

UT to Cane Creek Restoration Project Year 6 Final Monitoring Report

Alamance County, North Carolina

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

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

Report Prepared and Submitted by Michael Baker Engineering, Inc.

NC Professional Engineering License # F-1084



Mitigation Project Name UT to Cane Creek Restoration Project
 DMS ID 95729
 River Basin Cape Fear
 Cataloging Unit 03030002

County Alamance
 Date Project Instituted 10/29/2012
 Date Prepared 7/12/2019

USACE Action ID 2012-01907
 NCDWR Permit No 2013-1177

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Year (Wetland)
Potential Credits (Mitigation Plan)		4,603.000												
Potential Credits (As-Built Survey)		4,593.867												
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A		N/A	N/A
2 (Year 0 / As-Built)	30%	1,378.160			2014	12/1/2014	N/A				N/A		N/A	N/A
3 (Year 1 Monitoring)	10%	459.387			2015	4/23/2015	N/A				N/A		N/A	N/A
4 (Year 2 Monitoring)	10%	459.387			2016	4/25/2016	N/A				N/A		N/A	N/A
5 (Year 3 Monitoring)	10%	459.387			2017	4/3/2017	N/A				N/A		N/A	N/A
6 (Year 4 Monitoring)	5%	229.693			2018	4/25/2018	N/A				N/A		N/A	N/A
7 (Year 5 Monitoring)	10%	459.387			2019	4/26/2019	N/A				N/A		N/A	N/A
8 (Year 6 Monitoring)	5%				2020		N/A				N/A		N/A	N/A
9 (Year 7 Monitoring)	10%				2021		N/A				N/A		N/A	N/A
Stream Bankfull Standard	10%	459.387			2017	4/3/2017	N/A				N/A		N/A	N/A
Total Credits Released to Date		3,904.787												

NOTES:

CONTINGENCIES:


 Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

1 - For DMS, no credits are released during the first milestone
 2 - For DMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCEP Portal, provided the following criteria have been met:

- 1) Approval of the final Mitigation Plan
- 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
- 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
- 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required

January 28, 2020

Jeremiah Dow
NCDEQ, Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

Subject: Response letter to DMS review comments regarding the Draft Year 6 Monitoring Report for the UT to Cane Creek Restoration Project (#95729)
Cape Fear Basin – CU#03030002, Alamance County, North Carolina
Service Contract No. 004951, DMS No. 95729, RFP No. 16-004357, Baker No. 132700

Mr. Dow,

Please find enclosed one hardcopy of the Final Year 6 Monitoring Report and our responses to your review comments received on December 17, 2019 regarding the UT to Cane Creek Restoration Project located in Alamance County, NC. The sole comment and its corresponding response is outlined below:

1. Digital files/drawings:
 - a. R3, R4 Downstream, and R1 features in the geodatabase match the asset table, but remaining features do not. Please provide DMS with the remaining features that accurately characterize the creditable assets.
Response: Baker has revised the as-built stream shapefile in GIS and included it with the final e-submission documents. All of the creditable stream lengths now match those presented in the asset table (Table 1).

As requested, Baker has provided one (1) hardcopy and a pdf version of the Final report, along with all the revised digital data/drawings and e-submission files, which will be sent via secure ftp link. Please do not hesitate to contact me at 919-481-5731 or by email at scott.king@mbakerintl.com should you have any questions regarding our response submittal.

Sincerely,



Scott King, LSS, PWS
Project Manager

Enclosures

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY	1
2.0 METHODOLOGY	3
2.1 <i>Stream Assessment</i>	3
2.1.1 Morphological Parameters and Channel Stability.....	3
2.1.2 Hydrology.....	3
2.1.3 Photographic Documentation	4
2.1.4 Visual Stream Morphological Stability Assessment.....	4
2.2 <i>Vegetation Assessment</i>	4
3.0 REFERENCES	4

APPENDICES

Appendix A Project Vicinity Map and Background Tables

Figure	1	Vicinity Map and Directions
Figure	2	Mitigation Work Plan
Figure	3	Reference Locations
Table	1	Project Components and Mitigation Credits
Table	2	Project Activity and Reporting History
Table	3	Project Contacts Table
Table	4	Project Attribute Table

Appendix B Visual Assessment Data

Figure	4	Current Condition Plan View (CCPV)
Table	5a	Visual Stream Morphology Stability Assessment Table
Table	5b	Stream Problem Areas (SPAs)
Table	6a	Vegetation Condition Assessment
Table	6b	Vegetation Problem Areas (VPAs)
Stream Station Photo-Points		
Crest Gauge Photographs		
Project Maintenance, Repair, and Problem Area Photographs		

Appendix C Vegetation Plot Data*

Table	7*	<i>Vegetation Plot Criteria Attainment</i>
Table	8*	<i>CVS Vegetation Plot Metadata</i>
Table	9a*	<i>CVS Stem Count of Planted Stems by Plot and Species</i>
Table	9b*	<i>Stem Count For Each Species Arranged by Plot</i>
Table	9c*	<i>CVS Density Per Plot</i>
Table	9d*	<i>CVS Vegetation Summary and Totals</i>

Appendix D Stream Survey Data

*Figure 5** *Cross-Sections with Annual Overlays*
Table 10 Baseline Stream Data Summary Tables
*Table 11** *Cross-Section Morphology Data*

Appendix E Hydrologic Data

Table 12 Verification of Bankfull Events

* Note: The figures and tables marked above with an asterisk are not included as part of this Year 6 Monitoring Report, but were left listed in the Table of Contents to explain the otherwise out-of-sequence figure/table numbering and appendix designations. For clarity, Michael Baker wishes to preserve the continuity of the labeling for these features between monitoring years to avoid confusion (e.g. to allow Appendix C to always contain vegetation data, and Table 12 to always be the bankfull event table, etc. in each monitoring report). These figures and tables had been included in past reports and will be included again as part of the Year 7 monitoring report for 2020.

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 of native riparian species vegetation within the 19.9 acre 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) - Division of Mitigation Services' (DMS) Targeted Local Watershed (TLW) 03030002-050050 of the Cape Fear River Basin. The Project involved the restoration and enhancement of rural Piedmont streams, 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.

In accordance with the Mitigation Plan and the project-applicable DMS guidance document “Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation” dated 11/7/2011, no formal vegetation plot monitoring was performed, nor were any stream cross-sectional surveys conducted as part of this Year 6 monitoring effort. A visual assessment of the site is emphasized this year, with the full vegetation and cross-section survey work to resume for the Year 7 monitoring in 2020.

From the Year 6 visual inspection monitoring, all stream reaches appear stable and functioning. All stream riffle beds are vertically stable, the pools are maintaining depth, stream banks are stable and vegetating, and in-stream structures are physically intact and performing as designed as reported in Table 5a (Appendix B). No Stream Problem Areas (SPAs) were identified in Year 6.

As discussed in the Year 5 monitoring report, Baker had previously noted a Stream Problem Area (SPA) consisting of a section of bank scour along lower Reach R4 resulting from Hurricane Florence. This section of bank was initially planted with a dense livestake and several one-gallon plants in Feb 2019. However, continued rainfall throughout the late winter and early spring hampered plant establishment, so in June of 2019 the area was graded back in sections and matting was placed along the slope (allowing as many of the previously planted stems to come through the matting as possible). Additional inspections of this area in August and September of 2019 show that the area now appears to be stable and the planted vegetation is establishing. This area will be closely observed in the future to confirm continued stability. This bank repair work is shown on Figure 4 and in the project photographs found in Appendix B.

The Year 6 visual inspection monitoring also observed that the planted acreage performance categories were functioning at 100 percent with no eroding or bare areas to report, nor any areas of low stem density, low vigor, or poor growth observed as further detailed in Table 6a (Appendix B). However, a Vegetative Problem Area (VPA) was noted consisting of two sections of scattered Chinese privet (*Ligustrum sinense*) found along both banks within the wooded lower section of Reach R4 as detailed in Table 6b and shown in Figure 4 (Appendix B). These areas will be treated in the spring of 2020, when treatment methods are the most effective.

