FINAL MITIGATION PLAN

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, North Carolina

DMS Project ID No. 100058
Full Delivery Contract No. 7525
USACE Action ID No. SAW-2018-01170
RFP No. 16-007330

Cape Fear River Basin
Cataloging Unit 03030002

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
RALEIGH, NORTH CAROLINA 27699-1652

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November 2019

"This mitigation plan has been written in conformance with the requirements of the following:

- Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8 paragraphs (c)(2) through (c)(14).
- NCDEQ Division of Mitigation Services In-Lieu Fee Instrument signed and dated July 28, 2010

These documents govern NCDMS operations and procedures for the delivery of compensatory mitigation."

This document was assembled using the June 2017 *DMS Stream and Wetland Mitigation Plan Template and Guidance* and the October 24, 2016 NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*.

Slingshot Mitigation Plan Comment Responses:

DWR Comments, Mac Haupt and Erin Davis:

1. This site is in the Jordan Lake watershed, are there any plans to pursue riparian buffer or nutrient offset strategy?
    - No, RS has not been contracted by DMS for buffer or nutrient credits.
2. The number of crossings for the size of the site is a negative aspect of this site. Is there any way at least one crossing could be removed?
    - No, the conservation easement has already been recorded. The farthest downstream crossing was originally 45' in width and scaled down to a 25' width based on the IRT field notes. The additional crossings are required by the landowner.
3. Section 3.5- DWR noted that there is only one soil profile boring listed in the Appendix. Given that this site has wetland restoration credit, a much more thorough soil characterization will need to occur before DWR will approve the proposed wetlands in this mitigation plan. During the site visit, DWR field notes stated that many of our soil cores did not see lower chromas required for hydric soils.
    - Additional soil profiles have been added to the appendix, with the locations depicted on Figure 4.
4. Section 8.1.1- Outfall Structures- DWR does not support the use of the Terracell drop structure. DWR prefers the utilization of natural materials in the channel bed. Moreover, DWR does not believe the slope change is so drastic that the artificial structure is warranted.
    - Terracel has been changed to Drop Structure in Figure 5B, Figure 7B, and in the text of the document.
5. Section 8.3- Wetland Restoration – the plan states that, "…the construction of ephemeral pools will add an important component to groundwater restoration activities. These activities will result in the restoration of 1.02 acres of jurisdictional ….riverine wetlands." DWR would like to stress that if ephemeral pools are counted as wetland restoration then they will need to be constructed so that there is periodic drying.
    - Ephemeral pools will be constructed such that they dry during the summer and will have woody debris habitat incorporated into the feature.
6. Table 14 Planting Plan- DWR is recommending a cap of 5% in the planting of Green Ash due to the green ash borer.
    - The planting list has been updated to include species ordered for the Site. The final planting list includes 400 green ash, which is less than 4% the total number of planted stems.
7. Table 16- Monitoring Table-DWR requires a stream gauge on UT3 in the upper third of the reach.
    - This is an EII reach added by the IRT/DMS. As the channel was identified by the IRT, confirmed to be a stream by NCDWR and the Corps of Engineer during a PDJ, and no channel alternation work is to be conducted within, or adjacent to the channel, we respectfully request to leave this gauge off the monitoring protocol for the Site.
8. Table 16- DWR likes the fact that benthic macroinvertebrates will be monitored.
    - Good.
9. From a landscape position standpoint, DWR would rather not have mitigation sites draining (in close proximity) into ponds or lakes.
    - This is an unavoidable aspect of this Site and was discussed during our initial Site visit. Note: Downstream, Lake Reidsville, is a municipal drinking water source for the Town of Reidsville and the local government is very appreciative of the project for the water quality benefit.
10. Figure 5B- there are areas which appear to be in green where the current channel exists. Are these areas meant to be proposed for wetland restoration credit? If these areas are proposed for wetland credit, DWR believes restoration credit may not be appropriate.
    - RS has successfully performed and received R credit in old stream channels in the past. We

have data from many similar projects that shows that these areas are successfully converted back to wetlands.

11. DWR notes that there were no photos of the site in the mitigation plan. It is often beneficial in the review of the document to have the photos, especially if it has been awhile since the site visit. In addition, DWR would like to see photos associated with the cross sections (Appendix B) if at all possible.
    - Appendix J has been added to the document and contains Site photographs. Photographs of existing conditions cross sections is not available.
12. Design sheet 2C- shows an engineered riffle with rip rap being placed on the bank slope. DWR does not approve of rip rap being placed on the banks.
    - This has been removed from the plans set.
13. Design sheet 4- DWR needs to see a scale on these sheets. Also, the thick dashed black line, is that limits of disturbance? DWR prefers that significant markings on the plan view be clearly labeled.
    - Completed
14. Design sheet 8- DWR does not believe the utilization of a Terracell structure is warranted when the rest of the project was using log cross vanes.
    - Terracel has been changed to Drop Structure in Figure 5B, Figure 7B, and in the text of the document.
15. Design sheet E2- What activities will be done to return the areas utilized as haul roads back to natural conditions?
    - See construction notes, these will be added to the haul road sheets.
16. What percentage of this project has less than 50 foot buffers?
    - UT 4 has less than a 50-foot buffer on its right bank, as it enters the property. UT 4 is a preservation reach and accounts for less than 2% of the buffer area. All other streams have a minimum 50-foot buffer on both stream banks.

USACE Comments, Kim Browning:

17. The correct USACE Action ID is SAW-2018-01170. Please correct the cover page.
    - The USACE Action ID has been updated.
18. Please depict photo points/digital image stations on Figures 10. If the fixed cross-section locations are to be used, please describe that in the text in section 7.1.
    - A note was added to Table 15 indicating the following. "Visual Assessment will be complimented by permanent photographic points located at each permanent cross section and vegetation plot."
19. Section 8.3- Wetland Restoration – The inclusion of ephemeral/vernal pools is acceptable, and should be 8-14" depressions that dry up yearly so that predatory species cannot colonize.
    - Ephemeral pools will be constructed no deeper than 12 inches, will incorporate woody debris for habitat, and will be expected to dry during summer months.
20. This section also discusses filling drainage ditches. If ditches are to be filled, please show these areas on the construction plans, and the length of the ditch plug.
    - Channel plugs will be added to the construction plans.
21. It would be beneficial to add some coarse woody debris to the depressional areas in the buffers and throughout the adjacent wetlands for habitat, and to help store sediment, increase water storage/infiltration, and absorb water energy during overbank events.
    - Woody debris will be included as small piles in the riparian and wetland areas for habitat.
22. Please discuss how fescue will be treated within the buffer establishment area.
    - RS acknowledges that this site does face challenges based on the existing vegetation. These challenges will be overcome through a combination of herbicide applications and mechanical site prep techniques. Preliminary herbicide treatments have already been made targeting woody non-native invasive species (NNIS) including Kudzu, Tree of Heaven, Privet, and Multiflora Rose (September 2019) both within the site boundaries and along the

margins of the site on the parent tract. An additional herbicide treatment for privet and fescue is planned before the end of 2019 (pre-construction). During construction mechanical site prep techniques including ripping will be used to diminish any remaining undesired pasture grasses and facilitate tree establishment. The planned permanent seed mix will also mitigate the regrowth of fescue by including cool season forbs. After construction a regular herbicide program will be implemented targeting both dense pasture grasses and NNIS. This integrated approach will provide a high level of control of fescue and other undesired species and will support establishment of the desired hardwood forest community.

23. UT3- should have a flow gauge in the upper third of the reach.
    - This is an EII reach added by the IRT/DMS. As the channel was identified by the IRT, confirmed to be a stream by NCDWR and the Corps of Engineer during a PDJ, and no channel alteration work is to be conducted within, or adjacent to the channel, we respectfully request to leave this gauge off the monitoring protocol for the Site.
24. Section 7.0- Potential constraints…the last sentence is unclear.
    - Section 7.0 was altered to clarify work conducted for the document.
25. Table 1- Are additional credits for macroinvertebrate sampling being sought? If so, please clarify this table.
    - RS is not seeking extra credit for macroinvertebrate sampling on this project.
26. Table 16- Will fixed photo points be monitored annually? If so, please indicate if they will be at all cross- sections, or depict on monitoring map.
    - A note was added to Table 15 indicating the following. "Visual Assessment will be complimented by permanent photographic points located at each permanent cross section and vegetation plot."
27. Table 17 Success Criteria—Streams, please add a statement (regarding UT3) at least 30-days continuous surface water flow for intermittent streams.
    - The statement was added to Table 17 Success Criteria for streams.
28. Stream restoration will bisect existing wetlands where Slingshot Creek intersects with GA Wetland, and where UT1 intersects with GE Wetland. At least one wetland gauge should be installed in wetland GE to ensure no functional loss.
    - An additional groundwater gauge was added to Wetland GE to ensure no functional loss. In addition, Table 16 was updated to include 10 groundwater gauges, instead of 9 groundwater gauges.
29. Figure 3 in the JD—All streams are referred to as Troublesome Creek. Isn't this Slingshot Creek? Was this what it was called when proposed as a bank site? Please use consistent labeling throughout the review period, and it's especially important for the PCN to track impacts.
    - During our NCDMS review it was requested we change the name from Troublesome Creek (as designated in the PJD submittal) to Slingshot Creek.
30. When submitting the PCN, please include an estimate of the number of trees, or acres, to be cleared for the NLEB 4(d) Rule.
    - We will include an estimate of the number of trees, or acres to be cleared in our PCN submittal.
31. Table 14--Please confirm that one target community is being proposed for the entire Project Site (stream side, wetland, and upland areas). If multiple planting zones are proposed, please show zones on a figure/design sheet and reference in the planting table.
    - Figures 8A and 8B (Planting Plan) depict the locations of planting zones and the number of species to be planted within each planting zone. The table depicted in the figures match Table 14 in the document, which specifies species and number of seedlings to be planted in each planting zone.

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TABLES

TABLES (continued)

APPENDICES

1.0 PROJECT INTRODUCTION

The Slingshot Creek Stream & Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 11.6 acres of disturbed forest and livestock pasture along warm water, unnamed tributaries to Lake Hunt. The Site is located approximately 2 miles west of Reidsville, just east of Lake Hunt, and north NC Highway 158 in Rockingham County (Figures 1 and 2, Appendix A).

1.1 Directions to Site

Directions to the Site from Raleigh, North Carolina.

- From Raleigh travel west on I-40 for 45 miles,
- Take exit 148 onto NC-54W toward Graham/Chapel Hill and turn right onto Harden Street,
- Travel 1.6 miles, then turn right onto NC-87 N/W Elm Street,
- After 5 miles, turn right onto NC-87 N/Ossipee Road,
- Travel 19.3 miles, then turn left and stay on NC-87 N,
- After 4.1 miles, turn left toward US-158, then turn left onto US-158 W,
- After 0.9 mile, take a slight right onto Iron Works Road, then take a right onto Harbor Road,
- The Site is located north of the end of Harbor Road.
    - Site Latitude, Longitude
      36.334687ºN, 79.711665ºW (WGS84)

1.2 USGS Hydrologic Unit Code and NCDWR River Basin Designation

The Site is located within the Cape Fear River Basin in 14-digit United States Geological Survey (USGS) Cataloging Unit and **Targeted Local Watershed 03030002010010** of the South Atlantic/Gulf Region (North Carolina Division of Water Resources [NCDWR] subbasin number 03-06-01) [Figures 1 and 2, Appendix A]). Topographic features of the Site unnamed tributaries to Troublesome Creek (Lake Hunt), which has been assigned Stream Index Numbers 16-6-2-(1), and a Best Usage Classification of **WS-III, B, NSW** (NCDWR 2013). Site tributaries are not listed on the final 2016 NC 303(d) lists (NCDWR 2018).

1.3 Physiography and Land Use

The Site is located in the Northern Inner Piedmont Ecoregion of the Piedmont Physiographic Province within Rockingham County, North Carolina. Regional physiography is characterized by dissected irregular plains, low to high hills, ridges, and isolated monadnocks. Streams are low to moderate gradient with mostly cobble, gravel, and sand substrates (Griffith et al. 2002). Onsite elevations range from a high of 780 feet National Geodetic Vertical Datum (NGVD) at the upper reach of Slingshot Creek to a low of approximately 740 feet NGVD at the Site outfall (USGS Reidsville, North Carolina 7.5-minute topographic quadrangle) (Figures 1 and 3, Appendix A).

The Site provides water quality functions to an approximately 0.42-square mile (270-acre) watershed at the outfall; Site tributary watershed sizes range from 0.01 square mile (9 acres) to 0.10 square miles (65 acres) (Figure 3, Appendix A). The watershed is dominated by pasture, agricultural land, and sparse residential property. Impervious surfaces account for less than 5 percent of the upstream watershed land surface.

Land use at the Site is characterized by livestock pasture, hay fields, and disturbed forest. Livestock have unrestricted access to Site streams. A narrow riparian fringe has developed on the stream margins that is composed of opportunistic species, invasive species, and a few mature tree species.

1.4 Project Components and Structure

The Site encompasses 11.6 acres along warm water, unnamed tributaries to Troublesome Creek (Lake Hunt). In its current state, the Site includes 3944 linear feet perennial stream and 172 linear feet of intermittent stream (based on the approved PJD), 0.69 acre of degraded wetland, and 1.02 acre of drained hydric soil (Figure 4, Appendix A).

Proposed Site restoration activities include the construction of meandering, E/C-type stream channel resulting in 2501 linear feet of Priority I stream restoration, 587 linear feet of stream enhancement (Level I), 635 linear feet of stream enhancement (Level II), 391 linear feet of stream preservation, 1.018 acre of riparian wetland restoration, and 0.606 acre of riparian wetland enhancement (Table 1) (Figures 5A-5B, Appendix A).

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 1-4.

Table 1. Project Components and Mitigation Credits
Slingshot Creek Restoration Site

Reach ID	Stream Stationing	Existing Footage/ Acreage	Restoration Footage/ Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio	Comment
Slingshot Creek-Reach 1	00+00 to 03+05	305	305	Warm	Preservation	NA	10:1	
Slingshot Creek-Reach 2	03+05 to 04+59	154	154	Warm	Enhancement (Level II)	NA	2.5:1	
Slingshot Creek-Reach 3	04+59 to 05+78	156	119	Warm	Restoration	1	1:1	
Slingshot Creek-Reach 4	05+78 to 07+17	139	139	Warm	Enhancement (Level I)	3	1.5:1	
Slingshot Creek-Reach 5	07+17 to 27+77	2069	2060-50-51-25= 1934	Warm	Restoration	1	1:1	126 lf of Slingshot Creek is located outside of the conservation easement and therefore is not generating credit
Slingshot Creek-Reach 6	27+77 to 28+74	97	97	Warm	Enhancement (Level II)	NA	2.5:1	
UT 1A	00+00 to 01+95	195	195	Warm	Enhancement (Level II)	NA	2.5:1	
UT 1B	01+95 to 06+95	500	500-52= 448	Warm	Enhancement (Level I)	3	1.5:1	52 lf of the UT1 is located outside of the conservation easement and therefore is not generating credit
UT 1C	06+95 to 09+70	273	275	Warm	Restoration	1	1:1	
UT 2	00+04 to 01+78	130	173	Warm	Restoration	1	1:1	
UT 3	00+00 to 01+89	189	189	Warm	Enhancement (Level II)	NA	2.5:1	
UT 4	00+00 to 00+86	86	86	Warm	Preservation	NA	10:1	
Wetland Restoration	--	--	1.018	Riparian	Restoration	NA	1:1	
Wetland Enhancement	--	0.69	0.606	Riparian	Enhancement	NA	2:1	

Table 1. Project Components and Mitigation Credits (continued)
Slingshot Creek Restoration Site

Project Credits		
Restoration Level	**Warm Water Stream (SMUs)**	**Riparian Wetland (WMUs)**
Restoration	2501.000*	1.018
Enhancement (Level I)	391.333**	--
Enhancement (Level II)	254.000	--
Preservation	39.100	--
Enhancement	--	0.303
TOTALS	**3185.433**	**1.321**

*An additional 126 linear feet of stream restoration is proposed to occur outside of the conservation easement and is therefore not included in this total or in mitigation credit calculations.

**An additional 52 linear feet of stream enhancement (level I) is proposed to occur outside of the conservation easement and is therefore not included in this total or in mitigation credit calculations.

Table 2. Project Activity and Reporting History
Slingshot Creek Restoration Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-007330)	February 2, 2018	February 8, 2018
Institution Date (NCDMS Contract No. 100058)	--	April 24, 2018
Mitigation Plan	September 2018	June 2019
Construction Plans	--	--

Table 3. Project Contacts Table
Slingshot Creek Restoration Site

Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Worth Creech 919-755-9490
Designer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Attribute Table
Slingshot Creek Restoration Site

Project Information	
Project Name	Slingshot Creek Restoration Site
Project County	Rockingham County, North Carolina
Project Area (acres)	11.6
Project Coordinates (latitude & latitude)	36.334687ºN, 79.711665ºW
Planted Area (acres)	9.3
Project Watershed Summary Information	
Physiographic Province	Piedmont
Project River Basin	Cape Fear
USGS HUC for Project (14-digit)	03030002010010
NCDWR Sub-basin for Project	03-06-01
Project Drainage Area (acres)	270
Percentage of Project Drainage Area that is Impervious	<5%
CGIA Land Use Classification	Managed Herbaceous Cover & Hardwood Swamps

Table 4. Project Attribute Table
Slingshot Creek Restoration Site (continued)

Reach Summary Information					
Parameters	**Slingshot Creek**	**UT 1**	**UT 2**	**UT 3**	**UT 4**
Length of reach (linear feet)	2920	968	130	189	86
Valley Classification & Confinement	Alluvial, confined				
Drainage Area (acres)	270	60	65	9	22
NCDWR Stream ID Score	---	---	---	---	---
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Intermittent	Perennial
NCDWR Water Quality Classification	WS-III, B, NSW				
Existing Morphological Description (Rosgen 1996)	G4/5	G5	G5	C5	Eg4
Proposed Stream Classification (Rosgen 1996)	C/E 4	C/E 4	C/E 4	C5	Eg4
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	I/III/IV	III/IV	II/III	II/III
Underlying Mapped Soils	Clifford sandy clay loam, Codorus loam, Davie sandy loam, Fairview-Poplar complex, Nathalie sandy loam, Poplar Forest sandy clay loam				
Drainage Class	Well-drained, moderately well-drained, somewhat poorly-drained, well-drained, well-drained, well-drained, well-drained				
Hydric Soil Status	Nonhydric, nonhydric, nonhydric, nonhydric, nonhydric, nonhydric, nonhydric, respectively				
Valley Slope	0.0195	0.0315	0.0218	---	---
FEMA Classification	NA				
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest				
Watershed Land Use/Land Cover (Site)	43% forest,55% agricultural land, <2% low density residential/impervious surface				
Watershed Land Use/Land Cover (Cedarock Reference Channel)	65% forest, 30% agricultural land, <5% low density residential/impervious surface				
Percent Composition of Exotic Invasive Vegetation	<5%				

Table 4. Project Attribute Table
Slingshot Creek Restoration Site (continued)

Wetland Summary Information			
Parameters	**Wetlands**		
Wetland acreage	1.02 acre drained & 0.69 acre degraded		
Wetland Type	Riparian riverine		
Mapped Soil Series	Worsham		
Drainage Class	Poorly drained		
Hydric Soil Status	Hydric		
Source of Hydrology	Groundwater, stream overbank		
Hydrologic Impairment	Incised streams, compacted soils, livestock		
Native Vegetation Community	Piedmont/Low Mountain Alluvial Forest		
% Composition of Exotic Invasive Vegetation	<5%		
Restoration Method	Hydrologic, vegetative, livestock		
Enhancement Method	Vegetative, livestock		
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States-Section 401	Yes	Yes	JD Package (App D)
Waters of the United States-Section 404	Yes	Yes	JD Package (App D)
Endangered Species Act	Yes	Yes	CE Document (App E)
Historic Preservation Act	Yes	Yes	CE Document (App E)
Coastal Zone Management Act	No	--	NA
FEMA Floodplain Compliance	No	--	CE Document (App E)
Essential Fisheries Habitat	No	--	NA

2.0 WATERSHED APPROACH AND SITE SELECTION

Primary considerations for Site selection included the potential for improvement of water quality within a region of North Carolina under heavy development and livestock/agricultural pressure. More specifically, considerations included: desired aquatic resource functions; hydrologic conditions; soil characteristics; aquatic habitat diversity; habitat connectivity; compatibility with adjacent land uses; reasonably foreseeable effects the mitigation project will have on ecologically important aquatic and terrestrial resources; and potential development trends and land use changes. Site specific characteristics are summarized below, in addition to development trends and land use changes within the watershed.

Currently, the proposed Site is characterized by disturbed forest, hay fields, and livestock pasture. A summary of existing Site characteristics in favor of proposed stream and wetland activities include the following.

- Streams and wetlands are accessible to livestock
- Stream banks are trampled by livestock
- Streams and wetlands have been cleared of forest vegetation
- Site receives nonpoint source inputs including agricultural chemicals and livestock waste
- Wetland soils have been compacted by livestock and agricultural equipment
- Wetland hydrology has been removed by stream channel entrenchment
- Streams are classified as nutrient sensitive waters

In addition to the opportunity for ecological improvements at the Site, the use of the particular mitigation activities and methods proposed in the Design Approach & Mitigation Work Plan (Section 8.0) are expected to produce naturalized stream and wetland resources that will be ecologically self-sustaining, requiring minimal long-term management (Long-term Management Plan [Section 11.0]).

Development Trends and Land Use Changes in Cape Fear 03030002 (Cape Fear 02)

Between the 2000 and 2010 censuses, the Cape Fear 02 population increased approximately 17 percent. These data suggest land development activities will increase in frequency, as will aquatic ecosystem impacts related to such development. Therefore, there is an immediate and prolonged need for compensatory stream mitigation in the watershed. Of further benefit, aquatic ecosystem restoration projects are capable of reducing nutrient loading in sensitive downstream receiving waters such as Jordan Lake.

According to the *Cape Fear River Basinwide Water Quality Plan* (NCDWQ 2005), all land uses and discharges of wastewater and stormwater in the Cape Fear 02 subbasin 03-06-01 potentially contribute nutrients to B. Everett Jordan Lake. B. Everett Jordan Lake provides low-flow augmentation, flood control, recreation, fish and wildlife habitat, and water supply. The lake is impaired for aquatic life due to excessive levels of chlorophyll *a* in violation of current standards in all segments of the reservoir. In addition, the Site has a supplemental water quality classification of Nutrient Sensitive Waters, which designates areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. The proposed mitigation activities will reduce sediment and nutrient levels, and improve water quality within the Site and downstream watersheds.

The project is located within the Troublesome Creek and Little Troublesome Creek Local Watershed Planning area (NCEEP 2004); the project activities address priorities associated with the LWP as follows with Site specific information following the LWP goals in parenthesis.

1. Protect and improve water quality by restoring wetland, stream, and riparian area functions and values, which may have been, or may be, lost through historic, current, and future impacts (4114 linear feet of stream restoration/enhancement/preservation, 1.624 acres of wetland restoration/enhancement, and 11.6 acres of riparian buffer restoration/enhancement).
2. Achieve a net increase in riparian zone buffers and wetlands acreage, functions, and values (11.6 acres of riparian buffer restoration/enhancement, and increased wetland acreage by 0.934 acres).
3. Promote a comprehensive approach for the protection of natural resources (protection of the Site, streams, wetlands, and riparian buffer through a permanent conservation easement).

In addition to the defined Troublesome Creek LWP goals, additional goals for the area generally revolve around reduction of stressors to water quality. Stressors and how each will be addressed by project activities is as follows.

1. Nutrient Inputs – (nutrient model [Section 3.3] - livestock removal from streams will result in a direct reduction of 474.7 pounds of nitrogen, 39.3 pounds of phosphorus per year, and 4.7 x 10^{11} colonies of fecal coliform; eliminate fertilizer application; and install marsh treatment areas).
2. Streambank Erosion – (sediment model [Section 3.2] – reduction of 220 tons/year after mitigation is complete).
3. Stormwater – (reduction of bank height ratio and installation of marsh treatment area will reduce stormwater pulses).
4. Disturbed Riparian Buffer – (restoration/enhancement of 11.6 acres of riparian buffer along 4114 linear feet of stream).
5. Floodplain Alteration – (elimination of straightened, entrenched streams and the removal of spoil material deposited in the floodplain).

Site specific mitigation goals and objectives have been developed through the use of North Carolina Stream Assessment Method (NC SAM) and North Carolina Wetland Assessment Method (NC WAM) and are discussed further in Section 6.0 (Functional Uplift and Project Goals/Objectives).

3.0 BASELINE AND EXISTING CONDITIONS

3.1 Soils and Land Form

Soils that occur within the Site, according to the *Web Soil Survey* (USDA 2017) are described in Table 5.

Table 5. Web Soil Survey Soils Mapped within the Site

Map Unit Symbol	Map Unit Name (Classification)	Hydric Status	Description
CgB2	Clifford sandy clay loam (*Typic Kanhapludults*)	Non-hydric	This series consists of well-drained, moderately eroded soils found along 2-8 percent slopes. The parent material is saprolite derived from schist and/or gneiss.
CsA	Codorus loam (*Fluvaquentic Dystrudepts*)	Non-hydric	This series consists of moderately well-drained and somewhat poorly drained soils found on 0-2 percent slopes in floodplains. The parent material is alluvium derived from schist, gneiss, phyllite, and other metamorphic rocks.
DcB	Davie sandy loam (*Aquultic Hapludalfs*)	Non-hydric	This series consists of somewhat poorly-drained soils found along 2-8 percent slopes. The parent material is residuum from intermediate or mafic metamorphic or igneous rock.
FrE2	Fairview-Poplar complex (*Typic Kanhapludults*)	Non-hydric	This series consists of well-drained, moderately eroded soils found on 15-25 percent hill slopes on ridges. The parent material is saprolite derived from schist and/or gneiss.
NaB	Nathalie sandy loam (*Typic Fragiudults*)	Non-hydric	This series consists of well-drained soils found along 2-8 percent slopes. The parent material is residuum from felsic igneous or metamorphic rock.
PpD2	Poplar Forest sandy clay loam (*Typic Kanhapludults*)	Non-hydric	This series consists of well-drained soils found along 8-15 percent slopes. The parent material is residuum from felsic or intermediate, high-grade metamorphic or igneous rocks high in mica content.

Hydric soils and jurisdictional wetlands were delineated and mapped by a licensed soil scientist in October 26 and 27, 2017. Based on soil delineations approximately 0.69 acre of disturbed jurisdictional wetland occur within the Site boundaries. Wetlands have been disturbed by livestock grazing and clearing of vegetation within pastureland. In addition, 1.02 acre of drained hydric soil occurs within the Site boundaries. These hydric soils have been effectively drained by stream channel incision and/or relocation of stream channels to the margins of the floodplain.

3.2 Sediment Model

Sediment load modeling was performed using methodologies outlined in *A Practical Method of Computing Streambank Erosion Rate* (Rosgen 2009) along with *Estimating Sediment Loads using the Bank Assessment of Non-point Sources Consequences of Sediment* (Rosgen 2011). These models provide a quantitative prediction of streambank erosions by calculating Bank Erosion Hazard Index (BEHI) and Near-Bank Stress (NBS) along each Site reach. The resulting BEHI and NBS values are then compared to streambank erodibility graphs prepared for North Carolina by the NC Stream Restoration Institute and NC Sea Grant.

Streambank characteristics involve measurements of bank height, angles, materials, presence of layers, rooting depth, rooting density, and percent of the bank protected by rocks, logs, roots, or vegetation. Site reaches have been measured for each BEHI and NBS characteristic and predicted lateral erosion rate, height, and length to calculate a cubic volume of sediment contributed by the

reach each year. Data forms for the analysis are available upon request and the data output is presented in Appendix B. Results of the model are presented in the following table.

Table 6. BEHI and NBS Modeling Summary

Stream Reach	Proposed Mitigation Treatment	Predicted Sediment Contribution (tons/year)
Main	Restoration and Enhancement (Level I & II)	207.6
UT1	Restoration and Enhancement (Level I & II)	8.2
UT 2	Restoration	4.1
	Total Sediment Contribution (tons/year)	**220**

Based on this analysis, mitigation of Site streams will reduce streambank erosion and subsequent pollution of receiving waters.

3.3 Nutrient Model

Nutrient modeling was conducted using a method developed by NCDMS (NCDMS 2016) to determine nutrient and fecal coliform reductions from exclusion of livestock from the buffer.

The equation for nutrient reduction for this model includes the following:

TN reduction (lbs/yr) = 51.04 (lbs/ac/yr) x Area (ac)
TP reduction (lbs/yr) = 4.23 (lbs/ac/yr) x Area (ac)

Where:
TN – total nitrogen;
TP – total phosphorus; and
Area – total area of restored riparian buffers inside of livestock exclusion fences.

Equations for fecal coliform reduction for this model include the following.

Fecal coliform reduction (col) = 2.2×10^{11} (col/AU/day) x AU x 0.085

Where:
Col - quantities of Fecal Coliform bacteria
AU - animal unit (1000 lbs of livestock)

Results of the NCDMS analysis indicate approximately 474.7 lbs/yr of nitrogen, 39.3 lbs/yr of phosphorus, and 4.68×10^{11} col of fecal coliform/day will be reduced due to exclusion of livestock from the easement area.

3.4 Project Site Streams

Streams targeted for restoration include unnamed tributaries to Troublesome Creek, which have been cleared, dredged of cobble substrate, straightened, trampled by livestock, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from livestock. Approximately

55 percent of the existing stream channel has been degraded contributing to sediment export from the Site resulting from mechanical processes from livestock hoof shear. In addition, streamside wetlands have been cleared and drained by channel downcutting and land uses. Current Site conditions have resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

3.4.1 Existing Conditions Survey

Site stream dimension, pattern, and profile were measured to characterize existing channel conditions. Locations of existing stream reaches are depicted in Figure 4 (Appendix A) and cross-section locations are depicted in Figure B1 (Appendix B). Stream geometry measurements under existing conditions are summarized in Table 7 (Essential Morphology Parameters) and presented in detail in Table B1 (Appendix B).

Table 7. Essential Morphology Parameters

Parameter	Existing			Reference		Proposed		
	Slingshot Creek	UT 1	UT 2	Flint Rock Farm	Caswell Game Land	Slingshot Creek	UT 1	UT 2
Valley Width (ft)	50-100	9-100	11-12	50-100	23-44	50-100	30-90	30-90
Contributing Drainage Area (sq. mi.)	0.42	0.09	0.10	0.43	0.65	0.42	0.09	0.09
Channel/Reach Classification	G 4/5	G5	G5	E5	Cg3/4	E/C 3/4	E/C 3/4	E/C 3/4
Design Discharge Width (ft)	6.0-14.6	7.2	7.7	7.5	18.4	10.8-11.1	7.6	7.6
Design Discharge Depth (ft)	0.6-1.4	0.6	0.6	0.8	1.0	0.8-0.9	0.5	0.5
Design Discharge Area (ft^2)	8.3-11.1	4.0	4.3	6.1	17.6	8.3-11.1	4.1	4.1
Design Discharge Velocity (ft/s)	4.0	3.8	3.7	4.0	4.0	3.9-4.0	3.8	3.8
Design Discharge (cfs)	44.4	15.0	15.9	24.4	71.1	32.7-44.4	15.5	15.5
Water Surface Slope	0.0151	0.0267	0.0186	0.0049	0.0100	0.0170	0.0263	0.0263
Sinuosity	1.03	1.18	1.17	1.22	1.14	1.15	1.2	1.2
Width/Depth Ratio	4.3-24.3	12.0	12.8	9.6	19.6	14.0	14.0	14.0
Bank Height Ratio	1.3-4.5	2.4	2.8	1.0	1.8	1.0	1.0	1.0
Entrenchment Ratio	1.2-10.5	2.0	1.6	13.4	1.8	8.0	6.6	6.6
Substrate	Gravel	Sand	Sand	Sand	Gravel	Gravel	Gravel	Gravel

Note: UT 3 and UT 4 are proposed for Enhancement (level II) and Preservation; therefore, are not included in the existing and proposed morphology parameters tables.

3.4.2 Channel Classification and Morphology

Stream geometry and substrate data have been evaluated to classify existing stream conditions based on a classification utilizing fluvial geomorphic principles (Rosgen 1996). Existing Site reaches are classified as unstable G-type streams with variable sinuosity. Existing Site reaches are characterized by sand substrate as the result of channel impacts including livestock trampling, channel straightening, and riparian vegetation removal.

3.4.3 Channel Evolution

Site streams targeted for restoration have been channelized and are continually trampled by livestock resulting primarily in channels classified as channelized (Class II), degraded (Class III), and degraded and widened (Class IV) channels throughout the Site (Simon and Hupp 1986).

3.4.4 Valley Classification

The Site is characterized by small stream, headwater, confined, alluvial valleys with approximately 20- to 100-foot floodplain valley widths. Valley slopes of restoration reaches are typical for the Piedmont region and range from 0.0176-0.0315. Typical streams in this region include C- and E-type streams with slightly entrenched, meandering channels with a riffle-pool sequence.

3.4.5 Discharge

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 41.7 inches per year (USDA 1992). Drainage basin sizes range from 0.01- to 0.42-square mile.

The Site's discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for the Site (0.01- to 0.42-square mile watershed) ranges from 3.2 to 47.8 cubic feet per second. Based on indicators of bankfull at reference reaches and on-Site, the designed channel will equal approximately 93 percent of the channel size indicated by Piedmont regional curves; this is discussed in Section 5.2 (Bankfull Verification).

3.5 Project Site Wetlands

Jurisdictional wetlands/hydric soils within the Site were delineated in the field following guidelines set forth in the *Corps of Engineers Wetlands Delineation Manual* and subsequent regional supplements, and located using GPS technology with reported submeter accuracy (Environmental Laboratory 1987). A jurisdictional wetland delineation was completed and verbally approved by United States Army Corps of Engineers (USACE) representative David Bailey during a meeting on August 22, 2018; the signed Notification of Jurisdictional Determination can be found in Appendix D. Existing jurisdictional wetlands are depicted in light blue and green stripes, and drained hydric soils are depicted as black cross hatch on Figure 4 (Appendix A).

3.5.1 Hydrological Characterization

Construction activities are expected to restore approximately 1.018 acre of drained riparian hydric soils, and enhance 0.606 acre of cleared riparian wetlands. Areas of the Site targeted for riparian

wetlands will receive hydrological inputs from periodic overbank flooding of restored tributaries, groundwater migration into wetlands, upland/stormwater runoff, and, to a lesser extent, direct precipitation. Hydrological impairment in drained soils has resulted from lateral draw-down of the water table adjacent to existing, incised stream channels.

3.5.2 Soil Characterization

Detailed soil mapping conducted by a North Carolina Licensed Soil Scientist (NCLSS) in October 26 and 27, 2017 indicate that the Site is currently underlain by hydric soils of the Worsham Series (Figure 4, Appendix A). Wetlands have been disturbed by livestock grazing and cleared of vegetation within pastureland. These hydric soils have been effectively drained by stream channel incision or relocation of stream channels to the floodplain margins.

Onsite hydric soils are grey to gley in color and are compacted and pockmarked by livestock trampling. Livestock trampling, grazing, and clearing has resulted in an herbaceous vegetative community. Groundwater springs and surface runoff contribute hydrology to these areas, although the dominant hydrological influence is the lateral draw-down of the water table adjacent to incised stream channels or streams relocated to the floodplain margins. A detailed soil profile conducted by a NCLSS is as follows; the location is depicted on Figure 4 (Appendix A).

Table 8. Profile Description

Depth (inches)	Color	Texture
0 - 5	10 YR 3/3 10 YR 4/1 mottles 10%	Silt loam
5 - 8	10 YR 5/1	Loamy clay
8-14	10 YR 6/1	Sandy clay
14+	10 YR 6/1	Loamy sand

3.5.3 Plant Community Characterization

Areas proposed for wetland restoration and enhancement are primarily vegetated by fescue and opportunistic herbaceous species with very little vegetative diversity.

4.0 REFERENCE STUDIES

4.1 REFERENCE STREAMS

Two reference reaches were identified for the Site. The first reference stream (Flint Rock Farm) is located approximately 6 miles southwest of the Site on an unnamed tributary to Troublesome Creek. The second reference stream (Caswell Game Land) is located approximately 25 miles east of the Site on unnamed tributaries to South Country Line Creek.

4.1.1 Channel Classification

The streams were measured and classified by stream type (Rosgen 1996). The reference reaches are characterized as E-type and Cg-type streams; Flint Rock Farm is a moderately sinuous (1.22) channel dominated by sand substrate and Caswell Game Land had slightly lower sinuosity, due to a higher valley slope, with a gravel-dominated substrate.

4.1.2 Discharge

Field indicators of bankfull predict an average discharge of 24.4 and 71.7 cfs, respectively for the Flint Rock Farm and Caswell Game Lands reference reaches, which is 50 and 110 percent of that predicted by the regional curves.

4.1.3 Channel Morphology

Dimension: Data collected at Flint Rock Farm and Caswell Game Land indicate bankfull cross-sectional areas of 6.1 and 17.6 square feet, respectively. Flint Rock Farm was significantly smaller than the regional curves (12.1 square feet) and Caswell Game Land was slightly larger than predicted by regional curves (16.0 square feet). Flintrock Farm may not be a suitable reference site for determination of cross-sectional area; however, the channel is very stable and was useful in determination of pattern and slope ratios for design calculation. Flint Rock Farm and Caswell Game Land exhibit a bankfull width of 7.5 and 18.4, a bankfull depth of 0.8 and 1.0 feet, and width-to-depth ratios of 9.6 and 19.6, respectively (see Table B1, Morphological Stream Characteristics). The reference reaches exhibit a bank-height ratio of 1.0 and 1.8, respectively. The Caswell Game Land reference reach was slightly incised; however, defined bankfull indicators were present, which assisted with determining the appropriate cross-sectional area.

Pattern and Profile: In-field measurements of the reference reaches have yielded an average sinuosity of 1.22 at Flint Rock Farm and 1.14 at Caswell Game Land (thalweg distance/straight-line distance). Onsite valley slopes of Site restoration reaches range from 0.0176-0.0315. Valley slopes exhibited by reference channels range are characterized by similar slopes (0.0060 at Flintrock Farm and 0.0114 at Caswell Game Lands), providing a good range of slopes to compare existing and proposed Site conditions. Although slightly incised, the Caswell Game Land reference reach had a suitable pattern with no shoot cutoffs, eroding outer bends, or excessively tight radius of curvatures, in addition to appropriate pool-to-pool spacing and meander wavelengths.

Substrate: Reference channels are characterized by substrate dominated by gravel and sand sized particles, respectively.

4.2 Reference Forest Ecosystem

A Reference Forest Ecosystem (RFE) is a forested area on which to model restoration efforts at the Site in relation to soils and vegetation. RFEs should be ecologically stable climax communities and should be a representative model of the Site as it likely existed prior to human disturbances. Data describing plant community composition and structure should be collected at the RFEs and subsequently applied as reference data in an attempt to emulate a natural climax community.

The RFE for this project is located at the Abbey Lamm Stream and Wetland Mitigation Site. The RFE supports plant community and landform characteristics that restoration efforts will attempt to emulate. Tree and shrub species identified within the reference forest and outlined in Table 9 will be used, in addition to other relevant species in appropriate Schafale and Weakley (1990) and Schafale (2012) community descriptions.

Table 9. Reference Forest Ecosystem

Piedmont/Low Mountain Alluvial Forest	
red maple (*Acer rubrum*)	black gum (*Nyssa sylvatica*))
tag alder (*Alnus serrulata*)	black cherry (*Prunus serotina*)
ironwood (*Carpinus caroliniana*)	white oak (*Quercus alba*)
pignut hickory (*Carya glabra*)	swamp chestnut oak (*Quercus michauxii*)
green ash (*Fraxinus pennsylvanica*)	water oak (*Quercus nigra*)
eastern red cedar (*Juniperus virginiana*)	cherrybark oak (*Quercus pagoda*)
tulip poplar (*Liriodendron tulipifera*)	willow oak (*Quercus phellos*)
sweetgum (*Liquidambar styraciflua*)	slippery elm (*Ulmus rubra*)

5.0 CHANNEL ASSESSMENTS

5.1 Channel Stability Assessment

Stream power and shear stress were estimated for 1) existing dredged and straightened reaches, 2) the reference reaches, and 3) proposed Site conditions. Reference reach values for stream power and shear stress are slightly lower than the Site due to flatter valley and water surface slopes resulting in lower stream power and shear stress values. Existing, Site streams are characterized by a wide range of water surface slopes and varying degrees of degradation. In general, stream power values of existing streams are slightly elevated as compared to proposed values, and shear stress values of existing streams are significantly elevated as compared to proposed and reference reach values. Proposed stream power and shear stress values appear adequate to mobilize and transport sediment through the Site, without aggradation or erosion on proposed stream banks. Important input values and output results (including stream power, shear stress, and per unit shear power and shear stress) are presented in Table 10. Results of the analysis indicate the proposed channel reaches are expected to maintain stream power as a function of width values of approximately 2.89-3.77 lbs/sec^3 and shear stress values of approximately 0.64-0.82 lbs/ft^2 (Table 10).

Table 10. Stream Power (Ω) and Shear Stress (τ) Values

	Bankfull Discharge (ft^3/sec)	Water surface Slope (ft/ft)	Total Stream Power (Ω) (lb-ft /sec^3)	Ω/W (lb/sec^3)	Hydraulic Radius (ft)	Shear Stress (τ) (lb/ft^2)	Velocity (v) (ft/sec)	τ v (lb/ ft-sec)	τ_{max}, (lb/ft^2)
Existing Conditions									
Main Upstream	32.7	0.0149	30.40	**3.45**	3.39	**3.15**	0.91	2.87	4.72
Main Downstream	44.4	0.0171	47.38	**4.05**	4.41	**4.70**	0.74	3.46	7.06
UT1	15	0.0267	24.99	**6.75**	4.26	**7.09**	0.75	5.32	10.63
UT2	15.9	0.0186	18.45	**4.99**	12.74	**14.79**	0.27	3.93	22.19
Reference Conditions									
Flint Rock	24.4	0.0049	7.46	**0.99**	0.67	**0.20**	4.00	0.82	0.31
Caswell Game	71.7	0.0100	44.74	**2.43**	0.86	**0.54**	4.07	2.19	0.81
Proposed Conditions									
Main Upstream	32.7	0.0153	32.22	**2.89**	0.67	**0.64**	3.94	2.52	0.96
Main Downstream	44.4	0.017	47.1	**3.77**	0.78	**0.82**	4.00	3.29	1.24
UT1	15.5	0.0263	25.44	**3.35**	0.48	**0.78**	3.78	2.96	1.17
UT2	15.5	0.0263	25.44	**3.35**	0.48	**0.78**	3.78	2.96	1.17

5.2 Bankfull Verification

Discharge estimates for the Site utilize an assumed definition of "bankfull" and the return interval associated with that bankfull discharge. For this study, the bankfull channel is defined as the channel dimensions designed to support the "channel forming" or "dominant" discharge (Gordon et al. 1992).

Based on available Piedmont regional curves, the predicted bankfull discharge for the reference reaches averages approximately 48.4 and 65.2 cubic feet per second (cfs) for Flint Rock Farm and Caswell Game Land, respectively (Harmen et al. 1999). The USGS regional regression equation for the Piedmont region indicates that bankfull discharge for the reference reaches at a 1.3-1.5 year return interval average approximately 38-68 and 66-89 cfs, respectively (USGS 2006).

Field indicators of bankfull, primarily topographic breaks identified on the banks, and riffle cross-sections were utilized to obtain an average bankfull cross-sectional area for the reference reaches. The Piedmont regional curves were then utilized to plot the watershed area and discharge for the reference reach cross-sectional area. Field indicators of bankfull approximate an average discharge of 24.4 and 71.7 cfs, respectively for the reference reaches, which is 50 and 110 percent of that predicted by the regional curves. Ultimately, on-site and reference cross sections with good indicators of bankfull cross sectional areas should match close to the regional curves, which is verified by the range approximated by the USGS regional regression equation.

Based on the above analysis of methods to determine bankfull discharge, proposed conditions at the Site will be based on reference reaches and onsite indicators of bankfull (UT 1 cross-sections 3 and 7, Appendix B). Based on field indicators of bankfull at the Site (93 percent of the curves),

and the Reference Reaches, the designed onsite channel restoration area will equal approximately 93 percent of the channel size indicated by Piedmont regional curves. Therefore, Site bankfull discharges range from approximately 15.5-44.4 cfs. Table 11 summarizes all methods analyzed for estimating bankfull discharge.

Table 11. Reference Reach Bankfull Discharge Analysis

Method	Watershed Area (square miles)	Return Interval (years)	Discharge (cfs)
Flint Rock Farm Reference Reach			
Piedmont Regional Curves (Harman et al. 1999)	0.43	1.3-1.5	48.4
Piedmont Regional Regression Model (USGS 2004)	0.43	1.3-1.5	38-68
Field Indicators of Bankfull	0.43	1.3-1.5	24.4
Caswell Game Land Reference Reach			
Piedmont Regional Curves (Harman et al. 1999)	0.65	1.3-1.5	65.2
Piedmont Regional Regression Model (USGS 2004)	0.65	1.3-1.5	66-89
Field Indicators of Bankfull	0.65	1.3-1.5	71.7

6.0 FUNCTIONAL UPLIFT AND PROJECT GOALS/OBJECTIVES

Project goals are based on the *Cape Fear River Basin Restoration Priorities* (RBRP) report (NCEEP 2009) and on-site data collection of channel morphology and function observed during field investigations. The RBRP report documents benthic ratings vary between "Fair" and "Good-Fair" possibly due to cattle, dairy, and poultry operations.

The project is located within the Troublesome Creek and Little Troublesome Creek Local Watershed Planning area (NCEEP 2004); project activities address priorities associated with the LWP as follows with Site specific information following the LWP goals in parenthesis.

