



MONITORING YEAR 1 ANNUAL REPORT

Final

BIG HARRIS CREEK MITIGATION SITE

Cleveland County, NC
DMS Project No. 739
DEQ Contract 006256
DWR 401 Project No. 10-0811
USACE Action ID No. SAW-2009-0475
Broad River Basin
HUC 03050105

Data Collection Period: September - December 2018
Submission Date: February 6, 2019

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

February 6, 2019

Mr. Paul Wiesner
NC Department of Environmental Quality
Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Big Harris Creek Mitigation Site – Monitoring Year 1 Report
Final Submittal for DMS
Contract Number 006256, RFP Number 16-006119, DMS# 739
Broad River Basin – CU# 03050105; Cleveland County, NC

Dear Mr. Wiesner:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments and observations from the Big Harris Creek Mitigation Site Draft Monitoring Year 1 Report. The following are Wildlands' responses to your comments from the report noted in *italic lettering*.

DMS Comment; General and Table 1 – Mitigation Credits: The Big Harris project credits in Table 1 need to be synonymous with the final MY0 report and should not be changed in MY1:

- **Total R stream mitigation credits should be reported in the table as 25,228.21**
- **Total RE stream mitigation credits should be reported in the table as 101.795**
- **The project will yield a total 25,329.916**

Please update Table 1 and the report text (executive summary) accordingly.

Please note that these totals do not include the potential 2% based on a statistical improvement in water quality. To date, the IRT has not approved the proposal. Additionally, these credits will not be realized until the project closeout. MY1 invoicing and subsequent invoicing should be based on 25,330 credits until project closeout.

Wildlands Response; Table 1 and the Executive Summary text in the report have been revised to reflect the Big Harris Creek mitigation credits from the final MY0 report.

DMS Comment; General – DMS recommends including the Revised Water Quality Monitoring Proposal (submitted to the IRT on 10/25/18) in the report appendices and referencing it in the report text. The report text should note that the proposal is under IRT review and should be finalized in MY2 (2019).

Wildlands Response; Text in Section 1.2.6 has been updated to reference the Revised Water Quality Monitoring Proposal and an Appendix 6 with the proposal has been created.

DMS Comment; General – Janet Whisnant Property: Please provide a brief update in the response letter (not the MY1 report). DMS undertstands that Wildlands has made numerous attempts to have Janet Whisnant sign a revised conservation easement and plat, so the current driveway stream crossing is not located within the existing conservation easement. The draft MY1 report shows the revised CE plat and reports the mitigation assets based on finalizing the Whisnant property transaction. DMS recommends finalizing the MY1 report as presented and continued pursuit of a revised conservation easement and plat on the Whisnant property. If Mrs. Whisnant is unwilling to sign the revised conservation easement and associated plat prior to project closeout, mitigation assets and the associated contract invoices will need to be revised accordingly.

Wildlands Response; Ms. Whisnant has been unresponsive to previous attempts at revising the conservation easement and plat. Wildlands will continue to reach out to Ms. Whisnant including communication through a neighbor to try and resolve the issue.

DMS Comment; General – The structure at the very bottom of the Lower Big Harris Creek restoration reach may need attention soon. The energy from the elevation change over this sill appears to be "bowling" out the channel below it. How far into the floodplain does the log sill extend?

Wildlands Response; The log sill extends approximately 3 feet into the bank and is backfilled with rock material. The area will be assessed and addressed if necessary.

DMS Comment; Cover page – Please include the DWR project number on the report cover.

Wildlands Response; The DWR 401 project number associated with the water quality certification has been added to the cover page.

DMS Comment; Section 1.2.1 – The second paragraph describes degradation and fining of the substrate at cross-section 4. The description of the changes at this location would be better summarized by adding that the riffle constructed at this location has adjusted/eroded into a pool which helps explain the finer bed material.

Wildlands Response; The report text has been revised per comment to better describe the fining at cross-section 4.

DMS Comment; Stream Areas of Concern – In the report text, please note that bank scour areas are identified on the CCPV sheets.

Wildlands Response; A sentence has been added to note bank scour areas locations are identified on the CCPV maps.

DMS Comment; Stream Hydrology Assessment – Second paragraph; "began" should be updated to "begin".

Wildlands Response; The report text has been revised per comment.

DMS Comment; Section 1.2.4 – Vegetative Assessment – *Top of page 1-4*: Please insert the word planted when reporting the stem densities. Please report the range in addition to the average and do the same for the total stem counts. Also; recommend providing the range (min, max) for the number of species across plots.

Wildlands Response; All comments have been incorporated into the second paragraph of Section 1.2.4.

DMS Comment; Section 1.2.5 – Vegetation Areas of Concern: Chinese privet was identified on the CCPV sheets in numerous areas. Were Chinese privet, Japanese honeysuckle, and hardy orange treated in MY1 (2018). If not, please specify a proposed/anticipated treatment plan for the monitoring term.

Wildlands Response; Areas of Chinese privet and Japanese honeysuckle were treated during MY1; however, hardy orange was not. Invasive species will be treated through chemical and/or mechanical methods appropriate for the species during the spring and fall of MY2. Previously treated areas of invasives will also be evaluated during MY2. Follow up treatments will be completed, if necessary. The report text has been updated to include the treatment of Chinese privet and Japanese honeysuckle during MY1 as well as the anticipated MY2 invasive treatments.

DMS Comment; Table 1 – Project Components: Recommend removing "Proposed" from Stationing/Location.

Wildlands Response; The word "Proposed" has been removed from Table 1.

DMS Comment; Table 2: If possible, please specify vegetation data collection dates for MY0 and MY1 in Table 2. The IRT will want to see at least 6 months between MY0 and MY1 vegetation data collection dates.

Wildlands Response; Table 2 was revised to include the month that stream and vegetation data collection was completed in MY0 and MY1.

DMS Comment; Table 5 – Please QA/QC the footnotes for the tables. There are a couple minor spelling/grammar errors.

Wildlands Response; The spelling and grammar errors have been corrected in Table 5.

DMS Comment; Table 12 – Geomorph Calculations: It appears that WEI is attempting to use the new methods of calculation for BHR etc. While the method for calculating BHR requires holding the AB Bankfull area constant, that is not the intention for tracking the actual change in the channel area. Cross sectional area should be tracked using the LTOB if the intent is to follow the 2018 guidance of the Mitigation Technical Work Group.

Wildlands Response; Geomorphic cross-sectional data have been updated to reflect calculations based on the current year's LTOB, while holding the AB bankfull cross-sectional area constant for the calculation of the BHR.

DMS Comment; Appendix 4 – Cross-Section 4: If the channel is expected to remain a pool at this location, please update the category from riffle to pool and denote the adjustment in a footnote.

Wildlands Response; It is anticipated that repairs at Cross-section 4 will return the channel to a riffle; therefore, the text has not been revised.

DMS Comment; Appendix 5 – Stream Gage for Royster Creek (XS9 – SG #2) & Stream Gage for Bridges Creek (XS28 – SG#9): Please try to improve the scale of the graphs (if possible). As shown, it is difficult to see the interaction between the water depth and thalweg elevation.

Wildlands Response; The vertical scale was adjusted on the Royster Creek and Bridges Creek stream gage plots to improve clarity between the interaction of the water depth and the thalweg elevation. The rainfall data color was also changed to improve overall clarity.

Electronic Support Files (GIS): Please include all of the project CCPV GIS shapefiles on the MY1 support file CD. Only MY1_V-AOC's, MY1_S-AOC, and MY1_Veg_Plots are currently included in the draft electronic deliverables.

Wildlands Response; All the project's CCPV GIS shapefiles for MY1 have been included in the final electronic data support file CD.

Enclosed please find three (3) hard copies of the Final Monitoring Year 1 Report and one (1) CD with the final corrected electronic files for DMS distribution. Please contact me at 704-332-7754 x106 if you have any questions.

Sincerely,

Shawn Wilkerson
President
swilkerson@wildlandseng.com

PREPARED BY:

WILDLANDS ENGINEERING

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EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a design-build project for the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS) to restore 10,071 linear feet (LF) of streams, enhance 23,421 LF of streams, preserve 669 LF of streams, and provide water quality treatment for 171 acres of drainage area in Cleveland County, NC. The streams proposed for mitigation credit include Big Harris Creek and 25 tributaries. Buffer restoration also occurred but is not proposed for buffer mitigation credit. The project is expected to provide 25,330 stream mitigation units (SMUs) in the Broad River Basin. An additional 507 SMU's are proposed for statistical improvement in water quality parameters pending approval from the Interagency Review Team (IRT) of revised post-construction water quality sampling.

The Big Harris Creek Mitigation Site (Site) is located within the DMS targeted watershed for the Broad River Basin Hydrologic Unit Code (HUC) 03050105080060 and the North Carolina Division of Water Resources (NCDWR) Subbasin 03-08-04. The Big Harris Creek and Magness Creek HUC 03050105080060 was identified as a Targeted Local Watershed (TLW) in DMS's 2009 Broad River Basin Restoration Priority (RBRP) Plan (DMS, 2009). The Cleveland County Natural Resources Conservation Service has also identified this watershed as a priority area.

The watershed has a long history of agricultural activity and most of the stressors to stream functions are related to historic and current land use practices. Prior to restoration, the major stream stressors for the Site were cattle access, erosion from lateral instability, and gully headcutting in the headwater ephemeral reaches. The effects of these stressors resulted in degraded water quality and habitat throughout the watershed when compared to reference conditions. The design approach for the Site focused on evaluating the Site's existing functional condition and evaluating its potential for recovery and need for intervention.

The major goals established for the project; which align with the overall goals of the Broad River Basin RBRP, are to reduce sediment and nutrient inputs, reduce fecal coliform inputs through cattle exclusion, and reestablish native riparian corridors while preserving existing headwater aquatic habitats and riparian corridors.

The following specific project goals were established in the mitigation plan (Wildlands, 2016).

- Improve stream stability and reduce stream bed and bank erosion;
- Restore hydrologic connection between bankfull channels and floodplains, wetlands, and vernal pools;
- Improve instream habitat and instream habitat connectivity;
- Reduce agricultural pollutant loading to project streams; and
- Create and improve forested riparian buffers.

The Site construction and as-built surveys were completed between April 2017 and May 2018. Post-construction monitoring will be conducted for five years to evaluate project success. Planting and baseline vegetation data collection occurred between March and May 2018. Monitoring Year (MY) 1 assessments were completed between September and December 2018. Overall, the Site has met the required stream, vegetation, and hydrology success criteria for MY1. Overall, restored streams are stable and functioning as designed. However, fluctuation in channel dimension related to bed scour and/or deposition was documented in some of the MY1 cross-sections. In addition, small sections of bank scour were observed across the Site during visual assessments. The average planted stem density for the Site is 525 stems per acre and is on track to meet the MY3 interim requirement of 320 stems per acre. Bankfull events were recorded on almost all restoration and EI reaches since the completion of construction earlier this year.

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APPENDICES

Section 1: PROJECT OVERVIEW

The Site is located in western Cleveland County, approximately 2.5 miles west of the Town of Lawndale in the Broad River Basin HUC 03050105080060 and NCDWR Subbasin 03-08-04 and is being submitted for mitigation credit in the Broad River Basin HUC 03050105. (Figure 1). Located in the Inner Piedmont geologic belt within the Piedmont physiographic province (NCGS, 1985), the project watershed is dominated by agricultural and forested land. Big Harris Creek drains 3.9 square miles of rural land.

The development of the mitigation project for this Site has a long history. The Site was first identified in 2008 by DMS staff as a watershed-scale mitigation opportunity. The Site is located in a HUC that was designated as a high priority agricultural TLW and as a "focus area" for DMS in the 2009 Broad River Basin Restoration Priority (RBRP) Plan. The initial Environmental Resources Technical Report (ERTR) for the Site was completed in March 2009. Easement acquisition on 12 parcels, totaling 144.7 acres, was completed on the project area by the end of 2009. The IRT originally walked the Site in 2010 and requested a "light touch" approach to much of the Site. Water quality, benthic, fish, and storm water sampling has been collected for the project by multiple agencies and organizations between 2009 and 2013.

The availability of the pre-construction monitoring led to more precise management recommendations for the Site. The project approach incorporated previous and recent IRT feedback and minimized construction phase impacts to existing channels and riparian areas while providing the targeted uplifts to the system. Project components include intermittent and perennial stream restoration, enhancement, and preservation, as well as water quality treatment on ephemeral drainages. Stream restoration, enhancement, and preservation components include Big Harris Creek and 25 unnamed tributaries.

The watershed has a long history of agricultural activity and most of the stressors to stream functions are related to this historic and current land use. Prior to restoration, the major stream stressors for the project were cattle access, erosion from lateral instability, and gully headcutting in the headwater ephemeral reaches. The effects of these stressors resulted in degraded water quality and habitat throughout the watershed when compared to reference conditions.

Table 4 in Appendix 1 and Tables 6 in Appendix 2 present the pre-restoration conditions in more detail.

1.1 Project Goals and Objectives

The Site was identified by DMS to address major agricultural stressors within the watershed with specific focus on gully erosion, streambank erosion, and livestock access to streams. Restoration and enhancement of streams and buffers on the Site will address those identified stressors and thereby improve water quality in the Big Harris Creek watershed.

The major goals of this stream mitigation project are to reduce sediment and nutrient sources, reduce fecal coliform sources through cattle exclusion, and reestablish healthy riparian corridors while preserving existing, high quality headwater aquatic habitats. These goals will primarily be achieved by creating functional and stable stream channels by: 1) increasing and improving the interaction of stream hydrology with the riparian zone, 2) improving in-stream habitat and bed form diversity, 3) introducing large woody debris, and beginning the establishment of a native, forested riparian corridor along the stream reaches. These activities are known to support higher order functions like the processing of organic matter, nutrient cycling, and temperature regulation.

The project includes the majority of the headwater tributaries to Big Harris Creek and 35% of the 11-square mile Big Harris Creek watershed before it flows into the First Broad River. Within the project

limits, approximately 34,161 LF of stream channel were restored, enhanced or preserved. Water quality BMPs were also implemented to stabilize eroding ephemeral channels and provide water quality treatment on 171 acres of headwater drainage systems during the period after construction until the riparian buffer vegetation becomes established. A total of 5,536 LF of ephemeral drainages were buffered and conserved, enhancing the overall watershed water quality and function.

The following specific goals and objectives established in the mitigation plan address the identified stressors in the Big Harris Creek and Magness Creek TLW.

Goals	Objectives
Improve stream stability and reduce stream bed and bank erosion.	Grade back eroding stream and headwater gully slopes and/or install bioengineering. Add bank revetments and in-stream structures to protect enhanced streams.
	Construct new stream channels that will maintain a stable pattern and profile considering the hydrologic and sediment inputs to the system, the landscape setting, and the watershed conditions.
Restore hydrologic connection between bankfull channels and floodplains, wetlands, and vernal pools.	Construct new stream channels with appropriate dimension and depth relative to their functioning floodplain elevation.
Improve instream habitat and instream habitat connectivity.	Install habitat features such as constructed riffles and brush toes into restored/enhanced streams, adding woody materials to channel beds and constructing pools of varying depth.
	Replace existing culverts with bottomless arch culverts, partially buried culverts, or ford crossings and enhance profile by removing vertical steps at culvert outlets.
Reduce agricultural pollutant loading to project streams.	Install BMPs at concentrated flow locations in the watershed headwaters to treat agricultural runoff until riparian buffer vegetation becomes established and reduce gully erosion. Plant riparian buffers that will uptake runoff and reduce pollutants once established.
	Construct new stream channels with floodplain connectivity, allowing flood flows to filter through a vegetated floodplain.
	Install fencing around conservation easements adjacent to cattle pastures to exclude cattle from the easement.
Create and improve forested riparian buffers.	Plant native tree and understory species in riparian zone.

1.2 Monitoring Year 1 Data Assessment

Annual monitoring and quarterly site visits were conducted during MY1 to assess the condition of the project. The stream, vegetation, and hydrologic success criteria for the Site follows the approved success criteria presented in the Big Harris Creek Mitigation Plan (Wildlands, 2016).

1.2.1 Stream Assessment

In general, project streams appear stable with a majority of cross-sections showing little change in bankfull width, maximum depth ratio, and width-to-depth ratio with a majority of cross-sections falling within the parameters defined for channels of the appropriate stream type (Rosgen, 1994 & 1996). Minor adjustments in channel dimension related to scour or deposition were documented on several cross-sections. Adjustments are natural and expected after newly completed construction; however, bed and/or bank scour documented at cross-sections 3, 4, and 43 are more significant than expected. Adjustments in channel dimension are related to multiple large storm events (precipitation greater than two inches per event) during the fall of 2018 including the remnants of Hurricane Florence and Michael.

Pebble counts in restoration and EI reaches indicate maintenance of coarser materials in the riffle features and finer particles in the pool features. However, riffle 100 counts at cross-section 4 and 29 show a significant increase in fines. Erosion at cross-section 4 riffle removed the coarser substrate and created a pool. The increase in fines at cross-section 29, which is located on UT2 to Upper Stick Elliott Creek (USEC), appears to be a result of deposition from the larger Upper Stick Elliott Creek (USEC) floodplain rather than from UT2 to USEC. Refer to Appendix 2 for the visual stability assessment table, Current Condition Plan View (CCPV) map, and reference photographs. Refer to Appendix 4 for the morphological data and plots.

1.2.2 Stream Areas of Concern

Several areas of erosion in addition to those documented by cross-sections were observed by Wildlands during MY1 assessments. Refer to the CCPV maps in Appendix 2 for bank scour locations. Wildlands will review these areas and implement repairs to stabilize as necessary.

1.2.3 Stream Hydrology Assessment

At the end of the five-year monitoring period, two or more bankfull events and geomorphically significant (60%+ of bankfull flow) events must have occurred in separate years within the restoration and EI reaches. According to the stream gages, 11 of the 14 automated stream gages across the Site documented at least one bankfull event. The three exceptions occurred on Bridges Creek, Scott Creek and UT1 to Elliott Creek.

In addition to monitoring bankfull events, the presence of baseflow must be documented along Royster Creek Reach 1, Scott Creek, and Bridges Creek constructed with a Priority 1 Restoration approach. Baseflow must be present for at least 30 days (most likely in the winter/early spring) during each monitoring year with normal rainfall conditions. Baseflow monitoring did not begin until the completion of construction in late March and April. The stream gages recorded 201, 59, and 2 days of consecutive flow at Bridges Creek, Royster Creek Reach 1, and Scott Creek, respectively. Presence of baseflow was observed in Royster Creek Reach 1 and Bridges Creek during multiple site visits, however Scott Creek was observed dry throughout 2018. Scott Creek bed elevation was raised significantly using Priority I restoration, and it is expected that the groundwater elevation will take time to recover and raise to meet the new bed elevation. Refer to Appendix 5 for hydrology summary data and plots.

1.2.4 Vegetative Assessment

A total of 56 vegetation plots were established during the baseline monitoring within the project easement area. The vegetation plots were installed using a 100 square meter quadrant (10m x 10m or 5m x 20m). The final vegetative success criteria will be the survival of 260 planted stems per acre in the planted riparian corridor at the end of the required monitoring period (MY5). The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year (MY3).

The MY1 vegetation monitoring resulted in an average stem density of 525 planted stems per acre, which is greater than the interim requirement of 320 planted stems per acre required at MY3. Stem densities within individual monitoring plots range from 243 to 688 planted stems per acre with stem counts within individual plots ranging from six to 17 stems with an average of 13 planted stems per plot. The number of different species planted per plot ranged from three to eight. While most plots (55 of 56 plots) are on track to meet the stem density success criteria required for MY5 (Table 9, Appendix 3); one plot (20) does not currently meeting the interim MY3 criteria but exceeds the final MY5 requirement. Plot (29) does not meet the final success criteria. Poor soil nutrients, suffocation due to dense herbaceous coverage or dry soil conditions could all be factors impacting stem survival. Additionally, bush hogging within the easement occurred in the vicinity of Plots 19 and 20 shortly after construction. Several stems in these plots were broken or missing during the MY1 assessment. The easement encroachment has been addressed with the landowner and subsequent encroachment has not occurred. 78% of the stems have a vigor of 2 or greater. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.5 Vegetation Areas of Concern

Pockets of invasive species including Asian spiderwort (*Murdannia keisak*), Chinese privet (*Ligustrum sinense*), hardy orange (*Poncirus trifolata*), Japanese honeysuckle (*Lonicera japonica*), and kudzu (*Pueraria lobata*) were observed during MY1. During MY1 Asian spiderwort, Chinese privet, Japanese honeysuckle, kudzu was treated. Additional invasive treatments will be implemented during the spring and fall of MY2 using chemical and/or mechanical methods appropriate for the species. As warranted, future treatments will be performed. Refer to Appendix 2 for the vegetation condition assessment table and the CCPV map.

1.2.6 Additional Monitoring

A proposed post-construction water quality monitoring plan was proposed in September 2018. Components of the plan would include water quality sampling, benthic macroinvertebrate assessments, and fisheries data are proposed during MY3 – MY5. Refer to Appendix 6 for the Revised Water Quality Monitoring Proposal. The proposal is currently under IRT review and anticipated to be finalized in MY2 (2019).

1.3 Monitoring Year 1 Summary

Streams within the Site appear to be stable and functioning as designed with the exception of minor areas of erosion. These areas of erosion will be graded, seeded, matted, and planted to prevent further erosion. Bankfull events were documented on a majority of project streams; therefore, the Site has partially met the stream hydrological success criteria. The average stem density for the Site is 525 stems per acres is on track to meeting the MY5 success criteria however one individual plot (29) currently does not meet the MY5 success criteria as noted in the CCPV. Adaptive management will be implemented as necessary to address areas of stream erosion and invasive plant species.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the 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 were 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). All Integrated Current Condition Mapping was recorded using either a Trimble or Topcon handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gages were installed in surveyed riffle cross sections and monitored quarterly. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers (USACE, 2003) standards. Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2006).

Section 3: REFERENCES

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2006. CVS-EEP Protocol for Recording Vegetation Version 4.0. Retrieved from http://deq.nc.gov/document/cvs-eep-protocol-v42-lev1-2

North Carolina Division of Water Resources (NCDWR), 2015. Surface Water Classifications. http://portal.ncdenr.org/web/wq/ps/csu/classifications

North Carolina Division of Mitigation Services (DMS), 2009. Broad River Basin Restoration Priorities. https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Broad_River_Basin/Broad_RBRP_2009_final.pdf

North Carolina Division of Mitigation Services (DMS), February 2014. DMS Annual Monitoring and Closeout Reporting Template.

North Carolina Geological Survey (NCGS), 1985. Geologic Map of North Carolina: North Carolina Survey, General Geologic Map, scale 1:500,000. https://deq.nc.gov/about/divisions/energy-mineral-land-resources/north-carolina-geological-survey/ncgs-maps/1985-geologic-map-of-nc4

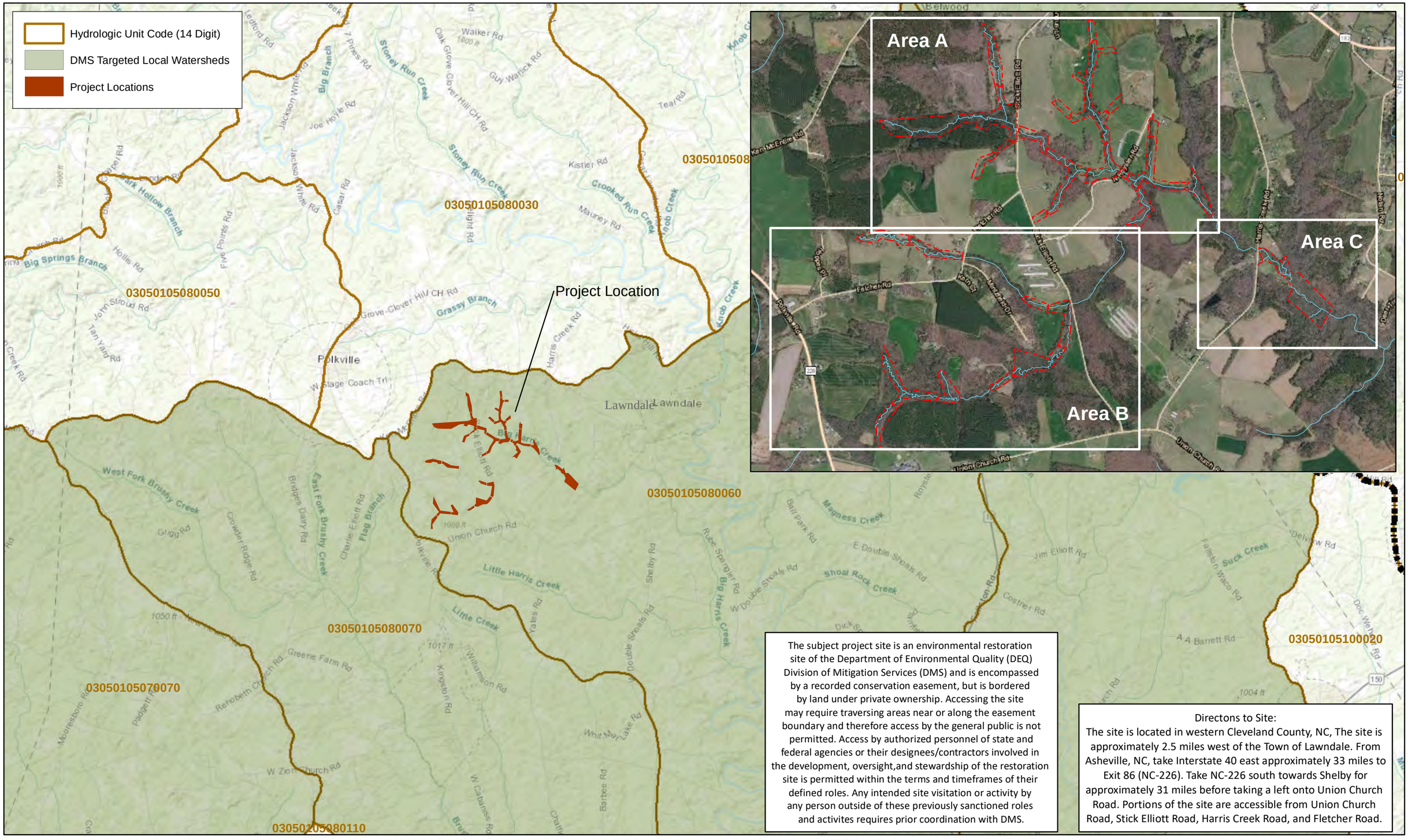
Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

United States Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Wildlands Engineering, Inc (Wildlands), 2016. Big Harris Creek Mitigation Site Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. General Figures and Tables



The subject project site is an environmental restoration site of the Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight,and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with DMS.

Directons to Site:
The site is located in western Cleveland County, NC, The site is approximately 2.5 miles west of the Town of Lawndale. From Asheville, NC, take Interstate 40 east approximately 33 miles to Exit 86 (NC-226). Take NC-226 south towards Shelby for approximately 31 miles before taking a left onto Union Church Road. Portions of the site are accessible from Union Church Road, Stick Elliott Road, Harris Creek Road, and Fletcher Road.

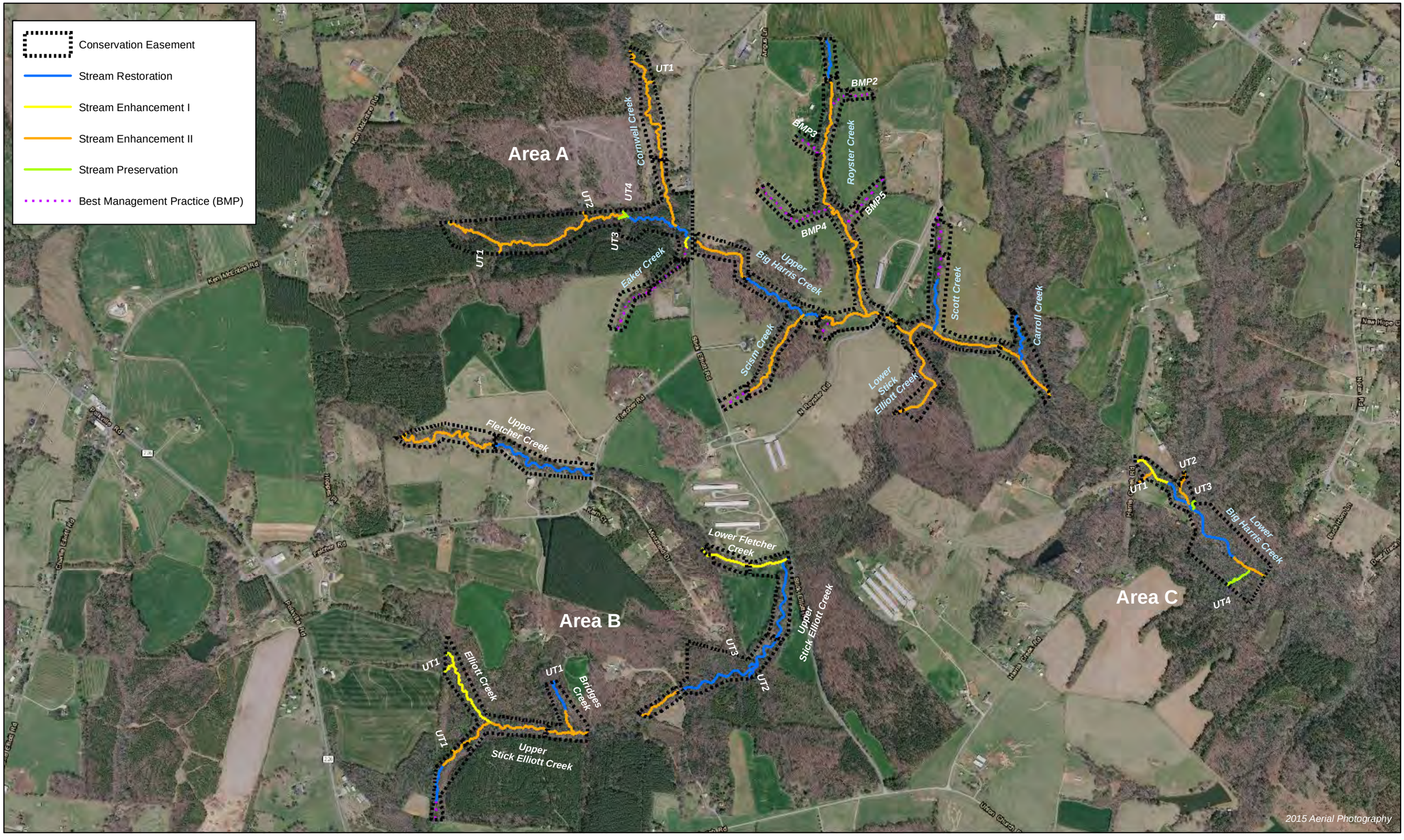
WILDLANDS ENGINEERING

0 1 2 Miles

N

Figure 1 Project Vicinity Map
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Cleveland County, NC



WILDLANDS ENGINEERING

0 500 1,000 Feet

N

Figure 2.0 Project Component/Asset Map
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 500 1,000 Feet

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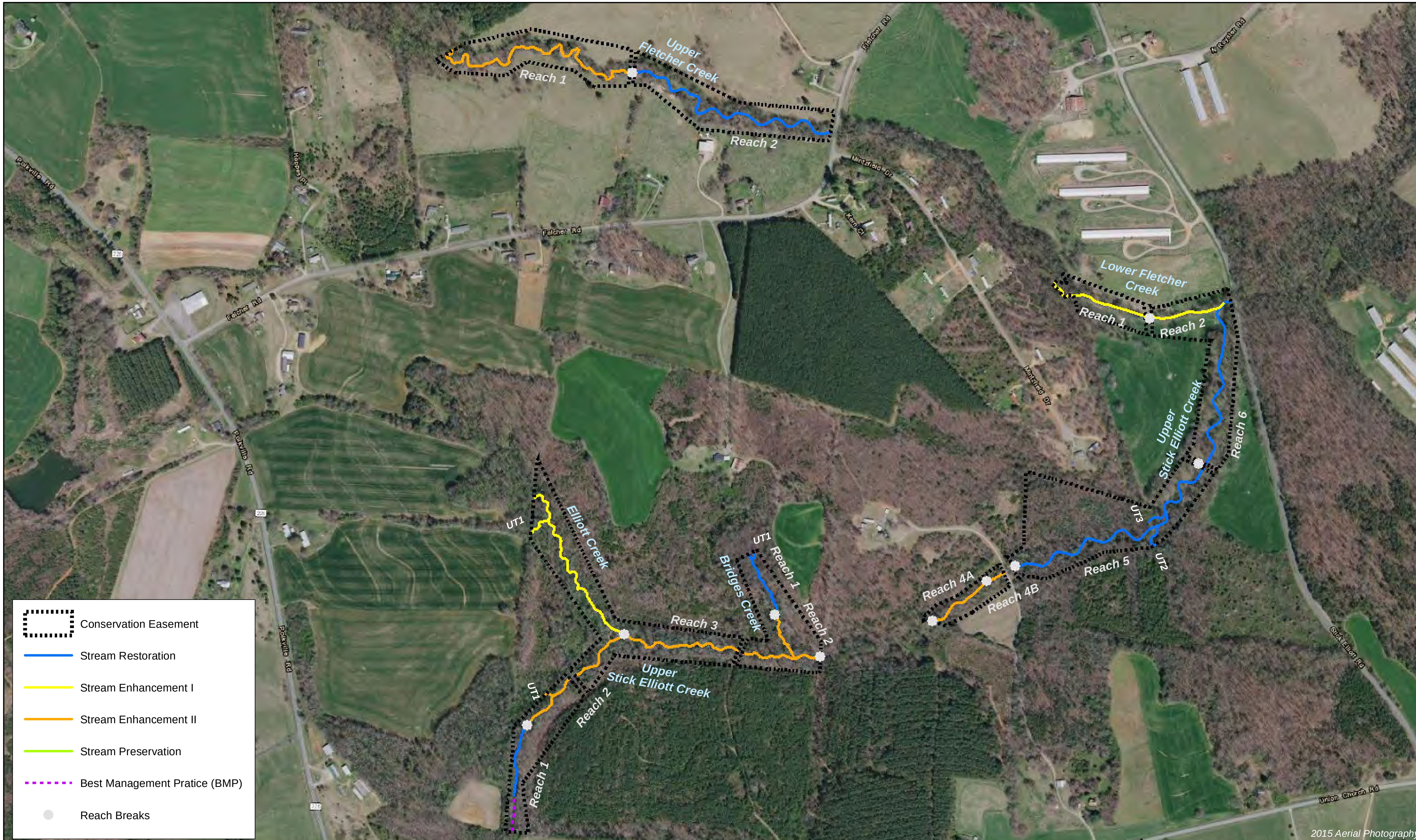
Figure 2.1 Project Component/Asset Map
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

Figure 2.2 Project Component/Asset Map
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 125 250 Feet

Figure 2.3 Project Component/Asset Map
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

Table 1. Project Components and Mitigation Credits
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	25,228.121	101.795	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project Components										
Project Area	Project Reach	Existing Footage (LF) [1]	Stationing/Location		Approach (P1, P2, etc.)	Restoration (R) or Restoration Equivalent (RE)	Restoration Footage (LF) [1]	Mitigation Ratio	Total Buffer Width Adjustments	Proposed Credit [2, 3, 4]
A	Cornwell Creek R1	2,144	403+44	425+20	cattle fencing; buffer planting	EII	2,144	2.5	25	883.000
	Cornwell Creek R2	286	425+20	428+27	Full restoration with structures	EII	307	2.5	0	123.000
	UT1 to Cornwell Creek	78	430+27	431+05	cattle fencing; buffer planting	EII	78	2.5	0	31.000
	Eaker Creek	135	513+11	514+45	cattle fencing, bank grading and in-stream structures	EI	134	1	0	134.000
	Eaker Creek SPSC BMP	N/A	N/A	N/A	headwater BMP	N/A	1309	N/A	N/A	N/A
	Scism Creek	1,189	606+92	618+81	BMP, bank grading and in-stream structures	EII	1,189	1.5	12	805.000
	Scism Creek EC	N/A	N/A	N/A	headwater BMP	N/A	358	N/A	N/A	N/A
	Royster Creek R1	438	802+54	807+13	Priority 2 Restoration	R	459	1	-5	454.000
	Royster Creek R2	3,185	807+40	839+40	cattle fencing; buffer planting	EII	3,170	2	21	1606.000
	Royster BMP2	N/A	N/A	N/A	headwater BMP	N/A	539	N/A	N/A	N/A
	Royster BMP3	N/A	N/A	N/A	headwater BMP	N/A	399	N/A	N/A	N/A
	Royster BMP4	N/A	N/A	N/A	headwater BMP	N/A	1022	N/A	N/A	N/A
	Royster BMP5	N/A	N/A	N/A	headwater BMP	N/A	669	N/A	N/A	N/A
	Lower Stick Elliott Creek	1,422	1101+13	1115+34	cattle fencing; buffer planting	EII	1,389	2.5	-29	527.000
	Scott Creek	630	1210+12	1216+74	Priority 1 Restoration	R	662	1	19	681.000
	Scott Creek SPSC BMP	N/A	N/A	N/A	headwater BMP	N/A	734	N/A	N/A	N/A
	Carroll Creek	553	1301+68	1307+63	Priority 2 Restoration	R	595	1	-56	539.000
	Upper Big Harris Creek R1	2,615	104+25	129+81	bank grading and in-stream structures; pine removal and buffer planting	EII	2,556	2.5	119	1141.000
	Upper Big Harris Creek R2	990	129+81	139+15	Priority 2 Restoration	R	934	1	126	1060.000
	Upper Big Harris Creek R3	880	139+75	148+45	cattle fencing; bank grading and in-stream structures	EII	870	2	75	510.000
	Upper Big Harris Creek R4	1,203	148+76	159+15	Priority 2 Restoration	R	1,039	1	11	1050.000
	Upper Big Harris Creek R5	845	159+58	168+03	cattle fencing; bank grading and in-stream structures	EII	845	1.5	41	604.000
	Upper Big Harris Creek R6A	824	168+63	177+50	cattle fencing; benching; bank grading and in-stream structures	EII	855	1.5	1	571.000

Table 1. Project Components and Mitigation Credits

Big Harris Creek Mitigation Site

DMS Project No. 739

Monitoring Year 1 - 2018

Mitigation Credits										
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset	
Type	R	RE	R	RE	R	RE				
Totals	25,228.121	101.795	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Project Components										
Project Area	Project Reach	Existing Footage (LF) [1]	Stationing/Location		Approach (P1, P2, etc.)	Restoration (R) or Restoration Equivalent (RE)	Restoration Footage (LF) [1]	Mitigation Ratio	Total Buffer Width Adjustments	Proposed Credit [2, 3, 4]
A	Upper Big Harris Creek R6B	1,434	177+50	191+84	cattle fencing; benching; bank grading and bank structures	EII	1,403	1.5	-10	925.000
	Upper Big Harris BMP	N/A	N/A	N/A	headwater BMP into Upper Big Harris Reach 5	N/A	166	N/A	N/A	N/A
	UT1 to Upper Big Harris Creek	84	197+13	197+97	bank grading and in-stream structures; pine removal and buffer planting	EII	84	2.5	-8	26.000
	UT2 to Upper Big Harris Creek	97	200+42	201+39	bank grading and in-stream structures; pine removal and buffer planting	EII	97	2.5	-4	35.000
	UT3 to Upper Big Harris Creek	105	202+00	203+05	preservation	P	105	10	0	11.000
	UT4 to Upper Big Harris Creek	84	204+00	204+84	preservation	P	84	10	-1	7.000
B	Elliott Creek	1,389	1400+85	1412+06	bank grading, segments of profile and bench restoration, in-stream structures	EI	1,121	1	42	1163.000
	UT1 to Elliott Creek	141	1415+87	1417+28	bank grading, segments of profile and bench restoration, in-stream structures	EI	141	1	-19	122.000
	Bridges Creek R1	445	1500+91	1504+67	Priority 1 Restoration	R	376	1	15	391.000
	Bridges Creek R2	366	1504+67	1507+84	bank grading and in-stream structures	EII	317	2	9	168.000
	UT1 to Bridges Creek	58	1510+46	1511+01	Priority 1 Restoration	R	55	1	-28	27.000
	Upper Stick Elliott Creek SPSC BMP	N/A	N/A	N/A	headwater BMP into USEC	N/A	206	N/A	N/A	N/A
	Upper Stick Elliott Creek R1	352	1002+89	1006+98	Priority 1 Restoration	R	409	1	-55	354.000
	Upper Stick Elliott Creek R2A	535	1006+98	1012+00	bank grading and in-stream structures	EII	471	2	4	240.000
	Upper Stick Elliott Creek R2B	334	1012+00	1015+10	bank grading and in-stream structures	EII	310	2	0	155.000
	Upper Stick Elliott Creek R3A	209	1015+10	1018+25	bank grading and benching	EII	315	2	17	175.000
	Upper Stick Elliott Creek R3B	1,336	1018+25	1027+44	bank grading, benching, and in-stream structures	EII	889	2	21	465.000
	Upper Stick Elliott Creek R4A	428	1038+11	1042+08	cattle fencing, bank grading and in-stream structures	EII	397	2	-17	182.000
	Upper Stick Elliott Creek R4B	113	1042+28	1043+21	in-stream structures	EII	113	1.5	-6	69.000
	Upper Stick Elliott Creek R5	1,909	1043+77	1058+84	Priority 2 -> Priority 1 Restoration	R	1,507	1	89	1596.000
	Upper Stick Elliott Creek R6	1,036	1059+14	1069+83	Priority 1 -> Priority 2 Restoration	R	1,069	1	0	1069.000
	UT1 to Upper Stick Elliott Creek	50	1078+08	1078+80	bank grading and in-stream structures	EII	72	1.5	-9	39.000
	UT2 to Upper Stick Elliott Creek	56	1080+00	1081+54	reconnection; Priority 1 Restoration	R	154	1	-10	144.000
	UT3 to Upper Stick Elliott Creek	107	1082+00	1083+18	reconnection; Priority 1 Restoration	R	118	1	0	118.000

Table 1. Project Components and Mitigation Credits
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	25,228.121	101.795	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project Components										
Project Area	Project Reach	Existing Footage (LF) [1]	Stationing/Location		Approach (P1, P2, etc.)	Restoration (R) or Restoration Equivalent (RE)	Restoration Footage (LF) [1]	Mitigation Ratio	Total Buffer Width Adjustments	Proposed Credit [2, 3, 4]
B	Upper Fletcher Creek R1	1,493	1600+00	1615+71	isolated bank grading and in-stream structures, livestock fencing, invasives treatment	EII	1,571	2.5	16	644.000
	Upper Fletcher Creek R2	1,465	1616+02	1630+09	Priority 2 Restoration	R	1,407	1	33	1440.000
	Lower Fletcher Creek R1	574	1641+28	1647+02	bank grading, benching, and in-stream structures	EI	574	1	-81	493.000
	Lower Fletcher Creek R2	467	1647+33	1651+60	bank grading, benching, and in-stream structures	EI	427	1	37	464.000
C	Lower Big Harris Creek R1A	509	300+13	305+13	bank grading, segments of profile and bench restoration, in-stream structures	EI	500	1.5	-29	304.000
	Lower Big Harris Creek R1B	385	305+13	308+33	Priority 2 Restoration	R	320	1	13	333.000
	Lower Big Harris Creek R2	987	308+33	318+00	Priority 2 Restoration	R	967	1	125	1092.000
	Lower Big Harris Creek R3	414	318+00	322+14	isolated bank grading and in-stream structures, invasives treatment	EII	414	2.5	32	198.000
	UT1 to Lower Big Harris Creek	229	330+68	332+96	isolated bank grading and in-stream structures, invasives treatment	EII	228	2.5	-39	53.000
	UT2 to Lower Big Harris Creek	511	334+20	338+60	heavy enhancement with in-stream structures, invasives treatment	EII	440	2	-37	183.000
	UT3 to Lower Big Harris Creek	99	341+69	342+87	preservation	P	118	10	-1	11.000
	UT4 to Lower Big Harris Creek	362	343+12	346+74	preservation	P	362	10	0	36.000
						Total Intermittent/Perennial (I/P) Streams	39,563			23,451.000
						Additional 4% Credit Based on I/P Stream Length for Extra Project Monitoring				1,366.000
						Additional 1.5% Credit Based on I/P Stream Length for Watershed Nature of Project				512.000
						Additional 2% Credit Based on Total SMUs for Statistical Improvement in Water Quality[5]				507.000
						Potential Total Credits[5]				25,329.916

Component Summation					
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)	Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
Restoration	10,071				
Enhancement	N/A				
Enhancement I	2,897				
Enhancement II	20,524				
Creation	N/A				
Wetland Rehabilitation	N/A				
Wetland Re-Establishment	N/A				
Preservation	669				
High Quality Preservation	N/A				

Notes:

1. Existing and proposed lengths include only reach length located within the conservation easement. No direct credit for BMPs. BMP lengths not included in proposed footage.
2. Credits reported have been adjusted based on buffer width deviations from standard 50-foot buffer width. Detailed calculations included in Appendix I of the Mitigation Plan (Wildlands, 2016).
3. The lengths of Royster Reach 2 and Scott Creek that are located underneath the existing overhead electric power line corridor have credits reduced by 100%.
4. The SMUs reported in this table were determined in the mitigation plan utilizing the design center line.
5. The potential SMU total does not inlclude the 2% increase for statistical improvement in water quality. If revised monitoring plan is approved, an addendum will be prepared and submitted.

Table 2. Project Activity and Reporting History

Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		February - July 2015	November 2016
Final Design - Construction Plans		May 2018	June 2018
Construction		April 2017 - May 2018	April 2017 - May 2018
Temporary S&E mix applied to entire project area[1]		April 2017 - May 2018	April 2017 - May 2018
Permanent seed mix applied to reach/segments		April 2017 - May 2018	April 2017 - May 2018
Bare root and live stake plantings for reach/segments		February 2018 - March 2018	February 2018 - March 2018
Baseline Monitoring Document (Year 0)	Stream Assessment	April 2018	June 2018
	Vegetation Assessment	May 2018	
Invasive Treatment		N/A	Summer 2018
Year 1 Monitoring	Stream Assessment	November 2018	December 2018
	Vegetation Assessment	November 2018	
Year 2 Monitoring		2019	November 2019
Year 3 Monitoring		2020	November 2020
Year 4 Monitoring		2021	November 2021
Year 5 Monitoring		2022	November 2022

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

Table 3. Project Contact Table

Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Designers Emily Reinicker, PE, CFM Angela Allen, PE - Area A Jake McLean, PE, CFM - Area C	**Wildlands Engineering, Inc.** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Kevin Tweedy, PE - Area B	**Ecosystem Planning & Restoration** 559 Jones Franklin Road, Suite 150 Raleigh, NC 27606
Construction Contractors	**Land Mechanics Designs Incorporated** 780 Landmark Road Willow Springs, NC 27611
	Fluvial Solutions Incorporated P.O. Box 28749 Raleigh, NC 27611
Planting Contractor	**Bruton Natural Systems, Inc.** 150 Old Black Creek Rd Freemont, NC 27830
Seeding Contractor	**Land Mechanics Designs Incorporated**
	Fluvial Solutions Incorporated
Seed Mix Sources	**Green Resource, LLC** 5204 Highgreen Court Colfax, NC 27235
	ACF Environmental 3313 Durham Drive Raleigh, NC 27603
Nursery Stock Suppliers **Bare Roots**	**Dykes & Son Nursery** 825 Maude Etter Rd. McMinnville, TN 37110
Live Stakes	**Foggy Mountain Nursery** 797 Helton Creek Road Lansing, NC 28643
	Bruton Natural Systems, Inc.
Herbaceous Plugs	**Wetland Plants Incorporated** 812 Drummonds Point Road Edenton, NC 27932
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kristi Suggs 704.332.7754, ext. 110

Table 4a. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA A

Project Information	
Project Name	Big Harris Creek Mitigation Site
County	Cleveland County
Project Area (acres)	145
Project Coordinates (latitude and longitude)	34° 24' 32.70"N, 81° 36' 41.55"W
Project Watershed Summary Information	
Physiographic Province	Piedmont Physiographic Province
River Basin	Broad
Temperature Regime	Warm
USGS Hydrologic Unit 8-digit	03050105
USGS Hydrologic Unit 14-digit	03050105080060
DWR Sub-basin	03-08-04
Project Drainage Area (acres)	2,509
Project Drainage Area Percentage of Impervious Area	<10%
CGIA Land Use Classification	Pasture (46%); Deciduous Forest (22%); Evergreen Forest (14%); Developed (10%); Herbaceous (2%); Shrub/Scrub (2%); Cultivated Crops (2%); Mixed Forest (1%); and Woody Wetlands (1%)

Reach Summary Information

Parameters	Area A																				
	Carroll Creek	Cornwell Creek	Cornwell Creek UT1	Eaker Creek	LSEC	Royster Creek		Scism Creek	Scott Creek	UBHC							UBHC UT1	UBHC UT2	UBHC UT3	UBHC UT4	
		R 1 & 2		R1	R1	R1	R2			R1	R2a	R2b	R3	R4	R5	R6					
Length of reach (linear feet) - Post-Restoration	595	2,451	78	134	1,389	459	3,170	1,189	662	2,556	934		870	1,039	845	2,258	84	97	105	84	
Drainage area (acres)	203	211		27	943	149		40	42	1,969											
NCDWR stream identification score	38	-	30	31.5/20.5	-	22.5	32	34/22.5	28.5	25 (I only)	-	-	-	-	-	-	-	-	-	24	
NCDWR Water Quality Classification	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	
Morphological Description (stream type)	P	P	P	P/I	P	I	P	P/I	I	P/I	P	P	P	P	P	P	P	I	I	P	
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V	VI		IIIa	V	III/IV	V/VI	III, IV, V	III	III	III		IV	IV	III	III	III	III	III	III	
Underlying mapped soils	Pacolet-Saw complex (PtD)	Chewacla loam (ChA)		Pacolet-Bethlehem complex (PbC2)	Toccoa loam (ToA)	Chewacla loam (ChA)		Pacolet-Saw complex (PtD)		Chewacla loam (ChA)											
Drainage class	Well drained	Somewhat poorly drained		Well drained	Well drained and moderately well drained	Somewhat poorly drained		Well drained		Somewhat poorly drained											
Soil hydric status	No	Yes		No	No	Yes		No		Yes											
Slope	15-25%	0-2%		8-15%	0-2%	0-2%		15-25%		0-2%											
FEMA classification	LBHC Reaches 1a, 1b, and 2 are a mapped Zone AE floodplain with defined base flood elevations.																				
Native vegetation community	Piedmont Alluvial Forest, Mesic Mixed Hardwood Forest, and Timber Forest (applies to UBHC - Reach 1, Reach 2, UT1, UT2, UT3 only)																				
Percent composition exotic invasive vegetation -Post-Restoration	0%																				

Table 4b. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA A

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 4087. USACE Action ID #SAW-2009-0045
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	NPDES Construction Stormwater General Permit NCG010000
Endangered Species Act	Yes	Yes	Big Harris Creek Mitigation Plan; Wildlands determined "no effect" on Cleveland County listed endangered species. USFWS indicates project will have no impact on possible endangered plants and the possibility of incidental take of the northern long-eared bat is exempt under the 4(d) rule at this location (email correspondence from 12/18/2008 and 05/09/2016).
Historic Preservation Act	Yes	Yes	No historic resources were found to be impacted (letter from SHPO dated 6/25/2008).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	LBHC Reaches 1a, 1b, and 2 are a mapped Zone AE floodplain with defined base flood elevations. (FEMA Zone AE, FIRM panels 2620 and 2621). Cleveland County Floodplain Development Permit #153715.
Essential Fisheries Habitat	No	N/A	N/A

Table 4c. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA B

Project Information	
Project Name	Big Harris Creek Mitigation Site
County	Cleveland County
Project Area (acres)	145.00
Project Coordinates (latitude and longitude)	34° 24' 32.70"N, 81° 36' 41.55"W
Project Watershed Summary Information	
Physiographic Province	Piedmont Physiographic Province
River Basin	Broad
Temperature Regime	Warm
USGS Hydrologic Unit 8-digit	03050105
USGS Hydrologic Unit 14-digit	03050105080060
DWR Sub-basin	03-08-04
Project Drainage Area (acres)	2509
Project Drainage Area Percentage of Impervious Area	<10%
CGIA Land Use Classification	Pasture (46%); Deciduous Forest (22%); Evergreen Forest (14%); Developed (10%); Herbaceous (2%); Shrub/Scrub (2%); Cultivated Crops (2%); Mixed Forest (1%); and Woody Wetlands (1%)

Reach Summary Information

Parameters	Area B																			
	Elliott Creek	Elliott Creek UT1	Bridges Creek		Bridges Creek UT1	LFC		USEC							USEC UT1	USEC UT2	USEC UT3	UFC	
	R1		R1	R2		R1	R2	R1	R2	R3	R4a	R4b	R5	R6				R1	R2
Length of reach (linear feet) - Post-Restoration	1,121	141	376	317	55	574	427	409	781	1,204	397	113	1,507	1,069	72	154	118	1,571	1,407
Drainage area (acres)	82		38		24	266		487							25.5	33	25.5	185	
NCDWR stream identification score	33.5	33.5	33/25.5	-		38	-	33.5	-	-	-	-	-	-				-	-
NCDWR Water Quality Classification	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV
Morphological Description (stream type)	P	P	P/I	P	I	P	P	P	P	P	P	P	P	P	I	P	I	P	P
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V	III	III/IV/V/VI			IV/V	III/IV	III/IV	IV/V	V	III/V/VI		IV	IV/V	-	-	-	VI	
Underlying mapped soils	Chewacla loam (ChA)		Pacolet sandy clay loam (PaC2)			Chewacla loam (ChA)													
Drainage class	Somewhat poorly drained		Well drained			Somewhat poorly drained													
Soil hydric status	Yes		No			Yes													
Slope	0-2%		8-15%			0-2%													
FEMA classification	no regulated floodplain																		
Native vegetation community	Piedmont Alluvial Forest and Mesic Mixed Hardwood Forest																		
Percent composition exotic invasive vegetation -Post-Restoration	0%																		

Table 4d. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA B

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 4087. USACE Action ID #SAW-2009-0045
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	NPDES Construction Stormwater General Permit NCG010000
Endangered Species Act	Yes	Yes	Big Harris Creek Mitigation Plan; Wildlands determined "no effect" on Cleveland County listed endangered species. USFWS indicates project will have no impact on possible endangered plants and the possibility of incidental take of the northern long-eared bat is exempt under the 4(d) rule at this location (email correspondence from 12/18/2008 and 05/09/2016).
Historic Preservation Act	Yes	Yes	No historic resources were found to be impacted (letter from SHPO dated 6/25/2008).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	LBHC Reaches 1a, 1b, and 2 are a mapped Zone AE floodplain with defined base flood elevations. (FEMA Zone AE, FIRM panels 2620 and 2621). Cleveland County Floodplain Development Permit #153715.
Essential Fisheries Habitat	No	N/A	N/A

Table 4e. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA C

Project Information	
Project Name	Big Harris Creek Mitigation Site
County	Cleveland County
Project Area (acres)	145.00
Project Coordinates (latitude and longitude)	34° 24' 32.70"N, 81° 36' 41.55"W

Project Watershed Summary Information	
Physiographic Province	Piedmont Physiographic Province
River Basin	Broad
Temperature Regime	Warm
USGS Hydrologic Unit 8-digit	03050105
USGS Hydrologic Unit 14-digit	03050105080060
DWR Sub-basin	03-08-04
Project Drainage Area (acres)	2509
Project Drainage Area Percentage of Impervious Area	<10%
CGIA Land Use Classification	Pasture (46%); Deciduous Forest (22%); Evergreen Forest (14%); Developed (10%); Herbaceous (2%); Shrub/Scrub (2%); Cultivated Crops (2%); Mixed Forest

Reach Summary Information

Parameters	Area C							
	LBHC				LBHC UT1	LBHC UT2	LBHC UT3	LBHC UT4
	R1a	R1b	R2	R3				
Length of reach (linear feet) - Post-Restoration	500	320	967	414	228	440	118	362
Drainage area (acres)	2,509							
NCDWR stream identification score	-	-	-	-	-	35.5	32	35.5
NCDWR Water Quality Classification	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV	WS-IV
Morphological Description (stream type)	P	P	P	P	P	P	P	P
Evolutionary trend (Simon's Model) - Pre- Restoration	IV/V							VI
Underlying mapped soils	Toccoa loam (ToA)							
Drainage class	Well drained and moderately well drained							
Soil hydric status	No							
Slope	0-2%							
FEMA classification	Zone AE			no regulated floodplain				
Native vegetation community	Piedmont Alluvial Forest and Mesic Mixed Hardwood Forest							
Percent composition exotic invasive vegetation -Post-Restoration	0%							

Table 4f. Project Information and Attributes
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA C

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 4087. USACE Action ID #SAW-2009-0045.
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Erosion and Sediment Control)	Yes	Yes	NPDES Construction Stormwater General Permit NCG010000
Endangered Species Act	Yes	Yes	Big Harris Creek Mitigation Plan; Wildlands determined "no effect" on Cleveland County listed endangered species. USFWS indicates project will have no impact on possible endangered plants and the possibility of incidental take of the northern long-eared bat is exempt under the 4(d) rule at this location (email correspondence from 12/18/2008 and 05/09/2016).
Historic Preservation Act	Yes	Yes	No historic resources were found to be impacted (letter from SHPO dated 6/25/2008).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	LBHC Reaches 1a, 1b, and 2 are a mapped Zone AE floodplain with defined base flood elevations. (FEMA Zone AE, FIRM panels 2620 and 2621). Cleveland County Floodplain Development Permit #153715.
Essential Fisheries Habitat	No	N/A	N/A

Table 5a. Monitoring Component Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area A - Restoration and Enhancement I Reaches

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		Carroll Creek	Royster Creek R1	Scott Creek	UBHC R2	UBHC R4	Eaker Creek		
Dimension	Riffle Cross-Section	1	1	1	2	2	N/A	Annual	
	Pool Cross-Section	1	1	1	2	2	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Substrate	Reach Wide (RW) / Riffle (RF) 100 Pebble Count	1 RW, 1 RF	1 RW, 1 RF	1 RW, 1 RF	1 RW, 2RF	1 RW, 2RF	N/A	Annual	
Hydrology	Crest Gage/Transducer	1	1	1	1		N/A	Quarterly	2
Vegetation	CVS Level 2	16					N/A	Annual	3
Water Quality	4 baseflow, 4 stormflow grab samples	up to 10 locations throughout project areas A, B, & C and 1 reference location					N/A	Years 3, 4, and 5	
Benthic Macroinvertebrates	NCDWR Qual 4						N/A	Years 3, 4, and 5	
Fisheries	NCDWR SOP						N/A	Year 5	
Exotic and Nuisance Vegetation								Semi-Annual	4
Project Boundary								Semi-Annual	5
Reference Photos	Photographs	18						Annual	

Notes:

1. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile will be collected during as-built baseline monitoring only, unless observations indicate a lack of stability and a profile survey is warranted in additional years.
2. Crest gages and/or transducers will be inspected quarterly or semi-annually, evidence of bankfull events will be documented with a photo when possible. Transducers will be set to record stage once every hour. Devices will be inspected and downloaded semi-annually. In addition, Scott Creek and Royster Creek Reach 1 will be monitored for the presence of baseflow (minimun of 30 consecutives days).
3. The total number of vegetation monitoring plots represents 2% of the open planted area. This is a reduction from the number of vegetation plots proposed in the Mitigation Plan, which wa based on 2% of the entire conservation easement. IRT and DMS approved the change in January 2018.
4. Locations of exotic and nuisance vegetation will be mapped
5. Locations of vegetation damage, boundary encroachments, etc. will be mapped

Table 5b. Monitoring Component Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area A - Enhancement II Reaches

Parameter	Monitoring Feature	Quantity / Length by Reach										Frequency	Notes
		Cornwell Creek	Cornwell Creek UT1	LSEC	Royster Creek R2	Scism Creek	UBHC R1	UBHC R3	UBHC R5	UBHC R6	UBHC UT1 & UT2		
Dimension	Riffle Cross-Section	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
	Pool Cross-Section	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Substrate	Reach Wide (RW) / Riffle (RF) 100 Pebble Count	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Hydrology	Crest Gage/Transducer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	
Vegetation	CVS Level 2	18										Annual	1
Exotic and Nuisance Vegetation												Semi-Annual	2
Project Boundary												Semi-Annual	3
Reference Photos	Photographs	38										Annual	4

Notes:

1. The total number of vegetation monitoring plots represents 2% of the open planted area. This is a reduction from the number of vegetation plots proposed in the Mitigation Plan, which was based on 2% of the entire conservation easement. IRT and DMS approved this change in January 2018.
2. Locations of exotic and nuisance vegetation will be mapped.
3. Locations of vegetation damage, boundary encroachments, etc. will be mapped.
4. Photographs will be taken along preservation reaches not noted above (3 photographs total).

Table 5c. Monitoring Component Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area B - Restoration and Enhancement I Reaches

Parameter	Monitoring Feature	Quantity / Length by Reach												Frequency	Notes
		Elliott Creek	Elliott Creek UT1	Bridges Creek R1	Bridges Creek UT1	LFC R1	LFC R2	Upper Stick Elliott Creek R1	USEC R5	USEC R6	USEC UT2	USEC UT3	UFC R2		
Dimension	Riffle Cross-Section	2	1	1	N/A	1	1	1	3	2	1	1	3	Annual	
	Pool Cross-Section	1	0	0	N/A	1	1	0	2	1	0	0	3		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	1
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Substrate	Reach Wide (RW) / Riffle (RF) 100 Pebble Count	1 RW, 2 RF	1 RW, 1 RF	1 RW, 1 RF	N/A	1 RW, 1 RF	1 RW, 1 RF	1 RW, 1 RF	1 RW, 3 RF	1 RW, 2 RF	1 RW, 1 RF	1 RW, 1 RF	1 RW, 3RF	Annual	
Hydrology	Crest Gage/Transducer	1	1	1	N/A	1		1	1		1	1	1	Quarterly	2
Vegetation	CVS Level 2	13												Annual	3
Water Quality	4 baseflow, 4 stormflow grab samples	up to 10 locations throughout project areas A, B, & C and 1 reference location												Years 3, 4, and 5	
Benthic Macroinvertebrates	NCDWR Qual 4													Years 3, 4, and 5	
Fisheries	NCDWR SOP													Year 5	
Exotic and Nuisance Vegetation														Semi-Annual	4
Project Boundary														Semi-Annual	5
Reference Photos	Photographs	27												Annual	

Notes:

1. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile will be collected during as-built baseline monitoring survey only, unless observations indicate a lack of stability and a profile survey is warranted in additional years.
2. Crest gages and/or transducers will be inspected quarterly or semi-annually, evidence of bankfull events will be documented with a photo when possible. Transducers will be set to record stage once every hour. Device will be inspected and downloaded semi-annually. In addition, Bridges Creek will be monitored for the presence of baseflow (minimun of 30 consecutives days).
3. The total number of vegetation monitoring plots represents 2% of the open planted area. This is a reduction from the number of vegetation plots proposed in the Mitigation Plan, which was based on 2% of the entire conservatio easement. IRT and DMS approved this change in January 2018.
4. Locations of exotic and nuisance vegetation will be mapped
5. Locations of vegetation damage, boundary encroachments, etc. will be mapped

Table 5d. Monitoring Component Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area B - Enhancement II Reaches

Parameter	Monitoring Feature	Quantity / Length by Reach						Frequency	Notes
		Bridges Creek R2	USEC R2	USEC R3	USEC R4a/4b	USEC UT1	UFC R1		
Dimension	Riffle Cross-Section	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
	Pool Cross-Section	N/A	N/A	N/A	N/A	N/A	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Substrate	Reach Wide (RW) / Riffle (RF) 100 Pebble Count	N/A	N/A	N/A	N/A	N/A	N/A	Annual	
Hydrology	Crest Gage/Transducer	N/A	N/A	N/A	N/A	N/A	N/A	Quarterly	
Vegetation	CVS Level 2	5						Annual	1
Exotic and Nuisance Vegetation								Semi-Annual	2
Project Boundary								Semi-Annual	3
Reference Photos	Photographs	12						Annual	

Notes:
1. The total number of vegetation monitoring plots represents 2% of the open planted area. This is a reduction from the number of vegetation plots proposed in the Mitigation Plan, which wa based on 2% of the entire conservation easement that included supplemental planting areas. IRT and DMS approved this change in January 2018.
2. Locations of exotic and nuisance vegetation will be mapped
3. Locations of vegetation damage, boundary encroachments, etc. will be mapped.

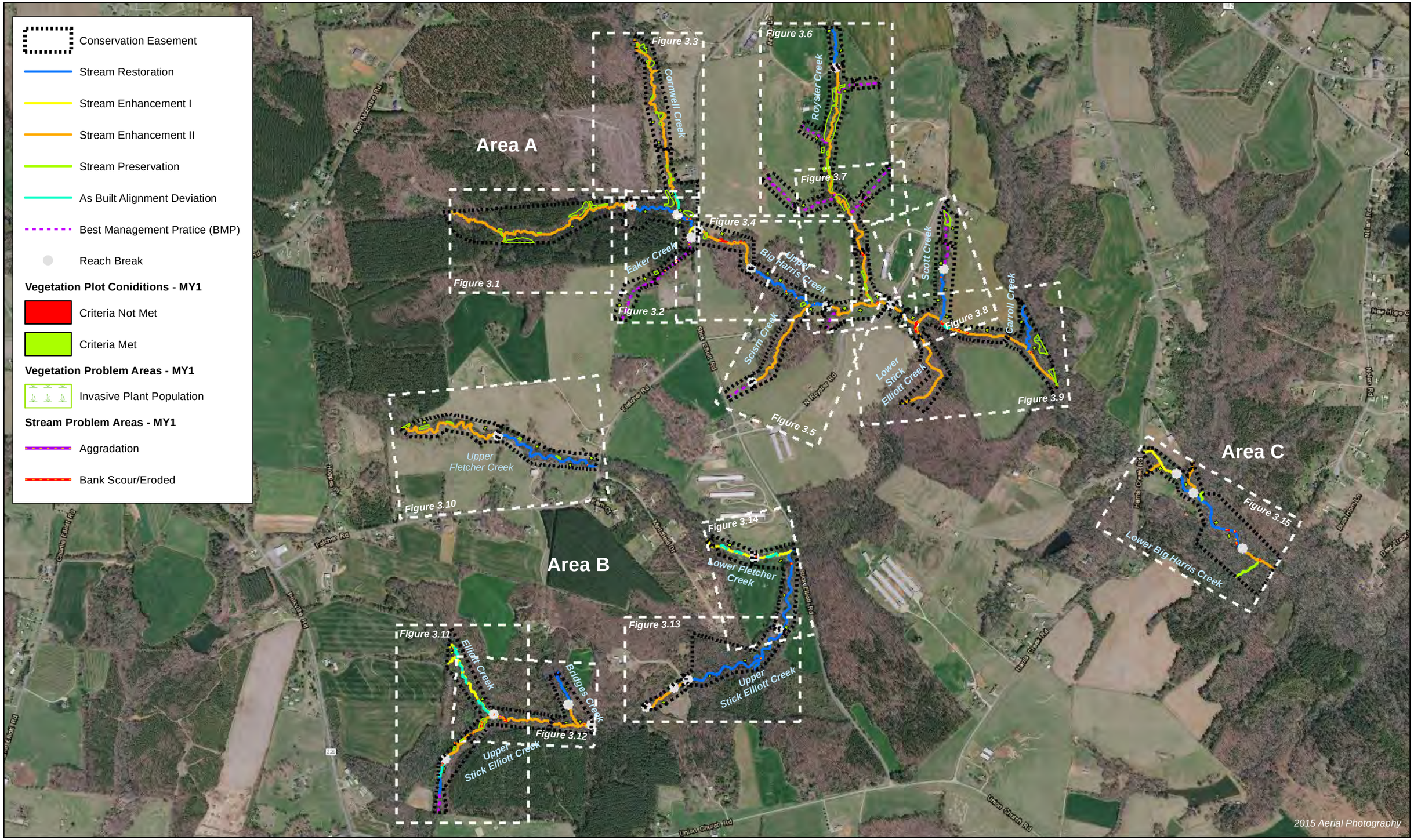
Table 5e. Monitoring Component Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area C - Restoration, Enhancement I, and II Reaches

Parameter	Monitoring Feature	Quantity / Length by Reach				Frequency	Notes
		LBHC Reach 1a	LBHC Reaches 1b & 2	LBHC UT1	LBHC UT2		
Dimension	Riffle Cross-Section	1	1	N/A	N/A	Annual	
	Pool Cross-Section	1	1	N/A	N/A		
Pattern	Pattern	N/A	N/A	N/A	N/A	Annual	1
Profile	Longitudinal Profile	N/A	N/A	N/A	N/A	Annual	
Substrate	Reach Wide (RW) / Riffle (RF) 100 Pebble Count	1 RW, 1 RF	1 RW, 1 RF	N/A	N/A	Annual	
Hydrology	Crest Gage/Transducer	1	1	N/A	N/A	Quarterly	2
Vegetation	CVS Level 2	4				Annual	3
Water Quality	4 baseflow, 4 stormflow grab samples	up to 10 locations throughout project areas A, B, & C and 1 reference location				Years 3, 4, and 5	
Benthic Macroinvertebrates	NCDWR Qual 4					Years 3, 4, and 5	
Fisheries	NCDWR SOP					Year 5	
Exotic and Nuisance Vegetation						Semi-Annual	4
Project Boundary						Semi-Annual	5
Reference Photos	Photographs	12				Annual	6

Notes:
1. Pattern and profile will be assessed visually during semi-annual site visits. Longitudinal profile will be collected during as-built baseline monitoring survey only unless observations indicate a lack of stability and a profile survey is warranted in additional years.
2. Crest gages and/or transducers will be inspected quarterly or semi-annually, evidence of bankfull events will be documented with a photo when possible Transducers will be set to record stage once every hour. Device will be inspected and downloaded semi-annually.
3. The total number of vegetation monitoring plots represents 2% of the open planted area. This is a reduction from the number of vegetation plots proposed in the Mitigation Plan, which was based on 2% of the entire conservation easement. IRT and DMS approved this change in January 2018.
4. Locations of exotic and nuisance vegetation will be mapped
5. Locations of vegetation damage, boundary encroachments, etc. will be mapped
6. Photographs will be taken along preservation reaches not noted above (2 photographs total)

APPENDIX 2. Visual Assessment Data

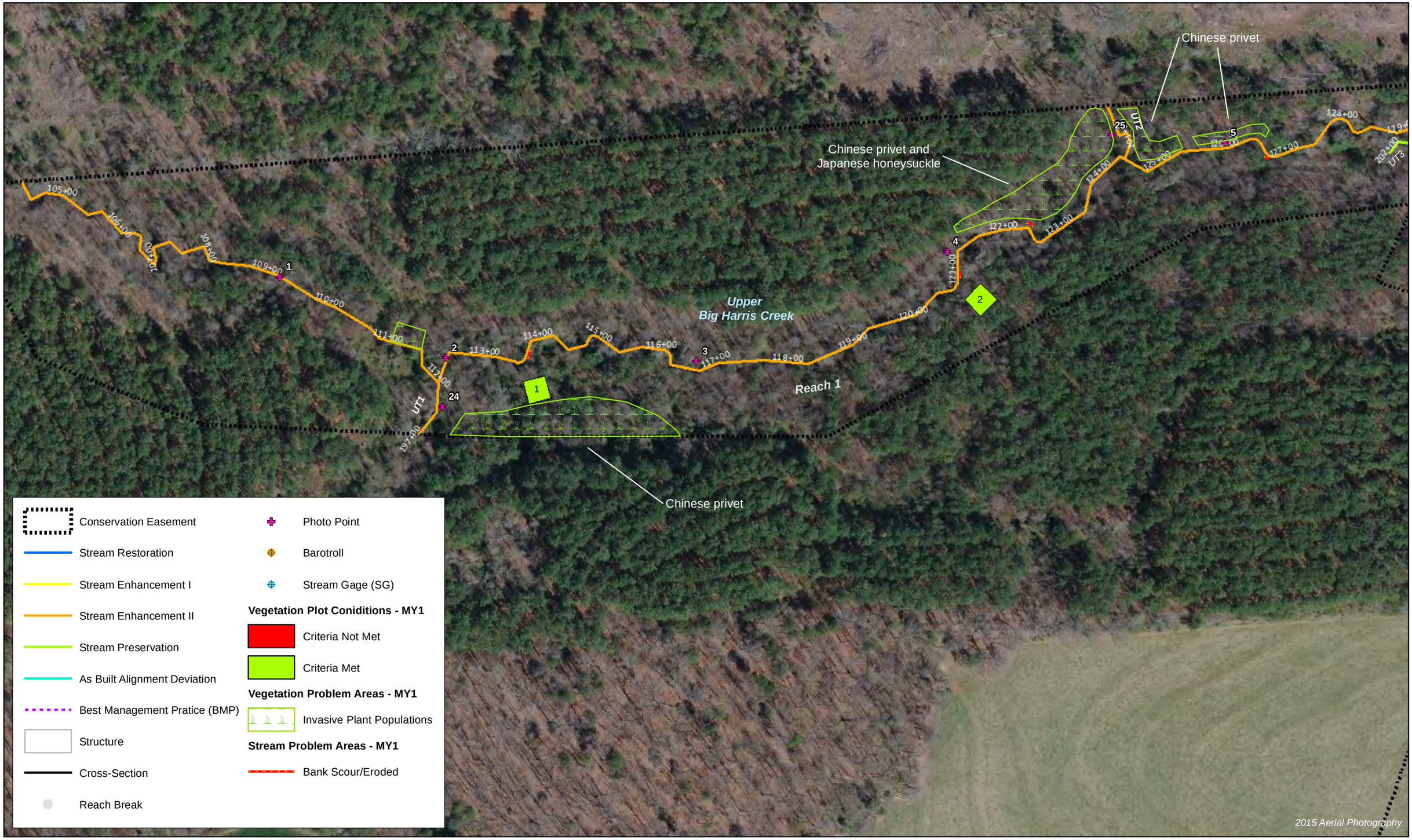


WILDLANDS ENGINEERING

0 500 1,000 Feet

N

Figure 3.0 Integrated Current Condition Plan View (Overview)
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

N

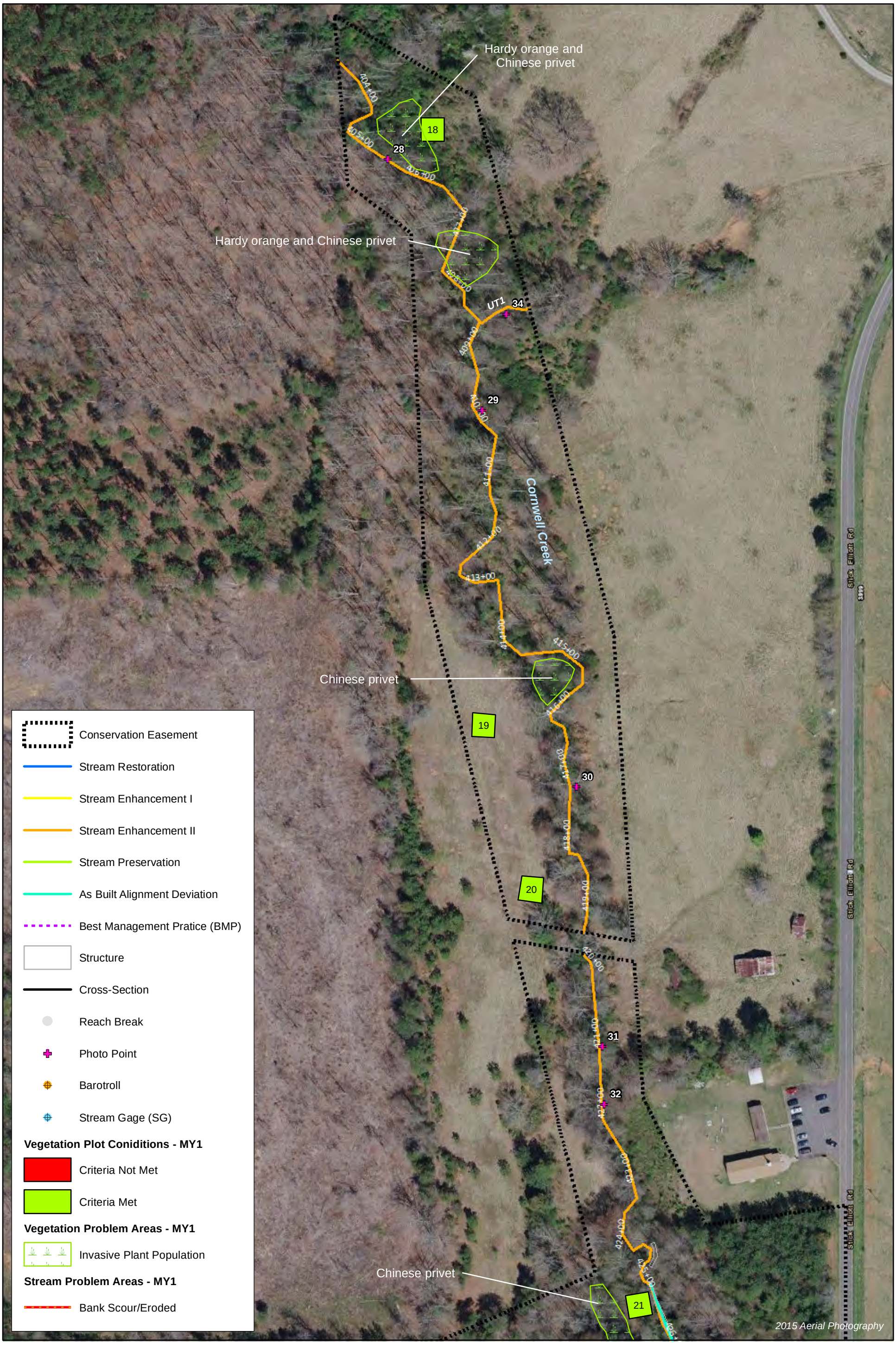
Figure 3.1 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 3.2 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

