

# **Lochill Farm Stream Mitigation Project Year 5 (2023) 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  
MY5 Data Collection Period: November 2023



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 2024

 This document was printed using 30% recycled paper.

January 23, 2024

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

**Subject:** Response to DMS Comments for MY5 Report  
Lochill Farm Stream Mitigation Project, Orange County  
DMS Project # 97083, DEQ Contract #6828, Neuse-01 River Basin

Ms. Mir:

Please find enclosed our responses to the NC Division of Mitigation Services (DMS) review comments received January 16, 2024 in reference to the Lochill Farm Stream Mitigation Project - DRAFT MY5 Report. We have revised the document in response to the review comments as outlined below.

DMS MY5 Draft Report Comments:

Report & Field Visit:

1. CCPV – a) Please add a call out box on the encroachment area along R1. b) It would be helpful to have the existing pond that is located inside and outside the conservation easement near Reach 4 displayed.

**Response: A callout box showing both encroachment areas, along with, the existing pond has been added to the CCPV.**

2. Some privet sprouts (<1 ft) were observed along Reach 3, please continue treatment.

**Response: Michael Baker will continue invasive treatment throughout the easement including the kudzu patch at the bottom of the project.**

3. Section 1.4 – Please add a line to indicate that 3-gal. trees will be planted in the encroachment area on R2.

**Response: Revision made as requested.**

4. Appendix D – Please adjust the photos so that they are not covering their caption title.

**Response: Photos have been adjusted and revised.**

Digital Comments:

1. The digital data submission included the vegetation summary table, the vegetation plot data was missing. Please submit the vegetation plot data.

**Response: Vegetation plot data is now included in the e-submission folder.**

Boundary Inspection:

- a) There are a several witness posts missing along the external crossings of Reach 1. Please replace all missing witness posts and signs where needed.

**Response: Michael Baker intends to resolve all issues with witness post and signage throughout the easement.**

- b) At the northwestern side of Reach 3, there are large utility poles within the conservation easement

(CE) and mowing. While on site we spoke to Tonya Bruno, who uses the area for horse exercise, and expressed that she would move the utility poles out of the CE. Please indicate what corrective action will be taken.

**Response: Michael Baker will follow up with Tonya Bruno and foresee that the utility poles have been removed from the easement.**

- c) Large debris at the upstream portion of Reach 3 were observed within the CE. Some of the items noted were a 55-gallon drum, animal feeders, and a deer stand which will need to be removed before IRT closeout.

**Response: Items will be removed from the easement as requested.**

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

Sincerely,



Andrew Powers  
Project Manager

Enclosures

# TABLE OF CONTENTS

<b>1.0</b>	<b>PROJECT SUMMARY .....</b>	<b>3</b>
1.1	PROJECT DESCRIPTION .....	3
1.2	GOALS AND OBJECTIVES.....	3
1.3	PROJECT SUCCESS CRITERIA .....	4
1.4	MONITORING RESULTS AND PROJECT PERFORMANCE.....	4
1.5	TECHNICAL AND METHODOLOGICAL DESCRIPTIONS .....	5
1.6	REFERENCES.....	5

## APPENDICES

<b>Appendix A</b>	<i>Background Tables and Figures</i>	
	Figure 1	Project Vicinity Map
	Figure 2	Project Asset Map
	Table 1	Project Components and Mitigation Credits
	Table 2	Project Activity and Reporting History
	Table 3	Project Contacts
	Table 4	Project Attributes
<b>Appendix B</b>	<i>Visual Assessment Data</i>	
	Figure 3	Current Condition Plan View (CCPV) Map
	Table 5	Visual Stream Morphology Stability Assessment
	Table 6	Vegetation Condition Assessment
		Stream Station Photo-Points
		Vegetation Plot Photographs
		Overbank Event Photographs
		Additional Monitoring Photographs
<b>Appendix C</b>	<i>Vegetation Plot Data</i>	
	Table 7	Planted Stem Counts by Plot and Species
<b>Appendix D</b>	<i>Stream Geomorphology Data</i>	
	Figure 4	Cross-Sections with Annual Overlay
	Table 8	Baseline Stream Data Summary
	Table 9	Cross-Section Morphology Data Summary
<b>Appendix E</b>	<i>Hydrologic Data (*Not required per 2022 IRT credit release)</i>	
	Figure 5	Automated Crest Gauge (Continuous Stage Recorder) Graph
	Figure 6	Wetland Monitoring Well Graphs*
	Figure 7	Observed Rainfall Versus Historic Averages
	Table 10	Verification of Bankfull Events
	Table 11	Wetland Hydrology Summary Data*



## 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 livestock 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 streams and riparian zones.

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 dimension, 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 5 monitoring, the planted acreage was successfully meeting all performance criteria. The average density of planted stems, based on data collected from the five permanent and one random monitoring plots for the Year 5 monitoring conducted in October 2023, was 510 planted stems per acre (Table 7 in Appendix C). Thus, the Year 5 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 May and August 2023, Michael Baker thinned both pine (*Pinus taeda*) and sweetgum (*Liquidambar styraciflua*) along the right floodplain in the middle of Reach 1; along with, the right floodplain of Reach 3. The planted stem density within these areas does not seem to be affected by the pine and sweetgum stems but were thinned to prevent competition. (see Figure 3 in Appendix C)

During Year 5 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. However, no overbank events were recorded during year 5 monitoring.

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 only one month exceeding the historic average precipitation average and three months below the 30% probable average. It was considerably dryer in the winter and spring of 2023 compared to previous monitoring years. A total of 37.5 inches of rainfall was observed for the site, a deficit of 10 inches in comparison with Orange County historic average of 47.5 inches.

The Year 5 monitoring survey data of the twelve permanent cross-sections indicates that these stream sections are geomorphically stable and are within the lateral/vertical stability and in-stream structure performance categories. Only very minor fluctuations in geometry were observed from year 3 (as shown in Figure 4 and Table 9 in Appendix D), but these fluctuations do not represent a trend towards instability based off visual field evaluations. All reaches are stable and performing as designed and are rated at 100 percent for all the parameters evaluated (Table 5 in Appendix B). There were no Stream Problem Areas (SPAs) identified.

During the September 13<sup>th</sup> site visit, the landowner informed Michael Baker that there was a misguidance between he and his son resulting in an encroachment to the conservation easement at the head of Reach 2. A hole approximately 5ft by 10ft and 3ft deep was dug out in the easement and the excess spoil pile was spread into the floodplain. The total encroachment area is approximately 530 square feet. Michael Baker has discussed the violation with the landowner and developed a plan to resolve the issue. The landowner

has since filled in the hole and plans on replanting the area using 3 gal containerized trees this winter in the dormmate season with species approved by Michael Baker staff. An additional encroachment area was identified on the left floodplain at the upper section of R1 where the landowner mowed into the easement while trying to make a turn in his pasture. This was an area that had previously been marked with horse tape to locate the boundary line but has since been torn down. The landowner is aware of the problem and Michael Baker intends to remark the boundary with t-post for a more permanent solution. Before and after photos of this area can be found in Appendix B Additional Monitoring Photos.

Per IRT April 2022 credit release meeting, all ground water wells have been removed from the site.

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 5 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.

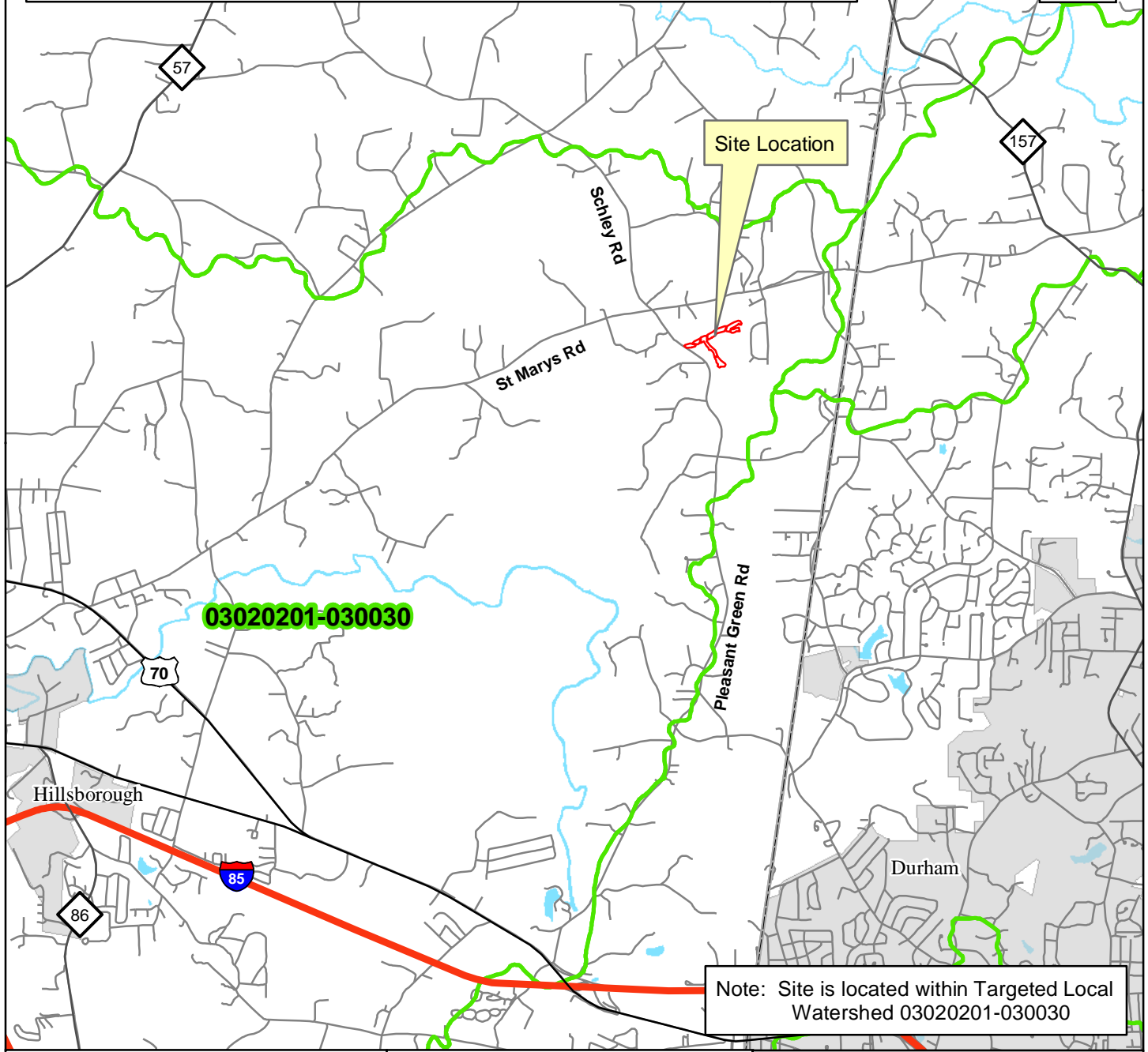
United States Army Corps of Engineers (USACE). 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," WRAP Technical Notes Collection (ERDC TN-WRAP-05-2), U.S. Army Engineer Research and Development Center. Vicksburg, MS.



