MONITORING YEAR 6 ANNUAL REPORT
Final

MARTIN DAIRY MITIGATION SITE
Orange County, NC
NCDEQ Contract No. 006831
DMS Project No. 97087
USACE Action ID No. 2016-00874
NCDWR Project No. 2016-0366

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MARTIN DAIRY MITIGATION SITE

Monitoring Year 6 Annual Report

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*Content omitted from Monitoring Year 6 Report

Section 1: PROJECT OVERVIEW

The Martin Dairy Mitigation Site (Site) is located in central Orange County, approximately eight miles northeast of Hillsborough, NC and eight miles south of Caldwell, NC off of Schley Road (Figure 1). The Site is located in the Neuse River Basin and within the Falls Lake Water Supply Watershed, which has been designated a Nutrient Sensitive Water. The project streams drain to the Eno River and eventually to the Falls Lake Reservoir. The Site is within Hydrologic Unit Code 03020201030030, which is a Targeted Local Watershed (Figure 1) as identified in the 2010 Neuse River Basin Restoration Priorities (RBRP) (Breeding, 2010). The Site is in in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The project watershed consists primarily of agricultural and wooded land and the drainage area for the Site is 526 acres (0.82 square miles).

The project streams consist of Martin Dairy and one unnamed tributary (UT1). Mitigation work within the Site included restoration of 2,135 linear feet of 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 March 2017. Construction activities were completed by Land Mechanic Designs, Inc. in July 2017. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in December 2017. Baseline monitoring (MY0) was conducted between August 2017 and January 2018. Annual monitoring will occur for seven years with the close-out anticipated to occur in 2025 given the 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 two tracts under the ownership of Ted H. Martin (PIN 9896-83-0483 & 9896-83-9111). A conservation easement was recorded on 11.155 acres (Deed Book 6218, Pages 270 - 289). The project is expected to provide 2,135 stream credits by 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 degradation at the Site was the clearing of vegetation and channelization of Martin Dairy and UT1. Channelization, as indicated by dredge spoil in the floodplain, involved straightening and deepening of the stream. Historic livestock grazing and hay cultivation on the Site further contributed to degradation of the riparian corridor and stream channel. Table 4 in Appendix 1 presents the pre-restoration conditions in detail.

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

The following project goals and related objectives established in the Mitigation Plan (Wildlands, 2017) include:

Goal	Objective	Expected Outcomes
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels with designed bankfull dimensions and depth based on reference reach data. Remove existing dredge spoil to reconnect channel with adjacent wetlands.	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.	Reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary. Support all stream functions above hydrology.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zones and plant native shrub and herbaceous species on streambanks.	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 the streams. Support all stream functions.
Improve in-stream habitat.	Install habitat features such as constructed riffles, lunker logs, and brush toes into restored 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 the streams.
Permanently protect the Site from harmful uses.	Establish a conservation easement on the Site.	Protect the Site from encroachment on the riparian corridor and direct impact to streams and wetlands. Support all stream functions.

Section 2: MONITORING YEAR 6 DATA ASSESSMENT

Annual monitoring and site visits were conducted during MY6 to assess the condition of the project. The vegetation and stream success criteria for the Site follow the approved success criteria presented in the Mitigation Plan. Per North Carolina Interagency Review Team (NCIRT) guidelines, detailed monitoring and analysis of vegetation and channel cross-sectional dimensions did not occur during MY6.

2.1 Vegetative Assessment

Detailed vegetation inventory and analysis is not required during MY6. Visual assessment during MY6 indicated that vegetation across most of the Site is performing adequately to attain terminal success criteria of 210 planted stems per acre averaging ten feet in height at the end of MY7.

2.2 Vegetation Areas of Concern and Management

The Divison of Water Resources (DWR) closed the buffer portion of the Site on July 18th 2023 with the recommendation that supplemental planting be completed on a 1.25 acre area. On November 14th, 2023 this area was planted with approximately 190 containerized trees. The list of species and quantities has been approved by the NCIRT and is included in Appendix 6. Prior to supplemental planting, blackberry management was performed in September and October to reduce competition and increase likelihood of survival of the newly planted trees. These new stems will receive soil amendments along the base of the trees in the spring to aid in growth.

To further ensure vegetative success, invasive removal of sporadic stems of Chinese privet (*Ligustrum sinense*), multiflora rose (*Rosa multiflora*), and Callery pear (*Pyrus calleryana*) was completed across the Site in 2023. Additional treatments to remove sporadic stems of invasive species will likely be needed in 2024. There are no concentrated populations of invasive species on the Site, however, resprouts and scattered stems are likely to exist.

Two applications of soil amendments were added to the base of shorter trees across the Site in May and June 2023. Soil amendments promote tree growth, which ideally will increase the tree height and reduce deer browsing. Tree height data will be shown in MY7.

2.3 Stream Assessment

Detailed dimensional survey and analysis is not required during MY6. Visual monitoring indicated that the stream channel is performing as designed. No deposition or erosion exceeding approximate natural levels or indicators of channel instability were observed.

2.4 Stream Areas of Concern and Management

No stream areas of concern were identified during MY6.

2.5 Hydrology Assessment

At the end of the seven-year monitoring period, 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. During MY6 Martin Dairy did not record a bankfull or geomorphically significant event, and UT1 recorded multiple bankfull and geomorphically significant events. Bankfull events and multiple geomorphically significant events were recorded on all restoration reaches during MY1, MY2, MY3, MY4, and MY5 resulting in attainment of the stream hydrology success criteria. Refer to Appendix 5 for hydrologic data.

While downloading gauges in October, it was discovered that the crest gauge on UT1 and the Barotroll (records atmospheric pressure) malfunctioned around September 1st. These two gauges were replaced on November 1st and will be checked again before the end of the year.

2.6 Monitoring Year 6 Summary

Visual assessment indicated that all stream reaches within the Site are geomorphically stable and functioning as designed. Vegetation is well established along the stream banks and desirable volunteer tree species continue to add to stem density and species diversity. Survival and growth of planted trees appear to be on track to surpass MY7 success criteria. On November 14th a supplemental planting of containerized trees occurred on approximately 1.25 acres along the right side of Martin Dairy near the confluence of UT1. This was recommended by DWR during a buffer closeout site walk on July 18th, 2023. Invasive vegetation treatment occurred across the Site to treat sporadic populations of invasive species. The Site will continue to receive follow-up invasive treatments as needed. In May and June, soil amendments were added to shorter trees to combat deer browsing and ensure tree height success. Multiple bankfull and geomorphically significant events were recorded on UT1, but none were recorded on Martin Dairy. The gauge on UT1 and the Barotroll malfunctioned around September 1st, and were replaced on November 1st. Overall, the Site is meeting its goals and is on track to meet final success criteria. No easement encroachments have been identified in MY6.

