

MONITORING YEAR 5 ANNUAL REPORT
Final

BUCKWATER BUFFER MITIGATION SITE
Orange County, NC
NCDEQ Contract No. 006829
DMS Project Number 97084
NCDWR Project Number 2016-0406v1

Data Collection Period: September 2023
Draft Submission Date: December 8, 2023
Final Submission Date: January 29, 2024

PREPARED FOR:

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

January 29, 2024

Jeremiah Dow
Eastern Regional Supervisor
North Carolina DEQ Division of Mitigation Services
217 West Jones Street, Raleigh, NC 27603

RE: DMS Comments on the MY5 Report
Buckwater, Project ID #97084, DMS Contract 6829

Dear Mr. Dow:

We have reviewed the comments on the Monitoring Year 5 Report for the above referenced project dated December 11, 2023 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.

Buffer Report:

1. Table 5 – Vegetation Condition Assessment Table should be consistent between the stream and buffer report.
   Response: *Table 5 has been updated to be consistent with the stream report.*

2. While individual heights are included, it may be useful for DWR's review to include average tree height for each veg plot, and site wide (recommend an additional column in Table 8), since the buffer portion of the site will be proposed for closeout this year.
   Response: *Table 8b: Average Vegetation Height by Plot and Graph 1: Vegetation Plot Trends are now included in the report.*

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

Jason Lorch, *Monitoring Coordinator*

PREPARED BY:

Wildlands Engineering, Inc.
312 West Millbrook Road, Suite 225
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BUCKWATER BUFFER MITIGATION SITE

Monitoring Year 5 Report

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APPENDICES

Section 1: PROJECT OVERVIEW

1.1 Project Summary

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Buckwater Mitigation Site (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) to restore a total of 16,276 linear feet of perennial and intermittent streams in Orange County, NC. The Site included the restoration of Buckwater Creek and 14 unnamed tributaries. The project also restored, enhanced, and preserved a total of 36.03 acres (1,569,567 ft^2) of riparian buffer at the Site, which will provide Riparian Buffer Credits and Nutrient Offset Credits. The Site is located approximately 4.5 miles northeast of Hillsborough, NC (Figure 1) in the Neuse River Basin 8-Digit Hydrologic Unit Code (HUC) 03020201 and NC Division of Water Resources (NCDWR) Subbasin 03-04-01 and is within the DMS-targeted HUC 03020201030030. The Site streams drain to the Eno River, which flows to Falls Lake, and are classified as Water Supply Waters (WS-IV) and Nutrient Sensitive Waters (NSW).

Work at the Site was planned, designed, and constructed per the Buckwater Mitigation Plan (Wildlands, 2017) and the Consolidated Buffer Mitigation Rule 15A NCAC 02B .0295 (effective November 1, 2015). The purpose of the riparian buffer restoration is to provide riparian buffer credits to compensate for buffer impacts within the HUC 03020201 and the Falls Lake Watershed. The service area for the Riparian Buffer and Nutrient Offset Credits is depicted in Figure 2. The mitigation credits generated from the Site are listed in Tables 1a and 1b and shown in Figure 3.

1.2 Project Goals and Objectives

Prior to construction activities, the primary causes of Site degradation were stream channelizing and livestock grazing/agriculture, 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 100 cows graze on two 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 was channelized. Landowners maintained lower Buckwater Creek below Walnut Hill Drive as a straightened channel until the 1990s.

The major goals of the buffer project are to provide ecological and water quality enhancements to the Neuse River Basin within the Falls Lake Water Supply Watershed by creating a functional riparian corridor and restoring the riparian buffer. This project supports specific goals identified in the 2010 Neuse River Basin Restoration Priorities Plan (RBRP) (Breeding, 2010) for the Neuse River Targeted Local Watershed. This document highlights the importance of riparian buffers for stream restoration projects. Riparian buffers immobilize and retain nutrients and suspended sediment. The RBRP also supports the Falls Lake Watershed Plan. Specific enhancements to water quality and ecological processes are outlined below:

- Decrease nutrient levels - Nutrient inputs will be decreased by filtering runoff from the agricultural fields through restored, native buffer zones. Nutrient inputs will also be absorbed on-site by native vegetation, further reducing nutrient inputs to waters of the Neuse River Basin.
- Decrease sediment input - Sediment loading will be deposited on restored floodplain areas, thereby reducing sediment inputs to Falls Lake.
- Create higher quality terrestrial habitat - Buffer areas will be restored by removing invasive vegetation and planting native vegetation. A variety of native vegetation will improve wildlife habitat.
- Permanently protect the Site from harmful uses - Establish a conservation easement on the Site, which will protect aquatic habitat and reduce pollutant loading to a water supply.

The 51.84-acre Site is protected with a permanent conservation easement. Of the 51.84 acres, Neuse Riparian Buffer Credits were generated by restoring 21.80 acres, preserving 8.66 acres, and enhancing 5.57 acres. The remaining 15.81 acres will not generate buffer mitigation credit. In general, riparian buffer restoration widths extend 200 feet from the stream channels' top of bank for Neuse River Riparian Buffer Credits. Figure 3 details the buffer credit generation.

1.3 Monitoring Year 5 Data Assessment

The Mitigation Plan (Wildlands, 2017) was submitted and accepted by DMS in December 2017. Construction activities by Ecotone, Inc. were finished in April 2019. The planting was completed by Bruton Natural Systems, Inc. in April 2019. The baseline as-built survey was completed by Turner Land Surveying in July 2019. Monitoring Year 1 (MY1) survey was completed in October 2019, MY2 survey was completed in September 2020, MY3 survey was completed in October 2021, and MY4 survey was completed in October 2022. Repairs of instream structures were completed in August 2023 and MY5 survey was completed in October 2023. Refer to Appendix 1 for detailed project activity, history, contact information, and watershed/site background information.

Vegetative performance for buffer restoration areas will be in accordance with 15A NCAC 02B .0295(n)(2)(B), and (n)(4) (effective November 1, 2015). To meet success criteria, areas generating buffer mitigation credits shall include a minimum of four native hardwood tree species, where no one species is greater than 50 percent of stems, and shall have a survival of at least 260 stems per acre at the end of the required five-year monitoring period. For the monitoring to be complete and buffer credit to be awarded, NCDWR must provide written approval of successful revegetation of buffer restoration areas.

1.3.1 Vegetative Assessment

The quantity of monitoring vegetation plots was determined in accordance with Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008) such that at least 2 percent of the Site is encompassed in monitoring plots. A total of 19 vegetation plots (10 meters by 10 meters) were established within the conservation easement boundaries and at least five feet from the top of stream banks. The plot corners have been marked and are recoverable either through field identification or with the use of a GPS unit. Reference photographs are taken at the origin looking diagonally across the plot to the opposite corner on an annual basis. Trees are annually marked with flagging tape. Also annually, species composition, vigor, height, density, and survival rates are evaluated by plot. As necessary, the extent of invasive species coverage is monitored and controlled.

The 2023 annual vegetation monitoring resulted in an average survival of 373 planted stems per acre. This is greater than the final requirement of 260 stems per acre, but approximately 35% less than the baseline density (MY0) recorded (601 planted stems per acre) in April 2019. There is an average of 10 stems per plot as compared to 15 stems per plot in MY0. A total of 15 of the 19 vegetation plots currently meet the final success criteria (260 stems per acre) required for MY5. Vegetation plots 6, 7, 8, and 18 do not meet the final success criteria. However, vegetation plots 6 and 7 are only failing to meet requirements by less than 10% with 243 stems per acre. Despite the mortality of planted stems in plot 18, when accounting for volunteer American elm, this plot also only fails to meet the final success criteria by less than 10%. Along with a diverse and developing successional canopy, the herbaceous vegetation is dense and providing wildlife habitat. These plots seem to be outliers from their surrounding areas and are not considered areas of concern.

Refer to Appendix 3 for vegetation plot criteria attainment data, CVS vegetation plot metadata, and vegetation summary tables and Appendix 2 for vegetation plot photographs, vegetation condition assessment table, and monitoring plan view.

1.3.2 Vegetation Areas of Concern

A small area of dense sweetgum (*Liquidambar styraciflua*) saplings was noted along T6 Reach 1 (Appendix 2). The sweetgum population was thinned to approximately 50% density in February 2023. Wildlands will continue to monitor and manage this area for overgrowth of sweetgums.

Several small areas totaling 1.72 acres of Chinese privet (*Ligustrum sinense*) growth were noted along Buckwater Creek Reaches 6 and 7, T2, and T4. The invasive removal was completed along Buckwater Creek Reach 6, T2, and T4 in March 2023 (Appendix 2). Wildlands will continue to manage and remove the remaining populations of Chinese privet along Buckwater Creek Reach 7 through winter 2023-2024.

In April 2023, several constructed instream structures along T3 Reach 2, T4, T4B Reach 1, and T6 Reach 3 were observed to be performing poorly or failing (Appendix 2). In August 2023, mechanical repairs to these structures were made which required equipment access into the easement. The resulting limits of disturbance (LOD) for all four repair areas totaled approximately 0.20 acres. Replanting of the LODs was completed by November 2023. A total of 140 containerized stems were planted across the four repair area LODs.

Soil amendments and ring sprays were conducted in April 2023. Soil amendments were applied locally to trees with low heights across the site. Ring sprays were conducted in areas across the site with dense fescue to reduce competition with planted trees.

In September 2023, it was noted that the utility company that maintains the electrical distribution easement adjoining the easement boundary south of T6 mowed within the easement. The entire mowed area is approximately 0.04 acres. The encroachment has been addressed with the utility company. Approximately one dozen containerized trees of species included in the approved planting list were planted in the mowed area in November 2023. Wildlands will check, refresh, and repost boundary signage throughout the site in winter 2023-2024.

1.4 Monitoring Year 5 Summary

A total of 15 of the 19 vegetation plots exceeded the MY5 final success criteria. However, vegetation plots 6, 7, and 18 are only failing to meet requirements by less than 10% with 243 stems per acre each. Vegetation has become well established along the stream banks providing shade, stability, and a source of organic material. Replanting of the repair areas' limits of disturbance has been partially completed and will be fully completed in winter 2023-2024. Management actions were completed in MY5 to ensure tree survivability and growth. An invasive vegetation treatment was completed in March 2023 and remaining Chinese privet will continue to be treated. Summary information/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: REFERENCES

Breeding, R. 2010. Neuse River Basin Restoration Priorities. North Carolina Ecosystem Enhancement Program.

