FINAL
YEAR 3 (2016) ANNUAL MONITORING REPORT
MARTIN'S CREEK II MITIGATION PROJECT

Cherokee County, North Carolina
DMS Project No. 92633 (Contract No. 005717)
USACE Action ID No. SAW – 2009-00209/DWR Project No. 10-0952
SCO No. 08-07251-01

Data Collection – March-November 2016

Hiwassee River Basin
Cataloging Unit 06020002170010

SUBMITTED TO/PREPARED FOR:

North Carolina Department of Environmental Quality
Division of Mitigation Services
217 West Jones Street, Suite 3000A
Raleigh, North Carolina 27603

December 2016

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SUBMITTED BY:

Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603

December 2016

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Appendices

1.0 PROJECT SUMMARY

The North Carolina Department of Environmental Quality - Division of Mitigation Services (DMS) has established the Martin's Creek II Mitigation Project (Site) located in Cherokee County, just south of the town of Murphy. The Site includes a 93.87-acre easement encompassed within 14-digit Cataloging Unit 06020002170010 of the Hiwassee River Basin (Figure 1, Appendix B and Table 4, Appendix A). Land use at the Site, prior to mitigation activities, was composed of livestock pasture, open land, a residence, and forested areas. Martin's Creek and its tributaries were impaired by historical and current land management practices, which included timber harvesting, pasture, channelization, and livestock grazing. Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A).

The Site is located along Martin's Creek and several unnamed tributaries, which have been assigned Stream Index Number 1-49 and Best Usage Classification of C. Site streams are listed on the NCDWQ draft 2014 and final 2012 Section 303(d) list of impaired streams due to a fair bioclassification for reduced ecological/biological integrity and fish communities, and elevated levels of fecal coliform bacteria. The Site is located within a Targeted Local Watershed that has been identified for stream and buffer restoration opportunities (NCDMS 2008).

The Site lies within the focus area of the *Peachtree-Martins Creek Local Watershed Plan* (LWP) and roughly corresponds to Restoration site #1 & Preservation site #1 of the LWP project atlas (NCDMS 2007). Goals of the LWP include implementation of wetland and stream restoration projects that reduce sources of sediment and nutrients by restoring riparian buffers, stabilizing stream banks, and restoring natural channel geomorphology, particularly in headwater streams.

The project goals will directly address stressors identified in the Peachtree-Martins Creek LWP, namely lack of riparian vegetation, channel modification, excess sediment inputs, excess nutrient inputs, and bacterial contamination as follows.

- Restore geomorphically stable stream channels within the Site;
- Restore or enhance wetlands;
- Exclude livestock from accessing project streams, wetlands, and riparian zones;
- Improve and restore hydrologic connections and achieve uplift of ecosystem functions;
- Improve water quality within the Site by reducing bank erosion, improving nutrient and sediment removal, and stabilizing stream banks;
- Restore and preserve headwater tributaries to the Peachtree-Martins Creek Watershed and the Hiwassee River; and
- Improve aquatic and terrestrial habitat by improving substrate and in-stream cover, adding woody debris, reducing water temperatures, and restoring riparian habitat.

The Site mitigation plan was completed in March 2010 with the final design and construction plans completed in November 2010 (Table 2, Appendix A). Project construction was completed between October 2012 and July 2013. The implemented mitigation is as follows (Figure 2, Appendix B and Table 1, Appendix A).

- 8817 Stream Mitigation Units
    - Restoring approximately 3486 linear feet of stream channel through construction of stable channel at the historic floodplain elevation.
    - Enhancing (level I) approximately 832 linear feet of stream channel through cessation of current land use practices, installing grade control structures, repairing bank erosion, restoring proper channel dimension, and planting with native forest vegetation.
    - Enhancing (level II) approximately 1903 linear feet of stream channel through cessation of current land use practices, removing invasive species, and planting with native forest vegetation.
    - Preserving 21,327 linear feet of stream channel.
- 5.97 Riparian Wetland Mitigation Units
    - Restoring approximately 5.20 acres of riparian wetland by removing spoil castings, restoring stream inverts to historic elevations rehydrating stream-side wetlands, removing drain tile, eliminating land use practices, and planting with native forest vegetation.
    - Enhancing approximately 1.61 acres of riparian wetland by fencing livestock and supplemental planting.
- Planting a native woody riparian buffer (at least 30 feet in width) adjacent to restored/enhanced streams and wetlands within the Site.
- Protecting the Site in perpetuity with a conservation easement.

Stream Success Criteria

Stream restoration success criteria for the Site are based on the *Stream Mitigation Guidelines* issued in April 2003 by the USACE and NCDWQ. Success criteria for stream restoration will include 1) documentation of two bankfull events, 2) little change in the channel cross-section from as-built conditions, 3) stable longitudinal profile, 4) substrate consistency, and 5) photographic evidence of stability.

