

Lochill Farm Stream Mitigation Project Year 4 (2022) Monitoring Report FINAL

DMS Project ID No. 97083, DEQ Contract No. 6828
USACE Action ID No. SAW-2016-00881, DWR# 16-0370
Orange County, North Carolina, Neuse River Basin: 03020201-030030
MY4 Data Collection Period: November 2022



Submitted to/Prepared for:

NC Department of Environmental Quality
Division of Mitigation Services (DMS)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Michael Baker

INTERNATIONAL

Submission Date: January 2023

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January 25, 2023

Lindsay Crocker, Project Manager
NCDEQ, Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

Subject: Response to DMS Comments for MY4 Report Lochill
Farm Stream Mitigation Project, Orange County
DMS Project # 97083, DEQ Contract #6828, Neuse-01 River Basin

Ms. Crocker:

Please find enclosed our responses to the NC Division of Mitigation Services (DMS) review comments received December 19, 2022 in reference to the Lochill Farm Stream Mitigation Project - DRAFT MY4 Report. We have revised the document in response to the review comments as outlined below.

DMS MY4 Draft Report Comments:

1. Pine and sweetgum thinning was noted on the Table 2. Please briefly describe the extent of this thinning and purpose in the MY4 narrative.

Response: A brief description has been added as requested.

Digital Comments:

2. Please submit the continuous stage recorded data referenced in the report.

Response: Continuous stage recorded data have been added to the e-submission as requested.

3. Please submit the photos for the required photos points indicated on the CCPV.

Response: Photos have been added to the e-submission as requested.

4. If the ground water monitoring wells indicated on the CCPV are required, submit the data and summary table.

Response: Ground water monitoring wells are not required and have been removed from the CCPV.

Please do not hesitate to contact me should you have any questions regarding our response submittal.

Sincerely,



Andrew Powers
Project Manager

Enclosures

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1.0 PROJECT SUMMARY

1.1 Project Description

Michael Baker Engineering, Inc. (Michael Baker) restored approximately 3,245 linear feet of existing jurisdictional stream, enhanced 2,227 linear feet of stream, and preserved 733 linear feet of unnamed tributaries to Buckwater Creek. Michael Baker also re-established approximately 3.9-acres of forested riparian buffer associated with this stream system and preserved an additional 11.9-acres. The project is located in the Neuse River Basin, within the Hydrologic Unit Code (HUC) 03020201-030030 (the Middle Eno River), which is identified as a Targeted Local Watershed (TLW) in DMS's 2010 Neuse River Basin Restoration Priority (RBRP) Plan and its March 2016 Update.

The Lochill Farm Stream Mitigation project is located on an active horse farm in Orange County, North Carolina, 6.2 miles northeast of the Town of Hillsborough (Figure 1). Historic agriculture uses on the project site included horse, cattle, and sheep animal operations as well as tobacco and small grain row-cropping and timber harvesting. These activities had negatively impacted both water quality and streambank stability along the project streams and their tributaries (Table 4). The project is being conducted as part of the DMS Full Delivery In-Lieu Fee Program and is anticipated to generate at close-out a total of 4,113 stream mitigation credits and 176,511 buffer mitigation credits (Table 1) and is protected by a 15.8-acre permanent conservation easement.

1.2 Goals and Objectives

The goals of this project are identified below:

- Reconnect stream reaches to their floodplains
- Stabilize steep and/or eroding stream banks
- Improve in-stream habitat
- Reestablish forested riparian buffers
- Permanently protect the project

To accomplish these goals, the following objectives were identified:

- To restore appropriate bankfull dimensions, remove spoil berms, and/or raise channel beds, by utilizing either a Priority I Restoration approach (R1) or an Enhancement Level I approach (R3).
- To construct streams of appropriate dimensions, pattern, and profile in restored reaches, slope stream banks and provide bankfull benches on enhanced streams, and utilize bio-engineering to provide long-term stability.
- Construct an appropriate channel morphology for all streams, increasing the number and depths of pools, with structures including cross vanes, geo-lifts, brush-toe, log vanes/weirs, boulder sills, root wads, and/or J-hooks. Also repair stream disconnects in the channels caused by clogged pipe culverts.
- Establish riparian buffers at a 50-foot minimum width along all stream reaches, planted with native tree and shrub species.
- Establish a permanent conservation easement restricting land use in perpetuity. This will prevent site disturbance and allow the project to mature and stabilize.

1.3 Project Success Criteria

The success criteria and performance standards for the project will follow the North Carolina Interagency Review Team (NCIRT) guidance document *Wilmington District Stream and Wetland Compensatory Mitigation Update* dated October 24, 2016 and as described in Section 7 of the approved Mitigation Plan. All specific monitoring activities will follow those outlined in detail in Section 8 of the approved Mitigation Plan and will be conducted for a period of seven years unless otherwise noted. Annual monitoring reports will follow the DMS document *Annual Monitoring Report Format, Data Requirements, and Content Guidance* from June 2017. The performance standards for the riparian buffer assets will be held in accordance with 15A NCAC 02B.0295(n)(2)(B) and 15A NCAC 02B.0295(n)(4), and annual monitoring reports will be submitted at the end of each of the first five monitoring years.

1.4 Monitoring Results and Project Performance

During Year 4 monitoring, the planted acreage was successfully meeting all performance categories. The average density of total planted stems, based on data collected from the five permanent and one random monitoring plots for the Year 4 monitoring conducted in November 2022, was 432 planted stems per acre (Table 7 in Appendix C). Thus, the Year 4 vegetation data demonstrate that the Site meets the minimum success interim criteria of 260 trees per acre by the end of Year 5. Furthermore, the vegetation on the project is also meeting the performance criteria for all Riparian Buffer assets, as per 15A NCAC 02B.0295(n)(2)(B), with greater than 260 stems/acre, and with a minimum of four native hardwood tree and/or shrub tree species, where no one species is greater than 50 percent of stems. During July and November 2022, Michael Baker thinned both pine (*Pinus taeda*) and sweetgum (*Liquidambar styraciflua*) along the left and right floodplain of Reach 1. The planted stem density within these areas do not seem affected by the pine and sweetgum but were thinned to prevent competition. (see Figure 3 in Appendix C)

During Year 4 monitoring, two separate post-construction bankfull events were documented (see Table 10 and Figure 5 in Appendix E and the Overbank Event Photographs in Appendix B). They were documented primarily through the use of an automated crest gauge, but also through manual cork crest gauge readings, and post-flood event site inspection photographs. Crest gauge 3 was changed to an automated in-stream crest gauge to better show overbank events due to the thick vegetation surrounding the gauge. It was noticed during site visits that overbank events happened on R3 but never captured by the original cork gauge.

As the observed monthly rainfall data for the project presented in Figure 7 in Appendix E demonstrates, the past 12 months have seen wide variability as compared to historic average precipitation, with three months exceeding the 70% probable average and four months below the 30% probable average. It was considerably wetter in the winter and spring of 2022 but was a very dry fall of 2022. A total of 39.5 inches of rainfall was observed for the site, a deficit of 8 inches in comparison with Orange County historic average of 47.5 inches.

