



# **MONITORING YEAR 4 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

Data Collection Period: January- October 2021

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### **PREPARED FOR:**



**NC Department of Environmental Quality**

**Division of Mitigation Services**

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## EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) implemented a full delivery project at the Martin Dairy Mitigation Site (Site) for the North Carolina Department of Environmental Quality Division of Mitigation Services (DMS) to restore a total of 2,135 linear feet (LF) of perennial streams in Orange County, NC. The Site is expected to generate 2,135 stream credits. All stream lengths were measured along the stream centerline for stream credit calculations. The Site is located approximately eight miles northeast of Hillsborough, NC and eight miles south of Caldwell, NC (Figure 1) in the Neuse River Basin 8-Digit Hydrologic Unit Code 03020201. The project is located within the Neuse River Basin Hydrologic Unit Code 03020201030030 and NC Division of Water Resources (DWR) Subbasin 03-04-01. There are two unnamed streams on the Site, Martin Dairy Creek and UT1 with a downstream drainage area of 526 acres. The Site drains to the Eno River which flows to Falls Lake and is classified as water supply waters (WS-IV). The 11.155-acre Site is protected with a permanent conservation easement.

The Site is located within the Neuse River Targeted Local Watershed as presented in the 2010 Neuse River Basin Restoration Priorities (RBRP) (Breeding, 2010), which highlights the importance of riparian buffers for stream restoration projects. The Site was an active dairy farm until 2014 when livestock were removed.

The project goals established in the Mitigation Plan (Wildlands, 2017) were developed considering the goals and objectives listed in the Neuse River RBRP plan. The project goals include:

- Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime;
- Improve the stability of stream channels;
- Restore and enhance native floodplain and streambank vegetation;
- Improve instream habitat; and
- Permanently protect the Site from harmful land uses.

The project will contribute to achieving the goals for the watershed listed in the Neuse River RBRP and provide ecological benefits within the Neuse River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. In addition, planned and implemented projects in the same watershed and basin as this Site will realize cumulative benefits.

The Site construction and as-built surveys were completed between July 2017 and January 2018. Monitoring Year 4 (MY4) assessments and site visits were completed between January and October 2021 to visually assess the conditions of the project and collect stream hydrology data. Per North Carolina Interagency Review Team (NCIRT) guidelines, detailed monitoring and analysis of vegetation, substrate, and channel cross-sectional dimensions did not occur during MY4. Visual observations, hydrology data, and management practices are included in this report. To preserve the clarity and continuity of reporting structure, this report maintains section and appendix numbering from previous monitoring reports. Omitted sections are denoted in the Table of Contents.

Site performance for vegetation, stream geomorphology, and hydrology appear to be successful based on visual assessments and are expected to exceed success criteria for MY5. Vegetation density and diversity have noticeably improved from MY3 and appear to be performing adequately to attain the interim success criteria of 260 stems per acre at the end of MY5. Visual observation indicated that stream channels have remained geomorphically stable and multiple bankfull events were recorded on both Martin Dairy and UT1.



**MARTIN DAIRY MITIGATION SITE**  
Monitoring Year 4 Annual Report

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\*Content omitted from Monitoring Year 4 Report

## Section 1: PROJECT OVERVIEW

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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 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 project site is 526 acres (0.82 square miles).

The project streams consist of Martin Dairy Creek and one unnamed tributary (UT1). Mitigation work within the Site included restoration of 2,135 linear feet (LF) 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. Monitoring Year 4 was conducted in 2021. 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 Creek 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 and Tables 10a and 10b found in Appendix 4 of the MY3 report present 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 instream habitat.	Install habitat features such as constructed riffles, lunger 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.

**1.2 Monitoring Year 4 Data Assessment**

Annual monitoring and quarterly site visits were conducted during monitoring year 4 (MY4) to visually assess the condition of the project and collect hydrology data. Per NCIRT guidelines, detailed monitoring and analysis of vegetation, substrate, and channel cross-sectional dimensions did not occur during MY4.

**1.2.1 Vegetative Assessment**

Detailed vegetation inventory and analysis is not required during MY4. Visual assessment during MY4 indicated that vegetation is performing adequately to attain interim success criteria of 260 planted stems per acre at the end of MY5 and terminal success criteria of 210 planted stems per acre averaging ten feet in height at the end of MY7.