1. Protect and improve water quality by restoring wetland, stream, and riparian area functions and values, which may have been, or may be, lost through historic, current, and future impacts (4115 linear feet of stream restoration/enhancement/preservation, 1.71 acres of wetland restoration/enhancement, and 11.6. acres of riparian buffer restoration/enhancement).
2. Achieve a net increase in riparian zone buffers and wetlands acreage, functions, and values (11.6 acres of riparian buffer restoration/enhancement, and increased wetland acreage by 1.02 acres).
3. Promote a comprehensive approach for the protection of natural resources (protection of the Site, streams, wetlands, and riparian buffer through a permanent conservation easement).

In addition to the defined Troublesome Creek LWP goals, additional goals for the area generally revolve around reduction of stressors to water quality. Stressors and how each will be addressed by project activities is as follows.

1. Nutrient Inputs – (nutrient model [Section 3.3] - livestock removal from streams will result in a direct reduction of 474.7 pounds of nitrogen, 39.3 pounds of phosphorus per year, and 4.7 x 10^{11} colonies of fecal coliform; eliminate fertilizer application; and install marsh treatment areas).
2. Streambank Erosion – (sediment model [Section 3.2] – reduction of 220 tons/year after mitigation is complete).
3. Stormwater – (reduction of bank height ratio and installation of marsh treatment area will reduce stormwater pulses).
4. Disturbed Riparian Buffer – (restoration/enhancement of 11.6 acres of riparian buffer along 4115 linear feet of stream).
5. Floodplain Alteration – (elimination of straightened, entrenched streams and the removal of spoil material deposited in the floodplain).

Site specific mitigation goals and objectives have been developed through the use of North Carolina Stream Assessment Method (NC SAM) and North Carolina Wetland Assessment Method (NC WAM) analyses of existing and reference stream systems at the Site (NC SFAT 2015 and NC WFAT 2010). These methodologies rate functional metrics for streams and wetlands as high, medium, or low based on field data collected on forms and transferred into a rating calculator. Using Boolean logic, the rating calculator assigns a high, medium, or low value for each metric and overall function. Site functional assessment data forms are available upon request and model output is included in Appendix B.

Tables 12A and 12B summarize NC SAM and NC WAM metrics targeted for functional uplift and the corresponding mitigation activities proposed to provide functional uplift. Metrics targeted to meet the Site's goals and objectives are depicted in bold.

Table 12A. Slingshot Creek NC SAM Summary

NC SAM Function Class Rating Summary	SAM 1 Main Downstream	SAM 2 UT 1	SAM 3 Main Middle	SAM 4 Main Upstream
(1) HYDROLOGY	**LOW**	**LOW**	**LOW**	MEDIUM
(2) Baseflow	HIGH	MEDIUM	HIGH	HIGH
(2) Flood Flow	**LOW**	**LOW**	**LOW**	MEDIUM
(3) Streamside Area Attenuation	**LOW**	**LOW**	**LOW**	**LOW**
(4) Floodplain Access	**LOW**	**LOW**	**LOW**	**LOW**
(4) Wooded Riparian Buffer	**LOW**	HIGH	**LOW**	HIGH
(3) Stream Stability	**LOW**	MEDIUM	**LOW**	HIGH
(4) Channel Stability	MEDIUM	HIGH	MEDIUM	HIGH
(4) Sediment Transport	**LOW**	HIGH	**LOW**	MEDIUM
(4) Stream Geomorphology	**LOW**	**LOW**	MEDIUM	HIGH
(1) WATER QUALITY	MEDIUM	**LOW**	MEDIUM	MEDIUM
(2) Baseflow	HIGH	MEDIUM	HIGH	HIGH
(2) Stream-side Area Vegetation	**LOW**	**LOW**	**LOW**	HIGH
(3) Upland Pollutant Filtration	**LOW**	**LOW**	**LOW**	HIGH
(3) Thermoregulation	MEDIUM	MEDIUM	MEDIUM	HIGH
(2) Indicators of Stressors	YES	YES	YES	YES
(2) Aquatic Life Tolerance	HIGH	HIGH	HIGH	HIGH
(1) HABITAT	**LOW**	HIGH	**LOW**	HIGH
(2) In-stream Habitat	**LOW**	HIGH	**LOW**	MEDIUM
(3) Baseflow	HIGH	MEDIUM	HIGH	HIGH
(3) Substrate	**LOW**	HIGH	**LOW**	MEDIUM
(3) Stream Stability	MEDIUM	MEDIUM	MEDIUM	HIGH
(3) In-Stream Habitat	**LOW**	HIGH	**LOW**	MEDIUM
(2) Stream-side Habitat	**LOW**	MEDIUM	**LOW**	HIGH
(3) Stream-side Habitat	**LOW**	MEDIUM	**LOW**	MEDIUM
(3) Thermoregulation	MEDIUM	MEDIUM	**LOW**	HIGH
OVERALL	**LOW**	**LOW**	**LOW**	MEDIUM

Based on NC SAM output, all three primary stream functional metrics (Hydrology, Water Quality, and Habitat), as well as 16 sub-metrics are under-performing as exhibited by a LOW metric rating. These same metrics measured in a relatively undisturbed upstream reach of Slingshot Creek (Enhancement Level II Reach) exhibits MEDIUM to HIGH metric ratings (see Figure 4, Appendix A for NC SAM data reaches). LOW performing metrics are to be targeted for functional uplift through mitigation activities, goals and objectives, as well as, monitoring and success criteria.

Table 12B. Slingshot Creek NC WAM Summary

NC WAM Sub-function Rating Summary	WAM-1
Wetland Type	Headwater Forest
(1) HYDROLOGY	MEDIUM
(2) Surface Storage & Retention	MEDIUM
(2) Sub-surface Storage and Retention	MEDIUM
(1) WATER QUALITY	HIGH
(2) Pathogen change	HIGH
(2) Particulate Change	**LOW**
(2) Soluble change	HIGH
(2) Physical Change	MEDIUM
(1) HABITAT	**LOW**
(2) Physical Structure	**LOW**
(2) Landscape Patch Structure	**LOW**
(2) Vegetative Composition	**LOW**
OVERALL	MEDIUM

NC WAM forms are filled out for wetland enhancement areas. Wetland restoration areas were not rated using the NC WAM methodology.

Table 12C outlines stream and wetland functions targeted for functional uplift, goals that are tied to the specific functions, and objectives to be completed to achieve the proposed goals.

Table 12C. Stream/Wetland Targeted Functions, Goals, and Objectives

Targeted Functions	Goals	Objectives
(1) HYDROLOGY		
(2) Flood Flow (Floodplain Access) (3) Streamside Area Attenuation (4) Floodplain Access (4) Wooded Riparian Buffer	• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement
(3) Stream Stability (4) Sediment Transport (4) Stream Geomorphology	• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Remove livestock • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer
(1) WATER QUALITY		
(2) Streamside Area Vegetation (3) Upland Pollutant Filtration (2) Indicators of Stressors Wetland Particulate Change	• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Install marsh treatment areas, where necessary • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams
(1) HABITAT		
(2) In-stream Habitat (3) Substrate (3) In-Stream Habitat (2) Stream-side Habitat (3) Stream-side Habitat (3) Thermoregulation Wetland Physical Structure Wetland Landscape Patch Structure Wetland Vegetation Composition	• Improve instream and stream-side habitat.	• Construct stable channels with cobble/gravel substrate • Add large woody debris in the form of log vane structures • Plant permanent seed mixtures along banks to add rooting material and leafy vegetation for macroinvertebrates • Plant woody riparian buffer to provide organic matter and shade • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams

7.0 SITE DESIGN AND IMPLEMENTATION CONSTRAINTS

The presence of conditions or characteristics that have the potential to hinder restoration activities on the Site was evaluated. The evaluation focused primarily on the presence of hazardous materials, utilities and restrictive easements, rare/threatened/endangered species or critical habitats, and the potential for hydrologic trespass. Existing information regarding Site constraints was acquired and reviewed. In addition, field surveys were conducted to confirm if constraints occur within, or adjacent to the Site boundaries.

No known Site constraints that may hinder proposed mitigation activities were identified during background research or field surveys. Potential constraints reviewed include the following.

7.1 Threatened & Endangered Species

Three federally protected species are listed as occurring in Rockingham County (USFWS 2018); the following table summarizes potential habitat and preliminary biological conclusions for each.

Table 13. Threatened and Endangered Species

Species	Habitat	Potential Habitat at Site	Biological Conclusion
James spinymussel (*Pleurobema collina*)	This freshwater mussel is limited to the James River drainage and the Dan/Mayo River drainage within the Roanoke River basin in Virginia, North Carolina, and West Virginia. This species' range does not include the Site, which is located in the Upper Cape Fear River drainage.	No	No Effect
Roanoke logperch (*Percina rex*)	In North Carolina, this species is found in the Dan and Mayo rivers, as well as Big Beaver Island Creek. This species' range does not include the Site, which is located in the Upper Cape Fear River drainage.	No	No Effect
Smooth coneflower (*Echinacea laevigata*)	This species grows in calcareous, basic, or circumneutral soils on roadsides, clear cuts, and power line right-of-ways where there is abundant light and little herbaceous competition. Fire-maintained woodlands also appear to provide potential habitat for the coneflower.	Yes	No Effect*

*Detailed field surveys for this species were conducted during the optimum survey window. Survey methodology and results are included in Appendix E.

Neither the James spinymussel nor the Roanoke logperch have ranges that extend into areas adjacent to or within the Site; therefore, this project will have no effect on these federally protected species. Suitable habitat for the smooth coneflower exists at the Site; therefore, surveys were conducted in May 2018, during the optimal survey window for this plant. Correspondence concerning survey methodology and results are presented in Appendix E.

7.2 Cultural Resources

The term "cultural resources" refers to prehistoric or historic archaeological sites, structures, or artifact deposits over 50 years old. "Significant" cultural resources are those that are eligible or

potentially eligible for inclusion in the National Register of Historic Places. Evaluations of site significance are made with reference to the eligibility criteria of the National Register (36 CFR 60) and in consultation with the North Carolina State Historic Preservation Office (SHPO).

Field visits were conducted at the Site late 2017 to ascertain the presence of structures or other features that may be eligible for inclusion on the National Register of Historic Places. No structures were identified within proposed easement boundaries; however, coordination with State Historic Preservation Office will occur prior to construction activities to determine if any significant cultural resources are present.

7.3 North Carolina Natural Heritage Elements

A query of the North Carolina Natural Heritage Program (NCNHP) database indicates there are no records for rare species, important natural communities, natural areas, or conservation/managed areas within the proposed project boundary. Within a one-mile radius of the project boundary NCNHP lists an element occurrence, a natural community, and a natural area, which are summarized in the NCNHP correspondence in Appendix E. In addition, North Carolina Division of Mitigation Services (NCDMS) Sharpe property wetland preservation Site is located within close proximity of the Site.

7.4 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710798400J, Panels 7984 and 7994, effective September 3, 2007, indicates that Site streams are not located in a Special Flood Hazard Area, and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this project.

7.5 Utilities

No utilities are located on the Site.

7.6 Air Transport Facilities

One air transport facility is located within 5 miles of the Site. Warf Airfield is located approximately 0.5 mile south of the Site.

8.0 DESIGN APPROACH AND MITIGATION WORK PLAN

8.1 Stream Design

Onsite streams targeted for restoration have endured significant disturbance from land use activities such as land clearing, livestock grazing, straightening and rerouting of channels, and other anthropogenic maintenance. Site streams will be restored to emulate historic conditions at the Site utilizing parameters from nearby, relatively undisturbed reference streams (see Section 4.1 Reference Streams).

Primary activities designed to restore Site streams include 1) stream restoration, 2) stream enhancement (Level I), 3) stream enhancement (Level II), 4) stream preservation, 5) wetland restoration, 6) wetland enhancement, and 7) vegetation planting (Figures 5A-5B, Appendix A).

8.1.1 Stream Restoration

Stream restoration efforts are designed to restore a stable stream that approximates hydrodynamics, stream geometry, and local microtopography relative to reference conditions. Restoration at the Site will be Priority I restoration; therefore, bankfull elevations will be raised to meet the adjacent valley floodplain elevation.

Stream restoration is expected to entail 1) channel excavation (Figure 6, Appendix A), 2) spoil stockpiling, 3) channel stabilization, 4) channel diversion, and 5) channel backfill.

In-stream Structures

The use of in-stream structures for grade control and habitat is essential for successful stream restoration (Figure 7A, Appendix A). In-stream structures may be placed in the channel to elevate local water surface profiles in the channel, potentially flattening the water energy slope or gradient and directing stream energy into the center of the channel and away from banks. The structures will consist of log cross-vanes or log j-hook vanes; however, at the discretion of the Engineer, rock cross-vanes or rock j-hook vanes may be substituted if dictated by field conditions. In addition, the structures will placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

Piped Channel Crossings

Landowner constraints will necessitate the installation of 4 piped channel crossings within breaks in the easement to allow access to portions of the property isolated by stream restoration activities. The crossings may be constructed of properly sized pipes and hydraulically stable rip-rap or suitable rock. Crossings will be large enough to handle the weight of anticipated vehicular traffic. Approach grades to the crossing will be at an approximate 10:1 slope and constructed of hard, scour-resistant crushed rock or other permeable material, which is free of fines.

Outfall Structures

One drop structure is proposed at the outfall of Slingshot Creek. The drop structure may be constructed out of large cobble depending upon anticipated scour from the restored stream channels (Figure 7B, Appendix A). The structure should be constructed to resist erosive forces associated with hydraulic drops proposed at the Site.

Marsh Treatment Areas

No areas of concentrated flow have been identified at this time; however, if during construction a point of concentrated flow is identified then a shallow wetland marsh treatment area will be excavated in the floodplain to intercept surface waters draining through agricultural areas prior to discharging into the Site. Marsh treatment areas are intended to improve the mitigation project and are not generating mitigation credit. The proposed marsh treatment area will consist of shallow depressions that will provide treatment and attenuation of initial stormwater pulses (Figure 7B, Appendix A). The outfall will be constructed of hydraulically stable rip-rap or other suitable material that will protect against headcut migration into the constructed depression. It is expected that the treatment area will fill with sediment and organic matter over time.

8.1.2 Stream Enhancement (Level I)

Stream enhancement (level I) will occur on reaches accessible by livestock. Stream dimension will be restored in these reaches, fencing will be erected to exclude livestock, and planting riparian buffers with native forest vegetation will occur where needed.

8.1.3 Stream Enhancement (Level II)

Stream enhancement (level II) will occur on reaches are characterized by channels with patches of mature riparian vegetation, good channel bed substrate, and little bank erosion. The reaches are accessible by livestock and will have fence erected to exclude livestock. Planting riparian buffers with native forest vegetation will occur where needed.

8.1.4 Stream Preservation

Stream preservation will occur on the upstream reaches of Slingshot Creek and the entirety of UT 4. These reaches are characterized by channels with mature riparian vegetation, good channel bed substrate, and little bank erosion. The reaches are not accessible by livestock and are included in the project to protect the upstream reaches from future impacts.

8.2 Individual Reach Descriptions

Mitigation strategies proposed for each reach are presented below.

8.2.1 Slingshot Creek (UT to Troublesome Creek)

Slingshot Creek enters the Site from the upstream property and extends for 2920 linear feet in its current location. The upper reach of Slingshot Creek is fenced from livestock and surrounded by mature vegetation. Once the stream enters pastureland, remnants of a breached impoundment are situated across the floodplain. Livestock have impacted the channel above and below the impoundment; however, the channel retains suitable pattern. The channel descends the valley to a nick point where the channel becomes deeply incised and appears to have been dredged and straightened. Adjacent to the majority of the straightened reach, vegetation remains in successional in patches, with unmaintained pasture comprising the rest of the channel banks and floodplain. The lower reaches of channel were dredged and straightened, as evidenced by oxbow wetlands in the floodplain. This reach was historically crossed by an elevated road bed. An undersized or blocked pipe beneath the road bed appears to have failed, resulting in extensive erosion above and below the road bed. The lower reach is characterized by mature vegetation on the left bank and pasture on the right bank.

In its current state, Slingshot Creek is classified as a G-type channel with entrenchment ratios averaging 1.6. Although entrenchment ratios exhibit some connection to the floodplain, the majority of the channel is incised, as evidenced by bank-height-ratios ranging from 1.3 to 4.5. Incision varies across the reach, with deep incision occurring in areas that appear to have been dredged and straightened, particularly downstream from the nick point. Dredging and straightening of the channel have resulted in a loss of riffle pool morphology.

Slingshot Creek is proposed for four mitigation treatments; 1) stream restoration, 2) stream enhancement (level I), 3) stream enhancement (level II), and 4) stream preservation.

Stream Restoration

Stream restoration is proposed for the majority of Slingshot Creek where the channel has been straightened, is deeply incised, and is heavily impacted by livestock. The reach is proposed for Priority 1 restoration on new location, reconnecting the channel to degraded/drained wetlands or hydric soils. Channel construction is expected to entail filling ditches/drainage features, installation of three piped crossings, excavating a channel that connects stream overbank events with adjacent wetlands, installation of grade control and habitat structures, and connecting the channel with downstream reaches.

Stream Enhancement (Level I)

Stream enhancement (level I) is proposed for the upper reaches of Slingshot Creek where channel pattern appears to exhibit suitable sinuosity and pool-to-pool spacing; however, the channel is relatively incised, impacted by livestock, and is characterized by low radius of curvature values in several bends. Mitigation in these areas will focus on elevating the stream bed, providing the proper channel dimension, and reducing shear on tight meander bends. Structures will be strategically placed to reduce pressure on channel banks and focus scour into the center of the channel. This reach will ultimately reconnect the channel to the floodplain and adjacent wetlands, and bring the channel to a suitable elevation.

Stream Enhancement (Level II)

The upper reaches of Slingshot Creek are proposed for stream enhancement (level II) through the removal of livestock, supplemental planting with native hardwood species, removal of remnants of a breached dam, and placement of a permanent conservation easement.

Stream Preservation

The upper reaches of Slingshot Creek and UT 4 are proposed for stream preservation. These areas are stable and livestock do not access the channels, or stream buffer. Preservation reaches will have invasive species treatment, fence upgrades to ensure livestock exclusion, and placement of a conservation easement.

8.2.2 UT 1

UT 1 enters the Site from the upstream property and extends for 968 linear feet in its current location. The upper reaches of UT 1 are crossed by an elevated road with a failing pipe. Currently, the upper reaches are impounded to a depth of approximately 3 feet. Stream flow overtops the road bed and is eroding the channel. A bedrock sill has reduced erosion and UT 1 maintains pattern for approximately 150 feet below the road, before the bedrock sill ends and the channel becomes incised. Historically, this reach below the bedrock sill may have been impounded, as evidenced by remnants of an earthen dam. Below the earthen dam, the channel appears to have been manipulated in the past and livestock have impacted the channel banks. The entire reach of UT 1 is surrounded by sparse mature trees and successional vegetation associated with neglected pastureland. Livestock have access to the entirety of UT 1 and channel banks are eroding from hoof shear.

In its current state, UT 1 is classified as a G-type channel with entrenchment ratios averaging 2.0. Although entrenchment ratios exhibit some connection to the floodplain, the majority of the

channel is incised, as evidenced by bank-height-ratios ranging from 1.2 to 3.7. Incision varies across the reach, with deep incision occurring in areas downstream from the nick point.

UT 1 is proposed for three mitigation treatments; 1) stream restoration, 2) stream enhancement (level I), and 3) stream enhancement (level II). During field reviews with Interagency Review Team (IRT) members it was discussed that a mix of mitigation treatments throughout the entire reach of UT was is likely to occur. However, large sections of mitigation treatment is proposed rather than many short alternating sections of mitigation treatments. Ultimately, UT 1 will include various mitigation strategies throughout each reach.

Stream Restoration

Stream restoration is proposed for the lower, downstream sections of UT 1 as the channel enters wetlands associated with the larger, Slingshot Creek floodplain. This reach of channel is currently incised (BHR of 2.3 and 1.6 in cross sections 1 and 2 [Appendix B]) and will be reconnected to the adjacent floodplain wetlands. In addition, as UT 1 meets Slingshot Creek floodplain the channel is proposed to be redirected across the floodplain to the natural topographic location, the lowest portion of the floodplain. The reach is proposed for Priority 1 restoration on new location. Channel construction is expected to entail excavating a channel that connects stream overbank events with adjacent wetlands, installation of grade control and habitat structures, and connecting the channel with downstream reaches.

Stream Enhancement (Level I)

Stream enhancement (level I) is proposed for the middle reaches of UT 1, below the bedrock sill and above the restoration reach. As stated above, this reach of channel will likely also include enhancement (level II) and restoration measures. Reaches of the channel where pattern appears to exhibit suitable sinuosity and pool-to-pool spacing, in channel manipulation of dimension and profile will be conducted. These reaches are incised; therefore, enhancement efforts are expected to rehydrate drained jurisdictional wetland within the narrow floodplain. Several tight meander bends will be eased to reduce erosion. In addition, the remnants of a historic dam will be removed to allow floodwaters to access floodplains below the dam.

Mitigation in these areas will focus on elevating the stream bed, providing the proper channel dimension, and reducing shear on tight meander bends. Structures will be strategically placed to reduce pressure on channel banks and focus scour into the center of the channel. This reach will ultimately reconnect the channel to the floodplain and adjacent wetlands, and bring the channel to a suitable elevation. In addition, a piped channel crossing will be installed in the upper reaches.

Stream Enhancement (Level II)

The upper reaches of UT 1 are impounded by a failing road crossing/culvert. This section of stream is proposed to have the road crossing upgraded with a new, appropriately sized piped crossing and the channel constructed to the proper dimension and slope. As stated above, this reach is proposed for multiple mitigation treatments, including restoration, enhancement (level I), and enhancement (level II) and has been lumped as one mitigation treatment for discussion and crediting purposes.

8.2.3 UT 2

UT 2 enters the Site from the upstream property and extends for 130 linear feet in its current location. UT 2 is a relatively short reach that has been dredged and straightened. The channel is excessively deep and parallels a driveway and metal structure outside of the easement boundaries. Both banks of UT 2 are characterized as agriculture pasture, with the left bank providing a holding pen for loading cattle into trailers.

In its current state, UT 2 is classified as a G-type channel with entrenchment ratios averaging 1.6. The entire reach is incised as evidenced by bank-height-ratios ranging from 2.5 to 3.9. Dredging and straightening of the channel have resulted in a loss of riffle pool morphology.

UT 2 is proposed for one mitigation treatment; 1) stream restoration.

Stream Restoration

Stream restoration is proposed for the entirety of UT 2 which will excavation of channel on new location. Channel construction is expected to entail filling ditches/drainage features, upgrading a forded channel crossing, excavating a channel that connects stream overbank events with adjacent wetlands, installation of grade control and habitat structures, and connecting the channel with downstream reaches.

8.2.4 UT 3

UT 3 enters the Site from the upstream property and extends for 189 linear feet in its current location. UT 3 is a relatively short reach that was dredged and straightened many years ago and has naturalized in its current location. The channel has disturbed forest on its left bank and pasture on its right bank. The channel is characterized by an intermittent flow regime. Livestock have access to the entire reach.

UT 3 is proposed for one mitigation treatment; 1) stream enhancement (level II).

Stream Enhancement (Level II)

The entire reach of UT 3 is proposed for stream enhancement (level II) through the removal of livestock with fencing, supplemental planting with native hardwood species, and placement of a permanent conservation easement.

8.2.5 UT 4

UT 4 enters the Site from the upstream property and extends for 86 linear feet in its current location. UT 4 is a relatively short reach that is characterized by mature forest vegetation and is isolated from livestock. The IRT specified this reach for preservation credit.

UT 4 is proposed for one mitigation treatment; 1) stream preservation.

Stream Preservation

UT 4 is proposed for stream preservation. These areas are stable and livestock do not access the channels, or stream buffer. Preservation reaches will have invasive species treatment, fence upgrades to ensure livestock exclusion, and placement of a conservation easement.

8.3 Wetland Restoration

Wetland restoration activities are designed to restore a fully functioning wetland system, which will provide surface water storage, nutrient cycling, removal of imported elements and compounds, and will create a variety and abundance of wildlife habitat.

Portions of the Site underlain by hydric soils have been impacted by drainage ditch excavation, vegetative clearing, agriculture plowing, herbicide application, and other land disturbances associated with land use management. Wetland restoration will focus on the restoration of vegetative communities, filling drainage ditches, the reestablishment of soil structure and microtopographic variations, and redirecting normal surface hydrology from streams back into the Site floodplains. In addition, the construction of (or provisions for) surface water storage depressions (ephemeral pools) will also add an important component to groundwater restoration activities. These activities will result in the restoration of 1.02 acres of jurisdictional riparian riverine wetlands.

Restoration of Historic Groundwater Elevations

Hydric soils appear to have been drained due to lowering of the groundwater tables and a lateral drainage effect from stream channel incision and straightening. Reconstructing streams at a natural depth, increasing stream sinuosity, and directing surface flow from adjacent properties across the ground surface is expected to rehydrate hydric soils within the Site, resulting in the restoration of jurisdictional hydrology to riparian wetlands.

Hydrophytic Vegetation

Site wetland areas have endured significant disturbance from land use activities such as land clearing, livestock trampling, herbicide application, and other anthropogenic maintenance. Wetland areas will be revegetated with native forest vegetation typical of wetland communities in the region. Emphasis will focus on developing a diverse plant assemblage.

8.4 Wetland Enhancement

Wetland enhancement will focus on the removal of livestock and restoration of vegetative communities resulting in the enhancement of 0.606 acre of riparian riverine wetland.

8.5 Soil Restoration

Soil grading will occur during stream restoration activities. Topsoil will be stockpiled during construction activities and will be spread on the soil surface once critical subgrade has been established. The replaced topsoil will serve as a viable growing medium for community restoration to provide nutrients and aid in the survival of planted species.

8.6 Natural Plant Community Restoration

Restoration of floodplain forest and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife. Reference Forest Ecosystem (RFE) data, onsite observations, and community descriptions from *Classification of the Natural*

Communities of North Carolina (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration activities.

8.6.1 Planting Plan

Stream-side trees and shrubs include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. Stream-side trees and shrubs will be planted within 15 feet of the channel top of bank throughout the meander belt-width. Shrub elements will be planted along the reconstructed stream banks, concentrated along outer bends. Piedmont Alluvial Forest is the target community for Site floodplains and Dry-Mesic Oak-Hickory Forest is the target community for upland side-slopes.

Bare-root seedlings within the Piedmont Alluvial and Dry-Mesic Oak-Hickory Forests will be planted at a density of approximately 680 stems per acre on 8-foot centers. Shrub species in the stream-side assemblage will be planted at a density of 2720 stems per acre on 4-foot centers.

Table 14 depicts the total number of stems and species distribution within each vegetation association (Figures 8A and 8B, Appendix A). Planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season.

Permanent seed mixes will be planted that quickly establish a low-growing groundcover on the Site which will reduce erosion, provide streambank stability, benefit wildlife, and facilitate the successful establishment of the planned hardwood tree community. Species mix is subject to commercial availability at time of planting; however, the general diversity and function of permanent seed mix will remain. Seed mix components will include the following.

Upland Seed Mix (2 lbs/ac)

1. Redtop (*Agrostis alba*)
2. Creeping Bentgrass (*Agrostis stolonifera*)
3. Winter Bentgrass (*Agrostis hyemalis*)
4. Purple Coneflower (*Echinacea laevigata*)
5. Partridge Pea (*Cassia fasciculata*)
6. Oxeye Daisy (*Chrysanthemum leucanthemum*)
7. Lanceleaf Coreopsis (*Coreopsis lanceolata*)
8. Blackeyed Susan (*Rudbeckia hirta*)
9. Plains Coreopsis (*Coreopsis tinctoria*)
10. Korean Lespedeza (*Lespedeza stipulacea*)
11. Mistflower (*Eupatorium coelestinum*)

Floodplain Seed Mix (6 lbs/ac)

1. Fox sedge (*Carex vulpinoidea*)
2. Soft rush (*Juncus effuses*)
3. Redtop (*Agrostis alba*)
4. Creeping Bentgrass (*Agrostis stolonifera*)
5. Winter Bentgrass (*Agrostis hyemalis*)
6. Purple Coneflower (*Echinacea laevigata*)
7. Partridge Pea (*Cassia fasciculata*)
8. Oxeye Daisy (*Chrysanthemum leucanthemum*)
9. Lanceleaf Coreopsis (*Coreopsis lanceolata*)
10. Blackeyed Susan (*Rudbeckia hirta*)
11. Plains Coreopsis (*Coreopsis tinctoria*)
12. Korean Lespedeza (*Lespedeza stipulacea*)
13. Mistflower (*Eupatorium coelestinum*)

Table 14. Planting Plan

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	**4.8**		**2.2**		**2.5**		**9.6**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	--	--	350	7	350
River birch (*Betula nigra*)	300	9	--	--	400	8	700
Ironwood (*Carpinus caroliniana*)	--	--	--	--	300	6	300
Sugarberry (*Celtis laevigata*))	--	--	300	14	--	--	300
Red bud (*Cercis canadensis*)	--	--	200	9	--	--	200
Silky dogwood (*Cornus amomum*)	--	--	--	--	1700	32	1700
Persimmon (*Diospyros virginiana*)	--	--	200	9	--	--	200
White ash (*Fraxinus americana*)	--	--	100	5	--	--	100
Green ash (*Fraxinus pennsylvanica*)	200	6	--	--	200	4	400
Tulip poplar (*Liriodendron tulipifera*)	500	14	--	--	--	--	500
Sycamore (*Platanus occidentalis*)	750	21	--	--	750	14	1500
Black gum (*Nyssa sylvatica*)	250	7	--	--	250	5	500
Cherry (*Prunus serotine*)	--	--	300	14	--	--	300
White oak (*Quercus alba*)	250	7	250	12	--	--	500
Water oak (*Quercus nigra*)	500	14	500	23	500	9	1500
Willow oak (*Quercus phellos*)	500	14	300	14	600	11	1400
Shumard oak (*Quercus shumardii*)	250	7	--	--	250	5	500
TOTAL	**3500**	**100**	**2150**	**100**	**5300**	**100**	**10,950**

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.

8.6.2 Nuisance Species Management

Invasive plant species will be observed and removed mechanically and/or chemically, as part of this project. No other nuisance species controls are proposed at this time. Inspections for beaver and other potential nuisance species will occur throughout the course of the monitoring period. Appropriate actions may be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis. The presences of nuisance species will be monitored over the course of the monitoring period. Appropriate actions will be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis.

9.0 MONITORING AND SUCCESS CRITERIA

Monitoring will be conducted by Axiom Environmental, Inc based on the schedule in Table 15. A summary of monitoring is outlined in Table 15 (Figures 9A–9B, Appendix A). Annual monitoring reports will be submitted to the NCDMS by Restoration Systems no later than December 31 of each monitoring year data is collected.

Table 15. Monitoring Schedule

Resource	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Streams	■	■	■		■		■
Wetlands	■	■	■	■	■	■	■
Vegetation	■	■	■		■		■
Macroinvertebrates			■		■		■
Visual Assessment*	■	■	■	■	■	■	■
Report Submittal	■	■	■	■	■	■	■

*Visual Assessment will be complimented by permanent photographic points located at each permanent cross section and vegetation plot.

Table 16. Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 14 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern will be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Stream Hydrology	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	No surface water gauges proposed at this time as stream flow regime is not in question.	NA
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	Surface water gauge on Slingshot Creek and UT 1	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	All restored stream channels	Visual evidence, photo documentation, and/or rain data.
Benthic Macroinvertebrates	"Qual 4" method described in *Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates, Version 5.0* (NCDWR 2016)	Pre-construction, Years 3, 5, and 7 during the "index period" referenced in *Small Streams Biocriteria Development* (NCDWQ 2009)	2 stations (one at the lower end of UT1 and one at the lower end of Slingshot Creek); however, the exact locations will be determined at the time pre-construction benthics are collected	Results* will be presented on a site-by-site basis and will include a list of taxa collected, an enumeration of *Ephemeroptera*, *Plecoptera*, and *Tricopetera* taxa as well as Biotic Index values.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-October 26	10 gauges spread throughout restored and enhanced wetlands	Soil temperature at the beginning of each monitoring period to verify the start of the growing season, groundwater and rain data for each monitoring period
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	10 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	2 plots randomly selected each year	Species and height

*Benthic Macroinvertebrate sampling data will not be tied to success criteria; however, the data may be used as a tool to observe positive gains to in-stream habitat.

9.1 Success Criteria

Monitoring and success criteria for stream restoration should relate to project goals and objectives identified from on-site NC SAM and NC WAM data collection. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving success criteria. The following summarizes Site success criteria.

Table 17. Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section over the monitoring period. • BHR at any measured riffle cross-section should not change by more than 10% from baseline condition over monitoring period. • A minimum of 30-days continuous surface flow for intermittent streams. • The stream project shall remain stable and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.
Wetland Hydrology
• Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 10 percent of the growing season, during average climatic conditions. Note: Growing season length will be confirmed with a continuous recording temperature gauge that will measure from February to April each monitoring year.
Vegetation
• Within planted portions of the Site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5; and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5, and 10 feet in height at year 7 in each plot. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis.

Note: BHR will be calculated using procedures outlined in the latest approved guidance from NCDMS.

9.2 Contingency

In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented.

9.2.1 Stream Contingency

Stream contingency may include, but may not be limited to 1) structure repair and/or installation; 2) repair of dimension, pattern, and/or profile variables; and 3) bank stabilization. The method of contingency is expected to be dependent upon stream variables that are not in compliance with success criteria. Primary concerns, which may jeopardize stream success, include 1) structure failure, 2) headcut migration through the Site, and/or 3) bank erosion.

Structure Failure

In the event that structures are compromised the affected structure will be repaired, maintained, or replaced. Once the structure is repaired or replaced, it must function to stabilize adjacent stream banks and/or maintain grade control within the channel. Structures which remain intact, but exhibit flow around, beneath, or through the header/footer will be repaired by excavating a trench on the upstream side of the structure and reinstalling filter fabric in front of the pilings. Structures which have been compromised, resulting in shifting or collapse of a header/footer, will be removed and replaced with a structure suitable for Site flows.

Headcut Migration Through the Site

In the event that a headcut occurs within the Site (identified visually or through measurements [i.e. bank-height ratios exceeding 1.4]), provisions for impeding headcut migration and repairing damage caused by the headcut will be implemented. Headcut migration may be impeded through the installation of in-stream grade control structures (rip-rap sill and/or log cross-vane weir) and/or restoring stream geometry variables until channel stability is achieved. Channel repairs to stream geometry may include channel backfill with coarse material and stabilizing the material with erosion control matting, vegetative transplants, and/or willow stakes.

Bank Erosion

In the event that severe bank erosion occurs within the Site, resulting in incision, lateral instability, and/or elevated width-to-depth ratios locally or systemically, contingency measures to reduce bank erosion and width-to-depth ratio will be implemented. Bank erosion contingency measures may include the installation of log-vane weirs and/or other bank stabilization measures. If the resultant bank erosion induces shoot cutoffs or channel abandonment, a channel may be excavated to reduce shear stress to stable values.

9.2.2 Wetland Contingency

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement is not achieved. Floodplain surface modifications, including construction of ephemeral pools, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. Recommendations for contingency to establish wetland hydrology will be implemented and monitored until Hydrology Success Criteria are achieved.

9.2.3 Vegetation Contingency

If vegetation success criteria are not achieved, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

9.3 Compatibility with Project Goals

The following table outlines the compatibility of Site performance criteria described above to Site goals and objectives that will be utilized to evaluate if Site goals and objectives are achieved.

Table 18. Compatibility of Performance Criteria to Project Goals and Objectives

Goals	Objectives	Success Criteria
(1) HYDROLOGY		
• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect Site with a perpetual conservation easement	• Over the monitoring period BHR not to exceed 1.2 • Document four overbank events in separate monitoring years • Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded
• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Remove livestock from the Site • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and structures • Over the monitoring period BHR not to exceed 1.2 • < 10% change in BHR over the monitoring period • Livestock excluded from the easement • Attain Vegetation Success Criteria
(1) WATER QUALITY		
• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Plant woody riparian buffer • Restore/enhance wetlands adjacent to Site streams	• Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT		
• Improve instream and stream-side habitat.	• Construct stable channels with cobble/gravel substrate • Plant riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows and plant woody riparian buffer • Protect Site with a perpetual conservation easement • Restore/enhance wetlands adjacent to Site streams	• Cross-section measurement indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

10.0 ADAPTIVE MANAGEMENT PLAN

In the event the mitigation Site or a specific component of the mitigation Site fails to achieve the necessary performance standards as specified in the mitigation plan, the sponsor shall notify the members of the IRT and work with the IRT to develop contingency plans and remedial actions.

11.0 LONG-TERM MANAGEMENT PLAN

The Site will be transferred to the North Carolina Division of Environmental Quality (NCDEQ) Stewardship Program. This party shall serve as conservation easement holder and long-term steward for the property and will conduct periodic inspection of the Site to ensure that restrictions required in the conservation easement are upheld. Funding will be supplied by the responsible party on a yearly basis until such time an endowment is established. The NCDEQ Stewardship Program is developing an endowment system within the non-reverting, interest-bearing Conservation Lands Conservation Fund Account. The use of funds from the Endowment Account will be governed by North Carolina General Statute GS 113A-232(d)(3). Interest gained by the endowment fund may be used for the purpose of stewardship, monitoring, stewardship administration, and land transaction costs, if applicable.

12.0 REFERENCES

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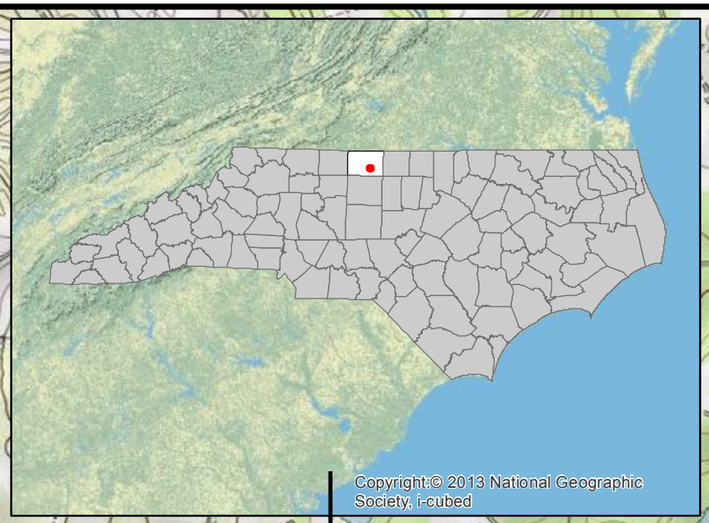
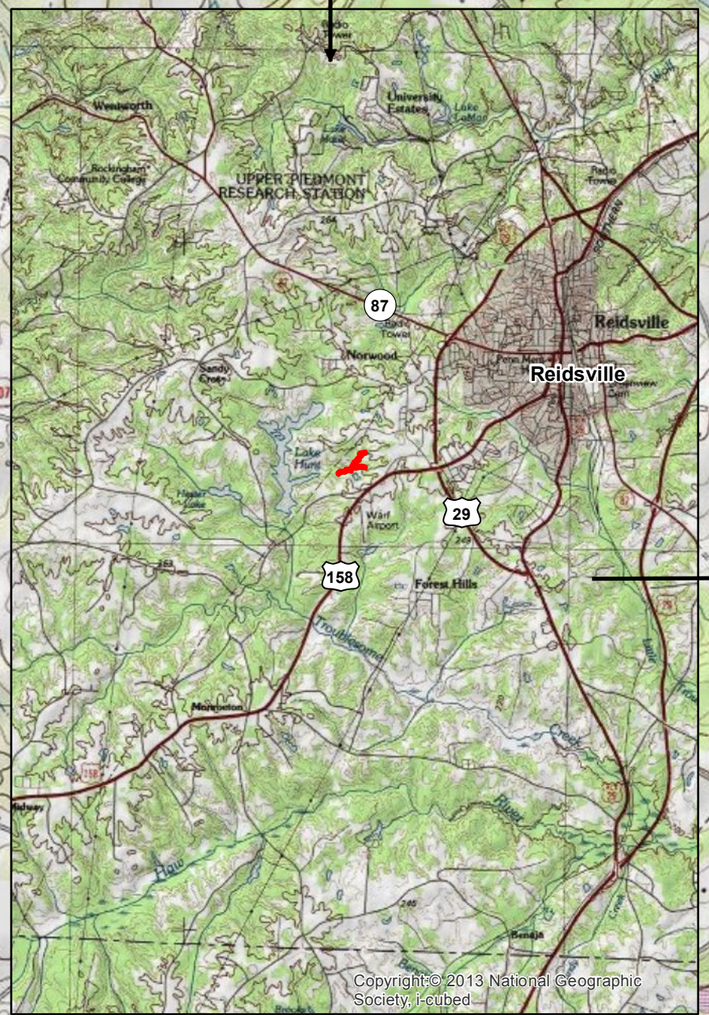
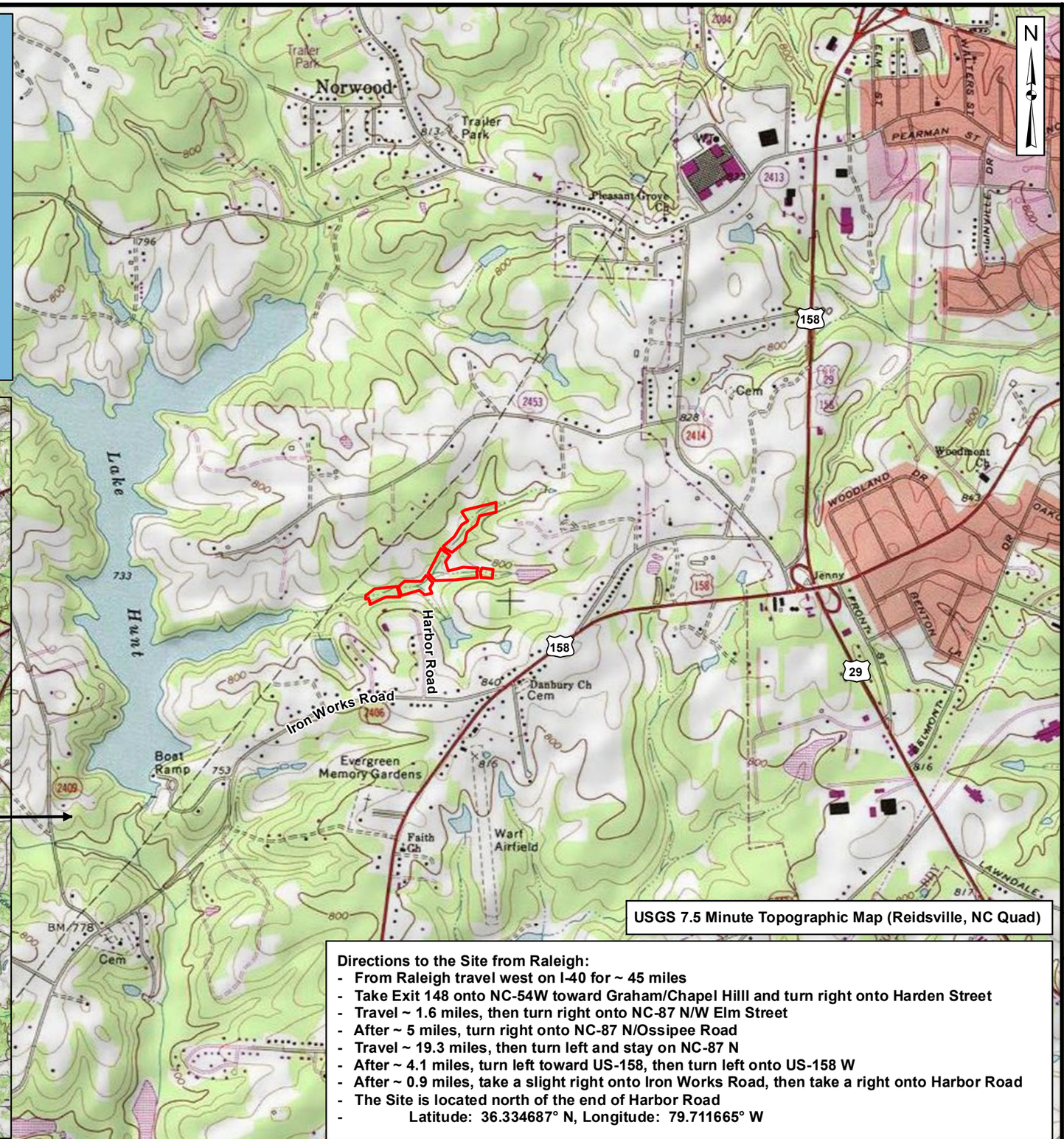
APPENDIX A
FIGURES

Figure 1. Site Location
Figure 2. Hydrologic Unit Map
Figures 3. Topography and Drainage Area
Figure 4. Existing Conditions and Soils
Figures 5A-5B. Restoration Plan
Figure 6. Proposed Dimension, Pattern, and Profile
Figures 7A-B. Typical Structure Details
Figures 8A-8B. Planting Plan
Figures 9A-9B. Monitoring Plan







USGS 7.5 Minute Topographic Map (Reidsville, NC Quad)

Directions to the Site from Raleigh:

- From Raleigh travel west on I-40 for ~ 45 miles
- Take Exit 148 onto NC-54W toward Graham/Chapel Hilll and turn right onto Harden Street
- Travel ~ 1.6 miles, then turn right onto NC-87 N/W Elm Street
- After ~ 5 miles, turn right onto NC-87 N/Ossipee Road
- Travel ~ 19.3 miles, then turn left and stay on NC-87 N
- After ~ 4.1 miles, turn left toward US-158, then turn left onto US-158 W
- After ~ 0.9 miles, take a slight right onto Iron Works Road, then take a right onto Harbor Road
- The Site is located north of the end of Harbor Road
- Latitude: 36.334687° N, Longitude: 79.711665° W

