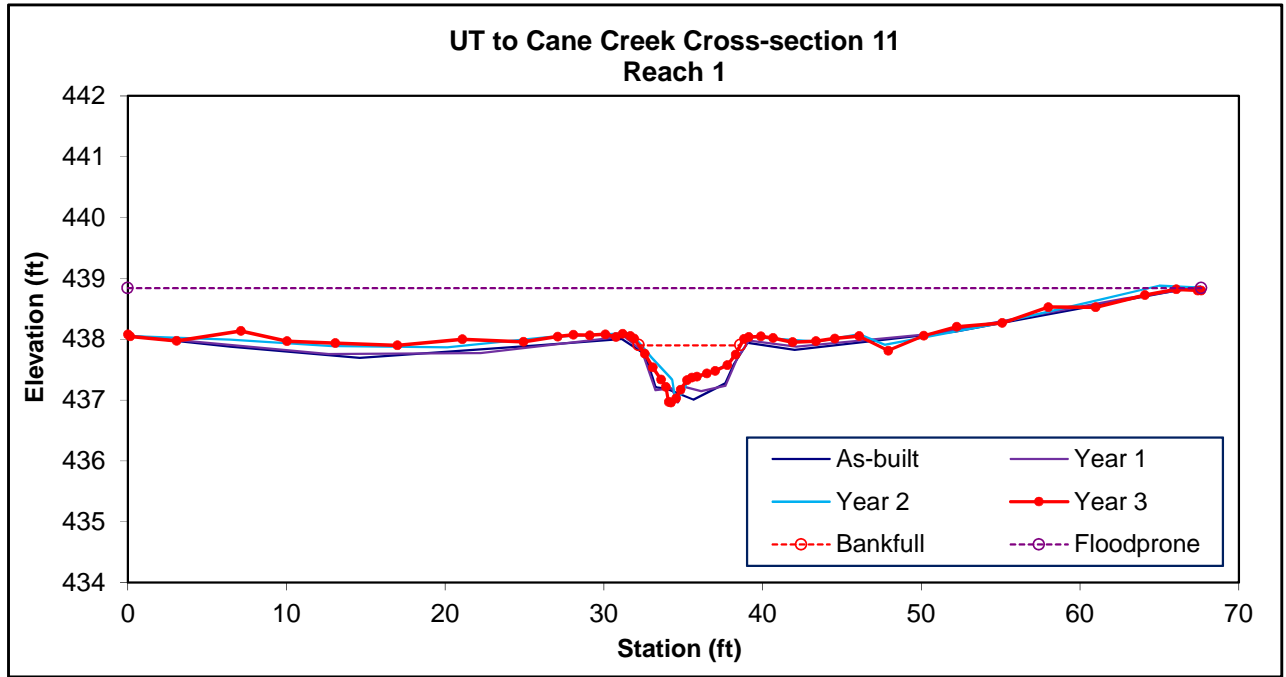


Permanent Cross-section 11, Reach 1

(Year 3 Data - Collected October 2016)



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	2.9	6.41	0.46	0.94	13.92	1.1	10.6	437.9	438.03



Permanent Cross-section 12, Reach 1
 (Year 3 Data - Collected October 2016)



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	3.8	6.34	0.59	0.93	10.68	1.1	13.9	434.7	434.77