Per IRT April 2022 credit release meeting, all ground water wells have been removed from the site. Also, per monitoring year 4 requirements stream cross sections were not preformed.

Summary information/data related to the Site and statistics related to 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 Baseline Monitoring Report and in the Mitigation Plan available on the DMS website. Any raw data supporting the tables and figures in the Appendices is available from DMS upon request.

This report documents the successful completion of the Year 4 monitoring activities for the post-construction monitoring period.

1.5 Technical and Methodological Descriptions

Stream survey data was collected to a minimum of Class C Vertical and Class A Horizontal Accuracy using a Leica TS06 Total Station and was georeferenced to the NAD83 State Plane Coordinate System, FIPS3200 in US Survey Feet, which was derived from the As-built Survey. This survey system collects point data with an accuracy of less than one tenth of a foot. The survey data from the permanent project cross-sections were collected and classified using the Rosgen Stream Classification System to confirm design stream type (Rosgen 1994 and 1996).

The six vegetation-monitoring quadrants (plots) were installed across the site in accordance with the CVS-DMS Protocol for Recording Vegetation, Version 4.1 (Lee 2007) and the data collected from each was input into the CVS-DMS Data Entry Tool v. 2.3.1 (CVS 2012).

The specific locations of monitoring features, such as vegetation plots, permanent cross-sections, reference photograph stations, and crest gauges, are shown on the CCPV map found in Appendix B.

1.6 References

Carolina Vegetation Survey (CVS) and NC Division of Mitigation Services (DMS). CVS-DMS Data Entry Tool v. 2.3.1. University of North Carolina, Raleigh, NC. 2012.

Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-DMS Protocol for Recording Vegetation, Version 4.1.

North Carolina Division of Mitigation Services. 2010. Neuse River Basin Restoration Priorities. NC Department of Environmental Quality. Raleigh, NC.

North Carolina Division of Mitigation Services. 2016. Neuse River Basin Restoration Priorities: Neuse-01 Catalog Unit *Update*. NC Department of Environmental Quality. Raleigh, NC.

North Carolina Division of Mitigation Services. 2017. *Annual Monitoring Report Format, Data Requirements, and Content Guidance June 2017*. NC Department of Environmental Quality. Raleigh, NC.

North Carolina Interagency Review Team (NCIRT). 2016. Guidance document “*Wilmington District Stream and Wetland Compensatory Mitigation Update*”. October 24, 2016

Rosgen, D.L. 1994. A Classification of Natural Rivers. *Catena* 22:169-199.

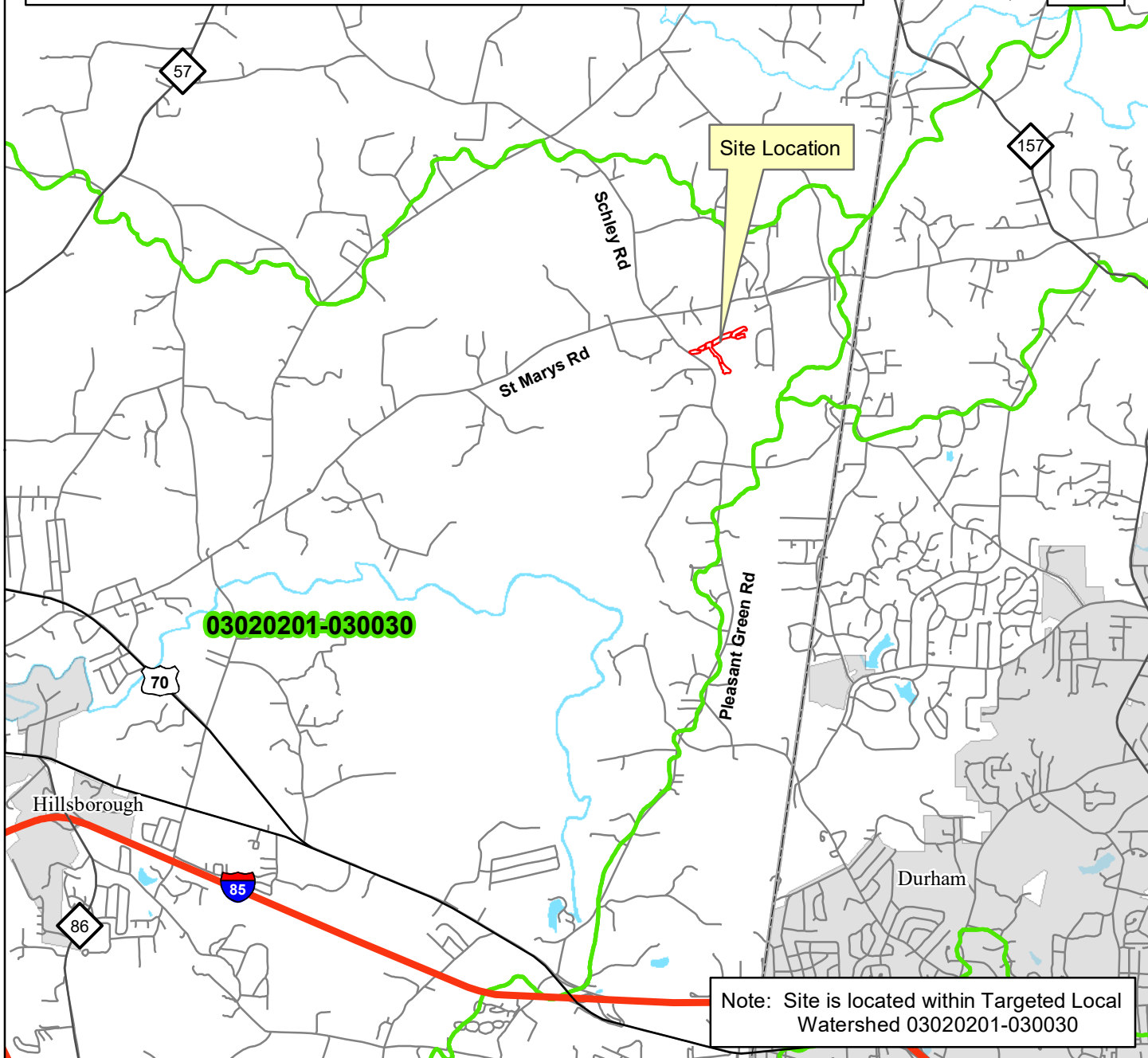
Rosgen, D.L. 1996. Applied River Morphology. Wildlands Hydrology. Pagosa Springs, CO.

United States Army Corps of Engineers (USACE). 2005. “Technical Standard for Water-Table Monitoring of Potential Wetland Sites,” WRAP Technical Notes Collection (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center. Vicksburg, MS.

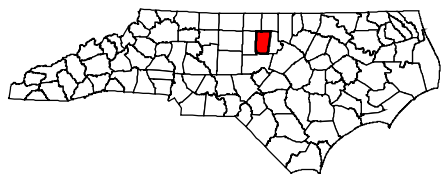
APPENDIX A

Background Tables and Figures

Directions to site: From I-85 South through Durham, take exit 170 for US-70 W and go 0.3 miles, then turn right at the stoplight onto Pleasant Green Rd and go 5.8 miles, then turn right at the stop sign onto St. Mary's Rd, then go 0.4 miles and turn right into the Lochill Farm driveway at 6120 St. Mary's Rd and park by the stables.



