FINAL MITIGATION PLAN
HERON STREAM AND WETLAND MITIGATION SITE
Alamance County, North Carolina

DMS Project ID No. 100014
Full Delivery Contract No. 7192
USACE Action ID No. SAW-2017-01471
RFP No. 16-006990

Cape Fear River Basin
Cataloging Unit 03030002

Prepared for:

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

July 2018

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Prepared by:

Restoration Systems, LLC
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Raleigh, North Carolina 27604
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919-755-9490 (phone)
919-755-9492 (fax)

And

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

July 2018

"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*.

Heron Stream and Wetland Mitigation Site IRT Comment Responses 7/10/2018

Mac Haupt, NCDWR, May 18, 2018:

1. Please note that in the future, the soils series mapped as Local Alluvial Land will be treated as a Fluvaquent and therefore will require a minimum hydro period saturation of 12% in the approved growing season.
- All wetlands identified in the restoration plan are mapped as Worsham Sandy Loam, or inclusions of hydric soils in series mapped other than Local Alluvial Land. At this time, no wetlands are proposed in the Local Alluvial Land Soil Series.

2. DWR notes that the wetland growing season proposed is March 1st-October 22nd. This is acceptable, however, DWR would like to know the frequency of soil temperature measurement that will occur from February through April. Since an extend growing season is proposed, DWR requests that the soil temperature measurements are taken from February two weeks prior to the growing season start date and maintained until the end of April.
- Soil temperature is proposed to be taken on daily intervals, using a continuous monitoring soil probe. The probe will be installed in mid-February and will record through April. Text in Table 16 has been added stating the following: "Note: Soil temperature for growing season establishment will be measured daily utilizing a continuous monitoring soil probe. Soil temperature will be measured from mid-February through the end of April (at a minimum)".

3. DWR accepts the 10% wetland saturation performance criteria. Please note that if any of the wetland restoration areas contained the Local Alluvial Land series the performance criteria would be as stated in #1.
- All wetlands identified in the restoration plan are mapped as Worsham Sandy Loam, or inclusions of hydric soils in series mapped other than Local Alluvial Land. At this time, no wetlands are proposed in the Local Alluvial Land Soil Series.

4. DWR requests that a stream gauge be placed at sta 2+75 on UT6.
- A stream gauge will be placed accordingly and depicted on Figure 10C (Monitoring Plan).

5. DWR requests that a stream gauge be placed at sta 2+50 on UT2.
- UT 2 is an Enhancement Level II reach, which doesn't typically require stream flow gauges; however, a gauge will be placed accordingly and

depicted on Figure 10A (Monitoring Plan).

6. DWR requires that a vegetation plot be placed at the top of UT7 (in the relic pond area), the current proposed plot at the beginning of the Enhancement 1 reach can be moved to the pond area.

- An additional vegetation plot will be located in the relic pond bed and depicted on Figure 10C (Monitoring Plan).

7. The same requirement goes for the vegetation plot near the top of UT5, please locate the vegetation plot in the relic pond bed.

- The vegetation plot depicted on Figure 10B will be moved to the relic pond bed.

8. DWR has an issue with the current design sheet plans. The proposed thalweg shows no bedform changes, especially when numerous grade control structures are proposed, for example plan sheets 4, 5, 7, 8, 9, 11, and 12. Please redo the design sheets to graphically show the proposed bedform changes per structure and in the reach.

- Design sheets have been updated to show riffles and pools.

9. The designer is well aware what DWR thinks of the Terracell drop structures. While currently, DWR is letting these structures be utilized, there are two locations in the proposed 4 applications where DWR questions their need. As per the design sheet 13, it appears that the end of UT6 is being raised, and therefore removes the need for a drop structure. Also, at the confluence of UT4 and UT5, the slope is the same that is being utilized upstream to manage grade with cross vanes.

- Profiles have been updated to depict tie-in elevations at the Site outfalls. The designer believes the slopes warrant suitable protection. DWR concerns for the use of Terracell is understood.

10. DWR would like to emphasize that in the future, highly fragmented and disconnected sites may receive a credit reduction. On the other hand, larger contiguous sites may garner more credit. Of course, the prior statement is pending IRT review and approval, nevertheless, DWR will continue to emphasize these points.

- The comment is duly noted.

Andrea Hughes, USACE, June 14, 2018:

1. The plan provides extensive discussion of the reference areas, and functional uplift and project goals/objectives. However, the mitigation plan does not provide adequate description of the existing resources and the proposed treatments. The plan should include a brief paragraph for each resource describing the existing conditions (including a description of the existing buffer) and impairments. The mitigation plan should also include a paragraph for each resource describing the proposed treatments that will be implemented to address the impairments. The plan indicates that the site includes stream restoration, enhancement I and enhancement II and wetland restoration and enhancement. The general descriptions provided are adequate for a prospectus document but lack sufficient detail for a draft

mitigation plan.

- Please see Section 7.2 (Individual Reach Descriptions) for requested information concerning existing resources and proposed treatments.

2. Tables should include a column for each tributary proposed for restoration. Table 8 combines UT3, UT4, UT5, and UT6, Table B1 combines UT 4 and UT 5. Neither table includes information on UT 2.
- Tables 8 and B1 have been updated in the document to include all tributaries.
3. Table 15 indicates that gauges or trail camera will be utilized to document bankfull on UT3, UT5, and UT 7. Bankfull must be documented for all stream restoration reaches.
- Flow gauges will be added to each reach to with an intermittent flow designation, reaches requested by the IRT, and reaches greater than 1000 linear feet (as per 2016 IRT guidance). Gauge locations will be updated in Table 15 and Figures 10A to 10D.
4. Stream gauges to document minimum flow should be placed in the upper third of all intermittent reaches proposed for restoration.
- All intermittent streams will be monitored for minimum flow standards. Monitoring figures (Figures 10A to 10D), Table 15, and Table 16 will be updated accordingly. Text has been added to Table 16 as follows. "Continuous surface flow must be documented each year for at least 30 consecutive days. Surface water monitoring gauges will be installed in the upper third of all intermittent channels, unless otherwise requested by the IRT."
- Please note: for UT 2 (Enhancement Level II) and UT 6 NCDWR has requested specific locations for flow gauge installation that may differ from USACE standards. We have located flow gauges as requested by NCDWR in these tributaries.
5. Under performance standards, ET for C/E channels should be $\geq$ 2.2.
- Text will be changed to the following throughout the document. "Entrenchment ratio (ER) must be no less than 2.2 for E- and C-type channels at any measured riffle cross-section. Note: B-type channels may have an ER less than 1.4."
6. Under vegetation success, a minimum of 260 stems per acre must be present at Year 5.
- Vegetation success has been changed to 260 stems per acre in year 5.
7. Section 8.2.2 provides a contingency for wetland enhancement areas but does not provide discussion for wetland re-establishment areas.
- Text will be changed to hydrology enhancement, re-establishment, and rehabilitation.
8. The plan indicates six shallow wetland marsh treatment areas will be excavated in the floodplain but will not receive mitigation credits. If these areas are not proposed to generate credits, then please remove the credit release schedule for Coastal Marsh Wetlands (page 30). However, since the marsh treatment areas are located within the stream buffers, the mitigation plan should include a performance standard for the marsh wetlands tied to vegetation success.

- The marsh treatment areas are approximately 1/100th acre in size and are intended to naturalize into the floodplain. The areas are slight depressions (0.5 to 1.5 feet in depth) that are intended to catch the first pulse of storm drainage prior to vegetation establishment. They are intended to fill over time and naturalize into the adjacent landscape. These are not stormwater BMPs which require maintenance to continue functioning. At this time, due to the small size and expectation of naturalization, we do not propose extensive monitoring beyond standard vegetative monitoring protocols outlined in IRT guidance.

9. According to field notes, a utility line on UT6 was proposed for relocation. The plan does not provide information regarding relocation.

- A brief paragraph will be included in Section 7.0 (Design Approach and Mitigation Work Plan). Currently, moving the powerline is depicted on Figure 6C; therefore, figure updates should not be required.

- Text has been added to the document including the following: "An existing powerline services an agriculture complex including a livestock barn. The powerline parallels the UT 7 stream bank and crosses both UT 7 and UT 6 in its current location. Coordination with Randolph Electric Membership Corporation has been initiated to move the powerline upstream, and outside of the UT 6 and UT 7 easement. A copy of the Utility Work Agreement with the Randolph Electric Membership Corporation is included in Appendix J. Work to be conducted under the Utility Work Agreement will be initiated upon approval of this Detailed Restoration Plan."

- In addition, the Utility Work Agreement between Mr. Russell B Hadley and the Randolph Electric Membership Corporation will be included as an appendix item.

10. According to field notes, some EII areas along UT 8 should be 5:1 ratio.

- The approved Post-IRT Site Visit Notes (dated July 28, 2017) indicate that EII reaches of UT 8 may be credited at a 2.5:1 ratio as presented in the field. A subsequent email from Mr. Haupt states the reach was "not a lock" for 2.5:1; however, no guidance was provided for how to proceed with the reach. Given the benefit for the project we believe a 2.5:1 ratio for the EII reach of UT 8 is justified.

11. According to field notes, the provider indicated they would provide additional information regarding whether the spray field is included in the easement areas. The mitigation plan does not provide information.

- Text has been added to Section 7.1 (Stream Design) to include the following: "Agriculture fields adjacent to, and west of, UT 8 have been utilized by the City of Burlington for the application of municipal waste. Communication with the City of Burlington Residuals Management Coordinator has been ongoing throughout the design process to update maps (map NC-AM – 16 [Michael Hadley]) such that land application of municipal waste will cease within, and immediately adjacent to, UT 8. Communications of the successful modification to City of Burlington maps are included in appendix K.

12. According to field notes, UT 2 was approved as EII. The plan indicates restoration for UT 2B.

- The reach of UT 2 proposed as restoration (UT 2B) extends from the terminus of the existing channel to the proposed channel tie-in with UT 1. This reach of channel will require the excavation of channel on new location. The reach proposed as restoration extends slightly upstream within the UT 2 channel, which is necessary to maintain proper slope of the channel (the bed of UT 2 at the extreme lower reach is below the design channel bed of UT 1 at its confluence).

Thank you,

Worth Creech

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

August 13, 2018

Regulatory Division

Re: NCIRT Review and USACE Approval of the Heron Site Draft Mitigation Plan; SAW-2017-01471; DMS Project #100014

Mr. Tim Baumgartner
North Carolina Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Mr. Baumgartner:

The purpose of this letter is to provide the North Carolina Division of Mitigation Services (NCDMS) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day review for the Heron Site Draft Mitigation Plan, which closed on June 1, 2018, 2018. Please note the comment period was extended to allow the provider to respond to project concerns. These comments are attached for your review.

Based on our review of these comments and the provider's response to comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan, which is considered approved with this correspondence. However, the provider's proposed changes to the draft mitigation plan in response to issues identified in the memo must be addressed in the Final Mitigation Plan.

The Final Mitigation Plan is to be submitted with the Preconstruction Notification (PCN) Application for Nationwide permit approval of the project along with a copy of this letter. All changes made to the Final Mitigation Plan should be summarized in an errata sheet included at the beginning of the document. If it is determined that the project does not require a Department of the Army permit, you must still provide a copy of the Final Mitigation Plan, along with a copy of this letter, to the appropriate USACE field office at least 30 days in advance of beginning construction of the project. Please note that this approval does not preclude the inclusion of permit conditions in the permit authorization for the project, particularly if issues referenced above are not satisfactorily addressed. Additionally, this letter provides initial approval for the Mitigation Plan, but this does not guarantee that the project will generate the requested amount of mitigation credit. As you are aware, unforeseen issues may arise during construction or monitoring of the project that may require maintenance or reconstruction that may lead to reduced credit.

Thank you for your prompt attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please contact Andrea Hughes at (919) 846-2564.

Sincerely,

for Henry M. Wicker
Deputy Chief, Wilmington District

Enclosures

Electronic Copies Furnished:
NCIRT Distribution List
Jeff Schaffer, NCDMS

TABLE OF CONTENTS

TABLES

APPENDICES

1.0 PROJECT INTRODUCTION

The Heron Stream and Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 17.5 acres of agricultural land along warm water, unnamed tributaries to Pine Hill Branch and unnamed tributaries to South Fork Cane Creek. The Site is located approximately 4 miles southeast of Snow Camp and 4.5 miles north of Silk Hope in southern Alamance County near the Chatham County line (Figures 1 and 2, Appendix A).

1.1 Directions to Site

Directions to the Site from Raleigh, North Carolina.

- Take US-64 West out of Raleigh and travel 25 miles,
- Take exit 381 and turn right onto NC-87 N,
- After 5 miles, take a left onto Castle Rock Farm Road,
- After 5.8 miles, turn left onto Greenhill Road,
- After 1.2 miles, turn left onto Lindley Mill Road,
- After 0.5 mile, turn right onto Bethel South Fork Road,
- Site can be accessed from Bethel South Fork Road.
    - Site Latitude, Longitude
      35.853955ºN, -79.363458ºW (WGS84)

1.2 USGS Hydrologic Unit Code and NCDWR River Basin Designation

The Site is located within the Cape Fear River Basin in 14-digit United States Geological Survey (USGS) Cataloging Unit and **Targeted Local Watershed 03030002050050** of the South Atlantic/Gulf Region (North Carolina Division of Water Resources [NCDWR], formerly the North Carolina Division of Water Quality, subbasin number 03-06-04) [Figures 1 and 2, Appendix A]). Topographic features of the Site drain to Pine Hill Branch and the South Fork Cane Creek which has been assigned Stream Index Numbers 16-28-5-1 and 16-28-5, respectively, and a Best Usage Classification of **WS-V, NSW** (NCDWR 2016a). Site tributaries and their immediate receiving waters are not listed on the draft 2016 or final 2014 NC 303(d) lists (NCDWR 2014, NCDWR 2016b).

1.3 Physiography and Land Use

The Site is located in the Carolina Slate Belt Ecoregion of the Piedmont Physiographic Province within Alamance County, North Carolina. Regional physiography is characterized by dissected irregular plains, some hills, linear ridges, isolated monadnocks, and low to moderate gradient streams with mostly boulder and cobble substrates (Griffith et al. 2002). Onsite elevations range from a high of 550 feet National Geodetic Vertical Datum (NGVD) to a low of approximately 490 feet NGVD (USGS Silk Hope, North Carolina 7.5-minute topographic quadrangle) (Figures 1 and 3, Appendix A).

The primary hydrologic features of the Site consist of unnamed tributaries (UTs) to Pine Hill Branch and UTs to South Fork Cane Creek. Site UT drainage areas range in size from 14.1-96.4 acres (0.02-0.15 square mile) (Figure 3, Appendix A). The Site drainage area is primarily

composed of pasture, forest, agriculture land, and sparse residential property. Impervious surfaces account for less than two-percent of the upstream land surface.

Site land use consists of disturbed forest and agricultural land used for livestock grazing and hay production. Livestock have unrestricted access to Site streams and stream banks are eroded vertically and laterally, and receive extensive sediment and nutrient inputs. Riparian zones are primarily composed of herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities.

A query of the North Carolina Natural Heritage Program database indicates there are no records for rare species, important natural communities, natural areas, or conservation/managed areas within the proposed project boundary, or within a one-mile radius of the project boundary. However, a North Carolina Division of Mitigation Services (NCDMS) conservation easement boundary occurs approximately 0.6 mile east of the Site boundaries.

1.4 Project Components and Structure

The Site encompasses17.5 acres of agricultural land along warm water, UTs to Pine Hill Branch and South Fork Cane Creek. In its current state, the Site includes 5285 linear feet of degraded stream channel (based on the approved PJD), 0.61 acre of degraded wetland, and 0.35 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 4183 linear feet of Priority I stream restoration, 1234 linear feet of stream enhancement (Level I), 1131 linear feet of stream enhancement (Level II), 0.35 acre of riparian wetland restoration, and 0.61 acre of riparian wetland enhancement (Table 1) (Figures 6A-6D, Appendix A).

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

Table 1. Project Components and Mitigation Credits
Heron 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 1A	00+00 to 04+70	470	470	Enhancement (Level I)	470	1.5:1	313	
UT 1B	04+70 to 13+06	753	836	Restoration	836-64= 772	1:1	772	64 lf of UT1 is located outside of the conservation easement and therefore is not generating credit
UT 2A	00+00 to 03+43	343	343	Enhancement (Level II)	343	2.5:1	137	
UT 2B	03+43 to 03+89	19	46	Restoration	46	1:1	46	
UT 3	00+00 to 02+79	269	279	Restoration	279	1:1	279	
UT 4	00+00 to 04+50	485	450	Restoration	450	1:1	450	
UT 5A	00+00 to 09+52	422	952	Restoration	952-53= 899	1:1	899	53 lf of UT5 is located outside of the conservation easement and therefore is not generating credit
UT 5B	09+52 to 14+90	538	538	Enhancement (Level II)	538	2.5:1	215	
UT 6	00+00 to 07+81	683	781	Restoration	781	1:1	781	
UT 7A	00+00 to 02+32	0	232	Restoration	232-42= 190	1:1	190	42 lf of the UT7 restoration reach is located outside of the conservation easement and therefore is not generating credit
UT 7B	02+32 to 09+96	764	764	Enhancement (Level I)	764-52= 712	1.5:1	475	52 lf of the UT7 enhancement reach is located outside of the conservation easement and therefore is not generating credit
UT8A	00+00 to 06+07	549	607	Restoration	607	1:1	607	
UT 8B	06+07 to 08+57	250	250	Enhancement (Level II)	250	2.5:1	100	
Wetland R	Riparian Riverine	--	0.35	Restoration	0.35	1:1	0.35	Wetland Restoration
Wetlands E	Riparian Riverine	0.61	0.61	Enhancement	0.61	2:1	0.31	Wetland Enhancement

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

Length & Area Summations by Mitigation Category		
Restoration Level	**Stream (linear footage)**	**Riparian Wetland (acreage)**
Restoration	4024*	0.35
Enhancement (Level I)	1182**	--
Enhancement (Level II)	1131	--
Enhancement	--	0.61

*An additional 159 linear feet of stream restoration is proposed to occur outside of the conservation easement and is therefore not included in this total or in mitigation credit calculations.

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

Overall Assets Summary	
Asset Category	**Overall Credits**
Stream	**5264**
Riparian Riverine Wetland	**0.66**

Table 2. Project Activity and Reporting History
Heron Restoration Site

Activity or Deliverable	**Data Collection Complete**	**Completion or Delivery**
Technical Proposal (RFP No. 16-006990)	January 11, 2017	January 11, 2017
Institution Date (NCDMS Contract No. 100014)	--	May 22, 2017
Mitigation Plan	--	July 2018
Construction Plans	--	--

Table 3. Project Contacts Table
Heron Restoration Site

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

Table 4. Project Attribute Table
Heron Restoration Site

Project Information	
Project Name	Heron Restoration Site
Project County	Alamance County, North Carolina
Project Area (acres)	17.5
Project Coordinates (latitude & latitude)	35.853955ºN, -79.363458ºW
Planted Area (acres)	12.05
Project Watershed Summary Information	
Physiographic Province	Piedmont
Project River Basin	Cape Fear
USGS HUC for Project (14-digit)	03030002050050
NCDWR Sub-basin for Project	03-06-04
Project Drainage Area (acres)	14 to 96
Percentage of Project Drainage Area that is Impervious	<2%
CGIA Land Use Classification	Managed Herbaceous Cover & Mixed Upland Hardwoods

Section 4. Project Attribute Table
Heron Restoration Site (continued)

Reach Summary Information								
Parameters	**UT1**	**UT2**	**UT 3**	**UT4**	**UT 5**	**UT6**	**UT 7**	**UT 8**
Length of reach (linear feet)	1155	363	269	485	907	683	202	1221
Valley Classification & Confinement	Alluvial, confined							
Drainage Area (acres)	96.4	7.1	11.7	17.2	38.1	14.1	20.9	30.8
NCDWR Stream ID Score	30.5	22.5	28.5	33.5	27.5	23.5	24.5	27.5
Perennial, Intermittent, Ephemeral	Perennial	Intermittent	Perennial/ Intermittent	Perennial	Perennial/ Intermittent	Perennial/ Intermittent	Intermittent	Perennial
NCDWR Water Quality Classification	WS-V, NSW							
Existing Morphological Description (Rosgen 1996)	Cg5	Gf5	Cg5	Eg5	Eg5	Cg5	Cg5	Eg5
Proposed Stream Classification (Rosgen 1996)	C/E 4	Gf 5	C/E 4	C/E 4	C/E 4	C/E 4	Eb4	C/E 4
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	I/III/IV	III/IV	II/III	II/III	III/IV	III/IV	II/III
Underlying Mapped Soils	Alamance silt loam, Georgeville silt loam, Goldston slaty silt loam, Herndon silt loam, Orange silt loam, Worsham sandy loam, Local Alluvial Land,							
Drainage Class	Well-drained, well-drained, well-drained, well-drained, well drained, poorly-drained, poorly-drained							
Hydric Soil Status	Nonhydric, nonhydric, nonhydric, nonhydric, nonhydric, hydric, hydric, respectively							
Valley Slope	0.0074	0.0270	0.0222	0.0244	0.0358	0.0300	0.0255	0.0218
FEMA Classification	NA							
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest							
Watershed Land Use/Land Cover (Site)	43% forest,55% agricultural land, <2% low density residential/impervious surface							
Watershed Land Use/Land Cover (Cedarock Reference Channel)	65% forest, 30% agricultural land, <5% low density residential/impervious surface							
Percent Composition of Exotic Invasive Vegetation	<5%							

Table 4. Project Attribute Table
Heron Restoration Site (continued)

Wetland Summary Information			
Parameters	**Wetlands**		
Wetland acreage	0.35 acre drained & 0.61 acre degraded		
Wetland Type	Riparian riverine		
Mapped Soil Series	Worsham and Local Alluvial Land		
Drainage Class	Poorly drained		
Hydric Soil Status	Hydric		
Source of Hydrology	Groundwater, stream overbank		
Hydrologic Impairment	Incised streams, compacted soils, livestock		
Native Vegetation Community	Piedmont/Low Mountain Alluvial Forest		
% Composition of Exotic Invasive Vegetation	<5%		
Restoration Method	Hydrologic, vegetative, livestock		
Enhancement Method	Vegetative, livestock		
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States-Section 401	Yes	Yes	JD Package (App D)
Waters of the United States-Section 404	Yes	Yes	JD Package (App D)
Endangered Species Act	No	--	CE Document (App E)
Historic Preservation Act	No	--	CE Document (App E)
Coastal Zone Management Act	No	--	NA
FEMA Floodplain Compliance	No	--	CE Document (App E)
Essential Fisheries Habitat	No	--	NA

2.0 WATERSHED APPROACH AND SITE SELECTION

The Cape Fear River basin is one of four rivers in North Carolina completely contained within the state's boundaries. Comprised of five major drainages—Haw River, Deep River, Northeast Cape Fear River, Black River, and the Cape Fear River—the basin drains portions of 26 counties and 115 municipalities with a total of 6386 stream miles. The most populated portions of the basin are located in the Triad, the Triangle, Fayetteville, and Wilmington (NCDWQ 2005).

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 agricultural land used for livestock grazing and hay production. A summary of existing Site characteristics in favor of proposed stream and wetland activities include the following.

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

In addition to the opportunity for ecological improvements at the Site, the use of the particular mitigation activities and methods proposed in the Design Approach & Mitigation Work Plan (Section 7.0) 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 10.0]).

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

Between the 2000 and 2010 censuses, the Cape Fear 02 population increased approximately 17 percent. The general trend of population growth appears to be continuing according to recent population estimates, which indicate Guilford, Orange, Chatham, and Durham counties are all growing at faster annual rates than North Carolina's 1.02 percent (USCB 2013). These data suggest land development activities will increase in frequency, as will aquatic ecosystem impacts related to such development. Therefore, there is an immediate and prolonged need for compensatory stream mitigation in the watershed. Of further benefit, aquatic ecosystem restoration projects are capable of reducing nutrient loading in sensitive downstream receiving waters such as Jordan Lake.

According to the *Cape Fear River Basinwide Water Quality Plan* (NCDWQ 2005), all land uses and discharges of wastewater and stormwater in the Cape Fear 02 subbasin 03-06-04 potentially contribute nutrients to B. Everett Jordan Lake. B. Everett Jordan Lake provides low-flow augmentation, flood control, recreation, fish and wildlife habitat, and water supply. The lake is impaired for aquatic life due to excessive levels of chlorophyll *a* in violation of current standards in all segments of the reservoir. In addition, the Site has a supplemental water quality classification of Nutrient Sensitive Waters, which designates areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment. The proposed mitigation activities will reduce sediment and nutrient levels, and improve water quality within the Site and downstream watersheds.

Table 5. Watershed Stressors and Usage Ratings

Site	Subbasin	Index #	Receiving Water	NCDWR Rating	303(d) status*
Pine Hill Branch	03-06-04	16-28-5-1	Cane Creek	WS-V, NSW	NL
South Fork	03-06-04	16-28-5	Cane Creek	WS-V, NSW	NL

*Draft 2016 and Final 2014 303(d) status (NCDWR 2014, NCDWR 2016b); NL = Not Listed

Project goals are based on the *Cape Fear River Basin Restoration Priorities* (RBRP) report (NCEEP 2009) and on-site data collection of channel morphology and function observed during field investigations. The Site is located within **Targeted Local Watershed (TLW) 03030002050050** (Figure 2, Appendix A). The RBRP report documents benthic ratings vary between "Fair" and "Good-Fair" possibly due to cattle, dairy, and poultry operations. The project is not located in a Regional or Local Watershed Planning Area; however, RBRP goals are addressed by project activities as follows with Site specific information following the RBRP goals in parenthesis.

1. Reduce and control sediment inputs (sediment model – reduction of 67.3 tons/year after mitigation is complete);
2. Reduce and manage nutrient inputs (nutrient model - livestock removal from streams, elimination of fertilizer application, and marsh treatment areas will result in a direct reduction of 893.2 pounds of nitrogen, 47.0 pounds of phosphorus per year, and $9.4x10^{11}$ colonies of fecal coliform);
3. Protect and augment designated natural heritage areas.

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 REFERENCE STREAMS

Two reference reaches were identified for the Site. The first reference stream (Cedarock) is located approximately 10 miles northeast of the Site in Cedarock Park on an unnamed tributary to Rock Creek (Figure 5A, Appendix A). The second reference stream (Causey Farm) is located less than 11 miles northeast of the Site, immediately north of Causey Airport on unnamed tributaries to Stinking Quarter Creek. The Causey Farm reference was measured in 2004 as a reference reach for the Causey Farm stream mitigation project, which was a successful project through five years of monitoring with no issues. The streams were measured and classified by stream type (Rosgen 1996). Stream data is available for the Causey Farm reference; however, no figures were available for inclusion with this document.

3.1 Channel Classification

The reference reaches are both characterized as E-type streams; Cedarock is a moderately sinuous (1.2) channel dominated by gravel substrate and Causey Farm had slightly higher sinuousity channel, due to a lower valley slope, with a sand-dominated substrate.

3.2 Discharge

Field indicators of bankfull approximate an average discharge of 31.3 and 59.8 cfs, respectively for the Cedar Fork and Causey Farm reference reaches, which is 108 and 94 percent of that predicted by the regional curves.

3.3 Channel Morphology

Dimension: Data collected at Cedarock and Causey Farm indicate bankfull cross-sectional areas of 8.0 and 14.7 square feet, respectively. Cedarock was slightly larger than predicted by regional curves (7.5 square feet) and Causey Farm was slightly smaller than predicted by regional curves (15.7 square feet). Cedarock and Causey exhibit a bankfull width of 8.1 and 11.0, a bankfull depth of 0.8 and 1.4 feet, and width-to-depth ratios of 10.1 and 9.0, respectively (see Table B1, Morphological Stream Characteristics). Figure 5C (Appendix A) provides plan view and cross-sectional data for the Cedarock reference reach. The reference reaches exhibit a bank-height ratio of 1.0 and 1.4, respectively. The Causey Farm reference reach was slightly incised; however, defined bankfull indicators were present, which assisted with determining the appropriate cross-sectional area.

Pattern and Profile: In-field measurements of the reference reaches have yielded an average sinuosity of 1.2 at Cedarock and 1.45 at Causey Farm (thalweg distance/straight-line distance). Onsite valley slopes of Site restoration reaches range from 0.0185-0.0241. Valley slopes exhibited by reference channels range from slightly higher (0.0310 at Cedarock) than the Site to slightly lower (0.0077 at Causey Farm), providing a good range of slopes to compare existing and proposed Site conditions. Although slightly incised, the Causey Farm reference reach had a suitable pattern with no shoot cutoffs, eroding outer bends, or excessively tight radius of curvatures, in addition to appropriate pool-to-pool spacing and meander wavelengths.

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

4.0 BASELINE AND EXISTING CONDITIONS

4.1 Soils and Land Form

Soils that occur within the Site, according to the *Web Soil Survey* (USDA 2016) are described in Table 6.

Table 6. Web Soil Survey Soils Mapped within the Site

Soil Series	Hydric Status	Description
Alamance silt loam (AaB)	Nonhydric	This series consist of moderately well-drained soils found on interfluves. These soils derived from residuum weathered from metavolcanics and/or argillite. Depth to restrictive features is 20-40 inches to paralithic bedrock and 40-80 inches to lithic bedrock. Depth to the water table is about 18-36 inches. Slopes are typically 2-6 percent.
Congaree fine sandy loam (Cg)	Nonhydric	This series consist of frequently flooded, moderately well-drained soils found on floodplains. These soils are loamy alluvium derived from igneous and metamorphic rock. Depth to restrictive features is more than 80 inches. Depth to the water table is about 30-48 inches. Slopes are typically 0-2 percent.
Efland silt loam (EaB2)	Nonhydric	This series consist of eroded, well-drained soils found on interfluves. These soils derived from residuum weathered from metavolcanics and/or argillite. Depth to restrictive features is 20-40 inches to paralithic bedrock and 40-80 inches to lithic bedrock. Depth to the water table is more than 80 inches. Slopes are typically 2-6 percent.
Georgeville silt loam (GaC, GaC2, GaE)	Nonhydric	This series consists of eroded, well-drained soils found on hillslopes on ridges. These soils derived from residuum weathered from metavolcanics and/or argillite. Depth to restrictive features depth to the water table is more than 80 inches. Slopes are typically 6-25 percent.
Goldston channery silt loam (GcD, GcE)	Nonhydric	This series consists of well-drained soils found on hillslopes on ridges. These soils derived from residuum weathered from metavolcanics and/or argillite. Depth to restrictive features is 10-20 inches to paralithic bedrock and 20-40 inches to lithic bedrock. Depth to the water table is more than 80 inches. Slopes are typically 10-25 percent.
Herndon silt loam (HdC, HdC2)	Nonhydric	This series consists of eroded, well-drained soils that soils formed from residuum weathered from metavolcanics and/or argillite. They are on hillslopes on ridges. Depth to restrictive features and the water table is more than 80 inches. Slopes are 6-10 percent.
Local alluvial land, poorly drained (Lc)	Hydric	This series consists of poorly drained soils found on floodplains and formed of loamy alluvium derived from igneous and metamorphic rock. Depth to restrictive features is more than 80 inches and the water table is about 0-12 inches. Slopes range from 0-2 percent.
Orange silt loam (ObC, ObB, ObB2)	Nonhydric	This series consists of moderately well-drained soils found on hillslopes on ridges. These soils derived from residuum weathered from metavolcanics and/or argillite. Depth to restrictive features is 20-40 inches to paralithic bedrock and 40-80 inches to lithic bedrock. Depth to the water table is about 12-36 inches. Slopes are 2-10 percent.
Worsham sandy loam (Wd)	Hydric	This series consists of poorly drained soils found in depressions and formed of alluvium and/or colluvium over saprolite derived from granite and gneiss. Depth to restrictive features is more than 80 inches and the water table is about 0-12 inches. Slopes range from 2-6 percent.

Hydric soils and jurisdictional wetlands were delineated and mapped by a licensed soil scientist in November 2016. Based on soil delineations approximately 0.61 acre of disturbed jurisdictional wetland occur within the Site boundaries. Wetlands have been disturbed by livestock grazing and

clearing of vegetation within pastureland. In addition, 0.35 acre of drained hydric soil occurs within the Site boundaries. These hydric soils have been effectively drained by stream channel incision and/or relocation of stream channels to the margins of the floodplain.

4.2 Sediment Model

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

Streambank characteristics involve measurements of bank height, angles, materials, presence of layers, rooting depth, rooting density, and percent of the bank protected by rocks, logs, roots, or vegetation. Site reaches have been measured for each BEHI and NBS characteristic and predicted lateral erosion rate, height, and length to calculate a cubic volume of sediment contributed by the reach each year. Data forms for the analysis are available upon request and the data output is presented in Appendix B. Results of the model are presented in the following table.

Table 7. BEHI and NBS Modeling Summary

Stream Reach	Proposed Mitigation Treatment	Predicted Sediment Contribution (tons/year)
UT 1	Restoration/Enhancement (Level I)	23.2
UT 2	Restoration/Enhancement (Level II)	1.7
UT 3	Restoration	13.6
UT 4	Restoration	3.8
UT 5	Restoration/Enhancement (Level II)	0.9
UT 6	Restoration	13.2
UT 7	Restoration/Enhancement (Level I)	1.5
UT 8	Restoration/Enhancement (Level II)	9.5
Total Sediment Contribution (tons/year)		**67.3**

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

4.3 Nutrient Model

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

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

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

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

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

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

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

Results of the NCDMS analysis indicate approximately 893.2 lbs/yr of nitrogen, 47.0 lbs/yr of phosphorus, and 9.4×10^{11} col of fecal coliform/day may be reduced due to exclusion of livestock from the easement area.

4.4 Project Site Streams

Streams targeted for restoration include unnamed tributaries to Pine Hill Branch and South Fork Cane Creek, which have been cleared, dredged of cobble substrate, straightened, trampled by livestock, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from livestock. Approximately 62 percent of the existing stream channel has been degraded contributing to sediment export from the Site resulting from mechanical processes from livestock hoof shear. In addition, streamside wetlands have been cleared and drained by channel downcutting and land uses. Current Site conditions have resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

4.4.1 Existing Conditions Survey

Site stream dimension, pattern, and profile were measured to characterize existing channel conditions. Locations of existing stream reaches are depicted in Figure 4 (Appendix A) and cross-section locations are depicted in Figure B1 (Appendix B). Stream geometry measurements under existing conditions are summarized in Table 8 (Essential Morphology Paramaters) and presented in detail in Table B1 (Appendix B).

