Brown Creek Tributaries Restoration Project
Final Year 1 Monitoring Report

Anson County, North Carolina

DMS Project ID No. 95351, DEQ Contract No. 004641

USACE Action ID: SAW-2012-01108, DWR Project #14-0345

Yadkin River Basin: 03040104-061030

Project Info:	Monitoring Year: 1 of 7 Year of Data Collection: 2015 (vegetation) and 2016 (survey) Year of Completed Construction: 2015 Submission Date: January 2017
Submitted To:	NC DEQ – Division of Mitigation Services 1625 Mail Service Center Raleigh, NC 27699

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Report Prepared and Submitted by Michael Baker Engineering, Inc.

NC Professional Engineering License # F-1084

Michael Baker
INTERNATIONAL

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APPENDICES

1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored 8,213 linear feet (LF) of perennial stream, enhanced 2,481 LF of stream, and preserved 518 LF of stream along Hurricane Creek (HC) and unnamed tributaries (UT4) to Brown Creek, a 303(d) listed stream that flows through the Pee Dee National Wildlife Refuge. Baker also planted approximately 33 acres (AC) of native riparian vegetation along the restored and enhanced reaches (Reaches HC-R1, HC-R2, and HC-R3 on the Hurricane Creek portion of the project, and UT4-R1a, UT4-R1b, UT4-R2, UT4-R3, UT4-R4a, UT4-R4b, UT4-R5a, and UT4-R5b on the unnamed tributary (UT4) portion of the project). A recorded conservation easement consisting of 43.3 acres protects and preserves all stream reaches, existing wetland areas, and riparian buffers in perpetuity. The Brown Creek Tributaries Restoration Project (Site) is located in Anson County, approximately four miles southeast of the Town of Ansonville (Figure 1). The Site is located in the NC Division of Water Resources (NCDWR) subbasin 03-07-10 and the NC Division of Mitigation Services (DMS) Targeted Local Watershed (TLW) 03040104-061030 of the Yadkin River Basin. The project involved the restoration and enhancement of a rural piedmont stream system (Schafale and Weakley 1990), which had been impaired due to past agricultural conversion and cattle grazing.

Based on the DMS 2009 Lower Yadkin-Pee Dee River Basin Restoration Priority (RBRP) Plan, the Brown Creek Tributaries Restoration Project area is located in an existing targeted local watershed (TLW) within the Yadkin River Basin, although it is not located in a Local Watershed Planning (LWP) area. The TLW selection criteria for the Yadkin Basin specifically targets projects that will address water resource impacts from nonpoint source (NPS) pollution. The restoration strategy for the Yadkin River Basin as a whole targets projects which focus on restoring stream functions by maintaining and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat.

The primary goals of the project were to improve ecologic functions to the impaired areas as described in the DMS 2009 Lower Yadkin-Pee Dee RBRP as identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce NPS inputs to receiving waters,
- Protect and improve water resources 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 them access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive stream bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment 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
- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

The Year 1 monitoring survey data of the fifteen cross-sections indicates that those stream sections are stable and are within the lateral/vertical stability and in-stream structure performance categories. Most reaches are geomorphically stable and performing as designed, as confirmed by the visual stability assessment. However, there were a few concerns noted on reaches UT4-R2, as well as one each on UT4-R3 and UT4-R4b. Reach UT4-R2 has significant scour on three riffle sections; their beds are degrading along their entire length. Headcuts have also formed along the thalweg in two of the riffles in their downstream sections, scouring and lengthening the downstream pools. These riffles were earth/sand riffles and were therefore more vulnerable to the scouring potential of high storm flows. There were also two additional areas of bank scour noted for this reach as well. For UT4-R3, the log vane located at the top of the reach at the confluence of UT4-R4b and UT4-R2 was undermined and washed out, along with a portion of the adjacent bank. Additionally, the right bank of the rock ford crossing on UT4-R4b washed out. It is believed that the harsh fall and winter rainstorms of 2015 (in particular Hurricane Joaquin in early October) damaged the site before it had time to establish protective vegetation cover. All of these stream problem areas will be corrected during the summer of 2016 by Riverworks personnel. The location and photographs for all of the stream problem areas can be found in Appendix B.

During Year 1 monitoring, the planted acreage performance categories were functioning at 100 percent with no bare areas or low stem density areas to report. The average density of total planted stems, based on data collected from the sixteen monitoring plots during Year 1 monitoring, is 716 stems per acre. The Year 1 data demonstrate that the Site is on track for meeting the minimum success interim criteria of 320 trees per acre by the end of Year 3.

Invasive species areas of concern were observed and documented accordingly. Following Year 1 monitoring, two areas along HC-R3 were found to contain sparse numbers of young resprouts of the invasive species Chinese privet (*Ligustrum sinsense*). The areas total approximately 0.1 acres and are located within the non-planted buffer along the right bank of HC-R3 that was already forested. This area of invasive species will be closely observed through Year 2 monitoring and any changes will be documented in the Year 2 monitoring report. No other areas were found to contain invasive species at this time.

In-stream flow for the restored channels of UT4 were recorded in 2015 by the use of two flow gauges (pressure transducers) located along reaches UT4-R1b and UT4-R4b. The flow gauges documented seasonal flow for Year 1 through these reaches of 92.0 and 37.0 consecutive days, respectively. It is also noted that the flow gauges demonstrated similar flow events relative to recorded rainfall events on site as demonstrated in the gauge graphs in Appendix E.

Two bankfull crest gauges are located along UT4-R2 and HC-R2. During Year 1 monitoring, both crest gauges documented at least one post-construction bankfull event.

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 North Carolina Division of Mitigation Services (NCDMS) website. Any raw data supporting the tables and figures in the Appendices are available from NCDMS upon request.

This report documents the successful completion of Year 1 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 project. The methodology and report template used to evaluate these components adheres to the DMS monitoring report template guidance document Version 1.3 (dated January 15, 2010), which will continue to serve as the template for subsequent monitoring years. The vegetation monitoring quadrants follow CVS-DMS monitoring levels 1 and 2 in accordance with CVS-DMS Protocol for Recording Vegetation, Version 4.1 (2007).

Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal Accuracy using a 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. This survey system collects point data with an accuracy of less than one tenth of a foot.

The specific locations of monitoring features, such as vegetation plots, permanent cross-sections, flow gauges, and crest gauges are shown on the CCPV sheets found in Appendix B.

The Year 1 vegetation data were collected in November 2015, while the cross-section survey data were collected in February 2016. The delayed survey effort was conducted with DMS permission to fulfill the 180-day requirement between the post-construction as-built survey and the monitoring Year 1 survey work (the as-built survey data was collected in July 2015). Visual site assessment data contained in Appendix B were collected in November and December of 2015, and February of 2016.

2.1 Stream Assessment

The project involved the restoration and enhancement of a rural piedmont stream system (Schafale and Weakley 1990), which 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 to restore natural flow regimes to the system. The existing channels abandoned within the restoration areas were partially to completely filled to decrease surface and subsurface drainage and to raise the local water table. Permanent cattle exclusion fencing was provided around all proposed reaches and riparian buffers in which cattle previously had access.

2.1.1 Morphologic Parameters and Channel Stability

Cross-sections were classified using the Rosgen Stream Classification System (Rosgen 1994) and all monitored cross-sections fall within the quantitative parameters defined for channels of their design stream type. Cross-sections were also compared to the baseline cross-section plots to evaluate change between construction and the MY1 survey. Morphological survey data is presented in Appendix D.

The Year 1 monitoring survey data of the fifteen 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. Most reaches are stable and performing as designed, as confirmed by the visual stability assessment. However, there were a few concerns noted on reaches UT4-R2, as well as one each on UT4-R3 and UT4-R4b. Reach UT4-R2 has three riffle sections that are exhibiting scour. Their beds are degrading, headcuts have formed along

the thalweg in two of the riffles, and the banks are now being undermined. The riffles were earth/sand riffles and were therefore more vulnerable to the scouring potential of high storm flows. There were also two areas of bank scour noted for this reach as well. For UT4-R3, the cross vane located at the top of the reach at the confluence of UT4-R4b and UT4-R2 was undermined and washed out along with a portion of the adjacent bank. Additionally, the right bank of the rock ford crossing on UT4-R4b washed out. It is believed that the harsh fall and winter rainstorms of 2015 (in particular Hurricane Joaquin in early October) damaged the site before it had time to establish protective vegetation cover. All of these stream problem areas will be corrected during the summer of 2016 by Riverworks personnel. The location and photographs of the stream problem areas can be found in Appendix B.

A longitudinal profile was surveyed for the entire length of each channel after construction to document the as-built baseline conditions for Monitoring Year 0 only. Annual longitudinal profiles will not be conducted during subsequent monitoring years unless channel instability has been documented or redmedial actions/repairs are required by the US Army Corps of Engineers (USACE) or DMS.

2.1.2 Hydrology

Total observed rainfall at the Anson County airport (KAFP) weather station located near Wadesboro, NC for the period of January 2015 through December 2015 was 42.47 inches. The WETS table for Anson County was used to calculate the 30-year average, and was found to be 47.03 inches. Thus, according to the KAFP weather station, for the period January 2015 through December 2015 the total rainfall during the Year 1 monitoring was 4.56 inches below the historic approximated average.

The occurrence of bankfull events within the monitoring period are documented by the use of two crest gauges, as well as photographs. One crest gauge is installed at bankfull elevation along on HC-R2 and a second crest gauge is installed along UT4-R2. Each gauge recorded at least one bankfull event during Year 1 monitoring. Crest gauge readings are presented in Appendix E.

To document seasonal flow in restored intermittent channels, two automated flow gauges (pressure transducers) are installed in the UT4 site. The flow gauges are installed along UT4-R1b and UT4-R4b and programmed to collect data every 6 hours. Success criteria are considered to have been met if 30 consecutive days of flow were observed at any point during the monitoring year. Year 1 monitoring results indicate that both UT4 flow gauges met the minimum consecutive days of surface flow required for success. The recorded flow data and observed rainfall graphs for each gauge, along with the flow gauge success summary are located in Appendix E.

2.1.3 Photographic Documentation

Reference photograph transects were taken at each permanent cross-section during the survey work in February 2016. 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 for Monitoring Year 1 were taken along all reaches for both the Hurricane Creek and UT4 project sites during October, November, and December 2015 site visits.

Stream flow cameras located on UT4-R4b and HC-R2 provided further documentation of seasonal flow. However, the camera on HC-R2 had persistent difficulties with vegetation obstruction at its original location, preventing the collection of useful photographs, so it was moved slightly downstream to Station 35+25 in October 2015.

The photographs of stream reaches, flow cameras, vegetation plots, monitoring gauges (both crest and flow gauges), and stream and vegetation problem areas are all located in Appendix B.

2.2 Vegetation Assessment

In order to determine if the criteria are achieved, vegetation-monitoring quadrants were installed and are monitored across the restoration site in accordance with the CVS-DMS Protocol for Recording Vegetation, Version 4.1 (2007) and the CVS-DMS data entry tool v 2.3.1 (2012). The vegetation monitoring plots were established randomly throughout the planted riparian buffer areas of UT4 and Hurricane Creek as per Monitoring Levels 1 and 2. The size of each individual quadrants are 100 square meters for woody tree species.

Based on the Year 1 vegetation plot monitoring data collected during November 2015, the average planted stem density is 716 stems per acre. Thus, the vegetation data demonstrate that the project is on track for meeting the minimum success criteria of 320 trees per acre by the end of Year 3.

Year 1 vegetation assessment information is provided in Appendices B and C.

2.2.1 Vegetation Concerns

Invasive species areas of concern were observed and documented accordingly. Following Year 1 monitoring, two areas along HC-R3 were found to contain the invasive species Chinese privet (*Ligustrum sinsense*). The areas total approximately 0.1 acres and are located within the non-planted buffer along the right bank of HC-R3 that was already forested. The area is currently only sparsely populated with young re-sprouts, so no treatment action is recommend at this time, however, this area of invasive species will be closely observed throughout Year 2 monitoring and any changes will be documented as necessary.

No other areas of concern regarding the existing vegetation were observed along the Hurricane Creek or UT4 sites. Year 1 vegetation assessment information is provided in Appendix C.

3.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Division of Mitigation Services (NCDMS). 2012. CVS-NCDMS 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. 2011. Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation. November 7, 2011.

North Carolina Division of Mitigation Services. 2010. Procedural Guidance and Content Requirements for DMS Annual Monitoring Reports. Version 1.3 (1/15/2010)

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, NC DEQ. Raleigh, NC.

United States Army Corps of Engineers. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-rs-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

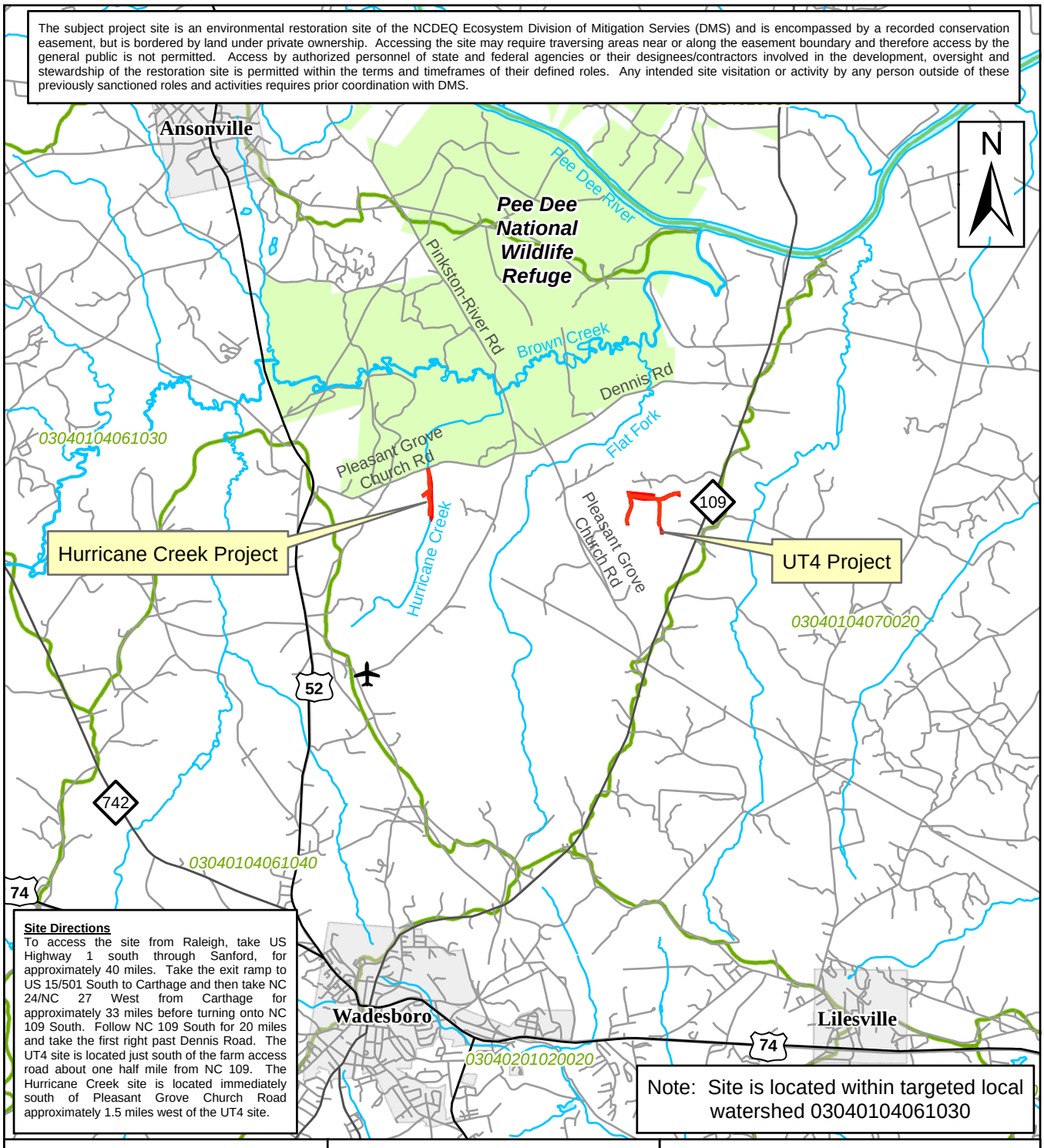
United States Army Corps of Engineers. 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," WRAP Technical Notes Collection (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center. Vicksburg, MS.

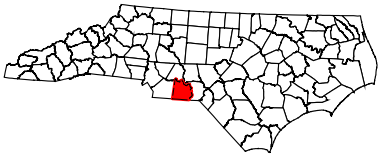
United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines, April 2003. Wilmington District, NC.

Appendix A

Project Vicinity Map and Background Tables

The subject project site is an environmental restoration site of the NCDEQ Ecosystem Division of Mitigation Servies (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.





Anson County

Figure 1
Project Vicinity Map
Brown Creek Tributaries

NCDEQ -
Division of Mitigation Services

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0 0.5 1 2
Miles

Table 1. Project Components and Mitigation Credits

Brown Creek Tributaries Restoration Project: DMS Project No ID. 95351

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE							
Totals	9,753.9	103.6							

Project Components

Project Component or Reach ID	Stationing/ Location [1]	Existing Footage/ Acreage (LF)	Approach	Restoration/ Restoration Equivalent (SMU)	Restoration Footage or Acreage (LF)	Mitigation Ratio
HC-R1	10+00 - 30+43	1,896	Restoration	2,043	2,043	1:1
HC-R2	30+43 - 30+52 & 30+82 - 44+67	1,288	Restoration	1,394	1,394	1:1
HC-R3	10+36 - 16+00	579	Enhancement Level II	225.6	564	2.5:1
UT4-R1a	10+00 - 15+18	518	Preservation	103.6	518	5:1
UT4-R1b	11+07 - 19+64	906	Restoration	858	858	1:1
UT4-R2	19+64 - 21+11 & 21+42 - 38+23	1,673	Restoration	1,828	1,828	1:1
UT4-R3	28+92 - 31+42	244	Restoration	250	250	1:1
UT4-R4a	10+00 - 13+96	395	Restoration	396	396	1:1
UT4-R4b	14+28 - 25+23 & 25+43 - 28+92	1,392	Restoration	1,444	1,444	1:1
UT4-R5a	09+44 - 13+35	386	Enhancement Level I	260.7	391	1.5:1
UT4-R5b	14+40 - 30+22	1,535	Enhancement Level I	1,054.7	1,582	1.5:1

Component Summation

Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)
		Riverine	Non-Riverine			
Restoration	8,213					
Enhancement I	1,973					
Enhancement II	564					
Preservation	518					

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

[1] All powerline easements and cattle/vehicular crossings were excluded from the conservation easement boundary and so no credit reductions are associated with those features.

Table 2. Project Activity and Reporting History			
Brown Creek Tributaries Restoration Project: DMS Project No ID. 95351			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan Prepared	N/A	N/A	Jan-14
Mitigation Plan Amended	N/A	N/A	Mar-14
Mitigation Plan Approved	Nov-13	N/A	Jun-14
Final Design – (at least 90% complete)	N/A	N/A	Jun-14
Construction Begins	Sep-13	N/A	Nov-14
Temporary S&E mix applied to entire project area	Jul-14	N/A	May-15
Permanent seed mix applied to entire project area	Jul-14	N/A	May-15
Planting of live stakes	Jul-14	N/A	May-15 [1]
Planting of bare root trees	Jul-14	N/A	May-15 [1]
End of Construction	Jul-14	N/A	May-15
Survey of As-built conditions (Year 0 Monitoring-baseline)	Jul-14	Jul-15	Jul-15
Baseline Monitoring Report	Feb-15	Jul-15	Nov-16 [2]
Year 1 Monitoring	Dec-15	Feb-16 [3]	Jan-17
Year 2 Monitoring	Dec-16	N/A	N/A
Year 3 Monitoring	Dec-17	N/A	N/A
Year 4 Monitoring	Dec-18	N/A	N/A
Year 5 Monitoring	Dec-19	N/A	N/A
Year 6 Monitoring	Dec-20	N/A	N/A
Year 7 Monitoring	Dec-21	N/A	N/A

[1] All of HC and Reaches R1, R2, and R5 for UT4 were planted in March, while Reaches R3 and R4 were planted in mid-May for UT4.

[2] As-built / Baseline Report submission was delayed due to conservation easement adjustment issues.

[3] Veg plot monitoring was conducted in Nov 2015, while survey data was collected in Feb 2016 to ensure 180 days between the As-Built and MY1 surveys.