Tree vigor and vegetative cover along UT1 has vastly improved from MY3. Container trees and tublings planted in MY3 have thrived and vegetative and herbaceous cover has benefited from the addition of soil amendments. The effects of the supplemental planting done during the prior year can be seen through improvements in stem density across the Site.

### **1.2.2 Vegetation Areas of Concern**

No Vegetative Areas of Concern were identified during MY4.

### **1.2.3 Stream Assessment**

Detailed dimensional survey and analysis is not required during MY4. 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.

### **1.2.4 Stream Areas of Concern**

No Stream Areas of Concern were identified during MY4.

### **1.2.5 Hydrology Assessment**

At the end of the MY7, two or more bankfull events must have occurred in separate years within the restoration reaches. Multiple bankfull events were recorded on both Martin Dairy Creek and UT1 with automated crest gages during MY4 data collection. Both Martin Dairy Creek and UT1 recorded bankfull events during MY1, MY2, MY3, and MY4 (Table 13); therefore, the Site has met the bankfull frequency success criteria for the seven year monitoring period.

## **1.3 Monitoring Year 4 Summary**

Visual assessment indicated that all stream reaches within the Site are geomorphically stable and functioning as designed. Vegetation has become well established along the stream banks providing shade, stability, and a source of organic material. Survival and growth of planted trees appear to be on track meet interim success criteria. The effects of the supplemental planting completed the prior year can be seen across the Site. Herbaceous vegetation is thriving, and species diversity and abundance appears to have increased. Bankfull event frequency criteria have been satisfied for the duration of the monitoring period.



## Section 2: METHODOLOGY

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All data collected for the Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS software. Crest gages and pressure transducers were installed in surveyed riffle cross sections and monitored quarterly. Hydrology attainment installation and monitoring methods are in accordance with the USACE (2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-NCDMS Level 2 Protocol (Lee et al., 2008). Summary information and data related to the success of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Mitigation Plan documents available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.





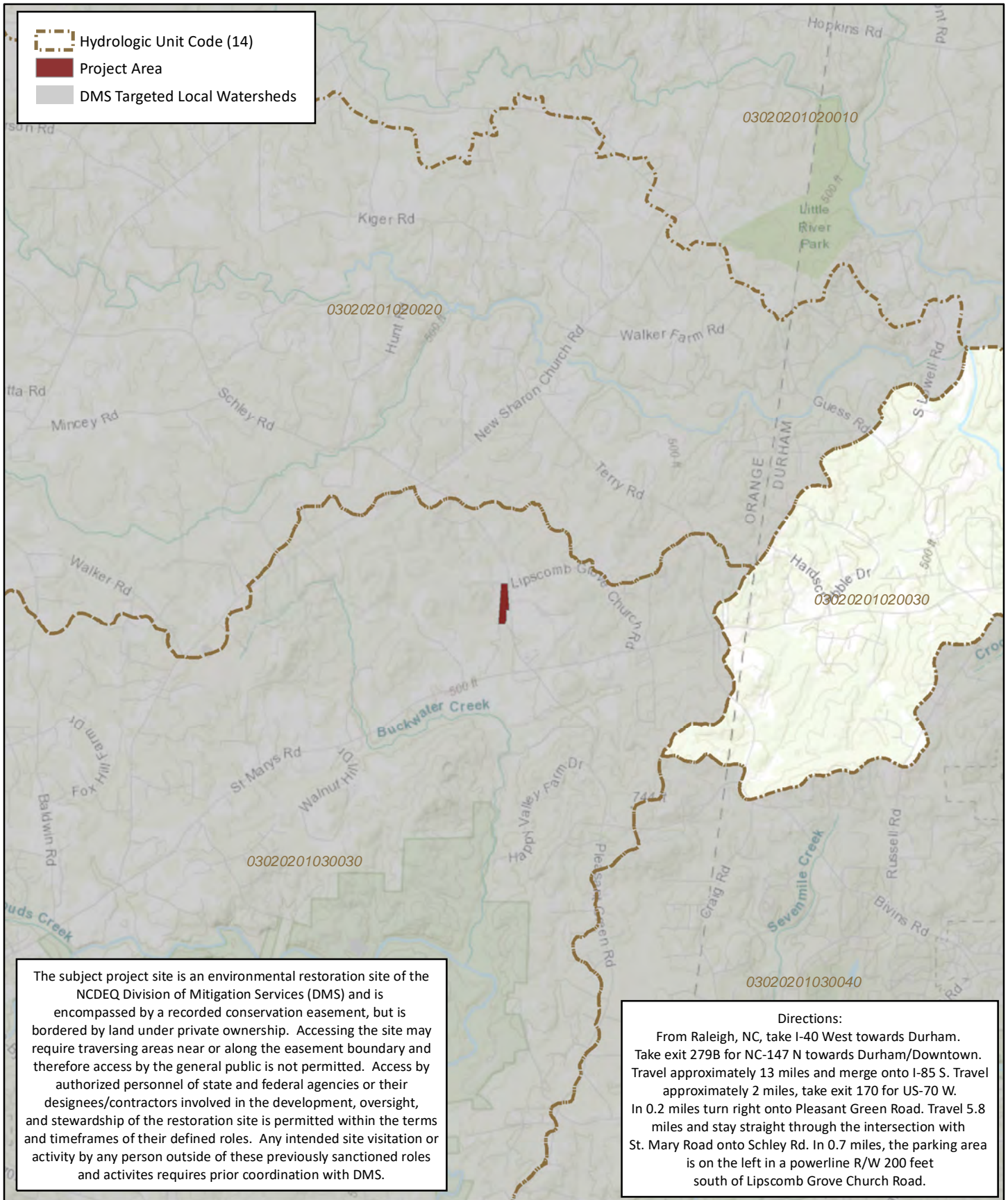
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- Wildlands Engineering, Inc. 2018. Martin Dairy Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. DMS, Raleigh, NC.
- Wildlands Engineering, Inc. 2017. Martin Dairy Mitigation Project Mitigation Plan. DMS, Raleigh, NC.