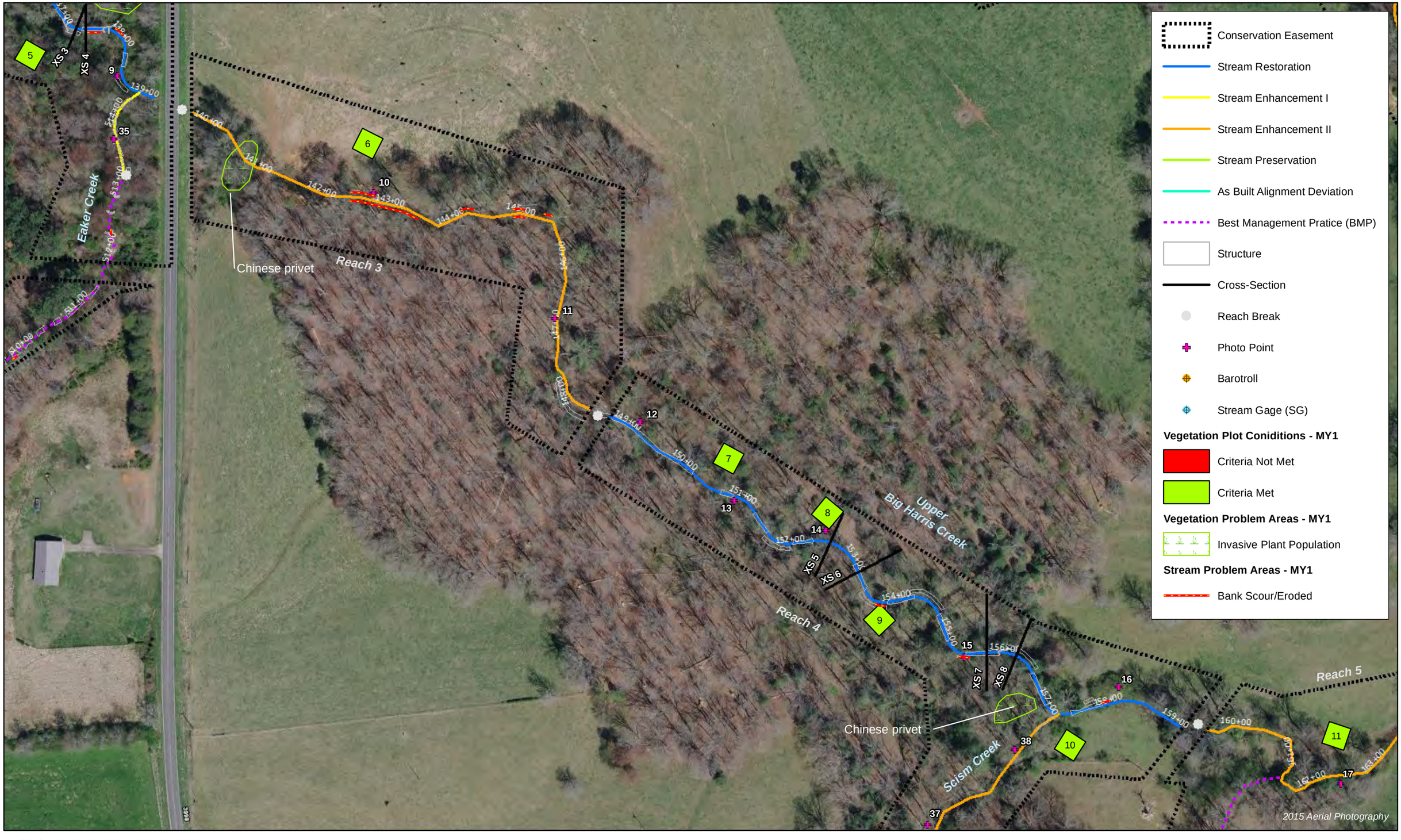


WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 3.3 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

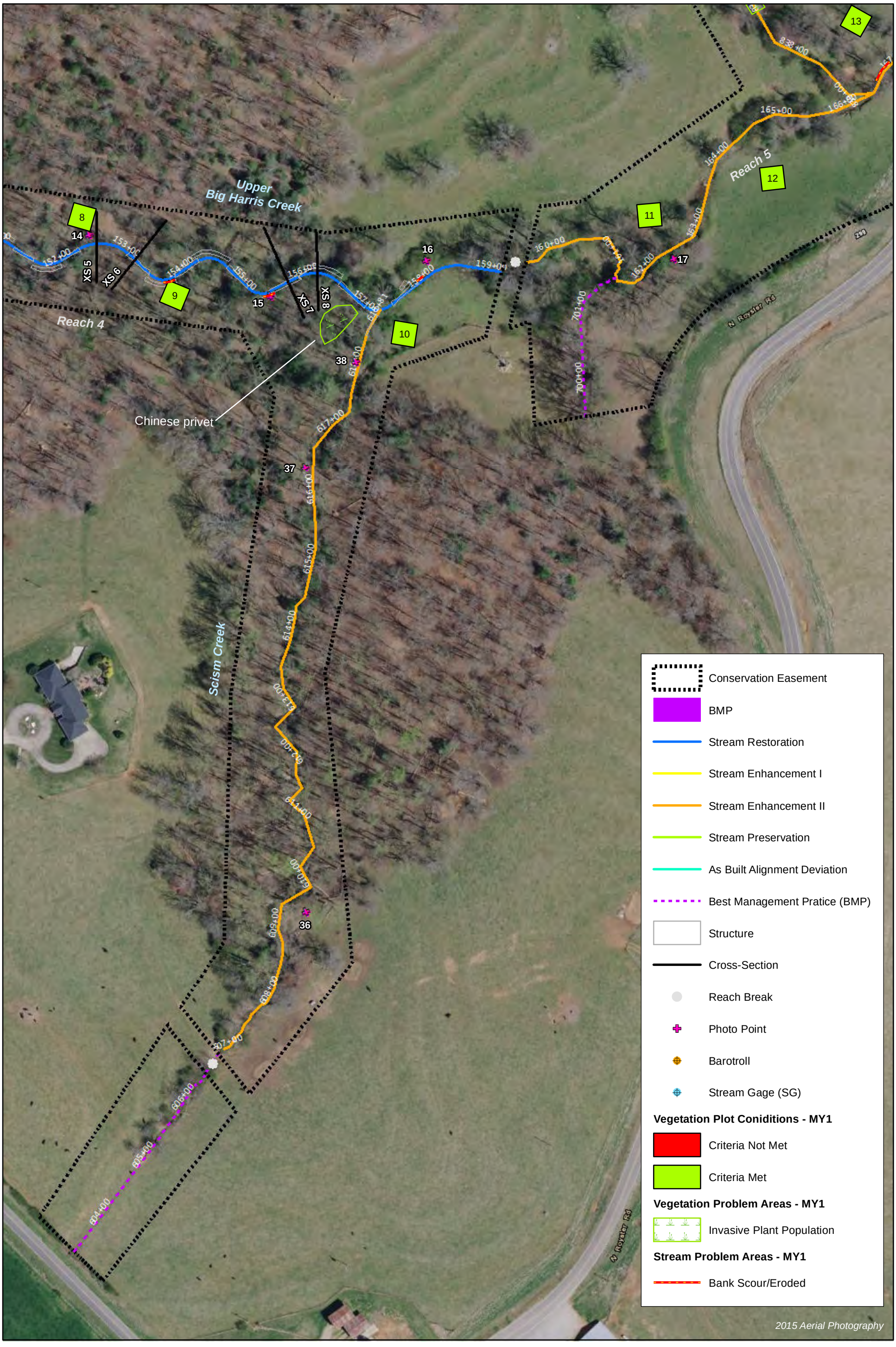


WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 3.4 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

Figure 3.5 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site -- Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Cleveland County, NC

Conservation Easement
Stream Restoration
Stream Enhancement I
Stream Enhancement II
Stream Preservation
As Built Alignment Deviation
Best Management Pratice (BMP)
Structure
Cross-Section
Reach Break
Photo Point
Barotroll
Stream Gage (SG)

Vegetation Plot Coniditions - MY1

Criteria Not Met
Criteria Met

Vegetation Problem Areas - MY1

Invasive Plant Population

Stream Problem Areas - MY1

Bank Scour/Eroded

24
39
SG 2
XS 9
40
XS 10
Reach 1
25
41
BMP2
42
26
Chinese privet
43
Chinese privet
BMP3
27
Reach 2
44
Chinese privet
Royster Creek
Chinese privet
45
BMP5
28
BMP4
29

2015 Aerial Photography

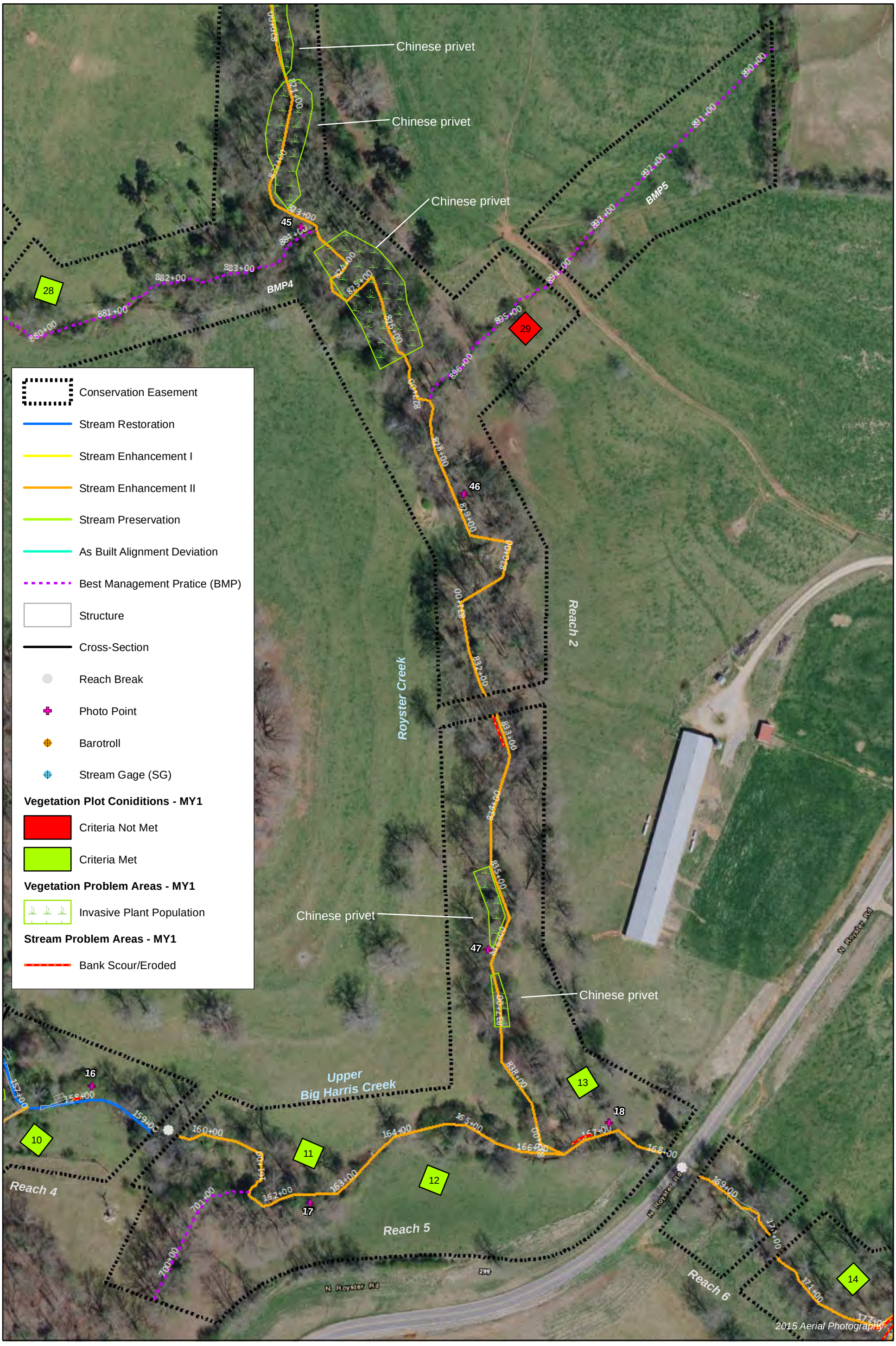
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3.6 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Cleveland County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

Figure 3.7 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

Conservation Easement
Stream Restoration
Stream Enhancement I
Stream Enhancement II
Stream Preservation
As Built Alignment Deviation
Best Management Pratice (BMP)
Structure
Cross-Section
Reach Break
Photo Point
Barotroll
Stream Gage (SG)

Vegetation Plot Coniditions - MY1

Criteria Not Met
Criteria Met

Vegetation Problem Areas - MY1

Invasive Plant Population

Stream Problem Areas - MY1

Bank Scour/Eroded

N Royster Rd
239
Chinese privet
30
31
Scott Creek
XS 11
51
SG 3
XS 12
52
32
33
Upper
Big Harris Creek
14
19
53
15
Reach 6
Lower Stick
Elliott Creek
50
20
2015 Aerial Photography

WILDLANDS ENGINEERING

0 100 200 Feet

Figure 3.8 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 150 300 Feet

Figure 3.9 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3.10 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

Conservation Easement
Stream Restoration
Stream Enhancement I
Stream Enhancement II
Stream Preservation
As Built Alignment Deviation
Best Management Pratice (BMP)
Structure
Cross-Section
Reach Break
Photo Point
Barotroll
Stream Gage (SG)

Vegetation Plot Coniditions - MY1

Criteria Not Met
Criteria Met

Vegetation Problem Areas - MY1

Invasive Plant Population

Stream Problem Areas - MY1

Aggradation
Bank Scour/Eroded

75
50
XS 27
79
SG 8
76
SG 7
UT1
XS 24
Elliott Creek
XS 25
XS 26
77
51
78
Chinese privet
Reach 3
59
60
Upper
Stick Elliott Creek
74
UT1
Reach 2
58
57
XS 15
SG 5
42
Reach 1

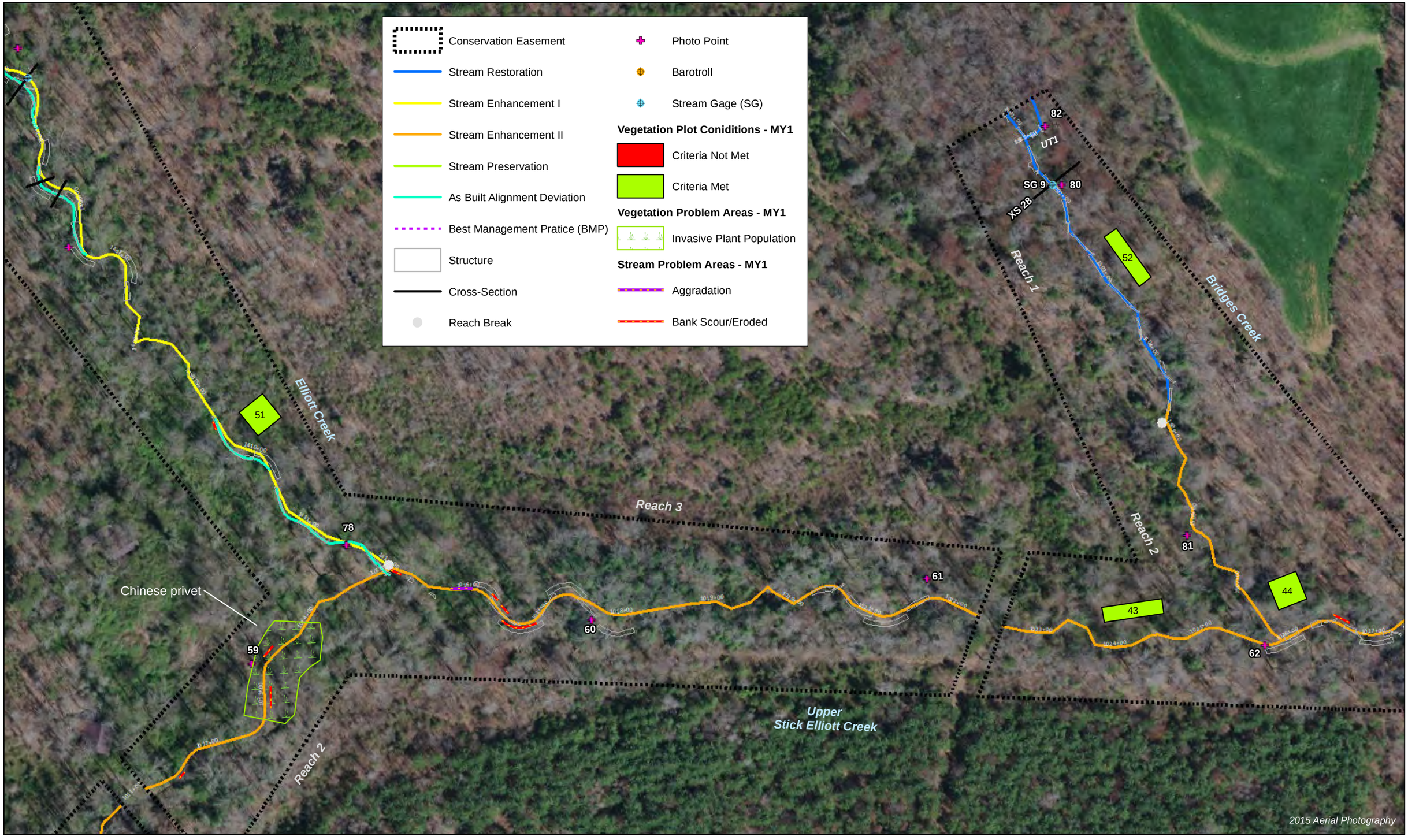
2015 Aerial Photography

WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3.11 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

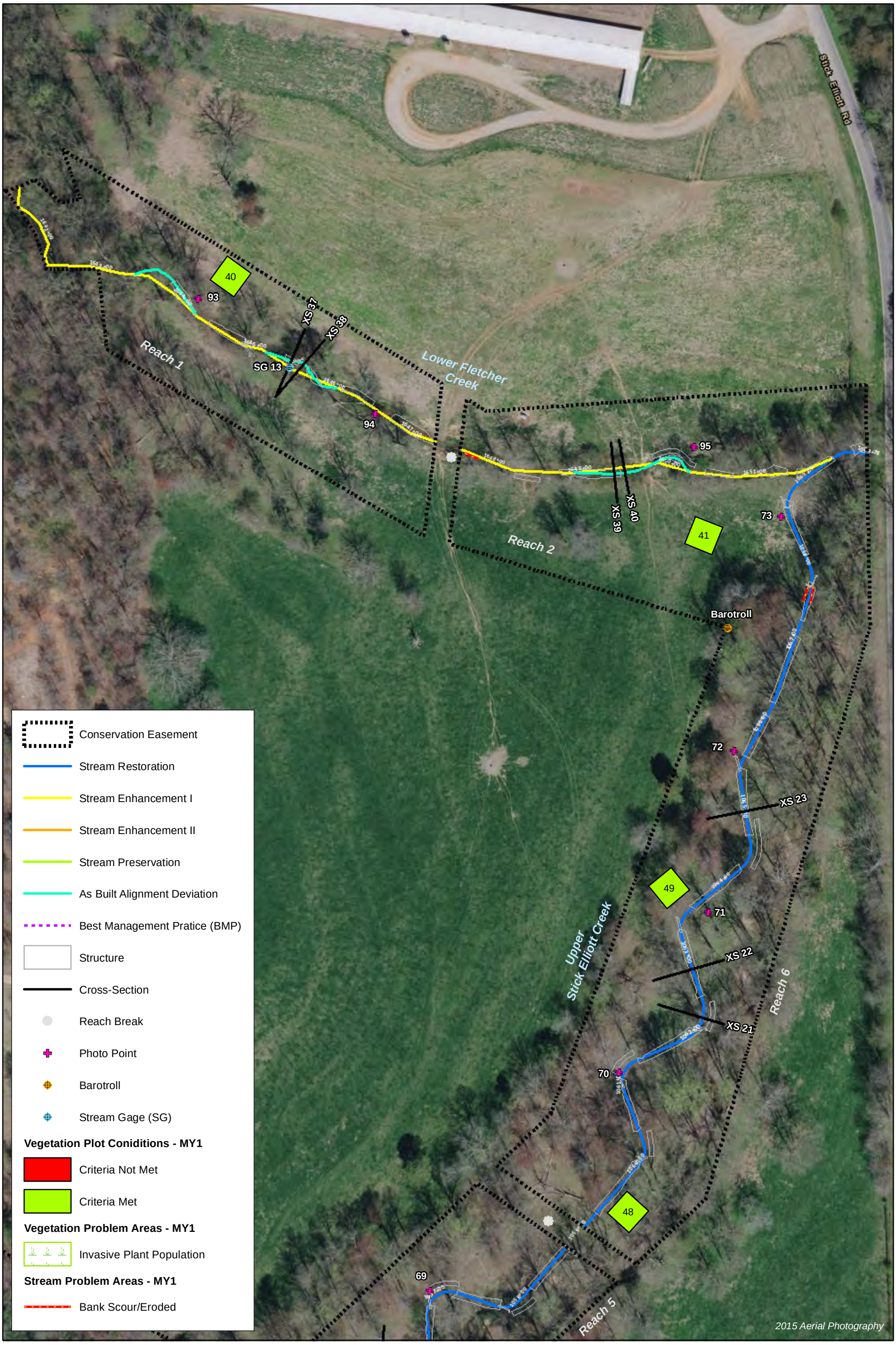
Figure 3.12 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

WILDLANDS ENGINEERING

0 125 250 Feet

N

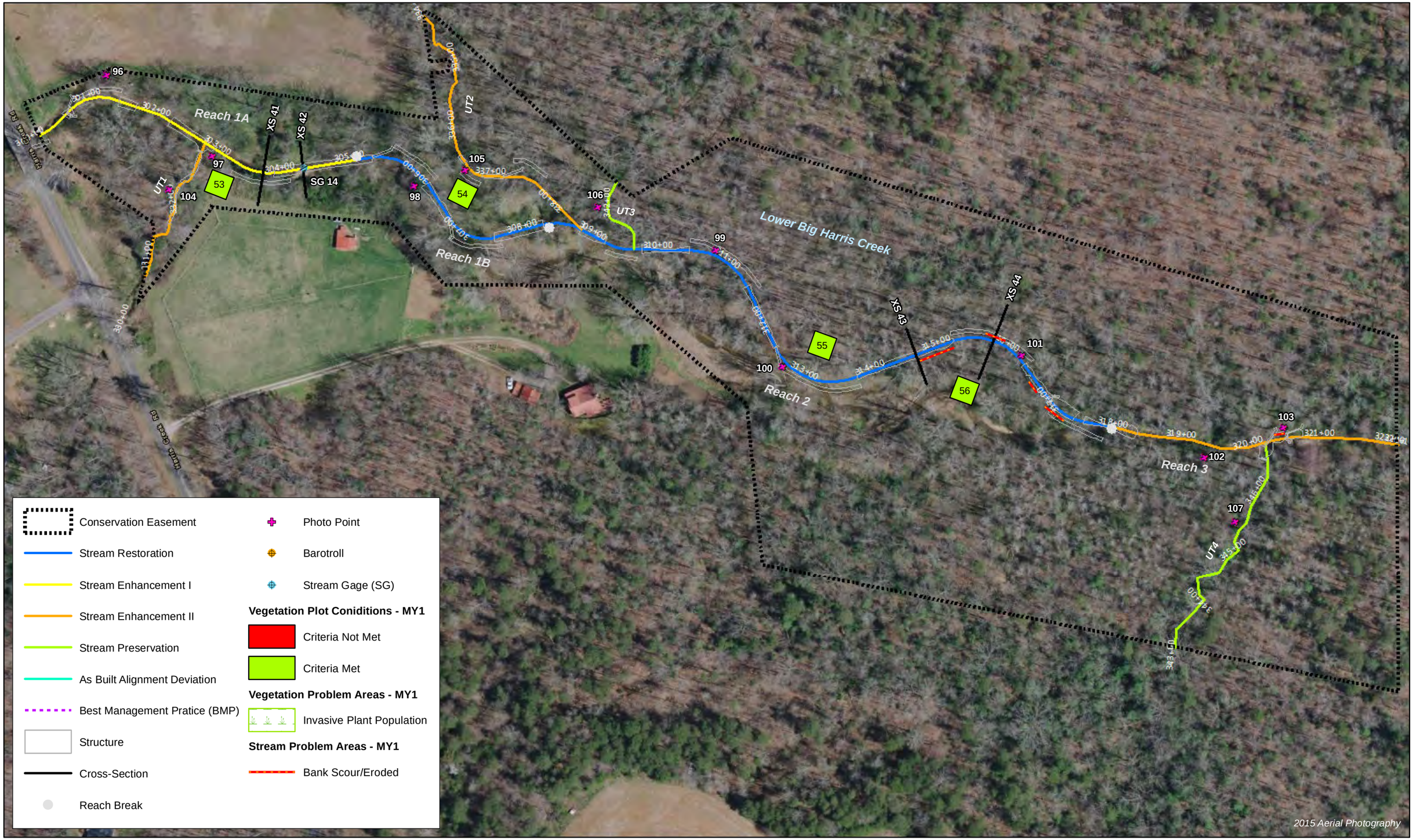
Figure 3.13 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

Figure 3.14 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

Figure 3.15 Integrated Current Condition Plan View
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018
Cleveland County, NC

Table 6a. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area A- Eaker Creek - 134 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	1	1			100%			
	3. Meander Pool Condition	Depth Sufficient	1	1			100%			
		Length Appropriate	1	1			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	1	1			100%			
		Thalweg centering at downstream of meander bend (Glide)	1	1			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6b. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area A- Royster Creek R1 - 459 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	9	9			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%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	14	14			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	12	12			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			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.	12	12			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6c. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area A- Scott Creek - 662 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			1	9	99%			
	2. Riffle Condition	Texture/Substrate	9	10			90%			
	3. Meander Pool Condition	Depth Sufficient	5	5			100%			
		Length Appropriate	5	5			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		Thalweg centering at downstream of meander bend (Glide)	5	5			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	29	96%	0%	0%	96%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	2	29	96%	0%	0%	96%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	19			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	19	19			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	19	19			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.	19	19			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6d. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area A- Carroll Creek - 595 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%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	1	1			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%.	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6e. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area A- UBHC R2 - 934 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	16	17			94%			
	3. Meander Pool Condition	Depth Sufficient	15	15			100%			
		Length Appropriate	15	15			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		Thalweg centering at downstream of meander bend (Glide)	15	15			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			3	56	94%	0%	0%	94%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	3	56	94%	0%	0%	94%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	7	7			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	7	7			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	9	9			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6f. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area A- UBHC R4 - 1,039 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	10	10			100%			
		Length Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			3	47	95%	0%	0%	95%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	3	47	95%	0%	0%	95%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	1	1			100%			
	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%.	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6g. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- Elliot Creek - 1,121 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	19	19			100%			
	3. Meander Pool Condition	Depth Sufficient	17	17			100%			
		Length Appropriate	17	17			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	17	17			100%			
		Thalweg centering at downstream of meander bend (Glide)	17	17			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			2	20	98%	0%	0%	98%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	2	20	98%	0%	0%	98%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	10	11			91%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	11	11			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6h. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- UT1 to Elliot Creek - 141 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	5	5			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Length Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	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.	2	2			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6i. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- Bridges Creek R1 - 376 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	10	10			100%			
		Length Appropriate	10	10			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	10	10			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	7	7			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	7	7			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	7	7			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	7	7			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6j. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- UT1 to Bridges Creek - 55 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	2	2			100%			
	3. Meander Pool Condition	Depth Sufficient	1	1			100%			
		Length Appropriate	1	1			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	1	1			100%			
		Thalweg centering at downstream of meander bend (Glide)	1	1			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			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.	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6k. Visual Stream Morphology Stability Assessment Table
Big Harris Creek Stream Mitigation Site
DMS Project No. 95 739
Monitoring Year 1 - 2018

Area B- USEC R1 - 409 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	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			4	34	92%	0%	0%	92%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	4	34	92%	0%	0%	92%
3. Engineered Structures[1]	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	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			100%			
	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.	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6I. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- USEC R5 - 1,507 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	15	15			100%			
	3. Meander Pool Condition	Depth Sufficient	13	13			100%			
		Length Appropriate	13	13			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		Thalweg centering at downstream of meander bend (Glide)	13	13			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	17	99%	0%	0%	99%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	1	17	99%	0%	0%	99%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	19			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%.	19	19			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	3	3			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6m. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- USEC R6 - 1,069 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			1	20	98%			
	2. Riffle Condition	Texture/Substrate	12	12			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			2	38	96%	0%	0%	96%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	2	38	96%	0%	0%	96%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	12	12			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	7	7			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6n. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- UT2 to USEC - 154 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	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6o. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- UT3 to USEC - 118 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	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6p. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- UFC R2 - 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	18	18			100%			
	3. Meander Pool Condition	Depth Sufficient	16	16			100%			
		Length Appropriate	16	16			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	16	16			100%			
		Thalweg centering at downstream of meander bend (Glide)	16	16			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	10	99%	0%	0%	99%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	1	10	99%	0%	0%	99%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	19			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	19	19			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	19	19			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6q. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- LFC R1 - 574 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	6	6			100%			
	3. Meander Pool Condition	Depth Sufficient	5	5			100%			
		Length Appropriate	5	5			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	5	5			100%			
		Thalweg centering at downstream of meander bend (Glide)	5	5			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	5	5			100%			

[1]Excludes constructed riffles since they are evaluated in section 1.

Table 6r. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area B- LFC R2 - 427 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	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	17	96%	0%	0%	96%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	1	17	96%	0%	0%	96%
3. Engineered Structures[1]	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	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			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.	n/a	n/a			n/a			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6s. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area C- LBHC R1A - 500 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	4	4			100%			
		Length Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	3			133%			
		Thalweg centering at downstream of meander bend (Glide)	4	3			133%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	1	1			100%			
	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.	1	1			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6t. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area C- LBHC R1B - 320 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	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	100%	100%	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	0	0	100%	100%	100%	100%
3. Engineered Structures[1]	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	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	2	2			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.	2	2			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 6u. Visual Stream Morphology Stability Assessment Table

Big Harris Creek Stream Mitigation Site

DMS Project No. 95 739

Monitoring Year 1 - 2018

Area C- LBHC R2 - 967 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	6	6			100%			
	3. Meander Pool Condition	Depth Sufficient	6	6			100%			
		Length Appropriate	6	6			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	6	6			100%			
		Thalweg centering at downstream of meander bend (Glide)	6	6			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			4	136	86%	0%	0%	86%
	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%	100%	100%	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	100%	100%	100%
				Totals	4	136	86%	0%	0%	86%
3. Engineered Structures[1]	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	1	1			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%.	2	2			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	2	2			100%			

[1] Excludes constructed riffles since they are evaluated in section 1.

Table 7. Vegetation Condition Assessment Table

Big Harris Creek Mitigation Site

DMS Project No. 739

Monitoring Year 1 - 2018

Planted Acreage **61.5**

Vegetation Category	Definitions	Mapping Threshold (acres)	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[1&2]	Woody stem densities clearly below target levels based on MY3, 4, 5, or 7 stem count criteria.	0.1	1	0.0	0%
		Total	**1**	**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	0	0.0	0%
		Cumulative Total	**1**	**0.0**	**0%**

Easement Acreage **144.7**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Planted Acreage
Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000	28	4.2	7%
Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	0	0	0%

[1]Acreage calculated from vegetation plots monitored for site.

[2]Area with low stem density is less than 0.1 acres.

STREAM PHOTOGRAPHS

Big Harris Creek - Area A
Monitoring Year 1

	
UBHC R1 Photo Point 1 – view upstream *(12/07/2018)*	**UBHC R1 Photo Point 1** – view downstream *(12/07/2018)*
	
UBHC R1 Photo Point 2 – view upstream *(12/07/2018)*	**UBHC R1 Photo Point 2** – view downstream *(12/07/2018)*
	
UBHC R1 Photo Point 3 – view upstream *(12/07/2018)*	**UBHC R1 Photo Point 3** – view downstream *(12/07/2018)*

	
UBHC R1 Photo Point 4 – view upstream *(12/07/2018)*	**UBHC R1 Photo Point 4** – view downstream *(12/07/2018)*
	
UBHC R1 Photo Point 5 – view upstream *(12/07/2018)*	**UBHC R1 Photo Point 5** – view downstream *(12/07/2018)*
	
UBHC R2A Photo Point 6 – view upstream *(12/07/2018)*	**UBHC R2A Photo Point 6** – view downstream *(12/07/2018)*

	
UBHC R2A Photo Point 7 – view upstream *(12/07/2018)*	**UBHC R2A Photo Point 7** – view downstream *(12/07/2018)*
	
UBHC R2B Photo Point 8 – view upstream *(11/30/2018)*	**UBHC R2B Photo Point 8** – view downstream *(11/30/2018)*
	
UBHC R2B Photo Point 9 – view upstream *(11/30/2018)*	**UBHC R2B Photo Point 9** – view downstream *(11/30/2018)*

	
UBHC R3 Photo Point 10 – view upstream *(12/07/2018)*	**UBHC R3 Photo Point 10** – view downstream *(12/07/2018)*
	
UBHC R3 Photo Point 11 – view upstream *(12/07/2018)*	**UBHC R3 Photo Point 11** – view downstream *(12/07/2018)*
	
UBHC R4 Photo Point 12 – view upstream *(12/07/2018)*	**UBHC R4 Photo Point 12** – view downstream *(12/07/2018)*

	
UBHC R4 Photo Point 13 – view upstream *(12/07/2018)*	**UBHC R4 Photo Point 13** – view downstream *(12/07/2018)*
	
UBHC R4 Photo Point 14 – view upstream *(12/07/2018)*	**UBHC R4 Photo Point 14** – view downstream *(12/07/2018)*
	
UBHC R4 Photo Point 15 – view upstream *(12/07/2018)*	**UBHC R4 Photo Point 15** – view downstream *(12/07/2018)*

	
UBHC R4 Photo Point 16 – view upstream *(11/29/2018)*	**UBHC R4 Photo Point 16** – view downstream *(11/29/2018)*
	
UBHC R5 Photo Point 17 – view upstream *(11/29/2018)*	**UBHC R5 Photo Point 17** – view downstream *(11/29/2018)*
	
UBHC R5 Photo Point 18 – view upstream *(11/29/2018)*	**UBHC R5 Photo Point 18** – view downstream *(11/29/2018)*

	
UBHC R6 Photo Point 19 – view upstream *(11/29/2018)*	**UBHC R6 Photo Point 19** – view downstream *(11/29/2018)*
	
UBHC R6 Photo Point 20 – view upstream *(11/29/2018)*	**UBHC R6 Photo Point 20** – view downstream *(11/29/2018)*
	
UBHC R6 Photo Point 21 – view upstream *(11/29/2018)*	**UBHC R6 Photo Point 21** – view downstream *(11/29/2018)*

	
UBHC R6 Photo Point 22 – view upstream *(11/29/2018)*	**UBHC R6 Photo Point 22** – view downstream *(11/29/2018)*
	
UBHC R6 Photo Point 23 – view upstream *(11/29/2018)*	**UBHC R6 Photo Point 23** – view downstream *(11/29/2018)*
	
UBHC UT1 Photo Point 24 – view upstream (*12/07/2018)*	**UBHC UT1 Photo Point 24** – view downstream *(12/07/2018)*

	
UBHC UT2 Photo Point 25 – view upstream *(12/07/2018)*	**UBHC UT2 Photo Point 25** – view downstream *(12/07/2018)*
	
UBHC UT3 Photo Point 26 – view upstream *(12/07/2018)*	**UBHC UT3 Photo Point 26** – view downstream *(12/07/2018)*
	
UBHC UT4 Photo Point 27 – view upstream *(12/07/2018)*	**UBHC UT4 Photo Point 27** – view downstream *(12/07/2018)*

	
Cornwell Creek Photo Point 28 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 28** – view downstream *(11/30/2018)*
	
Cornwell Creek Photo Point 29 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 29** – view downstream *(11/30/2018)*
	
Cornwell Creek Photo Point 30 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 30** – view downstream *(11/30/2018)*

	
Cornwell Creek Photo Point 31 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 31** – view downstream *(11/30/2018)*
	
Cornwell Creek Photo Point 32 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 32** – view downstream *(11/30/2018)*
	
Cornwell Creek Photo Point 33 – view upstream *(11/30/2018)*	**Cornwell Creek Photo Point 33** – view downstream *(11/30/2018)*

	
Cornwell Creek UT1 Photo Point 34 – view upstream (11/30/2018)	**Cornwell Creek UT1 Photo Point 34** – view downstream
	
Eaker Creek Photo Point 35 – view upstream *(11/30/2018)*	**Eaker Creek Photo Point 35** – view downstream *(11/30/2018)*
	
Scism Creek Photo Point 36 – view upstream *(11/29/2018)*	**Scism Creek Photo Point 36** – view downstream *(11/29/2018)*

Scism Creek Photo Point 37 – view upstream *(11/29/2018)*

Scism Creek Photo Point 37 – view downstream *(11/29/2018)*

Scism Creek Photo Point 38 – view upstream *(11/29/2018)*

Scism Creek Photo Point 38 – view downstream *(11/29/2018)*

Royster Creek Photo Point 39 – view upstream *(11/29/2018)*

Royster Creek Photo Point 39 – view downstream *(11/29/2018)*

	
Royster Creek Photo Point 40 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 40** – view downstream *(11/29/2018)*
	
Royster Creek Photo Point 41 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 41** – view downstream *(11/29/2018)*
	
Royster Creek Photo Point 42 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 42** – view downstream *(11/29/2018)*

	
Royster Creek Photo Point 43 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 43** – view downstream *(11/29/2018)*
	
Royster Creek Photo Point 44 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 44** – view downstream *(11/29/2018)*
	
Royster Creek Photo Point 45 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 45** – view downstream *(11/29/2018)*

	
Royster Creek Photo Point 46 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 46** – view downstream *(11/29/2018)*
	
Royster Creek Photo Point 47 – view upstream *(11/29/2018)*	**Royster Creek Photo Point 47** – view downstream *(11/29/2018)*
	
LSEC Photo Point 48 – view upstream *(11/29/2018)*	**LSEC Photo Point 48** – view downstream *(11/29/2018)*

	
LSEC Photo Point 49 – view upstream *(11/29/2018)*	**LSEC Photo Point 49** – view downstream *(11/29/2018)*
	
LSEC Photo Point 50 – view upstream *(11/29/2018)*	**LSEC Photo Point 50** – view downstream *(11/29/2018)*
	
Scott Creek Photo Point 51 – view upstream *(11/29/2018)*	**Scott Creek Photo Point 51** – view downstream *(11/29/2018)*

Scott Creek Photo Point 52 – view upstream *(11/29/2018)*

Scott Creek Photo Point 52 – view downstream *(11/29/2018)*

Scott Creek Photo Point 53 – view upstream *(11/29/2018)*

Scott Creek Photo Point 53 – view downstream *(11/29/2018)*

Carroll Creek Photo Point 54 – view upstream *(11/29/2018)*

Carroll Creek Photo Point 54 – view downstream *(11/29/2018)*

	
Carroll Creek Photo Point 55 – view upstream *(11/29/2018)*	**Carroll Creek Photo Point 55** – view downstream *(11/29/2018)*
	
Carroll Creek Photo Point 56 – view upstream *(11/29/2018)*	**Carroll Creek Photo Point 56** – view downstream *(11/29/2018)*

STREAM PHOTOGRAPHS

Big Harris Creek - Area B
Monitoring Year 1

	
USEC R1 Photo Point 57 – view upstream *(11/14/2018)*	**USEC R1 Photo Point 57** – view downstream *(11/14/2018)*
	
USEC R2 Photo Point 58 – view upstream *(11/14/2018)*	**USEC R2 Photo Point 58** – view downstream *(11/14/2018)*
	
USEC R2 Photo Point 59 – view upstream *(11/14/2018)*	**USEC R2 Photo Point 59** – view downstream *(11/14/2018)*

	
USEC R3 Photo Point 60 – view upstream *(11/14/2018)*	**USEC R3 Photo Point 60** – view downstream *(11/14/2018)*
	
USEC R3 Photo Point 61 – view upstream *(11/14/2018)*	**USEC R3 Photo Point 61** – view downstream *(11/14/2018)*
	
USEC R3 Photo Point 62 – view upstream *(11/14/2018)*	**USEC R3 Photo Point 62** – view downstream *(11/14/2018)*

	
USEC R4A Photo Point 63 – view upstream *(11/30/2018)*	**USEC R4A Photo Point 63** – view downstream *(11/30/2018)*
	
USEC R4B Photo Point 64 – view upstream *(11/30/2018)*	**USEC R4B Photo Point 64** – view downstream *(11/30/2018)*
	
USEC R5 Photo Point 65 – view upstream *(11/30/2018)*	**USEC R5 Photo Point 65** – view downstream *(11/30/2018)*

	
USEC R5 Photo Point 66 – view upstream *(11/30/2018)*	**USEC R5 Photo Point 66** – view downstream *(11/30/2018)*
	
USEC R5 Photo Point 67 – view upstream *(11/30/2018)*	**USEC R5 Photo Point 67** – view downstream *(11/30/2018)*
	
USEC R5 Photo Point 68 – view upstream *(011/30/2018)*	**USEC R5 Photo Point 68** – view downstream *(11/30/2018)*

	
USEC R5 Photo Point 69 – view upstream *(11/30/2018)*	**USEC R5 Photo Point 69** – view downstream *(11/30/2018)*
	
USEC R6 Photo Point 70 – view upstream *(11/30/2018)*	**USEC R6 Photo Point 70** – view downstream *(11/30/2018)*
	
USEC R6 Photo Point 71 – view upstream *(11/30/2018)*	**USEC R6 Photo Point 71** – view downstream *(11/30/2018)*

	
USEC R6 Photo Point 72 – view upstream *(11/30/2018)*	**USEC R6 Photo Point 72** – view downstream *(11/30/2018)*
	
USEC R6 Photo Point 73 – view upstream *(11/30/2018)*	**USEC R6 Photo Point 73** – view downstream *(11/30/2018)*
	
USEC UT1 Photo Point 74 – view upstream *(11/14/2018)*	**USEC UT1 Photo Point 74** – view downstream *(11/14/2018)*

	
Elliott Creek Photo Point 75 – view upstream *(11/14/2018)*	**Elliott Creek Photo Point 75** – view downstream *(11/14/2018)*
	
Elliott Creek Photo Point 76 – view upstream *(11/14/2018)*	**Elliott Creek Photo Point 76** – view downstream *(11/14/2018)*
	
Elliott Creek Photo Point 77 – view upstream *(11/14/2018)*	**Elliott Creek Photo Point 77** – view downstream *(11/14/2018)*

	
Elliott Creek Photo Point 78 – view upstream *(11/14/2018)*	**Elliott Creek Photo Point 78** – view downstream *(11/14/2018)*
	
Elliott Creek UT1 Photo Point 79 – view upstream *(11/14/2018)*	**Elliott Creek UT1 Photo Point 79** – view downstream *(04/25/2018)*
	
Bridges Creek R1 Photo Point 80 – view upstream *(11/14/2018)*	**Bridges Creek R1 Photo Point 80** – view downstream *(04/26/2018)*

	
Bridges Creek R2 Photo Point 81 – view upstream *(11/14/2018)*	**Bridges Crk R2 Photo Point 81** – view downstream *(11/14/2018)*
	
Bridges Creek UT1 Photo Point 82 – view upstream *(11/14/2018)*	**Bridges Crk UT1 Photo Point 82** – view downstream *(11/14/2018)*
	
USEC UT2 Photo Point 83 – view upstream *(11/30/2018)*	**USEC UT2 Photo Point 83** – view downstream *(11/30/2018)*

	
USEC UT3 Photo Point 84 – view upstream *(11/30/2018)*	**USEC UT3 Photo Point 84** – view downstream *(11/30/2018)*
	
UFC R1 Photo Point 85 – view upstream *(12/07/2018)*	**UFC R1 Photo Point 85** – view downstream *(12/07/2018)*
	
UFC R1 Photo Point 86 – view upstream *(12/07/2018)*	**UFC R1 Photo Point 86** – view downstream *(12/07/2018)*

	
UFC R1 Photo Point 87 – view upstream *(12/07/2018)*	**UFC R1 Photo Point 87** – view downstream *(12/07/2018)*
	
UFC R2 Photo Point 88 – view upstream *(12/07/2018)*	**UFC R2 Photo Point 88** – view downstream *(12/07/2018)*
	
UFC R2 Photo Point 89 – view upstream *(12/07/2018)*	**UFC R2 Photo Point 89** – view downstream *(12/07/2018)*

UFC R2 Photo Point 90 – view upstream *(12/07/2018)*

UFC R2 Photo Point 90 – view downstream *(12/07/2018)*

UFC R2 Photo Point 91 – view upstream *(12/07/2018)*

UFC R2 Photo Point 91 – view downstream *(12/07/2018)*

UFC R2 Photo Point 92 – view upstream *(12/07/2018)*

UFC R2 Photo Point 92 – view downstream *(12/07/2018)*

	
LFC R1 Photo Point 93 – view upstream *(12/07/2018)*	**LFC R1 Photo Point 93** – view downstream *(12/07/2018)*
	
LFC R1 Photo Point 94 – view upstream *(12/07/2018)*	**LFC R1 Photo Point 94** – view downstream *(12/07/2018)*
	
LFC R2 Photo Point 95 – view upstream *(12/07/2018)*	**LFC R2 Photo Point 95** – view downstream *(12/07/2018)*

STREAM PHOTOGRAPHS

Big Harris Creek - Area C
Monitoring Year 1

LBHC R1A Photo Point 96 – view upstream *(11/14/2018)*

LBHC R1A Photo Point 96 – view downstream *(11/14/2018)*

LBHC R1A Photo Point 97 – view upstream *(11/14/2018)*

LBHC R1A Photo Point 97 – view downstream *(11/14/2018)*

LBHC R1B Photo Point 98 – view upstream *(11/14/2018)*

LBHC R1B Photo Point 98 – view downstream *(11/14/2018)*

	
LBHC R2 Photo Point 99 – view upstream *(11/14/2018)*	**LBHC R2 Photo Point 99** – view downstream *(11/14/2018)*
	
LBHC R2 Photo Point 100 – view upstream *(11/14/2018)*	**LBHC R2 Photo Point 100** – view downstream *(11/14/2018)*
	
LBHC R2 Photo Point 101 – view upstream *(11/14/2018)*	**LBHC R2 Photo Point 101** – view downstream *(11/14/2018)*

	
LBHC R3 Photo Point 102 – view upstream *(11/14/2018)*	**LBHC R3 Photo Point 102** – view downstream *(11/14/2018)*
	
LBHC R3 Photo Point 103 – view upstream *(11/14/2018)*	**LBHC R3 Photo Point 103** – view downstream *(11/14/2018)*
	
LBHC UT1 Photo Point 104 – view upstream *(11/14/2018)*	**LBHC UT1 Photo Point 104** – view downstream *(11/14/2018)*

	
LBHC UT2 Photo Point 105 – view upstream *(11/14/2018)*	**LBHC UT2 Photo Point 105** – view downstream *(11/14/2018)*
	
LBHC UT3 Photo Point 106 – view upstream *(11/14/2018)*	**LBHC UT3 Photo Point 106** – view downstream *(11/14/2018)*
	
LBHC UT4 Photo Point 107 – view upstream *(11/14/2018)*	**LBHC UT4 Photo Point 107** – view downstream *(11/14/2018)*

VEGETATION PHOTOGRAPHS

Monitoring Year 1

Vegetation Plot 1 *(10/18/2018)*

Vegetation Plot 2 *(10/18/2018)*

Vegetation Plot 3 *(10/04/2018)*

Vegetation Plot 4 *(10/18/2018)*

Vegetation Plot 5 *(10/04/2018)*

Vegetation Plot 6 *(10/04/2018)*

	
Vegetation Plot 7 *(10/04/2018)*	**Vegetation Plot 8** *(10/04/2018)*
	
Vegetation Plot 9 *(10/04/2018)*	**Vegetation Plot 10** *(10/03/2018)*
	
Vegetation Plot 11 *(10/03/2018)*	**Vegetation Plot 12** *(11/14/2018)*

Vegetation Plot 13 *(10/03/2018)*

Vegetation Plot 14 *(11/30/2018)*

Vegetation Plot 15 *(11/30/2018)*

Vegetation Plot 16 *(11/30/2018)*

Vegetation Plot 17 *(11/30/2018)*

Vegetation Plot 18 *(11/30/2018)*

	
Vegetation Plot 19 *(11/30/2018)*	**Vegetation Plot 20** *(11/30/2018)*
	
Vegetation Plot 21 *(10/18/2018)*	**Vegetation Plot 22** *(10/04/2018)*
	
Vegetation Plot 23 *(10/04/2018)*	**Vegetation Plot 24** *(10/18/2018)*

Vegetation Plot 25 *(10/18/2018)*

Vegetation Plot 26 *(10/18/2018)*

Vegetation Plot 27 *(10/18/2018)*

Vegetation Plot 28 *(10/18/2018)*

Vegetation Plot 29 *(10/18/2018)*

Vegetation Plot 30 *(10/3/2018)*

Vegetation Plot 31 *(10/03/2018)*

Vegetation Plot 32 *(10/03/2018)*

Vegetation Plot 33 *(10/03/2018)*

Vegetation Plot 34 *(11/30/2018)*

Vegetation Plot 35 *(10/03/2018)*

Vegetation Plot 36 *(10/03/2018)*

Vegetation Plot 37 *(10/03/2018)*

Vegetation Plot 38 *(10/03/2018)*

Vegetation Plot 39 *(10/03/2018)*

Vegetation Plot 40 *(10/04/2018)*

Vegetation Plot 41 *(10/04/2018)*

Vegetation Plot 42 *(11/13/2018)*

	
Vegetation Plot 43 *(11/13/2018)*	**Vegetation Plot 44** *(11/13/2018)*
	
Vegetation Plot 45 *(12/07/2018)*	**Vegetation Plot 46** *(10/04/2018)*
	
Vegetation Plot 47 *(10/04/2018)*	**Vegetation Plot 48** *(10/04/2018)*

Vegetation Plot 49 *(10/04/2018)*

Vegetation Plot 50 *(11/13/2018)*

Vegetation Plot 51 *(11/13/2018)*

Vegetation Plot 52 *(11/13/2018)*

Vegetation Plot 53 *(11/14/2018)*

Vegetation Plot 54 *(11/14/2018)*

	
Vegetation Plot 55 *(10/15/2018)*	**Vegetation Plot 56** *(10/15/2018)*

APPENDIX 3. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment Table

Big Harris Creek Mitigation Site

DMS Project No. 739

Monitoring Year 1 - 2018

Plot	Success Criteria Met (Y/N)	Tract Mean
1	Y	98%
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	
15	y	
16	Y	
17	Y	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
25	Y	
26	Y	
27	Y	
28	Y	
29	N	
30	Y	
31	Y	
32	Y	
33	Y	
34	Y	
35	Y	
36	Y	
37	Y	
38	Y	
39	Y	
40	Y	
41	Y	
42	Y	
43	Y	
44	Y	
45	Y	
46	Y	
47	Y	
48	Y	
49	Y	
50	Y	
51	Y	
52	Y	
53	Y	
54	Y	
55	Y	
56	Y	

Table 9. CVS Vegetation Tables - Metadata

Big Harris Creek Mitigation Site

DMS Project No. 739

Monitoring Year 1 - 2018

Report Prepared By	Ian Eckardt
Date Prepared	12/12/2018 11:34
Database Name	cvs-eep-entrytool-v2.5.0.mdb
Database Location	Q:\ActiveProjects\005-02149 Big Harris Creek\Monitoring\Monitoring Year 1\Vegetation Assessment
Computer Name	IAN
File Size	95498240
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Project Planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Project 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	739
Project Name	Big Harris Creek Mitigation Site
Sampled Plots	56

Table 10. Planted and Total Stems
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

			Current Plot Data (MY1 2018) - Area A																				
			Vegetation Plot 1			Vegetation Plot 2			Vegetation Plot 3			Vegetation Plot 4			Vegetation Plot 5			Vegetation Plot 6			Vegetation Plot 7		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	5	5	55	3	3	43	3	3	3	4	4	19	5	5	5	3	3	3	3	3	3
Betula nigra	River birch	Tree	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1
Diospyros virginiana	American Persimmon	Tree															1			2			
Fagus	Beech	Tree																					
Fraxinus pennsylvanica	Green ash	Tree	3	3	3	1	1	1	4	4	4	2	2	2	3	3	3	5	5	5	1	1	1
Ilex opaca	American Holly	Shrub Tree																					
Liquidambar styraiflua	Sweet Gum	Tree			50			40			15			15			15			15			5
Liriodendron tulipifera	Tulip Poplar	Tree			50			25			15			10			15						5
Nyssa sylvatica	Blackgum	Tree	1	1	1	1	1	1	2	2	2	1	1	1				1	1	1	2	2	2
Platanus occidentalis	American sycamore	Tree	4	4	4	6	6	6	1	1	1	3	3	3	5	5	5				4	4	4
Quercus sp.	Oak	Tree																					
Quercus alba	White Oak	Tree																					
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree	1	1	1	2	2	2	1	1	1	2	2	2				1	1	1	1	1	1
Quercus phellos	Willow oak	Tree	1	1	1				1	1	1	1	1	1									
Quercus rubra	Red oak	Tree				1	1	1	2	2	2	1	1	1									
		Stem count	16	16	166	15	15	120	15	15	45	15	15	55	15	15	46	11	11	28	12	12	22
		Size (ares)		1			1			1			1			1		1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025		0.025			0.025	
		Species count	7	7	9	7	7	9	8	8	10	8	8	10	4	4	7	5	5	7	6	6	8
		Stems per ACRE	647	647	6718	607	607	4,856	607	607	1,821	607	607	2,226	607	607	1,862	445	445	1,133	486	486	890

			Current Plot Data (MY1 2018) - Area A																				
			Vegetation Plot 8			Vegetation Plot 9			Vegetation Plot 10			Vegetation Plot 11			Vegetation Plot 12			Vegetation Plot 13			Vegetation Plot 14		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	3	3	23	3	3	6	5	5	5	3	3	3	4	4	4	5	5	5	2	2	2
Betula nigra	River birch	Tree	1	1	1													1	1	1	2	2	2
Diospyros virginiana	American Persimmon	Tree									5												
Fagus	Beech	Tree																					
Fraxinus pennsylvanica	Green ash	Tree	5	5	5	4	4	4	3	3	3	4	4	4	2	2	2	2	2	2	3	3	3
Ilex opaca	American Holly	Shrub Tree																					
Liquidambar styraiflua	Sweet Gum	Tree			20																		50
Liriodendron tulipifera	Tulip Poplar	Tree			20			10						5						3			5
Nyssa sylvatica	Blackgum	Tree				1	1	1				1	1	1				1	1	1	1	1	1
Platanus occidentalis	American sycamore	Tree	4	4	4	7	7	7	6	6	6	5	5	5	4	4	4	1	1	1	5	5	5
Quercus sp.	Oak	Tree																					
Quercus alba	White Oak	Tree																					
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree	1	1	1				1	1	1				1	1	1				1	1	1
Quercus phellos	Willow oak	Tree	1	1	1													1	1	1	1	1	1
Quercus rubra	Red oak	Tree	1	1	1							1	1	1	1	1	1	2	2	2			
		Stem count	16	16	76	15	15	28	15	15	20	14	14	19	12	12	12	13	13	16	15	15	70
		Size (ares)		1			1			1			1			1		1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025		0.025			0.025	
		Species count	7	7	9	4	4	5	4	4	5	5	5	6	5	5	5	7	7	8	7	7	9
		Stems per ACRE	647	647	3,076	607	607	1,133	607	607	809	567	567	769	486	486	486	526	526	647	607	607	2,833

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%
Volunteers included

PnoLS: Number of planted stems excluding live stakes
P-All: Number of planted stems including live stakes
T: Total stems

Table 10. Planted and Total Stems
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

			Current Plot Data (MY1 2018) - Area A																				
			Vegetation Plot 15			Vegetation Plot 16			Vegetation Plot 17			Vegetation Plot 18			Vegetation Plot 19			Vegetation Plot 20			Vegetation Plot 21		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	1	1	1	1	1	1	5	5	5				3	3	3	1	1	1	1	1	51
Betula nigra	River birch	Tree	3	3	3				1	1	1	2	2	2				1	1	1	2	2	2
Diospyros virginiana	American Persimmon	Tree																					
Fagus	Beech	Tree																					
Fraxinus pennsylvanica	Green ash	Tree	2	2	2	4	4	4	3	3	3	5	5	5	1	1	1				2	2	2
Ilex opaca	American Holly	Shrub Tree																					
Liquidambar styraiflua	Sweet Gum	Tree						6			20									10			70
Liriodendron tulipifera	Tulip Poplar	Tree									20			15						5			40
Nyssa sylvatica	Blackgum	Tree							2	2	2	1	1	1	1	1	1				2	2	2
Platanus occidentalis	American sycamore	Tree	2	2	2	4	4	4	3	3	3				3	3	3	4	4	4	2	2	2
Quercus sp.	Oak	Tree				2	2	2															
Quercus alba	White Oak	Tree																					
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree	2	2	2							2	2	2							1	1	1
Quercus phellos	Willow oak	Tree							1	1	1	1	1	1							1	1	1
Quercus rubra	Red oak	Tree				1	1	1				1	1	1				1	1	1	2	2	2
		Stem count	10	10	10	12	12	18	15	15	55	12	12	27	8	8	8	7	7	22	13	13	173
		Size (ares)		1			1			1			1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025			0.025	
		Species count	5	5	5	5	5	6	6	6	8	6	6	7	4	4	4	4	4	6	8	8	10
		Stems per ACRE	405	405	405	486	486	728	607	607	2226	486	486	1093	324	324	324	283	283	890	526	526	7001

			Current Plot Data (MY0 2018) - Area A																				
			Vegetation Plot 22			Vegetation Plot 23			Vegetation Plot 24			Vegetation Plot 25			Vegetation Plot 26			Vegetation Plot 27			Vegetation Plot 28		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	3	3	3	5	5	5	3	3	3	1	1	1	1	1	1	4	4	4	1	1	1
Betula nigra	River birch	Tree				2	2	2	1	1	1	1	1	1				2	2	2	1	1	1
Diospyros virginiana	American Persimmon	Tree																					
Fagus	Beech	Tree																					
Fraxinus pennsylvanica	Green ash	Tree	3	3	3	2	2	2	1	1	1	1	1	1	4	4	4	2	2	2	3	3	3
Ilex opaca	American Holly	Shrub Tree																					
Liquidambar styraiflua	Sweet Gum	Tree																					
Liriodendron tulipifera	Tulip Poplar	Tree																					1
Nyssa sylvatica	Blackgum	Tree	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1			
Platanus occidentalis	American sycamore	Tree	5	5	5	3	3	3				1	1	1	7	7	7				3	3	4
Quercus sp.	Oak	Tree																					
Quercus alba	White Oak	Tree																					
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Quercus phellos	Willow oak	Tree													1	1	1				1	1	1
Quercus rubra	Red oak	Tree				1	1	1				2	2	2	1	1	1	2	2	2	1	1	1
		Stem count	12	12	12	15	15	15	8	8	8	8	8	8	16	16	16	12	12	12	10	10	12
		Size (ares)		1			1			1			1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025			0.025	
		Species count	4	4	4	7	7	7	5	5	5	7	7	7	7	7	7	6	6	6	6	6	7
		Stems per ACRE	486	486	486	607	607	607	324	324	324	324	324	324	647	647	647	486	486	486	405	405	486

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%
Volunteers included

PnoLS: Number of planted stems excluding live stakes
P-All: Number of planted stems including live stakes
T: Total stems

Table 10. Planted and Total Stems
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

			Current Plot Data (MY1 2018) - Area A																	
			Vegetation Plot 29			Vegetation Plot 30			Vegetation Plot 31			Vegetation Plot 32			Vegetation Plot 33			Vegetation Plot 34		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree				4	4	4	1	1	1	1	1	1	5	5	5	1	1	8
Betula nigra	River birch	Tree	2	2	3				1	1	1	2	2	2						
Diospyros virginiana	American Persimmon	Tree																		
Fagus	Beech	Tree																		
Fraxinus pennsylvanica	Green ash	Tree				3	3	3	3	3	3	2	2	2	3	3	3	2	2	2
Ilex opaca	American Holly	Shrub Tree																		
Liquidambar styraiflua	Sweet Gum	Tree												5			25			
Liriodendron tulipifera	Tulip Poplar	Tree															5			2
Nyssa sylvatica	Blackgum	Tree							1	1	1	2	2	2				4	4	4
Platanus occidentalis	American sycamore	Tree	2	2	13	5	5	5	1	1	1	3	3	3	2	2	2	1	1	1
Quercus sp.	Oak	Tree																		
Quercus alba	White Oak	Tree																		
Quercus nigra	Water Oak	Tree																		
Quercus pagoda	Cherrybark oak	Tree				1	1	1				1	1	1	1	1	1	1	1	1
Quercus phellos	Willow oak	Tree	1	1	1							1	1	1						
Quercus rubra	Red oak	Tree	1	1	1				2	2	2	2	2	2	1	1	1	2	2	2
		Stem count	6	6	18	13	13	13	9	9	9	14	14	19	12	12	42	11	11	20
		Size (ares)		1			1			1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025	
		Species count	4	4	4	4	4	4	6	6	6	8	8	9	5	5	7	6	6	7
		Stems per ACRE	243	243	728	526	526	526	364	364	364	567	567	769	486	486	1700	445	445	809

			Current Plot Data (MY1 2018) - Area B																				
			Vegetation Plot 35			Vegetation Plot 36			Vegetation Plot 37			Vegetation Plot 38			Vegetation Plot 39			Vegetation Plot 40			Vegetation Plot 41		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	2	2	2	4	4	4	2	2	2	2	2	7	3	3	3	2	2	2	5	5	30
Betula nigra	River birch	Tree							1	1	1	1	1	1									
Diospyros virginiana	American Persimmon	Tree																					
Fagus	Beech	Tree																					
Fraxinus pennsylvanica	Green ash	Tree	1	1	1	3	3	4	3	3	3	5	5	5	3	3	3	2	2	2	4	4	4
Ilex opaca	American Holly	Shrub Tree																					
Liquidambar styraiflua	Sweet Gum	Tree																					15
Liriodendron tulipifera	Tulip Poplar	Tree			3									10									
Nyssa sylvatica	Blackgum	Tree	3	3	3													1	1	1	2	2	2
Platanus occidentalis	American sycamore	Tree	3	3	3	6	6	6	3	3	3	5	5	5	5	5	5	6	6	6	1	1	1
Quercus sp.	Oak	Tree																					
Quercus alba	White Oak	Tree																					
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree							1	1	1				2	2	2	3	3	3			
Quercus phellos	Willow oak	Tree										2	2	2							2	2	2
Quercus rubra	Red oak	Tree	4	4	4							1	1	1	1	1	1				1	1	1
		Stem count	13	13	16	13	13	14	10	10	10	16	16	31	14	14	14	14	14	14	15	15	55
		Size (ares)		1			1			1			1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025			0.025	
		Species count	5	5	6	3	3	3	5	5	5	6	6	7	5	5	5	5	5	5	6	6	7
		Stems per ACRE	526	526	647	526	526	567	405	405	405	647	647	1255	567	567	567	567	567	567	607	607	2226

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%
Volunteers included

PnoLS: Number of planted stems excluding live stakes
P-All: Number of planted stems including live stakes
T: Total stems

Table 10. Planted and Total Stems
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

			Current Plot Data (MY1 2018) - Area B																				
			Vegetation Plot 42			Vegetation Plot 43			Vegetation Plot 44			Vegetation Plot 45			Vegetation Plot 46			Vegetation Plot 47			Vegetation Plot 48		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	1	1	11	2	2	7	3	3	18	2	2	2	2	2	7	4	4	14	3	3	28
Betula nigra	River birch	Tree				5	5	5	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1
Diospyros virginiana	American Persimmon	Tree												3									
Fagus sp.	Beech	Tree			1																		
Fraxinus pennsylvanica	Green ash	Tree	5	5	5	4	4	4	2	2	2	2	2	2	6	6	6	3	3	3	3	3	3
Ilex opaca	American Holly	Shrub Tree			1																		
Liquidambar styraiflua	Sweet Gum	Tree						3			11			10			2			10			
Liriodendron tulipifera	Tulip Poplar	Tree			20			13			4			20						10			25
Nyssa sylvatica	Blackgum	Tree	2	2	2				1	1	1	1	1	1	1	1	1				1	1	1
Platanus occidentalis	American sycamore	Tree	3	3	3	3	3	5	4	4	14	5	5	5	4	4	4	6	6	6	3	3	3
Quercus sp.	Oak	Tree																					
Quercus alba	White Oak	Tree			2																		
Quercus nigra	Water Oak	Tree																					
Quercus pagoda	Cherrybark oak	Tree	1	1	1							1	1	1	1	1	1				2	2	2
Quercus phellos	Willow oak	Tree			1							1	1	1	1	1	1						
Quercus rubra	Red oak	Tree				2	2	2	4	4	4										2	2	2
		Stem count	12	12	47	16	16	39	16	16	56	14	14	47	17	17	24	14	14	44	15	15	65
		Size (ares)		1			1			1			1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025			0.025	
		Species count	5	5	10	5	5	7	6	6	8	7	7	10	7	7	8	4	4	6	7	7	8
		Stems per ACRE	486	486	1902	647	647	1,578	647	647	2,266	567	567	1,902	688	688	971	567	567	1,781	607	607	2,630

			Current Plot Data (MY1 2018) - Area B											
			Vegetation Plot 49			Vegetation Plot 50			Vegetation Plot 51			Vegetation Plot 52		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	2	2	2	1	1	1						4
Betula nigra	River birch	Tree	3	3	3				1	1	1	2	2	2
Diospyros virginiana	American Persimmon	Tree												
Fagus	Beech	Tree												
Fraxinus pennsylvanica	Green ash	Tree	2	2	2	4	4	4	3	3	3	5	5	5
Ilex opaca	American Holly	Shrub Tree												
Liquidambar styraiflua	Sweet Gum	Tree			5						1			3
Liriodendron tulipifera	Tulip Poplar	Tree						3						7
Nyssa sylvatica	Blackgum	Tree	1	1	1				1	1	1			
Platanus occidentalis	American sycamore	Tree	2	2	2	1	1	1	2	2	2	4	4	4
Quercus sp.	Oak	Tree												
Quercus alba	White Oak	Tree												
Quercus nigra	Water Oak	Tree												
Quercus pagoda	Cherrybark oak	Tree	1	1	1	2	2	2				1	1	1
Quercus phellos	Willow oak	Tree				1	1	1	2	2	2			2
Quercus rubra	Red oak	Tree	1	1	1				2	2	2	2	2	2
		Stem count	12	12	17	9	9	12	11	11	12	14	14	30
		Size (ares)		1			1			1			1	
		Size (ACRES)		0.025			0.025			0.025			0.025	
		Species count	7	7	8	5	5	6	6	6	7	5	5	9
		Stems per ACRE	486	486	688	364	364	486	445	445	486	567	567	1214

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%
Volunteers included

PnoLS: Number of planted stems excluding live stakes
P-All: Number of planted stems including live stakes
T: Total stems

Table 10. Planted and Total Stems
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

			Current Plot Data (MY1 2018) - Area C												Annual Summaries					
			Vegetation Plot 53			Vegetation Plot 54			Vegetation Plot 55			Vegetation Plot 56			MY1 (9/2018 thru 11/2018)			MY0 (3/2018 thru 5/2018)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	Red maple	Tree	1	1	1	2	2	2	3	3	3	4	4	4	143	143	432	171	171	171
Betula nigra	River birch	Tree	2	2	2	1	1	1	4	4	4				61	61	62	99	99	99
Diospyros virginiana	American Persimmon	Tree															11			
Fagus	Beech	Tree															1			
Fraxinus pennsylvanica	Green ash	Tree	5	5	5	1	1	1	3	3	3	2	2	2	159	159	160	167	167	167
Ilex opaca	American Holly	Shrub Tree															1			
Liquidambar styraiflua	Sweet Gum	Tree						15						20			456			
Liriodendron tulipifera	Tulip Poplar	Tree															366			
Nyssa sylvatica	Blackgum	Tree										2	2	2	48	48	48	59	59	59
Platanus occidentalis	American sycamore	Tree	4	4	24	4	4	19	4	4	4	2	2	22	186	186	265	212	212	212
Quercus sp.	Oak	Tree	2	2	2										4	4	4	3	3	3
Quercus alba	White Oak	Tree															2			
Quercus nigra	Water Oak	Tree																		
Quercus pagoda	Cherrybark oak	Tree	3	3	3	2	2	2	2	2	2	1	1	1	49	49	49	55	55	55
Quercus phellos	Willow oak	Tree				2	2	2				1	1	1	25	25	28	46	46	46
Quercus rubra	Red oak	Tree				1	1	1				1	1	1	51	51	51	57	57	57
		Stem count	17	17	37	13	13	43	16	16	16	13	13	53	726	726	1936	869	869	869
		Size (ares)		1			1			1			1			56			56	
		Size (ACRES)		0.025			0.025			0.025			0.025			1.38			1.38	
		Species count	6	6	6	7	7	8	5	5	5	7	7	8	9	9	15	9	9	9
		Stems per ACRE	688	688	1497	526	526	1740	647	647	647	526	526	2145	525	525	1399	628	628	628

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%
Volunteers included

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 11a. Baseline Stream Data Summary
Area A
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area A

Pre-Restoration Condition

Parameter	Gage	Carroll Creek Reach 1 Min	Carroll Creek Reach 1 Max	Eaker Creek Reach 1 Min	Eaker Creek Reach 1 Max	Royster Creek Reach 1 Min	Royster Creek Reach 1 Max	Scott Creek Min	Scott Creek Max	UBHC Reach 2A Min	UBHC Reach 2A Max	UBHC Reach 2B Min	UBHC Reach 2B Max	UBHC Reach 4 Min	UBHC Reach 4 Max
Dimension and Substrate - Riffle															
Bankfull Width (ft)		9.4	10.8	3.5	3.6	3.6	6.1	4.4	10.3	7.0	8.2	11.3	12.0	18.7	26.8
Floodprone Width (ft)		13.1	14.2	6.7	7.1	6.0	7.0	5.2	12.4	9.5	10.0	15.5	16.5	22.0	34.6
Bankfull Mean Depth		0.9	1.4	0.5	0.5	0.6		0.3	0.6	0.7	0.8	0.9	1.0	0.8	1.1
Bankfull Max Depth		1.0	1.8	1.0	1.1	0.8	1.4	0.8	0.9	0.8	1.0	1.3	1.7	1.3	1.7
Bankfull Cross-sectional Area (ft^2)	N/A	11.4		1.9		3.7		2.9		5.6		11.3		20.4	
Width/Depth Ratio		6.6	12.5	6.6	6.9	6.1	10.2	7.4	30.8	9.1	11.5	11.4	12.7	17.6	30.3
Entrenchment Ratio		1.2	1.5	1.9	2.0	1.2	1.5	1.2	1.4	1.2	1.4	1.3	1.5	1.1	1.8
Bank Height Ratio		3.4	5.0	3.1	3.5	6.6	7.3	3.8	10.6	3.1	4.6	3.4	4.4	1.6	2.9
D_{50} (mm)		---		---		---		---		---		---		---	
Profile															
Riffle Length (ft)															
Riffle Slope (ft/ft)															
Pool Length (ft)	N/A														
Pool Max Depth (ft)		---		---	---			0.9	1.2	2.2	2.2	1.9	1.9	2.9	3.2
Pool Spacing (ft)															
Pool Volume (ft^3)															
Pattern															
Channel Beltwidth (ft)		---		---		---		---		---		---		---	
Radius of Curvature (ft)		---		---		---		---		---		---		---	
Rc:Bankfull Width (ft/ft)	N/A	---		---		---		---		---		---		---	
Meander Length (ft)		---		---		---		---		---		---		---	
Meander Width Ratio		---		---		---		---		---		---		---	
Ri%/Ru%/P%/G%/S%															
SC%/Sa%/G%/C%/B%/Be%															
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	N/A	0.16/0.39/4 .0/98.3/205		---		---		SC/0.19/2. 0/90.0/199		5.2/9.5/17/3		---		SC/0.36/1.0 /129.8/614.	
Reach Shear Stress (Competency) lb/ft^2		---		---		---		---		---		---		---	
Max part size (mm) mobilized at bankfull															
Stream Power (Capacity) W/m^2															
Additional Reach Parameters															
Drainage Area (SM)		0.32		0.04		0.23		0.07		0.36		0.74		0.83	
Watershed Impervious Cover Estimate (%)		<10%													
Rosgen Classification		E4-G4c		A4		B4		A4		G4c		F4		F4	
Bankfull Velocity (fps)		5.4		4.9		3.8		4.5		4.1		4.4		3.7	
Bankfull Discharge (cfs)		30		9.5		14		9		32		47		53	
Q-NFF regression (2-yr)		---		---		---		---		---		---		---	
Q-USGS extrapolation (1.2-yr)	N/A	18.0		---		26.0		6.6		24.8		44.0		51.0	
Q-Mannings		---		---		---	---	12	13	22	23	49	51	68	
Valley Slope (ft/ft)		0.0150		N/A		0.0325		0.0444		0.0152		0.0163		0.0129	
Channel Thalweg Length (ft)		553		135		438		630		990				1,203	
Sinuosity		1.16		1.01		1.01		1.08		1.22		1.22		1.28	
Bankfull/Channel Slope (ft/ft)		0.0180		0.0482		0.0153		0.0405		0.0163		0.0186		0.0118	