Table 3. Project Contacts **Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351**	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd, Suite 201 Asheville, NC 28806 Contact: Jake Byers, Tel. 828-412-6101
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seed Mix Sources Nursery Stock Suppliers	Green Resources, Tel. 336-855-6363 Mellow Marsh Farm, 919-742-1200 ArborGen, 843-528-3204
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518 Contact: Scott King, Tel. 919-481-5731
Stream Monitoring Point of Contact	Scott King, Tel. 919-481-5731
Vegetation Monitoring Point of Contact	Scott King, Tel. 919-481-5731

Table 4a. Project Attribute Information - Hurricane Creek (Pre-Construction) Brown Creek Tributaries Restoration Project Stream Mitigation Plan - DMS Project No. 95351			
Project Information			
Project Name	Brown Creek Tributaries Restoration Project – Hurricane Creek		
County	Anson		
Project Area (acres)	14.1		
Project Coordinates (latitude and longitude)	35.0498 N, -80.0665 W		
Watershed Summary Information			
Physiographic Province	Piedmont		
Geologic Unit	Triassic Basin		
River Basin	Yadkin		
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030		
NCDWR Sub-basin	03-07-10		
Project Drainage Area (acres)	1,383		
Project Drainage Area Percentage Impervious	2%		
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (2%)		
Stream Reach Summary Information			
Parameters	**HC-R1**	**HC-R2**	**HC-R3**
Length of Reach (linear feet)	1,347	1,384	546
Valley Classification (Rosgen)	VII	VII	VII
Drainage Area (acres)	1,077	1,383	119
NCDWR Stream Identification Score	26.5	31	23
NCDWR Water Resources Classification	Class C		
Morphological Description (Rosgen stream type)	Incised E	Incised E	G/Incised Bc
Evolutionary Trend	Incised	Incised E→G→F	Incised B → G → F
Underlying Mapped Soils	ChA	ChA	CrB
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Non-Hydric
Average Channel Slope (ft/ft)	0.0035	0.0024	0.0108
FEMA Classification	Zone AE	Zone AE	Zone AE
Native Vegetation Community	Piedmont Small Stream		
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%
Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

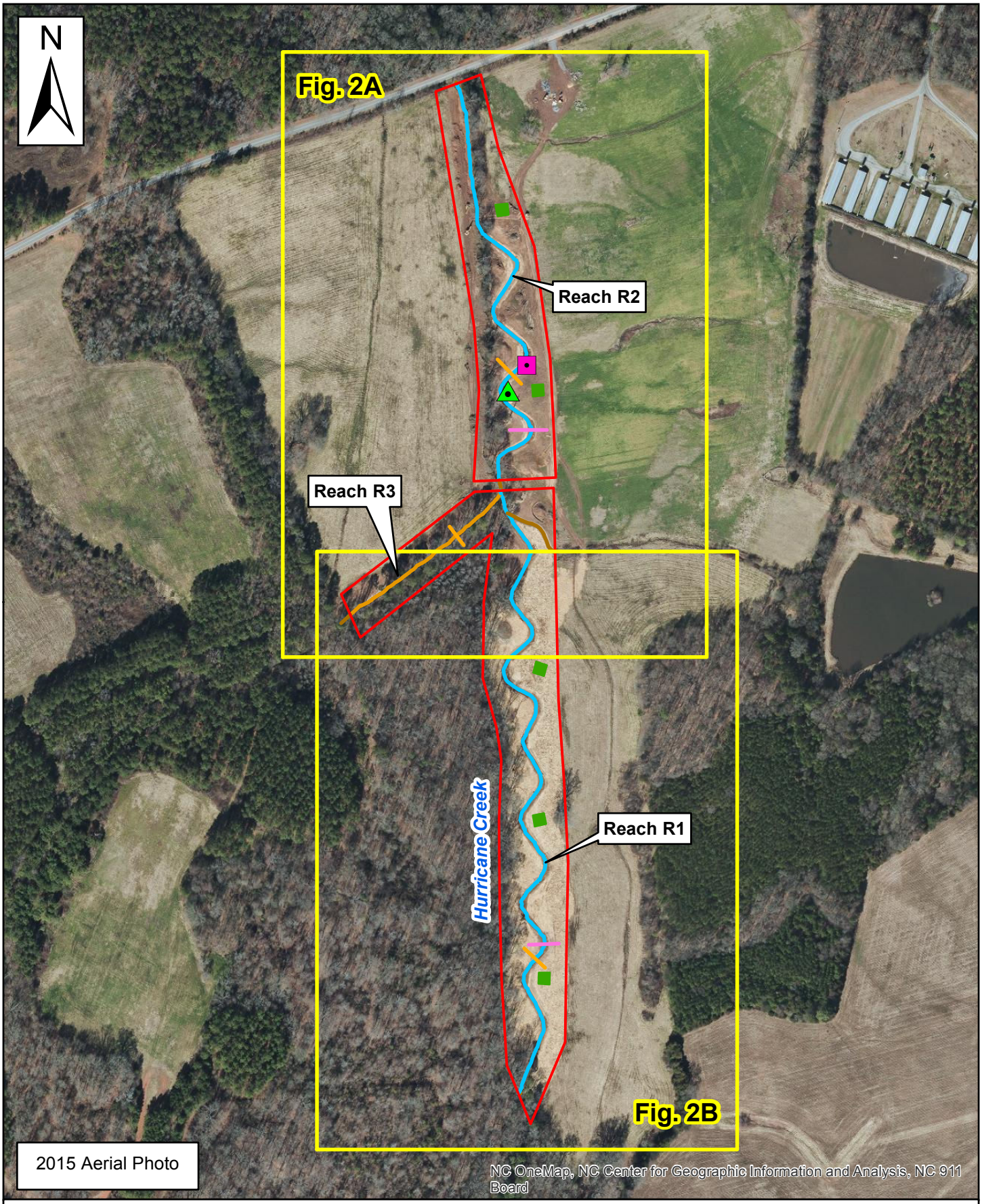
Table 4b. Project Attribute Information - UT4 (Pre-Construction)
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - DMS Project No. 95351

Project Information					
Project Name	Brown Creek Tributaries Restoration Project – UT4				
County	Anson				
Project Area (acres)	29.2				
Project Coordinates (latitude and longitude)	35.0477 N, -80.0274 W				
Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Yadkin				
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030				
DWR Sub-basin	03-07-10				
Project Drainage Area (acres)	974				
Project Drainage Area Percent Impervious	<2%				
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (<2%)				
Stream Reach Summary Information					
Parameters	**UT4-R1**	**UT4-R2**	**UT4-R3**	**UT4-R4**	**UT4-R5**
Length of Reach (linear feet)	1,417	1,627	242	1,716	1,564
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	218	706	974	267	452
NCDWR Stream Identification Score	28.5	29	32	26	23.5
NCDWR Water Resources Classification	Class C				
Morphological Description (Rosgen stream type)	F/G	Incised E	G	G	Incised Bc / C
Evolutionary Trend	Incised E → Gc → F	Bc → G → F	Bc→G→F	Incised E → G → F	Incised E → G → F
Underlying Mapped Soils	ChA	ChA	ChA	ChA, MaB	ChA
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0077	0.0053	0.0009	0.0073	0.0038
FEMA Classification	N/A	Zone AE	Zone AE	Zone AE	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 (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)

Appendix B

Visual Assessment Data



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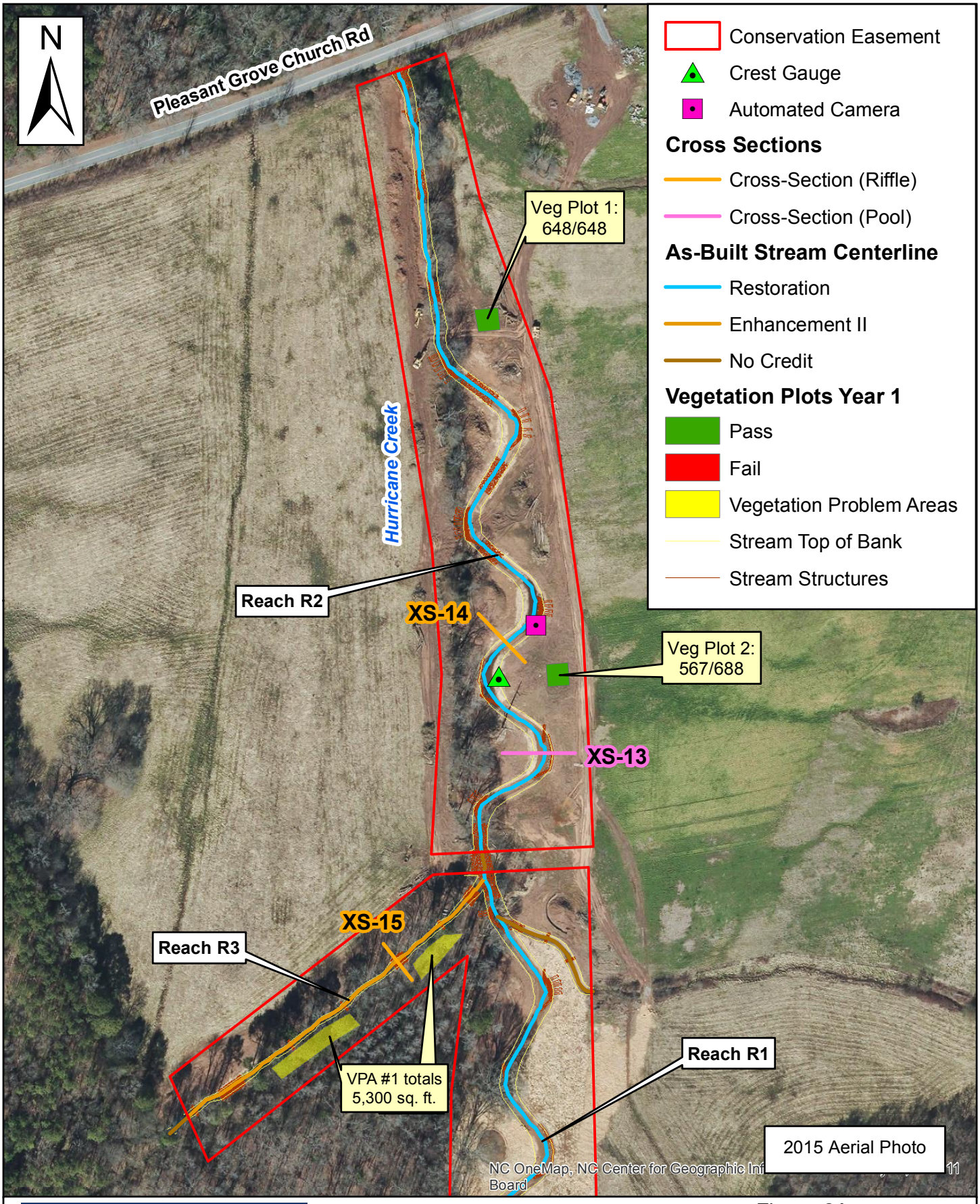
0 250 500 Feet

DMS Project #95351

Figure 2: Overview Map 1
Current Conditions Plan View
Monitoring Year 1
Hurricane Creek Site

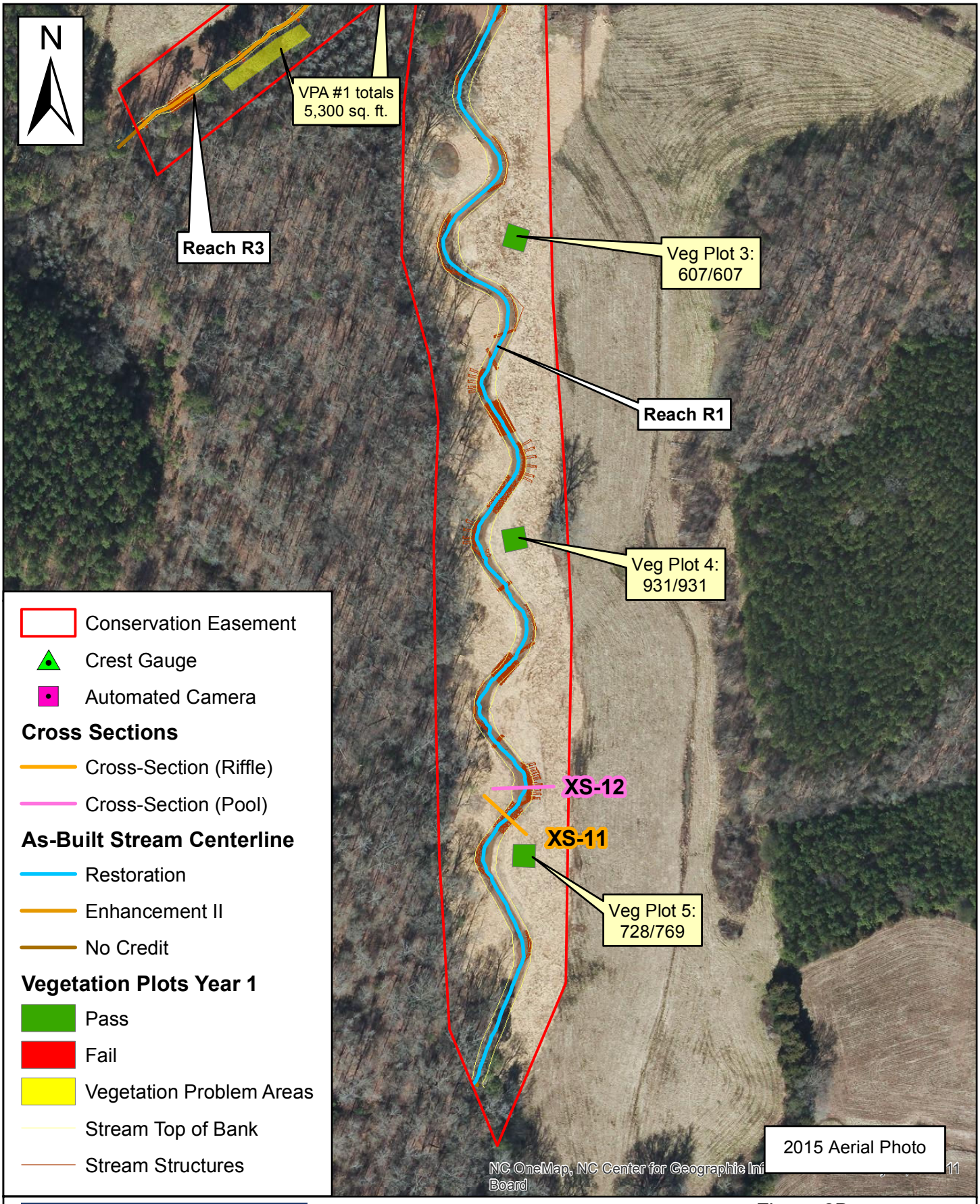


Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2A
Current Conditions Plan View
Monitoring Year 1
Hurricane Creek Site

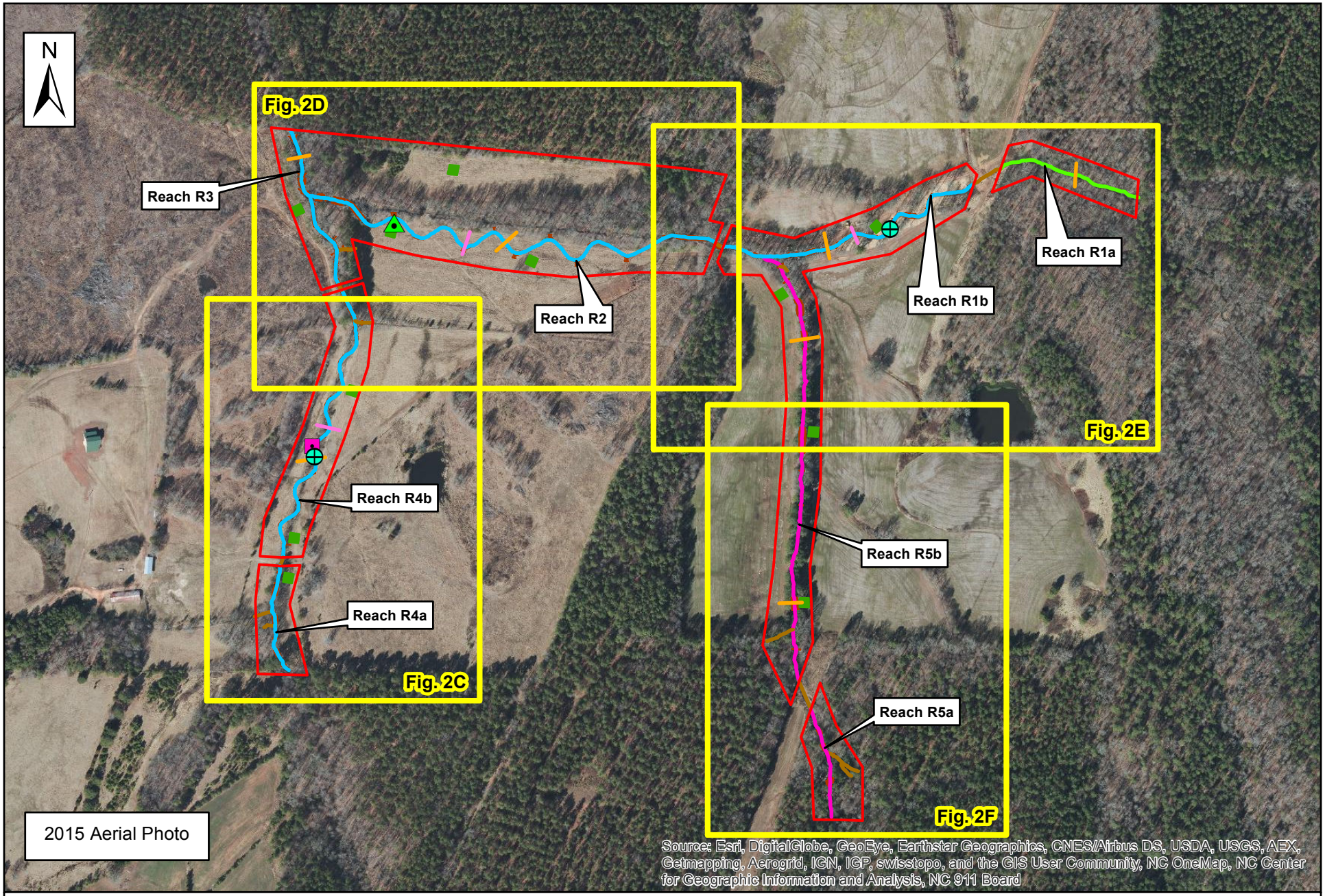


Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2B
Current Conditions Plan View
Monitoring Year 1
Hurricane Creek Site

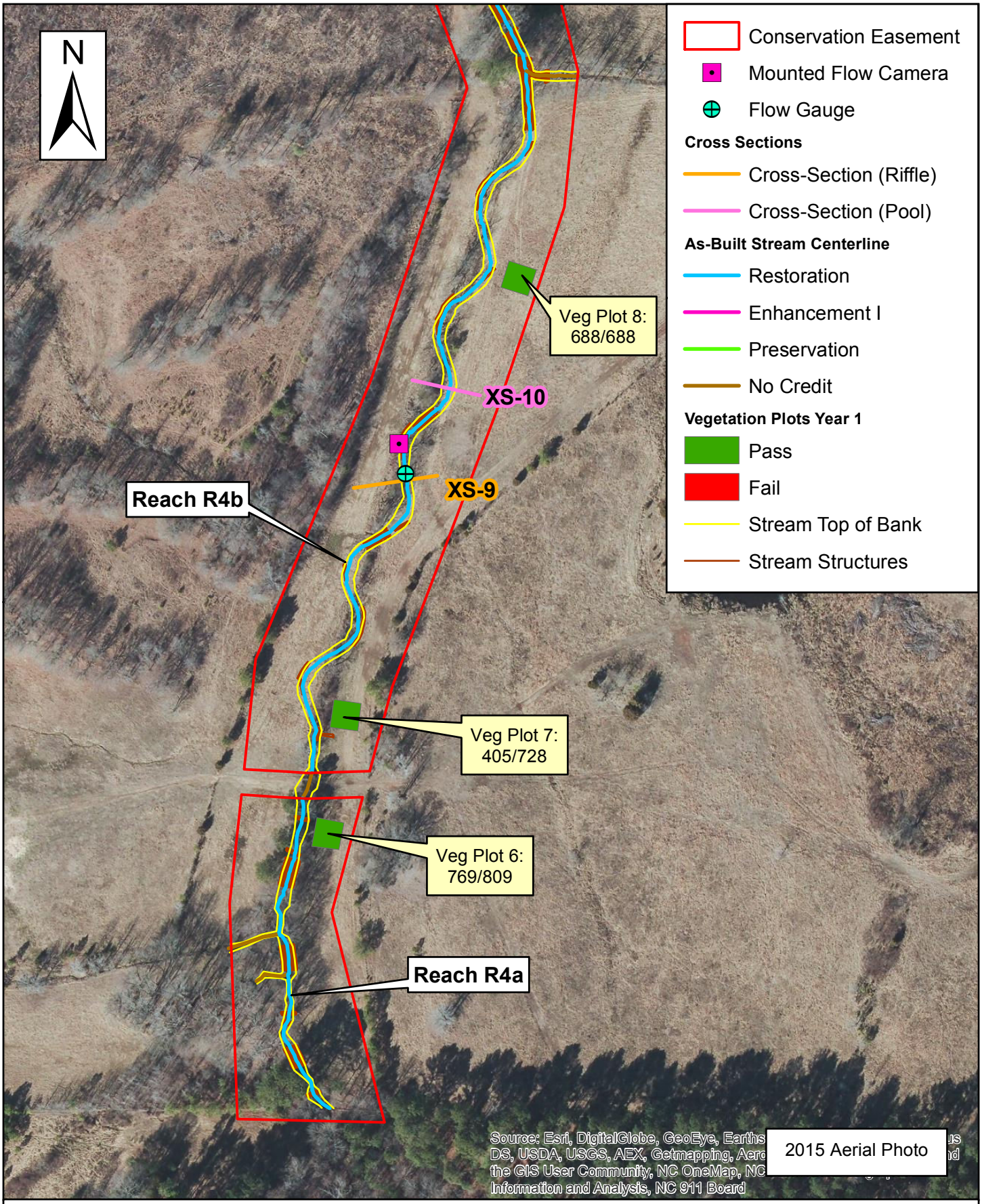


Michael Baker INTERNATIONAL

0 250 500 750 1,000 Feet

DMS Project #95351

Figure 2: Overview Map 2
Current Condition Plan View
Monitoring Year 1
Brown Creek Tribs: UT4 Site