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

SITE LOCATION

Drawn by: KRJ

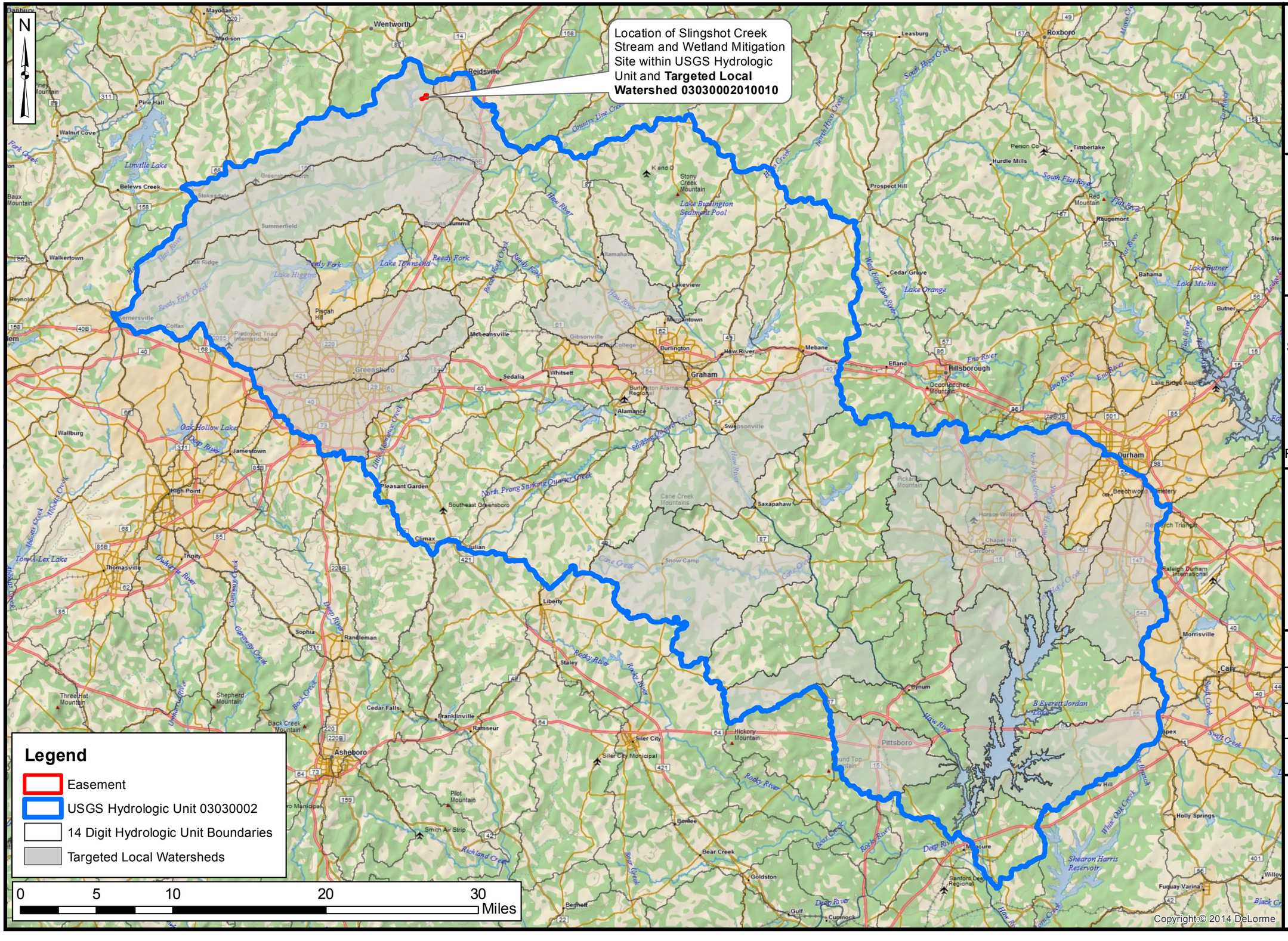
Date: DEC 2018

Scale: 1:20,000

Project No.: 18-013

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: KRJ

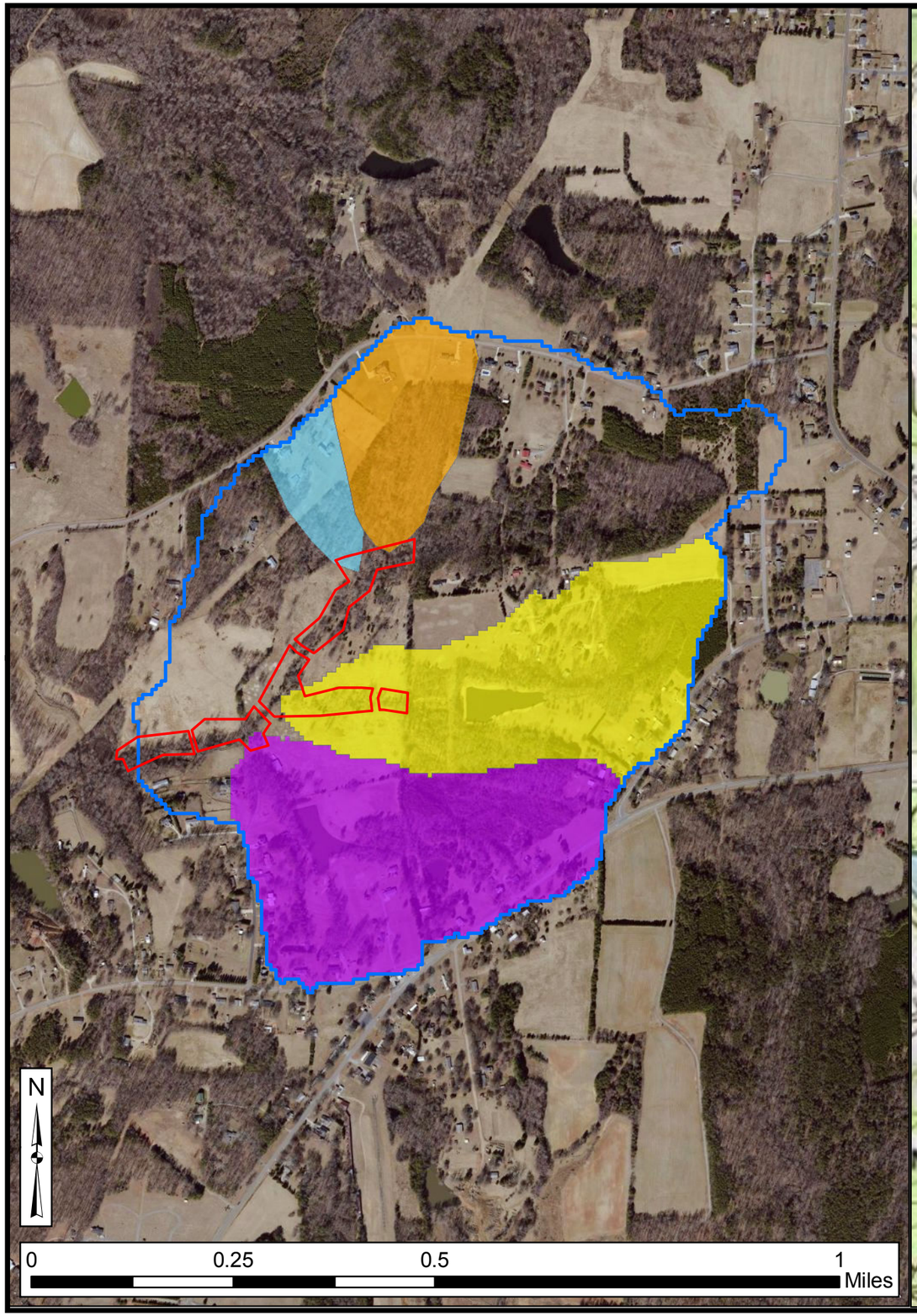
Date: DEC 2018

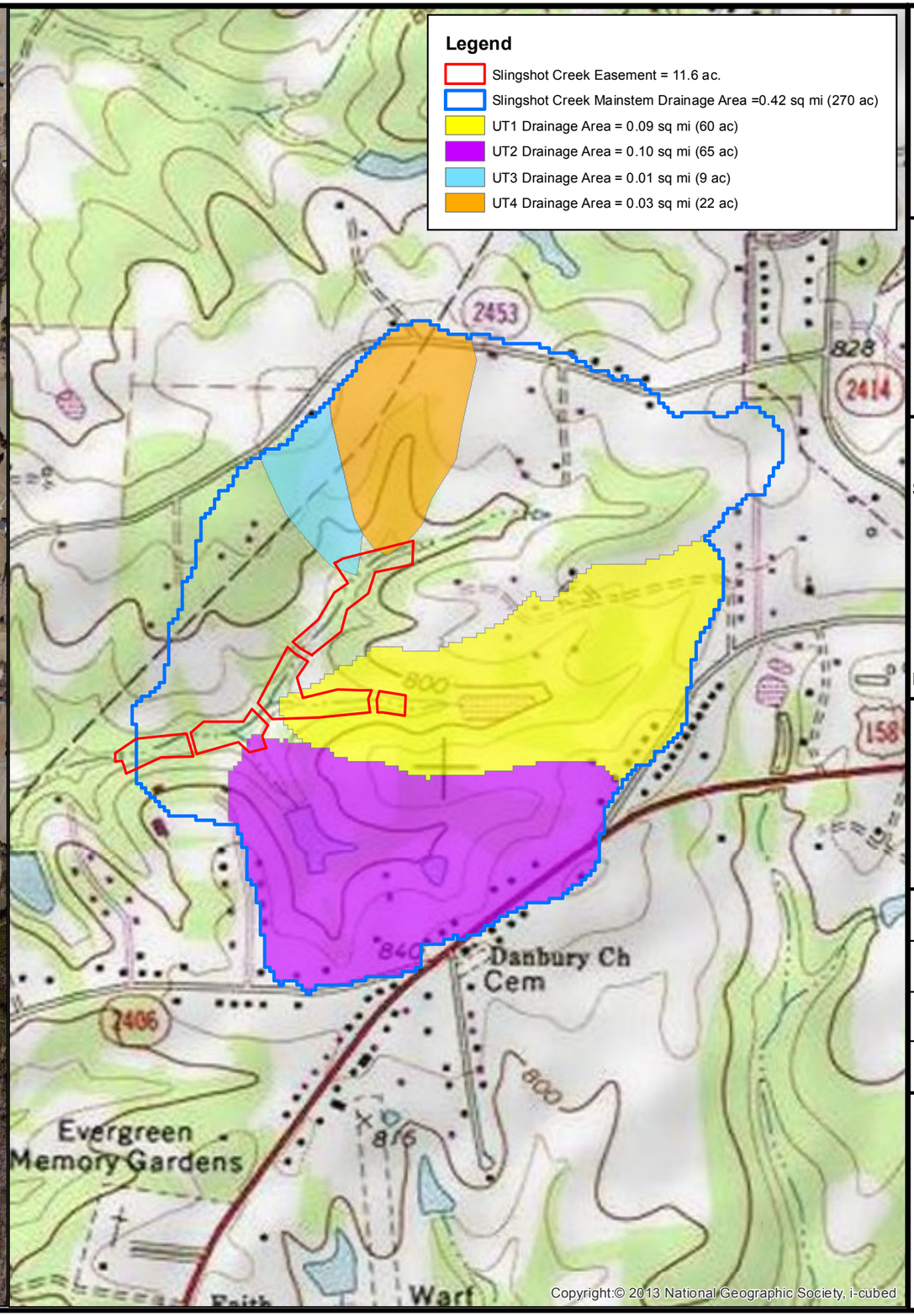
Scale: 1:375,000

Project No.: 18-013

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ

Date: DEC 2018

Scale: 1:10,000

Project No.: 18-013

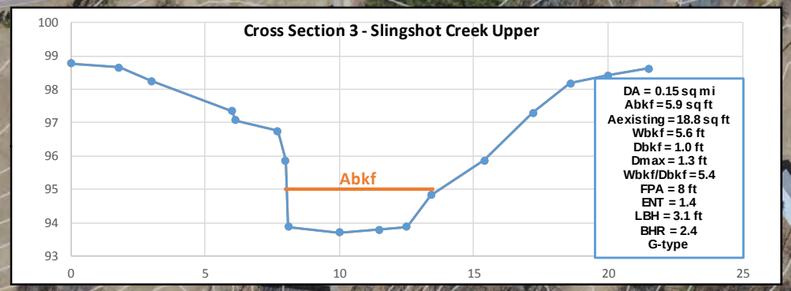
FIGURE

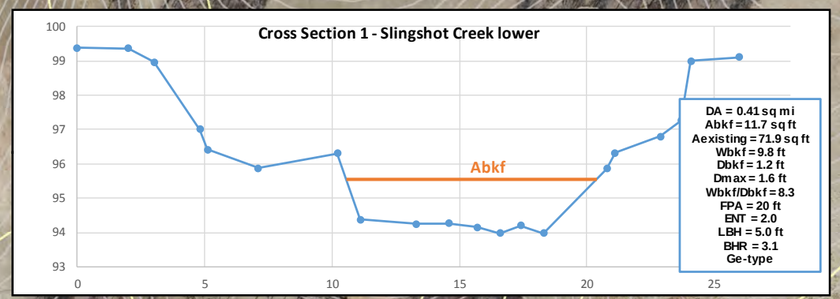
3

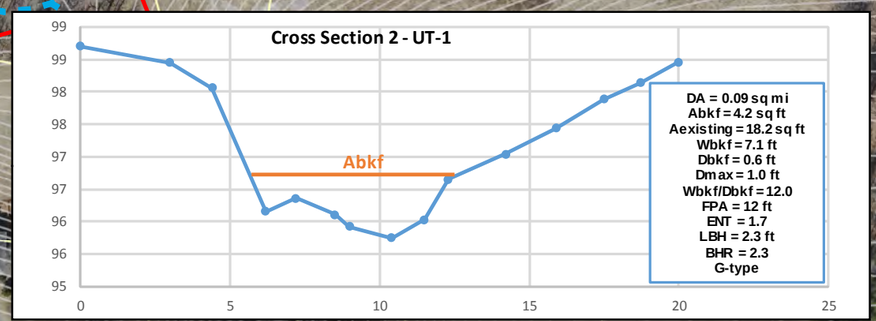
Legend

- Slingshot Creek Easement = 11.6 ac
- Existing Perennial Streams = 3913 ft
- Existing Intermittent Streams = 172 ft
- Existing Wetlands = 0.69 ac
- Existing Drained Hydric Soils = 1.02 ac
- Cross Sections
- Soil Profile
- NRCS Soil Boundaries
- 2-foot Topographic Contours

Soil Map Unit	Soil Series
CgB2	Clifford sandy clay loam, 2 to 8 % slopes
CsA	Codorus loam, 0 to 2 % slopes
DcB	Davie sandy loam, 2 to 8 % slopes
FrE2	Fairview-Poplar complex, 15 to 25 % slopes
NaB	Nathalie sandy loam, 2 to 8 % slopes
PpD2	Poplar Forest sandy clay loam, 8 to 15 % slopes







NCSAM Form 4 Score: Medium

NCSAM Form 3 Score: Low

NCSAM Form 2 Score: Low

NCWAM Form 1 Score: Medium

NCSAM Form 1 Score: Low

XS-1

XS-2

XS-3

UT-1

UT-2

UT-3

UT-4

Slingshot Creek

CgB2

DcB

PpD2

CsA

FrE2

NaB

0 250 500 1,000 Feet

N

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

Date: JUL 2019

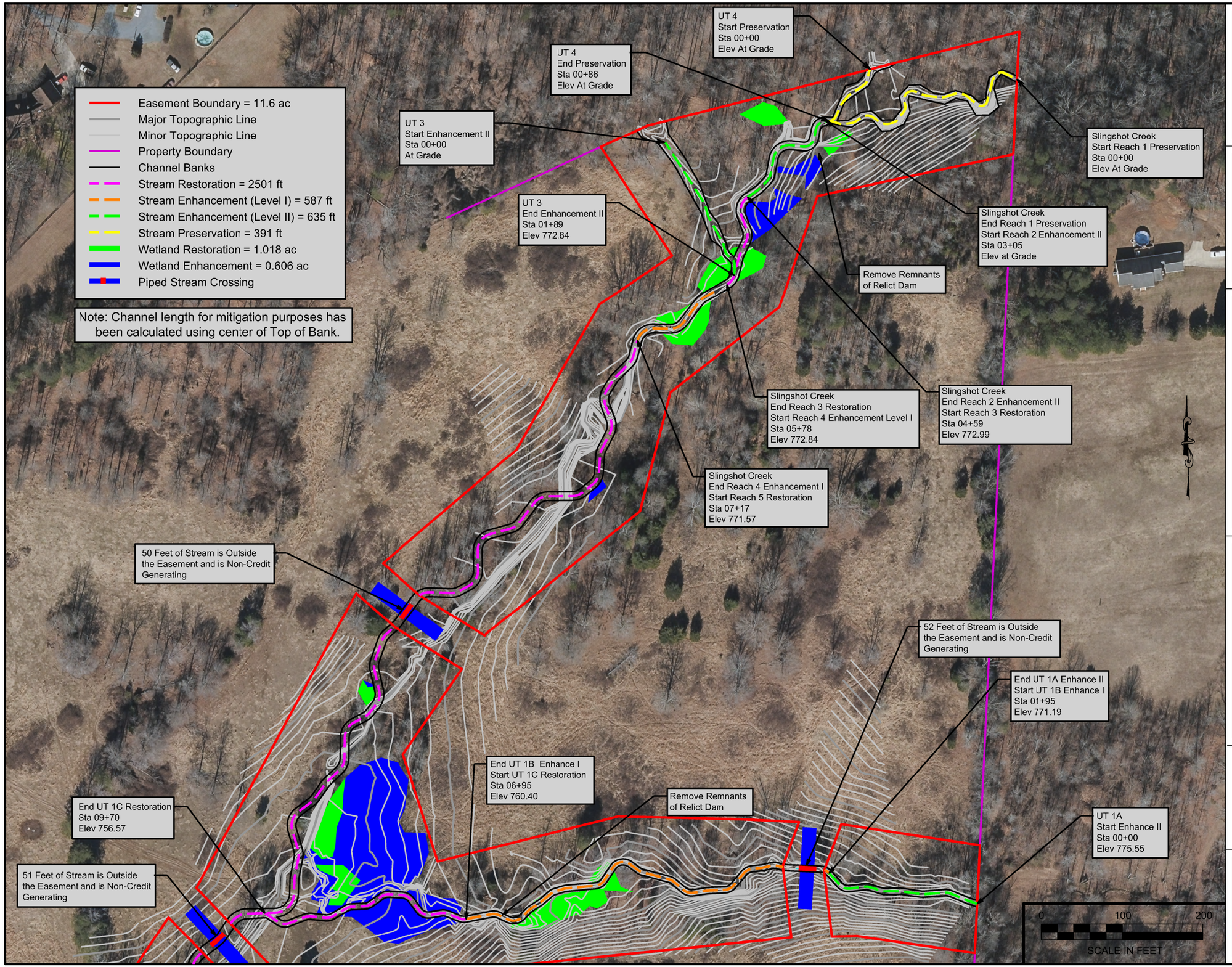
Scale: 1:2200

Project No.: 18-013

FIGURE

4

NCCGIA



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Slingshot
Mitigation Site

Rockingham County
North Carolina

Title:

Restoration Plan

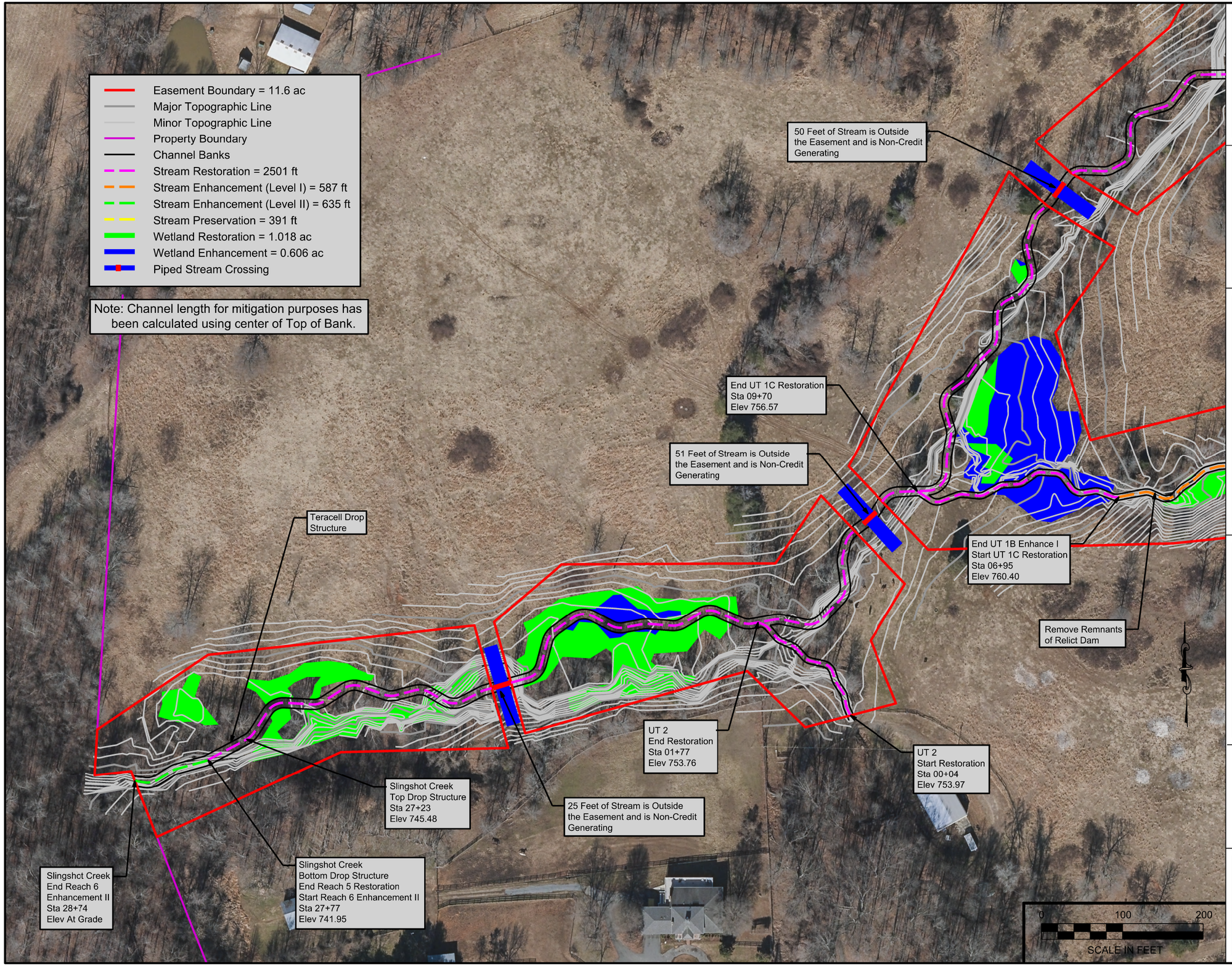
Scale: As Shown

Date: Oct 2018

Project No.: 18-013

FIGURE NO.

5A



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

Restoration Plan

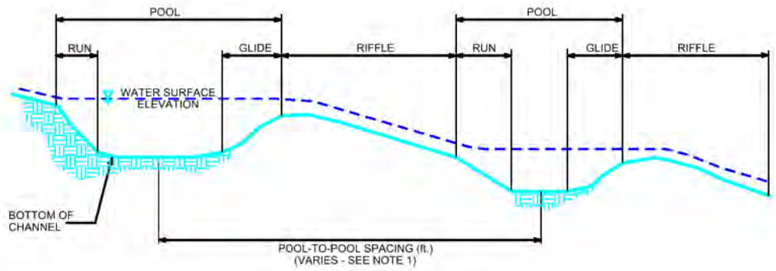
Scale: As Shown

Date: Oct 2018

Project No.: 18-013

FIGURE NO.

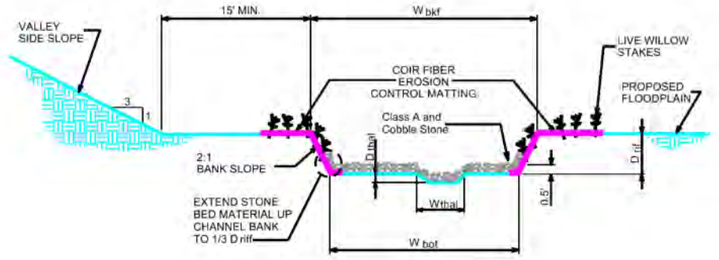
5B



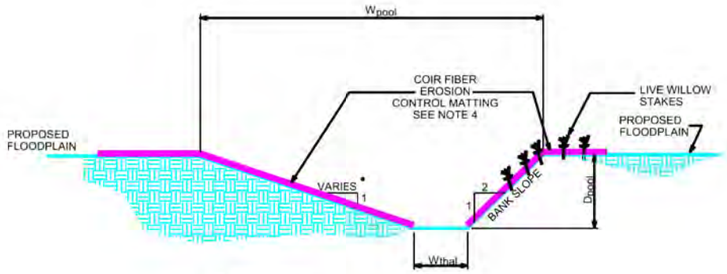
TYPICAL CHANNEL PROFILE

NOTES:

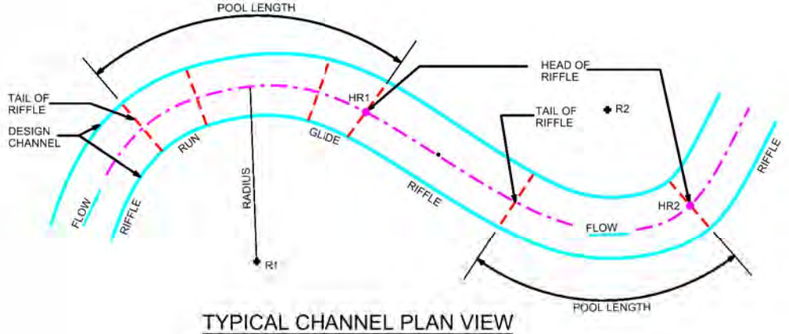
1. POOL-TO-POOL SPACING IS MEASURED FROM CENTER OF POOL BEND TO CENTER OF POOL BEND.



TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL CROSS-SECTION



TYPICAL CHANNEL PLAN VIEW

CHANNEL PLAN VIEW NOTES:

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BY LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS SHALL COMPLETE THE LAYOUT OF THE CHANNEL.

2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO SAVE TREES OR AVOID OBSTACLES. THE STAKE-OUT SHALL BE APPROVED BY THE CONSTRUCTION MANAGER BEFORE CONSTRUCTION OF THE CHANNEL.

CHANNEL CONSTRUCTION NOTES:

1. MATERIAL EXCAVATED FROM CHANNEL AND FLOODPLAIN SHALL BE USED TO BACKFILL EXISTING CHANNEL.

2. BANK PROTECTION SHALL CONSIST OF NATURAL COIR FIBER MATTING.

3. THE CONTRACTOR SHALL SUPPLY BED MATERIAL FOR THE ENTIRE BED LENGTH OF EACH RIFFLE SECTION. THE BED MATERIAL SHALL CONSIST OF A MIX OF CLASS A AND SMALLER STONE.

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
Slingshot Creek Upstream	10.8	6.4	1.0	0.1	1.5	11.9	2.9
Slingshot Creek Downstream	12.5	7.7	1.1	0.1	1.7	13.7	3.5
UT 1 and UT 2	7.6	4.4	0.7	0.1	1.0	8.3	2.3

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Oct 2018

Project No.: 18-013

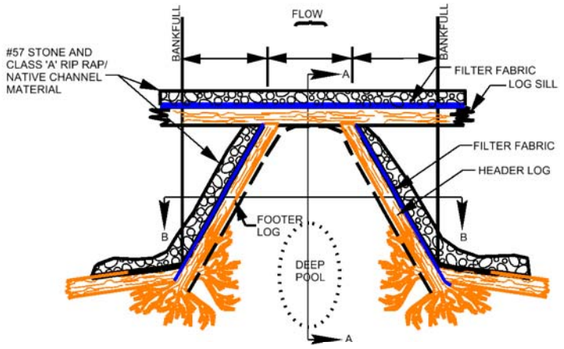
FIGURE NO.

6

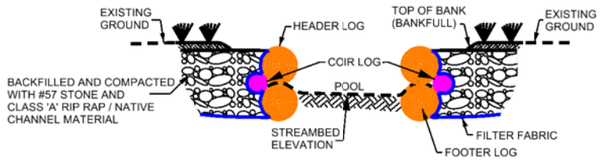
LOG CROSS VANE

SCALE:NTS

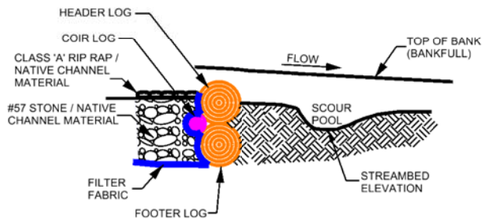
PLAN VIEW



NOTES:
1. HEADER AND FOOTER LOGS SHALL BE A MINIMUM OF 18" DIAMETER AND SHALL BE A HARDWOOD SPECIES. (FOOTER LOG MAY BE SUBSTITUTED WITH PINE)
2. A DOUBLE FOOTER LOG MAY BE REQUIRED IN SAND BED STREAMS.
3. ALL STONES ARE TO BE STRUCTURE STONES.
4. FILTER FABRIC SHALL BE PLACED ON THE UPSTREAM SIDE OF THE STRUCTURE TO PREVENT WASHOUT OF SEDIMENT THROUGH LOG GAPS. FILTER FABRIC SHALL EXTEND FROM THE BOTTOM OF THE FOOTER TO THE FINISHED GRADE ELEVATION AND SHALL BE PLACED THE ENTIRE LENGTH OF THE STRUCTURE.
5. PERPENDICULAR ROOTWAD LOGS ARE REQUIRED IF THE LOG VANE ARM DOES NOT HAVE A ROOTBALL TO TIE INTO THE BANK.



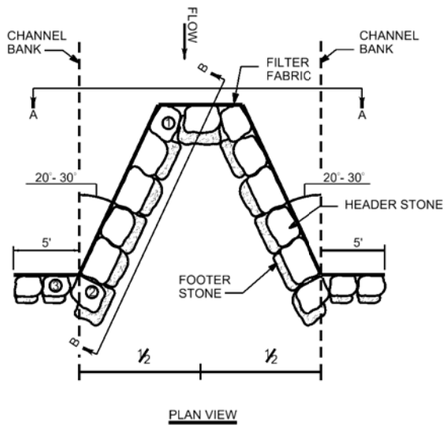
SECTION B-B



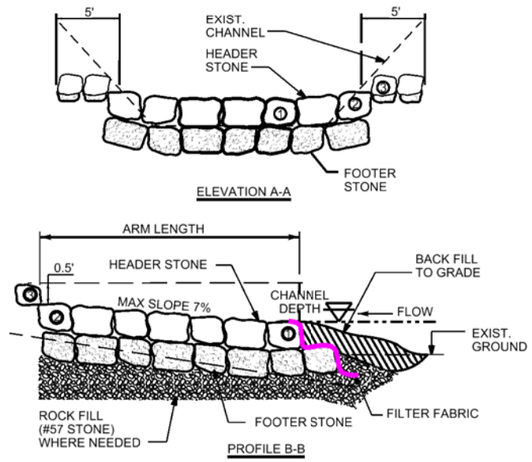
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 1 and 2	8	0.8
Slingshot Creek	12	1.2

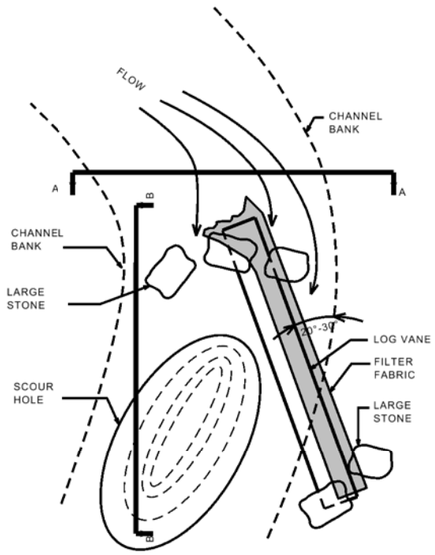
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW

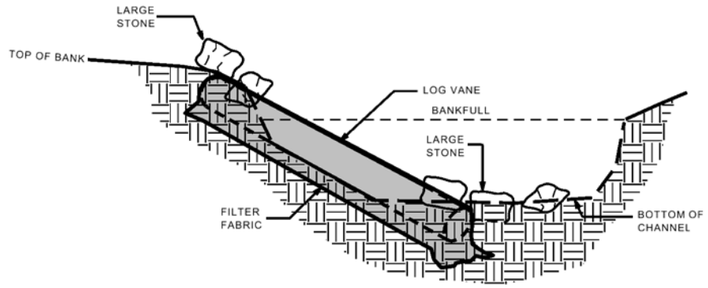


TYPICAL CROSS-VANE

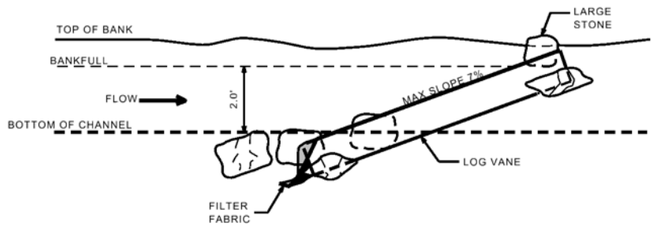


NOTE:
FILTER FABRIC TOED IN AND DRAPED ON UPSTREAM SIDE OF LOG VANE PRIOR TO BACKFILL.

PLAN VIEW
SCALE: N.T.S.



CROSS-SECTION A-A
SCALE: N.T.S.



PROFILE B-B
SCALE: N.T.S.

NOTE:
FILTER FABRIC TOED IN AND DRAPED ON UPSTREAM SIDE OF LOG VANE PRIOR TO BACKFILL.

TYPICAL LOG VANE

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NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

Scale: NO SCALE

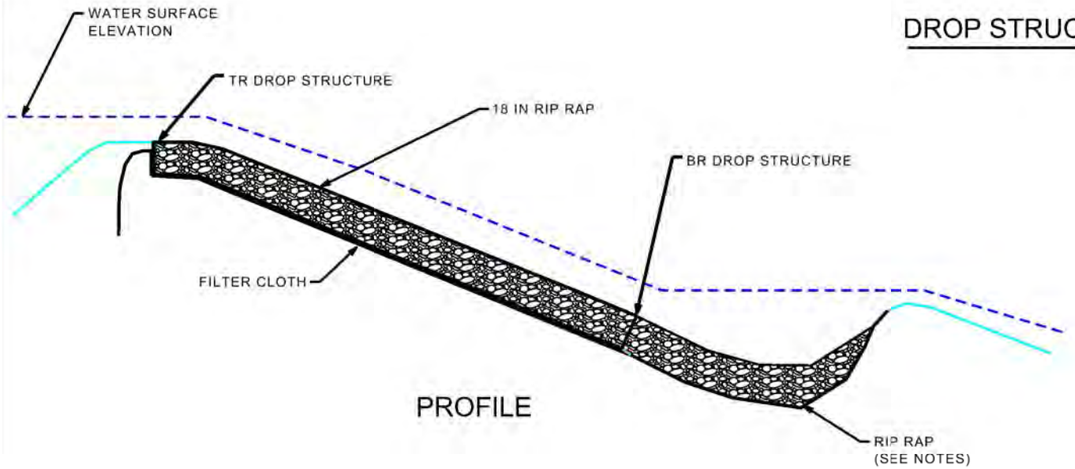
Date: Oct 2018

Project No.: 18-013

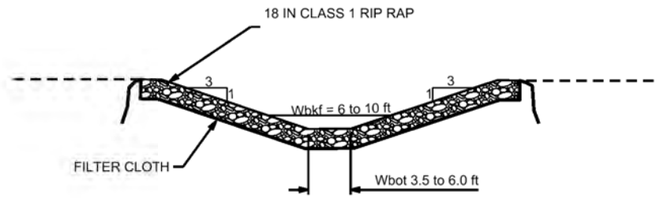
FIGURE NO.

7A

DROP STRUCTURE

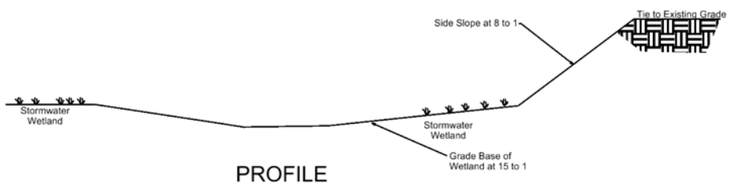


PROFILE

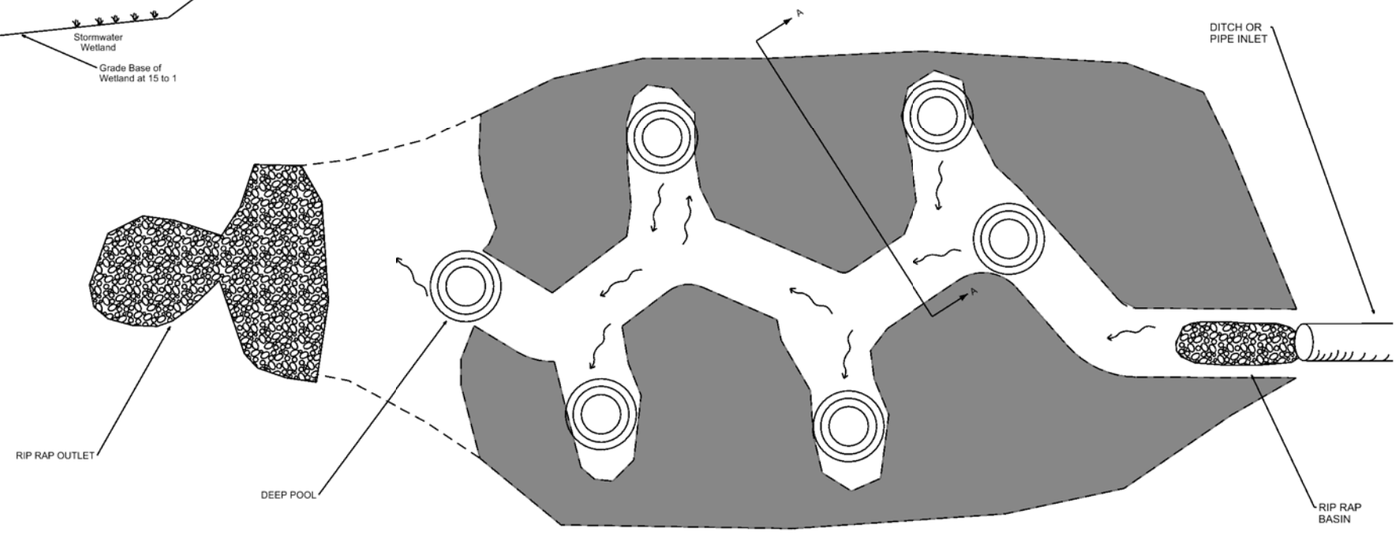


CROSS-SECTION

STRUCTURE NOTES:
1. CONTRACTOR WILL INSTALL EROSION CONTROL FABRIC AND 18-INCH DEPTH OF CLASS 1 RIP RAP OR OTHER SUITABLE MATTERIAL.



PROFILE
SECTION A-A



MARSH TREATMENT AREA

Axiom Environmental, Inc.

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NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

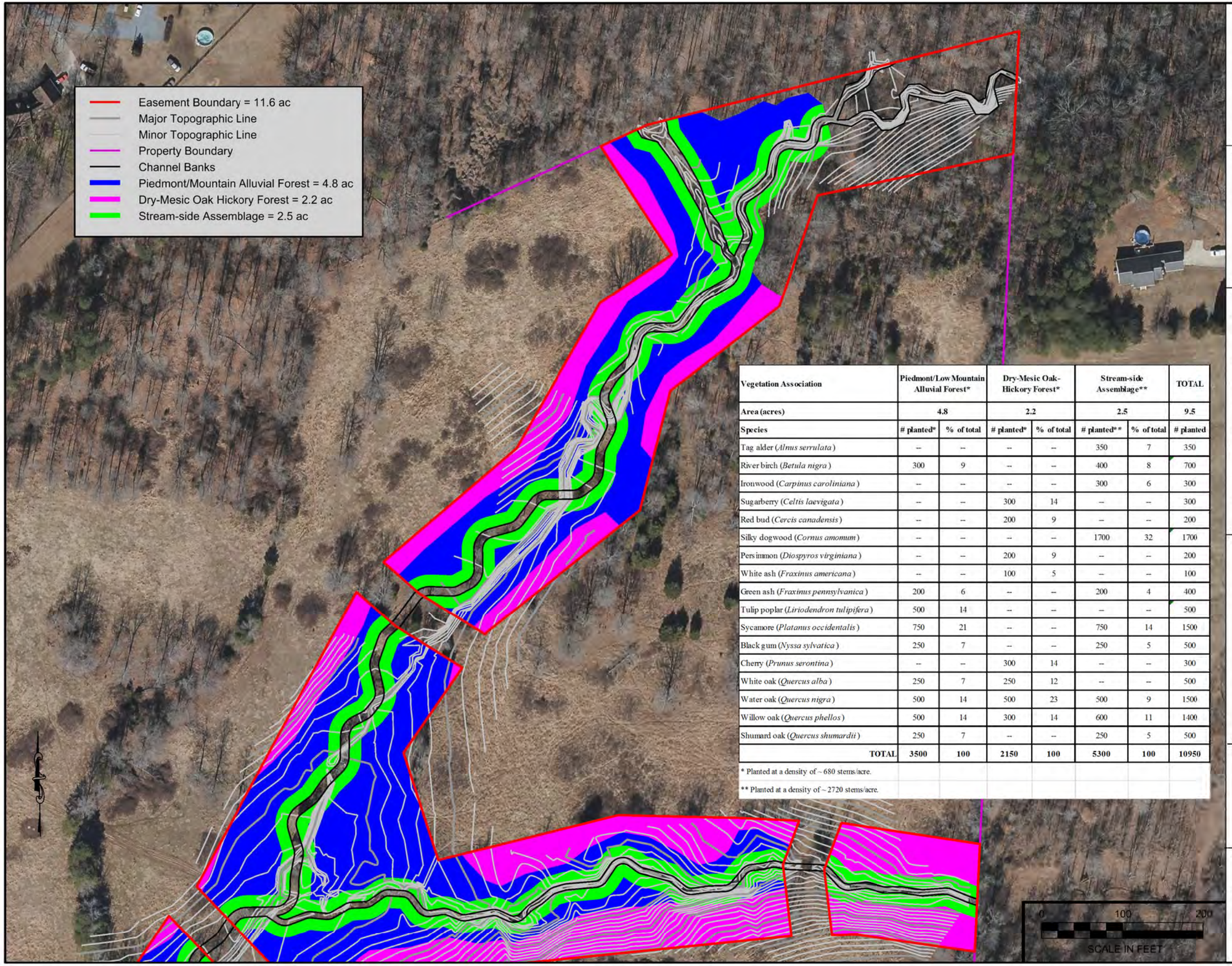
Scale: NO SCALE

Date: Oct 2018

Project No.: 18-013

FIGURE NO.

7B



Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	4.8		2.2		2.5		9.5
Species	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	--	--	--	--	350	7	350
River birch (*Betula nigra*)	300	9	--	--	400	8	700
Ironwood (*Carpinus caroliniana*)	--	--	--	--	300	6	300
Sugarberry (*Celtis laevigata*)	--	--	300	14	--	--	300
Red bud (*Cercis canadensis*)	--	--	200	9	--	--	200
Silky dogwood (*Cornus amomum*)	--	--	--	--	1700	32	1700
Persimmon (*Diospyros virginiana*)	--	--	200	9	--	--	200
White ash (*Fraxinus americana*)	--	--	100	5	--	--	100
Green ash (*Fraxinus pennsylvanica*)	200	6	--	--	200	4	400
Tulip poplar (*Liriodendron tulipifera*)	500	14	--	--	--	--	500
Sycamore (*Platanus occidentalis*)	750	21	--	--	750	14	1500
Black gum (*Nyssa sylvatica*)	250	7	--	--	250	5	500
Cherry (*Prunus serontina*)	--	--	300	14	--	--	300
White oak (*Quercus alba*)	250	7	250	12	--	--	500
Water oak (*Quercus nigra*)	500	14	500	23	500	9	1500
Willow oak (*Quercus phellos*)	500	14	300	14	600	11	1400
Shumard oak (*Quercus shumardii*)	250	7	--	--	250	5	500
TOTAL	3500	100	2150	100	5300	100	10950

* Planted at a density of ~ 680 stems/acre.

** Planted at a density of ~ 2720 stems/acre.

Axiom Environmental, Inc.