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 available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

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.

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.

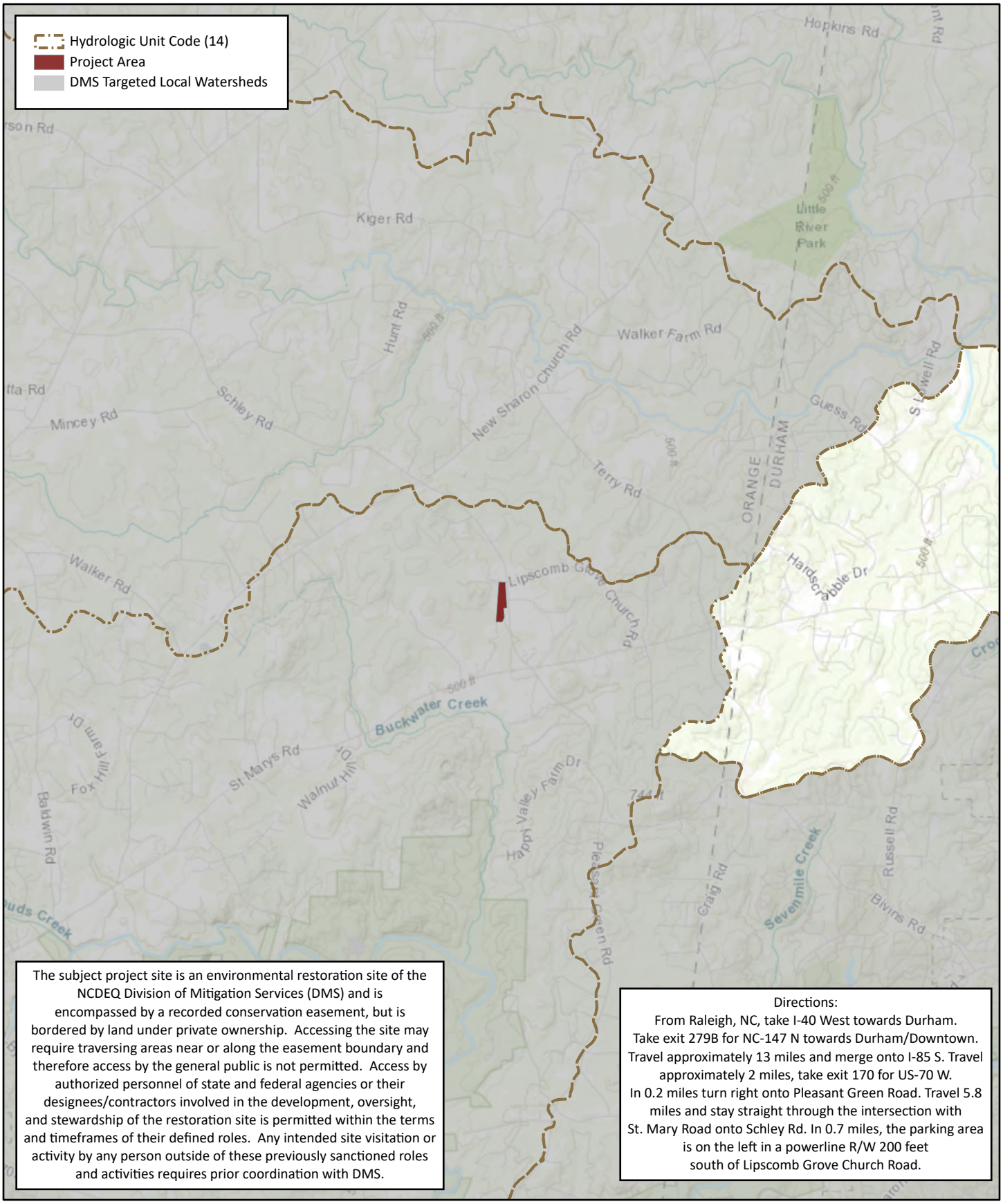
United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

United States Geological Survey. 1998. North Carolina Geology.

Wildlands Engineering, Inc. 2018. Martin Dairy Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. DMS, Raleigh, NC.