## **APPENDIX 1. General Tables and Figures**



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 activities 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. In 0.2 miles turn right onto Pleasant Green Road. Travel 5.8 miles and stay straight through the intersection with St. Mary Road onto Schley Rd. In 0.7 miles, the parking area is on the left in a powerline R/W 200 feet south of Lipscomb Grove Church Road.

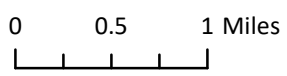


Figure 1. Project Vicinity Map  
 Martin Dairy Mitigation Site  
 DMS Project No. 97087  
 Monitoring Year 4 - 2021  
 Orange County, NC



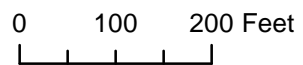
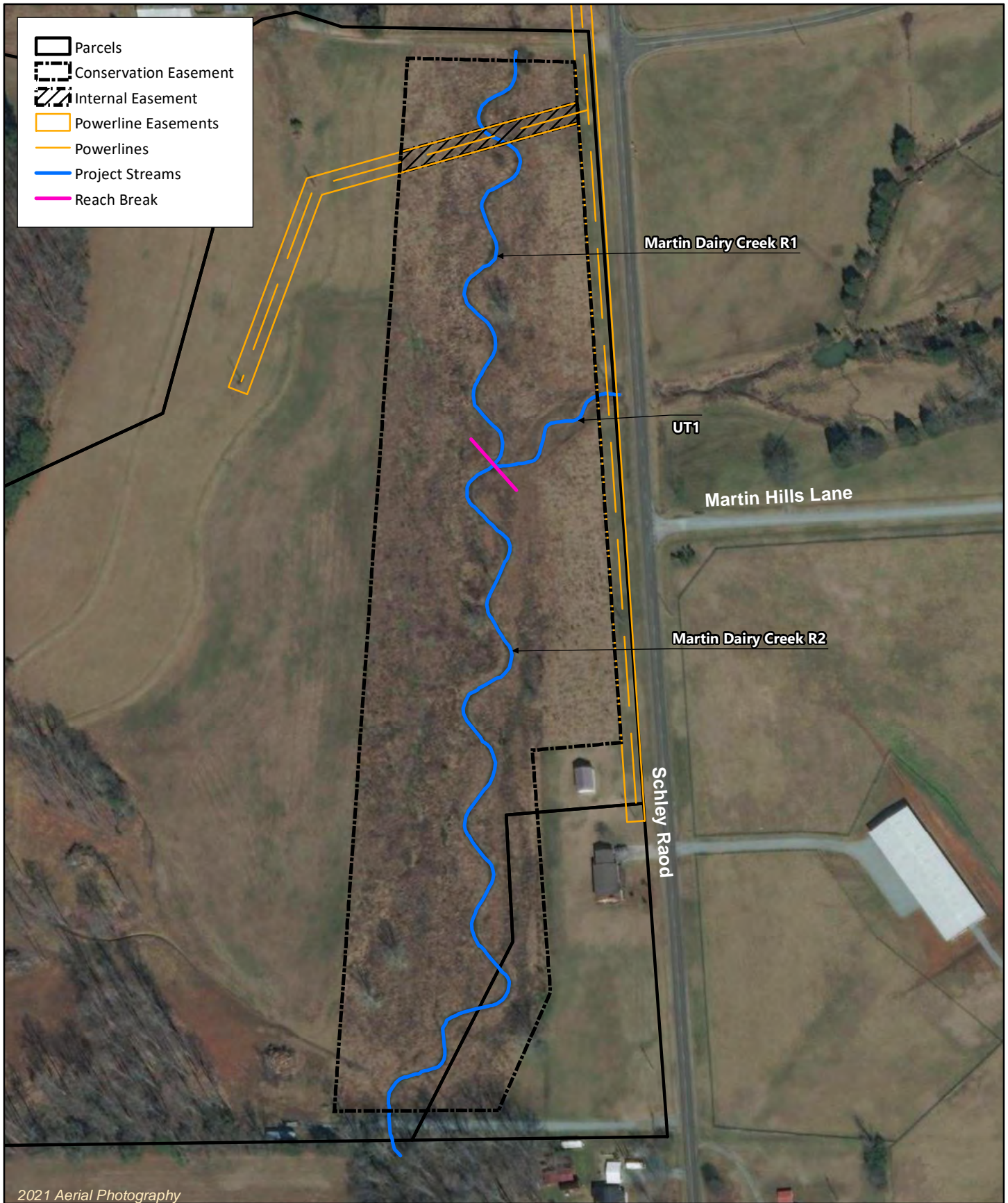