Table 8. Essential Morphology Parameters

Parameter	Existing								Reference	
	UT1	UT2	UT3	UT4	UT5	UT6	UT7	UT8	Cedarock Park	Causey Farm
Valley Width (ft)	50-100	20-50	50-100	50-100	50-100	50-100	20-50	50-100	50-100	150-200
Contributing Drainage Area (sq. mi.)	0.13	0.01	0.02	0.03	0.02	0.02	0.03	0.05	0.21	0.63
Channel/Reach Classification	Cg5	Gf 4/5	Cg5	Eg5	Eg5	Cg5	Cg5	Eg5	Eb4	E5
Design Discharge Width (ft)	4.7-11.1	3.9	3.2-5.9	3.1-4.9	2.5-6.0	4.6-9.6	4.1-6.7	4.2-6.1	8.1	11.0
Design Discharge Depth (ft)	0.5-1.1	0.3–0.7	0.2-0.4	0.4-0.6	0.3-0.7	0.2-0.3	0.3-0.5	0.4-0.6	0.8	1.4
Design Discharge Area (ft^2)	5.1	1.0	1.4	2.0	1.6	1.5	2.0	2.5	8.0	14.7
Design Discharge Velocity (ft/s)	3.8	1.9	3.6	3.7	3.4	3.5	3.5	3.6	3.6	4.1
Design Discharge Discharge (cfs)	19.3	19.3	5.0	7.3	5.5	5.2	7.0	9.1	28.8	60.6
Water Surface Slope	0.0057	0.017	0.0207	0.0283	0.0372	0.0280	0.0248	0.0210	0.0258	0.0053
Sinuosity	1.30	1.14	1.07	1.04	1.04	1.07	1.03	1.04	1.20	1.46
Width/Depth Ratio	4.3-22.0	10-24	8-29.5	5.2-12.3	3.6-20.0	15.3-48.0	8.2-22.3	7.0-15.3	10.1	9.0
Bank Height Ratio	1.4-2.5	3-3.7	1.7-2.4	1.3-4.0	1.3-2.7	3.7-7.5	1.8-4.1	1.4-3.7	1.0	1.4
Entrenchment Ratio	1.6-4.3	1.4-2.0	1.4-3.8	1.3-6.1	1.4-7.3	1.1-4.8	1.7-5.2	1.1-4.9	2.1	12
Substrate	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Gravel	Sand

Table 8 (continued). Essential Morphology Parameters

Parameter	Proposed							
	UT1	**UT2**	**UT3**	**UT4**	**UT5**	**UT6**	**UT7**	**UT8**
Valley Width (ft)	50-100	20-50	50-100	50-100	50-100	50-100	20-50	50-100
Contributing Drainage Area (sq. mi.)	0.13	0.01	0.02	0.03	0.02	0.02	0.03	0.05
Channel/Reach Classification	E/C4	Gf 4/5	E/C4	E/C4	E/C4	E/C4	Eb4	E/C4
Design Discharge Width (ft)	8.4	3.9	4.4	5.0	5.0	4.6	5.3	5.9
Design Discharge Depth (ft)	0.6	0.3–0.7	0.3	0.4	0.4	0.3	0.4	0.4
Design Discharge Area (ft^2)	5.1	1.0	1.4	2.0	1.6	1.5	2.0	2.5
Design Discharge Velocity (ft/s)	3.8	1.9	3.6	3.7	3.4	3.5	3.5	3.6
Design Discharge Discharge (cfs)	19.3	19.3	5.0	7.3	5.5	5.2	7.0	9.1
Water Surface Slope	0.0057	0.017	0.0193	0.0311	0.0311	0.0261	0.0222	0.0190
Sinuosity	1.30	1.14	1.15	1.15	1.15	1.15	1.15	1.15
Width/Depth Ratio	14.0	10-24	14.0	14.0	14.0	14.0	14.0	14.0
Bank Height Ratio	1.0	3-3.7	1.0	1.0	1.0	1.0	1.0	1.0
Entrenchment Ratio	8.9	1.4-2.0	9.0	10.0	10.0	10.9	9.4	8.5
Substrate	Gravel	Sand	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel

4.4.2 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 Cg- and Eg-type streams with variable sinuosity. Existing Site reaches are characterized by sand substrate as the result of channel impacts including livestock trampling, channel straightening, and riparian vegetation removal.

4.4.3 Channel Evolution

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

4.4.4 Valley Classification

The Site is characterized by small stream, headwater, confined, alluvial valleys with approximately 20- to 100-foot floodplain valley widths. Valley slopes of restoration reaches are typical for the Piedmont region and range from 0.0074-0.0358. Typical streams in this region include C- and E-type streams with slightly entrenched, meandering channels with a riffle-pool sequence. However, steeper slopes may trend towards B-type, bedrock confined, step-pool streams.

4.4.5 Discharge

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 40-50 inches per year (USDA 1960). Drainage basin sizes range from 0.02- to 0.15-square mile.

The Site's discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on regional curves (Harman et al. 1999), the bankfull discharge for the Site (0.02- to 0.15-square mile watershed) ranges from 5.0 to 21.0 cubic feet per second. Based on indicators of bankfull at reference reaches and on-Site, the designed channel will equal approximately 93 percent of the channel size indicated by Piedmont regional curves; this is discussed in Section 4.6 (Bankfull Verification).

4.5 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.

Traditional approaches for characterizing stability can be placed in one of two categories: 1) maximum permissible velocity and 2) tractive force, or stream power and shear stress. The former is advantageous in that velocity can be measured directly. Shear stress and stream power cannot be measured directly and must be computed from various flow parameters. However, stream

power and shear stress are generally better measures of fluid force on the channel boundary than velocity.

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 Table 9. 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 0.82-2.83 and shear stress values of approximately 0.19-0.60 (Table 9).

Table 9. Stream Power (Ω) and Shear Stress (τ) Values

	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									
UT1	19.3	0.0057	6.86	**0.81**	1.72	**0.61**	1.13	0.69	0.92
UT3	5.0	0.0207	6.46	**1.44**	1.10	**1.42**	0.89	1.27	2.13
UT4	5.5	0.0344	11.81	**3.19**	1.30	**2.79**	0.90	2.51	4.18
UT5	7.3	0.0344	15.67	**4.24**	1.30	**2.79**	1.20	3.33	4.18
UT6	5.2	0.0280	9.09	**1.42**	8.11	**14.18**	0.09	1.30	21.27
UT7	7.0	0.0248	10.83	**2.04**	1.52	**2.36**	0.75	1.78	3.54
UT8	9.1	0.0210	11.92	**2.34**	1.41	**1.85**	1.06	1.95	2.77
Reference Conditions									
Cedarock	28.8	0.0258	46.37	**5.72**	0.82	**1.33**	3.60	4.78	6.67
Causey Farm	60.6	0.0053	20.04	**1.82**	1.07	**0.35**	4.12	1.45	2.10
Proposed Conditions									
UT1	19.3	0.0057	6.86	**0.82**	0.53	**0.19**	3.78	0.72	0.28
UT3	5.0	0.0193	6.02	**1.37**	0.28	**0.34**	3.57	1.20	0.51
UT4	5.5	0.0311	10.67	**2.13**	0.31	**0.60**	3.06	1.84	0.90
UT5	7.3	0.0311	14.17	**2.83**	0.31	**0.60**	4.06	2.44	0.90
UT6	5.2	0.0261	8.47	**1.84**	0.29	**0.47**	3.47	1.63	0.70
UT7	7.0	0.0222	9.70	**1.83**	0.33	**0.45**	3.50	1.59	0.68
UT8	9.1	0.0190	10.79	**1.83**	0.37	**0.44**	3.64	1.61	0.66

Cedarock reference reach values for stream power and shear stress are higher due to steeper valley and water surface slopes resulting in higher stream power and shear stress values. Causey Farm

reference reach values for stream power and shear stress are slightly lower due to flatter valley and water surface slopes resulting in slightly lower stream power and shear stress values.

Existing, Site streams are characterized by a wide range of water surface slopes and varying degrees of degradation. In general, stream power values of existing streams are slightly elevated as compared to proposed values, and shear stress values of existing streams are significantly elevated as compared to proposed and reference reach values. Proposed stream power and shear stress values appear adequate to mobilize and transport sediment through the Site, without aggradation or erosion on proposed stream banks.

4.6 Bankfull Verification

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

Based on available Piedmont regional curves, the predicted bankfull discharge for the reference reaches averages approximately 28.8 and 63.8 cubic feet per second (cfs) for Cedarock and Causey Farm, respectively (Harmen et al. 1999). The USGS regional regression equation for the Piedmont region indicates that bankfull discharge for the reference reaches at a 1.3-1.5 year return interval average approximately 27-32 and 53-65 cfs, respectively (USGS 2006).

Field indicators of bankfull, primarily topographic breaks identified on the banks, and riffle cross-sections were utilized to obtain an average bankfull cross-sectional area for the reference reaches. The Piedmont regional curves were then utilized to plot the watershed area and discharge for the reference reach cross-sectional area. Field indicators of bankfull approximate an average discharge of 31.3 and 59.8 cfs, respectively for the reference reaches, which is 108 and 94 percent of that predicted by the regional curves; which is verified by the range approximated by the USGS regional regression equation.

Based on the above analysis of methods to determine bankfull discharge, proposed conditions at the Site will be based on reference reaches, onsite indicators of bankfull (UT 4 several cross-sections Appendix B), and indicators of bankfull on a cross-section located in an undisturbed reach located at the Abbey Lamm Mitigation Site (located less than 2 miles northwest of the Site and currently in its third year of successful monitoring). Indicators of bankfull were used at the Abbey Lamm Mitigation Site to compare the bankfull cross-sectional area to that predicted by the curves; however, a detailed reference reach analysis was not appropriate. Based on field indicators of bankfull on-Site (93 percent of the curves), and the Causey Farm Reference Reach (94 percent of the curves) and Abbey Lamm Mitigation Site (90 percent of the curves), the designed onsite channel restoration area will equal approximately 93 percent of the channel size indicated by Piedmont regional curves. Table 10 summarizes all methods analyzed for estimating bankfull discharge.

Table 10. Reference Reach Bankfull Discharge Analysis

Method	Watershed Area (square miles)	Return Interval (years)	Discharge (cfs)
Cedarock Reference Reach			
Piedmont Regional Curves (Harman et al. 1999)	0.2	1.3-1.5	28.8
Piedmont Regional Regression Model (USGS 2004)	0.2	1.3-1.5	27-32
Field Indicators of Bankfull	0.2	1.3-1.5	31.3
Causey Farm Reference Reach			
Piedmont Regional Curves (Harman et al. 1999)	0.6	1.3-1.5	63.8
Piedmont Regional Regression Model (USGS 2004)	0.6	1.3-1.5	53-65
Field Indicators of Bankfull	0.6	1.3-1.5	59.8

5.0 PROJECT SITE WETLANDS (EXISTING CONDITIONS)

5.1 Existing Jurisdictional Wetlands

Jurisdictional wetlands/hydric soils within the Site were delineated in the field following guidelines set forth in the *Corps of Engineers Wetlands Delineation Manual* and subsequent regional supplements, and located using GPS technology with reported submeter accuracy (Environmental Laboratory 1987). A jurisdictional wetland delineation was completed and verbally approved by United States Army Corps of Engineers (USACE) representative David Bailey during a field meeting on October 13, 2017; the signed Notification of Jurisdictional Determination dated December 21, 2017 can be found in Appendix D. Existing jurisdictional wetlands are depicted in green and drained hydric soils are depicted in pink on Figure 4 (Appendix A).

5.2 Hydrological Characterization

Construction activities are expected to restore approximately 0.35 acre of drained riparian hydric soils, and enhance 0.61 acre of cleared riparian wetlands. Areas of the Site targeted for riparian wetlands will receive hydrological inputs from periodic overbank flooding of restored tributaries, groundwater migration into wetlands, upland/stormwater runoff, and, to a lesser extent, direct precipitation. Hydrological impairment in drained soils has resulted from lateral draw-down of the water table adjacent to existing, incised stream channels.

5.3 Soil Characterization

5.3.1 Taxonomic Classification

Detailed soil mapping conducted by a North Carolina Licensed Soil Scientist (NCLSS) in November 2016 indicate that the Site is currently underlain by hydric soils of the Worsham Series (Figure 4, Appendix A). Wetlands have been disturbed by livestock grazing and cleared of

vegetation within pastureland. These hydric soils have been effectively drained by stream channel incision or relocation of stream channels to the floodplain margins.

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

5.3.2 Profile Description

Depth (inches)	Color	Texture
0 - 3	10 YR 4/4	Fine sandy loam
3 - 18	10 YR 7/2 10 YR 7/1 mottles 20% 10YR 6/1 mottles 10%	Sandy loam
18 +	10 YR 7/2 10 YR 7/1 mottles 20% 10 YR 5/6 mottles 20%	Sandy loam

5.4 Plant Community Characterization

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

5.5 Reference Forest Ecosystem

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

The RFE for this project is located 2.5 miles northwest of the Site at the Abbey Lamm Stream and Wetland Mitigation Site. The RFE supports plant community and landform characteristics that restoration efforts will attempt to emulate. Tree and shrub species identified within the reference forest and outlined in Table 11 will be used, in addition to other relevant species in appropriate Schafale and Weakley (1990) community descriptions.

Table 11. Reference Forest Ecosystem

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

6.0 FUNCTIONAL UPLIFT AND PROJECT GOALS/OBJECTIVES

Project goals are based on the *Cape Fear River Basin Restoration Priorities* (RBRP) report (NCEEP 2009) and on-site data collection of channel morphology and function observed during field investigations. The RBRP report documents benthic ratings vary between "Fair" and "Good-Fair" possibly due to cattle, dairy, and poultry operations. The project is not located in a Regional or Local Watershed Planning Area; however, RBRP goals are addressed by project activities as follows with Site specific information following the RBRP goals in parenthesis.

1. Reduce and control sediment inputs (sediment model [Section 4.2] – reduction of 67.3 tons/year after mitigation is complete);
2. Reduce and manage nutrient inputs (nutrient model [Section 4.3]- livestock removal from streams, elimination of fertilizer application, and marsh treatment areas will result in a direct reduction of 893.2 pounds of nitrogen and 47.0 pounds of phosphorus per year);

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

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

Table 12A. Heron Site NC SAM Summary

NC SAM Function Class Rating Summary	UT 1 (Up)	UT1 (Down)*	UT4	UT5	Reference
(1) HYDROLOGY	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(2) Baseflow	HIGH	HIGH	HIGH	HIGH	HIGH
(2) Flood Flow	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(3) Streamside Area Attenuation	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(4) Floodplain Access	**LOW**	**LOW**	HIGH	MEDIUM	HIGH
(4) Wooded Riparian Buffer	MEDIUM	**LOW**	**LOW**	**LOW**	HIGH
(4) Microtopography	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(3) Stream Stability	MEDIUM	**LOW**	HIGH	**LOW**	HIGH
(4) Channel Stability	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(4) Sediment Transport	MEDIUM	**LOW**	**LOW**	**LOW**	HIGH
(4) Stream Geomorophology	HIGH	HIGH	HIGH	HIGH	HIGH
(1) WATER QUALITY	MEDIUM	**LOW**	MEDIUM	**LOW**	HIGH
(2) Baseflow	HIGH	HIGH	HIGH	HIGH	HIGH
(2) Stream-side Area Vegetation	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(3) Upland Pollutant Filtration	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(3) Thermoregulation	MEDIUM	**LOW**	MEDIUM	**LOW**	HIGH
(2) Indicators of Stressors	**YES**	**YES**	**YES**	**YES**	NO
(1) HABITAT	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(2) In-stream Habitat	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(3) Baseflow	HIGH	HIGH	HIGH	HIGH	HIGH
(3) Substrate	MEDIUM	**LOW**	**LOW**	**LOW**	HIGH
(3) Stream Stability	**LOW**	**LOW**	HIGH	**LOW**	HIGH
(3) In-Stream Habitat	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(2) Stream-side Habitat	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(3) Stream-side Habitat	**LOW**	**LOW**	**LOW**	**LOW**	HIGH
(3) Thermoregulation	MEDIUM	**LOW**	**LOW**	**LOW**	HIGH
OVERALL	**LOW**	**LOW**	MEDIUM	**LOW**	HIGH

*Functional assessments completed on UT1 (Down) were used to determine potential functional uplift for UT3 due to similarities of the channels. UT2 is primarily proposed for enhancement (Level II) with the exception of a short reach that is proposed for restoration prior to tying into UT1.

Table 12A continued. Heron Site NC SAM Summary

NC SAM Function Class Rating Summary	UT6	UT7	UT8	Reference
(1) HYDROLOGY	**LOW**	MEDIUM	MEDIUM	HIGH
(2) Baseflow	HIGH	HIGH	HIGH	HIGH
(2) Flood Flow	**LOW**	MEDIUM	MEDIUM	HIGH
(3) Streamside Area Attenuation	**LOW**	**LOW**	**LOW**	HIGH
(4) Floodplain Access	MEDIUM	MEDIUM	MEDIUM	HIGH
(4) Wooded Riparian Buffer	**LOW**	**LOW**	**LOW**	HIGH
(4) Microtopography	MEDIUM	**LOW**	**LOW**	HIGH
(3) Stream Stability	**LOW**	HIGH	HIGH	HIGH
(4) Channel Stability	**LOW**	HIGH	HIGH	HIGH
(4) Sediment Transport	**LOW**	**LOW**	**LOW**	HIGH
(4) Stream Geomorophology	HIGH	HIGH	HIGH	HIGH
(1) WATER QUALITY	MEDIUM	**LOW**	MEDIUM	HIGH
(2) Baseflow	HIGH	HIGH	MEDIUM	HIGH
(2) Stream-side Area Vegetation	**LOW**	**LOW**	MEDIUM	HIGH
(3) Upland Pollutant Filtration	**LOW**	**LOW**	MEDIUM	HIGH
(3) Thermoregulation	MEDIUM	**LOW**	HIGH	HIGH
(2) Indicators of Stressors	**YES**	**YES**	**YES**	NO
(1) HABITAT	**LOW**	**LOW**	**LOW**	HIGH
(2) In-stream Habitat	**LOW**	**LOW**	**LOW**	HIGH
(3) Baseflow	HIGH	HIGH	MEDIUM	HIGH
(3) Substrate	**LOW**	**LOW**	**LOW**	HIGH
(3) Stream Stability	**LOW**	HIGH	MEDIUM	HIGH
(3) In-Stream Habitat	**LOW**	**LOW**	**LOW**	HIGH
(2) Stream-side Habitat	**LOW**	**LOW**	HIGH	HIGH
(3) Stream-side Habitat	**LOW**	**LOW**	HIGH	HIGH
(3) Thermoregulation	**LOW**	**LOW**	HIGH	HIGH
OVERALL	**LOW**	**LOW**	MEDIUM	HIGH

Based on NC SAM output, all three primary stream functional metrics (Hydrology, Water Quality, and Habitat), as well as 19 sub metrics are under-performing as exhibited by a LOW metric rating. These same metrics measured in a relatively undisturbed reference reach exhibit HIGH metric ratings (see Figure 4, Appendix A for NC SAM data reaches). LOW performing metrics are to be targeted for functional uplift through mitigation activities, goals and objectives, as well as, monitoring and success criteria.

Table 12B. Heron Site NC WAM Summary

NC WAM Sub-function Rating Summary	K1*	K2	K3
Wetland Type	HF	HF	HF
(1) HYDROLOGY	HIGH	HIGH	HIGH
(2) Surface Storage & Retention	HIGH	MEDIUM	MEDIUM
(2) Sub-surface Storage and Retention	HIGH	HIGH	HIGH
(1) WATER QUALITY	HIGH	**LOW**	HIGH
(2) Pathogen change	HIGH	HIGH	HIGH
(2) Particulate Change	HIGH	**LOW**	**LOW**
(2) Soluble change	MEDIUM	MEDIUM	MEDIUM
(2) Physical Change	HIGH	**LOW**	HIGH
(1) HABITAT	MEDIUM	**LOW**	**LOW**
(2) Physical Structure	HIGH	**LOW**	**LOW**
(2) Landscape Patch Structure	**LOW**	**LOW**	**LOW**
(2) Vegetative Composition	MEDIUM	MEDIUM	MEDIUM
OVERALL	HIGH	**LOW**	HIGH

Wetland Type - HF (Hardwood Forest)

* Reference Wetland – Slated for Enhancement

NC WAM forms are filled out for wetland enhancement areas. Wetland restoration areas are not able to be rated by the NC SAM methodology.

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

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

Targeted Functions	Goals	Objectives
(1) HYDROLOGY		
(2) Flood Flow (Floodplain Access) (3) Streamside Area Attenuation (4) Floodplain Access (4) Wooded Riparian Buffer (4) Microtopography	• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement
(3) Stream Stability (4) Channel 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 • Remove livestock • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer
(1) WATER QUALITY		
(2) Streamside Area Vegetation (3) Upland Pollutant Filtration (3) Thermoregulation (2) Indicators of Stressors Wetland Particulate Change Wetland Physical Change	• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Install marsh treatment areas • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams • Provide surface roughness through deep ripping/plowing • Restore overbank flooding by establishing proper channel dynamics • Cessation of municipal land application
(1) HABITAT		
(2) In-stream Habitat (3) Substrate (3) Stream Stability (3) In-Stream Habitat (2) Stream-side Habitat (3) Stream-side Habitat (3) Thermoregulation Wetland Physical Structure Wetland Landscape Patch Structure	• Improve instream and stream-side habitat.	• Construct stable channels with cobble/gravel substrate • 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

7.0 DESIGN APPROACH AND MITIGATION WORK PLAN

7.1 Stream Design

Onsite streams targeted for restoration have endured significant disturbance from land use activities such as land clearing, livestock grazing, straightening and rerouting of channels, and other anthropogenic maintenance. Site streams will be restored to emulate historic conditions at the Site utilizing parameters from nearby, relatively undisturbed reference streams (see Section 3.0 Reference Streams).

Primary activities designed to restore Site streams include 1) stream restoration, 2) stream enhancement (Level I), 3) stream enhancement (Level II), 4) wetland restoration, 5) wetland enhancement, 6) construction of marsh treatment areas, and 5) vegetation planting (Figures 6A-6D, Appendix A).

7.1.1 Stream Restoration

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

Stream restoration is expected to entail 1) channel excavation, 2) removal of an agriculture pond, 3) spoil stockpiling, 4) channel stabilization, 5) channel diversion, and 6) channel backfill.

In-stream Structures

The use of in-stream structures for grade control and habitat is essential for successful stream restoration (Figure 8A, Appendix A). In-stream structures may be placed in the channel to elevate local water surface profiles in the channel, potentially flattening the water energy slope or gradient and directing stream energy into the center of the channel and away from banks. The structures will consist of log cross-vanes or log j-hook vanes; however, at the discretion of the Engineer, rock cross-vanes or rock j-hook vanes may be substituted if dictated by field conditions. In addition, the structures will placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

Piped Channel Crossings

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

Outfall Structures

Four drop structure are proposed at the outfall of the UT5, UT6, and UT8 restoration reaches, and the outfall of the UT7 enhancement (level I) reach. The drop structures may be constructed out of Terracell, or large cobble depending upon anticipated scour from the restored stream channels

(Figure 8B, Appendix A). The structures should be constructed to resist erosive forces associated with hydraulic drops proposed at the Site.

Marsh Treatment Areas

Six shallow wetland marsh treatment areas will be excavated in the floodplain to intercept surface waters draining through agricultural areas prior to discharging into the Site. Marsh treatment areas are intended to improve the mitigation project and are not generating mitigation credit. The proposed marsh treatment area location is depicted on Figures 6A-6D (Appendix A) and will consist of shallow depressions that will provide treatment and attenuation of initial stormwater pulses (Figure 8B, 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.

Powerline relocation

An existing powerline services an agriculture complex including a livestock barn. The powerline parallels the UT 7 stream bank and crosses both UT 7 and UT 6 in its current location. Coordination with Randolph Electric Membership Corporation has been initiated to move the powerline upstream, and outside of the UT 6 and UT 7 easement. A copy of the Utility Work Agreement with the Randolph Electric Membership Corporation is included in Appendix J. Work to be conducted under the Utility Work Agreement will be initiated upon approval of this Detailed Restoration Plan.

City of Burlington Map Modification for Land Application

Agriculture fields adjacent to, and west of, UT 8 have been utilized by the City of Burlington for the application of municipal waste. Communication with the City of Burlington Residuals Management Coordinator has been ongoing throughout the design process to update maps (map NC-AM – 16 [Michael Hadley]) such that land application of municipal waste will cease within, and immediately adjacent to, UT 8. Communications of the successful modification to City of Burlington maps are included in appendix K.

7.1.2 Stream Enhancement (Level I)

Stream enhancement (Level I) is proposed on the upper reach of UT1 and along the majority of UT7. The channels will be enhanced by raising the channel bed to the historic floodplain, constructing a channel to the appropriate dimension, installing habitat/grade control structures, cessation of current land use practices, and planting with native hardwood vegetation.

7.1.3 Stream Enhancement (Level II)

Stream enhancement (level II) will occur on the majority of UT2, the lower reach of UT 5, and the lower reach of UT8. Stream enhancement will entail the cessation of current land management practices, excluding livestock, invasive species control (predominantly Chinese privet), and planting riparian buffers with native forest vegetation. Riparian buffers will extend a minimum of 50 feet from the top of stream banks to facilitate stream recovery and prevent further degradation of the stream.

7.2 Individual Reach Descriptions

Mitigation strategies proposed for each UT are presented below (Figures 6A to 6D).

7.2.1 UT 1

UT 1 enters the Site through a culvert and extends for 1155 linear feet in its current location. The upper half of the reach is characterized by a disturbed forest buffer, which is accessible by livestock resulting in poor understory growth and little herbaceous vegetation. The UT crosses a gas line midway through the Site and enters pasture land vegetated largely by herbaceous grasses and natural recruits. The entire reach is actively grazed by livestock.

In its current state, UT 1 is classified as a Cg-type channel with an entrenchment ratio ranging from 1.6 to 4.3 (averaging 2.5). Although entrenchment ratios exhibit some connection to the floodplain, the majority of the channel is incised, as evidenced by bank-height-ratios ranging from 1.4 to 2.5. Incision varies across the reach, with sections of deep incision in the far upper reaches (below the culvert and halfway through the woods) and pastureland in the mid-, to lower reaches. Reaches in the lower half of the woods are frequently characterized by debris jams, shallow and wide channels from extensive hoof shear to channel banks, and sediment choked channels resulting in lower incision values.

UT 1 is proposed for two mitigation treatments; 1) stream enhancement (level I) and 2) stream restoration.

Stream enhancement (level I) is proposed in the upper wooded reaches of UT1, where channel pattern appears to exhibit suitable sinuosity and pool-to-pool spacing; however, the channel is relatively incised, impacted by livestock, and is characterized by low radius of curvature values in several bends. Mitigation in these areas will focus on elevating the stream bed, providing the proper channel dimension, and reducing shear on tight meander bends. Structures will be strategically placed to reduce pressure on channel banks and focus scour into the center of the channel. This reach will ultimately reconnect the channel to the floodplain and adjacent wetlands, and bring the channel to a suitable elevation to initiate Priority 1 stream restoration in the downstream reach.

Stream restoration is proposed to initiate in the lower wooded reaches where the channel has been heavily impacted by livestock and debris jams, resulting a series of nearly braided channels, followed by an incised/scoured reach. The lower wooded reach appears to be significantly less sinuous than the upper wooded reaches and relict channel sections appear to be evident adjacent to the current channel. The reach is proposed for Priority 1 restoration on new location, reconnecting the channel to degraded/drained wetlands or hydric soils. Once the channel exits the lower wooded areas the channel will be excavated in a relatively wide, flat floodplain. The channel discharges through a culvert beneath the neighboring driveway.

7.2.2 UT 2

UT 2 initiates within the Site boundaries as a headwater stream system. A small agriculture pond, located upstream and outside of the project boundaries, discharges water which coalesces and forms the upstream channel initiation point. The channel drains for 363 linear feet before

converging with UT 1. The channel initiates in disturbed woods that are actively utilized by livestock for browse and shade. As UT 2 descends the valley, pasture abuts the right bank of the channel for the duration of its path.

Currently, UT 2 is classified as a Gf-type channel with entrenchment ratios ranging from 1.4 to 2.0 and bank-height-ratios ranging from 3.0 to 3.7. The channel does not appear to be actively eroding, possibly due to storm water attenuation from the upstream pond. The lack of bank erosion and intermittent flow regime for the channel resulted in the IRT designating the reach for stream enhancement (level II).

A small section of UT 2, at the downstream extent, is proposed for stream restoration. This reach extends from the terminus of the existing channel to the proposed channel tie-in with UT 1. This reach of channel will require the excavation of channel on new location. The reach proposed for restoration extends slightly upstream within the UT 2 channel, which is necessary to maintain proper slope of the channel (the bed of UT 2 at the extreme lower reach is below the design channel bed of UT 1 at its confluence).

7.2.3 UT 3

UT 3 is contained within an agriculture field ditch that drains roadside ditches and headwater wetlands in the upper slopes of livestock pasture. Both margins of UT 3 are characterized by pasture land which are vegetated by herbaceous species and actively grazed. The stream is designated as intermittent for the upper half and perennial for the lower half.

Currently, UT 3 is classified as a Cg-type channel with entrenchment ratios ranging from 1.4 to 3.8. The channel is deeply incised, as evidenced by bank-height-ratios of 1.7 to 2.4. The incised channel appears to be draining hydric soils along its margins. Excavation of UT 3 into an agriculture ditch is evidenced by a complete lack of sinuosity, riffle-pool structure, or other aquatic habitat zones.

UT 3 is proposed for stream restoration through a combination of raising the channel bed, lowering the adjacent floodplain, installation of log cross vane structures, planting vegetation, and removing livestock. A narrow, relatively steep valley slope necessitate a relatively low sinuosity stream channel which will ultimately be constructed as an E/C-type channel, but will function similar to a Cb-type channel.

7.2.4 UT 4

UT 4 enters the Site below a cattle crossing located at the juncture of a wooded stream and a heavily eroded ditch draining a chicken house complex. UT 4 drains through the Site for 485 feet prior to discharging into UT 5. The stream is bound on each side by disturbed forest, which is actively used by livestock for browse and shade. Pasture characterizes the outer margins of the easement, with agriculture runoff entering the stream.

UT 4 is classified as an Eg-type channel with entrenchment ratios of 1.3 to 6.1. The channel has drastically different depths due to high sediment loads from the eroding upstream ditch, which has aggraded the channel. Once streamflow passes the sediment plugged reaches, channel scour results from stormwater pulses, a lack of vegetation, and cattle hoof shear. The scoured channel

reaches have bank-height-ratios ranging from 1.3 to 4.0. The downstream end of UT 4 has a dirt ford crossing combined with a small sediment, or agriculture watering pond that further exacerbate sediment transport problems.

UT 4 is proposed for stream restoration through new channel excavation, installation of instream structures, removal of sediment sources, and removal of the agriculture watering pond. In addition, an upgraded piped crossing will be installed above the reach.

An important component of the stream restoration effort will be to control sediment originating from an eroding ditch immediately above the Site. As proposed, a sediment pond will be installed at the outlet of drainage discharging from the chicken house complex. In addition, the ditch draining from the chicken house complex will be stabilized with coir matting and plantings. The ditch will then drain to an additional marsh treatment area that will attenuate flows and allow for some additional sediment treatment until the ditch stabilizes. These features will discharge above the piped culvert prior to entering the Site.

7.2.5 UT 5

UT 5 originates within the Site boundaries in an agriculture pond and drains for 907 feet in its current location. The upper reaches of UT5 (above the dirt road) is completely contained within agriculture pasture. The middle reaches of UT 5 are split between agriculture pasture and fallow fields that appears to have been a lagoon, or some other wet flat with spoil piled in the lower sections before the tributary enters the woods. The lower reaches are characterized by disturbed forest.

Overall, UT 5 is classified as an Eg-type stream channel with entrenchment ratios ranging from 1.4 to 7.3. However, the upper reaches are characterized by more of an aggrading channel (pond attenuating stormwater pulses, pipes under roads fixing grade, and heavy livestock trampling of the channel below the pond) and subsequent higher entrenchment ratios. As the channel crosses under the road and progresses down valley, channel incision becomes more significant (bank-height-ratios up to 2.7). UT 5 enters a wooded section for the lower reaches by passing through extensive spoil piles (or possibly a relict dam) and has a significant hydraulic drop before stabilizing within the woods.

UT 5 is proposed for stream restoration in its upper reaches and enhancement (level II) in its lower reaches. Stream restoration is expected to entail the complete remove of the agriculture pond dam, excavation of the new channel within and adjacent to the existing channel, upgrading a road crossing that is paired with a piped cattle crossing of the stream, installation of instream structures (log cross vanes), installation of a TerraCell drop structure, planting, and removal of livestock from the easement.

Removal of the pond dam is expected to include 1) notching the dam to dewater sediments; 2) removal of the dam to the elevation of the adjacent floodplain; 3) excavating sediment that is unsuitable for channel bank construction; 4) backfilling areas of sediment removed with soil suitable for channel construction (if necessary); 5) excavation of the design channel, 6) stabilization of the channel with coir matting, seed, and mulch; and 7) installation of structures.

7.2.6 UT 6

UT 6 originates immediately downstream from a gas line crossing. The stream is intermittent for a brief period and converts to a perennial stream shortly thereafter and flows for 683 feet in its current location. The channel is bound by a combination of pasture and sparsely vegetated forest and is almost entirely accessible by livestock. A power line crosses over the middle section of the stream that provides power to a barn located outside the easement. In the lower sections of the stream, a small pond has been excavated for watering livestock. The pond dam was breached some years prior and a wetland complex has developed in the pond bottom.

Overall, UT 6 is classified as a Cg-type channel with entrenchment ratios ranging from 1.1 to 4.8. The upper reaches of the channel are relatively steep, particularly in the intermittent sections, prior to reaching a significant nick point where the channel slope flattens slightly. Channel flattening, combined with some backwater effect from the pond dam and heavy livestock traffic make classification of the channel atypical (width-depth ratios range between 15 and 48). The upper reaches are characteristic of a G-type channel (width-depth ratio <12) and the lower reaches are characteristic of an F-type channel (width-depth ratio <12). Both channels are characterized by significant incision, with bank-height-ratios ranging from 3.7 to 7.5.

UT 6 is proposed for stream restoration which is expected to entail stabilization of hydraulic drops in the channel, raising the channel bed, installation of structures (log cross vanes and log vanes), removing the agriculture pond and dam, moving the powerline crossing over the stream, installing TerraCell drop structures, planting with native hardwood forest, and fencing livestock from the stream.

Moving the powerline is to be conducted in conjunction with the Randolph County Electric Membership Corporation (a “Utility Work Agreement” is provided in Appendix J). The current work plan includes moving the utility easement upstream of the conservation easement for UT 6 and UT 7, thereby eliminating the easement break and maintenance associated with the utility.

7.2.7 UT 7

UT 7 originates in an agriculture pond and descends a relatively steep valley through pastureland. The entire reach of UT 7 is characterized by herbaceous grasses that are grazed by livestock. A powerline crosses the upper section of the stream and a gas line crosses the lower section of the stream. Attenuation of stormwater and the loss of channel forming flows has resulted in the loss of stream channel characteristics below the pond.

UT 7 is classified as a Cg-type channel, with entrenchment ratios of 1.7 to 5.2. The narrow steep valley exhibits characteristics of a B-type channel, which have been targeted during proposed channel design. The entire channel reach is incised (with the exception of a short reach near the gas line), with bank-height-ratios ranging from 1.8 to 4.1. Channel incision is likely to result from removal of vegetation, disturbance to the channel during development of pasture, and active livestock grazing. The channel has low sinuosity; however, this would be expected in a relatively steep, narrow valley.

UT 7 is proposed for two mitigation treatments; 1) stream restoration and 2) stream enhancement (level I).

Stream restoration is proposed within the pond bed and under the pond dam. Similar to the upper reaches of UT 5, removal of the pond dam is expected to include 1) notching the dam to dewater sediments; 2) removal of the dam to the elevation of the adjacent floodplain; 3) excavating sediment that is unsuitable for channel bank construction; 4) backfilling areas of sediment removed with soil suitable for channel construction (if necessary); 5) excavation of the design channel, 6) stabilization of the channel with coir matting, seed, and mulch; and 7) installation of structures.