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NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

Planting Plan

Scale: As Shown

Date: Oct 2018

Project No.: 18-013

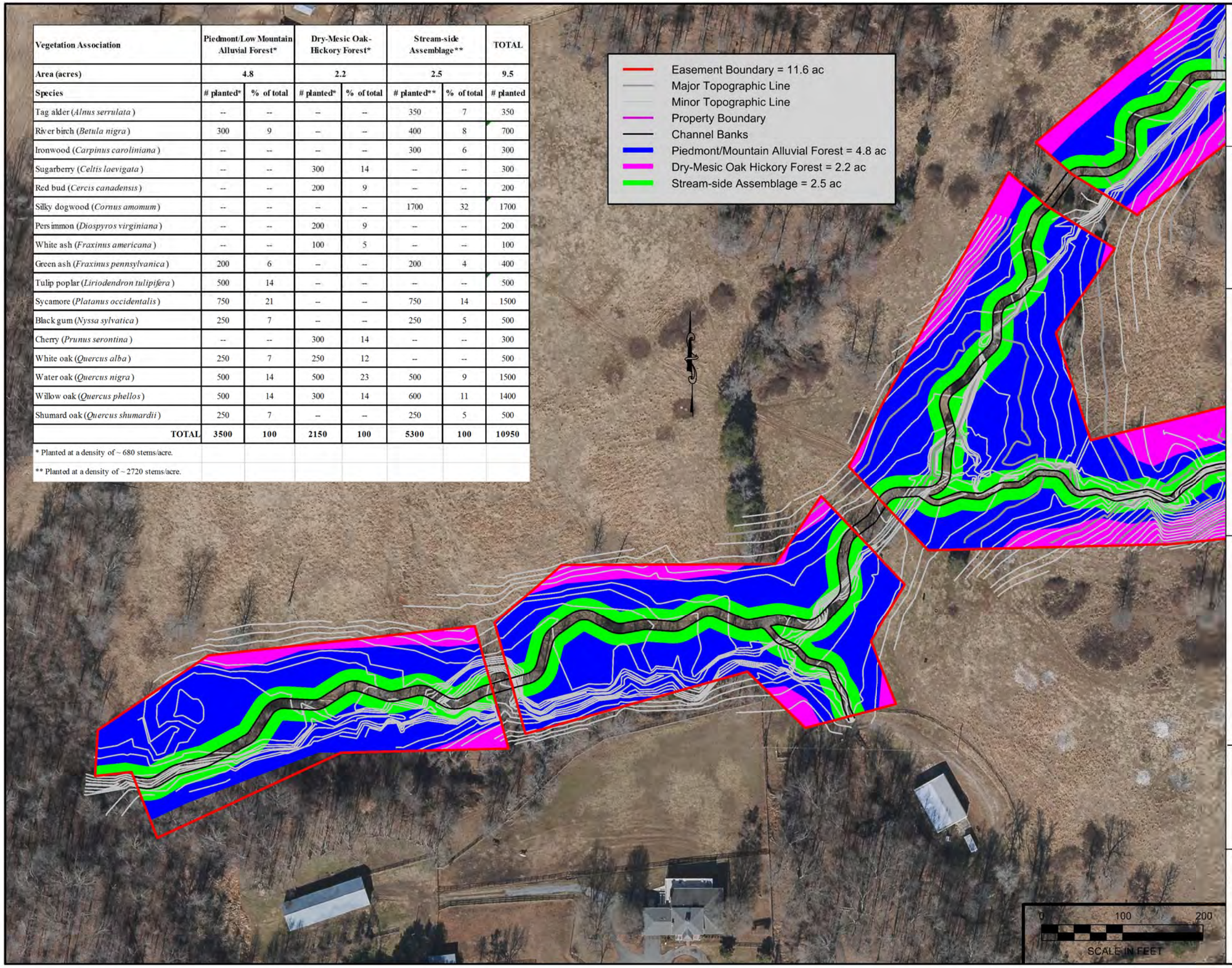
FIGURE NO.

8A

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	**4.8**		**2.2**		**2.5**		**9.5**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	--	--	350	7	350
River birch (*Betula nigra*)	300	9	--	--	400	8	700
Ironwood (*Carpinus caroliniana*)	--	--	--	--	300	6	300
Sugarberry (*Celtis laevigata*)	--	--	300	14	--	--	300
Red bud (*Cercis canadensis*)	--	--	200	9	--	--	200
Silky dogwood (*Cornus amomum*)	--	--	--	--	1700	32	1700
Persimmon (*Diospyros virginiana*)	--	--	200	9	--	--	200
White ash (*Fraxinus americana*)	--	--	100	5	--	--	100
Green ash (*Fraxinus pennsylvanica*)	200	6	--	--	200	4	400
Tulip poplar (*Liriodendron tulipifera*)	500	14	--	--	--	--	500
Sycamore (*Platanus occidentalis*)	750	21	--	--	750	14	1500
Black gum (*Nyssa sylvatica*)	250	7	--	--	250	5	500
Cherry (*Prunus serontina*)	--	--	300	14	--	--	300
White oak (*Quercus alba*)	250	7	250	12	--	--	500
Water oak (*Quercus nigra*)	500	14	500	23	500	9	1500
Willow oak (*Quercus phellos*)	500	14	300	14	600	11	1400
Shumard oak (*Quercus shumardii*)	250	7	--	--	250	5	500
TOTAL	**3500**	**100**	**2150**	**100**	**5300**	**100**	**10950**

* Planted at a density of ~ 680 stems/acre.

** Planted at a density of ~ 2720 stems/acre.



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NOTES/REVISIONS

Project:

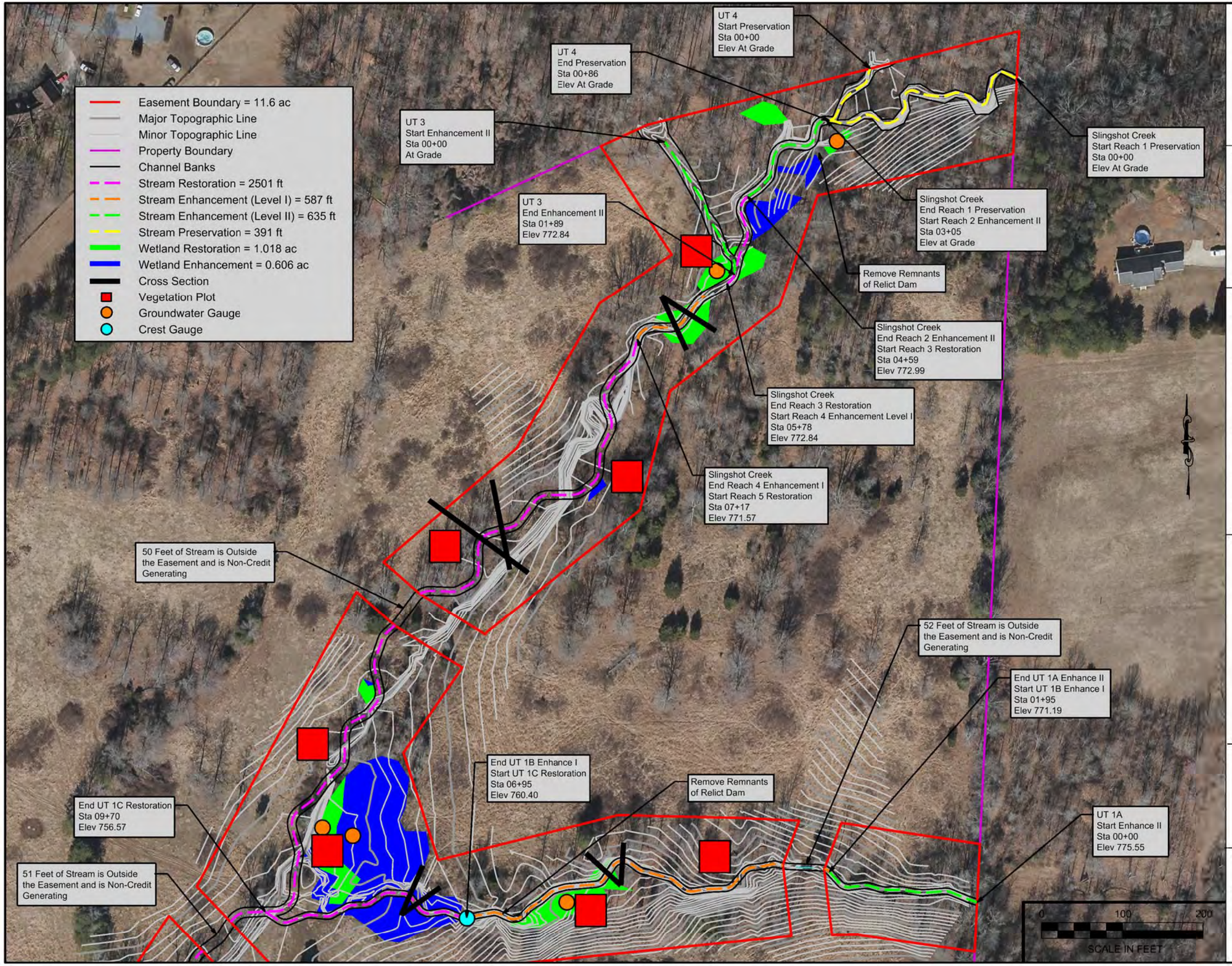
Slingshot
Mitigation Site

Rockingham County
North Carolina

Title:

Planting Plan

Scale:	FIGURE NO.
As Shown	8B
Date: Oct 2018	
Project No.: 18-013	



Axiom Environmental, Inc.

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NOTES/REVISIONS

Project:

Slingshot
Mitigation Site

Rockingham County
North Carolina

Title:

Monitoring Plan

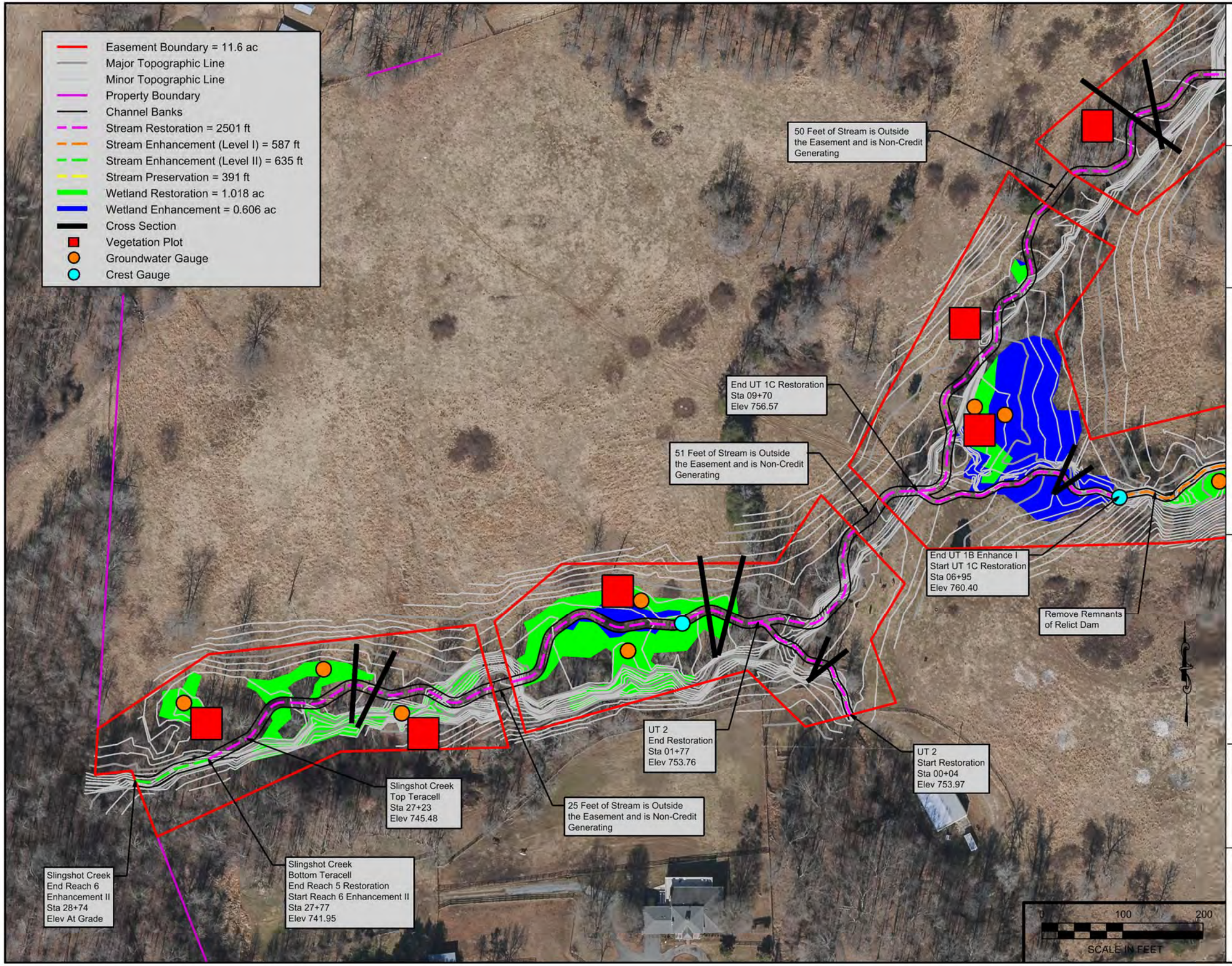
Scale:
As Shown

Date:
Oct 2018

Project No.:
18-013

FIGURE NO.

9A



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

Monitoring Plan

Scale: As Shown

Date: Oct 2018

Project No.: 18-013

FIGURE NO.

9B

Appendix B
Existing Stream Data

Table B1. Slingshot Morphological Stream Characteristics
Figure B1. Cross-section Locations
Existing Stream Cross-section Data
NC SAM Forms
NC WAM Forms
Sediment Data
NCDWQ Stream Forms

Table B1. Slingshot Morphological Stream Characteristics

Slingshot Mitigation Site

Variables	REFERENCE - FLINT ROCK FARM	REFERENCE - CASWELL GAME LAND	Existing UT 1	Existing UT 2	PROPOSED UT 1 and 2
Stream Type	E5	Cg 3/4	G 5	G 5	E/C 3/4
Drainage Area (mi^2)	0.43	0.65	0.09	0.10	0.10
Bankfull Discharge (cfs)	24.4	71.7	15.0	15.9	15.5
Dimension Variables					
Bankfull Cross-Sectional Area (A_{bkf})	6.1	17.6	4.0	4.3	4.1
Existing Cross-Sectional Area at TOB ($A_{existing}$)	6.1	17.6	5.8 - 34.1	19.2 - 40.7	4.1
Bankfull Width (W_{bkf})	Mean: 7.5 Range: 6.9 - 8.1	Mean: 18.4 Range: 14.6 - 21.9	Mean: 7.2 Range: 4.4 to 14.5	Mean: 7.7 Range: 6.2 to 8.4	Mean: 7.6 Range: 7.0 to 8.1
Bankfull Mean Depth (D_{bkf})	Mean: 0.8 Range: 0.7 - 0.9	Mean: 1.0 Range: 0.9 - 1.0	Mean: 0.6 Range: 0.3 to 0.9	Mean: 0.6 Range: 0.5 to 0.7	Mean: 0.5 Range: 0.5 to 0.6
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 1.4 - 1.4	Mean: 1.4 Range: 1.3 - 1.5	Mean: 1.1 Range: 0.6 to 1.4	Mean: 0.9 Range: 0.8 to 1.1	Mean: 0.8 Range: 0.6 to 0.8
Pool Width (W_{pool})	Mean: 7.7 Range: 6.7 - 8.6	Mean: 11.1 Range: 9.7 - 12.4	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 8.3 Range: 7.6 to 10.6
Maximum Pool Depth (D_{pool})	Mean: 2.0 Range: 1.6 - 2.3	Mean: 2.3 Range: 2.3 - 2.3			Mean: 1.0 Range: 0.7 to 1.1
Width of Floodprone Area (W_{fpa})	Mean: 100 Range: 100 - 100	Mean: 33.5 Range: 23.0 - 44.0	Mean: 12 Range: 9.0 to ####	Mean: 12 Range: 11.0 to 12.0	Mean: 50 Range: 30.0 to 90.0
Dimension Ratios					
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 13.4 Range: 12.3 - 14.5	Mean: 1.8 Range: 1.5 - 2.0	Mean: 2.0 Range: 1.4 to 13.7	Mean: 1.6 Range: 1.4 to 1.8	Mean: 6.6 Range: 4.0 to 11.9
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 9.6 Range: 7.7 - 11.6	Mean: 19.6 Range: 14.9 - 24.3	Mean: 12.0 Range: 4.9 to 48.3	Mean: 12.8 Range: 8.9 to 16.8	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf}/ D_{bkf} Ratio	Mean: 1.8 Range: 1.6 - 2.0	Mean: 1.5 Range: 1.3 - 1.7	Mean: 1.8 Range: 1.3 to 2.4	Mean: 1.6 Range: 1.3 to 1.8	Mean: 1.4 Range: 1.2 to 1.5
Low Bank Height / Max. D_{bkf} Ratio	Mean: 1.0 Range: 1.0 - 1.0	Mean: 1.8 Range: 1.4 - 2.2	Mean: 2.4 Range: 1.2 to 3.7	Mean: 2.8 Range: 2.5 to 3.9	Mean: 1.0 Range: 1.0 to 1.2
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	Mean: 2.5 Range: 1.8 - 3.3	Mean: 2.4 Range: 2.3 - 2.6	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1
Pool Width / Bankfull Width (W_{pool}/W_{bkf})	Mean: 1.0 Range: 0.8 - 1.2	Mean: 0.6 Range: 0.6 - 0.7			Mean: 1.1 Range: 1.0 to 1.4
Pool Area / Bankfull Cross Sectional Area	Mean: 1.5 Range: 1.0 - 1.6	Mean: 1.2 Range: 1.1 - 1.3			Mean: 1.4 Range: 1.1 to 1.6

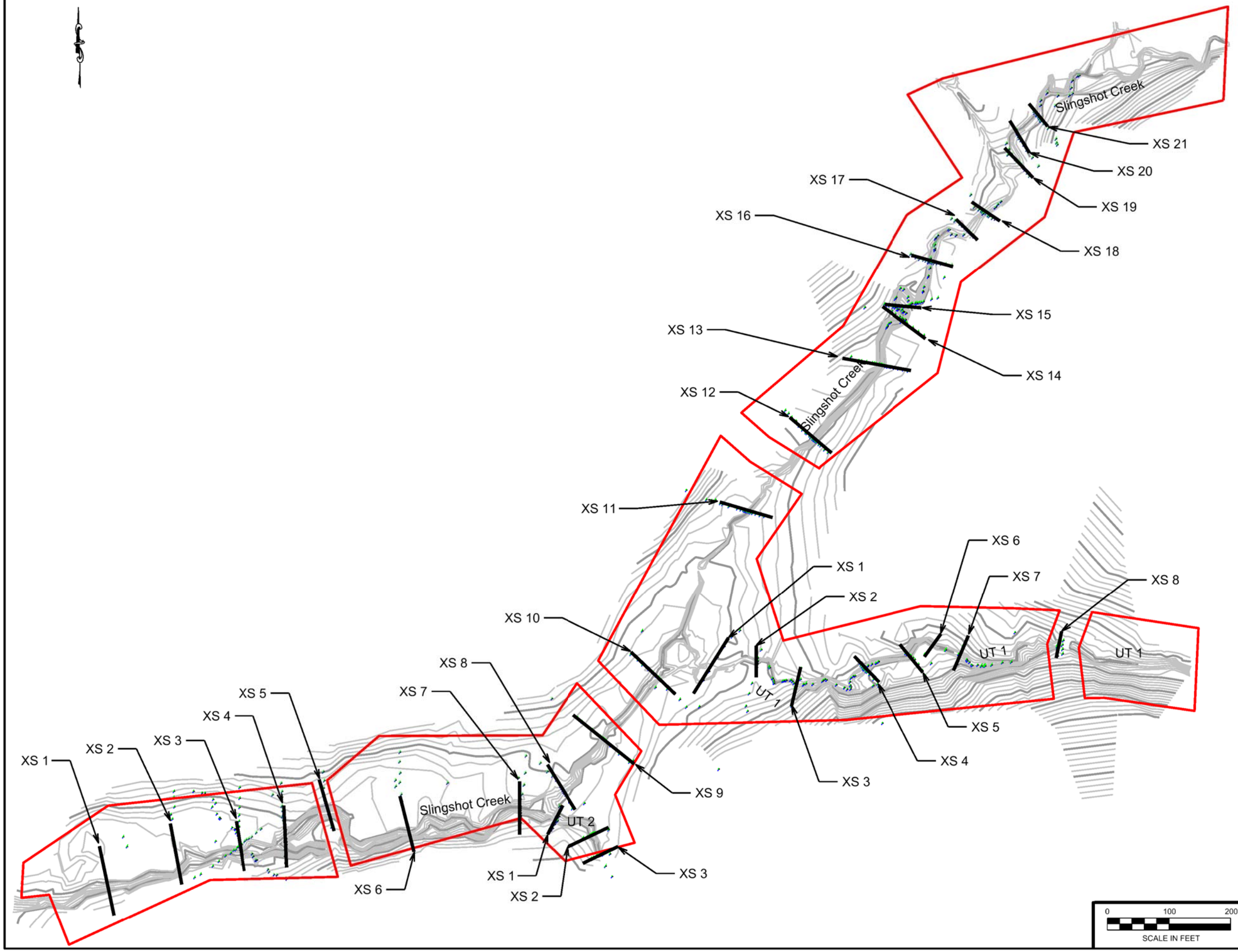
Variables	REFERENCE - FLINT ROCK FARM	REFERENCE - CASWELL GAME LAND	Existing UT 1	Existing UT 2	PROPOSED UT 1 and 2
Pattern Variables					
Pool to Pool Spacing (L_{p-p})	Med: 17.8 Range: 8.9 - 32.7	Med: 58.2 Range: 31.6 - 101.8	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 30.3 Range: 22.7 to 60.6
Meander Length (L_m)	Med: 29.4 Range: 13.4 - 47.2	Med: 104.6 Range: 61 - 154.7			Med: 64.4 Range: 45.5 to 90.9
Belt Width (W_{belt})	Med: 14.3 Range: 7.9 - 24.9	Med: 28.6 Range: 15 - 42.2			Med: 22.7 Range: 15.2 to 30.3
Radius of Curvature (R_c)	Med: 8.4 Range: 5.2 - 12.8	Med: 31.1 Range: 18.6 - 46.3			Med: 22.7 Range: 15.2 to 75.8
Sinuosity (Sin)	1.22	1.14	1.18	1.17	1.20
Pattern Ratios					
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	Med: 2.4 Range: 1.6 - 4.0	Med: 3.2 Range: 2.1 - 4.6	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0
Meander Length/ Bankfull Width (L_m/W_{bkf})	Med: 3.9 Range: 1.9 - 5.8	Med: 5.7 Range: 4.1 - 7.1			Med: 8.5 Range: 6.0 to 12.0
Meander Width Ratio (W_{belt}/W_{bkf})	Med: 1.9 Range: 1.1 - 4.1	Med: 1.6 Range: 1 - 1.9			Med: 3.0 Range: 2.0 to 4.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})	Med: 1.1 Range: 0.8 - 2.1	Med: 1.7 Range: 1.2 - 2.1			Med: 3.0 Range: 2.0 to 10.0
Profile Variables					
Average Water Surface Slope (S_{ave})	0.0049	0.0100	0.0267	0.0186	0.0263
Valley Slope (S_{valley})	0.0060	0.0114	0.0315	0.0218	0.0315
Riffle Slope (S_{riffle})	Mean: 0.0053 Range: 0 - 0.0193	Mean: 0.0153 Range: 0 - 0.036	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0394 Range: 0.0315 to 0.0525
Pool Slope (S_{pool})	Mean: 0.0013 Range: 0 - 0.0107	Mean: 0.0000 Range: 0 - 0.0037			Mean: 0.0026 Range: 0.0000 to 0.0184
Run Slope (S_{run})	Mean: 0.0064 Range: 0 - 0.0156	Mean: 0.002 Range: 0 - 0.53			Mean: 0.0105 Range: 0.0000 to 0.0210
Glide Slope (S_{glide})	Mean: 0.0049 Range: 0 - 0.0089	Mean: 0.0030 Range: 0 - 0.0112			Mean: 0.0029 Range: 0.0000 to 0.0210
Profile Ratios					
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	Mean: 1.1 Range: 0 - 3.94	Mean: 3.1 Range: 0 - 7.35	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.5 Range: 1.2 to 2.0
Pool Slope/Water Surface Slope (S_{pool}/S_{ave})	Mean: 0.3 Range: 0 - 2.18	Mean: 0.0 Range: 0 - 0.76			Mean: 0.10 Range: 0.0 to 0.7
Run Slope/Water Surface Slope (S_{run}/S_{ave})	Mean: 1.31 Range: 0 - 3.18	Mean: 0.41 Range: 0 - 10.82			Mean: 0.40 Range: 0.0 to 0.8
Glide Slope/Water Surface Slope (S_{glide}/S_{ave})	Mean: 1.00 Range: 0 - 1.82	Mean: 0.61 Range: 0 - 2.3			Mean: 0.11 Range: 0.0 to 0.8

Table B1. Slingshot Morphological Stream Characteristics

Slingshot Mitigation Site

Variables	Existing Slingshot Cr Upstream	PROPOSED Slingshot Cr Upstream	Existing Slingshot Cr Downstream	PROPOSED Slingshot Cr Downstream
Stream Type	G 4/5	E/C 3/4	G 4/5	E/C 3/4
Drainage Area (mi^2)	0.28	0.28	0.42	0.42
Bankfull Discharge (cfs)	32.7	32.7	44.4	44.4
Dimension Variables				
Bankfull Cross-Sectional Area (A_{bkf})	8.3	8.3	11.1	11.1
Existing Cross-Sectional Area at TOB ($A_{existing}$)	12.1 - 59.7	8.3	16.2 - 104.6	11.1
Bankfull Width (W_{bkf})	Mean: 8.8 6.0 to 14.6	Mean: 10.8 Range: 10.0 to 11.5	Mean: 11.7 8.7 to 15.8	Mean: 12.5 Range: 11.5 to 13.3
Bankfull Mean Depth (D_{bkf})	Mean: 0.9 Range: 0.6 to 1.4	Mean: 0.8 Range: 0.7 to 0.8	Mean: 1.0 Range: 0.7 to 1.3	Mean: 0.9 Range: 0.8 to 1.0
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 0.7 to 1.9	Mean: 1.1 Range: 0.9 to 1.2	Mean: 1.6 Range: 1.1 to 1.9	Mean: 1.2 Range: 1.1 to 1.3
Pool Width (W_{pool})	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 11.9 Range: 10.8 to 15.1	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 13.7 Range: 12.5 to 17.5
Maximum Pool Depth (D_{pool})		Mean: 1.5 Range: 1.0 to 1.6		Mean: 1.7 Range: 1.2 to 1.9
Width of Floodprone Area (W_{fpa})	Mean: 16 Range: 12.0 to 100.0	Mean: 50 Range: 30.0 to 70.0	Mean: 20 Range: 12.0 to 100.0	Mean: 100 Range: 70.0 to 150.0
Dimension Ratios				
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 1.5 Range: 1.2 to 11.4	Mean: 4.6 Range: 2.8 to 6.5	Mean: 1.6 Range: 1.1 to 10.5	Mean: 8.0 Range: 5.6 to 12.0
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 9.8 Range: 4.3 to 24.3	Mean: 14.0 Range: 12.0 to 16.0	Mean: 12.4 Range: 6.7 to 22.6	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.5 Range: 1.2 to 1.7	Mean: 1.4 Range: 1.2 to 1.5	Mean: 1.6 Range: 1.2 to 2.3	Mean: 1.4 Range: 1.2 to 1.5
Low Bank Height / Max. D_{bkf} Ratio	Mean: 2.2 Range: 1.4 to 3.6	Mean: 1.0 Range: 1.0 to 1.2	Mean: 3.0 Range: 1.3 to 4.5	Mean: 1.0 Range: 1.0 to 1.2
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1
Pool Width / Bankfull Width (W_{pool}/W_{bkf})		Mean: 1.1 Range: 1.0 to 1.4		Mean: 1.1 Range: 1.0 to 1.4
Pool Area / Bankfull Cross Sectional Area		Mean: 1.4 Range: 1.1 to 1.6		Mean: 1.4 Range: 1.1 to 1.6

Variables	Existing Main Upstream	PROPOSED Main Upstream	Existing Main Downstream	PROPOSED Main Downstream
Pattern Variables				
Pool to Pool Spacing (L_{p-p})	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 43.1 Range: 32.3 to 86.2	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 49.9 Range: 37.4 to 99.7
Meander Length (L_m)		Med: 91.6 Range: 64.7 to 129.4		Med: 106.0 Range: 74.8 to 149.6
Belt Width (W_{belt})		Med: 32.3 Range: 21.6 to 43.1		Med: 37.4 Range: 24.9 to 49.9
Radius of Curvature (R_c)		Med: 32.3 Range: 21.6 to 107.8		Med: 37.4 Range: 24.9 to 124.7
Sinuosity (Sin)	1.18	1.15	1.14	1.15
Pattern Ratios				
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0
Meander Length/ Bankfull Width (L_m/W_{bkf})		Med: 8.5 Range: 6.0 to 12.0		Med: 8.5 Range: 6.0 to 12.0
Meander Width Ratio (W_{belt}/W_{bkf})		Med: 3.0 Range: 2.0 to 4.0		Med: 3.0 Range: 2.0 to 4.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})		Med: 3.0 Range: 2.0 to 10.0		Med: 3.0 Range: 2.0 to 10.0
Profile Variables				
Average Water Surface Slope (S_{ave})	0.0149	0.0153	0.0171	0.0170
Valley Slope (S_{valley})	0.0176	0.0176	0.0195	0.0195
Riffle Slope (S_{riffle})	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0230 Range: 0.0184 to 0.0306	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0254 Range: 0.0203 to 0.0339
Pool Slope (S_{pool})		Mean: 0.0015 Range: 0.0000 to 0.0107		Mean: 0.0017 Range: 0.0000 to 0.0119
Run Slope (S_{run})		Mean: 0.0061 Range: 0.0000 to 0.0122		Mean: 0.0068 Range: 0.0000 to 0.0136
Glide Slope (S_{glide})		Mean: 0.0017 Range: 0.0000 to 0.0122		Mean: 0.0019 Range: 0.0000 to 0.0136
0.0118 (0.0089 - 0.0111)				
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.5 Range: 1.2 to 2.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.5 Range: 1.2 to 2.0
Pool Slope/Water Surface Slope (S_{pool}/S_{ave})		Mean: 0.10 Range: 0.0 to 0.7		Mean: 0.10 Range: 0.0 to 0.7
Run Slope/Water Surface Slope (S_{run}/S_{ave})		Mean: 0.40 Range: 0.0 to 0.8		Mean: 0.40 Range: 0.0 to 0.8
Glide Slope/Water Surface Slope (S_{glide}/S_{ave})		Mean: 0.11 Range: 0.0 to 0.8		Mean: 0.11 Range: 0.0 to 0.8



Axiom Environmental, Inc.

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NOTES/REVISIONS

Project:

Slingshot Mitigation Site

Rockingham County North Carolina

Title:

Cross Section Locations

Scale: As Shown

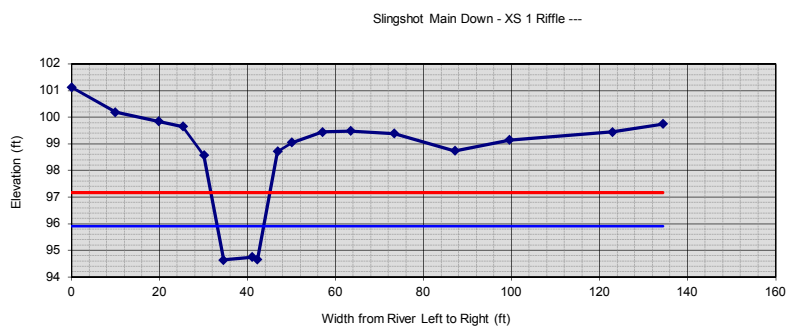
Date: Oct 2018

Project No.: 18-013

FIGURE NO.

B1

Cross Section



section: **Slingshot Main Down - XS 1**

Riffle

---

description: **Slingshot Main Down - XS 1**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-1.118239	101.1182
	☐	9.841732	-0.196768	100.1968
	☐	19.80654	0.156653	99.84335
	☐	25.26888	0.348295	99.65171
	☐	30.09017	1.431874	98.56813
	☐	34.48666	5.360869	94.63913
	☐	41.069	5.256818	94.74318
	☐	42.20173	5.334281	94.66572
	☐	46.82965	1.288958	98.71104
	☐	50.04862	0.946247	99.05375
	☐	57.07192	0.555092	99.44491
	☐	63.46422	0.514526	99.48547
	☐	73.334	0.610987	99.38901
	☐	87.09043	1.260658	98.73934
	☐	99.50213	0.858073	99.14193
	☐	122.9315	0.557035	99.44297
	☐	134.3797	0.249748	99.75025
	☐			
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	☐			

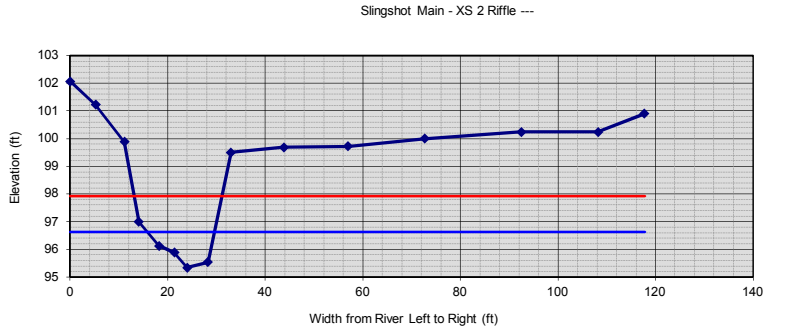
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
4.1	1.431874	12.0		
95.9	98.56813			

dimensions			
11.1	x-section area	1.1	d mean
10.5	width	11.5	wet P
1.3	d max	1.0	hyd radi
3.9	bank ht	10.0	w/d ratio
12.0	W flood prone area	1.1	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main - XS 2**

Riffle

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description: **Slingshot Main Down - XS 2**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.065403	102.0654
	☐	5.220875	-1.219297	101.2193
	☐	11.13574	0.117826	99.88217
	☐	14.07695	3.011959	96.98804
	☐	18.17888	3.879018	96.12098
	☐	21.35777	4.115188	95.88481
	☐	24.00866	4.658003	95.342
	☐	28.23949	4.467299	95.5327
	☐	32.96669	0.504857	99.49514
	☐	43.83265	0.320091	99.67991
	☐	56.94012	0.280702	99.7193
	☐	72.62156	0.003113	99.99689
	☐	92.46336	-0.243293	100.2433
	☐	108.2197	-0.243301	100.2433
	☐	117.7335	-0.896265	100.8963
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	☐			

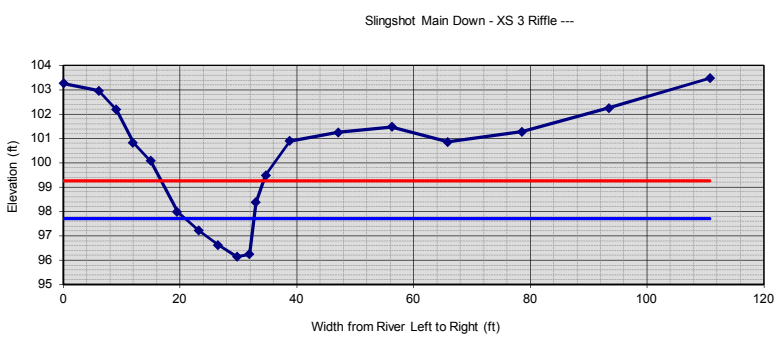
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.37	0.504857	20.0		
96.63	99.49514			

dimensions			
11.1	x-section area	0.8	d mean
13.8	width	14.3	wet P
1.3	d max	0.8	hyd radi
4.2	bank ht	17.2	w/d ratio
20.0	W flood prone area	1.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Down - XS 3**

Riffle

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description: **Slingshot Main Down - XS 3**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.270639	103.2706
	☐	6.051127	-2.962428	102.9624
	☐	9.037803	-2.204201	102.2042
	☐	11.94222	-0.830862	100.8309
	☐	14.91629	-0.088073	100.0881
	☐	19.48059	2.002278	97.99772
	☐	23.23445	2.786299	97.2137
	☐	26.51586	3.371098	96.6289
	☐	29.76652	3.852532	96.14747
	☐	31.87765	3.757847	96.24215
	☐	32.95928	1.628204	98.3718
	☐	34.6672	0.503372	99.49663
	☐	38.79301	-0.899698	100.8997
	☐	47.1203	-1.259578	101.2596
	☐	56.29231	-1.474403	101.4744
	☐	65.88281	-0.852308	100.8523
	☐	78.59893	-1.285711	101.2857
	☐	93.46087	-2.248781	102.2488
	☐	110.7982	-3.484903	103.4849
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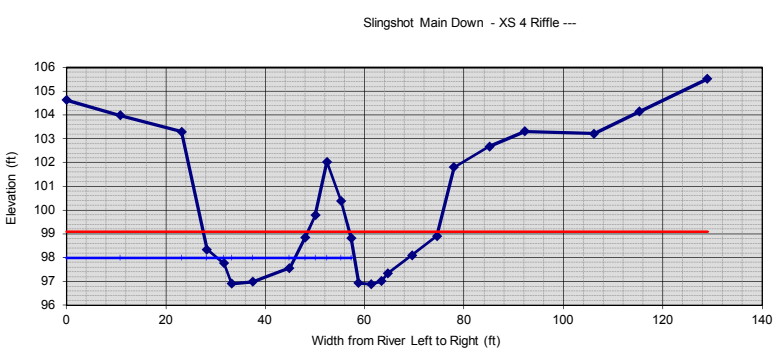
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.3	-0.830862	20.0		
97.7	100.8309			

dimensions			
11.1	x-section area	0.9	d mean
11.7	width	12.7	wet P
1.6	d max	0.9	hyd radi
4.7	bank ht	12.4	w/d ratio
20.0	W flood prone area	1.7	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Down - XS 4**

Riffle

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description: **Slingshot Main Down - XS 4**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.636748	104.6367
	☐	10.76066	-3.980285	103.9803
	☐	23.16632	-3.303942	103.3039
	☐	28.24717	1.653225	98.34678
	☐	31.66333	2.236968	97.76303
	☐	33.16673	3.101226	96.89877
	☐	37.45083	3.023158	96.97684
	☐	44.84742	2.436989	97.56301
	☐	48.00765	1.151527	98.84847
	☐	50.07668	0.197731	99.80227
	☐	52.40956	-2.013772	102.0138
	☐	55.18862	-0.372008	100.372
	☐	57.25223	1.17173	98.82827
	☑	58.7559	3.076115	96.92389
	☑	61.29491	3.120586	96.87941
	☑	63.37574	2.994798	97.0052
	☑	64.6963	2.650161	97.34984
	☑	69.53808	1.902722	98.09728
	☑	74.59431	1.097366	98.90263
	☑	77.95538	-1.799202	101.7992
	☑	85.12143	-2.673831	102.6738
	☑	92.17231	-3.305553	103.3056
	☑	106.1721	-3.214454	103.2145
	☑	115.2229	-4.147134	104.1471
	☑	128.9507	-5.51298	105.513

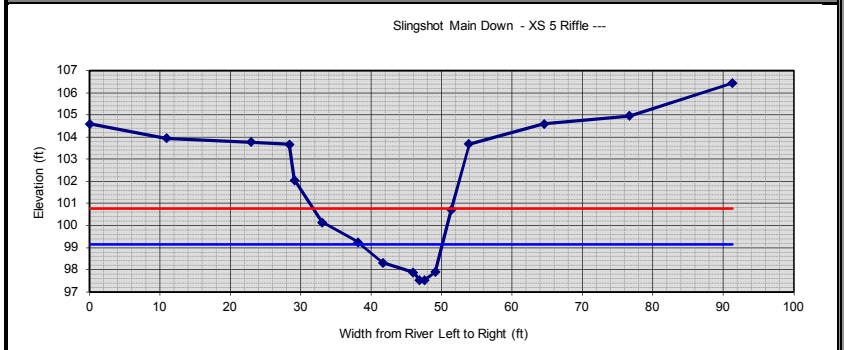
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.015	-1.799202	20.0		
97.985	101.7992			

dimensions			
11.1	x-section area	0.7	d mean
15.5	width	15.9	wet P
1.1	d max	0.7	hyd radi
4.9	bank ht	21.7	w/d ratio
20.0	W flood prone area	1.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Down - XS 5**

Riffle

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description: **Slingshot Main Down - XS 5**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.586397	104.5864
	☐	10.91601	-3.94046	103.9405
	☐	22.93095	-3.771698	103.7717
	☐	28.37406	-3.66552	103.6655
	☐	29.08018	-2.04091	102.0409
	☐	33.01738	-0.145577	100.1456
	☐	38.08383	0.758367	99.24163
	☐	41.64763	1.679101	98.3209
	☐	45.96884	2.119163	97.88084
	☐	46.81669	2.464531	97.53547
	☐	47.57106	2.467424	97.53258
	☐	49.0833	2.106944	97.89306
	☐	51.35869	-0.706639	100.7066
	☐	53.85649	-3.682903	103.6829
	☐	64.57603	-4.588886	104.5889
	☐	76.68293	-4.947497	104.9475
	☐	91.27859	-6.428244	106.4282
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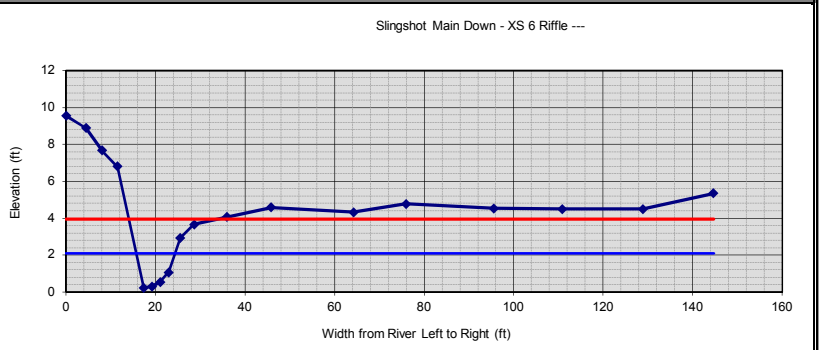
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.85	-3.66552	20.0		
99.15	103.6655			

dimensions			
11.1	x-section area	1.0	d mean
11.7	width	12.5	wet P
1.6	d max	0.9	hyd radi
6.1	bank ht	12.2	w/d ratio
20.0	W flood prone area	1.7	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Down - XS 6**

Riffle

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description: **Slingshot Main Down - XS 6**

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-9.541098	9.541098
	☐	4.484634	-8.885547	8.885547
	☐	7.988128	-7.665407	7.665407
	☐	11.45367	-6.807615	6.807615
	☐	17.34444	-0.226587	0.226587
	☐	19.16688	-0.300969	0.300969
	☐	21.0038	-0.538081	0.538081
	☐	22.85031	-1.057586	1.057586
	☐	25.52402	-2.919589	2.919589
	☐	28.62196	-3.671021	3.671021
	☐	35.93163	-4.070052	4.070052
	☐	45.83285	-4.586991	4.586991
	☐	64.24212	-4.323708	4.323708
	☐	75.97652	-4.76678	4.76678
	☐	95.51248	-4.529594	4.529594
	☐	110.8126	-4.494034	4.494034
	☐	128.887	-4.504217	4.504217
	☐	144.6218	-5.341457	5.341457
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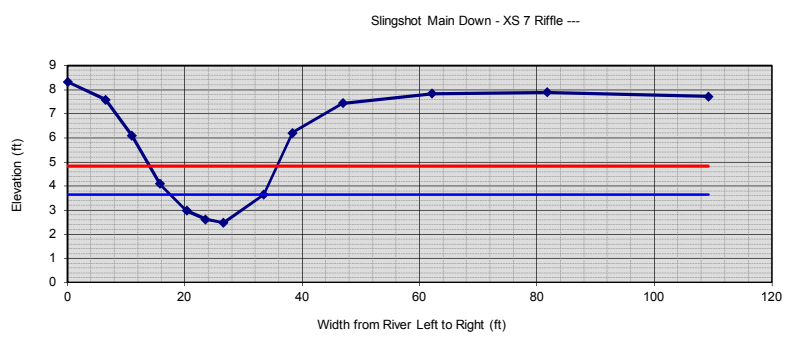
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.09	-3.671021	24.0		
2.09	3.671021			

dimensions			
11.1	x-section area	1.3	d mean
8.7	width	9.9	wet P
1.9	d max	1.1	hyd radi
3.4	bank ht	6.7	w/d ratio
24.0	W flood prone area	2.8	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



For additional cross sections make a copy of the "Dimension" worksheet.
To create a copy "right click" on the dimension tab below.

section:	**Slingshot Main Down - XS 7**
	Riffle

	---
description:	**Slingshot Main Down - XS 7**
height of instrument (ft):	

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-8.320437**	8.320437
	☐	**6.44713**	**-7.589669**	7.589669
	☐	**10.91114**	**-6.092062**	6.092062
	☐	**15.75833**	**-4.093535**	4.093535
	☐	**20.27371**	**-2.975954**	2.975954
	☐	**23.54056**	**-2.619091**	2.619091
	☐	**26.59358**	**-2.481401**	2.481401
	☐	**33.37528**	**-3.64493**	3.64493
	☐	**38.31006**	**-6.208606**	6.208606
	☐	**46.92966**	**-7.433901**	7.433901
	☐	**62.14152**	**-7.83927**	7.83927
	☐	**81.68209**	**-7.884251**	7.884251
	☐	**109.191**	**-7.712611**	7.712611
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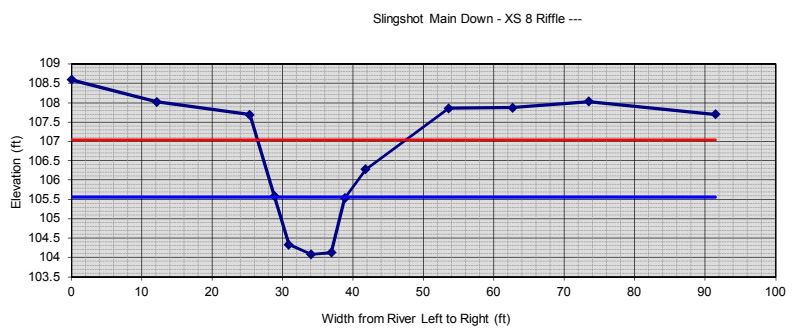
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-3.651	**-6.092062**	**22.0**		
3.651	6.092062			

dimensions			
11.1	x-section area	0.7	d mean
15.8	width	16.0	wet P
1.2	d max	0.7	hyd radi
3.6	bank ht	22.7	w/d ratio
22.0	W flood prone area	1.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot Main Down - XS 8
	Riffle

	---
description:	Slingshot Main Down - XS 8
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-8.587919	108.5879
	☐	12.05891	-8.01923	108.0192
	☐	25.31747	-7.694427	107.6944
	☐	28.81896	-5.591836	105.5918
	☐	30.8556	-4.33536	104.3354
	☐	34.02123	-4.081961	104.082
	☐	36.89518	-4.127121	104.1271
	☐	38.8191	-5.530435	105.5304
	☐	41.75062	-6.278157	106.2782
	☐	53.58046	-7.857178	107.8572
	☐	62.63777	-7.872442	107.8724
	☐	73.47781	-8.029028	108.029
	☐	91.41908	-7.695849	107.6958
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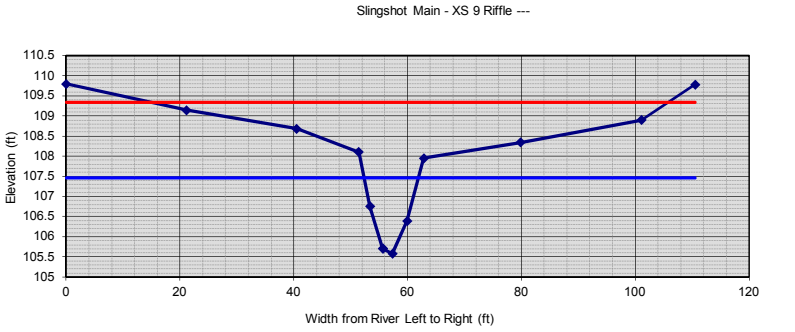
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-5.56	-7.694427	22.0		
105.56	107.6944			

dimensions			
11.1	x-section area	1.1	d mean
10.1	width	10.9	wet P
1.5	d max	1.0	hyd radi
3.6	bank ht	9.1	w/d ratio
22.0	W flood prone area	2.2	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot Main - XS 9
	Riffle

