FINAL
MONITORING REPORT
YEAR 3 (2020)
MUD LICK CREEK MITIGATION SITE
Chatham County, North Carolina
NCDMS Project No. 93482
Contract No. 7683
USACE Action ID No. SAW-2014-00736 & DWR Project No 2014-1127
SCO No. 1209857-01
Data Collection: September 2020
Submission: January 2021

PREPARED FOR:

N.C. DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1601 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1601

Mitigation Project Name	**Mud Lick Creek - Thomas Site**	**USACE Action ID**	**2014-00736**
DMS ID	**93482**	**DWR Permit**	**2014-1127**
River Basin	**Cape Fear**	**Date Project Instituted**	**2/13/2013**
Cataloging Unit	**03030003**	**Date Prepared**	**4/20/2020**
County	**Chatham**	**Stream/Wet. Service Area**	**Cape Fear 03030003**

Todd J Tugwell 9/21/2020

Signature & Date of Official Approving Credit Release

1 - For NCDMS, no credits are released during the first milestone

2 - For NCDMS projects, the initial credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the IRT by posting it to the DMS portal, provided the following have been met:

1) Approved of Final Mitigation Plan

2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.

3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan.

4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met.

Credit Release Milestone	**Warm Stream Credits**						
Project Credits	**Scheduled Releases %**	**Proposed Releases %**	**Proposed Released #**	**Not Approved # Releases**	**Approved Credits**	**Anticipated Release Year**	**Actual Release Date**
1 - Site Establishment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 - Year 0 / As-Built	30.00%	30.00%	849.700	0.000	849.700	2018	11/5/2018
3 - Year 1 Monitoring	10.00%	10.00%	283.233	0.000	283.233	2019	4/26/2019
4 - Year 2 Monitoring	10.00%	10.00%	283.233	0.000	283.233	2020	4/20/2020
5 - Year 3 Monitoring	10.00%					2021	
6 - Year 4 Monitoring	5.00%					2022	
7 - Year 5 Monitoring	10.00%					2023	
8 - Year 6 Monitoring	5.00%					2024	
9 - Year 7 Monitoring	10.00%					2025	
Stream Bankfull Standard	10.00%						
			Totals	0.000	1,416.166		

Total Gross Credits	2,832.333
Total Unrealized Credits to Date	0.000
Total Released Credits to Date	1,416.166
Total Percentage Released	50.00%
Remaining Unreleased Credits	1,416.167

Notes

Contingencies (if any)

Project Quantities

Mitigation Type	**Restoration Type**	**Physical Quantity**
Warm Stream	Restoration	1,215.000
Warm Stream	Enhancement II	2,426.000

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County	**Chatham**	**Stream/Wet. Service Area**	**Cape Fear 03030003**

Debits

							Stream Restoration Credits
Beginning Balance (mitigation credits)							**2,832.333**
Released Credits							**1,416.166**
Unrealized Credits							**0.000**
Owning Program	**Req. Id**	**TIP #**	**Project Name**	**USACE Permit #**	**DWR Permit #**	**DCM Permit #**	
NCDOT Stream & Wetland ILF Program	REQ-007390	U-2412A	SR 1486 / SR 4121 Improvements	2000-21876	2012-0211		283.233
NCDOT Stream & Wetland ILF Program	REQ-007390	U-2412A	SR 1486 / SR 4121 Improvements	2000-21876	2012-0211		364.500
NCDOT Stream & Wetland ILF Program	REQ-007390	U-2412A	SR 1486 / SR 4121 Improvements	2000-21876	2012-0211		485.200
Total Credits Debited							**1,132.933**
Remaining Available balance (Released credits)							**283.233**
Remaining balance (Unreleased credits)							**1,416.167**

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PREPARED BY:

AXIOM ENVIRONMENTAL, INC.
218 SNOW AVENUE
RALEIGH, NORTH CAROLINA 27603

Axiom Environmental, Inc.

Axiom Environmental, Inc.
218 Snow Avenue, Raleigh, NC 27603 919-215-1693

January 4, 2021

Mr. Jeremiah Dow
North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

RE: Mud Lick Creek Monitoring (DMS Project # 93482, Contract #7683)
Final MY3 (2020) Annual Monitoring Report

Dear Mr. Dow:

Axiom Environmental, Inc. (AXE) is pleased to provide you with one hard copy and a CD of digital files for the Final Mud Lick Creek MY3 (2020) Annual Monitoring Report. We received your comments via email on December 18, 2020 and have addressed them as follows:

1. Please verify the restoration reaches that had bankfull events. Was it both restoration reaches that had bankfull events in 2019 and 2020?
   Table 12 was updated to indicate where wrack, etc. was observed and which crest gauges indicated bankfull events. For all events documented in 2019 and 2020, all crest gauges indicated a bankfull event had occurred even when other indicators were observed only on individual reaches.

2. Please add a brief discussion of the beaver activity observed in the Visual Assessment section and include that the beavers were trapped and the six dams removed by the USDA on November 4
   A brief discussion of beaver management activities was included in the "Project Boundaries & Visual Assessments" section of the report.

3. Please add removed beaver dam location to the Figure 2 CCPV.
   The locations of the 2 larger removed dams were included on Figure 2.

Please let me know if you have any questions or comments regarding any component of this submittal. Thank you for the opportunity to continue to assist the Division of Mitigation Services with this important project.

Sincerely,
AXIOM ENVIRONMENTAL, INC

Kenan Jernigan

Attachments: 1 hard copy Final MY3 (2020) Mud Lick Creek Annual Monitoring Report
1 CD containing digital support files

PROJECT SUMMARY

The North Carolina Division of Mitigation Services (NCDMS) has established the Mud Lick Creek Mitigation Site (Site) located within the Cape Fear River Basin Cataloging Unit (CU) 03030003 in the Upper Rocky River local watershed planning (LWP) area and 14-digit HUC 03030003070010. The Site was identified as a priority mitigation project in the *Detailed Assessment and Targeting of Management Report* (Tetra Tech 2005). The main stressors to aquatic resources identified during the watershed assessments described in the LWP documents include the following.

- Nutrient (nitrogen and phosphorous) loading from farming;
- Sediment loading from overland runoff, disturbed surfaces, and streambank erosion;
- Cattle access to streams increasing bank erosion and fecal coliform contamination; and
- Insufficient bank vegetation.

The project will contribute to meeting management recommendations to offset these stressors as described above for the LWP area by accomplishing the following primary goals.

- Control and reduce nutrient sources from the Site;
- Reduce sediment loads from disturbed areas on the Site and from eroding stream banks;
- Increased aeration of flows within the project extent promoting increases in dissolved oxygen concentrations;
- Reduce sources of fecal coliform pollution;
- Improve instream habitat;
- Reduce thermal loadings;
- Reconnect channels with floodplains and raise local water table; and
- Restore riparian habitat.

These goals will be accomplished through the following objectives:

- Restore riparian vegetation on the Site and thereby reduce sediment loads to streams from stream banks and existing pastures, increase on-Site retention of sediment and nutrients, create riparian habitat, and provide shade for streams to reduce thermal loadings;
- Stabilize eroding streambanks to reduce sediment inputs;
- Install fencing around the perimeter of the conservation easement to eliminate livestock access to streams, thereby reducing sediment, nutrient, and fecal coliform inputs;
- Plant restored and stabilized streambanks with native species to improve stability and habitat;
- Install instream structures to improve stability, create habitat, and help aerate stream flows;
- Raise streambeds to reconnect restored channels to floodplains and raise local water tables; and
- Restore streams and vegetation so the Site looks natural and aesthetically pleasing.

Stream Success Criteria: The stream restoration performance criteria for the Site will follow approved performance criteria presented in the 2015 *Mud Lick Creek Mitigation Site Final Mitigation Plan* as described below.

Stream Dimension: Riffle cross-sections on the restoration reaches and enhancement II reaches, where banks were re-graded (three reaches of Mud Lick Creek), should be stable and should show little change in bankfull area, maximum depth, and width-to-depth ratio. Bank-height-ratios shall not exceed 1.2 and entrenchment ratios shall be at least 2.2 for restored channels to be considered stable. All riffle cross-sections should fall within the parameters defined for channels of the appropriate stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in

the width-to-depth ratio in meandering channels or an increase in pool depth. Remedial action would not be taken if channel changes indicate a movement toward stability.

Stream Pattern and Profile: The as-built survey will include a longitudinal profile for the baseline monitoring report. Longitudinal profile surveys will not be conducted during the seven-year monitoring period unless other indicators during the annual monitoring indicate a trend toward vertical and lateral instability.

Substrate: Substrate materials in the restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

Hydraulics: Two bankfull flow events, in separate monitoring years, must be documented on the restoration reaches and enhancement II reaches where banks were re-graded (three reaches of Mud Lick Creek) within the seven-year monitoring period.

Vegetation Success Criteria: The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of the required monitoring period (year seven). The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of the third monitoring year and at least 260 stems per acre at the end of the fifth year of monitoring. If this performance standard is met by year five and stem density is trending towards success (i.e., no less than 260 stems/acre), monitoring of vegetation on the Site may be terminated with written approval by the USACE in consultation with the NC Interagency Review Team. The extent of invasive species coverage will also be monitored and controlled as necessary throughout he required monitoring period (seven years).

Photo Documentation: Photographs should illustrate the Site's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent bars within the channel or vertical incision. Grade control structures should remain stable. Deposition of sediment on the bank side of vane arms is preferable. Maintenance of scour pools on the channel side of vane arms is expected.

Visual Assessments: Visual assessments should support performance standards as described above.

As per Sections 7.2 and 12.4 of the Mitigation Plan, physio-chemical and biological parameters were included as part of specialized monitoring, depending on the data that could be obtained during the baseline period. Monitoring of these parameters was for investigative purposes only and not tied to mitigation success or credit. The sample size and variability of the pre-construction physio-chemical data was inadequate for the purposes of post-construction comparison and therefore, these will not be monitored moving forward. However, fish and macrobenthos will be monitored at the stations indicated in the asset and monitoring features map (Figure 2, Appendix B).

Site Background: The Site is located in northwestern Chatham County, north of Siler City and northwest of Silk Hope (Figure 1, Appendix B). The Site is located within United States Geological Survey (USGS) Hydrologic Unit and Targeted Local Watershed 03030003070010 (North Carolina Division of Water Resources Subbasin 03-06-12) of the Cape Fear River Basin. Prior to construction, the Site was used for agricultural livestock production. The proposed project will improve water quality as well as provide numerous ecological benefits within the Cape Fear River Basin. The project will help meet management recommendations of the *Upper Rocky River Local Watershed Plan* by restoring a vegetated riparian buffer zone, stabilizing eroding stream banks, and removing livestock from streams and riparian zones. These activities will result in reduced nutrient, sediment, and fecal coliform inputs; improved aquatic and riparian habitat, and other ecological benefits.

Mitigation Components: Project mitigation efforts will generate 2832 Stream Mitigation Units (SMUs) as the result of the following (Table 1, Appendix A & Figure 2, Appendix B).

- Restoration of 1215 linear feet of Site streams
- Enhancement (Level II) of 2426 linear feet of Site streams

Site design was completed in June 2015. Site construction occurred May 24–August 25, 2017 (final walkthrough) and the Site was planted in February 2018. Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A). The assets and credits in the report and shown in Table 1 are based upon approved as-built numbers as approved by the IRT on 11/1/2018.

TABLE OF CONTENTS

APPENDICES

1.0 METHODS

Monitoring of restoration efforts will be performed for seven years, or until success criteria are fulfilled. Monitoring is proposed for the stream channel and vegetation. In general, the restoration success criteria, and required remediation actions, are based on the *Stream Mitigation Guidelines* (USACE et al. 2003). Monitoring features are summarized in the following table and described below; monitoring features are depicted on Figure 2 (Appendix B).

Monitoring Summary

Parameter	Monitoring Feature	Quantity	Frequency
Streams			
Dimension	Cross-sections	7 riffles & 3 pools	annually
Substrate	Pebble counts	3 riffles	annually
Hydrology	Crest gauges	3	annually
Vegetation	Vegetation Plots	12	annually
	Warranty Plots	10	MY1
Visual assessments		Entire Site	biannually
Exotic & nuisance species		Entire Site	annually
Project boundary		Entire Site	annually
Reference photographs		22	annually
Supplemental Monitoring			
Biological	Macrobenthos	5 sites (Preconstruction only) 3 sites (MY3, MY5, & MY7)	
	Fish	3 sites (Preconstruction only) 2 sites (MY4 & MY7)	

Streams

The restored stream reaches are proposed to be monitored for geometric activity as follows.

- 7 permanent riffle cross-sections
- 3 permanent pool cross-sections
- 3 riffle pebble count samples for substrate analysis
- 3 stream crest gauges

The data will be presented in graphic and tabular format. Data to be presented will include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, and 5) width-to-depth ratio. Substrate analysis will be evaluated through pebble counts at three riffle cross-sections and data presented as a D50 for stream classification and tracking purposes. The stream will subsequently be classified according to stream geometry and substrate (Rosgen 1996). Significant changes in channel morphology including bank-height-ratios and entrenchment ratios will be tracked and reported by comparing data to asbuilt measurements in addition to each successive monitoring year. Annual photographs will include 22 fixed station photographs (12 vegetation plots and 10 cross-sections) (Appendix B). In addition, the Site contains three stream crest gauges to assist with documentation of bankfull events. Two bankfull events were documented during monitoring year 3 (2020), making a total of 5 bankfull events over the monitoring period to date (Table 12, Appendix E).

Two stream areas of concern were observed during monitoring year 3 (2020). Stream Area of Concern #1 was previously documented during years 1 and 2 (2018 and 2019) along Mud Lick Creek R2 where

approximately 50 feet of the right bank and 20 feet of the left bank had eroded to the point of bank sloughing. This area remains unchanged from year 1 (2018); however, with the establishment of some herbaceous vegetation, appears relatively stable. Stream Area of Concern #2 consists of scour and sloughing along an outer bend along Mud Lick Creek R3, immediately downstream from cross-section 1. It was noted during year 3 (2020) that the material that had sloughed form the bank was stable and well-vegetated. Both stream areas of concern were observed within enhancement II stream reaches; stream reaches generating restoration credit were stable throughout and functioning as designed. These areas are depicted on Figure 2 in Appendix B.

Vegetation

Restoration monitoring procedures for vegetation will monitor plant survival and species diversity. Planting occurred within the entire Site. After planting of the area was completed, 12 vegetation plots were installed and monitored at the Site; annual results can be found in Appendix C. Annual measurements of vegetation will consist of the following.

- 10 plant warranty inspection plots (only MY1)
- 12 CVS vegetation plots

A photographic record of plant growth should be included in each annual monitoring report; baseline photographs are included in Appendix B. During the first year, vegetation will receive a cursory, visual evaluation on a periodic basis to ascertain the degree of overtopping of planted elements by nuisance species. Subsequently, quantitative sampling of vegetation will be performed as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008) in late fall/early winter of the first monitoring year and annually toward the end of the growing for the remainder of the monitoring period until vegetation success criteria are achieved.

Locations of exotic and nuisance vegetation will be documented and depicted on Figure 2 (Appendix B).

Measurements of temporary warranty plots and permanent CVS plots in Year 1 (2018) resulted in a total of 210 living planted stems in 22 plots (392 planted living stems per acre). Therefore, DMS sent a letter to the planting contractor invoking the warranty on survivability of planted stems. Approximately 700 bare roots were planted in five targeted areas within the site during January 2019. A map of these area as well as a plant list are provided in Appendix F.

Year 3 (2020) stem count measurements for twelve permanent CVS plots indicate the planted stem density across the Site is 323 planted stems per acre. Eight of the twelve individual CVS plots met success criteria based on planted stems alone; however, when including naturally recruited stems of black walnut (*Juglans nigra*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and box elder (*Acer negundo*), the stem densities of plots 6, 7, and 12 are above success criteria (Table 8, Appendix C). Several areas remain below success criteria primarily due to herbaceous competition. Additionally, several populations of dense Chinese privet (*Ligustrum sinense*) and tree of heaven (*Ailanthus altissima*) were observed scattered throughout the Site. These are depicted on Figure 2 (Appendix B).

Project Boundaries & Visual Assessments

Locations of any fence damage, vegetation damage, boundary encroachments, etc. will be documented and included on mapping.

Visual assessments will be performed along all streams on a bi-annual basis during the seven-year monitoring period. Problem areas will be noted such as channel instability (i.e. lateral and/or vertical

instability, in-stream structure failure/instability and/or piping, headcuts), vegetated buffer health (i.e. low stem density, vegetation mortality, invasive species or encroachment), beaver activity, or livestock access. Areas of concern will be mapped and photographed accompanied by a written description in the annual report. Problem areas will be re-evaluated during each subsequent visual assessment.

During year 3 (2020) monitoring, onsite beaver activity was observed including a dam along North Branch R3, a dam along Mud Lick Creek R2, and several smaller dams throughout the Site. In response, on November 4, 2020, USDA trapped beaver and removed six dams. Beaver activity will continue to be closely monitored throughout the remaining monitoring period. The locations of the two major removed dams are depicted on Figure 2 (Appendix B).

Supplementary Monitoring

Supplemental monitoring will include biological monitoring in the Spring as follows.

- 3 benthos sampling sites (MY3, MY5, & MY7)
- 2 fish sampling sites (MY4 & MY7)

These parameters are being monitored for analytical purposes and are not tied to mitigation success and associated credit releases. The primary criteria for indication of improvement for the benthos and fish will be an increase of at least one bioclassification between the pre-con assessment and the post-con monitoring. Richness and EPT metrics will be analyzed as well. Benthic results for MY3 (2020) are included in Appendix G. A summary of benthic results including preconstruction Habitat Field Data Assessment Sheets and Biotic Index values from laboratory analysis results is presented below.