Bankfull Events

Two bankfull flow events in separate years must be documented within the 5-year monitoring period. Otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

Cross-sections

Riffle cross-sections on restoration and enhancement reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Riffle cross-sections should generally fall within the parameters defined for channels of the appropriate Rosgen 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.

Longitudinal Profile

Longitudinal profile data for the stream reach should show that bedform features are remaining stable. The riffles should be steeper and shallower than the pools, while the pools should be deep with flat water surface slopes. The relative percentage of riffles and pools should not change significantly from the design parameters.

Bed Material Analysis

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

Photo Reference Sites
Photographs will be used to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures subjectively. Lateral photos should not indicate excessive erosion or continuing degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation.

Vegetation Success Criteria
Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria for this project includes an average density of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, 290 planted stems per acre must be surviving in year 4, and 260 planted stems per acre in year 5.

Wetland Success Criteria
Hydrologic success will be based on conditions of on-site reference wetlands. Success will be determined by the following criteria.

Years One Through Three
Hydrologic success criteria will be met if the Site demonstrates groundwater table levels within 12 inches of the soil surface for a minimum of 13% of the growing season (this criterion reflects a deviation of 50% from the duration of saturation expected for this type of wetland system (~25%). Success for monitoring years one through three will be determined based on this 50% tolerance of deviation from the duration of wetland hydrology at the reference sites.

Years Four and Five
Success for monitoring years four and five will be determined based on a 20% tolerance of deviation from the duration of wetland hydrology at the reference sites. Therefore, it is expected that in years four and five the site will achieve a minimum of 20% saturation. Based on reference conditions and the criterion stated above, it is expected that reference soil saturation for years one through five will continue to exceed the regulatory 12.5% minimum requirement of the growing season for Cherokee County. In order to attain conditions suitable for the formation of wetland vegetation and hydric soils, the Site should be saturated within 12 inches of the surface or inundated for consecutive period equal to 24 days. However, to meet hydrologic success criteria and mimic the reference wetland hydrology, the site should demonstrate wetland hydrology for a minimum of 25 days in years one through three. In years four and five, this will increase to a minimum of 38 days. Overbank flooding from the adjacent channel will also be noted during monitoring.

Reference areas will be monitored for a minimum of five years.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in tables and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the Division of Mitigation Services (DMS) website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

2.0 METHODOLOGY

Monitoring of the Site's restoration efforts will be performed until agreed upon success criteria are fulfilled. Monitoring is proposed for the stream channel, riparian vegetation, and hydrology for a period of five years (Figures 2 & 2A-2C, Appendix A). Monitoring reports of collected data will be submitted no later than December of each monitoring year.

2.1 Streams

Post-restoration monitoring will be conducted for five years following the completion of construction to evaluate the effectiveness of the restoration practices. Measurements were taken using a Topcon GTS 303 total station and Recon data collector. The raw total station file was processed using Carlson Survey Software into a Computer Aided Design (CAD) file. Coordinates were exported as a text/ASCII file to Microsoft Excel for processing and presentation of data, and are not georeferenced. Pebble counts were completed using the modified Wolman method (Rosgen 1993). Monitored stream parameters include stream dimension (cross-sections), pattern (longitudinal survey), profile (profile survey), and photographic documentation. Stream data can be found in Appendix D.

Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. One crest gauge was installed to record the highest watermark between site visits; the gauge will be checked each Site visit to determine if a bankfull event has occurred (Figure 2A, Appendix B). Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

One bankfull event has been documented to date during monitoring year 3 (2016) for a total of twelve bankfull events during years 1 (2014) and 3 (2016).

Cross-sections

A total of 19 permanent cross-sections, 12 riffle and 7 pool, were established and will be used to evaluate stream dimension; locations are depicted on Figures 2, 2A, and 2B (Appendix B) Because riffle cross-sections are critical in determining bankfull design parameters, the number of riffle cross-sections established will generally outnumber pool cross-sections. Each cross-section will be marked on both banks with permanent pins to establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. The annual cross-section survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System.

No areas of concern or indicators of instability were observed during year 3 (2016) monitoring; therefore, stream dimension measurements are currently meeting success criteria.

Longitudinal Profile

After Site construction, approximately 4493 linear feet of longitudinal profile was completed to document baseline conditions. Longitudinal profile will be resurveyed annually for the duration of the five-year monitoring period. Measurements include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each channel unit (e.g., riffle, pool) and at the maximum pool depth. The survey will be tied to a permanent benchmark.

No areas of concern or indicators of bedform instability were observed during year 3 (2016) monitoring; therefore, stream longitudinal profile measurements are currently meeting success criteria.

Bed Material Analysis

Pebble counts will be conducted annually on one permanent riffle cross-section (100-counts) at the time cross-section and longitudinal surveys are performed during the five year monitoring period. These samples will reveal changes in sediment gradation over time as the stream adjusts to upstream sediment loads.

