Brown Creek Tributaries Restoration Project
FINAL Year 3 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: 3 of 7 Year of Data Collection: 2017 Year of Completed Construction: 2015 Submission Date: November 2017
Submitted To:	NC DEQ – Division of Mitigation Services 1652 Mail Service Center Raleigh, NC 27699

Michael Baker
INTERNATIONAL

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January 5, 2018

Harry Tsomides
Western Region Project Manager
NCDEQ, Division of Mitigation Services
5 Ravenscroft Drive – Suite 102
Asheville, NC 28801

Subject: Response to DMS Comments for Task 9 Deliverables: Year 3 Monitoring Report
Brown Creek Tributaries Restoration Project
Yadkin River Basin – CU# 03040104
Anson County, North Carolina
DEQ Contract No. 004641, USACE AID SAW-2012-01108, DMS Project #95351

Mr. Tsomides:

Please find below our responses to the NC Division of Mitigation Services' (DMS) review comments letter dated January 3, 2018 in reference to the Brown Creek Tributaries Restoration Project in Anson County, NC. We have revised the Draft version of the Year 3 Monitoring Report in response to the review comments as outlined below:

1) Executive Summary - The MY02 report noted several areas of repair performed in 2016 – rock crossings, boulder revetments, failed J-hook, erosion and scour – how are these doing? Can we provide a brief update?

   Response: Several additional, more recent photographs of those previously repaired areas have been added to Appendix B of the report, and a short description was added to text as well to acknowledge their continued stability.

2) Executive Summary, last sentence of vegetation maintenance paragraph – Indicates recent visual inspection of planted areas revealed they are "doing well"; what does this mean exactly? Can you be more descriptive?

   Response: Additional descriptive text was added to that paragraph.

3) Report should have Appendix tabs if possible.

   Response: Appendix tabs have been added to the final report as requested.

4) Methodology Section – Stream and Vegetation Assessment detailed results are grouped into this section. Recommend reorganizing sections so that data and results are not included in the methodology section. You may do this however it makes the most sense and/or using available recent DMS templates.

   Response: A review of the project monitoring report template reveals that much of the information currently repeated within the Methodology section does not belong there and should only be found in the Executive Summary section. To avoid duplication and maintain the streamlined nature of the template, the more detailed stream and vegetation results and data discussions have been removed from the Methodology section.

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5) Table 1 (Assets) – Stream R and RE totals should reflect mitigation plan lengths calculated to the nearest tenth; R should be 9664.3, RE should be 102.2.

Response: Table 1 was previously revised to match the approved credits found in the project Mitigation Plan. As the Plan's final credit table reported all values in whole numbers, Baker would prefer to keep this MY3 credit table values in whole numbers as well so as to maintain a completely matching set of credit values.

This response letter will be included with the final report document as requested. Please do not hesitate to contact me should you have any questions regarding our response submittal.

Sincerely,

Scott King, LSS
Project Manager

Enclosures

Brown Creek Tributaries Restoration Project
FINAL Year 3 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

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Report Prepared and Submitted by Michael Baker Engineering, Inc.

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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 3 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. All reaches are geomorphically stable and performing as designed, as confirmed by the visual stability assessment.

In March of 2017 River Works personnel did repair two areas of concern noted previously in the Monitoring Year 2 report. They were two sections of scoured/eroded stream banks located on Reaches UT4-R2 and UT4-R4, which were regraded and had geo-lifts installed. They were subsequently planted with livestakes and all disturbed areas were re-seeded. During site visits in September of 2017, both areas appeared stable and vegetated. Additionally, a section of damaged fence was repaired along UT4-R2, and a fallen tree was removed from the upper portion of UT4-R5. The locations of each of these repaired areas can be found in the Current Conditions Plan View (Figure 2), while photographs of the repairs are shown in the Stream Maintenance and Repair photolog, both of which are located in Appendix B. Additionally, photographs of several previously repaired areas from June 2016 (as described in the Year 2 report) are also included in Appendix B. Those repaired areas have remained stable and vegetated.

Two pebble counts were conducted in MY3. The pebble count conducted on Hurricane Creek R2 shows that the bed material size distribution has remained relatively stable. The pebble count conducted on UT4-R4b shows a slight coarsening in the bed material size distribution during MY3. Pebble count data can be found in Appendix D.

Based on the Year 3 vegetation plot monitoring data collected during September of 2017, the average planted stem density is 567 stems per acre. Thus, the vegetation data demonstrate that the project as a whole is meeting the minimum success criteria of 320 trees per acre by the end of Year 3, as well as being on track to meet the success criteria of 260 trees per acre by the end of Year 5. However, Vegetation Plot #2 did not pass this year with 202 planted stems, as explained in further detail below.

There were a few Vegetation Problem Areas (VPAs) documented on the project during Year 3 monitoring. First, there were two areas of invasive species observed and documented on site during Year 3 monitoring: one small area at the uppermost portion of HC-R1, and another small area along the lower portion of UT4-R4 were both found to contain the invasive species Chinese privet (*Ligustrum sinsense*). The areas total approximately 0.07 acres (about 0.2% of the total easement area of the project). These areas will be treated in 2018.

The other VPAs are areas of low stem densities observed in portions of the floodplain along HC-R2, HC-R3, and UT4-R2 totaling approximately 1.21 acres (about 3.6% of the total easement area of the project). They were discovered during a vegetation assessment conducted in March and April of 2017 of several areas that were suspected of potentially having thin stem densities. The area on HC-R2 has significant weed pressure from dense cocklebur (*Xanthirum strumarium*), HC-R3 appears hindered by the shade from the adjacent mature forested area, and UT-R2 may have experienced delayed mortality of stems weakened by floodplain scouring relatively soon after construction. Vegetation Plot #2 is found within the most affected portion of the area along HC-R2 and likely as a result did not meet the Year 3 success criteria. These areas will be planted during the dormant season with supplemental bareroot stems.

There were also two areas of vegetation maintenance conducted on previously observed VPAs documented in the Year 2 report. First, the invasive Chinese privet found along HC-R3 was treated in January of 2017 by River Works personnel as shown in the CCPV (Figure 2). This location will continue to be observed throughout the remaining monitoring years to document any further re-sprouts. The second area of maintenance was the approximate 0.24 acre area of supplemental bareroot planting just downstream of the crossing on UT-R4 around vegetation plot #7. As noted in the Year 2 report, low-stem densities were observed in this area from the scouring observed from the heavy rains associated with Hurricane Joaquin before riparian vegetation had been fully established. A subsequent inspection of this planted area during monitoring activities in September 2017 revealed that the planted stems appeared to be alive and growing well, as numerous stems were quickly and easily identified in the field and had leaves and/or bud scars to indicate seasonal growth and all-around vigor.

Stream flow for the restored channels was recorded for 2017 through the use of three in-stream flow gauges (pressure transducers) located along reaches UT4-R4b (gauge BTFL1), UT4-R1b (gauge BTFL2), and HC-R1 (gauge HCFL1). The flow gauges documented seasonal flow for Year 3 in these reaches of 58, 34, and 64 days respectively. Thus, each gauge met the minimum success criteria of 30 consecutive days of flow. All of the flow gauges demonstrated similar flow events relative to recorded rainfall events on site as demonstrated in the gauge graphs in Appendix E. It should also be noted that as Figure 6 demonstrates, the observed monthly rainfall data for the project over the past 12 months has been quite dry as compared to historic averages. A total of just 24.9” of rainfall was observed for the site, while Anson County averages 47.0” of annual rainfall, a deficit of over 22.1”. The NCDWR drought monitoring history for Anson County also indicates that for significant periods of time over the past 12 months the County has been in Abnormally Dry (D0) or Moderate Drought (D1) conditions. Appendix E contains more details on the observed and historic rainfall data for the Site.

Two bankfull crest gauges are located along UT4-R2 and HC-R2. During Year 3 monitoring, the crest gauge on HC-R2 documented one post-construction bankfull event on 7/18/17, as confirmed by the HCFL1 flow gauge depth recorded on that same date (see flow gauge graph in Appendix E). While the crest gauge on UT4-R2 did not record a bankfull event in MY3, the two in-stream flow gauges on UT4-R4 and UT4-R1 did record several events that were very close to bankfull events, and visual evidence such as wrack lines and debris jams were clearly discovered along UT4-R5 as shown in photographs in Appendix B. Complete project crest gauge readings are presented in Table 13 found in Appendix E.

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 3 monitoring activities for the post-construction monitoring period.

2.0 METHODOLOGY

The seven-year monitoring plan for the Site includes criteria to evaluate the success of the stream and vegetation components of the 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 Figure 2 found in Appendix B.

The Year 3 vegetation data was collected in September of 2017, while the cross-section survey data was collected in November of 2017. Visual site assessment data contained in Appendix B was collected in September and October 2017, unless noted otherwise.

2.1 Stream Assessment

The project involved the restoration and enhancement of a rural piedmont stream system, 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 flood 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 all previous cross-section survey data to evaluate changes between construction and the current condition. Morphological survey data of the fifteen project cross-sections is presented in Appendix D.

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 remedial actions/repairs are required by the US Army Corps of Engineers (USACE) or DMS.

Particle size distribution assessments (pebble counts) were conducted using the modified Wolman method as described in Applied River Morphology (Rosgen, 1996).

2.1.2 Hydrology

To document seasonal flow in restored intermittent channels, two in-stream automated flow gauges (pressure transducers) were installed on the UT4 site (in UT4-R1b and UT4-R4b), and one was installed on the HC site (in HC-R1). Success criteria are considered to have been met if 30 consecutive days of flow were observed at any point during the monitoring year. The recorded flow data and observed rainfall graphs for each gauge, along with the flow gauge success summary table are all located in Appendix E.

The occurrence of bankfull events within the monitoring period are documented by the use of two crest gauges, flow camera photographs, and three in-stream flow gauges. One crest gauge is installed at bankfull elevation along on HC-R2 and a second crest gauge is installed along UT4-R2. The flow camera is installed on UT4-R4b at the in-stream flow gauge location along that reach. Flow camera

photographs and visual evidence of bankfull events are found in Appendix B, while all project crest gauge readings are presented in Table 13 in Appendix E.

It should be noted that as Figure 6 in Appendix E shows, the observed monthly rainfall data for the project over the past 12 months has been quite dry as compared to historic averages. A total of just 24.9" of rainfall was observed for the site, while Anson County averages 47.0" of annual rainfall, a deficit of over 22.1". The NCDWR drought monitoring history for Anson County also indicates that for significant periods of time over the past 12 months the County has been in Abnormally Dry (D0) or Moderate Drought (D1) conditions.

2.1.3 Photographic Documentation

Reference photograph transects were taken at each permanent cross-section during the survey work in November 2017. 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 3 were taken along all reaches and vegetation plots for both the Hurricane Creek and UT4 project sites during September 2017 site visits.

A stream flow camera is located along UT4-R4b at the location of the in-stream flow gauge to provide further documentation of seasonal flow.

The photographs of all stream reaches, flow cameras, vegetation plots, monitoring gauges (both crest and flow gauges), stream repair areas, as well as the 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 HC as per Monitoring Levels 1 and 2. The size of each individual quadrants are 100 square meters for woody tree species.

All Year 3 vegetation assessment information including vegetation plot data tables, and the photographs and locations of any Vegetation Problem Areas is provided in Appendices B and 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 (DMS). 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.

Rosgen, D.L. 1996. Applied River Morphology. Wildlands Hydrology. Pagosa Springs, CO.

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.

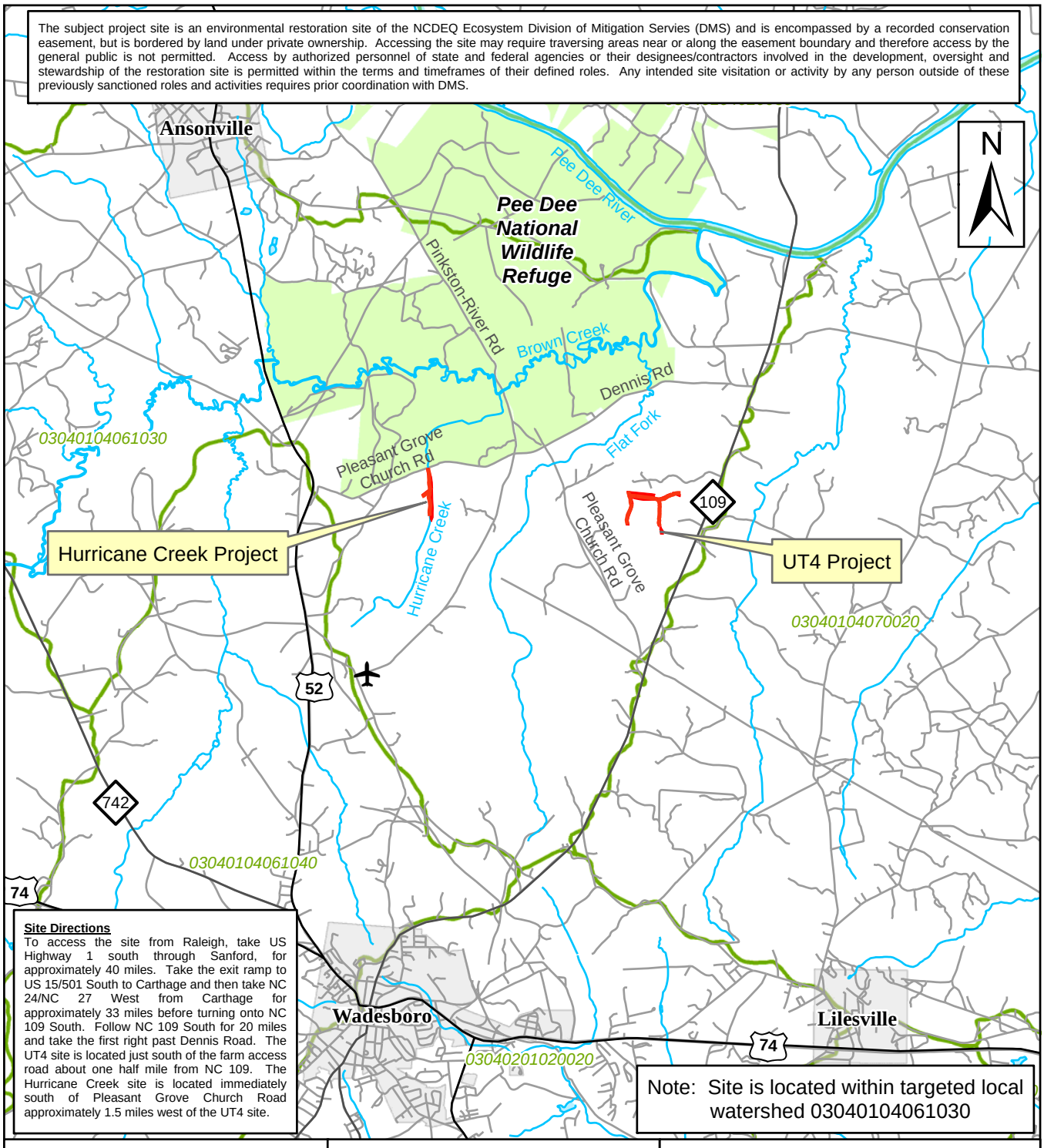
United States Army Corps of Engineers. 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," WRAP Technical Notes Collection (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center. Vicksburg, MS.

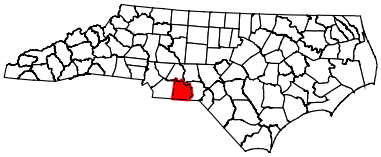
United States Army Corps of Engineers. 2003. "Stream Mitigation Guidelines, April 2003". Wilmington District, NC.

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

Michael Baker
INTERNATIONAL

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	9,664.0	102.0							

Project Components

Project Component or Reach ID	Stationing/ Location [1]	Existing Footage/ Acreage (LF)	Approach	Restoration/ Restoration Equivalent (SMU)[2]	Restoration Footage or Acreage (LF)	Mitigation Ratio
HC-R1	10+00 - 30+43	1,896	Restoration	2,035	2,043	1:1
HC-R2	30+43 - 30+52 & 30+82 - 44+67	1,288	Restoration	1,366	1,394	1:1
HC-R3	10+36 - 16+00	579	Enhancement Level II	232	564	2.5:1
UT4-R1a	10+00 - 15+18	518	Preservation	102	518	5:1
UT4-R1b	11+07 - 19+64	906	Restoration	849	858	1:1
UT4-R2	19+64 - 21+11 & 21+42 - 38+23	1,673	Restoration	1,827	1,828	1:1
UT4-R3	28+92 - 31+42	244	Restoration	227	250	1:1
UT4-R4a	10+00 - 13+96	395	Restoration	395	396	1:1
UT4-R4b	14+28 - 25+23 & 25+43 - 28+92	1,392	Restoration	1,452	1,444	1:1
UT4-R5a	09+44 - 13+35	386	Enhancement Level I	257	391	1.5:1
UT4-R5b	14+40 - 30+22	1,535	Enhancement Level I	1,024	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.

[2] The SMU credit numbers used here were taken directly from the mitigation plan credit table (Table 5.1) as per IRT instruction, and vary from those presented in the previous monitoring reports. This was done to address the differences between the anticipated credits in the mitigation plan and the final credits found in the baseline/as-built report, a result of survey differences between the use of stream centerline versus thalweg values.

