

Mitigation Project Name: Byrd's Creek Mitigation Site
 DMS ID: 06020
 River Basin: Neuse
 Cataloging Unit: 06020201

County: Person
 Date Project Instituted: 7/27/2011
 Date Prepared: 6/22/2018


USACE Action ID: 2012-00230
 NCDWR Permit No: 2012-0102

Credit Release Milestone	Stream Credits					Wetland Credits								
	Scheduled Release (Stream)	Warm	Coel	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Release (Forested)	Riparian Reserve	Riparian Non-forested	Non-riparian	Scheduled Release (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)	5,592,599													
Potential Credits (As-Built Survey)	3,379,687													
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A	N/A	N/A	N/A
2 (Year 1 Monitoring)	35%	4,811,200			2014	3/31/2014	30%				N/A	N/A	N/A	N/A
3 (Year 4 Monitoring)	15%	537,067			2015	4/29/2015	10%				N/A	N/A	N/A	N/A
4 (Year 2 Monitoring)	10%	537,067			2016	4/29/2016	15%				N/A	N/A	N/A	N/A
5 (Year 3 Monitoring)	10%	537,067			2017	4/29/2017	20%				N/A	N/A	N/A	N/A
6 (Year 4 Monitoring)	10%	537,067			2018	4/29/2018	10%				N/A	N/A	N/A	N/A
7 (Year 5 Monitoring)	10%				2019		15%				N/A	N/A	N/A	N/A
Stream Bankfull Standard	15%	805,600			2017	4/30/2017	N/A				N/A	N/A	N/A	N/A
Total Credits Released to Date		4,565,867												

DEBITS (released credits only)

Release	1	1.5	2.5	5	1	3	2	5	1	3	2	5	1	3	2	5
	Soilbank Mitigation	Soilbank Enhancement I	Stream Enhancement II	Stream Enhancement III	Stream Enhancement IV	Stream Enhancement V	Stream Enhancement VI	Stream Enhancement VII	Stream Enhancement VIII	Stream Enhancement IX	Stream Enhancement X	Stream Enhancement XI	Stream Enhancement XII	Stream Enhancement XIII	Stream Enhancement XIV	Stream Enhancement XV
As-Built Amounts (feet and acres)	3,096,900	2,482,600	2,055,000													
As-Built Amounts (mitigation credits)	3,095,000	1,454,687	829,099													
Percentage Released	85%	85%	85%													
Released Amounts (feet / acres)	2,631,630	1,054,760	1,743,500													
Released Amounts (credits)	2,631,630	1,036,407	697,000													
NCDWR Permit	USACE Action ID	Project Name														
2001-1688	2002-20610	NCDOT TIP R-2547 / R-2641 - Knightdale Bypass	84,800													
2001-0550	1999-01636	NCDOT TIP R-2609 - Wake Forest Bypass	430,000													
2001-0681	1997-00176	NCDOT TIP R-2607 - Widening of NC 55 at Sunset Lake	0,150													
2007-0018	2007-01105-202	42 East	210,700													
2007-1057	2007-02520-202	Perry Creek Road Ext	193,290													
2007-1057	2007-02520-202	Perry Creek Road Ext	326,420													
2006-1817	2006-20105-202	Wendell Falls	326,180	615,000												
2004-1111	2004-20254 / 2004-21570 / 2004-21571	Brightleaf at the Park	206,000													
2000-20343 to 2000-20346		Heritage SD	10,800	218,200	205,000											
2001-1688	2002-20610	2641 - Knightdale Bypass	300,600	718,200	205,000											
2003-0373	2002-21036 / 2003-21102	Bahworth Estates & Camson Park	121,410													
1996-0319	1990-20347	NCDOT TIP R-2005F / G - Northern Wake Expressway Farmington Woods Subdivision	1,080													
2000-0889	2000-21173	Stonewalls Subdivision	72,420													
2002-1034	2002-21496	Stonewalls Subdivision, Phase 2 & 3	149,480													
2005-1131	2005-21042 / 2006-20114	Repechage Parkway Extension	213,870													
2006-1800	2006-22526-202	Perry Creek	315,640	84,170												
2001-0550	1999-01636	NCDOT TIP R-2609 - Wake Forest Bypass	277,880													
2001-1688	2002-20610	2641 - Knightdale Bypass	183,350	512,500												
2000-1126	1995-21144	NCDOT TIP R-2542B - Edwards Mill Extension	8,590													
2001-1689	2002-20310	2641 - Knightdale Bypass	180,242													
2000-20343 to 2000-20346		Heritage SD	111,776	203,833												
2006-1817	2006-20105-202	Wendell Falls	14,567	205,000												
Remaining Amounts (feet / acres)	6,000	6,000	6,000													
Remaining Amounts (credits)	6,000	6,000	6,000													

Contingencies (if any): None

Signature of Wilmington District Official Approving Credit Release:  Date: 9/6/18

- 1 - For DMS, no credits are released during the first milestone
- 2 - For DMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCEEP Portal, provided the following criteria have been met:
 - 1) Approval of the final Mitigation Plan
 - 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
 - 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
 - 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required

3 - A 15% reserve of credits is to be held back until the bankfull event performance standard has been met



MONITORING YEAR 5 of 5 ANNUAL REPORT

FINAL

BYRDS CREEK MITIGATION SITE

Person County, NC

NCDEQ Contract 003987

DMS Project Number 95020

USACE Action ID Number 2012-00230

NCDWR Project Number 2012-0102

Data Collection Period: January 2018 - October 2018

Draft Submission Date: November 29, 2018

Final Submission Date: December 18, 2018

PREPARED FOR:



NC Department of Environment Quality

Division of Mitigation Services

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EXECUTIVE SUMMARY

Wildlands Engineering (Wildlands) completed a full delivery project for the North Carolina Division of Mitigation Services (DMS) to restore and enhance a total of 7,328 linear feet of stream in Person County, North Carolina. The project streams consist of Byrds Creek, a third order stream, as well as three unnamed first and second order tributaries to Byrds Creek (South Branch, Southeast Branch, and West Branch). The project provides 5,371 stream mitigation units (SMU's). At the downstream limits of the project, the drainage area is 2,957 acres (4.62 square miles).

The Byrds Creek Mitigation Site, hereafter referred to as the Site, is approximately 1.8 miles south of Hurdle Mills, NC off of Wolfe Road in southwestern Person County (Figure 1). The Site is located in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The Site is within the South Flat River watershed, North Carolina Division of Water Resources (NCDWR) Subbasin 03-04-01 of the Neuse River Basin, and United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 03020201010020. Land use within the watershed is rural and is dominated by forestry, agriculture, and livestock operations, with approximately 60% of the watershed used for agriculture and 40% forested. The Site is located in an active agricultural field surrounded by wooded lots, small agricultural operations, and rural residential areas. Prior to construction activities, the streams on the Site were heavily impacted by cattle, which led to stream bank erosion and instability.

The following project goals were established to address the effects from watershed and project site stressors:

- Reduce nutrient loads within the watershed and to downstream waters;
- Stabilize eroding stream banks greatly reducing sediment loads;
- Restore riffle/pool sequencing resulting in decreased water temperatures and increased dissolved oxygen concentrations;
- Establish in-stream structures to improve habitat diversity and trap detritus;
- Restore native vegetation and riparian buffers; and
- Protect the restored land in perpetuity through a conservation easement.

These goals were achieved by restoring 3,096 LF of perennial and intermittent stream channel and enhancing 4,232 LF of perennial stream channel. Restoration and enhancement construction was completed in September 2013 and planting efforts were completed in December 2013. A conservation easement is in place on 24.4 acres of riparian corridor and stream resources to protect them in perpetuity.

Monitoring Year 5 (MY-5) monitoring and site visits were completed between the months of January and October 2018 to assess the conditions of the Site. The Site's overall average planted stem density of 503 stems per acre is greater than the success criteria of 260 stems per acre required for MY-5. All streams within the Site are stable and functioning as designed. There are three areas of bank erosion on Byrds Creek reach 3 that will be repaired during the winter of 2018/2019. Two sections of stream had some minor erosion as a result of Hurricanes Florence and Michael, and a small section of stream erosion has resulted from a beaver dam. Overall, these isolated sections total approximately 90 linear feet. Hydrologic monitoring gages documented multiple bankfull events during subsequent years for all streams on the Site and have met the MY-5 hydrology success criteria.



BYRDS CREEK MITIGATION SITE
Monitoring Year 5 Annual Report

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Section 1: PROJECT OVERVIEW

The Byrds Creek Mitigation Site, hereafter referred to as the Site, is located in southwestern Person County within the Neuse River Basin (USGS Hydrologic Unit 03020201). The project site is located south of Hurdle Mills off of Wolfe Road and is in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The Multi-Resolution Land Characteristics Consortium (MRLC, 2001) classified approximately 57% of the land in the project watershed as managed herbaceous cover or agricultural, 42% is classified as forested/scrubland, and the remaining 1% as open water. The drainage area for the Byrds Creek Site is 2,957 acres (4.62 square miles).

The project stream reaches consist of Byrds Creek reach 2 (BC2), Byrds Creek reach 3 (BC3), South branch (SB1), Southeast branch reach 1 (SE1), and Southeast branch reach 2 (SE2) which are stream restoration and/or enhancement level I approach. The project also consists of Byrds Creek reach 1 (BC1), Byrds Creek reach 4 (BC4), and West branch (WB1) which are enhancement level II approach. Mitigation work within the Site included restoring and enhancing 7,328 linear feet of perennial and intermittent stream channel. The stream areas were also planted with native vegetation to improve habitat and protect water quality. The project provides 5,371 stream mitigation units (SMU's). The final mitigation plan was submitted and accepted by DMS in January 2013. Construction activities were completed by North State Environmental in September 2013 and planting and seeding activities were completed by Bruton Natural Systems, Inc. in December 2013. Baseline monitoring (MY-0) was conducted between September 2013 and January 2014. Annual monitoring has been conducted for five years with the close-out anticipated to commence in 2019 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project. Three separate conservation easements have been recorded and are in place along the riparian corridors and stream resources to protect them in perpetuity. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figure 2.

1.1 Project Goals and Objectives

Prior to construction activities, the streams on the Byrds Creek Site were heavily impacted by cattle, which led to stream bank erosion and instability. Related degradation included declining aquatic habitat, loss of forest, degraded riparian buffers, and water quality problems related to increased sediment and nutrient loadings. Tables 10a-c in Appendix 4 present the pre-restoration conditions in detail.

The Site was designed to meet the over-arching goals as described in the mitigation plan (Wildlands, 2013). The project is intended to provide numerous ecological benefits within the Neuse River Basin. While many of these benefits are limited to the Site, others, such as pollutant removal and improved aquatic and terrestrial habitat, have farther-reaching effects. The following project specific goals established in the mitigation plan included:

- Reduce nutrient loads within the watershed and to downstream waters;
- Stabilize eroding stream banks greatly reducing sediment loads;
- Restore riffle/pool sequencing resulting in decreased water temperatures and increased dissolved oxygen concentrations;
- Establish in-stream structures to improve habitat diversity and trap detritus;
- Restore native vegetation and riparian buffers; and
- Protect the restored land in perpetuity through a conservation easement.

The design features of this project were developed to achieve multiple project objectives. The stream restoration reaches were designed to frequently flood the reconnected floodplain. This design approach provides more frequent dissipation of energy from higher flows (bankfull and above) to improve channel

stability; provide water quality treatment through detention, settling, and biological removal of pollutants; and restore a more natural hydrologic regime. The project objectives defined in the mitigation plan (Wildlands, 2013) are as follows:

- On-site nutrient inputs will be decreased by removing cattle from streams and filtering on-site runoff through buffer zones. Off-site nutrient input will be absorbed on-site by filtering flood flows through restored floodplain areas, where flood flow will spread through native vegetation. Vegetation is expected to uptake excess nutrients.
- Stream bank erosion which contributes sediment load to the creek will be greatly reduced in the project area. Eroding stream banks will be stabilized using bioengineering, natural channel design techniques, and grading to reduce bank angles and bank height. Storm flow containing sediment will be filtered through restored floodplain areas, where flow will spread through native vegetation. Spreading flood flows will also reduce velocity and allow sediment to settle out. Sediment transport capacity of restored reaches will be improved so that capacity balances more closely to load. Sediment load reduction will be monitored through assessing bank stability with cross section and profile surveys and visual assessment through photo documentation which serves as an accepted surrogate for direct turbidity measurements.
- Restored riffle/pool sequences will promote aeration of water and create deep water zones, helping to lower water temperature. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating. Lower water temperatures will help maintain dissolved oxygen concentrations.
- In-stream structures will be constructed to improve habitat diversity and trap detritus. Wood habitat structures will be included in the stream as part of the restoration design. Such structures may include log drops and rock structures that incorporate woody debris.
- Adjacent buffer and riparian habitats will be restored with native vegetation as part of the project. Native vegetation will provide cover and food for terrestrial creatures. Native plant species will be planted and invasive species will be treated. Eroding and unstable areas will also be stabilized with vegetation as part of this project.
- The restored land will be protected in perpetuity through a conservation easement.

The design streams were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration to existing watershed conditions and trajectory. The designs were developed to correct incision and lack of pattern caused by channelization, bank instability caused by erosion and livestock access, lack of vegetation in riparian zones, and lack of riparian and aquatic habitat.

1.2 Monitoring Year 5 Data Assessment

Annual monitoring and site visits were conducted during MY-5 to assess the condition of the project. The stream success criteria for the Site follows the approved success criteria presented in the Byrds Creek Mitigation Plan (Wildlands, 2013).

1.2.1 Vegetative Assessment

A total of 14 vegetation plots were established within the project easement area during the baseline monitoring. Thirteen of the plots were established as standard 10 meter by 10 meter plots with one plot established as a 5 meter by 20 meter plot. The final vegetative success criteria is the survival of 260 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of MY-5.

The MY-5 vegetative survey was completed in August 2018. The 2018 annual vegetation monitoring resulted in an average planted stem density of 503 planted stems per acre, which is greater than the

requirement of 260 planted stems per acre. All 14 vegetation plots met success criteria during MY-5 with a range of 324 to 728 planted stems per acre. The MY-5 planted stem density is approximately 31% less than the baseline density recorded (734 stems per acre) in January 2014 and there is an average of 12 stems per plot. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

During MY-4 an area of easement encroachment was discovered along a portion of Byrds Creek reach 4. This area was replanted during the winter of 2017/2018 with trees of a similar age and size to the ones that were mowed. Refer to the CCPV Map in Appendix 2 for the area that was replanted.

1.2.3 Stream Assessment

Morphological surveys for MY-5 were conducted in June 2018. All streams within the Site are stable with the exception of a few isolated areas of bank erosion. Refer to Appendix 2 for the visual assessment table, integrated current condition plan view (CCPV) map (Figure 3), and reference photographs. Refer to Appendix 4 for the morphological data and plots.

While there have been some minor post-construction adjustments within the restored channels; the cross sections show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Surveyed riffle cross sections fell within the parameters defined for channels of the appropriate Rosgen stream type. The surveyed longitudinal profile data for BC2, BC3, SB1, SE1, SE2a and SE2b illustrates that the bedform features are maintaining lateral and vertical stability. The riffles are remaining steeper and shallower than the pools, while the pools are remaining deeper than the riffles and maintaining flat water surface slopes. The longitudinal profiles show that the bank height ratios remain at or very near to 1.0 for the restoration reaches. Entrenchment ratios vary slightly from year to year due to minor changes in bankfull widths. Small adjustments in width occur due to vegetation, sediment deposition, and many other factors. These minor changes do not indicate channel instability.

The Site was walked after Hurricane Florence and minimum damage was found. A debris jam was blocking the culvert on BC2 and was removed immediately.

Two beaver dams were observed along Byrds Creek reach 3 in November 2018 (MY-5) and the USDA was contracted to trap beaver and breach the dams. Trapping and dam removal have been initiated at the Site and beaver activity will continued to be monitored and controlled as necessary. Minor bank erosion was observed as a result of the dams. Also, after Hurricanes Florence and Michael two isolated areas of bank scour along Byrds Creek reach 3 were observed. Land Mechanics Designs, Inc. has been contracted to repair these areas. Stream banks will be graded, seeded, matted, and planted with live stakes as needed to stabilize any damaged areas and replace vegetation removed by beaver activity. Repair work is anticipated to be completed by the middle of December 2018.

1.2.4 Stream Areas of Concern

Beaver activity has not been observed on the Site since the removal of two beaver in early November 2018. Beaver presence and the repair areas discussed in section 1.2.3 above will continue to be monitored.

1.2.5 Hydrology Assessment

At the end of the five-year monitoring period, two or more bankfull events must have occurred in separate years within the restoration reaches. Bankfull events were recorded on all restoration reaches during MY-5. Byrds Creek and South Branch have each had bankfull events during MY-1, MY-2, MY-3,



and MY-4. Therefore, they have met the hydrology success criteria for the Site. Southeast Branch recorded bankfull events during MY-2, MY-3, and MY-4 meeting hydrology success criteria as well. Refer to Appendix 5 for hydrologic data.

1.2.6 Maintenance Plan

As described in section 1.2.3 above, stream repair work will be performed during the winter of 2018.

1.3 Monitoring Year 5 Summary

All individual vegetation plots met the MY-5 success criteria and the average planted stem density for the Site is 503 stems per acre. All streams within the Site are stable and functioning as designed. A few small areas of stream bank erosion will be repaired during the winter of 2018. Bankfull events were recorded on all three restoration reaches during MY-5. The terminal stream hydrology success criteria has been met on Byrds Creek, South Branch, and Southeast Branch. Beaver activity was observed during MY-5 and were removed from the Site in November 2018.

Summary information and data related to the performance of the 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 Mitigation Plan documents available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.



Section 2: METHODOLOGY

Geomorphic data was collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). Longitudinal and cross-sectional data was collected using a total station and were georeferenced. All CCPV mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcView. Crest gages were installed in surveyed riffle cross sections and monitored quarterly. Hydrology attainment installation and monitoring methods are in accordance with the USACE (2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-DMS Level 2 Protocol (Lee et al., 2008). Reporting follows the DMS Monitoring Report Template and Guidance Version 1.3 (DMS, 2010).



Section 3: REFERENCES

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APPENDIX 1. General Tables and Figures

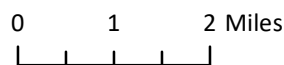
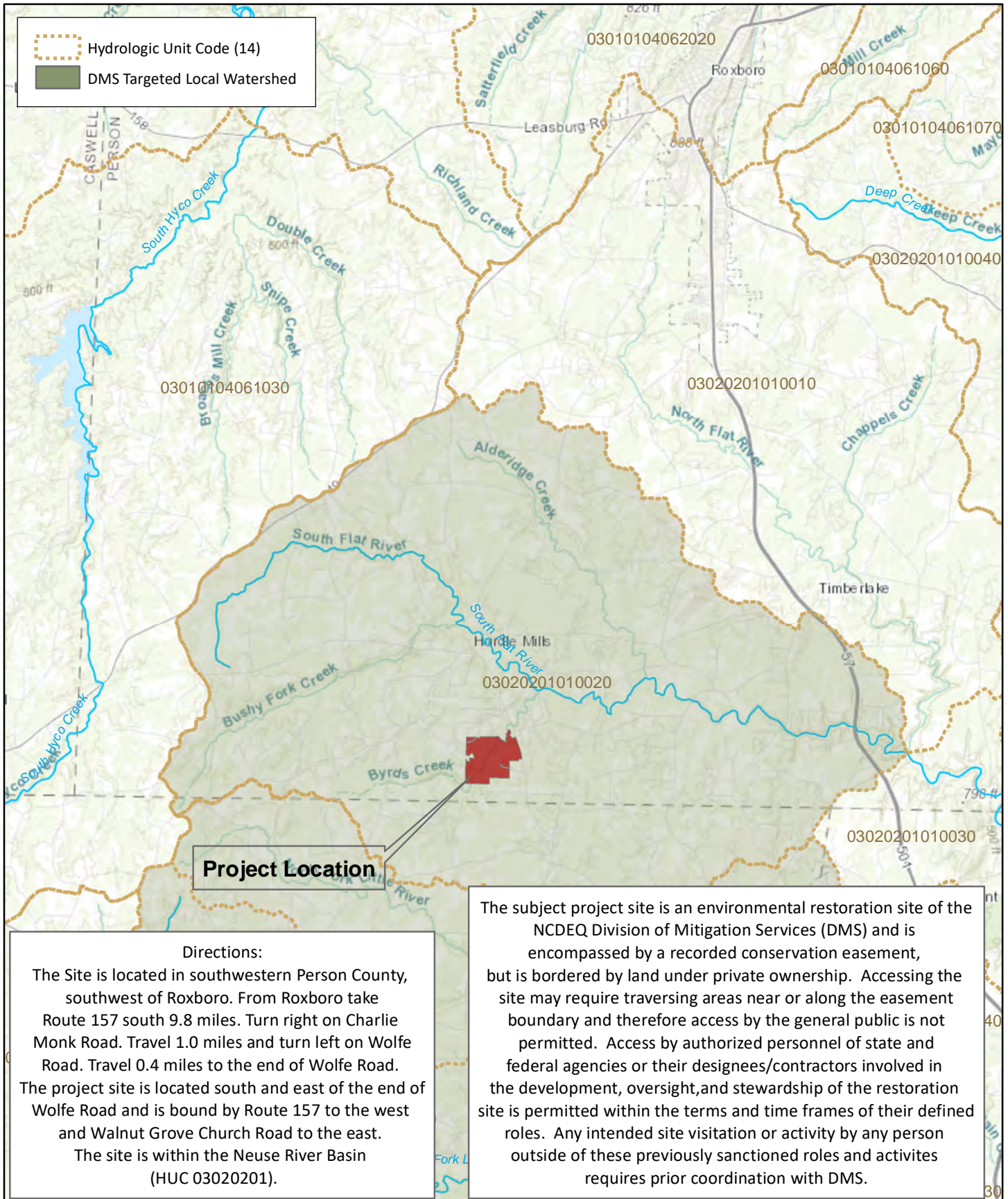


Figure 1 Project Vicinity Map
 Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

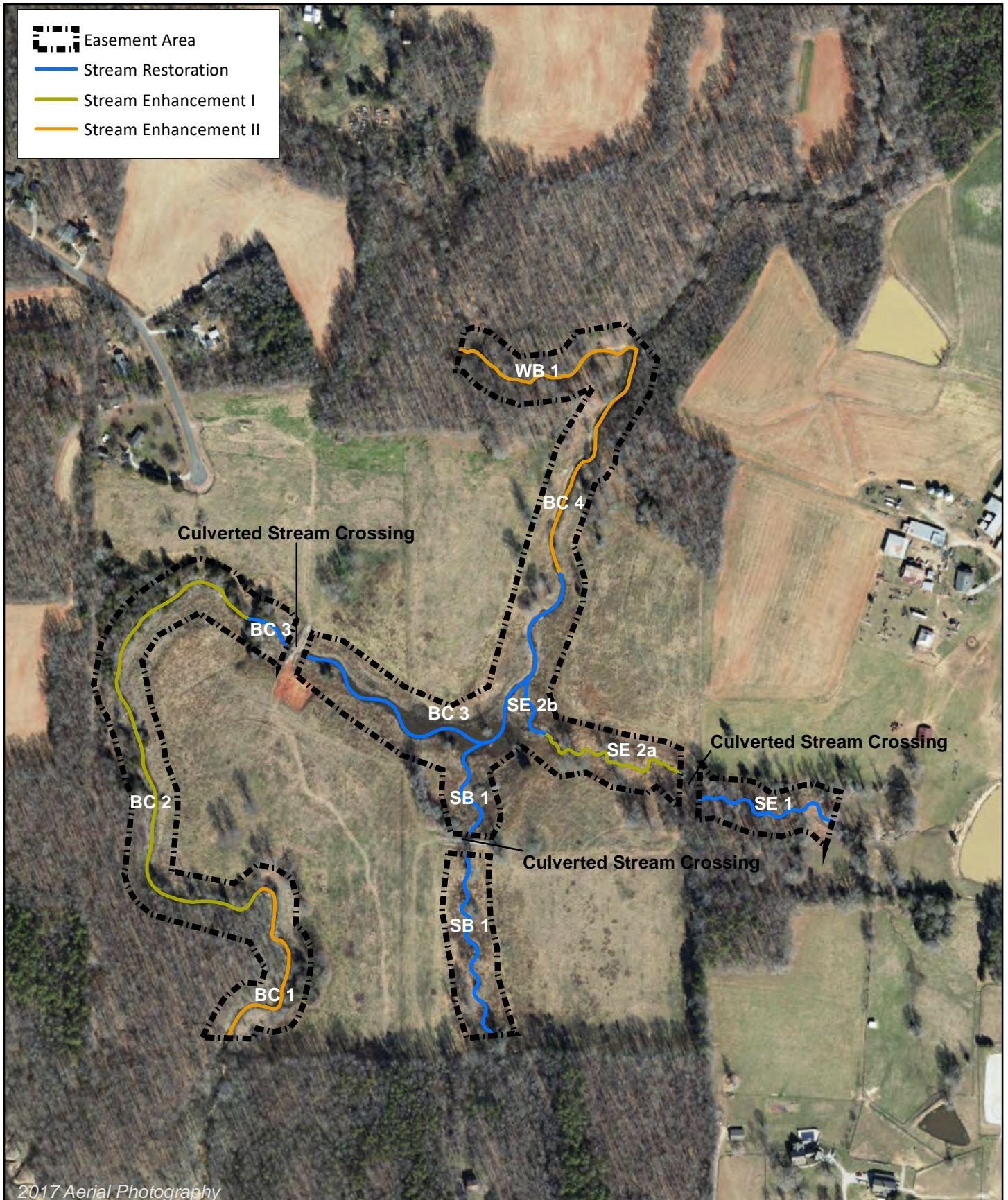
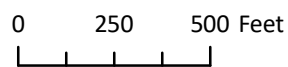


Figure 2 Project Component/Asset Map
 Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018



Person County, NC

Table 1. Project Components and Mitigation Credits

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	5,371	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Project Components									
Reach ID	As-Built Stationing / Location (LF)	Existing Footage (LF) / Acreage (Ac)	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF) / Acreage (Ac)	Mitigation Ratio	Credits (SMU / WMU)		
Streams									
BC1	10+00-16+43	643	N/A	Enhancement Level II	643	2.5:1	257		
BC2	16+43-32+89	1,630	N/A	Enhancement Level I	1,646	1.5:1	1,097		
BC3	32+89-34+05 34+64-47+55	1,368	Priority 1	Restoration	1,407	1:1	1,407		
BC4	47+55-55+51	796	N/A	Enhancement Level II	796	2.5:1	318		
SB1	60+00-66+48 67+08-70+69	976	Priority 1	Restoration	1,009	1:1	1,009		
SE1	80+00-84+85	916	Priority 1	Restoration	485	1:1	485		
SE2a	85+88-91+24	524	N/A	Enhancement Level I	536	1.5:1	357		
SE2b	91+24-93+19	50	Priority 1	Restoration	195	1:1	195		
WB1	100+00-106+11	611	N/A	Enhancement Level II	611	2.5:1	244		
Component Summation									
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)			
		Riverine	Non-Riverine						
Restoration	3,096	-	-	-	-	-			
Enhancement		-	-	-	-	-			
Enhancement I	2,182								
Enhancement II	2,050								
Creation		-	-	-					
Preservation		-	-	-					
High Quality Preservation		-	-	-					

Table 2. Project Activity and Reporting History

Byrds Creek Mitigation Site
 DMS Project No. 95020
Monitoring Year 5 - 2018

Activity or Report	Date Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	January 2013	January 2013
Final Design - Construction Plans	June 2013	June 2013
Construction	September 2013	September 2013
Temporary S&E mix applied to entire project area ¹	September 2013	September 2013
Permanent seed mix applied to reach/segments	September 2013	September 2013
Bare root and live stake plantings for reach/segments	December 2013	December 2013
Baseline Monitoring Document (Year 0)	Stream Survey	September 2013
	Vegetation Survey	January 2014
Year 1 Monitoring	Stream Survey	March 2014
	Vegetation Survey	September 2014
Tree of Heaven Treatment		August 2014
Additional Live Stake Planting		February 2015
Year 2 Monitoring	Stream Survey	March 2015
	Vegetation Survey	June 2015
Tree of Heaven Treatment		July 2015
Stream Repair Work		January 2016
Year 3 Monitoring	Stream Survey	March 2016
	Vegetation Survey	June 2016
Stream Repair Work		March 2017
Year 4 Monitoring	Stream Survey	May 2017
	Vegetation Survey	August 2017
Replanting of Easement Encroachment Area		January 2018
Stream Repair Work		Winter 2018
Year 5 Monitoring	Stream Survey	June 2018
	Vegetation Survey	August 2018

¹Seed and mulch is added as each section of construction is completed.