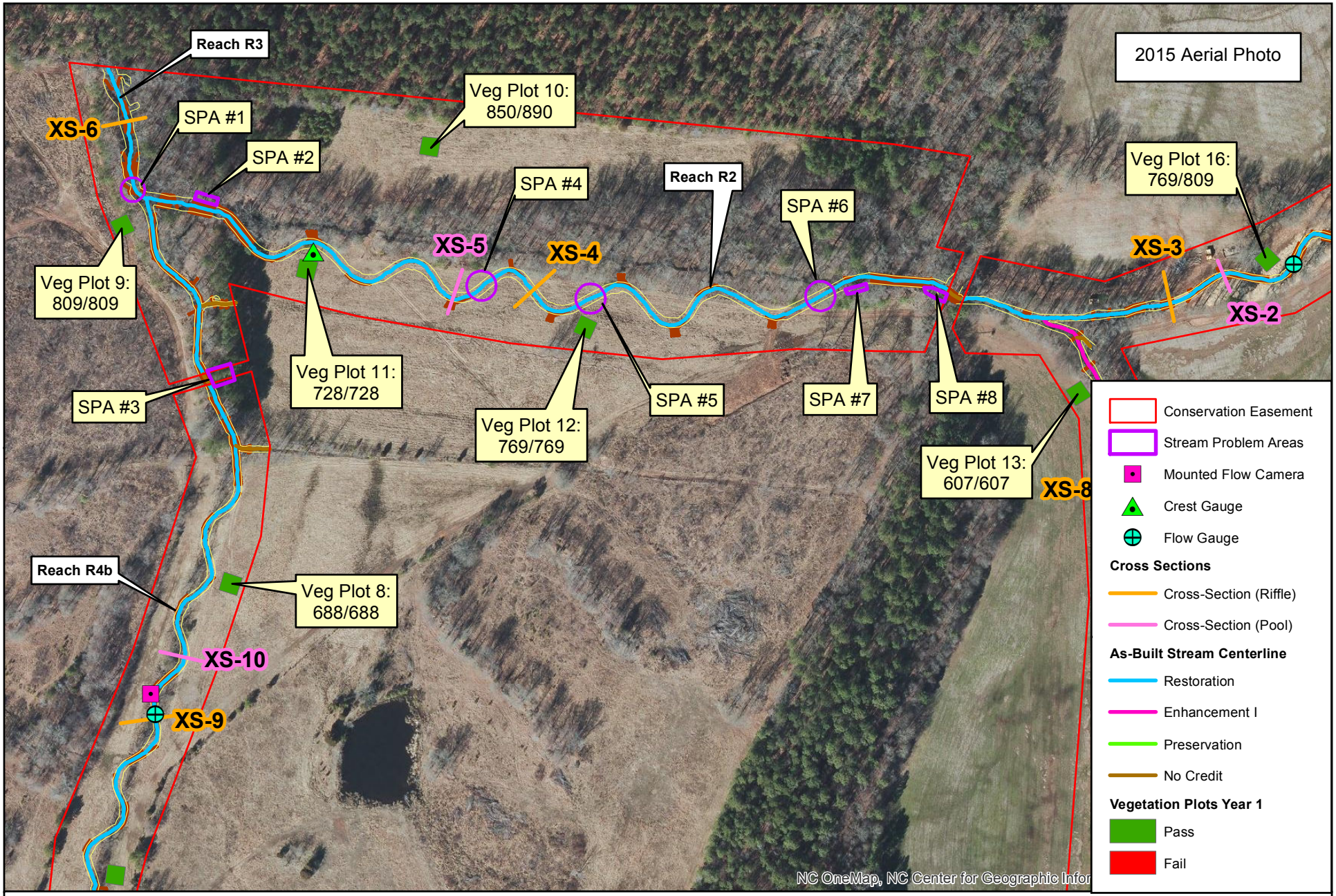


Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2C
Current Condition Plan View
Monitoring Year 1
Brown Creek Tribs: UT4 Site



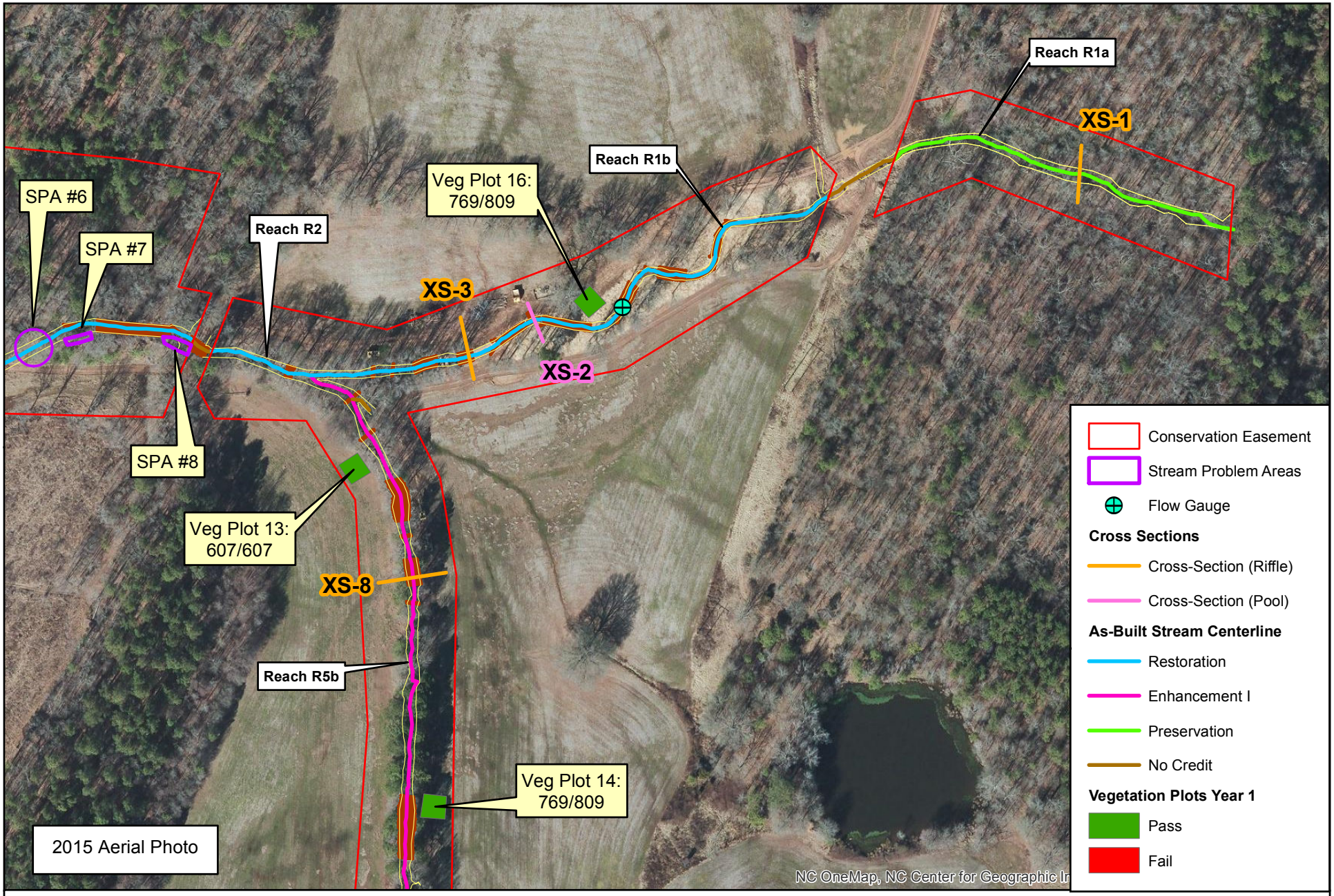
Michael Baker INTERNATIONAL

0 100 200 300 400 500 Feet

DMS Project #95351

N

Figure 2D
Current Condition Plan View
Monitoring Year 1
Brown Creek Tribs: UT4 Site



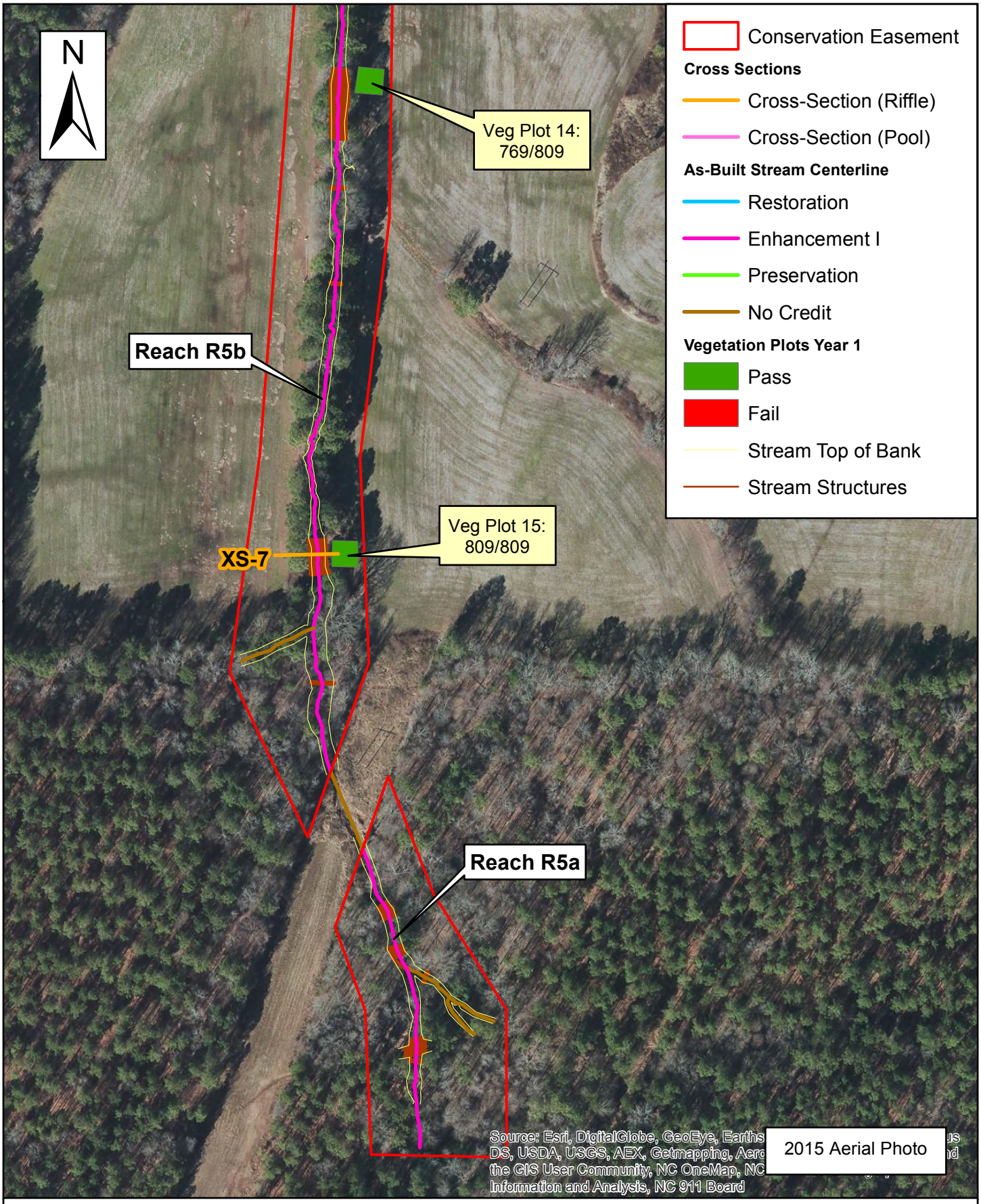
Michael Baker INTERNATIONAL

0 100 200 300 400 500 Feet

DMS Project #95351

N

Figure 2E
Current Condition Plan View
Monitoring Year 1
Brown Creek Tribs: UT4 Site



Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2F
Current Condition Plan View
Monitoring Year 1
Brown Creek Tribs: UT4 Site

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Reach ID: HC-R1
Assessed Length (LF): 2,043

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	14	14			100%			
		2. Length	14	14			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	14	14			100%			
		3. Thalweg centering along valley	15	15			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	37	37			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	13	13			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	18	18			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	37	37			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	27	27			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: HC-R2

Assessed Length (LF): 1,394

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	10	10			100%			
	3. Meander Pool Condition	1. Depth	9	9			100%			
		2. Length	9	9			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
		3. Thalweg centering along valley	10	10			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	22	22			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	7	7			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	22	22			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	13	13			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Reach ID: HC-R3
Assessed Length (LF): 564

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	5	5			100%			
	3. Meander Pool Condition	1. Depth	6	6			100%			
		2. Length	6	6			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	6	6			100%			
		3. Thalweg centering along valley	5	5			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	7	7			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	7	7			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	7	7			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	3	3			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: UT4-R1

Assessed Length (LF): 1,376

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	10	10			100%			
		2. Length	10	10			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
		3. Thalweg centering along valley	9	9			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	18	18			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	10	10			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	12	12			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	18	18			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	9	9			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: UT4-R2

Assessed Length (LF): 1,828

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			3	240	87%			
	2. Riffle Condition	1. Texture Substrate	12	15			80%			
	3. Meander Pool Condition	1. Depth	16	16			100%			
		2. Length	13	16			81%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	16	16			100%			
		3. Thalweg centering along valley	15	15			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	50	99%	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			1	12	99.7%	0	0	99.7%
				Totals	3	62	98%	0	0	98%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	27	27			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	23	23			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	22	23			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	23	23			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: UT4-R3

Assessed Length (LF): 250

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	3	3			100%			
	3. Meander Pool Condition	1. Depth	4	4			100%			
		2. Length	4	4			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)	4	4			100%			
		3. Thalweg centering along valley	3	3			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	10	98%	0	0	98%
	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	1	10	98%	0	0	98%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	5	6			83%			
	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	2	3			67%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	5	6			83%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	2	3			67%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: UT4-R4

Assessed Length (LF): 1,840

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	22	22			100%			
	3. Meander Pool Condition	1. Depth	23	23			100%			
		2. Length	23	23			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	22	22			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	23	23			100%			
		3. Thalweg centering along valley	22	22			100%			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	20	99%	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	1	20	99%	0	0	99%
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	47	47			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	28	28			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	29	29			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	47	47			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	28	28			100%			

Table 5a. Visual Stream Morphology Stability Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Reach ID: UT4-R5

Assessed Length (LF): 1,973

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	5	5			100%			
		2. Length	5	5			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	6	6			100%			
		2. Thalweg centering at downstream of meander bend (Glide)	5	5			100%			
		3. Thalweg centering along valley	6	6			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	16	16			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	14	14			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	16	16			100%			
	4. Habitat	Pool forming structures maintaining - Max Pool Depth, Rootwads/logs providing some cover at low flow	10	10			100%			

Table 5b. Stream Problem Areas (SPAs)

Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

SPA #	Feature Issue	Reach ID, Station Number	Suspected Cause	Photo # in Problem area Photo Log
1	Log J-Hook failure	UT4-R3, 29+00	Overbank flows from fall and winter storms[1]	1
2	Bank erosion	UT4-R2, 37+40	Overbank flows from fall and winter storms[1]	2
3	Ford crossing washed out	UT4-R4, 25+30	Overbank flows from fall and winter storms[1]	3
4	Riffle scour	UT4-R2, 31+00	Overbank flows from fall and winter storms[1]	4
5	Riffle scour	UT4-R2, 28+75	Overbank flows from fall and winter storms[1]	5
6	Riffle scour	UT4-R2, 24+00	Overbank flows from fall and winter storms[1]	6
7	Bank erosion	UT4-R2, 23+10	Overbank flows from fall and winter storms[1]	6
8	Scour in floodplain	UT4-R2, 21+40 to 21+75	Overbank flows from fall and winter storms[1]	7, 8

Note:

[1] The overbank flows from Hurricane Joaquin on Oct 2-3, 2015 contributed to the initial destabilization of the listed structures, banks, and floodplain area. Subsequent storm events of equal or greater size on November 2nd and 19th, and on December 30th continued the scour and structure damage. The SPAs resulted from an accumulation of these high flow events that cannot be attributed to any single large storm.

Table 6a. Vegetation Conditions Assessment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Planted Acreage: 33.5

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: 43.3

Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
5. Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale)	1000 ft²	yellow polygons	2	0.12	0.3%
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)
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

VPA #	Feature Issue	Station Number	Suspected Cause	Photo # in Problem area Photo Log
1	Chinese privet (*Ligustrum sinsense*)	HC-R3, station ~14+00	Resprout	9

Stream Photographs: UT4 Site

Reach UT4-R4ab – View upstream, Station 11+50

Reach UT4-R4a – View upstream, Station 12+10

Reach UT4-R4a – View upstream, Station 13+20

Reach UT4-R4a – View upstream, Station 14+00

Reach UT4-R4b – View downstream, Station 14+10

Reach UT4-R4b – View downstream, Station 17+80

Stream Photographs: UT4 Site

Reach UT4-R4b – View downstream, Station 18+90

Reach UT4-R4b – View upstream, Station 21+25

Reach UT4-R4b – View downstream, Station 24+00

Reach UT4-R4b – View upstream, Station 25+00

Reach UT4-R4b – View at Station 27+00

Reach UT4-R4b – View upstream, Station 28+00

Stream Photographs: UT4 Site

Reach UT4-R4b – View downstream, Station 28+00

Reach UT4-R3 – View downstream, Station 29+00

Reach UT4-R3 – View upstream, Station 29+90

Reach UT4-R3 – View downstream, Station 31+00

Reach UT4-R2 – View upstream, Station 36+90

Reach UT4-R2 – View upstream, Station 34+75

Stream Photographs: UT4 Site

Reach UT4-R2 – View downstream, Station 31+75

Reach UT4-R2 – View downstream, Station 27+00

Reach UT4-R2 – View upstream, Station 24+75

Reach UT4-R2 – View upstream, Station 23+00

Reach UT4-R2 – View of crossing at Station 21+25

Reach UT4-R2 – View downstream, Station 20+00

Stream Photographs: UT4 Site

Reach UT4-R2 – View upstream, Station 19+90

Reach UT4-R1b – View upstream, Station 19+00

Reach UT4-R1b – View upstream, Station 17+00

Reach UT4-R1b – View downstream, Station 14+50

Reach UT4-R1b – View upstream at Station 14+50

Reach UT4-R1b – View downstream, Station 13+10

Stream Photographs: UT4 Site

Reach UT4-R1a – View upstream, Station 12+00

Reach UT4-R1a – View downstream, Station 13+00

Reach UT4-R5b – View upstream, Station 28+25

Reach UT4-R5b – View upstream, Station 23+50

Reach UT4-R5b – View downstream, Station 22+10

Reach UT4-R5b – View upstream, Station 22+10

Stream Photographs: UT4 Site

Reach UT4-R5b – View downstream, Station 16+90

Reach UT4-R5a – View downstream, Station 11+80

Reach UT4-R5a – View upstream, Station 11+75

Reach UT4-R5a – View upstream, Station 11+25

Reach UT4-R5a – View upstream, Station 10+60

Reach UT4-R5a – View downstream, Station 10+00

Stream Photographs: Hurricane Creek Site

Reach HC-R2 – View downstream to culvert, Station 43+75

Reach HC-R2 – View downstream, Station 40+25

Reach HC-R2 – View of left floodplain at Station 39+50

Reach HC-R2 – View downstream, Station 38+75

Reach HC-R2 – View downstream, Station 37+15

Reach HC-R2 – View upstream, Station 37+15

Stream Photographs: Hurricane Creek Site

Reach HC-R2 – View upstream, Station 35+25

Reach HC-R1 – View upstream, Station 30+00

Reach HC-R1 – View upstream, Station 27+00

Reach HC-R1 –Floodplain pool at Station 26+00

Reach HC-R1 – View upstream, Station 24+20

Reach HC-R1 – View downstream, Station 20+50

Stream Photographs: Hurricane Creek Site

Reach HC-R1 – View upstream, Station 18+00

Reach HC-R1 – View upstream, Station 16+20

Reach HC-R1 – View upstream, Station 15+00

Reach HC-R1 – Log vane at Station 13+50

Reach HC-R3 – View of crossing at Station 10+20

Reach HC-R3 – View downstream from culvert, Station 10+30

Stream Photographs: Hurricane Creek Site

Reach HC-R3 – View downstream, Station 14+00

Reach HC-R3 – View downstream, Station 14+50

Reach HC-R3 – View upstream, Station 15+50

Stream Flow Camera Photographs

Reach UT4-R4b: 08/06/15

Reach UT4-R4b: 11/10/15

Reach UT4-R4b: 11/11/15

Reach UT4-R4b: 12/1/15

Reach UT4-R4b: 12/23/15

Reach HC-R2: 10/29/15

Vegetation Plot Photographs

Vegetation Plot 1 – HC-R2

Vegetation Plot 2 – HC-R2

Vegetation Plot 3 – HC-R1

Vegetation Plot 4 – HC-R1

Vegetation Plot 5– HC-R1

Vegetation Plot 6 – UT4-R4

Vegetation Plot Photographs

Vegetation Plot 7 – UT4-R4

Vegetation Plot 8 – UT4-R4

Vegetation Plot 9 – UT4-R3

Vegetation Plot 10 – UT4-R2

Vegetation Plot 11 – UT4-R2

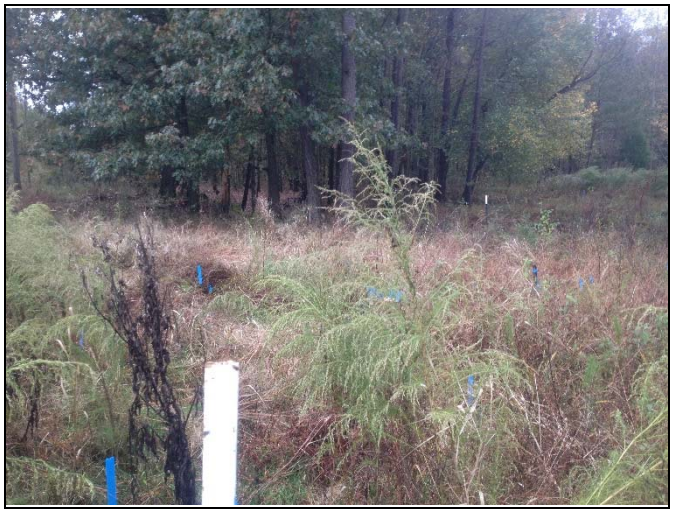
Vegetation Plot 12 – UT4-R2

Vegetation Plot Photographs

Vegetation Plot 13 – UT4-R5

Vegetation Plot 14 – UT4-R5

Vegetation Plot 15 – UT4-R5



Vegetation Plot 16 – UT4-R1

Monitoring Gauge Photographs

Reach UT4-R2 – Crest Gauge at Station 34+85

Reach UT4-R2: Overbank Event of 0.83’ (11/4/15)