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

APPENDIX 1. General Figures and Tables



WILDLANDS ENGINEERING

0 0.5 1 Miles

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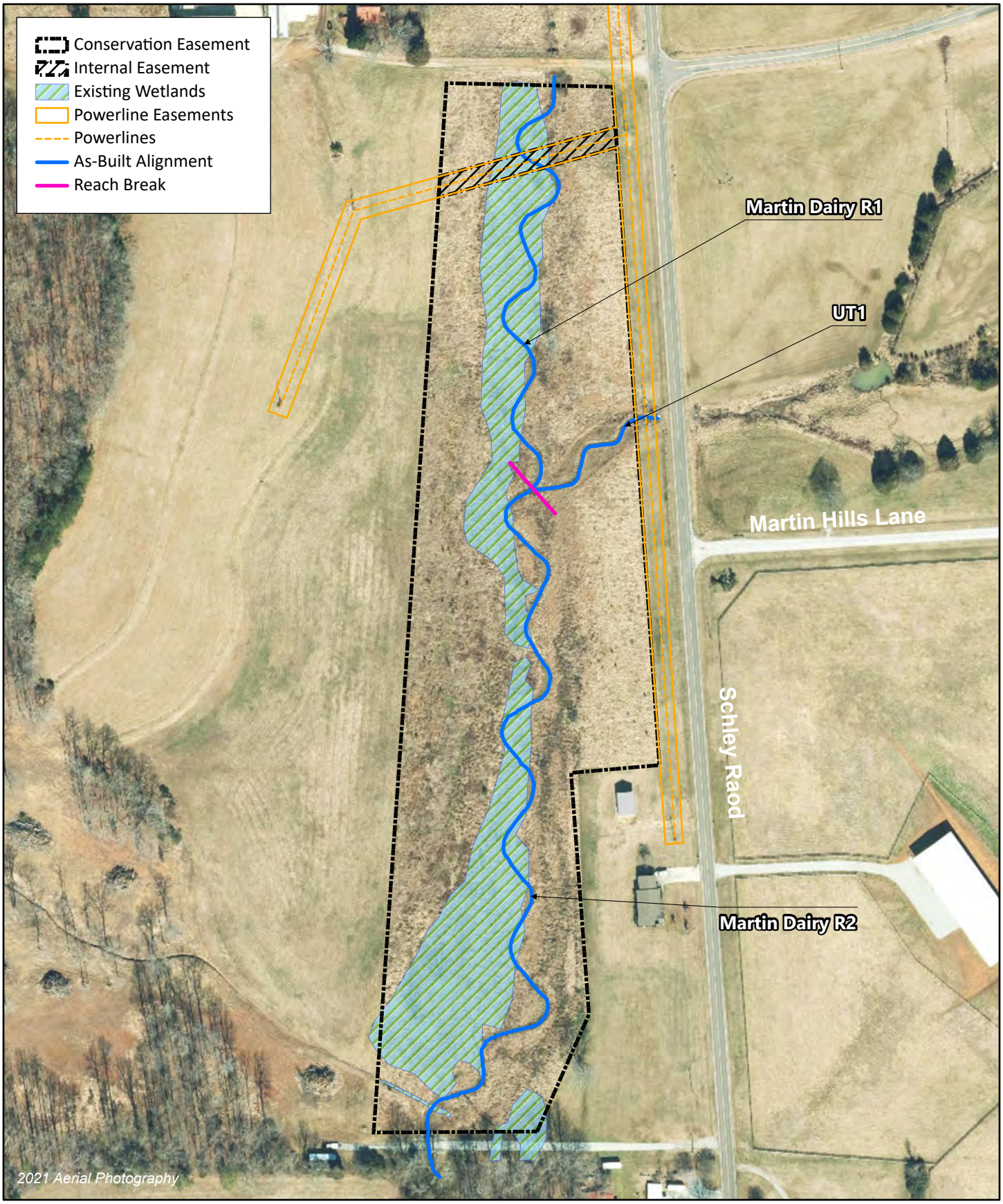
Figure 1. Project Vicinity Map
Martin Dairy Buffer Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023
Orange County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

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Figure 2. Project Component/Asset Map
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023
Orange County, NC

Table 1. Project Components and Mitigation Credits
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023

MITIGATION CREDITS									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	2,135	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

PROJECT COMPONENTS								
Reach ID	Centerline Stationing	Existing Footage	Approach	Restoration or Restoration Equivalent	Restoration Footage (LF)*	As-Built Thalweg Footage (LF)	Mitigation Ratio	Credits (SMU / WMU)
STREAMS								
Martin Dairy R1	100+13 - 101+38, 101+78 - 107+61	503	P1	Restoration	708	721	1	708
Martin Dairy R2	107+61 - 119+71	1,173	P1	Restoration	1,210	1,258	1	1,210
UT1	200+33 - 202+50	138	PII	Restoration	217	214	1	217

COMPONENT SUMMATION						
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (acres)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,135	-	-	-	-	-
Enhancement		-	-	-	-	-
Enhancement I	-					
Enhancement II	-					
Creation		-	-	-		
Preservation	-	-	-	-		-
High Quality Preservation	-	-	-	-		-

N/A: not applicable

*Linear footage calculated along stream centerline.

Table 2. Project Activity and Reporting History
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023

Activity or Report		Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan		March 2017	March 2017
Final Design - Construction Plans		March 2017	March 2017
Construction		June 2017 - July 2017	July 2017
Temporary S&E mix applied to entire project area[1]		June 2017 - July 2017	July 2017
Permanent seed mix applied to reach/segments[1]		June 2017 - July 2017	July 2017
Bare root and live stake plantings for reach/segments		December 2017	December 2017
Baseline Monitoring Document (Year 0)	Stream Survey	August 2017	January 2018
	Vegetation Survey	January 2018	
Year 1 Monitoring	Stream Survey	June 2018	December 2018
	Vegetation Survey	September 2018	
Year 2 Monitoring	Stream Survey	May 2019	December 2019
	Vegetation Survey	September 2019	
Year 3 Monitoring	Supplemental Planting	January 2020	December 2020
	Stream Survey	March 2020	
	Vegetation Survey	September 2020	
Year 4 Monitoring			December 2021
Year 5 Monitoring	Invasive Removal	April 2022	December 2022
	Vegetation Height Management	April-May 2022	
	Stream Survey	April 2022	
	Vegetation Survey	September 2022	
Year 6 Monitoring	Invasive Removal	Throughout 2023	December 2023
	Vegetation Height Management	May & July 2023	
	Buffer Project Closeout	July 2023	
	Blackberry Management	September & October 2023	
	Supplemental Planting	November 2023	
Year 7 Monitoring	Stream Survey	2024	December 2024
	Vegetation Survey	2024	

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

Table 3. Project Contact Table
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023

Designer Angela Allen, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
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	**Wildlands Engineering, Inc.**
Monitoring, POC	Jason Lorch 919.851.9986