*Byrds Creek Mitigation Site is a 5 year credit release project.

Table 3. Project Contact Table

Byrds Creek Mitigation Site
 DMS Project No. 95020
Monitoring Year 5 - 2018

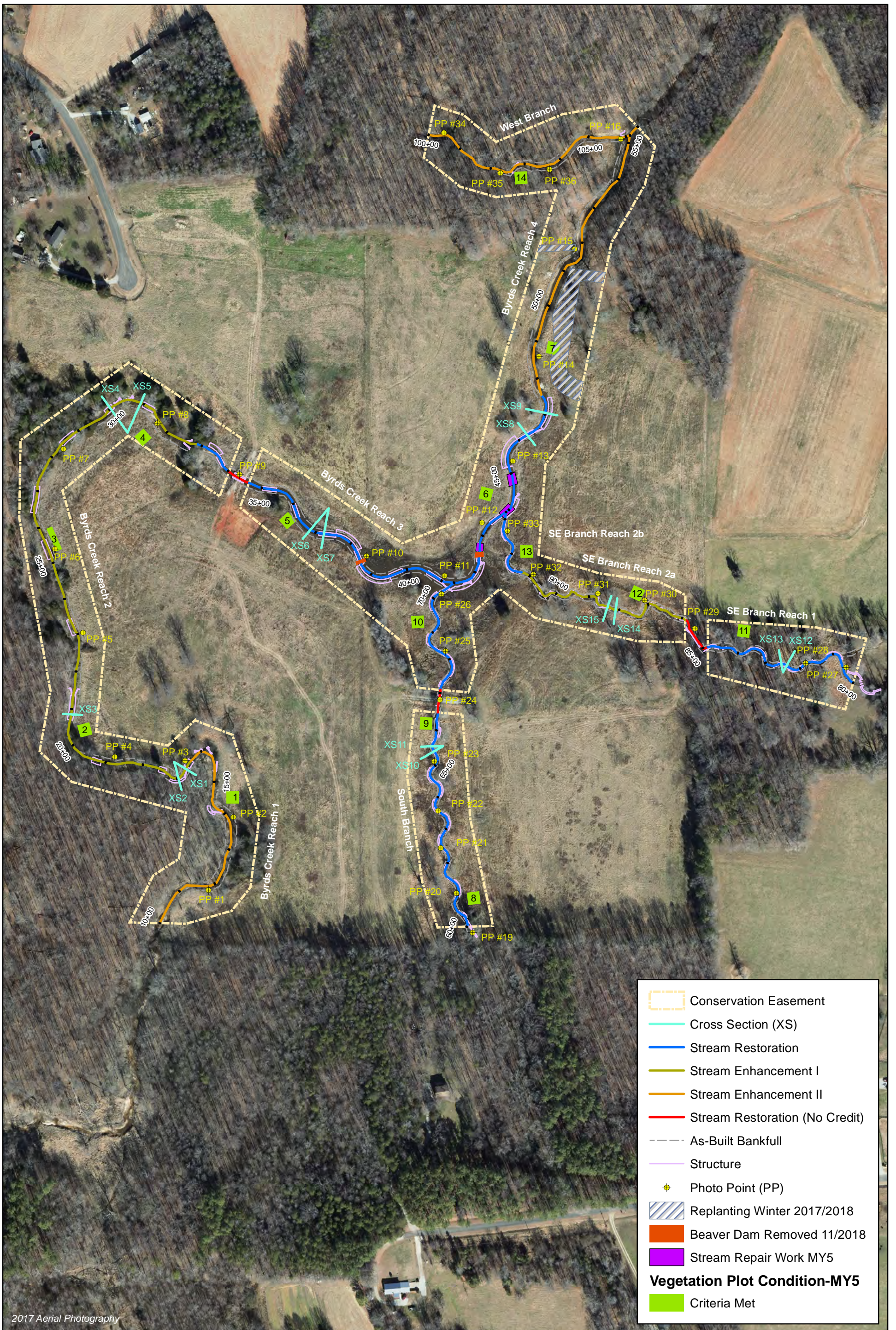
Designer Jeff Keaton, PE	Wildlands Engineering, Inc. 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	North State Environmental 2889 Lowery Street Winston Salem, NC 27101
Planting Contractor	Bruton Natural Systems, Inc P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	North State Environmental 2889 Lowery Street Winston Salem, NC 27101
Seed Mix Sources	Green Resource, LLC
Nursery Stock Suppliers	
Bare Roots	ArborGlen, Inc
Live Stakes	Foggy Mountain Nursery
Monitoring Performers Stream and Vegetation Monitoring, POC	Wildlands Engineering, Inc. Jason Lorch 919.851.9986, ext. 107

Table 4. Project Information and Attributes

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Project Information									
Project Name	Byrds Creek Mitigation Site								
County	Person County								
Project Area (acres)	24.4								
Project Coordinates (latitude and longitude)	36° 14.744' N, 79° 79' 2.636' W								
Project Watershed Summary Information									
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province								
River Basin	Neuse								
USGS Hydrologic Unit 8-digit	03020201								
USGS Hydrologic Unit 14-digit	03020201010020								
DWQ Sub-basin	03-04-01								
Project Drainage Area (acres)	2,957 ac								
Project Drainage Area Percentage of Impervious Area	<1%								
CGIA Land Use Classification	57% managed herbaceous cover/agricultural, 42% forested/scrubland, 1% open water								
Reach Summary Information									
Parameters	BC1	BC2	BC3	BC4	SB1	SE1	SE2a	SE2b	WB1
Length of reach (linear feet) - Post-Restoration	643	1,646	1,407	796	1,009	485	536	195	611
Drainage area (acres)	2,635	2,637	2,703	2,957	164	56	62	62	255
NCDWQ stream identification score	51.75				25.75		46.25		46.75
NCDWQ Water Quality Classification	WS-III, NSW								
Morphological Description (stream type)	P	P	P	P	I	P	P	P	P
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V	IV	IV/V	IV	III	IV/V	III/IV	III/IV	IV/V
Underlying mapped soils	Chewacla / Georgeville Loam								
Drainage class	---	---	---	---	---	---	---	---	---
Soil Hydric status	---	---	---	---	---	---	---	---	---
Slope	---	---	---	---	---	---	---	---	---
FEMA classification	---	---	---	---	---	---	---	---	---
Native vegetation community	Piedmont bottomland forest								
Percent composition exotic invasive vegetation -Post-Restoration	0.8%								
Regulatory Considerations									
Regulation	Applicable?	Resolved?	Supporting Documentation						
Waters of the United States - Section 404	X	X	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3885						
Waters of the United States - Section 401	X	X							
Division of Land Quality (Dam Safety)	N/A	N/A							
Endangered Species Act	X	X	Byrds Creek Mitigation Plan; no critical habitat for listed species exists within the project area (Pedestrian Survey)						
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO)						
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A						
FEMA Floodplain Compliance	N/A	N/A	N/A						
Essential Fisheries Habitat	N/A	N/A	N/A						

APPENDIX 2. Visual Assessment Data



2017 Aerial Photography



0 125 250 375 500 Feet



Figure 3 Integrated Current Condition Plan View
 Byrds Creek Stream Restoration Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018
 Person County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 1 (643 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Length Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
Thalweg centering at downstream of meander bend (Glide)		n/a	n/a	n/a						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 5b. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 2 (1,646 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	10	10		100%				
	3. Meander Pool Condition	Depth Sufficient	9	9		100%				
		Length Appropriate	9	9		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9		100%				
Thalweg centering at downstream of meander bend (Glide)		9	9	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	2	2		100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	1	1		100%				
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	1	1		100%				
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	2	2		100%				
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	1	1		100%				

Table 5c. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 3 (1,407 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	11	11		100%				
	3. Meander Pool Condition	Depth Sufficient	11	11		100%				
		Length Appropriate	11	11		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	11	11		100%				
Thalweg centering at downstream of meander bend (Glide)		11	11	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			3	90	94%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
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	3	3		100%				
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	3	3		100%				
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	3	3		100%				
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	1	1		100%				

Table 5d. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 4 (796 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Length Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
Thalweg centering at downstream of meander bend (Glide)		n/a	n/a	n/a						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 5e. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

South Branch Reach 1 (1,009 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	17	17		100%				
	3. Meander Pool Condition	Depth Sufficient	14	14		100%				
		Length Appropriate	14	14		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	14	14		100%				
Thalweg centering at downstream of meander bend (Glide)		14	14	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 5f. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 1 (485 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12		100%				
	3. Meander Pool Condition	Depth Sufficient	7	7		100%				
		Length Appropriate	7	7		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	7	7		100%				
Thalweg centering at downstream of meander bend (Glide)		7	7	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	11	11		100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	11	11		100%				
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	11	11		100%				
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	11	11		100%				
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a		n/a				

Table 5g. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 2a (536 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	12	12		100%				
	3. Meander Pool Condition	Depth Sufficient	8	8		100%				
		Length Appropriate	8	8		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8		100%				
Thalweg centering at downstream of meander bend (Glide)		8	8	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	9	9		100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	6	6		100%				
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	6	6		100%				
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	9	9		100%				
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	3	3		100%				

Table 5h. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 2b (195 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	4	4		100%				
	3. Meander Pool Condition	Depth Sufficient	3	3		100%				
		Length Appropriate	3	3		100%				
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	3	3		100%				
Thalweg centering at downstream of meander bend (Glide)		3	3	100%						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	3	3		100%				
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	3	3		100%				
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	3	3		100%				
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	3	3		100%				
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a		n/a				

Table 5i. Visual Stream Morphology Stability Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

West Branch Reach 1 (611 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	n/a	n/a			n/a			
	3. Meander Pool Condition	Depth Sufficient	n/a	n/a			n/a			
		Length Appropriate	n/a	n/a			n/a			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	n/a	n/a			n/a			
Thalweg centering at downstream of meander bend (Glide)		n/a	n/a	n/a						
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	n/a	n/a	n/a
	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	n/a	n/a	n/a
TOTALS					0	0	100%	n/a	n/a	n/a
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow	n/a	n/a			n/a			

Table 6. Vegetation Condition Assessment Table

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Planted Acreage 15.5

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	0	0	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	0	0.0	0.0%
Total			0	0.0	0.0%
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 Ac	0	0	0.0%
Cumulative Total			0	0.0	0.0%

Easement Acreage 24.4

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	0	0	0.0%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0.0%

Stream Photographs



PHOTO POINT 1 – looking upstream (5/17/2018)



PHOTO POINT 1 – looking downstream (5/17/2018)



PHOTO POINT 2 – looking upstream (5/17/2018)



PHOTO POINT 2 – looking downstream (5/17/2018)



PHOTO POINT 3 – looking upstream (5/17/2018)



PHOTO POINT 3 – looking downstream (5/17/2018)



PHOTO POINT 4 – looking upstream (10/18/2018)

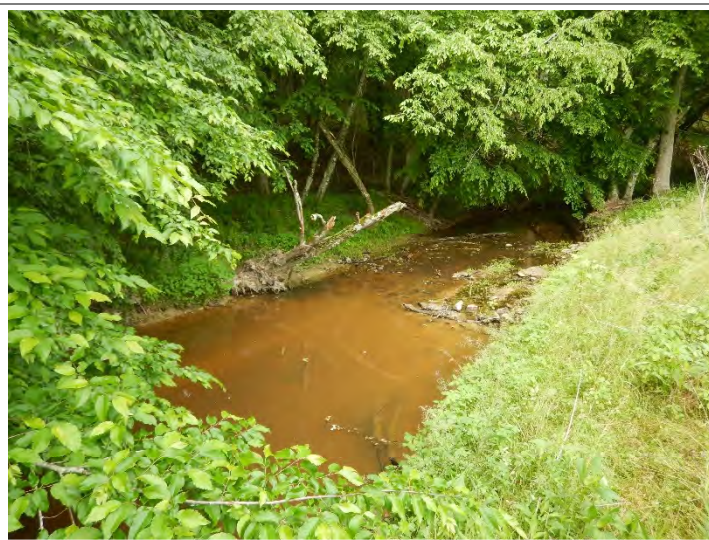


PHOTO POINT 4 – looking downstream (5/17/2018)



PHOTO POINT 5 – looking upstream (5/17/2018)



PHOTO POINT 5 – looking downstream (5/17/2018)



PHOTO POINT 6 – looking upstream (5/17/2018)



PHOTO POINT 6 – looking downstream (5/17/2018)



PHOTO POINT 7 – looking upstream (5/17/2018)



PHOTO POINT 7 – looking downstream (5/17/2018)



PHOTO POINT 8 – looking upstream (10/18/2018)



PHOTO POINT 8 – looking downstream (5/17/2018)



PHOTO POINT 9 – looking upstream (10/18/2018)



PHOTO POINT 9 – looking downstream (5/17/2018)



PHOTO POINT 10 – looking upstream (5/17/2018)



PHOTO POINT 10 – looking downstream (5/17/2018)



PHOTO POINT 11 – looking upstream (5/17/2018)



PHOTO POINT 11 – looking downstream (5/17/2018)



PHOTO POINT 12 – looking upstream (5/17/2018)



PHOTO POINT 12 – looking downstream (5/17/2018)



PHOTO POINT 13 – looking upstream (5/17/2018)



PHOTO POINT 13 – looking downstream (5/17/2018)



PHOTO POINT 14 – looking upstream (5/17/2018)



PHOTO POINT 14 – looking downstream (5/17/2018)



PHOTO POINT 15 – looking upstream (5/17/2018)



PHOTO POINT 15 – looking downstream (5/17/2018)



PHOTO POINT 16 – looking upstream (10/18/2018)



PHOTO POINT 16 – looking downstream (10/18/2018)



PHOTO POINT 19 – looking upstream (5/17/2018)

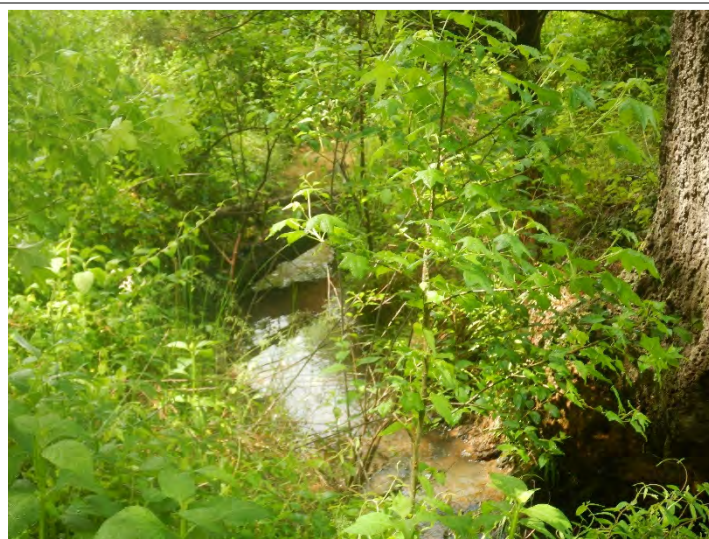


PHOTO POINT 19 – looking downstream (5/17/2018)



PHOTO POINT 20 – looking upstream (10/18/2018)



PHOTO POINT 20 – looking downstream (10/18/2018)



PHOTO POINT 21 – looking upstream (5/17/2018)



PHOTO POINT 21 – looking downstream (5/17/2018)



PHOTO POINT 22 – looking upstream (10/18/2018)



PHOTO POINT 22 – looking downstream (10/18/2018)



PHOTO POINT 23 – looking upstream (5/17/2018)



PHOTO POINT 23 – looking downstream (5/17/2018)



PHOTO POINT 24 – looking upstream (5/17/2018)



PHOTO POINT 24 – looking downstream (5/17/2018)



PHOTO POINT 25 – looking upstream (5/17/2018)



PHOTO POINT 25 – looking downstream (5/17/2018)



PHOTO POINT 26 – looking upstream (10/18/2018)



PHOTO POINT 26 – looking downstream (10/18/2018)



PHOTO POINT 27 – looking upstream (5/17/2018)



PHOTO POINT 27 – looking downstream (5/17/2018)



PHOTO POINT 28 – looking upstream (5/17/2018)



PHOTO POINT 28 – looking downstream (5/17/2018)



PHOTO POINT 29 – looking upstream (5/17/2018)



PHOTO POINT 29 – looking downstream (5/17/2018)



PHOTO POINT 30 – looking upstream (5/17/2018)



PHOTO POINT 30 – looking downstream (5/17/2018)



PHOTO POINT 31 – looking upstream (5/17/2018)



PHOTO POINT 31 – looking downstream (5/17/2018)



PHOTO POINT 32 – looking upstream (5/17/2018)



PHOTO POINT 32 – looking downstream (5/17/2018)



PHOTO POINT 33 – looking upstream (5/17/2018)



PHOTO POINT 33 – looking downstream (5/17/2018)



PHOTO POINT 34 – looking upstream (5/17/2018)



PHOTO POINT 34 – looking downstream (5/17/2018)



PHOTO POINT 35 – looking upstream (10/18/2018)

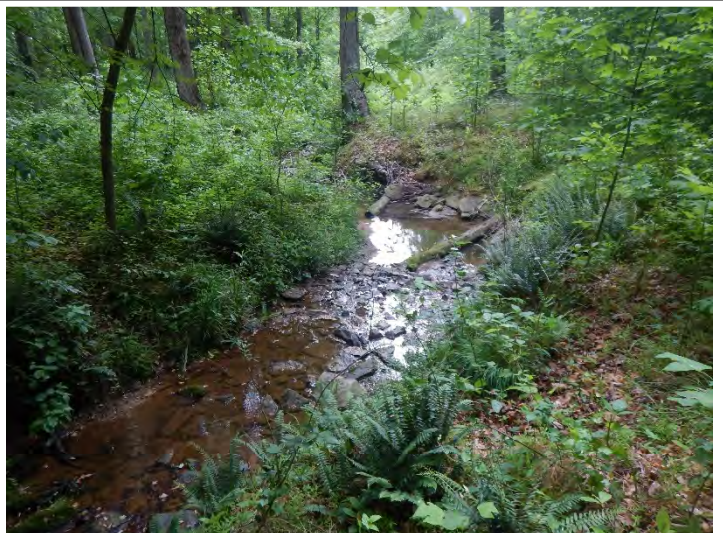


PHOTO POINT 35 – looking downstream (5/17/2018)



PHOTO POINT 36 – looking upstream (5/17/2018)



PHOTO POINT 36 – looking downstream (5/17/2018)

Vegetation Photographs



VEG PLOT 1 (08/07/2018)



VEG PLOT 2 (08/07/2018)



VEG PLOT 3 (08/07/2018)



VEG PLOT 4 (08/07/2018)



VEG PLOT 5 (08/07/2018)



VEG PLOT 6 (08/15/2018)



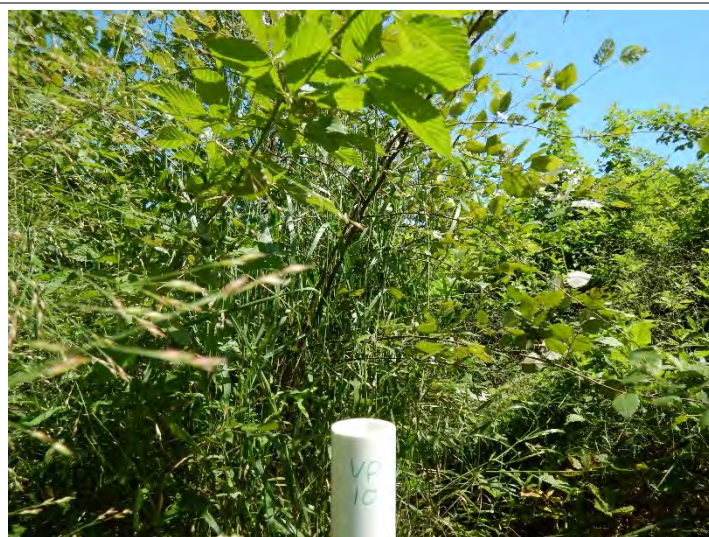
VEG PLOT 7 (08/15/2018)



VEG PLOT 8 (08/15/2018)



VEG PLOT 9 (08/15/2018)



VEG PLOT 10 (08/07/2018)



VEG PLOT 11 (08/15/2018)



VEG PLOT 12 (08/15/2018)



VEG PLOT 13 (08/15/2018)



VEG PLOT 14 (08/15/2018)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Plot	Success Criteria Met (Y/N)	Tract Mean
1	Y	100%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	Y	
13	Y	
14	Y	

Table 8. CVS Vegetation Table - Metadata

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Database name	Byrds Creek MY4 cvs-eep-entrytool-v2.3.1.mdb
Database location	F:\Projects\005-02128 Byrds Creek\Monitoring\Year 5\Vegetation
Computer name	CAROLYN-PC
File size	55648256
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	95020
project Name	Byrds Creek Mitigation Site
Description	Stream Mitigation Site
River Basin	Neuse
Sampled Plots	14

Table 9. Planted and Total Stem Counts

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MYS 2018)														
			95020-01-0001			95020-01-0002			95020-01-0003			95020-01-0004			95020-01-0005		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	boxelder	Tree															
<i>Acer rubrum</i>	red maple	Tree										3					
<i>Baccharis halimifolia*</i>	eastern baccharis	Shrub														1	
<i>Betula nigra</i>	river birch	Tree				1	1	9						1	1	1	
<i>Carpinus caroliniana</i>	American hornbeam	Tree															
<i>Carya</i>	hickory	Tree			2												
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub															
<i>Cercis canadensis</i>	eastern redbud	Tree															
<i>Cornus amomum</i>	silky dogwood	Shrub															
<i>Diospyros virginiana</i>	common persimmon	Tree															
<i>Fagus grandifolia</i>	American beech	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3	3	8	8	8	6	6	6	13	13	13	1	1	1
<i>Gleditsia triacanthos</i>	honeylocust	Tree										1					
<i>Juglans nigra</i>	black walnut	Tree															
<i>Juniperus virginiana</i>	eastern redcedar	Tree															
<i>Liquidambar styraciflua</i>	sweetgum	Tree			5			1				40					37
<i>Liriodendron tulipifera</i>	tuliptree	Tree	2	2	4	4	4	27							3	3	4
<i>Pinus taeda</i>	loblolly pine	Tree															
<i>Platanus occidentalis</i>	American sycamore	Tree	2	2	2	1	1	1	1	1	2				6	6	24
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	1	1	1	1	1	1									
<i>Quercus phellos</i>	willow oak	Tree	1	1	1	2	2	2	1	1	1	1	1	1	1	1	2
<i>Quercus rubra</i>	northern red oak	Tree	1	1	1	1	1	1									
<i>Rhus copallinum</i>	flameleaf sumac	shrub															
	Stem count		10	10	19	18	18	50	8	8	9	14	14	58	12	12	69
	size (ares)			1			1			1			1			1	
	size (ACRES)			0.02			0.02			0.02			0.02			0.02	
	Species count		6	6	8	7	7	8	3	3	3	2	2	5	5	5	7
	Stems per ACRE		405	405	769	728	728	2,023	324	324	364	567	567	2,347	486	486	2,792

