MONITORING YEAR 2 ANNUAL REPORT
Final

GLADE CREEK II RESTORATION PROJECT
Alleghany County, NC
DEQ Contract 6843
DMS Project Number 92343
USACE Action ID 2009-00589

Data Collection Period: March 2017 – November 2017
Final Submission Date: February 1, 2018

PREPARED FOR:

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

PREPARED BY:

Wildlands Engineering, Inc.
1430 South Mint Street, Suite 104
Charlotte, NC 28203
Phone: 704.332.7754
Fax: 704.332.3306

February 1, 2018

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

RE: Response to MY2 Draft Report Comments
Glade Creek II Mitigation Project
DMS Project # 92343
Contract Number 6843
New River Basin - #CU# 05050001 - Alleghany County, North Carolina

Dear Mr. Tsomides:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft Monitoring Year 2 report for the Glade Creek II Mitigation Project. The following Wildlands responses to DMS's report comments are noted in italics lettering.

DMS comment; Project overview – It is stated Table 6 (post-restoration visual assessment) describes pre-restoration conditions. Please clarify or amend.

Wildlands response; This sentences in Section 1.1 has been revised to clarify that both pre- and post-restoration conditions are represented in Tables 4 and 6.

DMS comment; Section 1.2 – spelling correction, "follow" to "follows" (first sentence).

Wildlands response; The text in Section 1.2 was edited to correct spelling error.

DMS comment; If possible please reformat the asset totals to reflect the nearest tenth SMU (2141 to 2140.7 "R", and 26 to 25.8 "RE").

Wildlands response; In Table 1, these asset totals were reformatted to reflect the nearest tenth SMU.

DMS comment; It is suggested that dredging out the top of UT Reach 1 (preservation) would help minimize the fine sediment accumulation and active braiding. Does Wildlands feel that this segment would not fill in again if the preservation channel were dredged out? The watershed upstream from the UT has always been in cattle usage; how would dredging out the channel prevent further aggradation?

Wildlands response; The sedimentation that is occurring starts at UT to Glade Creek Reach 1 in the Restoration Reach, approximate STA 11+00, below the preservation reach. Digging out the channel is not a long-term preventative method. The sedimentation occurring is going to be an ongoing concern unless it is addressed at the source, upstream of the project area. Through the few years Wildlands has

been monitoring this project post-construction, we have observed the sediment deposits are being flushed out over time with larger flows.

DMS comment; UT to Glade Creek field visit by DMS staff on 9/6/17 showed that noticeable aggradation had developed in the UT Reach 2 restoration segment flowing through Wetland D and downstream. Sediment accumulation is described as occurring around STA 11+00 (preservation reach) but not mentioned along Reach 2. Was the sedimentation across the entire UT (Reaches 1 and 2) observed? If so, is it all reflected in the 100 LF noted in the visual assessment table for the UT?

Wildlands response; Wildlands conducted a final CCPV site walk on December 4, 2017 and did not observe the sediment accumulation along UT1 Reach 2 as noted above from the DMS site walk in September. A large rain event was recorded for the area in October (11" rainfall) that could have flushed out the sediment in the lower portion of UT1 noted by DMS. Wildlands will plan to monitor this area closely during subsequent site visits and will report any adjustments noted on site.

DMS comment; *It is noted in the summary section that UT to Glade is not flowing properly due to the sediment and vegetation in the channel. The preservation reach was noted in the narrative, however much of the restoration reach (STA 11+29 to 14+48) showed excessive sediment accumulation during the DMS visit. Aerials do not show recent upstream logging as of October 2016, and cattle have always been present upstream of this reach. Has Wildlands observed upstream logging or new impacts other than cattle that might be a sediment source?*

Wildlands response; As stated in the previous DMS comment, Wildlands did not observe sedimentation in the same locations as DMS. This is most likely due to larger rainfall events occurring between site visits. Wildlands observed sediment deposition in the UT to Glade Creek Reach 1 restoration reach, not the preservation reach. During the MY2 site assessments, Wildlands observed construction equipment (i.e. bull dozer) on multiple occasions upstream of the project easement, but it is unclear what land management activities were being conducted.

DMS comment; Would Wildlands recommend dredging out the restoration UT channel as a long-term adaptive management solution or would the channel just fill in again because of the lack of adequate gradient and orientation through a restored wetland? As both the project designer and monitor, please provide more information on the long-term viability of any management actions along the entire length of the UT so DMS can make informed decisions about any potential adaptive management.

Wildlands response; Wildlands believes we can temporarily improve stream function on UT to Glade Creek by hand removing the sediment that appears to be coming from erosion in the upstream pasture and by hand removing the existing herbaceous vegetation. Together, these factors are forcing water onto the adjacent wetland/floodplain and bypassing the channel. Wildlands cannot guarantee that this is a long-term solution, but rather a jump start to improve channel function while the riparian vegetation matures. Most likely as the planted trees continue to grow, they will provide shade and instream vegetation will not be able grow as readily. The sedimentation that is occurring is going to be an ongoing concern unless it is addressed at the source, upstream of the project area. Through the few years Wildlands has been observing this project post-construction, we have observed the sediment deposits are being flushed out over time with larger flows. Wildlands will continue to monitor the deposition and inform DMS of any changes.

DMS comment; Visual assessment for UT - calculation for stable percent should be 78% not 88%, based on 100 LF impacted out of 448 LF assessed. Please clarify or correct.

Wildlands response; Table 6b has been updated to show 78% of the channel is stable.

DMS comment; Stationing on maps for the UT (0+00 to 3+45, starting at the restoration reach) do not match stationing numbering with the asset table (10+00 to 14+48 starting at the preservation reach); in addition, Reaches 1 and 2 on the CCPV figures appear incorrectly labelled (fig. 3) or unclear (fig. 2). Please clarify or correct.

Wildlands response; Wildlands has revised both the Asset Table 1 and the figures stationing to accurately represent the reaches on UT to Glade Creek.

DMS comment; Changing the vertical scaling on the longitudinal profile for the Ut would help show more subtle changes in the profiles.

Wildlands response; Longitudinal profile vertical scaling has been revised for UT to Glade Creek as requested above.

DMS comment; Table 10 (CVS table) should be printed landscape or on a larger fold out sheet.

Wildlands response; Table 10 has been printed in landscape layout in the final submittal.

DMS comment; It would be helpful in future reports to have a wrack line photo or two to accompany the bankfull events table, especially for smaller reaches (Ut).

Wildlands response; When possible, Wildlands will include wrack line photo(s) in future reports to accompany the bankfull event table.

DMS comment; Long-pro plot for the UT appears upside down in the hard copy. Please make sure any printed copy graphs and pages read right side up when printed.

Wildlands response; Hard copies of the Final Monitoring Report will be corrected for this issue.

Enclosed please find four (4) hard copies and one (1) electronic copy on CD of the Final Monitoring Report. Please contact me at 704-332-7754 x110 if you have any questions.

Sincerely,

Kirsten Y. Gimbert

Kirsten Y. Gimbert
Project Manager
kgimbert@wildlandseng.com

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) completed design and construction management on a design-bid-build project at the Glade Creek II Restoration Site (Site) for the North Carolina Division of Mitigation Services (DMS) in Alleghany County, NC. The project components included restoring and enhancing 2,579 linear feet (LF) and preserving 129 LF of perennial stream, restoring 0.16 acre of wetlands, and preserving 0.84 acre of existing wetland. Riparian buffers were also established by removing exotic invasive plants and installing a variety of native vegetation. The Site is expected to generate 2,167 stream mitigation units (SMUs) and 0.33 wetland mitigation units (WMUs) for the Glade Creek watershed (Table 1). The Site is located off US Highway 21 in the northern portion of Alleghany County, NC in the New River Basin, eight-digit Cataloging Unit (CU) 05050001 and the 14-digit Hydrologic Unit Code (HUC) 05050001030020 (Figure 1). The project streams consist of one unnamed tributary, UT to Glade Creek, and two reaches along Glade Creek mainstem (Reach 1 and Reach 2) (Figure 2). Glade Creek flows into the Little River 4 miles northeast of the Site near Fox Trot Lane in the Town of Hooker, Alleghany County. The land adjacent to the streams and wetlands is primarily maintained for forestry production of White Pine trees.

The Glade Creek II Restoration Project is located within a DMS Targeted Local Watershed (TLW) (Brush Creek, HUC 05050001030020, as documented within the 2009 River Basin Restoration Priorities (RBRP) for the New River Basin. Furthermore, the project site is located within a priority subwatershed for stream and wetland restoration (and habitat protection), Middle Glade Creek, as identified within 2006 Local Watershed Plan and Preliminary Project Atlas for Little River and Brush Creek. Primary stressors within the Brush Creek TLW and the Middle Glade Creek subwatershed include stream channelization, livestock access, degraded riparian buffers, and Christmas tree farming. Glade Creek is also classified as trout water and the project will help improve trout habitat in the watershed.

The project goals established in the mitigation plan addendum (Confluence, 2013) were completed with careful consideration of goals and objectives described in the RBRP and to address stressors identified in the LWP. The following project goals established include:

- Improve water quality by repairing eroding stream banks and establishing riparian buffers;
- Improve the community structure of the buffers;
- Improve stream function and habitat by re-establishing stream-to-floodplain connections;
- Restore long-term stability through the restoration of channel dimension, pattern and profile;
- Improve in-stream habitat using in-stream structures; and
- Remove exotic invasive plant species.

The Site construction was completed between December 2015 and April 2016. Planting was completed in February 2016. The as-built survey was completed in January 2016 with Monitoring Year 0 beginning in May 2016. Storm repairs prior to project closeout were completed in April 2016. Monitoring Year 2 (MY2) activities occurred between May and November 2017. MY2 profiles closely match the design parameters. Cross-section widths and pool depths slightly exceed design parameters, but are within a normal range of variability. The Site's overall average planted stem density of 580 stems/acres exceeds the interim vegetation success criterion of 320 stems/acres for MY3. Hydrologic success criteria was achieved for MY2 in the groundwater gage (GWG), and at least one bankfull event occurred on all monitored reaches. The Site has fully met the hydrological success criteria since bankfull events were also documented during MY1.

GLADE CREEK II RESTORATION PROJECT

Monitoring Year 2 Annual Report

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APPENDICES

Section 1: PROJECT OVERVIEW

The Site is a design-bid-build contract with DMS in Alleghany County, NC. The Site is located in the New River Basin, eight-digit Cataloging Unit (CU) 05050001 and the 14-digit Hydrologic Unit Code (HUC) 05050001030020 (Figure 1). Located in the Blue Ridge Belt (USGS,2016), Blue Ridge physiographic province, the project watershed includes primarily agricultural and forest land uses. The drainage area for the project site is 8.0 square miles.

The project stream reaches consist of Glade Creek and UT to Glade Creek (stream restoration). The project wetland areas consist of restoration and preservation (Wetlands A-D). Mitigation work within the Site included restoring and enhancing 2,579 linear feet (LF) and preserving 129 LF of perennial stream, restoring 0.16 acre of wetlands, and preserving 0.84 acre of existing wetland and proposes the generation of 2,167 SMUs and 0.33 WMUs. The stream and wetland areas were planted with native vegetation to improve habitat and protect water quality. Construction activities were completed by Carolina Environmental, Inc. in December 2015. Storm repairs prior to project closeout were completed in April 2016. Turner Land Surveying completed the as-built survey in January 2016 and the storm repairs were judged to have not resulted in changes that would warrant a revised as-built survey. The Site is located on a tract of land owned by the Sharon W. Beck. A 12.8-acre conservation easement on the tract was purchased in 2008 by the State of North Carolina and was recorded with Alleghany County Register of Deeds. The conservation easement protects the project area in perpetuity. Appendix 1 includes detailed project activity, history, contact information, and watershed/site background information. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figure 2. Please refer to the Project Component Map (Figure 2) for the stream and wetland features and to Table 1 for the project component and mitigation credit information for the Site.

1.1 Project Goals and Objectives

Prior to construction, the streams had been impacted by historic agricultural practices, silviculture and valley filling. In addition, there was widespread bank erosion, especially along the outside meander bends, and mid-channel deposition. The wetlands had been impacted by vegetation clearing, exotic invasive plant species, and the valley fill buried hydric soils. Table 4 in Appendix 1 and Tables 6a and 6b in Appendix 2 present the pre- and post-restoration conditions in detail.

This mitigation site is intended to provide numerous ecological benefits within the New River Basin and addresses habitat degradation, which is the primary water quality stressor described in the New River Basin Restoration Priorities Plan (2009). While many of the benefits are limited to the immediate project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat, have farther-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals were met by giving careful consideration to the goals and objectives described in the RBRP.

The project specific goals of the Glade Creek II Restoration Site included the following:

- Improve water quality by repairing eroding stream banks and establishing riparian buffers;
- Improve the community structure of the buffers;
- Improve stream function and habitat by re-establishing stream-to-floodplain connections;
- Restore long-term stability through the restoration of channel dimension, pattern and profile;
- Improve in-stream habitat using in-stream structures; and
- Remove exotic invasive plant species.

The project objectives have been defined as follows:

- Restoration and enhancement of approximately 2260 LF of Glade Creek;
- Restoration of 319 LF of the UT to Glade Creek;
- Preservation of 129 LF of UT to Glade Creek;
- Restoration of 0.16 acre of wetland by improving hydrologic connections;
- Preservation of 0.84 acre of existing jurisdictional wetland; and
- Establishment of riparian buffers by removing exotic invasive plants and installing a variety of native vegetation.

The stream and wetland performance criteria for the Site follow approved performance standards presented in the Glade Creek II Restoration Plan (December 2008). Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. The stream restoration and enhancement reaches (Glade Creek and UT to Glade Creek) of the project were assigned specific performance standards for stream morphology, hydrology, and vegetation. Wetland restoration areas were assigned specific performance standards for wetland hydrology, and vegetation. The Glade Creek Stream Restoration Project was instituted prior to 7/28/2010; therefore, the Site will be monitored for five years post-construction.

1.2 Monitoring Year 2 Data Assessment

Annual monitoring was conducted between May and November 2017 to assess the condition of the project. The stream restoration success criteria for the Site follows the approved monitoring plan presented in the Glade Creek II Restoration Plan (Ward, 2008).

1.2.1 Vegetation Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008). A total of six vegetation monitoring plots were established during the baseline monitoring within the project easement areas using a standard 10 by 10 meter plot. The final vegetation success criterion will be the survival of 260 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of year five of the monitoring period. The interim measure of vegetation success for the Site is the survival of at least 320 planted stems per acre at the end of year three of the monitoring period. Please refer to Figure 3 in Appendix 2 for the vegetation monitoring locations.