Site	MLC-2		MLC-3		MLC-5	
Habitat Assessment Field Data Sheet Data	**Precon (2015)**	**MY 3 (2020)**	**Precon (2015)**	**MY 3 (2020)**	**Precon (2015)**	**MY 3 (2020)**
Channel Modification	5	3	5	3	4	5
Instream Habitat	11	14	11	11	9	18
Bottom Substrate	3	8	3	11	1	11
Pool Variety	4	10	6	10	0	10
Riffle Habitats	7	14	7	10	0	16
Bank Stability and Veg	8	4	13	6	10	14
Light Penetration	7	7	7	7	2	2
Riparian Veg Zone Width	2	10	1	10	12	10
Total Score	**47**	**70**	**53**	**68**	**26**	**86**
Biotic Index	6.01	8.05	6.64	6.31	6.90	5.90

Based on values tabulated on Habitat Assessment Field Data Sheets, benthic macroinvertebrate habitat appears to be improving at the Site. Overall values for the data sheets improved by 15 to 60 points. In addition, each independent variable on the data sheets show improvement, except for channel modification. Biotic index (tolerance of a stream benthic community) has not shown significant improvement, with station MLC-2 shifting from a Fairly Poor to Very Poor designation. The other two stations appear to have biotic indices showing improving water quality shifting from Poor to Fairly Poor.

2.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

North Carolina Division of Mitigation Services (NCDMS) 2015. Mud Lick Creek Mitigation Site Final Mitigation Plan.

Rosgen D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Tetra Tech, 2005. Upper Rocky River Local Watershed Plan Preliminary Findings Report. Prepared for the North Carolina Ecosystem Enhancement Program.

United States Army Corps of Engineers (USACE), United States Environmental Protection Agency (USEPA), North Carolina Wildlife Resources Commission (NCWRC), Natural Resources Conservation Service (NRCS), and North Carolina Division of Water Quality (NCDWQ). 2003. Stream Mitigation Guidelines. State of North Carolina.

Appendix A.
Background Tables

Table 1. Project Mitigation Components
Table 2. Project Activity and Reporting History
Table 3. Project Contacts Table
Table 4. Project Attributes Table

Table 1. Mud Lick Creek (ID-93482) - Mitigation Assets and Components**

Project Component (reach ID, etc.)	Wetland Position and HydroType	Existing Footage	Stationing	Mitigation Plan Footage	As-Built Footage *	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Credits	Notes/Comments
North Branch R1		318	100+10 - 103+28	327	318	EII	-	1.5	212.000	Planting, fencing
North Branch R2		522	103+28 - 108+66	520	538	R	PI	1	538.000	
North Branch R3		351	108+66 - 111+51	303	265	R	P2	1	265.000	20 LF of restoration was removed from North Branch Reach 2 in order to account for an easement break
East Branch R1		165	200+05 - 201+69	168	164	EII	-	1.5	109.333	Planting, fencing
East Branch R2		315	201+69 - 205+81	409	412	R	P2	1	412.000	
Mud Lick Creek R1		525	300+72 - 306+23	623	551	EII	-	1.5	367.333	Planting, fencing, bank repairs
Mud Lick Creek R2		718	306+23 - 313+14	693	660	EII	-	1.5	440.000	Planting, fencing, bank repairs; 31 LF of enhancement II was removed from Mud Lick Creek Reach 2 in order to account for an easement break
Mud Lick Creek R3		733	313+14 - 320+47	748	733	EII	-	1.5	488.667	Planting, fencing, bank repairs

*Reach start and end stationing may differ slightly from the mitigation plan due to removal of stream lengths that are outside the conservation easement. The upstream ends of Mud Lick Creek, North Branch, and East Branch experienced footage reductions of 72', 10', and 5' respectively, while the downstream end of Mud Lick Creek experienced a footage reduction of 17'.

**The assets and credits in the report and shown in Table 1 are based upon approved as-built numbers as approved by the IRT on 11/1/2018

Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)
		Riverine	Non-Riverine	
Restoration	1215			
Enhancement				
Enhancement I				
Enhancement II	2426			
Creation				
Preservation				
High Quality Pres				

Overall Assets Summary

Asset Category	Overall Credits
Stream	2,832.333

Table 2. Project Activity and Reporting History
Mud Lick Creek (ID-93482)

Elapsed Time Since Grading Complete: 3 years 5 months
Elapsed Time Since Planting Complete: 2 year 11 months
Number of Reporting Years: 3

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Project Institution	--	February 13, 2013
Mitigation Plan	--	December 2015
404 Permit Date	--	March 25, 2016
Final Design – Construction Plans	--	June 2015
Construction	--	August 25, 2017
Bare Root; Containerized; and B&B Plantings for the Entire Project Site	February 2018	February 2018
Baseline Monitoring Document (Year 0 Monitoring Baseline)	July 2018	September 2018
Monitoring Year 1 (2018) Document	December 2018	December 2018
Monitoring Year 2 (2019) Document	September 2019	January 2020
Monitoring Year 3 (2020) Document	September/October 2020	January 2021

Table 3. Project Contact Table

Mud Lick Creek (ID-93482)

Designer	Wildlands Engineering, Inc. (License No. F-0831) 312 West Millbrook Rd, Suite 225 Raleigh, NC 27609 Angela N. Allen, PE (919) 851-9986
Construction Plans and Sediment and Erosion Control Plans	Wildlands Engineering, Inc. (License No. F-0831) 312 West Millbrook Rd, Suite 225 Raleigh, NC 27609 Angela N. Allen, PE (919) 851-9986
Construction Contractor	North State Environmental, Inc. 2889 Lowery Street Winston Salem, NC 27101 Michael Anderson (336) 725-2010
Planting Contractor	North State Environmental, Inc. 2889 Lowery Street Winston Salem, NC 27101 Stephen Joyce (336) 725-2010
As-built Surveyors	Allied Associates, PA 4720 Kester Mill Road Winston Salem, NC 27103 David Alley (336) 765-2377
Baseline Data Collection	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis (919) 215-1693

Table 4. Project Baseline Information and Attributes

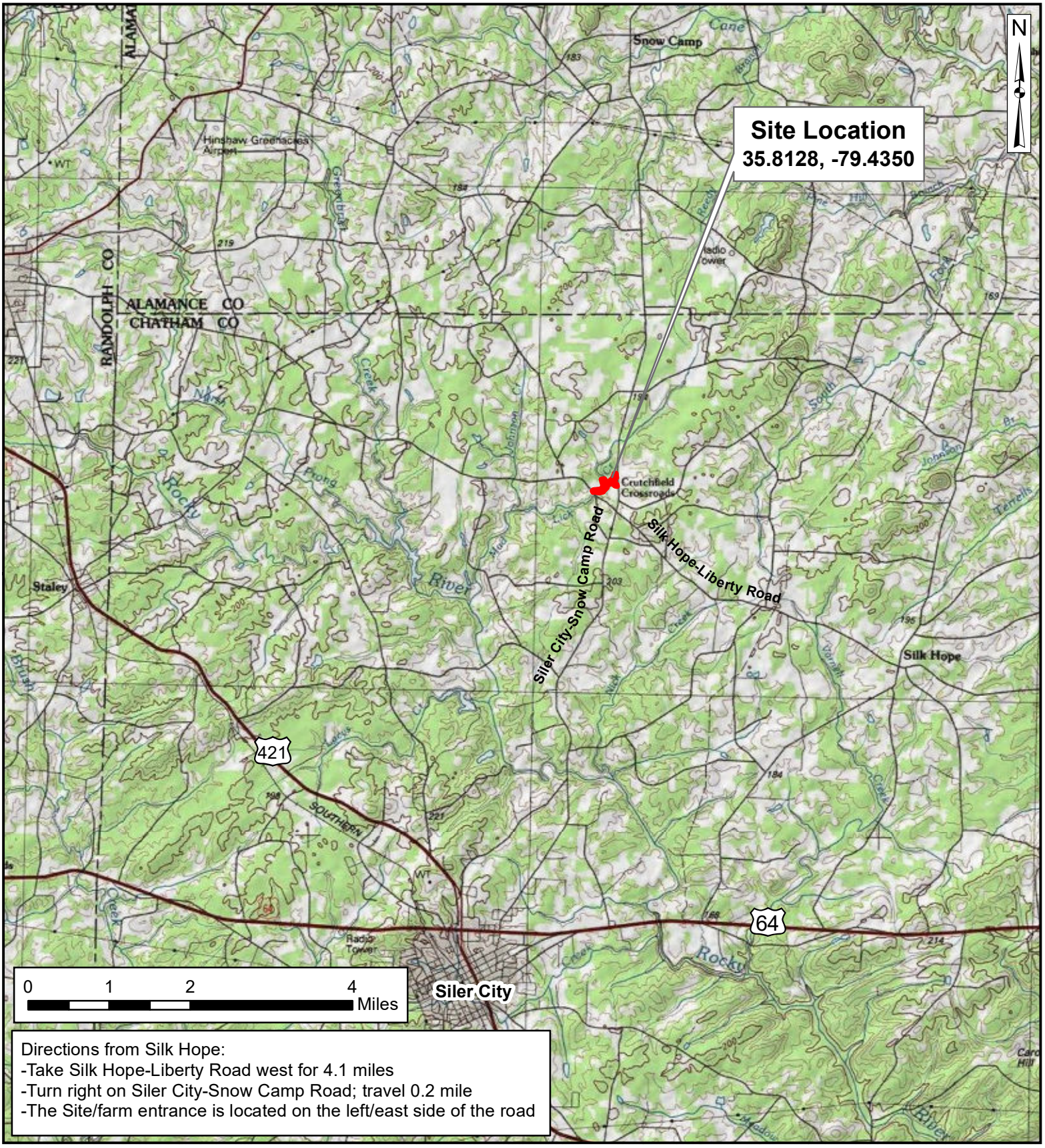
Mud Lick Creek (ID-93482)

Project Information						
Project name	Mud Lick Creek Mitigation Site					
Project county	Chatham County, North Carolina					
Project area (Acres)	11.2					
Project coordinates (lat/long)	35.8128°N, 79.4350°W					
Planted Acres	9.6					
Project Watershed Summary Information						
Physiographic region	Carolina Slate Belt of the Piedmont Physiographic Province					
Project river basin	Cape Fear River Basin					
USGS hydrologic unit (8 digit/14-digit)	03030003/03030003070010					
NCDWR Sub-basin	03-06-12					
Project drainage area (mi^2)	3.64					
% Drainage area impervious	< 1%					
CGIA land use classification	Developed, Forested/Scrubland, Agriculture/Managed Herb., Open Water					
Reach Summary Information						
Parameters	**Mud Lick Creek – R1**	**Mud Lick Creek – R2**	**Mud Lick Creek – R3**	**North Branch – R1**	**North Branch – R2**	**East Branch**
Restored length (linear feet)	551	660	733	856	265	576
Valley confinement	Slightly confined - unconfined					
Drainage area (acres/mi^2)	1747/2.73	2170/3.39	2330/3.64	236.8/0.37	416/0.65	172.8/0.27
Perennial (P), Intermittent (I)	P	P	P	P	P	P
NCDWR water quality classification	WS-III, CA					
Stream Classification (existing)	E4	C4	E4	E4	B4c	B4c
Stream Classification (proposed)	E4	C4	E4	C4	C4	C4
Evolutionary trend (Simon & Hupp)	IV/V	IV/V	IV/V	IV	IV	IV
FEMA classification	AE	AE	AE	AE	AE	AE

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the US – Section 404	Yes	Yes	SAW-2014-00736
Waters of the US – Section 401	Yes	Yes	SAW-2014-00736
Endangered Species Act	Yes	Yes	No Effect – CE Document
Historic Preservation Act	No	NA	CE Document
Coastal Zone Management Act (CZMA/CAMA)	No	NA	NA
FEMA Floodplain Compliance	Yes	Yes	Chatham County Floodplain Development Permit #14-001
Essential Fisheries Habitat	No	NA	NA

Appendix B
Visual Assessment Data

Figure 1. Site Location
Figure 2. Current Conditions Plan View
Tables 5A-5C. Visual Stream Morphology Stability Assessment
Table 6. Vegetation Condition Assessment
Vegetation Plot Photographs



Directions from Silk Hope:
-Take Silk Hope-Liberty Road west for 4.1 miles
-Turn right on Siler City-Snow Camp Road; travel 0.2 mile
-The Site/farm entrance is located on the left/east side of the road

Axiom Environmental, Inc.
Axiom Environmental
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693

SITE LOCATION
MUD LICK CREEK MITIGATION SITE
DMS PROJECT NUMBER 93482
Chatham County, North Carolina

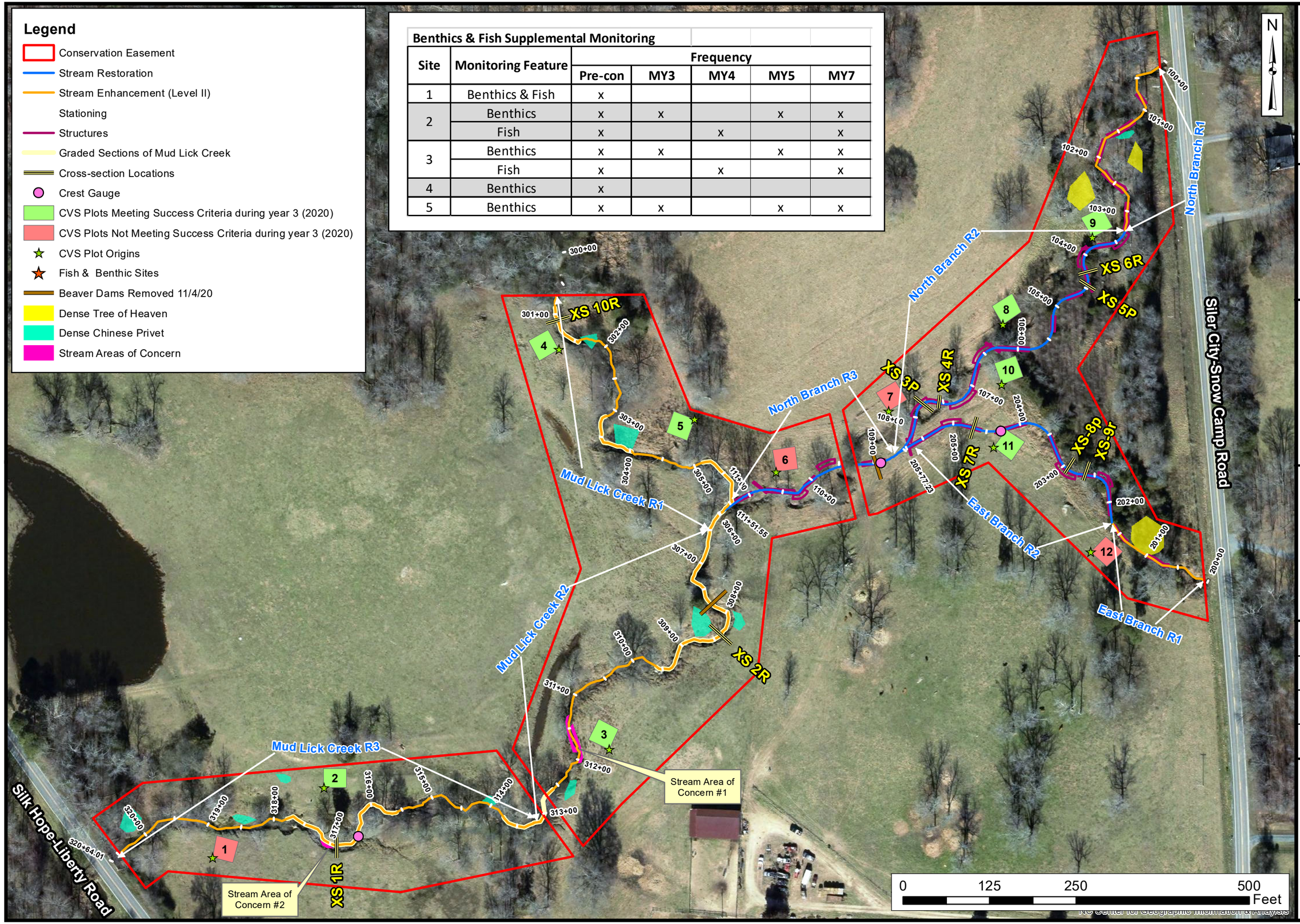
Dwn. by. CLF	FIGURE
Date: July 2018	1
Project: 12-004.22	

Legend

- Conservation Easement
- Stream Restoration
- Stream Enhancement (Level II)
- Stationing
- Structures
- Graded Sections of Mud Lick Creek
- Cross-section Locations
- Crest Gauge
- CVS Plots Meeting Success Criteria during year 3 (2020)
- CVS Plots Not Meeting Success Criteria during year 3 (2020)
- CVS Plot Origins
- Fish & Benthic Sites
- Beaver Dams Removed 11/4/20
- Dense Tree of Heaven
- Dense Chinese Privet
- Stream Areas of Concern

Benthics & Fish Supplemental Monitoring

Site	Monitoring Feature	Frequency				
		Pre-con	MY3	MY4	MY5	MY7
1	Benthics & Fish	x				
2	Benthics	x	x		x	x
	Fish	x		x		x
3	Benthics	x	x		x	x
	Fish	x		x		x
4	Benthics	x				
5	Benthics	x	x		x	x



Axiom Environmental, Inc.