Color Coding for Table

- 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%
- Volunteer species included in total

* Volunteer species not included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MYS 2018)														
			95020-01-0006			95020-01-0007			95020-01-0008			95020-01-0009			95020-01-0010		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	boxelder	Tree															
<i>Acer rubrum</i>	red maple	Tree															
<i>Baccharis halimifolia*</i>	eastern baccharis	Shrub			3												
<i>Betula nigra</i>	river birch	Tree	2	2	2	3	3	3	2	2	2	1	1	1	2	2	2
<i>Carpinus caroliniana</i>	American hornbeam	Tree															
<i>Carya</i>	hickory	Tree															
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub															
<i>Cercis canadensis</i>	eastern redbud	Tree							1	1	1	2	2	2			
<i>Cornus amomum</i>	silky dogwood	Shrub															
<i>Diospyros virginiana</i>	common persimmon	Tree											2				
<i>Fagus grandifolia</i>	American beech	Tree															
<i>Fraxinus pennsylvanica</i>	green ash	Tree	4	4	4				1	1	1	5	5	5	11	11	11
<i>Gleditsia triacanthos</i>	honeylocust	Tree									2						
<i>Juglans nigra</i>	black walnut	Tree															
<i>Juniperus virginiana</i>	eastern redcedar	Tree			1												
<i>Liquidambar styraciflua</i>	sweetgum	Tree			14						30			85		30	
<i>Liriodendron tulipifera</i>	tuliptree	Tree	1	1	2	2	2	2	1	1	6	3	3	5	1	1	1
<i>Pinus taeda</i>	loblolly pine	Tree			5												
<i>Platanus occidentalis</i>	American sycamore	Tree	4	4	4	2	2	2	3	3	3				1	1	1
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	1	1	1	1	1	1									
<i>Quercus phellos</i>	willow oak	Tree							2	2	2	2	2	2			
<i>Quercus rubra</i>	northern red oak	Tree	1	1	1	1	1	1	1	1	1						
<i>Rhus copallinum</i>	flameleaf sumac	shrub															
	Stem count		13	13	34	9	9	9	11	11	48	13	13	102	15	15	45
	size (ares)			1			1			1			1			1	
	size (ACRES)			0.02			0.02			0.02			0.02			0.02	
	Species count		6	6	10	5	5	5	7	7	9	5	5	7	4	4	5
	Stems per ACRE		526	526	1,376	364	364	364	445	445	1,942	526	526	4,128	607	607	1,821

Color Coding for Table

- 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%
- Volunteer species included in total

* Volunteer species not included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY5 2018)													
			95020-01-0011			95020-01-0012			95020-01-0013			95020-01-0014				
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T		
<i>Acer negundo</i>	boxelder	Tree														
<i>Acer rubrum</i>	red maple	Tree									4				2	
<i>Baccharis halimifolia*</i>	eastern baccharis	Shrub														
<i>Betula nigra</i>	river birch	Tree	2	2	2	1	1	1	4	4	4	2	2	2		
<i>Carpinus caroliniana</i>	American hornbeam	Tree														
<i>Carya</i>	hickory	Tree														
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub														
<i>Cercis canadensis</i>	eastern redbud	Tree				1	1	1								
<i>Cornus amomum</i>	silky dogwood	Shrub														
<i>Diospyros virginiana</i>	common persimmon	Tree														
<i>Fagus grandifolia</i>	American beech	Tree														
<i>Fraxinus pennsylvanica</i>	green ash	Tree	5	5	5	2	2	3	4	4	4	6	6	6		
<i>Gleditsia triacanthos</i>	honeylocust	Tree														
<i>Juglans nigra</i>	black walnut	Tree														
<i>Juniperus virginiana</i>	eastern redcedar	Tree			1											
<i>Liquidambar styraciflua</i>	sweetgum	Tree						50			50					
<i>Liriodendron tulipifera</i>	tuliptree	Tree	1	1	10						2	3	3	23		
<i>Pinus taeda</i>	loblolly pine	Tree						2								
<i>Platanus occidentalis</i>	American sycamore	Tree				4	4	6	4	4	5					
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	2	2	2	1	1	1	1	1	1	1	1	1		
<i>Quercus phellos</i>	willow oak	Tree	1	1	1	2	2	2	2	2	2	1	1	1		
<i>Quercus rubra</i>	northern red oak	Tree				1	1	1								
<i>Rhus copallinum</i>	flameleaf sumac	shrub						2								
Stem count			11	11	21	12	12	69	15	15	72	13	13	35		
size (ares)			1			1			1			1				
size (ACRES)			0.02			0.02			0.02			0.02				
Species count			5	5	6	7	7	10	5	5	8	5	5	6		
Stems per ACRE			445	445	850	486	486	2,792	607	607	2,914	526	526	1,416		

Color Coding for Table

- 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%
- Volunteer species included in total

* Volunteer species not included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

Table 9. Planted and Total Stem Counts

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Scientific Name	Common Name	Species Type	Annual Means																	
			MY5 (2018)			MY4 (2017)			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	boxelder	Tree						1												
<i>Acer rubrum</i>	red maple	Tree			9			8												
<i>Baccharis halimifolia*</i>	eastern baccharis	Shrub			4			5												
<i>Betula nigra</i>	river birch	Tree	21	21	29	19	19	26	18	18	18	24	24	24	29	29	29	41	41	41
<i>Carpinus caroliniana</i>	American hornbeam	Tree				1	1	1	1	1	1	1	1	1	3	3	3	12	12	12
<i>Carya</i>	hickory	Tree			2			1												
<i>Cephalanthus occidentalis</i>	common buttonbush	Shrub						2					11							
<i>Cercis canadensis</i>	eastern redbud	Tree	4	4	4	5	5	5	7	7	7	8	8	8	8	8	8			
<i>Cornus amomum</i>	silky dogwood	Shrub						1												
<i>Diospyros virginiana</i>	common persimmon	Tree			2															
<i>Fagus grandifolia</i>	American beech	Tree						5												
<i>Fraxinus pennsylvanica</i>	green ash	Tree	69	69	70	71	71	80	69	69	73	75	75	83	73	73	73	72	72	72
<i>Gleditsia triacanthos</i>	honeylocust	Tree			3															
<i>Juglans nigra</i>	black walnut	Tree						3												
<i>Juniperus virginiana</i>	eastern redcedar	Tree			2			2												
<i>Liquidambar styraciflua</i>	sweetgum	Tree			342			114			32		102							
<i>Liriodendron tulipifera</i>	tuliptree	Tree	21	21	86	23	23	124	23	23	63	25	25	81	40	40	40	49	49	49
<i>Pinus taeda</i>	loblolly pine	Tree			7															
<i>Platanus occidentalis</i>	American sycamore	Tree	28	28	50	27	27	51	27	27	27	30	30	70	31	31	31	32	32	32
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	9	9	9	11	11	11	11	11	11	11	11	11	13	13	13	19	19	19
<i>Quercus phellos</i>	willow oak	Tree	16	16	17	17	17	21	17	17	17	22	22	26	20	20	20	13	13	13
<i>Quercus rubra</i>	northern red oak	Tree	6	6	6	6	6	7	7	7	7	8	8	14	9	9	9	16	16	16
<i>Rhus copallinum</i>	flameleaf sumac	shrub			2			2												
Stem count			174	174	640	180	180	470	180	180	260	204	204	431	226	226	226	254	254	254
size (ares)			14			14			14			14			14			14		
size (ACRES)			0.35			0.35			0.35			0.35			0.35			0.35		
Species count			8	8	17	9	9	20	9	9	11	9	9	11	9	9	9	8	8	8
Stems per ACRE			503	503	1,850	520	520	1,359	520	520	752	590	590	1,246	653	653	653	734	734	734

Color Coding for Table

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%
Volunteer species included in total

* Volunteer species not included in total

PnoLS: Number of Planted stems excluding live stakes

P-all: Number of planted stems including live stakes,

T: Total Stems

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Byrds Creek

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data						Design				As-Built/Baseline					
		Byrds Creek Reach 2		Byrds Creek Reach 3		Spencer Creek Downstream		UT Cane Creek ¹		UT Richland Creek Upstream ²		UT Rocky Branch ²		Byrds Creek Reach 2		Byrds Creek Reach 3		Byrds Creek Reach 2		Byrds Creek Reach 3	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																					
Bankfull Width (ft)	N/A	19.0	26.1	27.4	35.9	10.7	11.2	11.5	12.3	8.8	10.4	12.2	33.2	38.3	25.0		28.9	42.7	20.4	36.9	
Floodprone Width (ft)		145	231	116	124	60.0	114+	31.0		27.6	31.4	72.0	156	160	95	350	150+	150+	150+	150+	
Bankfull Mean Depth		2.2	3.4	1.9	2.3	1.6	1.8	0.8	1.0	0.8	0.9	1.3	1.6	1.9	1.8		1.6	2.1	1.0	1.4	
Bankfull Max Depth		3.8	4.4	2.6	3.4	2.1	2.6	1.2	1.6	1.1	1.3	1.8	2.8	3.2	2.8		2.9	3.4	2.1	3.0	
Bankfull Cross Sectional Area (ft ²)		58.4	64.5	62.5	66.7	17.8	19.7	8.9	12.2	7.8	8.5	16.3	59.8	61.5	45.3		56.2	88.7	28.8	37.4	
Width/Depth Ratio		5.6	11.7	9.3	19.3	5.8	7.1	12.3	14.4	10.0	12.8	9.1	18.0	24.5	13.8		14.8	22.2	14.5	36.5	
Entrenchment Ratio ⁴		5.5	12.1	3.2	5.5	5.5	10.2	>2.5		2.5	4.0	6.0	4.1	4.8	3.8	14.0	3.5+	5.2+	4.7+	7.4+	
Bank Height Ratio ⁵		1.0	1.0	1.0	1.3	1.0		---		1.4	2.1	1.0	1.0		1.0		1.0	1.0	1.0	1.0	
D50 (mm)	0.41		22.6		---		---		---		---		---		---		12.5	26.4	29.3	45.0	
Profile																					
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		---		13	59	12	57
Riffle Slope (ft/ft)		0.0074	0.0075	0.0043	0.0133	0.0130		0.0188	0.0704	0.0210	0.0450	0.0606	0.0892	0.0029	0.0052	0.0076	0.0134	0.0036	0.0097	0.0022	0.0190
Pool Length (ft)		---		---		---		---		---		---		---		---		34	179	46	129
Pool Max Depth (ft)		---		---		---		---		---		---		---		---		1.21	2.58	0.97	2.43
Pool Spacing (ft)		54	103	70	124	71		27	73	N/A		26	81	102	211	60	141	84	278	73	129
Pool Volume (ft ³)		---		---		---		---		---		---		---		---		---		---	
Pattern																					
Channel Beltwidth (ft)	N/A	N/A		N/A		38	41	102		N/A		N/A		---		52	116	26	57	31	62
Radius of Curvature (ft)		N/A		N/A		11	15	23	38	N/A		N/A		---		50	80	19	79	44	84
Rc:Bankfull Width (ft/ft)		---		---		1.0	1.3	2.0	3.1	N/A		N/A		---		2.0	3.2	0.7	1.9	2.2	2.3
Meander Length (ft)		N/A		N/A		46	48	45	81	N/A		N/A		---		177	263	279	603	190	255
Meander Width Ratio		---		---		3.6	3.7	3.9	6.6	N/A		N/A		---		2.1	4.6	0.9	1.3	1.5	1.7
Substrate, Bed and Transport Parameters																					
Ri%/Ru%/P%/G%/S%	N/A	---		---		---		---		---		---		---		---		---		---	
SC%/Sa%/G%/C%/B%/Be%		---		---		---		---		---		---		---		---		---		---	
d16/d35/d50/d84/d95/d100		SC/0.19/0.41/116/232/>2048		SC/0.41/22.6/143.4/2048/>2048		---		---		---		---		---		---		SC/SC/55/128/362		SC/SC/107.3/362/>2048	
Reach Shear Stress (Competency) lb/ft ²		---		---		---		---		---		---		---		0.69	1.71	N/A		0.23	0.31
Max part size (mm) mobilized at bankfull		---		---		---		---		---		---		---		---		---		---	
Stream Power (Capacity) W/m ²		---		---		---		---		---		---		---		---		---		---	
Additional Reach Parameters																					
Drainage Area (SM)	N/A	4.12		4.22		0.96		0.29		0.28		1.10		4.12		4.22		4.12		4.22	
Watershed Impervious Cover Estimate (%)		1%		<1%		---		---		---		---		1%		<1%		1%		<1%	
Rosgen Classification		C5/E5		C4/E4		E4		C4/E4		C4/E4		E4b		C4		C4		C4		C4	
Bankfull Velocity (fps)		2.7	3.0	2.5	2.5	4.9	5.4	3.8	3.5	4.1	5.5	3.0	3.3	4.6	3.6	7.3					
Bankfull Discharge (cfs)		---		---		97		40		29.1		32.0		85.0		200		210		210	
Q-NFF regression		---		---		---		---		---		---		---		---		---		---	
Q-USGS extrapolation		---		---		---		---		---		---		---		---		---		---	
Q-Mannings		---		---		---		---		---		---		---		---		---		---	
Valley Length (ft)		---		---		---		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		1,630		1,368		---		---		---		---		1,630		1,402		1,646		1,407	
Sinuosity		1.18		1.01		1.30		1.40		1.00		1.10		---		1.11		1.18		1.06	
Water Surface Slope (ft/ft) ³		---		---		---		---		---		---		---		0.0039		0.0016		0.0043	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.0046		0.0013		0.0042	

(---): Data was not provided

N/A: Not Applicable

¹UT Cane Creek reference reach data only utilized for pattern and a reference point in the project specific regional curve.

²Data only utilized as a reference point on the the project-specific drainage area-discharge curve.

³Existing condition sinuosity based on valley length/channel length given no flow and therefore no water sureface shots at time of survey.

⁴Entrenchment Ratio is the flood prone width divided by the bankfull width.

⁵Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 10b. Baseline Stream Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

South Branch and Southeast Branch

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data								Design				As-Built/Baseline							
		South Branch Reach 1		Southeast Branch Reach 1		Spencer Creek Upstream		UT Richland Creek Downstream		UT Cane Creek ¹		UT Richland Creek Upstream ²		UT Rocky Branch ²		South Branch Reach 1		Southeast Branch Reach 1		South Branch Reach 1		Southeast Branch Reach 1			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Dimension and Substrate - Riffle																									
Bankfull Width (ft)	N/A	7.4	7.9	7.7	8.7	13.3	15.2	11.5	12.3	8.8	10.4	12.2	10.0		8.0		9.3		19.0						
Floodprone Width (ft)		96.0	98.0	9.5	229.0	>50		31.0		27.6	31.4	72.0	70.0	375.0	30	100	>100	>75							
Bankfull Mean Depth		1.0	1.2	0.8	1.2	1.1	1.3	0.8	1.0	0.8	0.9	1.3	1.0		0.7		0.7		0.5						
Bankfull Max Depth		2.3	2.4	1.0	1.9	1.8	2.1	1.2	1.6	1.1	1.3	1.8	1.3		1.0		1.4		1.5						
Bankfull Cross Sectional Area (ft ²)		8.0	8.7	6.2	10.6	16.5	17.5	8.9	12.2	7.8	8.5	16.3	9.6		5.7		6.5		9.6						
Width/Depth Ratio		6.2	7.8	9.6	7.3	10.1	13.9	12.3	14.4	10.0	12.8	9.1	10.4		11.2		13.4		37.7						
Entrenchment Ratio ⁴		12.4	13.1	1.2	26.3	>2.5		>2.5		2.5	4.0	6.0	7.0	37.5	3.8	12.5	>2.2	>2.2							
Bank Height Ratio ⁵		1.0		3.7		1.0		1.4	2.1	---		1.4	2.1	1.0		1.0		1.0		1.0					
D50 (mm)	1.0		0.09		---		---		---		---		---		---		56.1		28.5						
Profile																									
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		---		8		46		10		28	
Riffle Slope (ft/ft)		0.0176	0.0349	0.0247	0.049	0.0188	0.0704	0.0183	0.0355	0.0188	0.0704	0.0210	0.0450	0.0606	0.0892	0.0052	0.0199	0.0220	0.0410	0.0021	0.0178	0.0023	0.0527		
Pool Length (ft)		---		---		---		---		---		---		---		---		20		64		7		45	
Pool Max Depth (ft)		---		---		---		---		---		---		---		---		0.4		2.2		0.9		2.3	
Pool Spacing (ft)		30	62	35	90	13	47	33	93	27	73	N/A		26	81	34	85	21	53	36	116	26	58		
Pool Volume (ft ³)		---		---		---		---		---		---		---		---		---		---		---		---	
Pattern																									
Channel Beltwidth (ft)	N/A	N/A		N/A		24	52	NA		102		N/A		N/A		25	48	16	39	14	35	10	27		
Radius of Curvature (ft)		N/A		N/A		5.4	22.1	NA		23	38	N/A		N/A		20	35	18	26	17	32	14	30		
Rc:Bankfull Width (ft/ft)		---		---		0.6	2.5	NA		2.0	3.1	N/A		N/A		2.0	3.5	2.3	3.3	1.8	3.4	1.3	2.9		
Meander Length (ft)		N/A		N/A		54	196	NA		45	81	N/A		N/A		76	120	47	93	78	127	65	74		
Meander Width Ratio		---		---		2.8	6	NA		3.9	6.6	N/A		N/A		7.6	12.0	5.9	11.6	8.4	13.6	6.3	7.1		
Substrate, Bed and Transport Parameters																									
Ri%/Ru%/P%/G%/S%	N/A	---		---		---		---		---		---		---		---		---		---		---			
SC%/Sa%/G%/C%/B%/Be%		---		---		---		---		---		---		---		---		---		---		---			
d16/d35/d50/d84/d95/d100		SC/SC/1.0/45/107.33/180		SC/SC/0.09/26.23/50.61/180		---		---		---		---		---		---		SC/SC/SC/103.6/256/362		SC/SC/SC/68.1/180/362					
Reach Shear Stress (Competency) lb/ft ²		---		---		---		---		---		---		0.28		0.98	0.94	1.34	0.23		0.43				
Max part size (mm) mobilized at bankfull		---		---		---		---		---		---		---		---		---		---		---			
Stream Power (Capacity) W/m ²		---		---		---		---		---		---		---		---		---		---		---			
Additional Reach Parameters																									
Drainage Area (SM)	N/A	0.25		0.09		0.50		0.97		0.29		0.28		1.10		0.25		0.09		0.25		0.09			
Watershed Impervious Cover Estimate (%)		<1%		1%		---		---		---		---		---		<1%		1%		<1%		1%			
Rosgen Classification		E5		E6/G6		E4		C4/E4		C4/E4		C4/E4		E4b		E4		E4		C3		C4			
Bankfull Velocity (fps)		3.7		2.8		---		4.2	4.5	3.8	3.5	4.1	5.5		3.1		3.5		4.6		2.1				
Bankfull Discharge (cfs)		---		---		---		68.9	78.6	40	29.1	32.0	85.0		30		20		30		20				
Q-NFF regression		---		---		---		---		---		---		---		---		---		---		---			
Q-USGS extrapolation		---		---		---		---		---		---		---		---		---		---		---			
Q-Mannings		---		---		---		---		---		---		---		---		---		---		---			
Valley Length (ft)		---		---		---		---		---		---		---		---		---		---		---			
Channel Thalweg Length (ft)		976		916		---		---		---		---		---		971		792		1,009		485			
Sinuosity		1.03		1.31		1.40		1.10		1.40		1.00		1.10		---		1.13		1.06		1.18			
Water Surface Slope (ft/ft) ²		---		---		---		---		---		---		---		0.0068		0.0161		0.0070		0.0138			
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.0075		0.0182		0.0068		0.0136			

(---): Data was not provided

N/A: Not Applicable

¹UT Cane Creek reference reach data only utilized for pattern and a reference point in the project specific regional curve.

²Data only utilized as a reference point on the the project-specific drainage area-discharge curve.

³Existing condition sinuosity based on valley length/channel length given no flow and therefore no water surface shots at time of survey.

⁴Entrenchment Ratio is the flood prone width divided by the bankfull width.

⁵Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 10c. Baseline Stream Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Southeast Branch

Parameter	Gage	Pre-Restoration Condition		Reference Reach Data										Design				As-Built/Baseline					
		Southeast Branch Reach 2		Spencer Creek Upstream		UT Richland Creek Downstream		UT Cane Creek ¹		UT Richland Creek Upstream ²		UT Rocky Branch ²		Southeast Branch Reach 2a		Southeast Branch Reach 2b		Southeast Branch Reach 2a		Southeast Branch Reach 2b			
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Dimension and Substrate - Riffle																							
Bankfull Width (ft)	N/A	7.2	7.4	8.7	13.3	15.2	11.5	12.3	8.8	10.4	12.2	11.7	15.0	9.0			10.6						
Floodprone Width (ft)		8.0	9.8	229.0	>50		31.0		27.6	31.4	72.0	114.7	120.1	140.0	310.0			>100					
Bankfull Mean Depth		1.3	1.4	1.2	1.1	1.3	0.8	1.0	0.8	0.9	1.3	0.7	0.9	0.7			0.6						
Bankfull Max Depth		1.6	1.9	1.9	1.8	2.1	1.2	1.6	1.1	1.3	1.8	0.9	1.0	1.0			1.2						
Bankfull Cross Sectional Area (ft ²)		8.9	9.4	10.6	16.5	17.5	8.9	12.2	7.8	8.5	16.3	10.2	10.5	6.5			6.8						
Width/Depth Ratio		5.8	7.3	7.3	10.1	13.9	12.3	14.4	10.0	12.8	9.1	13.5	21.3	12.5			16.5						
Entrenchment Ratio ⁴		1.6	6.2	26.3	>2.5		>2.5		2.5	4.0	6.0	7.7	10.3	15.6	34.4			>2.2					
Bank Height Ratio ⁵		1.5	2.1	1.0	1.4	2.1	---		---	1.4	2.1	1.0	1.0		1.0		1.0						
D50 (mm)	0.04		---		---		---		---		---		---		---		37.2						
Profile																							
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		4	20	11	36				
Riffle Slope (ft/ft)		0.0047	0.0147	0.0188	0.0704	0.0183	0.0355	0.0188	0.0704	0.0210	0.0450	0.0606	0.0892	0.0122	0.0367	0.0202	0.0145	0.0454	0.0119	0.0606			
Pool Length (ft)		---		---		---		---		---		---		---		---		21	53	27	45		
Pool Max Depth (ft)		---		---		---		---		---		---		---		---		1.3	2.6	0.89	2.23		
Pool Spacing (ft)		17	122	13	47	33	93	27	73	N/A		26	81	27	55	43	49	25	54	34	73		
Pool Volume (ft ³)		---		---		---		---		---		---		---		---		---		---			
Pattern																							
Channel Beltwidth (ft)	N/A	N/A		24	52	NA		102		N/A		N/A		N/A		27	3	22	12	22			
Radius of Curvature (ft)		N/A		5.4	22.1	NA		23	38	N/A		N/A		N/A		22	30	7	58	21	25		
Rc:Bankfull Width (ft/ft)		---		0.6	2.5	NA		2.0	3.1	N/A		N/A		N/A		2.4	3.3	0.7	5.5	N/A			
Meander Length (ft)		N/A		54	196	NA		45	81	N/A		N/A		N/A		82.0		43	80	88	88		
Meander Width Ratio		---		2.8	6	NA		3.9	6.6	N/A		N/A		N/A		3.0	4.1	7.5	N/A				
Substrate, Bed and Transport Parameters																							
Ri%/Ru%/P%/G%/S%	N/A	---		---		---		---		---		---		---		---		---		---			
SC%/Sa%/G%/C%/B%/Be%		---		---		---		---		---		---		---		---		---		---			
d16/d35/d50/d84/d95/d100		SC/0.02/0.04/0.05/33.2/79.6		---		---		---		---		---		---		---		SC/SC/SC/70.9/256/362		SC/SC/SC/70.9/256/362			
Reach Shear Stress (Competency) lb/ft ²		---		---		---		---		---		---		0.93	1.14	0.93	1.14	0.47	N/A				
Max part size (mm) mobilized at bankfull		---		---		---		---		---		---		---		---		---		---			
Stream Power (Capacity) W/m ²		---		---		---		---		---		---		---		---		---		---			
Additional Reach Parameters																							
Drainage Area (SM)	N/A	0.09		0.50		0.97		0.29		0.28		1.10		0.09		0.10		0.09		0.10			
Watershed Impervious Cover Estimate (%)		1%		---		---		---		---		---		1%		1%		1%		1%			
Rosgen Classification		E6/G6		E4		C4/E4		C4/E4		C4/E4		E4b		C4		C4		C4		C4			
Bankfull Velocity (fps)		2.9	3.4	---		4.2	4.5	3.8	3.5	4.1	5.5	3.0	3.3	3.1	4.4	N/A							
Bankfull Discharge (cfs)		---		---		68.9	78.6	40	29.1	32.0	85.0	30		20	30	N/A							
Q-NFF regression		---		---		---		---		---		---		---		---		---					
Q-USGS extrapolation		---		---		---		---		---		---		---		---		---					
Q-Mannings		---		---		---		---		---		---		---		---		---					
Valley Length (ft)		---		---		---		---		---		---		---		---		---					
Channel Thalweg Length (ft)		524		---		---		---		---		---		533		180		536		195			
Sinuosity		1.17		1.40		1.10		1.40		1.00		1.10		---		1.21		1.11		1.23			
Water Surface Slope (ft/ft) ²		---		---		---		---		---		---		---		0.0101		0.0144		0.0160			
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.0122		0.0146		0.0168			

(---): Data was not provided

N/A: Not Applicable

¹UT Cane Creek reference reach data only utilized for pattern and a reference point in the project specific regional curve.