The MY2 vegetation survey was completed in September 2017, resulting in an average planted stem density of 580 stems per acre. The Site has met the interim requirement of 320 stems per acre, with 5 of the 6 plots (83%) individually meeting this requirement. The average stem height is 2.8 feet and approximately 90% of the planted stems have a health score (vigor) of 2 or greater. However, 50% of these stems have a vigor of 2; whereas in MY1, 50% of the stems had a vigor of 4. The increase in poor health is a result of dry soil conditions, insects and suffocation. Vegetation monitoring plot 1 contains only 6 stems, resulting in a density of 243 stems per acre; whereas plot 3 contains 22 stems with a density of 809 stems per acre. Please refer to Appendix 2 for vegetation plot photographs and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

The MY2 vegetation monitoring and visual assessment revealed few vegetation areas of concern. Small patches (approximately 6.3%) of bare or poor herbaceous cover in the riparian area of Glade Creek Reach 1 and 2 were observed. Supplemental planting is recommended in vegetation plot 1 and throughout the entire Site since the overall vigor of planted and surrounding stems have declined. Refer to Figure 3 in Appendix 2.

1.2.3 Stream Assessment

Morphological surveys for MY2 were conducted in May 2017. Results indicate that the channel dimensions are stable and functioning as designed. However, the Glade Creek cross-section widths and pools depths have slightly increased compared to MY1; whereas, UT to Glade Creek cross-section dimensions are relatively the same as MY1. In general, the substrate material within Glade Creek remained the same as MY1; however, the D_{50} for UT to Glade Creek changed between MY1 and MY2. The UT to Glade Creek reachwide material resulted in sand (0.8mm) during MY2 versus gravel material (11.9mm) during MY1. The material in cross-section 5 resulted in a D_{50} of 0.7mm (sand) during MY2 whereas MY1 reflected a coarser gravel of 22.6.

The surveyed longitudinal profile data for the project streams illustrates that bedform features are maintaining lateral and vertical stability. The longitudinal profiles on Glade Creek and UT to Glade Creek showed slight change from MY1 in slope (riffle, water surface, bankfull) and pool-to-pool spacing. The overall pattern of all project streams remained the same compared to the baseline data. Refer to Appendix 2 for the visual stability assessment table and the CCPV map. Refer to Appendix 4 for the morphological summary data and plots.

1.2.4 Stream Areas of Concern

UT to Glade Creek has experienced an increase in fine sediment throughout MY2. Approximately 6-8" of sediment deposition has accumulated and is impeding the flow beginning at station 11+00 for approximately 100 LF. As a result, the water has formed a braided system on the floodplain and the pool located at the first step structure around station 11+00 has filled with sediment, leaving little pool habitat. Land management activities upstream of the project easement are most likely contributing to the sedimentation on UT to Glade Creek; however, cattle activity adjacent to the beginning of UT Reach 1 was observed during MY2 site visits and could be attributing to the sediment flux observed. A fallen pine tree was also noted on UT to Glade Creek. The tree is currently crossing the channel; however, it is not currently affecting the stream flow. The limbs are holding the tree off the ground but once the limbs decay and break, the tree will most likely create a barrier within the channel.

There are a few areas of minor scour and erosion along Glade Creek. The brush mattress around station 18+00 has been displaced; therefore, exposing the bank and minor scouring has occurred. In addition, the left bank between stations 23+00 and 25+00 are showing signs of scour under the brush mattress and behind the boulders.

Minor adaptive management is recommended along UT to Glade Creek and Glade Creek. Within the upstream section of UT to Glade Creek Reach 1, hand removal of the sediment deposit and hand removal of the herbaceous material within the channel are recommended to temporarily improve stream function and reduce the active braiding. Where the tree has fallen across the UT to Glade Creek, removal of the fallen tree is recommended to prevent future blockage. Wildlands recommends replacing the brush mattresses on Glade Creek where bank erosion is occurring, and the brush mattress is no longer intact with the bank. Adding live stakes on the left bank between stations 23+00 and 25+00 is also recommended for bank stabilization.

1.2.5 Hydrology Assessment

At least one bankfull event occurred on all reaches during the MY2 data collection, which was recorded on crest gages and by visual indicators. Two bankfull flow events must be documented on the restoration reaches within the five-year monitoring period. The two bankfull events must occur in separate years. A bankfull event was also recorded during MY1; therefore, the Site has met the bankfull success criteria for the project. Refer to Appendix 5 for hydrologic data and graphs.

1.2.6 Wetland Assessment

One groundwater monitoring gage (GWG 1) was established during the baseline monitoring within the restoration area using logging hydrology pressure transducers. The gage was installed at an appropriate location so that the data collected will provide an indication of groundwater levels throughout the wetland restoration area. The target performance standard for wetland hydrology success consists of groundwater surface within 12 inches of the ground surface for 21 consecutive days (12.5%) of the defined 168 day growing season for Alleghany County (April 26th to October 11th) under typical precipitation conditions. The Site does not contain a rainfall gage; therefore, the daily precipitation data was collected from closest NC CRONOS Station, Glade Valley 3.0 ENE. The GWG 1 recorded 169 consecutive days (100%), meeting the performance standard for MY2. According to the climate data from nearby NC CRONOS station, the Site received less than typical amounts of rain in 2017; however, October received a substantial amount of rainfall. Please refer to Appendix 2 for the groundwater gage locations and Appendix 5 for groundwater hydrology data and plots.

1.2.7 Wetland Areas of Concern

Currently there are no wetland areas of concerns.

1.3 Monitoring Year 2 Summary

Glade Creek appears stable and functioning as designed; however, UT to Glade Creek is not flowing properly due to the sediment and vegetation in the channel. The average planted stem density (580 stems per acre) is currently on track to meet the MY3 success criterion. Only one plot does not meet the interim success criterion as noted in CCPV. The Site's groundwater gage met the performance standard for MY2 and the bankfull performance standard has been met for the project. The Site has fully met the bankfull hydrological success criteria since bankfull events were also documented during MY1. Some minor adaptive management would be beneficial to the Site. The areas of concern appear minor, but repairs and maintenance of these areas would benefit the Site long term and decrease additional impacts to the project.

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 annual monitoring reports can be found in the Mitigation Plan documents available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 2: METHODOLOGY

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

Section 3: REFERENCES

Confluence Engineering, P.C. (2013). Glade Creek II Restoration Project Final Mitigation Plan Addendum. NCEEP, Raleigh, NC.

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. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from: http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-2.pdf

North Carolina Division of Water Resources (NCDWR), 2011. Surface Water Classifications. http://portal.ncdenr.org/web/wq/ps/csu/classifications

North Carolina Ecosystem Enhancement Program (NCEEP), 2009. New River Basin Restoration Priorities. Accessed from: https://ncdenr.s3.amazonaws.com/s3fs-public/Mitigation%20Services/PublicFolder/Work%20With/Watershed%20Planners/New_RBRP_2009.pdf

North Carolina Ecosystem Enhancement Program (NCEEP). Little River and Brush Creek Local Watershed Plan. Accessed from: https://ncdenr.s3.amazonaws.com/s3fs-public/documents/files/LittleRiver-BrushCrk%20LWP%20FactSheet.pdf

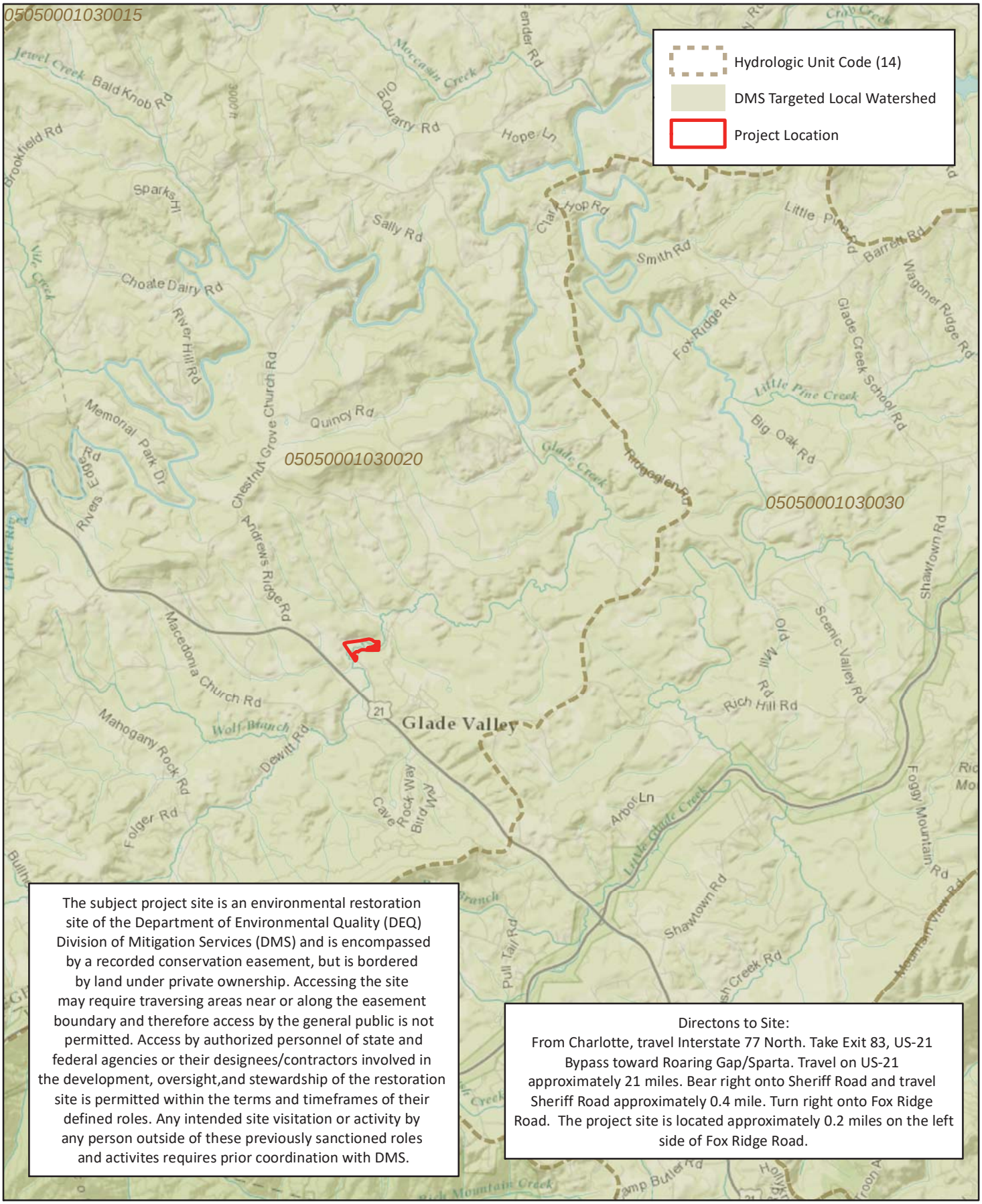
Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

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

United States Geological Survey (USGS), 2016. North Carolina Geology. Accessed from: http://ngmdb.usgs.gov/maps/mapview/

Ward Consulting Engineers, P.C. (2008). Glade Creek II Restoration Project Restoration Plan. NCEEP, Raleigh, NC.

APPENDIX 1. General Tables and Figures



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:
From Charlotte, travel Interstate 77 North. Take Exit 83, US-21 Bypass toward Roaring Gap/Sparta. Travel on US-21 approximately 21 miles. Bear right onto Sheriff Road and travel Sheriff Road approximately 0.4 mile. Turn right onto Fox Ridge Road. The project site is located approximately 0.2 miles on the left side of Fox Ridge Road.

WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1 Project Vicinity Map
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Alleghany County, NC

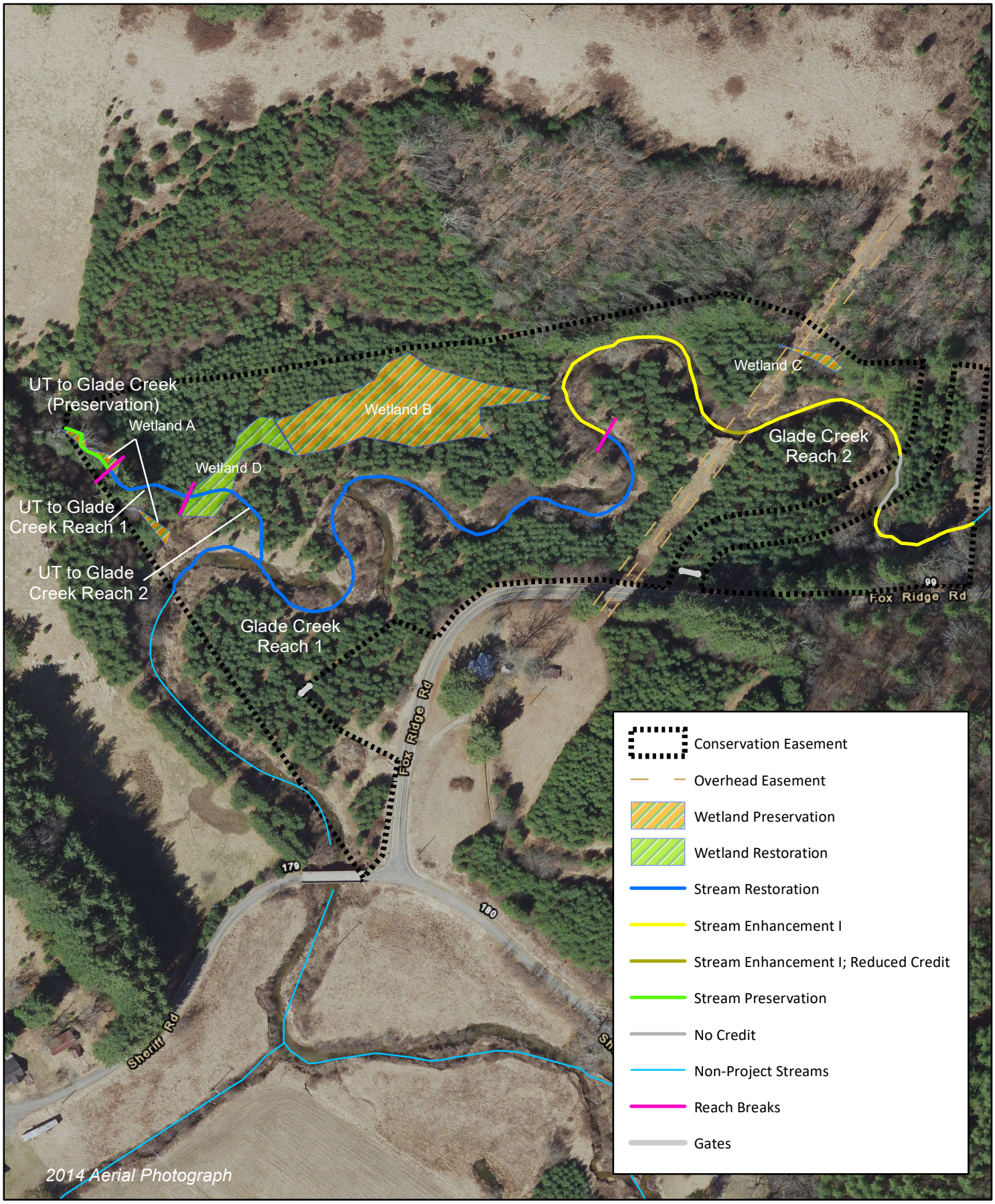


Figure 2 Project Component/Asset Map
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Alleghany County, NC