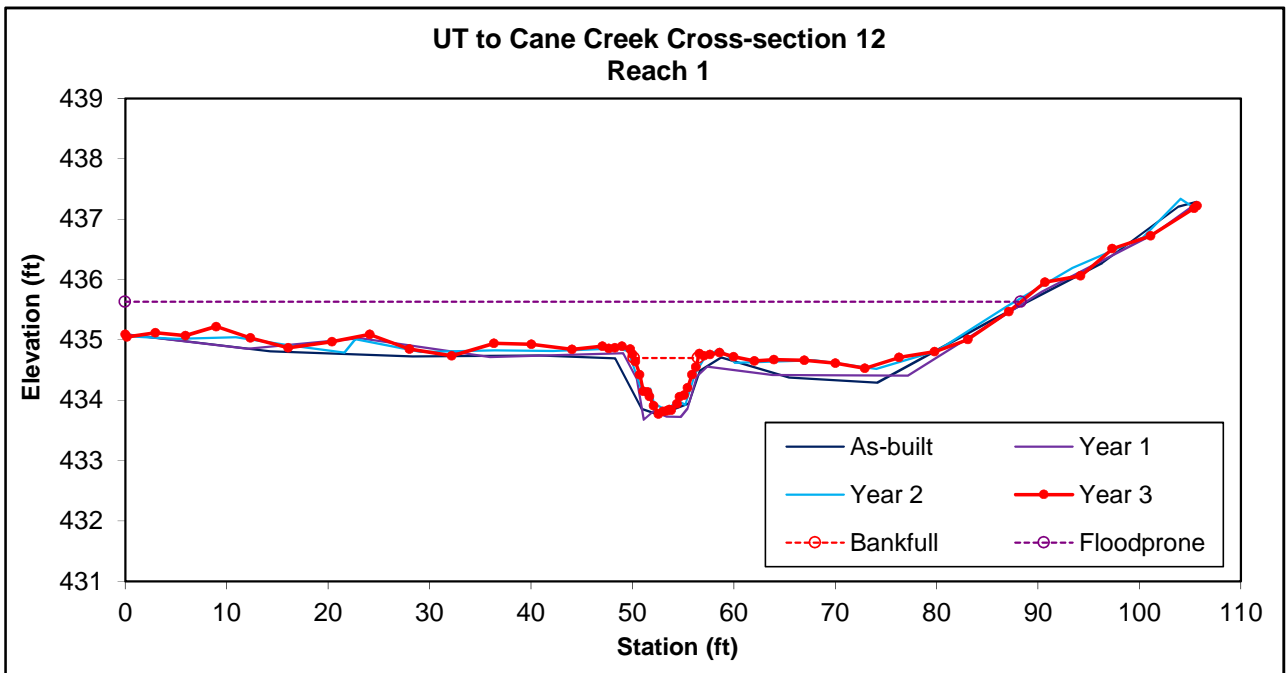


Table 10. Baseline Stream Summary																																				
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																				
Reach 1 (1,045 LF)																																				
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition ¹						Reference Reach(es) Data												Design					As-built								
											UT to Wells Creek						UT to Varnals Creek																			
											Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n											Min	Mean	Med	Max
Dimension and Substrate - Riffle			LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n							
	BF Width (ft)	----	23.0	80.0	4.9	5.6	----	----	7.3	----	----	----	8	----	----	----	----	----	9.7	----	----	----	----	----	6.9	----	----	----	----	7.2	----	----	9.1	----	----	
	Floodprone Width (ft)	----	----	----	----	6.8	----	----	>30	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	>20	----	----	----	----	65.6	----	----	84.4	----	----	
	BF Mean Depth (ft)	----	2.3	5.8	0.8	0.7	----	----	0.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.5	----	----	----	----	0.5	----	----	1.0	----	----	
	BF Max Depth (ft)	----	----	----	----	1.1	----	----	1.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.7	----	----	----	----	0.7	----	----	1.9	----	----	
	BF Cross-sectional Area (ft ²)	----	80.0	300.0	5.2	5.1	----	----	5.2	----	----	----	5.3	----	----	----	----	----	7.9	----	----	----	----	----	3.7	----	----	----	----	4.0	----	----	8.7	----	----	
	Width/Depth Ratio	----	----	----	----	6.1	----	----	10.5	----	----	7	----	----	26	----	----	8	----	----	18	----	----	----	13.0	----	----	----	----	9.6	----	----	15.2	----	----	
	Entrenchment Ratio	----	----	----	----	1.2	----	----	9.5	----	----	2.0	----	----	3.4	----	----	1.9	----	----	3.9	----	----	----	>2.2	----	----	----	----	6.9	----	----	10.8	----	----	
	Bank Height Ratio	----	----	----	----	1.6	----	Bank Height	4.3	----	----	1.4	----	----	2.5	----	----	1.1	----	----	1.5	----	----	----	1.0	----	----	----	----	1.0	----	----	1.3	----	----	
	d50 (mm)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Pattern																																				
	Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25.0	----	----	45.0	----	----	----	----	----	----	----	----	
	Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	4.0	----	----	0.8	----	----	2.3	----	----	14.0	----	----	21.0	----	----	----	----	----	----	----	----	
	Re:Bankfull width (ft/ft)	----	----	----	----	----	----	----	----	----	0.3	----	----	----	4.0	----	----	0.8	----	----	2.3	----	----	2.0	----	----	3.0	----	----	----	----	----	----	----	----	
	Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	4.4	----	----	----	8.8	----	----	4.9	----	----	6.9	----	----	50.0	----	----	80.0	----	----	----	----	----	----	----	----	
	Meander Width Ratio	----	----	----	----	----	----	----	----	----	1.3	----	----	----	4.4	----	----	1.2	----	----	1.8	----	----	3.6	----	----	6.5	----	----	----	----	----	----	----	----	
Profile																																				
	Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	7.9	----	----	2.9	----	----	5.0	----	----	28.0	----	----	42.0	----	----	----	----	----	----	----	----	
	Pool Max Depth (ft)	----	----	----	----	----	----	----	----	----	2.1	----	----	----	2.7	----	----	1.6	----	----	2.3	----	----	----	1.5	----	----	----	----	----	----	----	----	----	----	
	Pool Volume (ft ³)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Substrate and Transport Parameters																																				
	R1% / Ru% / P% / G% / S%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	SC% / Sa% / G% / B% / Be%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	d16 / d35 / d50 / d84 / d95	----	----	----	----	----	----	----	----	----	----	0.1 / 0.6 / 4.5 / 53 / 96	----	----	----	----	----	0.2 / 2.5 / 8 / 92 / 1,536	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
	Reach Shear Stress (competency) lb/ft	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Max part size (mm) mobilized at bankfull (Rosgen Curve)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Additional Reach Parameters																																				
	Drainage Area (SM)	----	----	----	----	----	----	----	0.125	----	----	----	----	----	0.13	----	----	----	----	----	0.24	----	----	----	----	----	0.125	----	----	----	----	----	0.125	----	----	
	Impervious cover estimate (%)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Rosgen Classification	----	----	----	----	G5c	----	----	E5	----	----	----	----	----	C4/1	----	----	----	----	----	B4/1a	----	----	----	E4/C4	----	----	----	----	----	E4/C4	----	----	----	----	
	BF Velocity (fps)	----	----	----	----	0.8	----	----	1.2	----	----	----	----	----	5.3	----	----	----	----	----	3.5	----	----	----	3.5	----	----	----	----	----	3.5	----	----	----	----	
	BF Discharge (cfs)	----	290.0	2000.0	19.8	----	----	----	19.8	----	----	----	----	----	25.2	----	----	----	----	----	46.6	----	----	----	13	----	----	----	----	----	13	----	----	----	----	
	Valley Length	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	859.4	----	----	----	----	----	
	Channel length (ft)	----	----	----	----	----	----	----	943	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1044.9	----	----	----	----	----	
	Sinuosity	----	----	----	----	----	----	----	1.09	----	----	----	----	----	1.40	----	----	----	----	----	1.20	----	----	----	1.20	----	----	----	----	----	1.2	----	----	----	----	
	Water Surface Slope (Channel) (ft/ft)	----	----	----	----	----	----	----	0.0127	----	----	----	----	----	0.0197	----	----	----	----	----	0.0405	----	----	----	0.012	----	----	----	----	----	0.0123	----	----	----	----	
	BF slope (ft/ft)	----	----	----	----	----	----	----	0.0135	----	----	----	----	----	0.028	----	----	----	----	----	0.0458	----	----	----	0.015	----	----	----	----	----	0.0150	----	----	----	----	
	Bankfull Floodplain Area (acres)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	BEHI VL% / L% / M% / H% / VH% / E%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Channel Stability or Habitat Metric	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Biological or Other	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	