²Data only utilized as a reference point on the the project-specific drainage area-discharge curve.

³Existing condition sinuosity based on valley length/channel length given no flow and therefore no water surface shots at time of survey.

⁴Entrenchment Ratio is the flood prone width divided by the bankfull width.

⁵Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12a. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Byrds Creek - Reach 2

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	28.9	42.7	24.7	36.6	22.9	36.9	22.1	35.6	20.8	35.9	27.3	39.8
Floodprone Width (ft)	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150
Bankfull Mean Depth	1.6	2.1	1.4	2.2	1.4	2.3	1.4	2.2	1.5	2.3	1.6	2.2
Bankfull Max Depth	2.9	3.4	2.7	3.2	2.7	3.3	2.7	3.1	3.1	3.2	3.1	3.7
Bankfull Cross-sectional Area (ft ²)	56.2	88.7	51.1	78.3	46.5	83.9	45.9	73.4	45.7	76.7	56.2	88.7
Width/Depth Ratio	14.8	22.2	11.8	26.2	11.3	24.6	10.6	25.0	9.5	24.1	13.3	24.3
Entrenchment Ratio ¹	3.4+	5.2+	4.1+	6.1+	4.1+	6.6+	4.2+	6.8+	4.2+	7.2+	3.8+	5.5+
Bank Height Ratio ²	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	<1.0	<1.0
D50 (mm)	12.5	26.4	28.7	42.9	18.0	36.4	19.0	37.9	24.2	49.1	16.6	64.5
Profile												
Riffle Length (ft)	13	59	12	59	18	59	12	59	14	59	11	61
Riffle Slope (ft/ft)	0.0036	0.0097	0.0019	0.0147	0.0003	0.0110	0.0009	0.0138	0.0025	0.0147	0.0008	0.0153
Pool Length (ft)	34	179	34	182	59	183	70	185	30	165	33	185
Pool Max Depth (ft)	3.7	4.6	4.3	4.5	4.2	5.8	3.6	4.8	3.1	5.0	1.2	2.5
Pool Spacing (ft)	84	278	80	214	81	225	85	211	107	219	72	231
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	26	57										
Radius of Curvature (ft)	19	79										
Rc:Bankfull Width (ft/ft)	0.7	1.9										
Meander Wave Length (ft)	279	603										
Meander Width Ratio	0.9	1.3										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4		C4		C4	
Channel Thalweg Length (ft)	1,646		1,646		1,646		1,646		1,646		1,646	
Sinuosity (ft)	1.2		1.2		1.2		1.2		1.2		1.2	
Water Surface Slope (ft/ft)	0.0016		0.0018		0.0019		0.0017		0.0017		0.0014	
Bankfull Slope (ft/ft)	0.0013		0.0018		0.0020		0.0016		0.0017		0.0019	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.2/0.6/5.6/55/128/362		0.3/1.2/2.9/75.9/122.5/256		0.21/1.0/3.7/80.3/168.1/362		0.34/1.24/2.4/85.0/163.3/362.0		0.55/0.99/4.0/92.1/175.7/512.0		0.86/2.27/49.8/123.3/165.3/256.0	
% of Reach with Eroding Banks			0%		0%		0%		0%		0%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12b. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Byrds Creek - Reach 3

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	17.6	20.4	17.6	22.6	18.3	23.4	19.5	21.2	20.2	22.5	18.1	24.2
Floodprone Width (ft)	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150	>150
Bankfull Mean Depth	1.2	1.4	1.3	1.4	1.3	1.4	1.2	1.3	1.3	1.3	1.1	1.3
Bankfull Max Depth	2.1	2.3	2.1	2.2	2.2	2.4	2.1	2.1	2.3	2.3	2.1	2.3
Bankfull Cross-sectional Area (ft ²)	20.5	28.8	23.4	31.0	24.9	31.0	23.2	26.6	25.8	29.2	20.5	31.0
Width/Depth Ratio	14.4	15.1	13.3	16.5	13.4	17.7	16.3	16.8	15.8	17.3	16.0	18.8
Entrenchment Ratio ¹	7.4+	8.5+	6.6+	8.5+	6.4+	8.2+	7.1+	7.7+	6.7+	7.4+	6.2+	8.3+
Bank Height Ratio ²	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
D50 (mm)	29.3	45.0	41.3	49.1	37.2	66.2	52.1	70.2	42.7	68.3	15.3	18.4
Profile												
Riffle Length (ft)	12	57	26	43	18	44	28	44	24	45	27	45
Riffle Slope (ft/ft)	0.0022	0.0190	0.0065	0.0311	0.0018	0.0304	0.0054	0.0304	0.0067	0.0263	0.0115	0.0204
Pool Length (ft)	46	129	33	134	32	132	31	134	31	128	33	132
Pool Max Depth (ft)	3.2	3.9	3.0	3.8	2.9	4.3	3.4	4.6	3.1	4.7	0.7	3.2
Pool Spacing (ft)	73	129	82	190	92	199	60	180	60	189	72	177
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	31	62										
Radius of Curvature (ft)	44	84										
Rc:Bankfull Width (ft/ft)	2.2	2.3										
Meander Wave Length (ft)	190	255										
Meander Width Ratio	1.5	1.7										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4		C4		C4	
Channel Thalweg Length (ft)	1,407		1,407		1,407		1,407		1,407		1,407	
Sinuosity (ft)	1.1		1.1		1.1		1.1		1.1		1.1	
Water Surface Slope (ft/ft)	0.0043		0.0045		0.0052		0.0047		0.0046		0.0044	
Bankfull Slope (ft/ft)	0.0042		0.0047		0.0047		0.0044		0.0047		0.0042	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.1/0.6/16/107.3/362/>2048		0.2/9.1/29/82.6/180/362		0.2/1.68/32.0/112.6/430.5/2048		0.5/4.73/23.4/105.6/256.0/2048		0.34/1.47/5.8/54.6/89.8/180.0		0.91/1.81/13.3/57.9/101.2/256.0	
% of Reach with Eroding Banks			0%		20%		4%		0%		6%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12c. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

South Branch - Reach 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	9.3		8.8		9.0		9.0		7.8		10.5	
Floodprone Width (ft)	>100		>100		>100		>100		>100		>100	
Bankfull Mean Depth	0.7		0.7		0.6		0.6		0.7		0.6	
Bankfull Max Depth	1.4		1.3		1.3		1.3		1.7		1.6	
Bankfull Cross-sectional Area (ft ²)	6.5		6.4		5.5		5.5		5.4		6.5	
Width/Depth Ratio	13.4		12.2		14.8		14.8		11.3		17.1	
Entrenchment Ratio ¹	10.7+		11.4+		11.1+		11.1+		12.9+		9.5+	
Bank Height Ratio ²	1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)	56.1		9.4		30.9		29.3		9.5		18.0	
Profile												
Riffle Length (ft)	8	46	10	39	13	37	10	38	12	38	11	39
Riffle Slope (ft/ft)	0.0021	0.0178	0.0022	0.0431	0.0029	0.0298	0.0023	0.0409	0.0030	0.0573	0.0089	0.0349
Pool Length (ft)	20	64	22	65	21	67	21	69	20	62	22	66
Pool Max Depth (ft)	2.0		1.9		2.8		2.5		3.2		1.8	
Pool Spacing (ft)	36	116	22	87	32	117	35	133	38	118	43	81
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	14	35										
Radius of Curvature (ft)	17	32										
Rc:Bankfull Width (ft/ft)	1.8	3.4										
Meander Wave Length (ft)	78	127										
Meander Width Ratio	8.4	13.6										
Additional Reach Parameters												
Rosgen Classification	C3		C3		C3		C3		C3		C3	
Channel Thalweg Length (ft)	1,009		1,009		1,009		1,009		1,009		1,009	
Sinuosity (ft)	1.1		1.1		1.1		1.1		1.1		1.1	
Water Surface Slope (ft/ft)	0.0070		0.0065		0.0078		0.0092		0.0079		0.0078	
Bankfull Slope (ft/ft)	0.0068		0.0062		0.0070		0.0072		0.0061		0.0072	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/SC/SC/103.6/256/362		SC/0.2/5.3/71.7/141.1/180		SC/0.09/0.3/75.9/143.4/256		SC/SC/0.6/99.5/180/512		0.27/2.0/4.8/37.9/180.0/362.0		0.15/4.0/8.7/55.0/107.3/180.0	
% of Reach with Eroding Banks			0%		0%		0%		0%		0%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12d. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Southeast Branch - Reach 1

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	10.4		9.1		8.2		8.5		8.6		8.1	
Floodprone Width (ft)	>75		>75		>75		>75		>75		>75	
Bankfull Mean Depth	0.6		0.5		0.7		0.7		0.7		0.8	
Bankfull Max Depth	1.5		0.9		1.3		1.3		1.5		1.4	
Bankfull Cross-sectional Area (ft ²)	6.7		4.7		5.6		6.0		5.7		6.7	
Width/Depth Ratio	16.3		17.6		12.0		12.0		12.9		9.8	
Entrenchment Ratio ¹	7.2+		8.3+		9.1+		8.8+		8.0+		9.2+	
Bank Height Ratio ²	1.0		1.0		1.0		1.0		1.0		1.1	
D50 (mm)	28.5		37.0		68.0		52.3		51.4		9.2	
Profile												
Riffle Length (ft)	10	28	10	28	11	29	12	32	9	28	6	28
Riffle Slope (ft/ft)	0.0023	0.0527	0.0100	0.0390	0.0039	0.0630	0.0035	0.0612	0.0019	0.0290	0.0038	0.0708
Pool Length (ft)	7	45	10	54	19	48	19	47	18	41	18	47
Pool Max Depth (ft)	2.5		2.3		2.6		2.8		2.6		2.0	
Pool Spacing (ft)	26	58	18	78	22	56	21	72	24	64	32	68
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	10	27										
Radius of Curvature (ft)	14	30										
Rc:Bankfull Width (ft/ft)	1.3	2.9										
Meander Wave Length (ft)	65	74										
Meander Width Ratio	6.3	7.1										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4		C4		C4	
Channel Thalweg Length (ft)	485		485		485		485		485		485	
Sinuosity (ft)	1.2		1.2		1.2		1.2		1.2		1.2	
Water Surface Slope (ft/ft)	0.0138		0.0140		0.0133		0.0143		0.0141		0.0134	
Bankfull Slope (ft/ft)	0.0136		0.0141		0.0126		0.0161		0.0171		0.0121	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.2/8/68.1/180/362		SC/0.1/4/67.2/151.8/362		SC/SC/0.3/86.7/180.0/512.0		SC/SC/4/101.2/170.1/256		SC/SC/0.3/84.6/151.8/256.0		SC/10.43/20.7/67.2/87.8/256.0	
% of Reach with Eroding Banks			0%		0%		0%		0%		0%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12e. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Southeast Branch - Reach 2a

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	10.6		9.7		9.3		9.0		9.1		8.9	
Floodprone Width (ft)	>100		>100		>100		>100		>100		>100	
Bankfull Mean Depth	0.6		0.6		0.5		0.7		0.8		0.8	
Bankfull Max Depth	1.2		1.0		1.0		1.3		1.3		1.4	
Bankfull Cross-sectional Area (ft ²)	6.8		5.8		4.9		5.9		7.7		6.8	
Width/Depth Ratio	16.5		16.4		17.6		13.8		10.8		11.6	
Entrenchment Ratio ¹	9.4+		10.3+		10.8+		11.1+		11.0+		11.3+	
Bank Height Ratio ²	1.0		1.0		1.0		1.0		1.0		1.1	
D50 (mm)	37.2		13.5		45.0		43.8		30.8		25.2	
Profile												
Riffle Length (ft)	4	20	4	26	3	28	4	27	3	28	7	45
Riffle Slope (ft/ft)	0.0145	0.0454	0.0017	0.0845	0.0026	0.0750	0.0010	0.0834	0.0049	0.0758	0.0039	0.0351
Pool Length (ft)	21	53	9	44	16	49	10	48	12	47	12	35
Pool Max Depth (ft)	3.5		3.2		3.4		2.9		3.1		2.4	
Pool Spacing (ft)	25	54	16	88	21	66	17	55	16	67	22	72
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	3	22										
Radius of Curvature (ft)	7	58										
Rc:Bankfull Width (ft/ft)	0.7	5.5										
Meander Wave Length (ft)	43	80										
Meander Width Ratio	4.1	7.5										
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4		C4		C4	
Channel Thalweg Length (ft)	536		536		536		536		536		536	
Sinuosity (ft)	1.1		1.1		1.1		1.1		1.1		1.1	
Water Surface Slope (ft/ft)	0.0144		0.0134		0.0137		0.0137		0.0125		0.0134	
Bankfull Slope (ft/ft)	0.0146		0.0135		0.0148		0.0122		0.0136		0.0121	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.1/17.1/70.9/256/362		SC/0.1/18/78.1/143.4/362		SC/0.13/24.7/128.0/214.7/256		SC/0.16/6.3/82.6/180/512		SC/3.82/15.0/98.37/192.5/362.0		SC/8.90/18.8/43.8/107.3/256.0	
% of Reach with Eroding Banks			0%		0%		0%		0%		0%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

Table 12f. Monitoring Data - Stream Reach Data Summary

Byrds Creek Mitigation Site
 DMS Project No. 95020
 Monitoring Year 5 - 2018

Southeast Branch - Reach 2b

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	10.6		9.7		9.3		9.0		9.1		8.9	
Floodprone Width (ft)	>100		>100		>100		>100		>100		>100	
Bankfull Mean Depth	0.6		0.6		0.5		0.7		0.8		0.8	
Bankfull Max Depth	1.2		1.0		1.0		1.3		1.3		1.4	
Bankfull Cross-sectional Area (ft ²)	6.8		5.8		4.9		5.9		7.7		6.8	
Width/Depth Ratio	16.5		16.4		17.6		13.8		10.8		11.6	
Entrenchment Ratio ¹	9.4+		10.3+		10.8+		11.1+		11.0+		11.3+	
Bank Height Ratio ²	1.0		1.0		1.0		1.0		1.0		1.1	
D50 (mm)	37.2		13.5		45.0		43.8		30.8		25.2	
Profile												
Riffle Length (ft)	11	36	14	36	12	31	12	41	13	37	15	34
Riffle Slope (ft/ft)	0.0119	0.0606	0.0017	0.0520	0.0073	0.0580	0.0021	0.0494	0.0164	0.0866	0.0054	0.0626
Pool Length (ft)	27	45	27	44	28	45	28	46	30	55	27	43
Pool Max Depth (ft)	3.5		3.2		2.7		2.7		3.1		1.9	
Pool Spacing (ft)	34	73	33	60	29	55	43	58	41	57	46	60
Pool Volume (ft ³)												
Pattern												
Channel Beltwidth (ft)	12	22										
Radius of Curvature (ft)	21	25										
Rc:Bankfull Width (ft/ft)	N/A											
Meander Wave Length (ft)	88	88										
Meander Width Ratio	N/A											
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4		C4		C4		C4	
Channel Thalweg Length (ft)	195		195		195		195		195		195	
Sinuosity (ft)	1.2		1.2		1.2		1.2		1.2		1.2	
Water Surface Slope (ft/ft)	0.0160		0.0085		0.0092		0.0124		0.0086		0.0224	
Bankfull Slope (ft/ft)	0.0168		0.0092		0.0081		0.0122		0.0055		0.0111	
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	SC/0.1/17.1/70.9/256/362		SC/0.1/18/78.1/143.4/362		SC/0.13/24.7/128.0/214.7/256		SC/0.16/6.3/82.6/180/512		SC/3.82/15.0/98.37/192.5/362.0		SC/8.90/18.8/43.8/107.3/256.0	
% of Reach with Eroding Banks			0%		0%		0%		0%		0%	

¹Entrenchment Ratio is the flood prone width divided by the bankfull width.

²Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

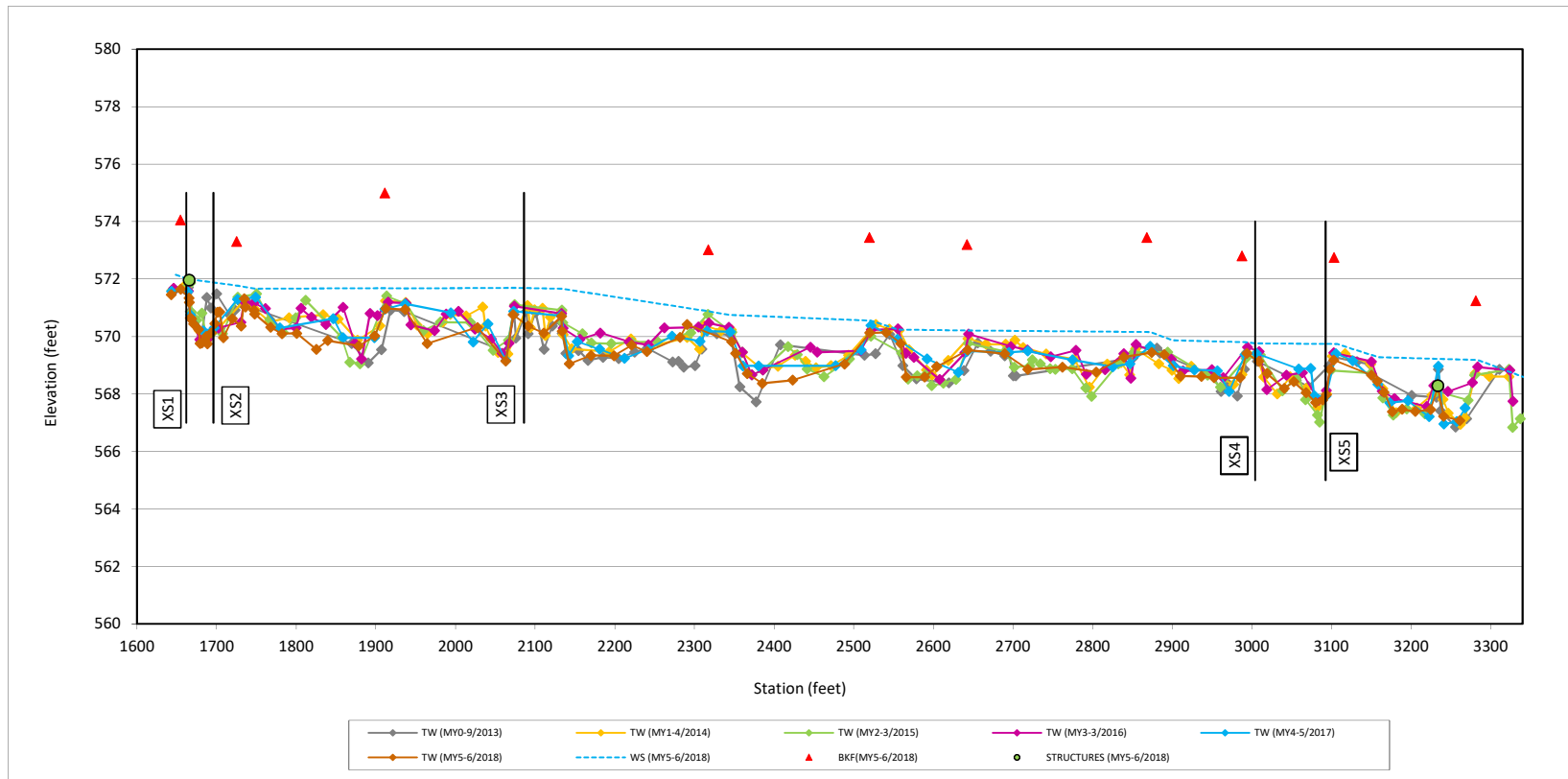
Longitudinal Profile Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 2



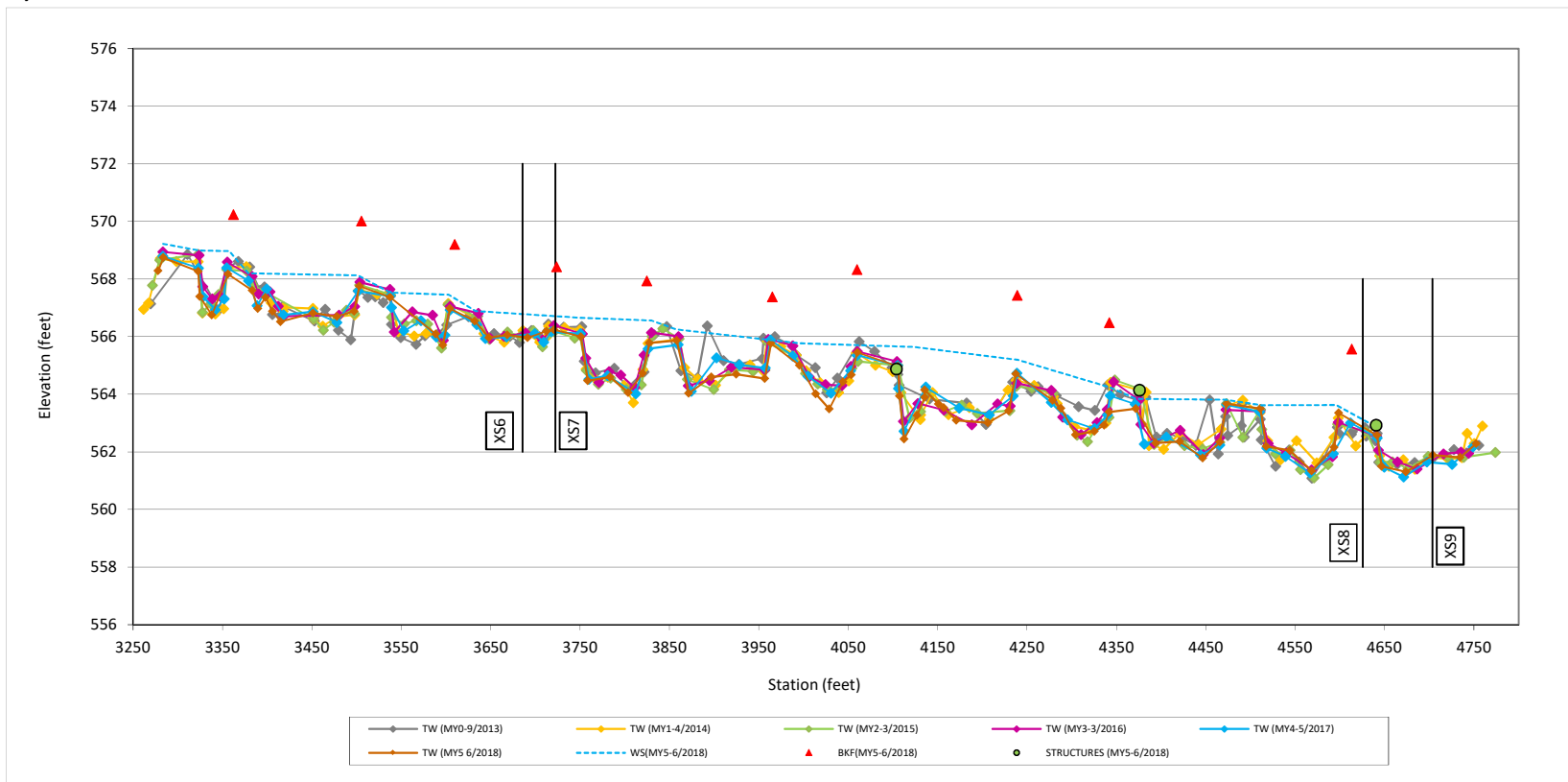
Longitudinal Profile Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek Reach 3