Table 1. Project Components and Mitigation Credits
Glade Creek II Restoration Project
DMS Project No.92343
Monitoring Year 2 - 2017

Mitigation Credits								
	Stream		Riparian Wetland	Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	R	RE			
Totals	2,140.7	25.8	0.33	N/A	N/A	N/A	N/A	

Project Components							
Reach ID	Existing Footage/ Acreage	Approach	Restoration (R) or Restoration Equivalent (RE)	As-Built Stationing/ Location	Restoration Footage/Acreage	Mitigation Ratio	Credits (SMU/WMU)
STREAMS							
Glade Creek Reach 1	1200 LF	P2	Restoration (R)	10+00 - 21+70	1,170	1:1	1170.0
Glade Creek Reach 2*	1074 LF	P2	Enhancement I (R)	21+70-26+41; 26+86-29+69; 30+59-32+60	1,090	1.5:1	651.7
UT to Glade Creek Preservation	129 LF	N/A	Preservation (RE)	10+00 - 11+29	129	5:1	25.8
UT to Glade Creek Reaches 1 and 2	197 LF	P1	Restoration (R)	11+29 - 14+48	319	1:1	319.0
WETLANDS							
Wetland A, B, C	0.84 AC	N/A	Preservation (RE)	N/A	0.84	5:1	0.17
Wetland D	0.16 AC	N/A	Restoration (R)	N/A	0.16	1:1	0.16

Component Summation							
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)		Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine				
Restoration	1,489		0.16				
Preservation	129		0.84				
Enhancement I	1,090						
Enhancement II							
Creation							

* Stream Enhancement I credit reduced; 90 LF removed at break in conservation easement and 45 LF reduced by 50% at overhead power easement.

Table 2. Project Activity and Reporting History
Glade Creek II Restoration Project
DMS Project No.92343
Monitoring Year 2 - 2017

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		December 2008	December 2008
Mitigation Plan Addendum		January 2013	January 2013
Final Design - Construction Plans		January 2015	January 2015
Construction		December 2015 - April 2016	April 2016
Temporary S&E mix applied to entire project area[1]		December 2015 - April 2016	April 2016
Permanent seed mix applied to reach/segments[1]		December 2015 - April 2016	April 2016
Bare root and live stake plantings for reach/segments		February 2016	February 2016
Baseline Monitoring Document (Year 0)		January - May 2016	June 2016
Year 1 Monitoring	Stream Survey	October 2016	December 2016
	Vegetation Survey	October 2016	
Year 2 Monitoring	Stream Survey	May 2017	December 2017
	Vegetation Survey	September 2017	
Year 3 Monitoring	Stream Survey	2018	November 2018
	Vegetation Survey	2018	
Year 4 Monitoring	Stream Survey	2019	November 2019
	Vegetation Survey	2019	
Year 5 Monitoring	Stream Survey	2020	November 2020
	Vegetation Survey	2020	

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

Table 3. Project Contact Table
Glade Creek II Restoration Project
DMS Project No.92343
Monitoring Year 2 - 2017

Designer Andrew Bick, PE, CFM	**Wildlands Engineering, Inc.** 167-B Haywood Rd. Asheville, NC 28806 828.774.5547
Construction Contractor	**Carolina Environmental Contracting, Inc.** PO Box 1905 Mt. Airy NC 27030
Planting Contractor	**Keller Environmental** 7921 Haymarket Lane Raleigh, NC 27615
Seeding Contractor	**Carolina Environmental Contracting, Inc.** PO Box 1905 Mt. Airy NC 27030
Seed Mix Sources	**Carolina Environmental Contracting, Inc.**
Wetland Enhancement **Nursery Stock Suppliers** **Bare Roots** **Live Stakes** **Plugs**	---
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kirsten Gimbert 704.332.7754, ext. 110

--- Data not provided

Table 4. Project Information and Attributes
Glade Creek II Restoration Project
DMS Project No.92343
Monitoring Year 2 - 2017

Project Information				
Project Name	Glade Creek II Restoration Project			
County	Alleghany			
Project Area (acres)	44.50			
Project Coordinates (latitude and longitude)	36° 28' 37.0878"N, -81° 3' 42.7896"W			
Project Watershed Summary Information				
Physiographic Province	Blue Ridge Mountains			
River Basin	New River			
USGS Hydrologic Unit 8-digit	05050001			
USGS Hydrologic Unit 14-digit	05050001030020			
DWR Sub-basin	05-07-03			
Project Drainiage Area (acres)	5,120			
Project Drainage Area Percentage of Impervious Area	<1%			
CGIA Land Use Classification	61% Forested, 35% Agriculture/Livestock, 3% Residential/Commercial			
Reach Summary Information				
Parameters	**Glade Creek Reach 1**	**Glade Creek Reach 2**	**UT to Glade Creek Reach 1**	**UT to Glade Creek Reach 2**
Length of reach (linear feet) - Post-Restoration	1,170	1,090	129	319
Drainage area (acres)	5,120		13	
NCDWR stream identification score	47		31	
NCDWR Water Quality Classification	C; Tr		-	-
Morphological Desription (stream type)	C4		B4	
Underlying mapped soils	Suncook			
FEMA classification	no regulated floodplain		no regulated floodplain	
Native vegetation community	White Pine Plantation			
Percent composition exotic invasive vegetation -Post-Restoration	0%		0%	
Parameters	**Wetlands A, B & C**		**Wetland D**	
Size of Wetland (acres)	0.84		0.16	
Wetland Type	Riparian-Non Riverine			
Underlying mapped soils	Suncook			
Drainage class	frequently flooded, excessively drained			
Soil hydric status	N/A			
Source of Hydrology	hillside seep			
Restoration or Enhancement Method (hydrologic, vegetative, etc.)	Preservation		hydrologic/ vegetative	
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. 3885. Action ID # 2009-00589	
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	Glade Creek II Restoration Project; Ward Consulting determined "no affect" on Alleghany County listed endangered species	
Historic Preservation Act	Yes	Yes	No recommendations received.	
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A	
FEMA Floodplain Compliance	N/A	N/A	The upper portion of Glade Creek is not currenlty mapped as a regulated flood zone	
Essential Fisheries Habitat	N/A	N/A	N/A	

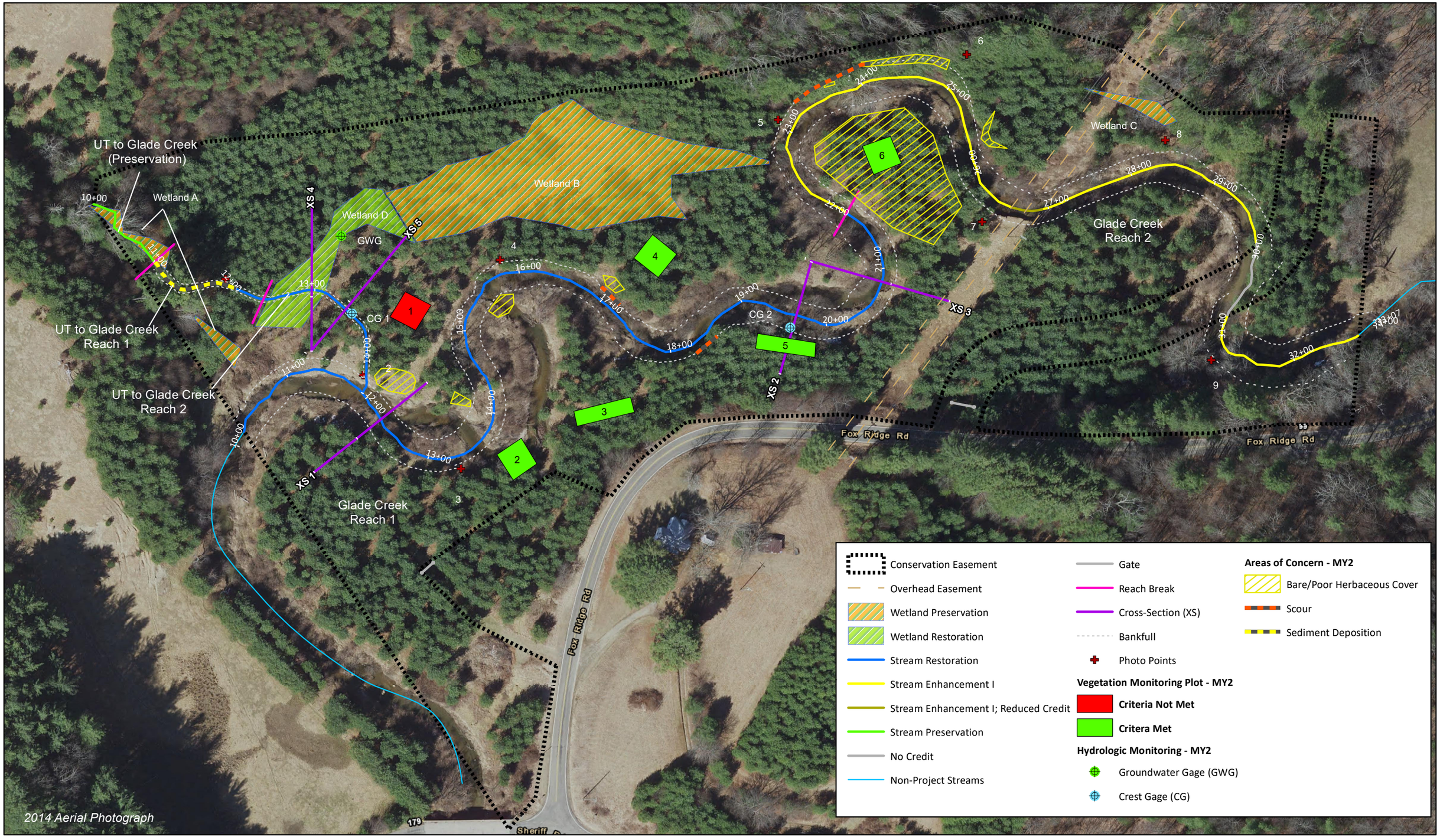
--- Data not provided

Table 5. Monitoring Component Summary
Glade Creek II Restoration Project
DMS Project No.92343
Monitoring Year 2 - 2017

Parameter	Monitoring Feature	Quantity/ Length by Reach			Frequency
		Glade Creek	UT to Glade Creek	Wetlands	
Dimension	Riffle Cross Section	2	1	N/A	Annual
	Pool Cross Section	1	1	N/A	
Pattern	Pattern	Yes	Yes	N/A	See Footnote[1]
Profile	Longitudinal Profile	Yes	Yes	N/A	Annual
Substrate	Reach Wide (RW) / Riffle 100 Pebble Count (RF)	RW-1, RF 1	RW-1, RF-1	N/A	Annual
Stream Hydrology	Crest Gage	1	1	N/A	Semi-Annual
Wetland Hydrology	Groundwater Gages	N/A	N/A	Enhancement I (R)	Semi-Annual
Vegetation	CVS Level 2	6			Annual
Visual Assessment	All Streams	Y	Y	Y	Semi-Annual
Exotic and nuisance vegetation					Semi-Annual
Project Boundary					Semi-Annual
Reference Photos	Photographs	9			Annual

[1]Pattern measurements will include sinuosity and meander width ratio and will be performed yearly. Measurements of radius of curvature will be monitored on newly constructed meanders for the first year only.

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 3 Integrated Current Condition Plan View
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Alleghany County, NC

Table 6a. Visual Stream Morphology Stability Assessment Table
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2-2017

Glade Creek (2,260 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	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			3	50	98%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	3	50	98%	n/a	n/a	n/a
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.	7	7			100%			

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

Table 6b. Visual Stream Morphology Stability Assessment Table

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 -2017

UT to Glade Creek (448 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			1	100	78%			
		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[2]	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%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	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.	7	7			100%			

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

[2]Applicable to only 2 meander bends because the other 2 meander bends are being impacted by sedimentation and the stream has braided.

Table 7. Vegetation Condition Assessment Table

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 -2017

Planted Acreage **6.4**

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	8	0.4	6.3%
Low Stem Density Areas[1]	Woody stem densities clearly below target levels based on MY3, 4, 5, or 7 stem count criteria.	0.1	1	0.025	0.4%
		Total	**9**	**0.4**	**6.6%**
Areas of Poor Growth Rates or Vigor[1]	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25	0	0.0	0%
		Cumulative Total	**9**	**0.4**	**6.6%**

Easement Acreage **12.8**

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	0	0.0	0%
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.