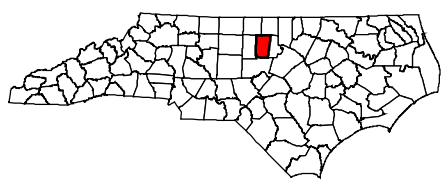
# **APPENDIX A**

## Background Tables and Figures

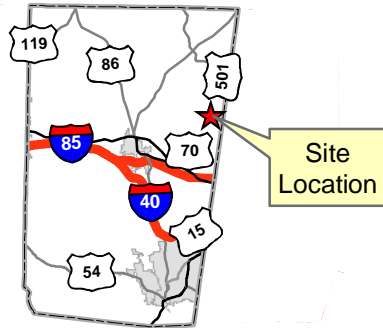
Directions to site: From I-85 South through Durham, take exit 170 for US-70 W and go 0.3 miles, then turn right at the stoplight onto Pleasant Green Rd and go 5.8 miles, then turn right at the stop sign onto St. Mary's Rd, then go 0.4 miles and turn right into the Lochill Farm driveway at 6120 St. Mary's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



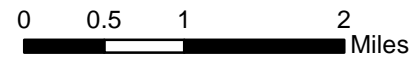
Note: Site is located within Targeted Local Watershed 03020201-030030



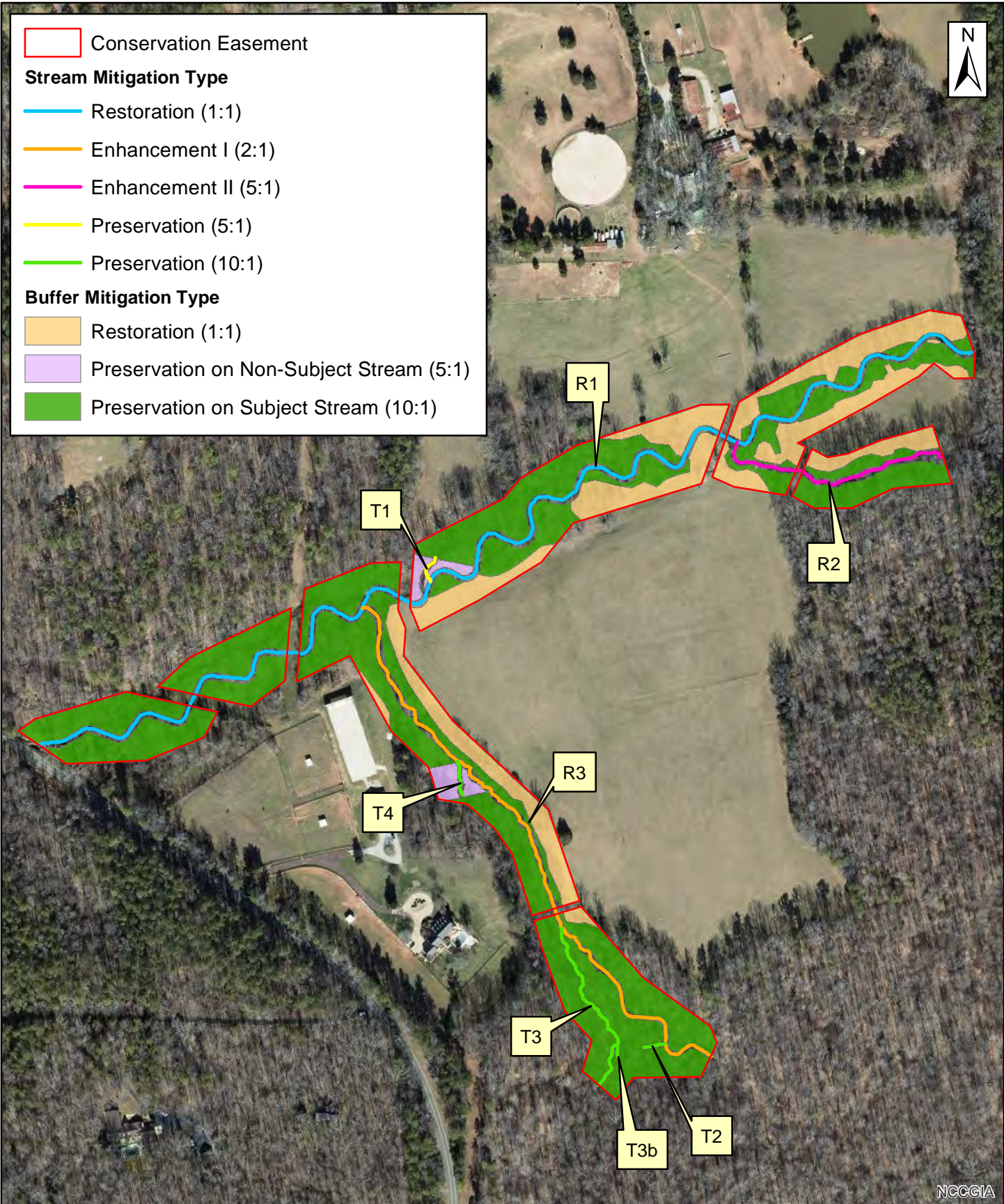
Orange County



**Figure 1**  
Project Vicinity Map  
Lochill Farm Site







**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 <sup>1</sup>	As-Built Centerline Footage, or SF <sup>2</sup>	Mitigation Plan Designed Footage	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits <sup>3</sup>
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:** 5 years and 0 months  
**Elapsed Time Since planting complete:** 4 years and 10 months  
**Number of Reporting Years<sup>1</sup>:** 5

<b>Activity or Deliverable</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
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	Nov-23	Dec-23
Pine and Sweetgum thinning	May-2023 and Aug-2023	
Kudzu Treatment	Sept-2023 and Oct-2023	
Year 6 Monitoring (anticipated)	Oct-24	Dec-24
Year 7 Monitoring (anticipated)	Oct-25	Dec-25

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

**Table 3. Project Contacts**

**Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083**

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

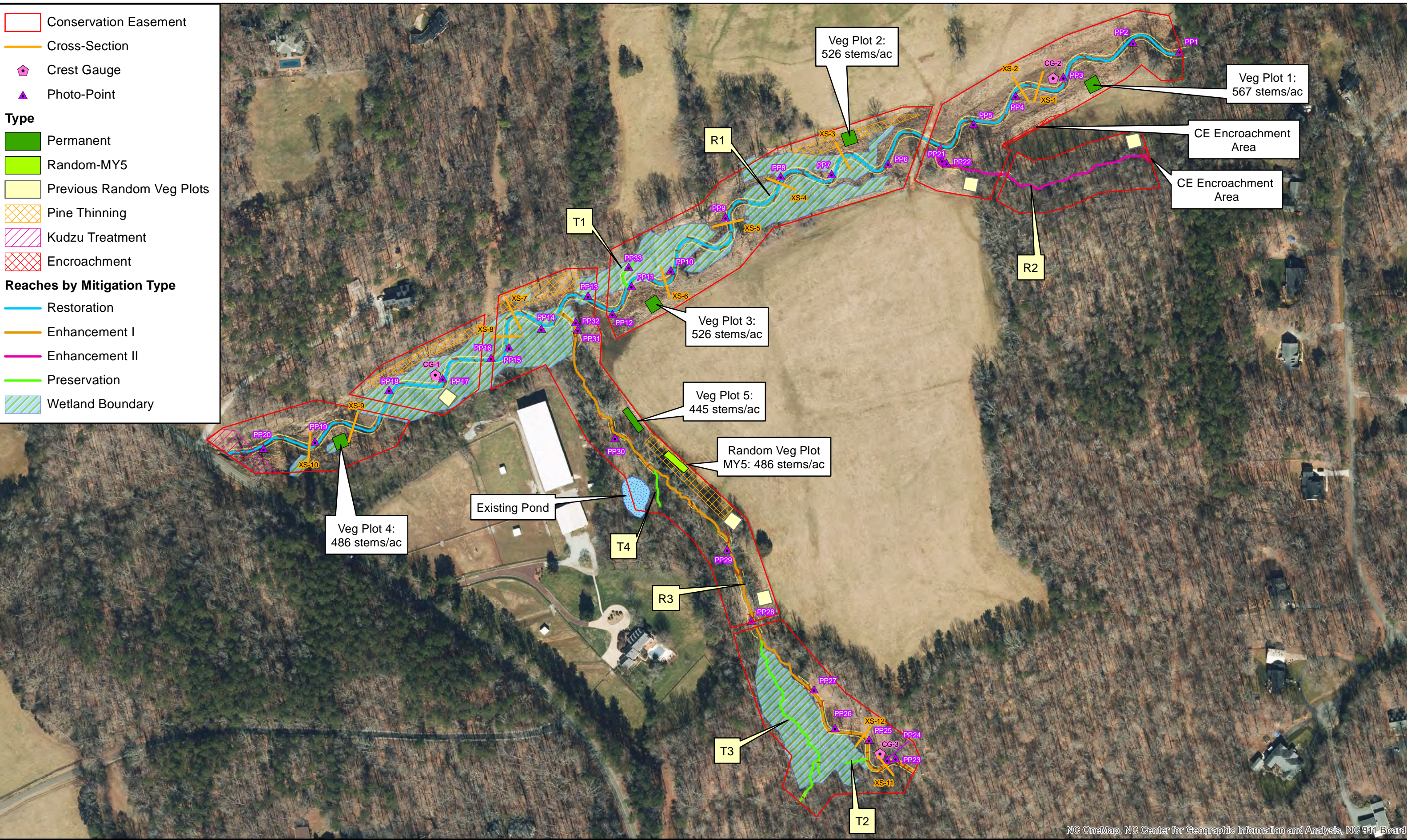
Project Name		Lochill Farm Stream Mitigation Project			
County		Orange County			
Project Area (acres)		15.8			
Project Coordinates (latitude and longitude)		36.113419 N, -78.991165 W			
Planted Acreage (Acres of Woody Stems Planted)		8.1			
<b>Project Watershed Summary Information</b>					
Physiographic 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			
<b>Existing Reach Summary Information</b>					
<b>Parameters</b>		<b>Reach R1</b>	<b>Reach R2</b>	<b>Reach R3</b>	<b>Reach T1</b>
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
<b>Existing Reach Summary Information</b>					
<b>Parameters</b>		<b>Reach T2</b>	<b>Reach T3</b>	<b>Reach T3b</b>	<b>Reach T4</b>
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
<b>Regulatory Considerations</b>					
<b>Parameters</b>		<b>Applicable?</b>	<b>Resolved?</b>	<b>Supporting Docs?</b>	
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



Conservation Easement  
 Cross-Section  
♠ Crest Gauge  
▲ Photo-Point  
**Type**  
 Permanent  
 Random-MY5  
 Previous Random Veg Plots  
 Pine Thinning  
 Kudzu Treatment  
 Encroachment  
**Reaches by Mitigation Type**  
 Restoration  
 Enhancement I  
 Enhancement II  
 Preservation  
 Wetland Boundary



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		
	4. Thalweg Position	2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	34	34			100%
		1. Thalweg centering at upstream of meander bend (Run)	32	32			100%
		2. Thalweg centering at downstream of meander bend (Glide)	34	34			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 collapse			0	0	100%
	<b>Totals</b>					0	0
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 <b>does not</b> 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		
	4. Thalweg Position	2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	1	1			100%
		1. Thalweg centering at upstream of meander bend (Run)	1	1			100%
		2. Thalweg centering at downstream of meander bend (Glide)	1	1			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 collapse			0	0	100%
	<b>Totals</b>					0	0
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 <b>does not</b> 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			100%
	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 collapse			0	0	100%	
					<b>Totals</b>	0	0	100%
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 <b>does not</b> 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**

<b>Planted Acreage: 9.8</b>						
<b>Vegetation Category</b>	<b>Defintions</b>	<b>Mapping Threshold (acres)</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
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%
<b>Total</b>				<b>0</b>	<b>0.00</b>	<b>0.0%</b>
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%
<b>Cumulative Total</b>				<b>0</b>	<b>0.00</b>	<b>0.0%</b>
<b>Easement Acreage: 15.8</b>						
<b>Vegetation Category</b>	<b>Defintions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Points</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 ft <sup>2</sup>	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	Red cross hatching	2	0.020	0.1%



**Lochill Farm: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Stream Station Photo-Points (taken 3/23/23)**



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: MY5 Vegetation Plot Photographs (taken 10/05/2023)