Table 4. Project Information and Attributes

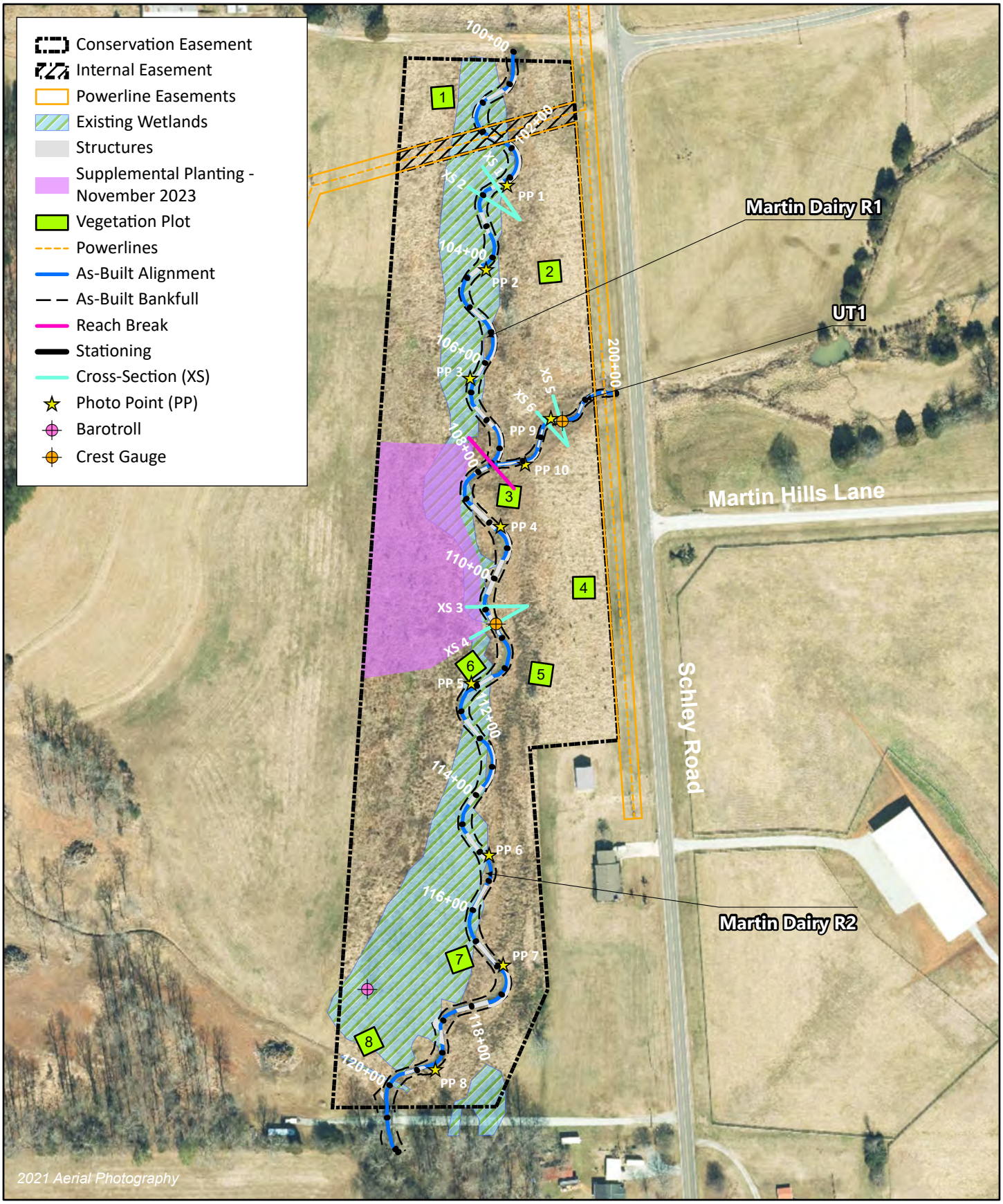
Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 6 - 2023

PROJECT INFORMATION			
Project Name	Martin Dairy Mitigation Site		
County	Orange County		
Project Area (acres)	11.155		
Planted Area (acres)	10.139		
Project Coordinates (latitude and longitude)	36° 7′ 25.76″ N, 79° 0′ 14.26″ 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 Drainiage Area (acres)	526		
Project Drainage Area Percentage of Impervious Area	0.4%		
CGIA Land Use Classification	59.0% forested, 40.6% cultivated, 0.4% impervious		
REACH SUMMARY INFORMATION			
Parameters	**Martin Dairy**	**UT1**	
Length of Reach (linear feet) - Post-Restoration	1,918	217	
Drainage Area (acres)	526	141	
NCDWR Stream Identification Score	36.75	30.75	
NCDWR Water Quality Classification	WS-IV		
Morphological Desription (stream type)	Perennial		
Evolutionary Trend (Simon's Model) - Pre-Restoration	IV: Degradation and Widening		
Underlying Mapped Soils	Chewacla loam, Herndon silt loam, Tatum silt loam		
Drainage Class	-	-	
Soil Hydric Status	-	-	
Slope	-	-	
FEMA Classification	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. 4087.
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	Martin Diary Mitigation Plan; Wildlands determined "no effect" on Orange County listed endangered species. The USFWS responded on June 3, 2016 and concurred with NCWRC 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 June 3, 2016 indicating they were not aware of any historic resources that would be affected by the project.
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	N/A	N/A	N/A
Essential Fisheries Habitat	N/A	N/A	N/A

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 3. Intergraded Current Condition Plan View
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023
Orange County, NC

Table 5a. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 6 - 2023

Martin Dairy Reach 1

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	9	9			100%			
		Length Appropriate	9	9			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			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.	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%.	5	5			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 5b. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 6 - 2023

Martin Dairy Reach 2

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	13	13			100%			
	3. Meander Pool Condition	Depth Sufficient	13	13			100%			
		Length Appropriate	13	13			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		Thalweg centering at downstream of meander bend (Glide)	13	13			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			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.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			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.	4	4			100%			

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

Table 5c. Visual Stream Morphology Stability Assessment Table
Martin Dairy Mitigation Project
DMS Project No. 97087
Monitoring Year 6 - 2023

UT1

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjust % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability (Riffle and Run Units)**	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	4	4			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Length Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			100%			
2. Bank	**1. Scoured/Eroded**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	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%.	1	1			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 6. Vegetation Condition Assessment Table

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023

Planted Acreage **10.139**

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	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	1.25*	12%
		Total	**1**	**1.25**	**12%**
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0	0	0	0%
		Cumulative Total	**1**	**1.25**	**12%**

*An approved supplemental planting occurred on November 14, 2023.