Year 3 (2016) pebble counts indicate the maintenance of coarser materials in the measured riffle feature; therefore, bed material is currently meeting success criteria.

Photo Reference Sites

A total of 26 photographs will be used to visually document restoration success for at least five years following construction. Photographs will be taken from a height of approximately five to six feet. Photo locations will be recorded using sub-meter GPS to ensure that the same locations (and view directions) on the Site are monitored in each monitoring period.

Year 3 (2016) photo reference sites show no channel aggradation or degradation, or bank erosion. In addition, riparian vegetation is meeting success criteria based on stem counts across the Site; however, it is too early in the monitoring period to show successive maturation of riparian vegetation.

2.2 Vegetation

After planting was completed, an initial evaluation was performed to verify planting methods were successful and to determine initial species composition and density. Fifteen sample vegetation plots (10-meter by 10-meter) were installed and measured within the Site as per guidelines established in *CVS-DMS Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008). Vegetation plots are permanently monumented with 6-foot metal t-posts at each corner. In each sample plot, vegetation parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph. Vegetation plot data can be found in Appendix C.

Supplemental planting occurred at the Site in February 2016 with 1,900 bare root stems as follows:

Riparian area plantings include:

- 150 *Betula nigra* - river birch
- 200 *Cercis canadensis* - eastern red bud
- 200 *Nyssa sylvatica* - black gum
- 200 *Platanus occidentalis* - sycamore
- 200 *Quercus coccinea* - scarlet oak
- 200 *Quercus rubra* - northern red oak

Wetland area plantings include:

- 250 *Betula nigra* - river birch
- 200 *Celtis laevigata* - hackberry
- 300 *Platanus occidentalis* - sycamore

Year 3 stem count measurements indicate an average of 413 planted stems per acre (excluding livestakes) across the Site; therefore, the Site is currently meeting vegetation success criteria. Thirteen of the fifteen individual vegetation plots met success criteria based on planted stems alone; plot 3 was one stem shy of meeting success criteria. Additionally, stems from the 2015 supplemental planting appear vigorous during year 3 (2016). A population of Chinese privet (*Ligustrum sinense*) was observed on the left bank of UT1-R3 during previous monitoring years. This area was treated during 2015, and though it responded well, quite a few privet resprouts were observed in this area during year 3 (2016). Three additional privet populations were observed along the lower reaches of the Right Prong Tributaries particularly in the vicinity of Photo Points 21, 23, and 24. These areas are depicted on Figures 2A and 2C, Appendix B. Furthermore, a small amount of multiflora rose (*Rosa multiflora*) was observed scattered throughout the Site.

2.3 Wetland Hydrology

Thirteen RDS Ecotone WM groundwater monitoring gauges were installed within Site wetland restoration areas to monitor groundwater hydrology (Figure 2A, Appendix A). Hydrological sampling will continue for five years with gauges recording daily and downloaded at a minimum of quarterly throughout the growing season (April 14-October 21). In addition, an on-site rain gauge will document rainfall data for comparison of groundwater conditions with extended drought conditions. Finally, groundwater gauges located within riverine wetlands adjacent to restored stream reaches will supplement crest gauge measurements to confirm overbank flooding events.

Seven of the thirteen groundwater gauges met or exceeded wetland success criteria for the Year 3 (2016) monitoring year. Below average precipitation throughout most of Year 3 (2016) likely attributed to moderately poor gauge success (Figure E1, Appendix E). Gauges 7 and 9 both malfunctioned due to dead batteries early in the growing season, resulting in loss of data. The batteries in these gauges were replaced as soon as this malfunction was observed, however the replacement batteries also failed, resulting in the loss of the remaining data for the growing season. The failure of these two gauges and the resulting loss of data can be attributed to a bad batch of batteries ordered from RDS. This issue has been resolved with RDS, however, the data remains unrecoverable. Gauge 9 had already met success criteria at the time of the malfunction, however Gauge 7 had issues throughout the growing season. It is assumed based on the few readings recovered from gauge 7 (water level was between 3.3-3.7 inches May 3-May 10) that this gauge was saturated/inundated a minimum of 27 days at the beginning of the growing season. Although it is too early in the monitoring period to determine the extent of wetland that is currently meeting wetland hydrology success criteria, Year 3 (2016) data indicates that the majority of the Site wetland area is successful.