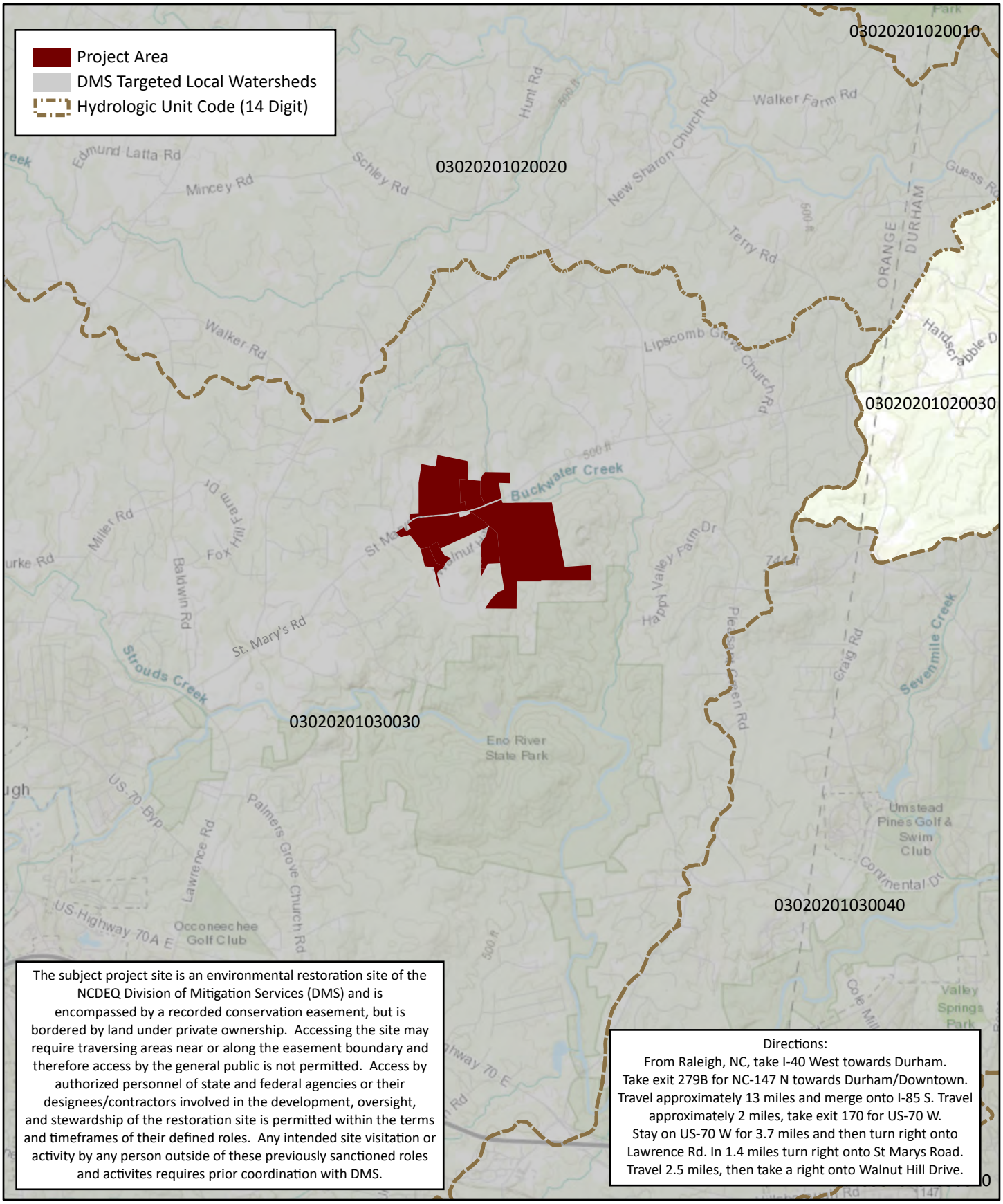
Lee, Michael T. Peet, Robert K., Steven D. Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-2.pdf

http://portal.ncdenr.org/c/document_library/get_file?uuid=864e82e8-725c-415e-8ed9-c72dfcb55012&groupId=60329

North Carolina Department of Environmental Quality, Division of Mitigation Services (NCDMS), 2017. Riparian Buffer and Nutrient Offset Buffer Baseline and Annual Monitoring Report Template version 2.0

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

APPENDIX 1. General Figures and Tables

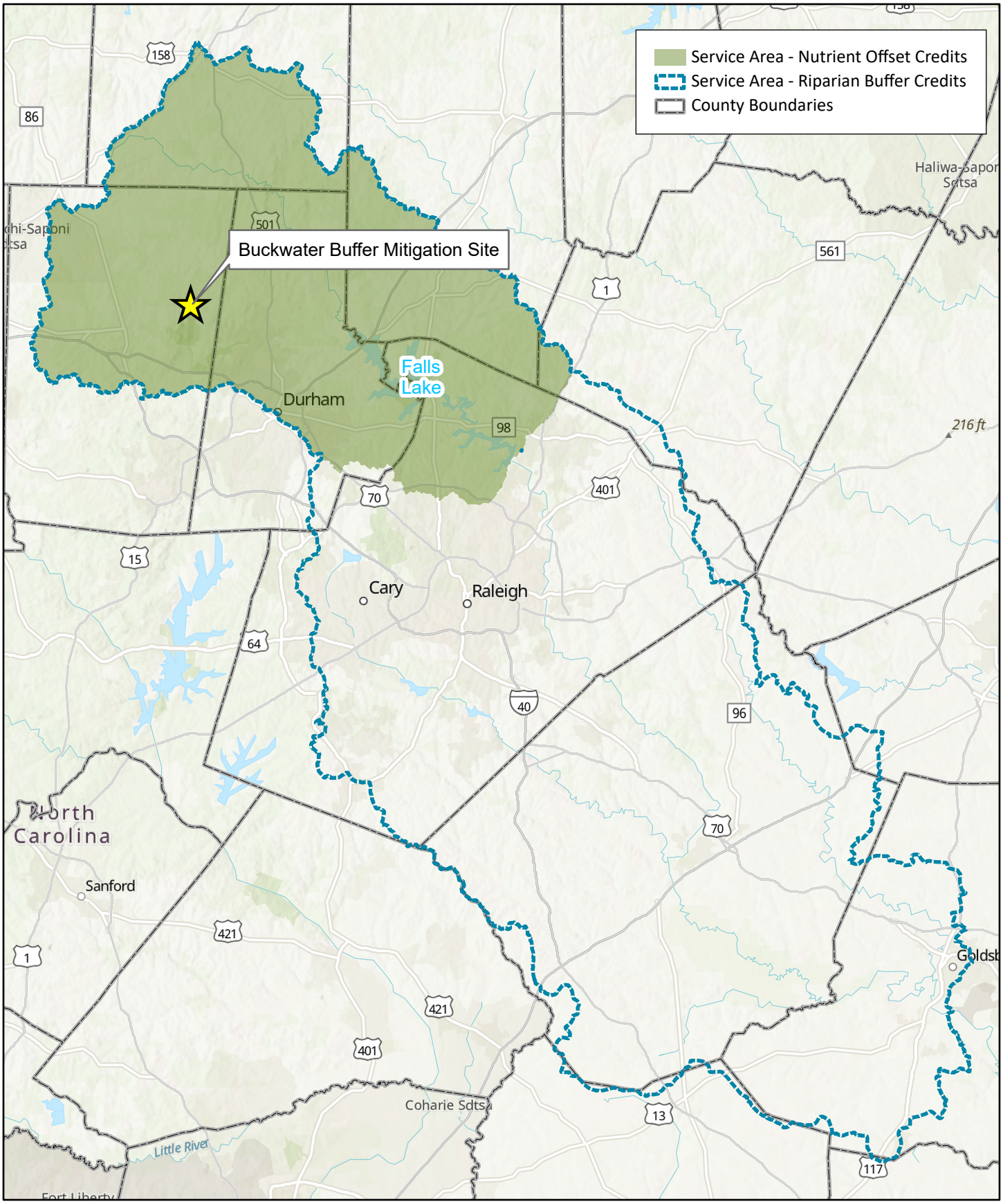


The subject project site is an environmental restoration site of the NCDEQ Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary 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

Figure 1. Project Vicinity Map
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)
Orange County, NC

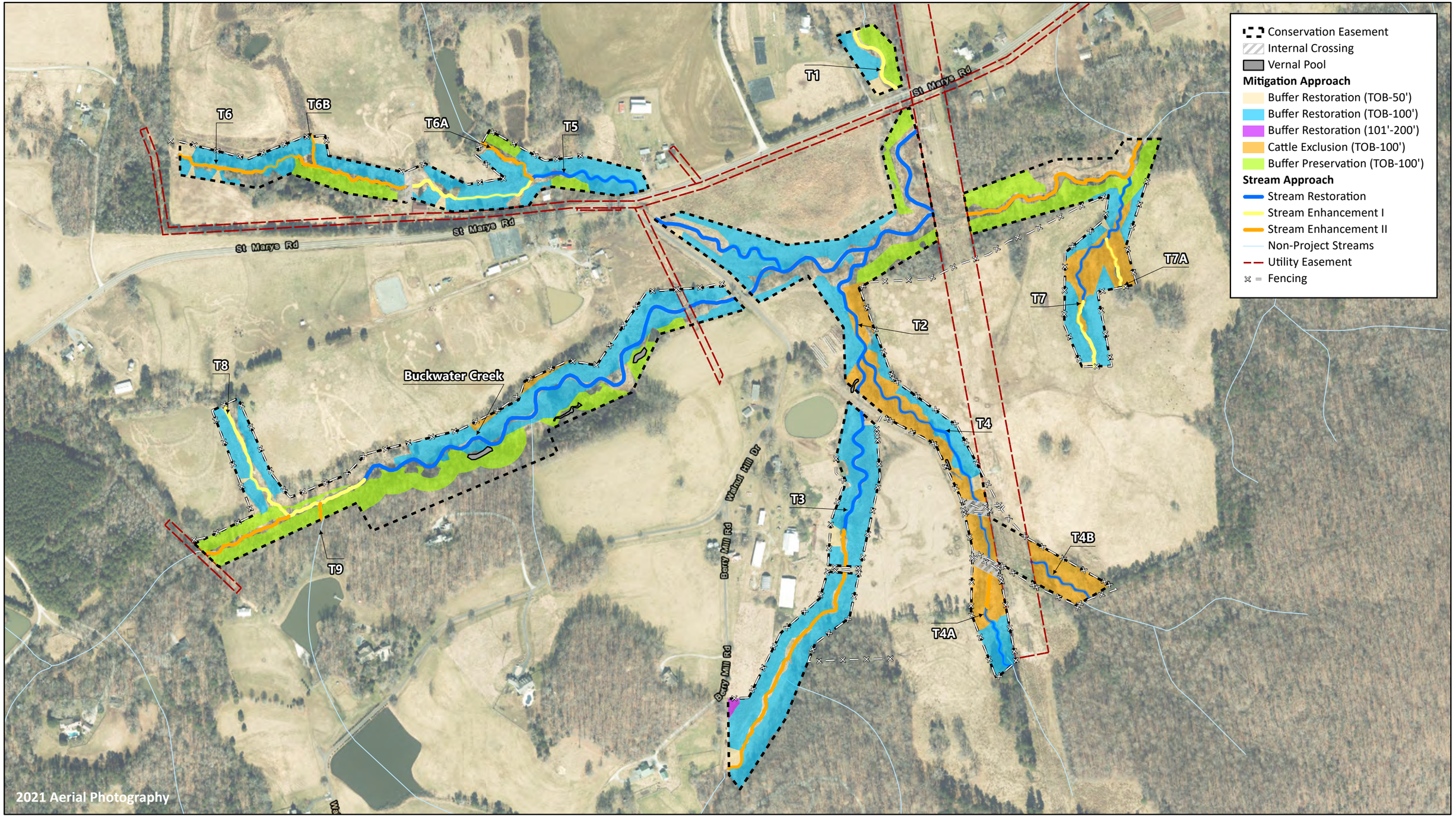


WILDLANDS ENGINEERING

0 5 10 Miles

N

Figure 2. Service Area
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)
Orange County, NC



WILDLANDS ENGINEERING

0 400 800 Feet

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Figure 3. Project Component / Asset Map
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)

Orange County, NC

Table 1a. Buffer Project Areas and Assets

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Location	Jurisdictional Streams	Method	Feature Name	Min-Max Buffer Width (ft)	Total Area (sf)*	Creditable Area (sf)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits
Rural	Subject	Restoration	Buffer Area E	20-29	27,683	27,683	1	75%	1.33333	20,762.302
Rural	Subject	Restoration	Buffer Area A	0-100	919,068	919,068	1	100%	1.00000	919,068.000
Rural	Subject	Restoration	Buffer Area B	101-200	2,899	2,899	1	33%	3.03030	956.671
Rural	Subject	Cattle Exclusion	Buffer Area C	0-100	242,491	242,491	2	100%	2.00000	121,245.500
					SUBTOTALS	**1,192,141**				**1,062,032.473**
			ELIGIBLE PRESERVATION AREA			**397,380**				
Location	**Jurisdictional Streams**	**Method**	**Feature Name**	**Min-Max Buffer Width (ft)**	**Total Area (sf)***	**Creditable Area (sf)**	**Initial Credit Ratio (x:1)**	**% Full Credit**	**Final Credit Ratio (x:1)**	**Riparian Buffer Credits**
Rural	Subject	Preservation	Buffer Area D	0-100	377,426	377,426	10	100%	10.00000	37,742.600
					SUBTOTALS	**377,426**				**37,742.600**
					TOTALS	**1,569,567**				**1,099,775.073**

*Differences in total area compared to the total area listed in the Mitigation Plan are due to the increased accuracy of the surveyed tree lines and the installation of vernal pools during stream construction.

Table 1b. Nutrient Offset Project Areas and Assets Available Upon Conversion

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Riparian Width	Credit Type	Mitigation Type	Feature Name	Credit Ratio	Mitigation Area from Survey (ac)	Mitigation Area from Survey (sq ft)	Credited Acerage	Generated Credits per Acre	Generated Credits (lb)
101' - 200'	Nitrogen	Restoration (TOB'-100)	Buffer Area A	1:1	21.10	919,068	21.10	2,273.02	**47,958.196**
		Restoration (101'-200)	Buffer Area B	1:1	0.07	2,899	0.07		**151.274**
	Phosphorous	Restoration (TOB'-100)	Buffer Area A	1:1	21.10	919,608	21.10	146.40	**3,088.879**
		Restoration (101'-200)	Buffer Area B	1:1	0.07	2,899	0.07		**9.743**
								Total Nitrogen Credits	**48,109.470**
								Total Phosphorous Credits	**3,098.622**

Table 2. Project Activity and Reporting History

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

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)	April 2019	July 2019
Invasive Treatment		October 2019
Year 1 Monitoring	October 2019	December 2019
Soil Amendments		August 2020
Year 2 Monitoring	September 2020	December 2020
Replanting and Soil Amendments		February 2021
Ring Sprays		March 2021
Year 3 Monitoring	October 2021	December 2021
Replanting and Soil Amendments		November 2022
Year 4 Monitoring	October 2022	December 2022
Sweetgum Thinning		February 2023
Invasive Treatment		March 2023
Soil Amendments and Ring Sprays		April 2023
Year 5 Monitoring	October 2023	December 2023

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

Table 3. Project Contact Table

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Designer Nicole Macaluso, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
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, ext. 107

Table 4. Project Information and Attributes

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

PROJECT INFORMATION	
Project Name	Buckwater Buffer Mitigation Site
County	Orange County
Project Area (acres)	51.84
Planted Area (acres)	23.60
Project Coordinates (latitude and longitude)	36° 6' 23.49" N, 79° 1' 29.11"W
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 Drainage Area (acres)	2,259
Project Drainage Area Percentage of Impervious Area	3.90%
CGIA Land Use Classification	63.9% forested, 32.1% cultivated, 3.9% impervious

Table 5. Adjacent Forested Areas Existing Tree and Shrub Species

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Common Name	Scientific Name	Wetland Indicator Status
American Beech	*Fagus grandifolia*	FACU
Black Walnut	*Juglans nigra*	FACU
Green Ash	*Fraxinus pennsylvanica*	FACW
Mockernut Hickory	*Carya tomentosa*	UPL
Red Maple	*Acer rubrum*	FAC
Red Cedar	*Juniperus virginiana*	FACU
Sweet Gum	*Liquidambar styraciflua*	FAC
Spice Bush	*Lindera benzoin*	FAC
Yellow Buckeye	*Aesculus flava*	FACU

Table 6. Planted Tree Species

Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Common Name	Scientific Name	Number Planted	% of Total
Willow Oak	*Quercus phellos*	1,842	10%
Sycamore	*Platanus occidentalis*	3,686	20%
River Birch	*Betula nigra*	2,764	15%
Overcup Oak	*Quercus lyrata*	1,106	6%
Swamp Chestnut Oak	*Quercus michauxii*	738	4%
Tulip Poplar	*Liriodendron tulipifera*	2,764	15%
White Oak	*Quercus alba*	922	5%
Shumard Oak	*Quercus shumardii*	920	5%
Green Ash	*Fraxinus pennsylvanica*	3,132	17%
Possumhaw Viburnum	*Viburnum dentatum*	184	1%
Allegheny Serviceberry	*Amelanchier laevis*	184	1%
Red Buckeye	*Aesculus pavia*	184	1%

APPENDIX 2. Visual Assessment Data

Figure 4a

Figure 4b

T6

T6B

T6A

T5

T1

St Marys Rd

T7A

T7

T2

T8

Buckwater Creek

T4

Walnut Hill Dr

T3

Berry Mill Rd

T4B

T4A

T9

2021 Aerial Photography

- Conservation Easement
- Internal Crossing
- Vernal Pool
- Encroachment (0.041 acres)

Vegetation Plots - MY5

- Criteria Met
- Criteria Not Met

Vegetation Area of Concern - MY5

- Repair Area Planting
- Chinese Privet Removal
- Sweetgum Thinning

Mitigation Approach

- Buffer Restoration (TOB-50')
- Buffer Restoration (TOB-100')
- Buffer Restoration (101'-200')
- Cattle Exclusion (TOB-100')
- Buffer Preservation (TOB-100')

Stream Approach

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

WILDLANDS ENGINEERING

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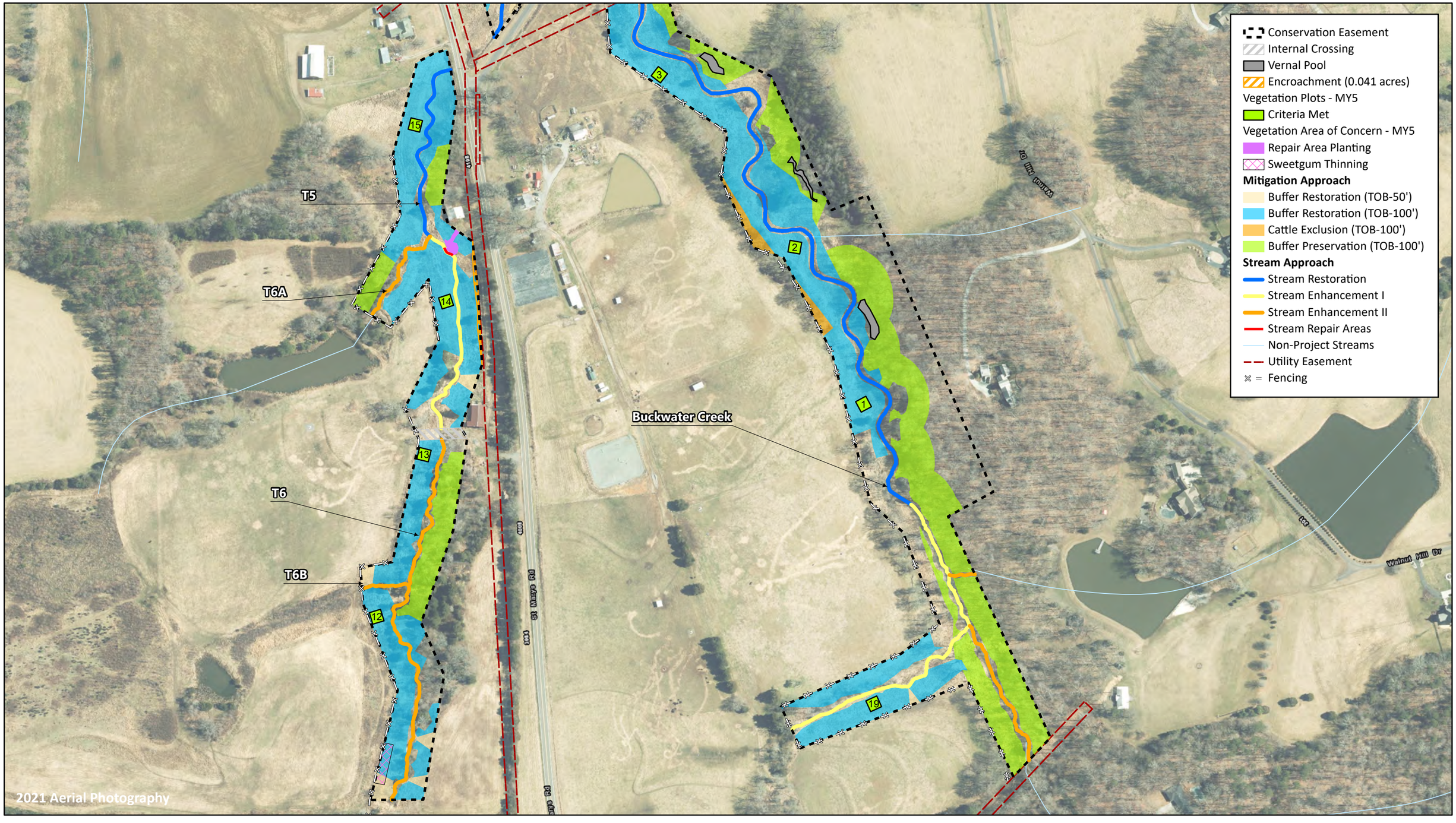
Figure 4. Monitoring Plan View Key
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)

Orange County, NC



WILDLANDS ENGINEERING

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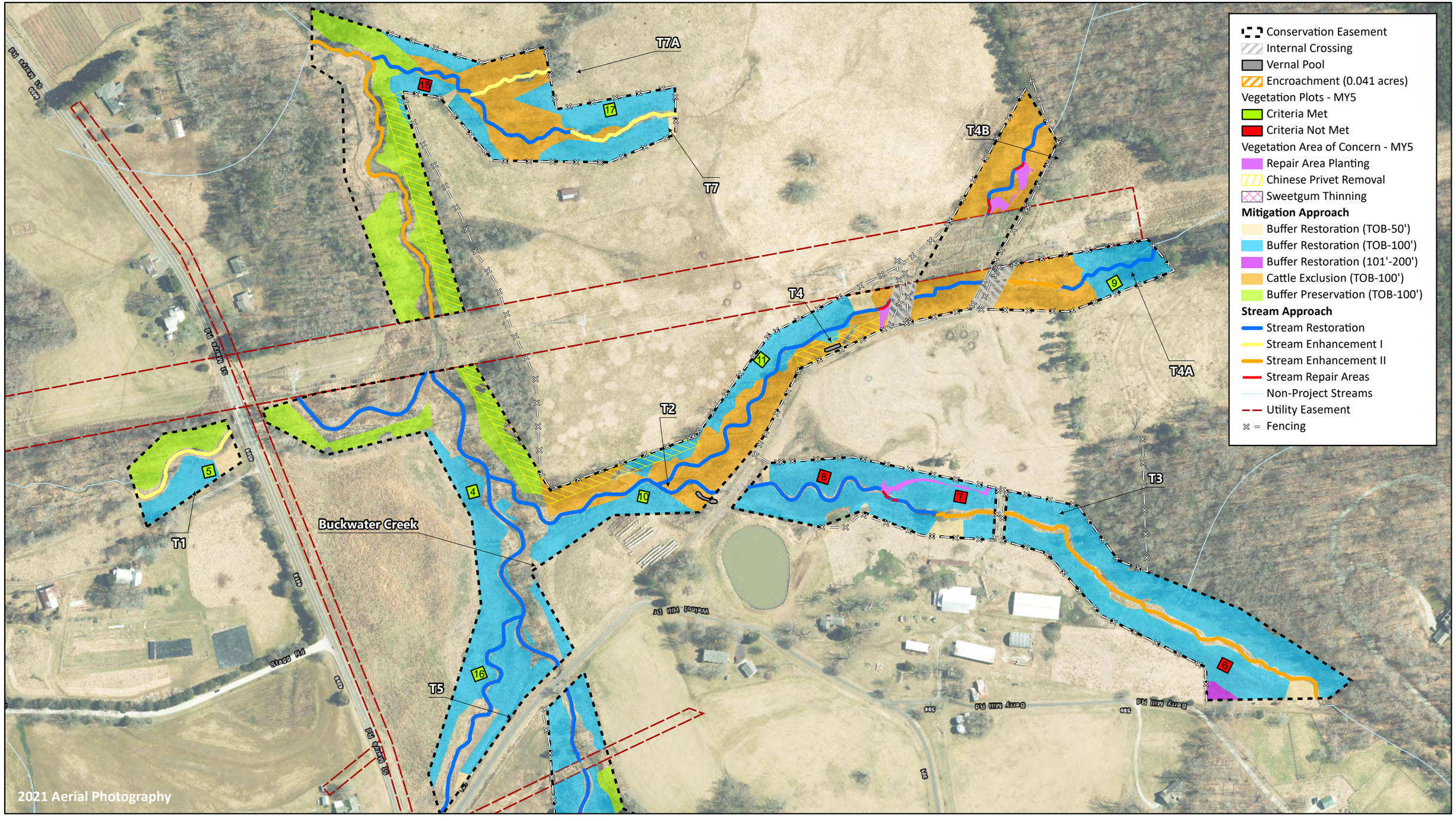
Figure 4a. Monitoring Plan View
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)

Orange County, NC



WILDLANDS ENGINEERING

0 250 500 Feet

Figure 4b. Monitoring Plan View
Buckwater Buffer Mitigation Site
Monitoring Year 5 - 2023
Neuse River Basin (03020201)

Orange County, NC

Table 7. Vegetation Condition Assessment Table
Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

Planted Acreage **23.60**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	0	0%
		Total	**0**	**0%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.25	0	0%
		Cumulative Total	**0**	**0%**

Easement Acreage **51.84**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Invasive species included in summation above should be identified in report summary.	0.10	1.72*	3%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	1 Encroachments Noted / 0.04 ac**	

*Chinese privet (Ligustrum sinense) was chemically treated along a 1.72-acre polygon in March 2023.
** Mowing occurred within the easement near T6 during maintenance of the adjacent utility easement.

VEGETATION PLOT PHOTOGRAPHS

	
VEG PLOT 1 *(10/03/2023)*	**VEG PLOT 2** *(10/03/2023)*
	
VEG PLOT 3 *(10/03/2023)*	**VEG PLOT 4** *(10/03/2023)*
	
VEG PLOT 5 *(10/03/2023)*	**VEG PLOT 6** *(10/03/2023)*

VEG PLOT 7 *(10/03/2023)*

VEG PLOT 8 *(10/03/2023)*

VEG PLOT 9 *(10/03/2023)*

VEG PLOT 10 *(10/03/2023)*

VEG PLOT 11 *(10/03/2023)*

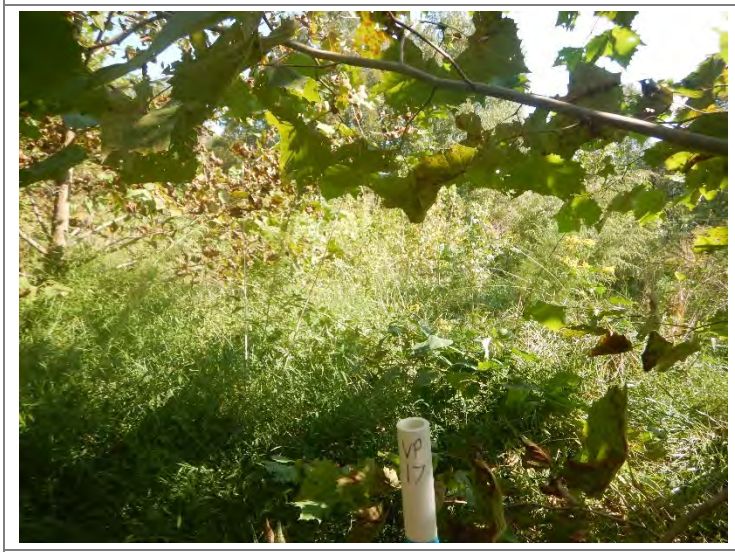
VEG PLOT 12 *(10/03/2023)*

VEG PLOT 13 *(10/03/2023)*

VEG PLOT 14 *(10/03/2023)*

VEG PLOT 15 *(10/03/2023)*

VEG PLOT 16 *(10/03/2023)*



VEG PLOT 17 *(10/03/2023)*

VEG PLOT 18 *(10/03/2023)*

VEG PLOT 19 *(10/03/2023)*

APPENDIX 3. Vegetation Plot Data

Table 8a. Vegetation Plot Criteria Attainment Table

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Success Criteria Met *	Tract Mean
1	Yes	79%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	No*	
7	No*	
8	No	
9	Yes	
10	Yes	
11	Yes	
12	Yes	
13	Yes	
14	Yes	
15	Yes	
16	Yes	
17	Yes	
18	No*	
19	Yes	

* Vegetation Plots 6, 7, and 18 only failed to meet criteria by less than 10%.

Table 8b. Average Vegetation Height by Plot

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Average Height by Plot (feet)					
Plot	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
1	2.6	2.8	3.3	3.9	4.1
2	2.6	4.0	5.6	8.2	10.3
3	3.0	4.4	7.6	9.6	10.2
4	2.3	2.9	3.2	4.7	5.9
5	2.4	2.7	2.2	2.7	3.9
6	2.6	4.4	5.5	9.8	14.6
7	2.5	4.4	4.6	5.7	7.8
8	2.3	3.2	5.1	7.1	11.8
9	2.9	7.3	6.2	8.3	15.5
10	2.3	3.5	4.9	6.9	8.5
11	2.6	3.6	4.3	4.2	5.4
12	3.0	3.9	4.0	5.7	7.3
13	2.9	4.4	7.5	10.8	15.8
14	2.5	2.9	4.0	4.3	6.1
15	2.9	3.4	4.6	6.1	7.9
16	2.4	3.1	3.2	4.7	5.9
17	2.9	3.4	3.0	3.3	4.9
18	2.4	2.6	2.6	4.1	5.2
19	2.5	3.7	4.2	6.1	7.1
Average	**2.0**	**2.9**	**3.7**	**5.2**	**8.6**

Graph 1. Vegetation Plot Trends

Buckwater Buffer Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

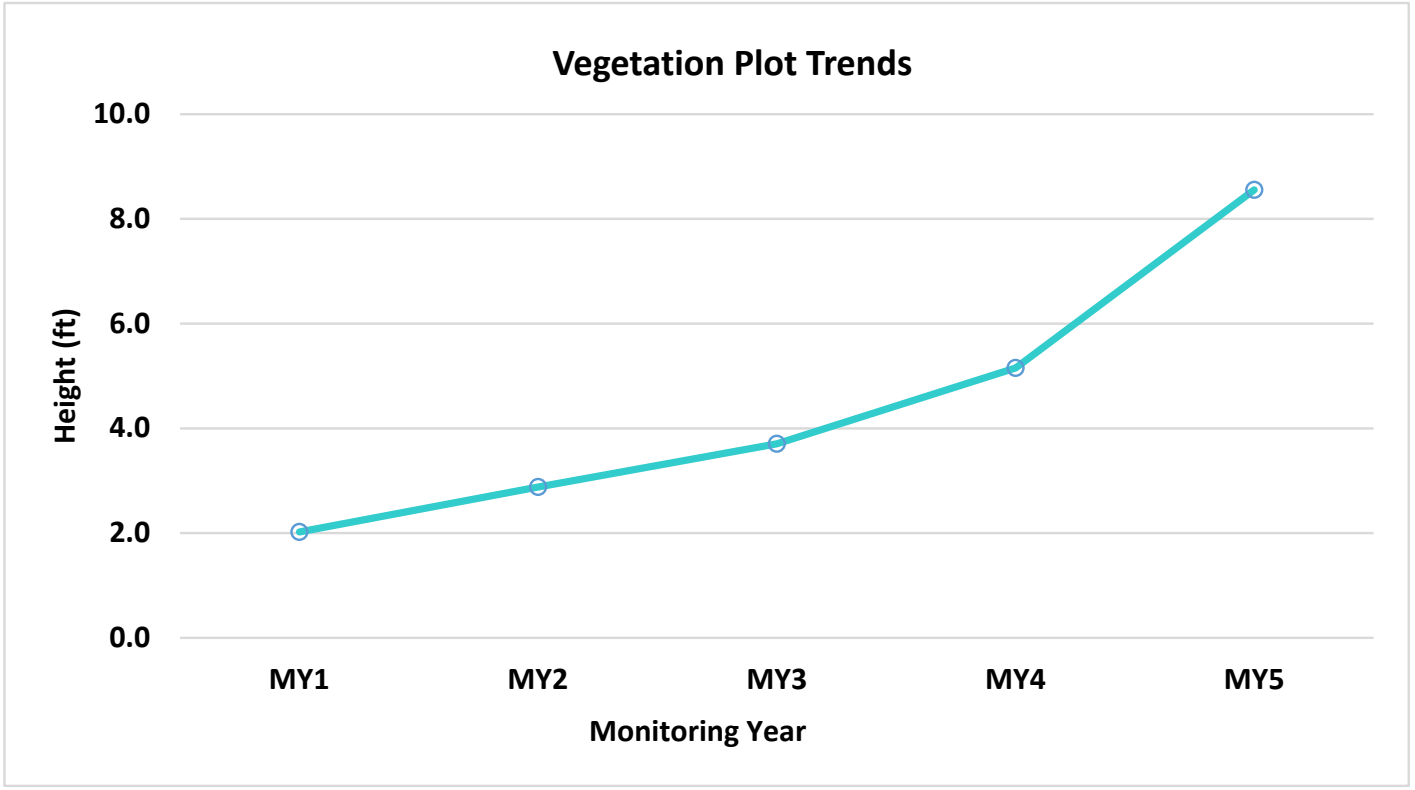


Table 9. CVS Vegetation Tables - Metadata
Buckwater Mitigation Project
DMS Project No. 97084
Monitoring Year 5 - 2023

Report Prepared By	Jason Lorch
Date Prepared	10/6/2023 9:04
Database Name	Buckwater Buffer- cvs-v2.5.0- MY5.mdb
Database Location	X:\Shared\Projects\W02157_Buckwater\Monitoring\Monitoring Year 5 - 2023\Buffer
Computer Name	RALEIGHINTERN
File Size	77860864
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 10. Planted and Total Stem Counts
Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)																				
			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**
Acer negundo	Box Elder	Tree																2	2	2			
Acer rubrum	Red Maple	Tree																					
Aesculus pavia	Red Buckeye	Shrub Tree																			1	1	1
Betula nigra	River Birch	Tree	1	1	1	2	2	2	3	3	3	2	2	2	1	1	1						
Carya	Hickory spp.	Tree																					
Celtis occidentalis	Hackberry	Shrub Tree																					
Diospyros virginiana	American Persimmon	Tree									1												
Fraxinus pennsylvanica	Green Ash	Tree	3	3	3	1	1	1	2	2	2	4	4	4	1	1	2						
Juglans nigra	Black Walnut	Tree			2						2												1
Juniperus virginiana	Eastern Red Cedar	Tree																					
Liquidambar styraciflua	Sweet Gum	Tree			2			1						1									
Liriodendron tulipifera	Tulip-poplar	Tree			1				1	1	1												
Nyssa biflora	Swamp Tupelo	Tree																					
Pinus taeda	Loblolly Pine	Tree															1						
Platanus occidentalis	Sycamore	Tree	1	1	1	5	5	5	4	4	4	2	2	2	4	4	4	4	4	4	1	1	1
Pyrus calleryana	Callery Pear	Exotic																					
Quercus alba	White Oak	Tree													2	2	2				2	2	2
Quercus lyrata	Overcup Oak	Tree										3	3	3	1	1	1						
Quercus michauxii	Swamp Chestnut Oak	Tree	1	1	1				1	1	1												
Quercus pagoda	Cherrybark Oak	Tree													1	1	1						
Quercus phellos	Willow Oak	Tree	1	1	1							3	3	3	1	1	1				1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree				2	2	2	1	1	1				2	2	2				1	1	1
Salix nigra	Black Willow	Tree																					
Ulmus	Elm spp.	Tree																					
Ulmus alata	Winged Elm	Tree																					
Ulmus americana	American Elm	Tree																					
Viburnum dentatum	Arrow-wood	Shrub Tree																					
		Stem count	7	7	8	10	10	10	12	12	13	14	14	14	13	13	14	6	6	6	6	6	6
		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	8	4	4	5	6	6	8	5	5	6	8	8	9	2	2	2	5	5	6
		Stems per ACRE	283	283	324	405	405	405	486	486	526	567	567	567	526	526	567	243	243	243	243	243	243

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: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts
Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)																				
			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**
Acer negundo	Box Elder	Tree													1	1	1						
Acer rubrum	Red Maple	Tree															1			2			
Aesculus pavia	Red Buckeye	Shrub Tree																					
Betula nigra	River Birch	Tree													2	2	2	4	4	4	5	5	5
Carya	Hickory spp.	Tree																					
Celtis occidentalis	Hackberry	Shrub Tree				2	2	2															
Diospyros virginiana	American Persimmon	Tree															2			1			
Fraxinus pennsylvanica	Green Ash	Tree							4	4	4	1	1	1			1	3	3	3	3	3	3
Juglans nigra	Black Walnut	Tree																					
Juniperus virginiana	Eastern Red Cedar	Tree															1						
Liquidambar styraciflua	Sweet Gum	Tree			8												1			16			7
Liriodendron tulipifera	Tulip-poplar	Tree																			1	1	1
Nyssa biflora	Swamp Tupelo	Tree																					
Pinus taeda	Loblolly Pine	Tree																					
Platanus occidentalis	Sycamore	Tree	4	4	4	3	3	3	1	1	1				5	5	5	4	4	4	3	3	4
Pyrus calleryana	Callery Pear	Exotic																					
Quercus alba	White Oak	Tree				1	1	1				4	4	4	1	1	1						
Quercus lyrata	Overcup Oak	Tree				1	1	1	2	2	2												
Quercus michauxii	Swamp Chestnut Oak	Tree							1	1	1				3	3	3				2	2	2
Quercus pagoda	Cherrybark Oak	Tree										1	1	1									
Quercus phellos	Willow Oak	Tree													2	2	2				1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree				1	1	1				1	1	1	1	1	1						
Salix nigra	Black Willow	Tree						1			6												
Ulmus	Elm spp.	Tree																		7			
Ulmus alata	Winged Elm	Tree																					
Ulmus americana	American Elm	Tree																					
Viburnum dentatum	Arrow-wood	Shrub Tree																			1	1	1
		Stem count	4	4	4	8	8	9	8	8	14	7	7	7	15	15	20	11	11	21	16	16	17
		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	1	1	2	5	5	6	4	4	5	4	4	4	7	7	12	3	3	7	7	7	8
		Stems per ACRE	162	162	162	324	324	364	324	324	567	283	283	283	607	607	809	445	445	850	647	647	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

PnoLS: Number of planted stems excluding live stakes

P-all: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts
Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Current Plot Data (MY5 2023)														
			VP 15			VP 16			VP 17			VP 18			VP 19		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer negundo	Box Elder	Tree							3	3	3						
Acer rubrum	Red Maple	Tree															
Aesculus pavia	Red Buckeye	Shrub Tree															
Betula nigra	River Birch	Tree	3	3	5	4	4	4				1	1	1	3	3	3
Carya	Hickory spp.	Tree															
Celtis occidentalis	Hackberry	Shrub Tree															
Diospyros virginiana	American Persimmon	Tree							2	2	2						
Fraxinus pennsylvanica	Green Ash	Tree	2	2	2	1	1	1	1	1	1	2	2	2	2	2	2
Juglans nigra	Black Walnut	Tree									4			1			
Juniperus virginiana	Eastern Red Cedar	Tree															
Liquidambar styraciflua	Sweet Gum	Tree			25						4			5			
Liriodendron tulipifera	Tulip-poplar	Tree															
Nyssa biflora	Swamp Tupelo	Tree															
Pinus taeda	Loblolly Pine	Tree												1			
Platanus occidentalis	Sycamore	Tree	4	4	4	4	4	4	1	1	1	1	1	1	2	2	2
Pyrus calleryana	Callery Pear	Exotic															
Quercus alba	White Oak	Tree															
Quercus lyrata	Overcup Oak	Tree										1	1	1			
Quercus michauxii	Swamp Chestnut Oak	Tree													1	1	1
Quercus pagoda	Cherrybark Oak	Tree				1	1	1									
Quercus phellos	Willow Oak	Tree				2	2	2							1	1	1
Quercus shumardii	Shumard Oak	Shrub Tree															
Salix nigra	Black Willow	Tree															7
Ulmus	Elm spp.	Tree															
Ulmus alata	Winged Elm	Tree															
Ulmus americana	American Elm	Tree												1			
Viburnum dentatum	Arrow-wood	Shrub Tree	2	2	2	1	1	1	1	1	1						
		Stem count	11	11	13	13	13	13	8	8	8	5	5	6	9	9	16
		size (ares)	1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02		
		Species count	4	4	5	6	6	6	5	5	7	4	4	8	5	5	6
		Stems per ACRE	445	445	526	526	526	526	324	324	324	202	202	243	364	364	647

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: All planted stems

T: Total stems

Table 10. Planted and Total Stem Counts
Buckwater Buffer Mitigation Site
DMS Project No. 97084
Monitoring Year 5 - 2023

			Annual Means																	
			MY5 (2023)			MY4 (2022)			MY3 (2021)			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**
Acer negundo	Box Elder	Tree	4	4	4	6	6	6	6	6	6									
Acer rubrum	Red Maple	Tree			3			5			6									
Aesculus pavia	Red Buckeye	Shrub Tree	1	1	1	1	1	1	2	2	2	1	1	1	9	9	9	10	10	10
Betula nigra	River Birch	Tree	30	30	32	30	30	32	33	33	33	22	22	24	34	34	35	41	41	41
Carya	Hickory spp.	Tree												1						
Celtis occidentalis	Hackberry	Shrub Tree	2	2	2	2	2	2	4	4	4									
Diospyros virginiana	American Persimmon	Tree	2	2	6	2	2	4	2	2	4			1						
Fraxinus pennsylvanica	Green Ash	Tree	30	30	32	29	29	30	32	32	38	33	33	33	34	34	34	34	34	34
Juglans nigra	Black Walnut	Tree			10			3			2			1			1			
Juniperus virginiana	Eastern Red Cedar	Tree			1			4			1									
Liquidambar styraciflua	Sweet Gum	Tree			70			49			27			5			3			
Liriodendron tulipifera	Tulip-poplar	Tree	2	2	3	1	1	1	2	2	2	2	2	2	22	22	22	32	32	32
Nyssa biflora	Swamp Tupelo	Tree												1						
Pinus taeda	Loblolly Pine	Tree			2			3			1									
Platanus occidentalis	Sycamore	Tree	51	51	52	51	51	57	53	53	58	47	47	49	56	56	56	62	62	62
Pyrus calleryana	Callery Pear	Exotic						1												
Quercus alba	White Oak	Tree	10	10	10	12	12	12	19	19	19	5	5	5	10	10	10	11	11	11
Quercus lyrata	Overcup Oak	Tree	8	8	8	10	10	11	12	12	12	13	13	13	25	25	25	22	22	22
Quercus michauxii	Swamp Chestnut Oak	Tree	7	7	7	11	11	11	16	16	16	10	10	10	13	13	13	13	13	13
Quercus pagoda	Cherrybark Oak	Tree	3	3	3	5	5	5	8	8	8									
Quercus phellos	Willow Oak	Tree	11	11	11	13	13	14	17	17	18	10	10	10	33	33	33	33	33	33
Quercus shumardii	Shumard Oak	Shrub Tree	9	9	9	12	12	12	12	12	12	5	5	5	8	8	8	9	9	9
Salix nigra	Black Willow	Tree			14			9			10			3						
Ulmus	Elm spp.	Tree			7						4									
Ulmus alata	Winged Elm	Tree							1	1	2									
Ulmus americana	American Elm	Tree			1			5												
Viburnum dentatum	Arrow-wood	Shrub Tree	5	5	5	7	7	7	7	7	7	9	9	9	13	13	13	15	15	15
		Stem count	175	175	211	192	192	231	226	226	264	157	157	168	257	257	259	282	282	282
		size (ares)	19			19			19			19			19			19		
		size (ACRES)	0.47			0.47			0.47			0.47			0.47			0.47		
		Species count	15	15	23	15	15	23	16	16	23	11	11	17	11	11	13	11	11	11
		Stems per ACRE	373	373	449	409	409	492	481	481	562	334	334	358	547	547	552	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

P-all: All planted stems

T: Total stems

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
1	*Quercus phellos*	willow oak	0.3	0.5	3.8	4
1	*Platanus occidentalis*	American sycamore	0.3	2.1	14.8	4
1	*Fraxinus pennsylvanica*	green ash	0.4	4.4	2.5	4
1	*Quercus alba*	white oak	0.6	7.1	M	Missing
1	*Fraxinus pennsylvanica*	green ash	0.6	9.7	2.8	4
1	*Betula nigra*	river birch	4.8	9.8	1.2	3
1	*Quercus michauxii*	swamp chestnut oak	4.8	8.0	2.0	3
1	*Quercus alba*	white oak	4.7	5.4	D	Dead
1	*Quercus michauxii*	swamp chestnut oak	4.6	3.1	D	Dead
1	*Fraxinus pennsylvanica*	green ash	4.4	0.6	1.4	3
1	*Quercus michauxii*	swamp chestnut oak	9.5	0.6	M	Missing
1	*Quercus phellos*	willow oak	9.6	3.0	D	Dead
1	*Quercus phellos*	willow oak	9.7	5.7	D	Dead
1	*Liriodendron tulipifera*	yellow-poplar	9.7	8.2	D	Dead
1	*Liriodendron tulipifera*	yellow-poplar	9.7	9.8	D	Dead

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
2	*Platanus occidentalis*	American sycamore	0.2	0.6	19.0	4
2	*Platanus occidentalis*	American sycamore	0.2	2.8	19.0	4
2	*Platanus occidentalis*	American sycamore	0.3	5.4	9.2	4
2	*Liriodendron tulipifera*	yellow-poplar	0.5	7.7	D	Dead
2	*Betula nigra*	river birch	0.4	9.6	8.7	4
2	*Quercus shumardii*	Shumard oak	4.7	9.0	M	Missing
2	*Quercus alba*	white oak	4.8	7.1	M	Missing
2	*Quercus shumardii*	Shumard oak	4.7	4.8	2.7	4
2	*Platanus occidentalis*	American sycamore	4.6	2.7	10.5	4
2	*Platanus occidentalis*	American sycamore	4.5	0.8	20.3	4
2	*Fraxinus pennsylvanica*	green ash	9.3	0.8	M	Missing
2	*Betula nigra*	river birch	9.6	2.2	8.2	4
2	*Quercus shumardii*	Shumard oak	9.7	5.8	2.3	4
2	*Liriodendron tulipifera*	yellow-poplar	9.8	7.4	D	Dead
2	*Fraxinus pennsylvanica*	green ash	9.8	9.4	2.8	3

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
3	*Quercus shumardii*	Shumard oak	0.4	0.6	1.5	3
3	*Quercus phellos*	willow oak	2.7	0.5	D	Dead
3	*Quercus michauxii*	swamp chestnut oak	5.0	0.5	8.5	4
3	*Quercus phellos*	willow oak	7.6	0.5	D	Dead
3	*Platanus occidentalis*	American sycamore	9.7	0.4	19.0	4
3	*Betula nigra*	river birch	9.6	4.6	11.5	4
3	*Betula nigra*	river birch	7.0	4.6	6.2	4
3	*Platanus occidentalis*	American sycamore	4.8	4.6	19.7	4
3	*Platanus occidentalis*	American sycamore	2.5	4.6	20.0	4
3	*Fraxinus pennsylvanica*	green ash	0.3	4.6	3.3	4
3	*Platanus occidentalis*	American sycamore	0.3	9.6	19.4	4
3	*Fraxinus pennsylvanica*	green ash	2.7	9.5	6.6	4
3	*Betula nigra*	river birch	5.2	9.5	4.8	4
3	*Liriodendron tulipifera*	yellow-poplar	7.3	9.5	1.6	4
3	*Quercus phellos*	willow oak	9.3	9.5	D	Dead

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
4	*Viburnum dentatum*	arrowwood	0.8	0.3	D	Dead
4	*Viburnum dentatum*	arrowwood	1.1	2.5	D	Dead
4	*Quercus phellos**	willow oak	0.8	0.3	6.5	4
4	*Quercus phellos**	willow oak	1.1	2.5	6.6	4
4	*Betula nigra*	river birch	1.6	5.0	7.3	4
4	*Fraxinus pennsylvanica*	green ash	1.9	7.2	2.2	4
4	*Fraxinus pennsylvanica*	green ash	2.3	9.7	2.7	4
4	*Quercus lyrata**	overcup oak	5.7	9.8	2.7	4
4	*Quercus lyrata**	overcup oak	5.7	7.5	6.4	4
4	*Platanus occidentalis*	American sycamore	5.7	9.8	D	Dead
4	*Platanus occidentalis*	American sycamore	5.7	7.5	D	Dead
4	*Betula nigra*	river birch	5.5	5.3	10.2	4
4	*Fraxinus pennsylvanica*	green ash	5.3	2.8	3.0	4
4	*Platanus occidentalis*	American sycamore	8.7	0.0	4.6	4
4	*Quercus alba*	white oak	8.8	2.4	D	Dead
4	*Platanus occidentalis*	American sycamore	8.9	4.9	D	Dead
4	*Quercus phellos**	willow oak	8.8	2.4	4.3	4
4	*Quercus lyrata**	overcup oak	8.9	4.9	2.6	4
4	*Fraxinus pennsylvanica*	green ash	9.3	7.5	8.2	4
4	*Platanus occidentalis*	American sycamore	9.5	10.0	15.1	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
5	*Quercus lyrata*	overcup oak	0.5	0.5	5.3	4
5	*Platanus occidentalis*	American sycamore	2.9	0.6	4.5	4
5	*Betula nigra*	river birch	5.3	0.6	D	Dead
5	*Liriodendron tulipifera*	yellow-poplar	7.5	0.7	D	Dead
5	*Platanus occidentalis*	American sycamore	9.6	0.6	6.5	4
5	*Quercus alba*	white oak	9.6	5.0	1.7	1
5	*Liriodendron tulipifera*	yellow-poplar	7.4	5.0	D	Dead
5	*Quercus lyrata*	overcup oak	5.3	4.9	D	Dead
5	*Betula nigra*	river birch	3.1	4.8	D	Dead
5	*Liriodendron tulipifera*	yellow-poplar	0.8	4.8	D	Dead
5	*Betula nigra*	river birch	3.1	4.8	D	Dead
5	*Platanus occidentalis*	American sycamore	2.7	9.3	3.7	4
5	*Betula nigra*	river birch	5.2	9.2	D	Dead
5	*Platanus occidentalis*	American sycamore	7.3	9.3	8.2	4
5	*Fraxinus pennsylvanica*	green ash	9.6	9.5	3.3	4
5	*Quercus shumardii**	Shumard oak	1.4	0.4	1.6	4
5	*Quercus shumardii**	Shumard oak	4.2	0.7	4.8	4
5	*Quercus phellos**	willow oak	6.9	0.5	2.9	4
5	*Quercus pagoda**	cherrybark oak	6.4	4.4	1.3	4
5	*Betula nigra**	river birch	3.6	3.2	4.7	4
5	*Quercus alba**	white oak	0.6	7.0	1.6	4
5	*Quercus pagoda**	cherrybark oak	0.3	9.0	M	Missing
5	*Quercus pagoda**	cherrybark oak	6.3	7.0	D	Dead

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
6	*Viburnum dentatum*	arrowwood	0.3	0.5	D	Dead
6	*Fraxinus pennsylvanica*	green ash	2.5	0.5	D	Dead
6	*Platanus occidentalis*	American sycamore	4.9	0.5	19.0	4
6	*Betula nigra*	river birch	7.3	0.5	D	Dead
6	*Quercus alba*	white oak	9.7	0.5	D	Dead
6	*Quercus phellos*	willow oak	9.4	4.9	D	Dead
6	*Quercus lyrata*	overcup oak	7.4	4.8	D	Dead
6	*Quercus phellos*	willow oak	5.2	4.8	D	Dead
6	*Platanus occidentalis*	American sycamore	2.8	4.9	16.4	4
6	*Aesculus pavia*	red buckeye	0.6	5.1	D	Dead
6	*Quercus lyrata*	overcup oak	0.2	9.2	D	Dead
6	*Platanus occidentalis*	American sycamore	2.5	9.3	15.7	4
6	*Fraxinus pennsylvanica*	green ash	4.8	9.6	D	Dead
6	*Quercus phellos*	willow oak	7.3	9.6	D	Dead
6	*Platanus occidentalis*	American sycamore	9.7	9.5	16.4	4
6	*Acer negundo**	boxelder	8.9	0.4	16.6	4
6	*Acer negundo**	boxelder	8.8	3.0	7.1	4
6	*Acer negundo**	boxelder	2.9	6.8	10.8	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
7	*Quercus phellos*	willow oak	0.3	0.5	D	4
7	*Aesculus pavia*	red buckeye	0.4	5.2	2.8	3
7	*Liriodendron tulipifera*	yellow-poplar	5.4	0.5	D	Dead
7	*Quercus alba*	white oak	7.4	0.4	D	Dead
7	*Quercus phellos*	willow oak	9.5	0.3	D	Dead
7	*Betula nigra*	river birch	9.6	4.8	D	Dead
7	*Quercus lyrata*	overcup oak	7.3	4.8	D	Dead
7	*Quercus shumardii*	Shumard oak	4.9	4.9	D	Dead
7	*Fraxinus pennsylvanica*	green ash	2.6	4.9	D	Dead
7	*Aesculus pavia*	red buckeye	0.4	5.2	D	Dead
7	*Platanus occidentalis*	American sycamore	0.4	9.5	26.9	4
7	*Quercus phellos*	willow oak	2.6	9.2	M	Missing
7	*Platanus occidentalis*	American sycamore	5.1	9.0	D	Dead
7	*Quercus alba*	white oak	7.9	9.2	D	Dead
7	*Quercus shumardii*	Shumard oak	9.8	9.3	D	Dead
7	*Quercus alba**	white oak	6.7	0.2	4.6	1
7	*Quercus shumardii**	Shumard oak	1.5	2.3	3.6	1
7	*Quercus phellos**	willow oak	5.6	5.4	2.5	2
7	*Quercus alba**	white oak	6.7	9.0	6.6	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
8	*Betula nigra*	river birch	0.3	0.6	D	Dead
8	*Quercus lyrata*	overcup oak	3.0	0.6	D	Dead
8	*Platanus occidentalis*	American sycamore	5.7	0.6	23.0	4
8	*Liriodendron tulipifera*	yellow-poplar	7.9	0.6	D	Dead
8	*Quercus phellos*	willow oak	9.9	0.4	D	Dead
8	*Platanus occidentalis*	American sycamore	9.9	5.0	7.1	4
8	*Liriodendron tulipifera*	yellow-poplar	8.0	5.0	D	Dead
8	*Quercus shumardii*	Shumard oak	5.5	4.9	M	Missing
8	*Fraxinus pennsylvanica*	green ash	3.0	4.9	D	Dead
8	*Liriodendron tulipifera*	yellow-poplar	0.5	5.0	D	Dead
8	*Quercus phellos*	willow oak	0.5	9.6	M	Missing
8	*Betula nigra*	river birch	2.3	9.2	D	Dead
8	*Platanus occidentalis*	American sycamore	5.1	9.2	D	Dead
8	*Platanus occidentalis*	American sycamore	7.8	9.2	8.9	4
8	*Platanus occidentalis*	American sycamore	10.0	9.2	8.3	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
9	*Liriodendron tulipifera*	yellow-poplar	0.2	0.6	D	Dead
9	*Platanus occidentalis*	American sycamore	2.5	0.6	32.8	4
9	*Quercus phellos*	willow oak	4.8	0.5	D	Dead
9	*Liriodendron tulipifera*	yellow-poplar	7.3	0.4	D	Dead
9	*Quercus lyrata*	overcup oak	9.5	0.4	5.6	4
9	*Betula nigra*	river birch	9.7	4.7	D	Dead
9	*Quercus lyrata*	overcup oak	7.6	4.7	M	Missing
9	*Platanus occidentalis*	American sycamore	5.3	4.8	36.1	4
9	*Quercus phellos*	willow oak	3.0	4.8	D	Dead
9	*Quercus lyrata*	overcup oak	9.8	8.7	D	Dead
9	*Aesculus pavia*	red buckeye	0.5	9.4	D	Dead
9	*Platanus occidentalis*	American sycamore	7.2	0.6	39.4	4
9	*Liriodendron tulipifera*	yellow-poplar	5.7	8.8	D	Dead
9	*Quercus lyrata**	overcup oak	7.2	0.6	D	Dead
9	*Quercus shumardii**	Shumard oak	4.5	1.6	4.3	2
9	*Quercus phellos**	willow oak	4.6	6.6	M	Missing
9	*Celtis occidnetalis**	hackberry	2.7	4.8	2.2	4
9	*Celtis occidnetalis**	hackberry	2.7	9.8	2.2	4
9	*Quercus alba**	white oak	7.2	8.5	1.1	2
9	*Quercus pagoda**	cherrybark oak	6.9	3.4	M	Missing
9	*Quercus alba**	white oak	1.0	1.6	M	Missing

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
10	*Quercus lyrata*	overcup oak	0.7	1.3	1.9	2
10	*Quercus michauxii*	swamp chestnut oak	2.8	1.5	4.4	4
10	*Quercus lyrata*	overcup oak	4.6	1.5	1.7	2
10	*Fraxinus pennsylvanica*	green ash	6.6	1.4	6.6	4
10	*Fraxinus pennsylvanica*	green ash	8.2	1.4	13.1	4
10	*Quercus lyrata*	overcup oak	4.6	5.1	M	Missing
10	*Quercus lyrata*	overcup oak	6.8	4.8	D	Dead
10	*Fraxinus pennsylvanica*	green ash	0.5	5.6	11.2	4
10	*Quercus lyrata*	overcup oak	2.8	5.5	D	Dead
10	*Liriodendron tulipifera*	yellow-poplar	2.8	8.9	D	Dead
10	*Platanus occidentalis*	American sycamore	4.6	8.9	19.7	4
10	*Fraxinus pennsylvanica*	green ash	6.7	8.9	9.8	4
10	*Quercus lyrata*	overcup oak	9.5	8.9	D	Dead

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
11	*Quercus lyrata*	overcup oak	0.3	1.0	D	Dead
11	*Aesculus pavia*	red buckeye	2.6	1.0	D	Dead
11	*Quercus phellos*	willow oak	5.0	1.0	D	Dead
11	*Viburnum dentatum*	arrowwood	7.5	1.0	D	Dead
11	*Liriodendron tulipifera*	yellow-poplar	9.5	1.0	D	Dead
11	*Quercus lyrata*	overcup oak	9.5	5.4	D	Dead
11	*Viburnum dentatum*	arrowwood	7.4	5.3	D	Dead
11	*Quercus phellos*	willow oak	4.9	5.3	D	Dead
11	*Fraxinus pennsylvanica*	green ash	2.8	5.1	6.6	4
11	*Platanus occidentalis*	American sycamore	0.6	4.8	D	Dead
11	*Viburnum dentatum*	arrowwood	0.7	9.2	D	Dead
11	*Platanus occidentalis*	American sycamore	3.0	9.1	D	Dead
11	*Quercus phellos*	willow oak	5.2	9.2	D	Dead
11	*Viburnum dentatum*	arrowwood	7.6	9.3	D	Dead
11	*Quercus lyrata*	overcup oak	9.8	9.4	D	Dead
11	*Quercus shumardii**	Shumard oak	1.2	6.7	M	Missing
11	*Quercus shumardii**	Shumard oak	3.7	9.4	D	Dead
11	*Quercus alba**	white oak	3.7	6.7	4.9	1
11	*Quercus alba**	white oak	0.8	7.0	6.0	4
11	*Quercus alba**	white oak	4.6	6.4	6.9	4
11	*Quercus pagoda**	cherrybark oak	9.2	9.5	3.1	4
11	*Quercus alba**	white oak	9.2	6.5	6.7	4
11	*Quercus shumardii**	Shumard oak	9.2	3.7	3.5	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
12	*Platanus occidentalis*	American sycamore	0.5	0.6	15.7	4
12	*Quercus michauxii*	swamp chestnut oak	0.5	2.2	4.6	4
12	*Platanus occidentalis*	American sycamore	0.5	4.4	14.8	4
12	*Liriodendron tulipifera*	yellow-poplar	0.4	7.0	D	Dead
12	*Liriodendron tulipifera*	yellow-poplar	0.5	9.4	D	Dead
12	*Liriodendron tulipifera*	yellow-poplar	5.0	9.4	D	Dead
12	*Betula nigra*	river birch	5.1	7.6	D	Dead
12	*Quercus michauxii*	swamp chestnut oak	5.1	4.6	D	Dead
12	*Platanus occidentalis*	American sycamore	5.2	2.1	12.0	4
12	*Aesculus pavia*	red buckeye	5.2	0.4	D	Dead
12	*Betula nigra*	river birch	9.5	0.4	2.6	4
12	*Aesculus pavia*	red buckeye	9.5	2.5	D	Dead
12	*Quercus michauxii*	swamp chestnut oak	9.5	4.9	2.3	4
12	*Quercus phellos*	willow oak	9.6	7.0	10.5	4
12	*Liriodendron tulipifera*	yellow-poplar	9.5	9.4	D	Dead
12	*Quercus phellos**	willow oak	0.5	3.3	8.7	4
12	*Quercus shumardii**	Shumard oak	2.5	9.5	3.9	4
12	*Platanus occidentalis**	American sycamore	2.5	6.0	11.8	4
12	*Quercus michauxii**	swamp chestnut oak	2.5	1.4	M	Missing
12	*Platanus occidentalis**	American sycamore	2.5	0.6	6.3	4
12	*Quercus michauxii**	swamp chestnut oak	7.0	0.7	2.2	4
12	*Betula nigra**	river birch	7.0	4.4	4.3	4
12	*Quercus alba**	white oak	7.0	7.5	6.2	4
12	*Acer negundo**	boxelder	7.0	9.4	M	Missing
12	*Acer negundo**	boxelder	9.1	9.7	3.6	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
13	*Fraxinus pennsylvanica*	green ash	0.5	0.5	19.0	4
13	*Platanus occidentalis*	American sycamore	2.7	0.5	18.4	4
13	*Betula nigra*	river birch	4.9	0.4	17.7	4
13	*Betula nigra*	river birch	7.3	0.5	11.8	4
13	*Quercus phellos*	willow oak	9.6	0.5	D	Dead
13	*Fraxinus pennsylvanica*	green ash	9.6	5.0	17.1	4
13	*Quercus michauxii*	swamp chestnut oak	7.5	5.0	M	Missing
13	*Platanus occidentalis*	American sycamore	5.0	5.0	16.7	4
13	*Platanus occidentalis*	American sycamore	2.7	5.1	20.0	4
13	*Platanus occidentalis*	American sycamore	0.3	5.1	20.7	4
13	*Fraxinus pennsylvanica*	green ash	0.5	9.6	6.0	4
13	*Liriodendron tulipifera*	yellow-poplar	2.7	9.5	D	Dead
13	*Quercus phellos*	willow oak	5.1	9.5	D	Dead
13	*Betula nigra*	river birch	7.7	9.4	15.1	4
13	*Betula nigra*	river birch	9.1	9.4	14.4	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
14	*Viburnum dentatum*	arrowwood	0.4	0.5	3.8	2
14	*Platanus occidentalis*	American sycamore	0.4	2.6	D	Dead
14	*Betula nigra*	river birch	0.5	5.4	3.4	2
14	*Fraxinus pennsylvanica*	green ash	0.5	7.7	4.8	4
14	*Quercus phellos*	willow oak	0.5	9.7	D	Dead
14	*Betula nigra*	river birch	4.9	9.8	10.5	4
14	*Betula nigra*	river birch	4.8	7.6	11.8	4
14	*Liriodendron tulipifera*	yellow-poplar	4.8	5.1	D	4
14	*Platanus occidentalis*	American sycamore	4.8	2.4	5.4	4
14	*Quercus michauxii*	swamp chestnut oak	4.7	0.4	D	4
14	*Liriodendron tulipifera*	yellow-poplar	9.4	0.4	0.7	4
14	*Fraxinus pennsylvanica*	green ash	9.4	2.1	2.4	4
14	*Liriodendron tulipifera*	yellow-poplar	9.5	5.5	D	Dead
14	*Fraxinus pennsylvanica*	green ash	9.5	8.6	9.0	4
14	*Betula nigra*	river birch	9.4	9.6	29.2	4
14	*Platanus occidentalis**	American sycamore	0.4	2.6	1.1	4
14	*Quercus michauxii**	swamp chestnut oak	3.1	4.7	3.6	4
14	*Quercus phellos**	willow oak	3.1	0.5	3.6	4
14	*Betula nigra**	river birch	6.7	0.5	3.1	4
14	*Platanus occidentalis**	American sycamore	6.7	3.5	3.3	3
14	*Quercus michauxii**	swamp chestnut oak	9.5	5.3	2.6	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
15	*Viburnum dentatum*	arrowwood	0.4	0.6	2.2	3
15	*Betula nigra*	river birch	0.4	2.5	11.8	4
15	*Aesculus pavia*	red buckeye	0.4	4.9	D	Dead
15	*Quercus phellos*	willow oak	0.4	7.8	D	Dead
15	*Quercus michauxii*	swamp chestnut oak	0.4	9.5	M	Missing
15	*Platanus occidentalis*	American sycamore	4.7	9.6	8.7	4
15	*Viburnum dentatum*	arrowwood	4.7	7.6	3.4	4
15	*Fraxinus pennsylvanica*	green ash	4.7	5.3	6.6	4
15	*Platanus occidentalis*	American sycamore	4.6	2.6	10.5	4
15	*Quercus shumardii*	Shumard oak	4.5	0.7	D	Dead
15	*Betula nigra*	river birch	9.5	0.4	2.6	3
15	*Platanus occidentalis*	American sycamore	9.5	2.2	8.2	4
15	*Betula nigra*	river birch	9.5	4.8	9.5	4
15	*Fraxinus pennsylvanica*	green ash	9.5	7.5	8.7	4
15	*Platanus occidentalis*	American sycamore	9.5	9.7	15.1	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
16	*Liriodendron tulipifera*	yellow-poplar	0.5	0.7	D	Dead
16	*Quercus phellos*	willow oak	2.6	0.8	D	Dead
16	*Quercus alba*	white oak	7.1	0.7	M	Missing
16	*Quercus alba*	white oak	7.1	0.7	D	Dead
16	*Fraxinus pennsylvanica*	green ash	9.4	0.8	3.1	4
16	*Betula nigra*	river birch	9.3	5.6	D	Dead
16	*Quercus phellos*	willow oak	7.5	5.5	D	Dead
16	*Platanus occidentalis*	American sycamore	5.4	5.4	10.5	4
16	*Liriodendron tulipifera*	yellow-poplar	3.1	5.5	D	Dead
16	*Betula nigra*	river birch	0.7	5.4	3.2	4
16	*Platanus occidentalis*	American sycamore	0.9	9.4	10.5	4
16	*Platanus occidentalis*	American sycamore	3.0	9.5	10.7	4
16	*Viburnum dentatum*	arrowwood	5.5	9.5	2.6	4
16	*Quercus phellos*	willow oak	8.2	9.6	D	Dead
16	*Quercus phellos*	willow oak	9.9	9.5	D	Dead
16	*Platanus occidentalis**	American sycamore	1.6	0.6	8.2	4
16	*Quercus pagoda**	cherrybark oak	6.2	0.8	4.1	4
16	*quercus alba**	white oak	8.5	4.9	M	Missing
16	*Quercus phellos**	willow oak	1.4	5.3	5.2	4
16	*Betula nigra**	river birch	3.8	4.6	4.2	4
16	*Betula nigra**	river birch	3.2	7.4	3.7	4
16	*Betula nigra**	river birch	7.5	9.5	7.2	4
16	*Quercus phellos**	willow oak	9.3	9.2	3.9	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
17	*Viburnum dentatum*	arrowwood	0.8	0.5	M	Missing
17	*Quercus alba*	white oak	1.0	2.7	D	Dead
17	*Platanus occidentalis*	American sycamore	1.1	4.8	19.7	4
17	*Betula nigra*	river birch	1.1	7.3	D	Dead
17	*Quercus phellos*	willow oak	1.2	9.6	M	Missing
17	*Viburnum dentatum*	arrowwood	5.1	9.2	2.9	4
17	*Betula nigra*	river birch	5.1	7.0	D	Dead
17	*Quercus lyrata*	overcup oak	5.2	5.2	D	Dead
17	*Aesculus pavia*	red buckeye	5.2	3.1	D	Dead
17	*Quercus lyrata*	overcup oak	5.1	0.7	D	Dead
17	*Betula nigra*	river birch	9.5	0.7	D	Dead
17	*Liriodendron tulipifera*	yellow-poplar	9.3	2.9	D	Dead
17	*Platanus occidentalis*	American sycamore	9.2	5.4	D	Dead
17	*Fraxinus pennsylvanica*	green ash	9.0	7.2	1.5	4
17	*Platanus occidentalis*	American sycamore	9.4	9.6	D	Dead
17	*Acer negundo**	boxelder	9.1	3.0	2.6	4
17	*Diospyros virginiana**	persimmon	7.5	5.5	3.8	4
17	*Diospyros virginiana**	persimmon	9.0	9.6	3.0	2
17	*Acer negundo**	boxelder	5.1	5.0	3.8	4
17	*Acer negundo**	boxelder	5.1	2.7	1.6	4

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
18	*Betula nigra*	river birch	0.4	0.8	D	Dead
18	*Fraxinus pennsylvanica*	green ash	2.6	0.6	1.0	4
18	*Quercus lyrata*	overcup oak	5.1	0.8	2.8	3
18	*Aesculus pavia*	red buckeye	7.6	0.5	D	Dead
18	*Liriodendron tulipifera*	yellow-poplar	9.6	0.5	D	Dead
18	*Platanus occidentalis*	American sycamore	9.6	4.5	17.1	4
18	*Viburnum dentatum*	arrowwood	7.3	4.4	D	Dead
18	*Betula nigra*	river birch	5.0	4.6	D	Dead
18	*Liriodendron tulipifera*	yellow-poplar	2.6	4.8	D	Dead
18	*Quercus lyrata*	overcup oak	0.4	5.1	D	Dead
18	*Platanus occidentalis*	American sycamore	0.4	9.3	D	Dead
18	*Betula nigra*	river birch	2.5	9.0	D	Dead
18	*Betula nigra*	river birch	4.8	8.8	D	Dead
18	*Viburnum dentatum*	arrowwood	7.2	8.8	D	Dead
18	*Quercus shumardii*	Shumard oak	9.6	9.0	D	Dead
18	*Fraxinus pennsylvanica**	American sycamore	7.2	8.8	2.6	4
18	*Ulmus alata**	winged elm	1.6	3.2	D	Dead
18	*Betula nigra**	river birch	9.7	8.3	2.6	4
18	*Celtis occidnetalis**	hackberry	1.5	1.5	D	Dead

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

Table 11. Vegetation Height Data

Buckwater Mitigation Site

DMS Project No. 97084

Monitoring Year 5 - 2023

Plot	Scientific Name	Common Name	X	Y	Height (ft.)	Vigor
19	*Platanus occidentalis*	American sycamore	0.4	0.6	D	Dead
19	*Quercus michauxii*	swamp chestnut oak	2.8	0.5	6.6	4
19	*Quercus michauxii*	swamp chestnut oak	5.0	0.5	D	Dead
19	*Quercus phellos*	willow oak	7.5	0.6	2.1	4
19	*Platanus occidentalis*	American sycamore	9.5	0.6	15.4	4
19	*Quercus phellos*	willow oak	9.4	5.2	D	Dead
19	*Liriodendron tulipifera*	yellow-poplar	7.2	5.2	D	Dead
19	*Betula nigra*	river birch	4.6	5.2	3.8	4
19	*Liriodendron tulipifera*	yellow-poplar	2.5	5.2	D	Dead
19	*Fraxinus pennsylvanica*	green ash	0.3	5.3	10.3	4
19	*Quercus phellos*	willow oak	0.4	9.5	D	Dead
19	*Platanus occidentalis*	American sycamore	2.3	9.6	D	Dead
19	*Fraxinus pennsylvanica*	green ash	4.9	9.6	3.2	4
19	*Platanus occidentalis*	American sycamore	7.0	9.6	17.7	4
19	*Quercus phellos*	willow oak	9.7	9.6	D	Dead
19	*Betula nigra**	river birch	0.4	9.5	2.1	4
19	*Betula nigra**	river birch	6.0	7.0	2.5	4
19	*Betula nigra**	river birch	3.0	4.0	M	Missing

* Trees supplementally planted between MY2 and MY4

Vigor: 4 = excellent, 3 = good, 2 = fair, 1 = unlikely to survive year, 0 = dead, M = Missing

APPENDIX 4. Overview Photographs

10/24/2023

10/24/2023

10/24/2023

10/24/2023