Stream Photographs

Photo Point 1 – view upstream UT Glade Creek *(5/10/2017)*

Photo Point 1 – view downstream UT Glade Creek *5/10/2017)*

Photo Point 2 – view upstream Glade Creek *(5/10/2017)*

Photo Point 2 – view downstream Glade Creek *(5/10/2017)*

Photo Point 2 – view upstream UT Glade Creek *(5/10/2017)*

Photo Point 3 – view upstream Glade Creek *(5/10/2017)*

Photo Point 3 – view downstream Glade Creek *(5/10/2017)*

Photo Point 4 – view upstream Glade Creek *(5/10/2017)*

Photo Point 4 – view downstream Glade Creek *(5/10/2017)*

Photo Point 5 – view upstream Glade Creek *(5/10/2017)*

Photo Point 5 – view downstream Glade Creek *(5/10/2017)*

	
Photo Point 6 – view upstream Glade Creek *(5/10/2017)*	**Photo Point 6** – view downstream Glade Creek *(5/10/2017)*
	
Photo Point 7 – view upstream Glade Creek *(5/10/2017)*	**Photo Point 7** – view downstream Glade Creek *(5/10/2017)*
	
Photo Point 8 – view upstream Glade Creek *(5/10/2017)*	**Photo Point 8** – view downstream Glade Creek *(5/10/2017)*

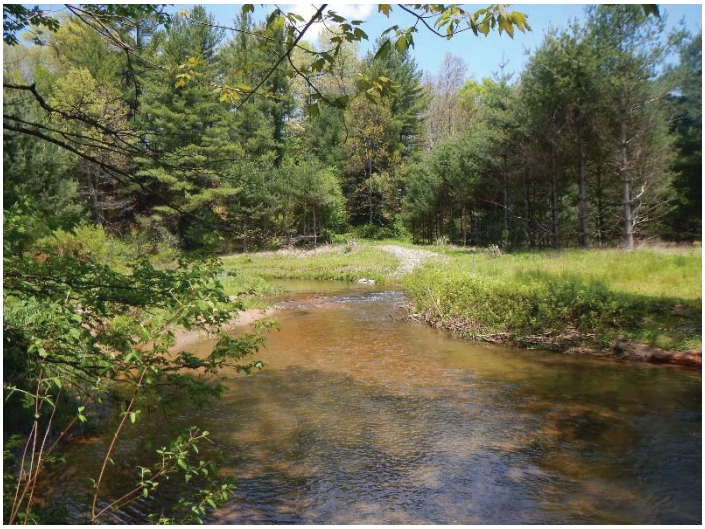


Photo Point 9 – view upstream Glade Creek *(5/10/2017)*	**Photo Point 9** – view downstream Glade Creek *(5/10/2017)*

Vegetation Photographs

Vegetation Plot 1 - *(9/5/2017)*

Vegetation Plot 2 - *(9/5/2017)*

Vegetation Plot 3 - *(9/5/2017)*

Vegetation Plot 4 - *(9/5/2017)*

Vegetation Plot 5 - *(9/5/2017)*

Vegetation Plot 6 - *(9/5/2017)*

APPENDIX 3. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Plot	MY1 Success Criteria Met (Y/N)	Tract Mean
1	N	83%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	

Table 9. CVS Vegetation Plot Metadata
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Report Prepared By	Ruby Davis
Date Prepared	11/10/2017 11:32
Database Name	cvs-eep-entrytool-v2.5.0 Glade MY2.mdb
Database Location	Q:\ActiveProjects\005-02161 Glade Creek II Monitoring\Monitoring\Monitoring Year 2\Vegetation Assessment
Computer Name	RUBY
File Size	49844224
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	92343
project Name	Glade Creek II Restoration Project
Description	Glade Creek II Restoration Project
Required Plots (calculated)	6
Sampled Plots	6

Table 10. Planted and Total Stem Counts
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

			Current Plot Data (MY1 2017)																	
			92343-WEI-0001			92343-WEI-0002			92343-WEI-0003			92343-WEI-0004			92343-WEI-0005			92343-WEI-0006		
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	3	3	3									1						
Alnus serrulata	Tag Alder	Shrub Tree			1	1	1	13			1	3	3	4	1	1	16	7	7	22
Carpinus caroliniana	American Hornbeam	Shrub Tree				1	1	1	1	1	1	1	1	1				1	1	1
Cercis canadensis	Eastern Redbud	Shrub Tree																		
Diospyros virginiana	American Persimmon	Tree				2	2	2				3	3	3	3	3	3	1	1	1
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2															
Hamamelis virginiana	Witch-hazel	Shrub Tree				4	4	4	1	1	1	2	2	2	3	3	3			
Liriodendron tulipifera	Tulip Poplar	Tree				3	3	3	12	12	12	2	2	2	4	4	4	2	2	2
Nyssa sylvatica	Black Gum	Tree				1	1	1	1	1	1	2	2	2						
Platanus occidentalis	Sycamore	Tree	1	1	1	3	3	3	5	5	5	2	2	2	3	3	3			
Sambucus canadensis	Common Elderberry	Shrub Tree				1	1	1				1	1	1	3	3	3			
		Stem count	6	6	7	16	16	28	20	20	21	16	16	18	17	17	32	11	11	26
		size (ares)		1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	3	3	4	8	8	8	5	5	6	8	8	9	6	6	6	4	4	4
		Stems per ACRE	243	243	283	647	647	1133	809	809	850	647	647	728	688	688	1295	445	445	1052

			Annual Summary								
			MY2 (2017)			MY1 (2016)			MY0 (2016)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	PnoLS	P-all	T
Acer rubrum	Red Maple	Tree	3	3	4	3	3	3	6	6	6
Alnus serrulata	Tag Alder	Shrub Tree	12	12	57	13	13	20	14	14	14
Carpinus caroliniana	American Hornbeam	Shrub Tree	4	4	4	4	4	4	4	4	4
Cercis canadensis	Eastern Redbud	Shrub Tree						1			
Diospyros virginiana	American Persimmon	Tree	9	9	9	10	10	10	11	11	11
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	2	2	2	3	3	3
Hamamelis virginiana	Witch-hazel	Shrub Tree	10	10	10	10	10	10	10	10	10
Liriodendron tulipifera	Tulip Poplar	Tree	23	23	23	24	24	24	28	28	28
Nyssa sylvatica	Black Gum	Tree	4	4	4	6	6	6	7	7	7
Platanus occidentalis	Sycamore	Tree	14	14	14	14	14	14	22	22	22
Sambucus canadensis	Common Elderberry	Shrub Tree	5	5	5	5	5	5	5	5	5
		Stem count	86	86	132	91	91	99	110	110	110
		size (ares)		6			6		6		
		size (ACRES)		0.15			0.15		0.148		
		Species count	10	10	10	10	10	11	10	10	10
		Stems per ACRE	580	580	890	614	614	668	742	741.9	741.9

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

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

APPENDIX 4. Morphological Summary Data and Plots

Table 11. Baseline Stream Data Summary
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data				Design				As-Built/Baseline			
		Glade Creek		UT to Glade Creek		Glade Creek Restoration		UT to Little Pine Trib 1		Glade Creek		UT to Glade Creek		Glade Creek		UT to Glade Creek	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Shallow																	
Bankfull Width (ft)	N/A	17.7	38.5	5.2	9.9	36.3	48.8	6.2	11.1	33.0		5.4		34.6	37.4	5.3	
Floodprone Width (ft)		47	115	7	12	69	118	14	46	99	165	22	33	106	111	61	
Bankfull Mean Depth		2.6	2.1	0.3	0.5	0.9	1.3	0.9	0.5	2.3		0.3		1.9	2.2	0.5	
Bankfull Max Depth		2.9	4.1	0.5	0.8	1.9	1.9	0.8	1.6	3.0		0.4		2.9	3.2	0.9	
Bankfull Cross-sectional Area (ft^2)		46.9	79.0	2.1	5.1	45.6	64.1	3.8	5.1	76.5		1.7		70.2	77.1	2.4	
Width/Depth Ratio		6.7	18.8	17.3	26.8	40.3	37.2	6.9	24.2	14.2		17.4		15.5	19.9	11.8	
Entrenchment Ratio		2.7	3.1	1.2	1.5	1.9	2.4	2.3	4.1	3.0	5.0	4.0	6.0	2.8	3.2	11.4	
Bank Height Ratio		1.1	1.7	0.0	0.0	1.0	1.0	1.0	2.1	1.0		1.0		1.0		1.0	
D50 (mm)		28.0	31.0	7.0	7.0	44.0	47.0	7.0	7.0	28.0	31.0	7.0		90.0		32.0	
Riffle Length (ft)	N/A					---		---		---		---		33	57	6.8	32.6
Riffle Slope (ft/ft)						---		---		---		---		0.0087	0.0271	0.0193	0.0964
Pool Length (ft)						---		---		5		---		64.0	197.8	8.8	32.9
Pool Max Depth (ft)		4.4	6.6	0.8		5.0		0.7	1.5	3.3	4.1	0.8	1.0	3.8	5.9	1.5	
Pool Spacing (ft)						---		---		---		---		107	353	33.0	70.0
Pool Volume (ft^3)																	
Pattern																	
Channel Beltwidth (ft)	N/A	60	240	7	16	---	---	19	26	112	205	17		155	282	75.0	
Radius of Curvature (ft)		21	114	---	---	---	---	30		59.0	99.0	30		59.0	99.0	30	
Rc:Bankfull Width (ft/ft)		1.2	3.0	---	---	---	---	3.2	5.9	1.8	3.0	5.5-6.0		1.8	3.0	5.5-6.0	
Meander Length (ft)[1]				---	---	---	---	---	---	---	---	---	---	230	425	150	
Meander Width Ratio		3.4	6.2	1.3	1.6	---	---	2.5	3.5	3.4	6.2	3.1	7.0	4.5	7.5	3.1	7.0
Substrate, Bed and Transport Parameters																	
Ri%/Ru%/P%/G%/S%	N/A																
SC%/Sa%/G%/C%/B%/Be%																	
d16/d35/d50/d84/d95/d100		-/-/3.1/8.6/11.0/16.0		---		-/0.1/0.2/0.5/4.0/8.0		0.1/3.0/8.8/77/180/-						1/26.47/42.3/128/180/>2048		.11/0.63/13.3/176/241.4/>204	
Reach Shear Stress (Competency) lb/ft^2		---		---						0.48		0.52	0.82	0.11	0.12		
Max part size (mm) mobilized at bankfull																	
Stream Power (Capacity) W/m^2																	
Additional Reach Parameters																	
Drainage Area (SM)	N/A	8.00		0.02		4.60		0.05		8.00		0.02		8.00		0.02	
Watershed Impervious Cover Estimate (%)		---		---		---		---		---		---		---		---	
Rosgen Classification		E4/C4		F4/B4		C4		C4/B4		C4		B4		C4		B4	
Bankfull Velocity (fps)		3.8	5.3	3.8	4.9	3.1	4.4	4.5	6.1	3.9		4.7		---		---	
Bankfull Discharge (cfs)		250	300	8	25	200		23		300		8		---		---	
Q-NFF regression (2-yr)		493		5		352											
Q-USGS extrapolation (1.2-yr)		561		4		335											
Q-Mannings		213	320	8		153	228										
Valley Length (ft)		---		---		---		---		1,322		280		1,322		280	
Channel Thalweg Length (ft)		1200		197		---		---		2,120		197		2,120		326	
Sinuosity		1.68		1.04		1.18		1.09		1.68		1.14		1.60		1.16	
Water Surface Slope (ft/ft)[2]		0.0038		0.048		0.0049		0.0473		0.0038		0.0440		0.0031		0.0397	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		0.0031		0.0326	

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable
[1]Meander Wave Length was adjusted in the MY2 report.
[2] Channel was dry during survey, slope was calculated using channel thalweg

Table 12. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

	Cross-Section 1, Glade Creek (Riffle)						Cross-Section 2, Glade Creek (Riffle)						Cross-Section 3, Glade Creek (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	2571.8	2571.8	2571.8				2569.7	2569.7	2569.7				2569.8	2569.8	2569.8			
Bankfull Width (ft)	37.4	34.4	38.7				34.6	35.0	36.2				31.9	30.0	32.5			
Floodprone Width (ft)	106	106	102				111	110	93				---	---	---			
Bankfull Mean Depth (ft)	1.9	1.9	1.8				2.2	2.2	2.1				2.8	2.9	2.8			
Bankfull Max Depth (ft)	2.9	2.9	2.8				3.2	3.2	3.2				4.2	4.2	4.7			
Bankfull Cross Sectional Area (ft^2)	70.2	66.9	70.2				77.1	78.0	77.6				89.0	88.4	91.5			
Bankfull Width/Depth Ratio	19.9	17.7	21.3				15.5	15.7	16.9				11.5	10.2	11.6			
Bankfull Entrenchment Ratio	2.8	3.1	2.6				3.2	3.2	2.6				---	---	---			
Bankfull Bank Height Ratio	1.0	1.0	0.8				1.0	1.0	1.0				---	---	---			

	Cross-Section 4, UT to Glade Creek (Pool)						Cross-Section 5, UT to Glade Creek (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	2574.0	2574.0	2574.0				2573.6	2573.6	2573.6			
Bankfull Width (ft)	5.3	7.1	7.0				5.3	6.1	5.9			
Floodprone Width (ft)	---	---	---				61	61	61			
Bankfull Mean Depth (ft)	0.9	0.8	0.7				0.5	0.4	0.5			
Bankfull Max Depth (ft)	1.5	1.3	1.5				0.9	0.8	1.0			
Bankfull Cross Sectional Area (ft^2)	4.7	5.5	4.9				2.4	2.7	3.1			
Bankfull Width/Depth Ratio	6.0	9.6	10.1				11.8	13.5	11.4			
Bankfull Entrenchment Ratio	---	---	---				11.4	10.0	10.3			
Bankfull Bank Height Ratio	---	---	---				1.0	1.0	1.0			

---: not applicable

Table 13a. Monitoring Data - Stream Reach Data Summary
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Glade Creek Main

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	34.6	37.4	34.4	35.0	36.2	38.7						
Floodprone Width (ft)	106	111	97	106	93.3	102.0						
Bankfull Mean Depth	1.9	2.2	1.9	2.2	1.8	2.1						
Bankfull Max Depth	2.9	3.2	2.9	3.2	2.8	3.2						
Bankfull Cross-sectional Area (ft^2)	70.2	77.1	66.9	78.0	70.2	77.6						
Width/Depth Ratio	15.5	19.9	15.7	17.7	16.9	21.3						
Entrenchment Ratio	2.8	3.2	2.8	3.1	2.6							
Bank Height Ratio	1.0		1.0		1.0							
D50 (mm)	90.0		34.3		39.8	47.7						
Profile												
Riffle Length (ft)	33	57	20	57	20	85						
Riffle Slope (ft/ft)	0.0087	0.0271	0.0065	0.0235	0.0011	0.0181						
Pool Length (ft)	64	198	66	190	62	222						
Pool Max Depth (ft)	3.8	5.9	4.2		4.4	5.4						
Pool Spacing (ft)	107	353	91	384	90	337						
Pool Volume (ft^3)												
Pattern[1]												
Channel Beltwidth (ft)	155	282	155	280	155	283						
Radius of Curvature (ft)	59.0	99.0	59.0	99.0	59.0	99.0						
Rc:Bankfull Width (ft/ft)	1.8	3.0	1.7	2.8	1.6	2.6						
Meander Wave Length (ft)	230	425	227	435	216	445						
Meander Width Ratio	4.5	7.5	4.5	8.0	4.2	7.3						
Additional Reach Parameters												
Rosgen Classification	C4		C4		C4							
Channel Thalweg Length (ft)	2,120		2,120		2,120							
Sinuosity (ft)	1.60		1.60		1.60							
Water Surface Slope (ft/ft)	0.0031		0.0030		0.0027							
Bankfull Slope (ft/ft)	0.0031		0.0031		0.0030							
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	1/26.47/42.3/128/180/>2048		3.35/19.49/30.4/97.6/137/256.0		3.4/12.5/29.6/75.6/115.5/362.0							
% of Reach with Eroding Banks	0%		0%		2%							

[1]Meander Wave Length was adjusted for MY0 and MY1 in the MY2 report.

