FINAL MITIGATION PLAN

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, North Carolina

DMS Project ID No. 100055
Full Delivery Contract No. 7515
USACE Action ID No. SAW-2018-01169
DWR Project No. 2018-0866
RFP No. 16-007337

Lumber River Basin
Cataloging Unit 03040203

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
1652 MAIL SERVICE CENTER
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November 2019

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November 26, 2019

Mrs. Lindsay Crocker
NC DEQ – Division of Mitigation Services
1652 Mail Service Center
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Subject: Shaw's Run - Mitigation Plan Comment Response Letter:
DMS Contract #: 7192; DMS Project ID: 100014; RFP # 16-006990

SDG Response Jason Harvey 11-25-2019

DWR Comments, Mac Haupt:

1. Table 4 – DWR believes that the upper reaches of UT1 and UT2 are at risk for losing flow. The DWR stream score provides evidence that these reaches are at risk. Thanks to DMS for recommending another flow gauge for the upper reach of UT1. In addition, DWR questions the design for these reaches maintaining a single thread channel.

   Section 8.1.1 (Stream Restoration) has been added to and now includes the following text. "The Site slope in the upper reaches of UT 1 and UT 2 exceeds 0.0035 rise/run and 0.003, respectively. The tributaries have a contributing drainage area at the top measuring 60.8 acres (0.10 sq mi) and 23 acres (0.04 sq mi). In addition, UT 2 has a drainage area characterized by drain tiled agriculture fields that contribute hydrology in a concentrated manner, effectively forming a spring head.

   Coastal plain streams with this slope and size would be expected to be characterized by single thread channels. However, in the event that Priority 1 stream restoration fails, and a braided headwater wetland system develops, the stream length will be modified to the down valley length and wetland credit for 50 feet on each side of the stream will be removed, as per headwater guidance. Stream gauges in the upper extent have been added to monitor flow duration and visual monitoring for the maintenance of a clear channel will be conducted."

2. Table 5 – thanks for including the taxonomic subgroup for the mapped soil series names.

   RS understands the taxonomy of a soil series gives much information about the development and mechanics of a Site.

3. Table 7 – Is the Angola site an appropriate reference for this stream restoration site?

   After an extensive reference reach search, Angola was the most suitable reference reach in the vicinity of the Site. Although it is not ideal, it offers suitable dimension parameters for a stream in similar geology and soils.

4. Section 3.5.2 – DWR will require more soil profiles for this site before final approval of this mitigation plan. One soil boring with a profile is not adequate.

   Additional soil profiles have been collected and are included in Appendix B. The location of the soil profiles is depicted on Figure 4.

5. Section 8.1.1 – the verbiage states all the stream restoration will be priority I type work. DWR believes the upper reaches of UT1 and UT2 should include more headwater type restoration work. It

appears there is more slope associated with the upper UT2 reach, however, the drainage area is small, or right at the minimum to maintain an intermittent channel from published research (25 acres).

The upper reaches of UT 1 has 60.8 acres (0.1 sq mi) and a slope exceeding 0.0035 (rise/run) which would be expected to maintain a single thread channel. In addition, UT 2 has a drainage area of 23 acres (0.04 sq mi) characterized by drain tile in agriculture fields that concentrate the groundwater table to the stream. This in combination with a Priority 2 tie in, that connects the channel to the groundwater table. The slope and concentrated flow from drain tiles would lead Restoration Systems to expected UT 2 to be a single thread stream channel.

a. Other verbiage suggests the designer may substitute rock as necessary. DWR believes very little rock needs to be placed in the proposed restoration features.

RS concurs that very little rock needs to be placed in the proposed restoration reaches and woody material will be the primary natural feature associated with the Site.

b. Outfall Structures – DWR does not believe use of a Terracell is warranted. Why not utilize log cross vanes as shown on the design sheets?

The drop structure will be updated to include natural material other than Terracell.

6. Section 8.2 – what is the drainage area at the top of UT1?

   60.8 acres

7. Table 15 – DWR recommends limiting Green Ash planting to no more than 5% due to the ash borer.

   The planting plan has been updated with a reduction in the number of Green Ash.

8. Table 17 – DWR would like the proposed growing season stated/written into the Table. We realize Axiom will monitor the soil temperature, however; we will need to know the proposed season, the location of the soil probes and the pairing of the soil temperature with the appropriate vegetative bud burst (not red maple, since they usually show early bud burst).

   Table 17 has been updated to indicate that the growing season will begin no earlier than March 1. In addition, text has been added to Figure 9 (Monitoring Plan) as follows; "The growing season is proposed to start no earlier than March 1. The growing season will be verified with soil temperature (continuous monitoring soil probe) and vegetative bud burst (not to include red maple). The soil probe will be installed in an open area within the conservation easement, in the approximate location as depicted above."

9. Table 18 – the 30 day flow criteria is only for intermittent streams. DWR expects near continuous flow for perennial streams.

   Understood.

10. DWR accepts and appreciates DMS's comment regarding the wetland performance criteria.

    Understood

11. Appendix A – Figures, in the future, for projects with proposed stream reaches high in the watershed, please include a LiDAR figure.

    A LiDAR map has been added as Appendix L.

12. In addition, it is also helpful to have pictures showing representative reaches, particularly when there has been at least a year since the site visit.

Appendix K has been added to the document and includes additional Site photographs.

13. Figure 6 – typical riffle cross section – DWR is assuming the designer will not line the channel and up the stream bank with rock.

    Rock will not be used to line the channel, as this is a sand-bed stream. Figure 6 in the detailed plan has been updated. Typical Riffle Cross Section has been updated with removal of rip rap stone.

14. Figure 9 – DWR likes the placement of the flow gauges, however; either some of the wetland gauges may need to be moved or other gauges added to monitor wetlands located in upper topo gradients.

    The Site includes 9 groundwater gauges, including 1 groundwater gauge that is monitoring a drained hydric soil. Of the 8 groundwater gauges, 5 are located on side slopes adjacent to the floodplain. To address this comment, we moved two of the 5 gauges in the upper extent of the Site further up the side slope; however, we feel the intent of the IRT to monitor wetlands out of the floodplain has been met.

15. Design sheet 2D – what is floodplain interceptor made out of and does the designer intend to install this feature?

    Text has been added to Section 8.1.1 (Stream Restoration), including the following. "A floodplain interceptor is a depression in the stream banks that directs return flow from the floodplain back into the stream channel at a specific location, thereby eliminating channel bank erosion. The interceptor is constructed by creating a low point in the channel banks, lining the low point with matting, and planting with stabilizing vegetation. In the Piedmont and Mountains rock would be added to the interceptor; however, this is not necessary or appropriate in the Coastal Plain.

    The determination of floodplain interceptor installation and/or location is expected to be made in the field. During construction the field manager will identify if concentrated flow is occurring across the floodplain, or down the valley walls. The field manager will direct the installation of a floodplain interceptor, if necessary, and will include the floodplain interceptor in red-line drawings for the as-built construction documents. "

16. Design sheet 4 – what is the line that borders the stream between the wetted perimeter line and limits of disturbance line? Also, please put a scale on all design sheets with stream planforms.

    The design sheets have been updated. Label "Limits of Construction" has been added for clarification.

17. Design sheet 5 – DWR believes the single thread channel should start at approximately station 7+00.

    Section 8.1.1 (Stream Restoration) has been added to and now includes the following text. "The Site slope in the upper reaches of UT 1 and UT 2 exceeds 0.0035 rise/run and 0.003, respectively. The tributaries have a contributing drainage area at the top measuring 60.8 acres (0.10 sq mi) and 23 acres (0.04 sq mi). In addition, UT 2 has a drainage area characterized by drain tiled agriculture fields that contribute hydrology in a concentrated manner, effectively forming a spring head.

    Coastal plain streams with this slope and size would be expected to be characterized by single thread channels. However, in the event that Priority 1 stream restoration fails, and a braided headwater wetland system develops, the stream length will be modified to the down valley length and wetland credit for 50 feet on each side of the stream will be removed, as per headwater guidance. Stream gauges in the upper extent have been added to monitor flow duration and visual monitoring for the maintenance of a clear channel will be conducted."

Summary: before final approval of this mitigation plan, DWR would like the following:

a. Information on number and location of soil profiles, including areas in upper topo gradients,
Axiom has collected additional soil profiles and included them in the Detailed Mitigation Plan. The location of the profiles is depicted on Figure 4.

b. Better explanation or case for starting with single thread channels at the top of the project,
See answers to question 1 and 17

c. Site pictures, particularly of the upper reach features.
Additional Site photographs have been included as Appendix K.

WRC Comments, Travis Wilson:

1. Significant portions of the watershed shown for UT 1 and UT 2 are located north of a road and railroad bed making it unclear how or if that area drains into those watersheds. The mitigation plan states UT 1 starts at a culvert under the roadbed but appears to still be interconnected with the roadside ditches and drainage. With a Priority 1 approach will the drainage coming under the road access the channel or be pushed further down the roadside ditch? There also does not appear to be any cross pipes connecting flow from the UT 2 watershed delineated on the north side of the road to UT 2 south of the road making that watershed significantly smaller.
   Piped culverts occur beneath a rail line and road in the upper watershed for UT 1. Roadside ditches drain towards the culvert and access the upper reaches of UT 1; therefore, a marsh treatment area is intended to capture stormwater pulses prior to the initiation of the UT 1 channel. The drainage area for UT 1 is correct in Mitigation Plan figures as the ditches drain towards UT 1.

   WRC is correct that the UT 2 drainage area is split by the road and no culverts cross beneath the road, effectively splitting the drainage area. However, drain tile in the field offsets this by attenuating storm flow, providing slow release of hydrology similar to a spring fed tributary. In addition, the upper reaches of UT 2 have a short section of Priority 2 restoration further maintaining contact with the groundwater table. The high slope of UT 2, spring like flow of UT 2 headwaters, and continuous contact with the groundwater table would be expressed as a lower perennial, single thread channel.

2. On paper this site looks like a better wetland restoration site with some amount of headwater stream restoration.
   RS feels there is adequate evidence to support the proposed stream restoration proposal including the soils in the lower reaches of the Site are mapped as Muckalee (a fluvial soil type), the Site is contained within an alluvial valley which matches the Coastal Plain guidance for the existence of a stream, the drainage area at the upper extent of the Site measures over 60 acres (Coastal Plain guidance suggests streams initiate at approximately 25 acres, and during the PJD Site visit the stream was called jurisdictional by the USACE and NCDWR.

3. The amount of Greene ash proposed for planting should be reduced to reflect our latest guidance of <5%
   The planting plan has been updated with a reduction in the number of Green Ash.

USACE Comments, Kim Browning:

1. The correct USACE Action ID is SAW-2018-01169. Please correct the cover page.

The USACE Action ID has been updated.

2. 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.
   Understood and agreed.

3. 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 spread across the Site instead of burned.

4. Table 17 Success Criteria – Streams, please add a statement (regarding UT3) at least 30-days continuous surface water flow for intermittent streams.
   Table 17 includes the parameters to be measured. Table 18 includes success criteria and has a statement that "continuous surface flow must be documented each year for at least 30 consecutive days".

5. Table 18 – Success Criteria: Please add a section on Photo Documentation or Digital Monitoring. An example would be that photographs should illustrate the site's vegetative and morphological stability on an annual basis, in fixed locations, depicted on the monitoring maps or at all cross-sections. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of mid-channel bars or vertical incision. Grade control structures should remain stable.
   Table 18 has been updated to include a Visual Assessment section outlining the above referenced information.

6. The upper end of UT1 will likely be intermittent and develop into more of a headwater system rather than a single thread. Photo documentation showing defined channel features will be important.
   The upper reaches of UT 1 will be monitored for maintenance of channel developing flow.

7. 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 the number of acres to be cleared with the PCN.

8. Maintenance Plan: Will the marsh treatment area within the easement require maintenance? If so, please discuss.
   Marsh treatment areas will not require maintenance and are expected to fill with sediment and naturalize over time.

9. Please include Lidar maps.
   We added a LiDAR map as appendix L.

Sincerely,

Raymond Holz
Restoration Systems

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

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*.

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TABLES

APPENDICES

1.0 PROJECT INTRODUCTION

The Shaw's Run Stream & Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 9.44 acres of disturbed forest and agricultural fields along warm water, unnamed tributaries to Greene Branch. The Site is located approximately 2 miles west of Chadbourn, NC and south of NC Highway 76 in Columbus County (Figures 1 and 2, Appendix A).

1.1 Directions to Site

Directions to the Site from Raleigh, North Carolina.

- Take I-40 East for 26 miles,
- Take exit 328A and merge onto I-95 South; travel 68 miles,
- Take exit 13A to merge onto I-74/US-74 East; travel 29 miles,
- Take the exit toward NC-242 South and turn right onto NC-242,
- After 3 miles turn right onto NC-242 South and continue for 4 miles,
- NC-242 will turn into Grist Road; continue for 0.8 mile,
- Turn right onto Braswell Road,
- After 0.3 mile, the Site is located on the left.
    - Site Latitude, Longitude
      34.3193ºN, 78.8666ºW (WGS84)

1.2 USGS Hydrologic Unit Code and NCDWR River Basin Designation

The Site is located within the Lumber River Basin in 14-digit United States Geological Survey (USGS) Cataloging Unit and **Targeted Local Watershed 03040203191010** of the South Atlantic/Gulf Region (North Carolina Division of Water Resources [NCDWR] subbasin number 03-07-51) [Figure 2, Appendix A]). Topographic features of the Site, unnamed tributaries to Greene Branch, have been assigned Stream Index Numbers 14-27-4-1, and a Best Usage Classification of **C, Sw** (NCDWR 2013). Greene Branch is not listed on the final 2016 or draft 2018 NC 303(d) lists (NCDWR 2018).

1.3 Physiography and Land Use

The Site is located in the Carolina Flatwoods of the Middle Atlantic Coastal Plain ecoregion of North Carolina. Regional physiography is characterized by flat plains on lightly dissected marine terraces and swamps with low gradient streams over sand- and silt-dominated substrate (Griffith et al. 2002). Onsite elevations are nearly level averaging 95-100 feet National Geodetic Vertical Datum (NGVD) (USGS Chadbourn, North Carolina 7.5-minute topographic quadrangle) (Figures 1 and 3, Appendix A).

The Site provides water quality functions to an approximately 0.17-square mile (106-acre) watershed at the outfall (Figure 3, Appendix A). The 1966 Farm Service Agency aerial photograph for Columbus County shows a narrow band of trees surrounding the historic streams with the adjacent areas in agricultural production. Clearing of the riparian vegetation is anticipated to have occurred during the 1970's. The watershed is dominated by row crop production, disturbed forest, and sparse residential development along the margins of Braswell Road. Impervious surfaces account for less than 5 percent of the upstream watershed land surface.

Land use at the Site is characterized by agricultural row crops and disturbed forest. Row crop production extends to, and abuts, ditched stream margins. Herbaceous vegetation and a few

shrubby species grow within the ditches, which are regularly maintained by bush hogging and herbicide application. As the ditch descends the valley towards Greene Branch, soils change from the Goldsboro and Lynchburg soil series (moderately well and somewhat poorly drained) to the Muckalee soil series (poorly drained), and disturbed forest vegetation becomes prevalent along stream margins and floodplains.

1.4 Project Components and Structure

The Site encompasses 9.44 acres of disturbed forest and agricultural fields along warm water, unnamed tributaries to Greene Branch. In its current state, the Site includes approximately 1757 linear feet of degraded stream channel (based on the approved PJD), 0.10 acre of degraded wetland, and 6.77 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 2285 linear feet of Priority I stream restoration, 5.852 acre of riparian wetland reestablishment, and 0.103 acre of riparian wetland preservation (Figure 5, Appendix A). Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 1-3.

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Table 1. Project Components and Mitigation Credits
Shaw's Run Restoration Site

Reach ID	Stream Stationing*/ Wetland Type	Existing Footage/ Acreage	Restoration Footage/ Acreage	Restoration Level	Restoration or Restoration Equivalent	Mitigation Ratio	Mitigation Credits	Comment
UT 1	00+00 to 19+39	1474	1939	Restoration	1939-20 = 1919	1:1	1919.000	20 lf of UT1 is located outside of the conservation easement and therefore is not generating credit
UT 2	00+44 to 04+10	283	366	Restoration	366	1:1	366.000	
Wetland R	Riparian Riverine	--	5.852	Reestablishment	5.852	1:1	5.852	
Wetland E	Riparian Riverine	0.10	0.103	Preservation	0.103	10:1	0.010	

*Stream stationing listed in Table 1 is based on center of design channel.

Length & Area Summations by Mitigation Category		
Restoration Level	**Stream (linear footage)**	**Riparian Wetland (acreage)**
Restoration	2285*	5.852
Preservation	--	0.103

*An additional 20 linear feet of stream restoration is proposed to occur in a crossing of UT1 outside of the conservation easement and is therefore not included in this total or in mitigation credit calculations.

Overall Assets Summary	
Asset Category	**Overall Credits**
Stream	**2285.000**
Riparian Riverine Wetland	**5.862**

Table 2. Project Activity and Reporting History
Shaw's Run Restoration Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-007337)	February 8, 2018	February 8, 2018
Institution Date (NCDMS Contract No. 7515)	--	April 20, 2018
Mitigation Plan	October 2018	March 2019
Construction Plans	--	--

Table 3. Project Contacts Table
Shaw's Run Restoration Site

Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 Raymond Holz 919-755-9490
Designer / Monitoring	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693
Engineer	Sungate Design Group, P.A. 905 Jones Franklin Road Raleigh, NC 27606 Josh Dalton (L-26971) 919-856-2243
Surveyor	k2 Design Group 5688 U.S. Hwy. 70 East Goldsboro, NC 27534 John Rudolph (L-4194) 919-394-2547
Planting Contractor	Carolina Silvics 114 E King Street PO Box 1017 Edenton, NC 27932 Mary-Margaret McKinney 252-482-8491
Construction Contractor	TBD

Table 4. Project Attribute Table
Shaw's Run Restoration Site

Project Information		
Project Name	Shaw's Run Restoration Site	
Project County	Columbus County, North Carolina	
Project Area (acres)	9.44	
Project Coordinates (latitude & latitude)	34.3193ºN, 78.8666 ºW	
Planted Area (acres)	7.7	
Project Watershed Summary Information		
Physiographic Province	Coastal Plain	
Project River Basin	Lumber	
USGS HUC for Project (14-digit)	03040203191010	
NCDWR Sub-basin for Project	03-07-51	
Project Drainage Area (acres)	106	
Percentage of Project Drainage Area that is Impervious	<2%	
CGIA Land Use Classification	Cultivated & Other Broadleaf Deciduous Forest	
Reach Summary Information		
Parameters	**UT1**	**UT2**
Length of reach (linear feet)	1474	283
Valley Classification & Confinement	Alluvial, moderately confined to unconfined	
Drainage Area (acres)	106.5	24.6
NCDWR Stream ID Score	19 (at intermittent origin)	21 (at intermittent origin)
Perennial, Intermittent, Ephemeral	Perennial/ Intermittent	Intermittent
NCDWR Water Quality Classification	C, Sw	
Existing Morphological Description (Rosgen 1996)	G5/6	F5/6
Proposed Stream Classification (Rosgen 1996)	E/C5	E/C5
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	III/IV
Underlying Mapped Soils	Goldsboro fine sandy loam, Lynchburg fine sandy loam, Muckalee fine sandy loam, Norfolk loamy fine sand	
Drainage Class	Moderately well-drained, somewhat poorly-drained, poorly-drained, well-drained, respectively	
Hydric Soil Status	Nonhydric, nonhydric but may contain hydric inclusions, hydric, nonhydric but may contain hydric inclusions, respectively	
Valley Slope	0.0033	0.0100

Table 4. Project Attribute Table Continued
Shaw's Run Restoration Site

FEMA Classification	Greene Branch is located in an AE flood zone
Native Vegetation Community	Coastal Plain Small Stream Swamp/Mesic-Mixed Hardwood Forest
Watershed Land Use/Land Cover	43% forest,55% row crops, <2% low density residential/impervious surface
Percent Composition of Exotic Invasive Vegetation	<2%

Wetland Summary Information	
Parameters	**Wetlands**
Wetland acreage	6.77 acre drained & 0.10 acre degraded
Wetland Type	Riparian riverine
Mapped Soil Series	Muckalee
Drainage Class	Poorly drained
Hydric Soil Status	Hydric
Source of Hydrology	Groundwater, stream overbank
Hydrologic Impairment	Ditched/dredged streams, compacted soils, row crops
Native Vegetation Community	Coastal Plain Bottomland Hardwood Forest
% Composition of Exotic Invasive Vegetation	0%
Restoration Method	Hydrologic, vegetative
Enhancement Method	NA

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	Yes	Yes	FEMA Checklist (App C)
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 and cropland. A summary of existing Site characteristics in favor of proposed stream and wetland activities include the following.

- Streams are dredged and straightened.
- Wetland hydrology has been removed by stream channel entrenchment and drain tile.
- Streams and wetlands have been cleared of forest vegetation.
- Site receives nonpoint source inputs from row crop production including agricultural chemicals and sediment.
- Wetland soils have been compacted by agricultural equipment.

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]).

The Site is located within **Targeted Local Watershed (TLW) 03040203191010** and subbasin 03-07-51. The project is not located within a Local Watershed Planning area; however, project activities address priorities associated with the 2008 *Lumber River Basin Restoration Priorities* report (Site specific information follows each goal).

1. Improve water quality through increased riparian buffer area (Project will restore approximately 7.7 acres of riparian buffer).
2. Reduce impacts from agricultural practices (Project will remove agricultural row crops from the Site).
3. Reduce impacts from impervious surfaces (Project will incorporate one marsh treatment area to treat ditches that receive roadside runoff).
4. Protection of existing resources (Project will be protected with a permanent conservation easement).

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In addition to the defined Cataloging Unit (CU) goals for the Lumber River, additional goals for the area generally revolve around reduction of stressors to water quality. Stressors and how each will be addressed by project activities are as follows.

1. Sedimentation - (sediment model [Section 3.2] – reduction of 15.8 tons/year after mitigation is complete).
2. Nutrients – (nutrient model [Section 3.3] - direct reduction of 89 pounds of nitrogen and 156 pounds of phosphorus per year by removing agricultural row crops; eliminate fertilizer application; and install a marsh treatment area).
3. Land Use Impacts (imperviousness) – (incorporation of one marsh treatment area to treat ditches that receive roadside runoff).
4. Stormwater – (reduction of bank height ratio, restoration of wetlands, reforestation, and installation of a marsh treatment area will reduce stormwater pulses).
5. Lack of Riparian Buffer – (restoration of 7.7 acres of riparian buffer).

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 the following table.

Table 5. Web Soil Survey Soils Mapped within the Site

Map Unit Symbol	Map Unit Name (Classification)	Hydric Status	Description
GoA	Goldsboro fine sandy loam (*Aquic Paleudults*)	Non-hydric	This series consists of moderately well-drained soils found along 0-2 percent slopes on broad interstream divides and flats of marine terraces. The parent material is loamy marine deposits.
LyA	Lynchburg fine sandy loam (*Aeric Paleaquults*)	Non-hydric*	This series consists of somewhat poorly drained soils found along 0-2 percent slopes on marine terraces. The parent material is loamy marine deposits.
Mk	Muckalee fine sandy loam (*Typic Fluvaquents*)	Hydric	This series consists of poorly-drained, frequently flooded soils found on nearly level floodplains. The parent material is sandy and loamy alluvium.
NoB	Norfolk loamy fine sand (*Typic Kandiudults*)	Non-hydric*	This series consists of well-drained soils found along 0-6 percent slopes on broad interstream divides and flats of marine terraces. The parent material is loamy marine deposits.

*Non-hydric soil that may contain hydric soil inclusions.

Hydric soils and jurisdictional wetlands were delineated and mapped by a licensed soil scientist in November 2018. Based on soil delineations approximately 0.10 acre of jurisdictional wetland occurs within the Site boundaries. In addition, 6.77 acres of drained hydric soil occurs within the Site boundaries. Hydric soils have been effectively drained by stream channel incision, drain tile installation, 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. 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)
UT 1 Right Bank	Restoration	8.1
UT 1 Left Bank	Restoration	7.7
UT 2	Restoration	0.0
	Total Sediment Contribution (tons/year)	**15.8**

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

3.3 Nutrient Model

A preliminary land use nutrient model was developed for the Site. The model uses estimates of nutrient management for typical fields, pasture, and hay crops in North Carolina (NC State 2016). Model inputs include stream length, Site width, percent land use, rainfall, and row-crop type. Using published values of Nitrogen and Phosphorus the model predicts the nutrient input of fertilizer associated with land use. A copy of the model input and output is presented in Appendix B.

Based on the land use nutrient model, cessation of land use activities at the Site will result in a direct reduction of 89 pounds of Nitrogen and 156 pounds of Phosphorus per year.

3.4 Project Site Streams

Streams targeted for restoration include unnamed tributaries to Greene Branch, which have been cleared, dredged and straightened, plowed annually for row crops, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from agriculture chemicals and sediment. The entire stream channel has been degraded in support of drain tile installation, which contributes to sediment export from the Site resulting from mechanical processes. In addition, streamside wetlands have been cleared and drained by channel downcutting, drain tile installation, and adjacent 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). Stream geometry measurements under existing conditions are summarized in the following table (Essential Morphology Parameters) and presented in detail in Table B1 (Appendix B).

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Table 7. Essential Morphology Parameters

Parameter	Existing		Reference				Proposed	
	UT1	UT2	Hog Swamp	Wildcat Branch	Mill Creek	Angola	UT1	UT2
Valley Width (ft)	30-70	30-70	100	130	300	300	30-70	30-70
Contributing Drainage Area (sq. mi.)	0.17	0.04	0.08	0.44	1.92	2.09	0.17	0.04
Channel/Reach Classification	G5/6	F5/6	E5	E5	E5	E6	E/C5	E/C45
Design Discharge Width (ft)	4.1-6.9	5.2-8.3	3.8	8.2	11.3	12.3	6.6	3.9
Design Discharge Depth (ft)	0.5-0.8	0.1-0.2	0.5	1.0	1.9	1.3	0.5	0.3
Design Discharge Area (ft^2)	13.6-31.6	15.0-25.8	1.8	8.5	21.0	12.2	3.1	1.1
Design Discharge Velocity (ft/s)	0.09-0.21	0.003-0.06	0.89	0.92	0.94	0.94	0.90	0.82
Design Discharge (cfs)	2.8	0.9	1.6	7.8	19.8	11.5	2.8	0.9
Water Surface Slope	0.0033	0.0100	0.0068	0.0024	0.0026	0.0002	0.0029	0.0087
Sinuosity	1.00	1.00	1.24	1.15	1.18	1.17	1.15	1.15
Width/Depth Ratio	5.3-14.9	24.6-62.6	7.9	6.1	8.0	9.7	12-16	12-16
Bank Height Ratio	3.4	6.8	1.0	1.0	1.0	1.0	1.0	1.0
Entrenchment Ratio	1.1-1.9	1.0-1.6	26.6	26.5	15.9	24.4	7.6	12.7
Substrate	Sand/Silt/Clay	Sand/Silt/Clay	Sand	Sand	Sand	Silt/Clay	Sand	Sand

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- and F-type streams with little to no sinuosity. Existing Site reaches are characterized by a straightened channel and riparian vegetation removal.

3.4.3 Channel Evolution

Site streams targeted for restoration have been channelized and are continually eroding resulting primarily in channels classified as degraded (Class III), and degraded and widened (Class IV) channels throughout the Site (Simon and Hupp 1986). Streams would likely follow the evolution to an aggradation stage (Class V) and ultimately to the re-stabilization stage (Class VI); however, continued maintenance (cleaning ditches and mowing vegetation) hinders the completion of the channel evolutionary process.

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 relatively steep for the Coastal Plain region and range from 0.0033-0.0100. Typical streams in this region include D-type braided stream swamps. However, steeper slopes may trend towards C- and E-type streams with slightly entrenched, meandering channels and a riffle-pool sequence.

3.4.5 Discharge

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 49.8 inches per year (USDA 1990). Drainage basin sizes range from 0.04- to 0.17-square mile.

The Site's discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Sweet and Geratz 2003), the bankfull discharge for the Site (0.04- to 0.17-square mile watershed) ranges from 0.7 to 2.2 cubic feet per second. Based on indicators of bankfull at reference reaches and on-Site, the designed channel will equal approximately 125 percent of the channel size indicated by Coastal Plain 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 approved by United States Army Corps of Engineers (USACE) representative Thomas Charles during a field meeting on January 10, 2018 and subsequently by a Notification of Jurisdictional Determination dated March 11, 2019 (Appendix D). Existing jurisdictional wetlands are depicted in blue and drained hydric soils are depicted in cross hatch on Figure 4 (Appendix A).

3.5.1 Hydrological Characterization

Construction activities are expected to restore approximately 5.852 acre of drained riparian hydric soils and preserve 0.103 acre of riparian wetlands. Approximately 0.95 acres of drained hydric soils will not be rehydrated. Areas that will remain drained include the upstream reach of UT 1 adjacent to an open ditch, and the lower reaches of UT1 adjacent to Greene Branch. Areas of the Site targeted for riparian wetland reestablishment 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 and subsurface drain tile within agricultural fields.

3.5.2 Soil Characterization

Detailed soil mapping conducted by a North Carolina Licensed Soil Scientist (NCLSS) indicate that the Site is currently underlain by hydric soils of the Muckalee series. A detailed soil profile conducted by a NCLSS is as follows; the location is depicted on Figure 4 (Appendix A) and a soil boring log is included in Appendix B.

Table 8. Profile Description

Depth (inches)	Color	Texture
0 - 9	10YR 3/2 10YR 4/1 mottles 10%	Loam
9 - 12	10YR 3/2	Loamy sand
12 - 18	10YR 5/1 10YR 4/1 mottles 20% 10YR 3/2 mottles 10% 10YR 6/1 mottles 10%	Fine sandy loam
18+	10YR 7/1 10YR 6/8 mottles 10%	Sandy clay

3.5.3 Plant Community Characterization

Areas proposed for wetland reestablishment and preservation occur within existing agricultural row crops and/or bottomland forest.

4.0 REFERENCE STUDIES

4.1 Reference Streams

Four reference reaches were identified for the Site. Three reference reaches (Mill Creek, UT to Wildcat Branch, and UT to Hog Swamp) were measured for the North Carolina Division of Mitigation Services (NCDMS) Brown Marsh Swamp Stream and Wetland Mitigation Site (NCDMS Contract No. 16-D06038), which was successfully closed out in 2012. The fourth reference stream is Angola Creek measured specifically for this project. Stream geometry measurements are summarized in Table 6 (Essential Morphology Parameters) and presented in detail in Table B1 (Appendix B).

4.1.1 Discharge

Field indicators of bankfull and corresponding average discharge is as follows.

Site	DA (mi^2)	Discharge (cfs)	% of Regional Curves
Mill Cr	1.92	19.8	137
UT Wildcat Br	0.44	7.8	165
UT Hog Sw	0.08	1.6	124
Angola Cr	2.09	11.5	75

Site drainage area is approximately 0.17 square miles, which is within the range of drainage areas exhibited by reference reaches.

4.1.2 Channel Morphology

Reference reach channel morphology includes the following values.

Site	Abkf (ft^2)	Wbkf (ft)	Dbkf (ft)	W/D	BHR
Mill Cr	21.0	11.3	1.9	6.1	1.0
UT Wildcat Br	8.5	8.2	1.0	8.0	1.0
UT Hog Sw	1.8	3.8	0.5	7.9	1.0
Angola Cr	12.2	12.3	1.3	9.7	1.0

In-field measurements of the reference reach pattern and slopes resulted in the following values.

Site	H20slope	Valley slope	SIN
Mill Cr	0.0026	0.0031	1.18
UT Wildcat Br	0.0024	0.0027	1.15
UT Hog Sw	0.0068	0.0084	1.24
Angola Cr	0.0002	0.0003	1.17

Site valley slopes are 0.0033 and 0.0100 which are similar to reference reaches, giving a good range of slopes for channel design and comparison.

4.2 Reference Forest Ecosystem

Reference Forest Ecosystems (RFEs) for this project included stable forested areas located at the western end of the Brown Marsh Swamp Stream and Wetland Mitigation Site (NCDMS Contract No. 16-D06038, successfully closed out in 2012) and along Ashpole Swamp near NC 130, which is located approximately 25 miles northwest and 23 miles northwest, respectively from the Site. The RFE supports plant community and landform characteristics that restoration efforts will attempt to emulate. Tree and shrub species identified within the reference forests are summarized in the following table.

Table 9. Reference Forest Ecosystem

Coastal Plain Small Stream Swamp	
red maple (*Acer rubrum*)	water tupelo (*Nyssa biflora*)
ironwood (*Carpinus caroliniana*)	laurel oak (*Quercus laurifolia*)
green ash (*Fraxinus pennsylvanica*)	swamp chestnut oak (*Quercus michauxii*)
American holly (*Ilex opaca*)	water oak (*Quercus nigra*)
tulip poplar (*Liriodendron tulipifera*)	American elm (*Ulmus americana*)
sweetgum (*Liquidambar styraciflua*)	

5.0 CHANNEL ASSESSMENTS

5.1 Channel Stability Assessment

Channel degradation or aggradation occurs when hydraulic forces exceed or do not approach the resisting forces in the channel. The amount of degradation or aggradation is a function of relative magnitude of these forces over time. The interaction of flow within the boundary of open channels is only imperfectly understood. Adequate analytical expressions describing this interaction have yet to be developed for conditions in natural channels. Thus, means of characterizing these processes rely heavily upon empirical formulas.

Stream power and shear stress were estimated for 1) existing dredged and straightened reaches, 2) the reference reaches, and 3) proposed Site conditions. Important input values and output results (including stream power, shear stress, and per unit shear power and shear stress) are presented in the following table. Average stream velocity and bankfull discharge values were calculated for the existing Site stream reaches, the reference reach, and proposed conditions.

In order to maintain sediment transport functions of a stable stream system, the proposed channel should exhibit stream power and shear stress values so the channel is neither aggrading nor degrading. Results of the analysis indicate the proposed channel reaches are expected to maintain stream power as a function of width values of approximately 0.08-0.13 and shear stress values of approximately 0.07-0.13.

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

Reach	Bankfull Discharge (ft^3/s)	Water surface Slope (ft/ft)	Total Stream Power (Ω)	Ω/W	Hydraulic Radius	Shear Stress (τ)	Velocity (v)	τ v	τ_{max}
Existing Conditions									
UT 1	2.8	0.0033	0.58	**0.10**	3.28	**0.67**	0.12	0.08	1.01
UT 2	0.9	0.0100	0.56	**0.07**	2.52	**1.57**	0.04	0.07	2.36
Reference Conditions									
Hog Swamp	1.6	0.0068	0.68	**0.18**	0.38	**0.16**	0.89	0.14	0.24
Wildcat Branch	7.8	0.0024	1.17	**0.14**	0.83	**0.12**	0.92	0.11	0.19
Mill Creek	19.8	0.0026	3.21	**0.28**	1.39	**0.23**	0.94	0.21	0.34
UT Angola Creek	11.5	0.0002	0.14	**0.01**	0.82	**0.01**	0.94	0.01	0.02
Proposed Conditions									
UT 1	2.8	0.0029	0.51	**0.08**	0.40	**0.07**	0.90	0.07	0.11
UT 2	0.9	0.0087	0.49	**0.13**	0.24	**0.13**	0.82	0.11	0.20

Stream power by width values appears relatively similar across existing, reference, and proposed conditions. However, shear stress for the existing condition channels appears elevated. Shear stress values of the existing streams range from 0.67 and 1.57, as compared to reference (0.01 - 0.23) and proposed condition (0.07 and 0.13) values. Proposed stream power and shear stress values are consistent with stable, reference values and are therefore expected to be characterized by stable channels after restoration. This would indicate the proposed channels have adequate energy to mobilize and transport sediment through the Site, without aggradation or erosion on proposed stream banks.

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 Coastal Plain regional curves, the predicted bankfull discharge for the reference reaches of 1.3, 4.7, 14.4, and 15.4 cubic feet per second (cfs) for Hog Swamp, Wildcat Branch, Mill Creek, and Angola, respectively (Sweet et al. 2003). The USGS regional regression equation for the Coastal Plain region indicates much higher bankfull discharges for the reference reaches at a 1.3-1.5 year return interval with ranges of approximately 6-8, 17-22, 50-62, and 55-67 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 Coastal Plain 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 1.6, 7.8, 19.8, and 11.5 cfs, respectively for the reference reaches, which is 124, 165, 137, and 75 percent of that predicted by the regional curves.

Proposed conditions at the Site will be based on bankfull indicators at reference reaches. Based on field indicators of bankfull at the Hog Swamp Reference Reach (124 percent of the curves), Wildcat Branch Reference Reach (165 percent of the curves), the Mill Creek Reference Reach (137 percent of the curves), and the Angola Reference Reach (75 percent of the curves), the designed onsite channel restoration area will equal approximately 125 percent of the channel size indicated by Coastal Plain regional curves. The following table 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)
Hog Swamp Reference Reach			
Coastal Plain Regional Curves (Harman et al. 2003)	0.08	1.3-1.5	1.3
Coastal Plain Regional Regression Model (USGS 2006)	0.08	1.3-1.5	6-8
Field Indicators of Bankfull	0.08	1.3-1.5	1.6
Wildcat Branch Reference Reach			
Coastal Plain Regional Curves (Harman et al. 2003)	0.44	1.3-1.5	4.7
Coastal Plain Regional Regression Model (USGS 2006)	0.44	1.3-1.5	17-22
Field Indicators of Bankfull	0.44	1.3-1.5	7.8
Mill Creek Reference Reach			
Coastal Plain Regional Curves (Harman et al. 2003)	1.92	1.3-1.5	14.4
Coastal Plain Regional Regression Model (USGS 2006)	1.92	1.3-1.5	50-62
Field Indicators of Bankfull	1.92	1.3-1.5	19.8
Angola Reference Reach			
Coastal Plain Regional Curves (Harman et al. 2003)	2.09	1.3-1.5	15.4
Coastal Plain Regional Regression Model (USGS 2006)	2.09	1.3-1.5	55-67
Field Indicators of Bankfull	2.09	1.3-1.5	11.5

6.0 FUNCTIONAL UPLIFT AND PROJECT GOALS/OBJECTIVES

The Site is located within **Targeted Local Watershed (TLW) 03040203191010** and subbasin 03-07-51. The project is not located within a Local Watershed Planning area; however, project activities address priorities associated with the 2008 *Lumber River Basin Restoration Priorities* report (See Section 2.0).

Site specific mitigation goals and objectives have been developed through the use of NC SAM and NC WAM analyses of existing 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.

The following table summarizes NC SAM output. Metrics targeted to meet the Site's goals and objectives are depicted in bold.

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Table 12A. Shaw's Run NC SAM Summary

NC SAM Function Class Rating Summary	SAM 1 UT 1	SAM 2 UT 2
(1) HYDROLOGY	**LOW**	**LOW**
(2) Baseflow	HIGH	HIGH
(2) Flood Flow	**LOW**	**LOW**
(3) Streamside Area Attenuation	**LOW**	**LOW**
(4) Floodplain Access	**LOW**	**LOW**
(4) Wooded Riparian Buffer	**LOW**	**LOW**
(4) Microtopography	**LOW**	**LOW**
(3) Stream Stability	MEDIUM	MEDIUM
(4) Channel Stability	HIGH	HIGH
(4) Sediment Transport	**NA**	**NA**
(4) Stream Geomorophology	**LOW**	**LOW**
(1) WATER QUALITY	MEDIUM	**LOW**
(2) Baseflow	HIGH	HIGH
(2) Stream-side Area Vegetation	**LOW**	**LOW**
(3) Upland Pollutant Filtration	**LOW**	**LOW**
(3) Thermoregulation	**LOW**	**LOW**
(2) Indicators of Stressors	NO	NO
(2) Aquatic Life Tolerance	MEDIUM	**LOW**
(1) HABITAT	**LOW**	**LOW**
(2) In-stream Habitat	**LOW**	**LOW**
(3) Baseflow	HIGH	HIGH
(3) Substrate	**LOW**	**LOW**
(3) Stream Stability	MEDIUM	MEDIUM
(3) In-Stream Habitat	MEDIUM	MEDIUM
(2) Stream-side Habitat	**LOW**	**LOW**
(3) Stream-side Habitat	**LOW**	**LOW**
(3) Thermoregulation	**LOW**	**LOW**
OVERALL	**LOW**	**LOW**

Based on NC SAM output, all three primary stream functional metrics (Hydrology, Water Quality, and Habitat), as well as 15 sub-metrics are under-performing as exhibited by a LOW metric rating (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.

Wetland reestablishment areas are not able to be rated by the NC WAM methodology. Therefore, NC WAM forms were not filled out for the project. However, wetland metrics will still be targeted for full functional uplift within the project.

The following table 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 12B. 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 (4) Microtopography Wetland – Surface and Sub-Surface Storage and Retention	• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning and degraded wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Cease row crop production within the easement • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement
(3) Stream Stability (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 • Cease row crop production within the easement • Construct stable channels with grade control structures. • Plant woody riparian buffer
(1) WATER QUALITY		

(2) Streamside Area Vegetation
(3) Upland Pollutant Filtration
(3) Thermoregulation
(2) Aquatic Life Tolerance
Wetland - Pathogen, Particulate, Soluble, and Physical Change
	• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Reduce agricultural land/inputs
		• Install marsh treatment areas
		• Plant woody riparian buffer
		• Restore jurisdictional wetlands adjacent to Site streams
		  o Remove drain tile
		  o Promote overbank flooding by P1 stream restoration.

(1) HABITAT		
(2) In-stream Habitat (3) Substrate (2) Stream-side Habitat (3) Stream-side Habitat (3) Thermoregulation Wetland - Physical Structure, Landscape Patch Structure, and Vegetation Composition	• Improve instream and stream-side habitat.	• Construct stable channels • Plant woody 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 riparian buffers with a perpetual conservation easement • Restore 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, any Site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

No known Site constraints, that may hinder proposed mitigation activities, were identified during field surveys. An Environmental Screening (Categorical Exclusion) document is included in Appendix E.

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, row crop production, 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 4.0 Reference Streams).

Primary activities designed to restore the Site include 1) Priority I stream restoration, 2) wetland reestablishment, 3) wetland preservation, 4) construction of a marsh treatment area, and 5) vegetation planting (Figure 5, 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.

The Site slope in the upper reaches of UT 1 and UT 2 exceeds 0.0035 rise/run and 0.003, respectively. The tributaries have a contributing drainage area at the top measuring 60.8 acres (0.10 sq mi) and 23 acres (0.04 sq mi). In addition, UT 2 has a drainage area characterized by drain tiled agriculture fields that contribute hydrology in a concentrated manner, effectively forming a spring head.

Coastal plain streams with this slope and size would be expected to be characterized by single thread channels. However, in the event that Priority 1 stream restoration fails, and a braided headwater wetland system develops, the stream length will be modified to the down valley length and wetland credit for 50 feet on each side of the stream will be removed, as per headwater guidance. Stream gauges in the upper extent have been added to monitor flow duration and visual monitoring for the maintenance of a clear channel will be conducted.

Stream restoration is expected to entail 1) channel excavation, 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 be placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

Floodplain Interceptor

A floodplain interceptor is a depression in the stream banks that directs return flow from the floodplain back into the stream channel at a specific location, thereby eliminating channel bank erosion. The interceptor is constructed by creating a low point in the channel banks, lining the low point with matting, and planting with stabilizing vegetation. In the Piedmont and Mountains rock would be added to the interceptor; however, this is not necessary or appropriate in the Coastal Plain.

The determination of floodplain interceptor installation and/or location is expected to be made in the field. During construction the field manager will identify if concentrated flow is occurring across the floodplain, or down the valley walls. The field manager will direct the installation of a floodplain interceptor, if necessary, and will include the floodplain interceptor in red-line drawings for the as-built construction documents.

Piped Channel Crossings

Landowner constraints will necessitate the installation of two piped channel crossing; one just upstream of the easement on UT2 and one within a break in the easement on UT1 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 UT1 to Greene Branch. The drop structure may be constructed out of Terracell, or 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

One shallow wetland marsh treatment area will be excavated in the floodplain to intercept surface waters draining through agricultural areas prior to discharging into UT1. The marsh treatment area is intended to improve the mitigation project and is not generating mitigation credit. The proposed marsh treatment area location is depicted on Figure 5 (Appendix A) and will consist of a shallow depression 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.

8.2 Individual Reach Descriptions

Mitigation strategies proposed for each UT are presented below (Figure 5, Appendix A).

UT 1

UT 1 originates within the Site in a ditch that extends from beneath a road/railroad. The stream originates at a wetland depression adjacent to the ditch and extends for 1474 linear feet in its current location within the Site. The majority (84 %) of the stream is characterized by row crops adjacent to a ditched, straightened, and incised Coastal Plain stream system with sand substrate. UT 1 descends towards the forested floodplain of Greene Branch and ultimately converges with Greene Branch at the Site outfall.

In its current state, UT 1 is classified as a G-type channel throughout its reach, with entrenchment ratios ranging from 1.1 to 1.9. The majority of the channel is highly incised, as evidenced by bank-height-ratios averaging 3.4. The channel exhibits low sinuosity (1.00) as expected for a ditched and straightened stream.

UT 1 is proposed for stream restoration throughout its entire reach. Restoration is expected to be initiated in the upper reaches, where ditches will be filled to allow for priority 1 channel construction on new location. The initiation point is a wetland depression that may have drain tile and is ditched. Drain tile will be investigated by the contractor by excavating transects across areas suspected to have tile. Once located, the contractor will remove all drain tile within the

easement. The upstream ditch will be filled such that positive drainage will occur into the stream initiation point. A marsh treatment area will be constructed immediately upstream of the initiation point. Once stream construction has been initiated, the new channel will be constructed throughout the entire reach of the Site, converging with Greene Branch at the Site outfall. A Terracell drop structure is proposed to tie elevations from the Site into the Greene Branch channel.

UT 2

UT 2 originates at a culvert outfall located on the Site boundary and extends for 283 linear feet in its current location. The entire reach of the stream is characterized by row crops adjacent to a sand bed, ditched, straightened, and incised Coastal Plain stream system. UT 2 descends a relatively steep valley and converges with UT 1.

In its current state, UT 2 is classified as an F-type channel, with entrenchment ratios ranging from 1.0 to 1.6. The majority of the channel is highly incised, as evidenced by bank-height-ratios averaging 6.8. The channel exhibits low sinuosity (1.00) as expected for a ditched and straightened stream.

UT 2 is proposed for stream restoration throughout its entire reach. UT 2 originates at a culvert that drains agricultural fields and drain tiles immediately upstream of the culvert. The culvert is to be replaced at a suitable grade to initiate priority 1 stream restoration. Once stream construction has been initiated, the new channel will be constructed throughout the Site, converging with UT 1.

8.3 Wetland Reestablishment

Portions of the Site underlain by hydric soils have been impacted by lowering of the groundwater table and a lateral drainage effect from stream channel incision and straightening; drainage tiles; vegetative clearing; agricultural plowing; herbicide application; and other land disturbances associated with land use management.

Wetland reestablishment will focus on the restoration of vegetative communities, the reestablishment of soil structure and microtopographic variations, and redirecting normal surface hydrology from streams back onto the Site floodplains. 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 5.85 acres jurisdictional hydrology to riparian wetlands. In addition, the construction of (or provisions for) surface water storage depressions (ephemeral pools) will also add an important component to groundwater restoration activities.

8.3.1 Groundwater Model

For this study, the Boussinesq equation was utilized to predict groundwater impacts associated with ditches or canals that will remain open upon completion of Site implementation. The Boussinesq equation represents a two-dimensional general flow equation for unconfined aquifers. The equation has been applied in the past to predict the decline in elevation of the water table near a pumping well as time progresses.

The Boussinesq equation was applied to Site ditches to predict the linear distance of groundwater drawdown that exceeds 1 foot for 12.5 percent of the growing season. The percentage of the growing season (12.5 percent) was selected based upon guidance from the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). The equation is solved for wetland impacts with data for the following variables: 1) equivalent hydraulic conductivity, 2) drainable porosity, 3) and estimated depth to the impermeable layer or aquiclude, 4) the time duration of the drawdown, 5) target water depth (1 foot below the soil surface), and 6) minimum ditch depth.

Results from the Boussinesq equation predicted lateral drainage effects to the groundwater table from agricultural ditches and or canals associated with Greene Branch after the project is complete. Results of the Boussinesq equation are summarized in the following table. Based on this analysis, a zone of influence from Greene Branch will extend 150 feet from the canal. Therefore, hydric soils within the zone of influence will remain drained hydric soils and has not been included in wetland reestablishment acreage. Similarly, the upper reaches of UT 1 will have a drainage ditch that affects the groundwater table. These features will result in 5.85 acres of wetland reestablishment, 0.10 acres of wetland preservation, and 0.95 acres of drained hydric soil, as depicted in Figure 5 (Appendix A).

Table 14. Results for Boussinesq Equation

Soil	Ditch Depth (ft)	Depth to Aquiclude (cm)	Ksat (cm/hr)	Growing Season (hrs)	Drainable Porosity (cm)	Ditch Impact (ft)
Muckalee* (Columbus County)	1	30.5	1.5	668	0.0103	16
	2	61.0	1.5	668	0.0103	116
	3	91.4	1.5	668	0.0103	142
	4	121.9	1.5	668	0.0103	150
	6	152.4	1.5	668	0.0103	155

*Based on a Bibb soil (also a *Typic Fluvaquent*)

8.4 Wetland Preservation

Wetland preservation will preserve 0.10 acre of forested 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. Coastal Plain Small Stream Swamp is the target community for Site floodplains and Mesic-Mixed Hardwood Forest is the target community for uplands. The following table depicts the total number of stems and species distribution within each vegetation association (Figure 8, 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.

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Table 15. Planting Plan

Vegetation Association	Coastal Plain Small Stream Swamp Forest*		Mesic-Mixed Hardwood Forest*		Stream-side Assemblage**		TOTAL***
Area (acres)	**3.8**		**2.4**		**1.5**		**7.7**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Bald cypress (*Taxodium distichum*)	517	20	--	--	408	10	925
Black gum (*Nyssa sylvatica*)	517	20	--	--	408	10	925
Swamp chestnut oak (*Quercus michauxii*)	258	10	245	15	--	--	503
Laurel oak (*Quercus laurifolia*)	258	10	163	10	--	--	422
River birch (*Betula nigra*)	258	10	163	10	408	10	830
Tulip poplar (*Liriodendron tulipifera*)	388	15	326	20	--	--	714
Water oak (*Quercus nigra*)	--	--	163	10	--	--	163
Willow oak (*Quercus phellos*)	--	--	163	10	--	--	163
Green ash (*Fraxinus pennsylvanica*)	129	5	82	5	--	--	211
Sycamore (*Platanus occidentalis*)	258	10	326	20	408	10	993
Silky dogwood (*Cornus amomum*)	--	--	--	--	612	15	612
Black willow (*Salix nigra*)	--	--	--	--	612	15	612
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	612	15	612
Elderberry (*Sambucus canadensis*)	--	--	--	--	612	15	612
TOTAL	**2584**	**100**	**1632**	**100**	**4080**	**100**	**8296**

* Planted at a density of 680 stems/acre.
** Planted at a density of 2720 stems/acre.
***Actual quantities will vary slightly based on standard lot sizes for bare-root stems.

In addition to planting seedlings, an herbaceous seed mix including a mix of grasses, forbs, and native wildflowers will be applied. This mix will provide ecological uplift through enhanced soil stability and wildlife/pollinator habitat and act as a nurse crop to the planted trees.

8.6.2 Nuisance Species Management

No nuisance species controls are proposed at this time; inspections for 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.

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 16 (Figure 9, Appendix A). Annual monitoring reports will be submitted to the NCDMS by Restoration Systems no later than December 1st of each monitoring year data is collected.

Table 16. 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							

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Table 17. 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 10 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	One surface water gauge on UT 1	Surface water data for each monitoring period
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	One surface water gauge on 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 UT 1 and one at the lower end of UT 2); 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 Reestablishment	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-November 12	9 gauges spread throughout restored wetlands	Soil temperature at the beginning of each monitoring period to verify the start of the growing season (no earlier than March 1), 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	7 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre

*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 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 18. Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Continuous surface flow must be documented each year for at least 30 consecutive days. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • Entrenchment ratio (ER) must be no less than 2.2 at any measured riffle cross-section. • BHR and ER at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period. • 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, 12 percent of the growing season, during average climatic conditions
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.
Visual Assessment
• Photographs at vegetation plots and cross sections should illustrate the Site's vegetative and morphological stability on an annual basis, including no excessive erosion or degradation on the channel banks, no mid channel bars, or vertical incision. In addition grade control structures should remain stable.

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 criteria 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.

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Table 19. 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 • Cease row crop production within the easement • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement	• BHR not to exceed 1.2 • Document four overbank events in separate monitoring years • Remove agricultural row crops from the easement • Monitoring wells will be successful if the water table is within 12 inches of the soil surface for 12% of the growing season • Vegetation plots will be successful if the plant density is 210 stems per acre with an average plant height of 10 feet at 7 years following planting • 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 • Cease row crop production within the easement • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • ER of 2.2 or greater • < 10% change in BHR and ER in any given year • Remove agricultural row crops from the easement • Vegetation plots will be successful if the plant density is 210 stems per acre with an average plant height of 10 feet at 7 years following planting
(1) WATER QUALITY		
• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Reduce agricultural land/inputs • Install marsh treatment areas • Plant woody riparian buffer • Restore jurisdictional wetlands adjacent to Site streams	• Remove agricultural row crops from the easement • Monitoring wells will be successful if the water table is within 12 inches of the soil surface for 12% of the growing season • Vegetation plots will be successful if the plant density is 210 stems per acre with an average plant height of 10 feet at 7 years following planting

Goals	Objectives	Success Criteria
(1) HABITAT		
• Improve instream and stream-side habitat.	• Construct stable channels • Plant woody 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 riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams	• Cross-section measurement indicate a stable channel • Visual documentation of stable channels and in-stream structures. • Monitoring wells will be successful if the water table is within 12 inches of the soil surface for 12% of the growing season • Vegetation plots will be successful if the plant density is 210 stems per acre with an average plant height of 10 feet at 7 years following planting • 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 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.