Reach UT4-R4b – Flow Gauge and Camera at Station 18+90

Reach UT4-R1b – Flow Gauge at Station 14+90

Reach HC-R2 – Crest Gauge at Station 31+75

Reach HC-R2: Overbank Event of 0.94’ (10/29/15)

Stream and Vegetation Problem Area Photographs

1) Reach UT4-R3 – Log vane failure and bank erosion at Station 29+00

2) Reach UT4-R2 – Bank erosion at Station 37+40

3) Reach UT4-R4b – Crossing erosion at Station 25+30

4) Reach UT4-R2 – Riffle scour at Station 31+00

5) Reach UT4-R2 – Riffle scour at Station 28+75

6) Reach UT4-R2 – Riffle scour at Station 24+00, and bank scour/mass wasting at Station 23+10

Stream and Vegetation Problem Area Photographs

7) Reach UT4-R2 – Scour in floodplain, view downstream, Station 21+25

8) Reach UT4-R2 – Scour in floodplain, view upstream, Station 22+00

9) Reach HC-R3 – VPA: Invasive species resprouts (Chinese privet), Station 14+00

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Plot ID	Vegetation Survival Threshold Met?	Total/Planted Stem Count*	Tract Mean
1	Y	648/648	716
2	Y	567/688	
3	Y	607/607	
4	Y	931/931	
5	Y	728/769	
6	Y	769/809	
7	Y	405/728	
8	Y	688/688	
9	Y	809/809	
10	Y	850/890	
11	Y	728/728	
12	Y	769/769	
13	Y	607/607	
14	Y	769/809	
15	Y	809/809	
16	Y	769/809	

Note: *Total/Planted Stem Count reflects the changes in stem density based on the density of stems at the time of the As-Built Survey (Planted) and the current total density of planted stems (Total)

Table 8. CVS Vegetation Metadata
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Report Prepared By	Dwayne Huneycutt
Date Prepared	4/4/2016 15:34
database name	MichaelBaker_2015_BrownCrkTribs_95351.mdb
database location	L:\Monitoring\Veg Plot Info\CVS Data Tool\Brown Crk Tribs
computer name	CARYLDHUNEYCUTT
file size	59568128
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	95351
project Name	Brown Creek Tributaries
Description	
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	16

Table 9a. CVS Stem Count of Planted Stems by Plot and Species
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

	Comment	Species	SpType	CommonName	Total Planted Stems	# plots	avg# stems	plot 95351-01-0001-year:1	plot 95351-01-0002-year:1	plot 95351-01-0003-year:1	plot 95351-01-0004-year:1	plot 95351-01-0005-year:1	plot 95351-01-0006-year:1	plot 95351-01-0007-year:1	plot 95351-01-0008-year:1	plot 95351-01-0009-year:1	plot 95351-01-0010-year:1	plot 95351-01-0011-year:1	plot 95351-01-0012-year:1	plot 95351-01-0013-year:1	plot 95351-01-0014-year:1	plot 95351-01-0015-year:1	plot 95351-01-0016-year:1
		Alnus serrulata	Shrub Tree	hazel alder	6	5	1.2		1		1		2				1			1				
		Asimina triloba	Shrub Tree	pawpaw	3	3	1											1				1	1	
		Betula nigra	Tree	river birch	66	15	4.4	8	6	1	3	2	6	3	10	5	5	5	2		5	2	3
		Carpinus caroliniana	Shrub Tree	American hornbeam	6	4	1.5	1											3		1	1	
		Cornus amomum	Shrub	silky dogwood	1	1	1				1												
		Diospyros virginiana	Tree	common persimmon	13	6	2.17				4		2			3		1			1	2	
		Fraxinus pennsylvanica	Tree	green ash	49	14	3.5	3	5	6	1	4	7		2	5	3		3	2	1	3	4
		Hamamelis virginiana	Shrub Tree	American witchhazel	5	2	2.5													2		3	
		Itea virginica	Shrub	Virginia sweetspire	1	1	1														1		
		Lindera benzoin	Shrub Tree	northern spicebush	1	1	1														1		
		Liriodendron tulipifera	Tree	tuliptree	5	5	1			1	1	1					1			1			
		Nyssa sylvatica	Tree	blackgum	18	9	2				2					1	1	4	1	1	2	4	2
		Platanus occidentalis	Tree	American sycamore	34	13	2.62			3	3	2	1	2	1	4	4	3	6	3	1		1
		Quercus alba	Tree	white oak	23	13	1.77	1		2		2	1	3	2		4	1	2	1	2	1	1
		Quercus michauxii	Tree	swamp chestnut oak	20	12	1.67	1	1		1	2		2		1	1	1	2	4	3		1
		Quercus nigra	Tree	water oak	1	1	1			1													
		Quercus phellos	Tree	willow oak	13	7	1.86	1		1	3	1				1		2					4
		Viburnum dentatum	Shrub Tree	southern arrowwood	18	9	2	1	1		3	4			2		1				1	3	2
TOT:	**0**	**18**	**18**	**18**	**283**	**18**		**16**	**14**	**15**	**23**	**18**	**19**	**10**	**17**	**20**	**21**	**18**	**19**	**15**	**19**	**20**	**19**

Table 9b. Stem Count for Each Species Arranged by Plot
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Botanical Name	Common Name	Plots																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Tree Species																		
Betula nigra	river birch	8	6	1	3	2	6	3	10	5	5	5	2	1	5	2	3	
Fraxinus pennsylvanica	green ash	3	5	6	1	4	7		2	5	3		3	2	1	3	4	
Liriodendron tulipfera	tulip poplar			1	1	1					1			1				
Nyssa sylvatica	swamp tupelo				2					1	1	4	1	1	2	4	2	
Plantanus occidentalis	sycamore			3	3	2	1	2	1	4	4	3	6	3	1		1	
Quecus alba	white oak	1		2		2	1	3	2		4	1	2	1	2	1	1	
Quercus michauxii	swamp chestnut oak	1	1		1	2		2		1	1	1	2	4	3		1	
Quercus nigra	water oak			1														
Quercus phellos	willow oak	1		1	3	1				1		2					4	
Shrub Species																		
Alnus serrulata	ironwood		1		1		2				1							
Asimina triloba	paw paw											1				1	1	
Carpinus caroliniana	ironwood	1											3		1	1		
Cornus ammomum	silkly dogwod				1													
Diospyros virginiana	persimmon				4		2			3		1			1	2		
Hamamelis virginiana	witch hazel													2		3		
Itea virginica	Virginia sweetspire														1			
Lindera benzoin	spicebush														1			
Viburnum dentatum	arrowwood viburnum	1	1		3	4			2		1				1	3	2	
Volunteer Species																		
N/A																		Average Stems Per Acre
Stems Per Plot (November 2015)		16	14	15	23	18	19	10	17	20	21	18	19	15	19	20	19	
Total Stems/Acre Year 1 (November 2015)		648	567	607	931	728	769	405	688	809	850	728	769	607	769	809	769	**716**
Total Stems/ Acre for Year 0 As-Built (Baseline Data)		648	688	607	931	769	809	728	688	809	890	728	769	607	809	809	809	**756**

Table 9c. Yearly Density Per Plot
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

			Current Plot Data (MY1 2015)																							
			95351-01-0001			95351-01-0002			95351-01-0003			95351-01-0004			95351-01-0005			95351-01-0006			95351-01-0007			95351-01-0008		
Scientific Name	Common Name	Species Type	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
Alnus serrulata	hazel alder	Shrub				1	1	1				1	1	1				2	2	2						
Asimina triloba	pawpaw	Tree																								
Betula nigra	river birch	Tree	8	8	8	6	6	6	1	1	1	3	3	3	2	2	2	6	6	6	3	3	3	10	10	10
Carpinus caroliniana	American hornbeam	Tree	1	1	1																					
Cornus amomum	silky dogwood	Shrub										1	1	1												
Diospyros virginiana	common persimmon	Tree										4	4	4				2	2	2						
Fraxinus pennsylvanica	green ash	Tree	3	3	3	5	5	5	6	6	6	1	1	1	4	4	4	7	7	7				2	2	2
Hamamelis virginiana	American witchhazel	Tree																								
Itea virginica	Virginia sweetspire	Shrub																								
Lindera benzoin	northern spicebush	Shrub																								
Liriodendron tulipifera	tuliptree	Tree							1	1	1	1	1	1	1	1	1									
Nyssa sylvatica	blackgum	Tree										2	2	2												
Platanus occidentalis	American sycamore	Tree							3	3	3	3	3	3	2	2	2	1	1	1	2	2	2	1	1	1
Quercus alba	white oak	Tree	1	1	1				2	2	2				2	2	2	1	1	1	3	3	3	2	2	2
Quercus michauxii	swamp chestnut oak	Tree	1	1	1	1	1	1				1	1	1	2	2	2				2	2	2			
Quercus nigra	water oak	Tree							1	1	1															
Quercus phellos	willow oak	Tree	1	1	1				1	1	1	3	3	3	1	1	1									
Viburnum dentatum	southern arrowwood	Shrub	1	1	1	1	1	1				3	3	3	4	4	4							2	2	2
		Stem count	16	16	16	14	14	14	15	15	15	23	23	23	18	18	18	19	19	19	10	10	10	17	17	17
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	7	7	7	5	5	5	7	7	7	11	11	11	8	8	8	6	6	6	4	4	4	5	5	5
		Stems per ACRE	647	647	647	567	567	567	607	607	607	931	931	931	728	728	728	769	769	769	405	405	405	688	688	688

Table 9c. (Continued) Yearly Density Per Plot
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

			Current Plot Data (MY1 2015)																							
			95351-01-0009			95351-01-0010			95351-01-0011			95351-01-0012			95351-01-0013			95351-01-0014			95351-01-0015			95351-01-0016			MY1 (2015)		
Scientific Name	Common Name	Species Type	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
Alnus serrulata	hazel alder	Shrub				1	1	1							1	1	1										6	6	6
Asimina triloba	pawpaw	Tree							1	1	1										1	1	1	1	1	1	3	3	3
Betula nigra	river birch	Tree	5	5	5	5	5	5	5	5	5	2	2	2				5	5	5	2	2	2	3	3	3	66	66	66
Carpinus caroliniana	American hornbeam	Tree										3	3	3				1	1	1	1	1	1				6	6	6
Cornus amomum	silky dogwood	Shrub																									1	1	1
Diospyros virginiana	common persimmon	Tree	3	3	3				1	1	1							1	1	1	2	2	2				13	13	13
Fraxinus pennsylvanica	green ash	Tree	5	5	5	3	3	3				3	3	3	2	2	2	1	1	1	3	3	3	4	4	4	49	49	49
Hamamelis virginiana	American witchhazel	Tree													2	2	2				3	3	3				5	5	5
Itea virginica	Virginia sweetspire	Shrub																1	1	1							1	1	1
Lindera benzoin	northern spicebush	Shrub																1	1	1							1	1	1
Liriodendron tulipifera	tuliptree	Tree				1	1	1							1	1	1										5	5	5
Nyssa sylvatica	blackgum	Tree	1	1	1	1	1	1	4	4	4	1	1	1	1	1	1	2	2	2	4	4	4	2	2	2	18	18	18
Platanus occidentalis	American sycamore	Tree	4	4	4	4	4	4	3	3	3	6	6	6	3	3	3	1	1	1				1	1	1	34	34	34
Quercus alba	white oak	Tree				4	4	4	1	1	1	2	2	2	1	1	1	2	2	2	1	1	1	1	1	1	23	23	23
Quercus michauxii	swamp chestnut oak	Tree	1	1	1	1	1	1	1	1	1	2	2	2	4	4	4	3	3	3				1	1	1	20	20	20
Quercus nigra	water oak	Tree																									1	1	1
Quercus phellos	willow oak	Tree	1	1	1				2	2	2													4	4	4	13	13	13
Viburnum dentatum	southern arrowwood	Shrub				1	1	1										1	1	1	3	3	3	2	2	2	18	18	18
		Stem count	20	20	20	21	21	21	18	18	18	19	19	19	15	15	15	19	19	19	20	20	20	19	19	19	283	283	283
		size (ares)	1			1			1			1			1			1			1			1			16		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.40		
		Species count	7	7	7	9	9	9	8	8	8	7	7	7	8	8	8	11	11	11	9	9	9	9	9	9	18	18	18
		Stems per ACRE	809	809	809	850	850	850	728	728	728	769	769	769	607	607	607	769	769	769	809	809	809	769	769	769	716	716	716

Table 9d. Vegetation Summary and Totals
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Year 1 (4-Nov-2015)

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	16	0	0	0	16	0
2	n/a	14	0	0	0	14	0
3	n/a	15	0	0	0	15	0
4	n/a	23	0	0	0	23	0
5	n/a	18	0	0	0	18	0
6	n/a	19	0	0	0	19	0
7	n/a	10	0	0	0	10	0
8	n/a	17	0	0	0	17	0
9	n/a	20	0	0	0	20	0
10	n/a	21	0	0	0	21	0
11	n/a	18	0	0	0	18	0
12	n/a	19	0	0	0	19	0
13	n/a	15	0	0	0	15	0
14	n/a	19	0	0	0	19	0
15	n/a	20	0	0	0	20	0
16	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	647	0	647	Yes
2	567	0	567	Yes
3	607	0	607	Yes
4	931	0	931	Yes
5	728	0	728	Yes
6	769	0	769	Yes
7	405	0	405	Yes
8	688	0	688	Yes
9	809	0	809	Yes
10	850	0	850	Yes
11	728	0	728	Yes
12	769	0	769	Yes
13	607	0	607	Yes
14	769	0	769	Yes
15	809	0	809	Yes
16	769	0	769	Yes
Project Avg	**716**	**0**	**716**	**Yes**

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 Assessment Data

Figure 3.

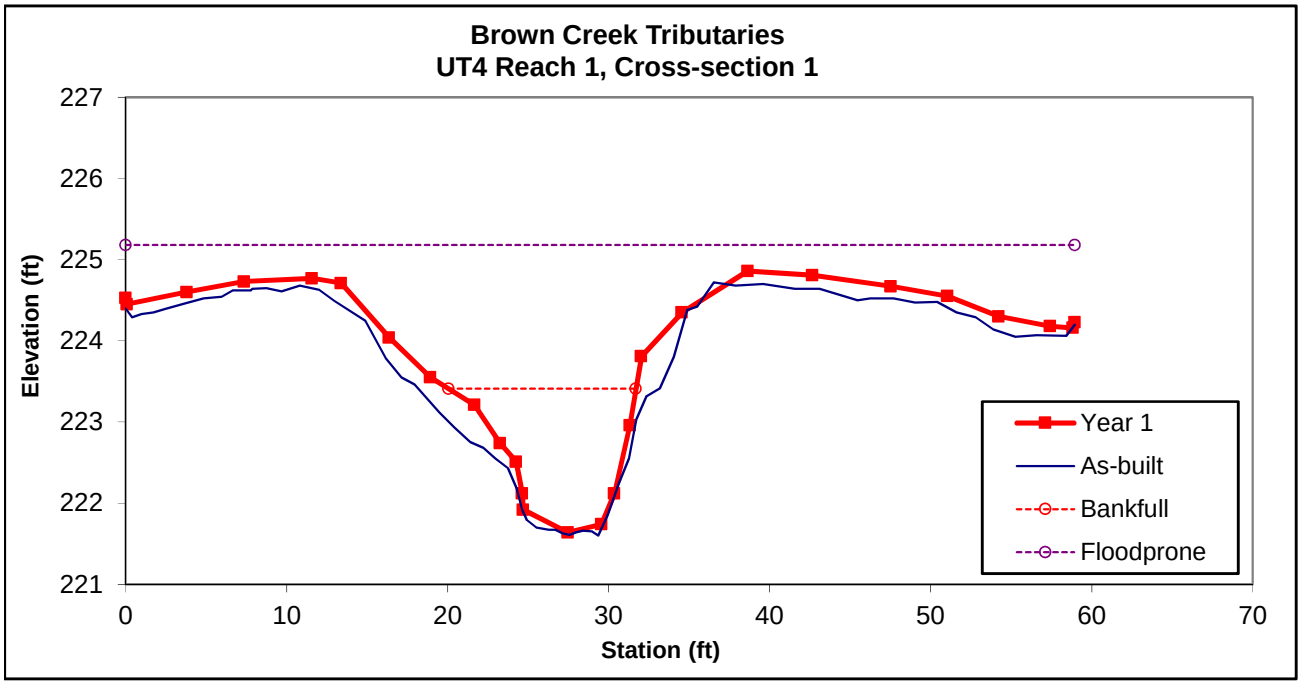
Permanent Cross-section 1

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	12.4	11.64	1.06	1.77	10.96	1.1	5.1	223.41	223.55



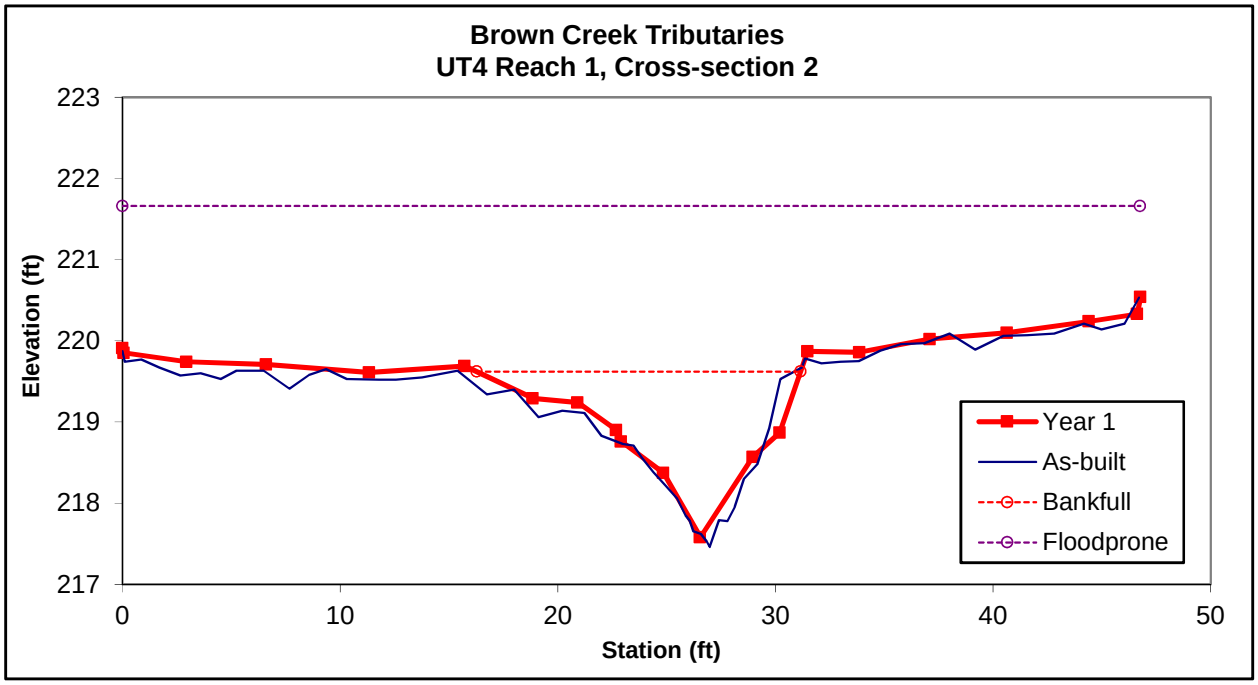
Permanent Cross-section 2

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		12.3	14.89	0.83	2.04	17.95	1	3.1	219.62	219.69