Easement Acreage **11.155**

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 Martin Dairy R1 – upstream *(4/7/2023)*	**PHOTO POINT 1 Martin Dairy R1 –** downstream *(4/7/2023)*
	
PHOTO POINT 2 Martin Dairy R1 – upstream *(4/7/2023)*	**PHOTO POINT 2 Martin Dairy R1 –** downstream *(4/7/2023)*
	
PHOTO POINT 3 Martin Dairy R1 – upstream *(4/7/2023)*	**PHOTO POINT 3 Martin Dairy R1 –** downstream *(4/7/2023)*

PHOTO POINT 4 Martin Dairy R2 – upstream *(4/7/2023)*

PHOTO POINT 4 Martin Dairy R2 – downstream *(4/7/2023)*

PHOTO POINT 5 Martin Dairy R2 – upstream *(4/7/2023)*

PHOTO POINT 5 Martin Dairy R2 – downstream *(4/7/2023)*

PHOTO POINT 6 Martin Dairy R2 – upstream *(4/7/2023)*

PHOTO POINT 6 Martin Dairy R2 – downstream *(4/7/2023)*

	
PHOTO POINT 7 Martin Dairy R2 – upstream *(4/7/2023)*	**PHOTO POINT 7 Martin Dairy R2 –** downstream *(4/7/2023)*
	
PHOTO POINT 8 Martin Dairy R2 – upstream *(4/7/2023)*	**PHOTO POINT 8 Martin Dairy R2 –** downstream *(4/7/2023)*
	
PHOTO POINT 9 UT1 – upstream *(4/7/2023)*	**PHOTO POINT 9 UT1 –** downstream *(4/7/2023)*

	
PHOTO POINT 10 UT1 – upstream *(4/7/2023)*	**PHOTO POINT 10 UT1 –** downstream *(4/7/2023)*

APPENDIX 3. Vegetation Plot Data

Vegetation inventory and analysis not required during MY6.

APPENDIX 4. Morphological Summary Data and Plots

Morphological survey and analysis not required during MY6.

APPENDIX 5. Hydrology Summary Data

Table 13. Verification of Bankfull Events

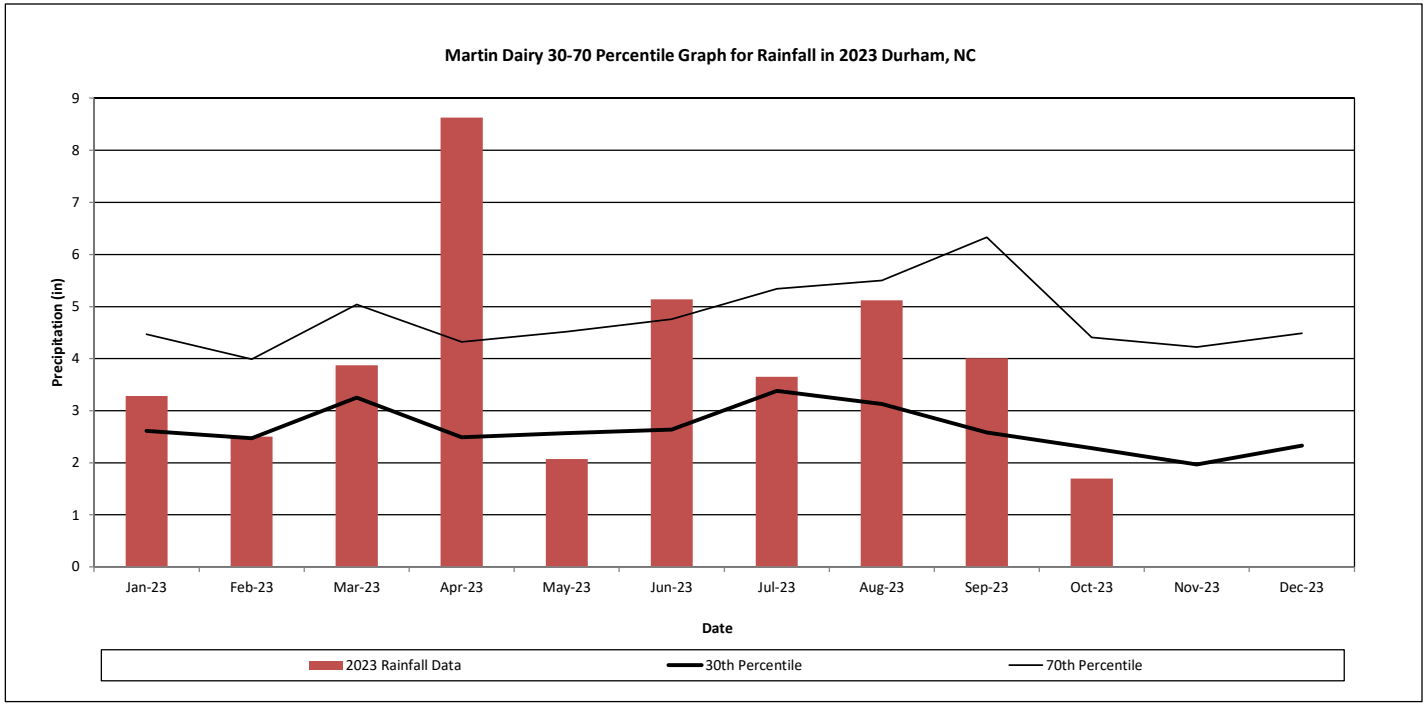
Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023

Reach	MY1 Date of Occurrence	MY2 Date of Occurrence	MY3 Date of Occurrence	MY4 Date of Occurrence	MY5 Date of Occurrence	MY6 Date of Occurrence	Method
Martin Dairy	4/15/2018	4/13/2019	1/24/2020	1/3/2021	5/24/2022	None	Crest Gage/ Pressure Transducer
	9/17/2018*	6/19/2019	2/6/2020	7/19/2021			
UT1	4/15/2018	3/24/2019	1/24/2020	1/3/2021	3/12/2022	1/15/2023	
	9/17/2018*	4/13/2019	2/6/2020	4/10/2021	5/24/2022	2/12/2023	
		6/19/2019	6/11/2020	7/19/2021	10/1/2022	4/7/2023	

*Hurricane Florence

Monthly Rainfall Data

Martin Dairy Mitigation Site
DMS Project No. 97087
Monitoring Year 6 - 2023



[1] 2023 monthly rainfall from USDA Station Durham 6.8 NNW.