Stream enhancement (level I) is proposed below the pond dam and is expected to include stabilization of hydraulic drops in the channel, a combination of raising the channel bed and lowering the adjacent floodplain, installation of structures (log cross vanes and log vanes), moving the powerline crossing over the stream, installing TerraCell drop structures, planting with native hardwood forest, and fencing livestock from the stream.

The narrow, relatively steep valley necessitate a relatively low sinuosity stream channel which will ultimately be constructed as an Eb-type channel, with shorter pool-to-pool spacing and more frequent structures, particularly in the upper reaches of the stream.

7.2.8 UT 8

UT 8 enters the Site from an adjacent property and flows for 1221 linear feet in its current location. The stream has been excavated as a ditch, apparently to move the channel to the property line and off pasture land. The upper half of the tributary flows through disturbed forest, accessible to livestock. The lower half of the tributary is fenced on the left bank, removing livestock from the channel.

In its current state, restoration reaches of UT 8 are classified as Eg-type channels with entrenchment ratios ranging from 1.1 to 4.9. Similar to other reaches on the Site, the channel has sections of incision and aggradation, likely resulting from extensive hoof shear to the channel banks and debris jams in the channel. The channel appears to be incised, as evidenced by bank-height-ratios ranging from 1.4 to 3.7. The upper reaches of channel have been ditched, and straightened and have relatively wide flat floodplains adjacent to the existing channel.

As originally proposed, UT 8 was to include preservation in the upper reaches. However, discrepancies with the county maintained GIS property lines (confirmed by a licensed surveyor) have removed that reach from the project. Currently, UT 8 is proposed for stream restoration in the upper reach and stream enhancement (level II) in the lower reach.

Stream restoration is proposed to initiate in the upper wooded reaches where the channel has been ditched and heavily impacted by livestock. This reach is proposed for Priority 1 restoration with the channel to be relocated to the adjacent floodplain. The channel will ultimately discharges into the existing channel that is fenced from livestock. The existing channel without livestock access is situated approximately 3 feet below the design channel bed and will be connected through the use of a TerraCell drop structure.

Stream enhancement (level II) is proposed for the lower half of the stream reach and is expected to include planting with native hardwood forest, and fencing livestock on the left bank of the easement.

7.3 Hydrological Modifications (Wetland Restoration)

Wetland restoration activities are designed to restore a fully functioning wetland system, which will provide surface water storage, nutrient cycling, removal of imported elements and compounds, and will create a variety and abundance of wildlife habitat. Portions of the Site underlain by hydric soils have been impacted by channel incision, ground surface compaction, vegetative clearing, and earth movement associated with agricultural practices. Wetland restoration options will focus on the removal of fill materials, restoration of vegetative communities, the reestablishment of soil structure and microtopographic variations, and redirecting normal surface hydrology back to Site floodplains. These activities will result in the restoration of 0.35 acre of riparian wetland.

Reestablishment of Historic Groundwater Elevations

Hydric soils adjacent to the incised channels appear to have been drained due to lowering of the groundwater table and a lateral drainage effect from existing stream reaches. Reestablishment of channel inverts is expected to rehydrate soils adjacent to Site streams, resulting in the restoration of jurisdictional hydrology to riparian wetlands.

Reestablishment of Soil Structure

Soil structure throughout the Site, particularly within wetland areas, will be reestablished to allow for penetration of rain water to the groundwater table. This will be accomplished by removing livestock from the Site, ripping compacted soils, and revegetating the Site.

Hydrophytic Vegetation

Site wetland areas targeted for restoration have endured significant disturbance from land use activities such as land clearing, livestock grazing, and other anthropogenic maintenance. Wetland areas will be revegetated with native vegetation typical of wetland communities in the region. Emphasis will focus on developing a diverse plant assemblage. Section 7.5 (Natural Plant Community Restoration) provides detailed information concerning community species associations.

7.4 Wetland Enhancement

Wetland enhancement will focus on the removal of livestock and restoration of vegetative communities resulting in the enhancement of 0.61 acre of riparian wetland.

7.5 Soil Restoration

Soil grading will occur during stream restoration activities. Topsoils 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.

7.6 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.

7.6.1 Planting Plan

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

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

Table 13 depicts the total number of stems and species distribution within each vegetation association (Figures 9A and 9B, 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.

In addition to planting seedlings, a seed mix will be spread within Marsh Treatment Wetland Areas as follows.

1. Virginia wildrye (*Elymus virginicus*)
2. Switch grass (*Panicum virgatum*)
3. Big blue stem (*Andropogon gerardii*)
4. Indian grass (*Sorghastrum nutans*)
5. Deer tongue (*Dichanthelium clandestinum*)

Table 13. Planting Plan

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Marsh Treatment Wetland**		Stream-side Assemblage**		TOTAL
Area (acres)	**3.0**		**5.2**		**0.05**		**3.8**		**12.05**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	--	--	14	10	517	5	530
River birch (*Betula nigra*)	204	10	--	--	--	--	204	10	721
Ironwood (*Carpinus caroliniana*)	--	--	707	20	--	--	--	--	707
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	27	20	--	--	27
Red bud (*Cercis canadensis*)	--	--	530	15	--	--	--	--	530
Sweet pepperbush (*Clethra alnifolia*)	--	--	--	--	20	15	--	--	20
Silky dogwood (*Cornus amomum*)	204	10	--	--	20	15	2067	20	2292
Persimmon (*Diospyros virginiana*)	--	--	354	10	--	--	--	--	354
White ash (*Fraxinus americana*)	--	--	177	5	--	--	--	--	177
Green ash (*Fraxinus pennsylvanica*)	408	20	--	--	--	--	2067	20	2475
Blueberry (*Vaccinium corymbosum*)	--	--	--	--	14	10	--	--	14
Tulip poplar (*Liriodendron tulipifera*)	204	10	--	--	--	--	--	--	204
Sycamore (*Platanus occidentalis*)	408	20	--	--	--	--	2067	20	2475
Black gum (*Nyssa sylvatica*)	--	--	530	15	--	--	--	--	530
Water oak (*Quercus nigra*)	306	15	707	20	--	--	1034	10	2047
Willow oak (*Quercus phellos*)	306	15	530	15	--	--	1034	10	1870
Black willow (*Salix nigra*)	--	--	--	--	--	--	1034	10	1034
Elderberry (*Sambucus canadensis*)	--	--	--	--	27	20	--	--	27
Possumhaw (*Viburnum nudum*)	--	--	--	--	14	10	--	--	14
TOTAL	**2040**	**100**	**3536**	**100**	**136**	**100**	**10336**	**100**	**16048**

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

7.6.2 Nuisance Species Management

Invasive plant species will be observed and controlled mechanically and/or chemically, as part of this project. No other nuisance species controls are not proposed at this time. Inspections for beaver and other potential nuisance species will occur throughout the course of the monitoring period. Appropriate actions may be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis. The presences of nuisance species will be monitored over the course of the monitoring period. Appropriate actions will be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis.

8.0 MONITORING AND SUCCESS CRITERIA

Monitoring will be conducted by Axiom Environmental, Inc based on the schedule in Table 14. A summary of monitoring is outlined in Table 15 (Figures 10A – 10D, Appendix A). Annual monitoring reports will be submitted to the NCDMS by Restoration Systems no later than December 31 of each monitoring year data is collected.

Table 14. 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	■	■	■	■	■	■	■

Table 15. 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 34 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern to 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	Total of 10 surface water gauges	Surface water data for each monitoring period as depicted in Figures 10A-10D.
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	Total of 10 surface water gauges: One gauge on UT1, 2, 3, 6 and 8. Two gauges on UT 5. Three gauges on UT 7	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	All restored stream channels	Visual evidence, photo documentation, and/or rain data.
Benthic Macroinvertebrates	"Qual 4" method described in *Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates, Version 5.0* (NCDWR 2016)	Pre-construction, Years 3, 5, and 7 during the "index period" referenced in *Small Streams Biocriteria Development* (NCDWQ 2009)	2 stations (one at the lower end of UT1 and one at the lower end of UT5); 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 to include a list of taxa collected, an enumeration of *Ephemeroptera, Plecoptera*, and *Tricopetera* taxa as well as Biotic Index.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-October 22	6 gauges spread throughout restored wetlands	Soil temperature at the beginning of each monitoring period to verify the start of the growing season, groundwater and rain data for each monitoring period
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	14 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	4 plots randomly selected each year	Species and height

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

8.1 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 16. 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. Surface water monitoring gauges will be installed in the upper third of all intermittent channels, unless otherwise requested by the IRT. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • Entrenchment ratio (ER) must be no less than 2.2 for E- and C-type channels at any measured riffle cross-section. Note: B-type channels may have an ER less than 1.4. • 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, 10 percent of the growing season, during average climatic conditions. Note: Soil temperature for growing season establishment will be measured daily utilizing a continuous monitoring soil probe. Soil temperature will be measured from mid-February through the end of April (at a minimum).
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.

8.2 Contingency

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

8.2.1 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.

8.2.2 Wetland Contingency

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology enhancement/restoration 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.

8.2.3 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.

8.3 Compatibility with Project Goals

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

Table 17. Compatibility of Performance Criteria to Project Goals and Objectives

Goals	Objectives	Success Criteria
(1) HYDROLOGY		
• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect Site with a perpetual conservation easement	• BHR not to exceed 1.2 • Document four overbank events in separate monitoring years • Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded
• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Remove livestock from the Site • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • ER of 2.2 or greater for C/E-type channels • < 10% change in BHR and ER in any given year • Livestock excluded from the easement • Attain Vegetation Success Criteria
(1) WATER QUALITY		
• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Remove livestock and reduce agricultural land/inputs • Install marsh treatment areas • Plant woody riparian buffer • Restore/enhance wetlands adjacent to Site streams	• Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT		
• Improve instream and stream-side habitat.	• Construct stable channels with cobble/gravel substrate • Plant riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows and plant woody riparian buffer • Protect Site with a perpetual conservation easement • Restore/enhance wetlands adjacent to Site streams	• Cross-section measurement indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

9.0 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.

10.0 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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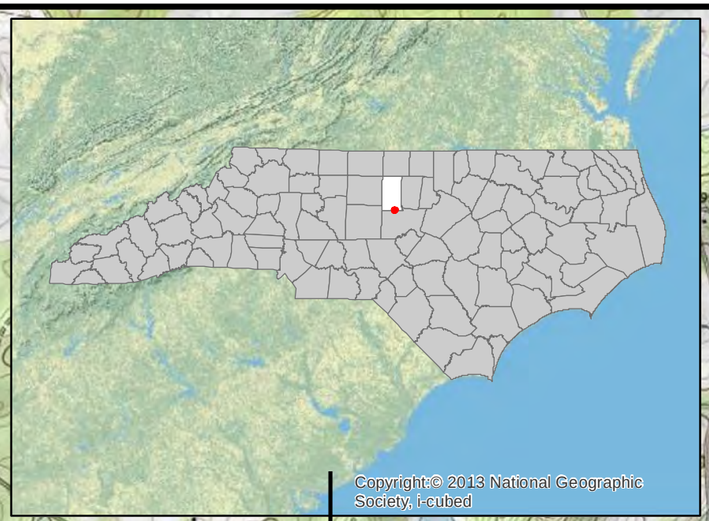
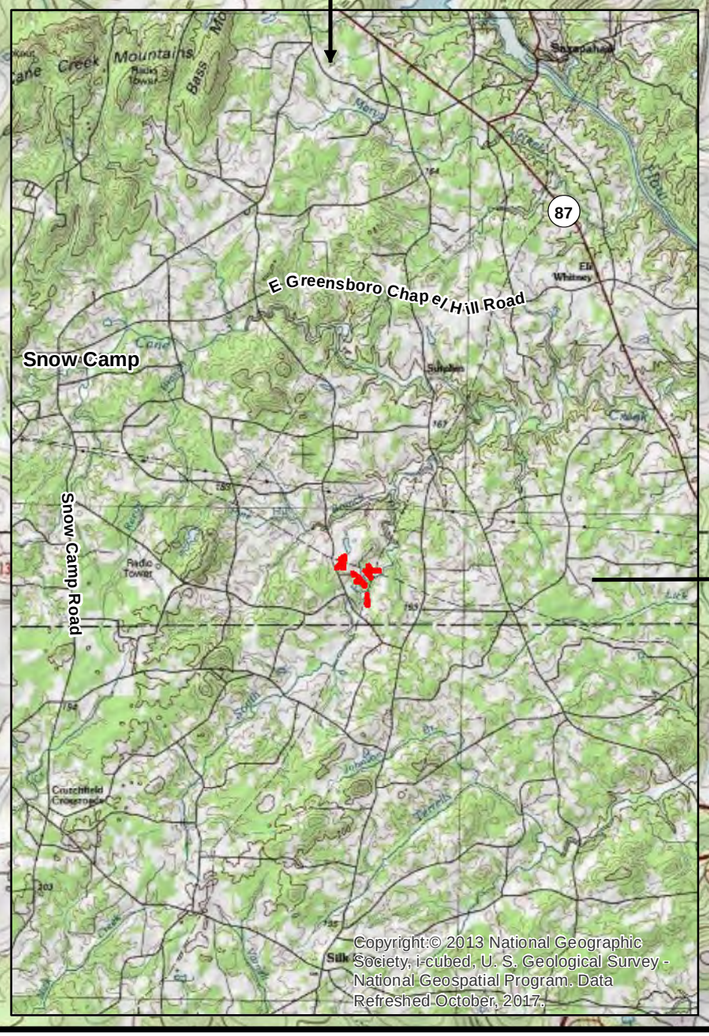
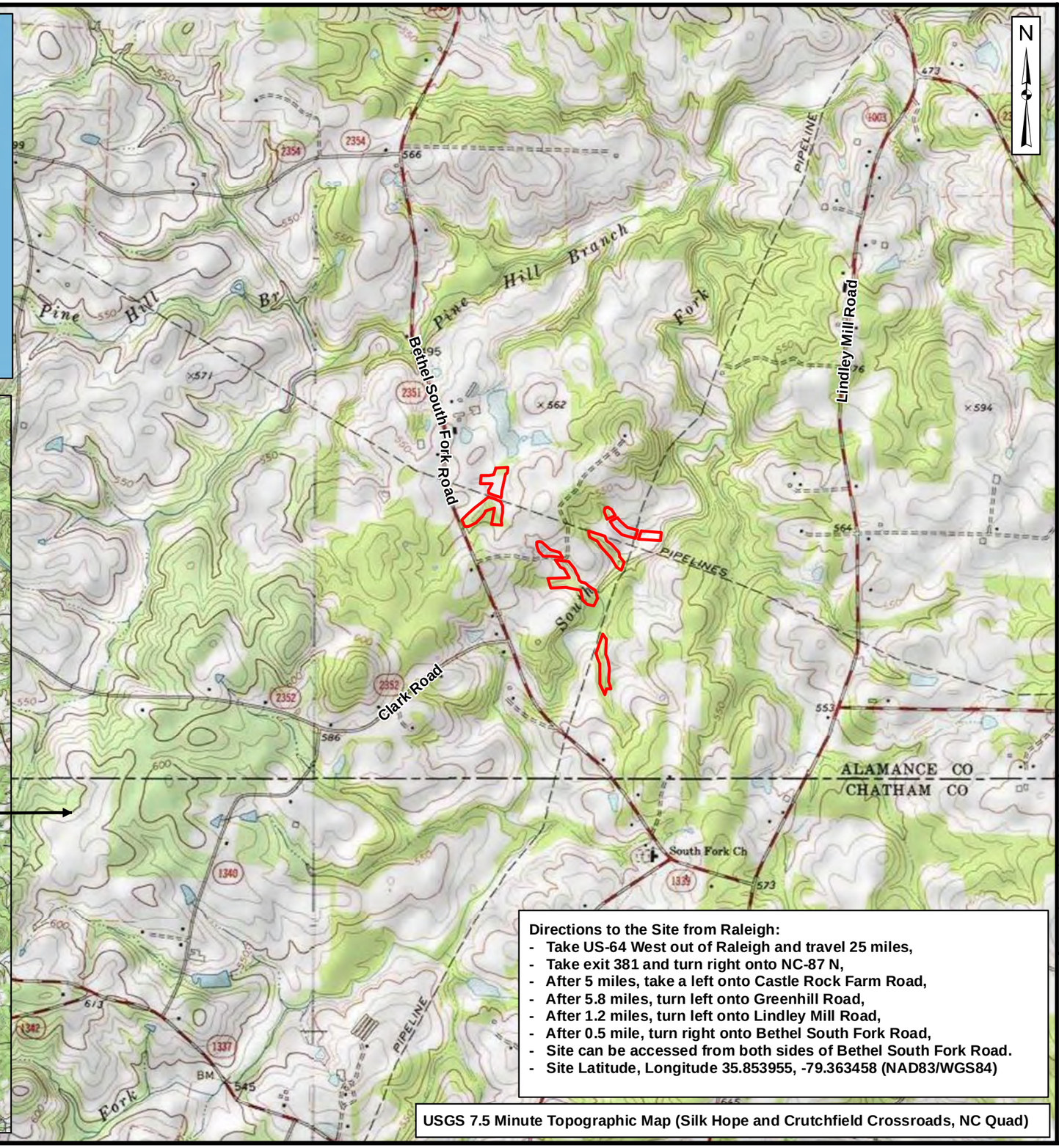
APPENDIX A
FIGURES

Figure 1. Project Location
Figure 2. Hydrologic Unit Map
Figures 3-3A. Topography and Drainage Area
Figure 4. Existing Conditions
Figure 5A. Cedarock Reference Drainage Area
Figure 5B. Cedarock Reference Existing Conditions
Figure 5C. Cedarock Reference Reach Dimension, Pattern, and Profile
Figures 6 & 6A-D. Restoration Plan
Figure 7. Proposed Dimension, Pattern, and Profile
Figures 8A-B. Typical Structure Details
Figures 9A-9C. Planting Plan
Figures 10A-10D. Monitoring Plan







Directions to the Site from Raleigh:
- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
- **After 5.8 miles, turn left onto Greenhill Road,**
- **After 1.2 miles, turn left onto Lindley Mill Road,**
- **After 0.5 mile, turn right onto Bethel South Fork Road,**
- **Site can be accessed from both sides of Bethel South Fork Road.**
- **Site Latitude, Longitude 35.853955, -79.363458 (NAD83/WGS84)**

USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

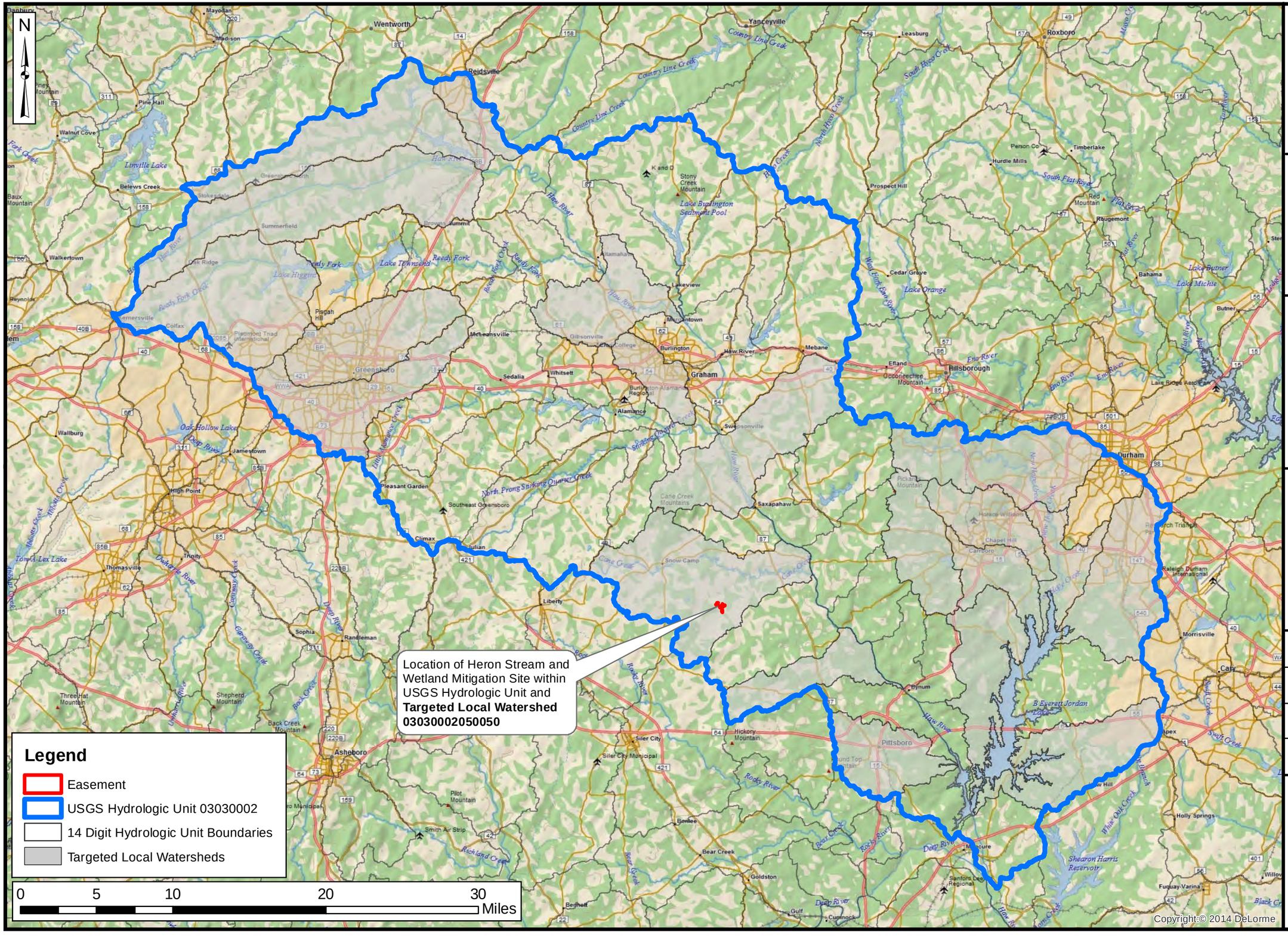
Date: DEC 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: KRJ

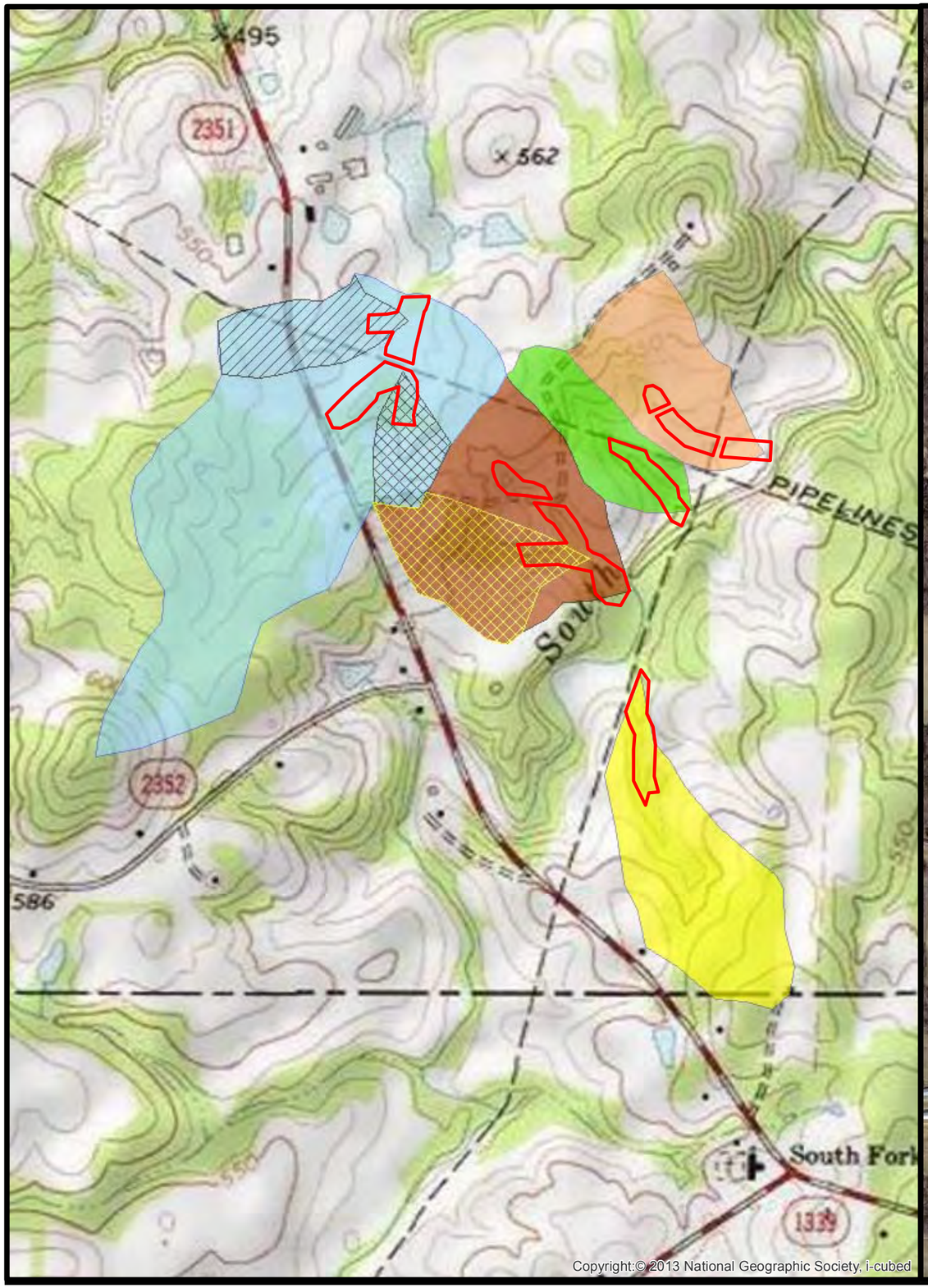
Date: DEC 2017

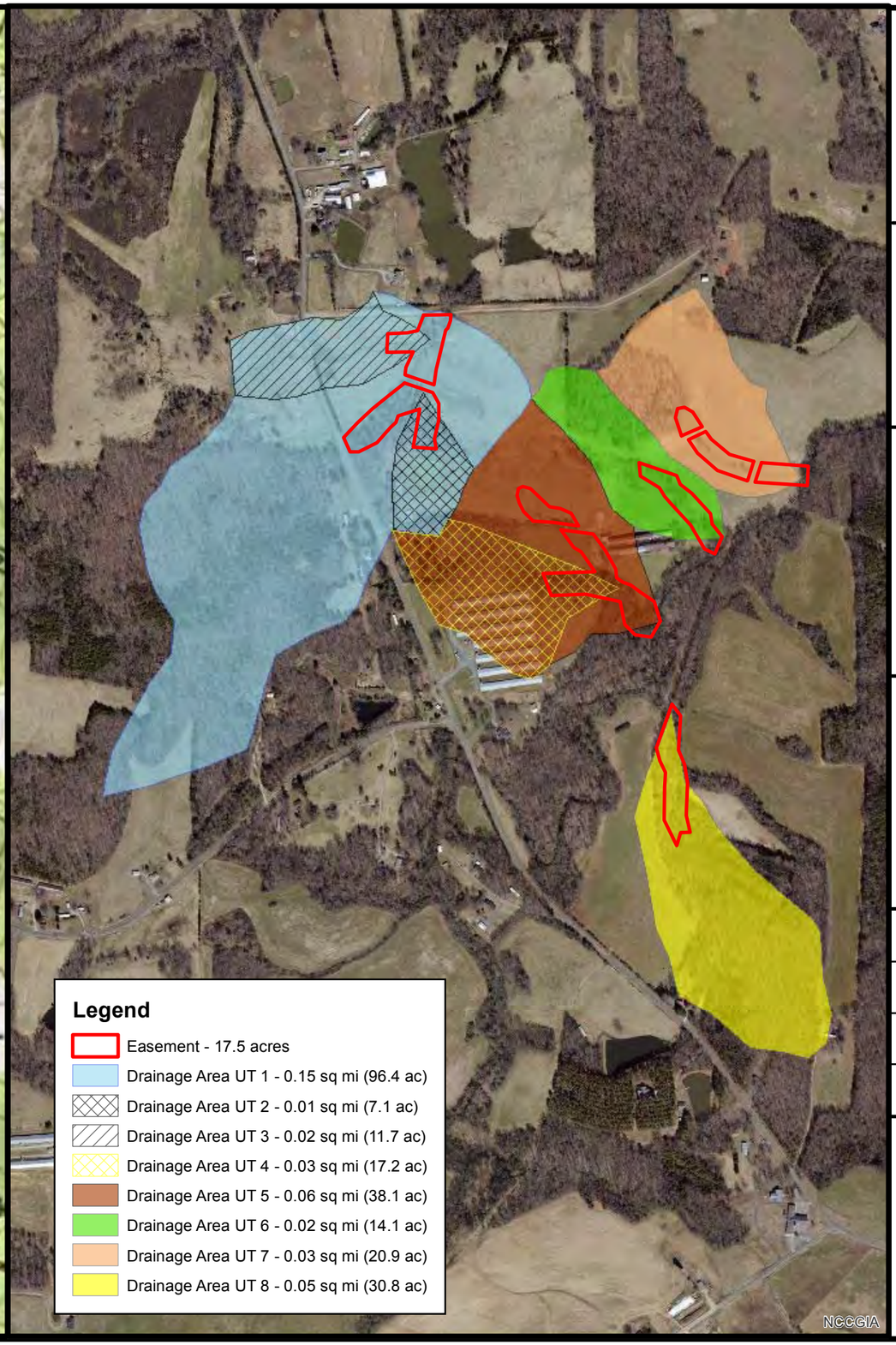
Scale: 1:375000

Project No.: 17-008

FIGURE

2





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ/CLF

Date: APR 2018

Scale: 1:10,000

Project No.: 17-008

FIGURE

3

Map Unit Symbol	Map Unit Name	Hydric Status	Taxonomy
AaB	Alamance Silt Loam	NA	Typic Hapludults
GaC2	Georgeville Silt Loam	NA	Typic Kanhapludults
GcE	Goldston Slaty Silt Loam	NA	Typic Dystrudepts
HdC & HdC2	Herndon Silt Loam	NA	Typic Kanhapludults
Lc	Local Alluvial Land, Poorly Drained	Hydric	NA
Mc	Mixed Alluvial Land, Poorly Drained	Hydric	NA
ObB	Orange Silt Loam	NA	Albaquic Hapludalfs
Wd	Worsham Sandy Loam	Hydric	Typic Endoaquults

Existing condition cross-section locations are depicted on Figure B1 (Appendix B).