Vegetation Plot 1



Vegetation Plot 2



Vegetation Plot 3



Vegetation Plot 4



Vegetation Plot 5



Random Vegetation Plot MY5



Lochill Farm: MY5 Overbank Event Photographs



Manual crest gauge reading of 0.59 ft on upper R1 (photo from 8/5/23)



Closeup of crest gauge reading



Crest Gauge 1 on lower R1 floodplain



Crest Gauge 2 (cork gauge) on upper R1 floodplain



Crest Gauge 3 (instream gauge) on upper R3



Overbank photo located at Crest Gauge 2 (4/7/2023)



Lochill Farm: MY5 Additional Monitoring Photographs



Stable crossing over Reach 2 (11/1/23)



Stable crossing at the top of R1 (3/23/23)



Pipe crossing on R3 at Station ~16+30 (3/23/23)



Stable pipe crossing on R3 at Station ~16+30 (10/5/23)



Pipes at crossing at top of R3 at Station 10+00  
(3/23/23)



Pipe crossing on R3 at Station ~16+30 (3/23/23)



Lochill Farm: MY5 Additional Monitoring Photographs



Stable crossing on R1 station 30+40 (3/26/23)



First kudzu treatment results (10/5/23)



Second kudzu treatment results (11/1/23)



Second kudzu treatment results (11/1/23)



Pine thinning along middle R1 (5/11/23)



Pine thinning along middle R1 (5/11/23)



Lochill Farm: MY5 Additional Monitoring Photographs



Pine thinning along lower R1 (5/11/23)



Pine thinning along lower R1 (5/11/23)



Pine thinning along R3 (8/23/23)



Pine thinning along R3 (8/23/23)



Encroachment area at the head of R2 (8/5/2023)



Encroachment area at the head of R2. The white tape is the easement boundary (8/5/2023)



Lochill Farm: MY5 Additional Monitoring Photographs



Encroachment area filled back in and graded out (photo from (11/1/23))



Encroachment area filled back in and graded out (photo from (11/1/23))



Encroachment area filled back in and graded out (photo from (11/1/23))



Mowing encroachment along left floodplain on the upper section of R1 (11/1/2023)



# **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 (MYS 2023)															Annual Means																													
			97083-01-0001			97083-01-0002			97083-01-0003			97083-01-0004			97083-01-0005			97083-01-MYS			MYS (2023)			MY4 (2022)			MY3 (2021)			MY2 (2020)			MY1 (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												
Acer negundo		Tree																																													
Alnus serrulata	Tag Alder	Shrub Tree				1	2	2				3		3	1		1				3	1	3	1		1	5	5	10	6	6	12	5	11	16	4	4	8	4	4	8	4	4	8			
Baccharis	High-tide Bush	Shrub Tree																																													
Betula nigra	River Birch	Tree	2		2	4	4	4							2		2										10	10	20	10	10	20	11		11	15		15	17		17	17		17			
Carpinus caroliniana	Iron Wood	Shrub Tree	2		2	1	1	1	1	1	2	1	1	2							1	1	2	1	1	2	6	1	7	5	5	10	6	6	12	10	10	20	10	10	20	10	10	20			
Celtis laevigata	Sugarberry	Shrub Tree				2	2	2				1		1				1	1	2	1	1	2	1	1	2	5	4	9	5	5	10	5	5	10	5	5	10	9	9	18	9	9	18			
Cercis canadensis	Red bud	Shrub Tree	1		1	1	1	1																			2	2	4	2	2	4	2	2	4	2	2	4	2	2	4	2	2	4			
Diospyros virginiana	American Persimmon, Possum	Tree																			2		2	2		2	2		2																		
Fraxinus pennsylvanica	Green Ash, Red Ash	Tree	3		3				2	2	4																3	2	5	3	3	6	5	5	10	8	8	16	5	5	10	5	5	10			
Ilex verticillata	Winterberry	Shrub Tree										1		1													1	1	2	1	1	2	1	1	2	2	2	4	3	3	6	3	3	6			
Juglans nigra	Black Walnut	Tree																																													
Lindera benzoin	Northern Spicebush	Shrub Tree										1		1													1	1	2	1	1	2	2	2	4	2	2	4	3	3	6	3	3	6			
Liquidambar styraciflua	Sweet Gum, Red Gum	Tree		10	10		10	10													4	4	8	4	4	8	30	30	60	14	14	28	33	33	66	1	1	2	1	1	2	1	1	2	1	1	2
Liriodendron tulipifera	Tulip Poplar	Tree	5		5										1		1							2		2	8	7	15	7	7	14	7	7	14	7	7	14	7	7	14	12	12	24			
Nyssa sylvatica	Sour Gum, Black Gum, Pepper	Tree										1		1													1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2			
Pinus taeda	Loblolly Pine, Old Field Pine	Tree		10	10		5	5		3	3							4	4	8		10	10				32	32	64	9	9	18	14	14	28												
Platanus occidentalis	Sycamore, Plane-tree	Tree	1	3	4	4	8	12				4	10	14	2	10	12	5	3	8	4		4				20	30	50	20	22	42	16	47	63	20	8	28	24	24	48	24	24	48			
Quercus lyrata	Overcup Oak	Tree										1		1										1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2			
Quercus michauxii	Basket Oak, Swamp Chestnut	Tree																			1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2			
Quercus pagoda	Cherrybark Oak, Swamp Spani	Tree																																													
Quercus phellos	Willow Oak	Tree					1	1	1		1	1	1	2													2	1	3	4	2	6							1	1	2	3	3	6	3	3	6
Salix nigra	Black Willow	Tree											10	10													10	10	20	5	5	10	5	5	10	5	5	10	5	5	10	5	5	10			
Ulmus americana	Elm	Tree											1	1													1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	3	3	6			
Viburnum dentatum	Arrow-wood	Shrub Tree														2	2										2	2	4	2	2	4	2	2	4	2	2	4	2	2	4	2	2	4			
Viburnum nudum	Southern Wild Raisin, Possum	Shrub Tree																									2	2	4	2	2	4	2	2	4	2	2	4	2	2	4	2	2	4			
	<b>Stem count</b>		14	23	37	13	36	41	13	18	31	12	21	33	11	14	25	12	14	26	75	114	186	74	56	130	67	120	187	85	18	103	105	0	105	105	0	105	105	0	105						
	<b>size (ares)</b>		1			1			1			1			1			1			6			6.00			6			6			6			6			6								
	<b>size (ACRES)</b>		0.02			0.02			0.02			0.02			0.02			0.02			0.15			0.15			0.15			0.15			0.15			0.15			0.15								
	<b>Species count</b>		6	3	8	6	10	11	7	5	10	10	3	12	5	4	8	7	2	9	18	10	22	17	8	22	15	9	20	16	8	21	15	0	15	15	0	15	15	0	15						
	<b>Stems per ACRE</b>		566.6	930.8	1497.3	526.1	1456.9	1659.2	526.1	728.4	1254.5	485.6	849.8	1335.5	445.2	566.6	1011.7	485.6	566.6	1052.2	505.9	768.9	1254.5	499.1	377.7	876.8	451.9	809.4	1261.3	573.3	121.4	694.7	708.2	0.0	708.2	708.2	0.0	708.2									

**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

<sup>1</sup> Plot MYS is a randomly located vegetation plot that will move locations each monitoring year.

# **APPENDIX D**

## Stream Geomorphology Data

**Permanent Cross-section 1**  
(Year 5 Data - September 2023)

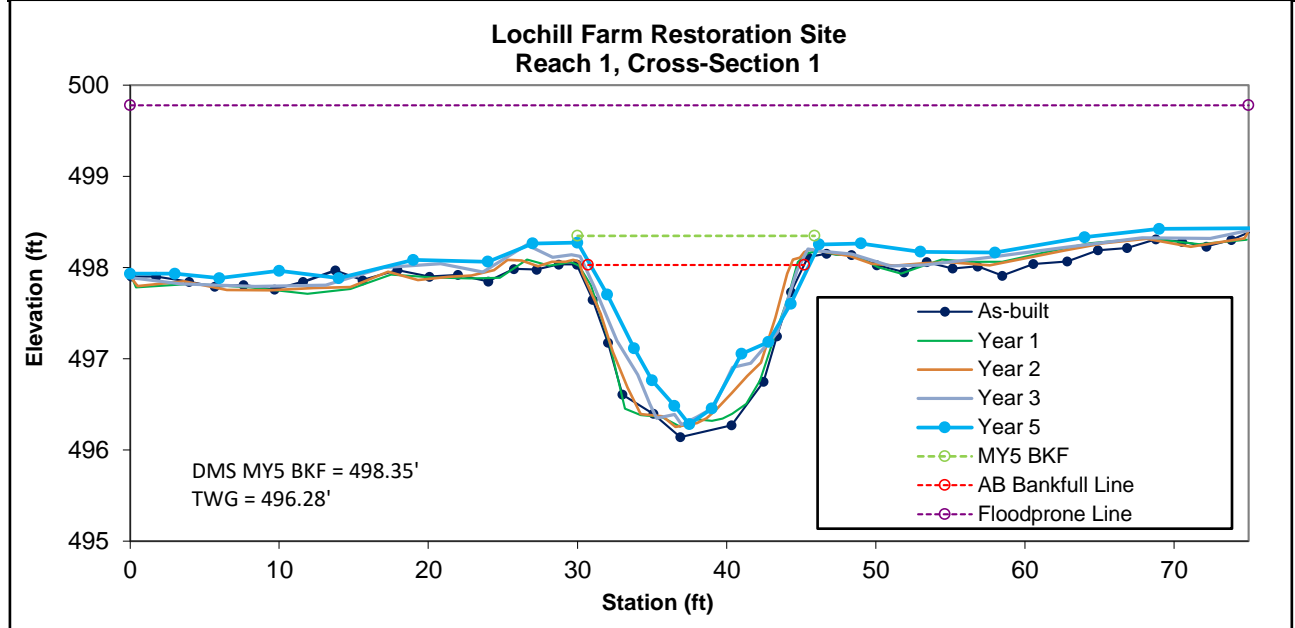


**Looking at the Left Bank**



**Looking at the Right Bank**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	14.3	14.7	1.0	1.7	15.1	1.0	4.6	498.03	498.25



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.