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APPENDIX A

PROJECT BACKGROUND DATA AND MAPS

Table 1. Project Components and Mitigation Credits
Martin's Creek II Mitigation Site

Mitigation Credit Summations							
Stream			**Riparian Wetland**				**Nonriparian Wetland**
8817			**5.97**				**---**
Projects Components							
Station Range		**Existing Linear Footage/Acreage**	**Priority Approach**	**Restoration/ Restoration Equivalent**	**Restoration Linear Footage/Acreage**	**Mitigation Ratio**	**Mitigation Credits**	**Comment**
Right Prong Martin's Creek and UTs		17,234	---	Preservation	17,234-203= 17,031	5:1	3406.2	Three short reaches in upstream portion of RP UT1 do not have adequate buffer to claim credit and therefore have been removed from the total linear footage and calculated mitigation credits.
Right Prong Martin 's Creek and UTs		971	---	Enhance II	971	2.5:1	388.4	Enhancement Level II - invasive species controls and localized erosion stabilization.
Martin's Creek UTs		4296	---	Preservation	4296	5:1	859.2	
Martin's Creek*		857	---	Enhance II	857	5:1*	171.4	Enhancement Level II - invasive species controls and localized erosion stabilization.
UT-2 to Martin's Creek		75	---	Enhance II	75	2.5:1	30.0	
UT 1 (Reach 3) to Martin's Creek Station 00+00 to 03+37		337	---	Enhance I	337	1.5:1	224.7	Level I stream enhancement - grade control structures, repair bank erosion, and restore proper dimension.
UT 1-3 (Reach 1) to Martin's Creek Station 00+00 to 04+95		495	---	Enhance I	495	1.5:1	330.0	Level I stream enhancement - grade control structures, repair bank erosion, and restore proper dimension.
UT 1 (Reach 2) to Martin's Creek Station 00+00 to 10+52		1052	I	Restoration	1052	1:1	1052	Construction of a new channel on the existing floodplain.
UT 1 (Reach 4) to Martin's Creek	05+46 to 05+91	332	II	Restoration	51	1:1	51.0	Construction of a new channel in a low slope valley.
	05+91 to 06+35**				37	2:1**	18.5	
	06+35 to 15+75				941	1:1	941.0	
	15+75 to 16+75**				100	2:1**	50.0	
UT 1-3 (Reach 2) to Martin's Creek	05+54 to 05+90	1068	II	Restoration	35	1:1	35.0	Construction of a new channel in a low slope valley.
	05+90 to 06+10***				20	2:1***	10.0	
	06+10 to 18+59				1250	1:1	1250.0	
Wetland Restoration		---	---	Restoration	5.14	1:1	5.14	Restoration of riparian wetlands through stream restoration activities, filling abandoned channels and drain tiles, removing spoil castings, and planting.
					0.06	2:1^	0.03	
Wetland Enhancement		1.61	---	Enhancement	1.604	2:1	0.802	Enhancement of existing riparian wetlands by fencing livestock and planting.
					0.006	4:1[+]	0.002	

Component Summation

Restoration Level	**Stream (linear footage)**	**Riparian Wetland (acreage)**	**Nonriparian Wetland (acreage)**
Restoration	3486	5.20	--
Enhancement (Level I)	832	--	--
Enhancement (Level II)	1903	1.61	--
Preservation	21,327	--	
Totals	**27,548**	**6.81**	--
Mitigation Units	**8817 SMUs**	**5.97 Riparian WMUs**	**0.00 Nonriparian WMUs**

* Martin's Creek proper is located beneath a power line; therefore, a credit ratio of 5:1 has been used to calculate mitigation units.
** UT1 (Reach 4) stations 05+91 to 06+35 and 15+75 to 16+75 are located beneath a power line; therefore, a credit ratio of 2:1 has been used to calculate mitigation units.
*** UT1-3 (Reach 2) station 05+90 to 06+10 is located beneath a power line; therefore, a credit ratio of 2:1 has been used to calculate mitigation units.
^0.06 acres of wetland restoration is located beneath a power line; therefore, a credit ratio of 2:1 has been used to calculate mitigation units.
[+]0.006 acres of wetland enhancement is located beneath a power line; therefore, a credit ratio of 4:1 has been used to calculate mitigation units.

Table 2. Project Activity and Reporting History
Martin's Creek II Mitigation Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Mitigation Plan	January 2010-July 2010	September 2010
Final Design – Construction Plans	September 2010-March 2011	March 2011
Construction	--	October 2012-July 2013
Temporary S&E Mix applied to Entire Project Site	--	October 2012-July 2013
Permanent Seed Mix applied to the Entire Project Site	--	October 2012-July 2013
Bare Root; Containerized; and B&B Plantings for the Entire Project Site	--	March 2014
Mitigation Plan/ As-Built (Year 0 Monitoring Baseline)	April 2014	April 2014
Invasive Species Treatment	--	July 2014
Year 1 Monitoring	October 2014	December 2014
Warranty Supplemental Planting	--	March 2015
Year 2 Monitoring	November 2015	December 2015
Warranty Supplemental Planting	--	February 2016
Invasive Species Treatment	--	July 2016
Invasive Species Treatment		September 2016
Year 3 Monitoring	November 2016	December 2016
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table
Martin's Creek II Mitigation Site