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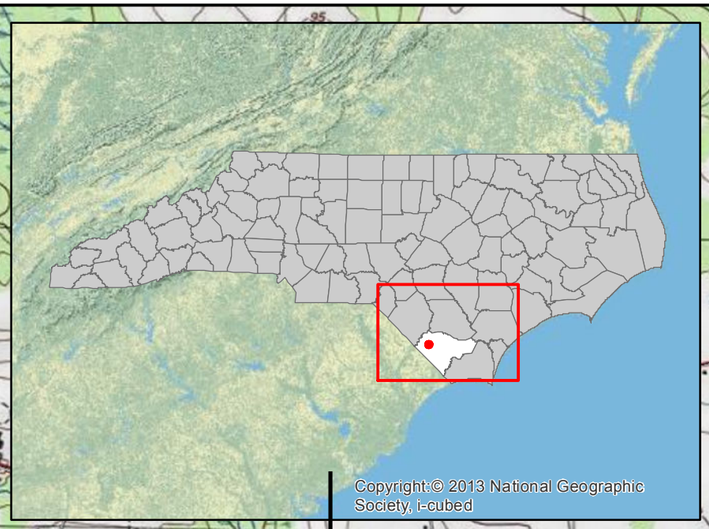
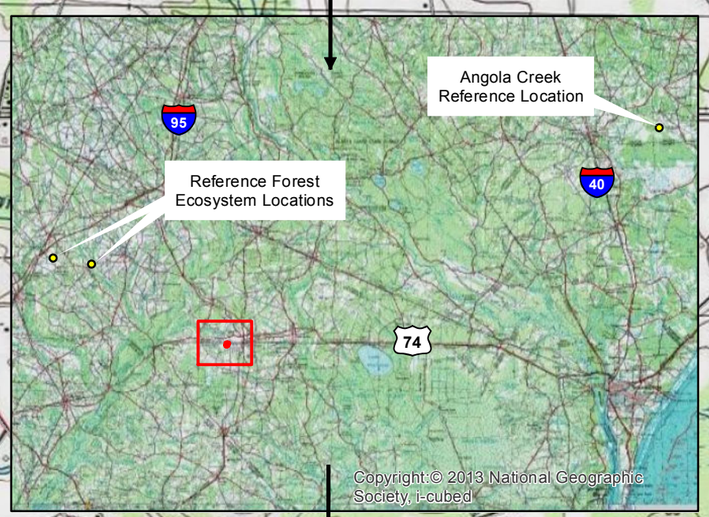
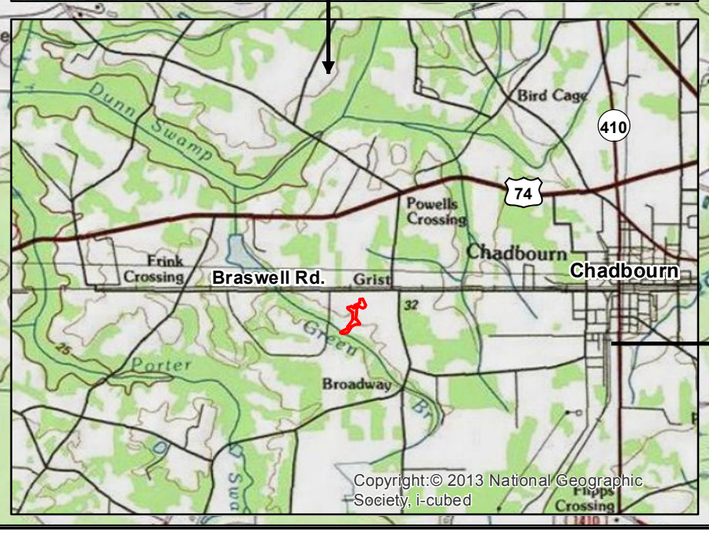
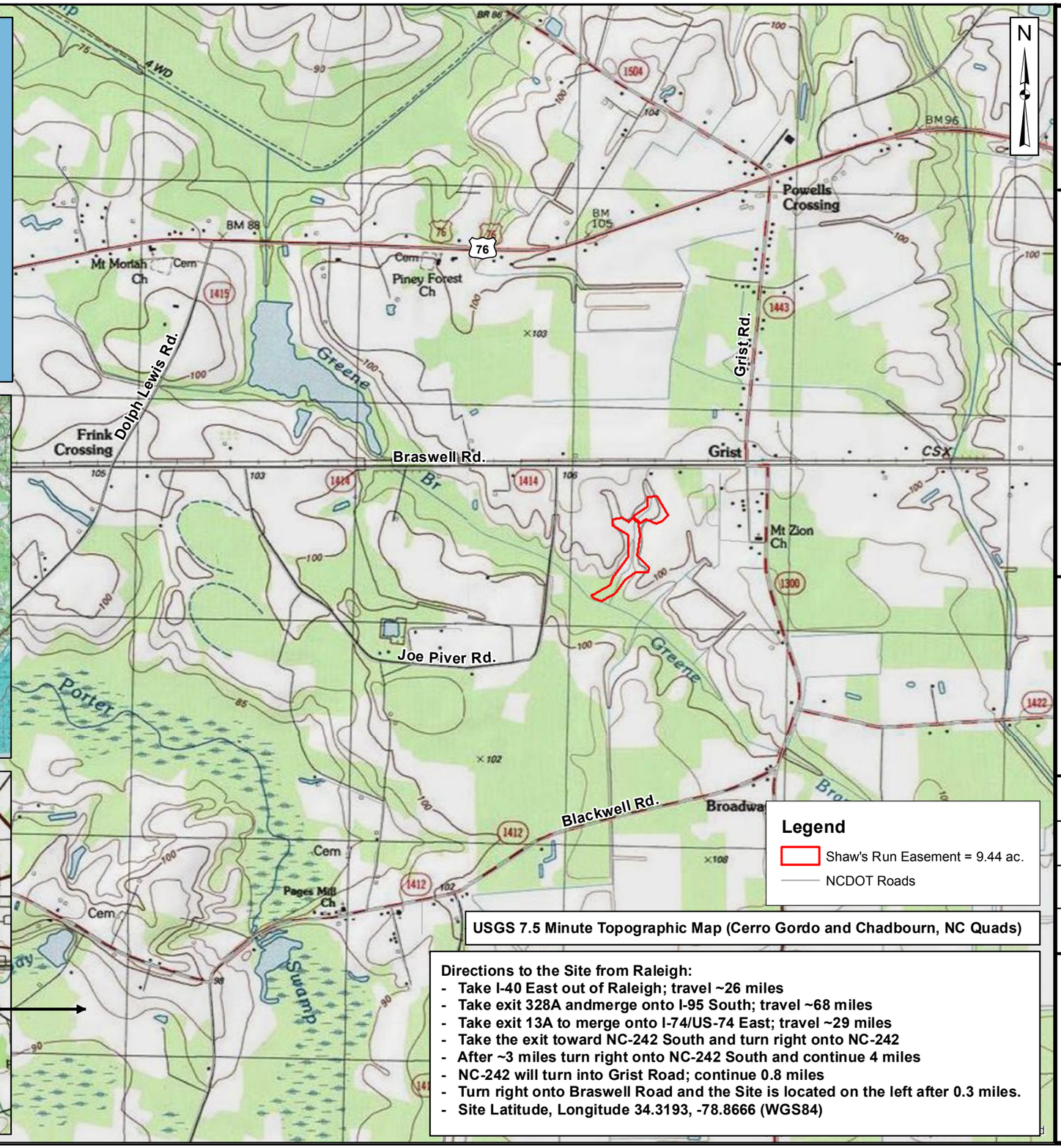
APPENDIX A
FIGURES

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









Legend

- Shaw's Run Easement = 9.44 ac.
- NCDOT Roads

USGS 7.5 Minute Topographic Map (Cerro Gordo and Chadbourn, NC Quads)

Directions to the Site from Raleigh:

- Take I-40 East out of Raleigh; travel ~26 miles
- Take exit 328A andmerge onto I-95 South; travel ~68 miles
- Take exit 13A to merge onto I-74/US-74 East; travel ~29 miles
- Take the exit toward NC-242 South and turn right onto NC-242
- After ~3 miles turn right onto NC-242 South and continue 4 miles
- NC-242 will turn into Grist Road; continue 0.8 miles
- Turn right onto Braswell Road and the Site is located on the left after 0.3 miles.
- Site Latitude, Longitude 34.3193, -78.8666 (WGS84)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

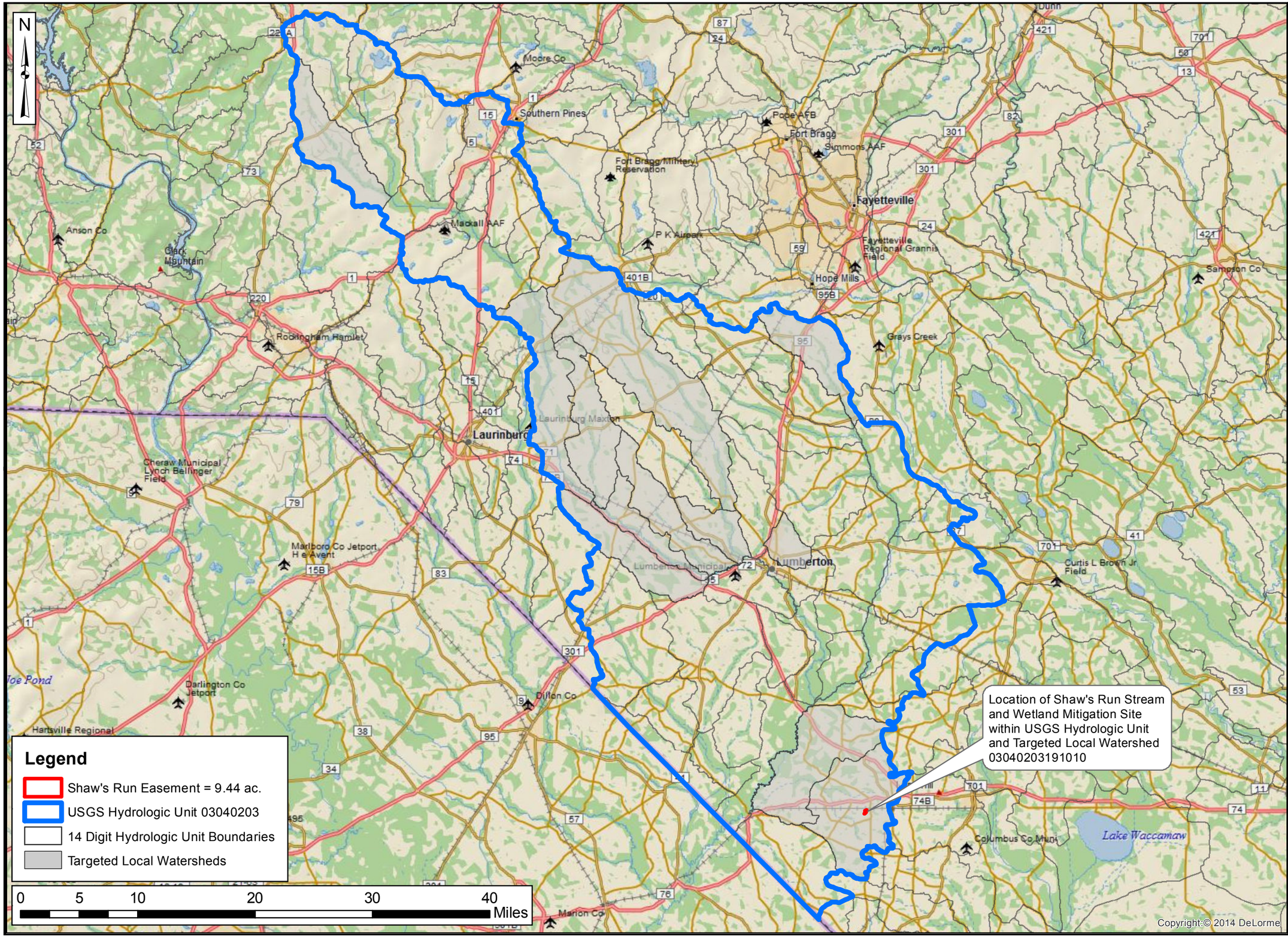
Date: FEB 2019

Scale: 1:20,000

Project No.: 18-014

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: CLF/KRJ

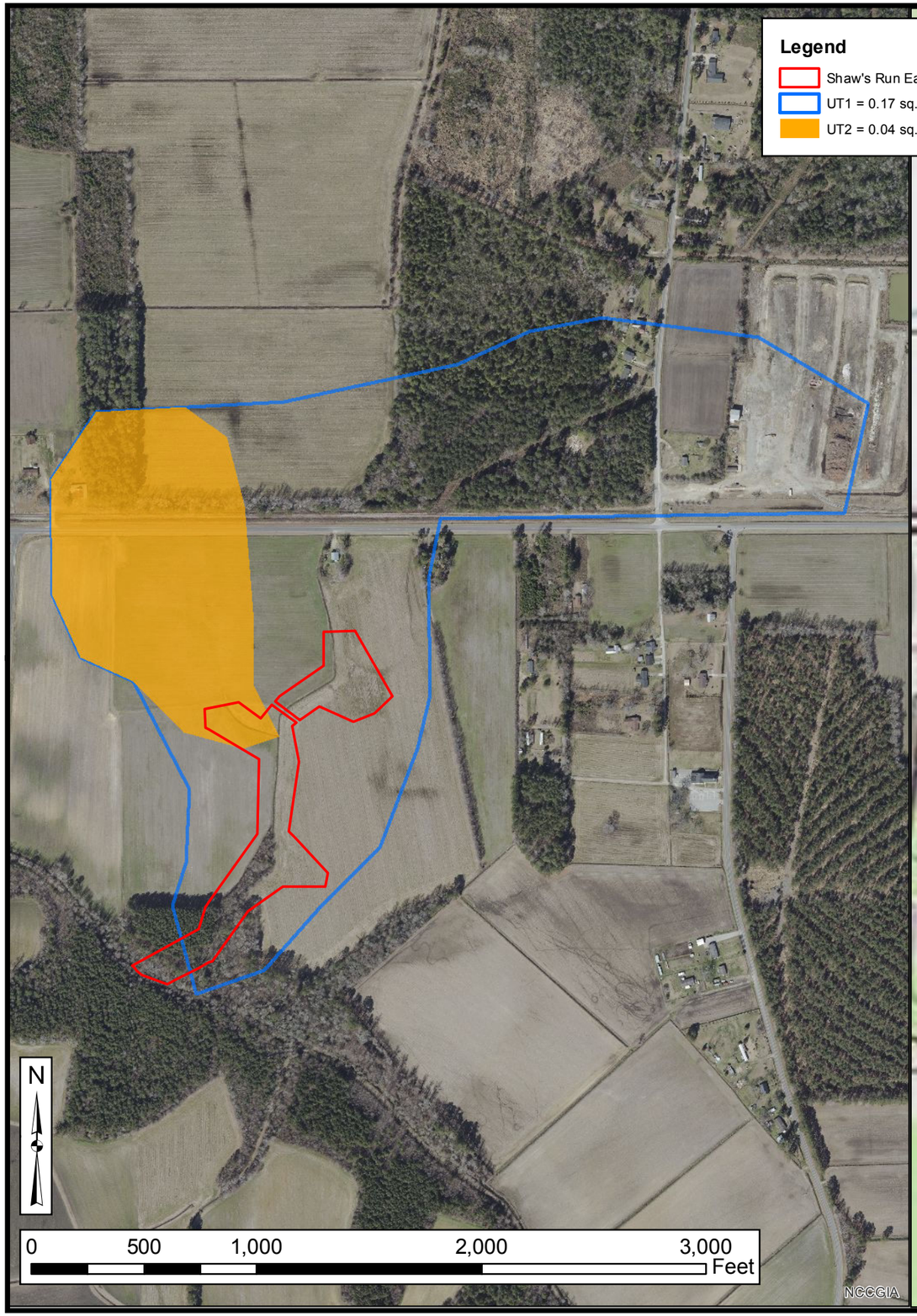
Date: FEB 2019

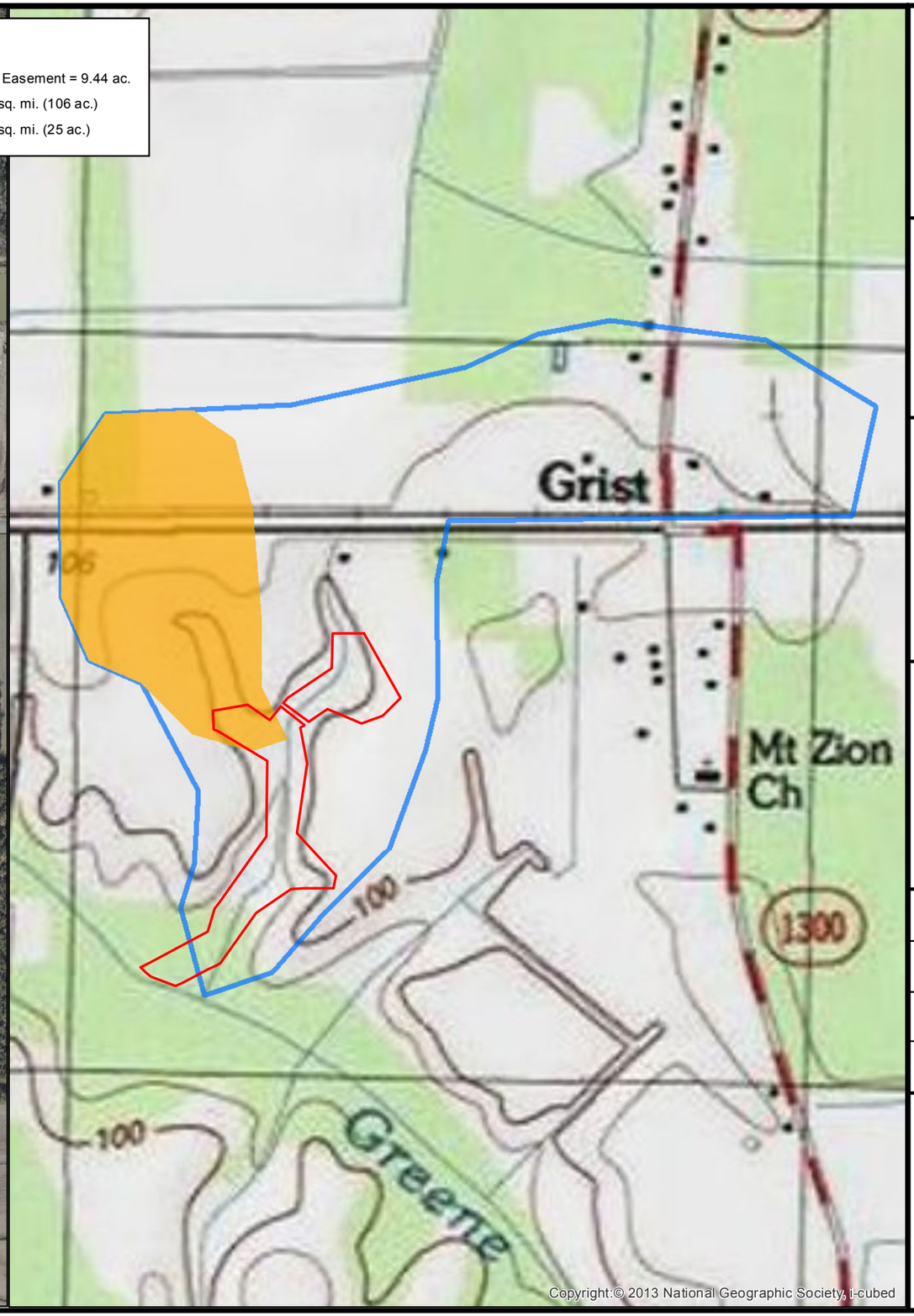
Scale: 1:490,000

Project No.: 18-014

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Colombus County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: CLF/KRJ

Date: FEB 2019

Scale: 1:6800

Project No.: 18-014

FIGURE

3

Soil Map Unit	Soil Series
GoA	Goldsboro fine sandy loam, 0 to 2 % slopes
LyA	Lynchburg fine sandy loam, 0 to 2 % slopes
Mk	Muckalee fine sandy loam
NoB	Norfolk loamy fine sand, 0 to 6 % slopes

N

GoA

LyA

2

3

GoA

5

UT-1

1

4

NCSAM Form 2
Score: LOW

NCSAM Form 1
Score: LOW

UT-2

Mk

Green Branch

NoB

LyA

RaA

Legend

- Shaw's Run Easement = 9.44 ac
- Existing Streams
- Drained Hydric Soils
- Existing Wetlands
- NC SAM Forms
- NC DWR Forms
- Soil Profile
- NRCS Soil Boundaries
- 2-foot Lidar Contours

0 150 300 600 Feet

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

Date: FEB 2019

Scale: 1:1600

Project No.: 18-014

FIGURE

4

Note - Channel lengths and SMUs based on center of design channel.

LEGEND

- Easement = 9.44 ac
- Major Topographic Line
- Minor Topographic Line
- Design Channel
- Stream Restoration = 2285 ft
- Wetland Reestablishment = 5.852 ac
- Wetland Preservation = 0.103 ac
- Drained Hydric Soils = 0.955 ac
- Piped Channel Crossing
- Marsh Treatment Area
- Terrcell Drop Structure

UT 1
End Restoration
Sta 19+39
Elev At Grade

Bottom Terracell
Sta 19+26
Elev 87.27

Top Terracell
Sta 18+41
Elev 89.84

UT 2
Start Credit Generation
Sta 00+44
Elev 94.90

UT 2
Start Restoration
Sta 00+00
Elev At Grade

UT 2
End Restoration
Sta 04+10
Elev 94.20

20 ft break in easement
is non-credit generating

Contractor shall conduct subsurface
investigations for drain tile in these
locations as directed by field managers

UT 1
Start Restoration
Sta 00+00
Elev 94.92

0 100 200
SCALE IN FEET

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run
Mitigation Site

Colombus County
North Carolina

Title:

Restoration Plan

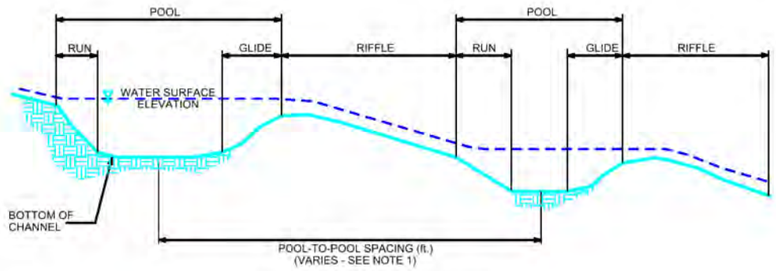
Scale: As Shown

Date: Feb 2019

Project No.: 18-014

FIGURE NO.

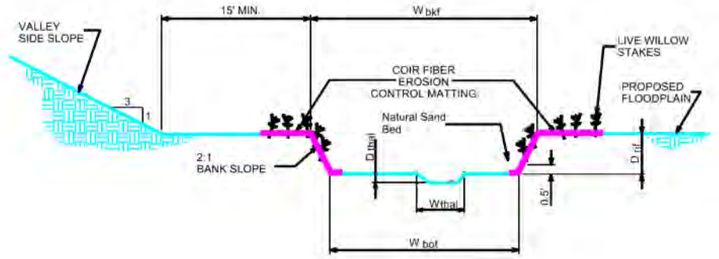
5



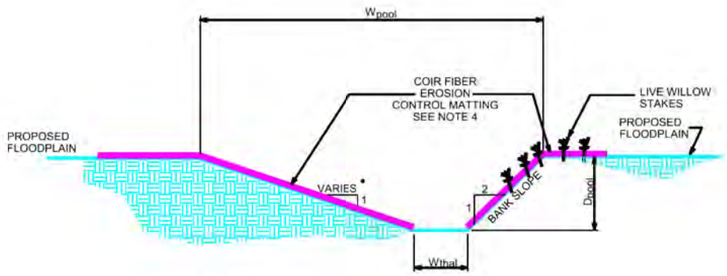
TYPICAL CHANNEL PROFILE

NOTES:

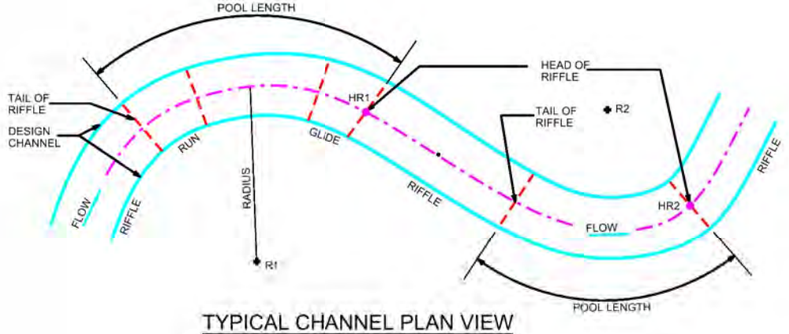
1. POOL-TO-POOL SPACING IS MEASURED FROM CENTER OF POOL BEND TO CENTER OF POOL BEND.



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.

CROSS-SECTION DIMENSIONS							
REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
UT 1	6.6	3.8	0.6	0.1	0.9	7.2	1.8
UT 2	3.9	2.3	0.3	0.1	0.5	4.3	1.3

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run Mitigation Site

Colombus County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Feb 2019

Project No.: 18-014

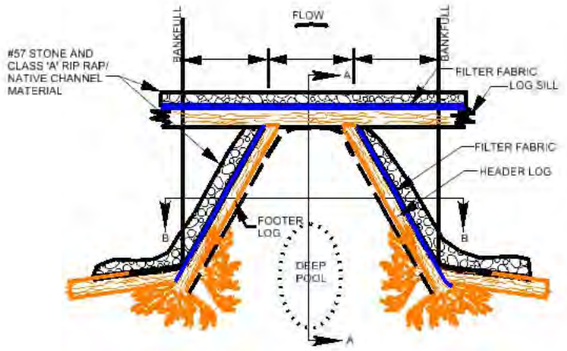
FIGURE NO.

6

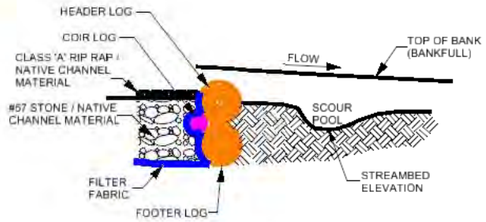
LOG CROSS VANE

SCALE:NTS

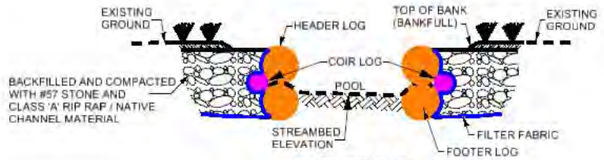
PLAN VIEW



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.



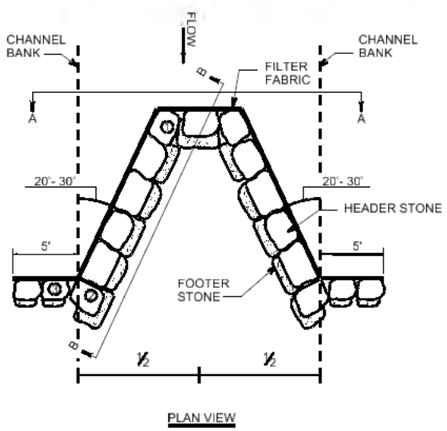
SECTION A-A



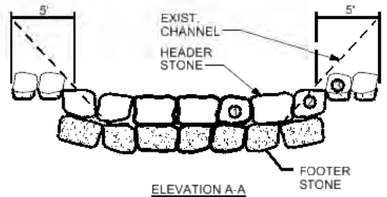
SECTION B-B

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 1	7	0.6 - 0.8
UT 2	4	0.3 - 0.5

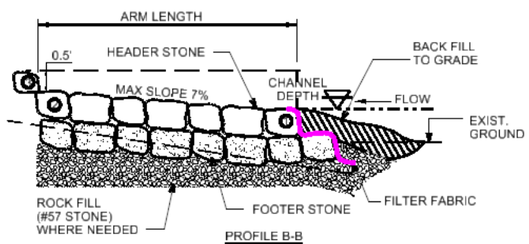
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW

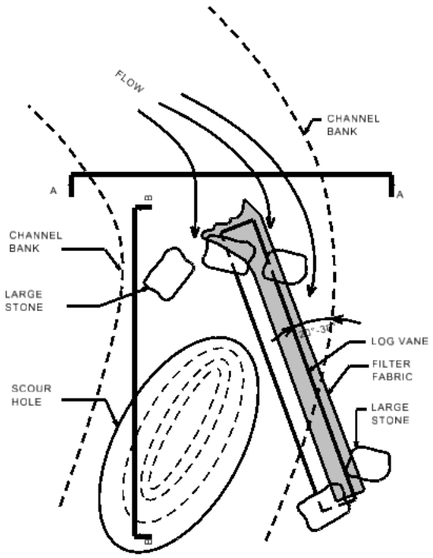


ELEVATION A-A



PROFILE B-B

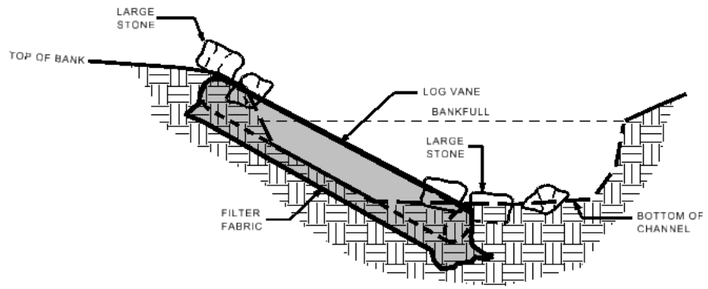
TYPICAL CROSS-VANE



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

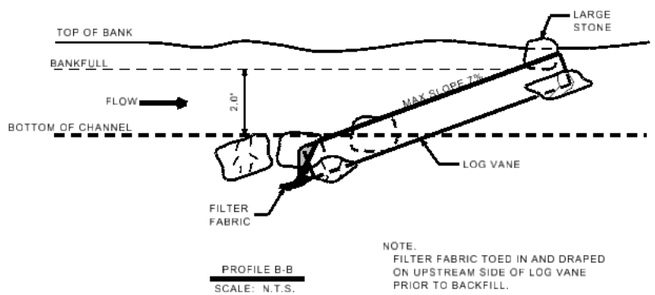
PLAN VIEW

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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RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run Mitigation Site

Colombus County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

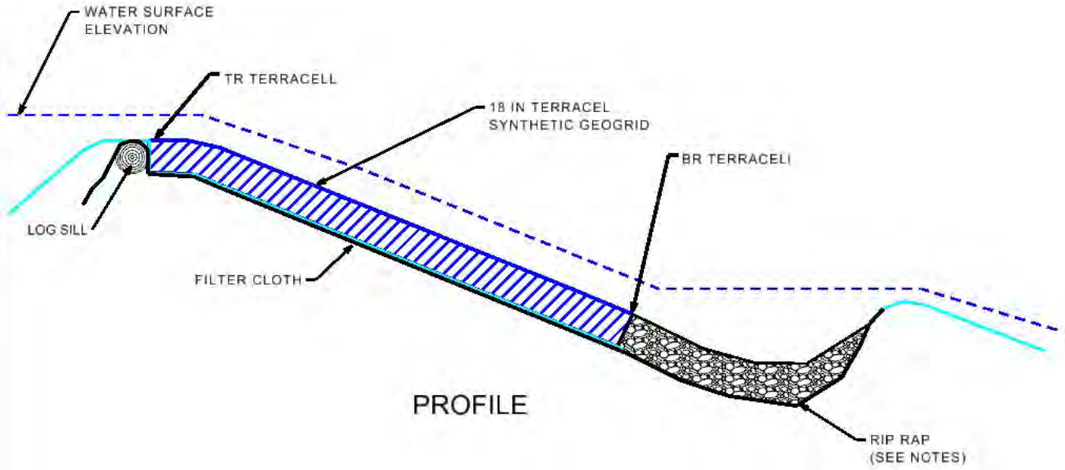
Scale: NO SCALE

Date: Feb 2019

Project No.: 18-014

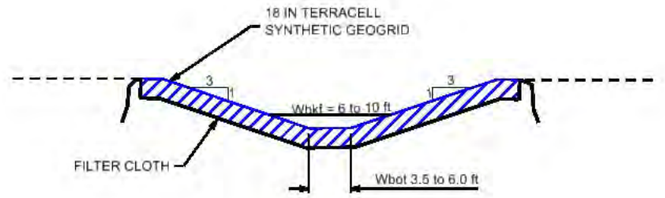
FIGURE NO.

7A



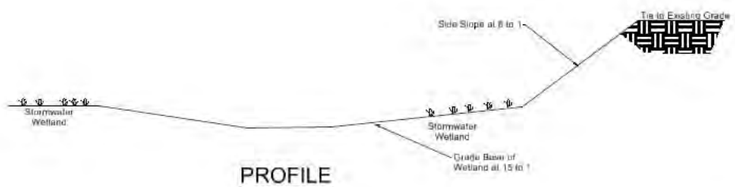
PROFILE

TERRACELL STRUCTURE NOTES:
1. CONTRACTOR WILL INSTALL 18-INCH TERRACELL SYNTHETIC GEOGRID AS PER THE MANUFACTURER'S SPECIFICATIONS.
2. AT BOTTOM RIFFLE DOWNSTREAM FROM TERRACELL STRUCTURE THE POOL WILL BE ARMORED WITH EROSION CONTROL FABRIC AND CLASS 1 RIP RAP OR OTHER SUITABLE MATERIAL.

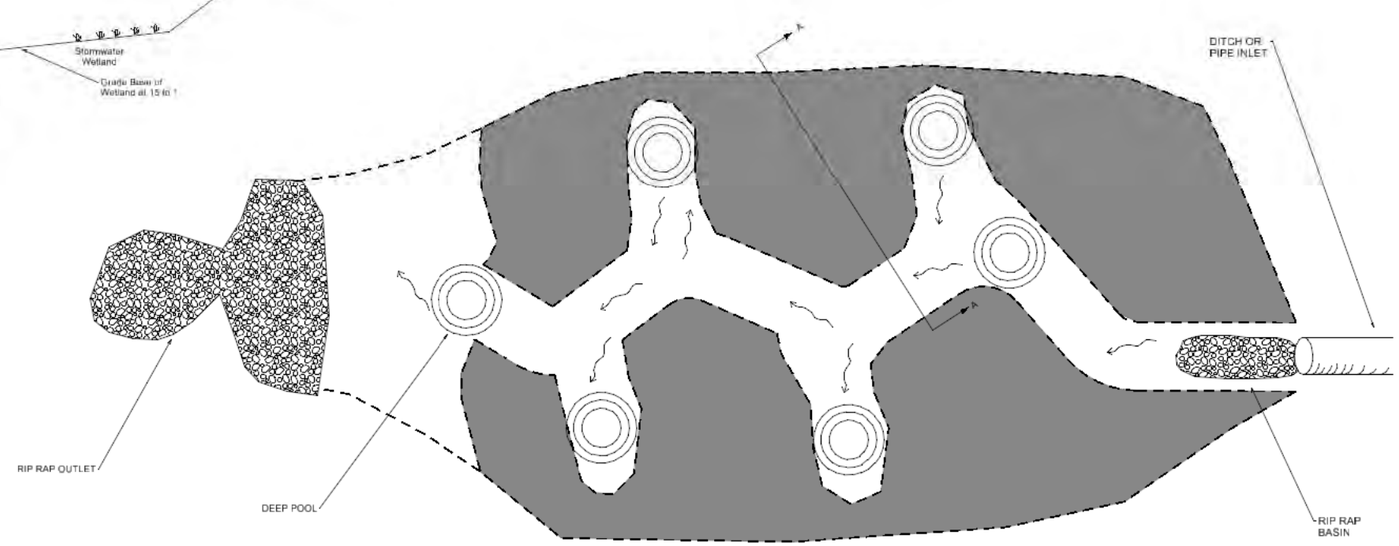


CROSS-SECTION

TERRACELL STRUCTURE NOTES:
1. CONTRACTOR WILL INSTALL 18-INCH TERRACELL SYNTHETIC GEOGRID AS PER THE MANUFACTURER'S SPECIFICATIONS.
2. ONCE THE SYNTHETIC GEOGRID HAS BEEN INSTALLED, GEOCELLS WILL BE BACKFILLED WITH GRAVEL AND TOPSOIL AND PLANTED WITH EROSION CONTROL GRASSES AND WILLOW STAKES (*SALIX NIGRA*).



PROFILE
SECTION A-A



MARSH TREATMENT AREA

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run Mitigation Site

Colombus County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

Scale: NO SCALE

Date: Feb 2019

Project No.: 18-014

FIGURE NO.

7B

Vegetation Association	Coastal Plain Small Stream Swamp Forest*		Mesic-Mixed Hardwood Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	3.8		2.4		1.5		7.7
Species	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Bald cypress (*Taxodium distichum*)	517	20	--	--	408	10	925
Black gum (*Nyssa sylvatica*)	517	20	--	--	408	10	925
Swamp chestnut oak (*Quercus michauxii*)	258	10	245	15	--	--	503
Laurel oak (*Quercus laurifolia*)	258	10	163	10	--	--	422
River birch (*Betula nigra*)	258	10	163	10	408	10	830
Tulip poplar (*Liriodendron tulipifera*)	388	15	326	20	--	--	714
Water oak (*Quercus nigra*)	--	--	163	10	--	--	163
Willow oak (*Quercus phellos*)	--	--	163	10	--	--	163
Green ash (*Fraxinus pennsylvanica*)	129	5	82	5	--	--	211
Sycamore (*Platanus occidentalis*)	258	10	326	20	408	10	993
Silky dogwood (*Cornus amomum*)	--	--	--	--	612	15	612
Black willow (*Salix nigra*)	--	--	--	--	612	15	612
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	612	15	612
Elderberry (*Sambucus canadensis*)	--	--	--	--	612	15	612
TOTAL	2584	100	1632	100	4080	100	8296

* Planted at a density of 680 stems/acre.

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

LEGEND

- Easement = 9.44 ac
- Major Topographic Line
- Minor Topographic Line
- Design Channel
- Stream-side Assemblage = 1.5 ac
- Coastal Plain Small Stream Swamp Forest = 3.8 ac
- Mesic-Mixed Hardwood Forest = 2.4 ac
- Marsh Treatment Area = 0.01 ac

0 100 200

SCALE IN FEET

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run
Mitigation Site

Colombus County
North Carolina

Title:

Planting Plan

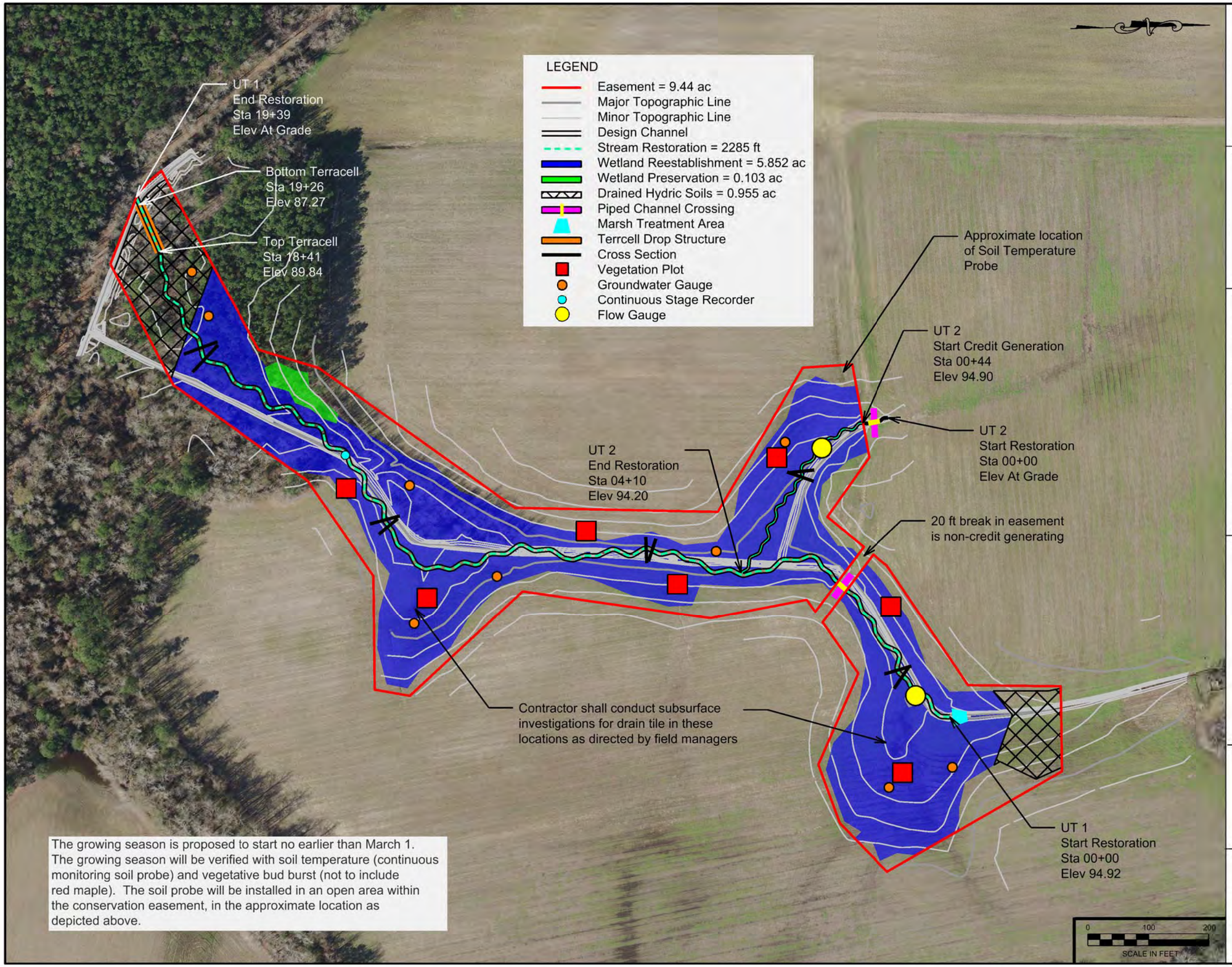
Scale: As Shown

Date: Feb 2019

Project No.: 18-014

FIGURE NO.

8



The growing season is proposed to start no earlier than March 1. The growing season will be verified with soil temperature (continuous monitoring soil probe) and vegetative bud burst (not to include red maple). The soil probe will be installed in an open area within the conservation easement, in the approximate location as depicted above.

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run
Mitigation Site

Colombus County
North Carolina

Title:

Monitoring Plan

Scale:	FIGURE NO.
As Shown	9
Date: Feb 2019	
Project No.: 18-014	

Appendix B
Existing Stream & Wetland Data

Table B1. Morphological Stream Characteristics
Figure B1. Cross-section Locations
Existing Stream Cross-section Data
NC SAM Forms
NCDWQ Stream Identification Forms
Nutrient Model
Sediment Data
Soil Boring Log

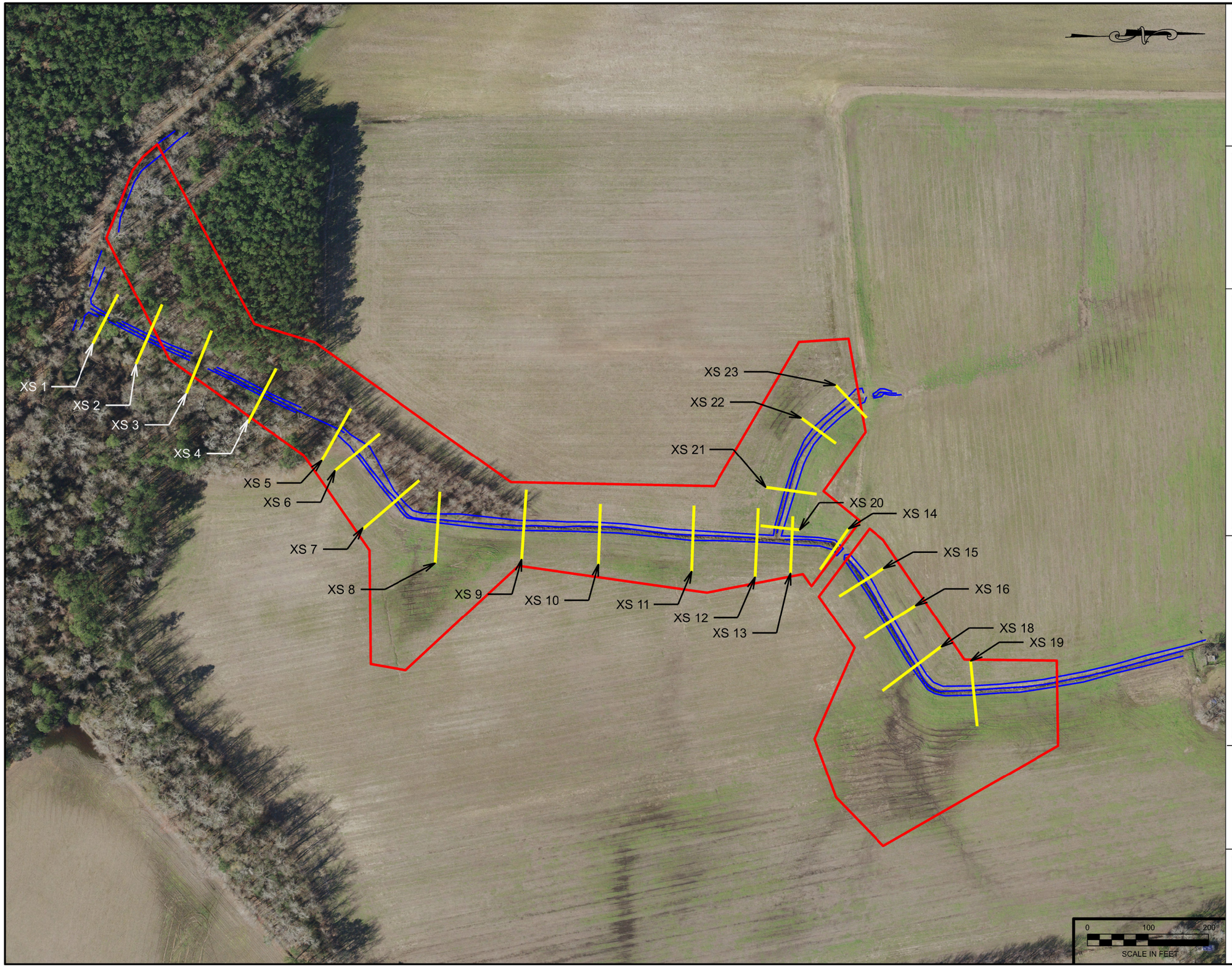
Table B1. Shaws Run Morphological Stream Characteristics
Lumber 03040203

Variables	REFERENCE - UT TO ANGOLA CREEK	*REFERENCE - MILL CREEK	*REFERENCE - UT TO WILD CAT	*REFERENCE - UT TO HOG SWAMP	Existing UT 1	PROPOSED UT 1	Existing UT 2	PROPOSED UT 2
Stream Type	E 6	E 5	E 5	E 5	G 5/6	E/C 5	F 5/6	E/C 5
Drainage Area (mi^2)	2.09	1.92	0.44	0.08	0.17	0.17	0.04	0.04
Bankfull Discharge (cfs)	11.5	19.8	7.8	1.6	2.8	2.8	0.9	0.9
Dimension Variables								
Bankfull Cross-Sectional Area (A_{bkf})	12.2	21.0	8.5	1.8	3.1	3.1	1.1	1.1
Existing Cross-Sectional Area at TOB ($A_{existing}$)	12.2	21.0	8.5	1.8	13.6 - 31.6	3.1	15.0 - 25.8	1.1
Bankfull Width (W_{bkf})	Mean: 12.3 Range: 8.8 - 13.6	Mean: 11.3 Range:	Mean: 8.2 Range:	Mean: 3.8 Range:	Mean: 5.9 Range: 4.1 to 6.9	Mean: 6.6 Range: 6.1 to 7.0	Mean: 7.9 Range: 5.2 to 8.3	Mean: 3.9 Range: 3.6 to 4.2
Bankfull Mean Depth (D_{bkf})	Mean: 1.3 Range: 1.0 - 1.4	Mean: 1.9 Range:	Mean: 1.0 Range:	Mean: 0.5 Range:	Mean: 0.5 Range: 0.5 to 0.8	Mean: 0.5 Range: 0.4 to 0.5	Mean: 0.1 Range: 0.1 to 0.2	Mean: 0.3 Range: 0.3 to 0.3
Bankfull Maximum Depth (D_{max})	Mean: 1.9 Range: 1.8 - 2.1	Mean: 2.6 Range:	Mean: 1.6 Range:	Mean: 0.7 Range:	Mean: 0.8 Range: 0.6 to 1.2	Mean: 0.7 Range: 0.6 to 0.8	Mean: 0.3 Range: 0.2 to 0.3	Mean: 0.4 Range: 0.3 to 0.5
Pool Width (W_{pool})	Mean: 11.2 Range: 8.7 - 11.5	Mean: 11.9 Range:	Mean: 8.8 Range:	Mean: 3.8 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 7.2 Range: 6.6 to 9.2	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 4.3 Range: 3.9 to 5.5
Maximum Pool Depth (D_{pool})	Mean: 2.9 Range: 2.8 - 3.0	Mean: 3.1 Range:	Mean: 1.8 Range:	Mean: 1.1 Range:		Mean: 0.9 Range: 0.6 to 1.0		Mean: 0.5 Range: 0.4 to 0.6
Width of Floodprone Area (W_{fpa})	Mean: 300.0 Range: 300 - 300	Mean: 300 Range:	Mean: 130.0 Range:	Mean: 100.0 Range:	Mean: 7 Range: 5.4 to 9.1	Mean: 50 Range: 30.0 to 70.0	Mean: 9 Range: 7.0 to 12.0	Mean: 50 Range: 30.0 to 70.0
Dimension Ratios								
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 24.4 Range: 22.1 - 34.1	Mean: 26.5 Range:	Mean: 15.9 Range:	Mean: 26.6 Range:	Mean: 1.3 Range: 1.1 to 1.9	Mean: 7.6 Range: 4.6 to 10.6	Mean: 1.2 Range: 1.0 to 1.6	Mean: 12.7 Range: 7.6 to 17.8
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 9.7 Range: 6.8 - 12.3	Mean: 6.1 Range:	Mean: 8.0 Range:	Mean: 7.9 Range:	Mean: 10.9 Range: 5.3 to 14.9	Mean: 14.0 Range: 12.0 to 16.0	Mean: 56.9 Range: 24.6 to 62.6	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.5 Range: 1.4 - 1.9	Mean: 1.4 Range:	Mean: 1.5 Range:	Mean: 1.4 Range:	Mean: 1.5 Range: 1.2 to 2.1	Mean: 1.4 Range: 1.2 to 1.7	Mean: 1.8 Range: 1.4 to 2.3	Mean: 1.4 Range: 1.2 to 1.7
Low Bank Height / Max. D_{bkf} Ratio	Mean: 1.0 Range: 1.0 - 1.0	Mean: 1.0 Range:	Mean: 1.0 Range:	Mean: 1.0 Range:	Mean: 3.4 Range: 2.8 to 4.7	Mean: 1.0 Range: 1.0 to 1.2	Mean: 6.8 Range: 6.0 to 9.5	Mean: 1.0 Range: 1.0 to 1.2
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	Mean: 2.2 Range: 2.2 - 2.3	Mean: 1.7 Range:	Mean: 1.7 Range:	Mean: 2.2 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.2	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.2
Pool Width / Bankfull Width (W_{pool}/W_{bkf})	Mean: 0.9 Range: 0.7 - 0.9	Mean: 1.0 Range:	Mean: 1.1 Range:	Mean: 1.0 Range:		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: Range: 1.4 - 2.0	Mean: Range:	Mean: Range:	Mean: Range:		Mean: 1.6 Range: 1.3 to 1.9		Mean: 1.6 Range: 1.3 to 1.9

Table B1. Shaws Run Morphological Stream Characteristics (continued)
Lumber 03040203

Variables	REFERENCE - UT TO ANGOLA CREEK	*REFERENCE - MILL CREEK	*REFERENCE - UT TO WILD CAT	*REFERENCE - UT TO HOG SWAMP	Existing UT 1	PROPOSED UT 1	Existing UT 2	PROPOSED UT 2
Pattern Variables					**Pattern Variables**		**Pattern Variables**	
Pool to Pool Spacing (L_{p-p})	Med: 64.6 Range: 34.5 - 137.1	Med: 36.2 Range: 11.4 - 61.0	Med: 15.3 Range: 14.0 - 16.6	Med: 16.0 Range: 9.0-23.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 26.4 Range: 19.8 to 52.7	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 15.7 Range: 11.8 to 31.4
Meander Length (L_m)	Med: 132.2 Range: 71.9 - 191.4	Med: 55.2 Range: 37.7 - 72.6	Med: 25.8 Range: 22.5 - 29.0	Med: 41.0 Range: 12.0-70.0		Med: 56.0 Range: 39.5 to 92.2		Med: 33.4 Range: 23.5 to 54.9
Belt Width (W_{belt})	Med: 48.2 Range: 26.6 - 76.6	Med: 21.1 Range: 15.1 - 27.0	Med: 16.6 Range: 13.8 - 19.4	Med: 10.8 Range: 5.6-16.0		Med: 19.8 Range: 9.9 to 32.9		Med: 11.8 Range: 5.9 to 19.6
Radius of Curvature (R_c)	Med: 22.9 Range: 6.6 - 44.8	Med: 19.8 Range: 9.7 - 29.8	Med: 13.1 Range: 10.9 - 15.3	Med: 25.0 Range: 4.4-45.6		Med: 19.8 Range: 13.2 to 65.9		Med: 11.8 Range: 7.8 to 39.2
Sinuosity (Sin)	1.17	1.18	1.15	1.24	1.00	1.15	1.00	1.15
Pattern Ratios					**Pattern Ratios**		**Pattern Ratios**	
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	Med: 5.3 Range: 2.8 - 11.1	Med: 3.2 Range: 1.0 - 5.4	Med: 1.9 Range: 1.7 - 2.0	Med: 4.2 Range: 2.4-6.1	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: 10.7 Range: 5.8 - 15.6	Med: 4.9 Range: 3.3 - 6.4	Med: 3.1 Range: 2.7 - 3.5	Med: 10.9 Range: 3.2-18.6		Med: 8.5 Range: 6.0 to 14.0		Med: 8.5 Range: 6.0 to 14.0
Meander Width Ratio (W_{belt}/W_{bkf})	Med: 3.9 Range: 2.2 - 6.2	Med: 1.9 Range: 1.3 - 2.4	Med: 2.0 Range: 1.7 - 2.4	Med: 2.8 Range: 1.5-4.2		Med: 3.0 Range: 1.5 to 5.0		Med: 3.0 Range: 1.5 to 5.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})	Med: 1.9 Range: 0.5 - 3.6	Med: 1.8 Range: 0.9 - 2.6	Med: 1.6 Range: 1.3 -1.9	Med: 6.6 Range: 1.2-12.1		Med: 3.0 Range: 2.0 to 10.0		Med: 3.0 Range: 2.0 to 10.0
Profile Variables					**Profile Variables**		**Profile Variables**	
Average Water Surface Slope (S_{ave})	0.0002	0.0026	0.0024	0.0068	0.0033	0.0029	0.0100	0.0087
Valley Slope (S_{valley})	0.0003	0.0031	0.0027	0.0084	0.0033	0.0033	0.0100	0.0100
Riffle Slope (S_{riffle})	Mean: 0.0001 Range: 0 - 0.0022	Mean: Range:	Mean: Range:	Mean: Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0043 Range: 0.0034 to 0.0057	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0130 Range: 0.0104 to 0.0174
Pool Slope (S_{pool})	Mean: 0.0001 Range: 0 - 0.0029	Mean: Range:	Mean: Range:	Mean: Range:		Mean: 0.0003 Range: 0.0000 to 0.0020		Mean: 0.0009 Range: 0.0000 to 0.0061
Run Slope (S_{run})	Mean: 0 Range: 0 - 0.0077	Mean: Range:	Mean: Range:	Mean: Range:		Mean: 0.0011 Range: 0.0000 to 0.0023		Mean: 0.0035 Range: 0.0000 to 0.0070
Glide Slope (S_{glide})	Mean: 0.0000 Range: 0 - 0.0027	Mean: Range:	Mean: Range:	Mean: Range:		Mean: 0.0003 Range: 0.0000 to 0.0023		Mean: 0.0010 Range: 0.0000 to 0.0070
Profile Ratios					**Profile Ratios**		**Profile Ratios**	
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	Mean: 0.4 Range: 0 - 9.2	Mean: Range:	Mean: Range:	Mean: Range:	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: 0.5 Range: 0 - 12.1	Mean: Range:	Mean: Range:	Mean: Range:		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: 0.00 Range: 0 - 31.9	Mean: Range:	Mean: Range:	Mean: Range:		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: 0.00 Range: 0 - 11.0	Mean: Range:	Mean: Range:	Mean: Range:		Mean: 0.11 Range: 0.0 to 0.8		Mean: 0.11 Range: 0.0 to 0.8

* References were measured for Brown Marsh Swamp (NCDMS Contract No. 16-D06038) that was successfully closed out in 2012.