**Permanent Cross-section 2**  
(Year 5 Data - September 2023)

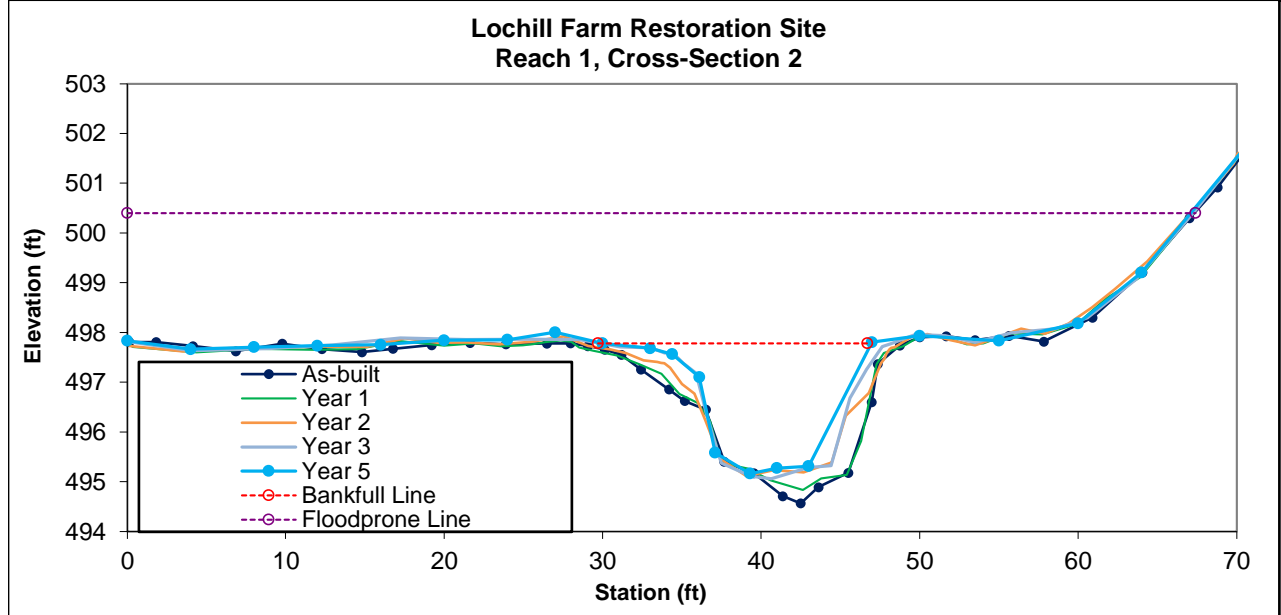


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	22.1	16.9	1.3	2.6	12.9	--	--	497.78	497.56





**Permanent Cross-section 3**  
(Year 5 Data - September 2023)

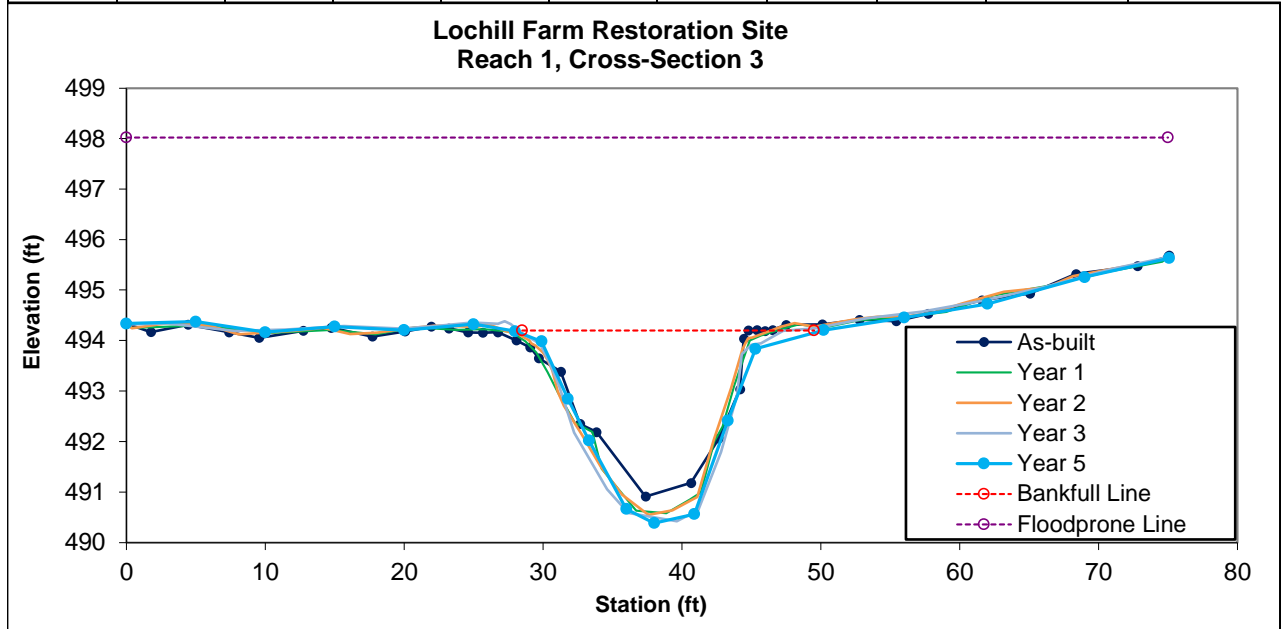


**Looking at the Left Bank**



**Looking at the Right Bank**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	39.8	22.5	1.8	3.8	12.7	--	--	494.20	493.83



**Permanent Cross-section 4**  
(Year 5 Data - September 2023)

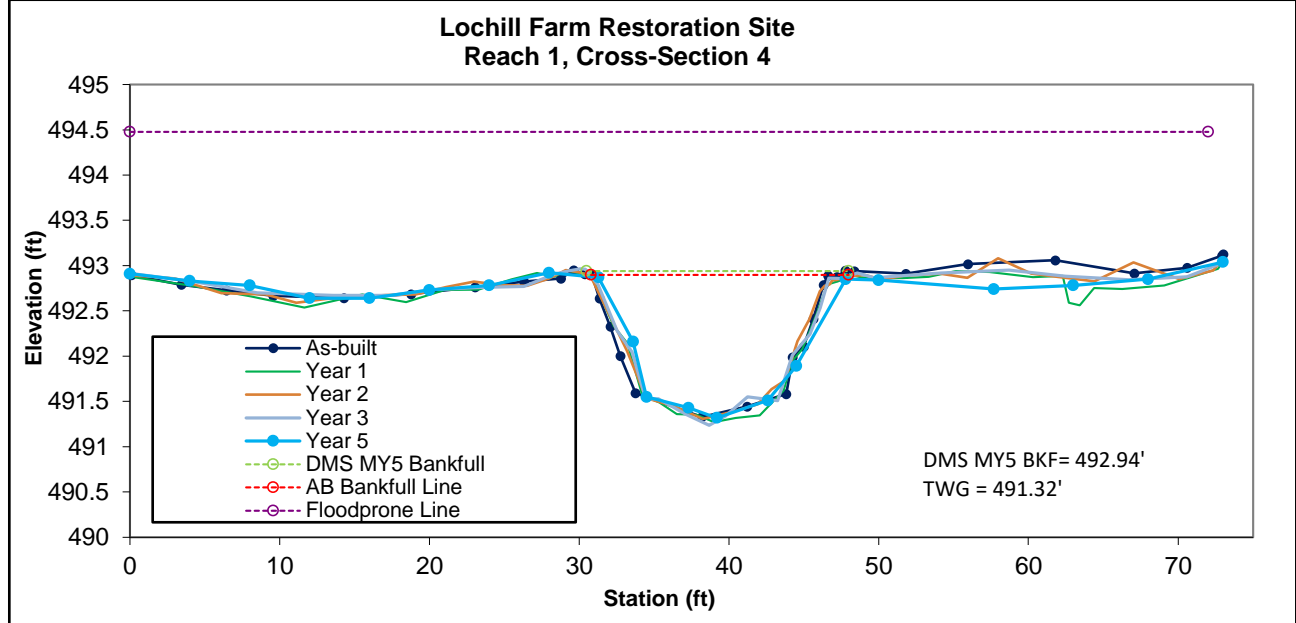


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	17.7	16.5	1.1	1.6	15.4	0.9	4.4	492.90	492.85



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.

**Permanent Cross-section 5**  
(Year 5 Data - September 2023)

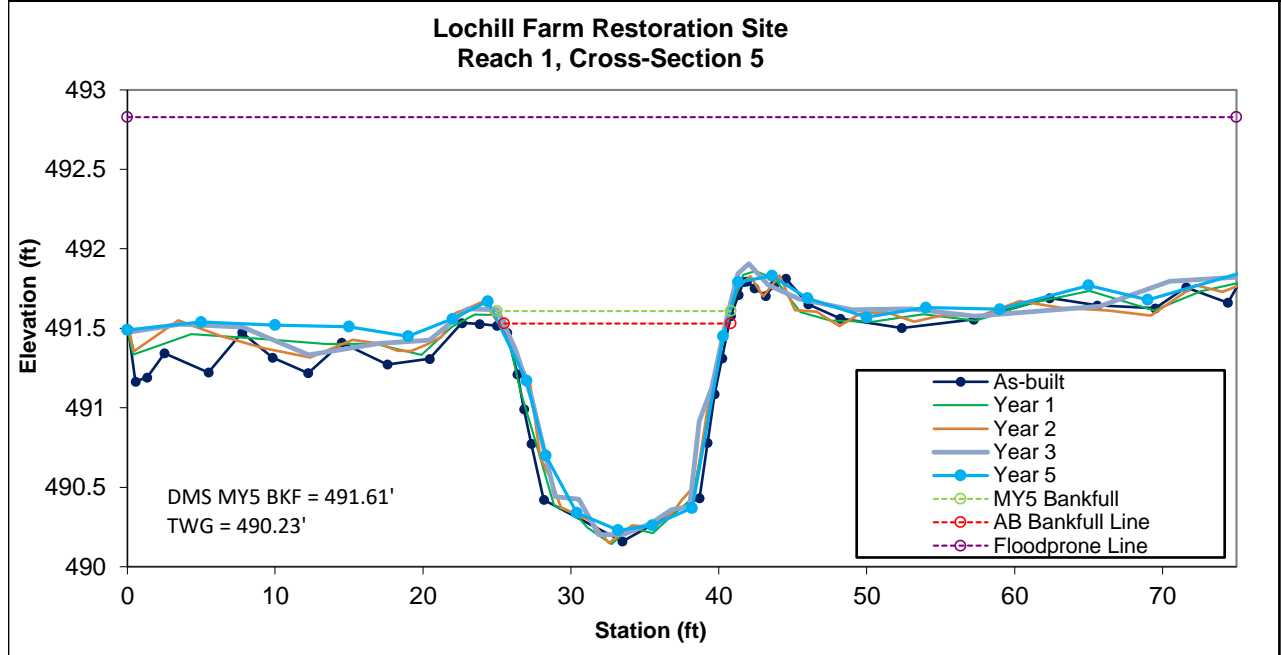


**Looking at the Left Bank**



**Looking at the Right Bank**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	14.3	15.4	0.9	1.3	16.6	1.0	4.7	491.53	491.67



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.



**Permanent Cross-section 6**  
(Year 5 Data - September 2023)

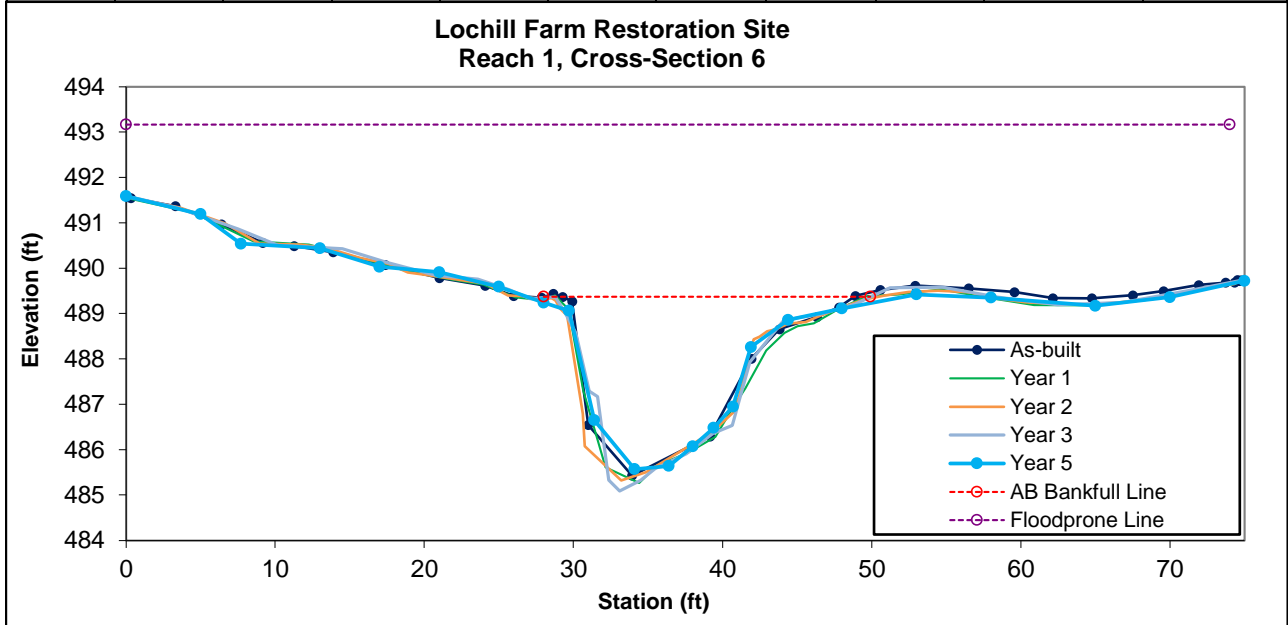


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	40.0	26.7	1.5	3.8	17.9	--	--	489.37	488.86