Figure 2. Project Component/Asset Map  
 Martin Dairy Mitigation Site  
 DMS Project No. 97087  
 Monitoring Year 4 - 2021  
 Orange County, NC

**Table 1. Project Components and Mitigation Credits**  
 Martin Dairy Mitigation Site  
 DMS Project No. 97087  
 Monitoring Year 4 - 2021

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 4 - 2021**

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 <sup>1</sup>	June 2017 - July 2017	July 2017
Permanent seed mix applied to reach/segments <sup>1</sup>	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
	Vegetation Survey	January 2018
Year 1 Monitoring	Stream Survey	June 2018
	Vegetation Survey	September 2018
Year 2 Monitoring	Stream Survey	May 2019
	Vegetation Survey	September 2019
Supplemental Planting		January 2020
Year 3 Monitoring	Stream Survey	March 2020
	Vegetation Survey	September 2020
Year 4 Monitoring		December 2021
Year 5 Monitoring	Stream Survey	2022
	Vegetation Survey	2022
Year 6 Monitoring		December 2023
Year 7 Monitoring	Stream Survey	2024
	Vegetation Survey	2024

<sup>1</sup>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 4 - 2021**

<b>Designer</b> Angela Allen, PE	<b>Wildlands Engineering, Inc.</b> 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
<b>Construction Contractor</b>	<b>Land Mechanic Designs, Inc.</b> 126 Circle G Lane Willow Spring, NC 27592
<b>Planting Contractor</b>	<b>Bruton Natural Systems, Inc</b> P.O. Box 1197 Fremont, NC 27830
<b>Seeding Contractor</b>	<b>Land Mechanic Designs, Inc.</b> 126 Circle G Lane Willow Spring, NC 27592
<b>Seed Mix Sources</b>	<b>Green Resource, LLC</b>
<b>Nursery Stock Suppliers</b> <b>Bare Roots</b>	<b>Dykes and Sons Nursery and Greenhouse</b>
<b>Live Stakes</b>	<b>Bruton Natural Systems, Inc</b>
<b>Monitoring Performers</b>	<b>Wildlands Engineering, Inc.</b>
Monitoring, POC	Jason Lorch 919.851.9986

**Table 4. Project Information and Attributes**

Martin Dairy Mitigation Site  
 DMS Project No. 97087  
 Monitoring Year 4 - 2021

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 Drainage 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 Description (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 Dairy 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