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run Mitigation Site

Colombus County North Carolina

Title:

Cross Section Locations

Scale: As Shown

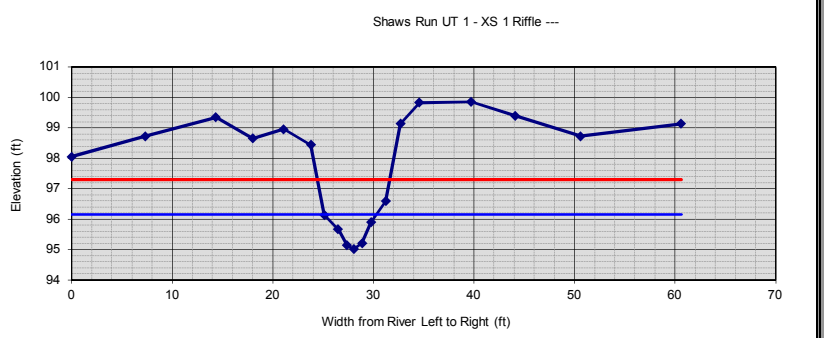
Date: Feb 2019

Project No.: 18-014

FIGURE NO.

B1

Cross Section



section: **Shaws Run UT 1 - XS 1**

Riffle

---

description: **Shaws Run UT 1 - XS 1**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.948927	98.05107
	☐	7.329736	1.272238	98.72776
	☐	14.32648	0.657684	99.34232
	☐	17.98602	1.354298	98.6457
	☐	21.0806	1.046371	98.95363
	☐	23.78438	1.558086	98.44191
	☐	25.12811	3.861374	96.13863
	☐	26.49897	4.33732	95.66268
	☐	27.36451	4.850322	95.14968
	☐	28.05955	4.99555	95.00445
	☐	28.89114	4.789417	95.21058
	☐	29.77898	4.105971	95.89403
	☐	31.23247	3.415726	96.58427
	☐	32.69935	0.871343	99.12866
	☐	34.58029	0.167391	99.83261
	☐	39.73777	0.150562	99.84944
	☐	44.09455	0.600448	99.39955
	☐	50.61266	1.282003	98.718
	☐	60.59681	0.864285	99.13572
	☐			
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	☐			
	☐			
	☐			

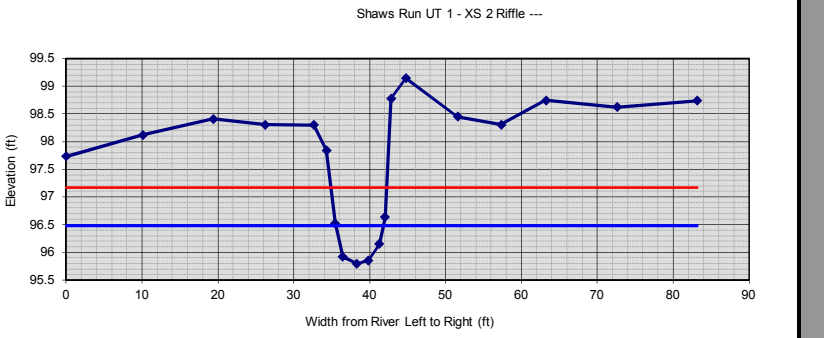
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.85	1.56	6.9		
96.15	98.44			

dimensions			
3.2	x-section area	0.6	d mean
5.2	width	5.8	wet P
1.1	d max	0.6	hyd radi
3.4	bank ht	8.4	w/d ratio
6.9	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: **Shaws Run UT 1 - XS 2**

Riffle

---

description: **Shaws Run UT 1 - XS 2**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	2.265177	97.73482
	☐	10.09565	1.881971	98.11803
	☐	19.38296	1.59292	98.40708
	☐	26.22367	1.6955	98.3045
	☐	32.61908	1.698876	98.30112
	☐	34.30649	2.161253	97.83875
	☐	35.4448	3.473276	96.52672
	☐	36.45308	4.080341	95.91966
	☐	38.3059	4.209107	95.79089
	☐	39.8498	4.147906	95.85209
	☐	41.25603	3.852919	96.14708
	☐	42.03599	3.363099	96.6369
	☐	42.84245	1.217912	98.78209
	☐	44.75125	0.856388	99.14361
	☐	51.62751	1.54816	98.45184
	☐	57.32467	1.694065	98.30594
	☐	63.26586	1.252761	98.74724
	☐	72.6007	1.376177	98.62382
	☐	83.17954	1.263431	98.73657
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

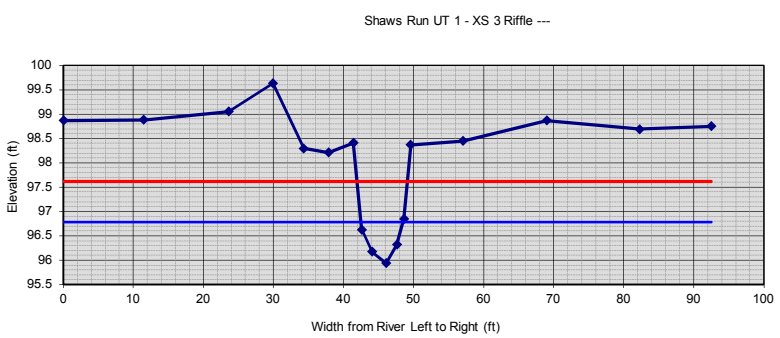
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.52	1.7	7.4		
96.48	98.3			

dimensions			
3.2	x-section area	0.5	d mean
6.3	width	6.6	wet P
0.7	d max	0.5	hyd radi
2.5	bank ht	12.3	w/d ratio
7.4	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: **Shaws Run UT 1 - XS 3**

Riffle

---

description: **Shaws Run UT 1 - XS 3**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.128165	98.87184
	☐	11.49427	1.114195	98.88581
	☐	23.59848	0.945613	99.05439
	☐	29.8826	0.370119	99.62988
	☐	34.27698	1.703286	98.29671
	☐	37.8659	1.788103	98.2119
	☐	41.4188	1.590791	98.40921
	☐	42.61383	3.369881	96.63012
	☐	44.046	3.826197	96.1738
	☐	46.04648	4.058484	95.94152
	☐	47.6218	3.674091	96.32591
	☐	48.6476	3.147541	96.85246
	☐	49.60344	1.630833	98.36917
	☐	57.04568	1.551948	98.44805
	☐	68.99024	1.129961	98.87004
	☐	82.2837	1.30608	98.69392
	☐	92.51419	1.248269	98.75173
	☐			
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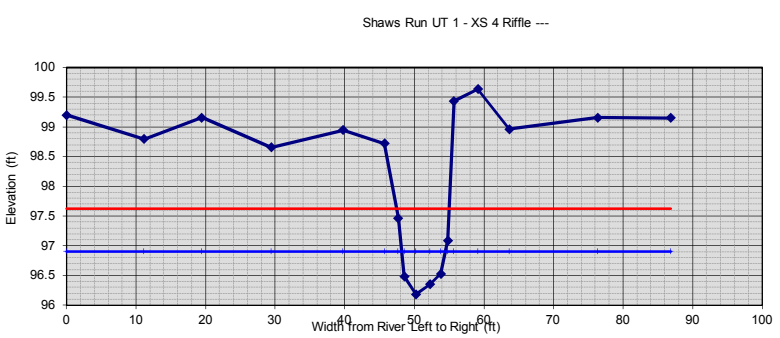
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.22	1.63	7.0		
96.78	98.37			

dimensions			
3.2	x-section area	0.5	d mean
6.0	width	6.3	wet P
0.8	d max	0.5	hyd radi
2.4	bank ht	11.2	w/d ratio
7.0	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: **Shaws Run UT 1 - XS 4**

Riffle

---

description: **Shaws Run UT 1 - XS 4**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.801863	99.19814
	☐	11.15295	1.203136	98.79686
	☐	19.43587	0.846692	99.15331
	☐	29.43327	1.345481	98.65452
	☐	39.761	1.051824	98.94818
	☐	45.69506	1.277827	98.72217
	☐	47.68596	2.534509	97.46549
	☐	48.56674	3.5233	96.4767
	☐	50.22154	3.822137	96.17786
	☐	52.23618	3.648765	96.35124
	☐	53.81249	3.473839	96.52616
	☐	54.78772	2.913373	97.08663
	☐	55.68324	0.566057	99.43394
	☐	59.12781	0.366669	99.63333
	☐	63.64146	1.039329	98.96067
	☐	76.35601	0.84343	99.15657
	☐	86.81481	0.847017	99.15298
	☐			
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.1	1.28	7.1		
96.9	98.72			

dimensions			
3.2	x-section area	0.5	d mean
6.3	width	6.6	wet P
0.7	d max	0.5	hyd radi
2.5	bank ht	12.5	w/d ratio
7.1	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: **Shaws Run UT 1 - XS 5**

Riffle

---

description: **Shaws Run UT 1 - XS 5**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-1.702239**	101.7022
	☐	**12.16159**	**-0.954969**	100.955
	☐	**29.56096**	**-0.137501**	100.1375
	☐	**41.29158**	**-0.248342**	100.2483
	☐	**46.49352**	**0.444256**	99.55574
	☐	**49.83136**	**2.412148**	97.58785
	☐	**51.52643**	**3.272242**	96.72776
	☐	**53.14427**	**3.734596**	96.2654
	☐	**54.76926**	**3.671462**	96.32854
	☐	**56.26529**	**3.500962**	96.49904
	☐	**57.84685**	**2.350028**	97.64997
	☐	**59.22762**	**1.266978**	98.73302
	☐	**60.70675**	**0.353176**	99.64682
	☐	**74.28223**	**-0.145289**	100.1453
	☑	**82.95627**	**-0.580084**	100.5801
	☐	**93.58425**	**-1.226905**	101.2269
	☐			
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	☐			

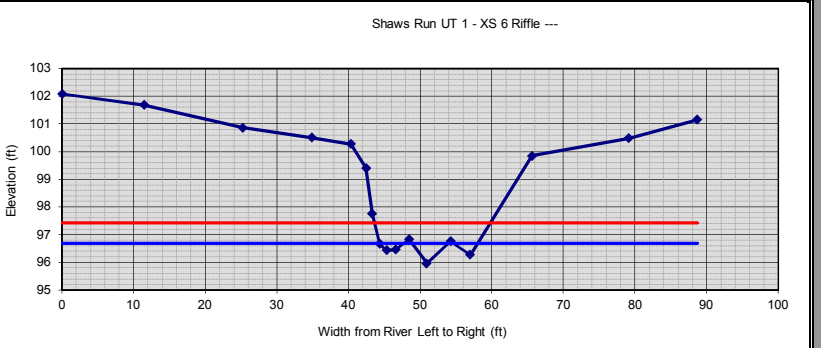
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.98	**0.44**	**8.0**		
97.02	99.56			

dimensions			
3.2	x-section area	0.5	d mean
6.0	width	6.3	wet P
0.8	d max	0.5	hyd radi
3.3	bank ht	11.4	w/d ratio
8.0	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: **Shaws Run UT 1 - XS 6**

Riffle

---

description: **Shaws Run UT 1 - XS 6**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-2.085331**	102.0853
	☐	**11.42513**	**-1.684628**	101.6846
	☐	**25.24157**	**-0.868039**	100.868
	☐	**34.89267**	**-0.510812**	100.5108
	☐	**40.3343**	**-0.278904**	100.2789
	☐	**42.45029**	**0.602439**	99.39756
	☐	**43.29813**	**2.248841**	97.75116
	☐	**44.3332**	**3.33821**	96.66179
	☐	**45.30065**	**3.561056**	96.43894
	☐	**46.58787**	**3.538341**	96.46166
	☐	**48.47143**	**3.170301**	96.8297
	☐	**50.90281**	**4.040928**	95.95907
	☐	**54.27795**	**3.244191**	96.75581
	☐	**56.968**	**3.731272**	96.26873
	☐	**65.56234**	**0.148862**	99.85114
	☐	**79.12868**	**-0.488154**	100.4882
	☐	**88.68931**	**-1.152913**	101.1529
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	☐			
	☐			
	☐			

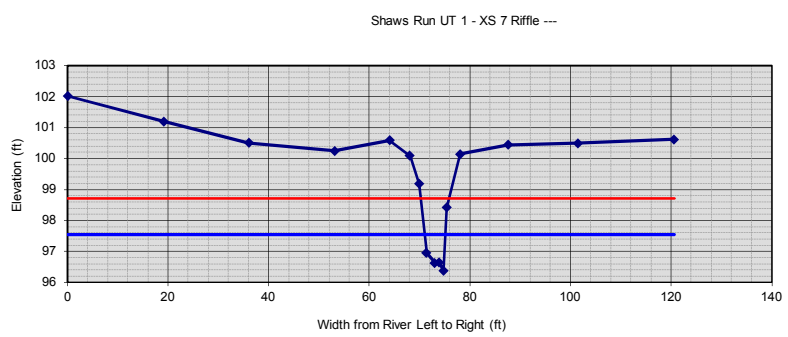
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.31	**0.15**	**16.7**		
96.69	99.85			

dimensions			
3.2	x-section area	0.3	d mean
11.9	width	12.3	wet P
0.7	d max	0.3	hyd radi
3.9	bank ht	45.0	w/d ratio
16.7	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:	Shaws Run UT 1 - XS 7
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.011079	102.0111
	☐	19.09242	-1.193657	101.1937
	☐	36.09283	-0.506062	100.5061
	☐	53.03873	-0.249529	100.2495
	☐	64.05764	-0.589475	100.5895
	☐	68.04353	-0.089377	100.0894
	☐	69.93255	0.820996	99.179
	☐	71.34806	3.049347	96.95065
	☐	73.00563	3.366132	96.63387
	☐	73.84376	3.349128	96.65087
	☐	74.67111	3.613476	96.38652
	☐	75.30968	1.581715	98.41829
	☐	78.06565	-0.142559	100.1426
	☐	87.55995	-0.43818	100.4382
	☐	101.4831	-0.495799	100.4958
	☐	120.5649	-0.61763	100.6176
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.45	-0.09	5.4		
97.55	100.09			

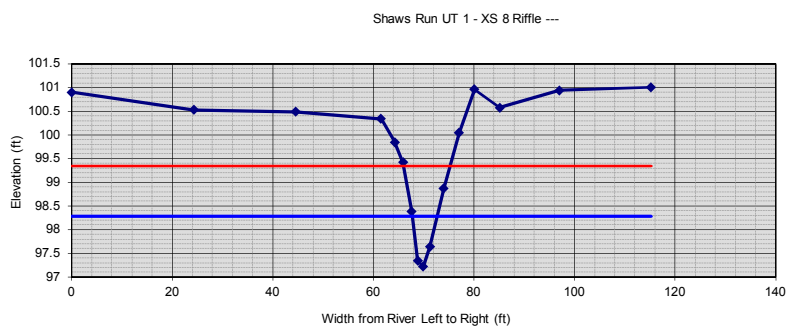
dimensions			
3.2	x-section area	0.8	d mean
4.1	width	5.3	wet P
1.2	d max	0.6	hyd radi
3.7	bank ht	5.2	w/d ratio
5.4	W flood prone area	1.3	ent ratio

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		

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: Shaws Run UT 1 - XS 8
Riffle

---
description: Shaws Run UT 1 - XS 8
height of instrument (ft): 100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-0.904623	100.9046
	☐	24.26017	-0.52776	100.5278
	☐	44.58714	-0.48686	100.4869
	☐	61.48354	-0.33967	100.3397
	☐	64.25518	0.152213	99.84779
	☐	65.91207	0.576992	99.42301
	☐	67.64268	1.622016	98.37798
	☐	68.83977	2.657603	97.3424
	☐	69.88971	2.783068	97.21693
	☐	71.2351	2.363116	97.63688
	☐	73.95019	1.131915	98.86809
	☐	77.03043	-0.045068	100.0451
	☐	80.07559	-0.961874	100.9619
	☐	85.09106	-0.577953	100.578
	☐	97.0221	-0.942679	100.9427
	☐	115.2073	-1.007975	101.008
	☐			
	☐			
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	☐			
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	☐			
	☐			
	☐			

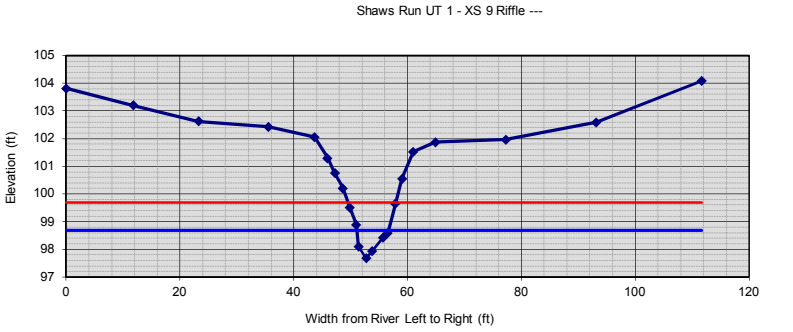
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.72	-0.34	9.1		
98.28	100.34			

dimensions			
3.2	x-section area	0.6	d mean
4.9	width	5.5	wet P
1.1	d max	0.6	hyd radi
3.1	bank ht	7.6	w/d ratio
9.1	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: Shaws Run UT 1 - XS 9
Riffle

---
description: Shaws Run UT 1 - XS 9
height of instrument (ft): 100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.808735	103.8087
	☐	11.80271	-3.197449	103.1974
	☐	23.27495	-2.624348	102.6243
	☐	35.48684	-2.42716	102.4272
	☐	43.63693	-2.055855	102.0559
	☐	45.90416	-1.288729	101.2887
	☐	47.21017	-0.749454	100.7495
	☐	48.63607	-0.203124	100.2031
	☐	49.83858	0.495756	99.50424
	☐	50.97476	1.117981	98.88202
	☐	51.37756	1.896902	98.1031
	☐	52.71415	2.325864	97.67414
	☐	53.76615	2.076992	97.92301
	☐	55.61967	1.586933	98.41307
	☐	56.5066	1.425043	98.57496
	☐	57.84412	0.360288	99.63971
	☐	59.04127	-0.554583	100.5546
	☐	60.99185	-1.520778	101.5208
	☐	64.86357	-1.870776	101.8708
	☐	77.21289	-1.967677	101.9677
	☐	93.17038	-2.584776	102.5848
	☐	111.6474	-4.079334	104.0793
	☐			
	☐			
	☐			

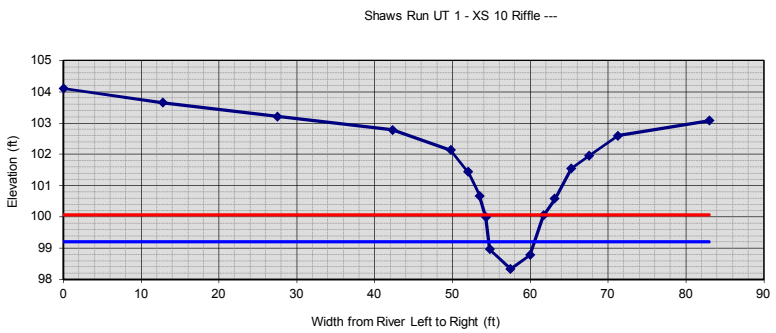
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.32	-1.52	8.0		
98.68	101.52			

dimensions			
3.2	x-section area	0.6	d mean
5.6	width	6.1	wet P
1.0	d max	0.5	hyd radi
3.8	bank ht	9.7	w/d ratio
8.0	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:	Shaws Run UT 1 - XS 10
	Riffle

	---
description:	Shaws Run UT 1 - XS 10
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.102852	104.1029
	☐	12.81956	-3.652562	103.6526
	☐	27.45933	-3.212766	103.2128
	☐	42.27911	-2.778945	102.7789
	☐	49.74378	-2.13241	102.1324
	☐	52.00524	-1.445657	101.4457
	☐	53.44902	-0.672693	100.6727
	☐	54.29207	0.006664	99.99334
	☐	54.76071	1.034412	98.96559
	☐	57.46748	1.667412	98.33259
	☐	59.96638	1.216488	98.78351
	☐	61.70465	-0.053574	100.0536
	☐	63.1365	-0.578432	100.5784
	☐	65.22057	-1.544372	101.5444
	☐	67.54118	-1.952889	101.9529
	☐	71.26896	-2.596446	102.5964
	☐	82.97418	-3.075993	103.076
	☐			
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	☐			

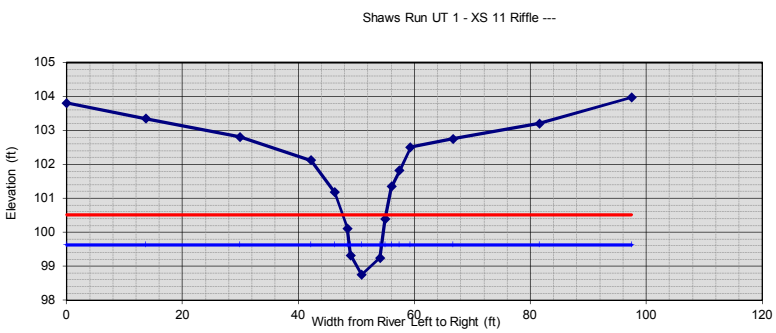
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.8	-1.45	7.4		
99.2	101.45			

dimensions			
3.2	x-section area	0.5	d mean
5.9	width	6.3	wet P
0.9	d max	0.5	hyd radi
3.1	bank ht	10.7	w/d ratio
7.4	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:	Shaws Run UT 1 - XS 11
	Riffle

	---
description:	Shaws Run UT 1 - XS 11
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.808775	103.8088
	☐	13.73986	-3.345819	103.3458
	☐	29.91724	-2.810201	102.8102
	☐	42.13031	-2.120409	102.1204
	☐	46.26245	-1.17281	101.1728
	☐	48.42327	-0.112651	100.1127
	☐	49.01901	0.684005	99.316
	☐	50.89614	1.256517	98.74348
	☐	54.03813	0.752434	99.24757
	☐	54.93797	-0.386235	100.3862
	☐	56.0264	-1.349388	101.3494
	☐	57.45164	-1.82704	101.827
	☐	59.31501	-2.501701	102.5017
	☐	66.68341	-2.750393	102.7504
	☐	81.53978	-3.199679	103.1997
	☐	97.42026	-3.972212	103.9722
	☐			
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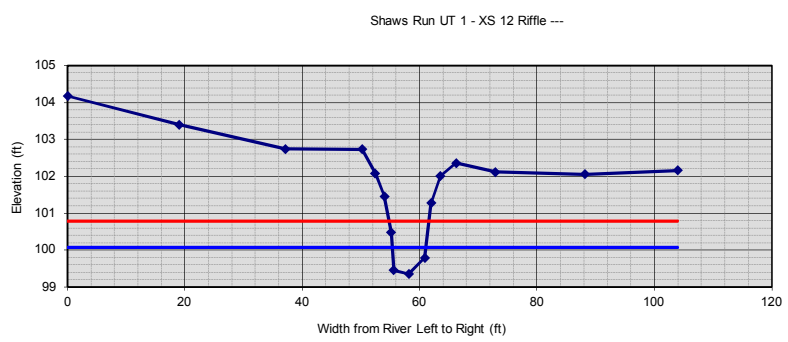
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.37	-2.12	6.5		
99.63	102.12			

dimensions			
3.2	x-section area	0.6	d mean
5.6	width	6.0	wet P
0.9	d max	0.5	hyd radi
3.4	bank ht	9.6	w/d ratio
6.5	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:	Shaws Run UT 1 - XS 12
	Riffle

	---
description:	Shaws Run UT 1 - XS 12
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.175099	104.1751
	☐	18.96142	-3.399283	103.3993
	☐	37.08321	-2.740135	102.7401
	☐	50.21561	-2.726817	102.7268
	☐	52.41269	-2.067579	102.0676
	☐	54.01764	-1.443139	101.4431
	☐	55.15667	-0.476152	100.4762
	☐	55.60165	0.545602	99.4544
	☐	58.15685	0.648029	99.35197
	☐	60.87087	0.211872	99.78813
	☐	61.93623	-1.28373	101.2837
	☐	63.53355	-2.006345	102.0063
	☐	66.19011	-2.355112	102.3551
	☐	72.93894	-2.113356	102.1134
	☐	88.1166	-2.052239	102.0522
	☐	103.9603	-2.161851	102.1619
	☐			
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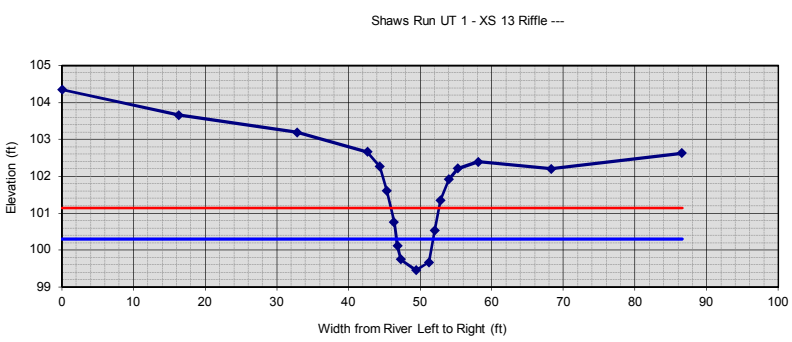
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.07	-2.01	6.7		
100.07	102.01			

dimensions			
3.2	x-section area	0.6	d mean
5.7	width	6.3	wet P
0.7	d max	0.5	hyd radi
2.7	bank ht	10.4	w/d ratio
6.7	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:	Shaws Run UT 1 - XS 13
	Riffle

	---
description:	Shaws Run UT 1 - XS 13
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.349976	104.35
	☐	16.27913	-3.660927	103.6609
	☐	32.82971	-3.192288	103.1923
	☐	42.66877	-2.661775	102.6618
	☐	44.3422	-2.275454	102.2755
	☐	45.28896	-1.608975	101.609
	☐	46.34177	-0.752635	100.7526
	☐	46.80828	-0.121313	100.1213
	☐	47.25128	0.253356	99.74664
	☐	49.4455	0.541892	99.45811
	☐	51.23188	0.328117	99.67188
	☐	51.99854	-0.537314	100.5373
	☐	52.80319	-1.34816	101.3482
	☐	53.99352	-1.913551	101.9136
	☐	55.21823	-2.213495	102.2135
	☐	58.08276	-2.394208	102.3942
	☐	68.2704	-2.203706	102.2037
	☐	86.55181	-2.622886	102.6229
	☐			
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	☐			

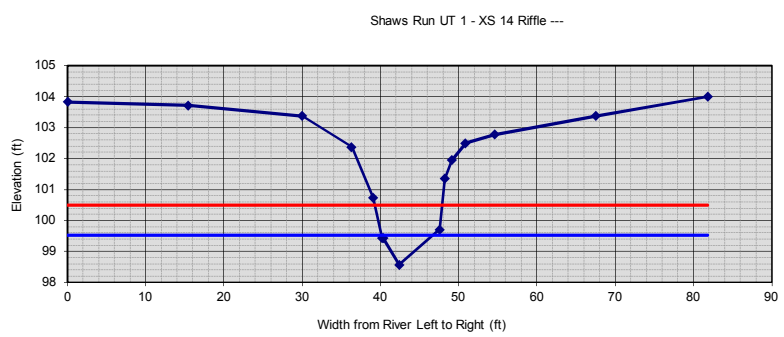
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.30	-1.91	6.0		
100.3	101.91			

dimensions			
3.2	x-section area	0.6	d mean
5.1	width	5.7	wet P
0.8	d max	0.6	hyd radi
2.5	bank ht	8.2	w/d ratio
6.0	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:	Shaws Run UT 1 - XS 14
	Riffle

	---
description:	Shaws Run UT 1 - XS 14
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.830681	103.8307
	☐	15.37473	-3.710414	103.7104
	☐	29.9994	-3.369216	103.3692
	☐	36.29853	-2.366411	102.3664
	☐	39.05719	-0.742115	100.7421
	☐	40.16116	0.557798	99.4422
	☐	40.32395	0.570198	99.4298
	☐	42.422	1.430229	98.56977
	☐	47.51802	0.296085	99.70392
	☐	48.22097	-1.34951	101.3495
	☐	49.09344	-1.943649	101.9436
	☐	50.84877	-2.489093	102.4891
	☐	54.55575	-2.777831	102.7778
	☐	67.48219	-3.372496	103.3725
	☐	81.78894	-3.992304	103.9923
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.47	-1.94	9.1		
99.53	101.94			

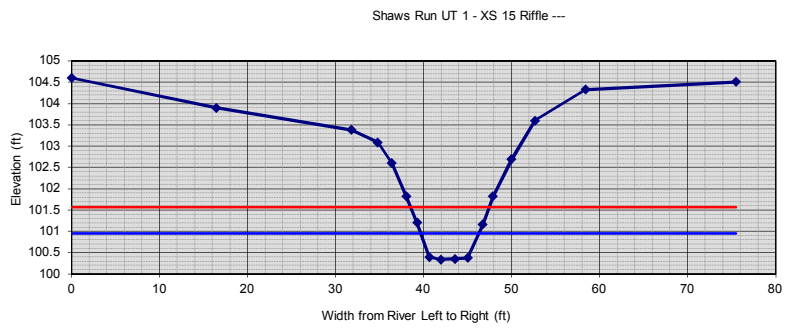
dimensions			
3.2	x-section area	0.5	d mean
6.6	width	7.0	wet P
1.0	d max	0.5	hyd radi
3.4	bank ht	13.8	w/d ratio
9.1	W flood prone area	1.4	ent ratio

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:	Shaws Run UT 1 - XS 15
	Riffle

	---
description:	Shaws Run UT 1 - XS 15
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.601035	104.601
	☐	16.42974	-3.896082	103.8961
	☐	31.78653	-3.380982	103.381
	☐	34.79432	-3.090451	103.0905
	☐	36.37436	-2.598544	102.5985
	☐	38.01891	-1.82871	101.8287
	☐	39.24636	-1.203852	101.2039
	☐	40.61825	-0.399387	100.3994
	☐	41.94631	-0.336639	100.3366
	☐	43.55216	-0.356294	100.3563
	☐	45.0089	-0.376403	100.3764
	☐	46.69355	-1.159736	101.1597
	☐	47.86951	-1.815401	101.8154
	☐	49.97509	-2.689767	102.6898
	☐	52.61639	-3.600645	103.6006
	☐	58.38457	-4.325443	104.3254
	☐	75.50133	-4.507182	104.5072
	☐			
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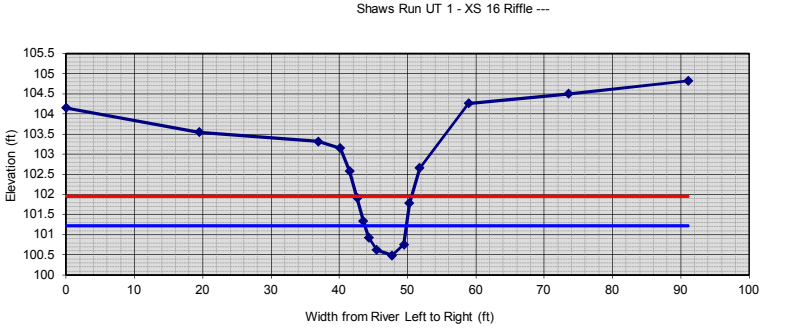
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.95	-3.09	8.7		
100.95	103.09			

dimensions			
3.2	x-section area	0.5	d mean
6.6	width	6.8	wet P
0.6	d max	0.5	hyd radi
2.8	bank ht	13.4	w/d ratio
8.7	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:	Shaws Run UT 1 - XS 16
	Riffle

	---
description:	Shaws Run UT 1 - XS 16
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.150869	104.1509
	☐	19.47968	-3.548467	103.5485
	☐	36.89765	-3.318739	103.3187
	☐	40.15508	-3.148433	103.1484
	☐	41.52048	-2.584223	102.5842
	☐	42.59582	-1.910185	101.9102
	☐	43.501	-1.339731	101.3397
	☐	44.32722	-0.931978	100.932
	☐	45.48076	-0.619048	100.619
	☐	47.71857	-0.489406	100.4894
	☐	49.46155	-0.756728	100.7567
	☐	50.251	-1.780207	101.7802
	☐	51.77227	-2.654372	102.6544
	☐	58.92534	-4.265939	104.2659
	☐	73.59307	-4.499308	104.4993
	☐	91.05381	-4.823374	104.8234
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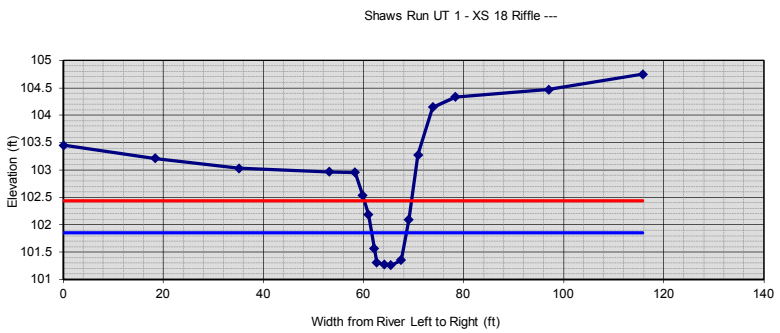
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.22	-3.15	7.7		
101.22	103.15			

dimensions			
3.2	x-section area	0.5	d mean
6.1	width	6.4	wet P
0.7	d max	0.5	hyd radi
2.7	bank ht	11.5	w/d ratio
7.7	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:	Shaws Run UT 1 - XS 18
	Riffle

	---
description:	Shaws Run UT 1 - XS 18
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.45388	103.4539
	☐	18.29728	-3.212221	103.2122
	☐	35.10378	-3.033291	103.0333
	☐	53.08442	-2.964474	102.9645
	☐	58.30282	-2.955748	102.9557
	☐	59.85264	-2.531337	102.5313
	☐	61.00248	-2.185088	102.1851
	☐	62.12172	-1.570837	101.5708
	☐	62.63844	-1.306037	101.306
	☐	64.19656	-1.277625	101.2776
	☐	65.46601	-1.265413	101.2654
	☐	67.50963	-1.355594	101.3556
	☐	69.02586	-2.098348	102.0983
	☐	70.89413	-3.278348	103.2783
	☐	73.85217	-4.149547	104.1495
	☐	78.29946	-4.332088	104.3321
	☐	97.03065	-4.469743	104.4697
	☐	115.8337	-4.750311	104.7503
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

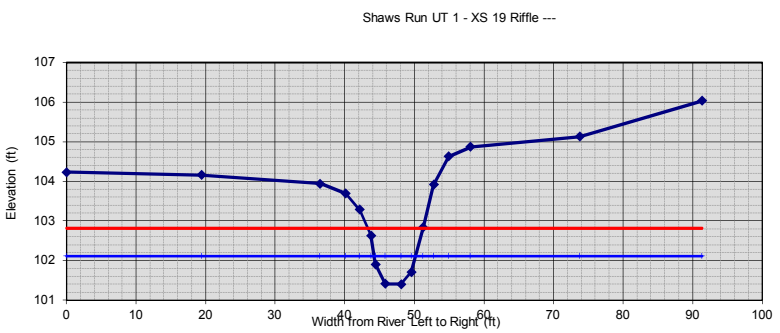
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.85	-2.96	9.1		
101.85	102.96			

dimensions			
3.2	x-section area	0.5	d mean
6.9	width	7.2	wet P
0.6	d max	0.5	hyd radi
1.7	bank ht	14.7	w/d ratio
9.1	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:	Shaws Run UT 1 - XS 19
	Riffle

	---
description:	Shaws Run UT 1 - XS 19
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.232399	104.2324
	☐	19.38978	-4.160069	104.1601
	☐	36.4537	-3.943113	103.9431
	☐	40.14015	-3.693077	103.6931
	☐	42.14981	-3.283483	103.2835
	☐	43.78687	-2.624839	102.6248
	☐	44.43202	-1.893078	101.8931
	☐	45.76987	-1.409453	101.4095
	☐	48.09326	-1.406577	101.4066
	☐	49.54528	-1.70776	101.7078
	☐	51.26943	-2.838025	102.838
	☐	52.75827	-3.924128	103.9241
	☐	54.91419	-4.626325	104.6263
	☐	58.07878	-4.872429	104.8724
	☐	73.79332	-5.129966	105.13
	☐	91.34482	-6.031631	106.0316
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

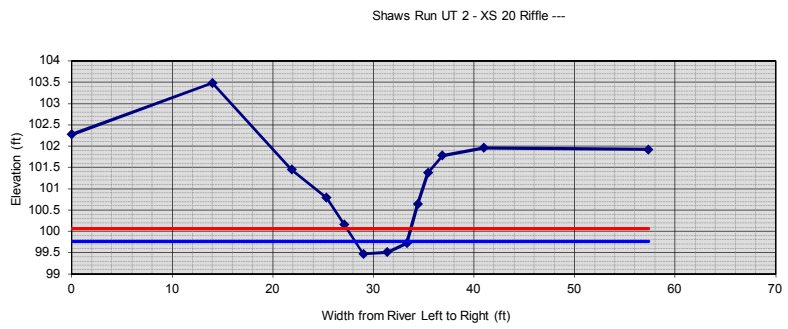
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.11	-3.69	7.5		
102.11	103.69			

dimensions			
3.2	x-section area	0.5	d mean
5.9	width	6.3	wet P
0.7	d max	0.5	hyd radi
2.3	bank ht	11.0	w/d ratio
7.5	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:	Shaws Run UT 2 - XS 20
	Riffle

	---
description:	Shaws Run UT 2 - XS 20
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.274847	102.2748
	☐	13.98263	-3.483621	103.4836
	☐	21.88009	-1.45195	101.452
	☐	25.33123	-0.790415	100.7904
	☐	27.0801	-0.161609	100.1616
	☐	28.99604	0.534501	99.4655
	☐	31.38774	0.487384	99.51262
	☐	33.34131	0.27694	99.72306
	☐	34.40756	-0.640959	100.641
	☐	35.43977	-1.373982	101.374
	☐	36.85146	-1.779837	101.7798
	☐	40.98318	-1.960268	101.9603
	☐	57.35117	-1.926411	101.9264
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	☐			
	☐			
	☐			

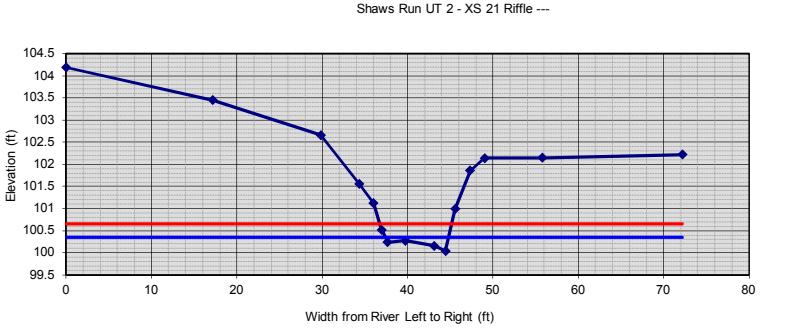
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.235	-1.37	7.0		
99.765	101.37			

dimensions			
1.1	x-section area	0.2	d mean
5.2	width	5.3	wet P
0.3	d max	0.2	hyd radi
1.9	bank ht	25.4	w/d ratio
7.0	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:	Shaws Run UT 2 - XS 21
	Riffle

	---
description:	Shaws Run UT 2 - XS 21
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.188081	104.1881
	☐	17.20222	-3.446275	103.4463
	☐	29.84018	-2.658548	102.6585
	☐	34.31063	-1.563955	101.564
	☐	36.01025	-1.117891	101.1179
	☐	36.93785	-0.520724	100.5207
	☐	37.64874	-0.237584	100.2376
	☐	39.7156	-0.276334	100.2763
	☐	43.0825	-0.157343	100.1573
	☐	44.44759	-0.042734	100.0427
	☐	45.58637	-0.990754	100.9908
	☐	47.31708	-1.854519	101.8545
	☐	49.00044	-2.138714	102.1387
	☐	55.79038	-2.144198	102.1442
	☐	72.17558	-2.218206	102.2182
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	☐			

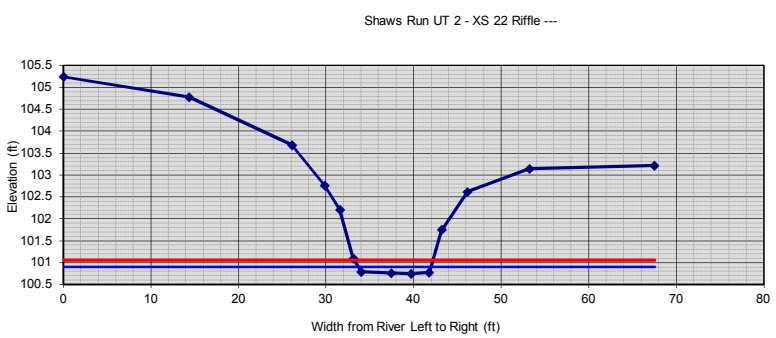
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.35	-1.85	12.0		
100.35	101.85			

dimensions			
1.1	x-section area	0.1	d mean
7.5	width	7.6	wet P
0.3	d max	0.1	hyd radi
1.8	bank ht	52.6	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:	Shaws Run UT 2 - XS 22
	Riffle

	---
description:	Shaws Run UT 2 - XS 22
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-5.243005	105.243
	☐	14.35528	-4.775874	104.7759
	☐	26.09044	-3.683001	103.683
	☐	29.8327	-2.759968	102.76
	☐	31.57145	-2.196527	102.1965
	☐	33.14612	-1.084295	101.0843
	☐	34.00837	-0.784949	100.7849
	☐	37.44848	-0.757106	100.7571
	☐	39.72723	-0.74565	100.7457
	☐	41.77949	-0.771632	100.7716
	☐	43.21951	-1.746614	101.7466
	☐	46.15208	-2.615674	102.6157
	☐	53.2284	-3.139513	103.1395
	☐	67.53073	-3.217318	103.2173
	☐			
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	☐			
	☐			
	☐			

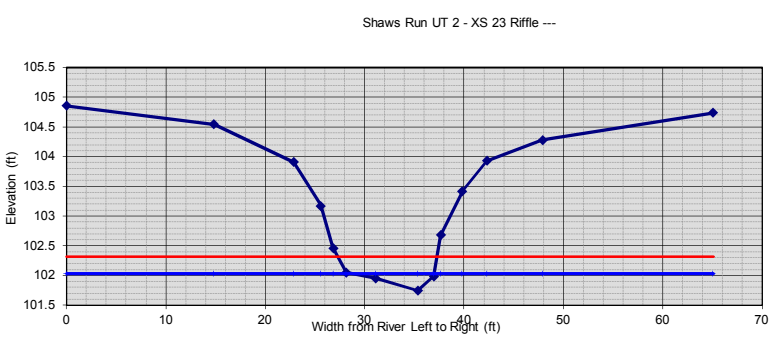
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.9	-2.62	8.7		
100.9	102.62			

dimensions			
1.1	x-section area	0.1	d mean
8.3	width	8.4	wet P
0.2	d max	0.1	hyd radi
1.9	bank ht	62.3	w/d ratio
8.7	W flood prone area	1.0	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:	Shaws Run UT 2 - XS 23
	Riffle

	---
description:	Shaws Run UT 2 - XS 23
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.8535	104.8535
	☐	14.83251	-4.54353	104.5435
	☐	22.83254	-3.907345	103.9073
	☐	25.58356	-3.169385	103.1694
	☐	26.86423	-2.453655	102.4537
	☐	28.11609	-2.048755	102.0488
	☐	31.07676	-1.954503	101.9545
	☐	35.35308	-1.743041	101.743
	☐	36.97057	-1.985924	101.9859
	☐	37.64982	-2.682738	102.6827
	☐	39.80944	-3.414694	103.4147
	☐	42.31788	-3.927974	103.928
	☐	47.92212	-4.278752	104.2788
	☐	65.06919	-4.737553	104.7376
	☐			
	☐			
	☐			
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	☐			
	☐			
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	☐			
	☐			
	☐			
	☐			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.03	-3.91	9.5		
102.03	103.91			

dimensions			
1.1	x-section area	0.1	d mean
8.3	width	8.4	wet P
0.3	d max	0.1	hyd radi
2.2	bank ht	60.9	w/d ratio
9.5	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		

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name: Shaw's Run - UT 1
Stream Category: Oa2
Date of Evaluation: 1/11/18
Assessor Name/Organization: Axiom Environmental, Inc.

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
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	**LOW**	
(3) Stream Stability	**MEDIUM**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	NA	
(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	**LOW**	
(2) Indicators of Stressors	**NO**	
(2) Aquatic Life Tolerance	**MEDIUM**	
(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	**MEDIUM**	
(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: Shaw's Run - UT 2
Date of Evaluation: 1/11/18
Stream Category: Oa1
Assessor Name/Organization: Axiom Environmental, Inc.

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
Additional stream information/supplementary measurements included (Y/N)	YES
NC SAM feature type (perennial, intermittent, Tidal Marsh Stream)	Intermittent

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**LOW**	**LOW**
(2) Baseflow	**HIGH**	**HIGH**
(2) Flood Flow	**LOW**	**LOW**
(3) Streamside Area Attenuation	**LOW**	**LOW**
(4) Floodplain Access	**LOW**	**LOW**
(4) Wooded Riparian Buffer	**LOW**	**LOW**
(4) Microtopography	**LOW**	**LOW**
(3) Stream Stability	**MEDIUM**	**MEDIUM**
(4) Channel Stability	**HIGH**	**HIGH**
(4) Sediment Transport	NA	NA
(4) Stream Geomorphology	**LOW**	**LOW**
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**LOW**	**LOW**
(2) Baseflow	**HIGH**	**HIGH**
(2) Streamside Area Vegetation	**LOW**	**LOW**
(3) Upland Pollutant Filtration	**LOW**	**LOW**
(3) Thermoregulation	**LOW**	**LOW**
(2) Indicators of Stressors	**NO**	**NO**
(2) Aquatic Life Tolerance	**LOW**	NA
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**LOW**	**LOW**
(2) In-stream Habitat	**LOW**	**LOW**
(3) Baseflow	**HIGH**	**HIGH**
(3) Substrate	**LOW**	**LOW**
(3) Stream Stability	**MEDIUM**	**MEDIUM**
(3) In-stream Habitat	**MEDIUM**	**MEDIUM**
(2) Stream-side Habitat	**LOW**	**LOW**
(3) Stream-side Habitat	**LOW**	**LOW**
(3) Thermoregulation	**LOW**	**LOW**
(2) Tidal Marsh In-stream Habitat	NA	NA
(3) Flow Restriction	NA	NA
(3) Tidal Marsh Stream Stability	NA	NA
(4) Tidal Marsh Channel Stability	NA	NA
(4) Tidal Marsh Stream Geomorphology	NA	NA
(3) Tidal Marsh In-stream Habitat	NA	NA
(2) Intertidal Zone Habitat	NA	NA
Overall	**LOW**	**LOW**

UT 1 Upper

NC DWQ Stream Identification Form Version 4.11

Date: 1/11/18	**Project/Site:** Shaws Run	**Latitude:** 34.320212
Evaluator: AXE	**County:** Columbus	**Longitude:** -78.866063
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 6.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	(0)	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	(0)	1	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 5)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	(1.5)
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 7.5)				
18. Fibrous roots in streambed	3	2	1	(0)
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	0	0.5	(1)	1.5
23. Crayfish	0	0.5	1	(1.5)
24. Amphibians	0	(0.5)	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; (OBL = 1.5) Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch: Crawfish
Fish
Amphipods
Egg sacks

UT2

NC DWQ Stream Identification Form Version 4.11

Date: 1/11/18	**Project/Site:** Shaws Run	**Latitude:** 34.319884
Evaluator: AxE Lewis	**County:**	**Longitude:** -78.867100
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 21	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 7.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	(2)	3
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	(0)	1	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	(0)	1	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	1	(1.5)
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 7)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	1	0.5	(0)
15. Sediment on plants or debris	(0)	0.5	1	1.5
16. Organic debris lines or piles	(0)	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 6.5)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; (OBL = 1.5) Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual

Notes:

Sketch: Riffle Beetles
Amphipods - Lots
Drain tile @ head of drainage feeds Stream.
Area may still be in D1 drought.

Land Use Nutrient Model

Stream Length	
Site Buffer Width	
Site Area (ft sq)	387684

Land Use	%
Pasture	
Woods	30
Row Crop	70
Urban	
must total 100	100

	Rainfall
Annual	

Land Use Characteristics		Number of Animals	N inputs lbs/au/yr	P inputs lbs/au/yr	Total N (lbs)	Total P (lbs)	
Pasture	Beef		113	40	0	0	
	Dairy		164	26	0	0	
	Pig		153	58	0	0	
	Horse		102	40	0	0	
	fert/ac		60	45	0	0	
					0	0	Total Pasture N and P

		% Row Crop Area	N inputs lbs/ac/yr	P inputs lbs/ac/yr	Total N	Total P	
Row Crop	Corn	50	20	20	89	89	
8.9	Cotton		20	20	0	0	
	Soybeans	50	0	15	0	67	
	Hay Fescue		50	45	0	0	
	Hay Bermuda		70	45	0	0	
	must total 100	100			89	156	Total Row Crop N and P

Woods Minimal Nutrients

		% Area	Runnoff	Concentration N (mg/l)	Concentration P (mg/l)	Total N (lbs)	Total P (lbs)	
Urban	Residential		0	2.2	0.4	0	0	
	Commercial/Industrial		0	2.3	0.3	0	0	
	Roadway		0	3.0	0.5	0	0	
						0.0	0.0	Total Urban N and P

Notes: Residential Assumes 25 % Impervious Surfac
Commercial/Industrial Assumes 75% Impervous Surface
Roadway Assumes 100% Impervious Surface
Annual Load (lbs) = 0.226*Annual Runoff (inches)*Concentration (mg/l)*Acres

Total Nutrients Removed within Easement

Total N Removed (lbs/yr)	**89**
Total P Removed (lbs/yr)	**156**

Site		Shaw's Run Stream and Wetland Mitigation Site						
Stream		UT 1			Bank Length		1580	
Observers		Kenan			Date		11-Jan-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	85	right	High	High	0.2	85	4.5	76.5
2	130	right	High	Mod	0.15	45	3	20.3
3	210	right	High	Low	0.1	80	2.5	20.0
4	370	right	Mod	Low	0.02	160	2.5	8.0
5	405	right	Low	Low	0	35	2.5	0.0
6	475	right	High	Low	0.1	70	2.5	17.5
7	570	right	Mod	Low	0.02	95	3	5.7
8	640	right	Low	Low	0	70	3	0.0
9	700	right	Mod	Low	0.02	60	3	3.6
10	995	right	Low	Low	0	295	3	0.0
11	1225	right	Mod	Low	0.02	230	3.5	16.1
12	1355	right	Low	Low	0	130	3	0.0
13	1580	right	Low	Low	0	225	2.5	0.0
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		167.7
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		6.2
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		8.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.005

Site		Shaw's Run Stream and Wetland Mitigation Site						
Stream		UT 1			Bank Length		1580	
Observers		Kenan			Date		11-Jan-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	85	left	High	High	0.2	85	4.5	76.5
2	130	left	High	Mod	0.15	45	3	20.3
3	210	left	High	Low	0.1	80	2.5	20.0
4	370	left	Mod	Low	0.02	160	2.5	8.0
5	460	left	Low	Low	0	90	2.5	0.0
6	580	left	Mod	Low	0.02	120	3	7.2
7	835	left	High	Low	0.1	255	3	76.5
8	995	left	Low	Low	0	160	3	0.0
9	1355	left	Low	Low	0	360	3.5	0.0
10	1580	left	Low	Low	0	225	3	0.0
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		208.5
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		7.7
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		10.0
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.006

Site		Shaw's Run Stream and Wetland Mitigation Site						
Stream		UT 2			Bank Length		520	
Observers		Kenan			Date		11-Jan-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	260	left	low	low	0	260	2.5	0.0
2								
3								
4								
5								
6								
7								
8								
9								
10	260	right	low	low	0	260	2.5	0.0
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		0.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.0
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.0
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.00

BEHI/NBS Summary

Stream Reach	Erosion Rate (tons/year)
UT 1 RB	8.1
UT 1 LB	7.7
UT 2	0.0
Total	**15.8**

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

SOIL BORING LOG

Date: 1/11/2018

Project/Site: Shaw's Run Stream & Wetland Mitigation Site

County, State: Columbus, NC

Sampling Point/ Coordinates: Hydric Soil Profile 1/ 34.318064, -78.866380

Investigator: Lewis

Soil Series: Muckalee

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

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-9	10YR 3/2	90	10YR 4/1	10	loam
9-12	10YR 3/2	100	--	--	sandy loam
12-18	10YR 5/1	60	10 YR 4/1	20	fine sandy loam
			10 YR 3/2	10	
			10 YR 6/1	10	
18+	10YR 7/1	90	10YR 6/8	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

Date: 11/19/2019

Project/Site: Shaw's Run Stream & Wetland Mitigation Site

County, State: Columbus, NC

Sampling Point/ Coordinates: Hydric Soil Profile 2/34.320270, -78.865177

Investigator: Lewis

Soil Series: Muckalee

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

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	10YR 3/1	100	--	--	Silt Loam
8-12	10YR 3/1	97	10yr 4/6	3	Silt Loam
12-25	7.5YR 2.5-1	95	10 YR 4/6	5	Silt Loam
25-30	7.5YR 8/1	90	10 YR 4/6	10	Loam
30+	7.5YR 6/1	80	11 YR 4/6	20	Silty Clay Loam

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

Date: 11/19/2019

Project/Site: Shaw's Run Stream & Wetland Mitigation Site

County, State: Columbus, NC

Sampling Point/ Coordinates: Hydric Soil Profile 3/34.320175, -78.865761

Investigator: Lewis

Soil Series: Muckalee

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

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-10	10YR 3/2	100	--	--	Loam
10-18	10YR 3/1	90	10yr 4/6	10	Silt Loam
18-30+	10YR 3/1	90	10yr 4/6	10	Silty Clay Loam

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

Date: 11/19/2019

Project/Site: Shaw's Run Stream & Wetland Mitigation Site

County, State: Columbus, NC

Sampling Point/ Coordinates: Hydric Soil Profile 4/34.319616, -78.866805

Investigator: Lewis

Soil Series: Muckalee

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

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-8	7.5YR 4/1	100	--	--	Loam
8-18	7.5YR 7/1	95	10yr 4/6	5	Silt Loam
18-30+	7.5YR 7/1	100	--	--	Snady Loam

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

Date: 11/19/2019

Project/Site: Shaw's Run Stream & Wetland Mitigation Site

County, State: Columbus, NC

Sampling Point/
Coordinates: Hydric Soil Profile 5/34.319116, -78.866415

Investigator: Lewis

Soil Series: Muckalee

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

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-10	7.5YR 4/1	100	--	--	Silty Clay
10-18	7.5YR 6/2	80	7.5YR 4/6	20	Clay
18-25	7.5YR 5/1	95	7.5YR 4/6	5	Clay
25-35	7.5YR 5/1	90	7.5YR 4/6	10	Silty Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

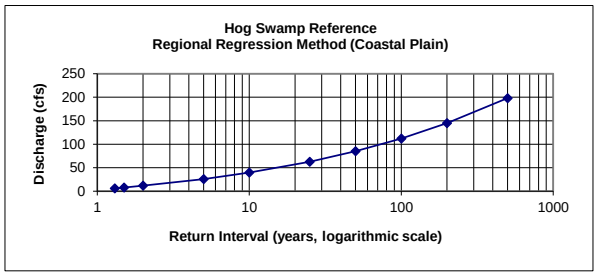
Name/Print: W. Grant Lewis

Appendix C
Flood Frequency Analysis Data/FEMA Coordination

Hog Swamp Reference
(DA = 0.08 square miles)
Region: Coastal Plain

Return Interval (years)	Discharge (cfs)
1.3	**6**
1.5	**8**
2	11.8
5	25.9
10	39.8
25	62.8
50	85
100	112
200	145
500	198

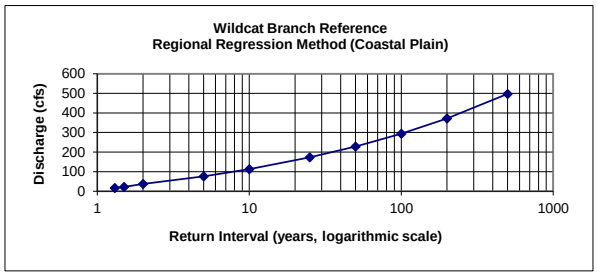
Bold indicates interpolated data.