^a Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology*. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Table 10. Baseline Stream Summary (continued)																																				
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																				
Reach 3 (398 LF)																																				
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition ¹						Reference Reach(es) Data												Design					As-built								
											UT to Wells Creek						UT to Varnals Creek																			
											Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n											Min	Mean	Med	Max
Dimension and Substrate - Rifle			LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n							
	BF Width (ft)	----	23.0	80.0	5.1	----	----	----	7.6	----	----	----	8	----	----	----	----	----	9.7	----	----	----	----	----	7.2	----	----	----	----	8.9	----	----	9.0	----	----	
	Floodprone Width (ft)	----	----	----	----	----	----	----	>16.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	12	----	----	20.0	----	----	24.4	----	----	36.3	----	----	
	BF Mean Depth (ft)	----	2.3	5.8	0.8	----	----	----	0.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.6	----	----	----	----	0.4	----	----	0.6	----	----	
	BF Max Depth (ft)	----	----	----	----	----	----	----	1.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.7	----	----	----	----	0.8	----	----	1.1	----	----	
	BF Cross-sectional Area (ft ²)	----	80.0	300.0	5.7	----	----	----	5.6	----	----	----	5.3	----	----	----	----	----	7.9	----	----	----	----	----	4.0	----	----	----	----	3.7	----	----	5.3	----	----	
	Width/Depth Ratio	----	----	----	----	----	----	----	9.9	----	----	7	----	----	26	----	----	8	----	----	18	----	----	----	13.0	----	----	----	----	15.3	----	----	21.7	----	----	
	Entrenchment Ratio	----	----	----	----	----	----	----	2.2	----	----	2.0	----	----	3.4	----	----	1.9	----	----	3.9	----	----	1.8	----	----	2.2	----	----	2.7	----	----	4.0	----	----	
	Bank Height Ratio	----	----	----	----	----	----	----	1.5	----	----	1.4	----	----	2.5	----	----	1.1	----	----	1.5	----	----	----	1.0	----	----	----	----	1.0	----	----	1.0	----	----	
	d50 (mm)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Pattern																																				
	Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Re:Bankfull width (ft/ft)	----	----	----	----	----	----	----	----	----	----	0.3	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	4.4	----	----	8.8	----	----	4.9	----	----	6.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	1.3	----	----	4.4	----	----	1.2	----	----	1.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Profile																																				
	Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	7.9	----	----	2.9	----	----	5.0	----	----	11	----	----	36	----	----	----	----	----	----	----	----	
	Pool Max Depth (ft)	----	----	----	----	----	----	----	----	----	----	2.1	----	----	7.9	----	----	2.9	----	----	5.0	----	----	11	----	----	36	----	----	----	----	----	----	----	----	
	Pool Volume (ft ³)	----	----	----	----	----	----	----	----	----	----	2.3	----	----	2.7	----	----	1.6	----	----	2.3	----	----	1.5	----	----	1.5	----	----	----	----	----	----	----	----	
Substrate and Transport Parameters																																				
	R1% / Ru% / P% / G% / S%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	SC% / Sa% / G% / B% / Be%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	d16 / d35 / d50 / d84 / d95	----	----	----	----	----	----	----	----	----	----	0.1 / 0.6 / 4.5 / 53 / 96	0.2 / 2.5 / 8 / 92 / 1,536	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
	Reach Shear Stress (competency) lb/ft	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Max part size (mm) mobilized at bankfull (Rosgen Curve)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Additional Reach Parameters																																				
	Drainage Area (SM)	----	----	----	----	----	----	----	0.1	----	----	----	----	----	0.13	----	----	----	----	----	0.24	----	----	----	0.1	----	----	----	----	----	0.1	----	----	----	----	
	Impervious cover estimate (%)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Rosgen Classification	----	----	----	----	----	----	----	B4c	----	----	----	----	----	C4/1	----	----	----	----	----	B4/1a	----	----	----	----	----	----	----	----	----	C4	----	----	----	----	
	BF Velocity (fps)	----	----	----	----	----	----	----	----	----	----	----	----	----	5.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	BF Discharge (cfs)	290.0	2000.0	21.7	----	----	----	----	21.7	----	----	----	----	----	25.2	----	----	----	----	----	46.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Valley Length	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	356.8	----	----	----	----	----	
	Channel length (ft)	----	----	----	----	----	----	----	425	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	389.1	----	----	----	----	----	
	Sinuosity	----	----	----	----	----	----	----	1.16	----	----	----	----	----	1.40	----	----	----	----	----	1.20	----	----	----	1.18	----	----	----	----	----	1.1	----	----	----	----	
	Water Surface Slope (Channel) (ft/ft)	----	----	----	----	----	----	----	0.0195	----	----	----	----	----	0.0197	----	----	----	----	----	0.0405	----	----	----	0.016	----	----	----	----	----	0.0172	----	----	----	----	
	BF slope (ft/ft)	----	----	----	----	----	----	----	0.0168	----	----	----	----	----	0.028	----	----	----	----	----	0.0458	----	----	----	0.018	----	----	----	----	----	0.0187	----	----	----	----	
	Bankfull Floodplain Area (acres)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	BEHI VL% / L% / M% / H% / VH% / E%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Channel Stability or Habitat Metric	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
	Biological or Other	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	