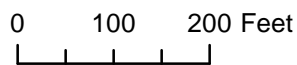
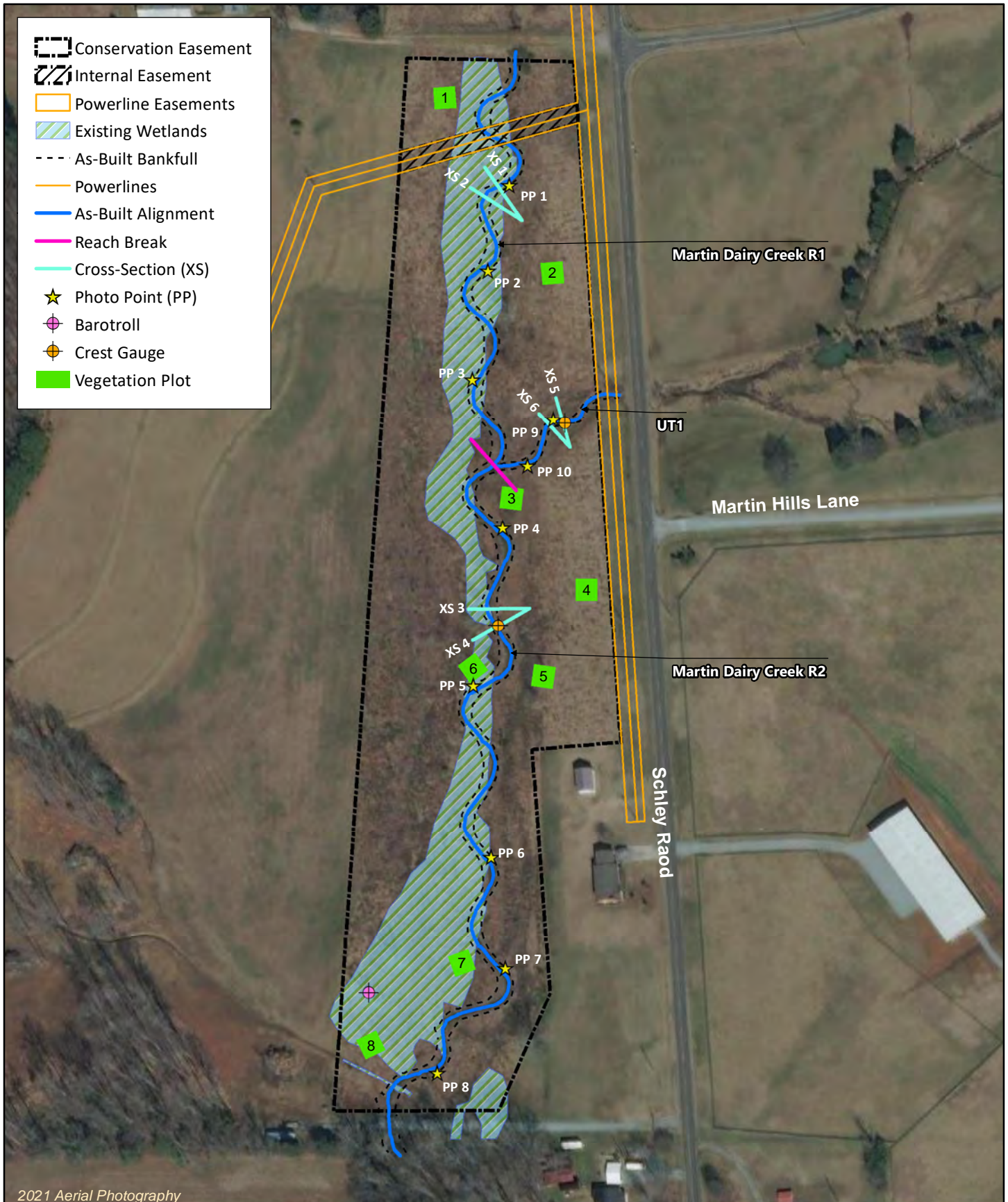


Figure 3. Intergrated Current Condition Plan View  
 Martin Dairy Mitigation Site  
 DMS Project No. 97087  
 Monitoring Year 4 - 2021  
 Orange County, NC