Wildcat Branch Reference
(DA = 0.44 square miles)
Region: Coastal Plain

Return Interval (years)	Discharge (cfs)
1.3	**17**
1.5	**22**
2	37.2
5	76.6
10	113
25	173
50	228
100	294
200	372
500	497

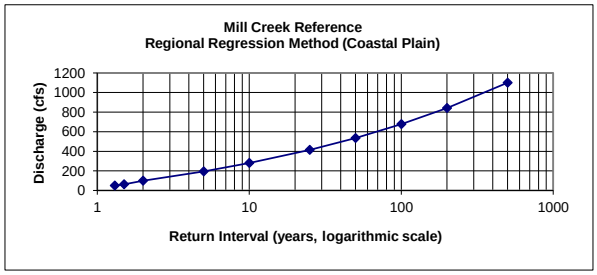
Bold indicates interpolated data.



Mill Creek Reference (DA = 1.92 square mile)
Region: Coastal Plain

Return Interval (years)	Discharge (cfs)
1.3	**50**
1.5	**62**
2	100
5	195
10	281
25	414
50	535
100	677
200	841
500	1100

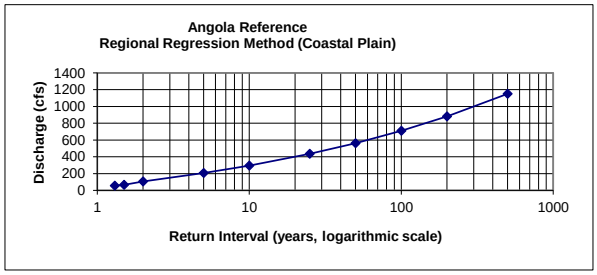
Bold indicates interpolated data.



Angola Reference
(DA = 2.09 square miles)
Region: Coastal Plain

Return Interval (years)	Discharge (cfs)
1.3	**55**
1.5	**67**
2	106
5	206
10	296
25	435
50	562
100	710
200	882
500	1150

Bold indicates interpolated data.



Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

February 21, 2019

Samantha Alsup
Columbus County Local Floodplain Administrator
306 Jefferson Street
Whiteville, NC 28472

Re: Shaw's Run Stream and Wetland mitigation project Columbus County FEMA Floodplain Requirements Checklist **18-014**

Dear Ms. Alsup:

The purpose of this letter is to request concurrence from the Columbus County concerning a stream and wetland restoration site located in Columbus County. The Site encompasses approximately 9.14 acres of agricultural land used for row crop production. Existing Site streams have been cleared, dredged and straightened, and receive extensive sediment and nutrient inputs from farming. Activities proposed at the Site include the restoration of perennial and intermittent stream channels, and restoration of riparian wetlands. Work proposed includes moving the channel to a relict and abandoned floodplain and planting with forest vegetation on cleared sections.

Stream reaches are depicted on the attached figures and lengths/priority are as follows:

Reach	**Length**	**Priority**
UT 1	1979	Priority 1 Restoration
UT 2	388	Priority 1 Restoration

FEMA mapping was reviewed to determine if the project is located in a FEMA study area (DFIRM panel numbers 372002200J). Based on existing floodplain mapping, the site is located in Special Flood Hazard Area and the project may require a "Conditional Letter of Map Revision" (CLOMR), and a subsequent "Letter of Map Revision" (LOMR).

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,

AXIOM ENVIRONMENTAL

W. Grant Lewis
Senior Project Manager

Attachments

- Figure 1 Project Location
- Figure 2 Hydrologic Unit Map
- Figure 3 Topography and Drainage Area
- Figure 4 Existing Conditions
- Figure 5 Restoration Plan
- EEP Floodplain Requirements Checklist
- FIRM

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. State NFIP Engineer), NC Floodplain Mapping Unit (attn. State NFIP Coordinator) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Shaw's Run Stream and Wetland Restoration Site
Name if stream or feature:	UT to Greene Branch
County:	Columbus
Name of river basin:	Lumber
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Columbus
DFIRM panel number for entire site:	3720022000J
Consultant name:	Axiom Environmental, Inc.
Phone number:	919-215-1693
Address:	218 Snow Avenue Raleigh, NC 27603

Design Information

Provide a general description of project (one paragraph). Include project limits on a reference orthophotograph at a scale of 1" = 500". (See Attached)

Summarize stream reaches or wetland areas according to their restoration priority.
(See Attached)

Example

Reach	Length	Priority
Example: Reach A	*1000*	*One (Restoration)*
Example: Reach B	*2000*	*Three (Enhancement)*

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

☑ Yes ☐ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☑ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation:

Check if applies:

☑ AE Zone

- ☑ Floodway
- ☐ Non-Encroachment
- ☐ None

☐ A Zone

- ☐ Local Setbacks Required
- ☐ No Local Setbacks Required

If local setbacks are required, list how many feet:

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

☐ Yes ☑ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

☑ Yes ☐ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, (919) 715-8000

Name of Local Floodplain Administrator: Samantha Alsup
Phone Number: 910-640-28512

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☐ No Action

☐ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

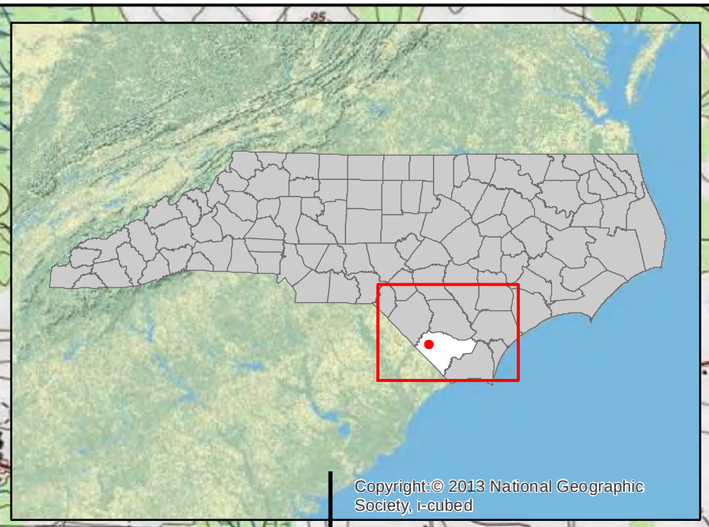
☐ Other Requirements

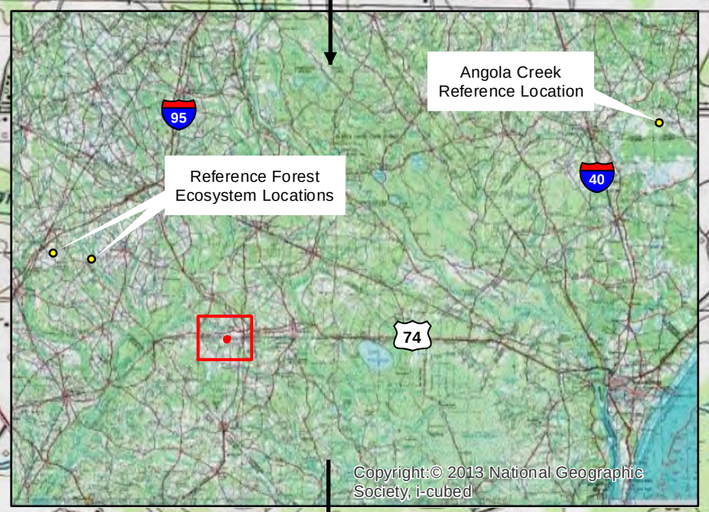
List other requirements:

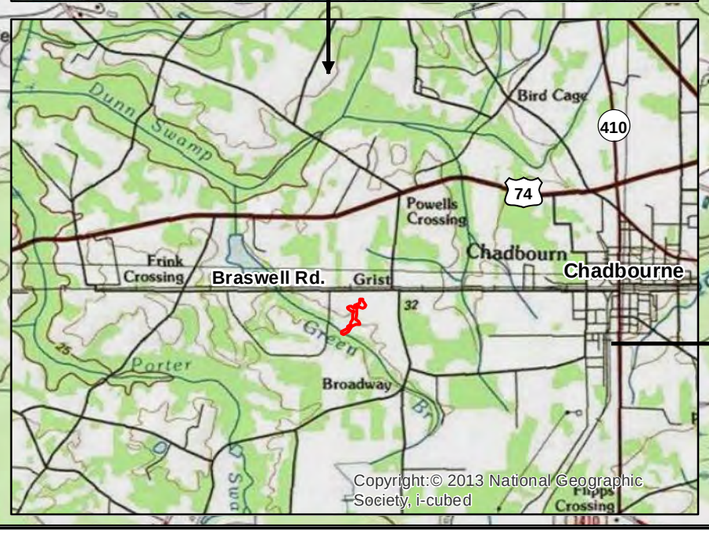
Comments:

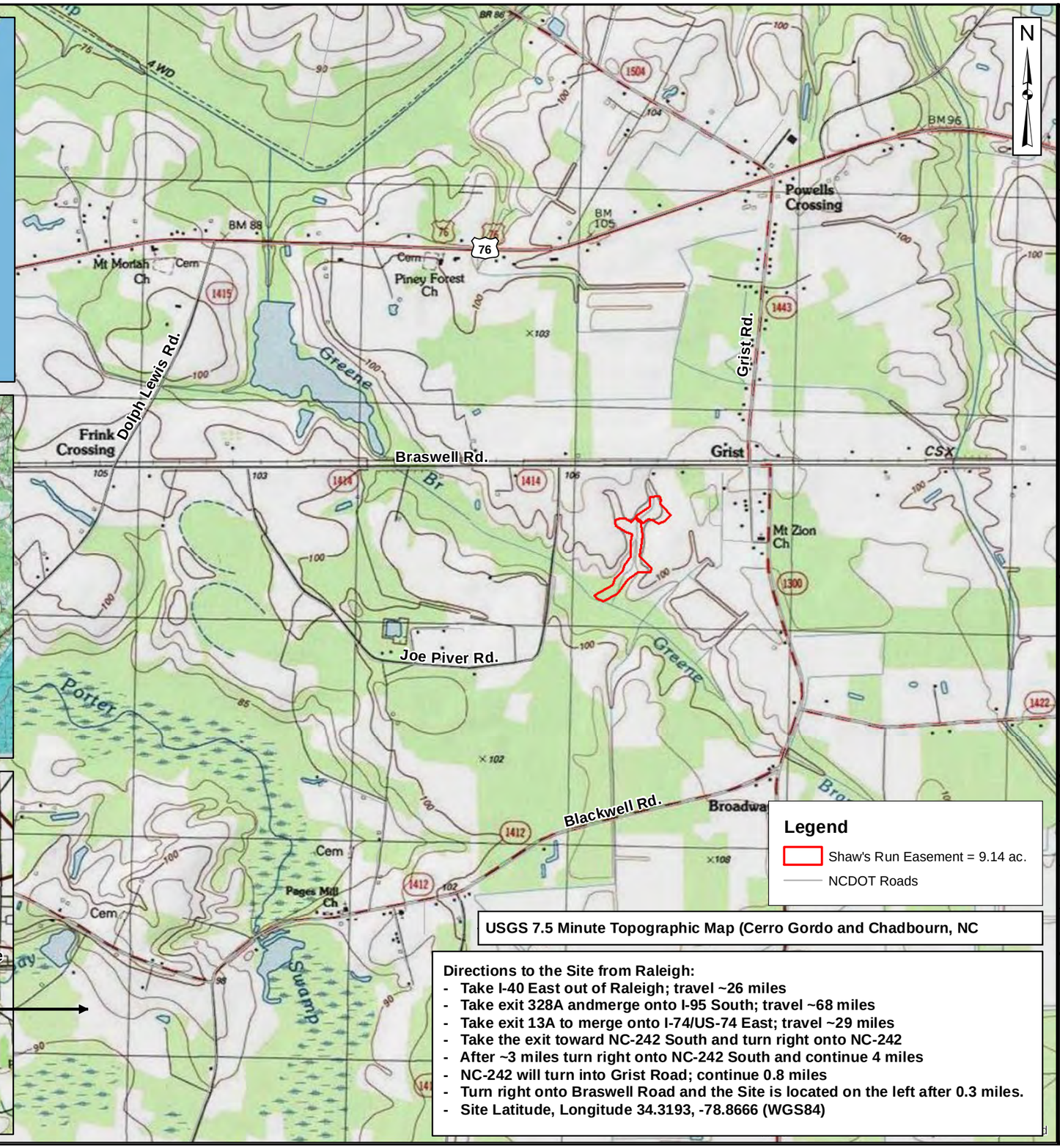
Name: W. Grant Lewis Signature: _____

Title: President Date: _____









Legend

- Shaw's Run Easement = 9.14 ac.
- NCDOT Roads

USGS 7.5 Minute Topographic Map (Cerro Gordo and Chadbourn, NC

Directions to the Site from Raleigh:

- **Take I-40 East out of Raleigh; travel ~26 miles**
- **Take exit 328A andmerge onto I-95 South; travel ~68 miles**
- **Take exit 13A to merge onto I-74/US-74 East; travel ~29 miles**
- **Take the exit toward NC-242 South and turn right onto NC-242**
- **After ~3 miles turn right onto NC-242 South and continue 4 miles**
- **NC-242 will turn into Grist Road; continue 0.8 miles**
- **Turn right onto Braswell Road and the Site is located on the left after 0.3 miles.**
- **Site Latitude, Longitude 34.3193, -78.8666 (WGS84)**

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

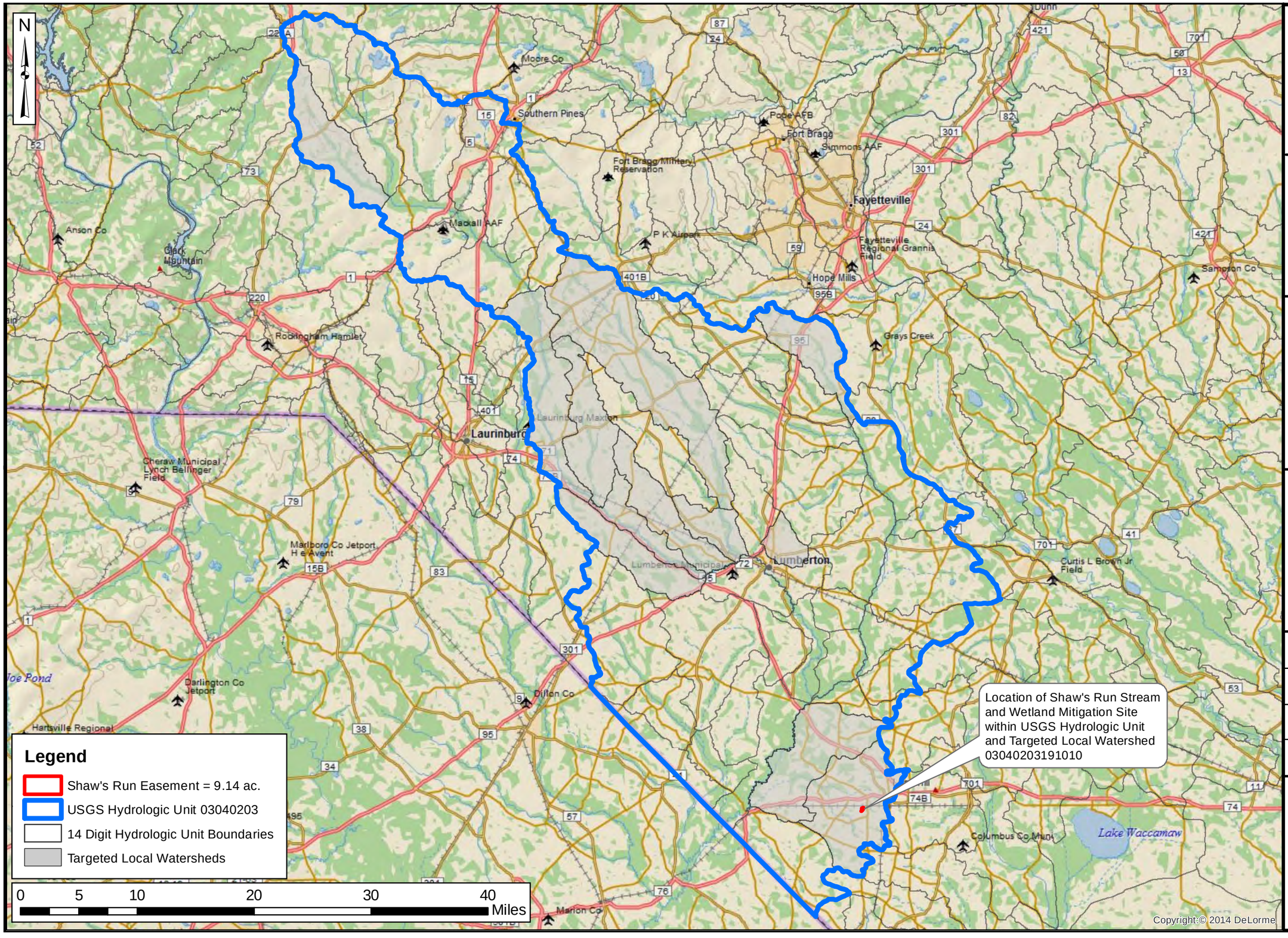
Date: FEB 2019

Scale: 1:20,000

Project No.: 18-014

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: CLF/KRJ

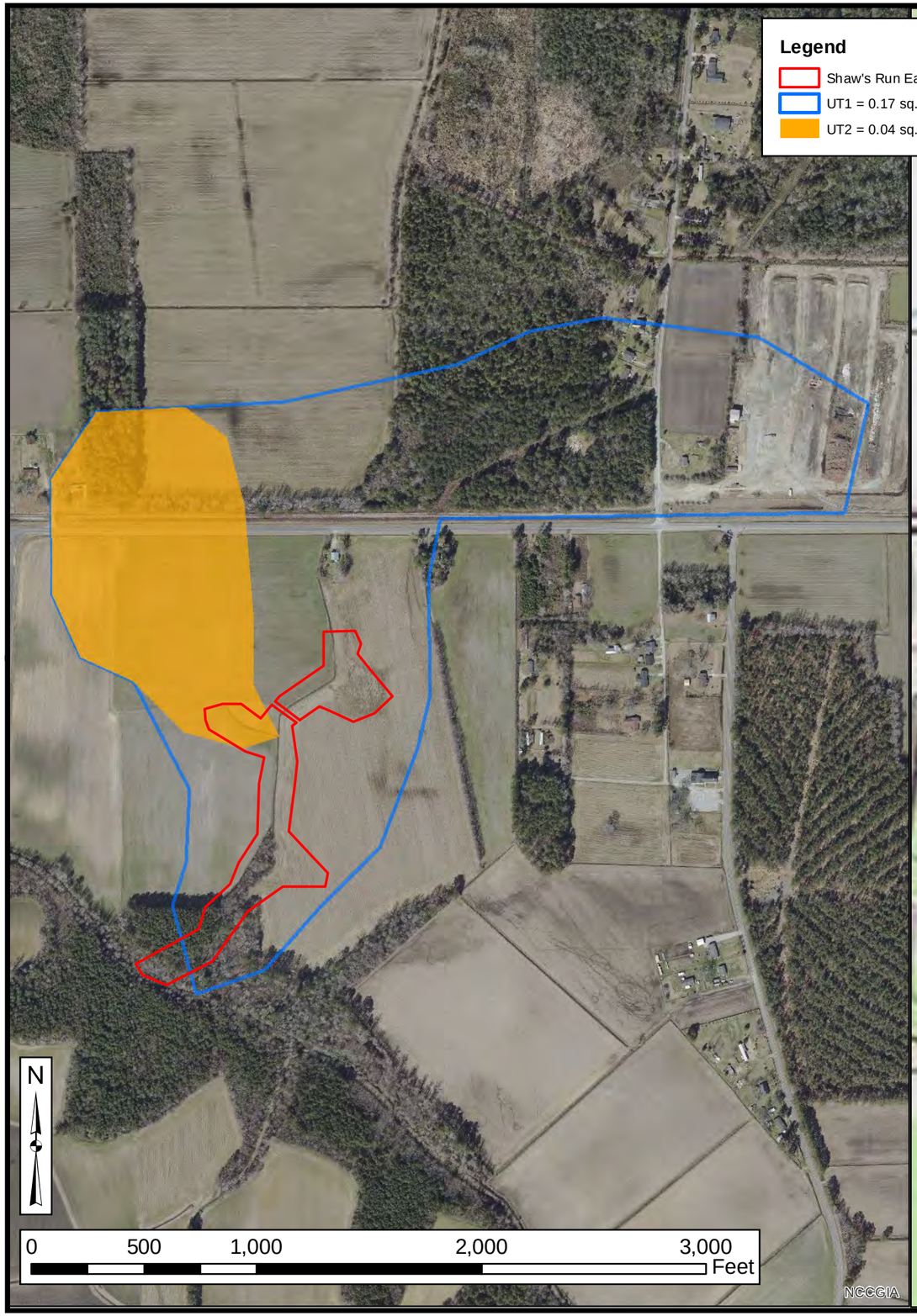
Date: FEB 2019

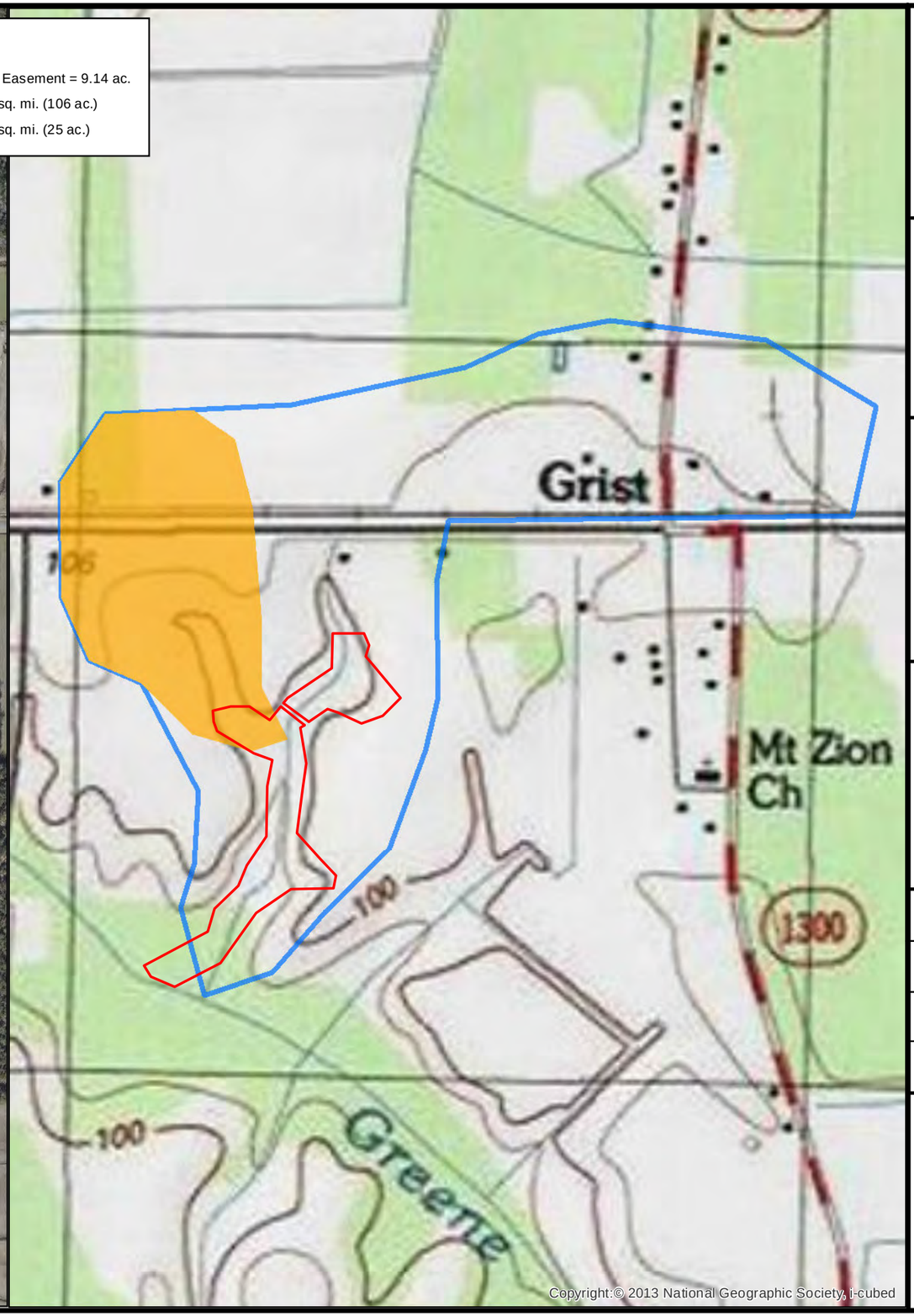
Scale: 1:490,000

Project No.: 18-014

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Colombus County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: CLF/KRJ

Date: FEB 2019

Scale: 1:6800

Project No.: 18-014

FIGURE

3

Soil Map Unit	Soil Series
GoA	Goldsboro fine sandy loam, 0 to 2 % slopes
LyA	Lynchburg fine sandy loam, 0 to 2 % slopes
Mk	Muckalee fine sandy loam
NoB	Norfolk loamy fine sand, 0 to 6 % slopes
RaA	Rains fine sandy loam, 0 to 2 % slopes

LyA

GoA

GoA

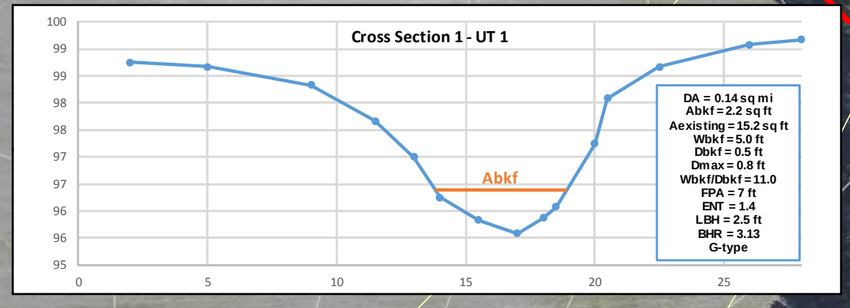
XS-1

UT-1

NCSAM Form 2
Score: LOW

NCSAM Form 1
Score: LOW

UT-2



NoB

LyA

Mk

Greene Branch

RaA

Legend

- Shaw's Run Easement = 9.14 ac
- Existing Streams = 1891 ft
- Drained Hydric Soils
- Existing Wetlands
- Cross Section
- NC SAM Forms
- NC DWR Forms
- Soil Profile
- NRCS Soil Boundaries
- 2-foot Lidar Contours

0 150 300 600 Feet

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

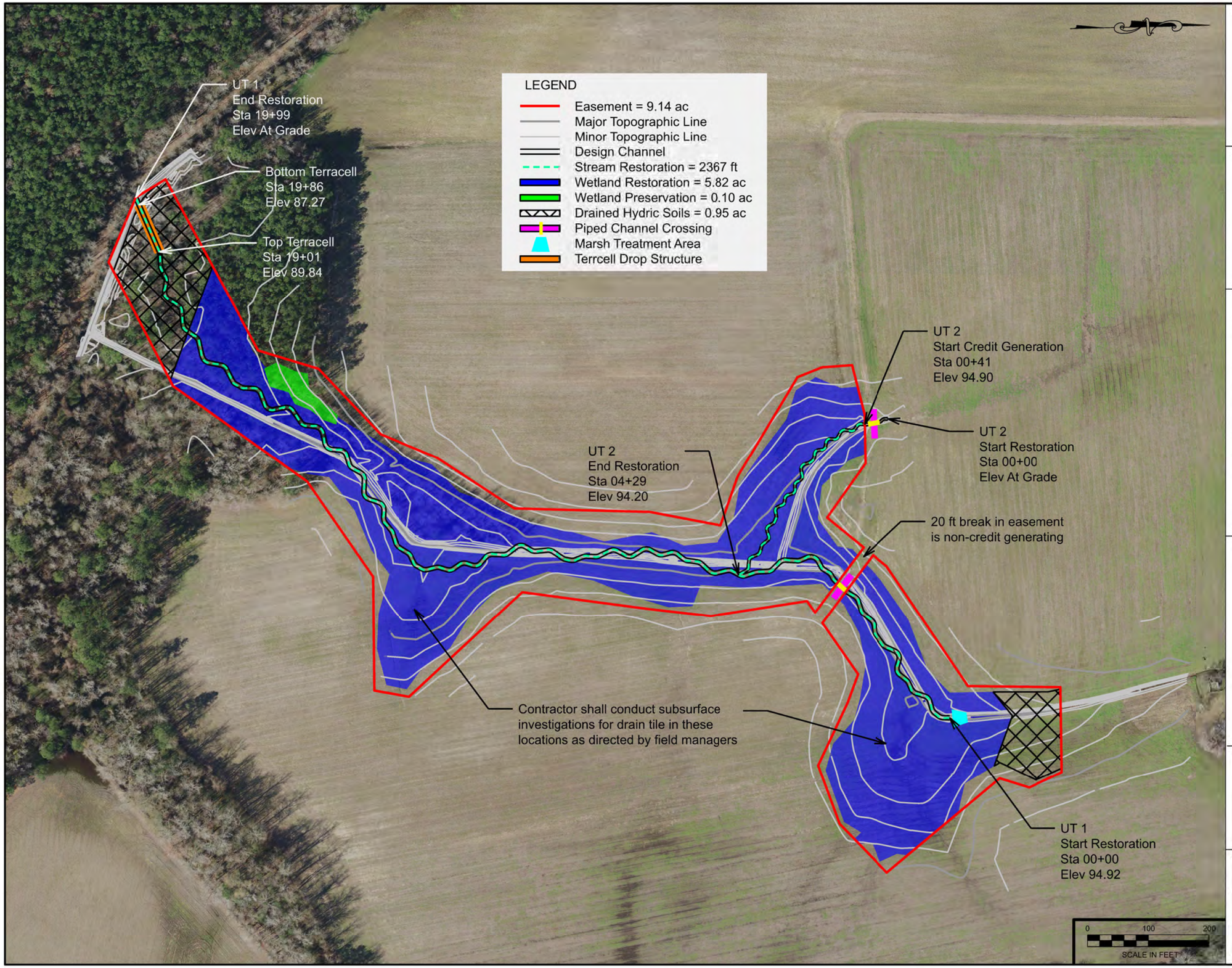
Date: FEB 2019

Scale: 1:1600

Project No.: 18-014

FIGURE

4



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Shaw's Run
Mitigation Site

Colombus County
North Carolina

Title:

Restoration Plan

Scale: As Shown

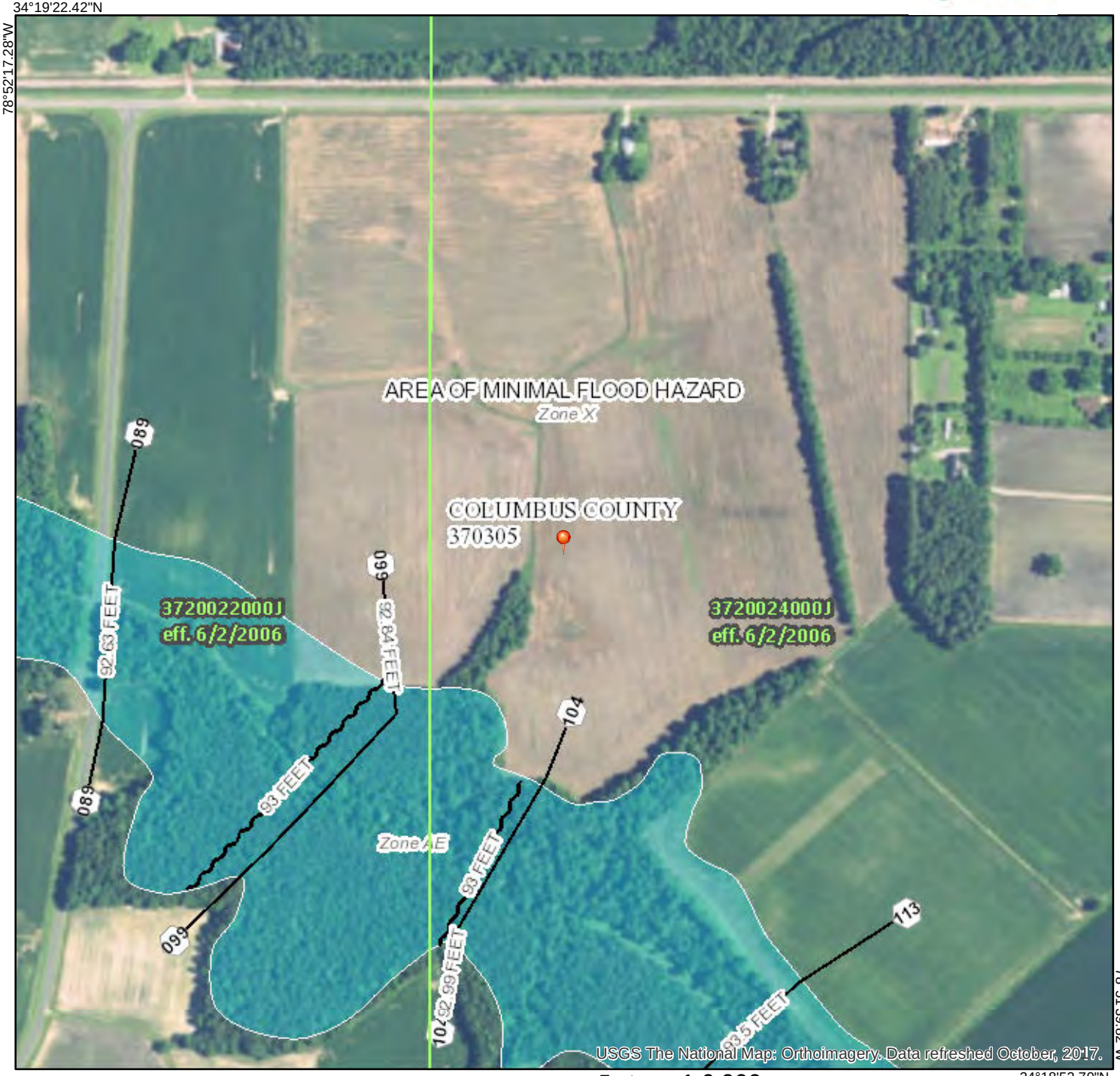
Date: Feb 2019

Project No.: 18-014

FIGURE NO.

5

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/21/2019 at 10:20:42 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix D
Notification of Jurisdictional Determination

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2019-00087** County: **Columbus** U.S.G.S. Quad: **NC- Chadbourn**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner/Applicant: **Michael W. Shaw**
1223 Braswell Road
Chadbourn, NC 2429

Permittee: **JD Hamby – Restoration Systems, LLC**
1101 Haynes Street, Suite 211
Raleigh NC, 27604

Size (acres)	**9.0**	Nearest Town	**Chadbourn**
Nearest Waterway	**Greene Branch**	River Basin	**Lower Pee Dee**
USGS HUC	**03040203**	Coordinates	Latitude: **34.3193**
			Longitude: **-78.8666**

Location description: **The project area is approximately 9 acres north of Blackwell Road, south of Braswell Road, east of Joe Piver Road, west of Walls Lane, Lower Pee Dee River, Columbus County, North Carolina.**

Indicate Which of the Following Apply:

A. Preliminary Determination

X There are waters 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 have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. 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 are wetlands on the above described 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 of the U.S. on your 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 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 of the U.S., including wetlands, on the above described project area 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 of the U.S. on your 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.

#FOLDER_DA_NUMBER#

_ The waters of the U.S., including wetlands, on your project area have been delineated and the delineation has been verified by the Corps. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA 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 of the U.S., including wetlands, have been delineated and surveyed and are accurately depicted on the plat signed by the Corps Regulatory Official identified below on _____. 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 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 **Thomas Charles at 910-251-4101 or Thomas.p.charles@usace.army.mil.**

D. Basis For Determination: **The project area exhibits wetland criteria as described in the 1987 Corps Wetland Delineation Manual and appropriate Regional Supplement. This determination is based on information submitted by JD Hamby – Restoration Systems, LLC and a site visit by Thomas Charles (1/10/2019). Please see attached PJD form.**

D. Remarks: **This determination is only for the project area depicted in solid red, Shaws Run Easement=8.5 ac on the attached figures 3a & 3b Wetland Delineation, Shaws Run Stream and Wetland Mitigation site map dated 11/2018.**

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 for Approved Jurisdiction Determinations **(as indicated in Section B. above)**

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____N/A_____.
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: CHARLES.THOMAS.P.1288547196 Digitally signed by CHARLES.THOMAS.P.1288547196
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=CHARLES.THOMAS.P.1288547196
Date: 2019.03.11 14:25:33 -04'00'

Date: **3/11/2019.** Expiration Date**: N/A.**

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.

#FOLDER_DA_NUMBER#

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **JD Hamby – Restoration Systems, LLC**	File Number: **SAW-2019-00087**	Date: 3/11/2019

Attached is: **Shaws Runn Stream and Wetland Mitigation Site Figure 3a & 3b Dated 11/2018**	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 http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits.aspx or 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 division engineer. This form must be received by the division engineer within 60 days of the date of this notice.

#FOLDER_DA_NUMBER#

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.

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: Thomas Charles** **69 Darlington Avenue** **Wilmington, NC 28403**	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.

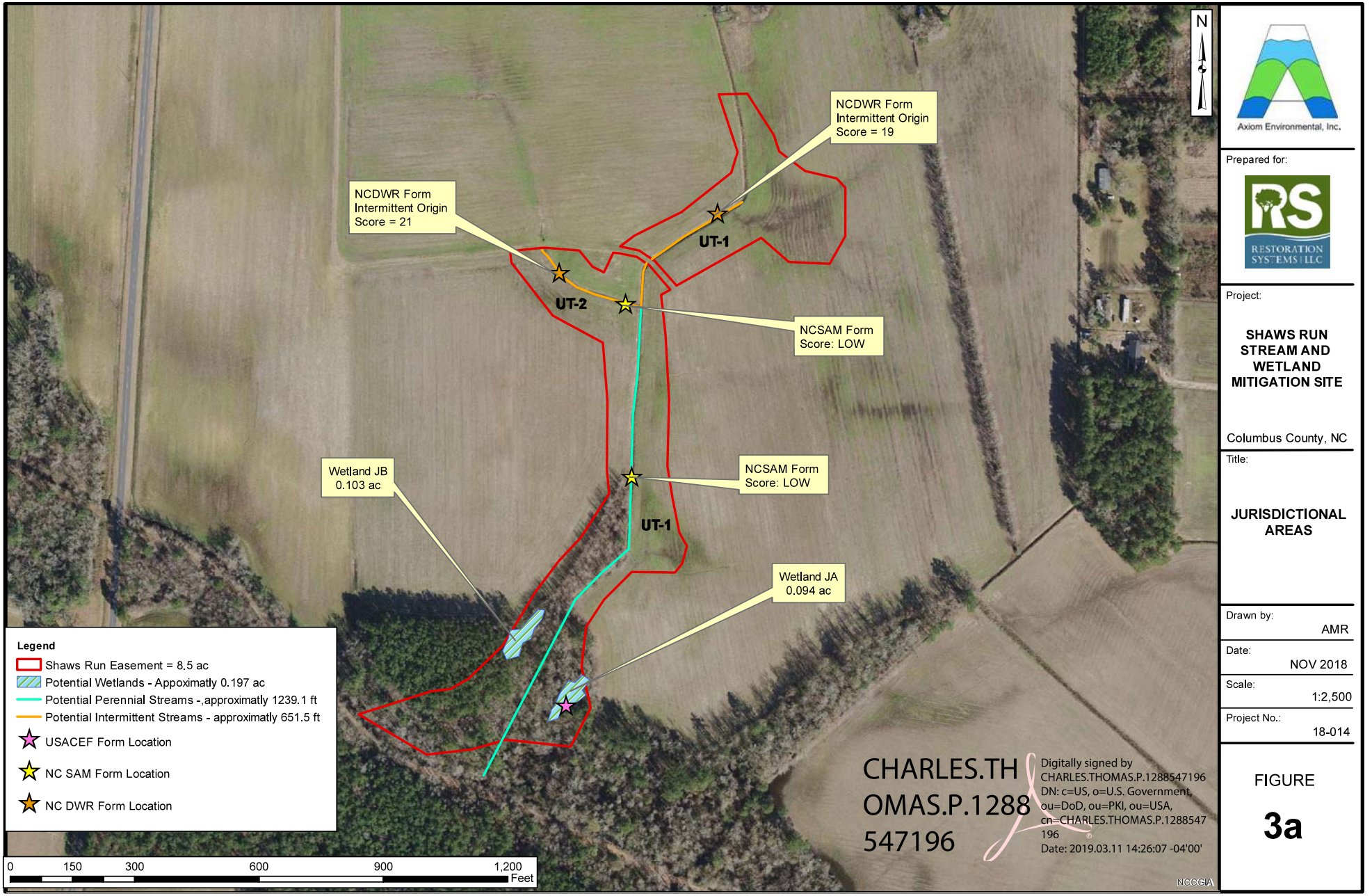
_____ Signature of appellant or agent.	Date:	Telephone number:

For appeals on Initial Proffered Permits send this form to:

District Engineer, Wilmington Regulatory Division, Attn: Thomas Charles, 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



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAWS RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

JURISDICTIONAL AREAS

Drawn by: AMR

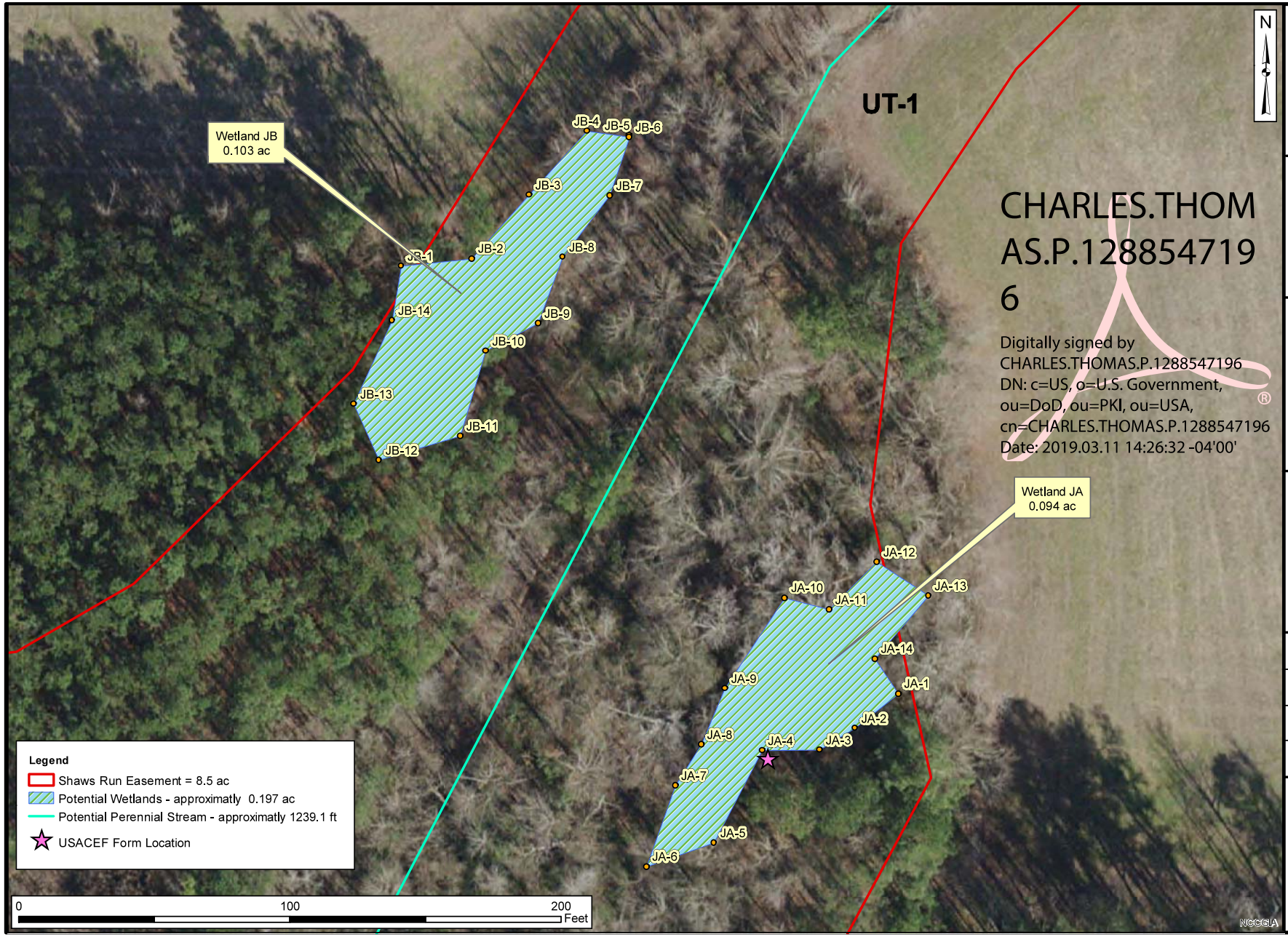
Date: NOV 2018

Scale: 1:2,500

Project No.: 18-014

FIGURE

3a



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Prepared for:

RESTORATION SYSTEMS LLC

Project:

SHAWS RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

JURISDICTIONAL AREAS

Drawn by: AMR

Date: NOV 2018

Scale: 1:400

Project No.: 18-014

FIGURE

3b

Appendix E
Categorical Exclusion Document

Shaw's Run Stream and Wetland Mitigation Site

Columbus County, North Carolina

DMS Project No. 100055

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 which are intensively managed for row crops. 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 US Fish and Wildlife Services

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.

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:	Shaw's Run Stream and Wetland Mitigation Site
County Name:	Columbus
EEP Number:	ID #: 100055 Contract #: 7515
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
DMSProject Manager:	Lindsay Crocker lindsay.crocker@ncdenr.gov

Project Description

The Site is located approx. 2 miles west of Chadbourn, NC along warm water, unnamed tributaries to Greene Branch with Targeted Local Watershed (TLW) 03040203191010. Restoration activities will include stream channel realignment and bank stabilization as all reaches have been highly manipulated by agricultural activities. Wetland restoration will occur in areas of drained hydric soils that are adjacent to streams. Woody vegetation will be planted throughout the easement.

For Official Use Only

Reviewed By:

7-19-2018 — LHCrocker.

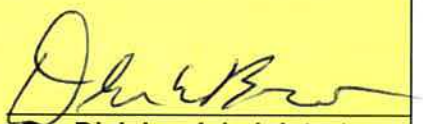
Date — **DMS Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

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

Final Approval By:

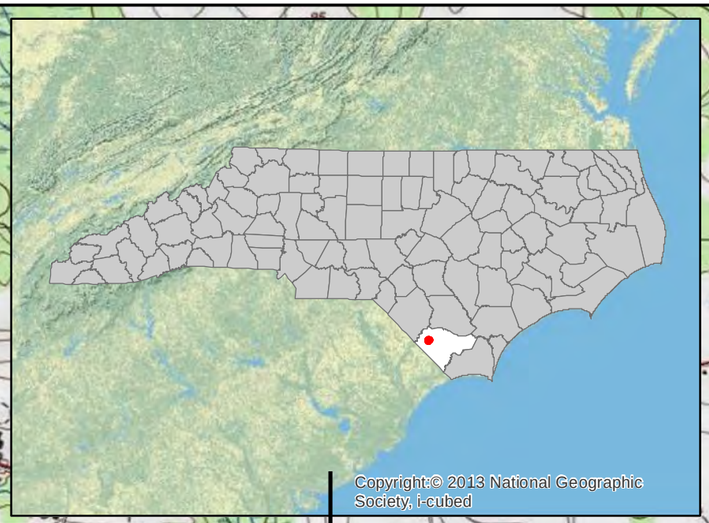
7-19-18 — 

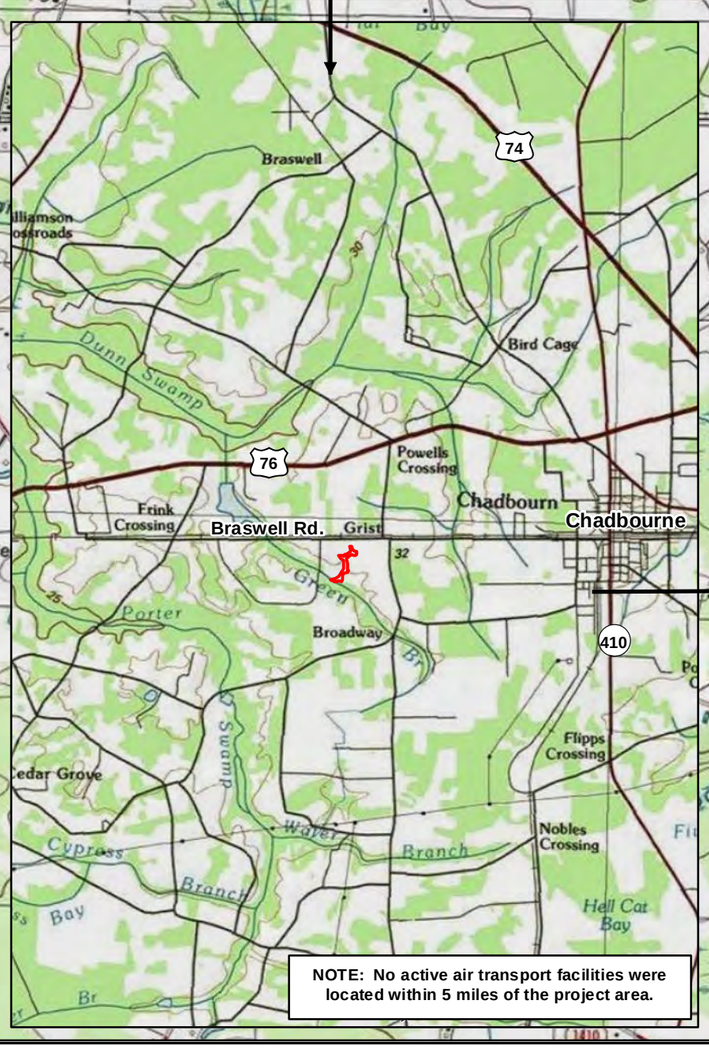
Date — **For Division Administrator FHWA**

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

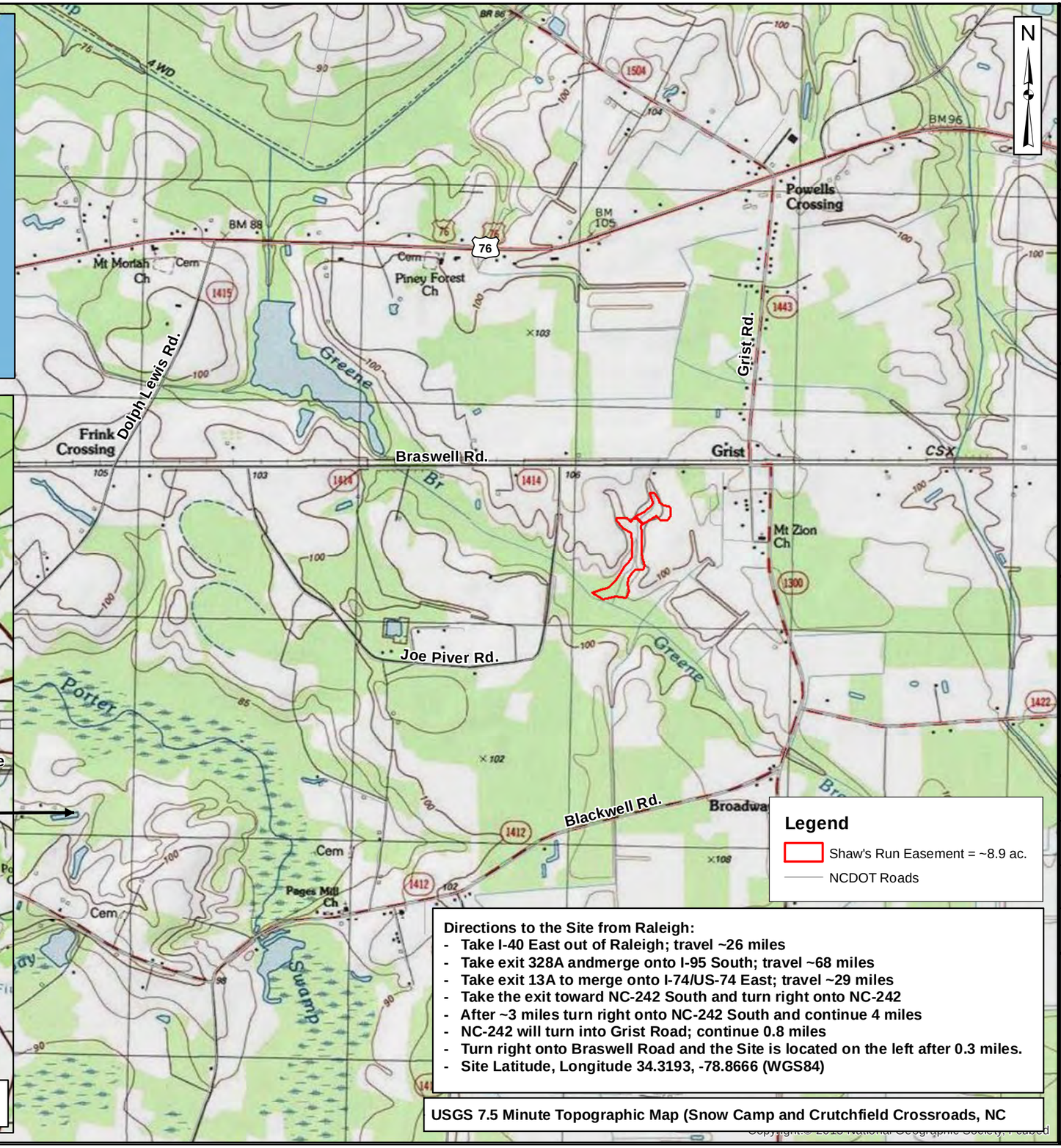
Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
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





NOTE: No active air transport facilities were located within 5 miles of the project area.