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

Project:

MUD LICK CREEK MITIGATION SITE

DMS Project Number 93482
Chatham County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: PHP, CLF

Date: JAN 2021

Scale: 1:1,500

Project No.: 12-004.22

FIGURE

2

Table 5A **Visual Stream Morphology Stability Assessment**
Reach ID North Branch R-2
Assessed Length 538

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	8	8			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	8	8			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	8	8			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	8	8			100%			

Table 5B **Visual Stream Morphology Stability Assessment**
Reach ID North Branch R-3
Assessed Length 265

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	3	3			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	3	3			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	3	3			100%			

Table 5C **Visual Stream Morphology Stability Assessment**
Reach ID East Branch R-2
Assessed Length 412

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
2. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	5	5			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	5	5			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	5	5			100%			

Table 6 — Vegetation Condition Assessment

Planted Acreage **9.6**

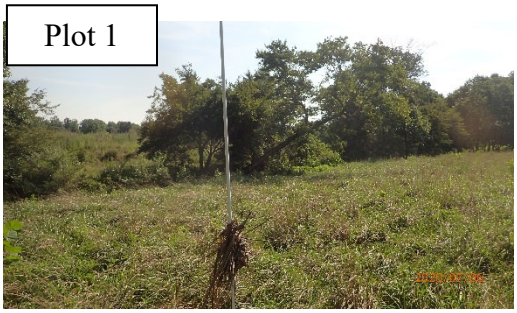
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	None	0.1 acres	None	0	0.00	0.0%
2. Low Stem Density Areas	None	0.1 acres	None	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	None	0.25 acres	None	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%

Easement Acreage **11.2**

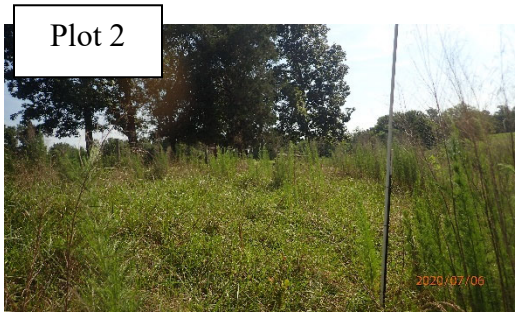
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Several small areas of dense Chinese privet and dense tree of heaven	200 SF	green and yellow polygons	13	0.20	1.8%
5. Easement Encroachment Areas	None	none	None	0	0.00	0.0%

Mud Lick Creek Stream Restoration Site
MY-03 Vegetation Monitoring Photographs
Taken July 2020

Plot 1



Plot 2



Plot 3

Plot 4

Plot 5

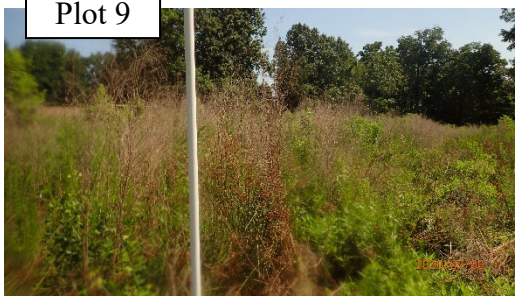
Plot 6

Plot 7

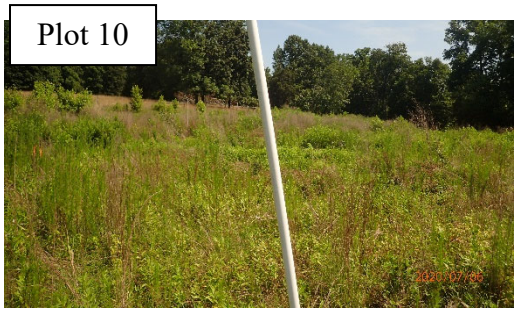
Plot 8

Mud Lick Creek Stream Restoration Site
MY-03 Vegetation Monitoring Photographs
Taken July 2020

Plot 9



Plot 10



Plot 11

Plot 12

Appendix C.
Vegetation Plot Data

Table 7. Planted Woody Vegetation
Table 8. Total and Planted Stems by Plot and Species

Table 7. Planted Woody Vegetation
Mud Lick Creek Restoration Project (#93482)

Species	Quantity
Green Ash (*Fraxinus pennsylvanica*)	300
Sycamore (*Platanus occidentalis*)	400
Eastern Redbud (*Cercis canadensis*)	400
Cottonwood *(Populus deltoides)*	300
River birch (*Betula nigra*)	300
Hackberry *(Celtis occidentalis)*	300
Black Gum *(Nyssa sylvatica)*	300
American Elm *(Ulmus americana)*	300
Eastern Hophornbeam *(Ostrya virginica)*	300
Elderberry *(Sambucus spp.)*	300
Black Locust *(Robinia psuedoaccia)*	300
Silky Dogwood *(Cornus ammomum)*	300
Witch Hazel *(Hamamelis virginica)*	550
Buttonbush *(Cephalanthus occidentalis)*	300
Persimmon (*Diospyros virginiana*)	300
Ironwood *(Carpinus caroliniana)*	400
Swamp Tupelo *(Nyssa biflora)*	100
Swamp Chestnut oak (*Quercus michauxii*)	100
Water oak (*Quercus nigra*)	100
Tulip Poplar *(Liridendron tulipifera)*	300
TOTAL	**5950**

Table 8. Total and Planted Stems by Plot and Species
Project Code 93482. Project Name: Mud Lick Creek

			Current Plot Data (MY3 2020)																						
			93482-01-0001			93482-01-0002			93482-01-0003			93482-01-0004			93482-01-0005			93482-01-0006			93482-01-0007			93482-01-0008		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree									1						3			3			1			
Acer rubrum	red maple	Tree																								
Alnus	alder	Shrub																								
Baccharis halimifolia	eastern baccharis	Shrub																								
Betula nigra	river birch	Tree										1	1	1	1	1	1	2	2	2				3	3	3
Carpinus caroliniana	American hornbeam	Tree																1	1	1				1	1	1
Carya	hickory	Tree																								
Celtis laevigata	sugarberry	Tree	2	2	2																					
Celtis occidentalis	common hackberry	Tree																								
Cephalanthus occidentalis	common buttonbush	Shrub										1	1	1				1	1	1				1	1	1
Cercis canadensis	eastern redbud	Tree	1	1	1							1	1	1												
Cornus amomum	silky dogwood	Shrub										3	3	3										1	1	1
Diospyros virginiana	common persimmon	Tree										1	1	1												
Fraxinus pennsylvanica	green ash	Tree				1	1	1				1	1	1	8	8	8			1						
Juglans nigra	black walnut	Tree																								
Liquidambar styraciflua	sweetgum	Tree																		14						17
Liriodendron tulipifera	tuliptree	Tree	2	2	2													1	1	1						
Nyssa	tupelo	Tree																								
Nyssa biflora	swamp tupelo	Tree				3	3	3	1	1	1															
Ostrya virginiana	hophornbeam	Tree																			2	2	2			
Platanus occidentalis	American sycamore	Tree							5	5	5	1	1	1						2	4	4	4			
Populus deltoides	eastern cottonwood	Tree																								
Quercus	oak	Tree																								
Quercus michauxii	swamp chestnut oak	Tree																						3	3	3
Quercus nigra	water oak	Tree																								
Robinia pseudoacacia	black locust	Tree																								
Ulmus americana	American elm	Tree				3	3	3	2	2	2															
Ulmus rubra	slippery elm	Tree				1	1	1													1	1	1			
Unknown		Shrub or Tree										1	1	1												
Viburnum dentatum	southern arrowwood	Shrub				2	2	2																		
		Stem count	5	5	5	10	10	10	8	8	9	10	10	10	9	9	12	5	5	25	7	7	8	9	9	26
		size (ares)	1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	3	3	3	5	5	5	3	3	4	8	8	8	2	2	3	4	4	8	3	3	4	5	5	6
		Stems per ACRE	202.3	202.3	202.3	404.7	404.7	404.7	323.7	323.7	364.2	404.7	404.7	404.7	364.2	364.2	485.6	202.3	202.3	1012	283.3	283.3	323.7	364.2	364.2	1052

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%

PnoLS = Planted excluding livestakes

P-all = Planting including livestakes

T = All planted and natural recruits including livestakes

T includes natural recruits

Table 8. Total and Planted Stems by Plot and Species (continued)
Project Code 93482. Project Name: Mud Lick Creek

			Current Plot Data (MY3 2020)												Annual Means											
			93482-01-0009			93482-01-0010			93482-01-0011			93482-01-0012			MY3 (2020)			MY2 (2019)			MY1 (2018)			MY0 (2018)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree															8			4	1	1	3	1	1	10
Acer rubrum	red maple	Tree			3												3						2			10
Alnus	alder	Shrub																								3
Baccharis halimifolia	eastern baccharis	Shrub																		2						
Betula nigra	river birch	Tree	1	1	1										8	8	8	8	8	8	6	6	6	4	4	4
Carpinus caroliniana	American hornbeam	Tree	5	5	5				1	1	1	2	2	2	10	10	10	11	11	11	12	12	12	15	15	15
Carya	hickory	Tree																								1
Celtis laevigata	sugarberry	Tree													2	2	2	2	2	2	2	2	2	1	1	1
Celtis occidentalis	common hackberry	Tree				2	2	2	1	1	1				3	3	3	3	3	3	3	3	3	3	3	3
Cephalanthus occidentalis	common buttonbush	Shrub													3	3	3	3	3	3	3	3	3	4	4	4
Cercis canadensis	eastern redbud	Tree													2	2	2	3	3	3	8	8	8	6	6	6
Cornus amomum	silky dogwood	Shrub	1	1	1							2	2	2	7	7	7	9	9	9	9	9	9	8	8	8
Diospyros virginiana	common persimmon	Tree	1	1	1	2	2	3	2	2	2	1	1	1	7	7	8	5	5	5	4	4	4	5	5	5
Fraxinus pennsylvanica	green ash	Tree										1	1	1	11	11	12	11	11	11	14	14	15	12	12	13
Juglans nigra	black walnut	Tree												3			3			4			1			5
Liquidambar styraciflua	sweetgum	Tree			6			50			30			7			124			98			19			10
Liriodendron tulipifera	tuliptree	Tree	1	1	4			1							4	4	8	4	4	7						
Nyssa	tupelo	Tree				1	1	1							1	1	1	2	2	2						
Nyssa biflora	swamp tupelo	Tree							1	1	1				5	5	5	5	5	5	6	6	6	6	6	6
Ostrya virginiana	hophornbeam	Tree													2	2	2	2	2	2	1	1	1	1	1	1
Platanus occidentalis	American sycamore	Tree				1	1	1							11	11	13	12	12	14	7	7	7	7	7	7
Populus deltoides	eastern cottonwood	Tree																3	3	3	4	4	4	3	3	3
Quercus	oak	Tree							1	1	1				1	1	1	1	1	1						
Quercus michauxii	swamp chestnut oak	Tree				1	1	1	1	1	1	1	1	1	6	6	6	6	6	6	6	6	6	7	7	7
Quercus nigra	water oak	Tree	1	1	1	1	1	1							2	2	2	2	2	2	3	3	3	3	3	3
Robinia pseudoacacia	black locust	Tree							1	1	1				1	1	1	1	1	1	1	1	1	1	1	1
Ulmus americana	American elm	Tree													5	5	5	5	5	5	4	4	5			
Ulmus rubra	slippery elm	Tree													2	2	2	2	2	2						
Unknown		Shrub or Tree													1	1	1	2	2	2	3	3	3	3	3	3
Viburnum dentatum	southern arrowwood	Shrub													2	2	2									
		Stem count	10	10	22	8	8	60	8	8	38	7	7	17	96	96	242	102	102	215	97	97	123	90	90	129
		size (ares)	1			1			1			1			12			12			12			12		
		size (ACRES)	0.02			0.02			0.02			0.02			0.30			0.30			0.30			0.30		
		Species count	6	6	8	6	6	8	7	7	8	5	5	7	22	22	26	22	22	26	19	19	22	18	18	23
		Stems per ACRE	404.7	404.7	890.3	323.7	323.7	2428	323.7	323.7	1538	283.3	283.3	688	323.7	323.7	816.1	344	344	725.1	327.1	327.1	414.8	303.5	303.5	435

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%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Appendix D.
Stream Geomorphology Data

Tables 10a-10c. Baseline Stream Data Summary
Tables 11a-11f. Monitoring Data-Dimensional Data Summary
Cross-section Plots
Substrate Plots

Table 10a. Baseline Stream Data Summary (Mud Lick Creek)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Gauge	Regional Curve			Pre-Existing Condition (Mud Lick Creek)					Reference Reach(es) Data					Design (Mud Lick Creek)			Monitoring Baseline (Mud Lick Creek)					
Dimension and Substrate - Riffle Only		**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Max**	**Med**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)					18.2		22.0	24.6		5.3		10.8	12.3					18.3		19.8	21		3
Floodprone Width (ft)					250.0		306.0	378.0		14		60	125					100		100	100		3
BF Mean Depth (ft)					1.9		2.1	2.3		0.8		1.0	1.8					1.6		2.0	2.7		3
BF Max Depth (ft)					3.0		4.0	4.2		1.0		1.5	2.6					3.6		3.7	3.8		3
BF Cross Sectional Area (ft^2)					41.3		46.3	47.5		5.4		10.6	19.7					33.0		40.4	49.8		3
Width/Depth Ratio					8.0		10.5	12.8		5.2		8.6	14.4					6.8		9.9	13.1		3
Entrenchment Ratio					12.4		13.7	17.2		1.7		4.3	>10.2					4.8		5.1	5.5		3
Bank Height Ratio					1.1		1.2	1.2		1.0		1.0	1.1					1.0		1.0	1.3		3
Profile																							
Riffle length (ft)																							
Riffle slope (ft/ft)										0.0040		0.0188	0.0704										
Pool length (ft)																							
Pool Max depth (ft)					3.7		4.4	5.2		1.2		1.8	3.3										
Pool spacing (ft)										9.0		46.0	73.0										
Pattern																							
Channel Beltwidth (ft)					26.1		52.9	69.9		10		41	102										
Radius of Curvature (ft)					9.9		24.8	58.8		11		21	85										
Rc:Bankfull width (ft/ft)					0.5		1.1	2.39		1.3		2	9.1										
Meander Wavelength (ft)					59.9		159.6	244.4		-		-	-										
Meander Width ratio					1.4		2.2	3.8		1.6		4.4	8.9										
Transport parameters																							
Reach Shear Stress (competency) lbs/ft^2																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m^2																							
Additional Reach Parameters																							
Rosgen Classification					E/C4					E/C4								E/C-type					
Bankfull Velocity (fps)					3.0 - 3.4					2.2 - 5.6													
Bankfull Discharge (cfs)					123.9 - 157.42					20 -97													
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1.20 - 1.37					1.0 - 2.3													
Water Surface Slope (ft/ft)																							
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Table 10b. Baseline Stream Data Summary (North Branch)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Gauge	Regional Curve			Pre-Existing Condition (North Branch)					Reference Reach(es) Data					Design (North Branch)			Monitoring Baseline (North Branch)					
Dimension and Substrate - Riffle Only		**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Max**	**Med**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)					8.3			10.4		5.3		10.8	12.3		13.8	14.0		14.6		16.2	17.7		2
Floodprone Width (ft)					33.3			80.0		14		60	125		30	70		100		100	100		2
BF Mean Depth (ft)					0.7			1.5		0.8		1.0	1.8		1.0	1.2		0.8		0.9	1.0		2
BF Max Depth (ft)					1.5			2.3		1.0		1.5	2.6		1.3	2.0		1.8		1.8	1.8		2
BF Cross Sectional Area (ft^2)					7.7			12.7		5.4		10.6	19.7		14.4	16.3		14.2		14.4	14.5		2
Width/Depth Ratio					5.4			14.0		5.2		8.6	14.4		12.0	13.0		14.6		18.4	22.1		2
Entrenchment Ratio					1.9			10.1		1.7		4.3	>10.2		2.2	5.0		5.6		6.2	6.8		2
Bank Height Ratio					1.7			2.0		1.0		1.0	1.1		1.0	1.0		1.0		1.0	1.0		2
Profile																							
Riffle length (ft)																							
Riffle slope (ft/ft)										0.0040		0.0188	0.0704		0.0060	0.0340							
Pool length (ft)																							
Pool Max depth (ft)					2.1			2.7		1.2		1.8	3.3		1.3	4.7							
Pool spacing (ft)										9.0		46.0	73.0		19.0	92.0							
Pattern																							
Channel Beltwidth (ft)					11		26	38.5		10		41	102		41	125							
Radius of Curvature (ft)					6.1		17	37		11		21	85		25	42							
Rc:Bankfull width (ft/ft)					0.73		1.6	4.46		1.3		2	9.1		1.8	3							
Meander Wavelength (ft)					37.9		64.1	100.6		-		-	-		41	168							
Meander Width ratio					1.1		2.8	4.6		1.6		4.4	8.9		3	15							
Transport parameters																							
Reach Shear Stress (competency) lbs/ft^2																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m^2																							
Additional Reach Parameters																							
Rosgen Classification					E5/B5c					E/C4					C4			C-type					
Bankfull Velocity (fps)					3.3 - 3.5					2.2 - 5.6					2.4 - 4.3								
Bankfull Discharge (cfs)					25.41 - 44.45					20 -97					34.6 - 70.1								
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1.22 - 1.32					1.0 - 2.3					1.2 - 1.3								
Water Surface Slope (ft/ft)																							
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Table 10c. Baseline Stream Data Summary (East Branch)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Gauge	Regional Curve			Pre-Existing Condition (East Branch)					Reference Reach(es) Data					Design (East Branch)			Monitoring Baseline (East Branch)					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD	n
BF Width (ft)						4.3				5.3		10.8	12.3				11.0	8.9		12.8	16.6		2
Floodprone Width (ft)						23.0				14		60	125		24	55		100		100	100		2
BF Mean Depth (ft)						1.1				0.8		1.0	1.8				0.9	0.6		0.7	0.8		2
BF Max Depth (ft)						1.4				1.0		1.5	2.6		0.9	1.5		1.2		1.4	1.5		2
BF Cross Sectional Area (ft^2)						4.8				5.4		10.6	19.7				9.7	6.7		8.7	10.6		2
Width/Depth Ratio						3.9				5.2		8.6	14.4				12.4	11.1		19.4	27.7		2
Entrenchment Ratio						2.1				1.7		4.3	>10.2		2.2	5.0		6.0		8.6	11.2		2
Bank Height Ratio						1.9				1.0		1.0	1.1		1.0	1.0		1.0		1.0	1.0		2
Profile																							
Riffle length (ft)																							
Riffle slope (ft/ft)										0.0040		0.0188	0.0704		0.0156	0.0442							
Pool length (ft)																							
Pool Max depth (ft)						1.6				1.2		1.8	3.3		1.0	3.5							
Pool spacing (ft)										9.0		46.0	73.0		15.0	73.0							
Pattern																							
Channel Beltwidth (ft)						--				10		41	102		22	98							
Radius of Curvature (ft)						--				11		21	85		20	30							
Rc:Bankfull width (ft/ft)						--				1.3		2	9.1		1.8	3							
Meander Wavelength (ft)						--				-		-	-		33	132							
Meander Width ratio						--				1.6		4.4	8.9		3	12							
Transport parameters																							
Reach Shear Stress (competency) lbs/ft^2																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m^2																							
Additional Reach Parameters																							
Rosgen Classification					B4c					E/C4					C4			C-type					
Bankfull Velocity (fps)					4.2					2.2 - 5.6					3.3								
Bankfull Discharge (cfs)					20.2					20 -97					32								
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1					1.0 - 2.3					1.20 -1.30								
Water Surface Slope (ft/ft)																							
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Cross Section 1 (Mud Lick Cr) Riffle							Cross Section 2 (Mud Lick Cr) Riffle							Cross Section 10 (Mud Lick Cr) Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	18.3	18.8	18.6	19.1				21.0	22.0	14.9	15.9				19.8	19.6	18.9	18.4			
Floodprone Width (ft) (approx)	100.0	100.0	100.0	100.0				100.0	100.0	100.0	100.0				100.0	100.0	100.0	100.0			
BF Mean Depth (ft)	2.7	2.6	2.7	2.6				1.6	1.5	2.2	2.1				2.0	2.1	2.1	2.2			
BF Max Depth (ft)	3.8	3.8	3.8	3.6				3.7	3.6	3.3	3.5				3.6	3.4	3.5	3.7			
Low Bank Height	5.0	5.1	5.0	3.7				3.7	3.6	3.9	4.0				3.6	3.4	3.7	3.8			
BF Cross Sectional Area (ft^2)	49.8	49.8	49.8	49.8				33.0	33.0	33.0	33.0				40.4	40.4	40.4	40.4			
Area at Low Bank (ft^2)	49.8	NA	75.8	75.8				33.0	NA	42.6	42.6				40.4	NA	43.2	43.2			
Width/Depth Ratio	6.7	7.1	6.9	7.3				13.4	14.7	6.7	7.7				9.7	9.5	8.8	8.4			
Entrenchment Ratio	5.5	5.3	NA**	NA**				4.8	4.5	NA**	NA**				5.1	5.1	NA**	NA**			
Bank Height Ratio*	1.3	1.3	1.3	1.0				1.0	1.0	1.2	1.1				1.0	1.0	1.1	1.0			
d50 (mm)	9.9	4.4	4.3	4.3				9.9	4.4	4.3	4.3				9.9	4.4	4.3	4.3			

*Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018).
** Based on the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018), entrenchment ratio is no longer reported for success criteria.

Table 11b. Monitoring Data - Stream Reach Data Summary
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Baseline (Mud Lick Creek)						MY-1 (Mud Lick Creek)						MY-2 (Mud Lick Creek)						MY-3 (Mud Lick Creek)						MY-4 (Mud Lick Creek)						MY-5 (Mud Lick Creek)					
Dimension and Substrate - Riffle Only	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)	18.3		19.8	21		3	18.8		19.6	22		3	14.9		18.6	18.9		3	15.9		18.4	19.1		3												
Floodprone Width (ft)	100		100	100		3	100		100.0	100		3	100		100	100		3	100		100	100		3												
BF Mean Depth (ft)	1.6		2.0	2.7		3	1.5		2.1	2.7		3	2.1		2.2	2.7		3	2.1		2.2	2.6		3												
BF Max Depth (ft)	3.6		3.7	3.8		3	3.4		3.6	3.8		3	3.3		3.5	3.8		3	3.5		3.6	3.7		3												
BF Cross Sectional Area (ft^2)	33.0		40.4	49.8		3	33.0		40.4	49.8		3	33.0		40.4	49.8		3	33.0		40.4	49.8		3												
Area at Low Bank (ft^2)	33.0		40.4	49.8		3	NA		NA	NA		NA	42.6		43.2	75.8		3	42.6		43.2	75.8		3												
Width/Depth Ratio	6.8		9.9	13.1		3	7.0		9.3	14.7		3	6.8		6.9	9.0		3	7.3		7.6	8.4		3												
Entrenchment Ratio	4.8		5.1	5.5		3	4.5		5.1	5.3		3	5.3		5.4	6.7		3	5.2		5.4	6.3		3												
Bank Height Ratio	1.0		1.0	1.3		3	1.0		1.0	1.3		3	1.1		1.2	1.3		3	1.0		1.0	1.1		3												
Riffle length (ft)																																				
Riffle slope (ft/ft)																																				
Pool length (ft)																																				
Pool Max depth (ft)																																				
Pool spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	C-type						Ce-type						Ce-type																							
Channel Thalweg Length (ft)																																				
Sinuosity																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
Ri%/RU%/P%/G%/S%																																				
SC%/SA%/G%/C%/B%/BE%																																				
d16/d35/d50/d84/d95																																				
% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Table 11c. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Cross Section 3 (North Branch) Pool							Cross Section 4 (North Branch) Riffle							Cross Section 5 (North Branch) Pool							Cross Section 6 (North Branch) Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	14.2	13.7	13.3	13.2				17.7	22.7	20.7	22.1				14.2	14.6	15.1	14.2				14.6	15.1	14.8	19.4			
Floodprone Width (ft) (approx)	NA	NA	NA	NA				100.0	100.0	100.0	100.0				NA	NA	NA	NA				100.0	100.0	100.0	100.0			
BF Mean Depth (ft)	1.1	1.1	1.2	1.2				0.8	0.6	0.7	0.6				1.3	1.3	1.2	1.3				1.0	1.0	1.0	0.7			
BF Max Depth (ft)	2.2	2.1	2.2	2.3				1.8	1.9	1.8	1.8				2.6	2.6	2.7	2.8				1.8	1.8	1.8	1.9			
Low Bank Height	2.2	2.1	2.3	2.5				1.8	1.9	1.8	1.8				2.6	2.6	2.8	2.9				1.8	1.8	1.8	2.1			
BF Cross Sectional Area (ft^2)	15.5	15.5	15.5	15.5				14.2	14.2	14.2	14.2				18.6	18.6	18.6	18.6				14.5	14.5	14.5	14.5			
Area at Low Bank (ft^2)	15.5	NA	18.0	18.0				14.2	NA	14.2	14.2				18.6	NA	20.3	20.3				14.5	NA	15.0	15.0			
Width/Depth Ratio	NA	NA	NA	NA				22.1	36.3	30.2	34.4				NA	NA	NA	NA				14.7	15.7	15.1	26.0			
Entrenchment Ratio	NA	NA	NA	NA				5.6	4.4	NA**	NA**				NA	NA	NA	NA				6.8	6.6	NA**	NA**			
Bank Height Ratio*	1.0	1.0	1.0	1.1				1.0	1.0	1.0	1.0				1.0	1.0	1.0	1.0				1.0	1.0	1.0	1.1			
d50 (mm)	--	--	--	--				18.8	8.0	8.4	4.0				--	--	--	--				18.8	8.0	8.4	4.0			

*Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018).
** Based on the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018), entrenchment ratio is no longer reported for success criteria.

Table 11d. Monitoring Data - Stream Reach Data Summary
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Baseline (North Branch)						MY-1 (North Branch)						MY-2 (North Branch)						MY-3 (North Branch)						MY-4 (North Branch)						MY-5 (North Branch)					
Dimension and Substrate - Riffle Only	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	14.6		16.2	17.7		2	15.1		18.9	22.7		2	14.8		17.8	20.7		2	19.4		20.8	22.1		2												
Floodprone Width (ft)	100		100	100		2	100		100.0	100		2	100		100	100		2	100		100	100		2												
BF Mean Depth (ft)	0.8		0.9	1.0		2	0.6		0.8	1.0		2	0.7		0.9	1.0		2	0.6		0.8	1.0		2												
BF Max Depth (ft)	1.8		1.8	1.8		2	1.8		1.9	1.9		2	1.8		1.8	1.8		2	1.8		1.8	1.9		2												
BF Cross Sectional Area (ft^2)	14.2		14.4	14.5		2	14.2		14.4	14.5		2	14.2		14.4	14.5		2	14.2		14.4	14.5		2												
Area at Low Bank (ft^2)	14.2		14.4	14.5		2	NA		NA	NA		NA	14.2		14.6	15.0		2	14.2		14.6	15.0		2												
Width/Depth Ratio	14.6		18.4	22.1		2	15.1		26.5	37.8		2	14.8		17.8	20.7		2	19.4		28.1	36.8		2												
Entrenchment Ratio	5.6		6.2	6.8		2	4.4		5.5	6.6		2	4.8		5.8	6.8		2	4.5		4.8	5.2		2												
Bank Height Ratio	1.0		1.0	1.0		2	1.0		1.0	1.0		2	1.0		1.0	1.0		2	1.0		1.1	1.1		2												
Profile																																				
Riffle length (ft)																																				
Riffle slope (ft/ft)																																				
Pool length (ft)																																				
Pool Max depth (ft)																																				
Pool spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	C-type						C-type						C-type																							
Channel Thalweg Length (ft)																																				
Sinuosity																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
Ri%/RU%P%G%/S%																																				
SC%/SA%/G%/C%/B%BE%																																				
d16/d35/d50/d84/d95																																				
% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Table 11e. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

Parameter	Cross Section 7 (East Branch) Riffle							Cross Section 8 (East Branch) Pool							Cross Section 9 (East Branch) Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	8.9	11.1	10.2	14.4				7.6	10.8	8.2	7.5				16.6	21.1	18.6	24.6			
Floodprone Width (ft) (approx)	100.0	100.0	100.0	100.0				NA	NA	NA	NA				100.0	100.0	100.0	100.0			
BF Mean Depth (ft)	0.8	0.6	0.7	0.5				1.4	1.0	1.3	1.4				0.6	0.5	0.6	0.4			
BF Max Depth (ft)	1.2	1.4	1.3	1.4				2.4	1.5	2.1	2.4				1.5	1.6	1.5	1.5			
Low Bank Height	1.2	1.4	1.4	1.4				2.4	1.5	2.2	2.4				1.5	1.6	1.5	1.5			
BF Cross Sectional Area (ft^2)	6.7	6.7	6.7	6.7				10.5	10.5	10.5	10.5				10.6	10.6	10.6	10.6			
Area at Low Bank (ft^2)	6.7	NA	7.5	7.5				10.5	NA	11.7	11.7				10.6	NA	10.7	10.7			
Width/Depth Ratio	11.8	18.4	15.5	30.9				NA	NA	NA	NA				26.0	42.0	32.6	57.1			
Entrenchment Ratio	11.2	9.0	NA**	NA**				NA	NA	NA	NA				6.0	4.7	NA**	NA**			
Bank Height Ratio*	1.0	1.0	1.1	1.0				1.0	1.0	1.0	1.0				1.0	1.0	1.0	1.0			
d50 (mm)	14.3	3.7	5.4	2.5				--	--	--	--				14.3	3.7	5.4	2.5			

*Bank Height Ratio is calculated based on the As-built (MY0) cross-sectional area as described in the Standard Measurement of the BHR Monitoring Parameter document produced by the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018).
** Based on the technical industry work group consisting of the NCIRT, NCDMS, and Industry Practitioners in NC (9/2018), entrenchment ratio is no longer reported for success criteria.

Table 11f. Monitoring Data - Stream Reach Data Summary
Mud Lick Creek Mitigation Project - NCDMS Project Number 93482

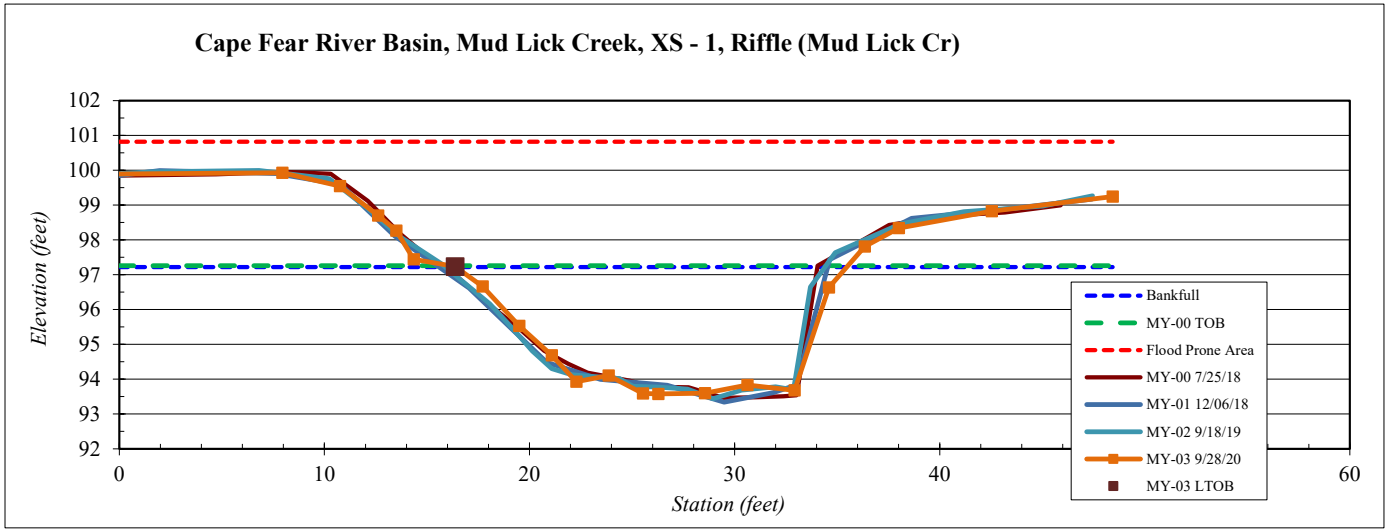
Parameter	Baseline (East Branch)						MY-1 (East Branch)						MY-2 (East Branch)						MY-3 (East Branch)						MY-4 (East Branch)						MY-5 (East Branch)					
Dimension and Substrate - Riffle Only	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
BF Width (ft)	8.9		12.8	16.6		2	11.1		16.2	21.2		2	10.2		14.5	18.7		2	14.4		19.5	24.6		2												
Floodprone Width (ft)	100		100	100		2	100		100	100		2	100		100	100		2	100		100	100		2												
BF Mean Depth (ft)	0.6		0.7	0.8		2	0.5		0.6	0.6		2	0.6		0.7	0.7		2	0.4		0.5	0.5		2												
BF Max Depth (ft)	1.2		1.4	1.5		2	1.4		1.5	1.6		2	1.3		1.4	1.5		2	1.4		1.5	1.5		2												
BF Cross Sectional Area (ft^2)	6.7		8.7	10.6		2	6.7		8.7	10.6		2	6.7		8.7	10.6		2	6.7		8.7	10.6		2												
Area at Low Bank (ft^2)	6.7		8.7	10.6		2	NA		NA	NA		NA	7.5		9.1	10.7		2	7.5		9.1	10.7		2												
Width/Depth Ratio	11.1		19.4	27.7		2	18.5		30.5	42.2		2	14.6		22.9	31.2		2	28.8		45.2	61.5		2												
Entrenchment Ratio	6.0		8.6	11.2		2	4.7		6.9	9		2	5.3		7.6	9.8		2	4.1		5.5	6.9		2												
Bank Height Ratio	1.0		1.0	1.0		2	1		1	1		2	1.0		1.0	1.1		2	1.0		1.0	1.0		2												
Profile																																				
Riffle length (ft)																																				
Riffle slope (ft/ft)																																				
Pool length (ft)																																				
Pool Max depth (ft)																																				
Pool spacing (ft)																																				
Pattern																																				
Channel Beltwidth (ft)																																				
Radius of Curvature (ft)																																				
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)																																				
Meander Width ratio																																				
Additional Reach Parameters																																				
Rosgen Classification	C-type						C-type						C-type																							
Channel Thalweg Length (ft)																																				
Sinuosity																																				
Water Surface Slope (Channel) (ft/ft)																																				
BF slope (ft/ft)																																				
Ri%/RU%/P%/G%/S%																																				
SC%/SA%/G%/C%/B%/BE%																																				
d16/d35/d50/d84/d95																																				
% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 1, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
-0.50	99.89
7.95	99.93
10.76	99.54
12.61	98.70
13.50	98.27
14.35	97.44
16.36	97.24
17.71	96.66
19.50	95.53
21.09	94.69
22.29	93.93
23.85	94.11
25.53	93.59
26.28	93.58
28.55	93.60
30.63	93.83
32.92	93.68
34.60	96.63
36.35	97.81
38.01	98.34
42.54	98.83
48.43	99.24

SUMMARY DATA	
Bankfull Elevation:	97.2
Bankfull Cross-Sectional Area:	49.8
Area at Low Bank:	75.8
Bankfull Width:	19.1
Flood Prone Area Elevation:	98.5
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.6
Low Bank Height:	3.7
Mean Depth at Bankfull:	2.6
W / D Ratio:	7.3
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	E