^a Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology*. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Table 10. Baseline Stream Summary (continued)																																		
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																		
Reach 4 (2,333 LF)																																		
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition ¹						Reference Reach(es) Data												Design					As-built						
											UT to Wells Creek						UT to Varnals Creek																	
											Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n											Min	Mean
Dimension and Substrate - Riffle																																		
BF Width (ft)	----	23.0	80.0	10.2	15.4	----	----	16.7	----	----	----	8	----	----	----	----	----	9.7	----	----	----	----	----	14.0	----	----	----	----	10.1	----	----	13.8	----	----
Floodprone Width (ft)	----	----	----	----	18.4	----	----	26.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	>30	----	----	----	----	80.1	----	----	105.0	----	----
BF Mean Depth (ft)	----	2.3	5.8	1.3	0.9	----	----	1.0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.0	----	----	----	----	0.6	----	----	1.2	----	----
BF Max Depth (ft)	----	----	----	----	1.3	----	----	1.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.2	----	----	----	----	1.1	----	----	2.0	----	----
BF Cross-sectional Area (ft ²)	----	80.0	300.0	16.9	14.8	----	----	15.5	----	----	----	5.3	----	----	----	----	----	7.9	----	----	----	----	----	14.0	----	----	----	----	7.5	----	----	12.3	----	----
Width/Depth Ratio	----	----	----	----	15.4	----	----	19.0	----	----	7	----	----	26	----	----	8	----	----	18	----	----	----	14.0	----	----	----	----	8.3	----	----	19.4	----	----
Entrenchment Ratio	----	----	----	----	1.2	----	----	1.6	----	----	2.0	----	----	3.4	----	----	1.9	----	----	3.9	----	----	----	>2.2	----	----	----	----	7.9	----	----	9.4	----	----
Bank Height Ratio	----	----	----	----	1.3	----	----	2.8	----	----	1.4	----	----	2.5	----	----	1.1	----	----	1.5	----	----	----	1.0	----	----	----	----	1.0	----	----	1.1	----	----
d50 (mm)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pattern																																		
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	38.0	79.0	----	120.0	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	21.0	26.0	----	31.0	----	----
Rc:Bankfull width (ft/ft)	----	----	----	----	----	----	----	----	----	----	0.3	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	38.0	79.0	----	120.0	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	4.4	----	----	8.8	----	----	4.9	----	----	6.9	----	----	----	----	----	----	----	----	72.0	104.0	----	124.0	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	1.3	----	----	4.4	----	----	1.2	----	----	1.8	----	----	----	----	----	----	----	----	3.5	6.0	----	8.0	----	----
Profile																																		
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.0046	0.0043	----	0.0039	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	2.1	----	----	7.9	----	----	2.9	----	----	5.0	----	----	42	----	----	84	----	----	41	----	72	57	----	----
Pool Max Depth (ft)	----	----	----	----	----	----	----	----	----	----	2.3	----	----	2.7	----	----	1.6	----	----	2.3	----	----	----	2.2	----	----	----	----	----	----	----	----	----	----
Pool Volume (ft ³)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Substrate and Transport Parameters																																		
R1% / Ru% / P% / G% / S%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SC% / Sa% / G% / B% / Be%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
d16 / d35 / d50 / d84 / d95	----	----	----	----	24.2 / 50.6 / 69.4 / 50.6 / 24.2						0.1 / 0.6 / 4.5 / 53 / 96						0.2 / 2.5 / 8 / 92 / 1,536																	
Reach Shear Stress (competency) lb/ft	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Additional Reach Parameters																																		
Drainage Area (SM)	----	----	----	----	----	----	----	0.7	----	----	----	----	----	0.13	----	----	----	----	----	0.24	----	----	----	----	----	0.7	----	----	----	----	----	0.7	----	----
Impervious cover estimate (%)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rosgen Classification	----	----	----	----	B3c	----	----	F5	----	----	----	----	----	C4/1	----	----	----	----	----	B4/1a	----	----	----	C4	----	----	----	----	----	C4	----	----	----	----
BF Velocity (fps)	----	----	----	----	4.4	----	----	4.6	----	----	----	----	----	5.3	----	----	----	----	----	4.0	----	----	----	4.0	----	----	----	----	----	3.0	----	----	----	----
BF Discharge (cfs)	----	290.0	2000.0	69.2	----	----	----	69.2	----	----	----	----	----	25.2	----	----	----	----	----	46.6	----	----	----	56.0	----	----	----	----	----	56.0	----	----	----	----
Valley Length	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	349	----	----	----	----
Channel length (ft)	----	----	----	----	----	----	----	2,783	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	386	----	----	----	----
Sinuosity	----	----	----	----	----	----	----	1.04	----	----	----	----	----	1.40	----	----	----	----	----	1.20	----	----	----	----	----	----	----	----	----	1.10	----	----	----	----
Water Surface Slope (Channel) (ft/ft)	----	----	----	----	----	----	----	0.0169	----	----	----	----	----	0.0197	----	----	----	----	----	0.0405	----	----	----	0.015	----	----	----	----	----	0.0074	----	----	----	----
BF slope (ft/ft)	----	----	----	----	----	----	----	0.0148	----	----	----	----	----	0.028	----	----	----	----	----	0.0458	----	----	----	0.017	----	----	----	----	----	0.0082	----	----	----	----
Bankfull Floodplain Area (acres)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
BEHI VL% / L% / M% / H% / VH% / E%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Channel Stability or Habitat Metric	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Biological or Other	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