Note: Site is located within Targeted Local Watershed 03020201-030030



Orange County

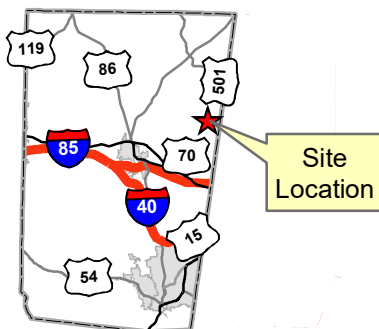
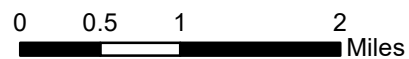
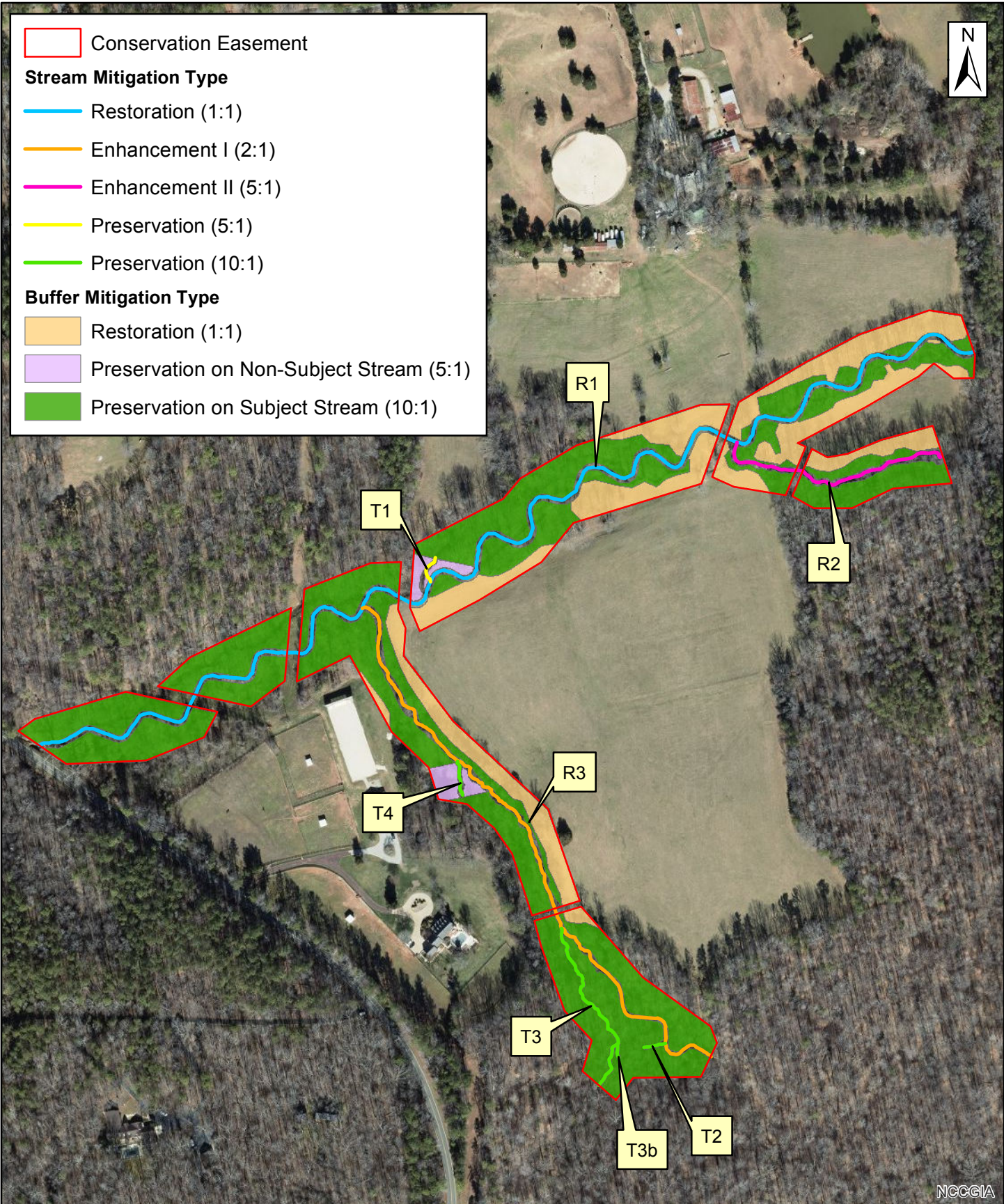


Figure 1
Project Vicinity Map
Lochill Farm Site

Michael Baker
INTERNATIONAL





NCCGIA

Table 1. Project Components and Mitigation Credits
Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Project Component (reach ID, etc.)	Wetland Position and HydroType	Existing Footage or Acreage	Stationing	As-Built Restored Footage, or SF ¹	As-Built Centerline Footage, or SF ²	Mitigation Plan Designed Footage	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits ³
Reach R1		2,925	10+00 -42+45	3,245	3,105	3,105	R	PI	1	3,105
Reach R2		590	10+00 -16+05	605	588	600	E	LII	5	120
Reach R3		1,697	10+00 -26+22	1,622	1,602	1,602	E	LI	2	801
Reach T1		96	10+00 -10+73	73	73	104	P	-	5	21
Reach T2		49	10+00 -10+54	54	54	59	P	-	10	6
Reach T3		482	10+00 -14+82	482	482	482	P	-	10	48
Reach T3b		34	10+00 -10+34	34	34	34	P	-	10	3
Reach T4		89	10+00 -10+90	90	89	89	P	-	10	9
Wetland Group 1										
Buffer Group 1 (BG1)				169,553	169,553		R		1	169,553
Buffer Group 2 (BG2)				13,067	13,067		P		5	2,613
Buffer Group 3 (BG3)				424,955	43,451		P		10	4,345

1 All stream stationing and restored footage numbers reported here, discussed in the report text, and shown in the as-built plan sheets use *thalweg* survey values.
 2 The stream footage reported here uses the as-built stream *centerline* survey values and have all easement breaks removed from their totals. Buffer group values reported here are the creditable areas as allowed for each group as described in detail in the mitigation plan.
 3 Credits reported here are taken directly from the approved mitigation plan Table 11.1

Table 1.1
As-Built Centerline Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Credited Buffer (square feet)
		Riverine	Non-Riverine		
Restoration	3,105				169,553
Enhancement					
Enhancement I	1,602				
Enhancement II	588				
Creation					
Preservation	732				56,518
High Quality Pres					

Table 1.2
Overall Assets Summary

Asset Category	Overall Credits
Stream	4,113.200
RP Wetland	-
NR Wetland	-
Buffer	176,511.500

Table 2. Project Activity and Reporting History
Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Elapsed Time Since grading complete: 4 years and 0 months
Elapsed Time Since planting complete: 3 years and 10 months
Number of Reporting Years¹: 4