Design

Parameter	Carroll Creek Reach 1 Min	Carroll Creek Reach 1 Max	Royster Creek Reach 1 Min	Royster Creek Reach 1 Max	Scott Creek Min	Scott Creek Max	UBHC Reach 2A Min	UBHC Reach 2A Max	UBHC Reach 2B Min	UBHC Reach 2B Max	UBHC Reach 4 Min	UBHC Reach 4 Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	10.40		8.30		6.50		10.20		12.80		13.80	
Floodprone Width (ft)	---		---		---		---		---		---	
Bankfull Mean Depth	0.8		0.6		0.5		0.8		1.0		1.0	
Bankfull Max Depth	1.2		1.0		0.7		1.2		1.5		1.6	
Bankfull Cross-sectional Area (ft^2)	8.2		5.3		3.1		7.9		12.5		14.4	
Width/Depth Ratio	13.2		13.0		13.6		13.2		13.1		13.2	
Entrenchment Ratio	2.2+		2.2+		1.4	2.2	2.2+		2.2+		2.2+	
Bank Height Ratio	1.0	1.2	1.0	1.2	1.0	1.2	1.0	1.2	1.0	1.2	1.0	1.2
D_{50} (mm)	N/A		N/A		N/A		N/A		N/A		N/A	
Profile												
Riffle Length (ft)	---		---		---		---		---		---	
Riffle Slope (ft/ft)	0.016	0.0500	0.033	0.0500	0.045	0.0530	0.016	0.0490	0.017	0.0500	0.017	0.0470
Pool Length (ft)	---		---		---		---		---		---	
Pool Max Depth (ft)	1.3	2.4	1.1	2.0	1.0	1.7	1.2	2.3	1.5	2.9	1.6	3.1
Pool Spacing (ft)	17	73	13	58	8	42	23	66	29	83	30	110
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	31	47	25	37	7	26	26	51	28	64	41	69
Radius of Curvature (ft)	19	47	15	37	16	29	18	41	23	51	25	62
Rc:Bankfull Width (ft/ft)	1.8	4.5	1.8	4.5	2.5	4.5	1.8	4.0	1.8	4.0	1.8	4.5
Meander Length (ft)	31	104	25	83	20	52	36	97	45	122	48	193
Meander Width Ratio	3.0	4.5	3.0	4.5	3.0	8.0	3.5	9.5	3.5	9.5	3.5	14.0
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$												
Reach Shear Stress (Competency) lb/ft^2	0.94		---		1.37		0.61		1.30		1.39	
Max part size (mm) mobilized at bankfull												
Stream Power (Capacity) W/m^2												
Additional Reach Parameters												
Drainage Area (SM)	0.32		0.23		0.07		0.36		0.74		0.83	
Watershed Impervious Cover Estimate (%)	<10%											
Rosgen Classification	C4		B4		B4a		C4		C4		C4	
Bankfull Velocity (fps)	3.9		4.4		3.9		4.2		4.2		3.8	
Bankfull Discharge (cfs)	32		23		12		33		53		55	
Q-NFF regression (2-yr)												
Q-USGS extrapolation (1.2-yr)												
Q-Mannings												
Valley Slope (ft/ft)	0.0150		0.0325		0.0444		0.0152		0.0163		0.0129	
Channel Thalweg Length (ft)	595		459		662		934				1,039	
Sinuosity	1.15		1.10		1.05	1.10	1.18		1.15		1.10	
Bankfull/Channel Slope (ft/ft)	0.0131		0.0295		0.0411		0.0130		0.0140		0.0105	

As-Built/Baseline

Parameter	Carroll Creek Reach 1 Min	Carroll Creek Reach 1 Max	Eaker Creek Reach 1 Min	Eaker Creek Reach 1 Max	Royster Creek Reach 1 Min	Royster Creek Reach 1 Max	Scott Creek Min	Scott Creek Max	UBHC Reach 2A Min	UBHC Reach 2A Max	UBHC Reach 2B Min	UBHC Reach 2B Max	UBHC Reach 4 Min	UBHC Reach 4 Max
Dimension and Substrate - Riffle														
Bankfull Width (ft)	11.4		N/A		10.0		6.8		16.0		11.3		15.5	16.0
Floodprone Width (ft)	82.0		N/A		46.7		67.1		108.7		170.3		118.0	190.0
Bankfull Mean Depth	0.7		N/A		0.4		0.5		0.7		1.6		0.8	1.1
Bankfull Max Depth	1.3		N/A		0.8		0.9		1.5		3.0		1.4	2.0
Bankfull Cross-sectional Area (ft^2)	7.9		N/A		3.6		3.6		11.6		17.7		13.1	17.6
Width/Depth Ratio	16.4		N/A		27.6		12.7		22.0		7.3		14.5	18.3
Entrenchment Ratio	7.2		N/A		4.7		9.9		6.8		15.0		7.6	11.9
Bank Height Ratio	1.0		N/A		1.0		1.0		1.0		1.0		1.0	1.0
D_{50} (mm)	51.00		N/A		43.50		51.60		44.20		83.80		46.20	85.60
Profile														
Riffle Length (ft)	14	65	10	19	7	42	22	47	11	40	8	39	19	56
Riffle Slope (ft/ft)	0.0084	0.0359	0.0093	0.0406	0.0068	0.0569	0.0164	0.0416	0.0006	0.0515	0.0215	0.0627	0.0119	0.0521
Pool Length (ft)	18	50	4	13	7	71	6	138	10	59	10	47	33	73
Pool Max Depth (ft)	1.9	2.8	1.3	2.1	1.6	2.5	1.9	5.2	1.9	3.3	2.6	3.4	2.4	3.8
Pool Spacing (ft)	45	67	20	22	38	70	17	69	29	75	21	79	62	125
Pool Volume (ft^3)														
Pattern														
Channel Beltwidth (ft)	26	45	N/A		9	18	25	45	13	31	20	35	19	67
Radius of Curvature (ft)	15	29	46	62	21	41	11	28	18	26	30	34	27	60
Rc:Bankfull Width (ft/ft)	1.3	2.5	N/A		2.1	4.1	1.6	4.1	1.1	1.6	2.7	3.0	1.7	3.8
Meander Length (ft)	89	139	N/A		95	125	30	59	74	102	108	125	122	178
Meander Width Ratio	2.2	3.9	N/A		0.9	1.8	3.7	6.6	0.8	1.9	1.8	3.1	1.2	4.2
Ri%/Ru%/P%/G%/S%														
SC%/Sa%/G%/C%/B%/Be%														
$D_{16}/D_{35}/D_{50}/D_{84}/D_{95}/D_{100}$	0.28/2/10.2/59.6 / 101.2/180		N/A		SC/2/11/71.7/98. 3/256		0.21/24.23/39.8/ 99.5/160.7/512		0.66/2.37/16.6/79.2/146.7/362				0.3/6.69/29.8/87 / 202.4/512	
Reach Shear Stress (Competency) lb/ft^2	0.75		N/A		---		1.19		0.64		1.18		0.63	0.86
Max part size (mm) mobilized at bankfull														
Stream Power (Capacity) W/m^2														
Additional Reach Parameters														
Drainage Area (SM)	0.32		0.04		0.23		0.07		0.36		0.74		0.83	
Watershed Impervious Cover Estimate (%)	<10%													
Rosgen Classification	C4		N/A		B/C4		B/C4		C4		C4		C4	
Bankfull Velocity (fps)	3.8		N/A		4.0		4.6		3.5		5.4		3.6	4.5
Bankfull Discharge (cfs)	30.3		N/A		14.5		16.5		41.2		94.9		47.2	78.4
Q-NFF regression (2-yr)														
Q-USGS extrapolation (1.2-yr)														
Q-Mannings														
Valley Slope (ft/ft)	0.0150		N/A		0.0325		0.0444		0.0152		0.0163		0.0129	
Channel Thalweg Length (ft)	590		135		459		644		930				1,296	
Sinuosity	1.2		N/A		1.1		1.1		1.1				1.4	
Bankfull/Channel Slope (ft/ft)	0.0171		0.0555		0.0395		0.0382		0.0146				0.0126	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11b. Baseline Stream Data Summary
Area B - Pre-Restoration Condition
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area B

		Pre-Restoration Condition																					
Parameter	**Gage**	**Elliott Creek Reach 1**		**Elliott Creek UT1**		**Bridges Creek Reach 1**		**UT1 to Bridges Creek**		**Lower Fletcher Creek Reach 1**		**Lower Fletcher Creek Reach 2**		**Upper Stick Elliot Creek Reach 1**		**Upper Stick Elliott Creek Reach 5**		**Upper Stick Elliott Creek Reach 6**		**Upper Stick Elliott Creek UT2**		**Upper Stick Elliott Creek UT3**		**Upper Fletcher Creek Reach 2**	
		Min	**Max**	**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 - Shallow																									
Bankfull Width (ft)		7.7		3.4		2.9	5.3	3.4		16.4		9.2		4.9		15.2		15.7	24.7	4.4		4.2		9.2	
Floodprone Width (ft)		18.0		6.0		6.0	17.0	4.0		21.0		11.0		6.0		14.0		19.0	58.0	7.0		5.0		19.0	
Bankfull Mean Depth		0.5		0.4		0.4	1.0	0.2		0.8		1.0		0.4		1.2		0.7	1.2	0.7		0.8		1.1	
Bankfull Max Depth		0.9		0.2		0.7	1.2	0.3		1.1		1.3		0.6		1.7		1.5	1.7	0.9		1.1		1.7	
Bankfull Cross-sectional Area (ft^2)	N/A	4.0		3.9		3.8		0.6		12.4		9.1		1.9		18.4		18.4		2.9		3.6		10.3	
Width/Depth Ratio		14.9		26.3		3.0	9.8	18.6		21.6		9.2		12.3		12.6		13.5	34.4	6.8		5.0		8.3	
Entrenchment Ratio		2.3		1.1		2.2	4.7	1.2		1.3		1.2		1.3		1.5		1.2	2.3	1.6		1.3		2.0	
Bank Height Ratio		1.9		17.3		1.9	2.3	6.2		5.1		2.3		20.7		1.7		1.4	3.5	4.0		4.1		3.2	
D_{50} (mm)		---		---		---		---		---		---		---		---		---		---		---		---	
Profile																									
Riffle Length (ft)																									
Riffle Slope (ft/ft)		0.0179		0.0250		0.0208		0.0812		0.0204		0.0198		0.0320		0.0150		0.0175		0.0200		---		0.0270	0.0458
Pool Length (ft)	N/A																								
Pool Max Depth (ft)		1.0	1.4	0.5	0.5	1.2	1.5	0.5	0.5	1.1	1.4	1.3	1.7	1.3	2.0	1.7	2.1	0.8	1.0	1.0	1.2	1.3	1.4	2.2	
Pool Spacing (ft)		15.0	100.0	22.5	27.9	22.1	51.2	3.8	4.1	65.0	80.0	6.0	80.0	14.1	68.1	15.0	90.0	15.0	90.0	29.5	49.3	21.5	21.5	77.0	259.0
Pool Volume (ft^3)																									
Pattern																									
Channel Beltwidth (ft)		3	40	4	20	11	26	9	13	21	43	39	43	4	37	21	97	20	49	7	38	17	17	48	143
Radius of Curvature (ft)		7	74	5	23	6	25	6	25	53	98	100	130	2	23	11	76	15	69	12	26	21	33	10	90
Rc:Bankfull Width (ft/ft)	N/A	0.9	9.6	1.4	6.9	2.0	4.8	1.7	7.5	3.2	6.0	10.9	14.1	0.5	4.6	0.8	5.0	0.9	2.8	2.8	6.0	5.0	7.9	1.1	9.8
Meander Length (ft)		54	166	45	56	44	102	44	102	249	336	318	336	28	136	72	134	142	304	59	99	43	43	200	295
Meander Width Ratio		0.3	5.1	0.7	3.6	3.8	8.9	3.8	8.9	4.2	4.7	4.2	4.7	5.8	27.8	1.4	6.4	0.8	2.0	1.5	8.7	4.0	4.0	5.2	15.5
Substrate, Bed and Transport Parameters																									
Ri%/Ru%/P%/G%/S%																									
SC%/Sa%/G%/C%/B%/Be%																									
d16/d35/d50/d84/d95/d100	N/A	---		---		---		---		---		---		---		---		---		---		---		---	
Reach Shear Stress (Competency) lb/ft^2		---		---		---		---		---		---		---		---		---		---		---		---	
Max part size (mm) mobilized at bankfull																									
Stream Power (Capacity) W/m^2																									
Additional Reach Parameters																									
Drainage Area (SM)		0.13		0.02		0.07		0..01		0.41		0.42		0.05		0.72		0.76		0.07		0.10		0.42	
Watershed Impervious Cover Estimate (%)		<10%																							
Rosgen Classification		Incised C5		F4		Incised E4		F5b		F4		F4		F4		B4c		Incised C4 / F4		G4		G4		F4	
Bankfull Velocity (fps)		4.2		5.2		3.8		3.9		4.8		4.1		4.8		2.8		2.9		4.2		4.2		3.6	
Bankfull Discharge (cfs)		17		3		12		3		35		37		9		52		54		12		15		21	
Q-NFF regression (2-yr)	N/A	---		---		---		---		---		---		---		---		---		---		---		---	
Q-USGS extrapolation (1.2-yr)		11		2		7		1		144		162		---		43		45		7		9		21	
Q-Mannings		15		9		12		2.4		46		44		---		73		53		11		20		40	60
Valley Slope (ft/ft)		0.0179		0.0135		0.0208		0.0812		0.0125		0.0198		0.0638		0.0143		0.0087		0.0208		0.0353		0.0160	
Channel Thalweg Length (ft)		1,389		141		445		58		574		467		352		1,909		1,036		56		107		1,465	
Sinuosity		1.30		1.17		1.06		1.16		1.10		1.03		1.04		1.53		1.09		1.22		1.22		1.23	
Bankfull/Channel Slope (ft/ft)		0.0138		0.0113		0.0196		0.0700		0.0113		0.0192		0.0613		0.0093		0.0080		0.0200		0.0289		0.0130	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11c. Baseline Stream Data Summary
Area B - Design Parameters
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area B

	Design																					
Parameter	**Elliott Creek Reach 1**		**Elliott Creek UT1**		**Bridges Creek Reach 1**		**UT1 to Bridges Creek**		**Lower Fletcher Creek Reach 1**		**Lower Fletcher Creek Reach 2**		**Upper Stick Elliott Creek Reach 5**		**Upper Stick Elliott Creek Reach 6**		**Upper Stick Elliott Creek UT2**		**Upper Stick Elliott Creek UT3**		**Upper Fletcher Creek Reach 2**	
	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 - Shallow																						
Bankfull Width (ft)	7.5		4.9		6.9		4.9		11.8		12.4		16.0		16.0		6.7		7.2		10.5	
Floodprone Width (ft)	16.5	---	10.8	---	9.7	15.3	10.8	---	26.0	---	27.3	---	22.5	35.3	35.3	---	14.8	---	15.9	---	50.0	100.0
Bankfull Mean Depth	0.5		0.4		0.5		0.4		0.8		0.9		1.1		1.1		0.5		0.6		0.9	
Bankfull Max Depth	1.1	1.9	0.8	1.4	1.1	1.9	0.8	1.4	1.7	3.0	1.8	3.1	2.3	4.0	2.3	4.0	1.0	1.8	1.1	1.9	2.2+	
Bankfull Cross-sectional Area (ft^2)	4.0		2.0		3.7		2.0		10.0		11.0		18.4		18.4		3.5		4.0		9.0	
Width/Depth Ratio	14.0		12.0		13.0		12.0		14.0		14.0		14.0		14.0		13.0		13.0		12.2	
Entrenchment Ratio	2.2+		2.2+		1.4	2.2	2.2+		2.2+		2.2+		1.4	2.2	2.2+		2.2+		2.2+		4.8	9.5
Bank Height Ratio	1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0	
D_{50} (mm)	---		---		---		---		---		---		---		---		---		---		---	
Profile																						
Riffle Length (ft)	---		---		---		---		---		---		---		---		---		---		---	
Riffle Slope (ft/ft)	0.020	0.030	0.030	0.050	0.025	0.047	0.074	0.098	0.013	0.018	0.022	0.029	0.009	0.014	0.015	0.020	0.005	0.007	0.020	0.026	0.021	0.032
Pool Length (ft)	---		---		---		---		---		---		---		---		---		---		---	
Pool Max Depth (ft)	1.1	1.9	0.8	1.4	1.1	1.9	0.8	1.4	1.7	3.0	1.8	3.1	2.3	4.0	2.3	4.0	1.0	1.8	1.1	1.9	2.2+	
Pool Spacing (ft)	26	45	17	29	24	55	17	29	41	71	43	74	88	119	63	109	24	45	25	43	40	100
Pool Volume (ft^3)																						
Pattern																						
Channel Beltwidth (ft)	19	60	17	39	---	---	17	39	41	95	43	99	61	81	62	78	24	54	25	58	25	95
Radius of Curvature (ft)	15	26	10	17	---	---	10	17	24	41	25	43	33	56	32	43	13	24	14	25	23	50
Rc:Bankfull Width (ft/ft)	2.0	3.5	2.0	3.5	---	---	2.0	3.5	2.0	3.5	2.0	3.5	2.1	3.5	2.0	2.7	1.9	3.6	1.9	3.5	2.2	4.8
Meander Length (ft)	52	90	34	59	---	---	34	59	83	142	87	149	139	192	166	191	47	81	50	87	100	200
Meander Width Ratio	2.5	8.0	3.5	8.0	---	---	3.5	8.0	3.5	8.0	3.5	8.0	3.8	5.0	3.8	4.8	3.5	8.0	3.5	8.0	2.4	9.0
Substrate, Bed and Transport Parameters																						
Ri%/Ru%/P%/G%/S%																						
SC%/Sa%/G%/C%/B%/Be%																						
d16/d35/d50/d84/d95/d100																						
Reach Shear Stress (Competency) lb/ft^2	0.47		---		0.65		---		0.73		0.45		0.55		0.69		---		---		---	
Max part size (mm) mobilized at bankfull																						
Stream Power (Capacity) W/m^2																						
Additional Reach Parameters																						
Drainage Area (SM)	0.13		0.02		0.07		0.01		0.41		0.42		0.72		0.76		0.07		0.10		0.29	
Watershed Impervious Cover Estimate (%)	<10%																					
Rosgen Classification	C5		C4		B4		C4		C4		C4		C4		C4		C4		C4		C	
Bankfull Velocity (fps)	4.3		3		3.2		1.5		3.5		3.4		2.8		2.9		3.4		3.8		3.3	
Bankfull Discharge (cfs)	17		6		12		3		35		37		52		54		12		15		30	
Q-NFF regression (2-yr)																						
Q-USGS extrapolation (1.2-yr)																						
Q-Mannings																						
Valley Slope (ft/ft)	0.0174		0.0302		0.0290		0.0580		0.0089		0.0150		0.0110		0.0115		0.0045		0.0150		0.0158	
Channel Thalweg Length (ft)	1,121		141		376		55		574		427		1,507		1,069		154		118		1,407	
Sinuosity	1.19		1.19		1.03		1.20		1.02		1.03		1.34		1.13		1.27		1.09		1.21	
Bankfull/Channel Slope (ft/ft)	0.0149		0.0255		0.028		0.049		0.0088		0.0088		0.0080		0.0101		0.0035		0.0130		0.0128	0.0263

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11d. Baseline Stream Data Summary
Area B - As-Built/Baseline Parameters
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area B

	As-Built/Baseline																							
Parameter	**Elliott Creek Reach 1**		**Elliott Creek UT1**		**Bridges Creek Reach 1**		**UT1 to Bridges Creek**		**Lower Fletcher Creek Reach 1**		**Lower Fletcher Creek Reach 2**		**Upper Stick Elliot Creek Reach 1**		**Upper Stick Elliott Creek Reach 5**		**Upper Stick Elliott Creek Reach 6**		**Upper Stick Elliott Creek UT2**		**Upper Stick Elliott Creek UT3**		**Upper Fletcher Creek Reach 2**	
	Min	**Max**	**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 - Shallow																								
Bankfull Width (ft)	6.4	8.2	5.2		9.3		N/A		12.3		9.9		6.7		15.9	18.4	16.7	18.3	7.9		7.2		11.5	12.0
Floodprone Width (ft)	19.0	19.6	14.0		23.6		N/A		26.4		28.4		37.2		169.2	178.4	148.5	192.7	25.0		63.8		72.0	99.5
Bankfull Mean Depth	0.6	0.7	0.5		0.4		N/A		0.8		0.6		0.7		1.0	1.2	1.1	1.2	0.5		0.5		0.8	0.8
Bankfull Max Depth	0.9	0.9	0.8		0.7		N/A		1.1		0.8		0.9		1.7	1.8	2.0	2.2	0.9		0.8		1.4	1.4
Bankfull Cross-sectional Area (ft^2)	4.1	5.6	2.5		3.3		N/A		9.7		6.3		4.7		18.9	19.2	19.1	22.4	3.8		3.7		9.2	9.5
Width/Depth Ratio	10.1	11.9	10.7		26.5		N/A		15.7		15.4		9.6		13.3	17.8	14.6	14.9	16.5		14.0		14.0	15.6
Entrenchment Ratio	2.4	2.9	2.7		2.5		N/A		2.1		2.9		5.5		9.2	10.9	8.9	10.5	3.2		8.8		6.0	8.6
Bank Height Ratio	1.0	1.0	1.0		1.0		N/A		1.0		1.0		1.0		1.0	1.0	1.0	1.0	1.0		1.0		1.0	1.0
D_{50} (mm)	32	42	31		53.7		N/A		35.3		11.0		32.0		35.0	39.8	41.1	46.1	14.9		14.4		39.1	54.8
Profile																								
Riffle Length (ft)	7	64	11	21	11	32	6	6	11	55	14	36	6	18	39	74	13	80	14	37	18	19	16	69
Riffle Slope (ft/ft)	0.0076	0.0712	0.0018	0.0429	0.0129	0.0576	0.0686	0.0862	0.0008	0.0466	0.0050	0.0396	0.0028	0.1323	0.0068	0.0218	0.0038	0.0653	0.0065	0.0167	0.0092	0.0257	0.0078	0.0631
Pool Length (ft)	10.98	73.26	12.42	18.46	6.36	34.19	8.56	8.56	10.61	44	17.92	53.39	3.72	55.52	14.68	66.89	14.35	79.03	18.84	51.34	8.77	14.02	13.89	63.47
Pool Max Depth (ft)	1.1	2.3	1.1	1.4	1.6	2.4	1.0	2.0	1.4	1.6	1.8	2.2	1.7	2.2	1.9	4.1	2.0	4.6	1.0	1.7	1.5	1.7	2.5	4.5
Pool Spacing (ft)	20	132	18	45	29	49	11	11	36	92	42	90	22	102	48	128	43	127	62	62	26	34	45	162
Pool Volume (ft^3)																								
Pattern																								
Channel Beltwidth (ft)	14	38	8	17	9	15	23	23	20	73	44		N/A	N/A	37	64	27	57	24	24	16	16	8	71
Radius of Curvature (ft)	8	42	15	20	10	19	19	19	12	50	53	79	N/A	N/A	25	48	24	39	20	17	9	12	23	50
Rc:Bankfull Width (ft/ft)	1.3	5.1	2.9	3.8	1.1	2.0	N/A		1.0	4.1	5.4	8.0	N/A	N/A	1.6	2.6	1.4	2.2	2.5	2.2	1.3	1.7	2.0	4.2
Meander Length (ft)	46	156	48	69	68	80	51	51	73	138	201	201	N/A	N/A	128	200	160	193	54	54	32	32	92	195
Meander Width Ratio	2.2	4.6	1.4	3.3	1.0	1.6	N/A		1.6	5.9	4.4	0.0	N/A	N/A	2.3	3.5	1.6	3.1	3.1	3.1	2.2	2.2	0.7	5.9
Substrate, Bed and Transport Parameters																								
Ri%/Ru%/P%/G%/S%																								
SC%/Sa%/G%/C%/B%/Be%																								
d16/d35/d50/d84/d95/d100	0.59/1.78/6/101.2/ 151.8/180		SC/1/5.9/47/101.2/180		SC/0.16/1/90/135.5/180		N/A		0.36/0.69/1.8/57.9/ 110.1/180		0.27/0.69/4.4/40.5/ 128.7/362		SC/3.15/20.7/68.5/ 137/256		0.15/2.18/23.6/64/ 103.6/10		SC/0.61/3.3/60.4/ 113.8/180		SC/0.14/0.2/26.1/48/64		SC/SC/0.2/20.5/35.9/ 180		SC/0.63/10.4/55.9/ 104/180	
Reach Shear Stress (Competency) lb/ft^2	0.66		1.08		1.35		N/A		0.40		0.71		3.66		0.35		0.41		0.44		0.46		0.55	
Max part size (mm) mobilized at bankfull																								
Stream Power (Capacity) W/m^2																								
Additional Reach Parameters																								
Drainage Area (SM)	0.13		0.02		0.07		0.01		0.41		0.42		0.05		0.72		0.76		0.07		0.10		0.29	
Watershed Impervious Cover Estimate (%)	<10%																							
Rosgen Classification	C/E4		C/E4		C5		N/A		C5		C4		E4		C4		C4		C5		C5		C4	
Bankfull Velocity (fps)	3.2		3.7		2.9		N/A		3.1		3.4		8.5		3.4	3.8	3.8	4.1	2.4		2.1		3.3	3.6
Bankfull Discharge (cfs)	13.3		9.2		9.7		N/A		29.9		21.3		39.9		63.4	72.8	73.1	90.9	9.0		7.7		30.2	34.1
Q-NFF regression (2-yr)																								
Q-USGS extrapolation (1.2-yr)																								
Q-Mannings																								
Valley Slope (ft/ft)	0.0174		0.0302		0.0290		0.0580		0.0089		0.0150		N/A		0.0110		0.0115		0.0045		0.0150		N/A	
Channel Thalweg Length (ft)	1,121		141		376		55		574		427		409		1,228		1,070		154		118		1,407	
Sinuosity	1.1		1.1		1.0		1.0		1.1		1.0		1.0		1.2		1.1		1.4		1.3		1.2	
Bankfull/Channel Slope (ft/ft)	0.0150		0.0247		0.0308		0.0598		0.0092		0.0162		0.0837		0.0081		0.0093		0.0101		0.0105		0.0125	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11e. Baseline Stream Data Summary
Area C
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Area C

		Pre-Restoration Condition				Design				As-Built/Baseline			
Parameter	**Gage**	**Lower Big Harris Creek Reach 1a/1b**		**Lower Big Harris Creek Reach 2**		**Lower Big Harris Creek Reach 1a/1b**		**Lower Big Harris Creek Reach 2**		**Lower Big Harris Creek Reach 1a/1b**		**Lower Big Harris Creek Reach 2**	
		Min	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Shallow													
Bankfull Width (ft)	N/A	25.2		25.2		26.0		27.0		26.20		26.70	
Floodprone Width (ft)		120.0		120.0		75.0	115.0	100.0	200.0	158		300	
Bankfull Mean Depth		2.4		2.4		2.1		2.2		1.9		1.7	
Bankfull Max Depth		3.6		3.6		2.9		3.0		3.0		2.8	
Bankfull Cross-sectional Area (ft^2)		60.5		60.5		54.4		58.5		49.4		46.0	
Width/Depth Ratio		10.5		10.5		12.4		12.5		13.9		15.5	
Entrenchment Ratio		4.8		4.8		2.9	4.4	3.7	7.4	6.0		11.2	
Bank Height Ratio		2.0		2.0		1.0		1.0		1.0		1.0	
D_{50} (mm)		---		---		---		---		32.0		87.4	
Profile													
Riffle Length (ft)	N/A					---		---		15	142	21	146
Riffle Slope (ft/ft)		0.0133	0.0512	0.0063	0.0177	---	0.0054	0.0054	0.0086	0.0055	0.0792	0.0019	0.0651
Pool Length (ft)						---		---		54.2	94.3	14.2	134.9
Pool Max Depth (ft)		4.1		3.2		6.0		6.2		3.9	6.2	4.6	6.0
Pool Spacing (ft)		200.0	250.0	410.0	480.0	185	240	150	250	116	218	37	291
Pool Volume (ft^3)													
Pattern													
Channel Beltwidth (ft)	N/A	75	120	85	125	53	112	110	145	58	105	80	117
Radius of Curvature (ft)		70	165	120	190	60	80	75	90	60	80	65	90
Rc:Bankfull Width (ft/ft)		2.8	6.5	4.8	7.5	2.3	3.1	2.8	3.3	2.3	3.1	2.4	3.4
Meander Length (ft)		350	450	250	300	290	440	344	420	157	419	236	396
Meander Width Ratio		3.0	4.8	3.4	5.0	2.0	4.3	4.1	5.4	2.2	4.0	3.0	4.4
Substrate, Bed and Transport Parameters													
Ri%/Ru%/P%/G%/S%	N/A												
SC%/Sa%/G%/C%/B%/Be%													
d16/d35/d50/d84/d95/d100		1.9/16/29/83/130/2048		1.9/16/29/83/130/2048						0.4/0.8/1.7/94/256/2048		0.2/0.3/5.6/94/256/2048	
Reach Shear Stress (Competency) lb/ft^2		---		---		---		---		---		---	
Max part size (mm) mobilized at bankfull													
Stream Power (Capacity) W/m^2													
Additional Reach Parameters													
Drainage Area (SM)	N/A	3.19	3.36	3.50	3.88	3.36		3.88		3.36		3.88	
Watershed Impervious Cover Estimate (%)		<10%											
Rosgen Classification		E4	G4c	E4	G4c	C		C		C5		C4	
Bankfull Velocity (fps)		2.9		3.2		3.3		3.4		3.6		3.0	
Bankfull Discharge (cfs)		176		194		176		194		176		137	
Q-NFF regression (2-yr)		---		---									
Q-USGS extrapolation (1.2-yr)		190		211									
Q-Mannings		182	255	205	350								
Valley Slope (ft/ft)		0.0053		0.0053		0.0053		0.0053		0.0053		0.0053	
Channel Thalweg Length (ft)		894		987		820		967		820		967	
Sinuosity		1.0		1.0		1.1		1.1		1.1		1.1	
Bankfull/Channel Slope (ft/ft)		0.0050		0.0050		0.0048		0.0048		0.0039		0.0032	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11f. Baseline Stream Data Summary
Big Harris Creek Mitigation Site
DMS Project No.739
Monitoring Year 1 - 2018

		Reference Reach Data																							
Parameter	**Gage**	**Group Camp Tributary**		**UT to South Crowders**		**UT to Cane Creek**		**Boyd Branch**		**Spencer Creek**		**Box Creek**		**Hall Creek**		**Meadow Fork**		**UT to Gap Branch**		**UT to Kelly Branch**		**UT to Sandy Run**		**UT to Little Pine Trib 1**	
		Min	**Max**	**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 - Shallow																									
Bankfull Width (ft)		4.2	4.4	6.1	8.4	11.5	12.3	13.5		10.7	11.2	23.5		20.7	27.0	21.4		6.2		7.9		7.3	7.8	12.2	
Floodprone Width (ft)		8.6	10.6	26.0	31.0	31.0		37.0		60.0	114.0	76.0		34.0	39.0	---		20.9		9.1		12.2	15.6	72.0	
Bankfull Mean Depth		0.8	0.8	1.0	1.1	0.8	1.0	1.1		1.6	1.8	1.2		1.4	1.8	2.1		0.6		0.7		0.7	0.8	1.3	
Bankfull Max Depth		1.0	1.2	1.4		1.2	1.6	1.9		2.1	2.6	1.9		3.1		3.1		1.0		1.1		1.1	1.4	1.8	
Bankfull Cross-sectional Area (ft^2)	N/A	3.4	3.6	6.4	8.7	8.9	12.2	15.4		17.8	19.7	28.9		36.9		44.0		3.8		5.7		5.7	6.2	16.3	
Width/Depth Ratio		5.2	55.0	5.8	8.0	12.3	14.4	11.8		5.8	7.1	19.1		11.6	19.7	10.4		10.1		10.9		6.6	9.8	9.1	
Entrenchment Ratio		1.9	2.5	3.7	4.3	2.5	2.7	2.8		5.5	10.2+	3.3		1.4	1.6	>2.2		3.4		1.2		1.6	2.1	6.0	
Bank Height Ratio		1.0	1.0	1.4	2.1	---	---	1.0		1.0		1.5		2.1	2.2	1.1		1.0		2.5		1.7	2.6	1.0	
D50 (mm)																									
Riffle Length (ft)		---		---		---		---		---		---		---		---		---		---		---		---	
Riffle Slope (ft/ft)		0.0105	0.1218	0.0202	0.0664	0.0188	0.0704	0.015	0.028	0.013		0.0100	0.0770	0.008	0.02	0.2390		0.01	0.14	---		0.004	0.04	0.0600	0.0892
Pool Length (ft)		---		---		---		---		---		---		---		---		---		---		---		---	
Pool Max Depth (ft)	N/A	1.8	2.8	1.3	3	1.8	2.3	2.6		3.3		4.4		2.7	3.5	---		15.0		---		1.3	1.5	2.2	
Pool Spacing (ft)		9	58	28	63	27	73	260	345	71		29	88	35	108	---		3	4	---		9	55	26	81
Pool Volume (ft^3)																									
Pattern																									
Channel Beltwidth (ft)		16	17	81		102		230.0		38	41	62	88	35	41	---		---		18	34	24	60	---	
Radius of Curvature (ft)		8	12	9	20	23	38	50	180	1.3	1.4	1	2	1	4	---		---		8	26	14	29	---	
Rc:Bankfull Width (ft/ft)	N/A	---		---		---		---		---		---		---		---		---		---		---		---	
Meander Length (ft)		31	34	45	72	45	81	600	623	46	48	39	76	78	200	---		---		27	94	63	72	---	
Meander Width Ratio		3.6	3.8	9.6	13.3	8.3	8.9	17.0		3.4	3.6	2.6	3.7	1.5	1.7	---		---		2.3	4.3	3.3	7.6	---	
Substrate, Bed and Transport Parameters																									
Ri%/Ru%/P%/G%/S%																									
SC%/Sa%/G%/C%/B%/Be%																									
d16/d35/d50/d84/d95/d100	N/A	0.1/0.3/16/55.6/---		0.8/12.1/19.7/49.5/75.9/---		0.6/12.2/27.8/74.5/128/---		---		<0.063/3/8.8/42/90/---		41/11/22/50/78/---		<0.063/1/13/70/110/---		69/16/31/120/230/ ---		0.4/8/19/102.3/256/---		---		0.062/1/19/76/150/---		<0.063/2.4/22.6/120/256	
Reach Shear Stress (Competency) lb/ft^2																									
Max part size (mm) mobilized at bankfull																									
Stream Power (Capacity) W/m^2																									
Additional Reach Parameters																									
Drainage Area (SM)		0.10		0.22		0.29		0.90		0.96		2.13		4.09		4.37		0.04		0.08		0.15		1.10	
Watershed Impervious Cover Estimate (%)		---		---		---		---		---		---		---		---		---		---		---		---	
Rosgen Classification		E5b		E4		E4		E4		E4		C4		B4c		E4		B4a		A4		E4		E4b	
Bankfull Velocity (fps)		3.4	3.6	4		3.8		3.2		4.9	5.4	3.3		4.3		5.1		5		6.2		3.2		5.5	
Bankfull Discharge (cfs)		12		30		40		51		97		94.9		159		224		18.7		23.2		19		85	
Q-NFF regression (2-yr)		---				---				---				---				---				---			
Q-USGS extrapolation (1.2-yr)	N/A	---				---				---				---				---				---			
Q-Mannings		---				---				---				---				---				---			
Valley Length (ft)		---		---		---		---		---		---		---		---		---		---		---		---	
Channel Thalweg Length (ft)		---		---		---		---		---		---		---		---		---		---		---		---	
Sinuosity		1.60		2.20		1.40		1.40		1.30		1.30		1.04		---		1.12		1.19		1.60		1.10	
Water Surface Slope $(ft/ft)^2$		---		---		---		---		---		---		---		---		---		---		---		---	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		---		---		---		---		---	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 12a. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA A

	Cross-Section 1, UBHC R2A (Riffle)						Cross-Section 2, UBHC R2a (Pool)						Cross-Section 3, UBHC R2B (Pool)						Cross-Section 4, UBHC R2B (Riffle)						Cross-Section 5, UBHC R4 (Pool)[2]					
Dimension[1] and Substrate	Base (3/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	929.2	929.0					928.7	928.7					921.0	921.2					920.8	921.0					900.1	900.2				
Low Bank Elevation (ft)	929.2	929.0					928.7	928.7					921.0	921.2					920.8	921.0					900.1	900.2				
Bankfull Width (ft)	16.0	10.4					13.5	12.2					12.0	16.1					11.3	18.2					17.0	19.2				
Floodprone Width (ft)	108.7	104.1					N/A	N/A					N/A	N/A					170.3	118.6					N/A	N/A				
Bankfull Mean Depth (ft)	0.7	0.6					1.4	0.9					1.2	1.7					1.6	2.4					1.4	1.1				
Bankfull Max Depth (ft)	1.5	1.4					3.1	1.7					1.9	4.0					3.0	4.2					2.7	2.7				
Bankfull Cross-Sectional Area (ft)	11.6	6.6					19.3	11.0					14.0	27.0					17.7	44.1					23.5	20.6				
Bankfull Width/Depth Ratio	22.0	16.5					N/A	N/A					N/A	N/A					7.3	7.5					N/A	N/A				
Bankfull Entrenchment Ratio	6.8	10.0					N/A	N/A					N/A	N/A					15.0	6.5					N/A	N/A				
Bankfull Bank Height Ratio	1.0	0.80					N/A	N/A					N/A	N/A					1.0	1.8					N/A	N/A				

	Cross-Section 6, UBHC R4 (Riffle)						Cross-Section 7, UBHC R4 (Riffle)						Cross-Section 8, UBHC R4 (Pool)						Cross-Section 9, Royster Cr R1 (Riffle)						Cross-Section 10, Royster Cr R1 (Pool)					
Dimension[1] and Substrate	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	899.7	899.7					896.5	896.5					896.0	895.9					965.0	965.0					961.5	961.4				
Low Bank Elevation (ft)	899.7	899.7					896.5	896.5					896.0	895.9					965.0	965.0					961.5	961.4				
Bankfull Width (ft)	15.5	16.2					16.0	15.7					20.9	16.9					10.0	9.4					12.3	11.2				
Floodprone Width (ft)	118.0	110.8					190.0	167.4					N/A	N/A					46.7	46.1					N/A	N/A				
Bankfull Mean Depth (ft)	0.8	0.6					1.1	0.9					1.5	1.8					0.4	0.4					0.9	0.9				
Bankfull Max Depth (ft)	1.4	1.3					2.0	2.0					3.3	3.7					0.8	0.8					1.9	1.8				
Bankfull Cross-Sectional Area (ft)	13.1	10.5					17.6	14.7					31.6	31.0					3.6	3.7					11.0	9.7				
Bankfull Width/Depth Ratio	18.3	25.1					14.5	16.6					N/A	N/A					27.6	24.1					N/A	N/A				
Bankfull Entrenchment Ratio	7.6	6.8					11.9	10.7					N/A	N/A					4.7	4.9					N/A	N/A				
Bankfull Bank Height Ratio	1.0	0.9					1.0	0.9					N/A	N/A					1.0	1.0					N/A	N/A				

	Cross-Section 11, Scott Cr (Riffle)						Cross-Section 12, Scott Cr (Pool)						Cross-Section 13, Carroll Cr R1 (Riffle)						Cross-Section 14, Carroll Cr R1 (Pool)					
Dimension[1] and Substrate	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	894.8	894.7					890.1	890.2					862.2	862.2					861.6	861.4				
Low Bank Elevation (ft)	894.8	894.7					890.1	890.2					862.2	862.2					861.6	861.4				
Bankfull Width (ft)	6.8	8.7					13.7	13.9					11.4	11.3					12.7	10.2				
Floodprone Width (ft)	67.1	44.8					N/A	N/A					82.0	82.1					N/A	N/A				
Bankfull Mean Depth (ft)	0.5	0.6					1.1	0.9					0.7	0.6					1.1	0.9				
Bankfull Max Depth (ft)	0.9	1.2					2.1	1.7					1.3	1.2					2.0	1.8				
Bankfull Cross-Sectional Area (ft)	3.6	5.1					14.9	12.2					7.9	7.0					13.4	9.4				
Bankfull Width/Depth Ratio	12.7	15.0					N/A	N/A					16.4	18.2					N/A	N/A				
Bankfull Entrenchment Ratio	9.9	5.1					N/A	N/A					7.2	7.3					N/A	N/A				
Bankfull Bank Height Ratio	1.0	1.2					N/A	N/A					1.0	0.9					N/A	N/A				

AREA B

	Cross-Section 15, USEC R1 (Riffle)						Cross-Section 16, USEC R5 (Pool)						Cross-Section 17, USEC R5 (Riffle)						Cross-Section 18, USEC R5 (Riffle)						Cross-Section 19, USEC R5 (Pool)						Cross-Section 20, USEC R5 (Riffle)					
Dimension[1] and Substrate	Base (4/2018)	MY1 (11/2018)[1]	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	979.1	979.1					934.0	934.0					932.1	932.1					930.9	930.7					928.9	928.7					925.7	925.6				
Low Bank Elevation (ft)	979.1	979.1					934.0	934.0					932.1	932.1					930.9	930.7					928.9	928.7					925.7	925.6				
Bankfull Width (ft)	6.7	7.7					17.4	18.0					18.4	18.3					18.1	16.4					20.8	20.9					15.9	16.6				
Floodprone Width (ft)	37.2	37.0					N/A	N/A					169.2	167.8					172.1	166.3					N/A	N/A					173.2	191.0				
Bankfull Mean Depth (ft)	0.7	0.6					1.5	1.2					1.0	1.0					1.1	1.0					1.9	1.6					1.2	1.1				
Bankfull Max Depth (ft)	0.9	0.9					2.3	2.1					1.7	1.7					1.7	1.5					3.5	3.9					1.8	1.8				
Bankfull Cross-Sectional Area (ft)	4.7	4.8					26.3	22.0					19.2	18.4					19.1	16.1					39.3	34.3					18.9	18.2				
Bankfull Width/Depth Ratio	9.6	12.3					N/A	N/A					17.8	18.1					17.2	16.7					N/A	N/A					13.3	15.1				
Bankfull Entrenchment Ratio	5.5	4.8					N/A	N/A					9.2	9.2					9.5	10.2					N/A	N/A					10.9	11.5				
Bankfull Bank Height Ratio	1.0	1.0					N/A	N/A					1.0	1.0					1.0	0.9					N/A	N/A					1.0	1.0				

	Cross-Section 21, USEC R6 (Pool)						Cross-Section 22, USEC R6 (Riffle)						Cross-Section 23, USEC R6 (Riffle)						Cross-Section 24, Elliott Cr (Riffle)						Cross-Section 25, Elliott Cr (Pool)						Cross-Section 26, Elliott Cr (Riffle)					
Dimension[1] and Substrate	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	919.8	919.8					919.4	919.3					917.5	917.6					972.1	972.2					970.5	970.5					970.1	970.1				
Low Bank Elevation (ft)	919.8	919.8					919.4	919.3					917.5	917.6					972.1	972.2					970.5	970.5					970.1	970.1				
Bankfull Width (ft)	21.8	22.3					18.3	16.3					16.7	16.2					6.4	7.1					7.6	8.9					8.2	8.6				
Floodprone Width (ft)	N/A	N/A					192.7	221.2					148.5	130.5					19.0	21.6					N/A	N/A					19.6	18.3				
Bankfull Mean Depth (ft)	2.1	1.7					1.2	1.2					1.1	1.2					0.6	0.6					1.5	0.9					0.7	0.6				
Bankfull Max Depth (ft)	5.2	3.8					2.2	2.6					2.0	2.2					0.9	1.0					1.9	1.5					0.9	0.9				
Bankfull Cross-Sectional Area (ft)	45.1	38.4					22.4	19.4					19.1	20.0					4.1	4.1					11.2	8.0					5.6	5.1				
Bankfull Width/Depth Ratio	N/A	N/A					14.9	13.7					14.6	13.1					10.1	12.3					N/A	N/A					11.9	14.5				
Bankfull Entrenchment Ratio	N/A	N/A					10.5	13.6					8.9	8.1					2.9	3.0					N/A	N/A					2.4	2.1				
Bankfull Bank Height Ratio	N/A	N/A					1.0	0.9					1.0	1.0					1.0	1.0					N/A	N/A					1.0	1.0				

[1] MY1 - MY5 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018). The remainder of the data is calculated based on the current year's low bank height (bankfull stage).

[2] The bankfull elevation at Cross-section 5 was set too high in the baseline report. The baseline bankfull elevation was updated in MY1.

Table 12b. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

AREA B

	Cross-Section 27, UT to Elliott Cr (Riffle)						Cross-Section 28, Bridges Cr (Riffle)						Cross-Section 29, USEC UT2 (Riffle)						Cross-Section 30, USEC UT3 (Riffle)[3]						Cross-Section 31, UFC R2 (Riffle)						Cross-Section 32, UFC R2 (Pool)					
Dimension[1] and Substrate	Base (4/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (4/2018)	MY1 (11/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (10/2017)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (10/2017)	MY1	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	976.8	976.7					966.8	966.7					926.9	926.9					926.9	926.9					969.5	969.5					969.1	969.2				
Low Bank Elevation (ft)	976.8	976.7					966.8	966.7					926.9	926.9					926.9	926.9					969.5	969.5					969.1	969.2				
Bankfull Width (ft)	5.2	4.9					9.3	6.4					7.9	8.1					7.2	7.4					11.4	11.2					12.3	13.6				
Floodprone Width (ft)	14.0	14.2					23.6	21.1					25.0	26.0					63.8	62.8					91.8	91.7					N/A	N/A				
Bankfull Mean Depth (ft)	0.5	0.5					0.4	0.4					0.5	0.4					0.5	0.5					0.7	0.7					1.4	1.3				
Bankfull Max Depth (ft)	0.8	0.9					0.7	0.6					0.9	0.9					0.8	0.8					1.1	1.1					2.6	2.7				
Bankfull Cross-Sectional Area (ft^2)	2.5	2.5					3.3	2.4					3.8	3.5					3.7	3.6					8.2	7.8					17.1	18.0				
Bankfull Width/Depth Ratio	10.7	9.7					26.5	17.2					16.5	18.6					14.0	15.5					15.7	16.0					N/A	N/A				
Bankfull Entrenchment Ratio	2.7	2.9					2.5	3.3					3.2	3.2					8.8	8.4					8.1	8.2					N/A	N/A				
Bankfull Bank Height Ratio	1.0	1.0					1.0	0.8					1.0	1.0					1.0	1.0					1.0	1.0					N/A	N/A				

	Cross-Section 33, UFC R2 (Pool)						Cross-Section 34, UFC R2 (Riffle)						Cross-Section 35, UFC R2 (Riffle)[3]						Cross-Section 36, UFC R2 (Pool)						Cross-Section 37, LFC R1 (Riffle)[2]						Cross-Section 38, LFC R1 (Pool)[3]					
Dimension[1] and Substrate	Base (10/2017)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (10/2017)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (10/2017)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (10/2017)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	965.9	966.0					965.5	965.5					960.5	960.4					960.1	960.1					919.4	919.3					918.9	918.8				
Low Bank Elevation (ft)	965.9	966.0					965.5	965.5					960.5	960.4					960.1	960.1					919.4	919.3					918.9	918.8				
Bankfull Width (ft)	13.2	13.4					12.0	12.3					11.5	11.7					14.7	14.2					12.3	12.8					11.2	10.5				
Floodprone Width (ft)	N/A	N/A					72.0	69.1					99.5	96.4					N/A	N/A					26.4	25.3					N/A	N/A				
Bankfull Mean Depth (ft)	1.2	1.2					0.8	0.7					0.8	0.8					1.5	1.3					0.8	0.7					0.7	0.6				
Bankfull Max Depth (ft)	2.3	2.3					1.4	1.2					1.4	1.4					2.8	2.8					1.1	1.0					1.1	1.0				
Bankfull Cross-Sectional Area (ft^2)	16.1	15.7					9.2	8.1					9.5	9.4					21.5	18.5					9.7	9.6					7.7	6.5				
Bankfull Width/Depth Ratio	N/A	N/A					15.6	18.7					14.0	14.7					N/A	N/A					15.7	17.1					N/A	N/A				
Bankfull Entrenchment Ratio	N/A	N/A					6.0	5.6					8.6	8.2					N/A	N/A					2.1	2.0					N/A	N/A				
Bankfull Bank Height Ratio	N/A	N/A					1.0	0.9					1.0	1.0					N/A	N/A					1.0	1.0					N/A	N/A				

	Cross-Section 39, LFC R2 (Riffle)[4]						Cross-Section 40, LFC R2 (Pool)					
Dimension[1] and Substrate	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5	Base (3/2018)	MY1 (10/2018)	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	915.9	915.9					916.0	915.9				
Low Bank Elevation (ft)	915.9	915.9					916.0	915.9				
Bankfull Width (ft)	9.9	9.8					11.5	10.9				
Floodprone Width (ft)	28.4	28.6					N/A	N/A				
Bankfull Mean Depth (ft)	0.6	0.5					1.0	0.9				
Bankfull Max Depth (ft)	0.8	0.9					1.5	1.3				
Bankfull Cross-Sectional Area (ft^2)	6.3	4.6					11.8	9.6				
Bankfull Width/Depth Ratio	15.4	20.5					N/A	N/A				
Bankfull Entrenchment Ratio	2.9	2.9					N/A	N/A				
Bankfull Bank Height Ratio	1.0	0.8					N/A	N/A				

AREA C

	Cross-Section 41, LBHC R1A (Pool)						Cross-Section 42, LBHC R1A (Riffle)[3]						Cross-Section 43, LBHC R1B/2 (Riffle)[2]						Cross-Section 44, LBHC R1B/2 (Pool)					
Dimension[1] and Substrate	Base (9/2017)	MY1	MY2	MY3	MY4	MY5	Base (9/2017)	MY1	MY2	MY3	MY4	MY5	Base (9/2017)	MY1	MY2	MY3	MY4	MY5	Base (9/2017)	MY1	MY2	MY3	MY4	MY5
Bankfull Elevation (ft)	848.0	847.5					847.6	847.5					844.2	844.2					843.5	843.7				
Low Bank Elevation (ft)	848.0	847.5					847.6	847.5					844.2	844.2					843.5	843.7				
Bankfull Width (ft)	41.6	24.0					26.2	25.7					26.7	27.2					26.8	27.2				
Floodprone Width (ft)	N/A	N/A					158.0	155.7					299.6	171.0					N/A	N/A				
Bankfull Mean Depth (ft)	2.5	1.4					1.9	1.5					1.7	1.9					2.8	3.3				
Bankfull Max Depth (ft)	5.8	2.6					3.0	2.9					2.8	3.3					5.5	7.8				
Bankfull Cross-Sectional Area (ft^2)	104.7	33.5					49.4	38.7					46.0	51.5					75.4	91.0				
Bankfull Width/Depth Ratio	N/A	N/A					13.9	17.1					15.5	14.3					N/A	N/A				
Bankfull Entrenchment Ratio	N/A	N/A					6.0	6.1					11.2	6.3					N/A	N/A				
Bankfull Bank Height Ratio	N/A	N/A					1.0	0.9					1.0	1.1					N/A	N/A				

[1] MY1 - MY5 Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018). The remainder of the data is calculated based on the current year's low bank height (bankfull stage

[2] The floodprone width and entrenchment ratio at Cross-section 37 and 43 were miscalculated during MY0. Both measurements were updated in MY1.

[3] The bankfull (low bank) elevations were recorded incorrectly at Cross-section 30, 35, 38, and 42 during MY0; therefore, subsequent cross-sectional data calculations were incorrect. MY0 data was updated in MY1.

[4] The Floodprone width for Cross-section 39 was incorrectly recorded MY0 and was updated in MY1.

Table 13a. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Big Harris Creek Reach 2A (Sta. 129+81 - 136+66)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	16.0		10.4									
Floodprone Width (ft)	108.7		104.1									
Bankfull Mean Depth	0.7		0.6									
Bankfull Max Depth	1.5		1.4									
Bankfull Cross-Sectional Area (ft2)	11.6		6.6									
Width/Depth Ratio	22.0		16.5									
Entrenchment Ratio[1]	6.8		10									
Bank Height Ratio[2]	1.0		<1.0									
D50 (mm)	44.2		30.6									
Profile												
Riffle Length (ft)	11	40										
Riffle Slope (ft/ft)	0.001	0.052										
Pool Length (ft)	10	59										
Pool Max Depth (ft)	1.9	3.3										
Pool Spacing (ft)	29	75										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	13	31										
Radius of Curvature (ft)	18	26										
Rc:Bankfull Width (ft/ft)	1.1	1.6										
Meander Wave Length (ft)	74	102										
Meander Width Ratio	0.8	1.9										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	685											
Sinuosity (ft)	1.14											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.015											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.66/2.37/16.6/79.2/146.7/362											
% of Reach with Eroding Banks	0%		3%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13b. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Big Harris Creek Reach 2B (Sta. 136+66 - 139+15)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	11.3		18.2									
Floodprone Width (ft)	170.3		118.6									
Bankfull Mean Depth	1.6		2.4									
Bankfull Max Depth	3.0		4.2									
Bankfull Cross-Sectional Area (ft2)	17.7		44.1									
Width/Depth Ratio	7.3		7.5									
Entrenchment Ratio[1]	15.0		6.5									
Bank Height Ratio[2]	1.0		1.8									
D50 (mm)	83.8		1.4									
Profile												
Riffle Length (ft)	8	39										
Riffle Slope (ft/ft)	0.022	0.063										
Pool Length (ft)	10	47										
Pool Max Depth (ft)	2.6	3.4										
Pool Spacing (ft)	21	79										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	20	35										
Radius of Curvature (ft)	30	34										
Rc:Bankfull Width (ft/ft)	2.7	3.0										
Meander Wave Length (ft)	108	125										
Meander Width Ratio	1.8	3.1										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	249											
Sinuosity (ft)	1.14											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.015											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.66/2.37/16.6/79.2/146.7/362											
% of Reach with Eroding Banks	0%		14%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13c. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Big Harris Creek Reach 4 (Sta. 148+76 - 159+15)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	15.5	16.0	15.7	16.2								
Floodprone Width (ft)	118.0	190.0	110.8	167.4								
Bankfull Mean Depth	0.8	1.1	0.6	0.9								
Bankfull Max Depth	1.4	2.0	1.3	2.0								
Bankfull Cross-Sectional Area (ft2)	13.1	17.6	10.5	14.7								
Width/Depth Ratio	14.5	18.3	16.6	25.1								
Entrenchment Ratio[1]	7.6	11.9	6.8	10.7								
Bank Height Ratio[2]	1.0	1.0	<1.0									
D50 (mm)	46.2	85.6	26.9	32								
Profile												
Riffle Length (ft)	19	56										
Riffle Slope (ft/ft)	0.012	0.052										
Pool Length (ft)	33	73										
Pool Max Depth (ft)	2.4	3.8										
Pool Spacing (ft)	62	125										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	19	67										
Radius of Curvature (ft)	27	60										
Rc:Bankfull Width (ft/ft)	1.7	3.8										
Meander Wave Length (ft)	122	178										
Meander Width Ratio	1.2	4.2										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,296											
Sinuosity (ft)	1.36											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.013											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.3/6.69/29.8/87/ 202.4/512											
% of Reach with Eroding Banks	0%		5%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13d. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Royster Creek Reach 1 (Sta. 802+54 - 807+13)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	10.0		9.4									
Floodprone Width (ft)	46.7		46.1									
Bankfull Mean Depth	0.4		0.4									
Bankfull Max Depth	0.8		0.8									
Bankfull Cross-Sectional Area (ft2)	3.6		3.7									
Width/Depth Ratio	27.6		24.1									
Entrenchment Ratio[1]	4.7		4.9									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	43.5		35.4									
Profile												
Riffle Length (ft)	7	42										
Riffle Slope (ft/ft)	0.007	0.057										
Pool Length (ft)	7	71										
Pool Max Depth (ft)	1.6	2.5										
Pool Spacing (ft)	38	70										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	9	18										
Radius of Curvature (ft)	21	41										
Rc:Bankfull Width (ft/ft)	2.1	4.1										
Meander Wave Length (ft)	95	125										
Meander Width Ratio	0.9	1.8										
Additional Reach Parameters												
Rosgen Classification	B/C4											
Channel Thalweg Length (ft)	459											
Sinuosity (ft)	1.05											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.040											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/2/11/71.7/98.3/256											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13e. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Scott Creek (Sta. 120+12 - 1216+74)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	6.8		8.7									
Floodprone Width (ft)	67.1		44.8									
Bankfull Mean Depth	0.5		0.6									
Bankfull Max Depth	0.9		1.2									
Bankfull Cross-Sectional Area (ft2)	3.6		5.1									
Width/Depth Ratio	12.7		15.0									
Entrenchment Ratio[1]	9.9		5.1									
Bank Height Ratio[2]	1.0		1.2									
D50 (mm)	51.6		33.3									
Profile												
Riffle Length (ft)	22	47										
Riffle Slope (ft/ft)	0.016	0.042										
Pool Length (ft)	6	138										
Pool Max Depth (ft)	1.9	5.2										
Pool Spacing (ft)	17	69										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	25	45										
Radius of Curvature (ft)	11	28										
Rc:Bankfull Width (ft/ft)	1.6	4.1										
Meander Wave Length (ft)	30	59										
Meander Width Ratio	3.7	6.6										
Additional Reach Parameters												
Rosgen Classification	B/C4											
Channel Thalweg Length (ft)	644											
Sinuosity (ft)	1.10											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.038											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.21/24.23/39.8/ 99.5/160.7/512											
% of Reach with Eroding Banks	0%		4%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13f. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Carroll Creek (Sta. 1301+68 - 1307+63)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	11.4		11.3									
Floodprone Width (ft)	82.0		82.1									
Bankfull Mean Depth	0.7		0.6									
Bankfull Max Depth	1.3		1.2									
Bankfull Cross-Sectional Area (ft2)	7.9		7.0									
Width/Depth Ratio	16.4		18.2									
Entrenchment Ratio[1]	7.2		7.3									
Bank Height Ratio[2]	1.0		<1.0									
D50 (mm)	51		41.3									
Profile												
Riffle Length (ft)	14	65										
Riffle Slope (ft/ft)	0.008	0.036										
Pool Length (ft)	18	50										
Pool Max Depth (ft)	1.9	2.8										
Pool Spacing (ft)	45	67										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	26	45										
Radius of Curvature (ft)	15	29										
Rc:Bankfull Width (ft/ft)	1.3	2.5										
Meander Wave Length (ft)	89	139										
Meander Width Ratio	2.2	3.9										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	590											
Sinuosity (ft)	1.15											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.017											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.28/2/10.2/59.6/ 101.2/180											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13g. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Stick Elliott Reach 1 (Sta. 1002+89 - 1006+98)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	6.7		7.7									
Floodprone Width (ft)	37.2		37.0									
Bankfull Mean Depth	0.7		0.6									
Bankfull Max Depth	0.9		0.9									
Bankfull Cross-Sectional Area (ft2)	4.7		4.8									
Width/Depth Ratio	9.6		12.3									
Entrenchment Ratio[1]	5.5		4.8									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	32.0		36.5									
Profile												
Riffle Length (ft)	6	18										
Riffle Slope (ft/ft)	0.003	0.132										
Pool Length (ft)	4	56										
Pool Max Depth (ft)	1.7	2.2										
Pool Spacing (ft)	22	102										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	---	---										
Radius of Curvature (ft)	---	---										
Rc:Bankfull Width (ft/ft)	---	---										
Meander Wave Length (ft)	---	---										
Meander Width Ratio	---	---										
Additional Reach Parameters												
Rosgen Classification	E4											
Channel Thalweg Length (ft)	409											
Sinuosity (ft)	1.00											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.084											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/3.15/20.7/68.5/ 137/256											
% of Reach with Eroding Banks	0%		8%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13h. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Stick Elliott Reach 5 (Sta. 1043+77 - 1058+84)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	15.9	18.4	16.4	18.3								
Floodprone Width (ft)	169.2	173.2	166.3	191.0								
Bankfull Mean Depth	1.0	1.2	1.0	1.1								
Bankfull Max Depth	1.7	1.8	1.5	1.8								
Bankfull Cross-Sectional Area (ft2)	18.9	19.2	16.1	18.4								
Width/Depth Ratio	13.3	17.8	15.1	18.1								
Entrenchment Ratio[1]	9.2	10.9	9.2	11.5								
Bank Height Ratio[2]	1.0	1.0	<1.0	1.0								
D50 (mm)	35.0	39.8	32.0	35.3								
Profile												
Riffle Length (ft)	39	74										
Riffle Slope (ft/ft)	0.007	0.022										
Pool Length (ft)	15	67										
Pool Max Depth (ft)	1.9	4.1										
Pool Spacing (ft)	48	128										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	37	64										
Radius of Curvature (ft)	25	48										
Rc:Bankfull Width (ft/ft)	1.6	2.6										
Meander Wave Length (ft)	128	200										
Meander Width Ratio	2.3	3.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,228											
Sinuosity (ft)	1.23											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.008											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.15/2.18/23.6/64/ 103.6/10											
% of Reach with Eroding Banks	0%		1%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13i. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Stick Elliott Reach 6 (Sta. 1059+14 - 1069+83)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	16.7	18.3	16.2	16.3								
Floodprone Width (ft)	148.5	192.7	130.5	221.2								
Bankfull Mean Depth	1.1	1.2	1.2	1.2								
Bankfull Max Depth	2.0	2.2	2.2	2.6								
Bankfull Cross-Sectional Area (ft)	19.1	22.4	19.4	20.0								
Width/Depth Ratio	14.6	14.9	13.1	13.7								
Entrenchment Ratio[1]	8.9	10.5	8.1	13.6								
Bank Height Ratio[2]	1.0	1.0	<1.0	1.0								
D50 (mm)	41.1	46.1	26.9	34								
Profile												
Riffle Length (ft)	13	80										
Riffle Slope (ft/ft)	0.004	0.065										
Pool Length (ft)	14	79										
Pool Max Depth (ft)	2.0	4.6										
Pool Spacing (ft)	43	127										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	27	57										
Radius of Curvature (ft)	24	39										
Rc:Bankfull Width (ft/ft)	1.4	2.2										
Meander Wave Length (ft)	160	193										
Meander Width Ratio	1.6	3.1										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,070											
Sinuosity (ft)	1.13											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.009											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/0.61/3.3/60.4/ 113.8/180											
% of Reach with Eroding Banks	0%		4%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13j. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek (Sta. 1400+85 - 1412+06)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	6.4	8.2	7.1	8.6								
Floodprone Width (ft)	19.0	19.6	18.3	21.6								
Bankfull Mean Depth	0.6	0.7	0.6	0.6								
Bankfull Max Depth	0.9	0.9	0.9	1.0								
Bankfull Cross-Sectional Area (ft)	4.1	5.6	4.1	5.1								
Width/Depth Ratio	10.1	11.9	12.3	14.5								
Entrenchment Ratio[1]	2.4	2.9	2.1	3.0								
Bank Height Ratio[2]	1.0	1.0	1.0	1.0								
D50 (mm)	32.0	41.7	23.9	49.1								
Profile												
Riffle Length (ft)	7	64										
Riffle Slope (ft/ft)	0.008	0.071										
Pool Length (ft)	11	73										
Pool Max Depth (ft)	1.1	2.3										
Pool Spacing (ft)	20	132										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	14	38										
Radius of Curvature (ft)	8	42										
Rc:Bankfull Width (ft/ft)	1.3	5.1										
Meander Wave Length (ft)	46	156										
Meander Width Ratio	2.2	4.6										
Additional Reach Parameters												
Rosgen Classification	C/E4											
Channel Thalweg Length (ft)	1,121											
Sinuosity (ft)	1.13											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.015											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.59/1.78/6/101.2/ 151.8/180											
% of Reach with Eroding Banks	0%		2%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13k. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek UT1 (Sta. 1415+87 - 1417+28)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	5.2		4.9									
Floodprone Width (ft)	14.0		14.2									
Bankfull Mean Depth	0.5		0.5									
Bankfull Max Depth	0.8		0.9									
Bankfull Cross-Sectional Area (ft)	2.5		2.5									
Width/Depth Ratio	10.7		9.7									
Entrenchment Ratio[1]	2.7		2.9									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	31.0		36.8									
Profile												
Riffle Length (ft)	11	21										
Riffle Slope (ft/ft)	0.002	0.043										
Pool Length (ft)	12	18										
Pool Max Depth (ft)	1.1	1.4										
Pool Spacing (ft)	18	45										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	8	17										
Radius of Curvature (ft)	15	20										
Rc:Bankfull Width (ft/ft)	2.9	3.8										
Meander Wave Length (ft)	48	69										
Meander Width Ratio	1.4	3.3										
Additional Reach Parameters												
Rosgen Classification	C/E4											
Channel Thalweg Length (ft)	141											
Sinuosity (ft)	1.07											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.025											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/1/5.9/47/101.2/180											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13l. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Bridges Creek Reach 1 (Sta. 1500+91 - 1504+67)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	9.3		6.4									
Floodprone Width (ft)	23.6		21.1									
Bankfull Mean Depth	0.4		0.4									
Bankfull Max Depth	0.7		0.6									
Bankfull Cross-Sectional Area (ft)	3.3		2.4									
Width/Depth Ratio	26.5		17.2									
Entrenchment Ratio[1]	2.5		3.3									
Bank Height Ratio[2]	1.0		<1.0									
D50 (mm)	53.7		29.0									
Profile												
Riffle Length (ft)	11	32										
Riffle Slope (ft/ft)	0.013	0.058										
Pool Length (ft)	6	34										
Pool Max Depth (ft)	1.6	2.4										
Pool Spacing (ft)	29	49										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	9	15										
Radius of Curvature (ft)	10	19										
Rc:Bankfull Width (ft/ft)	1.1	2.0										
Meander Wave Length (ft)	68	80										
Meander Width Ratio	1.0	1.6										
Additional Reach Parameters												
Rosgen Classification	C5											
Channel Thalweg Length (ft)	376											
Sinuosity (ft)	1.00											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.031											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/0.16/1/90/135.5/180											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13m. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Stick Elliott Creek UT2 (Sta. 1080+00 - 1081+54)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	7.9		8.1									
Floodprone Width (ft)	25.0		26.0									
Bankfull Mean Depth	0.5		0.4									
Bankfull Max Depth	0.9		0.9									
Bankfull Cross-Sectional Area (ft)	3.8		3.5									
Width/Depth Ratio	16.5		18.6									
Entrenchment Ratio[1]	3.2		3.2									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	14.9		0.5									
Profile												
Riffle Length (ft)	14	37										
Riffle Slope (ft/ft)	0.007	0.017										
Pool Length (ft)	19	51										
Pool Max Depth (ft)	1.0	1.7										
Pool Spacing (ft)	62	62										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	24	24										
Radius of Curvature (ft)	20	17										
Rc:Bankfull Width (ft/ft)	2.5	2.2										
Meander Wave Length (ft)	54	54										
Meander Width Ratio	3.1	3.1										
Additional Reach Parameters												
Rosgen Classification	C5											
Channel Thalweg Length (ft)	154											
Sinuosity (ft)	1.41											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.010											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/0.14/0.2/26.1/48/64											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13n. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Stick Elliott Creek UT3 (Sta. 182+00 - 183+18)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	7.2		7.4									
Floodprone Width (ft)	63.8		62.8									
Bankfull Mean Depth	0.5		0.5									
Bankfull Max Depth	0.8		0.8									
Bankfull Cross-Sectional Area (ft)	3.7		3.6									
Width/Depth Ratio	14.0		15.5									
Entrenchment Ratio[1]	8.8		8.4									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	14.4		18.9									
Profile												
Riffle Length (ft)	18	19										
Riffle Slope (ft/ft)	0.009	0.026										
Pool Length (ft)	9	14										
Pool Max Depth (ft)	1.5	1.7										
Pool Spacing (ft)	26	34										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	16	16										
Radius of Curvature (ft)	9	12										
Rc:Bankfull Width (ft/ft)	0.7	1.0										
Meander Wave Length (ft)	32	32										
Meander Width Ratio	1.3	1.3										
Additional Reach Parameters												
Rosgen Classification	C5											
Channel Thalweg Length (ft)	118											
Sinuosity (ft)	1.28											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.011											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/SC/0.2/20.5/35.9/ 180											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13o. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Upper Fletcher Creek Reach 2 (Sta. 1616+02 - 1630+09)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	11.4	12.0	11.2	12.3								
Floodprone Width (ft)	72.0	99.5	69.1	96.4								
Bankfull Mean Depth	0.7	0.8	0.7	0.8								
Bankfull Max Depth	1.1	1.4	1.1	1.4								
Bankfull Cross-Sectional Area (ft)	8.2	9.5	7.8	9.4								
Width/Depth Ratio	14.0	15.7	14.7	18.7								
Entrenchment Ratio[1]	6.0	8.6	5.6	8.2								
Bank Height Ratio[2]	1.0	1.0	<1.0	1.0								
D50 (mm)	39.1	54.8	33.4	39.5								
Profile												
Riffle Length (ft)	16	69										
Riffle Slope (ft/ft)	0.008	0.063										
Pool Length (ft)	14	63										
Pool Max Depth (ft)	2.5	4.5										
Pool Spacing (ft)	45	162										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	8	71										
Radius of Curvature (ft)	23	50										
Rc:Bankfull Width (ft/ft)	2.0	3.8										
Meander Wave Length (ft)	92	195										
Meander Width Ratio	0.7	5.4										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,407											
Sinuosity (ft)	1.20											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.013											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	SC/0.63/10.4/55.9/ 104/180											
% of Reach with Eroding Banks	0%		1%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13p. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Lower Fletcher Creek Reach 1 (Sta. 1641+28 - 1647+02)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	12.3		12.8									
Floodprone Width (ft)	26.4		25.3									
Bankfull Mean Depth	0.8		0.7									
Bankfull Max Depth	1.1		1.0									
Bankfull Cross-Sectional Area (ft)	9.7		9.6									
Width/Depth Ratio	15.7		17.1									
Entrenchment Ratio[1]	2.1		2.0									
Bank Height Ratio[2]	1.0		1.0									
D50 (mm)	35.3		10.4									
Profile												
Riffle Length (ft)	11	55										
Riffle Slope (ft/ft)	0.001	0.047										
Pool Length (ft)	11	44										
Pool Max Depth (ft)	1.4	1.6										
Pool Spacing (ft)	36	92										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	20	73										
Radius of Curvature (ft)	12	50										
Rc:Bankfull Width (ft/ft)	1.0	4.1										
Meander Wave Length (ft)	73	138										
Meander Width Ratio	1.6	5.9										
Additional Reach Parameters												
Rosgen Classification	C5											
Channel Thalweg Length (ft)	574											
Sinuosity (ft)	1.07											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.009											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.36/0.69/1.8/57.9/ 110.1/180											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13q. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Lower Fletcher Creek Reach 2 (Sta. 1647+33 - 1651+60)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	9.9		9.8									
Floodprone Width (ft)	28.4		28.6									
Bankfull Mean Depth	0.6		0.5									
Bankfull Max Depth	0.8		0.9									
Bankfull Cross-Sectional Area (ft)	6.3		4.6									
Width/Depth Ratio	15.4		20.5									
Entrenchment Ratio[1]	2.9		2.9									
Bank Height Ratio[2]	1.0		<1.0									
D50 (mm)	11.0		8.4									
Profile												
Riffle Length (ft)	14	36										
Riffle Slope (ft/ft)	0.005	0.040										
Pool Length (ft)	18	53										
Pool Max Depth (ft)	1.8	2.2										
Pool Spacing (ft)	42	90										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	44											
Radius of Curvature (ft)	53	79										
Rc:Bankfull Width (ft/ft)	5.4	8.0										
Meander Wave Length (ft)	201	201										
Meander Width Ratio	4.4	0.0										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	427											
Sinuosity (ft)	1.00											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.016											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.27/0.69/4.4/40.5/ 128.7/362											
% of Reach with Eroding Banks	0%		4%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13r. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Lower Big Harris Creek Reach 1a (Sta. 300+13 - 305+13)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	26.2		25.7									
Floodprone Width (ft)	158.0		155.7									
Bankfull Mean Depth	1.9		1.5									
Bankfull Max Depth	3.0		2.9									
Bankfull Cross-Sectional Area (ft)	49.4		38.7									
Width/Depth Ratio	13.9		17.1									
Entrenchment Ratio[1]	6.0		6.1									
Bank Height Ratio[2]	1.0		<1.0									
D50 (mm)	32.0		20.3									
Profile												
Riffle Length (ft)	15	142										
Riffle Slope (ft/ft)	0.005	0.079										
Pool Length (ft)	54	94										
Pool Max Depth (ft)	3.9	6.2										
Pool Spacing (ft)	116	218										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	58	105										
Radius of Curvature (ft)	60	80										
Rc:Bankfull Width (ft/ft)	2.0	2.6										
Meander Wave Length (ft)	157	419										
Meander Width Ratio	1.9	3.5										
Additional Reach Parameters												
Rosgen Classification	C5											
Channel Thalweg Length (ft)	500											
Sinuosity (ft)	1.10											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.004											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.4/0.8/1.7/94/256/2048											
% of Reach with Eroding Banks	0%		0%									

(---): Data was not provided

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

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

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13s. Monitoring Data - Stream Reach Data Summary
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

Lower Big Harris Creek Reach 1b/2 (Sta. 305+13 - 318+00)

Parameter	As-Built/Baseline 2018		MY1 2018		MY2 2019		MY3 2020		MY4 2021		MY5 2022	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate[3]												
Bankfull Width (ft)	26.7		27.2									
Floodprone Width (ft)	299.6		171.0									
Bankfull Mean Depth	1.7		1.9									
Bankfull Max Depth	2.8		3.3									
Bankfull Cross-Sectional Area (ft)	46.0		51.5									
Width/Depth Ratio	15.5		14.3									
Entrenchment Ratio[1]	11.2		6.3									
Bank Height Ratio[2]	1.0		1.1									
D50 (mm)	87.4		47.7									
Profile												
Riffle Length (ft)	21	146										
Riffle Slope (ft/ft)	0.002	0.065										
Pool Length (ft)	14	135										
Pool Max Depth (ft)	4.6	6.0										
Pool Spacing (ft)	37	291										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	80	117										
Radius of Curvature (ft)	65	90										
Rc:Bankfull Width (ft/ft)	2.4	3.4										
Meander Wave Length (ft)	236	396										
Meander Width Ratio	3.0	4.4										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,287											
Sinuosity (ft)	1.09											
Water Surface Slope (ft/ft)	---											
Bankfull Slope (ft/ft)	0.003											
Ri%/Ru%/P%/G%/S%	---											
SC%/Sa%/G%/C%/B%/Be%	---											
d16/d35/d50/d84/d95/d100	0.2/0.3/5.6/94/256/2048											
% of Reach with Eroding Banks	0%		11%									

(---): Data was not provided

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

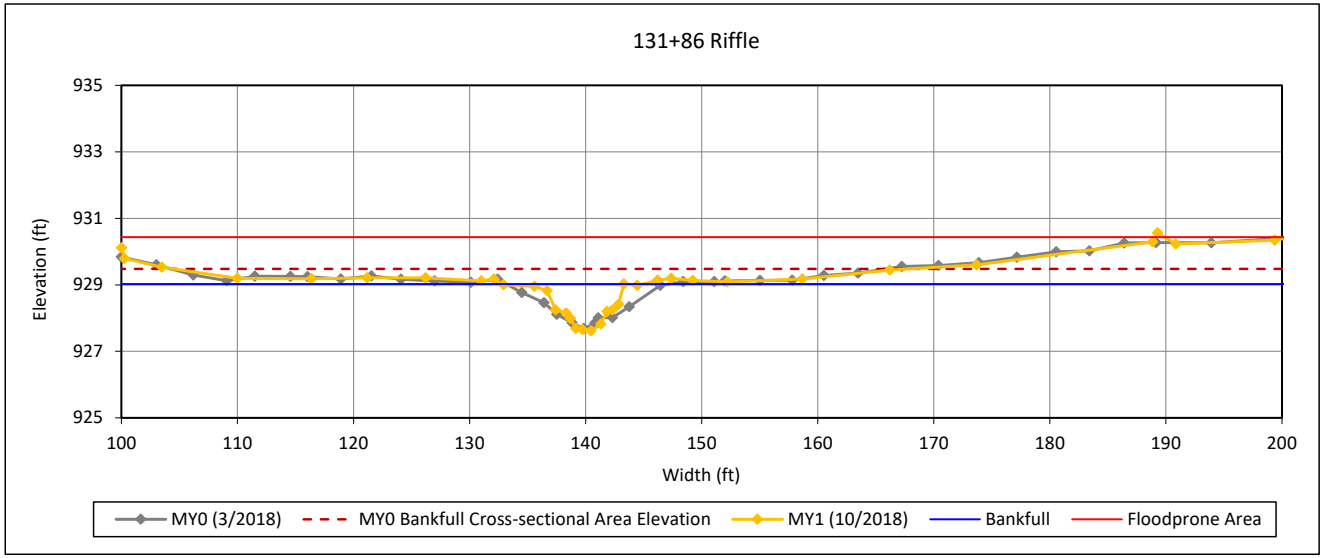
[2]Bank Height Ratio is the bank height divided by the max depth of the bankfull channel.

[3] For MY1 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2A: Cross-Section 1



Bankfull Dimensions	
6.6	x-section area (ft.sq.)
10.4	width (ft)
0.6	mean depth (ft)
1.4	max depth (ft)
11.3	wetted perimeter (ft)
0.6	hydraulic radius (ft)
16.5	width-depth ratio
104.1	W flood prone area (ft)
10.0	entrenchment ratio
0.8	low bank height ratio

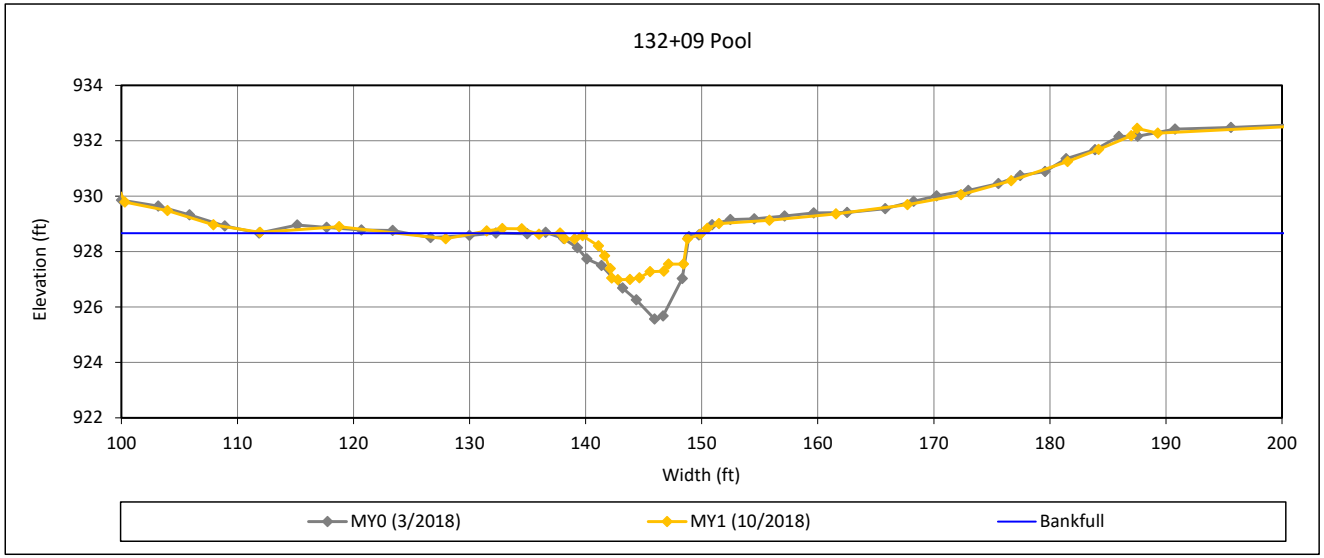
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2A: Cross-Section 2



Bankfull Dimensions	
11.0	x-section area (ft.sq.)
12.2	width (ft)
0.9	mean depth (ft)
1.7	max depth (ft)
13.6	wetted perimeter (ft)
0.8	hydraulic radius (ft)
13.5	width-depth ratio

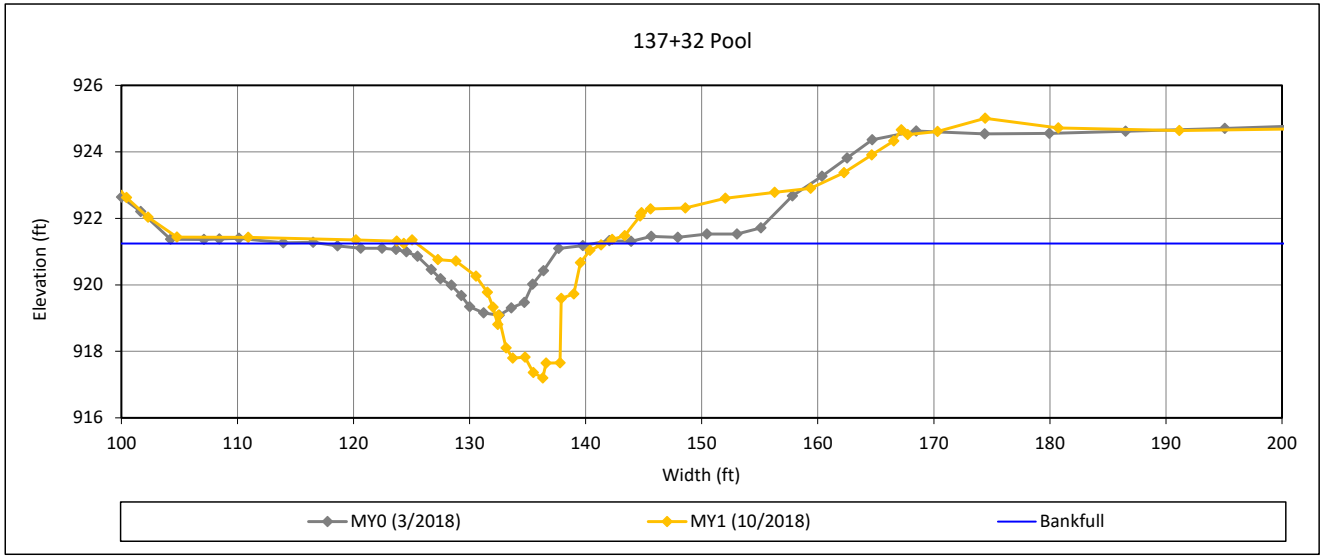
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2B: Cross-Section 3



Bankfull Dimensions	
27.0	x-section area (ft.sq.)
16.1	width (ft)
1.7	mean depth (ft)
4.0	max depth (ft)
22.9	wetted perimeter (ft)
1.2	hydraulic radius (ft)
9.6	width-depth ratio

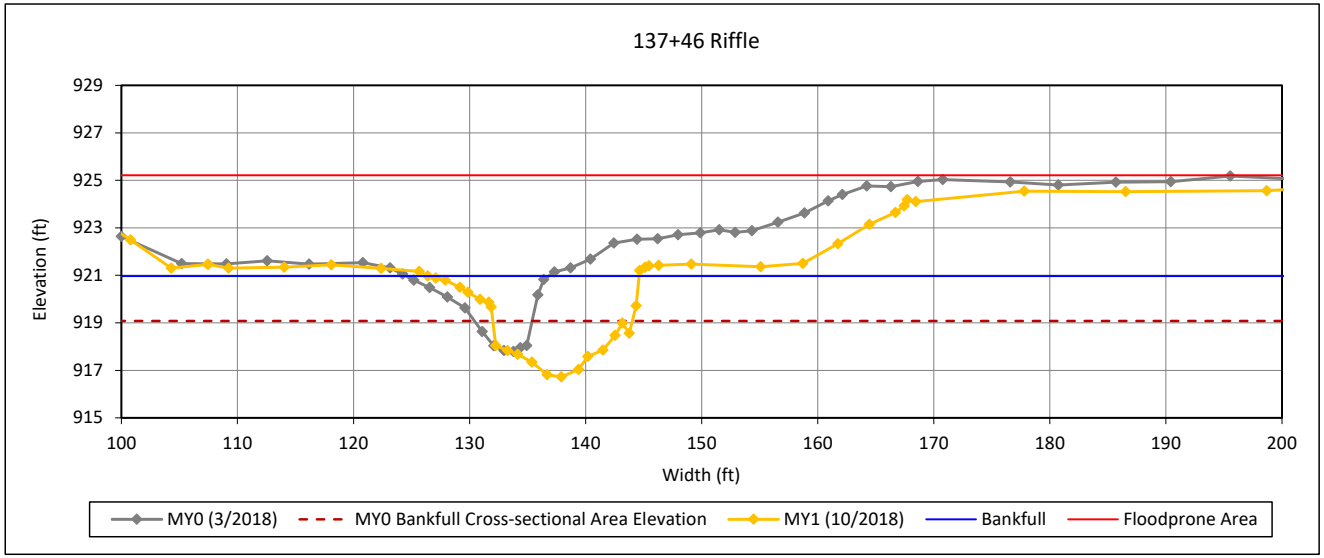
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2B: Cross-Section 4



Bankfull Dimensions	
44.1	x-section area (ft.sq.)
18.2	width (ft)
2.4	mean depth (ft)
4.2	max depth (ft)
22.3	wetted perimeter (ft)
2.0	hydraulic radius (ft)
7.5	width-depth ratio
118.6	W flood prone area (ft)
6.5	entrenchment ratio
1.8	low bank height ratio

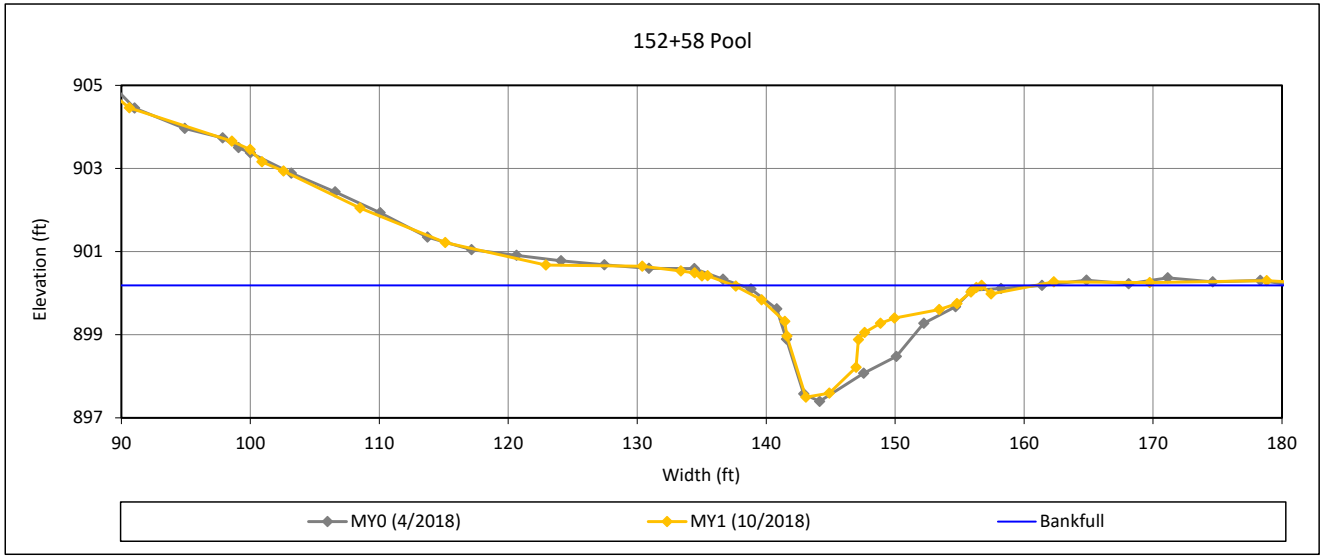
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4: Cross-Section 5



Bankfull Dimensions	
20.6	x-section area (ft.sq.)
19.2	width (ft)
1.1	mean depth (ft)
2.7	max depth (ft)
20.9	wetted perimeter (ft)
1.0	hydraulic radius (ft)
17.9	width-depth ratio

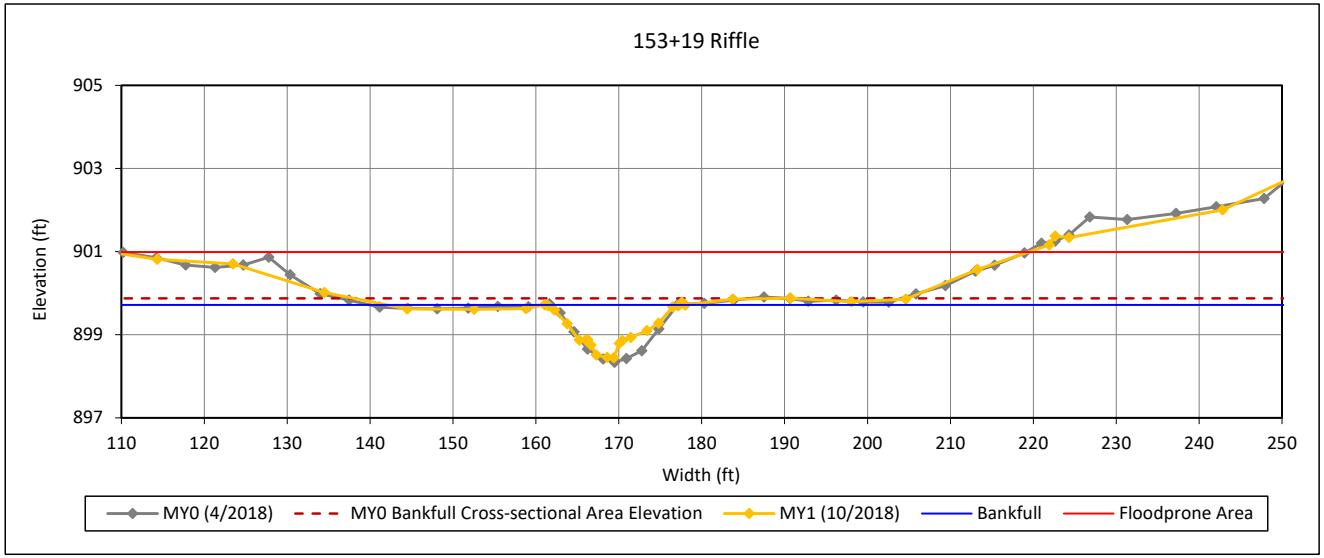
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4: Cross-Section 6



Bankfull Dimensions	
10.5	x-section area (ft.sq.)
16.2	width (ft)
0.6	mean depth (ft)
1.3	max depth (ft)
16.5	wetted perimeter (ft)
0.6	hydraulic radius (ft)
25.1	width-depth ratio
110.8	W flood prone area (ft)
6.8	entrenchment ratio
0.9	low bank height ratio

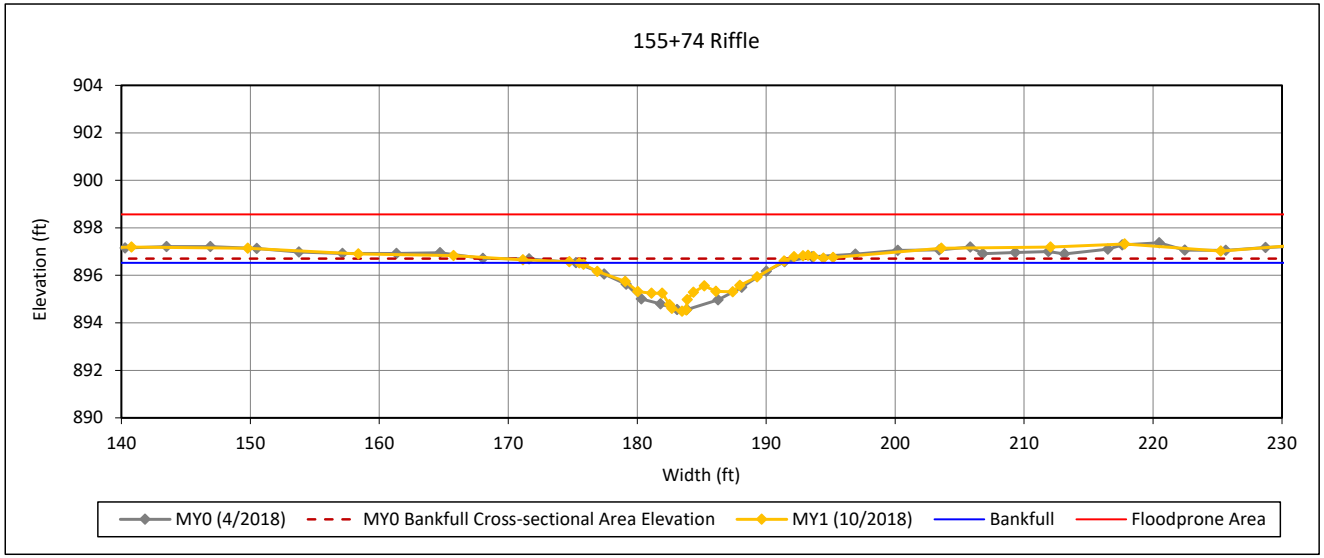
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4: Cross-Section 7



Bankfull Dimensions	
14.7	x-section area (ft.sq.)
15.7	width (ft)
0.9	mean depth (ft)
2.0	max depth (ft)
16.8	wetted perimeter (ft)
0.9	hydraulic radius (ft)
16.6	width-depth ratio
167.4	W flood prone area (ft)
10.7	entrenchment ratio
0.9	low bank height ratio

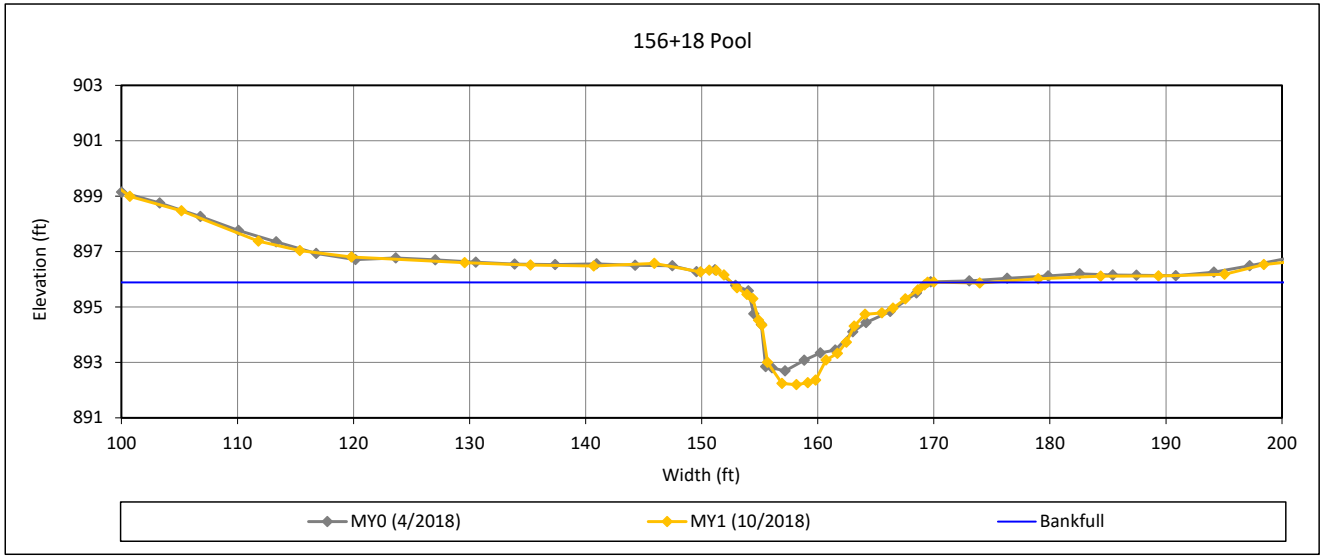
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4: Cross-Section 8



Bankfull Dimensions	
31.0	x-section area (ft.sq.)
16.9	width (ft)
1.8	mean depth (ft)
3.7	max depth (ft)
19.5	wetted perimeter (ft)
1.6	hydraulic radius (ft)
9.2	width-depth ratio

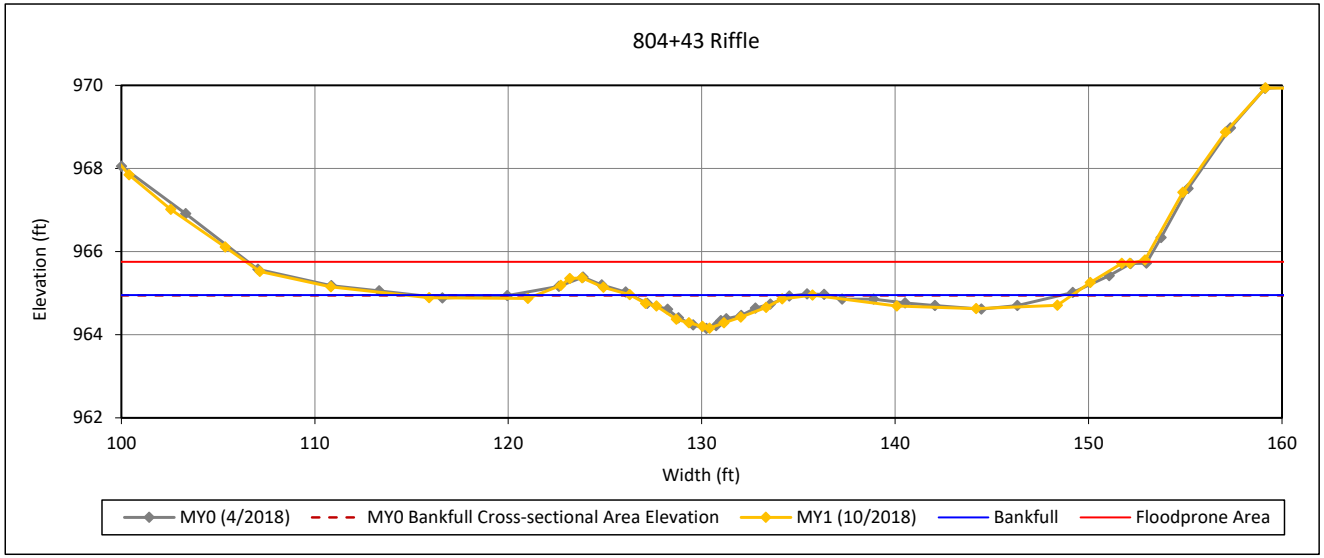
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Royster Creek Reach 1: Cross-Section 9



Bankfull Dimensions	
3.7	x-section area (ft.sq.)
9.4	width (ft)
0.4	mean depth (ft)
0.8	max depth (ft)
9.6	wetted perimeter (ft)
0.4	hydraulic radius (ft)
24.1	width-depth ratio
46.1	W flood prone area (ft)
4.9	entrenchment ratio
1.0	low bank height ratio

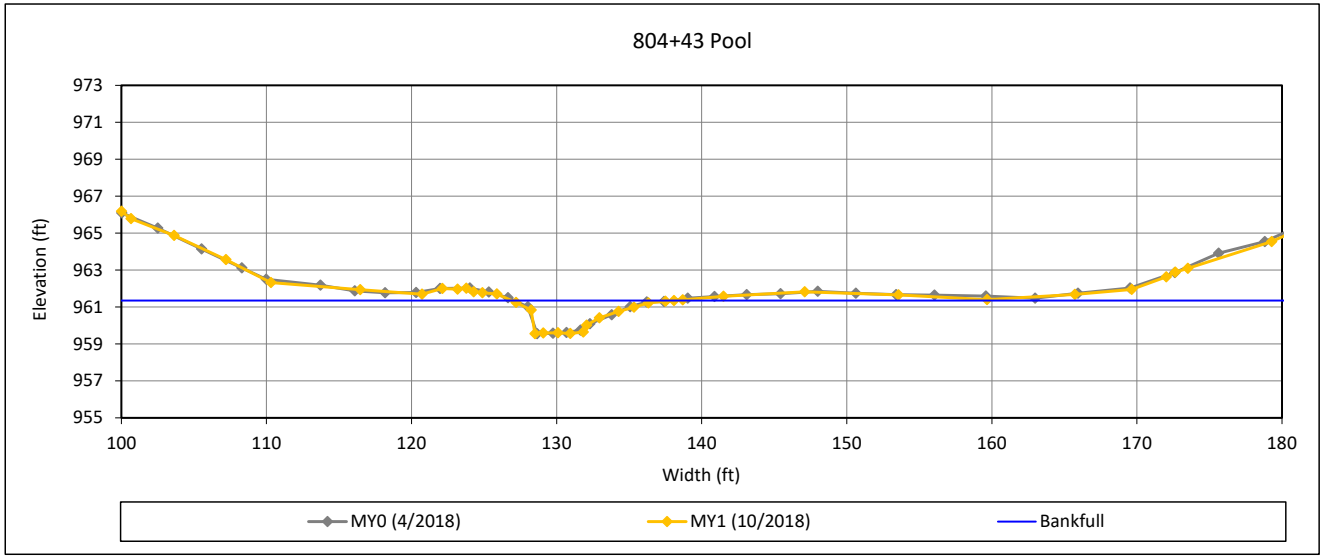
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Royster Creek Reach 1: Cross-Section 10



Bankfull Dimensions	
9.7	x-section area (ft.sq.)
11.2	width (ft)
0.9	mean depth (ft)
1.8	max depth (ft)
12.7	wetted perimeter (ft)
0.8	hydraulic radius (ft)
12.9	width-depth ratio

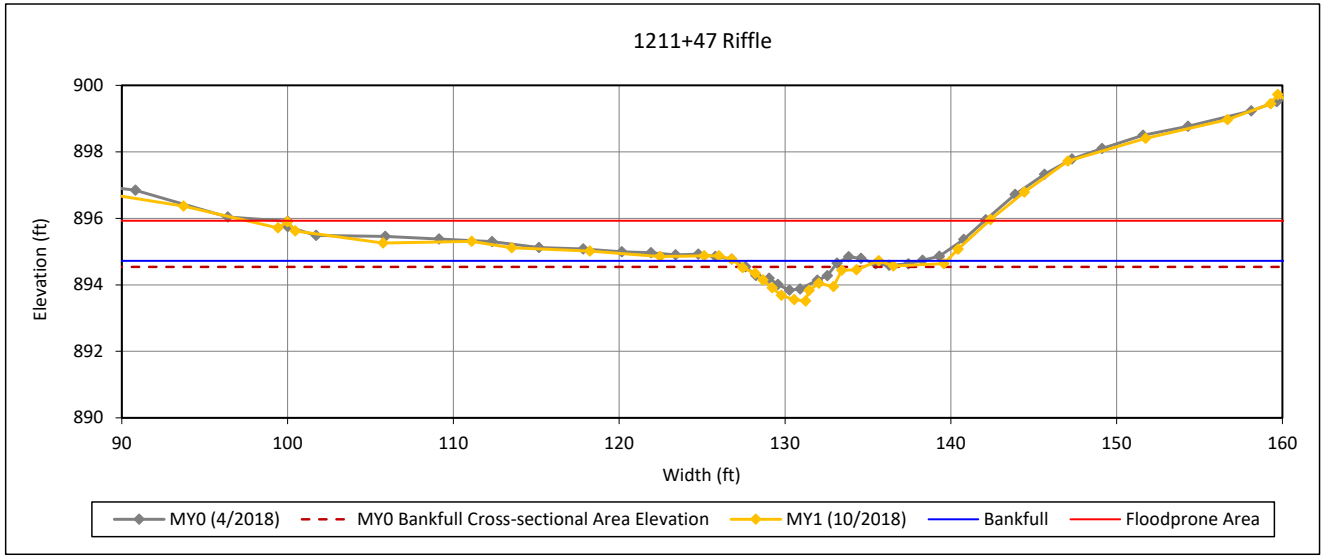
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Scott Creek: Cross-Section 11



Bankfull Dimensions	
5.1	x-section area (ft.sq.)
8.7	width (ft)
0.6	mean depth (ft)
1.2	max depth (ft)
9.4	wetted perimeter (ft)
0.5	hydraulic radius (ft)
15.0	width-depth ratio
44.8	W flood prone area (ft)
5.1	entrenchment ratio
1.2	low bank height ratio

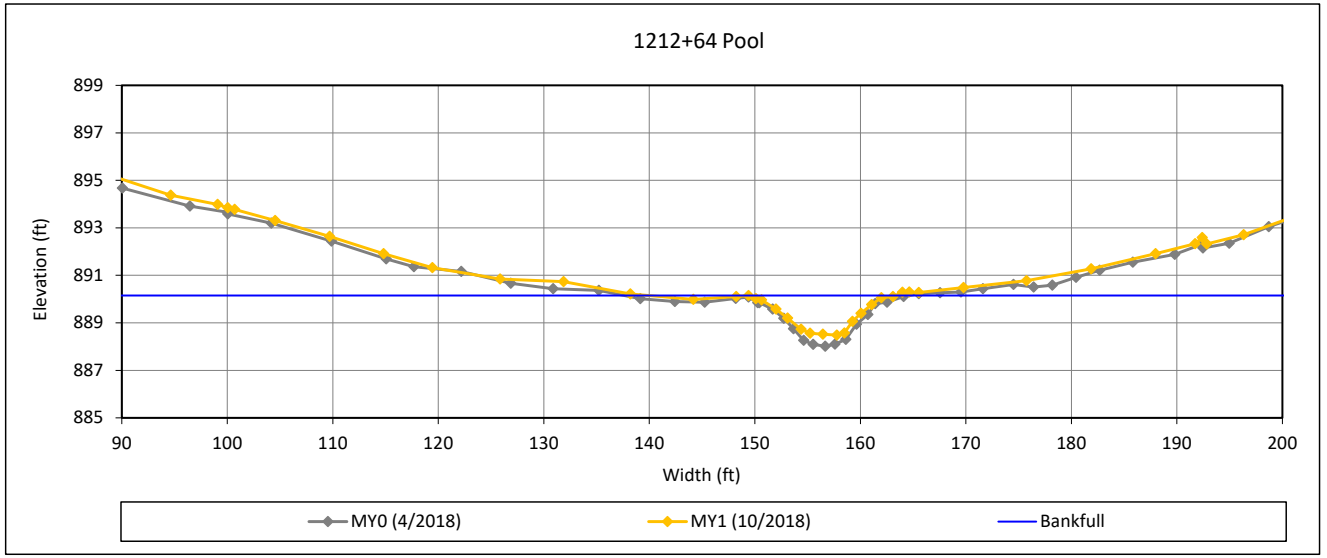
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Scott Creek: Cross-Section 12



Bankfull Dimensions	
12.2	x-section area (ft.sq.)
13.9	width (ft)
0.9	mean depth (ft)
1.7	max depth (ft)
14.5	wetted perimeter (ft)
0.8	hydraulic radius (ft)
15.8	width-depth ratio

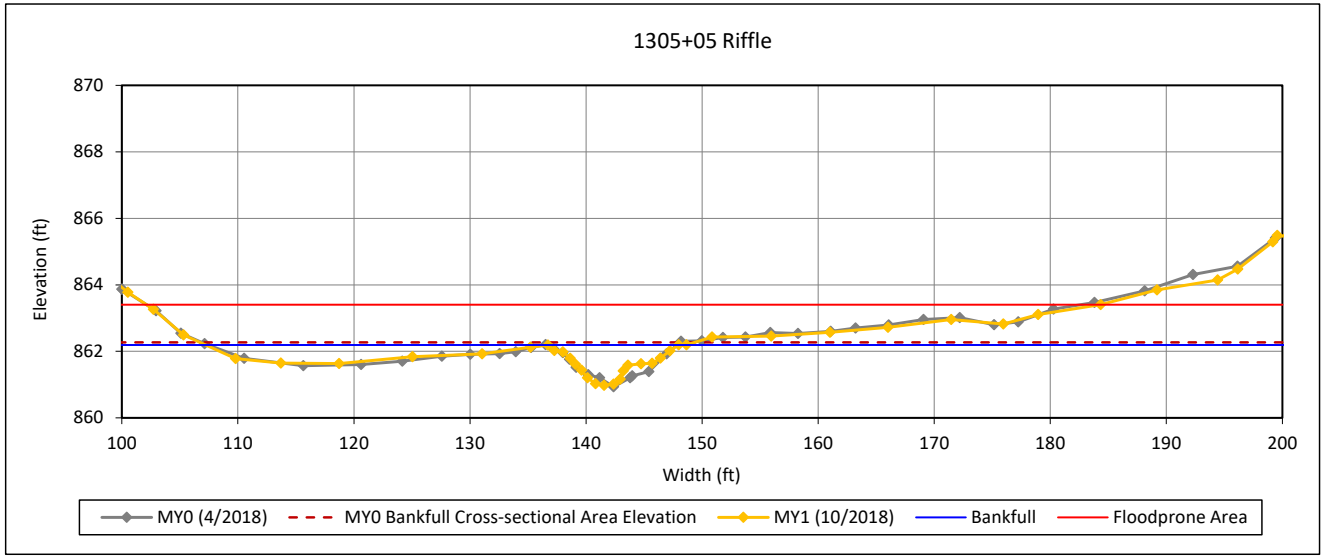
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

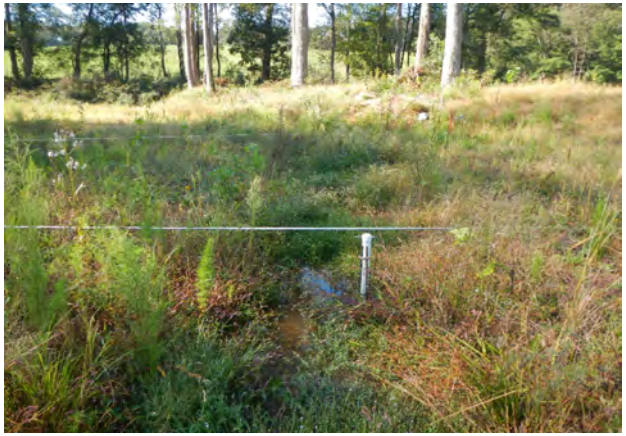
Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Carroll Creek Reach 1: Cross-Section 13



Bankfull Dimensions	
7.0	x-section area (ft.sq.)
11.3	width (ft)
0.6	mean depth (ft)
1.2	max depth (ft)
11.7	wetted perimeter (ft)
0.6	hydraulic radius (ft)
18.2	width-depth ratio
82.1	W flood prone area (ft)
7.3	entrenchment ratio
0.9	low bank height ratio

Survey Date: 10/2018
Field Crew: Wildlands Engineering

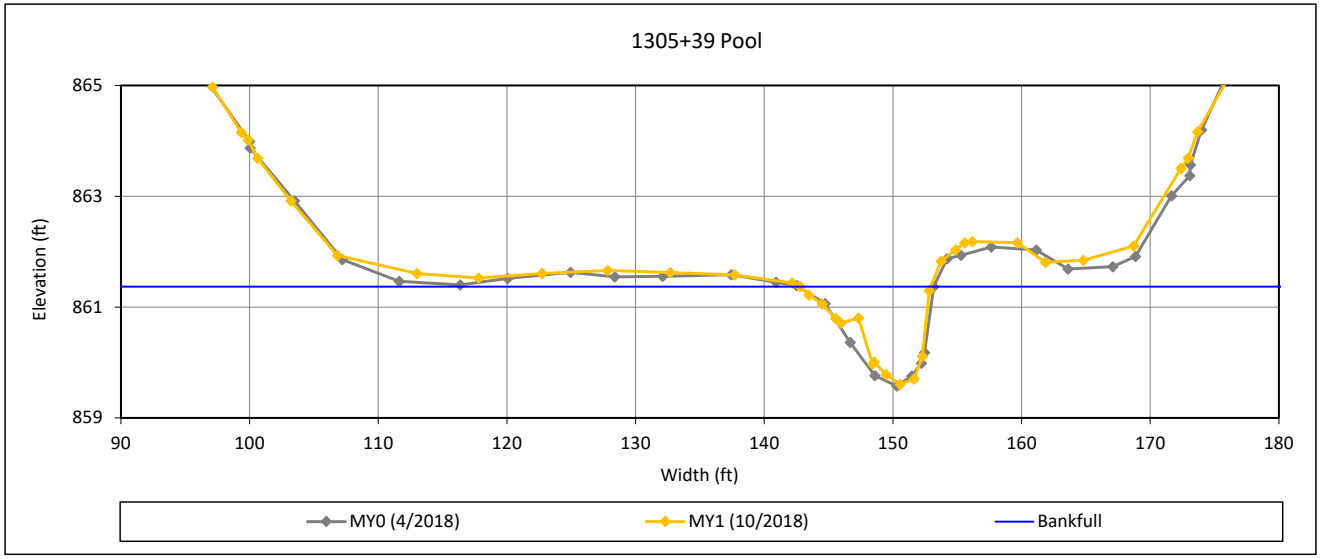


View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area A
NCDMS Project No. 739
Monitoring Year 1 - 2018

Carroll Creek Reach 1: Cross-Section 14



Bankfull Dimensions	
9.4	x-section area (ft.sq.)
10.2	width (ft)
0.9	mean depth (ft)
1.8	max depth (ft)
11.5	wetted perimeter (ft)
0.8	hydraulic radius (ft)
10.9	width-depth ratio

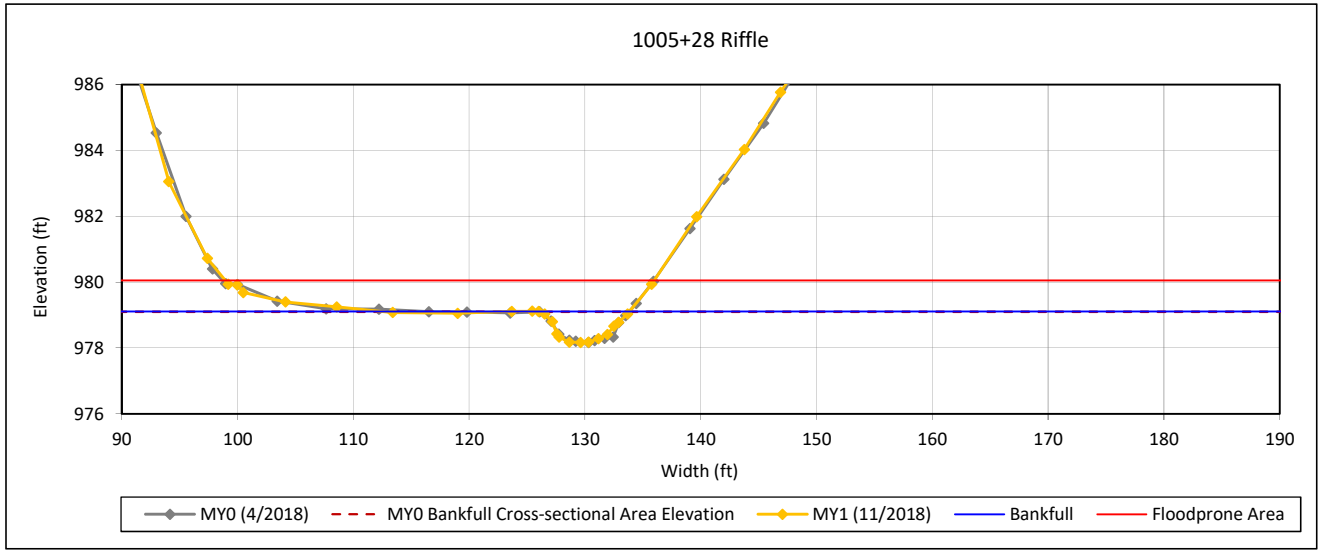
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 1: Cross-Section 15



Bankfull Dimensions	
4.8	x-section area (ft.sq.)
7.7	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
8.0	wetted perimeter (ft)
0.6	hydraulic radius (ft)
12.3	width-depth ratio
37.0	W flood prone area (ft)
4.8	entrenchment ratio
1.0	low bank height ratio

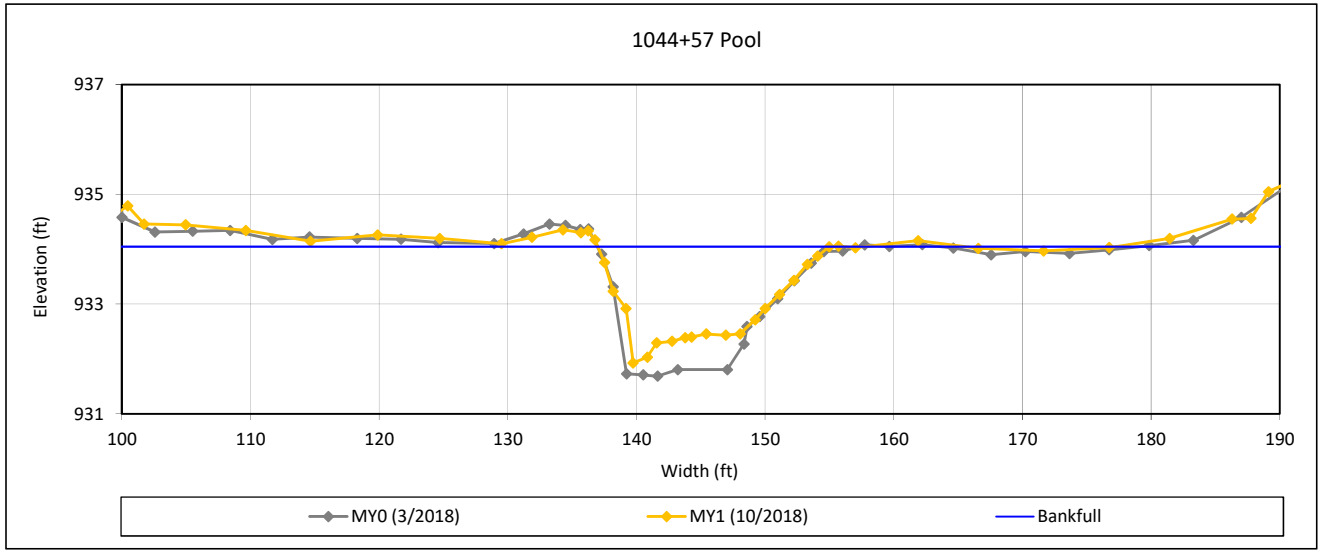
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5: Cross-Section 16



Bankfull Dimensions	
22.0	x-section area (ft.sq.)
18.0	width (ft)
1.2	mean depth (ft)
2.1	max depth (ft)
19.1	wetted perimeter (ft)
1.2	hydraulic radius (ft)
14.7	width-depth ratio

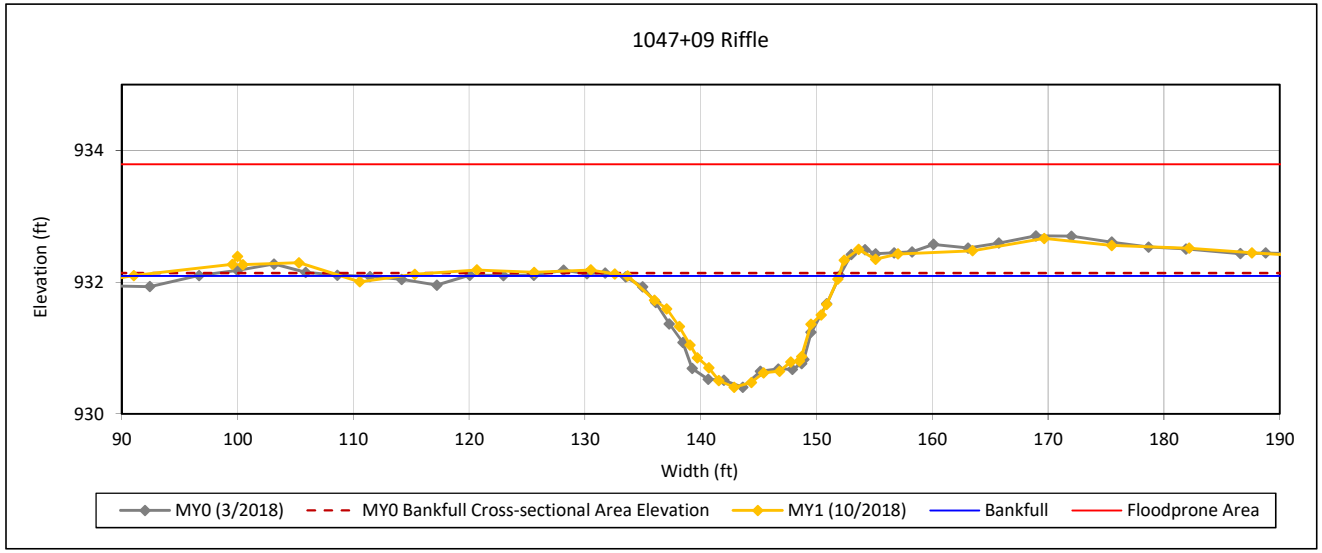
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5: Cross-Section 17



Bankfull Dimensions	
18.4	x-section area (ft.sq.)
18.3	width (ft)
1.0	mean depth (ft)
1.7	max depth (ft)
18.7	wetted perimeter (ft)
1.0	hydraulic radius (ft)
18.1	width-depth ratio
167.8	W flood prone area (ft)
9.2	entrenchment ratio
1.0	low bank height ratio

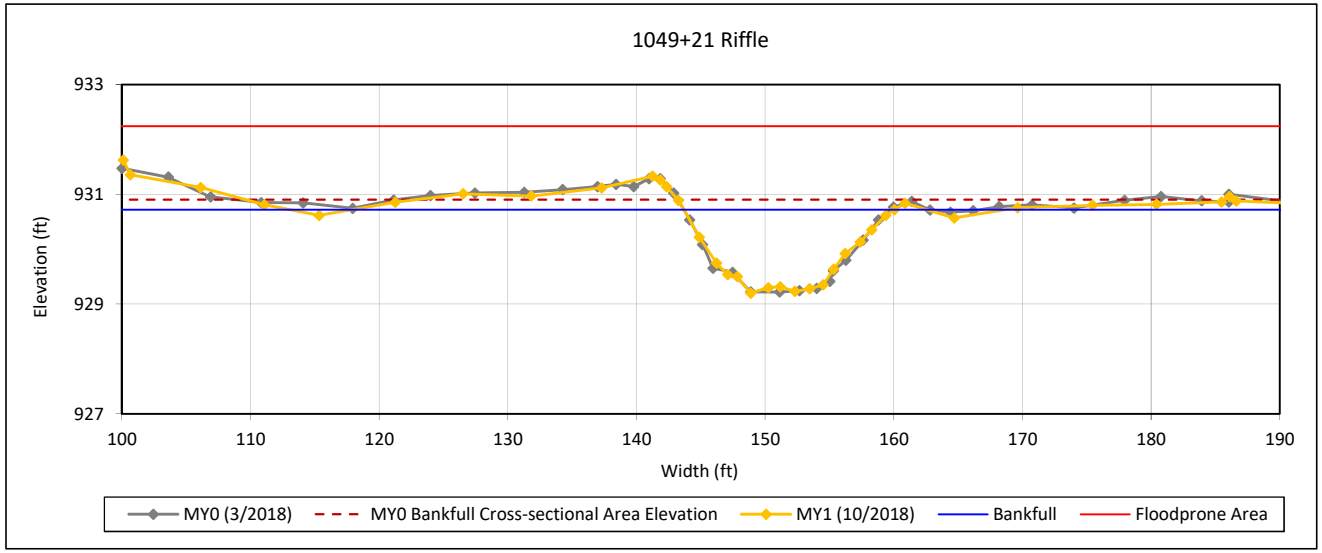
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5: Cross-Section 18



Bankfull Dimensions	
16.1	x-section area (ft.sq.)
16.4	width (ft)
1.0	mean depth (ft)
1.5	max depth (ft)
16.8	wetted perimeter (ft)
1.0	hydraulic radius (ft)
16.7	width-depth ratio
166.3	W flood prone area (ft)
10.2	entrenchment ratio
0.9	low bank height ratio

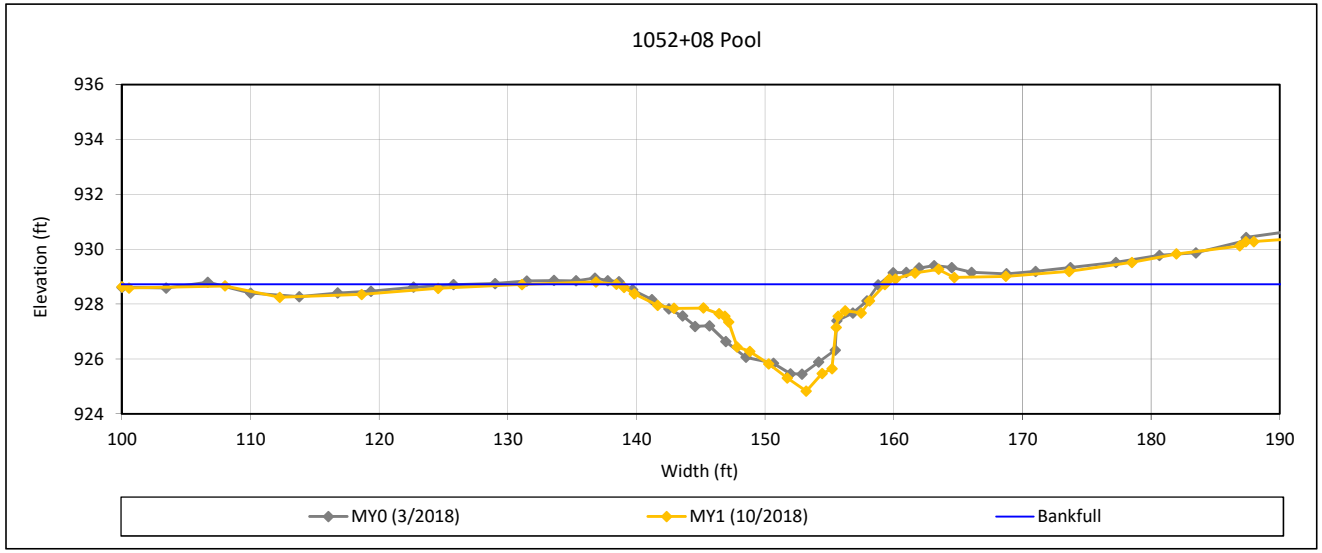
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5: Cross-Section 19



Bankfull Dimensions	
34.3	x-section area (ft.sq.)
20.9	width (ft)
1.6	mean depth (ft)
3.9	max depth (ft)
23.8	wetted perimeter (ft)
1.4	hydraulic radius (ft)
12.7	width-depth ratio

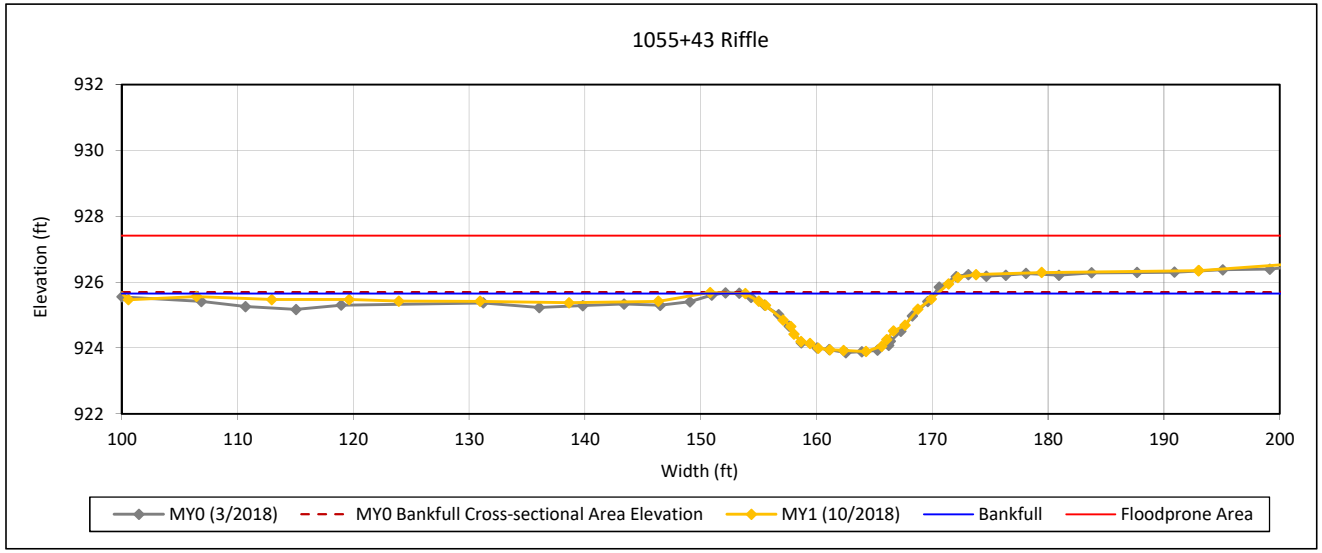
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5: Cross-Section 20



Bankfull Dimensions	
18.2	x-section area (ft.sq.)
16.6	width (ft)
1.1	mean depth (ft)
1.8	max depth (ft)
17.1	wetted perimeter (ft)
1.1	hydraulic radius (ft)
15.1	width-depth ratio
191.0	W flood prone area (ft)
11.5	entrenchment ratio
1.0	low bank height ratio

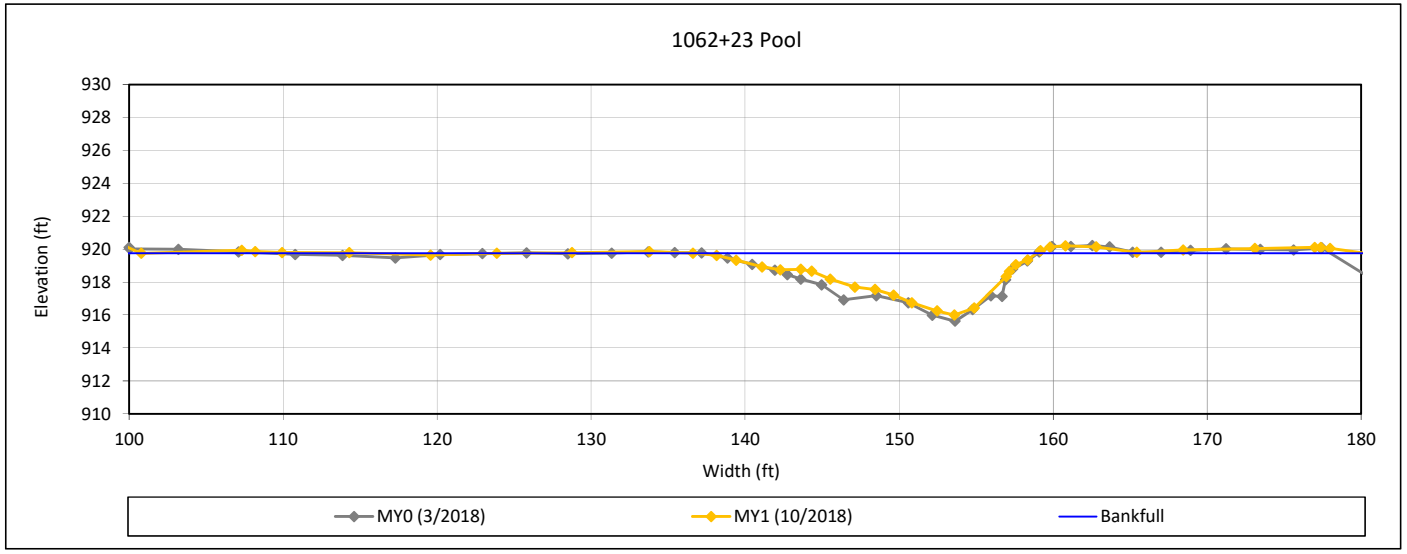
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6: Cross-Section 21



Bankfull Dimensions	
38.4	x-section area (ft.sq.)
22.3	width (ft)
1.7	mean depth (ft)
3.8	max depth (ft)
24.2	wetted perimeter (ft)
1.6	hydraulic radius (ft)
13.0	width-depth ratio

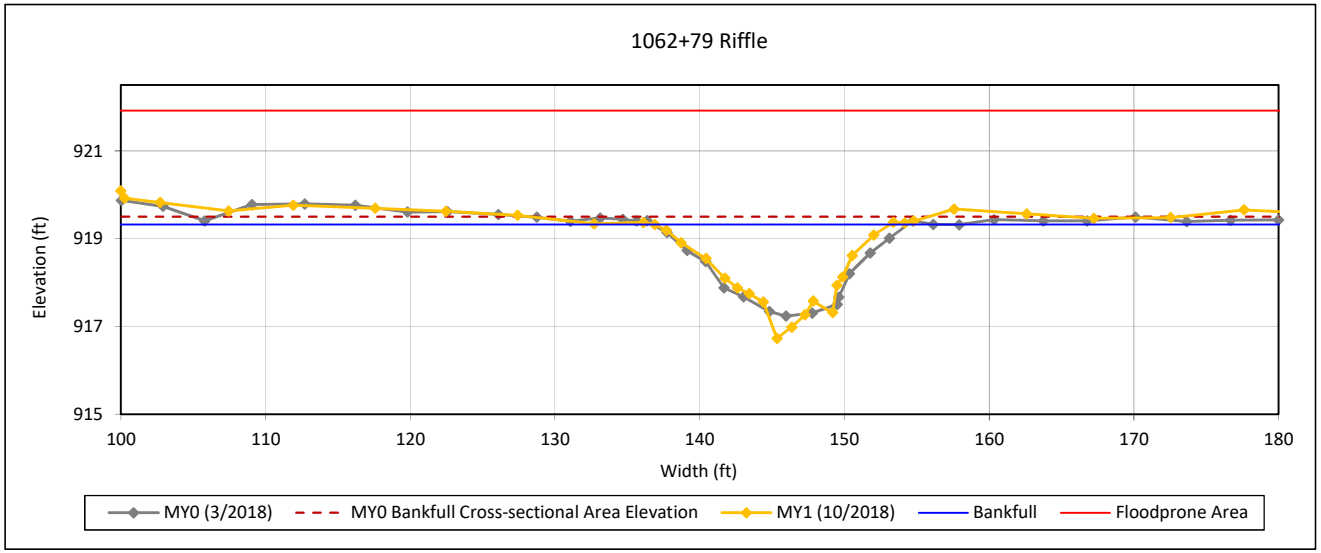
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6: Cross-Section 22



Bankfull Dimensions	
19.4	x-section area (ft.sq.)
16.3	width (ft)
1.2	mean depth (ft)
2.6	max depth (ft)
17.7	wetted perimeter (ft)
1.1	hydraulic radius (ft)
13.7	width-depth ratio
221.2	W flood prone area (ft)
13.6	entrenchment ratio
0.9	low bank height ratio

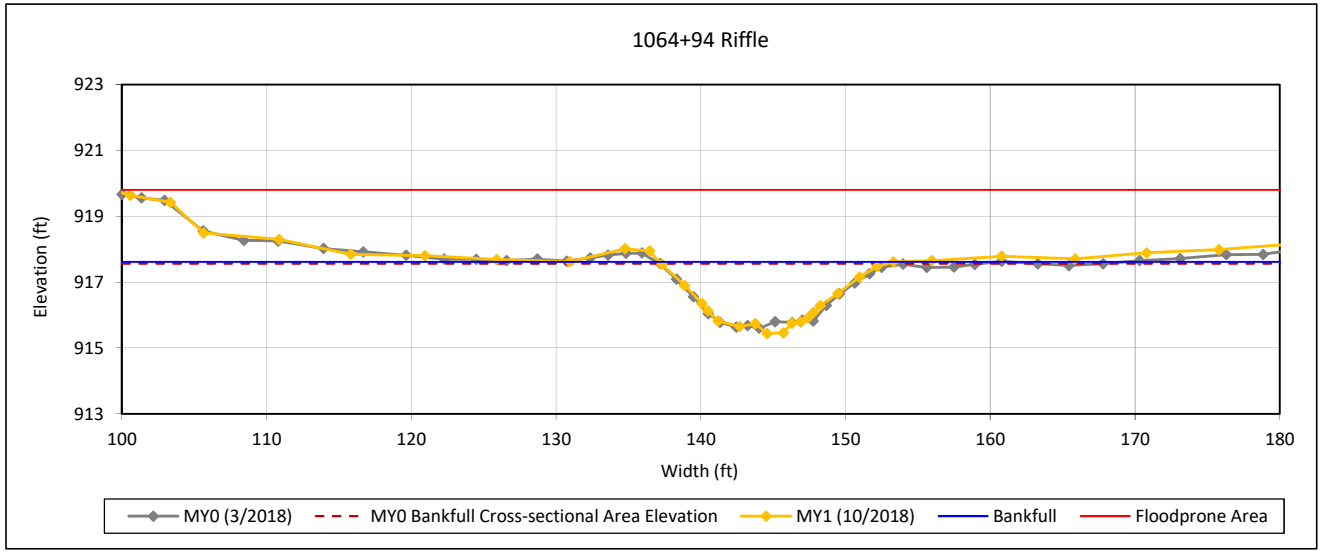
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6: Cross-Section 23



Bankfull Dimensions	
20.0	x-section area (ft.sq.)
16.2	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
17.0	wetted perimeter (ft)
1.2	hydraulic radius (ft)
13.1	width-depth ratio
130.5	W flood prone area (ft)
8.1	entrenchment ratio
1.0	low bank height ratio

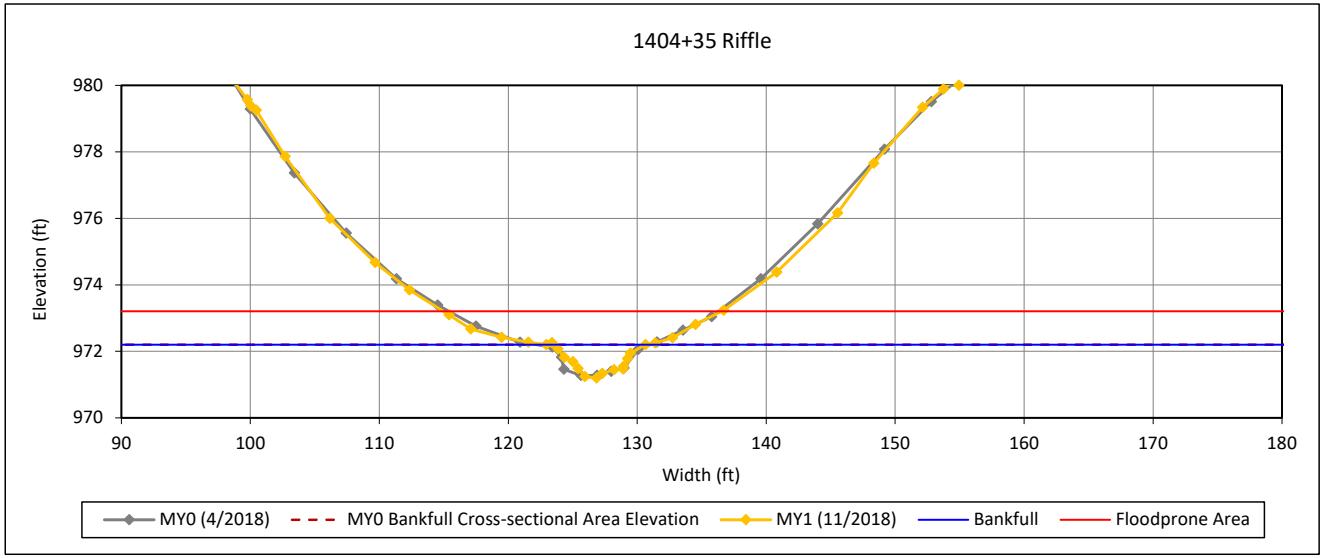
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek: Cross-Section 24



Bankfull Dimensions	
4.1	x-section area (ft.sq.)
7.1	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
7.5	wetted perimeter (ft)
0.5	hydraulic radius (ft)
12.3	width-depth ratio
21.6	W flood prone area (ft)
3.0	entrenchment ratio
1.0	low bank height ratio

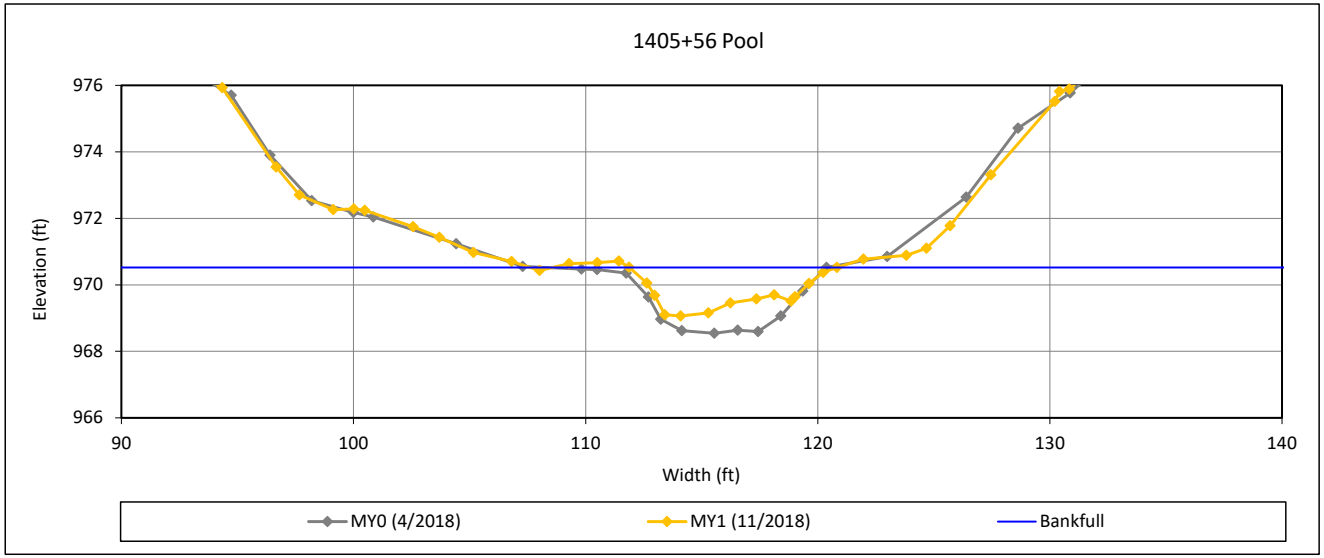
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek: Cross-Section 25



Bankfull Dimensions	
8.0	x-section area (ft.sq.)
8.9	width (ft)
0.9	mean depth (ft)
1.5	max depth (ft)
9.9	wetted perimeter (ft)
0.8	hydraulic radius (ft)
10.0	width-depth ratio

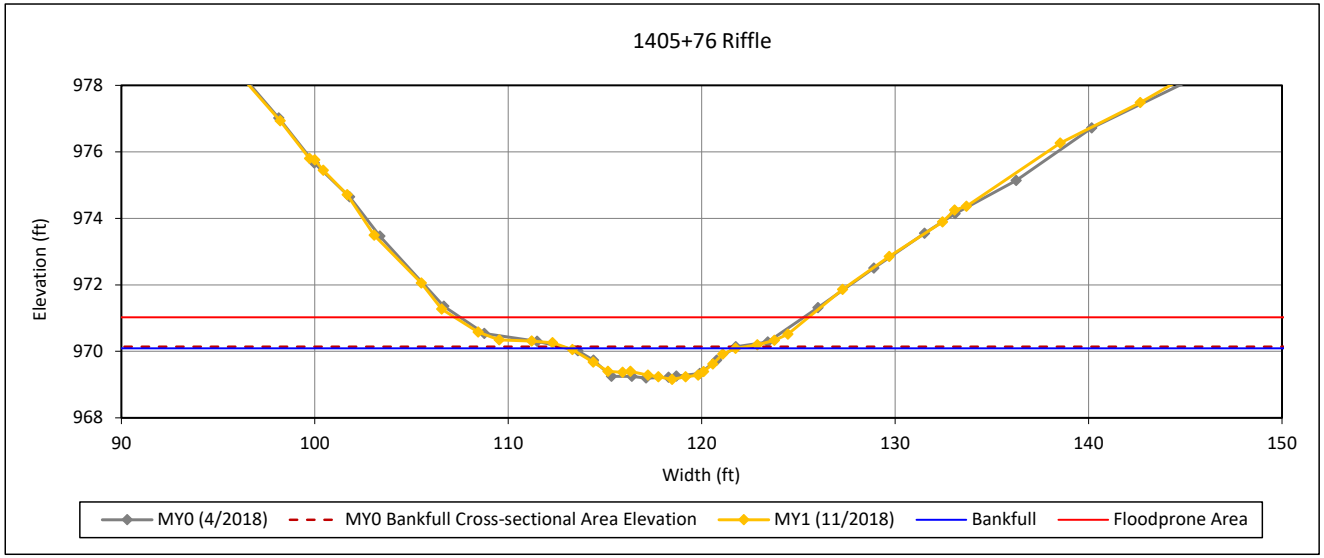
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek: Cross-Section 26



Bankfull Dimensions	
5.1	x-section area (ft.sq.)
8.6	width (ft)
0.6	mean depth (ft)
0.9	max depth (ft)
8.9	wetted perimeter (ft)
0.6	hydraulic radius (ft)
14.5	width-depth ratio
18.3	W flood prone area (ft)
2.1	entrenchment ratio
1.0	low bank height ratio

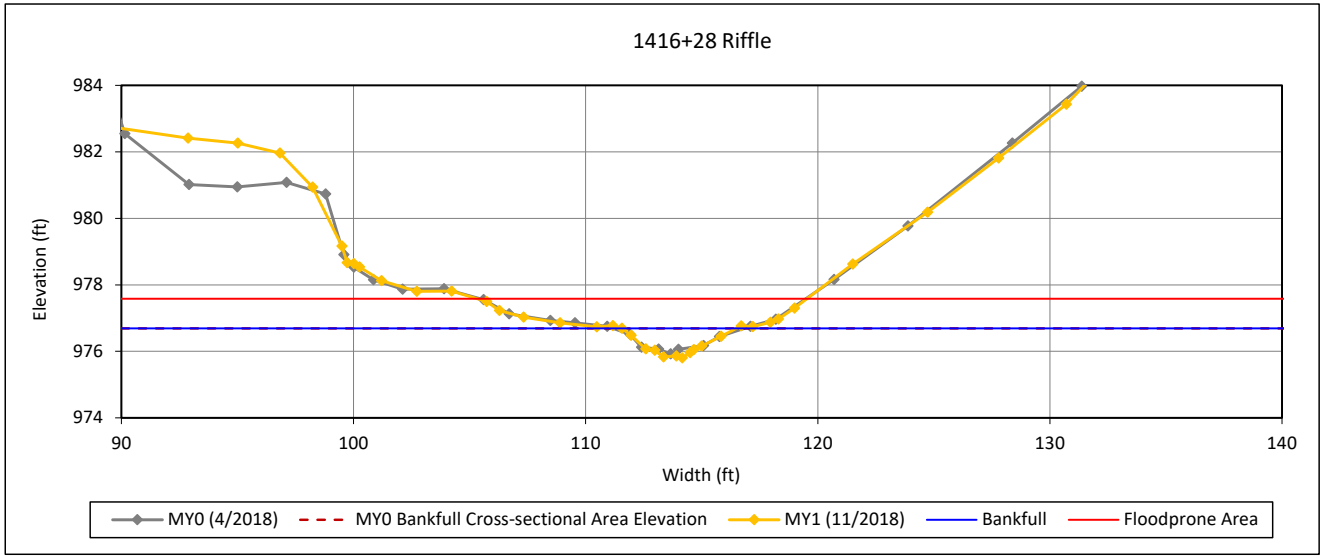
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UT1 to Elliott Creek: Cross-Section 27



Bankfull Dimensions	
2.5	x-section area (ft.sq.)
4.9	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
5.3	wetted perimeter (ft)
0.5	hydraulic radius (ft)
9.7	width-depth ratio
14.2	W flood prone area (ft)
2.9	entrenchment ratio
1.0	low bank height ratio

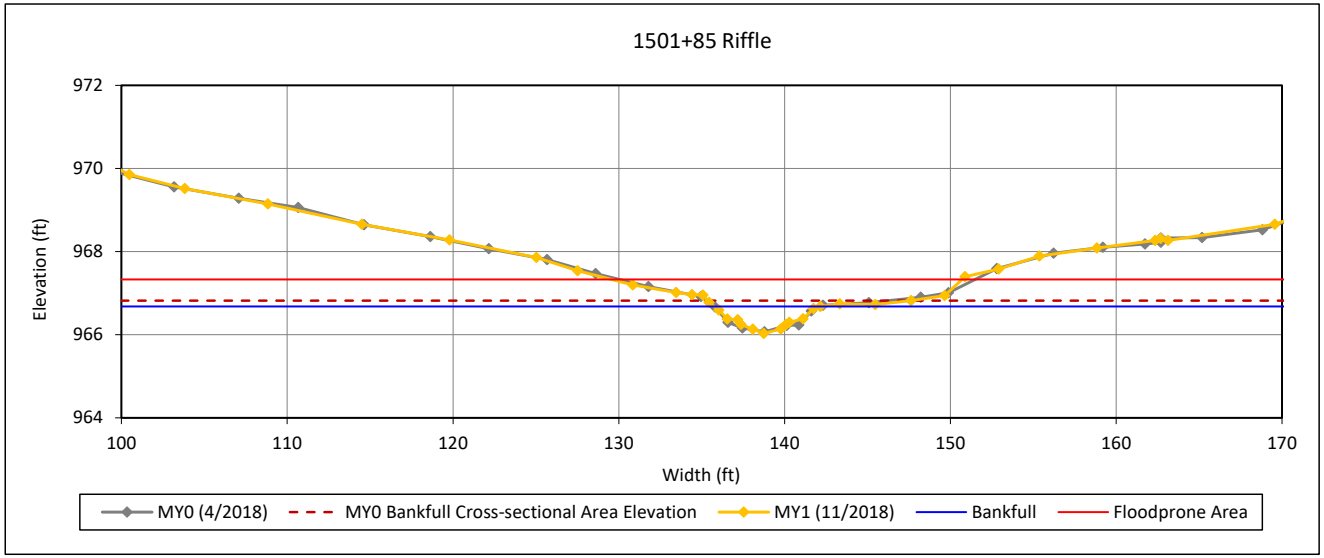
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

Bridges Creek: Cross-Section 28



Bankfull Dimensions	
2.4	x-section area (ft.sq.)
6.4	width (ft)
0.4	mean depth (ft)
0.6	max depth (ft)
6.6	wetted perimeter (ft)
0.4	hydraulic radius (ft)
17.2	width-depth ratio
21.1	W flood prone area (ft)
3.3	entrenchment ratio
0.8	low bank height ratio

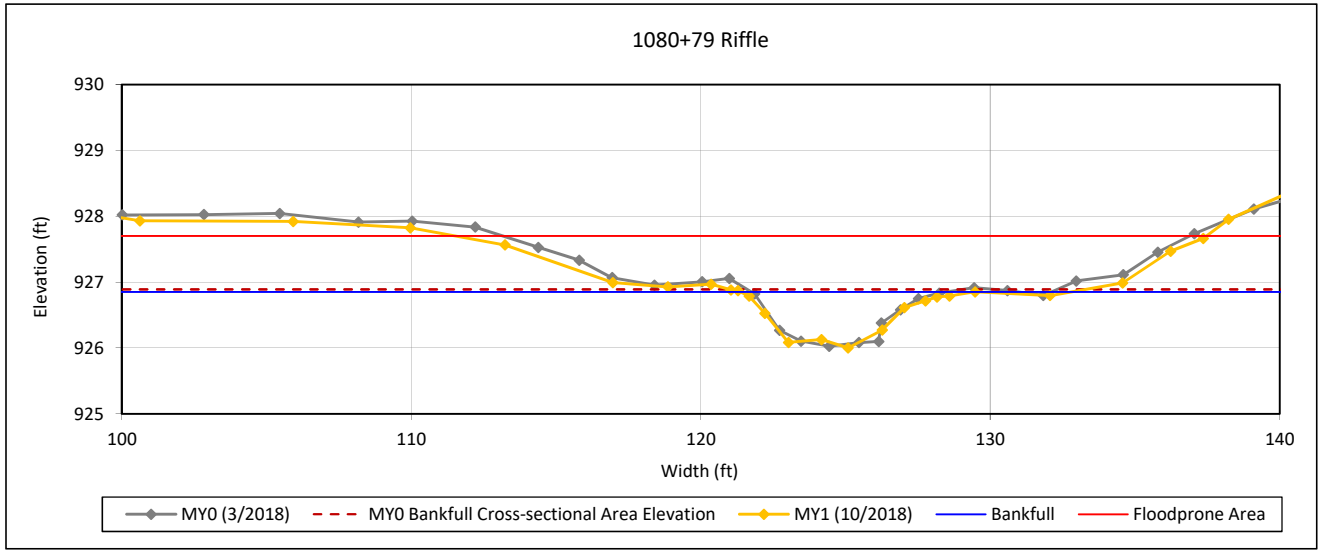
Survey Date: 11/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC UT2: Cross-Section 29



Bankfull Dimensions	
3.5	x-section area (ft.sq.)
8.1	width (ft)
0.4	mean depth (ft)
0.9	max depth (ft)
8.4	wetted perimeter (ft)
0.4	hydraulic radius (ft)
18.6	width-depth ratio
26.0	W flood prone area (ft)
3.2	entrenchment ratio
1.0	low bank height ratio

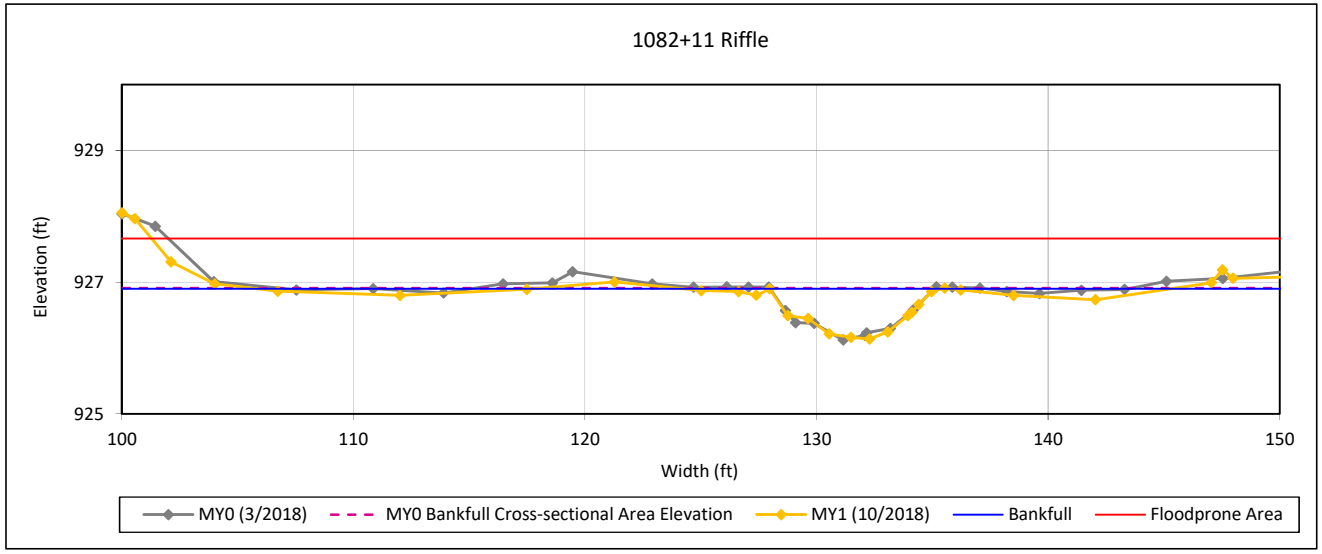
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach UT3: Cross-Section 30



Bankfull Dimensions	
3.6	x-section area (ft.sq.)
7.4	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
7.7	wetted perimeter (ft)
0.5	hydraulic radius (ft)
15.5	width-depth ratio
62.8	W flood prone area (ft)
8.4	entrenchment ratio
1.0	low bank height ratio

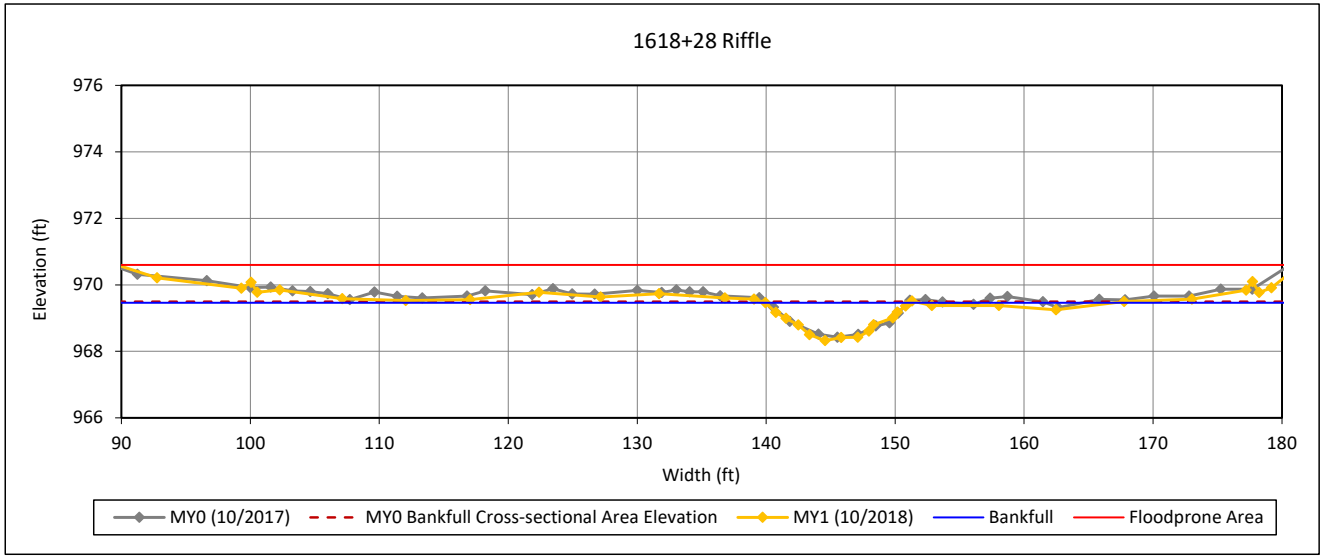
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 31



Bankfull Dimensions	
7.8	x-section area (ft.sq.)
11.2	width (ft)
0.7	mean depth (ft)
1.1	max depth (ft)
11.5	wetted perimeter (ft)
0.7	hydraulic radius (ft)
16.0	width-depth ratio
91.7	W flood prone area (ft)
8.2	entrenchment ratio
1.0	low bank height ratio

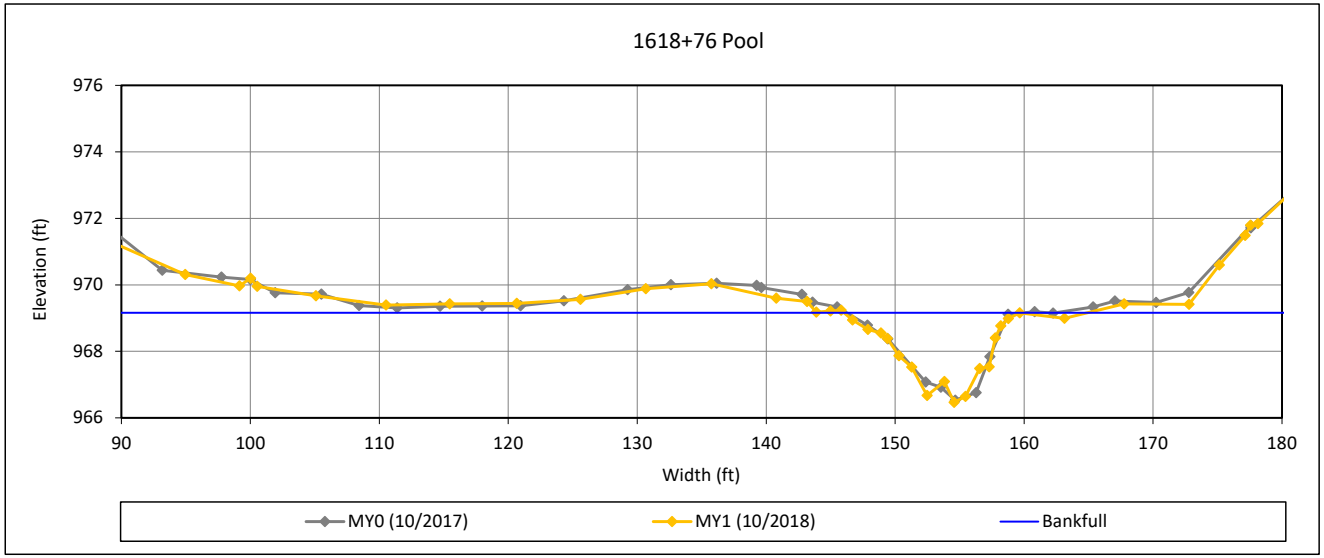
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 32



Bankfull Dimensions	
18.0	x-section area (ft.sq.)
13.6	width (ft)
1.3	mean depth (ft)
2.7	max depth (ft)
15.5	wetted perimeter (ft)
1.2	hydraulic radius (ft)
10.3	width-depth ratio

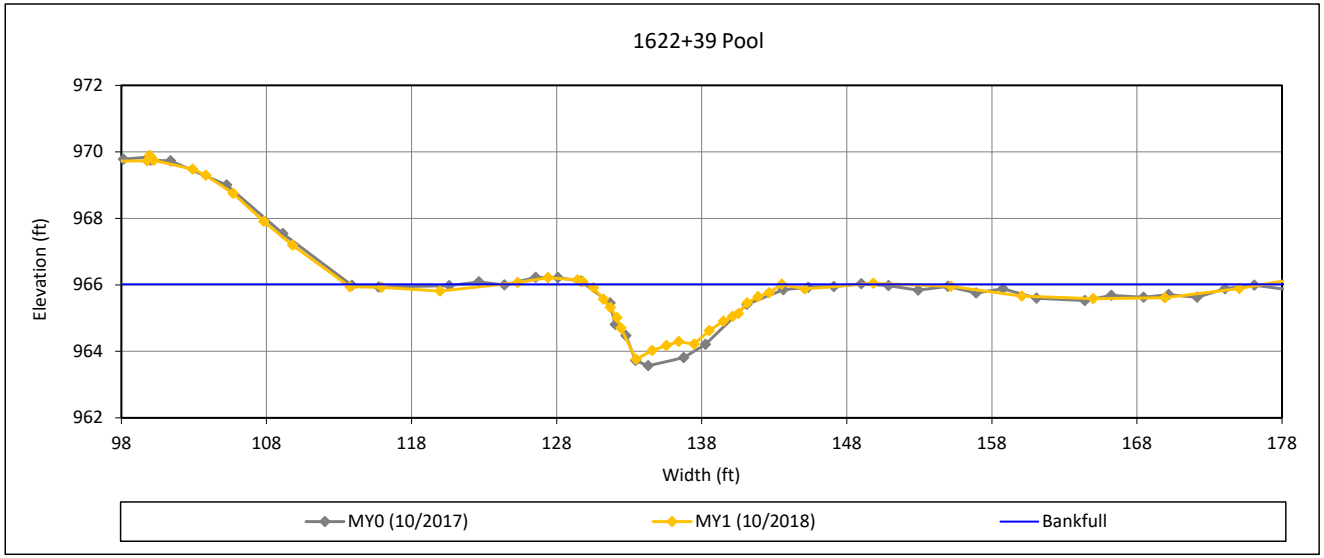
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 33



Bankfull Dimensions	
15.7	x-section area (ft.sq.)
13.4	width (ft)
1.2	mean depth (ft)
2.3	max depth (ft)
14.5	wetted perimeter (ft)
1.1	hydraulic radius (ft)
11.4	width-depth ratio

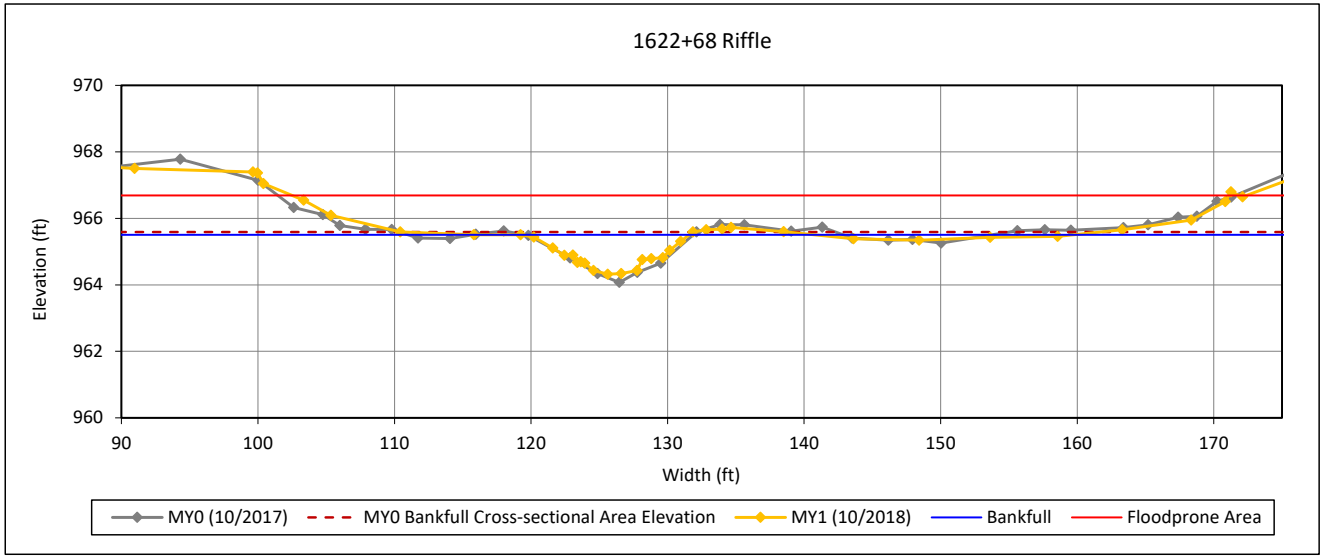
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 34



Bankfull Dimensions	
8.1	x-section area (ft.sq.)
12.3	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
12.8	wetted perimeter (ft)
0.6	hydraulic radius (ft)
18.7	width-depth ratio
69.1	W flood prone area (ft)
5.6	entrenchment ratio
0.9	low bank height ratio

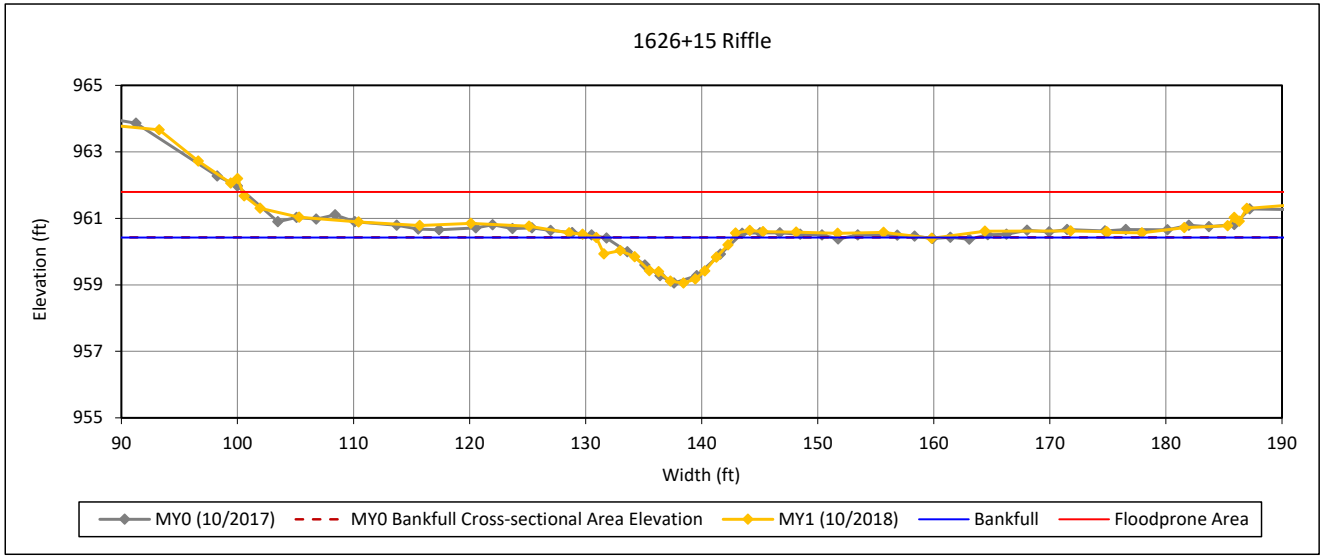
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 35



Bankfull Dimensions	
9.4	x-section area (ft.sq.)
11.7	width (ft)
0.8	mean depth (ft)
1.4	max depth (ft)
12.3	wetted perimeter (ft)
0.8	hydraulic radius (ft)
14.7	width-depth ratio
96.4	W flood prone area (ft)
8.2	entrenchment ratio
1.0	low bank height ratio

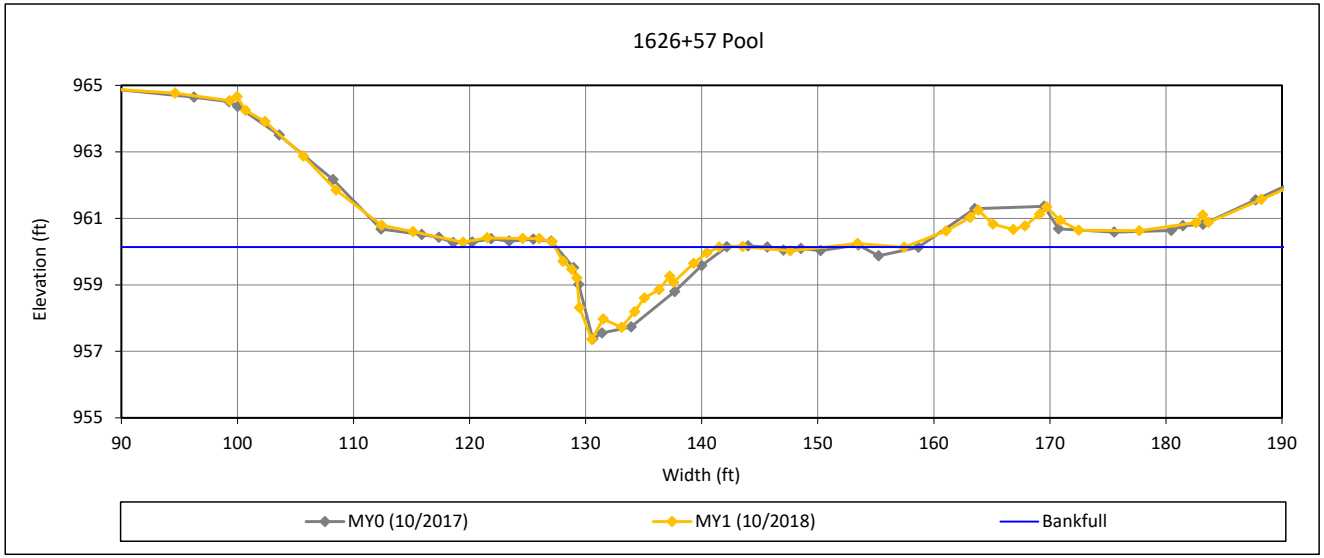
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2: Cross-Section 36



Bankfull Dimensions	
18.5	x-section area (ft.sq.)
14.2	width (ft)
1.3	mean depth (ft)
2.8	max depth (ft)
16.2	wetted perimeter (ft)
1.1	hydraulic radius (ft)
10.8	width-depth ratio

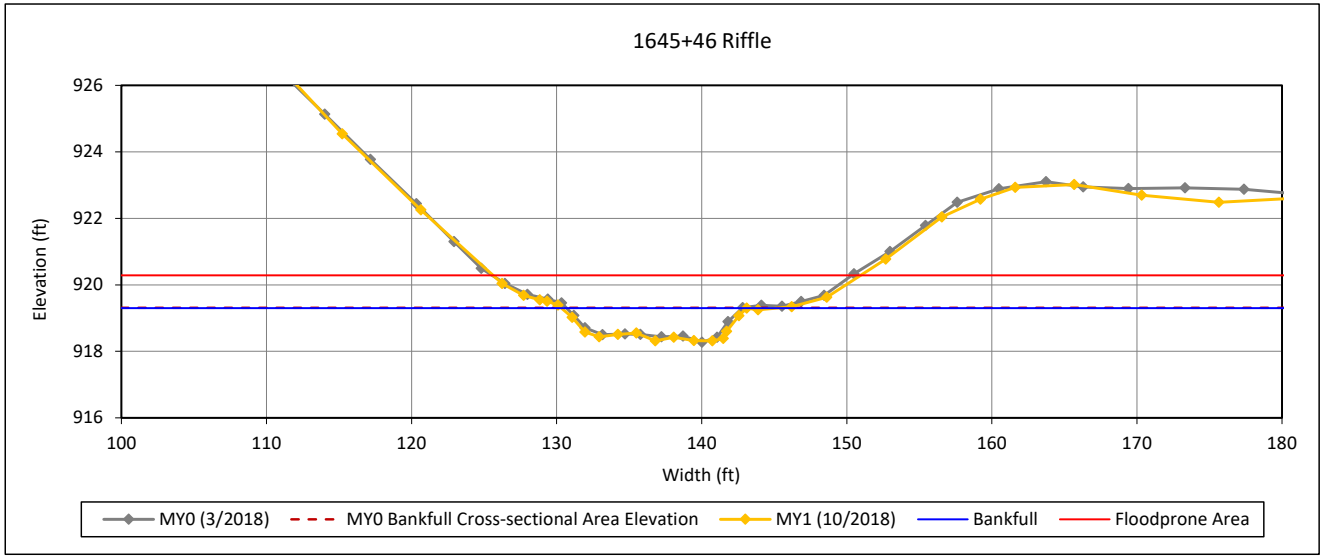
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 1: Cross-Section 37



Bankfull Dimensions	
9.6	x-section area (ft.sq.)
12.8	width (ft)
0.7	mean depth (ft)
1.0	max depth (ft)
13.2	wetted perimeter (ft)
0.7	hydraulic radius (ft)
17.1	width-depth ratio
25.3	W flood prone area (ft)
2.0	entrenchment ratio
1.0	low bank height ratio

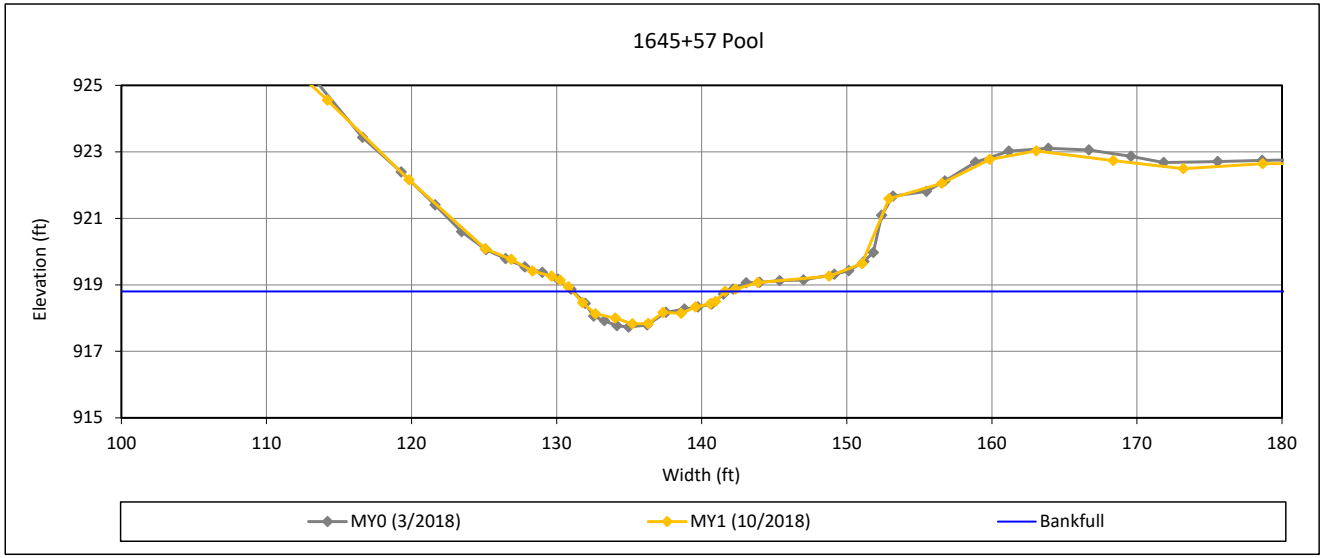
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 1: Cross-Section 38



Bankfull Dimensions	
6.5	x-section area (ft.sq.)
10.5	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
10.8	wetted perimeter (ft)
0.6	hydraulic radius (ft)
17.0	width-depth ratio

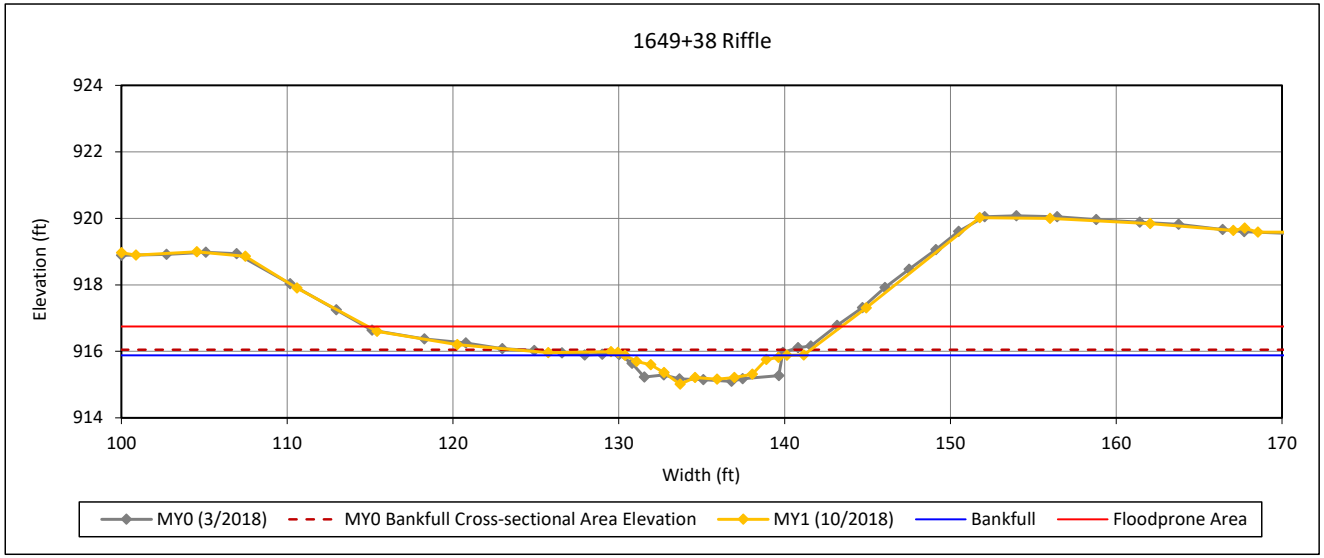
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 2: Cross-Section 39



Bankfull Dimensions	
4.6	x-section area (ft.sq.)
9.8	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
10.0	wetted perimeter (ft)
0.5	hydraulic radius (ft)
20.5	width-depth ratio
28.6	W flood prone area (ft)
2.9	entrenchment ratio
0.8	low bank height ratio

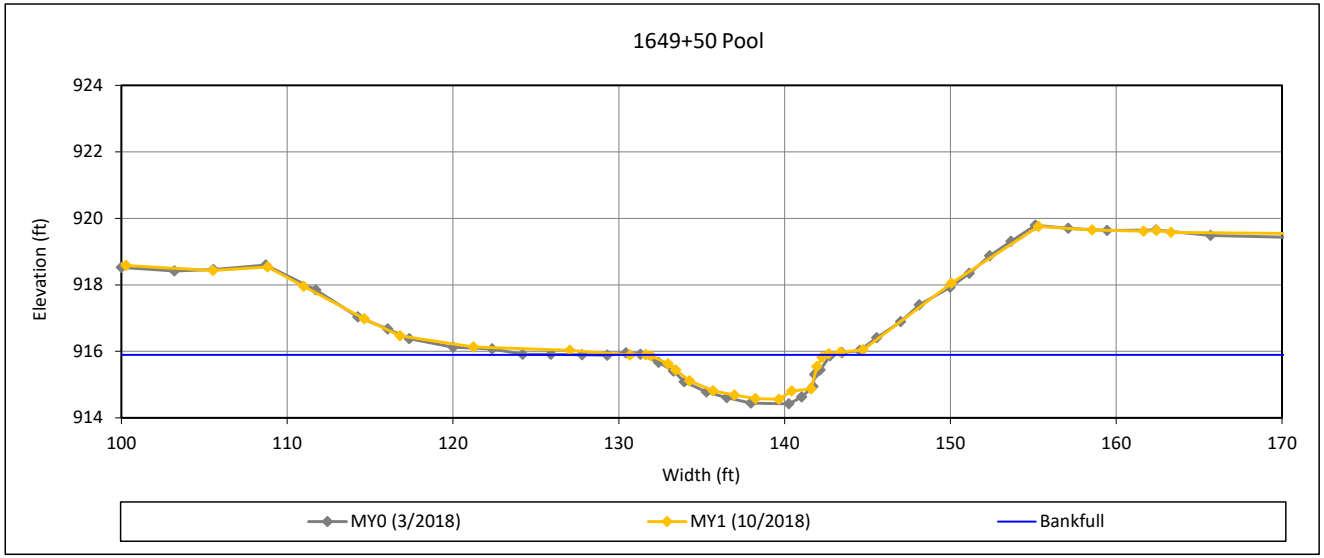
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area B
NCDMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 2: Cross-Section 40



Bankfull Dimensions	
9.6	x-section area (ft.sq.)
10.9	width (ft)
0.9	mean depth (ft)
1.3	max depth (ft)
11.6	wetted perimeter (ft)
0.8	hydraulic radius (ft)
12.4	width-depth ratio

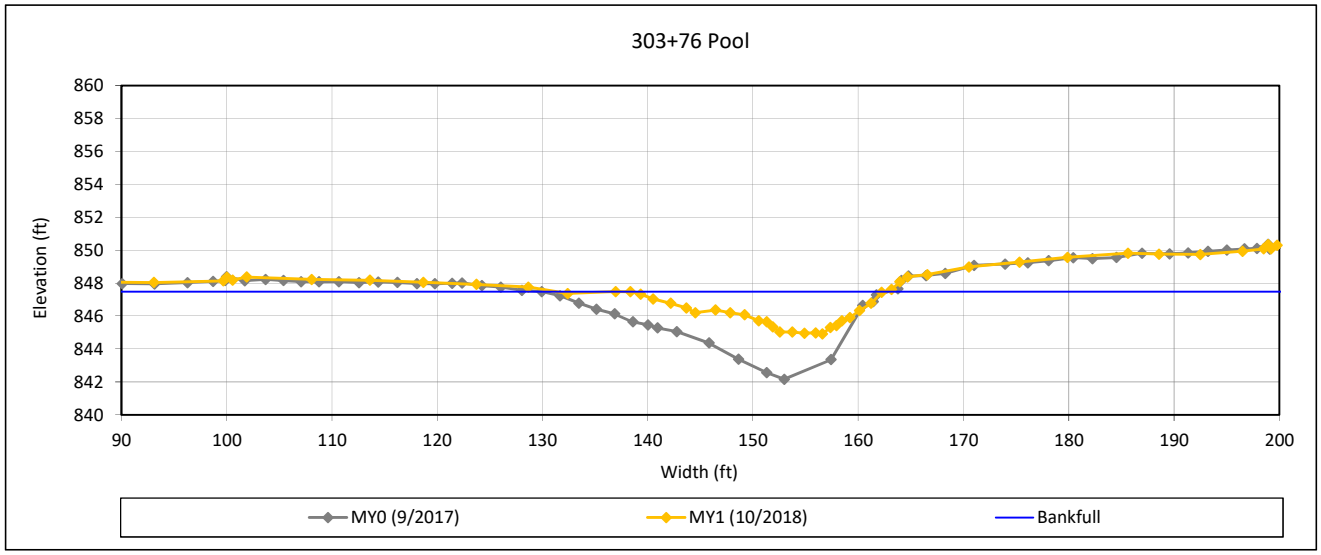
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area C
NCDMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1A: Cross-Section 41



Bankfull Dimensions	
33.5	x-section area (ft.sq.)
24.0	width (ft)
1.4	mean depth (ft)
2.6	max depth (ft)
25.0	wetted perimeter (ft)
1.3	hydraulic radius (ft)
17.2	width-depth ratio

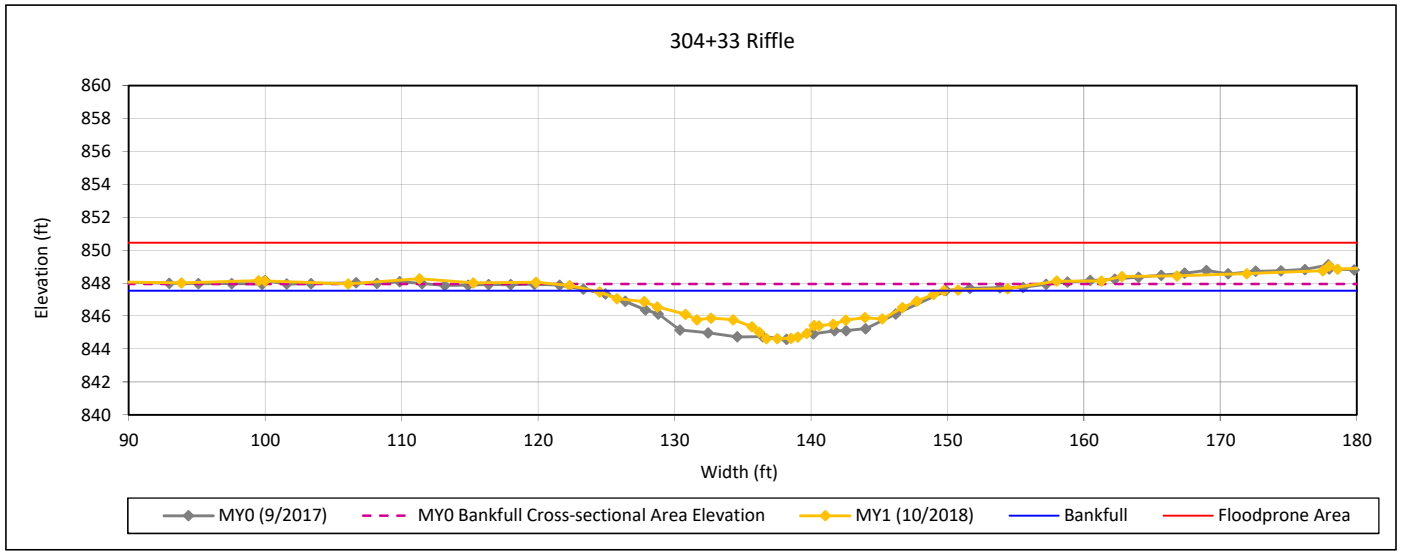
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area C
NCDMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1A: Cross-Section 42



Bankfull Dimensions	
38.7	x-section area (ft.sq.)
25.7	width (ft)
1.5	mean depth (ft)
2.9	max depth (ft)
26.9	wetted perimeter (ft)
1.4	hydraulic radius (ft)
17.1	width-depth ratio
155.7	W flood prone area (ft)
6.1	entrenchment ratio
0.9	low bank height ratio

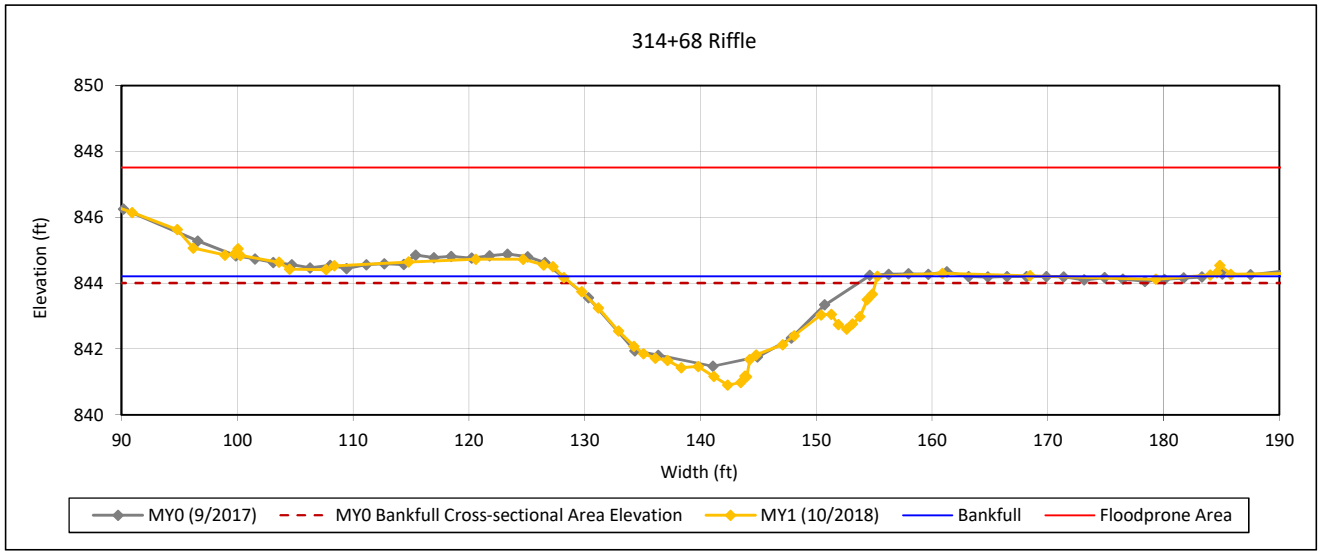
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area C
NCDMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1B/2: Cross-Section 43



Bankfull Dimensions	
51.5	x-section area (ft.sq.)
27.2	width (ft)
1.9	mean depth (ft)
3.3	max depth (ft)
28.8	wetted perimeter (ft)
1.8	hydraulic radius (ft)
14.3	width-depth ratio
171.0	W flood prone area (ft)
6.3	entrenchment ratio
1.1	low bank height ratio

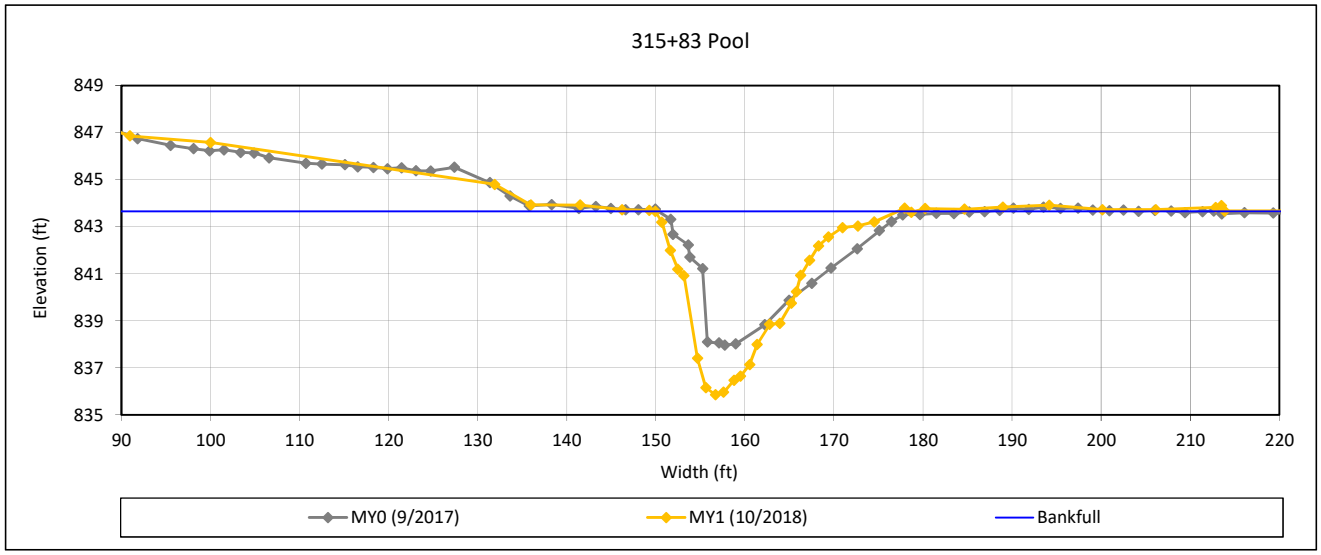
Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Big Harris Creek Mitigation Site - Area C
NCDMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1B/2: Cross-Section 44



Bankfull Dimensions	
91.0	x-section area (ft.sq.)
27.2	width (ft)
3.3	mean depth (ft)
7.8	max depth (ft)
33.4	wetted perimeter (ft)
2.7	hydraulic radius (ft)
8.1	width-depth ratio

Survey Date: 10/2018
Field Crew: Wildlands Engineering

View Downstream

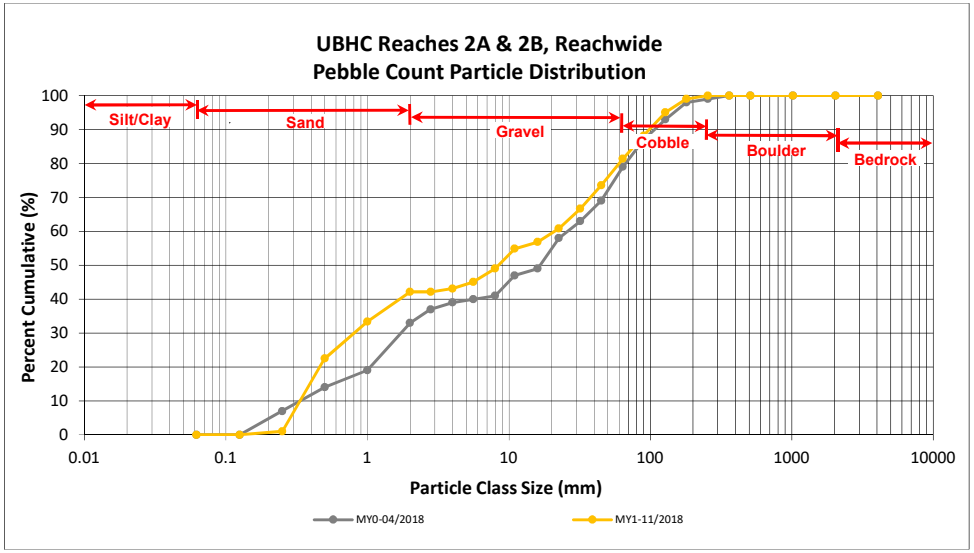
Reachwide and Cross-Section Pebble Count Plots

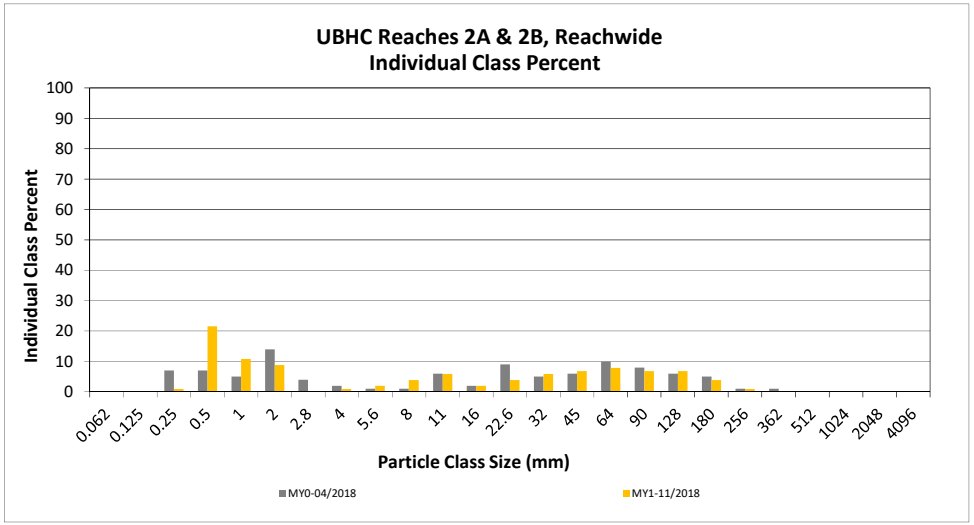
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reaches 2A & 2B, 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					0
SAND	Very fine	0.062	0.125					0
	Fine	0.125	0.250		1	1	1	1
	Medium	0.25	0.50	4	18	22	22	23
	Coarse	0.5	1.0		11	11	11	33
	Very Coarse	1.0	2.0	3	6	9	9	42
GRAVEL	Very Fine	2.0	2.8					42
	Very Fine	2.8	4.0		1	1	1	43
	Fine	4.0	5.6		2	2	2	45
	Fine	5.6	8.0		4	4	4	49
	Medium	8.0	11.0	2	4	6	6	55
	Medium	11.0	16.0	1	1	2	2	57
	Coarse	16.0	22.6	3	1	4	4	61
	Coarse	22.6	32	5	1	6	6	67
	Very Coarse	32	45	7		7	7	74
	Very Coarse	45	64	7	1	8	8	81
COBBLE	Small	64	90	7		7	7	88
	Small	90	128	7		7	7	95
	Large	128	180	4		4	4	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**	**52**	**102**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.41
D_{35} =	1.14
D_{50} =	8.4
D_{84} =	72.9
D_{95} =	127.4
D_{100} =	256.0





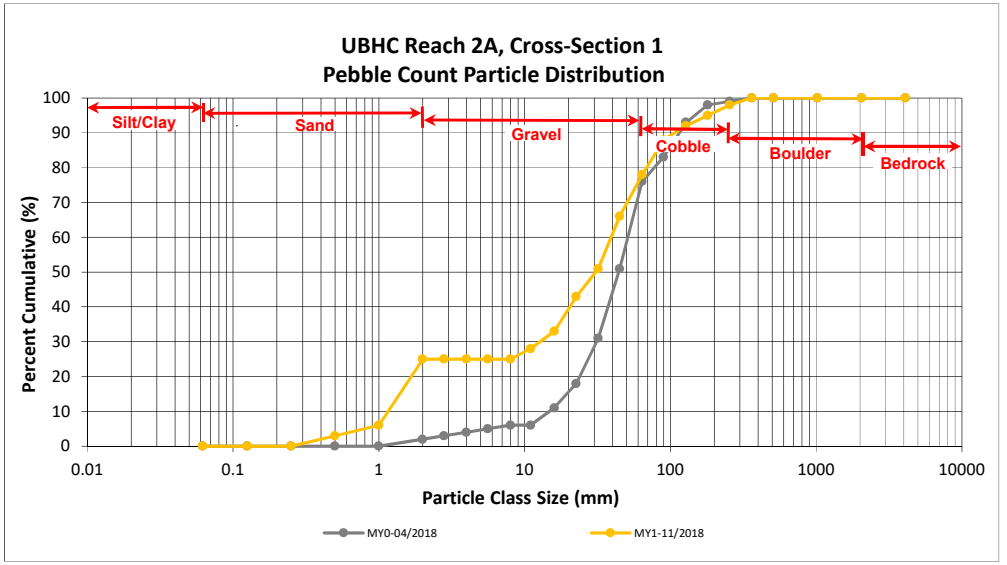
Reachwide and Cross-Section Pebble Count Plots

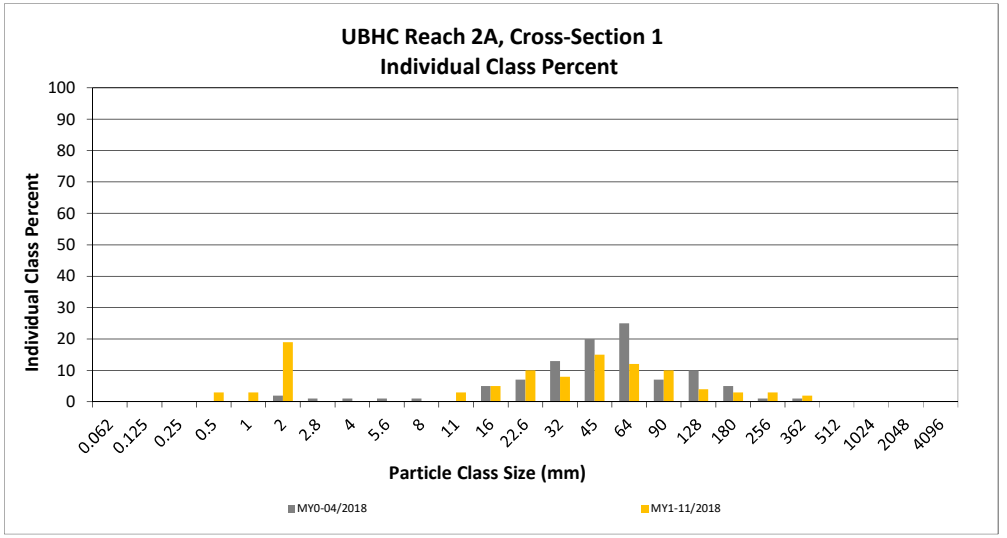
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2A, Cross-Section 1

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	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	3	3	3
	Coarse	0.5	1.0	3	3	6
	Very Coarse	1.0	2.0	19	19	25
GRAVEL	Very Fine	2.0	2.8			25
	Very Fine	2.8	4.0			25
	Fine	4.0	5.6			25
	Fine	5.6	8.0			25
	Medium	8.0	11.0	3	3	28
	Medium	11.0	16.0	5	5	33
	Coarse	16.0	22.6	10	10	43
	Coarse	22.6	32	8	8	51
	Very Coarse	32	45	15	15	66
	Very Coarse	45	64	12	12	78
COBBLE	Small	64	90	10	10	88
	Small	90	128	4	4	92
	Large	128	180	3	3	95
	Large	180	256	3	3	98
BOULDER	Small	256	362	2	2	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} =	1.44
D_{35} =	17.14
D_{50} =	30.6
D_{84} =	78.5
D_{95} =	180.0
D_{100} =	362.0





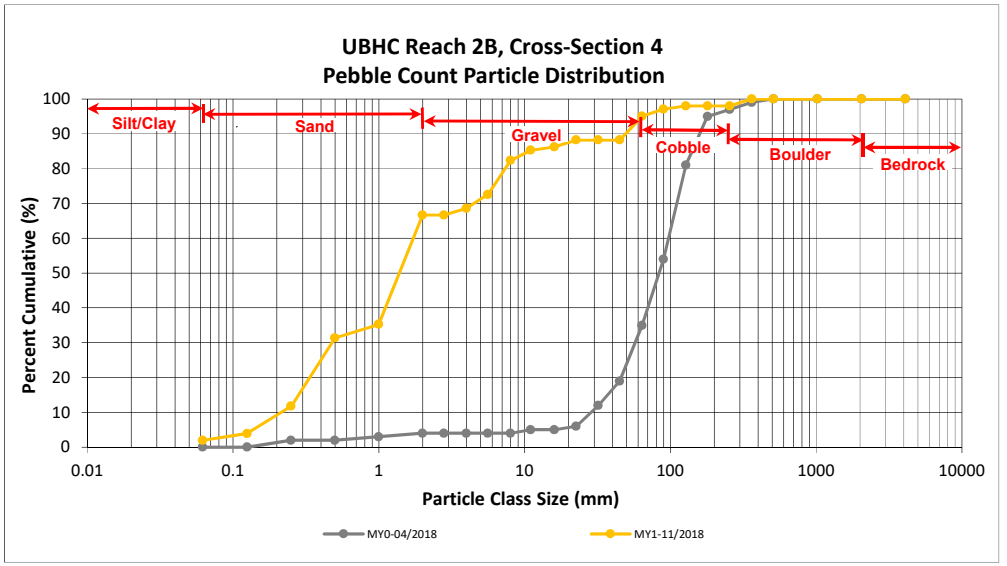
Reachwide and Cross-Section Pebble Count Plots

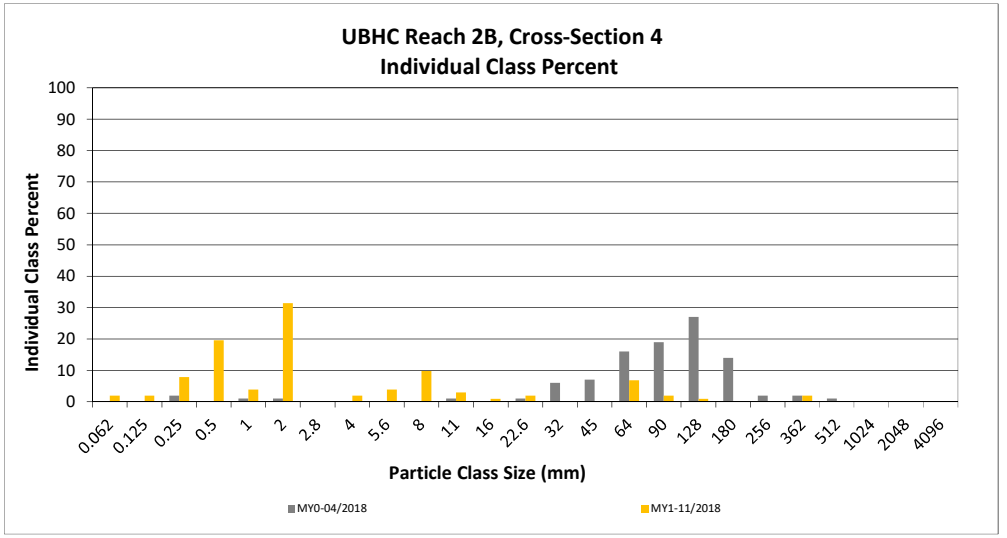
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 2B, Cross-Section 4

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	2	2
SAND	Very fine	0.062	0.125	2	2	4
	Fine	0.125	0.250	8	8	12
	Medium	0.25	0.50	20	20	31
	Coarse	0.5	1.0	4	4	35
	Very Coarse	1.0	2.0	32	31	67
GRAVEL	Very Fine	2.0	2.8			67
	Very Fine	2.8	4.0	2	2	69
	Fine	4.0	5.6	4	4	73
	Fine	5.6	8.0	10	10	82
	Medium	8.0	11.0	3	3	85
	Medium	11.0	16.0	1	1	86
	Coarse	16.0	22.6	2	2	88
	Coarse	22.6	32			88
	Very Coarse	32	45			88
	Very Coarse	45	64	7	7	95
COBBLE	Small	64	90	2	2	97
	Small	90	128	1	1	98
	Large	128	180			98
	Large	180	256			98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**102**	**100**	**100**

Cross-Section 4	
Channel materials (mm)	
D_{16} =	0.29
D_{35} =	0.95
D_{50} =	1.4
D_{84} =	9.6
D_{95} =	63.7
D_{100} =	362.0





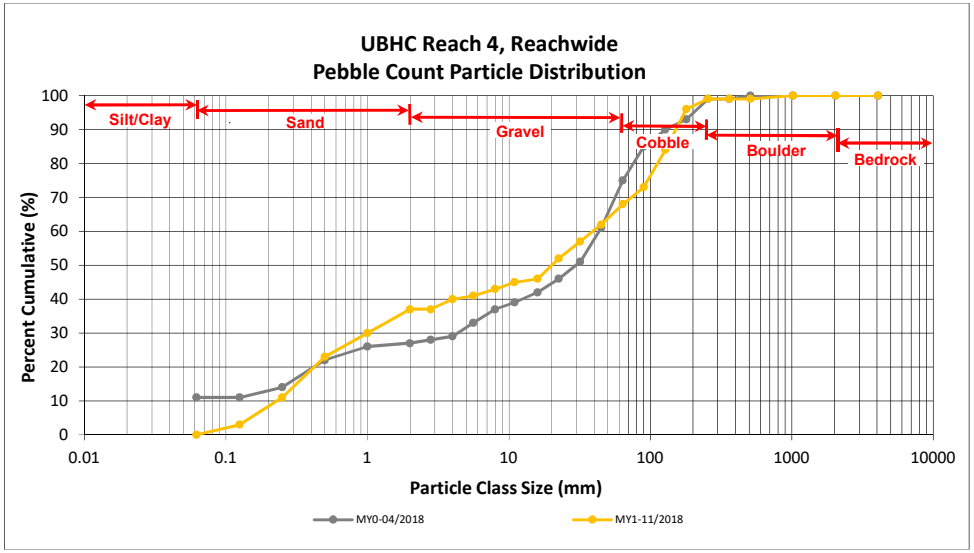
Reachwide and Cross-Section Pebble Count Plots

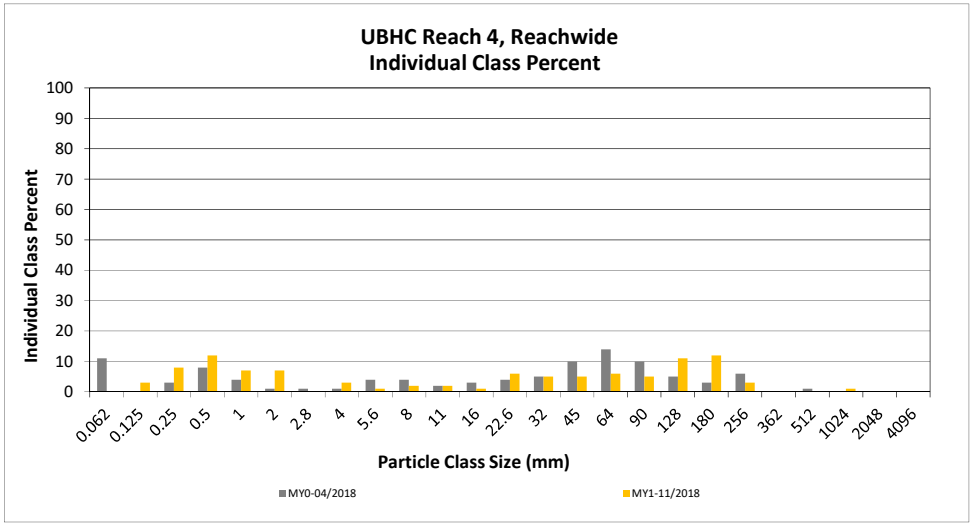
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4, 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					0
SAND	Very fine	0.062	0.125		3	3	3	3
	Fine	0.125	0.250		8	8	8	11
	Medium	0.25	0.50		12	12	12	23
	Coarse	0.5	1.0	2	5	7	7	30
	Very Coarse	1.0	2.0	3	4	7	7	37
GRAVEL	Very Fine	2.0	2.8					37
	Very Fine	2.8	4.0		3	3	3	40
	Fine	4.0	5.6		1	1	1	41
	Fine	5.6	8.0	2		2	2	43
	Medium	8.0	11.0	1	1	2	2	45
	Medium	11.0	16.0	1		1	1	46
	Coarse	16.0	22.6	3	3	6	6	52
	Coarse	22.6	32	5		5	5	57
	Very Coarse	32	45	3	2	5	5	62
	Very Coarse	45	64	4	2	6	6	68
COBBLE	Small	64	90	4	1	5	5	73
	Small	90	128	9	2	11	11	84
	Large	128	180	9	3	12	12	96
	Large	180	256	3		3	3	99
BOULDER	Small	256	362					99
	Small	362	512					99
	Medium	512	1024	1		1	1	100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.33
D_{35} =	1.64
D_{50} =	20.1
D_{84} =	128.0
D_{95} =	175.0
D_{100} =	1024.0





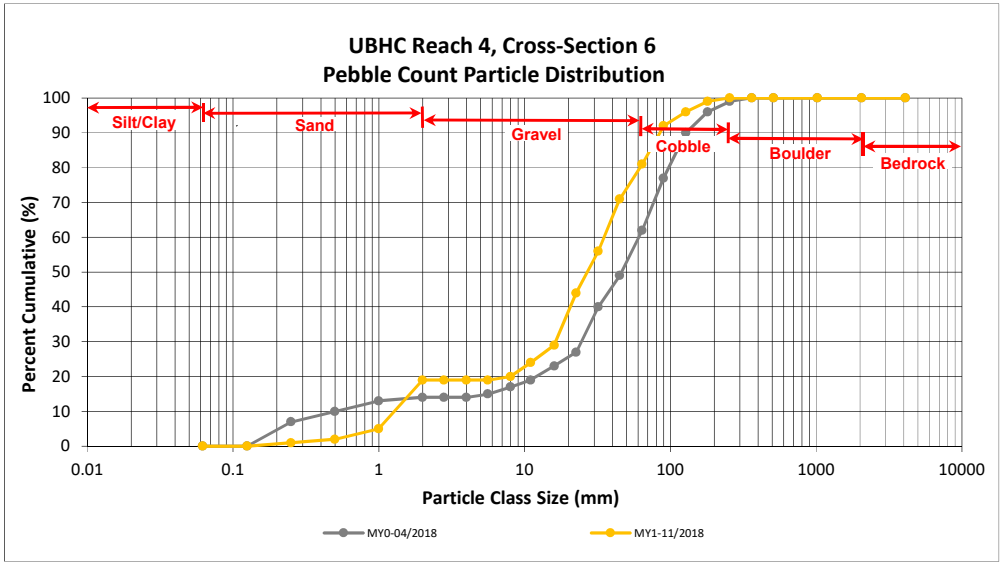
Reachwide and Cross-Section Pebble Count Plots

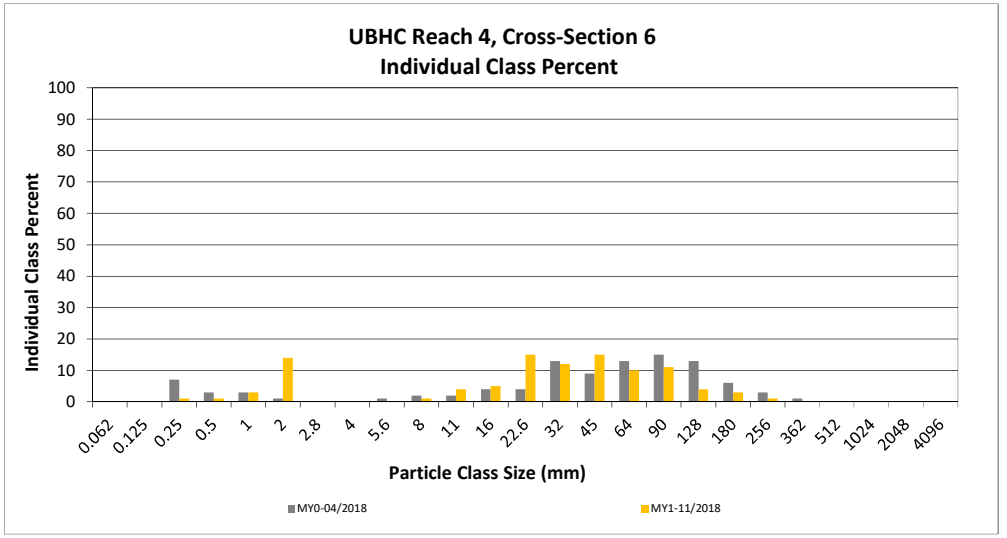
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4, Cross-Section 6

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	1	1	1
	Medium	0.25	0.50	1	1	2
	Coarse	0.5	1.0	3	3	5
	Very Coarse	1.0	2.0	14	14	19
GRAVEL	Very Fine	2.0	2.8			19
	Very Fine	2.8	4.0			19
	Fine	4.0	5.6			19
	Fine	5.6	8.0	1	1	20
	Medium	8.0	11.0	4	4	24
	Medium	11.0	16.0	5	5	29
	Coarse	16.0	22.6	15	15	44
	Coarse	22.6	32	12	12	56
	Very Coarse	32	45	15	15	71
	Very Coarse	45	64	10	10	81
COBBLE	Small	64	90	11	11	92
	Small	90	128	4	4	96
	Large	128	180	3	3	99
	Large	180	256	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	**100**	**100**	**100**

Cross-Section 6	
Channel materials (mm)	
D_{16} =	1.72
D_{35} =	18.37
D_{50} =	26.9
D_{84} =	70.2
D_{95} =	117.2
D_{100} =	256.0





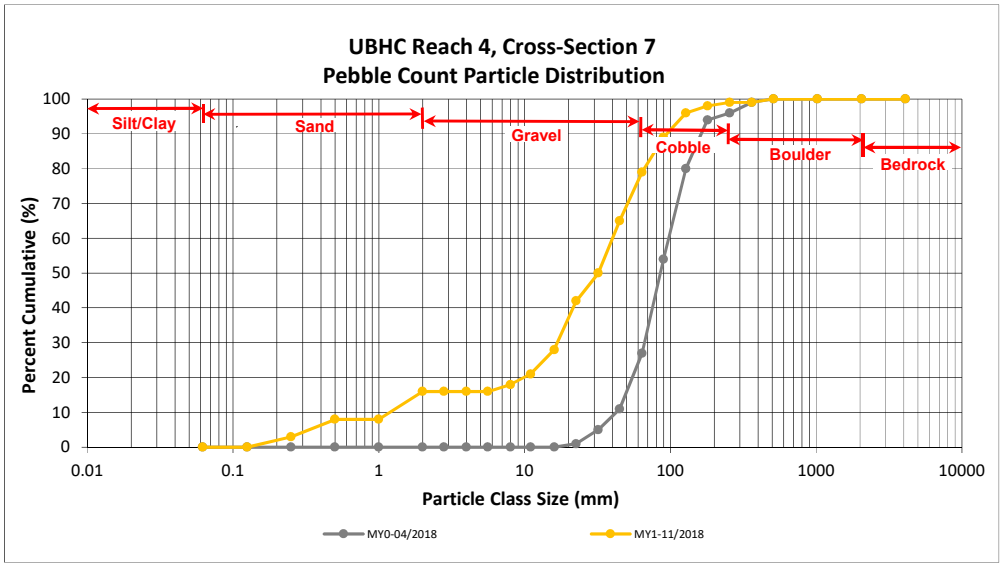
Reachwide and Cross-Section Pebble Count Plots

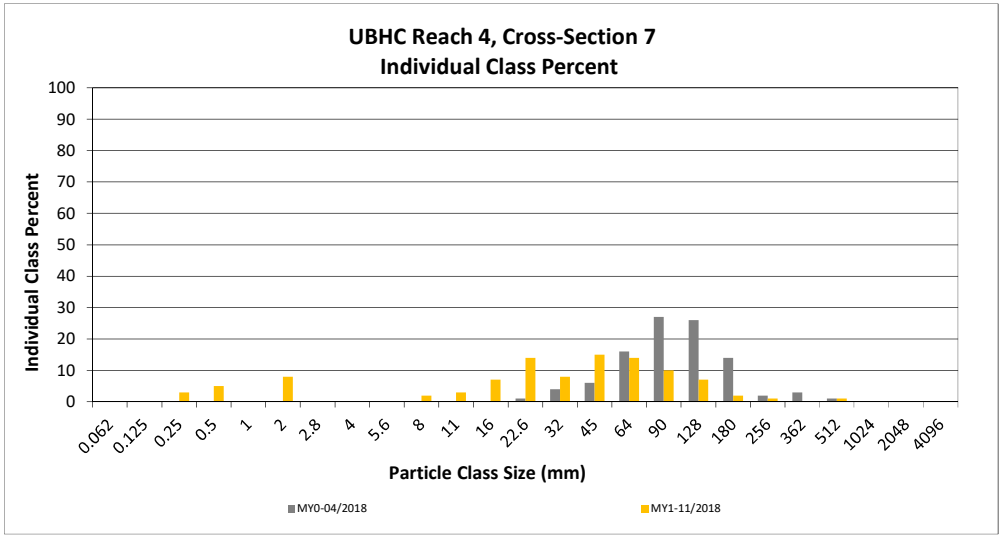
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

UBHC Reach 4, Cross-Section 7

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	3	3	3
	Medium	0.25	0.50	5	5	8
	Coarse	0.5	1.0			8
	Very Coarse	1.0	2.0	8	8	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6			16
	Fine	5.6	8.0	2	2	18
	Medium	8.0	11.0	3	3	21
	Medium	11.0	16.0	7	7	28
	Coarse	16.0	22.6	14	14	42
	Coarse	22.6	32	8	8	50
	Very Coarse	32	45	15	15	65
	Very Coarse	45	64	14	14	79
COBBLE	Small	64	90	10	10	89
	Small	90	128	7	7	96
	Large	128	180	2	2	98
	Large	180	256	1	1	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	**100**	**100**	**100**

Cross-Section 7	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	19.02
D_{50} =	32.0
D_{84} =	75.9
D_{95} =	121.7
D_{100} =	512.0





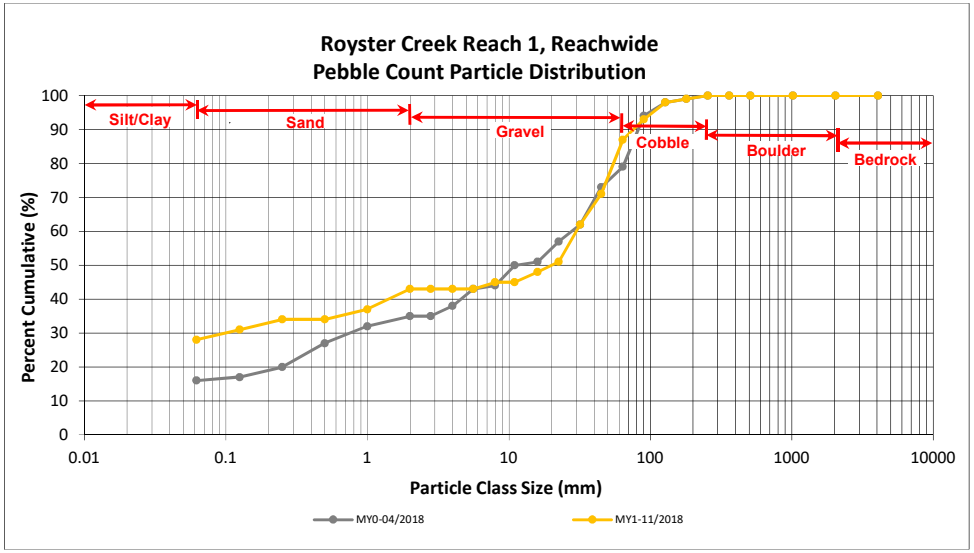
Reachwide and Cross-Section Pebble Count Plots

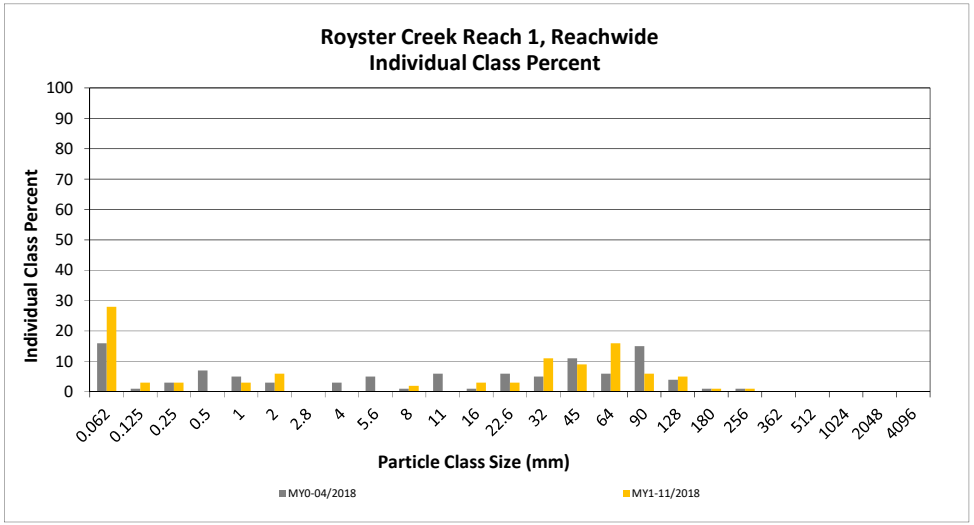
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Royster Creek Reach 1, 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		28	28	28	28
SAND	Very fine	0.062	0.125	1	2	3	3	31
	Fine	0.125	0.250		3	3	3	34
	Medium	0.25	0.50					34
	Coarse	0.5	1.0	1	2	3	3	37
	Very Coarse	1.0	2.0	1	5	6	6	43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.6					43
	Fine	5.6	8.0	1	1	2	2	45
	Medium	8.0	11.0					45
	Medium	11.0	16.0	3		3	3	48
	Coarse	16.0	22.6	1	2	3	3	51
	Coarse	22.6	32	11		11	11	62
	Very Coarse	32	45	7	2	9	9	71
	Very Coarse	45	64	15	1	16	16	87
COBBLE	Small	64	90	4	2	6	6	93
	Small	90	128	4	1	5	5	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} =	0.63
D_{50} =	20.1
D_{84} =	59.9
D_{95} =	103.6
D_{100} =	256.0





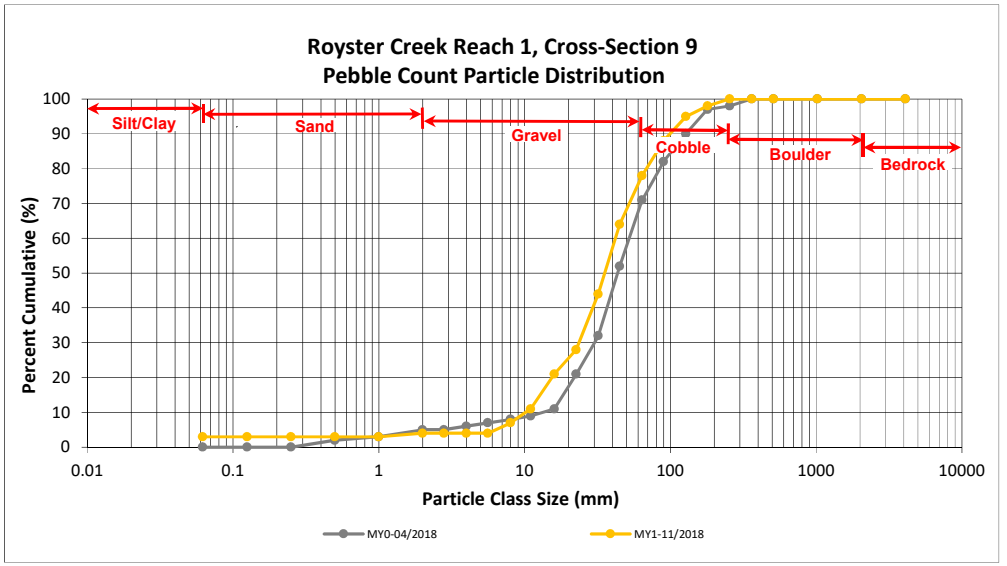
Reachwide and Cross-Section Pebble Count Plots

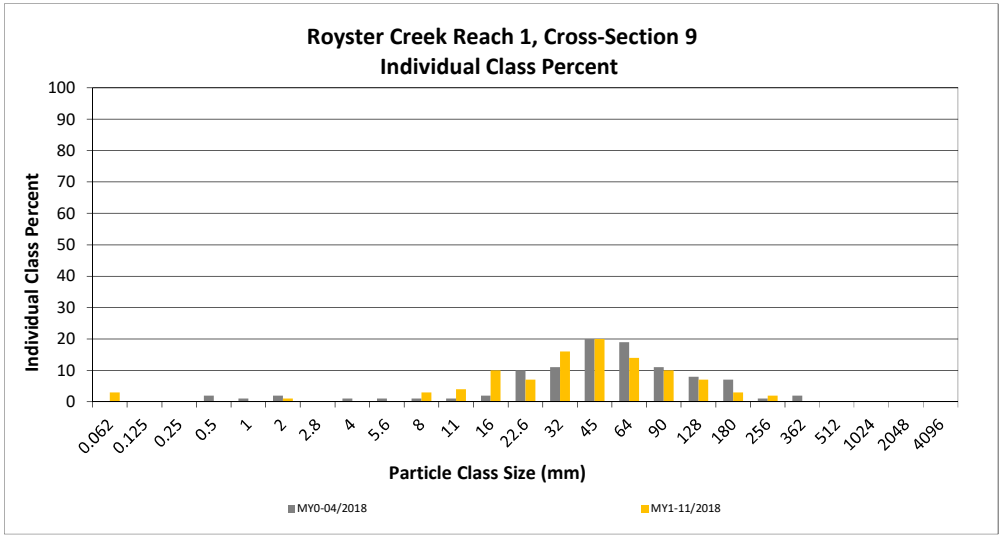
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Royster Creek Reach 1, Cross-Section 9

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	3	3
SAND	Very fine	0.062	0.125			3
	Fine	0.125	0.250			3
	Medium	0.25	0.50			3
	Coarse	0.5	1.0			3
	Very Coarse	1.0	2.0	1	1	4
GRAVEL	Very Fine	2.0	2.8			4
	Very Fine	2.8	4.0			4
	Fine	4.0	5.6			4
	Fine	5.6	8.0	3	3	7
	Medium	8.0	11.0	4	4	11
	Medium	11.0	16.0	10	10	21
	Coarse	16.0	22.6	7	7	28
	Coarse	22.6	32	16	16	44
	Very Coarse	32	45	20	20	64
	Very Coarse	45	64	14	14	78
COBBLE	Small	64	90	10	10	88
	Small	90	128	7	7	95
	Large	128	180	3	3	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 9	
Channel materials (mm)	
D_{16} =	13.27
D_{35} =	26.31
D_{50} =	35.4
D_{84} =	78.5
D_{95} =	128.0
D_{100} =	256.0





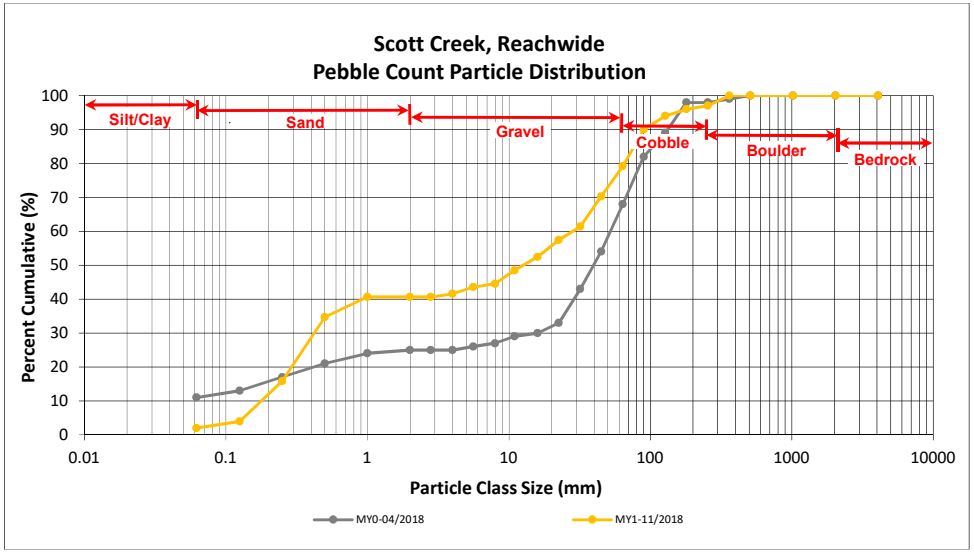
Reachwide and Cross-Section Pebble Count Plots

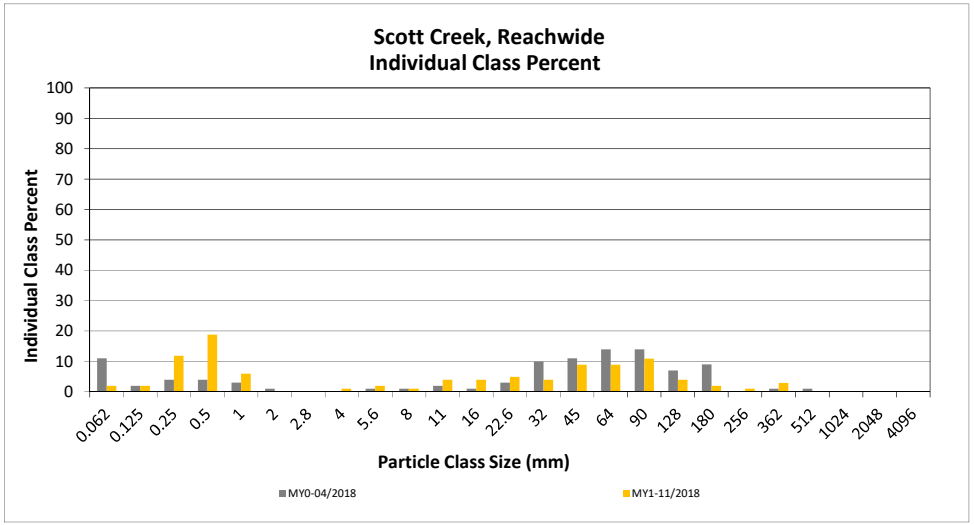
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Scott Creek, 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	1	2	2	2
SAND	Very fine	0.062	0.125		2	2	2	4
	Fine	0.125	0.250	4	8	12	12	16
	Medium	0.25	0.50	9	10	19	19	35
	Coarse	0.5	1.0	1	5	6	6	41
	Very Coarse	1.0	2.0					41
GRAVEL	Very Fine	2.0	2.8					41
	Very Fine	2.8	4.0		1	1	1	42
	Fine	4.0	5.6		2	2	2	44
	Fine	5.6	8.0		1	1	1	45
	Medium	8.0	11.0		4	4	4	49
	Medium	11.0	16.0	4		4	4	52
	Coarse	16.0	22.6	3	2	5	5	57
	Coarse	22.6	32	3	1	4	4	61
	Very Coarse	32	45	7	2	9	9	70
	Very Coarse	45	64	4	5	9	9	79
COBBLE	Small	64	90	8	3	11	11	90
	Small	90	128	2	2	4	4	94
	Large	128	180	1	1	2	2	96
	Large	180	256	1		1	1	97
BOULDER	Small	256	362	2	1	3	3	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**51**	**101**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.25
D_{35} =	0.52
D_{50} =	12.7
D_{84} =	74.4
D_{95} =	150.5
D_{100} =	362.0





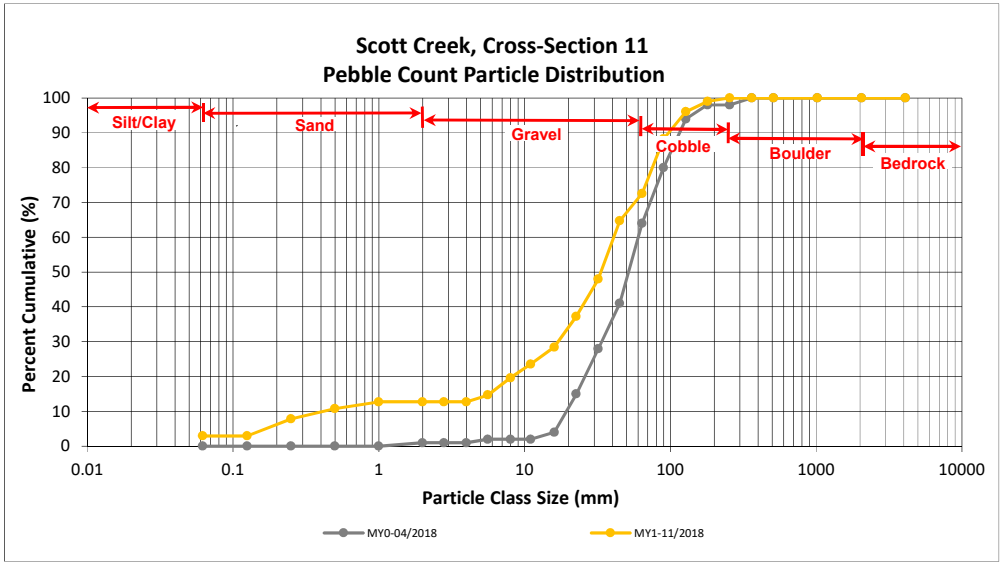
Reachwide and Cross-Section Pebble Count Plots

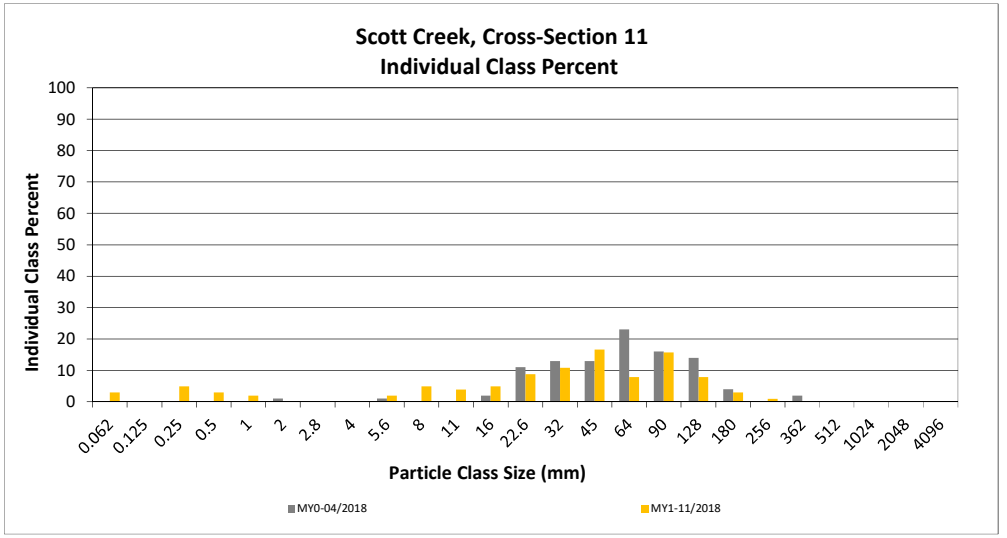
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Scott Creek, Cross-Section 11

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	3	3
SAND	Very fine	0.062	0.125			3
	Fine	0.125	0.250	5	5	8
	Medium	0.25	0.50	3	3	11
	Coarse	0.5	1.0	2	2	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	2	2	15
	Fine	5.6	8.0	5	5	20
	Medium	8.0	11.0	4	4	24
	Medium	11.0	16.0	5	5	28
	Coarse	16.0	22.6	9	9	37
	Coarse	22.6	32	11	11	48
	Very Coarse	32	45	17	17	65
	Very Coarse	45	64	8	8	73
COBBLE	Small	64	90	16	16	88
	Small	90	128	8	8	96
	Large	128	180	3	3	99
	Large	180	256	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	**102**	**100**	**100**

Cross-Section 11	
Channel materials (mm)	
D_{16} =	6.15
D_{35} =	20.69
D_{50} =	33.3
D_{84} =	82.1
D_{95} =	121.9
D_{100} =	256.0





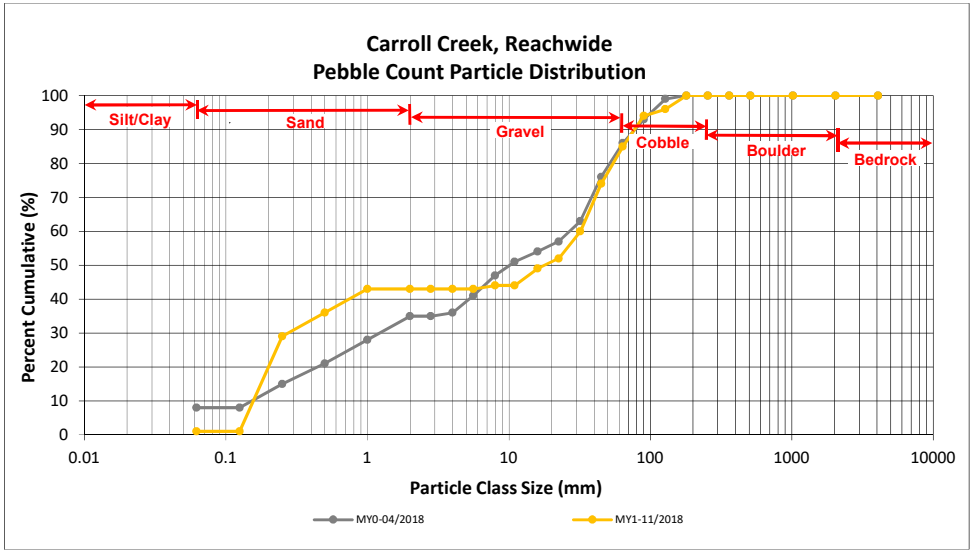
Reachwide and Cross-Section Pebble Count Plots

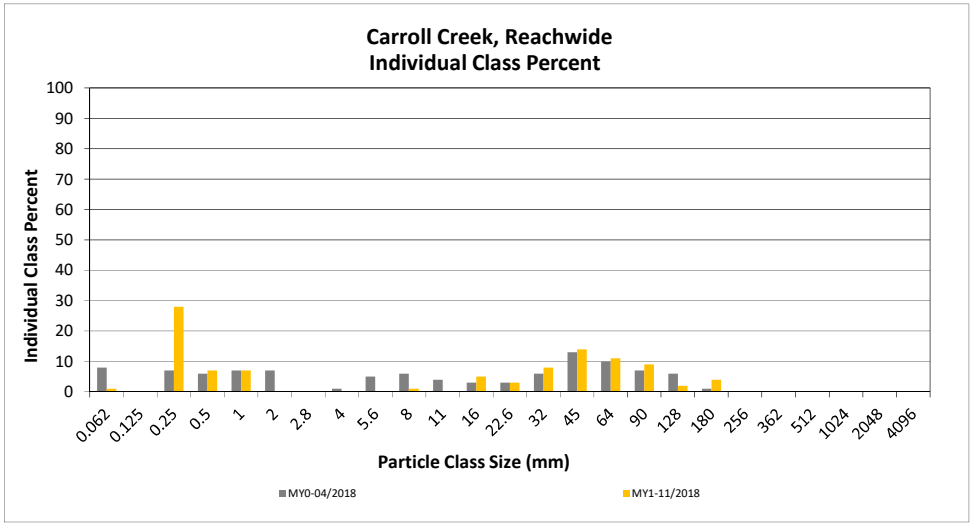
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Carroll Creek, 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	1	1	1
SAND	Very fine	0.062	0.125					1
	Fine	0.125	0.250	2	26	28	28	29
	Medium	0.25	0.50		7	7	7	36
	Coarse	0.5	1.0	5	2	7	7	43
	Very Coarse	1.0	2.0					43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.6					43
	Fine	5.6	8.0		1	1	1	44
	Medium	8.0	11.0					44
	Medium	11.0	16.0	2	3	5	5	49
	Coarse	16.0	22.6	3		3	3	52
	Coarse	22.6	32	6	2	8	8	60
	Very Coarse	32	45	11	3	14	14	74
	Very Coarse	45	64	8	3	11	11	85
COBBLE	Small	64	90	7	2	9	9	94
	Small	90	128	2		2	2	96
	Large	128	180	4		4	4	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} =	0.18
D_{35} =	0.45
D_{50} =	18.0
D_{84} =	62.0
D_{95} =	107.3
D_{100} =	180.0





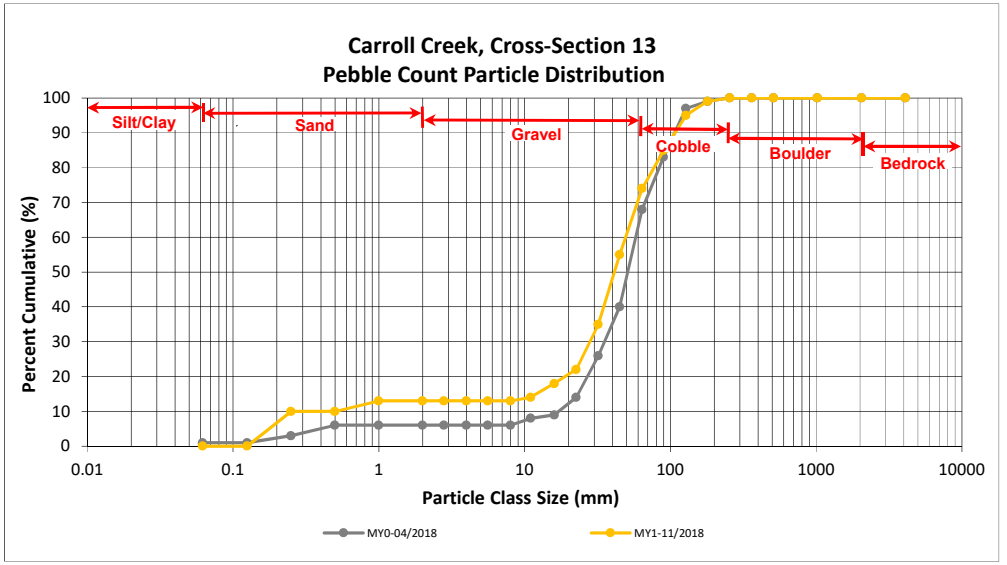
Reachwide and Cross-Section Pebble Count Plots

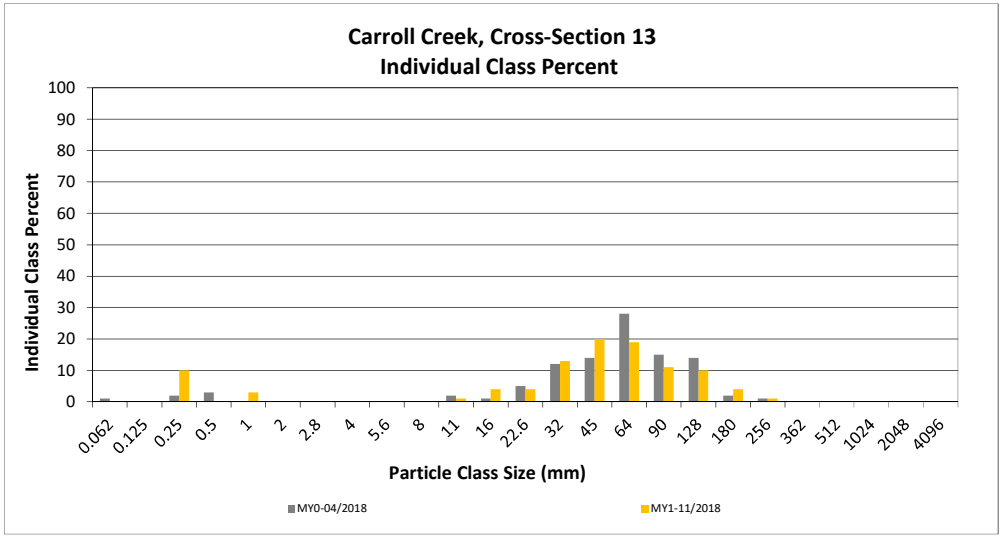
Big Harris Creek Mitigation Site - Area A
DMS Project No. 739
Monitoring Year 1 - 2018

Carroll Creek, Cross-Section 13

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary Class Percentage	Summary Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	10	10	10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0	3	3	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			13
	Fine	5.6	8.0			13
	Medium	8.0	11.0	1	1	14
	Medium	11.0	16.0	4	4	18
	Coarse	16.0	22.6	4	4	22
	Coarse	22.6	32	13	13	35
	Very Coarse	32	45	20	20	55
	Very Coarse	45	64	19	19	74
COBBLE	Small	64	90	11	11	85
	Small	90	128	10	10	95
	Large	128	180	4	4	99
	Large	180	256	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	**100**	**100**	**100**

Cross-Section 13	
Channel materials (mm)	
D_{16} =	13.27
D_{35} =	32.00
D_{50} =	41.3
D_{84} =	87.3
D_{95} =	128.0
D_{100} =	256.0





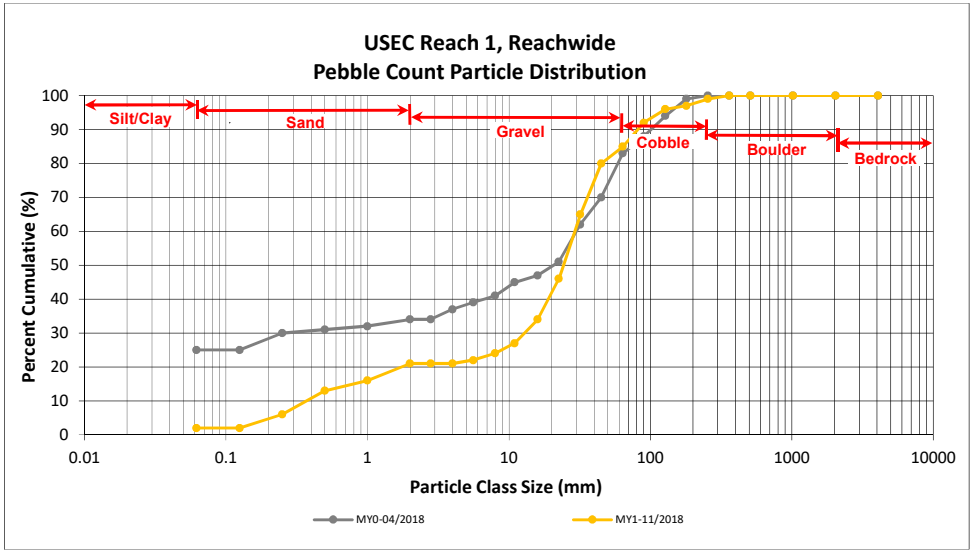
Reachwide and Cross-Section Pebble Count Plots

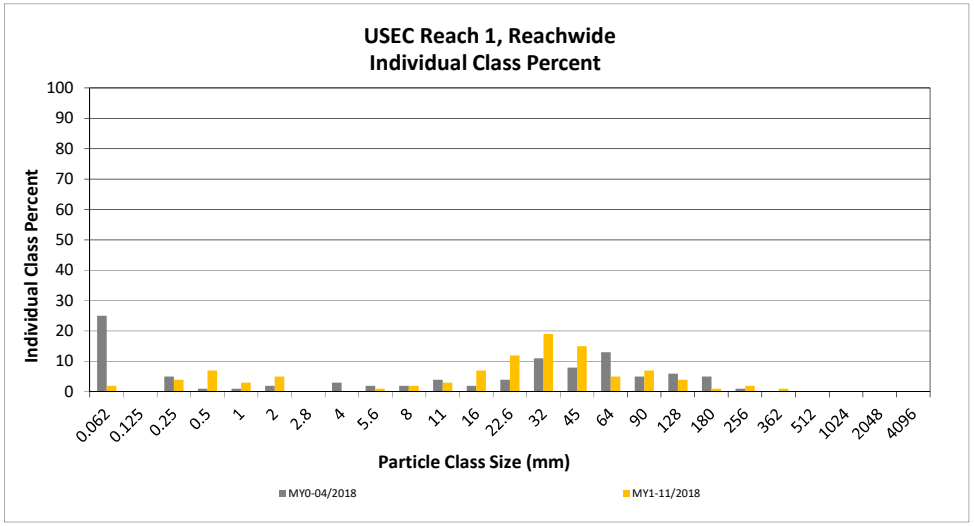
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 1, 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		4	4	4	6
	Medium	0.25	0.50	4	3	7	7	13
	Coarse	0.5	1.0	1	2	3	3	16
	Very Coarse	1.0	2.0	1	4	5	5	21
GRAVEL	Very Fine	2.0	2.8					21
	Very Fine	2.8	4.0					21
	Fine	4.0	5.6		1	1	1	22
	Fine	5.6	8.0	1	1	2	2	24
	Medium	8.0	11.0	2	1	3	3	27
	Medium	11.0	16.0	3	4	7	7	34
	Coarse	16.0	22.6	6	6	12	12	46
	Coarse	22.6	32	11	8	19	19	65
	Very Coarse	32	45	8	7	15	15	80
	Very Coarse	45	64	4	1	5	5	85
COBBLE	Small	64	90	7		7	7	92
	Small	90	128		4	4	4	96
	Large	128	180	1		1	1	97
	Large	180	256		2	2	2	99
BOULDER	Small	256	362	1		1	1	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} =	1.00
D_{35} =	16.47
D_{50} =	24.3
D_{84} =	59.6
D_{95} =	117.2
D_{100} =	362.0





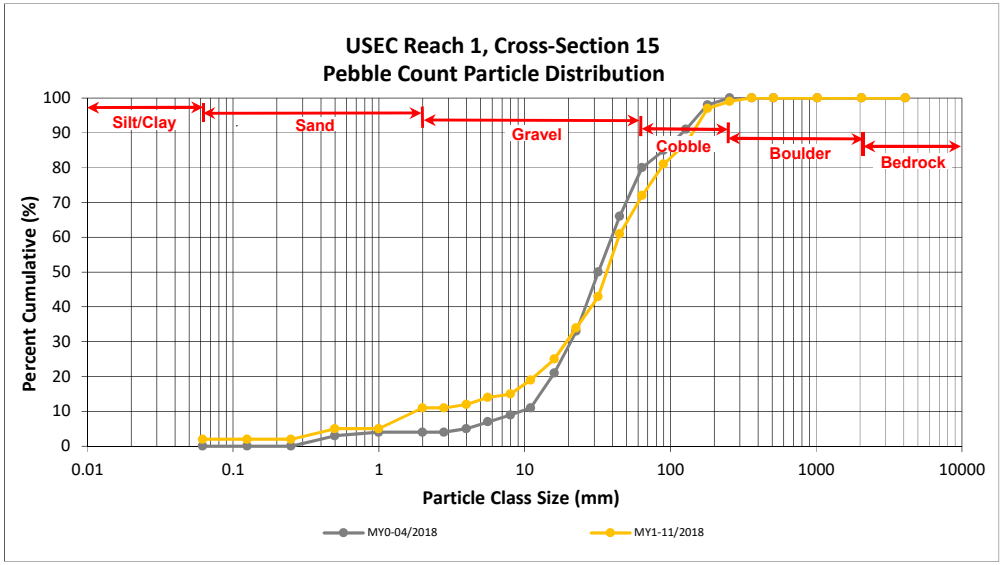
Reachwide and Cross-Section Pebble Count Plots

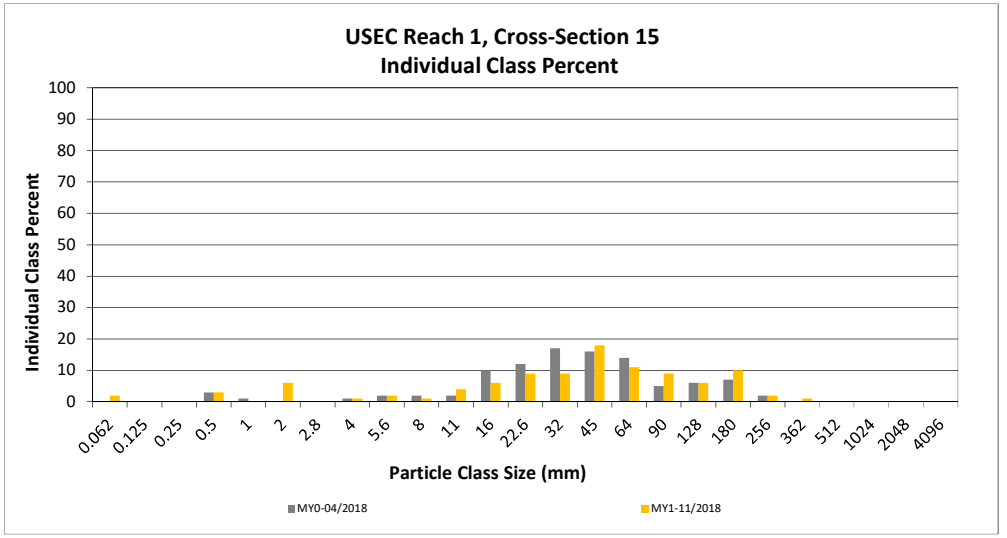
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 1, Cross-Section 15

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	3	3	5
	Coarse	0.5	1.0			5
	Very Coarse	1.0	2.0	6	6	11
GRAVEL	Very Fine	2.0	2.8			11
	Very Fine	2.8	4.0	1	1	12
	Fine	4.0	5.6	2	2	14
	Fine	5.6	8.0	1	1	15
	Medium	8.0	11.0	4	4	19
	Medium	11.0	16.0	6	6	25
	Coarse	16.0	22.6	9	9	34
	Coarse	22.6	32	9	9	43
	Very Coarse	32	45	18	18	61
	Very Coarse	45	64	11	11	72
COBBLE	Small	64	90	9	9	81
	Small	90	128	6	6	87
	Large	128	180	10	10	97
	Large	180	256	2	2	99
BOULDER	Small	256	362	1	1	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 15	
Channel materials (mm)	
D_{16} =	8.66
D_{35} =	23.49
D_{50} =	36.5
D_{84} =	107.3
D_{95} =	168.1
D_{100} =	362.0





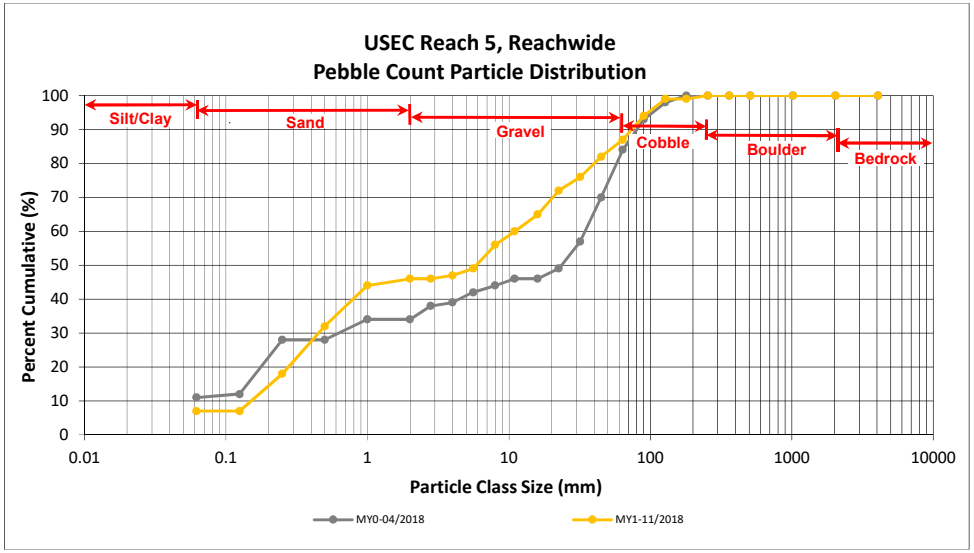
Reachwide and Cross-Section Pebble Count Plots

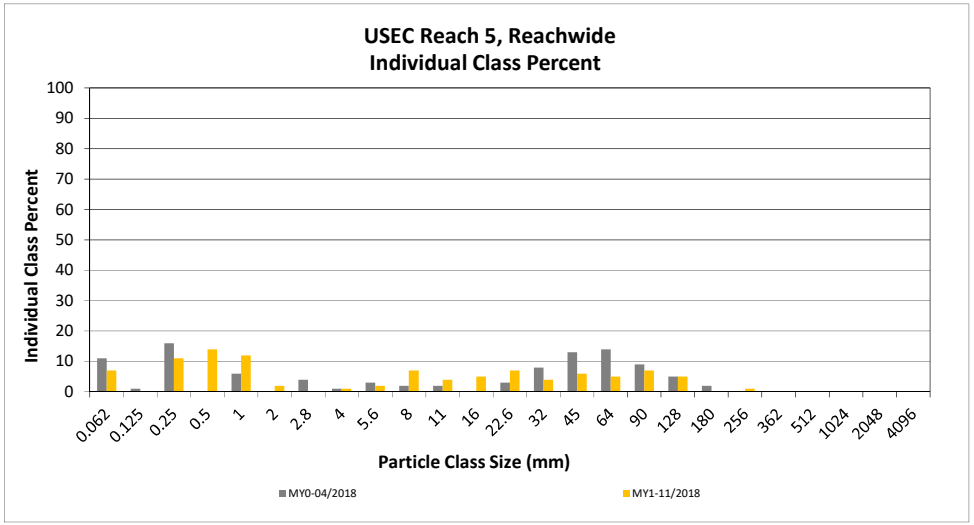
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5, 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	5	6	11	11	18
	Medium	0.25	0.50	2	12	14	14	32
	Coarse	0.5	1.0	2	10	12	12	44
	Very Coarse	1.0	2.0	2		2	2	46
GRAVEL	Very Fine	2.0	2.8					46
	Very Fine	2.8	4.0	1		1	1	47
	Fine	4.0	5.6	1	1	2	2	49
	Fine	5.6	8.0	1	6	7	7	56
	Medium	8.0	11.0	3	1	4	4	60
	Medium	11.0	16.0	2	3	5	5	65
	Coarse	16.0	22.6	5	2	7	7	72
	Coarse	22.6	32	2	2	4	4	76
	Very Coarse	32	45	5	1	6	6	82
	Very Coarse	45	64	5		5	5	87
COBBLE	Small	64	90	7		7	7	94
	Small	90	128	5		5	5	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} =	0.22
D_{35} =	0.59
D_{50} =	5.9
D_{84} =	51.8
D_{95} =	96.6
D_{100} =	256.0





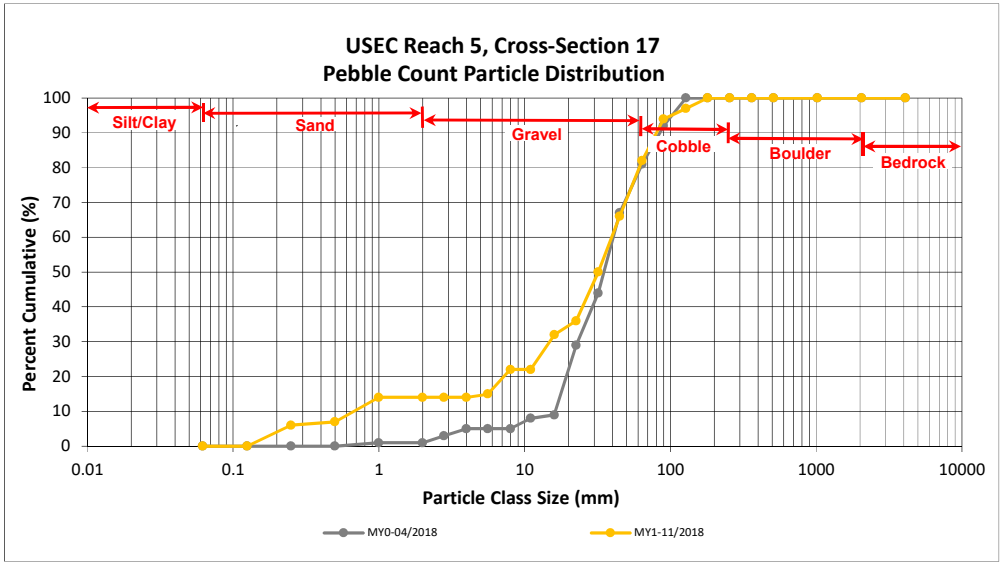
Reachwide and Cross-Section Pebble Count Plots

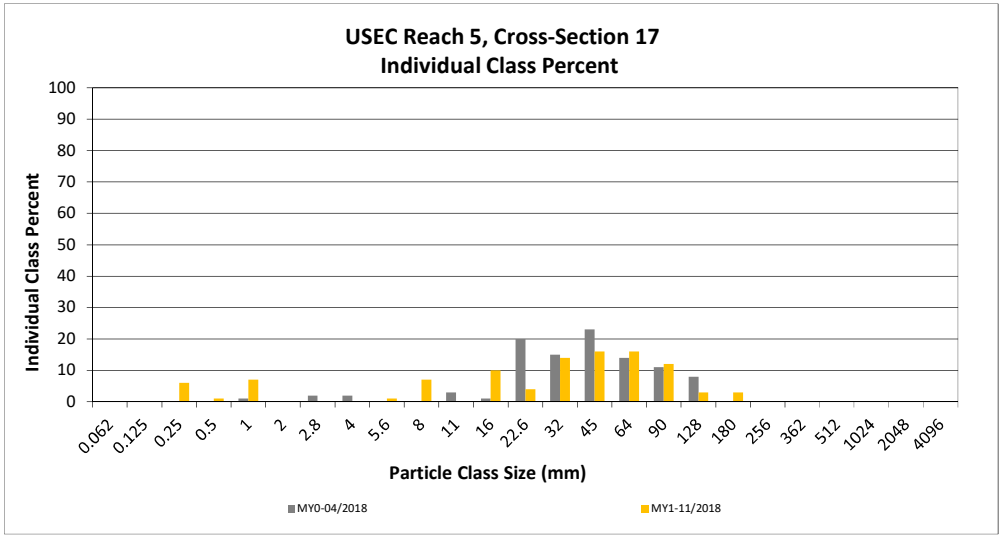
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5, Cross-Section 17

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	6	6	6
	Medium	0.25	0.50	1	1	7
	Coarse	0.5	1.0	7	7	14
	Very Coarse	1.0	2.0			14
GRAVEL	Very Fine	2.0	2.8			14
	Very Fine	2.8	4.0			14
	Fine	4.0	5.6	1	1	15
	Fine	5.6	8.0	7	7	22
	Medium	8.0	11.0			22
	Medium	11.0	16.0	10	10	32
	Coarse	16.0	22.6	4	4	36
	Coarse	22.6	32	14	14	50
	Very Coarse	32	45	16	16	66
	Very Coarse	45	64	16	16	82
COBBLE	Small	64	90	12	12	94
	Small	90	128	3	3	97
	Large	128	180	3	3	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 17	
Channel materials (mm)	
D_{16} =	5.89
D_{35} =	20.73
D_{50} =	32.0
D_{84} =	67.7
D_{95} =	101.2
D_{100} =	180.0





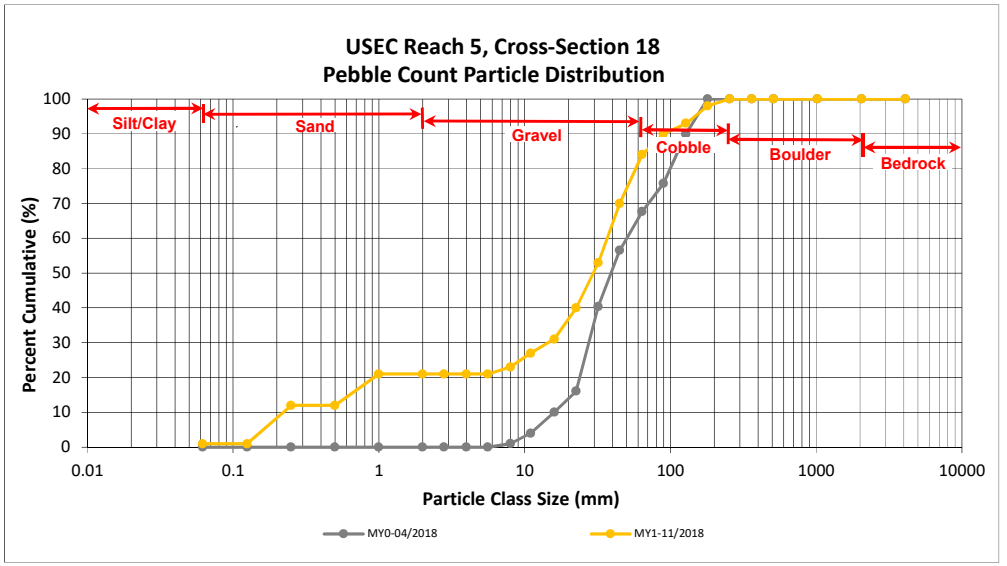
Reachwide and Cross-Section Pebble Count Plots

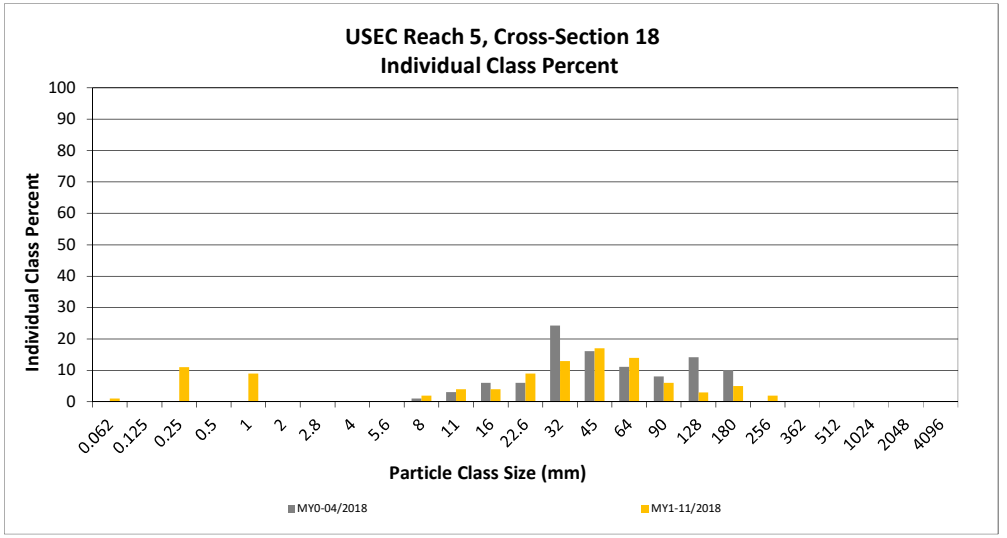
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5, Cross-Section 18

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	11	11	12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0	9	9	21
	Very Coarse	1.0	2.0			21
GRAVEL	Very Fine	2.0	2.8			21
	Very Fine	2.8	4.0			21
	Fine	4.0	5.6			21
	Fine	5.6	8.0	2	2	23
	Medium	8.0	11.0	4	4	27
	Medium	11.0	16.0	4	4	31
	Coarse	16.0	22.6	9	9	40
	Coarse	22.6	32	13	13	53
	Very Coarse	32	45	17	17	70
	Very Coarse	45	64	14	14	84
COBBLE	Small	64	90	6	6	90
	Small	90	128	3	3	93
	Large	128	180	5	5	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 18	
Channel materials (mm)	
D_{16} =	0.68
D_{35} =	18.65
D_{50} =	29.5
D_{84} =	64.0
D_{95} =	146.7
D_{100} =	256.0





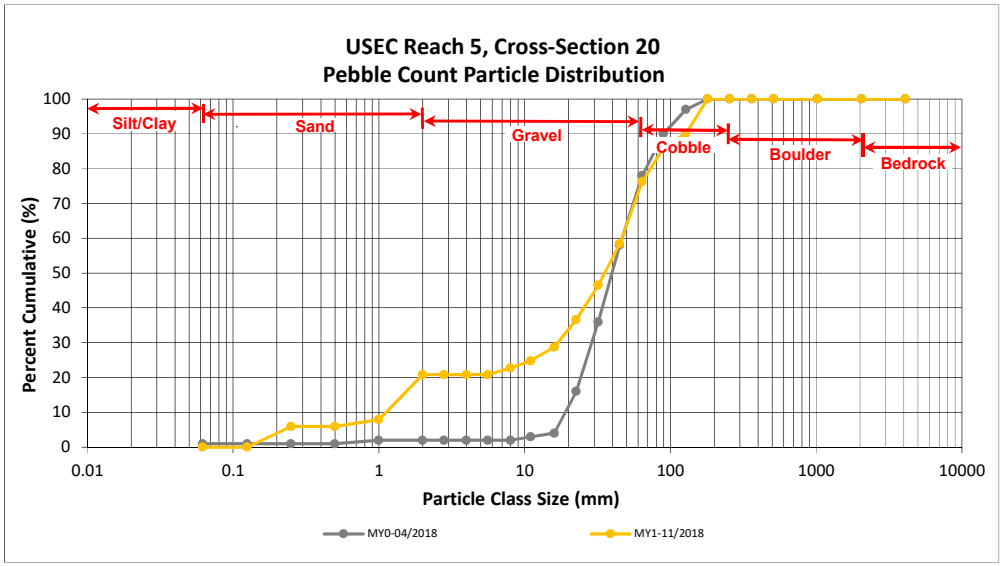
Reachwide and Cross-Section Pebble Count Plots

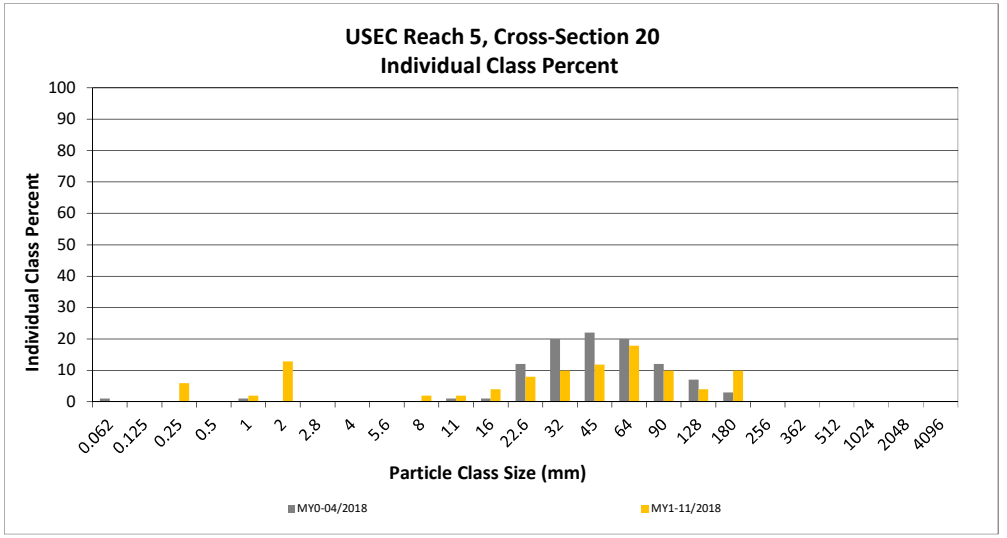
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 5, Cross-Section 20

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	6	6	6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0	2	2	8
	Very Coarse	1.0	2.0	13	13	21
GRAVEL	Very Fine	2.0	2.8			21
	Very Fine	2.8	4.0			21
	Fine	4.0	5.6			21
	Fine	5.6	8.0	2	2	23
	Medium	8.0	11.0	2	2	25
	Medium	11.0	16.0	4	4	29
	Coarse	16.0	22.6	8	8	37
	Coarse	22.6	32	10	10	47
	Very Coarse	32	45	12	12	58
	Very Coarse	45	64	18	18	76
COBBLE	Small	64	90	10	10	86
	Small	90	128	4	4	90
	Large	128	180	10	10	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	**101**	**100**	**100**

Cross-Section 20	
Channel materials (mm)	
D_{16} =	1.55
D_{35} =	21.05
D_{50} =	35.3
D_{84} =	83.6
D_{95} =	151.5
D_{100} =	180.0





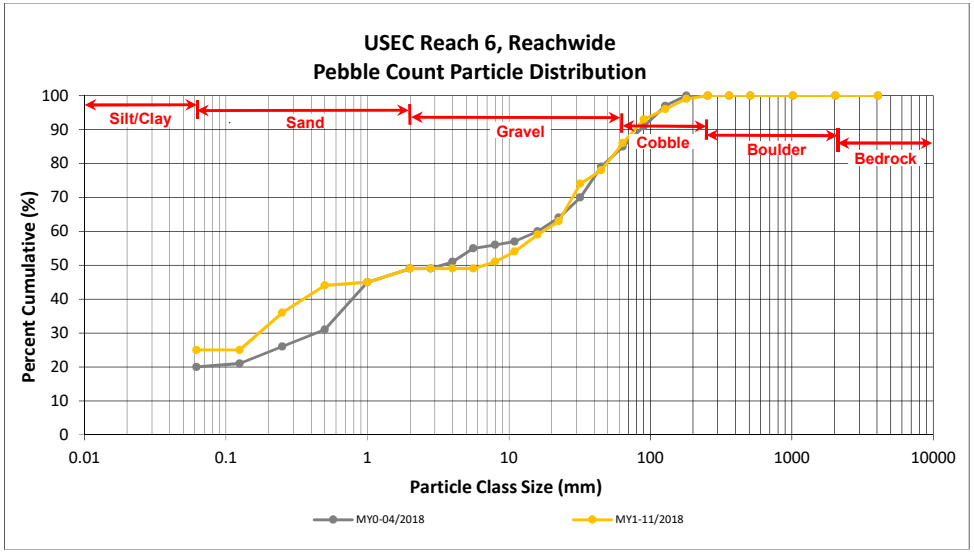
Reachwide and Cross-Section Pebble Count Plots

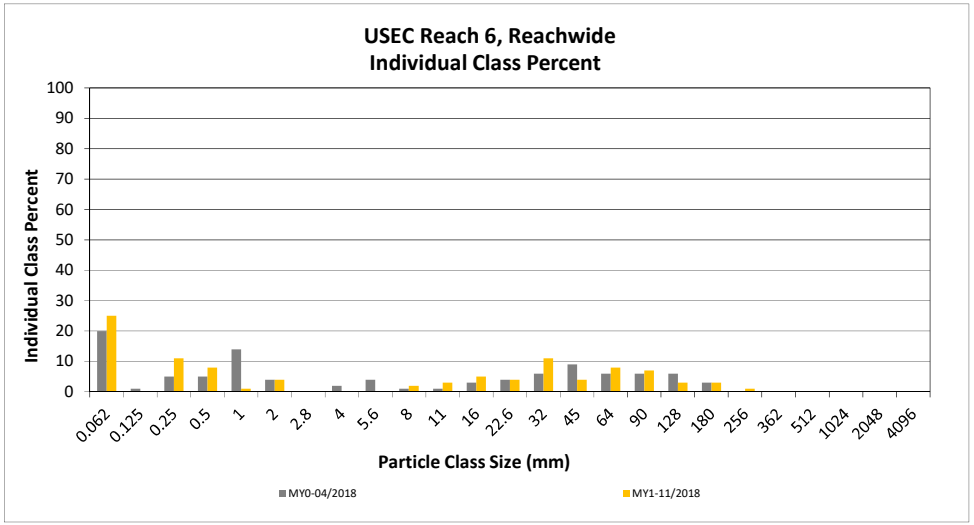
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6, 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		25	25	25	25
SAND	Very fine	0.062	0.125					25
	Fine	0.125	0.250	5	6	11	11	36
	Medium	0.25	0.50	1	7	8	8	44
	Coarse	0.5	1.0	1		1	1	45
	Very Coarse	1.0	2.0	2	2	4	4	49
GRAVEL	Very Fine	2.0	2.8					49
	Very Fine	2.8	4.0					49
	Fine	4.0	5.6					49
	Fine	5.6	8.0	2		2	2	51
	Medium	8.0	11.0	1	2	3	3	54
	Medium	11.0	16.0	3	2	5	5	59
	Coarse	16.0	22.6	2	2	4	4	63
	Coarse	22.6	32	9	2	11	11	74
	Very Coarse	32	45	3	1	4	4	78
	Very Coarse	45	64	7	1	8	8	86
COBBLE	Small	64	90	7		7	7	93
	Small	90	128	3		3	3	96
	Large	128	180	3		3	3	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} =	0.23
D_{50} =	6.7
D_{84} =	58.6
D_{95} =	113.8
D_{100} =	256.0





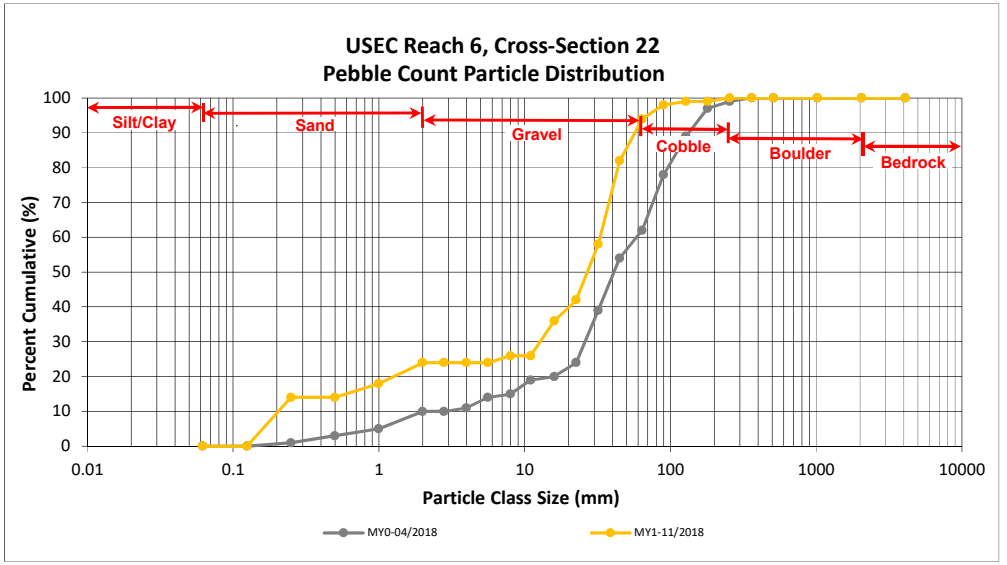
Reachwide and Cross-Section Pebble Count Plots

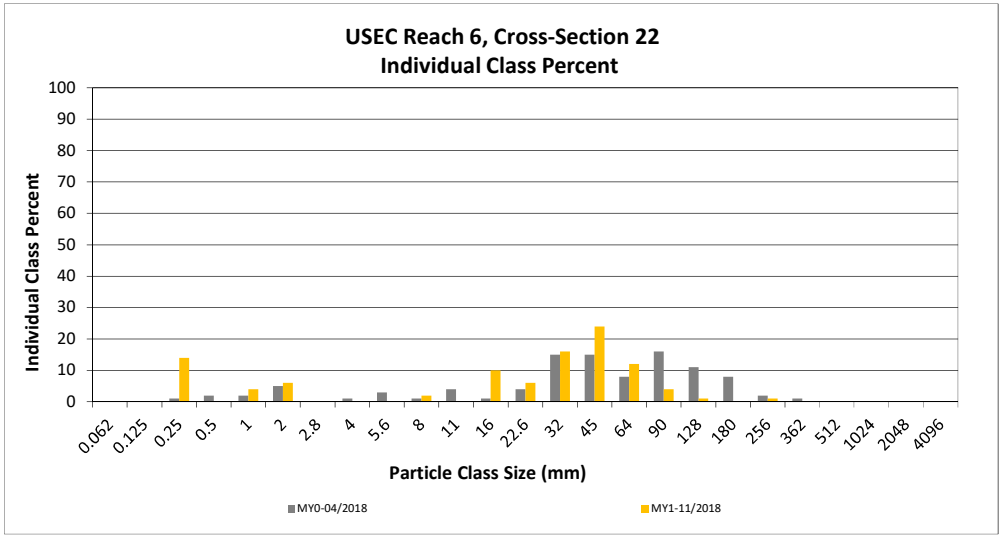
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6, Cross-Section 22

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	14	14	14
	Medium	0.25	0.50			14
	Coarse	0.5	1.0	4	4	18
	Very Coarse	1.0	2.0	6	6	24
GRAVEL	Very Fine	2.0	2.8			24
	Very Fine	2.8	4.0			24
	Fine	4.0	5.6			24
	Fine	5.6	8.0	2	2	26
	Medium	8.0	11.0			26
	Medium	11.0	16.0	10	10	36
	Coarse	16.0	22.6	6	6	42
	Coarse	22.6	32	16	16	58
	Very Coarse	32	45	24	24	82
	Very Coarse	45	64	12	12	94
COBBLE	Small	64	90	4	4	98
	Small	90	128	1	1	99
	Large	128	180			99
	Large	180	256	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	**100**	**100**	**100**

Cross-Section 22	
Channel materials (mm)	
D_{16} =	0.71
D_{35} =	15.41
D_{50} =	26.9
D_{84} =	47.7
D_{95} =	69.7
D_{100} =	256.0





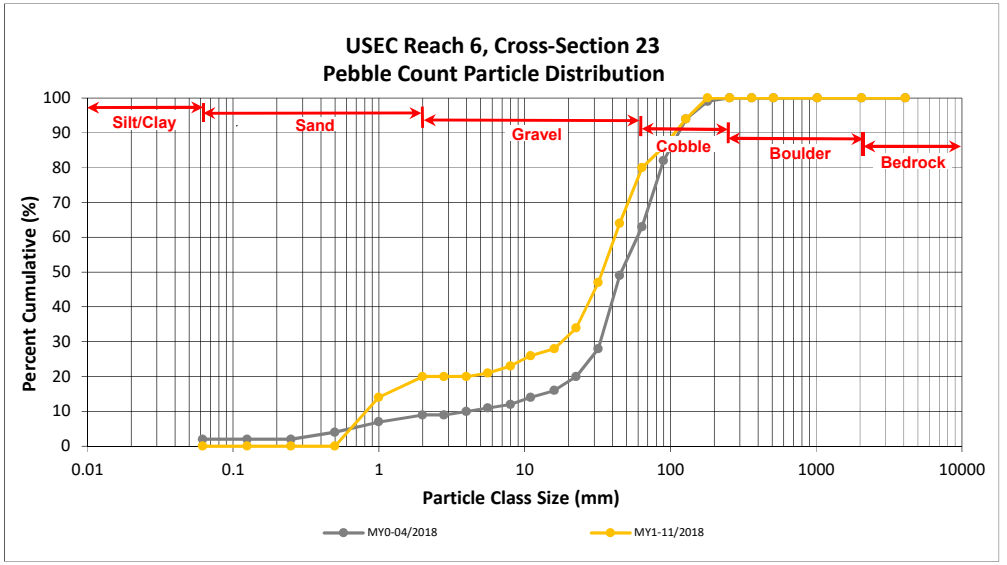
Reachwide and Cross-Section Pebble Count Plots

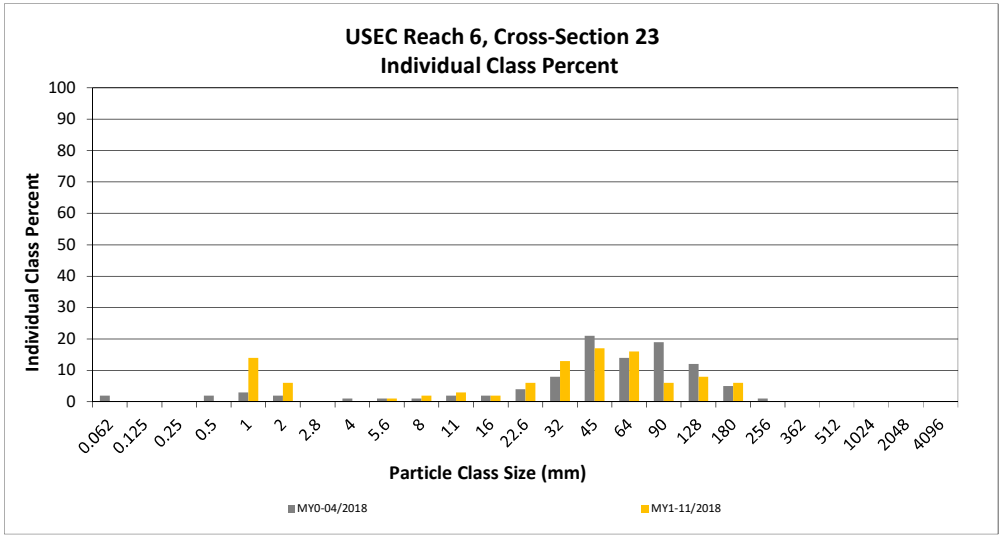
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC Reach 6, Cross-Section 23

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	14	14	14
	Very Coarse	1.0	2.0	6	6	20
GRAVEL	Very Fine	2.0	2.8			20
	Very Fine	2.8	4.0			20
	Fine	4.0	5.6	1	1	21
	Fine	5.6	8.0	2	2	23
	Medium	8.0	11.0	3	3	26
	Medium	11.0	16.0	2	2	28
	Coarse	16.0	22.6	6	6	34
	Coarse	22.6	32	13	13	47
	Very Coarse	32	45	17	17	64
	Very Coarse	45	64	16	16	80
COBBLE	Small	64	90	6	6	86
	Small	90	128	8	8	94
	Large	128	180	6	6	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 23	
Channel materials (mm)	
D_{16} =	1.26
D_{35} =	23.21
D_{50} =	34.0
D_{84} =	80.3
D_{95} =	135.5
D_{100} =	180.0





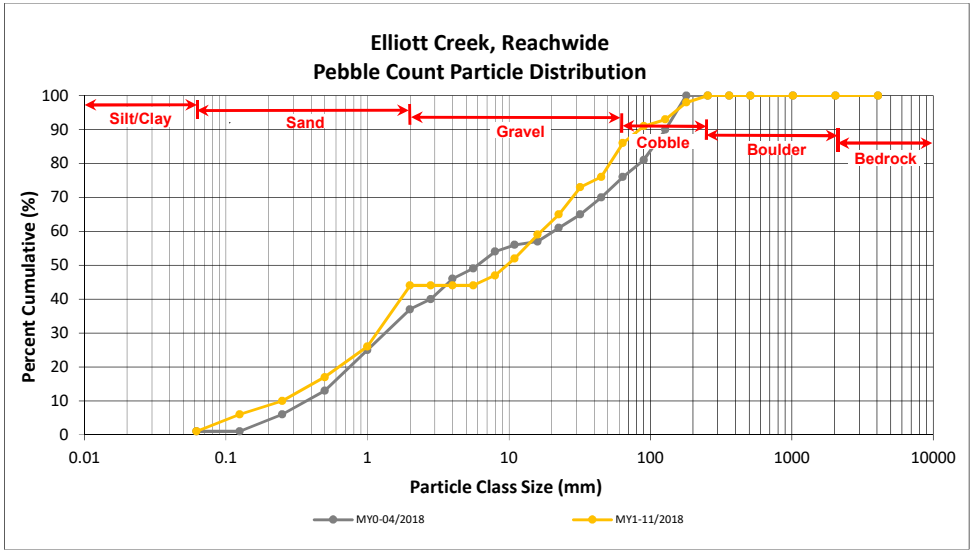
Reachwide and Cross-Section Pebble Count Plots

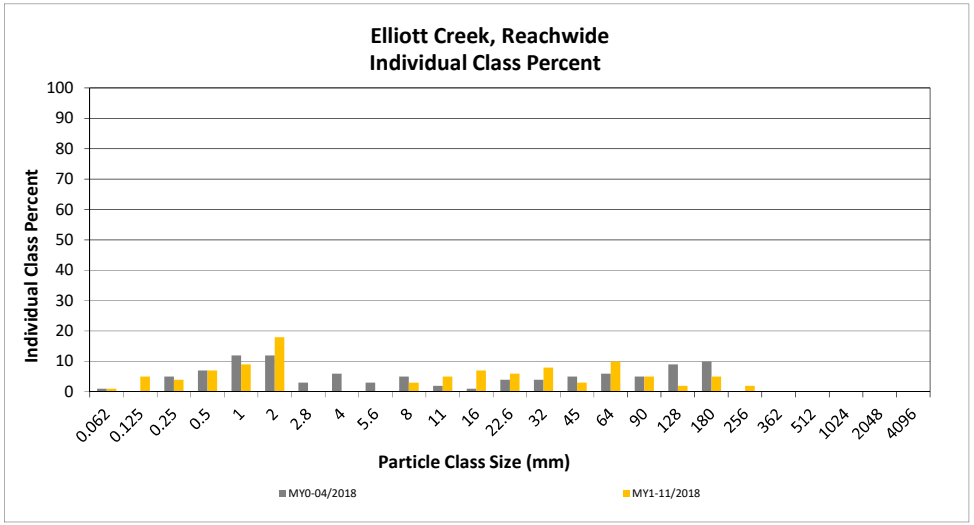
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek, 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	1	1	1
SAND	Very fine	0.062	0.125		5	5	5	6
	Fine	0.125	0.250	1	3	4	4	10
	Medium	0.25	0.50	4	3	7	7	17
	Coarse	0.5	1.0	3	6	9	9	26
	Very Coarse	1.0	2.0	6	12	18	18	44
GRAVEL	Very Fine	2.0	2.8					44
	Very Fine	2.8	4.0					44
	Fine	4.0	5.6					44
	Fine	5.6	8.0	3		3	3	47
	Medium	8.0	11.0	1	4	5	5	52
	Medium	11.0	16.0	3	4	7	7	59
	Coarse	16.0	22.6	2	4	6	6	65
	Coarse	22.6	32	7	1	8	8	73
	Very Coarse	32	45	2	1	3	3	76
	Very Coarse	45	64	8	2	10	10	86
COBBLE	Small	64	90	3	2	5	5	91
	Small	90	128	2		2	2	93
	Large	128	180	3	2	5	5	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} =	0.45
D_{35} =	1.41
D_{50} =	9.7
D_{84} =	59.6
D_{95} =	146.7
D_{100} =	256.0





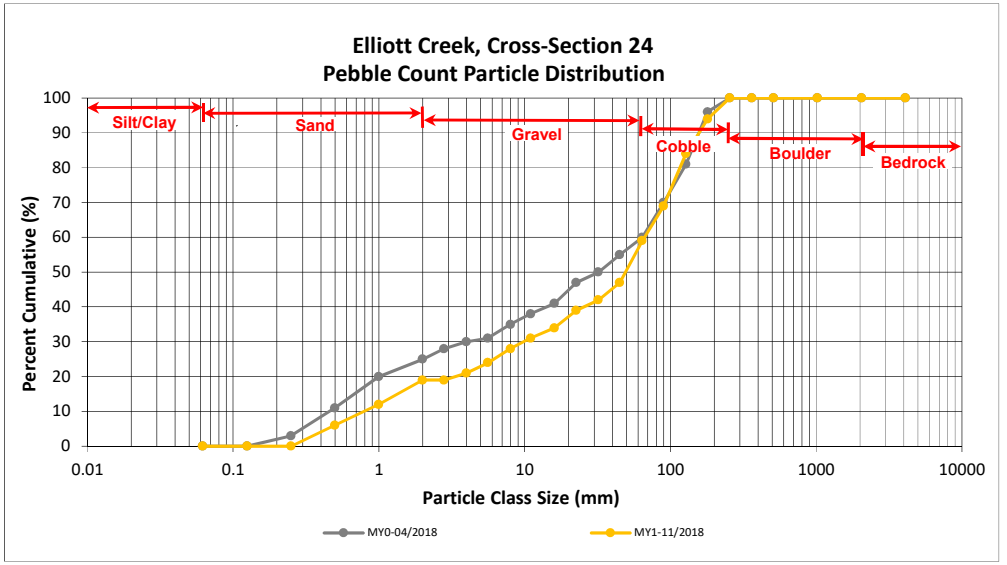
Reachwide and Cross-Section Pebble Count Plots

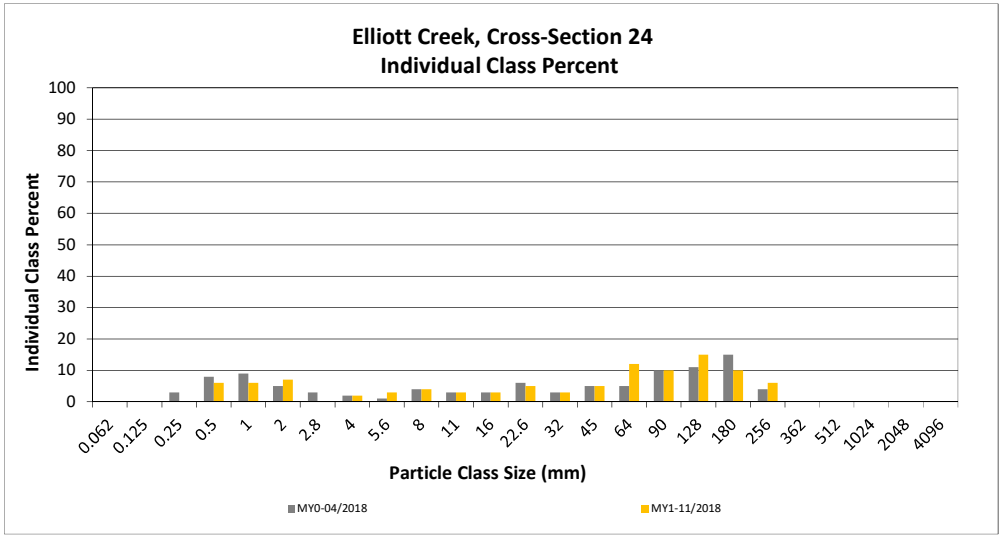
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek, Cross-Section 24

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	6	6	6
	Coarse	0.5	1.0	6	6	12
	Very Coarse	1.0	2.0	7	7	19
GRAVEL	Very Fine	2.0	2.8			19
	Very Fine	2.8	4.0	2	2	21
	Fine	4.0	5.6	3	3	24
	Fine	5.6	8.0	4	4	28
	Medium	8.0	11.0	3	3	31
	Medium	11.0	16.0	3	3	34
	Coarse	16.0	22.6	5	5	39
	Coarse	22.6	32	3	3	42
	Very Coarse	32	45	5	5	47
	Very Coarse	45	64	12	12	59
COBBLE	Small	64	90	10	10	69
	Small	90	128	15	15	84
	Large	128	180	10	10	94
	Large	180	256	6	6	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 24	
Channel materials (mm)	
D_{16} =	1.49
D_{35} =	17.14
D_{50} =	49.1
D_{84} =	128.0
D_{95} =	190.9
D_{100} =	256.0





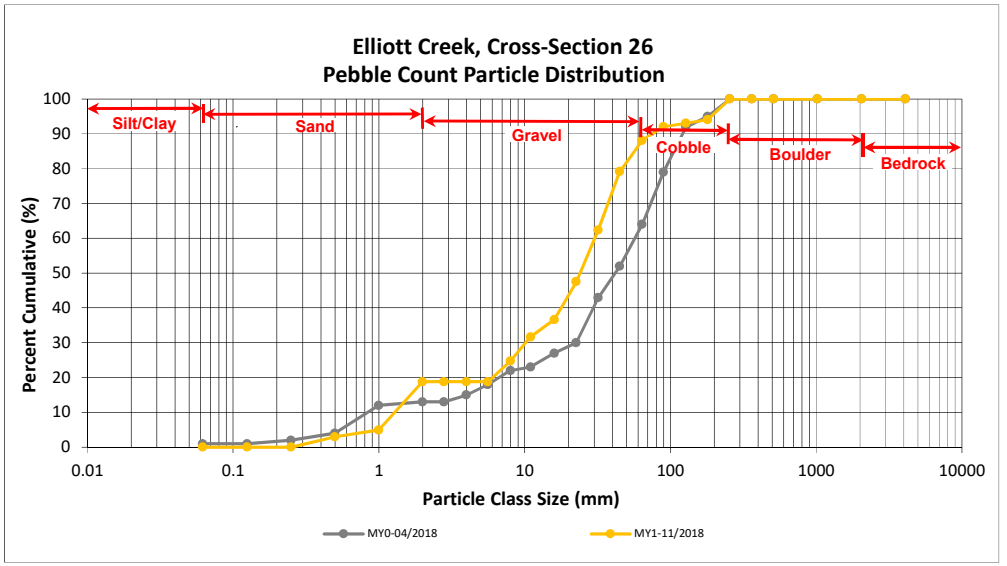
Reachwide and Cross-Section Pebble Count Plots

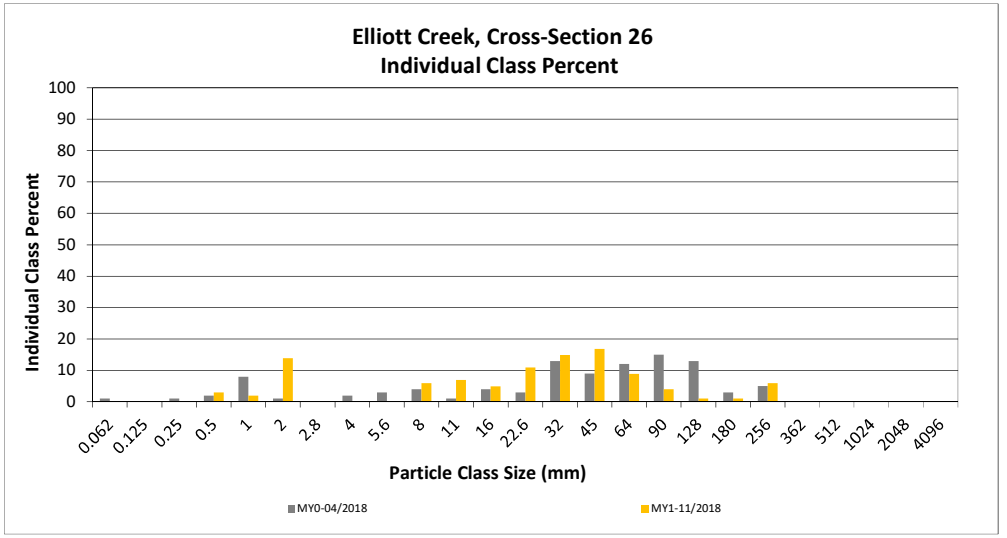
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek, Cross-Section 26

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	3	3	3
	Coarse	0.5	1.0	2	2	5
	Very Coarse	1.0	2.0	14	14	19
GRAVEL	Very Fine	2.0	2.8			19
	Very Fine	2.8	4.0			19
	Fine	4.0	5.6			19
	Fine	5.6	8.0	6	6	25
	Medium	8.0	11.0	7	7	32
	Medium	11.0	16.0	5	5	37
	Coarse	16.0	22.6	11	11	48
	Coarse	22.6	32	15	15	62
	Very Coarse	32	45	17	17	79
	Very Coarse	45	64	9	9	88
COBBLE	Small	64	90	4	4	92
	Small	90	128	1	1	93
	Large	128	180	1	1	94
	Large	180	256	6	6	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	**101**	**100**	**100**

Cross-Section 26	
Channel materials (mm)	
D_{16} =	1.74
D_{35} =	14.14
D_{50} =	23.9
D_{84} =	54.4
D_{95} =	190.3
D_{100} =	256.0





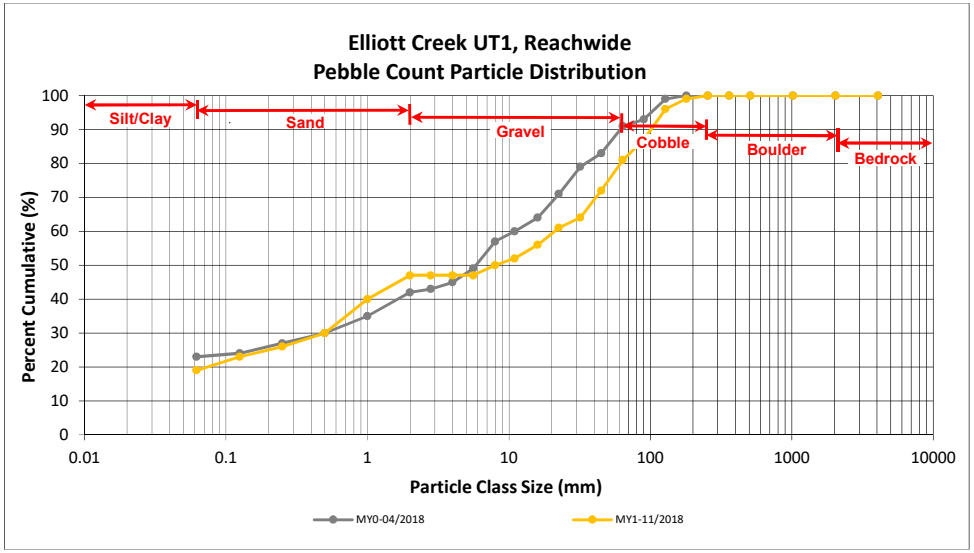
Reachwide and Cross-Section Pebble Count Plots

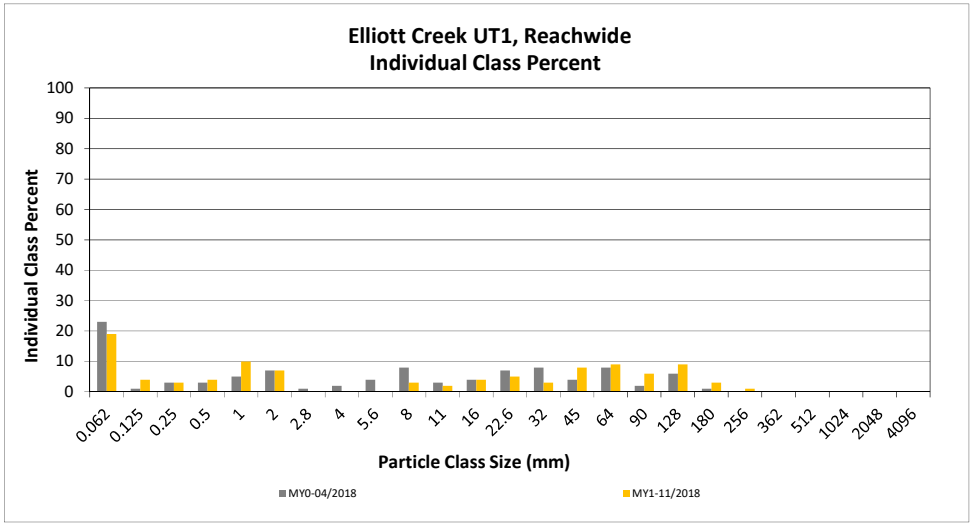
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek UT1, 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		19	19	19	19
SAND	Very fine	0.062	0.125		4	4	4	23
	Fine	0.125	0.250	1	2	3	3	26
	Medium	0.25	0.50		4	4	4	30
	Coarse	0.5	1.0	4	6	10	10	40
	Very Coarse	1.0	2.0	1	6	7	7	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0					47
	Fine	4.0	5.6					47
	Fine	5.6	8.0	1	2	3	3	50
	Medium	8.0	11.0	1	1	2	2	52
	Medium	11.0	16.0	2	2	4	4	56
	Coarse	16.0	22.6	5		5	5	61
	Coarse	22.6	32	3		3	3	64
	Very Coarse	32	45	6	2	8	8	72
	Very Coarse	45	64	9		9	9	81
COBBLE	Small	64	90	5	1	6	6	87
	Small	90	128	8	1	9	9	96
	Large	128	180	3		3	3	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} =	0.71
D_{50} =	8.0
D_{84} =	75.9
D_{95} =	123.1
D_{100} =	256.0





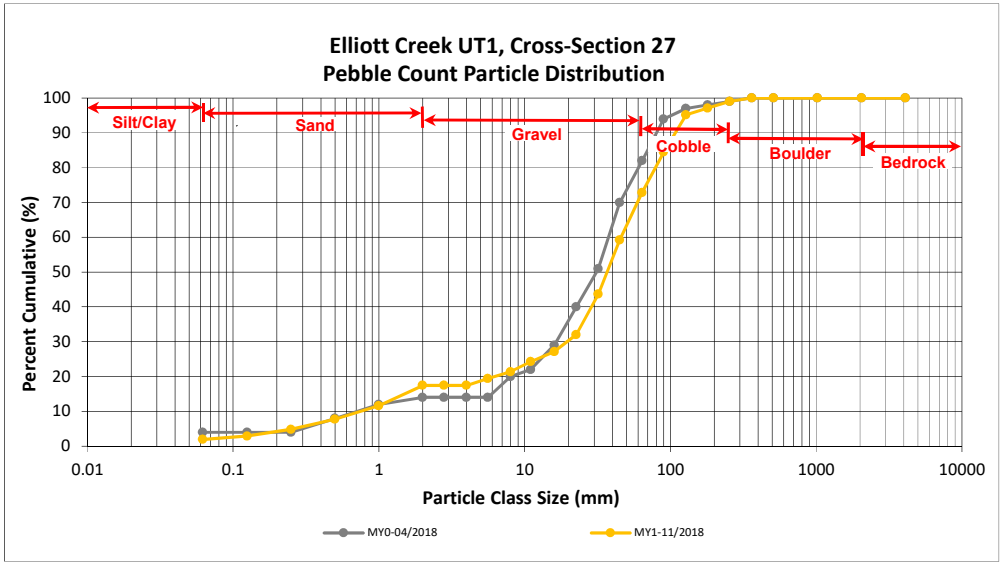
Reachwide and Cross-Section Pebble Count Plots

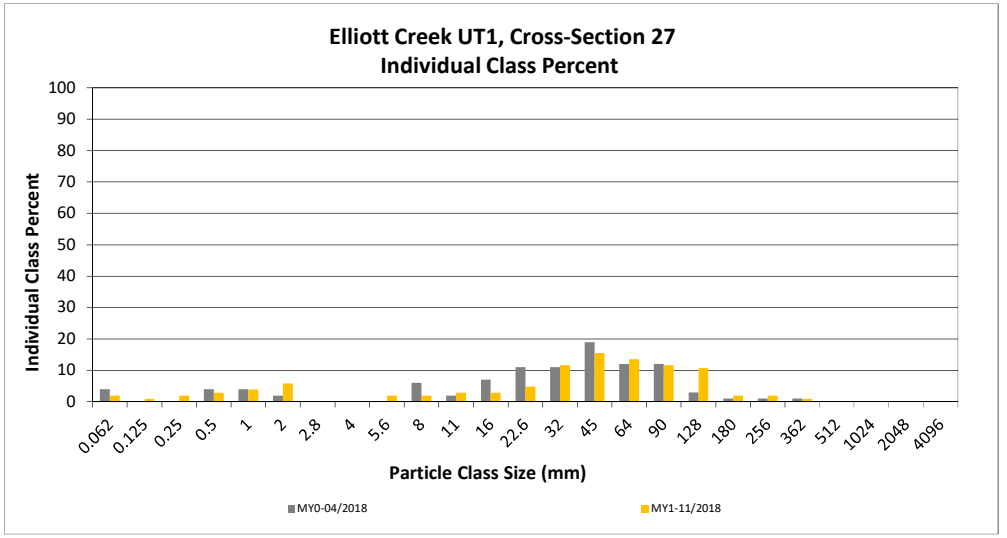
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Elliott Creek UT1, Cross-Section 27

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	2	2
SAND	Very fine	0.062	0.125	1	1	3
	Fine	0.125	0.250	2	2	5
	Medium	0.25	0.50	3	3	8
	Coarse	0.5	1.0	4	4	12
	Very Coarse	1.0	2.0	6	6	17
GRAVEL	Very Fine	2.0	2.8			17
	Very Fine	2.8	4.0			17
	Fine	4.0	5.6	2	2	19
	Fine	5.6	8.0	2	2	21
	Medium	8.0	11.0	3	3	24
	Medium	11.0	16.0	3	3	27
	Coarse	16.0	22.6	5	5	32
	Coarse	22.6	32	12	12	44
	Very Coarse	32	45	16	16	59
	Very Coarse	45	64	14	14	73
COBBLE	Small	64	90	12	12	84
	Small	90	128	11	11	95
	Large	128	180	2	2	97
	Large	180	256	2	2	99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**103**	**100**	**100**

Cross-Section 27	
Channel materials (mm)	
D_{16} =	1.68
D_{35} =	24.69
D_{50} =	36.8
D_{84} =	88.8
D_{95} =	127.4
D_{100} =	362.0





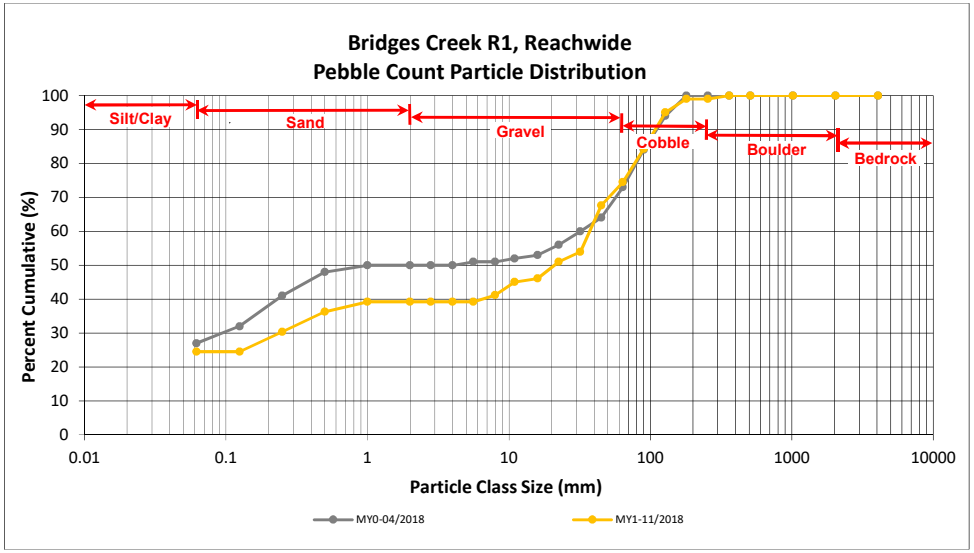
Reachwide and Cross-Section Pebble Count Plots

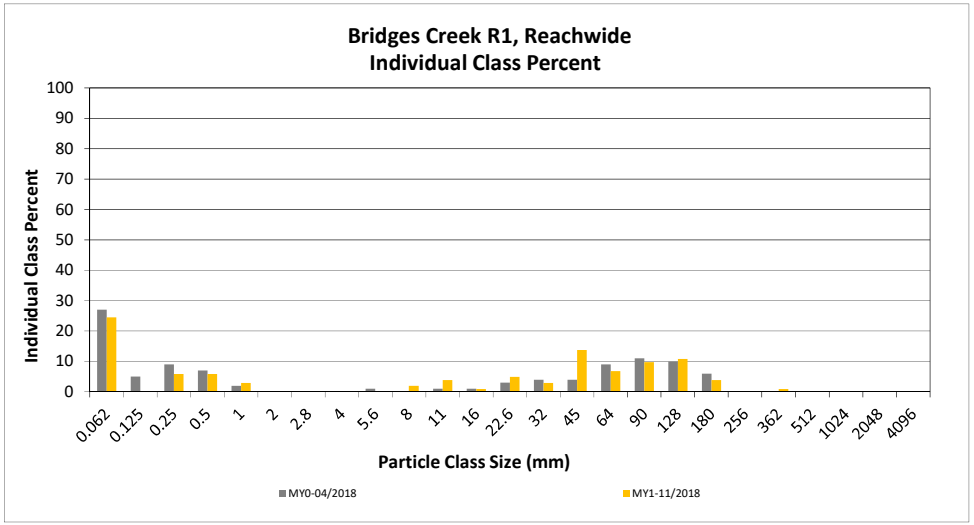
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Bridges Creek 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		25	25	25	25
SAND	Very fine	0.062	0.125					25
	Fine	0.125	0.250		6	6	6	30
	Medium	0.25	0.50		6	6	6	36
	Coarse	0.5	1.0		3	3	3	39
	Very Coarse	1.0	2.0					39
GRAVEL	Very Fine	2.0	2.8					39
	Very Fine	2.8	4.0					39
	Fine	4.0	5.6					39
	Fine	5.6	8.0		2	2	2	41
	Medium	8.0	11.0		4	4	4	45
	Medium	11.0	16.0	1		1	1	46
	Coarse	16.0	22.6	4	1	5	5	51
	Coarse	22.6	32	3		3	3	54
	Very Coarse	32	45	12	2	14	14	68
	Very Coarse	45	64	7		7	7	75
COBBLE	Small	64	90	10		10	10	84
	Small	90	128	10	1	11	11	95
	Large	128	180	3	1	4	4	99
	Large	180	256					99
BOULDER	Small	256	362	1		1	1	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**51**	**51**	**102**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.43
D_{50} =	21.1
D_{84} =	89.0
D_{95} =	127.6
D_{100} =	362.0





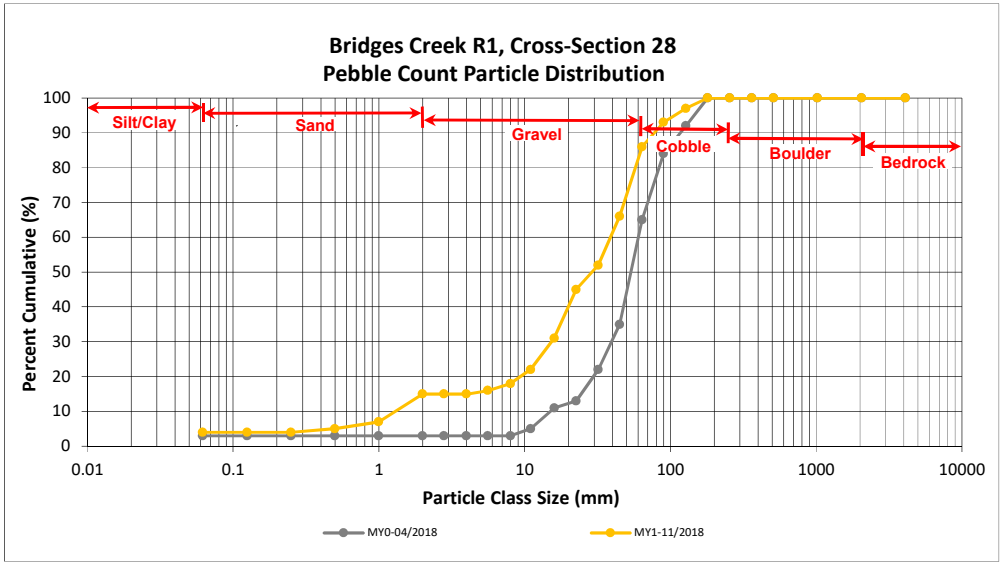
Reachwide and Cross-Section Pebble Count Plots

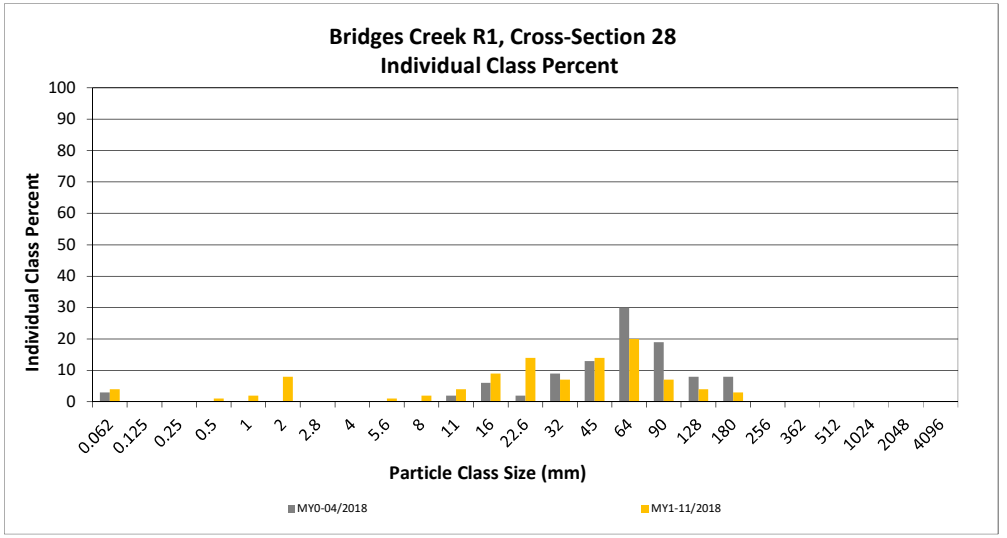
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

Bridges Creek R1, Cross-Section 28

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125			4
	Fine	0.125	0.250			4
	Medium	0.25	0.50	1	1	5
	Coarse	0.5	1.0	2	2	7
	Very Coarse	1.0	2.0	8	8	15
GRAVEL	Very Fine	2.0	2.8			15
	Very Fine	2.8	4.0			15
	Fine	4.0	5.6	1	1	16
	Fine	5.6	8.0	2	2	18
	Medium	8.0	11.0	4	4	22
	Medium	11.0	16.0	9	9	31
	Coarse	16.0	22.6	14	14	45
	Coarse	22.6	32	7	7	52
	Very Coarse	32	45	14	14	66
	Very Coarse	45	64	20	20	86
COBBLE	Small	64	90	7	7	93
	Small	90	128	4	4	97
	Large	128	180	3	3	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 28	
Channel materials (mm)	
D_{16} =	5.60
D_{35} =	17.66
D_{50} =	29.0
D_{84} =	61.8
D_{95} =	107.3
D_{100} =	180.0





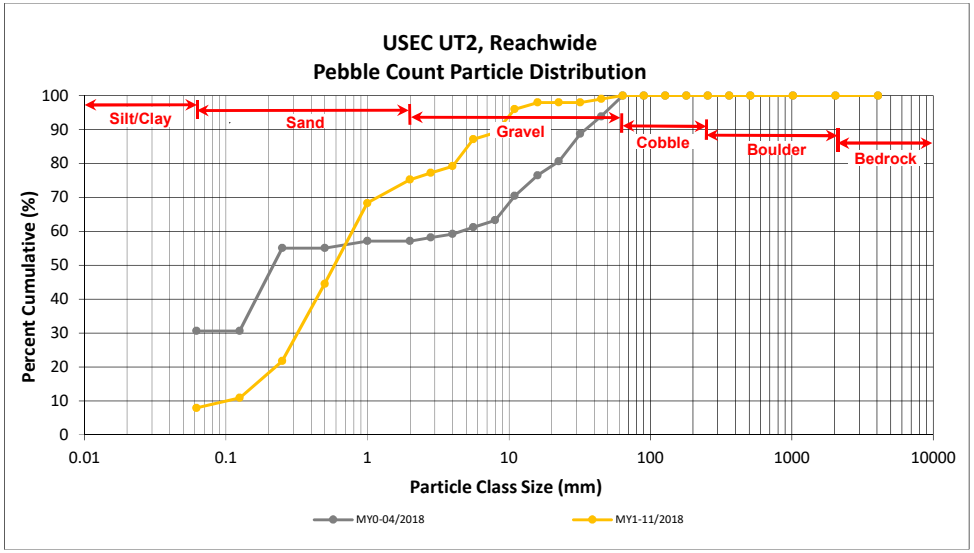
Reachwide and Cross-Section Pebble Count Plots

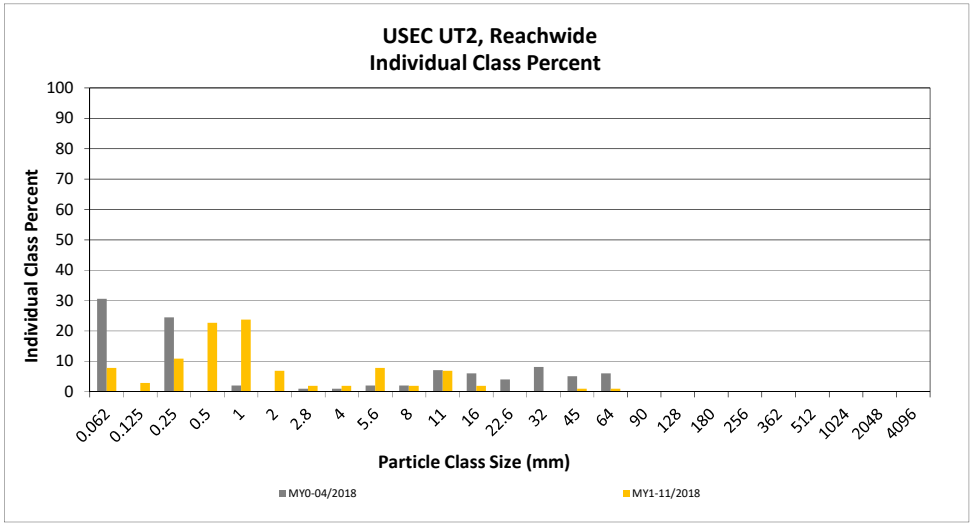
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC UT2, 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	6	8	8	8
SAND	Very fine	0.062	0.125	3		3	3	11
	Fine	0.125	0.250	1	10	11	11	22
	Medium	0.25	0.50	10	13	23	23	45
	Coarse	0.5	1.0	10	14	24	24	68
	Very Coarse	1.0	2.0	2	5	7	7	75
GRAVEL	Very Fine	2.0	2.8	1	1	2	2	77
	Very Fine	2.8	4.0	2		2	2	79
	Fine	4.0	5.6	7	1	8	8	87
	Fine	5.6	8.0	2		2	2	89
	Medium	8.0	11.0	6	1	7	7	96
	Medium	11.0	16.0	2		2	2	98
	Coarse	16.0	22.6					98
	Coarse	22.6	32					98
	Very Coarse	32	45	1		1	1	99
	Very Coarse	45	64	1		1	1	100
COBBLE	Small	64	90					100
	Small	90	128					100
	Large	128	180					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**	**51**	**101**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.17
D_{35} =	0.37
D_{50} =	0.6
D_{84} =	4.9
D_{95} =	10.5
D_{100} =	64.0





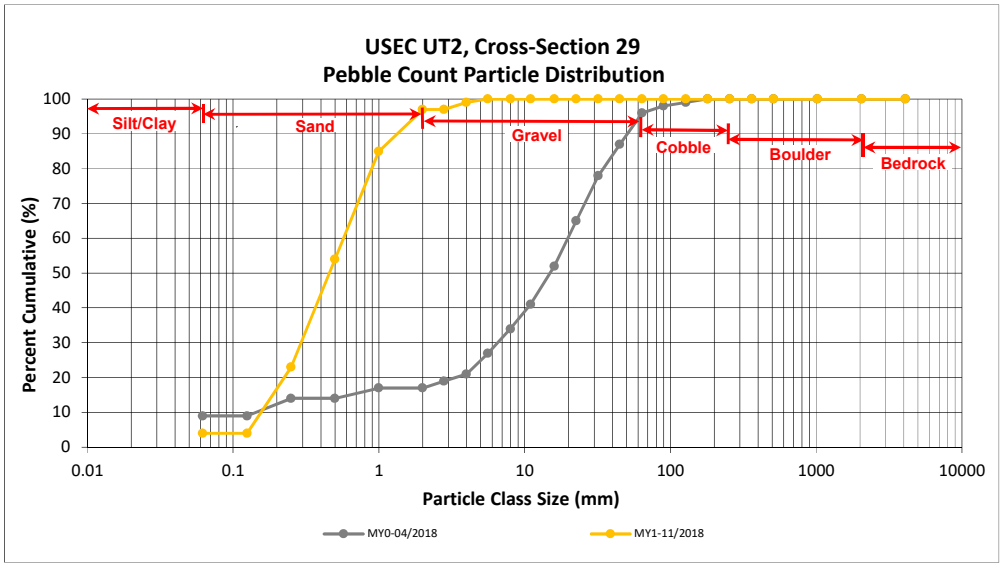
Reachwide and Cross-Section Pebble Count Plots

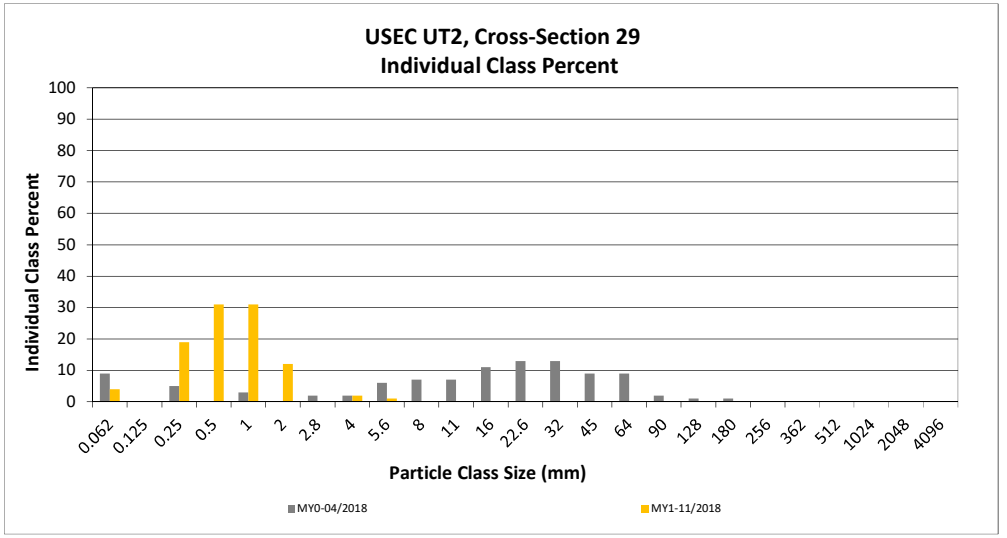
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC UT2, Cross-Section 29

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	4	4
SAND	Very fine	0.062	0.125			4
	Fine	0.125	0.250	19	19	23
	Medium	0.25	0.50	31	31	54
	Coarse	0.5	1.0	31	31	85
	Very Coarse	1.0	2.0	12	12	97
GRAVEL	Very Fine	2.0	2.8			97
	Very Fine	2.8	4.0	2	2	99
	Fine	4.0	5.6	1	1	100
	Fine	5.6	8.0			100
	Medium	8.0	11.0			100
	Medium	11.0	16.0			100
	Coarse	16.0	22.6			100
	Coarse	22.6	32			100
	Very Coarse	32	45			100
	Very Coarse	45	64			100
COBBLE	Small	64	90			100
	Small	90	128			100
	Large	128	180			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 29	
Channel materials (mm)	
D_{16} =	0.19
D_{35} =	0.33
D_{50} =	0.5
D_{84} =	1.8
D_{95} =	5.6
D_{100} =	5.6





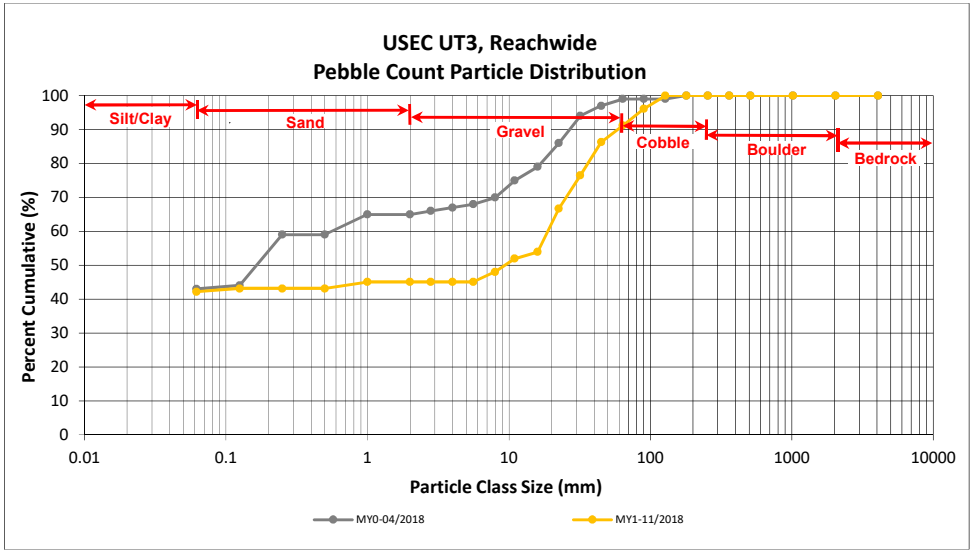
Reachwide and Cross-Section Pebble Count Plots

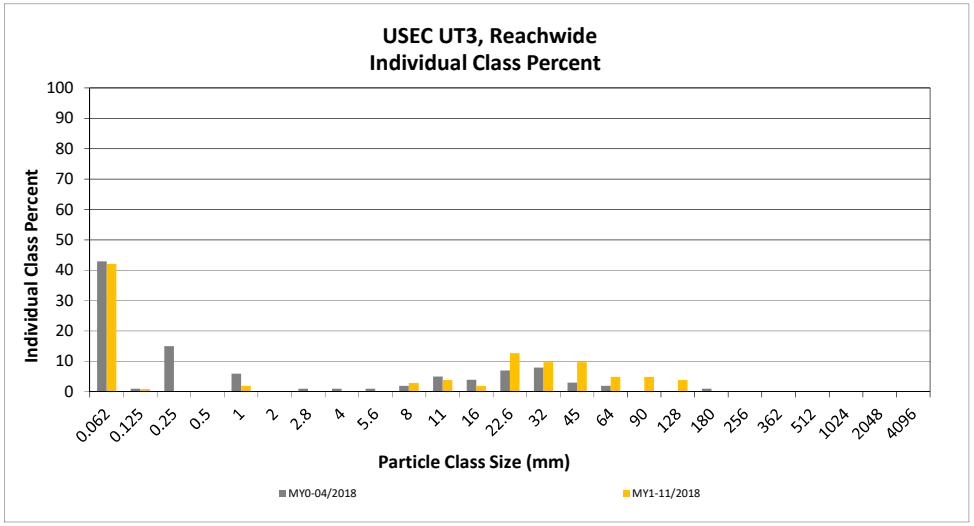
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC UT3, 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	7	36	43	42	42
SAND	Very fine	0.062	0.125	1		1	1	43
	Fine	0.125	0.250					43
	Medium	0.25	0.50					43
	Coarse	0.5	1.0		2	2	2	45
	Very Coarse	1.0	2.0					45
GRAVEL	Very Fine	2.0	2.8					45
	Very Fine	2.8	4.0					45
	Fine	4.0	5.6					45
	Fine	5.6	8.0	2	1	3	3	48
	Medium	8.0	11.0	2	2	4	4	52
	Medium	11.0	16.0	1	1	2	2	54
	Coarse	16.0	22.6	11	2	13	13	67
	Coarse	22.6	32	5	5	10	10	76
	Very Coarse	32	45	8	2	10	10	86
	Very Coarse	45	64	4	1	5	5	91
COBBLE	Small	64	90	5		5	5	96
	Small	90	128	4		4	4	100
	Large	128	180					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**	**52**	**102**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	9.4
D_{84} =	41.6
D_{95} =	83.5
D_{100} =	128.0





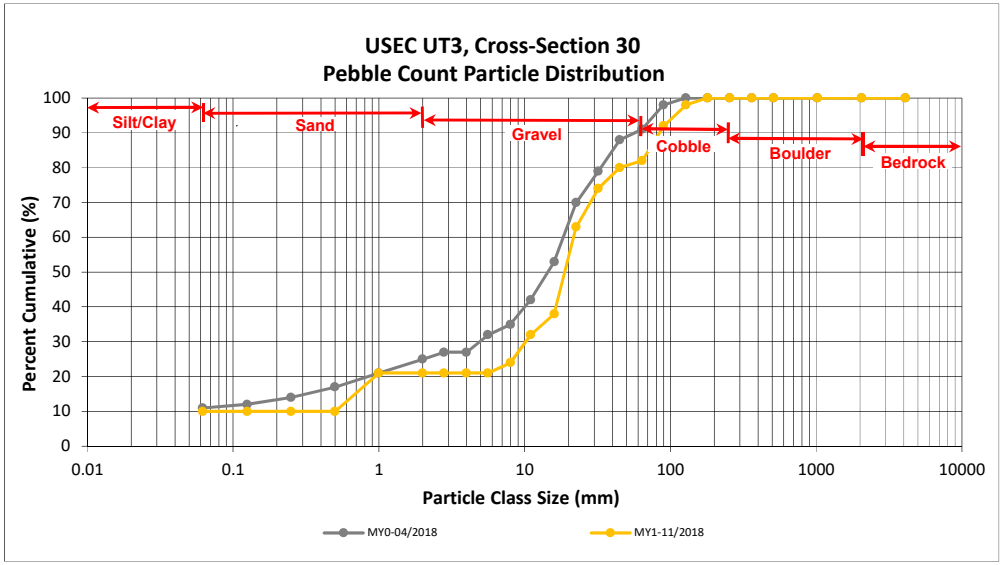
Reachwide and Cross-Section Pebble Count Plots

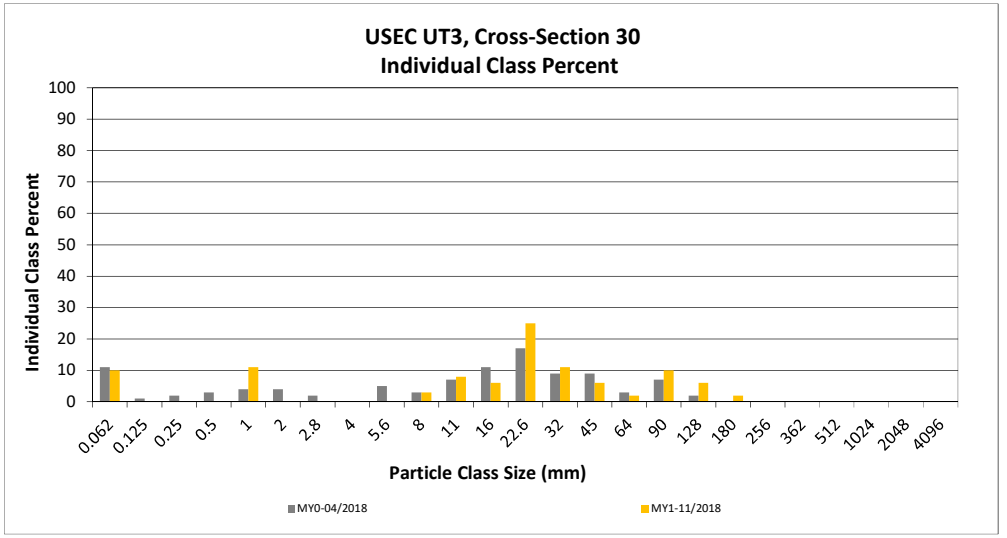
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

USEC UT3, Cross-Section 30

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	10	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250			10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0	11	11	21
	Very Coarse	1.0	2.0			21
GRAVEL	Very Fine	2.0	2.8			21
	Very Fine	2.8	4.0			21
	Fine	4.0	5.6			21
	Fine	5.6	8.0	3	3	24
	Medium	8.0	11.0	8	8	32
	Medium	11.0	16.0	6	6	38
	Coarse	16.0	22.6	25	25	63
	Coarse	22.6	32	11	11	74
	Very Coarse	32	45	6	6	80
	Very Coarse	45	64	2	2	82
COBBLE	Small	64	90	10	10	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 30	
Channel materials (mm)	
D_{16} =	0.73
D_{35} =	13.27
D_{50} =	18.9
D_{84} =	68.5
D_{95} =	107.3
D_{100} =	180.0





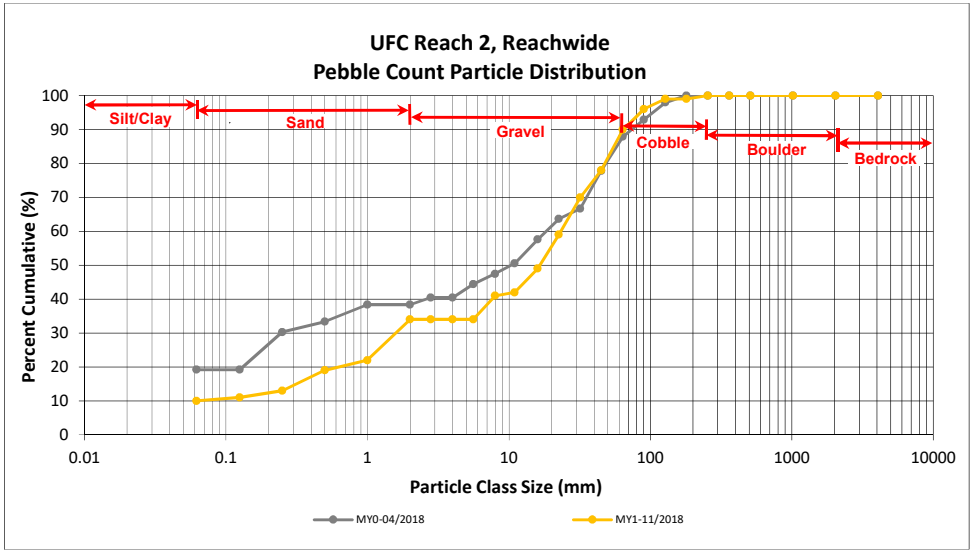
Reachwide and Cross-Section Pebble Count Plots

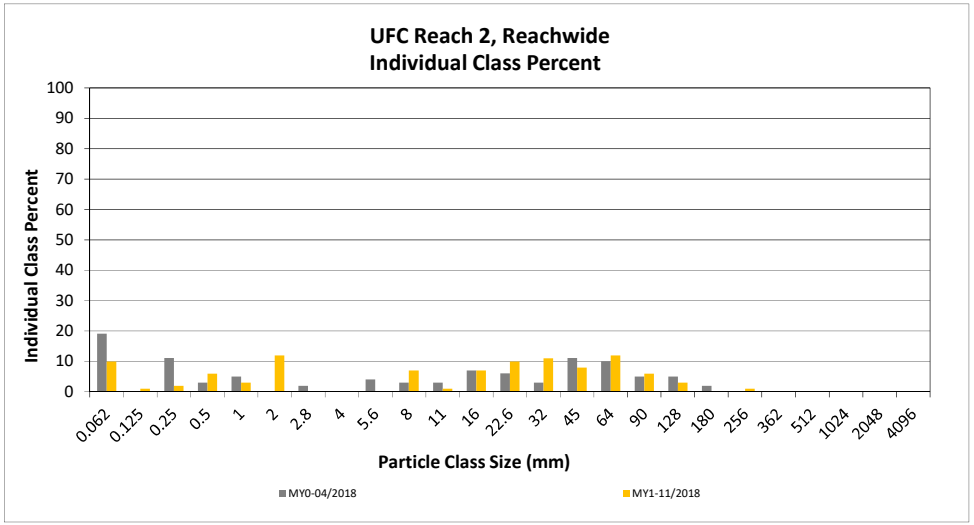
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2, 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	6	4	10	10	10
SAND	Very fine	0.062	0.125		1	1	1	11
	Fine	0.125	0.250		2	2	2	13
	Medium	0.25	0.50		6	6	6	19
	Coarse	0.5	1.0		3	3	3	22
	Very Coarse	1.0	2.0	4	8	12	12	34
GRAVEL	Very Fine	2.0	2.8					34
	Very Fine	2.8	4.0					34
	Fine	4.0	5.6					34
	Fine	5.6	8.0	3	4	7	7	41
	Medium	8.0	11.0		1	1	1	42
	Medium	11.0	16.0	2	5	7	7	49
	Coarse	16.0	22.6	4	6	10	10	59
	Coarse	22.6	32	6	5	11	11	70
	Very Coarse	32	45	7	1	8	8	78
	Very Coarse	45	64	8	4	12	12	90
COBBLE	Small	64	90	6		6	6	96
	Small	90	128	3		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} =	0.35
D_{35} =	5.89
D_{50} =	16.6
D_{84} =	53.7
D_{95} =	85.0
D_{100} =	256.0





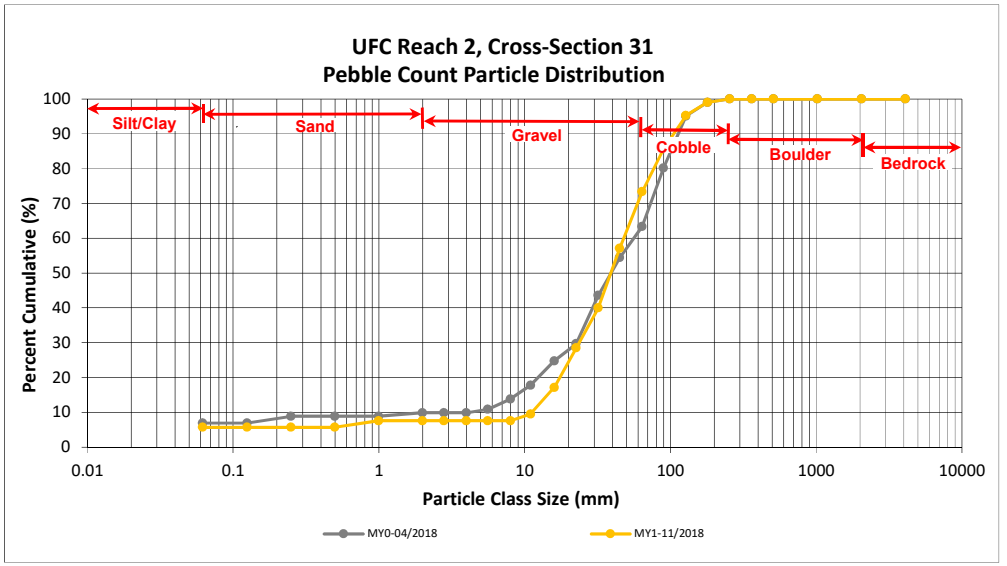
Reachwide and Cross-Section Pebble Count Plots

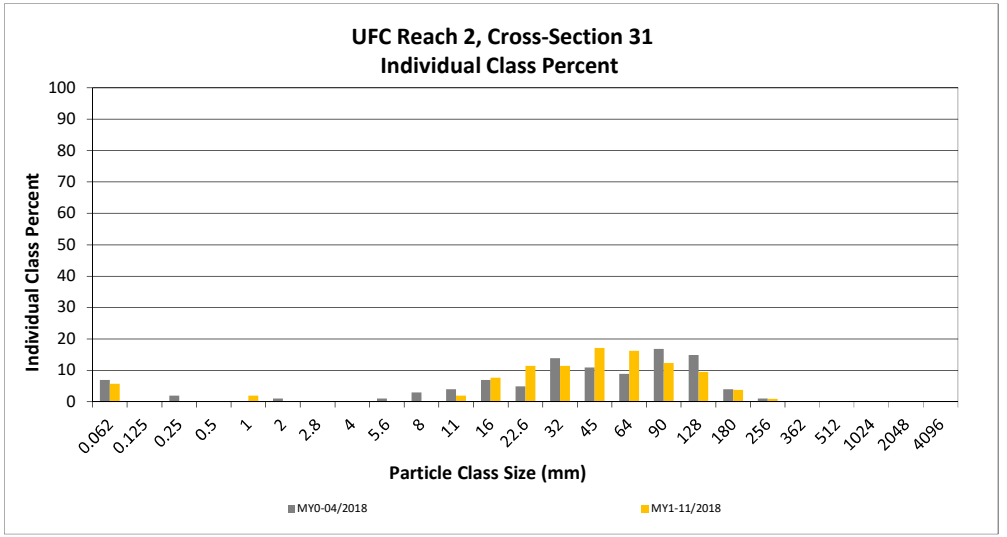
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2, Cross-Section 31

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0	2	2	8
	Very Coarse	1.0	2.0			8
GRAVEL	Very Fine	2.0	2.8			8
	Very Fine	2.8	4.0			8
	Fine	4.0	5.6			8
	Fine	5.6	8.0			8
	Medium	8.0	11.0	2	2	10
	Medium	11.0	16.0	8	8	17
	Coarse	16.0	22.6	12	11	29
	Coarse	22.6	32	12	11	40
	Very Coarse	32	45	18	17	57
	Very Coarse	45	64	17	16	73
COBBLE	Small	64	90	13	12	86
	Small	90	128	10	10	95
	Large	128	180	4	4	99
	Large	180	256	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	**105**	**100**	**100**

Cross-Section 31	
Channel materials (mm)	
D_{16} =	15.13
D_{35} =	27.48
D_{50} =	39.0
D_{84} =	85.9
D_{95} =	126.9
D_{100} =	256.0





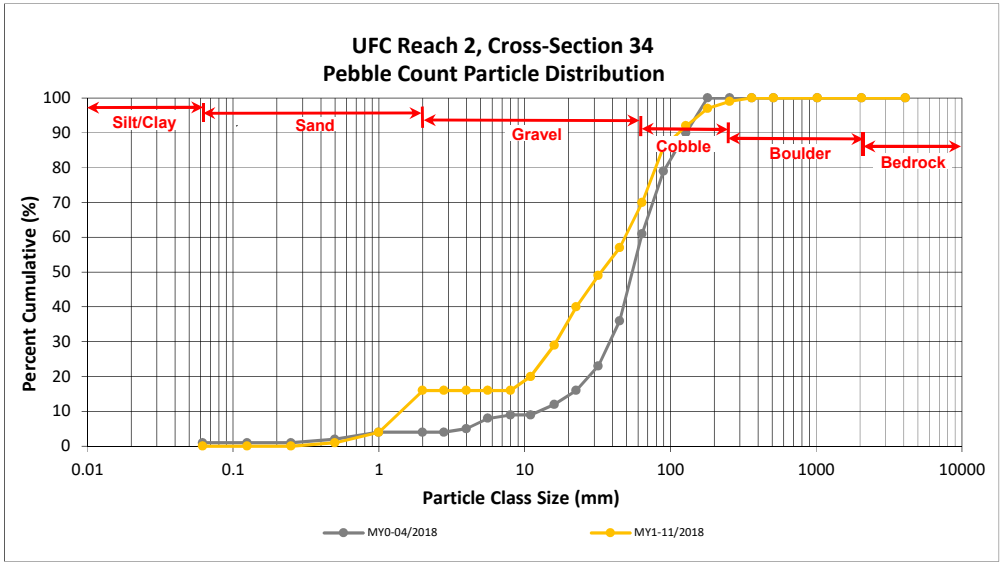
Reachwide and Cross-Section Pebble Count Plots

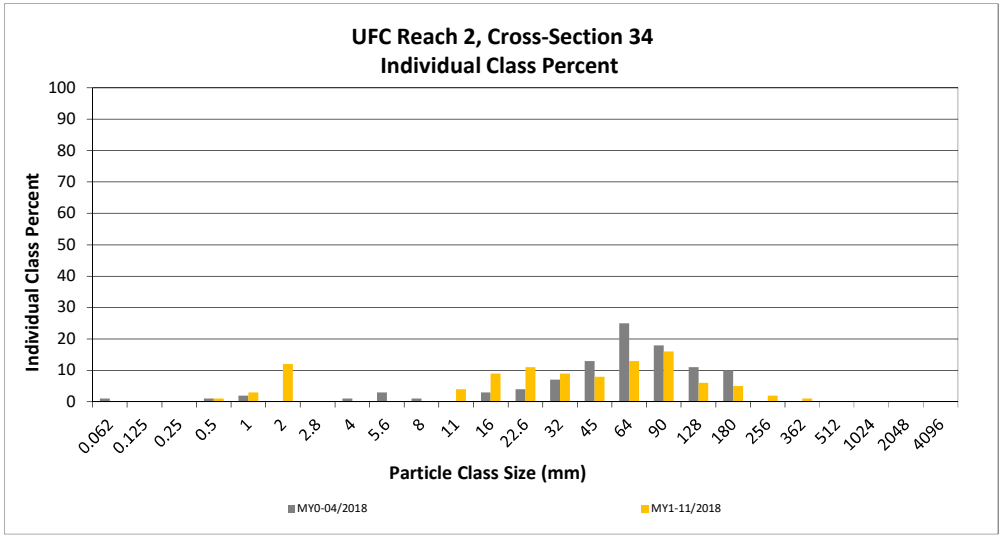
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2, Cross-Section 34

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	1	1	1
	Coarse	0.5	1.0	3	3	4
	Very Coarse	1.0	2.0	12	12	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6			16
	Fine	5.6	8.0			16
	Medium	8.0	11.0	4	4	20
	Medium	11.0	16.0	9	9	29
	Coarse	16.0	22.6	11	11	40
	Coarse	22.6	32	9	9	49
	Very Coarse	32	45	8	8	57
	Very Coarse	45	64	13	13	70
COBBLE	Small	64	90	16	16	86
	Small	90	128	6	6	92
	Large	128	180	5	5	97
	Large	180	256	2	2	99
BOULDER	Small	256	362	1	1	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 34	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	19.32
D_{50} =	33.4
D_{84} =	86.2
D_{95} =	157.1
D_{100} =	362.0





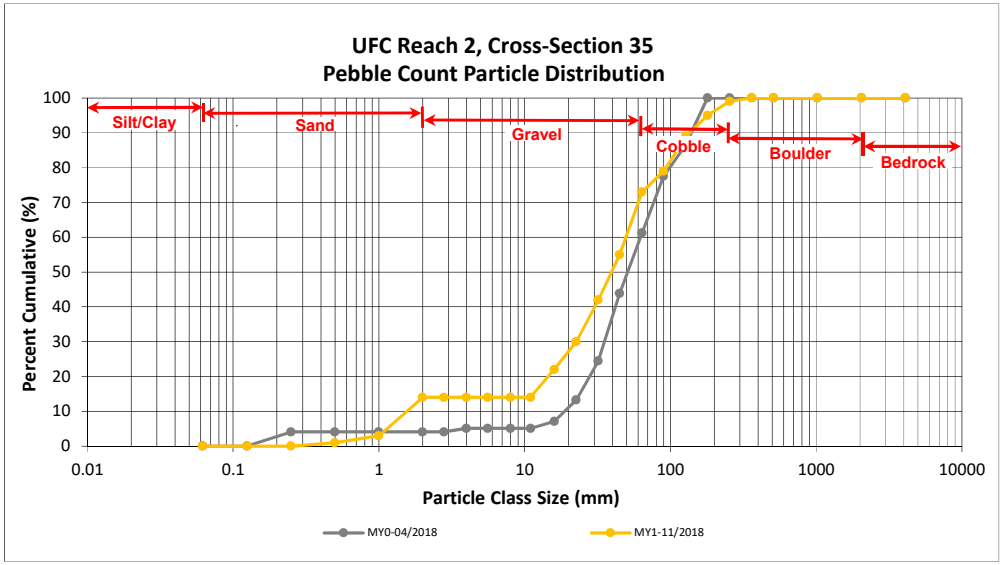
Reachwide and Cross-Section Pebble Count Plots

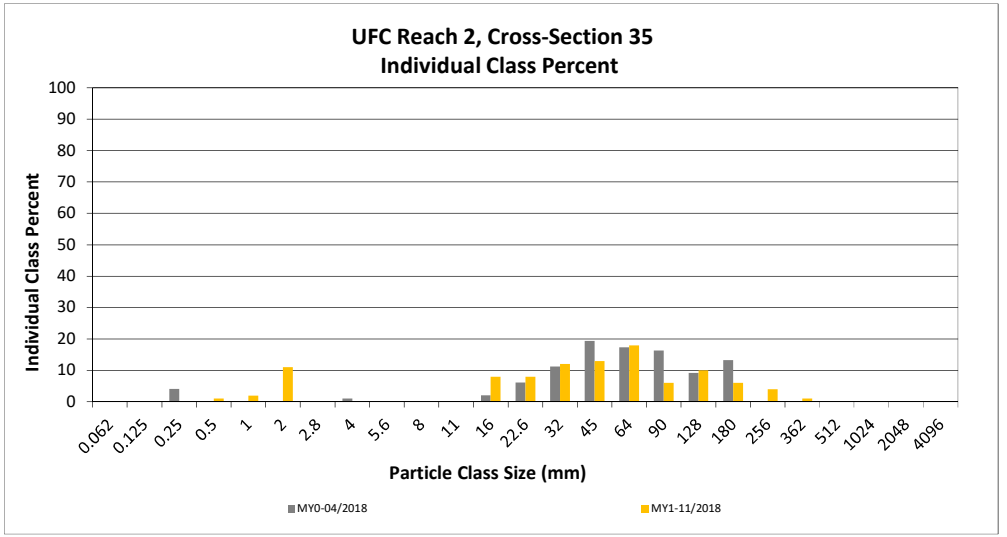
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

UFC Reach 2, Cross-Section 35

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	1	1	1
	Coarse	0.5	1.0	2	2	3
	Very Coarse	1.0	2.0	11	11	14
GRAVEL	Very Fine	2.0	2.8			14
	Very Fine	2.8	4.0			14
	Fine	4.0	5.6			14
	Fine	5.6	8.0			14
	Medium	8.0	11.0			14
	Medium	11.0	16.0	8	8	22
	Coarse	16.0	22.6	8	8	30
	Coarse	22.6	32	12	12	42
	Very Coarse	32	45	13	13	55
	Very Coarse	45	64	18	18	73
COBBLE	Small	64	90	6	6	79
	Small	90	128	10	10	89
	Large	128	180	6	6	95
	Large	180	256	4	4	99
BOULDER	Small	256	362	1	1	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 35	
Channel materials (mm)	
D_{16} =	12.08
D_{35} =	26.12
D_{50} =	39.5
D_{84} =	107.3
D_{95} =	180.0
D_{100} =	362.0





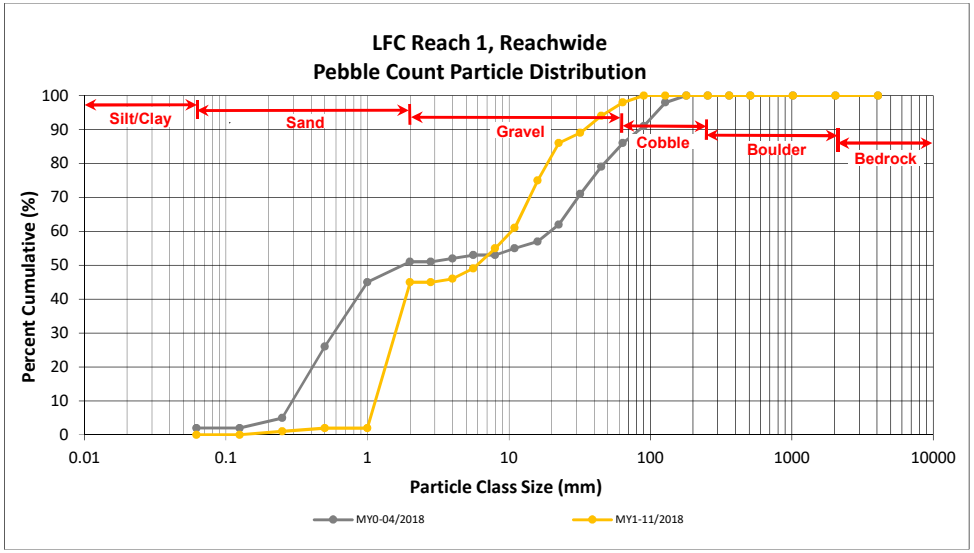
Reachwide and Cross-Section Pebble Count Plots

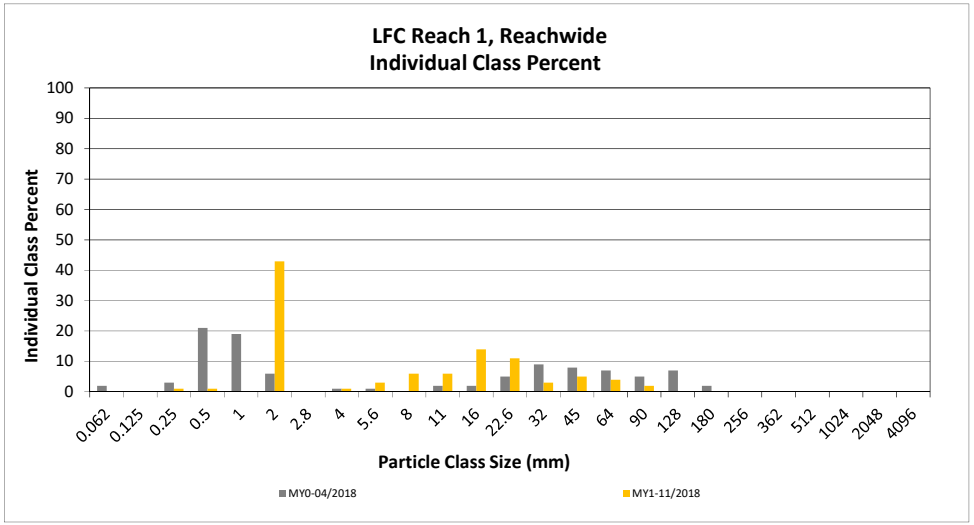
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 1, 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					0
SAND	Very fine	0.062	0.125					0
	Fine	0.125	0.250	1		1	1	1
	Medium	0.25	0.50	1		1	1	2
	Coarse	0.5	1.0					2
	Very Coarse	1.0	2.0	7	36	43	43	45
GRAVEL	Very Fine	2.0	2.8					45
	Very Fine	2.8	4.0	1		1	1	46
	Fine	4.0	5.6	1	2	3	3	49
	Fine	5.6	8.0	1	5	6	6	55
	Medium	8.0	11.0	5	1	6	6	61
	Medium	11.0	16.0	11	3	14	14	75
	Coarse	16.0	22.6	9	2	11	11	86
	Coarse	22.6	32	2	1	3	3	89
	Very Coarse	32	45	5		5	5	94
	Very Coarse	45	64	4		4	4	98
COBBLE	Small	64	90	2		2	2	100
	Small	90	128					100
	Large	128	180					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} =	1.25
D_{35} =	1.70
D_{50} =	5.9
D_{84} =	21.2
D_{95} =	49.1
D_{100} =	90.0





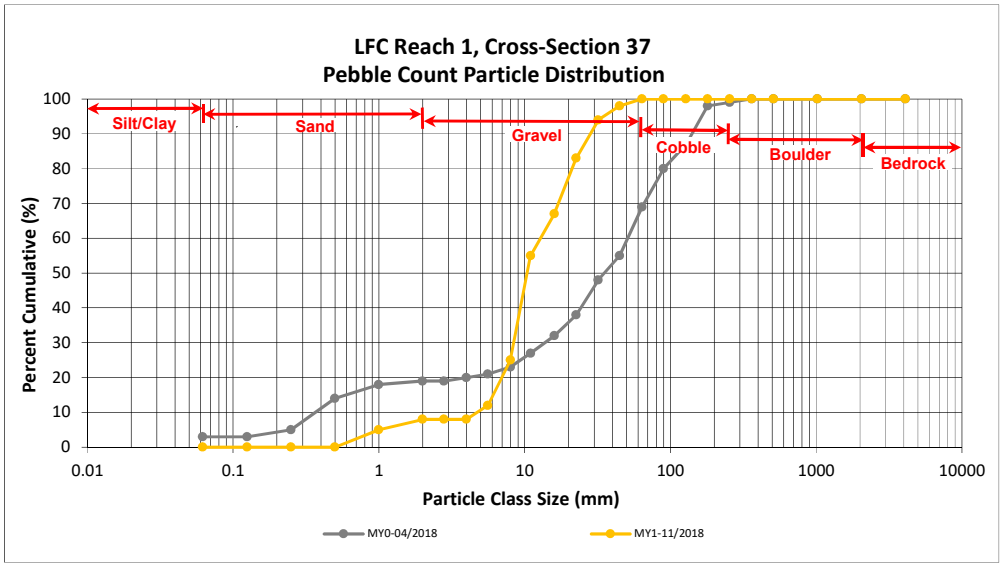
Reachwide and Cross-Section Pebble Count Plots

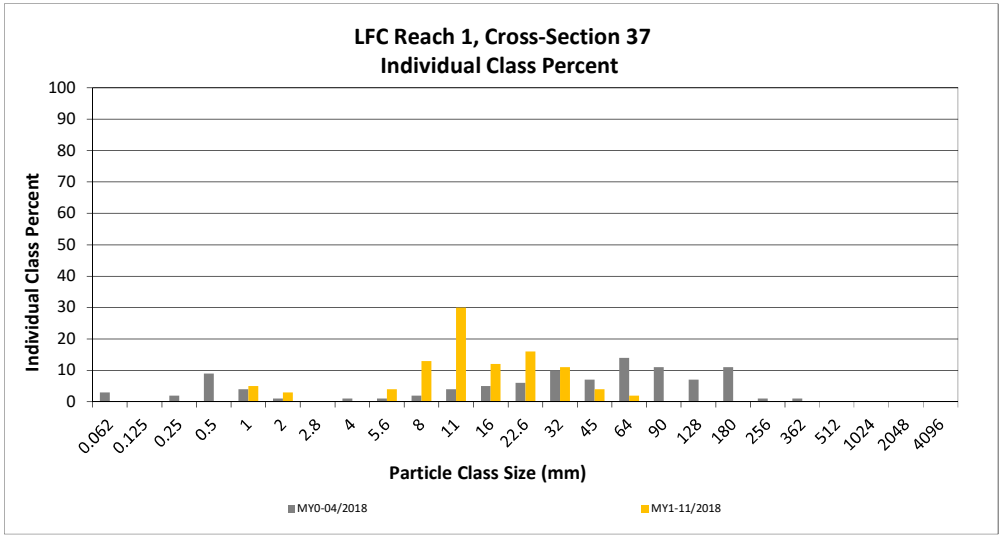
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 1, Cross-Section 37

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	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	5	5	5
	Very Coarse	1.0	2.0	3	3	8
GRAVEL	Very Fine	2.0	2.8			8
	Very Fine	2.8	4.0			8
	Fine	4.0	5.6	4	4	12
	Fine	5.6	8.0	13	13	25
	Medium	8.0	11.0	30	30	55
	Medium	11.0	16.0	12	12	67
	Coarse	16.0	22.6	16	16	83
	Coarse	22.6	32	11	11	94
	Very Coarse	32	45	4	4	98
	Very Coarse	45	64	2	2	100
COBBLE	Small	64	90			100
	Small	90	128			100
	Large	128	180			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 37	
Channel materials (mm)	
D_{16} =	6.25
D_{35} =	8.90
D_{50} =	10.4
D_{84} =	23.3
D_{95} =	34.8
D_{100} =	64.0





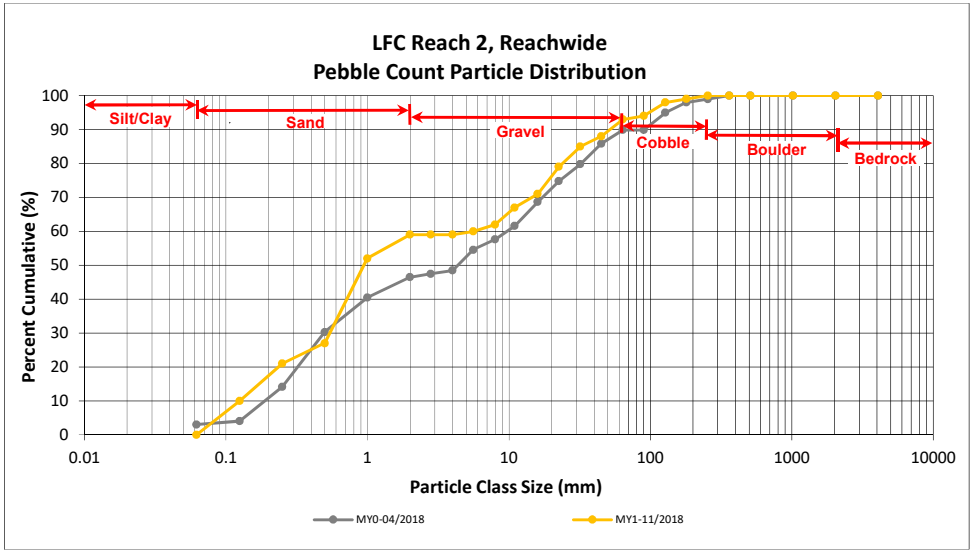
Reachwide and Cross-Section Pebble Count Plots

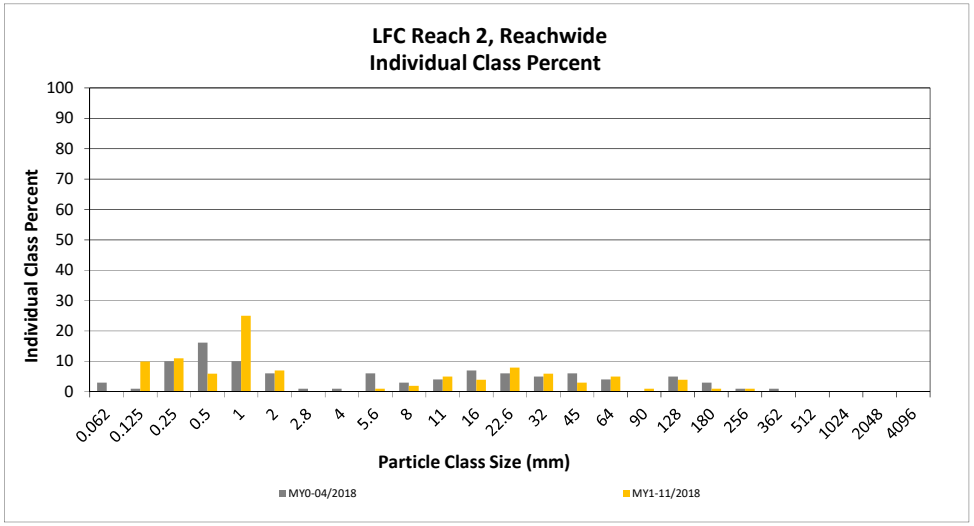
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 2, 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					0
SAND	Very fine	0.062	0.125		10	10	10	10
	Fine	0.125	0.250	1	10	11	11	21
	Medium	0.25	0.50	5	1	6	6	27
	Coarse	0.5	1.0	10	15	25	25	52
	Very Coarse	1.0	2.0	4	3	7	7	59
GRAVEL	Very Fine	2.0	2.8					59
	Very Fine	2.8	4.0					59
	Fine	4.0	5.6		1	1	1	60
	Fine	5.6	8.0	1	1	2	2	62
	Medium	8.0	11.0	2	3	5	5	67
	Medium	11.0	16.0	2	2	4	4	71
	Coarse	16.0	22.6	6	2	8	8	79
	Coarse	22.6	32	6		6	6	85
	Very Coarse	32	45	2	1	3	3	88
	Very Coarse	45	64	4	1	5	5	93
COBBLE	Small	64	90	1		1	1	94
	Small	90	128	4		4	4	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} =	0.18
D_{35} =	0.62
D_{50} =	0.9
D_{84} =	30.2
D_{95} =	98.3
D_{100} =	256.0





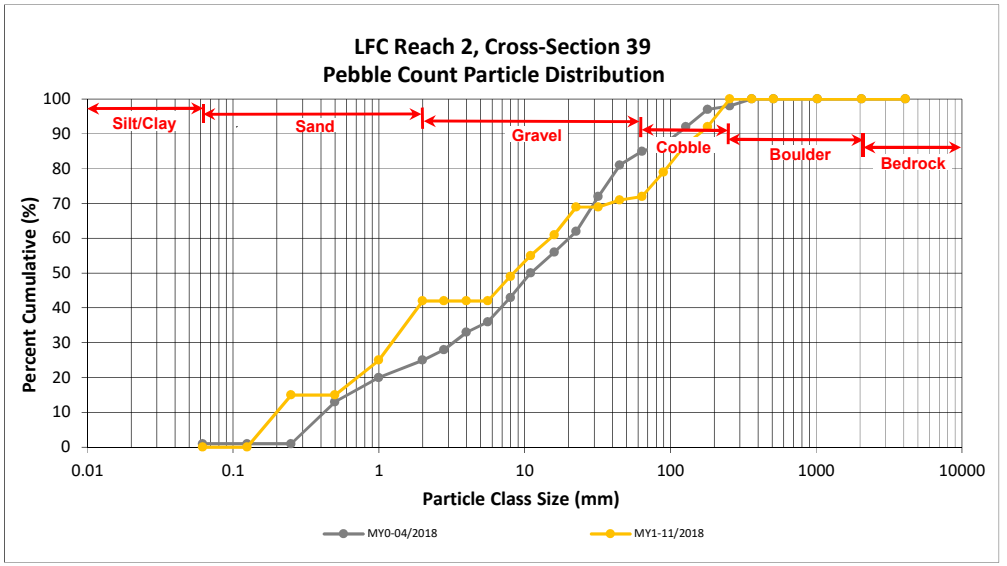
Reachwide and Cross-Section Pebble Count Plots

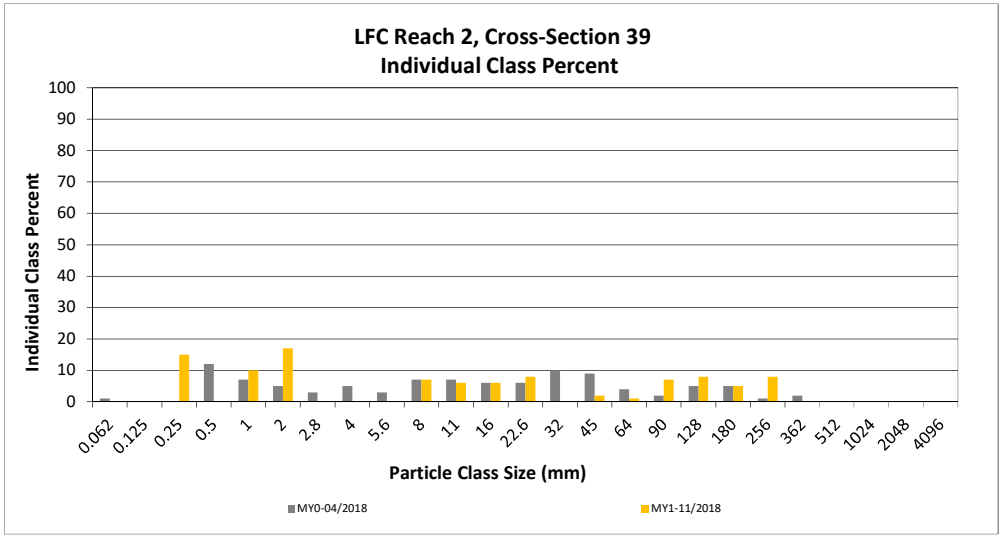
Big Harris Creek Mitigation Site - Area B
DMS Project No. 739
Monitoring Year 1 - 2018

LFC Reach 2, Cross-Section 39

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	15	15	15
	Medium	0.25	0.50			15
	Coarse	0.5	1.0	10	10	25
	Very Coarse	1.0	2.0	17	17	42
GRAVEL	Very Fine	2.0	2.8			42
	Very Fine	2.8	4.0			42
	Fine	4.0	5.6			42
	Fine	5.6	8.0	7	7	49
	Medium	8.0	11.0	6	6	55
	Medium	11.0	16.0	6	6	61
	Coarse	16.0	22.6	8	8	69
	Coarse	22.6	32			69
	Very Coarse	32	45	2	2	71
	Very Coarse	45	64	1	1	72
COBBLE	Small	64	90	7	7	79
	Small	90	128	8	8	87
	Large	128	180	5	5	92
	Large	180	256	8	8	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 39	
Channel materials (mm)	
D_{16} =	0.54
D_{35} =	1.50
D_{50} =	8.4
D_{84} =	112.2
D_{95} =	205.4
D_{100} =	256.0





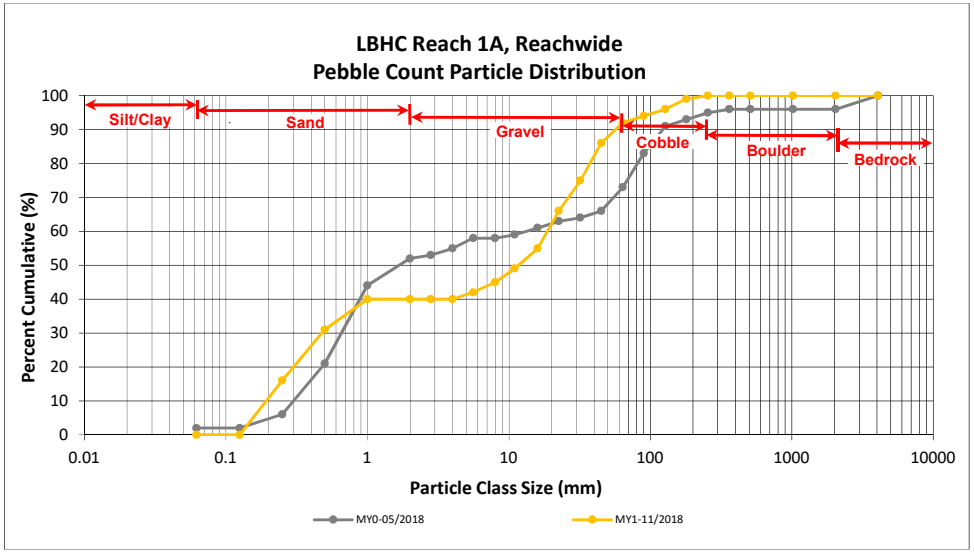
Reachwide and Cross-Section Pebble Count Plots

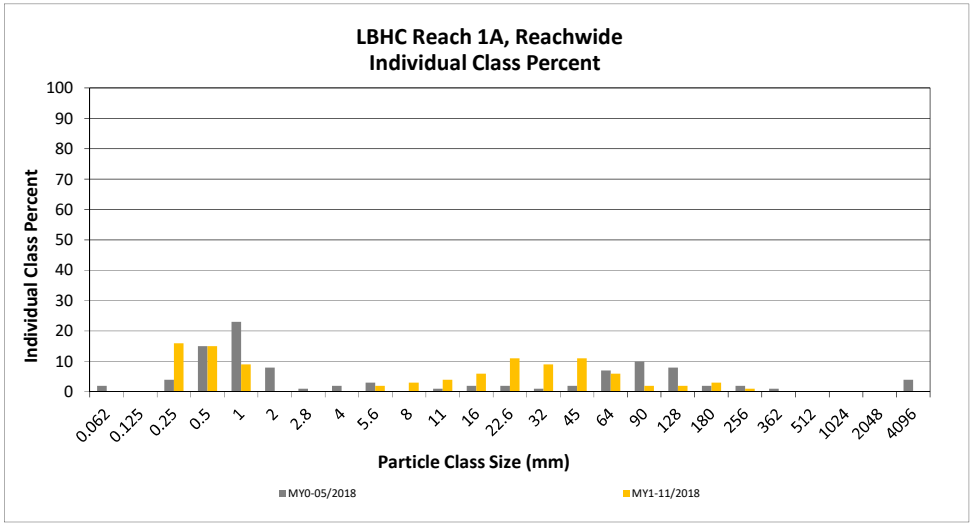
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1A, 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					0
SAND	Very fine	0.062	0.125					0
	Fine	0.125	0.250	1	15	16	16	16
	Medium	0.25	0.50	4	11	15	15	31
	Coarse	0.5	1.0	4	5	9	9	40
	Very Coarse	1.0	2.0					40
GRAVEL	Very Fine	2.0	2.8					40
	Very Fine	2.8	4.0					40
	Fine	4.0	5.6	1	1	2	2	42
	Fine	5.6	8.0	3		3	3	45
	Medium	8.0	11.0	3	1	4	4	49
	Medium	11.0	16.0	2	4	6	6	55
	Coarse	16.0	22.6	6	5	11	11	66
	Coarse	22.6	32	6	3	9	9	75
	Very Coarse	32	45	8	3	11	11	86
	Very Coarse	45	64	4	2	6	6	92
COBBLE	Small	64	90	2		2	2	94
	Small	90	128	2		2	2	96
	Large	128	180	3		3	3	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} =	0.25
D_{35} =	0.68
D_{50} =	11.7
D_{84} =	42.3
D_{95} =	107.3
D_{100} =	256.0





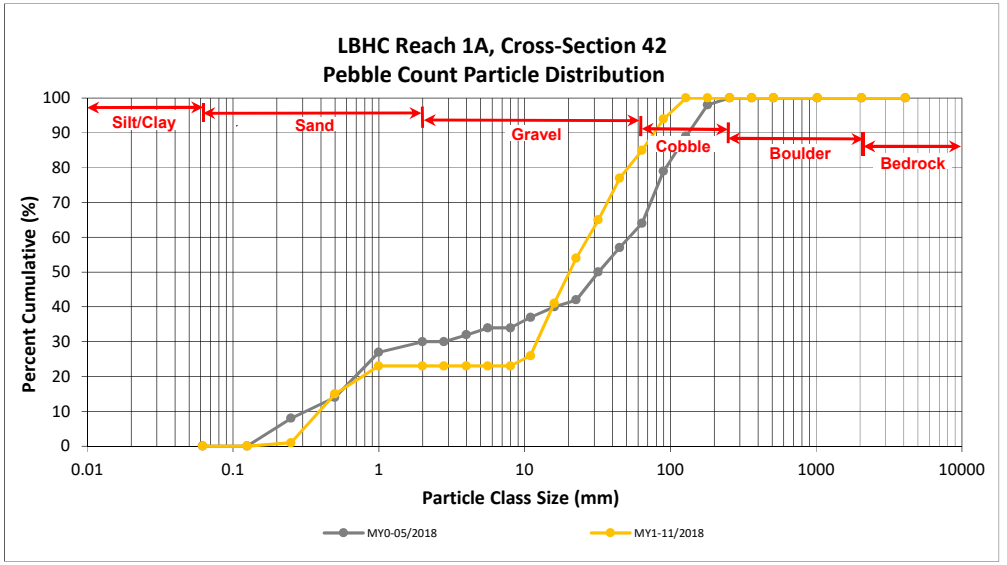
Reachwide and Cross-Section Pebble Count Plots

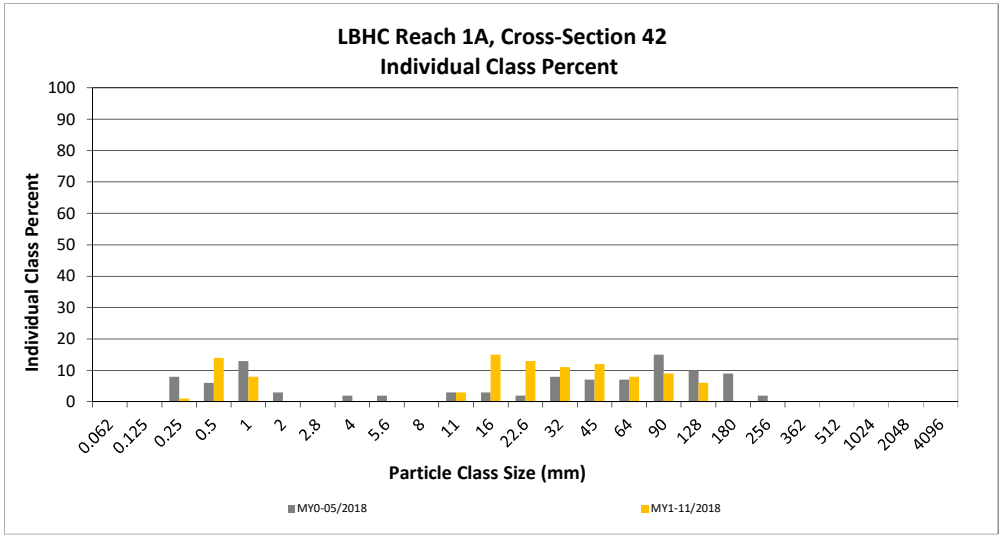
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reach 1A, Cross-Section 42

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	1	1	1
	Medium	0.25	0.50	14	14	15
	Coarse	0.5	1.0	8	8	23
	Very Coarse	1.0	2.0			23
GRAVEL	Very Fine	2.0	2.8			23
	Very Fine	2.8	4.0			23
	Fine	4.0	5.6			23
	Fine	5.6	8.0			23
	Medium	8.0	11.0	3	3	26
	Medium	11.0	16.0	15	15	41
	Coarse	16.0	22.6	13	13	54
	Coarse	22.6	32	11	11	65
	Very Coarse	32	45	12	12	77
	Very Coarse	45	64	8	8	85
COBBLE	Small	64	90	9	9	94
	Small	90	128	6	6	100
	Large	128	180			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 42	
Channel materials (mm)	
D_{16} =	0.55
D_{35} =	13.77
D_{50} =	20.3
D_{84} =	61.2
D_{95} =	95.4
D_{100} =	128.0





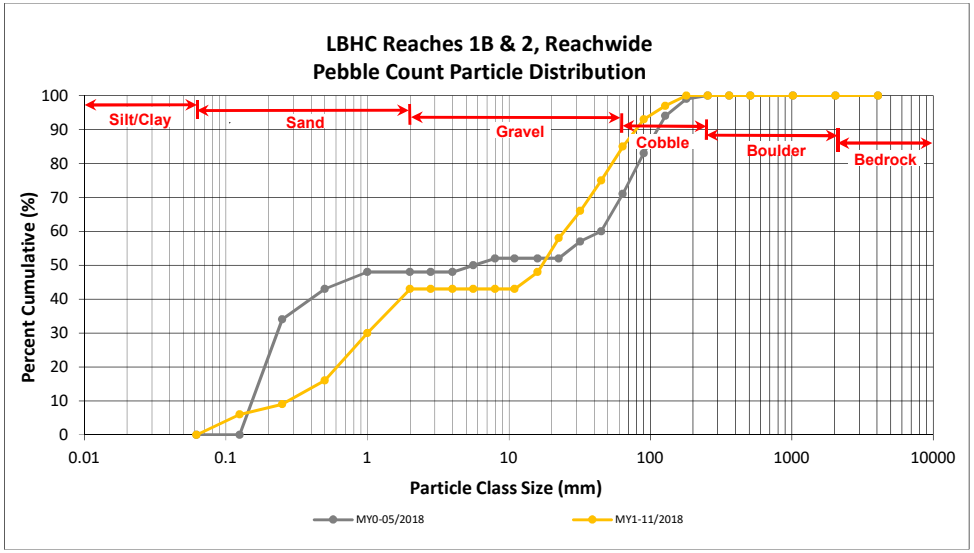
Reachwide and Cross-Section Pebble Count Plots

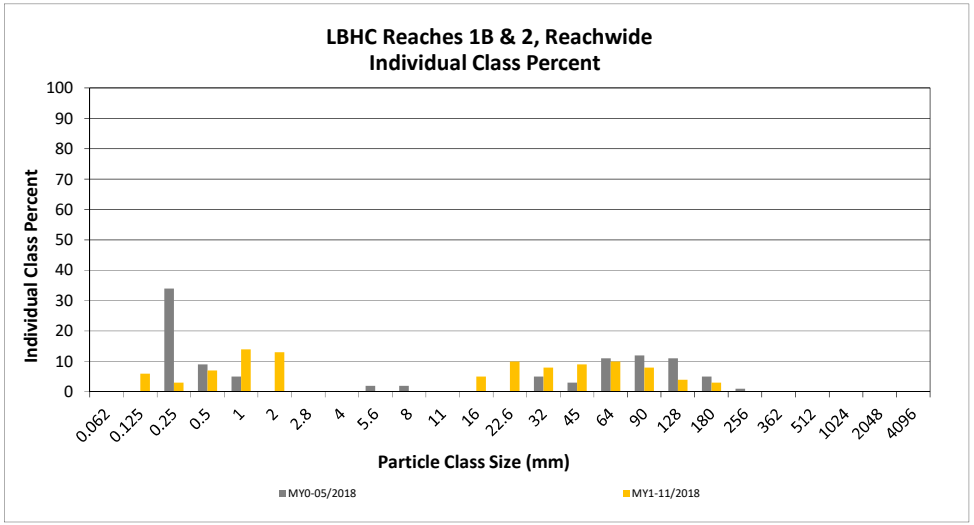
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reaches 1B & 2, 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					0
SAND	Very fine	0.062	0.125	2	4	6	6	6
	Fine	0.125	0.250	3		3	3	9
	Medium	0.25	0.50		7	7	7	16
	Coarse	0.5	1.0	2	12	14	14	30
	Very Coarse	1.0	2.0	1	12	13	13	43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0					43
	Fine	4.0	5.6					43
	Fine	5.6	8.0					43
	Medium	8.0	11.0					43
	Medium	11.0	16.0	2	3	5	5	48
	Coarse	16.0	22.6	8	2	10	10	58
	Coarse	22.6	32	6	2	8	8	66
	Very Coarse	32	45	7	2	9	9	75
	Very Coarse	45	64	5	5	10	10	85
COBBLE	Small	64	90	7	1	8	8	93
	Small	90	128	4		4	4	97
	Large	128	180	3		3	3	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} =	0.50
D_{35} =	1.31
D_{50} =	17.1
D_{84} =	61.8
D_{95} =	107.3
D_{100} =	180.0





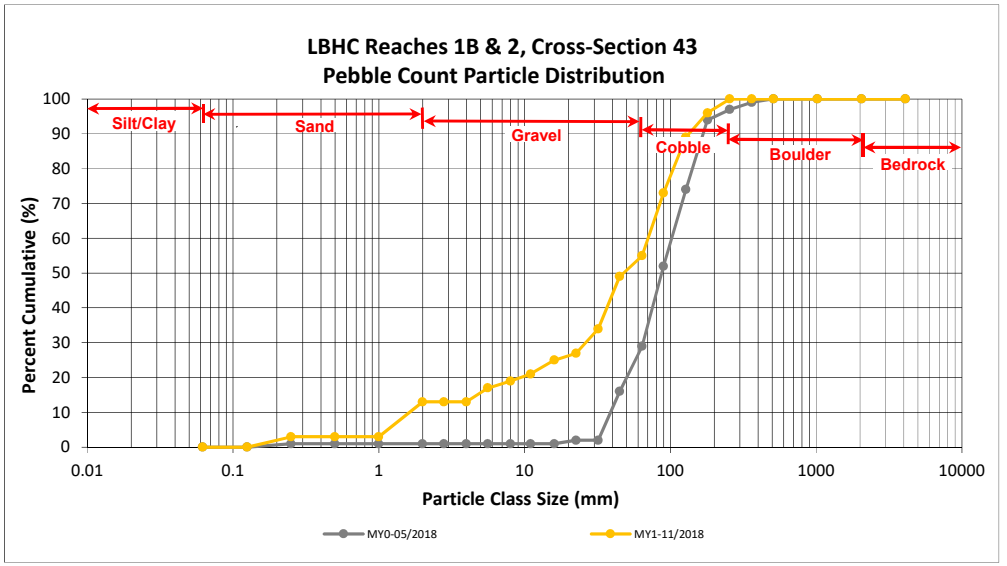
Reachwide and Cross-Section Pebble Count Plots

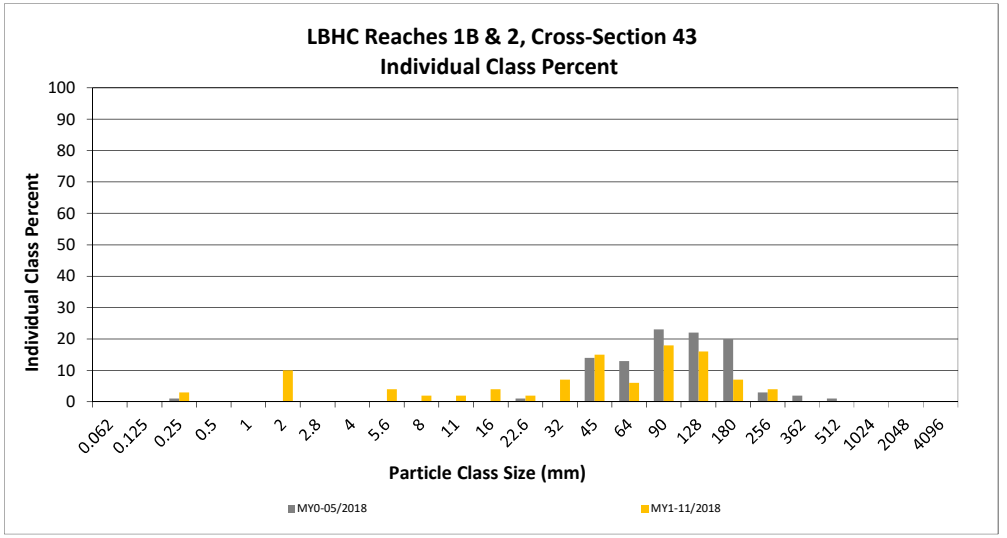
Big Harris Creek Mitigation Site - Area C
DMS Project No. 739
Monitoring Year 1 - 2018

LBHC Reaches 1B & 2, Cross-Section 43

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	3	3	3
	Medium	0.25	0.50			3
	Coarse	0.5	1.0			3
	Very Coarse	1.0	2.0	10	10	13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0			13
	Fine	4.0	5.6	4	4	17
	Fine	5.6	8.0	2	2	19
	Medium	8.0	11.0	2	2	21
	Medium	11.0	16.0	4	4	25
	Coarse	16.0	22.6	2	2	27
	Coarse	22.6	32	7	7	34
	Very Coarse	32	45	15	15	49
	Very Coarse	45	64	6	6	55
COBBLE	Small	64	90	18	18	73
	Small	90	128	16	16	89
	Large	128	180	7	7	96
	Large	180	256	4	4	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 43	
Channel materials (mm)	
D_{16} =	5.15
D_{35} =	32.74
D_{50} =	47.7
D_{84} =	114.7
D_{95} =	171.4
D_{100} =	256.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 14. Verification of Bankfull Events
Big Harris Creek Mitigation Site
DMS Project No. 739
Monitoring Year 1 - 2018

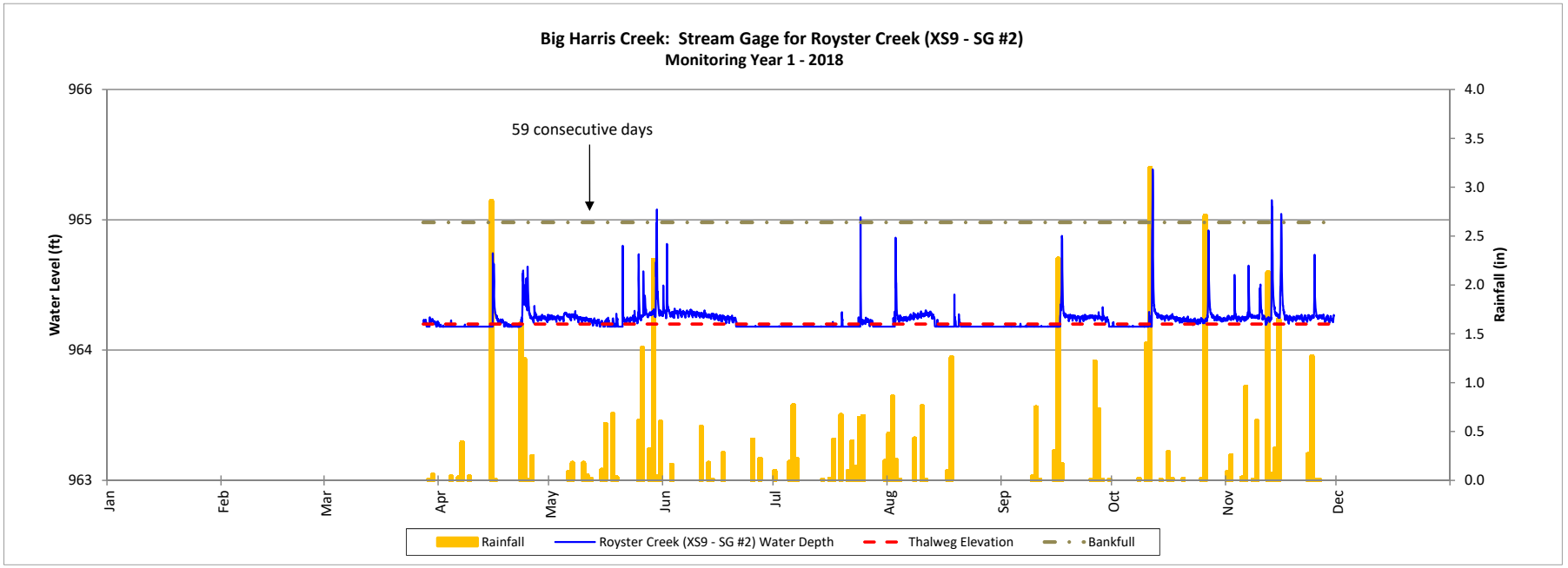
Reach	Monitoring Year	Date of Occurrence	Method
Upper Big Harris Creek Reach 2A	MY1	10/11/2018	Stream Gage
Royster Creek Reach 1		5/30/2018	
		7/24/2018	
		10/11/2018	
		11/12/2018 [1]	
		11/15/2018	
Scott Creek		---	
Carroll Creek		10/11/2018	
		11/15/2018	
Upper Stick Elliott Creek Reach 1		10/11/2018	
Upper Stick Elliott Creek Reach 5		10/11/2018 [2]	
		11/12/2018	
		11/15/2018	
Elliott Creek		10/11/2018	
UT1 to Elliott Creek		---	
Bridges Creek		---	
UT2 to Upper Stick Elliott Creek		7/19/2018	
		8/2/2018	
		10/11/2018	
		11/12/2018	
		11/15/2018	
UT3 to Upper Stick Elliott Creek		10/11/2018	
Upper Fletcher Creek Reach 2		7/24/2018	
		8/2/2018	
		10/11/2018	
		10/26/2018	
		11/12/2018	
		11/15/2018	
Lower Fletcher Creek Reach 1		8/2/2018	
		10/11/2018	
		10/26/2018	
		11/12/2018	
		11/15/2018	
Lower Big Harris Creek Reach 1A		10/11/2018	
		10/26/2018	
		11/12/2018	

[1] SG2 on Royster Creek Reach 1 experienced two bankfull events on 11/12/18.
[2] SG6 on Upper Stick Elliott Creek Reach 5 experienced two bankfull events on 10/11/18.
--- No bankfull events reported.

Recorded Stream Gage Plots

Big Harris Creek Mitigation Site (DMS Project No. 739)

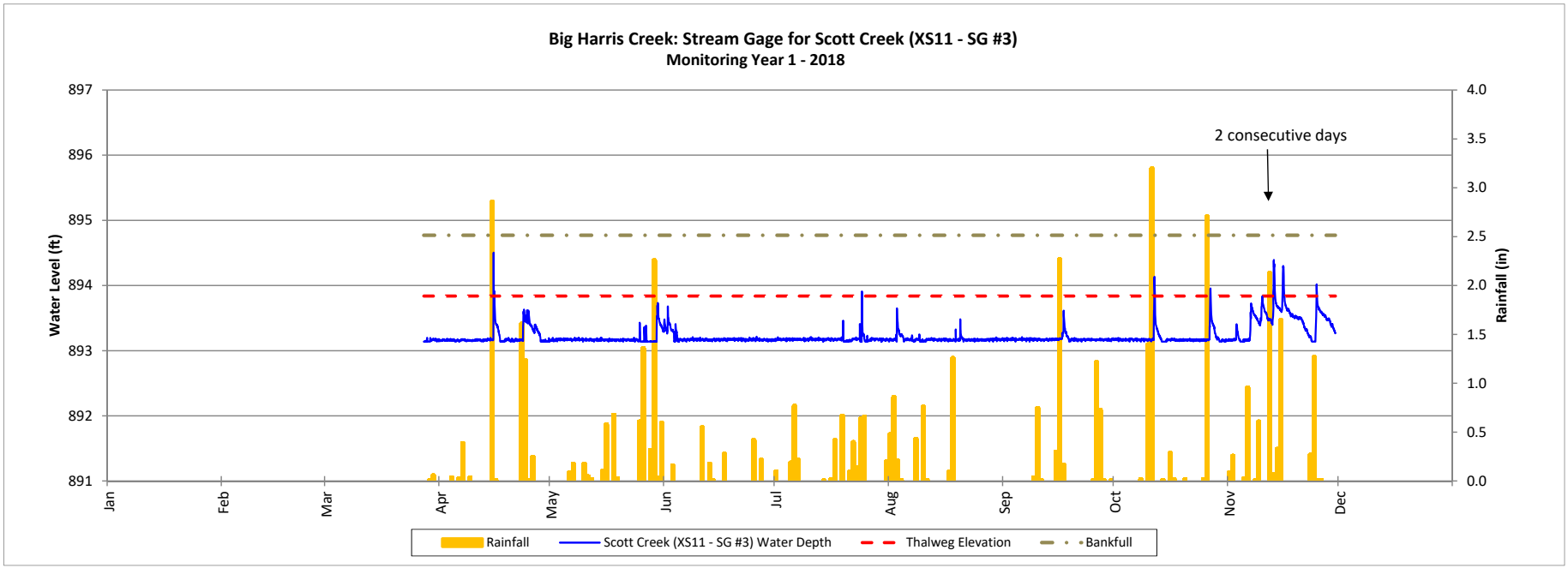
Monitoring Year 1 - 2018



Recorded Stream Gage Plots

Big Harris Creek Mitigation Site (DMS Project No. 739)

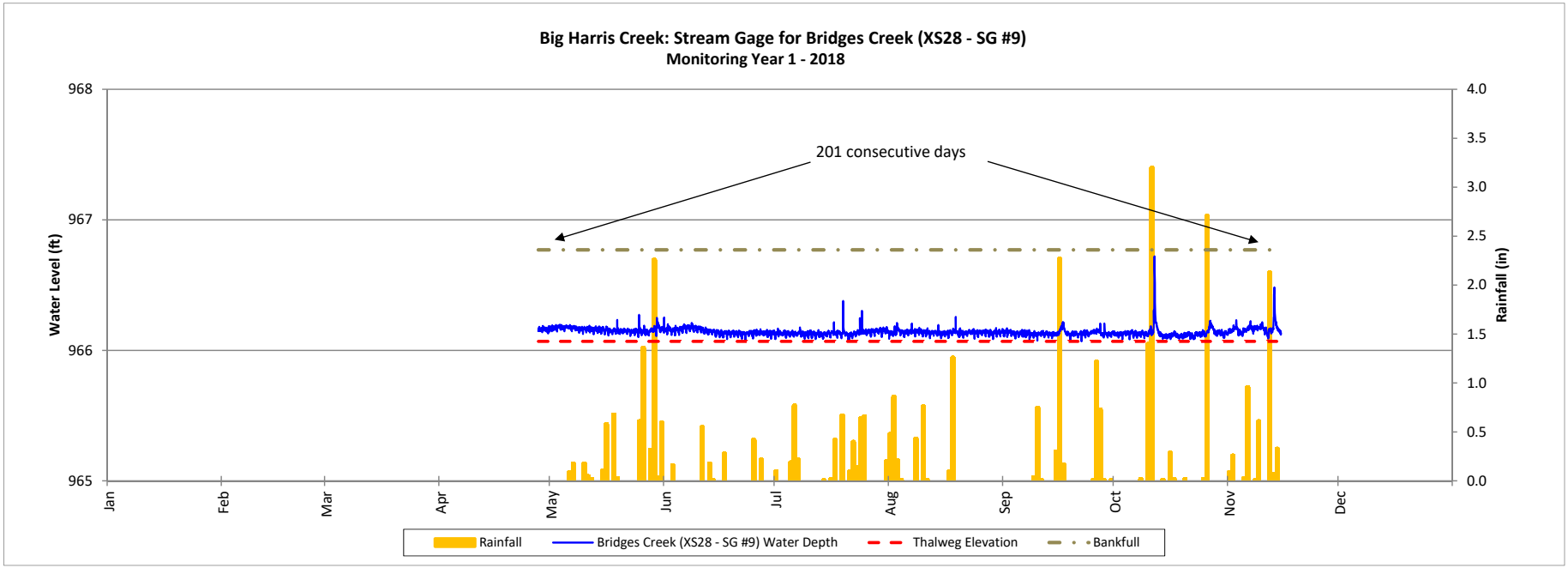
Monitoring Year 1 - 2018



Recorded Stream Gage Plots

Big Harris Creek Mitigation Site (DMS Project No. 739)

Monitoring Year 1 - 2018



APPENDIX 6. Revised Water Quality Monitoring Proposal

Technical Memorandum

Prepared for:	Interagency Review Team
Project Title:	Big Harris Creek Mitigation Site
Subject:	Revised Water Quality Monitoring Proposal
Date:	September 4, 2018
From:	Jeff Keaton

INTRODUCTION

The purpose of this Technical Memorandum is to provide the North Carolina Interagency Review Team (IRT) a summary of the proposed post-construction water quality and biological monitoring program for the Big Harris Creek Mitigation Site. As stated in the final mitigation plan (section 12.7), a 4% credit allowance based on the entire linear footage of the project will be granted for the inclusion of these parameters for a pre/post construction comparison. Also based on the mitigation plan, an additional 2% (507 SMUs) credit allowance will be granted if post-construction water quality monitoring demonstrates improvement as per the plan detailed below.

This memo describes a revised version of the water quality, benthic, and fish monitoring program that has been refined based on an analysis of the pre-construction data and a set of criteria to support statistically reliable detection of change. **This revised monitoring program will supersede the program described in the final mitigation plan.** The memo will also describe the proposed success criteria for the monitoring program.

ANALTICAL BASIS FOR POST-CON SAMPLING PLAN

Pre-con sampling was completed at 16 stations within the Big Harris watershed and at 4 reference stations in the Little Harris watershed by the Division of Water Resources Watershed Assessments Team (WAT) for nutrient and biological parameters using state certified procedures. Western Carolina University performed automated stormflow monitoring of suspended sediments and discharge at 4 key drainage locations. Selected reaches were also monitored for groundwater hydrology. These monitoring activities were funded by the Division of Mitigation Services (DMS). The pre-construction (baseline) data were analyzed and several criteria were used to determine whether post-construction monitoring of a parameter was warranted at a given station. The statistical analysis was performed by DMS staff member, Greg Melia, with consultation and review by Wildlands Engineering staff. The hierarchy of the criteria used to select post-construction monitoring parameters and stations are as follows:

1. The levels of the pre-con data for a given parameter at a given station had to demonstrate that they were elevated compared to regulatory standards, the Little Harris reference sites, or relevant regional data sets/literature. The main consideration here is whether there is meaningful room for improvement at a given station.

2. There exists a reasonable likelihood for improvement in the given parameter at the given location because the direct stressors can be largely addressed. Examples of where stressors might not be addressed include cases where land owner easement grants do not permit capture of the major lateral inputs.
3. The pre-construction data indicates that a given station can be adequately represented by one of the pre-construction sampling stations (to include consolidation, where sensible).
4. Statistical analysis of the pre-construction distributions using minimal detectable change (MDC) analysis (Spooner et al., 2011) was performed by DMS for each parameter at each station. Using the variance of the pre-construction distribution, the MDC provides an estimate of the minimum percent change in a pollutant concentration that will be required to support statistically reliable detection of that change (assuming and alpha of 0.05). The more variability in the distribution of the data, the greater the MDC must be for reliable change detection. MDC results $\geq$ 50% were generally considered too variable and resulted in exclusion of that parameter at that station for post-construction monitoring. However, in some case best professional judgement was applied. MDCs that were slightly over 50% may have been included if outliers in the raw data could be identified or the parameter distributions and/or site characteristics exhibited other qualities that made it sensible to override a slightly elevated MDC.
5. Statistical Assumptions – The use of the MDC in item 4 assumes the approximation of a normal distribution, however in many cases the MDC analysis is robust against the violation of this assumption after pooling the post-con data with the pre-data. Therefore, this criterion was used to assist in decision making, but was a lesser factor than the other criteria.

Wildlands Engineering will contract Western Carolina University (WCU) to collect the post-construction water quality data which will include both baseflow and stormflow monitoring. Table 1 provides the matrix of parameters to be collected at a given station based on the analysis and criteria described above. The locations of the monitoring stations are shown on the attached map (Figure 1). The station numbers in the matrix correspond to the stations listed on the map. The samples will be collected using protocols utilized by the NC Department of Environmental Quality (DEQ), which are consistent with the methods used to collect pre-construction water samples. All samples will be analyzed at the NC DEQ labs in Swannanoa and/or Raleigh.

The four water quality monitoring locations are the four previously monitored sites (Sites 2, 8, 9, 14). ISCO automated samplers will be used to collect the samples at each of these four sites. Samples at the automated ISCO stations listed in will be collected as flow-proportional composites. Samples at the non-automated sites will be collected as grab samples. Fecal coliform will be collected exclusively as grab samples in all cases. Conductivity will be measured directly in-situ with a water quality meter. Baseflow samples will be collected at the frequencies described below. Fifteen to twenty storm events will be targeted between years 2 and 5 to cover storm water samples.

Table 1. Parameter Matrix

Type	**NA**	**NA**	**A**	**NA**	**NA**	**NA**	**A**	**A**	**NA**	**A**	Baseflow	
Station	0	1	2	4	5a	6	8	9	13	14	Stormflow	
Fecal											Base and Storm	
Cond											ISCO Station	**A**
TSS											Not Automated	**NA**

NH3											Watershed Control	
TKN												
NO2-NO3												
TP												
Macrobenthos												
Fish												

Baseflow Monitoring

The base flow monitoring program proposed is as follows:

a. Fecal coliform – Once per month during years 3, 4, and 5 at Stations 2, 4 ,8, and 9.
b. Conductivity – Once per month during years 2, 3, and 5 at Stations 0, 1, 2, 8, 9, and 13, and 14 and at stations when benthos or fish are to be sampled.
c. TSS baseflow solids – Once per month during years 3, 4, 5 at Stations 2, 9, and 14.
d. Ammonia (NH_3) – Once per month during years 4 and 5 at Stations 8 and 9.
e. Total Kjeldahl nitrogen (TKN) – Once per month during years 4 and 5 at Station 9.
f. Nitrite (NO_2)-nitrate (NO_3) nitrogen – Once per month during years 4 and 5 at Stations 2, 8, 9, and 14.
g. Total phosphorous (TP) – Once per month during years 4 and 5 at Stations 2, 8, 9, and 14.

Stormflow Monitoring

The proposed stormflow monitoring program is as follows:

a. Fecal coliform – Sites 2 and 9.
b. Conductivity – Site 1
c. Ammonia (NH_3) –Sites 2, 8, 9, and 14.
d. Total Kjeldahl nitrogen (TKN) – Sites 2, 9, and 14.
e. Nitrite (NO_2)-nitrate (NO_3) nitrogen – Sites 2, 8, 9, and 14.
f. Total phosphorous (TP) – Sites 2, 8, 9, and 14.

Biological Monitoring

The proposed fish community and benthic macroinvertebrate monitoring program is as follows:

a. Fish community sampling will be conducted with a backpack electrofisher once per year during years 3 and 5 at stations 4, 5a, 9, and 13.
b. Benthic macroinvertebrate sampling will be conducted once per year during years 3 and 5 at stations 0, 1, 4, 6, 8, and 14. Three macro-benthic sites will be sampled on Upper Fletcher Creek at and above station 1 for a total of 8 macro-benthic sites across the project site. This is being done to demonstrate the extent of post-construction habitat improvement on this reach as compared to the pre-construction data. The increase in habitat brought about by the restoration treatments should demonstrate a greater extent and improved recruitment of the

benthic community. The water quality results for Upper Fletcher Creek will be the result of the synthesis of the benthos data from these three stations.

Biological sampling will be performed directly by Wildlands personnel. Approved Qual 4 DEQ Standard Operating Procedures will be followed for all biological sampling. The classification criteria for benthos will follow the NCBI thresholds - for small streams (NC DEQ, 2016).

Notes on Monitoring Plan

a. Site 0 will be used as watershed control point using conductivity and benthos as an indicator of incoming water quality. The drainage above this location indicated relatively high pollutant inputs possibly due to hay fields at the drainage headwaters on some very steep slopes. Monitoring station 0 for conductivity as a surrogate for overall water quality will provide comparison to pre-construction levels for any post-construction results below this point.
b. Site 13 will also serve as a watershed control. It had good water quality pre-construction, but during the design phase an upstream landowner created a large disturbance in this drainage and conductivity will be measured at this point to see how it compares to the pre-con conductivity distribution.
c. Sites 8 and 9 were only sampled at baseflow pre-construction, but site 7, which was immediately downstream of the confluence of sites 8 and 9 will serve as the stormflow baseline for sites 8 and 9. This was deemed appropriate because when pooled, the baseflow data at sites 8 and 9 closely represented the pre-con baseflow at site 7. The storm data for sites 8 and 9 will be synthesized to provide the post-construction stormflow comparison to Site 7 pre-construction stormflow baseline.
d. Site 14 was only sampled for baseflow pre-construction, but the distributions for the pre-construction water quality parameters were very similar for sites 10 and 14. Therefore, the storm data from site 10 will serve as the pre-construction storm baseline for the storm data collected at site 14 post-construction.
e. For all other sites, post-construction baseflow and stormflow data will be compared to pre-construction baseflow and stormflow data respectively for the same sites.

SUCCESS CRITERIA

Each year when sampling is complete, data will be evaluated for any changes or trends that may be developing. Any observations will be reported in annual monitoring reports. However, ultimate success or failure for each monitoring station will be determined after the final dataset is collected prior to close out. At this time, each parameter in the overall post-construction data set (years 3-5) will be compared to the same parameter in the pre-construction data set using hypothesis testing. Improvement for any given physicochemical parameter will require a minimum of a 15% reduction in the mean of the distribution and demonstrate statistical significance (alpha 0.05). If parametric tests of assumption are not met, non-parametric methods may be employed. If a particular physicochemical parameter at a given station does not demonstrate a 15% improvement while meeting these criteria using hypothesis testing, time series analysis will be applied to demonstrate whether a significant negative trend exists. That is, the trend line will have to demonstrate a negative slope that is significantly different than 0 at an alpha of 0.05 that would meet the 15% minimum reduction criterion if extrapolated out to a decade from the As-built. For biological parameters, success will be determined based on whether there is an improvement of at least one bio-classification level (i.e. fair to good).

The number of parameters that demonstrate success as described above will determine the proportion of credit that would be generated. For example, if there are 4 parameters at a station then each parameter represents 25% of the total available station credits credit. The number of parameters at

station that will contribute to success will include both baseflow and stormflow samples. The following equation will be used to quantify the additional credits:

# of parameters meeting success criteria at station/total # of parameters at station x total available station credits = additional credit

Total available station credits refers to the total possible additional credit that would be given for the reaches of the project that are at or upstream of that station either to the project limits or to another station. The total available station credits to be assigned if complete success is demonstrated at each station are summarized in Table 2 below. Total available station credits for stations 2 and 4 and stations 10 and 14 have been combined to balance out the effort/cost of collecting data with the credit amounts that would be generated by showing success at these stations.

REFERENCES:

NC Department of Environmental Quality. 2016. Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates. Division of Water Resources. Raleigh, North Carolina. February 2016

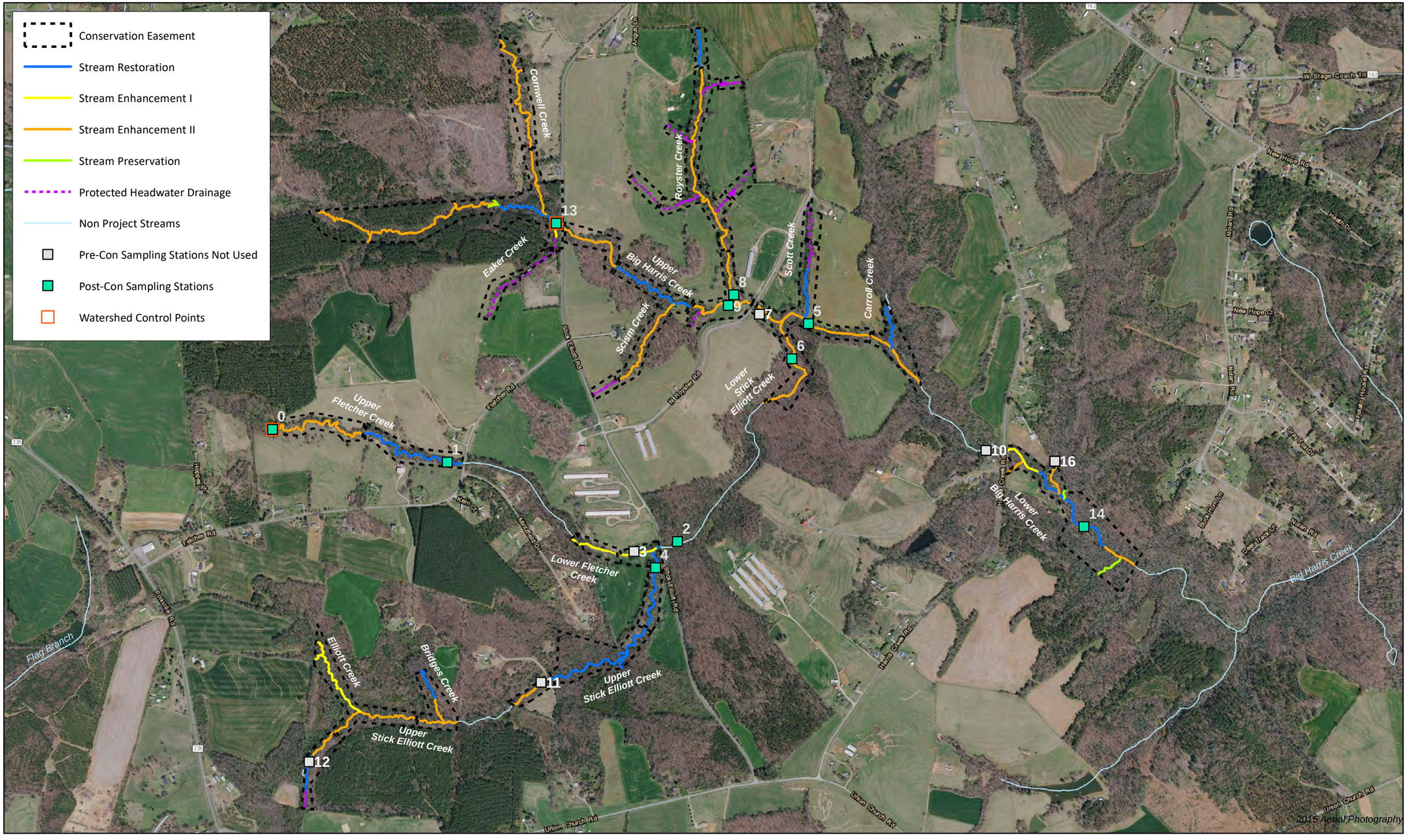
Spooner, Jean; Dressing, Stephen A.; and Meals, Donald W. 2011. Minimum Detectable Change Analysis. Tech Notes 7, December 2011. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 21 p.

Table 2. Total Available Station Credits Assigned by Station

Station	Parameters	Reaches Represented	Credits for Reaches (from MP)	Credits * Multiplier	2% of Credits	2% of Credits * Multiplier
1	Cond, MB	Upper Fletcher Creek R1-R2	2084	2251	42	45
2 & 4	Site 2: FC, Cond, TSS, NH3, TKN, NO2-NO3, TP Site 4:MB, Fish	Lower Fletcher Creek R1-R2	7434	8030	149	161
5a	Fish, Cond	Scott Creek Upper Big Harris R6A	1252	1352	25	27
6	MB	Lower Stick Elliot Creek	527	569	11	11
8	MB, FC, Cond, NH3,NO2-NO3, TP	Royster Creek R1-R2	2060	2225	41	45
9	Fish, FC, Cond, TSS, NH3, TKN, NO2-NO3, TP	Upper Big Harris Creek R3-R5, Scism Creek	2969	3207	59	64
10 & 14	Site 10: Fish Site 14:MB, Cond, TSS, NH3, TKN, NO2-NO3, TP	Upper Big Harris R6B, Carrol Creek	3674	3969	73	79
13	Fish	Upper Big Harris Creek R1-R2, Cornwell Creek R1-R2, UT1 to Cornwell Creek, Eaker Creek	3451	3728	69	75
Total			23451	25331	469	507
TotalCredits from MP including additional credit for monitoring and watershed approach			25331			
Multiplier to get credits per reach (=25331/23451)			1.080167157050870			

Appendix A:

Minimum Detectable Change Analysis Reference Paper



WILDLANDS ENGINEERING

0 500 1,000 2,000 3,000 4,000 Feet

N

Proposed Water Quality Monitoring Locations
Big Harris Creek Mitigation Site
Broad River Basin (03050105)
Cleveland County, NC

National Nonpoint Source Monitoring Program

Tech NOTES 7

December 2011

Jean Spooner, Steven A. Dressing, and Donald W. Meals. 2011. Minimum detectable change analysis. Tech Notes 7, December 2011. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 21 p. Available online at www.bae.ncsu.edu/programs/extension/wqg/319monitoring/tech_notes.htm.

Through the National Nonpoint Source Monitoring Program **(NNPSMP)**, states monitor and evaluate a subset of watershed projects funded by the Clean Water Act Section 319 Nonpoint Source Control Program.

The program has two major objectives:

1. To scientifically evaluate the effectiveness of watershed technologies designed to control nonpoint source pollution
2. To improve our understanding of nonpoint source pollution

NNPSMP Tech Notes is a series of publications that shares this unique research and monitoring effort. It offers guidance on data collection, implementation of pollution control technologies, and monitoring design, as well as case studies that illustrate principles in action.

Minimum Detectable Change Analysis

Introduction

The purpose of this technical note is to present and demonstrate the basic approach to minimum detectable change (MDC) analysis. This publication is targeted toward persons involved in watershed nonpoint source monitoring and evaluation projects such as those in the National Nonpoint Source Monitoring Program (NNPSMP) and the Mississippi River Basin Initiative, where documentation of water quality response to the implementation of management measures is the objective. The MDC techniques discussed below are applicable to water quality monitoring data collected under a range of monitoring designs including single fixed stations and paired watersheds. MDC analysis can be performed on datasets that include either pre- and post-implementation data or just the typically limited pre-implementation data that watershed projects have in the planning phase. Better datasets, however, provide more useful and accurate estimates of MDC.

Minimum detectable change analysis can answer questions like: "How much change must be measured in a water resource to be considered statistically significant?" or "Is the proposed monitoring plan sufficient to detect the change in concentration expected from BMP implementation?"

Minimum Detectable Change

The Minimum Detectable Change (MDC) is the minimum change in a pollutant concentration (or load) over a given period of time required to be considered statistically significant.

The calculation of MDC has several practical uses. Data collected in the first several years of a project or from a similar project can be used to determine how much change must be measured in the water resource to be considered statistically significant and not an artifact of system variability. Calculation of MDC provides feedback to the project managers as to whether the proposed land treatment and water quality monitoring designs are sufficient

to accomplish and detect the expected changes in water quality over a pre-specified length of time. These calculations facilitate realistic expectations when evaluating watershed studies. Calculation of the magnitude of the water quality change required can serve as a useful tool to evaluate water quality monitoring designs for their effectiveness in detecting changes in water quality. Closely related, these calculations can also be used to design effective water quality monitoring networks (Spooner et al., 1987; 1988).

Bernstein and Zalinski (1983) make a valid distinction between the magnitude of the 'statistically' and 'biologically' significant changes. The size of a statistically significant detectable change depends on the number of samples. For a fixed sample variability, a large number of samples results in a large number of degrees of freedom in the statistical trend test, and therefore, a relatively small value for the MDC. However, a small statistically significant difference may have no biological or practical significance. In contrast, with small sample sizes, statistically significant detectable changes may be much larger than biologically significant changes. A system may have exhibited a biologically significant change that cannot be statistically detected because sample sizes are too small.

MDC is an extension of the Least Significant Difference (LSD) concept (Snedecor and Cochran, 1967). The MDC for a system can be estimated from data collected within the same system or similar systems. A system is defined by the watershed size, water resource, monitoring design, pollutants measured, sampling frequency, length of monitoring time, hydrology, and meteorology.

MDC is a quantity that is calculated using the pre-planned statistical trend tests on the measured observations, typically in the pre-BMP project phase. MDC is used as a guide to calculate the minimum amount of change expected to be detected given the sample variability, number of samples, monitoring design, statistical trend tests, and significance level.

MDC analysis must be consistent with and based on the planned statistical approach to analyzing project data.

General Considerations

The following assumptions are made in the calculation of MDC.

- Historical sample measurements are representative of the temporal and spatial variation of the past and future conditions.
- Variability due to sampling, transport or laboratory error is negligible compared to variability over time.

Typically, the pollutant concentrations or load values exhibit a log-normal distribution. When this is the case, the MDC is expressed as a percent change relative to the initial annual geometric mean concentration. Given a particular monitoring scheme, the water quality observations and their variability can be used to calculate the MDC required in the geometric mean pollutant concentration over time.

When the water quality values are log-normal, calculations for the MDC values are performed on the base 10 logarithmic scale. Analyses on the logarithmic scale have several beneficial features:

- The log normal distribution generally fits the distribution of water quality data. One feature of a log normal distribution is skewed data on the original scale (e.g., many lower values with a few higher values).
- The logarithmic transformation on the water quality variables is usually required for the distributional assumptions of parametric trend analyses to be met.
- The results become dimensionless and are independent of the units of measurements.
- MDC can be expressed as a percentage, rather than an absolute difference, because the calculations are performed on the logarithmic scale.

Sampling frequency determination is very closely related to MDC calculations. Sample size determination is usually performed by fixing a significance level, power of the test, the minimum change one wants to detect, the duration of monitoring, and the type of statistical test. MDC is calculated similarly except the sample size (i.e., number of samples) is fixed and the power is set to 50 percent. MDC is the amount of change you can detect given the sample variability. Many of the formulas that are used for confidence limit and sample size determination are similar to those used to calculate MDC.

Sampling frequency and MDC are closely related parameters. The planned sampling frequency and duration strongly influence the MDC, and the MDC largely dictates the sampling frequency necessary to measure such change within a specified time period.

Factors Affecting the Magnitude of the MDC

The MDC is a function of pollutant variability, sampling frequency, length of monitoring time, explanatory variables or covariates (e.g., season, meteorological, and hydrologic variables) used in the analyses which 'adjust' or 'explain' some of the variability in the measured data, magnitude and structure of the autocorrelation, and statistical techniques and the significance level used to analyze the data.

Spatial and Temporal Variability

The basic concept in the calculation of MDC is simple: variability in water quality measurements is examined to estimate the magnitude of changes in water quality needed to detect significant differences over time. Hydrologic systems are highly variable, often resulting in large values for MDC. Variations in water quality measurements occur in both spatial and temporal dimensions, and are due to several factors including:

- A change in land treatment resulting in decreased concentrations and/or loadings to receiving waters (determining the amount of water quality change is usually a key objective of a watershed project)

- Sampling and analytical error
- Monitoring design (e.g., sampling frequency, sampling location, variables measured)
- Changes in meteorological and hydrologic conditions
- Seasonality
- Changes in input to and exports from the system. For example, changes in upstream concentrations can affect the downstream water quality.

MDC is proportionally related to the standard deviation of the sample estimate of trend (e.g., standard deviation of the sample estimate of slope for a linear trend or standard deviation of samples in the pre-BMP time period for a step trend). This standard deviation is a function of the variability in Y that is not explained by the statistical trend model (i.e., error variance). As such, any known sources of variation that can be added to the statistical trend model to minimize the error variance will also serve to reduce the MDC and increase the ability to detect a real change in water quality due to land treatment. For example, adjusting for changes in explanatory variables such as streamflow or changes in land use (other than the BMPs) would reduce both the standard error and the MDC.

It should be noted that sample variability may be affected by sampling frequency. For frequent sampling directed at including storm events, variability is usually higher than for fixed-interval sampling directed at monitoring ambient conditions. In addition, the nature of collection and data aggregation will directly affect the variability and the autocorrelation. Composite or aggregated samples are generally less variable than single grab samples and exhibit a lower degree of autocorrelation as compared to non-aggregated data.

Sampling Frequency and Record Length

The MDC calculation is the change required for a specified sample frequency and duration. MDC decreases with an increase in the number of samples and/or duration of sampling.

Increasing sampling frequency and/or record length (e.g., increasing the number of years for monitoring) results in an increase in the number of samples (N), and therefore increases the degrees of freedom in the statistical trend tests and results in a smaller MDC value. Increasing the number of samples results in a decrease in MDC (on the logarithmic scale) approximately proportional to the increase in the square root of N. However, increasing N by increasing the sample frequency may not decrease the MDC by this total proportion due to the effects of temporal autocorrelation.

Increasing record length has several advantages over increasing sampling frequency. Increasing record length serves to add degrees of freedom to the statistical trend models. In addition, increasing the number of years adds extra verification that the observed changes are real and not a result of an unknown or unmeasured variable that also exhibits large year-to-year variations. Increasing record length also serves to increase the time base from which extrapolations may be made.

Seasonal, Meteorological and Hydrologic Variability

The standard error of a trend estimate can effectively be reduced by accounting for seasonality and meteorological and hydrologic variables in the trend tests. Because these variables or covariates can help reduce the amount of variability that cannot be 'explained' they are commonly called 'explanatory variables.' For example, Hirsch and Gilroy (1985) found that a model that removes variability in sulfate loading rates due to precipitation and varying seasonal mean values can reduce the step trend standard deviation by 32%, and therefore, the magnitude of change needed for statistically detectable change would also be reduced by 32%.

Incorporation of appropriate explanatory variables increases the probability of detecting significant changes and serves to produce statistical trend analysis results that better represent true changes due to BMP implementation rather than changes due to hydrologic and meteorological variability. Commonly used explanatory variables for hydrologic and meteorological variability include streamflow and total precipitation.

Adjustment for seasonal, meteorological and hydrologic variability is also important to remove bias in trend estimates due to changes in these factors between sampling times and years. Interpretations regarding the direction, magnitude, and significance in water quality changes may be incorrect if hydrologic and/or meteorological variability is not accounted for in the statistical trend models.

If significant variation exists between the seasonal means and/or variances and is not considered in the statistical trend models, then the assumptions of identical and independent distribution of the residuals (from the statistical model) will be violated and the results for the statistical trend analyses (both parametric and nonparametric) will not be valid. Non-identical distributions can occur when the seasonal means vary from the overall mean and/or the variances within seasons are different for each season. Non-independence can occur because seasons have cyclic patterns, e.g., winters are similar to winters, summers to summers, etc.

Autocorrelation

Temporal autocorrelation exists if an observation is related or correlated with past observations (not independent). Autocorrelation in water quality observations taken less frequently than daily is usually positive and follows an autoregressive structure of order 1, AR(1). More complicated autocorrelation models (AutoRegressive Integrated Moving-Average or ARIMA models with more lag terms and moving average terms) are usually needed for daily or more frequent sampling designs. Positive autocorrelation usually results in a reduction of information (e.g., less degrees of freedom than the actual number of samples) in a data series and affects statistical trend analyses and their interpretations. Each additional sample adds information, but not a full degree of freedom if it's not independent of the previous sample.

If significant autocorrelation exists and is not considered in the statistical trend models, then the assumption of independence of the residuals will have been violated. The result is incorrect estimates of the standard deviations on the statistical parameters (e.g., mean, slope, step trend estimate) which in turn results in incorrect interpretations regarding the statistical significance of these statistical parameters. Autocorrelation must be incorporated into the statistical trend models to obtain an accurate estimate of MDC (e.g., using time series analyses). Autocorrelation can also be reduce by data aggregation (e.g., weekly, monthly), but this will decrease the degrees of freedom.

Statistical Trend Tests

MDC is influenced by the statistical trend test selected. For the MDC estimate to be valid, the required assumptions must be met. Independent and identically distributed residuals are requirements for both parametric and nonparametric trend tests. Normality is an additional assumption placed on most parametric trend tests. However, parametric tests for step or linear trends are fairly robust and therefore do not require 'ideally' normal data to provide valid results.

The standard error on the trend estimate, and therefore, the MDC estimate will be minimized if the form of the expected water quality trend is correctly represented in the statistical trend model. For example, if BMP implementation occurs in a short period of time after a pre-BMP period, a trend model using a step change would be appropriate. If the BMPs are implemented over a longer period of time, a linear or ramp trend would be more appropriate.

MDC is influenced by the statistical trend test selected. The MDC will be minimized if the correct statistical trend model (e.g., step vs. linear or ramp) is selected.

A step change can be examined by the use of tests such as the parametric Student's *t*-test or the nonparametric Wilcoxon rank sum test. The two-sample Student's *t*-test and the nonparametric Wilcoxon rank sum tests for step change are popular step change tests

used in water quality trend analyses because they are easy to use. Analysis of Covariance (ANCOVA) can test for step changes after adjusting for variability in explanatory variables or covariates (e.g., streamflow). When a sudden system alteration, such as BMP implementation occurs, the BMPs can be called an 'intervention.' In statistical terms, intervention analysis can be used to extend the two-sample Student's *t*-test to include adjustments for autocorrelation.

The most popular types of statistical models for linear change include the parametric linear regression and the nonparametric Kendall's tau (with the Sen's Slope Estimator). Autocorrelation is most easily accounted for by the use of linear regression models with time series errors. When using a statistical software package that can adjust for autocorrelation (e.g., PROC AUTOREG in SAS (SAS, 1999)), it requires no extra effort to correctly incorporate the needed time series as well as explanatory variables. See Tech Notes #6 (Meals et al. 2011) for an overview of other statistical software packages that may be useful here.

Steps to Calculate the MDC

The calculation MDC or the water quality concentration change required to detect significant trends requires several steps. The procedure varies slightly based upon:

- Pattern of the expected change and therefore appropriate statistical model (e.g., step, linear, or ramp trend).
- Whether the data used are in the original scale (e.g., mg/l or kg) or log-transformed.
- Incorporation of time series to adjust for autocorrelation.
- Addition of explanatory variables such as streamflow or season.

The following steps and examples are adopted from Spooner et al. (1987 and 1988):

Step 1. ***Define the Monitoring Goal and Choose the Appropriate Statistical Trend Test Approach.*** One goal may be to detect a statistically significant linear trend in the annual mean (geometric mean if using log-transformed data) pollutant concentrations that may be related to land treatment changes. A linear regression model using log-transformed data would then be appropriate. An alternative goal to detect a statistically significant change in the post-BMP period as compared to a pre-BMP period would require a step change statistical test such as the *t*-test or ANCOVA.

For linear trends, an appropriate regression trend model would be a linear trend either without:

$$Y_t = \beta_0 + \beta_1 \mathbf{DATE} + e_t$$

or, with explanatory variables as appropriate:

$$Y_t = \beta_0 + \beta_1 \mathbf{DATE} + \Sigma \beta_i X_i + e_t$$

Where: Y_t = Water quality variable value at time *t*. If Y is log normal, then Y_t is the log-transformed water quality variable value.

X_i = Explanatory variable, i=2,3… (X_2, X_3, etc. could also be log-transformed; the DATE variable is considered X1)

β_0 = Intercept

β_1 = Slope or linear trend on DATE

β_i = Regression coefficients for explanatory variables

e_t = Error term (this is denoted as V_t if the error series has an autocorrelated structure; see Step 4 and Example 1)

Note that even though no (zero) trend is expected if this test uses only the pre-BMP data, it is appropriate to include the trend (DATE) term in the statistical model when this is the planned statistical model.

For a step trend, the DATE can have the values of 0 for pre-BMP or 1 for post-BMP data. When planning or evaluating a monitoring design, there may not yet be any post-BMP data and only pre-BMP data would then be used in the MDC calculations.

Note: the paired-watershed study and the above/below-before/after watershed designs are analyzed using an ANCOVA where 'Date' is 0 or 1 and the explanatory variable is either the control watershed values (concentrations/loads) or the upstream values paired with the treatment or downstream values, respectively.

Step 2. ***Perform Exploratory Data Analyses.*** Preliminary data inspections are performed to determine if the residuals are distributed with a normal distribution and constant variance. Normal distribution is required in the parametric analyses; constant variance is required in both parametric and nonparametric analyses. The water quality monitoring data are usually not normal, however, and often do not exhibit constant variance over the data range.

Exploratory data analysis (*Meals and Dressing 2005*) is an important step in determining whether available data meet the assumptions (e.g., normality, constant variance) of planned statistical tests.

The water quality data sets are examined using univariate procedures such as those available with the SAS procedure PROC UNIVARIATE or within JMP (SAS Institute 2010, 2008) to verify distributional assumptions required for statistical procedures. Specific attention is given to the statistics on normality, skewness, and kurtosis. Both the original and logarithmic transformed values are tested.

Step 3. ***Perform Data Transformations.*** Water quality data typically follow log-normal distributions and the base 10 logarithmic transformation is typically used to minimize the violation of the assumptions of normality and constant variance. In this case, the MDC calculations use the log-transformed data until the last step of expressing the percent change. Alternatively, the natural log transformation may be used.

The logarithmic base 10 transformation applies to all dependent water quality variables used in trend detection (i.e., suspended sediment, TP, ortho phosphorus, and fecal coliform). Technically, explanatory variables in statistical trend models do not have any distributional requirements because it is only the distribution of the residuals that is crucial. However, if they do exhibit log normal distributions, explanatory variables are also log-transformed which usually helps with the distribution requirements of the residuals. Typical explanatory variables that are log-transformed include upstream concentrations and stream flow.

Step 4. ***Test for Autocorrelation.*** Tests are performed on the water quality time series to determine if there is autocorrelation. An autoregressive, lag 1 (AR(1)) error structure (i.e., correlation between two sequential observations) in the water quality trend data is common. The tests usually assume samples are collected with equal time intervals. The regression trend models used are the same as those planned for the future trend analyses (See Step 1). The data should be ordered by collection date.

The Durbin Watson (DW) test for autocorrelation can be performed on the residuals from the linear regression models to determine if the concentration measurements are related to previous measurements. This test can be performed with the SAS procedure PROC REG or PROC AUTOREG (SAS Institute, 1999), or within the least squares regression analysis of JMP. The Durbin Watson test assumes the residuals exhibit an AR(1) autocorrelation structure. Alternatively, the significance of the first order autocorrelation coefficient is tested in SAS using a time series statistical procedure such as PROC AUTOREG or time series analyses within JMP. It should be noted that PROC AUTOREG allows for missing Y-values, but equally-spaced date entries should all be included in the data set.

Appropriate statistics software packages can make the job of MDC analysis a lot easier, but it is important to not treat these packages as black boxes.

Alternatively, the assumption of independent residuals can be tested by passing the residuals from these regression trend models to the SAS procedure PROC ARIMA

(SAS Institute, 1999) or time series analysis within JMP (SAS Institute, 2008). The autocorrelation structure is examined to determine if the independence assumption is valid and, if not, to determine the appropriate autocorrelation structure for the simple trend models. The chi-square test of white noise supplied by PROC ARIMA is also used to test whether the residuals are independent.

Step 5. ***Calculate the Estimated Standard Error.*** The variability observed in either historic or pre-BMP water quality monitoring data is used to estimate the MDC. Any available post-BMP data can also be included in this step. The estimated standard error is obtained by running the same statistical model that will be used to detect a trend once BMPs have been installed (same trend models identified in Step 1).

For a linear trend, an estimate of the **standard deviation on the slope** over time is obtained by using the output from statistical regression analysis with a linear trend, time series errors (if applicable), and appropriate explanatory variables. If the planned monitoring timeframe will be longer than that from which the existing data were obtained, the standard deviation on the future slope can be estimated by:

$$s_b = s'_b \sqrt{\frac{(n - 2)}{(C * n - 2)}}$$

Where: s_b = estimate for the standard deviation of the trend for the total planned duration of monitoring

s'_b = standard deviation of the slope for the existing data

n = number of samples in the existing data

C = correction factor equal to the proportional increase in planned samples. For example, if 4 years of existing data are available and 8 years of total monitoring is planned, C=2 (i.e., 8/4). This factor will reduce the standard error on the slope and, therefore, the amount of change per year required for statistical significance.

A large sample approximation for the adjustment factor is:

$$s_b = s'_b \sqrt{\frac{1}{C}}$$

For a step trend, it is necessary to have an estimate of the **standard deviation of the difference between the mean values of the pre-BMP vs. post-BMP data** ($s_{(\bar{X}pre\text{-}\bar{X}post)}$). In practice, an estimate is obtained by using the following formula:

$$s_{(\bar{X}pre\text{-}\bar{X}post)} = \sqrt{\frac{MSE}{n_{pre}} + \frac{MSE}{n_{post}}}$$

Where: $s_{(\bar{X}pre\text{-}\bar{X}post)}$= estimated standard error of the difference between the mean values of the pre- and the post-BMP periods.

MSE = s_p^2 = Estimate of the pooled Mean Square Error (MSE) or, equivalently, variance (s_p^2) within each period. The MSE estimate is obtained from the output of a statistical analysis using a *t*-test or ANCOVA with appropriate time series and explanatory variables.

The variance (square of the standard deviation) of pre-BMP data can be used to estimate MSE or s_p^2 for both pre- and post-BMP periods if post-BMP data are not available and there are no explanatory variables or autocorrelation (see Example 2). For log normal data calculate this value on the log-transformed data.

Missing values are allowed. It is not important here that no trend is present because this step obtains the estimate on the standard deviation of the trend statistic.

For both linear and step trends, if autocorrelation is present a time series statistical procedure such as SAS's PROC AUTOREG that uses Generalized Least Squares (GLS) with Yule Walker methods should be employed because it takes into account the autocorrelation structure of the residuals to obtain valid standard deviations (Brocklebank and Dickey, 1986). The standard error on the trend estimate for simple trend models (e.g., step, linear, or ramp trends) with AR(1) error terms is **larger** than that (incorrectly) calculated by Ordinary Least Squares (OLS). Matalas (1967) cited theoretical adjustments that can be used. The true standard deviation has the following large sample approximation:

$$s_b = s'_b \sqrt{\frac{1+\rho}{1-\rho}}$$

Where: s_b = true standard deviation of the trend (slope or difference between 2 means) estimate (e.g., calculated using GLS)

s'_b = incorrect variance of the trend estimate calculated without regard to autocorrelation using OLS (e.g., using a statistical linear regression procedure that

For projects in the planning phase it is possible to estimate MSE using only pre-BMP data or data from nearby and similar watersheds. The MDC estimates from such approaches, however, are likely to be less reliable than those made using datasets from the study watershed with appropriate explanatory variables and multiple years of data.

does not take into account autocorrelation)

ρ = autocorrelation coefficient for autoregressive lag 1, AR(1)

Step 6. ***Calculate the MDC.*** MDC is essentially one-half of the confidence interval for the slope of a linear regression model or for the difference between the mean values of the pre- and post-BMP periods.

For a **linear trend**, the MDC is calculated by multiplying the **estimated standard deviation of the slope** by the *t*-statistic and the total monitoring timeframe:

$$MDC = (N) * t_{(n*N-2)df} * 365 * s_{b1}$$

Where: $t_{(n*N-2)df}$ = One-sided Student's *t*-statistic (α=.05)

N = Number of monitoring years

n = Number of samples per year

df = degrees of freedom

365 = Correction factor to put the slope on an annual basis when DATE is entered as a Date (day) variable, e.g., the slope is in units per day. If DATE values were 1-12 for months and the slope was expressed 'per month' then this value would be "12."

s_{b1} = Standard deviation on the slope estimated for the total expected monitoring duration (from Step 5)

MDC = the MDC on either the original data scale or the log scale if the data were log-transformed

For a **step trend**, the MDC is one-half of the confidence interval for detecting a change between the mean values in the pre- vs. post-BMP periods.

$$MDC = t_{(n_{pre} + n_{post}-2)} * s_{(\bar{X}pre-\bar{X}post)}$$

In practice, an estimate is obtained by using the following equivalent formula:

$$MDC = t_{(n_{pre} + n_{post}-2)} \sqrt{\frac{MSE}{n_{pre}} + \frac{MSE}{n_{post}}}$$

Where: $t_{(n_{pre} + n_{post}-2)}$ = one-sided Student's *t*-value with $(n_{pre} + n_{post}-2)$ degrees of freedom.

$n_{pre} + n_{post}$ = the combined number of samples in the pre- and post-BMP periods

$s_{(\bar{X}pre-\bar{X}post)}$ = estimated standard error of the difference between the mean values in the pre- and the post-BMP periods.

MSE = s_p^2 = Estimate of the pooled Mean Square Error (MSE) or, equivalently, variance (s_p^2) within each period. The MSE estimate is obtained from the output of a statistical analysis using a *t*-test or ANCOVA with appropriate time series

and explanatory variables. If post-BMP data are not available, no autocorrelation is present, and no explanatory variables are appropriate, MSE or s_p^2 can be estimated by the variance (square of the standard deviation) of pre-BMP data.

The pre- and post-BMP periods can have different sample sizes but should have the same sampling frequency (e.g., weekly).

The following considerations should be noted:

- The choice of one- or two-sided *t*-statistic is based upon the question being asked. Typically, the question is whether there has been a statistically significant decrease in pollutant loads or concentrations and a one-sided *t*-statistic would be appropriate. A two-sided *t*-statistic would be appropriate if the question being evaluated is whether a change in pollutant loads or concentrations has occurred. The value of the *t*-statistic for a two-sided test is larger, resulting in a larger MDC value.
- At this stage in the analysis, the MDC is either in the original data scale (e.g., mg/L) if non-transformed data are used, or, more typically in the log scale if log-transformed data are used.

Step 7. ***Express MDC as a Percent Decrease.*** If the data analyzed were not transformed, MDC as a percent change (MDC%) is simply the MDC from Step 6 divided by the average value in the pre-BMP period expressed as a percentage (i.e., MDC% = 100*(MDC/mean of pre-BMP data)).

When calculating MDC as a percent change it is important to note whether the data analyzed were log-transformed because the formula is different from that used for data that were not log-transformed.

If the data were **log-transformed**, a simple calculation can be performed to express the MDC as a percent decrease in the geometric mean concentration relative to the initial geometric mean concentration or load. The calculation is:

$$\mathbf{MDC\% = (1 - 10^{-MDC}) * 100}$$

Where: MDC is on the log scale and MDC% is a percentage.

For log-transformed data MDC is the difference required on the logarithmic scale to detect a significant decreasing trend (calculated in Steps 5 and 6 using log-transformed data). MDC% and MDC are positive numbers if mean concentrations decrease over time. For example, for MDC= 0.1 ($10^{-0.1}$ = 0.79), the MDC% or percent reduction in water quality required for statistical significance = 21%; for MDC = 0.2 ($10^{-0.2}$ = 0.63), MDC% = 37%. In the cases where detection of a positive trend is desired (e.g., Secchi depth measurements), the percent decrease would be negative and the input for MDC must be forced to be negative.

It should be noted that if the natural logarithmic transformation had been used, then:

$$MDC\% = (1 - \exp^{-MDC}) * 100$$

Examples

Example 1. ***A linear trend with autocorrelation and covariates or explanatory variables; Y values log-transformed.*** The basic statistical trend model used in this example is linear regression with time series errors, techniques documented by Brocklebank and Dickey (1986). Typically, Autoregressive Lag 1 or AR(1) is appropriate and a DATE explanatory variable is included in the model. The DATE variable is used to estimate the magnitude of a linear trend and to estimate the variation not accounted for by the linear trend term observed in the water quality measurements. The estimate of variation on the "slope" of DATE is then used to calculate an estimate of Minimum Detectable Change (MDC). The significance of the linear trend, its magnitude, or its direction is not important in the calculation of MDC. The important statistical parameter is the **standard deviation on the slope estimate** of the linear trend.

The SAS procedure, PROC AUTOREG (SAS Institute, 1999) can be used in this analysis. The linear regression model estimated at each monitoring location is:

$$Y_t = \beta_0 + \beta_1 \mathbf{DATE} + V_t$$

or, with explanatory variables:

$$Y_t = \beta_0 + \beta_1 \mathbf{DATE} + \Sigma \beta_i X_i + V_t$$

Where: Y_t = Log-transformed water quality variable value at time *t*,
V_t = Error term assumed to be generated by an autoregressive process of order 1, AR(1).
β_0 = Intercept
β_1 = Slope or linear trend on DATE
β_i = Unique regression coefficients for each explanatory variable
X_i = Explanatory variable, i=2,3,..,

The standard deviations on the slope over time from linear regression models are used to calculate the MDCs. A significance level of $\alpha = .05$ and a Type II error of $b=0.5$ are assumed. The standard deviation on the slope is a function of the mean square error (MSE or s^2) estimated by the Yule Walker Method and Generalized Least Squares, degree of autocorrelation, and the degrees of freedom (d.f.). The d.f. is a function of the number of monitoring years and sample frequency. If continued sampling is planned, the estimate of the standard deviation of the trend slope is adjusted by a correction factor given in Step 5.

MDC is calculated by:

$$\mathbf{MDC = (N) * t_{(n*N-2)df} * 365 * s_{b1}}$$

Where: $t_{(n*N-2)df}$ = One-sided Student's *t*-statistic ($\alpha = .05$)

N = Number of monitoring years

n = Number of samples per year

365 = Correction factor to put the slope on an annual basis because DATE is assumed to be entered as a Date variable (i.e., the slope is in units per day). If DATE values were entered as 1–12 for months causing the slope to be expressed as 'per month' then this value would be "12."

s_{b1} = Standard deviation on the slope

MDC = MDC on the log scale in this case

The calculations are illustrated below with the following assumptions:

N = 5 years existing (10 years planned)
n = 52 weekly samples per year

DATE was entered into the computer program as a DATE, so the slope is expressed in units per day

$t_{(n*N-2)df} = t_{258} = 1.6513$ (one-sided)

$s_{b1} = 0.0000229$ (This is the standard deviation on the slope for the trend, which is log scale for this example because log-transformed data are assumed. It is very important to carry several significant digits because the number might be small.)

The MDC for the existing 5 years of data can be calculated as follows. The calculations for MDC and then MDC% for this example using Y values that are log-transformed are:

$MDC = (N) * t_{(n*N-2)df} * 365 * s_{b1}$
$MDC = 5 * 1.6513 * 365 * 0.0000229$
$MDC = 0.06901$ (units on log scale)
$MDC\% = (1 - 10^{-MDC}) * 100$ (percentage on geometric mean)
$MDC\% = (1 - 10^{-0.06901}) * 100$
MDC% = 15% (percentage on geometric mean) or an average of 3% change per year

Note: If a 2-sided *t*-statistic value was used then *t*=1.969, MDC (log scale) is 0.0823, and MDC% is 17%.

The MDC estimate if the sampling duration will be doubled to a total of 10 years:

$$s_{b1(10\,years)} = s'_{b1(5\,years)} \sqrt{\frac{(n-2)}{(C*n-2)}} = 0.0000229 \sqrt{\frac{(260-2)}{(2*260-2)}}$$

$$= 0.0000229 * 0.70574$$

$$= 0.00001616$$

$$\text{MDC (10 years)} = 10 * 1.6513 * 365 * 0.00001616$$

$$= 0.0974 \text{ (units on log scale)}$$

$$= 20\% \text{ over 10 years (or an average of 2\% change per year)}$$

The addition of explanatory variables can decrease the magnitude of the MDC.

The addition of appropriate explanatory variables and sampling frequency can decrease the magnitude of the calculated MDC. For example, Spooner et al. (1987) demonstrated that adding salinity as a covariate in the Tillamook Bay, Oregon watershed study decreased the MDC% for fecal coliform over an 11-year period of time (with biweekly samples) from 42% to 36%. For the same study, the MDC% for fecal coliform decreased from 55% to 42% when comparing monthly to biweekly sampling over an 11-year study. Spooner et al. (1987 and 1988) also demonstrated that variability and therefore MDC is also affected by the pollutant measured, the size of the watershed, and appropriate selection of explanatory variables.

Example 2. ***A step trend, no autocorrelation, and no covariates or explanatory variables; Y values on original scale (not transformed).*** In this example, the plan would be to detect a significant change in the average values between the pre- and post-BMP periods. The pre- and post-BMP periods can have different sample sizes but should have the same sampling frequency (e.g., weekly).

In this simplified situation, the MDC would be equivalent to the Least Significant Difference (LSD). MDC would be calculated as:

$$\text{MDC} = t_{(n_{pre} + n_{post}-2)} \sqrt{\frac{MSE}{n_{pre}} + \frac{MSE}{n_{post}}}$$

Where: $t_{(n_{pre} + n_{post}-2)}$ = one-sided Student's *t*-value with $(n_{pre} + n_{post}-2)$ degrees of freedom.
$n_{pre} + n_{post}$ = the combined number of samples in the pre- and post-BMP periods
MSE = Estimate of the pooled Mean Square Error (MSE) or variance (s_p^2) within each period. The variance (square of the standard deviation) of pre-BMP

data can be used to estimate MSE or s_p^2 for both pre- and post-BMP periods if post-BMP data are not available (the usual case when designing monitoring programs). For log normal data calculate this value on the log-transformed data.

The calculations are illustrated below with the following assumptions:

n_{pre} = 52 samples in the pre-BMP period
n_{post} = 52 samples in the post-BMP period
Mean X = 36.9 mg/l, mean of the 52 samples in the pre-BMP period
s_p = 21.2 mg/L = standard deviation of the 52 pre-BMP samples
MSE = s_p^2 = 449.44
$t_{(n_{pre} + n_{post}-2)} = t_{102} = 1.6599$

The MDC would be:

$$MDC = t_{(n_{pre} + n_{post}-2)} \sqrt{\frac{MSE}{n_{pre}} + \frac{MSE}{n_{post}}}$$

$$MDC = 1.6599 \sqrt{\frac{449}{52} + \frac{449}{52}}$$

MDC = 6.9 mg/l

Percent change required = MDC% = 100*(6.9/36.9) = 19%.

Use the equation described under "Step 7" above to calculate percent change for log-transformed data. If the data are autorcorrelated, use a time series model, or the approximation given in Step 5 to adjust the standard error of the difference in the pre- and post-BMP means.

Example 3. ***Paired-watershed study or Above/Below-Before/After watershed study analyzed using Analysis of Covariance (ANCOVA); Y values log-transformed; no autocorrelation.*** The paired-watershed approach requires a minimum of two watersheds, control and treatment, and two periods of study, calibration and treatment (Clausen and Spooner, 1993). The control watershed accounts for year-to-year or seasonal climatic variations. During the calibration period, the two watersheds are treated identically and paired water quality data are collected (e.g., event-based, weekly). During the treatment period, the treatment watershed is treated with a BMP(s) while the control watershed remains under the same management employed during the calibration period. Under the **above/below-before/after** approach water quality downstream and upstream of a BMP location is monitored for time periods before and after BMP implementation.

Data from these two watershed designs can be analyzed with similar **ANCOVA** approaches. The Y values in the equation below are taken from either the treatment watershed in a paired-watershed study or the downstream site in an above/below study. The values for the explanatory (X) variable are taken from the control watershed in a paired-watershed design or from the upstream site in an above/below design. Each monitoring design has another explanatory variable that is represented by 0 or 1 for the 'pre-BMP' and 'post-BMP' periods, respectively.

The ANCOVA model is:

$$Y_t = \beta_0 + \beta_1(\textbf{Period}) + \beta_2 X_t + e_t$$

Where: Y_t = Water quality variable value at time t (from treatment watershed or downstream site). If Y is log normal, then Y_t is the log-transformed water quality variable value.

Period = '0' for pre-BMP period and '1' for post-BMP period (alternatively, period can be treated as a grouping variable and entered as characters).

X_t = Explanatory variable value at time t (water quality values from control watershed or upstream site). Values are log-transformed if distribution is log-normal.

β_0 = Y intercept

β_1, β_2 = Regression coefficients

e_t = Error term

The SAS procedure PROC GLM (SAS Institute, 2010), JMP (SAS Institute, 2008), or SPSS (IBM, 2011) can be used for the analysis. Period would be identified as a 'Class' variable in PROC GLM or 'Character' variable in JMP. The "Fit Model" dialog box would be used in JMP. Users would select the Y variable, use the "Add" option to include the X (i.e., control) and Period variables, and then choose 'Run Model.'

It is important to note that because MDCs are generally calculated prior to the treatment period, this example assumes that the slopes for the pre- and post-BMP periods will be similar. The Durbin Watson statistic to check for autocorrelation can be calculated as an option under both SPSS and either SAS procedure. If autocorrelation is significant, PROC AUTOREG can be used for the analysis with Period values set to numeric '0' and '1'.

The treatment effect will be the difference in the least square means (lsmeans) between the pre- and post-BMP periods. The MDC is the difference that would be statistically significant and therefore based upon the standard error of the difference between lsmeans values. The lsmeans are the estimates of the values of Y for the pre- and post-BMP periods evaluated at the overall average value of all the X (treatment) values collected during the entire study period. MDC is calculated from the standard error on the

difference in lsmeans. The standard error is given by the JMP procedure when users choose the option for 'detailed comparisons'.

The MDC on the log values would be:

$$\mathbf{MDC} = t_{(n_{pre} + n_{post}-3)} * s_{(\text{lsmean}_{pre}-\text{lsmean}_{post})}$$

Where: $t_{(n_{pre} + n_{post}-3)}$ = One-sided Student's *t*-value with $(\mathbf{n}_{pre} + \mathbf{n}_{post}\mathbf{-3})$ degrees of freedom (Note that the *t*-statistic given in JMP is the two-sided value).

$\mathbf{n}_{pre} + \mathbf{n}_{post}$ = The combined number of samples in the pre- and post-BMP periods

$s_{(\text{lsmean}_{pre}-\text{lsmean}_{post})}$ = Estimated standard error of the difference between the least square mean values in the pre- and the post-BMP periods. This is computed by using the following approximation (adapted from Snedecor and Cochran, 1967, p. 423):

$$\sqrt{\text{MSE} * \frac{2}{n}} * \textit{Factor}$$

MSE is found in the Analysis of Variance table from the output of the applied statistical analysis, and n is the number of samples within each period. The adjustment "Factor" is 1 or greater and increases when the difference between the mean of the X (control watershed or upstream) data in the pre-BMP period compared to the post-BMP period increases. It is assumed to be "1" for MDC calculations. This "Factor" adjustment makes clear the importance of collecting samples in the pre-BMP and post-BMP periods that have similar ranges and variability in hydrological conditions.

To express MDC as a percentage change required in geometric mean value:

$$\mathbf{MDC\% = (1 - 10^{-MDC}) * 100, \text{ where MDC is on the log scale}}$$

Summary

The Minimum Detectable Change is the minimum change in a pollutant concentration (or load) over a given period of time required to be considered statistically significant. MDC calculations can be very helpful in the design of cost-effective monitoring programs, as well as increasing awareness regarding the potential a watershed project has for achieving measurable results. These calculations also illustrate the value of adjusting for changes in hydrologic and meteorological variables. Not only is the ability to detect real changes increased, but valid conclusions regarding the magnitude and direction of measured change(s) in a water quality variable can be made. Calculation of MDC can also be used to illustrate the importance of relatively long monitoring time frames. In

addition, comparison of the actual changes in water quality to the MDC values can be used to document BMP effectiveness on a subwatershed basis.

The magnitude of MDC is often larger than expected by watershed projects and funding agencies, leading to misunderstanding regarding the needed level of BMP implementation, intensity of monitoring, and duration of monitoring. The magnitude of MDC can be reduced by:

- Accounting for changes in discharge, precipitation, ground water table depth, or other applicable hydrologic/meteorological explanatory variable(s).
- Accounting for changes in incoming pollutant concentrations upstream of the BMP implementation subwatershed (i.e., upstream concentrations).
- Increasing the length of the monitoring period.
- Increasing the sample frequency.
- Applying the statistical trend technique that best matches the implementation of BMPs and other land use changes.

References

Bernstein, B.B. and J. Zalinski. 1983. An optimum sampling design and power tests for environmental biologists. Journal of Environmental Management 16(1):35–43.

Brocklebank, J.C. and D. Dickey. 1986. SAS system for forecasting time series, 1986 Edition. SAS Institute Inc., Cary, North Carolina. 240 p.

Clausen, J. and J. Spooner. 1993. Paired watershed study design. USEPA, 841-F-93-009. Office of Water, Washington, D.C.

Hirsch, R.M. and E.J. Gilroy. 1985. Detectability of step trends in the rate of atmospheric deposition of sulfate. Water Resources Bulletin 21(5):773–784.

IBM. 2011. IBM SPSS Statistics, IBM, *http://www-01.ibm.com/software/* [Accessed September 23, 2011].

Matalas, N.C. 1967. Time series analysis. Water Resources Research, 3(3):817–829.

Meals, D.W. and S.A. Dressing. 2005. Monitoring data – exploring your data, the first step, Tech Notes 1, July 2005. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 14 p. Available online at *www.bae.ncsu.edu/programs/extension/wqg/319monitoring/tech_notes.htm* [Accessed September 23, 2011].

Meals, D.W., J. Spooner, S.A. Dressing, and J.B. Harcum. 2011. Statistical analysis for monotonic trends, Tech Notes 6, November 2011. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 23 p. Available online at

www.bae.ncsu.edu/programs/extension/wqg/319monitoring/tech_notes.htm. [Accessed September 23, 2011].

SAS Institute Inc. 1999. SAS/ETS User's Guide, Version 8. SAS Institute Inc. Cary, North Carolina.

SAS Institute Inc. 2008. JMP Software: Version 8. SAS Institute Inc., Cary, North Carolina.

SAS Institute Inc. 2010. SAS Software, Version 9.1. SAS Institute Inc. Cary, North Carolina.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical Methods, Sixth Edition. The Iowa State University Press, Ames, Iowa. 593 p.

Spooner, J., S.L. Brichford, D.A. Dickey, R.P. Maas, M.D. Smolen, G.J. Ritter and E.G. Flaig. 1988. Determining the sensitivity of the water quality monitoring program in the Taylor Creek-Nubbin Slough, Florida project. Lake and Reservoir Management, 4(2):113–124.

Spooner, J., R.P. Maas, M.D. Smolen and C.A. Jamieson. 1987. Increasing the sensitivity of nonpoint source control monitoring programs. p. 243–257. In: Symposium On Monitoring, Modeling, and Mediating Water Quality. American Water Resources Association, Bethesda, Maryland. 710p.