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	Nov-16	Jan-17
Year 3 Monitoring	Dec-17	Nov-17	Nov-17
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: Bill Wright, Tel. 919-582-3574
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Bill Wright, Tel. 919-582-3574
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Bill Wright, Tel. 919-582-3574
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)

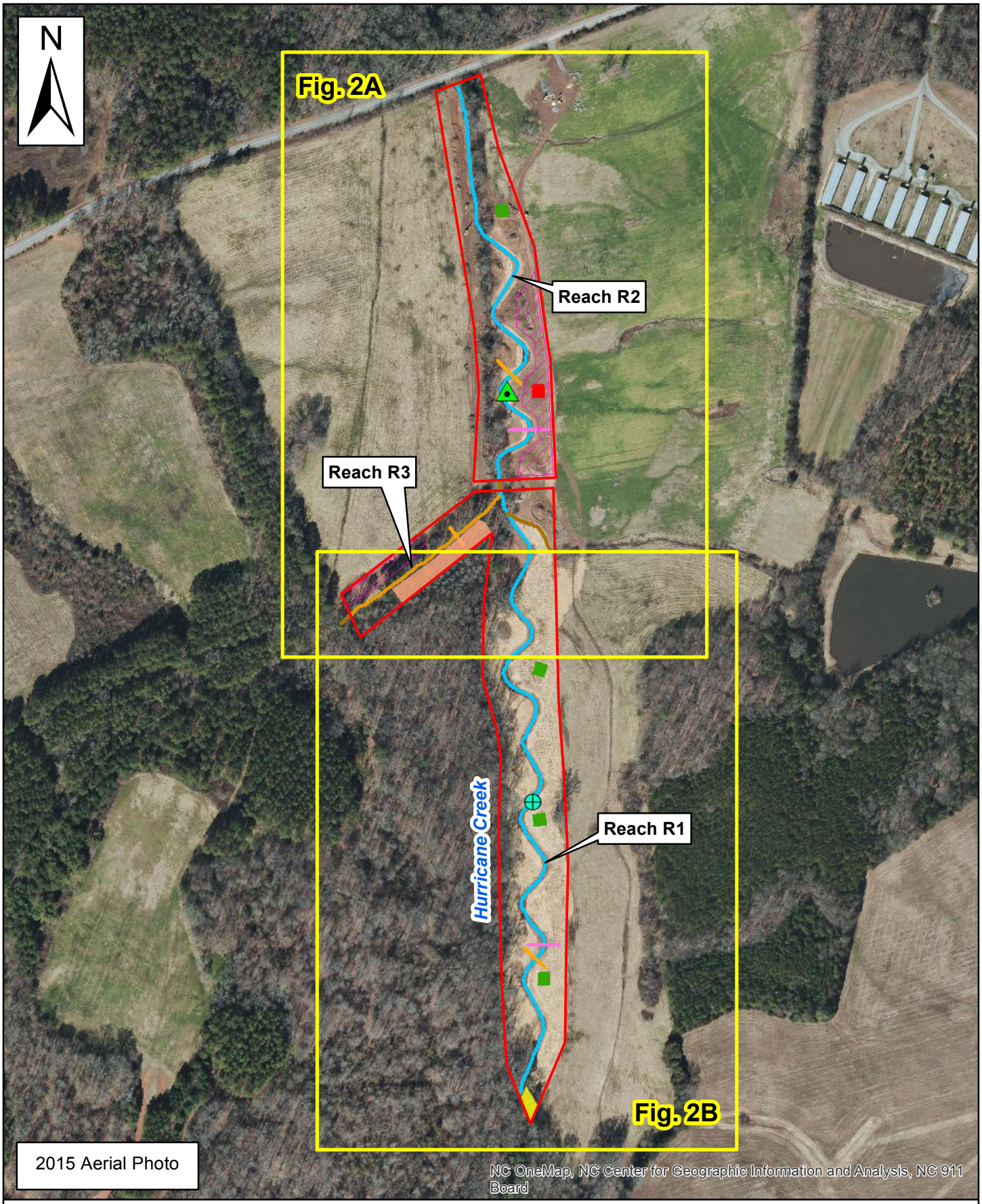
Table 4b. Project Attribute Information - UT4 (Pre-Construction)
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - DMS Project No. 95351

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

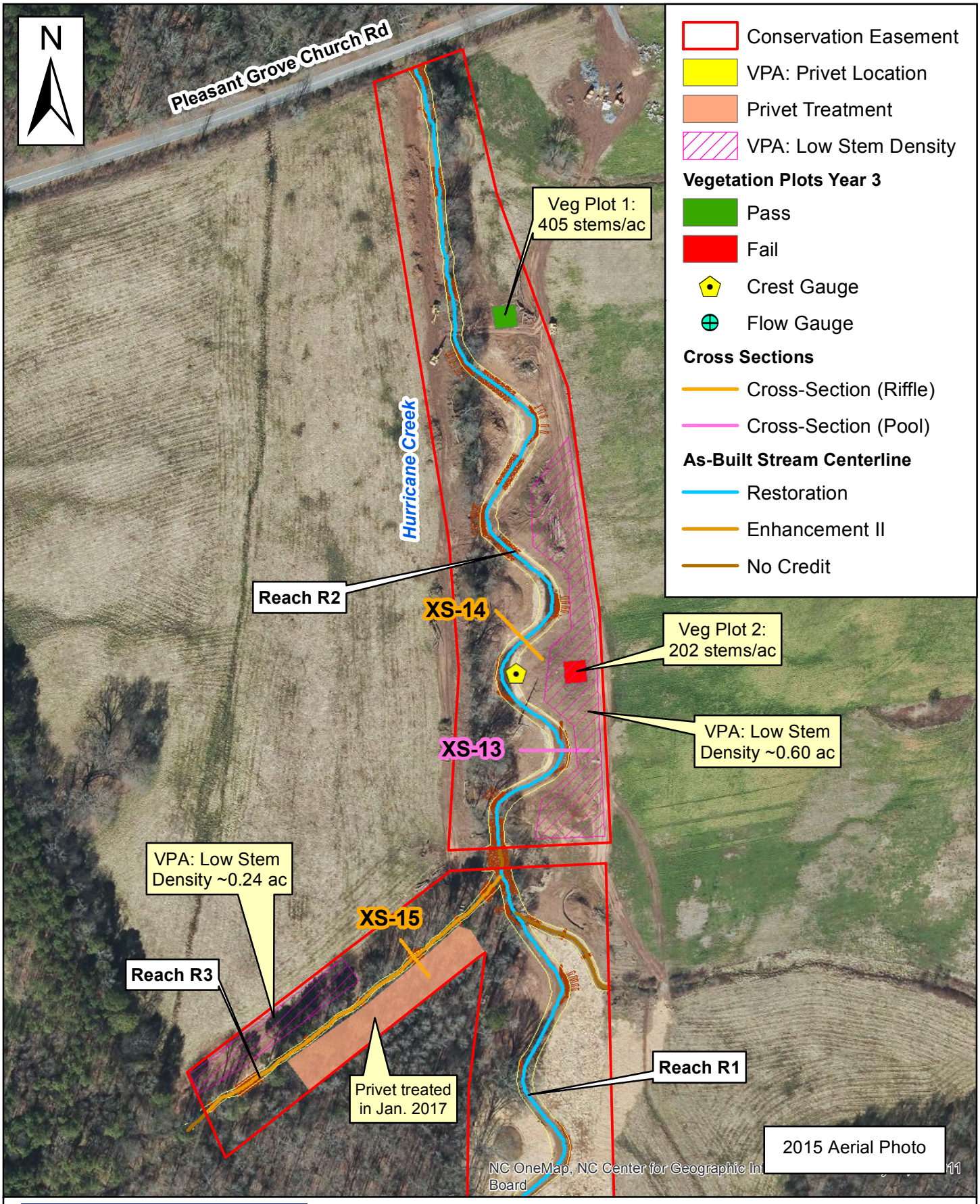


Michael Baker INTERNATIONAL

0 250 500 Feet

DMS Project #95351

Figure 2: Overview Map 1
Current Conditions Plan View
Monitoring Year 3
Hurricane Creek Site

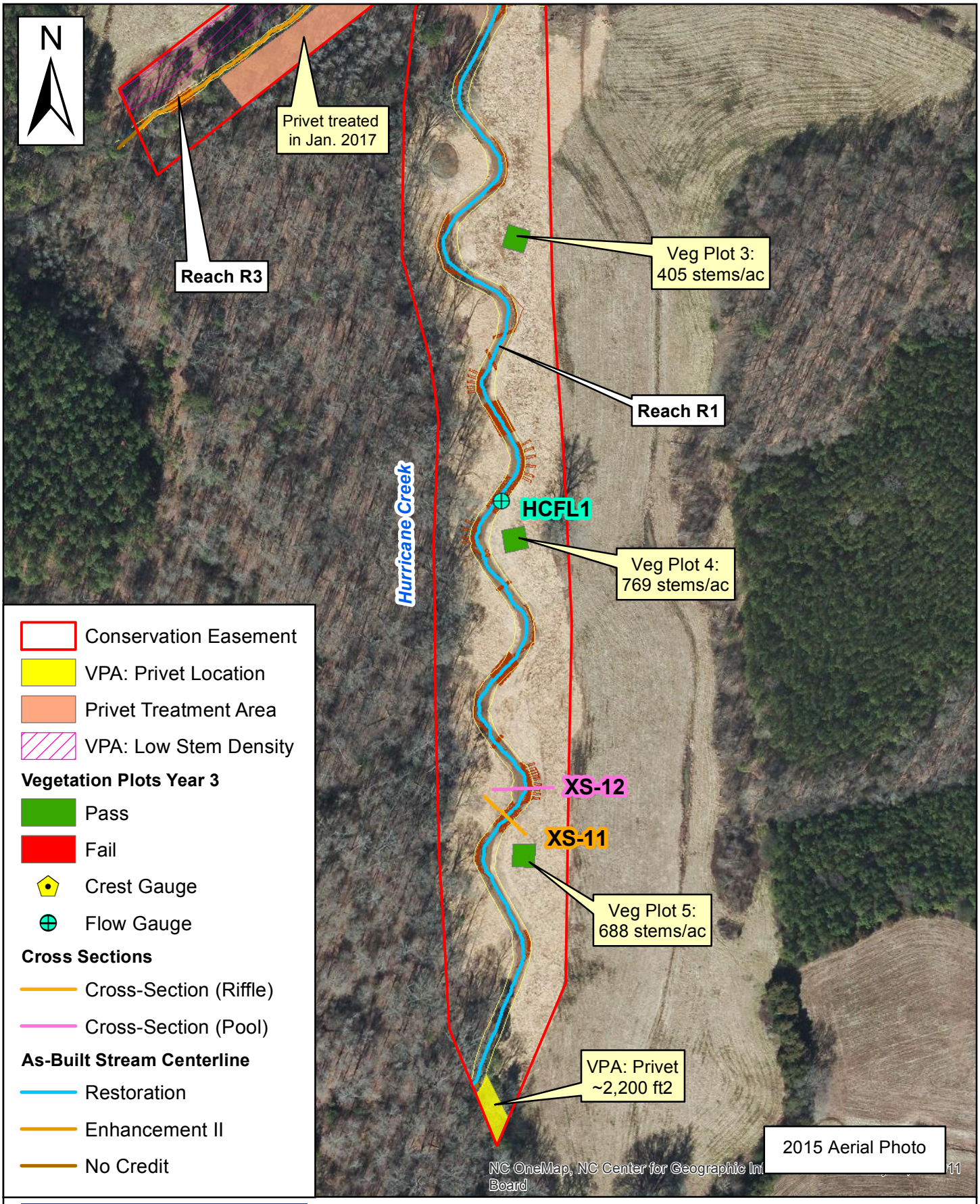


Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2A
Current Conditions Plan View
Monitoring Year 3
Hurricane Creek Site

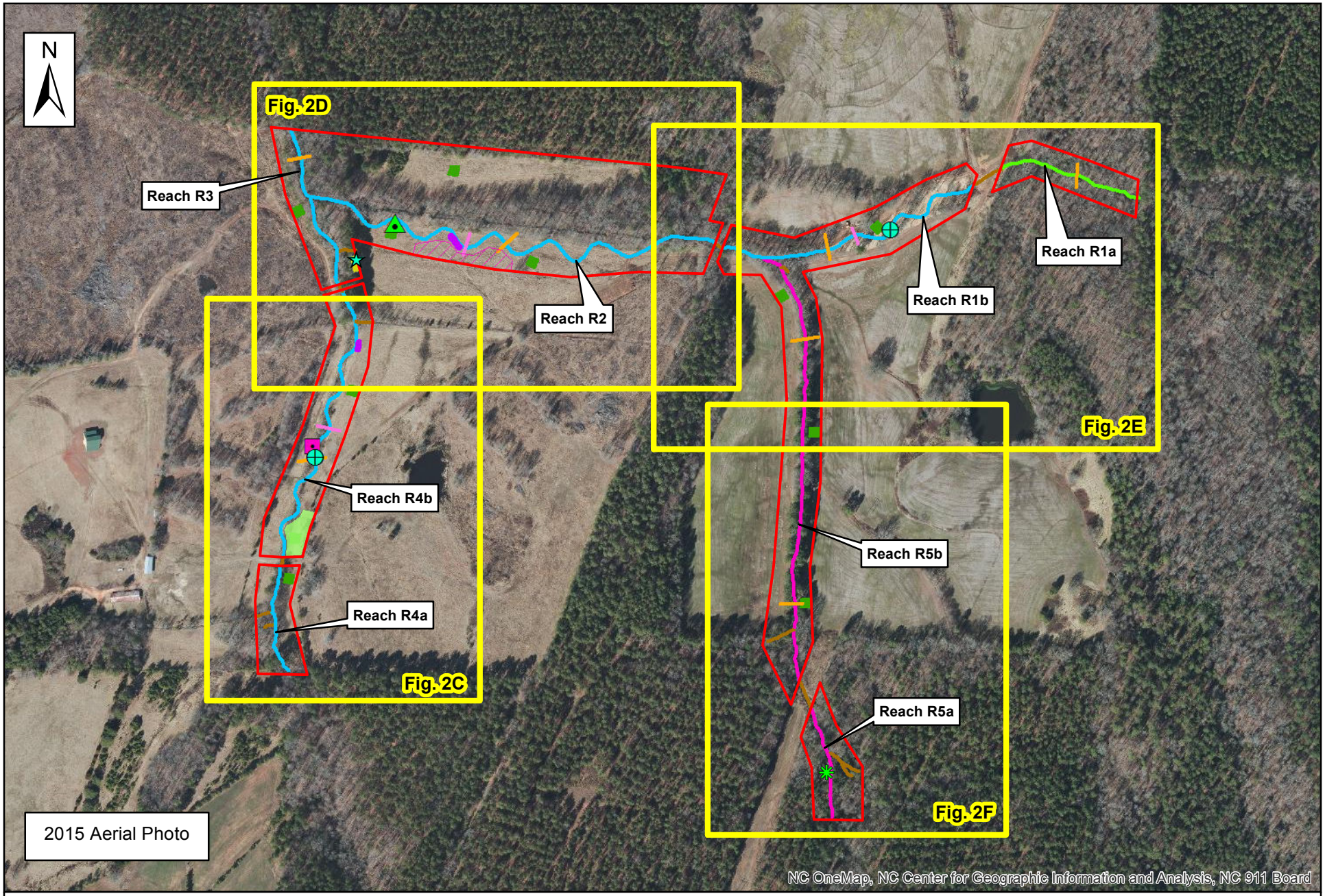


Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2B
Current Conditions Plan View
Monitoring Year 3
Hurricane Creek Site

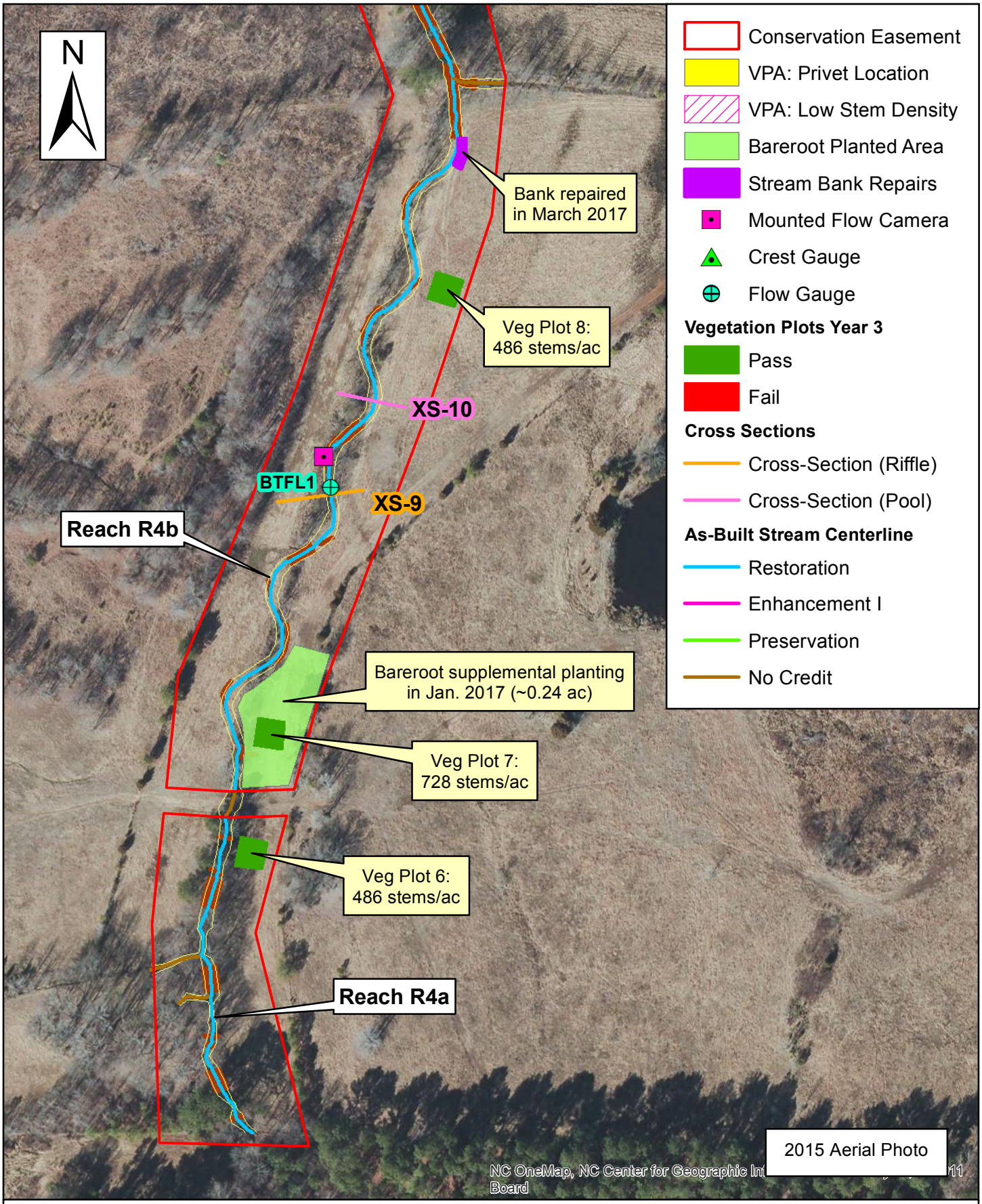


Michael Baker INTERNATIONAL

0 250 500 750 1,000 Feet

DMS Project #95351

Figure 2: Overview Map 2
Current Condition Plan View
Monitoring Year 3
Brown Creek Tribs: UT4 Site



Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2C
Current Condition Plan View
Monitoring Year 3
Brown Creek Tribs: UT4 Site

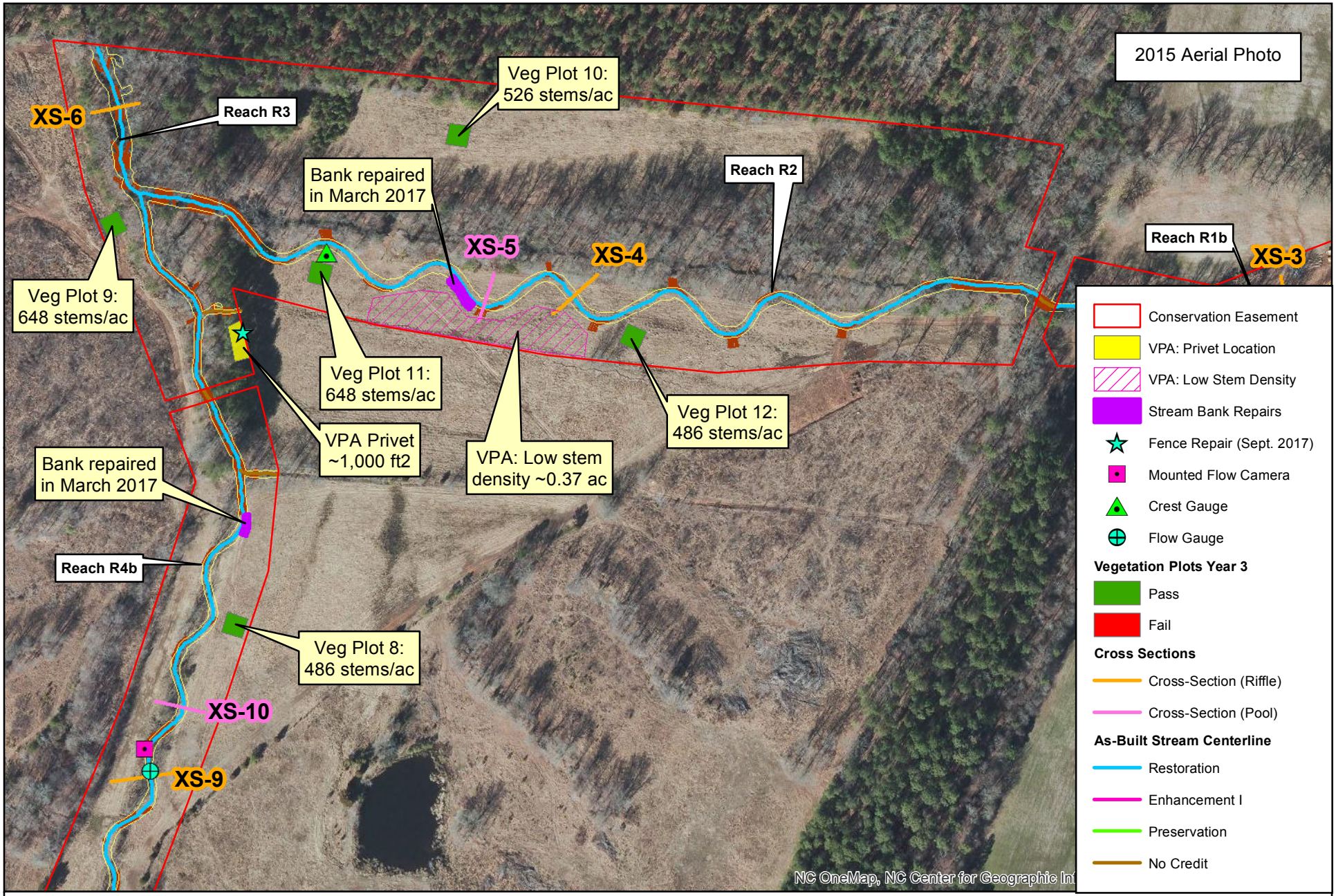
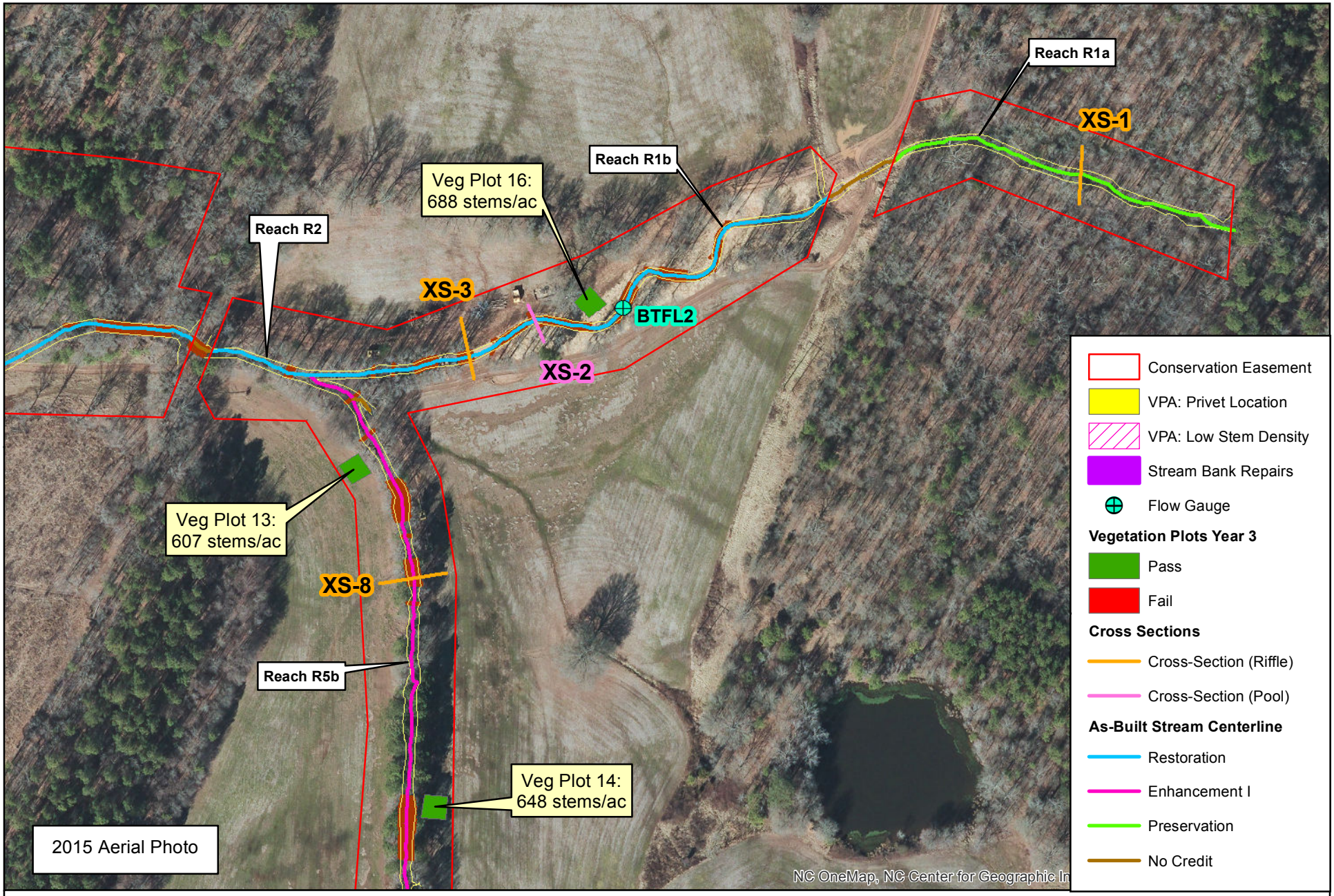


Figure 2D
Current Condition Plan View
Monitoring Year 3
Brown Creek Tribs: UT4 Site



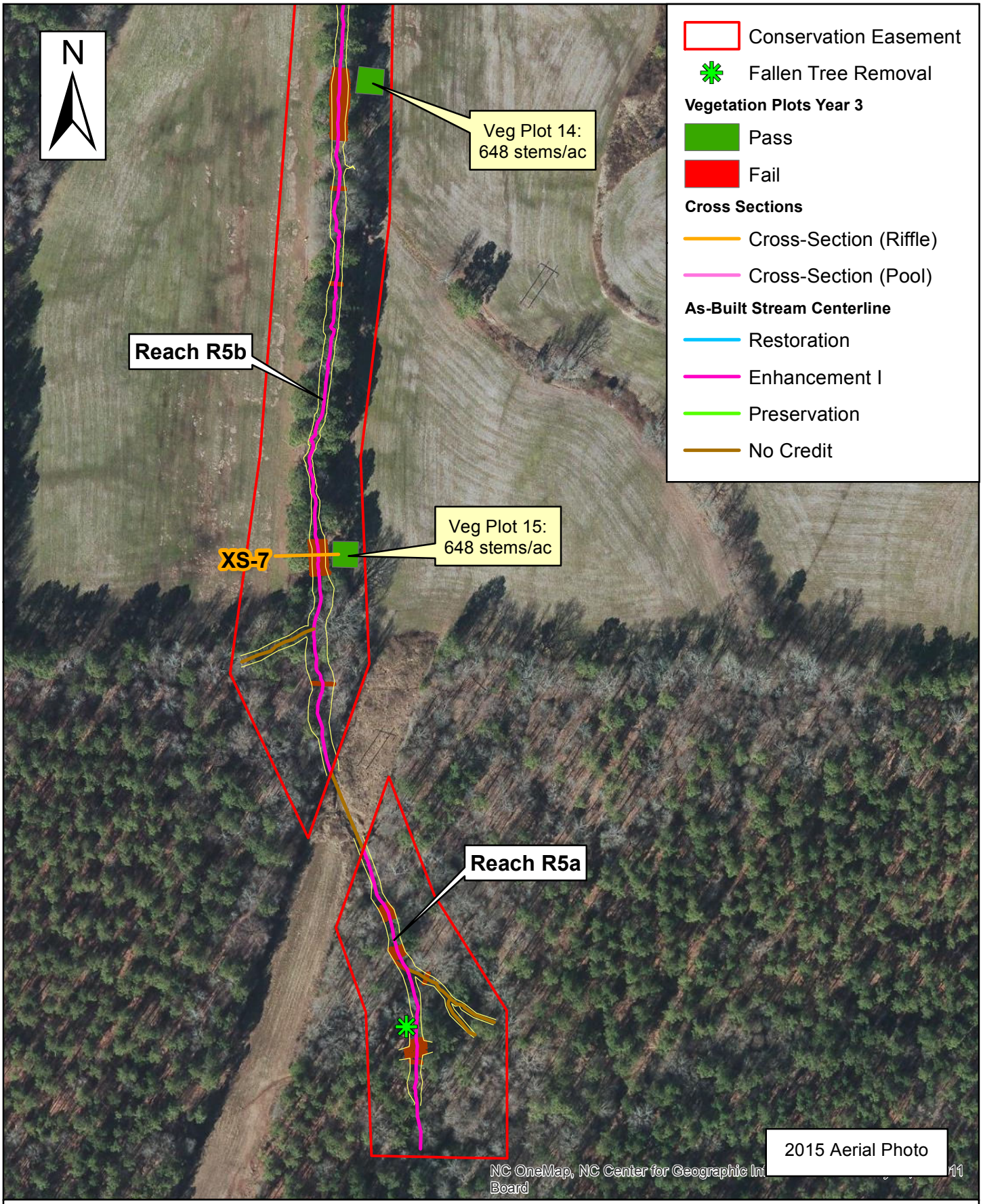
Michael Baker INTERNATIONAL

0 100 200 300 400 500 Feet

DMS Project #95351

N

Figure 2E
Current Condition Plan View
Monitoring Year 3
Brown Creek Tribs: UT4 Site



Michael Baker INTERNATIONAL

0 100 200 300 Feet

DMS Project #95351

Figure 2F
Current Condition Plan View
Monitoring Year 3
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			0	0	100%			
	2. Riffle Condition	1. Texture Substrate	15	15			100%			
	3. Meander Pool Condition	1. Depth	16	16			100%			
		2. Length	16	16			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)	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			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	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			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	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sill or arms	3	3			100%			
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	6	6			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-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			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	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**
-	N/A	N/A	N/A	N/A
Notes:				

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

Planted Acreage:	**33.5**					
Vegetation Category	**Definitions**	**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	N/A	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	Fig. 2A and 2D (pink hatch polygon)	3	1.21	3.6%
			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	N/A	0	0.00	0.0%
			Cumulative Total	**0**	**0.00**	**0.0%**
Easement Acreage:	**43.3**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 ft²	Fig. 2B and 2D (yellow polygons)	2	0.07	0.2%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	none	N/A	0	0.00	0.0%

Table 6b. Vegetation Problem Areas (VPAs)
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Feature Issue	Station Number	Area	Suspected Cause	Photo # in Problem Area Photo Log
Low stem density	HC-R2, Station 30+50 to 39+00 (right bank)	~0.60 acres	Grass/Weed Competition[1]	1
Low stem density	HC-R3, Station 10+50 to 13+00 (left bank)	~0.24 acres	Grass Competition and Shading[2]	2
Low stem density	UT4-R2, Station 29+50 to 33+50 (left bank)	~0.37 acres	Effects of Old Storm Scour[3]	3
Chinese privet (*Ligustrum sinsense*)	HC-R1, Station 10+00 to 10+50 (right bank)	~2,200 ft^2	Resprouts	-
Chinese privet (*Ligustrum sinsense*)	UT4-R4b, Station 26+00 (left bank)	~1,000 ft^2	Resprouts	-

Notes:
1 Fescue grass and weed competition from the dense stands of cocklebur (*Xanthirum strumarium*) have apparently hurt stem growth on this portion of HC-R2.

1 Fescue grass and shading from the adjacent mature woodline is suspected to have hurt stem growth for this portion of HC-R3.

2 The true cause of the slightly low stem density observed here is ultimately unknown. It is merely suspected that stems in this area were weakened by the project-wide flooding caused by the heavy rainfall from Hurricane Joaquin in October 2015, which resulted in floodplain scour before the site had fully stabilized with herbaceous vegetation. The weakened stems found in this area did not thrive and/or did not survive this very dry past year.

Stream Photographs: Hurricane Creek Site

HC Reach 1, view downstream at Station 10+00

HC Reach 1, view downstream at Station 11+80

HC Reach 1, view downstream at Station 14+50

HC Reach 1, view upstream at Station 17+50

HC Reach 1, view downstream at Station 18+00

HC Reach 1, view upstream at Station 19+25

Stream Photographs: Hurricane Creek Site

HC Reach 1, view downstream at Station 19+75

HC Reach 1, view upstream at Station 22+40

HC Reach 1, view downstream at Station 24+00

HC Reach 1, vernal pool at Station 26+25

HC Reach 1, view downstream at Station 29+30

HC Reach 2, view upstream at Station 31+40

Stream Photographs: Hurricane Creek Site

HC Reach 2, view upstream at Station 32+75

HC Reach 2, view downstream at Station 33+00

HC Reach 2, view upstream at Station 35+70

HC Reach 2, view downstream at Station 36+00

HC Reach 2, view downstream at Station 39+10

HC Reach 2, view downstream at Station 40+75

Stream Photographs: Hurricane Creek Site

HC Reach 2, view upstream at Station 43+75

HC Reach 2, view downstream at Station 44+25

HC Reach 3, view upstream at Station 11+40

HC Reach 3, view downstream at Station 14+00

HC Reach 3, view downstream at Station 15+50

HC Reach 3, view upstream at Station 15+90

Stream Photographs: UT4 Site

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

Reach UT4-R4a – View downstream, Station 12+40

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

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

Reach UT4-R4b – View downstream, Station 14+75

Reach UT4-R4b – View downstream, Station 17+00

Stream Photographs: UT4 Site

Reach UT4-R4b – View upstream, Station 18+20

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

Reach UT4-R4b – View downstream, Station 19+00

Reach UT4-R4b – View downstream, Station 21+00

Reach UT4-R4b – View upstream at Station 22+50

Reach UT4-R4b – View downstream, Station 23+25

Stream Photographs: UT4 Site

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

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

Reach UT4-R4b – View downstream, Station 25+75

Reach UT4-R4b – View upstream, Station 27+00

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

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

Stream Photographs: UT4 Site

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

Reach UT4-R3 – View downstream, Station 29+50

Reach UT4-R3 – View downstream, Station 30+25

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

Reach UT4-R2 – View upstream at Station 37+50

Reach UT4-R2 – View upstream, Station 37+00

Stream Photographs: UT4 Site

Reach UT4-R2 – View upstream, Station 35+50

Reach UT4-R2 – View downstream, Station 33+50

Reach UT4-R2 – View upstream, Station 31+50

Reach UT4-R2 – View upstream, Station 30+50

Reach UT4-R2 – View upstream at Station 29+00

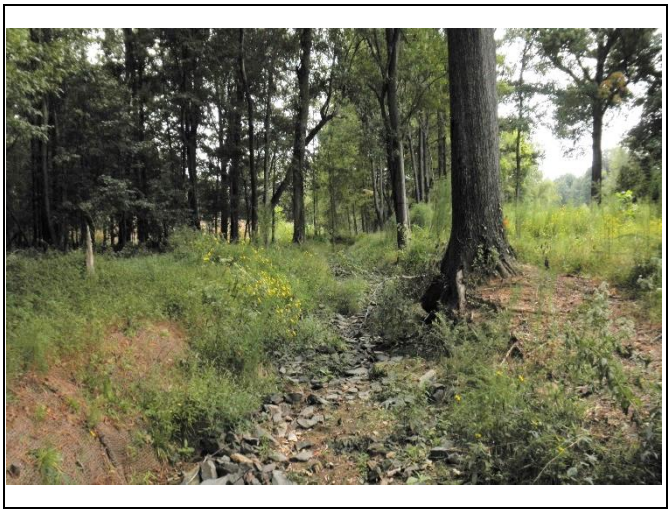
Reach UT4-R2 – View upstream, Station 28+00

Stream Photographs: UT4 Site

Reach UT4-R2 – View upstream, Station 26+00

Reach UT4-R2 – View upstream, Station 24+50

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



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

Reach UT4-R2 – View downstream, Station 20+40

Reach UT4-R2 – View upstream, Station 21+00

Stream Photographs: UT4 Site

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

Reach UT4-R5b – View upstream, Station 29+00

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

Reach UT4-R5b – View downstream, Station 26+40

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

Reach UT4-R5b – View upstream, Station 20+75

Stream Photographs: UT4 Site

Reach UT4-R5b – View upstream, Station 17+50

Reach UT4-R5b – View upstream, Station 15+50

Reach UT4-R5a – View upstream, Station 12+75

Reach UT4-R5a – View upstream, Station 12+00

Reach UT4-R5a – View of side tributary at Station 11+75

Reach UT4-R5a – View upstream, Station 11+50

Stream Photographs: UT4 Site

Reach UT4-R5a – View upstream, Station 10+75

Reach UT4-R1a – View upstream, Station 12+40

Reach UT4-R1a – View downstream, Station 12+40

Reach UT4-R1b – View downstream, Station 11+25

Reach UT4-R1b – View downstream, Station 12+75

Reach UT4-R1b – View downstream, Station 13+25

Stream Photographs: UT4 Site

Reach UT4-R1b – View upstream, Station 14+25

Reach UT4-R1b – View downstream, Station 15+25

Reach UT4-R1b – View downstream, Station 17+50

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

Stream Flow Camera Photographs

Reach UT4-R4b: 01/02/17

Reach UT4-R4b: 01/07/17

Reach UT4-R4b: 01/11/17

Reach UT4-R4b: 01/23/17

Reach UT4-R4b: 02/04/17

Reach UT4-R4b: 02/15/17

Stream Flow Camera Photographs

Reach UT4-R4b: 02/23/17

Reach UT4-R4b: 03/16/17

Reach UT4-R4b: 03/27/17

Reach UT4-R4b: 04/04/17

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

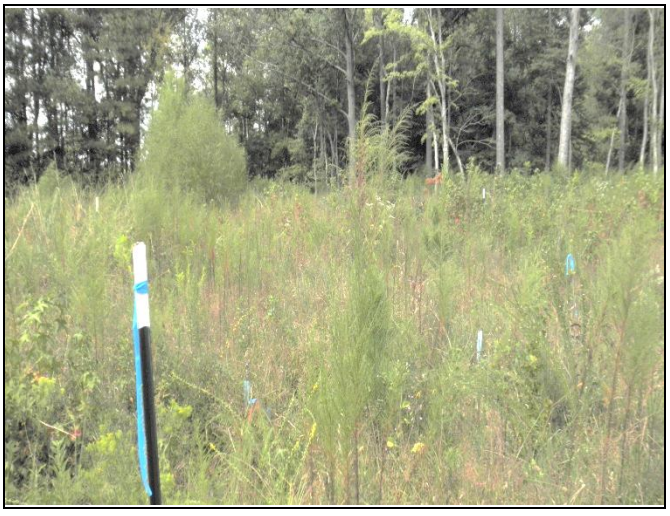
Vegetation Plot Photographs

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 HC-R2: Crest Gauge at Station 31+75

Reach HC-R2: Overbank Event of 0.33’ (9/19/2017)

Reach HC-R1: Evidence of overbank flooding (rack lines and debris in floodplain).