^a Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology*. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Table 10. Baseline Stream Summary (continued)																																		
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																		
Reach 5 (1,461 LF)																																		
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition					Reference Reach(es) Data										Design					As-built									
										UT to Wells Creek					UT to Varnals Creek																			
										Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max											SD	n	Min	Mean	Med
Dimension and Substrate - Riffle																																		
BF Width (ft)	----	23.0	80.0	Eq.	----	----	----	8.9	----	----	----	8	----	----	----	----	----	9.7	----	----	----	----	----	10.8	----	----	----	----	10.2	----	----	12.0	----	----
Floodprone Width (ft)	----	----	----	----	----	----	----	11.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	>25	----	----	----	----	76.0	----	----	103.7	----	----
BF Mean Depth (ft)	----	2.3	5.8	1.2	----	----	----	1.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.8	----	----	----	----	0.7	----	----	1.4	----	----
BF Max Depth (ft)	----	----	----	----	----	----	----	1.5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.1	----	----	----	----	1.2	----	----	2.8	----	----
BF Cross-sectional Area (ft ²)	----	80.0	300.0	12.5	----	----	----	10.9	----	----	----	5.3	----	----	----	----	----	7.9	----	----	----	----	----	9.0	----	----	----	----	7.1	----	----	15.8	----	----
Width/Depth Ratio	----	----	----	----	----	----	----	7.2	----	----	7	----	----	26	----	----	8	----	----	18	----	----	----	13.0	----	----	----	----	8.0	----	----	17.8	----	----
Entrenchment Ratio	----	----	----	----	----	----	----	1.3	----	----	2.0	----	----	3.4	----	----	1.9	----	----	3.9	----	----	----	>2.2	----	----	----	----	3.2	----	----	9.2	----	----
Bank Height Ratio	----	----	----	----	----	----	----	2.6	----	----	1.4	----	----	2.5	----	----	1.1	----	----	1.5	----	----	----	1.0	----	----	----	----	1.0	----	----	1.0	----	----
d50 (mm)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pattern																																		
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Re:Bankfull width (ft/ft)	----	----	----	----	----	----	----	----	----	----	0.3	----	----	4.0	----	----	0.8	----	----	2.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	4.4	----	----	8.8	----	----	4.9	----	----	6.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	1.3	----	----	4.4	----	----	1.2	----	----	1.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Profile																																		
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	2.1	----	----	7.9	----	----	2.9	----	----	5.0	----	----	32.0	----	65.0	----	----	----	----	----	----	----	----	----
Pool Max Depth (ft)	----	----	----	----	----	----	----	----	----	----	2.3	----	----	2.7	----	----	1.6	----	----	2.3	----	----	----	2.0	----	----	----	----	----	----	----	----	----	----
Pool Volume (ft ³)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Substrate and Transport Parameters																																		
Ri% / Ru% / P% / G% / S%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SC% / Sa% / G% / B% / Be%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
d16 / d35 / d50 / d84 / d95	----	----	----	----	16.6/31.2/47.0/85.3/116.1	----	----	----	----	----	0.1 / 0.6 / 4.5 / 53 / 96	----	----	----	----	----	0.2 / 2.5 / 8 / 92 / 1,536	----	----	----	----	----	6.74 / 20.49 / 29.79 / 63.73 / 118.25	----	----	----	----	----	----	----	----	----	----	----
Reach Shear Stress (competency) lb/ft	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Additional Reach Parameters																																		
Drainage Area (SM)	----	----	----	----	----	----	0.5	----	----	----	----	----	0.13	----	----	----	----	----	0.24	----	----	----	----	----	0.5	----	----	----	----	----	0.5	----	----	----
Impervious cover estimate (%)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rosgen Classification	----	----	----	----	----	----	G4	----	----	----	----	----	C4/1	----	----	----	----	----	B4/1a	----	----	----	----	C4	----	----	----	----	----	C4	----	----	----	----
BF Velocity (fps)	----	----	----	----	----	----	4.5	----	----	----	----	----	5.3	----	----	----	----	----	46.6	----	----	----	----	4.4	----	----	----	----	----	4.4	----	----	----	----
BF Discharge (cfs)	290.0	2000.0	50.0	----	----	----	50	----	----	----	----	----	25.2	----	----	----	----	----	46.6	----	----	----	----	40	----	----	----	----	----	40	----	----	----	----
Valley Length	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Channel length (ft)	----	----	----	----	1848	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sinuosity	----	----	----	----	----	----	1.07	----	----	----	----	----	1.40	----	----	----	----	----	1.20	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Water Surface Slope (Channel) (ft/ft)	----	----	----	----	----	----	0.0144	----	----	----	----	----	0.0197	----	----	----	----	----	0.0405	----	----	----	0.014	----	----	----	----	----	0.014	----	----	----	----	----
BF slope (ft/ft)	----	----	----	----	----	----	0.0128	----	----	----	----	----	0.028	----	----	----	----	----	0.0458	----	----	----	0.017	----	----	----	----	----	0.017	----	----	----	----	----
Bankfull Floodplain Area (acres)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
BEHI VL% / L% / M% / H% / VH% / E%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Channel Stability or Habitat Metric	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Biological or Other	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