Legend

- Conservation Easement - 17.5 acres
- Perennial Stream = 3,947 ft
- Intermittent Stream = 1,338 ft
- Jurisdictional Wetlands = 0.61 ac
- Drained Hydric Soil = 0.35 ac
- SAM Forms
- WAM Forms
- Soil Profile
- Power Line
- Gas Pipeline
- NRCS Soil Boundary
- 2 ft LIDAR Contour

0 500 1,000 2,000 Feet

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

EXISTING CONDITIONS

Drawn by: KRJ/CLF

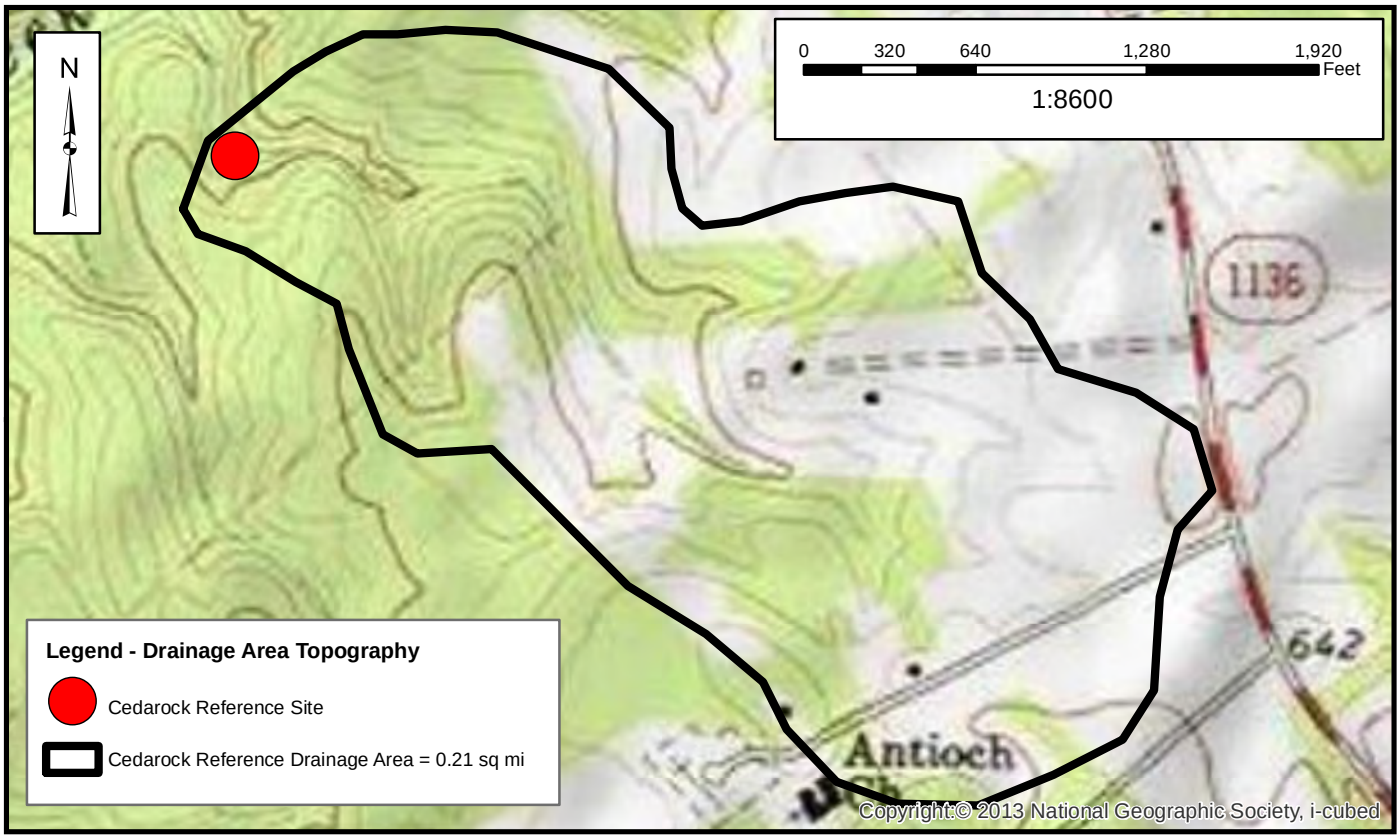
Date: APR 2018

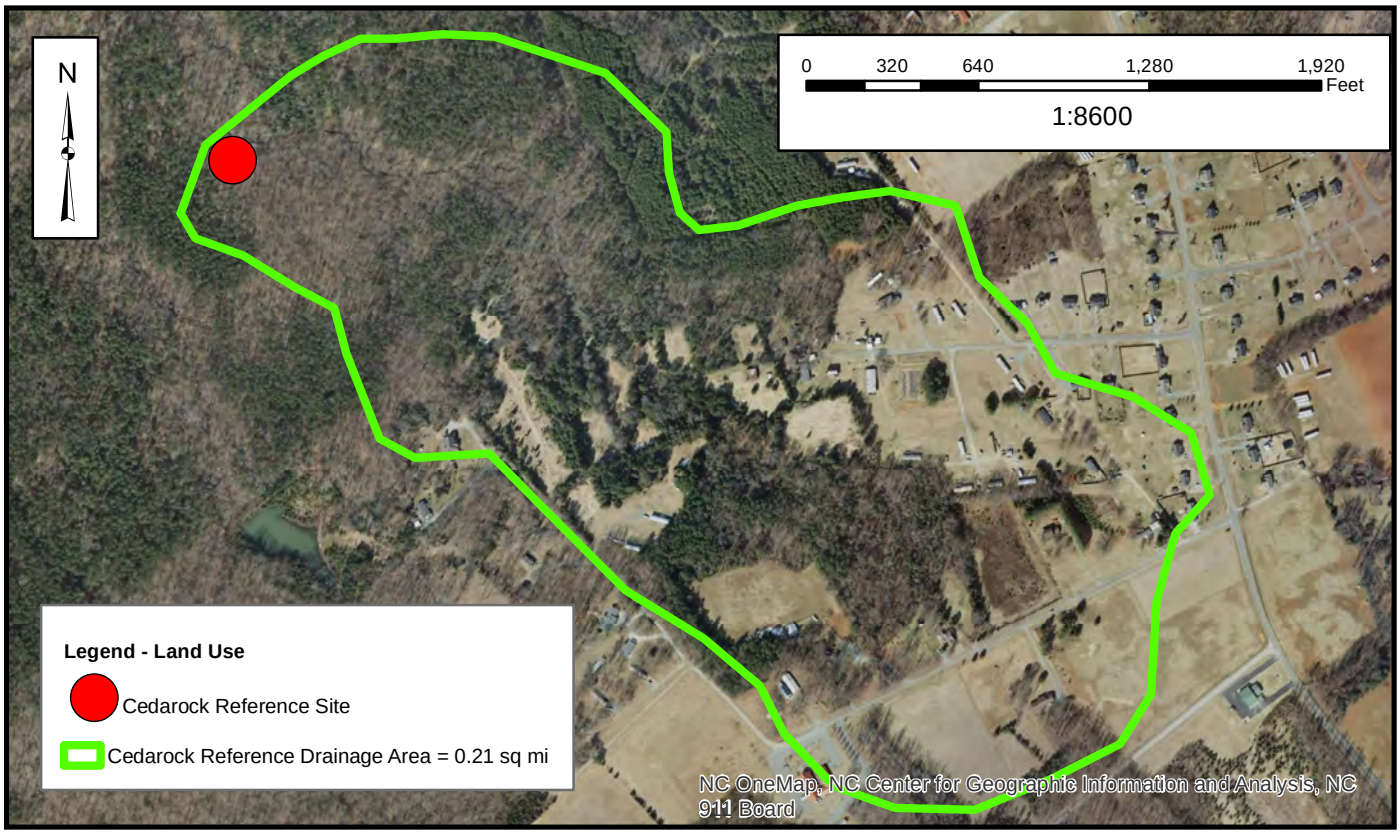
Scale: 1:5000

Project No.: 17-008

FIGURE

4



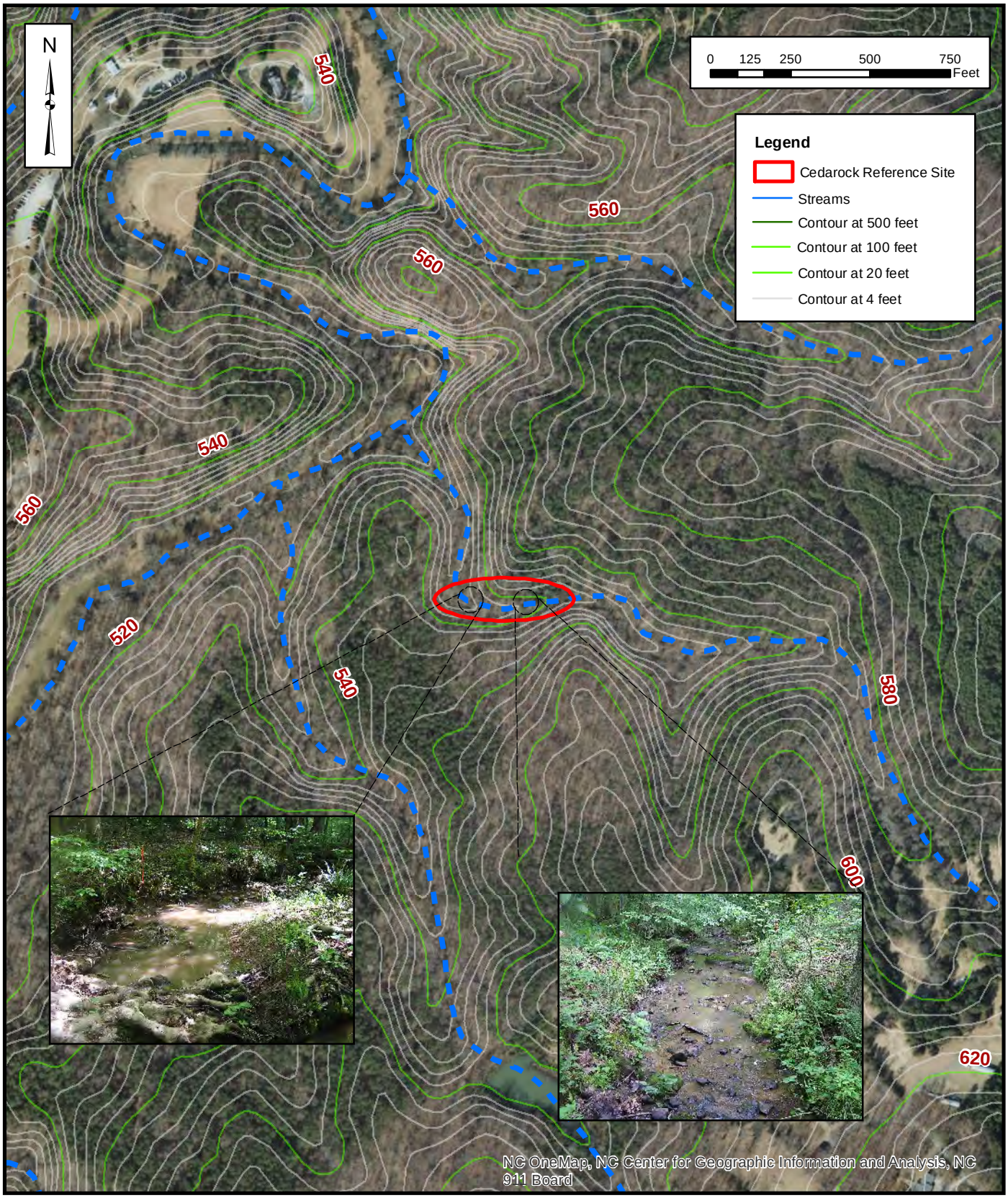


Axiom Environmental, Inc.
Axiom Environmental
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693

CEDAROCK REFERENCE DRAINAGE AREA
HERON STREAM AND WETLAND
MITIGATION SITE
Alamance County, North Carolina

Dwn. by.	WGL
Date:	Mar 2014
Project:	17-009

FIGURE
5A

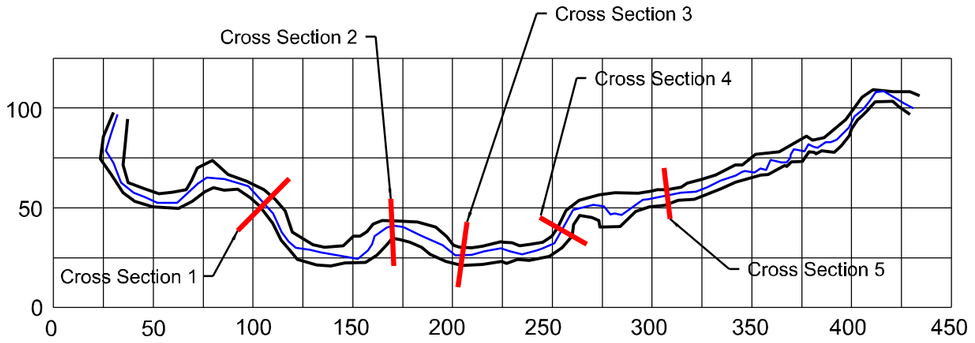


Axiom Environmental
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693
Axiom Environmental, Inc.

EXISTING CONDITIONS CEDAROCK REFERENCE REACH
HERON STREAM AND WETLAND MITIGATION SITE
Alamance County, North Carolina

Dwn. by.	WGL
Date:	Mar 2014
Project:	17-009

FIGURE
5B

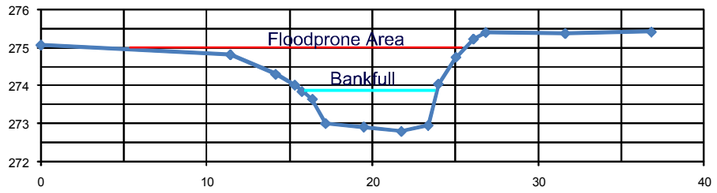


Reference Pattern

Lp-p = 37 (25 - 68) ft
Lm = 68 (44 - 116) ft
Wbelt = 23 (20 - 38) ft
Rc = 16 (11 - 27) ft
Lp-p/Wbkf = 4.6 (3.1 - 8.4)
Lm/Wbkf = 8.4 (5.5 - 14.3)
Wbelt/Wbkf = 2.8 (2.4 - 4.7)
Rc/Wbkf = 2.0 (1.4 - 3.3)
SIN = 1.20

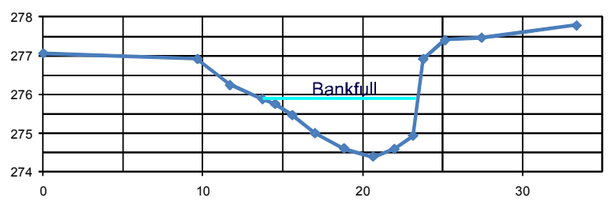
Pattern Legend

- Top of Bank
- Thalweg
- Cross Section



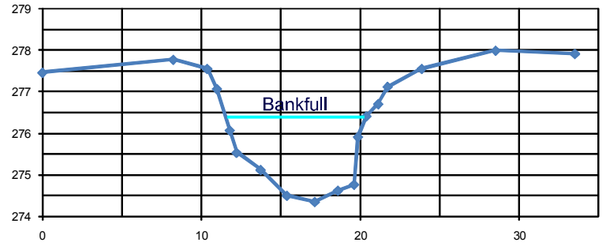
Cross Section 1 - Riffle

Abkf = 6.6 ft
Dave = 0.8 ft
Wbkf = 8.1 ft
Dmax = 1.1 ft
Bank Height = 2.0 ft
Bank Height Ratio = 1.8
W/D = 10.0
FPA = 18
ENT = 2.2
Stream Type = E



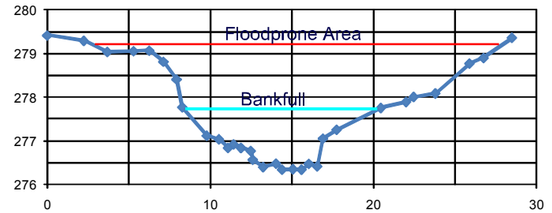
Cross Section 2 - Pool

Abkf = 9.0 ft
Wbkf = 9.7 ft
Dmax = 1.5 ft



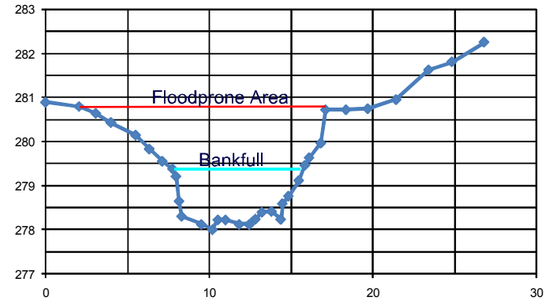
Cross Section 3 - Pool

Abkf = 13.1 ft
Wbkf = 8.9 ft
Dmax = 2.1 ft



Cross Section 4 - Riffle

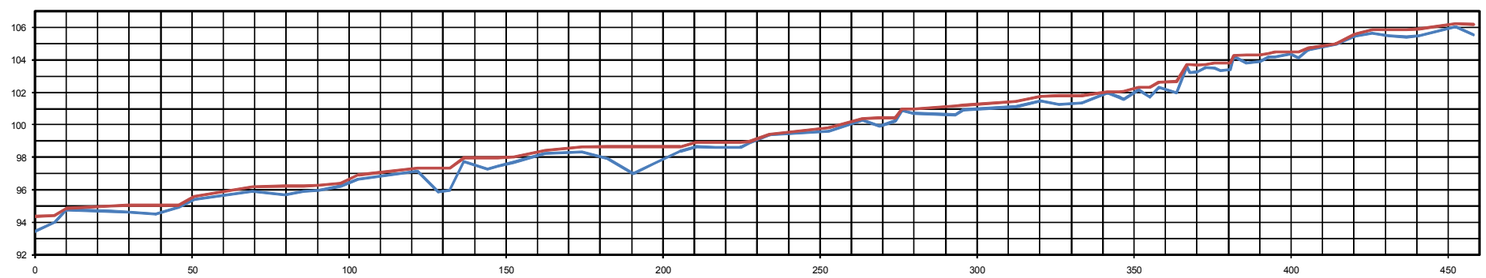
Abkf = 9.6 ft
Dave = 0.8 ft
Wbkf = 12.1 ft
Dmax = 1.4 ft
Bank Height = 1.4 ft
Bank Height Ratio = 1.0
W/D = 15.2
FPA = 25
ENT = 2.1
Stream Type = Eb



Cross Section 5 - Riffle

Abkf = 8.0 ft
Dave = 1.0 ft
Wbkf = 8.0 ft
Dmax = 1.4 ft
Bank Height = 1.4 ft
Bank Height Ratio = 1.0
W/D = 8.0
FPA = 15
ENT = 1.9
Stream Type = Eb

Cedarock Reference Reach



Profile (Reference Reach)

Save = 0.0258 rise/run
Svalley = 0.0310 rise/run
Sriffle = 0.0316 (0 - 0.0576) rise/run
Spool = 0.0007 (0 - 0.018) rise/run
Srun = 0.0353 (0 - 0.3565) rise/run
Sglide = 0.0029 (0 - 0.0431) rise/run

- Water Surface
- Channel Bed

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Stream and Wetland Mitigation Site

Alamance County
North Carolina

Title:

Cedarock Reference Reach Dimension, Pattern, and Profile

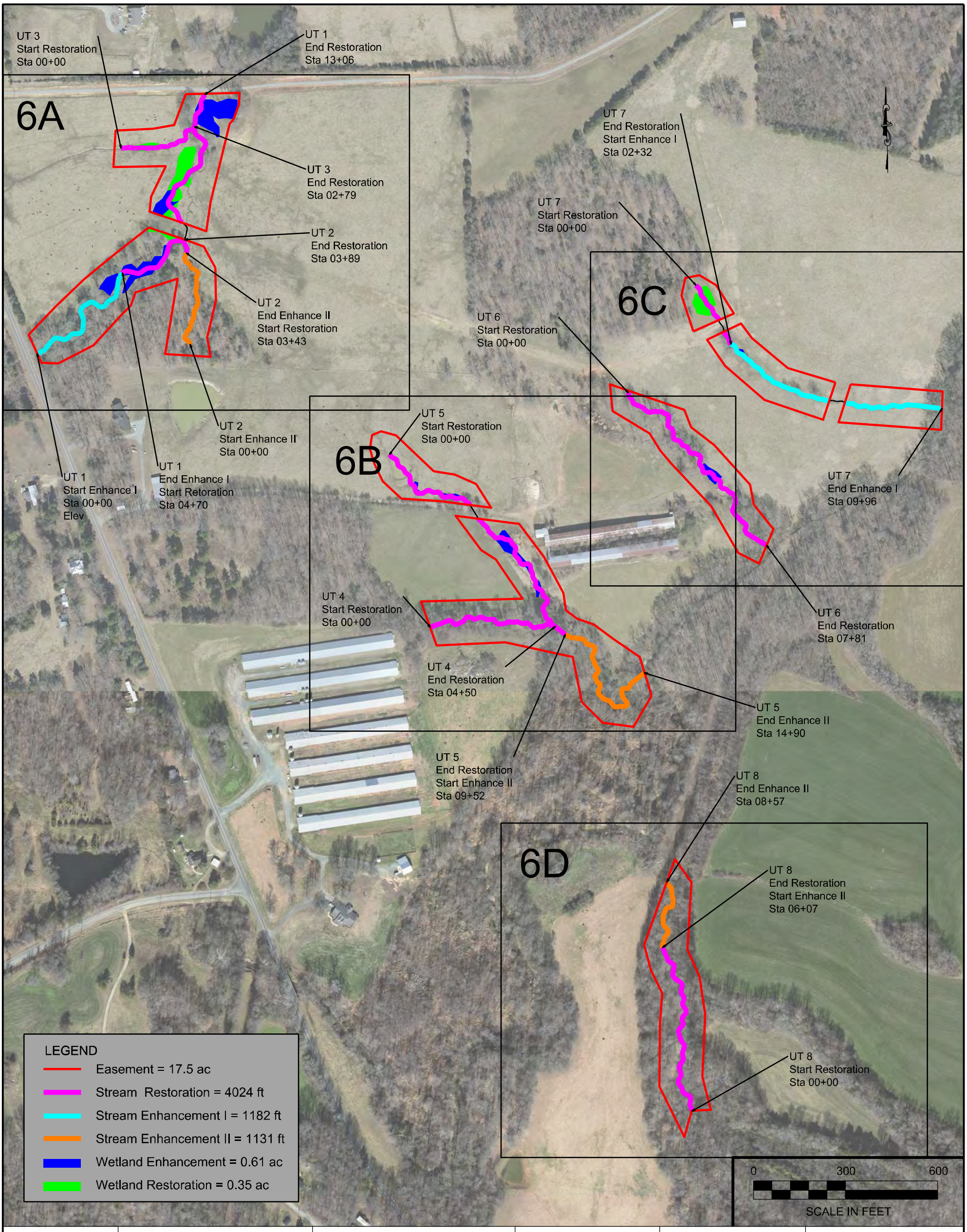
Scale: NA

Date: August 2017

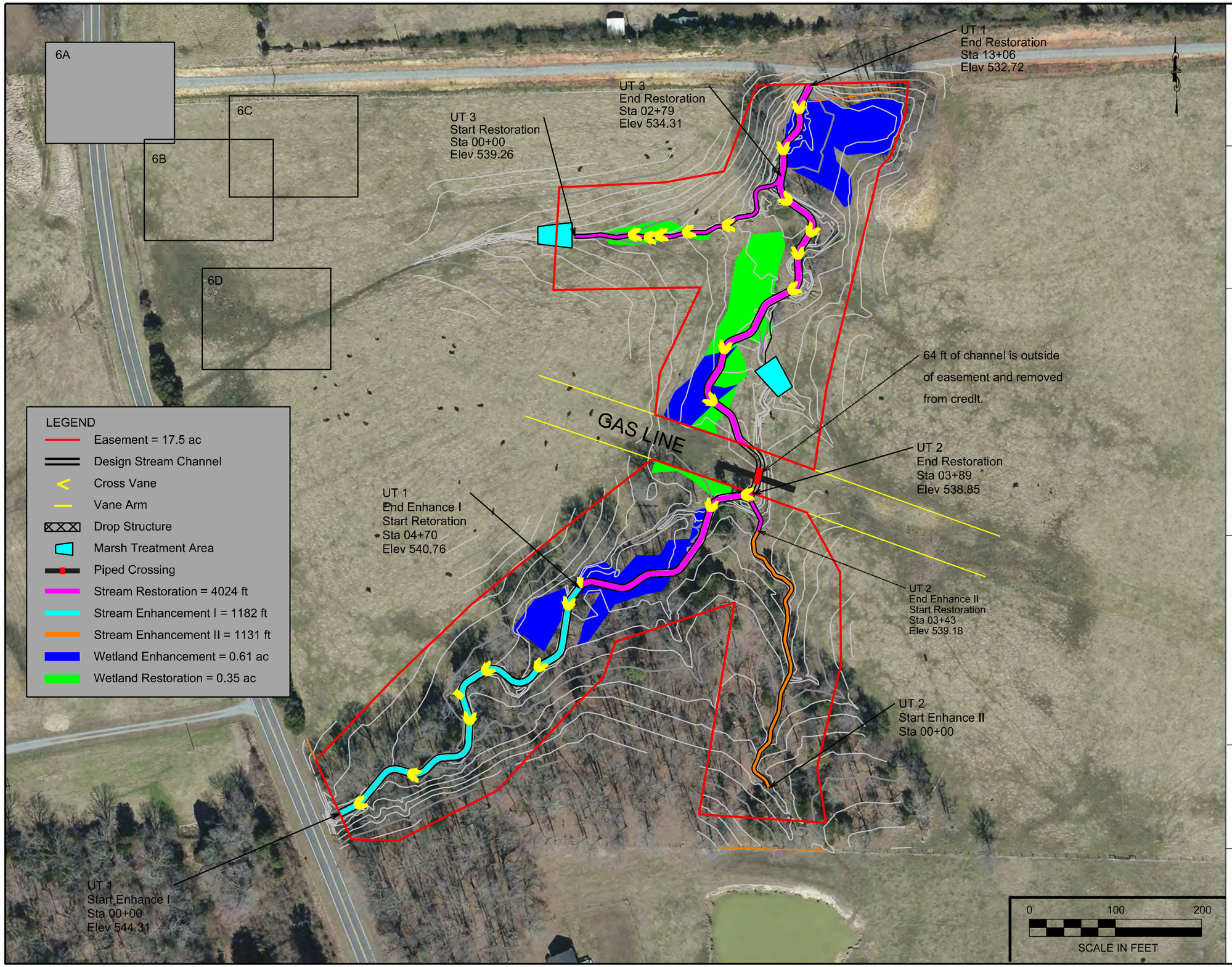
Project No.: 17-009

FIGURE NO.

5C



Scale: As Shown Date: Nov 2017 Project No.: 17-008 FIGURE NO. 6	Title: RESTORATION PLAN	Project: Heron Mitigation Site Alamance County North Carolina	NOTES/REVISIONS	RESTORATION SYSTEMS | LLC	Axiom Environmental, Inc.



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

RESTORATION
PLAN

Scale: AS SHOWN

Date: Nov 2017

Project No.: 17-008

FIGURE NO.

6A

UT 5
Start Restoration
Sta 00+00
Elev 538.00

Remove
Dam

53 ft of channel is outside
of easement and removed
from credit.

6A

6B

6C

6D

UT 5
Top of TerraCell
Sta 09+12
Elev 514.53

UT 4
Start Restoration
Sta 00+00
Elev 522.80

UT 5
End Restoration
Start Enhance II
Sta 09+52
Elev 510.87

UT 5
End Enhance II
Sta 14+90

UT 4
End Restoration
Sta 04+50
Elev 514.53

Stabilize ditch
with cloth, vegetation,
and/or stone.

LEGEND

- Easement = 17.5 ac
- Design Stream Channel
- Cross Vane
- Vane Arm
- Drop Structure
- Marsh Treatment Area
- Piped Crossing
- Stream Restoration = 4024 ft
- Stream Enhancement I = 1182 ft
- Stream Enhancement II = 1131 ft
- Wetland Enhancement = 0.61 ac
- Wetland Restoration = 0.35 ac

0 100 200
SCALE IN FEET

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

RESTORATION
PLAN

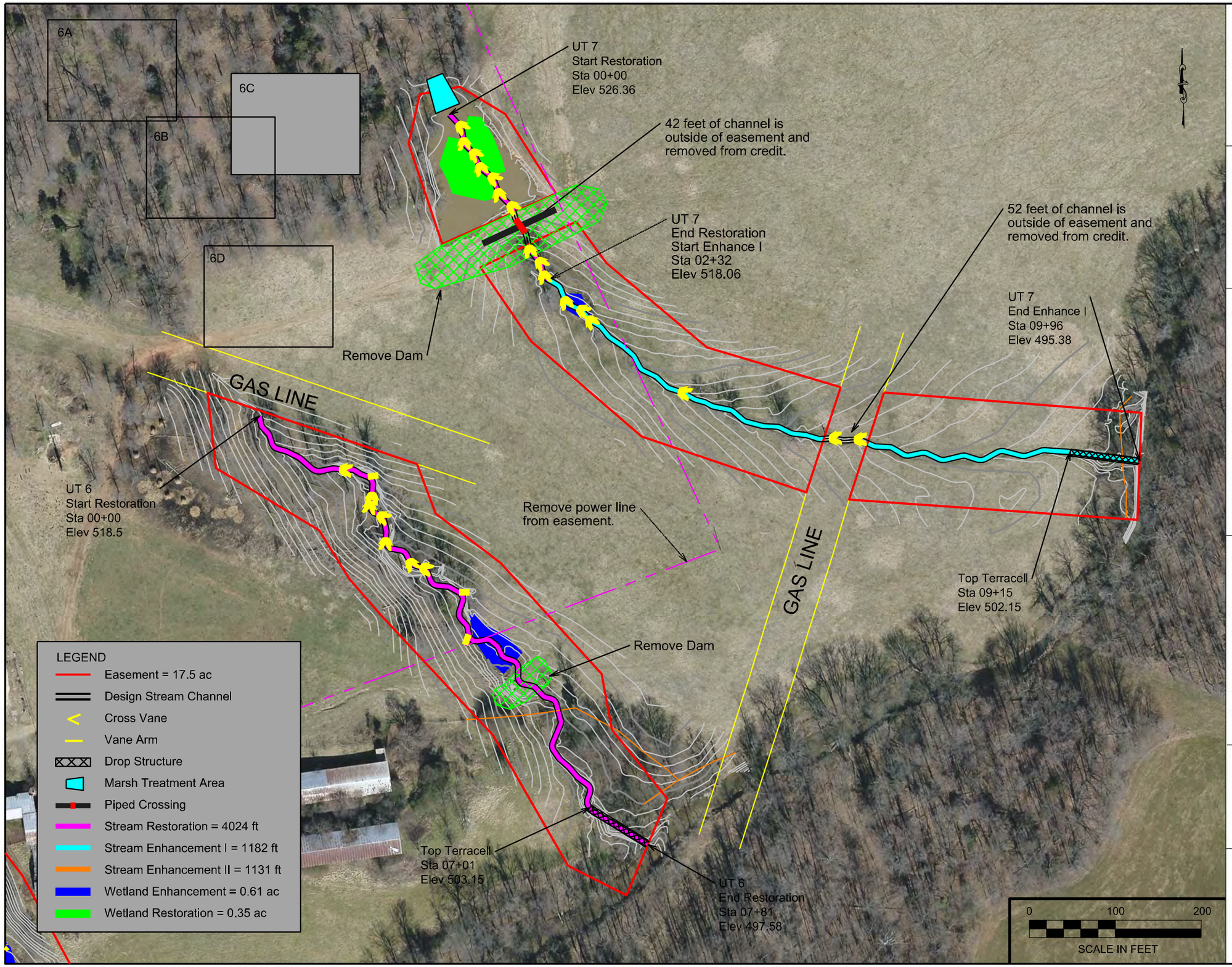
Scale: AS SHOWN

Date: Nov 2017

Project No.: 17-008

FIGURE NO.

6B



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

RESTORATION
PLAN

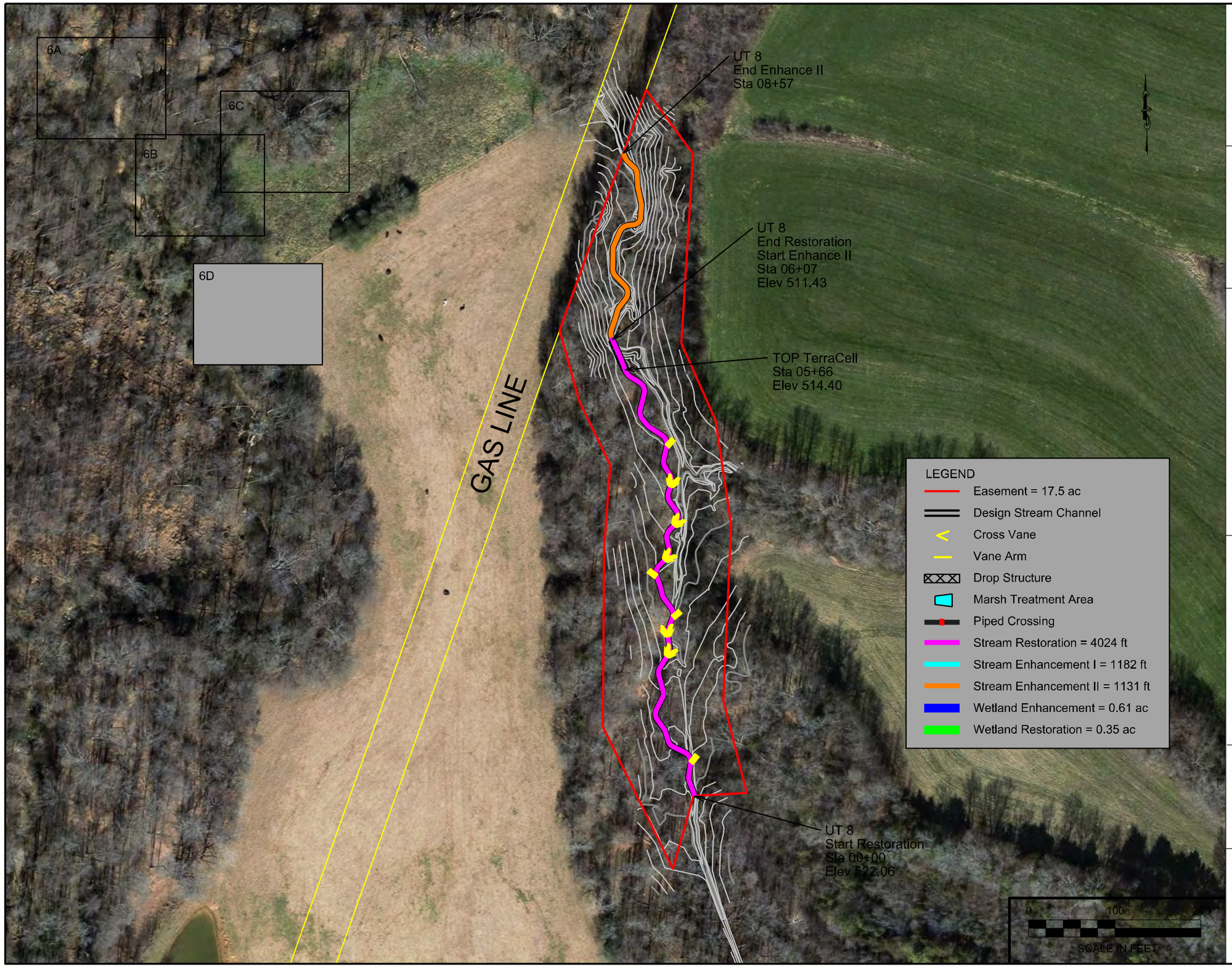
Scale:
AS SHOWN

Date:
Nov 2017

Project No.:
17-008

FIGURE NO.

6C



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

RESTORATION
PLAN

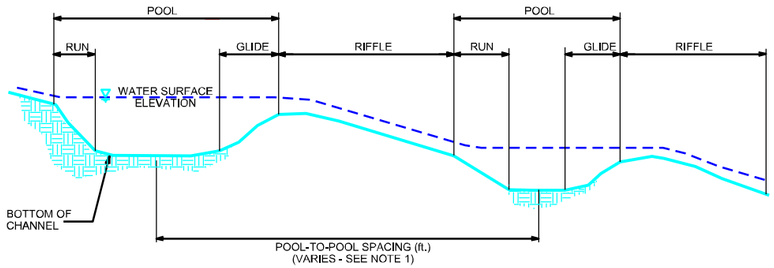
Scale:
AS SHOWN

Date:
Nov 2017

Project No.:
17-008

FIGURE NO.

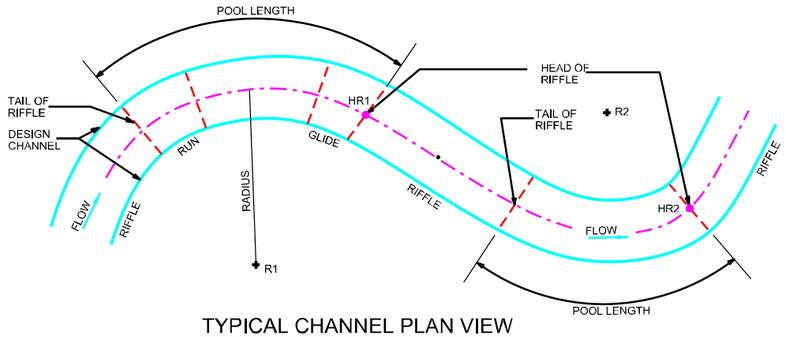
6D



TYPICAL CHANNEL PROFILE

NOTES:

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

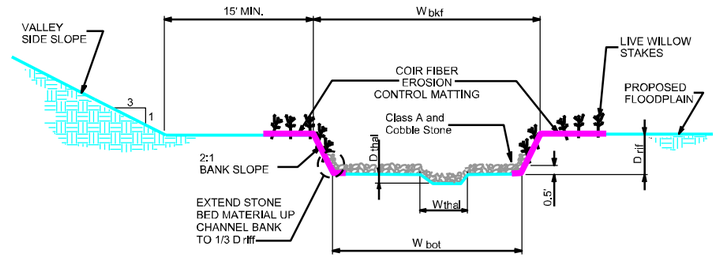


TYPICAL CHANNEL PLAN VIEW

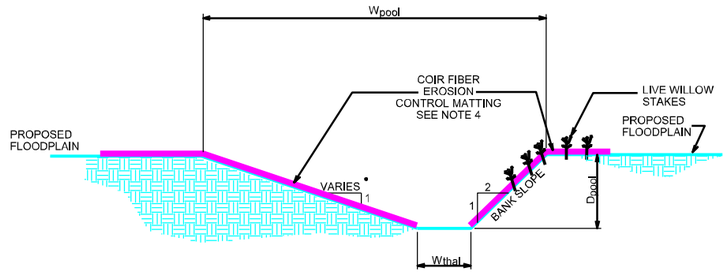
CHANNEL PLAN VIEW NOTES:

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.



TYPICAL RIFFLE CROSS-SECTION



• MAX. 1:1 SLOPE

TYPICAL POOL CROSS-SECTION

CHANNEL CONSTRUCTION NOTES:

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

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

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

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
UT 1	8.4	5.2	0.7	0.1	1.1	9.3	2.5
UT 3	4.4	2.8	0.3	0.1	0.6	4.9	1.0
UT 4, 5, and 6	4.8	3.2	0.4	0.1	0.6	5.2	1.5
UT 7	5.3	3.7	0.3	0.1	0.7	5.8	1.0
UT 8	5.9	4.3	0.3	0.1	0.8	6.5	1.5

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron Mitigation Site

Alamance County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Nov 2017

Project No.: 17-008

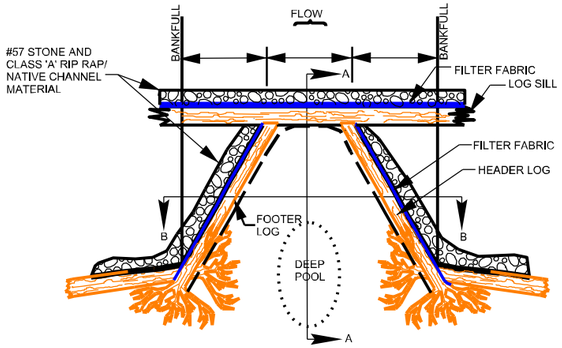
FIGURE NO.

7

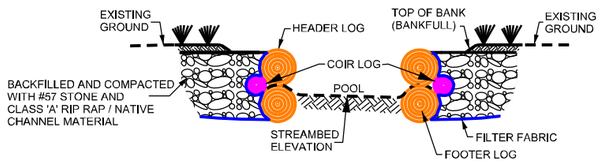
LOG CROSS VANE

SCALE:NTS

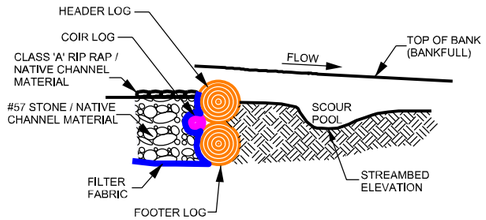
PLAN VIEW



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



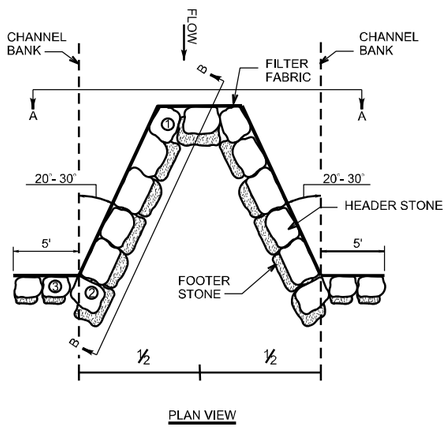
SECTION B-B



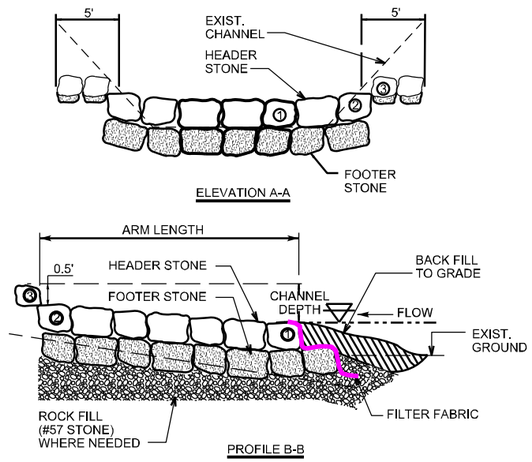
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 3, 4, 5, 6, 7, and 8	7	0.4 - 0.5
UT 1	10	0.8

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



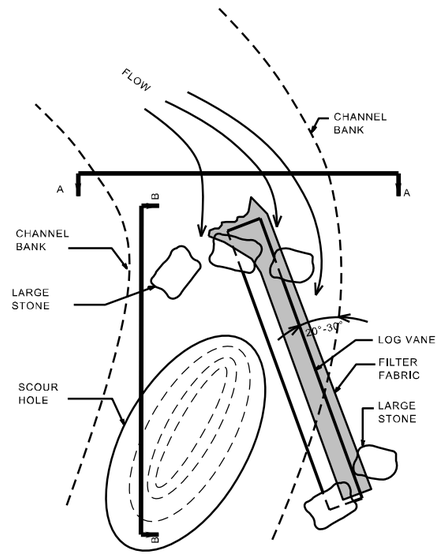
PLAN VIEW



ELEVATION A-A

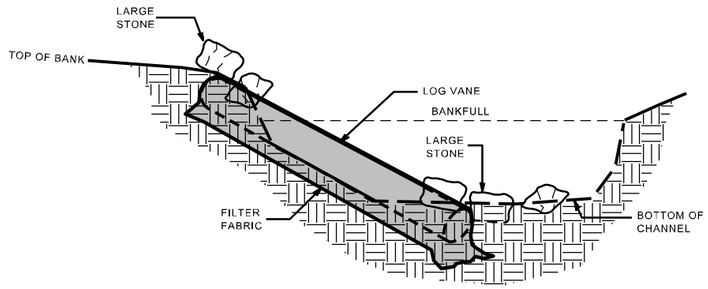
PROFILE B-B

TYPICAL CROSS-VANE

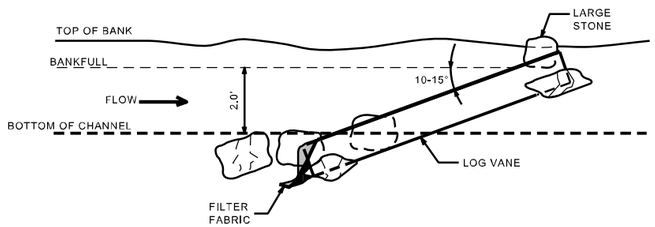


NOTE:
FILTER FABRIC TOED IN AND DRAPED ON UPSTREAM SIDE OF LOG VANE PRIOR TO BACKFILL.

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

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

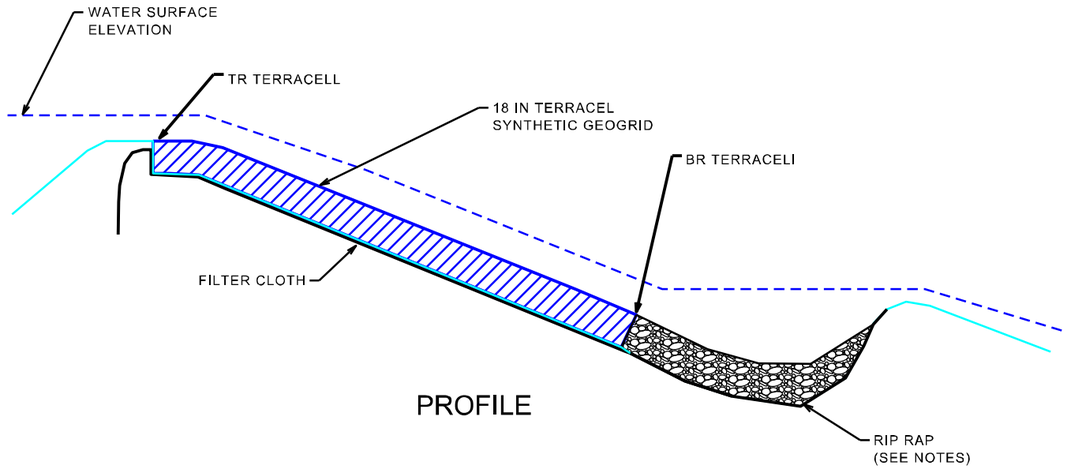
Heron Mitigation Site

Alamance County
North Carolina

Title:

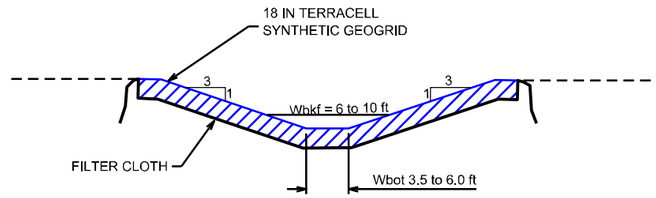
TYPICAL STRUCTURE DETAILS

Scale:	FIGURE NO.
NO SCALE	8A
Date: Nov 2017	
Project No.: 17-008	



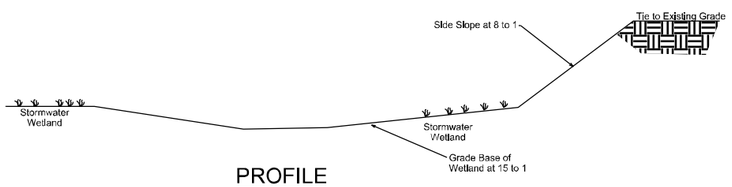
PROFILE

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.

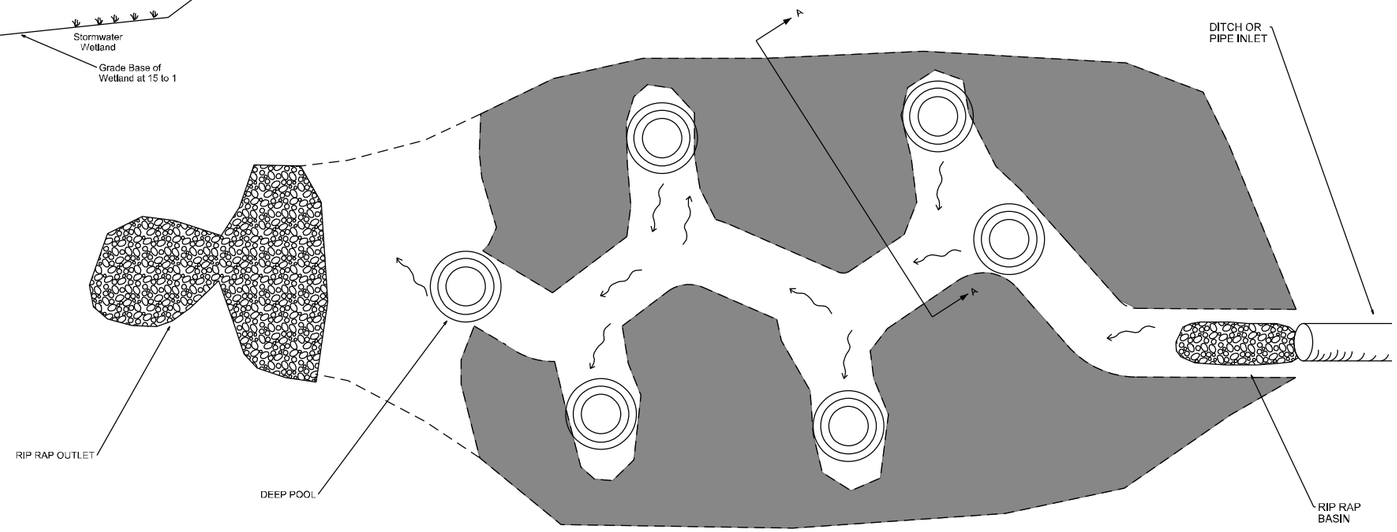


CROSS-SECTION

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:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

TYPICAL
STRUCTURE
DETAILS

Scale:
NO SCALE

Date:
Nov 2017

Project No.:
17-008

FIGURE NO.

8B

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Marsh Treatment Wetland**		Stream-side Assemblage**		TOTAL
Area (acres)	**3**		**5.2**		**0.05**		**3.8**		**12.05**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	--	--	14	10	517	5	530
River birch (*Betula nigra*)	204	10	--	--	--	--	517	5	721
Ironwood (*Carpinus caroliniana*)	--	--	707	20	--	--	--	--	707
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	27	20	--	--	27
Red bud (*Cercis canadensis*)	--	--	530	15	--	--	--	--	530
Sweet pepperbush (*Clethra alnifolia*)	--	--	--	--	20	15	--	--	20
Silky dogwood (*Cornus amomum*)	204	10	--	--	20	15	2067	20	2292
Persimmon (*Diospyros virginiana*)	--	--	354	10	--	--	--	--	354
White ash (*Fraxinus americana*)	--	--	177	5	--	--	--	--	177
Green ash (*Fraxinus pennsylvanica*)	408	20	--	--	--	--	2067	20	2475
Blueberry (*Vaccinium corymbosum*)	--	--	--	--	14	10	--	--	14
Tulip poplar (*Liriodendron tulipifera*)	204	10	--	--	--	--	--	--	204
Sycamore (*Platanus occidentalis*)	408	20	--	--	--	--	2067	20	2475
Black gum (*Nyssa sylvatica*)	--	--	530	15	--	--	--	--	530
Water oak (*Quercus nigra*)	306	15	707	20	--	--	1034	10	2047
Willow oak (*Quercus phellos*)	306	15	530	15	--	--	1034	10	1870
Black willow (*Salix nigra*)	--	--	--	--	--	--	1034	10	1034
Elderberry (*Sambucus canadensis*)	--	--	--	--	27	20	--	--	27
Possumhaw (*Viburnum nudum*)	--	--	--	--	14	10	--	--	14
TOTAL	**2040**	**100**	**3536**	**100**	**136**	**100**	**10336**	**100**	**16048**
* Planted at a density of 680 stems/acre.									
** Planted at a density of 2720 stems/acre.									

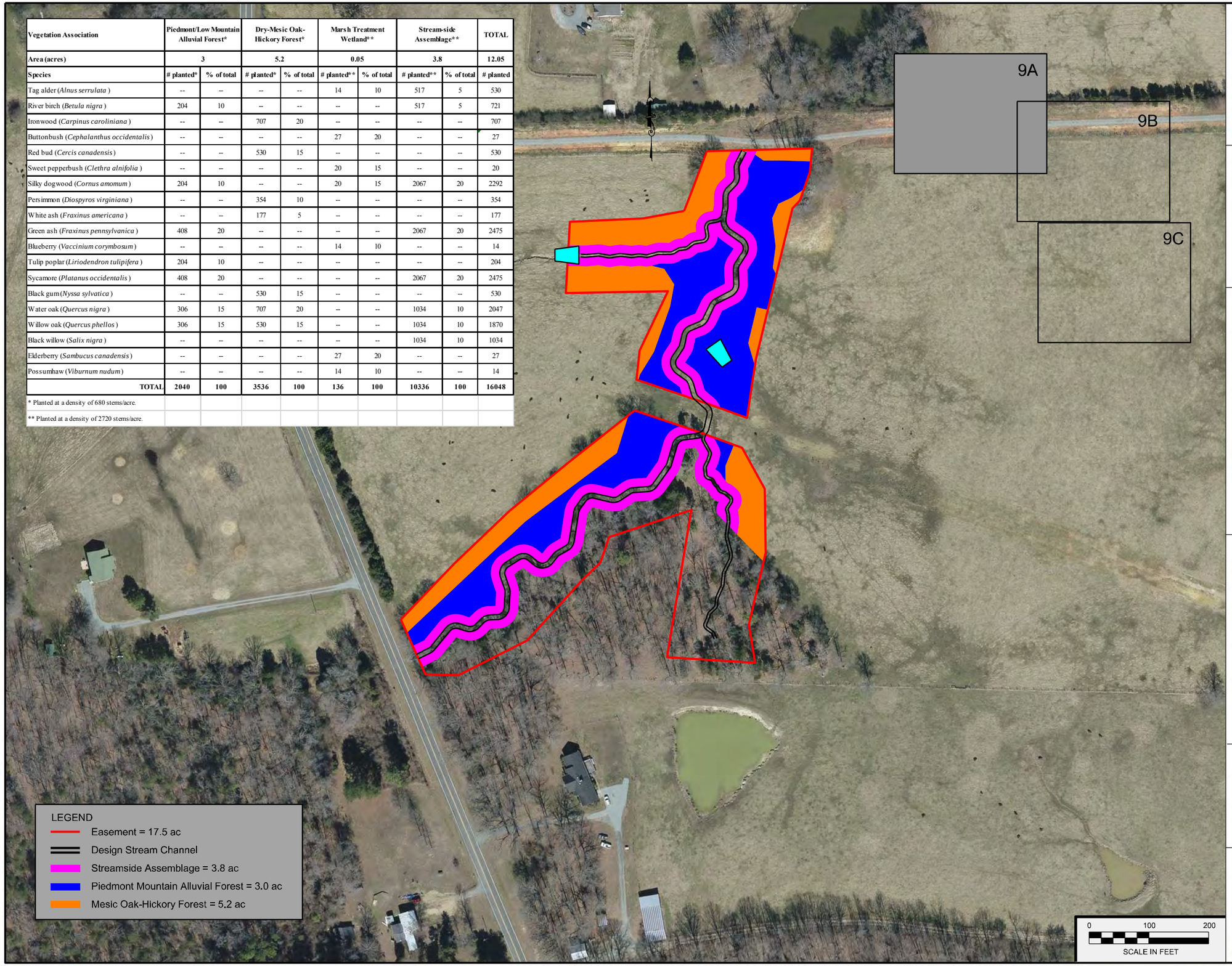


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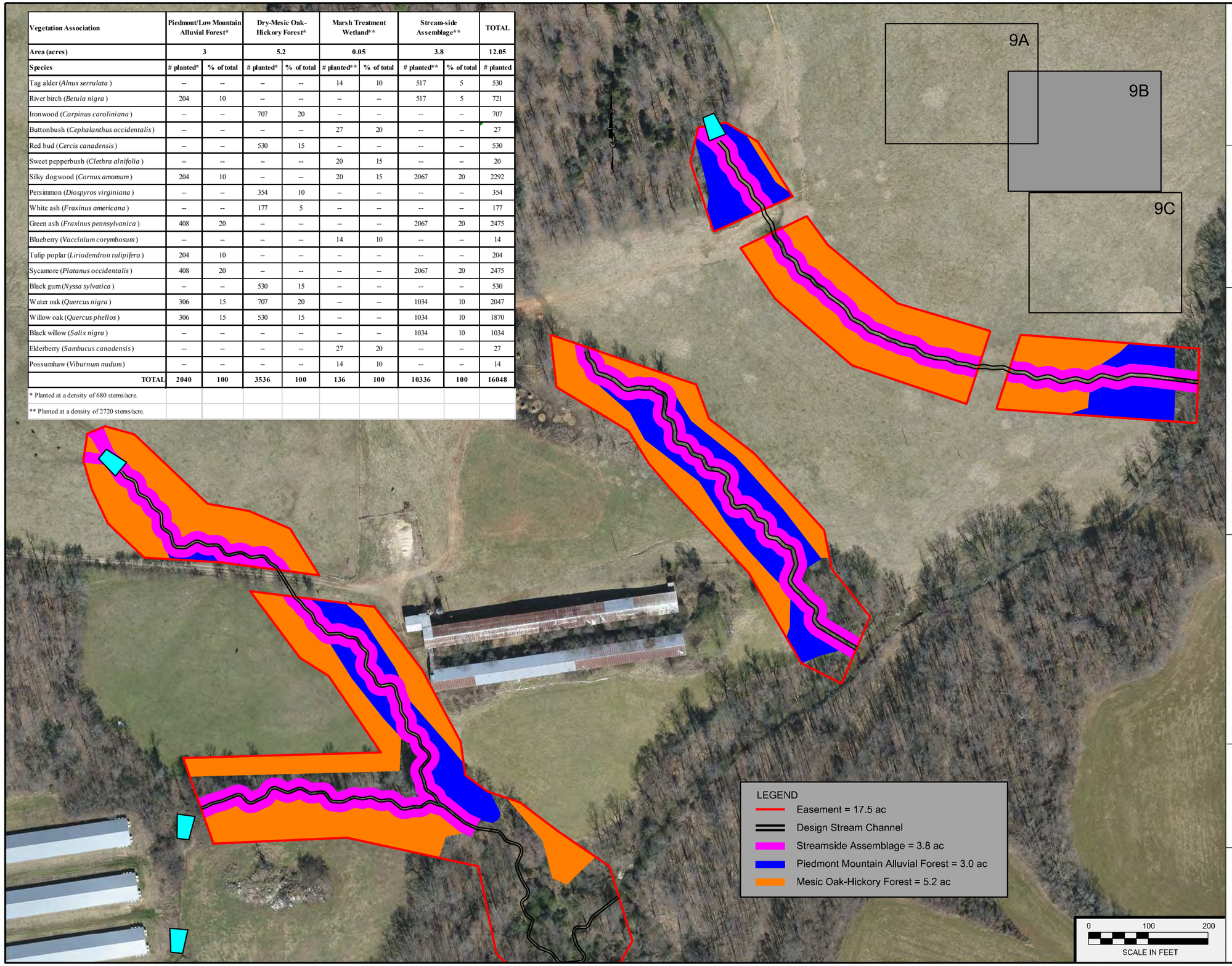
FIGURE NO.

9A

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Marsh Treatment Wetland**		Stream-side Assemblage**		TOTAL
Area (acres)	**3**		**5.2**		**0.05**		**3.8**		**12.05**
Species	**# planted***	**% of total**	**# planted***	**% of total**	**# planted****	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	--	--	14	10	517	5	530
River birch (*Betula nigra*)	204	10	--	--	--	--	517	5	721
Ironwood (*Carpinus caroliniana*)	--	--	707	20	--	--	--	--	707
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	27	20	--	--	27
Red bud (*Cercis canadensis*)	--	--	530	15	--	--	--	--	530
Sweet pepperbush (*Clethra alnifolia*)	--	--	--	--	20	15	--	--	20
Silky dogwood (*Cornus amomum*)	204	10	--	--	20	15	2067	20	2292
Persimmon (*Diospyros virginiana*)	--	--	354	10	--	--	--	--	354
White ash (*Fraxinus americana*)	--	--	177	5	--	--	--	--	177
Green ash (*Fraxinus pennsylvanica*)	408	20	--	--	--	--	2067	20	2475
Blueberry (*Vaccinium corymbosum*)	--	--	--	--	14	10	--	--	14
Tulip poplar (*Liriodendron tulipifera*)	204	10	--	--	--	--	--	--	204
Sycamore (*Platanus occidentalis*)	408	20	--	--	--	--	2067	20	2475
Black gum (*Nyssa sylvatica*)	--	--	530	15	--	--	--	--	530
Water oak (*Quercus nigra*)	306	15	707	20	--	--	1034	10	2047
Willow oak (*Quercus phellos*)	306	15	530	15	--	--	1034	10	1870
Black willow (*Salix nigra*)	--	--	--	--	--	--	1034	10	1034
Elderberry (*Sambucus canadensis*)	--	--	--	--	27	20	--	--	27
Possumhaw (*Viburnum nudum*)	--	--	--	--	14	10	--	--	14
TOTAL	**2040**	**100**	**3536**	**100**	**136**	**100**	**10336**	**100**	**16048**

* Planted at a density of 680 stems/acre.

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



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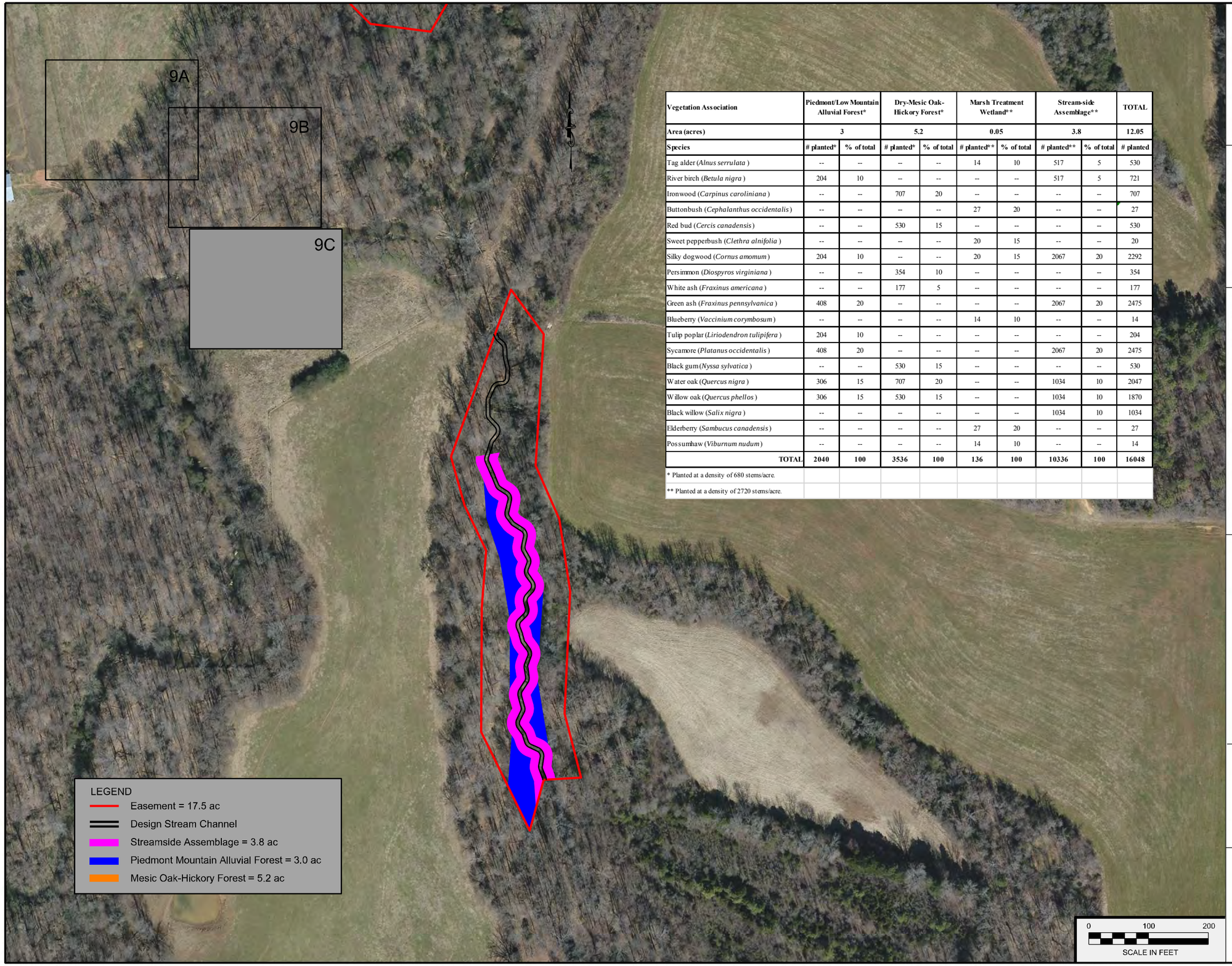
Scale: As Shown

Date: Nov 2017

Project No.: 17-008

FIGURE NO.

9B



Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Marsh Treatment Wetland**		Stream-side Assemblage**		TOTAL
Area (acres)	3		5.2		0.05		3.8		12.05
Species	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	--	--	--	--	14	10	517	5	530
River birch (*Betula nigra*)	204	10	--	--	--	--	517	5	721
Ironwood (*Carpinus caroliniana*)	--	--	707	20	--	--	--	--	707
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	27	20	--	--	27
Red bud (*Cercis canadensis*)	--	--	530	15	--	--	--	--	530
Sweet pepperbush (*Clethra alnifolia*)	--	--	--	--	20	15	--	--	20
Silky dogwood (*Cornus amomum*)	204	10	--	--	20	15	2067	20	2292
Persimmon (*Diospyros virginiana*)	--	--	354	10	--	--	--	--	354
White ash (*Fraxinus americana*)	--	--	177	5	--	--	--	--	177
Green ash (*Fraxinus pennsylvanica*)	408	20	--	--	--	--	2067	20	2475
Blueberry (*Vaccinium corymbosum*)	--	--	--	--	14	10	--	--	14
Tulip poplar (*Liriodendron tulipifera*)	204	10	--	--	--	--	--	--	204
Sycamore (*Platanus occidentalis*)	408	20	--	--	--	--	2067	20	2475
Black gum (*Nyssa sylvatica*)	--	--	530	15	--	--	--	--	530
Water oak (*Quercus nigra*)	306	15	707	20	--	--	1034	10	2047
Willow oak (*Quercus phellos*)	306	15	530	15	--	--	1034	10	1870
Black willow (*Salix nigra*)	--	--	--	--	--	--	1034	10	1034
Elderberry (*Sambucus canadensis*)	--	--	--	--	27	20	--	--	27
Possumhaw (*Viburnum nudum*)	--	--	--	--	14	10	--	--	14
TOTAL	**2040**	**100**	**3536**	**100**	**136**	**100**	**10336**	**100**	**16048**

* Planted at a density of 680 stems/acre.

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

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Date: Nov 2017

Project No.: 17-008

FIGURE NO.

9C

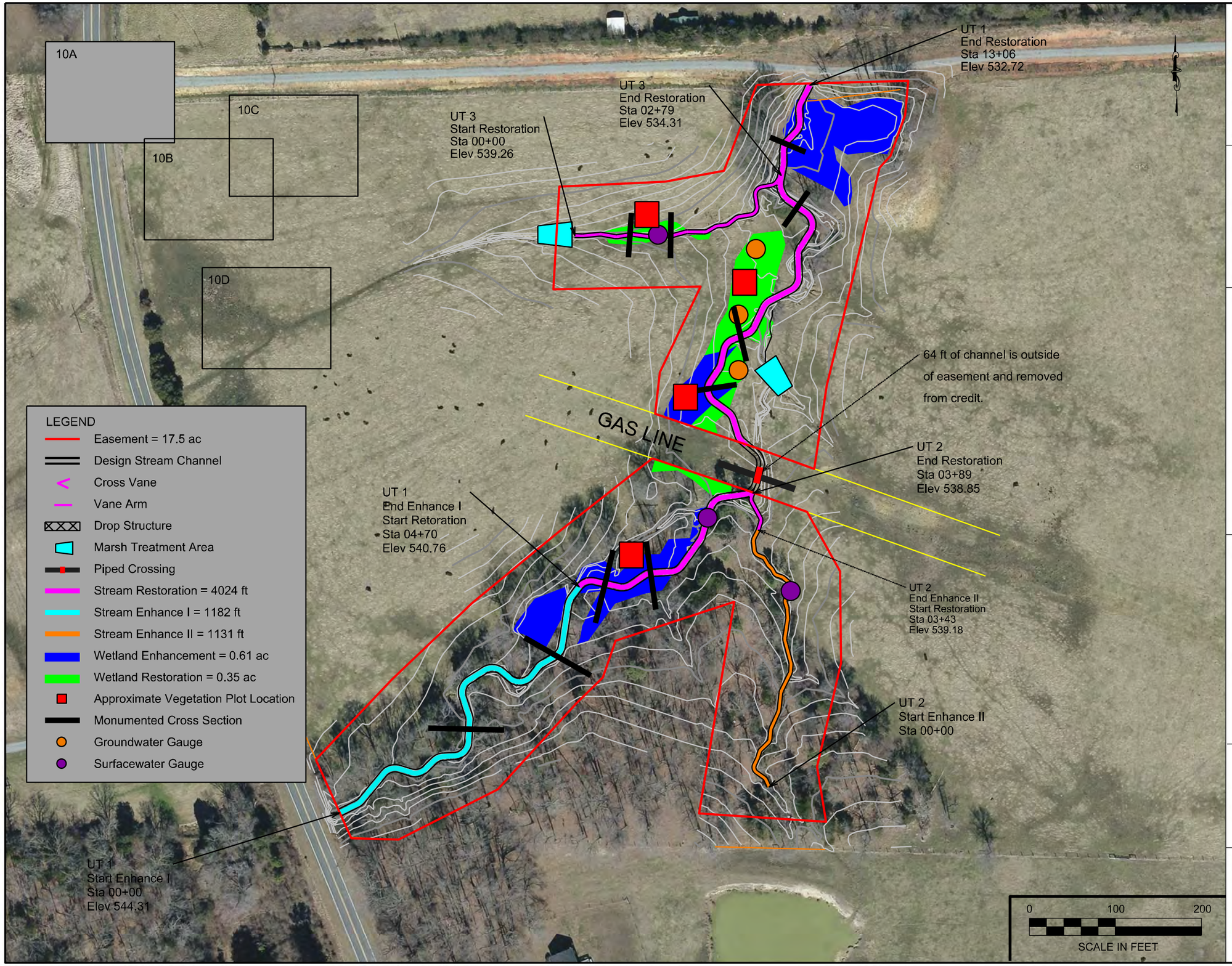

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FIGURE NO.

10A

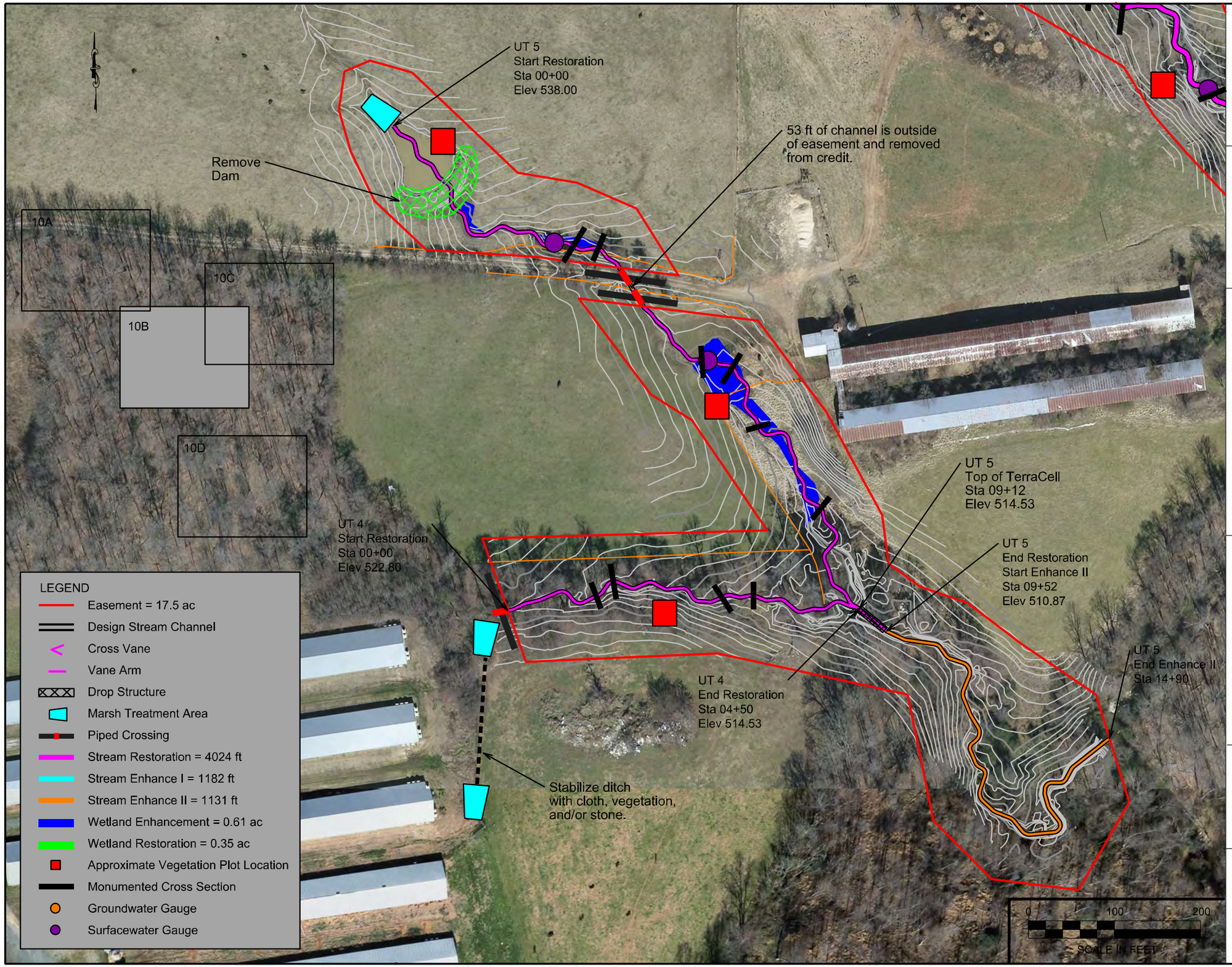

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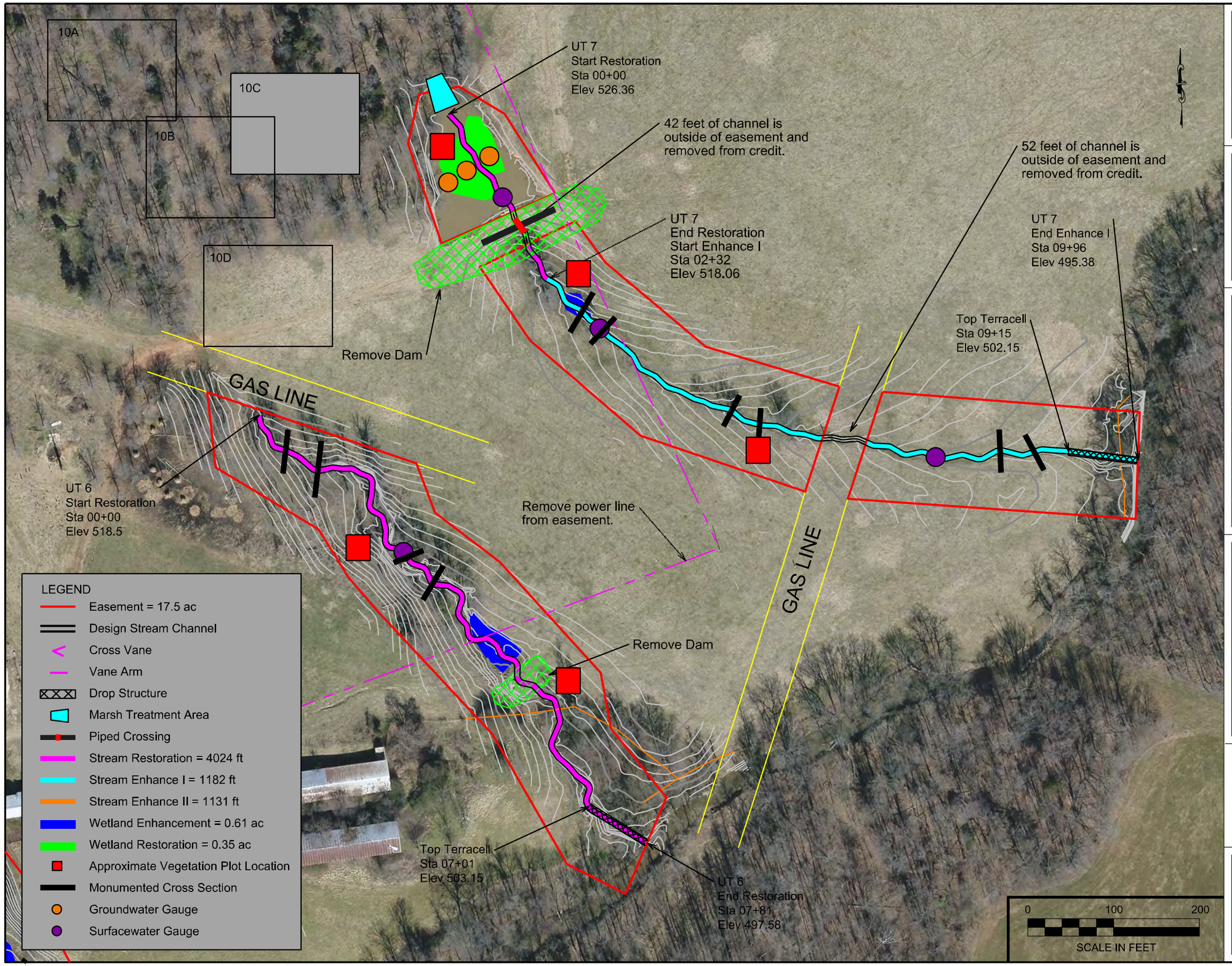
FIGURE NO.

10B



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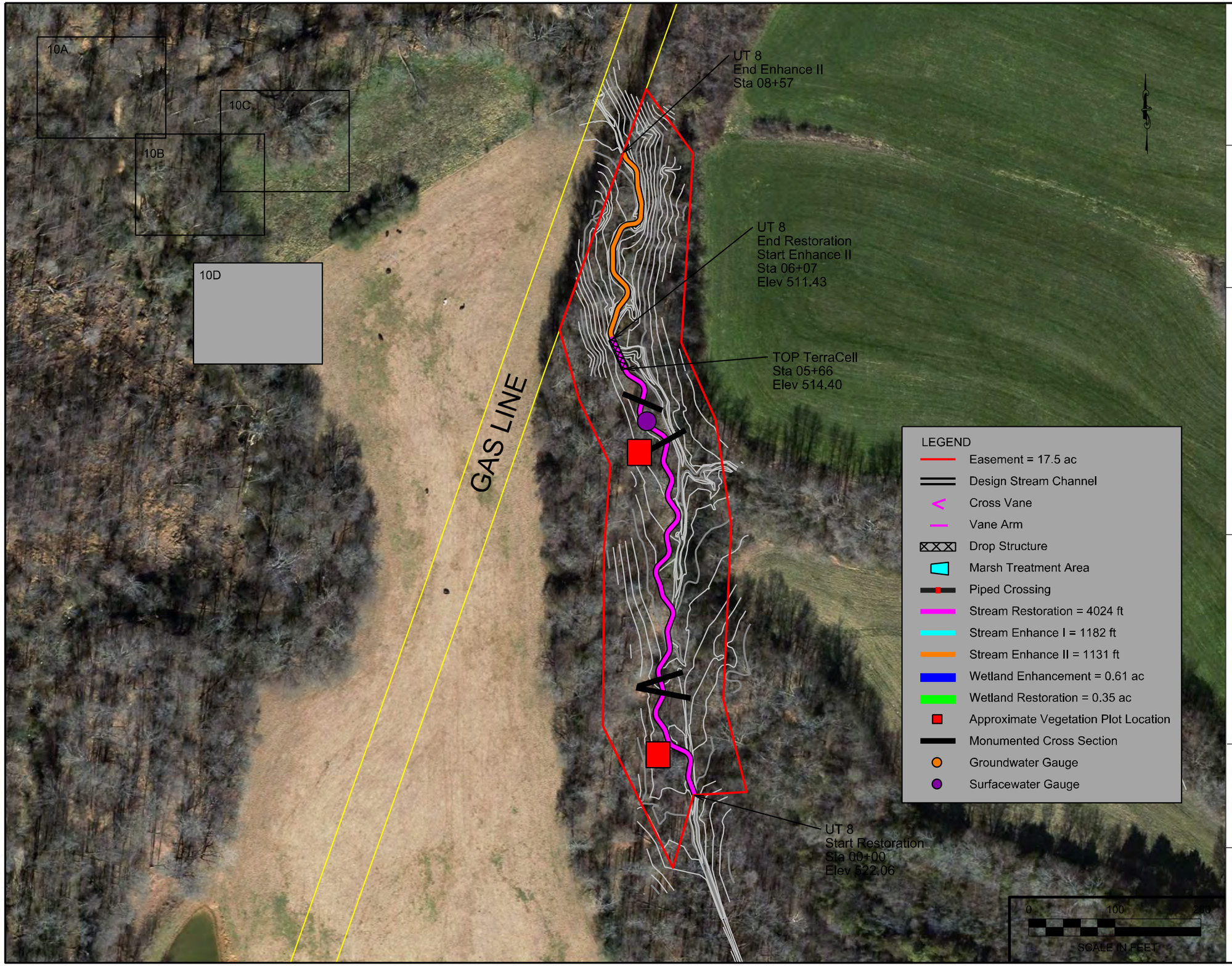
Scale:	FIGURE NO.
AS SHOWN	10C
Date: Nov 2017	
Project No.: 17-008	



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Scale:	FIGURE NO.
AS SHOWN	10D
Date: Nov 2017	
Project No.: 17-008	

Appendix B
Existing Stream Data

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

Table B1. Heron Site Morphological Stream Characteristics

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 1	Proposed	Existing UT 2	Existing UT 3	PROPOSED
Stream Type	Eb 4	E 5	Cg 5	E/C 4	Gf 4/5	Cg 5	E/C 4
Drainage Area (mi^2)	0.21	0.63	0.13	0.13	0.01	0.02	0.02
Bankfull Discharge (cfs)	28.8	60.6	19.3	19.3	3.2	5.0	5.0
Dimension Variables							
Bankfull Cross-Sectional Area (A_{bkf})	8.0	14.7	5.1	5.1	1.0	1.4	1.4
Existing Cross-Sectional Area at TOB ($A_{existing}$)	8.0	14.7	9.5 - 24.6	5.1	5.8 - 9.0	3.9 - 7.3	1.4
Bankfull Width (W_{bkf})	Mean: 8.1 Range: 8.0 - 12.1	Mean: 11.0 Range: 10.7 - 11.3	Mean: 8.5 Range: 4.7 to 11.1	Mean: 8.4 Range: 7.8 to 9.0	Mean: 3.9 Range: 3.0 to 4.8	Mean: 4.5 Range: 3.2 to 5.9	Mean: 4.4 Range: 4.1 to 4.7
Bankfull Mean Depth (D_{bkf})	Mean: 0.8 Range: 0.8 - 1.0	Mean: 1.4 Range: 1.3 - 1.4	Mean: 0.7 Range: 0.5 to 1.1	Mean: 0.6 Range: 0.6 to 0.7	Mean: 0.3 Range: 0.2 to 0.3	Mean: 0.3 Range: 0.2 to 0.4	Mean: 0.3 Range: 0.3 to 0.3
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 1.1 - 1.4	Mean: 2.0 Range: 1.9 - 2.0	Mean: 1.1 Range: 0.8 to 2.0	Mean: 0.8 Range: 0.7 to 1.0	Mean: 0.5 Range: 0.3 to 0.7	Mean: 0.6 Range: 0.5 to 0.7	Mean: 0.4 Range: 0.4 to 0.5
Pool Width (W_{pool})	Mean: 9.3 Range: 8.9 - 9.7	Mean: 10.5 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 9.3 Range: 8.4 to 11.8	Mean: 3.7 Range: 3.5 to 3.8	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 4.9 Range: 4.4 to 6.2
Maximum Pool Depth (D_{pool})	Mean: 1.8 Range: 1.5 - 2.1	Mean: 2.7 Range:		Mean: 1.1 Range: 0.8 to 1.3	Mean: 0.4 Range: 0.4 to 0.4		Mean: 0.6 Range: 0.4 to 0.7
Width of Floodprone Area (W_{fpa})	Mean: 18 Range: 15 - 25	Mean: 131 Range: 122 - 140	Mean: 20 Range: 13 to 30	Mean: 75 Range: 40 to 100	Mean: 6 Range: 6 to 6	Mean: 14 Range: 9 to 21	Mean: 40 Range: 20 to 60
Dimension Ratios							
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 2.1 Range: 1.9 - 2.2	Mean: 12 Range: 11 - 13	Mean: 2.5 Range: 1.6 to 4.3	Mean: 8.9 Range: 5.1 to 11.1	Mean: 1.6 Range: 1.4 to 2.0	Mean: 2.2 Range: 1.4 to 3.8	Mean: 9.0 Range: 4.9 to 12.7
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 10.1 Range: 8.0 - 15.1	Mean: 9 Range: 8 - 9	Mean: 14.6 Range: 4.3 to 22.0	Mean: 14.0 Range: 12.0 to 16.0	Mean: 15.6 Range: 10.0 to 24.0	Mean: 17.4 Range: 8.0 to 29.5	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.4 Range: 1.4 - 1.8	Mean: 1.4 Range: 1.4 - 1.5	Mean: 1.8 Range: 1.3 to 2.2	Mean: 1.4 Range: 1.2 to 1.5	Mean: 1.7 Range: 1.3 to 2.3	Mean: 2.0 Range: 1.7 to 2.5	Mean: 1.4 Range: 1.2 to 1.5
Low Bank Height / Max. D_{bkf} Ratio	Mean: 1.0 Range: 1.0 - 1.8	Mean: 1.4 Range:	Mean: 1.9 Range: 1.4 to 2.5	Mean: 1.0 Range: 1.0 to 1.3	Mean: 3.3 Range: 3.0 to 3.7	Mean: 2.2 Range: 1.7 to 2.4	Mean: 1.0 Range: 1.0 to 1.3
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	Mean: 1.9 Range: 0 - 2.1	Mean: 2 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1	Mean: 1.7 Range: 1.3 to 2.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1
Pool Width / Bankfull Width (W_{pool}/W_{bkf})	Mean: 1.1 Range: 0 - 1.2	Mean: 1 Range:		Mean: 1.1 Range: 1.0 to 1.4	Mean: 0.9 Range: 0.8 to 0.9		Mean: 1.1 Range: 1.0 to 1.4
Pool Area / Bankfull Cross Sectional Area	Mean: 1.4 Range: 0 - 1.6	Mean: 1.4 Range:		Mean: 1.4 Range: 1.1 to 1.6	Mean: 1.0 Range: 1.0 to 1.0		Mean: 1.4 Range: 1.1 to 1.6

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 1	Proposed	Existing UT 2	Existing UT 3	PROPOSED
Pattern Variables							
Pool to Pool Spacing (L_{p-p})	Med: 37.2 Range: 25 - 69	Med: 44.3 Range: 22 - 81	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 33.8 Range: 25.3 to 67.6	Med: 23.4 Range: 10.3 to 37.2	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 17.7 Range: 13.3 to 35.4
Meander Length (L_m)	Med: 68.4 Range: 44 - 116	Med: 62.9 Range: 10 - 91		Med: 71.8 Range: 50.7 to 101.4	Med: 39.3 Range: 22.4 to 62.6		Med: 37.6 Range: 26.6 to 53.1
Belt Width (W_{belt})	Med: 22.8 Range: 20 - 38	Med: 29.8 Range: 17 - 36		Med: 33.8 Range: 25.3 to 50.7	Med: 22.7 Range: 17.7 to 31.1		Med: 17.7 Range: 13.3 to 26.6
Radius of Curvature (R_c)	Med: 16.5 Range: 11 - 27	Med: 30.6 Range: 9 - 113		Med: 25.3 Range: 16.9 to 84.5	Med: 10.2 Range: 5.2 to 17.0		Med: 13.3 Range: 8.9 to 44.3
Sinuosity (Sin)	1.20	1.46	1.30	1.30	1.14	1.07	1.15
Pattern Ratios							
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	Med: 4.6 Range: 3.1 - 8.4	Med: 4 Range: 2.0 - 7.4	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0	Med: 6.0 Range: 2.6 to 9.5	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0
Meander Length/ Bankfull Width (L_m/W_{bkf})	Med: 8.4 Range: 5.5 - 14.3	Med: 5.7 Range: 0.9 - 8.3		Med: 8.5 Range: 6.0 to 12.0	Med: 10.1 Range: 5.7 to 16.1		Med: 8.5 Range: 6.0 to 12.0
Meander Width Ratio (W_{belt}/W_{bkf})	Med: 2.8 Range: 2.4 - 4.7	Med: 2.7 Range: 1.5 - 3.5		Med: 4.0 Range: 3.0 to 6.0	Med: 5.8 Range: 4.5 to 8.0		Med: 4.0 Range: 3.0 to 6.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})	Med: 2.0 Range: 1.4 - 3.3	Med: 2.8 Range: 0.8 - 10.3		Med: 3.0 Range: 2.0 to 10.0	Med: 2.6 Range: 1.3 to 4.4		Med: 3.0 Range: 2.0 to 10.0
Profile Variables							
Average Water Surface Slope (S_{ave})	0.0258	0.0053	0.0057	0.0057	0.0170	0.0207	0.0193
Valley Slope (S_{valley})	0.0310	0.0077	0.0074	0.0074	0.0194	0.0222	0.0222
Riffle Slope (S_{riffle})	Mean: 0.0316 Range: 0.01 - 0.0576	Mean: 0.0098 Range: 0.002 - 0.01198	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0091 Range: 0.0068 to 0.0103	Insufficient Water in Channel to Measure Slope	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0309 Range: 0.0232 to 0.0347
Pool Slope (S_{pool})	Mean: 0.0007 Range: 0 - 0.018	Mean: 0.0006 Range: 0 - 0.004		Mean: 0.0006 Range: 0.0000 to 0.0040			Mean: 0.0019 Range: 0.0000 to 0.0135
Run Slope (S_{run})	Mean: 0.0353 Range: 0 - 0.3565	Mean: Range:		Mean: 0.0023 Range: 0.0000 to 0.0046			Mean: 0.0077 Range: 0.0000 to 0.0154
Glide Slope (S_{glide})	Mean: 0.0029 Range: 0 - 0.0431	Mean: Range:		Mean: 0.0006 Range: 0.0000 to 0.0046			Mean: 0.0021 Range: 0.0000 to 0.0154
Profile Ratios							
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	Mean: 1.2 Range: 0.39 - 2.23	Mean: 1.6 Range: 0 - 3.7	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8	Insufficient Water in Channel to Measure Slope	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8
Pool Slope/Water Surface Slope (S_{pool}/S_{ave})	Mean: 0.0 Range: 0 - 0.70	Mean: 0.1 Range: 0 - 0.8		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: 1.37 Range: 0 - 13.82	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: 0.11 Range: 0 - 1.67	Mean: Range:		Mean: 0.11 Range: 0.0 to 0.8			Mean: 0.11 Range: 0.0 to 0.8

* Causey Farm Reference includes measurments from a Reference Site measured in 2004.

Table B1 continued. Heron Site Morphological Stream Characteristics

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 4	Existing UT 5	Proposed	Existing UT 6	PROPOSED
Stream Type	Eb 4	E 5	Eg 5	Eg 5	E/C 4	Cg 5	E/C 4
Drainage Area (mi^2)	0.21	0.63	0.03	0.02	0.02 - 0.03	0.02	0.02
Bankfull Discharge (cfs)	28.8	60.6	7.3	5.5	5.5 - 7.3	5.2	5.2
Dimension Variables							
Bankfull Cross-Sectional Area (A_{bkf})	8.0	14.7	2.0	1.6	1.8	1.5	1.5
Existing Cross-Sectional Area at TOB ($A_{existing}$)	8.0	14.7	2.7 - 6.9	2.5 - 9.7	1.8	15.4 - 98.2	1.5
Bankfull Width (W_{bkf})	Mean: 8.1 Range: 8.0 - 12.1	Mean: 11.0 Range: 10.7 - 11.3	Mean: 3.8 Range: 3.1 to 4.9	Mean: 3.7 Range: 2.5 to 6.0	Mean: 5.0 Range: 4.6 to 5.4	Mean: 6.4 Range: 4.6 to 9.6	Mean: 4.6 Range: 4.2 to 4.9
Bankfull Mean Depth (D_{bkf})	Mean: 0.8 Range: 0.8 - 1.0	Mean: 1.4 Range: 1.3 - 1.4	Mean: 0.5 Range: 0.4 to 0.6	Mean: 0.5 Range: 0.3 to 0.7	Mean: 0.4 Range: 0.3 to 0.4	Mean: 0.3 Range: 0.2 to 0.3	Mean: 0.3 Range: 0.3 to 0.4
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 1.1 - 1.4	Mean: 2.0 Range: 1.9 - 2.0	Mean: 0.8 Range: 0.7 to 0.9	Mean: 0.8 Range: 0.5 to 0.9	Mean: 0.5 Range: 0.4 to 0.6	Mean: 0.5 Range: 0.4 to 0.8	Mean: 0.5 Range: 0.4 to 0.5
Pool Width (W_{pool})	Mean: 9.3 Range: 8.9 - 9.7	Mean: 10.5 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 5.5 Range: 5.0 to 7.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 5.0 Range: 4.6 to 6.4
Maximum Pool Depth (D_{pool})	Mean: 1.8 Range: 1.5 - 2.1	Mean: 2.7 Range:			Mean: 0.7 Range: 0.5 to 0.8		Mean: 0.6 Range: 0.4 to 0.7
Width of Floodprone Area (W_{fpa})	Mean: 18 Range: 15 - 25	Mean: 131 Range: 122 - 140	Mean: 15 Range: 6 to 30	Mean: 12 Range: 4 to 30	Mean: 50 Range: 25 to 75	Mean: 16 Range: 7 to 46	Mean: 50 Range: 25 to 75
Dimension Ratios							
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 2.1 Range: 1.9 - 2.2	Mean: 12 Range: 11 - 13	Mean: 3.9 Range: 1.3 to 6.1	Mean: 3.1 Range: 1.4 to 7.3	Mean: 10.0 Range: 5.4 to 14.0	Mean: 2.4 Range: 1.1 to 4.8	Mean: 10.9 Range: 5.9 to 15.3
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 10.1 Range: 8.0 - 15.1	Mean: 9 Range: 8 - 9	Mean: 7.7 Range: 5.2 to 12.3	Mean: 8.8 Range: 3.6 to 20.0	Mean: 14.0 Range: 12.0 to 16.0	Mean: 26.7 Range: 15.3 to 48.0	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.4 Range: 1.4 - 1.8	Mean: 1.4 Range: 1.4 - 1.5	Mean: 1.5 Range: 1.3 to 1.8	Mean: 1.5 Range: 1.3 to 2.0	Mean: 1.4 Range: 1.2 to 1.5	Mean: 2.2 Range: 1.3 to 4.0	Mean: 1.4 Range: 1.2 to 1.5
Low Bank Height / Max. D_{bkf} Ratio	Mean: 1.0 Range: 1.0 - 1.8	Mean: 1.4 Range:	Mean: 2.3 Range: 1.3 to 4.0	Mean: 2.0 Range: 1.3 to 2.7	Mean: 1.0 Range: 1.0 to 1.3	Mean: 5.0 Range: 3.7 to 7.5	Mean: 1.0 Range: 1.0 to 1.3
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	Mean: 1.9 Range: 0 - 2.1	Mean: 2 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1
Pool Width / Bankfull Width (W_{pool}/W_{bkf})	Mean: 1.1 Range: 0 - 1.2	Mean: 1 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: 1.4 Range: 0 - 1.6	Mean: 1.4 Range:			Mean: 1.4 Range: 1.1 to 1.6		Mean: 1.4 Range: 1.1 to 1.6

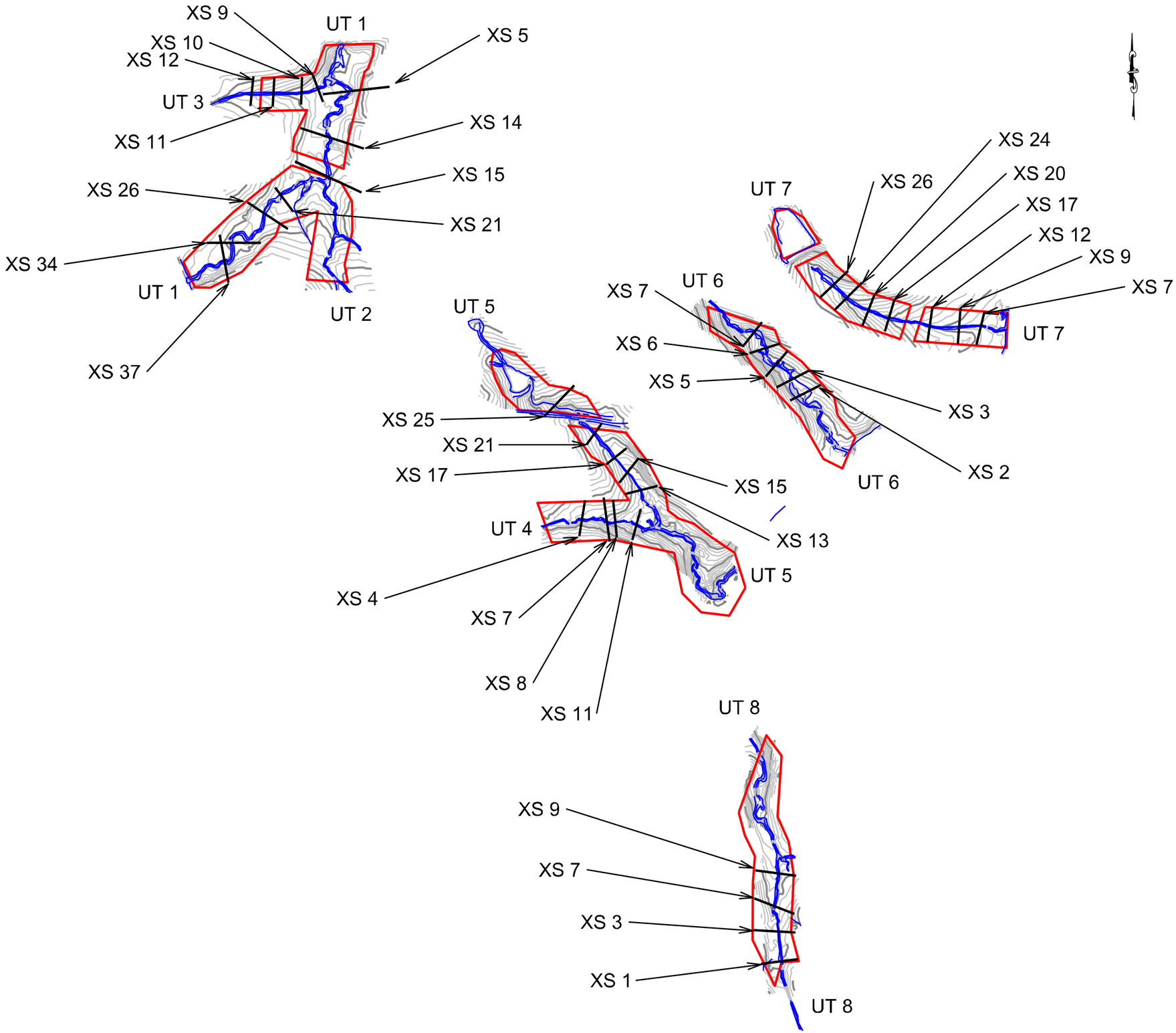
Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 4	Existing UT 5	Proposed	Existing UT 6	PROPOSED
Pattern Variables							
Pool to Pool Spacing (L_{p-p})	Med: 37.2 Range: 25 - 69	Med: 44.3 Range: 22 - 81	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 20.1 Range: 15.1 to 40.2	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 18.3 Range: 13.7 to 36.7
Meander Length (L_m)	Med: 68.4 Range: 44 - 116	Med: 62.9 Range: 10 - 91			Med: 42.7 Range: 30.1 to 60.2		Med: 39.0 Range: 27.5 to 55.0
Belt Width (W_{belt})	Med: 22.8 Range: 20 - 38	Med: 29.8 Range: 17 - 36			Med: 20.1 Range: 15.1 to 30.1		Med: 18.3 Range: 13.7 to 27.5
Radius of Curvature (R_c)	Med: 16.5 Range: 11 - 27	Med: 30.6 Range: 9 - 113			Med: 15.1 Range: 10.0 to 50.2		Med: 13.7 Range: 9.2 to 45.8
Sinuosity (Sin)	1.20	1.46	1.09	1.04	1.15	1.07	1.15
Pattern Ratios							
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	Med: 4.6 Range: 3.1 - 8.4	Med: 4 Range: 2.0 - 7.4	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0
Meander Length/ Bankfull Width (L_m/W_{bkf})	Med: 8.4 Range: 5.5 - 14.3	Med: 5.7 Range: 0.9 - 8.3			Med: 8.5 Range: 6.0 to 12.0		Med: 8.5 Range: 6.0 to 12.0
Meander Width Ratio (W_{belt}/W_{bkf})	Med: 2.8 Range: 2.4 - 4.7	Med: 2.7 Range: 1.5 - 3.5			Med: 4.0 Range: 3.0 to 6.0		Med: 4.0 Range: 3.0 to 6.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})	Med: 2.0 Range: 1.4 - 3.3	Med: 2.8 Range: 0.8 - 10.3			Med: 3.0 Range: 2.0 to 10.0		Med: 3.0 Range: 2.0 to 10.0
Profile Variables							
Average Water Surface Slope (S_{ave})	0.0258	0.0053	0.0283	0.0372	0.0311	0.0280	0.0261
Valley Slope (S_{valley})	0.0310	0.0077	0.0260	0.0358	0.0358	0.0300	0.0300
Riffle Slope (S_{riffle})	Mean: 0.0316 Range: 0.01 - 0.0576	Mean: 0.0098 Range: 0.002 - 0.01198	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0498 Range: 0.0373 to 0.0560	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0418 Range: 0.0313 to 0.0470
Pool Slope (S_{pool})	Mean: 0.0007 Range: 0 - 0.018	Mean: 0.0006 Range: 0 - 0.004			Mean: 0.0031 Range: 0.0000 to 0.0218		Mean: 0.0026 Range: 0.0000 to 0.0183
Run Slope (S_{run})	Mean: 0.0353 Range: 0 - 0.3565	Mean: Range:			Mean: 0.0124 Range: 0.0000 to 0.0249		Mean: 0.0104 Range: 0.0000 to 0.0209
Glide Slope (S_{glide})	Mean: 0.0029 Range: 0 - 0.0431	Mean: Range:			Mean: 0.0034 Range: 0.0000 to 0.0249		Mean: 0.0029 Range: 0.0000 to 0.0209
Profile Ratios							
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	Mean: 1.2 Range: 0.39 - 2.23	Mean: 1.6 Range: 0 - 3.7	No distinct repetitive pattern of riffles and pools due to staightening activities	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8
Pool Slope/Water Surface Slope (S_{pool}/S_{ave})	Mean: 0.0 Range: 0 - 0.70	Mean: 0.1 Range: 0 - 0.8			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: 1.37 Range: 0 - 13.82	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: 0.11 Range: 0 - 1.67	Mean: Range:			Mean: 0.11 Range: 0.0 to 0.8		Mean: 0.11 Range: 0.0 to 0.8

* Causey Farm Reference includes measurments from a Reference Site measured in 2004.

Table B1 continued. Heron Site Morphological Stream Characteristics

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 7	Proposed	Existing UT 8	PROPOSED
Stream Type	Eb 4	E 5	Cg 5	Eb 4	Eg 5	E/C 4
Drainage Area (mi^2)	0.21	0.63	0.03	0.03	0.05	0.05
Bankfull Discharge (cfs)	28.8	60.6	7.0	7.0	9.1	9.1
Dimension Variables						
Bankfull Cross-Sectional Area (A_{bkf})	8.0	14.7	2.0	2.0	2.5	2.5
Existing Cross-Sectional Area at TOB ($A_{existing}$)	8.0	14.7	2.5 - 16.1	2	4.7 - 12.5	2.5
Bankfull Width (W_{bkf})	Mean: 8.1 Range: 8.0 - 12.1	Mean: 11.0 Range: 10.7 - 11.3	Mean: 5.3 Range: 4.1 to 6.7	Mean: 5.3 Range: 4.9 to 5.7	Mean: 5.1 Range: 4.2 to 6.1	Mean: 5.9 Range: 5.5 to 6.3
Bankfull Mean Depth (D_{bkf})	Mean: 0.8 Range: 0.8 - 1.0	Mean: 1.4 Range: 1.3 - 1.4	Mean: 0.4 Range: 0.3 to 0.5	Mean: 0.4 Range: 0.4 to 0.4	Mean: 0.5 Range: 0.4 to 0.6	Mean: 0.4 Range: 0.4 to 0.5
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 1.1 - 1.4	Mean: 2.0 Range: 1.9 - 2.0	Mean: 0.6 Range: 0.4 to 0.8	Mean: 0.5 Range: 0.5 to 0.6	Mean: 0.8 Range: 0.6 to 1.0	Mean: 0.6 Range: 0.5 to 0.7
Pool Width (W_{pool})	Mean: 9.3 Range: 8.9 - 9.7	Mean: 10.5 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 5.8 Range: 5.3 to 7.4	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 6.5 Range: 5.9 to 8.3
Maximum Pool Depth (D_{pool})	Mean: 1.8 Range: 1.5 - 2.1	Mean: 2.7 Range:		Mean: 0.7 Range: 0.5 to 0.8		Mean: 0.8 Range: 0.5 to 0.9
Width of Floodprone Area (W_{fpa})	Mean: 18 Range: 15 - 25	Mean: 131 Range: 122 - 140	Mean: 13 Range: 7 to 29	Mean: 50 Range: 25 to 75	Mean: 15 Range: 5 to 30	Mean: 50 Range: 25 to 75
Dimension Ratios						
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 2.1 Range: 1.9 - 2.2	Mean: 12 Range: 11 - 13	Mean: 2.4 Range: 1.7 to 5.2	Mean: 9.4 Range: 5.1 to 13.3	Mean: 2.7 Range: 1.1 to 4.9	Mean: 8.5 Range: 4.6 to 11.9
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 10.1 Range: 8.0 - 15.1	Mean: 9 Range: 8 - 9	Mean: 14.5 Range: 8.2 to 22.3	Mean: 14.0 Range: 12.0 to 16.0	Mean: 11.3 Range: 7.0 to 15.3	Mean: 14.0 Range: 12.0 to 16.0
Max. D_{bkf} / D_{bkf} Ratio	Mean: 1.4 Range: 1.4 - 1.8	Mean: 1.4 Range: 1.4 - 1.5	Mean: 1.6 Range: 1.3 to 2.0	Mean: 1.4 Range: 1.2 to 1.5	Mean: 1.7 Range: 1.2 to 2.3	Mean: 1.4 Range: 1.2 to 1.5
Low Bank Height / Max. D_{bkf} Ratio	Mean: 1.0 Range: 1.0 - 1.8	Mean: 1.4 Range:	Mean: 2.5 Range: 1.8 to 4.1	Mean: 1.0 Range: 1.0 to 1.3	Mean: 2.3 Range: 1.4 to 3.7	Mean: 1.0 Range: 1.0 to 1.3
Maximum Pool Depth / Bankfull Mean Depth (D_{pool}/D_{bkf})	Mean: 1.9 Range: 0 - 2.1	Mean: 2 Range:	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.9 Range: 1.3 to 2.1
Pool Width / Bankfull Width (W_{pool}/W_{bkf})	Mean: 1.1 Range: 0 - 1.2	Mean: 1 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: 1.4 Range: 0 - 1.6	Mean: 1.4 Range:		Mean: 1.4 Range: 1.1 to 1.6		Mean: 1.4 Range: 1.1 to 1.6
Pattern Variables						
Pool to Pool Spacing (L_{p-p})	Med: 37.2 Range: 25 - 69	Med: 44.3 Range: 22 - 81	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 21.2 Range: 15.9 to 42.3	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 23.7 Range: 17.7 to 47.3
Meander Length (L_m)	Med: 68.4 Range: 44 - 116	Med: 62.9 Range: 10 - 91		Med: 45.0 Range: 31.7 to 63.5		Med: 50.3 Range: 35.5 to 71.0
Belt Width (W_{belt})	Med: 22.8 Range: 20 - 38	Med: 29.8 Range: 17 - 36		Med: 21.2 Range: 15.9 to 31.7		Med: 23.7 Range: 17.7 to 35.5
Radius of Curvature (R_c)	Med: 16.5 Range: 11 - 27	Med: 30.6 Range: 9 - 113		Med: 15.9 Range: 10.6 to 52.9		Med: 17.7 Range: 11.8 to 59.2
Sinuosity (Sin)	1.20	1.46	1.03	1.15	1.04	1.15
Pattern Ratios						
Pool to Pool Spacing/ Bankfull Width (L_{p-p}/W_{bkf})	Med: 4.6 Range: 3.1 - 8.4	Med: 4 Range: 2.0 - 7.4	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0	No distinct repetitive pattern of riffles and pools due to staightening activities	Med: 4.0 Range: 3.0 to 8.0
Meander Length/ Bankfull Width (L_m/W_{bkf})	Med: 8.4 Range: 5.5 - 14.3	Med: 5.7 Range: 0.9 - 8.3		Med: 8.5 Range: 6.0 to 12.0		Med: 8.5 Range: 6.0 to 12.0
Meander Width Ratio (W_{belt}/W_{bkf})	Med: 2.8 Range: 2.4 - 4.7	Med: 2.7 Range: 1.5 - 3.5		Med: 4.0 Range: 3.0 to 6.0		Med: 4.0 Range: 3.0 to 6.0
Radius of Curvature/ Bankfull Width (Rc/W_{bkf})	Med: 2.0 Range: 1.4 - 3.3	Med: 2.8 Range: 0.8 - 10.3		Med: 3.0 Range: 2.0 to 10.0		Med: 3.0 Range: 2.0 to 10.0
Profile Variables						
Average Water Surface Slope (S_{ave})	0.0258	0.0053	0.0248	0.0222	0.0210	0.0190
Valley Slope (S_{valley})	0.0310	0.0077	0.0255	0.0255	0.0218	0.0218
Riffle Slope (S_{riffle})	Mean: 0.0316 Range: 0.01 - 0.0576	Mean: 0.0098 Range: 0.002 - 0.01198	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0355 Range: 0.0266 to 0.0400	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 0.0304 Range: 0.0228 to 0.0342
Pool Slope (S_{pool})	Mean: 0.0007 Range: 0 - 0.018	Mean: 0.0006 Range: 0 - 0.004		Mean: 0.0022 Range: 0.0000 to 0.0155		Mean: 0.0019 Range: 0.0000 to 0.0133
Run Slope (S_{run})	Mean: 0.0353 Range: 0 - 0.3565	Mean: Range:		Mean: 0.0089 Range: 0.0000 to 0.0178		Mean: 0.0076 Range: 0.0000 to 0.0152
Glide Slope (S_{glide})	Mean: 0.0029 Range: 0 - 0.0431	Mean: Range:		Mean: 0.0024 Range: 0.0000 to 0.0178		Mean: 0.0021 Range: 0.0000 to 0.0152
Profile Ratios						
Riffle Slope/ Water Surface Slope (S_{riffle}/S_{ave})	Mean: 1.2 Range: 0.39 - 2.23	Mean: 1.6 Range: 0 - 3.7	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8	No distinct repetitive pattern of riffles and pools due to staightening activities	Mean: 1.60 Range: 1.2 to 1.8
Pool Slope/Water Surface Slope (S_{pool}/S_{ave})	Mean: 0.0 Range: 0 - 0.70	Mean: 0.1 Range: 0 - 0.8		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: 1.37 Range: 0 - 13.82	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: 0.11 Range: 0 - 1.67	Mean: Range:		Mean: 0.11 Range: 0.0 to 0.8		Mean: 0.11 Range: 0.0 to 0.8

* Causey Farm Reference includes measurments from a Reference Site measured in 2004.



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Heron
Mitigation Site

Alamance County
North Carolina

Title:

CROSS SECTION
LOCATIONS

Scale: AS SHOWN

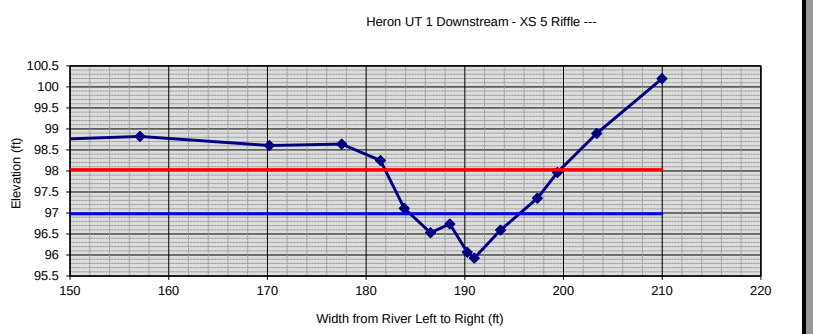
Date: Nov 2017

Project No.: 17-008

FIGURE NO.

B1

Cross Section



section:	Heron UT 1 Downstream - XS 5
	Riffle

	---
description:	Heron UT 1 Downstream - XS 5
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	0.623351	99.37665
		7.141859	0.104731	99.89527
		115.5975	1.126542	98.87346
		131.9495	1.16911	98.83089
		143.0791	1.291963	98.70804
		157.0825	1.178553	98.82145
		170.1934	1.394636	98.60536
		177.5247	1.360445	98.63956
		181.4555	1.752192	98.24781
		183.8654	2.889266	97.11073
		186.5252	3.470384	96.52962
		188.4829	3.260898	96.7391
		190.2495	3.935042	96.06496
		190.9624	4.072136	95.92786
		193.6178	3.407056	96.59294
		197.3507	2.648945	97.35106
		199.3812	2.036114	97.96389
		203.359	1.108439	98.89156
		209.9819	-0.196692	100.1967

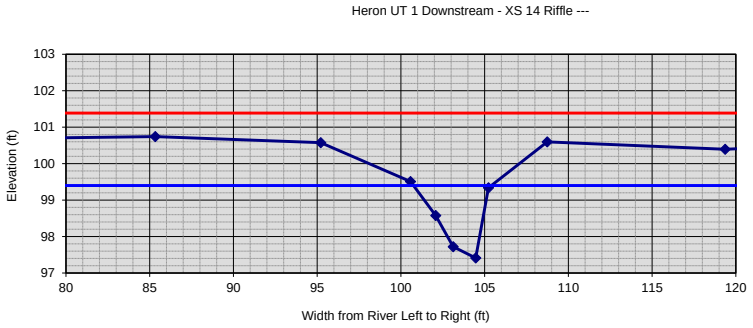
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.02	1.75	18.0		
96.98	98.25			

dimensions			
5.1	x-section area	0.5	d mean
11.1	width	11.4	wet P
1.1	d max	0.5	hyd radi
2.3	bank ht	23.8	w/d ratio
18.0	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:	Heron UT 1 Downstream - XS 14
	Riffle

	---
description:	Heron UT 1 Downstream - XS 14
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-2.634284	102.6343
		17.70195	-1.018483	101.0185
		31.34842	-0.483043	100.483
		50.15866	-0.812219	100.8122
		69.37479	-0.648303	100.6483
		85.33167	-0.741994	100.742
		95.21324	-0.575222	100.5752
		100.5737	0.491768	99.50823
		102.0789	1.423755	98.57625
		103.1212	2.278733	97.72127
		104.4663	2.587277	97.41272
		105.228	0.662185	99.33782
		108.7364	-0.597238	100.5972
		119.3615	-0.394237	100.3942
		133.6049	-0.674295	100.6743

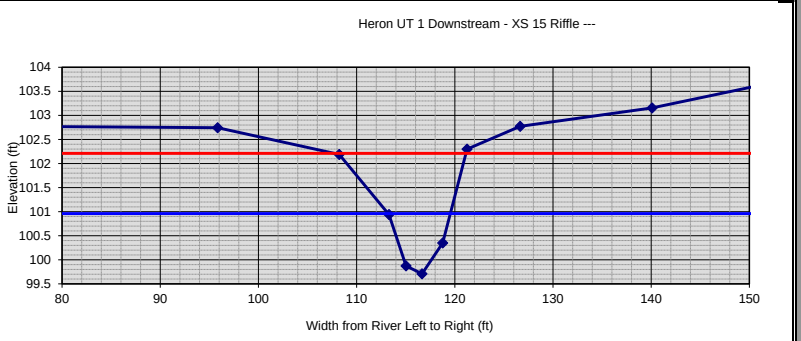
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.6	-0.6	20.0		
99.4	100.6			

dimensions			
5.1	x-section area	1.1	d mean
4.7	width	6.5	wet P
2.0	d max	0.8	hyd radi
3.2	bank ht	4.2	w/d ratio
20.0	W flood prone area	4.3	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:	Heron UT 1 Downstream - XS 15
	Riffle --- ---
description:	Heron UT 1 Downstream - XS 15
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-2.543241	102.5432
		19.63581	-2.219617	102.2196
		36.5558	-2.23059	102.2306
		56.16111	-2.320444	102.3204
		74.47336	-2.77354	102.7735
		95.84345	-2.744081	102.7441
		108.224	-2.18905	102.1891
		113.2956	-0.940293	100.9403
		115.0309	0.126744	99.87326
		116.6572	0.29137	99.70863
		118.7639	-0.349115	100.3491
		121.2467	-2.299033	102.299
		126.652	-2.772475	102.7725
		140.0924	-3.155201	103.1552
		152.9345	-3.704474	103.7045

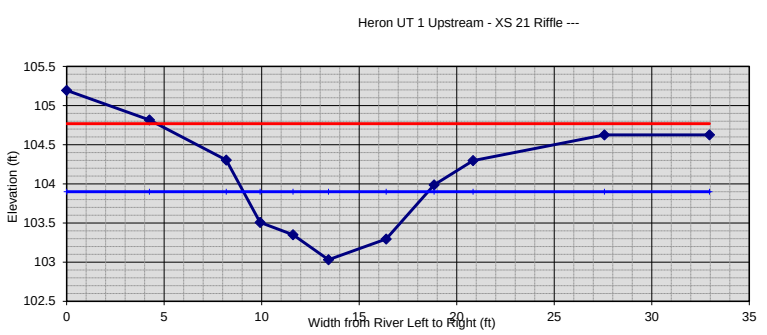
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.96	-2.19	13.0		
100.96	102.19			

dimensions			
5.1	x-section area	0.8	d mean
6.3	width	6.9	wet P
1.3	d max	0.7	hyd radi
2.5	bank ht	7.9	w/d ratio
13.0	W flood prone area	2.1	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:	Heron UT 1 Upstream - XS 21
	Riffle --- ---
description:	Heron UT 1 Upstream - XS 21
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-5.194343	105.1943
		4.245586	-4.816305	104.8163
		8.184355	-4.304283	104.3043
		9.917778	-3.50807	103.5081
		11.60643	-3.350289	103.3503
		13.42516	-3.031462	103.0315
		16.38291	-3.295584	103.2956
		18.84005	-3.987242	103.9872
		20.83721	-4.297119	104.2971
		27.5728	-4.625698	104.6257
		32.95613	-4.625881	104.6259

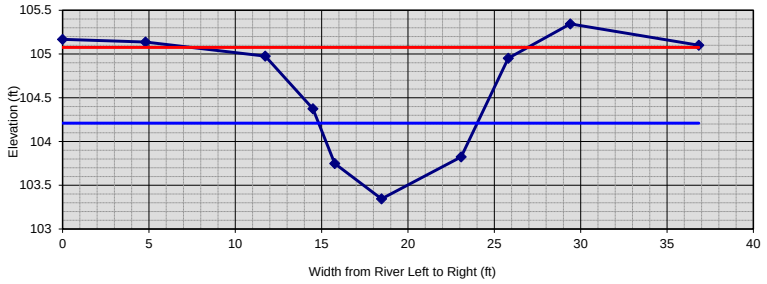
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-3.9	-4.3	30.0		
103.9	104.3			

dimensions			
5.1	x-section area	0.5	d mean
9.5	width	9.7	wet P
0.9	d max	0.5	hyd radi
1.3	bank ht	17.6	w/d ratio
30.0	W flood prone area	3.2	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:	Heron UT 1 Upstream - XS 26
	Riffle

	---
description:	Heron UT 1 Upstream - XS 26
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-5.167462	105.1675
		4.802315	-5.136844	105.1368
		11.73415	-4.975743	104.9757
		14.49488	-4.374457	104.3745
		15.75786	-3.748539	103.7485
		18.46675	-3.344715	103.3447
		23.07794	-3.824306	103.8243
		25.80613	-4.951802	104.9518
		29.39871	-5.344177	105.3442
		36.83811	-5.100516	105.1005

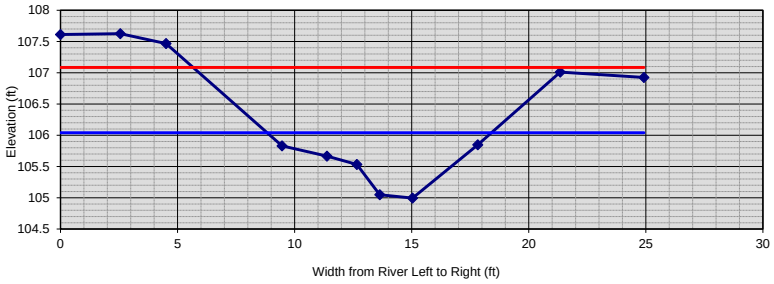
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-4.21	-4.98	17.0		
104.21	104.98			

dimensions			
5.1	x-section area	0.6	d mean
9.2	width	9.4	wet P
0.9	d max	0.5	hyd radi
1.6	bank ht	16.6	w/d ratio
17.0	W flood prone area	1.9	ent ratio

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

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

Cross Section



section:	Heron UT 1 Upstream - XS 34
	Riffle

	---
description:	Heron UT 1 Upstream - XS 34
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-7.612184	107.6122
		2.553356	-7.625539	107.6255
		4.507179	-7.467489	107.4675
		9.462164	-5.830091	105.8301
		11.38079	-5.666231	105.6662
		12.65811	-5.533168	105.5332
		13.63662	-5.048589	105.0486
		15.03585	-4.995079	104.9951
		17.82174	-5.847315	105.8473
		21.34502	-7.010728	107.0107
		24.91908	-6.924956	106.925

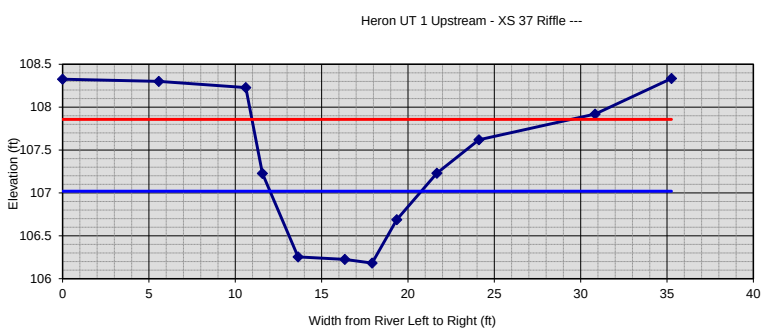
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.04	-7.01	25.0		
106.04	107.01			

dimensions			
5.1	x-section area	0.5	d mean
9.6	width	9.9	wet P
1.0	d max	0.5	hyd radi
2.0	bank ht	17.9	w/d ratio
25.0	W flood prone area	2.6	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:	**Heron UT 1 Upstream - XS 37**
	Riffle

	---
description:	**Heron UT 1 Upstream - XS 37**
height of instrument (ft):	**100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-8.325709**	108.3257
	☐	**5.570001**	**-8.300416**	108.3004
	☐	**10.60834**	**-8.228118**	108.2281
	☐	**11.56947**	**-7.227906**	107.2279
	☐	**13.63712**	**-6.254176**	106.2542
	☐	**16.34398**	**-6.225243**	106.2252
	☐	**17.92128**	**-6.182287**	106.1823
	☐	**19.35178**	**-6.688275**	106.6883
	☐	**21.67276**	**-7.229984**	107.23
	☐	**24.10806**	**-7.619447**	107.6194
	☐	**30.83467**	**-7.919251**	107.9193
	☐	**35.25682**	**-8.334285**	108.3343
	☐			
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-7.02	**-8.23**	**19.0**		
107.02	108.23			

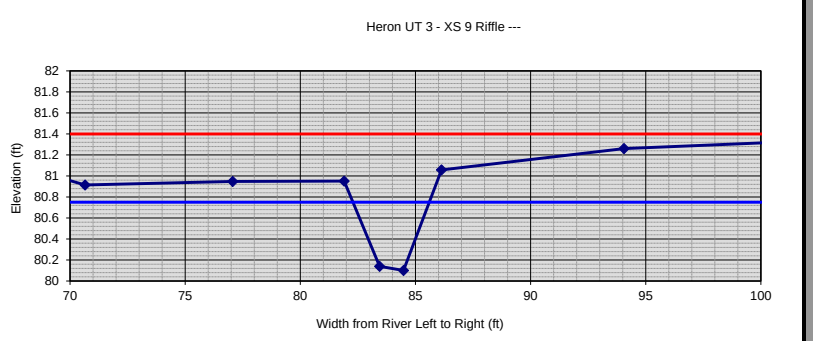
dimensions			
5.1	x-section area	0.6	d mean
8.8	width	9.1	wet P
0.8	d max	0.6	hyd radi
2.0	bank ht	15.1	w/d ratio
19.0	W flood prone area	2.2	ent ratio

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

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

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:	Heron UT 3 - XS 9
	Riffle

	---
description:	Major Hill - XS 16
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	11.7482	88.2518
		24.5893	14.79431	85.20569
		41.8566	16.5648	83.4352
		57.57014	18.25934	81.74066
		70.65327	19.08588	80.91412
		77.06373	19.0525	80.9475
		81.90404	19.0488	80.9512
		83.44283	19.8602	80.1398
		84.47991	19.89957	80.10043
		86.13026	18.94262	81.05738
		94.0556	18.73933	81.26067
		107.6749	18.61595	81.38406
		112.895	18.07476	81.92524
		125.9637	16.47982	83.52018
		135.175	15.05789	84.94211
		151.1903	13.4547	86.5453

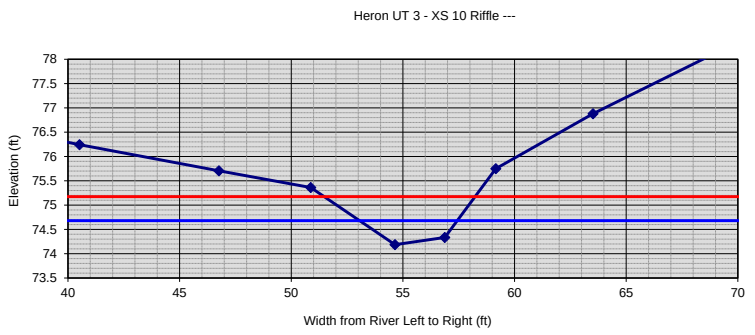
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
19.25	19.05	15.0		
80.75	80.95			

dimensions			
1.4	x-section area	0.4	d mean
3.3	width	3.6	wet P
0.6	d max	0.4	hyd radi
0.8	bank ht	8.0	w/d ratio
15.0	W flood prone area	4.5	ent ratio

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

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

Cross Section



section:	Heron UT 3 - XS 10
	Riffle

	---
description:	Heron UT 3 - XS 10
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	21.22466	78.77534
		11.32494	21.91026	78.08974
		32.716	23.03771	76.96229
		40.51483	23.75684	76.24316
		46.75931	24.2945	75.7055
		50.87182	24.63855	75.36145
		54.64443	25.81375	74.18626
		56.87534	25.66565	74.33435
		59.15972	24.25127	75.74873
		63.51316	23.12055	76.87945
		72.44177	21.08707	78.91293
		80.25382	19.85817	80.14183
		92.96824	18.3565	81.6435
		103.141	16.88098	83.11902
		112.3654	15.68455	84.31545

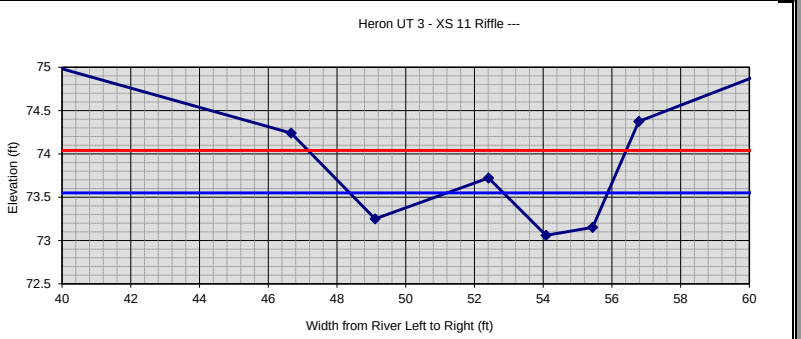
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
25.32	24.64	6.0		
74.68	75.36			

dimensions			
1.4	x-section area	0.3	d mean
4.4	width	4.6	wet P
0.5	d max	0.3	hyd radi
1.2	bank ht	13.4	w/d ratio
6.0	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:	Heron UT 3 - XS 11
	Riffle

	---
description:	Heron UT 3 - XS 11
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	22.30247	77.69753
		13.38725	22.88239	77.11762
		28.67774	23.81444	76.18556
		38.96493	24.90284	75.09717
		46.66575	25.7597	74.2403
		49.10806	26.7494	73.2506
		52.4095	26.27791	73.72209
		54.08237	26.93989	73.06011
		55.43899	26.84785	73.15215
		56.78182	25.62497	74.37504
		66.14574	24.19208	75.80792
		76.71326	22.58253	77.41747
		84.047	21.24407	78.75593

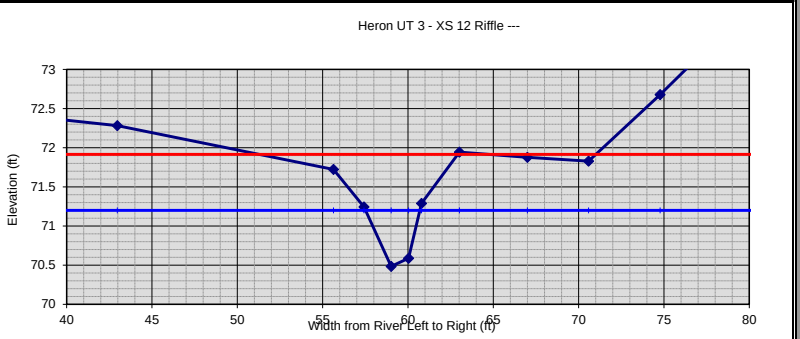
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
26.45	25.76	9.0		
73.55	74.24			

dimensions			
1.4	x-section area	0.2	d mean
5.9	width	6.2	wet P
0.5	d max	0.2	hyd radi
1.2	bank ht	24.3	w/d ratio
9.0	W flood prone area	1.5	ent ratio

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

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

Cross Section



section:	Heron UT 3 - XS 12
	Riffle

	---
description:	Heron UT 3 - XS 12
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	25.54737	74.45263
		14.86919	26.39094	73.60906
		22.17293	26.7646	73.2354
		32.81466	27.48145	72.51855
		42.97031	27.71816	72.28185
		55.63639	28.27697	71.72303
		57.4224	28.75634	71.24366
		59.01435	29.51518	70.48482
		60.03552	29.41176	70.58824
		60.79263	28.71092	71.28908
		63.01452	28.05585	71.94415
		66.99702	28.1227	71.87731
		70.58041	28.17123	71.82877
		74.77227	27.32233	72.67767
		81.30691	25.92309	74.07691

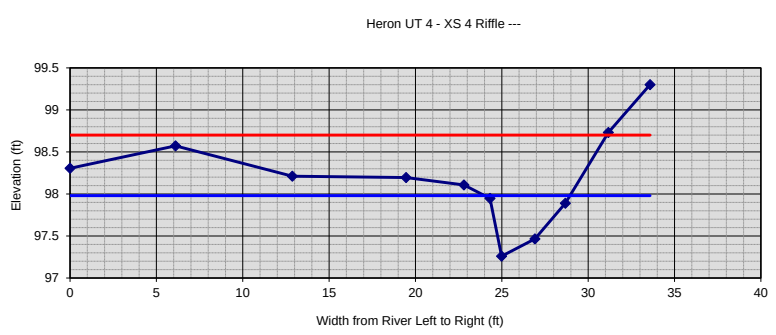
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
28.8	28.28	12.0		
71.2	71.72			

dimensions			
1.4	x-section area	0.4	d mean
3.2	width	3.6	wet P
0.7	d max	0.4	hyd radi
1.2	bank ht	7.2	w/d ratio
12.0	W flood prone area	3.8	ent ratio

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

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

Cross Section



section:	Heron UT 4 - XS 4
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	1.694436	98.30556
	☐	6.107382	1.427643	98.57236
	☐	12.87004	1.788489	98.21151
	☐	19.45521	1.804471	98.19553
	☐	22.80475	1.892467	98.10753
	☐	24.31504	2.052573	97.94743
	☐	24.98728	2.740409	97.25959
	☐	26.91684	2.534657	97.46534
	☐	28.67838	2.110186	97.88981
	☐	31.1678	1.268863	98.73114
	☐	33.58251	0.699518	99.30048
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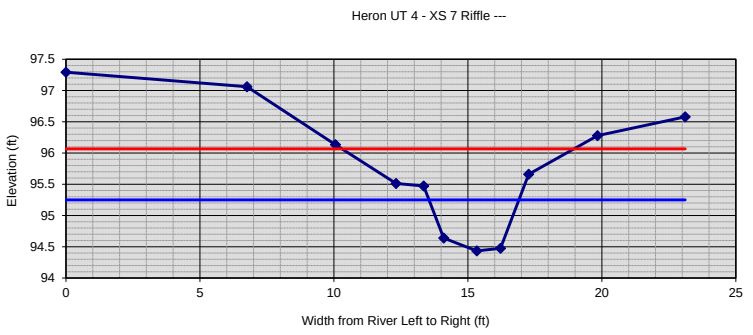
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.02	1.89	30.0		
97.98	98.11			

dimensions			
2.0	x-section area	0.4	d mean
4.9	width	5.3	wet P
0.7	d max	0.4	hyd radi
0.9	bank ht	12.2	w/d ratio
30.0	W flood prone area	6.1	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:	Heron UT 4 - XS 7
	Riffle

	---
description:	Heron UT 4 - XS 7
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	2.7071	97.2929
	☐	6.755045	2.93935	97.06065
	☐	10.05756	3.867045	96.13296
	☐	12.31761	4.487377	95.51262
	☐	13.34873	4.527618	95.47238
	☐	14.09767	5.360661	94.63934
	☐	15.33231	5.566278	94.43372
	☐	16.21627	5.524861	94.47514
	☐	17.26792	4.339966	95.66003
	☐	19.83652	3.722157	96.27784
	☐	23.10894	3.421325	96.57868
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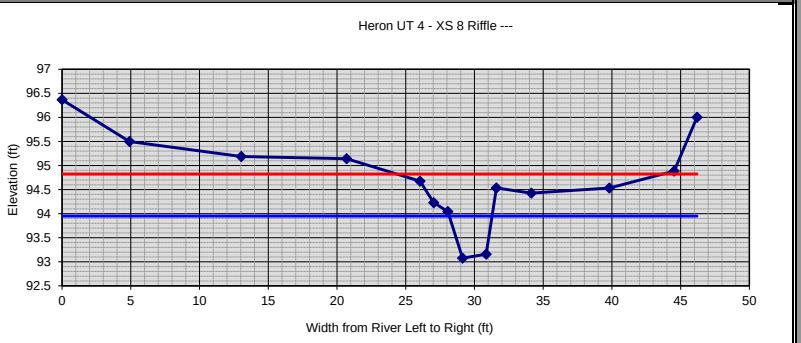
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
4.75	4.53	9.0		
95.25	95.47			

dimensions			
2.0	x-section area	0.6	d mean
3.4	width	4.0	wet P
0.8	d max	0.5	hyd radi
1.0	bank ht	5.6	w/d ratio
9.0	W flood prone area	2.7	ent ratio

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

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

Cross Section



section:	Heron UT 4 - XS 8
	Riffle

	---
description:	Heron UT 4 - XS 8
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	3.633353	96.36665
		4.903892	4.50065	95.49935
		13.03446	4.812957	95.18704
		20.70104	4.858116	95.14188
		26.03952	5.324838	94.67516
		27.03662	5.771755	94.22825
		28.06329	5.956416	94.04358
		29.13589	6.923974	93.07603
		30.85242	6.841524	93.15848
		31.59596	5.465802	94.5342
		34.13591	5.572918	94.42708
		39.81314	5.467448	94.53255
		44.52521	5.115702	94.8843
		46.19017	3.997243	96.00276

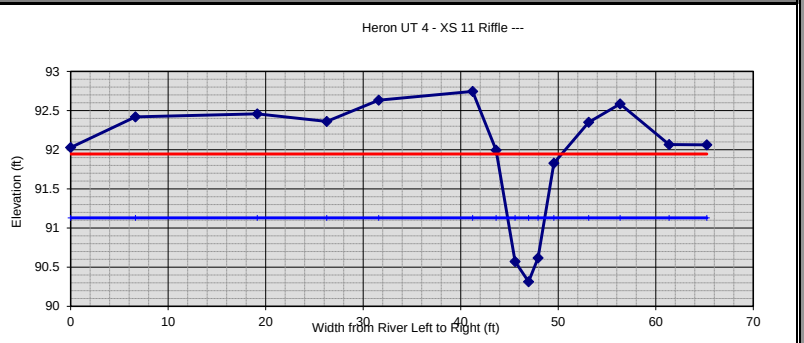
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.05	5.47	16.0		
93.95	94.53			

dimensions			
2.0	x-section area	0.6	d mean
3.1	width	3.9	wet P
0.9	d max	0.5	hyd radi
1.5	bank ht	4.8	w/d ratio
16.0	W flood prone area	5.1	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:	Heron UT 4 - XS 11
	Riffle

	---
description:	Heron UT 4 - XS 11
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	7.971875	92.02813
		6.642123	7.580386	92.41961
		19.13462	7.542352	92.45765
		26.26106	7.63884	92.36116
		31.59086	7.367332	92.63267
		41.22064	7.255318	92.74468
		43.62667	8.005464	91.99454
		45.57215	9.427821	90.57218
		46.95691	9.685429	90.31457
		47.92821	9.381981	90.61802
		49.55128	8.171974	91.82803
		53.11971	7.649413	92.35059
		56.34191	7.415014	92.58499
		61.36438	7.933947	92.06605
		65.2343	7.937619	92.06238

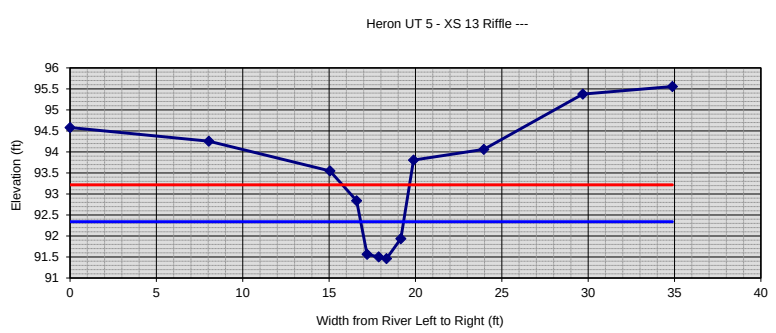
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.87	7.94	6.0		
91.13	92.06			

dimensions			
2.0	x-section area	0.5	d mean
3.8	width	4.2	wet P
0.8	d max	0.5	hyd radi
1.7	bank ht	7.3	w/d ratio
6.0	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: **Heron UT 5 - XS 13**
Riffle

---
description: **Heron UT 5 - XS 13**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	5.420035	94.57997
	☐	8.035526	5.744535	94.25547
	☐	15.04724	6.451709	93.54829
	☐	16.59244	7.160926	92.83907
	☐	17.19698	8.435369	91.56463
	☐	17.87092	8.496997	91.503
	☐	18.32244	8.537821	91.46218
	☐	19.15329	8.064174	91.93583
	☐	19.88785	6.193678	93.80632
	☐	23.9561	5.938399	94.0616
	☐	29.69039	4.623736	95.37626
	☐	34.87577	4.443241	95.55676
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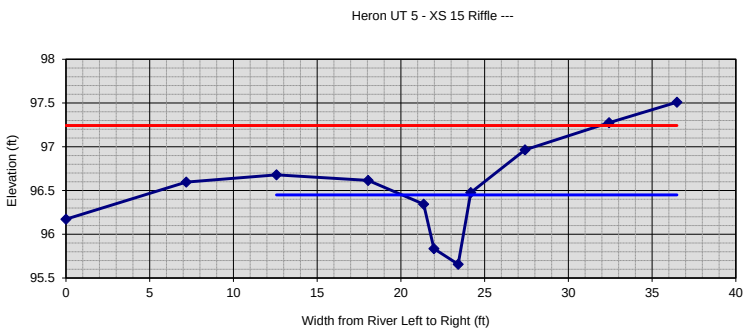
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.66	6.45	3.5		
92.34	93.55			

dimensions			
1.6	x-section area	0.7	d mean
2.5	width	3.4	wet P
0.9	d max	0.5	hyd radi
2.1	bank ht	3.8	w/d ratio
3.5	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: **Heron UT 5 - XS 15**
Riffle

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description: **Heron UT 5 - XS 15**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	3.827859	96.17214
	☑	7.180778	3.403673	96.59633
	☐	12.57163	3.320819	96.67918
	☐	18.04137	3.384488	96.61551
	☐	21.3569	3.655956	96.34404
	☐	21.97126	4.164515	95.83549
	☐	23.41986	4.342916	95.65708
	☐	24.17143	3.523664	96.47634
	☐	27.41051	3.035459	96.96454
	☐	32.42741	2.725272	97.27473
	☐	36.48266	2.490952	97.50905
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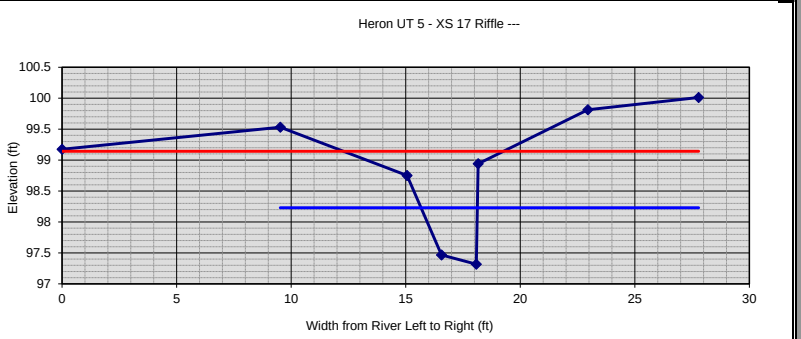
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3.55	3.38	30.0		
96.45	96.62			

dimensions			
1.6	x-section area	0.4	d mean
4.1	width	4.6	wet P
0.8	d max	0.3	hyd radi
1.0	bank ht	10.4	w/d ratio
30.0	W flood prone area	7.3	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:	Heron UT 5 - XS 17
	Riffle

	---
description:	Heron UT 5 - XS 17
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	0.825247	99.17475
	☐	9.525424	0.468832	99.53117
	☐	15.05768	1.249297	98.7507
	☐	16.56215	2.533309	97.46669
	☐	18.08031	2.682392	97.31761
	☐	18.16204	1.058901	98.9411
	☐	22.94981	0.186391	99.81361
	☐	27.78454	-0.011614	100.0116
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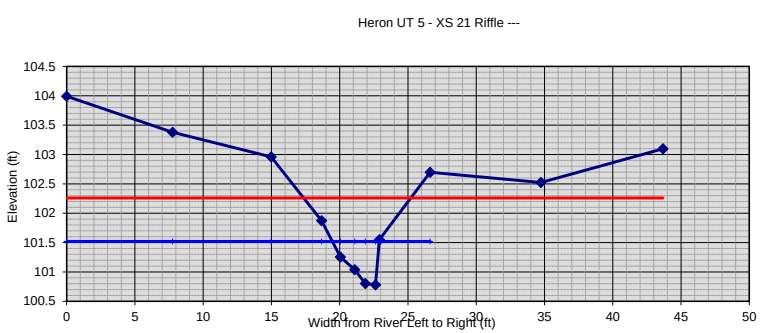
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.77	1.25	7.0		
98.23	98.75			

dimensions			
1.6	x-section area	0.7	d mean
2.5	width	3.6	wet P
0.9	d max	0.5	hyd radi
1.4	bank ht	3.7	w/d ratio
7.0	W flood prone area	2.8	ent ratio