Activity or Deliverable	Data Collection Complete	Completion or Delivery
404 permit date	N/A	Mar-18
Mitigation Plan	N/A	Jan-18
Final Design – Construction Plans	N/A	Nov-17
Construction Grading Completed	N/A	Nov-18
As-Built Survey	Dec-18	Dec-18
Livestake and Bareroot Planting Completed	N/A	Jan-19
As-Built Baseline Monitoring Report (MY0)	Feb-19	Apr-19
Year 1 Monitoring	Oct-19	Jan-20
Year 2 Monitoring	Oct-20	Jan-21
Supplemental bare root planting on R1 and R3	Planted in January 2020	
Riparian seed mixes placed in thin areas on R1 to establish herbaceous vegetation	Seeded in March, July, and September 2020	
Scattered privet treated along R1 and R3	Treated July 2020	
Year 3 Monitoring	Oct-21	Dec-21
Supplemental 1-gal plantings on lower R3	Planted in February 2021	
Year 4 Monitoring	Nov-22	Dec-22
Pine and Sweetgum thinning	Jul-22 and Nov 22	
Year 5 Monitoring (anticipated)	Oct-23	Dec-23
Year 6 Monitoring (anticipoated)	Oct-24	Dec-24
Year 7 Monitoring (anticipated)	Oct-25	Dec-25

¹ = The number of monitoring reports excluding the as-built/baseline report

Table 3. Project Contacts

Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

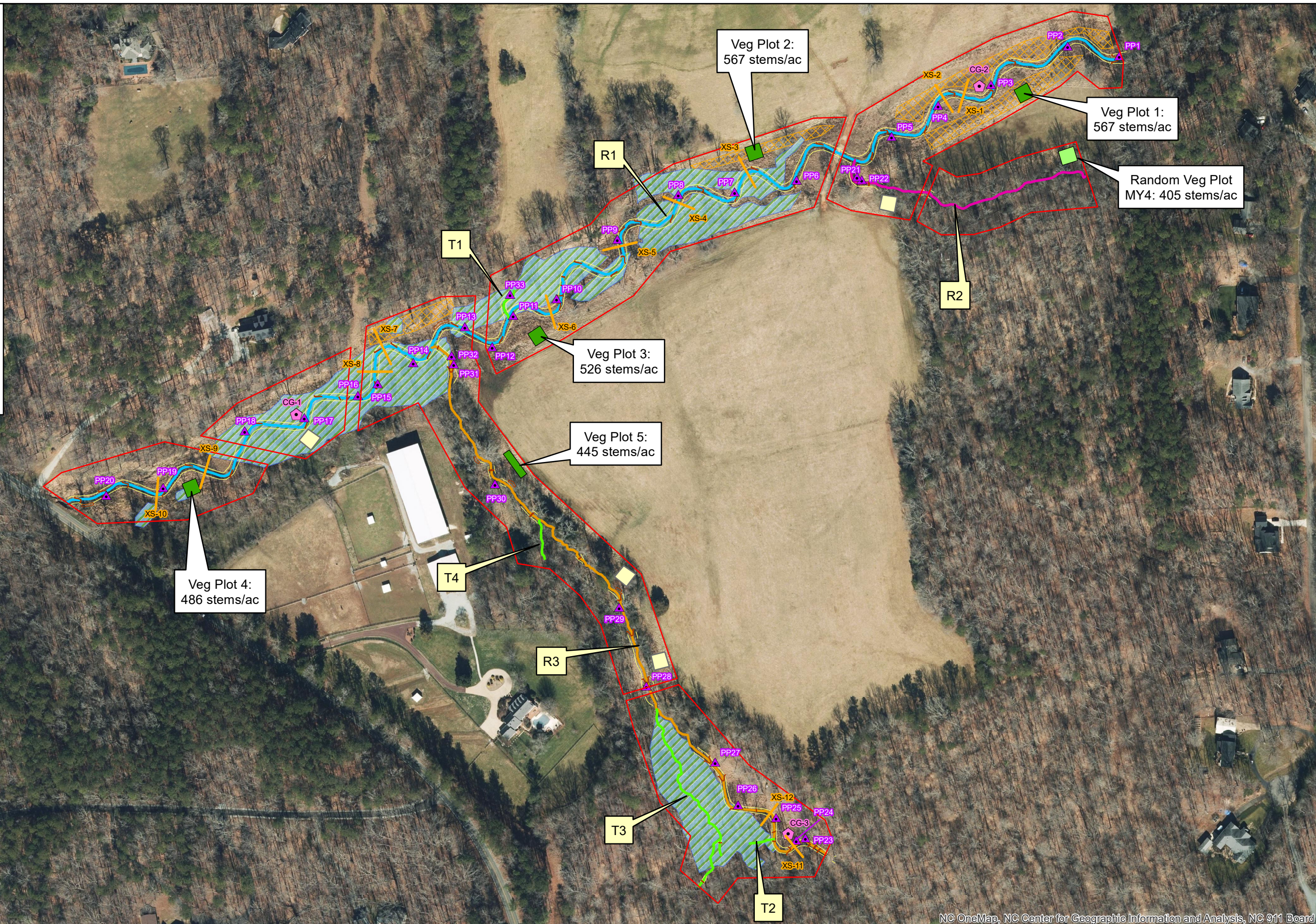
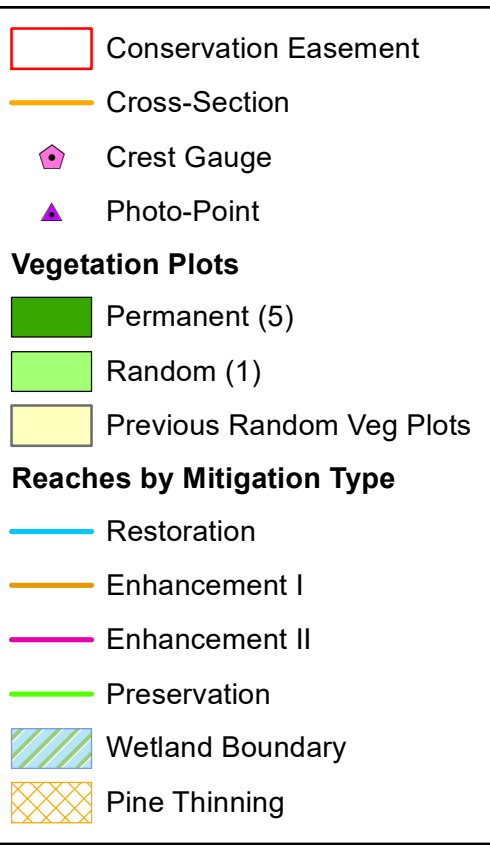
Designer	8000 Regency Parkway, Suite 600
Michael Baker Engineering, Inc.	Cary, NC 27518 Contact: Katie McKeithan, Tel. 919-418-5703
Construction Contractor	5616 Coble Church Rd
KBS Earthworks	Julian, NC 27283 Contact: Chris Sizemore, Telephone: 336-362-0289
Survey Contractor	88 Central Avenue
Kee Mapping and Surveying	Asheville, NC 28801 Contact: Brad Kee, Tel. 828-575-9021
Planting Contractor	5616 Coble Church Rd
KBS Earthworks	Julian, NC 27283 Contact: Chris Sizemore, Telephone: 336-362-0289
Seeding Contractor	5616 Coble Church Rd
KBS Earthworks	Julian, NC 27283 Contact: Chris Sizemore, Telephone: 336-362-0289
Seed Mix Sources	
Green Resources	Telephone: 336-855-6363
Nursery Stock Suppliers	
Mellow Marsh Farm	Telephone: 919-742-1200
ArborGen	Telephone: 843-528-3204
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518
Stream Monitoring POC	Drew Powers, Tel. 919-464-5003
Vegetation Monitoring POC	Drew Powers, Tel. 919-464-5003

Table 4. Project Attributes
Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Project Name		Lochill Farm Stream Mitigation Project			
County		Orange County			
Project Area (acres)		15.8			
Project Coordinates (latitude and longitude)		36.113419 N, -78.991165 W			
Planted Acreage (Acres of Woody Stems Planted)		8.1			
Project Watershed Summary Information					
Physiographic Province		Piedmont			
River Basin		Neuse			
USGS Hydrologic Unit 8-digit	3020201	USGS Hydrologic Unit 14-digit	3020201-030030		
DWR Sub-basin		03-04-01			
Project Drainage Area (Acres and Square Miles)		1,020 acres/1.59 square miles (at downstream end of R1)			
Project Drainage Area Percentage of Impervious Area		<1% impervious area			
CGIA Land Use Classification		80.6% forested, 12.7% agriculture, 6.5% developed, 0.2% open water			
Existing Reach Summary Information					
Parameters		Reach R1	Reach R2	Reach R3	Reach T1
Length of reach (linear feet)		2,925	590	1,697	96
Valley confinement (Confined, moderately confined, unconfined)		Unconfined	Unconfined	Unconfined	Unconfined
Drainage area (Acres)		1,020	12	190	0.8
Perennial, Intermittent, Ephemeral		Perennial	Intermittent	Perennial	Intermittent
NCDWR Water Quality Classification		WS-IV, NSW	WS-IV, NSW	WS-IV, NSW	WS-IV, NSW
Stream Classification (existing)		E4 (incised)	B5	E4b to B4	E5
Stream Classification (proposed)		C4	B5	C4b	E5
Evolutionary trend (Simon)		IV - Degradation and Widening	I - Stable System	IV - Degradation and Widening	I - Stable System
FEMA classification		Zone X	Zone X	Zone X	Zone X
Existing Reach Summary Information					
Parameters		Reach T2	Reach T3	Reach T3b	Reach T4
Length of reach (linear feet)		49	482	34	89
Valley confinement (Confined, moderately confined, unconfined)		Unconfined	Unconfined	Unconfined	Unconfined
Drainage area (Acres and Square Miles)		0.7	37	36	2.9
Perennial, Intermittent, Ephemeral		Intermittent	Perennial	Perennial	Perennial
NCDWR Water Quality Classification		WS-IV, NSW	WS-IV, NSW	WS-IV, NSW	WS-IV, NSW
Stream Classification (existing)		E5	E5	E5	E5
Stream Classification (proposed)		E5	R5	E5	E5
Evolutionary trend (Simon)		I - Stable System	I - Stable System	I - Stable System	I - Stable System
FEMA classification		Zone X	Zone X	Zone X	Zone X
Regulatory Considerations					
Parameters		Applicable?	Resolved?	Supporting Docs?	
Water of the United States - Section 404		Yes	Yes	PCN / NWP 27 / JD	
Water of the United States - Section 401		Yes	Yes	PCN / NWP 27 / JD	
Endangered Species Act		Yes	Yes	Categorical Exclusion	
Historic Preservation Act		Yes	Yes	Categorical Exclusion	
Coastal Zone Management Act (CZMA or CAMA)		No	N/A	N/A	
FEMA Floodplain Compliance		No	N/A	N/A	
Essential Fisheries Habitat		No	N/A	N/A	

APPENDIX B

Visual Assessment Data



NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board

Table 5. Visual Stream Morphology Stability Assessment
Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Reach ID: Reach R1							
Assessed Length (LF): 3,245							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	32	32			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth ≥ 1.5)	34	34			100%
		2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	34	34			100%
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	32	32			100%
2. Thalweg centering at downstream of meander bend (Glide)		34	34			100%	
Totals							
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected			0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%
Totals							
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	38	38			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	38	38			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	38	38			100%
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	38	38			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio ≥ 1.5. Rootwads/logs providing some cover at low flow	36	36			100%

Reach ID: Reach R2							
Assessed Length (LF): 605							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	2	2			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth ≥ 1.5)	1	1			100%
		2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	1	1			100%
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	1	1			100%
2. Thalweg centering at downstream of meander bend (Glide)		1	1			100%	
Totals							
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected			0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%
Totals							
3. Engineering Structures	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 or around sills or arms	1	1			100%
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	1	1			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio ≥ 1.5. Rootwads/logs providing some cover at low flow	1	1			100%

Table 5. Visual Stream Morphology Stability Assessment

Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Reach ID: Reach R3							
Assessed Length (LF):		1,622					
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	8	8			100%
		1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth ≥ 1.5)	10	10			100%
	3. Meander Pool Condition	2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	10	10			100%
		4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	8	8		
2. Thalweg centering at downstream of meander bend (Glide)	10		10			100%	
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected			0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapsing			0	0	100%
	Totals					0	0
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	19	19			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	19	19			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	19	19			100%
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	19	19			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio ≥ 1.5. Rootwads/logs providing some cover at low flow	17	17			100%

Table 6. Vegetation Conditions Assessment
 Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Planted Acreage: 9.8						
Vegetation Category	Defintions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover both woody and herbaceous material.	0.1	N/A	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	N/A	0	0.00	0.0%
Total				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems or a size class that are obviously small given the monitoring year.	0.25	N/A	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
Easement Acreage: 15.8						
Vegetation Category	Defintions	Mapping Threshold	CCPV Depiction	Number of Points	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 ft ²	N/A	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	none	N/A	0	0.00	0.0%

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-1: Reach 1, view downstream, Station 10+00



PP-2: Reach 1, view downstream, Station 11+50



PP-3: Reach 1, view downstream, Station 13+75



PP-4: Reach 1, view downstream, Station 15+25



PP-5: Reach 1, view downstream, Station 16+50



PP-6: Reach 1, view upstream, Station 19+50

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-7: Reach 1, view downstream, Station 21+50



PP-8: Reach 1, view downstream, Station 23+00



PP-9: Reach 1, view downstream, Station 25+00



PP-10: Reach 1, view upstream, Station 27+50



PP-11: Reach 1, view downstream, Station 29+00



PP-12: Reach 1, view downstream, Station 30+00

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-13: Reach 1, view downstream, Station 30+50



PP-14: Reach 1, view downstream, Station 32+00



PP-15: Reach 1, view downstream, Station 33+50



PP-16: Reach 1, view downstream, Station 34+25



PP-17: Reach 1, view downstream, Station 35+75



PP-18: Reach 1, view downstream, Station 37+25

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-19: Reach 1, view downstream, Station 39+75