**Permanent Cross-section 7**  
(Year 5 Data - September 2023)

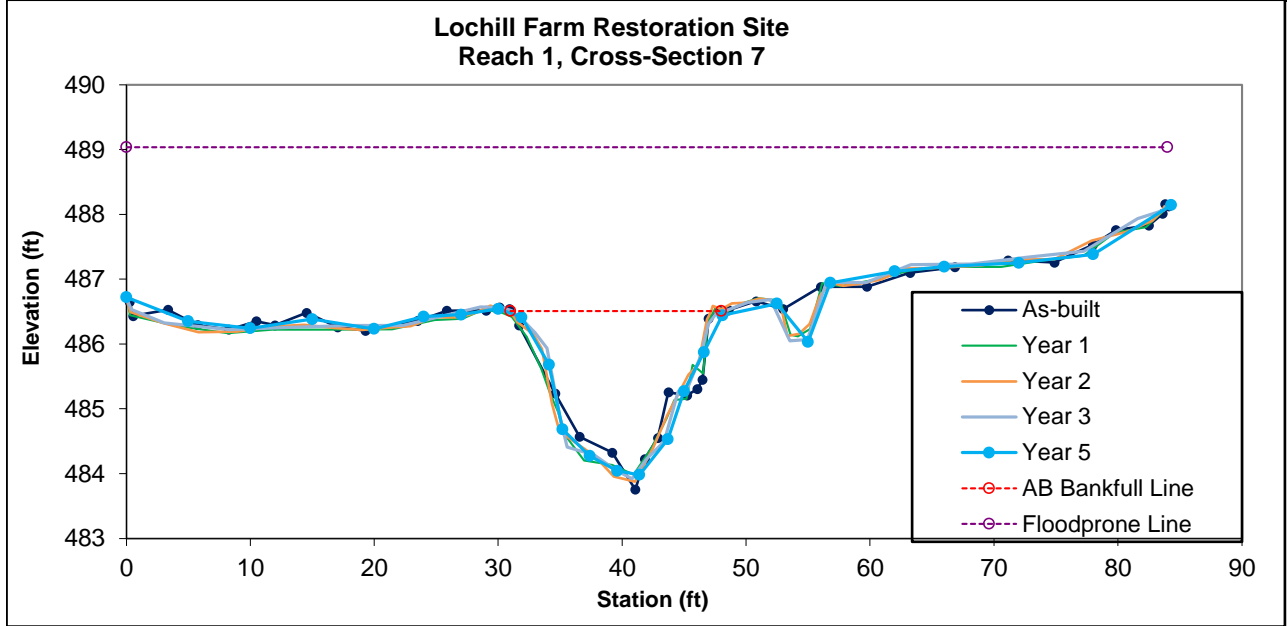


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	26.0	19.3	1.4	2.5	14.3	--	--	486.51	486.44



**Permanent Cross-section 8**  
(Year 5 Data - September 2023)

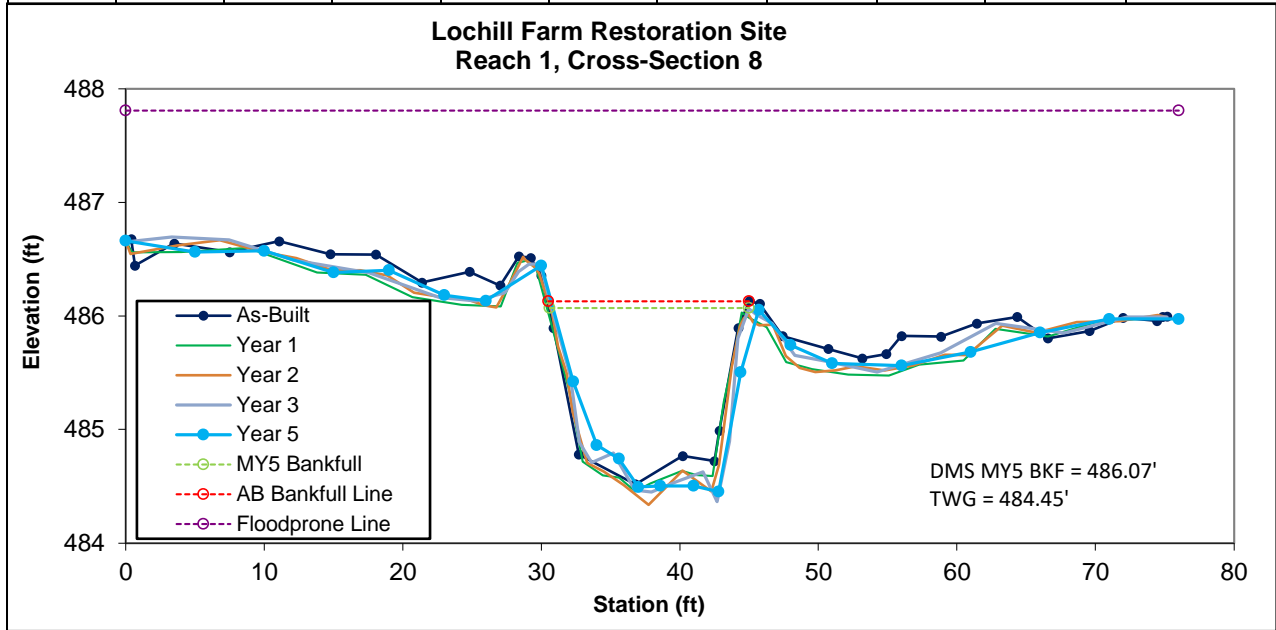


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	18.3	15.0	1.2	1.7	12.3	1.0	5.1	486.13	486.05



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.



**Permanent Cross-section 9**  
(Year 5 Data - September 2023)

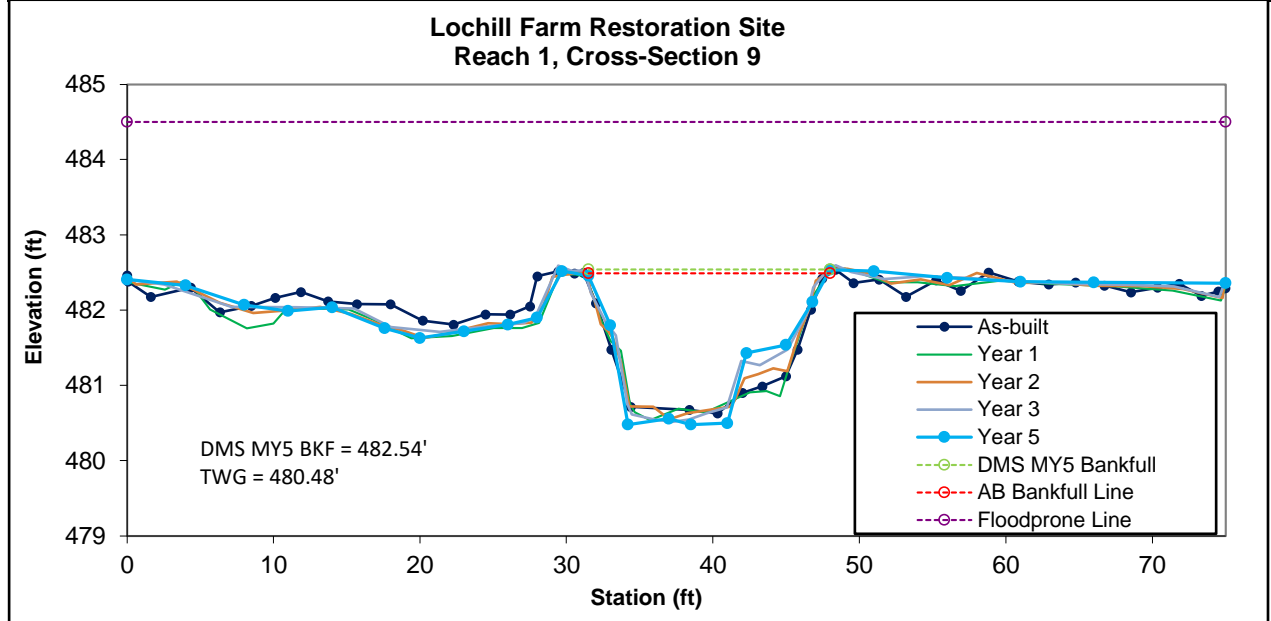


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	21.8	17.4	1.3	2.0	13.8	1.0	4.1	482.49	482.46



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.

**Permanent Cross-section 10**  
(Year 5 Data - September 2023)

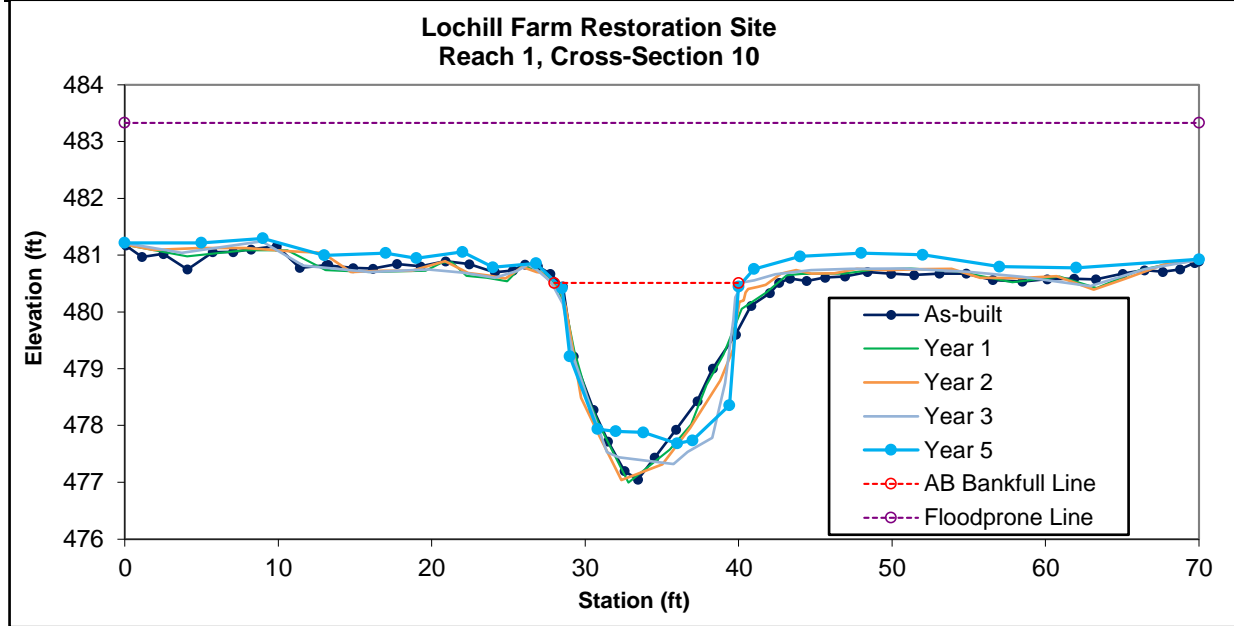


**Looking at the Left Bank**



**Looking at the Right Bank**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	27.1	12.1	2.2	2.8	5.4	--	--	480.51	480.76



**Permanent Cross-section 11**  
(Year 5 Data - September 2023)

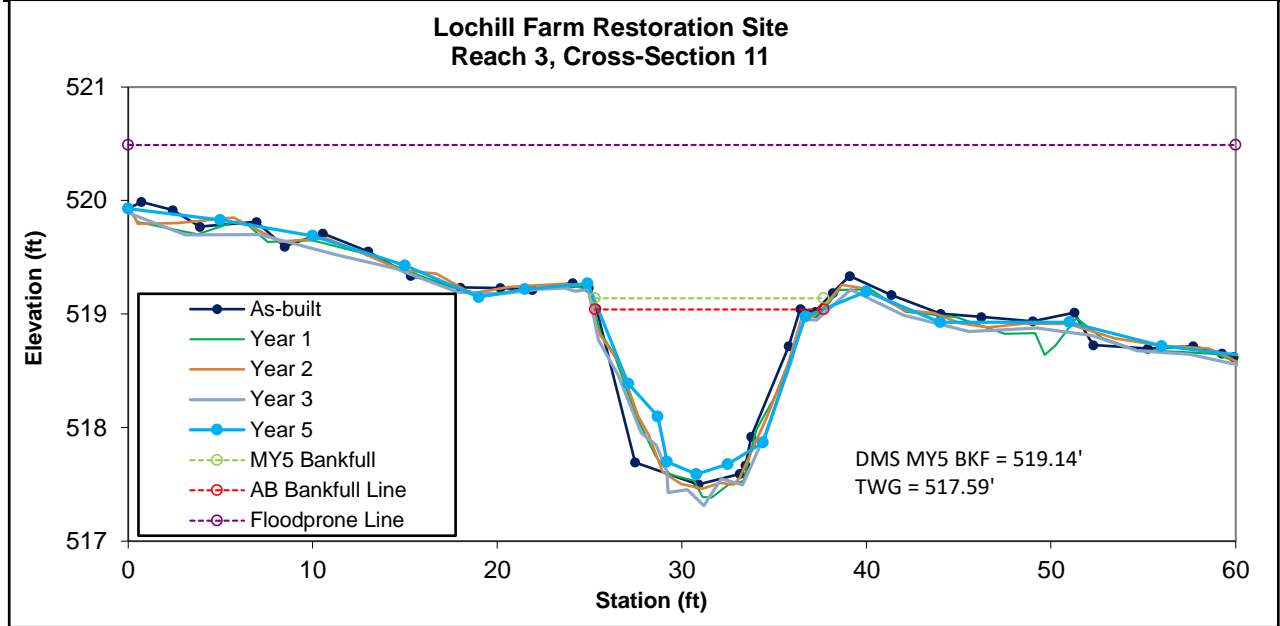


**Looking at the Left Bank**



**Looking at the Right Bank**

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Riffle	C	10.9	12.2	0.9	1.5	13.6	1.0	4.4	519.04	519.20



Note: Per DMS/IRT request, the bank height ratio for MY5 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the original as-built bankfull elevation, as was done for previous monitoring reports.



**Permanent Cross-section 12**  
(Year 5 Data - September 2023)

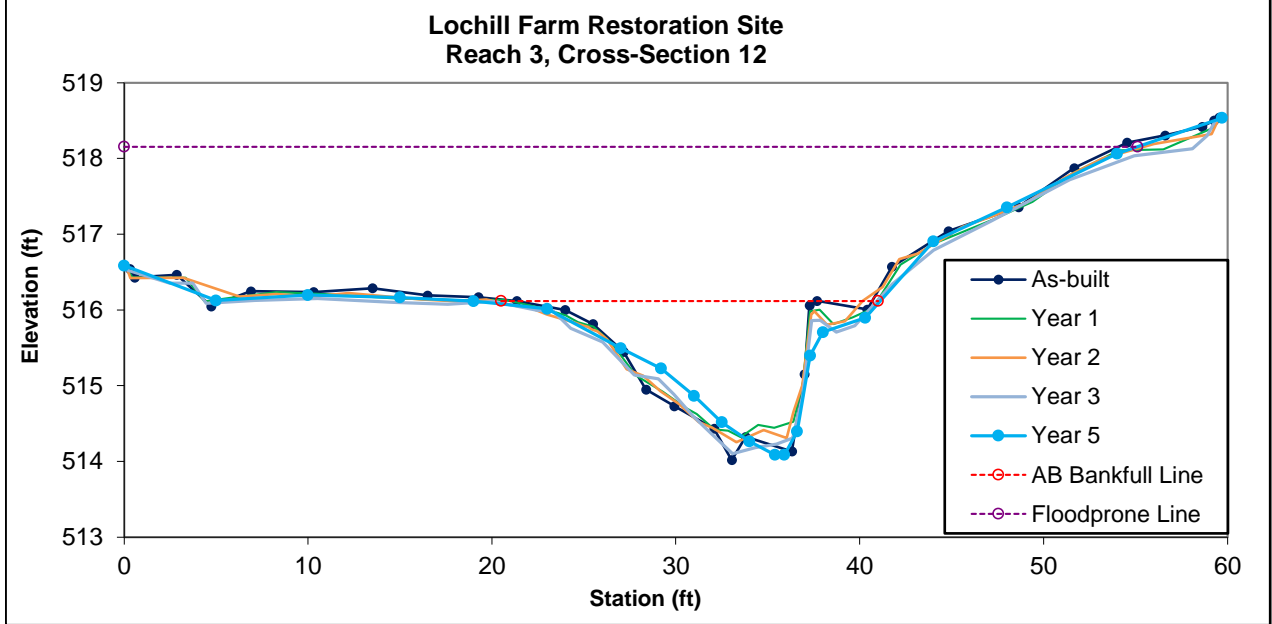


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	AB BKF Elev	LTOB Elev
Pool	--	17.2	22.6	0.8	2.0	29.6	--	--	516.12	515.70



**Table 8. Baseline Stream Data Summary**  
**Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083**

Reach 1																	
Parameter	Pre-Existing Condition				Reference Reach(es) Data				Design				As-built				
					Composite												
Dimension and Substrate - Riffle	Min	Mean	Med	Max	Min	Mean	Med	Max	Min	Mean	Med	Max	Min	Mean	Med	Max	
BF Width (ft)	10.1	12.4	----	14.6	8.7	16.8	14.7	33.2	----	15.7	----	----	14.6	16.0	16.6	16.9	
Floodprone Width (ft)	13	56	----	99	26	79	52	229	65	83	----	100	73	75	75	76	
BF Mean Depth (ft)	1.3	1.6	----	1.9	0.9	1.2	0.9	2.3	----	1.2	----	----	0.9	1.2	1.2	1.3	
BF Max Depth (ft)	1.9	2.3	----	2.6	1.4	1.8	1.5	2.8	----	1.5	----	----	1.4	1.7	1.6	1.9	
BF Cross-sectional Area (ft <sup>2</sup> )	15.3	19.4	----	23.5	10.6	23.3	13.6	75.1	----	19.0	----	----	15.5	18.6	18.3	22.7	
Width/Depth Ratio	5.2	7.9	----	10.6	7.3	14.5	14.5	18.6	----	13.0	----	----	12.0	14.0	12.5	18.4	
Entrenchment Ratio	1.5	5.0	----	8.5	2.0	6.6	2.9	26.3	4.1	5.3	----	6.4	4.4	4.7	4.5	5.2	
Bank Height Ratio	1.7	2.2	----	2.6	1.0	1.0	1.0	1.0	----	1.0	----	----	1.0	1.0	1.0	1.0	
d50 (mm)	17.7	21.7	----	25.6	----	----	----	----	----	----	----	----	36	54	59	64	
<b>Pattern</b>																	
Channel Beltwidth (ft)	25	47	----	68	14	31	28	52	56	91	----	125	55	71	73	83	
Radius of Curvature (ft)	23	44	----	65	5	18	19	26	31	39	----	47	30	36	35	49	
Rc/Bankfull width (ft/ft)	1.5	4.0	----	6.4	0.6	1.5	1.4	2.5	2.0	2.5	----	3.0	1.9	2.3	2.2	3.0	
Meander Wavelength (ft)	52	87	----	121	32	87	74	196	112	152	----	192	124	155	152	199	
Meander Width Ratio	1.7	4.2	----	6.7	1.1	2.7	2.4	6.0	3.6	5.8	----	8.0	3.4	4.4	4.6	5.2	
<b>Profile</b>																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	19	48	48	82	
Riffle Slope (ft/ft)	----	0.0260	----	----	0.0100	0.0282	0.0190	0.0670	0.0062	0.0075	----	0.0101	0.0046	0.0070	0.0068	0.0120	
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	21	35	33	62	
Pool to Pool Spacing (ft)	49	130	----	211	13	92	64	277	64	87	----	110	49	98	102	140	
Pool Max Depth (ft)	4.2	5.5	----	6.8	1.8	2.6	2.5	4.1	2.5	3.3	----	4.0	2.8	3.3	3.3	3.9	
<b>Substrate and Transport Parameters</b>																	
SC% / Sa% / G% / C% / Bo%	1% / 10% / 77% / 11% / 1%				----	----	----	----	----	----	----	----	0% / 1% / 61% / 38% / 1%				
d16 / d35 / d50 / d84 / d95	4 / 9 / 13 / 49 / 110				----	----	----	----	----	----	----	----	23 / 41 / 54 / 96 / 158				
<b>Additional Reach Parameters</b>																	
Drainage Area (SM)	----	1.59	----	----	0.41	2.57	0.75	8.35	----	1.59	----	----	----	1.59	----	----	
Impervious cover estimate (%)	----	0.27%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Rosgen Classification	----	E4	----	----	----	C4	----	----	----	C4	----	----	----	C4	----	----	
BF Velocity (fps)	3.2	3.8	----	4.3	3.5	4.3	----	5.0	----	3.9	----	----	----	----	----	----	
BF Discharge (cfs)	----	75	----	----	----	----	----	----	----	75	----	----	----	----	----	----	
Valley Length	----	2,559	----	----	----	----	----	----	----	2,559	----	----	----	2,559	----	----	
Channel Length (ft)	----	2,936	----	----	----	----	----	----	----	3,252	----	----	----	3,245	----	----	
Sinuosity	----	1.15	----	----	1.2	1.3	----	1.4	----	1.27	----	----	----	1.27	----	----	
Water Surface Slope (Channel) (ft/ft)	----	0.0081	----	----	0.0070	0.0112	0.0132	0.0133	0.0052	0.0066	----	0.0153	----	0.0066	----	----	

**Table 8. Baseline Stream Data Summary**  
**Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083**

Reach 3																	
Parameter	Pre-Existing Condition				Reference Reach(es) Data				Design				As-built				
	Min	Mean	Med	Max	Min	Mean	Med	Max	Min	Mean	Med	Max	Min	Mean	Med	Max	
<b>Dimension and Substrate - Riffle</b>																	
BF Width (ft)	6.2	8.6	----	11.0	----	----	----	----	----	11.0	----	----	----	11.8	----	----	----
Floodprone Width (ft)	14	37	----	60	----	----	----	----	24.0	42.0	----	60.0	----	60.3	----	----	----
BF Mean Depth (ft)	0.9	1.1	----	1.2	----	----	----	----	0.9	----	----	----	----	1.0	----	----	----
BF Max Depth (ft)	1.3	1.4	----	1.4	----	----	----	----	1.2	----	----	----	----	1.5	----	----	----
BF Cross-sectional Area (ft <sup>2</sup> )	7.5	9.1	----	10.6	----	----	----	----	10.3	----	----	----	----	12.1	----	----	----
Width/Depth Ratio	5.2	8.3	----	11.3	12	15	----	18	12.2	----	----	----	----	11.5	----	----	----
Entrenchment Ratio	2.3	3.9	----	5.4	----	----	----	----	2.2	3.9	----	5.5	----	5.1	----	----	----
Bank Height Ratio	1.6	1.7	----	1.7	----	1.0	----	----	1.0	----	----	----	----	1.0	----	----	----
d50 (mm)	----	23.0	----	----	----	----	----	----	----	----	----	----	----	55	----	----	----
<b>Pattern</b>																	
*Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	54	57	----	60	55	57	56	61	
*Radius of Curvature (ft)	----	----	----	----	----	----	----	----	27	30	----	33	26	30	31	33	
*Rc/Bankfull width (ft/ft)	----	----	----	----	2.0	2.5	----	3.0	2.0	2.5	----	3.0	2.2	2.5	2.6	2.8	
*Meander Wavelength (ft)	----	----	----	----	----	----	----	----	96	123	----	150	94	125	128	153	
*Meander Width Ratio	----	----	----	----	3.5	6.8	----	10.0	4.9	5.2	----	5.5	4.7	4.9	4.7	5.2	
<b>Profile</b>																	
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	24	40	36	60	
Riffle Slope (ft/ft)	----	0.0258	----	----	----	----	----	----	----	0.027	----	----	----	0.027	----	----	
Pool Length (ft)	----	----	----	----	----	----	----	----	----	----	----	----	16	25	27	34	
Pool to Pool Spacing (ft)	20	36	----	51	----	----	----	----	20	39	----	57	12	34	32	70	
Pool Max Depth (ft)	1.4	1.7	----	2.0	----	----	----	----	----	2.5	----	----	----	2.1	----	----	
<b>Substrate and Transport Parameters</b>																	
SC% / Sa% / G% / C% / B%		1% / 11% / 68% / 20% / 0%				----	----	----	----	----	----	----	----	0% / 0% / 60% / 39% / 1%			
d16 / d35 / d50 / d84 / d95		5.9 / 13 / 23 / 79 / 141				----	----	----	----	----	----	----	----	31 / 43 / 55 / 113 / 170			
<b>Additional Reach Parameters</b>																	
Drainage Area (SM)	----	0.30	----	----	----	----	----	----	----	0.30	----	----	----	0.30	----	----	----
Impervious cover estimate (%)	----	0.27%	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
*Rosgen Classification	----	B4 to E4b	----	----	----	C4b	----	----	----	C4b	----	----	----	C4b	----	----	----
BF Velocity (fps)	3.6	5.5	----	7.4	4.0	5.0	----	6.0	4.4	----	----	----	----	----	----	----	----
BF Discharge (cfs)	----	45	----	----	----	----	----	----	45	----	----	----	----	----	----	----	----
Valley Length	----	1,488	----	----	----	----	----	----	1,488	----	----	----	----	1,488	----	----	----
Channel Length (ft)	----	1,599	----	----	----	----	----	----	1,616	----	----	----	----	1,622	----	----	----
Sinuosity	----	1.07	----	----	1.1	1.2	----	1.3	1.09	----	----	----	----	1.09	----	----	----
Water Surface Slope (Channel) (ft/ft)	----	0.0220	----	----	----	----	----	----	0.0216	----	----	----	----	0.0213	----	----	----

\* These parameters apply only to the upper portion of Reach R3 where the channel was relocated with improved pattern, profile, and in-stream structures.

**Table 9. Cross-Section Morphology Data Summary**  
**Lochill Farm Stream Mitigation Project - NCDMS Project No. 97083**

Stream Reach	Reach 1																											
	Cross-section X-1 (Riffle)							Cross-section X-2 (Pool)							Cross-section X-3 (Pool)							Cross-section X-4 (Riffle)						
Dimension and substrate	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Based on fixed baseline bankfull elevation</b>																												
BF Width (ft)	15.2	14.8	14.1	14.5	14.7			21.0	22.3	21.1	18.4	16.9			21.5	20.2	23.5	19.3	22.5			16.6	17.4	16.4	15.9	16.5		
BF Mean Depth (ft)	1.3	1.3	1.2	1.1	1.0			1.5	1.4	1.3	1.3	1.3			1.6	1.9	1.6	2.1	1.8			1.1	1.1	1.1	1.1	1.1		
Width/Depth Ratio	12.0	11.7	11.7	13.3	15.1			13.7	16.1	16.3	13.7	12.9			13.8	10.8	14.8	9.2	12.7			15.0	16.5	15.4	14.4	15.4		
BF Cross-sectional Area (ft²)	19.4	18.5	17.1	15.7	14.3			32.3	31.3	27.2	24.6	22.1			33.6	37.7	37.2	40.6	39.8			18.3	18.5	17.5	17.7	17.7		
BF Max Depth (ft)	1.9	1.8	1.8	1.8	1.7			3.2	2.9	2.7	2.7	2.6			3.3	3.6	3.6	3.8	3.8			1.6	1.6	1.6	1.7	1.6		
Width of Floodprone Area (ft)	75	75	75	75	75			-	-	-	-	-			-	-	-	-	-			73	73	73	73	73		
Entrenchment Ratio	4.9	5.1	5.3	5.2	4.6			-	-	-	-	-			-	-	-	-	-			4.4	4.2	4.5	4.6	4.4		
Bank Height Ratio (MY5 will provide standard)*	1.0	1.0	0.9	0.9	1.0			-	-	-	-	-			-	-	-	-	-			1.0	1.0	1.0	1.0	0.9		
Wetted Perimeter (ft)	15.9	15.5	14.8	15.1	15.2			22.8	24.1	22.5	20.2	18.5			23.5	22.2	25.5	21.7	24.5			17.2	18.0	16.9	16.5	17.0		
Hydraulic Radius (ft)	1.2	1.2	1.2	1.0	0.9			1.4	1.3	1.2	1.2	1.2			1.4	1.7	1.5	1.9	1.6			1.1	1.0	1.0	1.1	1.0		
d50 (mm)	36	-	-	-	-			-	-	-	-	-			-	-	-	-	-			-	-	-	-	-		
<b>Stream Reach</b>	<b>Reach 1</b>																											
Dimension and substrate	Cross-section X-5 (Riffle)							Cross-section X-6 (Pool)							Cross-section X-7 (Pool)							Cross-section X-8 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Based on fixed baseline bankfull elevation</b>																												
BF Width (ft)	16.9	15.0	15.4	15.0	15.4			19.6	20.8	23.6	21.8	26.7			16.8	18.0	16.5	17.0	19.3			14.6	14.9	14.4	14.4	15.0		
BF Mean Depth (ft)	0.9	1.0	0.9	0.9	0.9			2.0	2.1	1.8	1.9	1.5			1.5	1.4	1.5	1.5	1.4			1.2	1.2	1.3	1.3	1.2		
Width/Depth Ratio	18.4	14.9	16.6	16.1	16.6			9.6	9.9	12.9	11.4	17.9			11.4	12.5	10.7	11.5	14.3			12.3	12.3	11.2	11.2	12.3		
BF Cross-sectional Area (ft²)	15.5	15.0	14.4	14.0	14.3			40.1	43.4	43.0	41.8	40.0			24.7	26.1	25.4	25.1	26.0			17.3	18.0	18.5	18.3	18.3		
BF Max Depth (ft)	1.4	1.4	1.4	1.3	1.3			3.9	4.1	4.0	4.3	3.8			2.8	2.5	2.6	2.6	2.5			1.6	1.7	1.8	1.8	1.7		
Width of Floodprone Area (ft)	76	76	76	76	76			-	-	-	-	-			-	-	-	-	-			75	75	75	75	75		
Entrenchment Ratio	4.5	5.1	4.9	5.0	4.7			-	-	-	-	-			-	-	-	-	-			5.2	5.0	5.2	5.2	5.1		
Bank Height Ratio (MY5 will provide standard)*	1.0	1.0	0.9	1.0	1.0			-	-	-	-	-			-	-	-	-	-			1.0	1.0	1.0	1.0	1.0		
Wetted Perimeter (ft)	17.4	15.4	15.9	15.5	15.8			22.4	23.4	26.7	25.0	29.1			18.3	19.5	17.7	18.3	20.3			15.4	15.7	15.3	15.5	15.5		
Hydraulic Radius (ft)	0.9	1.0	0.9	0.9	0.9			1.8	1.9	1.6	1.7	1.4			1.4	1.3	1.4	1.4	1.3			1.1	1.1	1.2	1.2	1.2		
d50 (mm)	64	-	-	-	-			-	-	-	-	-			-	-	-	-	-			-	-	-	-	-		
<b>Stream Reach</b>	<b>Reach 1</b>												<b>Reach 3</b>															
Dimension and substrate	Cross-section X-9 (Riffle)							Cross-section X-10 (Pool)							Cross-section X-11 (Riffle)							Cross-section X-12 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
<b>Based on fixed baseline bankfull elevation</b>																												
BF Width (ft)	16.9	17.3	17.8	16.4	17.4			14.3	14.7	14.0	12.5	12.1			11.8	12.4	11.2	12.8	12.2			16.4	16.6	18.4	20.9	22.6		
BF Mean Depth (ft)	1.3	1.3	1.2	1.3	1.3			1.9	1.9	2.0	2.3	2.2			1.0	1.0	1.1	1.0	0.9			1.0	1.0	0.9	0.9	0.8		
Width/Depth Ratio	12.5	13.1	14.5	12.6	13.8			7.6	7.9	6.8	5.4	5.4			11.5	12.9	10.6	12.9	13.6			15.9	17.3	20.2	23.4	29.6		
BF Cross-sectional Area (ft²)	22.7	22.8	21.9	21.3	21.8			26.8	27.3	28.6	29.0	27.1			12.1	12.0	11.9	12.7	10.9			16.9	16.0	16.7	18.6	17.2		
BF Max Depth (ft)	1.9	2.0	1.9	2.0	2.0			3.5	3.5	3.5	3.2	2.8			1.5	1.7	1.6	1.7	1.5			2.1	1.8	1.9	2.0	2.0		
Width of Floodprone Area (ft)	75	75	75	75	75			-	-	-	-	-			60	60	60	60	60			-	-	-	-	-		
Entrenchment Ratio	4.4	4.3	4.2	4.6	4.1			-	-	-	-	-			5.1	4.8	5.4	4.7	4.4			-	-	-	-	-		
Bank Height Ratio (MY5 will provide standard)*	1.0	1.0	1.0	1.0	1.0			-	-	-	-	-			1.0	1.0	0.9	1.0	1.0			-	-	-	-	-		
Wetted Perimeter (ft)	17.7	18.3	18.8	17.4	18.5			16.3	16.6	16.4	15.2	15.2			12.5	13.1	11.8	13.6	13.6			18.0	21.4	19.4	22.0	23.4		
Hydraulic Radius (ft)	1.3	1.2	1.2	1.2	1.2			1.6	1.6	1.7	1.9	1.9			1.0	0.9	1.0	0.9	0.9			0.9	0.8	0.9	0.8	0.7		
d50 (mm)	59	-	-	-	-			-	-	-	-	-			55	-	-	-	-			-	-	-	-	-		