	---
description:	Slingshot Main Down - XS 9
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-9.798264	109.7983
	☐	21.16832	-9.145507	109.1455
	☐	40.53593	-8.684654	108.6847
	☐	51.44361	-8.103553	108.1036
	☐	53.38116	-6.752125	106.7521
	☐	55.61648	-5.699256	105.6993
	☐	55.64651	-5.699008	105.699
	☐	57.33513	-5.581039	105.581
	☐	59.90818	-6.392034	106.392
	☐	62.82412	-7.948842	107.9488
	☐	79.83589	-8.33967	108.3397
	☐	101.0572	-8.894365	108.8944
	☐	110.5173	-9.778086	109.7781
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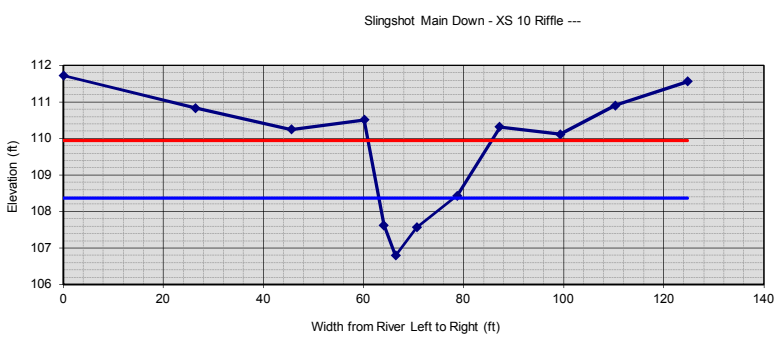
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-7.46	-7.948842	100.0		
107.46	107.9488			

dimensions			
11.1	x-section area	1.2	d mean
9.5	width	10.4	wet P
1.9	d max	1.1	hyd radi
2.4	bank ht	8.2	w/d ratio
100.0	W flood prone area	10.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Down - XS 10**

Riffle

---

description: **Slingshot Main Down - XS 10**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-11.72477**	111.7248
	☐	**26.35273**	**-10.8359**	110.8359
	☐	**45.56182**	**-10.25184**	110.2518
	☐	**60.19275**	**-10.50924**	110.5092
	☐	**64.06973**	**-7.626526**	107.6265
	☐	**66.44868**	**-6.789104**	106.7891
	☐	**70.67096**	**-7.567744**	107.5677
	☐	**78.71627**	**-8.433418**	108.4334
	☐	**87.18605**	**-10.32147**	110.3215
	☐	**99.3175**	**-10.11889**	110.1189
	☐	**110.3142**	**-10.90174**	110.9017
	☐	**124.7625**	**-11.56382**	111.5638

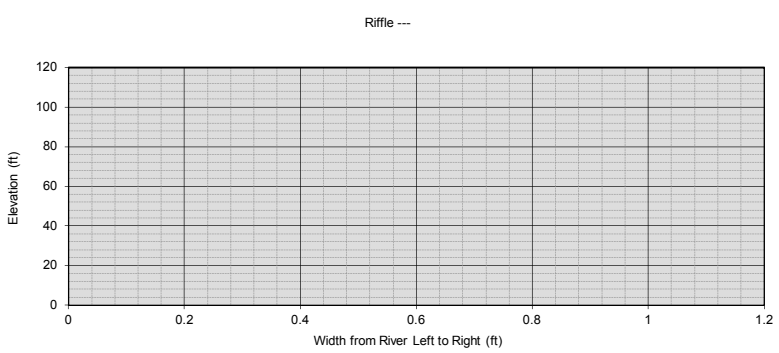
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-8.365	**-10.32147**	**16.0**		
108.365	110.3215			

dimensions			
11.1	x-section area	0.7	d mean
15.0	width	15.5	wet P
1.6	d max	0.7	hyd radi
3.5	bank ht	20.3	w/d ratio
16.0	W flood prone area	1.1	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:

Riffle

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description:

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐			
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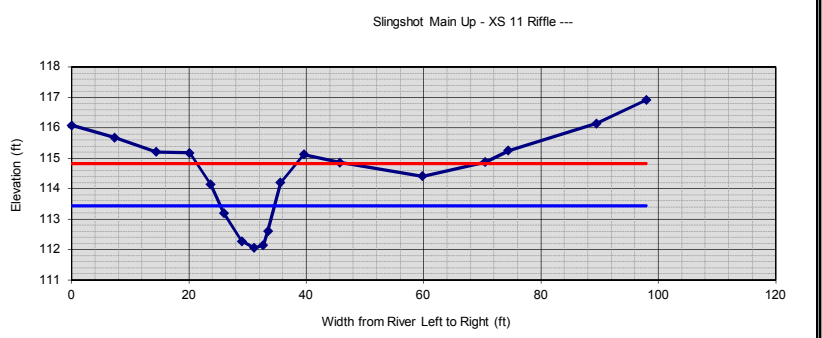
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
100	---			

dimensions			
0.0	x-section area	0.0	d mean
0.0	width	0.0	wet P
0.0	d max	0.0	hyd radi
0.0	bank ht	0.0	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 11**

Riffle

---

description: **Slingshot Main Up - XS 11**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-16.07678	116.0768
	☐	7.2903	-15.68629	115.6863
	☐	14.4492	-15.20739	115.2074
	☐	20.10958	-15.17902	115.179
	☐	23.71635	-14.13319	114.1332
	☐	25.95716	-13.19378	113.1938
	☐	29.01784	-12.27003	112.27
	☐	31.05406	-12.05352	112.0535
	☐	32.66713	-12.13472	112.1347
	☐	33.46301	-12.60812	112.6081
	☐	35.61056	-14.19506	114.1951
	☐	39.59799	-15.11925	115.1193
	☐	45.67109	-14.86574	114.8657
	☐	59.78789	-14.40457	114.4046
	☐	70.43508	-14.87534	114.8753
	☐	74.4139	-15.25163	115.2516
	☐	89.49198	-16.14229	116.1423
	☐	97.97772	-16.90849	116.9085
	☐			
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	☐			
	☐			
	☐			

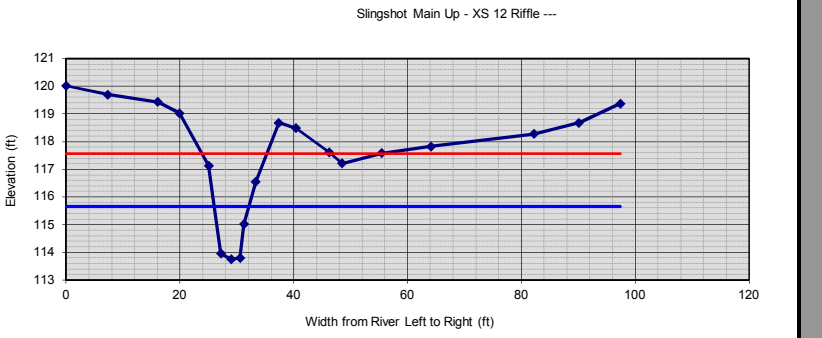
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-13.44	-15.11925	16.0		
113.44	115.1193			

dimensions			
8.3	x-section area	0.9	d mean
9.2	width	9.8	wet P
1.4	d max	0.8	hyd radi
3.1	bank ht	10.2	w/d ratio
16.0	W flood prone area	1.7	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 12**

Riffle

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description: **Slingshot Main Up - XS 12**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-20.01339	120.0134
	☐	7.318018	-19.70071	119.7007
	☐	16.11376	-19.43636	119.4364
	☐	19.85371	-19.0289	119.0289
	☐	25.02321	-17.11446	117.1145
	☐	27.20201	-13.95143	113.9514
	☐	29.01114	-13.73758	113.7376
	☐	30.55891	-13.79675	113.7968
	☐	31.20909	-15.01289	115.0129
	☐	33.29927	-16.55681	116.5568
	☐	37.34741	-18.68008	118.6801
	☐	40.41423	-18.4806	118.4806
	☐	46.17884	-17.61215	117.6122
	☐	48.52413	-17.20668	117.2067
	☐	55.45523	-17.58471	117.5847
	☐	64.0769	-17.82743	117.8274
	☐	82.20302	-18.27054	118.2705
	☐	90.12592	-18.68483	118.6848
	☐	97.3948	-19.37518	119.3752
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	☐			
	☐			
	☐			

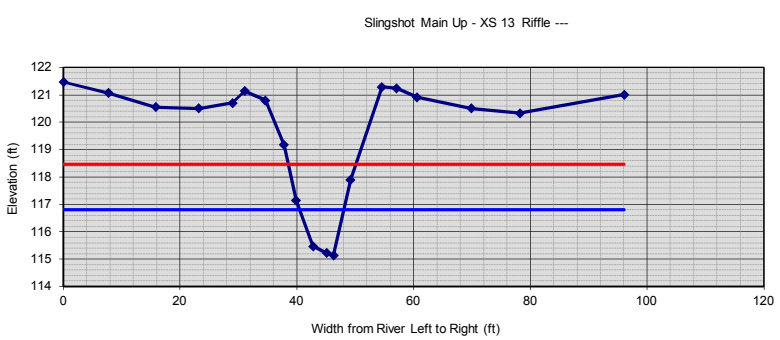
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-15.65	-18.68008	12.0		
115.65	118.6801			

dimensions			
8.3	x-section area	1.4	d mean
6.0	width	7.9	wet P
1.9	d max	1.0	hyd radi
4.9	bank ht	4.4	w/d ratio
12.0	W flood prone area	2.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot Main Up - XS 13
	Riffle

	---
description:	Slingshot Main Up - XS 13
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-21.46922	121.4692
	☐	7.775851	-21.06852	121.0685
	☐	15.8317	-20.55758	120.5576
	☐	23.21456	-20.50209	120.5021
	☐	28.97027	-20.7078	120.7078
	☐	31.06924	-21.13243	121.1324
	☐	34.61362	-20.80154	120.8015
	☐	37.79069	-19.17024	119.1702
	☐	39.88356	-17.14064	117.1406
	☐	42.7825	-15.46754	115.4675
	☐	45.08681	-15.2175	115.2175
	☐	46.32793	-15.13958	115.1396
	☐	49.20659	-17.90032	117.9003
	☐	54.56207	-21.29393	121.2939
	☐	57.01747	-21.24692	121.2469
	☐	60.52927	-20.9147	120.9147
	☐	69.92617	-20.50651	120.5065
	☐	78.17864	-20.33334	120.3333
	☐	96.07873	-21.01287	121.0129
	☐			
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	☐			
	☐			
	☐			

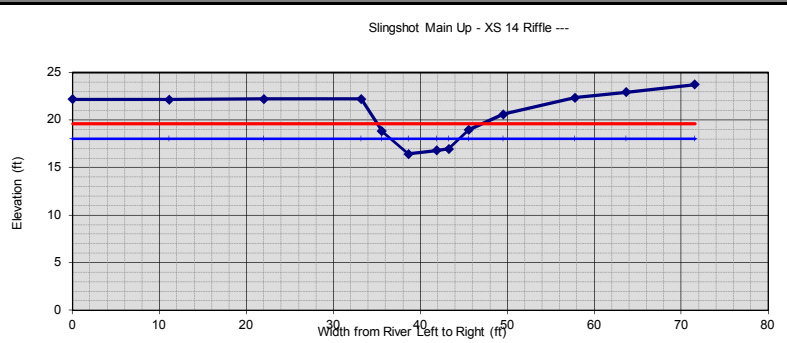
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-16.8	-20.80154	12.0		
116.8	120.8015			

dimensions			
8.3	x-section area	1.1	d mean
7.6	width	8.6	wet P
1.7	d max	1.0	hyd radi
5.7	bank ht	6.9	w/d ratio
12.0	W flood prone area	1.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot Main Up - XS 14
	Riffle

	---
description:	Slingshot Main Up - XS 14
height of instrument (ft):	

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-22.18543	22.18543
	☐	11.07758	-22.13787	22.13787
	☐	21.9769	-22.20049	22.20049
	☐	33.20385	-22.21274	22.21274
	☐	35.56728	-18.80795	18.80795
	☐	38.632	-16.43166	16.43166
	☐	41.86616	-16.79258	16.79258
	☐	43.26008	-16.98035	16.98035
	☐	45.58278	-19.00112	19.00112
	☐	49.53083	-20.61095	20.61095
	☐	57.78855	-22.35726	22.35726
	☐	63.65791	-22.9309	22.9309
	☐	71.56233	-23.72878	23.72878
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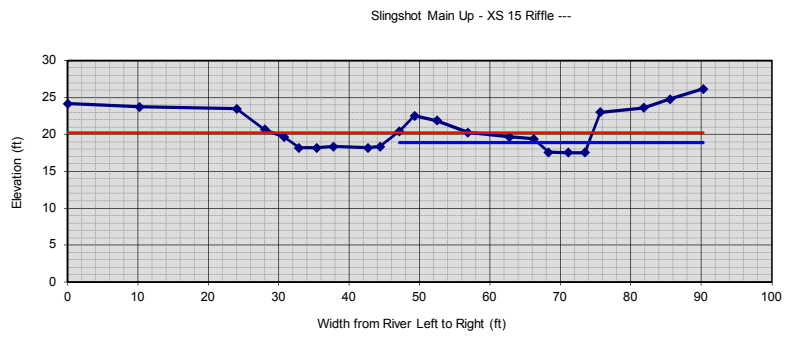
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-18.01	-22.21274	12.0		
18.01	22.21274			

dimensions			
8.3	x-section area	1.1	d mean
7.8	width	8.8	wet P
1.6	d max	0.9	hyd radi
5.8	bank ht	7.4	w/d ratio
12.0	W flood prone area	1.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 15**

Riffle

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description: **Slingshot Main Up - XS 15**

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	-24.1768	24.1768
	☑	10.23196	-23.73941	23.73941
	☑	24.02452	-23.46944	23.46944
	☑	28.03893	-20.66931	20.66931
	☑	30.7653	-19.6471	19.6471
	☑	32.87398	-18.16698	18.16698
	☑	35.35015	-18.17336	18.17336
	☑	37.77305	-18.35224	18.35224
	☑	42.67833	-18.15745	18.15745
	☑	44.38778	-18.35214	18.35214
	☐	47.14545	-20.41874	20.41874
	☐	49.27363	-22.52512	22.52512
	☐	52.45326	-21.84874	21.84874
	☐	56.79592	-20.26014	20.26014
	☐	62.77009	-19.66884	19.66884
	☐	66.19821	-19.38062	19.38062
	☐	68.31645	-17.56017	17.56017
	☐	71.1399	-17.5279	17.5279
	☐	73.43419	-17.5263	17.5263
	☐	75.62999	-22.97164	22.97164
	☐	81.81486	-23.61366	23.61366
	☐	85.55393	-24.76723	24.76723
	☐	90.23725	-26.161	26.161
	☐			
	☐			

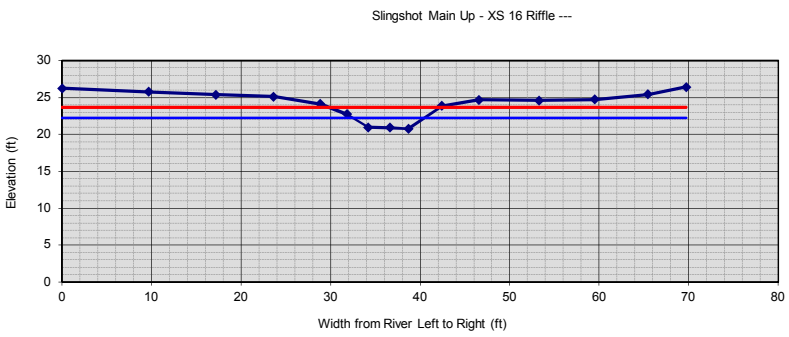
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-18.88	66.19821	17.0		
18.88	-66.19821			

dimensions			
8.3	x-section area	1.1	d mean
7.2	width	8.6	wet P
1.4	d max	1.0	hyd radi
-83.7	bank ht	6.3	w/d ratio
17.0	W flood prone area	2.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 16**

Riffle

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description: **Slingshot Main Up - XS 16**

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-26.25599	26.25599
	☐	9.674725	-25.77017	25.77017
	☐	17.18865	-25.35693	25.35693
	☐	23.6367	-25.09495	25.09495
	☐	28.86139	-24.13932	24.13932
	☐	31.83888	-22.74129	22.74129
	☐	34.17709	-20.96783	20.96783
	☐	36.58961	-20.90987	20.90987
	☐	38.65802	-20.76049	20.76049
	☐	42.43399	-23.87082	23.87082
	☐	46.57957	-24.69194	24.69194
	☐	53.24457	-24.61642	24.61642
	☐	59.47176	-24.7305	24.7305
	☐	65.44371	-25.41935	25.41935
	☐	69.70529	-26.42433	26.42433
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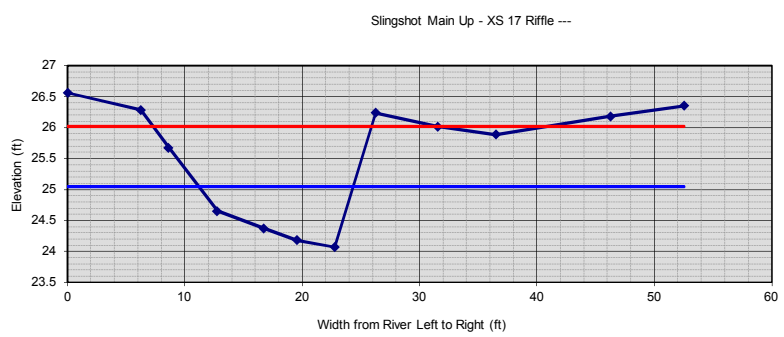
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-22.22	-23.87082	12.0		
22.22	23.87082			

dimensions			
8.3	x-section area	1.0	d mean
7.9	width	8.9	wet P
1.5	d max	0.9	hyd radi
3.1	bank ht	7.5	w/d ratio
12.0	W flood prone area	1.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	**Slingshot Main Up - XS 17**
	Riffle

	---
description:	**Slingshot Main Up - XS 17**
height of instrument (ft):	

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-26.56118**	26.56118
	☐	**6.237477**	**-26.28507**	26.28507
	☐	**8.601788**	**-25.67484**	25.67484
	☐	**12.74498**	**-24.65037**	24.65037
	☐	**16.70412**	**-24.37584**	24.37584
	☐	**19.54381**	**-24.18378**	24.18378
	☐	**22.75019**	**-24.06977**	24.06977
	☐	**26.25569**	**-26.23781**	26.23781
	☐	**31.53685**	**-26.01792**	26.01792
	☐	**36.51177**	**-25.88621**	25.88621
	☐	**46.27131**	**-26.18042**	26.18042
	☐	**52.52957**	**-26.34963**	26.34963
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-25.045	**-26.23781**	**18.0**		
25.045	26.23781			

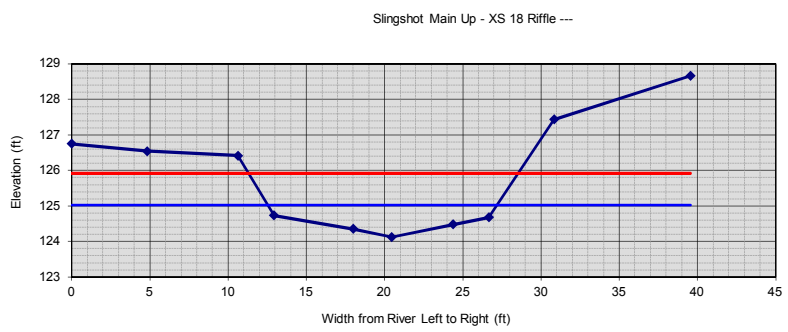
dimensions			
8.3	x-section area	0.6	d mean
13.2	width	13.5	wet P
1.0	d max	0.6	hyd radi
2.2	bank ht	20.9	w/d ratio
18.0	W flood prone area	1.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

For additional cross sections make a copy of the "Dimension" worksheet.
To create a copy "right click" on the dimension tab below.

Cross Section



section:	Slingshot Main Up - XS 18
	Riffle

	---
description:	Slingshot Main Up - XS 18
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-26.75152	126.7515
	☐	4.824612	-26.54156	126.5416
	☐	10.63694	-26.41427	126.4143
	☐	12.9437	-24.73325	124.7332
	☐	17.98036	-24.35372	124.3537
	☐	20.46312	-24.11933	124.1193
	☐	24.39794	-24.48201	124.482
	☐	26.66031	-24.68073	124.6807
	☐	30.83599	-27.43191	127.4319
	☐	39.55869	-28.66526	128.6653
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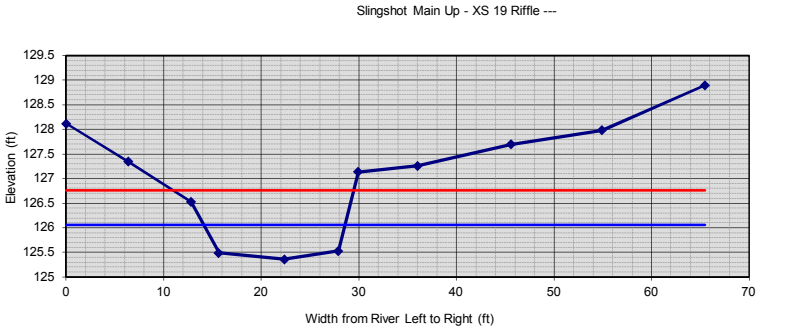
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-25.02	-26.41427	18.0		
125.02	126.4143			

dimensions			
8.3	x-section area	0.6	d mean
14.6	width	14.9	wet P
0.9	d max	0.6	hyd radi
2.3	bank ht	25.7	w/d ratio
18.0	W flood prone area	1.2	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot Main Up - XS 19
	Riffle

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description:	Slingshot Main Up - XS 19
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-28.11369	128.1137
	☐	6.381211	-27.34198	127.342
	☐	12.78478	-26.52719	126.5272
	☐	15.63316	-25.48733	125.4873
	☐	22.34729	-25.36081	125.3608
	☐	27.90574	-25.5298	125.5298
	☐	29.9418	-27.13147	127.1315
	☐	36.04292	-27.25723	127.2572
	☐	45.58484	-27.69114	127.6911
	☐	54.89782	-27.98189	127.9819
	☐	65.44273	-28.89355	128.8935
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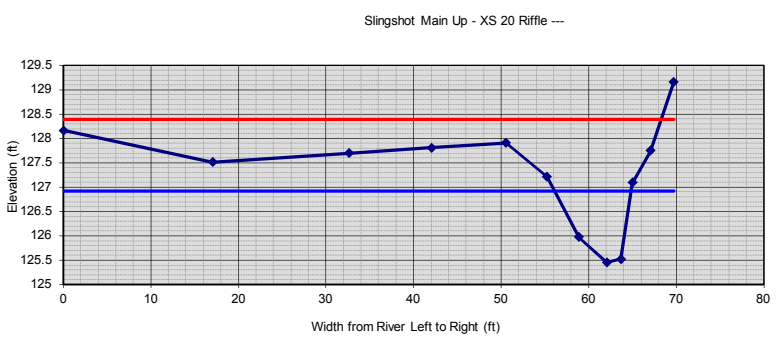
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-26.06	-26.52719	18.0		
126.06	126.5272			

dimensions			
8.3	x-section area	0.6	d mean
14.5	width	14.8	wet P
0.7	d max	0.6	hyd radi
1.2	bank ht	25.3	w/d ratio
18.0	W flood prone area	1.2	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 20**

Riffle

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description: **Slingshot Main Up - XS 20**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-28.16689	128.1669
	☐	17.0484	-27.51325	127.5132
	☐	32.65039	-27.69731	127.6973
	☐	42.04655	-27.81099	127.811
	☐	50.5578	-27.90927	127.9093
	☐	55.20901	-27.21758	127.2176
	☐	58.87736	-25.97781	125.9778
	☐	62.09529	-25.45059	125.4506
	☐	63.70724	-25.52512	125.5251
	☐	64.98882	-27.09377	127.0938
	☐	67.08229	-27.76154	127.7615
	☐	69.72128	-29.1682	129.1682
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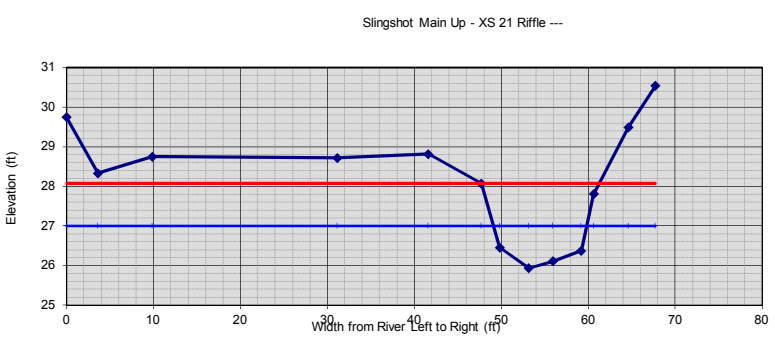
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-26.92	-27.76154	100.0		
126.92	127.7615			

dimensions			
8.3	x-section area	0.9	d mean
8.8	width	9.6	wet P
1.5	d max	0.9	hyd radi
2.3	bank ht	9.2	w/d ratio
100.0	W flood prone area	11.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot Main Up - XS 21**

Riffle

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description: **Slingshot Main Up - XS 21**

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-29.74201	29.74201
	☐	3.606783	-28.32771	28.32771
	☐	9.880804	-28.7493	28.7493
	☐	31.13449	-28.71321	28.71321
	☐	41.5833	-28.81313	28.81313
	☐	47.71694	-28.06514	28.06514
	☐	49.819	-26.45365	26.45365
	☐	53.15838	-25.92991	25.92991
	☐	55.90481	-26.10706	26.10706
	☐	59.19095	-26.37281	26.37281
	☐	60.65149	-27.80941	27.80941
	☐	64.62072	-29.49103	29.49103
	☐	67.69754	-30.53034	30.53034
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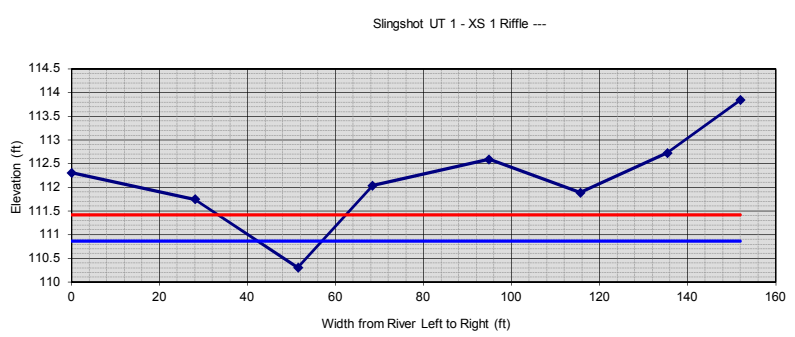
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-27	-27.80941	13.0		
27	27.80941			

dimensions			
8.3	x-section area	0.8	d mean
10.7	width	11.2	wet P
1.1	d max	0.7	hyd radi
1.9	bank ht	13.9	w/d ratio
13.0	W flood prone area	1.2	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 1 - XS 1
	Riffle

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description:	Slingshot UT 1 - XS 1
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-12.30267	112.3027
	☐	28.02568	-11.74187	111.7419
	☐	51.48205	-10.30275	110.3028
	☐	68.41451	-12.03457	112.0346
	☐	94.89088	-12.59181	112.5918
	☐	115.619	-11.88828	111.8883
	☐	135.3724	-12.7257	112.7257
	☐	151.9899	-13.84132	113.8413
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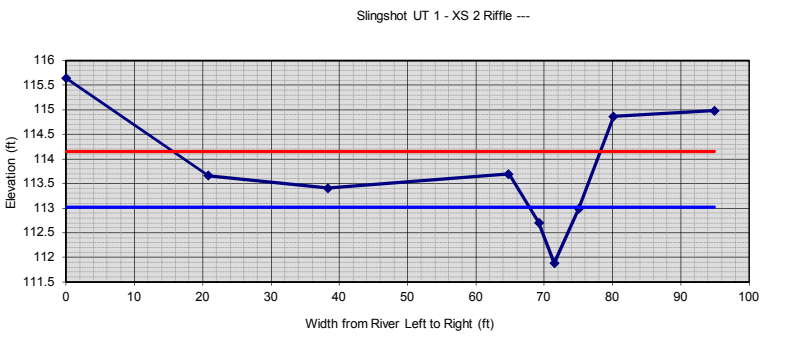
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-10.86	-11.74187	28.0		
110.86	111.7419			

dimensions			
4.0	x-section area	0.3	d mean
14.5	width	14.6	wet P
0.6	d max	0.3	hyd radi
1.4	bank ht	52.2	w/d ratio
28.0	W flood prone area	1.9	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 1 - XS 2
	Riffle

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description:	Slingshot UT 1 - XS 2
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-15.64442	115.6444
	☐	20.83608	-13.65861	113.6586
	☐	38.33961	-13.40431	113.4043
	☐	64.77966	-13.68997	113.69
	☐	69.22226	-12.69507	112.6951
	☐	71.4766	-11.88543	111.8854
	☐	75.02275	-12.98645	112.9864
	☐	80.16991	-14.86308	114.8631
	☐	94.93451	-14.97858	114.9786
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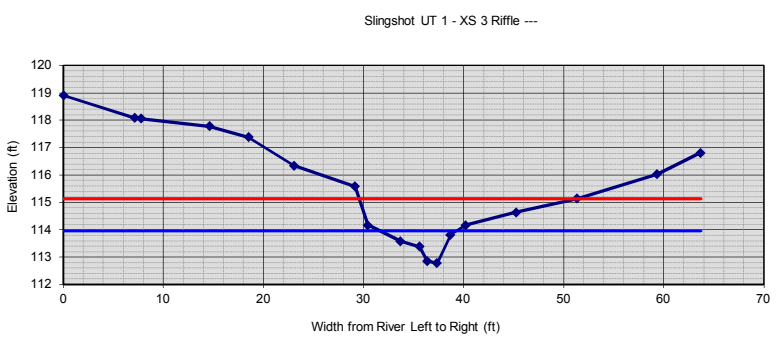
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-13.02	-13.68997	100.0		
113.02	113.69			

dimensions			
4.0	x-section area	0.5	d mean
7.3	width	7.7	wet P
1.1	d max	0.5	hyd radi
1.8	bank ht	13.6	w/d ratio
100.0	W flood prone area	13.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 1 - XS 3
	Riffle

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description:	Slingshot UT 1 - XS 3
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-18.90854	118.9085
	☐	7.144681	-18.08644	118.0864
	☐	7.746858	-18.06085	118.0608
	☐	14.58059	-17.78373	117.7837
	☐	18.48739	-17.37988	117.3799
	☐	23.04079	-16.3436	116.3436
	☐	29.14428	-15.57751	115.5775
	☐	30.41857	-14.16563	114.1656
	☐	33.63991	-13.57885	113.5789
	☐	35.5922	-13.37864	113.3786
	☐	36.33686	-12.8623	112.8623
	☐	37.32662	-12.77211	112.7721
	☐	38.6777	-13.81207	113.8121
	☐	40.20781	-14.16675	114.1668
	☐	45.22245	-14.63708	114.6371
	☐	51.34275	-15.13734	115.1373
	☐	59.31902	-16.02887	116.0289
	☐	63.6857	-16.81409	116.8141
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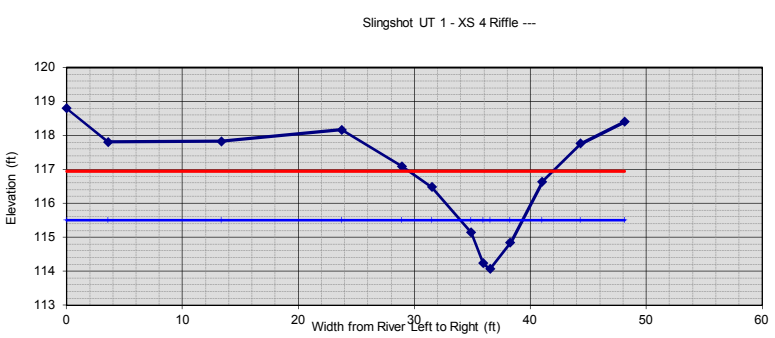
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-13.95	-14.16563	22.0		
113.95	114.1656			

dimensions			
4.0	x-section area	0.5	d mean
7.7	width	8.2	wet P
1.2	d max	0.5	hyd radi
1.4	bank ht	14.8	w/d ratio
22.0	W flood prone area	2.9	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 1 - XS 4
	Riffle

	---
description:	Slingshot UT 1 - XS 4
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-18.79316	118.7932
	☐	3.56834	-17.80488	117.8049
	☐	13.34388	-17.82378	117.8238
	☐	23.73976	-18.16738	118.1674
	☐	28.90083	-17.0927	117.0927
	☐	31.51244	-16.47927	116.4793
	☐	34.87725	-15.14965	115.1496
	☐	35.91088	-14.23225	114.2322
	☐	36.53616	-14.06077	114.0608
	☐	38.2636	-14.83611	114.8361
	☐	41.02943	-16.64203	116.642
	☐	44.34928	-17.75925	117.7593
	☐	48.11056	-18.40095	118.4009
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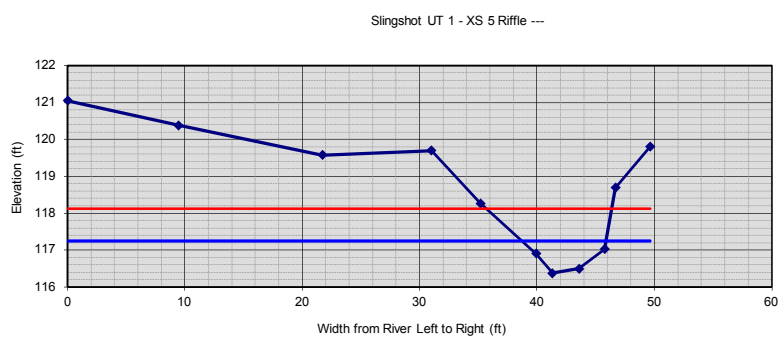
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-15.5	-17.75925	12.0		
115.5	117.7593			

dimensions			
4.0	x-section area	0.8	d mean
5.3	width	6.1	wet P
1.4	d max	0.7	hyd radi
3.7	bank ht	7.0	w/d ratio
12.0	W flood prone area	2.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot UT 1 - XS 5**

Riffle

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description: **Slingshot UT 1 - XS 5**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-21.04514**	121.0451
	☐	**9.465144**	**-20.38037**	120.3804
	☐	**21.71789**	**-19.57425**	119.5742
	☐	**31.01538**	**-19.69909**	119.6991
	☐	**35.17207**	**-18.26286**	118.2629
	☐	**39.93259**	**-16.90533**	116.9053
	☐	**41.31157**	**-16.37733**	116.3773
	☐	**43.59882**	**-16.4986**	116.4986
	☐	**45.75325**	**-17.02724**	117.0272
	☐	**46.67841**	**-18.68816**	118.6882
	☐	**49.61348**	**-19.79861**	119.7986
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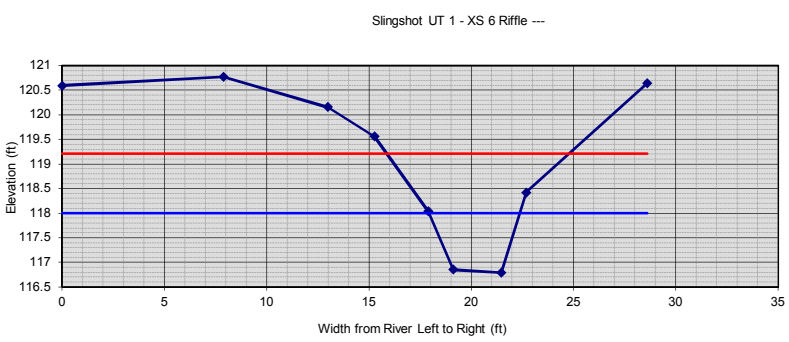
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-17.25	**-19.69909**	**10.0**		
117.25	119.6991			

dimensions			
4.0	x-section area	0.6	d mean
7.2	width	7.5	wet P
0.9	d max	0.5	hyd radi
3.3	bank ht	12.9	w/d ratio
10.0	W flood prone area	1.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot UT 1 - XS 6**

Riffle

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description: **Slingshot UT 1 - XS 6**

height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-20.59148**	120.5915
	☐	**7.885488**	**-20.77196**	120.772
	☐	**12.99046**	**-20.15897**	120.159
	☐	**15.26981**	**-19.55827**	119.5583
	☐	**17.8884**	**-18.03921**	118.0392
	☐	**19.11159**	**-16.85516**	116.8552
	☐	**21.46004**	**-16.79132**	116.7913
	☐	**22.66634**	**-18.42215**	118.4221
	☐	**28.58846**	**-20.63782**	120.6378
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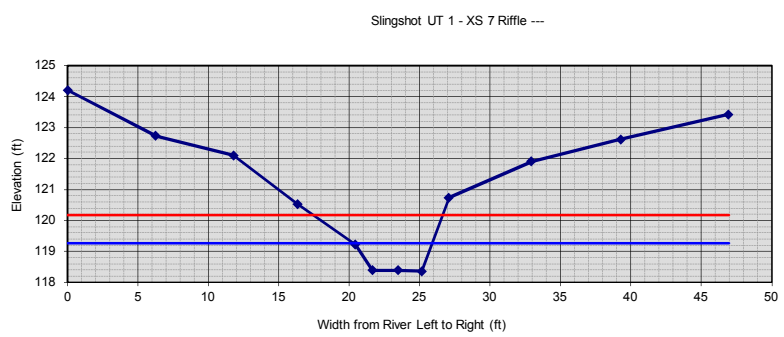
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-18.00	**-20.15897**	**9.0**		
118	120.159			

dimensions			
4.0	x-section area	0.9	d mean
4.4	width	5.5	wet P
1.2	d max	0.7	hyd radi
3.4	bank ht	4.9	w/d ratio
9.0	W flood prone area	2.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 1 - XS 7
	Riffle

	---
description:	Slingshot UT 1 - XS 7
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-24.20948	124.2095
	☐	6.261932	-22.73563	122.7356
	☐	11.78617	-22.10452	122.1045
	☐	16.30862	-20.5281	120.5281
	☐	20.42162	-19.23136	119.2314
	☐	21.64957	-18.3909	118.3909
	☐	23.44181	-18.39829	118.3983
	☐	25.12842	-18.36415	118.3642
	☐	27.073	-20.74339	120.7434
	☐	32.92997	-21.90254	121.9025
	☐	39.26414	-22.61534	122.6153
	☐	46.92826	-23.42544	123.4254
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-19.27	-20.5281	10.0		
119.27	120.5281			

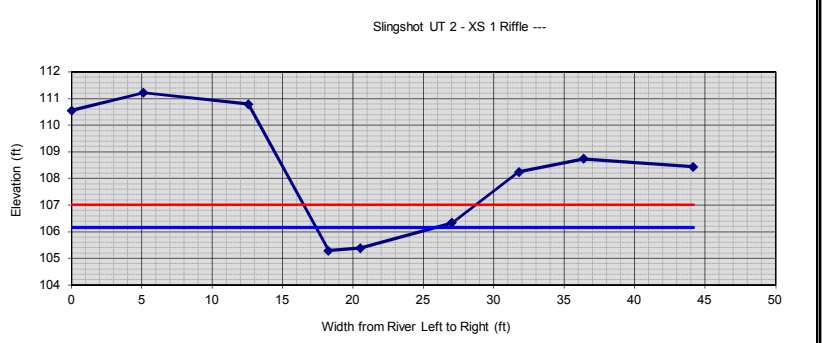
dimensions			
4.0	x-section area	0.7	d mean
5.6	width	6.3	wet P
0.9	d max	0.6	hyd radi
2.2	bank ht	7.8	w/d ratio
10.0	W flood prone area	1.8	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

For additional cross sections make a copy of the "Dimension" worksheet.
To create a copy "right click" on the dimension tab below.

Cross Section



section:	Slingshot UT 2 - XS 1
	Riffle

	---
description:	Slingshot UT 2 - XS 1
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-10.55708	110.5571
	☐	5.112146	-11.21918	111.2192
	☐	12.52251	-10.79628	110.7963
	☐	18.23563	-5.28693	105.2869
	☐	20.51304	-5.382989	105.383
	☐	27.01432	-6.331952	106.332
	☐	31.74942	-8.239007	108.239
	☐	36.34605	-8.74037	108.7404
	☐	44.14964	-8.433736	108.4337
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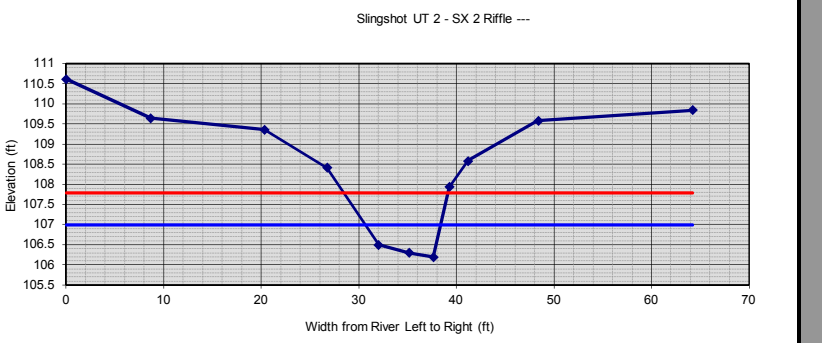
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.15	-8.74037	12.0		
106.15	108.7404			

dimensions			
4.3	x-section area	0.5	d mean
8.4	width	8.8	wet P
0.9	d max	0.5	hyd radi
3.5	bank ht	16.7	w/d ratio
12.0	W flood prone area	1.4	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	Slingshot UT 2 - SX 2
	Riffle

	---
description:	Slingshot UT 2 - SX 2
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-10.6163	110.6163
	☐	8.649839	-9.643712	109.6437
	☐	20.32684	-9.360532	109.3605
	☐	26.74394	-8.409137	108.4091
	☐	32.03769	-6.496054	106.4961
	☐	35.17202	-6.296876	106.2969
	☐	37.64324	-6.195824	106.1958
	☐	39.26637	-7.933064	107.9331
	☐	41.20084	-8.577214	108.5772
	☐	48.39838	-9.583002	109.583
	☐	64.23516	-9.844487	109.8445
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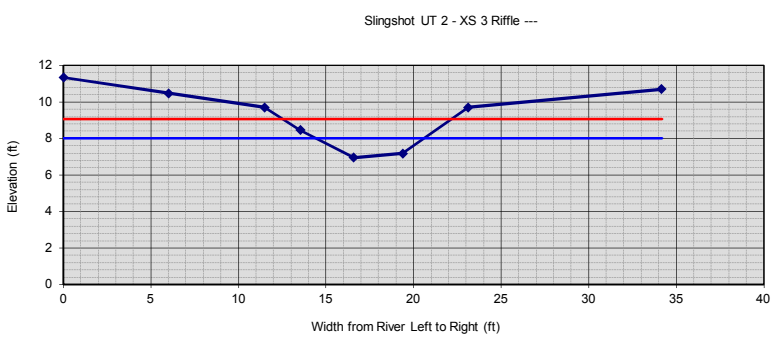
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.99	-8.409137	12.0		
106.99	108.4091			

dimensions			
4.3	x-section area	0.6	d mean
7.7	width	8.2	wet P
0.8	d max	0.5	hyd radi
2.2	bank ht	13.7	w/d ratio
12.0	W flood prone area	1.6	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section: **Slingshot UT 2 - XS 3**

Riffle

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description: **Slingshot UT 2 - XS 3**

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-11.33741**	11.33741
	☐	**6.018279**	**-10.48301**	10.48301
	☐	**11.48294**	**-9.713021**	9.713021
	☐	**13.52407**	**-8.4539**	8.4539
	☐	**16.55359**	**-6.951982**	6.951982
	☐	**19.3683**	**-7.182234**	7.182234
	☐	**23.12649**	**-9.700147**	9.700147
	☐	**34.16581**	**-10.71134**	10.71134
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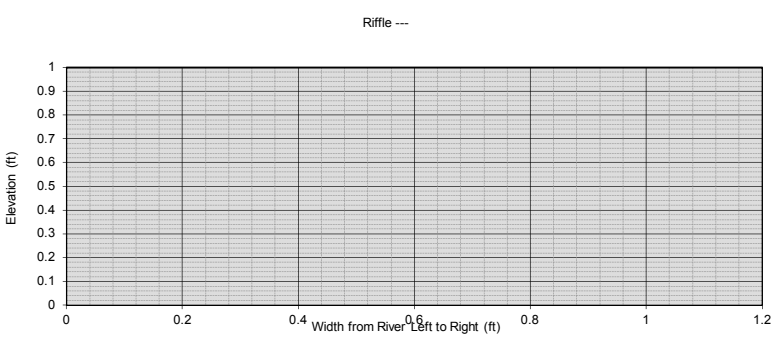
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-8.01	**-9.700147**	**11.0**		
8.01	9.700147			

dimensions			
4.3	x-section area	0.7	d mean
6.2	width	6.7	wet P
1.1	d max	0.6	hyd radi
2.7	bank ht	8.9	w/d ratio
11.0	W flood prone area	1.8	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:

Riffle

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description:

height of instrument (ft):

notes	omit pt.	distance (ft)	FS (ft)	elevation
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0	---			

dimensions			
0.0	x-section area	0.0	d mean
0.0	width	0.0	wet P
0.0	d max	0.0	hyd radi
0.0	bank ht	0.0	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
0	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name: SAM 1 (Main Downstream) | Date of Evaluation: 20172121
Stream Category: Pb2 | Assessor Name/Organization: Perkinson - Axiom

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**LOW**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**LOW**	
(3) Streamside Area Attenuation	**LOW**	
(4) Floodplain Access	**LOW**	
(4) Wooded Riparian Buffer	**LOW**	
(4) Microtopography	NA	
(3) Stream Stability	**LOW**	
(4) Channel Stability	**MEDIUM**	
(4) Sediment Transport	**LOW**	
(4) Stream Geomorphology	**LOW**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**LOW**	
(3) Upland Pollutant Filtration	**LOW**	
(3) Thermoregulation	**MEDIUM**	
(2) Indicators of Stressors	**YES**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**LOW**	
(2) In-stream Habitat	**LOW**	
(3) Baseflow	**HIGH**	
(3) Substrate	**LOW**	
(3) Stream Stability	**MEDIUM**	
(3) In-stream Habitat	**LOW**	
(2) Stream-side Habitat	**LOW**	
(3) Stream-side Habitat	**LOW**	
(3) Thermoregulation	**MEDIUM**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone Habitat	NA	
Overall	**LOW**	

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name: SAM 2 (UT 1) | Date of Evaluation: 20171221
Stream Category: Pb1 | Assessor Name/Organization: Perkinson - Axiom

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**LOW**	
(2) Baseflow	**MEDIUM**	
(2) Flood Flow	**LOW**	
(3) Streamside Area Attenuation	**LOW**	
(4) Floodplain Access	**LOW**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**MEDIUM**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**HIGH**	
(4) Stream Geomorphology	**LOW**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**LOW**	
(2) Baseflow	**MEDIUM**	
(2) Streamside Area Vegetation	**LOW**	
(3) Upland Pollutant Filtration	**LOW**	
(3) Thermoregulation	**MEDIUM**	
(2) Indicators of Stressors	**YES**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**HIGH**	
(3) Baseflow	**MEDIUM**	
(3) Substrate	**HIGH**	
(3) Stream Stability	**MEDIUM**	
(3) In-stream Habitat	**HIGH**	
(2) Stream-side Habitat	**MEDIUM**	
(3) Stream-side Habitat	**MEDIUM**	
(3) Thermoregulation	**MEDIUM**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone Habitat	NA	
Overall	**LOW**	

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name: SAM 3 (Main Middle) | Date of Evaluation: 20171221
Stream Category: Pb2 | Assessor Name/Organization: Perkinson - Axiom

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**LOW**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**LOW**	
(3) Streamside Area Attenuation	**LOW**	
(4) Floodplain Access	**LOW**	
(4) Wooded Riparian Buffer	**LOW**	
(4) Microtopography	NA	
(3) Stream Stability	**LOW**	
(4) Channel Stability	**MEDIUM**	
(4) Sediment Transport	**LOW**	
(4) Stream Geomorphology	**MEDIUM**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**LOW**	
(3) Upland Pollutant Filtration	**LOW**	
(3) Thermoregulation	**MEDIUM**	
(2) Indicators of Stressors	**YES**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**LOW**	
(2) In-stream Habitat	**LOW**	
(3) Baseflow	**HIGH**	
(3) Substrate	**LOW**	
(3) Stream Stability	**MEDIUM**	
(3) In-stream Habitat	**LOW**	
(2) Stream-side Habitat	**LOW**	
(3) Stream-side Habitat	**LOW**	
(3) Thermoregulation	**LOW**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone Habitat	NA	
Overall	**LOW**	

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name: SAM 4 (Main Upstream) | Date of Evaluation: 20171221
Stream Category: Pb2 | Assessor Name/Organization: Perkinson - Axiom

Notes of Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Perennial

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**MEDIUM**	
(3) Streamside Area Attenuation	**LOW**	
(4) Floodplain Access	**LOW**	
(4) Wooded Riparian Buffer	**HIGH**	
(4) Microtopography	NA	
(3) Stream Stability	**HIGH**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**MEDIUM**	
(4) Stream Geomorphology	**HIGH**	
(2) Stream/Intertidal Zone Interaction	NA	
(2) Longitudinal Tidal Flow	NA	
(2) Tidal Marsh Stream Stability	NA	
(3) Tidal Marsh Channel Stability	NA	
(3) Tidal Marsh Stream Geomorphology	NA	
(1) Water Quality	**MEDIUM**	
(2) Baseflow	**HIGH**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**YES**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**HIGH**	
(2) In-stream Habitat	**MEDIUM**	
(3) Baseflow	**HIGH**	
(3) Substrate	**MEDIUM**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**MEDIUM**	
(2) Stream-side Habitat	**HIGH**	
(3) Stream-side Habitat	**MEDIUM**	
(3) Thermoregulation	**HIGH**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone Habitat	NA	
Overall	**MEDIUM**	

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WAM-1	Date	12-21-2017
Wetland Type	Headwater Forest	Assessor Name/Organization	

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	YES
Wetland is intensively managed (Y/N)	NO
Assessment area is located within 50 feet of a natural tributary or other open water (Y/N)	YES
Assessment area is substantially altered by beaver (Y/N)	NO
Assessment area experiences overbank flooding during normal rainfall conditions (Y/N)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-Surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
	Soluble Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Physical Change	Condition	**MEDIUM**
		Condition/Opportunity	**HIGH**
		Opportunity Presence? (Y/N)	**YES**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence? (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics/Notes	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**HIGH**
	Condition/Opportunity	**HIGH**
	Opportunity Presence? (Y/N)	**YES**
Habitat	Condition	**LOW**

Overall Wetland Rating **MEDIUM**

Site		Slingshot Stream and Wetland Mitigation Site						
Stream		Main channel (UT to Troublesome (			Bank Length		5540	
Observers		Kenan and Andrew			Date		7-Dec-17	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	350	left	high	high	0.2	350	5	350.0
2	470	left	very high	high	1	120	6	720.0
3	835	left	high	high	0.2	365	5	365.0
4	1100	left	moderate	moderate	0.05	265	4	53.0
5	1165	left	high	moderate	0.15	65	3.5	34.1
6	1230	left	high	high	0.2	65	3	39.0
7	1320	left	high	moderate	0.15	90	3.5	47.3
8	1385	left	high	high	0.2	65	5	65.0
9	1520	left	moderate	low	0.02	135	2.5	6.8
10	1840	left	high	high	0.2	320	3.5	224.0
11	2065	left	high	high	0.2	225	6	270.0
12	2770	left	low	low	0	705	1.5	0.0
1	355	right	high	high	0.2	355	5	355.0
2	475	right	very high	high	1	120	6	720.0
3	830	right	high	high	0.2	355	5	355.0
4	1100	right	moderate	moderate	0.05	270	4	54.0
5	1165	right	high	moderate	0.15	65	3.5	34.1
6	1220	right	moderate	moderate	0.05	55	3	8.3
7	1320	right	high	moderate	0.15	100	3.5	52.5
8	1385	right	high	high	0.2	65	4.5	58.5
9	1520	right	moderate	low	0.02	135	2.5	6.8
10	1840	right	high	high	0.2	320	3.5	224.0
11	2065	right	high	high	0.2	225	6	270.0
12	2770	right	low	low	0	705	1.5	0.0
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		4312.3
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		159.7
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		207.6
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.04

Site		Slingshot Steam and Wetland Mitigation Site						
Stream		UT 1 to Troublesome Creek			Bank Length		1900	
Observers		Kenan and Andrew			Date		7-Dec-17	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	45	left	moderate	low	0.02	45	2.5	2.3
2	85	left	high	high	0.2	40	3	24.0
3	145	left	moderate	low	0.02	60	2.5	3.0
4	355	left	low	low	0	210	1.5	0.0
5	405	left	high	high	0.2	50	5.5	55.0
6	455	left	low	low	0	50	3	0.0
7	645	left	moderate	low	0.02	190	3.5	13.3
8	950	left	low	low	0	305	1.5	0.0
9								
10	145	right	moderate	low	0.02	145	2.5	7.3
11	355	right	low	low	0	210	1.5	0.0
12	405	right	high	high	0.2	50	5.5	55.0
13	455	right	low	low	0	50	3.5	0.0
14	645	right	moderate	low	0.02	190	3	11.4
15	950	right	low	low	0	305	1.5	0.0
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		171.2
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		6.3
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		8.2
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.004

Site		Slingshot Steam and Wetland Mitigation Site						
Stream		UT 2 to Troublesome Creek			Bank Length		260	
Observers		Kenan and Andrew			Date		7-Dec-17	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	40	left	high	high	0.2	40	5	40.0
2	75	left	moderate	low	0.02	35	3.5	2.5
3	130	left	low	low	0	55	3	0.0
4								
5								
6								
7								
8								
9								0.0
10	40	right	high	high	0.2	40	5	40.0
11	75	right	moderate	low	0.02	35	3.5	2.5
12	130	right	low	low	0	55	3	0.0
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		84.9
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		3.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		4.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.02

BEHI/NBS Summary

Stream Reach	Erosion Rate (tons/year)
Main Channel	207.6
UT 1	8.2
UT 2	4.1
Total	**220.0**

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Project/Site: Slingshot Stream & Wetland Mitigation Site

County, State: Rockingham, NC

Sampling Point/ Coordinates: Hydric Soil 1/ 36.334113, -79.713389

Investigator: Lewis

Notes: Location of soil profile is depicted on Figure 4 (Existing Conditions).

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-5	10YR 3/3	90	10YR 4/1	10	silt loam
5-8	10YR 5/1	100	--	--	loamy clay
8-14	10YR 6/1	100	--	--	sandy clay
14+	10YR 6/1	100	--	--	loamy sand

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Project/Site: Slingshot Stream & Wetland Mitigation Site

County, State: Rockingham, NC

Sampling Point/ Coordinates: Hydric Soil 2/ 36.334803, -79.711736

Investigator: Lewis

Notes: Location of soil profile is depicted on Figure 4 (Existing Conditions).

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	7.5YR 5/2	100	-	-	Clay Loam
4-8	7.5YR 6/2	95	7.5YR 5/6	5	Clay Loam
8-12	7.5YR 6/2	90	7.5YR 5/6	10	Silty Clay
12-18	7.5YR 6/1	85	7.5YR 5/6	15	Silty Clay
18-25+	7.5YR 6/2	90	7.5YR 5/6	10	Sandy Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Project/Site: Slingshot Stream & Wetland Mitigation Site

County, State: Rockingham, NC

Sampling Point/ Coordinates: Hydric Soil 3/ 36.334515, -79.710766

Investigator: Lewis

Notes: Location of soil profile is depicted on Figure 4 (Existing Conditions).

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	10YR 4/3	100	-	-	Sandy Loam
4-8	10yr 5/6	90	10yr 7/8	10	Sandy Loam
8-12	7.5YR 6/2	90	7.5YR 6/8	10	Loam
12-18	7.5YR 6/1	85	7.5YR 5/6	15	Silty Clay
18-25+	7.5YR 6/2	90	7.5YR 5/6	10	Sandy Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC
218 Snow Avenue
Raleigh, North Carolina 27603
919-215-1693

SOIL BORING LOG

Project/Site: Slingshot Stream & Wetland Mitigation Site

County, State: Rockingham, NC

Sampling Point/ Coordinates: Hydric Soil 4/ 36.336517, -79.710230

Investigator: Lewis

Notes: Location of soil profile is depicted on Figure 4 (Existing Conditions).

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-5	7.5yr 4/1	100	-	-	Loam
5-10	7.5yr 6/1	50	7.5 YR 5/8	20	Clay Loam
10-20	7.5YR 6/2	90	7.5YR 5/6	10	Clay Loam
20-30+	7.5YR 6/1	95	7.5YR 5/6	5	Sandy Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

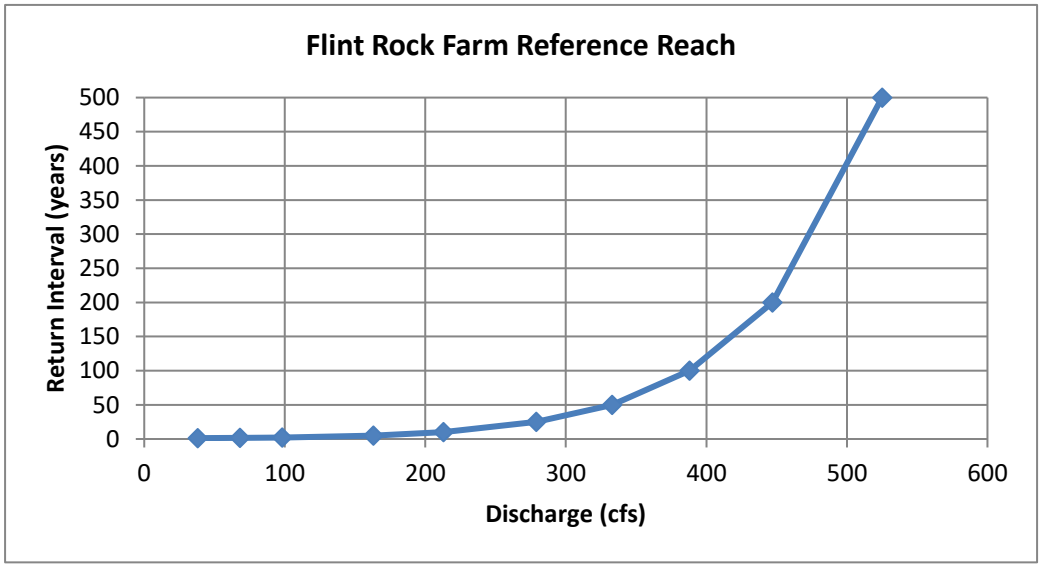
Name/Print: W. Grant Lewis

Appendix C
Flood Frequency Analysis Data

Reference Reaches
Flood Frequency Analaysis-Regional Regression Equation (USGS 2015)

Flint Rock Farm Reference Reach

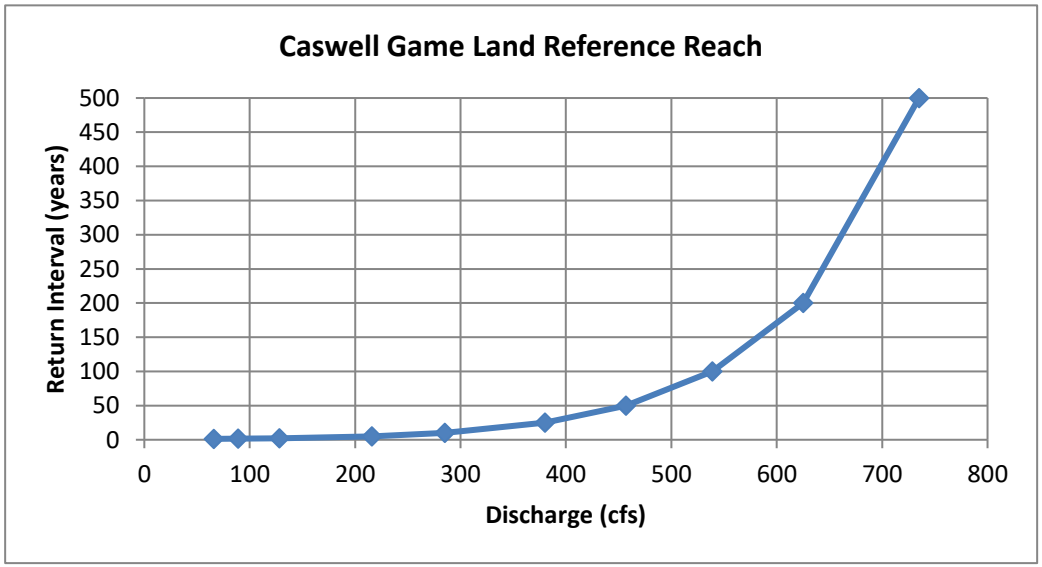
Return Interval (years)	Discharge (cfs)
1.3	**38**
1.5	**68**
2	98.2
5	163
10	213
25	279
50	333
100	388
200	447
500	525



Note: Bold values are interpolated.

Caswell Reference Reach

Return Interval (years)	Discharge (cfs)
1.3	**66**
1.5	**89**
2	128
5	216
10	285
25	380
50	457
100	539
200	625
500	735



Appendix D
Jurisdictional Determination Info

SAW-2018-01170

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2018-01170** County: **Rockingham** U.S.G.S. Quad: **NC-Reidsville**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner: **NCDEQ DMS**
Attn: Tim Baumgartner
Address: **1619 Mail Service Center**
Raleigh, NC 27699-1619

Size (acres)	**~12**	Nearest Town	**Reidsville**
Nearest Waterway	**UT to Troublesome Creek / Lake Hunt**	River Basin	**Cape Fear**
USGS HUC	**03030002**	Coordinates	**36.333480 N, -79.715103 W**

Location description: **The project area is located approximately 0.1 mile north of the northern terminus of Harbor Road, near Reidsville, Rockingham County, North Carolina. The Project Area is shown as the "Slingshot Creek Stream Restoration Site Easement" on the attached Figure 3, titled "Slingshot Creek Stream and Wetland Mitigation Site Potential Waters of the US."**

Indicate Which of the Following Apply:

A. Preliminary Determination

☒ **There appear to be waters including wetlands, on the above described project area, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). The waters including wetlands, have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. The approximate boundaries of these waters are shown on the enclosed delineation map dated August 2018. Therefore this preliminary jurisdiction determination may be used in the permit evaluation process, including determining compensatory mitigation. For purposes of computation of impacts, compensatory mitigation requirements, and other resource protection measures, a permit decision made on the basis of a preliminary JD will treat all waters and wetlands that would be affected in any way by the permitted activity on the site as if they are jurisdictional waters of the U.S. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). However, you may request an approved JD, which is an appealable action, by contacting the Corps district for further instruction.**

☐ There appear to be waters including wetlands, on the above described project area/property, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). However, since the waters including wetlands, have not been properly delineated, this preliminary jurisdiction determination may not be used in the permit evaluation process. Without a verified wetland delineation, this preliminary determination is merely an effective presumption of CWA/RHA jurisdiction over all of the waters including wetlands, at the project area, which is not sufficiently accurate and reliable to support an enforceable permit decision. We recommend that you have the waters including wetlands, on your project area/property delineated. As the Corps may not be able to accomplish this wetland delineation in a timely manner, you may wish to obtain a consultant to conduct a delineation that can be verified by the Corps.

B. Approved Determination

☐ There are Navigable Waters of the United States within the above described project area/property subject to the permit requirements of Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403) and Section 404 of the Clean Water Act (CWA)(33 USC § 1344). Unless there is a change in law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

☐ There are waters including wetlands, on the above described project area/property subject to the permit requirements of Section 404 of the Clean Water Act (CWA) (33 USC § 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

☐ We recommend you have the waters including wetlands, on your project area/property delineated. As the Corps may not be able to accomplish this wetland delineation in a timely manner, you may wish to obtain a consultant to conduct a delineation that can be verified by the Corps.

☐ The waters including wetlands, on your project area/property have been delineated and the delineation has been verified by the Corps. The approximate boundaries of these waters are shown on the enclosed delineation map dated MAP DATE. If you wish to have the delineation surveyed, the Corps can review and verify the survey upon completion. Once verified, this survey will

provide an accurate depiction of all areas subject to CWA and/or RHA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

☐ The waters including wetlands, have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on SURVEY SIGNED DATE. Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

☐ There are no waters of the U.S., to include wetlands, present on the above described project area/property which are subject to the permit requirements of Section 404 of the Clean Water Act (33 USC 1344). Unless there is a change in the law or our published regulations, this determination may be relied upon for a period not to exceed five years from the date of this notification.

☐ The property is located in one of the 20 Coastal Counties subject to regulation under the Coastal Area Management Act (CAMA). You should contact the Division of Coastal Management in Morehead City, NC, at (252) 808-2808 to determine their requirements.

Placement of dredged or fill material within waters of the US, including wetlands, without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). Placement of dredged or fill material, construction or placement of structures, or work within navigable waters of the United States without a Department of the Army permit may constitute a violation of Sections 9 and/or 10 of the Rivers and Harbors Act (33 USC § 401 and/or 403). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **David Bailey at (919) 554-4884 X 30 or David.E.Bailey2@usace.army.mil**.

C. Basis For Determination: See the Preliminary Jurisdictional Determination form dated 5/7/2019.

D. Remarks: None.

E. Attention USDA Program Participants

This delineation/determination has been conducted to identify the limits of Corps' Clean Water Act jurisdiction for the particular site identified in this request. The delineation/determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985. If you or your tenant are USDA Program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

F. Appeals Information **(This information applies only to approved jurisdictional determinations as indicated in B. above)**

This correspondence constitutes an approved jurisdictional determination for the above described site. If you object to this determination, you may request an administrative appeal under Corps regulations at 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and request for appeal (RFA) form. If you request to appeal this determination you must submit a completed RFA form to the following address:

US Army Corps of Engineers
South Atlantic Division
Attn: Jason Steele, Review Officer
60 Forsyth Street SW, Room 10M15
Atlanta, Georgia 30303-8801

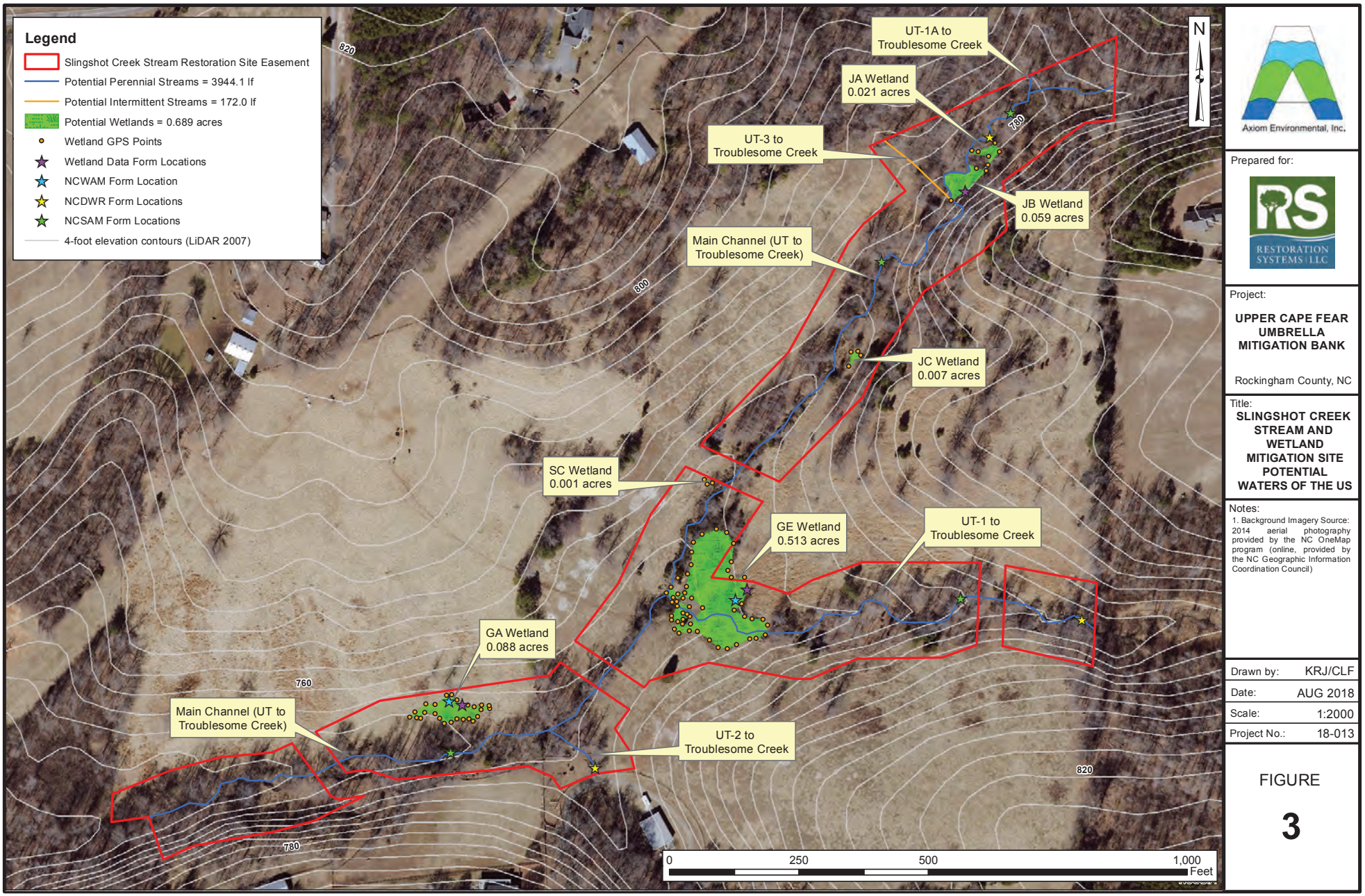
In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be received at the above address by **Not applicable**.
It is not necessary to submit an RFA form to the Division Office if you do not object to the determination in this correspondence.

Corps Regulatory Official:  Digitally signed by BAILEY.DAVID.E.1379283736 Date: 2019.05.07 11:48:14 -04'00'

Date of JD: **5/7/2019** Expiration Date of JD: **Not applicable**

The Wilmington District is committed to providing the highest level of support to the public. To help us ensure we continue to do so, please complete our Customer Satisfaction Survey, located online at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Copy furnished:
Grant Lewis, Axiom Environmental, Inc., 218 Snow Avenue, Raleigh, NC 27603
Sue Homewood, NCDEQ-DWR, 450 W. Hanes Mill Rd, Suite 300, Winston-Salem, NC 27105



Axiom Environmental, Inc.

Prepared for:

RS RESTORATION SYSTEMS | LLC

Project:

UPPER CAPE FEAR UMBRELLA MITIGATION BANK

Rockingham County, NC

Title:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE POTENTIAL WATERS OF THE US

Notes:

1. Background Imagery Source: 2014 aerial photography provided by the NC OneMap program (online, provided by the NC Geographic Information Coordination Council)

Drawn by:	KRJ/CLF
Date:	AUG 2018
Scale:	1:2000
Project No.:	18-013

FIGURE

3

SAW-2018-01170

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **NCDEQ DMS (Attn: Tim Baumgartner)**	File Number: **SAW-2018-01170**	Date: **5/7/2019**

Attached is:	See Section below
☐ INITIAL PROFFERED PERMIT (Standard Permit or Letter of permission)	A
☐ PROFFERED PERMIT (Standard Permit or Letter of permission)	B
☐ PERMIT DENIAL	C
☐ APPROVED JURISDICTIONAL DETERMINATION	D
☒ PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at or http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx or the Corps regulations at 33 CFR Part 331.

A: INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district engineer. Your objections must be received by the district engineer within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district engineer will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district engineer will send you a proffered permit for your reconsideration, as indicated in Section B below.

B: PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit, you may sign the permit document and return it to the district engineer for final authorization. If you received a Letter of Permission (LOP), you may accept the LOP and your work is authorized. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

C: PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

D: APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the district engineer. This form must be received by the division engineer within 60 days of the date of this notice.

E: PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SAW-2018-01170

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT		
REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)		
ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.		
POINT OF CONTACT FOR QUESTIONS OR INFORMATION:		
If you have questions regarding this decision and/or the appeal process you may contact: **District Engineer, Wilmington Regulatory Division** **attn: David E. Bailey** **Raleigh Regulatory Field Office** **3331 Heritage Trade Drive, Suite 105** **Wake Forest, North Carolina 27587**	If you only have questions regarding the appeal process you may also contact: **Mr. Jason Steele, Administrative Appeal Review Officer** **CESAD-PDO** **U.S. Army Corps of Engineers, South Atlantic Division** **60 Forsyth Street, Room 10M15** **Atlanta, Georgia 30303-8801** **Phone: (404) 562-5137**	
RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.		
_____ Signature of appellant or agent.	Date:	Telephone number:

For appeals on Initial Proffered Permits send this form to:

District Engineer, Wilmington Regulatory Division, **David Bailey, 69 Darlington Avenue, Wilmington, North Carolina 28403**

For Permit denials, Proffered Permits and Approved Jurisdictional Determinations send this form to:

Division Engineer, Commander, U.S. Army Engineer Division, South Atlantic, Attn: Mr. Jason Steele, Administrative Appeal Officer, CESAD-PDO, 60 Forsyth Street, Room 10M15, Atlanta, Georgia 30303-8801
Phone: (404) 562-5137

Appendix 2 - PRELIMINARY JURISDICTIONAL DETERMINATION (PJD) FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PJD: 5/7/2019

B. NAME AND ADDRESS OF PERSON REQUESTING PJD: Grant Lewis - Axiom Environmental, Inc, 218 Snow Avenue, Raleigh, NC 27603

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: CESAW-RG-R, SAW-2018-01170

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:
(USE THE TABLE BELOW TO DOCUMENT MULTIPLE AQUATIC RESOURCES AND/OR AQUATIC RESOURCES AT DIFFERENT SITES)

State: NC County/parish/borough: Rockingham City: Reidsville

Center coordinates of site (lat/long in degree decimal format):

Lat.: 36.333480 Long.: -79.715103

Universal Transverse Mercator:

Name of nearest waterbody: UT to Troublesome Creek / Lake Hunt

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

☒ Office (Desk) Determination. Date: 5/7/2019

☒ Field Determination. Date(s): 1/6/2015

TABLE OF AQUATIC RESOURCES IN REVIEW AREA WHICH "MAY BE" SUBJECT TO REGULATORY JURISDICTION.

Site number	Latitude (decimal degrees)	Longitude (decimal degrees)	Estimated amount of aquatic resource in review area (acreage and linear feet, if applicable)	Type of aquatic resource (i.e., wetland vs. non-wetland waters)	Geographic authority to which the aquatic resource "may be" subject (i.e., Section 404 or Section 10/404)
See attached					

Site Number/ Feature Name	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resources
Main Channe (UT to Troublesom Creek)	36.335113	-79.711581	R3UB1/2	2808.4 feet	Non-section 10 - Non-wetland
UT 1 to Troublesome Creek	36.33468	-79.710414	R3UB1/2	968.2 feet	Non-section 10 - Non-wetland
UT 2 to Troublesome Creek	36.333898	-79.712397	R3UB1/2	130.4 feet	Non-section 10 - Non-wetland
UT 3 to Troublesome Creek	36.3371	-79.7102	R2UB1/2	172.0 feet	Non-section 10 - Non-wetland
UT 1A to Troublesome Creek	36.3374	-79.7095	R3UB1/2	37.1 feet	Non-section 10 - Non-wetland
GA	36.334091	-79.713219	PSS1	0.088 acres	Non-section 10 - Wetland
GE	36.334714	-79.711486	PSS1	0.513 acres	Non-section 10 - Wetland
SC	36.33531	-79.711542	PSS1	0.001 acres	Non-section 10 - Wetland
JC	36.335981	-79.710591	PSS1	0.007 acres	Non-section 10 - Wetland
JB	36.33692	-79.709894	PSS1	0.059 acres	Non-section 10 - Wetland
JA	36.337071	-79.709727	PSS1	0.021 acres	Non-section 10 - Wetland

1) The Corps of Engineers believes that there may be jurisdictional aquatic resources in the review area, and the requestor of this PJD is hereby advised of his or her option to request and obtain an approved JD (AJD) for that review area based on an informed decision after having discussed the various types of JDs and their characteristics and circumstances when they may be appropriate.

2) In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an AJD for the activity, the permit applicant is hereby made aware that: (1) the permit applicant has elected to seek a permit authorization based on a PJD, which does not make an official determination of jurisdictional aquatic resources; (2) the applicant has the option to request an AJD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an AJD could possibly result in less compensatory mitigation being required or different special conditions; (3) the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) undertaking any activity in reliance upon the subject permit authorization without requesting an AJD constitutes the applicant's acceptance of the use of the PJD; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a PJD constitutes agreement that all aquatic resources in the review area affected in any way by that activity will be treated as jurisdictional, and waives any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an AJD or a PJD, the JD will be processed as soon as practicable. Further, an AJD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331. If, during an administrative appeal, it becomes appropriate to make an official determination whether geographic jurisdiction exists over aquatic resources in the review area, or to provide an official delineation of jurisdictional aquatic resources in the review area, the Corps will provide an AJD to accomplish that result, as soon as is practicable. This PJD finds that there *"may be"* waters of the U.S. and/or that there *"may be"* navigable waters of the U.S. on the subject review area, and identifies all aquatic features in the review area that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for PJD (check all that apply)

Checked items should be included in subject file. Appropriately reference sources below where indicated for all checked items:

- [x] Maps, plans, plots or plat submitted by or on behalf of the PJD requestor:
  Map: Aerial, soils, and topo maps (Axiom).
- [x] Data sheets prepared/submitted by or on behalf of the PJD requestor.
  - [x] Office concurs with data sheets/delineation report.
  - [ ] Office does not concur with data sheets/delineation report. Rationale: _____.
- [ ] Data sheets prepared by the Corps: _____.
- [ ] Corps navigable waters' study: _____.
- [ ] U.S. Geological Survey Hydrologic Atlas: _____.
  - [ ] USGS NHD data.
  - [ ] USGS 8 and 12 digit HUC maps.
- [x] U.S. Geological Survey map(s). Cite scale & quad name: 1:24,000 Reisdville Quad.
- [x] Natural Resources Conservation Service Soil Survey. Citation: Rockingham Co. Soil Survey.
- [ ] National wetlands inventory map(s). Cite name: _____.
- [ ] State/local wetland inventory map(s): _____.
- [ ] FEMA/FIRM maps: _____.
- [ ] 100-year Floodplain Elevation is: _____.(National Geodetic Vertical Datum of 1929)
- [x] Photographs: [x] Aerial (Name & Date): 2014 NC OneMap.
  or [ ] Other (Name & Date): _____.
- [ ] Previous determination(s). File no. and date of response letter: _____.
- [x] Other information (please specify): LiDAR (NC Floodmaps).

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

_____	_____
Signature and date of Regulatory staff member completing PJD	Signature and date of person requesting PJD (REQUIRED, unless obtaining the signature is impracticable)[1]

[1] Districts may establish timeframes for requestor to return signed PJD forms. If the requestor does not respond within the established time frame, the district may presume concurrence and no additional follow up is necessary prior to finalizing an action.

This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

Digitally signed by BAILEY.DAVID.E.1379283736
Date: 2019.05.07 11:43:36 -04'00'

Signature and date of
Regulatory Project Manager
(REQUIRED)

W. Grant Lewis

Digitally signed by W. Grant Lewis
DN: cn=W. Grant Lewis, o=Axiom Environmental, Inc., ou, email=glewis@axiomenvironmental.org, c=US
Date: 2018.01.02 09:45:03 -05'00'

Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining
the signature is impracticable)

A. PARCEL INFORMATION

Street Address: 1400 Front Street

City, State: Reidsville, NC

County: Rockingham

Parcel Index Number(s) (PIN): 170686

B. REQUESTOR INFORMATION

Name: Grant Lewis - Axiom Environmental, Inc

Mailing Address: 218 Snow Avenue

Raleigh, NC 27603

Telephone Number: (919) 215-1693

Electronic Mail Address: glewis@axiomenvironmental.org

Select one:

- ☐ I am the current property owner.
- ☑ I am an Authorized Agent or Environmental Consultant[1]
- ☐ Interested Buyer or Under Contract to Purchase
- ☐ Other, please explain. _____

_____

C. PROPERTY OWNER INFORMATION[2]

Name: Robert L. Wheless

Mailing Address: 1400 Front Street

Reidsville, NC 27320

Telephone Number: (336) 634-3862

Electronic Mail Address: _____

[1] Must provide completed Agent Authorization Form/Letter.

[2] Documentation of ownership also needs to be provided with request (copy of Deed, County GIS/Parcel/Tax Record).

D. PROPERTY ACCESS CERTIFICATION[3,4]

By signing below, I authorize representatives of the Wilmington District, U.S. Army Corps of Engineers (Corps) to enter upon the property herein described for the purpose of conducting on-site investigations, if necessary, and issuing a jurisdictional determination pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899. I, the undersigned, am either a duly authorized owner of record of the property identified herein, or acting as the duly authorized agent of the owner of record of the property.

W. Grant Lewis

Print Name

Capacity: ☐ Owner ☑ Authorized Agent[5]

Date

* Please see attached Agent Authorization form

Signature

E. REASON FOR JD REQUEST: (Check as many as applicable)

☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all aquatic resources.

☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all jurisdictional aquatic resources under Corps authority.

☑ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps, and the JD would be used to avoid and minimize impacts to jurisdictional aquatic resources and as an initial step in a future permitting process.

☐ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps; this request is accompanied by my permit application and the JD is to be used in the permitting process.

☐ I intend to construct/develop a project or perform activities in a navigable water of the U.S. which is included on the district Section 10 list and/or is subject to the ebb and flow of the tide.

☐ A Corps JD is required in order obtain my local/state authorization.

☐ I intend to contest jurisdiction over a particular aquatic resource and request the Corps confirm that jurisdiction does/does not exist over the aquatic resource on the parcel.

☐ I believe that the site may be comprised entirely of dry land.

☐ Other:_____

[3] For NCDOT requests following the current NCDOT/USACE protocols, skip to Part E.

[4] If there are multiple parcels owned by different parties, please provide the following for each additional parcel on a continuation sheet.

[5] Must provide agent authorization form/letter signed by owner(s).

F. JURISDICTIONAL DETERMINATION (JD) TYPE (Select One)

☑ I am requesting that the Corps provide a preliminary JD for the property identified herein.

A Preliminary Jurisdictional Determination (PJD) provides an indication that there may be "waters of the United States" or "navigable waters of the United States"on a property. PJDs are sufficient as the basis for permit decisions. For the purposes of permitting, all waters and wetlands on the property will be treated as if they are jurisdictional "waters of the United States". PJDs cannot be appealed (33 C.F.R. 331.2); however, a PJD is "preliminary" in the sense that an approved JD can be requested at any time. PJDs do not expire.

☐ I am requesting that the Corps provide an approved JD for the property identified herein.

An Approved Jurisdictional Determination (AJD) is a determination that jurisdictional "waters of the United States" or "navigable waters of the United States" are either present or absent on a site. An approved JD identifies the limits of waters on a site determined to be jurisdictional under the Clean Water Act and/or Rivers and Harbors Act. Approved JDs are sufficient as the basis for permit decisions. AJDs are appealable (33 C.F.R. 331.2). The results of the AJD will be posted on the Corps website. A landowner, permit applicant, or other "affected party" (33 C.F.R. 331.2) who receives an AJD may rely upon the AJD for five years (subject to certain limited exceptions explained in Regulatory Guidance Letter 05-02).

☐ I am unclear as to which JD I would like to request and require additional information to inform my decision.

G. ALL REQUESTS

☑ Map of Property or Project Area. This Map must clearly depict the boundaries of the review area.

☑ Size of Property or Review Area ~12 acres.

☐ The property boundary (or review area boundary) is clearly physically marked on the site.

H. REQUESTS FROM CONSULTANTS

☑ Project Coordinates (Decimal Degrees): Latitude: 36.333480
Longitude: -79.715103

☑ A legible delineation map depicting the aquatic resources and the property/review area. Delineation maps must be no larger than 11x17 and should contain the following: (Corps signature of submitted survey plats will occur after the submitted delineation map has been reviewed and approved).[6]

- North Arrow
- Graphical Scale
- Boundary of Review Area
- Date
- Location of data points for each Wetland Determination Data Form or tributary assessment reach.

For Approved Jurisdictional Determinations:

- Jurisdictional wetland features should be labeled as Wetland Waters of the US, 404 wetlands, etc. Please include the acreage of these features.
- Jurisdictional non-wetland features (i.e. tidal/navigable waters, tributaries, impoundments) should be labeled as Non-Wetland Waters of the US, stream, tributary, open water, relatively permanent water, pond, etc. Please include the acreage or linear length of each of these features as appropriate.
- Isolated waters, waters that lack a significant nexus to navigable waters, or non-jurisdictional upland features should be identified as Non-Jurisdictional. Please include a justification in the label regarding why the feature is non-jurisdictional (i.e. "Isolated", "No Significant Nexus", or "Upland Feature"). Please include the acreage or linear length of these features as appropriate.

For Preliminary Jurisdictional Determinations:

- Wetland and non-wetland features should not be identified as Jurisdictional, 404, Waters of the United States, or anything that implies jurisdiction. These features can be identified as Potential Waters of the United States, Potential Non-wetland Waters of the United States, wetland, stream, open water, etc. Please include the acreage and linear length of these features as appropriate.

☑ Completed Wetland Determination Data Forms for appropriate region
(at least one wetland and one upland form needs to be completed for each wetland type)

[6] Please refer to the guidance document titled "Survey Standards for Jurisdictional Determinations" to ensure that the supplied map meets the necessary mapping standards. http://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Jurisdiction/

- [x] Completed appropriate Jurisdictional Determination form
  - **PJDs,** please complete a Preliminary Jurisdictional Determination Form[7] and include the Aquatic Resource Table
  - **AJDs**, please complete an Approved Jurisdictional Determination Form[8]
- [x] Vicinity Map
- [x] Aerial Photograph
- [x] USGS Topographic Map
- [x] Soil Survey Map
- [x] Other Maps, as appropriate (e.g. National Wetland Inventory Map, Proposed Site Plan, previous delineation maps, LIDAR maps, FEMA floodplain maps)
- [ ] Landscape Photos (if taken)
- [x] NCSAM and/or NCWAM Assessment Forms and Rating Sheets
- [x] NC Division of Water Resources Stream Identification Forms
- [ ] Other Assessment Forms

[7] www.saw.usace.army.mil/Portals/59/docs/regulatory/regdocs/JD/RGL_08-02_App_A_Prelim_JD_Form_fillable.pdf
[8] Please see http://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Jurisdiction/

Principal Purpose: The information that you provide will be used in evaluating your request to determine whether there are any aquatic resources within the project area subject to federal jurisdiction under the regulatory authorities referenced above.
Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public, and may be made available as part of a public notice as required by federal law. Your name and property location where federal jurisdiction is to be determined will be included in the approved jurisdictional determination (AJD), which will be made available to the public on the District's website and on the Headquarters USACE website.
Disclosure: Submission of requested information is voluntary; however, if information is not provided, the request for an AJD cannot be evaluated nor can an AJD be issued.

Appendix E
T&E Correspondence
NHP Letters
Categorical Exclusion Document

From:	Allison Keith
To:	"jhamby@restorationsystems.com"
Cc:	Grant Lewis
Subject:	Slingshot T&E Biological Conclusion
Date:	Friday, May 25, 2018 10:56:00 AM

Good Morning,

This email provides a summary of the results of an Axiom Environmental, Inc. (Axiom) federally protected species survey at the Slingshot Creek Mitigation site in Rockingham County. The approximately 12-acre site is located north of Highway 158, 2 miles west of Reidsville, NC.

Smooth Coneflower

Smooth coneflower (*Echinacea laevigata*) is typically found on calcareous, basic, or circumneutral soils within clearcuts, power line right-of-ways, roadsides, and open woodlands where there is abundant light and little herbaceous competition. Suitable habitat for smooth coneflower occurs within open areas of the site, field borders, woodland edges, and forested areas along stream channels. Systematic surveys performed within areas of suitable habitat were performed by Axiom biologists Allison Keith and Andrew Radecki on May 21, 2018, and identified no individuals. As of May 25, 2018, the NCNHP has no record of this species within 1.0 mile of the site. The proposed project will have No Effect on smooth coneflower.

We appreciate the opportunity to assist with this project. If you have any questions about this information, please let us know.

Sincerely,
Allison Keith

Allison Keith
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603
Cell (423)400-8882
akeith@axiomenvironmental.org

Axiom Environmental, Inc.

Axiom Environmental, Inc.

218 Snow Avenue, Raleigh, North Carolina 27603 919 270-9306

May 28, 2015

Worth Creech
Restoration Systems
1101 Haynes St #211
Raleigh, NC 27604

Re: Federally Protected Species Assessment Results **15-007.05**
Slingshot Creek, Reidsville, Rockingham County

Dear Mr. Creech

Axiom Environmental, Inc. (Axiom) is pleased to provide you with this summary letter of the results of a survey for federally protected species on an approximately 12-acre tract (hereafter referred to as the site) planned for Slingshot Creek Mitigation Site in Reidsville, NC (see attached map). The survey was conducted by three Axiom biologists, Kenan Jernigan, Ryan Gibbons, and Allison Keith, on May 28, 2015.

Site Description

The site is in the Piedmont physiographic region of the state in southeastern Rockingham County. The site contains dissected, irregular plains with moderate to steep slopes and low to moderate gradient streams. Land use at the site is characterized by livestock pastures where livestock have unrestricted access to the streams. The majority of the site is dominated by herbaceous vegetation with some scattered shrubs, although, a narrow riparian fringe has developed along the stream margins that contains opportunistic species as well as a few mature trees. Dominant herbaceous species include a multitude of grasses, common pokeweed (*Phytolacca americana*), oxeye daisy (*Leucanthemum vulgare*), grape (*Muscadinia* sp.), and Japanese honeysuckle (*Lonicera japonica*). The scattered shrubs include winged sumac (*Rhus copallinum*), sweetgum (*Liquidambar styraciflua*), redbud (*Cercis canadensis*) and flowering dogwood (*Cornus florida*). The riparian fringes support narrow forests dominated by a canopy of loblolly pine (*Pinus taeda*), eastern red cedar (*Juniperus virginiana),* sweetgum (*Liquidambar styraciflua*), and a mix of oaks (*Quercus* sp.).

Federally Protected Species

The U.S. Fish and Wildlife Service (USFWS) has identified one species with ranges that extend into Rockingham County: Smooth coneflower (*Echinacea laevigata*).

A brief description of the species' habitat requirements follows, along with the Biological Conclusion rendered based on survey results in the study area. Habitat requirements for this species are based on the current best available information from referenced literature and/or USFWS.