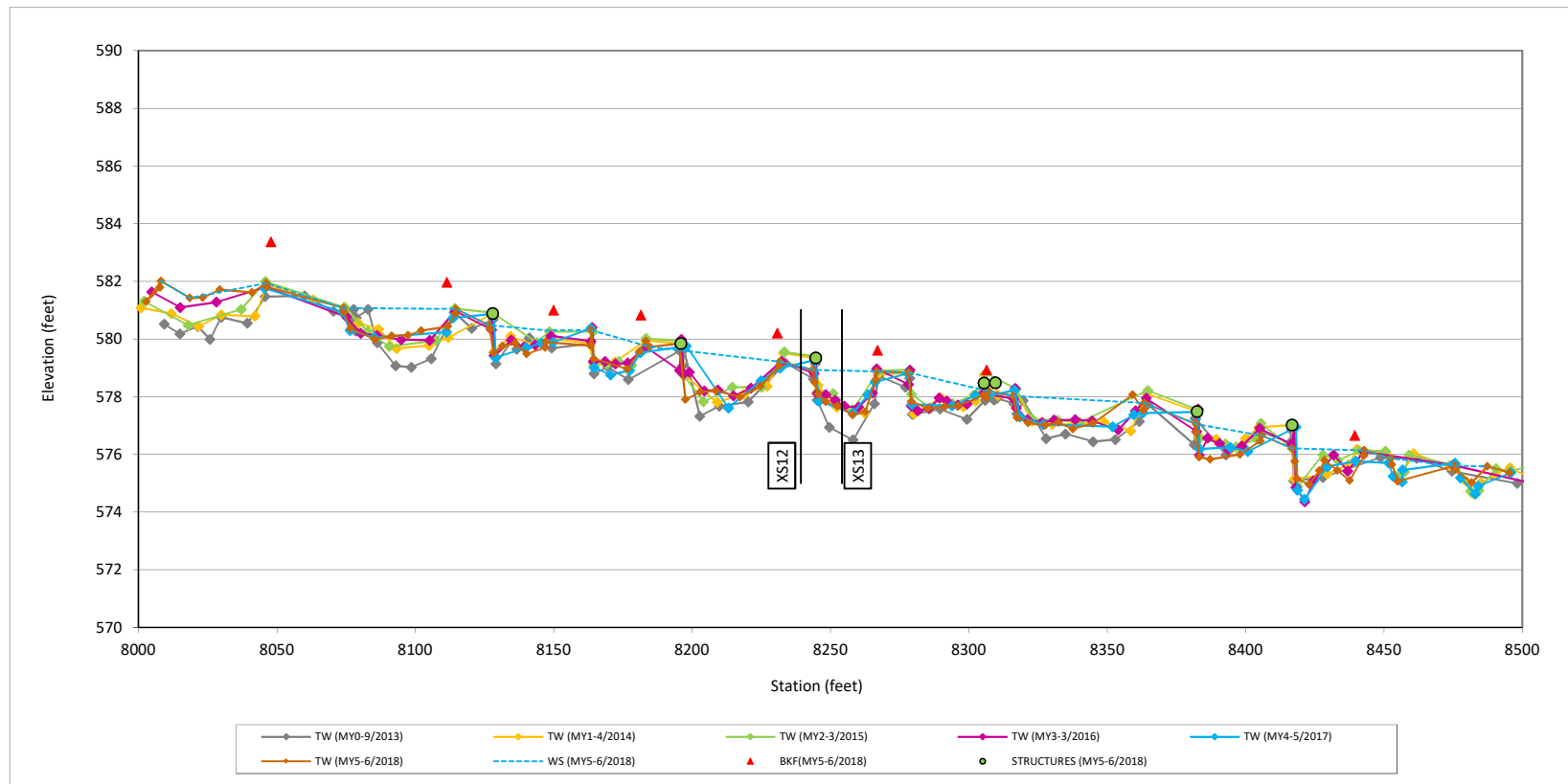
Longitudinal Profile Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 1



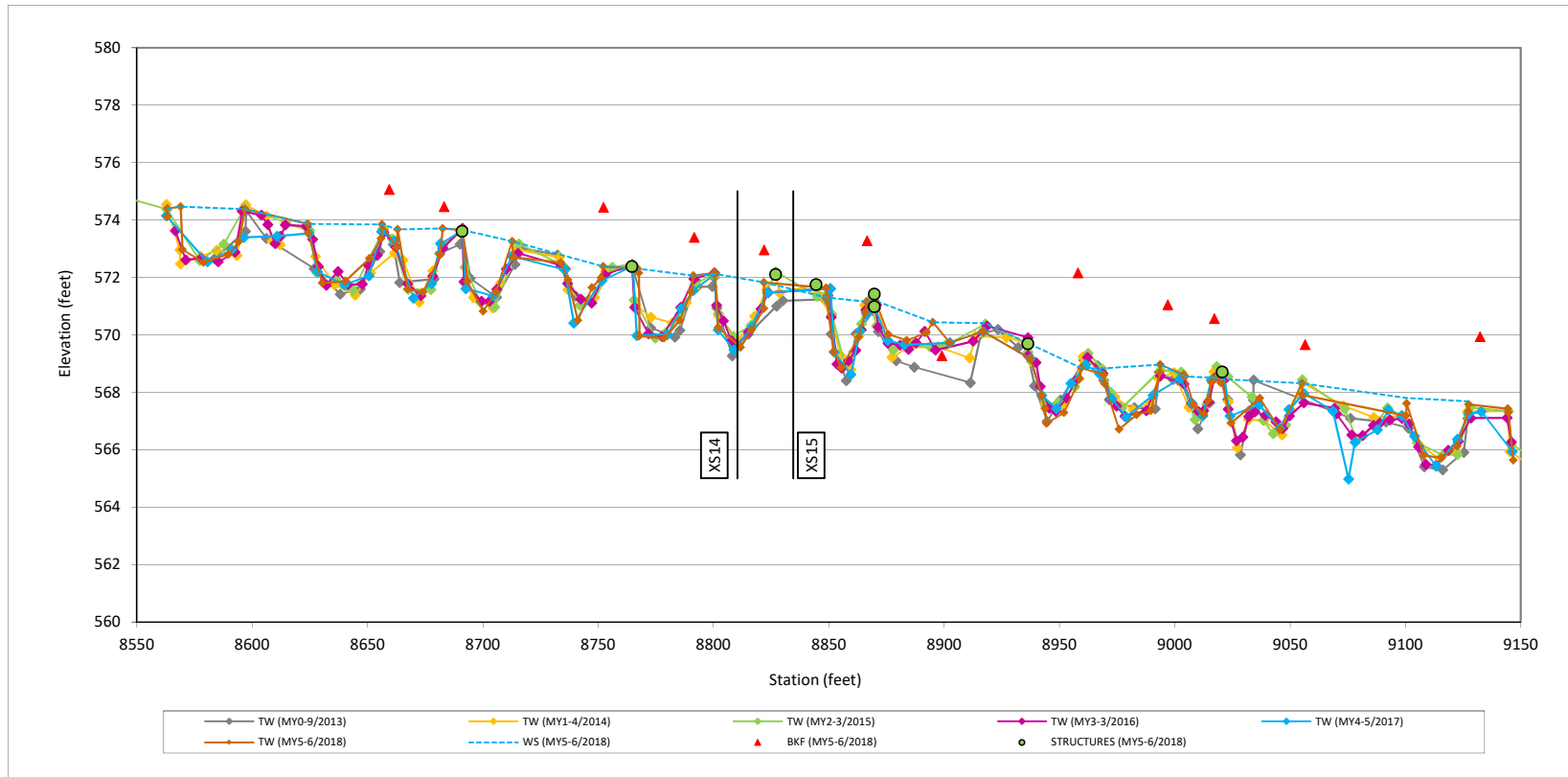
Longitudinal Profile Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 2a



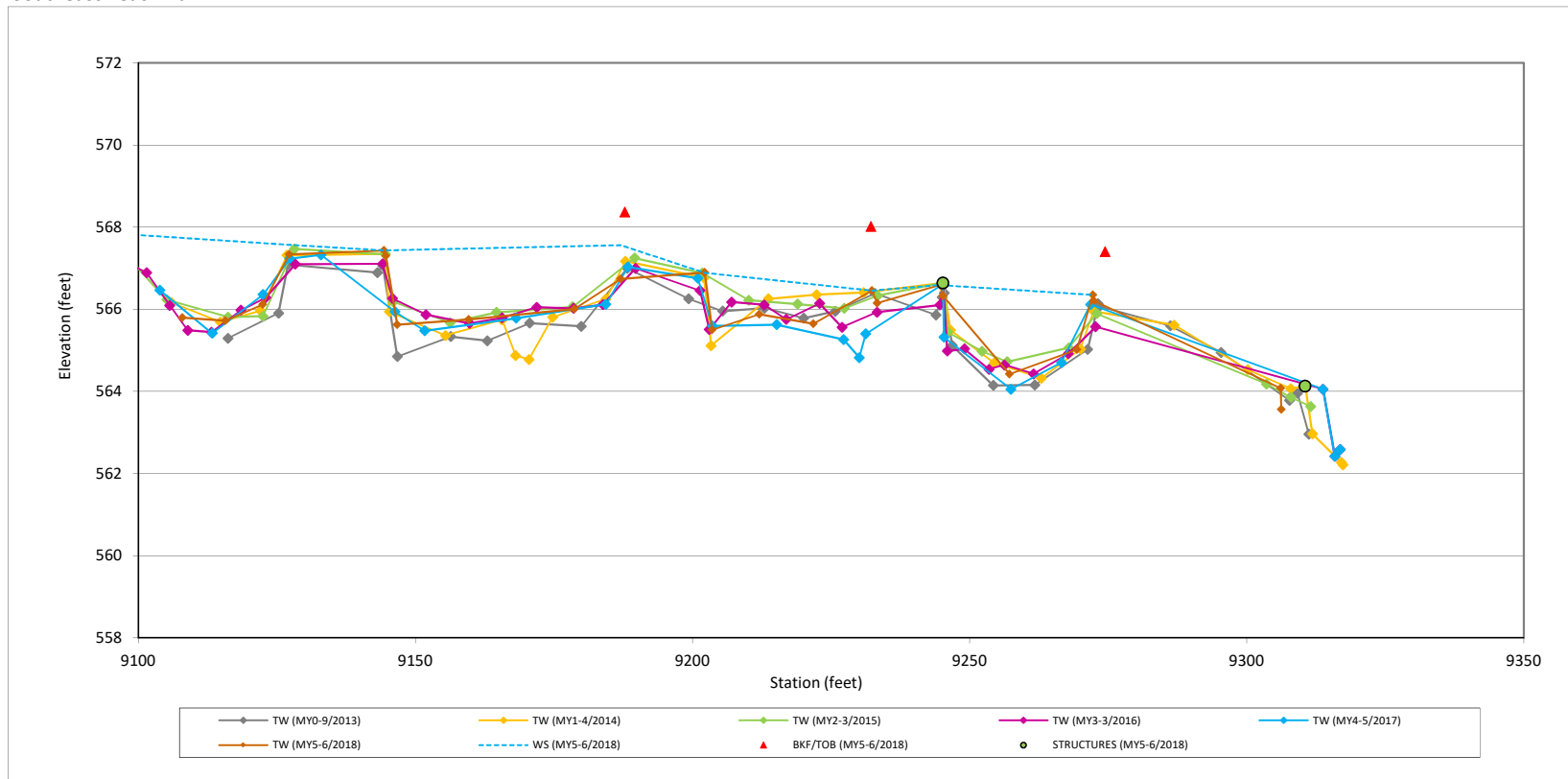
Longitudinal Profile Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast Reach 2b



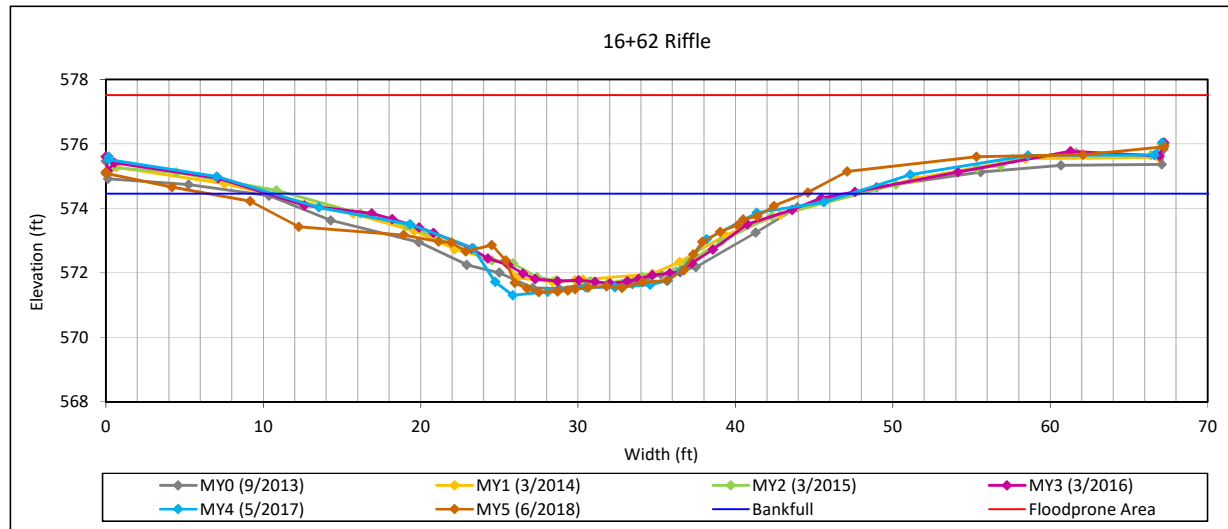
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 1 - Byrds Creek Reach 2



Bankfull Dimensions

59.3	x-section area (ft.sq.)
37.9	width (ft)
1.6	mean depth (ft)
3.1	max depth (ft)
39.1	wetted perimeter (ft)
1.5	hyd radi (ft)
24.3	width-depth ratio
150.0	W flood prone area (ft)
4.0	entrenchment ratio
0.9	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

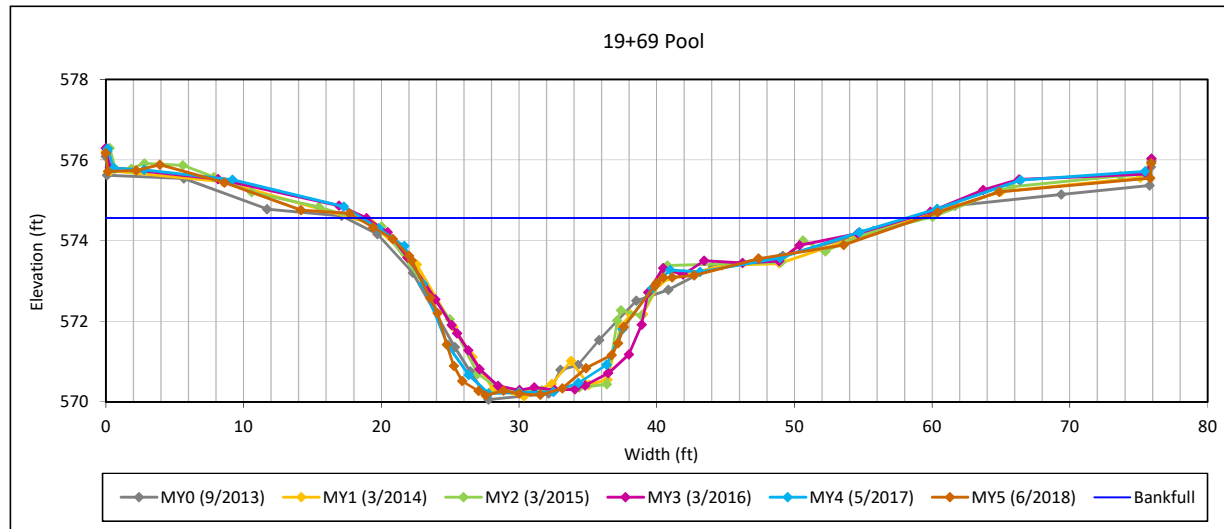
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 2 - Byrds Creek Reach 2



Bankfull Dimensions

80.3	x-section area (ft.sq.)
41.0	width (ft)
2.0	mean depth (ft)
4.4	max depth (ft)
43.0	wetted perimeter (ft)
1.9	hyd radi (ft)
20.9	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

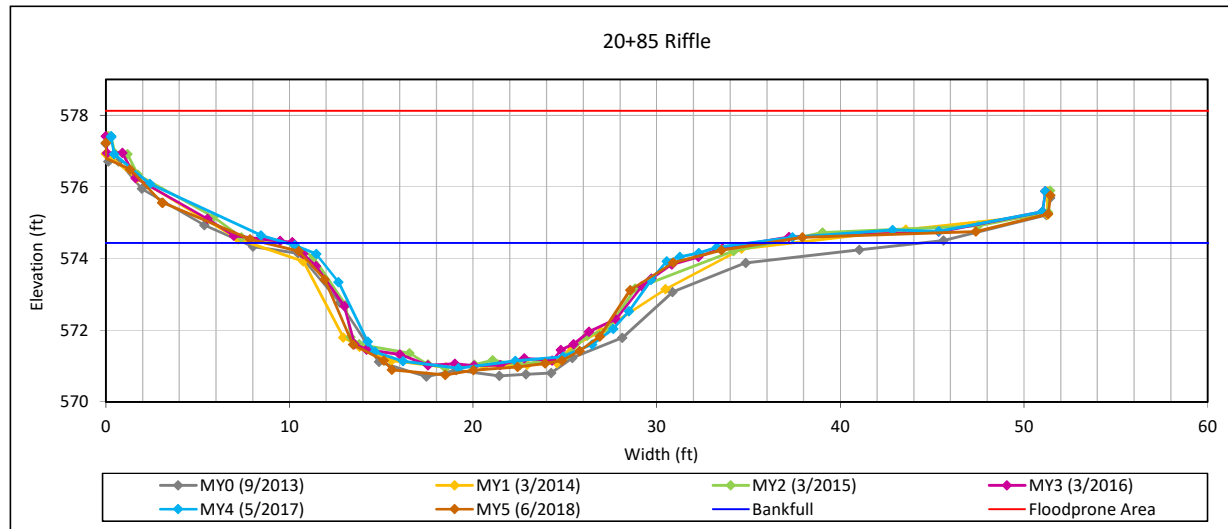
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 3 - Byrds Creek Reach 2



Bankfull Dimensions

56.2	x-section area (ft.sq.)
27.3	width (ft)
2.1	mean depth (ft)
3.7	max depth (ft)
29.3	wetted parimeter (ft)
1.9	hyd radi (ft)
13.3	width-depth ratio
150.0	W flood prone area (ft)
5.5	entrenchment ratio
0.9	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

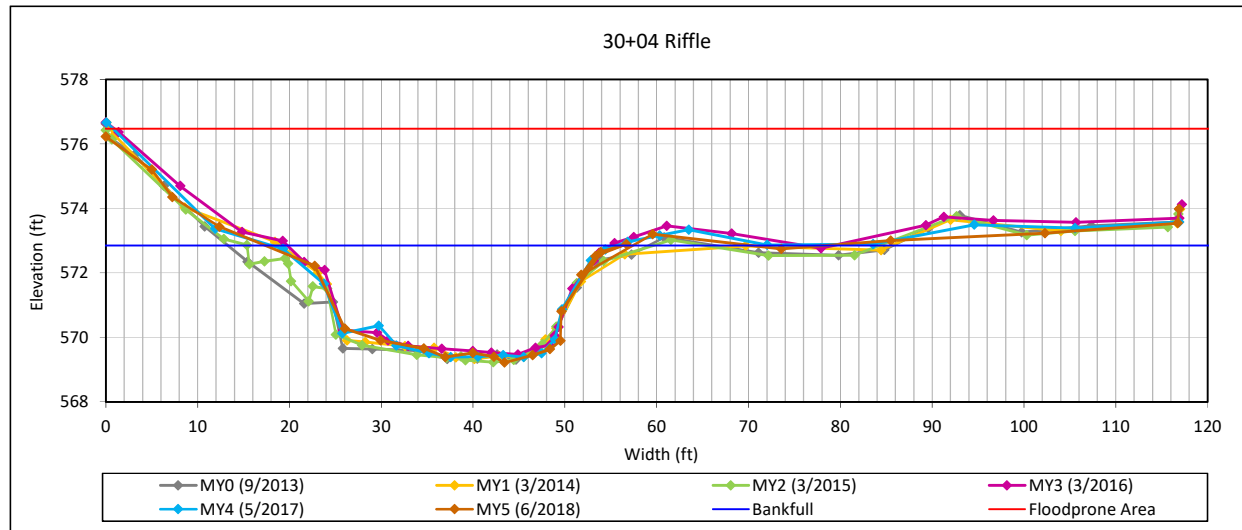
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 4 - Byrds Creek Reach 2



Bankfull Dimensions

88.7	x-section area (ft.sq.)
39.8	width (ft)
2.2	mean depth (ft)
3.6	max depth (ft)
50.8	wetted perimeter (ft)
1.7	hyd radi (ft)
17.9	width-depth ratio
150.0	W flood prone area (ft)
3.8	entrenchment ratio
0.9	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

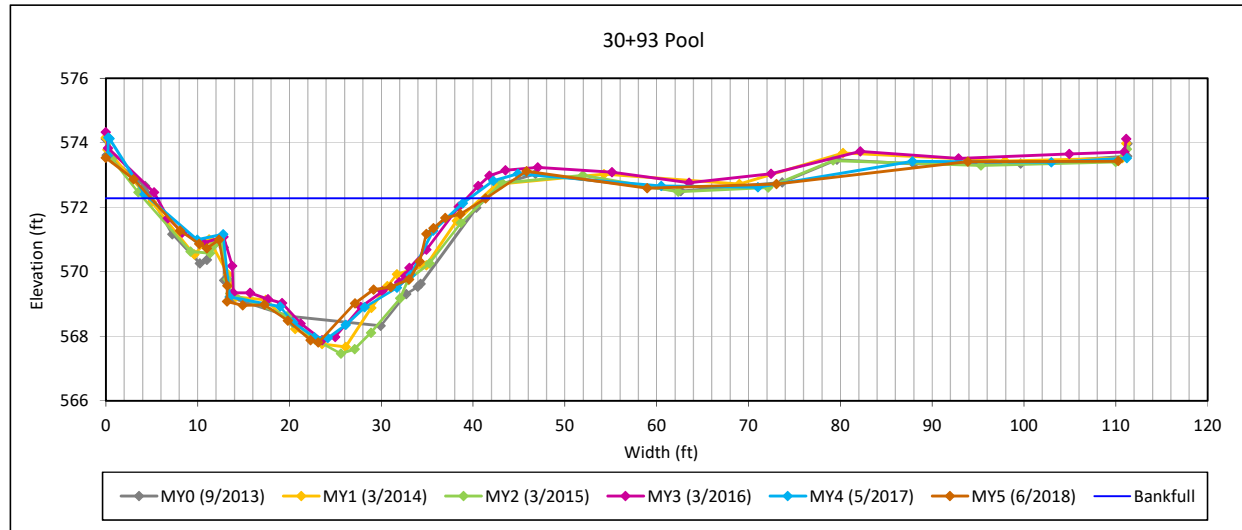
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 5 - Byrds Creek Reach 2



Bankfull Dimensions

84.3	x-section area (ft.sq.)
36.5	width (ft)
2.3	mean depth (ft)
4.5	max depth (ft)
39.0	wetted perimeter (ft)
2.2	hyd radi (ft)
15.8	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

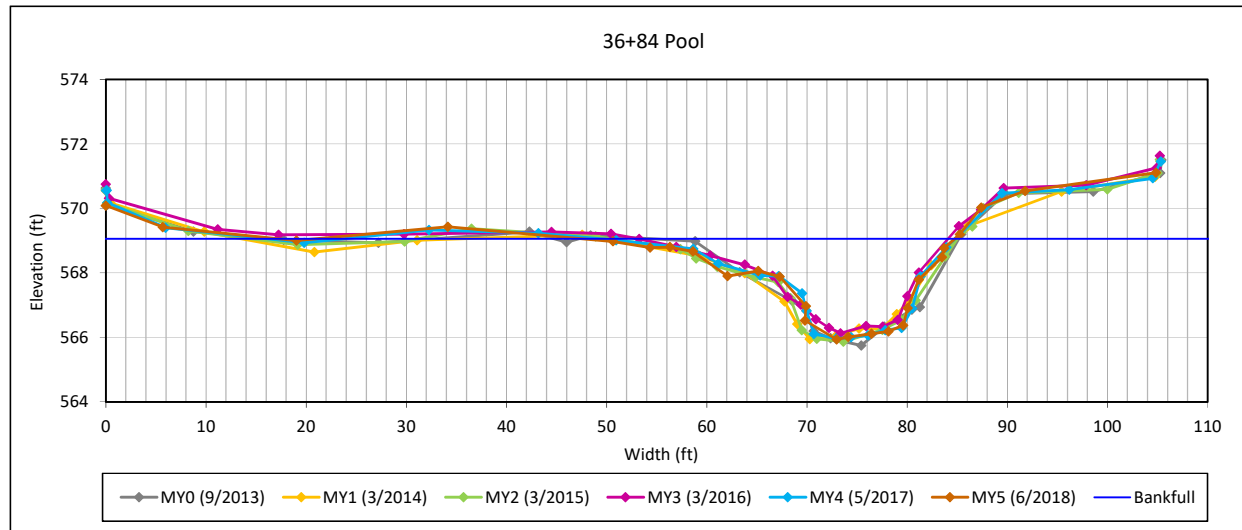
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 6 - Byrds Creek Reach 3



Bankfull Dimensions

47.5	x-section area (ft.sq.)
30.4	width (ft)
1.6	mean depth (ft)
3.1	max depth (ft)
32.1	wetted perimeter (ft)
1.5	hyd radi (ft)
19.5	width-depth ratio

Survey Date:
Field Crew: Wildlands Engineering



View Downstream

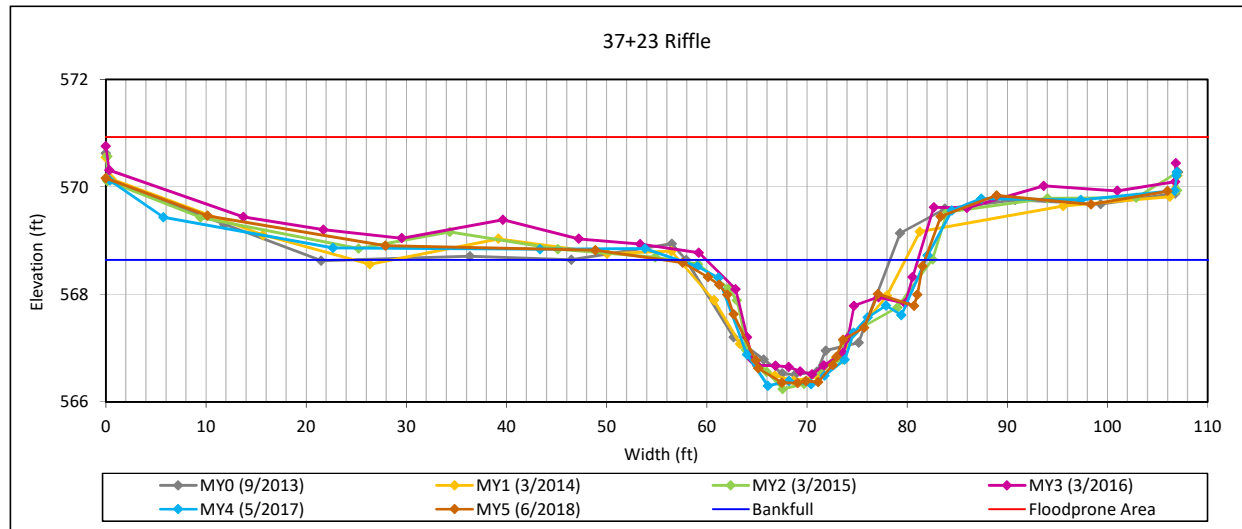
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 7 - Byrds Creek Reach 3