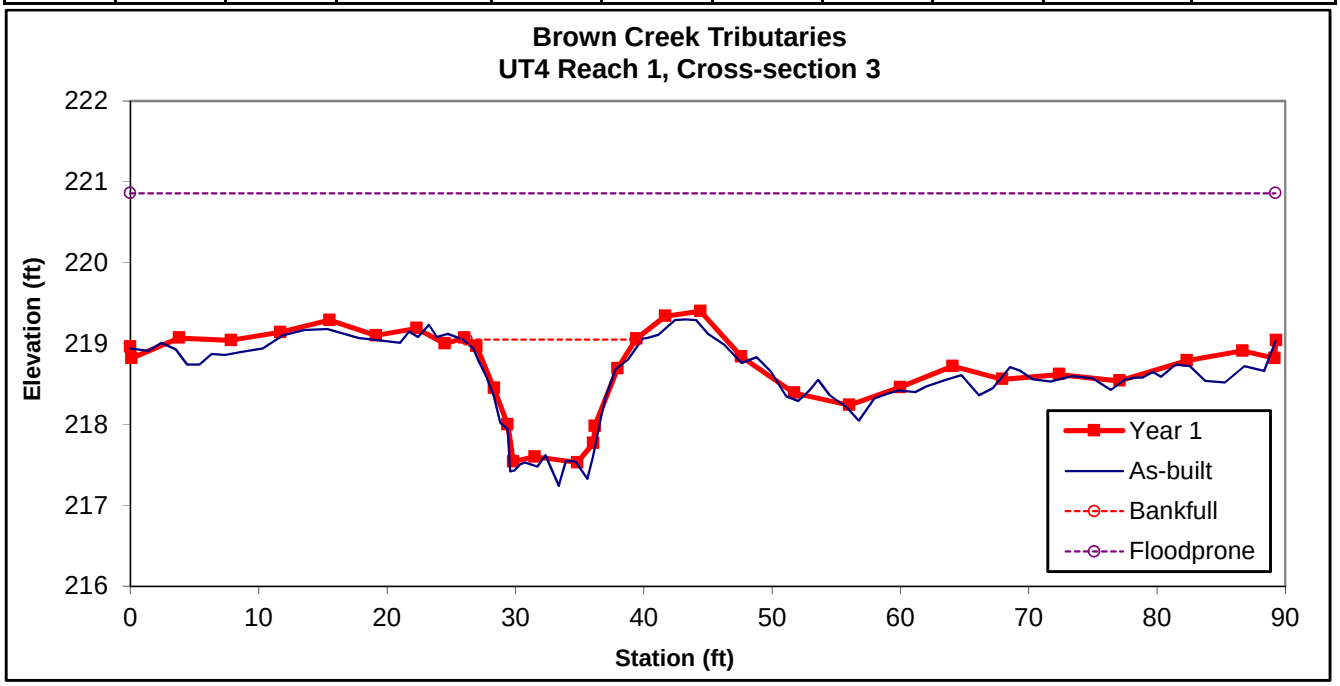
Permanent Cross-section 3

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

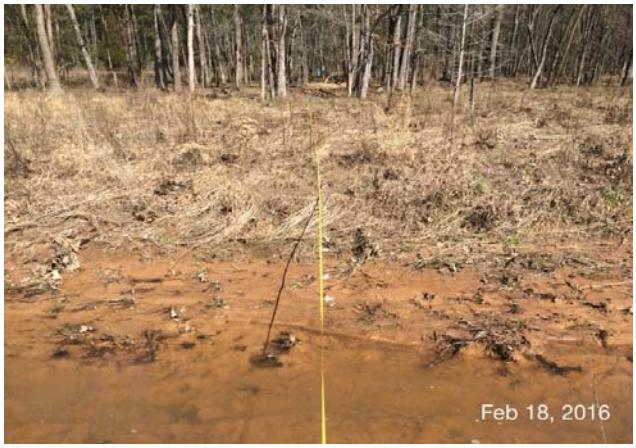
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	12.7	13.18	0.97	1.52	13.62	1	6.8	219.05	219.06



Permanent Cross-section 4

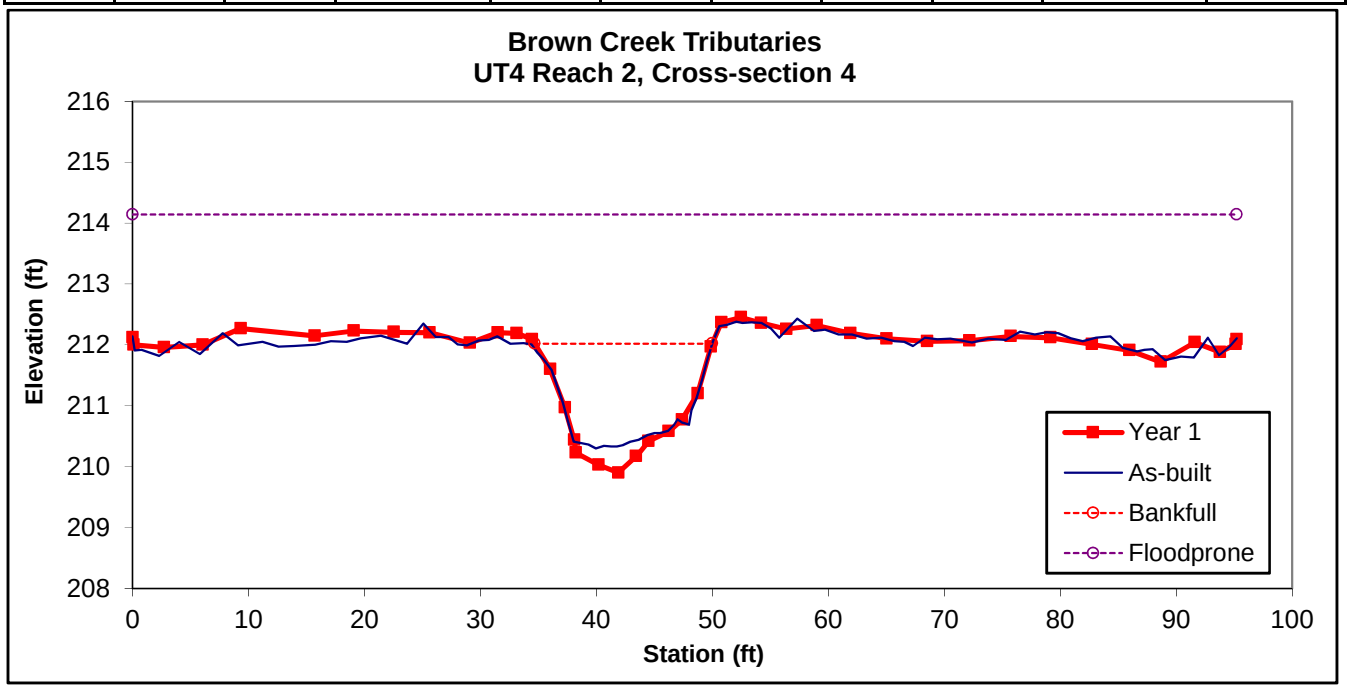
Year 1 Data - Collected February 2016

Looking at the Left Bank



Looking at the Right Bank

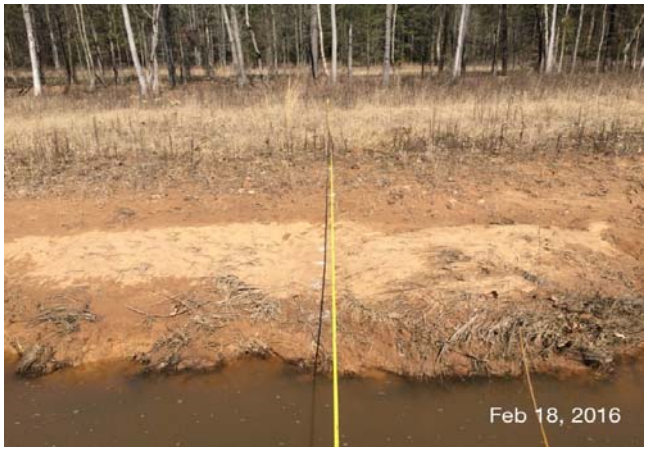
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	20.7	15.32	1.35	2.12	11.34	1	6.2	212.02	212.09



Permanent Cross-section 5

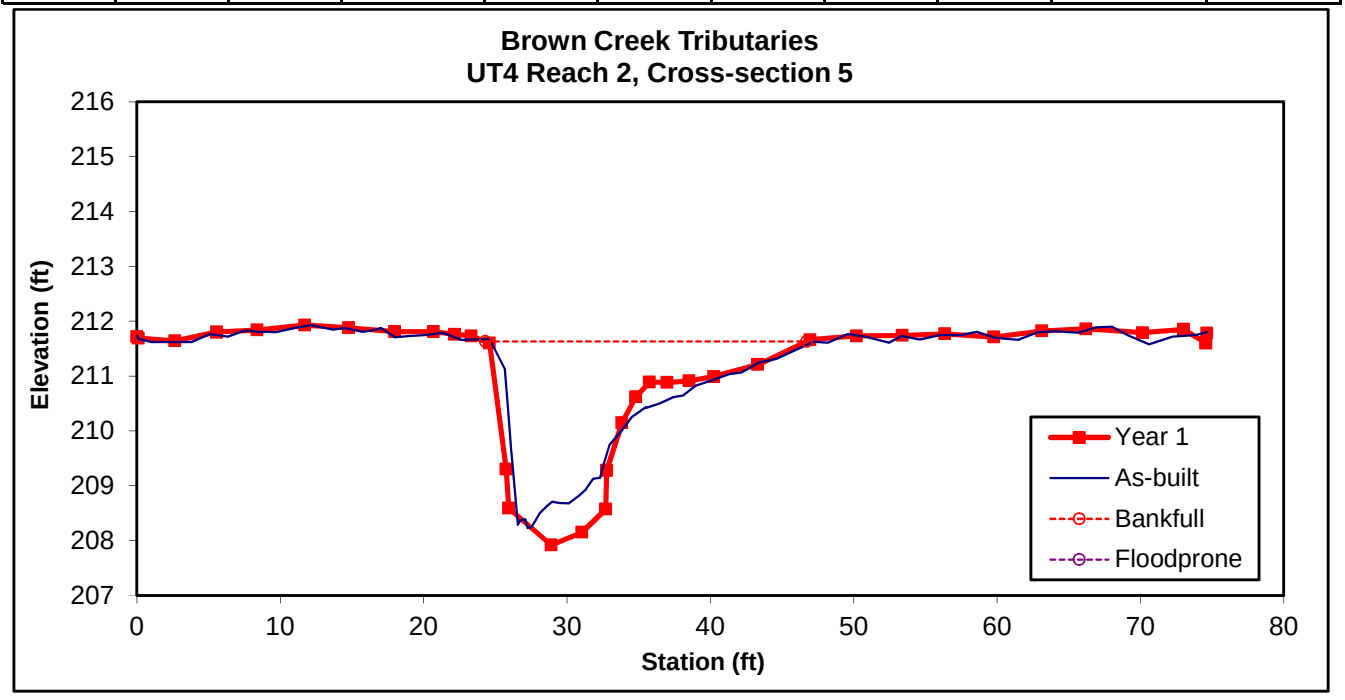
Year 1 Data - Collected February 2016

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		34.8	22.43	1.55	3.71	14.44	1	3.3	211.63	211.6



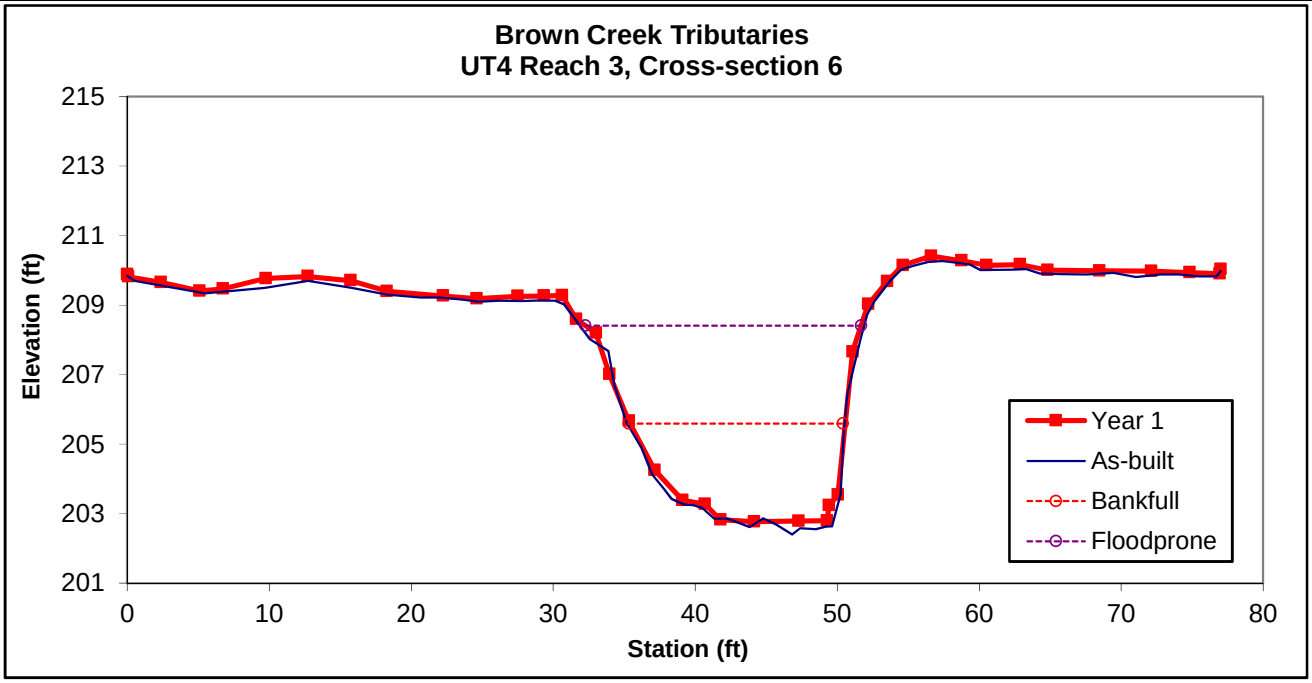
Permanent Cross-section 6

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Gc	34.22	15.13	2.26	2.82	6.7	1.9	1.3	205.59	208.2



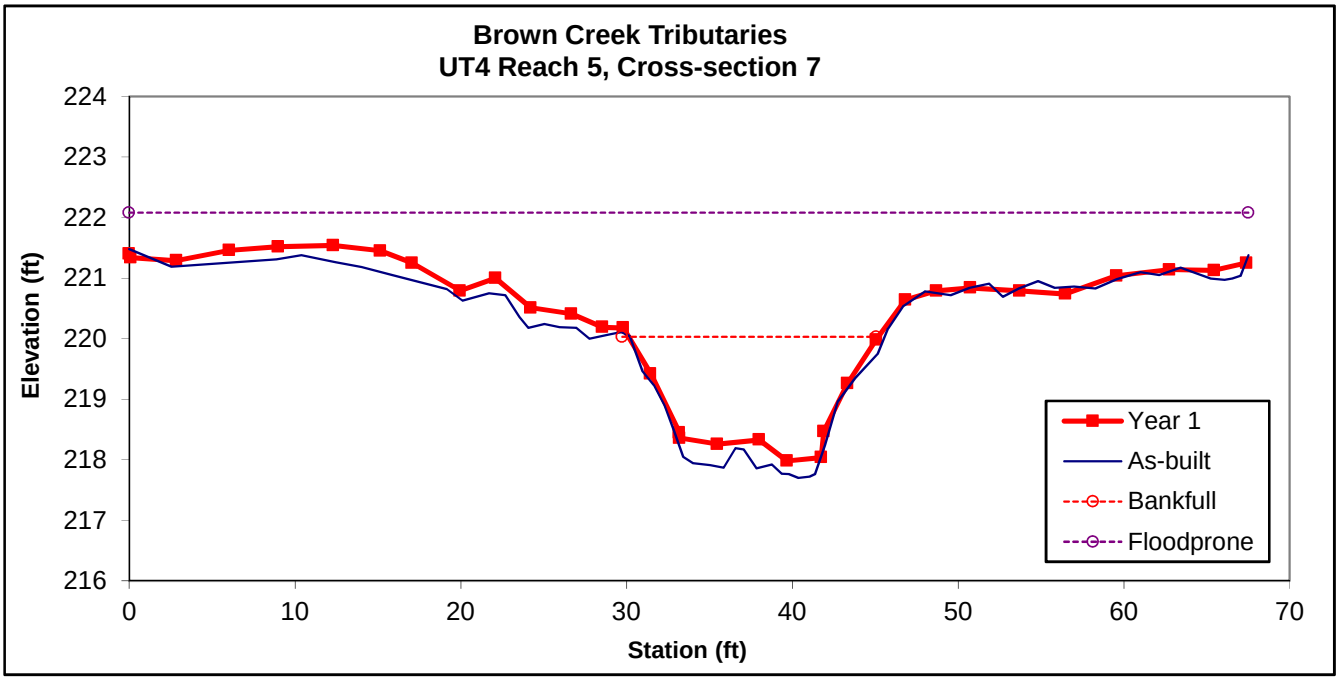
Permanent Cross-section 7

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	20.6	15.08	1.37	2.05	11	1.1	4.5	220.03	220.18



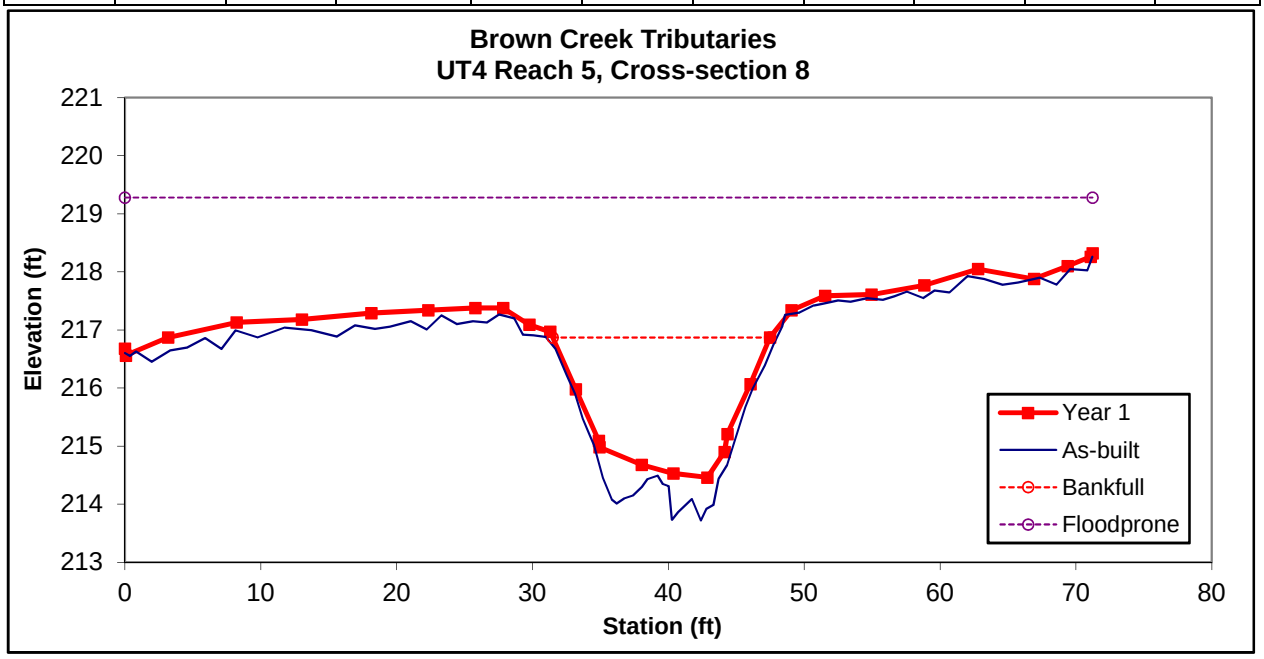
Permanent Cross-section 8

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank
(photo from April)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	26.5	15.97	1.66	2.41	9.63	1	4.5	216.87	216.97