^a Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Table 10. Baseline Stream Summary (continued)																																		
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																		
Reach 5a (145 LF)																																		
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition						Reference Reach(es) Data												Design						As-built					
											UT to Wells Creek						UT to Varnals Creek																	
											Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n												
Dimension and Substrate - Riffle																																		
BF Width (ft)	----	23.0	80.0	2.4	----	----	----	13.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Floodprone Width (ft)	----	----	----	----	----	----	----	16.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
BF Mean Depth (ft)	----	2.3	5.8	0.5	----	----	----	0.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
BF Max Depth (ft)	----	----	----	----	----	----	----	0.5	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
BF Cross-sectional Area (ft ²)	----	80.0	300.0	1.7	----	----	----	4.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Width/Depth Ratio	----	----	----	----	----	----	----	45.0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Entrenchment Ratio	----	----	----	----	----	----	----	1.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Bank Height Ratio	----	----	----	----	----	----	----	2.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
d50 (mm)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Pattern																																		
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Rc:Bankfull width (ft/ft)	----	----	----	----	----	----	----	0.3	----	----	----	4.0	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Meander Wavelength (ft)	----	----	----	----	----	----	----	4.4	----	----	----	8.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Meander Width Ratio	----	----	----	----	----	----	----	1.3	----	----	----	4.4	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Profile																																		
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Riffle Slope (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Pool Spacing (ft)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
Pool Max Depth (ft)	----	----	----	----	----	----	----	2.1	----	----	----	7.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Pool Volume (ft ³)	----	----	----	----	----	----	----	2.3	----	----	----	2.7	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Substrate and Transport Parameters																																		
R1% / Ru% / P% / G% / S%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
SC% / Sa% / G% / B% / Be%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----					
d16 / d35 / d50 / d84 / d95	----	----	----	----	----	----	----	----	----	----	----	0.1 / 0.6 / 4.5 / 53 / 96	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Reach Shear Stress (competency) lb/ft ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Max part size (mm) mobilized at bankfull (Rosgen Curve)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Stream Power (transport capacity) W/m ²	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Additional Reach Parameters																																		
Drainage Area (SM)	----	----	----	----	----	----	----	0.025	----	----	----	0.13	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Impervious cover estimate (%)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Rosgen Classification	----	----	----	----	----	----	----	----	----	----	----	C4/1	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
BF Velocity (fps)	----	----	----	----	----	----	----	1.7	----	----	----	5.3	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
BF Discharge (cfs)	290.0	2000.0	6.2	----	----	----	----	7.1	----	----	----	25.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Valley Length	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Channel length (ft)	----	----	----	----	----	----	----	144	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Sinuosity	----	----	----	----	----	----	----	1.19	----	----	----	1.40	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Water Surface Slope (Channel) (ft/ft)	----	----	----	----	----	----	----	0.0236	----	----	----	0.0197	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
BF slope (ft/ft)	----	----	----	----	----	----	----	0.0224	----	----	----	0.028	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Bankfull Floodplain Area (acres)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
BEHI VL% / L% / M% / H% / VH% / E%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Channel Stability or Habitat Metric	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						
Biological or Other	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----						