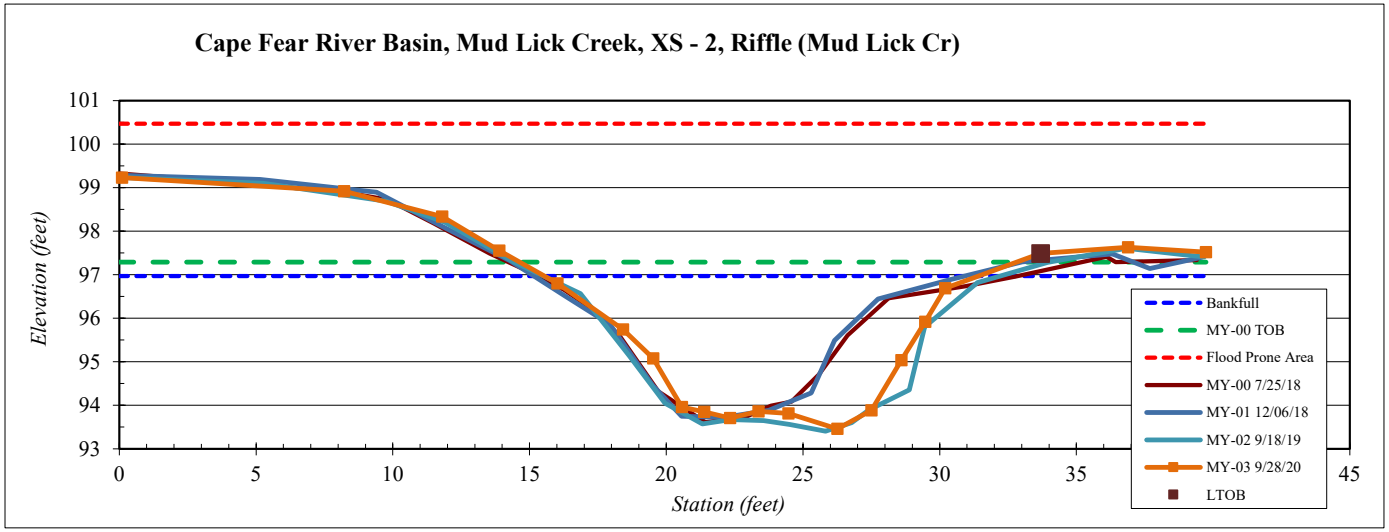


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 2, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.10	99.23
8.21	98.92
11.81	98.33
13.89	97.55
16.02	96.80
18.42	95.74
19.52	95.08
20.58	93.96
21.39	93.85
22.33	93.71
23.37	93.86
24.47	93.81
26.25	93.46
27.51	93.88
28.60	95.04
29.47	95.92
30.20	96.69
33.69	97.49
36.89	97.63
39.74	97.52

SUMMARY DATA	
Bankfull Elevation:	97.0
Bankfull Cross-Sectional Area:	33.0
Area at Low Bank:	42.6
Bankfull Width:	15.9
Flood Prone Area Elevation:	97.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.5
Low Bank Height:	4.0
Mean Depth at Bankfull:	2.1
W / D Ratio:	7.7
Entrenchment Ratio:	NA
Bank Height Ratio:	1.1

Stream Type	E



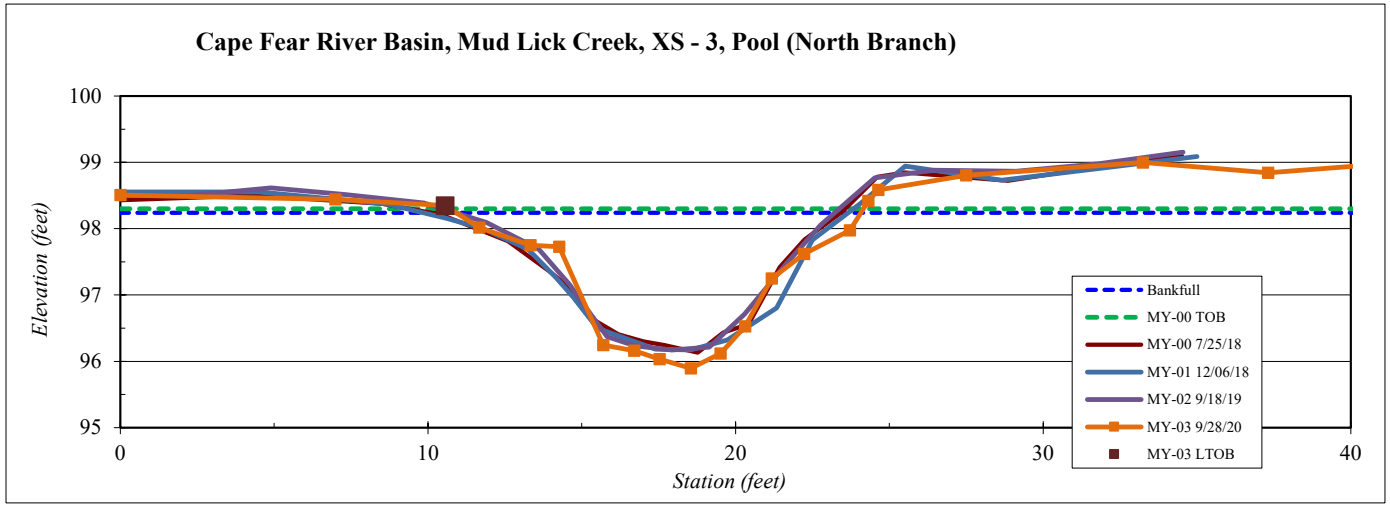
Scouring on the right bank of this cross-section is apparent, howerver this is an EII reach and localized at this location.

River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 3, Pool (North Branch)
Drainage Area (sq mi):	0.65
Date:	9/28/2020
Field Crew:	Perkinson, Keith

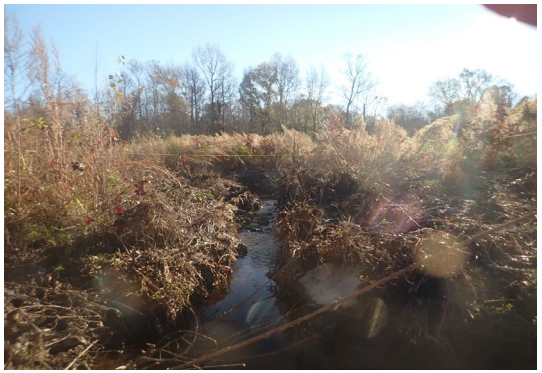
Station	Elevation
0.00	98.51
6.99	98.44
10.55	98.35
11.67	98.02
13.33	97.75
14.26	97.73
15.69	96.24
16.70	96.16
17.53	96.03
18.55	95.90
19.51	96.12
20.31	96.53
21.17	97.25
22.22	97.62
23.72	97.97
24.31	98.42
24.64	98.59
27.49	98.80
33.24	99.00
37.31	98.84
40.91	98.97

SUMMARY DATA	
Bankfull Elevation:	98.2
Bankfull Cross-Sectional Area:	15.5
Area at Low Bank:	18.0
Bankfull Width:	13.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.3
Low Bank Height:	2.5
Mean Depth at Bankfull:	1.2
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.1

Stream Type	E



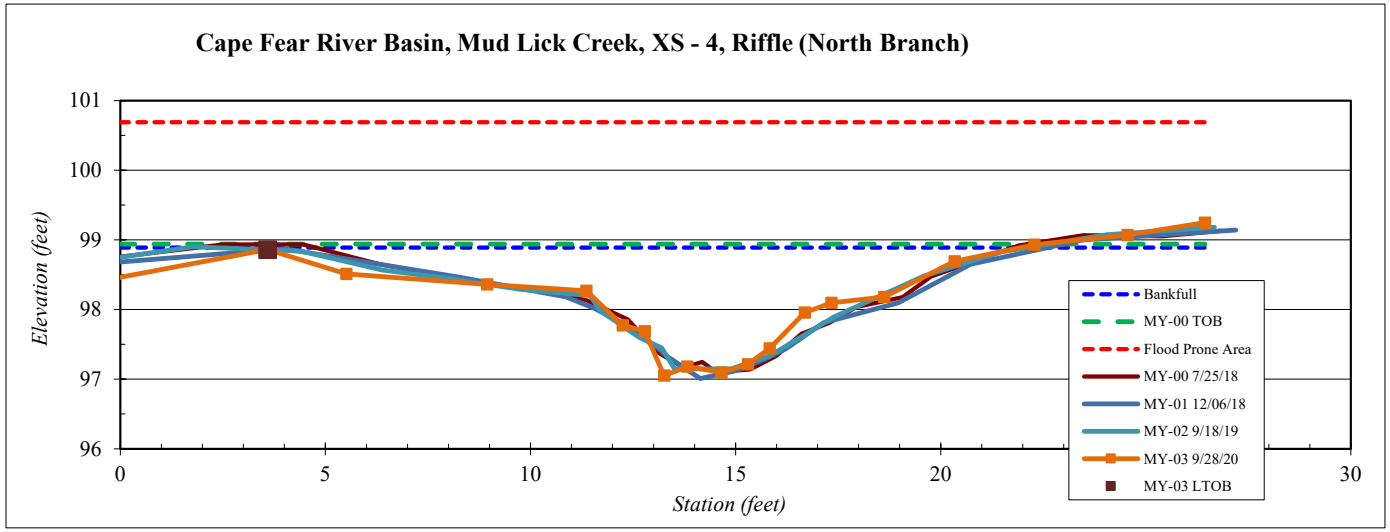
River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 4, Riffle (North Branch)
Drainage Area (sq mi):	0.65
Date:	9/28/2020
Field Crew:	Perkinson, Keith



Station	Elevation
-0.20	98.44
3.59	98.86
5.51	98.51
8.94	98.36
11.36	98.27
12.25	97.77
12.79	97.69
13.26	97.05
13.82	97.18
14.66	97.10
15.30	97.22
15.83	97.44
16.69	97.96
17.34	98.10
18.63	98.18
20.34	98.69
22.28	98.93
24.56	99.07
26.44	99.25

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	14.2
Area at Low Bank:	14.2
Bankfull Width:	22.1
Flood Prone Area Elevation:	98.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.8
Low Bank Height:	1.8
Mean Depth at Bankfull:	0.6
W / D Ratio:	34.4
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

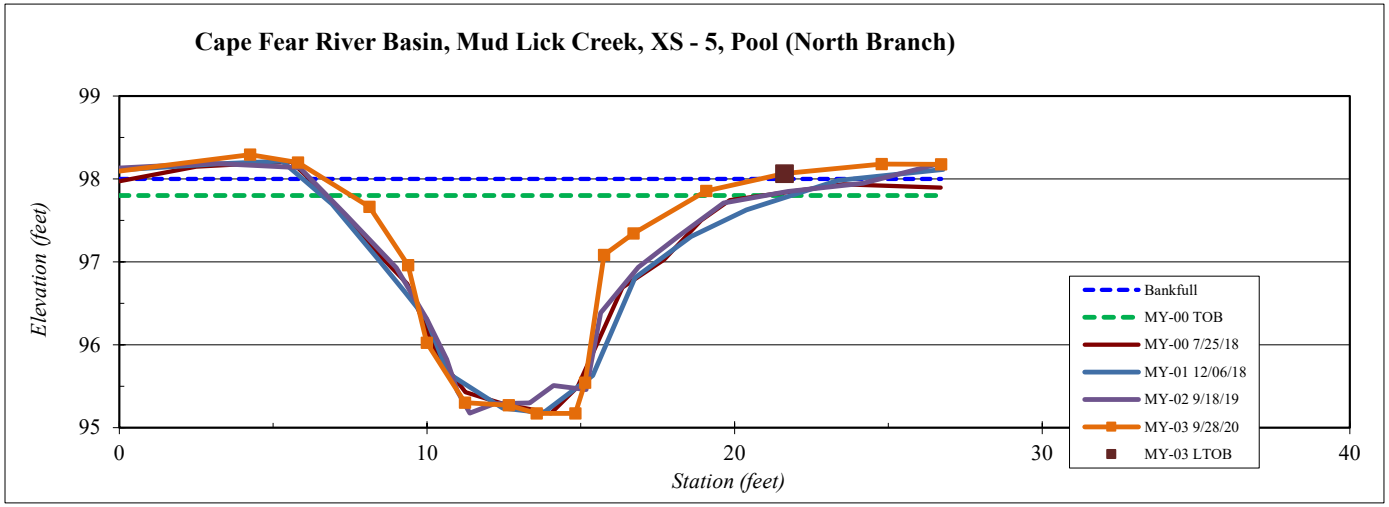


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 5, Pool (North Branch)
Drainage Area (sq mi):	0.65
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
-0.10	98.09
4.25	98.29
5.80	98.20
8.13	97.66
9.38	96.96
9.99	96.02
11.24	95.30
12.66	95.27
13.57	95.17
14.82	95.17
15.14	95.54
15.75	97.08
16.71	97.34
19.08	97.86
21.62	98.07
24.78	98.18
26.71	98.18

SUMMARY DATA	
Bankfull Elevation:	98.0
Bankfull Cross-Sectional Area:	18.6
Area at Low Bank:	20.3
Bankfull Width:	14.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.8
Low Bank Height:	2.9
Mean Depth at Bankfull:	1.3
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

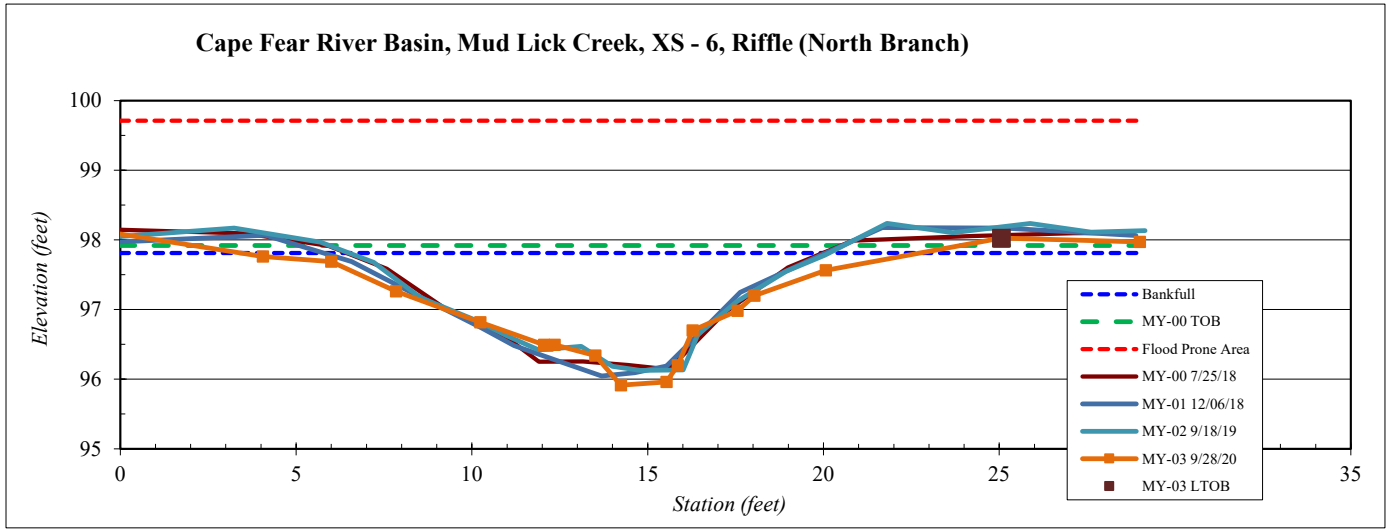


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 6, Riffle (North Branch)
Drainage Area (sq mi):	0.65
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
-0.20	98.10
4.05	97.76
6.00	97.69
7.84	97.26
10.24	96.82
12.06	96.49
12.15	96.48
12.35	96.49
13.51	96.34
14.23	95.91
15.53	95.96
15.85	96.20
16.27	96.70
17.55	96.98
18.03	97.20
20.07	97.56
25.05	98.02
29.00	97.97

SUMMARY DATA	
Bankfull Elevation:	97.8
Bankfull Cross-Sectional Area:	14.5
Area at Low Bank:	15.0
Bankfull Width:	19.4
Flood Prone Area Elevation:	98.0
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.9
Low Bank Height:	2.1
Mean Depth at Bankfull:	0.7
W / D Ratio:	26.0
Entrenchment Ratio:	NA
Bank Height Ratio:	1.1