**Table 5a. Visual Stream Morphology Stability Assessment Table**

Martin Dairy Mitigation Project

DMS Project No. 97087

Monitoring Year 4 - 2021

**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
<b>1. Bed</b>	<b>1. Vertical Stability (Riffle and Run Units)</b>	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	<b>2. Riffle Condition</b>	Texture/Substrate	8	8			100%			
	<b>3. Meander Pool Condition</b>	Depth Sufficient	9	9			100%			
		Length Appropriate	9	9			100%			
	<b>4. Thalweg Position</b>	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	9	9			100%			
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
<b>2. Bank</b>	<b>1. Scoured/Eroded</b>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	<b>2. Undercut</b>	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
	<b>3. Mass Wasting</b>	Bank slumping, calving, or collapse.			0	0	100%	n/a	n/a	n/a
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
<b>3. Engineered Structures<sup>1</sup></b>	<b>1. Overall Integrity</b>	Structures physically intact with no dislodged boulders or logs.	5	5			100%			
	<b>2. Grade Control</b>	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	<b>2a. Piping</b>	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	<b>3. Bank Protection</b>	Bank erosion within the structures extent of influence does not exceed 15%.	5	5			100%			
	<b>4. Habitat</b>	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

<sup>1</sup>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 4 - 2021

**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
<b>1. Bed</b>	<b>1. Vertical Stability (Riffle and Run Units)</b>	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	<b>2. Riffle Condition</b>	Texture/Substrate	13	13			100%			
	<b>3. Meander Pool Condition</b>	Depth Sufficient	13	13			100%			
		Length Appropriate	13	13			100%			
	<b>4. Thalweg Position</b>	Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		Thalweg centering at downstream of meander bend (Glide)	13	13			100%			
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
<b>2. Bank</b>	<b>1. Scoured/Eroded</b>	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	n/a
	<b>2. Undercut</b>	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
	<b>3. Mass Wasting</b>	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
<b>3. Engineered Structures<sup>1</sup></b>	<b>1. Overall Integrity</b>	Structures physically intact with no dislodged boulders or logs.	8	8			100%			
	<b>2. Grade Control</b>	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	<b>2a. Piping</b>	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	<b>3. Bank Protection</b>	Bank erosion within the structures extent of influence does not exceed 15%.	8	8			100%			
	<b>4. Habitat</b>	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

<sup>1</sup>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 4 - 2021

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%			
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
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
<b>Totals</b>					0	0	100%	n/a	n/a	n/a
3. Engineered Structures <sup>1</sup>	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%			

<sup>1</sup>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 4 - 2021**

**Planted Acreage 10.139**

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage
<b>Bare Areas</b>	Very limited cover of both woody and herbaceous material	0	0	0	0%
<b>Low Stem Density Areas</b>	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0	0	0	0%
<b>Total</b>			<b>0</b>	<b>0</b>	<b>0%</b>
<b>Areas of Poor Growth Rates or Vigor</b>	Areas with woody stems of a size class that are obviously small given the monitoring year.	0	0	0	0%
<b>Cumulative Total</b>			<b>0</b>	<b>0.00</b>	<b>0%</b>

**Easement Acreage 11.155**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
<b>Invasive Areas of Concern</b>	Areas of points (if too small to render as polygons at map scale).	1,000	0	0	0%
<b>Easement Encroachment Areas</b>	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 (4/9/2021)**



**PHOTO POINT 1 Martin Dairy R1 – downstream (4/9/2021)**



**PHOTO POINT 2 Martin Dairy R1 – upstream (4/9/2021)**



**PHOTO POINT 2 Martin Dairy R1 – downstream (4/9/2021)**



**PHOTO POINT 3 Martin Dairy R1 – upstream (4/9/2021)**



**PHOTO POINT 3 Martin Dairy R1 – downstream (4/9/2021)**





**PHOTO POINT 4 Martin Dairy R2 – upstream (4/9/2021)**



**PHOTO POINT 4 Martin Dairy R2 – downstream (4/9/2021)**



**PHOTO POINT 5 Martin Dairy R2 – upstream (4/9/2021)**



**PHOTO POINT 5 Martin Dairy R2 – downstream (4/9/2021)**



**PHOTO POINT 6 Martin Dairy R2 – upstream (4/9/2021)**



**PHOTO POINT 6 Martin Dairy R2 – downstream (4/9/2021)**





**PHOTO POINT 7 Martin Dairy R2 – upstream (4/9/2021)**



**PHOTO POINT 7 Martin Dairy R2 – downstream (4/9/2021)**



**PHOTO POINT 8 Martin Dairy R2 – upstream (4/9/2021)**



**PHOTO POINT 8 Martin Dairy R2 – downstream (4/9/2021)**



**PHOTO POINT 9 UT1 – upstream (4/9/2021)**



**PHOTO POINT 9 UT1 – downstream (4/9/2021)**





**PHOTO POINT 10 UT1 – upstream (4/9/2021)**



**PHOTO POINT 10 UT1 – downstream (4/9/2021)**

**VEGETATION PLOT PHOTOGRAPHS**





**VEG PLOT 1 (09/24/2021)**



**VEG PLOT 2 (09/24/2021)**



**VEG PLOT 3 (09/24/2021)**



**VEG PLOT 4 (09/24/2021)**



**VEG PLOT 5 (09/24/2021)**



**VEG PLOT 6 (09/24/2021)**





**VEG PLOT 7 (09/24/2021)**



**VEG PLOT 8 (09/24/2021)**

## **APPENDIX 3. Vegetation Plot Data**

Vegetation inventory and analysis not required during MY4

## **APPENDIX 4. Morphological Summary Data and Plots**

Morphological survey and analysis not required during MY4

## **APPENDIX 5. Hydrology Summary Data and Plots**



**Table 13. Verification of Bankfull Events**

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 4 - 2021

	MY1	MY2	MY3	MY4	
Reach	Date of Occurrence	Date of Occurrence	Date of Occurrence	Date of Occurrence	Method
Martin Dairy	4/15/2018	4/13/2019	1/24/2020	1/3/2021	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	
	9/17/2018*	4/13/2019	2/6/2020	4/10/2021	
		6/19/2019	6/11/2020	7/19/2021	

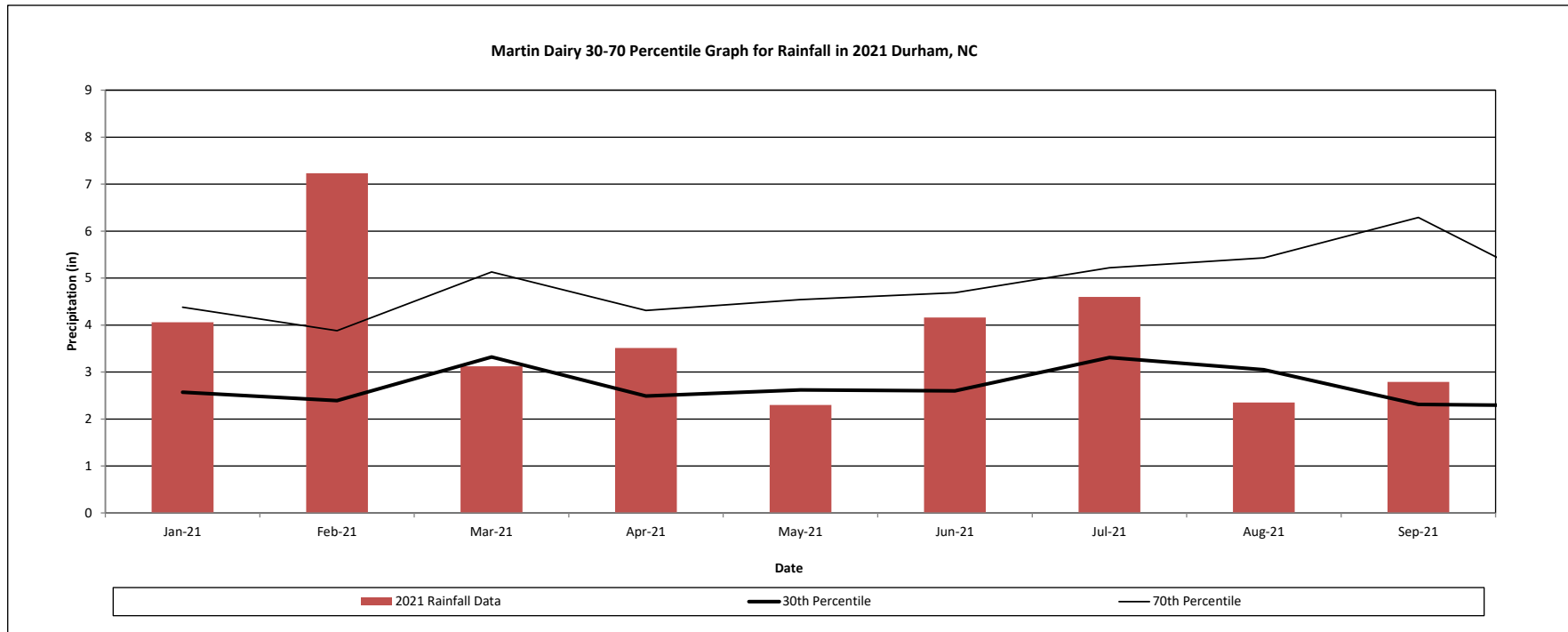
\*Hurricane Florence

**Monthly Rainfall Data**

Martin Dairy Mitigation Site

DMS Project No. 97087

Monitoring Year 4 - 2021



<sup>1</sup> 2021 monthly rainfall from USDA Station Durham 6.8 NNW.