Designer	Michael Baker Engineering, Inc. 797 Haywood Road, Suite 201 Asheville, NC 28806 Micky Clemmons 828-350-1408
Construction Plans and Sediment and Erosion Control Plans	Michael Baker Engineering, Inc. 797 Haywood Road, Suite 201 Asheville, NC 28806 Micky Clemmons 828-350-1408
Construction Contractor	River Works, Inc. 6105 Chapel Hill Rd. Raleigh, NC 27607 919-582-3574
Planting Contractor	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 (252) 482-8491
As-built Surveyor	Turner Land Surveying. PLLC 3201 Glenridge Drive Raleigh, NC 27604 919-875-1378
Baseline Data Collection	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Attribute Table
Martin's Creek II Mitigation Site

Project County	Cherokee County, North Carolina							
Physiographic Region	Blue Ridge							
Ecoregion	Broad Basins							
Project River Basin	Hiwassee							
USGS HUC for Project (14 digit)	06020002170010							
NCDWQ Sub-basin for Project	04-05-02							
Planning Area	Yes – Peachtree-Martins Creek LWP							
WRC Class (Warm, Cool, Cold)	Cold							
% of project easement fenced or demarcated	100							
Beaver activity observed during design phase?	No							
	Right Prong Martin's Creek		Martin's Creek					
	RP UT1	RP Mainstem	MC UT1		MC UT1-3		MC UT2	MC Mainstem
			LII Enh	PI Rest	LI Enh	PI Rest		
Drainage Area	.17	0.6	0.02 – 0.18		0.07 – 0.08		0.39	6.81
Stream Order (USGS topo)	1st	3rd	2nd		1st		1st	3rd
Restored Length (feet)								
Perennial or Intermittent	I/P	I/P	P	P	P	P	P	P
Watershed Type	Rural							
Watershed impervious cover	<10%							
NCDWQ AU/Index number	1-49 (Martin's Creek), 1-49-3 (Right Prong Martins Creek)							
NCDWQ Classification	C		C		C		C	C
303d listed?	No							
Upstream of a 303d listed	No							
Reasons for 303d listed segment	NA							
Total acreage of easement	93.87							
Total existing vegetated acreage of easement	-							
Total planted restoration acreage	17 acres							
Rosgen Classification of preexisting	B	B	Eb/Fb/B/G	Cb/G	Eb/B	C/F	B	C
Rosgen Classification of As-built	B	B	B/C	B/C	B	C	B	C
Valley type	II		II		VIII		VIII	VIII
Valley slope	N/A		0.015 - 0.05		0.007 – 0.04		N/A	N/A
Cowardin classification of proposed	N/A		N/A		N/A		N/A	N/A
Trout waters designation	No							
Species of concern, endangered etc.	No							
Dominant Soil Series	Cullowhee fine sandy loam		Thurmont-Dillard Complex Arkaqua loam		Dillard loam Arkaqua loam		Arkaqua loam	Arkaqua loam

APPENDIX B

VISUAL ASSESSMENT DATA

Figures 2 and 2A-2C. Current Conditions Plan View (CCPV)

Tables 5A-5E. Visual Stream Morphology Stability Assessment

Table 6. Vegetation Condition Assessment

Stream Station Photographs

Vegetation Plot Photographs

Insert Tables 5A-5C and Table 6. Stream Visual Assessments and Vegetation Conditions Assessment

Martin's Creek II
Fixed Station Photographs
Taken August 2016

Photo Point 1

Photo Point 2

Photo Point 3

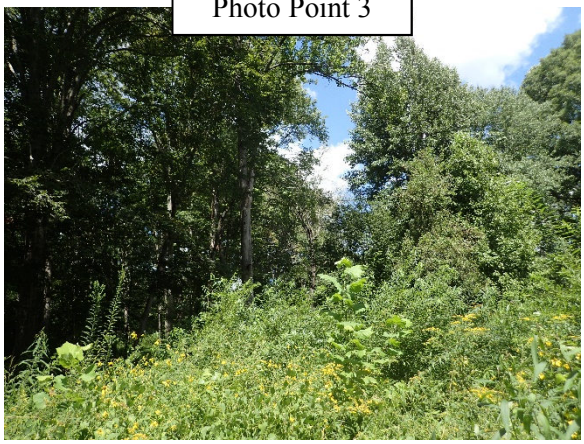


Photo Point 4

Photo Point 5

Photo Point 6

Martin's Creek II
Fixed Station Photographs
Taken August 2016 (continued)

Photo Point 7

Photo Point 8

Photo Point 9

Photo Point 10

Photo Point 11

Photo Point 12

Martin's Creek II
Fixed Station Photographs
Taken August 2016 (continued)