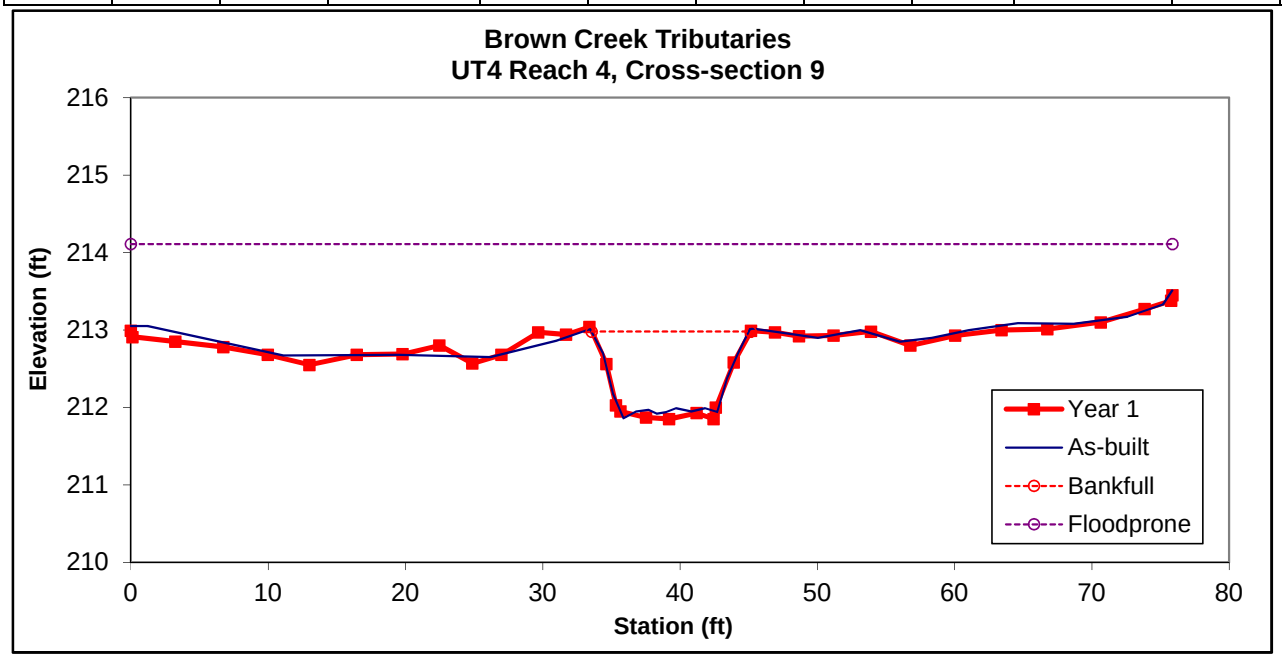
Permanent Cross-section 9

Year 1 Data - Collected February 2016

Looking at the Left Bank
(photo from April)

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	9.7	11.58	0.84	1.13	13.75	1	6.6	212.98	212.99



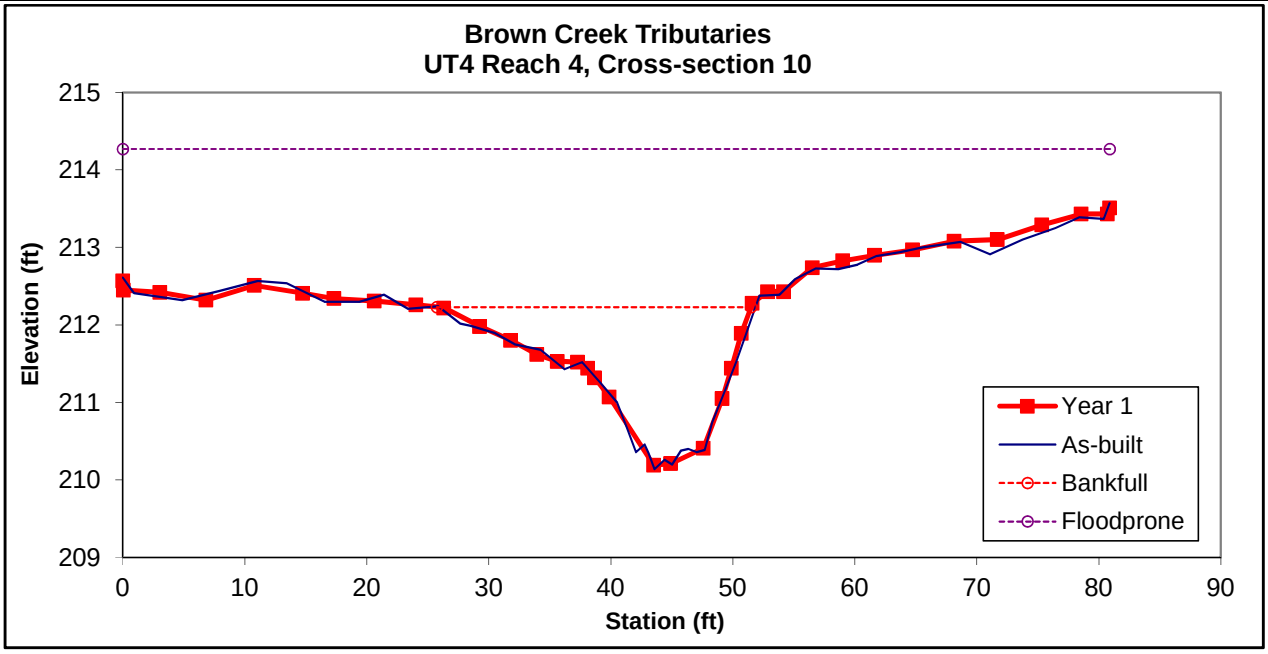
Permanent Cross-section 10

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		24.4	25.74	0.95	2.04	27.13	1	3.1	212.23	212.22



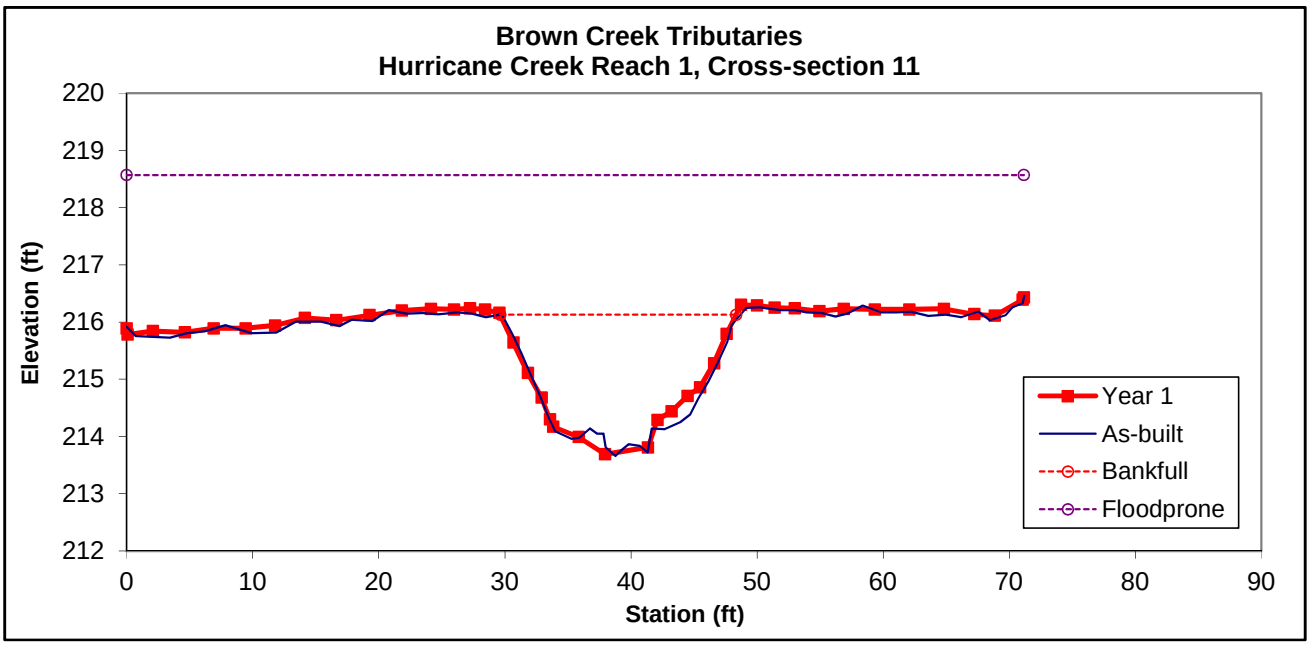
Permanent Cross-section 11

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	29.8	18.71	1.59	2.44	11.75	1	3.8	216.13	216.16



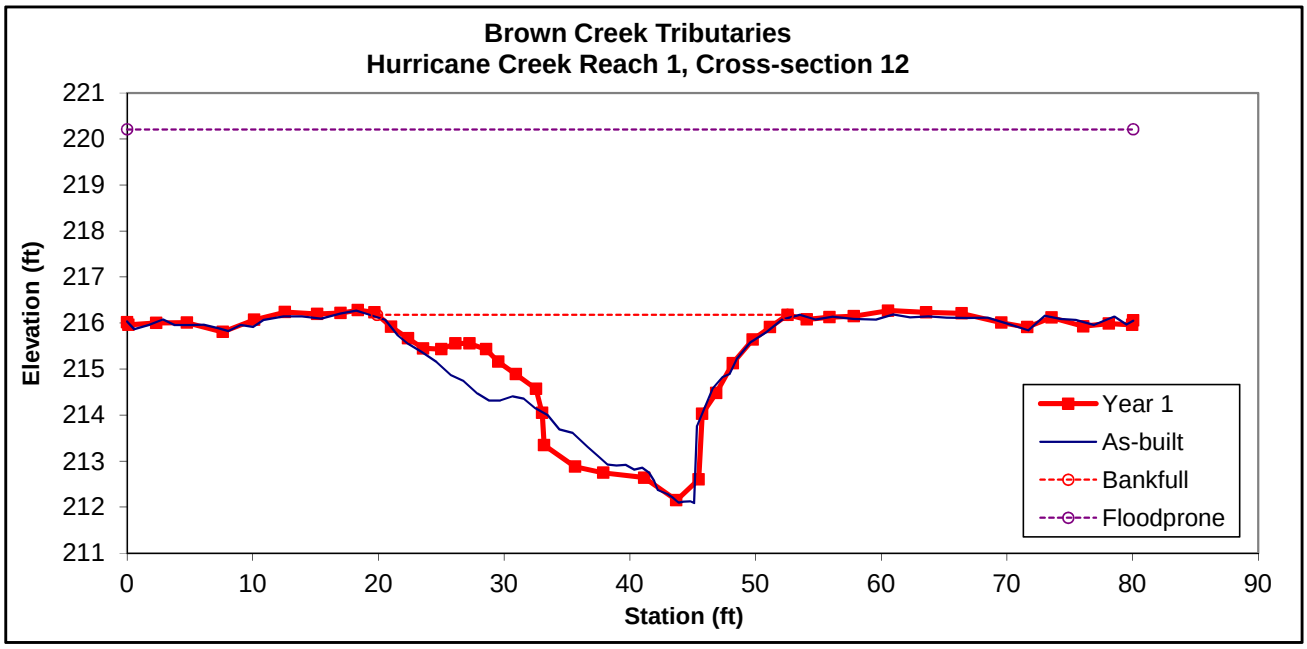
Permanent Cross-section 12

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		60.6	32.66	1.85	4.03	17.61	1	2.5	216.18	216.18



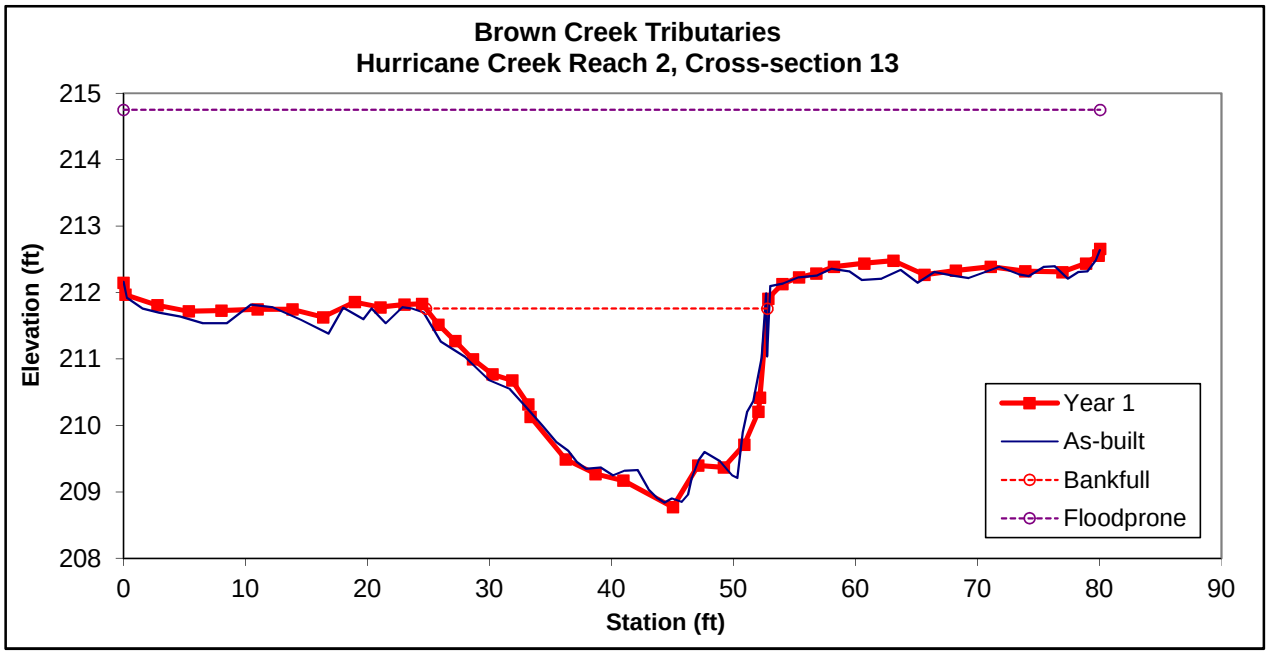
Permanent Cross-section 13

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		52	27.99	1.86	2.99	15.06	1	2.9	211.76	211.83



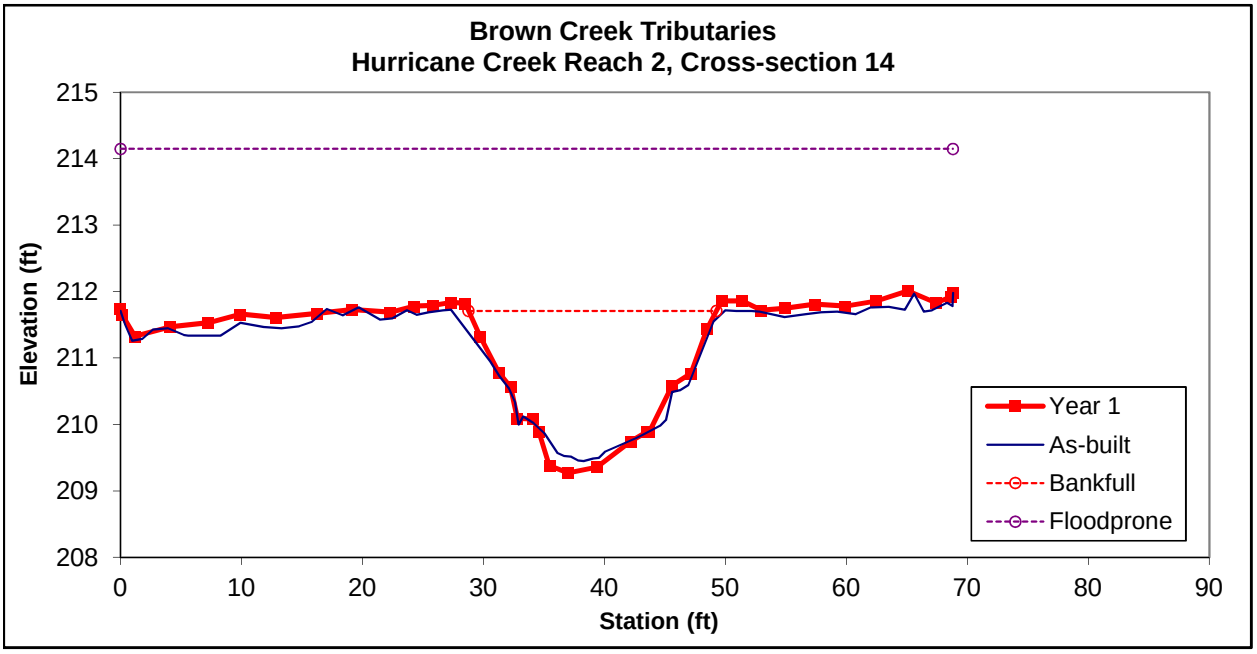
Permanent Cross-section 14

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	31.3	20.48	1.53	2.44	13.39	1	3.4	211.71	211.82



Permanent Cross-section 15

Year 1 Data - Collected February 2016

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	17.6	10.72	1.64	2.74	6.52	1	5	213.77	213.83

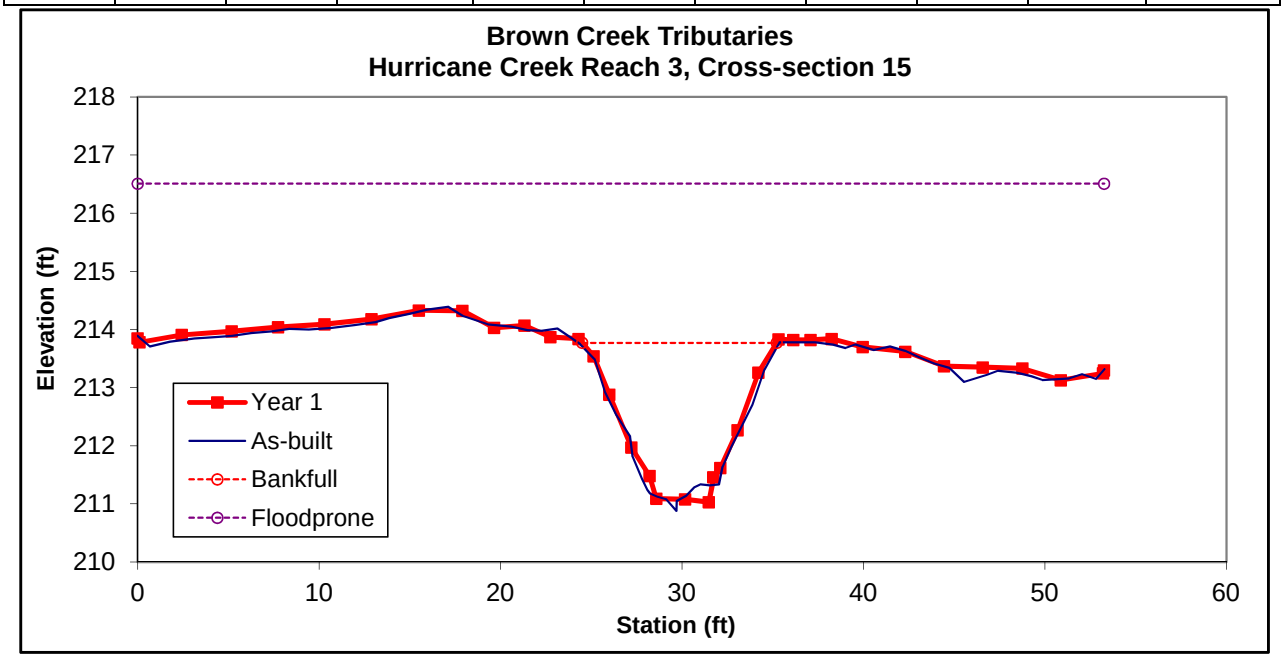


Figure 4

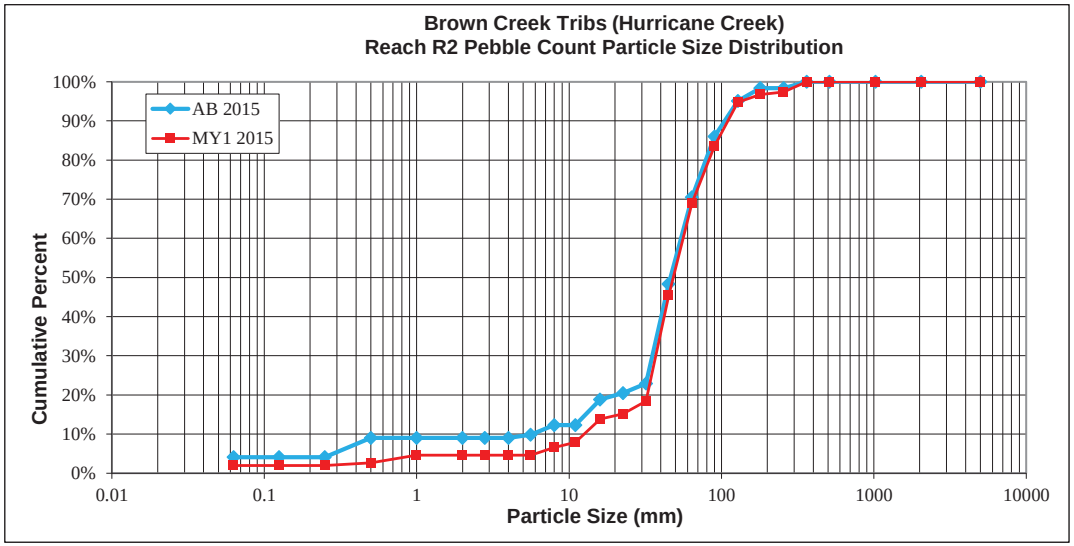
Pebble Count; Monitoring Year 1
Brown Creek Tribs Mitigation Project, DMS# 95351

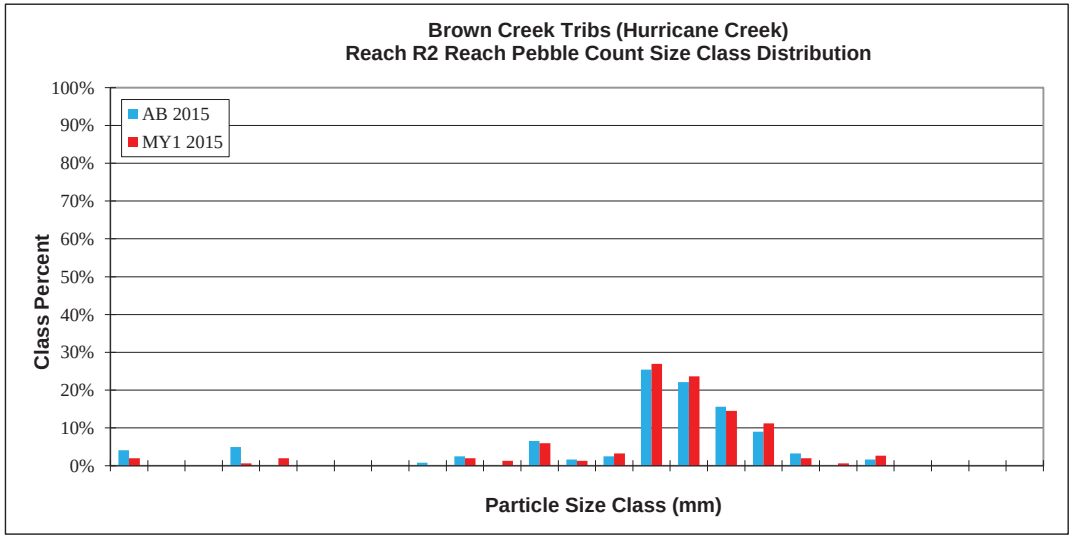
SITE OR PROJECT:	Brown Creek Tribs (Hurricane Creek)
REACH/LOCATION:	Reach R2 (Station 38+00)
FEATURE:	Rock Riffle
DATE:	17-Feb-16

			MY1 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	3	2%	2%	0.063
Sand	Very Fine	.063 - .125			2%	0.125
	Fine	.125 - .25			2%	0.25
	Medium	.25 - .50	1	1%	3%	0.50
	Coarse	.50 - 1.0	3	2%	5%	1.0
	Very Coarse	1.0 - 2.0			5%	2.0
Gravel	Very Fine	2.0 - 2.8			5%	2.8
	Very Fine	2.8 - 4.0			5%	4.0
	Fine	4.0 - 5.6			5%	5.6
	Fine	5.6 - 8.0	3	2%	7%	8.0
	Medium	8.0 - 11.0	2	1%	8%	11.0
	Medium	11.0 - 16.0	9	6%	14%	16.0
	Coarse	16 - 22.6	2	1%	15%	22.6
	Coarse	22.6 - 32	5	3%	18%	32
	Very Coarse	32 - 45	41	27%	45%	45
	Very Coarse	45 - 64	36	24%	69%	64
Cobble	Small	64 - 90	22	14%	84%	90
	Small	90 - 128	17	11%	95%	128
	Large	128 - 180	3	2%	97%	180
	Large	180 - 256	1	1%	97%	256
Boulder	Small	256 - 362	4	3%	100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			152	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	24.8	D84 =	91.3
D35 =	39.5	D95 =	134.0
D50 =	48.2	D100 =	256 - 362





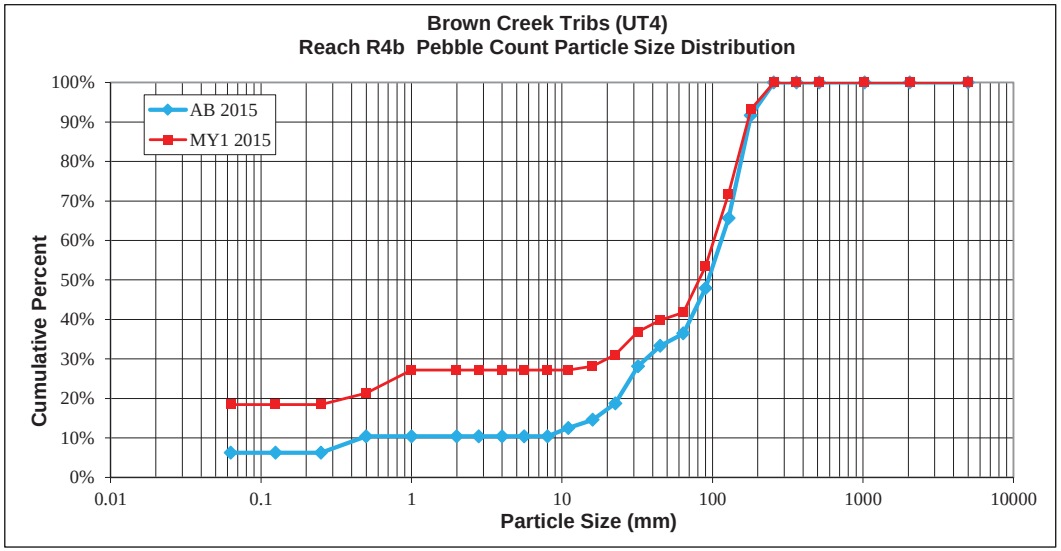
Pebble Count; Monitoring Year 1
Brown Creek Tribs Mitigation Project, DMS# 95351

SITE OR PROJECT:	Brown Creek Tribs (UT4)
REACH/LOCATION:	Reach R4b (Station 19+25)
FEATURE:	Rock Riffle
DATE:	17-Feb-16

			MY1 2015			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	19	18%	18%	0.063
Sand	Very Fine	.063 - .125			18%	0.125
	Fine	.125 - .25			18%	0.25
	Medium	.25 - .50	3	3%	21%	0.50
	Coarse	.50 - 1.0	6	6%	27%	1.0
	Very Coarse	1.0 - 2.0			27%	2.0
Gravel	Very Fine	2.0 - 2.8			27%	2.8
	Very Fine	2.8 - 4.0			27%	4.0
	Fine	4.0 - 5.6			27%	5.6
	Fine	5.6 - 8.0			27%	8.0
	Medium	8.0 - 11.0			27%	11.0
	Medium	11.0 - 16.0	1	1%	28%	16.0
	Coarse	16 - 22.6	3	3%	31%	22.6
	Coarse	22.6 - 32	6	6%	37%	32
	Very Coarse	32 - 45	3	3%	40%	45
	Very Coarse	45 - 64	2	2%	42%	64
Cobble	Small	64 - 90	12	12%	53%	90
	Small	90 - 128	19	18%	72%	128
	Large	128 - 180	22	21%	93%	180
	Large	180 - 256	7	7%	100%	256
Boulder	Small	256 - 362			100%	362
	Small	362 - 512			100%	512
	Medium	512 - 1024			100%	1024
	Large-Very Large	1024 - 2048			100%	2048
Bedrock	Bedrock	> 2048			100%	5000
Total % of whole count			103	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	#N/A	D84 =	155.4
D35 =	28.6	D95 =	197.6
D50 =	81.5	D100 =	180 - 256



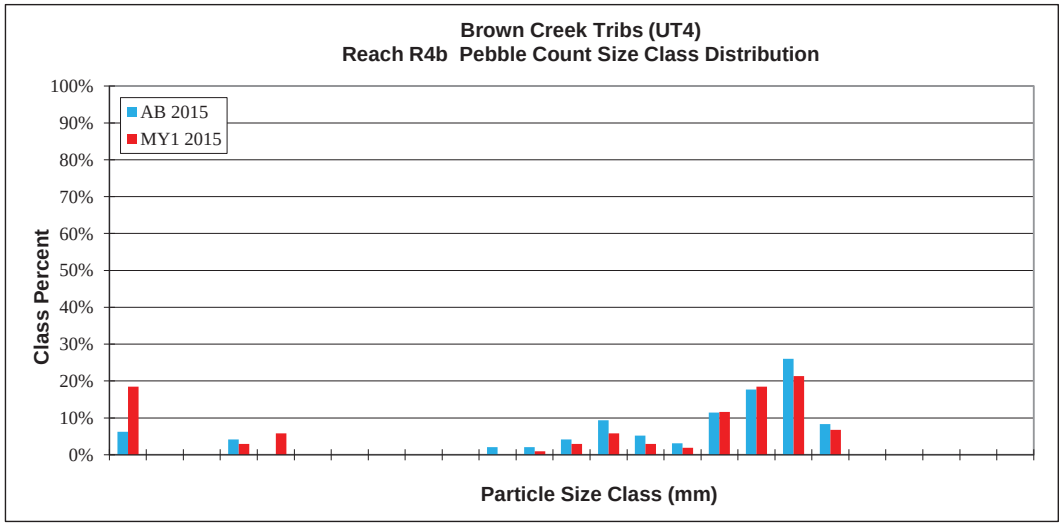


Table 10. Baseline Stream Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Hurricane Creek (Reach 1) Length 2,043 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.8	14.9	-----	-----	-----	-----	13.5	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	19.1	-----	-----	-----	-----	-----	18.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	106.0	-----	-----	50.0	-----	-----	53.0	-----	-----	45.0	-----	-----	79.0	-----	-----	-----	71.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.8	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.5	-----	-----	-----	-----	-----	1.6	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.8	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.8	-----	-----	-----	-----	-----	2.5	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	22.5	30.5	-----	-----	-----	-----	30.0	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	28.0	-----	-----	-----	-----	-----	30.4	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	6.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13.0	-----	-----	-----	-----	-----	11.8	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	7.9	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	3.8	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.7	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	0.6	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	69	-----	-----	140	-----	-----	-----	93.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	39.0	-----	-----	55.0	-----	-----	-----	55.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	130.0	-----	-----	230.0	-----	-----	-----	227.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.5	-----	-----	-----	4.9	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	48.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0170	-----	-----	-----	-----	-----	0.0102	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	80.0	-----	-----	138.0	-----	-----	-----	133.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.0	-----	-----	-----	-----	-----	4.0	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.13 / 0.33 / 0.6 / 4.5 / 14.1						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----						
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.68	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.68	-----	-----	-----	-----	-----	1.68	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	E5/C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.9	3.9	-----	-----	-----	-----	4.3	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	87.4	129.5	194.3	-----	-----	-----	129.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	110	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1745.5	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1896	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2043.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.07	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0120	-----	-----	-----	-----	-----	0.0029	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Hurricane Creek (Reach 2) Length 1,394 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.8	14.9	-----	-----	-----	-----	16.0	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	20.1	-----	-----	-----	-----	-----	22.5	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	162.0	-----	-----	50.0	-----	-----	53.0	-----	-----	49.0	-----	-----	85.0	-----	-----	-----	69.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.8	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.6	-----	-----	-----	-----	-----	1.4	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	3.5	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	2.0	-----	-----	-----	-----	-----	2.3	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	22.5	30.5	-----	-----	-----	-----	34.6	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	31.0	-----	-----	-----	-----	-----	31.6	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	7.4	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13.0	-----	-----	-----	-----	-----	16.1	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	10.1	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	3.1	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.3	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.9	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	74	-----	-----	150	-----	-----	-----	100.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	40.0	-----	-----	60.0	-----	-----	-----	55.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.4	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	140.0	-----	-----	250.0	-----	-----	-----	230.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.5	-----	-----	-----	4.4	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	54.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0170	-----	-----	-----	-----	-----	0.0080	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	85.0	-----	-----	149.0	-----	-----	-----	149.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.2	-----	-----	-----	-----	-----	2.9	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.11 / 0.23 / 0.3 / 1.4 / 4.0						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----			13.6 / 37.6 / 46.2 / 86.0 / 127.6			
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)	-----	-----	-----	-----	-----	-----	-----	2.16	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	2.16	-----	-----	-----	-----	-----	2.16	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	E5/C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.9	3.9	-----	-----	-----	-----	4.4	-----	-----	-----	-----	-----	N/P	-----	-----	-----	4.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	87.4	129.5	194.3	-----	-----	-----	155.0	-----	-----	-----	-----	-----	N/P	-----	-----	-----	130	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1159.0	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1288	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1393.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.07	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.2	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0120	-----	-----	-----	-----	-----	0.0029	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0023	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

Hurricane Creek (Reach 3) Length 564 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	16.6	16.6	-----	-----	-----	-----	5.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	9.1	-----	-----	-----	-----	-----	5.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	9.1	-----	-----	50.0	-----	-----	53.0	-----	-----	21.0	-----	-----	36.0	-----	-----	-----	10.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.4	1.9	-----	-----	-----	-----	1.0	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.8	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.3	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	26.8	36.2	-----	-----	-----	-----	5.8	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	6.9	-----	-----	-----	-----	-----	4.7	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	5.6	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	12.0	-----	-----	-----	-----	-----	7.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.6	-----	-----	3.0	-----	-----	3.3	-----	-----	1.8	-----	-----	2.2	-----	-----	-----	1.6	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.0	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	2.3	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	79.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0050	-----	-----	-----	-----	-----	0.0046	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	18.0	-----	-----	50.0	-----	-----	-----	80.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			(0.29/ 0.63 / 1.0/ 3.4 / 6.7)						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.19	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.19	-----	-----	-----	-----	-----	0.19	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	B5c	-----	-----	-----	-----	-----	B5c	-----	-----
BF Velocity (fps)	-----	3.0	4.4	-----	-----	-----	-----	4.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	106.1	155.0	231.8	-----	-----	-----	26.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	22	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	559.0	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	579	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	564.0	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.02	-----	-----	-----	-----	-----	1.20	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.01	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0078	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0160	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.008	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0025	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 1) Length 1,376 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	7.1	7.5	-----	8.6	-----	-----	11.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	11.4	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	12.7	-----	-----	15.6	-----	-----	50.0	-----	-----	53.0	-----	-----	26.0	-----	-----	46.0	-----	-----	-----	89.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	0.9	1.1	-----	0.9	-----	-----	1.3	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.9	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.2	-----	-----	1.9	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.1	-----	-----	-----	-----	-----	1.8	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	7.4	10.3	-----	10.5	-----	-----	11.3	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	10.0	-----	-----	-----	-----	-----	14.1	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	6.5	-----	-----	13.2	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	13.8	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	1.3	-----	-----	1.5	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.4	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	2.1	-----	-----	2.4	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	2.1	-----		-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	40.0	-----	-----	80.0	-----	-----	-----	60.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	23.0	-----	-----	34.0	-----	-----	-----	40.0	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	70.0	-----	-----	90.0	-----	-----	-----	146.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	7.0	-----	-----	-----	4.3	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.2	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0078	-----	-----	-----	-----	-----	0.0153	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	39	-----	-----	80	-----	-----	-----	78.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.4	-----	-----	-----	-----	-----	2.2	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.06 / 0.34 / 2.12 / 36.6 / 101.8 (R2)						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.34	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.34	-----	-----	-----	-----	-----	0.34	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	G	-----	-----	F	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/B5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.4	3.9	-----	3.6	-----	-----	3.9	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	25.2	40.9	63.0	-----	-----	-----	41.0	-----	-----	-----	-----	-----	N/P	-----	-----	-----	37	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	784	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,417	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	858	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.11	-----	-----	-----	-----	-----	-----	-----	1.09	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	-----	-----	0.0101	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	-----	-----	0.0113	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 2) Length 1,828 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	12.2	12.4	-----	-----	-----	-----	13.8	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	16.5	-----	-----	-----	-----	-----	15.9	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	36.6	-----	-----	50.0	-----	-----	53.0	-----	-----	38.0	-----	-----	66.0	-----	-----	-----	95.2	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.6	1.2	-----	-----	-----	-----	1.7	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.3	-----	-----	-----	-----	-----	1.2	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.5	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.6	-----	-----	-----	-----	-----	1.7	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	16.7	22.9	-----	-----	-----	-----	23.8	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	21.0	-----	-----	-----	-----	-----	19.0	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	8.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	13.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	2.7	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.0	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	2.1	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	60.0	-----	-----	100.0	-----	-----	-----	75.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	33.0	-----	-----	50.0	-----	-----	-----	46.3	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	2.9	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	115.0	-----	-----	180.0	-----	-----	-----	173.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	3.5	-----	-----	6.0	-----	-----	-----	10.9	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	51.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0040	-----	-----	-----	-----	-----	0.0043	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	32	-----	-----	65	-----	-----	-----	105.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	1.8	-----	-----	-----	-----	-----	3.3	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.06 / 0.34 / 2.12 / 36.6 / 101.8 (R2)						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.10	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	F	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.6	4.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	62.8	95.6	144.3	-----	-----	-----	95.6	-----	-----	-----	-----	-----	N/P	-----	-----	-----	80.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1590.34	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,673	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1827	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.19	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----	-----	0.0034	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0063	-----	-----	-----	-----	-----	0.0039	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 3) Length 250 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built[5]					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	14.1	14.2	-----	-----	-----	-----	13.1	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	19.8	-----	-----	-----	-----	-----	15.4	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	18.3	-----	-----	50.0	-----	-----	53.0	-----	-----	44.0	-----	-----	76.0	-----	-----	-----	21.0	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.3	1.7	-----	-----	-----	-----	2.2	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.4	-----	-----	-----	-----	-----	2.4	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	3.2	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.7	-----	-----	-----	-----	-----	3.2	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	21.0	28.5	-----	-----	-----	-----	28.7	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	28.0	-----	-----	-----	-----	-----	36.8	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	6.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	6.4	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.4	-----	-----	3.0	-----	-----	3.3	-----	-----	1.8	-----	-----	2.2	-----	-----	-----	1.4	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.7	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	0.48	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	20.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0130	-----	-----	-----	-----	-----	0.0153	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	45	-----	-----	80	-----	-----	-----	50.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	3.5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.06 / 0.15 / 0.48 / 10.3 / 130.2						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	1.52	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	1.52	-----	-----	-----	-----	-----	1.52	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	G	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	B5c	-----	-----	-----	-----	-----	G5c	-----	-----
BF Velocity (fps)	-----	2.8	4.1	-----	-----	-----	-----	4.1	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	80.7	120.5	181.1	-----	-----	-----	120.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	103.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	237	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	244	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	250	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	1.05	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0078	-----	-----	-----	-----	-----	0.0056	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0080	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and on past project evaluations
[5] Ultimately, a Rosgen "G" stream type was maintained for this reach due to its stable location with mature trees eastablished along its banks

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 4) Length 1,840 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	7.8	8.2	-----	-----	-----	-----	7.7	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	12.0	-----	-----	-----	-----	-----	11.6	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	-----	-----	-----	10.9	-----	-----	50.0	-----	-----	53.0	-----	-----	28.0	-----	-----	48.0	-----	-----	-----	75.9	-----	-----	-----	-----
BF Mean Depth (ft)	-----	0.9	1.1	-----	-----	-----	-----	1.6	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	0.9	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	2.1	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.1	-----	-----	-----	-----	-----	1.1	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	8.5	11.8	-----	-----	-----	-----	12	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	11.0	-----	-----	-----	-----	-----	9.5	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	-----	-----	-----	5.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	13	-----	-----	-----	-----	-----	14.1	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	-----	-----	-----	1.1	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	6.5	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	-----	-----	-----	3.1	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.50	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.3	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	40	-----	-----	70	-----	-----	-----	55.0	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	24.0	-----	-----	36.0	-----	-----	-----	48.3	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	2.0	-----	-----	3.0	-----	-----	-----	4.2	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	84.0	-----	-----	140.0	-----	-----	-----	150.0	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	7.0	-----	-----	12.0	-----	-----	-----	13.0	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0100	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	42	-----	-----	82	-----	-----	-----	-----	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----		0.13 / 0.43 / 1.5 / 14.2 / 22.6						6.0 / NP,/ 45.0 / 125.0 / NP					-----	-----	-----	-----	-----	-----		11.1 / 23.8 / 36.6 / 60.1 / 126.3				
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.42	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.42	-----	-----	-----	-----	-----	0.42	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	G	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/B5c	-----	-----	-----	-----	-----	C5	-----	-----
BF Velocity (fps)	-----	2.5	3.9	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.6	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	29.5	47.3	73.4	-----	-----	-----	47.4	-----	-----	-----	-----	-----	N/P	-----	-----	-----	40.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1657	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,787	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1840	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.15	-----	-----	-----	-----	-----	1.20	-----	-----	-----	1.12	-----	-----	-----	-----	-----	-----	-----	1.11	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0058	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0063	-----	-----	-----	-----	-----	0.0054	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0069	-----	-----	-----	-----	-----	0.0062	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 10. Baseline Stream Summary (continued)
Brown Creek Tributaries Restoration Project: EEP Project ID No. 95351