Legend

- Shaw's Run Easement = ~8.9 ac.
- NCDOT Roads

Directions to the Site from Raleigh:

- Take I-40 East out of Raleigh; travel ~26 miles
- Take exit 328A andmerge onto I-95 South; travel ~68 miles
- Take exit 13A to merge onto I-74/US-74 East; travel ~29 miles
- Take the exit toward NC-242 South and turn right onto NC-242
- After ~3 miles turn right onto NC-242 South and continue 4 miles
- NC-242 will turn into Grist Road; continue 0.8 miles
- Turn right onto Braswell Road and the Site is located on the left after 0.3 miles.
- Site Latitude, Longitude 34.3193, -78.8666 (WGS84)

USGS 7.5 Minute Topographic Map (Snow Camp and Crutchfield Crossroads, NC

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

SITE LOCATION

Drawn by: CLF/KRJ

Date: JAN 2018

Scale: 1:20,000

Project No.: 17-001.05

FIGURE

1

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: CLF/KRJ

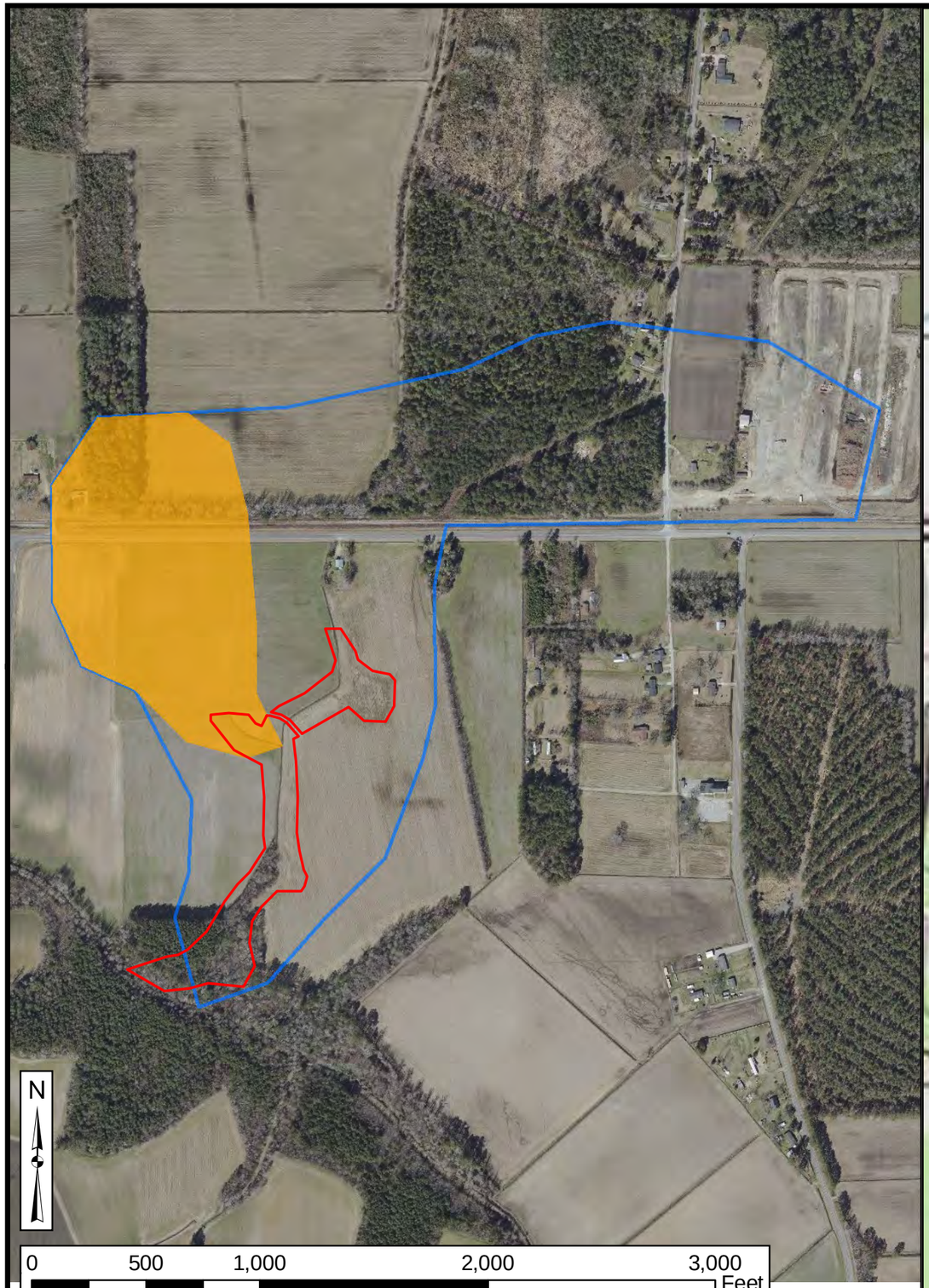
Date: JAN 2018

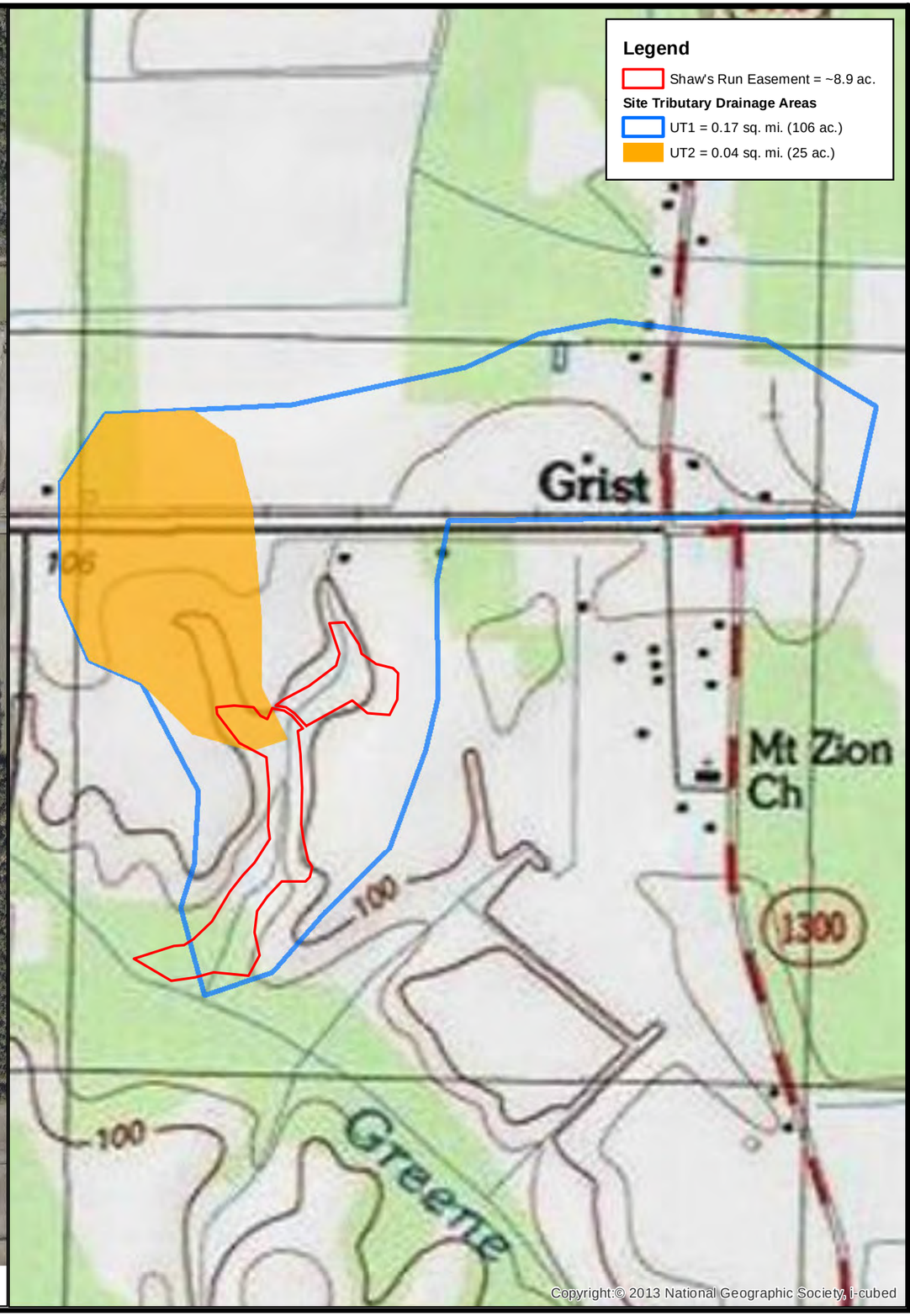
Scale: 1:490,000

Project No.: 17-001.05

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: CLF/KRJ

Date: JAN 2018

Scale: 1:6800

Project No.: 17-001.05

FIGURE

3

Soil Map Unit	Soil Series
GoA	Goldsboro fine sandy loam, 0 to 2 % slopes
LyA	Lynchburg fine sandy loam, 0 to 2 % slopes
Mk	Muckalee fine sandy loam
NoB	Norfolk loamy fine sand, 0 to 6 % slopes
RaA	Rains fine sandy loam, 0 to 2 % slopes

N

LyA

GoA

GoA

XS-1

UT-1

NCSAM Form 2
Score: LOW

NCSAM Form 1
Score: LOW

UT-2

Cross Section 1 - UT 1

DA = 0.14 sq mi
Abkf = 2.2 sq ft
Aexisting = 15.2 sq ft
Wbkf = 5.0 ft
Dbkf = 0.5 ft
Dmax = 0.8 ft
Wbkf/Dbkf = 11.0
FPA = 7 ft
ENT = 1.4
LBH = 2.5 ft
BHR = 3.13
G-type

Abkf

NoB

LyA

Mk

Greene Branch

RaA

Legend

- Shaw's Run Easement = 8.9 ac
- Streams Perennial = 1239 ft
- Streams Intermittent = 652 ft
- Drained Hydric Soils
- Cross Section
- NC SAM Forms
- NC DWR Forms
- NRCS Soil Boundaries
- Soil Profile
- 2-foot Lidar Contours

0 150 300 600 Feet

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

Date: JAN 2018

Scale: 1:1600

Project No.: 17-001.05

FIGURE

4

June 12th, 2018

Mr. Michael Shaw
2255 Braswell Road
Chadbourn, NC 28431

Dear Mr. Shaw:

The purpose of this letter is to notify you that Restoration Systems, LLC, in offering to purchase your property in Columbus 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

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: Shaw's Run 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:	Shaw's Run Stream & Wetland Mitigation Site
Project Location:	2255 Braswell Rd. Chadbourn, NC 28431
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

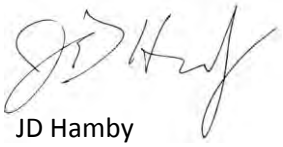
identify no features within the Site boundaries and two features within a 1.0 mile radius of the Site, listed here:

- CB0112 : James W. Powell House (Approximate site)
- CB0060 : Store

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 22, 2018

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

Re: Shaw's Run Stream & Wetland Mitigation Site, Columbus County, ER 18-1206

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, 2018

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

Re: Shaw's Run Stream and Wetland Mitigation Site, Columbus 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 Columbus County for the N.C. Division of Mitigation Services. The project will restore an unnamed tributary to Greene's Branch and drained riparian wetlands in existing row crop fields and forested areas. 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 9 acre footprint identified.

The Shaw's Run 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 Lumber River Basin, CU 03040203.

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

July 12, 2018

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

Subject: Request for Environmental Information for the Shaw's Run Stream and Wetland Mitigation Site, Columbus County, North Carolina.

Dear Mr. Hamby,

Biologists with the North Carolina Wildlife Resources Commission (NCWRC) have reviewed the proposed project description. Comments are provided in accordance with certain provisions of the Clean Water Act of 1977 (as amended), 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.).

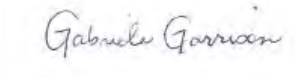
Restoration Systems, LLC has developed the Shaw's Run Stream and Wetland Mitigation Site for the NC Division of Mitigation Services. Proposed work includes restoring an unnamed tributary to Greene's Branch and drained riparian wetlands in existing row crops and forested areas. This project will provide in-kind mitigation for unavoidable impacts to streams and wetlands within watersheds of the Lumber River Basin, CU 03040203. The project area is located southeast of the intersection of Braswell and Joe Piver Roads, west of Chadbourn.

Stream and wetland 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. The NCWRC recommends the use of biodegradable and wildlife-friendly sediment and erosion control devices. Silt fencing, fiber rolls and/or other products should have loose-weave netting that is made of natural fiber materials with movable joints between the vertical and horizontal twines. Silt fencing and similar products that have been reinforced with plastic or metal mesh should be avoided as they impede the movement of terrestrial wildlife species. Excessive silt and sediment loads can have detrimental effects on aquatic resources including destruction of spawning habitat, suffocation of eggs and clogging of gills. Any invasive plant species that are found onsite should be removed.

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

Thank you for the opportunity to review and comment on this project. If I can be of further assistance, please contact me at (910) 409-7350 or gabriela.garrison@ncwildlife.org.

Sincerely,



Gabriela Garrison
Eastern Piedmont Habitat Conservation Coordinator
Habitat Conservation Program

May 18th, 2018

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

Re: Shaw's Run Stream and Wetland Mitigation Site, Columbus 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 the Shaw's Run Stream and Wetland Mitigation Site, Columbus 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 Site is characterized by agricultural fields utilized for row crop production and disturbed forest. All Site hydrology drains through unnamed tributaries to Greene Branch. The proposed conservation easement area contains approximately 9 acres.

The Site is located in the Carolina Flatwoods portion of the Middle Atlantic Coastal Plain ecoregion of North Carolina. Regional physiography is characterized by flat plains on lightly dissected marine terraces and swamps with low gradient streams over sand- and silt-dominated substrate (Griffith et al. 2002). Onsite elevations are nearly level averaging 95-100 feet National Geodetic Vertical Datum (NGVD) (USGS Chadbourn, North Carolina 7.5-minute topographic quadrangle).

The Site provides water quality functions to an approximately 0.17-square mile (106-acre) watershed at the outfall. The watershed is dominated by row crop production, disturbed forest, and sparse residential development along the margins of Braswell Road. Impervious surfaces account for less than 5 percent of the upstream watershed land surface.

Land use at the Site is characterized by agricultural row crops and disturbed forest. Row crop production extends to, and abuts ditched stream margins. Herbaceous vegetation and a few shrubby species grow within the ditches, which are regularly maintained by bush hogging and herbicide application. As the ditch descends the valley towards Greene Branch, soils change from the Goldsboro and Lynchburg Soil series

(moderately well and somewhat poorly drained) to the Muckalee Soil series (poorly drained), and disturbed forest vegetation becomes prevalent along stream margins and floodplains.

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.

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, row crop production, 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 4.4 acres of jurisdictional, riparian riverine wetlands.

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.

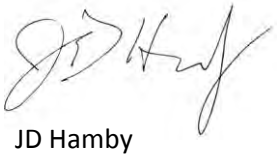
Variations in vegetative planting will occur based on topography and hydraulic condition of soils. Vegetative species composition will be based on RFEs, site-specific features, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990). Community associations to be utilized include:
1) Coastal Plain Bottomland Hardwood Forest (Brownwater Subtype), 2) Mesic Mixed Hardwood Forest (Coastal Plain Subtype), and 3) Streamside Assemblage.

Bare-root seedlings within the Coastal Plain Bottomland Hardwood Forest Mesic Mixed Hardwood 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: AD-1006 Form
Location Maps

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: Shaw's Run Stream & Wetland Restoration Site	Federal Agency Involved: Federal Highway Administration
Proposed Land Use: Stream and Wetland Restoration	County And State: Columbus, 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: 218 acres
Major Crop(s): CORN	Farmable Land In Govt. Jurisdiction Acres: 333,904 acres % 56		Amount Of Farmland As Defined in FPPA Acres: 316,337 acres % 53	
Name Of Land Evaluation System Used: Columbus 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	9.0			
B. Total Acres To Be Converted Indirectly	0.0			
C. Total Acres In Site	9.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	7.1			
B. Total Acres Statewide And Local Important Farmland	0.0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0022			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	47.3			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	66	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	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	12			
4. Protection Provided By State And Local Government	20	0			
5. Distance From Urban Builtup Area	15	15			
6. Distance To Urban Support Services	15	10			
7. Size Of Present Farm Unit Compared To Average	10	0			
8. Creation Of Nonfarmable Farmland	10	0			
9. Availability Of Farm Support Services	5	4			
10. On-Farm Investments	20	5			
11. Effects Of Conversion On Farm Support Services	10	0			
12. Compatibility With Existing Agricultural Use	10	1			
TOTAL SITE ASSESSMENT POINTS	160	72	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	66	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	72	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	138	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)

Shaw's Run Columbus County, North Carolina

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.

5 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 28 days 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.

THERE ARE NO MIGRATORY BIRDS OF CONSERVATION CONCERN EXPECTED TO OCCUR AT THIS LOCATION.

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.

THERE ARE NO U.S. FISH AND WILDLIFE SERVICE REFUGES OR FISH HATCHERIES AT THIS LOCATION.

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.

This project overlaps known wetland areas.

1. Contact the U.S. Army Corps of Engineers
   Permitting for impacts to wetlands and other aquatic habitats is handled by the Regulatory Program of the local U.S. Army Corps of Engineers District.

Shaw's Run Columbus County, North Carolina

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.

Birds

NAME	DETERMINATION
Red-cockaded Woodpecker Picoides borealis	None
Wood Stork Mycteria americana	None

Reptiles

NAME	DETERMINATION
American Alligator Alligator mississippiensis	None

Flowering Plants

NAME	DETERMINATION
Cooley's Meadowrue Thalictrum cooleyi	None
Rough-leaved Loosestrife Lysimachia asperulaefolia	None

Critical habitats

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 17, 2018

John Hamby
Restoration Systems
1101 Haynes St #211
Raleigh, NC 27604

Re: Federally Protected Species Assessment Results **18-014**
Shaw's Run, Columbus County

Dear Mr. Hamby,

Axiom Environmental, Inc. (Axiom) is pleased to provide you with this summary letter for federally protected species surveys completed on the Shaw's Run Stream & Wetland Mitigation Site (hereafter referred to as the "Site"). The Site encompasses 8.9 acres of disturbed forest and agricultural fields along warm water, unnamed tributaries to Greene Branch. The Site is located approximately 2 miles west of Chadbourn, NC and south of NC Highway 76 in Columbus County (Figure 1). Surveys were conducted by two Axiom biologists, Kenan Jernigan and Grant Lewis, on July 17, 2018.

Site Description

The Site is located in the Carolina Flatwoods of the Middle Atlantic Coastal Plain ecoregion of North Carolina. Land use at the Site is characterized by agricultural row crops and disturbed forest. Row crop production extends to, and abuts ditched stream margins (Figure 3). Herbaceous vegetation and a few shrubby species grow within the ditches, which are regularly maintained by bush hogging and herbicide application. As the ditch descends the valley towards Greene Branch, soils change from the Goldsboro and Lynchburg Soil series (moderately well and somewhat poorly drained) to the Muckalee Soil series (poorly drained), and disturbed forest vegetation becomes prevalent along stream margins and floodplains.

Federally Protected Species

Based on the most recent list as updated by the USFWS on June 27, 2018, there are six federally protected species listed as occurring in Columbus County; the following table summarizes potential habitat and biological conclusions for each. A more detailed description of surveys completed for Cooley's meadowrue (*Thalictrum cooleyi*) follows the table.

Threatened and Endangered Species for Columbus County

Species Federal Status	Habitat	Potential Habitat at Site	Biological Conclusion
American alligator (*Alligator mississippiensis*) Threatened due to Similarity of Appearance	Found in rivers, streams, canals, lakes, swamps, and coastal marshes.	Yes	Not Required*
Red-cockaded woodpecker (*Picoides borealis*) Endangered	Open stands of pine containing trees 60 years or older for nesting and roosting. Cavity excavation occurs in living pine trees.	No	No Effect
Waccamaw silverside (*Menidia extensa*) Threatened	Occur only in Lake Waccamaw and the upper Waccamaw River.	No	No Effect
Wood stork (*Mycteria americana*) Threatened	Freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands.	No	No Effect
Cooley's meadowrue (*Thalictrum cooleyi*) Endangered	Occurs on circumneutral soils in grass-sedge bogs and wet pine savannahs and savannah like areas. It may also grow along fire plow lines, in roadside ditches, woodland clearings, and powerline rights-of-way, and needs some type of disturbance such as fire or mowing to maintain its open habitat.	Yes	No Effect
Rough-leaved loosestrife (*Lysimachia asperulaefolia*) Endangered	Generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil) on moist to seasonally saturated sands and on shallow organic soils overlaying sand.	No	No Effect

*Detailed field surveys of ditched stream channels within the Site completed on July 17, 2018 resulted in no findings or evidence of American alligator within the Site.

Cooley's meadowrue

USFWS Optimal Survey Window: mid-June-early July

Habitat Description: Cooley's meadowrue, documented in the Pine Savanna natural community, occurs in circumneutral soils in sunny, moist to wet grass-sedge bogs, wet-pine savannas over calcareous clays, and savannah-like areas, often at the ecotones of intermittent drainages or non-riverine swamp forests. This rhizomatous perennial herb is also found along plowed firebreaks, roadside ditches and rights-of-way, forest clearings dominated by grass or sedge, and power line or utility rights-of-way. The species requires some type of disturbance (e.g., mowing, clearing, periodic fire) to maintain its open habitat. The plant typically occurs on slightly acidic (pH 5.8-6.6) soils that are loamy fine sand, sandy loam, or fine sandy loam; at least seasonally moist or saturated; and mapped as Foreston, Grifton, Muckalee, Torhunta, or Woodington series.

Biological Conclusion: No Effect. Suitable habitat for Cooley's meadowrue occurs throughout the Site within ditched stream channels. A review of NCNHP records, updated January 17, 2018, indicates no known Cooleys's meadowrue occurrences within 1.0 mile of the study area. Axiom biologists visited a known population of Cooley's meadowrue located approximately 17 miles southeast of the Site off of Highway 130 on July 17, 2018 (Figure 2). Cooley's meadowrue plants were found north of Highway 130 near a large area of open water; plants were found in bloom as well as seeding. Subsequently, systematic surveys were performed in all areas of suitable habitat within the Site on July 17, 2018 and no individuals of this species were identified within the Site; therefore, this project will have no effect on Cooley's meadowrue.

I hope this summary is sufficient for your review. Should you have any questions, please do not hesitate to call (919-215-1693) or email (glewis@axiomenvironmental.org) me.

Sincerely,
AXIOM ENVIRONMENTAL, INC.

W Grant Lewis

W. Grant Lewis
Project Manager

Attachments: Figure 1. Site Location
Figure 2. *Thalictrum Cooleyi* Populations
Figure 3. Existing Conditions & Soils

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-0762
Event Code: 04EN2000-2018-E-01665
Project Name: Shaw's Run

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-0762

Event Code: 04EN2000-2018-E-01665

Project Name: Shaw's Run

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

Project Description: This proposal describes the Shaw’s Run 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 03040203191010, approximately 2 miles west of Chadbourn, NC and south of NC Highway 76 along warm water, unnamed tributaries to Greene Branch (Figures 1 and 2, Appendix A). The Site is not located within a Local Watershed Planning area.
The Site is proposed to include 2200 linear feet of stream restoration and 4.4 acres of reestablished riparian riverine wetlands. Site alterations include the cessation of row crop production, restoration of streams and wetlands, and planting native, woody vegetation within the entire 8.9-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 2200 Stream Mitigation Units and 4.4 Riparian Riverine Wetland Mitigation Units. Site 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/34.31877480435264N78.86668929683658W

Counties: Columbus, NC

Endangered Species Act Species

There is a total of 5 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.

Birds

NAME	STATUS
Red-cockaded Woodpecker *Picoides borealis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7614	Endangered
Wood Stork *Mycteria americana* Population: AL, FL, GA, MS, NC, SC No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8477	Threatened

Reptiles

NAME	STATUS
American Alligator *Alligator mississippiensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/776	Similarity of Appearance (Threatened)

Flowering Plants

NAME	STATUS
Cooley's Meadowrue *Thalictrum cooleyi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3281	Endangered
Rough-leaved Loosestrife *Lysimachia asperulaefolia* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2747	Endangered

Critical habitats

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

Shaws Run
2555 Braswell Road
Chadbourn, NC 28431

Inquiry Number: 5328451.5s
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

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

2555 BRASWELL ROAD
CHADBOURN, NC 28431

COORDINATES

Latitude (North):	34.3197220 - 34° 19' 10.99''
Longitude (West):	78.8665470 - 78° 51' 59.56''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	696299.7
UTM Y (Meters):	3799472.8
Elevation:	98 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5945147 CHADBOURN, NC
Version Date:	2013
West Map:	5944820 CERRO GORDO, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140519
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
2555 BRASWELL ROAD
CHADBOURN, NC 28431

Click on Map ID to see full detail.

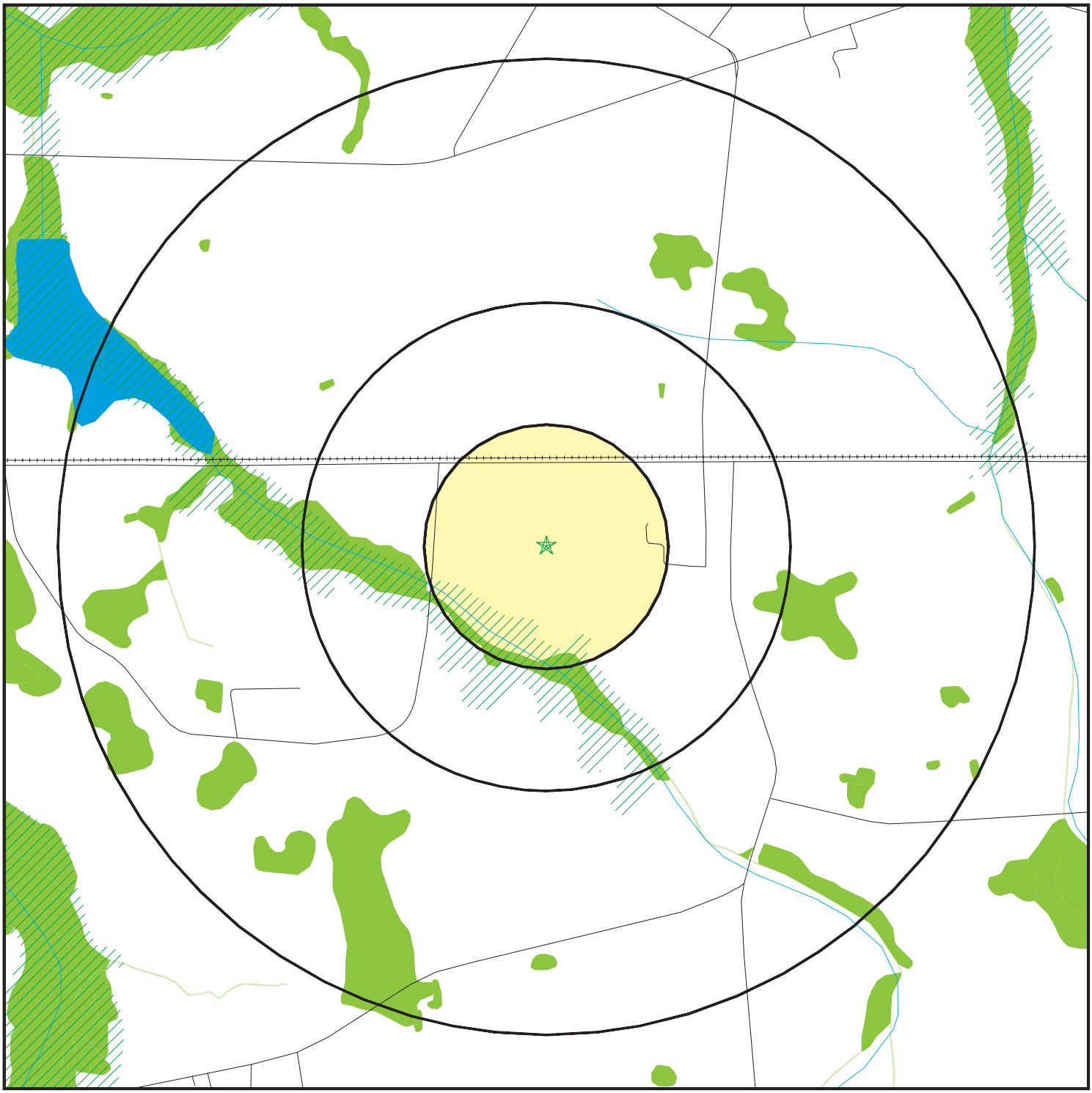
MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION

NO MAPPED SITES FOUND

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 5328451.5S



- 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

0 1/4 1/2 1 Miles

N

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: Shaws Run ADDRESS: 2555 Braswell Road Chadbourn NC 28431 LAT/LONG: 34.319722 / 78.866547	CLIENT: Restoration Systems, LLC CONTACT: JD Hamby INQUIRY #: 5328451.5s DATE: June 11, 2018 4:32 pm

Appendix F
Federally Protected Species Information

Natural Heritage Program Report
Federally Protected Species Assessment Results

North Carolina Department of Natural and Cultural Resources
Natural Heritage Program

Governor Roy Cooper | Secretary Susi H. Hamilton

NCNHDE-5088

January 17, 2018

Phillip Perkinson
Axiom Environmental Inc.
218 Snow Avenue
Raleigh, NC 27612
RE: Shaws Run; 17-001.05

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
Shaws Run
Project No. 17-001.05
January 17, 2018
NCNHDE-5088

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	33739	Somatochlora georgiana	Coppery Emerald	2004-Pre	H?	5-Very Low	---	Significantly Rare	G3G4	S2?
Vascular Plant	5182	Dionaea muscipula	Venus Flytrap	1958-06	X	5-Very Low	Species of Concern	Special Concern Vulnerable	G3	S2
Vascular Plant	16018	Helenium pinnatifidum	Dissected Sneezeweed	1958-06	X	5-Very Low	---	Significantly Rare Peripheral	G4	S2

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

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 January 17, 2018; 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-5088: Shaws Run

January 17, 2018

Project Boundary

Buffered Project Boundary

1:23,317

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

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 17, 2018

John Hamby
Restoration Systems
1101 Haynes St #211
Raleigh, NC 27604

Re: Federally Protected Species Assessment Results **18-014**
Shaw's Run, Columbus County

Dear Mr. Hamby,

Axiom Environmental, Inc. (Axiom) is pleased to provide you with this summary letter for federally protected species surveys completed on the Shaw's Run Stream & Wetland Mitigation Site (hereafter referred to as the "Site"). The Site encompasses 8.9 acres of disturbed forest and agricultural fields along warm water, unnamed tributaries to Greene Branch. The Site is located approximately 2 miles west of Chadbourn, NC and south of NC Highway 76 in Columbus County (Figure 1). Surveys were conducted by two Axiom biologists, Kenan Jernigan and Grant Lewis, on July 17, 2018.

Site Description

The Site is located in the Carolina Flatwoods of the Middle Atlantic Coastal Plain ecoregion of North Carolina. Land use at the Site is characterized by agricultural row crops and disturbed forest. Row crop production extends to, and abuts ditched stream margins (Figure 3). Herbaceous vegetation and a few shrubby species grow within the ditches, which are regularly maintained by bush hogging and herbicide application. As the ditch descends the valley towards Greene Branch, soils change from the Goldsboro and Lynchburg Soil series (moderately well and somewhat poorly drained) to the Muckalee Soil series (poorly drained), and disturbed forest vegetation becomes prevalent along stream margins and floodplains.

Federally Protected Species

Based on the most recent list as updated by the USFWS on June 27, 2018, there are six federally protected species listed as occurring in Columbus County; the following table summarizes potential habitat and biological conclusions for each. A more detailed description of surveys completed for Cooley's meadowrue (*Thalictrum cooleyi*) follows the table.

Threatened and Endangered Species for Columbus County

Species Federal Status	Habitat	Potential Habitat at Site	Biological Conclusion
American alligator (*Alligator mississippiensis*) Threatened due to Similarity of Appearance	Found in rivers, streams, canals, lakes, swamps, and coastal marshes.	Yes	Not Required*
Red-cockaded woodpecker (*Picoides borealis*) Endangered	Open stands of pine containing trees 60 years or older for nesting and roosting. Cavity excavation occurs in living pine trees.	No	No Effect
Waccamaw silverside (*Menidia extensa*) Threatened	Occur only in Lake Waccamaw and the upper Waccamaw River.	No	No Effect
Wood stork (*Mycteria americana*) Threatened	Freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands.	No	No Effect
Cooley's meadowrue (*Thalictrum cooleyi*) Endangered	Occurs on circumneutral soils in grass-sedge bogs and wet pine savannahs and savannah like areas. It may also grow along fire plow lines, in roadside ditches, woodland clearings, and powerline rights-of-way, and needs some type of disturbance such as fire or mowing to maintain its open habitat.	Yes	No Effect
Rough-leaved loosestrife (*Lysimachia asperulaefolia*) Endangered	Generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil) on moist to seasonally saturated sands and on shallow organic soils overlaying sand.	No	No Effect

*Detailed field surveys of ditched stream channels within the Site completed on July 17, 2018 resulted in no findings or evidence of American alligator within the Site.

Cooley's meadowrue

USFWS Optimal Survey Window: mid-June-early July

Habitat Description: Cooley's meadowrue, documented in the Pine Savanna natural community, occurs in circumneutral soils in sunny, moist to wet grass-sedge bogs, wet-pine savannas over calcareous clays, and savannah-like areas, often at the ecotones of intermittent drainages or non-riverine swamp forests. This rhizomatous perennial herb is also found along plowed firebreaks, roadside ditches and rights-of-way, forest clearings dominated by grass or sedge, and power line or utility rights-of-way. The species requires some type of disturbance (e.g., mowing, clearing, periodic fire) to maintain its open habitat. The plant typically occurs on slightly acidic (pH 5.8-6.6) soils that are loamy fine sand, sandy loam, or fine sandy loam; at least seasonally moist or saturated; and mapped as Foreston, Grifton, Muckalee, Torhunta, or Woodington series.

Biological Conclusion: No Effect. Suitable habitat for Cooley's meadowrue occurs throughout the Site within ditched stream channels. A review of NCNHP records, updated January 17, 2018, indicates no known Cooleys's meadowrue occurrences within 1.0 mile of the study area. Axiom biologists visited a known population of Cooley's meadowrue located approximately 17 miles southeast of the Site off of Highway 130 on July 17, 2018 (Figure 2). Cooley's meadowrue plants were found north of Highway 130 near a large area of open water; plants were found in bloom as well as seeding. Subsequently, systematic surveys were performed in all areas of suitable habitat within the Site on July 17, 2018 and no individuals of this species were identified within the Site; therefore, this project will have no effect on Cooley's meadowrue.

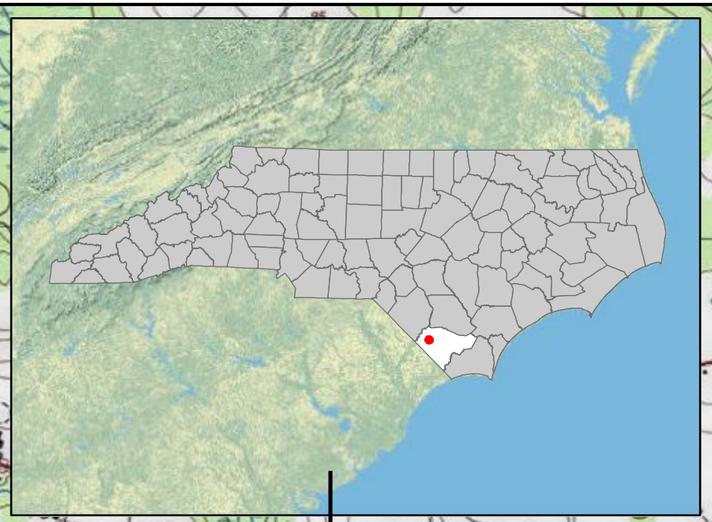
I hope this summary is sufficient for your review. Should you have any questions, please do not hesitate to call (919-215-1693) or email (glewis@axiomenvironmental.org) me.

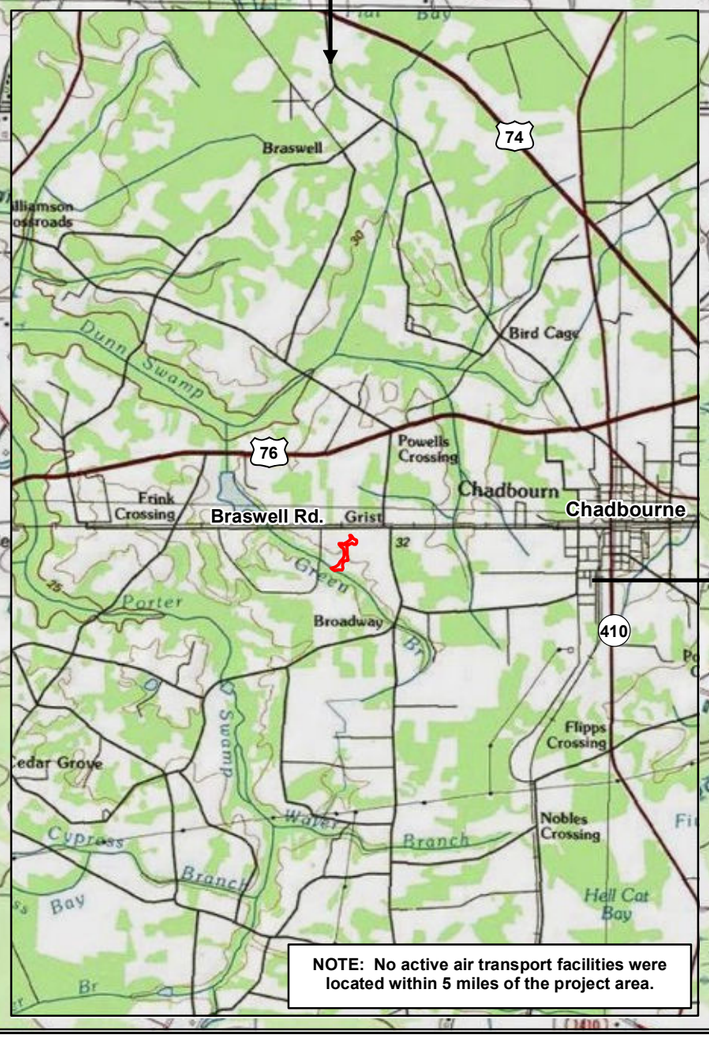
Sincerely,
AXIOM ENVIRONMENTAL, INC.

W Grant Lewis

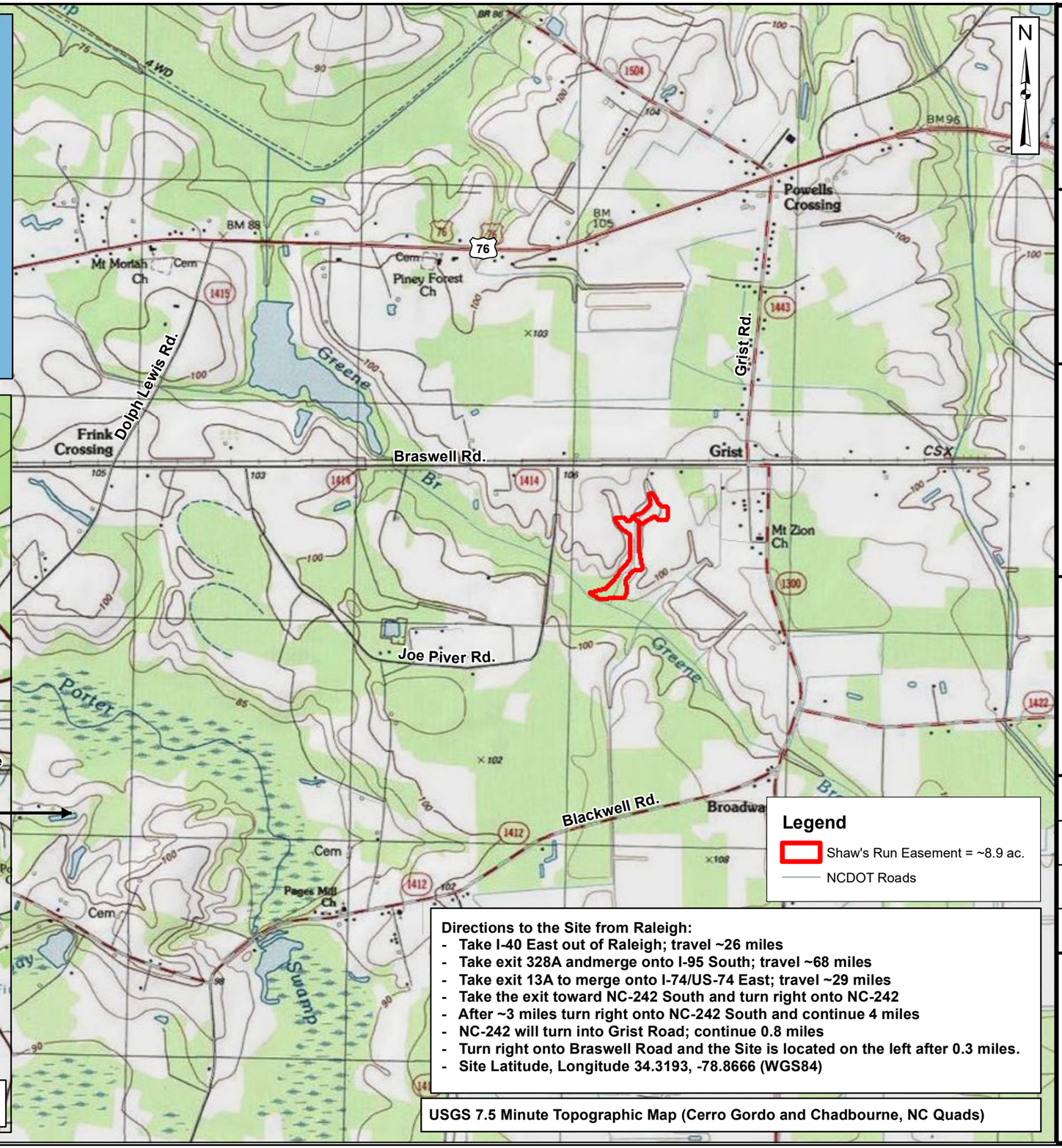
W. Grant Lewis
Project Manager

Attachments: Figure 1. Site Location
Figure 2. *Thalictrum Cooleyi* Populations
Figure 3. Existing Conditions & Soils





NOTE: No active air transport facilities were located within 5 miles of the project area.



Legend

- Shaw's Run Easement = ~8.9 ac.
- NCDOT Roads

Directions to the Site from Raleigh:

- Take I-40 East out of Raleigh; travel ~26 miles
- Take exit 328A andmerge onto I-95 South; travel ~68 miles
- Take exit 13A to merge onto I-74/US-74 East; travel ~29 miles
- Take the exit toward NC-242 South and turn right onto NC-242
- After ~3 miles turn right onto NC-242 South and continue 4 miles
- NC-242 will turn into Grist Road; continue 0.8 miles
- Turn right onto Braswell Road and the Site is located on the left after 0.3 miles.
- Site Latitude, Longitude 34.3193, -78.8666 (WGS84)

USGS 7.5 Minute Topographic Map (Cerro Gordo and Chadbourne, NC Quads)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

SITE LOCATION

Drawn by: CLF/KRJ

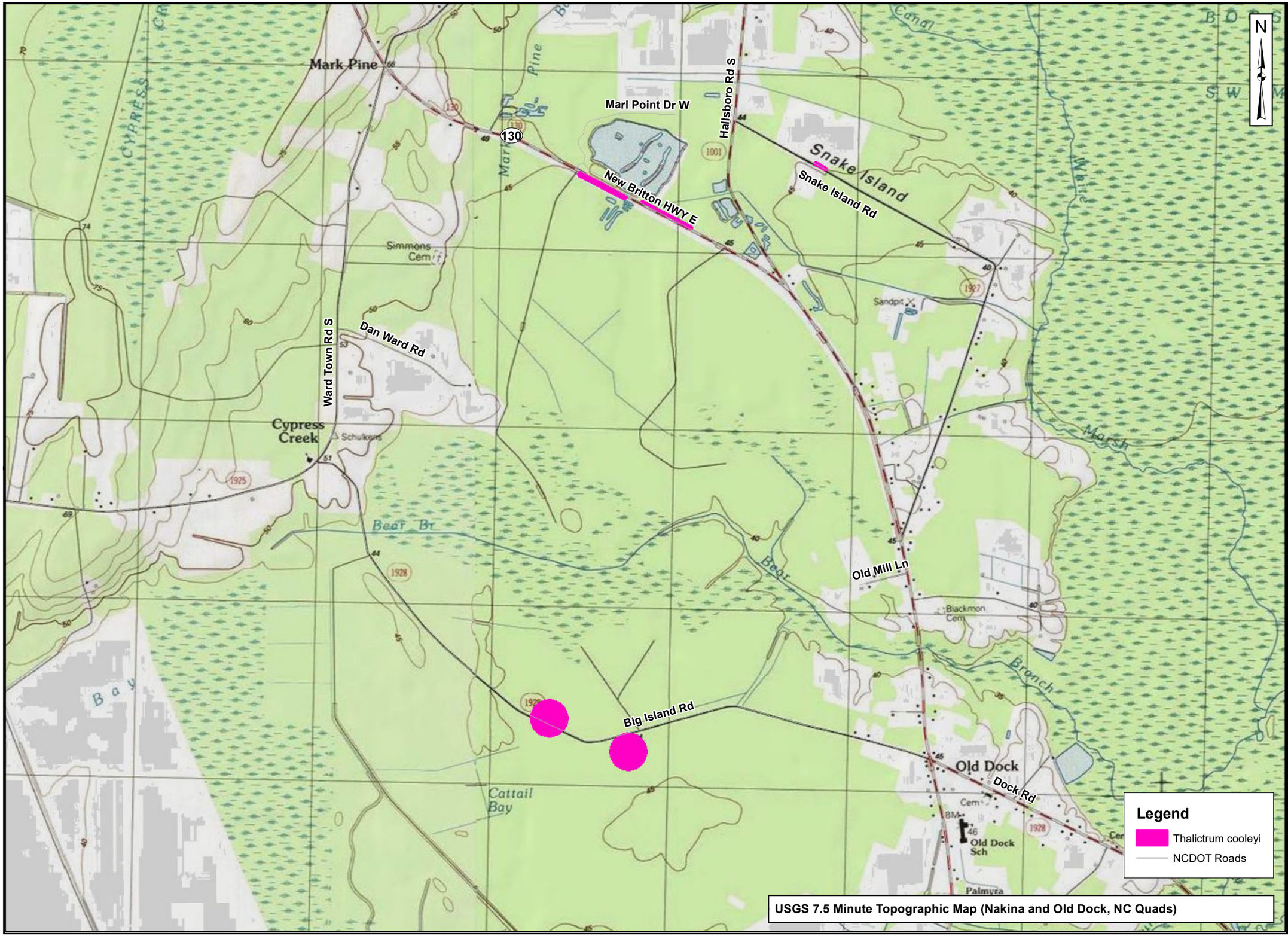
Date: July 2018

Scale: 1:20,000

Project No.: 18-014

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

THALICTRUM COOLEYI POPULATIONS

Drawn by: CLF

Date: July 2018

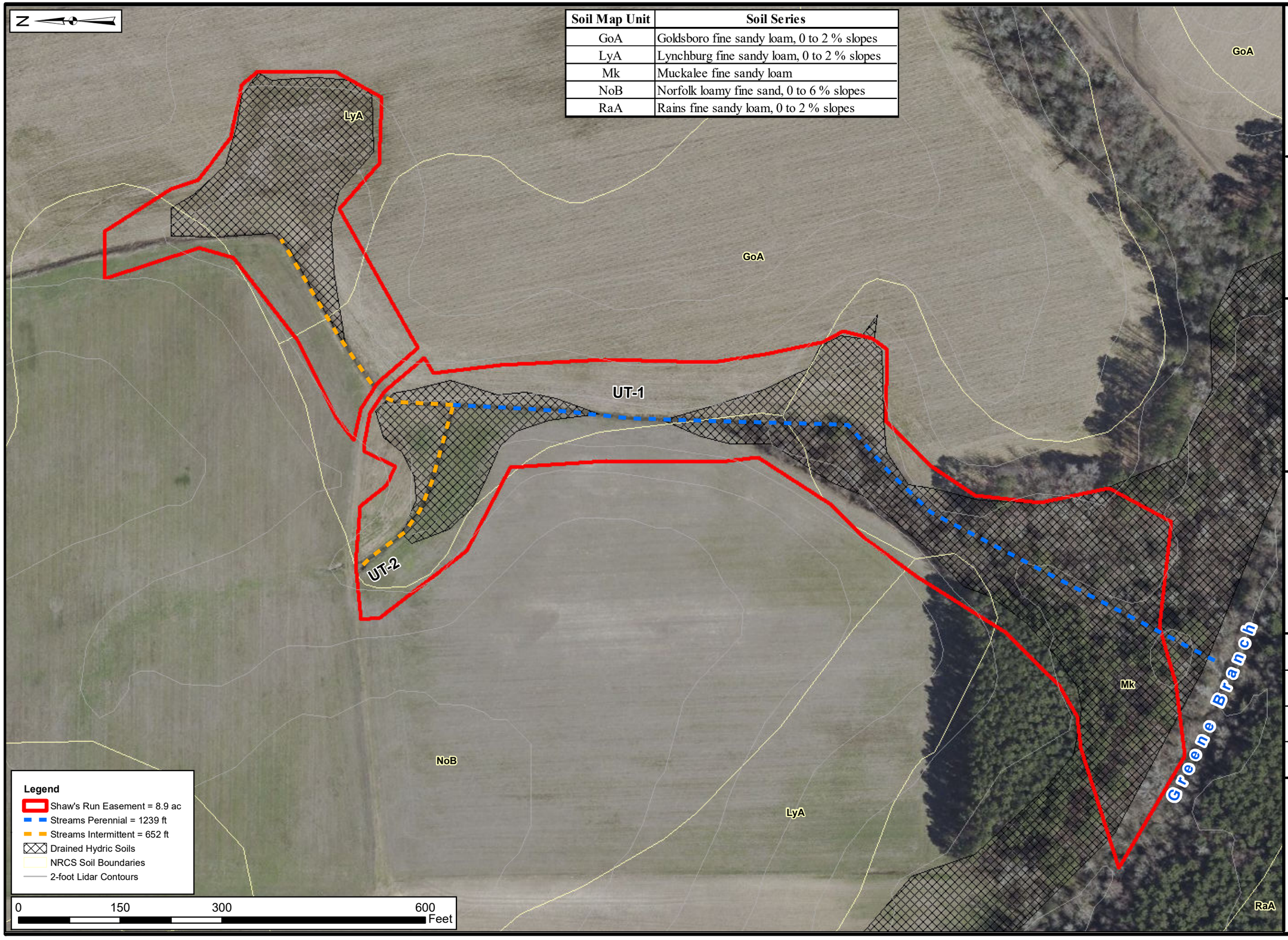
Scale: 1:20,000

Project No.: 18-014

FIGURE

2

Soil Map Unit	Soil Series
GoA	Goldsboro fine sandy loam, 0 to 2 % slopes
LyA	Lynchburg fine sandy loam, 0 to 2 % slopes
Mk	Muckalee fine sandy loam
NoB	Norfolk loamy fine sand, 0 to 6 % slopes
RaA	Rains fine sandy loam, 0 to 2 % slopes



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ/CLF

Date: July 2018

Scale: 1:1600

Project No.: 18-014

FIGURE

3

Appendix G
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 H
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 I
Credit Release Schedule

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 and completion following criteria:

1) Approval of the final Mitigation Plan
2) The mitigation site must be secured
3) Delivery of the financial assurances described in the Mitigation Plan
4) Recordation of the long-term protection mechanism and title opinion acceptable to the USACE
5) Issuance of the 404 permit verification for construction of the site, if required.

