Logan Creek Stream Restoration Project
Year 2 Monitoring Report

Jackson County, North Carolina

NCDMS Project ID No. 92515; Contract No. D06046-A

Savannah River Basin: 03060101-010020

Project Info:	Monitoring Year: 2 of 5 Year of Data Collection: 2016 Year of Completed Construction: May 2015 Submission Date: December 2016
Submitted To:	NCDEQ – Division of Mitigation Services 5 Ravenscroft Drive, Suite 102 Asheville, NC 28801 NCDEQ Contract ID No. D06046-A

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APPENDICES

1.0 EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) restored, enhanced or preserved 5,110 linear feet (LF) of perennial stream channel along Logan Creek and eight unnamed tributaries (UT1,UT2, UT3, UT4, UT5, UT6, UT7 and UT8) in Jackson County, NC (Appendix A). The nearest town, Cashiers, is approximately five miles west of the Logan Creek Project site. The site lies in the Savannah River Basin within the Targeted Local Watershed 03060101-010020 (Horsepasture River) and within the North Carolina Division of Water Resources (NCDWR) sub-basin formerly known as 03-06-01-01 (Keowee River Subbasin). The Horsepasture River is a National Wild and Scenic River and a state-designated Natural and Scenic River. The project involved the restoration, enhancement, and preservation of a stable channel and a Montane Alluvial/Montane Oak-Hickory Forest system (NCWAM 2010, Schafale and Weakley 1990) from impairments within the project area due to past agricultural conversion including orchard development, trout hatchery development, mink farming and more recently single-family home development.

The project goals directly address stressors identified in the Savannah River Basin Restoration Priority Plan (RBRP) (DMS 2001 and updated 2008) such as habitat degradation, inadequate riparian buffer cover, channel modification, and excess nutrient and sediment loading. The primary restoration goals, as outlined in the approved mitigation plan, are described below:

- Create geomorphically stable stream channels within the Logan Creek project site.
- Protect stable areas as well as mature trees and other desirable vegetation.
- Improve water quality within the Logan Creek project area through reduction of bank erosion, improved nutrient and sediment removal, and stabilization of streambanks.
- Improve aquatic and terrestrial habitat.

To accomplish these goals, we recommend the following actions:

- Restore the existing eroding or over-wide stream reaches by creating a stable channel that has access to its floodplain.
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools, providing woody debris for habitat, moving sand deposits through the reach and reducing bank erosion.
- Establish native stream bank and floodplain vegetation to increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature, provide cover, improve wildlife habitat and protect this area with a permanent conservation easement.
- Improve terrestrial habitat by increasing the density of tree species that root deeply, by thinning the thick stands of rhododendron within the easement area and planting a more diverse native plant community.

During Monitoring Year 2 (MY2), our monitoring activities indicated that the planted acreage was functioning well with most banks, benches and floodplain areas developing a diverse herbaceous community and having good growth of planted trees. The access areas used during construction were particularly difficult to stabilize but after hydro-seeding they are now well vegetated. The Vegetative Problem Area noted in the MY1 report developed a good stand of herbaceous vegetation, along with the planted trees and is no longer a problem area. Our discussions with the landowner concerning mowing encroachments along the easement line (MY1: EA-1 & EA-2) by maintenance staff and their encroachment by installing the outlet of a drainpipe within the easement were addressed and were not an issue this year. There were no Vegetative Problem Areas identified during 2016. There was one Encroachment Area (EA-1) noted in 2016. A new maintenance staff person had the

nature trail mowed, which is allowed under the easement; however, a wider area was mowed than we verbally agreed should be maintained. The width was 10-12 feet wide, while we had agreed to a width that is 4-6 feet wide, which is approximately the width of the previously existing nature trail. We discussed this with one of the Lonesome Valley staff, they agreed to address this issue with the trail maintenance staff, and to be sure they know the proper width for future maintenance.

The three channel problem areas noted in the MY1 report stabilized naturally. During December 2015 and January 2016, two greater than bankfull flows occurred. The crest gauge shows a depth on the floodplain at the gauge location of 25.75 inches and photos of wrack lines showed flooding on the floodplain more than 50 feet from the top of the stream bank. This flooding caused five small areas of bank erosion or instability along the project reach. We have shown photos of these areas from the summer of 2016 (Appendix D, Table 14) which indicate that these sites are naturally stabilizing. All of these areas are less than ten feet by five feet in area and will be further stabilized by sloping the area, seeding, mulching, matting and installing live stakes during the winter of 2017.

As noted in the Baseline report, we installed eight (8) vegetation monitoring plots at this site, with seven (7) being installed along the restoration reach (Logan Creek, Reach 1) and one (1) being installed along the enhancement reach (Logan Creek, Reach 2). The location of these vegetation monitoring plots can be seen on Figures 2A-C. The average density of total planted stems following the MY2 growing season is 728 stems per acre (SPA). Volunteer stems were much more common this year with volunteers being observed in six out of the eight plots and the average density of volunteer trees was 516 SPA.

Stream geomorphological stability and performance during MY2 was assessed by surveying thirteen (13) cross-sections (8 on Logan Creek, 2 on UT3, 2 on UT6 and 1 on UT8) and a profile of Logan Creek, UT3, UT6 and UT8, evaluating the bed particle size with 3 riffle pebble counts and by observation and replicating channel location photographs. An additional cross-section was added on UT8 during MY2 surveying so that we have cross-sections on all restored tributaries. Cross-sections of all the channels indicated that there was very little change in the cross-sections during MY2. The particle size observed in MY2 pebble counts has decreased slightly which may be attributed to the drought conditions that this area experienced during MY2. No observed changes indicate any instability. The Visual Morphological Stability Assessment indicates that the Site is stable and performing well. All but one structure (CPA-2), are functioning as designed during MY2. CPA-2 is a log that is part of the rock-and-roll structure and the fabric was torn during flooding (Table 14 in e-file data). This will be repaired prior to the 2017 growing season. Channel morphology is responding as designed and meeting project goals.

Lonesome Valley installed a trail crossing near the top of the project site. This crossing replaces a crossing that existed prior to this project. This addition required a reduction of three feet from the total restoration footage, restoration SMUs and a slight increase in preservation footage and SMUs. These modifications are reflected in Table 1.

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 NCDMS website. All raw data supporting the tables and figures in the appendices are available from NCDMS upon request.

2.0 METHODOLOGY

The 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 NCDMS monitoring guidance document dated December 1, 2009 and other mitigation guidance (NCEEP 2009 and USACE 2003), which will continue to serve as the template for subsequent monitoring years. The

specific locations of monitoring features: vegetation plots, permanent cross-sections and profiles, and the crest gauge location, are shown on the Current Conditions Plan View (CCPV) sheets found in Appendix A.

Vegetation monitoring plots, pebble counts and site photo points were monitored in September 2016. Site surveys for channel cross-sections, photos and profiles were conducted in October 2016.

2.1 Vegetation Assessment

In order to determine if success criteria are achieved, vegetation monitoring quadrants (veg plots) were installed and are monitored in accordance with the CVS-NCDMS Protocol for Recording Vegetation, Version 4.1 (CVS 2007 and Lee, Peet, Roberts and Wentworth 2007). The vegetation monitoring plots are a minimum of two percent of the planted portion of the Site with eight plots established randomly within the planted riparian buffer, per CVS Monitoring Level 2. No veg plots were established within the undisturbed forested areas along the northern part of the project or within the undisturbed forested areas along Reach II of Logan Creek and UT5. A small area was disturbed within this enhancement reach so that structures and channel repairs could be made during construction. Veg Plot 1 is located in this area where bare root trees and seed were planted. The sizes of individual quadrants are 100 square meters for woody (tree) species and 1 square meter for herbaceous vegetation. Herbaceous vegetation quadrants were established in one corner of the larger woody vegetation plots and monitored by comparative photographs taken each year.

Trees surviving within vegetation monitoring plots were visually accessed during year two monitoring. We found that all vegetation was in good condition. All plots indicated that most trees were growing and in good to excellent condition and herbaceous vegetation was well established and growing well. The average density of total planted stems following the MY2 growing season is 728 SPA (n=8) with a range from 445 SPA to 971 SPA. The average density of volunteer trees was 516 SPA and the density ranged from 0 to 1,133 SPA. The overall SPA including both planted and volunteer stems was 1,244. With an average planted density of 728 stems per acre, the Site is on track to meet the minimum interim success criteria of 320 stems per acre by the end of MY3, and the final success criteria of 260 stems per acre by the end of MY5.

There were few invasive species observed at this site during Year 2. Observation during monitoring activities indicated that there were only a few scattered individual small plants of the invasive species, Multiflora rose. Larger individual plants of this species were treated during construction and killed but new growth appears to be occurring from the existing seed bank. We will continue to monitor for additional plants growing and will treat these as needed. No areas of concern regarding the existing vegetation was observed along Logan Creek or any of the tributaries. Year 2 vegetation assessment information is provided in Appendix C.

2.2 Stream Assessment

The approach for the Logan Creek Site includes the restoration of channels to a stable morphology that allows for the transport of water and sediment through the Site and allows stream flows larger than bankfull flows to spread onto the floodplain. Stream monitoring efforts focus on visual observations, a crest gauge to document bankfull flooding events, surveying established stream cross-sections and channel profiles to assess channel stability and pebble counts to assess if proper sediment transport is taking place.

Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal Accuracy using Leica TS06 Total Station and was georeferenced to the NAD83 State Plane Coordinate System, FIPS3200 in US Survey Feet, which was derived from the As-built Survey. This survey system collects point data with an accuracy of less than one tenth of a foot.

2.2.1 Morphologic Parameters and Channel Stability

Cross-sections were classified using the Rosgen Stream Classification System (Rosgen 1994) and all cross-sections were evaluated to determine if they meet design expectations. Cross-sections were also

compared to the baseline and MY1 cross-section plots to evaluate changes in the cross sections. Morphological survey data is presented in Appendix D.

A longitudinal profile was surveyed for the entire length of Logan Creek, UT3 and UT6, and UT8 to document changes during year 2 of monitoring. The survey was tied to a permanent benchmark and measurements included thalweg, water surface (where flow was present), and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth.

Stream geomorphological stability and performance during MY2 was assessed by surveying thirteen (13) cross-sections (8 on Logan Creek, 2 on UT3, 2 on UT6 and 1 on UT8) and a profile of these channels as described above. The bed particle size was evaluated with three riffle pebble counts and by observation and replicating channel location photographs. An additional riffle cross-section and profile was added on UT8 during MY2 surveying, so that we have this information on all the restored tributaries. Cross-sections and profiles of all the channels indicated that there was very little change in the channel during MY2. Some pools became shallower during the year, however, this site like most of western North Carolina, experienced severe to extreme drought that began in March and is continuing at the time of this report. The low flow within the channel has caused sand to accumulate within the pools. Once the drought is over and normal flows return, the pools should return to their design depth through natural scour. The Visual Morphological Stability Assessment indicates that the Site is stable and performing at 98 to 100 percent for all parameters. One structure (on Logan Creek Reach 1) was piping during MY2 (CPA-2). This structure had fabric that was sealing the upstream side of the log, torn during flooding. This issue will be repaired prior to the next growing season (Table 14 in e-file data). Overall, channel morphology is responding as designed and meeting project goals.

Pebble count data for MY2 indicates a shift back to smaller particle sizes at all of the riffles sampled. This is the opposite of what was observed in MY1. The channel had a mean D50 of 16.5 mm during baseline sampling and 36.9 mm during MY1 but this changed to an average of 22.2 mm in MY2. This represents a change from very coarse gravel in MY1 to coarse gravel this year. Again, this may be related to the very low flows during the drought that has continued for most of 2016 and the streambed will likely coarsen again when flows become more normal.

2.2.2 Hydrology

A crest gauge was installed on the floodplain at the bankfull elevation along the right top of bank on Logan Creek at approximate Station 30+00. There was at least one major bankfull event recorded on the crest gauge during MY2. The crest gauge indicated a water depth on the floodplain of 25.75 inches during this flooding. Stream flow data from a recording station at Lake Toxaway indicates that these storms may have occurred on December 29, 2015 or February 3, 2016. There were also physical indications of this flooding, such as large debris and wrack lines that indicated a flooding situation that extended well beyond the top of bank (see photos with Table 11). Crest gauge readings are presented in Appendix D.

2.2.3 Photographic Documentation

Reference transects were photographed at each permanent cross-section. A survey tape is normally centered in the photograph when the tape is used to identify the transect. The water line was located in the lower area of the frame, and as much of the bank as possible included in each photograph. Photographs were taken at specific photo points established along each channel during year 2 monitoring. Photographs from these points are replicated each year and used to document changes along the channel. Points were selected to include grade control structures as well as other structural components installed during construction. Annual photographs from the established photo points are shown in Appendix D.

2.2.4 Project Problem Areas

Project problem areas fall into three types: Vegetation Problem Areas (VPA), Encroachment Areas (EA), and Channel Problem Areas (CPA). All observed problem areas are shown on the CCPV maps. There were no VPAs identified during MY2. Vegetation was well established across the entire project site. During winter of 2015/2016, two greater than bankfull flows occurred as discussed above and this resulted in five channel problem areas (CPA 1-6). This flooding caused five small areas of bank erosion or instability along the project reach. In the photos included with Table 14, we have shown photos of each CPA, with photos of some of these sites from summer 2016, which indicates that the these sites are naturally stabilizing. All of these areas are less than ten feet by five feet in area and will be further stabilized by sloping the area, seeding, mulching, matting and installing live stakes during the winter of 2017.

A nature trail exists along the stream beginning at the lower end of Reach 1 and continuing upstream to the trout pond. This trail falls within the easement in many locations but also passes out of the easement in others. This was a pre-existing nature trail and the right to maintain it is allowed in the conservation easement. There was one Encroachment Area (EA-1) noted in 2016 along the nature trail, in the area of stations 23+00 to 28+00. A new maintenance staff person had the nature trail mowed; however, a wider area was mowed than we verbally agreed should be maintained. The width was 10-12 feet wide, while we had agreed to a width of 4-6 feet wide, which approximates the width of the previously existing nature trail. We discussed this with staff at Lonesome Valley and they agreed to address this issue with the trail maintenance staff, and to be sure they know the proper width for future maintenance. All issues discussed above reference the CCPV mapping and the Stream Problem Area table included in the e-File data with associated photos.

3.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2007. CVS-NCEEP Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC.

Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1.

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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, NCDENR. Raleigh, NC.

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____. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

Appendix A

Project Vicinity Map and Background Tables

Includes:

Figure 1. Project Vicinity Map and Directions

Figure 2. Current Condition Plan View (CCPV) – Overview Map, MY2

Figure 2A. CCPV MY2, North Area

Figure 2B. CCPV MY2, Middle Area

Figure 2C. CCPV MY2, South Area

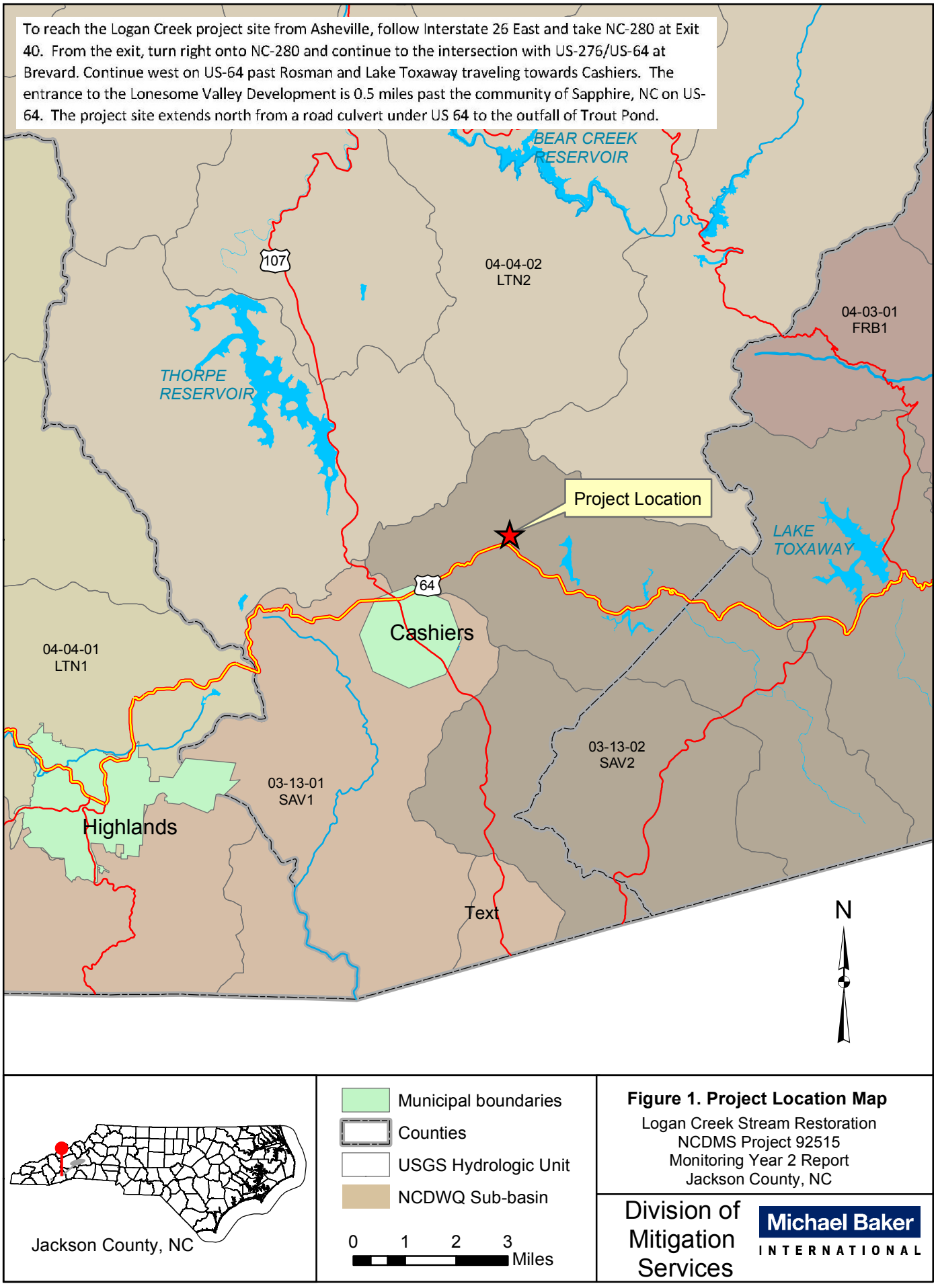
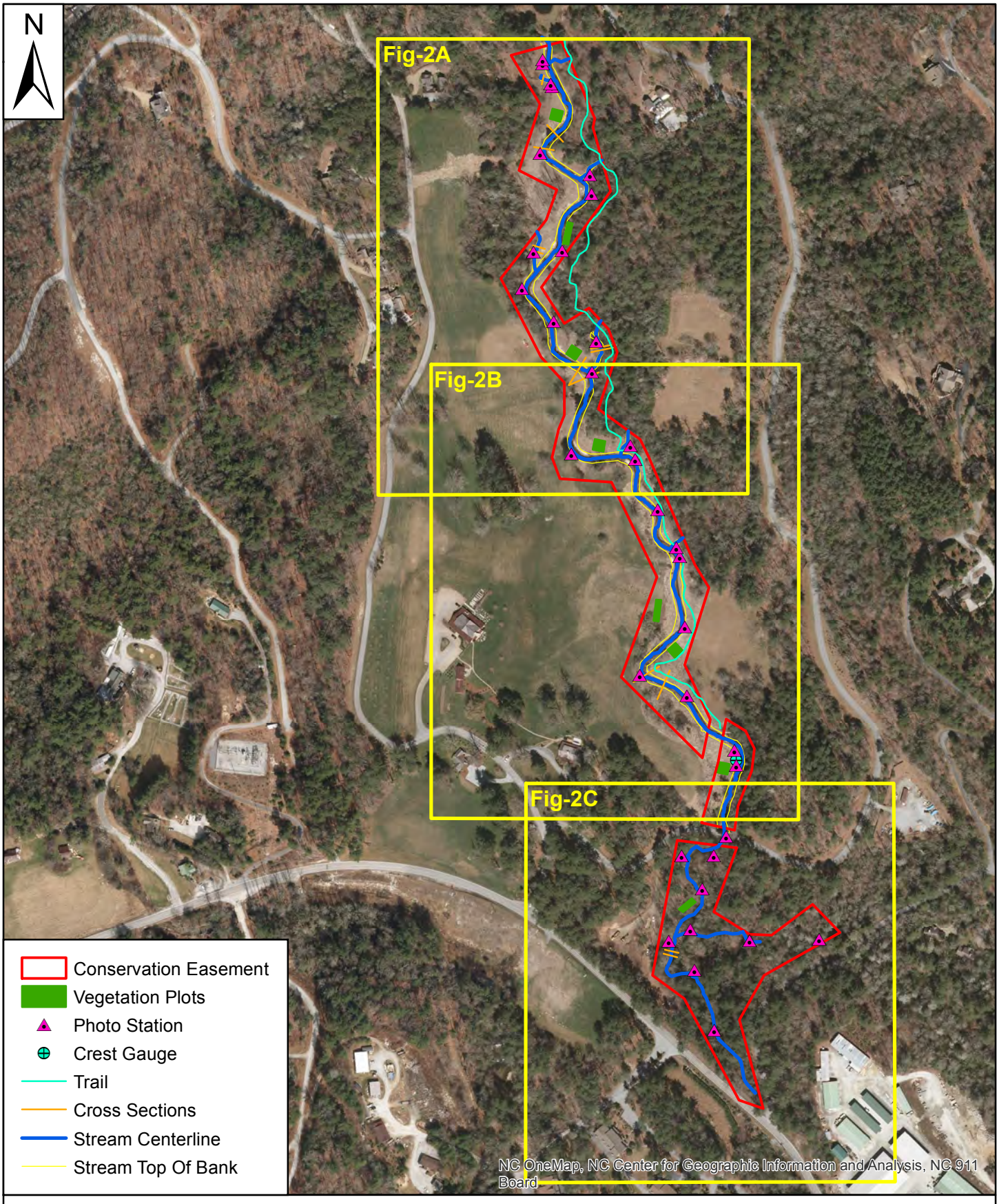


Figure 1. Project Location Map

Logan Creek Stream Restoration
NCDMS Project 92515
Monitoring Year 2 Report
Jackson County, NC