^a Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

**Table 11. Morphology and Hydraulic Monitoring Summary
UT to Cane Creek Restoration Project: DMS Project ID No. 95729**

Reach 1 (1,045 LF)																												
Dimension and substrate	Cross-section X-10 (Pool)							Cross-section X-11 (Riffle)							Cross-section X-12 (Riffle)							Base	MY1	MY2	MY3	MY4	MY5	MY+
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
Based on fixed baseline bankfull elevation																												
BF Width (ft)	9.11	8.98	8.05	7.80				7.21	6.98	6.24	6.41				7.83	7.08	7.23	6.34										
BF Mean Depth (ft)	0.95	1.05	0.88	0.94				0.57	0.57	0.41	0.46				0.51	0.56	0.55	0.59										
Width/Depth Ratio	9.6	8.6	9.1	8.3				12.8	12.3	15.1	13.9				15.2	12.6	13.2	10.7										
BF Cross-sectional Area (ft²)	8.7	9.4	7.1	7.3				4.1	4.0	2.6	2.9				4.0	4.0	4.0	3.8										
BF Max Depth (ft)	1.9	1.8	1.7	1.9				0.9	0.9	0.9	0.9				0.7	0.8	0.9	0.9										
Width of Floodprone Area (ft)	65.62	61.92	61.19	62.11				65.90	67.22	63.14	67.63				84.37	85.88	87.20	88.30										
Entrenchment Ratio	6.9	6.9	7.6	8.0				9.1	9.6	10.1	10.6				10.8	12.1	12.0	13.9										
Bank Height Ratio	1.1	1.1	1.2	1.1				1.0	1.1	1.2	1.1				1.3	1.1	1.0	1.1										
Wetted Perimeter (ft)	11.0	11.1	9.8	9.7				8.4	8.1	7.1	7.3				8.9	8.2	8.3	7.5										
Hydraulic Radius (ft)	0.8	0.8	0.7	0.8				0.5	0.5	0.4	0.4				0.5	0.5	0.5	0.5										
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)																												
d50 (mm)																												

Reach 3 (398 LF)																											
Dimension and substrate	Cross-section X-5 (Riffle)							Cross-section X-6 (Pool)							Base	MY1	MY2	MY3	MY4	MY5	MY+						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+													
Based on fixed baseline bankfull elevation																											
BF Width (ft)	8.94	9.55	7.08	5.43				8.98	8.70	6.17	7.25																
BF Mean Depth (ft)	0.41	0.35	0.32	0.36				0.59	0.59	0.61	0.78																
Width/Depth Ratio	21.7	27.3	22.4	15.0				15.3	14.7	10.2	9.3																
BF Cross-sectional Area (ft²)	3.7	3.3	2.2	2.0				5.3	5.2	3.7	5.7																
BF Max Depth (ft)	0.8	0.6	0.6	0.6				1.1	1.2	1.0	1.2																
Width of Floodprone Area (ft)	24.39	22.72	22.20	21.79				36.29	36.27	33.48	41.49																
Entrenchment Ratio	2.7	2.4	3.1	4.0				4.0	4.2	5.4	5.7																
Bank Height Ratio	1.0	0.9	1.2	1.0				1.0	1.1	1.1	1.0																
Wetted Perimeter (ft)	9.8	10.3	7.7	6.2				10.2	9.9	7.4	8.8																
Hydraulic Radius (ft)	0.4	0.3	0.3	0.3				0.5	0.5	0.5	0.6																
Based on current/developing bankfull feature																											
BF Width (ft)																											
BF Mean Depth (ft)																											
Width/Depth Ratio																											
BF Cross-sectional Area (ft²)																											
BF Max Depth (ft)																											
Width of Floodprone Area (ft)																											
Entrenchment Ratio																											
Bank Height Ratio																											
Wetted Perimeter (ft)																											
Hydraulic Radius (ft)																											
Cross Sectional Area between end pins (ft²)																											
d50 (mm)																											