Photo Point 13

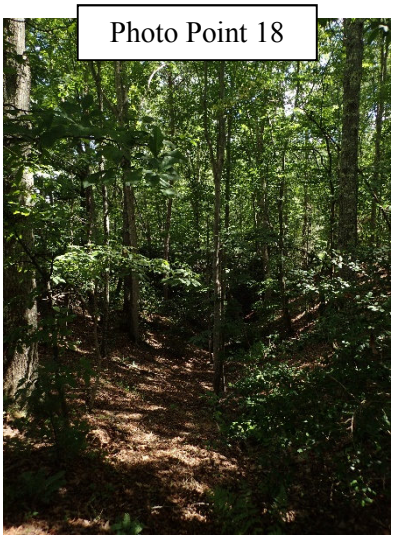
Photo Point 14

Photo Point 15

Photo Point 16

Photo Point 17

Photo Point 18



Martin's Creek II
Fixed Station Photographs
Taken August 2016 (continued)

Photo Point 19

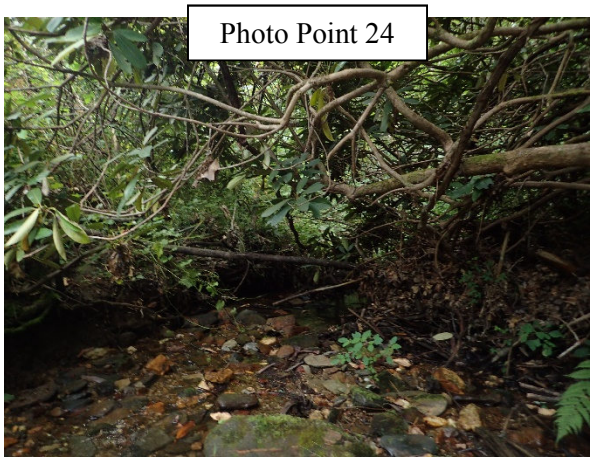
Photo Point 20

Photo Point 21

Photo Point 22

Photo Point 23

Photo Point 24

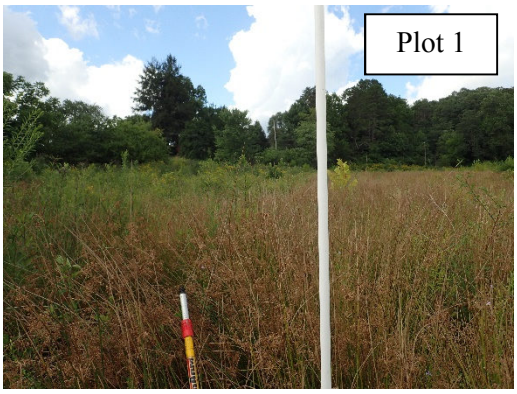


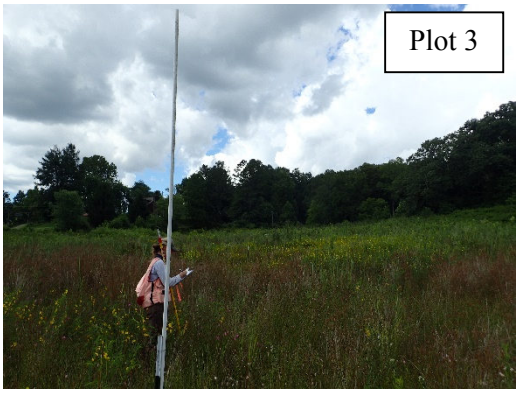
Martin's Creek II
Fixed Station Photographs
Taken August 2016 (continued)

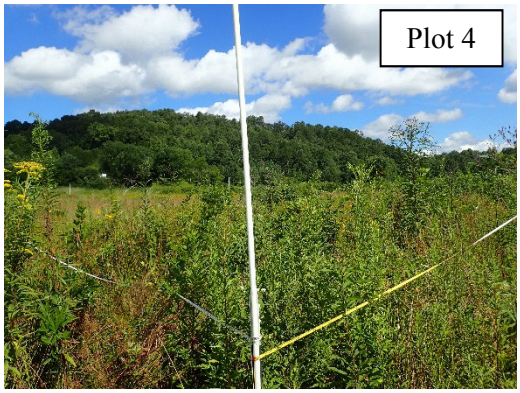
Photo Point 25

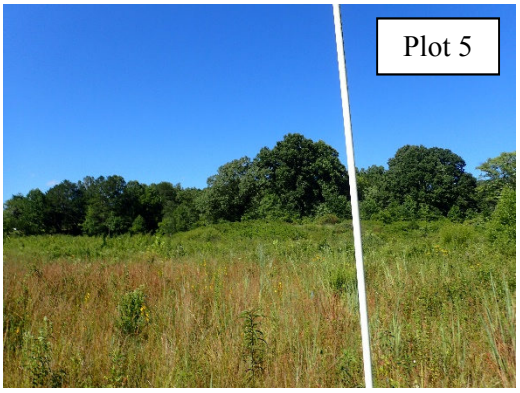
Photo Point 26

Martin's Creek II
Vegetation Monitoring Photographs
Taken August 2016

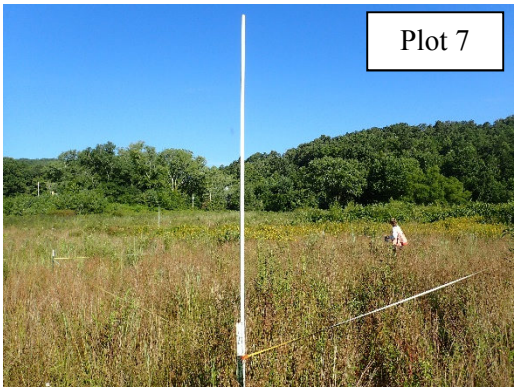


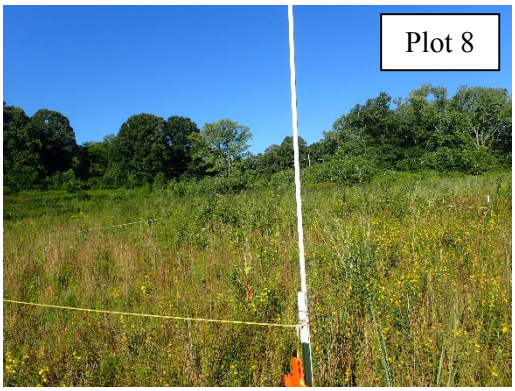


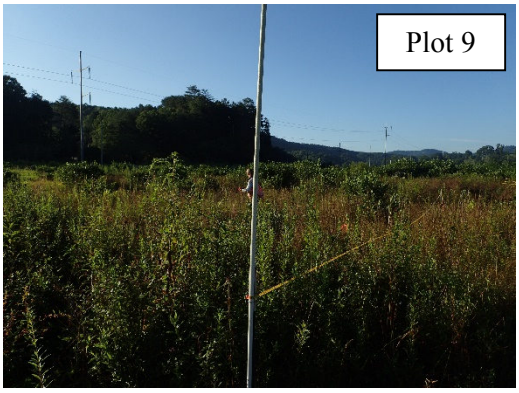


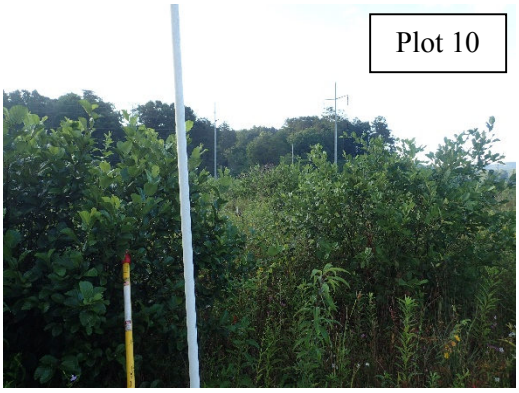


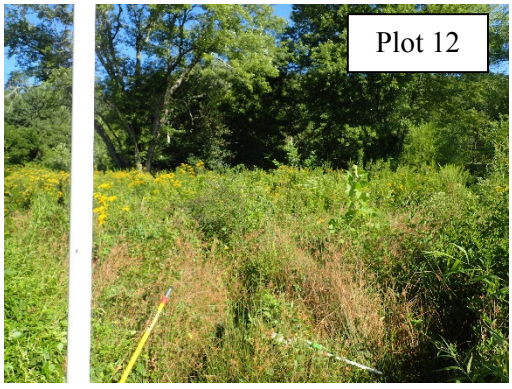
Martin's Creek II
Vegetation Monitoring Photographs
Taken August 2016
(continued)











Martin's Creek II
Vegetation Monitoring Photographs
Taken August 2016
(continued)

APPENDIX C

VEGETATION PLOT DATA

Table 7. Vegetation Plot Criteria Attainment

Table 8. CVS Vegetation Plot Metadata

Table 9. Total and Planted Stems by Plot and Species

Table 7. Vegetation Plot Criteria Attainment Based on Planted Stems

Martin's Creek II Mitigation Site (DMS Project Number 92633)

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	87%
2	Yes	
3	No	
4	No	
5	Yes	
6	Yes	
7	Yes	
8	Yes	
9	Yes	
10	Yes	
11	Yes	
12	Yes	
13	Yes	
14	Yes	
15	Yes	

Table 8. CVS Vegetation Plot Metadata
Martin's Creek II Mitigation Site (DMS Project Number 92633)

Report Prepared By	Corri Faquin
Date Prepared	11/7/2016 13:07
database name	Axiom-MartinsII-2016-A-v2.3.1.mdb
database location	S:\Business\Projects\12\12-004 EEP Monitoring\12-004.16 UT to Martins and Martins\Martins II\2016\CVS
computer name	CORRI2-PC
file size	47353856
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	92633
project Name	Martin's Creek II
Description	Stream and Wetland Restoration
River Basin	Hiwassee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	15