Table 13b. Monitoring Data - Stream Reach Data Summary
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

UT to Glade Creek

Parameter	As-Built/Baseline		MY-1		MY-2		MY-3		MY-4		MY-5	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	5.3		6.1		5.9							
Floodprone Width (ft)	61		32.3		61.0							
Bankfull Mean Depth	0.5		0.4		0.5							
Bankfull Max Depth	0.9		0.8		1.0							
Bankfull Cross-sectional Area (ft^2)	2.4		2.7		3.1							
Width/Depth Ratio	11.8		13.5		11.4							
Entrenchment Ratio	11.4		5.3		10.3							
Bank Height Ratio	1.0		1.0		1.0							
D50 (mm)	32.0		22.6		0.7							
Profile												
Riffle Length (ft)	6.8	32.6	17.3	51.4	5.0	42.0						
Riffle Slope (ft/ft)	0.0193	0.0964	0.0118	0.0866	0.0148	0.1416						
Pool Length (ft)	8.8	32.9	15.6	32.6	3.0	5.0						
Pool Max Depth (ft)	1.5		1.3		1.1	2.4						
Pool Spacing (ft)	33.0	70.0	38.8	84.0	16	99						
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	75.0		75.0		75.0							
Radius of Curvature (ft)	30		30		30							
Rc:Bankfull Width (ft/ft)	5.5-6.0		5.5-6.0		5.5-6.0							
Meander Wave Length (ft)	150		150		150							
Meander Width Ratio	3.1	7.0	3.1	7.0	3.1	7.0						
Additional Reach Parameters												
Rosgen Classification	B4		B4		B4							
Channel Thalweg Length (ft)	326		326		326							
Sinuosity (ft)	1.16		1.16		1.16							
Water Surface Slope (ft/ft)	0.0397		0.0372		0.0323							
Bankfull Slope (ft/ft)	0.0326		0.0317		0.0318							
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.11/0.63/13.3/176/241.4/>204		0.19/4.65/11.9/124.6/163.3/256		0.2/0.4/0.8/111.2/151.8/256.0							
% of Reach with Eroding Banks	0%		0%		0%							

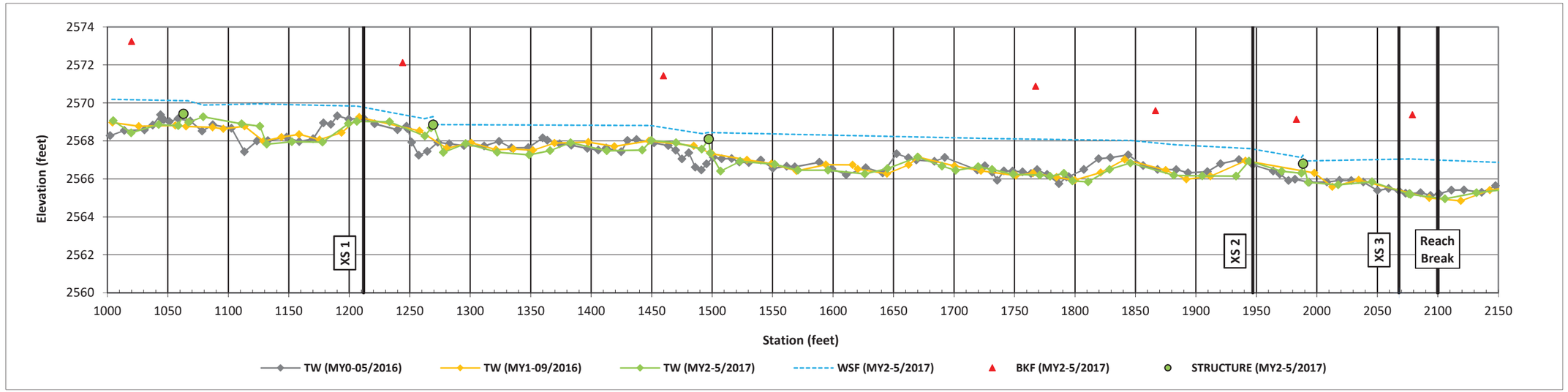
Longitudinal Profile Plots

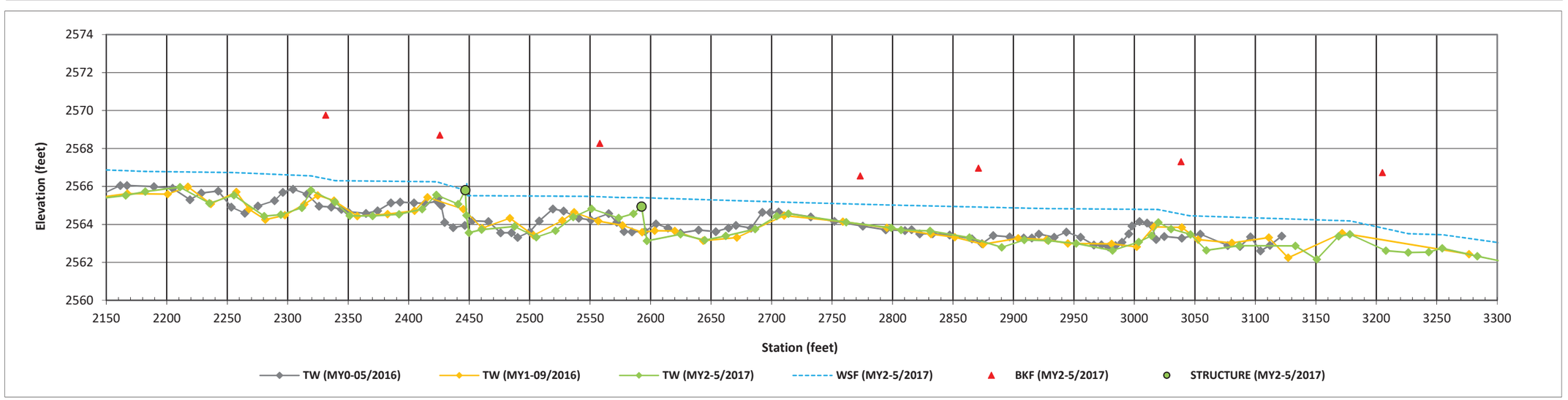
Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Glade Creek Reach 1 and 2 (STA 10+00 - STA 31+20)





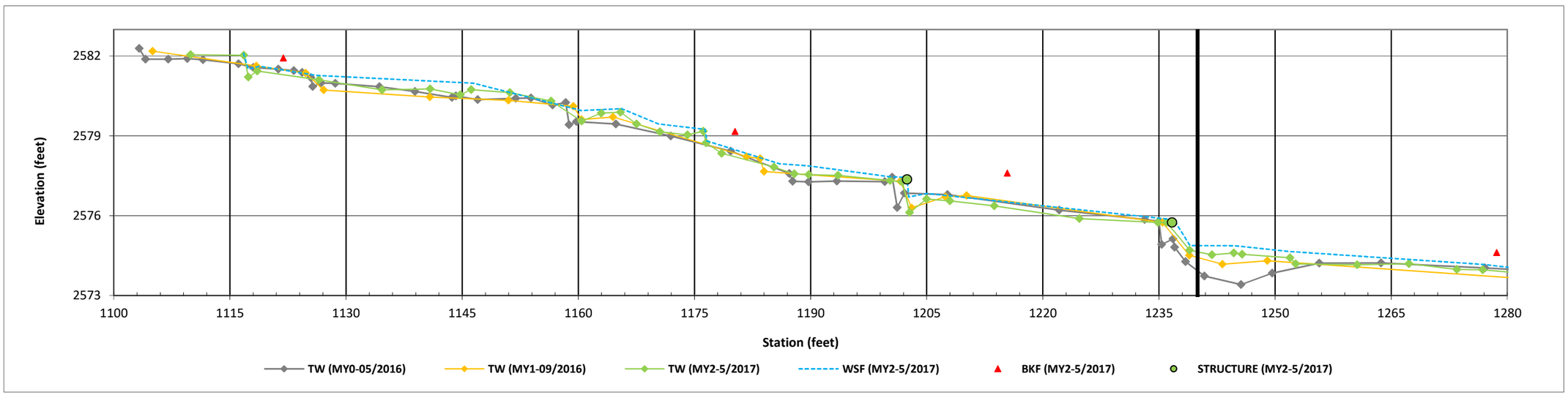
Longitudinal Profile Plots

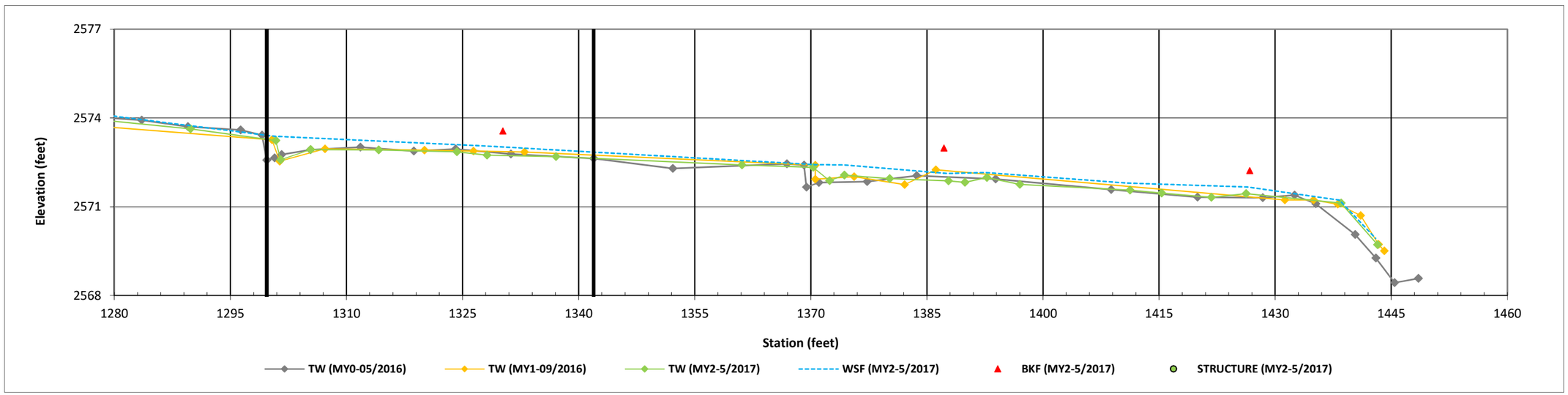
Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

UT Glade Creek (STA 11+29 - STA 14+48)





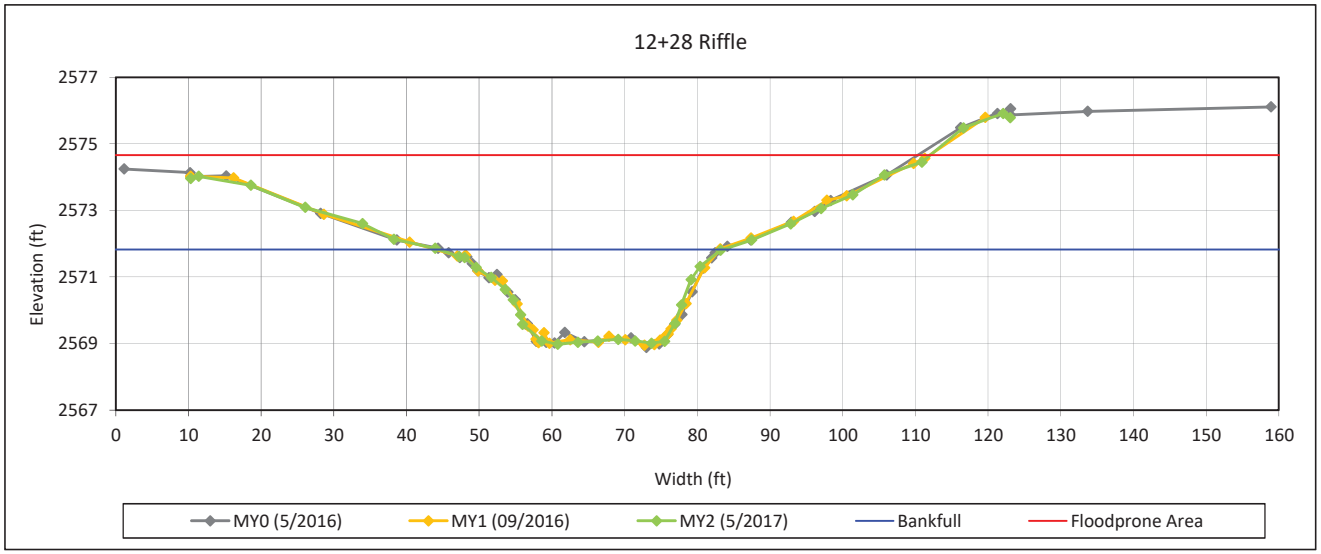
Cross-Section Plots

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Cross-Section 1 - Glade Creek



Bankfull Dimensions	
70.2	x-section area (ft.sq.)
38.7	width (ft)
1.8	mean depth (ft)
2.8	max depth (ft)
39.7	wetted perimeter (ft)
1.8	hydraulic radius (ft)
21.3	width-depth ratio
102	W flood prone area (ft)
2.6	entrenchment ratio
0.8	low bank height ratio

Survey Date: 5/2017

Field Crew: Wildlands Engineering

View Downstream

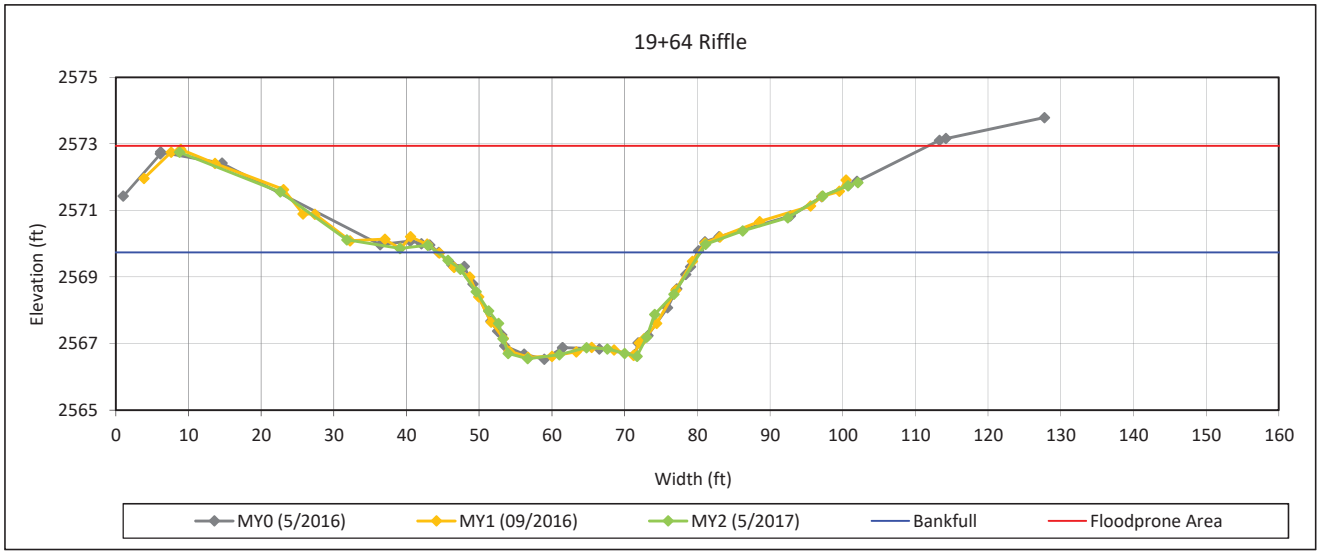
Cross-Section Plots

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Cross-Section 2 - Glade Creek



Bankfull Dimensions	
77.6	x-section area (ft.sq.)
36.2	width (ft)
2.1	mean depth (ft)
3.2	max depth (ft)
37.4	wetted perimeter (ft)
2.1	hydraulic radius (ft)
16.9	width-depth ratio
93.3	W flood prone area (ft)
2.6	entrenchment ratio
1.0	low bank height ratio

Survey Date: 5/2017

Field Crew: Wildlands Engineering

View Downstream

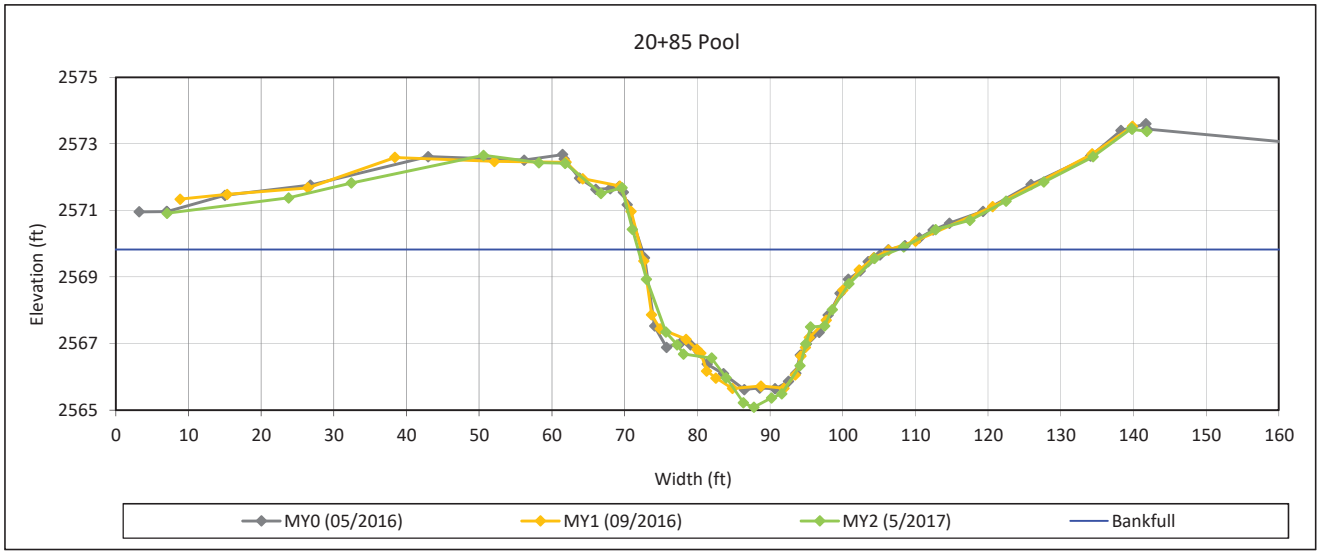
Cross-Section Plots

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Cross-Section 3 - Glade Creek



Bankfull Dimensions	
91.5	x-section area (ft.sq.)
32.5	width (ft)
2.8	mean depth (ft)
4.7	max depth (ft)
34.5	wetted perimeter (ft)
2.7	hydraulic radius (ft)
11.6	width-depth ratio

Survey Date: 5/2017

Field Crew: Wildlands Engineering

View Downstream

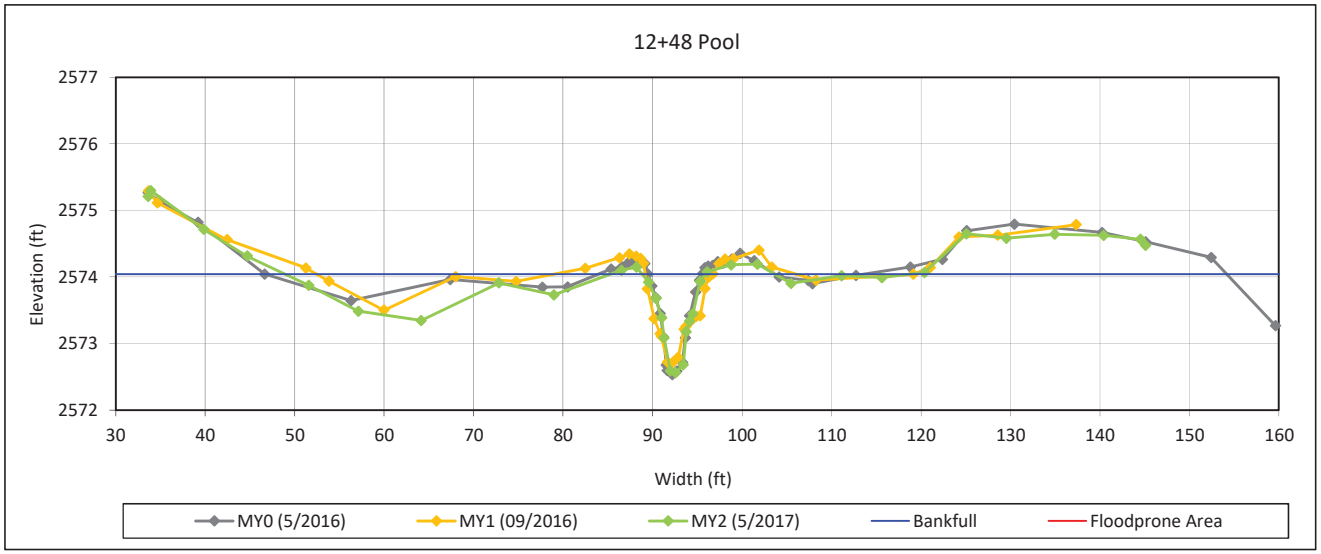
Cross-Section Plots

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Cross-Section 4 - UT to Glade Creek



Bankfull Dimensions	
4.9	x-section area (ft.sq.)
7.0	width (ft)
0.7	mean depth (ft)
1.5	max depth (ft)
7.9	wetted perimeter (ft)
0.6	hydraulic radius (ft)
10.1	width-depth ratio

Survey Date: 5/2017

Field Crew: Wildlands Engineering

View Downstream

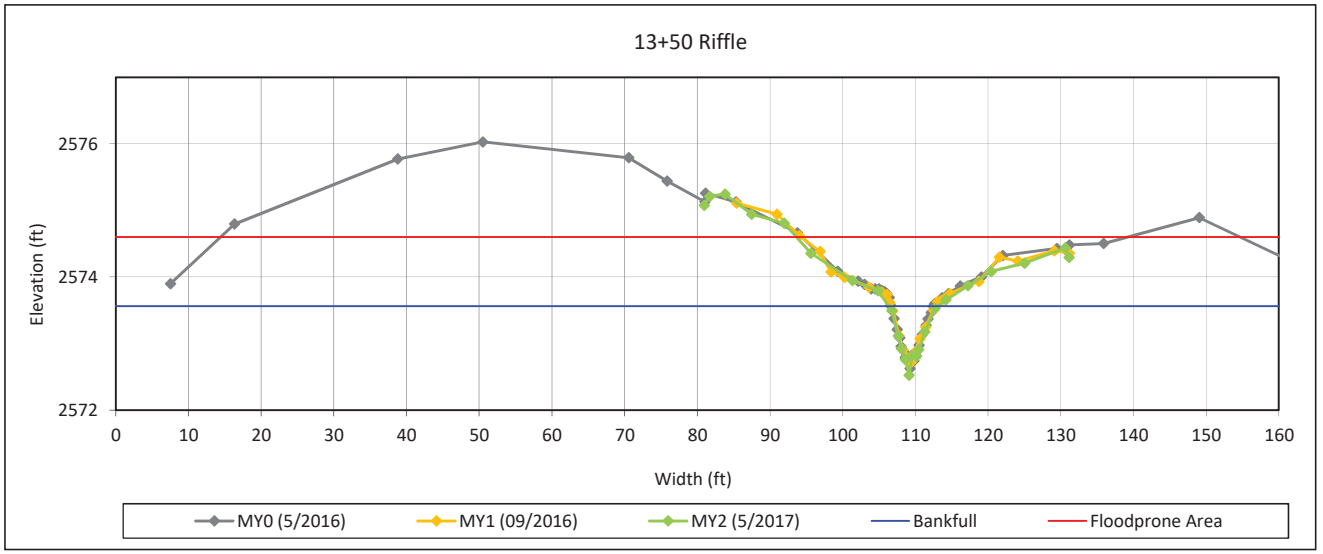
Cross-Section Plots

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017

Cross-Section 5 - UT to Glade Creek



Bankfull Dimensions	
3.1	x-section area (ft.sq.)
5.9	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
6.3	wetted perimeter (ft)
0.5	hydraulic radius (ft)
11.4	width-depth ratio
61.0	W flood prone area (ft)
10.3	entrenchment ratio
1.0	low bank height ratio

Survey Date: 5/2017

Field Crew: Wildlands Engineering

View Downstream

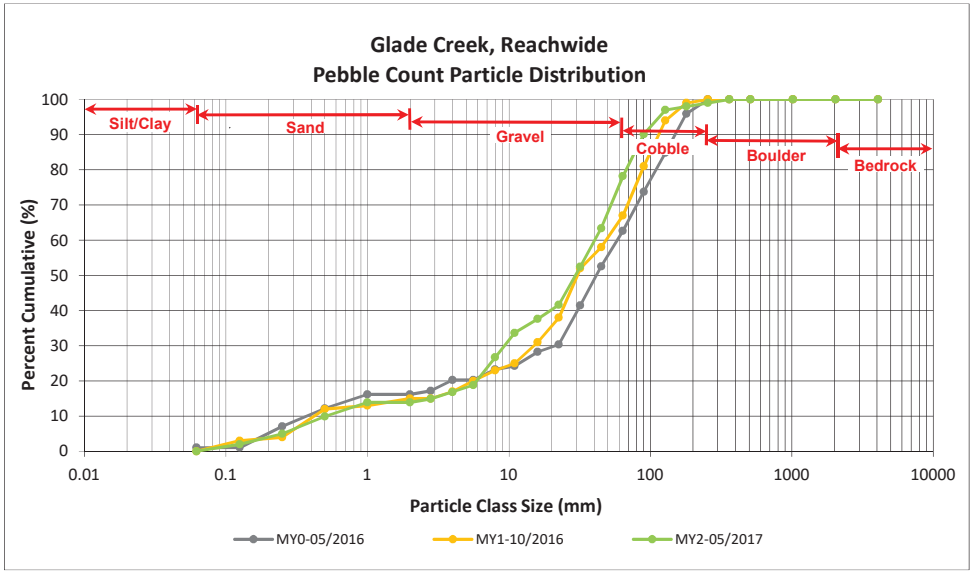
Reachwide and Cross-Section Pebble Count Plots

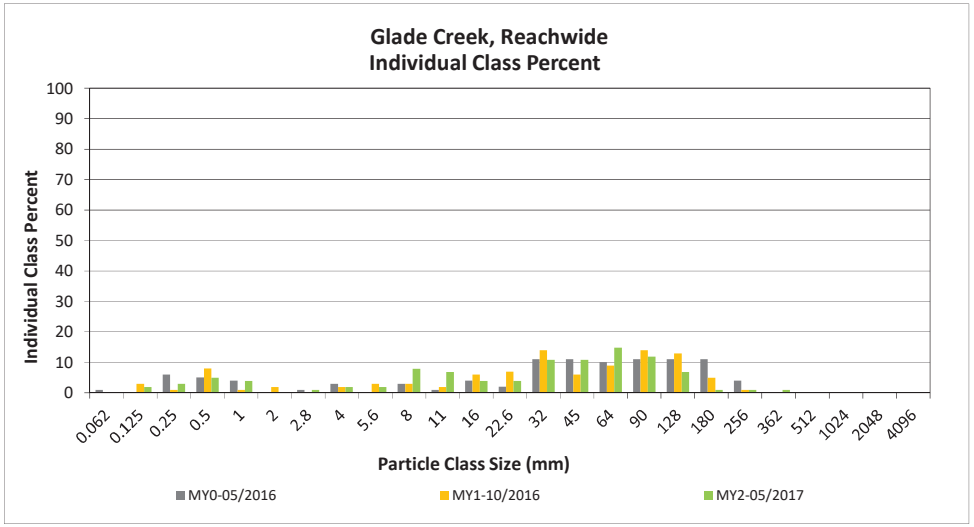
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Glade 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					0
SAND	Very fine	0.062	0.125		2	2	2	2
	Fine	0.125	0.250		3	3	3	5
	Medium	0.25	0.50		5	5	5	10
	Coarse	0.5	1.0		4	4	4	14
	Very Coarse	1.0	2.0					14
GRAVEL	Very Fine	2.0	2.8	1		1	1	15
	Very Fine	2.8	4.0		2	2	2	17
	Fine	4.0	5.6	1	1	2	2	19
	Fine	5.6	8.0	1	7	8	8	27
	Medium	8.0	11.0	4	3	7	7	34
	Medium	11.0	16.0	1	3	4	4	38
	Coarse	16.0	22.6	4		4	4	42
	Coarse	22.6	32	8	3	11	11	52
	Very Coarse	32	45	8	3	11	11	63
	Very Coarse	45	64	10	5	15	15	78
COBBLE	Small	64	90	7	5	12	12	90
	Small	90	128	5	2	7	7	97
	Large	128	180		1	1	1	98
	Large	180	256		1	1	1	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**	**50**	**101**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	3.4
D_{35} =	12.5
D_{50} =	29.6
D_{84} =	75.6
D_{95} =	115.5
D_{100} =	362.0





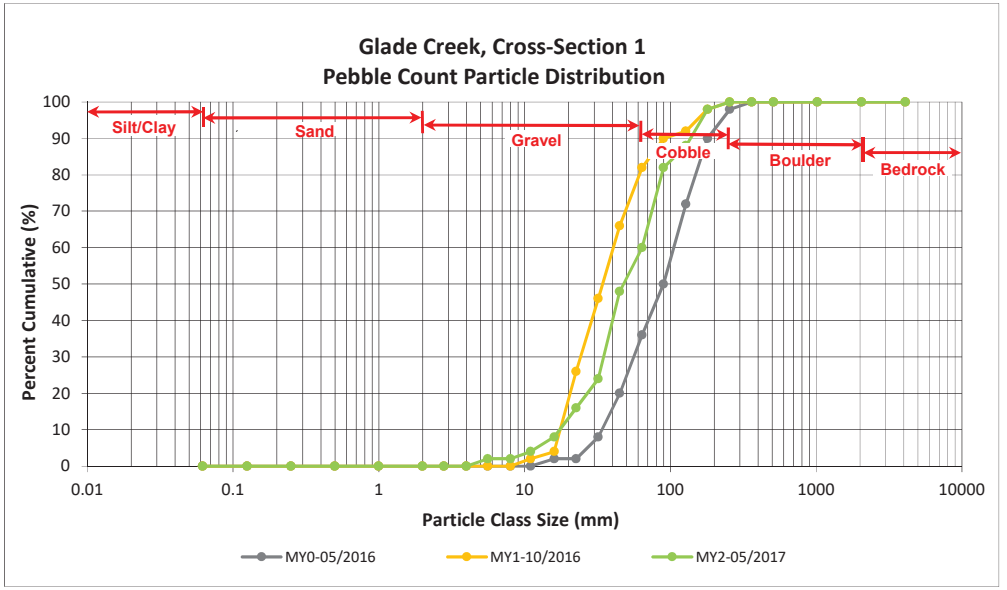
Reachwide and Cross-Section Pebble Count Plots

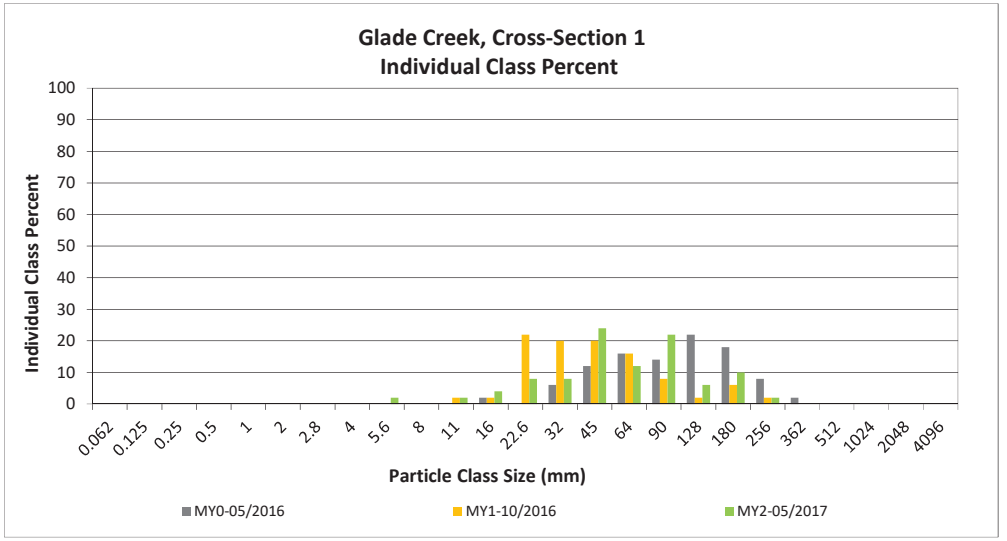
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Glade Creek, Cross-Section 1

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			0
	Very Coarse	1.0	2.0			0
GRAVEL	Very Fine	2.0	2.8			0
	Very Fine	2.8	4.0			0
	Fine	4.0	5.6	1	2	2
	Fine	5.6	8.0			2
	Medium	8.0	11.0	1	2	4
	Medium	11.0	16.0	2	4	8
	Coarse	16.0	22.6	4	8	16
	Coarse	22.6	32	4	8	24
	Very Coarse	32	45	12	24	48
	Very Coarse	45	64	6	12	60
COBBLE	Small	64	90	11	22	82
	Small	90	128	3	6	88
	Large	128	180	5	10	98
	Large	180	256	1	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**	**100**	**100**

Cross Section 1	
Channel materials (mm)	
D_{16} =	22.6
D_{35} =	37.4
D_{50} =	47.7
D_{84} =	101.2
D_{95} =	162.5
D_{100} =	256.0





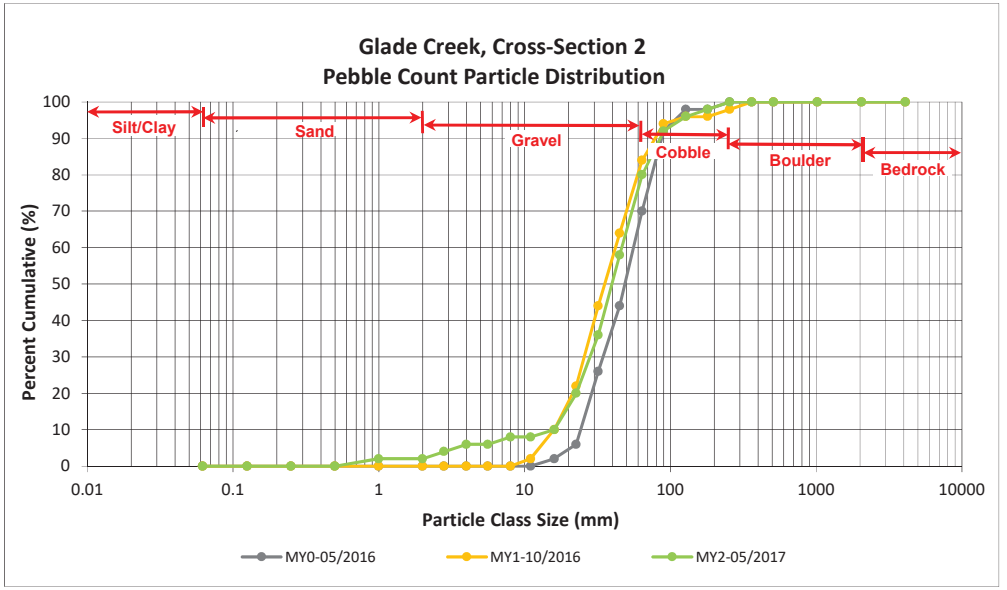
Reachwide and Cross-Section Pebble Count Plots

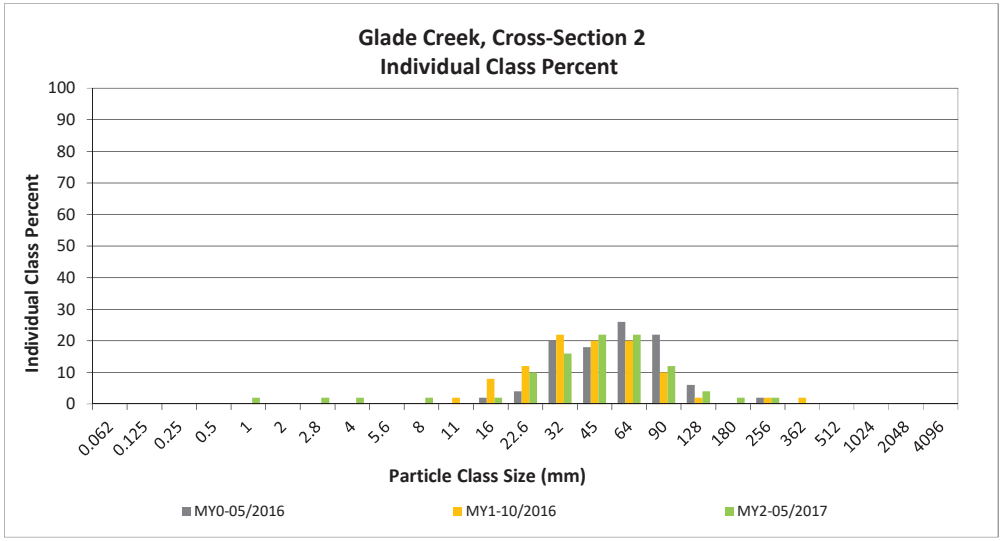
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Glade Creek, Cross-Section 2

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			0
	Coarse	0.5	1.0	1	2	2
	Very Coarse	1.0	2.0			2
GRAVEL	Very Fine	2.0	2.8	1	2	4
	Very Fine	2.8	4.0	1	2	6
	Fine	4.0	5.6			6
	Fine	5.6	8.0	1	2	8
	Medium	8.0	11.0			8
	Medium	11.0	16.0	1	2	10
	Coarse	16.0	22.6	5	10	20
	Coarse	22.6	32	8	16	36
	Very Coarse	32	45	11	22	58
	Very Coarse	45	64	11	22	80
COBBLE	Small	64	90	6	12	92
	Small	90	128	2	4	96
	Large	128	180	1	2	98
	Large	180	256	1	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**	**100**	**100**

Cross Section 2	
Channel materials (mm)	
D_{16} =	19.7
D_{35} =	31.3
D_{50} =	39.8
D_{84} =	71.7
D_{95} =	117.2
D_{100} =	256.0





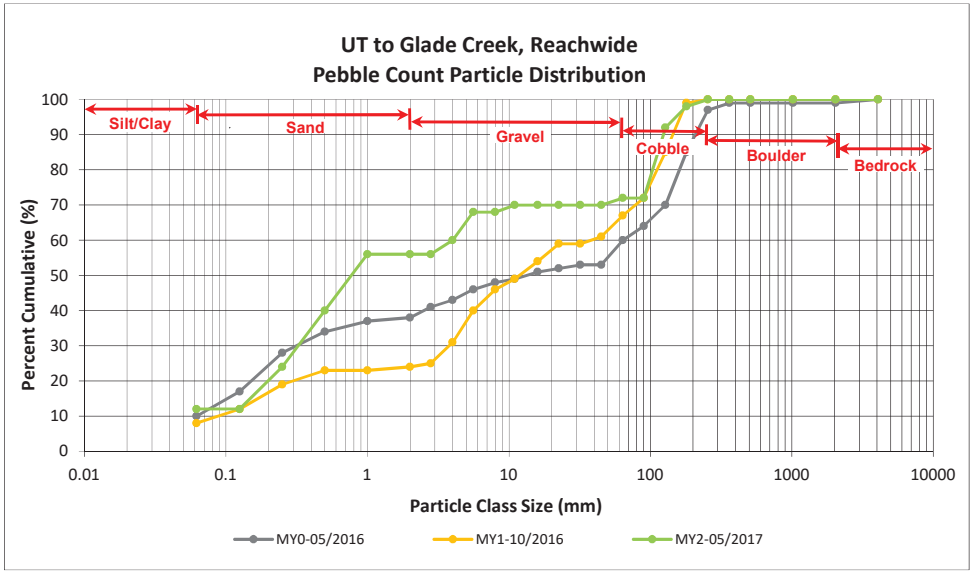
Reachwide and Cross-Section Pebble Count Plots

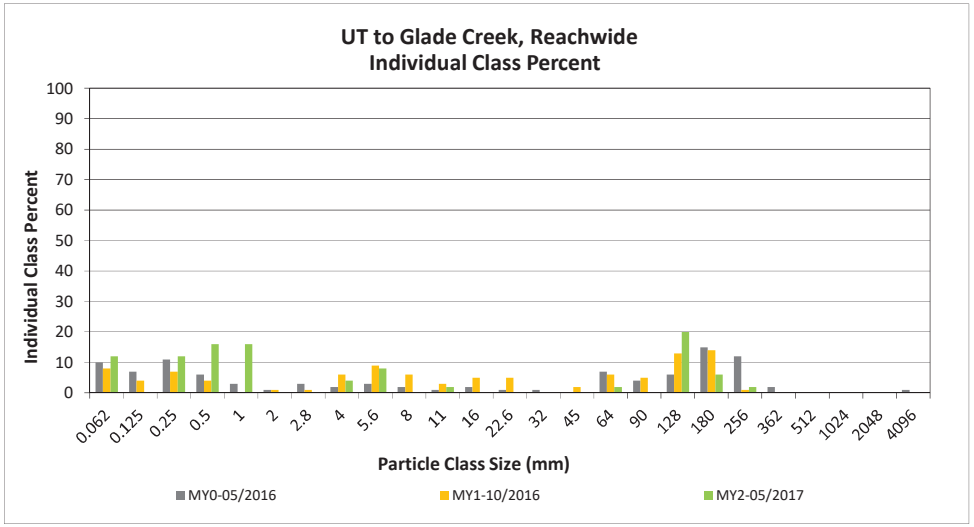
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