Bankfull Dimensions

31.0	x-section area (ft.sq.)
24.2	width (ft)
1.3	mean depth (ft)
2.3	max depth (ft)
25.1	wetted perimeter (ft)
1.2	hyd radi (ft)
18.8	width-depth ratio
150.0	W flood prone area (ft)
6.2	entrenchment ratio
1.0	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

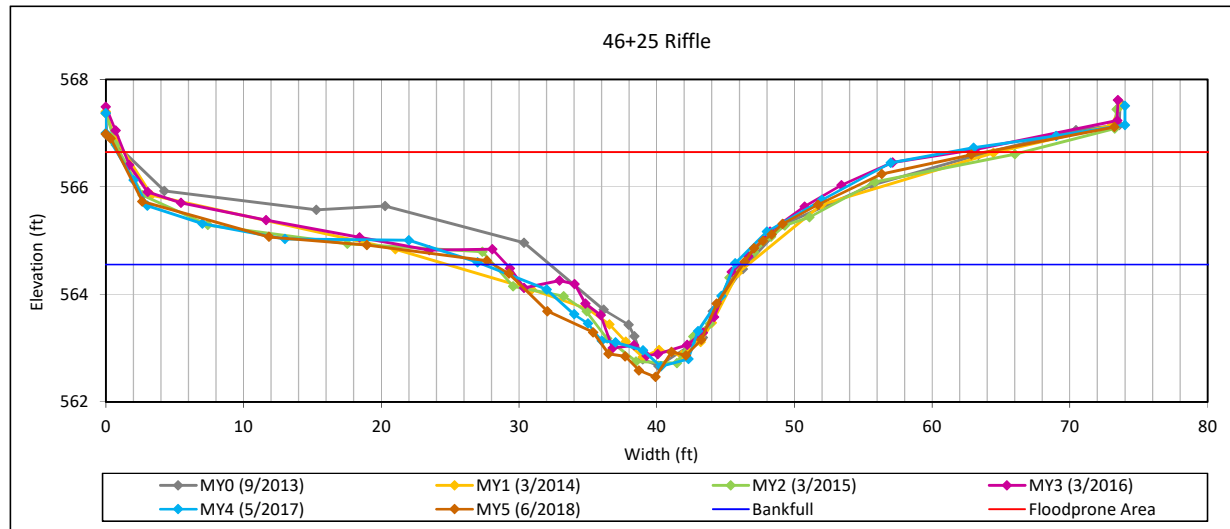
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 8 - Byrds Creek Reach 3



Bankfull Dimensions

20.5	x-section area (ft.sq.)
18.1	width (ft)
1.1	mean depth (ft)
2.1	max depth (ft)
18.8	wetted parimeter (ft)
1.1	hyd radi (ft)
16.0	width-depth ratio
150.0	W flood prone area (ft)
8.3	entrenchment ratio
1.1	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

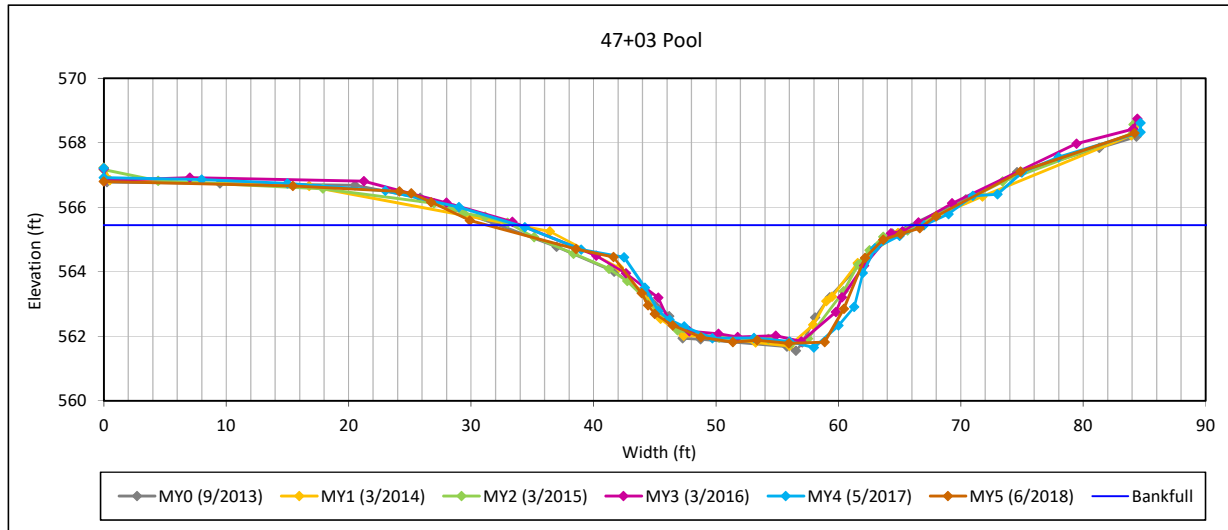
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 9 - Byrds Creek Reach 3



Bankfull Dimensions

69.6	x-section area (ft.sq.)
35.6	width (ft)
2.0	mean depth (ft)
3.7	max depth (ft)
37.2	wetted parimeter (ft)
1.9	hyd radi (ft)
18.2	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

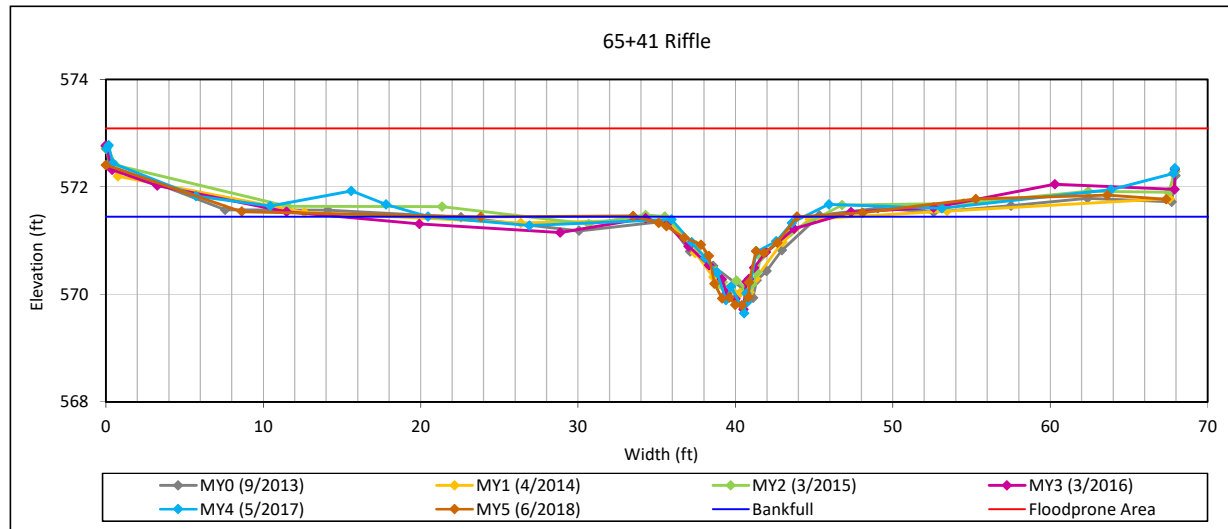
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 10 - South Branch Reach 1



Bankfull Dimensions

6.5	x-section area (ft.sq.)
10.5	width (ft)
0.6	mean depth (ft)
1.6	max depth (ft)
11.6	wetted perimeter (ft)
0.6	hyd radi (ft)
17.1	width-depth ratio
100.0	W flood prone area (ft)
9.5	entrenchment ratio
1.0	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

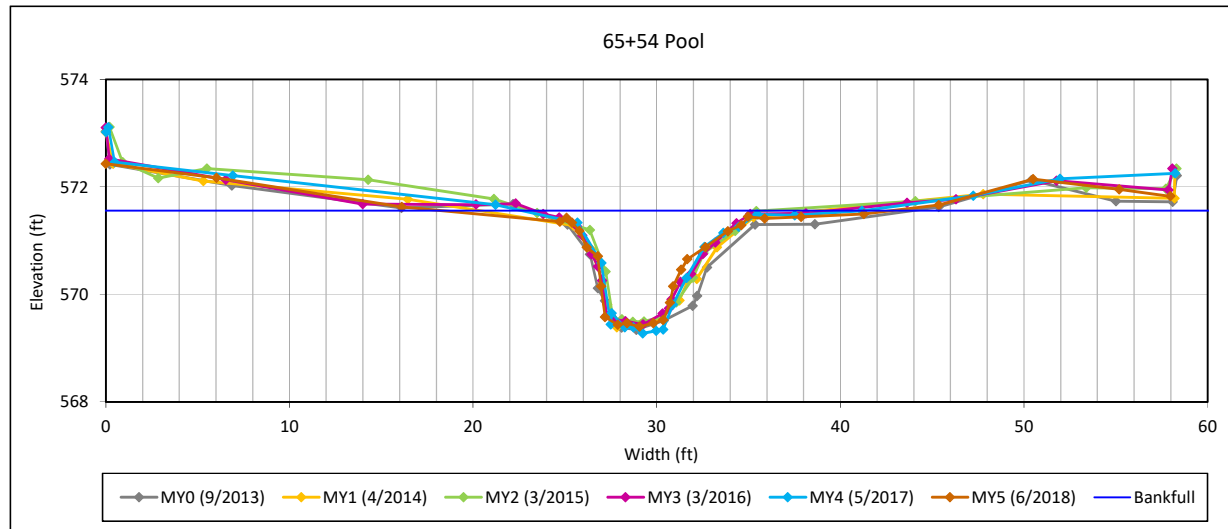
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 11 - South Branch Reach 1



Bankfull Dimensions

11.6	x-section area (ft.sq.)
9.5	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
11.0	wetted perimeter (ft)
1.1	hyd radi (ft)
7.8	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

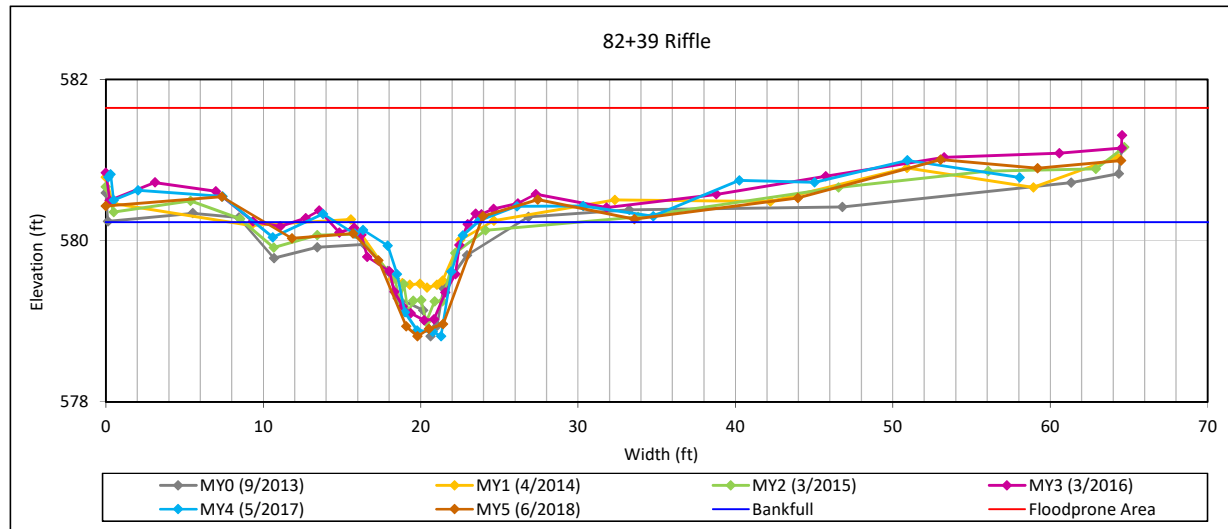
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 12 - Southeast Reach 1



Bankfull Dimensions

6.7	x-section area (ft.sq.)
8.1	width (ft)
0.8	mean depth (ft)
1.4	max depth (ft)
8.7	wetted parimeter (ft)
0.8	hyd radi (ft)
9.8	width-depth ratio
75.0	W flood prone area (ft)
9.2	entrenchment ratio
1.1	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

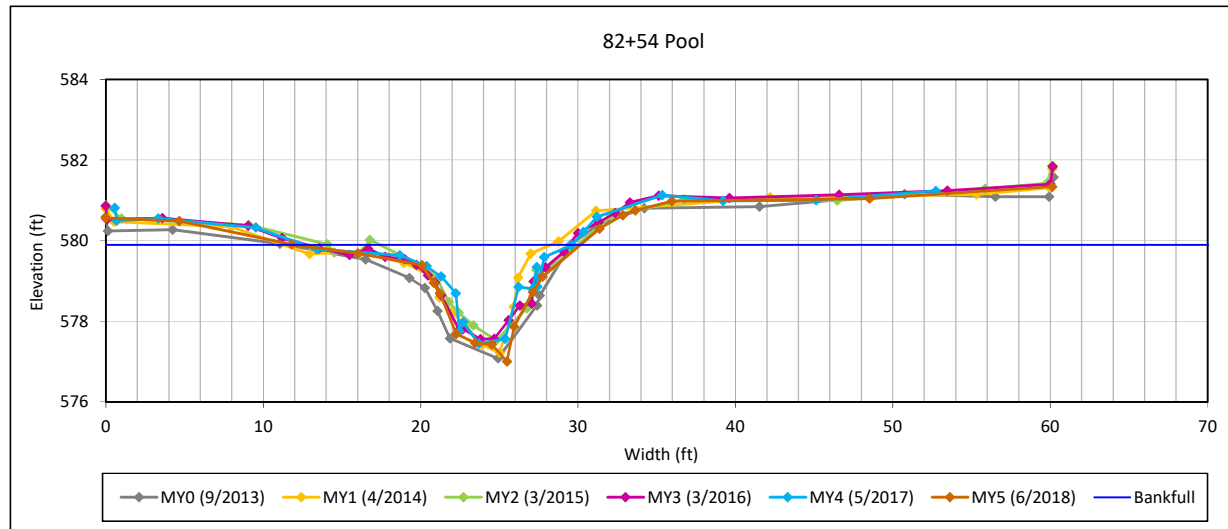
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 13 - Southeast Reach 1



Bankfull Dimensions

15.3	x-section area (ft.sq.)
10.1	width (ft)
1.5	mean depth (ft)
2.9	max depth (ft)
11.8	wetted perimeter (ft)
1.3	hyd radi (ft)
6.6	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

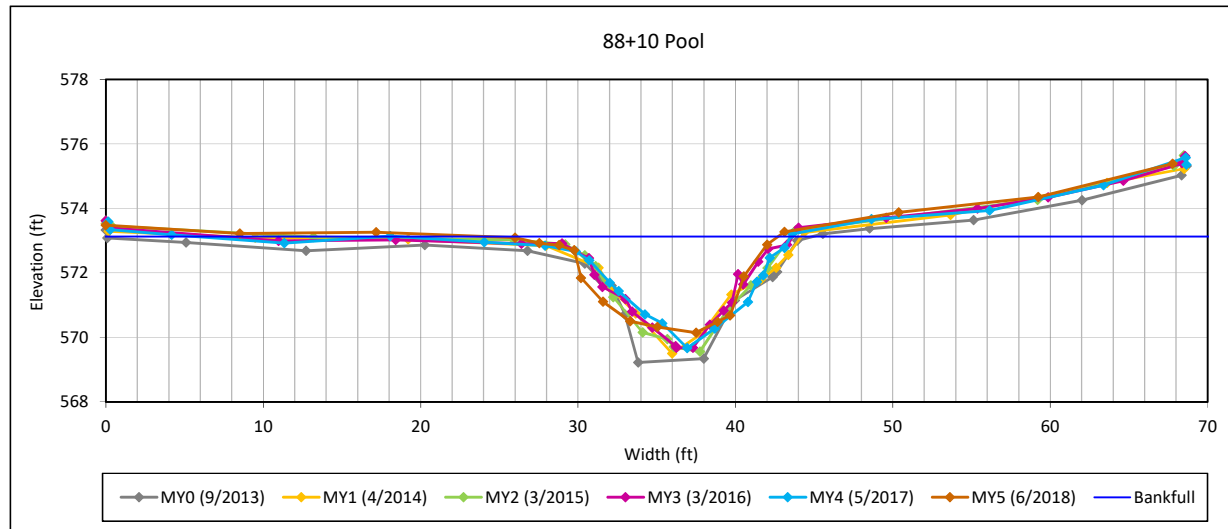
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 14 - Southeast Reach 2



Bankfull Dimensions

28.0	x-section area (ft.sq.)
18.7	width (ft)
1.5	mean depth (ft)
3.0	max depth (ft)
20.5	wetted perimeter (ft)
1.4	hyd radi (ft)
12.4	width-depth ratio

Survey Date: 6/2018
Field Crew: Wildlands Engineering



View Downstream

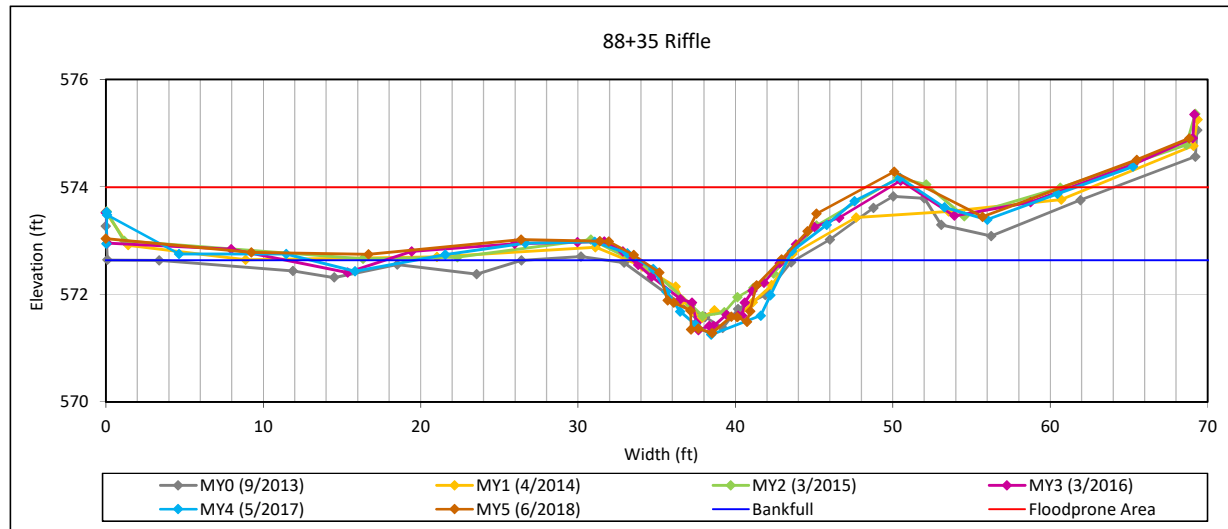
Cross Section Plots

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Cross Section 15 - Southeast Reach 2



Bankfull Dimensions

6.8	x-section area (ft.sq.)
8.9	width (ft)
0.8	mean depth (ft)
1.4	max depth (ft)
9.8	wetted perimeter (ft)
0.7	hyd radi (ft)
11.6	width-depth ratio
100.0	W flood prone area (ft)
11.3	entrenchment ratio
1.1	low bank height ratio

Survey Date: 6/2018

Field Crew: Wildlands Engineering



View Downstream

Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

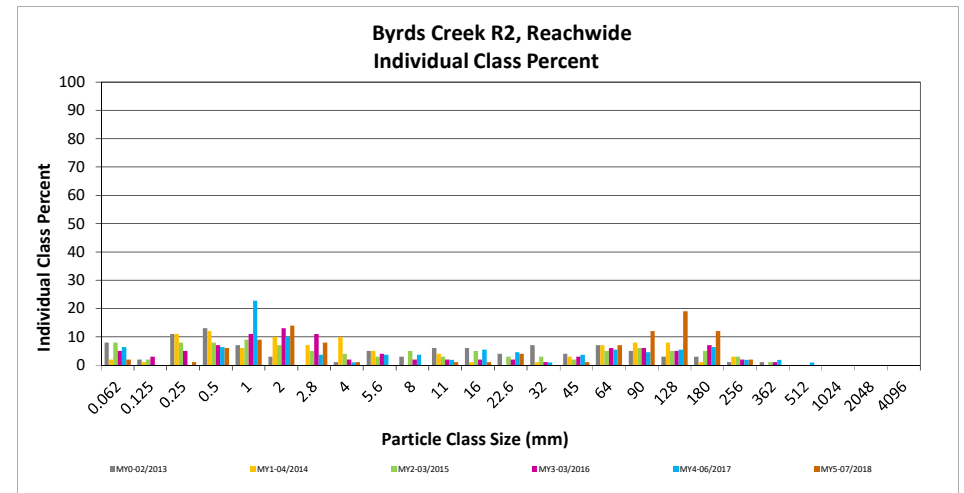
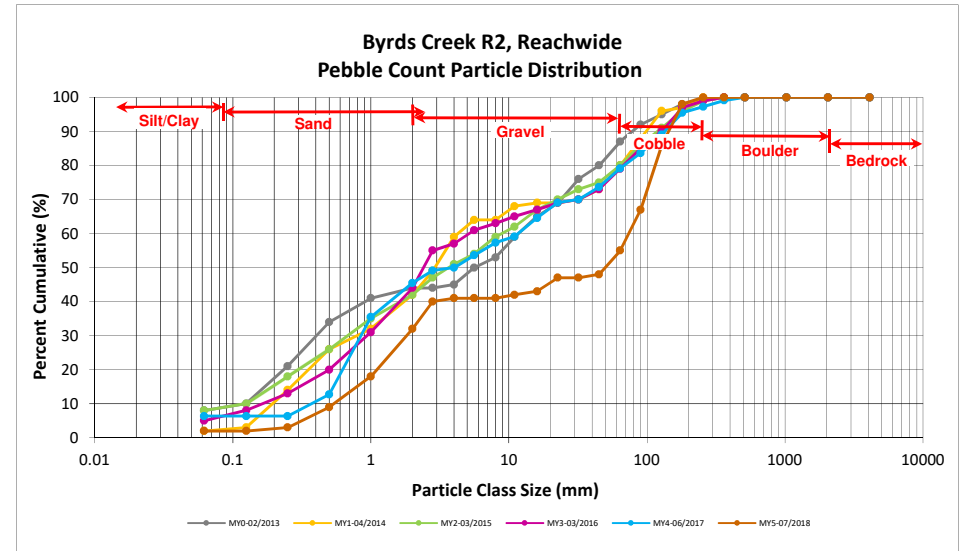
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		2	2	2	2
SAND	Very fine	0.062	0.125					2
	Fine	0.125	0.250		1	1	1	3
	Medium	0.25	0.50		6	6	6	9
	Coarse	0.5	1.0	2	7	9	9	18
	Very Coarse	1.0	2.0	6	8	14	14	32
GRAVEL	Very Fine	2.0	2.8	1	7	8	8	40
	Very Fine	2.8	4.0		1	1	1	41
	Fine	4.0	5.6					41
	Fine	5.6	8.0					41
	Medium	8.0	11.0	1		1	1	42
	Medium	11.0	16.0		1	1	1	43
	Coarse	16.0	22.6	3	1	4	4	47
	Coarse	22.6	32					47
	Very Coarse	32	45	1		1	1	48
	Very Coarse	45	64	4	3	7	7	55
COBBLE	Small	64	90	7	5	12	12	67
	Small	90	128	15	4	19	19	86
	Large	128	180	8	4	12	12	98
	Large	180	256	2		2	2	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	0.86
D ₃₅ =	2.27
D ₅₀ =	49.8
D ₈₄ =	123.3
D ₉₅ =	165.3
D ₁₀₀ =	256.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

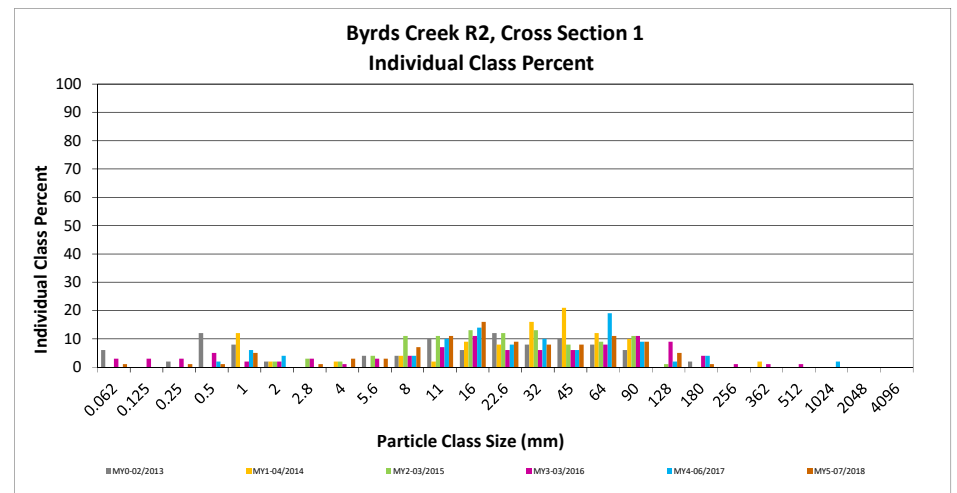
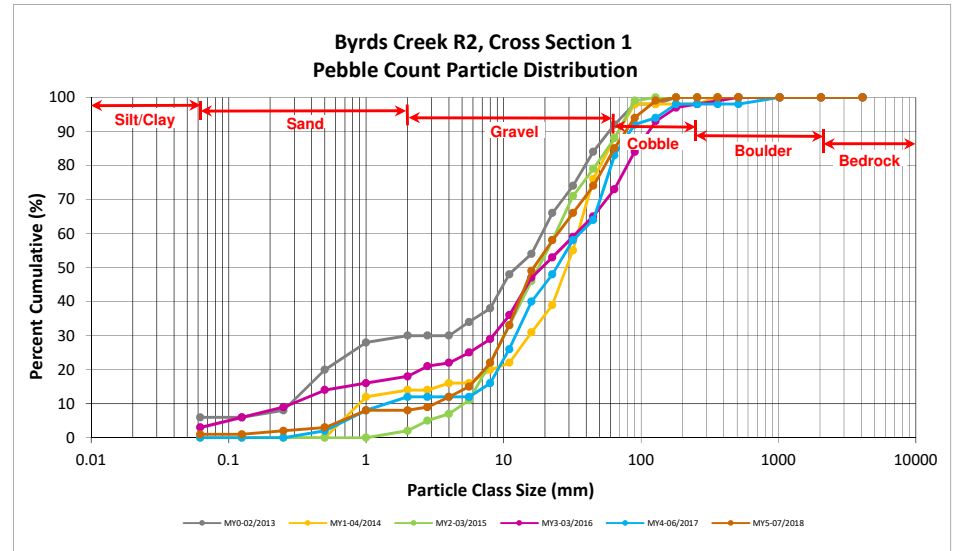
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R2, Cross Section 1

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	1	1	2
	Medium	0.25	0.50	1	1	3
	Coarse	0.5	1.0	5	5	8
	Very Coarse	1.0	2.0			8
GRAVEL	Very Fine	2.0	2.8	1	1	9
	Very Fine	2.8	4.0	3	3	12
	Fine	4.0	5.6	3	3	15
	Fine	5.6	8.0	7	7	22
	Medium	8.0	11.0	11	11	33
	Medium	11.0	16.0	16	16	49
	Coarse	16.0	22.6	9	9	58
	Coarse	22.6	32	8	8	66
	Very Coarse	32	45	8	8	74
	Very Coarse	45	64	11	11	85
COBBLE	Small	64	90	9	9	94
	Small	90	128	5	5	99
	Large	128	180	1	1	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 1	
Channel materials (mm)	
D ₁₆ =	5.89
D ₃₅ =	11.53
D ₅₀ =	16.6
D ₈₄ =	62.0
D ₉₅ =	96.6
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

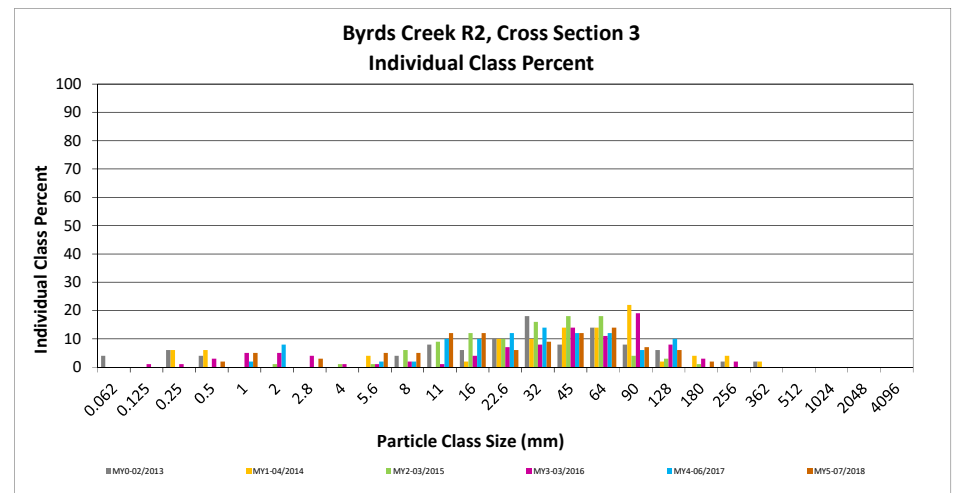
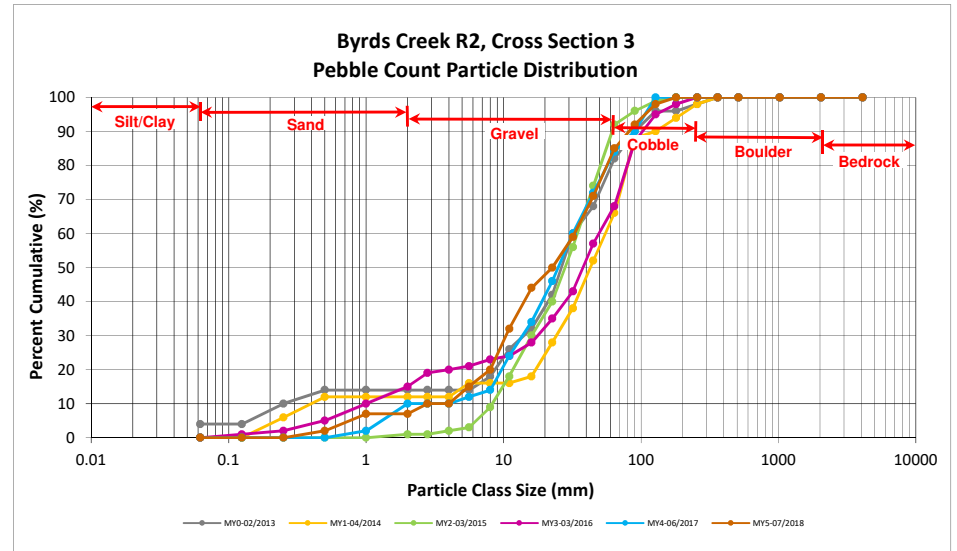
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R2, Cross Section 3

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50	2	2	2
	Coarse	0.5	1.0	5	5	7
	Very Coarse	1.0	2.0			7
GRAVEL	Very Fine	2.0	2.8	3	3	10
	Very Fine	2.8	4.0			10
	Fine	4.0	5.6	5	5	15
	Fine	5.6	8.0	5	5	20
	Medium	8.0	11.0	12	12	32
	Medium	11.0	16.0	12	12	44
	Coarse	16.0	22.6	6	6	50
	Coarse	22.6	32	9	9	59
	Very Coarse	32	45	12	12	71
	Very Coarse	45	64	14	14	85
COBBLE	Small	64	90	7	7	92
	Small	90	128	6	6	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 3	
Channel materials (mm)	
D ₁₆ =	6.01
D ₃₅ =	12.08
D ₅₀ =	22.6
D ₈₄ =	62.4
D ₉₅ =	107.3
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

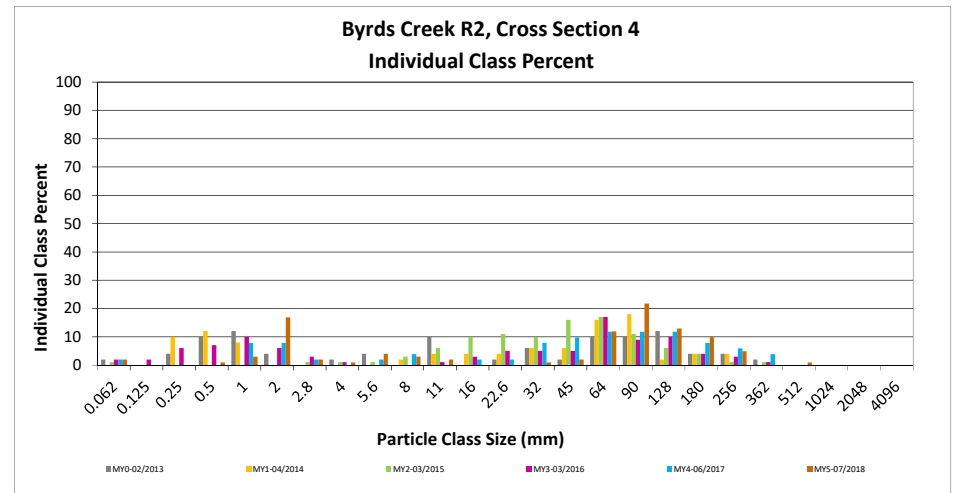
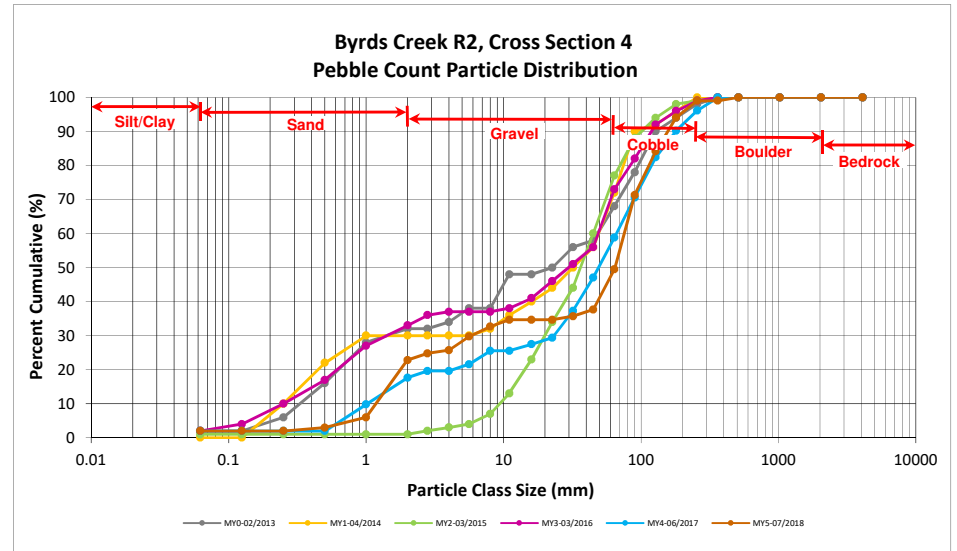
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R2, Cross Section 4

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	2	2	2
SAND	Very fine	0.062	0.125			2
	Fine	0.125	0.250			2
	Medium	0.25	0.50	1	1	3
	Coarse	0.5	1.0	3	3	6
	Very Coarse	1.0	2.0	17	17	23
GRAVEL	Very Fine	2.0	2.8	2	2	25
	Very Fine	2.8	4.0	1	1	26
	Fine	4.0	5.6	4	4	30
	Fine	5.6	8.0	3	3	33
	Medium	8.0	11.0	2	2	35
	Medium	11.0	16.0			35
	Coarse	16.0	22.6			35
	Coarse	22.6	32	1	1	36
	Very Coarse	32	45	2	2	38
	Very Coarse	45	64	12	12	50
COBBLE	Small	64	90	22	22	71
	Small	90	128	13	13	84
	Large	128	180	10	10	94
	Large	180	256	5	5	99
BOULDER	Small	256	362			99
	Small	362	512	1	1	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				101	100	100

Cross Section 4	
Channel materials (mm)	
D ₁₆ =	1.51
D ₃₅ =	25.53
D ₅₀ =	64.5
D ₈₄ =	127.4
D ₉₅ =	192.5
D ₁₀₀ =	512.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

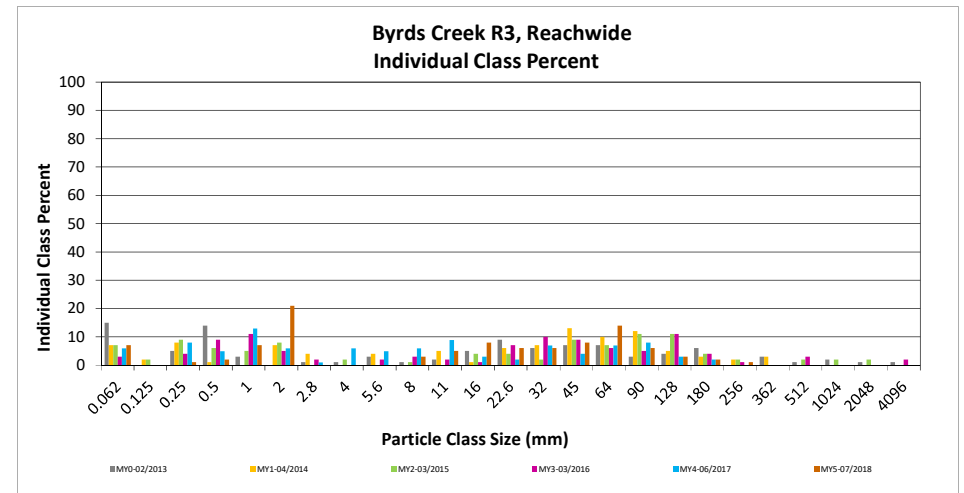
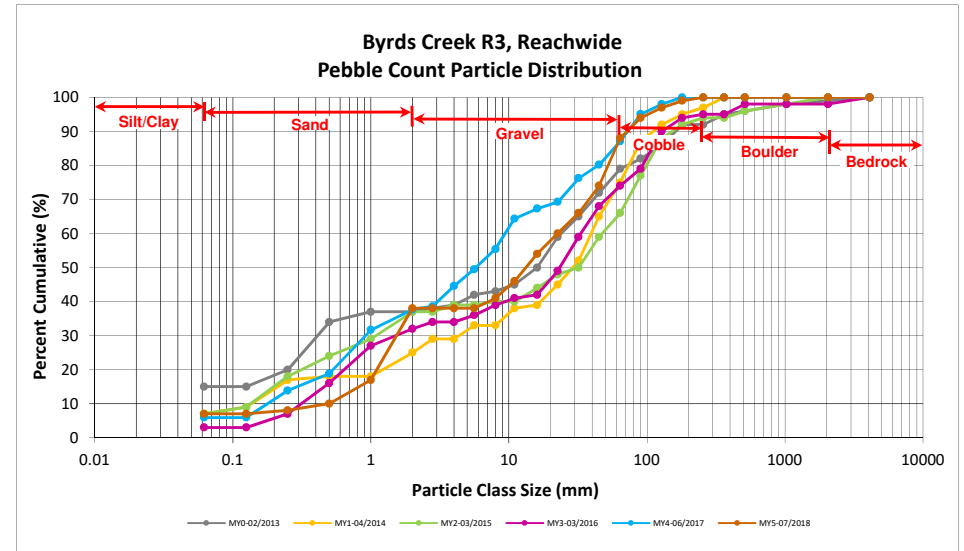
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	6	7	7	7
SAND	Very fine	0.062	0.125					7
	Fine	0.125	0.250	1		1	1	8
	Medium	0.25	0.50	1	1	2	2	10
	Coarse	0.5	1.0		7	7	7	17
	Very Coarse	1.0	2.0	7	14	21	21	38
GRAVEL	Very Fine	2.0	2.8					38
	Very Fine	2.8	4.0					38
	Fine	4.0	5.6					38
	Fine	5.6	8.0	1	2	3	3	41
	Medium	8.0	11.0	4	1	5	5	46
	Medium	11.0	16.0	5	3	8	8	54
	Coarse	16.0	22.6	3	3	6	6	60
	Coarse	22.6	32	3	3	6	6	66
	Very Coarse	32	45	5	3	8	8	74
	Very Coarse	45	64	11	3	14	14	88
COBBLE	Small	64	90	4	2	6	6	94
	Small	90	128	2	1	3	3	97
	Large	128	180	1	1	2	2	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	0.91
D ₃₅ =	1.81
D ₅₀ =	13.3
D ₈₄ =	57.9
D ₉₅ =	101.2
D ₁₀₀ =	256.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

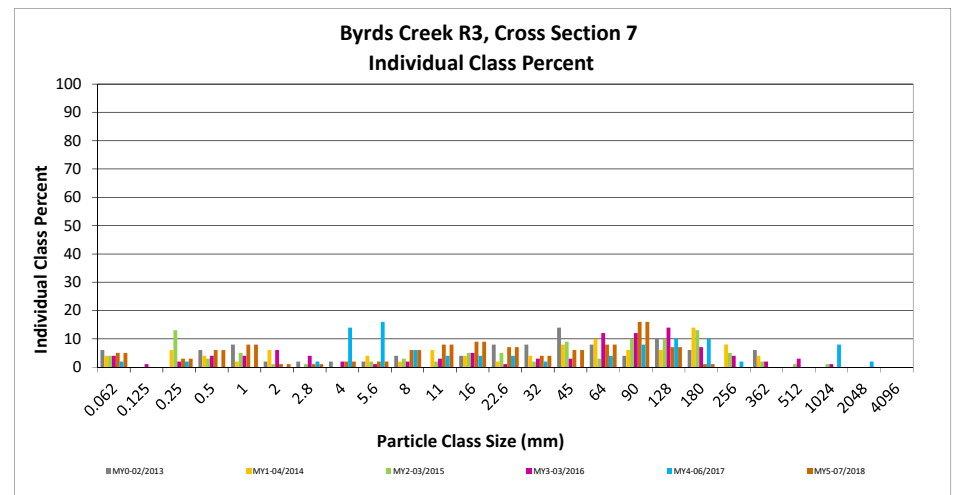
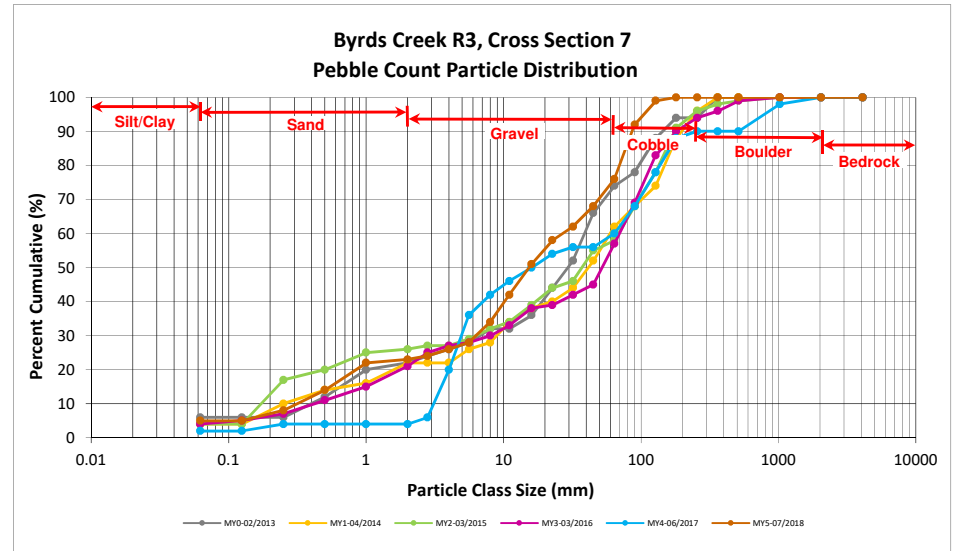
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R3, Cross Section 7

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	5	5	5
SAND	Very fine	0.062	0.125			5
	Fine	0.125	0.250	3	3	8
	Medium	0.25	0.50	6	6	14
	Coarse	0.5	1.0	8	8	22
	Very Coarse	1.0	2.0	1	1	23
GRAVEL	Very Fine	2.0	2.8	1	1	24
	Very Fine	2.8	4.0	2	2	26
	Fine	4.0	5.6	2	2	28
	Fine	5.6	8.0	6	6	34
	Medium	8.0	11.0	8	8	42
	Medium	11.0	16.0	9	9	51
	Coarse	16.0	22.6	7	7	58
	Coarse	22.6	32	4	4	62
	Very Coarse	32	45	6	6	68
	Very Coarse	45	64	8	8	76
COBBLE	Small	64	90	16	16	92
	Small	90	128	7	7	99
	Large	128	180	1	1	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
		Total		100	100	100

Cross Section 7	
Channel materials (mm)	
D ₁₆ =	0.59
D ₃₅ =	8.32
D ₅₀ =	15.3
D ₈₄ =	75.9
D ₉₅ =	104.7
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

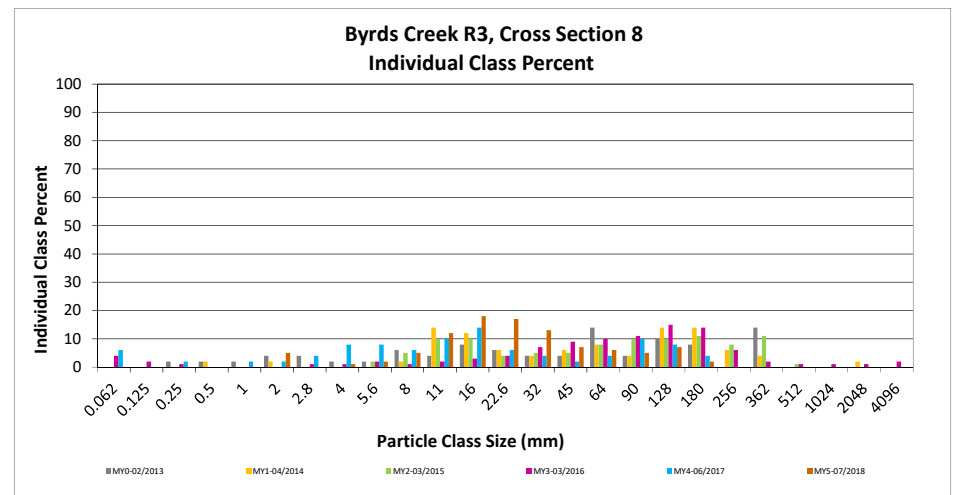
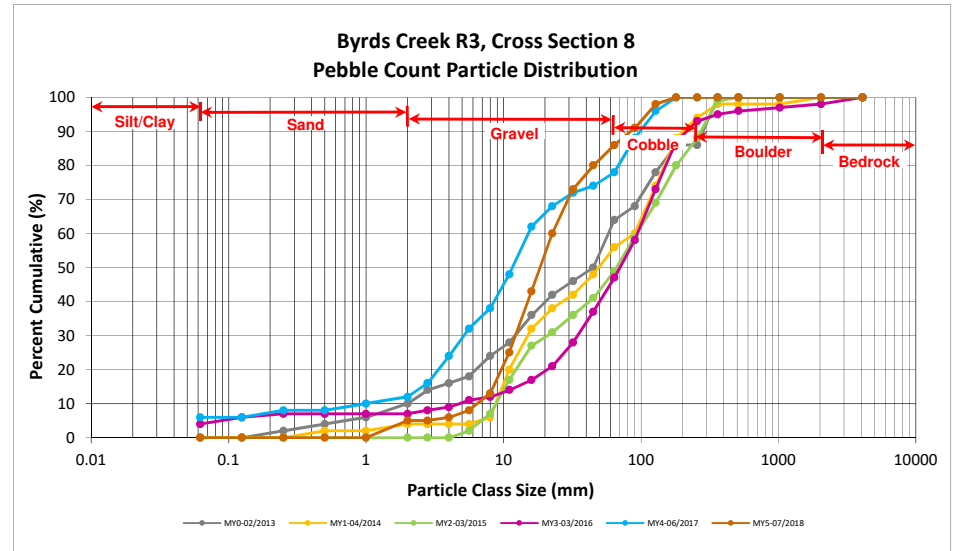
DMS Project No. 95020

Monitoring Year 5 - 2018

Byrds Creek R3, Cross Section 8

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0	5	5	5
GRAVEL	Very Fine	2.0	2.8			5
	Very Fine	2.8	4.0	1	1	6
	Fine	4.0	5.6	2	2	8
	Fine	5.6	8.0	5	5	13
	Medium	8.0	11.0	12	12	25
	Medium	11.0	16.0	18	18	43
	Coarse	16.0	22.6	17	17	60
	Coarse	22.6	32	13	13	73
	Very Coarse	32	45	7	7	80
	Very Coarse	45	64	6	6	86
COBBLE	Small	64	90	5	5	91
	Small	90	128	7	7	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 8	
Channel materials (mm)	
D ₁₆ =	8.66
D ₃₅ =	13.55
D ₅₀ =	18.4
D ₈₄ =	56.9
D ₉₅ =	110.1
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