Table 9. Total and Planted Stems by Plot and Species

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APPENDIX D

STREAM SURVEY DATA

Cross-section Plots

Longitudinal Profile Plots

Substrate Plots

Tables 10a-f. Baseline Stream Data Summary

Tables 11a-f. Monitoring Data

APPENDIX E

HYDROLOGY DATA

Table 12. Verification of Bankfull Events

Table 13. Wetland Hydrology Criteria Attainment Summary

Figure E1. Martin's Creek II 30-70 Percentile Graph for Rainfall

Groundwater Gauge Graphs

Table 12. Verification of Bankfull Events
Martin's Creek II Mitigation Site (DMS Project Number 92633)

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
August 25, 2014	April 7, 2014	Crest gauge data indicates a bankfull event after approximately 2.4 inches of rain documented in one day at an onsite rain gauge.	---
August 25, 2014	July 1, 2014	Crest gauge data indicates a bankfull event after approximately 2.02 inches of rain was documented over two days at an onsite rain gauge.	---
August 25, 2014	August 24, 2014	Crest gauge data indicates a bankfull event after approximately 1.39 inches of rain documented over two days at an onsite rain gauge.	---
October 27, 2014	September 3, 2014	Crest gauge data indicates a bankfull event after approximately 1.67 inches of rain documented in one day at an onsite rain gauge.	---
October 27, 2014	October 14, 2014	Crest gauge data and laid back vegetation indicate a bankfull event after approximately 2.5 inches of rain documented in one day at an onsite rain gauge.	1
April 12, 2015	November 17, 2014	Crest gauge data indicates a bankfull event after approximately 1.44 inches of rain documented in one day at an onsite rain gauge.	---
July 13, 2015	June 11, 2015	Crest gauge data indicates a bankfull event after approximately 1.68 inches of rain documented in one day at an onsite rain gauge.	---
July 13, 2015	June 26, 2015	Crest gauge data indicates a bankfull event after approximately 1.57 inches of rain was documented in one day at an onsite rain gauge.	---
September 11, 2015	August 19, 2015	Crest gauge data indicates a bankfull event after approximately 2.94 inches of rain was documented over three days at an onsite rain gauge.	---
November 18, 2015	September 26, 2015	Crest gauge data indicates a bankfull event after approximately 2.65 inches of rain was documented over two days at an onsite rain gauge.	---
November 18, 2015	October 3, 2015	Crest gauge data indicates a bankfull event after approximately 4.50 inches of rain was documented over three days at an onsite rain gauge.	---
August 22, 2016	June 5, 2016	Crest gauge data, floodplain scour, and laid back vegetation indicate a bankfull event after approximately 2.28 inches of rain was documented over two days at an onsite rain gauge.	2

Photo 1: Laid back vegetation after a bankfull event

Photo 2: Scour and laid back vegetation after a bankfull event

Table 13. Wetland Hydrology Criteria Attainment Summary
Martin's Creek II Mitigation Site (DMS Project Number 92633)

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)
1	Yes/75 Days (39%)	Yes/118 Days (61.8%)	Yes/49 Days (25.7%)		
2	No/21 Days (11%)	Yes/36 Days (18.8%)	No/12 Days (6.3%)		
3	Yes/52 Days (27%)	Yes/72 Days (37.7%)	Yes/45 Days (23.6%)		
4	No/21 Days (11%)	Yes/27 Days (14.1%)	No/12 Days (6.3%)		
5	No/15 Days (7.8%)	Yes/25 Days (13.1%)	No/12 Days (6.3%)		
6	Yes/58 Days (30%)	Yes/69 Days (36.1%)	Yes/47 Days (24.6%)		
7	Yes/85 Days (44%)	Yes/69 Days (36.1%)	Yes*/27 Days (14.1%)		
8	Yes/65Days (34%)	Yes/72 Days (37.7%)	Yes/45 Days (23.6%)		
9	No/22 Days (11.5%)	Yes/27 Days (14.1%)	Yes**/27 Days (14.1%)		
10	No/24 Days (12.5%)	Yes/28 Days (14.7%)	No/12 Days (6.3%)		
11	No/18 Days (9%)	No/22 Days (11.5%)	No/7 Days (3.7%)		
12	No/20 Days (10%)	Yes/27 Days (14.1%)	No/12 Days (6.3%)		
13	Yes/116 Days (61%)	Yes/117 Days (61.2%)	Yes/66 Days (34.6%)		

*This gauge had many technical difficulties throughout the growing season; however, the water level from May 3-May 10 was between 3.3-3.7 inches. It is assumed that the gauge was saturated/inundated at the beginning of the growing season and was therefore saturated/inundated a minimum of 27 days (April 14-May 10).

**This gauge malfunctioned on May 10, 2016 resulting in loss of data for the remainder of the growing season; however, it was saturated/ inundated for 27 days prior to its malfunction.