Additionally, there were a few areas of scattered privet previously identified as Vegetation Problem Areas (VPAs) in Year 5 that were treated in early April of 2019 through spraying and/or cutting depending on plant size. A total of approximately 0.88 acres of scattered privet were treated along sections of the lower Reach R4 as shown in Figure 4 and in the project photographs (both found in Appendix B). Some of these treated areas overlap with the current VPA privet locations and are simply re-sprouts. These areas will continue to be observed closely in the future for any sign of new re-sprouting.

During Year 6 monitoring, both the Reach R5 crest gauge (crest gauge #1) and the Reach R3 crest gauge (crest gauge #2) documented one post-construction bankfull event from a storm on April 14, 2019 as reported in Table 12 (Appendix E). The project met the bankfull event success criteria in MY3 (2016).

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 6 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 guidance document “Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation” dated 11/7/11 (DMS 2011), and to the Monitoring Report Template, Version 1.5 (DMS 2012), 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 Current Condition Plan View (CCPV) map (Figure 4) found in Appendix B.

In accordance with both the Mitigation Plan and the project-applicable DMS guidance document “Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation” dated 11/7/11, no formal vegetation plot monitoring was performed, nor were any stream cross-sectional surveys conducted as part of this Year 6 monitoring effort. A visual assessment of the site is emphasized this year, with the full vegetation and cross-section survey work to resume for the Year 7 monitoring in 2020.

The Year 6 site visual site assessment data contained in Appendix B was collected in September and October 2019, unless otherwise noted.

2.1 Stream Assessment

The Project involved the restoration and enhancement of a rural Piedmont stream system 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.

2.1.1 Morphological Parameters and Channel Stability

A longitudinal profile was surveyed for the entire length of channel immediately after construction to document as-built baseline monitoring conditions (Year 0) 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.

As per the Mitigation Plan and DMS monitoring guidance for this project, no cross-section survey data were collected for this Monitoring Year 6 assessment. Consequently, none of the cross-sectional survey graphs (Figure 5) or morphology data (Table 11) are presented in Appendix D as in previous monitoring reports.

2.1.2 Hydrology

To monitor on-site bankfull events, two manual cork 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 6 monitoring, one above-bankfull stage event was documented by both Crest gauge #1 and Crest gauge #2 from a large storm on April 14, 2019. The crest gauge readings are presented in Appendix E, with photographic documentation presented in Appendix B.

2.1.3 Photographic Documentation

Representative project photographs were taken of grade control structures and buffer areas along the restored streams. Select stream photographs from Year 6 monitoring are provided 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 6 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. All stream reaches appear stable and functioning. All stream riffle beds are vertically stable, the pools are maintaining depth, stream banks are stable and vegetating, and in-stream structures are physically intact and performing as designed. No Stream Problem Areas (SPAs) were documented during Year 6 monitoring. A more detailed summary of the results for the visual stream stability assessment can be found in Tables 5a and 5b in Appendix B.

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 (Lee 2007) using the CVS-DMS Data Entry Tool v. 2.3.1 (CVS 2012). 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.

As per the Mitigation Plan and DMS monitoring guidance for this project, there was no vegetation plot monitoring conducted for the Year 6 monitoring effort, and thus no vegetation data summary tables are included in Appendix C as in previous monitoring reports. However, as reported in Tables 6a (Appendix B), the planted acreage performance categories were functioning at 100 percent with no bare areas to report, no low stem density areas, nor areas of poor growth or low vigor. There was a Vegetation Problem Area (VPA) noted consisting of two areas of scattered Chinese privet (*Ligustrum sinense*) totaling 0.50 acres as further described in Table 6b and shown in Figure 4 (both found in Appendix B). These areas will be treated in the spring of 2020 when treatment methods are the most effective.

3.0 REFERENCES

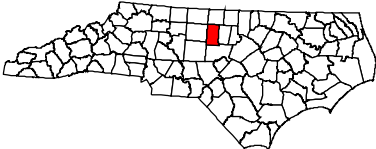
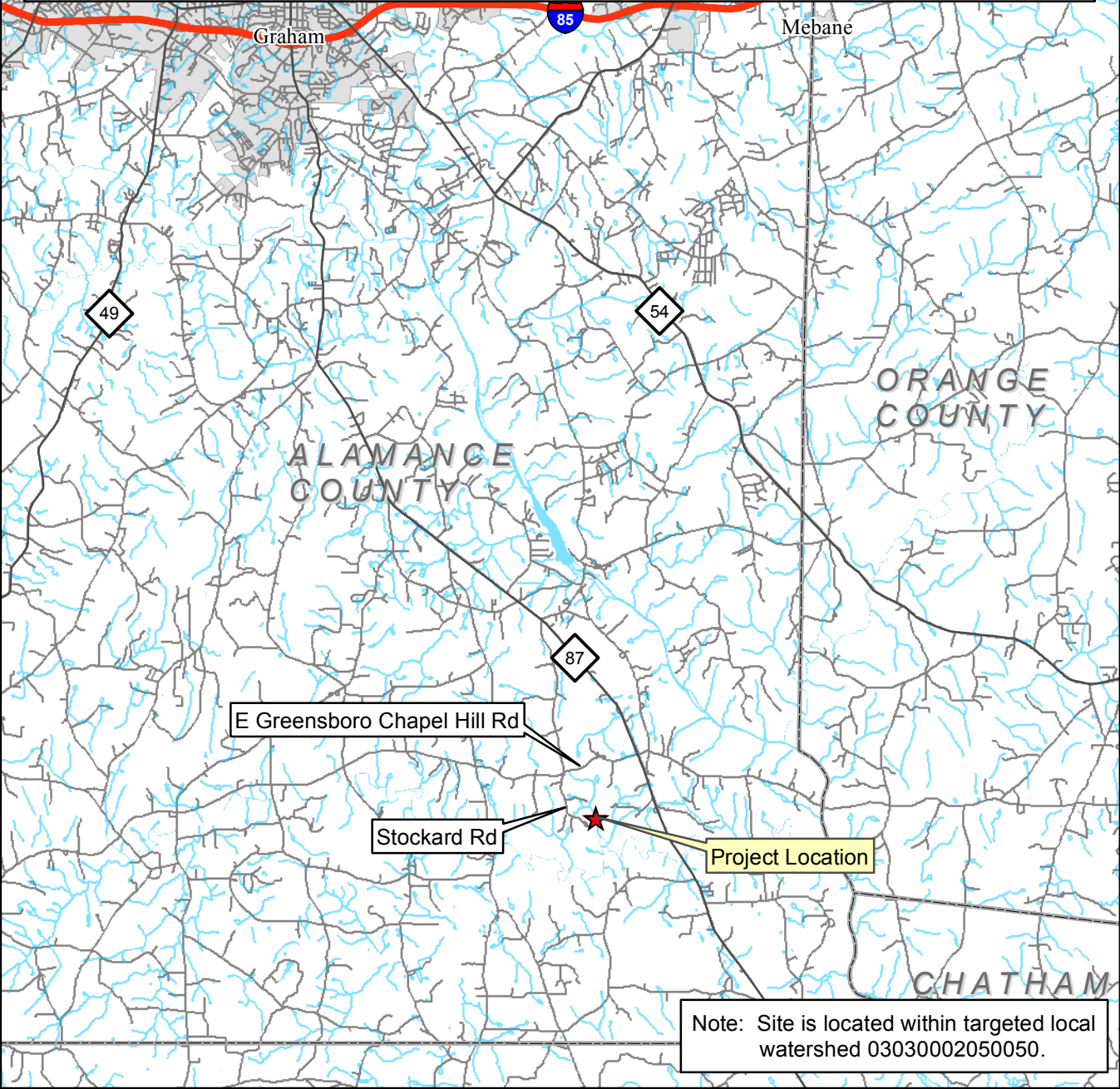
- Carolina Vegetation Survey (CVS) and NC Division of Mitigation Services (DMS). CVS-DMS Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC. 2012.
- Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-DMS Protocol for Recording Vegetation, Version 4.1.
- North Carolina Division of Mitigation Services (DMS). 2012. NCDMS Monitoring Report Template, Version 1.5, June 8, 2012.
- 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). 2009. Cape Fear River Basin Restoration Priorities.
- 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

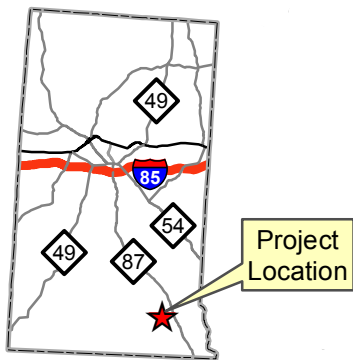
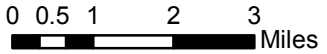


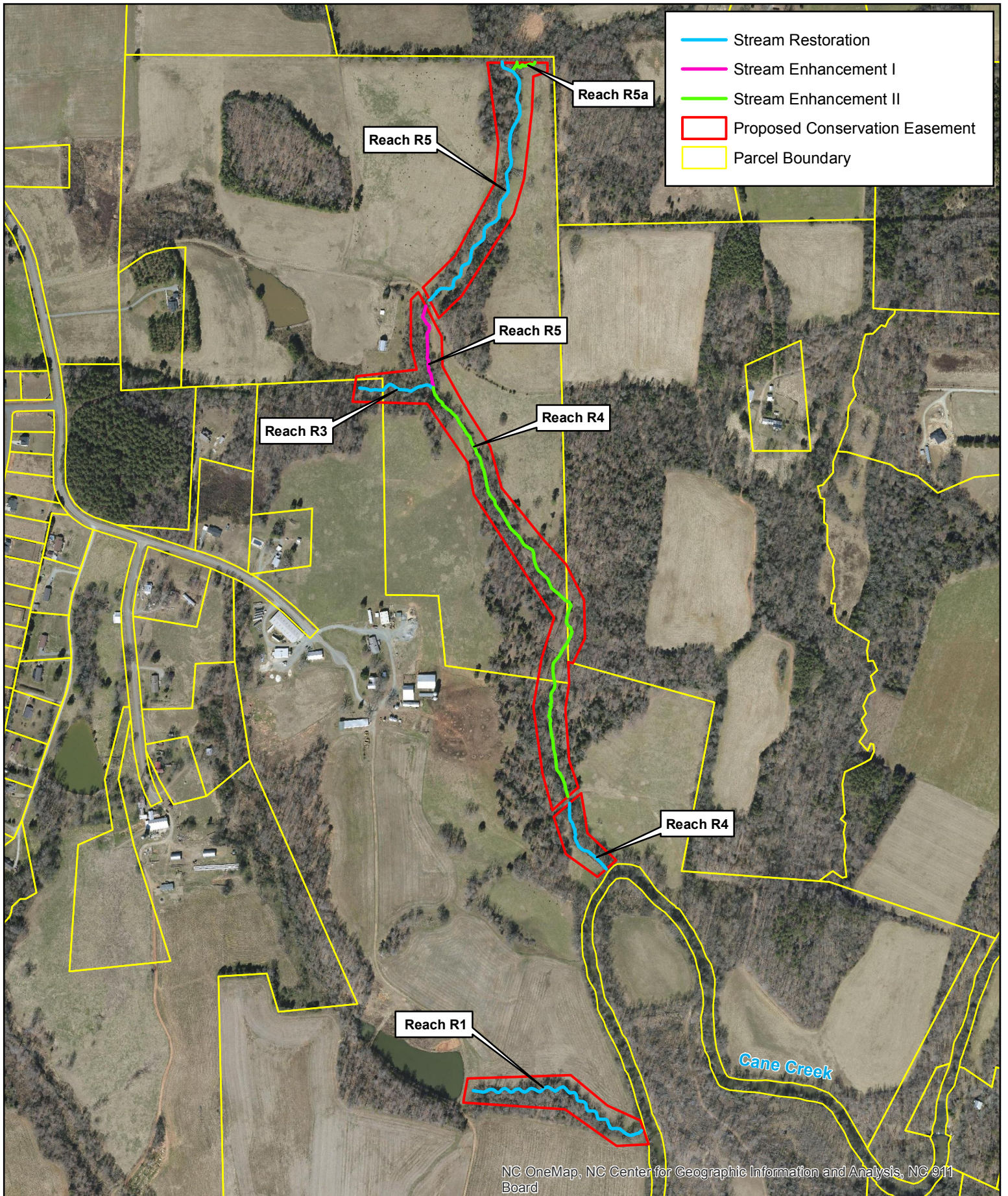
Figure 1
Project Vicinity Map
UT to Cane Creek Site

DEQ - Division of
Mitigation Services



Michael Baker
INTERNATIONAL





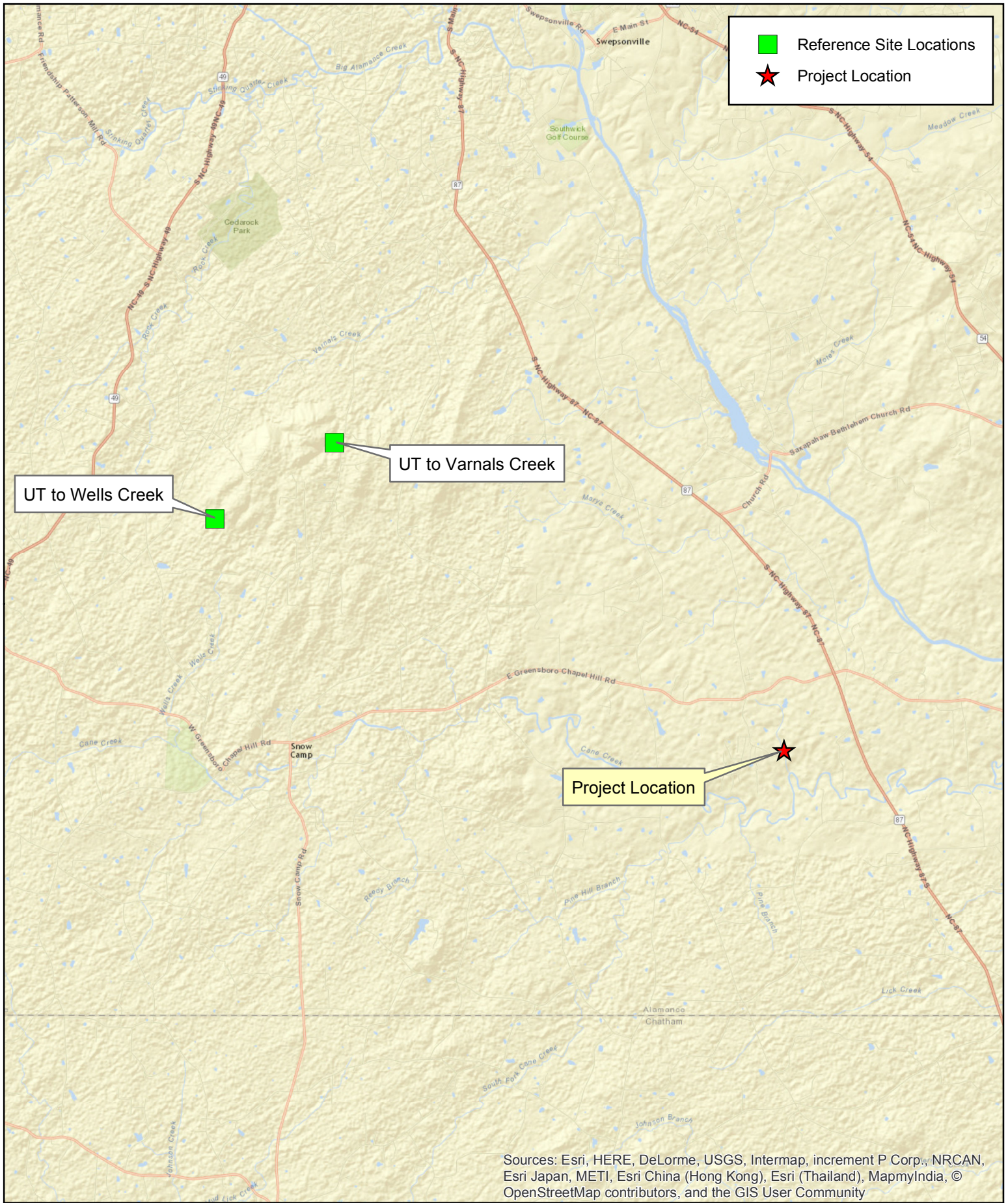
Michael Baker
INTERNATIONAL

0 500 1,000 Feet

DEQ -Division of Mitigation Services
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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DEQ - Division of Mitigation Services
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	Oct-17	Nov-17
Year 5 Monitoring	Dec-18	Oct-18	Dec-18
Year 6 Monitoring	Dec-19	Oct-19	Jan-20
Year 7 Monitoring	Dec-20	N/A	N/A

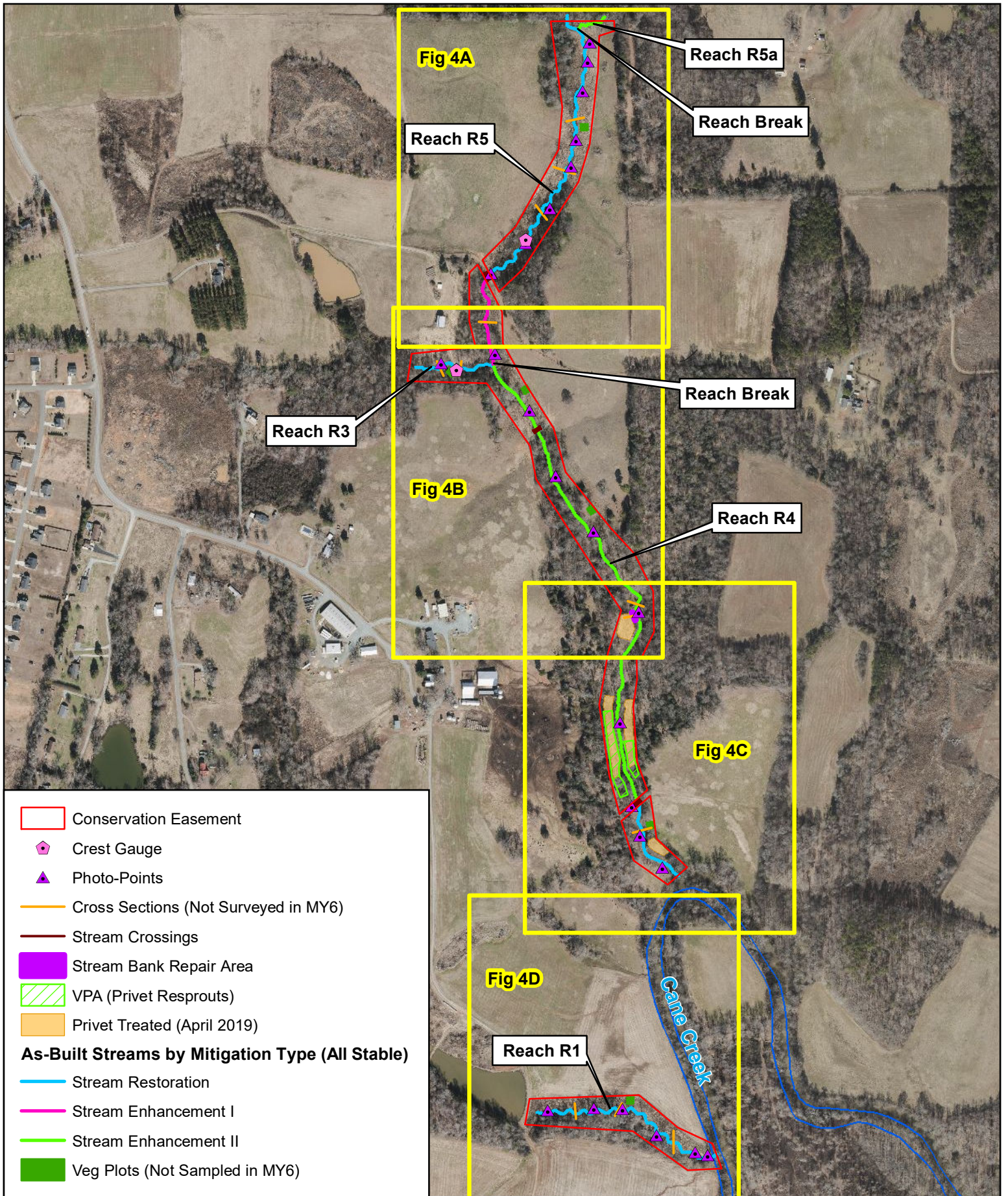
Table 3. Project Contacts	
UT to Cane Creek Restoration Project: DMS Project ID No. 95729	
Designer	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 <u>Contact:</u> Katie McKeithan, Telephone: 919-481-5703
Construction Contractor	
River Works, Inc.	114 W. Main St. Clayton, NC 27520 <u>Contact:</u> Stephen Carroll, Telephone: 919-428-8368
Planting Contractor	
River Works, Inc.	114 W. Main St. Clayton, NC 27520 <u>Contact:</u> Stephen Carroll, Telephone: 919-428-8368
Seeding Contractor	
River Works, Inc.	114 W. Main St. Clayton, NC 27520 <u>Contact:</u> Stephen Carroll, Telephone: 919-428-8368
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	Scott King, Tel. 919-481-5731
Vegetation Monitoring Point of Contact	Scott King, Tel. 919-481-5731

Table 4. Project Attributes (Pre-Construction Conditions)
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



- Conservation Easement
 - ◆ Crest Gauge
 - ▲ Photo-Points
 - Cross Sections (Not Surveyed in MY6)
 - Stream Crossings
 - Stream Bank Repair Area
 - VPA (Privet Resprouts)
 - Privet Treated (April 2019)
- As-Built Streams by Mitigation Type (All Stable)**
- Stream Restoration
 - Stream Enhancement I
 - Stream Enhancement II
 - Veg Plots (Not Sampled in MY6)



Conservation Easement

Crest Gauge

Photo-Points

Cross Sections (Not Surveyed in MY6)

Stream Crossings

In-Stream Structures

Stream Top Of Bank

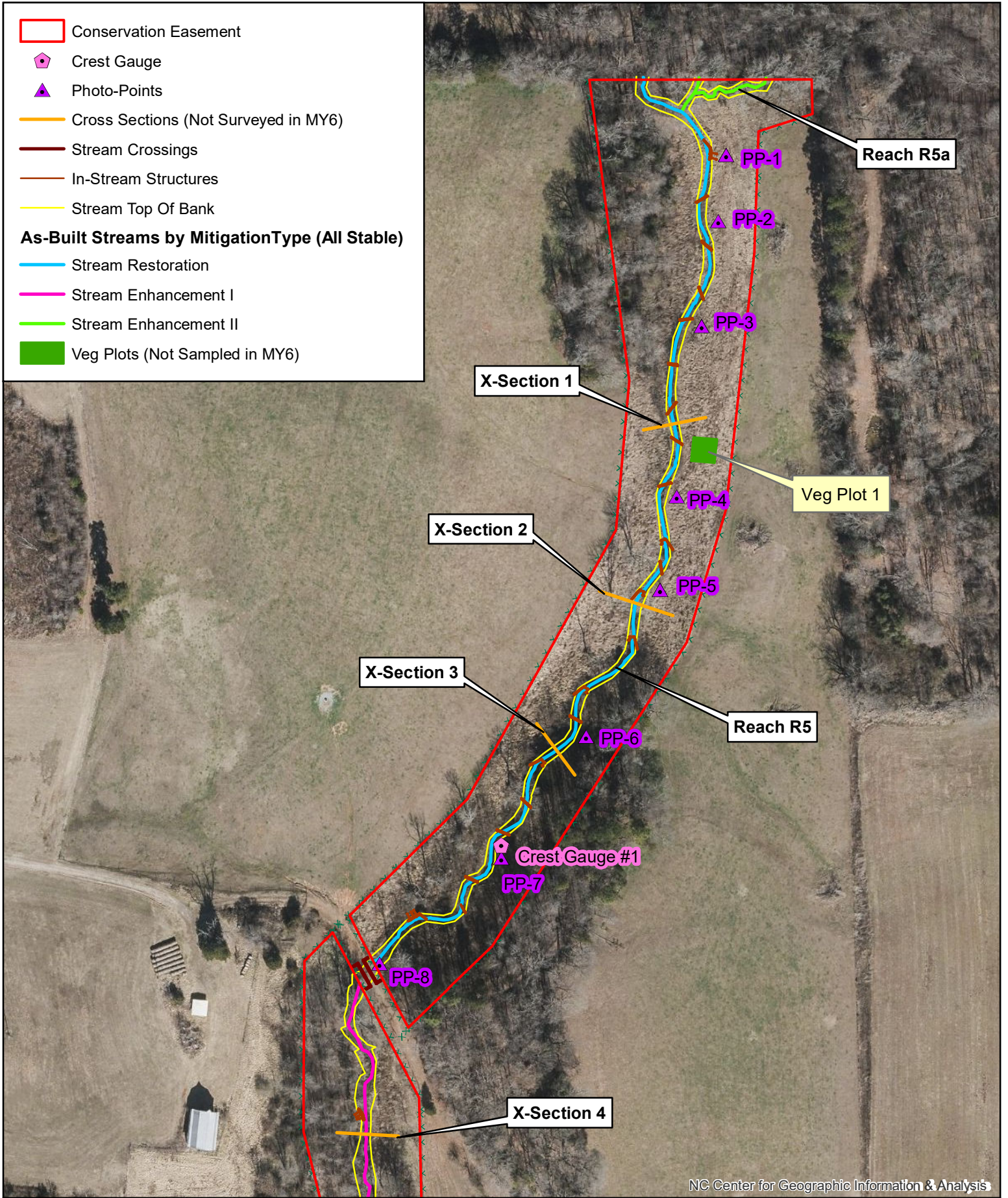
As-Built Streams by MitigationType (All Stable)

Stream Restoration

Stream Enhancement I

Stream Enhancement II

Veg Plots (Not Sampled in MY6)



NC Center for Geographic Information & Analysis

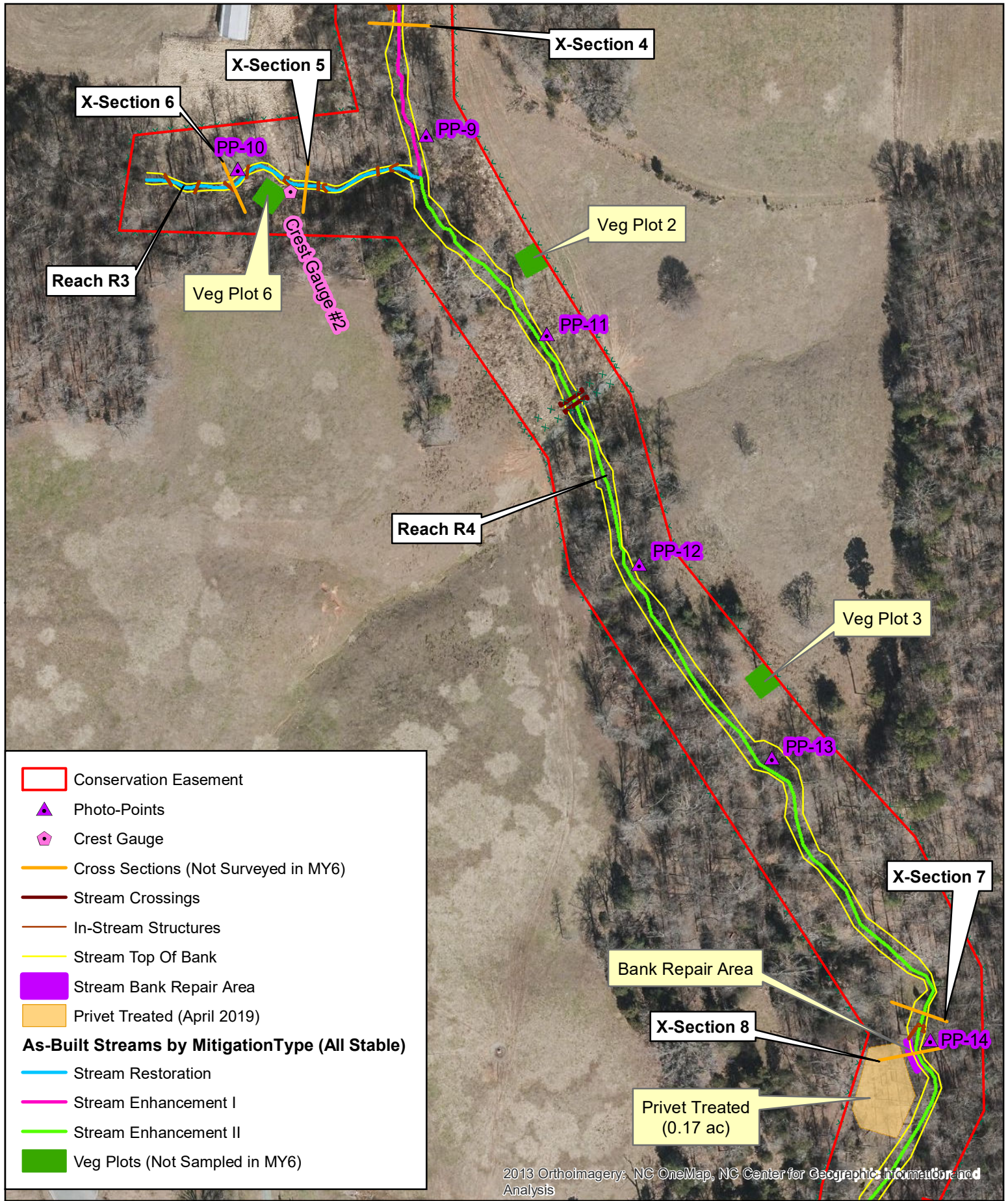
Michael Baker
INTERNATIONAL

0 100 200
Feet

DEQ - Division of Mitigation Services
Project # 95729



Current Condition
Plan View - Figure 4A
Monitoring Year 6
UT to Cane Creek Site



- Conservation Easement
 - ▲ Photo-Points
 - ◆ Crest Gauge
 - Cross Sections (Not Surveyed in MY6)
 - Stream Crossings
 - In-Stream Structures
 - Stream Top Of Bank
 - Stream Bank Repair Area
 - Privet Treated (April 2019)
- As-Built Streams by MitigationType (All Stable)**
- Stream Restoration
 - Stream Enhancement I
 - Stream Enhancement II
 - Veg Plots (Not Sampled in MY6)

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

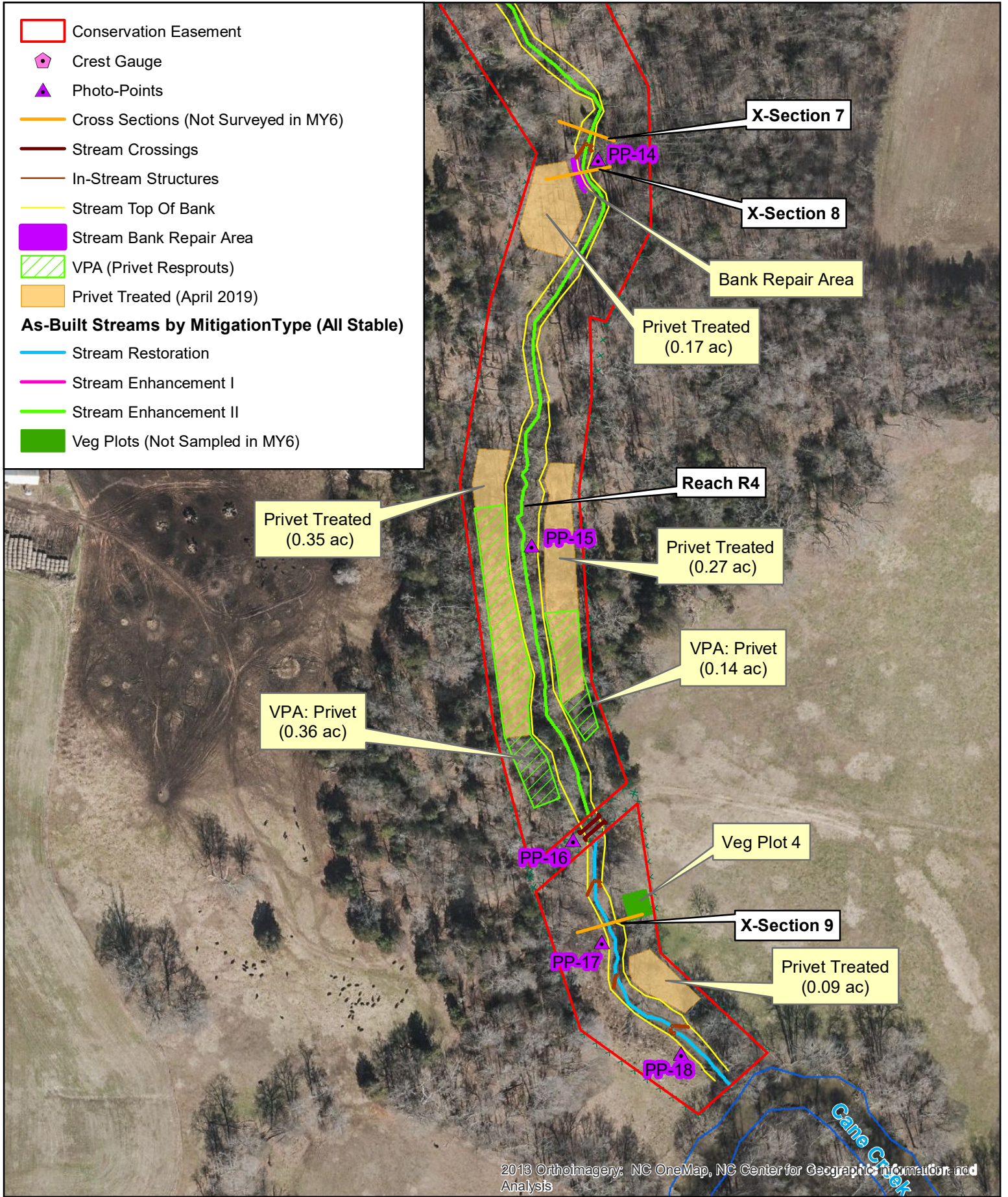
Michael Baker
INTERNATIONAL

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



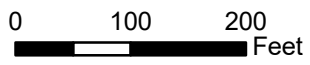
**Current Condition
Plan View - Figure 4B
Monitoring Year 6
UT to Cane Creek Site**

- Conservation Easement
 - ◆ Crest Gauge
 - ▲ Photo-Points
 - Cross Sections (Not Surveyed in MY6)
 - Stream Crossings
 - In-Stream Structures
 - Stream Top Of Bank
 - Stream Bank Repair Area
 - VPA (Privet Resprouts)
 - Privet Treated (April 2019)
- As-Built Streams by MitigationType (All Stable)**
- Stream Restoration
 - Stream Enhancement I
 - Stream Enhancement II
 - Veg Plots (Not Sampled in MY6)



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

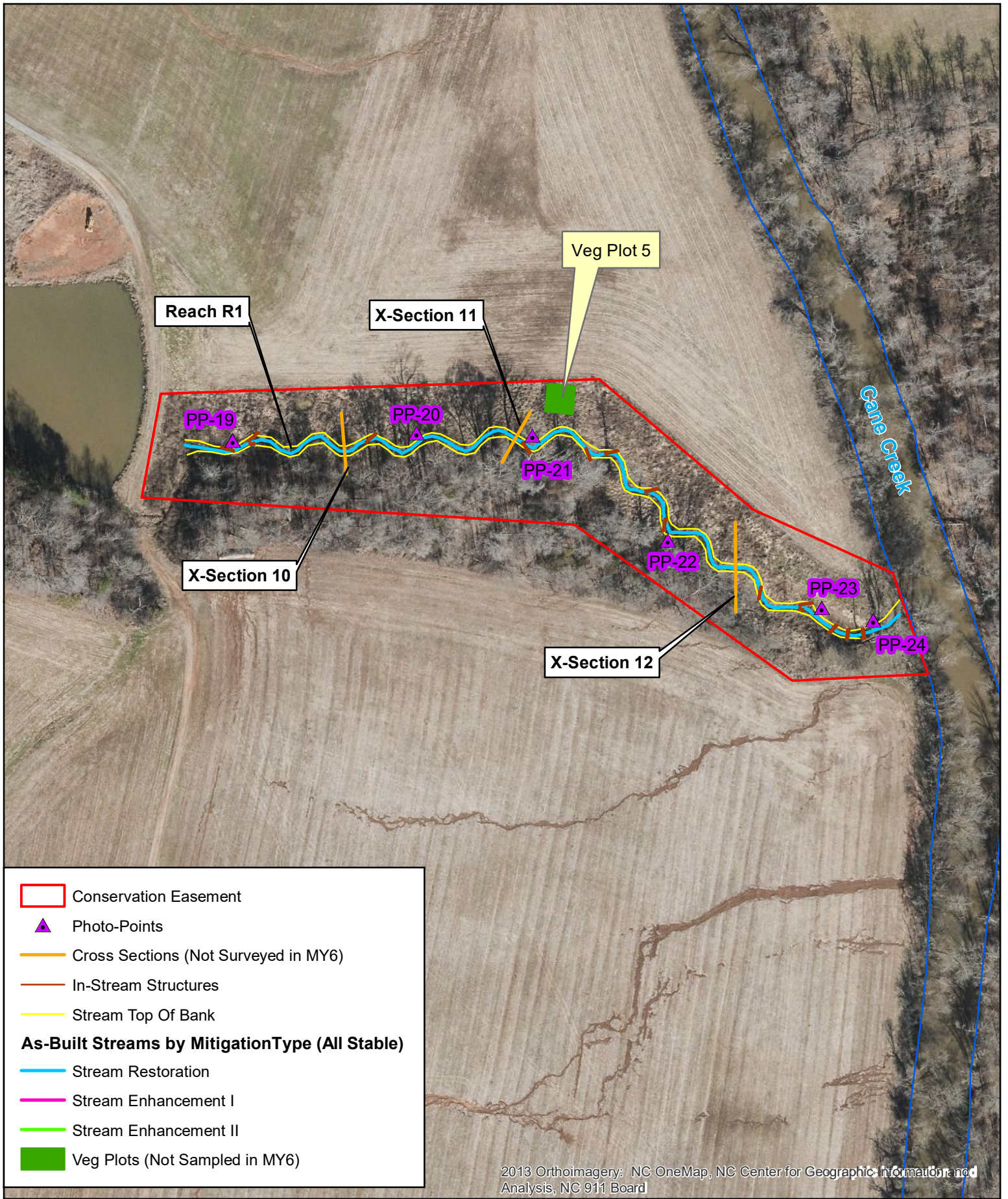
Michael Baker
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DEQ - Division of Mitigation Services
Project # 95729



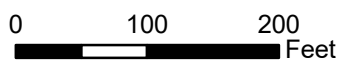
Current Condition
Plan View - Figure 4C
Monitoring Year 6
UT to Cane Creek Site



- Conservation Easement
- ▲ Photo-Points
- Cross Sections (Not Surveyed in MY6)
- In-Stream Structures
- Stream Top Of Bank
- As-Built Streams by MitigationType (All Stable)**
- Stream Restoration
- Stream Enhancement I
- Stream Enhancement II
- Veg Plots (Not Sampled in MY6)

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

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DEQ - Division of Mitigation Services
Project # 95729



Current Condition
Plan View - Figure 4D
Monitoring Year 6
UT to Cane Creek Site

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%			
	Totals										
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										
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%			
	Totals										
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										
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	99%
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	99%
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 Numbers	Suspected Cause	Photos
None	-	-	-

Table 6a. Vegetation Conditions Assessment						
UT to Cane Creek Restoration Project: DMS Project ID No. 95729						
Planted Acreage: 14.0						
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: 19.9						
Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
5. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 ft²	Green polygons with hatching	2	0.50	2.5%
6. Easement Encroachment Areas	Areas or 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 Numbers	Suspected Cause	Photos
Chinese privet (<i>Ligustrum sinense</i>)	Reach R4: Stations 49+00 to 52+50 (right bank), and 50+00 to 52+00 (left bank). Total area ~0.50 acres	Re-sprouts	N/A

UT to Cane Creek: MY6 Stream Station Photo-Points (from 10/24/19)



PP-1: Reach R5, view upstream, Station 11+50



PP-2: Reach R5, view upstream, Station 12+50



PP-3: Reach R5, view upstream, Station 13+75



PP-4: Reach R5, view upstream, Station 16+50



PP-5: Reach R5, view upstream, Station 17+25



PP-6: Reach R5, view upstream, Station 20+00

UT to Cane Creek: MY6 Stream Station Photo-Points (from 10/24/19)



PP-7: Reach R5, view upstream from crest gauge, Station 22+00



PP-8: Reach R5, view upstream of culvert crossing, Station 24+75



PP-9: Reach R5, view upstream, Station 28+50



PP-10: Reach R3, view upstream, at cross-section 6



PP-11: Reach R4, view upstream, Station 31+50



PP-12: Reach R4, view of upstream, Station 35+00

UT to Cane Creek: MY6 Stream Station Photo-Points (from 10/24/19)



PP-13: Reach R4, view upstream, Station 38+50



PP-14: Reach R4, view upstream, Station 43+50



PP-15: Reach R4, view upstream, Station 49+00



PP-16: Reach R4, view upstream at crossing, Station 53+00



PP-17: Reach R4, view upstream, Station 54+75



PP-18: Reach R4, view upstream, Station 56+50

UT to Cane Creek: MY6 Stream Station Photo-Points (from 10/24/19)



PP-19: Reach R1, view upstream, Station 10+50



PP-20: Reach R1, view upstream, Station 13+50



PP-21: Reach R1, view upstream, Station 15+00



PP-22: Reach R1, view upstream, Station 17+00



PP-23: Reach R1, view upstream, Station 19+25



PP-24: Reach R1, view upstream, Station 20+00

UT to Cane Creek: MY6 Crest Gauge Photographs



Reach R5: Crest Gauge #1, 0.83 feet on 6/6/19



Reach R3: Closeup of Crest Gauge #1 on 6/6/19



Reach R3: Crest Gauge #2, 0.46 feet on 6/6/19



Reach R3: Closeup of Crest Gauge #2 on 6/6/19

UT to Cane Creek: MY6 Project Maintenance, Repair, and Problem Area Photographs



Reach R4 lower: Privet treated in April 2019



Reach R4 lower: Privet treated in April 2019



Reach R4 middle: Privet treated in April 2019
(bare stems difficult to see in photograph)



Reach R4 middle: Privet treated in April 2019



Reach R4 Station 43+50: Previously documented stream bank scour from Hurricane Florence in Sept 2018



Reach R4 Station 43+50: Bank repair with livestock and 1-gal plantings into stream bank (Feb 2019)

UT to Cane Creek: MY6 Project Maintenance, Repair, and Problem Area Photographs



Reach R4 Station 43+50: Additional bank repair with seed and matting (June 2018)



Reach R4 Station 43+50: Bank repair (Sept 2019)

Appendix C

Vegetation Plot Data*

***No vegetation plot monitoring was required for Year 6.**

Appendix D

Stream Survey Data*

***No cross-section stream survey monitoring was required for Year 6.**

Table 10. Baseline Stream Summary																																			
UT to Cane Creek Restoration Project: DMS Project ID No. 95729																																			
Reach 1 (L045 LF)																																			
Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999) ^a			Pre-Existing Condition ¹						Reference Reach(es) Data										Design					As-built									
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	UT to Wells Creek					UT to Varnah Creek					Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n			
Dimension and Substrate - Riffle	BF Width (ft)	---	---	---	5.6	---	7.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Floodplain Width (ft)	---	23.0	80.0	4.9	6.8	---	>30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF Mean Depth (ft)	---	2.3	5.8	0.8	0.7	---	0.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Max Depth (ft)	---	---	---	---	1.1	---	1.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Cross-sectional Area (ft ²)	---	80.0	300.0	5.2	5.1	---	5.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Width/Depth Ratio	---	---	---	---	6.1	---	10.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Entrenchment Ratio	---	---	---	---	1.2	---	9.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Bank Height Ratio d50 (mm)	---	---	---	---	1.6	---	4.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Pattern	Channel Beltwidth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Radius of Curvature (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Rc-Bankfull width (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Meander Wavelength (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Profile	Meander Width Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Riffle Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Riffle Slope (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Substrate and Transport Parameters	Pool Spacing (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Max Depth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Volume (ft ³)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Reach Shear Stress (competency) lb-F	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Additional Reach Parameters	Max part size (mm) mobilized at bankfull (Roggen Curve)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Stream Power (transport capacity) W/m ²	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Additional Reach Parameters	Drainage Area (SM)	---	---	---	---	---	---	0.125	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Impervious cover estimate (%)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Roggen Classification	---	---	---	---	G5c	---	E5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Velocity (fps)	---	---	---	---	0.8	---	1.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Discharge (cfs)	---	290.0	2000.0	19.8	---	---	19.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Valley Length	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Channel length (ft) ²	---	---	---	---	---	---	943	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Sinuosity	---	---	---	---	---	---	1.09	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Water Surface Slope (Channel) (ft/ft)	---	---	---	---	---	---	0.0127	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF slope (ft/ft)	---	---	---	---	---	---	0.0135	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bankfull Floodplain Area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BEHI VL%/ L%/ M%/ H%/ V1%/ V2%	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
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. Wetland Hydrology. AWRA Symposium Proceedings. D.S. Otten 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										
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	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)	---	---	---	---	---	---	7.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Floodplain Width (ft)	---	23.0	80.0	5.1	---	---	---	>16.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	BF Mean Depth (ft)	---	2.3	5.8	0.8	---	---	---	0.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF Max Depth (ft)	---	---	---	---	---	---	---	1.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF Cross-sectional Area (ft ²)	---	80.0	300.0	5.7	---	---	---	5.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Width/Depth Ratio	---	---	---	---	---	---	---	9.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Entrenchment Ratio	---	---	---	---	---	---	---	2.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bank Height Ratio	---	---	---	---	---	---	---	1.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
d50 (mm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Pattern	Channel Beltwidth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Radius of Curvature (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Rc-Bankfull width (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Meander Wavelength (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Profile	Meander Width Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Riffle Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Riffle Slope (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Substrate and Transport Parameters	Pool Spacing (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Max Depth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Pool Volume (ft ³)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Reach Shear Stress (competency) lb-F	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Additional Reach Parameters	Max part size (mm) mobilized at bankfull (Roggen Curvo)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Stream Power (transport capacity) W/m ²	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Additional Reach Parameters	Drainage Area (SM)	---	---	---	---	---	---	0.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Impervious cover estimate (%)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Roggen Classification	---	---	---	---	---	---	B4c	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Velocity (fps)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Discharge (cfs)	---	290.0	2000.0	21.7	---	---	---	21.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Valley Length	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Channel length (ft) ²	---	---	---	---	---	---	---	425	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Sinuosity	---	---	---	---	---	---	---	1.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Water Surface Slope (Channel) (ft/ft)	---	---	---	---	---	---	---	0.0195	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF slope (ft/ft)	---	---	---	---	---	---	---	0.0168	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bankfull Floodplain Area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BEHI VL% / L% / M% / H% / V1% / 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. Wetland Hydrology. AWRA Symposium Proceedings. D.S. Otten and J.P. Potyondy, eds. American Water Resources Association, June 30-July 2, 1999. Bozeman, MT.

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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														
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	UT to Wells Creek					UT to Varnab Creek					Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n							
Dimension and Substrate - Riffle	BF Width (ft)	---	---	---	15.4	---	---	16.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---									
	Floodplain Width (ft)	23.0	80.0	10.2	18.4	---	---	26.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---								
	BF Mean Depth (ft)	---	2.3	5.8	1.3	0.9	---	---	1.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---							
	BF Max Depth (ft)	---	---	---	1.3	---	---	1.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---						
	BF Cross-sectional Area (ft ²)	---	80.0	300.0	16.9	14.8	---	---	15.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---						
	Width/Depth Ratio	---	---	---	15.4	---	---	19.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---					
	Entrenchment Ratio	---	---	---	1.2	---	---	1.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---					
Bank Height Ratio d50 (mm)	---	---	---	1.3	---	---	2.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---					
Pattern	Channel Beltwidth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---					
	Radius of Curvature (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---				
	Rc-Bankfull width (ft)	---	---	---	0.3	---	---	4.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---				
	Meander Wavelength (ft)	---	---	---	4.4	---	---	8.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
Profile	Meander Width Ratio	---	---	---	1.3	---	---	4.4	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	Riffle Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Riffle Slope (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
Substrate and Transport Parameters	Pool Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Pool Spacing (ft)	---	---	---	2.1	---	---	7.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Pool Max Depth (ft)	---	---	---	2.3	---	---	2.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Pool Volume (ft ³)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Reach Shear Stress (competency) lb/F	---	---	---	---	---	---	24.2 / 50.6 / 69.4 / 50.6 / 24.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Additional Reach Parameters	Max part size (mm) mobilized at bankfull (Roggen Curve)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Stream Power (transport capacity) W/ft ²	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
Additional Reach Parameters	Drainage Area (SM)	---	---	---	---	---	---	0.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Impervious cover estimate (%)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Rosgen Classification	---	---	---	B5c	---	---	F5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF Velocity (fps)	---	---	---	4.4	---	---	4.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BF Discharge (cfs)	---	290.0	2000.0	69.2	---	---	69.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Valley Length	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Channel length (ft) ²	---	---	---	---	---	---	2,783	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Sinuosity	---	---	---	---	---	---	1.04	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Water Surface Slope (Channel) (ft/ft)	---	---	---	---	---	---	0.0169	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF slope (ft/ft)	---	---	---	---	---	---	0.0148	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Bankfull Floodplain Area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	BEHI VL% / L% / M% / FN% / VFN% / E%	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Channel Stability or Habitat Metric Biological or Other	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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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) ¹			Pre-Existing Condition ¹					Reference Reach(es) Data												Design					As-built											
										UT to Wells Creek						UT to Varnahs Creek																						
		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	Min	Mean	Med	Max	SD	n				
Dimension and Substrate - Riffle																																						
BF Width (ft)		23.0	80.0	8.4				8.9							9.7																							
Floodplain Width (ft)								11.8																														
BF Mean Depth (ft)		2.3	5.8	1.2				1.2																														
BF Max Depth (ft)								1.5																														
BF Cross-sectional Area (ft ²)		80.0	300.0	12.5				10.9							7.9																							
Width/Depth Ratio								7.2							8																							
Entrenchment Ratio								1.3							1.9																							
Bank Height Ratio								2.6							1.1																							
d50 (mm)																																						
Pattern																																						
Channel Beltwidth (ft)																																						
Radius of Curvature (ft)																																						
Rc-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																																						
Rf% / Ra% / 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) Jb-F																																						
Max part size (mm) mobilized at bankfull (Roggen Curve)																																						
Stream Power (transport capacity) W/ft ²																																						
Additional Reach Parameters																																						
Drainage Area (SM)								0.5						0.13						0.24																	0.5	
Impervious cover estimate (%)																																						
Roggen Classification								G4						C4/1						B4/1a							C4											
BF Velocity (fps)								4.5						5.3						4.4							4.4											
BF Discharge (cfs)		290.0	2000.0	50.0				50						25.2						46.6							40											
Valley Length																																						
Channel length (ft) ²								1848																														
Sinuosity								1.07						1.40						1.20																		
Water Surface Slope (Channel) (ft/ft)								0.0144						0.0197						0.0405							0.014											
BF slope (ft/ft)								0.0128						0.028						0.0458							0.017											
Bankfull Floodplain Area (acres)																																						
BEHI VL% / L% / M% / H% / VHP% / E%																																						
Channel Stability or Habitat Metric																																						
Biological or Other																																						

¹ 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. Wetland Hydrology. AWRA Symposium Proceedings. D.S. Otten 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 ¹						Reference Reach(es) Data												Design					As-built									
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	UT to Wells Creek						UT to Varnahs Creek						Design					As-built									
										Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n				
Dimension and Substrate - Riffle																																					
	BF Width (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---				
	Floodplain Width (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---				
	BF Mean Depth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---				
	BF Max Depth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	BF Cross-sectional Area (ft ²)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	Width/Depth Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
	Entrenchment Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Bank Height Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	d50 (mm)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
Pattern																																					
	Channel Beltwidth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Radius of Curvature (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Rc-Bankfull width (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Meander Wavelength (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Meander Width Ratio	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Profile																																					
	Riffle Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Riffle Slope (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Pool Length (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Pool Spacing (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Pool Max Depth (ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Pool Volume (ft ³)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Substrate and Transport Parameters																																					
	Ri% / Ru% / P% / G% / S%	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	SC% / Sa% / G% / B% / Be%	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	d16 / d35 / d50 / d84 / d95	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Reach Shear Stress (competency) /b-F	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Max part size (mm) mobilized at bankfull (Roggen Curvo)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Stream Power (transport capacity) W/m ²	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Additional Reach Parameters																																					
	Drainage Area (SM)	---	---	---	---	---	---	0.025	---	---	---	---	0.13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	Impervious cover estimate (%)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Roggen Classification	---	---	---	---	---	---	---	---	---	---	---	C4/1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---		
	BF Velocity (fps)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF Discharge (cfs)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Valley Length	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Channel length (ft) ²	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Sinuosity	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Water Surface Slope (Channel) (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BF slope (ft/ft)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Bankfull Floodplain Area (acres)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	BEHI VL% / L% / M% / H% / V1% / 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. Wetland Hydrology. AWRA Symposium Proceedings. D.S. Otten and J.P. Potyondy, eds. American Water Resources Association, June 30-July 2, 1999. Bozeman, MT.

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				
10/01/2014	NA	0.18	07/16/2014	Crest Gauge
Year 2 Monitoring				
03/25/2015	0.33	NA	03/06/2015	Crest Gauge
10/13/2015	0.62	0.79	10/03/2015	Crest Gauge
Year 3 Monitoring				
07/27/2016	1.21	NA	02/17/2016	Crest Gauge
09/30/2016	1.31	1.12	09/19/2016	Crest Gauge
11/09/2016	0.75	0.66	10/09/2016	Crest Gauge
Year 4 Monitoring				
05/03/2017	0.76	0.46	04/24/2017	Crest Gauge
Year 5 Monitoring				
09/24/2018	1.22	1.08	09/17/2018 (Hurricane Florence)	Crest Gauge
Year 6 Monitoring				
06/06/2019	0.83	0.46	04/14/2019	Crest Gauge