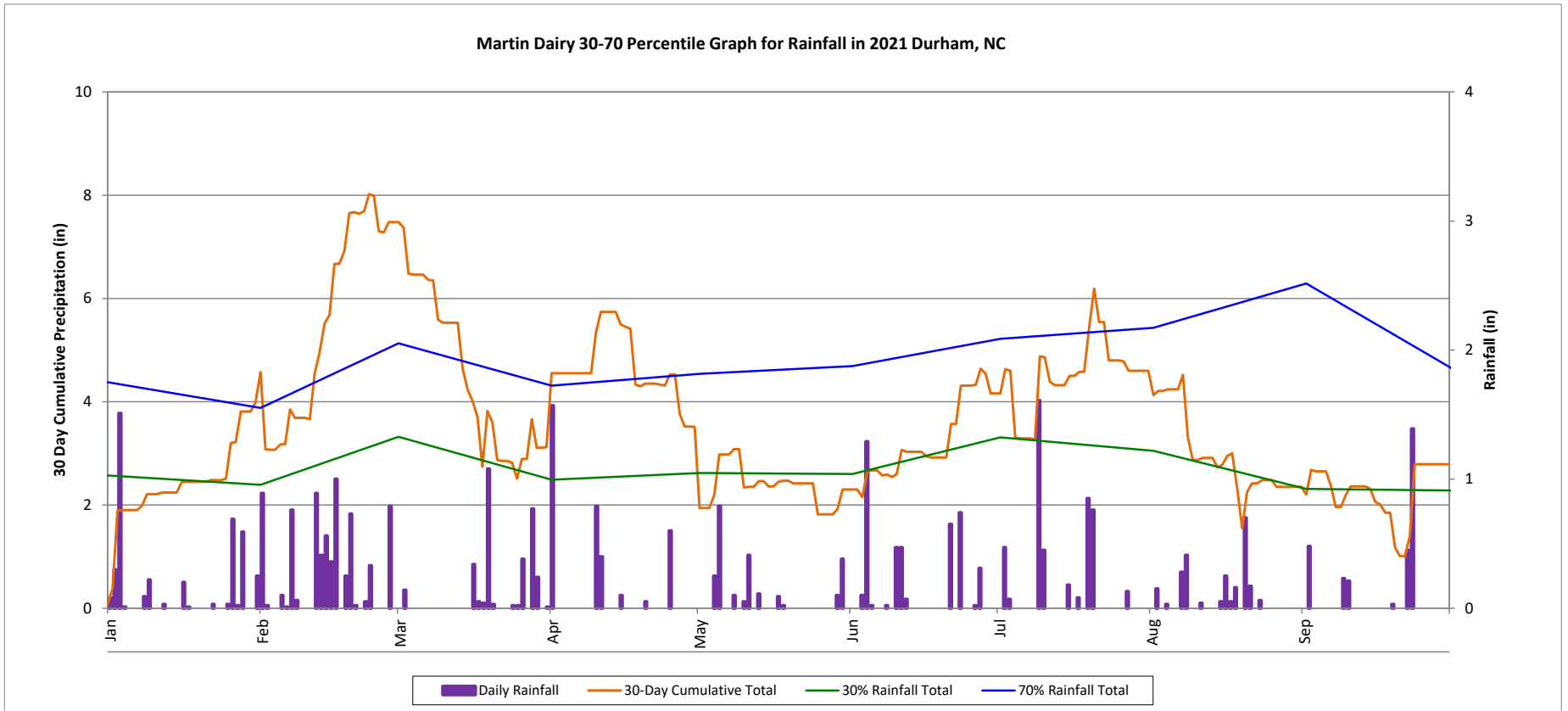
<sup>2</sup> 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2021).

### 30-Day Cumulative Total Rainfall Data

Martin Dairy Mitigation Project

DMS Project No. 97087

Monitoring Year 4 - 2021



<sup>1</sup> 2021 monthly rainfall from USDA Station Durham 6.8 NNW.

<sup>2</sup> 30th and 70th percentile rainfall data collected from weather station Chapel Hill 2 W, NC (USDA, 2021).