Division of Mitigation Services

Michael Baker INTERNATIONAL



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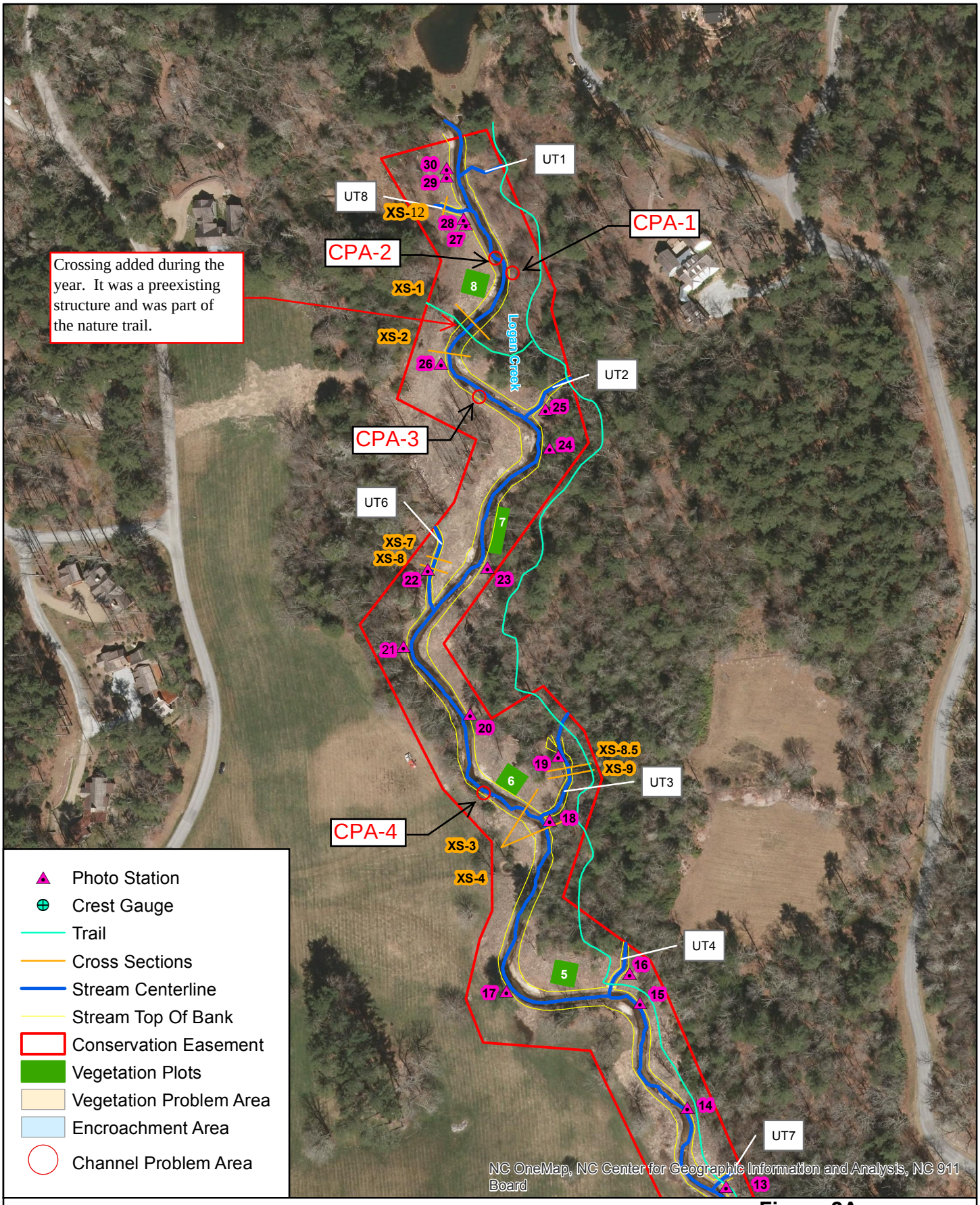
0 400 800 Feet

DMS Project # 92515

Figure 2
Current Conditions Plan View
Monitoring Year 2
Logan Creek Site



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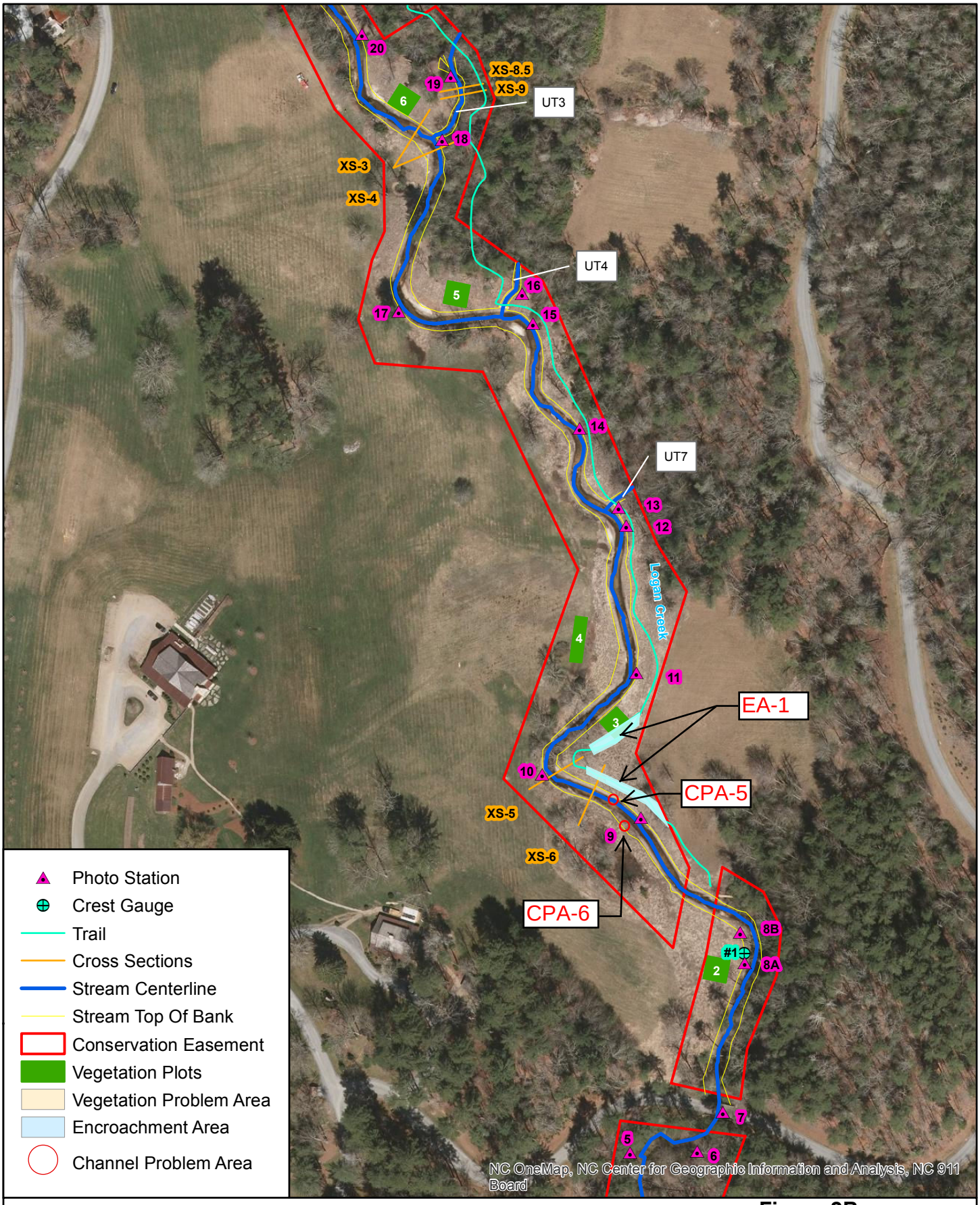
DMS Project # 92515

Figure 2A
Current Conditions Plan View
Monitoring Year 2
Logan Creek Site

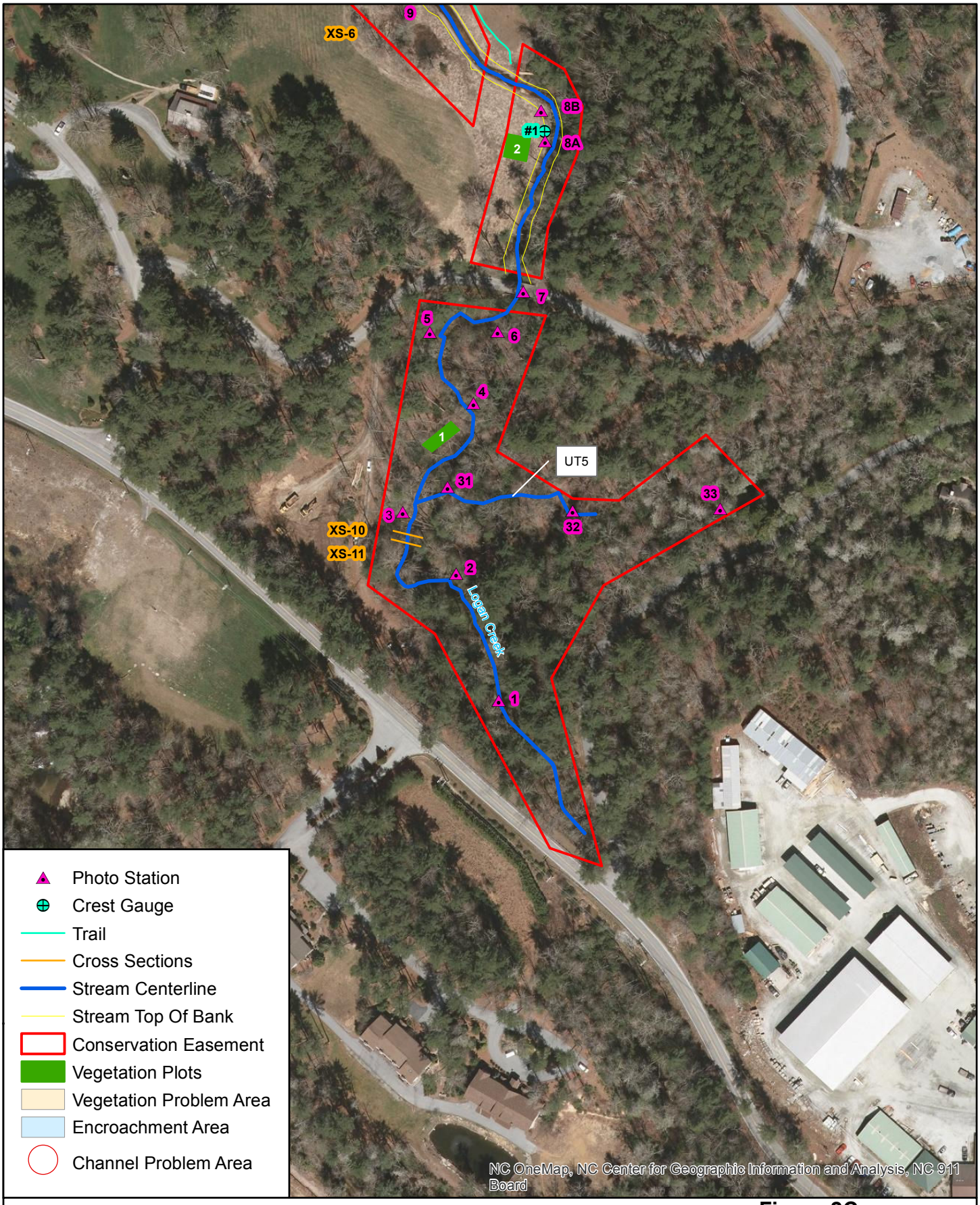


Michael Baker INTERNATIONAL

0 150 300 Feet

DMS Project # 92515

Figure 2B
Current Conditions Plan View
Monitoring Year 2
Logan Creek Site



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0 150 300 Feet

DMS Project # 92515

Figure 2C
Current Conditions Plan View
Monitoring Year 2
Logan Creek Site

Appendix B
General Project Tables

Includes:

Table 1. Project Components and Mitigation Credits
Figure 3. Project Asset Map
Table 2. Project Activity and Reporting History
Table 3. Project Contacts
Table 4. Project Attributes

Table 1. Project Components and Mitigation Credits

Logan Creek Restoration Project: DMS Project ID No. 92515

Mitigation Credits

	Stream				Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	EI	EII	P					
Totals	3,441 SMU	692 SMU	136 SMU	58 SMU					

Project Components

Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration/ Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
STREAMS						
Logan Creek						
Reach 1	0+00 to 31+84	3134 LF	Restoration - PI	3,131* SMU	3,131* LF	1:1
Reach 2	32+43 to 42+81	1038 LF	Enhancement I	692 SMU	1,038 LF	1.5:1
UT1	0+00 to 0+71	71 LF	Enhancement II	28 SMU	71 LF	2.5:1
UT2	0+00 to 0+92	92 LF	Enhancement II	37 SMU	92 LF	2.5:1
UT3						
Reach 1	0+00 to 0+40	40 LF	Enhancement II	16 SMU	40 LF	2.5:1
Reach 2	0+40 to 1+78	138 LF	Restoration - PI	138 SMU	138 LF	1:1
UT4	0+00 to 0+84	84 LF	Enhancement II	34 SMU	84 LF	2.5:1
UT5	0+00 to 2+87	290 LF	Preservation	58* SMU	290* LF	5:1
UT6	0+00 to 1+27	127 LF	Restoration - PI	127 SMU	127 LF	1:1
UT7	0+00 to 0+54	54 LF	Enhancement II	21 SMU	54 LF	2.5:1
UT8	0+00 to 0+45	45 LF	Restoration - P1	45 SMU	45 LF	1:1

Component Summation

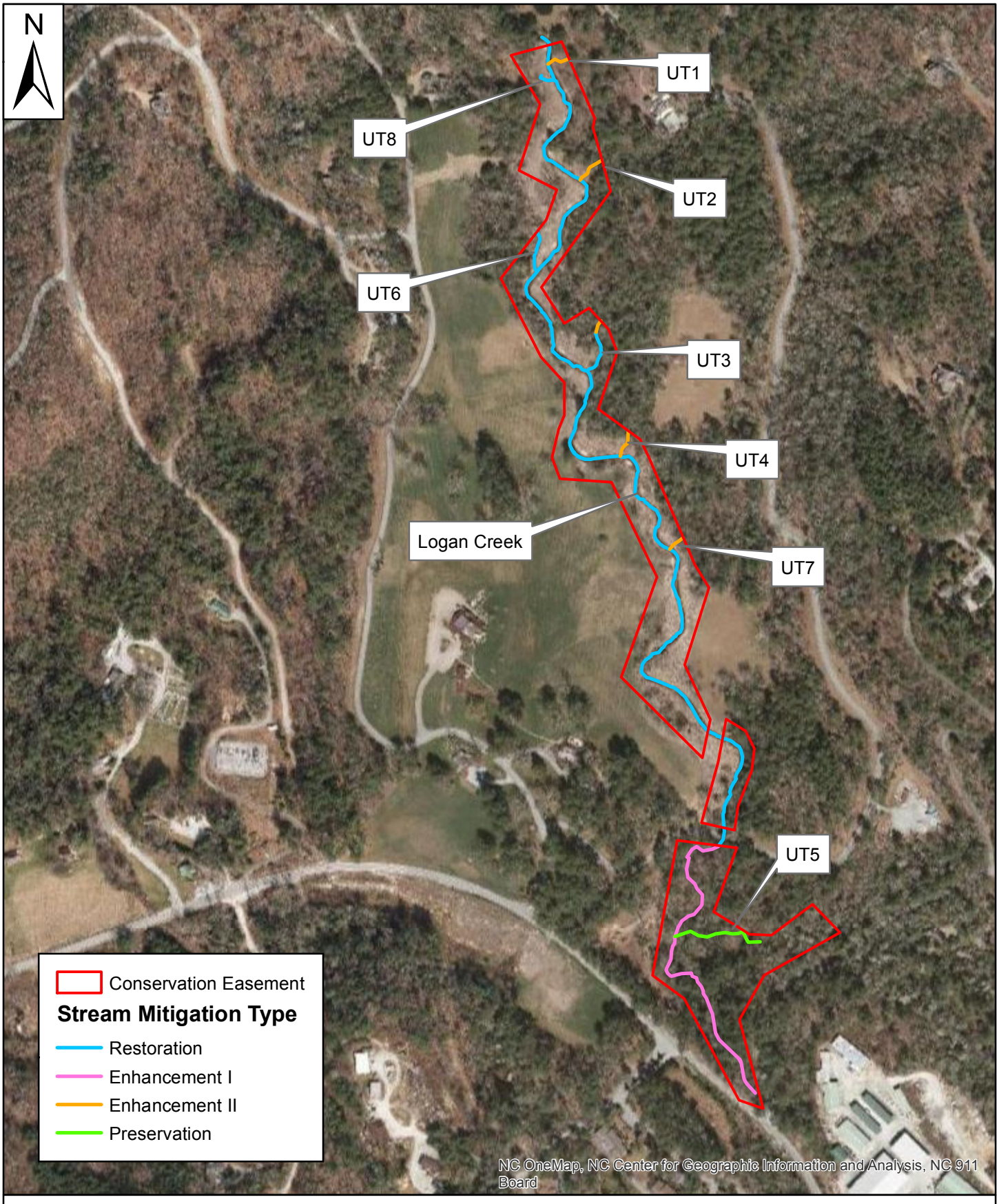
Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)
Restoration	3,441					
Enhancement I	1,038					
Enhancement II	341					
Creation						
Preservation	290					
High Quality Preservation						

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

* Lonesome Valley replaced a footbridge at approximately station 3+15 during September 2016. This crossing was part of their original nature trail system. We reduced restoration footage and SMUs for this reach due to this crossing; however, additional footage was added on the preservation reach to partially offset the loss in total SMUs



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0 200 400 600 800 1,000 Feet

DMS Project # 92515

Figure 3
Stream Asset Map
Monitoring Year 2
Logan Creek Site

Table 2. Project Activity and Reporting History
Logan Creek Restoration Project: DMS Project ID No. 92515

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Mitigation Plan Prepared	Jun-07	06-07	Apr-08
Mitigation Plan Amended	Apr-13	N/A	May-13
Mitigation Plan Approved	N/A	N/A	Jun-13
Final Design – (at least 90% complete)	N/A	N/A	May-13
Construction Begins	N/A	N/A	Jun-14
Temporary S&E mix applied to entire project area	N/A	N/A	Jan-15*
Permanent seed mix applied to entire project area	N/A	N/A	Jan-15*
Planting of bare root trees and live stakes	N/A	N/A	Jan-15*
End of Construction	N/A	N/A	May-15**
Survey of As-built conditions (Year 0 Monitoring-baseline)	N/A	Mar-15	Aug-15
As-Built Baseline Report	N/A	N/A	Nov-15
Year 1 Monitoring	N/A	N/A	Apr-16
Year 2 Monitoring	Dec-16	Nov-16	Dec-16
Year 3 Monitoring	Dec-17	N/A	N/A
Year 4 Monitoring	Dec-18	N/A	N/A
Year 5 Monitoring	Dec-19	N/A	N/A

* Began seeding with the start of construction June, 2014 and site was seeded multiple times with a final entire area overseeding at the time the bare root trees were planted.

*** Construction of the majority of the site was completed by November 1, 2014 after a 2 week extension of the trout moratorium. The Enhancement Reach was done after April 15, 2015 (when Trout Moratorium ends) and was completed by May 12, 2015.

Table 3. Project Contacts	
Logan Creek Restoration Project: DMS Project ID No. 92515	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact: Micky Clemmons, Tel. 828-412-6100
Construction Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Planting Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seeding Contractor	
River Works, Inc.	6105 Chapel Hill Road Raleigh, NC 27607 Contact: Phillip Todd, Tel. 919-582-3575
Seed Mix Sources	Green Resources (seed), Tel. 336-855-6363
Nursery Stock Suppliers	ArborGen Inc. (trees), 843-528-3204 Dykes and Son (trees), 931-668-8833
Monitoring Performers	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact:
Stream and Vegetation Monitoring	Micky Clemmons, Tel. 828-412-6100
Monitoring Surveyor	Kee Mapping and Surveying P.O. Box 2566 Asheville, NC 28802 Contact: Brad Kee, License #C-3039; Phone: 828-575-9021

Table 4. Project Attributes			
Logan Creek Restoration Project: DMS Project ID No. 92515			
Project Information			
Project Name	Logan Creek Mitigation Project		
County	Jackson		
Project Area (acres)	12.71		
Project Coordinates (latitude and longitude)	Latitude 35.132803° Longitude -83.061046°		
Watershed Summary Information			
Physiographic Province	Blue Ridge		
River Basin	Savannah River Basin		
USGS Hydrologic Unit 8-digit and 14-digit	03060101 / 03060101010020		
DWR Sub-basin	Keowee River: 0306010101		
Project Drainage Area (AC)	Mainstem 1353.5 at beginning to 1714 at end, UT1, UT4, UT6, UT7 & UT8 <13, UT2 = 26; UT3 = 32, UT5 = 128.		
Project Drainage Area Percentage of Impervious Area	<2%		
USGA Land Use Classification	Deciduous Forest (76%)		
	Evergreen Forest (8%)		
	Pasture Land (4.6%)		
NCDMS Land Use Classification for this Hydrologic Unit	Forest (91%)	Shrub (1%)	
	Developed (6%)	Other (.5%)	
	Agriculture (1.5%)		
Stream Reach Summary Information			
Parameters	**Mainstem - Reach 1**	**Mainstem - Reach 2**	**UT3**
			R1 **R2**
Length of Reach (LF)	3,134	1,038	40 138
Valley Classification (Rosgen)	VIII	VIII	II
Drainage Area (AC)	1,557	1,714	32
NCDWR Stream Identification Score	52.5	52.5	41.5
NCDWR Water Quality Classification	C; TR: +HQW	C; TR: +HQW	C; TR: +HQW
Morphological Description (Rosgen stream type)	C-E	C-E	B
Evolutionary Trend	C→E	C→E	B
Underlying Mapped Soils	NkA	SaC	NkA, SaC
Drainage Class	Poorly drained to very poorly drained soils	Very deep, well drained, mod permeable soils	Somewhat poorly to well drained
Soil Hydric Status	Non-Hydric	Non-Hydric	Site-specific
Average Channel Slope (ft/ft)	0.004	0.007	0.012
FEMA Classification	Zone AE	Zone AE	None
Native Vegetation Community	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland
Percent Composition of Exotic/Invasive Vegetation[2]	<1%	<1%	<1%
Parameters	**UT6**	**UT5**	**5 other small UTs in R1**
Length of Reach (LF)	127	290	45 - 127
Valley Classification (Rosgen)	II	II	II
Drainage Area (AC)	38	117	.02 to .04
NCDWR Stream Identification Score	32.5	48	40.5 - 32.5
NCDWR Water Quality Classification	C; TR: +HQW	C; TR: +HQW	C; TR: +HQW
Morphological Description (Rosgen stream type)	B	B - E	E - B
Evolutionary Trend	B	E	B→C→E
Underlying Mapped Soils	NkA, SaC	NkA, SaC	NkA, SaC
Drainage Class	Somewhat poorly to well drained	Somewhat poorly to well drained	Somewhat poorly to well drained
Soil Hydric Status	Site-specific	Site-specific	Site-specific
Average Channel Slope (ft/ft)	0.012	0 - 60%	0.0134 (UT6)
FEMA Classification	None	None	None
Native Vegetation Community	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland	Mixed Forested/Rhododendron and grassland
Percent Composition of Exotic/Invasive Vegetation[2]	<1%	<1%	<1%
Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Permit: Action ID #2008-01711
Waters of the United States – Section 401	Yes	Yes	Permit: WQC #3885
Endangered Species Act	No	Yes	Categorical Exclusion
Historic Preservation Act	No	Yes	Categorical Exclusion
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	No-Rise	Certification, June 27, 2016
Essential Fisheries Habitat	No	N/A	N/A

Notes:
1. See Figure 2.5 of Mitigation Plan for key to soil series symbols.
3. USGS Land Use Data (2001) used rather than CGIA Land Use Classification data which is more dated (1996)

Appendix C

Vegetation Assessment Data

Includes:

Table 5. Vegetation Plot Mitigation Success Summary

Table 6. CVS Vegetation Metadata Table

Table 7. Stem Count Arranged by Plot and Species

Figure 4. Vegetation Monitoring Plot Photos

Table 5. Vegetation Plot Mitigation Success Summary (2016, MY2)

(per acre)

Plot #	Stream/ Wetland Stems[1]	Volunteers[2]	Total[3]	Success Criteria Met?
1	931	0	931	Yes
2	445	121	567	Yes
3	647	486	1133	Yes
4	688	0	688	Yes
5	850	1133	1983	Yes
6	769	890	1659	Yes
7	971	850	1821	Yes
8	526	647	1174	Yes
Project Avg	**728**	**516**	**1244**	**Yes**

Stem Class	Characteristics
[1]Stream/ Wetland Stems	Native planted woody stems. Includes shrubs, does NOT include live stakes. No vines
[2]Volunteers	Native woody stems. Not planted. No vines.
[3]Total	Planted + volunteer native woody stems. Excludes live stakes, exotics and vines.