Reach 4 (2,333 LF)																													
Dimension and substrate	Cross-section X-7 (Rifle)							Cross-section X-8 (Pool)							Cross-section X-9 (Rifle)														
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	
Based on fixed baseline bankfull elevation																													
BF Width (ft)	18.74	17.33	16.00	16.34				17.08	16.13	13.37	11.82				13.77	13.66	13.01	11.06											
BF Mean Depth (ft)	0.79	0.81	0.62	0.95				1.45	0.96	1.33	1.31				1.02	0.97	0.72	0.61											
Width/Depth Ratio	23.7	21.5	25.7	17.2				11.8	16.8	10.1	9.0				13.5	14.1	18.1	18.1											
BF Cross-sectional Area (ft²)	14.8	14.0	10.0	15.5				24.7	15.5	17.8	15.5				14.1	13.3	9.3	6.8											
BF Max Depth (ft)	1.24	1.23	1.01	1.72				3.41	2.18	2.73	2.30				1.85	1.52	1.22	1.00											
Width of Floodprone Area (ft)	56.09	57.30	30.16	59.70				72.51	45.24	59.00	46.32				33.85	32.12	29.41	28.41											
Entrenchment Ratio	3.0	2.0	1.9	3.7				4.2	2.8	4.4	3.9				2.5	2.4	2.3	2.6											
Bank Height Ratio	1.9	1.0	1.0	1.0				1.1	1.2	1.0	1.1				1.1	1.1	1.1	1.0											
Wetted Perimeter (ft)	20.3	19.0	17.2	18.2				20.0	18.1	16.0	14.4				15.8	15.6	14.5	12.3											
Hydraulic Radius (ft)	0.7	0.7	0.6	0.8				1.2	0.9	1.1	1.1				0.9	0.9	0.6	0.6											
Based on current/developing bankfull feature																													
BF Width (ft)																													
BF Mean Depth (ft)																													
Width/Depth Ratio																													
BF Cross-sectional Area (ft²)																													
BF Max Depth (ft)																													
Width of Floodprone Area (ft)																													
Entrenchment Ratio																													
Bank Height Ratio																													
Wetted Perimeter (ft)																													
Hydraulic Radius (ft)																													
Cross Sectional Area between end pins (ft²)								-																					
d50 (mm)								-																					

Reach 5 (1,461 LF)																													
Dimension and substrate	Cross-section X-1 (Rifle)							Cross-section X-2 (Pool)							Cross-section X-3 (Rifle)							Cross-section X-4 (Rifle)							
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	
Based on fixed baseline bankfull elevation																													
BF Width (ft)	10.41	10.06	9.02	8.75				11.24	11.28	10.75	10.79				12.00	11.16	10.04	10.43											
BF Mean Depth (ft)	0.68	0.71	0.65	0.62				1.41	1.37	1.35	1.45				0.68	0.65	0.61	0.61											
Width/Depth Ratio	15.2	14.2	14.0	14.1				8.0	8.3	8.0	7.4				17.8	17.3	16.6	17.0											
BF Cross-sectional Area (ft²)	7.1	7.2	5.8	5.4				15.8	15.4	14.5	15.7				8.1	7.2	6.1	6.4											
BF Max Depth (ft)	1.19	1.33	1.04	1.07				2.79	2.66	2.39	2.50				1.16	1.16	1.08	1.08											
Width of Floodprone Area (ft)	85.05	85.00	85.07	85.13				103.66	103.67	103.65	103.61				76.03	76.48	76.04	76.19											
Entrenchment Ratio	8.2	8.5	9.4	9.7				9.2	9.2	9.6	9.6				6.3	6.9	7.6	7.3											
Bank Height Ratio	1.0	1.0	1.0	1.1				1.0	1.0	1.1	1.1				1.0	1.0	1.0	1.1											
Wetted Perimeter (ft)	11.8	11.5	10.3	10.0				14.1	14.0	13.5	13.7				13.4	12.5	11.3	11.7											
Hydraulic Radius (ft)	0.6	0.6	0.6	0.5				1.1	1.1	1.1	1.1				0.6	0.6	0.5	0.5											
Based on current/developing bankfull feature																													
BF Width (ft)																													
BF Mean Depth (ft)																													
Width/Depth Ratio																													
BF Cross-sectional Area (ft²)																													
BF Max Depth (ft)																													
Width of Floodprone Area (ft)																													
Entrenchment Ratio																													
Bank Height Ratio																													
Wetted Perimeter (ft)																													
Hydraulic Radius (ft)																													
Cross Sectional Area between end pins (ft²)																													
d50 (mm)																													

Appendix E

Hydrologic Data

Table 12. Verification of Bankfull Events				
UT to Cane Creek Restoration Project: DMS Project ID No. 95729				
Date of Data Collection	Crest Gauge 1 (Reach 5)	Crest Gauge 2 (Reach 3)	Estimated Occurrence of Bankfull Event	Method of Data Collection
Year 1 Monitoring				
10/1/2014	NA	0.18	7/16/2014	Crest Gauge
Year 2 Monitoring				
3/25/2015	0.33	NA	3/6/2015	Crest Gauge
10/13/2015	0.62	0.79	10/3/2015	Crest Gauge
Year 3 Monitoring				
7/27/2016	1.21	NA	2/17/2016	Crest Gauge
9/30/2016	1.31	1.12	9/19/2016	Crest Gauge
11/9/2016	0.75	0.66	10/9/2016	Crest Gauge