Stream Type	C

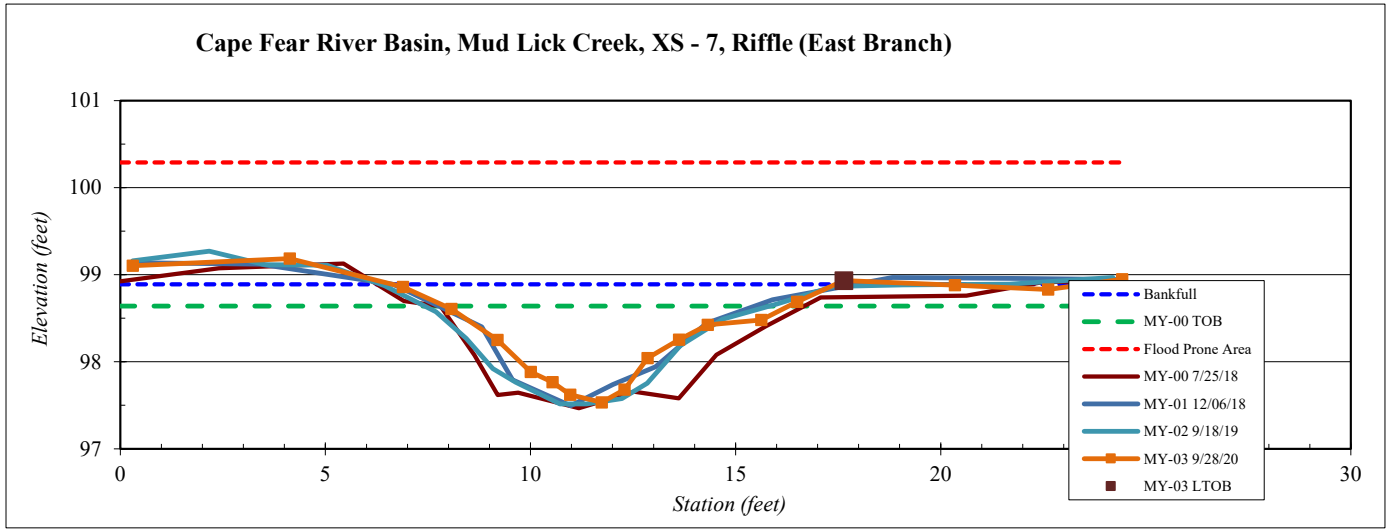


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 7, Riffle (East Branch)
Drainage Area (sq mi):	0.27
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.30	99.10
4.13	99.19
6.89	98.86
8.07	98.61
9.19	98.25
10.01	97.88
10.54	97.77
10.97	97.62
11.73	97.53
12.29	97.68
12.85	98.04
13.62	98.26
14.32	98.42
15.63	98.48
16.50	98.69
17.64	98.93
20.35	98.88
22.62	98.83
24.42	98.95

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	6.7
Area at Low Bank:	7.5
Bankfull Width:	14.4
Flood Prone Area Elevation:	98.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.4
Low Bank Height:	1.4
Mean Depth at Bankfull:	0.5
W / D Ratio:	30.9
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

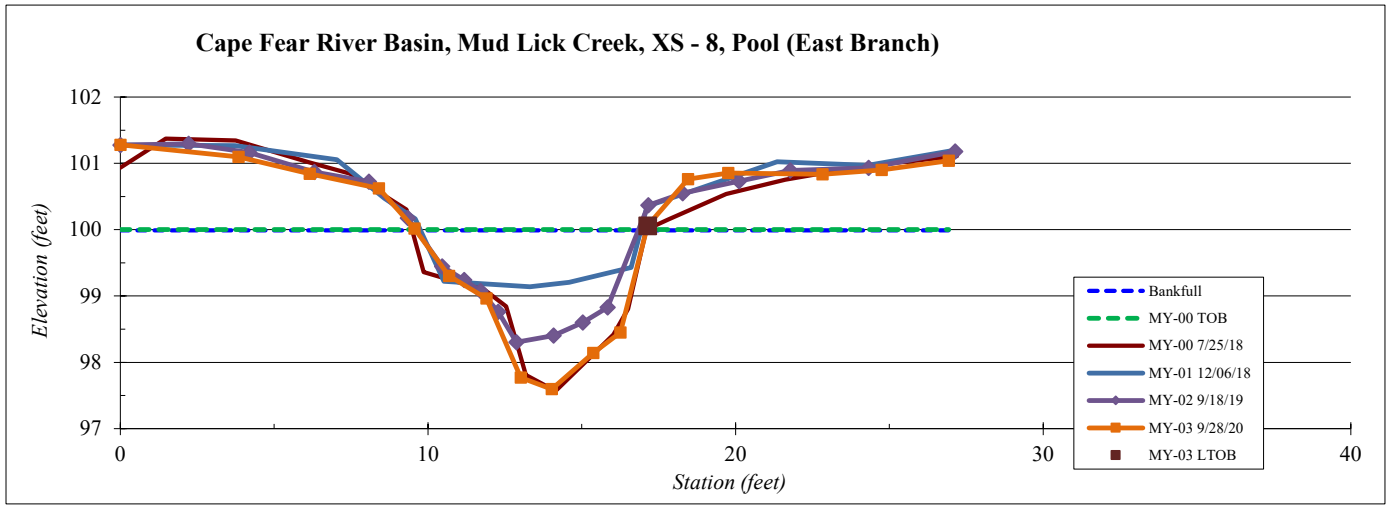


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 8, Pool (East Branch)
Drainage Area (sq mi):	0.27
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	101.28
3.84	101.10
6.16	100.84
8.40	100.62
9.56	100.02
10.69	99.30
11.90	98.96
13.02	97.77
14.02	97.60
15.37	98.14
16.25	98.45
17.13	100.06
18.46	100.76
19.76	100.85
22.83	100.83
24.75	100.90
26.93	101.04

SUMMARY DATA	
Bankfull Elevation:	100.0
Bankfull Cross-Sectional Area:	10.5
Area at Low Bank:	11.7
Bankfull Width:	7.5
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.4
Low Bank Height:	2.4
Mean Depth at Bankfull:	1.4
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

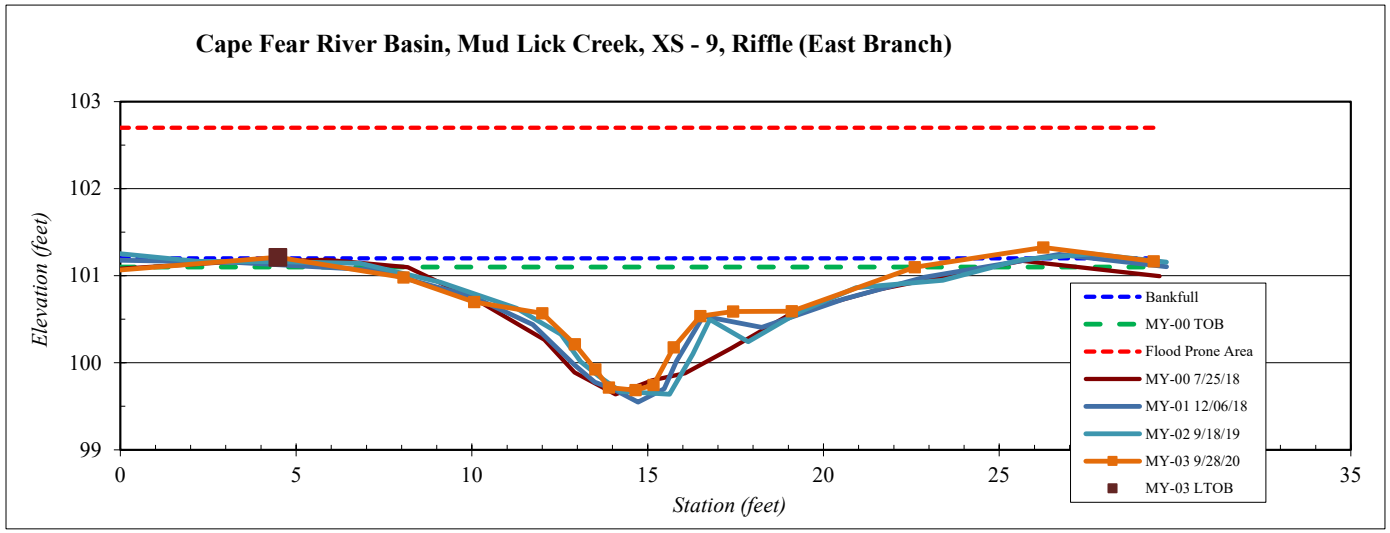


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 9, Riffle (East Branch)
Drainage Area (sq mi):	0.27
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
-0.30	101.06
4.47	101.21
8.05	100.98
10.06	100.70
12.00	100.57
12.93	100.21
13.51	99.92
13.89	99.71
14.65	99.69
15.16	99.75
15.74	100.18
16.50	100.54
17.43	100.59
19.10	100.59
22.59	101.10
26.25	101.32
29.39	101.16

SUMMARY DATA	
Bankfull Elevation:	101.2
Bankfull Cross-Sectional Area:	10.6
Area at Low Bank:	10.7
Bankfull Width:	24.7
Flood Prone Area Elevation:	101.2
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.5
Low Bank Height:	1.5
Mean Depth at Bankfull:	0.4
W / D Ratio:	57.6
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C

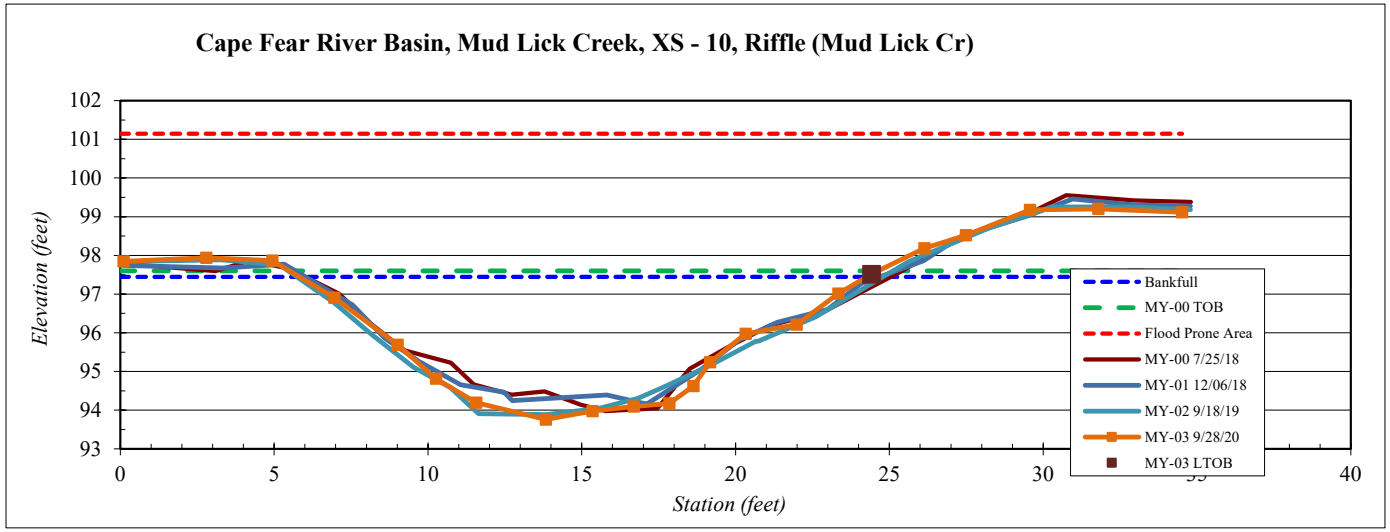


River Basin:	Cape Fear
Site Name	Mud Lick Creek
XS ID	XS - 10, Riffle (Mud Lick Cr)
Drainage Area (sq mi):	3.64
Date:	9/28/2020
Field Crew:	Perkinson, Keith

Station	Elevation
0.10	97.85
2.79	97.94
4.94	97.87
6.96	96.91
9.01	95.69
10.26	94.81
11.57	94.19
13.83	93.76
15.35	93.97
16.68	94.09
17.84	94.17
18.62	94.63
19.17	95.24
20.33	95.97
21.98	96.21
23.34	97.01
24.41	97.51
26.14	98.18
27.48	98.52
29.57	99.18
31.79	99.20
34.51	99.11

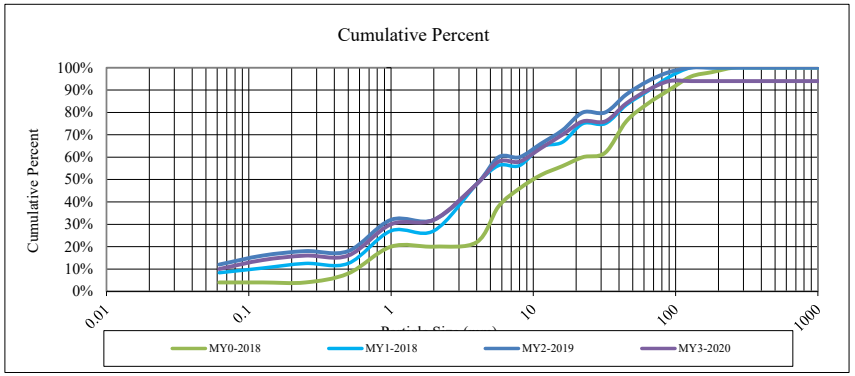
SUMMARY DATA	
Bankfull Elevation:	97.4
Bankfull Cross-Sectional Area:	40.4
Area at Low Bank:	43.2
Bankfull Width:	18.4
Flood Prone Area Elevation:	97.5
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.7
Low Bank Height:	3.8
Mean Depth at Bankfull:	2.2
W / D Ratio:	8.4
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

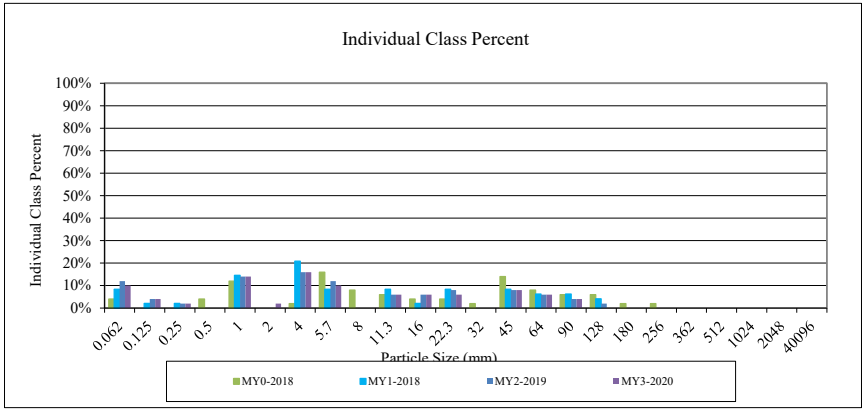
Stream Type	E



Project Name: Mudlick Creek					
Cross-Section: 2					
Feature: Riffle					
			2020		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	6	12%	12%
Sand	very fine sand	0.125	2	4%	16%
	fine sand	0.250	1	2%	18%
	medium sand	0.50	0	0%	18%
	coarse sand	1.00	7	14%	32%
	very coarse sand	2.0	0	0%	32%
Gravel	very fine gravel	4.0	8	16%	48%
	fine gravel	5.7	6	12%	60%
	fine gravel	8.0	0	0%	60%
	medium gravel	11.3	3	6%	66%
	medium gravel	16.0	3	6%	72%
	course gravel	22.3	4	8%	80%
	course gravel	32.0	0	0%	80%
	very coarse gravel	45	4	8%	88%
	very coarse gravel	64	3	6%	94%
Cobble	small cobble	90	2	4%	98%
	medium cobble	128	1	2%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			50	100%	100%

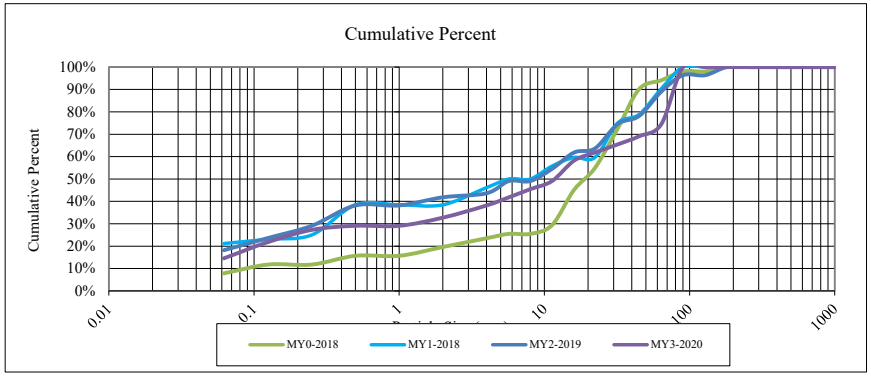
Summary Data	
D16	0.125
D35	2.28
D50	4.3
D84	38
D95	70

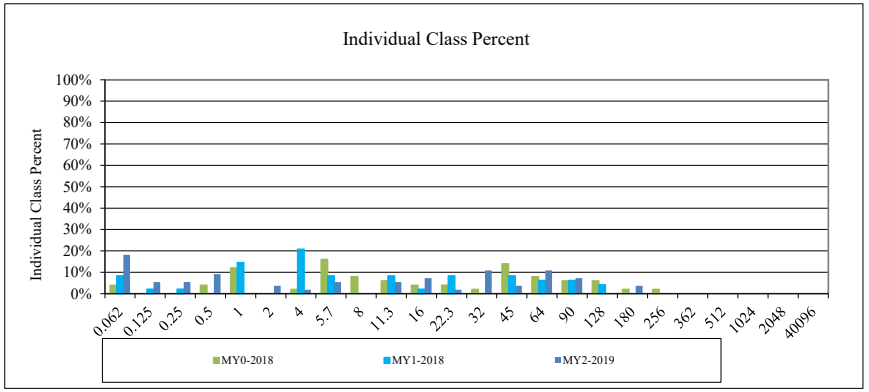




Project Name: North Branch					
Cross-Section: 4					
Feature: Riffle					
			2020		
Description	Material	Size (mm)	Total #	Item %	Cum %
Silt/Clay	silt/clay	0.062	8	19%	19%
Sand	very fine sand	0.125	4	10%	29%
	fine sand	0.250	3	7%	36%
	medium sand	0.50	1	2%	38%
	coarse sand	1.00	0	0%	38%
	very coarse sand	2.0	2	5%	43%
Gravel	very fine gravel	4.0	3	7%	50%
	fine gravel	5.7	2	5%	55%
	fine gravel	8.0	2	5%	60%
	medium gravel	11.3	2	5%	64%
	medium gravel	16.0	5	12%	76%
	course gravel	22.3	2	5%	81%
	course gravel	32.0	2	5%	86%
	very coarse gravel	45	2	5%	90%
	very coarse gravel	64	3	7%	98%
Cobble	small cobble	90	0	0%	98%
	medium cobble	128	0	0%	98%
	large cobble	180	1	2%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			42	100%	100%