Reach HC-R1: Evidence of overbank flooding (debris caught in wires at cattle crossing ~3.3’ height).

Reach HC-R1: Flow Gauge at Station 19+80

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

Monitoring Gauge Photographs

Reach UT4-R5b: Evidence of overbank flooding (rack lines and debris on bank)

Reach UT4-R5b: Evidence of overbank flooding (rack lines and debris on bank)

Reach UT4-R5b: Evidence of overbank flooding (rack line and debris jam)

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

Reach UT4-R1b: Flow gauge at Station 14+90

Vegetation Problem Area Photographs

1) VPA: HC-R2, Low stem densities due to grass/weed pressure (especially from cocklebur shown here).

2) VPA: HC-R3, Low stem densities due to grass and shade pressure.

3) VPA: Reach UT4-R2, Low stem densities along portion of left bank (but area is vegetated and stable).

Stream Maintenance and Repair Photographs (2017)

1) Reach UT4-R2: Bank Erosion, Station 31+75 (BEFORE)

2) Reach UT4-R2: Geolift Installed March 2017 (AFTER)

3) Reach UT4-R4b: Bank Erosion, Station 23+30 (BEFORE)

4) Reach UT4-R4b: Geolift Installed March 2017 (AFTER)

5) Reach UT4-R4b: Supplemental Planting Around VP-7 in Jan. 2017 (new stems flagged in pink)

6) Reach HC-R3: Privet Treatment on Right Bank (Jan. 2017)

Previous Stream Repair Photographs (Repairs completed in June 2016, photos below from Sept 2017)

1) Reach UT4-R4b: Rock crossing, Station 25+30

2) Reach UT4-R3: Boulder revetment, Station 29+00

3) Reach UT4-R2: Bank regraded, Station 37+40

4) Reach UT4-R2: Riffle stabilized, Station 31+00

5) Reach UT4-R2: Riffle stabilized, Station 28+75

6) Reach UT4-R2: Riffle stabilized, Station 24+00

Previous Stream Repair Photographs (Repairs completed in June 2016, photos below from Sept 2017)

7) Reach UT4-R2: Bank regraded, Station 22+00

8) Reach UT4-R2: Bank at crossing stabilized with rock, Station 21+40

9) Reach UT4-R5a: Banks regraded, Station 11+50

10) Reach UT4-R5a: Banks regraded, Station 11+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	405/648	567
2	N	202/688	
3	Y	405/607	
4	Y	769/931	
5	Y	688/769	
6	Y	486/809	
7	Y	728/728	
8	Y	486/688	
9	Y	648/809	
10	Y	526/890	
11	Y	648/728	
12	Y	486/769	
13	Y	607/607	
14	Y	648/809	
15	Y	648/809	
16	Y	688/809	

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

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

Report Prepared By	Scott King
Date Prepared	9/29/2017 16:01
Database name	MichaelBaker_2017_BrownCrkTribs_95351.mdb
Database location	L:\Projects\128975\Monitoring\Veg Plots\Year 3_2017
Computer name	CARYLSKING
File size	65675264
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.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	95351
Project Name	Brown Creek Tributaries
Description	
River Basin	Yadkin-Pee Dee
Length (ft)	3716
Stream-to-edge width (ft)	50
Area (sq m)	34519.28
Required Plots (calculated)	10
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-year3	plot 95351-01-0002-year3	plot 95351-01-0003-year3	plot 95351-01-0004-year3	plot 95351-01-0005-year3	plot 95351-01-0006-year3	plot 95351-01-0007-year3	plot 95351-01-0008-year3	plot 95351-01-0009-year3	plot 95351-01-0010-year3	plot 95351-01-0011-year3	plot 95351-01-0012-year3	plot 95351-01-0013-year3	plot 95351-01-0014-year3	plot 95351-01-0015-year3	plot 95351-01-0016-year3
	Alnus serrulata	Shrub Tree	hazel alder	5	4	1.25				1		2				1			1			
	Asimina triloba	Shrub Tree	pawpaw	2	2	1															1	1
	Betula nigra	Tree	river birch	37	14	2.64	3	2	1	3	2	1		4	5	3	4	1		3	2	3
	Carpinus caroliniana	Shrub Tree	American hornbeam	5	5	1	1						1					1		1	1	
	Cornus amomum	Shrub	silky dogwood	1	1	1				1												
	Diospyros virginiana	Tree	common persimmon	12	7	1.71				3		1		1	3					1	2	1
	Fraxinus pennsylvanica	Tree	green ash	44	15	2.93	2	3	5	1	3	4	5	2	5	2		3	2	2	2	3
	Hamamelis virginiana	Shrub Tree	American witchhazel	4	2	2													2		2	
	Itea virginica	Shrub	Virginia sweetspire	2	2	1						1		1								
	Lindera benzoin	Shrub Tree	northern spicebush	1	1	1														1		
	Liriodendron tulipifera	Tree	tuliptree	4	4	1				1	1						1		1			
	Nyssa sylvatica	Tree	blackgum	13	7	1.86										1	4	1	1	2	2	2
	Platanus occidentalis	Tree	American sycamore	29	13	2.23			1	2	2	1	7	2	1	2	2	4	3	1		1
	Quercus alba	Tree	white oak	14	11	1.27	1		1		2	1	2	1		2		1	1	1	1	
	Quercus michauxii	Tree	swamp chestnut oak	20	12	1.67	1			1	2		3	1	1	1	1	1	4	3		1
	Quercus nigra	Tree	water oak	1	1	1			1													
	Quercus phellos	Tree	willow oak	11	7	1.57	1		1	2	1				1		2					3
	Viburnum dentatum	Shrub Tree	southern arrowwood	19	9	2.11	1			4	4	1				1	2			1	3	2
TOT:	**0**	**18**	**18**	**18**	**224**	**18**		**10**	**5**	**10**	**19**	**17**	**12**	**18**	**12**	**16**	**13**	**16**	**12**	**15**	**16**	**16**	**17**

Table 9b. Total Stem Counts 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	3	2	1	3	2	1		4	5	3	4	1		3	2	3	
Fraxinus pennsylvanica	green ash	6	3	6	1	3	5	5	3	5	2		3	3	2	2	3	
Liriodendron tulipfera	tulip poplar				1	1						1		1				
Nyssa sylvatica	blackgum		1								1	4	1	1	2	2	2	
Plantanus occidentalis	sycamore			1	2	2	1	7	3	1	3	2	4	5	1		1	
Quecus alba	white oak	1		1		2	1	2	1		2		1	2	1	1		
Quercus michauxii	swamp chestnut oak	1			1	2		3	1	2	1	1	1	5	3		1	
Quercus nigra	water oak			1														
Quercus phellos	willow oak	1		1	2	1				1		2					3	
Ulmus americana	American elm				1									1				
Ulmus alata	winged elm										1						2	
Shrub Species																		
Alnus serrulata	hazel alder				1		2				1			1				
Asimina triloba	paw paw															1	1	
Carpinus caroliniana	ironwood	1						1					1		1	1		
Cornus ammomum	silkly dogwood				1													
Diospyros virginiana	persimmon				3	1	2		1	3	1				1	2	1	
Hamamelis virginiana	witch hazel													2		2		
Itea virginica	Virginia sweetspire						1		1									
Lindera benzoin	spicebush														1			
Rhus copallinum	winged sumac															2		
Viburnum dentatum	arrowwood viburnum	1			4	4	1				1	2			1	3	2	
Total Stems Per Plot Year 3* (September 2017)		14	6	11	20	18	14	18	14	17	16	16	12	21	16	18	19	
Total Stems/Acre Year 3* (September 2017)		567	243	445	809	728	567	728	567	688	648	648	486	850	648	728	769	**632**
Total Stems/Acre Year 2 (November 2016)		486	364	405	850	688	567	202	486	647	769	647	607	607	688	728	728	592
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

*Note: Monitoring Year 3 (2017) includes volunteer species data, which was collected for the first time, whereas previous monitoring years only reported planted species data.

Table 9c. Yearly Density Per Plot
DMS Project Code 95351. Project Name: Brown Creek Tributaries

			Current Plot Data (MY3 2017)																											
			95351-01-0001			95351-01-0002			95351-01-0003			95351-01-0004			95351-01-0005			95351-01-0006			95351-01-0007			95351-01-0008			95351-01-0009		
Scientific Name	Common Name	Species Type	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T
Alnus serrulata	hazel alder	Shrub										1		1				2		2										
Asimina triloba	pawpaw	Tree																												
Betula nigra	river birch	Tree	3		3	2		2	1		1	3		3	2		2	1		1				4		4	5		5
Carpinus caroliniana	American hornbeam	Tree	1		1																1		1						
Cornus amomum	silky dogwood	Shrub										1		1															
Diospyros virginiana	common persimmon	Tree										3		3		1	1	1	1	2				1		1	3		3
Fraxinus pennsylvanica	green ash	Tree	2	4	6	3		3	5	1	6	1		1	3		3	4	1	5	5		5	2	1	3	5		5
Hamamelis virginiana	American witchhazel	Tree																											
Itea virginica	Virginia sweetspire	Shrub																1		1				1		1			
Lindera benzoin	northern spicebush	Shrub																											
Liriodendron tulipifera	tuliptree	Tree										1		1	1		1												
Nyssa sylvatica	blackgum	Tree					1	1																					
Platanus occidentalis	American sycamore	Tree							1		1	2		2	2		2	1		1	7		7	2	1	3	1		1
Quercus alba	white oak	Tree	1		1				1		1				2		2	1		1	2		2	1		1			
Quercus michauxii	swamp chestnut oak	Tree	1		1							1		1	2		2				3		3	1		1	1	1	2
Quercus nigra	water oak	Tree							1		1																		
Quercus phellos	willow oak	Tree	1		1				1		1	2		2	1		1										1		1
Rhus copallinum	winged sumac	Shrub																											
Ulmus alata	winged elm	Tree																											
Ulmus americana	American elm	Tree											1	1															
Viburnum dentatum	southern arrowwood	Shrub	1		1							4		4	4		4	1		1									
		Stem count	10	4	14	5	1	6	10	1	11	19	1	20	17	1	18	12	2	14	18	0	18	12	2	14	16	1	17
		Size (ares)	1			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			0.02		
		Species count	7	1	7	2	1	3	6	1	6	10	1	11	8	1	9	8	2	8	5	0	5	7	2	7	6	1	6
		Stems per ACRE	404.7	161.9	566.6	202.3	40.47	242.8	404.7	40.47	445.2	768.9	40.47	809.4	688	40.47	728.4	485.6	80.94	566.6	728.4	0	728.4	485.6	80.94	566.6	647.5	40.47	688

Color Key
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Includes Volunteer species

P = Planted stems
V = Volunteer stems
T = Total stems

			Current Plot Data (MY3 2017)																					Annual Means						
			95351-01-0010			95351-01-0011			95351-01-0012			95351-01-0013			95351-01-0014			95351-01-0015			95351-01-0016			MY3 (2017)*			MY2 (2016)			MY1 (2015)		
Scientific Name	Common Name	Species Type	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T
Alnus serrulata	hazel alder	Shrub	1		1							1		1										5		5	5		5	6		6
Asimina triloba	pawpaw	Tree																1		1	1		1	2		2	2		2	3		3
Betula nigra	river birch	Tree	3		3	4		4	1		1				3		3	2		2	3		3	37		37	42		42	66		66
Carpinus caroliniana	American hornbeam	Tree							1		1				1		1	1		1				5		5	5		5	6		6
Cornus amomum	silky dogwood	Shrub																						1		1	1		1	1		1
Diospyros virginiana	common persimmon	Tree		1	1										1		1	2		2	1		1	12	3	15	15		15	13		13
Fraxinus pennsylvanica	green ash	Tree	2		2				3		3	2	1	3	2		2	2		2	3		3	44	8	52	41		41	49		49
Hamamelis virginiana	American witchhazel	Tree										2		2				2		2				4		4	4		4	5		5
Itea virginica	Virginia sweetspire	Shrub																						2		2	2		2	1		1
Lindera benzoin	northern spicebush	Shrub													1		1							1		1	1		1	1		1
Liriodendron tulipifera	tuliptree	Tree				1		1				1		1										4		4	4		4	5		5
Nyssa sylvatica	blackgum	Tree	1		1	4		4	1		1	1		1	2		2	2		2	2		2	13	1	14	16		16	18		18
Platanus occidentalis	American sycamore	Tree	2	1	3	2		2	4		4	3	2	5	1		1				1		1	29	4	33	26		26	34		34
Quercus alba	white oak	Tree	2		2				1		1	1	1	2	1		1	1		1				14	1	15	19		19	23		23
Quercus michauxii	swamp chestnut oak	Tree	1		1	1		1	1		1	4	1	5	3		3				1		1	20	2	22	20		20	20		20
Quercus nigra	water oak	Tree																						1		1	1		1	1		1
Quercus phellos	willow oak	Tree				2		2													3		3	11		11	11		11	13		13
Rhus copallinum	winged sumac	Shrub																	2	2					2	2						
Ulmus alata	winged elm	Tree		1	1																	2	2		3	3						
Ulmus americana	American elm	Tree											1	1											2	2						
Viburnum dentatum	southern arrowwood	Shrub	1		1	2		2							1		1	3		3	2		2	19		19	19		19	18		18
		Stem count	13	3	16	16	0	16	12	0	12	15	6	21	16	0	16	16	2	18	17	2	19	224	26	250	234	0	234	283	0	283
		Size (ares)	1			1			1			1			1			1			1			16			16			16		
		Size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.40			0.40			0.40		
		Species count	8	3	10	7	0	7	7	0	7	8	5	9	10	0	10	9	1	10	9	1	10	18	9	21	18	0	18	18	0	18
		Stems per ACRE	526.1	121.4	647.5	647.5	0	647.5	485.6	0	485.6	607	242.8	849.8	647.5	0	647.5	647.5	80.94	728.4	688	80.94	768.9	566.6	65.76	632.3	591.9	0	591.9	715.8	0	715.8

*Note: Monitoring Year 3 (2017) includes volunteer species data, which was collected for the first time, whereas previous monitoring years only reported planted species data.

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

Year 3 (14-Sep-2017 to 19-Sep-2017)
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	10	0	0	4	14	0
2	n/a	5	0	0	1	6	0
3	n/a	10	0	0	1	11	0
4	n/a	19	0	0	1	20	0
5	n/a	17	0	0	1	18	0
6	n/a	12	0	0	2	14	0
7	n/a	18	0	0	0	18	0
8	n/a	12	0	0	2	14	0
9	n/a	16	0	0	1	17	0
10	n/a	13	0	0	3	16	0
11	n/a	16	0	0	0	16	0
12	n/a	12	0	0	0	12	0
13	n/a	15	0	0	6	21	0
14	n/a	16	0	0	0	16	0
15	n/a	16	0	0	2	18	0
16	n/a	17	0	0	2	19	0

Wetland/Stream Vegetation Totals (per acre)

Plot #	Stream/ Wetland Stems[2]	Volunteers[3]	Total[4]	Success Criteria Met?
1	405	162	567	Yes
2	202	40	243	No
3	405	40	445	Yes
4	769	40	809	Yes
5	688	40	728	Yes
6	486	81	567	Yes
7	728	0	728	Yes
8	486	81	567	Yes
9	647	40	688	Yes
10	526	121	647	Yes
11	647	0	647	Yes
12	486	0	486	Yes
13	607	243	850	Yes
14	647	0	647	Yes
15	647	81	728	Yes
16	688	81	769	Yes
Project Avg	**567**	**66**	**632**	**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.

Color Key
Exceeds requirements by 10%
Fails to meet requirements by more than 10%

Appendix D

Stream Assessment Data

Figure 3.

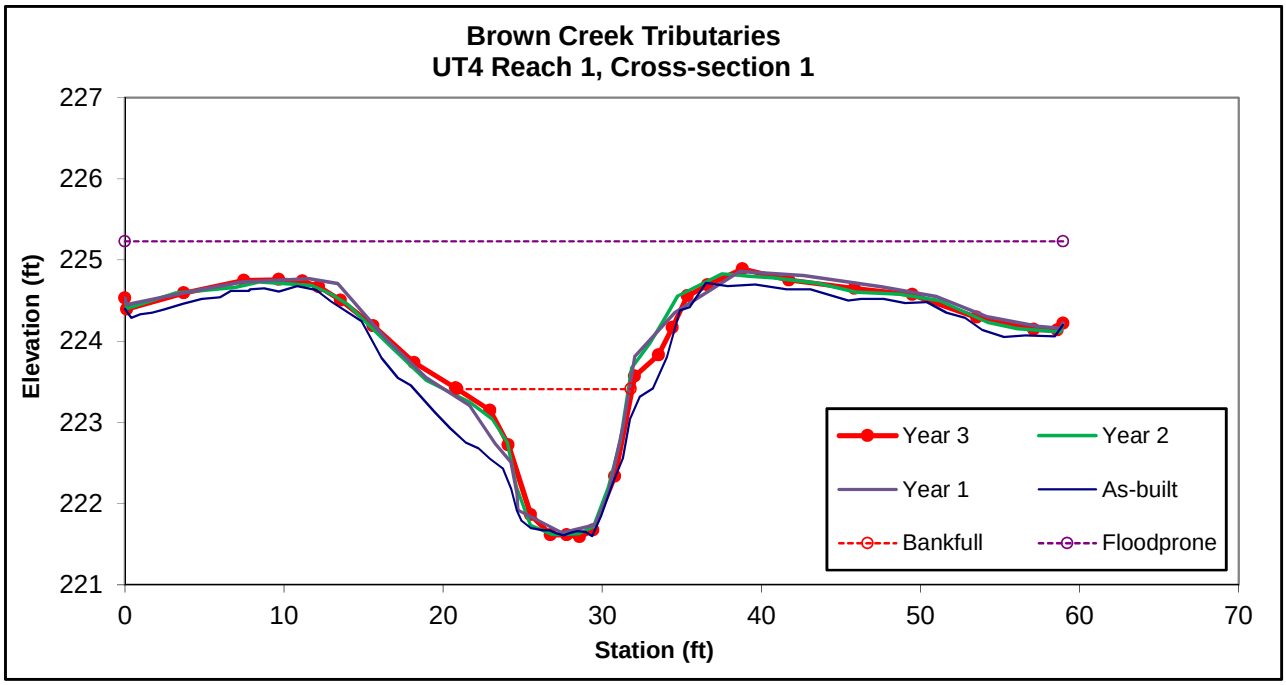
Permanent Cross-Section 1

Year 3 Data - Collected November 2017

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	11.78	11	1.07	1.82	10.28	1.0	5.36	223.41	223.42