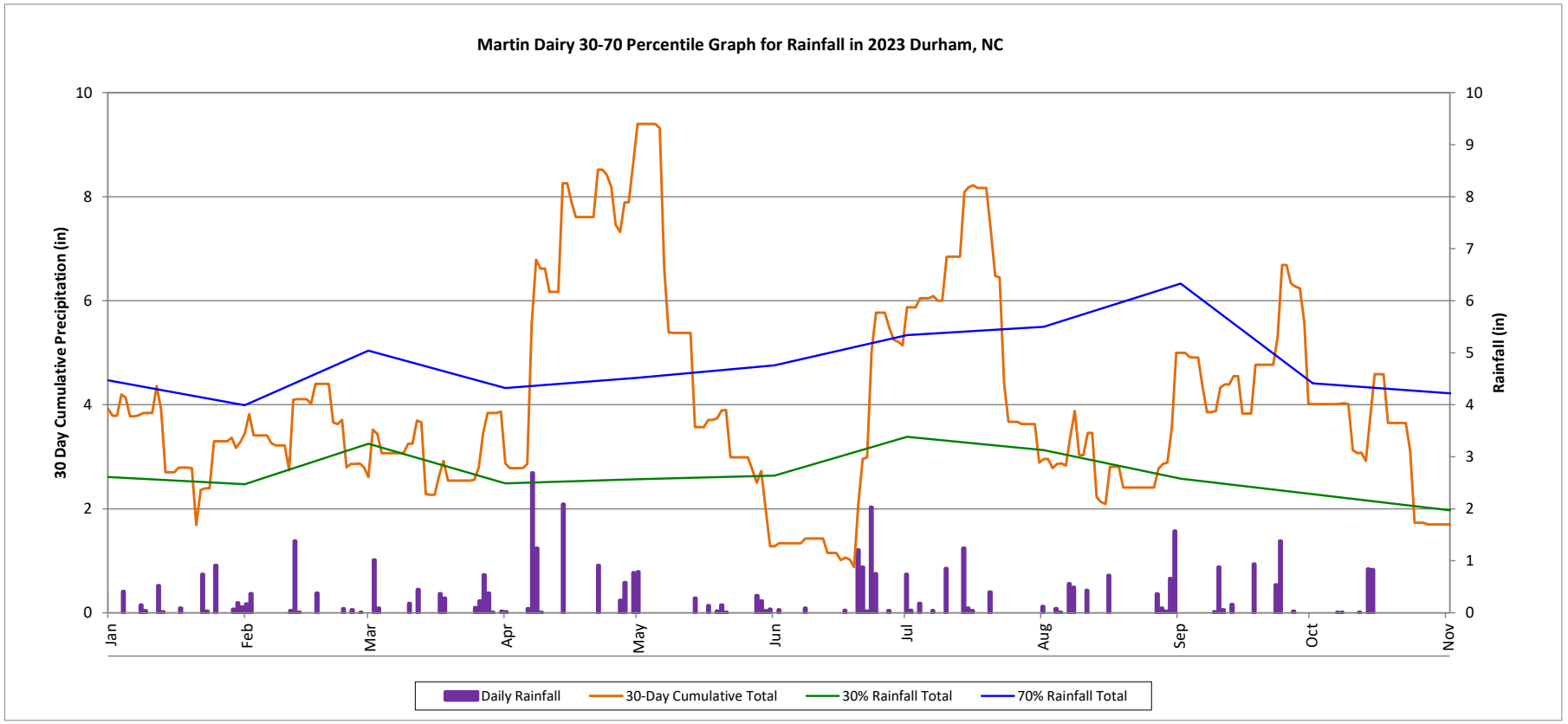
[2] 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2023).