UT to Glade 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	3	3	6	12	12
SAND	Very fine	0.062	0.125					12
	Fine	0.125	0.250	2	4	6	12	24
	Medium	0.25	0.50	4	4	8	16	40
	Coarse	0.5	1.0	3	5	8	16	56
	Very Coarse	1.0	2.0					56
GRAVEL	Very Fine	2.0	2.8					56
	Very Fine	2.8	4.0		2	2	4	60
	Fine	4.0	5.6	4		4	8	68
	Fine	5.6	8.0					68
	Medium	8.0	11.0	1		1	2	70
	Medium	11.0	16.0					70
	Coarse	16.0	22.6					70
	Coarse	22.6	32					70
	Very Coarse	32	45					70
	Very Coarse	45	64	1		1	2	72
COBBLE	Small	64	90					72
	Small	90	128	8	2	10	20	92
	Large	128	180	3		3	6	98
	Large	180	256	1		1	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	**30**	**20**	**50**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.2
D_{35} =	0.4
D_{50} =	0.8
D_{84} =	111.2
D_{95} =	151.8
D_{100} =	256.0





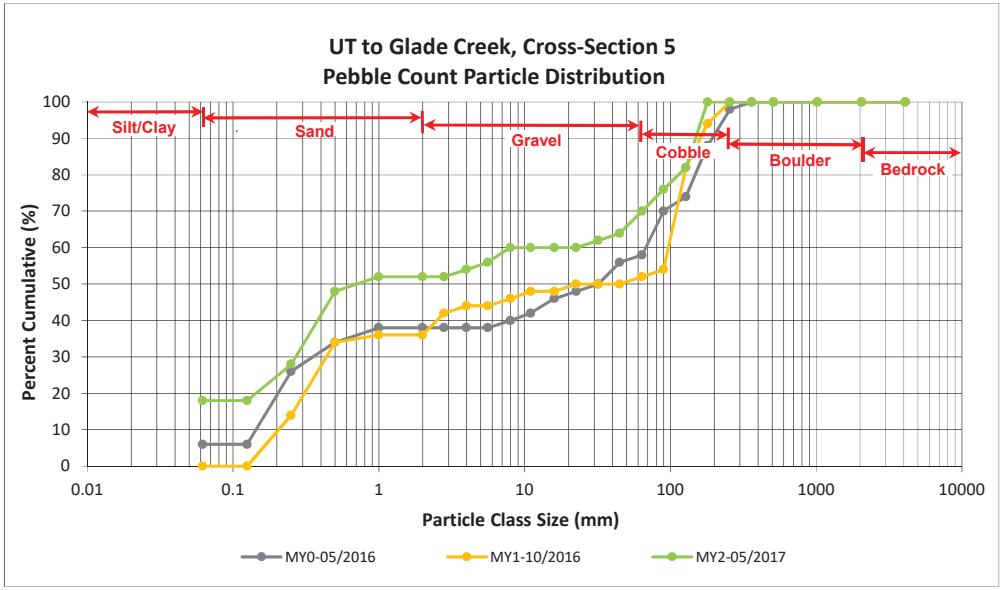
Reachwide and Cross-Section Pebble Count Plots

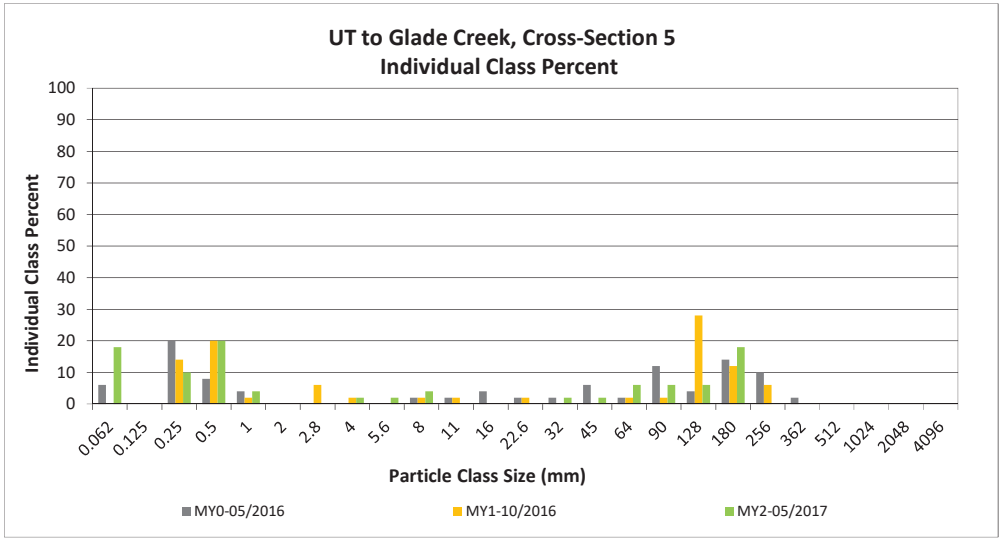
Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

UT to Glade Creek, Cross-Section 5

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	9	18	18
SAND	Very fine	0.062	0.125			18
	Fine	0.125	0.250	5	10	28
	Medium	0.25	0.50	10	20	48
	Coarse	0.5	1.0	2	4	52
	Very Coarse	1.0	2.0			52
GRAVEL	Very Fine	2.0	2.8			52
	Very Fine	2.8	4.0	1	2	54
	Fine	4.0	5.6	1	2	56
	Fine	5.6	8.0	2	4	60
	Medium	8.0	11.0			60
	Medium	11.0	16.0			60
	Coarse	16.0	22.6			60
	Coarse	22.6	32	1	2	62
	Very Coarse	32	45	1	2	64
	Very Coarse	45	64	3	6	70
COBBLE	Small	64	90	3	6	76
	Small	90	128	3	6	82
	Large	128	180	9	18	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**	**100**	**100**

Cross Section 5	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.3
D_{50} =	0.7
D_{84} =	132.9
D_{95} =	163.7
D_{100} =	180.0





APPENDIX 5. Hydrology Summary Data and Plots

Table 14. Verification of Bankfull Events

Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Glade Creek, UT

Reach	MY of Occurrence	Date of Occurrence	Date of Data Collection	Method
Glade Creek	MY1	6/27/2016	10/4/2016	Crest Gage
	MY2	10/9/2017	12/4/2017	Wrackline
UT	MY1	6/27/2016	10/4/2016	Crest Gage
	MY2	10/9/2017	12/5/2017	Wrackline

Table 15. Wetland Gage Attainment Summary

Glade Creek II Restoration Project
DMS Project No. 92343
Monitoring Year 2 - 2017

Summary of Groundwater Gage Results for MY2					
Gage	Success Criteria Achieved/Max Consecutive Days During Growing Season (%)				
	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)	Year 4 (2019)	Year 5 (2020)
1	Yes/127 Days (75.6%)	Yes/169 Days (100%)			

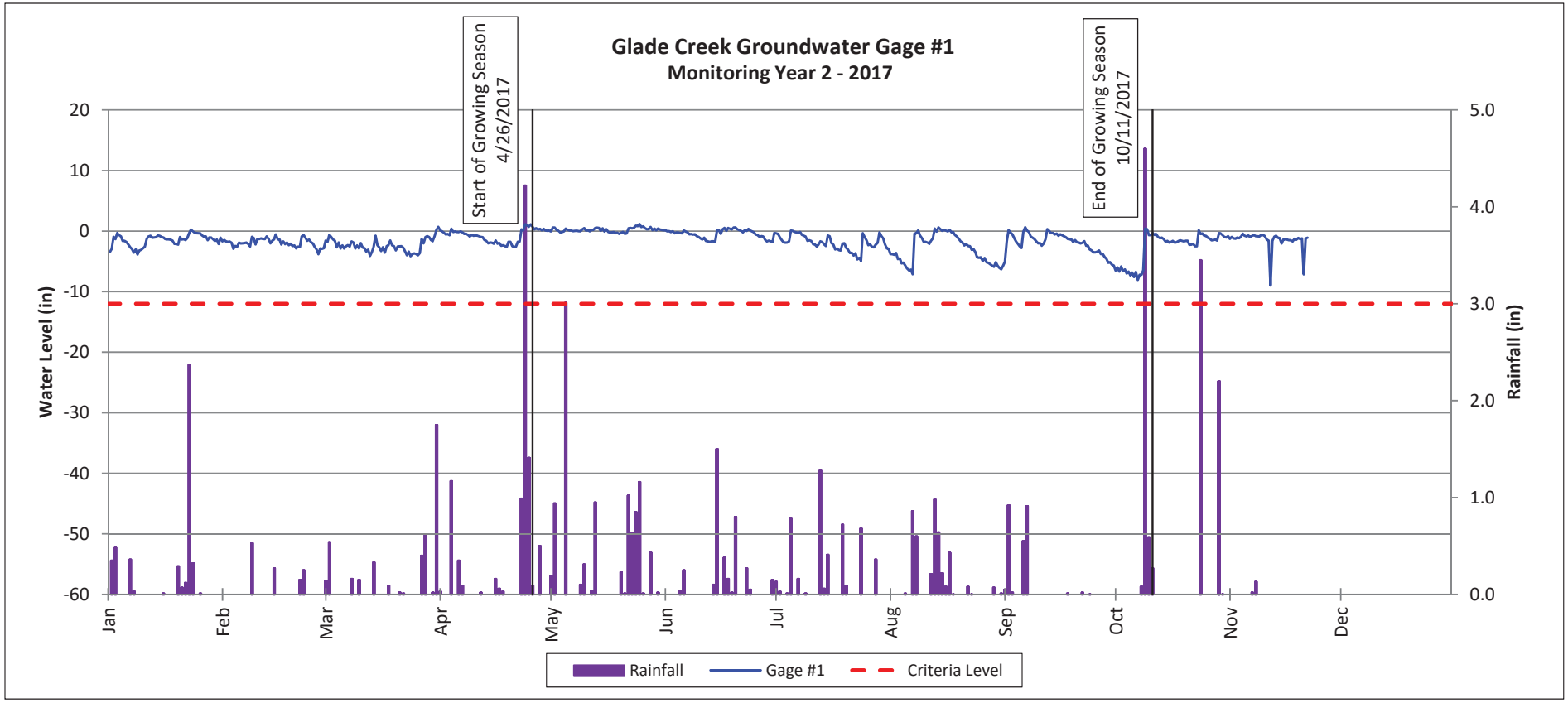
Wetland success criteria is 12.5% of growing season (21 consecutive days).

Groundwater Gage Plots

Glade Creek II Restoration Project (DMS Project No. 92343)

Monitoring Year 2 - 2017

Wetland D

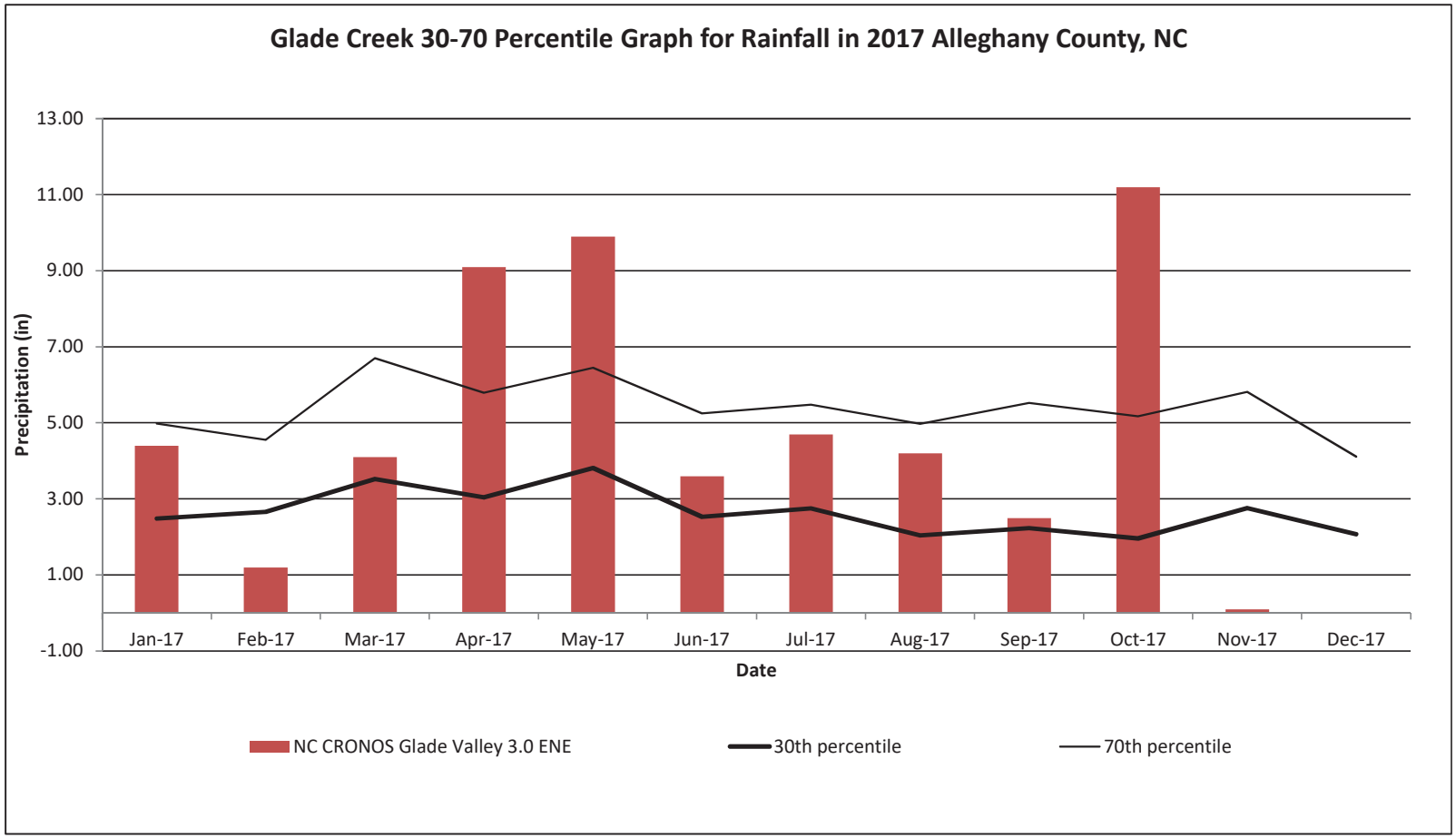


Monthly Rainfall Data

Glade Creek II Restoration Project

DMS Project No. 92343

Monitoring Year 2 - 2017



[1] 2017 rainfall collected from NC CRONOS Station Name: Glade Valley 3.0 ENE (NCSU, 2016)

[2] 30th and 70th percentile rainfall data collected from weather station Sparta, NC8158 (USDA, 2017)

[3] No onsite data available.