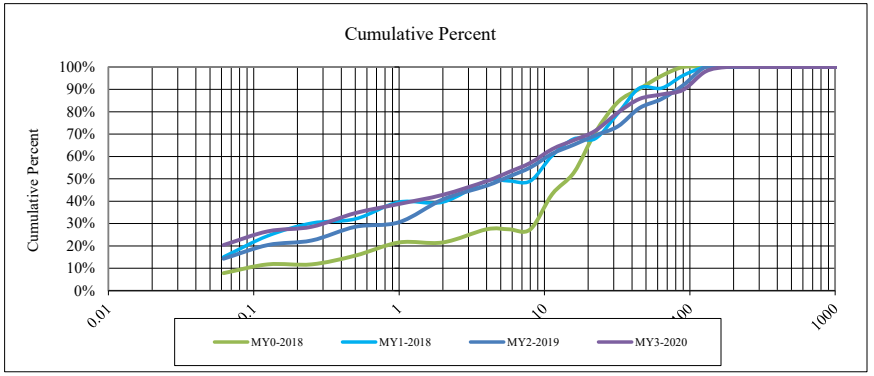
Summary Data	
D16	NA
D35	0.39
D50	8.4
D84	54
D95	84

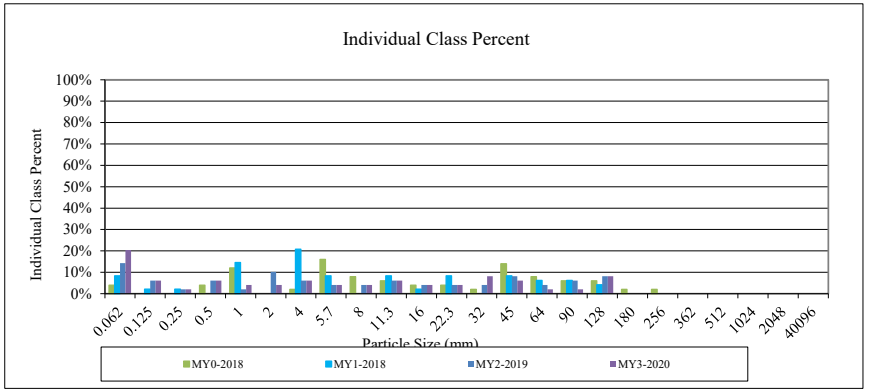




Project Name: East Branch					
Cross-Section: 7					
Feature: Riffle					
			2020		
Description	**Material**	**Size (mm)**	**Total #**	**Item %**	**Cum %**
Silt/Clay	silt/clay	0.062	10	21%	21%
Sand	very fine sand	0.125	3	6%	27%
	fine sand	0.250	1	2%	29%
	medium sand	0.50	3	6%	35%
	coarse sand	1.00	1	2%	38%
	very coarse sand	2.0	5	10%	48%
Gravel	very fine gravel	4.0	3	6%	54%
	fine gravel	5.7	2	4%	58%
	fine gravel	8.0	2	4%	63%
	medium gravel	11.3	3	6%	69%
	medium gravel	16.0	2	4%	73%
	course gravel	22.3	2	4%	77%
	course gravel	32.0	2	4%	81%
	very coarse gravel	45	4	8%	90%
	very coarse gravel	64	2	4%	94%
Cobble	small cobble	90	3	6%	100%
	medium cobble	128	0	0%	100%
	large cobble	180	0	0%	100%
	very large cobble	256	0	0%	100%
Boulder	small boulder	362	0	0%	100%
	small boulder	512	0	0%	100%
	medium boulder	1024	0	0%	100%
	large boulder	2048	0	0%	100%
Bedrock	bedrock	40096	0	0%	100%
TOTAL % of whole count			48	100%	100%

Summary Data	
D16	0.075
D35	1.35
D50	5.4
D84	55
D95	103





Appendix E.
Hydrology Data

Table 12. Verification of Bankfull Events

Table 12. Verification of Bankfull Events
Mud Lick Creek Restoration Site (DMS Project No. 93482

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
December 6, 2018	October 16-17, 2018	Observations throughout floodplain and crest gauge indicate a bankfull event after 4.61 inches of rain fell over 48 hours.	1, 2
May 8, 2019	February 24, 2019	Observation of wrack in floodplain along North Branch R2 and crest gauge data from all site crest gauges indicate a bankfull event after 2.27 inches of rain fell over 48 hours.	3
September 18, 2019	July 24, 2019	Observation of wrack on Mud Lick Creek R2 floodplain fences and crest gauge data from all site crest gauges indicate a bankfull event after 3.02 inches of rain fell over 48 hours.	4
May 29, 2020	February 7, 2020	Observations of wrack throughout site along all stream reaches, and crest gauge data from all site crest gauges indicate a bankfull event after approximately 3.59 inches of rain fell over 24-hour period.	5, 6, 7
November 16, 2020	November 12, 2020	Observations of wrack throughout site along all stream reaches, and crest gauge data from all site crest gauges indicate a bankfull event after approximately 4.60 inches of rain fell over 48-hour period.	8, 9


Photo-5
2020/05/29


Photo-6
2020/05/29


Photo-7
2020/05/29

Photo-8

Photo-9

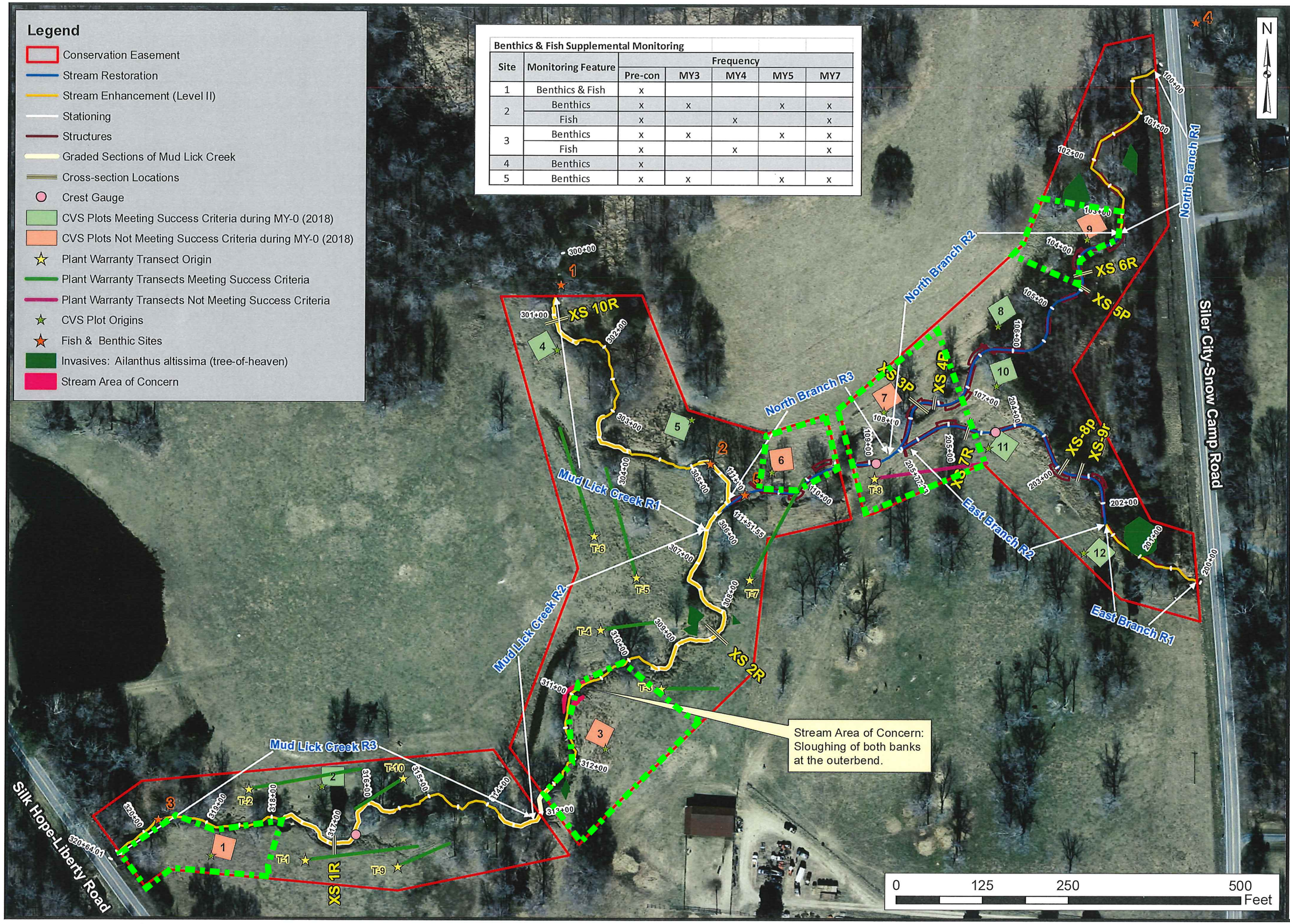
Appendix F.
2019 Warranty Replant Information

Legend

- Conservation Easement
- Stream Restoration
- Stream Enhancement (Level II)
- Stationing
- Structures
- Graded Sections of Mud Lick Creek
- Cross-section Locations
- Crest Gauge
- CVS Plots Meeting Success Criteria during MY-0 (2018)
- CVS Plots Not Meeting Success Criteria during MY-0 (2018)
- Plant Warranty Transect Origin
- Plant Warranty Transects Meeting Success Criteria
- Plant Warranty Transects Not Meeting Success Criteria
- CVS Plot Origins
- Fish & Benthic Sites
- Invasives: Ailanthus altissima (tree-of-heaven)
- Stream Area of Concern

Benthics & Fish Supplemental Monitoring

Site	Monitoring Feature	Frequency				
		Pre-con	MY3	MY4	MY5	MY7
1	Benthics & Fish	x				
2	Benthics	x	x		x	x
	Fish	x		x		x
3	Benthics	x	x		x	x
	Fish	x		x		x
4	Benthics	x				
5	Benthics	x	x		x	x



Axiom Environmental, Inc.

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

Project:

MUD LICK CREEK MITIGATION SITE

DMS Project Number 93482
Chatham County, NC

Title:

CURRENT CONDITIONS PLAN VIEW

Drawn by: PHP, CLF

Date: Sept 2018

Scale: 1:1,500

Project No.: 12-004.22

FIGURE

A

Dykes & Son Nursery

825 Maude Etter Rd
TN 37110

Packing Slip

Date	Invoice #
1/7/2019	23341

Ship To
NORTH STATE ENVIRONMENTAL 2889 LOWERY ST WINSTON SALEM, NC 27101

P.O. No.	Ship	Via	FOB	Project
mud lick/green tryon	1/7/2019			

Quantity	Item Code	Description
		Mud Lick Creek
175	Bare Root	River Birch 12-18"
175	Bare Root	Tulip Poplar 12-18"
175	Bare Root	Sycamore 12-18"
175	Bare Root	Red Bud 12-18"
		Greens of Tryon
100	Bare Root	Poplar 12-18"
50	Bare Root	Sycamore 12-18"
50	Bare Root	River Birch 12-18"
1	Freight	UPS Charges
1	Packing	Packing

No claims, errors, shortages, etc. will be considered unless made within 10 days of receipt.

Appendix G.
2020 Benthic Data

Results
Habitat Assessment Forms

AXIOM, MUD LICK CREEK, CHATHAM COUNTY, NC, BENTHIC MACROINVERTEBRATES COLLECTED 6/5 AND 6/9/2020.

PAI ID NO			53930	53931	53932
STATION			MLC-3	MLC-5	MLC-2
DATE					
SPECIES	T.V.	F.F.G.			
ANNELIDA					
Clitellata					
Oligochaeta		CG			
Naididae		CG			
Tubificinae w.o.h.c.		CG	1		
Lumbriculida					
Lumbriculidae		CG		2	
ARTHROPODA					
Crustacea					
Amphipoda		CG			
Crangonyctidae					
Crangonyx sp.	7.2	CG		1	
Decapoda					
Cambaridae					
Procambarus sp.	9.3	SH			1
Insecta					
Ephemeroptera					
Baetidae		CG		1	
Leptophlebiidae		CG			
Paraleptophlebia sp.	1.2	CG	1	1	
Odonata					
Coenagrionidae		P		1	
Enallagma sp.	8.5	P			1
Corduliidae					
Neurocordulia sp.	5.3		5		
Plecoptera					
Perlidae		P			
Perlesta placida	2.9	P	4		
Perlesta sp.	2.9	P		4	1
Hemiptera					
Corixidae		PI	1	1	
Megaloptera					
Sialidae		P			
Sialis sp.	7	P		2	
Trichoptera					
Hydropsychidae		FC			
Cheumatopsyche sp.	6.6	FC	2		
Coleoptera					
Curculionidae			1		
Elmidae		CG			
Stenelmis sp.	*5.6*	SC		1	

AXIOM, MUD LICK CREEK, CHATHAM COUNTY, NC, BENTHIC MACROINVERTEBRATES COLLECTED 6/5 AND 6/9/2020.

PAI ID NO			**53930**	**53931**	**53932**
STATION			**MLC-3**	**MLC-5**	**MLC-2**
DATE					
SPECIES	**T.V.**	**F.F.G.**			
Hydrophilidae		**P**			
Tropisternus sp.	*9.3*	**P**		1	
Noteridae		**P**			
Hydrocanthus sp.		**P**			1
Diptera					
Chironomidae					
Chironomus sp.	*9.3*	**CG**	1		
Conchapelopia sp.	8.4	**P**	5	4	5
Cricotopus bicinctus	*8.7*	**CG**		4	4
Microtendipes pedellus gp.	*3.9*	**CG**	1	1	1
Natarsia sp.	*9.6*	**P**	2	1	3
Parakiefferiella sp.	*4.8*	**CG**	1		
Polypedilum illinoense gp.	*8.7*	**SH**	6		
Tanytarsus sp.	*6.6*	**FC**		1	
Culicidae		**FC**			
Anopheles sp.	*8.6*	**FC**	1		
Ephydridae		**PI**		2	
Simuliidae		**FC**			
Simulium sp.	*4.9*	**FC**		11	
TOTAL NO. OF ORGANISMS			**32**	**39**	**17**
TOTAL NO. OF TAXA			**14**	**17**	**8**
EPT TAXA			**3**	**3**	**1**
BIOTIC INDEX ASSIGNED VALUES			**6.31**	**5.90**	**8.05**

MLC #2

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 70

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Mud Lick Creek 2 Location/road: (rutabield) Crossroads (Road Name Siler City Snow Camp) County Chatham

Date 200609 **CC#** 03030003 **Basin** Cape Fear **Subbasin** 03-06-08

Observer(s) PHP Type of Study: ☐ Fish ☑ Benthos ☐ Basinwide ☐ Special Study (Describe) ______

Latitude 35.413326 Longitude -79.434704 Ecoregion: ☐ MT ☑ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature ______ °C DO ______ mg/l Conductivity (corr.) ______ µS/cm pH ______

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 30 %Forest ______ %Residential 70 %Active Pasture ______ % Active Crops ______ %Fallow Fields ______ % Commercial ______ %Industrial ______ %Other - Describe: ______

Watershed land use : ☐ Forest ☐ Agriculture ☐ Urban ☐ Animal operations upstream

Width: (meters) Stream 3 Channel (at top of bank) 5 **Stream Depth:** (m) Avg .1 Max 1
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1.2

Bank Angle: 90 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☑ Deeply incised-steep, straight banks ☐ Both banks undercut at bend ☐ Channel filled in with sediment
☐ Recent overbank deposits ☐ Bar development ☐ Buried structures ☐ Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐ Green tinge ☐ Sewage smell

Manmade Stabilization: ☑ N ☐ Y: ☐ Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐ Berm/levee

Flow conditions : ☐ High ☑ Normal ☐ Low

Turbidity: ☐ Clear ☑ Slightly Turbid ☐ Turbid ☐ Tannic ☐ Milky ☐ Colored (from dyes)

Good potential for Wetlands Restoration Project?? ☑ **YES** ☐ **NO Details** ______

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed .... ☑
B. Water fills >75% of available channel, or <25% of channel substrate is exposed....................... ☐
C. Water fills 25-75% of available channel, many logs/snags exposed.. ☐
D. Root mats out of water.. ☐
E. Very little water in channel, mostly present as standing pools.. ☐

Weather Conditions: cloudy/hot **Photos:** ☐ N ☐ Y ☐ Digital ☐ 35mm

Remarks: no rain past 48 hours, channel has not been restored, but planted w/ native species and fenced

• stream channel has not been altered, only riparian planting and livestock exclusion

I. Channel Modification

	Score
A. channel natural, frequent bends	5
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	(3)
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks _____ Subtotal 3

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

____**Rocks** ____**Macrophytes** ✓**Sticks and leafpacks** ✓**Snags and logs** ____**Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	11	7
2 types present	18	(14)	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks _____ Subtotal 14

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	11
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	(8)
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks _____ Subtotal 8

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☐ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☑ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 35

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles Frequent Score	Riffles Infrequent Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	(14)	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☑Typical for area ☐Steep=fast flow ☐Low=like a coastal stream Subtotal 14

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	(2)	(2)
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 4

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	(7)
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 7

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM	Lft. Bank Score	Rt. Bank Score
Dominant vegetation: ~~☐Trees~~ ~~☐Shrubs~~ ☐~~Grasses~~ ☑~~Weeds/old field~~ ☐Exotics (kudzu, etc)		
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5?)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