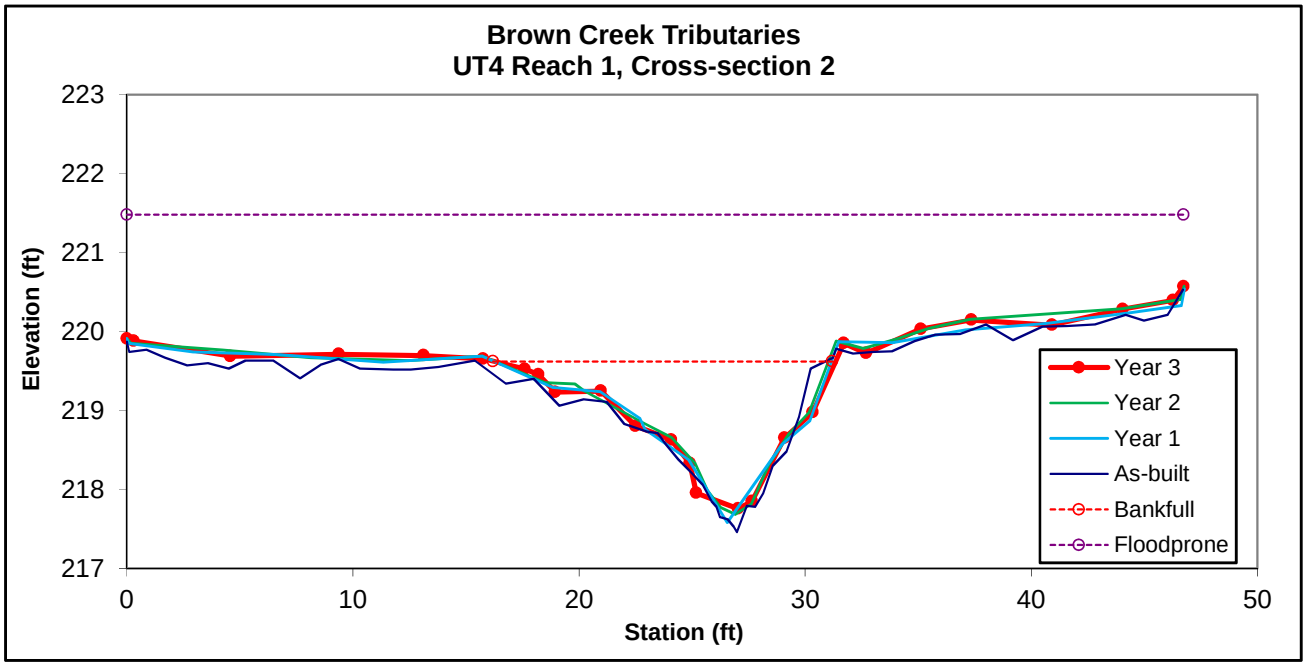
Permanent Cross-Section 2

Year 3 Data - Collected November 2017

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	C	12.48	15.08	0.83	1.86	18.17	0.9	3.1	219.62	219.46



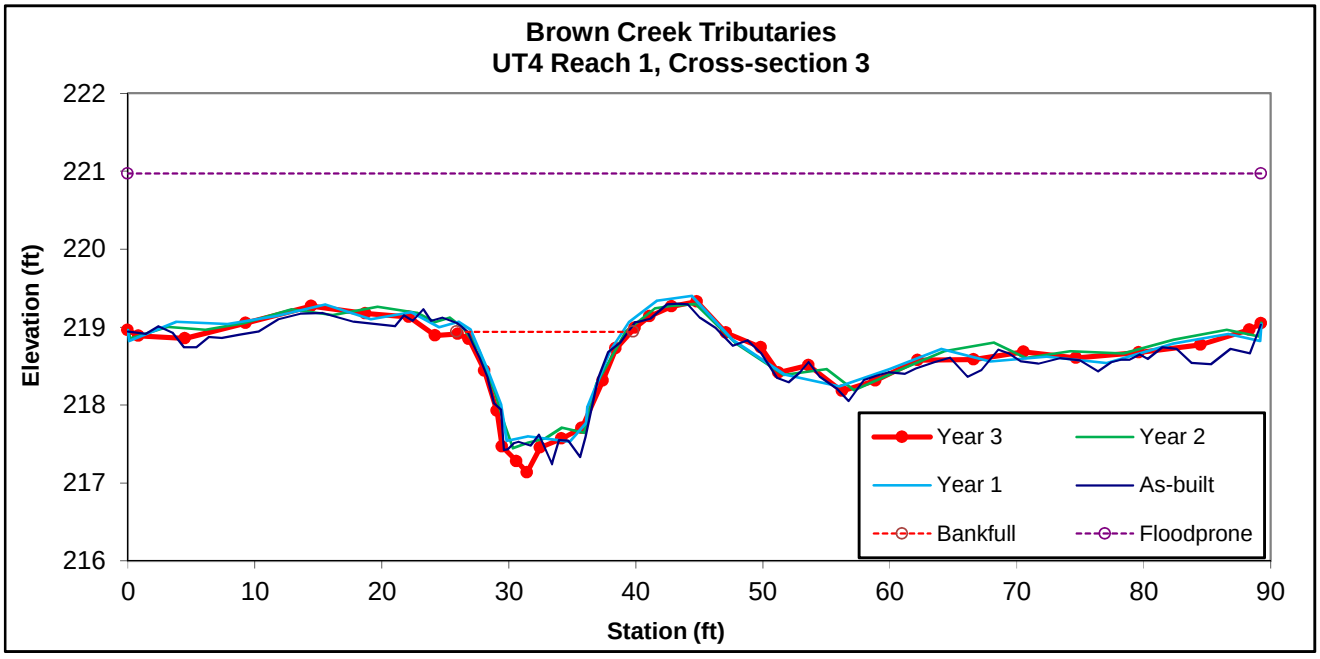
Permanent Cross-Section 3

Year 3 Data - Collected November 2017

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	13.25	15.87	0.83	1.81	18.05	1.0	5.89	218.94	218.99



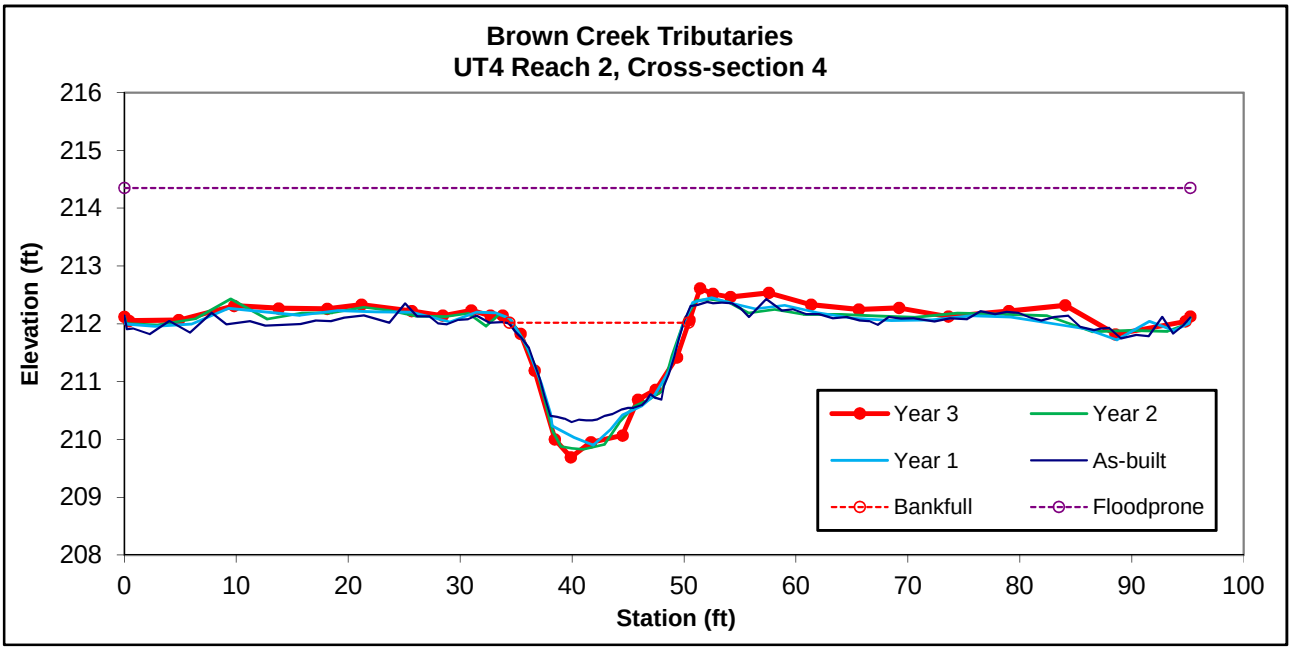
Permanent Cross-Section 4

Year 3 Data - Collected November 2017

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	22.24	16	1.39	2.33	11.51	1.1	5.95	212.02	212.14



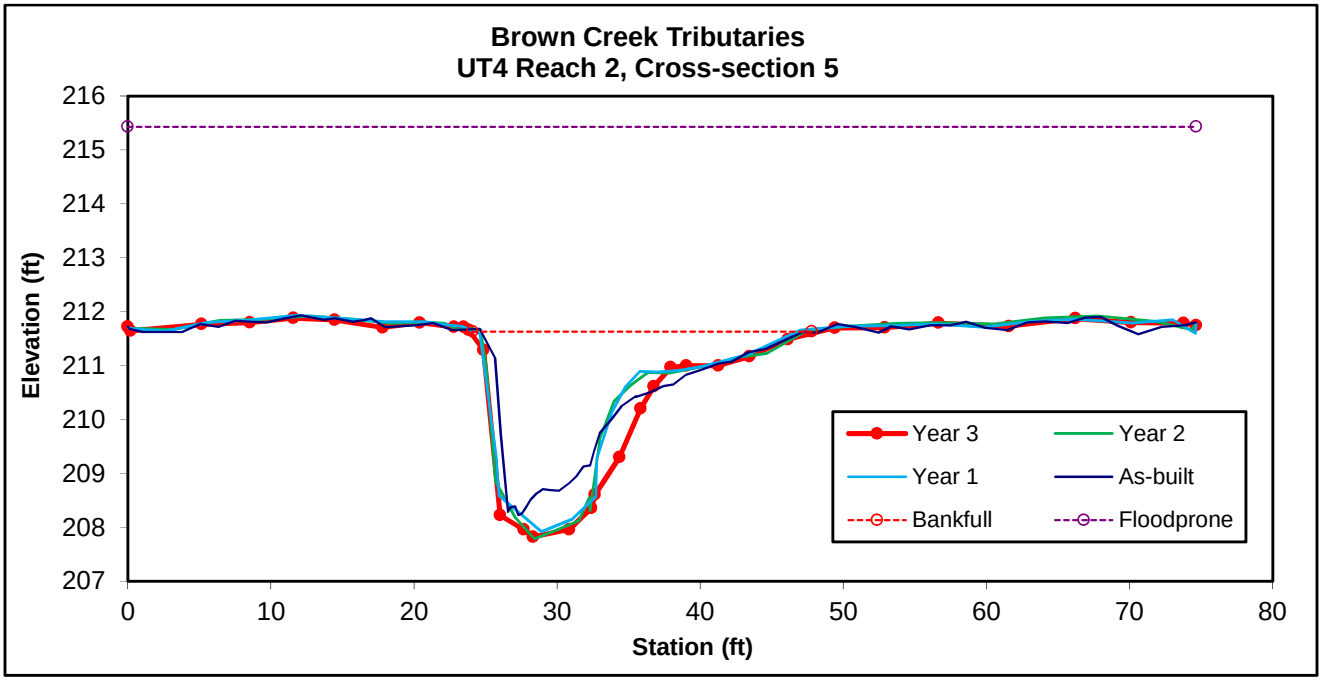
Permanent Cross-Section 5

Year 3 Data - Collected November 2017

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	C	39.98	24.44	1.64	3.8	14.9	1.0	3.05	211.63	211.66



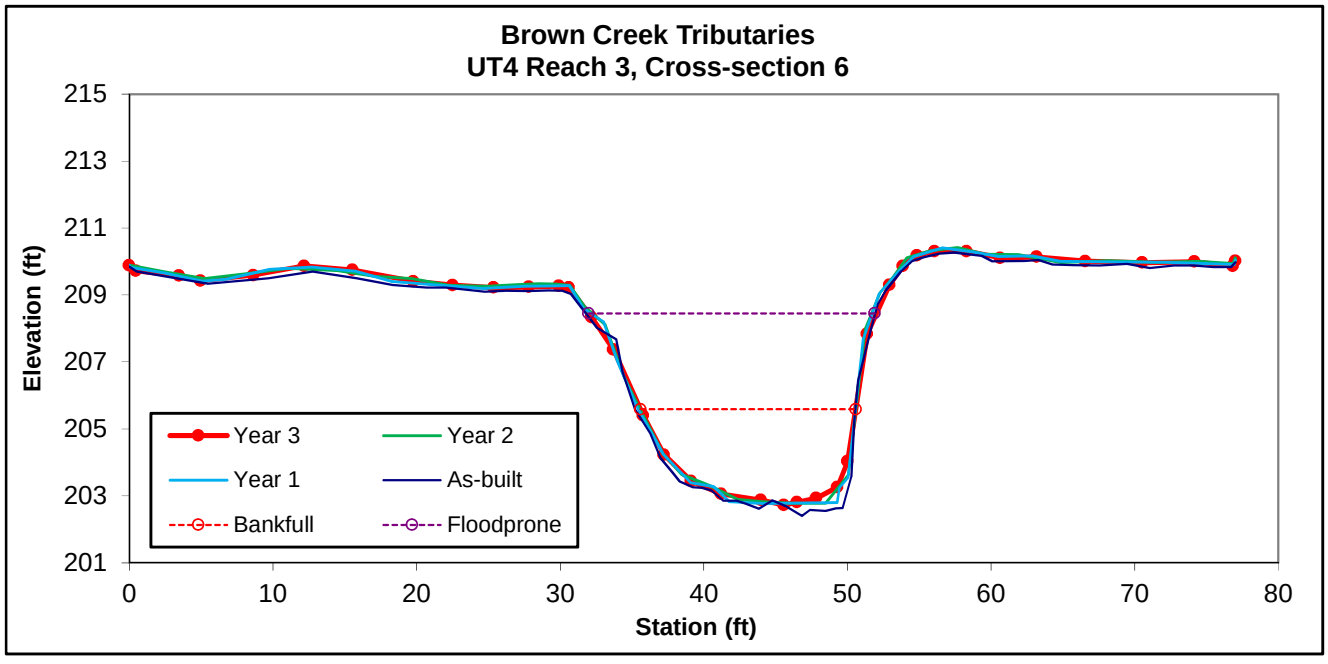
Permanent Cross-Section 6

Year 3 Data - Collected November 2017

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	G	32.75	14.99	2.19	2.86	6.84	2.3	1.34	205.59	209.23



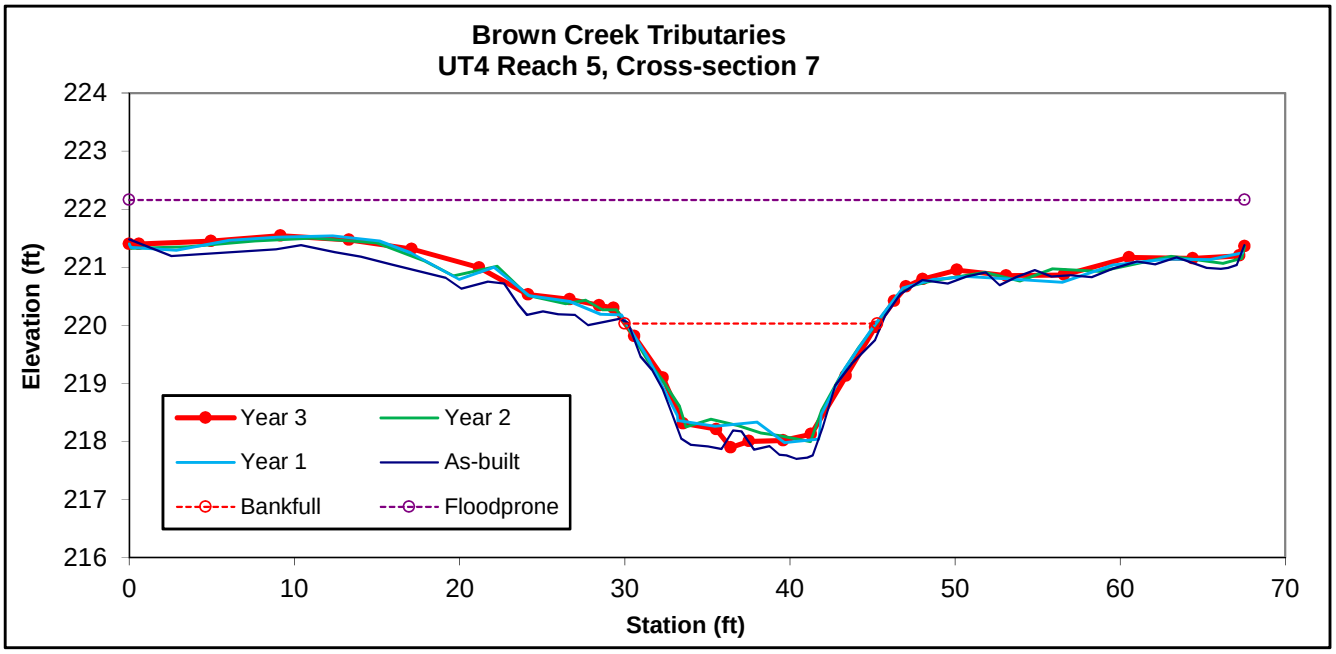
Permanent Cross-Section 7

Year 3 Data - Collected November 2017

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	21.59	15.31	1.41	2.13	10.86	1.1	4.41	220.03	220.30



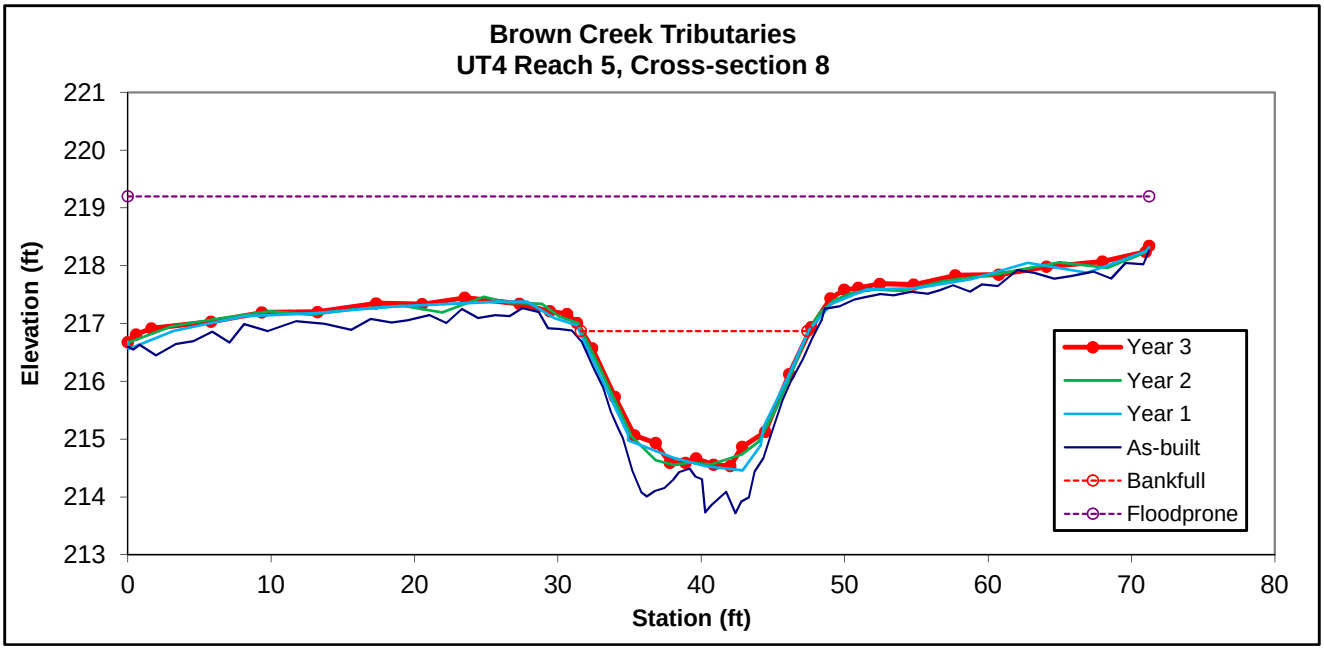
Permanent Cross-Section 8

Year 3 Data - Collected November 2017

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	25.12	15.87	1.58	2.33	10.04	1.1	4.49	216.87	217.01



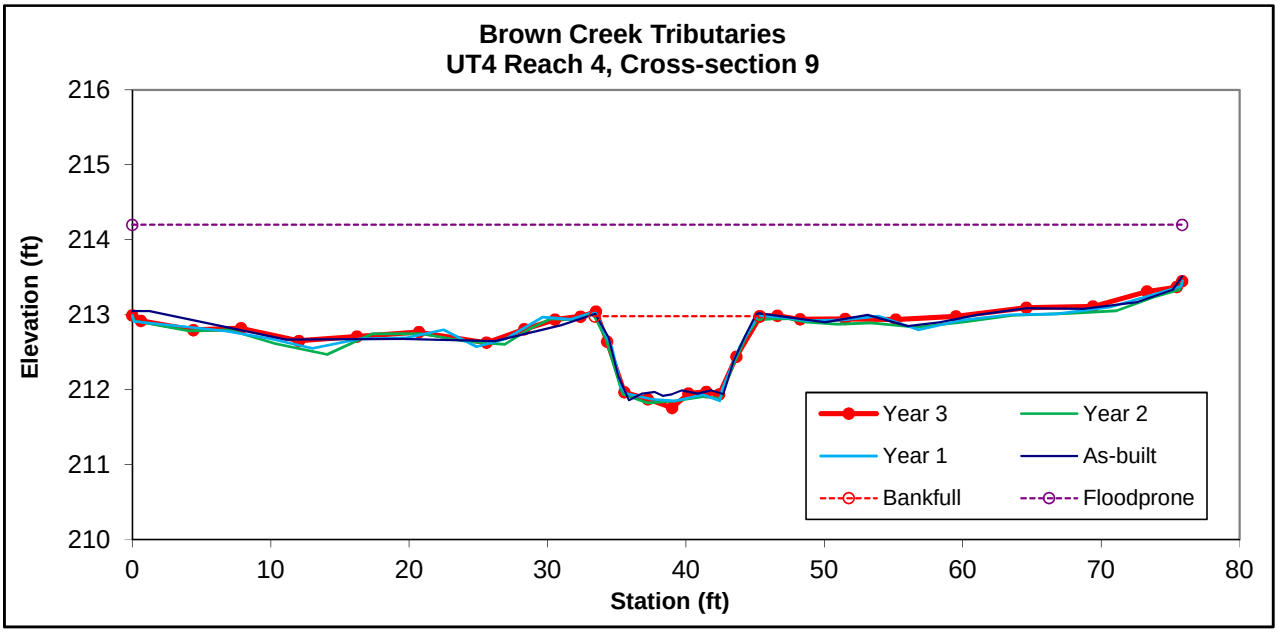
Permanent Cross-Section 9

Year 3 Data - Collected November 2017

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	9.85	11.99	0.82	1.22	14.62	1.0	6.33	212.98	212.98



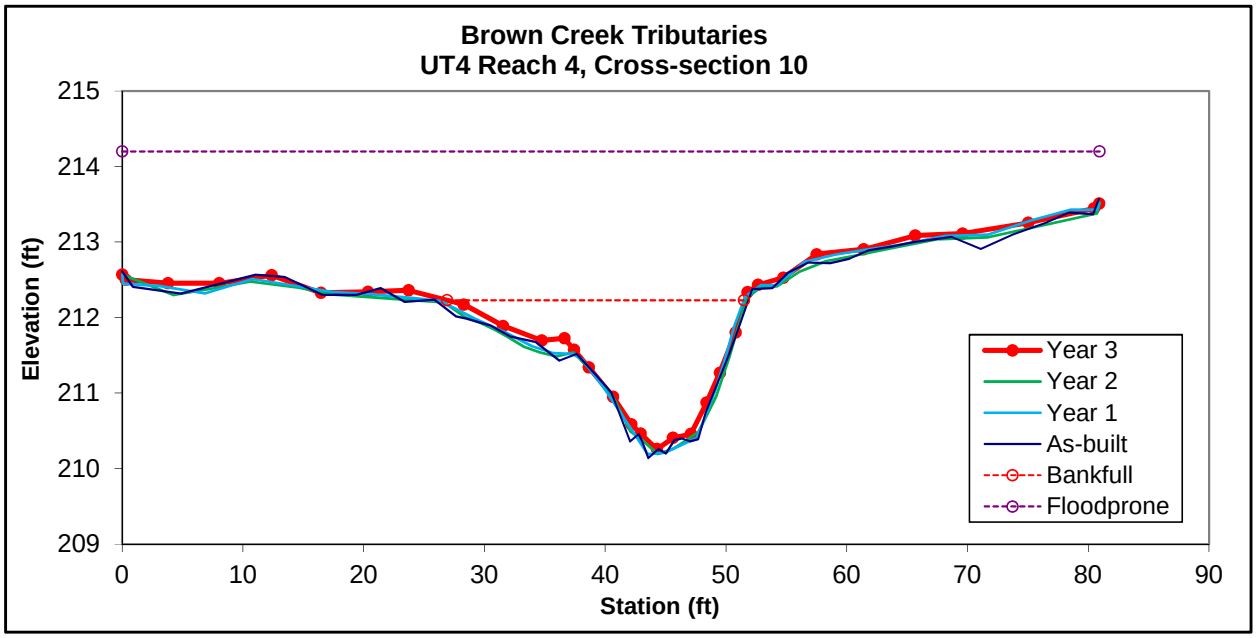
Permanent Cross-Section 10

Year 3 Data - Collected November 2017

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	C	22.24	24.69	0.9	1.97	27.43	0.7	3.28	212.23	211.57



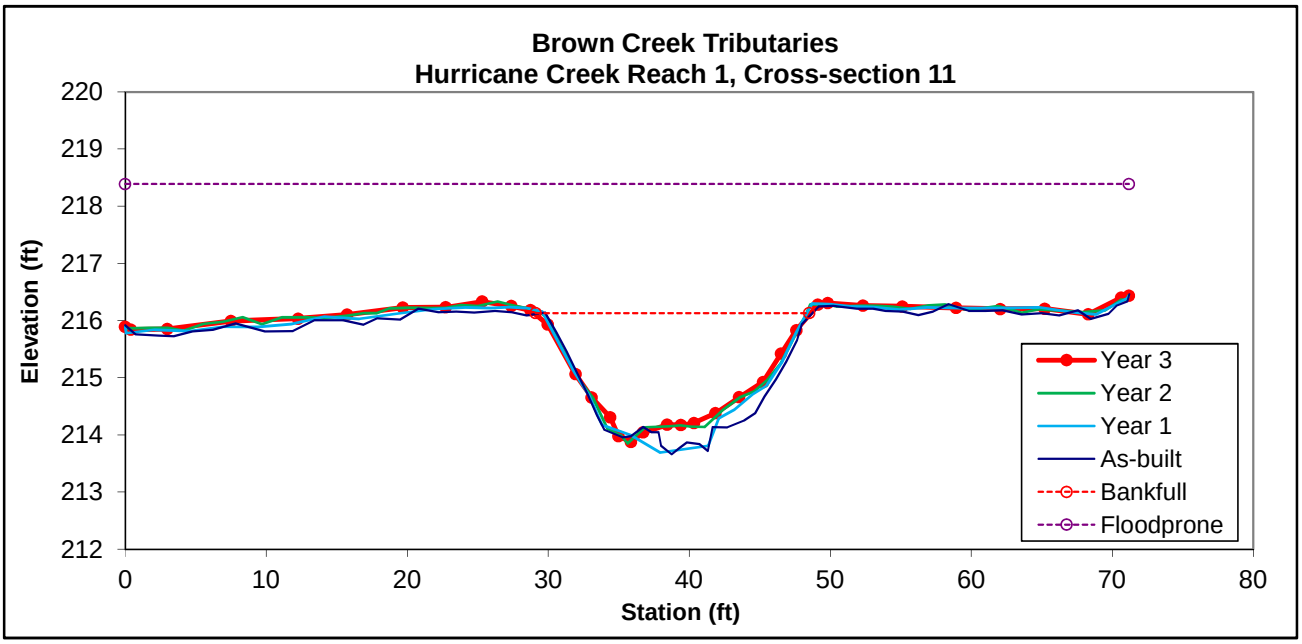
Permanent Cross-Section 11

Year 3 Data - Collected November 2017

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	26.6	19.9	1.34	2.25	14.8	1.0	3.57	216.13	216.18



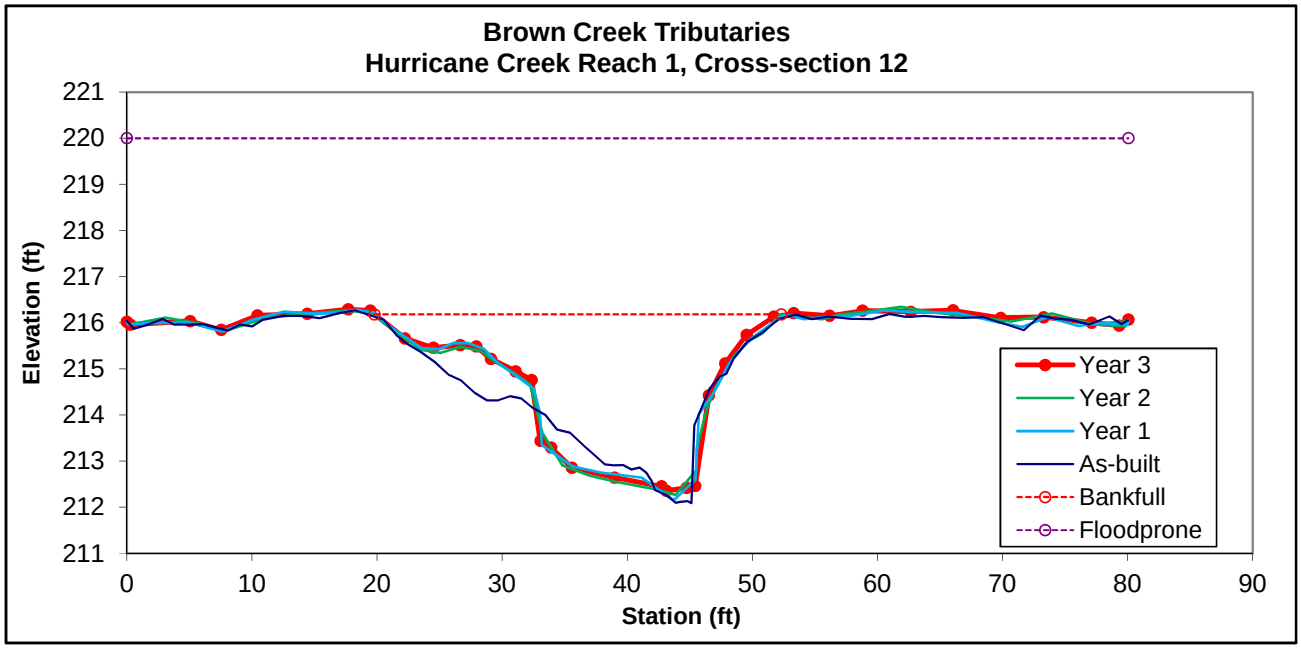
Permanent Cross-Section 12

Year 3 Data - Collected November 2017

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	C	60.78	33.17	1.83	3.83	18.13	1.0	2.41	216.18	215.49



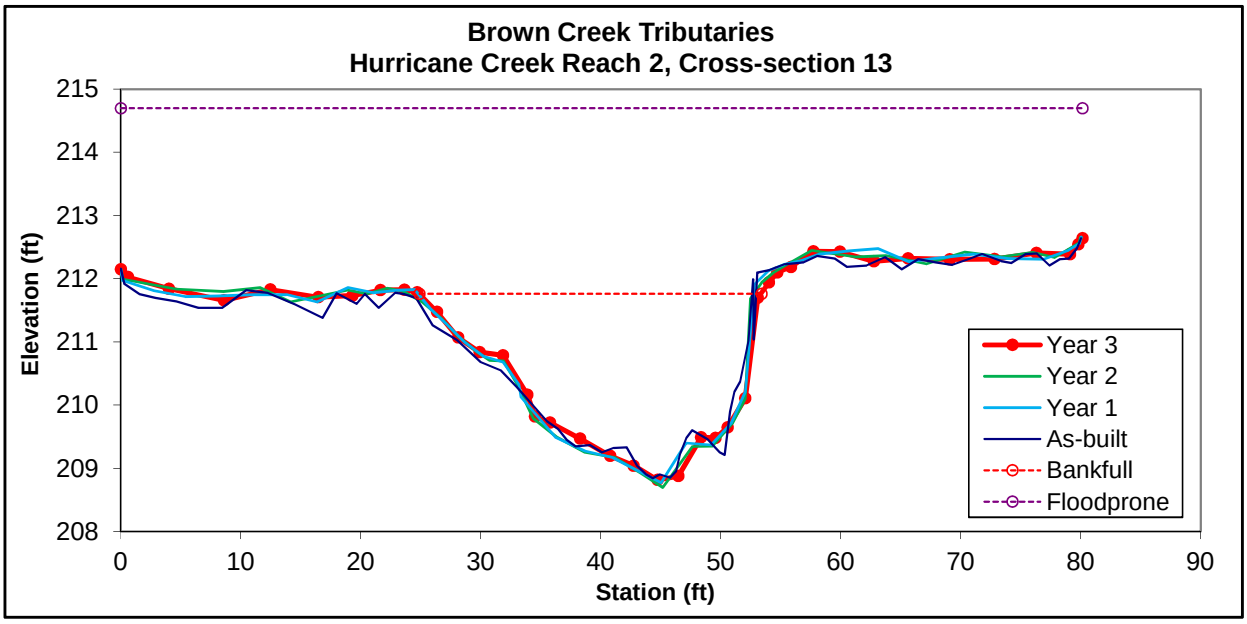
Permanent Cross-Section 13

Year 3 Data - Collected November 2017

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	C	51.47	28.47	1.81	2.94	15.73	1.0	2.82	211.76	211.70



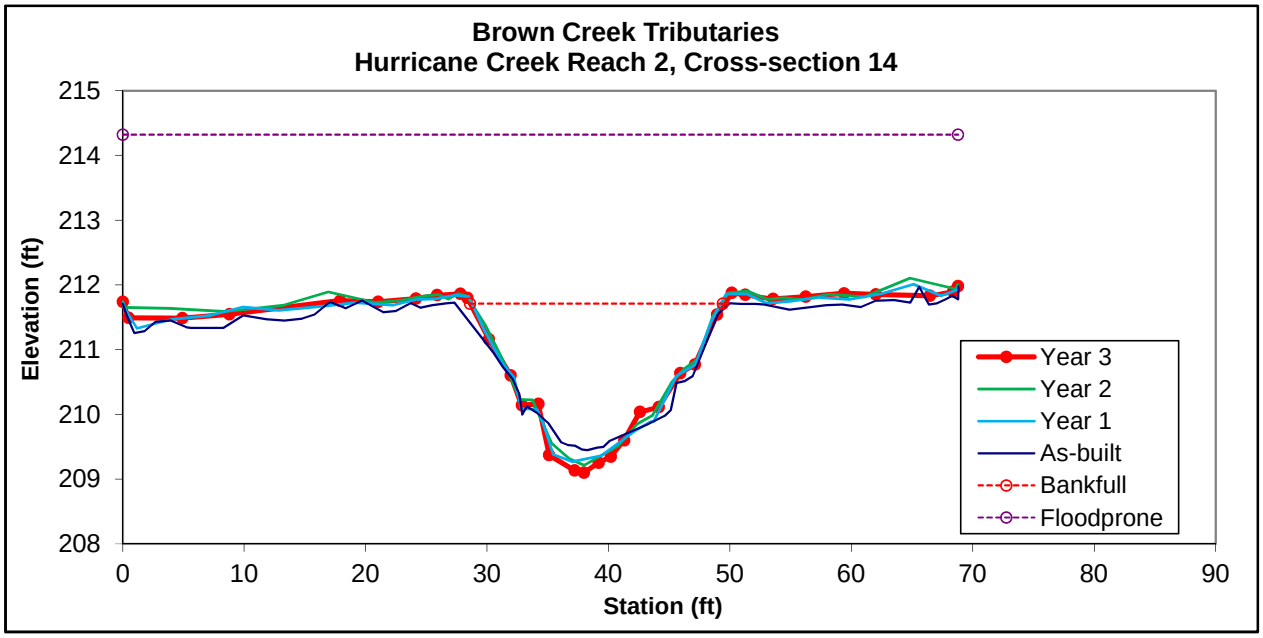
Permanent Cross-Section 14

Year 3 Data - Collected November 2017

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	31.68	20.9	1.52	2.61	13.75	0.9	3.29	211.71	211.54



Permanent Cross-Section 15

Year 3 Data - Collected November 2017

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	17.05	10.77	1.58	2.58	6.82	1.1	4.95	213.77	213.95

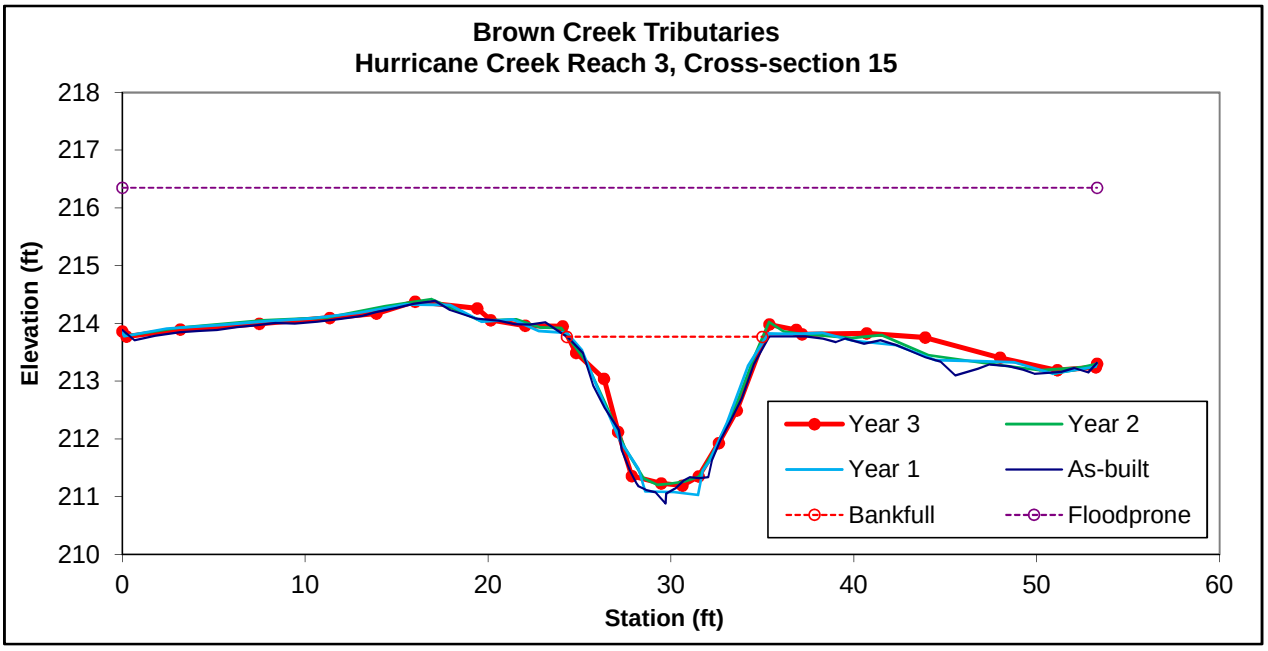


Figure 4.

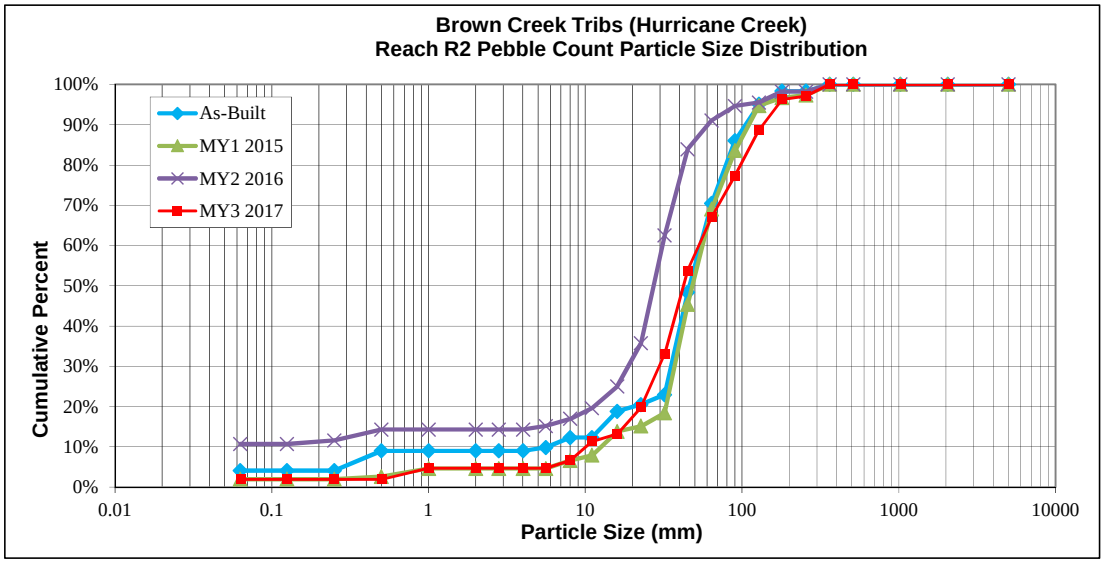
Pebble Count; Monitoring Year 3
Brown Creek Tribs Mitigation Project, DMS# 95351

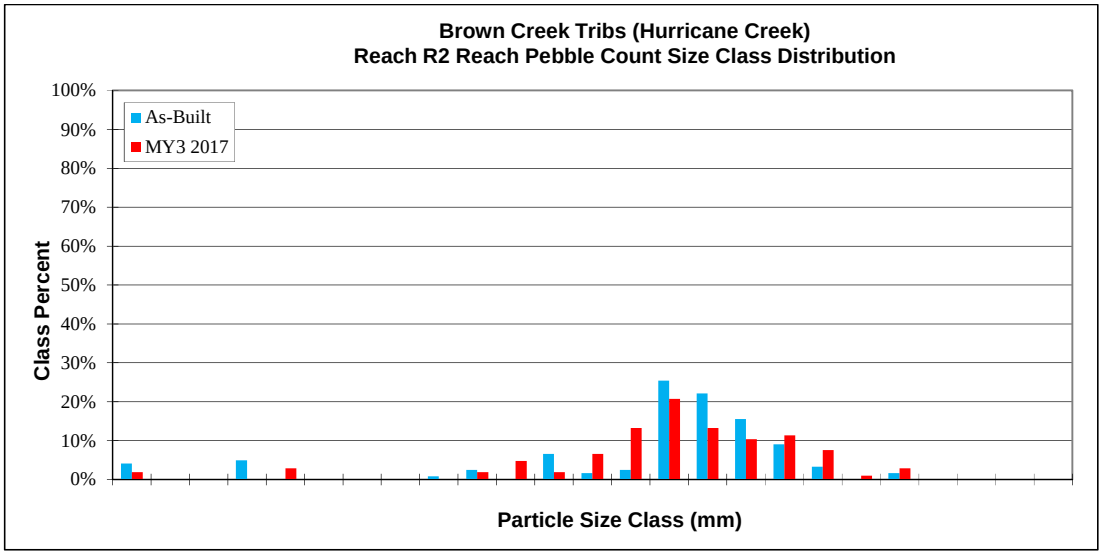
SITE OR PROJECT:	Brown Creek Tribs (Hurricane Creek)
REACH/LOCATION:	Reach R2 (Station 38+00)
FEATURE:	Rock Riffle
DATE:	19-Sep-17

			MY3 2017			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063	2	2%	2%	0.063
Sand	Very Fine	.063 - .125			2%	0.125
	Fine	.125 - .25			2%	0.25
	Medium	.25 - .50			2%	0.50
	Coarse	.50 - 1.0	3	3%	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	2	2%	7%	8.0
	Medium	8.0 - 11.0	5	5%	11%	11.0
	Medium	11.0 - 16.0	2	2%	13%	16.0
	Coarse	16 - 22.6	7	7%	20%	22.6
	Coarse	22.6 - 32	14	13%	33%	32
	Very Coarse	32 - 45	22	21%	54%	45
	Very Coarse	45 - 64	14	13%	67%	64
Cobble	Small	64 - 90	11	10%	77%	90
	Small	90 - 128	12	11%	89%	128
	Large	128 - 180	8	8%	96%	180
	Large	180 - 256	1	1%	97%	256
Boulder	Small	256 - 362	3	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			106	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	6.6	D84 =	45.2
D35 =	22.1	D95 =	103.6
D50 =	27.2	D100 =	256 - 362





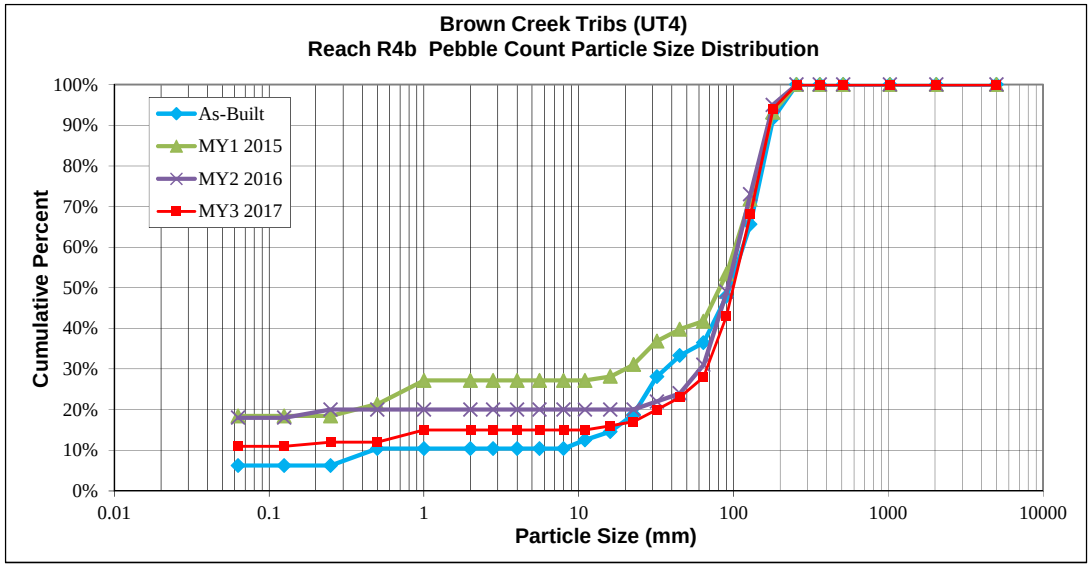
Pebble Count; Monitoring Year 3
Brown Creek Tribs Mitigation Project, DMS# 95351

SITE OR PROJECT:	Brown Creek Tribs (UT4)
REACH/LOCATION:	Reach R4b (Station 19+25)
FEATURE:	Rock Riffle
DATE:	28-Sep-17

			MY3 2017			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**5.00**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063	11	11%	11%	0.063
Sand	Very Fine	.063 - .125			11%	0.125
	Fine	.125 - .25	1	1%	12%	0.25
	Medium	.25 - .50			12%	0.50
	Coarse	.50 - 1.0	3	3%	15%	1.0
	Very Coarse	1.0 - 2.0			15%	2.0
Gravel	Very Fine	2.0 - 2.8			15%	2.8
	Very Fine	2.8 - 4.0			15%	4.0
	Fine	4.0 - 5.6			15%	5.6
	Fine	5.6 - 8.0			15%	8.0
	Medium	8.0 - 11.0			15%	11.0
	Medium	11.0 - 16.0	1	1%	16%	16.0
	Coarse	16 - 22.6	1	1%	17%	22.6
	Coarse	22.6 - 32	3	3%	20%	32
	Very Coarse	32 - 45	3	3%	23%	45
	Very Coarse	45 - 64	5	5%	28%	64
Cobble	Small	64 - 90	15	15%	43%	90
	Small	90 - 128	25	25%	68%	128
	Large	128 - 180	26	26%	94%	180
	Large	180 - 256	6	6%	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			100	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	#N/A	D84 =	151.8
D35 =	69.0	D95 =	180.0
D50 =	91.3	D100 =	180 - 256



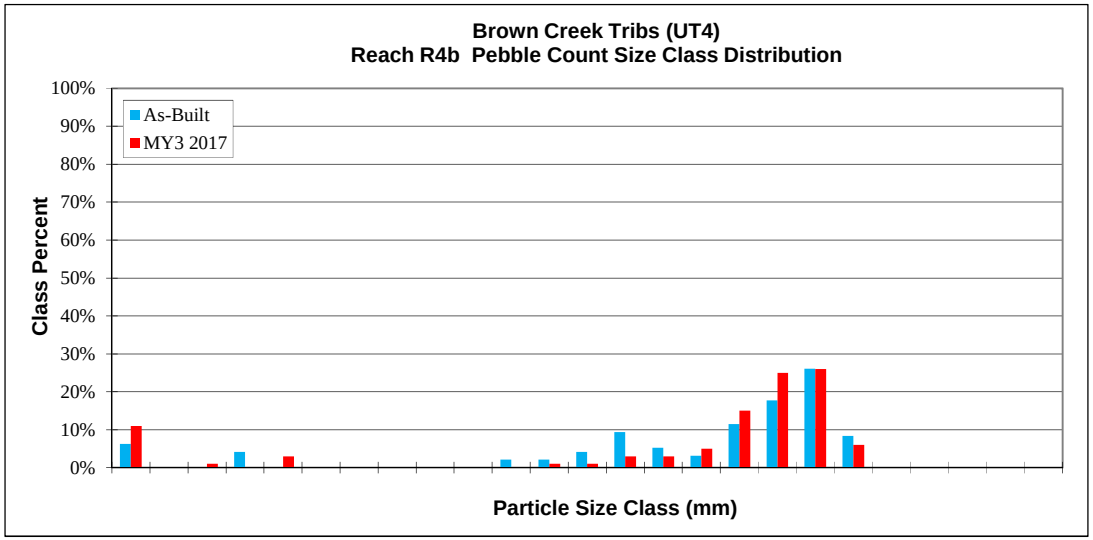


Table 10. Baseline Stream Summary
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351
Hurricane Creek (Reach 1) Length 2,043 ft

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 (1,482 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)	14.9	11.6	11.6	11.0				15.4	14.9	14.7	15.1				14.0	13.2	14.2	15.9				
BF Mean Depth (ft)	1.0	1.1	1.0	1.1				0.9	0.8	0.8	0.8				1.0	1.0	0.9	0.8				
Width/Depth Ratio	14.6	11.0	11.2	10.3				17.7	18.0	18.0	18.2				13.8	13.6	15.2	18.1				
BF Cross-sectional Area (ft²)	15.3	12.4	12.0	11.8				13.4	12.3	12.1	12.5				14.1	12.7	13.1	13.3				
BF Max Depth (ft)	1.8	1.8	1.8	1.8				2.2	2.0	1.9	1.9				1.8	1.5	1.6	1.8				
Width of Floodprone Area (ft)	59.0	59.0	58.9	59.0				46.7	46.8	46.8	46.7				89.2	89.3	89.3	89.2				
Entrenchment Ratio	3.9	5.1	5.1	5.4				3.0	3.1	3.2	3.1				6.4	6.8	6.3	5.9				
Bank Height Ratio	1.0	1.1	1.1	1.0				1.0	1.0	1.0	0.9				1.0	1.0	1.0	1.0				
Wetted Perimeter (ft)	17.0	13.8	13.7	12.0				17.2	16.6	16.4	15.9				16.0	15.1	16.0	16.6				
Hydraulic Radius (ft)	0.9	0.9	0.9	1.0				0.8	0.7	0.7	0.8				0.9	0.8	0.8	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 (1,859 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)	15.9	15.3	15.3	16.0				22.4	22.4	22.7	24.4				17.6	17.7	15.0	15.0				
BF Mean Depth (ft)	1.19	1.4	1.4	1.4				1.39	1.6	1.6	1.6				4.04	3.9	2.2	2.2				
Width/Depth Ratio	13.3	11.3	10.8	11.5				16.1	14.4	14.4	14.9				4.35	4.6	6.8	6.8				
BF Cross-sectional Area (ft²)	19.0	20.7	21.6	22.2				31.2	34.8	35.9	39.9				71.0	68.4	33.5	32.8				
BF Max Depth (ft)	1.7	2.1	2.2	2.3				3.4	3.7	3.8	3.8				5.3	4.9	2.8	2.9				
Width of Floodprone Area (ft)	95.2	95.2	95.2	95.2				74.6	74.7	74.6	74.7				77.0	77.1	19.3	19.9				
Entrenchment Ratio	6.0	6.2	6.2	6.0				3.3	3.3	3.3	3.1				4.4	4.4	1.3	1.3				
Bank Height Ratio	1.0	1.0	1.0	1.1				1.0	1.0	1.0	1.0				1.0	1.1	2.3	2.3				
Wetted Perimeter (ft)	18.3	18.0	18.1	17.0				25.2	25.5	25.9	27.4				25.7	25.4	19.5	17.1				
Hydraulic Radius (ft)	1.0	1.1	1.2	1.3				1.2	1.4	1.4	1.5				2.8	2.7	1.7	1.9				
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)	-							-														

Table 11 continued. Cross-section Morphology Data

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

Stream Reach	UT4 Reach 5 (2,022 LF)														UT4 Reach 4 (1,892 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)	15.9	15.5	15.2	15.3				17.0	16.0	15.8	15.9				11.6	11.6	12.3	12.0				25.9	25.7	27.6	24.7			
BF Mean Depth (ft)	1.6	1.4	1.3	1.4				1.9	1.7	1.7	1.6				0.8	0.8	0.8	0.8				1.0	1.0	0.9	0.9			
Width/Depth Ratio	10.1	11.0	11.4	10.9				8.8	9.6	9.6	10.0				14.1	13.8	15.7	14.6				27.1	27.1	30.5	27.4			
BF Cross-sectional Area (ft²)	25.0	21.8	20.3	21.6				32.8	26.5	26.0	25.1				9.6	9.7	9.7	9.9				24.8	24.4	25.0	22.2			
BF Max Depth (ft)	2.4	2.1	2.0	2.1				3.2	1.7	2.3	2.3				1.1	1.1	1.1	1.2				2.1	2.0	2.0	2.0			
Width of Floodprone Area (ft)	67.5	67.5	67.5	67.5				71.2	71.2	71.2	71.2				75.9	75.9	75.9	75.9				80.9	80.9	80.9	80.9			
Entrenchment Ratio	4.3	4.4	4.4	4.4				4.2	4.5	4.5	4.5				6.6	6.6	6.2	6.3				3.1	3.1	2.9	3.3			
Bank Height Ratio	1.0	1.0	1.1	1.1				1.0	1.0	1.1	1.1				1.0	1.0	1.0	1.0				1.0	1.0	1.0	0.7			
Wetted Perimeter (ft)	19.0	18.3	17.9	16.2				20.9	19.3	19.1	16.9				13.2	13.3	13.9	12.4				27.9	27.6	29.4	25.2			
Hydraulic Radius (ft)	1.3	1.2	1.1	1.3				1.6	1.4	1.4	1.5				0.7	0.7	0.7	0.8				0.9	0.9	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 (1,424 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)	18.9	18.7	18.5	19.9				34.3	32.7	37.3	33.2				29.0	28.0	28.8	28.5				22.5	20.5	20.5	20.9			
BF Mean Depth (ft)	1.61	1.59	1.50	1.34				1.84	1.85	1.67	1.83				1.77	1.86	1.83	1.81				1.40	1.53	1.49	1.52			
Width/Depth Ratio	11.8	11.8	12.5	14.8				18.6	17.6	22.3	18.1				16.4	15.1	15.8	15.7				16.1	13.4	13.7	13.8			
BF Cross-sectional Area (ft²)	30.4	29.8	27.3	26.6				63.2	60.6	62.5	60.8				51.5	52.0	52.7	51.5				31.6	31.3	30.6	31.7			
BF Max Depth (ft)	2.47	2.44	2.30	2.25				4.09	4.03	3.91	3.83				2.92	2.99	3.06	2.94				2.26	2.44	2.49	2.61			
Width of Floodprone Area (ft)	71.2	71.2	71.2	71.2				80.1	80.1	80.1	80.1				80.0	80.1	80.1	80.2				68.8	68.8	68.8	68.8			
Entrenchment Ratio	3.8	3.8	3.9	3.6				2.3	2.5	2.1	2.4				2.8	2.9	2.8	2.8				3.1	3.4	3.4	3.3			
Bank Height Ratio	1.0	1.0	1.1	1.0				1.0	1.0	1.0	1.0				1.0	1.0	1.0	1.0				1.0	1.0	1.0	0.9			
Wetted Perimeter (ft)	22.1	21.9	21.5	20.6				38.0	36.4	40.7	36.7				32.6	31.7	32.5	29.8				25.3	23.5	23.5	21.9			
Hydraulic Radius (ft)	1.4	1.4	1.3	1.3				1.7	1.7	1.5	1.7				1.6	1.6	1.6	1.7				1.2	1.3	1.3	1.5			
Based on current/developing bankfull feature																												
BF Width (ft)																												
BF Mean Depth (ft)																												
Width/Depth Ratio																												
BF Cross-sectional Area (ft²)																												
BF Max Depth (ft)																												
Width of Floodprone Area (ft)																												
Entrenchment Ratio																												
Bank Height Ratio																												
Wetted Perimeter (ft)																												
Hydraulic Radius (ft)																												
Cross Sectional Area between end pins (ft²)																												
d50 (mm)																												