UT4 (Reach 5) Length 1,973 ft

Parameter	USGS Gauge	Regional Curve			Pre-Existing Condition[1]						Reference Reach(es) Data[3] Richland Creek (Moore County)						Design[4]						As-built					
		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
Dimension and Substrate - Riffle																												
BF Width (ft)	-----	9.9	10.2	-----	16.8	-----	-----	23.5	-----	-----	16.2	-----	-----	16.7	-----	-----	-----	13.9	-----	-----	-----	-----	-----	16.2	-----	-----	-----	-----
Floodprone Width (ft)	-----	-----	-----	-----	33.6	-----	-----	94.3	-----	-----	50.0	-----	-----	53.0	-----	-----	32.0	-----	-----	55.0	-----	-----	-----	69.4	-----	-----	-----	-----
BF Mean Depth (ft)	-----	1.0	1.3	-----	0.7	-----	-----	0.7	-----	-----	0.9	-----	-----	0.9	-----	-----	-----	1.2	-----	-----	-----	-----	-----	1.8	-----	-----	-----	-----
BF Max Depth (ft)	-----	-----	-----	-----	1.3	-----	-----	2.4	-----	-----	1.4	-----	-----	1.5	-----	-----	-----	1.5	-----	-----	-----	-----	-----	2.7	-----	-----	-----	-----
BF Cross-sectional Area (ft^2)	-----	12.3	16.9	-----	11.2	-----	-----	15.4	-----	-----	15.0	-----	-----	15.5	-----	-----	-----	16.0	-----	-----	-----	-----	-----	28.4	-----	-----	-----	-----
Width/Depth Ratio	-----	-----	-----	-----	25.2	-----	-----	36.0	-----	-----	18.0	-----	-----	18.6	-----	-----	-----	12	-----	-----	-----	-----	-----	9.3	-----	-----	-----	-----
Entrenchment Ratio	-----	-----	-----	-----	2.0	-----	-----	4.0	-----	-----	3.0	-----	-----	3.3	-----	-----	-----	>2.2	-----	-----	-----	-----	-----	4.3	-----	-----	-----	-----
Bank Height Ratio	-----	-----	-----	-----	1.0	-----	-----	1.7	-----	-----	1.6	-----	-----	1.7	-----	-----	-----	1.0	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----
d50 (mm)	-----	-----	-----	-----	-----	1.30	-----	-----	-----	-----	-----	45.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	14.3	-----	-----	26.1	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Rc / Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5.5	-----	-----	5.7	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	-----	-----	94	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.5	-----	-----	2.4	-----	-----	N/A	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	-----
Profile																												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	46.0	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.013	-----	-----	0.0413	-----	-----	-----	0.0050	-----	-----	-----	-----	-----	0.0086	-----	-----	-----	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool to Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	37.3	-----	-----	95.8	-----	-----	50	-----	-----	90	-----	-----	-----	101.0	-----	-----	-----	-----
Pool Max Depth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2.3	-----	-----	2.5	-----	-----	-----	2.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Volume (ft^3)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	N/P	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																												
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
[2] d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----			0.30 / 0.70 / 1.3 / 5.5 / 8.4						6.0 / NP,/ 45.0 / 125.0 / NP				-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----
Reach Shear Stress (competency) lb/f^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m^2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																												
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.71	-----	-----	-----	-----	-----	1.00	-----	-----	-----	-----	-----	0.71	-----	-----	-----	-----	-----	0.71	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	-----	-----	E/Bc	-----	-----	-----	-----	-----	C4	-----	-----	-----	-----	-----	C5/E5	-----	-----	-----	-----	-----	E5	-----	-----
BF Velocity (fps)	-----	2.9	4.5	-----	-----	-----	-----	4.5	-----	-----	-----	-----	-----	N/P	-----	-----	-----	3.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	44.4	69.2	106.1	-----	-----	-----	69.3	-----	-----	-----	-----	-----	N/P	-----	-----	-----	60.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1838	-----	-----
Channel length (ft)[2]	-----	-----	-----	-----	-----	-----	-----	1,921	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1916	-----	-----
Sinuosity	-----	-----	-----	-----	-----	-----	-----	1.08	-----	-----	-----	-----	-----	1.20	-----	-----	-----	N/A	-----	-----	-----	-----	-----	-----	-----	1.04	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0033	-----	-----	-----	0.0136	-----	-----	-----	-----	-----	0.0033	-----	-----	-----	-----	-----	0.0053	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	0.0035	-----	-----	-----	0.0133	-----	-----	-----	-----	-----	0.0035	-----	-----	-----	-----	-----	0.0061	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

[1] Existing conditions survey data was compiled for each reach of Hurricane Creek and UT4 respectively
[2] Bulk samples taken for pre-existing condition and pebble counts taken for as-built and annual monitoring
[3] Reference reach data for Richland Creek in Moore County from the NC DOT reference reach database was used in the design
[4] Values were chosen based on previous sand-bed reference reach data and past project evaluations

Table 11. Cross-section Morphology Data

Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Stream Reach	UT4 Reach 1 (1,376 LF)																			
	Cross-section X-1 (Riffle)							Cross-section X-2 (Pool)							Cross-section X-3 (Riffle)							
Dimension and substrate	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)	14.93	11.6						15.43	14.89						13.95	13.18						
BF Mean Depth (ft)	1.02	1.1						0.87	0.83						1.01	0.97						
Width/Depth Ratio	14.58	11.0						17.74	17.95						13.83	13.6						
BF Cross-sectional Area (ft²)	15.3	12.4						13.42	12.3						14.07	12.7						
BF Max Depth (ft)	1.81	1.8						2.16	2.04						1.81	1.52						
Width of Floodprone Area (ft)	58.95	59.0						46.7	46.77						89.23	89.27						
Entrenchment Ratio	3.9	5.1						3.03	3.1						6.39	6.8						
Bank Height Ratio	1.0	1.1						1.0	1.0						1.0	1.0						
Wetted Perimeter (ft)	17.0	13.8						17.2	16.6						16.0	15.1						
Hydraulic Radius (ft)	0.9	0.9						0.8	0.7						0.9	0.8						
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)																						

Stream Reach	UT4 Reach 2 (1,828 LF)														UT4 Reach 3 (250 LF)							
	Cross-section X-4 (Riffle)							Cross-section X-5 (Pool)							Cross-section X-6 (Riffle)							
Dimension and substrate	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)	15.94	15.3						22.4	22.4						15.35	15.1						
BF Mean Depth (ft)	1.19	1.4						1.39	1.6						2.4	2.3						
Width/Depth Ratio	13.3	11.3						16.1	14.4						6.4	6.7						
BF Cross-sectional Area (ft²)	19.0	20.7						31.16	34.8						36.8	34.2						
BF Max Depth (ft)	1.7	2.1						3.4	3.7						3.19	2.8						
Width of Floodprone Area (ft)	95.2	95.2						74.63	74.7						20.98	19.4						
Entrenchment Ratio	6.0	6.2						3.33	3.3						1.4	1.3						
Bank Height Ratio	1.0	1.0						1.0	1.0						1.7	1.9						
Wetted Perimeter (ft)	18.3	18.0						25.2	25.5						20.2	19.7						
Hydraulic Radius (ft)	1.0	1.1						1.2	1.4						1.8	1.7						
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)	-							-														

Table 11 continued. Cross-section Morphology Data

Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Stream Reach	UT4 Reach 5 (1,973 LF)														UT4 Reach 4 (1,840 LF)													
	Cross-section X-7 (Riffle)							Cross-section X-8 (Riffle)							Cross-section X-9 (Riffle)							Cross-section X-10 (Pool)						
Dimension and substrate	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)	15.35	15.08						16.99	15.97						11.58	11.58						25.93	25.74					
BF Mean Depth (ft)	1.56	1.37						1.93	1.66						0.82	0.84						0.96	0.95					
Width/Depth Ratio	9.8	11.0						8.8	9.6						14.1	13.8						27.1	27.1					
BF Cross-sectional Area (ft²)	23.9	20.6						32.8	26.5						9.5	9.7						24.8	24.4					
BF Max Depth (ft)	2.33	2.05						3.15	2.41						1.14	1.1						2.09	2.04					
Width of Floodprone Area (ft)	67.5	67.5						71.2	71.2						75.9	75.9						80.9	80.9					
Entrenchment Ratio	4.4	4.5						4.2	4.5						6.5	6.6						3.1	3.1					
Bank Height Ratio	1.0	1.1						1.0	1.0						1.0	1.0						1.0	1.0					
Wetted Perimeter (ft)	18.5	17.8						20.9	19.3						13.2	13.3						27.9	27.6					
Hydraulic Radius (ft)	1.3	1.2						1.6	1.4						0.7	0.7						0.9	0.9					
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)																												

Stream Reach	Hurricane Creek Reach 1 (2,043 LF)														Hurricane Creek Reach 2 (1,394 LF)													
	Cross-section X-11 (Riffle)							Cross-section X-12 (Pool)							Cross-section X-13 (Pool)							Cross-section X-14 (Riffle)						
Dimension and substrate	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)	18.92	18.71						34.27	32.66						29.02	27.99						22.54	20.48					
BF Mean Depth (ft)	1.61	1.59						1.84	1.85						1.77	1.86						1.40	1.53					
Width/Depth Ratio	11.8	11.8						18.6	17.6						16.4	15.1						16.1	13.4					
BF Cross-sectional Area (ft²)	30.4	29.8						63.2	60.6						51.5	52.0						31.6	31.3					
BF Max Depth (ft)	2.47	2.44						4.09	4.03						2.92	2.99						2.26	2.44					
Width of Floodprone Area (ft)	71.2	71.2						80.1	80.1						80.0	80.1						68.8	68.8					
Entrenchment Ratio	3.8	3.8						2.3	2.5						2.8	2.9						3.1	3.4					
Bank Height Ratio	1.0	1.0						1.0	1.0						1.0	1.0						1.0	1.0					
Wetted Perimeter (ft)	22.1	21.9						38.0	36.4						32.6	31.7						25.3	23.5					
Hydraulic Radius (ft)	1.4	1.4						1.7	1.7						1.6	1.6						1.2	1.3					
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)																												

Table 11 continued. Cross-section Morphology Data

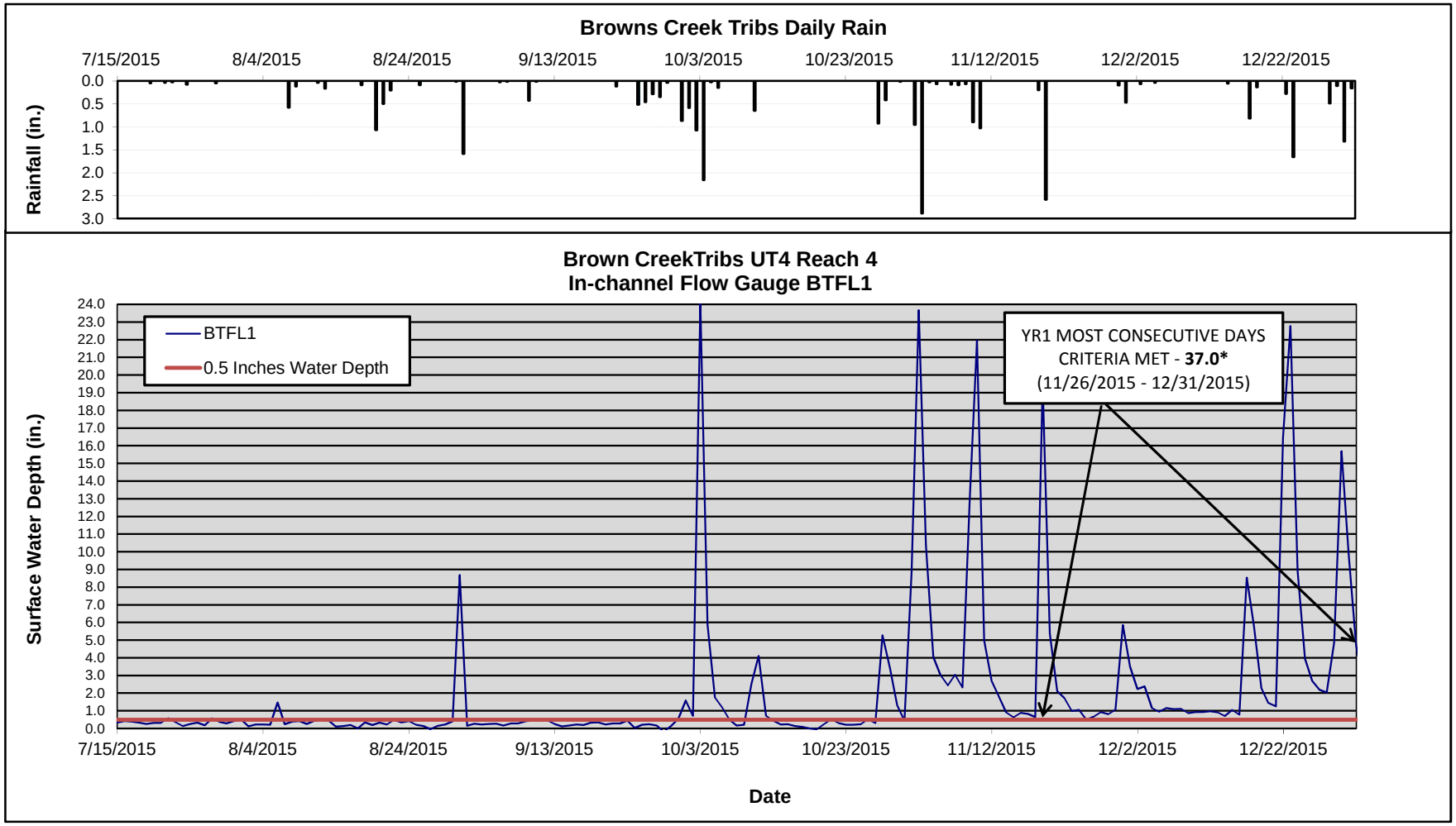
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

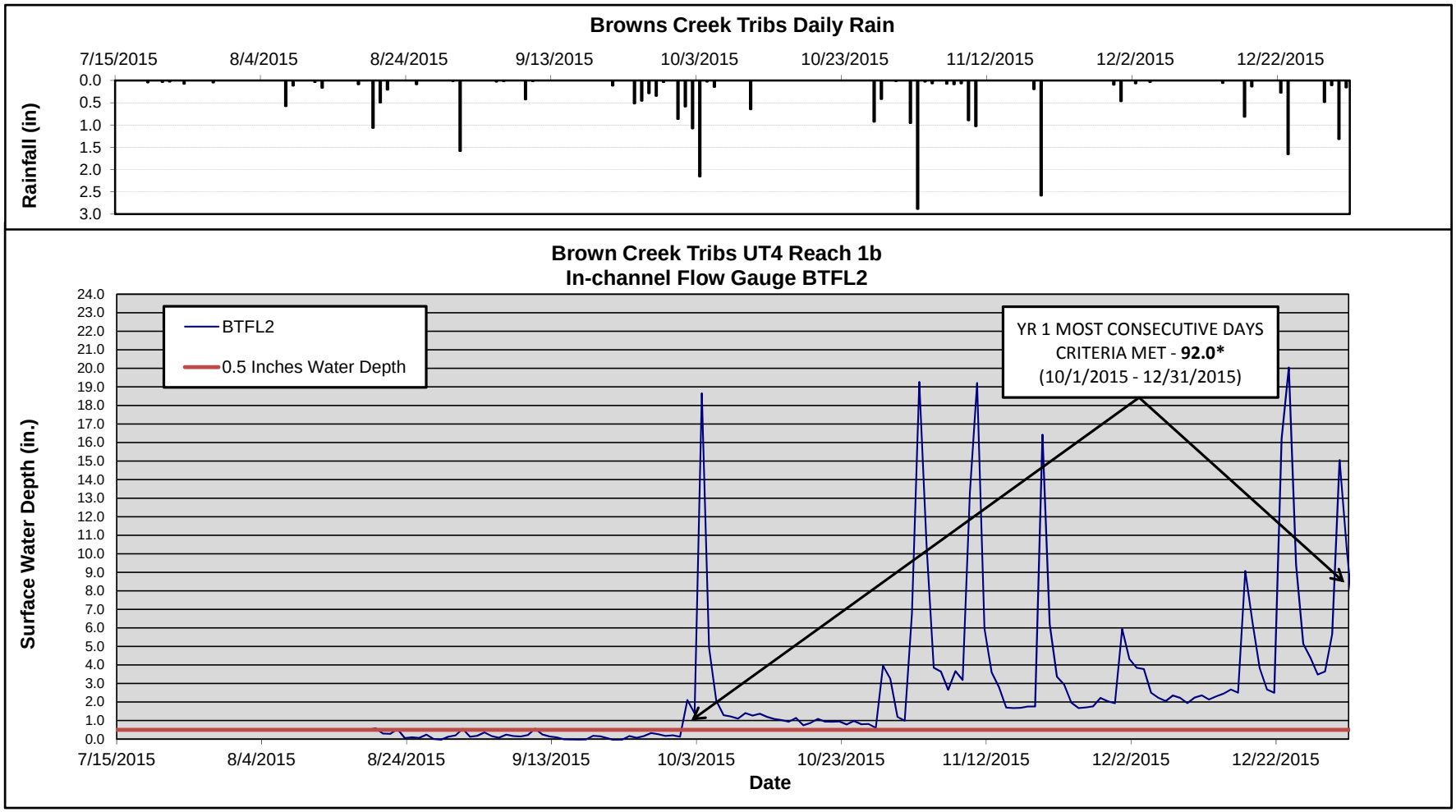
Stream Reach	**Hurricane Creek Reach 3 (564 LF)**									
	Cross-section X-15 (Riffle)									
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+			
Based on fixed baseline bankfull elevation										
BF Width (ft)	11.06	10.7								
BF Mean Depth (ft)	1.65	1.6								
Width/Depth Ratio	6.7	6.5								
BF Cross-sectional Area (ft²)	18.2	17.6								
BF Max Depth (ft)	2.89	2.7								
Width of Floodprone Area (ft)	53.3	53.3								
Entrenchment Ratio	4.8	5.0								
Bank Height Ratio	1.0	1.0								
Wetted Perimeter (ft)	14.4	14.0								
Hydraulic Radius (ft)	1.3	1.3								
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

Figure 5.


Browns Creek Tribs Daily Rain
Rainfall (in.)
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
10/23/2015
11/12/2015
12/2/2015
12/22/2015
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Brown CreekTribs UT4 Reach 4
In-channel Flow Gauge BTFL1
Surface Water Depth (in.)
BTFL1
0.5 Inches Water Depth
YR1 MOST CONSECUTIVE DAYS
CRITERIA MET - 37.0*
(11/26/2015 - 12/31/2015)
24.0
23.0
22.0
21.0
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
7/15/2015
8/4/2015
8/24/2015
9/13/2015
10/3/2015
10/23/2015
11/12/2015
12/2/2015
12/22/2015
Date



* Surface water flow is estimated to have occurred when the pressure transducer reading is equal to or above 0.5 inches in depth.

Figure 6. Observed Rainfall versus Historic Average

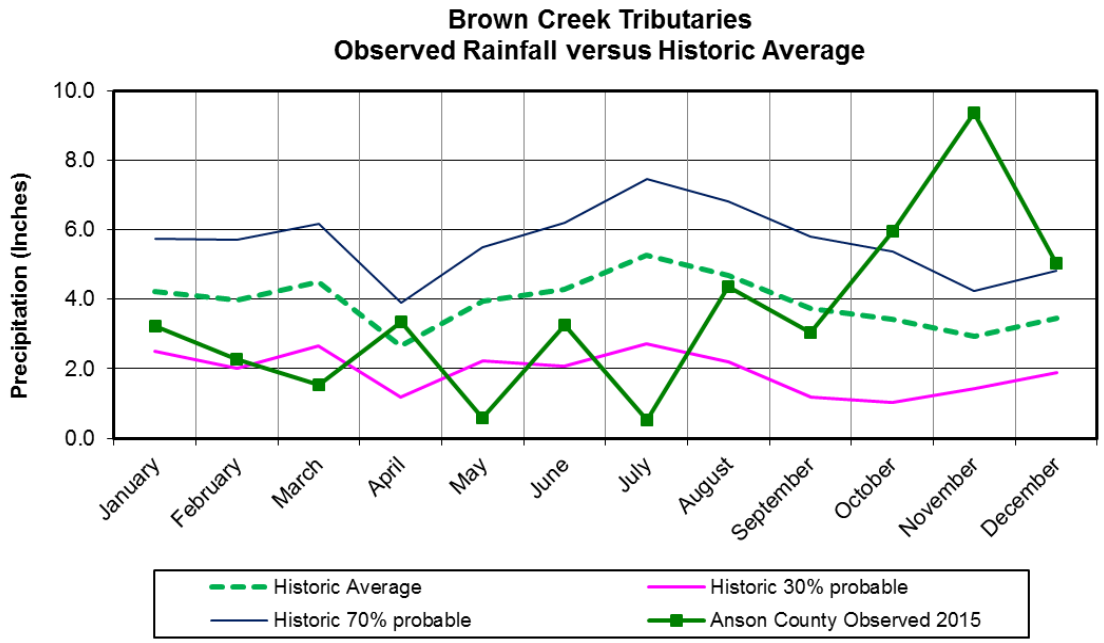


Table 12. Flow Gauge Success (2015) Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351		
Flow Gauge ID	**Consecutive Days of Flow[1]**	**Cumulative Days of Flow[2]**
UT4 Reach 4 Flow Gauge		
BTFL1	37.0	83.0
UT4 Reach 2 Flow Gauge		
BTFL2	92.0	97.0
Notes:		
[1]Indicates the number of consecutive days within the monitoring year where flow was measured.		
[2]Indicates the number of cumulative days within the monitoring year where flow was measured.		
BTFL1 was installed on 7/17/2015 and recorded consecutive flow for 37.0 days for Year 1/2015. BTFL2 was installed on 8/17/2015 and recorded consecutive flow for 92.0 for Year 1/2015		
Surface water flow is estimated to have occurred when the pressure transducer reading is ≥0.5 inches in depth.		
Flow success criteria for the Site: A restored stream reach will be considered at least intermittent when the flow duration occurs for a minimum of 30 consecutive days.		

Table 13. Crest Gauge Success (2015) Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351				
Date of Data Collection	Estimated Occurrence of Bankfull Event	Method of Data Collection	Crest Location	Measured Bankfull (ft)
10/29/2015	10/3/2015	Crest Gauge	HC-R2	0.94
11/4/2015	10/3/2015	Crest Gauge	UT4-R2	0.83