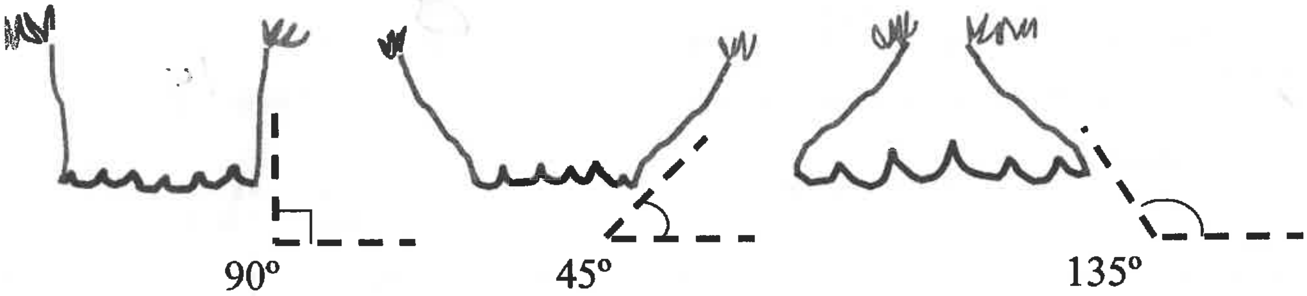
Remarks Dense herbaceous veg, scattered trees and shrubs Total 35

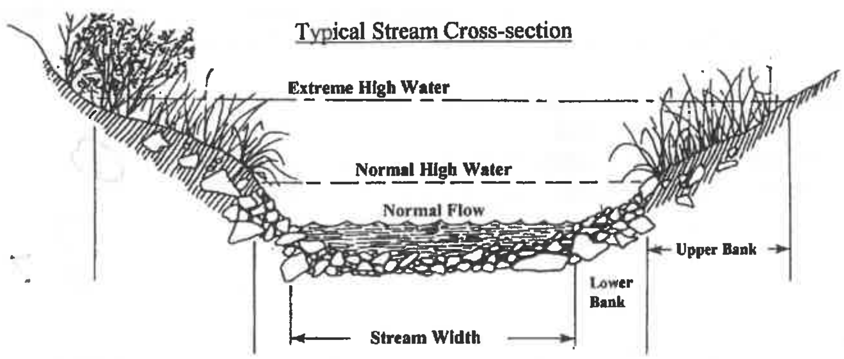
Page Total 10

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 70

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments:

- upstream reach of site, erosion along banks
frequent storm events past three years

MCC #3 MCC #3

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 68

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream Mudlick Creek R3 Location/road: Crutchfield crossroads (Road Name Silk Hope Liberty)County Chatham

Date 200605 CC# 03030003 Basin Cape Fear Subbasin 03-06-08

Observer(s) DKW Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) ______

Latitude ______ Longitude ______ Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature ______ °C DO ______ mg/l Conductivity (corr.) ______ µS/cm pH ______

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 30 %Forest ______ %Residential 70 %Active Pasture ______ % Active Crops
______ %Fallow Fields ______ % Commercial ______ %Industrial ______ %Other - Describe: ______

Watershed land use : ☒ Forest ☒ Agriculture ☐ Urban ☐ Animal operations upstream

Width: (meters) Stream 2 Channel (at top of bank) 5 **Stream Depth:** (m) Avg .2 Max 1
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) ______

Bank Angle: 85 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐ Deeply incised-steep, straight banks ☐ Both banks undercut at bend ☐ Channel filled in with sediment
☐ Recent overbank deposits ☐ Bar development ☐ Buried structures ☐ Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐ Green tinge ☐ Sewage smell

Manmade Stabilization: ☒ N ☐ Y: ☐ Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐ Berm/levee

Flow conditions : ☐ High ☒ Normal ☐ Low

Turbidity: ☐ Clear ☒ Slightly Turbid ☐ Turbid ☐ Tannic ☐ Milky ☐ Colored (from dyes)

Good potential for Wetlands Restoration Project?? ☒ **YES** ☐ **NO Details** ______

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☐
C. Water fills 25-75% of available channel, many logs/snags exposed	☐
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: Drizzle/mist **Photos:** ☐ N ~~☐ Y~~ ☐ Digital ☐ 35mm

Remarks: Stream enhancement reach w/ no channel work, only riparian veg replant and exclusion of livestock

MCC #3

I. Channel Modification

	Score
A. channel natural, frequent bends	5
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	(3)
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks _____ Subtotal 3

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

____Rocks ____Macrophytes ✓Sticks and leafpacks ✓Snags and logs ✓Undercut banks or root mats

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	(11)	7
2 types present	18	14	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks _____ Subtotal 11

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	(11)
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks _____ Subtotal 11

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☐ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 35

MCC 3

mCC + 3

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	16	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	(10)	3
D. riffles absent.....	0	

Channel Slope: ☑Typical for area ☐Steep=fast flow ☐Low=like a coastal stream Subtotal 10

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	(3)	(3)
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 6

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	(7)
D. Stream with **minimal** canopy - full sun in all but a few areas.....	2
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 7

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM	Lft. Bank Score	Rt. Bank Score
Dominant vegetation: ☑Trees ☑Shrubs ☑Grasses ☐ Weeds/old field ☐Exotics (kudzu, etc)		
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
3. width 6-12 meters.....	3	3
4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0
		Total 10

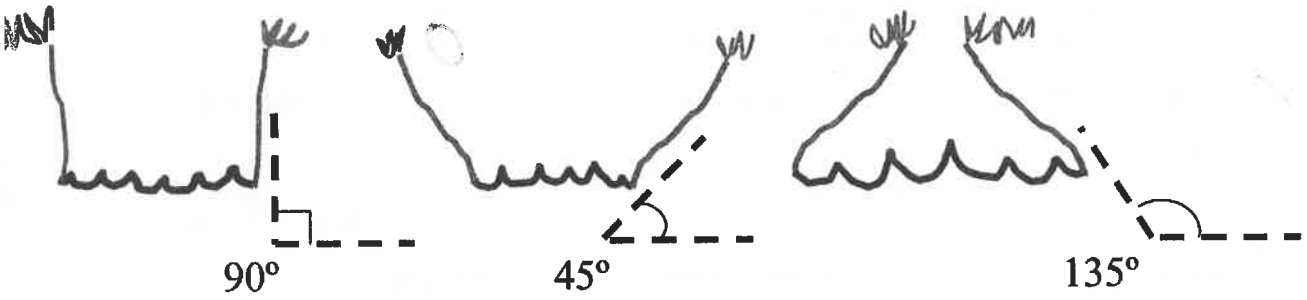
Remarks -E2 reach, planted w/ native species livestock were seen fenced out of stream

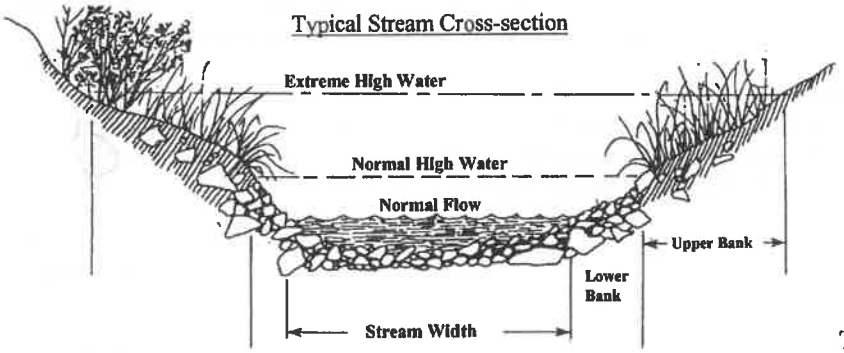
Page Total 33

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 68

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments: _____

MCC#5

3/06 Revision 6

12-004.22

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ

TOTAL SCORE 86

Directions for use: The observer is to survey a **minimum of 100 meters with 200 meters preferred** of stream, preferably in an **upstream** direction starting above the bridge pool and the road right-of-way. The segment which is assessed should represent average stream conditions. To perform a proper habitat evaluation the observer needs to get into the stream. To complete the form, select the description which best fits the observed habitats and then circle the score. If the observed habitat falls in between two descriptions, select an intermediate score. A final habitat score is determined by adding the results from the different metrics.

Stream North Branch R3 Location/road: _____ (Road Name _____) County Chatham

Date 200605 **CC#** 03030003 **Basin** Cape Fear **Subbasin** 03-06-08

Observer(s)_____ Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35.813196 Longitude -79.434522 Ecoregion: ☐ MT ☑ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature_____°C DO _____mg/l Conductivity (corr.) _____µS/cm pH _____

Physical Characterization: Visible land use refers to immediate area that you can see from sampling location - include what you estimate driving thru the watershed in watershed land use.

Visible Land Use: 30 %Forest _____%Residential 70 %Active Pasture _____% Active Crops
_____%Fallow Fields _____% Commercial _____%Industrial _____%Other - Describe:_____

Watershed land use : ☐Forest ☐Agriculture ☐Urban ☐ Animal operations upstream

Width: (meters) Stream .5 Channel (at top of bank) 1 **Stream Depth:** (m) Avg .1 Max .5
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m)_____

Bank Angle: 130 ° or ☐ NA (Vertical is 90°, horizontal is 0°. Angles > 90° indicate slope is towards mid-channel, < 90° indicate slope is away from channel. NA if bank is too low for bank angle to matter.)

☐ Channelized Ditch
☐Deeply incised-steep, straight banks ☐Both banks undercut at bend ☐Channel filled in with sediment
☐ Recent overbank deposits ☐Bar development ☐Buried structures ☐Exposed bedrock
☐ Excessive periphyton growth ☐ Heavy filamentous algae growth ☐Green tinge ☐ Sewage smell
Manmade Stabilization: ☐N ☒Y: ☐Rip-rap, cement, gabions ☐ Sediment/grade-control structure ☐Berm/levee
Flow conditions : ☐High ☒Normal ☐Low
Turbidity: ☐Clear ☐Slightly Turbid ☐Turbid ☐Tannic ☐Milky ☐Colored (from dyes)
Good potential for Wetlands Restoration Project?? ☑ **YES** ☐ **NO Details**_____

Channel Flow Status

Useful especially under abnormal or low flow conditions.

A. Water reaches base of both lower banks, minimal channel substrate exposed	☐
B. Water fills >75% of available channel, or <25% of channel substrate is exposed	☐
C. Water fills 25-75% of available channel, many logs/snags exposed	☐
D. Root mats out of water	☐
E. Very little water in channel, mostly present as standing pools	☐

Weather Conditions: cloudy/warmer **Photos:** ☐N ☒Y ☐ Digital ☐35mm

Remarks: Stream restoration reach, several large crayfish abundant, juvenile crayfish, several small salamanders

no rain past 48 hours, rainfall near average prior to collection

MLC #5

I. Channel Modification

	Score
A: channel natural, frequent bends	(5)
B. channel natural, infrequent bends (channelization could be old)	4
C. some channelization present	3
D. more extensive channelization, >40% of stream disrupted	2
E. no bends, completely channelized or rip rapped or gabioned, etc	0

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☐Banks of uniform shape/height

Remarks restored channel

Subtotal 5

II. Instream Habitat: Consider the percentage of the reach that is favorable for benthos colonization or fish cover. If >70% of the reach is rocks, 1 type is present, circle the score of 17. Definition: leafpacks consist of older leaves that are packed together and have begun to decay (not piles of leaves in pool areas). Mark as Rare, Common, or Abundant.

✓ **Rocks** ____ **Macrophytes** ✓ **Sticks and leafpacks** ____ **Snags and logs** ____ **Undercut banks or root mats**

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

	>70% Score	40-70% Score	20-40% Score	<20% Score
4 or 5 types present	20	16	12	8
3 types present	19	15	11	7
2 types present	(18)	14	10	6
1 type present	17	13	9	5
No types present	0			

☐ No woody vegetation in riparian zone Remarks

Subtotal 18

III. Bottom Substrate (silt, sand, detritus, gravel, cobble, boulder) Look at entire reach for substrate scoring, but only look at riffle for embeddedness, and use rocks from all parts of riffle-look for "mud line" or difficulty extracting rocks.

	Score
A. substrate with good mix of gravel, cobble and boulders	
1. embeddedness <20% (very little sand, usually only behind large boulders)	15
2. embeddedness 20-40%	12
3. embeddedness 40-80%	8
4. embeddedness >80%	3
B. substrate gravel and cobble	
1. embeddedness <20%	14
2. embeddedness 20-40%	(11)
3. embeddedness 40-80%	6
4. embeddedness >80%	2
C. substrate mostly gravel	
1. embeddedness <50%	8
2. embeddedness >50%	4
D. substrate homogeneous	
1. substrate nearly all bedrock	3
2. substrate nearly all sand	3
3. substrate nearly all detritus	2
4. substrate nearly all silt/ clay	1

Remarks

Subtotal 11

IV. Pool Variety Pools are areas of deeper than average maximum depths with little or no surface turbulence. Water velocities associated with pools are always slow. Pools may take the form of "pocket water", small pools behind boulders or obstructions, in large high gradient streams, or side eddies.

	Score
A. Pools present	
1. Pools Frequent (>30% of 200m area surveyed)	
a. variety of pool sizes	(10)
b. pools about the same size (indicates pools filling in)	8
2. Pools Infrequent (<30% of the 200m area surveyed)	
a. variety of pool sizes	6
b. pools about the same size	4
B. Pools absent	0

Subtotal 10

☑ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks

Page Total 44

MCC#5

V. Riffle Habitats

Definition: Riffle is area of reaeration-can be debris dam, or narrow channel area.

	Riffles **Frequent** Score	Riffles **Infrequent** Score
A. well defined riffle and run, riffle as wide as stream and extends 2X width of stream....	(16)	12
B. riffle as wide as stream but riffle length is not 2X stream width	14	7
C. riffle not as wide as stream and riffle length is not 2X stream width	10	3
D. riffles absent.....	0	

Channel Slope: ☐Typical for area ☐Steep=fast flow ☐Low=like a coastal stream

Subtotal 16

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion	(7)	(7)
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	5	5
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0

Total 14

Remarks _____

VII. Light Penetration Canopy is defined as tree or vegetative cover directly above the stream's surface. Canopy would block out sunlight when the sun is directly overhead. Note shading from mountains, but not use to score this metric.

	Score
A. Stream with **good** canopy with some breaks for light penetration	10
B. Stream with **full canopy** - breaks for light penetration absent.....	8
C. Stream with **partial** canopy - sunlight and shading are essentially equal.....	7
D. Stream with **minimal** canopy - full sun in all but a few areas.....	(2)
E. **No canopy** and no shading.....	0

Remarks _____ Subtotal 2

VIII. Riparian Vegetative Zone Width

Definition: Riparian zone for this form is area of natural vegetation adjacent to stream (can go beyond floodplain). Definition: A break in the riparian zone is any place on the stream banks which allows sediment or pollutants to directly enter the stream, such as paths down to stream, storm drains, uprooted trees, otter slides, etc.

FACE UPSTREAM Dominant vegetation: ☐ Trees ☐ Shrubs ☐ Grasses ☐ Weeds/old field ☐Exotics (kudzu, etc)	Lft. Bank Score	Rt. Bank Score
A. Riparian zone **intact** (no breaks)		
1. width > 18 meters.....	(5)	(5)
2. width 12-18 meters.....	4	4
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4. width < 6 meters.....	2	2
B. Riparian zone **not intact** (breaks)		
1. breaks rare		
a. width > 18 meters.....	4	4
b. width 12-18 meters.....	3	3
c. width 6-12 meters.....	2	2
d. width < 6 meters.....	1	1
2. breaks common		
a. width > 18 meters.....	3	3
b. width 12-18 meters.....	2	2
c. width 6-12 meters.....	1	1
d. width < 6 meters.....	0	0

Remarks riparian zone planted and regenerated w/s bean fence

Total 10

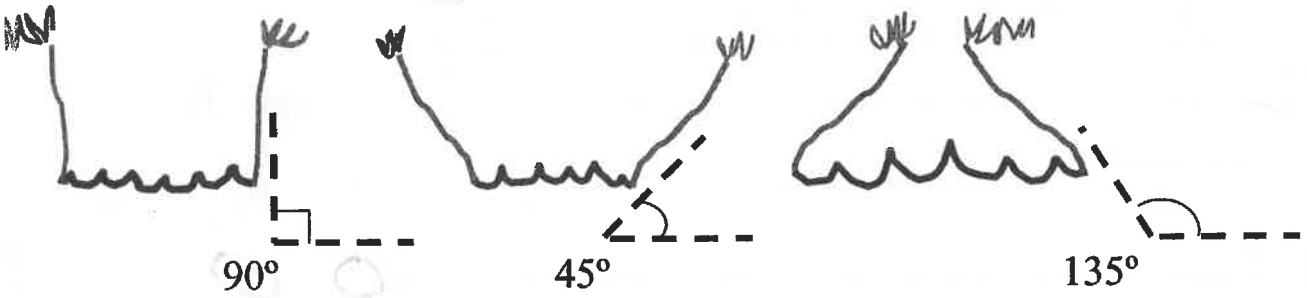
Page Total 42

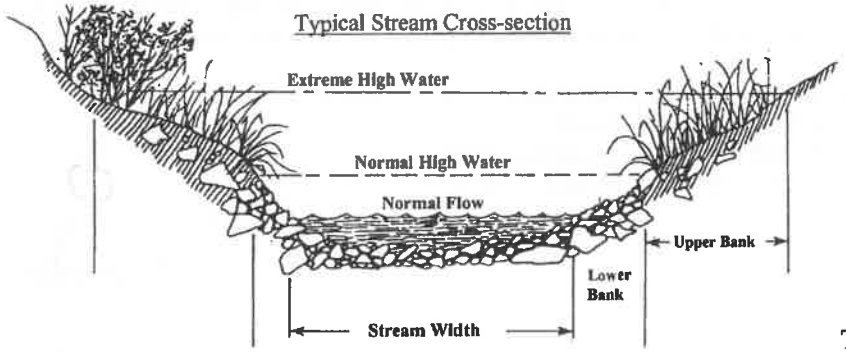
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream.

TOTAL SCORE 86

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments: