MONITORING YEAR 3 ANNUAL REPORT

Final

BUCKWATER MITIGATION SITE

Orange County, NC
NCDEQ Contract No. 006829
DMS Project Number 97084
USACE Action ID Number 2016-00873
NCDWR Project Number 2016-0406

Data Collection Period: January – November 2021
Draft Submission Date: November 29, 2021
Final Submission Date: December 13, 2021

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
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PREPARED BY:

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December 13, 2021

Jeremiah Dow
DMS Project Manager
North Carolina DEQ Division of Mitigation Services
217 West Jones Street, Raleigh, NC 27603

RE: Task 9 MY3 Monitoring Report - Buckwater Mitigation Site, DMS ID# 97084
Neuse River Basin – CU# 03020201
Orange County, North Carolina
Contract No. 006829

Dear Mr. Dow:

We have reviewed the comments on the Monitoring Year 3 Report for the above referenced project dated December 8, 2021 and have revised the report based on these comments. The revised documents are submitted with this letter. Below are responses to each of your comments. For your convenience, the comments are reprinted with our response in italics.

1. **Table 1 – Please update the EI total to be 1,715.334 and the total credits to be 12,621.934 (these are the numbers you get if you round to 3 decimal places in Excel and also match our database).**
   The correction has been made.

2. **Please include the assessed lengths on the visual assessment tables.**
   The assessed lengths have been added to the visual assessment tables.

3. **Please review cross-section calculations and ensure that the bankfull elevation based on as-built bankfull cross sectional area (BKF – ab) is accurate, and verify that all points outside of the main channel are excluded before identifying BKF – ab. For example, the BKF – ab value for XS 4 does not recreate the MY0 cross sectional area of 21.9.**
   The cross-section calculations have been reviewed and appropriate corrections have been made.

4. **In the buffer report, Section 1.2 says in the last paragraph that "In general, riparian buffer restoration widths extend 200 feet from the stream channels…" Please clarify since nearly the entire site is 100 feet or less.**
   The appropriate correction has been made.

5. **This project has a monitoring phase performance bond which must be approved and in place through MY4 before we can authorize you to invoice Task 9.**
   The performance bond has been requested.

6. **Please include a CVS mdb that will reproduce Table 10 in the buffer report.**

The CVS database for the buffer report has been included in the final submission. The database is created to comply with IRT regulations. Due to a difference in regulations between the IRT and DWR some manual editing was required to Table 10.

If you have any questions, please contact me by phone (919) 851-9986, or by email (jlorch@wildlandseng.com).
Sincerely,

Jason Lorch, *Monitoring Coordinator*

BUCKWATER MITIGATION SITE

Monitoring Year 3 Annual Report

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APPENDICES

Section 1: PROJECT OVERVIEW

The Buckwater Mitigation Site (Site) is located in central Orange County, approximately 4.5 miles northeast of Hillsborough, NC off of Walnut Hill Drive (Figure 1) and within the Falls Lake Water Supply Watershed and Neuse River Basin. Both the Neuse River and Falls Lake are designated as Nutrient Sensitive Waters. The Site streams drain to the Eno River and are within Hydrologic Unit Code (HUC) 03020201030030, which is a Targeted Local Watershed (TLW) (Figure 1). The Site lies in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The drainage area for the Site is 2,259 acres (3.53 square miles) and consists primarily of agricultural and forested land.

The project streams include Buckwater Creek and fourteen unnamed tributaries. Mitigation work within the Site includes restoration, enhancement I, and enhancement II of 16,276 linear feet of intermittent and perennial stream channels. The riparian areas were planted with native vegetation to improve habitat and protect water quality. The final Mitigation Plan (Wildlands, 2017) was submitted to and accepted by DMS in December 2017. Construction activities were completed by Ecotone, Inc. in April 2019. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in April 2019. Baseline monitoring (MY0) was conducted between January and April 2019. Annual monitoring will occur for seven years with the close-out anticipated to commence in 2026 provided success criteria are met. Appendix 1 provides additional details on project activity, history, contact information, and watershed background information for the Site.

The Site is located on eleven parcels under nine different landowners. A conservation easement was recorded on 51.84 acres. The project is expected to provide 12,621.934 stream credits at closeout. A project vicinity map and directions are provided in Figure 1, and project components/assets are illustrated in Figure 2.

1.1 Project Goals and Objectives

Prior to construction activities, the primary causes of Site degradation were stream channelization and livestock grazing, both of which originated prior to 1938. Agricultural activity remained intensive through the 1990s with several thousand beef cattle and three hog houses. Currently, approximately 130 cows graze on three properties and non-forested land is used for cultivating hay. Several ponds along Buckwater Creek, T3, and T5 were built between 1938 and 1955. According to 1955 aerial photography, the top 1,000 feet of Buckwater Creek on the Site were channelized. Landowners maintained lower Buckwater Creek below Walnut Hill Drive as a straightened channel until the 1990s. Table 4 in Appendix 1 and Tables 10a through 10c in Appendix 4 present the pre-restoration conditions data.

The project is intended to provide numerous ecological benefits. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. The table below describes expected outcomes to water quality and ecological processes and provides project goals and objectives. The project goals and objectives were developed as part of the Mitigation Plan (Wildlands, 2017) considering the goals and objectives listed in the Neuse River RBRP plan and strive to maximize ecological and water quality uplift within the watershed.

Goals	Objectives	Expected Outcomes
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels for bankfull dimensions and depth relative to the existing floodplain.	Raise water table and hydrate riparian wetlands. Allow more frequent flood flows to disperse on the floodplain. Support geomorphology and higher level functions.
Improve the stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Significantly reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary. Support all stream functions above hydrology.
Exclude cattle from project streams.	Install fencing around conservation easements adjacent to cattle pastures.	Reduce and control sediment inputs; reduce and manage nutrient inputs; reduce and manage fecal coliform inputs. Contribute to protection of or improvement to a Water Supply Waterbody. Support Falls Lake recovery plan.
Improve instream habitat.	Install habitat features such as constructed riffles, cover/lunker logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.	Increase and diversify available habitats for macroinvertebrates, fish, and amphibians leading to colonization and increase in biodiversity over time. Add complexity including LWD to streams.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zone and plant appropriate species on streambank.	Reduce sediment inputs from bank erosion and runoff. Increase nutrient cycling and storage in floodplain. Provide riparian habitat. Add a source of LWD and organic material to stream. Support all stream functions.
Permanently protect the Site from harmful uses.	Establish conservation easements on the Site.	Protect Site from encroachment on the riparian corridor and direct impact to streams and wetlands. Support all stream functions.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring and site visits were conducted during MY3 to assess the condition of the project. The vegetation and stream success criteria for the Site were presented in the approved Mitigation Plan (Wildlands, 2017).

1.2.1 Vegetative Assessment

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., 2008). During the baseline monitoring, 19 vegetation plots, measuring 10-meters by 10-meters, were established.

The final vegetation success criteria at the end of MY7 is the survival of 210 planted stems per acre averaging 10 feet in height. Interim success criteria are the survival of 320 planted stems per acre at the end of MY3 and 260 planted stems per acre with an average stem height of 7 feet at the end of MY5.

The MY3 vegetative survey was completed in October 2021 which included replanted stems from February 2021 on 10.7 acres of the Site. While the replanted stems will not be counted towards the planted stems density until two years after planting, they are shown in a separate column, labeled MY 3

R, in Table 9 of Appendix 3 to show the replant effectiveness. Without the replanted stems (shown Table 9 column labeled 'MY0 P'), 9 out of 19 vegetation plots have met the MY3 interim success criteria of 320 planted stems per acre. Vegetation monitoring resulted in an average stem density of 322 planted stems per acre. However, when including the replanting, 17 out of 19 vegetation plots have met the MY3 interim success criteria. Replanting resulted in an average stem density of 481 planted stems per acre. Vegetation Plots 8 and 18, the two plots that did not meet MY3 interim success criteria, are still able to meet the final success criteria of 210 planted stems per acres. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

An Adaptive Management Plan (Appendix 6) was submitted to the North Carolina Interagency Review Team (IRT) on December 7, 2020 to address the tree mortality and low vegetative growth areas seen during MY2. The document details contributing factors to the high mortality rate, specific trees and quantities to be planted, and a course of action to prevent future tree loss.

A component of the Adaptive Management Plan was replanting 10.7 acres (Figure 3a-e) across the Site. Replanting and soil amendments occurred in February 2021, while ring sprays followed in March 2021. The replanting was successful overall, except on two small areas along T4 and T7 around vegetation plot 11 and 18, respectively. These areas are too small to meet the 0.1-acre mapping threshold for low stem density; however, Wildlands during MY4 will do a follow up ring spray treatment to reduce the herbaceous competition. Soil amendments were also added to the 1.4-acre area of low vegetative growth identified during MY2 along T5 (upstream of St. Mary's Rd) and T6 (Figure 3e CCPV). The soil amendments greatly improved the herbaceous layer during MY3 (see Appendix 2 Vegetation Area of Concern Photographs).

1.2.3 Stream Assessment

Morphological surveys for MY3 were conducted in May 2021. All streams within the Site are stable and functioning as designed. All but one of the 36 cross-sections show little to no change in the bankfull area and width-to-depth ratio, and bank height ratios are less than 1.2. Cross-section 34 on T7A shows some aggradation in the pool, but the riffle (cross-section 33) is not aggrading. T7A is stable and functioning as designed, and the sediment source is believed to be coming from outside the conservation easement. Substrate measurements indicate the maintenance of coarser materials in the riffle reaches and finer particles in the pools. Longitudinal profile surveys are not required on the project unless visual inspection indicates reach wide vertical instability. Refer to Appendix 2 for the visual stability assessment table, CCPV maps, and stream photographs. Refer to Appendix 4 for the morphological data and plots.

1.2.4 Stream Areas of Concern

No stream areas of concern were identified during MY3.

1.2.5 Hydrology Assessment

By the end of MY7, two or more bankfull events must have occurred in separate years within the restoration reaches. Also, two geomorphically significant events must be documented during the monitoring period. Bankfull or gemorphically significant events were recorded on Buckwater Creek Reach 6, T4, and T5 (upstream and downstream of St. Mary's Road), and T7 Reach 3. Due to gauge freezing during the winter of MY3, T1 Reach 2 and T2 had no discernable bankfull events. Buckwater Creek Reach 6, T4, and T5 (upstream and downstream of St. Mary's Road) and T7 Reach 3 are on track to

fulfill the bankfull hydrologic requirement. T1 Reach 2 and T2 are expected to fulfill the bankfull hydrologic requirement in future monitoring years.

In addition, the presence of baseflow must be documented on restored intermittent reaches (T4A, T4B, T6, T7 Reach 2, T7A, and T8) for a minimum of 30 consecutive days during a normal precipitation year. In-stream flow gages equipped with pressure transducers were installed to monitor continuity of baseflow. All reaches maintained baseflow as expected for intermittent streams with maximum consecutive days ranging from 52 to 250. Refer to Appendix 5 for hydrologic data.

1.2.6 Wetland Assessment

Three groundwater gauges were installed and monitored within the existing wetlands zones. All gauges were installed at locations requested by NCDWR and were downloaded and maintained quarterly. The purpose of these gauges is to assess potential effects to wetland hydrology from the construction of restored stream channels through these areas. The results of this monitoring are not tied to any success criteria. The measured hydroperiod ranged from 3.1% to 43% of the growing season consecutively. Per the Mitigation Plan (Wildlands, 2017) selected wetlands will be redelineated during MY4 or MY5. Refer to Appendix 5 for wetland data.

1.2.7 Adaptive Management Plan

No management plan was identified at this time. The low stem density areas identified during MY2 and replanted during MY3 will continued to be monitored to ensure no excessive tree mortality occurs.

1.3 Monitoring Year 3 Summary

Replanting and soil amendments occurred in February 2021 on 10.7 acres across the Site. Ring sprays occurred in March 2021. With the replanted stems, 17 out of the 19 vegetation plots met the MY3 interim requirement of 320 planted stems per acre. However, without the replanted stems, 9 vegetation plots would have met. Overall, the replanting is considered a success, but Wildlands will continue to monitor the vegetation and address areas of concern, as needed. The 1.4-acres of low vegetative growth identified in MY2 along upper T5 received soil amendments and is looking healthy. All streams within the Site are stable and functioning as designed. Bankfull or geomorphically significant events were documented on Buckwater Creek Reach 6, T4, and T5 (upstream and downstream of St. Mary's Road) and T7 Reach 3 during MY3. Due to gauge freezing, T1 Reach 2 and T2 had no discernable bankfull events. Greater than 30 days of consecutive flow were recorded on all intermittent reaches with flow gauges.

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 (Wildlands, 2017) 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 Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gages and pressure transducers were installed in riffle cross-sections and monitored throughout the year. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers standards (USACE, 2003). Vegetation monitoring protocols followed the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 3: REFERENCES

Breeding, R. 2010. Neuse River Basin Restoration Priorities 2010. NCEEP, 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, C.C., Rawlins, C.L., Potyondy, J.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, M.T., Peet, R.K., S.D., Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf.

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.

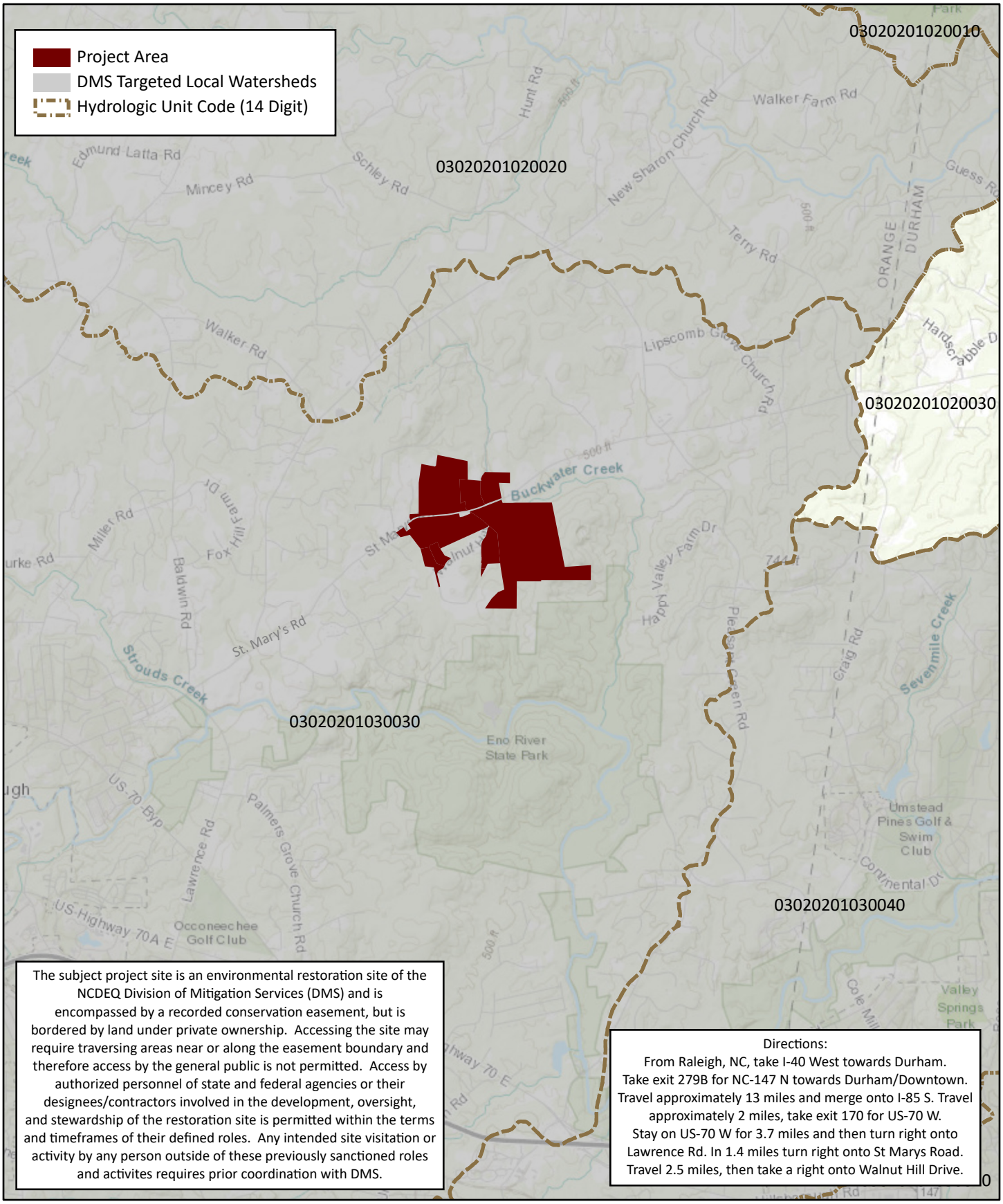
Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. Center For Computational Hydroscience and Bioengineering, Oxford Campus, University of Mississippi, Pages 12-22.

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

United States Geological Survey. 1998. North Carolina Geology. http://www.geology.enr.state.nc.us/usgs/carolina.htm

Wildlands Engineering, Inc. 2017. Buckwater Mitigation Project Mitigation Plan. DMS, Raleigh, NC.

APPENDIX 1. General Figures and Tables



The subject project site is an environmental restoration site of the NCDEQ 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.

Directions:
From Raleigh, NC, take I-40 West towards Durham. Take exit 279B for NC-147 N towards Durham/Downtown. Travel approximately 13 miles and merge onto I-85 S. Travel approximately 2 miles, take exit 170 for US-70 W. Stay on US-70 W for 3.7 miles and then turn right onto Lawrence Rd. In 1.4 miles turn right onto St Marys Road. Travel 2.5 miles, then take a right onto Walnut Hill Drive.

WILDLANDS ENGINEERING

0 0.5 1 Miles

N

Figure 1. Project Vicinity Map
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021
Orange County, NC

WILDLANDS ENGINEERING

0 400 800 Feet

N

Figure 2. Project Component / Asset Map
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC

Table 1. Mitigation Assets and Components
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

PROJECT COMPONENTS								
Reach ID	**Existing Footage**	**Mitigation Plan Footage**	**Mitigation Category**	**Restoration Level**	**Priority Level**	**Mitigation Ratio (X:1)**	**As-Built Footage**	**Comments**
STREAMS								
Buckwater Reach 1	445	445	Warm	EII	N/A	2.5	433	Grade Control Structures, Bank Repair, Conservation Easement
Buckwater Reach 2	160	160	Warm	EI	P3	1.5	162	Grade Control Structures, Bank Repair, Planted Buffer
Buckwater Reach 3	232	232	Warm	EI	P1.5*	1.5	232	Grade Control Structures, Bank Repair, Planted Buffer
Buckwater Reach 4	2,282	2,067	Warm	R	P1	1.0	2,071	Full Channel Restoration, Planted Buffer, Invasive Control
		30				0.0	29	Utility Crossing
		206	Warm	R	P1	1.0	209	Full Channel Restoration, Planted Buffer
		72				0.0	70	Road Crossing
		194	Warm	R	P1	1.0	198	Full Channel Restoration, Planted Buffer
Buckwater Reach 5	435	486	Warm	R	P1.5*	1.0	485	Full Channel Restoration, Planted Buffer, Invasive Control
Buckwater Reach 6	884	379	Warm	R	P1.5*	1.0	363	Full Channel Restoration, Planted Buffer, Invasive Control
		118				0.0	30	Utility Crossing
Buckwater Reach 7	941	43				0.0	132	Utility Crossing
		891	Warm	EII	N/A	2.5	885	Grade Control Structures, Bank Repair, Enhancement Work Was Completed Beyond The Limits Of The Conservation Easement
Buckwater Reach 8	178	188	Warm	EII	N/A	2.5	185	Bank Repair, Conservation Easement
T1 Reach 1	501	366	Warm	EI	P1.5*	1.5	375	Grade Control Structures, Planted Buffer
		119				0.0	0	Road Crossing
T1 Reach 2	572	123				0.0	244	Utility Crossing
		485	Warm	R	P1	1.0	477	Full Channel Restoration, Planted Buffer
		25				0.0	43	Utility Crossing
T2	548	587	Warm	R	P1	1.0	592	Full Channel Restoration, Planted Buffer
T3 Reach 1	1,303	1,101	Warm	EII	N/A	2.5	1,107	Livestock Exclusion, Grade Control Strucres, Planted Buffer
		30				0.0	29	Road Crossing
		166	Warm	EII	N/A	2.5	167	Livestock Exclusion, Grade Control Structures, Planted Buffer
T3 Reach 2	877	658	Warm	R	P1	1.0	665	Full Channel Restoration, Planted Buffer, Livestock Exclusion
		63					93	Road Crossing
		193	Warm	R	P1	1.0	197	Full Channel Restoration, Planted Buffer, Livestock Exclusion
T4	1,081	961	Warm	R	P1	1.0	956	Full Channel Restoration, Planted Buffer
T4A Reach 1	312	311	Warm	R	P1	1.0	327	Farm Pond Drained, Full Channel Restoration, Planted Buffer
T4A Reach 2	259	175	Warm	EII	N/A	2.5	155	Livestock Exclusion, Grade Control Structures, Conservation Easement
		72				0.0	75	Road Crossing
T4A Reach 3	145	201	Warm	R	P1	1.0	208	Full Channel Restoration, Planted Buffer
		64				0.0	66	Road Crossing
T4B Reach 1	419	345	Warm	R	P1	1.0	346	Full Channel Restoration, Livestock Exclusion
T5	1,291	548	Warm	R	P1	1.0	554	Full Channel Restoration, Planted Buffer, Invasive Control
		167				0.0	0	Road Crossing
		711	Warm	R	P1	1.0	722	Full Channel Restoration, Planted Buffer, Farm Pond Drained
T6 Reach 1	697	695	Warm	EII	N/A	2.5	697	Invasive Control, Bank Repair, Conservation Easement
T6 Reach 2	492	458	Warm	EII	N/A	2.5	458	Invasive Control, Bank Repair, Conservation Easement
		30				0.0	30	Road Crossing
T6 Reach 3	704	620	Warm	EI	P1 & P1.5*	1.5	623	Grade Control Structures, Planted Buffer, Invasive Control
T6A	324	311	Warm	EII	N/A	2.5	313	Grade Control Structures, Bank Repair, Conservation Easement
T6B	136	136	Warm	EII	N/A	2.5	136	Grade Control Structures, Bank Repair, Conservation Easement
T7 Reach 1	317	322	Warm	EI	P1.5*	1.5	320	Grade Control Structures, Planted Buffer
T7 Reach 2	323	363	Warm	R	P1	1.0	367	Full Channel Restoration, Planted Buffer
T7 Reach 3	368	356	Warm	R	P2	1.0	357	Full Channel Restoration, Planted Buffer
T7A	227	242	Warm	EI	P1	1.5	240	Grade Control Structures, Planted Buffer
T8	620	631	Warm	EI	P1	1.5	621	Grade Control Structures, Planted Buffer
T9	73	73	Warm	EII	N/A	2.5	73	Grade Control Structures, Conservation Easement

*Priority 1.5 refers to a combination of Priority 1 and Priority 2 where the existing channel was raised and the floodplain was graded.

PROJECT CREDITS							
Restoration Level	**Stream**			**Riparian Wetland**		**Non-Riparian Wetland**	**Coastal Marsh**
	Warm	**Cool**	**Cold**	**Riverine**	**Non-Riverine**		
Restoration	9,051.000						
Enhancement I	1,715.334						
Enhancement II	1,855.600						
Preservation							
Re-Establishment							
Rehabilitation							
Enhancement							
Creation							
Totals	**12,621.934**						

Table 2. Project Activity and Reporting History

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		December 2017	December 2017
Final Design - Construction Plans		April 2018	April 2018
Construction		April 2018-April 2019	April 2019
Temporary S&E mix applied to entire project area [1]		April 2018-April 2019	April 2019
Permanent seed mix applied to reach/segments [1]		April 2018-April 2019	April 2019
Bare root and live stake plantings for reach/segments		April 2019	April 2019
Baseline Monitoring Document (Year 0)	Stream Survey	April 2019	July 2019
	Vegetation Survey	April 2019	
In-stream Repairs			August 2019
Invasive Treatment			October 2019
Year 1 Monitoring	Stream Survey	October 2019	December 2019
	Vegetation Survey	October 2019	
Stream Bank Repairs			April 2020
Soil Amendments			August 2020
In-stream Vegetation Treatment			August 2020
Year 2 Monitoring	Stream Survey	April 2020	December 2020
	Vegetation Survey	September 2020	
Replanting & Soil Amendments			February 2021
Ring Sprays			March 2021
Year 3 Monitoring	Stream Survey	May 2021	December 2021
	Vegetation Survey	October 2021	
Year 4 Monitoring			December 2022
Year 5 Monitoring	Stream Survey	2023	December 2023
	Vegetation Survey	2023	
Year 6 Monitoring			December 2024
Year 7 Monitoring	Stream Survey	2025	December 2025
	Vegetation Survey	2025	

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

Table 3. Project Contact Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Designer Nicole Macaluso, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Ecotone, Inc** 2120 High Point Rd Forest Hill, MD 21050
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Ecotone, Inc** 2120 High Point Rd Forest Hill, MD 21050
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers Bare Roots	**Dykes and Sons Nursery and Greenhouse**
Live Stakes	**Bruton Natural Systems, Inc**
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

Table 4. Project Information and Attributes

Buckwater Mitigation Site

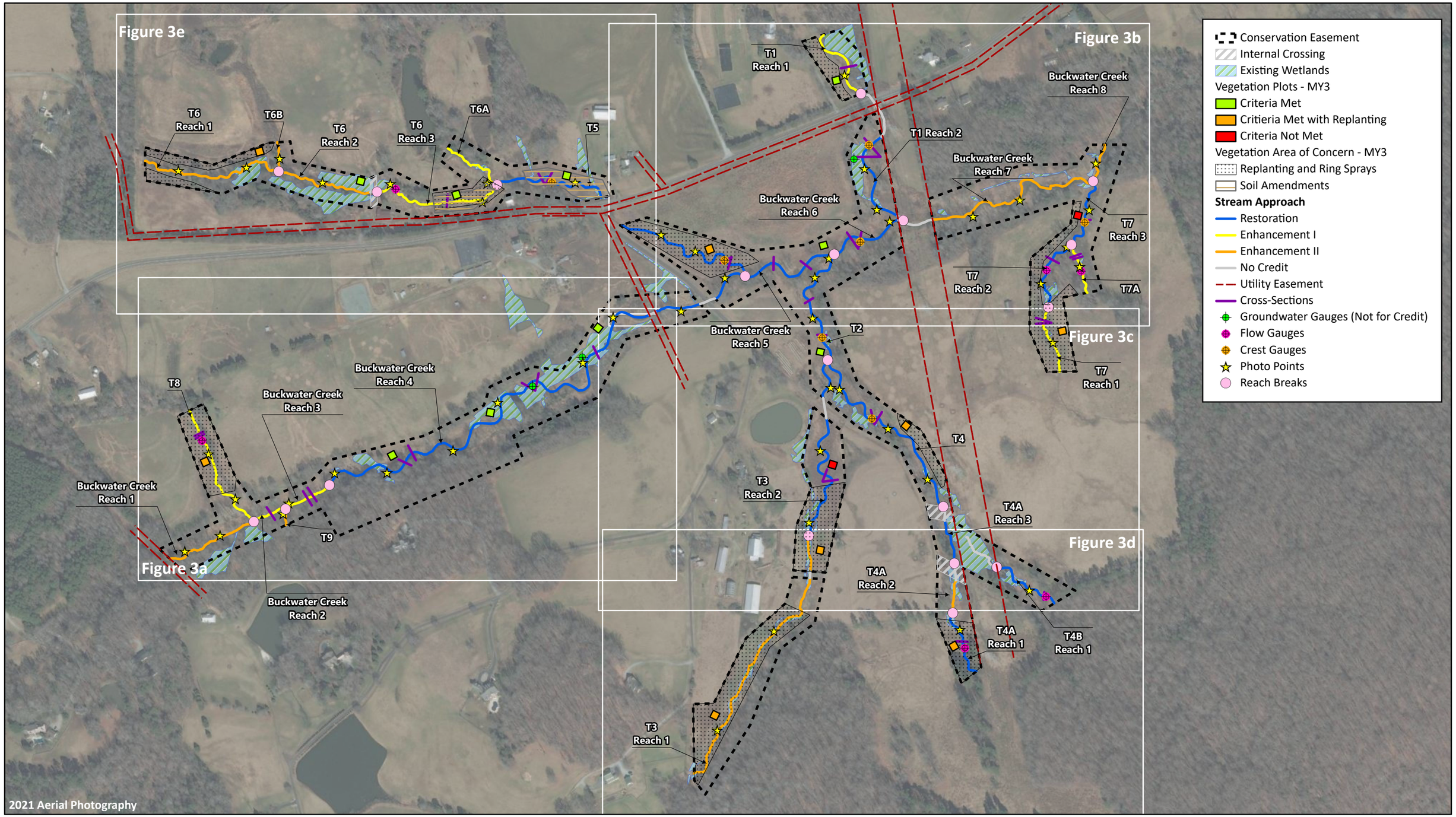
DMS Project No. 97084

Monitoring Year 3 - 2021

PROJECT INFORMATION							
Project Name	Buckwater Mitigation Site						
County	Orange County						
Project Coordinates (latitude and longitude)	36° 6′ 23.49″ N, 79° 1′ 29.11″ W						
Project Area (acres)	51.84						
Planted Acerage (acres of woody stems planted)	23.60						
PROJECT WATERSHED SUMMARY INFORMATION							
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province						
River Basin	Neuse River						
USGS Hydrologic Unit 8-digit	03020201						
USGS Hydrologic Unit 14-digit	03020201030030						
DWR Sub-basin	03-04-01						
Project Drainiage Area (acres)	2,259						
Project Drainage Area Percentage of Impervious Area	3.9%						
CGIA Land Use Classification	63.9% forested, 32.1% cultivated, 3.9% impervious						
Reaches	**Buckwater**	**T1**	**T2 & T3**	**T4, T4A, & T4B**	**T5 & T6**	**T7 & T7A**	**T8**
Length of Reach (linear feet) - Post-Restoration	5,223	852	2,728	1,992	3,054	1,284	621
Drainage Area (acres)	2,259	1,216	218	77	109	28	21
NCDWR Stream Identification Score	42	37.5	42	40.5	60	30	30.5
NCDWR Water Quality Classification	WS-IV						
Morphological Desription (stream type)	Perennial	Perennial	Perennial	Intermittent	Intermittent	Intermittent	Intermittent
Evolutionary Trend (Simon's Model) - Pre-Restoration	V - Aggradation and Widening		IV- Degradation and Widening				
Underlying Mapped Soils	Appling-Helena, Chewacla loam, Herndon Tarrus Series						
Drainage Class	-			-			
Soil Hydric Status	-			-			
Slope	-			-			
FEMA Classification	Zone AE		Buckwater Floodplain Fringe			N/A	
Native Vegetation Community	Piedmont Bottomland Forest						
Percent Composition Exotic Invasive Vegetation - Post-Restoration	0%						

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. 4134.
Waters of the United States - Section 401	Yes	Yes	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	Yes	Yes	Buckwater Mitigation Plan; Wildlands determined "no effect" on Orange County listed endangered species. The USFWS responded on May 5, 2016 stating that "the proposed action is not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act."
Historic Preservation Act	Yes	Yes	Correspondence from SHPO on May 6, 2016 stated the project would "have no effect on the archaeological potential of the Saint Mary's Road Rural Historic District" and the project "will not adversely affect" the Saint Mary's Road Rural Historic District nor the adjacent Holden-Roberts Farm (OR0673).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	Yes	Yes	A CLOMR was approved prior to the start of construction, as well as local floodplain development permit. A LOMR was approved by the State Floodplain Mapping Program on September 11, 2020.
Essential Fisheries Habitat	N/A	N/A	N/A

APPENDIX 2. Visual Assessment Data



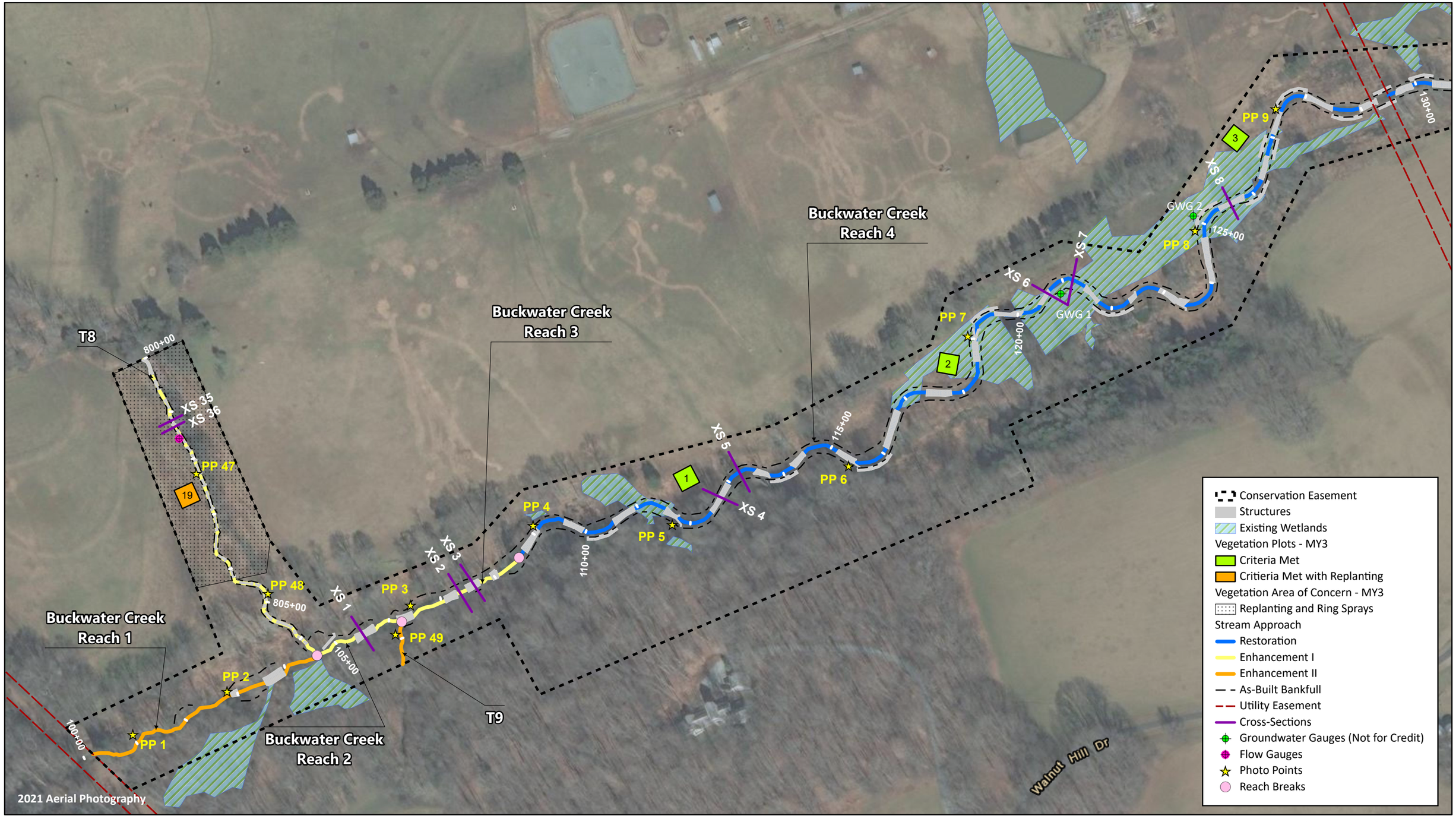
WILDLANDS ENGINEERING

0 400 800 Feet

N

Figure 3. Integrated Current Condition Plan View Key
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3a. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC

Conservation Easement
Structures
Existing Wetlands
Vegetation Plots - MY3
Criteria Met
Critieria Met with Replanting
Criteria Not Met
Vegetation Area of Concern - MY3
Replanting and Ring Sprays
Soil Amendments

Stream Approach
Restoration
Enhancement I
Enhancement II
As-Built Bankfull
Utility Easement
Cross-Sections
Groundwater Gauges (Not for Credit)
Crest Gauges
Flow Gauges
Photo Points
Reach Breaks

T1 Reach 1
T1 Reach 2
T2
T7 Reach 3
T7 Reach 2
T7A
Buckwater Creek Reach 5
Buckwater Creek Reach 6
Buckwater Creek Reach 7
Buckwater Creek Reach 8
St Marys Rd
Stagg Rd
Walnut Hill Dr
4506
4414
4398
133
200+00
210+00
140+00
135+00
130+00
150+00
145+00
155+00
710+00
705+00
750+00
325+00
PP 9
PP 10
PP 11
PP 12
PP 13
PP 14
PP 15
PP 16
PP 17
PP 18
PP 19
PP 25
PP 26
PP 40
PP 41
PP 43
PP 44
PP 45
PP 46
XS 6
XS 10
XS 11
XS 12
XS 13
XS 14
XS 15
XS 19
XS 27
XS 28
XS 29
XS 30
XS 31
XS 32
XS 33
XS 34
GWG 3
3
4
5
16
18
2021 Aerial Photography

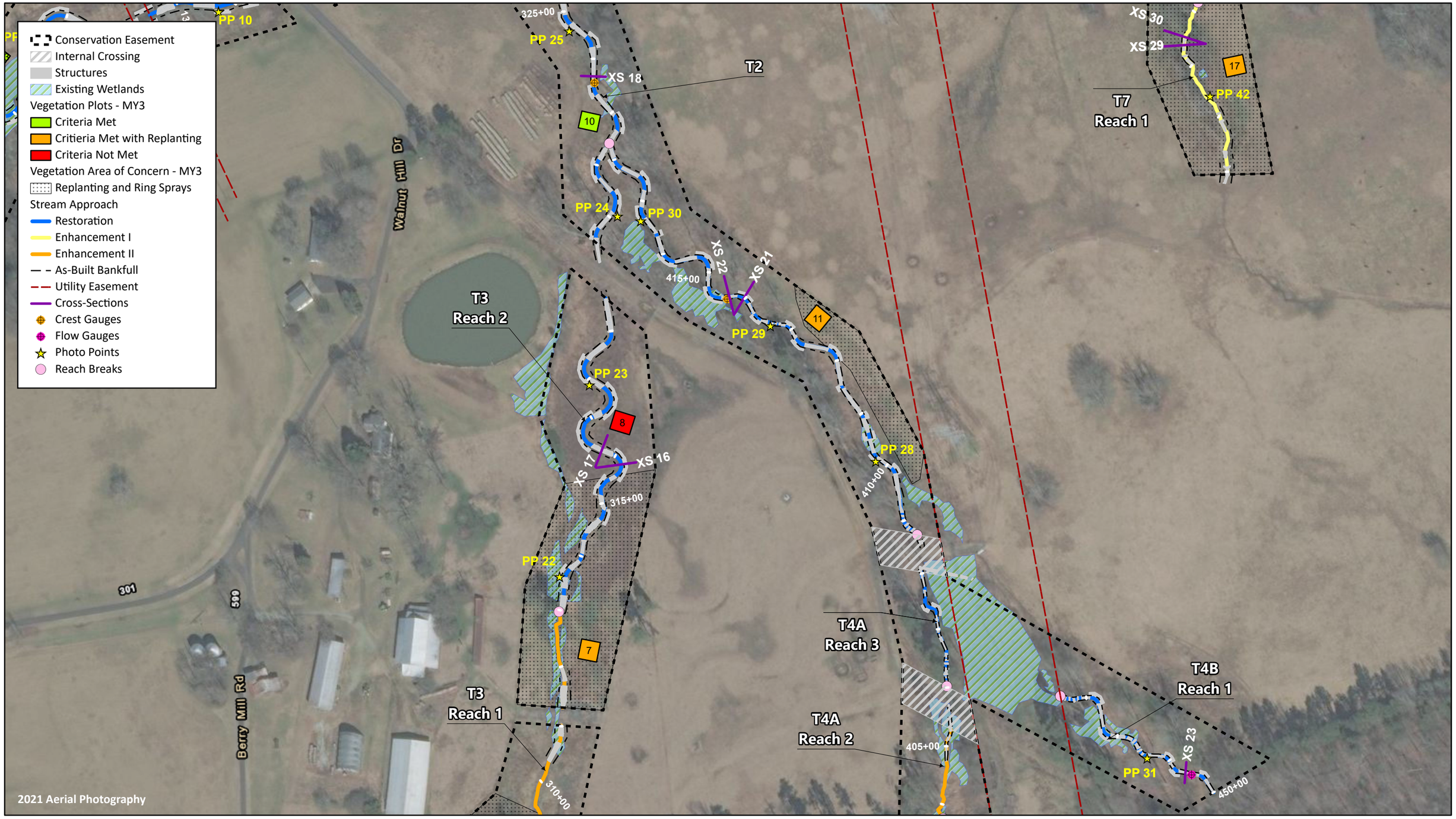
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3b. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC



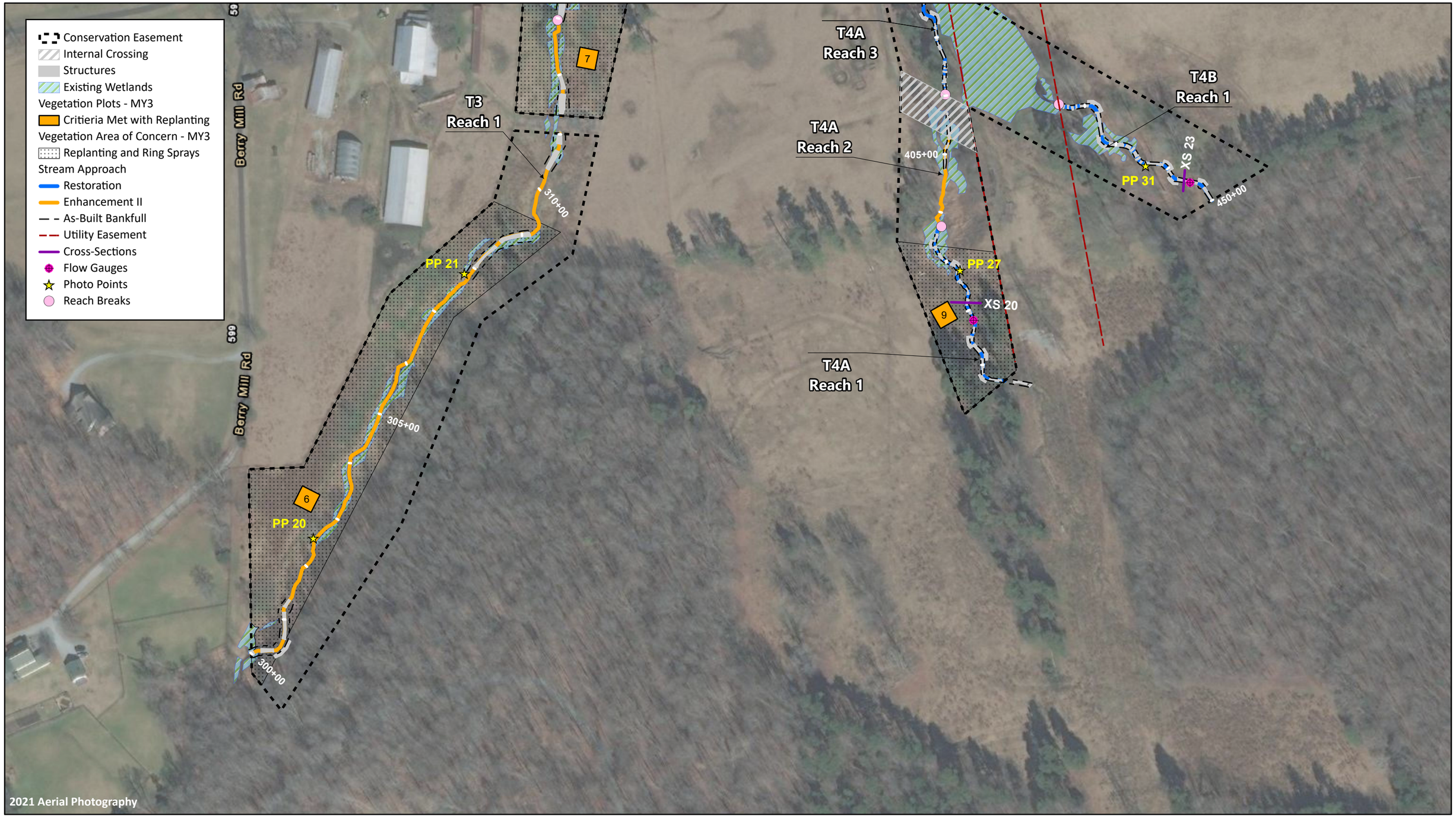
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3c. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC



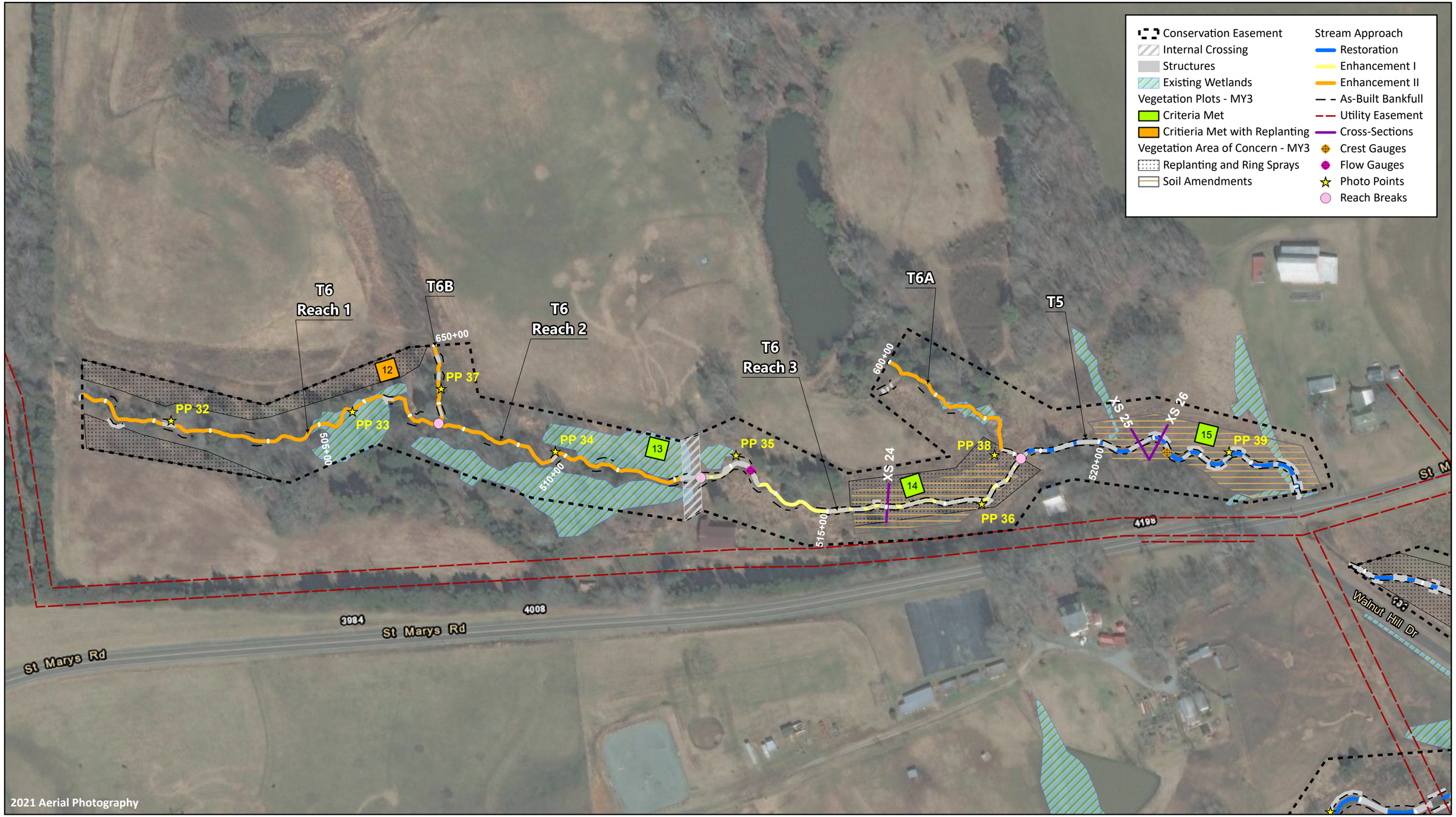
WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3d. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC



WILDLANDS ENGINEERING

0 150 300 Feet

N

Figure 3e. Integrated Current Condition Plan View
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Orange County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Reach 2/3 - 394 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.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, caving, or collapse.			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	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%.	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	0	0			N/A			

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

Table 5b. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Reach 4 - 2,478 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	27	27			100%			
	3. Meander Pool Condition	Depth Sufficient	25	25			100%			
		Length Appropriate	25	25			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	27	27			100%			
		Thalweg centering at downstream of meander bend (Glide)	25	25			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.	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%.	11	11			100%			
	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 5c. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Reach 5/6 - 848 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	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, 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.	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%.	8	8			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	8	8			100%			

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

Table 5d. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T1 - 852 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	14	14			100%			
		Length Appropriate	14	14			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	15	15			100%			
		Thalweg centering at downstream of meander bend (Glide)	14	14			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, 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.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	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 5e. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T2/T3 - 2,728 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	25	25			100%			
	3. Meander Pool Condition	Depth Sufficient	23	23			100%			
		Length Appropriate	23	23			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	25	25			100%			
		Thalweg centering at downstream of meander bend (Glide)	23	23			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.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	17	17			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	17	17			100%			

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

Table 5f. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T4/T4A - 1,646 LF

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	41	41			100%			
	3. Meander Pool Condition	Depth Sufficient	37	37			100%			
		Length Appropriate	37	37			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	41	41			100%			
		Thalweg centering at downstream of meander bend (Glide)	37	37			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.	3	3			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	23	23			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	23	23			100%			

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

Table 5g. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T4B - 346 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	9	9			100%			
		Length Appropriate	9	9			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	9	9			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, 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.	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%.	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 5h. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T5/T6 - 3,054 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	40	40			100%			
	3. Meander Pool Condition	Depth Sufficient	37	37			100%			
		Length Appropriate	37	37			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	40	40			100%			
		Thalweg centering at downstream of meander bend (Glide)	37	37			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.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	13	13			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	13	13			100%			

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

Table 5i Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T7 - 1,044 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	40	40			100%			
	3. Meander Pool Condition	Depth Sufficient	35	35			100%			
		Length Appropriate	35	35			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	40	40			100%			
		Thalweg centering at downstream of meander bend (Glide)	35	35			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.	5	5			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	20	20			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	20	20			100%			

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

Table 5j. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T7A - 240 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)	10	10			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, 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.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	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 5k. Visual Stream Morphology Stability Assessment Table
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

T8 - 621 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	25	25			100%			
	3. Meander Pool Condition	Depth Sufficient	24	24			100%			
		Length Appropriate	24	24			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	25	25			100%			
		Thalweg centering at downstream of meander bend (Glide)	24	24			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.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	6	6			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

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

Table 6. Vegetation Condition Assessment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Planted Acreage **23.60**

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

Easement Acreage **51.84**

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

STREAM PHOTOGRAPHS

	
PHOTO POINT 1 Buckwater R1 – upstream *(4/9/2021)*	**PHOTO POINT 1 Buckwater R1 – downstream *(4/9/2021)***
	
PHOTO POINT 2 Buckwater R1 – upstream *(4/9/2021)*	**PHOTO POINT 2 Buckwater R1 – downstream *(4/9/2021)***
	
PHOTO POINT 3 Buckwater R3 – upstream *(4/9/2021)*	**PHOTO POINT 3 Buckwater R3 – downstream *(4/9/2021)***

PHOTO POINT 4 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 4 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 5 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 5 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 6 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 6 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 7 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 7 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 8 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 8 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 9 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 9 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 10 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 10 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 11 Buckwater R4 – upstream *(4/9/2021)*

PHOTO POINT 11 Buckwater R4 – downstream *(4/9/2021)*

PHOTO POINT 12 Buckwater R5 – upstream *(4/9/2021)*

PHOTO POINT 12 Buckwater R5 – downstream *(4/9/2021)*

PHOTO POINT 13 Buckwater R6 – upstream *(4/9/2021)*

PHOTO POINT 13 Buckwater R6 – downstream *(4/9/2021)*

PHOTO POINT 14 Buckwater R7 – upstream *(4/9/2021)*

PHOTO POINT 14 Buckwater R7 – downstream *(4/9/2021)*

PHOTO POINT 15 Buckwater R7 – upstream *(4/9/2021)*

PHOTO POINT 15 Buckwater R7 – downstream *(4/9/2021)*

PHOTO POINT 16 Buckwater R8 – upstream *(4/9/2021)*

PHOTO POINT 16 Buckwater R8 – downstream *(4/9/2021)*

PHOTO POINT 17 T1 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 17 T1 Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 18 T1 Reach 2 – upstream *(4/9/2021)*

PHOTO POINT 18 T1 Reach 2 – downstream *(4/9/2021)*

PHOTO POINT 19 T1 Reach 2 – upstream *(4/9/2021)*

PHOTO POINT 19 T1 Reach 2 – downstream *(4/9/2021)*

PHOTO POINT 20 T3 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 20 T3 Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 21 T3 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 21 T3 Reach 1 – downstream *(4/9/2021)*

	
PHOTO POINT 22 T3 Reach 2 – upstream *(4/9/2021)*	**PHOTO POINT 22 T3 Reach 2 – downstream *(4/9/2021)***
	
PHOTO POINT 23 T3 Reach 2 – upstream *(4/9/2021)*	**PHOTO POINT 23 T3 Reach 2 – downstream *(4/9/2021)***
	
PHOTO POINT 24 T3 – upstream *(4/9/2021)*	**PHOTO POINT 24 T3 – downstream *(4/9/2021)***

	
PHOTO POINT 25 T2 – upstream *(4/9/2021)*	**PHOTO POINT 25 T2 – downstream *(4/9/2021)***
	
PHOTO POINT 26 T2 – upstream *(4/9/2021)*	**PHOTO POINT 26 T2 – downstream *(4/9/2021)***
	
PHOTO POINT 27 T4A Reach 1 – upstream *(4/9/2021)*	**PHOTO POINT 27 T4A Reach 1 – downstream *(4/9/2021)***

	
PHOTO POINT 28 T4 – upstream *(4/9/2021)*	**PHOTO POINT 28 T4 – downstream *(4/9/2021)***
	
PHOTO POINT 29 T4 – upstream *(4/9/2021)*	**PHOTO POINT 29 T4 – downstream *(4/9/2021)***
	
PHOTO POINT 30 T4 – upstream *(4/9/2021)*	**PHOTO POINT 30 T4 – downstream *(4/9/2021)***

PHOTO POINT 31 T4B Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 31 T4B Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 32 T6 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 32 T6 Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 33 T6 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 33 T6 Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 34 T6 Reach 2 – upstream *(4/9/2021)*

PHOTO POINT 34 T6 Reach 2 – downstream *(4/9/2021)*

PHOTO POINT 35 T6 Reach 3 – upstream *(4/9/2021)*

PHOTO POINT 35 T6 Reach 3 – downstream *(4/9/2021)*

PHOTO POINT 36 T6 Reach 3 – upstream *(4/9/2021)*

PHOTO POINT 36 T6 Reach 3 – downstream *(4/9/2021)*

	
PHOTO POINT 37 T6B – upstream *(4/9/2021)*	**PHOTO POINT 37 T6B – downstream *(4/9/2021)***
	
PHOTO POINT 38 T6A – upstream *(4/9/2021)*	**PHOTO POINT 38 T6A – downstream *(4/9/2021)***
	
PHOTO POINT 39 T5 – upstream *(4/9/2021)*	**PHOTO POINT 39 T5 – downstream *(4/9/2021)***

PHOTO POINT 40 T5 – upstream *(4/9/2021)*

PHOTO POINT 40 T5 – downstream *(4/9/2021)*

PHOTO POINT 41 T5 – upstream *(4/9/2021)*

PHOTO POINT 41 T5 – downstream *(4/9/2021)*

PHOTO POINT 42 T7 Reach 1 – upstream *(4/9/2021)*

PHOTO POINT 42 T7 Reach 1 – downstream *(4/9/2021)*

PHOTO POINT 43 T7 Reach 2 – upstream *(4/9/2021)*

PHOTO POINT 43 T7 Reach 2 – downstream *(4/9/2021)*

PHOTO POINT 44 T7 Reach 2 – upstream *(4/9/2021)*

PHOTO POINT 44 T7 Reach 2 – downstream *(4/9/2021)*

PHOTO POINT 45 T7 Reach 3 – upstream *(4/9/2021)*

PHOTO POINT 45 T7 Reach 3 – downstream *(4/9/2021)*

	
PHOTO POINT 46 T7A – upstream *(4/9/2021)*	**PHOTO POINT 46 T7A – downstream *(4/9/2021)***
	
PHOTO POINT 47 T8 – upstream *(4/9/2021)*	**PHOTO POINT 47 T8 – downstream *(4/9/2021)***
	
PHOTO POINT 48 T8 – upstream *(4/9/2021)*	**PHOTO POINT 48 T8 – downstream *(4/9/2021)***

	
PHOTO POINT 49 T9 – upstream *(4/9/2021)*	**PHOTO POINT 49 T9 – downstream *(4/9/2021)***

VEGETATION PLOT PHOTOGRAPHS

VEG PLOT 1 *(10/13/2021)*

VEG PLOT 2 *(10/13/2021)*

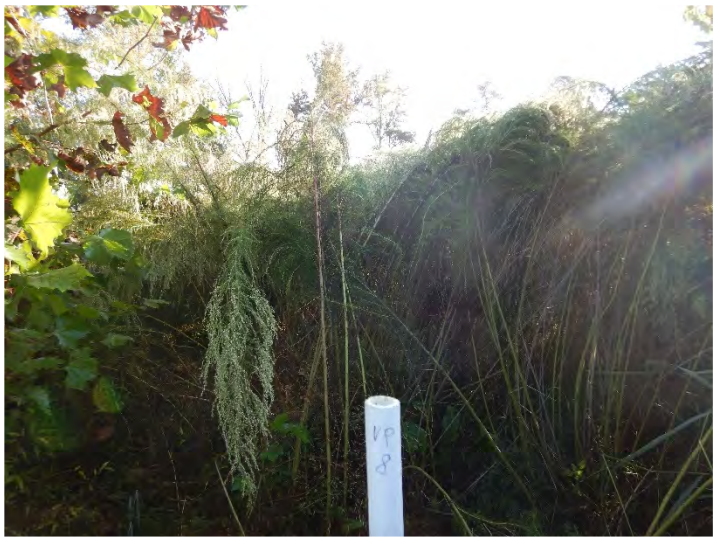
VEG PLOT 3 *(10/13/2021)*

VEG PLOT 4 *(10/13/2021)*

VEG PLOT 5 *(10/13/2021)*

VEG PLOT 6 *(10/13/2021)*

VEG PLOT 7 *(10/13/2021)*



VEG PLOT 8 *(10/13/2021)*

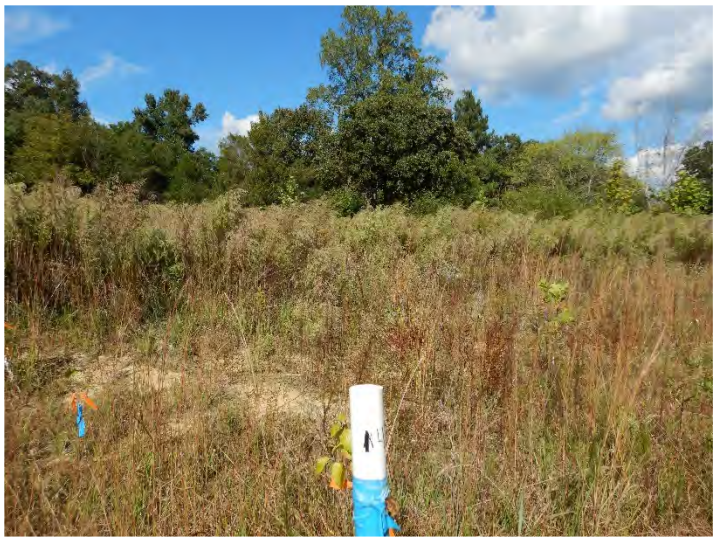
VEG PLOT 9 *(10/13/2021)*

VEG PLOT 10 *(10/13/2021)*

VEG PLOT 11 *(10/13/2021)*

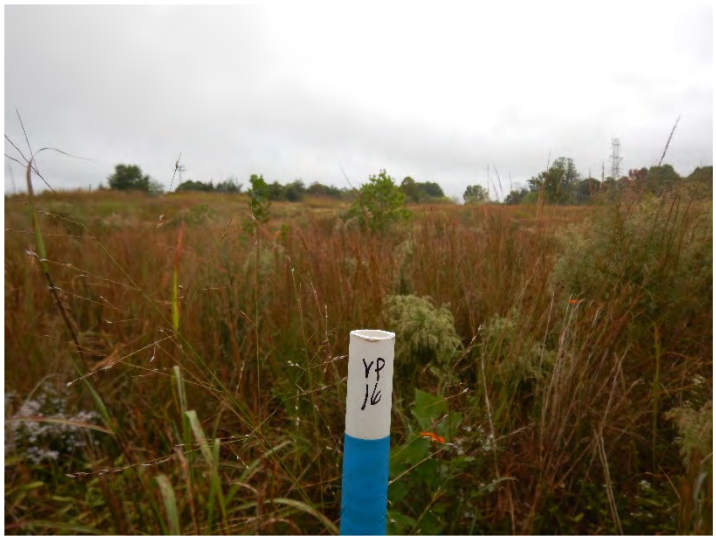
VEG PLOT 12 *(10/13/2021)*

VEG PLOT 13 *(10/13/2021)*



VEG PLOT 14 *(10/13/2021)*

VEG PLOT 15 *(10/13/2021)*



VEG PLOT 16 *(10/13/2021)*

VEG PLOT 17 *(10/13/2021)*

VEG PLOT 18 *(10/13/2021)*

VEG PLOT 19 *(10/13/2021)*

Vegetation Area of Concern Photographs

Bare Area Along T5

Before – Bare Area Along T5 (6/23/2020)

After – Bare Area Along T5 with Soil Amendments (10/21/2021)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Plot	Success Criteria Met without February 2021 Replanting*[1]	Success Criteria Met with February 2021 Replanting*[1]	Tract Mean without February 2021 Replanting	Tract Mean with February 2021 Replanting
1	Yes	Yes	53%	90%
2	Yes	Yes		
3	Yes	Yes		
4	Yes	Yes		
5	Yes	Yes		
6	No	Yes		
7	No	Yes		
8	No	No		
9	No	Yes		
10	Yes	Yes		
11	No	Yes		
12	No	Yes		
13	Yes	Yes		
14	Yes	Yes		
15	Yes	Yes		
16	No	Yes		
17	No	Yes		
18	No	No		
19	No	Yes		

*Success Criteria Met is based on the interim success criteria for MY3 of 310 planted stems per acre.

1. February 2021 replanting cannot be counted towards success criteria for two years, however Wildlands is recording replanted stems to determine their success.

Table 8. CVS Vegetation Tables - Metadata
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 3 - 2021

Report Prepared By	Jason Lorch
Date Prepared	10/14/2021 9:45
Database Name	Buckwater- cvs-v2.5.0- MY3.mdb
Database Location	F:\Monitoring\Buckwater\MY3
Computer Name	NICOLE-PC
File Size	77271040
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	97084
Project Name	Buckwater Mitigation Site
Description	Buffer Restoration Project
Sampled Plots	19

Table 9. Planted and Total Stem Counts

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

			Current Plot Data (MY3 2021)														
			VP 1			VP 2			VP 3			VP 4			VP 5		
Scientific Name	**Common Name**	**Species Type**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**
Acer negundo	Box Elder	Tree															
Acer rubrum	Red Maple	Tree															
Aesculus pavia	Red Buckeye	Shrub Tree															
Betula nigra	River Birch	Tree	1	1	1	2	2	2	3	3	3	2	2	2		2	2
Carya	Hickory spp.	Tree															
Celtis occidentalis	Hackberry	Tree															
Diospyros virginiana	American Persimmon	Tree									1						
Fraxinus pennsylvanica	Green Ash	Tree	3	3	3	2	2	2	2	2	2	4	4	4	1	1	2
Juglans nigra	Black Walnut	Tree									1						
Juniperus virginiana	Eastern Red Cedar	Tree															
Liquidambar styraciflua	Sweet Gum	Tree			1												1
Liriodendron tulipifera	Tulip-poplar	Tree							1	1	1						
Nyssa biflora	Swamp Tupelo	Tree															
Pinus taeda	Loblolly Pine	Tree															
Platanus occidentalis	Sycamore	Tree	1	1	1	5	5	5	4	4	4	2	2	5	4	4	4
Quercus alba	White Oak	Tree	1	1	1	1	1	1							1	4	4
Quercus lyrata	Overcup Oak	Tree										3	3	3	2	2	2
Quercus michauxii	Swamp Chestnut Oak	Tree	2	2	2				1	1	1						
Quercus pagoda	Cherrybark Oak	Tree														3	3
Quercus phellos	Willow Oak	Tree	1	1	1							3	3	3		1	2
Quercus shumardii	Shumard Oak	Tree				3	3	3	1	1	1					2	2
Salix nigra	Black Willow	Tree															4
Ulmus	Elm spp.	Tree															
Ulmus alata	Winged Elm	Tree															
Viburnum dentatum	Arrow-wood	Shrub Tree															
		Stem count	9	9	10	13	13	13	12	12	14	14	14	17	8	19	26
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	7	5	5	5	6	6	8	5	5	5	4	8	10
		Stems per ACRE	364	364	405	526	526	526	486	486	567	567	567	688	324	769	1,052

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

MY0 P: Number of planted stems excluding replanted stems from February 2021

MY3 R: Number of planted stems including replanted stems from February 2021

T: Total stems

Table 9. Planted and Total Stem Counts

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

			Current Plot Data (MY3 2021)														
			VP 6			VP 7			VP 8			VP 9			VP 10		
Scientific Name	**Common Name**	**Species Type**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**
Acer negundo	Box Elder	Tree		3	3												
Acer rubrum	Red Maple	Tree															
Aesculus pavia	Red Buckeye	Shrub Tree				1	1	1									
Betula nigra	River Birch	Tree					1	1									
Carya	Hickory spp.	Tree															
Celtis occidentalis	Hackberry	Tree											2	2			
Diospyros virginiana	American Persimmon	Tree															
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1	1	1	1	1	1	1				4	4	4
Juglans nigra	Black Walnut	Tree															
Juniperus virginiana	Eastern Red Cedar	Tree															
Liquidambar styraciflua	Sweet Gum	Tree									11						
Liriodendron tulipifera	Tulip-poplar	Tree															
Nyssa biflora	Swamp Tupelo	Tree															
Pinus taeda	Loblolly Pine	Tree															
Platanus occidentalis	Sycamore	Tree	4	4	4	1	1	1	4	4	4	3	3	3	1	1	1
Quercus alba	White Oak	Tree		1	1		2	2					2	2			
Quercus lyrata	Overcup Oak	Tree										2	3	3	3	3	3
Quercus michauxii	Swamp Chestnut Oak	Tree		1	1		2	2							1	1	1
Quercus pagoda	Cherrybark Oak	Tree											1	1			
Quercus phellos	Willow Oak	Tree				1	2	2	1	1	1		1	1			
Quercus shumardii	Shumard Oak	Tree					1	1	1	1	1		1	1			
Salix nigra	Black Willow	Tree															
Ulmus	Elm spp.	Tree															
Ulmus alata	Winged Elm	Tree															
Viburnum dentatum	Arrow-wood	Shrub Tree															
		Stem count	5	10	10	4	11	11	7	7	18	5	13	13	9	9	9
		size (ares)		1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	2	5	5	4	8	8	4	4	5	2	7	7	4	4	4
		Stems per ACRE	202	405	405	162	445	445	283	283	728	202	526	526	364	364	364

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

MY0 P: Number of planted stems excluding replanted stems from February 2021
MY3 R: Number of planted stems including replanted stems from February 2021
T: Total stems

Table 9. Planted and Total Stem Counts

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

			Current Plot Data (MY3 2021)														
			VP 11			VP 12			VP 13			VP 14			VP 15		
Scientific Name	**Common Name**	**Species Type**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**	**MY0 P**	**MY3 R**	**T**
Acer negundo	Box Elder	Tree					2	2									
Acer rubrum	Red Maple	Tree						2			4						
Aesculus pavia	Red Buckeye	Shrub Tree															
Betula nigra	River Birch	Tree				1	2	2	4	4	4	4	5	5	3	3	3
Carya	Hickory spp.	Tree															
Celtis occidentalis	Hackberry	Tree															
Diospyros virginiana	American Persimmon	Tree												1			
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1			1	3	3	3	3	3	3	2	2	2
Juglans nigra	Black Walnut	Tree												1			
Juniperus virginiana	Eastern Red Cedar	Tree						1									
Liquidambar styraciflua	Sweet Gum	Tree									5						1
Liriodendron tulipifera	Tulip-poplar	Tree										1	1	1			
Nyssa biflora	Swamp Tupelo	Tree															
Pinus taeda	Loblolly Pine	Tree															
Platanus occidentalis	Sycamore	Tree				3	5	5	4	4	4	1	3	4	4	4	4
Quercus alba	White Oak	Tree		4	4		1	1									
Quercus lyrata	Overcup Oak	Tree															
Quercus michauxii	Swamp Chestnut Oak	Tree				2	4	4	1	1	1		2	2	1	1	1
Quercus pagoda	Cherrybark Oak	Tree		3	3												
Quercus phellos	Willow Oak	Tree		2	2	1	1	1					1	1			
Quercus shumardii	Shumard Oak	Tree		3	3												
Salix nigra	Black Willow	Tree															
Ulmus	Elm spp.	Tree									4						
Ulmus alata	Winged Elm	Tree						1									
Viburnum dentatum	Arrow-wood	Shrub Tree										1	1	1	2	2	2
		Stem count	1	13	13	7	15	20	12	12	25	10	16	19	12	12	13
		size (ares)		1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	1	5	5	4	6	10	4	4	7	5	7	9	5	5	6
		Stems per ACRE	40	526	526	283	607	809	486	486	1,012	405	647	769	486	486	526

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

MY0 P: Number of planted stems excluding replanted stems from February 2021
MY3 R: Number of planted stems including replanted stems from February 2021
T: Total stems

Table 9. Planted and Total Stem Counts

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

			Current Plot Data (MY3 2021)											
			VP 16			VP 17			VP 18			VP 19		
Scientific Name	Common Name	Species Type	MY0 P	MY3 R	T	MY0 P	MY3 R	T	MY0 P	MY3 R	T	MY0 P	MY3 R	T
Acer negundo	Box Elder	Tree					1	1						
Acer rubrum	Red Maple	Tree												
Aesculus pavia	Red Buckeye	Shrub Tree												
Betula nigra	River Birch	Tree	1	4	4					1	1	1	4	4
Carya	Hickory spp.	Tree												
Celtis occidentalis	Hackberry	Tree					1	1		1	1			
Diospyros virginiana	American Persimmon	Tree					2	2						
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1	1	1	4			1	2	2	2
Juglans nigra	Black Walnut	Tree												
Juniperus virginiana	Eastern Red Cedar	Tree												
Liquidambar styraciflua	Sweet Gum	Tree						3			3			2
Liriodendron tulipifera	Tulip-poplar	Tree												
Nyssa biflora	Swamp Tupelo	Tree												
Pinus taeda	Loblolly Pine	Tree									1			
Platanus occidentalis	Sycamore	Tree	3	4	4	1	1	1	1	1	2	2	2	2
Quercus alba	White Oak	Tree	1	2	2	1	1	1						
Quercus lyrata	Overcup Oak	Tree							1	1	1			
Quercus michauxii	Swamp Chestnut Oak	Tree										1	1	1
Quercus pagoda	Cherrybark Oak	Tree		1	1									
Quercus phellos	Willow Oak	Tree		2	2	1	1	1				1	1	1
Quercus shumardii	Shumard Oak	Tree												
Salix nigra	Black Willow	Tree						1						5
Ulmus	Elm spp.	Tree												
Ulmus alata	Winged Elm	Tree								1	1			
Viburnum dentatum	Arrow-wood	Shrub Tree	1	1	1	2	2	2	1	1	1			
		Stem count	7	15	15	6	10	17	3	6	11	7	10	17
		size (ares)		1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02	
		Species count	5	7	7	5	8	10	3	6	9	5	5	7
		Stems per ACRE	283	607	607	243	405	688	121	243	445	283	405	688

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

MY0 P: Number of planted stems excluding replanted stems from February 2021
MY3 R: Number of planted stems including replanted stems from February 2021
T: Total stems

Table 9. Planted and Total Stem Counts

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

			Annual Means											
			MY3 (2021)			MY2 (2020)			MY1 (2019)			MY0 (2019)		
Scientific Name	Common Name	Species Type	MY0 P	MY3 R	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	Box Elder	Tree		6	6									
Acer rubrum	Red Maple	Tree			6									
Aesculus pavia	Red Buckeye	Shrub Tree	1	1	1	1	1	1	9	9	9	10	10	10
Betula nigra	River Birch	Tree	22	34	34	22	22	24	34	34	35	41	41	41
Carya	Hickory spp.	Tree						1						
Celtis occidentalis	Hackberry	Tree		4	4									
Diospyros virginiana	American Persimmon	Tree		2	4			1						
Fraxinus pennsylvanica	Green Ash	Tree	32	32	38	33	33	33	34	34	34	34	34	34
Juglans nigra	Black Walnut	Tree			2			1			1			
Juniperus virginiana	Eastern Red Cedar	Tree			1									
Liquidambar styraciflua	Sweet Gum	Tree			27			5			3			
Liriodendron tulipifera	Tulip-poplar	Tree	2	2	2	2	2	2	22	22	22	32	32	32
Nyssa biflora	Swamp Tupelo	Tree						1						
Pinus taeda	Loblolly Pine	Tree			1									
Platanus occidentalis	Sycamore	Tree	48	53	58	47	47	49	56	56	56	62	62	62
Quercus alba	White Oak	Tree	5	19	19	5	5	5	10	10	10	11	11	11
Quercus lyrata	Overcup Oak	Tree	11	12	12	13	13	13	25	25	25	22	22	22
Quercus michauxii	Swamp Chestnut Oak	Tree	9	16	16	10	10	10	13	13	13	13	13	13
Quercus pagoda	Cherrybark Oak	Tree		8	8									
Quercus phellos	Willow Oak	Tree	9	17	18	10	10	10	33	33	33	33	33	33
Quercus shumardii	Shumard Oak	Tree	5	12	12	5	5	5	8	8	8	9	9	9
Salix nigra	Black Willow	Tree			10			3						
Ulmus	Elm spp.	Tree			4									
Ulmus alata	Winged Elm	Tree		1	2									
Viburnum dentatum	Arrow-wood	Shrub Tree	7	7	7	9	9	9	13	13	13	15	15	15
		Stem count	151	226	291	157	157	173	257	257	262	282	282	282
		size (ares)		19			19			19			19	
		size (ACRES)		0.47			0.47			0.47			0.47	
		Species count	11	16	23	11	11	17	11	11	13	11	11	11
		Stems per ACRE	322	481	620	334	334	368	547	547	558	601	601	601

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

MY0 P: Number of planted stems excluding replanted stems from February 2021
MY3 R: Number of planted stems including replanted stems from February 2021
T: Total stems

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

Buckwater R4 & R5/6

		PRE-RESTORATION CONDITION			REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	Buckwater Creek Reach 4		Buckwater Creek Reach 5/6	Franklin Creek		Spencer Creek 2		Foust Creek		Buckwater Creek Reach 4		Buckwater Creek Reach 5/6		Buckwater Creek Reach 4		Buckwater Creek Reach 5/6	
					Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																		
Bankfull Width (ft)		13		15.0	18.2		10.7	11.2	18.5	19.4	17.6		19.0		13.8	17.2	20.5	21.5
Floodprone Width (ft)		17	44	20	---		60	114	49	63	38	87	40	91	150	200	200	
Bankfull Mean Depth		1.5	1.8	1.8	1.2		1.6	1.8	1.3	1.4	1.3		1.6		0.9	1.3	1.5	
Bankfull Max Depth		2.1	2.2	2.3	---		2.1	2.6	1.8	2.1	1.2	1.5	1.2	1.5	1.7	2.2	2.5	2.6
Bankfull Cross-Sectional Area (ft2)	N/A	20.0	24.0	28	21.7		17.8	19.7	23.9	24.1	22.5		29.7		12.5	21.9	30.6	33.6
Width/Depth Ratio		7.3	8.6	8.3	15.2		5.8	7.1	13.9	14.2	14.0		12.0		13.5	15.3	13.8	13.9
Entrenchment Ratio		1.3	3.3	1.3	3.6		5.5	10.2	2.6	3.4	2.5	5.0	2.2	5.0	8.7	14.5	9.3	9.8
Bank Height Ratio		1.6	1.7	2.0	1.0		1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)		16.0		18.0	---		---		---		---		---		30.0	37.0	25.6	44.0
Profile																		
Riffle Length (ft)		---		---	---		---		---		---		---		13	60	25	65
Riffle Slope (ft/ft)		---		---	---		0.013		0.015	0.035	0.009	0.022	0.005	0.015	0.001	0.025	0.003	0.016
Pool Length (ft)	N/A	---		---	---		---		---		---		---		46	82	54	94
Pool Max Depth (ft)		2.9	3.1	---	---		3.3		2.5	2.9	2.6	3.8	3.1	4.7	2.6	4.9	3.6	5.2
Pool Spacing (ft)		---		---	---		71		49	91	69	139	40	138	51	130	83	143
Pool Volume (ft^3)																		
Pattern																		
Channel Beltwidth (ft)		24	64	---	---		38	41	N/A		53	150	57	162	53	150	57	162
Radius of Curvature (ft)		19	48	---	---		11	15	N/A		35	53	38	57	35	53	38	57
Rc:Bankfull Width (ft/ft)	N/A	1.4	3.7	---	---		1.3	1.4	N/A		2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Meander Length (ft)		45	250	---	---		46	48	N/A		88	246	95	266	88	246	95	266
Meander Width Ratio		1.8	4.9	---	---		3.4	3.6	N/A		3.0	8.5	3.0	8.5	3.0	8.5	3.0	8.5
Substrate, Bed and Transport Parameters																		
Ri%/Ru%/P%/G%/S%																		
SC%/Sa%/G%/C%/B%/Be%																		
d16/d35/d50/d84/d95/d100	N/A	0.33/1.3/4.4/47/85/256		.34/39/7.8/33/71/>2048	8.8/25/68.7/>2048/>2048/>2048		<0.063/3/8.8/42/90/-		---		---		---		0.1/11/33.8/90/154.7/256		0.1/2.68/11.8/81.3/214.7/>2048	
Reach Shear Stress (Competency) lb/ft^2		0.87		0.53							0.57		0.69		0.97		0.54	
Max part size (mm) mobilized at bankfull																		
Stream Power (Capacity) W/m^2																		
Additional Reach Parameters																		
Drainage Area (SM)		1.00		1.60	2.15		0.96		1.37		1.00		1.60		1.00		1.60	
Watershed Impervious Cover Estimate (%)		3.9%		3.9%	---		---		---		3.9%		3.9%		3.9%		3.9%	
Rosgen Classification		E4/G4c		G4c	B4		E4		C4		C4		E4		C4		E4	
Bankfull Velocity (fps)		3.7		4	5.4		4.9	5.4	2.9	3.7	3.6		3.1	3.7	4.3		3.6	
Bankfull Discharge (cfs)		80		110	120		97		88		78		91	100	53		109	
Q-NFF regression																		
Q-USGS extrapolation	N/A																	
Q-Mannings																		
Valley Length (ft)		---		---	---		---		---		---		---		1,928		813	
Channel Thalweg Length (ft)		2,282		1,272	---		---		---		2,467		865		2,538		979	
Sinuosity		1.14		1.41	1.18		2.30		1.10		1.30		1.40		1.30		1.40	
Water Surface Slope $(ft/ft)^2$		0.007		0.007	0.023		0.005		0.009		0.007		0.004	0.007	0.007		0.006	
Bankfull Slope (ft/ft)		---		---	---		0.005		---		---		---		0.007		0.006	

(---): Data was not provided

Table 10b. Baseline Stream Data Summary
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T2 & T3

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	T2		T3		UT to Wells		Spencer Creek 3		UT to Varnals Creek		T2		T3		T2		T3	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)		8.8	11	7.5	13	6.2	8.6	6.3	9.3	9.3	10.5	10.6		9.6		9.1		14.4	
Floodprone Width (ft)		14	49	22	26	16	22	14	125	60	100	23	53	21	48	100		300	
Bankfull Mean Depth		0.9	1.4	0.6	0.8	0.6	1	0.8	1	1.1	1.2	0.8		0.8		0.7		1.1	
Bankfull Max Depth		1.2	1.8	1.1	1.3	0.9	1.4	1	1.2	1.5	1.7	1.2	1.3	0.9	1.1	1.2		2.0	
Bankfull Cross-Sectional Area (ft2)		8.3	15	6.2	7.5	3.9	6.3	6.6	8.7	10.3	12.3	8.9		7.3		6.4		15.3	
Width/Depth Ratio		7.9	9.4	9.2	23	6.1	12.6	7.9	9.3	8.1	9.3	13.0		13.0		13.2		13.6	
Entrenchment Ratio		1.3	>5.6	1.7	>3.4	1.9	4.1	1.7	4.3	5.7	10.0	2.2	5.0	2.2	5.0	10.9		20.8	
Bank Height Ratio		1.4	2.0	1.2	1.7	1.0	1.8	1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)	N/A	21		45		---		---		---		---		---		48.9		45.0	
Profile																			
Riffle Length (ft)		---		---		---		---		---		---		---		16	61	8	56
Riffle Slope (ft/ft)		---		---		0.017	0.078	0.018	0.034	0.024	0.057	0.019	0.071	0.015	0.038	0.006	0.073	0.004	0.036
Pool Length (ft)		---		---		---		---		---		---		---		12.0	55.0	13.0	65.0
Pool Max Depth (ft)		1.5		1.8		1.6	1.9	1.2	1.8	2.5	2.6	1.7	2.6	1.5	2.3	1.6	3.8	1.7	3.0
Pool Spacing (ft)		---		---		17	63	9	46	8	82	23	93	33	93	27	71	30	81
Pool Volume (ft^3)	N/A																		
Pattern																			
Channel Beltwidth (ft)		---		---		10	35	10	50	15	45	27	90	24	82	27	90	24	82
Radius of Curvature (ft)		---		---		2.3	32	12	85	8	47	21	32	19	29	21	32	19	29
Rc:Bankfull Width (ft/ft)		---		---		0.3	4.0	1.9	9.1	0.6	3.2	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0
Meander Length (ft)		---		---		35	70	55.0	142.0	16.0	47.0	80	159	72	144	80	159	72	144
Meander Width Ratio	N/A	---		---		4.4	8.8	8.7	15.3	1.1	3.2	2.5	8.5	2.5	8.5	2.5	8.5	2.5	8.5
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%																			
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		.45/4.4/9.7/71.1/183/>208		0.43/11.3/20.9/55.7/110/180		0.1/0.6/4.5/53/96/x		1.87/8.85/11/65/128/x		---		---		---		0.25/16/32.7/80.3/227.6/1024		0.28/10.32/21.5/103.6/193.1/512	
Reach Shear Stress (Competency) lb/ft^2		1.18		1.00		---		---		---		0.8		0.6		0.8		1.1	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2	N/A																		
Additional Reach Parameters																			
Drainage Area (SM)		0.34		0.22		0.13		0.37		0.41		0.34		0.22		0.34		0.22	
Watershed Impervious Cover Estimate (%)		0.2%		2.0%		---		---		---		0.2%		2.0%		0.2%		2.0%	
Rosgen Classification		E4/G4c		E4/Incised B4c		C4		E4		B4/E4b		B4/C4		C4		B4/C4		C4	
Bankfull Velocity (fps)		3.1	4.3	3.5	4.2	3.8	5.3	5.0	5.6	4.4	5.2	4.0		3.6		3.1		4.3	
Bankfull Discharge (cfs)		36		26		15		35		54		36		26		20		66	
Q-NFF regression																			
Q-USGS extrapolation																			
Q-Mannings																			
Valley Length (ft)		---		---		---		---		---		---		---		508		729	
Channel Thalweg Length (ft)		543		918		---		---		---		587		851		591		903	
Sinuosity		1.2		1.2		1.4		1.0	1.3	1.2		1.2		1.3		1.2		1.2	
Water Surface Slope $(ft/ft)^2$		0.015		0.018		0.019		0.019	0.022	0.17		0.012	0.02	0.010	0.023	0.017		0.016	
Bankfull Slope (ft/ft)	N/A	---		---		---		---		---		---		---		0.017		0.016	

(---): Data was not provided

Table 10c. Baseline Stream Data Summary
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T4 & T5

		PRE-RESTORATION CONDITION				REFERENCE REACH DATA						DESIGN				AS-BUILT/BASELINE			
Parameter	Gage	T4		T5		UT to Wells		Spencer Creek 3		UT to Varnals Creek		T4		T5		T4		T5	
						Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																			
Bankfull Width (ft)	N/A	7.2		6.1	8.9	6.2	8.6	6.3	9.3	9.3	10.5	7.6		9.7		6.7		6.1	8.6
Floodprone Width (ft)		9		10	22	16	22	14	125	60	100	11	17	20	46	150		100	200
Bankfull Mean Depth		0.6		0.6		0.6	1	0.8	1	1.1	1.2	0.6		0.7		0.5		0.8	1.0
Bankfull Max Depth		0.8		0.9	1.4	0.9	1.4	1	1.2	1.5	1.7	0.7	0.9	0.8	1.0	1.0		1.1	1.5
Bankfull Cross-Sectional Area (ft2)		4.8	5.1	6.2	6.3	3.9	6.3	6.6	8.7	10.3	12.3	4.3		6.7		3.6		8.1	8.5
Width/Depth Ratio		11		9.7	13	6.1	12.6	7.9	9.3	8.1	9.3	13.0		14.0		12.3		4.5	8.7
Entrenchment Ratio		1.3		1.6	2.3	1.9	4.1	1.7	4.3	5.7	10.0	1.4	2.2	2.2	5.0	22.3		11.7	33.0
Bank Height Ratio		1.6		2.1	4.1	1.0	1.8	1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)		54.0		8.5		---		---		---		---		---		90		37.2	50.3
Profile																			
Riffle Length (ft)	N/A	---		---		---		---		---		---		---		20	55	13	40
Riffle Slope (ft/ft)		---		---		0.017	0.078	0.018	0.034	0.024	0.057	0.026	0.103	0.014	0.043	0.001	0.046	0.015	0.023
Pool Length (ft)		---		---		---		---		---		---		---		9.0	38.0	36.0	71.0
Pool Max Depth (ft)		1.9		---		1.6	1.9	1.2	1.8	2.5	2.6	1.1	1.8	1.4	2.1	1.4	2.7	1.5	3.1
Pool Spacing (ft)		---		---		17	63	9	46	8	82	17	67	20	61	23	66	16	51
Pool Volume (ft^3)																			
Pattern																			
Channel Beltwidth (ft)	N/A	---		---		10	35	10	50	15	45	---		29	82	---		29	82
Radius of Curvature (ft)		---		---		2.3	32	12	85	8	47	---		18	28	---		18	28
Rc:Bankfull Width (ft/ft)		---		---		0.3	4.0	1.9	9.1	0.6	3.2	---		2.0	3.0	---		2.0	3.0
Meander Length (ft)		---		---		35	70	55	142	16	47	---		49	136	---		49	136
Meander Width Ratio		---		---		4.4	8.8	8.7	15.3	1.1	3.2	---		3.0	8.5	---		3.0	8.5
Substrate, Bed and Transport Parameters																			
Ri%/Ru%/P%/G%/S%	N/A																		
SC%/Sa%/G%/C%/B%/Be%																			
d16/d35/d50/d84/d95/d100		.05/8.0/32.0/93.6/157/256		0.16/0.42/4.2/66.8/107/>2048		0.1/0.6/4.5/53/96/x		1.87/8.85/11/65/128/x		---		---		---		0.16/0.55/5.6/107.3/ 155.5/256		0.16/5.60/17.3/80.3/120.1/180	
Reach Shear Stress (Competency) lb/ft^2		1.09		0.24		---		---		---		0.8		0.4		1.0		0.58	
Max part size (mm) mobilized at bankfull																			
Stream Power (Capacity) W/m^2																			
Additional Reach Parameters																			
Drainage Area (SM)	N/A	0.12		0.17		0.13		0.37		0.41		0.12		0.17		0.12		0.17	
Watershed Impervious Cover Estimate (%)		0.0%		1.0%		---		---		---		0.0%		1.0%		0.0%		1.0%	
Rosgen Classification		G4		Incised E4/C4		C4		E4		B4/E4b		B4/C4		B4/C4		B4		C4	
Bankfull Velocity (fps)		3.3	3.6	3	3.4	3.8	5.3	5.0	5.6	4.4	5.2	3.9		3.3		3.4		2.6	
Bankfull Discharge (cfs)		17		21		15		35		54		18		22		70		12	
Q-NFF regression																			
Q-USGS extrapolation																			
Q-Mannings																			
Valley Length (ft)		---		---		---		---		---		---		---		878		992	
Channel Thalweg Length (ft)		1,081		1,291		---		---		---		961		1,259		982		1,295	
Sinuosity		1.1		1.1		1.4		1.0	1.3	1.2		1.2		1.3		1.1		1.3	
Water Surface Slope $(ft/ft)^2$		0.027		0.015		0.020		0.019	0.022	0.17		0.024		0.013		0.024		0.014	
Bankfull Slope (ft/ft)		---		---		---		---		---		---		---		0.024		0.014	

(---): Data was not provided

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

	Buckwater Creek Reach 2						Buckwater Creek Reach 3											
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	509.51	509.51	509.61	509.59			508.12	508.03	508.22	508.14			509.71	509.65	509.85	509.70		
Low Bank Elevation (ft)	509.51	509.51	509.61	509.59			508.12	508.03	508.22	508.14			509.71	509.65	509.85	509.70		
Bankfull Width (ft)	20.7	20.3	21.4	21.2			19.6	19.0	18.9	18.7			23.7	22.8	24.4	23.5		
Floodprone Width (ft)	200	200	200	200			N/A	N/A	N/A	N/A			150	150	150	150		
Bankfull Mean Depth (ft)	1.5	1.5	1.5	1.6			2.5	2.4	2.6	2.5			2.3	2.4	2.5	2.4		
Bankfull Max Depth (ft)	2.2	2.1	2.1	2.2			3.4	3.4	3.6	3.5			3.5	3.7	3.9	3.7		
Bankfull Cross-Sectional Area (ft^2)	31.9	31.2	32.9	33.4			49.1	45.3	48.6	47.5			55.3	54.9	61.5	56.2		
Bankfull Width/Depth Ratio	13.5	13.2	13.9	13.4			7.9	7.9	7.4	7.4			10.1	9.5	9.6	9.9		
Entrenchment Ratio[1]	9.6	9.8	9.4	9.4			N/A	N/A	N/A	N/A			6.3	6.6	6.2	6.4		
Bankfull Bank Height Ratio[2]	1.0	<1.0	1.0	1.0			N/A	N/A	N/A	N/A			1.0	1.0	1.0	1.0		
	Buckwater Creek Reach 4																	
	Cross-Section 4 (Riffle)						Cross-Section 5 (Pool)						Cross-Section 6 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	505.91	505.93	505.88	505.89			506.10	506.05	506.10	506.09			500.92	501.01	501.00	501.07		
Low Bank Elevation (ft)	505.91	505.93	505.88	505.89			506.10	506.06	506.10	506.09			500.92	501.01	501.00	501.07		
Bankfull Width (ft)	17.2	17.7	16.6	16.6			24.8	24.1	24.1	24.1			16.5	14.8	16.7	14.7		
Floodprone Width (ft)	150	150	150	150			N/A	N/A	N/A	N/A			200	200	200	200		
Bankfull Mean Depth (ft)	1.3	1.2	1.2	1.2			2.0	2.0	2.1	2.0			1.1	1.2	1.1	1.2		
Bankfull Max Depth (ft)	2.2	2.1	2.1	2.1			3.4	3.3	3.5	3.4			2.2	2.1	2.0	2.2		
Bankfull Cross-Sectional Area (ft^2)	21.9	21.7	20.1	20.2			50.4	47.8	49.8	48.4			17.8	17.6	18.1	18.3		
Bankfull Width/Depth Ratio	13.5	14.5	13.7	13.6			12.2	12.2	11.7	12.0			15.3	12.4	15.4	14.7		
Entrenchment Ratio[1]	8.7	8.5	9.0	9.0			N/A	N/A	N/A	N/A			12.1	13.5	12.0	13.6		
Bankfull Bank Height Ratio[2]	1.0	1.0	<1.0	<1.0			N/A	N/A	N/A	N/A			1.0	1.0	1.0	1.0		
	Buckwater Creek Reach 4												Buckwater Creek Reach 5					
	Cross-Section 7 (Pool)						Cross-Section 8 (Riffle)						Cross-Section 9 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	500.69	500.88	500.92	500.85			496.69	496.55	496.63	496.92			488.72	488.74	488.72	488.74		
Low Bank Elevation (ft)	500.69	500.88	500.92	500.85			496.69	496.55	496.63	496.62			488.72	488.74	488.72	488.74		
Bankfull Width (ft)	22.9	25.0	25.5	24.3			13.8	12.2	12.3	12.0			16.4	15.9	15.6	16.2		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			200	200	200	200			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.7	1.6	1.6	1.6			0.9	0.8	0.9	0.9			1.3	1.3	1.3	1.3		
Bankfull Max Depth (ft)	3.7	3.9	3.9	3.6			1.7	1.5	1.6	1.6			2.0	2.0	1.9	2.0		
Bankfull Cross-Sectional Area (ft^2)	38.8	39.8	41.8	39.4			12.5	9.8	11.0	11.1			21.7	21.2	20.0	21.6		
Bankfull Width/Depth Ratio	13.6	15.7	15.5	15.0			15.3	15.1	13.9	12.9			12.4	11.9	12.2	12.2		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			14.5	16.4	16.2	16.7			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	<1.0	<1.0	<1.0			N/A	N/A	N/A	N/A		
	Buckwater Creek Reach 5						Buckwater Creek Reach 6											
	Cross-Section 10 (Riffle)						Cross-Section 11 (Pool)						Cross-Section 12 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	488.49	488.43	488.55	488.52			486.68	486.46	486.67	486.69			487.04	487.06	487.08	487.06		
Low Bank Elevation (ft)	488.49	488.43	488.55	488.52			486.68	486.46	486.67	486.69			487.04	487.06	487.08	487.06		
Bankfull Width (ft)	21.5	20.5	21.5	20.8			23.6	22.3	23.3	23.8			20.5	20.5	21.1	20.6		
Floodprone Width (ft)	200	200	200	200			N/A	N/A	N/A	N/A			200	200	200	200		
Bankfull Mean Depth (ft)	1.5	1.5	1.5	1.5			2.2	2.1	2.1	2.1			1.5	1.4	1.4	1.4		
Bankfull Max Depth (ft)	2.5	2.3	2.4	2.4			3.9	3.9	4.0	3.9			2.6	2.4	2.4	2.4		
Bankfull Cross-Sectional Area (ft^2)	33.3	30.0	32.9	31.8			52.4	46.0	50.0	49.8			30.6	29.1	30.0	28.8		
Bankfull Width/Depth Ratio	13.9	14.0	14.1	13.6			10.6	10.8	10.9	11.3			13.8	14.5	14.8	14.7		
Entrenchment Ratio[1]	9.3	9.8	9.3	9.6			N/A	N/A	N/A	N/A			9.8	9.7	9.5	9.7		
Bankfull Bank Height Ratio[2]	1.0	<1.0	<1.0	<1.0			N/A	N/A	N/A	N/A			1.0	<1.0	<1.0	<1.0		

[1]Entrenchment Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

[2]Bank Height Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

	T1 Reach 1						T1 Reach 2											
	Cross-Section 13 (Riffle)						Cross-Section 14 (Riffle)						Cross-Section 15 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	488.81	488.82	488.78	488.88			487.70	487.70	487.73	487.76			487.21	487.66	487.65	487.49		
Low Bank Elevation (ft)	488.81	488.82	488.78	488.88			487.70	487.70	487.73	487.76			487.21	487.66	487.65	487.49		
Bankfull Width (ft)	22.0	21.6	20.7	21.0			20.8	20.5	20.5	20.6			27.0	33.5	29.3	26.3		
Floodprone Width (ft)	150	150	150	150			200	200	200	200			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.3			1.6	1.5	1.5	1.6			1.6	1.7	1.8	1.7		
Bankfull Max Depth (ft)	2.4	2.2	2.2	2.5			2.5	2.1	2.3	2.4			3.2	3.6	3.7	3.4		
Bankfull Cross-Sectional Area (ft^2)	31.5	28.3	27.0	27.3			32.7	30.9	31.8	32.7			42.2	55.5	52.8	44.5		
Bankfull Width/Depth Ratio	15.4	16.5	15.8	16.2			13.2	13.6	13.3	13.0			17.3	20.3	16.3	15.6		
Entrenchment Ratio[1]	6.8	6.9	7.3	7.1			9.6	9.8	9.7	9.7			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	1.0	<1.0	<1.0	<1.0			1.0	<1.0	<1.0	1.0			N/A	N/A	N/A	N/A		
	T3 Reach 2												T2					
	Cross-Section 16 (Pool)						Cross-Section 17 (Riffle)						Cross-Section 18 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	505.82	505.97	506.03	505.98			505.31	505.32	505.28	505.31			494.17	494.19	494.21	494.21		
Low Bank Elevation (ft)	505.82	505.97	506.03	505.98			505.31	505.32	505.28	505.31			494.17	494.19	494.21	494.21		
Bankfull Width (ft)	12.7	12.9	13.5	13.6			14.4	14.1	13.8	14.6			9.1	9.0	9.0	9.0		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			300	300	300	300			100	100	100	100		
Bankfull Mean Depth (ft)	1.4	1.5	1.5	1.5			1.1	1.1	1.1	1.0			0.7	0.7	0.7	0.7		
Bankfull Max Depth (ft)	2.5	2.8	2.9	2.8			2.0	2.0	1.9	1.9			1.2	1.3	1.2	1.3		
Bankfull Cross-Sectional Area (ft^2)	17.6	19.5	19.9	20.1			15.3	15.7	14.7	15.1			6.4	6.2	6.3	6.5		
Bankfull Width/Depth Ratio	9.1	8.5	9.2	9.2			13.6	12.6	13.0	14.2			13.2	12.9	12.8	12.5		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			20.8	21.3	21.7	20.5			10.9	11.2	11.1	11.1		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	1.0	<1.0	<1.0			1.0	<1.0	<1.0	1.0		
	T2						T4A Reach 1						T4					
	Cross-Section 19 (Pool)						Cross-Section 20 (Riffle)						Cross-Section 21 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	491.10	491.21	491.16	491.14			539.53	539.56	539.52	539.57			502.51	502.53	502.59	502.64		
Low Bank Elevation (ft)	491.10	491.21	491.16	491.14			539.53	539.56	539.52	539.57			502.51	502.53	502.59	502.64		
Bankfull Width (ft)	13.9	14.3	13.8	13.8			3.3	2.6	2.5	2.4			7.4	6.7	7.6	7.1		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			20	20	20	20			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.0	0.9	0.9	0.9			0.4	0.4	0.4	0.3			0.9	0.8	0.8	0.8		
Bankfull Max Depth (ft)	1.9	2.0	1.9	1.9			0.7	0.7	0.7	0.8			1.6	1.3	1.4	1.6		
Bankfull Cross-Sectional Area (ft^2)	13.6	13.4	13.1	12.3			1.3	1.0	1.0	0.8			6.7	5.3	5.8	5.6		
Bankfull Width/Depth Ratio	14.3	15.2	14.5	15.6			8.4	6.7	6.3	7.0			9.3	8.5	10.0	8.9		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			6.0	7.7	8.1	8.2			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	<1.0	<1.0	<1.0			N/A	N/A	N/A	N/A		
	T4						T4B Reach 1						T6 Reach 3					
	Cross-Section 22 (Riffle)						Cross-Section 23 (Riffle)						Cross-Section 24 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	502.09	502.12	502.12	502.19			540.79	540.75	540.76	540.81			517.07	517.02	517.07	517.05		
Low Bank Elevation (ft)	502.09	502.12	502.12	502.19			540.79	540.75	540.76	540.81			517.07	517.02	517.07	517.05		
Bankfull Width (ft)	6.7	6.4	6.3	6.9			4.3	4.2	4.2	4.4			8.8	8.1	8.5	8.4		
Floodprone Width (ft)	150	150	150	150			25	25	25	25			100	100	100	100		
Bankfull Mean Depth (ft)	0.5	0.4	0.5	0.6			0.5	0.5	0.5	0.5			0.8	0.9	0.9	0.8		
Bankfull Max Depth (ft)	1.0	0.7	0.9	1.0			0.8	0.6	0.6	0.6			1.3	1.6	1.7	1.5		
Bankfull Cross-Sectional Area (ft^2)	3.6	2.8	3.2	3.8			2.1	2.0	2.0	2.0			7.1	7.4	7.3	6.6		
Bankfull Width/Depth Ratio	12.3	14.3	12.6	12.3			8.4	9.0	9.0	9.7			10.8	9.0	10.0	10.9		
Entrenchment Ratio[1]	22.3	23.6	23.6	21.8			5.9	6.0	6.0	5.6			11.4	12.3	11.7	11.8		
Bankfull Bank Height Ratio[2]	1.0	<1.0	<1.0	1.0			1.0	<1.0	<1.0	<1.0			1.0	1.0	1.0	<1.0		

[1]Entrenchment Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

[2]Bank Height Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

Table 11. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

	T5																	
	Cross-Section 25 (Riffle)						Cross-Section 26 (Pool)						Cross-Section 27 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	504.92	504.93	504.97	504.96			504.17	504.15	504.19	504.19			491.22	491.29	491.49	491.45		
Low Bank Elevation (ft)	504.92	504.93	504.97	504.96			504.17	504.15	504.19	504.19			491.22	491.29	491.49	491.45		
Bankfull Width (ft)	8.6	8.0	8.5	8.2			8.7	8.4	8.3	4.4			6.1	6.6	7.5	6.0		
Floodprone Width (ft)	100	100	100	100			N/A	N/A	N/A	N/A			200	200	200	200		
Bankfull Mean Depth (ft)	1.0	1.0	0.9	0.9			1.0	0.5	0.5	0.7			0.8	0.6	0.7	0.9		
Bankfull Max Depth (ft)	1.5	1.5	1.4	1.5			1.8	1.0	1.2	1.3			1.1	1.0	1.2	1.2		
Bankfull Cross-Sectional Area (ft^2)	8.5	7.8	8.0	7.7			8.5	3.8	3.8	3.2			8.1	3.9	5.4	5.3		
Bankfull Width/Depth Ratio	8.7	8.1	9.1	8.8			9.0	18.3	18.2	6.0			4.5	11.2	10.4	6.8		
Entrenchment Ratio[1]	11.7	12.6	11.7	12.2			N/A	N/A	N/A	N/A			33.0	30.1	26.7	33.3		
Bankfull Bank Height Ratio[2]	1.0	1.0	<1.0	<1.0			N/A	N/A	N/A	N/A			1.0	<1.0	1.1	1.1		
	T5						T7 Reach 1											
	Cross-Section 28 (Pool)						Cross-Section 29 (Riffle)						Cross-Section 30 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	490.75	490.78	490.77	490.77			506.31	506.29	506.41	506.41			505.68	505.88	505.96	505.95		
Low Bank Elevation (ft)	490.75	490.78	490.77	490.77			506.31	506.29	506.41	506.41			505.68	505.88	505.96	505.95		
Bankfull Width (ft)	9.3	9.7	9.5	9.0			10.0	9.7	10.5	11.0			8.6	9.9	10.2	10.5		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			100	100	100	100			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	1.6	1.3	1.2	1.4			0.7	0.7	0.8	0.7			0.9	0.9	0.9	0.9		
Bankfull Max Depth (ft)	2.5	2.4	2.5	2.5			1.0	1.5	1.6	1.4			1.5	1.7	1.8	1.7		
Bankfull Cross-Sectional Area (ft^2)	15.2	12.3	11.8	11.6			7.4	7.0	7.9	8.1			7.5	8.9	9.5	9.2		
Bankfull Width/Depth Ratio	5.7	7.7	7.7	6.5			13.5	13.5	13.9	14.9			9.8	11.0	10.9	12.1		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			10.0	10.3	9.6	9.1			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	<1.0	1.0	1.0			N/A	N/A	N/A	N/A		
	T7 Reach 2						T7 Reach 3						T7A					
	Cross-Section 31 (Riffle)						Cross-Section 32 (Riffle)						Cross-Section 33 (Riffle)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	493.84	493.84	493.87	493.93			485.52	485.60	485.56	485.56			490.11	490.07	490.07	490.18		
Low Bank Elevation (ft)	493.84	493.84	493.87	493.93			485.52	485.60	485.56	485.56			490.11	490.07	490.07	490.18		
Bankfull Width (ft)	8.2	7.8	7.9	7.9			9.5	10.2	10.2	8.5			5.8	5.7	5.2	6.0		
Floodprone Width (ft)	100	100	100	100			25	25	25	25			50	50	50	50		
Bankfull Mean Depth (ft)	0.6	0.5	0.5	0.5			0.5	0.5	0.5	0.5			0.6	0.5	0.6	0.5		
Bankfull Max Depth (ft)	0.9	1.0	1.0	0.9			0.9	0.9	0.9	0.9			1.0	1.0	1.2	1.0		
Bankfull Cross-Sectional Area (ft^2)	4.6	4.0	4.3	4.3			5.2	5.3	4.9	4.6			3.3	3.1	3.1	3.0		
Bankfull Width/Depth Ratio	14.8	15.0	14.6	14.6			17.6	19.6	21.1	15.9			10.2	10.5	9.0	12.2		
Entrenchment Ratio[1]	12.2	12.9	12.6	12.6			2.6	2.5	2.5	2.9			8.6	8.8	9.5	8.3		
Bankfull Bank Height Ratio[2]	1.0	<1.0	<1.0	<1.0			1.0	1.0	<1.0	<1.0			1.0	<1.0	<1.0	<1.0		
	T7A						T8											
	Cross-Section 34 (Pool)						Cross-Section 35 (Riffle)						Cross-Section 36 (Pool)					
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft)	489.85	489.92	489.73	489.87			529.20	529.22	529.24	529.29			528.62	528.78	528.84	528.96		
Low Bank Elevation (ft)	489.85	489.92	489.73	489.87			529.20	529.22	529.24	529.29			528.62	528.78	528.84	528.96		
Bankfull Width (ft)	10.5	11.6	9.8	10.3			5.1	5.1	5.4	5.4			6.1	6.4	6.5	7.0		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			100	100	100	100			N/A	N/A	N/A	N/A		
Bankfull Mean Depth (ft)	0.9	0.7	0.7	0.6			0.5	0.4	0.5	0.5			1.1	0.9	1.0	1.0		
Bankfull Max Depth (ft)	2.0	1.5	1.3	1.0			0.7	0.8	0.7	0.8			1.7	1.4	1.4	1.4		
Bankfull Cross-Sectional Area (ft^2)	9.4	8.5	6.6	6.4			2.6	2.2	2.5	2.5			6.7	6.0	6.7	6.7		
Bankfull Width/Depth Ratio	11.6	15.9	14.5	16.7			9.8	11.4	11.7	11.3			5.5	6.7	6.2	7.3		
Entrenchment Ratio[1]	N/A	N/A	N/A	N/A			19.8	19.8	18.7	18.7			N/A	N/A	N/A	N/A		
Bankfull Bank Height Ratio[2]	N/A	N/A	N/A	N/A			1.0	<1.0	<1.0	<1.0			N/A	N/A	N/A	N/A		

[1]Entrenchment Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

[2]Bank Height Ratio is calculated using the method specified in the Industry Technical Workgroup Memorandum.

Table 12a. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

Buckwater Reach 4

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	13.8	17.2	12.2	17.7	12.3	16.7	14.7	16.6				
Floodprone Width (ft)	150	200	150	200	150	200	150	200				
Bankfull Mean Depth	0.9	1.3	0.8	1.2	0.9	1.2	1.2					
Bankfull Max Depth	1.7	2.2	1.5	2.1	1.6	2.1	2.1	2.2				
Bankfull Cross-Sectional Area (ft^2)	12.5	21.9	9.8	21.7	11.0	20.1	18.3	20.2				
Width/Depth Ratio	13.5	15.3	12.4	15.1	13.7	15.4	13.6	14.7				
Entrenchment Ratio	8.7	14.5	8.5	16.4	9.0	16.2	9.0	13.6				
Bank Height Ratio	1.0		<1.0	1.0	<1.0	1.0	<1.0	1.0				
Profile												
Riffle Length (ft)	13	60										
Riffle Slope (ft/ft)	0.0010	0.0250										
Pool Length (ft)	46	82										
Pool Max Depth (ft)	2.6	4.9										
Pool Spacing (ft)	51	83										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	53	150										
Radius of Curvature (ft)	35	53										
Rc:Bankfull Width (ft/ft)	2.0	3.0										
Meander Wave Length (ft)	88	246										
Meander Width Ratio	3.0	8.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	2,538											
Sinuosity (ft)	1.30											
Water Surface Slope (ft/ft)	0.0071											
Bankfull Slope (ft/ft)	0.007											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.1/11/33.8/90/154.7/256		SC/6.69/27.6/90/157.1/256		0.71/12.46/26.5/90.0/135.5/180		1.68/6.31/12.5/66.5/117.2/256.0					
% of Reach with Eroding Banks	1%		0%		0%		0%					

Table 12b. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

Buckwater Reach 5/6

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	20.5	21.5	20.5		21.1	21.5	20.6	20.8				
Floodprone Width (ft)	200		200		200		200					
Bankfull Mean Depth	1.5		1.4	1.5	1.4	1.5	1.4	1.5				
Bankfull Max Depth	2.5	2.6	2.3	2.4	2.4		2.4					
Bankfull Cross-Sectional Area (ft^2)	30.6	33.6	29.1	30.0	30.0	32.9	28.8	31.8				
Width/Depth Ratio	13.8	13.9	14.0	14.5	14.1	14.8	13.6	14.7				
Entrenchment Ratio	9.3	9.8	9.7	9.8	9.3	9.5	9.6	9.7				
Bank Height Ratio	1.0		<1.0		<1.0		<1.0					
Profile												
Riffle Length (ft)	25	65										
Riffle Slope (ft/ft)	0.0034	0.0158										
Pool Length (ft)	54	94										
Pool Max Depth (ft)	3.6	5.2										
Pool Spacing (ft)	83	143										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	57	162										
Radius of Curvature (ft)	38	57										
Rc:Bankfull Width (ft/ft)	2.0	3.0										
Meander Wave Length (ft)	95	266										
Meander Width Ratio	3.0	8.5										
Additional Reach Parameters												
Rosgen Classification	E4											
Channel Thalweg Length (ft)	979											
Sinuosity (ft)	1.40											
Water Surface Slope (ft/ft)	0.0060											
Bankfull Slope (ft/ft)	0.00582											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.1/2.68/11.8/81.3/ 214.7/>2048		.38/11/29/78.1/ 128 /512		0.25/4.89/26.9/79.5 /151.8/362		0.19/5.60/25.0/120.7 /202.4/362					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Table 12c. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

T2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	9.1		9.0		9.0		9.0					
Floodprone Width (ft)	100		100		100		100					
Bankfull Mean Depth	0.7		0.7		0.7		0.7					
Bankfull Max Depth	1.2		1.3		1.2		1.3					
Bankfull Cross-Sectional Area (ft^2)	6.4		6.2		6.3		6.5					
Width/Depth Ratio	13.2		12.9		12.8		12.5					
Entrenchment Ratio	10.9		11.2		11.1		11.1					
Bank Height Ratio	1.0		<1.0		<1.0		1.0					
Profile												
Riffle Length (ft)	16	61										
Riffle Slope (ft/ft)	0.006	0.073										
Pool Length (ft)	12.0	55.0										
Pool Max Depth (ft)	1.6	3.8										
Pool Spacing (ft)	27	71										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	27	90										
Radius of Curvature (ft)	21	32										
Rc:Bankfull Width (ft/ft)	2.0	3.0										
Meander Wave Length (ft)	80	159										
Meander Width Ratio	2.5	8.5										
Additional Reach Parameters												
Rosgen Classification	B4/C4											
Channel Thalweg Length (ft)	591											
Sinuosity (ft)	1.2											
Water Surface Slope (ft/ft)	0.0170											
Bankfull Slope (ft/ft)	0.0170											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.25/16/32.7/80.3/ 227.6/1024		SC/0.35/24.4/80.3/ 123.1/256		0.27/7.10/25.7/75.9 /143.4/256		0.08/.0.34/18.0/94.1 /168.1/256					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Table 12d. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

T3 Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	14.4		14.1		13.8		14.6					
Floodprone Width (ft)	300		300		300		300					
Bankfull Mean Depth	1.1		1.1		1.1		1.0					
Bankfull Max Depth	2.0		2.0		1.9		1.9					
Bankfull Cross-Sectional Area (ft^2)	15.3		15.7		14.7		15.1					
Width/Depth Ratio	13.6		12.6		13.0		14.2					
Entrenchment Ratio	20.8		21.3		21.7		20.5					
Bank Height Ratio	1.0		1.0		<1.0		<1.0					
Profile												
Riffle Length (ft)	8	56										
Riffle Slope (ft/ft)	0.004	0.036										
Pool Length (ft)	13.0	65.0										
Pool Max Depth (ft)	1.7	3.0										
Pool Spacing (ft)	30	81										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	24	82										
Radius of Curvature (ft)	19	29										
Rc:Bankfull Width (ft/ft)	2.0	3.0										
Meander Wave Length (ft)	72	144										
Meander Width Ratio	2.5	8.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	903											
Sinuosity (ft)	1.2											
Water Surface Slope (ft/ft)	0.0159											
Bankfull Slope (ft/ft)	0.0155											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.28/10.32/21.5/ 103.6/193.1/512		SC/SC/1.7/64/128/180		SC/0.39/16.0/64.0 /113.8/180		SC/0.20/8.7/47.7 /68.5/128					
% of Reach with Eroding Banks	11%		0%		0%		0%					

Table 12e. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

T4

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	6.7		6.4		6.3		6.9					
Floodprone Width (ft)	150		150		150		150					
Bankfull Mean Depth	0.5		0.4		0.5		0.6					
Bankfull Max Depth	1.0		0.7		0.9		1.0					
Bankfull Cross-Sectional Area (ft^2)	3.6		2.8		3.2		3.8					
Width/Depth Ratio	12.3		14.3		12.6		12.3					
Entrenchment Ratio	22.3		23.6		23.6		21.8					
Bank Height Ratio	1.0		<1.0		<1.0		1.0					
Profile												
Riffle Length (ft)	20	55										
Riffle Slope (ft/ft)	0.001	0.046										
Pool Length (ft)	9.0	38.0										
Pool Max Depth (ft)	1.4	2.7										
Pool Spacing (ft)	23	66										
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	B4											
Channel Thalweg Length (ft)	982											
Sinuosity (ft)	1.1											
Water Surface Slope (ft/ft)	0.0239											
Bankfull Slope (ft/ft)	0.0244											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.16/0.55/5.6/107.3/ 155.5/256		SC/.19/1/71.7/115.7/ 362		0.35/6.40/13.0/55.0 /107.3/180		SC/0.25/28.5/103.1 /165.3/362					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Table 12f. Monitoring Data - Stream Reach Data Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

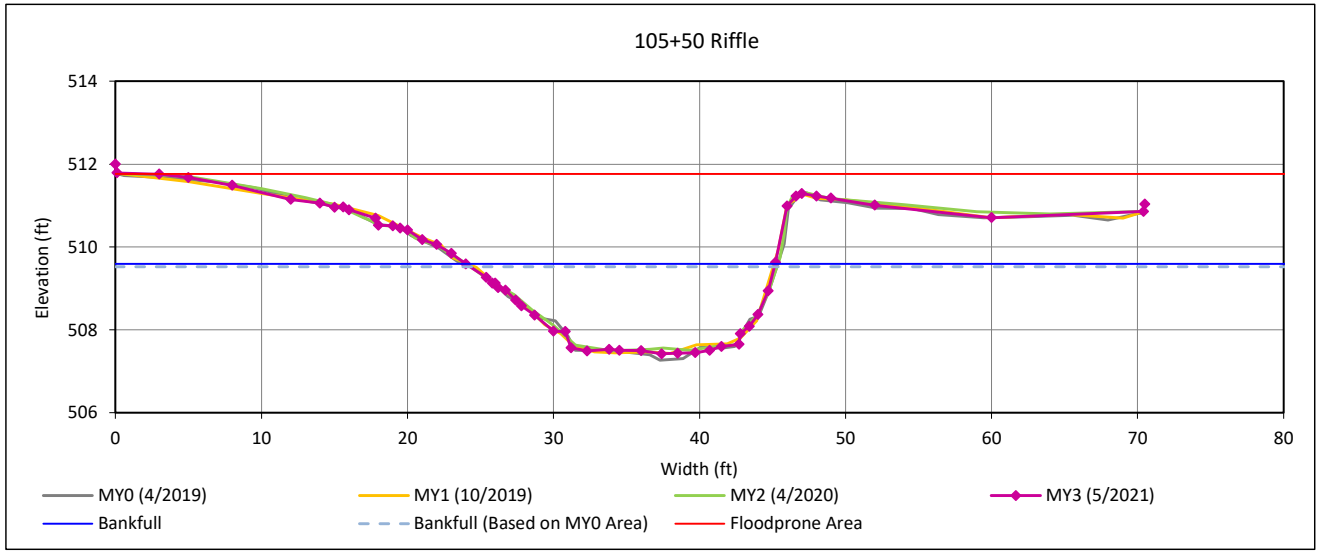
T5

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY5		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle												
Bankfull Width (ft)	6.1	8.6	6.6	8.0	7.5	8.5	6.0	8.2				
Floodprone Width (ft)	100	200	100	200	100	200	100	200				
Bankfull Mean Depth	0.8	1.0	0.6	1.0	0.7	0.9	0.9					
Bankfull Max Depth	1.1	1.5	1.0	1.5	1.2	1.4	1.2	1.5				
Bankfull Cross-Sectional Area (ft^2)	8.1	8.5	3.9	7.8	5.4	8.0	5.3	7.7				
Width/Depth Ratio	4.5	8.7	8.1	11.2	9.1	10.4	6.8	8.8				
Entrenchment Ratio	11.7	33.0	12.6	30.1	11.7	26.7	12.2	33.3				
Bank Height Ratio	1.0		<1.0	1.0	<1.0	1.1	<1.0	1.1				
Profile												
Riffle Length (ft)	13	40										
Riffle Slope (ft/ft)	0.015	0.023										
Pool Length (ft)	36.0	71.0										
Pool Max Depth (ft)	1.5	3.1										
Pool Spacing (ft)	16	51										
Pool Volume (ft^3)												
Pattern												
Channel Beltwidth (ft)	29	82										
Radius of Curvature (ft)	18	28										
Rc:Bankfull Width (ft/ft)	2.0	3.0										
Meander Wave Length (ft)	49	136										
Meander Width Ratio	3.0	8.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Channel Thalweg Length (ft)	1,295											
Sinuosity (ft)	1.3											
Water Surface Slope (ft/ft)	0.0138											
Bankfull Slope (ft/ft)	0.0136											
Ri%/Ru%/P%/G%/S%												
SC%/Sa%/G%/C%/B%/Be%												
d16/d35/d50/d84/d95/d100	0.16/5.60/17.3/80.3/ 120.1/180		0.84/8.37/20.1/90/ 180 />2048		0.13/2.57/7.2/56.9 /101.2/180.0		SC/1.00/16.7/64.0 /87.5/128.0					
% of Reach with Eroding Banks	0%		0%		0%		0%					

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 1 - Buckwater Creek Reach 2



Bankfull Dimensions	
33.4	x-section area (ft.sq.)
21.2	width (ft)
1.6	mean depth (ft)
2.2	max depth (ft)
22.4	wetted perimeter (ft)
1.5	hydraulic radius (ft)
13.4	width-depth ratio
200.0	W flood prone area (ft)
9.4	entrenchment ratio
1.0	low bank height ratio

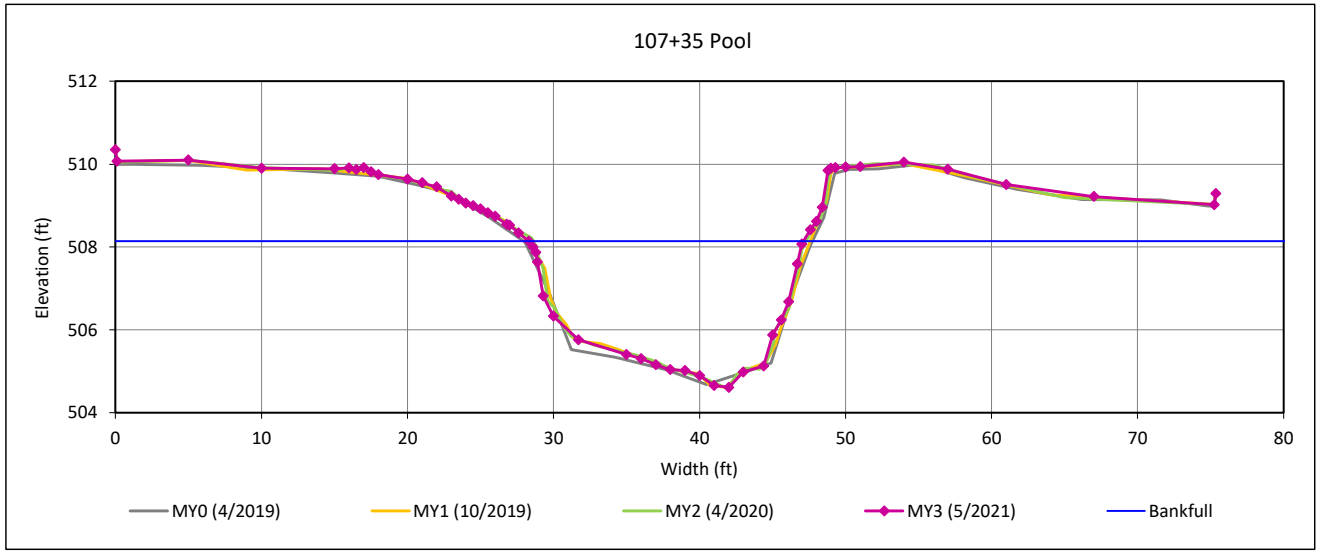
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 2 - Buckwater Creek Reach 3



Bankfull Dimensions	
47.5	x-section area (ft.sq.)
18.7	width (ft)
2.5	mean depth (ft)
3.5	max depth (ft)
21.2	wetted perimeter (ft)
2.2	hydraulic radius (ft)
7.4	width-depth ratio

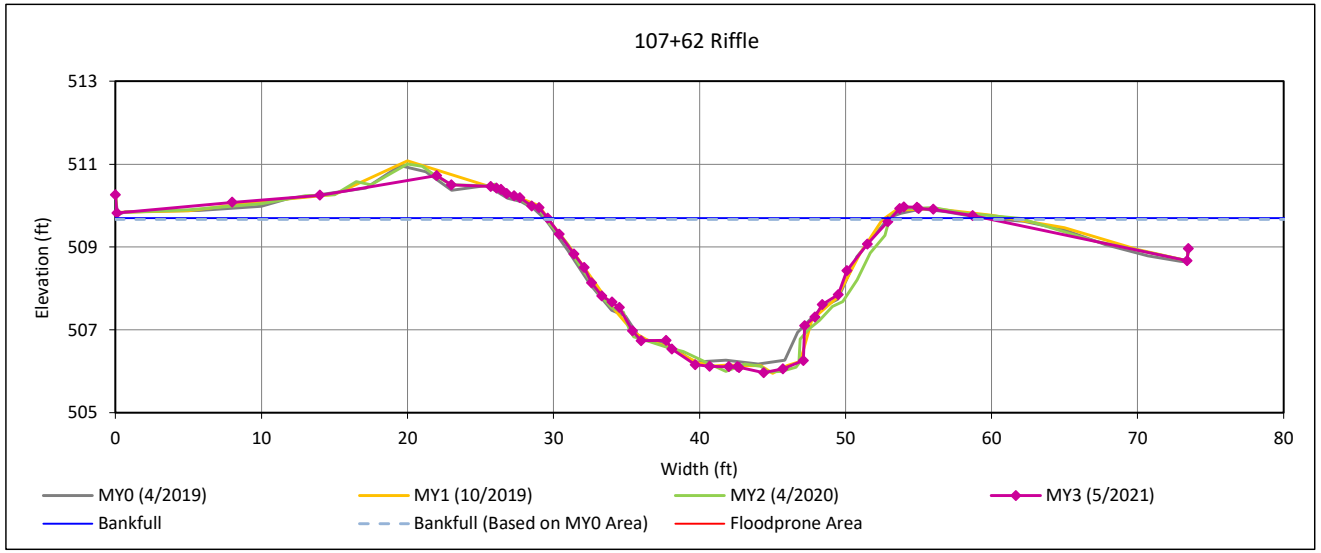
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 3 - Buckwater Creek Reach 3



Bankfull Dimensions	
56.2	x-section area (ft.sq.)
23.5	width (ft)
2.4	mean depth (ft)
3.7	max depth (ft)
25.9	wetted perimeter (ft)
2.2	hydraulic radius (ft)
9.9	width-depth ratio
150.0	W flood prone area (ft)
6.4	entrenchment ratio
1.0	low bank height ratio

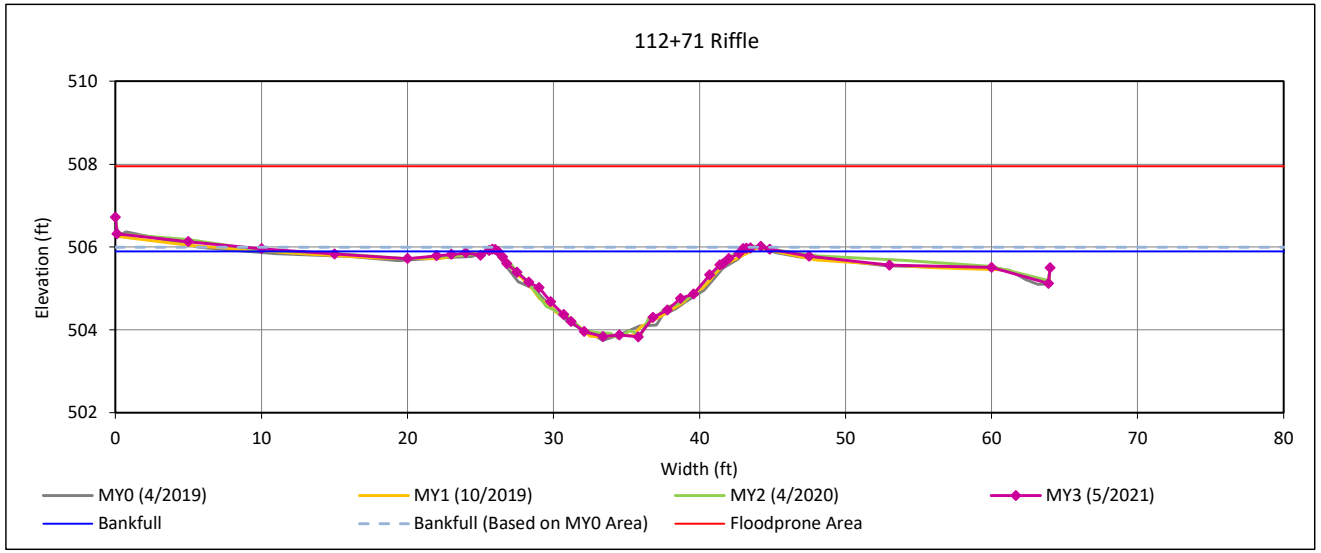
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 4 - Buckwater Creek Reach 4



Bankfull Dimensions	
20.2	x-section area (ft.sq.)
16.6	width (ft)
1.2	mean depth (ft)
2.1	max depth (ft)
17.3	wetted perimeter (ft)
1.2	hydraulic radius (ft)
13.6	width-depth ratio
150.0	W flood prone area (ft)
9.0	entrenchment ratio
< 1.0	low bank height ratio

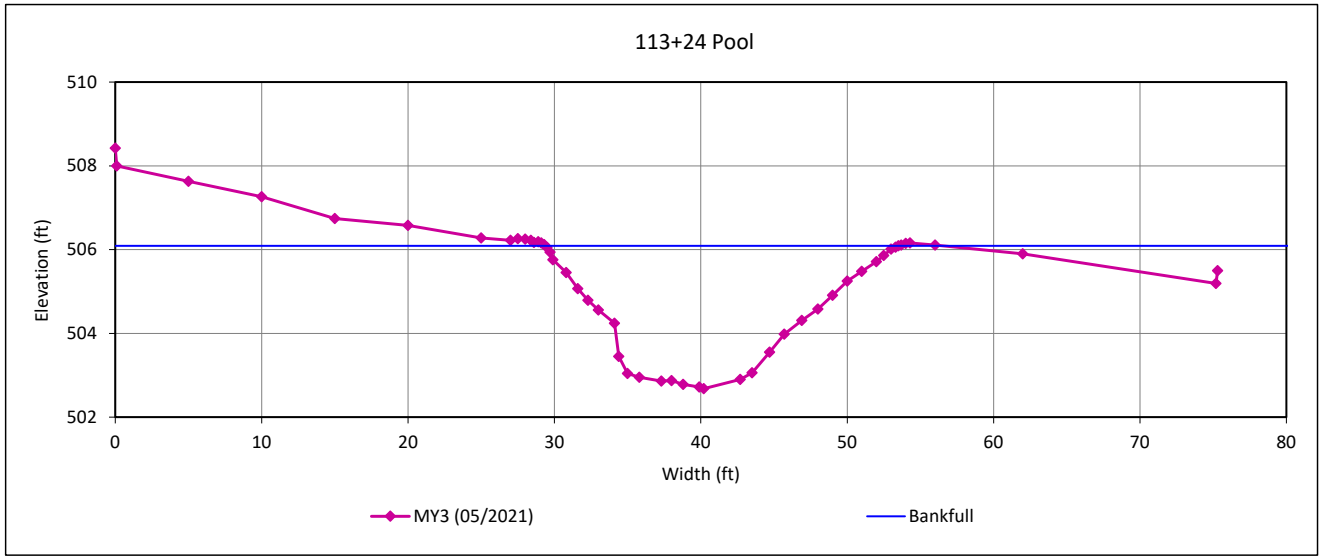
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 5 - Buckwater Creek Reach 4



Bankfull Dimensions	
48.4	x-section area (ft.sq.)
24.1	width (ft)
2.0	mean depth (ft)
3.4	max depth (ft)
25.7	wetted perimeter (ft)
1.9	hydraulic radius (ft)
12.0	width-depth ratio

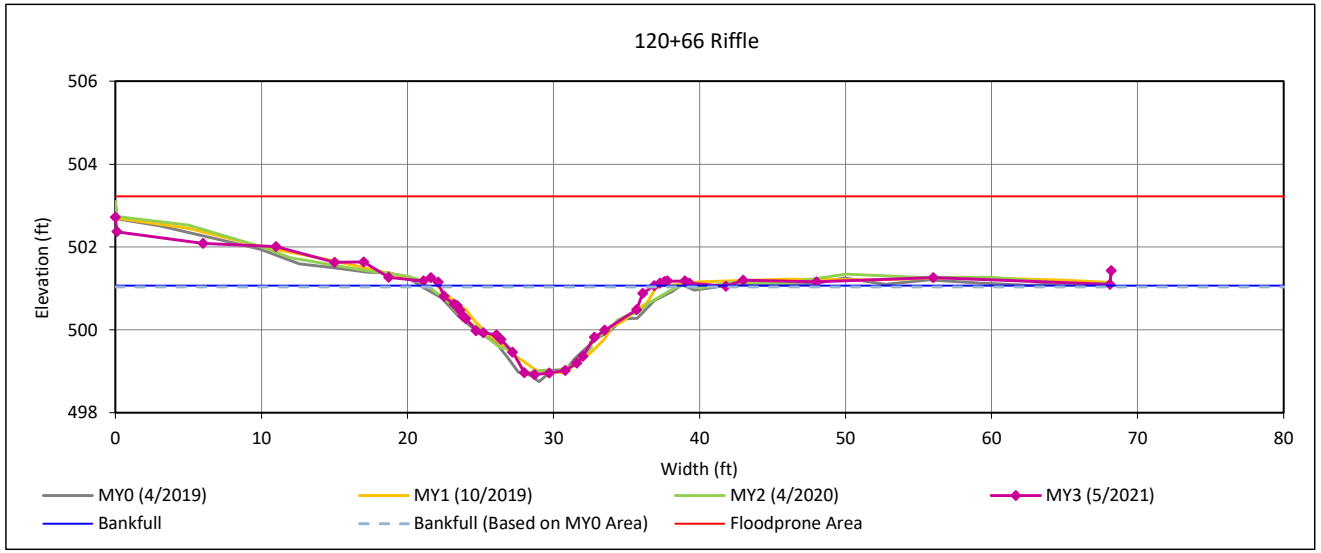
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 6 - Buckwater Creek Reach 4



Bankfull Dimensions	
18.3	x-section area (ft.sq.)
14.7	width (ft)
1.2	mean depth (ft)
2.2	max depth (ft)
15.6	wetted perimeter (ft)
1.2	hydraulic radius (ft)
11.8	width-depth ratio
200.0	W flood prone area (ft)
13.6	entrenchment ratio
1.0	low bank height ratio

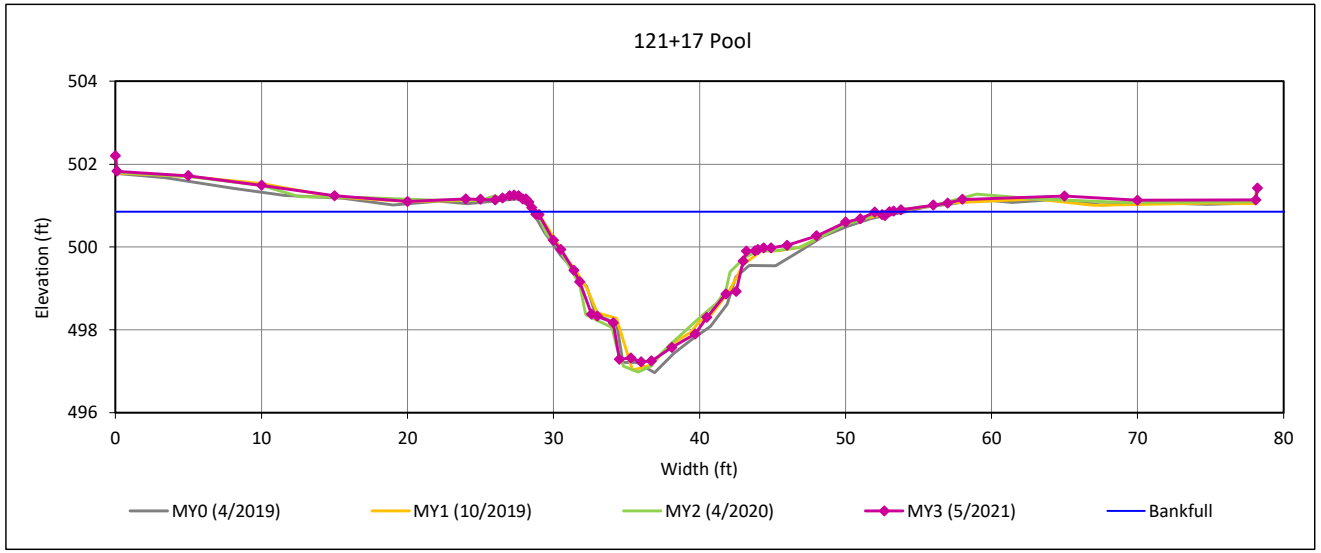
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 7 - Buckwater Creek Reach 4



Bankfull Dimensions	
39.4	x-section area (ft.sq.)
24.3	width (ft)
1.6	mean depth (ft)
3.6	max depth (ft)
26.5	wetted perimeter (ft)
1.5	hydraulic radius (ft)
15.0	width-depth ratio

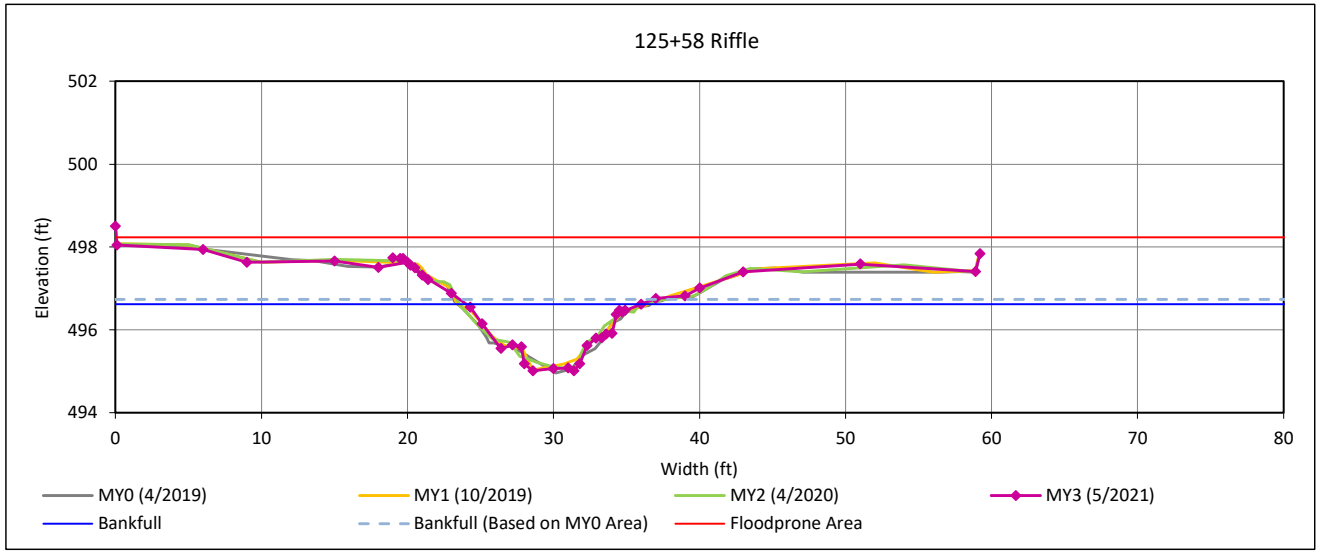
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 8 - Buckwater Creek Reach 4



Bankfull Dimensions	
11.1	x-section area (ft.sq.)
12.0	width (ft)
0.9	mean depth (ft)
1.6	max depth (ft)
13.0	wetted perimeter (ft)
0.9	hydraulic radius (ft)
12.9	width-depth ratio
200.0	W flood prone area (ft)
16.7	entrenchment ratio
< 1.0	low bank height ratio

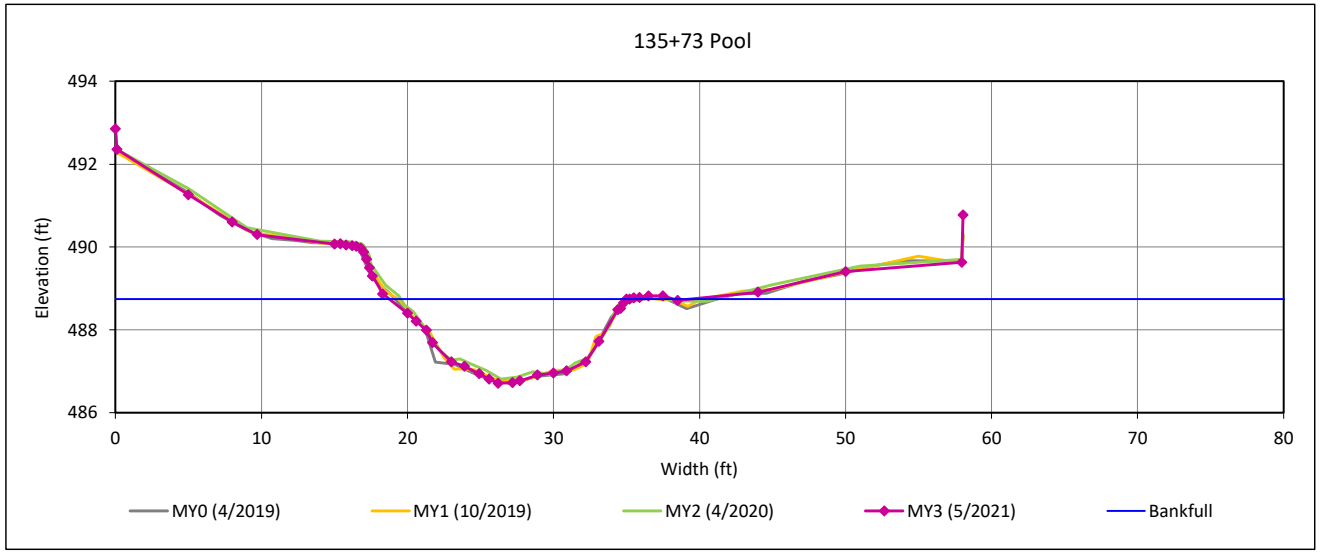
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 9 - Buckwater Creek Reach 5



Bankfull Dimensions	
21.6	x-section area (ft.sq.)
16.2	width (ft)
1.3	mean depth (ft)
2.0	max depth (ft)
17.0	wetted perimeter (ft)
1.3	hydraulic radius (ft)
12.2	width-depth ratio

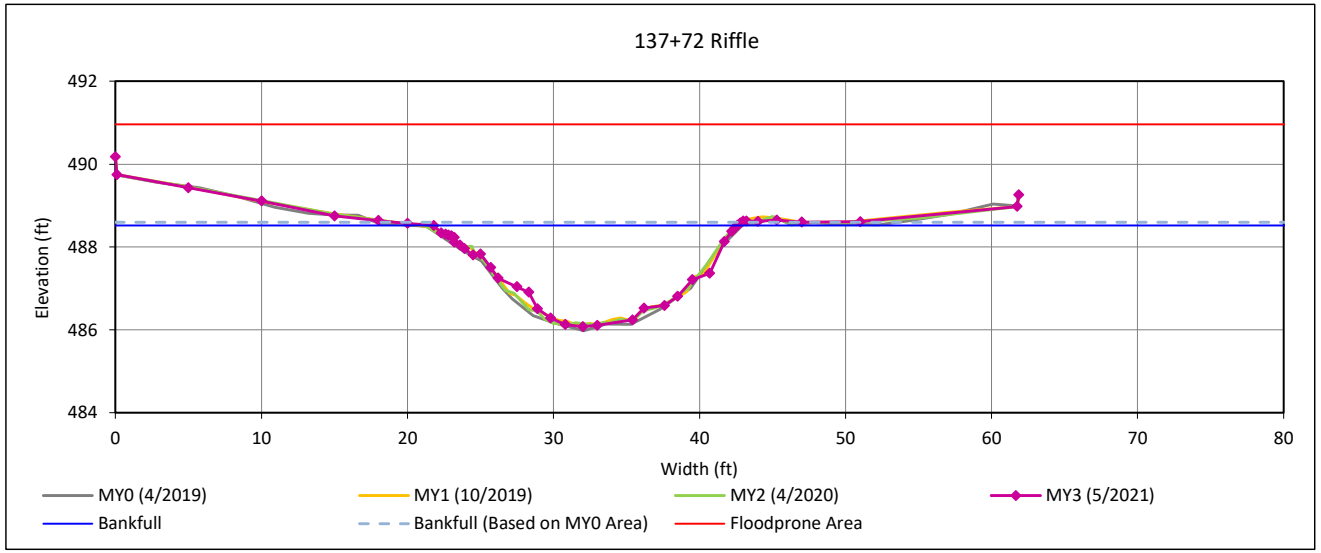
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 10 - Buckwater Creek Reach 5



Bankfull Dimensions	
31.8	x-section area (ft.sq.)
20.8	width (ft)
1.5	mean depth (ft)
2.4	max depth (ft)
21.8	wetted perimeter (ft)
1.5	hydraulic radius (ft)
13.6	width-depth ratio
200.0	W flood prone area (ft)
9.6	entrenchment ratio
< 1.0	low bank height ratio

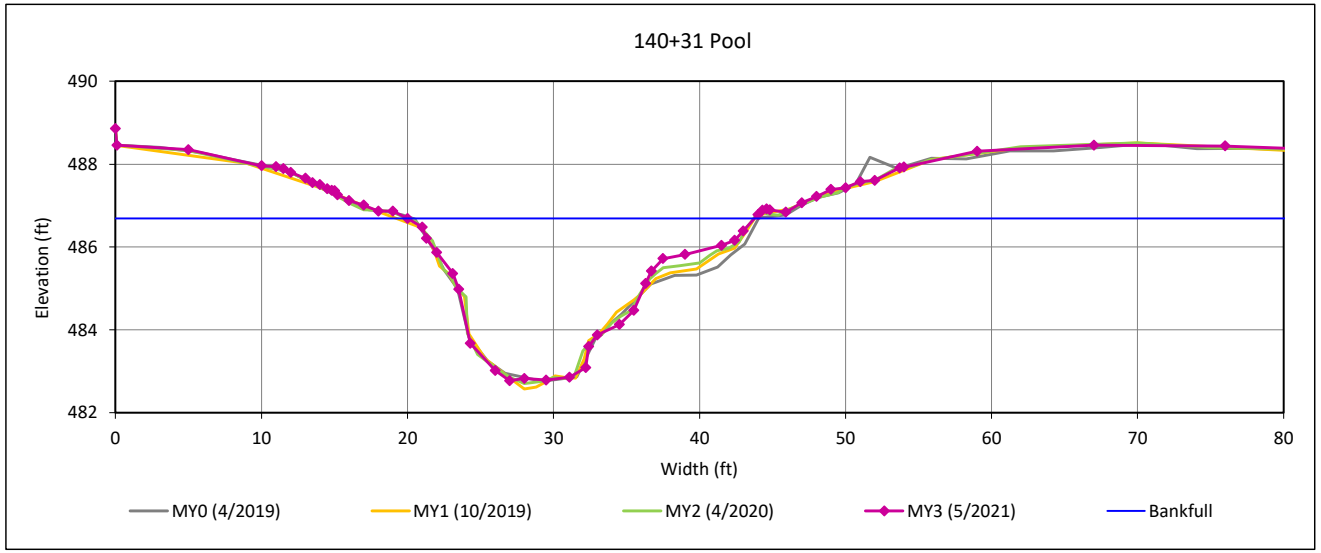
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 11 - Buckwater Creek Reach 6



Bankfull Dimensions	
49.8	x-section area (ft.sq.)
23.8	width (ft)
2.1	mean depth (ft)
3.9	max depth (ft)
26.1	wetted perimeter (ft)
1.9	hydraulic radius (ft)
11.3	width-depth ratio

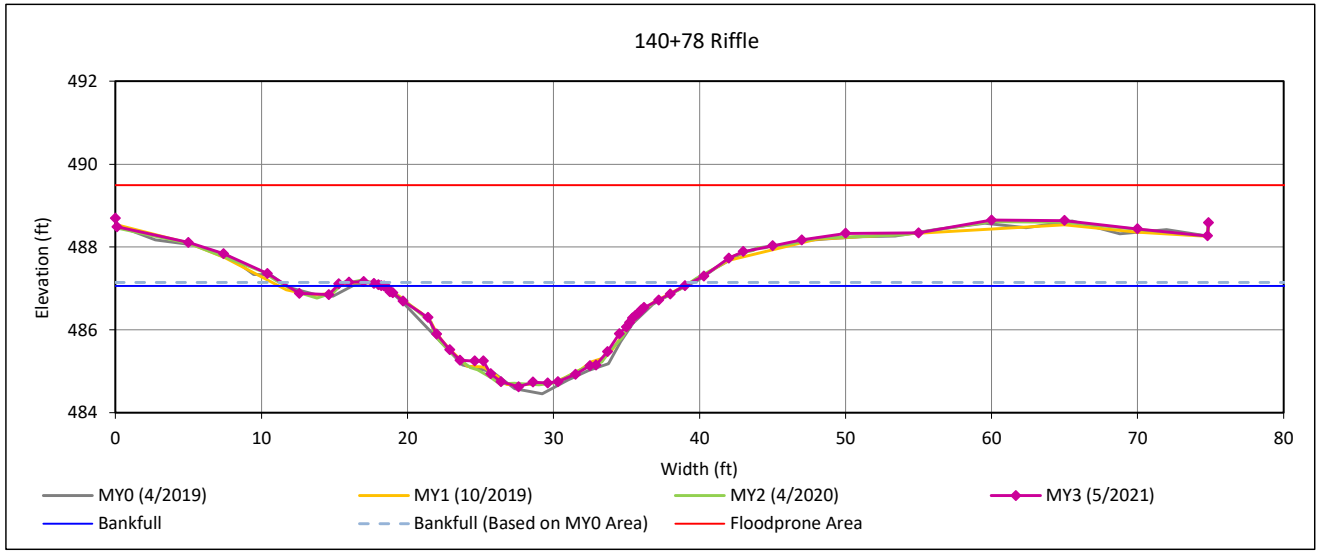
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 12 - Buckwater Creek Reach 6



Bankfull Dimensions	
28.8	x-section area (ft.sq.)
20.6	width (ft)
1.4	mean depth (ft)
2.4	max depth (ft)
21.4	wetted perimeter (ft)
1.3	hydraulic radius (ft)
14.7	width-depth ratio
200.0	W flood prone area (ft)
9.7	entrenchment ratio
< 1.0	low bank height ratio

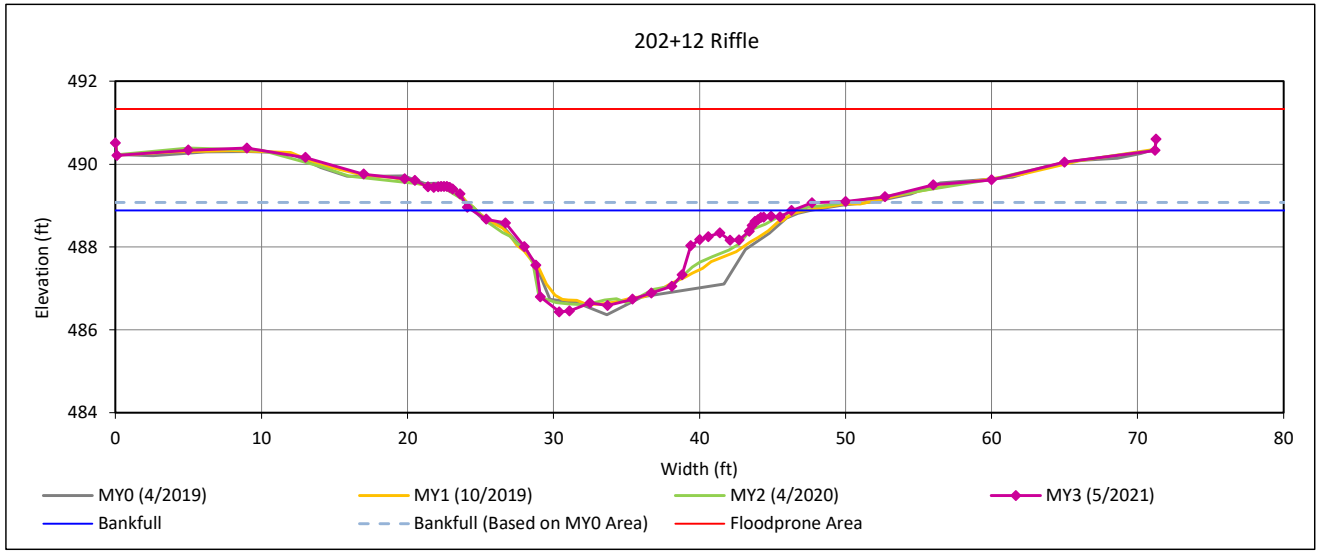
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 13 - T1 Reach 1



Bankfull Dimensions	
27.3	x-section area (ft.sq.)
21.0	width (ft)
1.3	mean depth (ft)
2.5	max depth (ft)
22.4	wetted perimeter (ft)
1.2	hydraulic radius (ft)
16.2	width-depth ratio
150.0	W flood prone area (ft)
7.1	entrenchment ratio
< 1.0	low bank height ratio

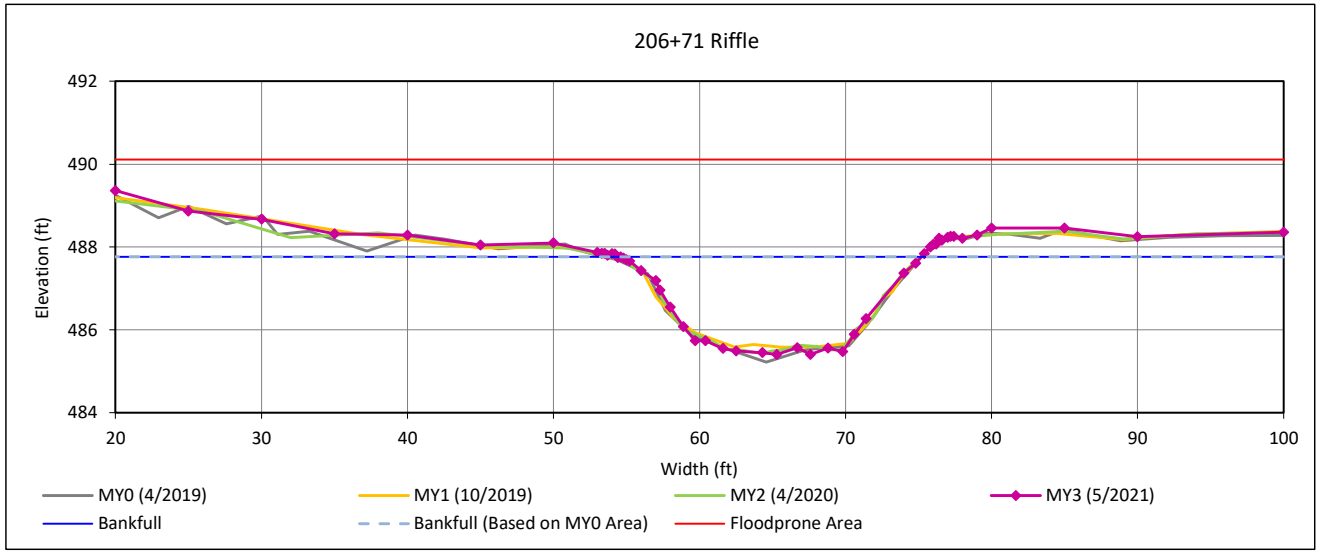
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 14 - T1 Reach 2



Bankfull Dimensions	
32.6	x-section area (ft.sq.)
20.6	width (ft)
1.6	mean depth (ft)
2.3	max depth (ft)
21.6	wetted perimeter (ft)
1.5	hydraulic radius (ft)
13.0	width-depth ratio
200.0	W flood prone area (ft)
9.7	entrenchment ratio
1.0	low bank height ratio

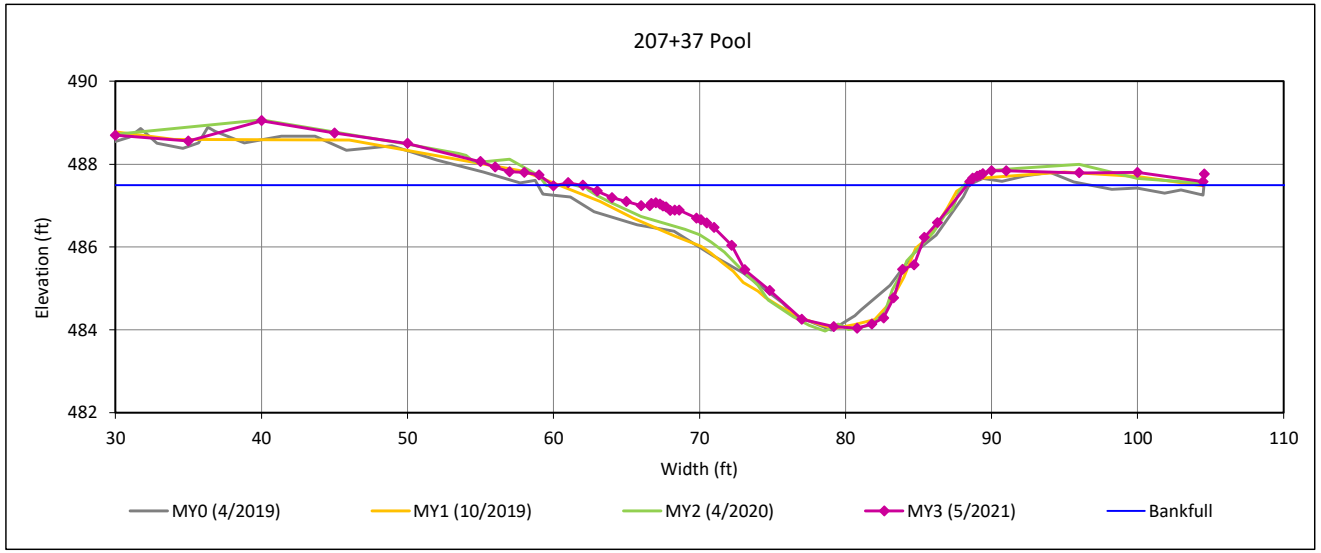
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 15 - T1 Reach 2



Bankfull Dimensions	
44.5	x-section area (ft.sq.)
26.3	width (ft)
1.7	mean depth (ft)
3.4	max depth (ft)
27.9	wetted perimeter (ft)
1.6	hydraulic radius (ft)
15.6	width-depth ratio

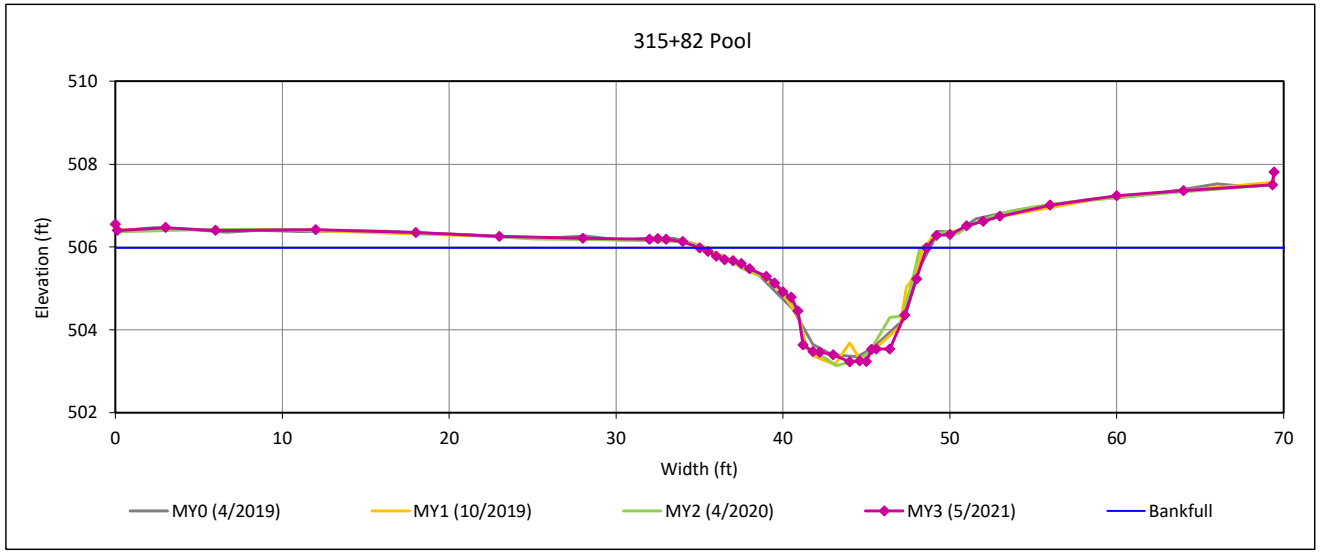
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 16 - T3 Reach 2



Bankfull Dimensions	
20.1	x-section area (ft.sq.)
13.6	width (ft)
1.5	mean depth (ft)
2.8	max depth (ft)
15.7	wetted perimeter (ft)
1.3	hydraulic radius (ft)
9.2	width-depth ratio