Smooth coneflower
USFWS optimal survey window: late May-October

Habitat Description: Smooth coneflower, a perennial herb, is typically found in meadows, open woodlands, the ecotonal regions between meadows and woodlands, cedar barrens, dry limestone bluffs, clear cuts, and roadside and utility right-of-ways. In North Carolina, the species normally grows in magnesium- and calcium-rich soils associated with gabbro and diabase parent material, and typically occurs in Iredell, Misenheimer, and Picture soil series. It grows best where there is abundant sunlight, little competition in the herbaceous layer, and periodic disturbances (e.g., regular fire regime, well-timed mowing, and careful clearing) that prevents encroachment of shade producing woody shrubs and trees. On sites where woody succession is held in check, it is characterized by a number of species with prairie affinities.

Biological Conclusion: No Effect. Suitable habitat for smooth coneflower occurs throughout the study area within utility line corridors, along woodland edges, and within residential yards. A review of NCNHP records, updated April 2015, indicates no known smooth coneflower occurrences within 1.0 mile of the study area. Axiom biologists visited the UNC Botanical Garden on May 28, 2015 and found their smooth coneflowers to be in bloom. Subsequently, systematic surveys were performed in all areas of suitable habitat on the same day and no individuals of this species were identified within the study area.

I hope this summary is sufficient for your review. Should you have any questions, please do not hesitate to send me an email (kjernigan@axiomenvironmental.org) or give me a call (919-215-9465).

Sincerely,
AXIOM ENVIRONMENTAL, INC.

Kenan R. Jernigan
Project Scientist

North Carolina Department of Natural and Cultural Resources
Natural Heritage Program

Governor Roy Cooper | Secretary Susi H. Hamilton

NCNHDE-4944

December 20, 2017

Phillip Perkinson
Axiom Environmental Inc.
218 Snow Avenue
Raleigh, NC 27612
RE: Slingshot

Dear Phillip Perkinson:

The North Carolina Natural Heritage Program (NCNHP) appreciates the opportunity to provide information about natural heritage resources for the project referenced above.

A query of the NCNHP database, based on the project area mapped with your request, indicates that there are no records for rare species, important natural communities, natural areas, or conservation/managed areas within the proposed project boundary. Please note that although there may be no documentation of natural heritage elements within the project boundary, it does not imply or confirm their absence; the area may not have been surveyed. The results of this query should not be substituted for field surveys where suitable habitat exists. In the event that rare species are found within the project area, please contact the NCNHP so that we may update our records.

The attached 'Potential Occurrences' table summarizes rare species and natural communities that have been documented within a one-mile radius of the property boundary. The proximity of these records suggests that these natural heritage elements may potentially be present in the project area if suitable habitat exists and is included for reference. Tables of natural areas and conservation/managed area within a one-mile radius of the project area, if any, are also included in this report.

Please note that natural heritage element data are maintained for the purposes of conservation planning, project review, and scientific research, and are not intended for use as the primary criteria for regulatory decisions. Information provided by the NCNHP database may not be published without prior written notification to the NCNHP, and the NCNHP must be credited as an information source in these publications. Maps of NCNHP data may not be redistributed without permission.

The NC Natural Heritage Program may follow this letter with additional correspondence if a Dedicated Nature Preserve (DNP), Registered Heritage Area (RHA), Clean Water Management Trust Fund (CWMTF) easement, or Federally-listed species are documented near the project area.

If you have questions regarding the information provided in this letter or need additional assistance, please contact Rodney A. Butler at rodney.butler@ncdcr.gov or 919.707.8603.

Sincerely,
NC Natural Heritage Program

MAILING ADDRESS:
1651 Mail Service Center
Raleigh, NC 27699-1651

Telephone: (919) 707-8107
www.ncnhp.org

LOCATION:
121 West Jones Street
Raleigh, NC 27603

Natural Heritage Element Occurrences, Natural Areas, and Managed Areas Within a One-mile Radius of the Project Area
Slingshot
December 20, 2017
NCNHDE-4944

Element Occurrences Documented Within a One-mile Radius of the Project Area

Taxonomic Group	EO ID	Scientific Name	Common Name	Last Observation Date	Element Occurrence Rank	Accuracy	Federal Status	State Status	Global Rank	State Rank
Dragonfly or Damselfly	33770	Somatochlora georgiana	Coppery Emerald	2004-Pre	H?	5-Very Low	---	Significantly Rare	G3G4	S2?
Natural Community	27686	Dry Basic Oak--Hickory Forest	---	2010	BC	2-High	---	---	G2G3	S2S3

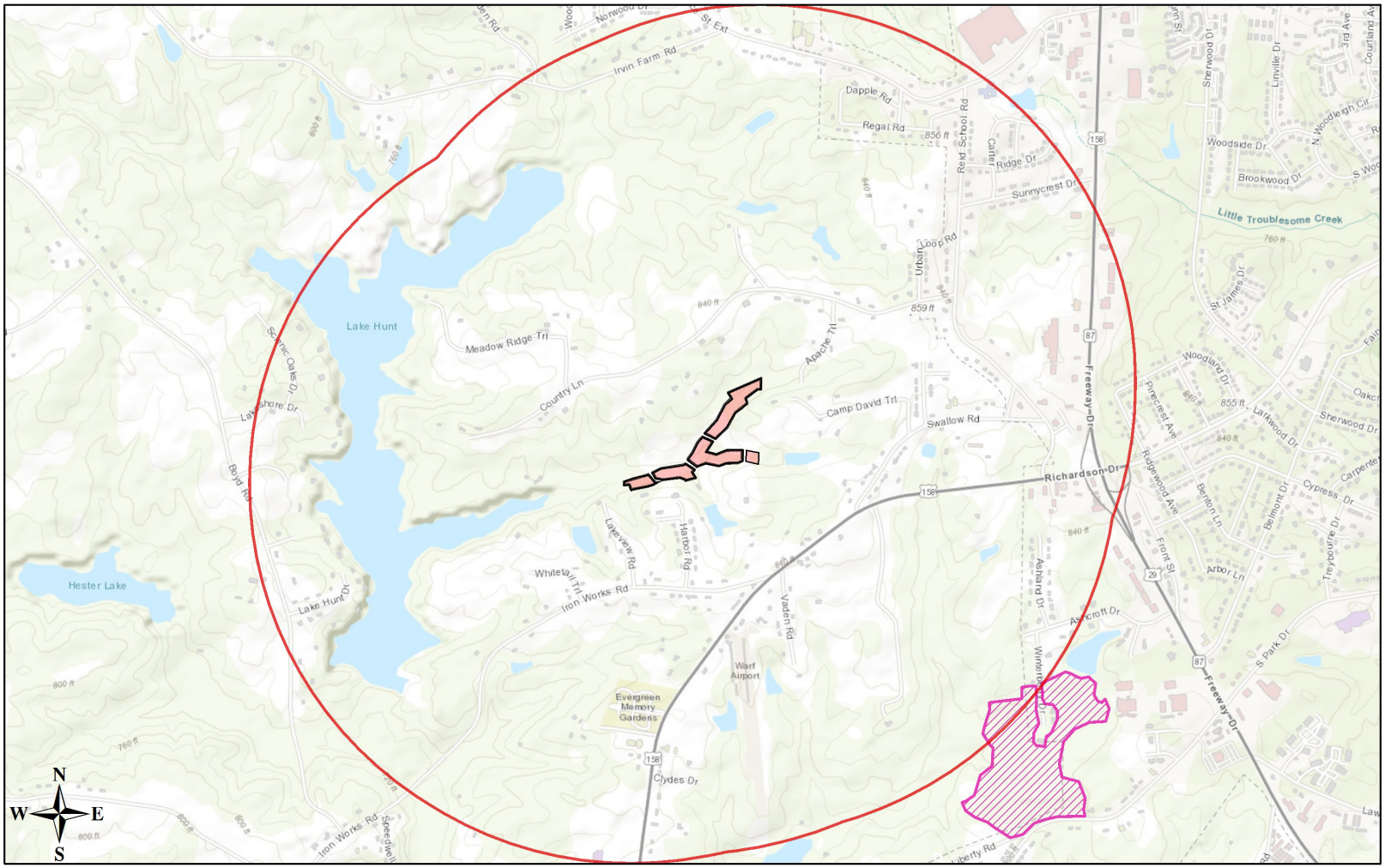
Natural Areas Documented Within a One-mile Radius of the Project Area

Site Name	Representational Rating	Collective Rating
Warf Airfield Forest	R5 (General)	C5 (General)

No Managed Areas are Documented Within a One-mile Radius of the Project Area

Definitions and an explanation of status designations and codes can be found at https://ncnhde.natureserve.org/content/help. Data query generated on December 20, 2017; source: NCNHP, Q4 October 2017. Please resubmit your information request if more than one year elapses before project initiation as new information is continually added to the NCNHP database.

NCNHDE-4944: Slingshot



December 20, 2017

- Project Boundary
- Buffered Project Boundary
- NHP Natural Area (NHNA)

1:23,283

0 0.2 0.4 0.8 mi

0 0.3 0.6 1.2 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Slingshot Stream and Wetland Mitigation Site

Rockingham County, North Carolina

DMS Project No. 100058

Categorical Exclusion/ERTR

Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

1652 Mail Service Center

Raleigh, NC 27699-1652

June 2018

TASK 1 b.) Categorical Exclusion Summary:

Part 1: General Project Information

(Attached) Part 2: All Projects

Regulation/Questions

Coastal Zone Management Act

Not applicable – project is not located within a CAMA county.

CERCLA

No issue within project boundaries – please see the attached Executive Summary from a Limited Phase 1 Site Assessment performed by Environmental Data Resources, Inc. (EDR) on June 12th, 2018.

National Historic Preservation Act (Section 106)

No Issue – please see attached letter from Ramona M. Bartos- State of the Historic Preservation Office.

Uniform Act

Please see the attached letter, sent to the landowner June 12th, 2018.

Part 3: Ground-Disturbing Activates Regulation/Questions

American Indian Religious Freedom Act (AIRFA)

Not applicable – project is not located in a county claimed as "territory" by the Eastern Band of Cherokee Indians.

Antiquities Act (AA)

Not applicable – project is not located on Federal land.

Archaeological Resources Protection Act (ARPA)

Not applicable – project is not located on federal or Indian lands.

Endangered Species Act (ESA)

Project activities were determined to pose "No Effect" to Endangered or Threatened Species. The proposed project will occur in existing agricultural fields. There is not Potential Habitat at Site for any of the T&E species and no endangered species were observed during field surveys. Record searches from the Natural Heritage Program indicate that federally protected species have not been documented within a mile of the Site boundaries.

Executive Order 13007 (Indian Sacred Sites)

Not applicable – project is not located in a county claimed as "territory" by the Eastern Band of Cherokee Indians.

Farmland Protection Policy Act (FPPA)

Please find the attached Form AD-1006 and letter from Milton Cortes of the NRCS.

Fish and Wildlife Coordination Act (FWCA)

Please find the attached response from the Fish and Wildlife Service

Land & Water Conservation Fund Act (Section 6(f))

Not applicable

Magnuson-Stevens Fishery Conservation and management Act (Essential Fish Habitat)

Not applicable – project is not located within an estuarine system

Migratory Bird Treaty Act (MBTA)

USFWS has no recommendation with the project relative to the MBTA

Wilderness Act

Not applicable – the project is not located within a Wilderness area.

North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

June 18, 2018

JD Hamby
Restoration Systems, LLC
1101 Haynes Street, Suite 211
Raleigh, NC 27604

Re: Slingshot Stream & Wetland Mitigation Site, 222 Harbor Road, Reidsville, Rockingham County, ER 18-1209

Dear Mr. Hamby:

Thank you for your letter of May 18, 2018, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

From:	Elizabeth Toombs
To:	Browning, Kimberly D CIV USARMY CESAW (US)
Subject:	[Non-DoD Source] RE: US Army Corps of Engineers Public Notice SAW-2018-01170 (UNCLASSIFIED)
Date:	Wednesday, December 05, 2018 11:19:28 AM

Many thanks for the review request, Ms. Browning. Rockingham County, North Carolina is outside the Cherokee Nation's Area of Interest. Thus, this Office respectfully defers to federally recognized Tribes that have an interest in this landbase.

Thank you for the opportunity to comment upon this proposed undertaking. Please contact me if there are any questions or concerns.

Wado,

Elizabeth Toombs, Tribal Historic Preservation Officer

Cherokee Nation

Tribal Historic Preservation Office

PO Box 948

Tahlequah, OK 74465-0948

918.453.5389

From: Browning, Kimberly D CIV USARMY CESAW (US) [mailto:Kimberly.D.Browning@usace.army.mil]
Sent: Thursday, November 8, 2018 11:19 AM
To: Baumgartner, Tim <tim.baumgartner@ncdenr.gov>
Cc: Schaffer, Jeff <jeff.schaffer@ncdenr.gov>; worth@restorationsystems.com; John Hamby <jhamby@restorationsystems.com>
Subject: <EXTERNAL> US Army Corps of Engineers Public Notice SAW-2018-01170 (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

You are hereby notified that the Wilmington District, United States Army Corps of Engineers has issued a Public Notice. The text of this document can be found on the RIBITS web site at: Blockedhttps://ribits.usace.army.mil . To access the public notices, first select the Wilmington District from the Filter View drop-down menu in the lower left-hand corner, and then select the Bank & ILF Establishment tab. NCDMS Slingshot Stream and Wetland Mitigation Site.

The current notice involves:

Corps Action ID#: SAW-2018-01170

Issue Date: November 8, 2018

County: Rockingham

Applicant: NC Division of Mitigation Services

Expiration Date: December 8, 2018

Point of Contact: Kim Browning

PROJECT DESCRIPTION: The purpose of the proposal is the modification of the Division of Mitigation Services In-Lieu-Fee Program Instrument to add an additional mitigation site. The Slingshot Stream and Wetland Mitigation Site proposes the restoration and enhancement of approximately 3,827 linear feet of stream, and the enhancement and reestablishment of 1.65 acres of wetlands. Stream restoration activities will include restoring appropriate dimension, pattern, and profile with Priority 1 restoration, which will improve wetland hydrology. Stabilization structures will be installed, which will also provide habitat. Native riparian buffers will be established, and all reaches will have fencing for livestock exclusion. Enhancement activities will include cattle exclusion, installing bed structures to enhance pool habitat, invasive treatment, and establishing a native woody riparian buffer.

CLASSIFICATION: UNCLASSIFIED

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Slingshot Stream and Wetland Mitigation Site
County Name:	Rockingham
EEP Number:	ID #: 100058 Contract #: 7525
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	JD Hamby
Project Contact Address:	1101 Haynes Street, Suite 211, Raleigh, NC 27604
Project Contact E-mail:	jhamby@restorationsystems.com
EEP Project Manager:	Jeff Schaffer jeff.schaffer@ncdenr.gov

Project Description

The Site is located within Targeted Local Watershed (TLW) 03030002010010. The Site is proposed to include 2328 linear feet of stream restoration, 752 linear feet of stream enhancement (level I), 747 linear feet of stream enhancement (level II), 0.96 acres of reestablished riparian riverine wetlands, and 0.69 acre of enhanced riparian riverine wetland. Site alterations include removing livestock, restoration of streams and wetlands, and planting native, woody vegetation

For Official Use Only

Reviewed By:

7/19/18
Date

EEP Project Manager

Conditional Approved By:

Date

For Division Administrator
FHWA

☐ **Check this box if there are outstanding issues**

Final Approval By:

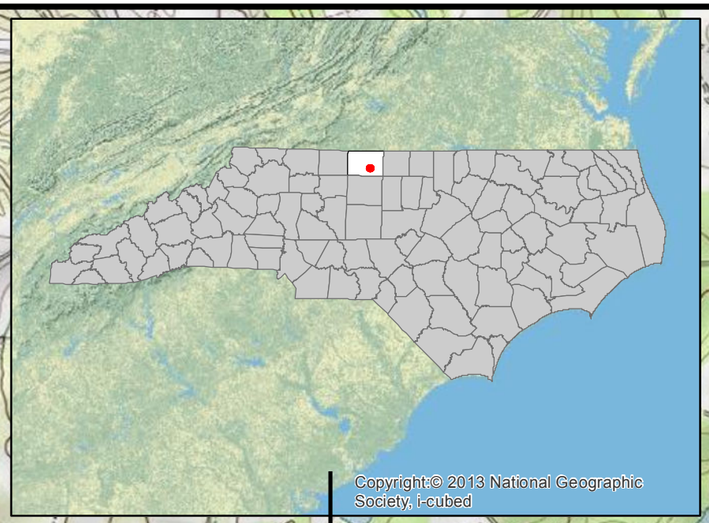
7-18-18
Date

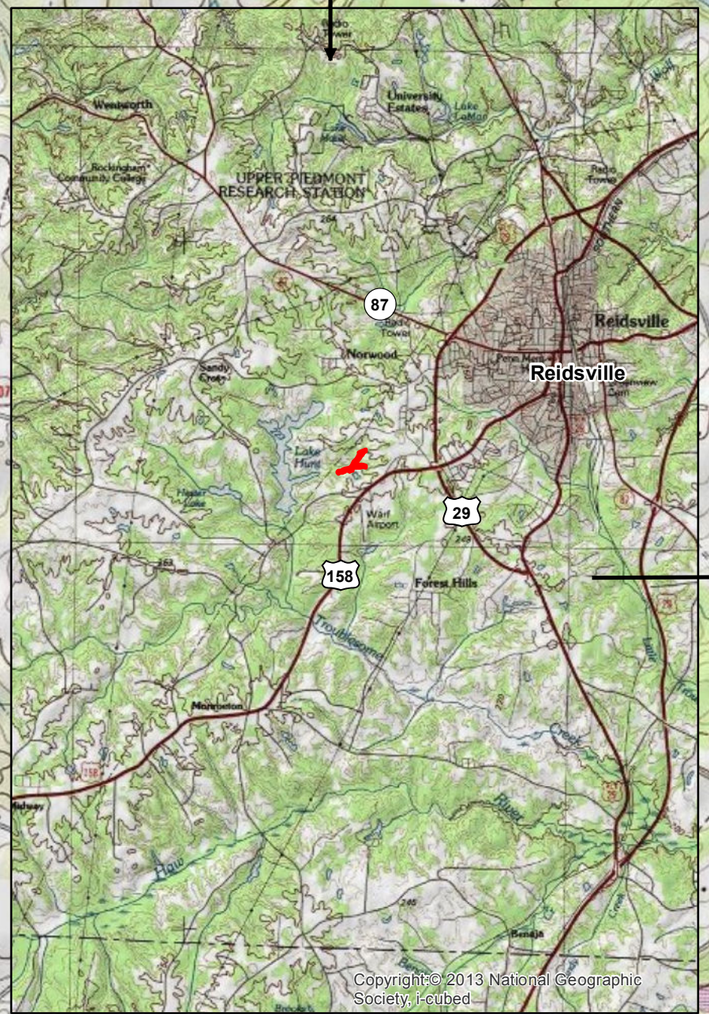
For Division Administrator
FHWA

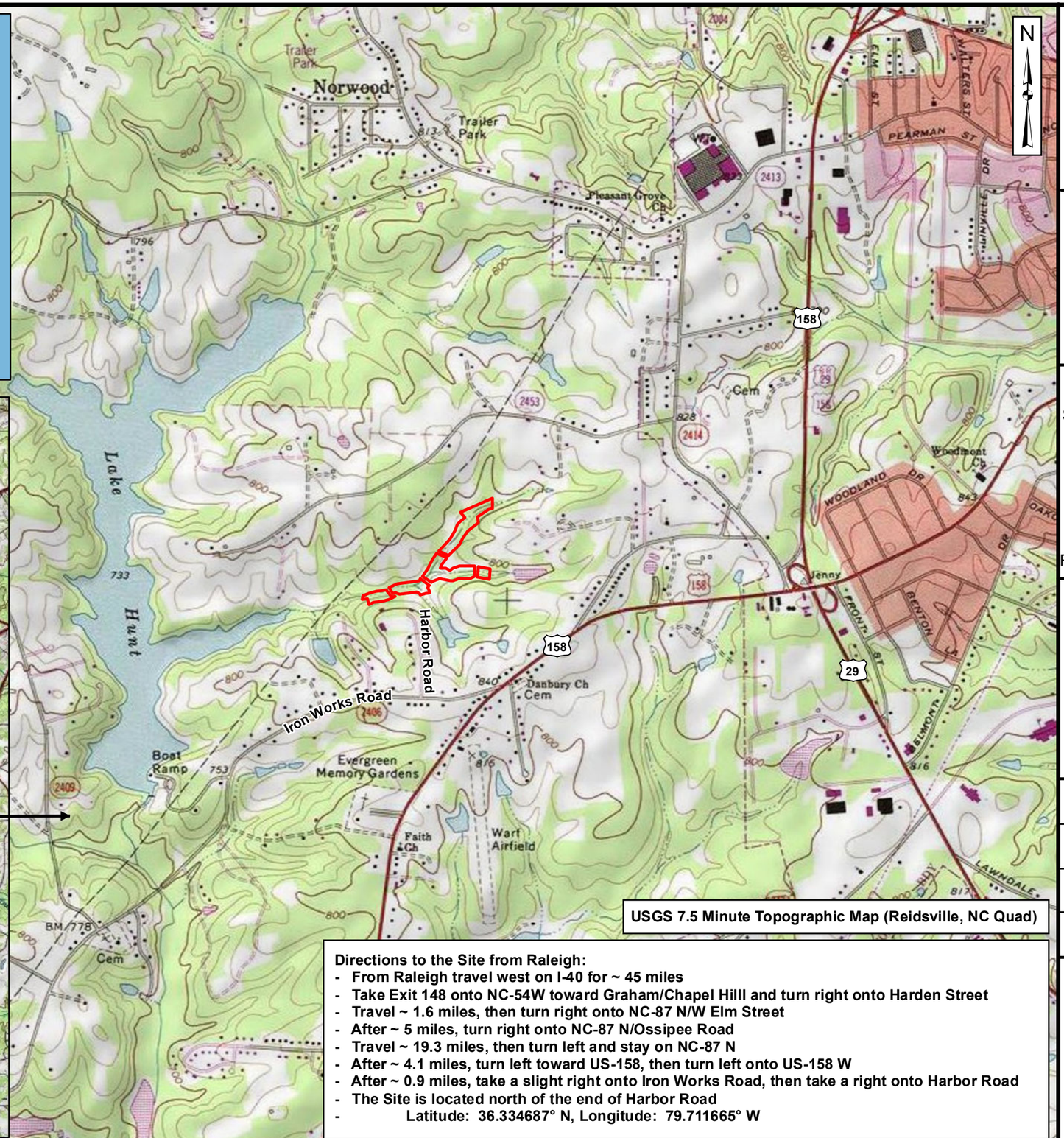
Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☑ Yes ☐ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☑ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☑ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☑ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☑ Yes ☑ No ☐ N/A
6. Is there an approved hazardous mitigation plan?	☑ Yes ☑ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☑ Yes ☐ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☐ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☐ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☐ Yes ☑ No
2. Does the project require the acquisition of real estate?	☐ Yes ☐ No ☑ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☑ Yes ☐ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A







USGS 7.5 Minute Topographic Map (Reidsville, NC Quad)

Directions to the Site from Raleigh:

- From Raleigh travel west on I-40 for ~ 45 miles
- Take Exit 148 onto NC-54W toward Graham/Chapel Hilll and turn right onto Harden Street
- Travel ~ 1.6 miles, then turn right onto NC-87 N/W Elm Street
- After ~ 5 miles, turn right onto NC-87 N/Ossipee Road
- Travel ~ 19.3 miles, then turn left and stay on NC-87 N
- After ~ 4.1 miles, turn left toward US-158, then turn left onto US-158 W
- After ~ 0.9 miles, take a slight right onto Iron Works Road, then take a right onto Harbor Road
- The Site is located north of the end of Harbor Road
- Latitude: 36.334687° N, Longitude: 79.711665° W

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

SITE LOCATION

Drawn by: KRJ

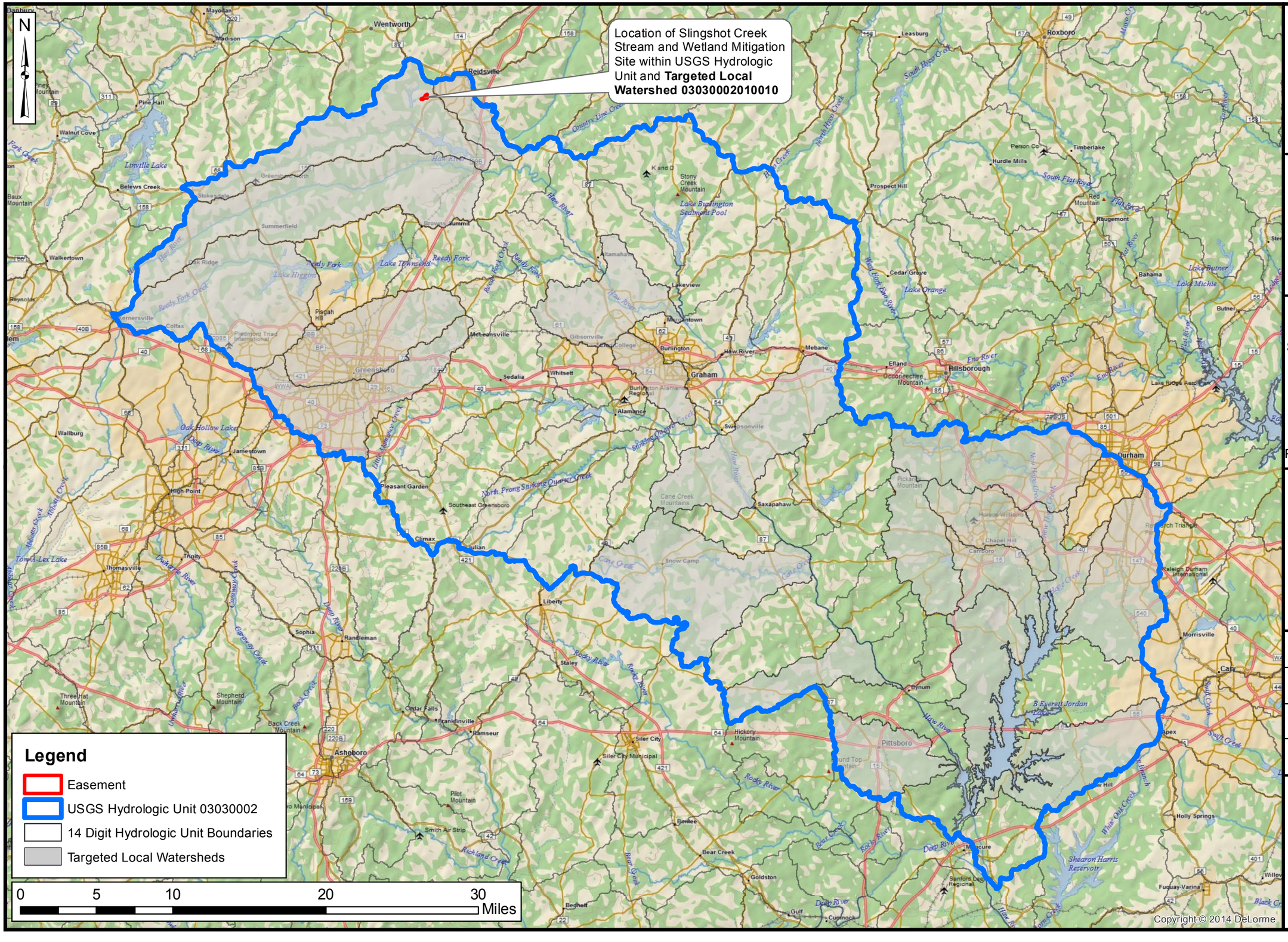
Date: DEC 2017

Scale: 1:20,000

Project No.: 17-001.02

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: KRJ

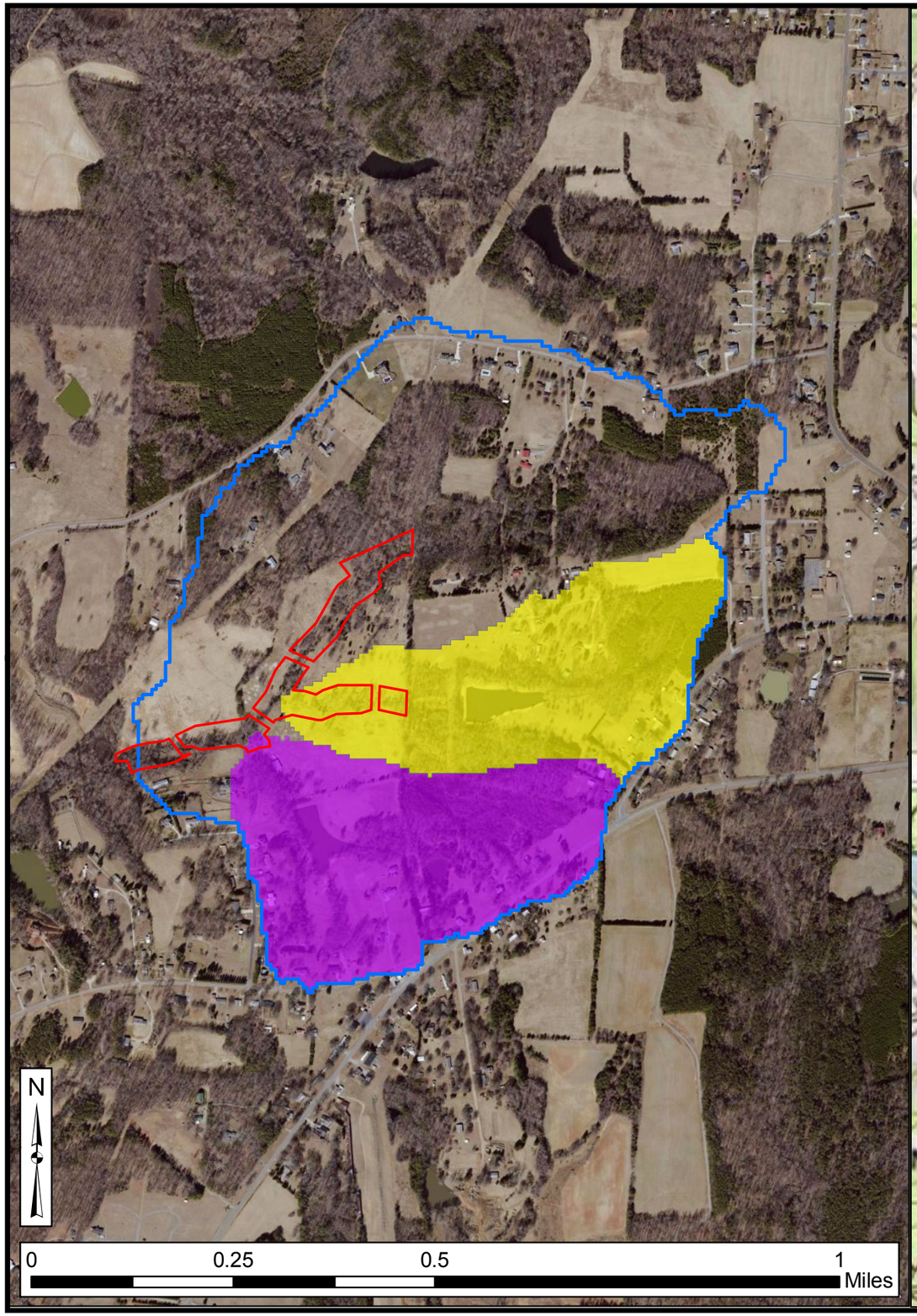
Date: DEC 2017

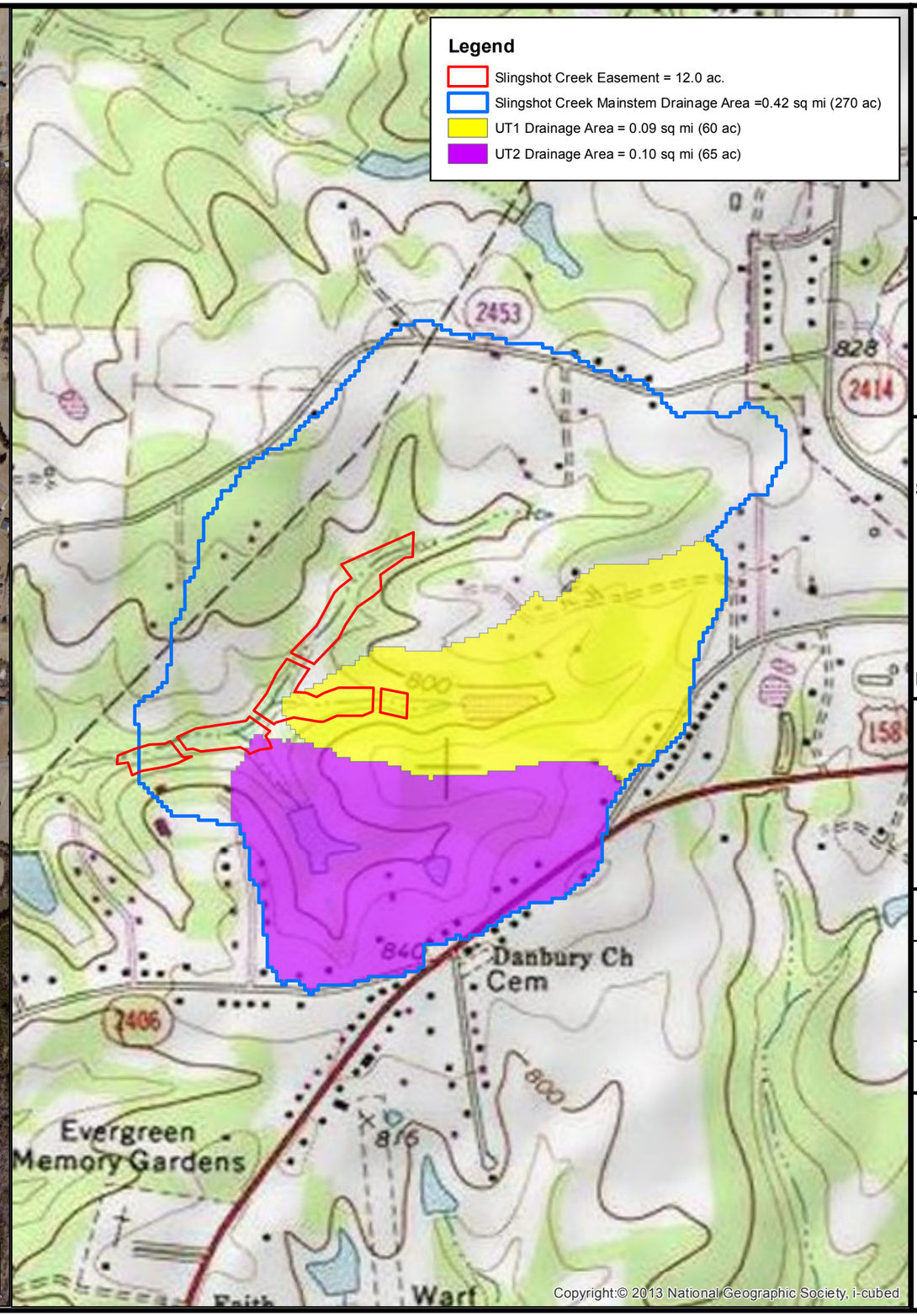
Scale: 1:375,000

Project No.: 17-001.02

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ

Date: DEC 2017

Scale: 1:10,000

Project No.: 17-001.02

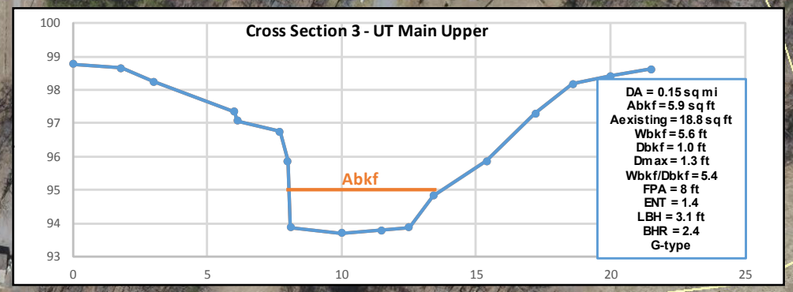
FIGURE

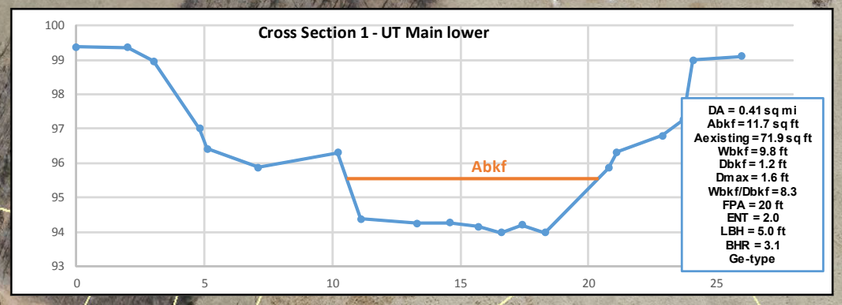
3

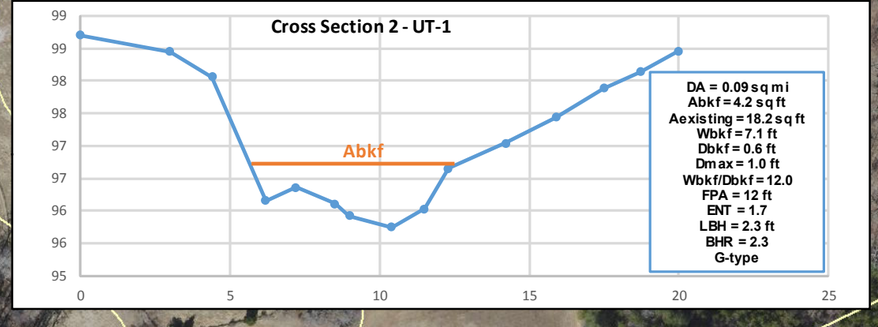
Legend

- Slingshot Creek Easement = 12.0 ac
- Existing Streams = 3907 ft
- Existing Wetlands = 0.69 ac
- Existing Drained Hydric Soils = 0.96 ac
- Cross Sections
- Soil Profile
- NRCS Soil Boundaries

Soil Map Unit	Soil Series
CgB2	Clifford sandy clay laom, 2 to 8 % slopes
CsA	Codorus loam, 0 to 2 % slopes
DcB	Davie sandy loam, 2 to 8 % slopes
FrE2	Fairview-Poplar complex, 15 to 25 % slopes
NaB	Nathalie sandy loam, 2 to 8 % slopes
PpD2	Poplar Forest sandy clay loam, 8 to 15 % slopes







NCSAM Form 4
Score: Medium

XS-3

Main Channel

PpD2

NCSAM Form 3
Score: Low

CgB2

DcB

UT-1

NCSAM Form 2
Score: Low

PpD2

XS-2

NCWAM Form 1
Score: Medium

NCSAM Form 1
Score: Low

CsA

XS-1

FrE2

UT-2

0 250 500 1,000 Feet

N

NCCGIA

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SLINGSHOT CREEK STREAM AND WETLAND MITIGATION SITE

Rockingham County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

Date: DEC 2017

Scale: 1:2200

Project No.: 17-001.02

FIGURE

4

June 12th, 2018

Mr. Robert L. Wheless
222 Harbor Rd.
Reidsville, NC 27320

Dear Mr. Wheless:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Rockingham County, North Carolina, does not have the power to acquire it by eminent domain. Also, Restoration Systems' offer to purchase your property is based on what we believe to be its fair market.

If you have any questions, please feel free to call me at 919-755-9490.

Sincerely,

JD Hamby
Project Manager

May 18th, 2018

Shannon Deaton,
Habitat Conservation Program Manager
North Carolina Wildlife Resources Commission
1701 Mail Service Center
Raleigh, NC 27699-1701

Re: Slingshot Stream and Wetland Mitigation Site, Rockingham County, NC

Dear Ms. Deaton:

The purpose of this letter is to request concurrence from the North Carolina Wildlife Recourse Commission concerning a stream restoration project located in Rockingham County for the N.C. Division of Mitigation Services. Site land use consists of disturbed forest and livestock pasture. All Site hydrology drains to unnamed tributaries to Lake Hunt. The proposed conservation easement area contains approximately 12 acres. Please review and comment on any possible issues that might emerge with respect to the Fish and Wildlife Coordination Act from the potential stream restoration project. Attached is a USGS base map with the projects 12 acre footprint identified.

The Slingshot Stream and Wetland Mitigation Site has been identified for the purpose of providing in-kind mitigation for unavoidable impacts to streams wetlands within watersheds of the Cape Fear River Basin, CU 03030002.

We thank you in advance for your timely response and cooperation. Please feel free to contact the below referenced Project Manager with any questions that you may have concerning the extent of site disturbance associated with this project.

Yours truly,

Restoration Systems, LLC

JD Hamby
Project Manager
jhamby@restorationsytems.com
919-755-9490

Attachments: Location and USGS Map

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

20 June 2018

Mr. JD Hamby
Restoration Systems LLC
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604

Subject: Request for Project Review and Comments
Slingshot Stream & Wetland Mitigation Site
Rockingham County, North Carolina

Dear Mr. Hamby,

Biologists with the North Carolina Wildlife Resource Commission (NCWRC) received your letter on 30 May 2018 requesting review and comment on any possible concerns regarding the Slinghsot Stream & Wetland Mitigation Site. Biologists with NCWRC have reviewed the provided documents. Comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) and North Carolina General Statutes (G.S. 113-131 et seq.).

The Slingshot Stream & Mitigation Site is located north of the terminus of Harbor Road near Reidsville, Rockingham County, North Carolina. The project occurs on approximately 12 acres of livestock fields and disturbed forests. The project will provide in-kind mitigation for unavoidable impacts to streams and wetlands within the Cape Fear River Basin (HUC 03030002). The project will restore portions of unnamed tributaries of Lake Hunt. The site occurs within the Water Supply Watershed of Troublesome Creek, which is classified as a Water Supply III and Nutrient Sensitive Water by the N.C. Division of Water Resources (NCDWR).

The U.S. Fish and Wildlife Service lists the federally endangered smooth coneflower (*Echinacea laevigata*) as having the potential to occur if suitable habitat is present. We have no records of rare, threatened, or endangered species within or near the mitigation site, although the lack of records from the project area does not imply or confirm the absence of federal or state protected species. Based upon the information provided to NCWRC, it is unlikely that stream and wetland mitigation will adversely affect any federal or state-listed species. However, we recommend leaving snags and mature trees or if necessary, remove tees outside the maternity roosting season for bats (May 15 – August 15).

We recommend that riparian buffers are as wide as possible, given site constraints and landowner needs. NCWRC generally recommends a woody buffer of 100 feet on perennial streams to maximize the

Mailing Address: Habitat Conservation • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

benefits of buffers, including bank stability, stream shading, treatment of overland runoff, and wildlife habitat.

Stream restoration projects often improve water quality and aquatic habitat. Establishing native, forested buffers in riparian areas will help protect water quality, improve aquatic and terrestrial habitats, and provide a travel corridor for wildlife species. Provided measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this proposed project. If I can be of additional assistance, please call (336) 290-0056 or email olivia.munzer@ncwildlife.org.

Sincerely,

Olivia Munzer
Western Piedmont Habitat Conservation Coordinator
Habitat Conservation Program

May 18th, 2018

Renee Gledhill-Earley,
Environmental Review Coordinator
North Carolina State Historic Preservation Office
109 East Jones Street
Raleigh, NC 27699-4617
Sent electronically to Environmental.Review@ncdcr.gov

Re: Slingshot Stream & Wetland Mitigation Site, Columbus County, NC

Dear Renee,

The purpose of this letter is to request written concurrence from the State Historic Preservation Office (SHPO) for the Shaw's Run Stream & Wetland Mitigation Site in Columbus County, a Full-Delivery project for the N.C. Davison of Mitigation Services. Please review and comment on any possible issues that might emerge with respect to SHPO from a potential stream restoration project depicted on the attached mapping.

Project Name:	Slingshot Stream & Wetland Mitigation Site
Project Location:	222 Harbor Rd. Reidsville, NC
Project Contact:	JD Hamby, Restoration Systems LLC, 1101 Haynes St. Suite 211, Raleigh, NC 27604

Project Description: The project has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Permits from the NC DWR and USACE will be obtained to restore waters of the US. Soil and erosion control permits will also be obtained. The project encompasses 9 acres of drained hydric soils, and cleared riparian buffer area currently used for row crop production. Approximately 2200 linear feet of stream and 4.4 acres of riparian wetland will be restored.

The term "cultural resources" refers to prehistoric or historic archaeological sites, structures, or artifact deposits over 50 years old. "Significant" cultural resources are those that are eligible or potentially eligible for inclusion in the National Register of Historic Places. Evaluations of site significance are made with reference to the eligibility criteria of the National Register (36 CFR 60) and in consultation with the North Carolina State Historic Preservation Office (SHPO).

Field visits were conducted in January 2017 to conduct evaluations for presence of structures or features that may be eligible for the National Register of Historic Places. No structures were identified within the Site boundaries that may be eligible for the National Register. In addition to field reviews for historically relevant structures, a records search was conducted at the SHPO office to determine if documented occurrences of historic structures or artifacts occur within, or adjacent to the Site. The SHPO records identify no features within the Site boundaries and seven features within a 1.0 mile radius of the Site, listed here:

- RK1436 | Carter House
- RK1829 | D.C. Smith Farm (DOE: 2005)
- RK1589 | Bartee Log House (DOE: 2005)
- RK1430 | Reid School
- RK1437 | House
- RK1431 | Alfred Reid House
- RK1440 | Pritchard-Tuttle House

Typical SHPO coordination will occur prior to construction activities to determine if any significant cultural resources are present; however, no constraints are expected at this time. We thank you in advance for your timely response and cooperation. Please feel free to contact me with any questions that you may have concerning the extent of site disturbance associated with this project.

Yours truly,

RESTORATION SYSTEMS, LLC

JD Hamby
Project Manager
jhamby@restorationsytems.com
919-755-9490

Attachments – USGS Map, Existing Conditions

North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

June 18, 2018

JD Hamby
Restoration Systems, LLC
1101 Haynes Street, Suite 211
Raleigh, NC 27604

Re: Slingshot Stream & Wetland Mitigation Site, 222 Harbor Road, Reidsville, Rockingham County, ER 18-1209

Dear Mr. Hamby:

Thank you for your letter of May 18, 2018, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

May 18th, 2017

Milton Cortes
USDA Natural Resources Conservation Service
4407 Bland Road
Suite 117
Raleigh, NC 27609

Re: Slingshot Stream and Wetland Mitigation Site, Alamance County, NC

Restoration Systems, LLC (RS), of Raleigh, NC has been awarded a contract by DMS to provide 2200 Stream Mitigation Units and 4.4 Wetland Mitigation Units at Slingshot Stream and Wetland Mitigation Site, Alamance County, North Carolina.

One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. DMS must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

In order for the project to proceed, RS is obligated to coordinate with the NRCS to complete Form AD-1006 in compliance with the Farmland Protection Policy Act on behalf of the FHWA. The purpose of this letter is to request your assistance in completion of the Form.

Project Location & Description

The Slingshot Creek Stream & Wetland Mitigation Site (hereafter referred to as the "Site"), is located approximately 2 miles west of Reidsville, NC, east of Lake Hunt, and north NC Highway 158. Site land use consists of disturbed forest, hay fields, and livestock pasture. All Site hydrology drains to unnamed tributaries to Lake Hunt. The proposed conservation easement area contains approximately 12 acres.

The Site is located within Targeted Local Watershed (TLW) 03030002010010 and subbasin 03-06-01. According to the Cape Fear River Basinwide Water Quality Plan (NCDWQ 2005), all land uses and discharges of wastewater and stormwater in subbasin 03-06-01 potentially contribute nutrients to B. Everett Jordan Lake. B. Everett Jordan Lake provides low-flow augmentation, flood control, recreation, fish and wildlife habitat, and water supply. The lake is impaired for aquatic life due to excessive levels of chlorophyll a in violation of current standards in all segments of the reservoir. In addition, the Site has a supplemental water quality classification of Nutrient Sensitive Waters, which include areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. The proposed mitigation activities will reduce sediment and nutrient levels, and improve water quality within the Site and downstream watersheds.

The project is located within the Troublesome Creek and Little Troublesome Creek Local Watershed Planning area (NCEEP 2004).

Restoration Means & Methods

Stream restoration efforts are designed to restore a stable stream that approximates hydrodynamics, stream geometry, and local microtopography relative to reference conditions. Restoration at the Site will be Priority I restoration; therefore, bankfull elevations will be raised to meet the adjacent valley floodplain elevation.

Stream restoration is expected to entail 1) channel excavation, 2) channel stabilization, 3) channel diversion, and 4) channel backfill.

The use of in-stream structures for grade control and habitat is essential for successful stream restoration. In-stream structures may be placed in the channel to elevate local water surface profiles in the channel, potentially flattening the water energy slope or gradient and directing stream energy into the center of the channel and away from banks. The structures will consist of log cross-vanes or log j-hook vanes; however, at the discretion of the Engineer, rock cross-vanes or rock j-hook vanes may be substituted if dictated by field conditions. In addition, the structures will placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

One drop structure is proposed at the Site outfall; the drop structure may be constructed out of Terracell, or large cobble depending upon anticipated scour from the restored stream channels. The structure should be constructed to resist erosive forces associated with hydraulic drops proposed at the Site.

Stream enhancement (level I) will occur on reaches accessible by livestock. Stream dimension will be restored in these reaches, fencing will be erected to exclude livestock, and planting riparian buffers with native forest vegetation will occur where needed and will extend a minimum of 50 feet from the top of stream banks to facilitate stream recovery and prevent further degradation of the stream.

Stream enhancement (level II) will occur on reaches are characterized by channels with patches of mature riparian vegetation, good channel bed substrate, and little bank erosion. The reaches are accessible by livestock and will have fence erected to exclude livestock. Planting riparian buffers with native forest vegetation will occur where needed and will extend a minimum of 50 feet from the top of stream banks to facilitate stream recovery and prevent further degradation of the stream.

Alternatives for wetland reestablishment are designed to restore a fully functioning wetland system, which will provide surface water storage, nutrient cycling, removal of imported elements and compounds, and will create a variety and abundance of wildlife habitat.

Portions of the Site underlain by hydric soils have been impacted by stream degradation (incised and ditched channels), vegetative clearing, agriculture plowing, livestock compaction, herbicide application, and other land disturbances associated with land use management. Wetland reestablishment options should focus on the restoration of vegetative communities, restoration of stream corridors and historic groundwater tables, and the reestablishment of soil structure and microtopographic variations. In addition, the construction of (or provisions for) surface water storage depressions (ephemeral pools) will also add an important component to groundwater restoration activities. These activities will result in the reestablishment 0.96 acre and the enhancement of 0.69 acre of jurisdictional riparian riverine wetlands. Wetland enhancement will focus on the removal of livestock and restoration of vegetative communities resulting in the enhancement of 0.69 acre of riparian wetland

Restoration of floodplain forest allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary

benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife.

Revegetating floodplains will provide overall system stability, shade, and wildlife habitat. In addition, viable riparian communities will improve system biogeochemical function by filtering pollutants from overland and shallow subsurface flows and providing organic materials to adjacent stream channels.

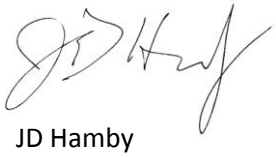
Variations in vegetative planting will occur based on topography and hydraulic condition of soils. Vegetative species composition will be based on RFEs, site-specific features, and community descriptions from Classification of the Natural Communities of North Carolina (Schafale and Weakley 1990). Community associations to be utilized include: 1) Piedmont/Low Mountain Alluvial Forest, 2) Dry-Mesic Oak-Hickory Forest and 3) Streamside Assemblage.

Bare-root seedlings within the Piedmont Alluvial Forest and Dry-Mesic Oak-Hickory Forest will be planted at a density of approximately 680 stems per acre on 8-foot centers, and in the stream-side assemblage at a density of approximately 2720 stems per acre on 4-foot centers. Planting will be performed between November 15 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season.

Should you have any questions or if any additional information is needed to complete the Form, please feel free to contact me at the office 919.334.9111. Your valuable time and cooperation are much appreciated.

Yours truly,

RESTORATION SYSTEMS, LLC



JD Hamby
Project Manager
jhamby@restorationsytems.com
919-334-9111

Attachments

John Hamby

From: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>
Sent: Sunday, June 24, 2018 3:09 PM
To: John Hamby
Subject: RE: Request Farmland Impact Evaluation-Stream and Wetland Mitigation Sites
Attachments: Arabia Bay Wetland Restoration Site_AD1006.pdf; Phantom Mill_AD1006.pdf; Shaws Run_AD1006.pdf; Slingshot Restoration Site_AD1006.pdf

Importance: High

Follow Up Flag: Follow up
Flag Status: Completed

John:

Please find attached the Farmland Conversion Impact Rating forms, AD1026, for:

Arabia Bay Wetland Rest Hoke Co.
Phantom Mill Stream & Wet Rest Alamance Co.
Shaw's Run Stream & Wet Rest Columbus Co.
Slingshot Stream & Wet Rest Rockingham Co.

Please let us know if we can be of further assistance.

Cordially:

Milton Cortes

Acting State Soil Scientist
Natural Resources Conservation Service
4407 Bland Rd, Suite 117
Raleigh, NC 27609
Phone: 919-873-2171
milton.cortes@nc.usda.gov

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request
Name Of Project: Slingshot Stream & Wetland Restoration Site	Federal Agency Involved: Federal Highway Administration
Proposed Land Use: Stream and Wetland Restoration	County And State: Rockingham, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS: 5/18/18

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☑	No ☐	Acres Irrigated: none	Average Farm Size: 124 acres
Major Crop(s): CORN	Farmable Land In Govt. Jurisdiction Acres: 260,767 acres	% 71	Amount Of Farmland As Defined in FPPA Acres: 249,142 acres	% 68
Name Of Land Evaluation System Used: Rockingham Co. NC LESA	Name Of Local Site Assessment System: N/A		Date Land Evaluation Returned By NRCS: 6/24/18	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	12.0			
B. Total Acres To Be Converted Indirectly	0.0			
C. Total Acres In Site	12.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	4.2			
B. Total Acres Statewide And Local Important Farmland	7.0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0045			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	49.6			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	72	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	8			
2. Perimeter In Nonurban Use	10	9			
3. Percent Of Site Being Farmed	20	15			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	5			
6. Distance To Urban Support Services	15	0			
7. Size Of Present Farm Unit Compared To Average	10	1			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	5			
10. On-Farm Investments	20	9			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	1			
TOTAL SITE ASSESSMENT POINTS	160	53	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	72	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	53	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	125	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Clear Form

Form AD-1006 (10-83)

Regulatory review

The IPaC regulatory review process helps evaluate the potential impacts of your project on resources managed by the U.S. Fish and Wildlife Service. It walks through regulations covering each protected resource, and offers suggestions and assistance in designing your project.

Endangered species

Endangered species are protected under the Endangered Species Act [1].

3 endangered species are known to occur or may be affected by activities in this location.

1. Request an official species list
   An official species list was generated about a month ago.
2. Evaluate determination keys
   There are no determination keys available in this project area.
3. **Make effect determinations**
   For each listed species in the project area, a determination must be made regarding the potential effects of this project.

   REVIEW SPECIES

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act [2] and the Bald and Golden Eagle Protection Act [3].

6 migratory birds of conservation concern are expected to occur or may be affected by activities in this location.

1. Contact the local U.S. Fish and Wildlife Service field office
   There is currently no regulatory review process in IPaC for migratory birds. Please contact the local U.S. Fish and Wildlife Service field office to evaluate effects and authorize take.

Facilities

U.S. Fish and Wildlife Service facilities are protected under the National Wildlife Refuge System Administration Act [4] and the National Fish Hatchery System [5].

Refuge and fish hatchery information is not available at this time

TRY AGAIN

Wetlands

Wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act [6], or other State/Federal statutes.

THERE ARE NO KNOWN WETLANDS AT THIS LOCATION.

Species determinations

For listed species 1 not covered by determination keys, an impact analysis should be performed to reach a conclusion about how this project will impact the species. These conclusions will result in *determinations* for each species, which will be used in consultation with the U.S. Fish and Wildlife Service.

Fishes

NAME	DETERMINATION
Roanoke Logperch Percina rex	None

Clams

NAME	DETERMINATION
James Spinymussel Pleurobema collina	None

Flowering Plants

NAME	DETERMINATION
Smooth Coneflower Echinacea laevigata	None

Critical habitats

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Threatened & Endangered Species

Three federally protected species are listed as occurring in Rockingham County (USFWS 2015); the following table summarizes potential habitat and preliminary biological conclusions for each.

Threatened and Endangered Species

Species	Habitat	Potential Habitat at Site	Biological Conclusion
James spinymussel (*Pleurobema collina*)	This freshwater mussel is limited to the James River drainage and the Dan/Mayo River drainage within the Roanoke River basin in Virginia, North Carolina, and West Virginia. This species' range does not include the Site, which is located in the Upper Cape Fear River drainage.	No	No Effect
Roanoke logperch (*Percina rex*)	In North Carolina, this species is found in the Dan and Mayo rivers, as well as Big Beaver Island Creek. This species' range does not include the Site, which is located in the Upper Cape Fear River drainage.	No	No Effect
Smooth coneflower (*Echinacea laevigata*)	This species grows in calcareous, basic, or circumneutral soils on roadsides, clear cuts, and power line right-of-ways where there is abundant light and little herbaceous competition. Fire-maintained woodlands also appear to provide potential habitat for the coneflower.	Yes	No Effect*

*Detailed field surveys for this species were conducted during the optimum survey window. Smooth coneflower (Echinacea laevigata) is typically found on calcareous, basic, or circumneutral soils within clearcuts, power line right-of-ways, roadsides, and open woodlands where there is abundant light and little herbaceous competition. Suitable habitat for smooth coneflower occurs within open areas of the site, field borders, woodland edges, and forested areas along stream channels. Systematic surveys performed within areas of suitable habitat were performed by Axiom biologists Allison Keith and Andrew Radecki on May 21, 2018, and identified no individuals. As of May 25, 2018, the NCNHP has no record of this species within 1.0 mile of the site. The proposed project will have No Effect on smooth coneflower.

Neither the James spinymussel nor the Roanoke logperch have ranges that extend into areas adjacent to or within the Site; therefore, this project will have no effect on these federally protected species. Suitable habitat for the smooth coneflower exists at the Site; therefore, surveys were conducted in May 2015, during the optimal survey window for this plant. Correspondence concerning survey methodology and results are presented in Appendix C.

John Hamby

From: Allison Keith <akeith@axiomenvironmental.org>
Sent: Friday, May 25, 2018 10:56 AM
To: John Hamby
Cc: Grant Lewis
Subject: Slingshot T&E Biological Conclusion

Good Morning,

This email provides a summary of the results of an Axiom Environmental, Inc. (Axiom) federally protected species survey at the Slingshot Creek Mitigation site in Rockingham County. The approximately 12-acre site is located north of Highway 158, 2 miles west of Reidsville, NC.

Smooth Coneflower

Smooth coneflower (*Echinacea laevigata*) is typically found on calcareous, basic, or circumneutral soils within clearcuts, power line right-of-ways, roadsides, and open woodlands where there is abundant light and little herbaceous competition. Suitable habitat for smooth coneflower occurs within open areas of the site, field borders, woodland edges, and forested areas along stream channels. Systematic surveys performed within areas of suitable habitat were performed by Axiom biologists Allison Keith and Andrew Radecki on May 21, 2018, and identified no individuals. As of May 25, 2018, the NCNHP has no record of this species within 1.0 mile of the site. The proposed project will have No Effect on smooth coneflower.

We appreciate the opportunity to assist with this project. If you have any questions about this information, please let us know.

Sincerely,
Allison Keith

Allison Keith
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603
Cell (423)400-8882
akeith@axiomenvironmental.org

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
Phone: (919) 856-4520 Fax: (919) 856-4556

In Reply Refer To:
Consultation Code: 04EN2000-2018-SLI-0763
Event Code: 04EN2000-2018-E-01667
Project Name: Slingshot

May 18, 2018

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The species list generated pursuant to the information you provided identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Section 7 of the Act requires that all federal agencies (or their designated non-federal representative), in consultation with the Service, insure that any action federally authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any federally-listed endangered or threatened species. A biological assessment or evaluation may be prepared to fulfill that requirement and in determining whether additional consultation with the Service is necessary. In addition to the federally-protected species list, information on the species' life histories and habitats and information on completing a biological assessment or

evaluation and can be found on our web page at http://www.fws.gov/raleigh. Please check the web site often for updated information or changes

If your project contains suitable habitat for any of the federally-listed species known to be present within the county where your project occurs, the proposed action has the potential to adversely affect those species. As such, we recommend that surveys be conducted to determine the species' presence or absence within the project area. The use of North Carolina Natural Heritage program data should not be substituted for actual field surveys.

If you determine that the proposed action may affect (i.e., likely to adversely affect or not likely to adversely affect) a federally-protected species, you should notify this office with your determination, the results of your surveys, survey methodologies, and an analysis of the effects of the action on listed species, including consideration of direct, indirect, and cumulative effects, before conducting any activities that might affect the species. If you determine that the proposed action will have no effect (i.e., no beneficial or adverse, direct or indirect effect) on federally listed species, then you are not required to contact our office for concurrence (unless an Environmental Impact Statement is prepared). However, you should maintain a complete record of the assessment, including steps leading to your determination of effect, the qualified personnel conducting the assessment, habitat conditions, site photographs, and any other related articles.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

Not all Threatened and Endangered Species that occur in North Carolina are subject to section 7 consultation with the U.S Fish and Wildlife Service. Atlantic and shortnose sturgeon, sea turtles,when in the water, and certain marine mammals are under purview of the National Marine Fisheries Service. If your project occurs in marine, estuarine, or coastal river systems you should also contact the National Marine Fisheries Service, http://www.nmfs.noaa.gov/

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office. If you have any questions or comments, please contact John Ellis of this office at john_ellis@fws.gov.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Raleigh Ecological Services Field Office
Post Office Box 33726
Raleigh, NC 27636-3726
(919) 856-4520

Project Summary

Consultation Code: 04EN2000-2018-SLI-0763

Event Code: 04EN2000-2018-E-01667

Project Name: Slingshot

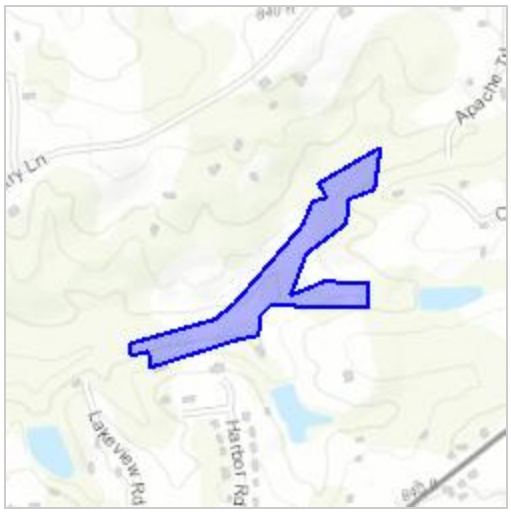
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES

Project Description: This proposal describes the Slingshot Creek Stream & Wetland Mitigation Site (Site) and is designed specifically to assist in fulfilling North Carolina Department of Environment and Natural Resources (NCDENR) Division of Mitigation Services (NCDMS) mitigation goals. The Site is located within 14-digit Cataloging Unit and Targeted Local Watershed 03030002010010, approximately 2 miles west of Reidsville, NC, east of Lake Hunt, and north NC Highway 158 (Figures 1 and 2, Appendix A). The Site is located within the Troublesome Creek and Little Troublesome Creek Local Watershed Planning area (NCEEP 2004). The Site is situated along warm water, unnamed tributaries to Lake Hunt.

The Slingshot Creek Stream & Wetland Mitigation Site is proposed to include 2328 linear feet of stream restoration, 752 linear feet of stream enhancement (level I), 747 linear feet of stream enhancement (level II), 0.96 acres of reestablished riparian riverine wetlands, and 0.69 acre of enhanced riparian riverine wetland. Site alterations include removing livestock, restoration of streams and wetlands, and planting native, woody vegetation within the entire 12-acre Site easement. Mitigation outlined in this report will result in net gains in hydrology, water quality, and habitat functions, and are designed to provide 3128 Stream Mitigation Units and 1.31 Riparian Riverine Wetland Mitigation Units
Construction and planting will occur outside of growing season during the winter months.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/36.33542092009579N79.71107015124949W



Counties: Rockingham, NC

Endangered Species Act Species

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Fishes

NAME	STATUS
Roanoke Logperch *Percina rex* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1134	Endangered

Clams

NAME	STATUS
James Spinymussel *Pleurobema collina* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2212	Endangered

Flowering Plants

NAME	STATUS
Smooth Coneflower *Echinacea laevigata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3473	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Slingshot
0 Harbor Road
Reidsville, NC 27320

Inquiry Number: 5328451.8s
June 11, 2018

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

0 HARBOR ROAD
REIDSVILLE, NC 27320

COORDINATES

Latitude (North):	36.3348500 - 36° 20' 5.46''
Longitude (West):	79.7117580 - 79° 42' 42.32''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	615619.1
UTM Y (Meters):	4021658.0
Elevation:	787 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5948275 REIDSVILLE, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140705
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
0 HARBOR ROAD
REIDSVILLE, NC 27320

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
1	DJ'S COMMUNITY MART	120 IRON WORKS RD	LUST, UST, Financial Assurance	Higher	2016, 0.382, SSE

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
NPL LIENS ---------- Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ---------- National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY ---------- Federal Facility Site Information listing
SEMS ---------- Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE ---------- Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS ---------- Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ---------- RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ---------- RCRA - Large Quantity Generators
RCRA-SQG ---------- RCRA - Small Quantity Generators
RCRA-CESQG ---------- RCRA - Conditionally Exempt Small Quantity Generator

Federal institutional controls / engineering controls registries

LUCIS ---------- Land Use Control Information System
US ENG CONTROLS ---------- Engineering Controls Sites List

US INST CONTROL Sites with Institutional Controls

Federal ERNS list

ERNS Emergency Response Notification System

State- and tribal - equivalent NPL

NC HSDS Hazardous Substance Disposal Site

State- and tribal - equivalent CERCLIS

SHWS Inactive Hazardous Sites Inventory

State and tribal landfill and/or solid waste disposal site lists

SWF/LF List of Solid Waste Facilities
OLI Old Landfill Inventory

State and tribal leaking storage tank lists

LAST Leaking Aboveground Storage Tanks
INDIAN LUST Leaking Underground Storage Tanks on Indian Land
LUST TRUST State Trust Fund Database

State and tribal registered storage tank lists

FEMA UST Underground Storage Tank Listing
UST Petroleum Underground Storage Tank Database
AST AST Database
INDIAN UST Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

INST CONTROL No Further Action Sites With Land Use Restrictions Monitoring

State and tribal voluntary cleanup sites

VCP Responsible Party Voluntary Action Sites
INDIAN VCP Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

BROWNFIELDS Brownfields Projects Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

HIST LF Solid Waste Facility Listing

SWRCY Recycling Center Listing
INDIAN ODI Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9 Torres Martinez Reservation Illegal Dump Site Locations
ODI Open Dump Inventory
IHS OPEN DUMPS Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL Delisted National Clandestine Laboratory Register
US CDL National Clandestine Laboratory Register

Local Land Records

LIENS 2 CERCLA Lien Information

Records of Emergency Release Reports

HMIRS Hazardous Materials Information Reporting System
SPILLS Spills Incident Listing
IMD Incident Management Database
SPILLS 90 SPILLS 90 data from FirstSearch
SPILLS 80 SPILLS 80 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR RCRA - Non Generators / No Longer Regulated
FUDS Formerly Used Defense Sites
DOD Department of Defense Sites
SCRD DRYCLEANERS State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR Financial Assurance Information
EPA WATCH LIST EPA WATCH LIST
2020 COR ACTION 2020 Corrective Action Program List
TSCA Toxic Substances Control Act
TRIS Toxic Chemical Release Inventory System
SSTS Section 7 Tracking Systems
ROD Records Of Decision
RMP Risk Management Plans
RAATS RCRA Administrative Action Tracking System
PRP Potentially Responsible Parties
PADS PCB Activity Database System
ICIS Integrated Compliance Information System
FTTS FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS Material Licensing Tracking System
COAL ASH DOE Steam-Electric Plant Operation Data
COAL ASH EPA Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER PCB Transformer Registration Database
RADINFO Radiation Information Database
HIST FTTS FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS Incident and Accident Data
CONSENT Superfund (CERCLA) Consent Decrees
INDIAN RESERV Indian Reservations
FUSRAP Formerly Utilized Sites Remedial Action Program
UMTRA Uranium Mill Tailings Sites
LEAD SMELTERS Lead Smelter Sites

US AIRS ---- Aerometric Information Retrieval System Facility Subsystem
US MINES ---- Mines Master Index File
ABANDONED MINES ---- Abandoned Mines
FINDS ---- Facility Index System/Facility Registry System
ECHO ---- Enforcement & Compliance History Information
DOCKET HWC ---- Hazardous Waste Compliance Docket Listing
UXO ---- Unexploded Ordnance Sites
FUELS PROGRAM ---- EPA Fuels Program Registered Listing
AIRS ---- Air Quality Permit Listing
ASBESTOS ---- ASBESTOS
COAL ASH ---- Coal Ash Disposal Sites
DRYCLEANERS ---- Drycleaning Sites
Financial Assurance ---- Financial Assurance Information Listing
NPDES ---- NPDES Facility Location Listing
UIC ---- Underground Injection Wells Listing
AOP ---- Animal Operation Permits Listing

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP ---- EDR Proprietary Manufactured Gas Plants
EDR Hist Auto ---- EDR Exclusive Historical Auto Stations
EDR Hist Cleaner ---- EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS ---- Recovered Government Archive State Hazardous Waste Facilities List
RGA LF ---- Recovered Government Archive Solid Waste Facilities List
RGA LUST ---- Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STANDARD ENVIRONMENTAL RECORDS

State and tribal leaking storage tank lists

EXECUTIVE SUMMARY

LUST: The Leaking Underground Storage Tank Incidents Management Database contains an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environment, & Natural Resources' Incidents by Address.

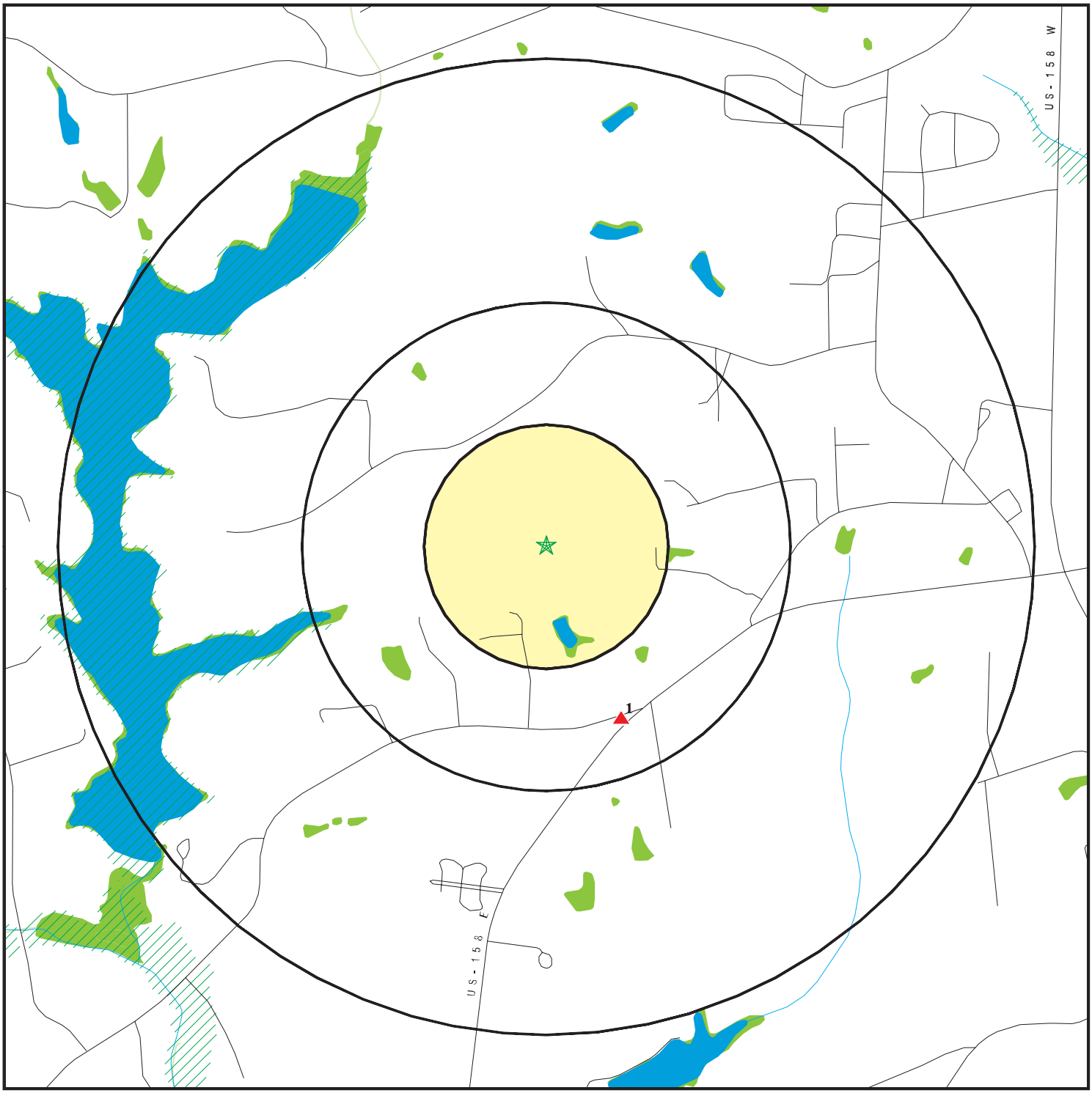
A review of the LUST list, as provided by EDR, and dated 02/02/2018 has revealed that there is 1 LUST site within approximately 0.5 miles of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
DJ'S COMMUNITY MART	***120 IRON WORKS RD***	***SSE 1/4 - 1/2 (0.382 mi.)***	***1***	***8***
Incident Phase: Follow Up				
Incident Number: 3878				
Current Status: File Located in House				

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 5328451.8S



0 1/4 1/2 1 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Slingshot ADDRESS: 0 Harbor Road Reidsville NC 27320 LAT/LONG: 36.33485 / 79.711758	CLIENT: Restoration Systems, LLC CONTACT: JD Hamby INQUIRY #: 5328451.8s DATE: June 11, 2018 4:35 pm

Axiom Environmental, Inc.

Axiom Environmental, Inc.

218 Snow Avenue, Raleigh, North Carolina 27603 919 270-9306

May 28, 2015

Worth Creech
Restoration Systems
1101 Haynes St #211
Raleigh, NC 27604

Re: Federally Protected Species Assessment Results **15-007.05**
Slingshot Creek, Reidsville, Rockingham County

Dear Mr. Creech

Axiom Environmental, Inc. (Axiom) is pleased to provide you with this summary letter of the results of a survey for federally protected species on an approximately 12-acre tract (hereafter referred to as the site) planned for Slingshot Creek Mitigation Site in Reidsville, NC (see attached map). The survey was conducted by three Axiom biologists, Kenan Jernigan, Ryan Gibbons, and Allison Keith, on May 28, 2015.

Site Description

The site is in the Piedmont physiographic region of the state in southeastern Rockingham County. The site contains dissected, irregular plains with moderate to steep slopes and low to moderate gradient streams. Land use at the site is characterized by livestock pastures where livestock have unrestricted access to the streams. The majority of the site is dominated by herbaceous vegetation with some scattered shrubs, although, a narrow riparian fringe has developed along the stream margins that contains opportunistic species as well as a few mature trees. Dominant herbaceous species include a multitude of grasses, common pokeweed (*Phytolacca americana*), oxeye daisy (*Leucanthemum vulgare*), grape (*Muscadinia* sp.), and Japanese honeysuckle (*Lonicera japonica*). The scattered shrubs include winged sumac (*Rhus copallinum*), sweetgum (*Liquidambar styraciflua*), redbud (*Cercis canadensis*) and flowering dogwood (*Cornus florida*). The riparian fringes support narrow forests dominated by a canopy of loblolly pine (*Pinus taeda*), eastern red cedar (*Juniperus virginiana),* sweetgum (*Liquidambar styraciflua*), and a mix of oaks (*Quercus* sp.).

Federally Protected Species

The U.S. Fish and Wildlife Service (USFWS) has identified one species with ranges that extend into Rockingham County: Smooth coneflower (*Echinacea laevigata*).

A brief description of the species' habitat requirements follows, along with the Biological Conclusion rendered based on survey results in the study area. Habitat requirements for this species are based on the current best available information from referenced literature and/or USFWS.

Smooth coneflower
USFWS optimal survey window: late May-October

Habitat Description: Smooth coneflower, a perennial herb, is typically found in meadows, open woodlands, the ecotonal regions between meadows and woodlands, cedar barrens, dry limestone bluffs, clear cuts, and roadside and utility right-of-ways. In North Carolina, the species normally grows in magnesium- and calcium-rich soils associated with gabbro and diabase parent material, and typically occurs in Iredell, Misenheimer, and Picture soil series. It grows best where there is abundant sunlight, little competition in the herbaceous layer, and periodic disturbances (e.g., regular fire regime, well-timed mowing, and careful clearing) that prevents encroachment of shade producing woody shrubs and trees. On sites where woody succession is held in check, it is characterized by a number of species with prairie affinities.

Biological Conclusion: No Effect. Suitable habitat for smooth coneflower occurs throughout the study area within utility line corridors, along woodland edges, and within residential yards. A review of NCNHP records, updated April 2015, indicates no known smooth coneflower occurrences within 1.0 mile of the study area. Axiom biologists visited the UNC Botanical Garden on May 28, 2015 and found their smooth coneflowers to be in bloom. Subsequently, systematic surveys were performed in all areas of suitable habitat on the same day and no individuals of this species were identified within the study area.

I hope this summary is sufficient for your review. Should you have any questions, please do not hesitate to send me an email (kjernigan@axiomenvironmental.org) or give me a call (919-215-9465).

Sincerely,
AXIOM ENVIRONMENTAL, INC.

Kenan R. Jernigan
Project Scientist

North Carolina Department of Natural and Cultural Resources
Natural Heritage Program

Governor Roy Cooper | Secretary Susi H. Hamilton

NCNHDE-4944

December 20, 2017

Phillip Perkinson
Axiom Environmental Inc.
218 Snow Avenue
Raleigh, NC 27612
RE: Slingshot

Dear Phillip Perkinson:

The North Carolina Natural Heritage Program (NCNHP) appreciates the opportunity to provide information about natural heritage resources for the project referenced above.

A query of the NCNHP database, based on the project area mapped with your request, indicates that there are no records for rare species, important natural communities, natural areas, or conservation/managed areas within the proposed project boundary. Please note that although there may be no documentation of natural heritage elements within the project boundary, it does not imply or confirm their absence; the area may not have been surveyed. The results of this query should not be substituted for field surveys where suitable habitat exists. In the event that rare species are found within the project area, please contact the NCNHP so that we may update our records.

The attached 'Potential Occurrences' table summarizes rare species and natural communities that have been documented within a one-mile radius of the property boundary. The proximity of these records suggests that these natural heritage elements may potentially be present in the project area if suitable habitat exists and is included for reference. Tables of natural areas and conservation/managed area within a one-mile radius of the project area, if any, are also included in this report.

Please note that natural heritage element data are maintained for the purposes of conservation planning, project review, and scientific research, and are not intended for use as the primary criteria for regulatory decisions. Information provided by the NCNHP database may not be published without prior written notification to the NCNHP, and the NCNHP must be credited as an information source in these publications. Maps of NCNHP data may not be redistributed without permission.

The NC Natural Heritage Program may follow this letter with additional correspondence if a Dedicated Nature Preserve (DNP), Registered Heritage Area (RHA), Clean Water Management Trust Fund (CWMTF) easement, or Federally-listed species are documented near the project area.

If you have questions regarding the information provided in this letter or need additional assistance, please contact Rodney A. Butler at rodney.butler@ncdcr.gov or 919.707.8603.

Sincerely,
NC Natural Heritage Program

MAILING ADDRESS:
1651 Mail Service Center
Raleigh, NC 27699-1651

Telephone: (919) 707-8107
www.ncnhp.org

LOCATION:
121 West Jones Street
Raleigh, NC 27603

Natural Heritage Element Occurrences, Natural Areas, and Managed Areas Within a One-mile Radius of the Project Area
Slingshot
December 20, 2017
NCNHDE-4944

Element Occurrences Documented Within a One-mile Radius of the Project Area

Taxonomic Group	EO ID	Scientific Name	Common Name	Last Observation Date	Element Occurrence Rank	Accuracy	Federal Status	State Status	Global Rank	State Rank
Dragonfly or Damselfly	33770	Somatochlora georgiana	Coppery Emerald	2004-Pre	H?	5-Very Low	---	Significantly Rare	G3G4	S2?
Natural Community	27686	Dry Basic Oak--Hickory Forest	---	2010	BC	2-High	---	---	G2G3	S2S3

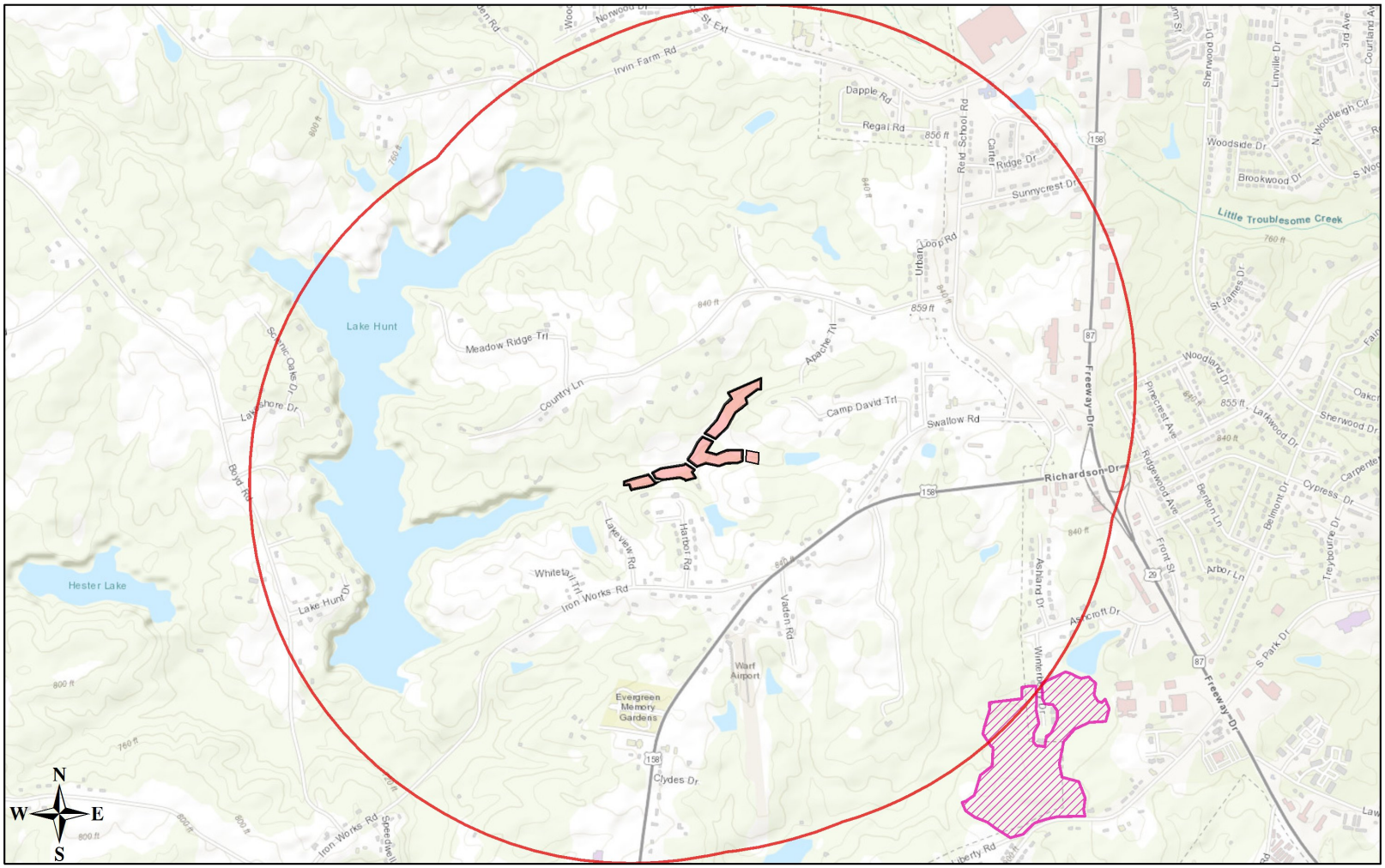
Natural Areas Documented Within a One-mile Radius of the Project Area

Site Name	Representational Rating	Collective Rating
Warf Airfield Forest	R5 (General)	C5 (General)

No Managed Areas are Documented Within a One-mile Radius of the Project Area

Definitions and an explanation of status designations and codes can be found at https://ncnhde.natureserve.org/content/help. Data query generated on December 20, 2017; source: NCNHP, Q4 October 2017. Please resubmit your information request if more than one year elapses before project initiation as new information is continually added to the NCNHP database.

NCNHDE-4944: Slingshot



December 20, 2017

- Project Boundary
- Buffered Project Boundary
- NHP Natural Area (NHNA)

1:23,283

0 0.2 0.4 0.8 mi

0 0.3 0.6 1.2 km

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Appendix F
Financial Assurances

Pursuant to Section IV H and Appendix III of the Division of Mitigation Service's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural Resources has provided the US Army Corps of Engineers Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.

Appendix G
Site Protection Instrument

STATE OF NORTH CAROLINA **DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT**

_____ COUNTY

SPO File Number:
DMS Project Number:

Prepared by: Office of the Attorney General
Property Control Section
Return to: NC Department of Administration
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this _____day of _____, 20__, by _____ *Landowner name goes here* , ("**Grantor**"), whose mailing address is _____ *Landowner address goes here* _____, to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Division of Mitigation Services (formerly known as the Ecosystem Enhancement Program and Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the

protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between *(insert name and address of full delivery contract provider)* and the North Carolina Department of Environmental Quality, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environmental Quality Purchase and Services Contract Number _____.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Division of Mitigation Services (formerly Ecosystem Enhancement Program) is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Division of Mitigation Services (formerly Ecosystem Enhancement Program) with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Division of Mitigation Services in the Department of Environmental Quality, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in _____ Township, _____ County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately _____ acres and being conveyed to the Grantor by deed as recorded in **Deed Book _____ at Page ____** of the _____ County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of ***if known, insert name of stream, branch, river or waterway here***.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access.

The Conservation Easement Area consists of the following:

Tracts Number _____ containing a total of _____ **acres** as shown on the plats of survey entitled "Final Plat, Conservation Easement for North Carolina Division of Mitigation Services, Project Name: _____, SPO File No._____, EEP Site No. _____, Property of _____," dated _____, 20__ by *name of surveyor*, PLS Number _____ and recorded in the _____ County, North Carolina Register of Deeds at **Plat Book _____ Pages _____.**

See attached "**Exhibit A**", Legal Description of area of the Property hereinafter referred to as the "Conservation Easement Area"

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat**.**

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. **Damage to Vegetation.** Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. **Roads and Trails.** There shall be no construction or maintenance of new roads, trails, walkways, or paving in the Conservation Easement.

All existing roads, trails and crossings within the Conservation Easement Area shall be shown on the recorded survey plat.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the Division of Mitigation Services, 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities on the property to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. Conservation Easements are purchased to protect the investments by the State (Grantee) in natural resources. Livestock within conservations easements damages the investment and can result in reductions in natural resource value and mitigation credits which would cause financial harm to the State. Therefore, Landowners (Grantor) with livestock are required to restrict livestock access to the Conservation Easement area. Repeated failure to do so may result in the State (Grantee) repairing or installing livestock exclusion devices (fences) within the conservation area for the purpose of restricting livestock access. In such cases, the landowner (Grantor) must provide access to the State (Grantee) to make repairs.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the

power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the

obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Division of Mitigation Services Program Manager
NC State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

_____ (SEAL)

NORTH CAROLINA
COUNTY OF _____

I, _____, a Notary Public in and for the County and State aforesaid, do hereby certify that _____, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the _____ day of _____, 20__.

_____
Notary Public

My commission expires:

_____

Exhibit A

[INSERT LEGAL DESCRIPTION]

Appendix H
Credit Release Schedule

Table 3 – Schedule of Monitoring Events

Monitoring Event	Monitoring Activities Required	
	Streams	**Wetlands**
Pre-Construction	• Water Quality (Section VII(A)) • Macroinvertebrate & Fish (Section VII(B-C))*	• Per Mitigation Plan
Year 0 (As-Built)	• As-built Survey (includes longitudinal profile and sampling point locations)	• As-built Survey
Year 1	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 2	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 3	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Macroinvertebrate & Fish (Section VII(B-C))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 4	• Water Quality (Section VII(A)) * • Visual, two times (Section X)	• Visual (Section X) • Wetland Hydrology (Section IX)
Year 5	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A)) * • Macroinvertebrate & Fish (Section VII(B-C)) * • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 6	• Water Quality (Section VII(A)) * • Visual, two times (Section X)	• Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 7	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A)) * • Macroinvertebrate & Fish (Section VII(B-C)) * • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)

*Indicates optional monitoring activities

XIV. Credit Release Schedules

The standard release schedule for mitigation bank and ILF credits generated through stream and wetland mitigation projects has been modified to meet the new standards for the monitoring timeframes provided in this guidance document. For mitigation banks, the first credit release (15% of the bank's total stream restoration and/or enhancement credits) will occur upon establishment of the mitigation bank, and upon completion following criteria:

1) Execution of the MBI or UMBI by the Sponsor and the USACE
2) Approval of the final Mitigation Plan

3) The mitigation bank site must be secured
4) Delivery of the financial assurances described in the Mitigation Plan
5) Recordation of the long-term protection mechanism and title opinion acceptable to the USACE
6) Issuance of the 404 permit verification for construction of the site, if required.

For mitigation sites that include preservation-only credits, 100% of the preservation credits will be released with the completion of the six criteria stated above.

For ILF sites (including all NCDMS projects), no initial release of credits (Milestone 1) is provided because ILF programs utilized advance credits, so no initial release is necessary to help fund site construction. To account for this, the 15% credit release associated with the first milestone (bank establishment) is held until the second milestone, so that the total credits release at the second milestone is 30%. In order for NCDMS to receive the 30% release (shown in the schedules as Milestone 2), they must comply with the credit release requirements stated in Section IV(I)(3) of the approved NCDMS Instrument.

The following conditions apply to the credit release schedules:

A. A reserve of 10% of a site's total stream credits will be released after four bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than four bankfull events occur during the monitoring period, release of these reserve credits is at the discretion of the NCIRT.

B. For mitigation banks, implementation of the approved Mitigation Plan must be initiated no later than the first full growing season after the date of the first credit transaction (credit sale).

C. After the second milestone, the credit releases are scheduled to occur on an annual basis, assuming that the annual monitoring report has been provided to the USACE in accordance with Section IV (General Monitoring Requirements) of this document, and that the monitoring report demonstrates that interim performance standards are being met and that no other concerns have been identified on-site during the visual monitoring. All credit releases require written approval from the USACE.

D. The credits associated with the final credit release milestone will be released only upon a determination by the USACE, in consultation with the NCIRT, of functional success as defined in the Mitigation Plan.

The schedules below list the updated credit release schedules for stream and wetland mitigation projects developed by bank and ILF sites in North Carolina:

Credit Release Schedule and Milestones for Wetlands					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%	10%	100%

*Please note that vegetation plot data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

Credit Release Schedule and Milestones for Streams					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable, performance standards have been met	10%	90% (100%**)	10%	90% (100%**)

*Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

**10% reserve of credits to be held back until the bankfull event performance standard has been met.

Appendix I
Maintenance Plan

Maintenance Plan

The Site shall be monitored on a regular basis and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Beaver	Beaver and associated dams are to be removed as they colonize and until the project is closed.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree- blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Terracell Drop Structure	Routine maintenance and repair activities may include removal of debris and supplemental installation of live stakes and other target vegetation along the channel. Undermining of the structure may require repair or replacement.

Appendix J
Site Photographs