30-Day Cumulative Total Rainfall Data

Martin Dairy Mitigation Project

DMS Project No. 97087

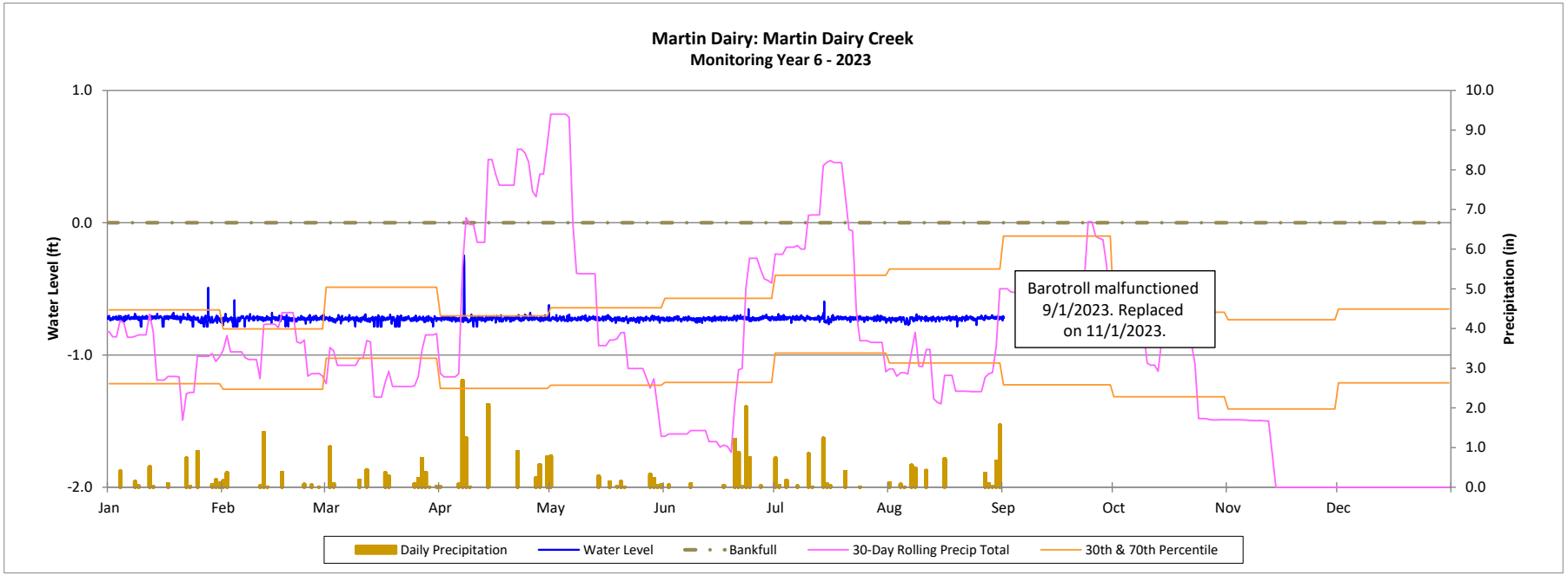
Monitoring Year 6 - 2023



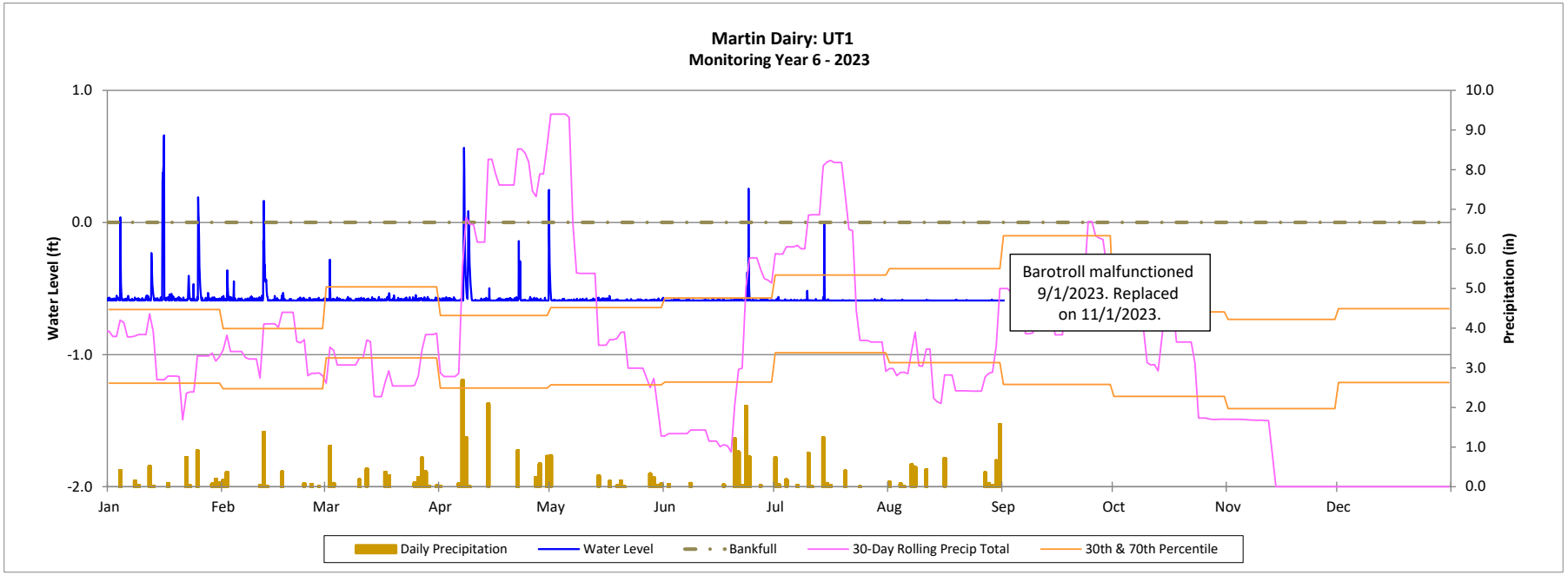
[1] 2023 monthly rainfall from USDA Station Durham 6.8 NNW.

[2] 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2023).

Recorded Bankfull Events Plot
Martin Dairy Mitigation SIte
DMS Project No. 97087
Monitoring Year 6 - 2023



Recorded Bankfull Events Plot
Martin Dairy Mitigation SIte
DMS Project No. 97087
Monitoring Year 6 - 2023



APPENDIX 6. Additional Documentation

Technical Memorandum

TO: Katie Merritt

FROM: Jason Lorch

DATE: August 4, 2023

SUBJECT: Winter 2023 Supplemental Planting
Martin Dairy Buffer Mitigation Site
DWR Project No. 2016-0366

INTRODUCTION

The Martin Dairy Buffer Mitigation Site ("Site") Monitoring Year 5 (MY5) report was submitted to the North Carolina Division of Water Resources (NCDWR) on December 29, 2022. A closeout site walk was completed on July 18, 2023 with NCDWR and North Carolina Division of Mitigation Services (NCDMS) during which Wildlands Engineering received a request to provide documentation for supplemental planting on a small portion of the Site.

SUPPLEMENTAL PLANTING

During the closeout site walk, NCDWR indicated that supplemental planting would be needed on approximately 1.25 acres of the Site for closeout approval. A visual depiction of the anticipated November 2023 supplemental planting area, including the division between upland and wetland planting zones, can be seen in Figure 1.

It is suspected that tree growth has been impacted by poor soil conditions from a rock harvest completed during construction. Constant deer browsing and wet floodplain conditions have likely played a role as well. Species selected for supplemental planting include some species originally approved by NCDWR in the Martin Dairy Buffer Mitigation Bank Parcel Development Package, as well as additional species deemed more likely to succeed at the Site. Table 1 below lists species selected along with their planted quantities and composition. Table 2 lists species that will be used for livestaking exclusively in the wetland area depicted in Figure 1.

Table 1. Tree Species Selected for Supplemental Planting

Species	Common Name	Type	Wetland Indicator Status	Upland or Wetland Zone	Stems per Species	Planting Composition
Betula nigra	River Birch	Gallon	FACW	Both**	37	20%
Acer negundo	Box Elder	Gallon	FAC	Upland	19	10%
Quercus nigra	Water Oak	Gallon	FAC	Both**	19	10%
Quercus michauxii	Swamp Chestnut Oak	Gallon	FACW	Both**	19	10%
Quercus phellos	Willow Oak	Gallon	FAC	Upland	19	10%
Quercus falcata	Southern Red Oak	Gallon	FACU	Upland	19	10%
*Juniperus virginiana**	Eastern Red Cedar	Gallon	FACU	Upland	19	10%
Nyssa sylvatica	Black Tupelo	Gallon	FAC	Both	10	5%

Species	Common Name	Type	Wetland Indicator Status	Upland or Wetland Zone	Stems per Species	Planting Composition
Viburnum nudum	Possum Haw Viburnum	Gallon	OBL	Wetland	10	5%
Ulmus americana	American Elm	Gallon	FACW	Both	19	10%
			Totals		**190**	**100%**
***This species was selected based on deer resistant qualities. **Higher concentrations of these species will be found in the wetland zone, as seen on Figure 1.**						

Table 2. Livestake Species

Species	Common Name	Type	Wetland Indicator Status	Stems per Species	Planting Composition
Salix nigra	Black Willow	Livestake	OBL	24	40%
Salix sericea	Silky Willow	Livestake	OBL	24	40%
Cornus amomum	Silky Dogwood	Livestake	FACW	12	20%
			Totals	**60**	**100%**

To ensure better tree survival, Wildlands will implement additional management actions throughout the supplemental planting process. Soil amendments will be added to each augured hole for the gallon-sized trees. Prior to replanting this fall, Wildlands will brush-cut blackberry pockets within the replanting polygon. After the trees have had time to establish, a mixture of soil amendments will be applied at the base of each tree in late spring or early summer of 2024.