PP-20: Reach 1, view downstream, Station 41+00



PP-21: Reach 2, view upstream, Station 15+50



PP-22: Reach 2, view downstream, Station 15+75



PP-23: Reach 3, view upstream, Station 10+50



PP-24: Reach 3, view downstream, Station 10+75

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-25: Reach R3, view upstream, Station 11+75



PP-26: Reach 3, view downstream, Station 12+75



PP-27: Reach 3, view downstream, Station 14+00



PP-28: Reach 3, view downstream, Station 16+25



PP-29: Reach 3, view downstream, Station 18+25



PP-30: Reach 3, view downstream, Station 22+50

Lochill Farm: MY4 Stream Station Photo-Points (taken 3/15/22)



PP-31: Reach 3, view upstream, Station 25+50



PP-32: Reach 3, view downstream, Station 25+75



PP-33: Reach T1, view downstream, Station 10+00

Lochill Farm: MY4 Vegetation Plot Photographs (taken 11/22/2022)



Vegetation Plot 1



Vegetation Plot 2



Vegetation Plot 3



Vegetation Plot 4



Vegetation Plot 5



Random Vegetation Plot MY4

Lochill Farm: MY4 Overbank Event Photographs



Manual crest gauge reading of 0.67 ft on upper R1 (photo from 3/15/22)



Closeup of crest gauge reading



Closeup of wrack line on R1 showing evidence of overbank flow



Closeup of wrack line on R1 showing evidence of overbank flow



Debris jam/wrack line near crossing (photo from 3/15/22)



Debris jam/wrack line near crossing (photo from 3/15/22)

Lochill Farm: MY4 Additional Monitoring Photographs



Stable crossing over Reach 2 (11/21/22)



Stable crossing at the top of R1 (11/21/22)



Pipe crossing on R3 at Station ~16+30 (3/15/22)



Stable pipe crossing on R3 at Station ~16+30 (11/21/22)



Pipes at crossing at top of R3 at Station 10+00
(3/15/22)



Stable bridge crossing over Reach 1 (11/21/22)

Lochill Farm: MY4 Additional Monitoring Photographs



Overbank camera moved to R1 Station 13+30 (7/14/22)



Stable crossing on R1 station 30+40 (11/21/22)



Previously thin/sparse herbaceous area of R1 floodplain (as noted in MY1) revegetating well (photo 7/14/22)



Previously thin/sparse herbaceous area of R1 floodplain (as noted in MY1) revegetating well (photo 7/14/22)



Pine thinning along upper R1 (photo from 7/14/22)



Pine thinning along lower R1 (11/21/22)

APPENDIX C

Vegetation Plot Data

Table 7. Planted Stem Counts by Plot and Species
Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Scientific Name	Common Name	Species Type	Current Plot Data (MY4, 2022)															Annual Means																	
			Veg Plot 1			Veg Plot 2			Veg Plot 3			Veg Plot 4			Veg Plot 5			MY4 Random Plot ¹			MY4 (2022)			MY3 (2021)			MY2 (2020)			MY1 (2019)			MY0/AB (2019)		
			P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T	P	V	T
<i>Acer negundo</i>	Boxelder	Tree							3			1		1				2		2	4		6	7	6	13	4		4	4	4	5			
<i>Alnus serrulata</i>	Tag Alder	Shrub Tree				1		1				1		1		1			3		3	3	2	5	6		6	6		6	6				
<i>Asimina triloba</i>	Pawpaw	Shrub Tree																													1				
<i>Baccaris</i>									2	2										2	2	11		11	15		15	17		17	18				
<i>Betula nigra</i>	River Birch	Tree	2		2	4		4			2		2		2			10		10	11		11	15		15	17		17	18					
<i>Carpinus caroliniana</i>	Ironwood	Shrub Tree	2		2	1		1	1		1		1		1			5		5	6		6	10		10	10		10	10					
<i>Celtis laevigata</i>	Sugarberry	Shrub Tree				2		2				1		1		1		1	4	1	5	6		6	5		5	9		9	7				
<i>Cercis canadensis</i>	Redbud	Shrub Tree	1		1	1		1										2		2	2		2	2	1	3									
<i>Diospyros virginiana</i>	Persimmon	Tree							1	1								1	1							2	2								
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	3		3													3		3	5	5	10	5	1	6	5		5	5					
<i>Ilex verticillata</i>	Winterberry	Shrub Tree							1	1								1	1	1	1	2	3	2	3		3		3	3					
<i>Juglans nigra</i>	Black Walnut	Tree														1	1		1	1	2	3		1	1										
<i>Lindera benzoin</i>	Northern Spicebush	Shrub Tree							1	1								1	1	2	2	2	2	2	2	3		3		3					
<i>Liquidambar styraciflua</i>	Sweet Gum	Tree		2	2		5	5						2	2		5	5	14	14	33	33		1	1										
<i>Liriodendron tulipifera</i>	Tulip tree	Tree	5		5	1		1			1		1					7		7	11		11	7		7	12		12	10					
<i>Nyssa sylvatica</i>	Black Gum	Tree									1		1					1		1	2		2	1		1	1		1	1					
<i>Pinus taeda</i>	Loblolly Pine	Tree		3	3		2	2		2	2			2	2				9	9	10	14													
<i>Platanus occidentalis</i>	Sycamore	Tree	1		1	4	5	9	4	5	9	2	5	7	5	3	8	4	4	16	22	38	20	47	67	20	8	28	24		24	19			
<i>Quercus lyrata</i>	Overcup Oak	Tree									1		1					1		1	1		1												
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree																						1		1	1		1	1					
<i>Quercus pagoda</i>	Cherrybark Oak	Tree																				1	1		1	1									
<i>Quercus phellos</i>	Willow Oak	Tree							1	1	1	1					2	2	2	4	1	1	1	1	1	3		3		7					
<i>Salix nigra</i>	Black Willow	Tree										5	5						5	5		5	5												
<i>Ulmus americana</i>	American Elm	Tree																							3	3									
<i>Viburnum dentatum</i>	Arrow-wood	Shrub Tree												2		2			2	2	2	2	2	2	2	2	5		5	5					
<i>Viburnum nudum</i>	Poosumhaw	Shrub Tree							2	2								2	2	2	2	2	2	2	2	2	2	2	2	2					
	Stem count		14	5	19	14	12	26	13	10	23	12	10	22	11	7	18	10	5	15	64	56	123	94	113	209	100	18	118	122		122	121		
	size (ares)		1			1			1			1			1			1			6			6			6			6			6		
	size (ACRES)		0.025			0.025			0.025			0.025			0.025			0.025			0.148			0.148			0.148			0.148			0.148		
	Species count		6	2	8	7	3	9	7	4	10	10	2	11	5	3	7	5	1	6	16	8	22	18	10	22	17	8	22	16		16	17		
	Stems per ACRE		567	202	769	567	486	1052	526	405	931	486	405	890	445	283	728	405	202	607	432	378	830	634	762	1410	674	121	796	823		823	816		

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%

P = Planted Stem
V = Volunteer
T = Total

¹ Plot MY4 is a randomly located vegetation plot that will move locations each monitoring year

APPENDIX D

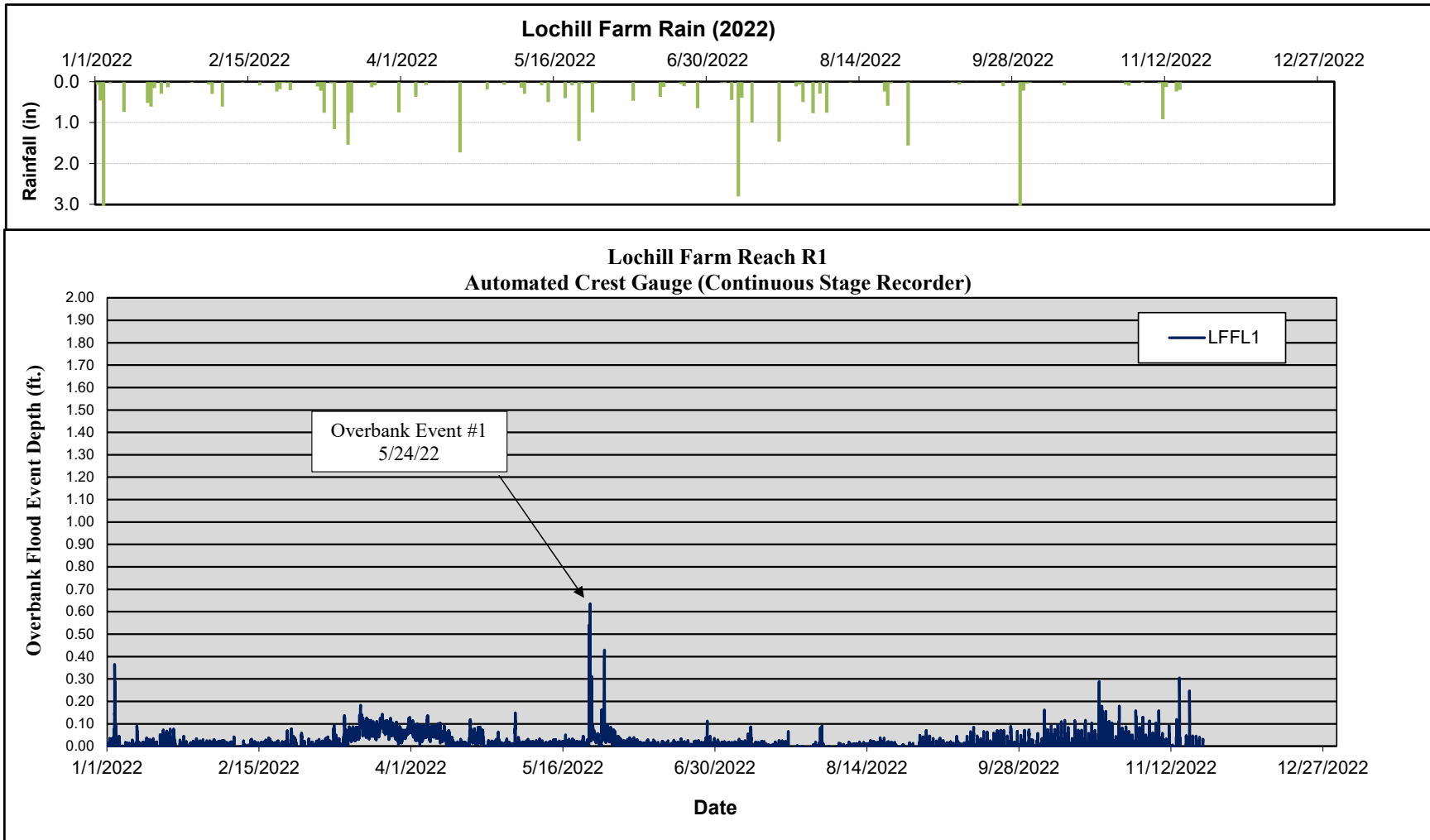
Stream Geomorphology Data

*Cross-sections are not required for MY4.

APPENDIX E

Hydrologic Data

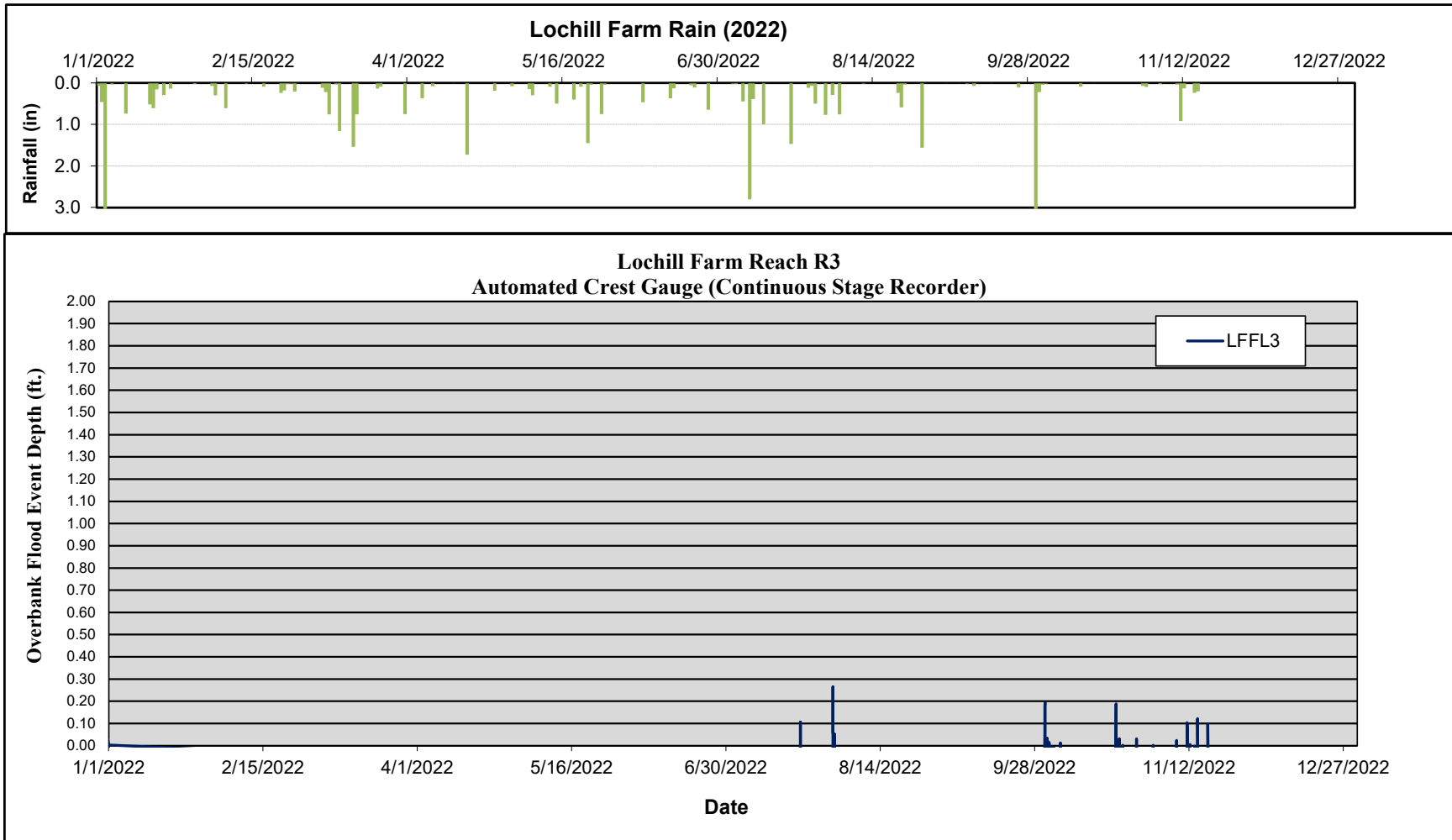
Figure 5. Automated Crest Gauge (Continuous Stage Recorder) Graph



Note: Data presented here is from 1/1/22 thru 11/21/22

Only the largest overbank event is called out here and in the report. However, several smaller overbank events also appear to have occurred as shown in the graph above.

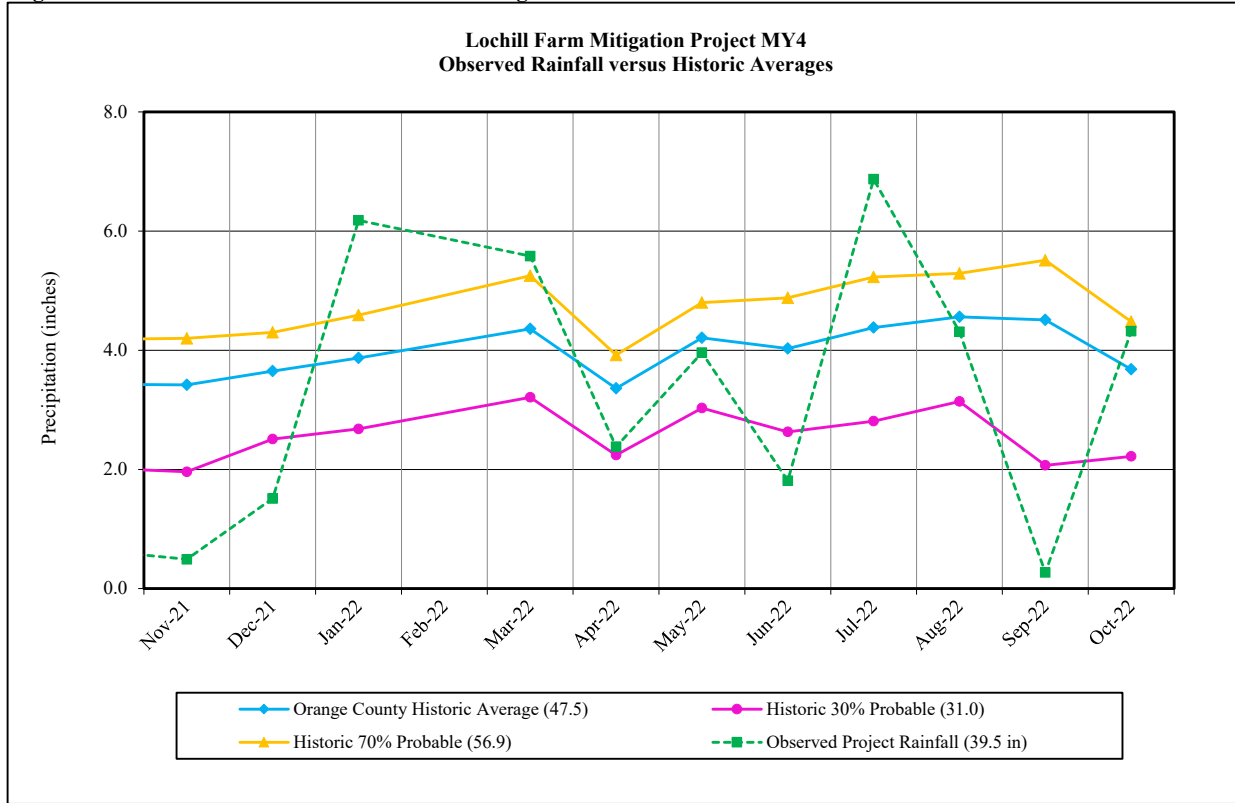
Figure 5. Automated Crest Gauge (Continuous Stage Recorder) Graph



Crest Gauge installed 7/15/2022

Note: Data presented here is from 7/15/22 thru 11/21/22

Figure 7. Observed Rainfall Versus Historic Averages



Note: Historic average annual rainfall for Orange County is 47.5", while the observed project rainfall recorded a total of 39.5" over the previous 12 months (from 11/1/2021 to 10/31/2022). Project rainfall was collected from the nearest NC-CRONOS station.

Table 10. Verification of Bankfull Events

Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083

Date of Manual Gauge Collection	Reach R1 Manual Cork Crest Gauge	Reach R1 Automated Crest Gauge (Continuous Stage Recorder)	Reach R3 Crest Gauge (Continuous Stage Recorder)	Date of Bankfull Event Occurrence	Method of Data Collection
Year 1 Monitoring (2019)					
3/7/19	N/A ¹	0.42 ft	N/A ¹	2/23/19 (1.3" rain event)	Continuous Stage Recorder, Photos
4/18/19	0.71 ft	0.96 ft	0.30 ft	4/13/19 (1.8" rain event)	Cork Crest Gauges, Continuous Stage Recorder, Photos
6/19/19	0.81 ft	0.90 ft	0.29 ft	6/18/19 (1.32" rain event)	Cork Crest Gauges, Continuous Stage Recorder, Photos
Year 2 Monitoring (2020)					
2/27/20	0.41 ft	0.52 ft	N/A	2/6/20 (2.56" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
5/8/20	0.23 ft	0.43 ft	N/A	3/25/20 (1.3" rain event, after 0.82" over the previous 24 hours)	Continuous Stage Recorder, Cork Crest Gauge, Photos
7/10/20	0.69 ft	0.87 ft	0.16 ft	5/20/20 (2.08" rain event, after 1.76" over the previous 24 hours)	Continuous Stage Recorder, Cork Crest Gauge, Photos
10/14/20	0.71 ft	0.57 ft	N/A	10/11/20 (1.65" rain event, after 0.59" over previous 24 hours, all related to Hurricane Delta)	Continuous Stage Recorder, Cork Crest Gauge, Photos
Year 3 Monitoring (2021)					
-	-	0.95 ft	-	1/3/2021 (1.12" rain event)	Continuous Stage Recorder
3/11/21	1.01 ft	1.08 ft	0.56 ft	2/16/2021 (0.95" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
6/24/21	0.57 ft	0.44 ft	N/A	2021 (0.52" rain event, after previous rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
10/20/21	1.17 ft	0.98 ft	N/A	7/19/2021 (1.25" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
Year 4 Monitoring (2022)					
3/15/22	0.67 ft	N/A	N/A	1/3/2022 (3.12" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
5/24/22	N/A	0.63 ft	N/A	5/24/2022 (1.45" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos

Note: Manual cork crest gauge readings were corroborated with associated spikes in the automated Continuous Stage Recorder (see graph in Appendix E) and/or with photographs (Appendix B).