This color indicates that the number includes volunteer stems.

Indicates that the stems per Acre exceeds requirements by 10%

Indicates that the stems per Acre exceeds requirements, but by less than 10%

Table 6. Vegetation Metadata

Logan Creek Stream and Restoration Project - Project #92515

Report Prepared By	Micky Clemmons
Date Prepared	10/12/2016 16:28
database name	92515_Logan_cvs-eep-entrytool-v2.3.1.mdb
database location	L:\projects\109243 - Logan Creek\Monitoring\YR2 monitoring\2.0 - Monitoring Data\App C - Vegetation Data\Veg
computer name	ASHELMCLEMMONS
file size	46104576

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	92515
project Name	Logan Creek
Description	This Project will restore or enhance 4823 linear feet (LF) of stream along Logan Creek.
River Basin	Savannah
length(ft)	5110
stream-to-edge width (ft)	30
area (sq m)	28481.19
Required Plots (calculated)	8
Sampled Plots	8

Table 7. Stem Count Arranged by Plot
Project: Logan Creek, DMS Project #92515.

			Current Plot Data (MY2 2016)																							
			92515-01-0001			92515-01-0002			92515-01-0003			92515-01-0004			92515-01-0005			92515-01-0006			92515-01-0007			92515-01-0008		
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
Alnus serrulata	hazel alder	Shrub				3	3	6	6	12	18	2		2	7		7	3		3	6		6	5	15	20
Betula nigra	river birch	Tree							1		1	4		4	3		3	1		1	1		1	2		2
Diospyros virginiana	common persimmon	Tree				1		1	1		1	2		2	4		4	3		3	6		6	1		1
Fraxinus pennsylvanica	green ash	Tree				1		1	3		3	4		4	2		2	8		8	3		3	2		2
Hamamelis virginiana	American witchhazel	Tree	9		9																					
Leucothoe fontanesiana	highland doghobble	Shrub				1		1							1		1				1		1			
Lindera benzoin	northern spicebush	Shrub	2		2																					
Liriodendron tulipifera	tuliptree	Tree				1		1				2		2		20	20	1	20	21	3	15	18	2		2
Nyssa sylvatica	blackgum	Tree	1		1	1		1	2		2				1		1				2		2	1		1
Oxydendrum arboreum	sourwood	Tree														2	2									
Pinus strobus	eastern white pine	Tree														6	6		2	2		6	6			
Quercus alba	white oak	Tree				3		3				2		2	2		2									
Quercus rubra	northern red oak	Tree							3		3	1		1	1		1	3		3	2		2			
Robinia pseudoacacia	black locust	Tree																							1	1
Sambucus canadensis	Common Elderberry	Shrub																								
Unknown		Shrub or Tree																								
Viburnum dentatum	southern arrowwood	Shrub	11		11																					
		Stem count	23		23	11	3	14	16	12	28	17		17	21	28	49	19	22	41	24	21	45	13	16	29
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	4		4	7	1	7	6	1	6	7		7	8	3	11	6	2	7	8	2	9	6	2	7
		Stems per ACRE	931		931	445	121	567	647	486	1133	688		688	850	1133	1983	769	890	1659	971	850	1821	526	647	1174

P = Planted
V = Volunteer
T = Total

This color indicates that the number includes volunteer stems.
Indicates that the stems per Acre exceeds requirements by 10%
Indicates that the stems per Acre exceeds requirements, but by less than 10%

Table 7. Stem Count Arranged by Plot, continued.
Project: Logan Creek, DMS Project #92515.

			Annual Means																	
			MY0 (2015)			MY1 (2015)			MY2 (2016)			MY3 (2017)			MY4 (2018)			MY5 (2019)		
Scientific Name	Common Name	Species Type	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T
Alnus serrulata	hazel alder	Shrub	33		33	32		32	32	30	62									
Betula nigra	river birch	Tree	13		13	11		11	12		12									
Diospyros virginiana	common persimmon	Tree	24		24	20		20	18		18									
Fraxinus pennsylvanica	green ash	Tree	24		24	24		24	23		23									
Hamamelis virginiana	American witchhazel	Tree				11		11	9		9									
Leucothoe fontanesiana	highland doghobble	Shrub	4		4	3		3	3		3									
Lindera benzoin	northern spicebush	Shrub				2		2	2		2									
Liriodendron tulipifera	tuliptree	Tree	17		17	11		11	9	55	64									
Nyssa sylvatica	blackgum	Tree	20		20	9		9	8		8									
Oxydendrum arboreum	sourwood	Tree								2	2									
Pinus strobus	eastern white pine	Tree								14	14									
Quercus alba	white oak	Tree	6		6	6		6	7		7									
Quercus rubra	northern red oak	Tree	13		13	12		12	10		10									
Robinia pseudoacacia	black locust	Tree								1	1									
Sambucus canadensis	Common Elderberry	Shrub					1	1												
Unknown		Shrub or Tree	7		7															
Viburnum dentatum	southern arrowwood	Shrub	9		9	11		11	11		11									
		Stem count	170		170	152	1	153	144	102	246	0		0	0		0	0		0
		size (ares)	8			8			9			9			9			9		
		size (ACRES)	0.20			0.20			0.20			0.22			0.22			0.22		
		Species count	11	0	11	12	1	13	12		15	0		0	0		0	0		0
		Stems per ACRE	860	0	860	769	5	774	728	516	1244	0		0	0		0	0		0

P = Planted
V = Volunteer
T = Total

This color indicates that the number includes volunteer stems.
Indicates that the stems per Acre exceeds requirements by 10%
Indicates that the stems per Acre exceeds requirements, but by less than 10%

Figure 4. Logan Creek Site – Monitoring Year 2 Vegetation Plot Photos, DMS Project #92515

Photo 1. Vegetation Plot 1 – Tree photo (September 2016).

Photo 2. Vegetation Plot 1 – Herbaceous photo (September 2016).

Photo 3. Vegetation Plot 2 – Tree photo (September 2016).

Photo 4. Vegetation Plot 2 – Herbaceous photo (September 2016).

Photo 5. Vegetation Plot 3 – Tree photo (September 2016).

Photo 6. Vegetation Plot 3 – Herbaceous photo (September 2016).

Logan Creek Site - Vegetation Plot Photos,
DMS Project #92515 - continued

Photo 7. Vegetation Plot 4 – Tree photo (September 2016).

Photo 8. Vegetation Plot 4 – Herbaceous photo (September 2016).

Photo 9. Vegetation Plot 5 – Tree photo (September 2016).

Photo Point 10, Vegetation Plot 5 – Herbaceous photo (September 2016).

Photo 11. Vegetation Plot 6 – Tree photo (September 2016).

Photo 12. Vegetation Plot 6 – Herbaceous photo (September 2016).

Logan Creek Site - Vegetation Plot Photos,
DMS Project #92515 - continued

Photo 13. Vegetation Plot 7 – Tree photo (September 2016).

Photo 14. Vegetation Plot 7 – Herbaceous photo (September 2016).

Photo 15. Vegetation Plot 8 – Tree photo (September 2016).

Photo 16. Vegetation Plot 8 – Herbaceous photo (September 2016).

Appendix D

Stream Assessment Data

Includes:

Figure 5. Stream Photos by Channel and Station
Table 8. Visual Morphological Stability Assessment
Table 9. Verification of Bankfull Events
Figure 6. Cross-Sections with Annual Overlays
Figure 7. Longitudinal Profiles with Annual Overlays
Figure 8. Pebble Count Plots with Annual Overlays
Table 10. MY2 Stream Summary
Table 11. Morphology and Hydraulic Monitoring Summary

Figure 5. Stream Photos by Channel and Station
Logan Creek Stream Restoration Project
Photo Points - Monitoring Year 2
(Stationing is the approximate location)

Photo 1. Logan Creek Photo Point 1 – Station 40+45 (September 2016) upstream view from right bank.

Photo 2. Logan Creek Photo Point 1 – Station 40+45 (September 2016) downstream view from right bank.

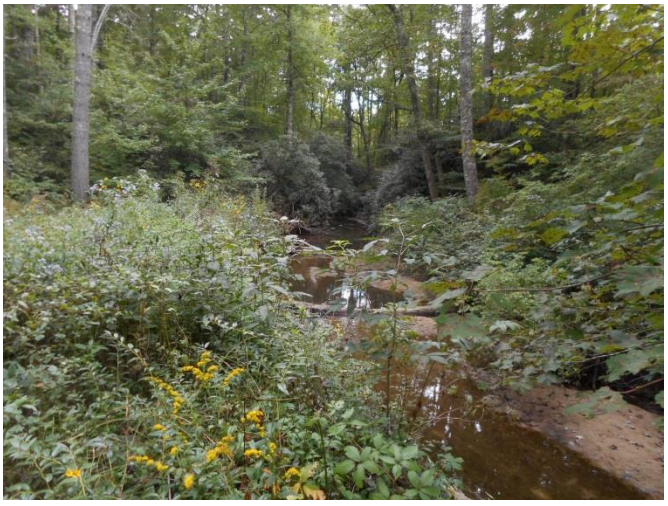


Photo 3. Logan Creek Photo Point 2 – Station 38+60 (September 2016) downstream view from left bank.

Photo 4. Logan Creek Photo Point 2 – Station 38+60 (September 2016) upstream view from left bank.

Photo 5. Logan Creek Photo Point 3 – Station 36+75 (September 2016) upstream view from right bank.

Photo 6. Logan Creek Photo Point 3 – Station 36+75 (September 2016) downstream view from right bank.

Photo 7. Logan Creek Photo Point 4 – Station 34+80 (September 2016) downstream from left bank.

Photo 8. Logan Creek Photo Point 4 – Station 34+80 (September 2016) upstream from left bank.

Photo 9. Logan Creek Photo Point 5 – Station 33+60 (September 2016) upstream from right bank.

Photo 10. Logan Creek Photo Point 5 – Station 33+60 (September 2016) downstream from right bank.

Photo 11. Logan Creek Photo Point 6 – Station 32+70 (September 2016) downstream view from left bank.

Photo 12. Logan Creek Photo Point 6 – Station 32+70 (September 2016) upstream view from left bank.

Photo 13. Logan Creek Photo Point 7 – Station 32+15 (September 2016) downstream view from bridge.

Photo 14. Logan Creek Photo Point 7 – Station 32+00 (September 2016) upstream view from bridge.

Photo 15. Logan Creek Photo Point 8a – Station 29+75 (September 2016) downstream view from right bank.

Photo 16. Logan Creek Photo Point 8b – Station 29+25 (September 2016) upstream view from right bank.

Photo 17. Logan Creek Photo Point 9 – Station 26+75 (September 2016) downstream view from left bank.

Photo 18. Logan Creek Photo Point 9 – Station 26+75 (September 2016) upstream view from left bank.

Photo 19. Logan Creek Photo Point 10 – Station 25+25 (September 2016) upstream view from right bank.

Photo 20. Logan Creek Photo Point 10 – Station 25+25 (September 2016) downstream view from right bank.

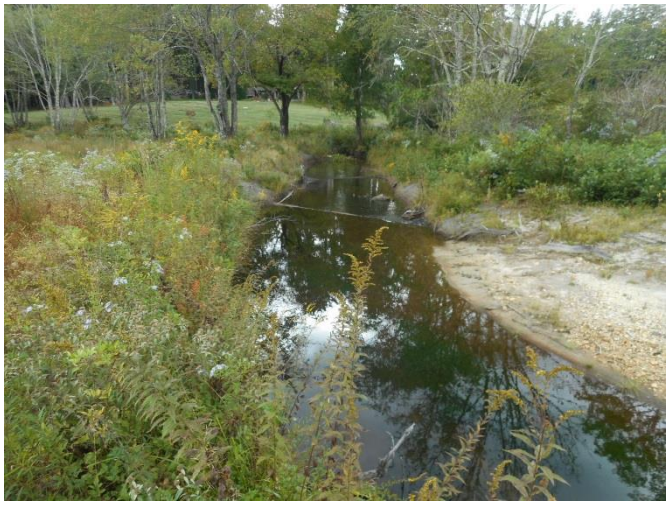


Photo 21. Logan Creek Photo Point 11 – Station 23+20 (September 2016) downstream view from left bank.

Photo 22. Logan Creek Photo Point 11 – Station 23+20 (September 2016) upstream view from left bank.

Photo 23. Logan Creek Photo Point 12 – Station 21+20 (September 2016) downstream view from left bank.

Photo 24. Logan Creek Photo Point 12 – Station 21+20 (September 2016) upstream view from left bank.

Photo 25. UT7 Photo Point 13 – (September 2016) upstream view from left bank.

Photo 26. UT7 Photo Point 13 – (September 2016) downstream view from left bank.

Photo 27. Logan Creek Photo Point 14 – Station 19+45 (September 2016) downstream view from left bank.

Photo 28. Logan Creek Photo Point 14 – Station 19+45 (September 2016) upstream view from left bank.

Photo 29. Logan Creek Photo Point 15 – Station 17+45 (September 2016) downstream view from left bank.

Photo 30. Logan Creek Photo Point 15 – Station 17+45 (September 2016) upstream view from left bank.

Photo 31. UT4 Photo Point 16 – Station 0+40 (September 2016) downstream view from left bank.

Photo 32. UT4 Photo Point 16 – Station 0+40 (September 2016) upstream view from left bank.

Photo 32. Logan Creek Photo Point 17 – Station 15+50 (September 2016) upstream view from right bank.

Photo 33. Logan Creek Photo Point 17 – Station 15+50 (September 2016) downstream view from right bank.

Photo 34. Logan Creek Photo Point 18 – Station 12+90 (September 2016) downstream view from left bank.

Photo 35. Logan Creek Photo Point 18 – Station 12+90 (September 2016) upstream view from left bank.

Photo 36. UT3 Photo Point 19 – Station 00+60 (September 2016) upstream from left bank.

Photo 37. UT3 Photo Point 19 – Station 00+60 (September 2016) downstream from left bank.

Photo 38. UT3 Photo Point 19 – Station 00+60 (September 2016) upstream from left bank to vernal pool.

Photo 39. Intentionally left blank.

Photo 40. Logan Creek Photo Point 20 – Station 10+60 (September 2016) downstream view from left bank.

Photo 41. Logan Creek Photo Point 20 – Station 10+60 (September 2016) upstream view from left bank.

Photo 42. Logan Creek Photo Point 21 – Station 9+40 (September 2016) upstream view from right bank.

Photo 43. Logan Creek Photo Point 21 – Station 9+40 (September 2016) downstream view from right bank.

Photo 44. UT6 Photo Point 22 – Station 0+75 (September 2016) upstream view from right bank.

Photo 45. UT6 Photo Point 22 – Station 0+75 (September 2016) downstream view from right bank.

Photo 46. Logan Creek Photo Point 23 – Station 7+70 (September 2016) downstream view from left bank.

Photo 47. Logan Creek Photo Point 23 – Station 7+70 (September 2016) upstream view from left bank.

Photo 48. Logan Creek, Photo Point 24 – Station 5+70 (September 2016) downstream view from left bank.

Photo 49. Logan Creek, Photo Point 24 – Station 5+70 (September 2016) upstream view from left bank.

Photo 50. UT2, Photo Point 25 – Station 0+65 (September 2016) upstream view from left bank.

Photo 51. UT2, Photo Point 25 – Station 0+65 (September 2016) downstream view from left bank.

Photo 52. Logan Creek, Photo Point 26 – Station 3+80 (September 2016) upstream view from right bank.

Photo 53. Logan Creek, Photo Point 26 – Station 3+80 (September 2016) downstream view from right bank.

Photo 54. Logan Creek, Photo Point 27 – Station 1+12 (September 2016) upstream view from right bank.

Photo 55. Logan Creek, Photo Point 27 – Station 1+12 (September 2016) downstream view from right bank.

Photo 56. UT8, Photo Point 28 – Station 1+10 (September 2016) upstream view from right bank and confluence.

Photo 57. UT1, Photo Point 29 – Station 0+50 (September 2016) view upstream and confluence.

Photo 58. Logan Creek, Photo Point 30 – Station 0+50 (September 2016) upstream view from right bank.

Photo 59. Logan Creek, Photo Point 30 – Station 0+50 (September 2016) downstream view from right bank.

Photo 60. UT5 - Preservation, Photo Point 31 – Station 1+80 (September 2016) downstream view from mid-channel to confluence.

Photo 61. UT5 - Preservation, Photo Point 31 – Station 1+80 (September 2016) upstream view from mid-channel to confluence.

Photo 62. UT5 - Preservation, Photo Point 32 – (September 2016) downstream view from right bank.

Photo 63. UT5 - Preservation, Photo Point 32 – (September 2016) upstream view from right bank.

Photos 64, 65, and 66 were not included this year and will not be included in the future, because the location for these photos was outside of the easement area where stream mitigation units are requested.

Table 8. Visual Morphological Stability Assessment

Logan Creek Stream Restoration Project: DMS Project ID No. 92515

Logan Creek, Reach 1 (3,184 LF), Restoration Reach

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	18	18	0	100	
	2. Armor stable (e.g. no displacement)?	18	18	0	100	
	3. Facet grades appears stable?	18	18	0	100	
	4. Minimal evidence of embedding/fining?	18	18	0	100	
	5. Length appropriate?	18	18	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	35	35	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	35	35	0	100	
	3. Length appropriate?	35	35	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	19	19	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	19	19	0	100	
	3. Apparent Rc within spec?	19	19	0	100	
	4. Sufficient floodplain access and relief?	19	19	0	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	3,184	3,184	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	3,184	3,184	0	100	**100%**
F. Vanes, Rock/Log Drop Structures*	1. Free of back or arm scour?	24	24	0	100	
	2. Height appropriate?	24	24	0	100	
	3. Angle and geometry appear appropriate?	24	24	0	100	
	4. Free of piping or other structural failures?	23	24	0	96	**99%**
G. Wads/ Boulders	1. Free of scour?	24	24	0	100	
	2. Footing stable?	24	24	0	100	**100%**

Logan Creek, Reach 2 (1,038 LF), Enhancement Reach

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	10	10	0	100	
	2. Armor stable (e.g. no displacement)?	10	10	0	100	
	3. Facet grades appears stable?	10	10	0	100	
	4. Minimal evidence of embedding/fining?	10	10	0	100	
	5. Length appropriate?	10	10	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	13	13	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	13	13	0	100	
	3. Length appropriate?	13	13	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	5	5	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	5	5	0	100	
	3. Apparent Rc within spec?	5	5	0	100	
	4. Sufficient floodplain access and relief?	5	5	0	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	1,038	1,038	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	1,038	1,038	0	100	**100%**
F. Vanes, Rock/Log Drop Structures*	1. Free of back or arm scour?	11	11	0	100	
	2. Height appropriate?	11	11	0	100	
	3. Angle and geometry appear appropriate?	11	11	0	100	
	4. Free of piping or other structural failures?	11	11	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	0	0	0		
	2. Footing stable?	0	0	0		

* Note: Due to very low water levels some piping is occurring, only one structure may need to be repaired to fix the issue. Most structures in Reach 2 were designed to have water go under them during low water, in order to move sand through the reach.