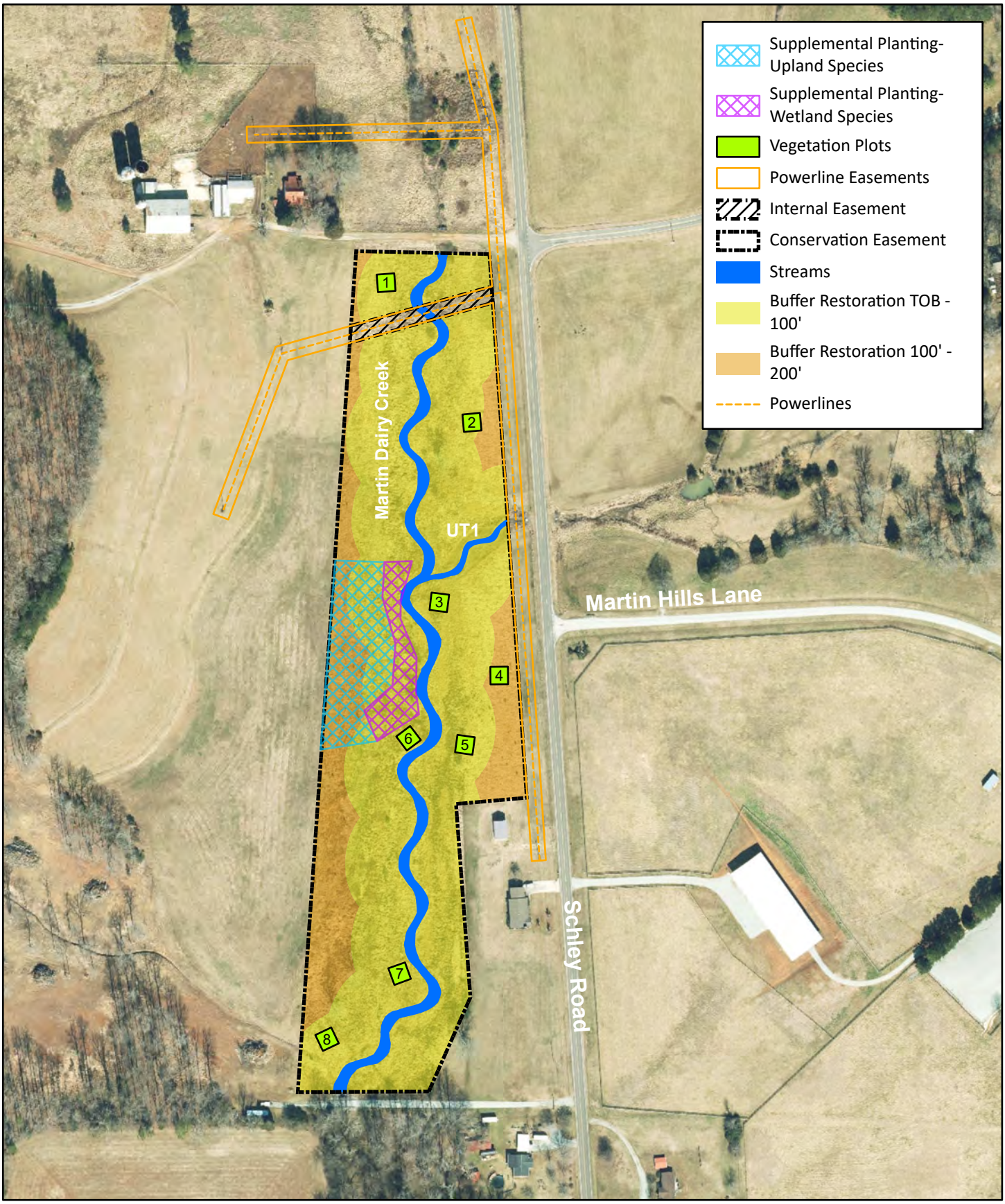
CONCLUSION

A 1.25-acre supplemental planting will occur in the winter of 2023. The suspected cause of widespread planted stem fatality is likely due to lower quality soil conditions from rock harvesting during construction, and constant deer browsing activity. It is anticipated that new stems being treated with soil amendments will have a greater chance of survival.

Upon approval of this memorandum, NCDWR indicated that the Site will be accepted for closeout.

Please contact me if you have any questions at (919) 851-9986 or via email at jlorch@wildlandseng.com.

Attachments:
Updated Figure 1. Supplemental Planting Map



WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 1. Supplemental Planting Map
Martin Dairy Buffer Mitigation Site
DMS Project No. 97087

Orange County, NC

Jason Lorch

From: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>
Sent: Tuesday, August 22, 2023 4:16 PM
To: Jason Lorch
Cc: Dow, Jeremiah J; Angela Allen; Haywood, Casey M CIV USARMY CESAW (USA)
Subject: RE: Martin Dairy

The IRT has no concerns with the proposed species. Thanks for the information.

Regards,
Kim

From: Jason Lorch <jlorch@wildlandseng.com>
Sent: Thursday, August 17, 2023 8:47 AM
To: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>
Cc: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Angela Allen <aallen@wildlandseng.com>
Subject: [URL Verdict: Unknown][Non-DoD Source] Martin Dairy

Kim, Wildlands recently had a closeout site walk with DWR on the buffer portion of the Martin Dairy Mitigation Site. As part of the contingency to closeout the buffer portion of the project, Katie Merritt asked that we supplementally plant a small area (approximately 12%) of the site. This is a NCDMS Full Delivery Project with stream and buffer restoration included within the same conservation easement. Since we are planning to add species that weren't included in the original planting plan, we wanted to get approval from the IRT on the new species. Attached is the proposed supplemental planting plan and the original planting plan for Martin Dairy. Could you review this and provide any comments you may have before we send it to DWR for approval? Thanks!

Jason Lorch, GISP | *Senior Environmental Scientist*
O: 919.851.9986 x107 **M**: 919.413.1214

Wildlands Engineering, Inc.
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