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 (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. 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 ILF sites in North Carolina:

Credit Release Schedule and Milestones for Wetlands				
Credit Release Milestone	**Release Activity**		**ILF/NCDMS**	
			Interim Release	**Total Released**
1	Site Establishment (includes all required criteria stated above)		0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan		30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met		10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met		10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met		15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met		5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met		15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met		5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met		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**		**ILF/NCDMS**	
			Interim Release	**Total Released**
1	Site Establishment (includes all required criteria stated above)		0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan		30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met		10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met		10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met		10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met		5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met		10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met		5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable, performance standards have been met		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 J
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 K
Site Photographs


2019/11/19


2019/11/19

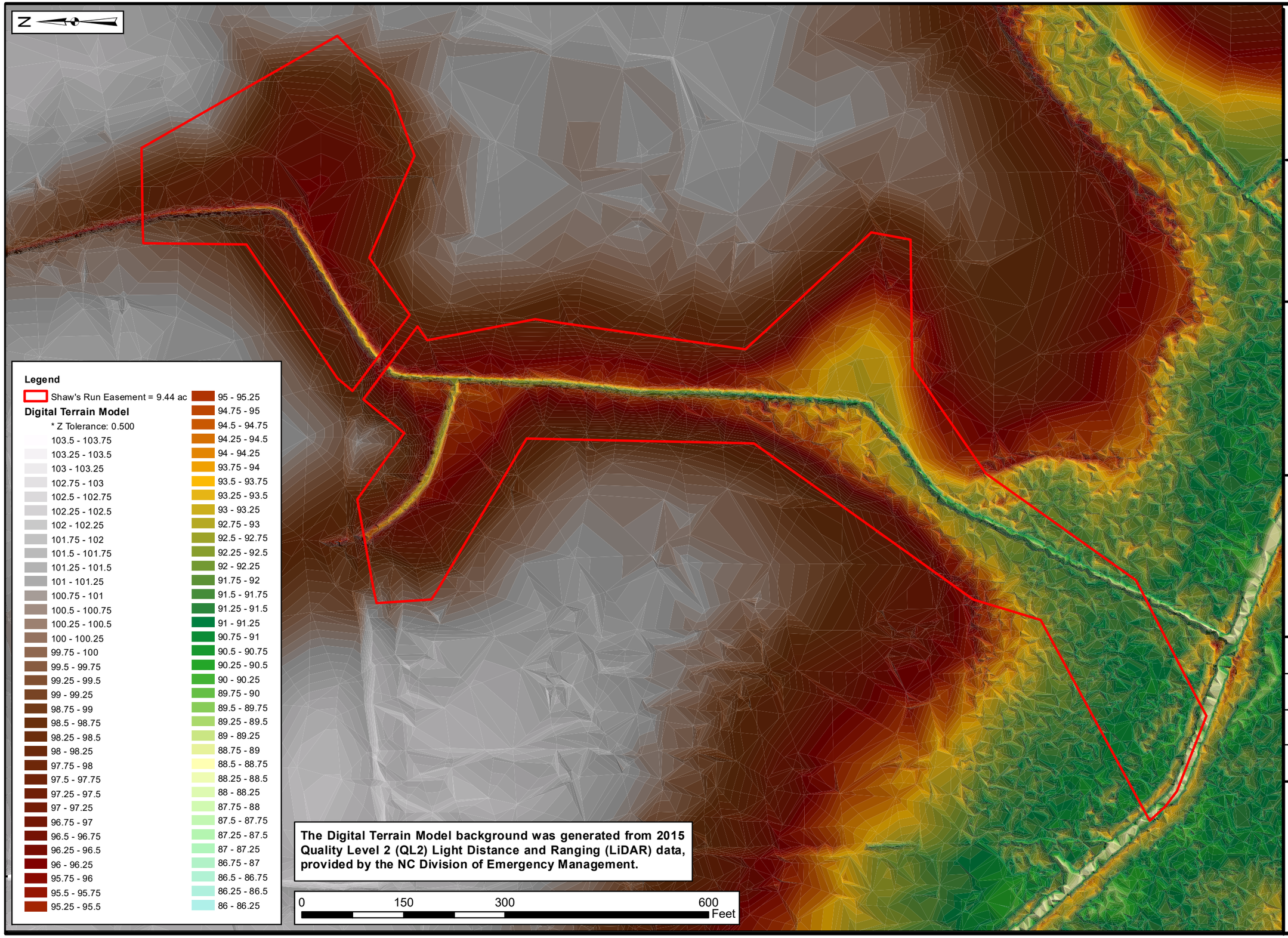

2019/11/19


2019/11/19


2019/11/19


2019/11/19

Appendix L
LiDAR Map



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

SHAW'S RUN STREAM AND WETLAND MITIGATION SITE

Columbus County, NC

Title:

LiDAR Mapping

Drawn by: SGD

Date: NOV 2019

Scale: 1:1600

Project No.: 18-014

APPENDIX

L

Appendix K
Construction Plans

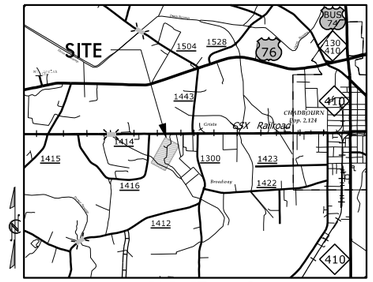
09/08/69

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES

CONSTRUCTION PLANS
SHAWS RUN CREEK SITE

LOCATION: COLUMBUS COUNTY, NORTH CAROLINA

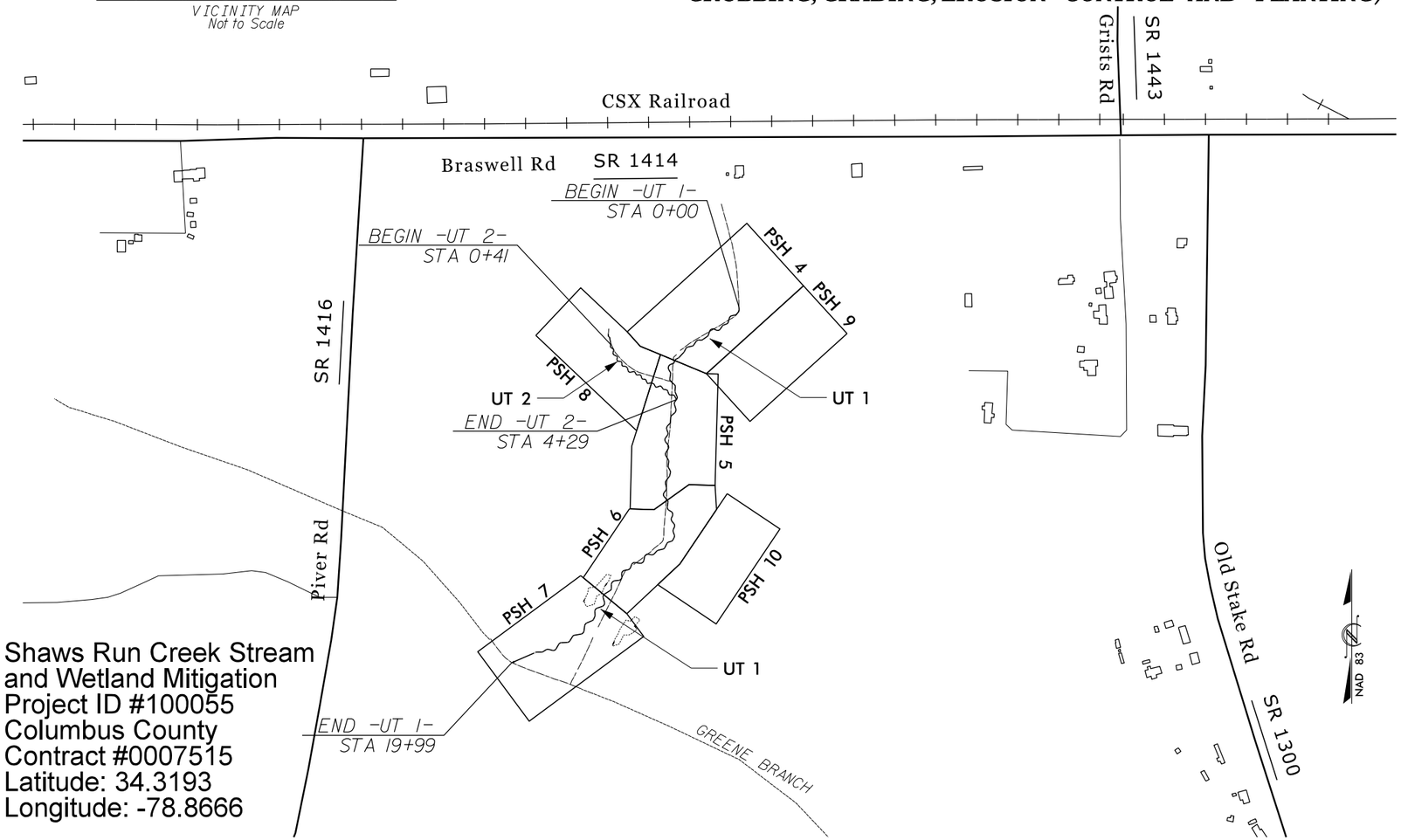
TYPE OF WORK: STREAM RESTORATION AND ENHANCEMENT (CLEARING, GRUBBING, GRADING, EROSION CONTROL AND PLANTING)



VICINITY MAP
Not to Scale

INDEX OF SHEETS

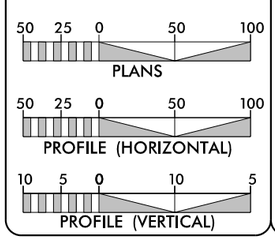
SHEET NUMBER	SHEET
01	Title Sheet
01A	Symbology
02	Typicals
02A THRU 02D	Details
03	Control Points and Location Map
03A	Easement
04 THRU 10	Plan and Profile Sheets
E-03 THRU E-03D	Erosion Control Details
E-03E	Haul Road Locations
E-04 THRU E-10	Erosion Control Plan Sheets



Shaws Run Creek Stream
and Wetland Mitigation
Project ID #100055
Columbus County
Contract #0007515
Latitude: 34.3193
Longitude: -78.8666

CONTRACT: SHAWS RUN CREEK SITE

GRAPHIC SCALES



PROPOSED LENGTH OF -UT 1- = 1999 LF		PROPOSED LENGTH OF -UT 2 -= 388 LF	
TOTAL STREAM LENGTH = 2428 LF			
RESTORATION LEVEL	STREAM (linear footage)	RIPARIAN WETLAND (acreage)	NONRIPARIAN WETLAND (acreage)
RESTORATION	2367	5.850	0.000
ENHANCEMENT	0	0.000	0.000
PRESERVATION	0	0.100	0.000
TOTALS	2367	5.950	0.000
MITIGATION UNITS	2367 SMUs	5.860 RIPARIAN WMUs	NONRIPARIAN WMUs

Axiom Environmental, Inc.
Axiom Environmental
218 Snow Ave
Raleigh, NC 27603
GRANT LEWIS
PROJECT DESIGNER

RESTORATION SYSTEMS | LLC
Restoration Systems
1101 Haynes St.
Suite 211
Raleigh, NC 27604
WORTH CREECH
SITE CONSTRUCTION MANAGER

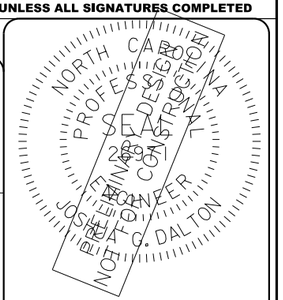
Prepared in the Office of:
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

JOSHUA G. DALTON, P.E.
PROJECT ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



DATE:

11/26/2019
ShawsRun_Hyd_PSH_01.dgn
jharvey

CONVENTIONAL PLAN SHEET SYMBOLS

Note: Not to Scale **S.U.E. = Subsurface Utility Engineering*

SHEET NAME	SHEET NUMBER
SYMBOLOGY	1A

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE
COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin — EIP
- Computed Property Corner
- Property Monument — ECM
- Parcel/Sequence Number — 123
- Existing Fence Line
- Proposed Fence
- Proposed Fence Gate
- Proposed Barbed Wire Fence
- Existing Wetland Boundary — WLB
- Proposed Wetland Boundary — WLB
- Existing Endangered Animal Boundary — EAB
- Existing Endangered Plant Boundary — EPB
- Existing Historic Property Boundary — HPB

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign — S
- Well — W
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream — JS
- Buffer Zone 1 — BZ 1
- Buffer Zone 2 — BZ 2
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch — FLOW

RIGHT OF WAY & PROJECT CONTROL:

- Secondary Horiz and Vert Control Point
- Primary Horiz Control Point
- Primary Horiz and Vert Control Point

- Exist Permanent Easment Pin and Cap
- New Permanent Easement Pin and Cap
- Vertical Benchmark
- Existing Right of Way Marker
- Existing Right of Way Line
- New Right of Way Line — RW
- New Right of Way Line with Pin and Cap — RW
- New Right of Way Line with Concrete or Granite R/W Marker — RW
- New Control of Access Line with Concrete C/A Marker — CA
- Existing Control of Access — CA
- New Control of Access — CA
- Existing Easement Line — E
- New Conservation Easement — E
- New Temporary Drainage Easement — TDE
- New Permanent Drainage Easement — PDE
- New Permanent Drainage / Utility Easement — DUE
- New Permanent Utility Easement — PUE
- New Temporary Utility Easement — TUE
- New Aerial Utility Easement — AUE

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut — C
- Proposed Slope Stakes Fill — F
- Proposed Curb Ramp — CR
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard — Vineyard

EXISTING STRUCTURES:

MAJOR:

- Bridge, Tunnel or Box Culvert — CONC
- Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR:

- Head and End Wall — CONC HW

- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB — CB
- Paved Ditch Gutter
- Storm Sewer Manhole — S
- Storm Sewer — S

UTILITIES:

POWER:

- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole — P
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole
- H-Frame Pole
- U/G Power Line LOS B (S.U.E.*) — P
- U/G Power Line LOS C (S.U.E.*) — P
- U/G Power Line LOS D (S.U.E.*) — P

TELEPHONE:

- Existing Telephone Pole

WATER:

- Water Manhole — W
- Water Meter
- Water Valve
- Water Hydrant
- U/G Water Line LOS B (S.U.E*) — W
- U/G Water Line LOS C (S.U.E*) — W
- U/G Water Line LOS D (S.U.E*) — W
- Above Ground Water Line — A/G Water

GAS:

- Gas Valve
- Gas Meter
- U/G Gas Line LOS B (S.U.E.*) — G
- U/G Gas Line LOS C (S.U.E.*) — G
- U/G Gas Line LOS D (S.U.E.*) — G
- Above Ground Gas Line — A/G Gas

SANITARY SEWER:

- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer

- SS Forced Main Line LOS B (S.U.E.*) — FSS
- SS Forced Main Line LOS C (S.U.E.*) — FSS
- SS Forced Main Line LOS D (S.U.E.*) — FSS

MISCELLANEOUS:

- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box — S
- Utility Unknown U/G Line LOS B (S.U.E.*) — UTL
- U/G Tank; Water, Gas, Oil
- Underground Storage Tank, Approx. Loc. — UST
- A/G Tank; Water, Gas, Oil
- Geoenvironmental Boring
- U/G Test Hole LOS A (S.U.E.*)
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

- Riffle Rip Rap
- Wetted Perimeter
- Log Vane
- Log Cross Vane
- Step Pool Structure — Begin / End
- Stream Plug
- Floodplain Interceptor
- Limits of Disturbance — LOD

SHEET NAME	SHEET NUMBER
TYPICALS	2

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

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905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
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ENG FIRM LICENSE NO. C-890

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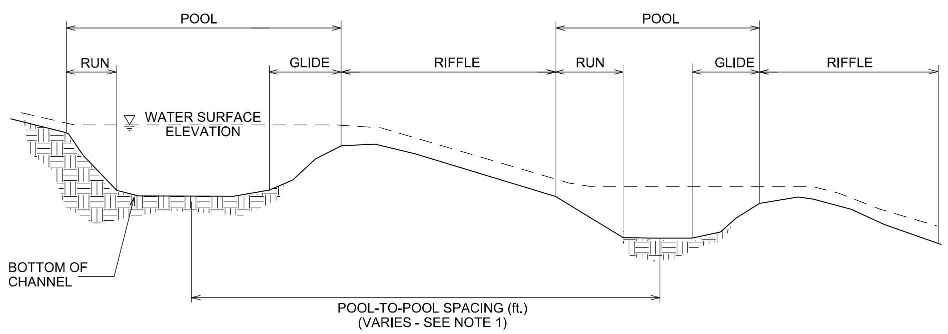
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON

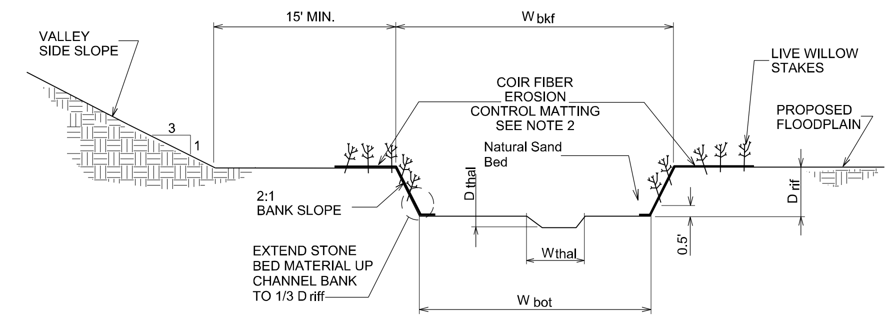
DATE:



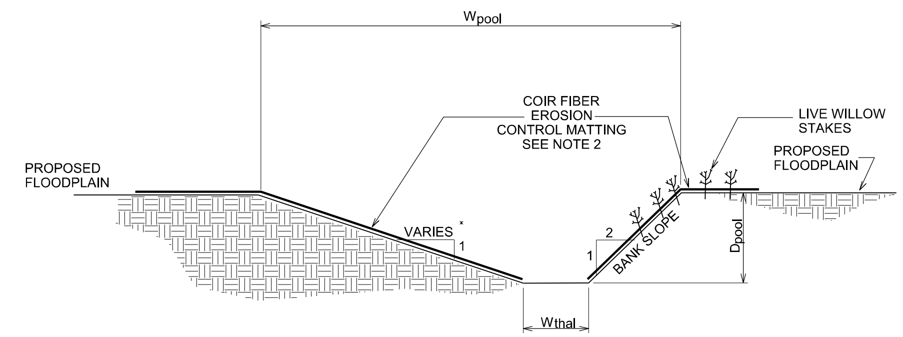
TYPICAL CHANNEL PROFILE

NOTES:

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

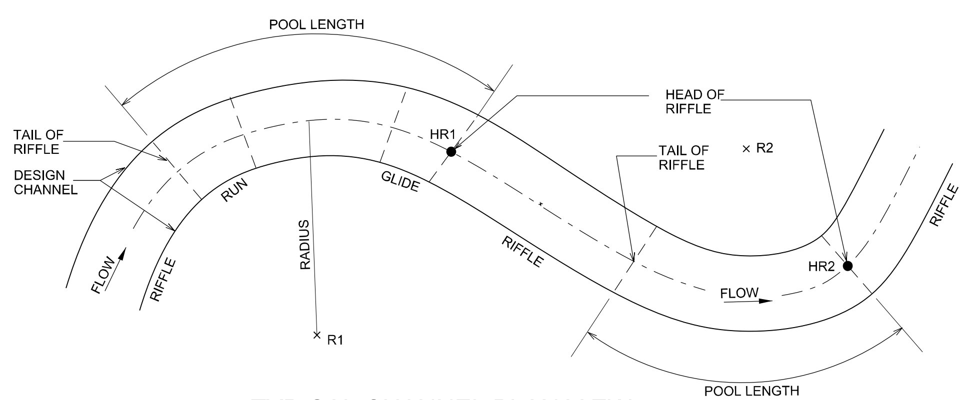


TYPICAL RIFFLE CROSS-SECTION



* MAX. 1:1 SLOPE

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 AND PLACED TO THE TOP OF BANK. (SEE DETAIL COIR FIBER MATTING, SHEET E-3D).

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.)
UT 1	6.6	3.8	0.6	0.1	0.9	7.2	1.8
UT 2	3.9	2.3	0.3	0.1	0.5	4.3	1.3

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SHEET NAME	SHEET NUMBER
DETAILS	2A

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE
COUNTY: COLUMBUS DATE: 2019

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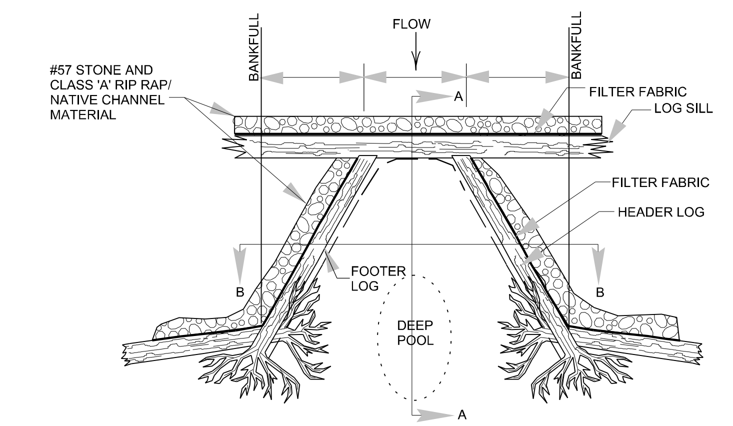
NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

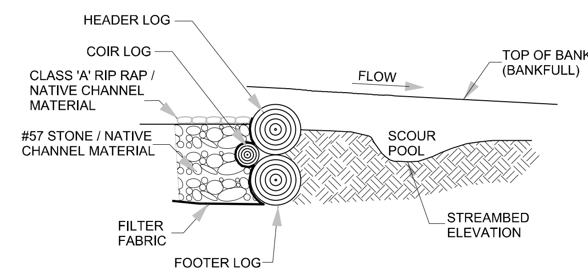
LOG CROSS VANE

SCALE:NTS

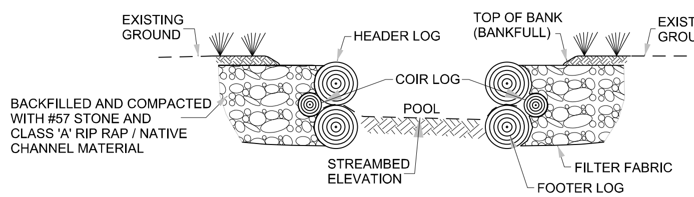
PLAN VIEW



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.



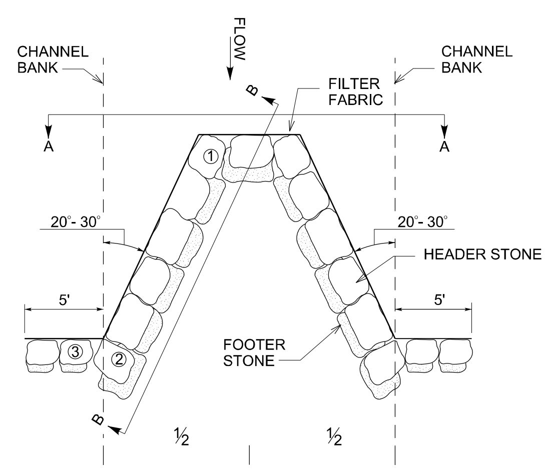
SECTION A-A



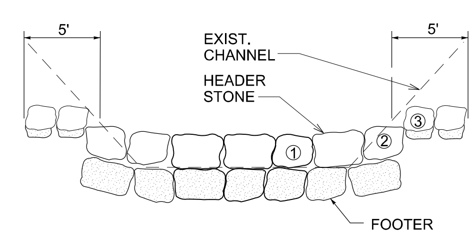
SECTION B-B

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 1	7	0.6-.08
UT 2	4	0.3-.05

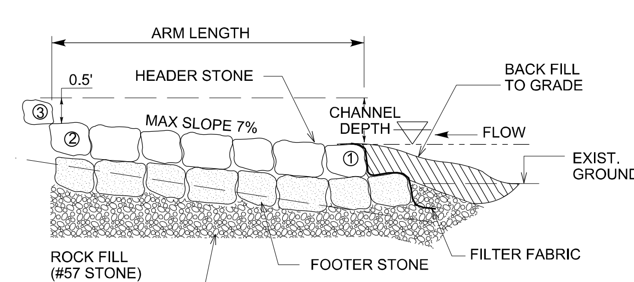
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW

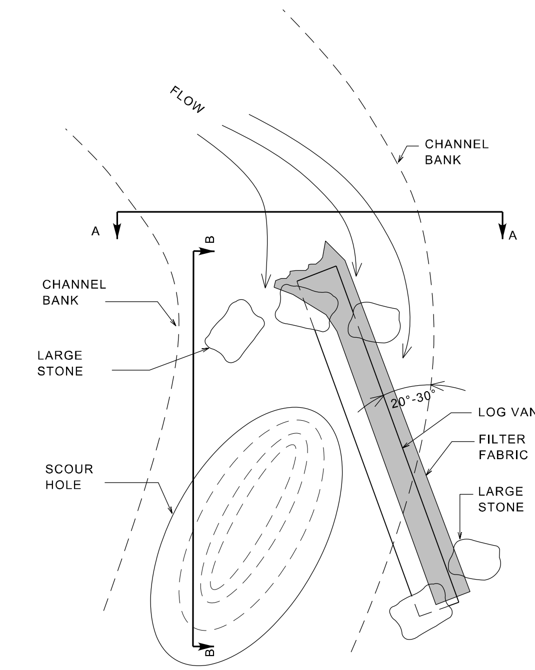


ELEVATION A-A



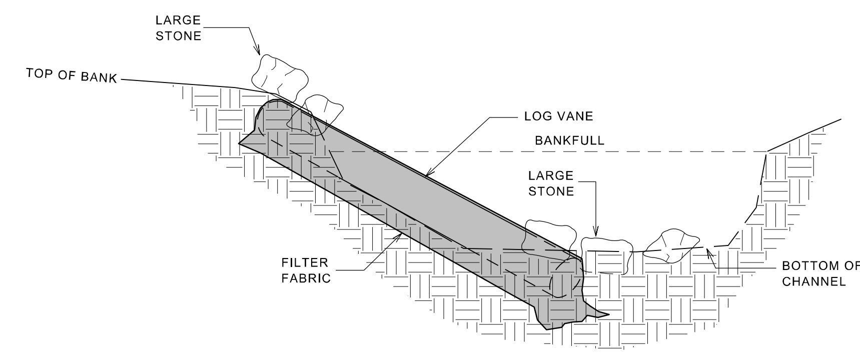
PROFILE B-B

TYPICAL CROSS-VANE

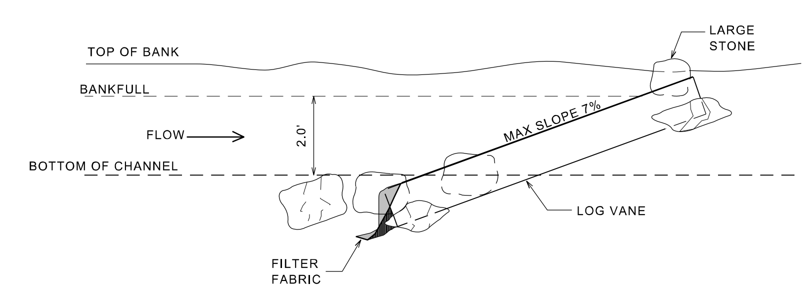


NOTE:
FILTER FABRIC TOED IN AND DRAPED ON UPSTREAM SIDE OF LOG VANE PRIOR TO BACKFILL.

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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SHEET NAME		SHEET NUMBER
DETAILS		2B
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE		
	COUNTY: COLUMBUS	DATE: 2019

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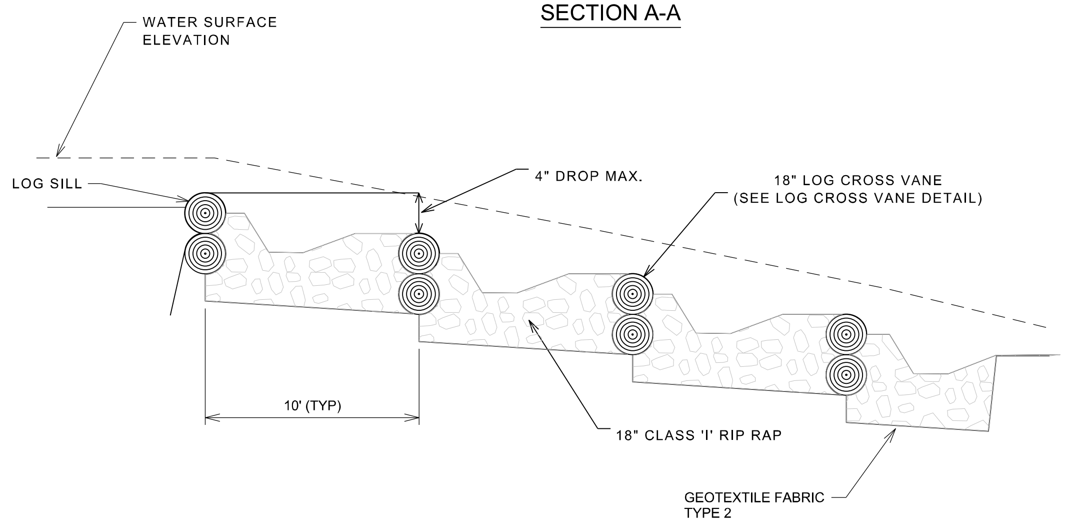
NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

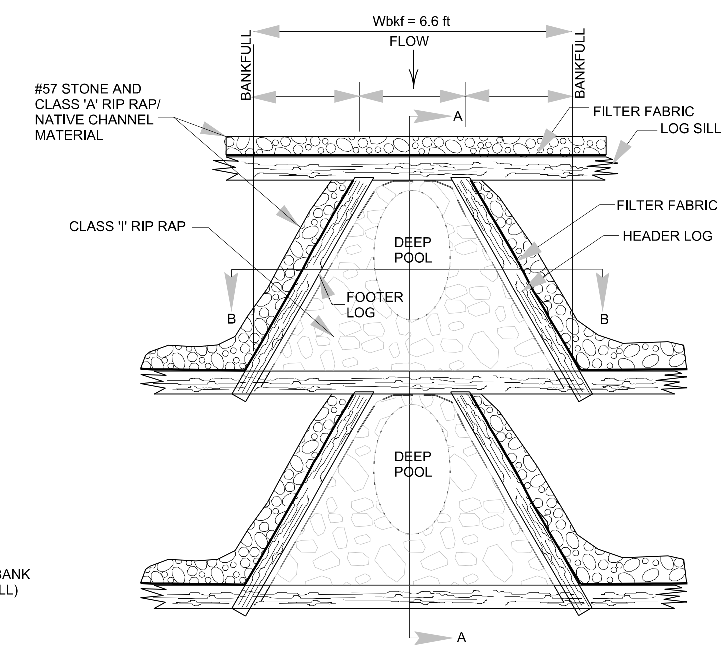
DATE:

STEP POOL STRUCTURE -UT1-

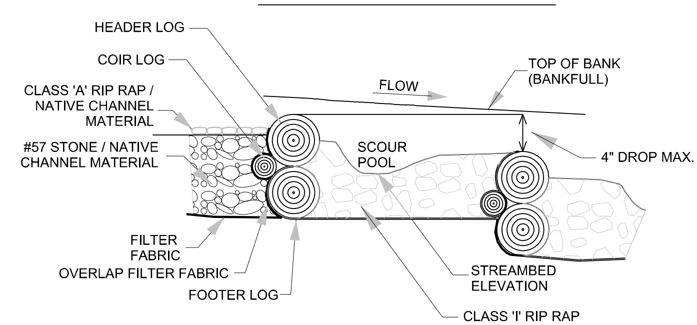
SECTION A-A



PLAN VIEW

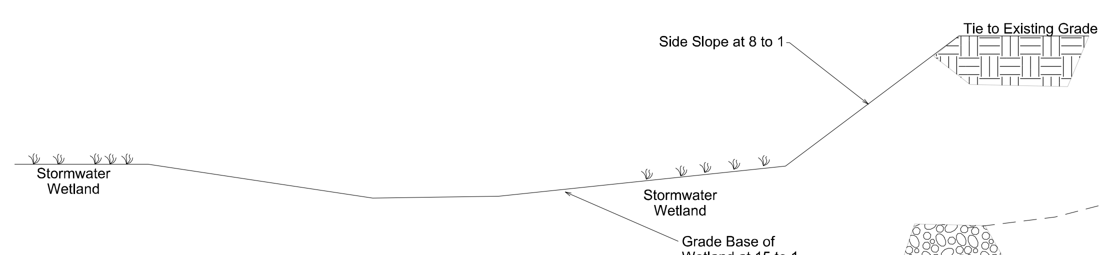


STEP POOL ENLARGEMENT



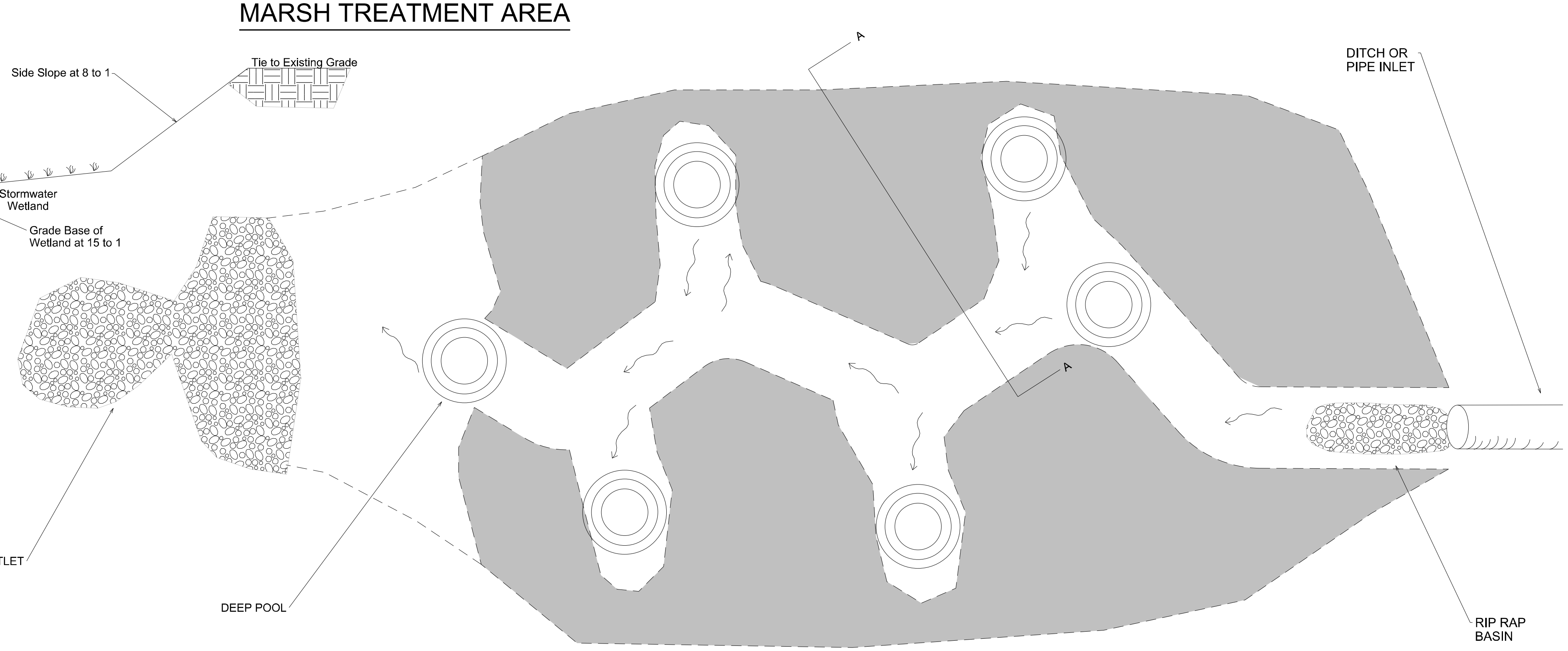
STRUCTURE NOTES:
1. FILL CLASS '1' RIP RAP VOIDS WITH CLASS 'A' RIP RAP/ #57 STONE/ NATIVE CHANNEL MATERIAL MIXTURE.

MARSH TREATMENT AREA



PROFILE

SECTION A-A



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SHEET NAME		SHEET NUMBER
DETAILS		2C
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE		
	COUNTY: COLUMBUS	DATE: 2019

Axiom Environmental, Inc.

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905 JONES FRANKLIN ROAD
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TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

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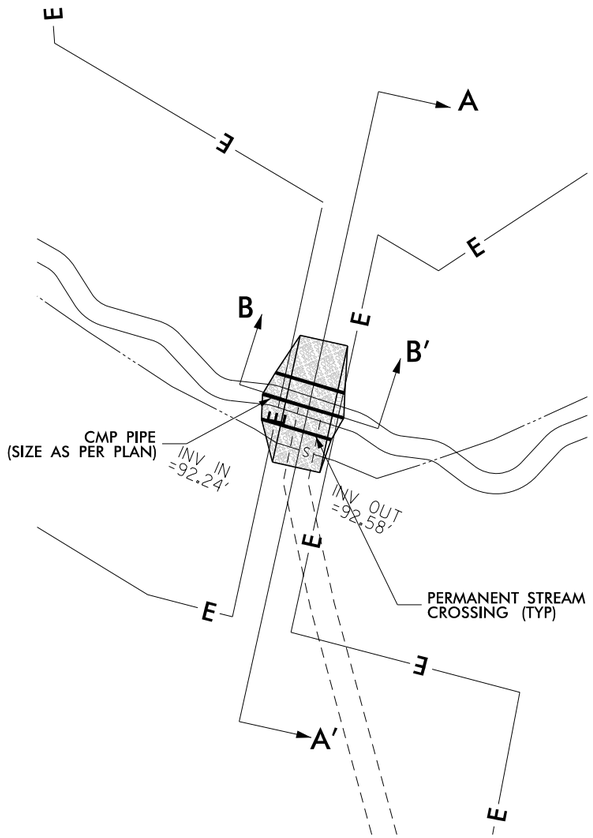
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29601 JOSEPH C. DALTON

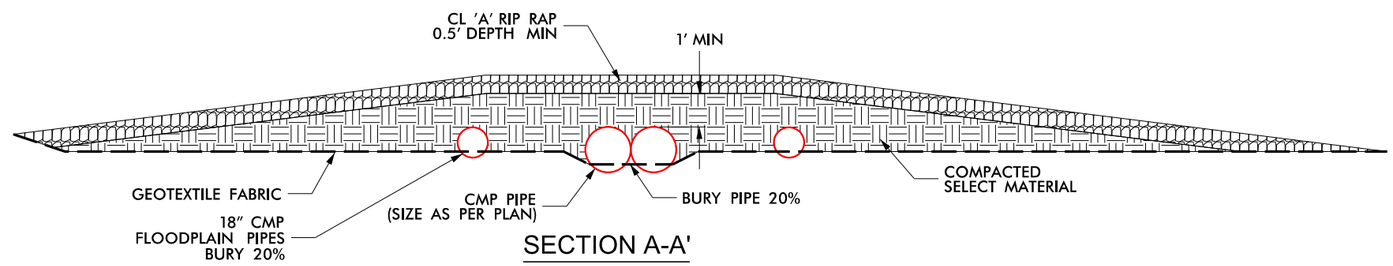
DATE:



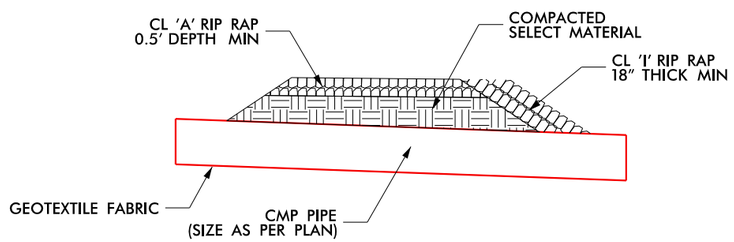
PERMANENT CROSSING

SCALE: N.T.S.

NOTES:
1) INSTALL PERMANENT CROSSING WHILE CONSTRUCTION LOCATION WITHIN STREAM HAS BEEN DEWATERED.
2) IF UNABLE TO INSTALL WHILE LOCATION IS DRY, PLACE MATTING ON EXPOSED SOILS.
3) INSTALL 18" CMP FLOODPLAIN PIPES IN FLOODPLAIN AS INDICATED ON PLANS.



SECTION A-A'



SECTION B-B'

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SHEET NAME	SHEET NUMBER
DETAILS	2D
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE	
COUNTY: COLUMBUS	DATE: 2019

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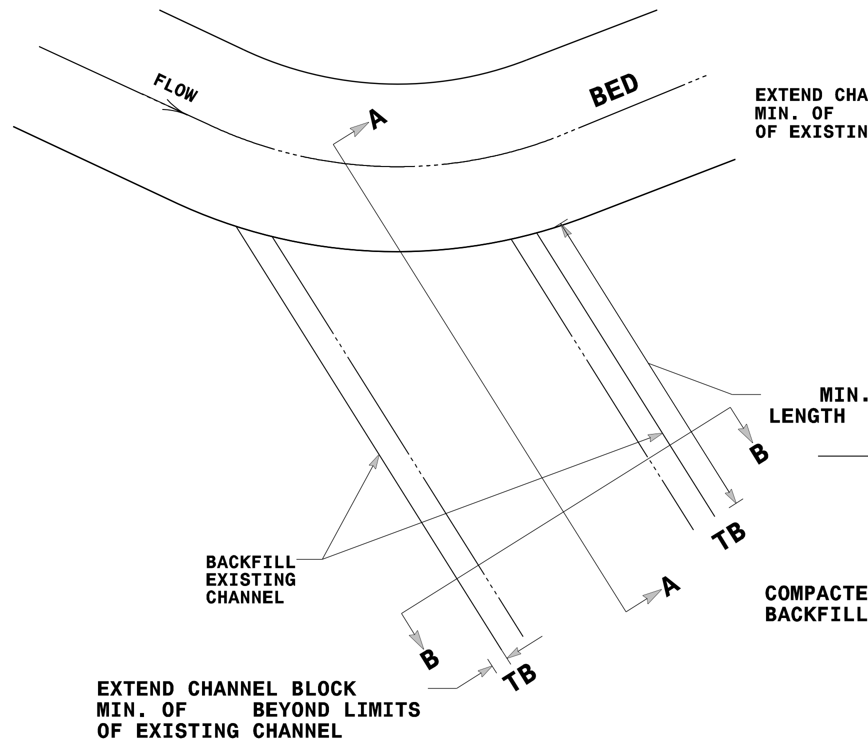
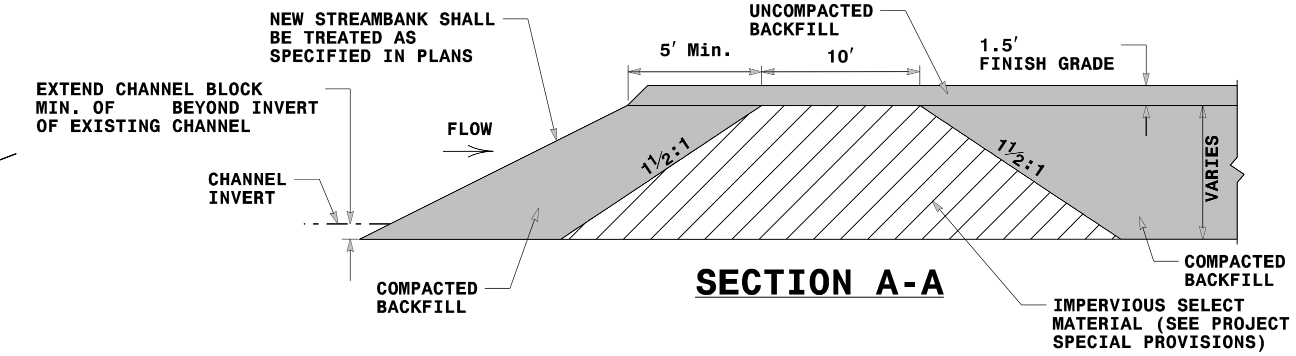
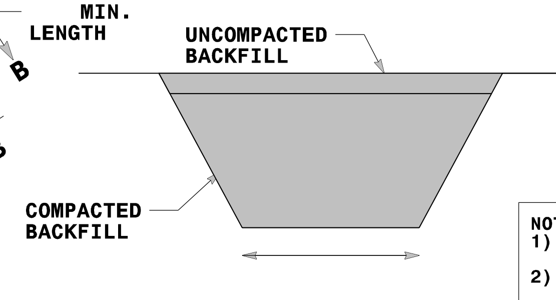


PLAN VIEW



SECTION A-A

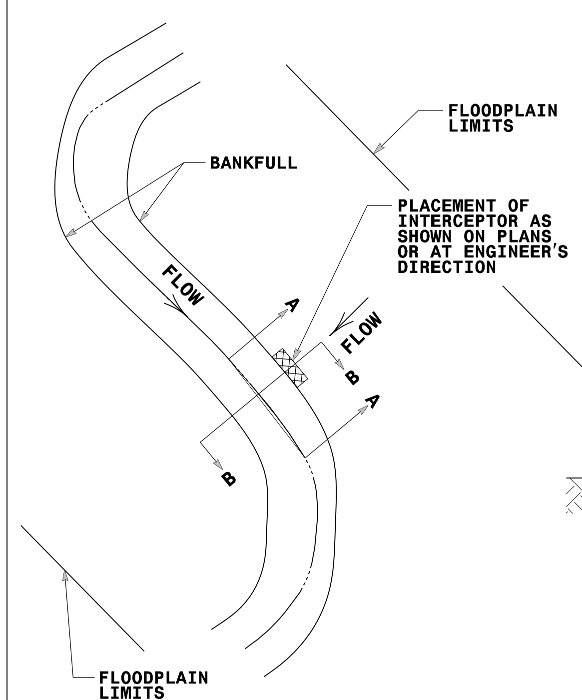


SECTION B-B

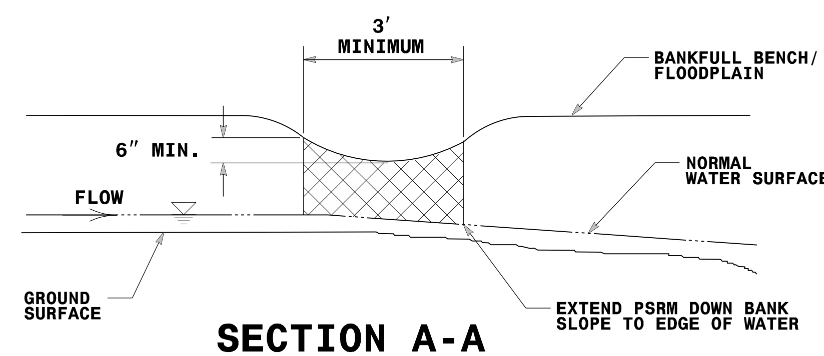
STREAM PLUG

NOT TO SCALE

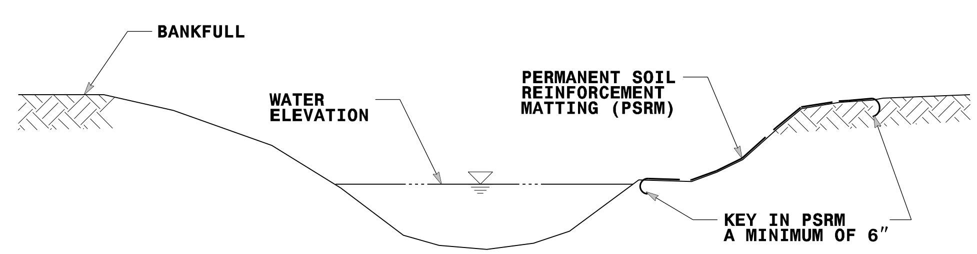
NOTES:
1) CHANNEL BLOCK SHALL BE INSTALLED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2) BLOCK SHOULD BE INSTALLED AT THE INTERFACE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL.
3) BOTTOM OF BLOCK SHOULD BE A MINIMUM OF BELOW THE INVERT OF THE EXISTING CHANNEL.
4) BLOCK SHOULD EXTEND A MINIMUM OF BEYOND THE LIMITS OF THE EXISTING STREAM CHANNEL.
5) INSTALL EROSION CONTROL MATTING AND SEED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS IMMEDIATELY AFTER GRADING.
6) COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.



PLAN VIEW



SECTION A-A



SECTION B-B

FLOODPLAIN INTERCEPTOR DETAIL

NOT TO SCALE

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SHEET NAME		SHEET NUMBER
CONTROL POINTS		3
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE		
	COUNTY: COLUMBUS	DATE: 2019

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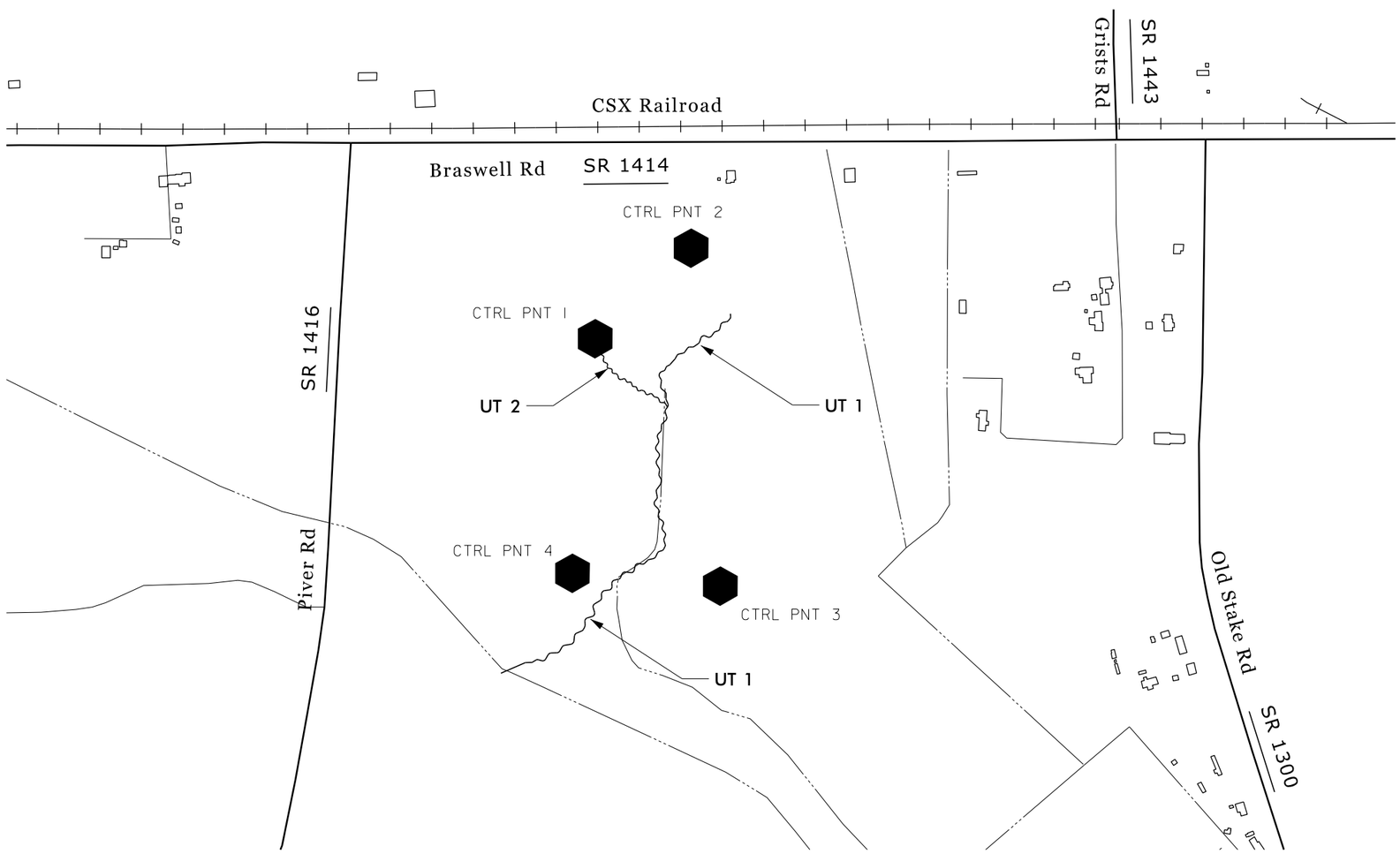
SURVEY INFORMATION PROPERTY/ EASEMENT PROVIDED BY:
K2 DESIGN GROUP, P.A.
5688 U.S. HIGHWAY 70 EAST
GOLDSBORO, NC 27534

500' 250' 0 500' 1000'
SCALE: 1" = 500'



Shaws Run Control Points				
Pt ##	Northing	Easting	Elevation	Type
CP 1	207558.510	2040054.717	98.46	ISS CAP
CP 2	207896.964	2040413.350	101.13	ISS CAP
CP 3	206633.718	2040522.169	99.04	ISS CAP
CP 4	206681.763	2039969.629	96.61	ISS CAP

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SHEET NAME		SHEET NUMBER
EASEMENT		3A
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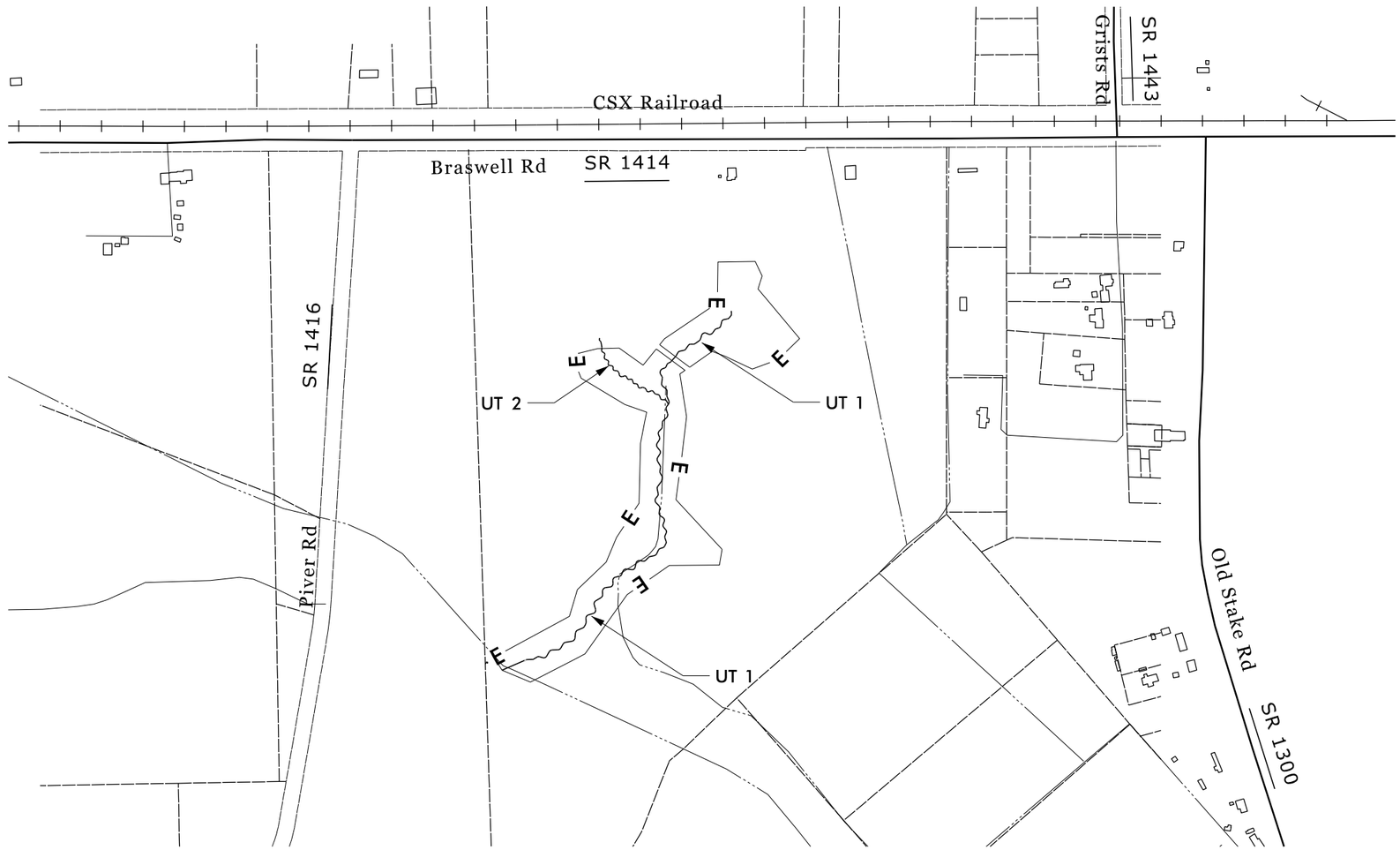
5688 U.S. HIGHWAY 70 EAST
GOLDSBORO, NC 27534

500′ 250′ 0 500′ 1000′
SCALE: 1″ = 500′



SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	4

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

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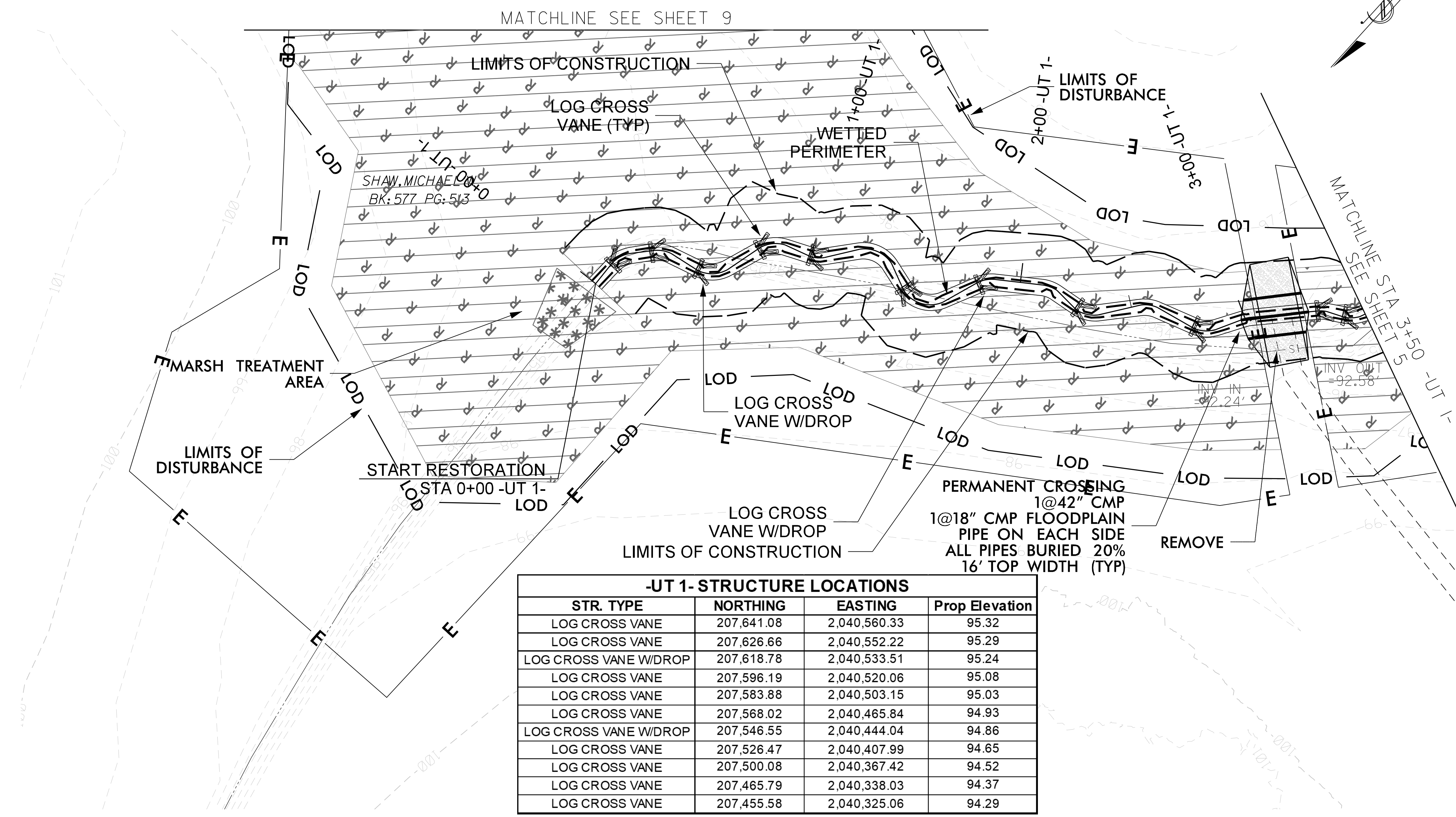
DATE:



-UT 1- STRUCTURE LOCATIONS

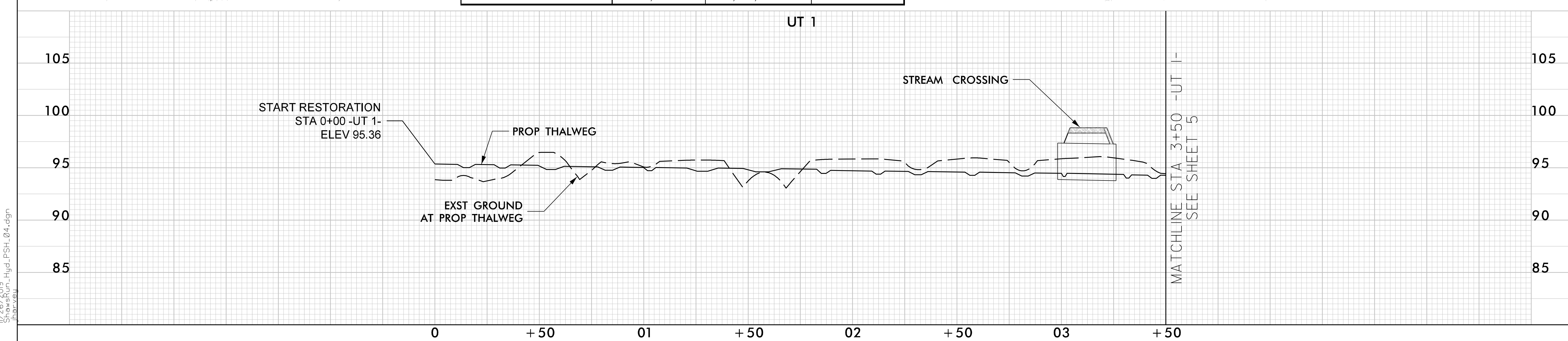
STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE	207,641.08	2,040,560.33	95.32
LOG CROSS VANE	207,626.66	2,040,552.22	95.29
LOG CROSS VANE W/DROP	207,618.78	2,040,533.51	95.24
LOG CROSS VANE	207,596.19	2,040,520.06	95.08
LOG CROSS VANE	207,583.88	2,040,503.15	95.03
LOG CROSS VANE	207,568.02	2,040,465.84	94.93
LOG CROSS VANE W/DROP	207,546.55	2,040,444.04	94.86
LOG CROSS VANE	207,526.47	2,040,407.99	94.65
LOG CROSS VANE	207,500.08	2,040,367.42	94.52
LOG CROSS VANE	207,465.79	2,040,338.03	94.37
LOG CROSS VANE	207,455.58	2,040,325.06	94.29

THE EASEMENT WILL NOT BE FENCED. THE EASEMENT BOUNDARY WILL BE MARKED APPROPRIATELY.

DENOTES MARSH TREATMENT AREA

DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



11/26/2019
ShawsRun_Hyd_PSH_04.dgn

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	5

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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RALEIGH, NORTH CAROLINA 27606
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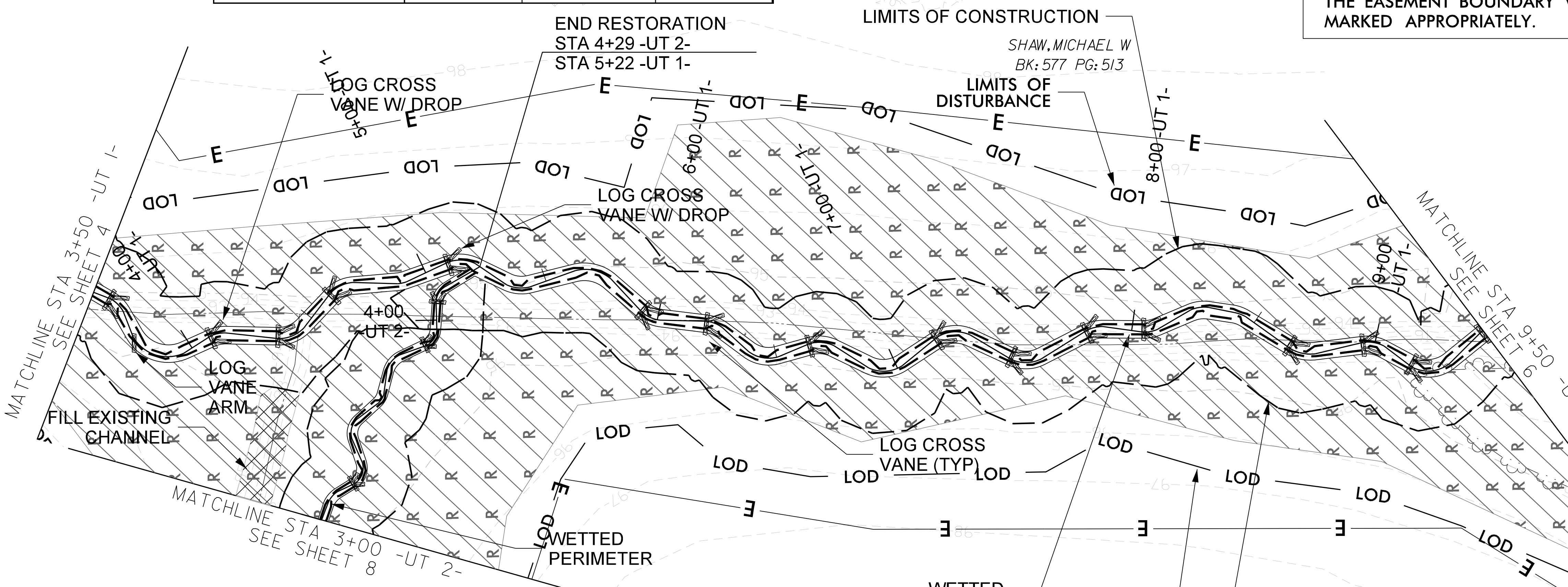
DATE:

NAD 83

-UT 1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE	207,443.71	2,040,316.03	94.26
LOG VANE ARM	207,434.62	2,040,302.82	94.22
LOG CROSS VANE W/DROP	207,405.43	2,040,300.39	94.16
LOG CROSS VANE	207,380.09	2,040,300.44	93.99
LOG CROSS VANE	207,359.29	2,040,315.16	93.93
LOG CROSS VANE W/DROP	207,314.62	2,040,325.79	93.80
LOG CROSS VANE	207,241.16	2,040,306.57	93.56
LOG CROSS VANE	207,217.36	2,040,300.71	93.50
LOG CROSS VANE	207,178.35	2,040,291.16	93.39
LOG CROSS VANE	207,130.04	2,040,292.19	93.27
LOG CROSS VANE	207,101.86	2,040,285.00	93.19
LOG CROSS VANE	207,072.92	2,040,293.28	93.12
LOG CROSS VANE	207,051.40	2,040,294.03	93.06
LOG CROSS VANE	206,996.09	2,040,286.34	92.89
LOG CROSS VANE	206,968.31	2,040,285.74	92.82
LOG CROSS VANE	206,950.03	2,040,278.00	92.77
LOG CROSS VANE	206,922.82	2,040,288.79	92.70

THE EASEMENT WILL NOT BE FENCED. THE EASEMENT BOUNDARY WILL BE MARKED APPROPRIATELY.

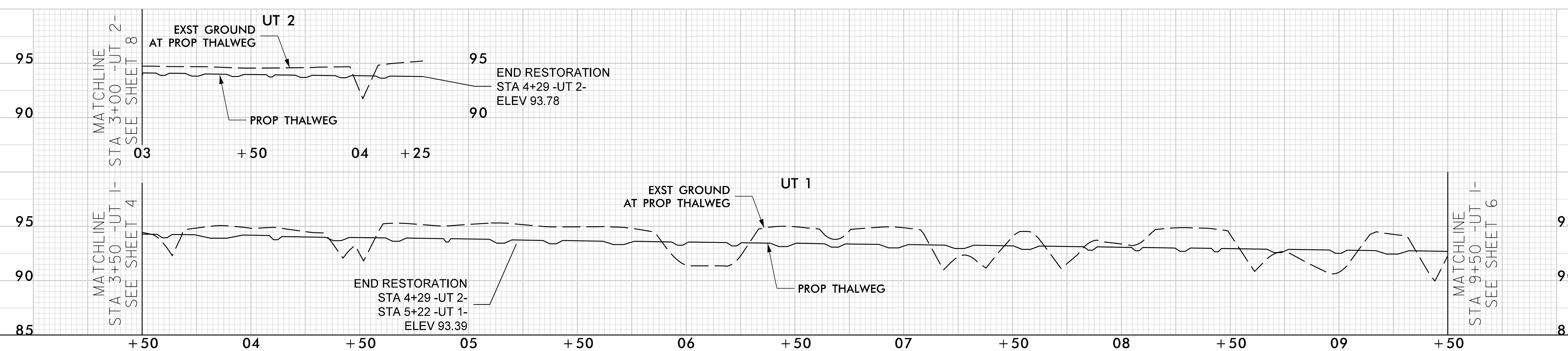


DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

-UT 2- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE	207,353.00	2,040,243.71	94.07
LOG CROSS VANE	207,324.35	2,040,295.66	93.87
LOG CROSS VANE	207,319.13	2,040,311.85	93.84



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SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	6

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

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NORTH CAROLINA PROFESSIONAL ENGINEER JOSEPH S. DALTON — PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

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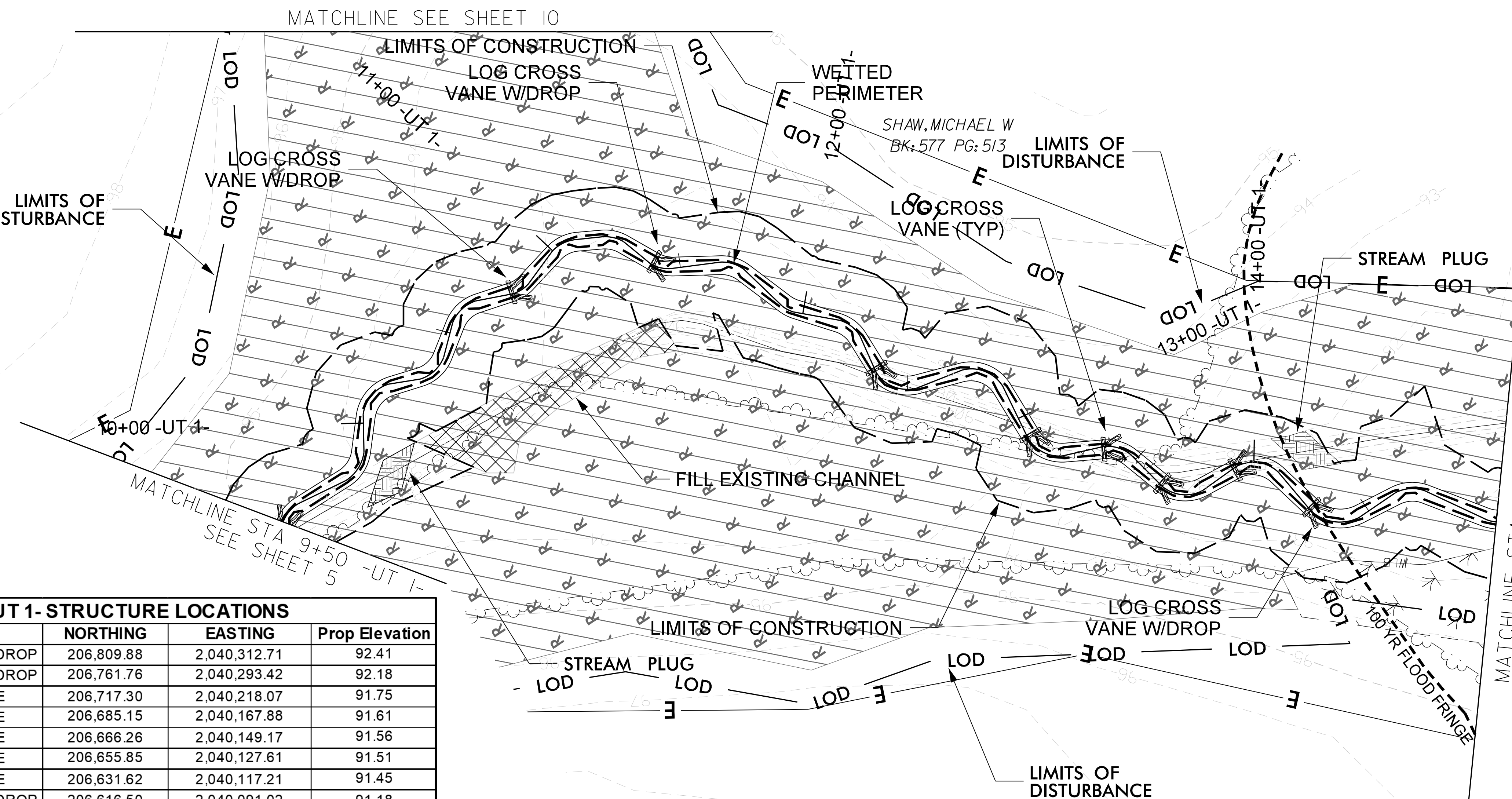
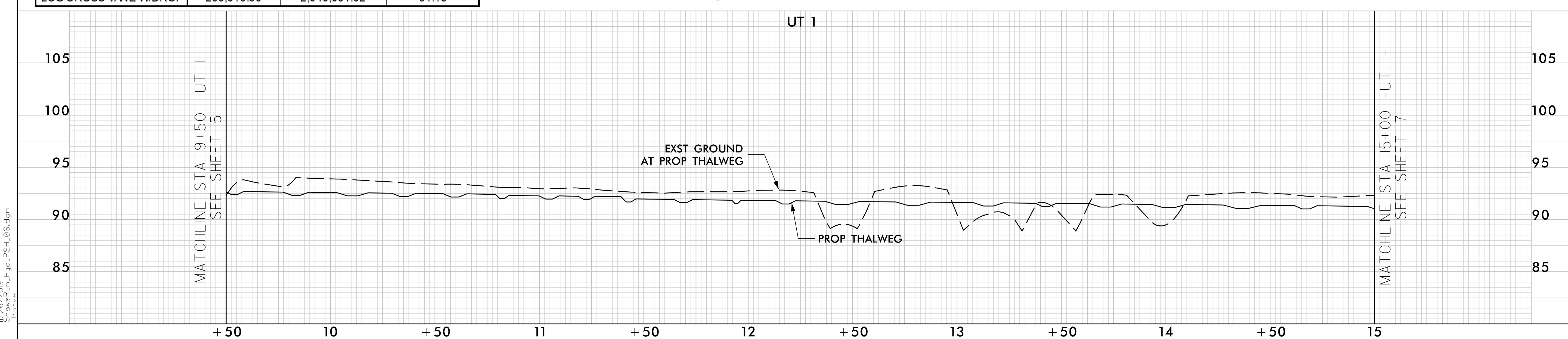
THE EASEMENT BOUNDARY WILL BE MARKED APPROPRIATELY.



-UT 1- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE W/DROP	206,809.88	2,040,312.71	92.41
LOG CROSS VANE W/DROP	206,761.76	2,040,293.42	92.18
LOG CROSS VANE	206,717.30	2,040,218.07	91.75
LOG CROSS VANE	206,685.15	2,040,167.88	91.61
LOG CROSS VANE	206,666.26	2,040,149.17	91.56
LOG CROSS VANE	206,655.85	2,040,127.61	91.51
LOG CROSS VANE	206,631.62	2,040,117.21	91.45
LOG CROSS VANE W/DROP	206,616.50	2,040,091.02	91.18

R R DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



11/26/2019
ShawsRun_Hyd_PSH_06.dgn
jharvey

-UT 1- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE W/DROP	206,535.55	2,040,051.65	91.18
LOG CROSS VANE W/DROP	206,428.51	2,039,974.74	90.68
LOG CROSS VANE W/DROP	206,411.24	2,039,939.81	91.10
LOG CROSS VANE W/DROP	206,350.11	2,039,820.04	90.63
DROP STRUCTURE	206,346.73	2,039,791.84	89.64
DROP STRUCTURE	206,307.78	2,039,702.36	87.27

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	7

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

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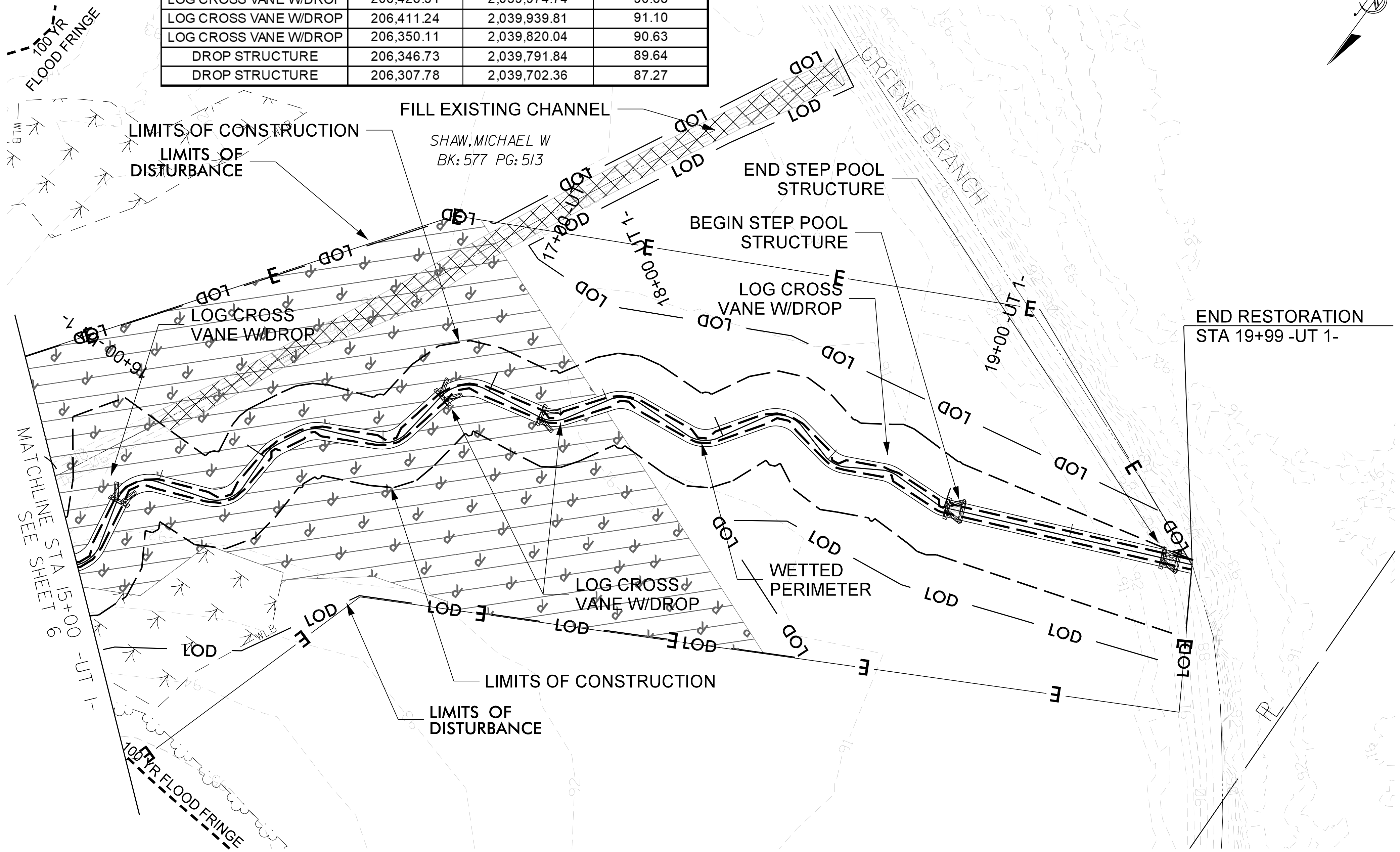
NORTH CAROLINA PROFESSIONAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

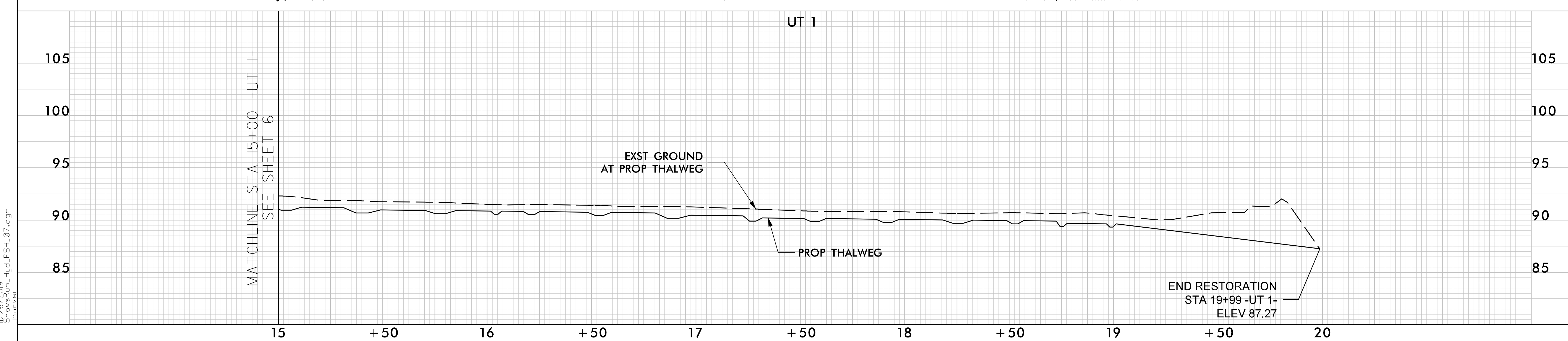
DATE:



THE EASEMENT WILL NOT BE FENCED. THE EASEMENT BOUNDARY WILL BE MARKED APPROPRIATELY.

DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



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jharvey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	8

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS | DATE: 2019

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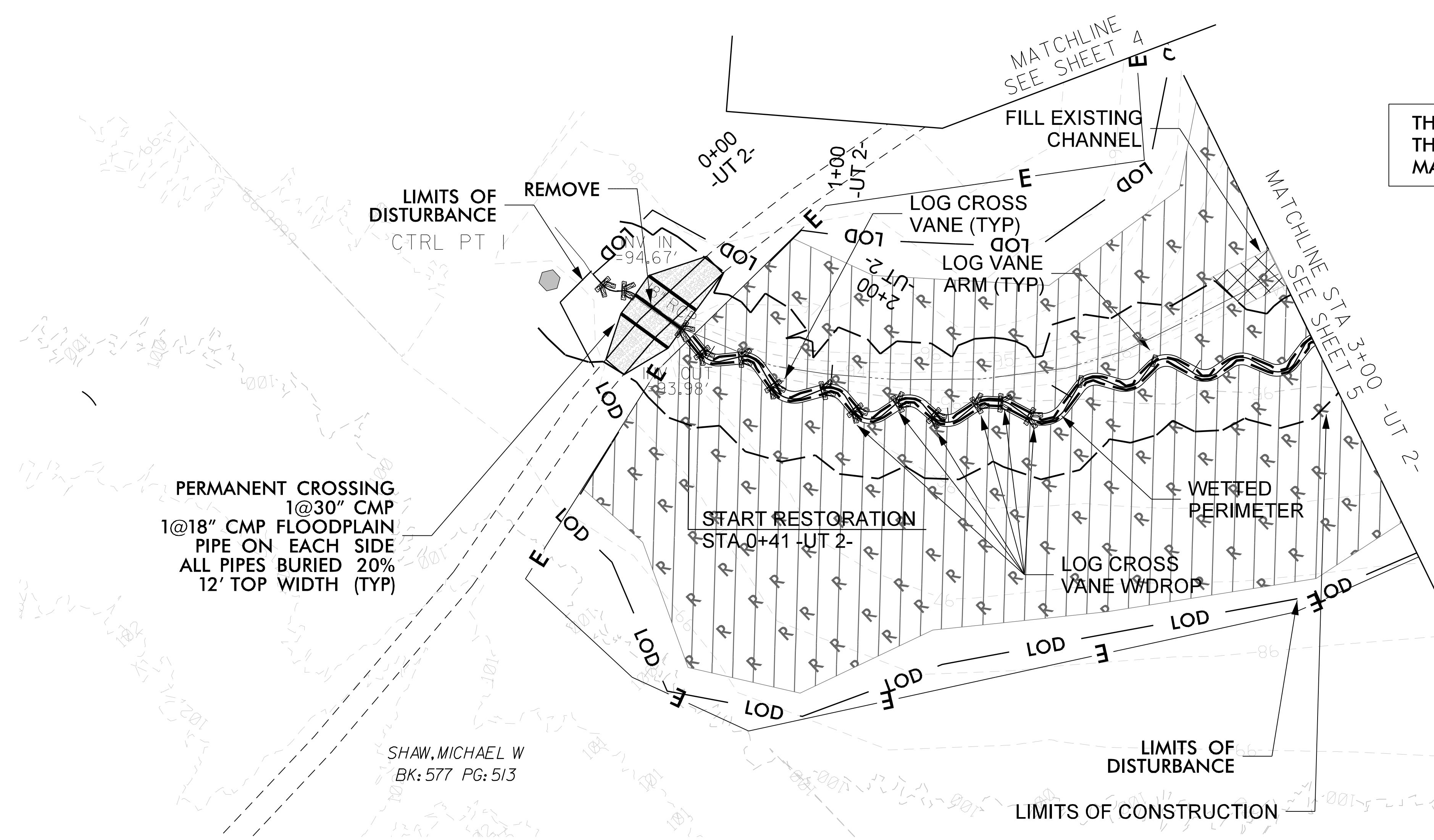
NORTH CAROLINA PROFESSIONAL ENGINEER JOSEPH C. DALTON — PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

R R — DENOTES RESTORED WETLANDS

NAD 83

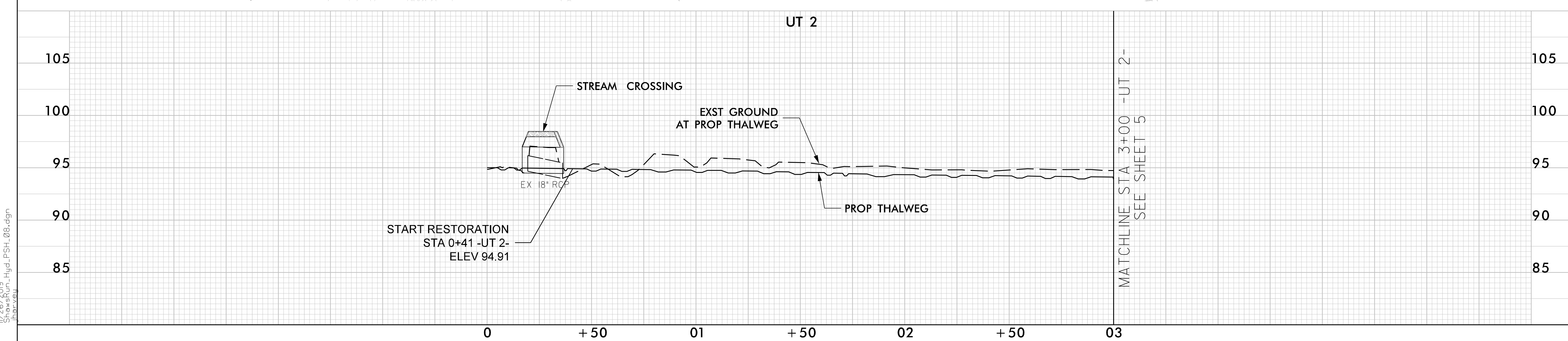
THE EASEMENT WILL NOT BE FENCED. THE EASEMENT BOUNDARY WILL BE MARKED APPROPRIATELY.



-UT 2- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG CROSS VANE	207,545.16	2,040,070.07	95.01
LOG CROSS VANE	207,538.54	2,040,070.67	94.99
LOG CROSS VANE	207,515.43	2,040,076.09	94.92
LOG CROSS VANE	207,504.87	2,040,075.57	94.89
LOG CROSS VANE	207,494.41	2,040,083.89	94.86
LOG CROSS VANE	207,479.89	2,040,085.33	94.82
LOG CROSS VANE	207,467.04	2,040,096.75	94.78
LOG CROSS VANE W/DROP	207,454.70	2,040,100.05	94.75
LOG CROSS VANE W/DROP	207,446.26	2,040,112.04	94.68
LOG CROSS VANE W/DROP	207,434.93	2,040,118.29	94.61
LOG CROSS VANE W/DROP	207,427.45	2,040,131.26	94.54
LOG CROSS VANE W/DROP	207,422.48	2,040,137.82	94.48
LOG CROSS VANE W/DROP	207,412.23	2,040,141.97	94.40
LOG VANE ARM	207,407.84	2,040,161.05	94.33
LOG VANE ARM	207,396.00	2,040,183.97	94.26

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



11/26/2019 ShawsRun_Hyd_PSH_08.dgn jharvey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	9

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

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905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

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PRELIMINARY DESIGN NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL JOSEPH C. DALTON

DATE:

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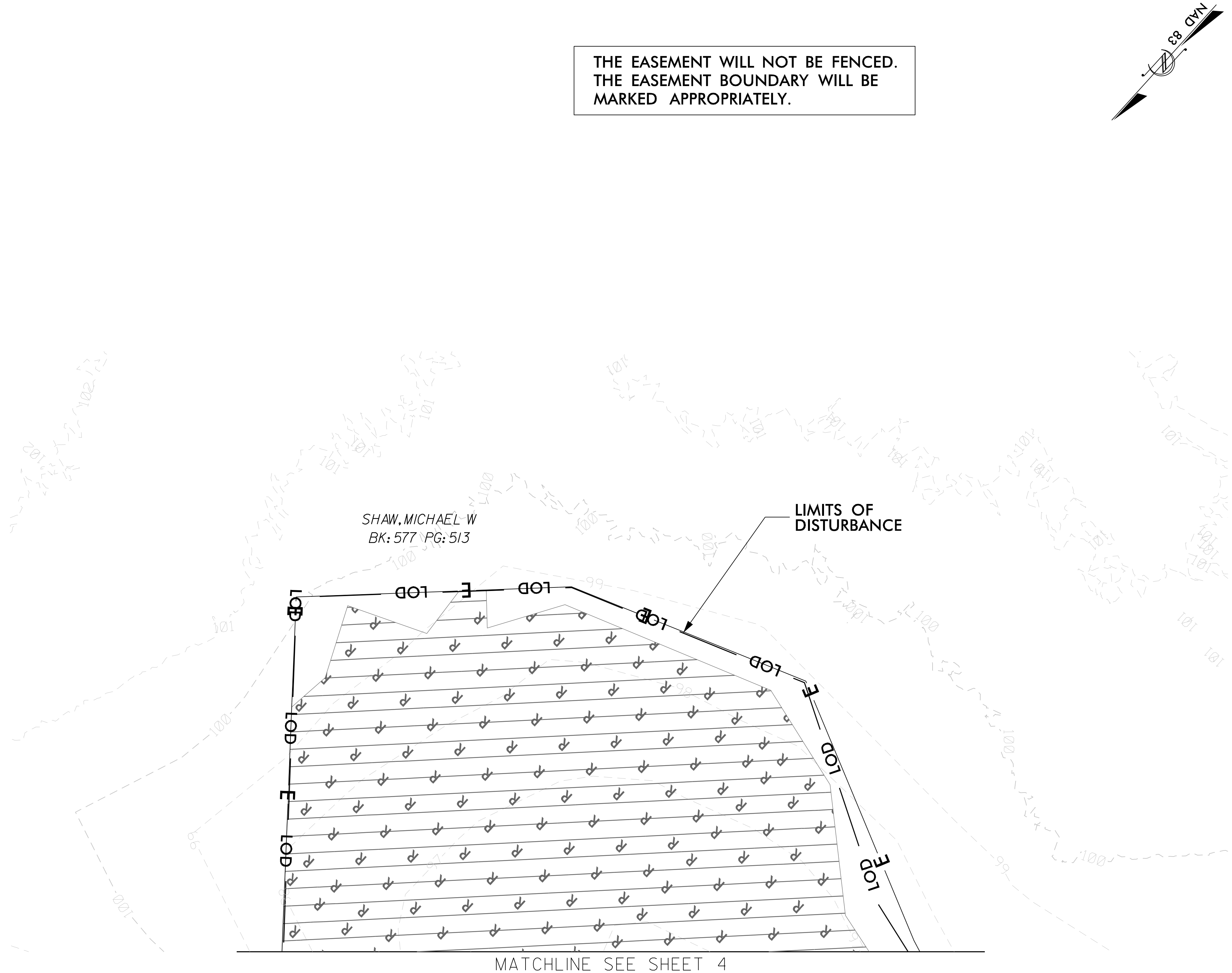

DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

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SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	10

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS — DATE: 2019

Axiom Environmental, Inc.

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905 JONES FRANKLIN ROAD
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PRELIMINARY DESIGN NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSHUA G. DALTON

DATE:

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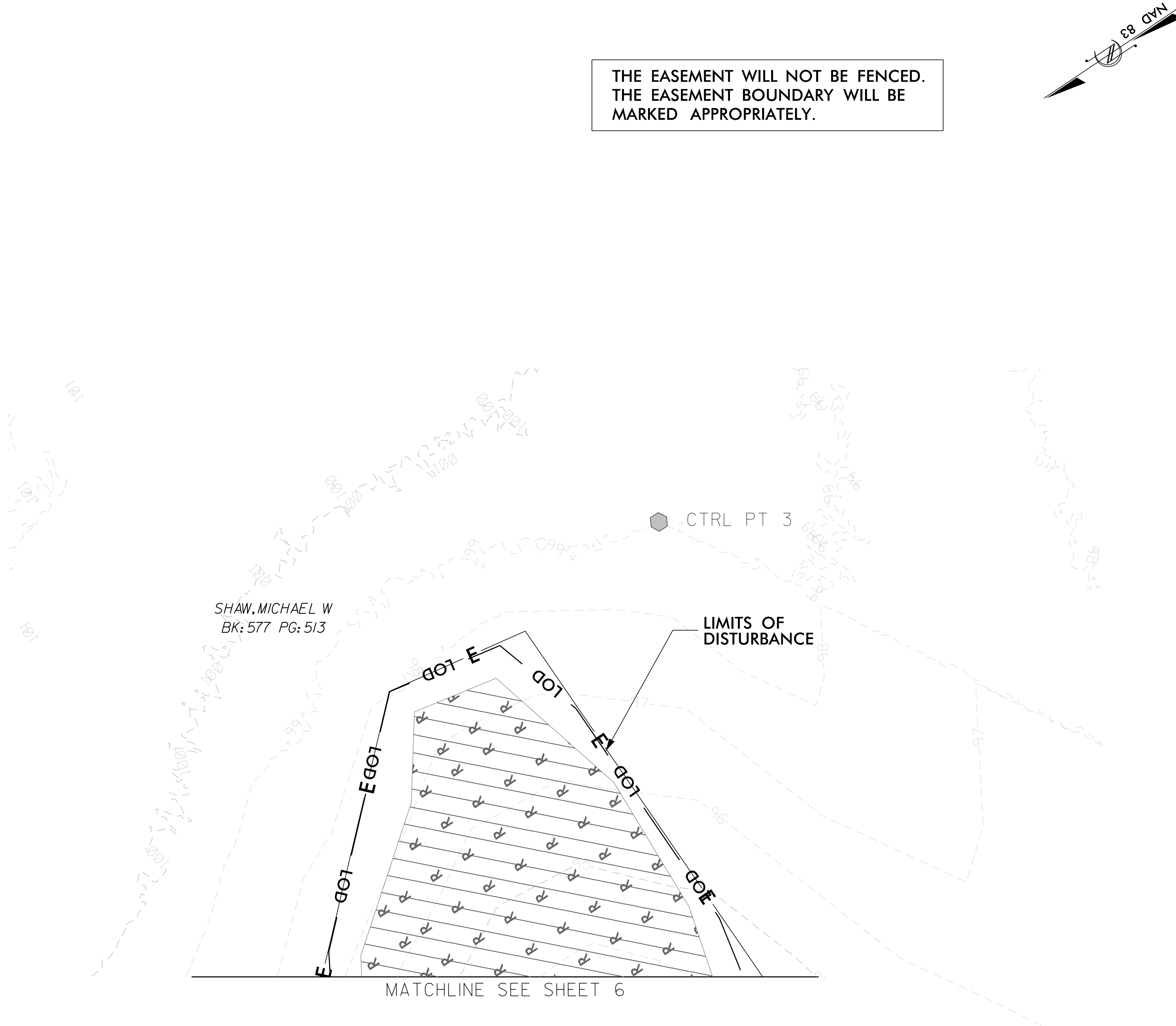

DENOTES RESTORED WETLANDS

TOPOGRAHY OUTSIDE
OF SURVEY LIMITS BASED ON
NC SPATIAL DATA QL2 LIDAR

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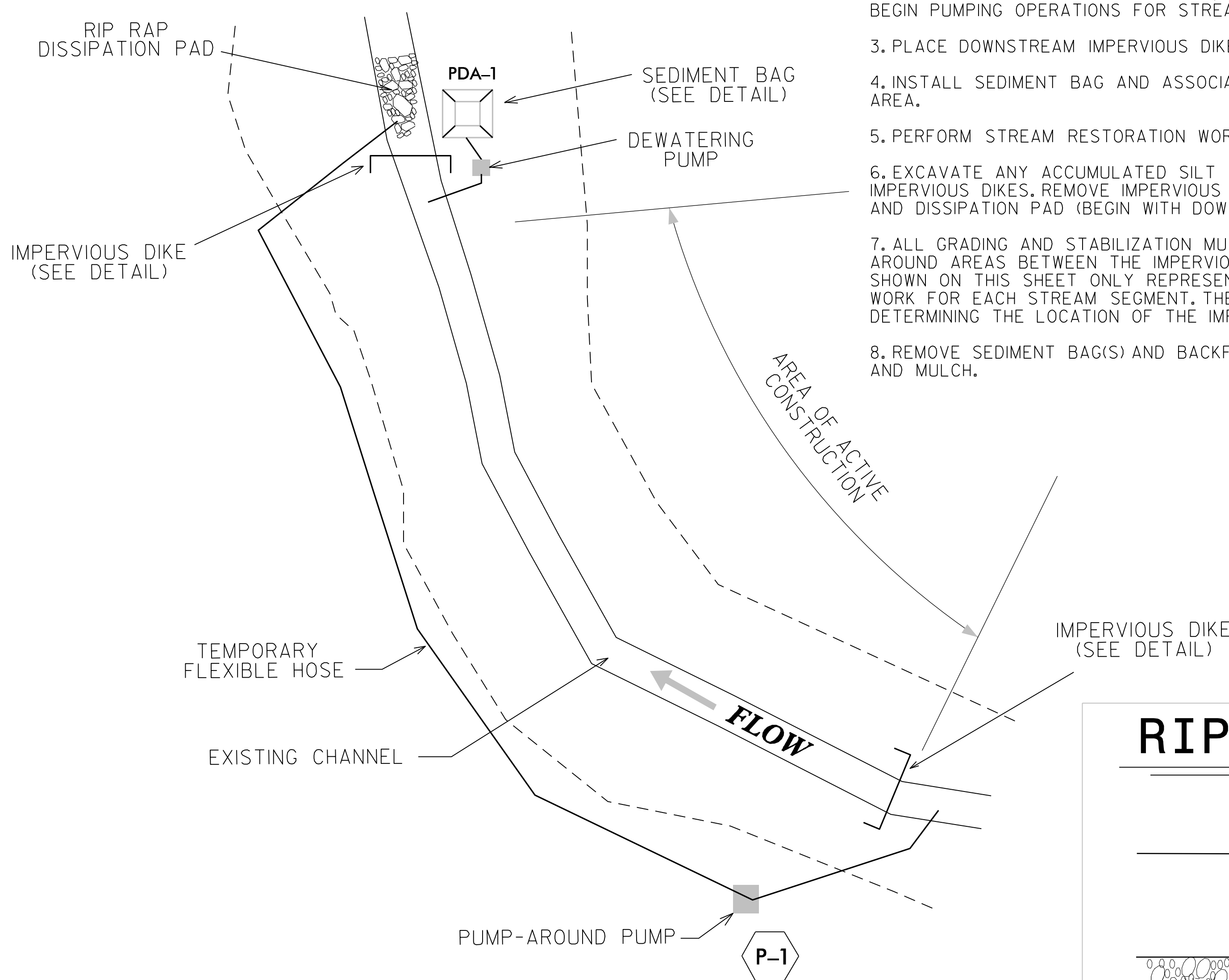
DATE:

CONSTRUCTION SEQUENCE FOR TYPICAL PUMP-AROUND:

1. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
2. PLACE UPSTREAM IMPERVIOUS DIKE, DOWNSTREAM RIP RAP DISSIPATION PAD, AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
3. PLACE DOWNSTREAM IMPERVIOUS DIKE.
4. INSTALL SEDIMENT BAG AND ASSOCIATED PUMP. DEWATER THE ENTRAPPED AREA.
5. PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLANS.
6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, TEMPORARY FLEXIBLE HOSE, AND DISSIPATION PAD (BEGIN WITH DOWNSTREAM IMPERVIOUS DIKE FIRST).
7. ALL GRADING AND STABILIZATION MUST BE COMPLETED WITHIN THE PUMP AROUND AREAS BETWEEN THE IMPERVIOUS DIKES. THE IMPERVIOUS LOCATIONS AS SHOWN ON THIS SHEET ONLY REPRESENT THE UPPER AND LOWER EXTENT OF WORK FOR EACH STREAM SEGMENT. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE LOCATION OF THE IMPERVIOUS DIKES.
8. REMOVE SEDIMENT BAG(S) AND BACKFILL. STABILIZE DISTURBED AREA WITH SEED AND MULCH.

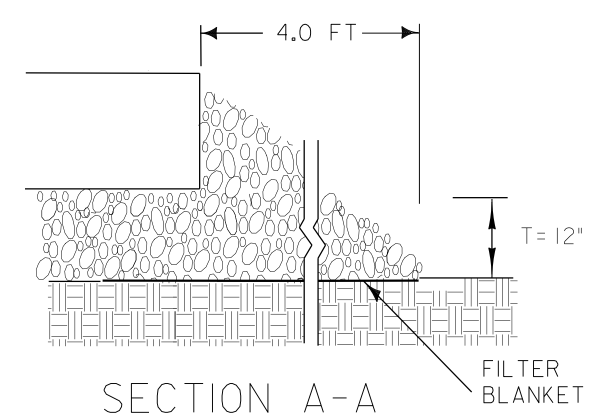


NOTES:

1. ALL EXCAVATION SHALL BE PERFORMED IN ONLY DRY OR ISOLATED SECTIONS OF CHANNEL
2. IMPERVIOUS DIKES ARE TO BE USED TO ISOLATE WORK FROM STREAM FLOW WHEN NECESSARY
3. ALL GRADED STREAM BANKS SHALL BE SEEDED, MULCHED, AND MATTED AT THE END OF EACH WORKING DAY. ALL OTHER GRADED AREAS SHALL BE SEEDED IN ACCORDANCE WITH THE CONSTRUCTION DOCUMENTS.
4. MAINTENANCE OF STREAM FLOW OPERATIONS SHALL BE INCIDENTAL TO THE WORK. THIS INCLUDES POLYETHYLENE SHEETING, DIVERSION PIPES, PUMPS, AND HOSES.
5. PUMPS AND HOSES SHALL BE OF A SUFFICIENT SIZE AND NUMBER TO DEWATER THE WORK AREA.
6. RIP RAP DISSIPATION PAD TO BE INSTALLED DOWNSTREAM OF LOWER IMPERVIOUS DIKE

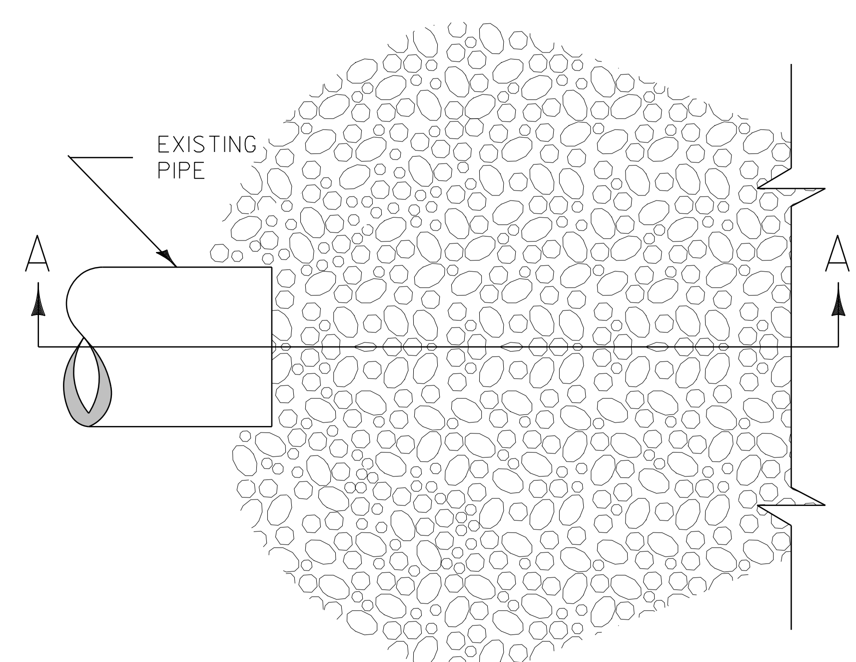
TYPICAL PUMP-AROUND OPERATION

RIPRAP DISSIPATION PAD



SECTION A-A

PLAN VIEW



NOTES:

1. La IS THE LENGTH OF THE RIPRAP APRON.
2. T = THICKNESS
3. IN A WELL-DEFINED CHANNEL EXTEND THE APRON UP THE CHANNEL BANKS TO THE TOP OF THE BANK.
4. A FILTER BLANKET OR FILTER FABRIC SHOULD BE INSTALLED BETWEEN THE RIPRAP AND SOIL FOUNDATION.

RIP RAP DISIPATION PAD SPECIFICATIONS						
ASSUMED HOSE SIZE (IN)	PERMANENT (Y/N)	LENGTH La (FT)	WIDTH Wo (FT)	STONE SIZE d50 (IN)	STONE CLASS	THICKNESS (IN)
4"	N	4.0	1.0	3	A	12

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3A

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
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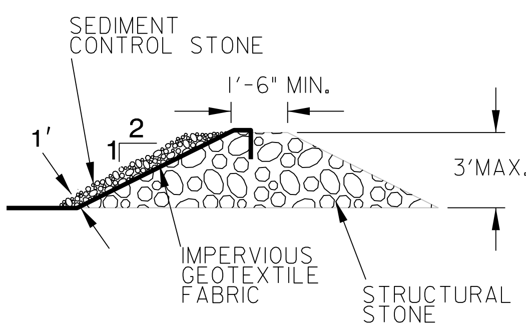
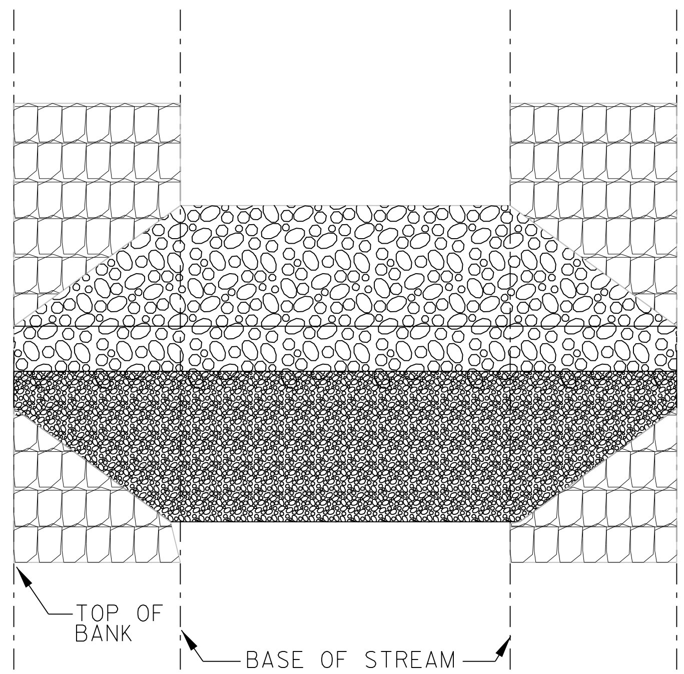
DATE:

IMPERVIOUS DIKE



CROSS SECTION VIEW



TOP VIEW

NOTES:

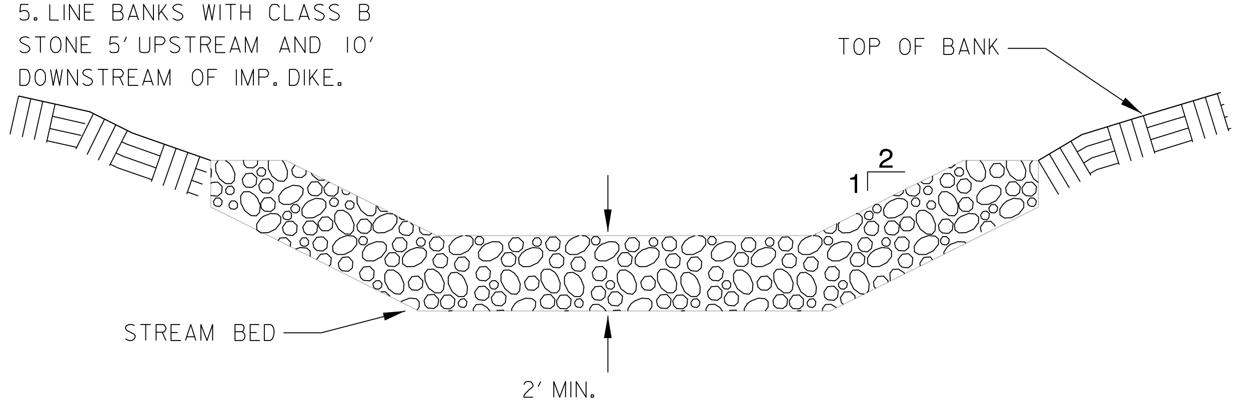
1. USE CLASS B STONE FOR STRUCTURAL STONE.

2. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL.

3. CONSTRUCT DAM A MAXIMUM OF 1 FT. ABOVE NORMAL FLOW DEPTH.

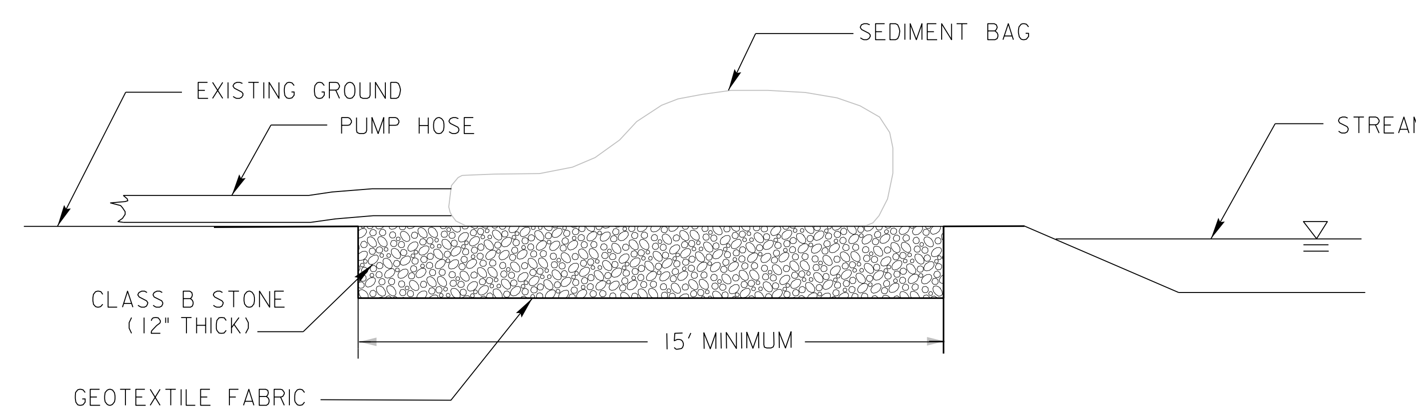
4. TOE IN IMPERVIOUS MATERIAL

5. LINE BANKS WITH CLASS B STONE 5' UPSTREAM AND 10' DOWNSTREAM OF IMP. DIKE.



FRONT VIEW

SEDIMENT BAG



INSTALLATION:

1. INSTALL SEDIMENT BAG ON A SLOPE SO INCOMING WATER FLOWS DOWNHILL THROUGH BAG WITHOUT CREATING MORE EROSION. TO INCREASE THE EFFICIENCY OF FILTRATION, PLACE THE BAG ON A GRAVEL BED IN ORDER TO MAXIMIZE WATER FLOW THROUGH THE SURFACE AREA OF THE BAG.

2. BAG IS FULL WHEN IT NO LONGER CAN EFFICIENTLY FILTER SEDIMENT OR ALLOW WATER TO PASS AT A REASONABLE RATE. FLOW RATES WILL VARY DEPENDING ON THE SIZE OF SEDIMENT BAG, THE TYPE AND AMOUNT OF SEDIMENT DISCHARGED INTO THE BAG, THE TYPE OF GROUND, ROCK OR OTHER SUBSTANCE UNDER THE BAG AND THE DEGREE OF THE SLOPE ON WHICH THE BAG LIES. UNDER MOST CIRCUMSTANCES THE SEDIMENT BAG WILL ACCOMMODATE FLOW RATES OF 1100 GALLONS PER MINUTE. USE OF EXCESSIVE FLOW RATES OR OVERFILLING WITH SEDIMENT WILL CAUSE THE BAG TO RUPTURE OR FAILURE OF THE HOSE ATTACHMENT STRAPS.

3. DISPOSE OF SEDIMENT BAG AS DIRECTED BY THE SITE DESIGNER. IF ALLOWED, BAG MAY BE CUT OPEN AND THE CONTENTS SEEDED AFTER REMOVING VISIBLE FABRIC.

4. REFER TO DETAIL REGARDING GEOTEXTILE FABRIC ATTRIBUTES.

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3B
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE	
COUNTY: COLUMBUS	DATE: 2018

Axiom Environmental, Inc.

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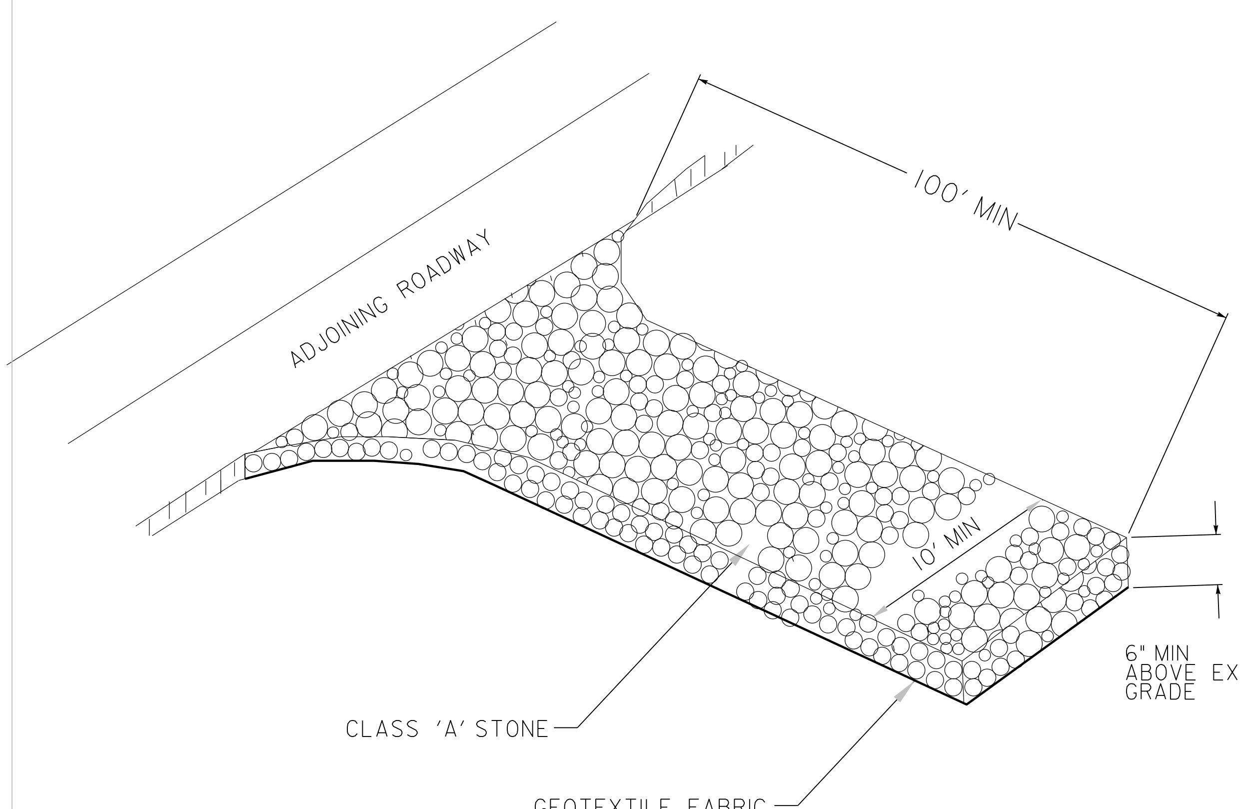
NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON PRELIMINARY DESIGN NOT FOR CONSTRUCTION

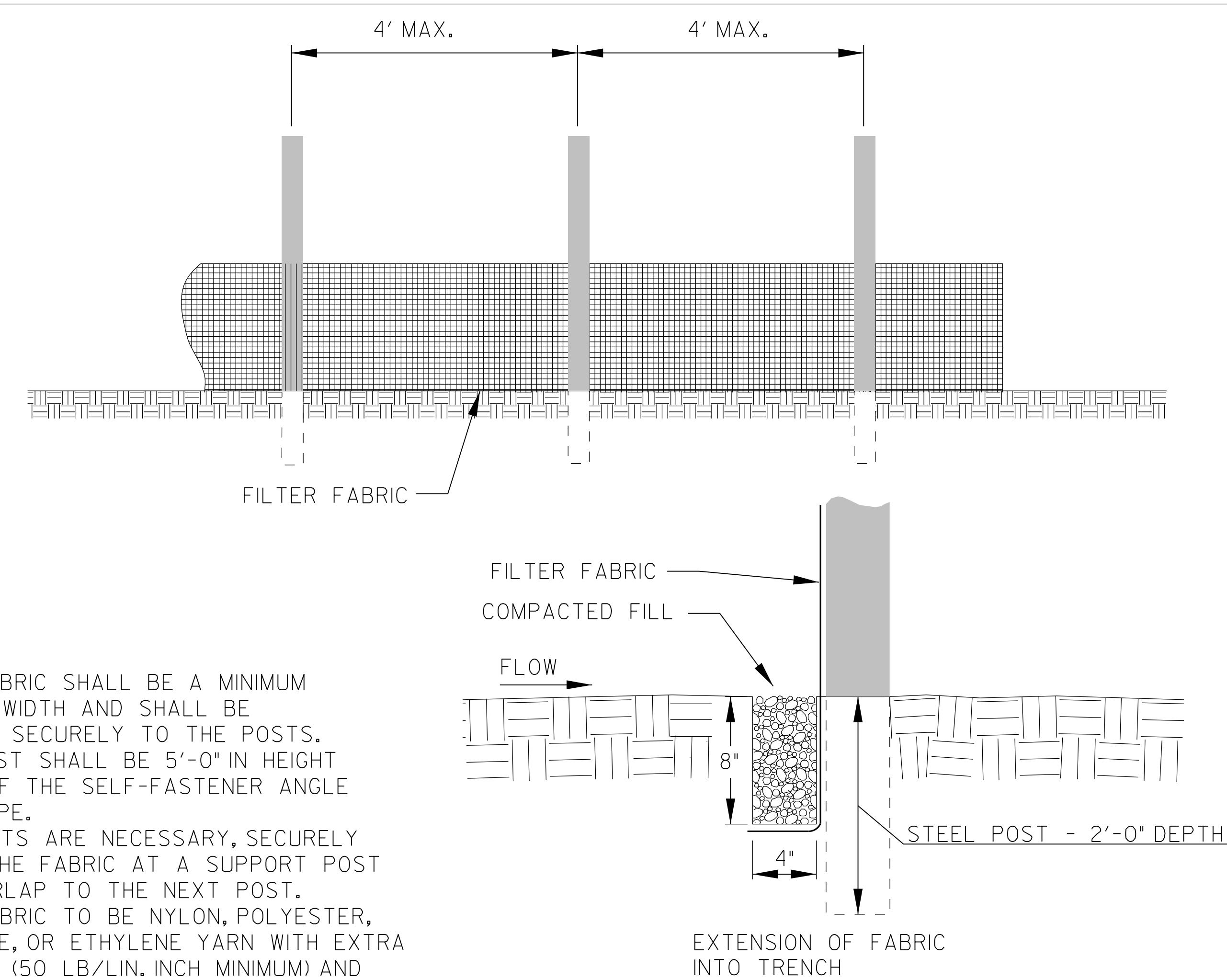
DATE:

NOTES:

1. USE CLASS 'A' STONE ON PAD. PAD TO BE MINIMUM 100' LONG x 12' WIDE x 6" DEEP.
2. TURNING RADIUS SHOULD BE SUFFICIENT TO ACCOMODATE LARGE TRUCKS.
3. ENTRANCE(S) SHOULD BE LOCATED AS TO PROVIDE MAXIMUM UTILITY BY ALL CONSTRUCTION VEHICLES.
4. ENTRANCE(S) MUST BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR DIRECT FLOW OF MUD ONTO ADJACENT ROADWAYS. PERIODIC TOP DRESSING WITH STONE MAY BE NECESSARY.
5. ANY MATERIAL WHICH FINDS ITS WAY ONTO THE ADJACENT ROADWAY MUST BE CLEANED UP IMMEDIATELY.



TEMPORARY CONSTRUCTION ENTRANCE/EXIT



NOTES:

1. FILTER FABRIC SHALL BE A MINIMUM OF 36" IN WIDTH AND SHALL BE FASTENED SECURELY TO THE POSTS.
2. STEEL POST SHALL BE 5'-0" IN HEIGHT AND BE OF THE SELF-FASTENER ANGLE STEEL TYPE.
3. WHEN JOINTS ARE NECESSARY, SECURELY FASTEN THE FABRIC AT A SUPPORT POST WITH OVERLAP TO THE NEXT POST.
4. FILTER FABRIC TO BE NYLON, POLYESTER, PROPYLENE, OR ETHYLENE YARN WITH EXTRA STRENGTH (50 LB/LIN. INCH MINIMUM) AND WITH A MINIMUM FLOW RATE OF 0.3 GAL/FT/MIN. FABRIC SHOULD CONTAIN ULTRAVIOLET RAY INHIBITORS AND STABILIZERS.

SILT FENCE

11/26/2019
ShawsRun_Hyd_PSH_E03b.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3C

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

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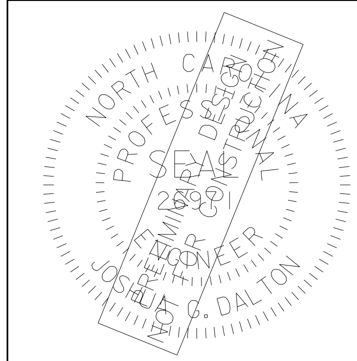
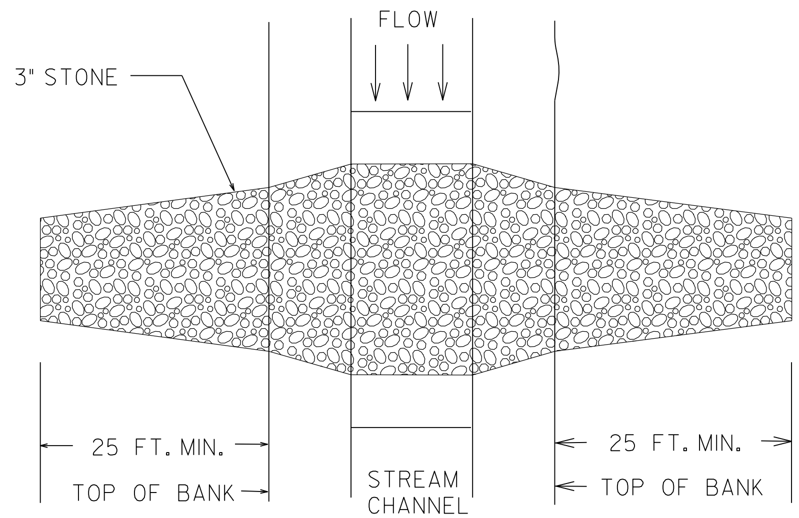


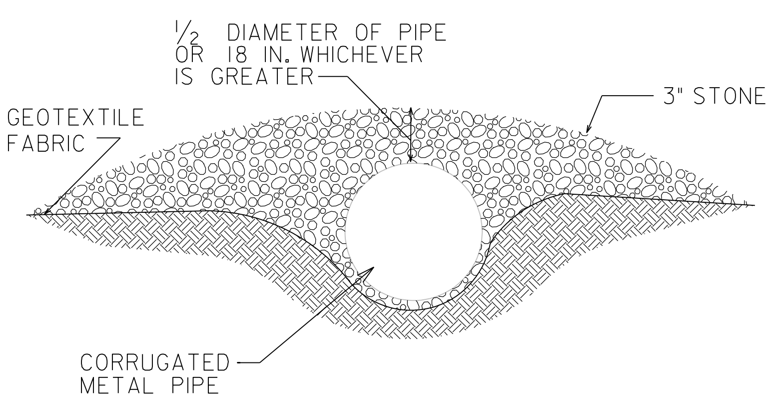
DATE:

TEMPORARY CULVERTED STREAM CROSSING

NOTE: FOR USE IN EXISTING CHANNELS ONLY.
NOT FOR USE IN RESTORED STREAMS.

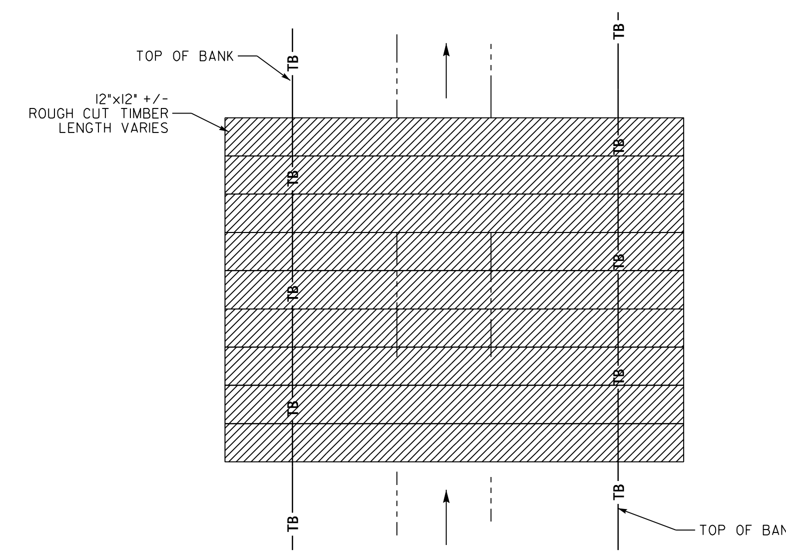


PLAN VIEW



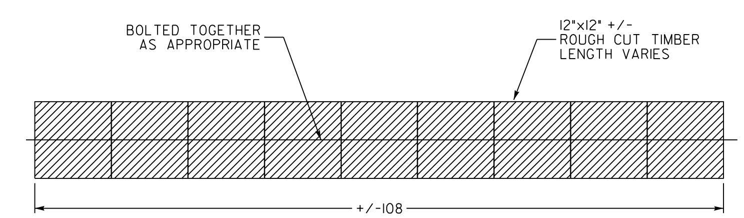
PROFILE VIEW

LOG MAT BRIDGE

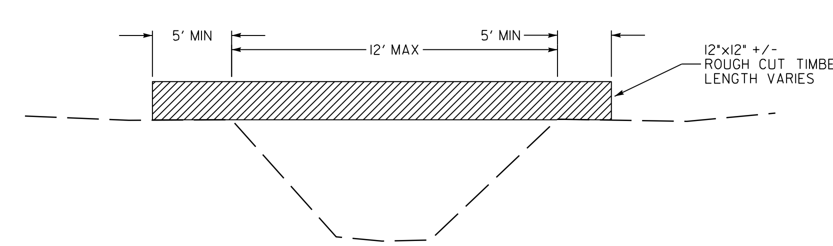


PLAN VIEW

NOTE:
DETAIL PROVIDED FOR INFORMATIONAL PURPOSES. USE OF LOG MAT BRIDGE IS AT CONTRACTORS DISCRETION.



SECTION THROUGH LOG MAT BRIDGE



CROSS SECTION VIEW

11/26/2019
ShawsRun_Hyd_PSH_E03c.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3D

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS | DATE: 2018

Axiom Environmental, Inc.

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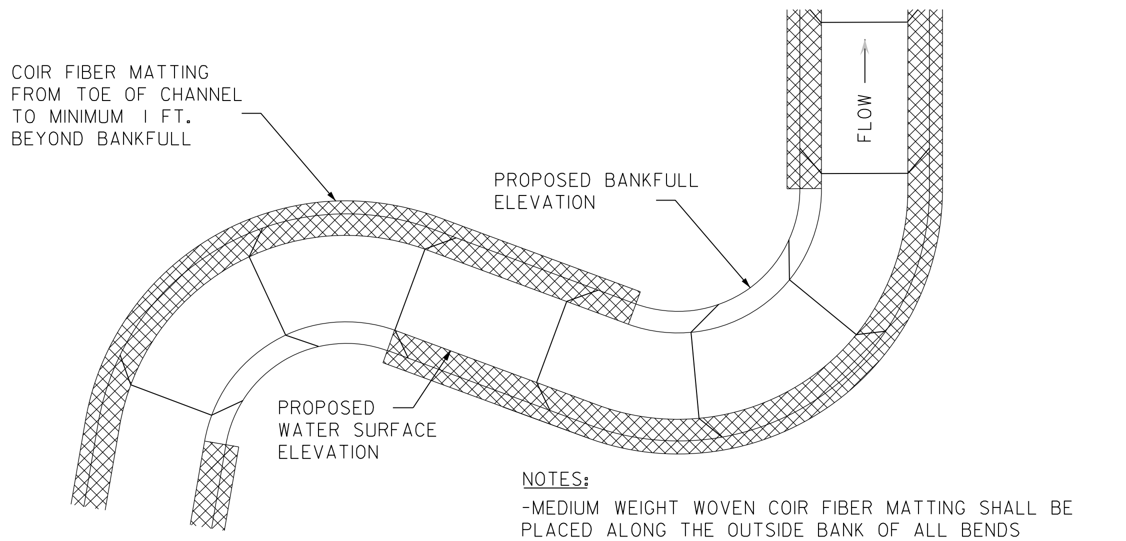
NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

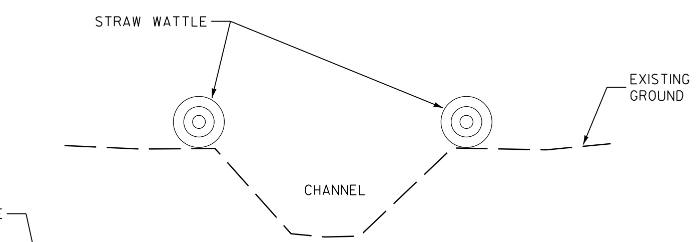
DATE:

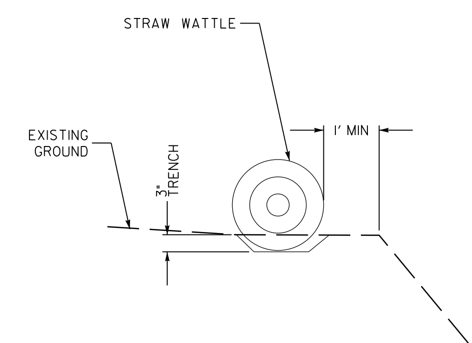
TYPICAL MATTING LOCATION



NOTES:
-MEDIUM WEIGHT WOVEN COIR FIBER MATTING SHALL BE PLACED ALONG THE OUTSIDE BANK OF ALL BENDS AND ALONG BOTH SIDES OFTHE CHANNEL IN TANGENT AREAS.
-FIELD ADJUSTMENTS TO MATTING LOCATION MAY BE MADE AT THE DESIGNERS OR CONTRACTORS DISCRETION AS NECESSARY.

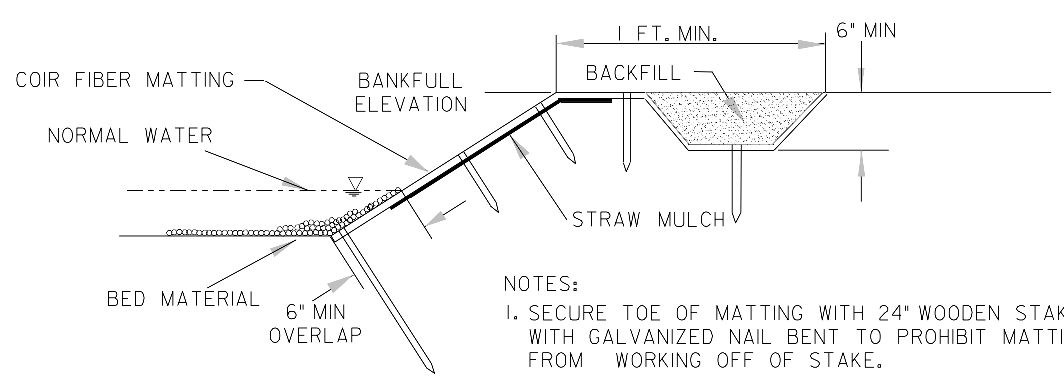
STRAW WATTLE





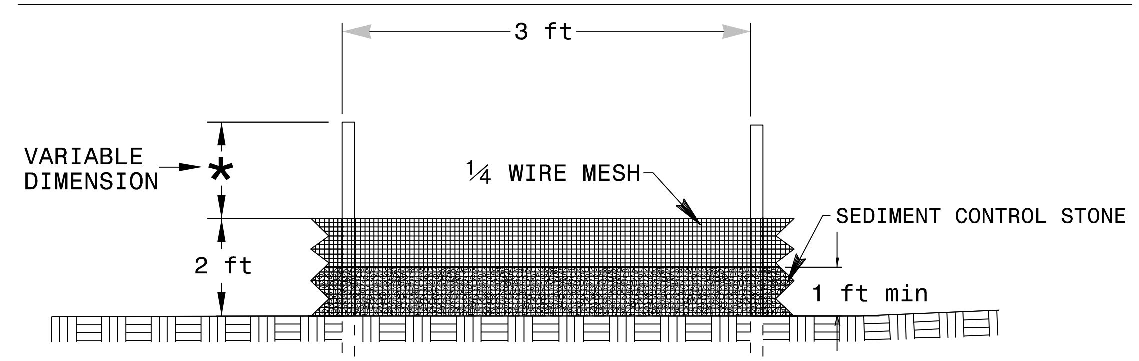
NOTES:
1. STRAW WATTLE TO BE INSTALLED AT THE DISCRETION OF THE CONTRACTOR OR DESIGNER IN AREAS THAT MAY NEED ADDITIONAL RUNOFF PROTECTION.
2. INSTALL STRAW WATTLE ALONG TOP OF BANKFULL CHANNEL.
3. SECURE STRAW WATTLE WITH 1"x2"x18" WOODEN STAKES, SPACE AT 5' MAXIMUM.
4. STRAW SHALL BE CERTIFIED WEED FREE.

COIR MATTING CROSS SECTION



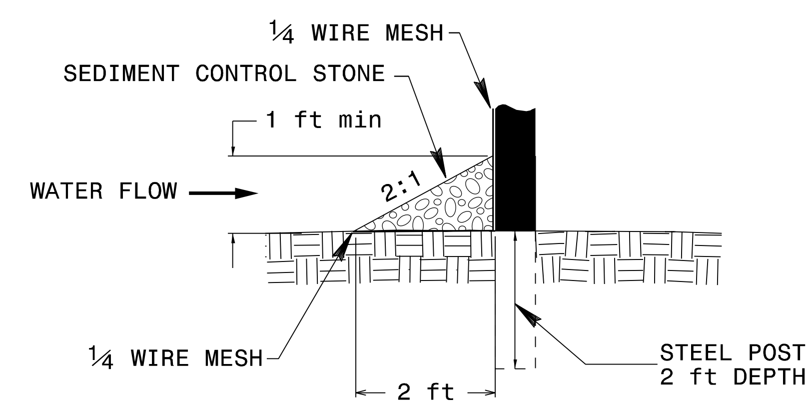
NOTES:
1. SECURE TOE OF MATTING WITH 24" WOODEN STAKES WITH GALVANIZED NAIL BENT TO PROHIBIT MATTING FROM WORKING OFF OF STAKE.
2. USE 12" WOODEN STAKES ON 5' CENTERS OR AS DIRECTED BY MANUFACTURER'S RECOMMENDATIONS.
3. MINIMUM 1' WIDE, 6" DEEP TRENCH OVER TOP OF BANK WITH MATTING LAID FLAT AND STAKED. TRENCH TO BE BACKFILLED WITH EXCAVATED MATERIAL.

SPECIAL SEDIMENT CONTROL FENCE BREAK



NOTE:

-INSTALL 9 FT SECTION OF SEDIMENT CONTROL FENCE AS A BREAK IN TEMPORARY SILT FENCE TO RELIEVE ACCUMULATION OF RUNOFF AS DIRECTED ON PLANS AND AS DEEMED NECESSARY BY CONTRACTOR OR DESIGNER.



CONSTRUCTION NOTES:
1. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL STONE.
2. USE HARDWARE CLOTH 24 GAUGE WIRE MESH WITH 1/4 INCH MESH OPENINGS.
3. INSTALL 5 FT. SELF FASTENER ANGLE STEEL POST 2 FT. DEEP MINIMUM.
4. SPACE POST A MAXIMUM OF 3 FT.

11/26/2019
ShawsRun_Hyd_PSH_E03d.dgn
jharvey

SHEET NAME		SHEET NUMBER
HAUL ROADS		E3E
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE		
	COUNTY: COLUMBUS	DATE: 2019

Axiom Environmental, Inc.

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905 JONES FRANKLIN ROAD
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TEL (919) 859-2243
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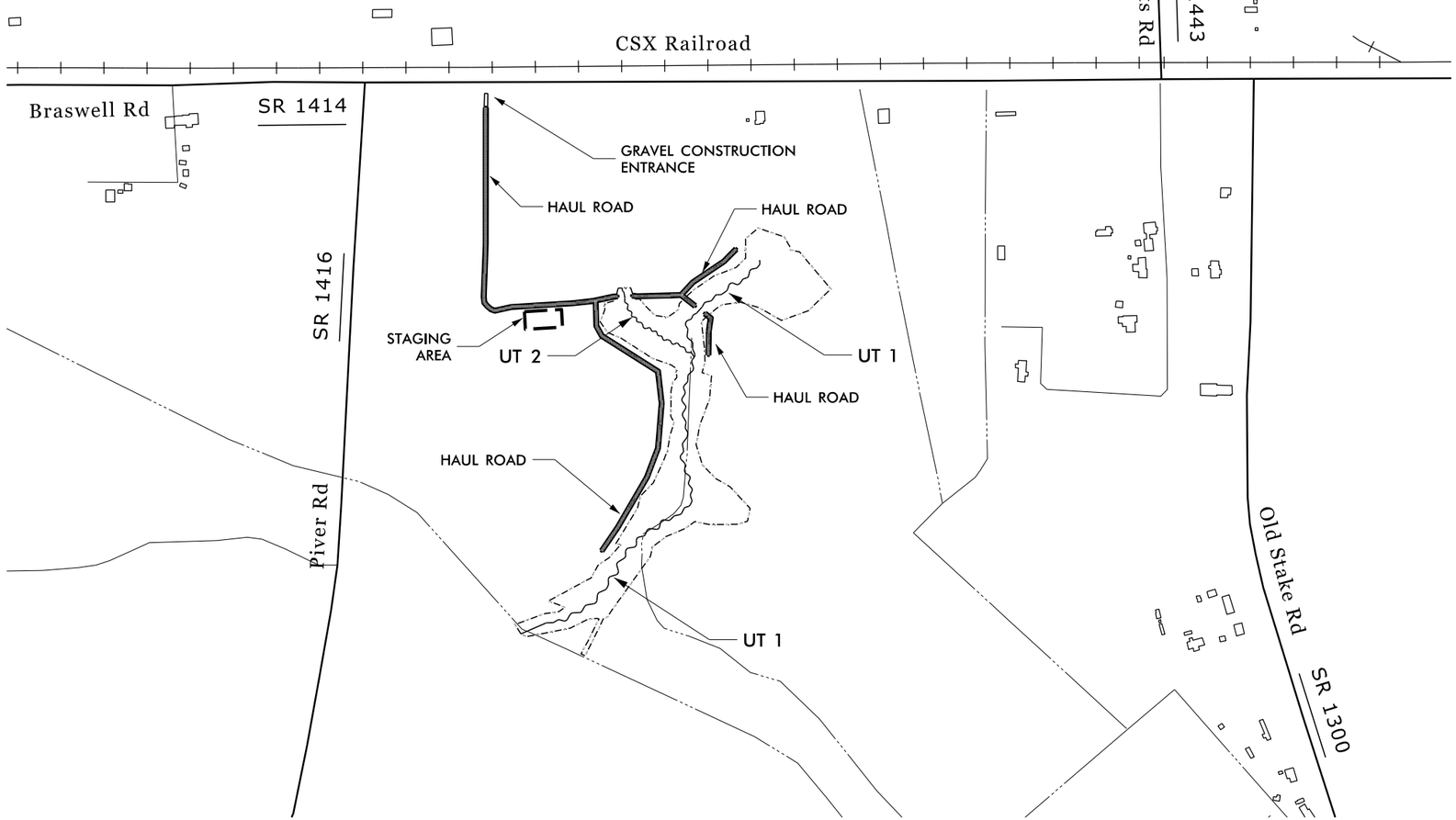
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

DATE:

ALL HAUL ROAD LOCATIONS TO BE RESTORED TO PRE-CONSTRUCTION CONDITIONS.

500′ 250′ 0 500′ 1000′
SCALE: 1″ = 500′



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S:\Projects\...Hyd_PSH_E03e_HaulRoad.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E4

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

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NORTH CAROLINA PROFESSIONAL SEAL 28... ENGINEER JOSEPH C. DALTON

PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

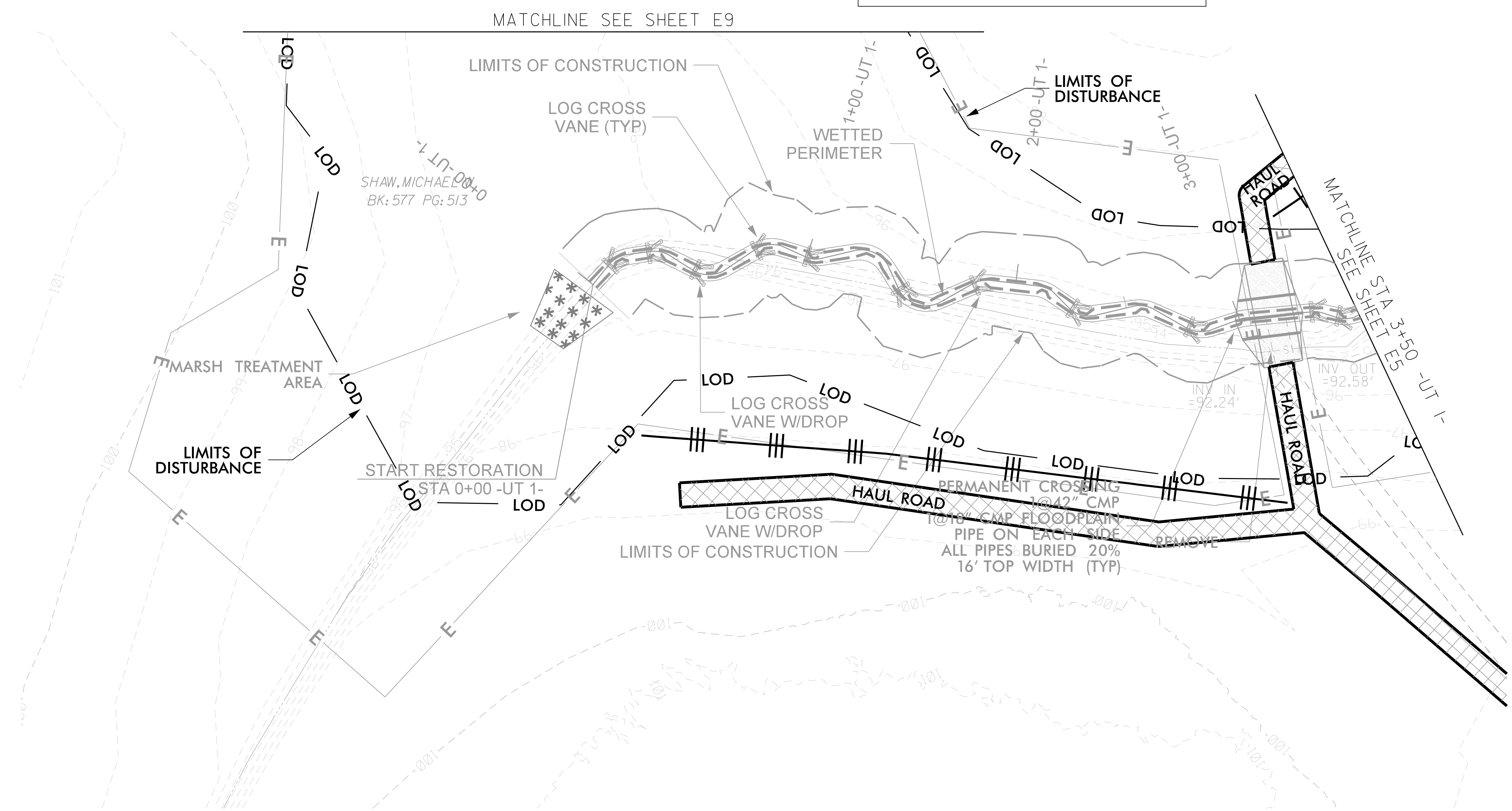
LOD — LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK

NAD 83



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E04.dgn

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E5

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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RALEIGH, NORTH CAROLINA 27606
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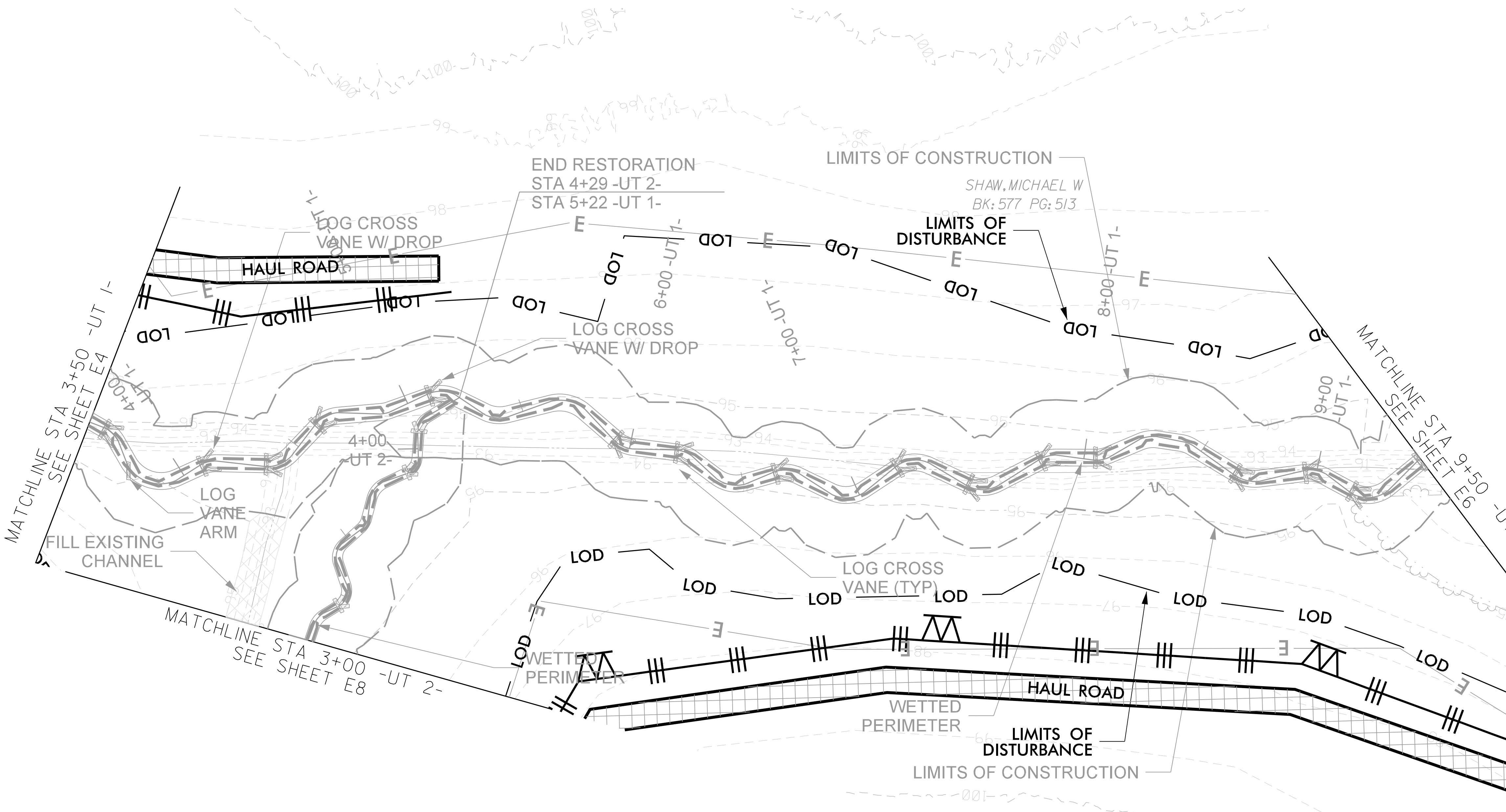
DATE:

— LOD —	LIMITS OF DISTURBANCE
—‖‖—	TEMPORARY SILT FENCE
(hatched)	HAUL ROAD
(symbol)	SPECIAL SEDIMENT CONTROL FENCE BREAK

NAD 83



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E05.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E6

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

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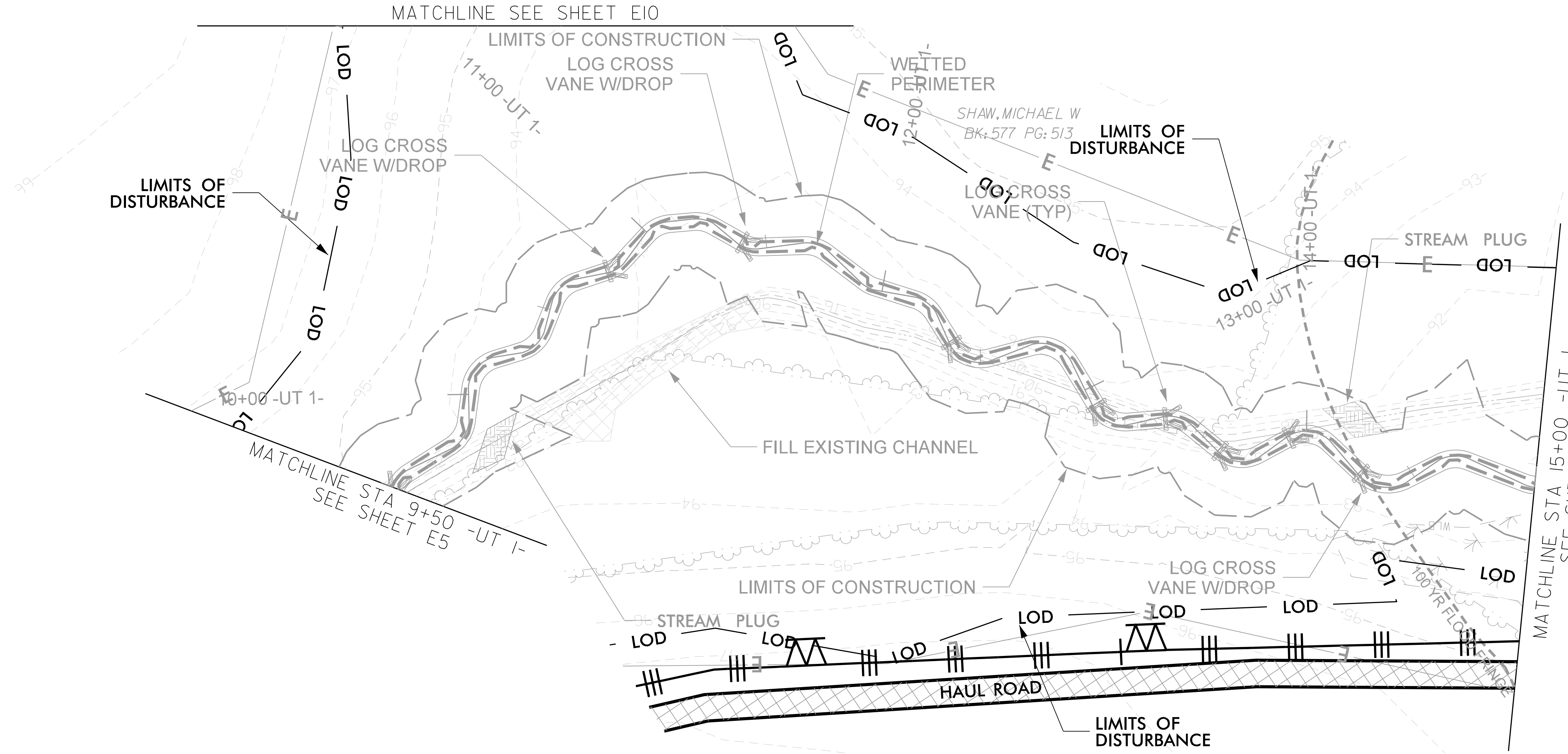
NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

— LOD —	LIMITS OF DISTURBANCE
—‖‖—	TEMPORARY SILT FENCE
(hatched)	HAUL ROAD
(symbol)	SPECIAL SEDIMENT CONTROL FENCE BREAK

NAD 83



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E06.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E7

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

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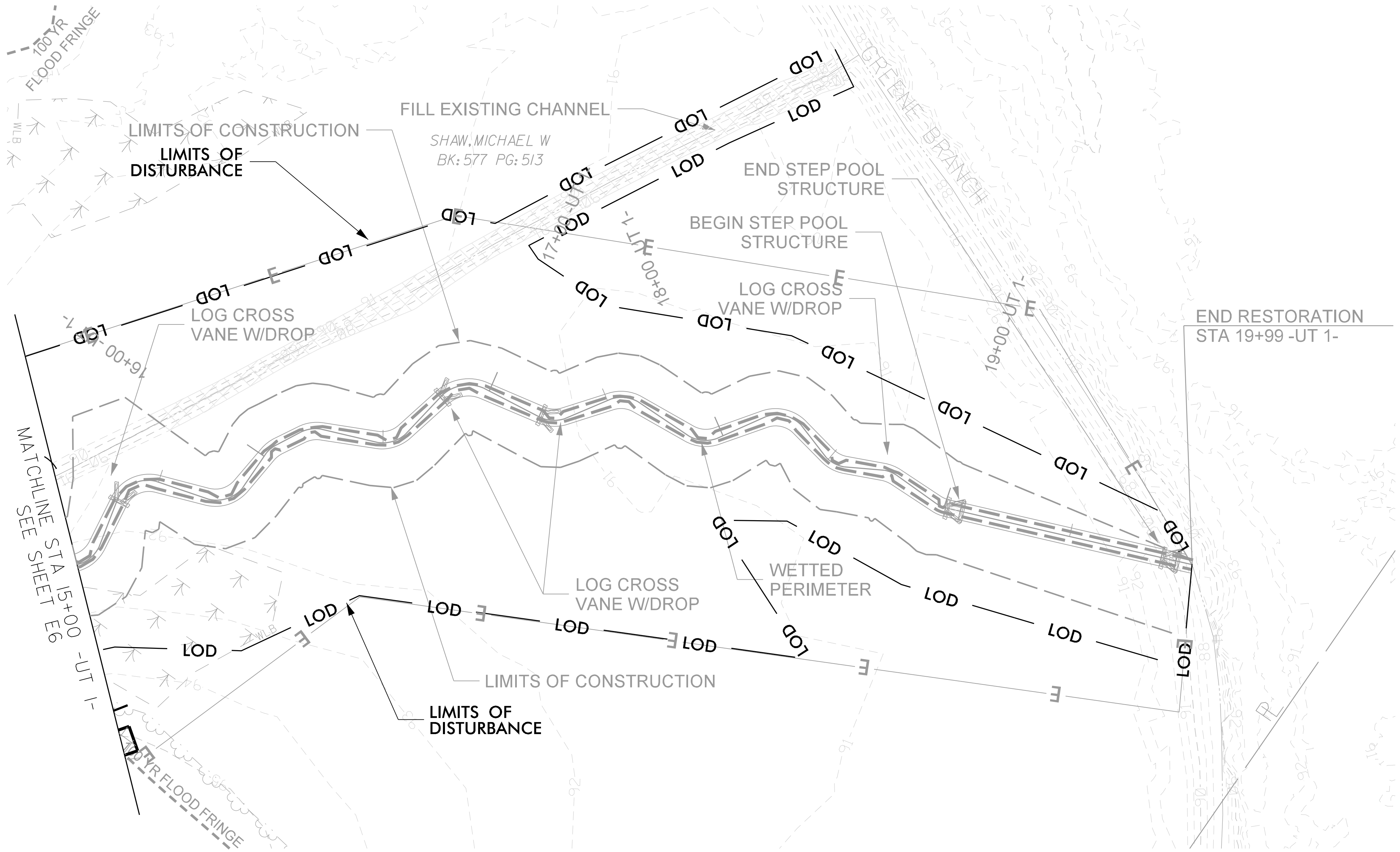
DATE:

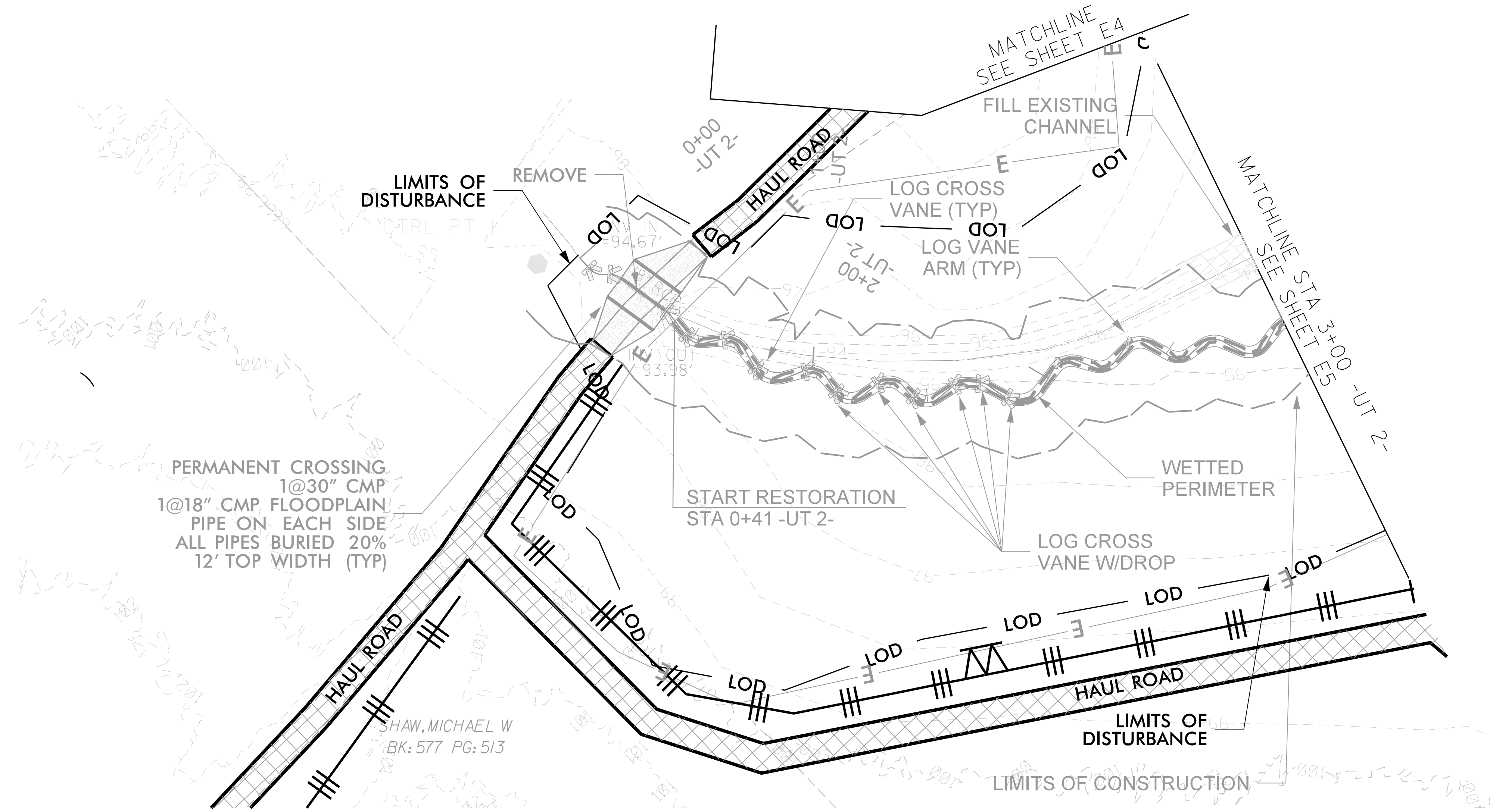
— LOD —	LIMITS OF DISTURBANCE
—‖‖—	TEMPORARY SILT FENCE
[hatched box]	HAUL ROAD
[symbol]	SPECIAL SEDIMENT CONTROL FENCE BREAK



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E07.dgn
jharvey

LOD	LIMITS OF DISTURBANCE
(symbol)	TEMPORARY SILT FENCE
(symbol)	HAUL ROAD
(symbol)	SPECIAL SEDIMENT CONTROL FENCE BREAK



NAD 83

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E8
PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE	
COUNTY: COLUMBUS	DATE: 2019

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NORTH CAROLINA PROFESSIONAL SEAL ENGINEER JOSEPH C. DALTON
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E08.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E9

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS | DATE: 2019

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL JOSEPH C. DALTON

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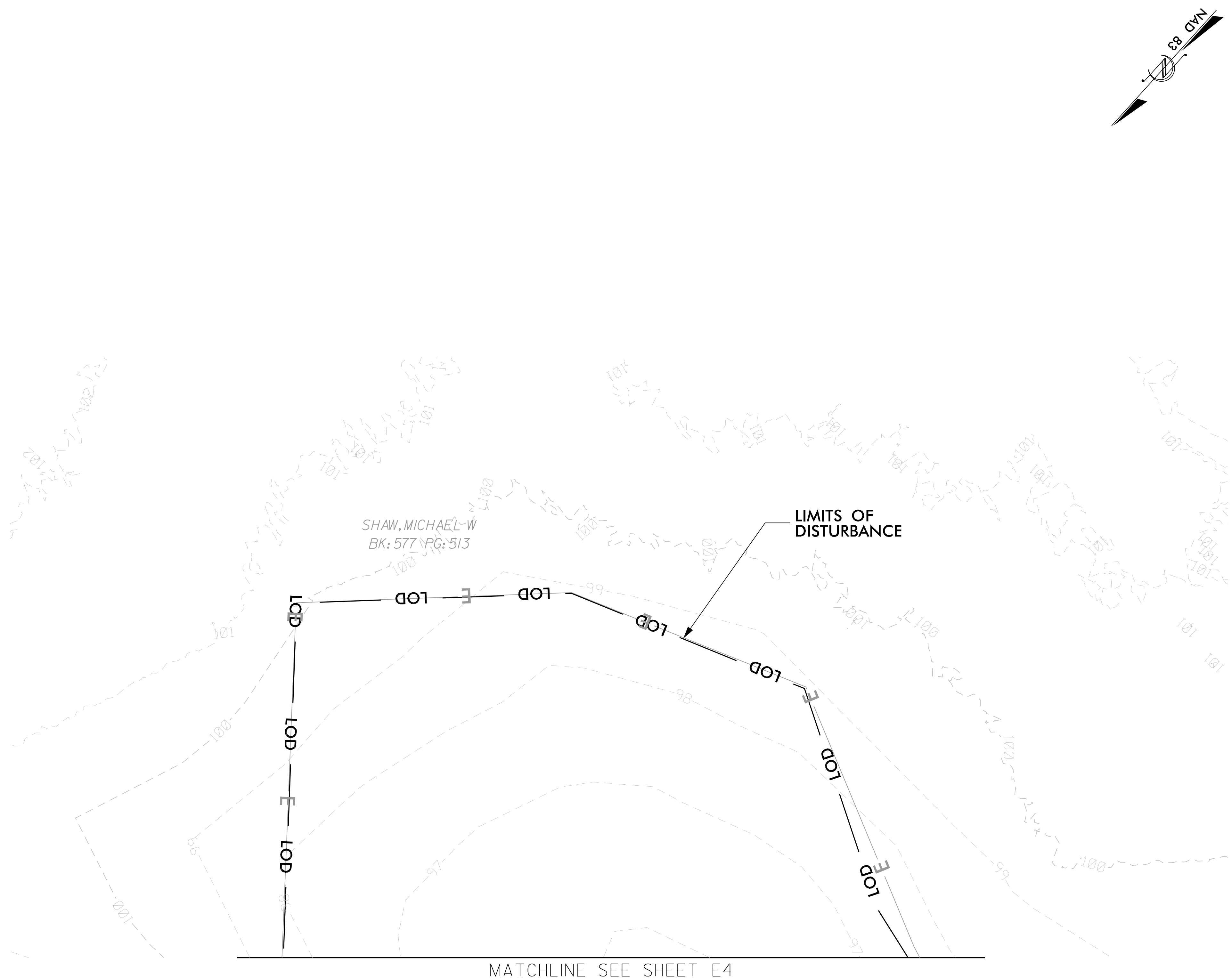
DATE:



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E09.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E10

PROJECT NAME: SHAWS RUN STREAM AND WETLAND RESTORATION SITE

COUNTY: COLUMBUS DATE: 2019

Axiom Environmental, Inc.

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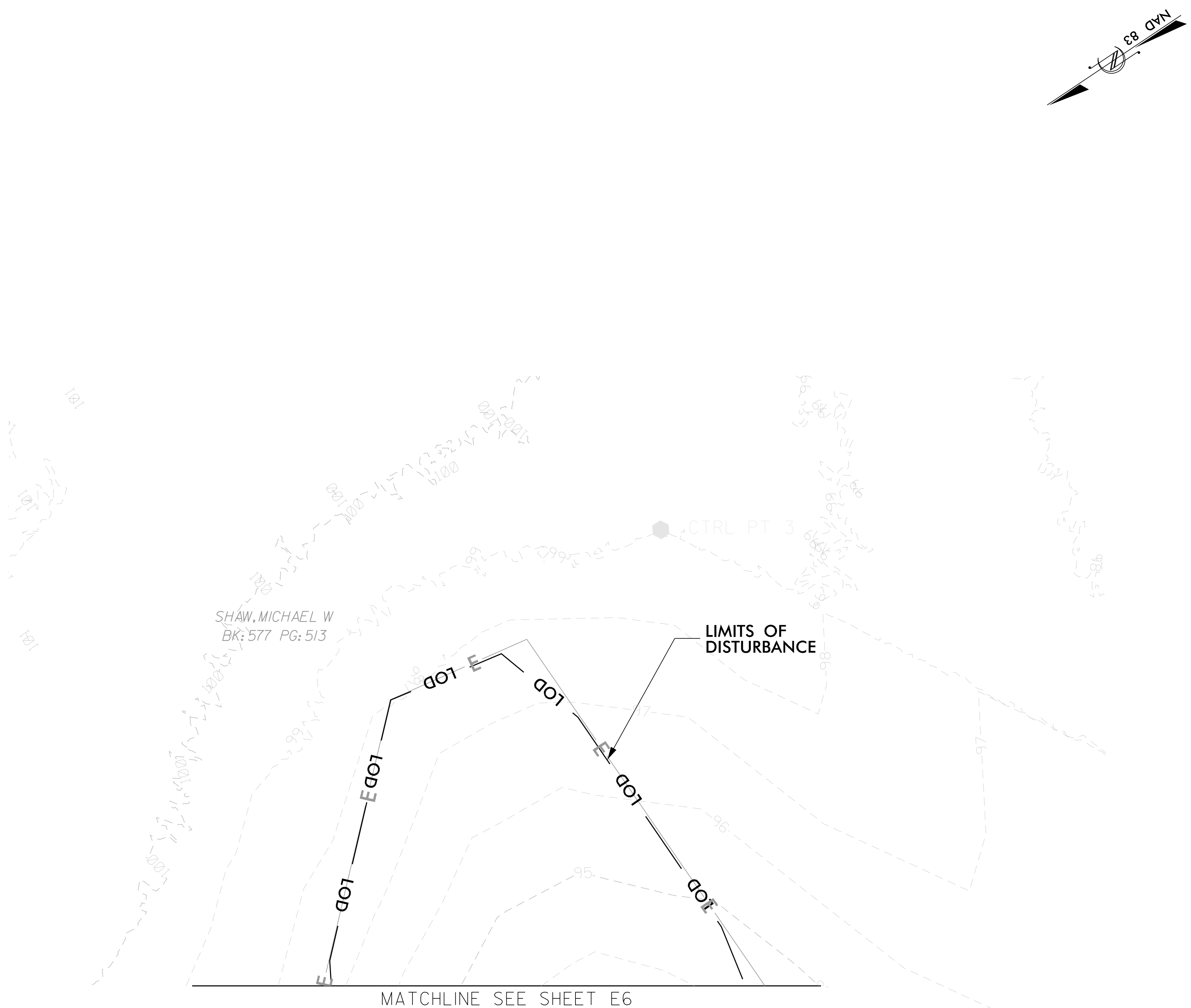
PRELIMINARY DESIGN NOT FOR CONSTRUCTION

DATE:



TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

11/26/2019
ShawsRun_Hyd_PSH_E10.dgn
jharvey