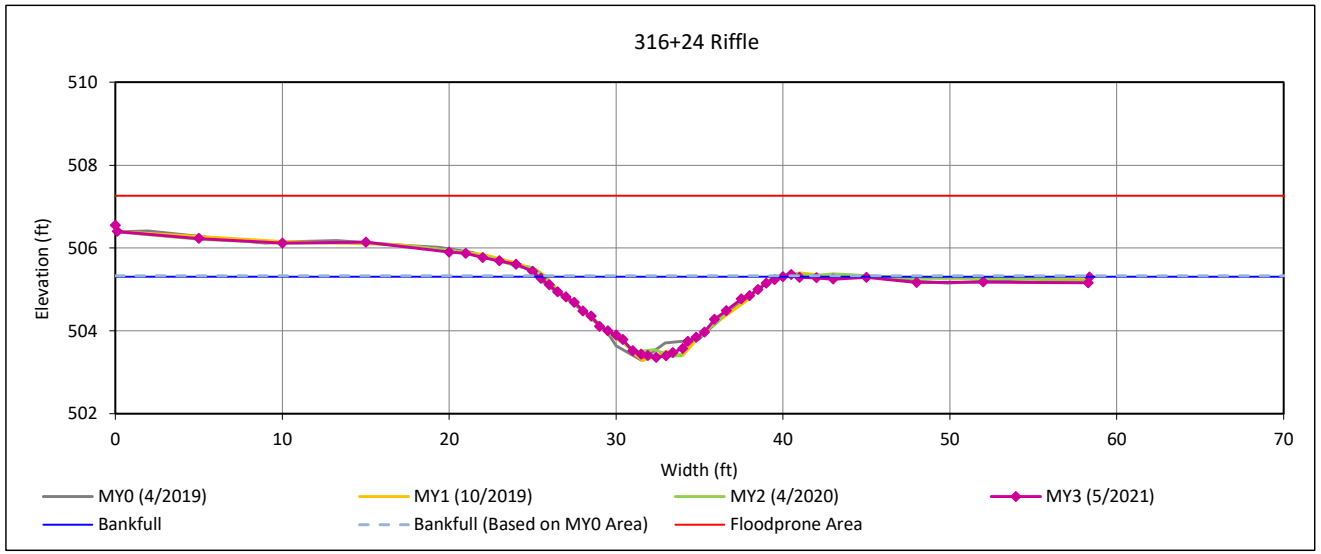
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 17 - T3 Reach 2



Bankfull Dimensions	
15.1	x-section area (ft.sq.)
14.6	width (ft)
1.0	mean depth (ft)
1.9	max depth (ft)
15.2	wetted perimeter (ft)
1.0	hydraulic radius (ft)
14.2	width-depth ratio
300.0	W flood prone area (ft)
20.5	entrenchment ratio
< 1.0	low bank height ratio

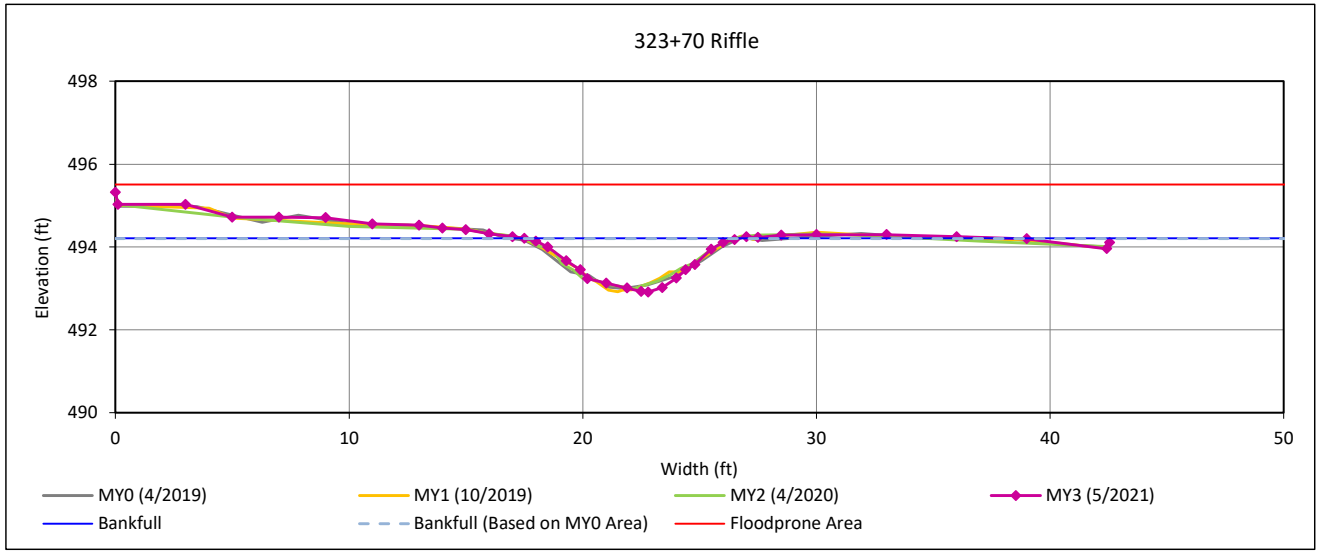
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 18 - T2



Bankfull Dimensions	
6.5	x-section area (ft.sq.)
9.0	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
9.5	wetted perimeter (ft)
0.7	hydraulic radius (ft)
12.5	width-depth ratio
100.0	W flood prone area (ft)
11.1	entrenchment ratio
1.0	low bank height ratio

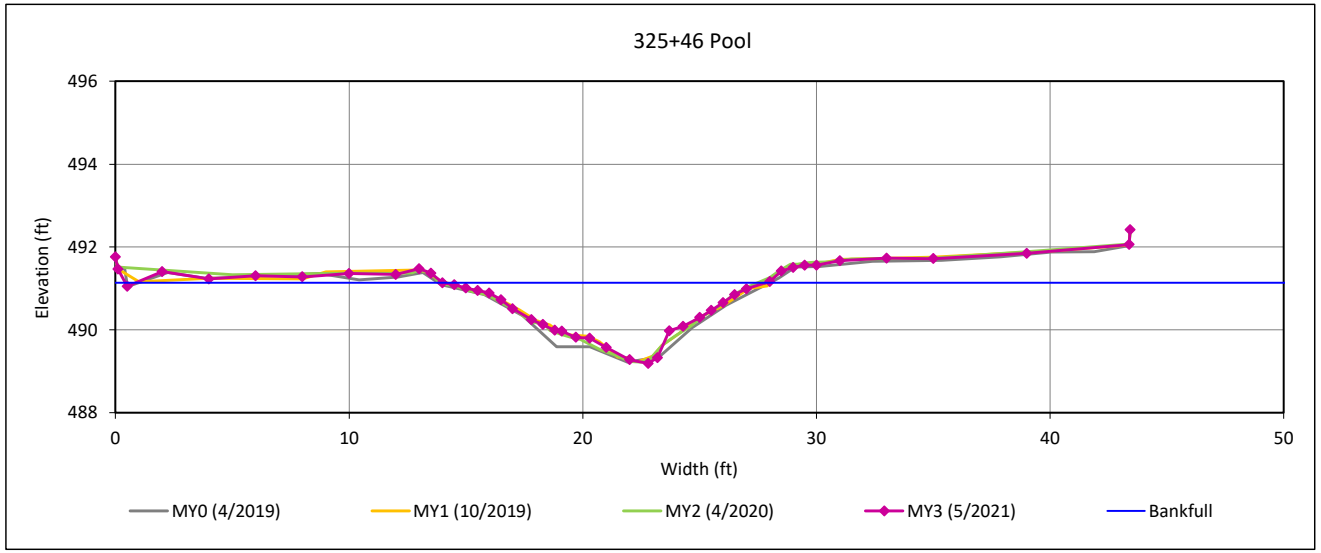
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 19 - T2



Bankfull Dimensions	
12.3	x-section area (ft.sq.)
13.8	width (ft)
0.9	mean depth (ft)
1.9	max depth (ft)
14.6	wetted perimeter (ft)
0.8	hydraulic radius (ft)
15.6	width-depth ratio

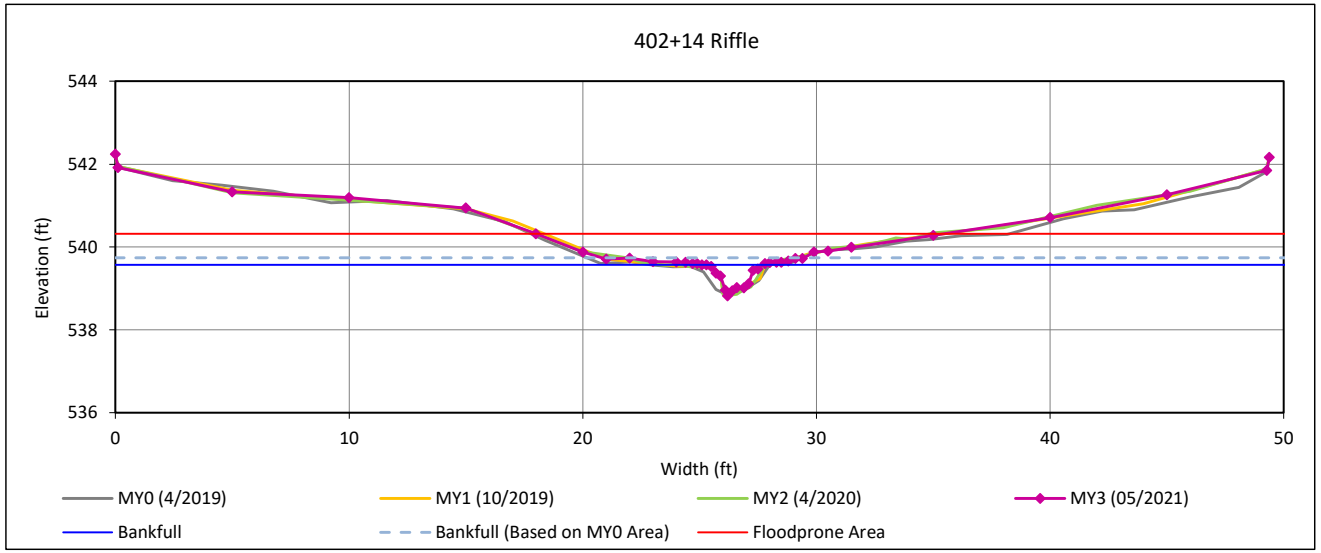
Survey Date: 5/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 20 - T4A Reach 1



Bankfull Dimensions	
0.8	x-section area (ft.sq.)
2.4	width (ft)
0.3	mean depth (ft)
0.8	max depth (ft)
3.1	wetted perimeter (ft)
0.3	hydraulic radius (ft)
7.0	width-depth ratio
20.0	W flood prone area (ft)
8.2	entrenchment ratio
< 1.0	low bank height ratio

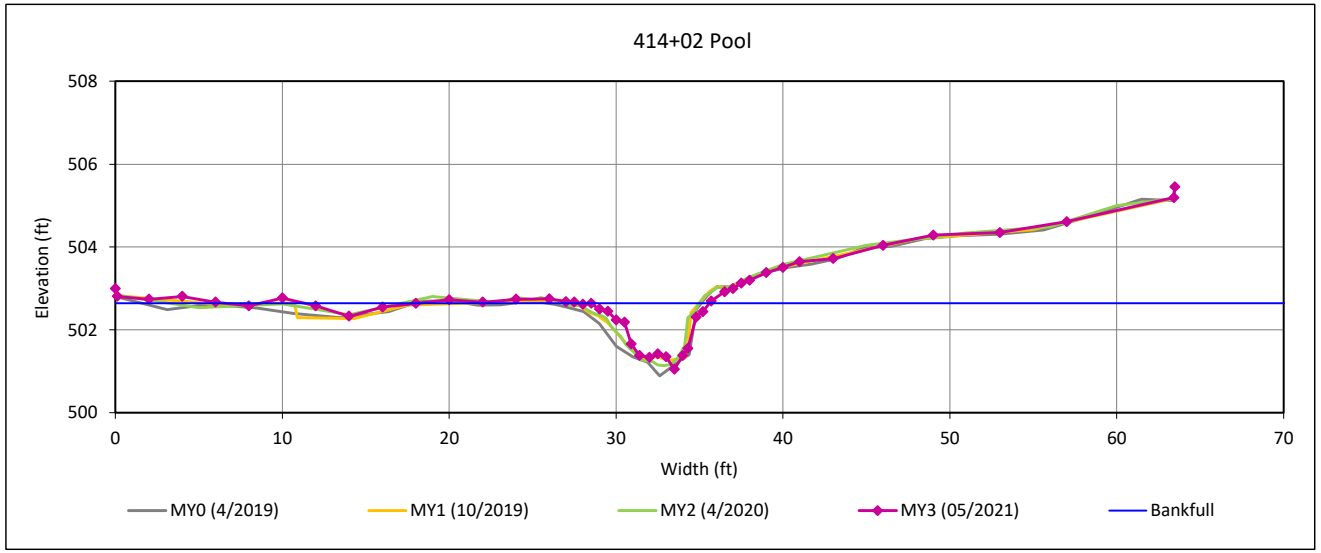
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 21 - T4



Bankfull Dimensions	
5.6	x-section area (ft.sq.)
7.1	width (ft)
0.8	mean depth (ft)
1.6	max depth (ft)
8.2	wetted perimeter (ft)
0.7	hydraulic radius (ft)
8.9	width-depth ratio

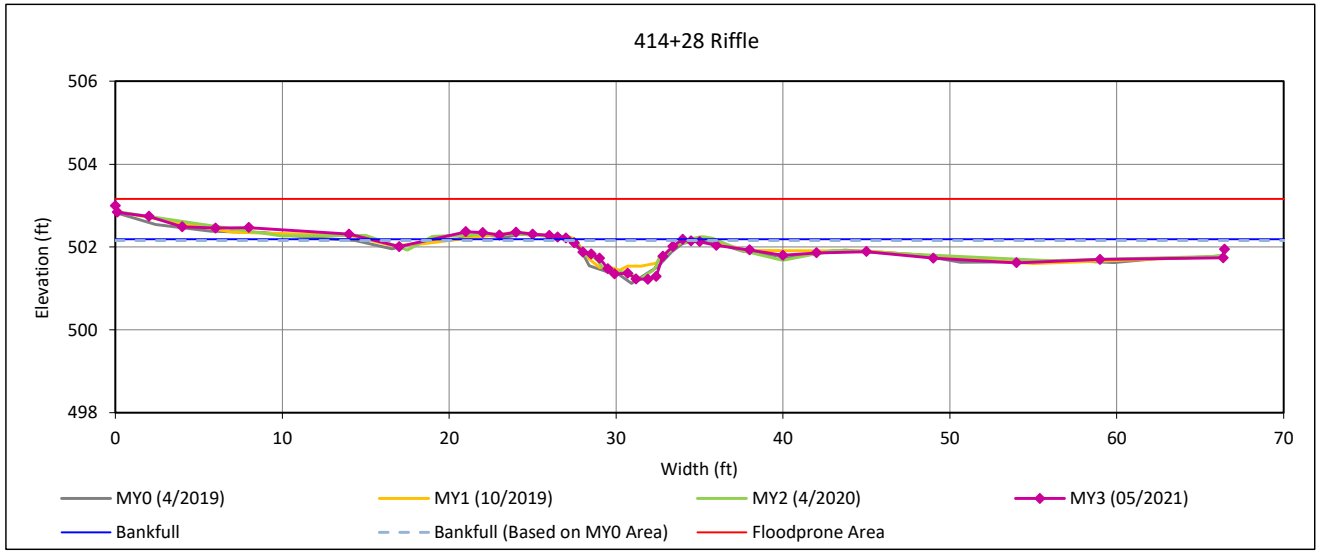
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 22 - T4



Bankfull Dimensions	
3.8	x-section area (ft.sq.)
6.9	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
7.4	wetted perimeter (ft)
0.5	hydraulic radius (ft)
12.3	width-depth ratio
150.0	W flood prone area (ft)
21.8	entrenchment ratio
1.0	low bank height ratio

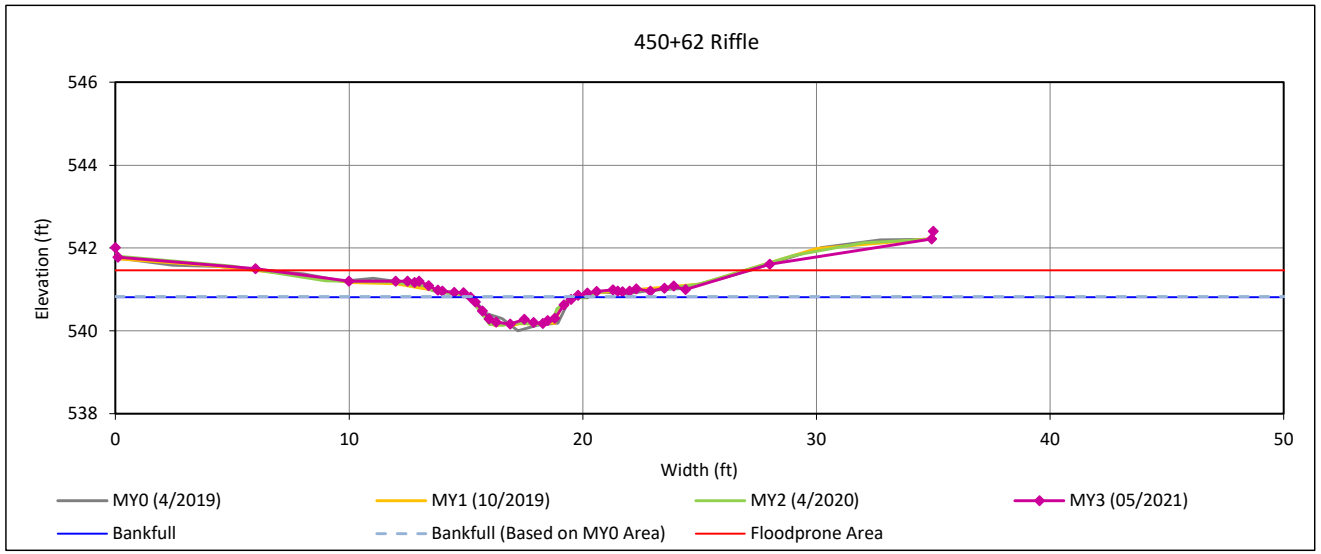
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 23 - T4B Reach 1



Bankfull Dimensions	
2.0	x-section area (ft.sq.)
4.4	width (ft)
0.5	mean depth (ft)
0.6	max depth (ft)
4.8	wetted perimeter (ft)
0.4	hydraulic radius (ft)
9.7	width-depth ratio
25.0	W flood prone area (ft)
5.6	entrenchment ratio
< 1.0	low bank height ratio

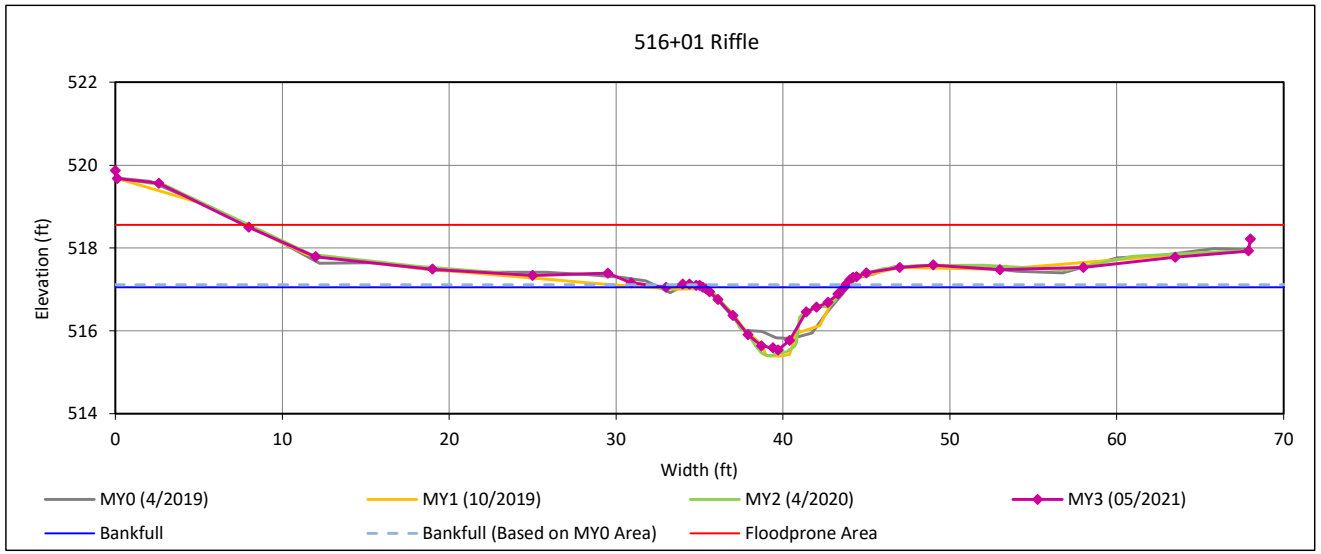
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 24 - T6 Reach 3



Bankfull Dimensions	
6.6	x-section area (ft.sq.)
8.4	width (ft)
0.8	mean depth (ft)
1.5	max depth (ft)
9.1	wetted perimeter (ft)
0.7	hydraulic radius (ft)
10.9	width-depth ratio
100.0	W flood prone area (ft)
11.8	entrenchment ratio
< 1.0	low bank height ratio

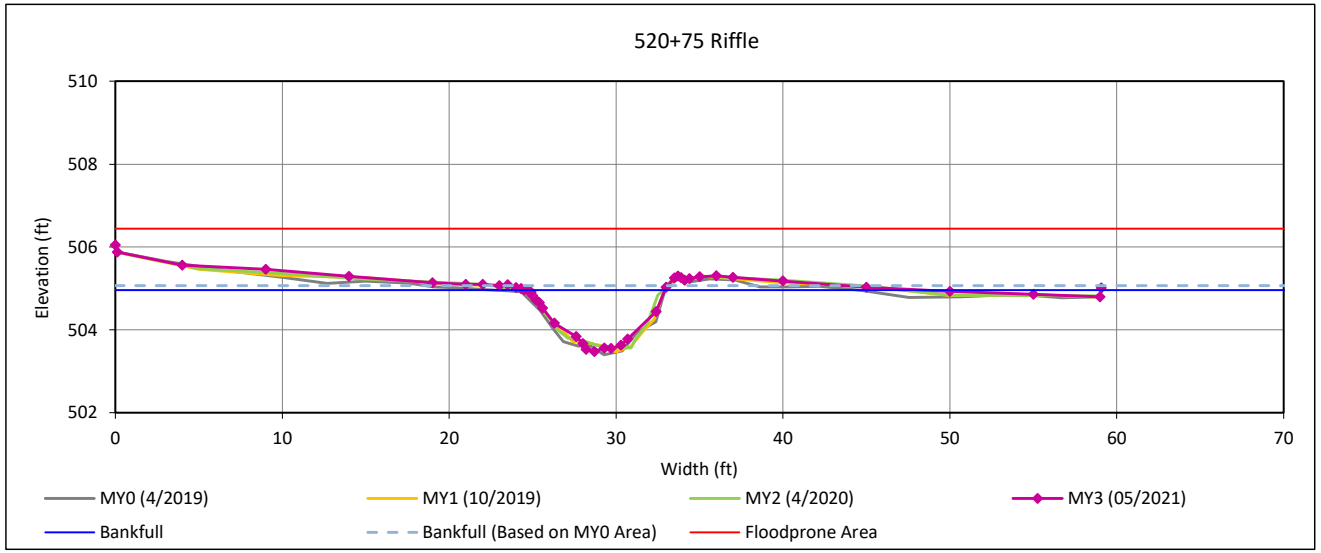
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 25 - T5



Bankfull Dimensions	
7.7	x-section area (ft.sq.)
8.2	width (ft)
0.9	mean depth (ft)
1.5	max depth (ft)
8.9	wetted perimeter (ft)
0.9	hydraulic radius (ft)
8.8	width-depth ratio
100.0	W flood prone area (ft)
12.2	entrenchment ratio
< 1.0	low bank height ratio

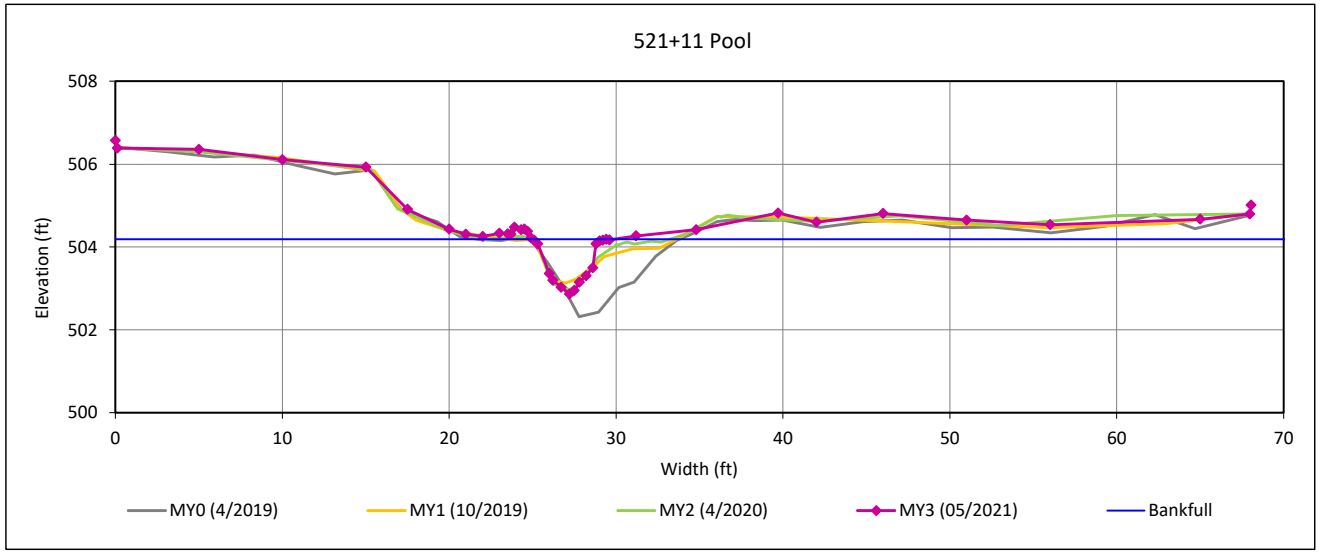
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 26 - T5



Bankfull Dimensions	
3.2	x-section area (ft.sq.)
4.4	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
5.4	wetted perimeter (ft)
0.6	hydraulic radius (ft)
6.0	width-depth ratio

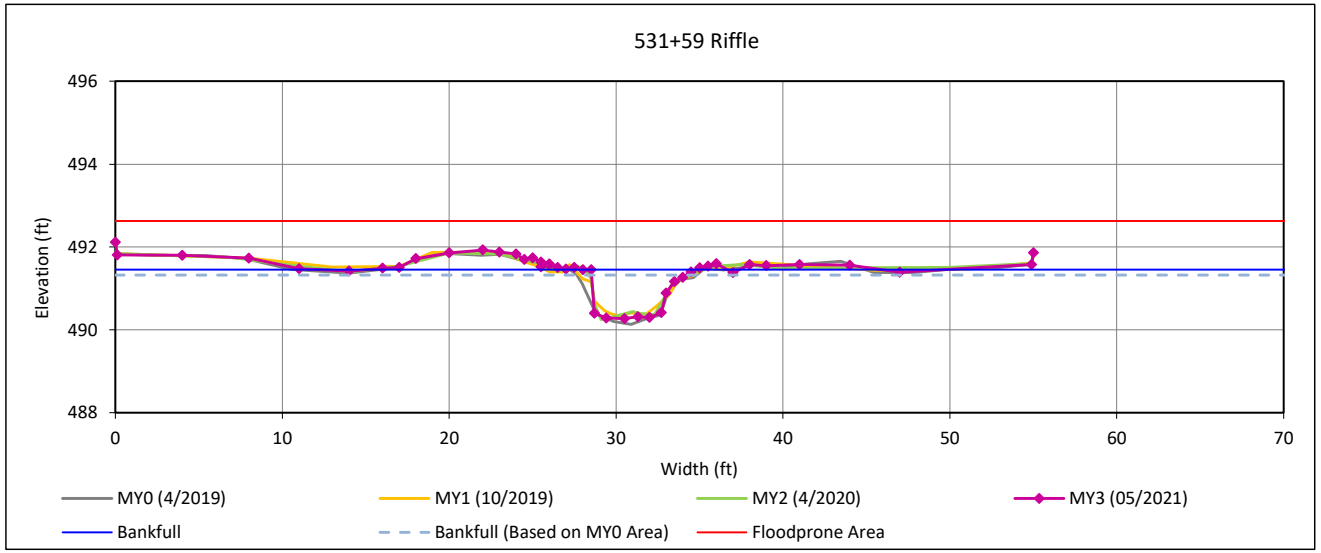
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 27 - T5



Bankfull Dimensions	
5.3	x-section area (ft.sq.)
6.3	width (ft)
0.8	mean depth (ft)
1.2	max depth (ft)
7.5	wetted perimeter (ft)
0.7	hydraulic radius (ft)
7.4	width-depth ratio
200.0	W flood prone area (ft)
32.0	entrenchment ratio
1.1	low bank height ratio

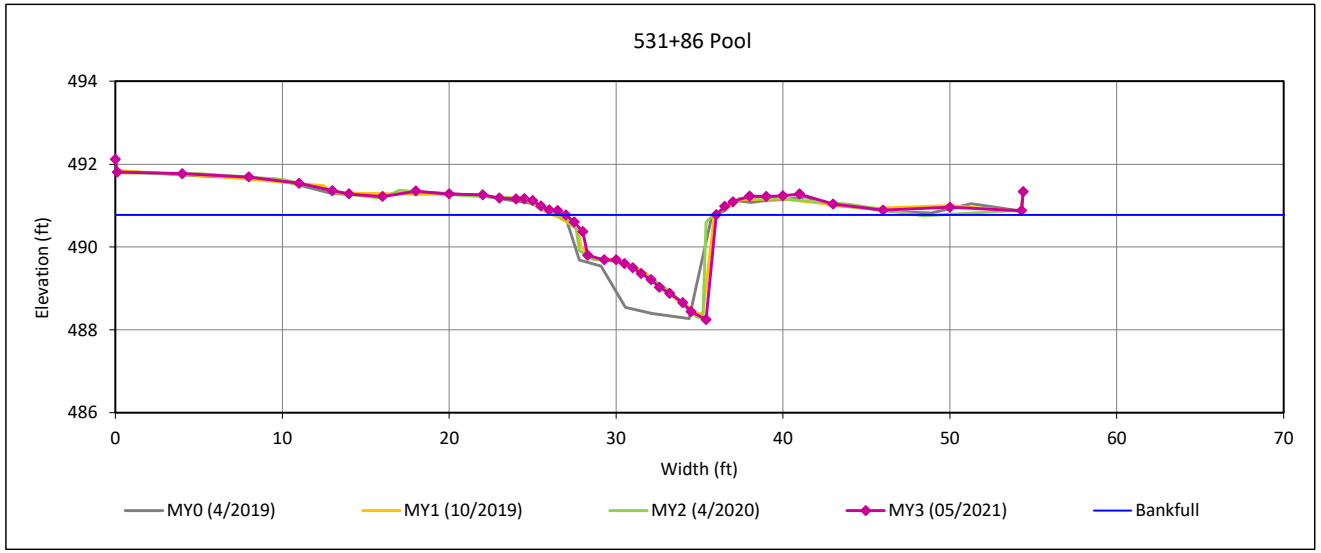
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 28 - T5



Bankfull Dimensions	
12.5	x-section area (ft.sq.)
9.0	width (ft)
1.4	mean depth (ft)
2.5	max depth (ft)
11.6	wetted perimeter (ft)
1.1	hydraulic radius (ft)
6.5	width-depth ratio

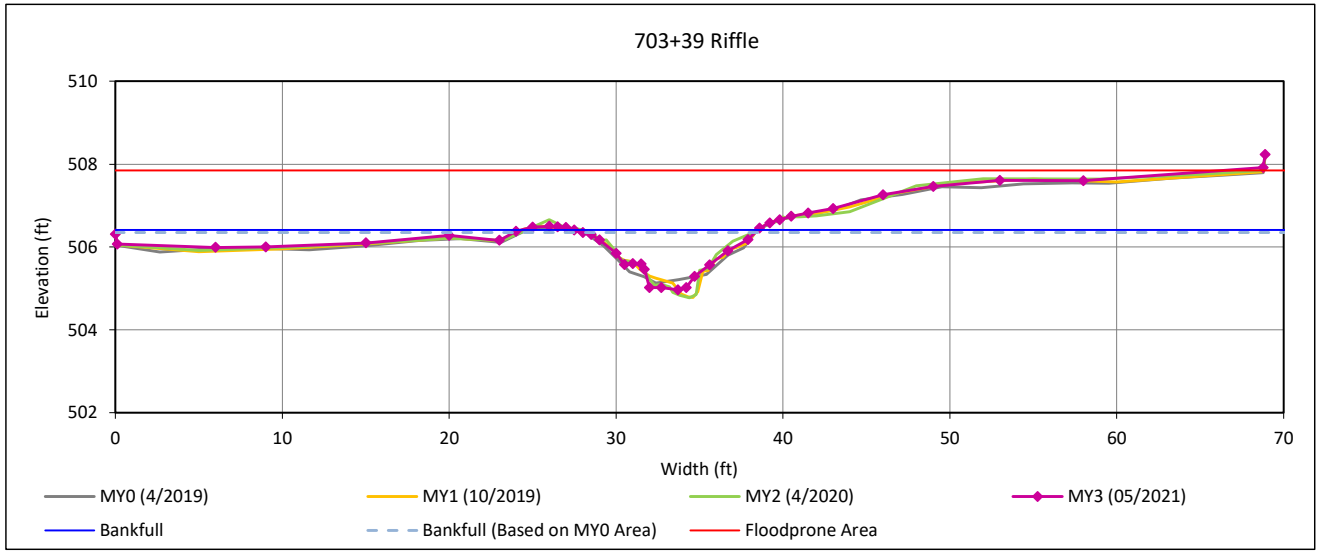
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 29 - T7 Reach 1



Bankfull Dimensions	
8.1	x-section area (ft.sq.)
11.0	width (ft)
0.7	mean depth (ft)
1.4	max depth (ft)
11.6	wetted perimeter (ft)
0.7	hydraulic radius (ft)
14.9	width-depth ratio
100.0	W flood prone area (ft)
9.1	entrenchment ratio
1.0	low bank height ratio

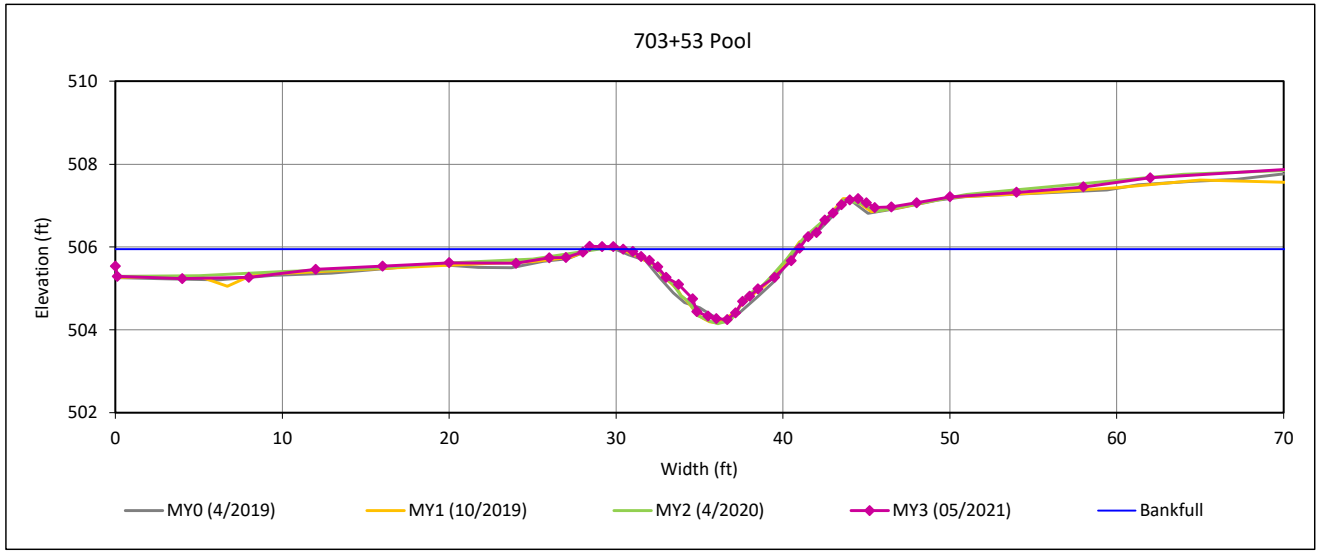
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 30 - T7 Reach 1



Bankfull Dimensions	
9.2	x-section area (ft.sq.)
10.5	width (ft)
0.9	mean depth (ft)
1.7	max depth (ft)
11.3	wetted perimeter (ft)
0.8	hydraulic radius (ft)
12.1	width-depth ratio

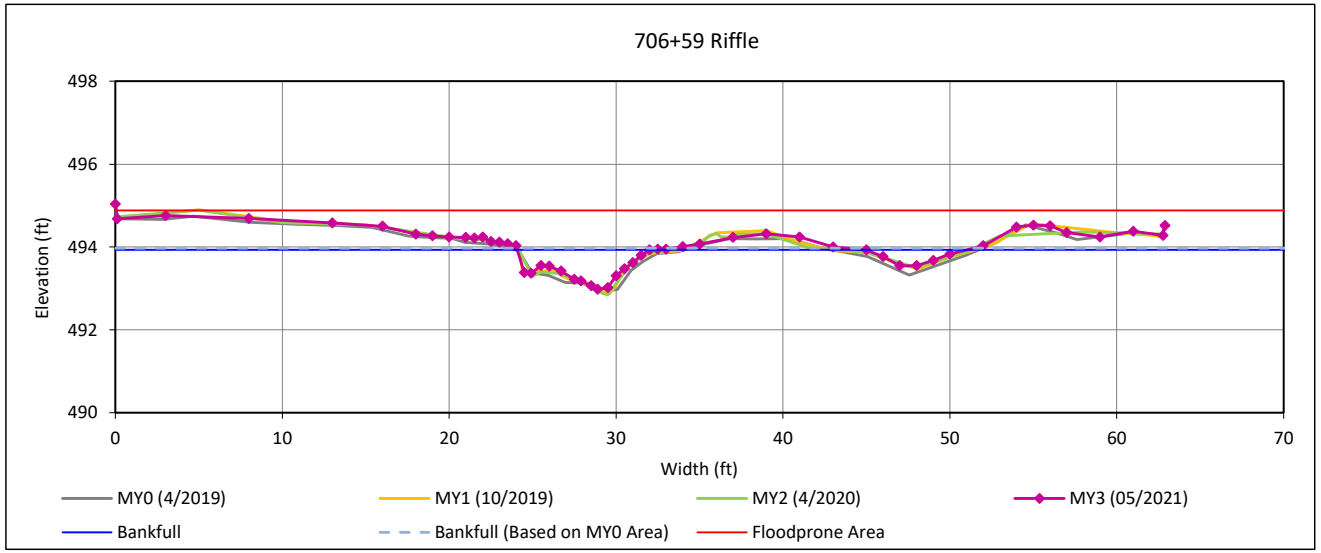
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 31 - T7 Reach 2



Bankfull Dimensions	
4.3	x-section area (ft.sq.)
7.9	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
8.5	wetted perimeter (ft)
0.5	hydraulic radius (ft)
14.6	width-depth ratio
100.0	W flood prone area (ft)
12.6	entrenchment ratio
< 1.0	low bank height ratio