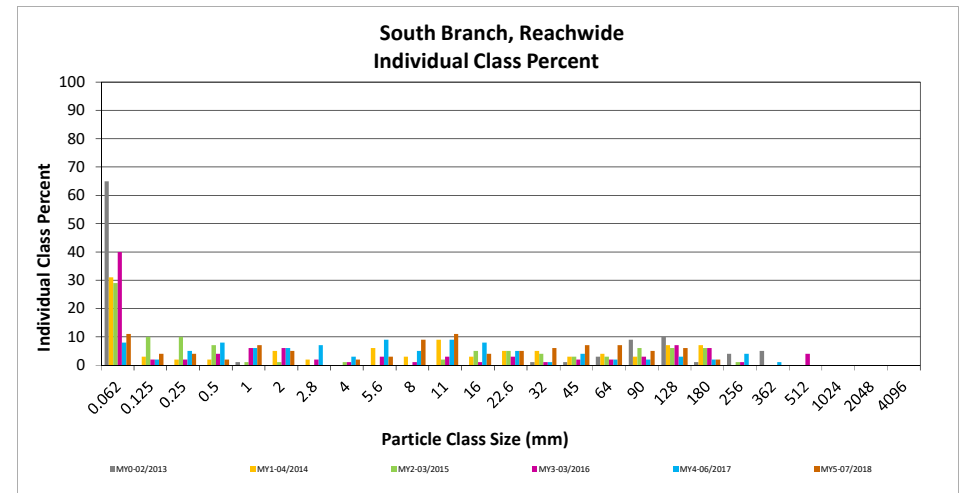
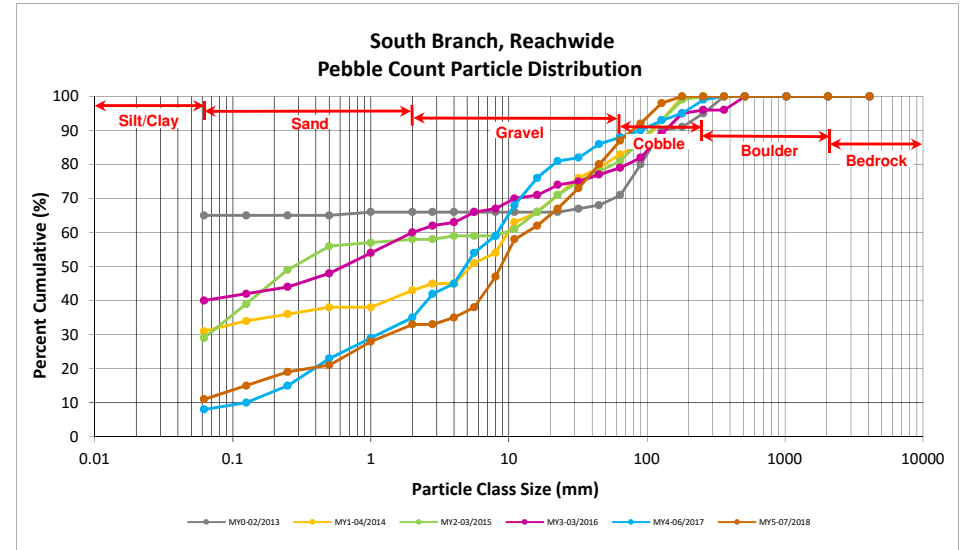
DMS Project No. 95020

Monitoring Year 5 - 2018

South Branch, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		11	11	11	11
SAND	Very fine	0.062	0.125		4	4	4	15
	Fine	0.125	0.250		4	4	4	19
	Medium	0.25	0.50		2	2	2	21
	Coarse	0.5	1.0	2	5	7	7	28
	Very Coarse	1.0	2.0	3	2	5	5	33
GRAVEL	Very Fine	2.0	2.8					33
	Very Fine	2.8	4.0		2	2	2	35
	Fine	4.0	5.6	2	1	3	3	38
	Fine	5.6	8.0	4	5	9	9	47
	Medium	8.0	11.0	6	5	11	11	58
	Medium	11.0	16.0	2	2	4	4	62
	Coarse	16.0	22.6	4	1	5	5	67
	Coarse	22.6	32	6		6	6	73
	Very Coarse	32	45	5	2	7	7	80
	Very Coarse	45	64	7		7	7	87
COBBLE	Small	64	90	5		5	5	92
	Small	90	128	2	4	6	6	98
	Large	128	180	2		2	2	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	0.15
D ₃₅ =	4.00
D ₅₀ =	8.7
D ₈₄ =	55.0
D ₉₅ =	107.3
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

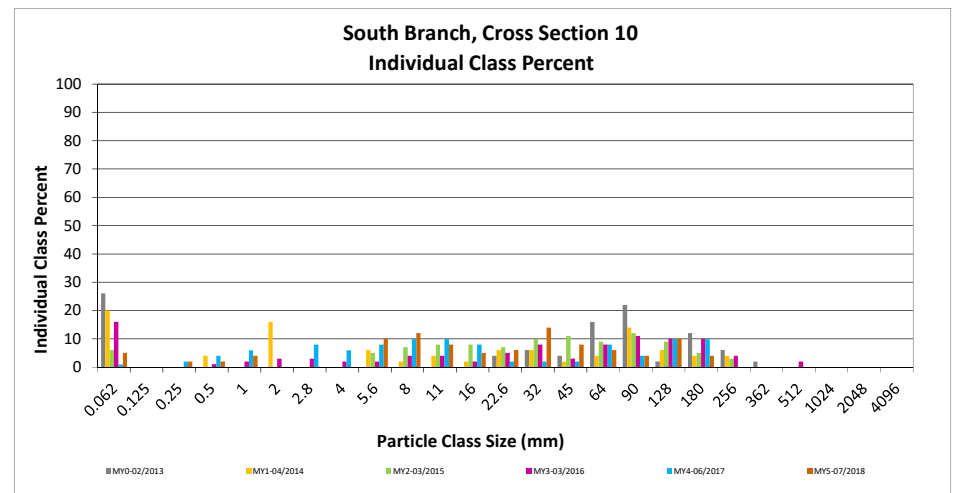
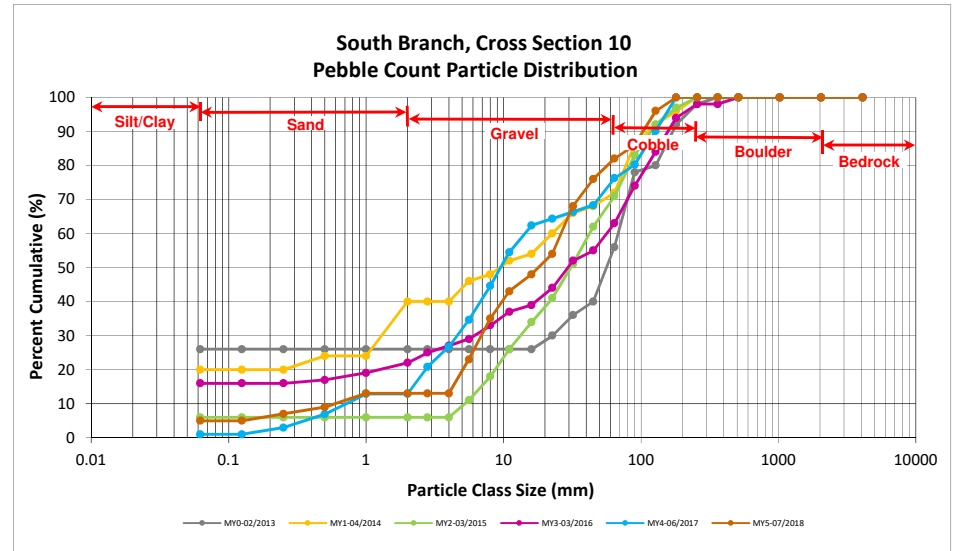
DMS Project No. 95020

Monitoring Year 5 - 2018

South Branch, Cross Section 10

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	5	5	5
SAND	Very fine	0.062	0.125			5
	Fine	0.125	0.250	2	2	7
	Medium	0.25	0.50	2	2	9
	Coarse	0.5	1.0	4	4	13
	Very Coarse	1.0	2.0			13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0			13
	Fine	4.0	5.6	10	10	23
	Fine	5.6	8.0	12	12	35
	Medium	8.0	11.0	8	8	43
	Medium	11.0	16.0	5	5	48
	Coarse	16.0	22.6	6	6	54
	Coarse	22.6	32	14	14	68
	Very Coarse	32	45	8	8	76
	Very Coarse	45	64	6	6	82
COBBLE	Small	64	90	4	4	86
	Small	90	128	10	10	96
	Large	128	180	4	4	100
BOULDER	Large	180	256			100
	Small	256	362			100
BEDROCK	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 10	
Channel materials (mm)	
D ₁₆ =	4.42
D ₃₅ =	8.00
D ₅₀ =	18.0
D ₈₄ =	75.9
D ₉₅ =	123.6
D ₁₀₀ =	180.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

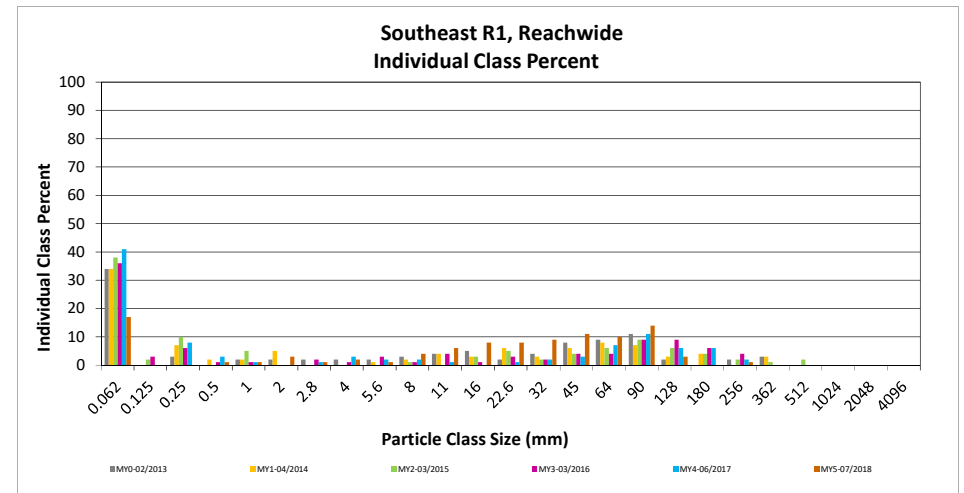
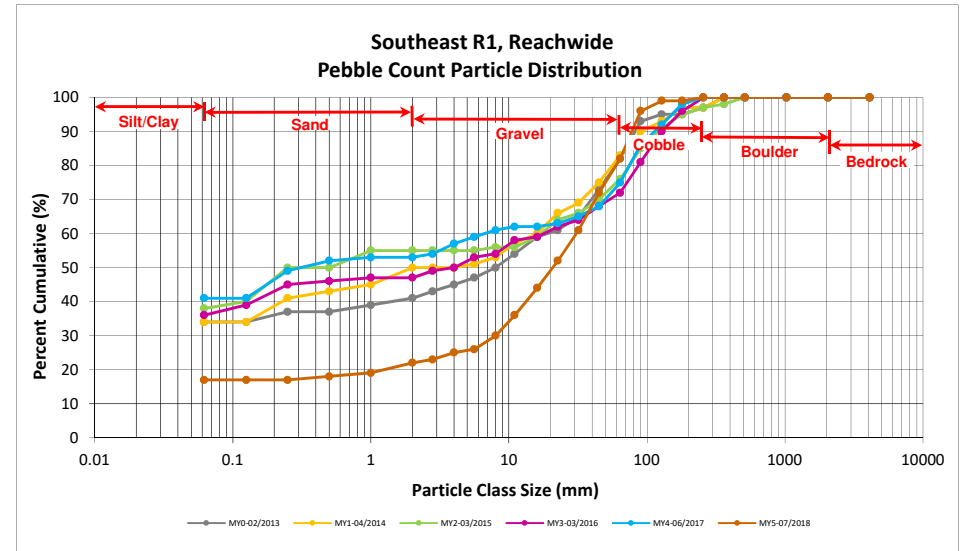
DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast R1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	15	17	17	17
SAND	Very fine	0.062	0.125					17
	Fine	0.125	0.250					17
	Medium	0.25	0.50		1	1	1	18
	Coarse	0.5	1.0		1	1	1	19
	Very Coarse	1.0	2.0		3	3	3	22
GRAVEL	Very Fine	2.0	2.8		1	1	1	23
	Very Fine	2.8	4.0		2	2	2	25
	Fine	4.0	5.6	1		1	1	26
	Fine	5.6	8.0		4	4	4	30
	Medium	8.0	11.0	1	5	6	6	36
	Medium	11.0	16.0	3	5	8	8	44
	Coarse	16.0	22.6	4	4	8	8	52
	Coarse	22.6	32	6	3	9	9	61
	Very Coarse	32	45	10	1	11	11	72
	Very Coarse	45	64	8	2	10	10	82
COBBLE	Small	64	90	13	1	14	14	96
	Small	90	128	2	1	3	3	99
	Large	128	180					99
	Large	180	256		1	1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	10.43
D ₅₀ =	20.7
D ₈₄ =	67.2
D ₉₅ =	87.8
D ₁₀₀ =	256.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

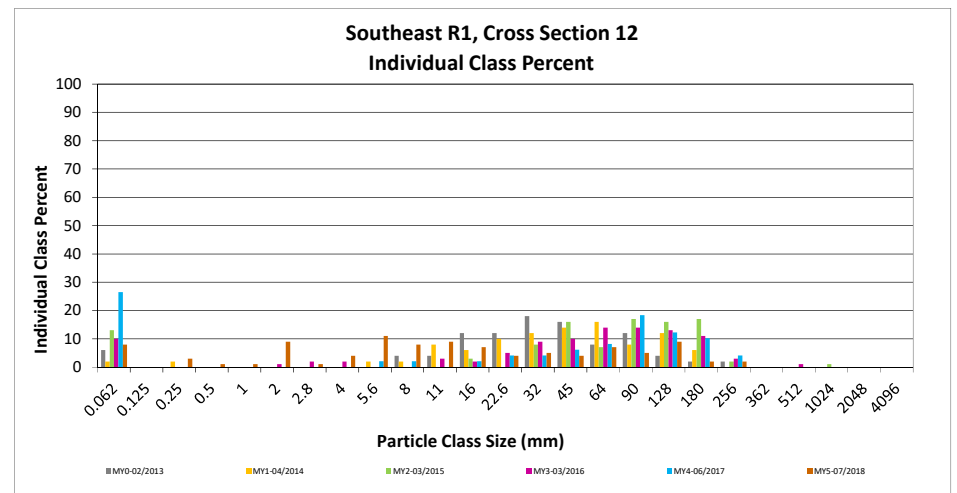
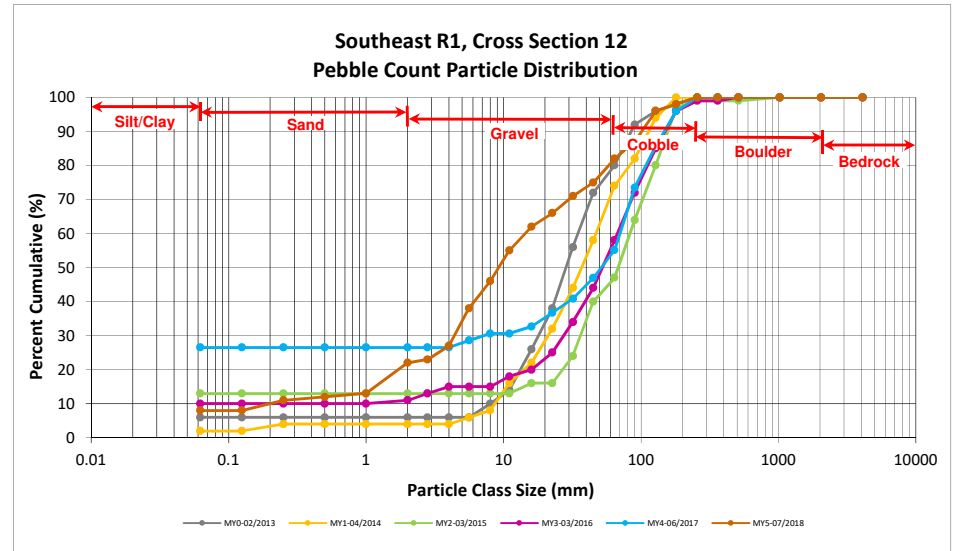
DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast R1, Cross Section 12

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	8	8	8
SAND	Very fine	0.062	0.125			8
	Fine	0.125	0.250	3	3	11
	Medium	0.25	0.50	1	1	12
	Coarse	0.5	1.0	1	1	13
	Very Coarse	1.0	2.0	9	9	22
GRAVEL	Very Fine	2.0	2.8	1	1	23
	Very Fine	2.8	4.0	4	4	27
	Fine	4.0	5.6	11	11	38
	Fine	5.6	8.0	8	8	46
	Medium	8.0	11.0	9	9	55
	Medium	11.0	16.0	7	7	62
	Coarse	16.0	22.6	4	4	66
	Coarse	22.6	32	5	5	71
	Very Coarse	32	45	4	4	75
	Very Coarse	45	64	7	7	82
COBBLE	Small	64	90	5	5	87
	Small	90	128	9	9	96
	Large	128	180	2	2	98
	Large	180	256	2	2	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 12 Channel materials (mm)	
D ₁₆ =	1.26
D ₃₅ =	5.11
D ₅₀ =	9.2
D ₈₄ =	73.4
D ₉₅ =	123.1
D ₁₀₀ =	256.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

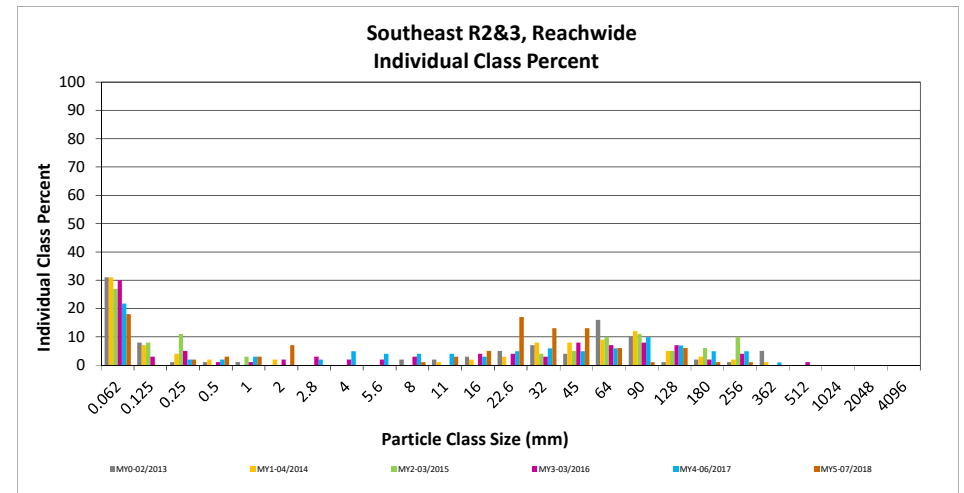
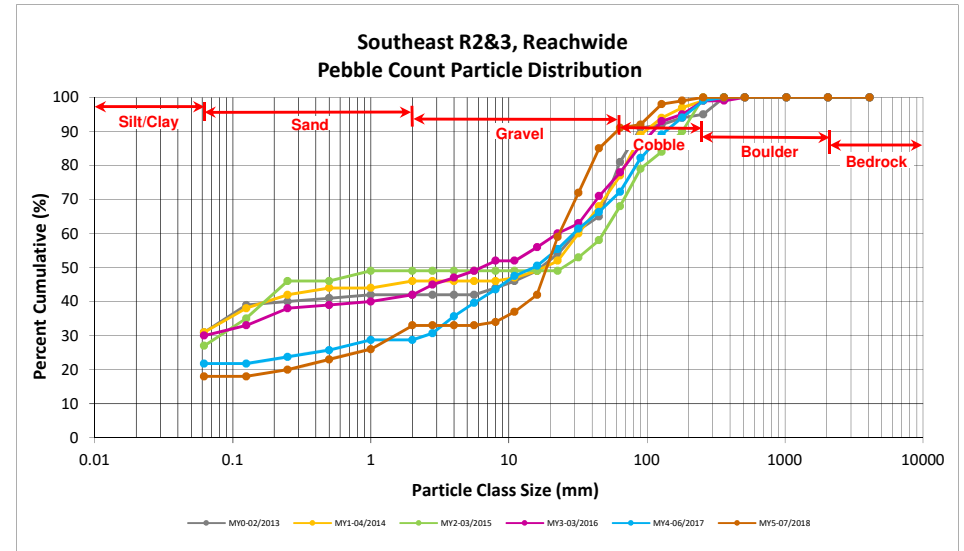
DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast R2&3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	14	18	18	18
SAND	Very fine	0.062	0.125					18
	Fine	0.125	0.250	1	1	2	2	20
	Medium	0.25	0.50		3	3	3	23
	Coarse	0.5	1.0	1	2	3	3	26
	Very Coarse	1.0	2.0	2	5	7	7	33
GRAVEL	Very Fine	2.0	2.8					33
	Very Fine	2.8	4.0					33
	Fine	4.0	5.6					33
	Fine	5.6	8.0		1	1	1	34
	Medium	8.0	11.0	2	1	3	3	37
	Medium	11.0	16.0	3	2	5	5	42
	Coarse	16.0	22.6	10	7	17	17	59
	Coarse	22.6	32	8	5	13	13	72
	Very Coarse	32	45	9	4	13	13	85
	Very Coarse	45	64	6		6	6	91
COBBLE	Small	64	90		1	1	1	92
	Small	90	128	2	4	6	6	98
	Large	128	180	1		1	1	99
	Large	180	256	1		1	1	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
Total				50	50	100	100	100

Reachwide Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	8.90
D ₅₀ =	18.8
D ₈₄ =	43.8
D ₉₅ =	107.3
D ₁₀₀ =	256.0



Reachwide and Cross Section Pebble Count Plots

Byrds Creek Mitigation Project

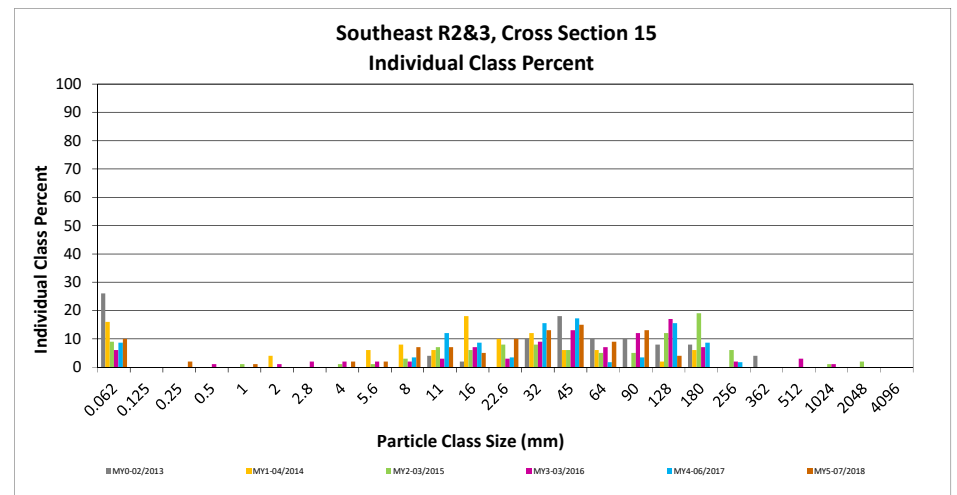
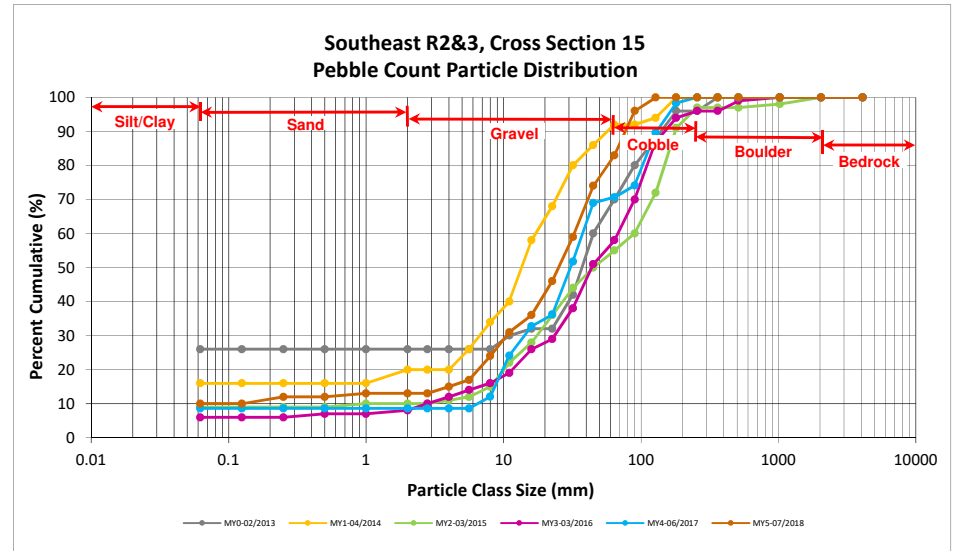
DMS Project No. 95020

Monitoring Year 5 - 2018

Southeast R2&3, Cross Section 15

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	10	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250	2	2	12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0	1	1	13
	Very Coarse	1.0	2.0			13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0	2	2	15
	Fine	4.0	5.6	2	2	17
	Fine	5.6	8.0	7	7	24
	Medium	8.0	11.0	7	7	31
	Medium	11.0	16.0	5	5	36
	Coarse	16.0	22.6	10	10	46
	Coarse	22.6	32	13	13	59
	Very Coarse	32	45	15	15	74
	Very Coarse	45	64	9	9	83
COBBLE	Small	64	90	13	13	96
	Small	90	128	4	4	100
	Large	128	180			100
BOULDER	Large	180	256			100
	Small	256	362			100
BOULDER	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross Section 15	
Channel materials (mm)	
D ₁₆ =	4.73
D ₃₅ =	14.84
D ₅₀ =	25.2
D ₈₄ =	65.7
D ₉₅ =	87.7
D ₁₀₀ =	128.0



APPENDIX 5. Hydrology Summary Data and Plots

Table 13. Verification of Bankfull Events

Byrds Creek Mitigation Site

DMS Project No. 95020

Monitoring Year 5 - 2018

Reach	Date of Data Collection	Date of Occurrence	Method
Byrds Creek	5/16/2018	4/16/2018	Crest Gage/ Pressure Transducer
	11/20/2018	5/17/2018	
	11/20/2018	8/2/2018	
	11/20/2018	9/17/2018*	
	11/20/2018	11/13/2018	
South Branch	11/20/2018	9/17/2018*	
	11/20/2018	11/13/2018	
Southeast Branch	11/20/2018	9/17/2018*	
	11/20/2018	11/13/2018	

*Bankfull flow attributed to Hurricane Florence