UT3 (178 LF)

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	3	3	0	100	
	2. Armor stable (e.g. no displacement)?	3	3	0	100	
	3. Facet grades appears stable?	3	3	0	100	
	4. Minimal evidence of embedding/fining?	3	3	0	100	
	5. Length appropriate?	3	3	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	3	3	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	3	3	0	100	
	3. Length appropriate?	3	3	0	100	**100%**
C. Thalweg[1]	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	0	0			
	2. Of those eroding, # w/concomitant point bar formation?	0	0			
	3. Apparent Rc within spec?	0	0			
	4. Sufficient floodplain access and relief?	0	0			
E. Bed General	1. General channel bed aggradation areas (bar formation)	178	178	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	178	178	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	4	4	0	100	
	2. Height appropriate?	4	4	0	100	
	3. Angle and geometry appear appropriate?	4	4	0	100	
	4. Free of piping or other structural failures?	4	4	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	0	0			
	2. Footing stable?	0	0			

Table 8. Visual Morphological Stability Assessment - Continued
Logan Creek Stream Restoration Project: DMS Project ID No. 92515

UT6, (127 LF)

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	3	3	0	100	
	2. Armor stable (e.g. no displacement)?	3	3	0	100	
	3. Facet grades appears stable?	3	3	0	100	
	4. Minimal evidence of embedding/fining?	3	3	0	100	
	5. Length appropriate?	3	3	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	2	2	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	2	2	0	100	
	3. Length appropriate?	2	2	0	100	**100%**
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	100	
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A	100	
	3. Apparent Rc within spec?	N/A	N/A	N/A	100	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	127	127	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	127	127	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	2	2	0	100	
	2. Height appropriate?	2	2	0	100	
	3. Angle and geometry appear appropriate?	2	2	0	100	
	4. Free of piping or other structural failures?	2	2	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	N/A	N/A	
	2. Footing stable?	N/A	N/A	N/A	N/A	**N/A**

UT8, (45 LF)

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Perfomance Mean or Total
A. Riffles	1. Present?	1	1	0	100	
	2. Armor stable (e.g. no displacement)?	1	1	0	100	
	3. Facet grades appears stable?	1	1	0	100	
	4. Minimal evidence of embedding/fining?	1	1	0	100	
	5. Length appropriate?	1	1	0	100	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	0	0	0		
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	0	0	0		
	3. Length appropriate?	0	0	0		
C. Thalweg	1. Upstream of pool (structure) centering? (%)	100	100	0	100	
	2. Downstream of pool (structure) centering? (%)	100	100	0	100	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	100	
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A	100	
	3. Apparent Rc within spec?	N/A	N/A	N/A	100	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	100	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	45	45	0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	45	45	0	100	**100%**
F. Vanes, Rock/Log Drop Structures	1. Free of back or arm scour?	1	1	0	100	
	2. Height appropriate?	1	1	0	100	
	3. Angle and geometry appear appropriate?	1	1	0	100	
	4. Free of piping or other structural failures?	1	1	0	100	**100%**
G. Wads/ Boulders	1. Free of scour?	N/A	N/A	N/A	N/A	
	2. Footing stable?	N/A	N/A	N/A	N/A	**N/A**

Table 9. Verification of Bankfull or Greater than Bankfull Events Logan Creek Stream Restoration Project: DMS Project ID No. 92515			
Date of Data Collection	Date of Event	Method of Data Collection	Gauge Watermark Height (inches)*
			Logan Creek Station 30+00
3/18/2016	2 events: 1 in Dec-15 and 1 in Jan-16.	Crest Gauge	25.75 inches
8/17/2016	undetermined	Crest Gauge	1.56 inches

* height indicates the highest position of cork shavings on the dowel.

Crest Gauge reading taken on 3/18/16 shows highest water level recorded during high water events that occurred during December 2015 and January 2016.

Crest Gauge reading taken on 8/17/16 shows minimal water level rise between 3/18/16 and 8/17/16.

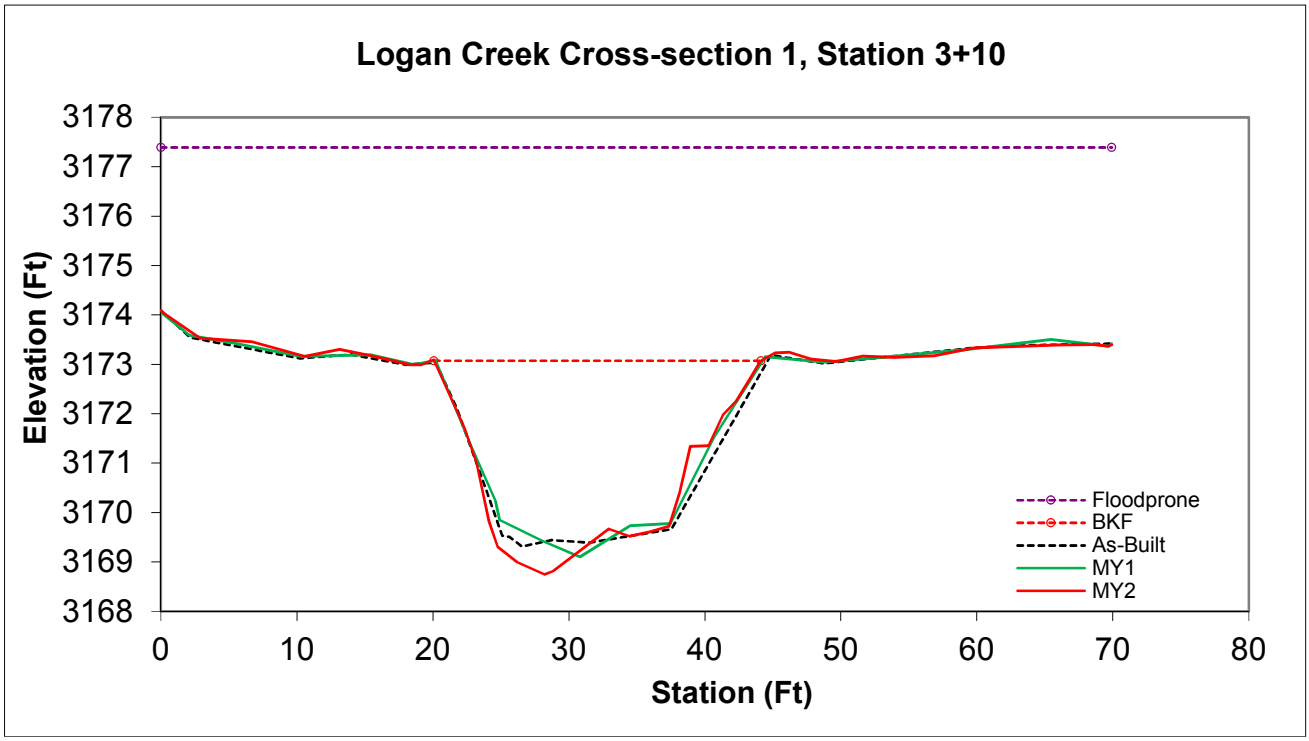
Wrack lines well back from the stream, indicating wide flooding of the floodplain during storms of late December 2015 and early February 2016.

Large debris scattered across the floodplain indicating the significant flooding during storms of late December 2015 and early February 2016.

Figure 6. Cross-Sections with Annual Overlays.

Permanent Cross-Section 1
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	64.8	24.05	2.7	4.32	8.92	1	2.9	3173.07	3173.16

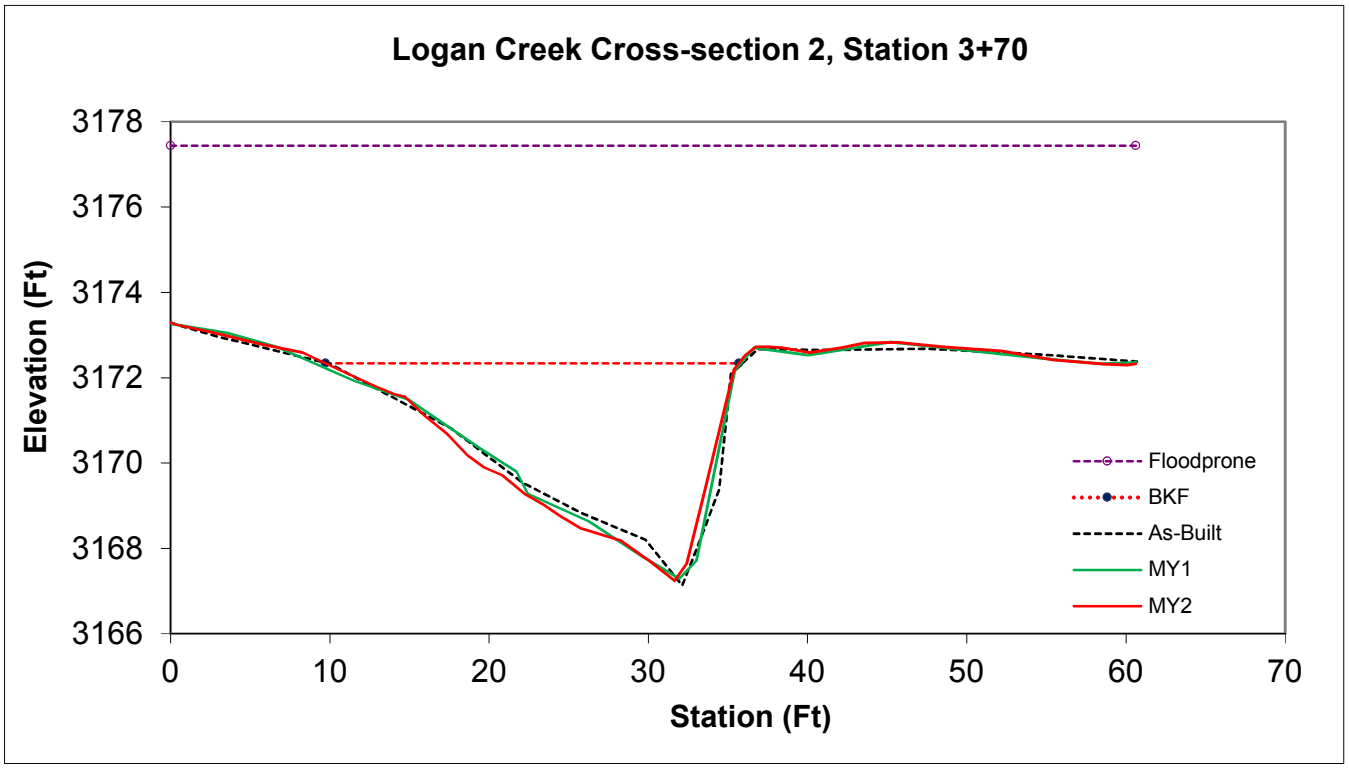


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-Section 2
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		65.5	25.95	2.52	5.1	10.28	1	2.3	3172.34	3172.59

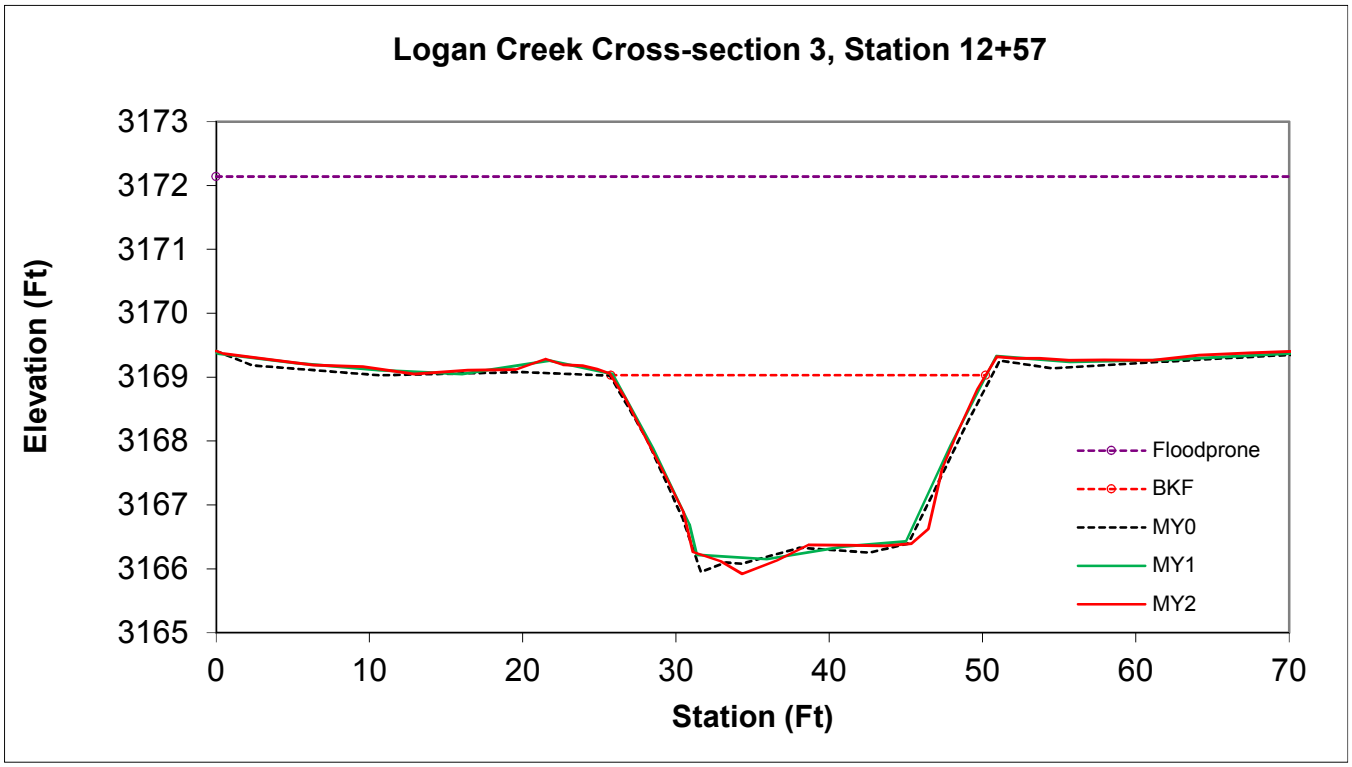


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-Section 3
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	52.7	24.46	2.15	3.11	11.36	1	4.1	3169.03	3169.18

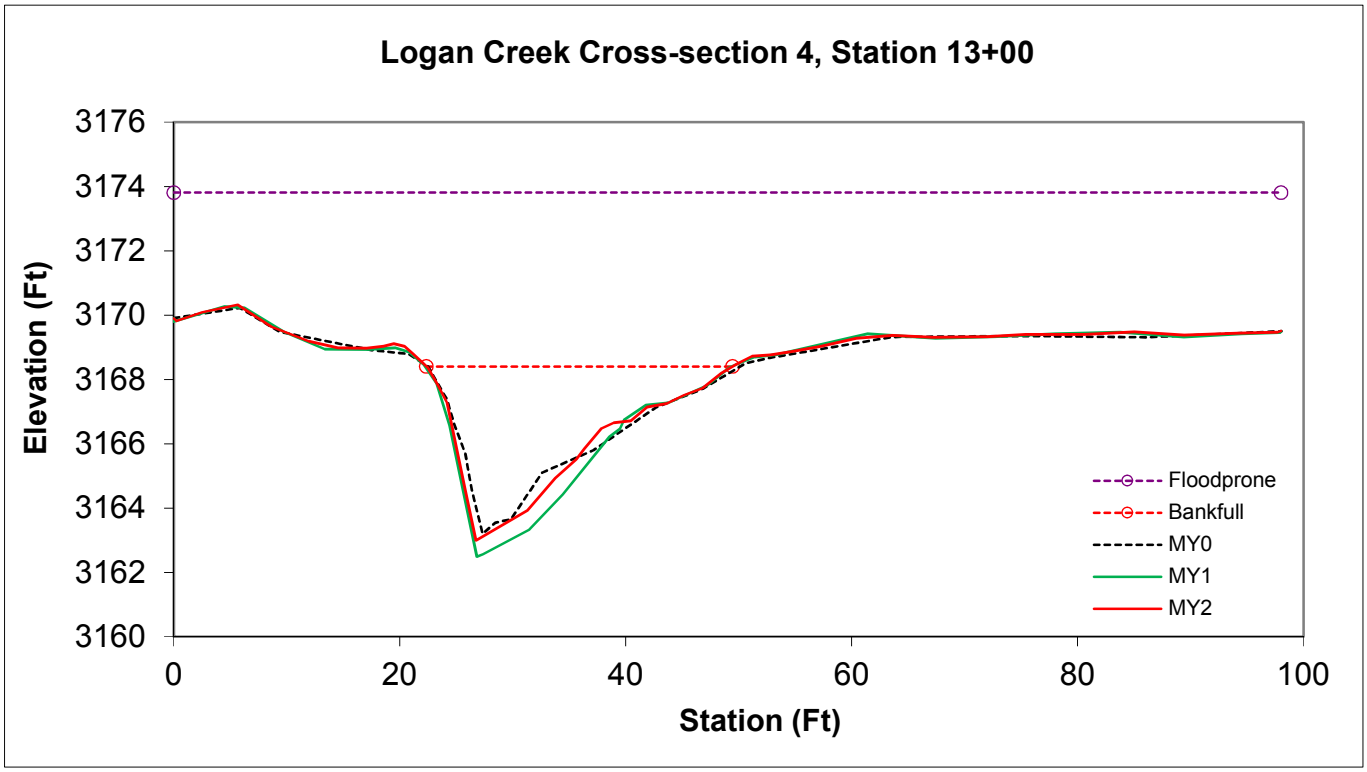


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-Section 4
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		65.4	27.09	2.41	5.41	11.23	1.1	3.6	3168.4	3168.72

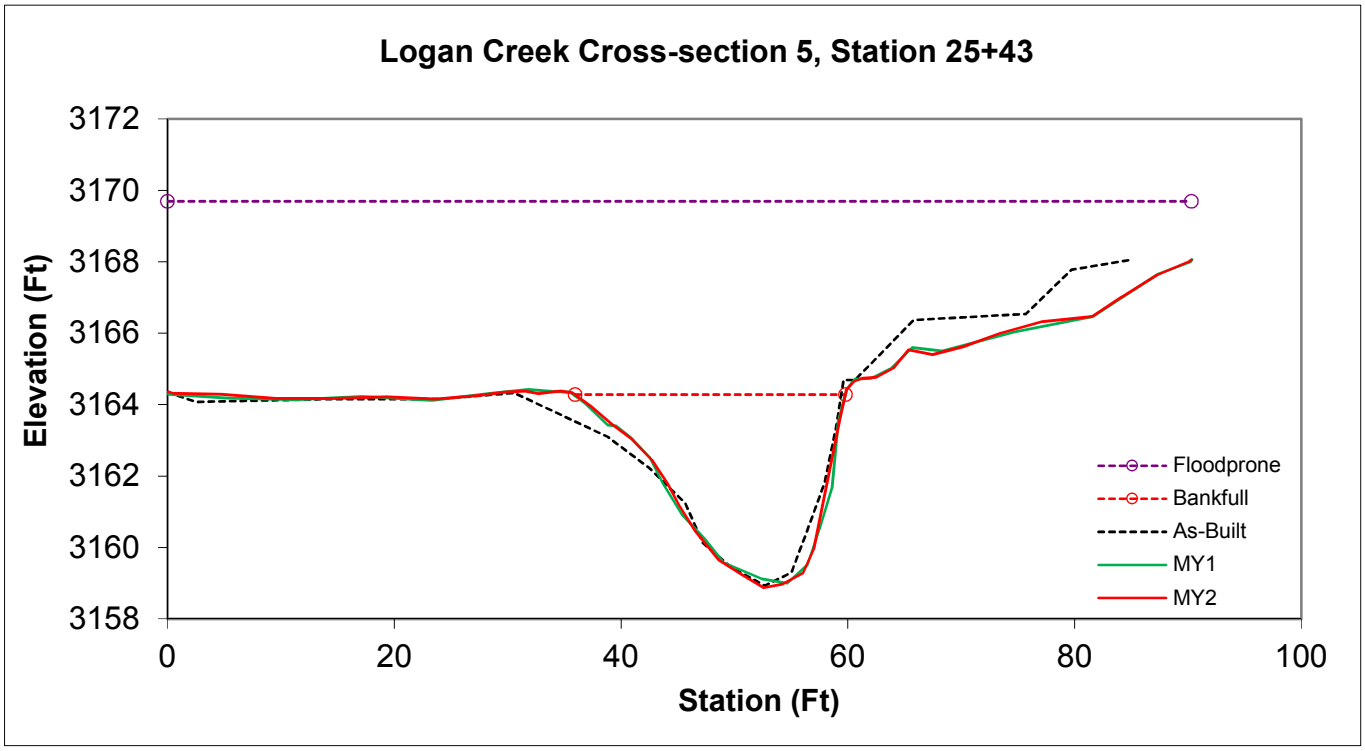


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-Section 5
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		73.3	23.86	3.07	5.41	7.76	1	3.8	3164.28	3164.34

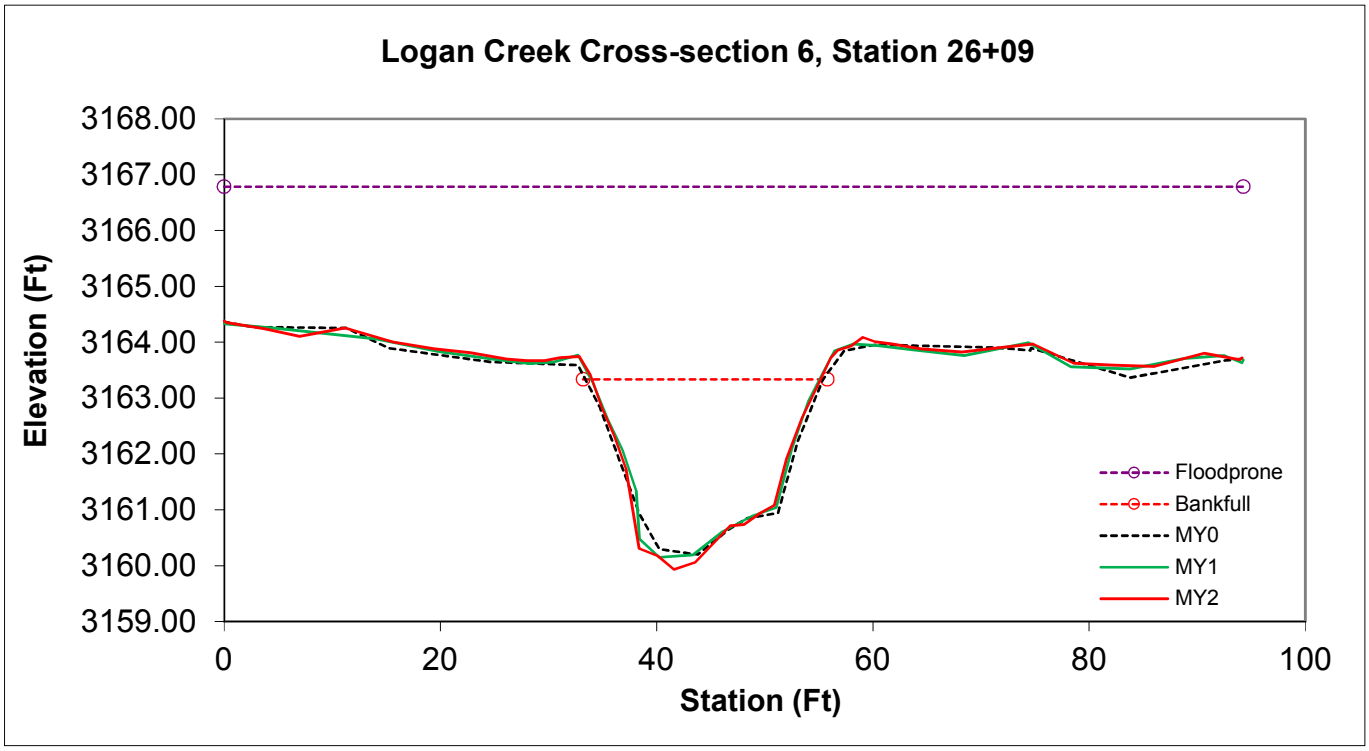


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-Section 6
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	51.4	22.51	2.28	3.67	9.86	1	4.2	3163.6	3163.75

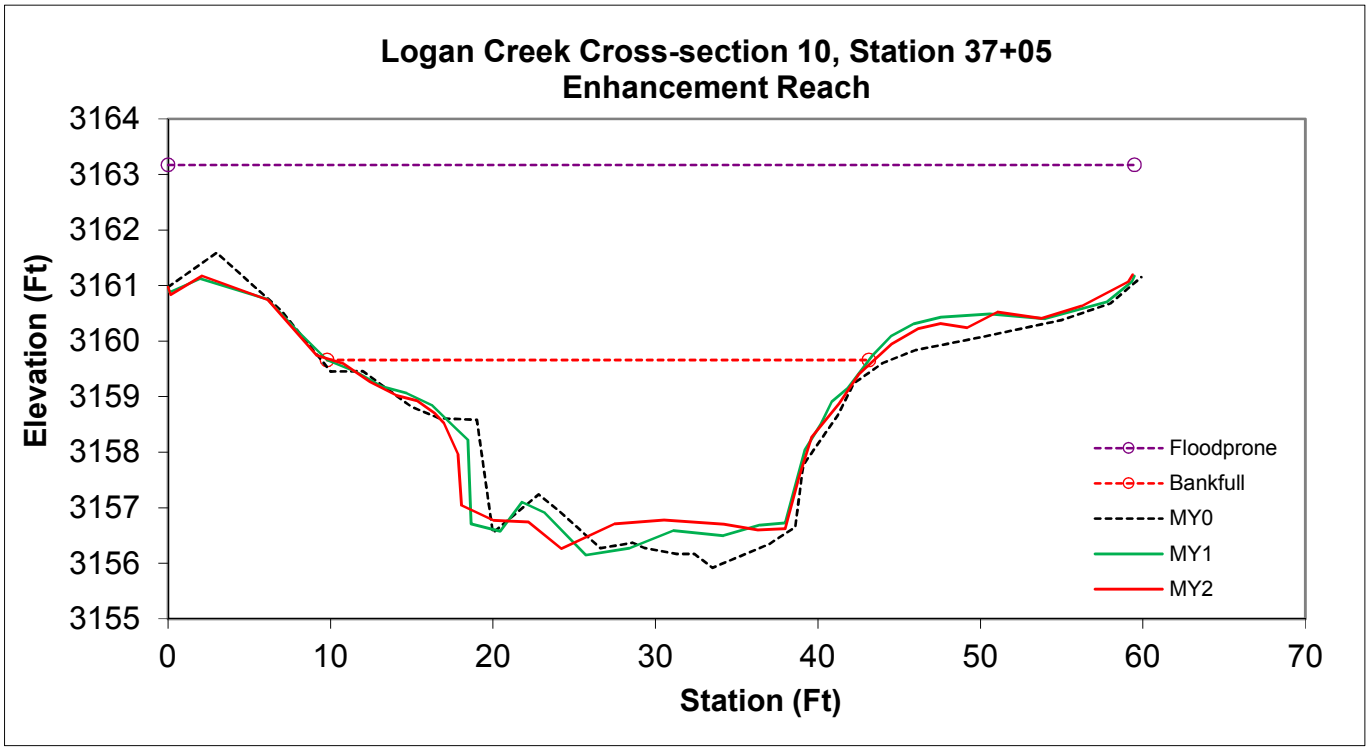


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 10
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		70.3	33.42	2.1	3.39	15.89	1.0	1.8	3159.66	3158.53

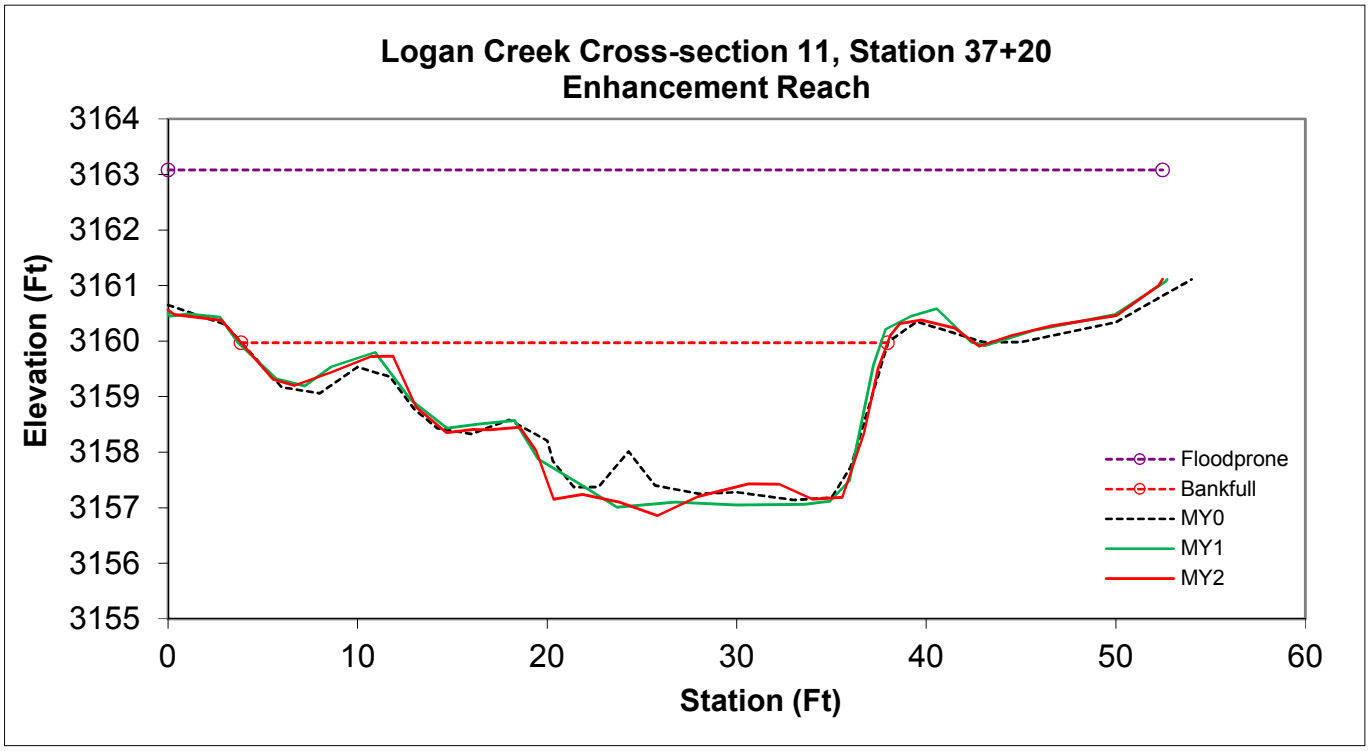


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 11
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	61.8	33.92	1.82	2.96	18.62	1.2	1.6	3159.97	3160.43

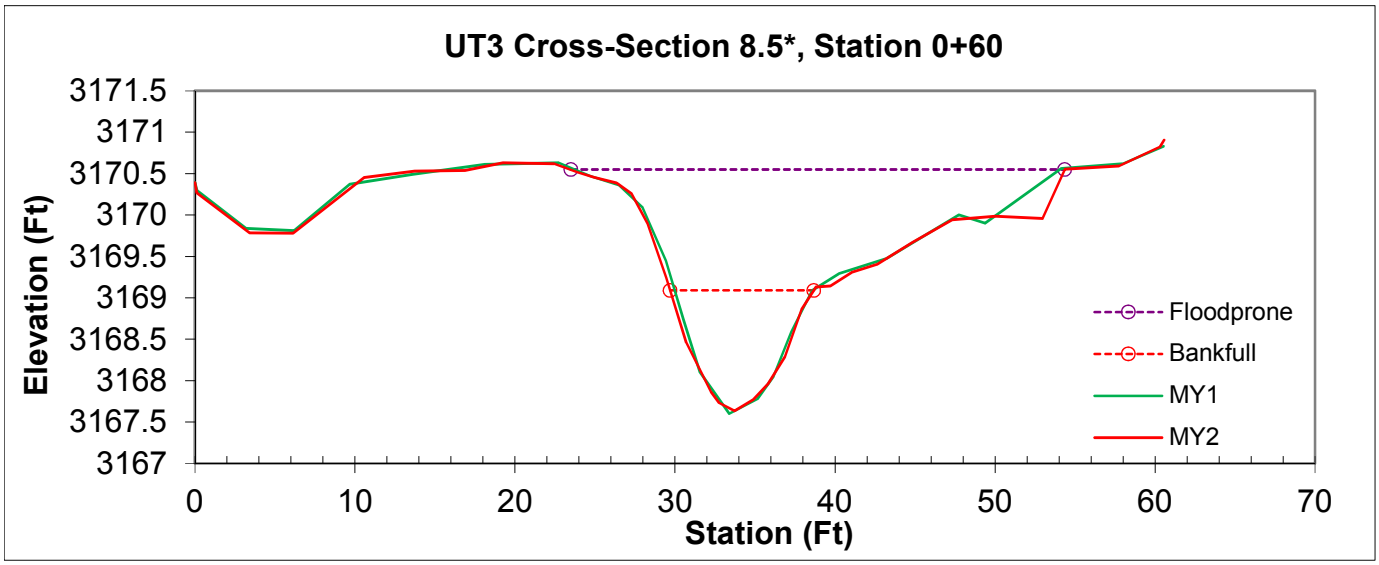


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 8.5
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		8.2	8.98	0.91	1.46	9.88	1	3.4	3169.09	3169.13



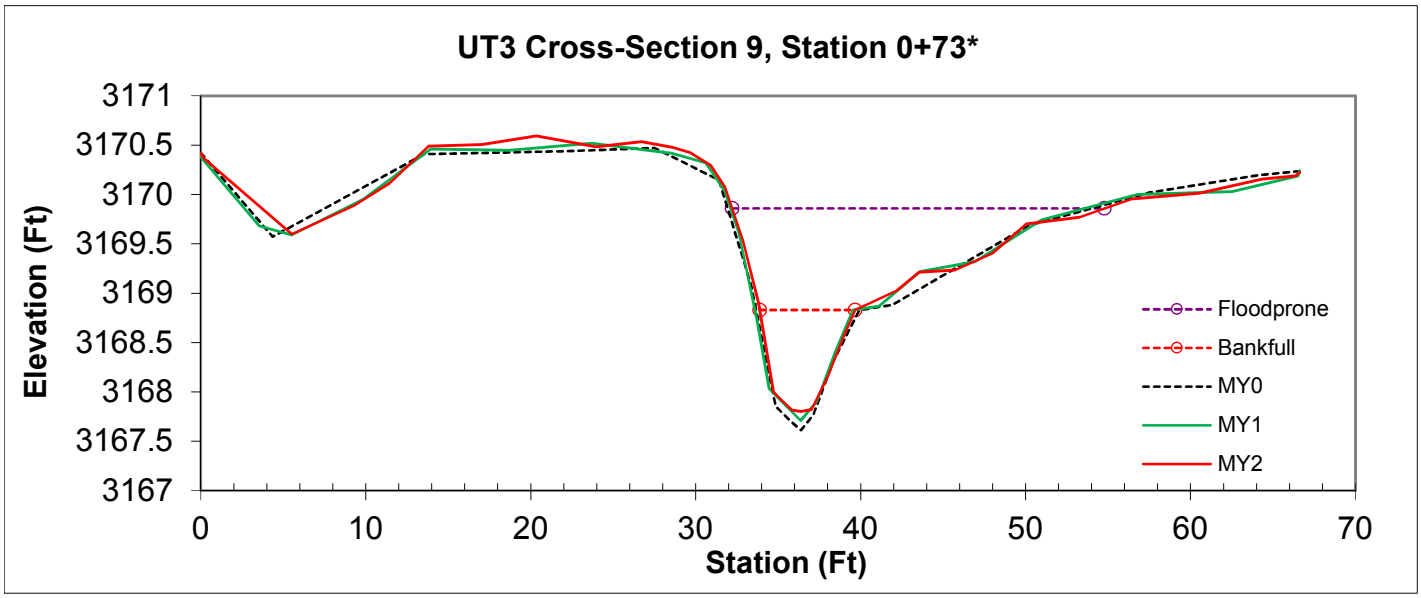
Looking at the Left Bank

Looking at the Right Bank

* This Pool cross-section was not taken for the baseline but was added during MY1 survey and will be continued each year going forward. The station location has been changed to match the MY2 profile.

Permanent Cross-section 9
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	4	5.78	0.69	1.03	8.43	1	3.9	3168.83	3168.83



Looking at the Left Bank

Looking at the Right Bank

* Station location is modified with this report because station reported in previous reports was incorrect.

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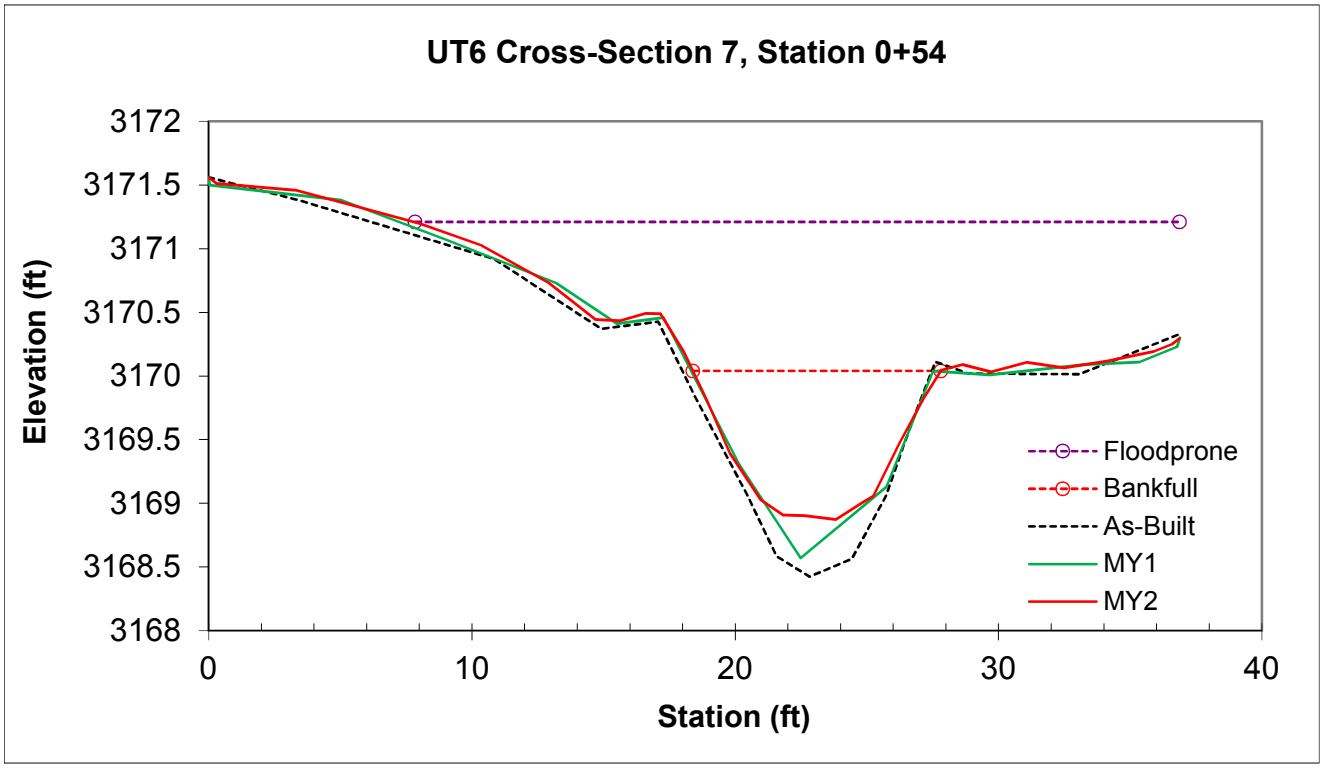
Permanent Cross-section 7
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		7.4	9.41	0.78	1.17	12.05	1	3.1	3170.04	3170.04

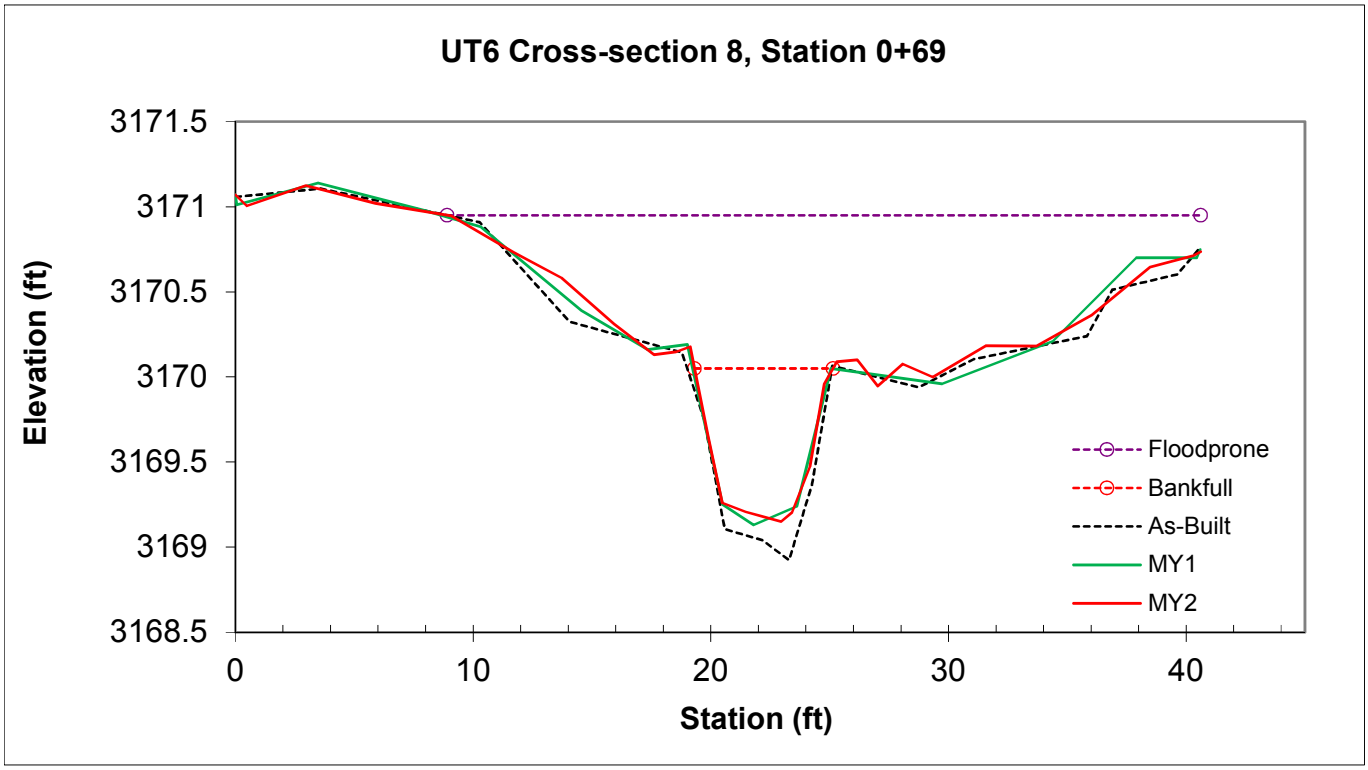


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 8
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	3.7	5.83	0.64	0.9	9.11	1	5.4	3170.05	3170.09

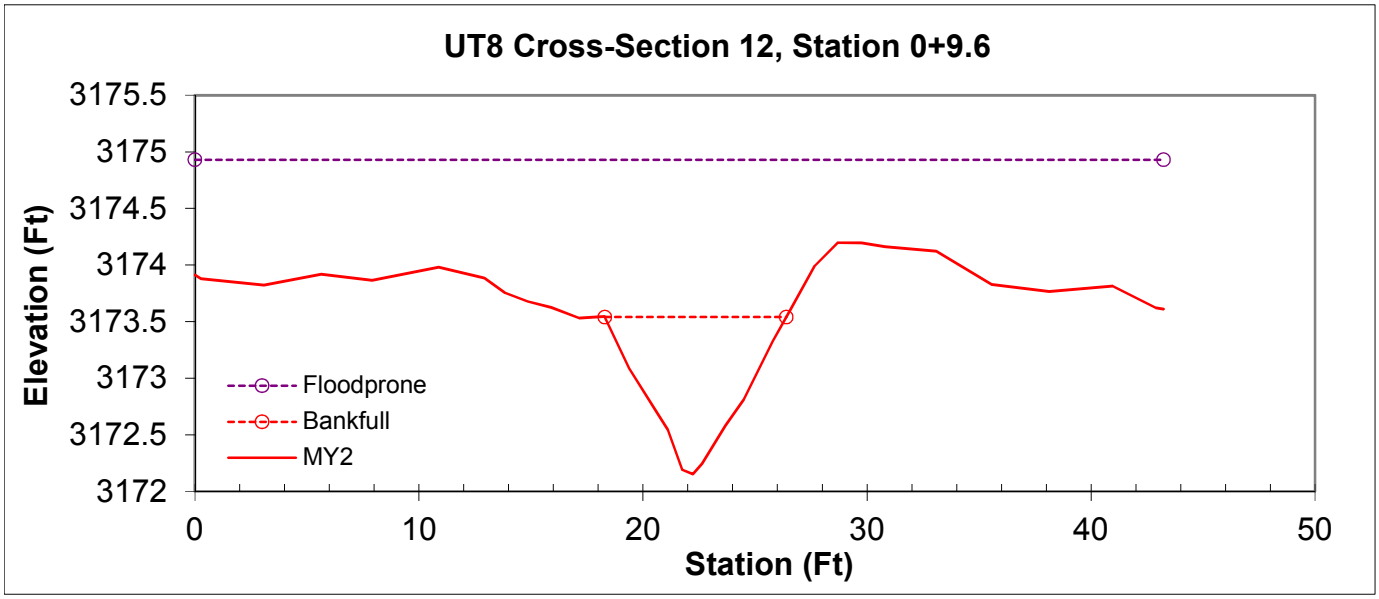


Looking at the Left Bank

Looking at the Right Bank

Permanent Cross-section 12
(MY2 Data - collected October, 2016)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	6	8.11	0.74	1.39	10.97	1	5.3	3173.54	3173.54

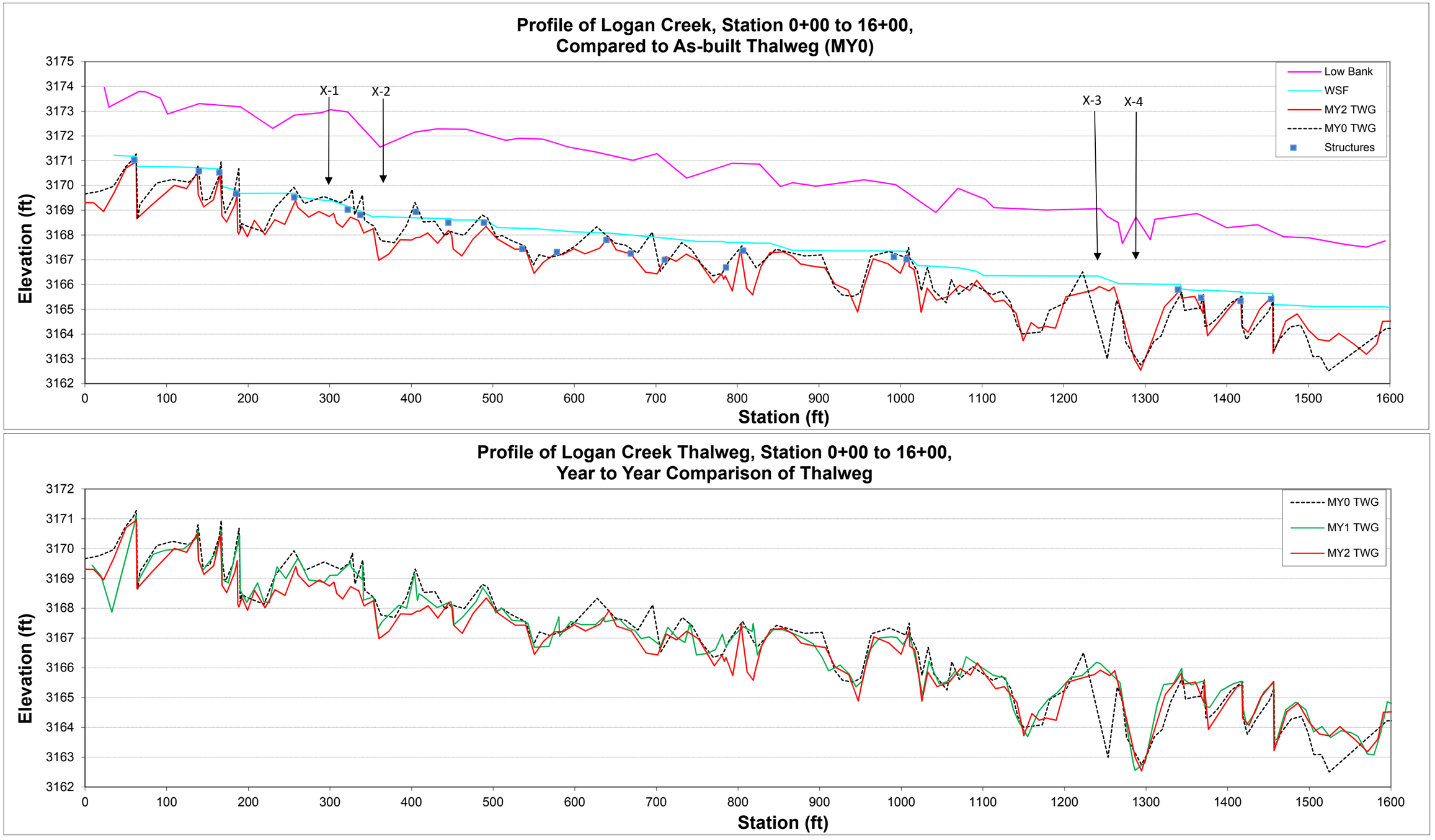


Looking at the Left Bank

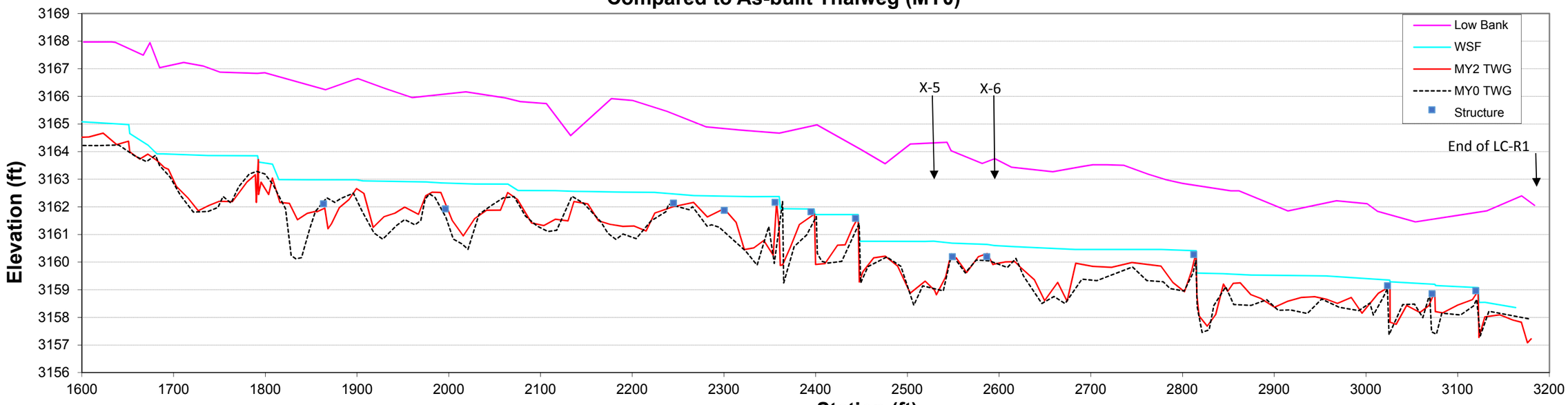
Looking at the Right Bank

This Riffle cross-section was not taken during AB or MY1 surveys but was added in MY2 and will be continued each year going forward.

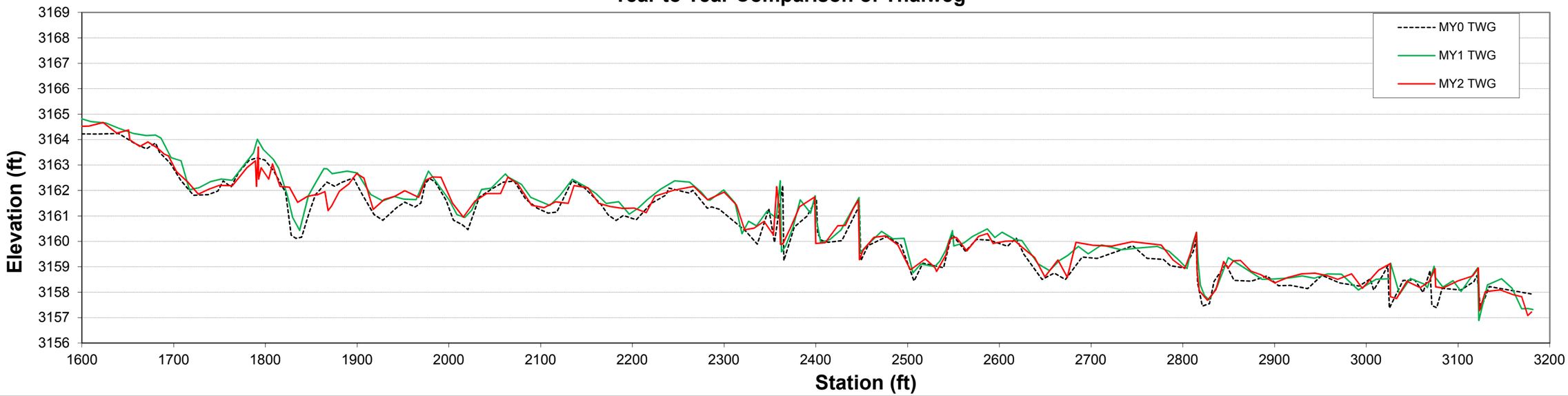
Figure 7. Longitudinal Profiles with Annual Overlays.



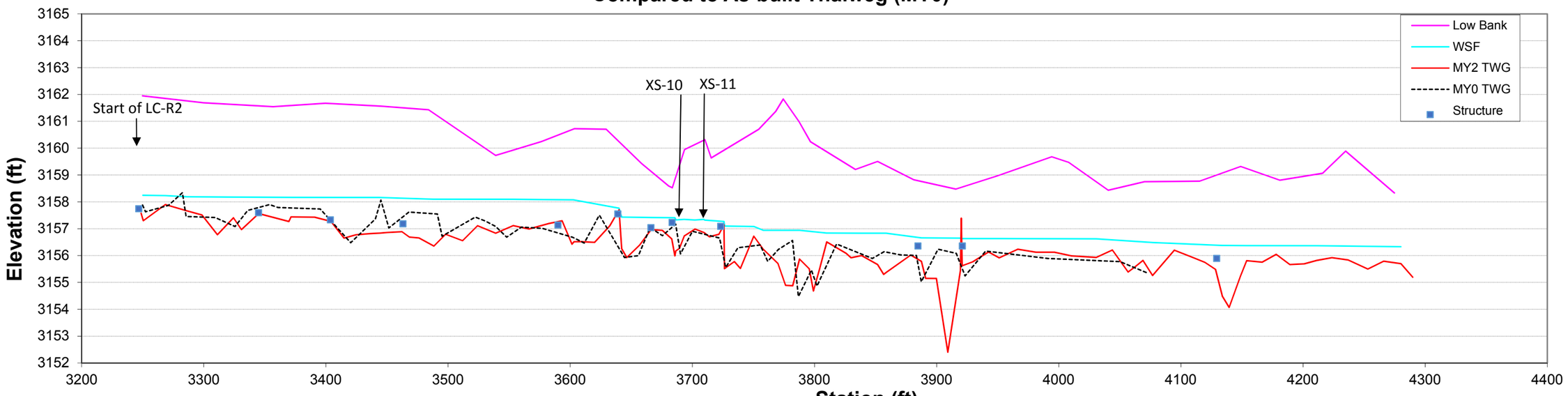
Profile of Logan Creek, Station 16+00 to 32+00
Compared to As-built Thalweg (MY0)



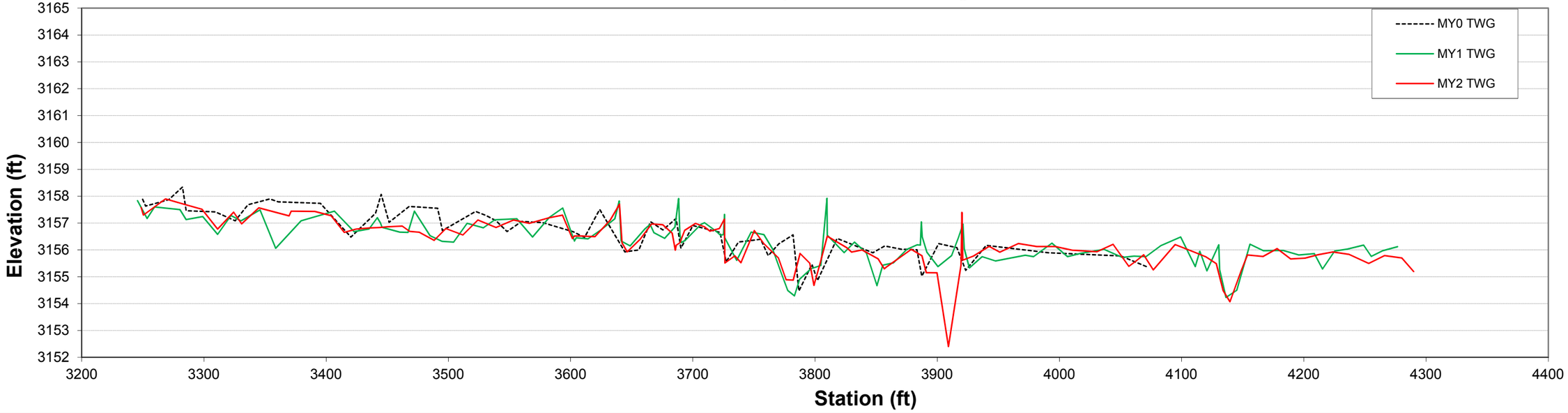
Profile of Logan Creek Thalweg, Station 16+00 to 32+00
Year to Year Comparison of Thalweg

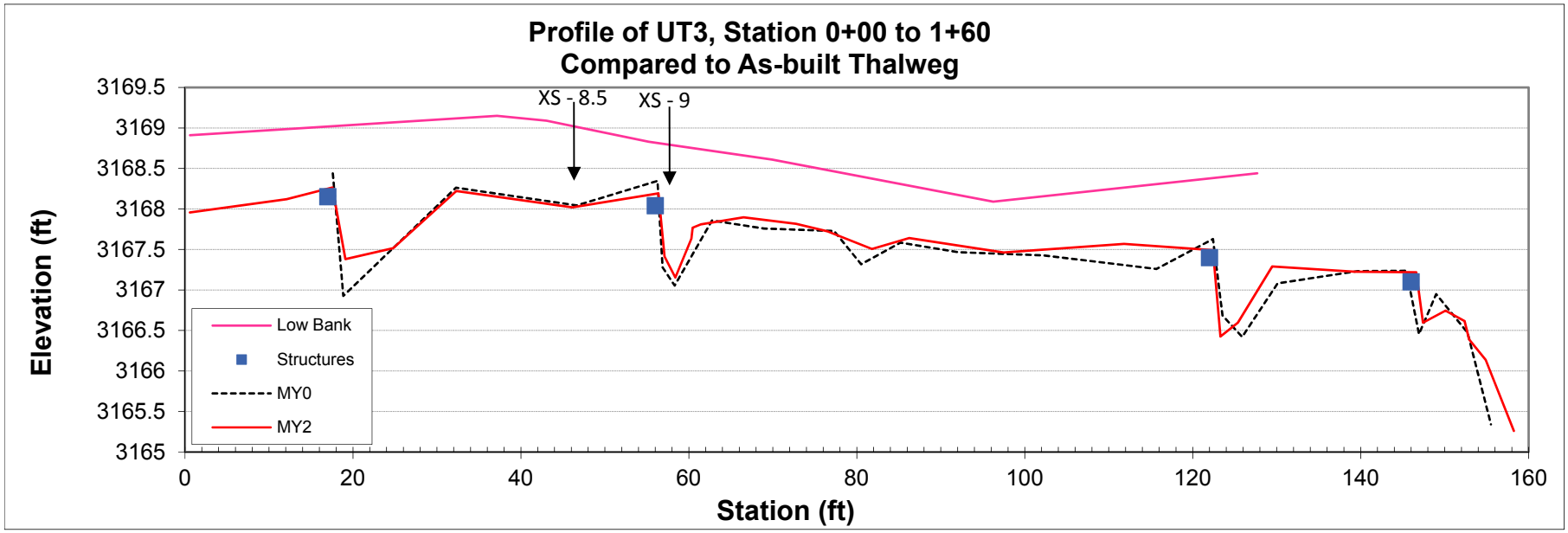


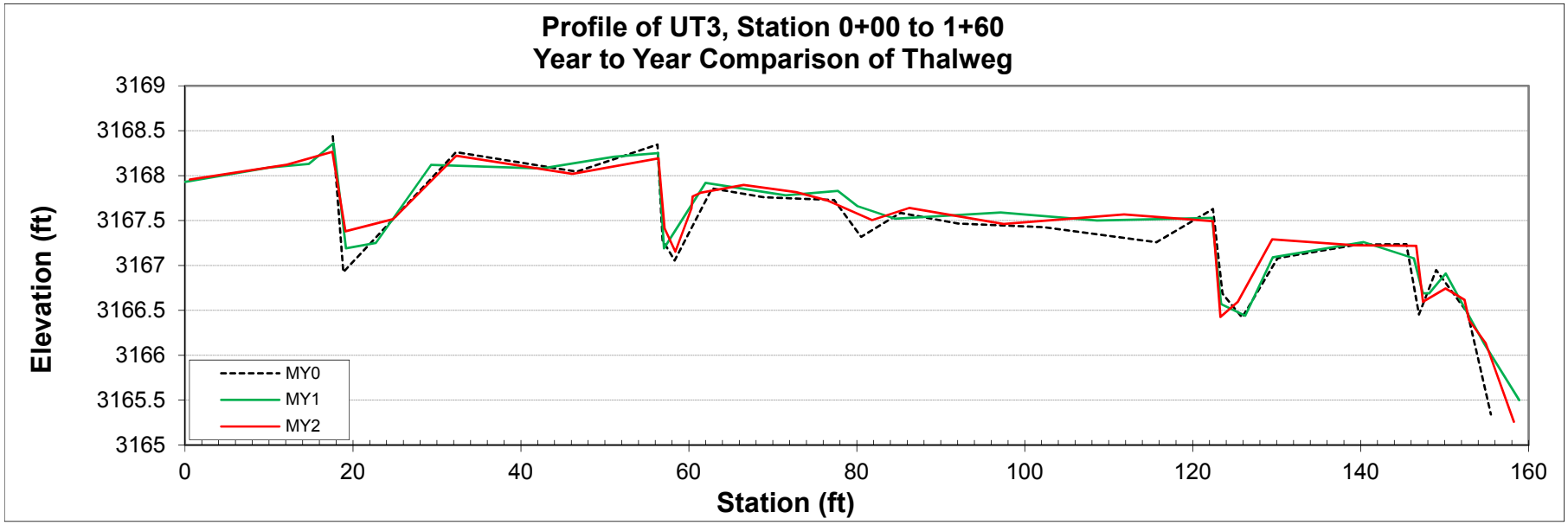
Profile of Logan Creek, Station 32+43 to 42+81
Compared to As-built Thalweg (MY0)

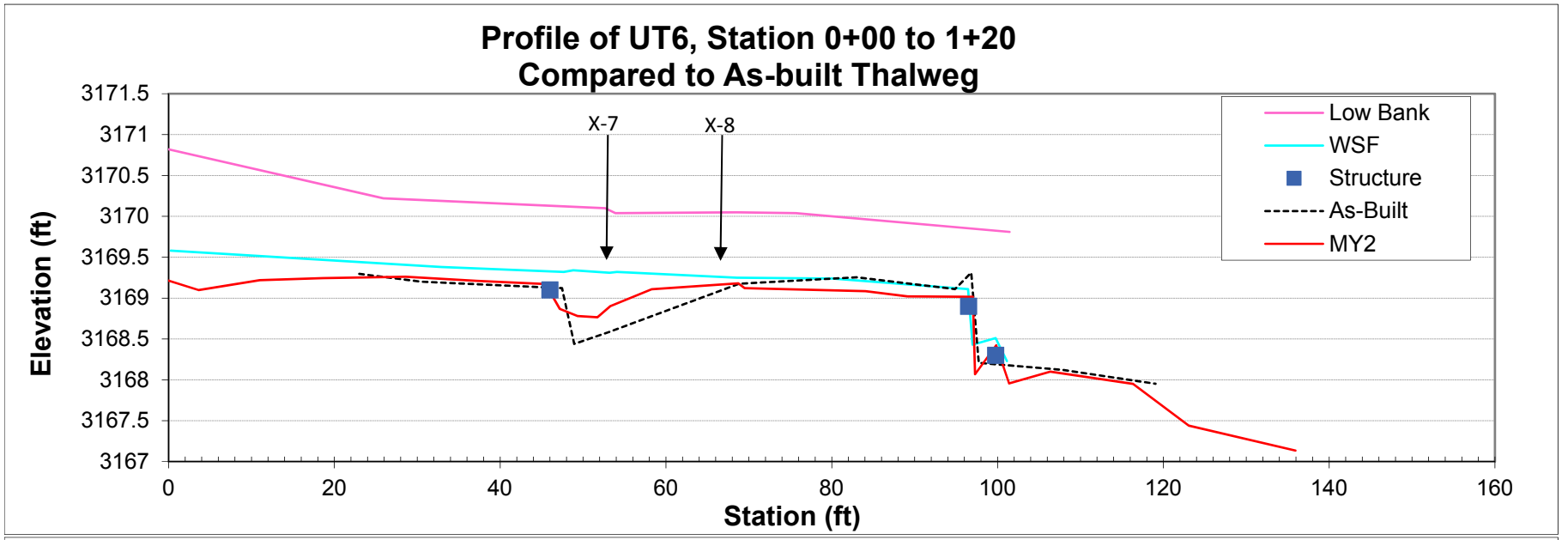


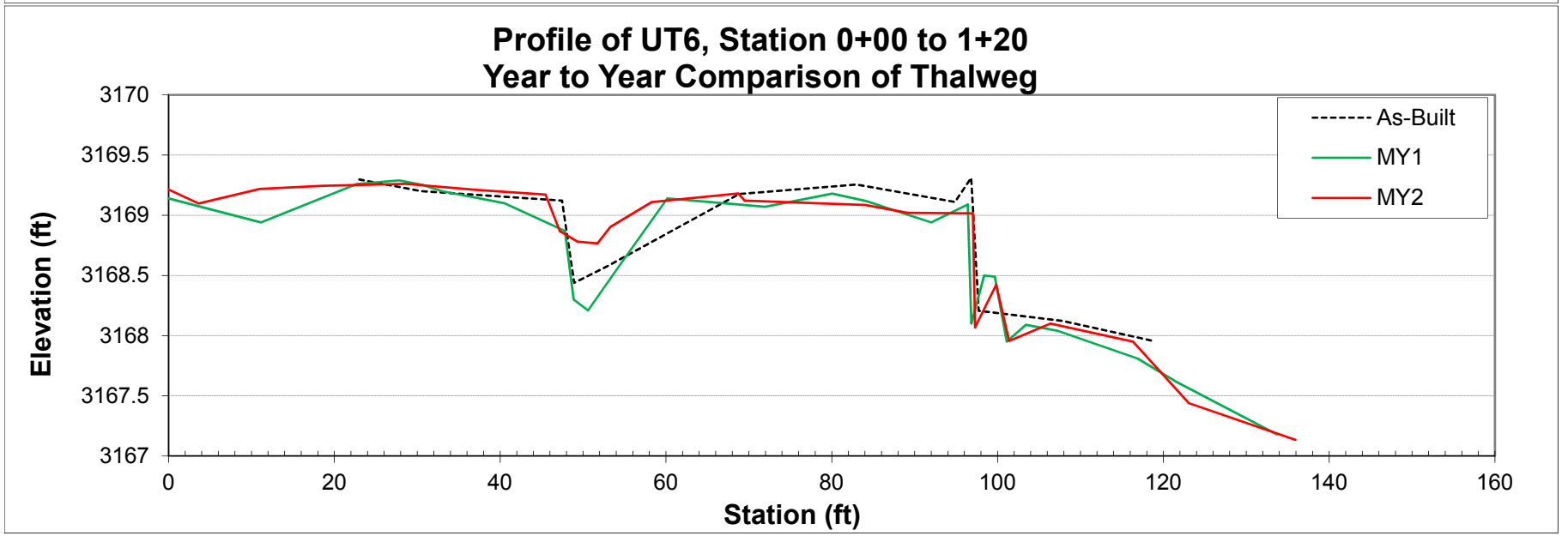
Profile of Logan Creek Thalweg, Station 32+43 to 42+81
Year to Year Comparison of Thalweg

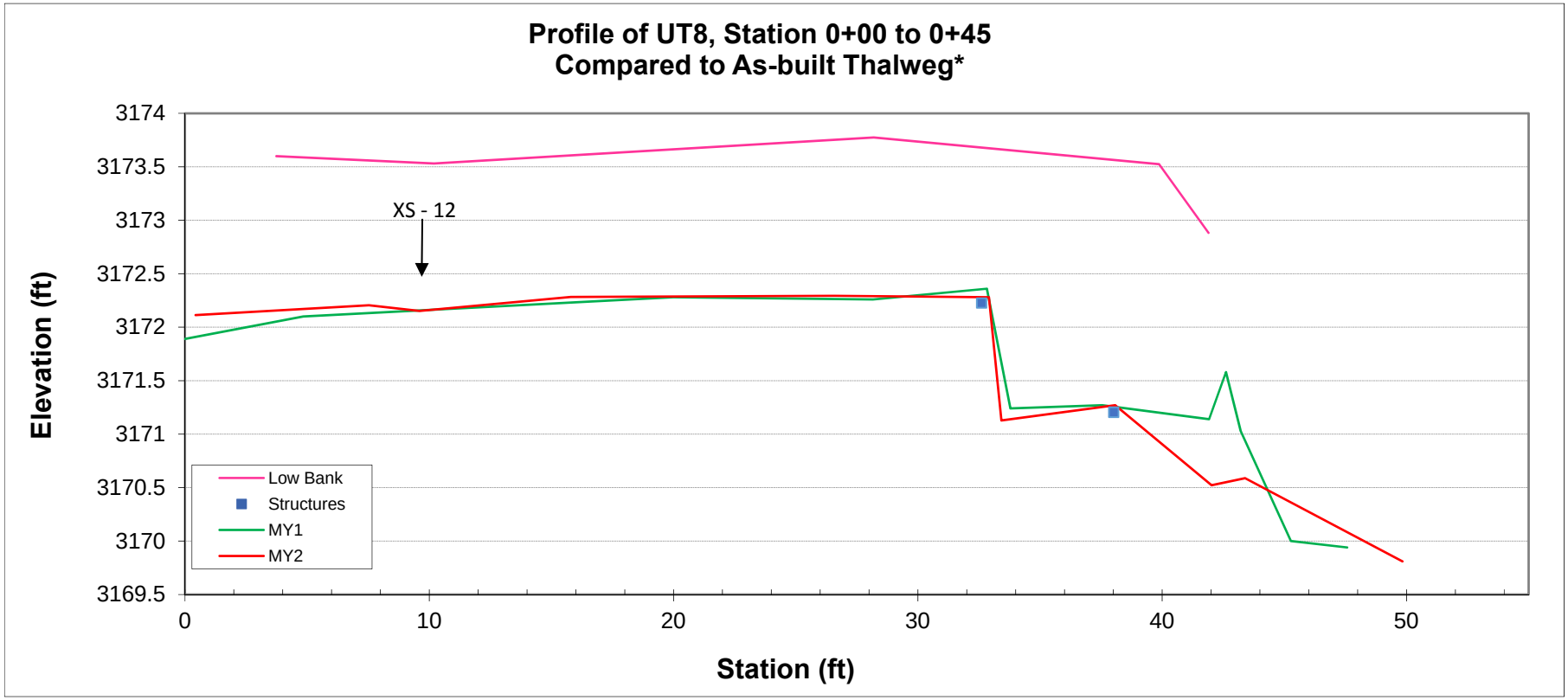



Profile of UT3, Station 0+00 to 1+60
Compared to As-built Thalweg
XS - 8.5
XS - 9
Low Bank
Structures
MY0
MY2
Elevation (ft)
Station (ft)
3169.5
3169
3168.5
3168
3167.5
3167
3166.5
3166
3165.5
3165
0
20
40
60
80
100
120
140
160


Profile of UT3, Station 0+00 to 1+60
Year to Year Comparison of Thalweg
MY0
MY1
MY2
Elevation (ft)
Station (ft)
3169
3168.5
3168
3167.5
3167
3166.5
3166
3165.5
3165
0
20
40
60
80
100
120
140
160


Profile of UT6, Station 0+00 to 1+20
Compared to As-built Thalweg
Elevation (ft)
Station (ft)
X-7
X-8
Low Bank
WSF
Structure
As-Built
MY2
3171.5
3171
3170.5
3170
3169.5
3169
3168.5
3168
3167.5
3167
0
20
40
60
80
100
120
140
160


Profile of UT6, Station 0+00 to 1+20
Year to Year Comparison of Thalweg
Elevation (ft)
Station (ft)
As-Built
MY1
MY2
3170
3169.5
3169
3168.5
3168
3167.5
3167
0
20
40
60
80
100
120
140
160



* Note: This profile was added in MY1 because restoration credit is being requested for this reach. However, the profile on this reach was not surveyed and included in the MY0 report.

Figure 8. Pebble count plots with annual overlays.

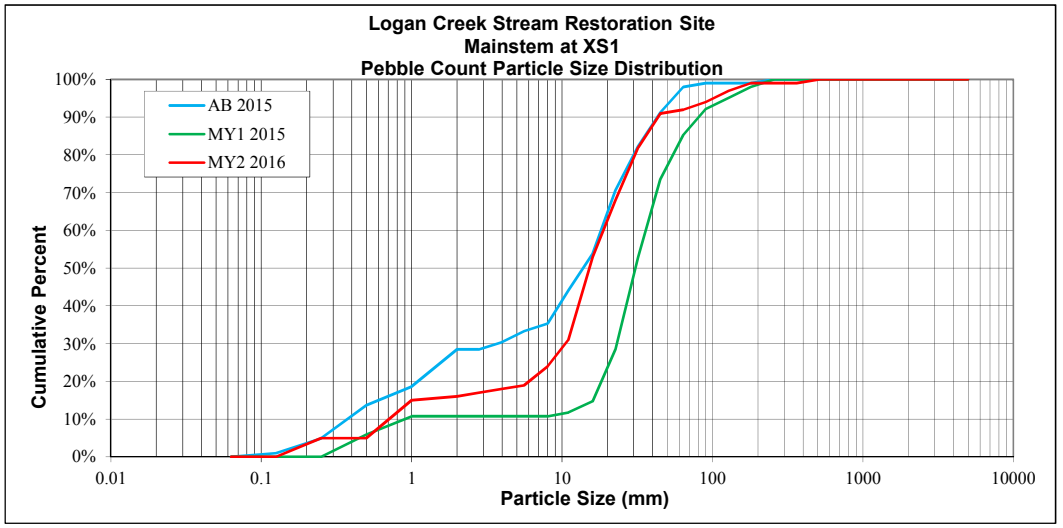
Cross-Section Pebble Count; Monitoring Year 2
Logan Creek Mitigation Project, DMS #92515

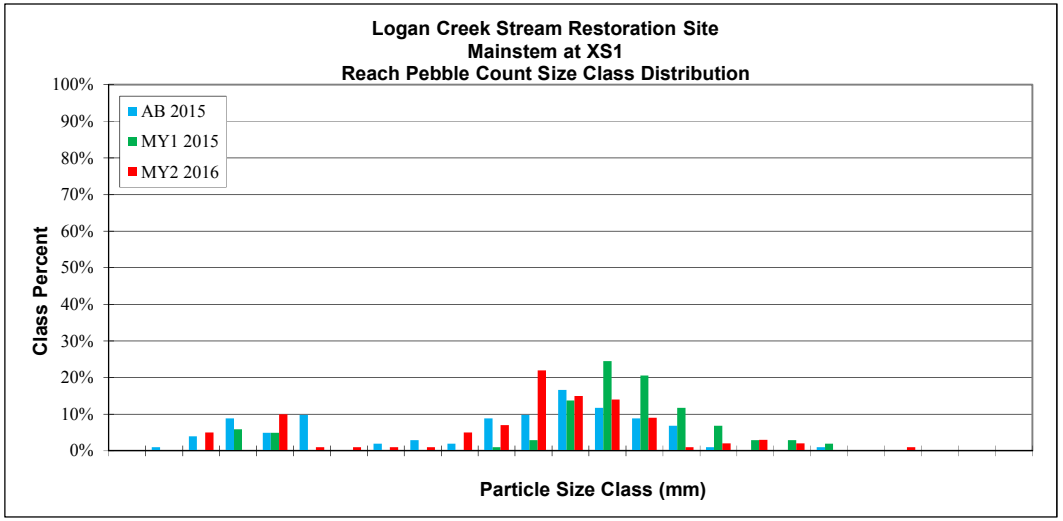
SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS1
FEATURE:	Riffle
DATE:	22-Sep-16

			MY2 2016			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063			0%	0.063
Sand	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25	5	5%	5%	0.25
	Medium	.25 - .50			5%	0.50
	Coarse	.50 - 1.0	10	10%	15%	1.0
	Very Coarse	1.0 - 2.0	1	1%	16%	2.0
Gravel	Very Fine	2.0 - 2.8	1	1%	17%	2.8
	Very Fine	2.8 - 4.0	1	1%	18%	4.0
	Fine	4.0 - 5.6	1	1%	19%	5.6
	Fine	5.6 - 8.0	5	5%	24%	8.0
	Medium	8.0 - 11.0	7	7%	31%	11.0
	Medium	11.0 - 16.0	22	22%	53%	16.0
	Coarse	16 - 22.6	15	15%	68%	22.6
	Coarse	22.6 - 32	14	14%	82%	32
	Very Coarse	32 - 45	9	9%	91%	45
	Very Coarse	45 - 64	1	1%	92%	64
Cobble	Small	64 - 90	2	2%	94%	90
	Small	90 - 128	3	3%	97%	128
	Large	128 - 180	2	2%	99%	180
	Large	180 - 256			99%	256
Boulder	Small	256 - 362			99%	362
	Small	362 - 512	1	1%	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= 128

Summary Data			
Channel materials			
D16 =	2.0	D84 =	34.5
D35 =	11.8	D95 =	101.2
D50 =	15.2	D100 =	362-512





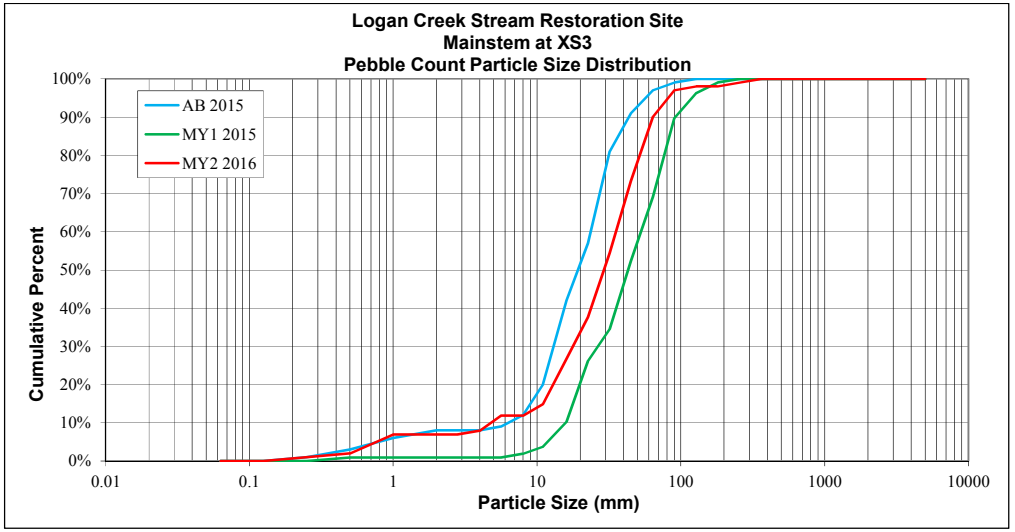
Cross-Section Pebble Count; Monitoring Year 2
Logan Creek Mitigation Project, DMS #92515

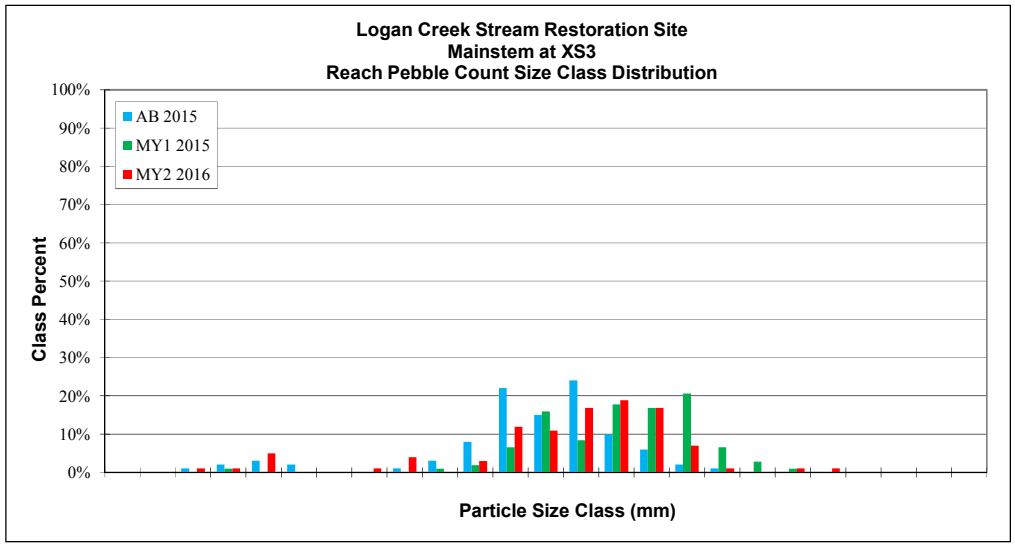
SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS3
FEATURE:	Riffle
DATE:	22-Sep-16

			MY2 2016			Distribution
MATERIAL	**PARTICLE**	**SIZE (mm)**	**Total**	**Class %**	**% Cum**	**Plot Size (mm)**
Silt/Clay	Silt / Clay	< .063			0%	0.063
Sand	Very Fine	.063 - .125			0%	0.125
	Fine	.125 - .25	1	1%	1%	0.25
	Medium	.25 - .50	1	1%	2%	0.50
	Coarse	.50 - 1.0	5	5%	7%	1.0
	Very Coarse	1.0 - 2.0			7%	2.0
Gravel	Very Fine	2.0 - 2.8			7%	2.8
	Very Fine	2.8 - 4.0	1	1%	8%	4.0
	Fine	4.0 - 5.6	4	4%	12%	5.6
	Fine	5.6 - 8.0			12%	8.0
	Medium	8.0 - 11.0	3	3%	15%	11.0
	Medium	11.0 - 16.0	12	12%	27%	16.0
	Coarse	16 - 22.6	11	11%	38%	22.6
	Coarse	22.6 - 32	17	17%	54%	32
	Very Coarse	32 - 45	19	19%	73%	45
	Very Coarse	45 - 64	17	17%	90%	64
Cobble	Small	64 - 90	7	7%	97%	90
	Small	90 - 128	1	1%	98%	128
	Large	128 - 180			98%	180
	Large	180 - 256	1	1%	99%	256
Boulder	Small	256 - 362	1	1%	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			101	100%		

Largest particle= 256

Summary Data			
Channel materials			
D16 =	11.4	D84 =	56.3
D35 =	20.8	D95 =	81.5
D50 =	29.2	D100 =	256-362





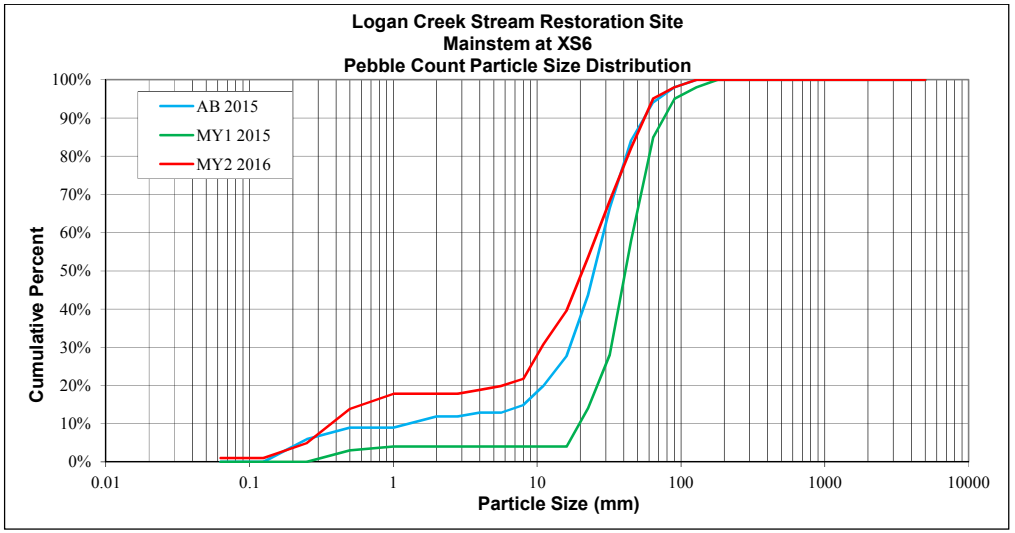
Cross-Section Pebble Count; Monitoring Year 2
Logan Creek Mitigation Project, DMS #92515

SITE OR PROJECT:	Logan Cr
REACH/LOCATION:	Riffle at XS6
FEATURE:	Riffle
DATE:	22-Sep-16

			MY2 2016			Distribution
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum	Plot Size (mm)
Silt/Clay	Silt / Clay	< .063	1	1%	1%	0.063
Sand	Very Fine	.063 - .125			1%	0.125
	Fine	.125 - .25	4	4%	5%	0.25
	Medium	.25 - .50	9	9%	14%	0.50
	Coarse	.50 - 1.0	4	4%	18%	1.0
	Very Coarse	1.0 - 2.0			18%	2.0
Gravel	Very Fine	2.0 - 2.8			18%	2.8
	Very Fine	2.8 - 4.0	1	1%	19%	4.0
	Fine	4.0 - 5.6	1	1%	20%	5.6
	Fine	5.6 - 8.0	2	2%	22%	8.0
	Medium	8.0 - 11.0	9	9%	31%	11.0
	Medium	11.0 - 16.0	9	9%	40%	16.0
	Coarse	16 - 22.6	14	14%	53%	22.6
	Coarse	22.6 - 32	15	15%	68%	32
	Very Coarse	32 - 45	14	14%	82%	45
	Very Coarse	45 - 64	13	13%	95%	64
Cobble	Small	64 - 90	3	3%	98%	90
	Small	90 - 128	2	2%	100%	128
	Large	128 - 180			100%	180
	Large	180 - 256			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			101	100%		

Largest particle= 90

Summary Data			
Channel materials			
D16 =	0.7	D84 =	47.3
D35 =	13.2	D95 =	63.9
D50 =	20.7	D100 =	90-128



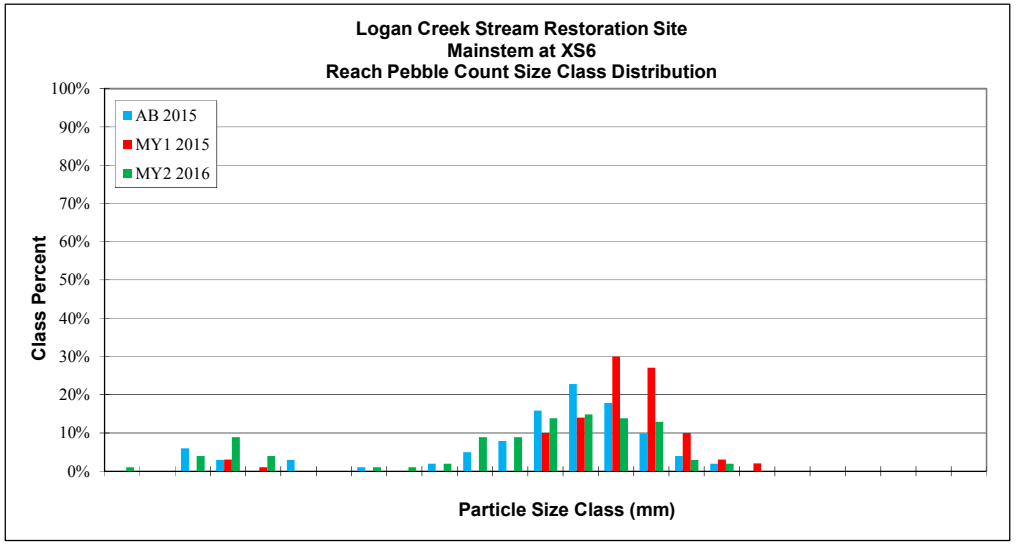


Table 10. Monitoring Year 2 Stream Summary
Logan Creek Restoration Project; DMS Project ID No. 94645

Logan Creek Mainstem

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition[1]						Reference Reach Data: Right Prong Logan Creek						Design						As-built						MY1						MY2					
Dimension and Substrate - Riffle		NC Mtn. Regional Curve			Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	26.4	28.3	-	22.9	27.3	23.8	38.7	6.6	4	-	16.7	-	-	-	-	-	26.0	-	-	-	-	23.6	24.3	24.1	25.2	0.67	3	22.6	23.7	24.0	24.3	0.77	3	22.5	26.2	24.3	33.9	4.50	4
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	150.00	-	-	-	-	-	>150	-	-	-	3	-	>150	-	-	-	3	>54	>80	-	>100		4
BF Mean Depth (ft)	-	1.4	1.5	-	1.50	2.2	2.4	2.60	0.4	4	-	1.06	-	-	-	-	-	2.3	-	-	-	-	2.1	2.3	2.2	2.6	0.22	3	2.1	2.3	2.2	2.6	0.21	3	0.2	1.8	2.3	2.6	0.95	4
BF Max Depth (ft)	-	-	-	-	3.4	3.6	3.5	3.8	0.2	4	-	1.54	-	-	-	-	-	4.0	-	-	-	-	3.1	3.4	3.4	3.7	0.24	3	2.9	3.4	3.5	4.0	0.45	3	3.0	3.5	3.4	4.3	0.53	4
BF Cross-sectional Area (ft²)	-	37.5	42.7	-	55.8	58.0	58.4	59.5	1.36	4	-	17.7	-	-	-	-	-	58.5	-	-	-	-	51.7	56.0	53.2	63.0	5.01	3	50.2	54.6	51.2	62.4	5.53	3	51.4	57.7	57.3	64.8	5.74	4
Width/Depth Ratio	-	-	-	-	8.9	13.6	9.8	25.7	7.01	4	-	15.8	-	-	-	-	-	12	-	-	-	-	9.2	10.7	10.8	12.0	1.12	3	9.3	10.3	10.1	11.6	0.96	3	8.9	12.2	10.6	18.6	3.81	4
Entrenchment Ratio	-	-	-	-	3.4	11.3	12.0	17.8	5.83	4	-	2.0	-	-	-	-	-	5.8	-	-	-	-	2.9	3.6	3.9	4.0	0.50	3	2.9	3.7	4.0	4.1	0.54	3	1.6	3.2	3.5	4.2	1.06	4
Bank Height Ratio	-	-	-	-	1	1.2	1.1	1.5	0.2	4	-	1.2	-	-	-	-	-	1.0	-	-	-	-	1.0	1.00	1.00	1.0	0.00	3	1.0	1.0	1.0	1.1	0.05	3	1.0	1.1	1.0	1.2	0.09	4
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.4	-	-	-	-	12.4	12.4	12.4	12.4	0.00	1	30.7	38.3	41.1	43.0	5.41	3	15.2	21.7	20.7	29.2	5.8	3
Pattern																																								
Channel Beltwidth (ft)	-	-	-	-	194	216	217	252	18.13	7	-	80	-	-	-	-	65	-	-	140	-	-	130.0	193.2	190.0	258.0	41.45	6	130.0	193.2	190.0	258.0	41.5	6	130.0	193.2	190.0	258.0	41.5	6
Radius of Curvature (ft)	-	-	-	-	23	32	30	46	8.6	5	-	23	-	-	-	-	28	-	-	75	-	-	44.0	63.9	66.1	104.0	17.17	9	44.0	63.9	66.1	104.0	17.2	9	44.0	63.9	66.1	104.0	17.2	9
Rc:Bankfull width (ft/ft)	-	-	-	-	0.85	1.19	1.11	1.7	0.32	5	-	1.38	-	-	-	-	1.1	-	-	2.9	-	-	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9	1.80	2.60	2.70	4.30	0.71	9
Meander Wavelength (ft)	-	-	-	-	120	177	197	239	46.75	5	-	150	-	-	-	-	118	-	-	236	-	-	145.0	236.7	244.5	321.0	48.10	12	145.0	236.7	244.5	321.0	48.1	12	145.0	236.7	244.5	321.0	48.1	12
Meander Width Ratio	-	-	-	-	4.44	6.56	7.3	8.85	1.73	5	-	4.8	-	-	-	-	2.5	-	-	5.4	-	-	6.0	9.7	10.1	13.2	1.98	12	6.0	9.7	10.1	13.2	2.0	12	6.0	9.7	10.1	13.2	2.0	12
Profile																																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.7	68.1	65.3	149.8	31.6	16	18.6	90.5	93.5	162.3	47.4	9
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.003	-	-	0.007	-	-	-	-	-	-	-	-	0.0009	0.0079	0.0049	0.0218	0.0065	16	0.0025	0.0076	0.0075	0.0162	0.0042	9
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.0	66.4	64.5	112.2	25.4	19	48.1	89.2	82.2	150.6	29.1	14
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	94	-	-	165	-	-	-	-	-	-	-	-	86.6	148.6	143.5	292.6	51.9	20	50	127.4	119.8	264	46.3	24
Pool Max Depth (ft)	-	-	-	-	2.9	3.8	4.0	4.5	0.64	3	-	2.28	-	-	-	-	-	6.00	-	-	-	-	5.2	5.3	5.2	5.4	0.1	3	5.1	5.4	5.3	5.9	0.36	3	5	5.3	5.4	5.4	0.15	3
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																								
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	0.8 / 5.8 / 12.4 / 35.4 / 169.6						-	-	-	-	-	-	-	-	-	-	-	-	mean 5.1 / 10.9 / 16.5 / 34.8 / 55.9						mean 17.3/ 28.6 / 36.9 / 71.8 / 123.1						mean 6.7/ 16.3 / 22.2 / 45.4 / 91.4					
Reach Shear Stress (competency) lb/ft²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters																																								
Drainage Area (SM)	-	2.1 to 2.67			2.1 at upper end of project to 2.67 towads end of project						-	0.83	-	-	-	-	2.1 at upper end of project to 2.67 towads end of project						2.1 at upper end of project to 2.67 towads end of project						2.1 at upper end of project to 2.67 towads end of project						2.1 at upper end of project to 2.67 towads end of project					
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-	-	2.67	-	-	-	-
Rosgen Classification	-	-	-	-	-	C4 to E4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-	-	C4	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	-	-	3.55	-	-	-	-	-	4.31	-	-	-	-	-	4.33	-	-	-	-	-	4.20	-	-	-	-	-	4.20	-	-	-	-
BF Discharge (cfs)	-	205.7	237.0		-	-	-	-	-	-	-	98	-	-	-	-	-	271.5	-	-	-	-	-	242.6	-	-	-	-	-	264.8	-	-	-	-	-	264.8	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)	-	-	-	-	-	4,700	-	-	-	-	-	-	-	-	-	-	-	4,101	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-	-	4,172	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	1.3	-	-	-	-	-	1.31	-	-	-	-	-	1.34	-	-	-	-	-	1.34	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	0.0035	-	-	-	-	-	0.0039	-	-	-	-	-	0.0033	-	-	-	-	-	0.0033	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	0.0047	-	-	-	-	-	0.0052	-	-	-	-	-	0.0044	-	-	-	-	-	0.0044	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1 . Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

UT3

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition[1]						Reference Reach Data: Morgan Creek						Design						As-built						MY1						MY2					
Dimension and Substrate - Riffle		NC Mtn./NC Pied. Rural			Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	6.1	6.2	6.2	6.3	0.06	2	-	5.9	-	-	-	1	-	5.8	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-	>27	-	-	-	-	-	28.1	-	-	-	1	-	22.6	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-	0.7	-	-	-	-	0.70	0.70	0.70	0.80	0.02	2.00	-	0.70	-	-	-	1	-	0.70	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-		-	-	-	-	1.1	1.2	1.2	1.2	0.0	2	-	1.1	-	-	-	1	-	1.0	-	-	-	1
BF Cross-sectional Area (ft²)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	-	4.2	-	-	-	-	4.5	4.6	4.6	4.6	0.1	2	-	4.1	-	-	-	1	-	4.0	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-		-	-	-	-	8.1	8.4	8.4	8.7	0.3	2	-	8.5	-	-	-	1	-	8.4	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	4.3	5.5	5.5	6.6	1.2	2	-	4.0	-	-	-	1	-	3.9	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	2	-	1.0	-	-	-	1	-	1.0	-	-	-	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern																																								
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile																																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	14.3	18.7	14.9	30.5	6.9	4	27.1	43.8	43.8	60.51	16.7	2	24.1	42.8	39.3	64.9	16.8	3
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	0.0000	0.0078	0.0118	0.0140	0.0084	4	0.0000	0.0032	0.0032	0.0064	0.0032	2	0.0072	0.0092	0.0084	0.0121	0.0021	3
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	6.5	11.6	7.9	21.4	5.7	5	5.68	11.56	11.70	17.29	4.70	3	7.50	10.90	10.20	15.00	3.10	3
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	22.2	39.0	42.4	48.8	10.2	4	21.23	42.9	38.02	69.37	20	3	24.1	42.8	39.3	64.9	16.8	3
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	1.7	-	-	-	-	1	-	1.5	-	-	-	-	-	1.5	-	-	-	-
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																								
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/ft²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters																																								
Drainage Area (SM)	-	0.05				0.05					-	0.83	-	-	-	-	-	-	-	-	-	-	-	0.05					-	0.05	-	-	-	-	-	0.05	-	-	-	-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	C	-	-	-	-	-	C	-	-	-	-	-	E	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	-	-	-	-	-	-	4.27	-	-	-	-	-	4.81	-	-	-	-	-	4.81	-	-	-	-
BF Discharge (cfs)	-	7.8	18.3		-	-	-	-	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	212.2	-	-	-	-	-	22.1	-	-	-	-	-	22.1	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)[2]	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	350	-	-	-	-	-	153	-	-	-	-	-	153	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	1.17	-	-	-	-	-	1.17	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	0.0225	-	-	-	-	-	0.0225	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Harman, W.A., D.E Wise, M.A. Walker, R. Morris, MA Cantrell, M. Clemmons, G.D. Jennings, D.R. Clinton, J.M. Patterson. 2000. Bankfull Regional Curves for North Carolina Mountain Streams. In: AWRA Conference Proceedings, D.L. Kane, editor. American Water Resources Specialty Conference on Water Resources in Extreme Environments. Anchorage, Alaska.

Table 10. Monitoring Year 2 Stream Summary
Logan Creek Restoration Project; DMS Project ID No. 94645

UT6

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition[1]						Reference Reach Data – Morgan Creek						Design						As-built						MY1						MY2					
Dimension and Substrate - Riffle		NC Mtn./NC Pied. Rural			Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	6.1	6.2	6.2	6.3	0.06	2	-	5.8	-	-	-	1	-	5.8	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-	>27	-	-	-	-	-	32.4	-	-	-	1	-	>35	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-	0.7	-	-	-	-	0.70	0.70	0.70	0.80	0.02	2.00	-	0.70	-	-	-	1	-	0.60	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	1.1	1.2	1.2	1.2	0.0	2	-	0.9	-	-	-	1	-	0.9	-	-	-	1
BF Cross-sectional Area (ft²)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	-	4.2	-	-	-	-	4.5	4.6	4.6	4.6	0.1	2	-	3.8	-	-	-	1	-	3.7	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-	-	-	-	-	-	8.1	8.4	8.4	8.7	0.3	2	-	9.0	-	-	-	1	-	9.1	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	4.3	5.5	5.5	6.6	1.2	2	-	5.6	-	-	-	1	-	5.4	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	2	-	1.0	-	-	-	1	-	1.0	-	-	-	1
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Pattern																																								
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile																																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	14.3	18.7	14.9	30.5	6.9	4	17.81	27.00	27.03	36.25	9.2	2	27.5	31	31	34.5	3.5	2
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	0.0000	0.0078	0.0118	0.0140	0.0084	4	0.0014	0.0052	0.0052	0.0090	0.0038	2	0.0029	0.0033	0.0033	0.0036	0.0004	2
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	6.5	11.6	7.9	21.4	5.7	5	19.75	26.73	26.73	33.70	7.0	2	9.40	16.30	16.30	23.20	6.9	2
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	22.2	39.0	42.4	48.8	10.2	4	39.46	42.9	42.9	46.34	3.4	2	45.6	46.85	46.85	48.1	1.25	2
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	1.7	-	-	-	-	1	-	1.5	-	-	-	-	-	1.17	-	-	-	-
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																								
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/f²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters																																								
Drainage Area (SM)	-		0.02				0.02		-	-	-	0.83	-	-	-	-	-	-	-	-	-	-	-		0.02		-	-	-		0.02		-	-	-		0.02		-	-	-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-	-	E	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	-	-	-	-	-	-	4.27	-	-	-	-	-	3.32	-	-	-	-	-	3.32	-	-	-	-
BF Discharge (cfs)	-	7.8	18.3		-	-	-	-	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	212.2	-	-	-	-	-	15.2	-	-	-	-	-	15.2	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)²	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	350	-	-	-	-	-	104	-	-	-	-	-	104	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	-	-	-	-	-	-	1.5	-	-	-	-	-	1.04	-	-	-	-	-	1.04	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	0.0043	-	-	-	-	-	0.0114	-	-	-	-	-	0.0114	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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UT8

Parameter	USGS Gauge	Regional Curve Interval [1]			Pre-Existing Condition[1]						Reference Reach Data – Morgan Creek						Design						As-built						MY1						MY2					
Dimension and Substrate - Riffle		NC Mtn./NC Pied. Rural			Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	-	5.3	4.1	-	-	-	-	-	-	-	-	16.7	-	-	-	-	-	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.1	-	-	-	1
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	35.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	>50	-	-	-	1
BF Mean Depth (ft)	-	0.4	0.5	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.70	-	-	-	1
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	-	-	-	1
BF Cross-sectional Area (ft²)	-	1.9	4.1	-	-	-	-	-	-	-	-	17.7	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	-	1
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	15.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.0	-	-	-	1
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	-	-	-	1
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0	-	-	-	1
d50 (mm)	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pattern: reach is to short for this data.																																								
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rc:Bankfull width (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Meander Width Ratio	-	-	-	-	-	-	-	-	-	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile: reach is to short for this data.																																								
Riffle Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.0	31.8	19.0	77.0	26.3	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	0.0052	0.0107	0.0106	0.017	0.0041	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Length (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.0	-	-	0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Spacing (ft)	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	18.0	22.7	24.0	26.0	3.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	2.28	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pool Volume (ft³)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Substrate and Transport Parameters																																								
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SC% / Sa% / G% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d16 / d35 / d50 / d84 / d95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reach Shear Stress (competency) lb/f²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stream Power (transport capacity) W/m²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Additional Reach Parameters																																								
Drainage Area (SM)	-		0.02				0.02		-	-	-	0.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-
Impervious cover estimate (%)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5%	-	-	-	-
Rosgen Classification	-	-	-	-	-	-	-	-	-	-	-	C4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	E	-	-	-	-
BF Velocity (fps)	-	-	-	-	-	-	-	-	-	7	-	3.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.32	-	-	-	-
BF Discharge (cfs)	-	7.8	18.3		-	-	-	-	-	-	-	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.2	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel length (ft)²	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-	-	-	311.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	-	-	-	-
Sinuosity	-	-	-	-	-	-	-	-	-	-	-	2.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.04	-	-	-	-
Water Surface Slope (Channel) (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.0079	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0114	-	-	-	-
BF slope (ft/ft)	-	-	-	-	-	-	-	-	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Floodplain Area (acres)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEHI VL% / L% / M% / H% / VH% / E%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Channel Stability or Habitat Metric	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biological or Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

Logan Creek (4,172 LF)

	Cross-section X-1, Station 3+10 (Riffle), Restoration Reach							Cross-section X-2, Station 3+70 (Pool), Restoration Reach							Cross-section X-3, Station 12+57 (Riffle), Restoration Reach							Cross-section X-4, Station 13+00 (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)	24.1	24.0	24.1	-	-	-	-	25.9	26.8	26.0	-	-	-	-	25.2	24.3	24.46	-	-	-	-	27.6	27.1	27.1	-	-	-	-
BF Mean Depth (ft)	2.6	2.6	2.7	-	-	-	-	2.5	2.4	2.5	-	-	-	-	2.1	2.1	2.15	-	-	-	-	2.3	2.7	2.4	-	-	-	-
Width/Depth Ratio	9.2	9.3	8.9	-	-	-	-	10.5	11.0	10.3	-	-	-	-	12.0	11.6	11.36	-	-	-	-	12.1	10.0	11.2	-	-	-	-
BF Cross-sectional Area (ft^2)	63.0	62.4	64.8	-	-	-	-	63.9	65.2	65.5	-	-	-	-	53.2	51.2	52.7	-	-	-	-	62.8	73.8	65.4	-	-	-	-
BF Max Depth (ft)	3.7	4.0	4.3	-	-	-	-	5.2	5.1	5.1	-	-	-	-	3.1	2.9	3.11	-	-	-	-	5.2	5.9	5.4	-	-	-	-
Width of Floodprone Area (ft)	>70	>70	>70	-	-	-	-	>60	>60	>60	-	-	-	-	>100	>100	>100	-	-	-	-	>100	>100	>100	-	-	-	-
Entrenchment Ratio	2.9	2.9	2.9	-	-	-	-	2.3	2.3	2.3	-	-	-	-	3.9	4.1	4.1	-	-	-	-	3.6	3.6	3.6	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	-	-	-	-	1.1	1.1	1.0	-	-	-	-	1.0	1.1	1.0	-	-	-	-	1.0	1.0	1.1	-	-	-	-
Wetted Perimeter (ft)	29.3	29.3	29.5	-	-	-	-	30.9	31.7	31.0	-	-	-	-	29.5	28.6	28.8	-	-	-	-	32.2	32.6	31.9	-	-	-	-
Hydraulic Radius (ft)	2.1	2.1	2.2	-	-	-	-	2.1	2.1	2.1	-	-	-	-	1.8	1.8	1.8	-	-	-	-	2.0	2.3	2.0	-	-	-	-
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)	13.8	30.7	15.2	-	-	-	-	-	-	-	-	-	-	-	19.2	43	29.2	-	-	-	-	-	-	-	-	-	-	-

	Cross-section X-5, Station 25+43 (Pool), Restoration Reach							Cross-section X-6, Station 26+09 (Riffle), Restoration Reach							Cross-section 10, Station 37+05 (Pool), Enhancement Reach							Cross-section 11, Station 37+20 (Riffle), Enhancement Reach						
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)	21.3	24.0	23.9	-	-	-	-	23.6	22.6	22.5	-	-	-	-	31.0	33.4	33.4	-	-	-	-	29.2	33.9	33.9	-	-	-	-
BF Mean Depth (ft)	3.0	3.1	3.1	-	-	-	-	2.2	2.2	2.3	-	-	-	-	2.1	2.1	2.1	-	-	-	-	2.1	1.8	1.8	-	-	-	-
Width/Depth Ratio	7.1	7.8	7.8	-	-	-	-	10.8	10.1	9.9	-	-	-	-	14.4	15.6	15.9	-	-	-	-	14.0	18.6	18.6	-	-	-	-
BF Cross-sectional Area (ft^2)	63.9	74.3	73.3	-	-	-	-	51.7	50.2	51.4	-	-	-	-	66.6	71.2	70.3	-	-	-	-	60.7	61.8	61.8	-	-	-	-
BF Max Depth (ft)	5.4	5.3	5.4	-	-	-	-	3.4	3.5	3.7	-	-	-	-	3.5	3.5	3.4	-	-	-	-	2.9	3.0	3.0	-	-	-	-
Width of Floodprone Area (ft)	>80	>90	>90	-	-	-	-	>95	>95	>95	-	-	-	-	>60	>60	>60	-	-	-	-	>54	>54	>54	-	-	-	-
Entrenchment Ratio	4.4	4.4	3.8	-	-	-	-	4.0	4.0	4.2	-	-	-	-	4.2	1.8	1.8	-	-	-	-	4.5	1.6	1.6	-	-	-	-
Bank Height Ratio	1.0	1.0	1.0	-	-	-	-	1.0	1.0	1.0	-	-	-	-	1.0	1.1	1.0	-	-	-	-	1.1	1.2	1.2	-	-	-	-
Wetted Perimeter (ft)	27.3	30.2	30.0	-	-	-	-	28.0	27.0	27.1	-	-	-	-	35.2	37.6	37.6	-	-	-	-	33.4	37.6	37.6	-	-	-	-
Hydraulic Radius (ft)	2.3	2.5	2.4	-	-	-	-	1.8	1.9	1.9	-	-	-	-	1.9	1.9	1.9	-	-	-	-	1.8	1.6	1.6	-	-	-	-
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)	-	-	-	-	-	-	-	24.9	41.1	20.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

UT3 (178 LF)

	Cross-section X-8.5, Station 0+60* (Pool)							Cross-section X-9, Station 0+73* (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)	-	8.6	8.2	-	-	-	-	6.3	5.9	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Mean Depth (ft)	-	0.9	0.9	-	-	-	-	0.7	0.7	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Width/Depth Ratio	-	9.4	9.9	-	-	-	-	8.7	8.5	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Cross-sectional Area (ft^2)	-	7.9	8.2	-	-	-	-	4.5	4.1	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Max Depth (ft)	-	1.5	1.5	-	-	-	-	1.2	1.1	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Width of Floodprone Area (ft)	-	32.0	30.9	-	-	-	-	26.8	23.8	22.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Entrenchment Ratio	-	3.7	3.4	-	-	-	-	4.3	4.0	3.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Bank Height Ratio	-	1.1	1.0	-	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Wetted Perimeter (ft)	-	10.4	10.0	-	-	-	-	7.7	7.3	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Hydraulic Radius (ft)	-	0.8	0.8	-	-	-	-	0.6	0.6	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
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)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

*Stationing is corrected in this report.

UT6 (127 LF)

	Cross-section X-7, Station 0+54 (Pool)							Cross-section X-8, Station 0+69 (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)	9.8	9.2	9.4	-	-	-	-	6.1	5.8	5.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Mean Depth (ft)	1.0	0.9	0.8	-	-	-	-	0.8	0.7	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Width/Depth Ratio	9.5	10.7	12.1	-	-	-	-	8.1	9.0	9.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Cross-sectional Area (ft^2)	10.1	7.9	7.4	-	-	-	-	4.6	3.8	3.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Max Depth (ft)	1.7	1.5	1.2	-	-	-	-	1.1	0.9	0.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Width of Floodprone Area (ft)	> 50	> 50	> 50	-	-	-	-	> 35	> 35	> 35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Entrenchment Ratio	3.8	4.0	3.1	-	-	-	-	6.6	5.6	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Bank Height Ratio	1.0	1.0	1.0	-	-	-	-	1.0	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Wetted Perimeter (ft)	11.8	10.9	11.0	-	-	-	-	7.7	7.1	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Hydraulic Radius (ft)	0.9	0.7	0.7	-	-	-	-	0.6	0.5	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Based on current/developing bankfull feature																															
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
BF Cross-sectional Area (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)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

Table 11. Morphology and Hydraulic Monitoring Summary
Logan Creek Restoration Project: DMS Project ID No. 92515

UT8 (45 LF)																														
	Cross-section X-12, Station 0+9.6 (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+	Base	MY1	MY2	MY3	MY4	MY5	MY+		
Based on fixed baseline bankfull elevation																														
BF Width (ft)	-	-	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Mean Depth (ft)	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Width/Depth Ratio	-	-	11.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Cross-sectional Area (ft²)	-	-	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Max Depth (ft)	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Width of Floodprone Area (ft)	-	-	> 50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Entrenchment Ratio	-	-	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Bank Height Ratio	-	-	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Wetted Perimeter (ft)	-	-	9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Hydraulic Radius (ft)	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Based on current/developing bankfull feature																														
BF Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Cross-sectional Area (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
BF Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Width of Floodprone Area (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Wetted Perimeter (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Hydraulic Radius (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Cross Sectional Area between end pins (ft²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
d50 (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		