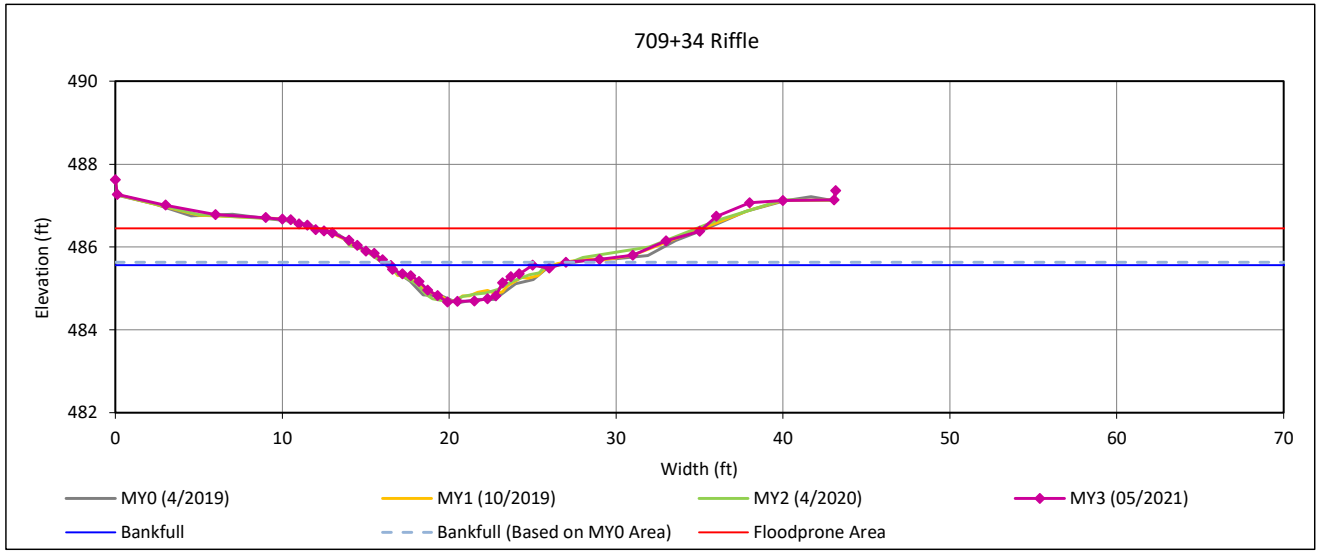
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 32 - T7 Reach 3



Bankfull Dimensions	
4.6	x-section area (ft.sq.)
8.5	width (ft)
0.5	mean depth (ft)
0.9	max depth (ft)
8.8	wetted perimeter (ft)
0.5	hydraulic radius (ft)
15.9	width-depth ratio
25.0	W flood prone area (ft)
2.9	entrenchment ratio
< 1.0	low bank height ratio

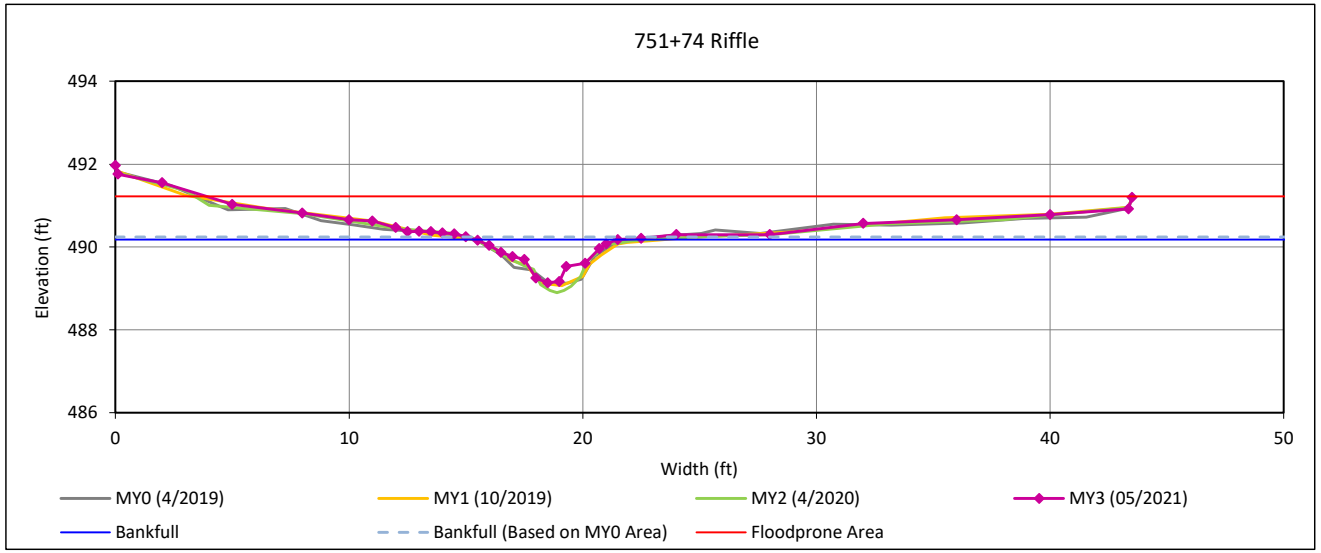
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 33 - T7A



Bankfull Dimensions	
3.0	x-section area (ft.sq.)
6.0	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
6.5	wetted perimeter (ft)
0.5	hydraulic radius (ft)
12.2	width-depth ratio
50.0	W flood prone area (ft)
8.3	entrenchment ratio
< 1.0	low bank height ratio

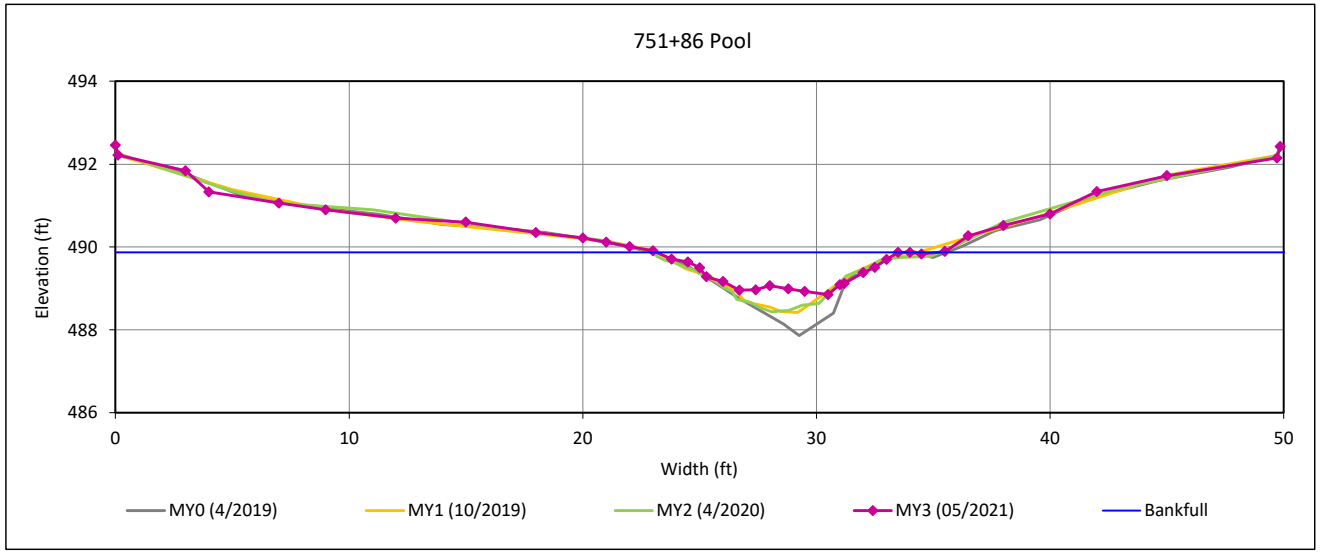
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 34 - T7A



Bankfull Dimensions	
6.4	x-section area (ft.sq.)
10.3	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
10.7	wetted perimeter (ft)
0.6	hydraulic radius (ft)
16.7	width-depth ratio

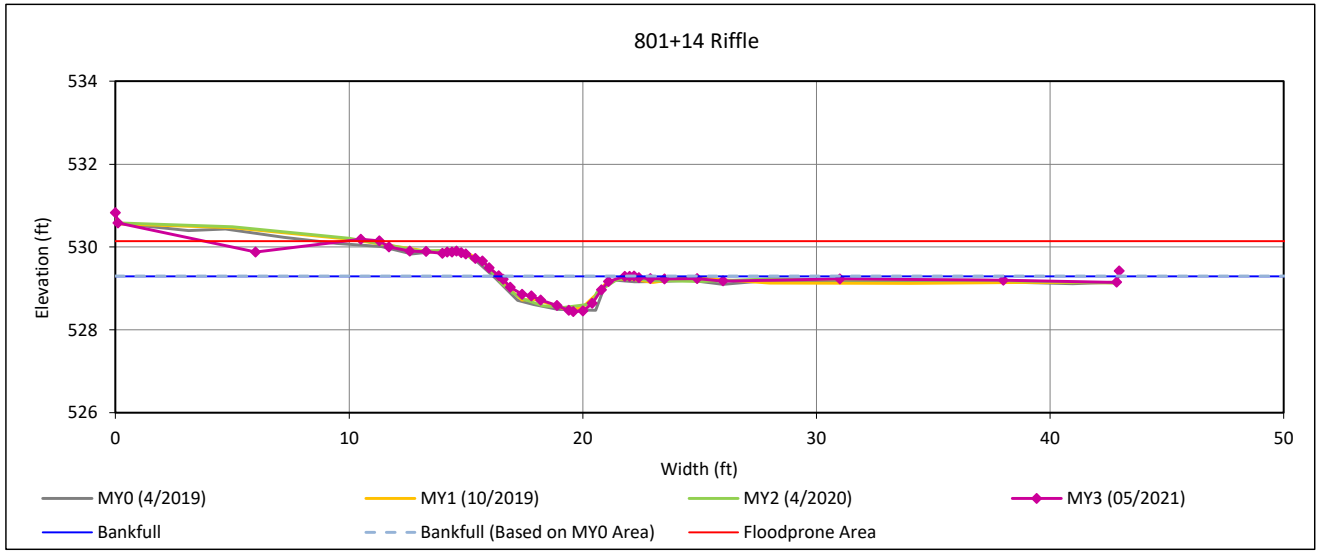
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 35 - T8



Bankfull Dimensions	
2.5	x-section area (ft.sq.)
5.4	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
5.7	wetted perimeter (ft)
0.4	hydraulic radius (ft)
11.3	width-depth ratio
100.0	W flood prone area (ft)
18.7	entrenchment ratio
< 1.0	low bank height ratio

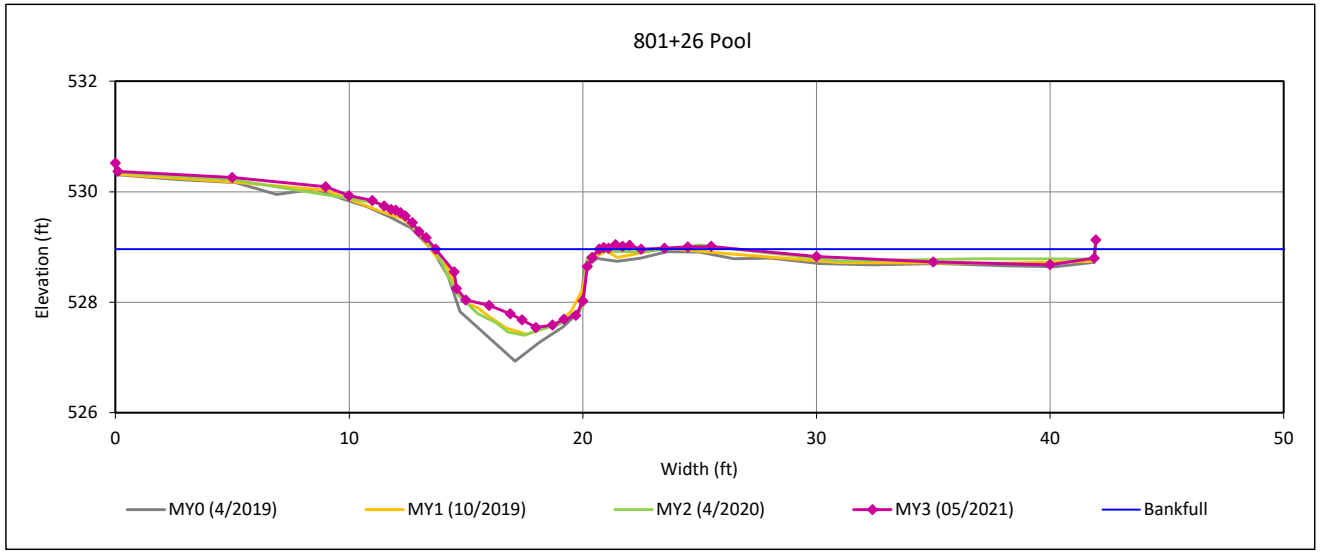
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Cross-Section 36 - T8



Bankfull Dimensions	
6.7	x-section area (ft.sq.)
7.0	width (ft)
1.0	mean depth (ft)
1.4	max depth (ft)
8.1	wetted perimeter (ft)
0.8	hydraulic radius (ft)
7.3	width-depth ratio

Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

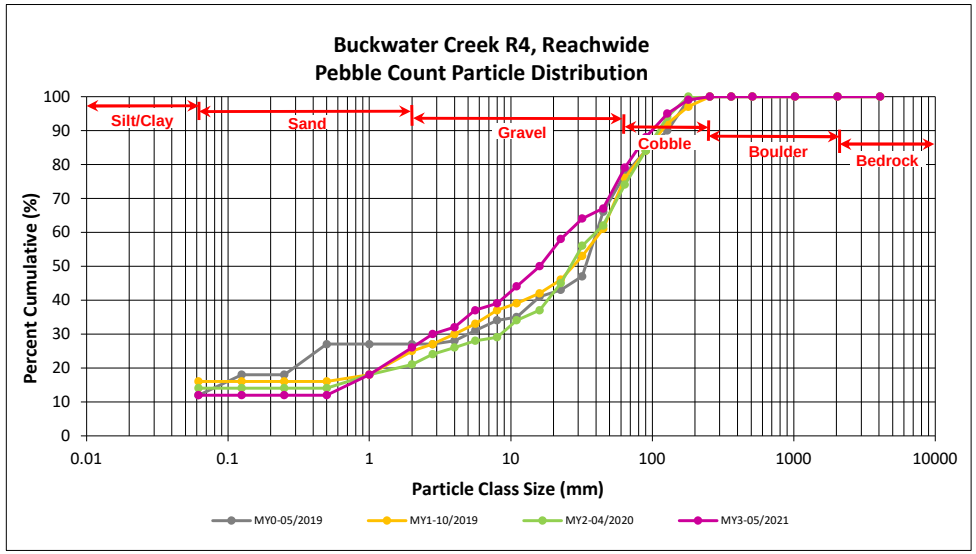
Reachwide Pebble Count Plots

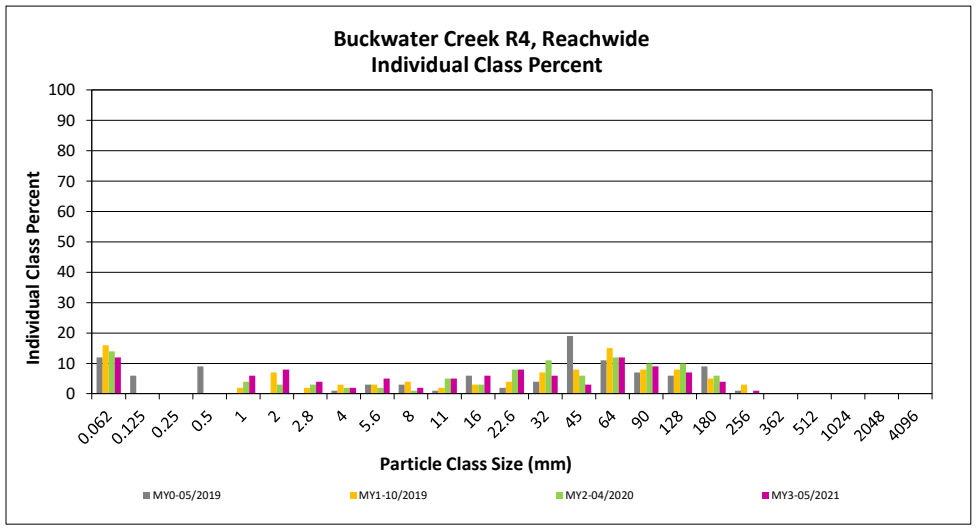
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Creek R4, 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					2
	Medium	0.25	0.50					2
	Coarse	0.5	1.0	2	9	11	11	13
	Very Coarse	1.0	2.0	1	3	4	4	17
GRAVEL	Very Fine	2.0	2.8	1	7	8	8	25
	Very Fine	2.8	4.0		2	2	2	27
	Fine	4.0	5.6	1	4	5	5	32
	Fine	5.6	8.0	3	6	9	9	41
	Medium	8.0	11.0	2	5	7	7	48
	Medium	11.0	16.0	3	3	6	6	54
	Coarse	16.0	22.6	6	2	8	8	62
	Coarse	22.6	32	3	3	6	6	68
	Very Coarse	32	45	2	1	3	3	71
	Very Coarse	45	64	10	2	12	12	83
COBBLE	Small	64	90	9		9	9	92
	Small	90	128	3	1	4	4	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} =	1.68
D_{35} =	6.31
D_{50} =	12.5
D_{84} =	66.5
D_{95} =	117.2
D_{100} =	256.0





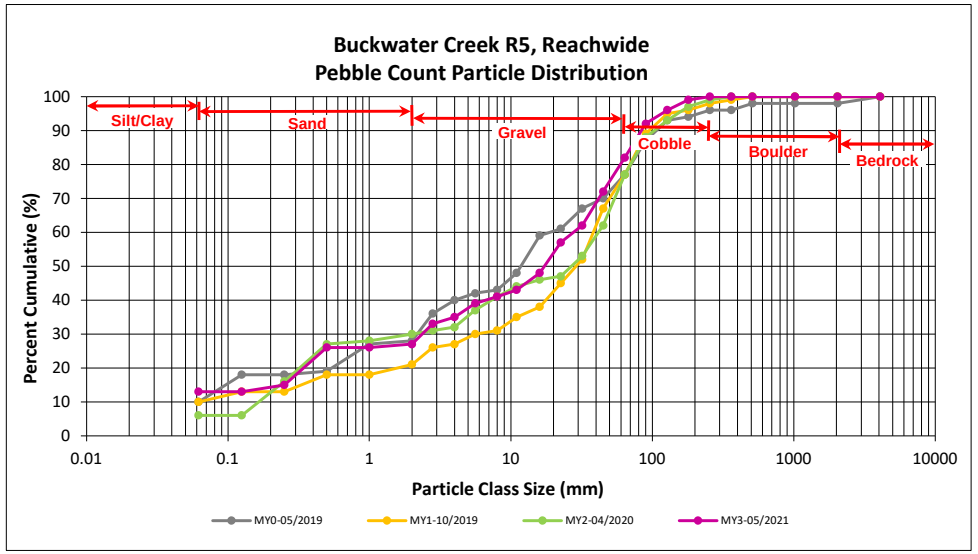
Reachwide Pebble Count Plots

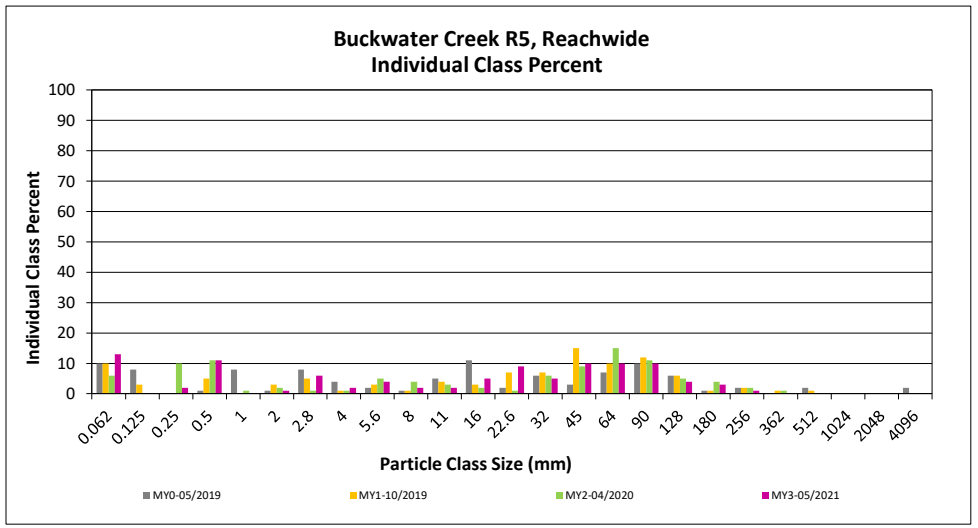
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Creek R5, 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		13	13	13	13
SAND	Very fine	0.062	0.125					13
	Fine	0.125	0.250		2	2	2	15
	Medium	0.25	0.50		11	11	11	26
	Coarse	0.5	1.0					26
	Very Coarse	1.0	2.0		1	1	1	27
GRAVEL	Very Fine	2.0	2.8		6	6	6	33
	Very Fine	2.8	4.0	1	1	2	2	35
	Fine	4.0	5.6	1	3	4	4	39
	Fine	5.6	8.0		2	2	2	41
	Medium	8.0	11.0		2	2	2	43
	Medium	11.0	16.0	2	3	5	5	48
	Coarse	16.0	22.6	7	2	9	9	57
	Coarse	22.6	32	5		5	5	62
	Very Coarse	32	45	9	1	10	10	72
	Very Coarse	45	64	8	2	10	10	82
COBBLE	Small	64	90	10		10	10	92
	Small	90	128	3	1	4	4	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} =	0.27
D_{35} =	4.00
D_{50} =	17.3
D_{84} =	68.5
D_{95} =	117.2
D_{100} =	256.0





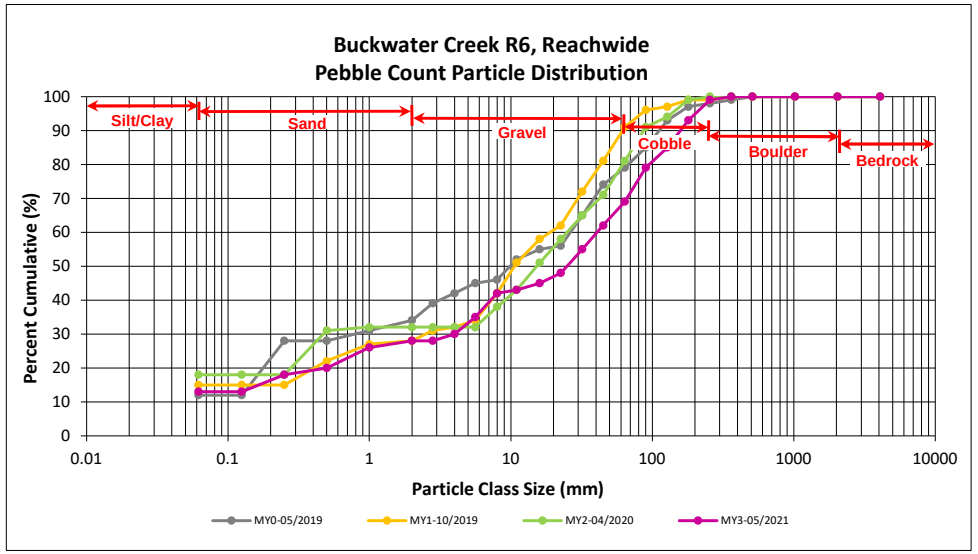
Reachwide Pebble Count Plots

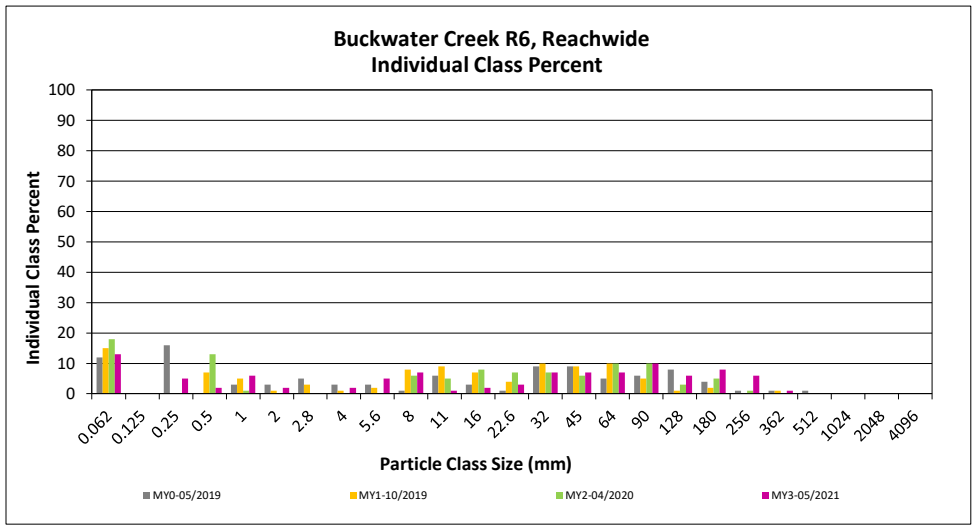
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Buckwater Creek R6, 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	10	13	13	13
SAND	Very fine	0.062	0.125					13
	Fine	0.125	0.250	1	4	5	5	18
	Medium	0.25	0.50		2	2	2	20
	Coarse	0.5	1.0		6	6	6	26
	Very Coarse	1.0	2.0		2	2	2	28
GRAVEL	Very Fine	2.0	2.8					28
	Very Fine	2.8	4.0		2	2	2	30
	Fine	4.0	5.6	1	4	5	5	35
	Fine	5.6	8.0	1	6	7	7	42
	Medium	8.0	11.0		1	1	1	43
	Medium	11.0	16.0		2	2	2	45
	Coarse	16.0	22.6		3	3	3	48
	Coarse	22.6	32	4	3	7	7	55
	Very Coarse	32	45	4	3	7	7	62
	Very Coarse	45	64	7		7	7	69
COBBLE	Small	64	90	10		10	10	79
	Small	90	128	5	1	6	6	85
	Large	128	180	7	1	8	8	93
	Large	180	256	6		6	6	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} =	0.19
D_{35} =	5.60
D_{50} =	25.0
D_{84} =	120.7
D_{95} =	202.4
D_{100} =	362.0





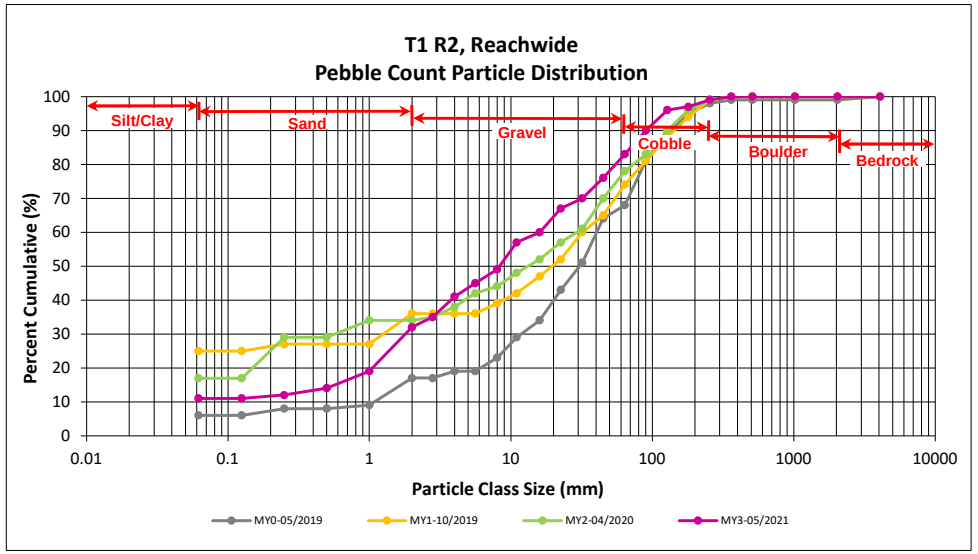
Reachwide Pebble Count Plots

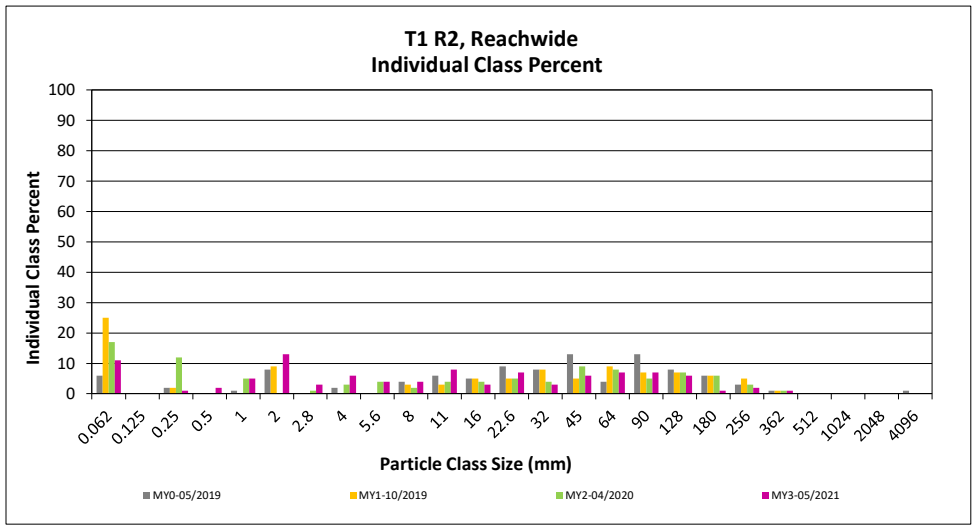
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T1 R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	9	11	11	11
SAND	Very fine	0.062	0.125					11
	Fine	0.125	0.250		1	1	1	12
	Medium	0.25	0.50		2	2	2	14
	Coarse	0.5	1.0		5	5	5	19
	Very Coarse	1.0	2.0	2	11	13	13	32
GRAVEL	Very Fine	2.0	2.8	1	2	3	3	35
	Very Fine	2.8	4.0	2	4	6	6	41
	Fine	4.0	5.6		4	4	4	45
	Fine	5.6	8.0	1	3	4	4	49
	Medium	8.0	11.0	2	6	8	8	57
	Medium	11.0	16.0	3		3	3	60
	Coarse	16.0	22.6	7		7	7	67
	Coarse	22.6	32	2	1	3	3	70
	Very Coarse	32	45	5	1	6	6	76
	Very Coarse	45	64	6	1	7	7	83
COBBLE	Small	64	90	7		7	7	90
	Small	90	128	6		6	6	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} =	0.66
D_{35} =	2.80
D_{50} =	8.3
D_{84} =	67.2
D_{95} =	120.7
D_{100} =	362.0





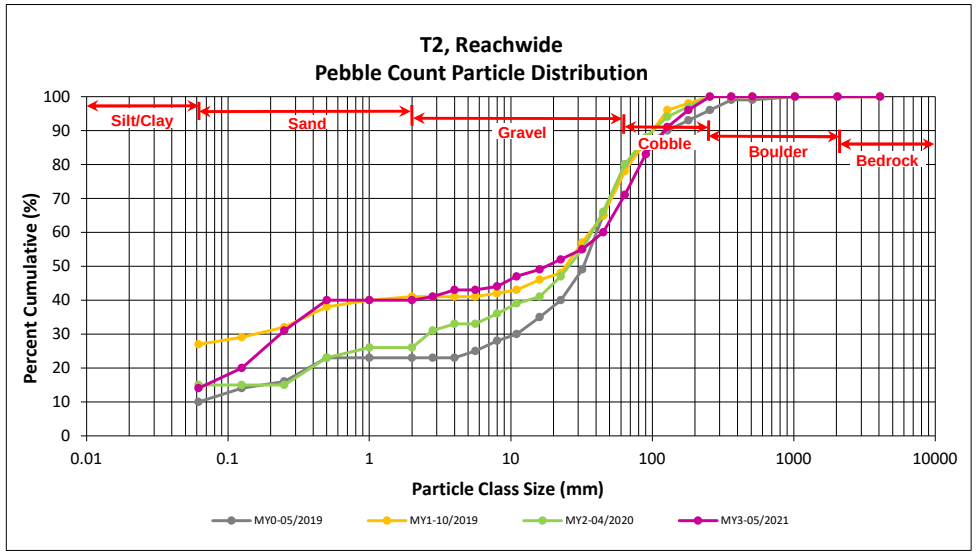
Reachwide Pebble Count Plots

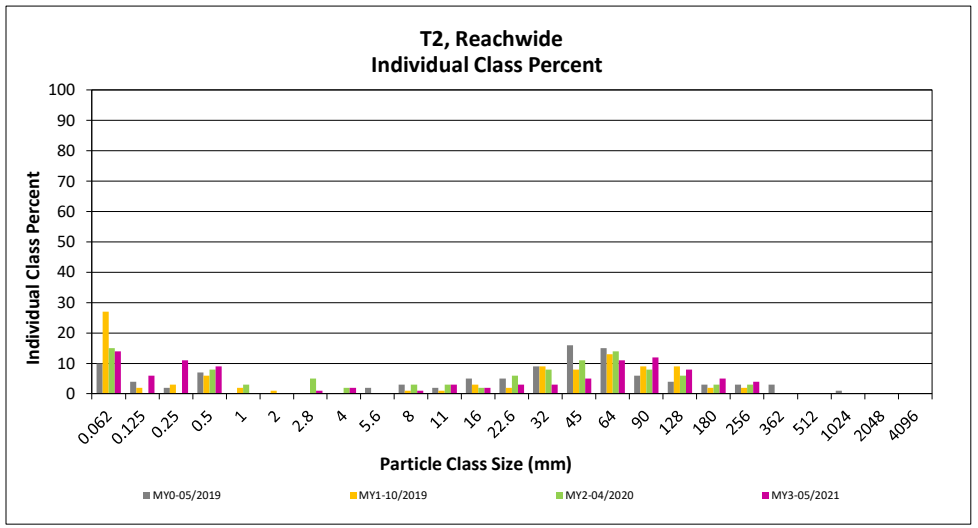
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T2, 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	13	14	14	14
SAND	Very fine	0.062	0.125		6	6	6	20
	Fine	0.125	0.250	1	10	11	11	31
	Medium	0.25	0.50	3	6	9	9	40
	Coarse	0.5	1.0					40
	Very Coarse	1.0	2.0					40
GRAVEL	Very Fine	2.0	2.8		1	1	1	41
	Very Fine	2.8	4.0		2	2	2	43
	Fine	4.0	5.6					43
	Fine	5.6	8.0	1		1	1	44
	Medium	8.0	11.0	2	1	3	3	47
	Medium	11.0	16.0	1	1	2	2	49
	Coarse	16.0	22.6	1	2	3	3	52
	Coarse	22.6	32	2	1	3	3	55
	Very Coarse	32	45	3	2	5	5	60
	Very Coarse	45	64	8	3	11	11	71
COBBLE	Small	64	90	11	1	12	12	83
	Small	90	128	7	1	8	8	91
	Large	128	180	5		5	5	96
	Large	180	256	4		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	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.08
D_{35} =	0.34
D_{50} =	18.0
D_{84} =	94.1
D_{95} =	168.1
D_{100} =	256.0





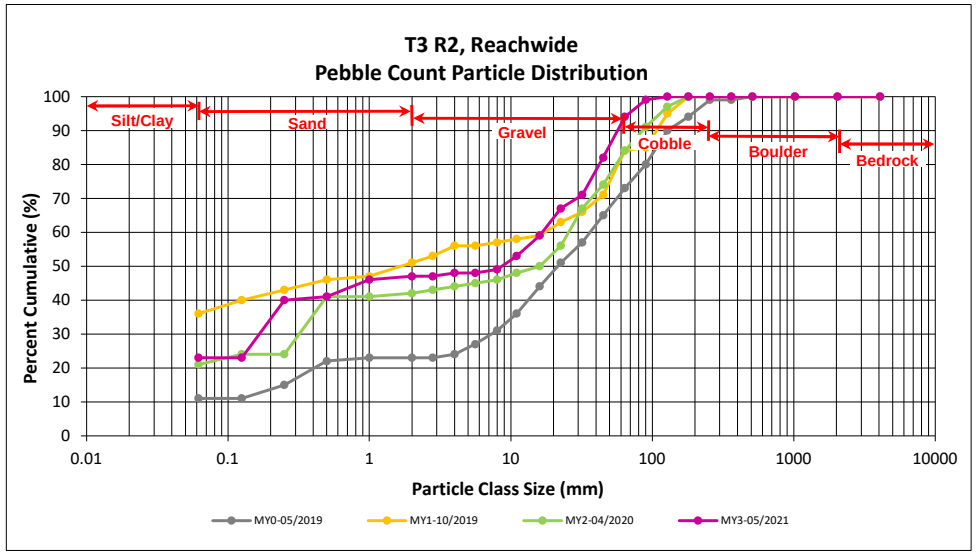
Reachwide Pebble Count Plots

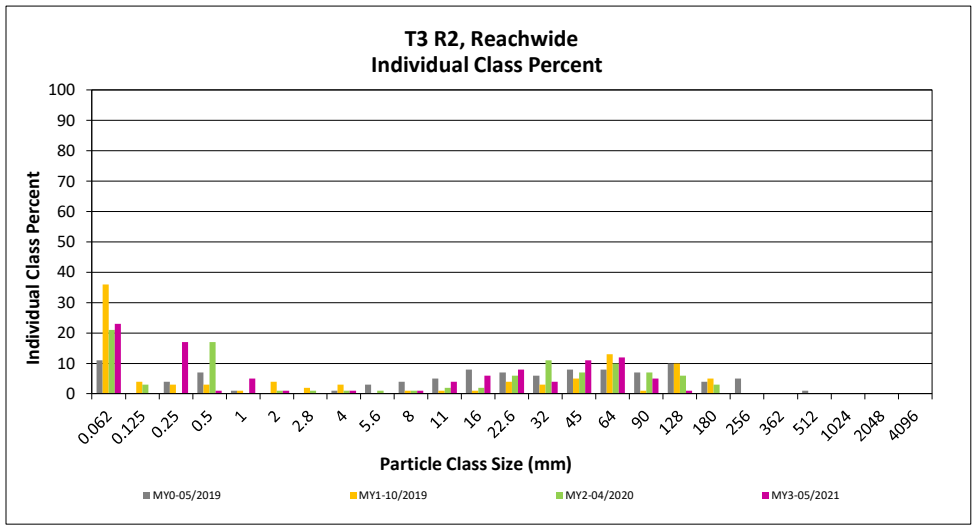
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T3 R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	21	23	23	23
SAND	Very fine	0.062	0.125					23
	Fine	0.125	0.250		17	17	17	40
	Medium	0.25	0.50	1		1	1	41
	Coarse	0.5	1.0		5	5	5	46
	Very Coarse	1.0	2.0	1		1	1	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0	1		1	1	48
	Fine	4.0	5.6					48
	Fine	5.6	8.0	1		1	1	49
	Medium	8.0	11.0	3	1	4	4	53
	Medium	11.0	16.0	4	2	6	6	59
	Coarse	16.0	22.6	7	1	8	8	67
	Coarse	22.6	32	4		4	4	71
	Very Coarse	32	45	10	1	11	11	82
	Very Coarse	45	64	11	1	12	12	94
COBBLE	Small	64	90	4	1	5	5	99
	Small	90	128	1		1	1	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} =	Silt/Clay
D_{35} =	0.20
D_{50} =	8.7
D_{84} =	47.7
D_{95} =	68.5
D_{100} =	128.0





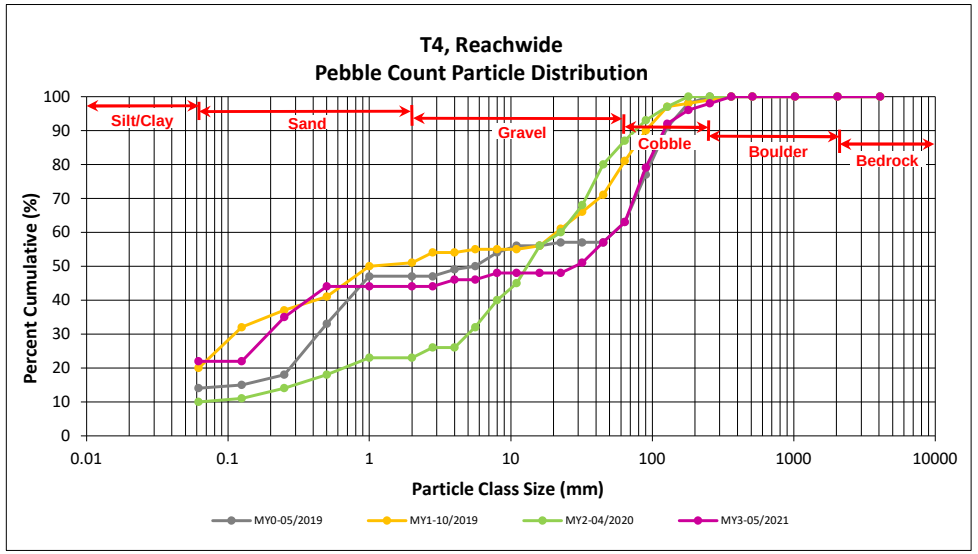
Reachwide Pebble Count Plots

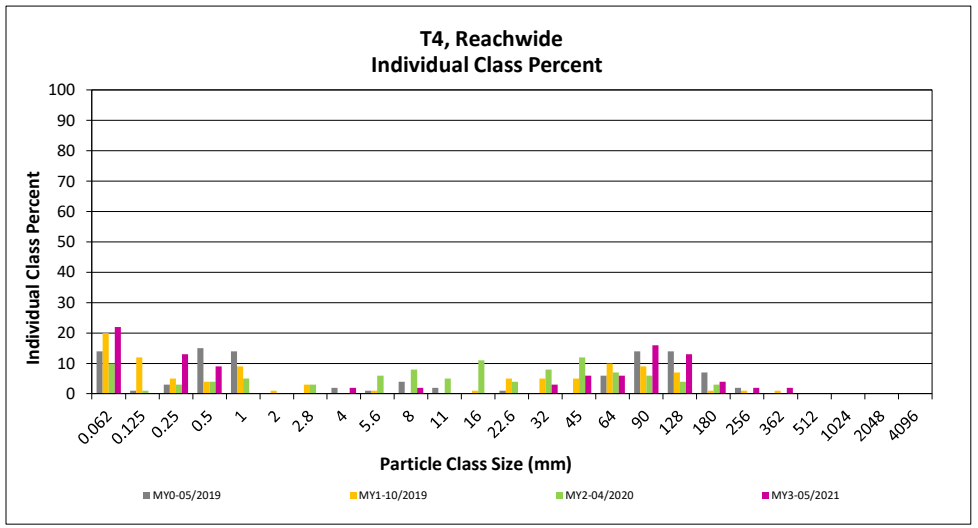
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T4, 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	21	22	22	22
SAND	Very fine	0.062	0.125					22
	Fine	0.125	0.250		13	13	13	35
	Medium	0.25	0.50	1	8	9	9	44
	Coarse	0.5	1.0					44
	Very Coarse	1.0	2.0					44
GRAVEL	Very Fine	2.0	2.8					44
	Very Fine	2.8	4.0		2	2	2	46
	Fine	4.0	5.6					46
	Fine	5.6	8.0		2	2	2	48
	Medium	8.0	11.0					48
	Medium	11.0	16.0					48
	Coarse	16.0	22.6					48
	Coarse	22.6	32	2	1	3	3	51
	Very Coarse	32	45	4	2	6	6	57
	Very Coarse	45	64	5	1	6	6	63
COBBLE	Small	64	90	16		16	16	79
	Small	90	128	13		13	13	92
	Large	128	180	4		4	4	96
	Large	180	256	2		2	2	98
BOULDER	Small	256	362	2		2	2	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} =	0.25
D_{50} =	28.5
D_{84} =	103.1
D_{95} =	165.3
D_{100} =	362.0





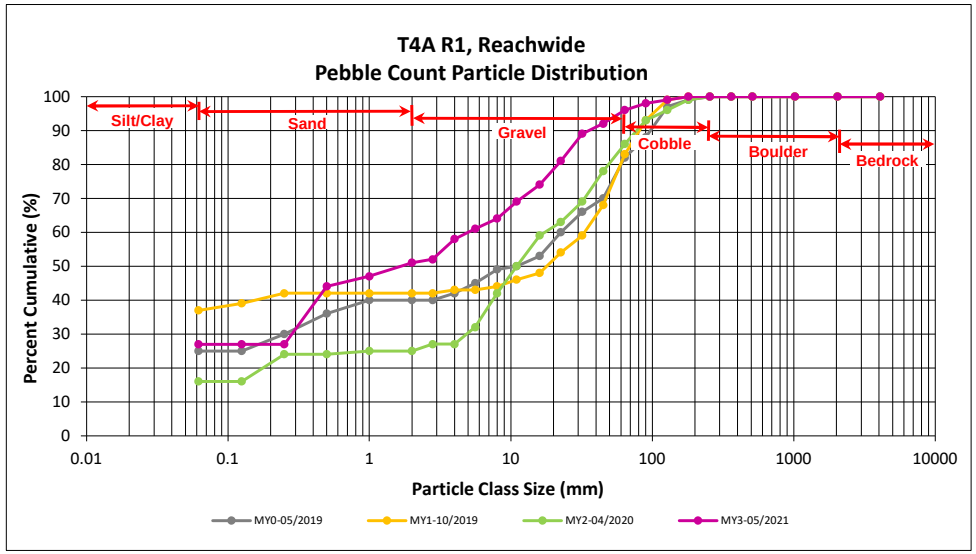
Reachwide Pebble Count Plots

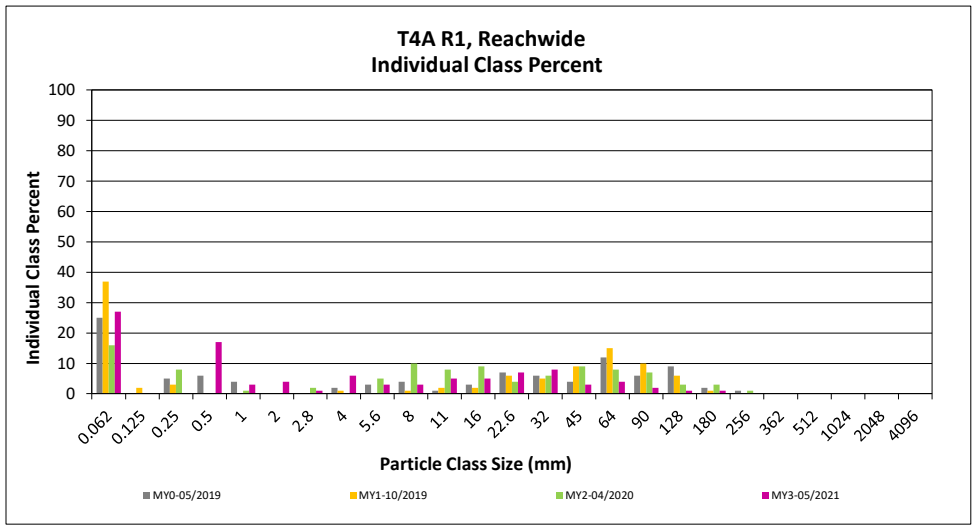
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T4A 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	3	24	27	27	27
SAND	Very fine	0.062	0.125					27
	Fine	0.125	0.250					27
	Medium	0.25	0.50	2	15	17	17	44
	Coarse	0.5	1.0		3	3	3	47
	Very Coarse	1.0	2.0	1	3	4	4	51
GRAVEL	Very Fine	2.0	2.8		1	1	1	52
	Very Fine	2.8	4.0	5	1	6	6	58
	Fine	4.0	5.6	3		3	3	61
	Fine	5.6	8.0	2	1	3	3	64
	Medium	8.0	11.0	5		5	5	69
	Medium	11.0	16.0	4	1	5	5	74
	Coarse	16.0	22.6	6	1	7	7	81
	Coarse	22.6	32	8		8	8	89
	Very Coarse	32	45	3		3	3	92
	Very Coarse	45	64	4		4	4	96
COBBLE	Small	64	90	2		2	2	98
	Small	90	128	1		1	1	99
	Large	128	180	1		1	1	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.35
D_{50} =	1.7
D_{84} =	25.7
D_{95} =	58.6
D_{100} =	180.0





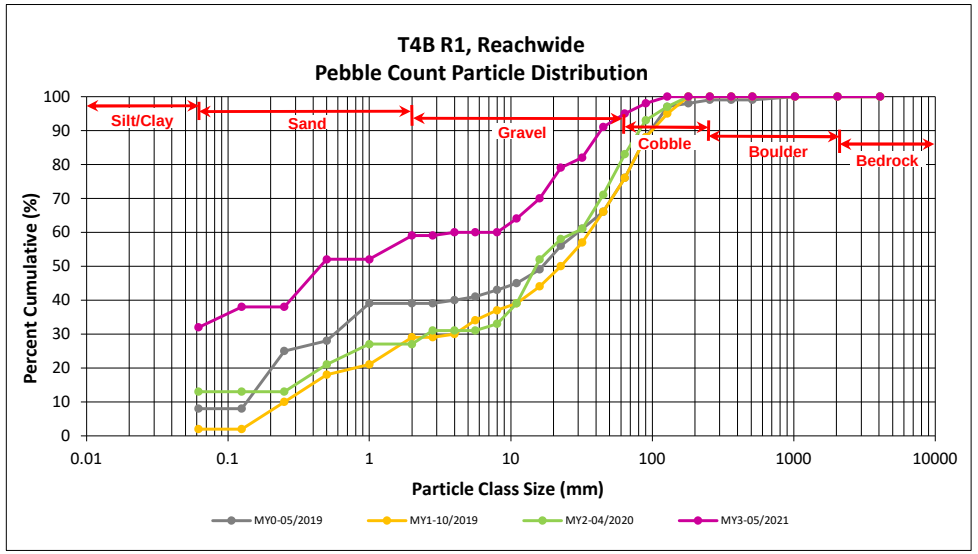
Reachwide Pebble Count Plots

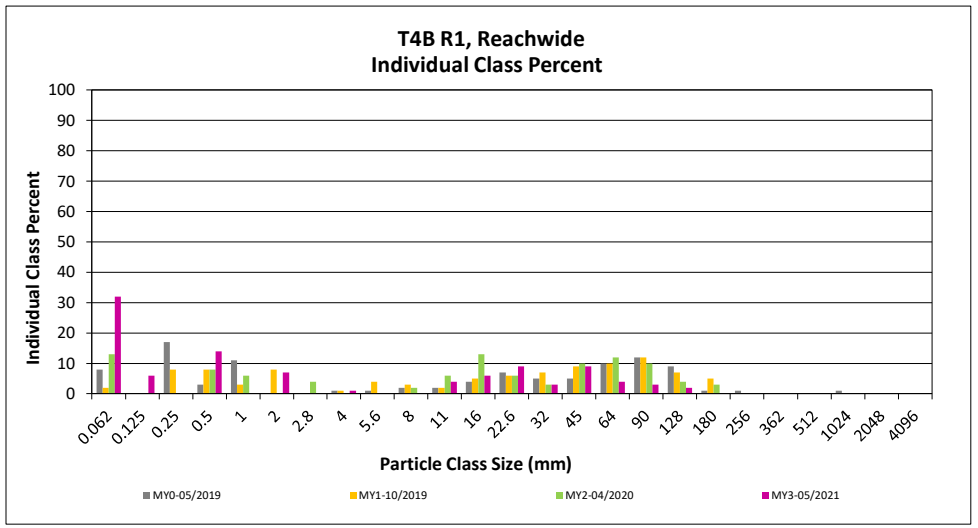
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T4B 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	6	26	32	32	32
SAND	Very fine	0.062	0.125		6	6	6	38
	Fine	0.125	0.250					38
	Medium	0.25	0.50	5	9	14	14	52
	Coarse	0.5	1.0					52
	Very Coarse	1.0	2.0	2	5	7	7	59
GRAVEL	Very Fine	2.0	2.8					59
	Very Fine	2.8	4.0		1	1	1	60
	Fine	4.0	5.6					60
	Fine	5.6	8.0					60
	Medium	8.0	11.0	4		4	4	64
	Medium	11.0	16.0	5	1	6	6	70
	Coarse	16.0	22.6	8	1	9	9	79
	Coarse	22.6	32	3		3	3	82
	Very Coarse	32	45	8	1	9	9	91
	Very Coarse	45	64	4		4	4	95
COBBLE	Small	64	90	3		3	3	98
	Small	90	128	2		2	2	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} =	Silt/Clay
D_{35} =	0.09
D_{50} =	0.5
D_{84} =	34.5
D_{95} =	64.0
D_{100} =	128.0





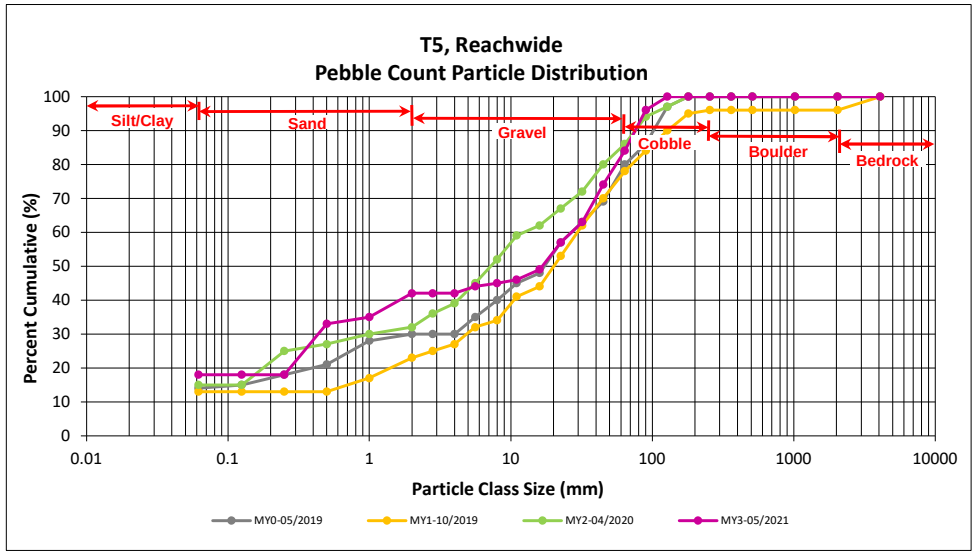
Reachwide Pebble Count Plots

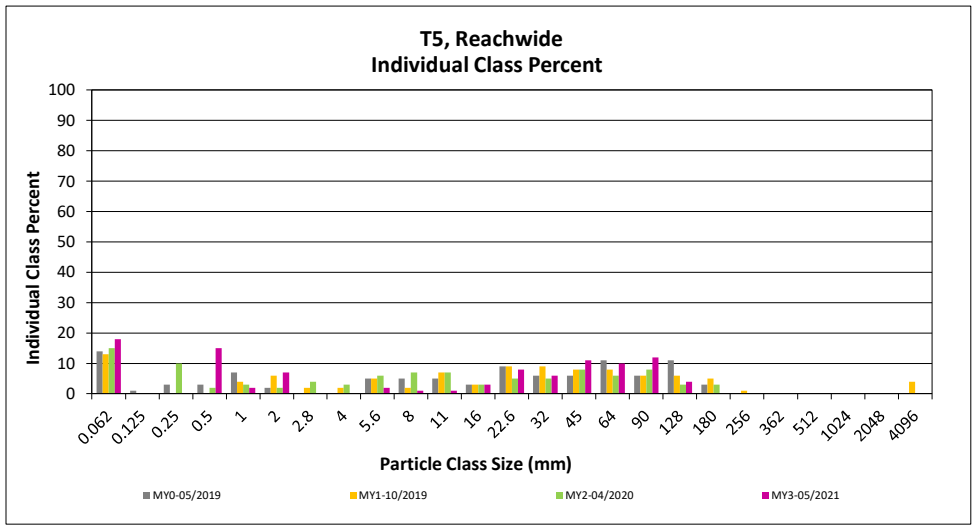
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T5, 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	15	3	18	18	18
SAND	Very fine	0.062	0.125					18
	Fine	0.125	0.250					18
	Medium	0.25	0.50	13	2	15	15	33
	Coarse	0.5	1.0		2	2	2	35
	Very Coarse	1.0	2.0	7		7	7	42
GRAVEL	Very Fine	2.0	2.8					42
	Very Fine	2.8	4.0					42
	Fine	4.0	5.6	1	1	2	2	44
	Fine	5.6	8.0	1		1	1	45
	Medium	8.0	11.0		1	1	1	46
	Medium	11.0	16.0		3	3	3	49
	Coarse	16.0	22.6	3	5	8	8	57
	Coarse	22.6	32	2	4	6	6	63
	Very Coarse	32	45	2	9	11	11	74
	Very Coarse	45	64	3	7	10	10	84
COBBLE	Small	64	90	2	10	12	12	96
	Small	90	128	1	3	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**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	1.00
D_{50} =	16.7
D_{84} =	64.0
D_{95} =	87.5
D_{100} =	128.0





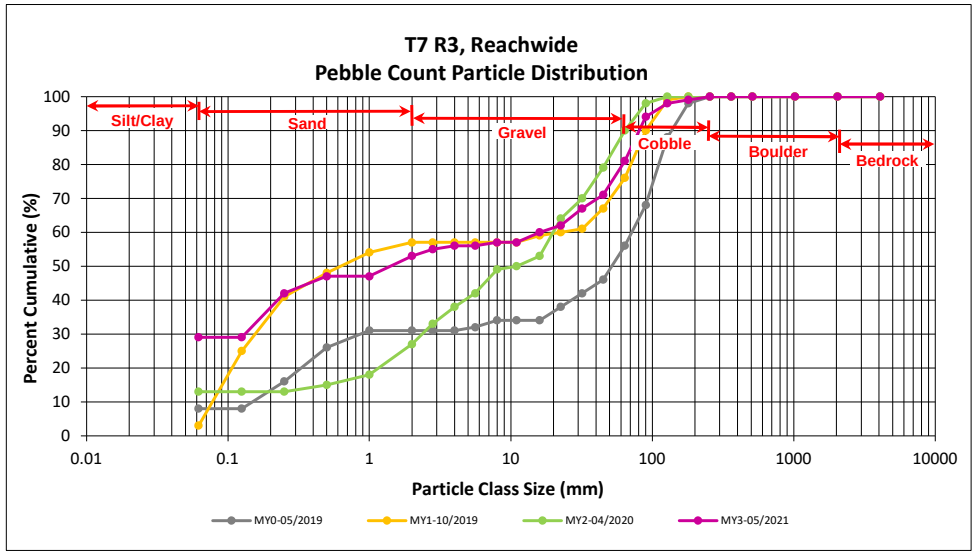
Reachwide Pebble Count Plots

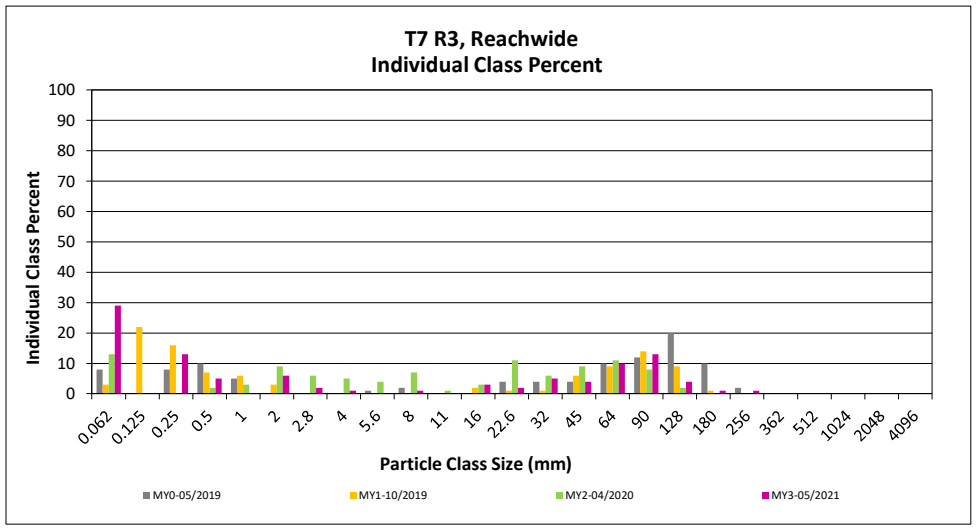
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

T7 R3, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	23	29	29	29
SAND	Very fine	0.062	0.125					29
	Fine	0.125	0.250		13	13	13	42
	Medium	0.25	0.50	2	3	5	5	47
	Coarse	0.5	1.0					47
	Very Coarse	1.0	2.0		6	6	6	53
GRAVEL	Very Fine	2.0	2.8	1	1	2	2	55
	Very Fine	2.8	4.0		1	1	1	56
	Fine	4.0	5.6					56
	Fine	5.6	8.0		1	1	1	57
	Medium	8.0	11.0					57
	Medium	11.0	16.0	3		3	3	60
	Coarse	16.0	22.6	2		2	2	62
	Coarse	22.6	32	4	1	5	5	67
	Very Coarse	32	45	4		4	4	71
	Very Coarse	45	64	9	1	10	10	81
COBBLE	Small	64	90	13		13	13	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} =	Silt/Clay
D_{35} =	0.17
D_{50} =	1.4
D_{84} =	69.2
D_{95} =	98.3
D_{100} =	256.0





APPENDIX 5. Hydrology Summary Data

Table 13. Bankfull Events

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

Reach	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
	Date of Occurrence	Date of Occurrence	Date of Occurrence				
Buckwater Creek Reach 6	6/18/2019	2/6/2020* 5/21/2020	1/3/2021* 4/9/2021*				
T1 Reach 2	4/13/2019	2/6/2020* 5/21/2020*	**				
T2	6/18/2019*	2/6/2020* 5/21/2020*	**				
T4	4/14/2019* 6/18/2019	2/6/2020 5/21/2020	1/3/2021 3/31/2021*				
T5: US of St. Mary's Rd	N/A	2/6/2020 5/21/2020	1/3/2021* 4/9/2021*				
T5: DS of St. Mary's Rd	4/13/2019 6/18/2019	2/6/2020 5/21/2020	1/3/2021* 4/9/2021*				
T7 Reach 3	6/18/2019*	2/6/2020	1/3/2021[1] 4/9/2021*				

*Only a geomorphically significant event. Not a bankfull event.
**No bankfull or geomorphically significant events discernible due to gauge freezing.
1. T7 Reach 3 recorded bankfull events on the flow gauge but not the crest gague. Bankfull events were not discernible on the crest gauge due to freezing.

Table 14. Rainfall Summary

Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021

	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
Annual Precip Total	43.35	61.38	37.79*				
WETS 30th Percentile	43.75	43.73	43.79				
WETS 70th Percentile	51.13	50.88	51.30				
Normal	Y	Y	*				

*Annual precipitation total was collected up until 11/10/2021. Data will be updated in MY4.
WETS Station (Annual, 30th & 70th Percentile): Chapel Hill 2 W, NC

Table 15. Wetland Gauge Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

Summary of Groundwater Gauge Results for Monitoring Years 1 through 7							
Gauge	Max Consecutive Days During Growing Season (Percentage)						
	MY1 (2019)	MY2 (2020)	MY3 (2021)	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
1	**55 Days (20.7%)**	**34 Days (12.8%)**	**24 Days (9.4%)**				
2	**13 Days (4.9%)**	**6 Days (2.3%)**	**8 Days (3.1%)**				
3	**58 Days (21.8%)**	**135 Days (50.4%)**	**110 Days (43.0%)**				

Performance Standard: None

WETS Station (Daily Rainfall): Durham 6.8 NNW, NC

WETS Station (30th & 70th Percentile): Chapel Hill 2 W, NC

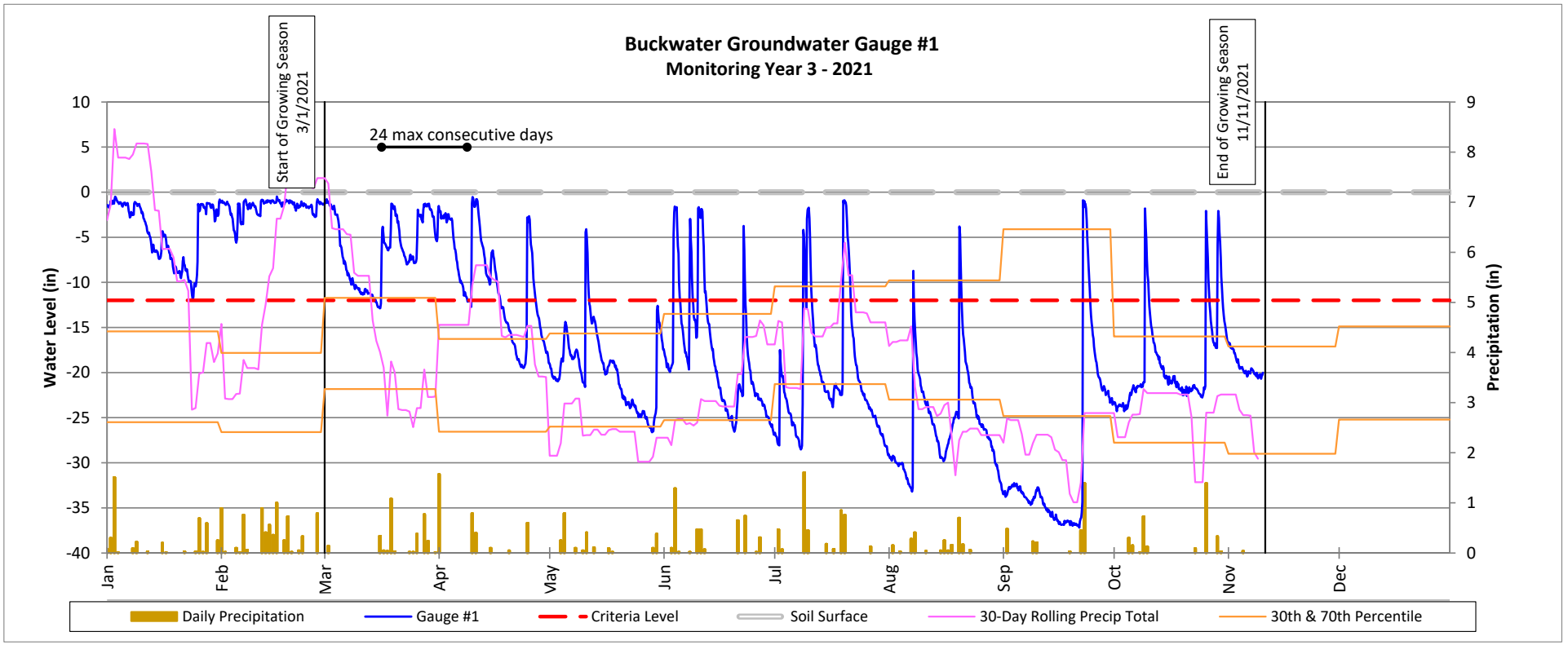
Growing Season: 3/1/2021 to 11/11/2021 (255 Days)

Groundwater Gauge Plots

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

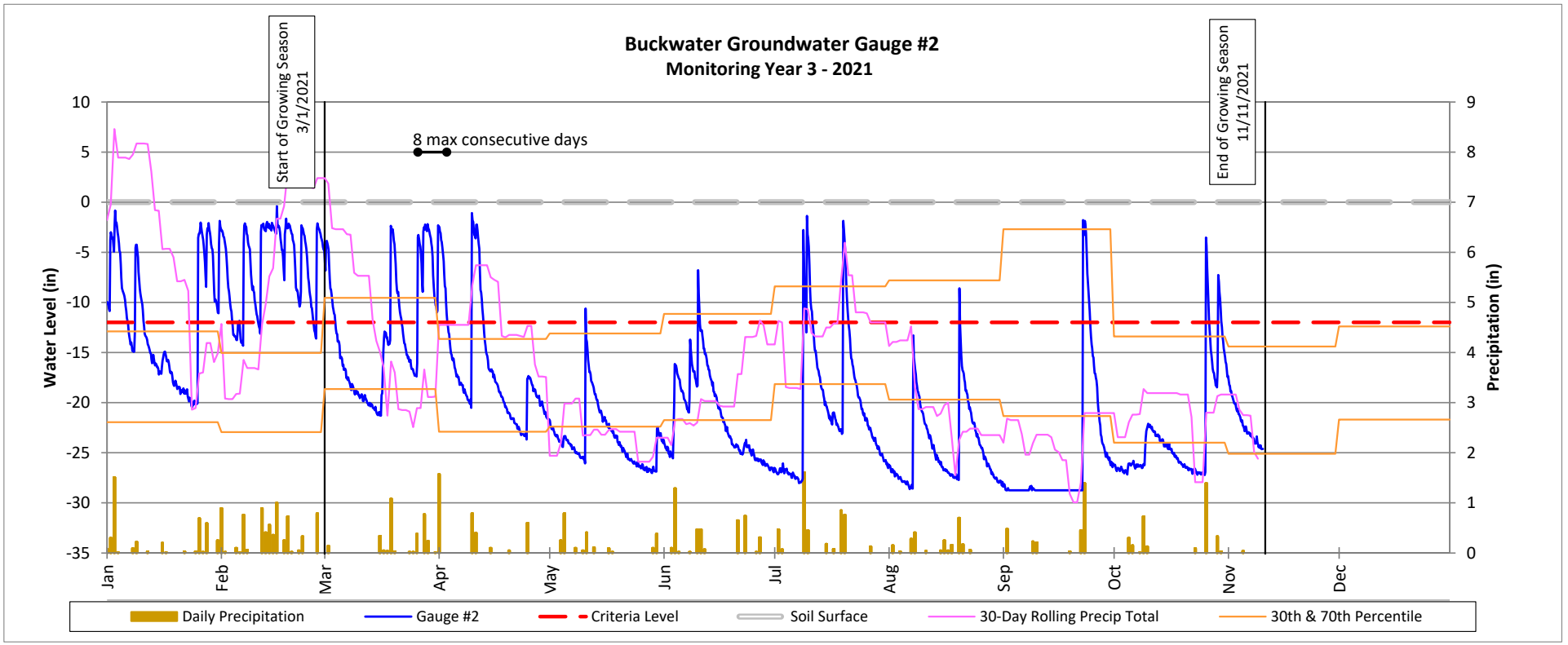


Groundwater Gauge Plots

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021



Groundwater Gauge Plots

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

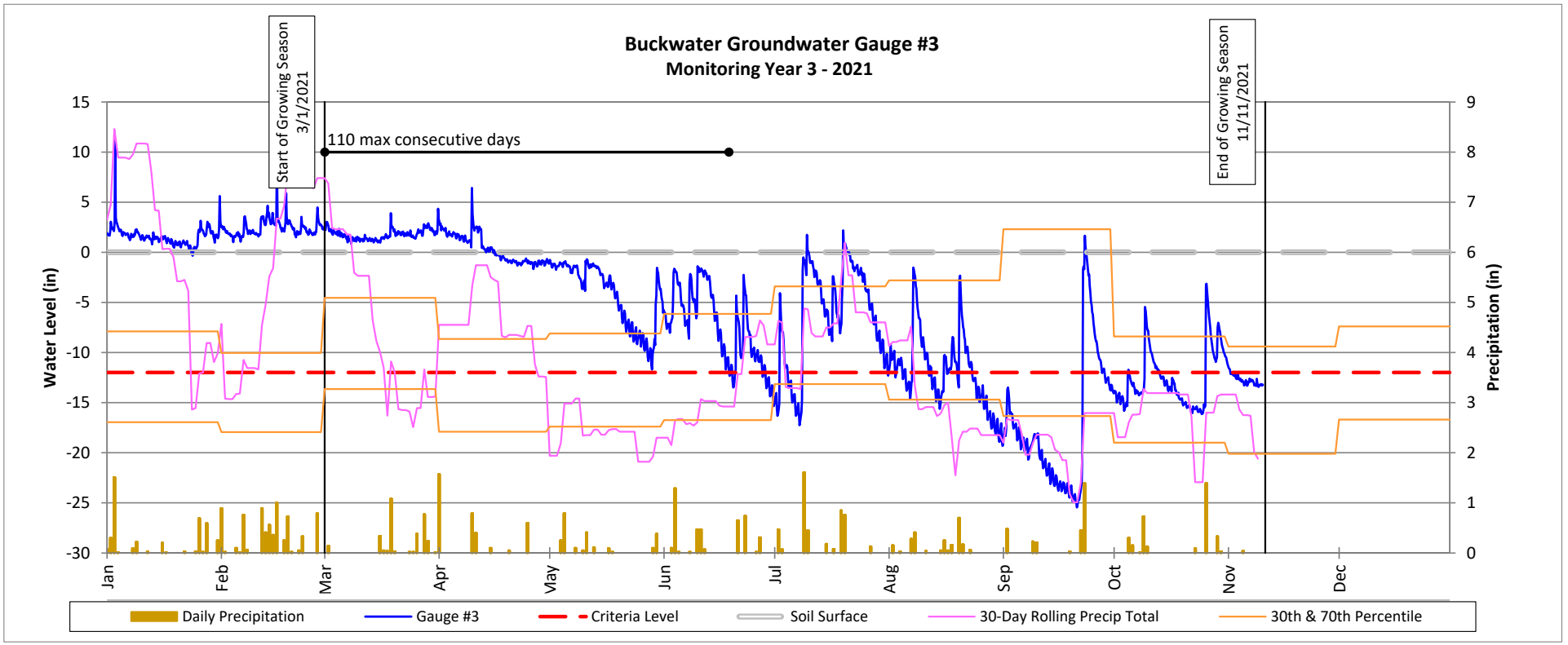


Table 16. Recorded In-Stream Flow Events Summary

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 3 - 2021

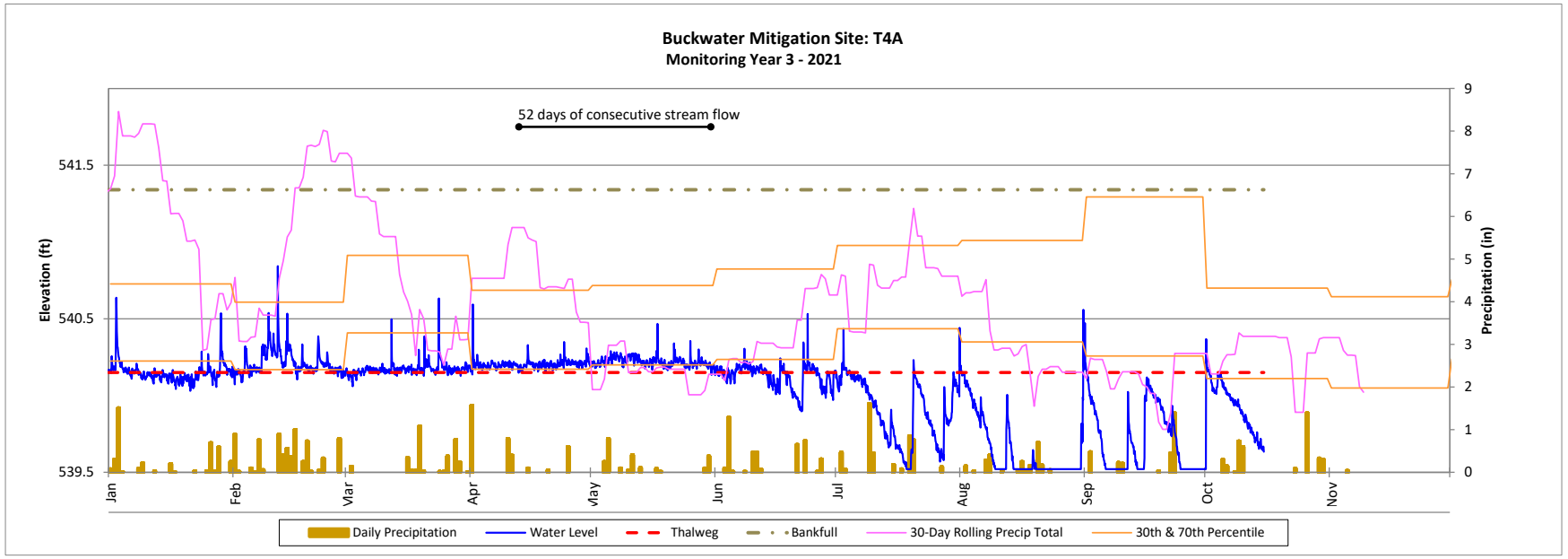
Reach	Max Consecutive Days/ Total Days Meeting Success Criteria*						
	MY1 (2019)	MY2 (2020)	MY3 (2021)***	MY4 (2022)	MY5 (2023)	MY6 (2024)	MY7 (2025)
T4A	96 Days/ 120 Days	70 Days/ 216 Days	52 Days/ 155 Days				
T4B	63 Days/ 91 Days	208 Days/ 290 Days	188 Days/ 235 Days				
T6	73 Days/ 103 Days	294 Days/ 294 Days	238 Days/ 265 Days				
T7 Reach 2	Not Installed	194 Days/ 234 Days	146 Days/ 171 Days				
T7A	169 Days/ 233 Days	133 Days/ 281 Days	250 Days/ 286 Days				
T8	19 Days/ 21 Days**	207 Days/ 272 Days	101 Days/ 158 Days				

*Success criteria is 30 consecutive days of flow.

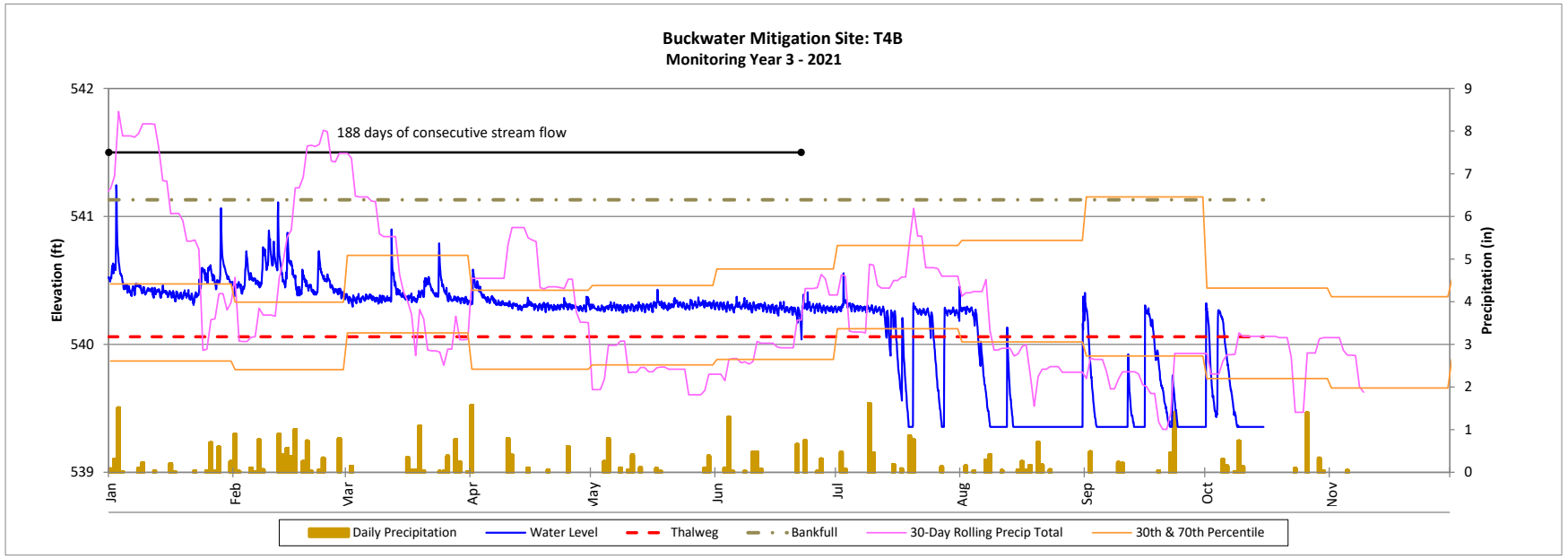
**Gauge Malfunctioned.

***Data collected through November 10, 2021, will update in MY4.

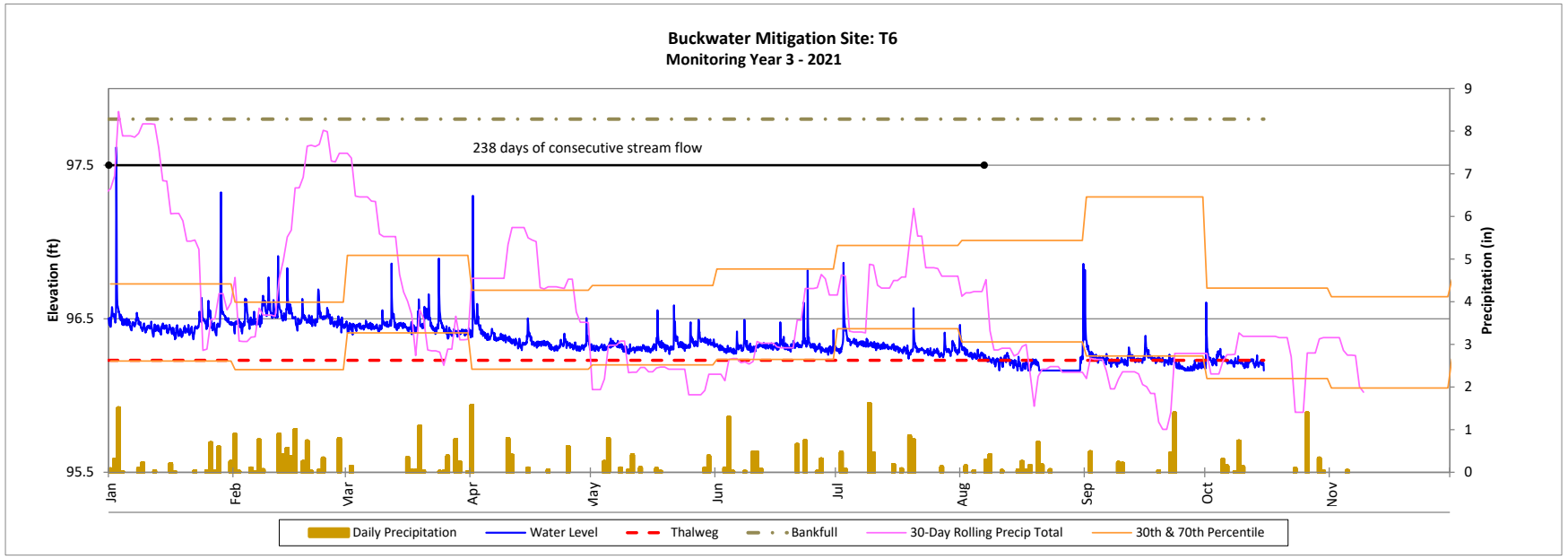
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



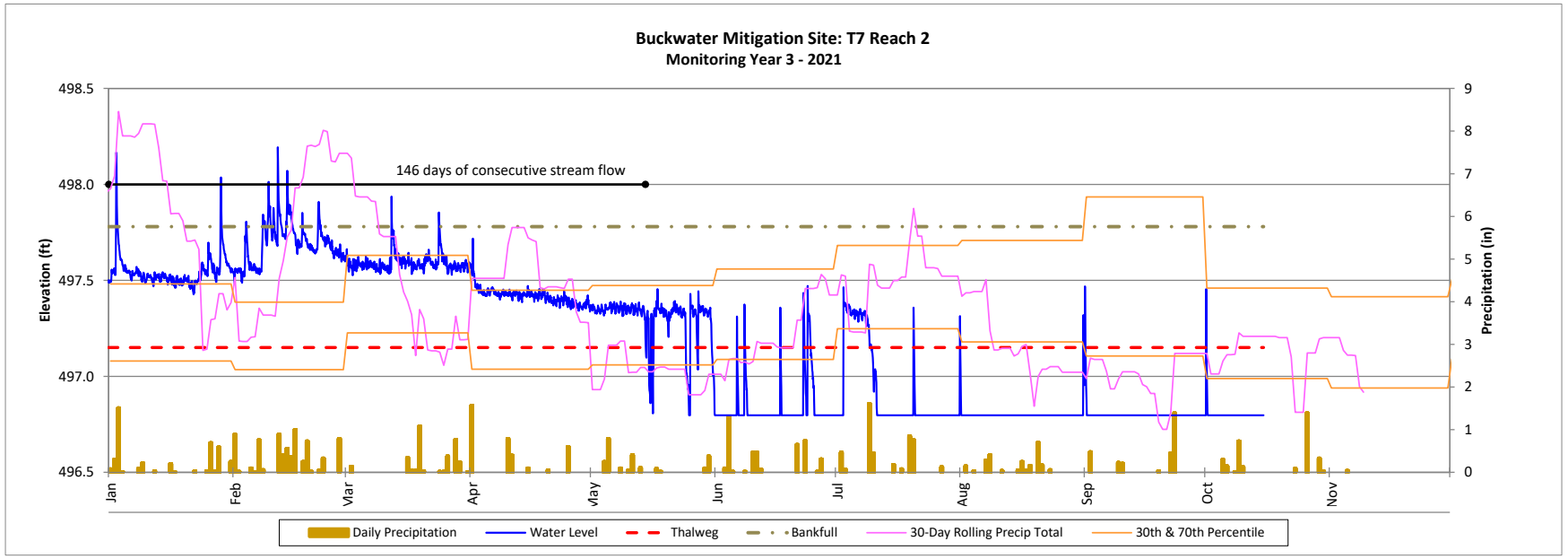
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



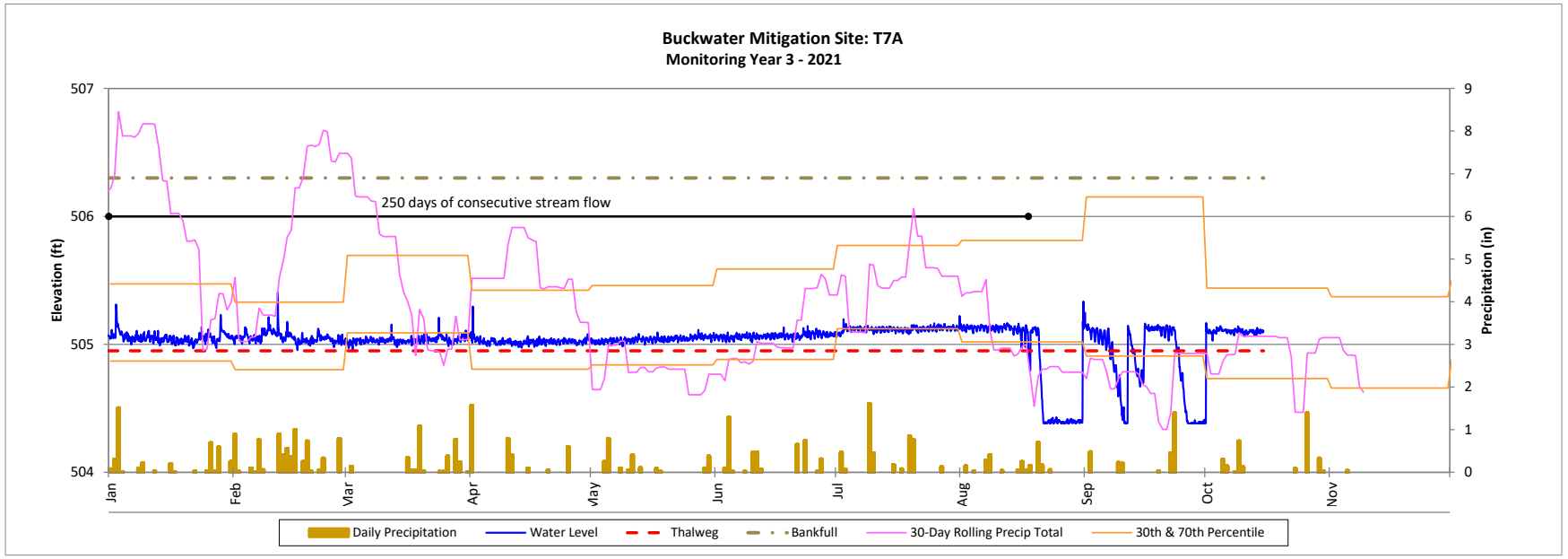
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



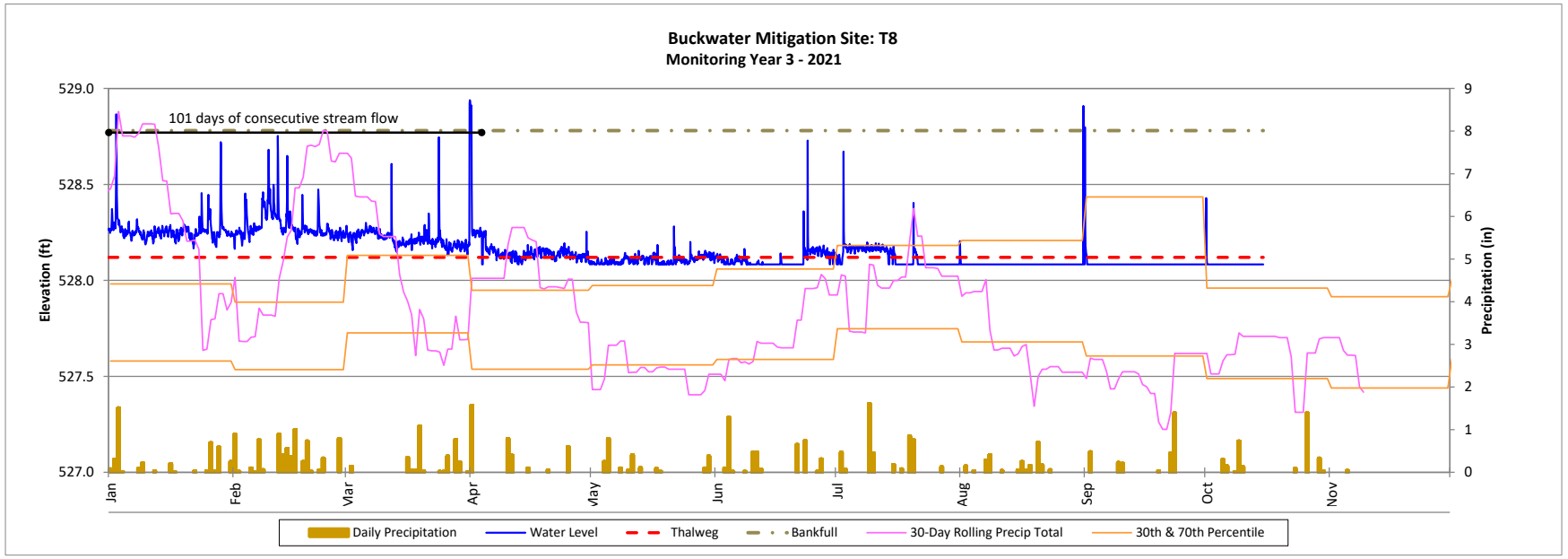
Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



Recorded In-Stream Flow Events Plots
Buckwater Mitigation Site
DMS Project No. 97084
Monitoring Year 3 - 2021



APPENDIX 6. Additional Documentation




ADAPTIVE MANAGEMENT PLAN

BUCKWATER MITIGATION SITE
Orange County, NC
NCDEQ Contract No. 006829
DMS Project Number 97084
USACE Action ID Number 2016-00873
NCDWR Project Number 2016-0406

Data Collection Period: January - October 2020
Submission Date: December 7, 2020

PREPARED FOR:

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

PREPARED BY:

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
Raleigh, NC 27609

Chris Roessler
croessler@wildlandseng.com
Phone: 919.851.9986

Section 1: Introduction

Wildlands Engineering submitted a Monitoring Year 2 (MY2) report at the end of 2020 describing vegetation areas of concern on the Buckwater Mitigation Site (Site) and planned efforts to improve those areas. The MY2 vegetation survey completed in September 2020 identified eleven of nineteen vegetation plots that are not on track to meet MY3 interim success criteria of 320 planted stems per acre. Of those eleven plots, four are not on track to meet the final success criteria of 210 planted stems per acre. Additionally, two low vegetative growth areas totaling approximately 1.4 acres were noted along T5 and T6 near St. Mary's Road, likely due to construction grading. After multiple site walks, Wildlands developed this plan for remedial action to address the high mortality rate and low vegetative growth areas observed during MY2.

Tables 1 and 2 show the results of MY2 vegetation plot monitoring.

Section 2: Supplemental Vegetation Planting

Following the MY2 vegetative survey, Wildlands surveyed the Site to assess the extent of the tree mortality and explored reasons why mortality was higher in some areas compared to others. After assessing the Site, 10.7-acres were identified for supplemental planting in early winter of 2021. Wildlands believes significant factors for the high mortality rate are competition from dense herbaceous vegetation and drought conditions during the end of the first growing season. The NC Drought Management Advisory Council maintains map archives (https://www.ncdrought.org/map-archives) that show abnormally dry and moderate drought conditions during 2019 in the Buckwater area beginning September 17 and ending December 3.

Throughout the 10.7-acres, a mixture of nine species will be planted at a density of 200 to 300 stems per acre (Figures 1, 1a, and 1b). This is 46% of the original planted area. Planted trees will primarily be bare root stock with fewer one-gallon container trees. Species and quantities of trees to be planted are shown in Table 3. Three of the species (hackberry, persimmon, and box elder) are not on the original mitigation plan planting list but we believe they will do well at the site as early successional pioneers. Sycamore are proposed to be planted in select areas that currently have especially low stem densities for the purpose of providing shade for slower growing species. Wildlands proposes to plant sycamore where the vegetation plots report the lowest stem density and where sycamore is not exceeding 25% of the surviving stems. This includes vegetation plots 7, 11, 17, and 18. Immediately after supplemental planting, sycamore stems will not exceed 20% of the surviving stems in any vegetation plot. White oak and hackberry (*Celtis occidentalis*) will be planted only in drier areas primarily at the top of slopes and higher elevations. Any tree added to a vegetation plot will be flagged with a color different from what was used to flag the originally planted trees. The additional trees will not be counted towards success criteria until two growing seasons have passed.

After planting but before bud break, herbicide will be sprayed in an 18-24-inch radius from the center of each stem. The herbicide will be a 2.5% aquatic safe glyphosate solution. This measure effectively reduces competition from dense herbaceous vegetation.

Also included in the appendices is the original as-built planting list.

Section 3: Supplemental Soil Amendments

The two low vegetative growth areas totaling 1.4-acres along T5 (upstream of St. Mary's Rd) and T6 (Figure 1a) will be further treated with soil amendments. Grading during construction exposed poor-quality rocky subsoils near the surface. Soil amendments were applied to this area in December 2019 and August 2020 and will continue to be applied during MY3. Soil amendments planned to be added in

MY3 include humic acid, biochar, dried molasses, slow-release fertilizer, rock phosphate, and azomite. Beyond boosting macronutrients in the soil, adding these amendments will improve soil properties and biota. Expected improvements include higher moisture-holding capacity, organic matter, nutrient availability for plants, and saprophytic and mycorrhizal fungal growth. The amendments will be applied to the base of each stem rather than broadcasted on the entire 1.4-acre area.

Section 4: Conclusion

In summary, Wildlands will plant nine species in winter 2021 over 10.7-acres at a density of 200 to 300 stems per acre. The supplemental plants will be a combination of one-gallon container and bare root stock. To reduce competition from dense herbaceous vegetation, ring sprays will be performed around the center of each stem. Soil amendments will also be added during MY3 on the 1.4 acres of low vegetative growth along T5 and T6.

Wildlands will continue to monitor Site vegetation as previously planned. If the monitoring requirements are not met during MY7 in any of the planted areas, including ones with supplemental planting, for those areas Wildlands proposes to add another year of vegetation monitoring. Vegetation monitoring will continue until success criteria are met.

Figure 1a

Figure 1b

T6

T6B

T6A

T5

T1

St Marys Rd

T7A

T7

T2

T8

Buckwater Creek

T4

T3

T4B

T4A

T9

Walnut Hill Dr

Berry Mill Rd

Cedar Trl

2020 Aerial Photography

- Conservation Easement
- Internal Crossing
- Vernal Pool

Vegetation Plot Condition - MY2

- Criteria Met
- Criteria Not Met

Vegetation Problem Area - MY2

- Low Stem Density
- Low Growth Area

Stream Approach

- Stream Restoration
- Stream Enhancement I
- Stream Enhancement II
- Non-Project Streams
- Utility Easement
- Fencing

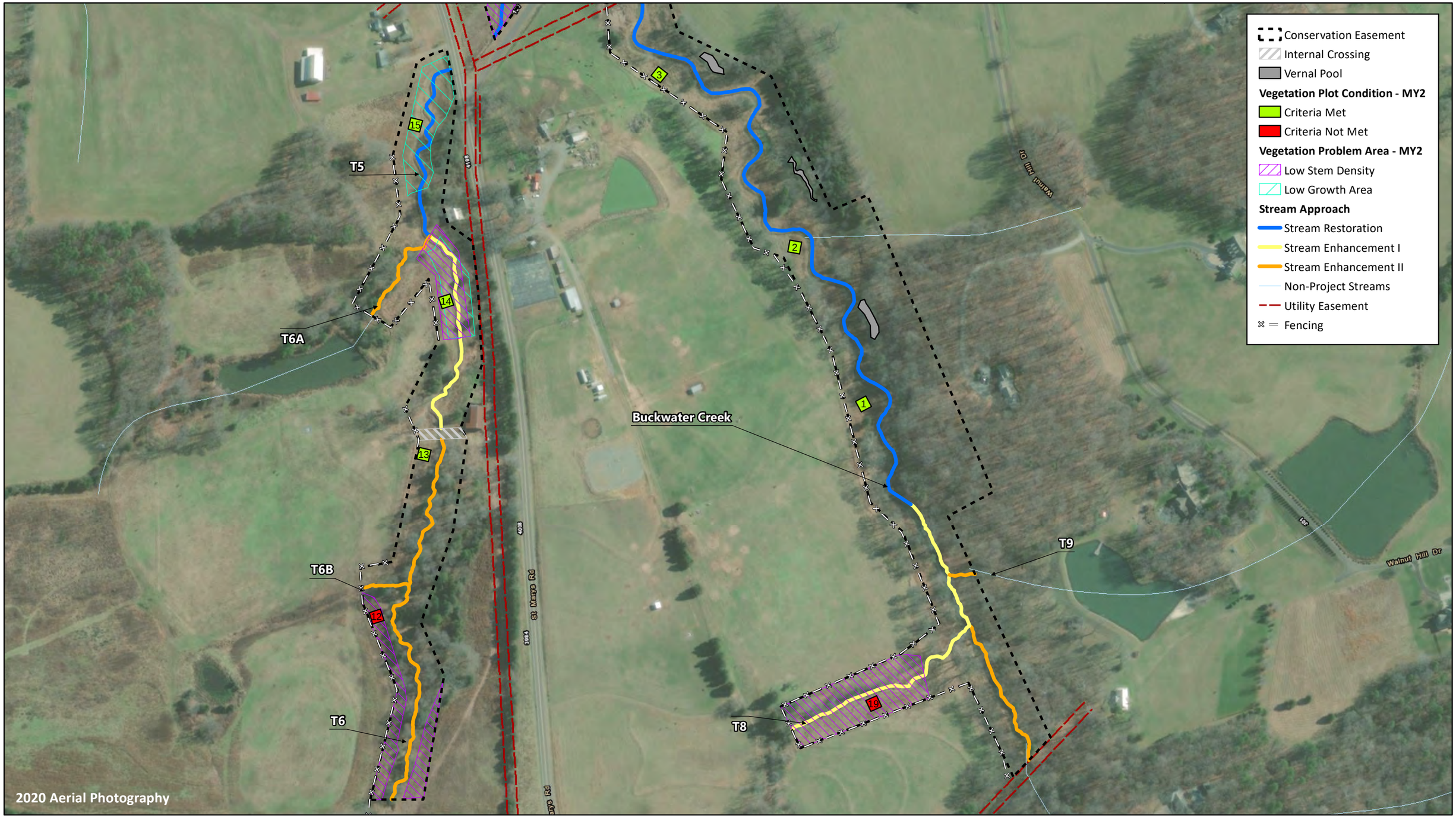
WILDLANDS ENGINEERING

0 400 800 Feet

N

Figure 1. Supplemental Planting Map Key
Buckwater Mitigation Site
Adaptive Management Plan
Neuse River Basin (03020201)

Orange County, NC

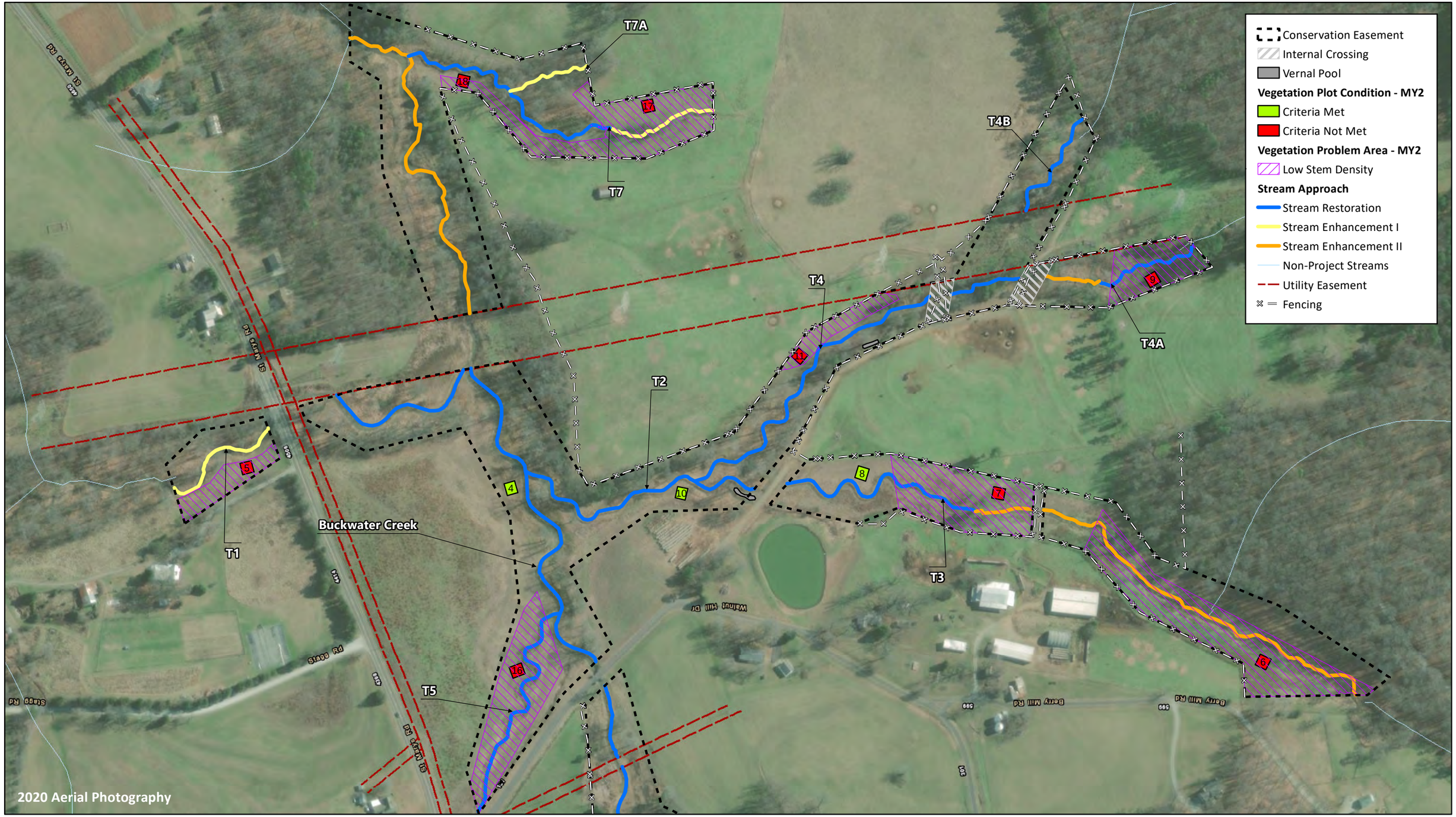


WILDLANDS ENGINEERING

0 250 500 Feet

Figure 1a. Supplemental Planting Map
Buckwater Mitigation Site
Adaptive Management Plan
Neuse River Basin (03020201)

Orange County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

Figure 1b. Supplemental Planting Map
Buckwater Mitigation Site
Adaptive Management Plan
Neuse River Basin (03020201)

Orange County, NC

Table 1. Vegetation Plot Criteria Attainment Table

Buckwater Mitigation Site

DMS Project No. 97084

Adaptive Management Plan

Plot	MY2 Success Criteria Met *	Tract Mean
1	Yes	
2	Yes	
3	Yes	
4	Yes	
5	No	
6	No	
7	No	
8	Yes	
9	No	
10	Yes	47%
11	No	
12	No	
13	Yes	
14	Yes	
15	Yes	
16	No	
17	No	
18	No	
19	No	

*Success Criteria Met is based on the interim success criteria for MY3 of 310 planted stems per acre.

Table 2. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Adaptive Management Plan

			Current Plot Data (MY2 2020)																				
			VP 1			VP 2			VP 3			VP 4			VP 5			VP 6			VP 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**
Aesculus pavia	Red Buckeye	Shrub Tree																			1	1	1
Betula nigra	River Birch	Tree	1	1	3	2	2	2	3	3	3	2	2	2									
Carya	Hickory	Tree															1						
Diospyros virginiana	Persimmon	Tree																					
Fraxinus pennsylvanica	Green Ash	Tree	3	3	3	2	2	2	2	2	2	3	3	3	1	1	1	2	2	2	1	1	1
Juglans nigra	Black Walnut	Tree									1												
Liquidambar styraciflua	Sweet Gum	Tree																					
Liriodendron tulipifera	Tulip Poplar	Tree							1	1	1												
Nyssa biflora	Swamp Tupelo	Tree																					
Platanus occidentalis	Sycamore	Tree	1	1	1	5	5	5	4	4	4	2	2	3	3	3	3	4	4	4	1	1	1
Quercus alba	White Oak	Tree	1	1	1	1	1	1							1	1	1						
Quercus lyrata	Overcup Oak	Tree										3	3	3	2	2	2						
Quercus michauxii	Swamp Chestnut Oak	Tree	3	3	3				1	1	1												
Quercus phellos	Willow Oak	Tree	1	1	1				1	1	1	3	3	3							1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree				3	3	3	1	1	1												
Salix nigra	Black Willow	Tree																					
Viburnum dentatum	Arrow-wood	Shrub Tree																					
		Stem count	10	10	12	13	13	13	13	13	14	13	13	14	7	7	8	6	6	6	4	4	4
		size (ares)	1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	6	6	6	5	5	5	7	7	8	5	5	5	4	4	5	2	2	2	4	4	4
		Stems per ACRE	405	405	486	526	526	526	526	526	567	526	526	567	283	283	324	243	243	243	162	162	162

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

Table 2. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Adaptive Management Plan

			Current Plot Data (MY2 2020)																				
			VP 8			VP 9			VP 10			VP 11			VP 12			VP 13			VP 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**
Aesculus pavia	Red Buckeye	Shrub Tree																					
Betula nigra	River Birch	Tree													1	1	1	4	4	4	4	4	4
Carya	Hickory	Tree																					
Diospyros virginiana	Persimmon	Tree																					
Fraxinus pennsylvanica	Green Ash	Tree	1	1	1				4	4	4	1	1	1				3	3	3	3	3	3
Juglans nigra	Black Walnut	Tree																					
Liquidambar styraciflua	Sweet Gum	Tree															1			2			
Liriodendron tulipifera	Tulip Poplar	Tree																			1	1	1
Nyssa biflora	Swamp Tupelo	Tree																					1
Platanus occidentalis	Sycamore	Tree	4	4	4	3	3	3	1	1	1				3	3	3	4	4	4	1	1	1
Quercus alba	White Oak	Tree																					
Quercus lyrata	Overcup Oak	Tree	1	1	1	2	2	2	4	4	4												
Quercus michauxii	Swamp Chestnut Oak	Tree							1	1	1				2	2	2	1	1	1			
Quercus phellos	Willow Oak	Tree	1	1	1										1	1	1						
Quercus shumardii	Shumard Oak	Shrub Tree	1	1	1																		
Salix nigra	Black Willow	Tree									2												
Viburnum dentatum	Arrow-wood	Shrub Tree										1	1	1							1	1	1
		Stem count	8	8	8	5	5	5	10	10	12	2	2	2	7	7	8	12	12	14	10	10	11
		size (ares)		1			1			1			1			1			1			1	
		size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	5	5	5	2	2	2	4	4	5	2	2	2	4	4	5	4	4	5	5	5	6
		Stems per ACRE	324	324	324	202	202	202	405	405	486	81	81	81	283	283	324	486	486	567	405	405	445

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

Table 2. Planted and Total Stem Counts
Buckwater Mitigation Site
DMS Project No. 97084
Adaptive Management Plan

			Current Plot Data (MY2 2020)															Annual Means								
			VP 15			VP 16			VP 17			VP 18			VP 19			MY2 (2020)			MY1 (2019)			MY0 (2019)		
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**	**PnoLS**	**P-all**	**T**
Aesculus pavia	Red Buckeye	Shrub Tree																1	1	1	9	9	9	10	10	10
Betula nigra	River Birch	Tree	3	3	3	1	1	1							1	1	1	22	22	24	34	34	35	41	41	41
Carya	Hickory	Tree																		1						
Diospyros virginiana	Persimmon	Tree									1									1						
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	33	33	33	34	34	34	34	34	34
Juglans nigra	Black Walnut	Tree																		1			1			
Liquidambar styraciflua	Sweet Gum	Tree									1			1						5			3			
Liriodendron tulipifera	Tulip Poplar	Tree																2	2	2	22	22	22	32	32	32
Nyssa biflora	Swamp Tupelo	Tree																		1						
Platanus occidentalis	Sycamore	Tree	4	4	4	3	3	3	1	1	1	1	1	2	2	2	2	47	47	49	56	56	56	62	62	62
Quercus alba	White Oak	Tree				1	1	1	1	1	1							5	5	5	10	10	10	11	11	11
Quercus lyrata	Overcup Oak	Tree										1	1	1				13	13	13	25	25	25	22	22	22
Quercus michauxii	Swamp Chestnut Oak	Tree	1	1	1										1	1	1	10	10	10	13	13	13	13	13	13
Quercus phellos	Willow Oak	Tree							1	1	1				1	1	1	10	10	10	33	33	33	33	33	33
Quercus shumardii	Shumard Oak	Shrub Tree																5	5	5	8	8	8	9	9	9
Salix nigra	Black Willow	Tree															1			3						
Viburnum dentatum	Arrow-wood	Shrub Tree	2	2	2	1	1	1	2	2	2	2	2	2				9	9	9	13	13	13	15	15	15
		Stem count	12	12	12	7	7	7	6	6	8	5	5	7	7	7	8	157	157	173	257	257	262	282	282	282
		size (ares)	1			1			1			1			1			19			19			19		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.47			0.47			0.47		
		Species count	5	5	5	5	5	5	5	5	7	4	4	5	5	5	6	11	11	17	11	11	13	11	11	11
		Stems per ACRE	486	486	486	283	283	283	243	243	324	202	202	283	283	283	324	334	334	368	547	547	558	601	601	601

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
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T: Total stems

Table 3. Supplemental Vegetation Planting

Buckwater Mitigation Site
DMS Project No. 97084
Adaptive Management Plan

Common Name	Scientific Name	One Gallon	Bare Root	Total
Willow Oak	*Quercus phellos*	50	220	270
Sycamore	*Platanus occidentalis*	80	220	300
River Birch	*Betula nigra*	50	350	400
Swamp Chestnut Oak	*Quercus michauxii*	80	370	450
White Oak	*Quercus alba*	80	345	425
Shumard Oak	*Quercus shumardii*	25	160	185
Hackberry	*Celtis occidentalis*	0	225	235
Persimmon	*Diospyros virginiana*	0	340	325
Boxelder	*Acer negundo*	0	310	325
	Total	**365**	**2,540**	**2,915**

Zone 1 - Streambank Planting Zone
(See Detail 3, Sheet 5.6)

Zone 2 - Buffer Planting Zone
(See Detail 4, Sheet 5.6)

Zone 3 - Overhead Electric Utility Easement Planting Zone

Streambank Planting Zone

Live Stakes					
Species	**Common Name**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**% of Stems**
Salix nigra	Black Willow	3-6 ft.	0.5"-1.5" cal.	Shrub	15%
Cornus ammomum	Silky Dogwood	3-6 ft.	0.5"-1.5" cal.	Shrub	45%
Salix sericea	Silky Willow	3-6 ft.	0.5"-1.5" cal.	Shrub	40%
					100%
Herbaceous Plugs					
Juncus effusus	Common Rush	4 ft.	1.0"- 2.0" plug	Herb	40%
Carex alata	Broadwing Sedge	4 ft.	1.0"- 2.0" plug	Herb	40%
Panicum virgatum	Switchgrass	4 ft.	1.0"- 2.0" plug	Herb	20%
					100%

Buffer Planting Zone - 23.6 Acres

Bare Root						
Species	**Common Name**	**Max Spacing**	**Indiv. Spacing**	**Min. Caliper Size**	**Stratum**	**# of Stems**
Quercus phellos	Willow Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Platanus occidentalis	Sycamore	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	20%
Betula nigra	River Birch	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	15%
Quercus michauxii	Swamp Chestnut Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	10%
Liriodendron tulipifera	Tulip Poplar	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	15%
Quercus alba	White Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Quercus shumardii	Shumard Oak	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	5%
Fraxinus pennsylvanica	Green Ash	12 ft.	6-12 ft.	0.25"-1.0"	Canopy	17%
**Viburnum nudum*	Possumhaw Viburnum	24 ft.	12-24 ft.	0.25"-1.0"	Understory	1%
**Amelanchier laevis*	Allegheny Serviceberry	24 ft.	12-24 t.	0.25"-1.0"	Understory	1%
**Aesculus pavia*	Red Buckeye	24 ft.	12-24 ft.	0.25"-1.0"	Understory	1%
						100%

Overhead Electric Utility Easement Planting Zone

Live Stakes					
Species	**Common Name**	**Indiv. Spacing**	**Min. Size**	**Stratum**	**% of Stems**
Cornus ammomum	Silky Dogwood	6-12 ft.	0.5"-1.5" cal.	Shrub	50%
Salix sericea	Silky Willow	6-12 ft.	0.5"-1.5" cal.	Shrub	50%
					100%

Zones 1, 2 and 3

Permanent Riparian Seeding

Pure Live Seed (20 lbs / acre)						
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**	**pH**	**Percentage**
All Year	*Panicum rigidulum*	Redtop Panicgrass	Herb	1.5	5.0-7.5	5%
All Year	*Agrostis hyemalis*	Winter Bentgrass	Herb	3.0	5.0-7.5	15%
All Year	*Chasmanthium latifolium*	River Oats	Herb	2.0	5.0-7.0	10%
All Year	*Rudbeckia hirta*	Blackeyed Susan	Herb	1.0	6.0-7.0	5%
All Year	*Coreopsis lanceolata*	Lanceleaf Coreopsis	Herb	1.0	6.0-7.0	5%
All Year	*Carex vulpinoidea*	Fox Sedge	Herb	4.0	6.8-8.9	20%
All Year	*Panicum clandestinum*	Deertongue	Herb	3.4	4.0-7.5	24%
All Year	*Elymus virginicus*	Virginia Wild Rye	Herb	3.0	5.0-7.4	15%
All Year	*Asclepias syrica*	Common Milkweed	Herb	0.2	5.5-7.3	1%
						100%

Permanent Seeding Outside Easement

Approved Date	Species Name	Common Name	Stratum	Density (lbs/acre)	Percentage
All Year	*Festuca arundinacea*	Tall Fescue	Herb	40	70%
All Year	*Festuca rubra*	Creeping Red Fescue	Herb	40	10%
All Year	*Dactylis glomerata*	Orchardgrass	Herb	40	20%
					100%

Temporary Seeding

Pure Live Seed				
Approved Date	**Species Name**	**Common Name**	**Stratum**	**Density (lbs/acre)**
Aug 15 - May 1	*Secale cereale*	Rye Grain	Herb	140
May 1 - Aug 15	*Setaria italica*	German Millet	Herb	50

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 037445 NICOLE MACALUSO

Buckwater Mitigation Site
Orange County, North Carolina
Planting Tables

Revisions:

Date: 07.01.2019
Job Number: 005-02157
Project Engineer: NMM
Drawn By: CAW
Checked By: JTL

Sheet 2.0

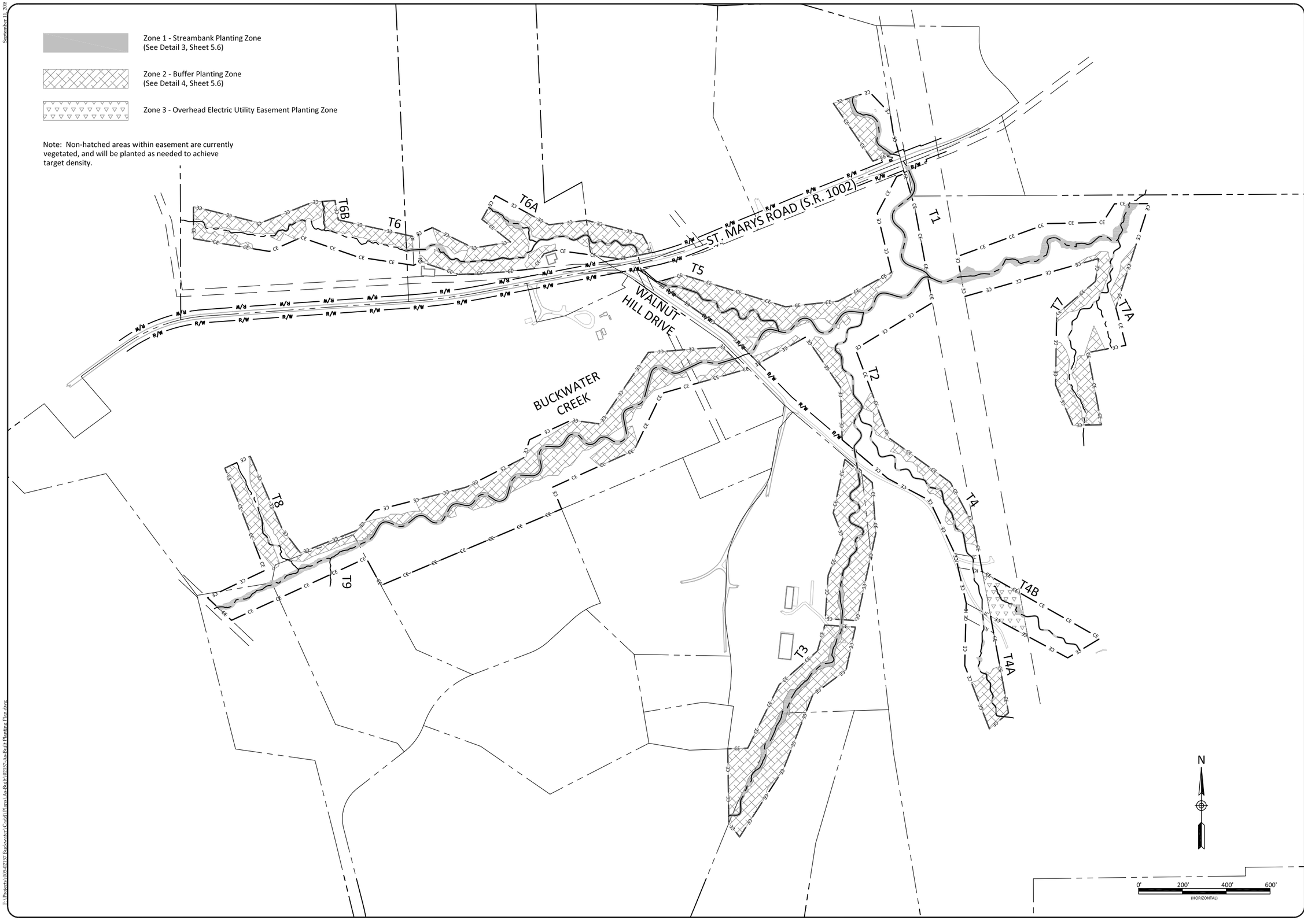
September 11, 2019

Zone 1 - Streambank Planting Zone
(See Detail 3, Sheet 5.6)

Zone 2 - Buffer Planting Zone
(See Detail 4, Sheet 5.6)

Zone 3 - Overhead Electric Utility Easement Planting Zone

Note: Non-hatched areas within easement are currently vegetated, and will be planted as needed to achieve target density.



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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 037445 NICOLE MACALUSO

Buckwater Mitigation Site
Orange County, North Carolina

Planting Plan

Revisions:

Date: 07.01.2019
Job Number: 005-02157
Project Engineer: NMM
Drawn By: CAW
Checked By: JTE

Sheet 2.1

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