Annual Monitoring Report

Monitoring Year 2 of 5

FINAL

Middle South Muddy Stream Restoration Site
NCDMS Contract No.: 6783
NCDMS Project No.: 93875

McDowell County, North Carolina
Data Collected: February - October 2017
Date Submitted: November 2017

Submitted to:

North Carolina Division of Mitigation Services

NCDEQ-DMS, 1652 Mail Service Center Raleigh NC 27699-1652

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December 4, 2017

Matthew Reid
Project Manager
DENR Division of Mitigation Services
5 Ravenscroft Dr., #102
Asheville, NC 28801

Subject: Revisions to Middle South Muddy Restoration Monitoring Year 2 (MY2) Report; NCDMS Project #93875

Dear Mr. Reid,

The North Carolina Division of Mitigation Services contracted the services of Equinox to compile and report on the MY2 conditions of the Middle South Muddy Restoration project. Comments provided by NCDMS on November 30th, 2017 are listed below with red text indicating how each was addressed:

Section 1.3.2 Stream Geomorphology

• Report indicates structure at STA: 108+83 that was previously classified as being stressed has stabilized between MY1 and MY2. The structure is shown on the CCPV as being stressed. Table 5 also indicates the structure is stressed as well as a problem area photo on page 43. If the structure has stabilized, please update report sections to reflect this. Also, the section indicates the downstream riffle has stabilized, but the CCPV and Table 5 show it as degraded. Please verify and update as necessary. The stressed structure has been removed from Table 5, the CCPV and the problem area photo on page 43. Table 5 and the CCPV has also been changed to reflect the stabilization of the riffle just downstream of the structure.

•Last two paragraphs in section has a few grammatical errors. Please QA/QC final deliverable. Final deliverable has been checked for grammatical errors.

Table 2

• Under Year 2 Monitoring, please add two lines of additional data with dates. One for vegetation monitoring and one for geomorphology monitoring. The IRT would like to know when data is collected for monitoring years. Table 2 has been updated to show dates for MY1 and MY2 vegetation and morphology monitoring.

Cross-Section Graphs and Table 11a

• Table 11a and cross-section graphs show BHR as 1.0 for all years. The IRT has requested that BHR be calculated on an annual basis to show any changes throughout the monitoring years. Please verify that BHR has been calculated and is show correctly. If the BHR measurement of 1.0 is a result of rounding, please increase the significant digits to 2 or 3 places. BHR has been updated on the cross-section graphs and Table 11a/11b for MY1 and MY2.

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The Equinox project manager for this project is Mr. Drew Alderman. His contact is as follows:

Natural Resource Specialist
Equinox
37 Haywood Street
Asheville, NC 28801
Office: 828-253-6856 ext. 213
Fax: 828-253-8256

Sincerely,

Drew Alderman

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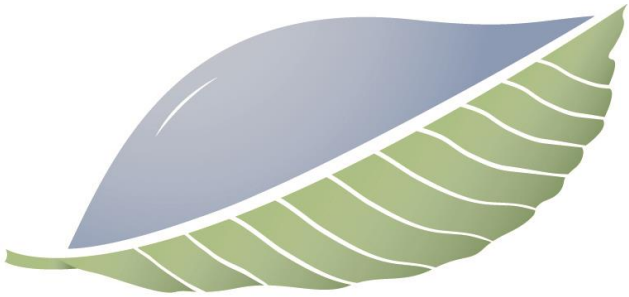
Prepared by:



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1.0 PROJECT SUMMARY

1.1. Goals and Objectives

The following goals were established to guide the restoration process for the project as outlined in the Final Mitigation Plan:

- Improve local water quality within the restored channel reaches as well as the downstream watercourses through: (a) the reduction of current channel sediment loads by restoring appropriately sized channels with stable beds and banks, (b) the reduction of nutrient loads from adjacent agricultural fields with a restored riparian buffer, and (c) the reduction of water temperatures provided through shading of the channel by canopy species along with the resultant increase in oxygen content.
- Improve local aquatic and terrestrial habitat and diversity within the restored channels and their vicinity through: (a) the restoration of appropriate bed form to provide habitat for fish, amphibian, and benthic species, (b) the restoration of a suitable riparian buffer corridor in order to provide both vertical and horizontal structure and connectivity with adjacent upland areas, and (c) the restoration of understory and canopy species in order to provide forage, cover, and nesting for a variety of mammals, reptiles, and avian species.
- Preclude land disturbing activities including the construction of additional infrastructure, future mining activities and agricultural practices including cattle grazing and the application of pesticides and fertilizer within the riparian buffer area by providing a permanent conservation easement.

The following objectives were proposed for accomplishing the above listed goals as outlined in the Final Mitigation Plan:

- Provide approximately 3,281 stream mitigation units (SMU's) through Priority I and II restoration of approximately 1,989 linear feet of stream, enhancement of approximately 196 linear feet of stream, and preservation of approximately 5,836 linear feet of stream threatened by mining activities.
- Restore natural stable channel morphology and proper sediment transport capacity.
- Create and/or improve bed form diversity and improve aquatic and benthic macroinvertebrate habitat.
- Construct a floodplain bench that is accessible at the proposed bankfull discharge.
- Improve channel and stream bank stabilization by integrating in-stream structures and native bank vegetation.
- Provide approximately 5.87 acres of riparian buffer restoration by establishing a native forested and herbaceous riparian buffer plant community with a minimum width of 30 feet from the edge of the restored channels. This new community will be established in conjunction with the eradication of any existing exotic and/or undesirable plant species.
- Construct barricades on an existing dirt road network on the Haney Tract to prevent future vehicular trespassing.

1.2. Success Criteria

1.2.1. Morphological Parameters and Channel Stability

Restored and enhanced streams should demonstrate morphologic stability to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the several months that follow construction and some change/variation subsequent to that period is also to be

expected. However, the observed change should not be unidirectional such that it represents a robust trend. If some trend is evident, it should be very modest or indicate migration to a stable form.

Dimension - Cross-section measurements should indicate little change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether the adjustments are associated with increased stability or whether they indicate movement towards an unstable condition.

Pattern and Profile – Measurements and calculated values should indicate stability whit little deviation from as-built conditions and established morphological ranges from the restored stream type. Annual measurements should indicate stable bed form features with little change from the as-built survey. The pools should maintain their depth with flatter water surface slopes, while riffles should remain shallower and steeper.

Substrate - Calculated D_{50} and D_{84} values should indicate coarser size class distribution of bed materials in riffles and finer size class distribution in pools. Generally, it is anticipated that the bed material will coarsen over time.

Sediment Transport - Depositional features should be consistent with a stable stream that is effectively managing its sediment load. Point bar and inner berm features, if present, should develop without excessive encroachment of the channel. Lateral and mid-channel bar features should typically not be present and if so only in isolated instances. Bar features may be more prevalent in sand bed channels but should be transient in nature and should occupy no more than 20% of the cross-sectional area.

1.2.2. Surface Water Hydrology

Monitoring of stream surface water stages should indicate recurrence of bankfull flows on average every 1 to 2 years. At a minimum, throughout the monitoring period, the surface water stage should achieve bankfull or greater elevations at least twice. The bankfull events must occur during separate monitoring years.

1.2.3. Vegetation

Riparian vegetation monitoring shall be conducted for a minimum of five years to ensure that success criteria are met per USACE guidelines. Accordingly, success criteria will consist of a minimum survival of 320 stems per acre by the end of the Year 3 monitoring period and a minimum of 260 stems per acre at the end of Year 5. If monitoring indicates either that the specified survival is not being met or the development of detrimental conditions (i.e., invasive species, diseased vegetation), appropriate corrective actions will be developed and implemented.

1.3. Project Setting and Background

The Middle South Muddy Stream Restoration Site (MSM) is located in the Catawba River Basin (NCDWQ sub-basin 03-08-30 and HUC 03050101040020) approximately 9.5 miles southeast of Marion, NC in southeast McDowell County at latitude 35.5635° N and longitude 81.9249° W. MSM is comprised of two tracts, the Middle South Muddy Creek tract, which encompasses approximately 5.87 acres of predominately agricultural and forested land, and the 41.05 acre Haney Preservation Tract, which is predominately forested. The Middle South Muddy Creek Tract consists of portions of three streams, Iva Branch (462 feet), Sprouse Branch (635 feet), and South Muddy Creek (1,088 feet). The Haney Tract consists of approximately 5,836 linear feet of stream. The tract is comprised of portions of South Muddy Creek and approximately four tributaries, including Jackson Branch and Moores Branch. MSM is located

within the Muddy Creek Local Watershed planning area and the Site's watershed was identified as a Targeted Local Watershed (TLW) in DMS' 2009 Upper Catawba River Basin Restoration Priority report (RBRP).

Historic land use at MSM consisted primarily of agriculture, livestock grazing, and mining operations. Livestock previously had unrestricted access to the majority of the streams on site, resulting in significant local disturbance to stream banks (Table 4). Additional land use practices, including the maintenance and removal of riparian vegetation, and the relocating, dredging, and straightening of on-site streams contributed to the degraded water quality and unstable channel characteristics on the site.

During the Asbuilt Baseline Monitoring Report, stream lengths in the Haney Tract was increased by 3,960 LF from the approved Mitigation Plan length of 5,836 LF to a total of 9,796 LF. The increase in length was due to mapping of streams within the conservation easement during the Asbuilt Baaseline Monitoring field work data collection stage. Upon verification, DMS determined that many of the included streams have been highly manipulated by past land use (mining) and were not candidates for preservation credit. These streams (UT1-8 and UT-10) were removed by DMS from credit calculations. DMS and IRT viewed the remaining streams within the easement (UT9, UT11, Jackson Branch, Moores Branch and South Muddy Creek). These streams were impacted less by past use and both DMS and IRT agreed they would be suitable for preservation credit. In lieu of breaking out stream reaches and applying different rations for preservation credit based on quality and function, the IRT and DMS agreed that reverting to the approved Mitigation Plan preservation length assets would be acceptable. The MY2 Monitoring Report has been updated to reflect the change in the preservation assets for the Haney Tract to 5,836 LF at a 5:1 ratio for a total of 1,167 SMUs as found in the Mitigation Plan. The total number of SMUs for the Middle South Muddy site has also been changed to 3,281 SMUs to reflect the Mitigation Plan as well.

1.4. Project Performance

Monitoring Year 2 (MY2) data was collected during January to October 2017. Monitoring activities included visual assessment of all reaches and the surrounding easement, collection of images at 31 permanent photo stations, inventory of five permanent vegetation monitoring plots, surveying of 10 cross-sections, conducting three pebble counts, and collection of longitudinal profile survey data for approximately 2,166 linear feet of stream channel.

Summary information/data related to the occurrence of items such as beaver or encroachment 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 (formerly Mitigation Plan) and in the Mitigation Plan (formerly Restoration Plan) documents available on the NCDMS website (http://portal.NCDEQ.org/web/eep). All raw data supporting the tables and figures in the appendices is available from DMS upon request.

1.4.1. Vegetation

Visual assessment of vegetation outside of the monitoring plots (Appendix B – Table 6) indicates that the herbaceous vegetation is becoming established throughout the project. South Muddy Creek has some areas of bare, rocky ground, located primarily along the bankfull bench, This is to be expected in the first few years following construction and will be monitored in future site visits.

Monitoring of the permanent vegetation plots (n = 5; VP) was completed in September 2017. Summary tables and photographs associated with MY vegetation monitoring are located in Appendix C. MY2

monitoring data indicates that all vegetation plots are on track to meet the MY3 interim success criteria of 320 planted stems per acre. Planted stem densities among plots ranged from 324 to 607 planted stems per acre with an annual mean of 469 planted stems per acre across all plots. A total of 9 species were documented within the plots. When volunteer stems are included, the mean annual total stems per acre rose to 720 and ranged between 324 and 1,012 stems per acre.

1.4.2. Stream Geomorphology

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. The structure on South Muddy Creek at STA 108+83 that was classified as being stressed, has stabilized between MY1 and MY2. The downstream head-of-riffle has also stabilized, lowering approximately 0.1ft between MY1 and MY2 (Table 5 and Figure 2). Deposition of fine sediment that occurred throughout the South Muddy Creek reach during MY1 also stabilized in MY2. While these large sediment blankets have not flushed out of the system, no large scale fine sediment influxes were noted during MY2. On Iva Branch, the boulder step structure at STA 303+67, has failed (Figure 2). Scour around the LDB of the arm of the top 3 boulder arches has undermined the structure. Material from the pools of the boulder steps has migrated downstream to fill in the riffle at STA 303+75 (Figure 2). While the upstream structures remain intact, the material from the boulder arches of the structures (STA 301+94 & 303+07) have also migrated into the downstream riffle causing aggradation at STA 302+25 and 303+25 (Figure 2). These area will be assessed during future site visits.

Geomorphic data for MY2 was collected from April through July 2017. Summary tables and cross-section data plots related to stream morphology are located in Appendix D. Noticeable change in the cross-section data between MY1 and MY2 occurred at riffle cross-sections 5 and 7, where scour along the right descending bankfull bench led to an increase in the bankfull width by 1.2 feet and 2.8 feet respectively. (Appendix B, Table 11a).

Generally, longitudinal profile data (Appendix B, Table 11b) indicated relatively little change in riffle and pool dimensions between MY1 and MY2. Mean pool depths of South Muddy Creek have increased 0.5 feet between MY1 and MY2, reverting back to baseline conditions. Profile dimensions of both Sprouse Branch and Iva Branch saw little to no change from MY1 to M2 (Table 11b).

Riffle dimensions on South Muddy Creek showed little to no change from MY1 to MY2. The most notable changes were the increase in bankfull width by 1.0 foot and an increase in width/depth ratio by 0.8. Riffle dimensions remained relatively similar between MY1 and MY2 on Lower Sprouse Branch. The most notable change was that the width/depth ratio increased by 1.4 feet on Lower Sprouse Branch. Riffle dimensions on Iva Branch also remained stable from MY1 to MY2. The most notable changes were the increase of the bankfull cross-sectional area by 0.4ft^2 and a decrease in width/depth ratio by 2.6. Iva Branch was dry downstream of the culvert during the MY2 morphological survey, therefore no water surface slope data was collected.

1.4.3. Stream Hydrology

Since project completion in December 2015 two bankfull events have been documented on all reaches of the Middle South Muddy Project. Based on precipitation data, the suspected date is February 2nd, 2016 for the first event, and October 23rd, 2017 for the second event.

2.0 METHODS

The visual assessment of the project was performed at the beginning and end of each monitoring year. Permanent photo station photos were taken during the initial visual assessment when leaf-off conditions exist. Additional photos of vegetation or stream problem areas were taken as needed.

Geomorphic measurements were taken during low flow conditions using a Nikon® NPR 332 Total Station. Three-dimensional coordinates associated with cross-section and profile data were collected in the field and geo-referenced (NAD83 State Plane feet FIPS 3200). Morphological data were collected at 10 cross-sections. Survey data was imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. Channel substrate was characterized using a Wolman Pebble Count as outlined in Harrelson et al. (1994) and processed using Microsoft Excel.

Vegetation success is being monitored at 5 permanent monitoring plots. Vegetation monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data is processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with rebar and photos of each plot are taken from the origin each monitoring year.

Precipitation data was reported from the NCCRONOS station NGFS in Marion, NC. Bankfull events were documented with two crest gauges, one located on South Muddy Creek and another on Sprouse Branch. Crest gauges will be monitored semi-annually. The height of the corklines was recorded and cross-referenced with known bankfull elevations at each crest gauge.

3.0 REFERENCES

Equinox Environmental. 2008. Muddy Creek Local Watershed Plan. Report prepared for North Carolina Department of Environment and Natural Resources, Division of Water Quality. September.

Harrelson, Cheryl, C. Rawlins and J. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. Gen. Tech. Rep. RM-245. Rocky Mountain Forest and Range Experiment Station. USDA Forest Service. Fort Collins, Colorado

North Carolina Ecosystem Enhancement Program (EEP). February 2009. Upper Catawba River Basin Restoration Priorities 2009. https://ncdenr.s3.amazonaws.com/s3fs-public/PublicFolder/Work%20With/Watershed%20Planners/Upper_Catawba_RBRP_2009.pdf.

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. http://cvs.bio.unc.edu/methods.htm; accessed November 2008.

Wolf Creek Engineering. 2012. Final Mitigation Plan Middle South Muddy Creek Restoration. Prepared for North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Final Mitigation Plan, Middle South Muddy Restoration, McDowell County. EEP Project No: 93875

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Appendix A
General Tables and Figures

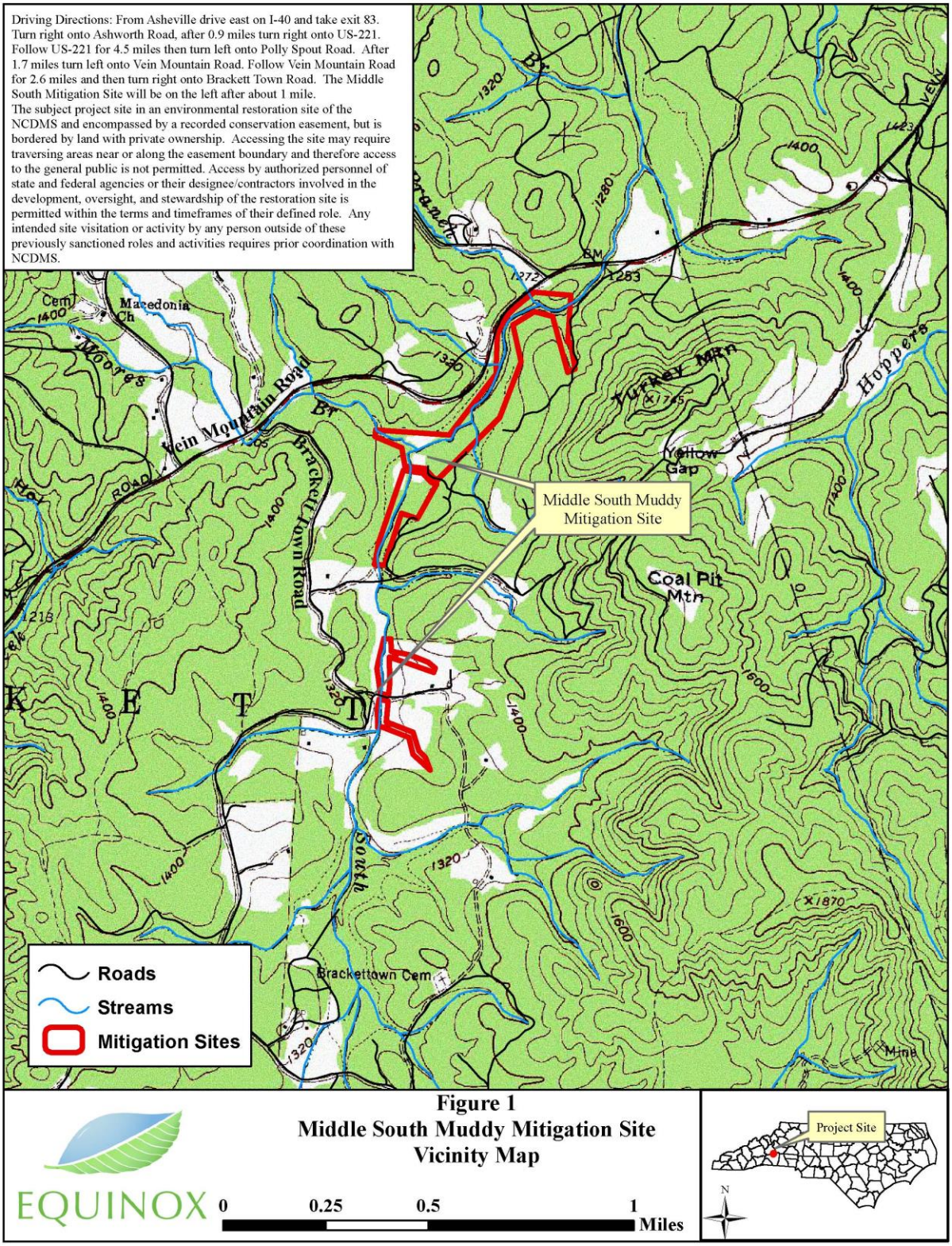
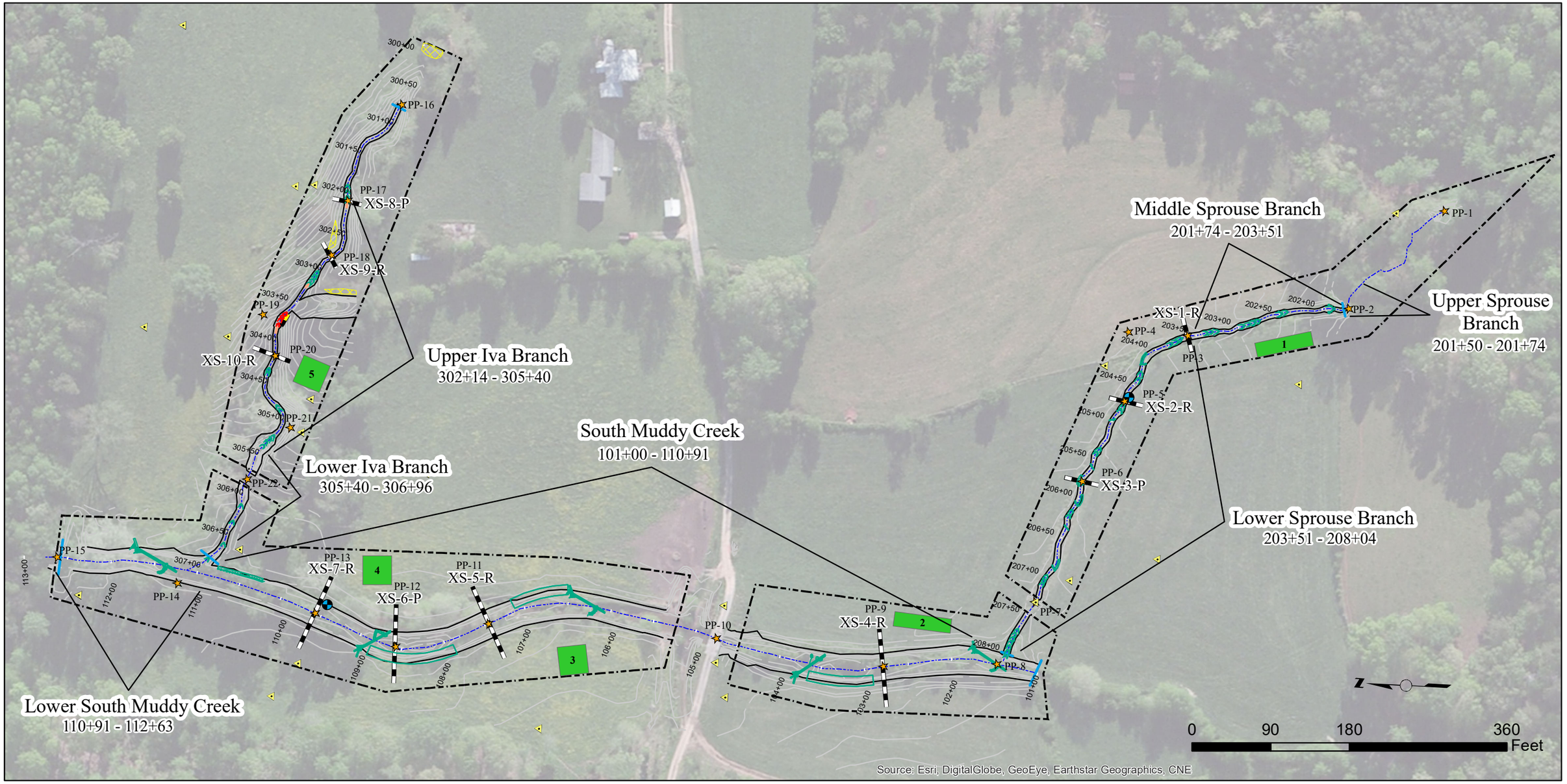


Figure 1
Middle South Muddy Mitigation Site
Vicinity Map

Figure 2. Integrated Current Condition Plan View



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Natural and Cultural Resources

Middle South Muddy
Stream Restoration Project
Monitoring Year 2
McDowell County, NC
NCDMS Contract No.: 00006783
NCDMS Project No.: 93875
October 2017
Sheet 1 of 2

Photo Point
Crest Gauge
Control Point
Structure
Cross-Section
Long Pro Start/End
Easement
Thalweg
Top of Bank
Contour (1 ft)

Vegetation Plots
Vegetation Plot Criteria Met

Invasive-Exotic Vegetation
Present

Stream Problem Areas
Aggradation
Bank Erosion
Failed Structure

Hook-Log Run
Hook Run
Boulder-Arch
Boulder-Arch with Log
Armored Riffle
Log Vane with Hook
Log Sill
Log Sill no Baffle
Brush Toe

Notes:
1) Baseline Data Provided by Turner Land Surveying

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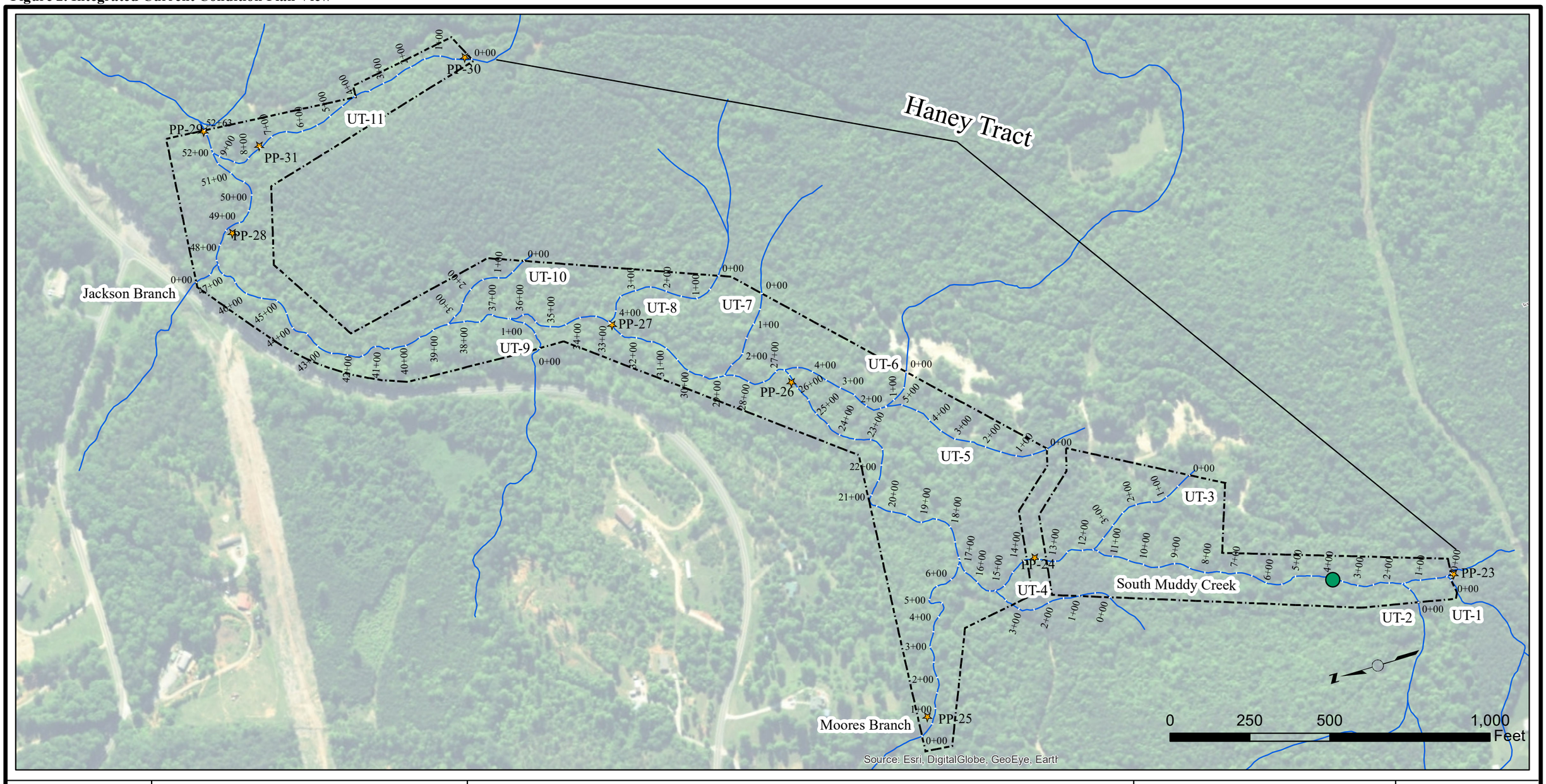
Figure 2. Integrated Current Condition Plan View



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Middle South Muddy
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Monitoring Year 2
McDowell County, NC
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Sheet 2 of 2

- Photo Point
- Crest Gauge
- Control Point
- Cross-Section
- Long Pro Start/End
- Easement
- Preservation Streams
- Top of Bank
- Contour (1 ft)
- Pump Intake

- Hook-Log Run
- Hook Run
- Boulder-Arch
- Boulder-Arch with Log
- Armored Riffle
- Log Vane with Hook
- Log Sill
- Log Sill no Baffle
- Brush Toe

Notes:
1) Baseline Data Provided by Turner Land Surveying

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Table 1. Project Mitigation Components and Summation

Middle South Muddy Stream Restoration Site

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	**2,114**	**1,167**							

Project Components

Project Component -or- Reach ID	Stationing/Location	Existing Footage/Acreage	Restoration Footage or Acreage	Restoration -or- Restoration Equivalent	Approach (PI, PII etc.)	Mitigation Ratio	Mitigation Credits	Footage Excluded due to Easement Crossing/ Break
South Muddy Creek	101+00 – 110+91	931	916	R	PII	1:1	916	75
Lower South Muddy Creek	110+91 – 112+63	177	172	R	EI	1.5:1	115	-
Upper Sprouse Branch	201+50 – 201+74	24	24	R	EII	2.5:1	10	-
Middle and Lower Sprouse Branch	201+74– 208+04	598	611	R	PII	1:1	611	19
Upper and Lower Iva Branch	302+14 – 306+96	471	462	R	PI	1:1	462	20
Haney Tract		5,836	5,836	RE	Preservation	5:1	1,167	-

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	1,989					
Enhancement						
Enhancement I	172					
Enhancement II	24					
Creation						
Preservation	5,836					
High Quality Preservation						

BMP Elements

Element	Location	Purpose/Function	Notes
FB	Entire Site	Protect Stream Channel	

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; FB = Forested Buffer

Table 2. Project Activity and Reporting History Middle South Muddy Stream Restoration Site		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Mitigation Plan	Feb - 2012	Mar - 2012
Final Design - Construction Plans	N/A	Nov - 2012
Construction	N/A	Dec - 2015
Permanent Seed Mix Applied	-	Mar - 2016
Live Stake Plantings	-	Mar - 2016
Baseline Monitoring Document (Year 0 Monitoring - Baseline)	May - 2016	June -2016
Year 1 Monitoring	Dec - 2016	Jan - 2017
Year 1 Geomorphology Monitoring	Dec - 2016	-
Year 1 Vegetation Monitoring	Oct - 2016	-
Year 2 Monitoring	Oct - 2017	Nov - 2017
Year 2 Geomorphology Monitoring	June - 2017	-
Year 2 Vegetation Monitoring	Sept - 2017	-
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts	
Middle South Muddy Stream Restoration Site	
Prime Contractor	North Carolina Division of Mitigation Services 217 W Jones Street Suite 3000a Raleigh, North Carolina 27603 Matthew Reid (828) 231-7812
Designer	Wolf Creek Engineering 12 1/2 Wall Street Suite C Asheville, North Carolina 28801 S. Grant Ginn (828) 449-1930
Construction Contractor	River Works, Inc 6105 Chapel Hill Road Raleigh, North Carolina 27607 Jon Harrell (919) 710-3326
Seeding Contractor	River Works, Inc 6105 Chapel Hill Road Raleigh, North Carolina 27607 Jon Harrell (919) 710-3326
Planting Contractor	River Works, Inc 6105 Chapel Hill Road Raleigh, North Carolina 27607 Jon Harrell (919) 710-3326
As-built Surveys	Turner Land Surveying 3719 Benson Drive Raleigh, North Carolina 27609 David Turner (919) 827-0745
Seeding Mix Source	Green Resource 5204 Highreen Court Colfax, North Carolina 27235 (336) 855-6363
Live Stakes	Foggy Mountain Nursery 797 Helton Creek Road Lansing, North Carolina (336) 384-5323
Monitoring Performers (MY0-MY2) 2017	Equinox Environmental 37 Haywood St. Asheville, North Carolina 28801 Drew Alderman (828) 253-6856

Table 4. Project Baseline Information and Attributes			
Project Information			
Project Name	Middle South Muddy Creek		
County	McDowell		
Project Area (acres)	5.87		
Project Coordinates (latitude and longitude)	35.5635° N , 81.9249° W		
Project Watershed Summary Information			
Physiographic Province	Blue Ridge		
River Basin	Catawba River		
USGS Hydrologic Unit 8-digit	3050101	USGS Hydrologic Unit 14-digit	03050101040020
DWR Sub-basin	03-08-30		
Project Drainage Area (acres)	2,893		
Project Drainage Area Percentage of Impervious Area	> 1%		
CGIA Land Use Classification	2.03.01.01		
Reach Summary Information			
Parameters	**South Muddy Creek**	**Iva Branch**	**Sprouse Branch**
Length of reach (linear feet)	1,108	471	622
Valley classification (Rosgen)	Valley Type VIIIb	Valley Type II	Valley Type II
Drainage area (acres)	3,002	27	29
NCDWQ stream identification score	44	31	34
NCDWQ Water Quality Classification	C	C	C
Morphological Description (stream type) (Rosgen)	G4	G5	G5
Evolutionary trend (Rosgen)	F4	G5	G5
Underlying mapped soils	Iotla, Hayesville Clay	Iotla, Hayesville Clay	Iotla, Hayesville Clay
Drainage class	Poorly drained	Poorly drained	Poorly drained
Soil Hydric status	Non-hydric	Non-hydric	Non-hydric
Slope	0.40%	4.60%	2.20%
FEMA classification	Limited Detail	N/A	N/A
Native vegetation community	Agricultural	Agricultural	Agricultural
Percent composition of exotic invasive vegetation	<1%	<1%	<1%
Wetland Summary Information			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)	-	-	-
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	-	-	-
Mapped Soil Series	-	-	-
Drainage class	-	-	-
Soil Hydric Status	-	-	-
Source of Hydrology	-	-	-
Hydrologic Impairment	-	-	-
Native vegetation community	-	-	-
Percent composition of exotic invasive vegetation	-	-	-

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	NW 27 (2011-02233)
Waters of the United States – Section 401	Yes	Yes	401 Certification (DWR# 12-0383)
Endangered Species Act	No	N/A	ERTR
Historic Preservation Act	No	N/A	ERTR
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	
FEMA Floodplain Compliance	Yes	Yes	Case #: 14-04-0367R
Essential Fisheries Habitat	No	N/A	

Appendix B
Visual Assessment Data

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Table 5. Visual Stream Morphology Stability Assessment Middle South Muddy Stream Restoration Site - South Muddy Creek Assessed Length 1,088 feet										
Major Channel Category	**Channel Sub-Category**	**Metric**	**Number Stable, Performing as Intended**	**Total Number in As-built**	**Number of Unstable Segments**	**Amount of Unstable Footage**	**% Stable, Performing as Intended**	**Number with Stabilizing Woody Vegetation**	**Footage with Stabilizing Woody Vegetation**	**Adjusted % for Stabilizing Woody Vegetation**
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	5	5			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6).	5	5			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	5	5			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run).	5	5			100%			
		2. Thalweg centering at downstream of meander bend (Glide).	5	5			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	5	5			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	5	5			100%			

Table 5 Cont'd. Visual Stream Morphology Stability Assessment Middle South Muddy Stream Restoration Project - Sprouse Branch Assessed Length 611 feet										
Major Channel Category	**Channel Sub-Category**	**Metric**	**Number Stable, Performing as Intended**	**Total Number in As-built**	**Number of Unstable Segments**	**Amount of Unstable Footage**	**% Stable, Performing as Intended**	**Number with Stabilizing Woody Vegetation**	**Footage with Stabilizing Woody Vegetation**	**Adjusted % for Stabilizing Woody Vegetation**
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	14	14			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6).	16	16			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	16	16			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run).	16	16			100%			
		2. Thalweg centering at downstream of meander bend (Glide).	16	16			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	18	18			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	18	18			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	18	18			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	18	18			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	18	18			100%			

Table 5 Cont'd. Visual Stream Morphology Stability Assessment Middle South Muddy Stream Restoration Project - Iva Branch Assessed Length 462 feet										
Major Channel Category	**Channel Sub-Category**	**Metric**	**Number Stable, Performing as Intended**	**Total Number in As-built**	**Number of Unstable Segments**	**Amount of Unstable Footage**	**% Stable, Performing as Intended**	**Number with Stabilizing Woody Vegetation**	**Footage with Stabilizing Woody Vegetation**	**Adjusted % for Stabilizing Woody Vegetation**
1. Bed	**1. Vertical Stability** (Riffle and Run Units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			3	15	96%			
		2. Degradation - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate.	9	9			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6).	9	9			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	9	9			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run).	9	9			100%			
		2. Thalweg centering at downstream of meander bend (Glide).	9	9			100%			
2. Bank	**1. Scoured / Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			1	15	98%	0	0	98%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
				Totals	1	15	98%	0	0	98%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	9	10			90%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	9	10			90%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	9	10			90%			
	3. Bank Protection	Bank erosion within the structures extent of influence does NOT exceed 15%.	9	10			90%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	10	10			100%			

Table 6. Vegetation Condition Assessment Middle South Muddy Stream Restoration Site					
Planted Acreage: 5.87					
Vegetation Category	**Definitions**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	Very limited cover of both woody and herbaceous material.	N/A	0	0.00	0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	N/A	0	0.00	0%
		Totals	0	0.00	0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	N/A	0	0.00	0%
		Cumulative Totals	0	0.00	0%
Easement Acreage: 5.87					
Vegetation Category	**Definitions**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Easement Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	Cross Hatch (Red - Dense/Yellow - Present)	3	0.01	<1%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	N/A	0	0.00	0%

N/A - Item does not apply.

Upper Sprouse Branch – Permanent Photo Station 1
Looking Downstream

Upper Sprouse Branch – Permanent Photo Station 2
Looking Downstream

Lower Sprouse Branch – Permanent Photo Station 3
Looking Downstream at Cross-Section 1

Lower Sprouse Branch – Permanent Photo Station 4
Looking Downstream, Northwest- 292 degrees

Lower Sprouse Branch – Permanent Photo Station 4
Looking Upstream; South 182 degrees

Lower Sprouse Branch – Permanent Photo Station 5
Looking Downstream at Cross-Section 2

Lower Sprouse Branch – Permanent Photo Station 6
Looking Downstream at Cross-Section 3

Lower Sprouse Branch – Permanent Photo Station 7
Looking Upstream from Crossing

Lower Sprouse Branch – Permanent Photo Station 8
Station 101+50 - Looking Upstream at Confluence with South Muddy

South Muddy Creek – Permanent Photo Station 8
Station 101+50 - Looking Downstream

South Muddy Creek – Permanent Photo Station 8
Station 101+50 - Looking Upstream

South Muddy Creek – Permanent Photo Station 9
Station 102+75 - Looking Downstream at Cross-Section 4

South Muddy Creek – Permanent Photo Station 10
Station 104+75 - Looking Upstream from Bridge

South Muddy Creek – Permanent Photo Station 10
Station 104+75 - Looking Downstream from Bridge

South Muddy Creek – Permanent Photo Station 11
Station 107+45 - Looking Downstream at Cross-Section 5

South Muddy Creek – Permanent Photo Station 12
Station 108+58- Looking Downstream at Cross-Section 6

South Muddy Creek – Permanent Photo Station 13
Station 109+58 - Looking Downstream at Cross-Section 7

Lower South Muddy Creek – Permanent Photo Station 14
Station 111+20 - Looking Upstream

Lower South Muddy Creek – Permanent Photo Station 14
Station 111+20 - Looking Downstream

Lower Iva Branch – Permanent Photo Station 14
Station 111+20 - Looking Upstream from Confluence

Lower South Muddy Creek – Permanent Photo Station 15
Station 112+62 - Looking Upstream

Upper Iva Branch – Permanent Photo Station 16
Station 300+50 - Looking Downstream

Upper Iva Branch – Permanent Photo Station 17
Station 300+50 - Looking Downstream at Cross-Section 8

Upper Iva Branch – Permanent Photo Station 18
Station 300+50 - Looking Downstream at Cross-Section 9

Upper Iva Branch – Permanent Photo Station 19
Station 303+75 - Looking Upstream

Upper Iva Branch – Permanent Photo Station 20
Station 300+50 - Looking Downstream at Cross-Section 10

Upper Iva Branch – Permanent Photo Station 21
Station 305+10 - Looking Upstream

Lower Iva Branch – Permanent Photo Station 22
Station 305+85 - Looking Upstream from Crossing

Haney Tract – Permanent Photo Station 23
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 24
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 24
Looking Downstream South Muddy Creek

Haney Tract – Permanent Photo Station 25
Looking Downstream Tributary to South Muddy Creek

Haney Tract – Permanent Photo Station 26
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 26
Looking Downstream South Muddy Creek

Haney Tract – Permanent Photo Station 26
Looking Upstream Tributary to South Muddy Creek

Haney Tract – Permanent Photo Station 27
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 27
Looking Downstream South Muddy Creek

Haney Tract – Permanent Photo Station 28
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 28
Looking Downstream South Muddy Creek

Haney Tract – Permanent Photo Station 28
Looking Upstream Tributary to South Muddy Creek

Haney Tract – Permanent Photo Station 29
Looking Upstream South Muddy Creek

Haney Tract – Permanent Photo Station 30
Looking Downstream Tributary to South Muddy Creek

Haney Tract – Permanent Photo Station 31
Looking Upstream Tributary to South Muddy Creek

Problem Area Photos

Failed Structure – Iva Branch STA 303+67 (looking downstream)

Failed Structure – Iva Branch STA 303+67 (looking upstream)

Problem Area Photos

Aggradation/ Failed Structure – Iva Branch STA 303+75

Aggradation – Iva Branch 303+25

Problem Area Photos

Aggradation – Iva Branch STA 302+25

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Appendix C
Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment		
Middle South Muddy Stream Restoration Site		
Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	

Table 8. CVS Vegetation Plot Metadata Middle South Muddy Stream Restoration Site	
Report Prepared By	Owen Carson
Date Prepared	9/25/2017 14:30
database name	Equinox_2017_A_MiddleSouthMuddy_MY2.mdb
database location	Z:\ES\NRI&M\EEP Monitoring\Middle South Muddy\MY2-2017\Data\Veg
computer name	FIELD-PC
file size	60526592
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	natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	93875
project Name	Middle South Middy
Description	
River Basin	Catawba
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	5

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Table 9. Total Planted Stem Counts (Stems by Plot)
Middle South Muddy Stream Restoration Project

			Current Plot Data (MY2 2017)															
			Plot 1			Plot 2			Plot 3			Plot 4			Plo 5		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum var. rubrum	Red Maple	Tree	2	2	2	1	1	1				1	1	1	7	7	7
Betula nigra	River Birch	Tree	3	3	3	3	3	3	1	1	1						
Carpinus caroliniana	American Hornbeam	Tree										2	2	2	2	2	2
Cercis canadensis	Eastern Redbud	Tree				1	1	1									
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	3	3	3	4	4	4	2	2	2			
Platanus occidentalis	American Sycamore	Tree	4	4	4	7	7	7	1	1	1	6	6	6	2	2	2
Platanus occidentalis var	Sycamore	Tree												12			7
Rhus copallinum	Flameleaf Sumac	shrub															
Rhus glabra	Smooth Sumac	shrub			2			1						4			5
Ulmus americana	American Elm	Tree							2	2	2				2	2	2
Stem count			11	11	13	15	15	16	8	8	8	11	11	27	13	13	25
size (ares)			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	5	5	5	6	4	4	4	4	4	6	4	4	6
Stems per ACRE			445	445	526	607	607	647	324	324	324	445	445	1093	526	526	1012

[1]PnoLS: No livestakes included in tally; P-all: All planted stems included in tally; T: Total stems including recruitment.

Table 9 Cont'd. Total Planted Stem Counts (Annual Means)
Middle South Muddy Stream Restoration Project

			Annual Means								
			MY2 (2017)			MY1 (2016)			MY0 (2016)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum var. rubrum	Red Maple	Tree	11	11	11	11	11	11	11	11	11
Betula nigra	River Birch	Tree	7	7	7	7	7	7	5	5	5
Carpinus caroliniana	American Hornbeam	Tree	4	4	4	4	4	4	5	5	5
Cercis canadensis	Eastern Redbud	Tree	1	1	1	1	1	1	1	1	1
Fraxinus pennsylvanica	Green Ash	Tree	11	11	11	11	11	11	11	11	11
Platanus occidentalis	American Sycamore	Tree	20	20	20	20	20	20	20	20	20
Platanus occidentalis var.	Sycamore	Tree			19						
Rhus copallinum	Flameleaf Sumac	shrub						11			
Rhus glabra	Smooth Sumac	shrub			12						
Ulmus americana	American Elm	Tree	4	4	4	6	6	6	7	7	7
Stem count			58	58	89	60	60	71	60	60	60
size (ares)			5			5			5		
size (ACRES)			0.12			0.12			0.12		
Species count			7	7	9	7	7	8	7	7	7
Stems per ACRE			469	469	720	486	486	575	486	486	486

[1]PnoLS: No livestakes included in tally; P-all: All planted stems included in tally; T: Total stems including recruitment.

Color for Density

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%
- Recruit Stems

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Middle South Muddy - Vegetation Monitoring Plot 1
September 19th, 2017

Middle South Muddy - Vegetation Monitoring Plot 2
September 19th, 2017

Middle South Muddy - Vegetation Monitoring Plot 3
September 19th, 2017

Middle South Muddy - Vegetation Monitoring Plot 4
September 19th, 2017

Middle South Muddy - Vegetation Monitoring Plot 5
September 19th, 2017

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Appendix D
Stream Geomorphology Data

Table 10. Baseline Stream Data Summary
Middle South Muddy - South Muddy Creek / Lower South Muddy Creek (1,088 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	30.7	-	-	-	-	-	-	-	19.4	-	-	36.6	-	-	-	30.8	-	30.7	31.1	31.0	31.6	0.5	3
Floodprone Width (ft)				-	-	-	-	-	-	30.0	-	-	65.0	-	-	-	65.0	-	65.0	84.7	88.0	101.0	18.2	3
Bankfull Mean Depth (ft)	-	1.8	-	-	-	-	-	-	-	1.6	-	-	1.6	-	-	-	1.7	-	1.6	1.9	1.9	2.1	0.3	3
Bankfull Max Depth (ft)				-	-	-	-	-	-	2.0	-	-	2.2	-	-	-	2.2	-	2.3	2.7	2.8	2.9	0.4	3
Bankfull Cross Sectional Area (ft^2)		51.7		-	-	-	-	-	-	30.2	-	-	36.6	-	-	-	52.2	-	50.5	58.1	59.0	64.9	7.2	3
Width/Depth Ratio				-	-	-	-	-	-	12.3	-	-	14.9	-	-	-	18.1	-	14.8	16.8	15.9	19.8	2.6	3
Entrenchment Ratio				-	-	-	-	-	-	1.3	-	-	2.8	-	-	-	2.1	-	2.1	2.7	2.8	3.3	0.6	3
Bank Height Ratio				-	-	-	-	-	-	1.0	-	-	1.2	-	-	-	1.0	-	1.0	1.0	1.0	1.0	0.0	3
d50 (mm)				-	-	-	-	-	-	-	29.0	-	-	-	-									
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	17.7	-	-	64.0	-	-	-	-	-	54.4	109.6	85.4	229.5	68.9	5
Riffle Slope (ft/ft)				-	-	-	-	-	-	0.77	-	-	3.60	-	-	-	-	-	0.001	0.003	0.003	0.005	0.001	5
Pool Length (ft)				-	-	-	-	-	-	12.0	-	-	36.0	-	-	-	-	-	34.8	50.8	51.3	66.3	12.4	5
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	-	-	2.9	-	-	-	3.3	-	3.2	4.6	4.5	6.0	0.9	6
Pool Spacing (ft)				-	-	-	-	-	-	97.5	-	-	193.0	-	-	154.5	-	220.7	112.6	196.3	187.9	323.2	89.4	5
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	63.72	86.44	92.6	103	20.34	3
Radius of Curvature (ft)				-	-	-	-	-	-	32.0	-		514.0	-	-	-	61.0	-	102.1	114.7	120.1	121.8	10.9	3
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	3.7	3.9	3.9	0.4	3
Meander Wavelength (ft)				-	-	-	-	-	-	-	300.0	-	-	-	-	-	-	-	466.5	495.0	497.3	521.1	27.4	3
Meander Width Ratio				-	-	-	-	-	-	-	4.3	-	-	-	-	-	3.2	-	2.0	2.8	3.0	3.3	0.7	3
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%					-						-									55% / 11% / 26% / 8% / 0%				
SC% / Sa% / G% / C% / B% / Be%					-						1% / 8% / 72% / 17% / 1% / 1%													
d16 / d35 / d50 / d84 / d95 / di^p / di^{sg} (mm)					-						7.2 / 20 / 29 / 42 / 69 / 120 / - / -													
Reach Shear Stress (Competency) lb/ft^2					-						0.857						-			-				
Max Part Size (mm) Mobilized at Bankfull					-						760						-			-				
Stream Power (Transport Capacity) W/m^2					-						-						-							
Additional Reach Parameters																								
Drainage Area (mi^2)					-						3.33						4.7							
Impervious Cover Estimate (%)					-						-						-							
Rosgen Classification					-						C4						C4			C4				
Bankfull Velocity (fps)		-			-						3.9						-							
Bankfull Discharge (cfs)		-			-						143.0						-							
Valley Length (ft)					-						550						1,136							
Channel Thalweg Length (ft)					-						600						1,161			1,163				
Sinuosity					-						1.10						1.03			1.03				
Water Surface Slope (ft/ft)					-						-						0.003			0.003				
Bankfull Slope (ft/ft)					-						-						0.003			0.002				
Bankfull Floodplain Area (acres)					-						-													
Proportion Over Wide (%)					-						-													
Entrenchment Class (ER Range)					-						-													
Incision Class (BHR Range)					-						-													
BEHI					-						-													
Channel Stability or Habitat Metric					-						-													
Biological or Other					-						-													

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Middle South Muddy - Middle Sprouse Branch (177 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	4.8	-	-	-	-	-	-	-	23.4	-	-	24.7	-	-	-	4.8	-	-	-	-	-	-	-
Floodprone Width (ft)				-	-	-	-	-	-	43.0	-	-	52.0	-	-	-	15.0	-	-	-	-	-	-	-
Bankfull Mean Depth (ft)	-	0.5	-	-	-	-	-	-	-	1.3	-	-	1.5	-	-	-	0.3	-	-	-	-	-	-	-
Bankfull Max Depth (ft)				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	0.5	-	-	-	-	-	-	-
Bankfull Cross Sectional Area (ft^2)		0.5		-	-	-	-	-	-	33.4	-	-	34.6	-	-	-	1.6	-	-	-	-	-	-	-
Width/Depth Ratio				-	-	-	-	-	-	15.8	-	-	18.4	-	-	-	14.1	-	-	-	-	-	-	-
Entrenchment Ratio				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	3.2	-	-	-	-	-	-	-
Bank Height Ratio				-	-	-	-	-	-	1.4	-	-	1.6	-	-	-	1.0	-	-	-	-	-	-	-
d50 (mm)				-	-	-	-	-	-	-	45.0	-	-	-	-									
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	-	-	40.0	-	-	-	-	-	15.2	20.0	16.1	28.8	7.6	3
Riffle Slope (ft/ft)				-	-	-	-	-	-	1.500	-	-	4.300	-	-	-	-	-	0.005	0.007	0.008	0.010	0.002	3
Pool Length (ft)				-	-	-	-	-	-	6.0	-	-	42.0	-	-	-	-	-	3.7	9.2	8.2	16.5	5.3	4
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	-	-	2.3	-	-	-	0.8	-	1.6	2.0	1.8	2.7	0.5	4
Pool Spacing (ft)				-	-	-	-	-	-	51.0	-	-	113.0	-	-	15.9	-	22.7	43.0	49.1	44.4	60.1	9.5	3
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-	-	-	-	7.1	7.9	7.8	8.9	0.9	3
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	-	-	103.0	-	-	-	-	-	8.2	15.0	14.0	23.8	6.9	4
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	3.1	2.9	5.0	1.4	4
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	20.4	26.3	27.1	30.7	4.5	4
Meander Width Ratio				-	-	-	-	-	-	-	1.8	-	-	-	-	-	2.3	-	1.5	1.7	1.6	1.9	0.2	3
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%						-						-									39% / 0% / 24% / 8% / 29%			
SC% / Sa% / G% / C% / B% / Be%						-						1% / 10% / 48% / 41% / 0% / 1%												
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)						-						5.2 / 22 / 45 / 75 / 130 / 190 / - / -												
Reach Shear Stress (Competency) lb/ft^2						-						1.947					-				-			
Max Part Size (mm) Mobilized at Bankfull						-						91					-				-			
Stream Power (Transport Capacity) W/m^2						-						-					-							
Additional Reach Parameters																								
Drainage Area (mi^2)						-						2.77					0.03							
Impervious Cover Estimate (%)						-						-					-							
Rosgen Classification						-						B4					B5				B5			
Bankfull Velocity (fps)		-				-						6.1					-							
Bankfull Discharge (cfs)		-				-						210.0					-							
Valley Length (ft)						-						380					187							
Channel Thalweg Length (ft)						-						400					177				177			
Sinuosity						-						1.1					1.06				1.01			
Water Surface Slope (ft/ft)						-						-					0.031				0.029			
Bankfull Slope (ft/ft)						-						-					0.031				0.029			
Bankfull Floodplain Area (acres)						-						-												
Proportion Over Wide (%)						-						-												
Entrenchment Class (ER Range)						-						-												
Incision Class (BHR Range)						-						-												
BEHI						-						-												
Channel Stability or Habitat Metric						-						-												
Biological or Other						-						-												

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Middle South Muddy - Lower Sprouse Branch (434 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	5.3	-	-	-	-	-	-	-	23.4	-	-	24.7	-	-	-	5.2	-	5.1	5.3	5.3	5.4	0.2	2
Floodprone Width (ft)				-	-	-	-	-	-	43.0	-	-	52.0	-	-	-	15.0	-	14.0	19.0	19.0	24.0	3.5	2
Bankfull Mean Depth (ft)	-	0.5	-	-	-	-	-	-	-	1.3	-	-	1.5	-	-	-	0.4	-	0.3	0.3	0.3	0.3	0.0	2
Bankfull Max Depth (ft)				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	0.6	-	0.6	0.6	0.6	0.6	0.0	2
Bankfull Cross Sectional Area (ft^2)		2.2		-	-	-	-	-	-	33.4	-	-	34.6	-	-	-	1.9	-	1.7	1.7	1.7	1.8	0.0	2
Width/Depth Ratio				-	-	-	-	-	-	15.8	-	-	18.4	-	-	-	14.3	-	15.1	15.9	15.9	16.7	1.1	2
Entrenchment Ratio				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	2.9	-	2.6	3.6	3.6	4.5	1.3	2
Bank Height Ratio				-	-	-	-	-	-	1.4	-	-	1.6	-	-	-	1.0	-	1.0	1.0	1.0	1.0	0.0	2
d50 (mm)				-	-	-	-	-	-	-	45.0	-	-	-	-									
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	-	-	40.0	-	-	-	-	-	6.0	16.2	14.2	32.2	9.3	9
Riffle Slope (ft/ft)				-	-	-	-	-	-	1.5	-	-	4.3	-	-	-	-	-	0.003	0.011	0.011	0.025	0.007	9
Pool Length (ft)				-	-	-	-	-	-	6.0	-	-	42.0	-	-	-	-	-	3.4	8.7	9.0	12.1	3.1	11
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	-	-	2.3	-	-	-	0.8	-	1.3	1.8	1.8	2.3	0.3	11
Pool Spacing (ft)				-	-	-	-	-	-	51.0	-	-	113.0	-	-	18.1	-	25.8	19.0	32.9	32.2	55.1	10.5	10
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-	-	-	-	10.1	10.4	10.4	10.6	0.3	3
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	-	-	103.0	-	-	-	-	-	8.8	10.6	10.6	12.5	1.9	4
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	2.0	2.0	2.4	0.4	4
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	33.2	38.1	38.5	42.9	3.5	5
Meander Width Ratio				-	-	-	-	-	-	-	1.8	-	-	-	-	-	3.1	-	1.9	2.0	2.0	2.0	0.0	3
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%						-						-									41% / 6% / 27% / 9% / 17%			
SC% / Sa% / G% / C% / B% / Be%						-						1% / 10% / 48% / 41% / 0% / 1%												
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)						-						5.2 / 22 / 45 / 75 / 130 / 190 / - / -												
Reach Shear Stress (Competency) lb/ft^2						-						1.947					-				-			
Max Part Size (mm) Mobilized at Bankfull						-						91					-				-			
Stream Power (Transport Capacity) W/m^2						-						-					-							
Additional Reach Parameters																								
Drainage Area (mi^2)						-						2.77					0.04							
Impervious Cover Estimate (%)						-						-					-							
Rosgen Classification						-						B4					B5				B5			
Bankfull Velocity (fps)		-				-						6.1					-							
Bankfull Discharge (cfs)		-				-						210.0					-							
Valley Length (ft)						-						380.0					422							
Channel Thalweg Length (ft)						-						400.0					453				453			
Sinuosity						-						1.1					1.07				1.07			
Water Surface Slope (ft/ft)						-						-					0.014				0.017			
Bankfull Slope (ft/ft)						-						-					0.014				0.017			
Bankfull Floodplain Area (acres)						-						-												
Proportion Over Wide (%)						-						-												
Entrenchment Class (ER Range)						-						-												
Incision Class (BHR Range)						-						-												
BEHI						-						-												
Channel Stability or Habitat Metric						-						-												
Biological or Other						-						-												

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Middle South Muddy - Upper Iva Branch (326 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	4.8	-	-	-	-	-	-	-	23.4	-	-	24.7	-	-	-	4.8	-	4.6	4.9	4.9	5.3	0.5	2
Floodprone Width (ft)				-	-	-	-	-	-	43.0	-	-	52	-	-	-	15.0	-	14.0	15.5	15.5	17.0	2.1	2
Bankfull Mean Depth (ft)	-	0.5	-	-	-	-	-	-	-	1.3	-	-	1.5	-	-	-	0.3	-	0.4	0.4	0.4	0.4	0.0	2
Bankfull Max Depth (ft)				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	0.5	-	0.6	0.6	0.6	0.7	0.1	2
Bankfull Cross Sectional Area (ft^2)		1.8		-	-	-	-	-	-	33.4	-	-	34.6	-	-	-	1.6	-	1.9	2.0	2.0	2.1	0.1	2
Width/Depth Ratio				-	-	-	-	-	-	15.8	-	-	18.4	-	-	-	14.1	-	11.0	12.2	12.2	13.3	1.6	2
Entrenchment Ratio				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	3.2	-	3.0	3.1	3.1	3.2	0.1	2
Bank Height Ratio				-	-	-	-	-	-	1.4	-	-	1.6	-	-	-	1.0	-	1.0	1.0	1.0	1.0	0.0	2
d50 (mm)				-	-	-	-	-	-	-	45.0	-	-	-	-									
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	-	-	40.0	-	-	-	-	-	26.7	48.8	40.1	90.6	24.6	5
Riffle Slope (ft/ft)				-	-	-	-	-	-	1.50	-	-	4.30	-	-	-	-	-	0.001	0.004	0.002	0.009	0.003	5
Pool Length (ft)				-	-	-	-	-	-	6.0	-	-	42.0	-	-	-	-	-	2.1	2.8	2.7	3.4	0.6	4
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	-	-	2.3	-	-	-	0.8	-	0.5	0.8	0.8	1.2	0.3	4
Pool Spacing (ft)				-	-	-	-	-	-	51.0	-	-	113.0	-	-	15.9	-	22.7	47.1	55.5	59.0	60.4	7.3	3
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-	-	-	-	11.9	14.8	14.8	17.6	4.0	2
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	-	-	103.0	-	-	-	-	-	7.6	9.4	8.4	13.2	2.6	4
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.9	1.7	2.7	0.5	4
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	43.2	48.1	47.7	53.8	5.0	4
Meander Width Ratio				-	-	-	-	-	-	-	1.8	-	-	-	-	-	2.5	-	2.4	3.0	3.0	3.5	0.8	2
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%					-						-								80% / 0% / 4% / 2% / 14%					
SC% / Sa% / G% / C% / B% / Be%					-						1% / 10% / 48% / 41% / 0% / 1%													
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)					-						5.2 / 22 / 45 / 75 / 130 / 190 / - / -													
Reach Shear Stress (Competency) lb/ft^2					-						1.947						-			-				
Max Part Size (mm) Mobilized at Bankfull					-						91						-			-				
Stream Power (Transport Capacity) W/m^2					-						-						-							
Additional Reach Parameters																								
Drainage Area (mi^2)					-						2.77						0.03							
Impervious Cover Estimate (%)					-						-						-							
Rosgen Classification					-						B4						B5			B5				
Bankfull Velocity (fps)		-			-						6.1						-							
Bankfull Discharge (cfs)		-			-						210.0						-							
Valley Length (ft)					-						380						424							
Channel Thalweg Length (ft)					-						400						326			326				
Sinuosity					-						1.10						1.09			1.10				
Water Surface Slope (ft/ft)					-						-						0.058			0.056				
Bankfull Slope (ft/ft)					-						-						0.058			0.056				
Bankfull Floodplain Area (acres)					-						-													
Proportion Over Wide (%)					-						-													
Entrenchment Class (ER Range)					-						-													
Incision Class (BHR Range)					-						-													
BEHI					-						-													
Channel Stability or Habitat Metric					-						-													
Biological or Other					-						-													

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Middle South Muddy - Lower Iva Branch (136 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	5.6	-	-	-	-	-	-	-	23.4	-	-	24.7	-	-	-	5.5	-	-	-	-	-	-	-
Floodprone Width (ft)				-	-	-	-	-	-	43.0	-	-	52	-	-	-	15.0	-	-	-	-	-	-	-
Bankfull Mean Depth (ft)	-	0.5	-	-	-	-	-	-	-	1.3	-	-	1.5	-	-	-	0.4	-	-	-	-	-	-	-
Bankfull Max Depth (ft)				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	0.6	-	-	-	-	-	-	-
Bankfull Cross Sectional Area (ft^2)		2.4		-	-	-	-	-	-	33.4	-	-	34.6	-	-	-	2.1	-	-	-	-	-	-	-
Width/Depth Ratio				-	-	-	-	-	-	15.8	-	-	18.4	-	-	-	14.4	-	-	-	-	-	-	-
Entrenchment Ratio				-	-	-	-	-	-	1.8	-	-	2.2	-	-	-	2.7	-	-	-	-	-	-	-
Bank Height Ratio				-	-	-	-	-	-	1.4	-	-	1.6	-	-	-	1.0	-	-	-	-	-	-	-
d50 (mm)				-	-	-	-	-	-	-	45.0	-	-	-	-									
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	-	-	40.0	-	-	-	-	-	9.4	11.8	11.8	14.3	3.5	2
Riffle Slope (ft/ft)				-	-	-	-	-	-	1.50	-	-	4.30	-	-	-	-	-	0.010	0.021	0.021	0.033	0.016	2
Pool Length (ft)				-	-	-	-	-	-	6.0	-	-	42.0	-	-	-	-	-	5.8	9.4	9.4	12.9	3.3	4
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	-	-	2.3	-	-	-	0.9	-	1.0	1.1	1.1	1.2	0.1	4
Pool Spacing (ft)				-	-	-	-	-	-	51.0	-	-	113.0	-	-	19.3	-	27.5	20.8	25.9	20.8	36.1	8.9	3
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-				8.9	9.6	9.6	10.3	1.0	2
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	-	-	103.0	-	-				12.2	12.5	12.5	12.8	0.4	2
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-				2.2	2.3	2.3	2.3	0.1	2
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-				23.0	27.4	25.5	33.6	5.6	3
Meander Width Ratio				-	-	-	-	-	-	-	1.8	-	-	-	-	-	2.2	-	1.6	1.7	1.7	1.9	0.2	2
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%						-						-									24% / 17% / 38% / 20% / 0%			
SC% / Sa% / G% / C% / B% / Be%						-						1% / 10% / 48% / 41% / 0% / 1%												
d16 / d35 / d50 / d84 / d95 / di^9 / di^{99} (mm)						-						5.2 / 22 / 45 / 75 / 130 / 190 / - / -												
Reach Shear Stress (Competency) lb/ft^2						-						1.947					-				-			
Max Part Size (mm) Mobilized at Bankfull						-						91					-				-			
Stream Power (Transport Capacity) W/m^2						-						-					-							
Additional Reach Parameters																								
Drainage Area (mi^2)						-						2.77					0.046							
Impervious Cover Estimate (%)						-						-					-							
Rosgen Classification						-						B4					B5				B5			
Bankfull Velocity (fps)		-				-						6.1					-							
Bankfull Discharge (cfs)		-				-						210.0					-							
Valley Length (ft)						-						380.0					151							
Channel Thalweg Length (ft)						-						400.0					156				156			
Sinuosity						-						1.10					1.02				1.03			
Water Surface Slope (ft/ft)						-						-					0.026				0.032			
Bankfull Slope (ft/ft)						-						-					0.026				0.035			
Bankfull Floodplain Area (acres)						-						-												
Proportion Over Wide (%)						-						-												
Entrenchment Class (ER Range)						-						-												
Incision Class (BHR Range)						-						-												
BEHI						-						-												
Channel Stability or Habitat Metric						-						-												
Biological or Other						-						-												

- Information unavailable.

Non-Applicable.

Table 11a. Baseline Morphology & Hydraulic Monitoring Summary
Middle South Muddy Stream Restoration Site

	Cross-Section 1 (Riffle) Lower Sprouse Branch						Cross-Section 2 (Riffle) Lower Sprouse Branch						Cross-Section 3 (Pool) Lower Sprouse Branch						Cross-Section 4 (Riffle) South Muddy Creek						Cross-Section 5 (Riffle) South Muddy Creek					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Record Elevation (datum) Used	1,278.1	1,278.1	1,278.1				1,275.8	1,275.8	1,275.8				1,273.7	1,273.7	1,273.7				1,269.4	1,269.4	1,269.4				1,267.9	1,267.9	1,267.9			
Bankfull Width (ft)	5.4	6.1	6.3				5.1	5.3	5.4				6.1	6.8	6.8				31.6	32.6	31.8				30.7	30.6	31.8			
Floodprone Width (ft)	14.0	14.0	14.0				23.0	23.0	23.0				32.0	32.0	32.0				65.0	65.0	65.0				101.0	101.0	101.0			
Bankfull Mean Depth (ft)	0.3	0.2	0.2				0.3	0.2	0.2				1.0	0.9	0.9				1.6	1.7	1.7				1.9	1.9	1.9			
Bankfull Max Depth (ft)	0.6	0.5	0.4				0.6	0.5	0.5				1.5	1.6	1.7				2.3	2.6	2.6				2.8	2.8	3.0			
Bankfull Cross Sectional Area (ft^2)	1.8	1.5	1.5				1.7	1.3	1.2				5.9	6.3	6.3				50.5	54.1	52.8				59.0	57.9	61.3			
Bankfull Width/Depth Ratio	16.7	25.4	25.8				15.1	21.5	23.7				6.3	7.5	7.3				19.8	19.7	19.1				15.9	16.2	16.4			
Bankfull Entrenchment Ratio	2.6	2.3	2.2				4.5	4.3	4.3				5.3	4.7	4.7				2.1	2.0	2.0				3.3	3.3	3.2			
Bankfull Bank Height Ratio*	1.0	0.888	0.879				1.0	1.019	0.941				1.0	1.051	1.033				1.0	0.942	0.988				1.0	1.044	1.060			
d50 (mm)	N/A	N/A	N/A				N/A	N/A	N/A				N/A	N/A	N/A				N/A	14.0	27.0				N/A	18.0	15.0			
	Cross-Section 6 (Pool) South Muddy Creek						**Cross-Section 7 (Riffle) South Muddy Creek**						**Cross-Section 8 (Pool) Upper Iva Branch**						**Cross-Section 9 (Riffle) Upper Iva Branch**						**Cross-Section 10 (Riffle) Upper Iva Branch**					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Record Elevation (datum) Used	1,268.0	1,268.0	1,268.0				1,267.3	1,267.3	1,267.3				1,286.1	1,286.1	1,286.11				1,285.3	1,285.3	1,285.3				1,277.1	1,277.1	1,277.1			
Bankfull Width (ft)	35.3	35.9	36.7				31.0	31.2	34.0				5.5	5.8	5.6				4.6	4.2	4.1				5.3	5.6	5.8			
Floodprone Width (ft)	166.0	166.0	166.0				88.0	88.0	88.0				17.0	17.0	17.0				14.0	14.0	14.0				17.0	17.0	17.0			
Bankfull Mean Depth (ft)	2.4	2.4	2.4				2.1	2.2	2.0				1.0	1.0	1.0				0.4	0.4	0.5				0.4	0.3	0.4			
Bankfull Max Depth (ft)	4.0	3.9	3.9				2.9	3.0	3.1				1.8	1.7	1.7				0.7	0.6	0.8				0.6	0.6	0.6			
Bankfull Cross Sectional Area (ft^2)	85.7	86.3	89.2				64.9	67.7	67.9				5.7	5.6	5.6				1.9	1.8	2.1				2.1	1.9	2.5			
Bankfull Width/Depth Ratio	14.5	14.9	15.1				14.8	14.4	17.0				5.4	6.1	5.5				11.0	9.8	8.0				13.3	16.7	13.3			
Bankfull Entrenchment Ratio	4.7	4.6	4.5				2.8	2.8	2.6				3.1	2.9	3.1				3.0	3.3	3.5				3.2	3.0	3.0			
Bankfull Bank Height Ratio*	1.0	0.999	0.995				1.0	0.944	0.946				1.0	0.922	0.976				1.0	0.989	0.897				1.0	1.000	1.048			
d50 (mm)	N/A	N/A	N/A				N/A	0.91	1.3				N/A	N/A	N/A				N/A	N/A	N/A				N/A	N/A	N/A			

N/A - Item does not apply.

*Ratios calculated using recorded baseline bankfull elevation. Ratios <1 indicate a lowering of the banknkfull elevation from baseline conditions. Please refer to the Cross-Sectional Graphs for a visual display.

Table 11b. Monitoring Data - Stream Reach Data Summary
Middle South Muddy Stream Restoration Site - South Muddy Creek (1,088 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5					
Dimension & Substrate - Riffle	**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**
Bankfull Width (ft)	30.7	31.1	31.0	31.6	0.5	3	30.6	31.5	31.2	32.6	1.0	3	31.8	32.5	31.8	34.0	1.3	3																		
Floodprone Width (ft)	65.0	84.7	88.0	101.0	18.2	3	65.0	84.7	88.0	101.0	18.2	3	65.0	84.7	88.0	101.0	18.2	3																		
Bankfull Mean Depth (ft)	1.6	1.9	1.9	2.1	0.3	3	1.7	1.9	1.9	2.2	0.3	3	1.7	1.9	1.9	2.0	0.2	3																		
Bankfull Max Depth (ft)	2.3	2.7	2.8	2.9	0.4	3	2.6	2.8	2.8	3.0	0.2	3	2.6	2.9	3.0	3.1	0.3	3																		
Bankfull Cross-Sectional Area (ft^2)	50.5	58.1	59.0	64.9	7.2	3	54.1	59.9	57.9	67.7	7.0	3	52.8	60.7	61.3	67.9	7.5	3																		
Width/Depth Ratio	14.8	16.8	15.9	19.8	2.6	3	14.4	16.7	16.2	19.7	2.7	3	16.4	17.5	17.0	19.1	1.4	3																		
Entrenchment Ratio	2.1	2.7	2.8	3.3	0.6	3	2.0	2.7	2.8	3.3	0.7	3	2.0	2.6	2.6	3.2	0.6	3																		
Bank Height Ratio*	1.0	1.0	1.0	1.0	0.0	3	0.94	0.98	0.94	1.04	0.06	3	0.95	1.00	0.99	1.06	0.06	3																		
Profile																																				
Riffle Length (ft)	54.4	109.6	85.4	229.5	68.9	5	64.1	111.4	90.3	203.5	56.0	5	58.0	108.2	99.1	202.2	57.7	5																		
Riffle Slope (ft/ft)	0.001	0.003	0.003	0.005	0.001	5	0.001	0.005	0.004	0.009	0.003	5	0.001	0.004	0.003	0.008	0.003	5																		
Pool Length (ft)	34.8	50.8	51.3	66.3	12.4	5	17.8	56.4	48.5	96.8	30.1	5	23.4	56.0	56.9	95.7	26.5	5																		
Pool Max Depth (ft)	3.2	4.6	4.5	6.0	0.9	6	3.4	4.1	3.8	5.4	0.8	5	3.7	4.6	4.4	5.8	0.8	5																		
Pool Spacing (ft)	112.6	196.3	187.9	323.2	89.4	5	177.1	247.4	239.1	334.2	68.6	4	179.1	249.1	230.1	357.2	81.2	4																		
Pattern																																				
Channel Belt Width (ft)	63.7	86.4	92.6	103.0	20.34	3																														
Radius of Curvature (ft)	102.1	114.7	120.1	121.8	10.94	3																														
Rc: Bankfull Width (ft/ft)	3.28	3.7	3.86	3.92	0.35	3																														
Meander Wavelength (ft)	466.5	495.0	497.3	521.1	27.38	3																														
Meander Width Ratio	2.0	2.8	3.0	3.3	0.65	3																														
Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4																							
Channel Thalweg Length (ft)	1,163						1,158						1,174																							
Sinuosity (ft)	1.03						1.03						1.05																							
Water Surface Slope (Channel) (ft/ft)	0.003						0.0033						0.0033																							
Bankfull Slope (ft/ft)	0.002						0.0029						0.0037																							
Ri% / Ru% / P% / G% / S%	55%	11%	26%	8%	0%		56%	6%	28%	9%	0%		54%	10%	28%	8%	0%																			

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Table 11b Cont'd. Monitoring Data - Stream Reach Data Summary
Middle South Muddy Stream Restoration Site - Middle Sprouse Branch (177 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5					
Dimension & Substrate - Riffle	**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**
Bankfull Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Cross-Sectional Area (ft^2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Profile																																				
Riffle Length (ft)	15.2	20.0	16.1	28.8	7.6	3	18.1	27.3	23.6	40.1	11.5	3	16.9	24.0	19.6	35.5	10.0	3																		
Riffle Slope (ft/ft)	0.005	0.007	0.008	0.010	0.002	3	0.003	0.008	0.009	0.013	0.005	3	0.002	0.010	0.011	0.017	0.008	3																		
Pool Length (ft)	3.7	9.2	8.2	16.5	5.3	4	6.5	9.4	9.9	11.5	2.2	4	5.7	8.1	7.4	11.9	2.7	4																		
Pool Max Depth (ft)	1.6	2.0	1.8	2.7	0.5	4	1.1	1.8	1.8	2.4	0.6	4	1.3	1.8	1.7	2.4	0.5	4																		
Pool Spacing (ft)	43.0	49.1	44.4	60.1	9.5	3	52.3	58.9	52.6	71.7	11.1	3	42.4	49.3	47.2	58.3	8.2	3																		
Pattern																																				
Channel Belt Width (ft)	7.1	7.9	7.8	8.9	0.9	3																														
Radius of Curvature (ft)	8.2	15.0	14.0	23.8	6.9	4																														
Rc: Bankfull Width (ft/ft)	1.7	3.1	2.9	5.0	1.4	4																														
Meander Wavelength (ft)	20.4	26.3	27.1	30.7	4.5	4																														
Meander Width Ratio	1.5	1.7	1.6	1.9	0.2	3																														
Additional Reach Parameters																																				
Rosgen Classification	B5						B5						B5																							
Channel Thalweg Length (ft)	177						159						160																							
Sinuosity (ft)	1.01						1.02						1.03																							
Water Surface Slope (Channel) (ft/ft)	0.029						0.028						0.029																							
Bankfull Slope (ft/ft)	0.029						0.025						0.026																							
Ri% / Ru% / P% / G% / S%	39%	0%	24%	8%	29%		44%	0%	20%	7%	28%		46%	0%	21%	7%	27%																			

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Table 11b Cont'd. Monitoring Data - Stream Reach Data Summary
Middle South Muddy Stream Restoration Site - Lower Sprouse Branch (434 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5					
Dimension & Substrate - Riffle	**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**
Bankfull Width (ft)	5.1	5.3	5.3	5.4	0.2	2	5.3	5.7	5.7	6.1	0.6	2	5.4	5.8	5.8	6.3	0.6	2																		
Floodprone Width (ft)	14.0	19.0	19.0	24.0	3.5	2	14.0	18.5	18.5	23.0	6.4	2	14.0	18.5	18.5	23.0	6.4	2																		
Bankfull Mean Depth (ft)	0.3	0.3	0.3	0.3	0.0	2	0.2	0.2	0.2	0.2	0.0	2	0.2	0.2	0.2	0.2	0.0	2																		
Bankfull Max Depth (ft)	0.6	0.6	0.6	0.6	0.0	2	0.5	0.5	0.5	0.5	0.1	2	0.4	0.5	0.5	0.5	0.1	2																		
Bankfull Cross-Sectional Area (ft^2)	1.7	1.7	1.7	1.8	0.0	2	1.3	1.4	1.4	1.5	0.1	2	1.2	1.4	1.4	1.5	0.2	2																		
Width/Depth Ratio	15.1	15.9	15.9	16.7	1.1	2	21.5	23.4	23.4	25.4	2.8	2	23.7	24.8	24.8	25.8	1.5	2																		
Entrenchment Ratio	2.6	3.6	3.6	4.5	1.3	2	2.3	3.3	3.3	4.3	1.4	2	2.2	3.2	3.2	4.3	1.4	2																		
Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	2	0.88	0.95	0.95	1.02	0.09	2	0.88	0.91	0.91	0.94	0.04	2																		
.88Profile																																				
Riffle Length (ft)	6.0	16.2	14.2	32.2	9.3	9	7.6	19.1	14.2	39.7	11.0	9	5.3	15.1	10.6	30.2	9.2	9																		
Riffle Slope (ft/ft)	0.003	0.011	0.011	0.025	0.007	9	0.004	0.009	0.009	0.016	0.004	9	0.004	0.012	0.010	0.025	0.007	9																		
Pool Length (ft)	3.4	8.7	9.0	12.1	3.1	11	5.2	10.4	10.4	15.7	3.6	11	3.8	9.3	9.1	15.5	4.2	11																		
Pool Max Depth (ft)	1.3	1.8	1.8	2.3	0.3	11	1.0	1.8	1.9	2.3	0.4	11	1.4	1.7	1.7	2.1	0.3	11																		
Pool Spacing (ft)	19.0	32.9	32.2	55.1	10.5	10	26.3	39.2	38.6	62.5	10.8	10	17.3	32.9	33.0	54.6	10.1	10																		
Pattern																																				
Channel Belt Width (ft)	10.1	10.4	10.4	10.6	0.3	3																														
Radius of Curvature (ft)	8.8	10.6	10.6	12.5	1.9	4																														
Rc: Bankfull Width (ft/ft)	1.7	2.0	2.0	2.4	0.4	4																														
Meander Wavelength (ft)	33.2	38.1	38.5	42.9	3.5	5																														
Meander Width Ratio	1.9	2.0	2.0	2.0	0.0	3																														
Additional Reach Parameters																																				
Rosgen Classification	B5						B5						B5																							
Channel Thalweg Length (ft)	453						465						463																							
Sinuosity (ft)	1.07						1.04						1.04																							
Water Surface Slope (Channel) (ft/ft)	0.017						0.014						0.017																							
Bankfull Slope (ft/ft)	0.017						0.016						0.020																							
Ri% / Ru% / P% / G% / S%	41%	6%	27%	9%	17%		41%	6%	27%	9%	16%		39%	6%	29%	10%	16%																			

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Table 11b Cont'd. Monitoring Data - Stream Reach Data Summary
Middle South Muddy Stream Restoration Site - Upper Iva Branch (326 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5					
Dimension & Substrate - Riffle	**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**
Bankfull Width (ft)	4.6	4.9	4.9	5.3	0.5	2	4.2	4.9	4.9	5.6	1.0	2	4.1	4.9	4.9	5.8	1.2	2																		
Floodprone Width (ft)	14.0	15.5	15.5	17.0	2.1	2	14.0	15.5	15.5	17.0	2.1	2	14	16	16	17	2.1	2																		
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	0.0	2	0.3	0.4	0.4	0.4	0.1	2	0.4	0.5	0.5	0.5	0.1	2																		
Bankfull Max Depth (ft)	0.6	0.6	0.6	0.7	0.1	2	0.6	0.6	0.6	0.6	0.1	2	0.6	0.7	0.7	0.8	0.1	2																		
Bankfull Cross-Sectional Area (ft^2)	1.9	2.0	2.0	2.1	0.1	2	1.8	1.9	1.9	1.9	0.0	2	2.1	2.3	2.3	2.5	0.3	2																		
Width/Depth Ratio	11.0	12.2	12.2	13.3	1.6	2	9.8	13.2	13.2	16.7	4.9	2	8.0	10.6	10.6	13.3	3.7	2																		
Entrenchment Ratio	3.0	3.1	3.1	3.2	0.1	2	3.0	3.2	3.2	3.3	0.2	2	3.0	3.2	3.2	3.5	0.4	2																		
Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	2	0.99	0.99	0.99	1.00	0.01	2	0.90	0.97	0.97	1.05	0.11	2																		
Profile																																				
Riffle Length (ft)	26.7	48.8	40.1	90.6	24.6	5	21.8	46.1	37.7	88.5	25.5	5	23.6	46.3	35.6	87.7	25.1	5																		
Riffle Slope (ft/ft)	0.001	0.004	0.002	0.009	0.003	5	0.005	0.007	0.007	0.011	0.002	5	0.006	0.008	0.007	0.011	0.002	5																		
Pool Length (ft)	2.1	2.8	2.7	3.4	0.6	4	3.2	4.5	4.1	6.7	1.7	4	1.6	4.2	4.2	6.9	2.3	4																		
Pool Max Depth (ft)	0.5	0.8	0.8	1.2	0.3	4	0.4	0.5	0.5	0.8	0.2	4	0.3	0.5	0.4	1.0	0.3	4																		
Pool Spacing (ft)	47.1	55.5	59.0	60.4	7.3	3	49.6	54.9	54.9	60.1	5.3	3	48.2	54.8	53.9	62.3	7.1	3																		
Pattern																																				
Channel Belt Width (ft)	11.9	14.8	14.8	17.6	4.0	2																														
Radius of Curvature (ft)	7.6	9.4	8.4	13.2	2.6	4																														
Rc: Bankfull Width (ft/ft)	1.5	1.9	1.7	2.7	0.5	4																														
Meander Wavelength (ft)	43.2	48.1	47.7	53.8	5.0	4																														
Meander Width Ratio	2.4	3.0	3.0	3.5	0.8	2																														
Additional Reach Parameters																																				
Rosgen Classification	B5						B5						B5																							
Channel Thalweg Length (ft)	326						330						328																							
Sinuosity (ft)	1.10						1.11						1.11																							
Water Surface Slope (Channel) (ft/ft)	0.056						-						-																							
Bankfull Slope (ft/ft)	0.056						0.0598						0.0595																							
Ri% / Ru% / P% / G% / S%	80%	0%	4%	2%	14%		75%	0%	6%	4%	15%		75%	0%	5%	4%	15%																			

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Table 11b Cont'd. Monitoring Data - Stream Reach Data Summary
Middle South Muddy Stream Restoration Site - Lower Iva Branch (136 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5					
Dimension & Substrate - Riffle	**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**
Bankfull Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bankfull Cross-Sectional Area (ft^2)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
Profile																																				
Riffle Length (ft)	9.4	11.8	11.8	14.3	3.5	2	10.4	16.5	16.5	22.7	8.7	2	11.6	17.2	17.2	22.8	7.9	2																		
Riffle Slope (ft/ft)	0.010	0.021	0.021	0.033	0.016	2	0.005	0.015	0.015	0.026	0.015	2	0.009	0.015	0.015	0.020	0.007	2																		
Pool Length (ft)	5.8	9.4	9.4	12.9	3.3	4	2.9	5.3	5.0	8.3	2.7	4	3.4	5.8	4.9	10.0	3.1	4																		
Pool Max Depth (ft)	1.0	1.1	1.1	1.2	0.1	4	0.6	1.0	1.0	1.5	0.3	4	0.5	1.1	1.0	1.7	0.5	4																		
Pool Spacing (ft)	20.8	25.9	20.8	36.1	8.9	3	18.0	23.4	24.4	27.8	5.0	3	18.9	23.8	25.0	27.6	4.5	3																		
Pattern																																				
Channel Belt Width (ft)	8.9	9.6	9.6	10.3	1.0	2																														
Radius of Curvature (ft)	12.2	12.5	12.5	12.8	0.4	2																														
Rc: Bankfull Width (ft/ft)	2.2	2.3	2.3	2.3	0.1	2																														
Meander Wavelength (ft)	23.0	27.4	25.5	33.6	5.6	3																														
Meander Width Ratio	1.6	1.7	1.7	1.9	0.2	2																														
Additional Reach Parameters																																				
Rosgen Classification	B5						B5						B5																							
Channel Thalweg Length (ft)	156						154						159																							
Sinuosity (ft)	1.03						1.03						1.07																							
Water Surface Slope (Channel) (ft/ft)	0.032						-						-																							
Bankfull Slope (ft/ft)	0.035						0.0257						0.0326																							
Ri% / Ru% / P% / G% / S%	24%	17%	38%	20%	0%		43%	17%	28%	14%	0%		45%	14%	30%	11%	0%																			

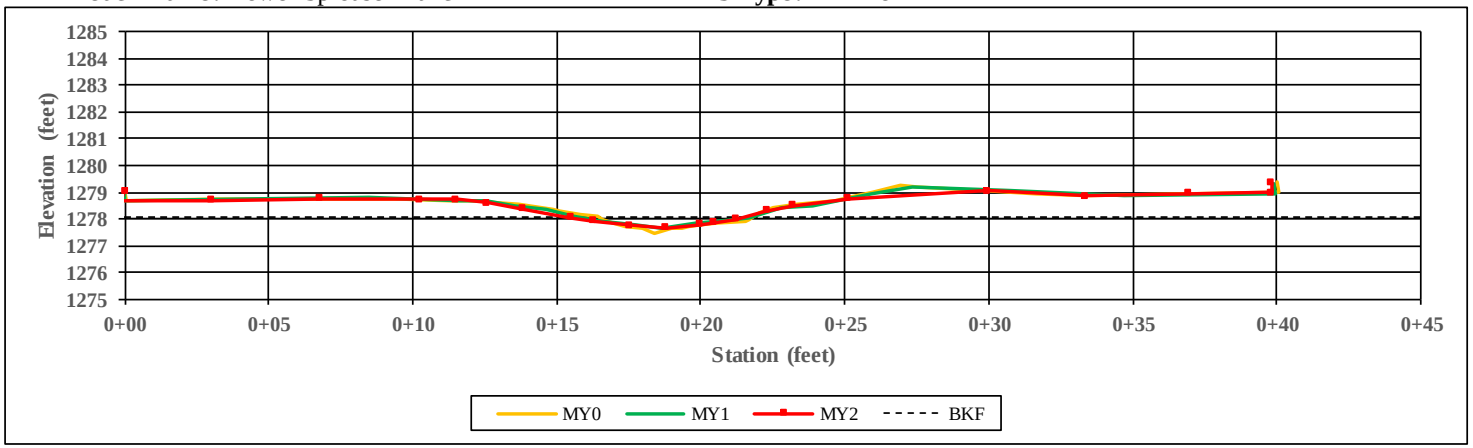
- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

Project Name: Middle South Muddy **XS Number:** 1 **Station:** 203+60

Reach Name: Lower Sprouse Branch **XS Type:** Riffle



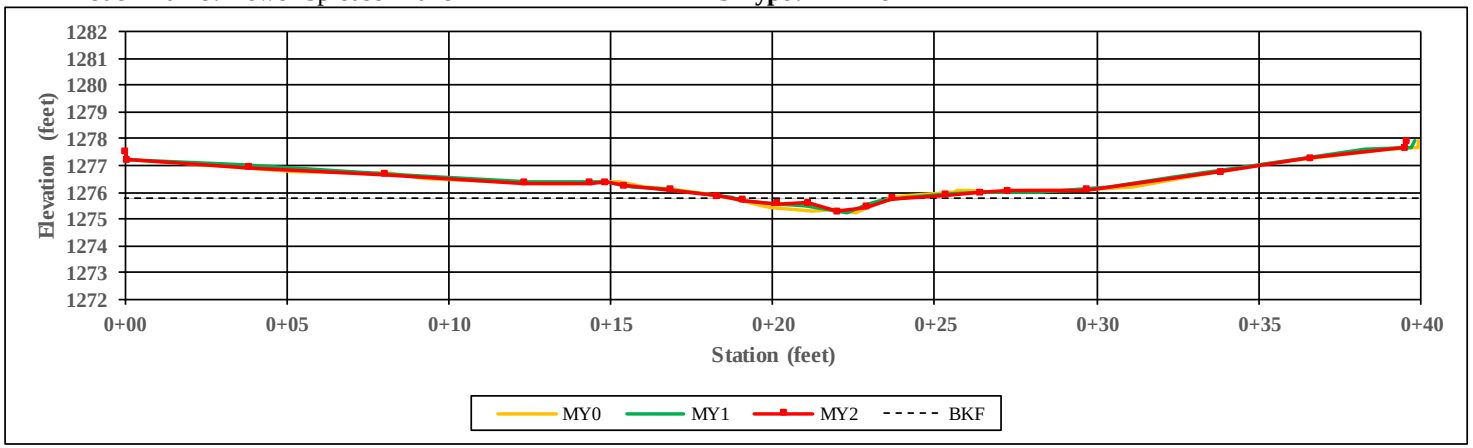
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	5.4	6.1	6.3	-	-	-	-	-
Floodprone Width (ft)	14.0	14.0	14.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.3	0.2	0.2	-	-	-	-	-
Bankfull Max Depth (ft)	0.6	0.5	0.4	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	1.8	1.5	1.5	-	-	-	-	-
Width/Depth Ratio	16.7	25.4	25.8	-	-	-	-	-
Entrenchment Ratio	2.6	2.3	2.2	-	-	-	-	-
Bank Height Ratio	1.0	0.888	0.879	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 2 **Station:** 204+72

Reach Name: Lower Sprouse Branch **XS Type:** Riffle



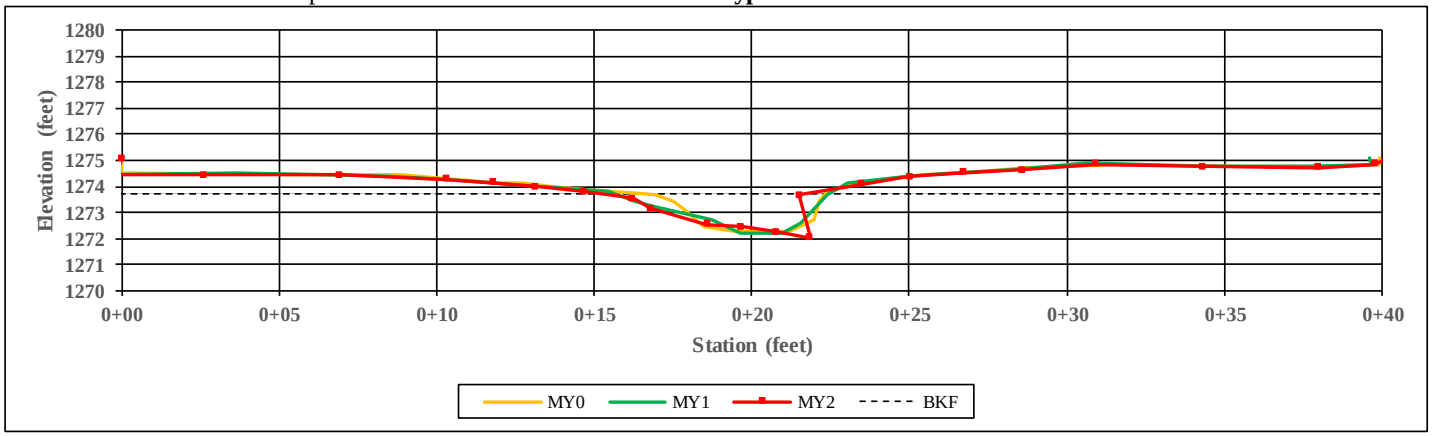
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	5.1	5.3	5.4	-	-	-	-	-
Floodprone Width (ft)	23.0	23.0	23.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.3	0.2	0.2	-	-	-	-	-
Bankfull Max Depth (ft)	0.6	0.5	0.5	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	1.7	1.3	1.2	-	-	-	-	-
Width/Depth Ratio	15.1	21.5	23.7	-	-	-	-	-
Entrenchment Ratio	4.5	4.3	4.3	-	-	-	-	-
Bank Height Ratio	1.0	1.019	0.941	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 3 **Station:** 205+79

Reach Name: Lower Sprouse Branch **XS Type:** Pool



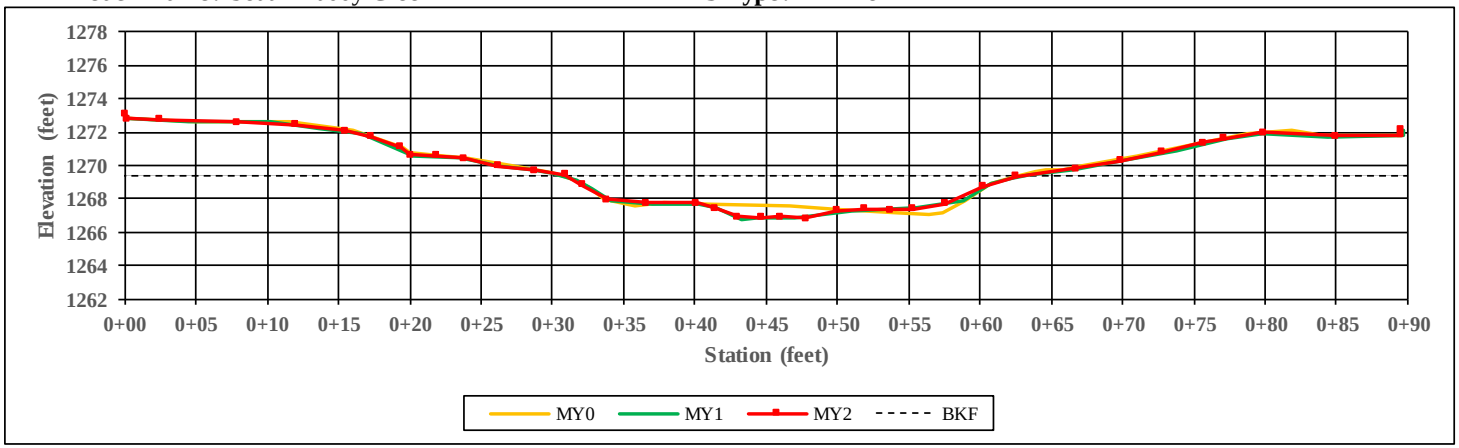
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	6.1	6.8	6.8	-	-	-	-	-
Floodprone Width (ft)	32.0	32.0	32.0	-	-	-	-	-
Bankfull Mean Depth (ft)	1.0	0.9	0.9	-	-	-	-	-
Bankfull Max Depth (ft)	1.5	1.6	1.7	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	5.9	6.3	6.3	-	-	-	-	-
Width/Depth Ratio	6.3	7.5	7.3	-	-	-	-	-
Entrenchment Ratio	5.3	4.7	4.7	-	-	-	-	-
Bank Height Ratio	1.0	1.051	1.033	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 4 **Station:** 102+79

Reach Name: South Muddy Creek **XS Type:** Riffle



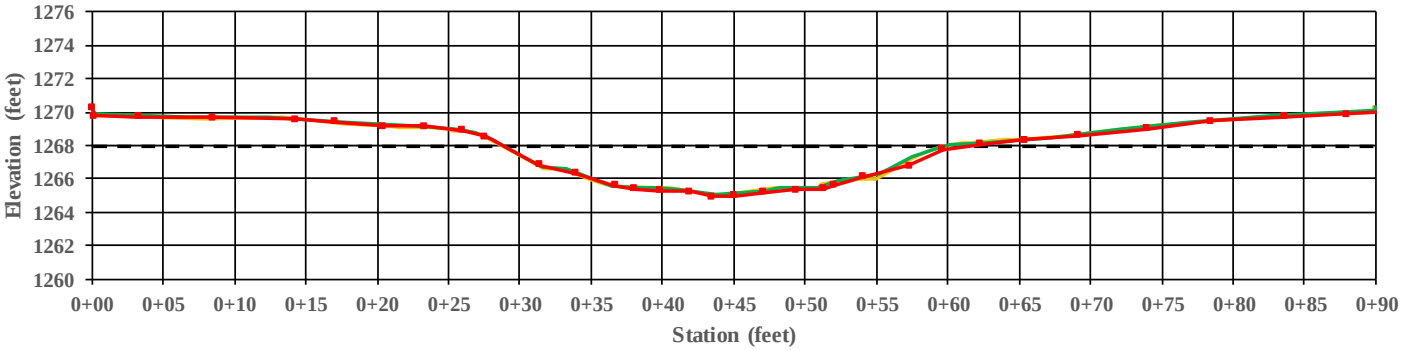
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	31.6	32.6	31.8	-	-	-	-	-
Floodprone Width (ft)	65.0	65.0	65.0	-	-	-	-	-
Bankfull Mean Depth (ft)	1.6	1.7	1.7	-	-	-	-	-
Bankfull Max Depth (ft)	2.3	2.6	2.6	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	50.5	54.1	52.8	-	-	-	-	-
Width/Depth Ratio	19.8	19.7	19.1	-	-	-	-	-
Entrenchment Ratio	2.1	2.0	2.0	-	-	-	-	-
Bank Height Ratio	1.0	0.942	0.988	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 5 **Station:** 107+45

Reach Name: South Muddy Creek **XS Type:** Riffle



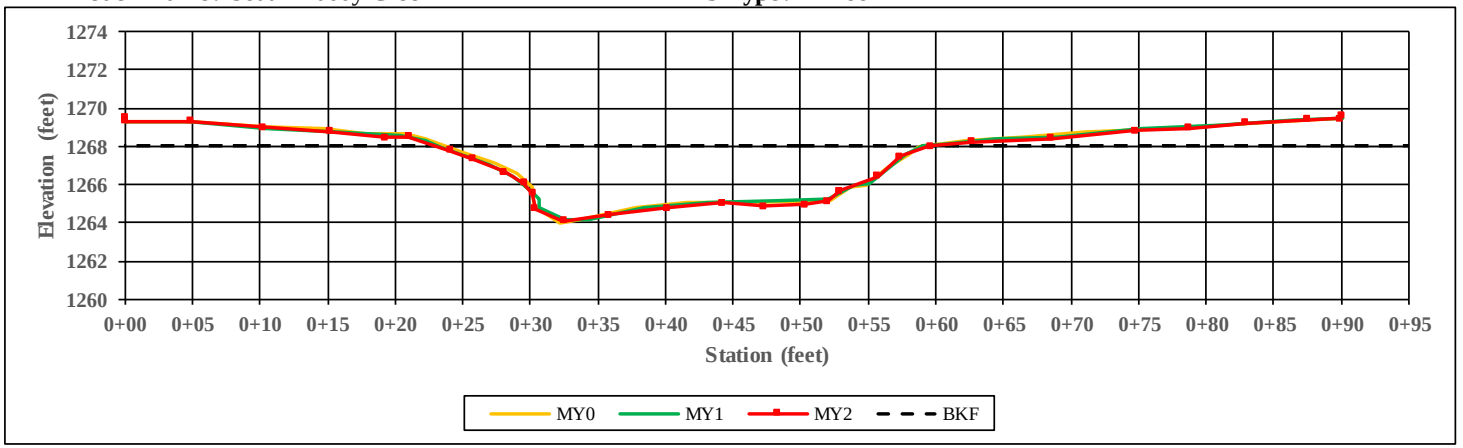
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	30.7	30.6	31.8	-	-	-	-	-
Floodprone Width (ft)	101.0	101.0	101.0	-	-	-	-	-
Bankfull Mean Depth (ft)	1.9	1.9	1.9	-	-	-	-	-
Bankfull Max Depth (ft)	2.8	2.8	3.0	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	59.0	57.9	61.3	-	-	-	-	-
Width/Depth Ratio	15.9	16.2	16.4	-	-	-	-	-
Entrenchment Ratio	3.3	3.3	3.2	-	-	-	-	-
Bank Height Ratio	1.0	1.044	1.060	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 6 **Station:** 108+57

Reach Name: South Muddy Creek **XS Type:** Pool



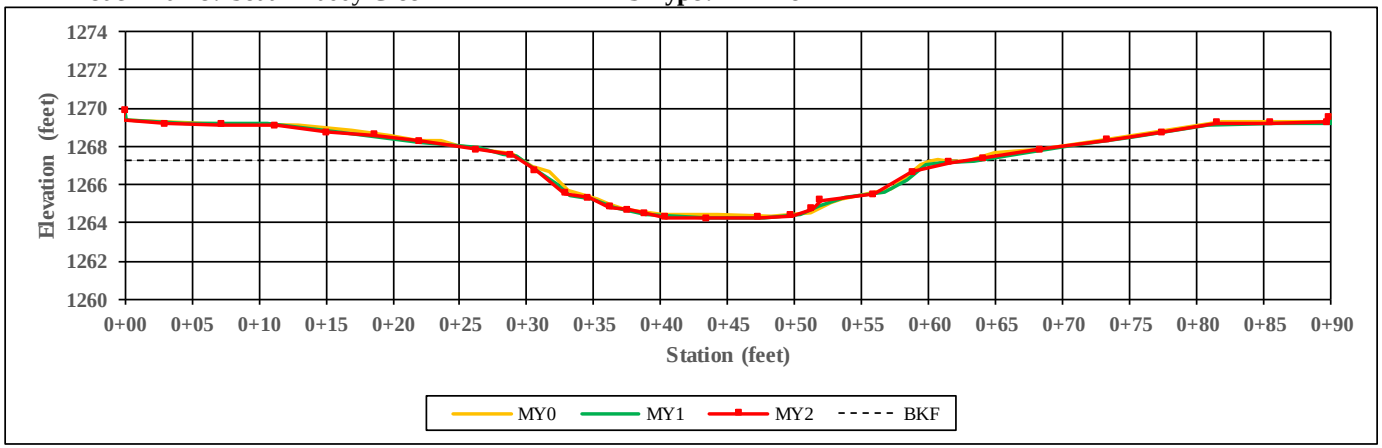
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	35.3	35.9	36.7	-	-	-	-	-
Floodprone Width (ft)	166.0	166.0	166.0	-	-	-	-	-
Bankfull Mean Depth (ft)	2.4	2.4	2.4	-	-	-	-	-
Bankfull Max Depth (ft)	4.0	3.9	3.9	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	85.7	86.3	89.2	-	-	-	-	-
Width/Depth Ratio	14.5	14.9	15.1	-	-	-	-	-
Entrenchment Ratio	4.7	4.6	4.5	-	-	-	-	-
Bank Height Ratio	1.0	0.999	0.995	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 7 **Station:** 109+57

Reach Name: South Muddy Creek **XS Type:** Riffle



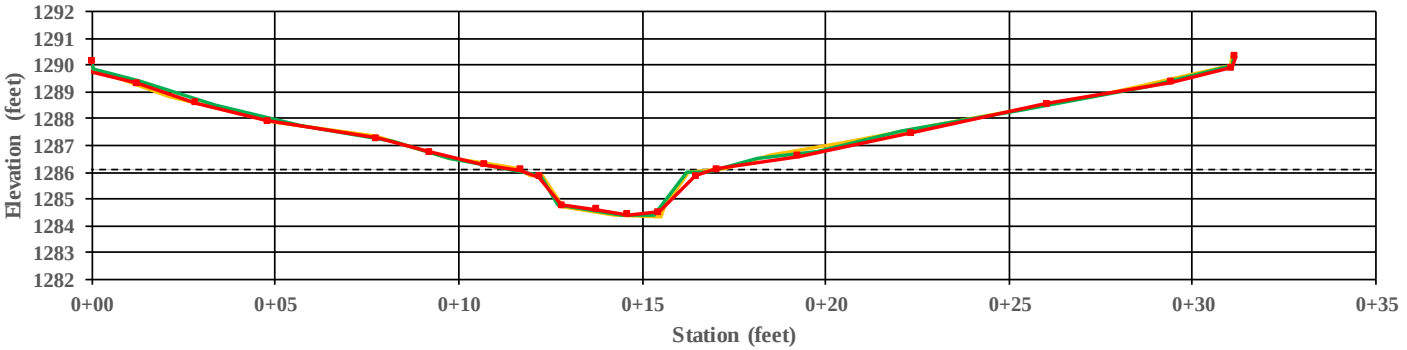
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	31.0	31.2	34.0	-	-	-	-	-
Floodprone Width (ft)	88.0	88.0	88.0	-	-	-	-	-
Bankfull Mean Depth (ft)	2.1	2.2	2.0	-	-	-	-	-
Bankfull Max Depth (ft)	2.9	3.0	3.1	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	64.9	67.7	67.9	-	-	-	-	-
Width/Depth Ratio	14.8	14.4	17.0	-	-	-	-	-
Entrenchment Ratio	2.8	2.8	2.6	-	-	-	-	-
Bank Height Ratio	1.0	0.944	0.946	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 8 **Station:** 302+13

Reach Name: Upper Iva Branch **XS Type:** Pool



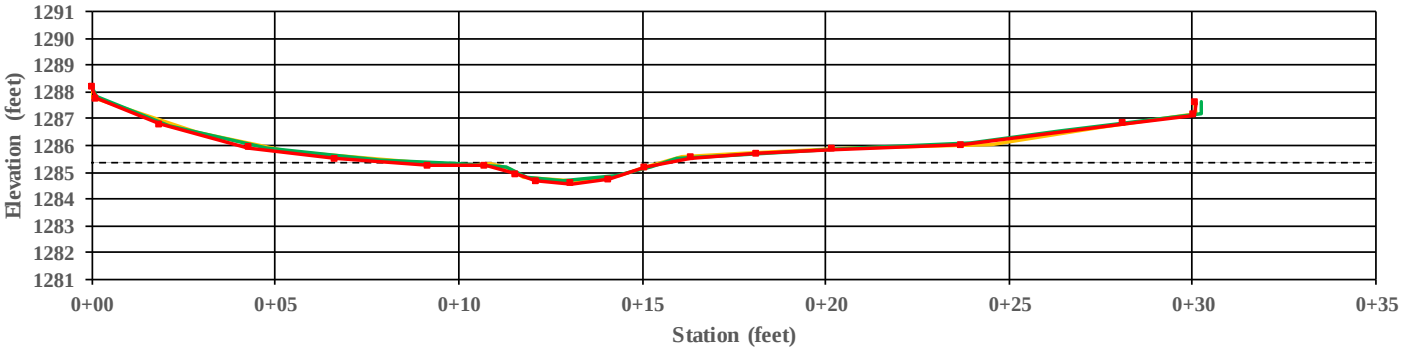
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	5.5	5.8	5.6	-	-	-	-	-
Floodprone Width (ft)	17.0	17.0	17.0	-	-	-	-	-
Bankfull Mean Depth (ft)	1.0	1.0	1.0	-	-	-	-	-
Bankfull Max Depth (ft)	1.8	1.7	1.7	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	5.7	5.6	5.6	-	-	-	-	-
Width/Depth Ratio	5.4	6.1	5.5	-	-	-	-	-
Entrenchment Ratio	3.1	2.9	3.1	-	-	-	-	-
Bank Height Ratio	1.0	0.922	0.976	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 9 **Station:** 302+82

Reach Name: Upper Iva Branch **XS Type:** Riffle



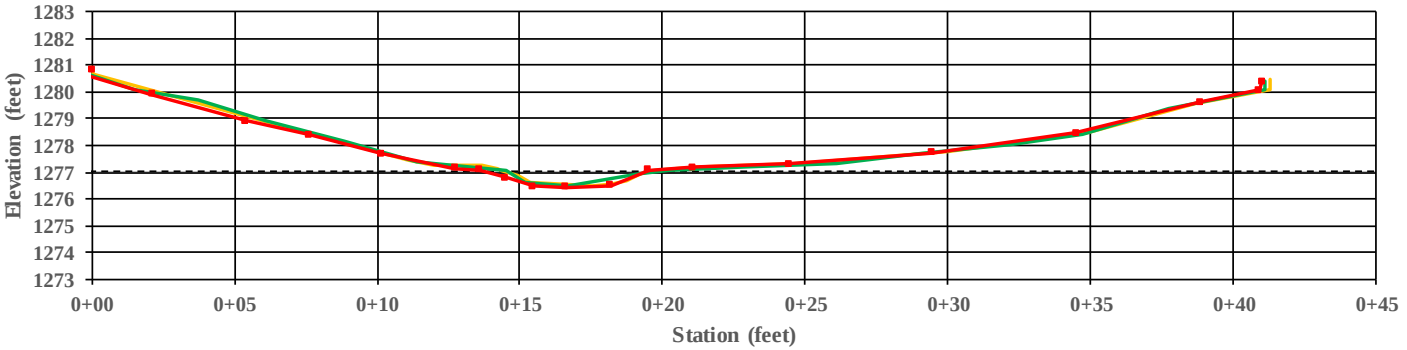
CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	4.6	4.2	4.1	-	-	-	-	-
Floodprone Width (ft)	14.0	14.0	14.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.4	0.4	0.5	-	-	-	-	-
Bankfull Max Depth (ft)	0.7	0.6	0.8	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	1.9	1.8	2.1	-	-	-	-	-
Width/Depth Ratio	11.0	9.8	8.0	-	-	-	-	-
Entrenchment Ratio	3.0	3.3	3.5	-	-	-	-	-
Bank Height Ratio	1.0	0.989	0.897	-	-	-	-	-

Left Descending Bank

Right Descending Bank

Project Name: Middle South Muddy **XS Number:** 10 **Station:** 304+20

Reach Name: Upper Iva Branch **XS Type:** Riffle

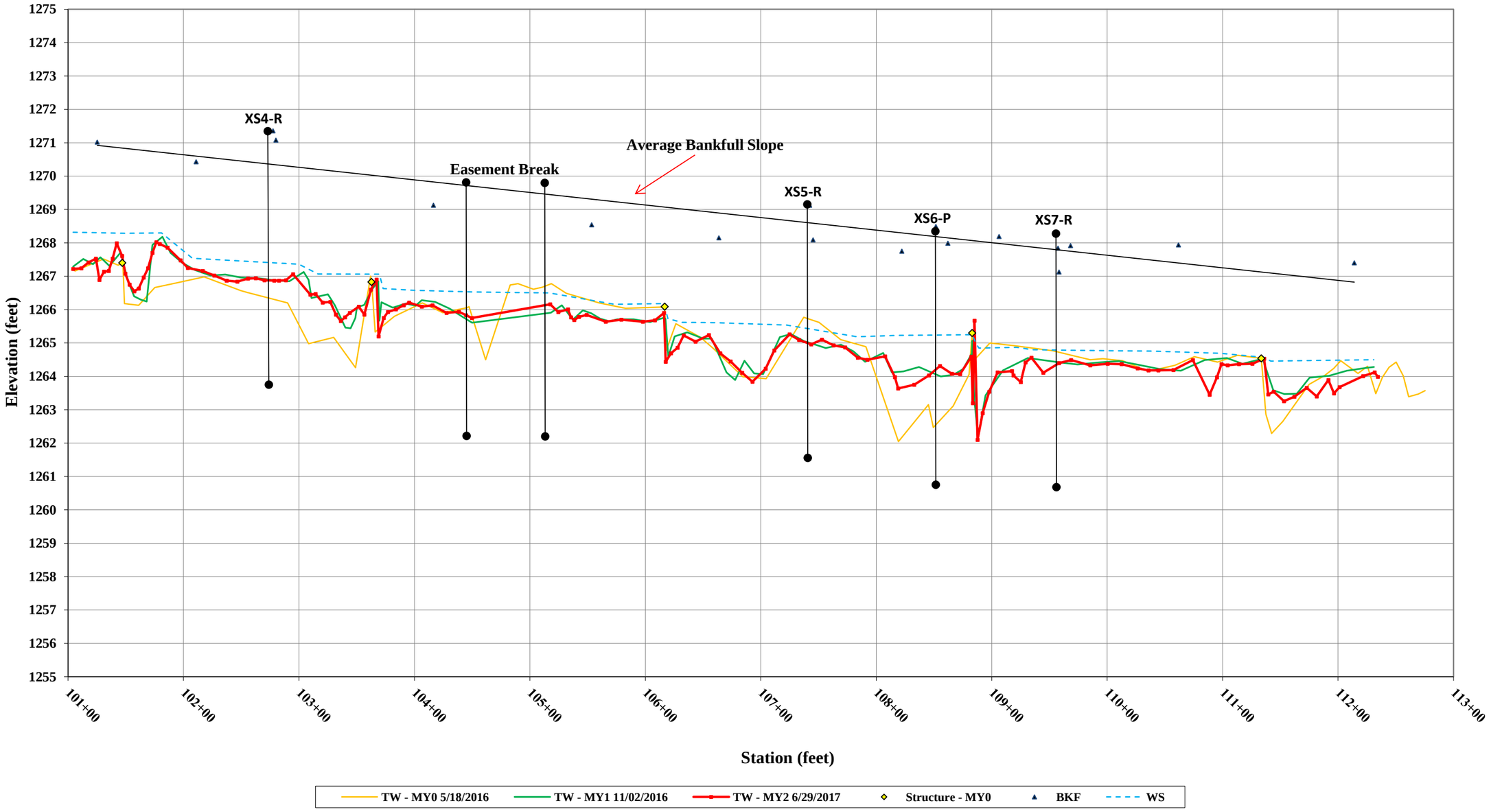


CHANNEL DIMENSIONS SUMMARY	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankful Width (ft)	5.3	5.6	5.8	-	-	-	-	-
Floodprone Width (ft)	17.0	17.0	17.0	-	-	-	-	-
Bankfull Mean Depth (ft)	0.4	0.3	0.4	-	-	-	-	-
Bankfull Max Depth (ft)	0.6	0.6	0.6	-	-	-	-	-
Bankfull Cross-Sectional Area (ft^2)	2.1	1.9	2.5	-	-	-	-	-
Width/Depth Ratio	13.3	16.7	13.3	-	-	-	-	-
Entrenchment Ratio	3.2	3.0	3.0	-	-	-	-	-
Bank Height Ratio	1.0	1.000	1.048	-	-	-	-	-

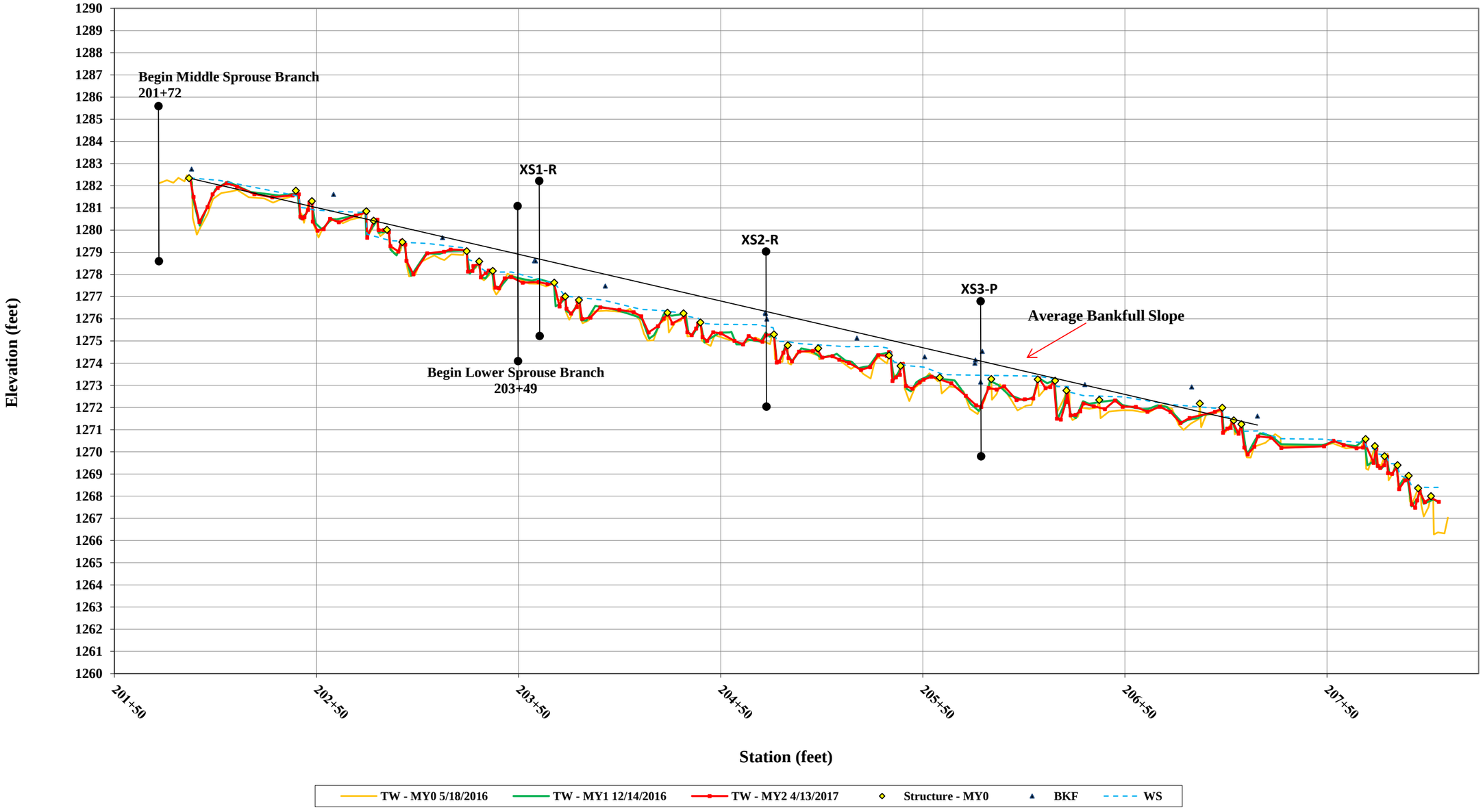
Left Descending Bank

Right Descending Bank

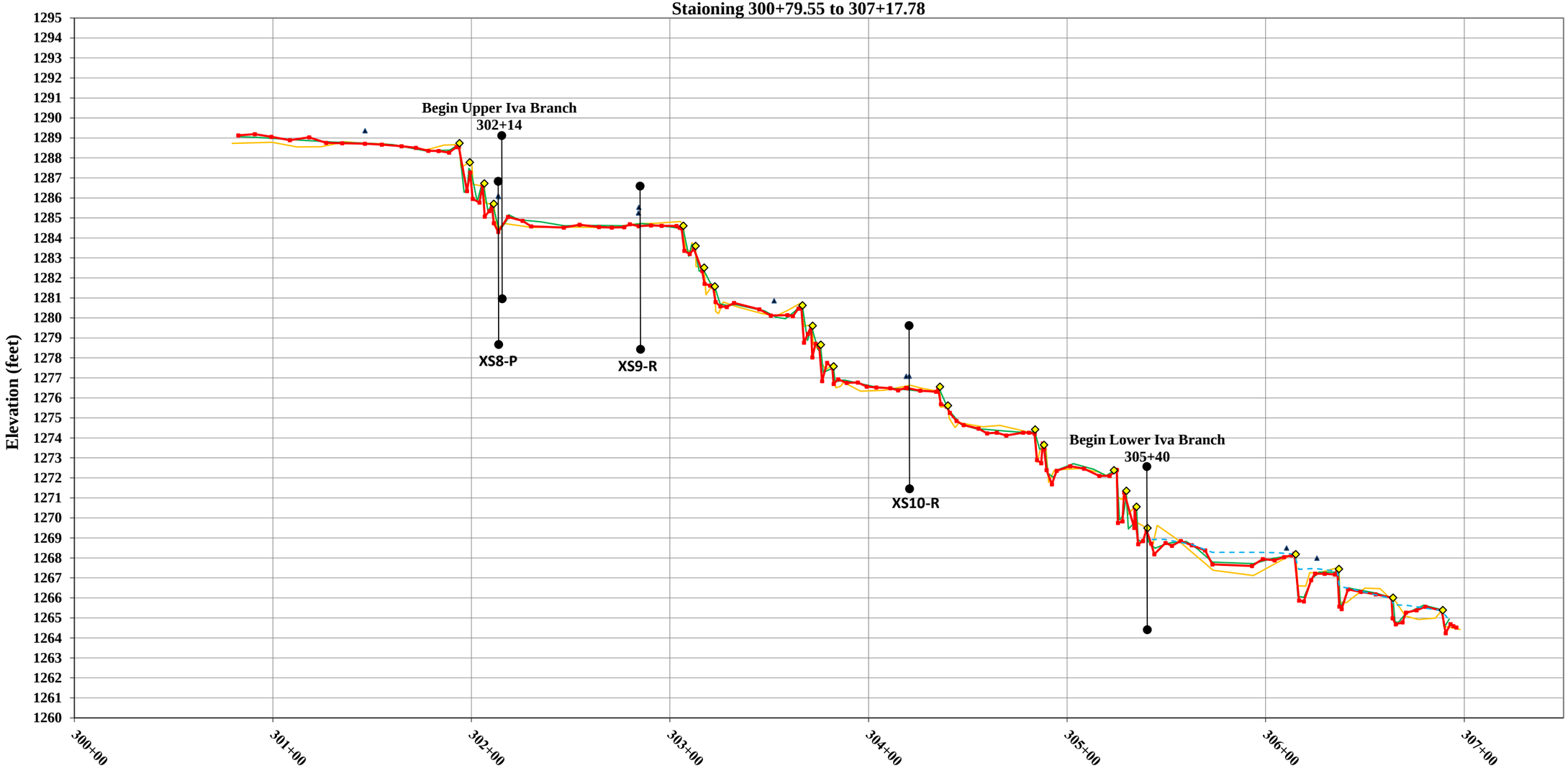
Middle South Muddy
South Muddy Creek
Longitudinal Profile
Staioning 101+00 to 112+75.16



Middle South Muddy
Sprouse Branch
Longitudinal Profile
Staioning 201+72.34 to 208+91.81



Middle South Muddy
Iva Branch
Longitudinal Profile
Staioning 300+79.55 to 307+17.78



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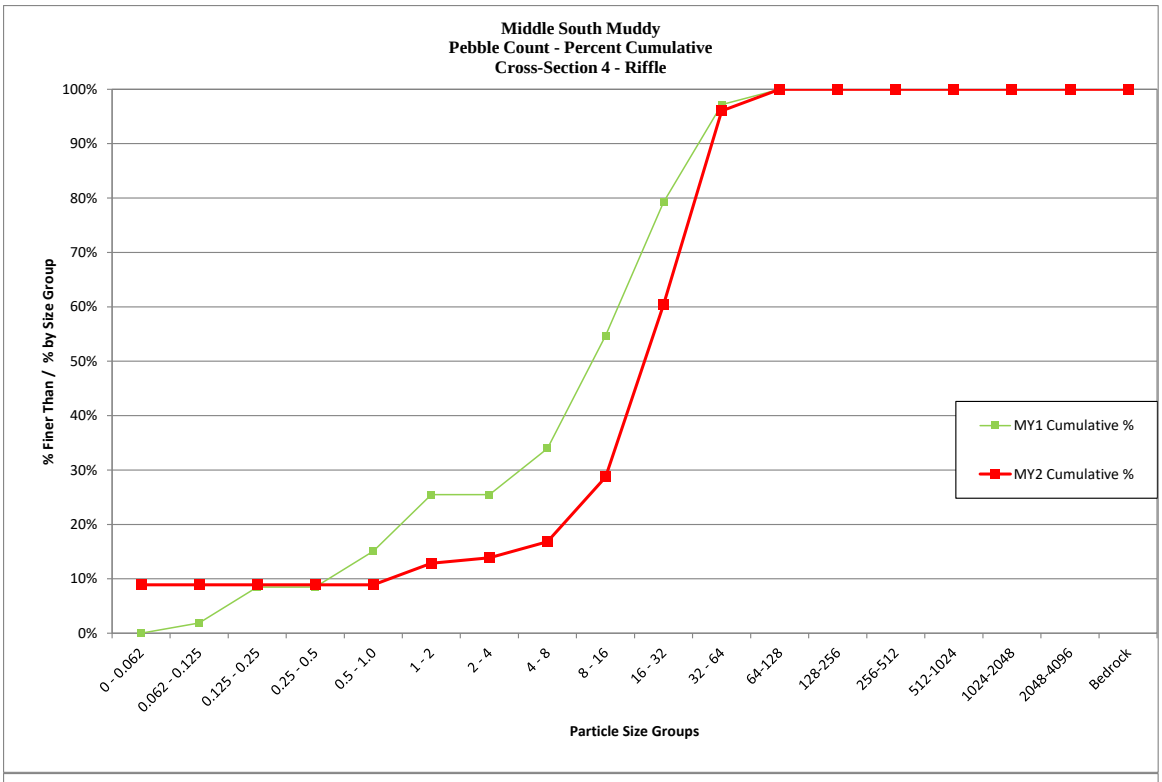
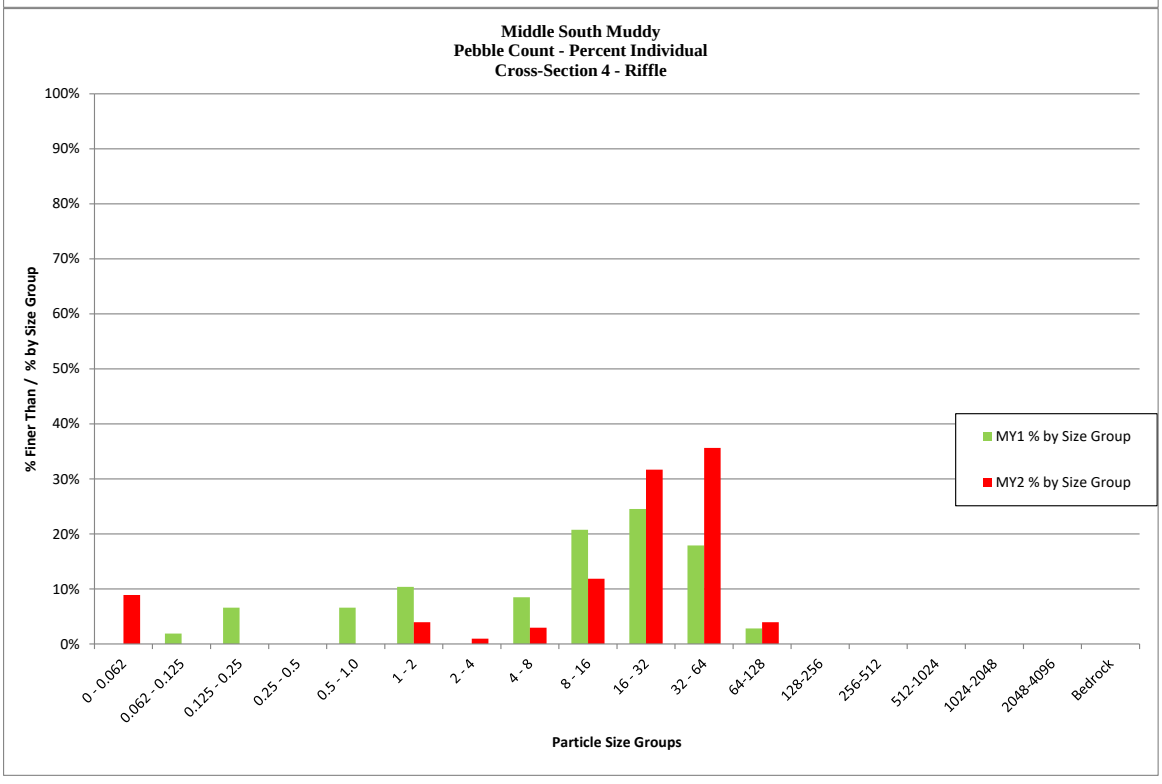
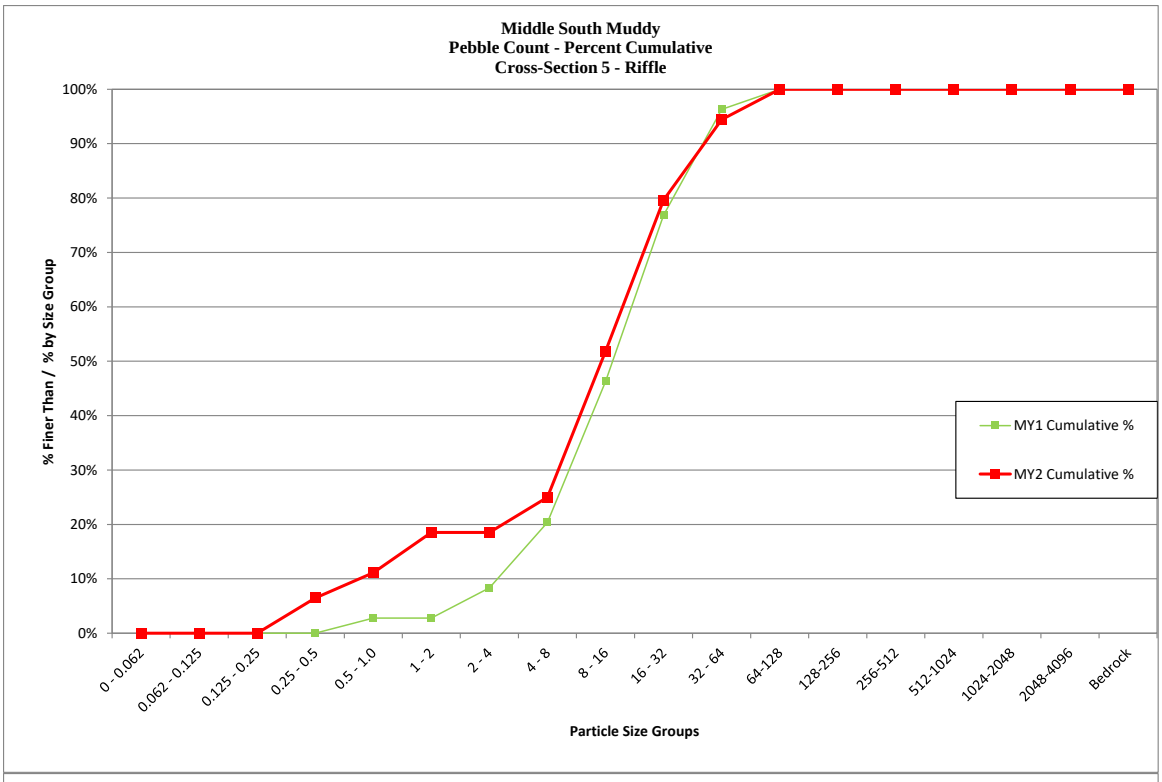
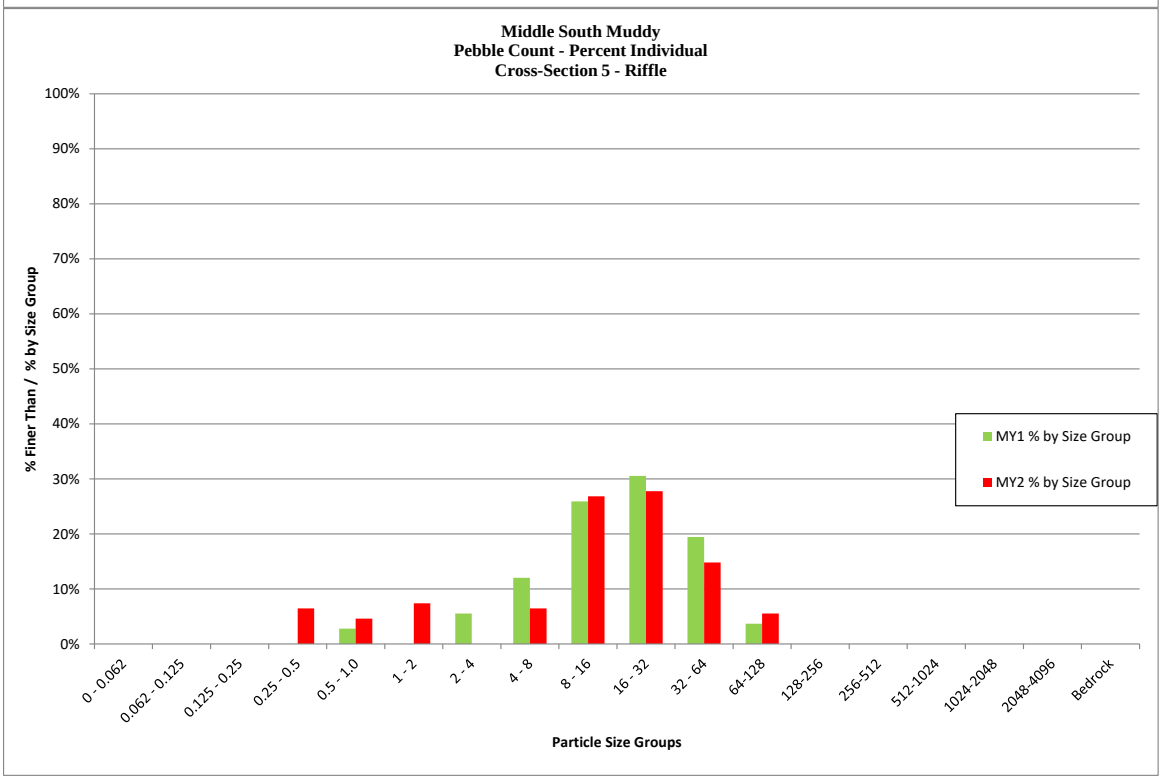
Middle South Muddy			
Cross Section 4 - Riffle			
Monitoring Year - 2017; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	9	8.9%	9%
0.062 - 0.125	0	0.0%	9%
0.125 - 0.25	0	0.0%	9%
0.25 - 0.5	0	0.0%	9%
0.5 - 1.0	0	0.0%	9%
1 - 2	4	4.0%	13%
2 - 4	1	1.0%	14%
4 - 8	3	3.0%	17%
8 - 16	12	11.9%	29%
16 - 32	32	31.7%	60%
32 - 64	36	35.6%	96%
64-128	4	4.0%	100%
128-256	0	0.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**101**	**100%**	**100%**
		Summary Data	
		D50	**27**
		D84	**50**
		D95	**63**


Middle South Muddy
Pebble Count - Percent Cumulative
Cross-Section 4 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 Cumulative %
MY2 Cumulative %

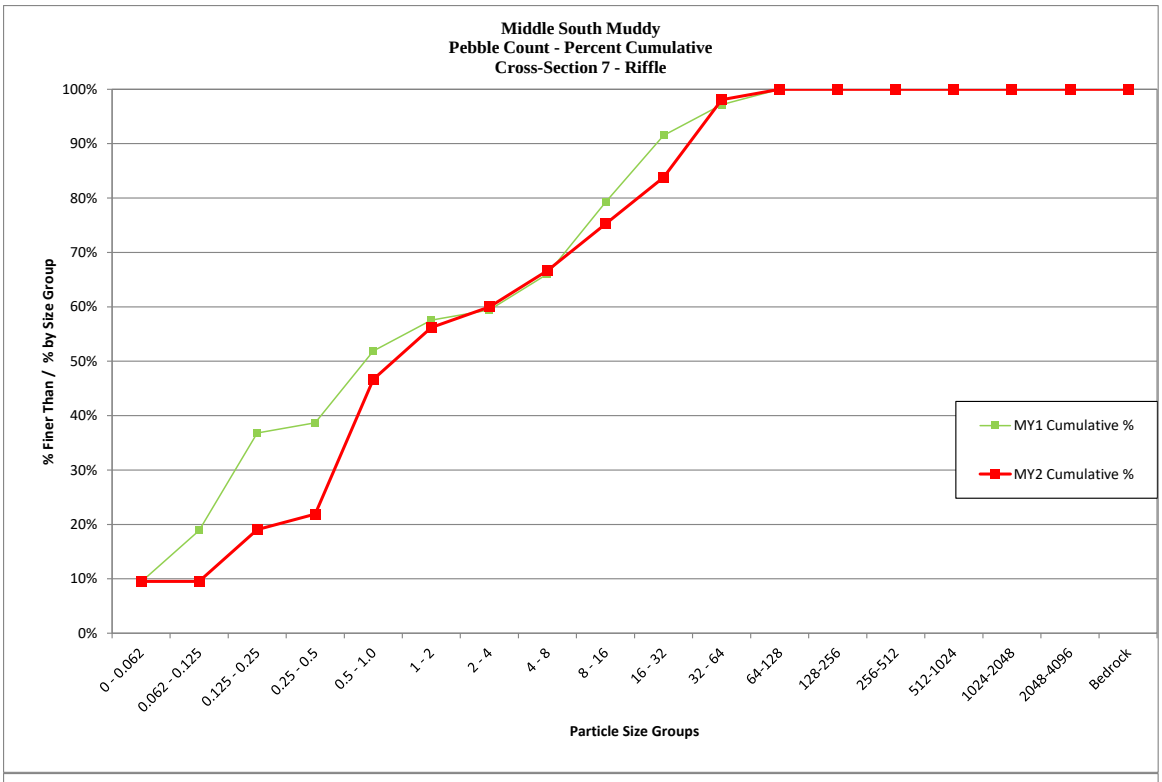

Middle South Muddy
Pebble Count - Percent Individual
Cross-Section 4 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 % by Size Group
MY2 % by Size Group

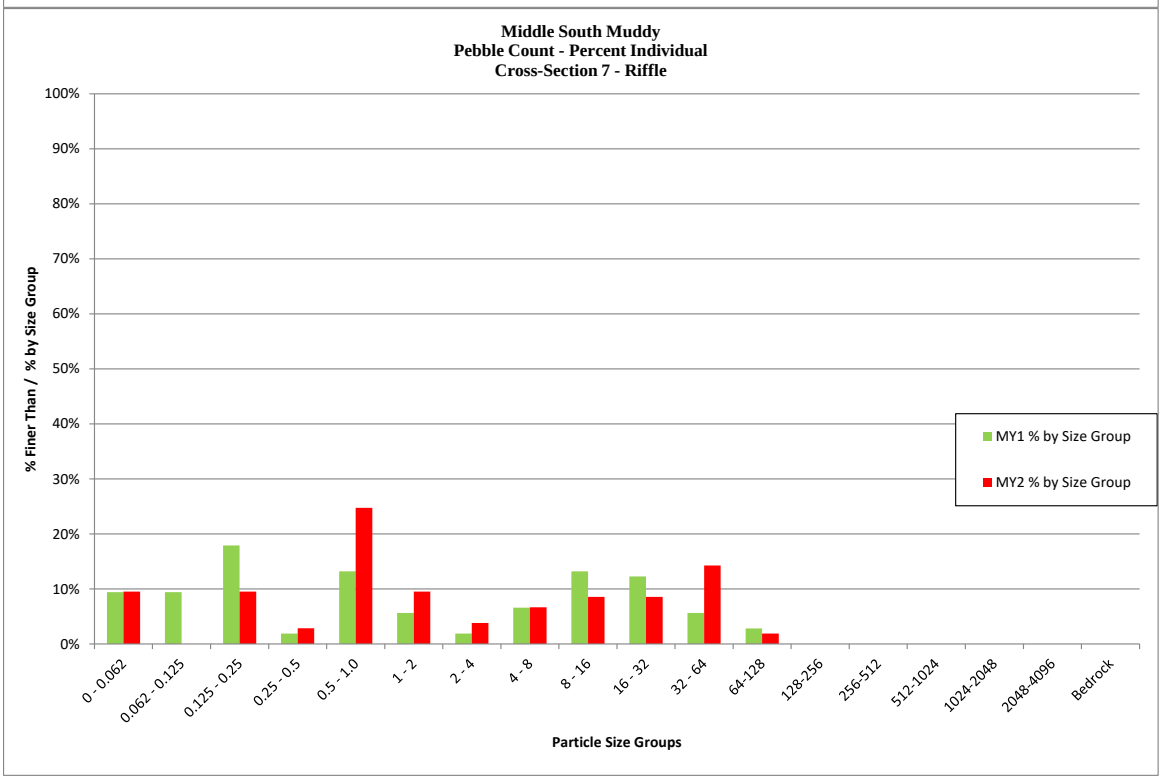
Middle South Muddy			
Cross Section 5 - Riffle			
Monitoring Year - 2017; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	0	0.0%	0%
0.062 - 0.125	0	0.0%	0%
0.125 - 0.25	0	0.0%	0%
0.25 - 0.5	7	6.5%	6%
0.5 - 1.0	5	4.6%	11%
1 - 2	8	7.4%	19%
2 - 4	0	0.0%	19%
4 - 8	7	6.5%	25%
8 - 16	29	26.9%	52%
16 - 32	30	27.8%	80%
32 - 64	16	14.8%	94%
64-128	6	5.6%	100%
128-256	0	0.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**108**	**100%**	**100%**
		Summary Data	
		D50	**15**
		D84	**38**
		D95	**69**


Middle South Muddy
Pebble Count - Percent Cumulative
Cross-Section 5 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 Cumulative %
MY2 Cumulative %


Middle South Muddy
Pebble Count - Percent Individual
Cross-Section 5 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 % by Size Group
MY2 % by Size Group

Middle South Muddy			
Cross Section 7 - Riffle			
Monitoring Year - 2017; MY2			
Bed Surface Material Particle Size Class (mm)	**Number**	**% Individual**	**% Cumulative**
0 - 0.062	10	9.5%	10%
0.062 - 0.125	0	0.0%	10%
0.125 - 0.25	10	9.5%	19%
0.25 - 0.5	3	2.9%	22%
0.5 - 1.0	26	24.8%	47%
1 - 2	10	9.5%	56%
2 - 4	4	3.8%	60%
4 - 8	7	6.7%	67%
8 - 16	9	8.6%	75%
16 - 32	9	8.6%	84%
32 - 64	15	14.3%	98%
64-128	2	1.9%	100%
128-256	0	0.0%	100%
256-512	0	0.0%	100%
512-1024	0	0.0%	100%
1024-2048	0	0.0%	100%
2048-4096	0	0.0%	100%
Bedrock	0	0.0%	100%
Total	**105**	**100%**	**100%**
		Summary Data	
		D50	**1.3**
		D84	**32**
		D95	**51**


Middle South Muddy
Pebble Count - Percent Cumulative
Cross-Section 7 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 Cumulative %
MY2 Cumulative %


Middle South Muddy
Pebble Count - Percent Individual
Cross-Section 7 - Riffle
% Finer Than / % by Size Group
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0 - 0.062
0.062 - 0.125
0.125 - 0.25
0.25 - 0.5
0.5 - 1.0
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64-128
128-256
256-512
512-1024
1024-2048
2048-4096
Bedrock
Particle Size Groups
MY1 % by Size Group
MY2 % by Size Group

Appendix E
Hydrologic Data

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Table 12. Verification of Bankfull Events Middle South Muddy Stream Restoration Project				
South Muddy Creek				
Date of Data Collection	**Date of Occurrence**	**Method**	**Feet Above Bankfull Elevation**	**Photo # (if available)**
2/25/2016	Unknown[1]	Wrack Lines	Unknown	-
10/27/2017	Unknown[2]	Wrack Lines	Unknown	1
Sprouse Branch				
Date of Data Collection	**Date of Occurrence**	**Method**	**Feet Above Bankfull Elevation**	**Photo # (if available)**
3/23/2016	Unknown[1]	Wrack Lines	Unknown	-
10/27/2017	Unknown[2]	Crest Gauge	1.08	2
Iva Branch				
Date of Data Collection	**Date of Occurrence**	**Method**	**Feet Above Bankfull Elevation**	**Photo # (if available)**
2/25/2016	Unknown[1]	Wrack Lines	Unknown	-
10/27/2017	Unknown[2]	Wrack Lines	Unknown	3

[1]Potential Date is 2/2/2016

[2]Potential Date is 10/23/2017

Photo Verification of Bankfull Events

Photo #1 - South Muddy Creek Wrack Lines STA 104+00

Photo Verification of Bankfull Events

Photo #2 – Sprouse Branch Crest Gauge at 22 inches

Photo #3 – Iva Branch Wrack Lines at STA 305+00

Figure 3. Daily Precipitation Totals for the Middle South Muddy Stream Restoration Site Project

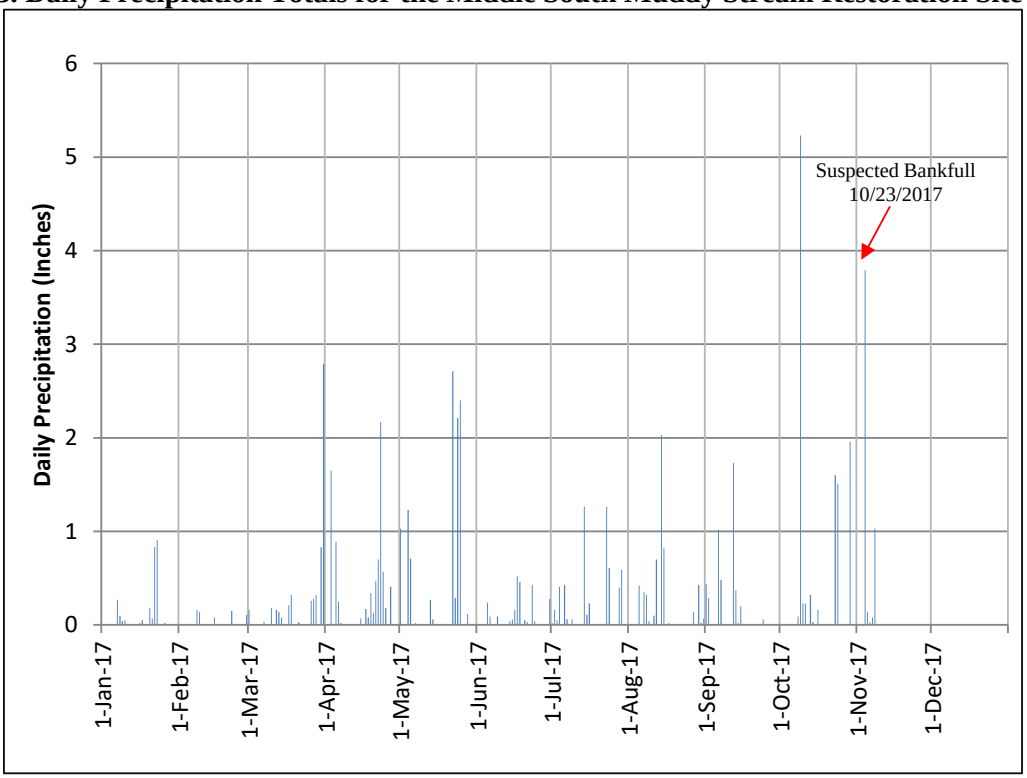

Figure 4. Monthly Precipitation Data Compared to 30th and 70th Percentiles for McDowell County