Table 11 continued. Cross-section Morphology Data

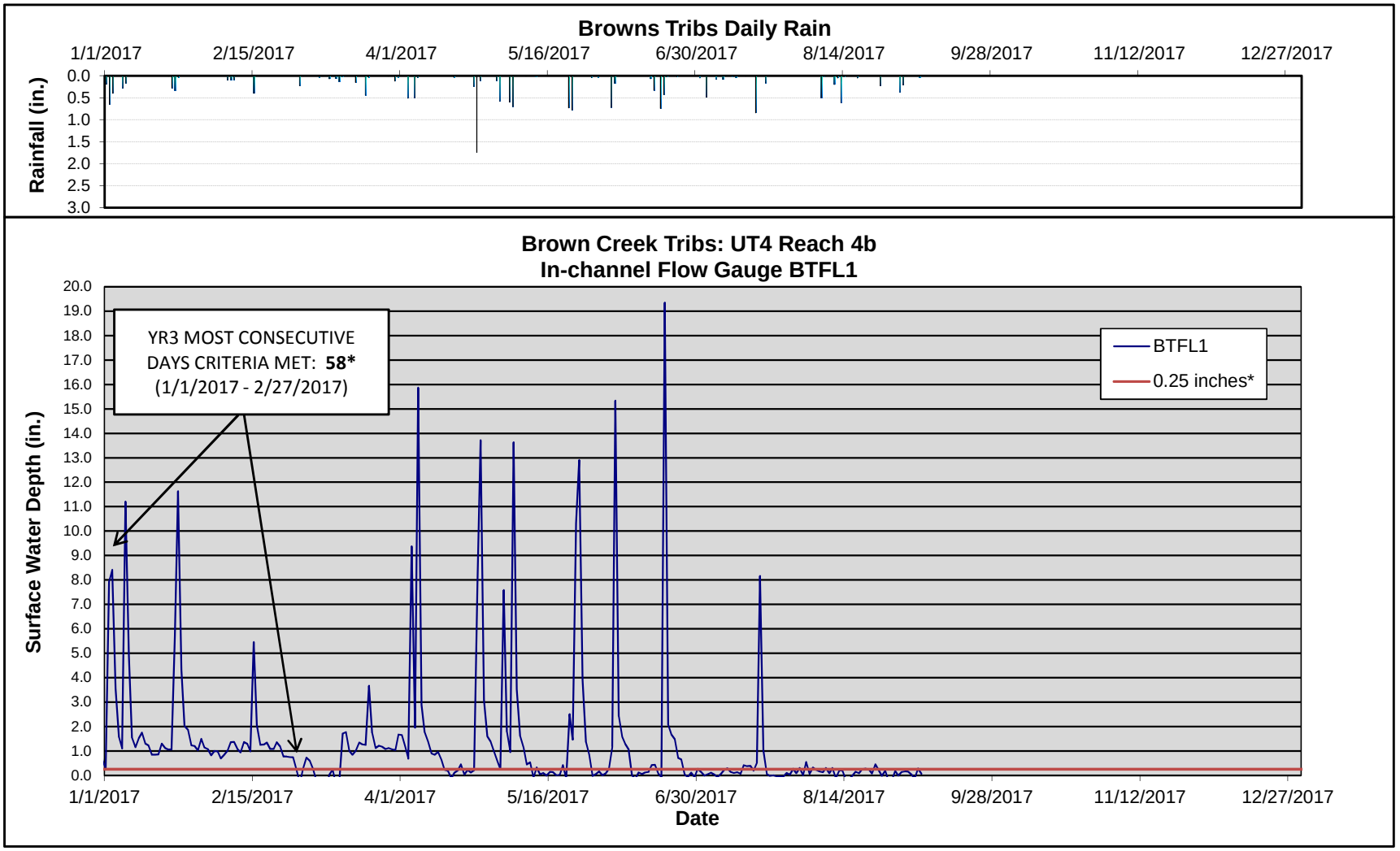
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Stream Reach	**Hurricane Creek Reach 3 (600 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)	11.1	10.7	10.7	10.8						
BF Mean Depth (ft)	1.7	1.6	1.6	1.6						
Width/Depth Ratio	6.7	6.5	6.7	6.8						
BF Cross-sectional Area (ft^2)	18.2	17.6	17.1	17.1						
BF Max Depth (ft)	2.9	2.7	2.6	2.6						
Width of Floodprone Area (ft)	53.3	53.3	53.3	53.3						
Entrenchment Ratio	4.8	5.0	5.0	5.0						
Bank Height Ratio	1.0	1.0	1.0	1.1						
Wetted Perimeter (ft)	14.4	14.0	13.9	12.2						
Hydraulic Radius (ft)	1.3	1.3	1.2	1.4						
Based on current/developing bankfull feature										
BF Width (ft)										
BF Mean Depth (ft)										
Width/Depth Ratio										
BF Cross-sectional Area (ft^2)										
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 (ft^2)										
d50 (mm)										

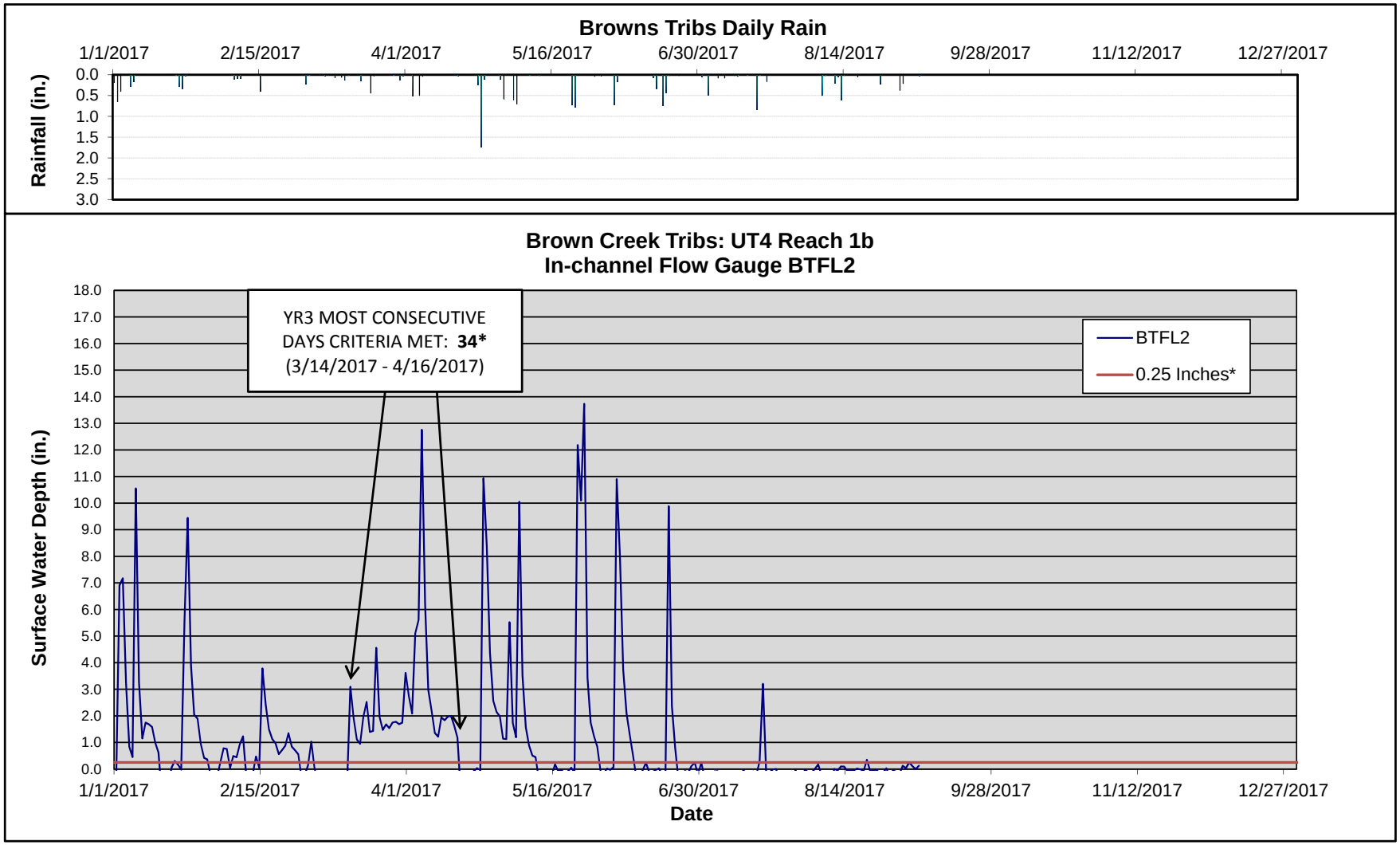
Appendix E

Hydrologic Data

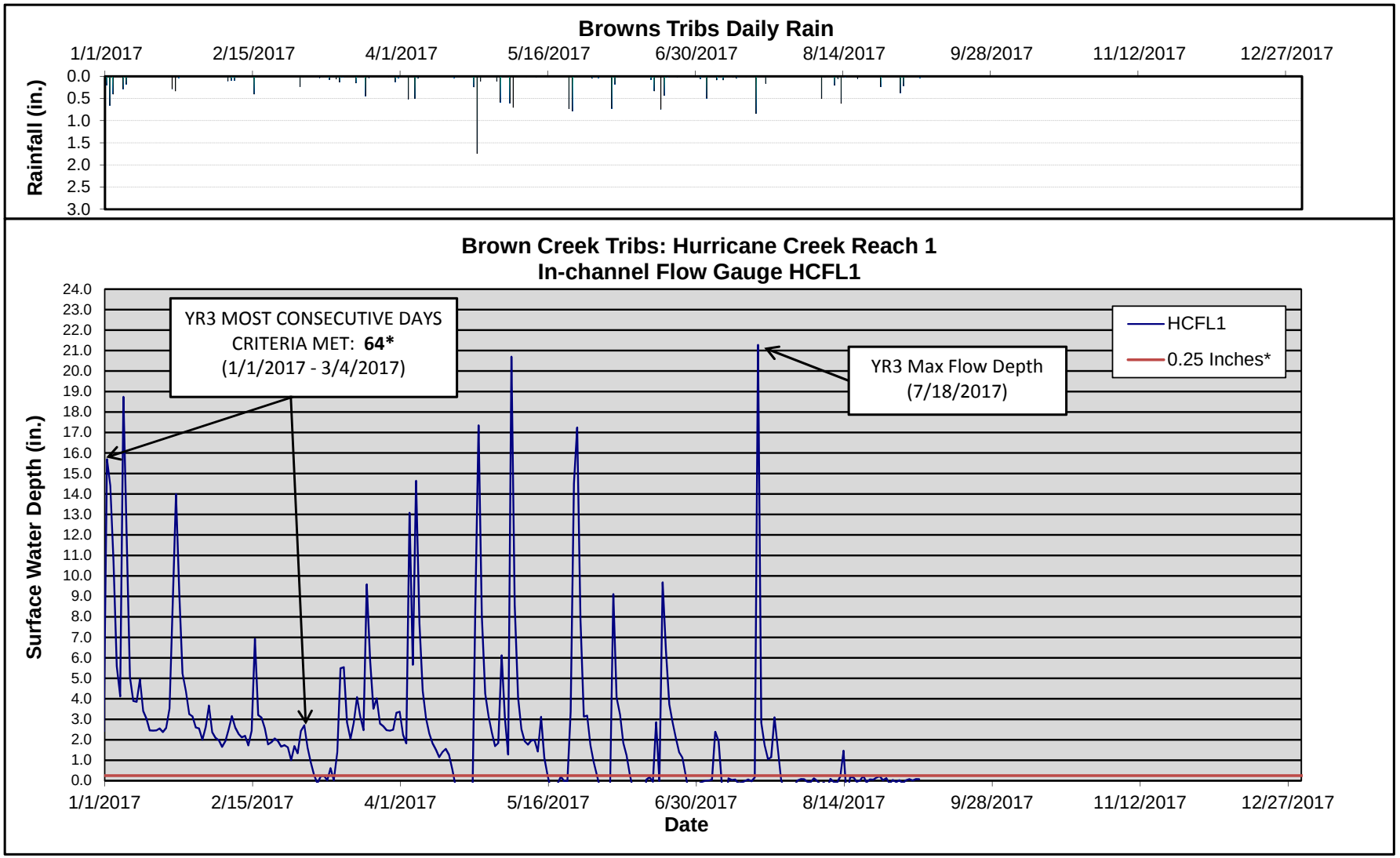
Figure 5.



* Surface water flow is estimated to have occurred when the pressure transducer reading is equal to or above 0.25 inches in depth.

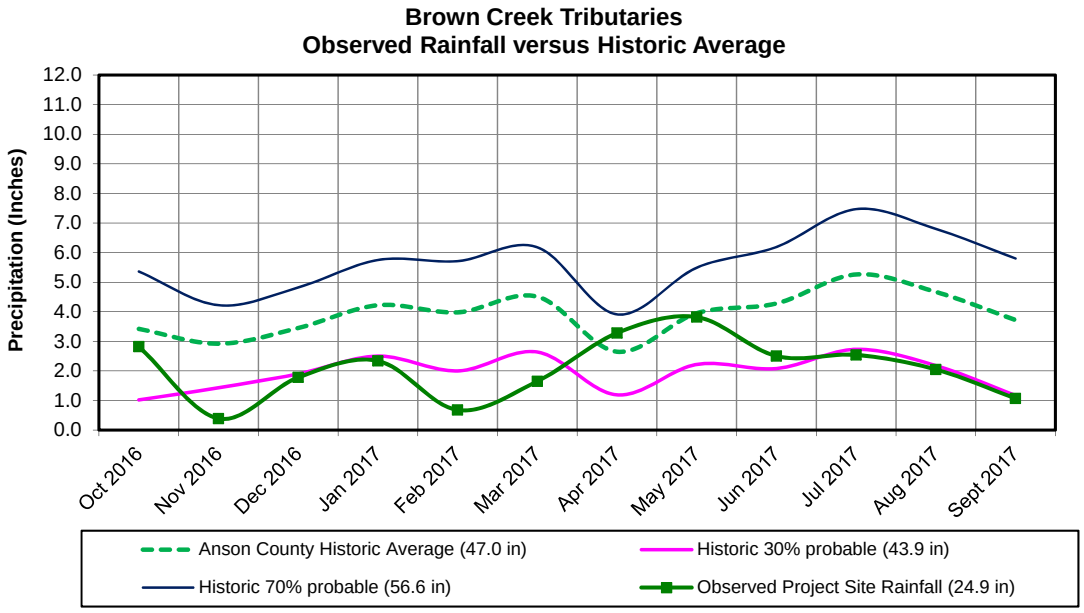


* Surface water flow is estimated to have occurred when the pressure transducer reading is equal to or above 0.25 inches in depth.



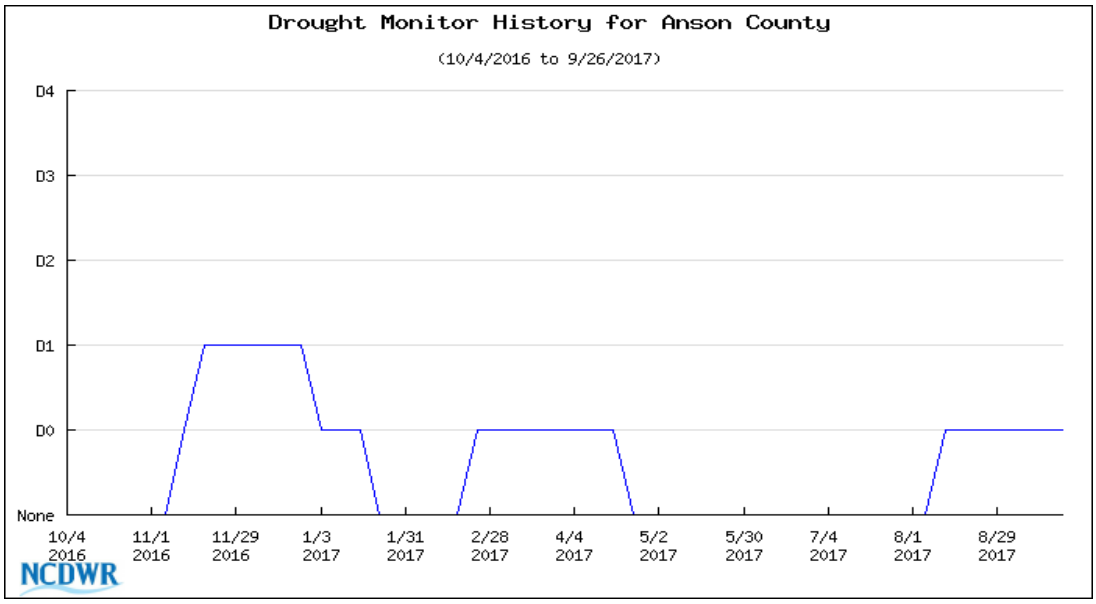
* Surface water flow is estimated to have occurred when the pressure transducer reading is equal to or above 0.25 inches in depth.

Figure 6. Observed Rainfall versus Historic Average



Note: Historic average annual rainfall for Anson County is 47.0", while the project site recorded a total of just 24.9" of rainfall over the previous 12 months.

NCDEQ's Division of Water Resources Drought Monitor History also recorded significant periods of Abnormally Dry (D0) and Moderate Drought (D1) conditions for Anson County during the previous 12 months as shown below:



Source: https://www.ncwater.org/Drought_Monitoring/dmhistory/

Table 12. Flow Gauge Success
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Flow Gauge ID	Most Consecutive Days Meeting Criteria[1]							Cumulative Days Meeting Criteria[2]						
	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)	Year 6 (2020)	Year 7 (2021)	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)	Year 6 (2020)	Year 7 (2021)
UT4 Flow Gauges (Installed July 17, 2015)														
BTFL1	37.0	77.0	58.0					37.0	77.0	152.0				
BTFL2	92.0	106.0	34.0					92.0	106.0	113.0				
Hurricane Creek Flow Gauge (Installed July 19, 2016)														
HCFL1[3]	N/A	12.0	64.0					N/A	12.0	154.0				

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.
[3]The Hurricane Creek Flow Gauge (HCFL1) was installed in Reach HC-R1 on July 19, 2016 to document in-channel stream flow.
Flow success criteria for the Site is stated as: **A restored stream reach will be considered at least intermittent when the flow duration occurs for a minimum of 30 consecutive days.**
Surface water flow is estimated to have occurred when the pressure transducer reading is equal to or above 0.25 inches in depth.

Table 13. Verification of Bankfull Events
Brown Creek Tributaries Restoration Project: DMS Project ID No. 95351

Date of Data Collection	Estimated Occurrence of Bankfull Event	Method of Data Collection	Crest Gauge Reading (Hurricane Creek-R2)	Crest Gauge Reading (UT4-R2)
MY1 (2015)				
10/29/2015	10/3/2015	Crest Gauge	0.94'	
11/4/2015	10/3/2015	Crest Gauge		0.83'
MY2 (2016)				
2/17/2016	2/3/2016	Crest Gauge	1.05'	
7/19/2016	6/29/2016	Crest Gauge	0.19'	0.28'
11/3/2016	10/8/2016	Crest Gauge	1.1'	0.97'
MY3 (2017)				
9/19/2017	7/18/2017*	Crest Gauge	0.33'	

* See flow gauge HC-FL1 graph in Appendix E for corresponding flow depth spike on this date.