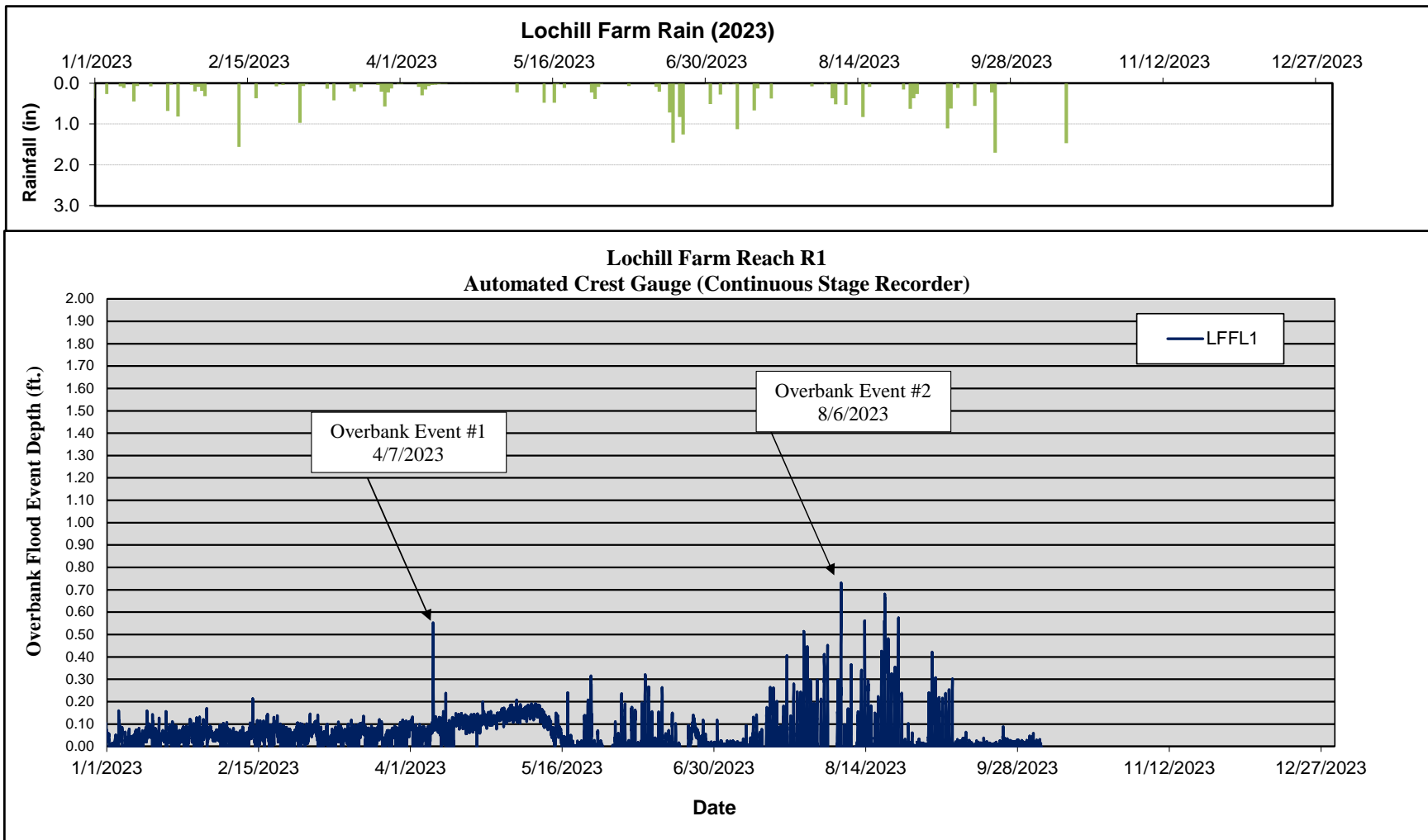
\* Per DMS/IRT request, bank height ratio for has been calculated using a bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

# **APPENDIX E**

## Hydrologic Data



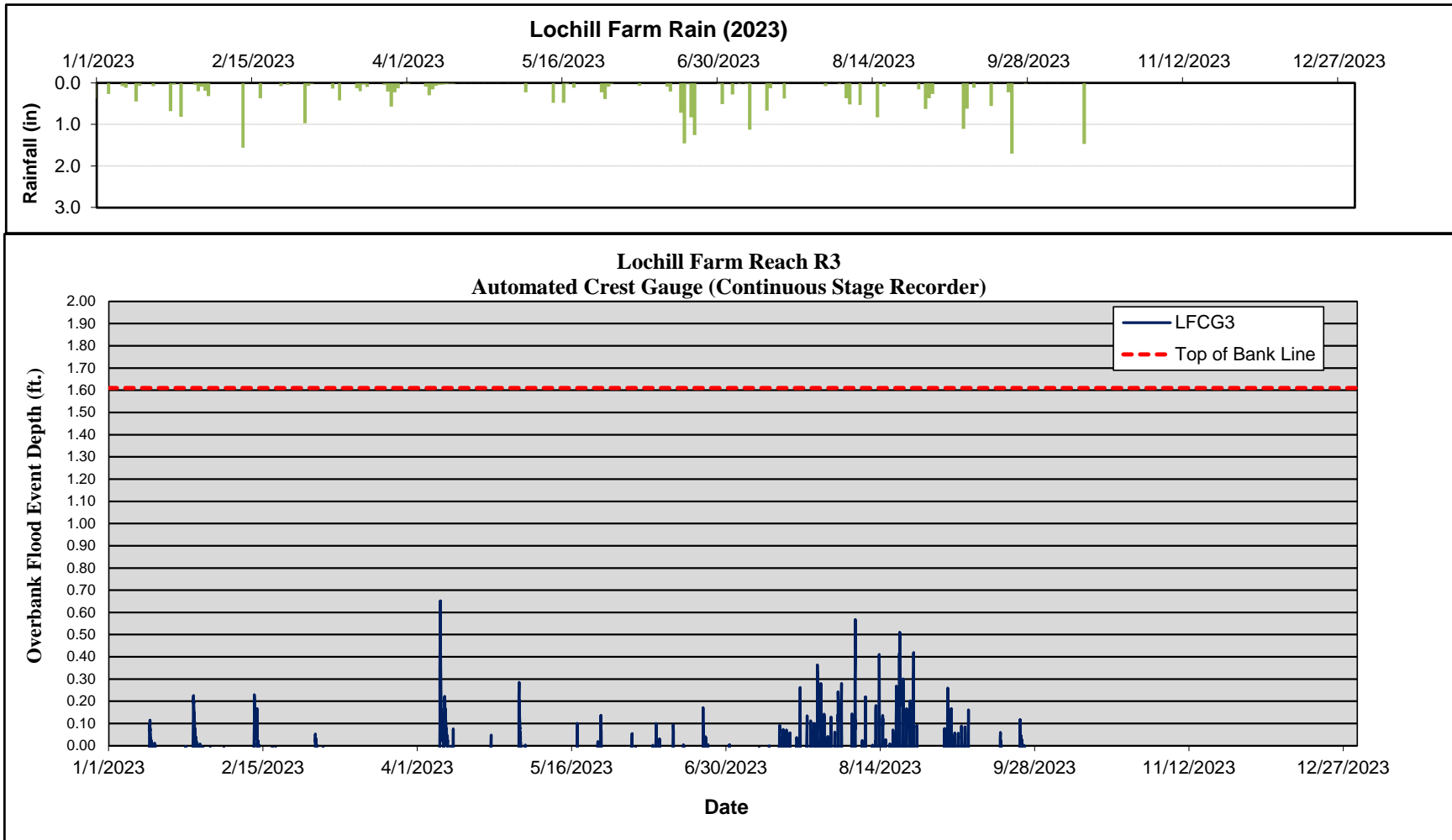
Figure 5. Automated Crest Gauge (Continuous Stage Recorder) Graph



Note: Data presented here is from 1/1/23 thru 10/4/23

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.

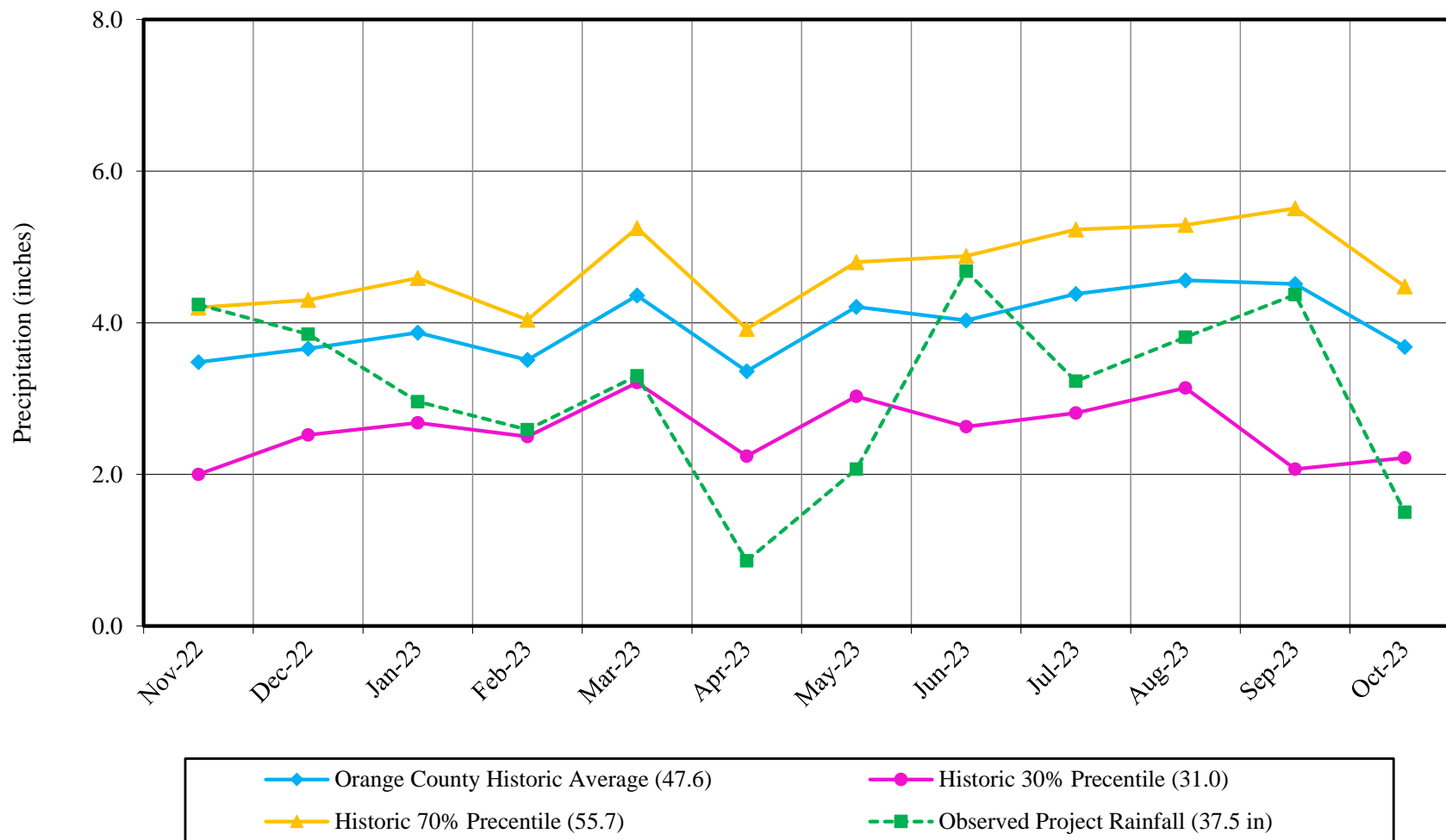
Figure 5. Automated Crest Gauge (Continuous Stage Recorder) Graph



Crest Gauge installed 7/15/2022

Note: Data presented here is from 1/1/23 thru 10/4/23

### Lochill Farm Mitigation Project MY5 Observed Rainfall versus Historic Averages



**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
<b>Year 1 Monitoring (2019)</b>					
3/7/19	N/A <sup>1</sup>	0.42 ft	N/A <sup>1</sup>	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
<b>Year 2 Monitoring (2020)</b>					
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
<b>Year 3 Monitoring (2021)</b>					
-	-	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	4/9/2021 (0.52" rain event, after previous rain events)	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
<b>Year 4 Monitoring (2022)</b>					
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
<b>Year 5 Monitoring 2023</b>					
4/7/23	N/A	0.55	N/A	3/27/2023 (.57" rain event)	Continuous Stage Recorder, Cork Crest Gauge, Photos
8/6/23	0.59	0.73	N/A	8/6/2023 (.52" 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).