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

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

Cross Section



section:	Heron UT 5 - XS 21
	Riffle

	---
description:	Heron UT 5 - XS 21
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.992094	103.9921
	☐	7.759706	-3.37844	103.3784
	☐	14.98396	-2.959636	102.9596
	☐	18.67251	-1.873156	101.8732
	☐	20.05036	-1.254372	101.2544
	☐	21.10004	-1.03901	101.039
	☐	21.87788	-0.802834	100.8028
	☐	22.62185	-0.780614	100.7806
	☐	22.90749	-1.54967	101.5497
	☐	26.62143	-2.697188	102.6972
	☑	34.73989	-2.523626	102.5236
	☑	43.67771	-3.097858	103.0979
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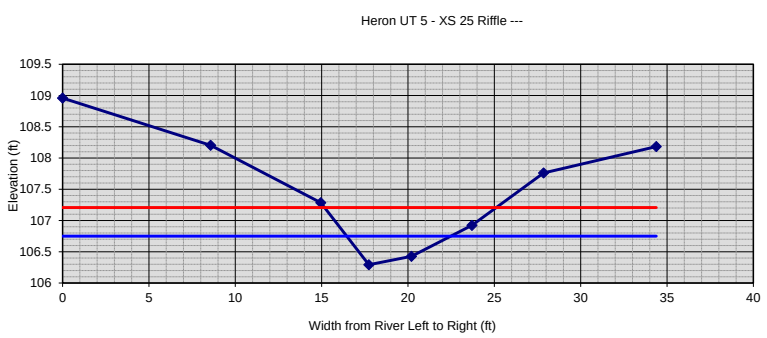
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.52	-2.7	8.0		
101.52	102.7			

dimensions			
1.6	x-section area	0.5	d mean
3.4	width	4.1	wet P
0.7	d max	0.4	hyd radi
1.9	bank ht	7.5	w/d ratio
8.0	W flood prone area	2.3	ent ratio

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

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

Cross Section



section:	Heron UT 5 - XS 25
	Riffle

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description:	Heron UT 5 - XS 25
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-8.95915	108.9592
		8.572748	-8.203612	108.2036
		14.95056	-7.285359	107.2854
		17.73405	-6.292567	106.2926
		20.20078	-6.42717	106.4272
		23.70184	-6.922685	106.9227
		27.84943	-7.760692	107.7607
		34.37466	-8.183252	108.1833

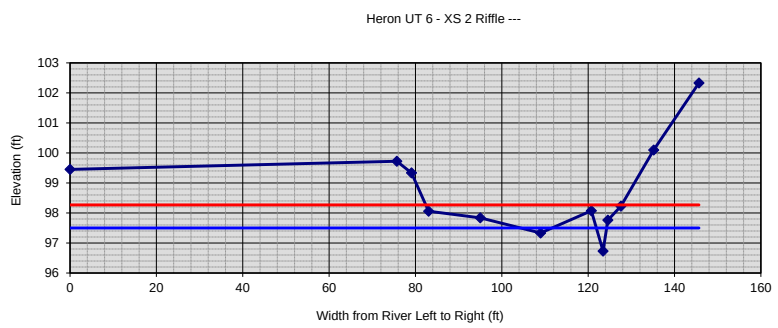
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.75	-7.29	10.0		
106.75	107.29			

dimensions			
1.6	x-section area	0.3	d mean
6.0	width	6.1	wet P
0.5	d max	0.3	hyd radi
1.0	bank ht	22.4	w/d ratio
10.0	W flood prone area	1.7	ent ratio

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

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

Cross Section



section:	Heron UT 6 - XS 2
	Riffle

	---
description:	Heron UT 6 - XS 2
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	0.547934	99.45207
	☐	75.6793	0.276923	99.72308
	☐	79.08149	0.6636	99.3364
	☐	83.04675	1.941313	98.05869
	☐	95.00282	2.161566	97.83843
	☐	108.9772	2.666726	97.33327
	☐	120.7377	1.925947	98.07405
	☐	123.4493	3.268897	96.7311
	☐	124.5573	2.237795	97.76221
	☐	127.5813	1.773138	98.22686
	☐	135.1713	-0.097745	100.0977
	☐	145.6592	-2.331051	102.3311

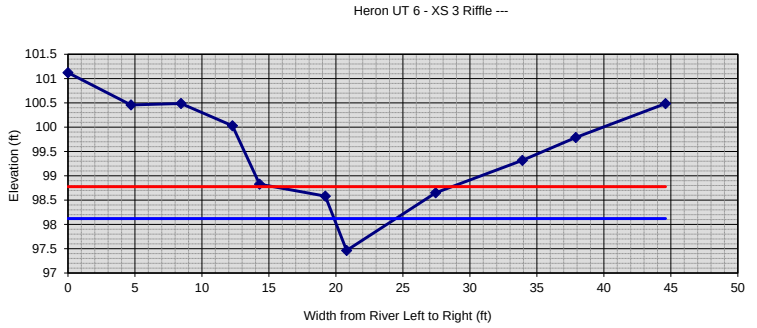
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.5	0.28	46.0		
97.5	99.72			

dimensions			
1.5	x-section area	0.2	d mean
9.6	width	10.1	wet P
0.8	d max	0.2	hyd radi
3.0	bank ht	61.1	w/d ratio
46.0	W flood prone area	4.8	ent ratio

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

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

Cross Section



section:	Heron UT 6 - XS 3
	Riffle

	---
description:	Heron UT 6 - XS 3
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-1.121737	101.1217
	☐	4.704173	-0.457747	100.4577
	☐	8.436327	-0.487734	100.4877
	☐	12.27512	-0.029507	100.0295
	☐	14.30199	1.17257	98.82743
	☐	19.20736	1.41803	98.58197
	☐	20.80005	2.53594	97.46406
	☐	27.44519	1.349299	98.6507
	☐	33.9146	0.68249	99.31751
	☐	37.90464	0.211612	99.78839
	☐	44.60083	-0.485294	100.4853

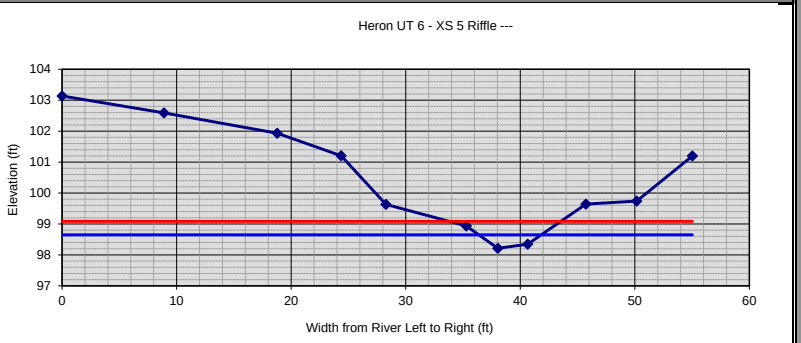
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.88	-0.03	14.0		
98.12	100.03			

dimensions			
1.5	x-section area	0.3	d mean
4.6	width	4.9	wet P
0.7	d max	0.3	hyd radi
2.6	bank ht	14.0	w/d ratio
14.0	W flood prone area	3.0	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:	Heron UT 6 - XS 5
	Riffle

	---
description:	Heron UT 6 - XS 5
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-3.136383	103.1364
		8.896437	-2.590998	102.591
		18.77993	-1.932003	101.932
		24.36105	-1.204845	101.2048
		28.27157	0.36611	99.63389
		35.28761	1.063859	98.93614
		38.03767	1.785655	98.21435
		40.64508	1.653322	98.34668
		45.7294	0.357226	99.64277
		50.16445	0.259825	99.74018
		55.02288	-1.19803	101.198

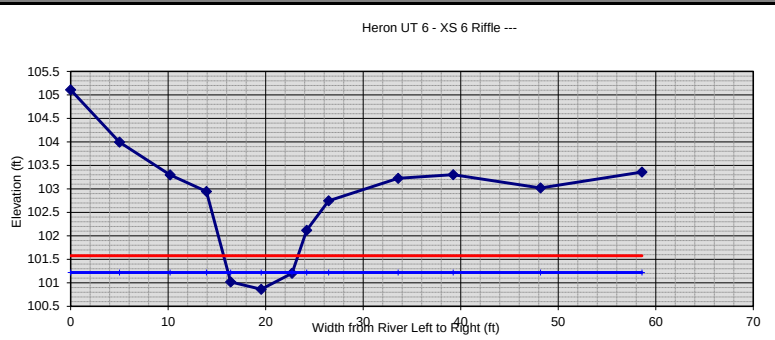
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.35	-1.19	9.0		
98.65	101.19			

dimensions			
1.5	x-section area	0.3	d mean
5.5	width	5.6	wet P
0.4	d max	0.3	hyd radi
3.0	bank ht	19.8	w/d ratio
9.0	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:	Heron UT 6 - XS 6
	Riffle

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description:	Heron UT 6 - XS 6
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-5.107818	105.1078
		5.010166	-3.995349	103.9953
		10.19764	-3.297722	103.2977
		13.92587	-2.945199	102.9452
		16.40797	-1.019446	101.0194
		19.53875	-0.863434	100.8634
		22.70209	-1.203885	101.2039
		24.20329	-2.119199	102.1192
		26.45447	-2.745982	102.746
		33.58295	-3.22527	103.2253
		39.22602	-3.301976	103.302
		48.18361	-3.019769	103.0198
		58.58147	-3.358079	103.3581

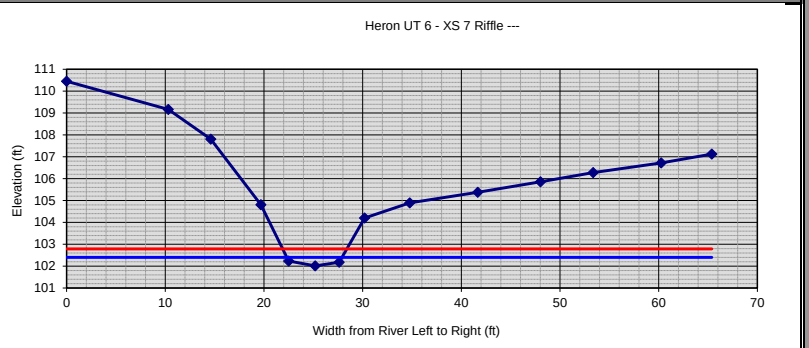
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.22	-2.75	7.0		
101.22	102.75			

dimensions			
1.5	x-section area	0.2	d mean
6.6	width	6.7	wet P
0.4	d max	0.2	hyd radi
1.9	bank ht	29.1	w/d ratio
7.0	W flood prone area	1.1	ent ratio

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

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

Cross Section



section:	**Heron UT 6 - XS 7**
	Riffle

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description:	**Heron UT 6 - XS 7**
height of instrument (ft):	**100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-10.45259**	110.4526
	☐	**10.307**	**-9.163992**	109.164
	☐	**14.60834**	**-7.807966**	107.808
	☐	**19.68968**	**-4.807787**	104.8078
	☐	**22.50318**	**-2.234225**	102.2342
	☐	**25.1908**	**-2.012344**	102.0123
	☐	**27.62137**	**-2.178747**	102.1787
	☐	**30.19682**	**-4.200131**	104.2001
	☐	**34.76816**	**-4.892201**	104.8922
	☐	**41.66387**	**-5.376576**	105.3766
	☐	**48.01961**	**-5.855613**	105.8556
	☐	**53.35921**	**-6.276139**	106.2761
	☐	**60.2526**	**-6.718926**	106.7189
	☐	**65.37831**	**-7.122694**	107.1227
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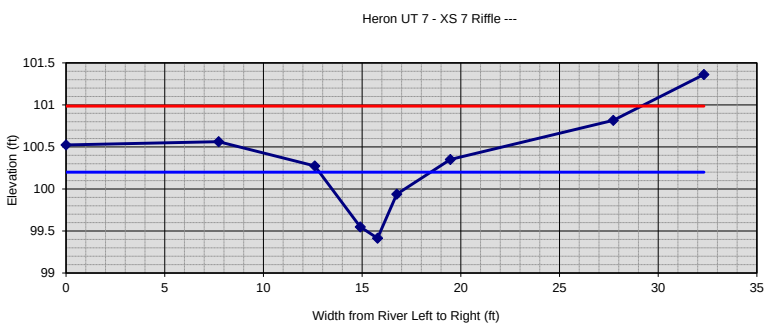
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.4	**-4.2**	**7.0**		
102.4	104.2			

dimensions			
1.5	x-section area	0.3	d mean
5.6	width	5.7	wet P
0.4	d max	0.3	hyd radi
2.2	bank ht	20.4	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:	Heron UT 7 - XS 7
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-0.523832	100.5238
		7.731476	-0.562583	100.5626
		12.60067	-0.273892	100.2739
		14.90647	0.451663	99.54834
		15.78147	0.585913	99.41409
		16.75517	0.06176	99.93824
		19.46844	-0.350763	100.3508
		27.72427	-0.81638	100.8164
		32.31623	-1.361813	101.3618

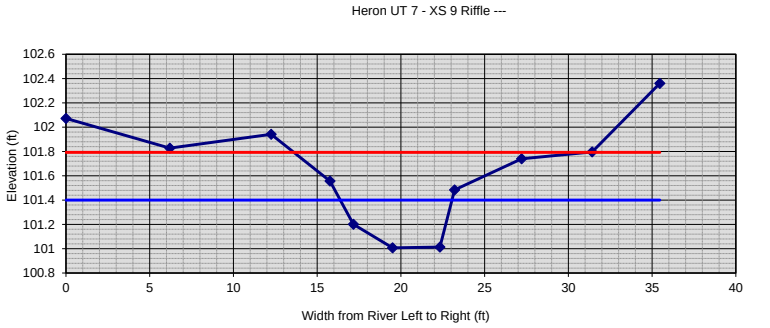
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.2	-0.27	29.0		
100.2	100.27			

dimensions			
2.0	x-section area	0.4	d mean
5.6	width	5.9	wet P
0.8	d max	0.3	hyd radi
0.9	bank ht	15.6	w/d ratio
29.0	W flood prone area	5.1	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:	Heron UT 7 - XS 9
	Riffle

	---
description:	Heron UT 7 - XS 9
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-2.072011	102.072
		6.20136	-1.827711	101.8277
		12.25262	-1.94154	101.9415
		15.76485	-1.556707	101.5567
		17.16263	-1.201165	101.2012
		19.50172	-1.007097	101.0071
		22.3296	-1.013441	101.0134
		23.20473	-1.483784	101.4838
		27.20733	-1.739905	101.7399
		31.41874	-1.796409	101.7964
		35.46019	-2.360602	102.3606

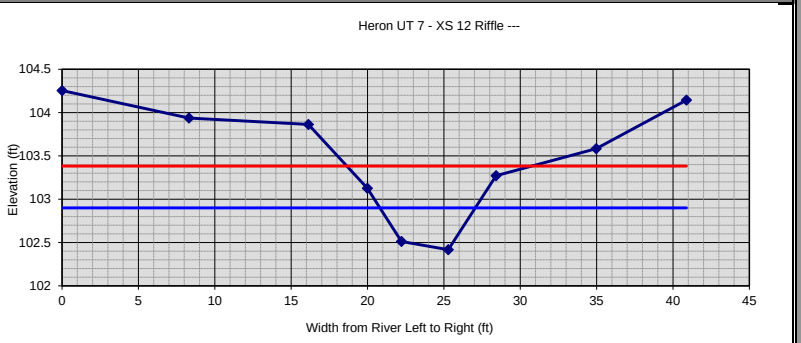
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.4	-1.74	15.0		
101.4	101.74			

dimensions			
2.0	x-section area	0.3	d mean
6.7	width	6.8	wet P
0.4	d max	0.3	hyd radi
0.7	bank ht	22.1	w/d ratio
15.0	W flood prone area	2.2	ent ratio

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

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

Cross Section



section:	Heron UT 7 - XS 12
	Riffle

	---
description:	Heron UT 7 - XS 12
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-4.254249	104.2542
		8.309588	-3.937043	103.937
		16.12729	-3.863113	103.8631
		19.98634	-3.126591	103.1266
		22.21859	-2.512588	102.5126
		25.28428	-2.417518	102.4175
		28.41638	-3.271587	103.2716
		34.96921	-3.583582	103.5836
		40.87922	-4.144088	104.1441

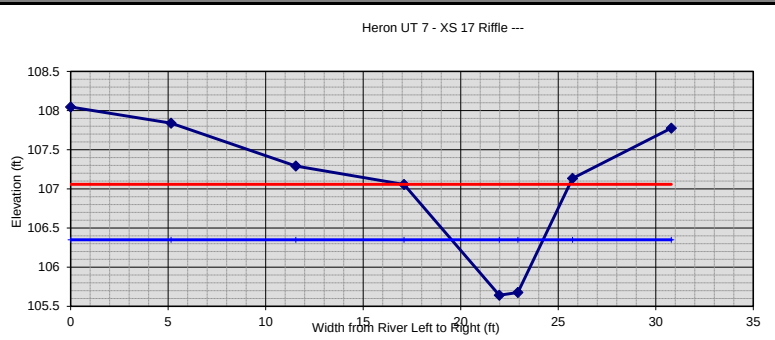
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.9	-3.27	11.0		
102.9	103.27			

dimensions			
2.0	x-section area	0.3	d mean
6.2	width	6.4	wet P
0.5	d max	0.3	hyd radi
0.9	bank ht	19.2	w/d ratio
11.0	W flood prone area	1.8	ent ratio

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

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

Cross Section



section:	Heron UT 7 - XS 17
	Riffle

	---
description:	Heron UT 7 - XS 17
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-8.045835	108.0458
		5.149854	-7.839129	107.8391
		11.54465	-7.291559	107.2916
		17.09062	-7.056377	107.0564
		21.9781	-5.641773	105.6418
		22.93059	-5.677179	105.6772
		25.73133	-7.134241	107.1342
		30.79654	-7.775702	107.7757

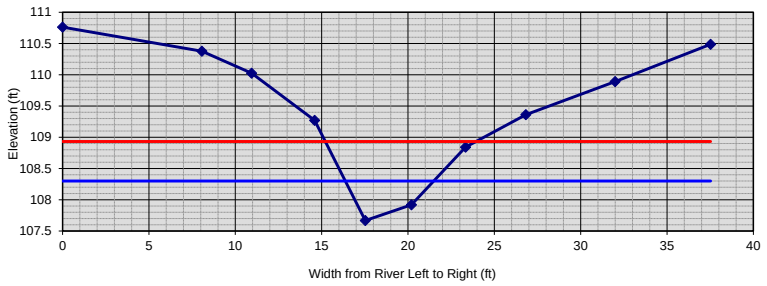
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.35	-7.06	8.0		
106.35	107.06			

dimensions			
2.0	x-section area	0.4	d mean
4.7	width	5.0	wet P
0.7	d max	0.4	hyd radi
1.4	bank ht	11.2	w/d ratio
8.0	W flood prone area	1.7	ent ratio

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

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

Cross Section



section:	Heron UT 7 - XS 20
	Riffle

	---
description:	Heron UT 7 - XS 20
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-10.7622	110.7622
		8.065011	-10.3768	110.3768
		10.94477	-10.02548	110.0255
		14.59385	-9.271015	109.271
		17.52783	-7.667701	107.6677
		20.19874	-7.919425	107.9194
		23.33275	-8.842173	108.8422
		26.82446	-9.361239	109.3612
		31.99289	-9.890877	109.8909
		37.52137	-10.48745	110.4874

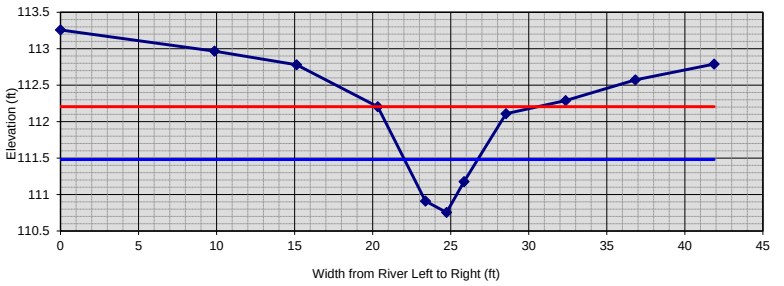
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-8.3	-8.84	9.0		
108.3	108.84			

dimensions			
2.0	x-section area	0.4	d mean
5.1	width	5.3	wet P
0.6	d max	0.4	hyd radi
1.2	bank ht	13.3	w/d ratio
9.0	W flood prone area	1.8	ent ratio

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

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

Cross Section



section:	Heron UT 7 - XS 24
	Riffle

	---
description:	Heron UT 7 - XS 24
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	-13.25754	113.2575
		9.864924	-12.96695	112.9669
		15.12648	-12.77942	112.7794
		20.32538	-12.20463	112.2046
		23.38181	-10.91072	110.9107
		24.7345	-10.75463	110.7546
		25.85328	-11.17708	111.1771
		28.5445	-12.10904	112.109
		32.36256	-12.28898	112.289
		36.82847	-12.57291	112.5729
		41.8736	-12.7895	112.7895

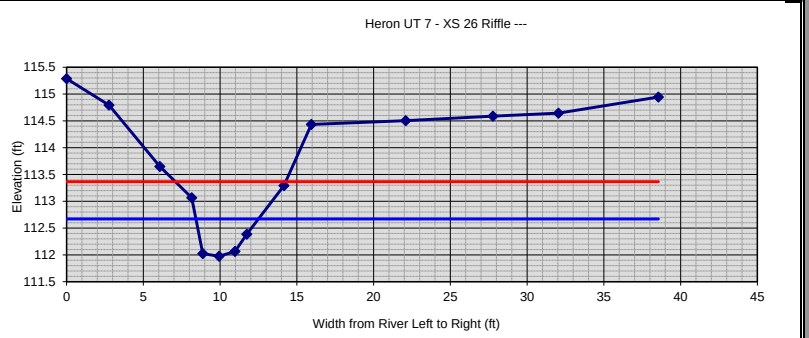
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-11.48	-12.11	10.0		
111.48	112.11			

dimensions			
2.0	x-section area	0.4	d mean
4.7	width	4.9	wet P
0.7	d max	0.4	hyd radi
1.4	bank ht	11.2	w/d ratio
10.0	W flood prone area	2.1	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:	**Heron UT 7 - XS 26**
	Riffle

	---
description:	**Heron UT 7 - XS 26**
height of instrument (ft):	**100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-15.28737**	115.2874
	☐	**2.765166**	**-14.79357**	114.7936
	☐	**6.075137**	**-13.64934**	113.6493
	☐	**8.153354**	**-13.06612**	113.0661
	☐	**8.872197**	**-12.02397**	112.024
	☐	**9.932695**	**-11.97454**	111.9745
	☐	**10.97186**	**-12.06528**	112.0653
	☐	**11.73865**	**-12.38588**	112.3859
	☐	**14.16051**	**-13.29205**	113.2921
	☐	**15.9442**	**-14.43332**	114.4333
	☐	**22.09039**	**-14.50346**	114.5035
	☐	**27.77384**	**-14.588**	114.588
	☐	**32.04153**	**-14.64375**	114.6437
	☐	**38.55112**	**-14.94434**	114.9443
	☐			
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	☐			
	☐			
	☐			

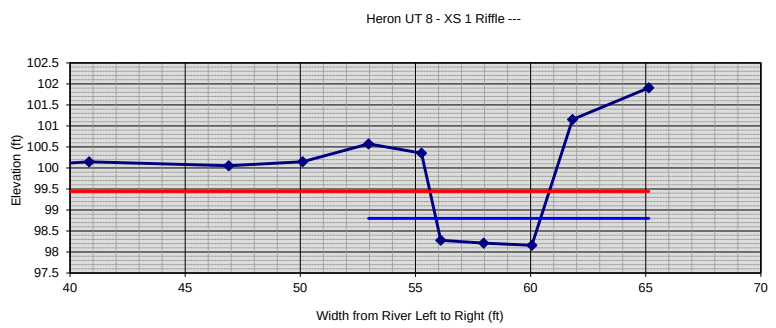
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-12.67	**-14.43**	**7.0**		
112.67	114.43			

dimensions			
2.0	x-section area	0.5	d mean
4.1	width	4.5	wet P
0.7	d max	0.4	hyd radi
2.5	bank ht	8.4	w/d ratio
7.0	W flood prone area	1.7	ent ratio

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

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

Cross Section



section:	Heron UT 8 - XS 1
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	-1.117236	101.1172
	☑	8.275911	-0.216394	100.2164
	☑	12.15419	0.035229	99.96477
	☑	14.25501	0.193747	99.80625
	☑	17.20332	0.072038	99.92796
	☑	20.06543	-0.176183	100.1762
	☑	24.16952	-0.455964	100.456
	☑	29.88498	-0.3465	100.3465
	☑	35.15644	0.044835	99.95517
	☑	40.82853	-0.146373	100.1464
	☑	46.88908	-0.051993	100.052
	☑	50.10052	-0.147639	100.1476
	☐	52.96448	-0.57291	100.5729
	☐	55.26177	-0.352528	100.3525
	☐	56.09861	1.720733	98.27927
	☐	57.96073	1.788399	98.2116
	☐	60.05384	1.841078	98.15892
	☐	61.82056	-1.152496	101.1525
	☐	65.13363	-1.907464	101.9075
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

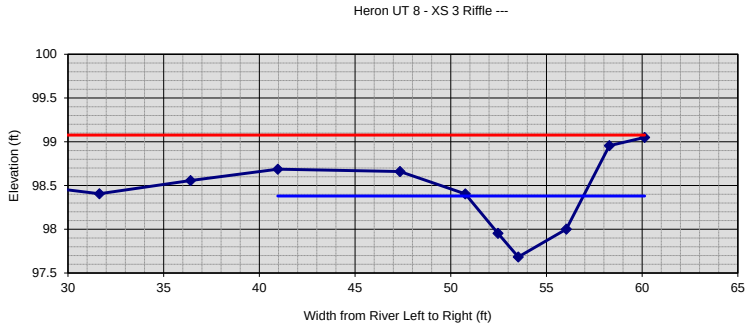
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.2	-0.35	5.0		
98.8	100.35			

dimensions			
2.5	x-section area	0.5	d mean
4.5	width	5.3	wet P
0.6	d max	0.5	hyd radi
2.2	bank ht	8.3	w/d ratio
5.0	W flood prone area	1.1	ent ratio

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

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

Cross Section



section:	Heron UT 8 - XS 3
	Riffle

	---
description:	Heron UT 8 - XS 3
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	0.419896	99.5801
	☑	4.113782	0.670189	99.32981
	☑	6.947179	0.944041	99.05596
	☑	8.994383	1.215496	98.7845
	☑	13.97982	1.599571	98.40043
	☑	17.04856	1.600382	98.39962
	☑	22.87377	1.361008	98.63899
	☑	31.64206	1.594101	98.4059
	☑	36.4029	1.443296	98.5567
	☐	40.96194	1.313445	98.68656
	☐	47.34645	1.340018	98.65998
	☐	50.75908	1.595763	98.40424
	☐	52.46533	2.046049	97.95395
	☐	53.52631	2.316586	97.68341
	☐	56.03851	1.998953	98.00105
	☐	58.28549	1.044607	98.95539
	☐	60.12967	0.95043	99.04957
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

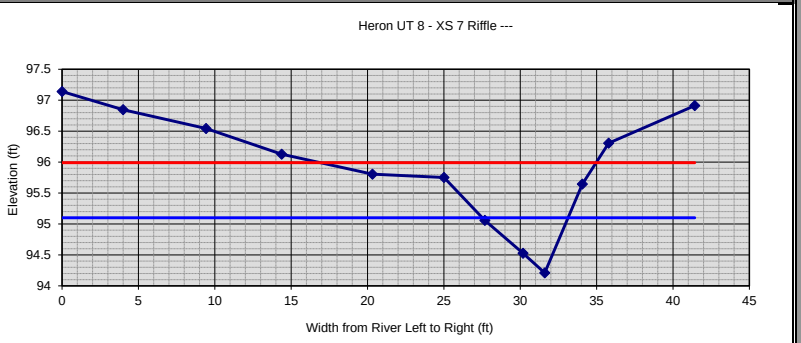
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.62	1.34	30.0		
98.38	98.66			

dimensions			
2.5	x-section area	0.4	d mean
6.1	width	6.3	wet P
0.7	d max	0.4	hyd radi
1.0	bank ht	15.0	w/d ratio
30.0	W flood prone area	4.9	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: **Heron UT 8 - XS 7**
Riffle

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description: **Heron UT 8 - XS 7**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	2.859724	97.14028
	☐	3.995977	3.153086	96.84691
	☐	9.426356	3.457071	96.54293
	☐	14.37777	3.87241	96.12759
	☐	20.32053	4.194979	95.80502
	☐	25.00651	4.24882	95.75118
	☐	27.68249	4.942054	95.05795
	☐	30.17905	5.472811	94.52719
	☐	31.6015	5.790353	94.20965
	☐	34.06269	4.35529	95.64471
	☐	35.78611	3.693789	96.30621
	☐	41.42228	3.08775	96.91225
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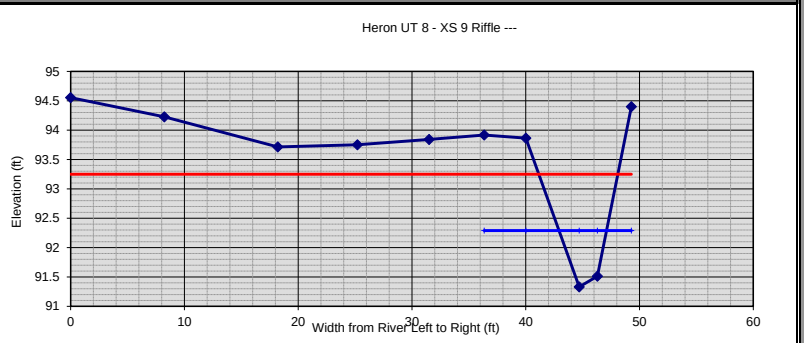
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
4.9	4.25	18.0		
95.1	95.75			

dimensions			
2.5	x-section area	0.4	d mean
5.6	width	5.9	wet P
0.9	d max	0.4	hyd radi
1.5	bank ht	12.6	w/d ratio
18.0	W flood prone area	3.2	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: **Heron UT 8 - XS 9**
Riffle

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description: **Heron UT 8 - XS 9**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	5.44624	94.55376
	☑	8.235645	5.773291	94.22671
	☑	18.20695	6.285572	93.71443
	☑	25.20287	6.248966	93.75103
	☑	31.50498	6.158461	93.84154
	☐	36.34834	6.083236	93.91676
	☐	40.00856	6.136026	93.86397
	☐	44.70053	8.669149	91.33085
	☐	46.29624	8.486908	91.51309
	☐	49.28275	5.600659	94.39934
	☐			
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	☐			
	☐			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.71	6.14	7.0		
92.29	93.86			

dimensions			
2.5	x-section area	0.6	d mean
4.2	width	4.7	wet P
1.0	d max	0.5	hyd radi
2.5	bank ht	6.8	w/d ratio
7.0	W flood prone area	1.7	ent ratio

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

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

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 1			Bank Length		2738	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	85	left	low	low	0	85	2	0.0
2	195	left	high	low	0.1	110	1.75	19.3
3	225	left	low	low	0	30	1.5	0.0
4	520	left	high	low	0.1	295	3.9	115.1
5	605	left	low	low	0	85	1.5	0.0
6	655	left	high	low	0.1	50	2.5	12.5
7	1015	left	low	low	0	360	1.5	0.0
8	1369	left	high	low	0.1	354	2.5	88.5
9								0.0
10	85	right	low	low	0	85	2	0.0
11	210	right	high	low	0.1	125	1.75	21.9
12	510	right	high	low	0.1	300	3.9	117.0
13	580	right	low	low	0	70	1.5	0.0
14	655	right	high	low	0.1	75	2.5	18.8
15	1015	right	low	low	0	360	1.5	0.0
16	1369	right	high	low	0.1	354	2.5	88.5
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		481.4
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		17.8
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		23.2
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.01

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 2			Bank Length		755	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	45	left	high	low	0.1	45	1.5	6.8
2	95	left	low	low	0	50	1	0.0
3	115	left	high	low	0.1	20	1.5	3.0
4	145	left	low	low	0	30	1	0.0
5	190	left	high	low	0.1	45	1.5	6.8
6	380	left	low	low	0	190	1	0.0
7								0.0
8								0.0
9								0.0
10	60	right	high	low	0.1	60	1.5	9.0
11	90	right	low	low	0	30	1.5	0.0
12	120	right	high	low	0.1	30	1.5	4.5
13	155	right	low	low	0	35	1.5	0.0
14	185	right	high	low	0.1	30	1.5	4.5
15	375	right	low	low	0	190	1.5	0.0
16								0.0
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		34.5
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		1.3
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		1.7
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.00

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 3			Bank Length		902	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	263	left	very high	low	0.15	263	2.9	114.4
2	451	left	high	low	0.1	188	1.4	26.3
3								0.0
4								0.0
5								0.0
6								0.0
7								0.0
8								0.0
9								0.0
10	263	right	very high	low	0.15	263	2.9	114.4
11	451	right	high	low	0.1	188	1.4	26.3
12								0.0
13								0.0
14								0.0
15								0.0
16								0.0
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		281.5
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		10.4
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		13.6
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.02

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 4			Bank Length		832	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	75	left	low	low	0	75	0.7	0.0
2	150	left	high	low	0.1	75	1.3	9.8
3	195	left	low	low	0	45	0.7	0.0
4	305	left	high	low	0.1	110	2.7	29.7
5	416	left	low	low	0	111	1.2	0.0
6								0.0
7								0.0
8								0.0
9								0.0
10	75	right	low	low	0	75	0.7	0.0
11	150	right	high	low	0.1	75	1.3	9.8
12	195	right	low	low	0	45	0.7	0.0
13	305	right	high	low	0.1	110	2.7	29.7
14	416	right	low	low	0	111	1.2	0.0
15								0.0
16								0.0
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		78.9
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		2.9
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		3.8
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.00

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 5			Bank Length		1292	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	323	left	moderate	low	0.02	323	1.5	9.7
2	646	left	low	low	0	323	1	0.0
3								0.0
4								0.0
5								0.0
6								0.0
7								0.0
8								0.0
9								0.0
10	323	right	moderate	low	0.02	323	1.5	9.7
11	646	right	low	low	0	323	1	0.0
12								0.0
13								0.0
14								0.0
15								0.0
16								0.0
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		19.4
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.7
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.9
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.00

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 6			Bank Length		1450	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	35	left	high	low	0.1	35	1.2	4.2
2	50	left	low	low	0	15	0.9	0.0
3	60	left	high	low	0.1	10	1.3	1.3
4	140	left	low	low	0	80	1.2	0.0
5	185	left	high	low	0.1	45	2.9	13.1
6	270	left	high	low	0.1	85	1.6	13.6
7	340	left	high	low	0.1	70	3	21.0
8	495	left	low	low	0	155	0.5	0.0
9	545	left	high	low	0.1	50	2.5	12.5
10	570	left	low	low	0	25	1	0.0
11	730	left	high	low	0.1	160	4	64.0
12								0.0
13	12	right	low	low	0	12	1.2	0.0
14	70	right	high	low	0.1	58	1.2	7.0
15	145	right	low	low	0	75	1	0.0
16	195	right	high	low	0.1	50	2.9	14.5
17	280	right	high	low	0.1	85	1.6	13.6
18	415	right	high	low	0.1	135	2.7	36.5
19	485	right	low	low	0	70	0.5	0.0
20	510	right	high	low	0.1	25	3.5	8.8
21	560	right	low	low	0	50	1	0.0
22	720	right	high	low	0.1	160	4	64.0
23								
24								

Sum eronsion sub-totals for each BEHI/NBS	Total Erosion (ft3/yr)	273.9
Divide total erosion (ft3) by 27	Total Erosion (yd/yr)	10.1
Multiply Total erosion (yard3) by 1.3	Total Erosion (tons/yr)	13.2
Erosion per unit length	Total Eronsion (Tons/yr/ft)	0.01

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 7			Bank Length		1557	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	120	left	low	low	0	120	0.4	0.0
2	427	left	moderate	low	0.02	307	1.3	8.0
3	488	left	low	low	0	61	1.3	0.0
4	776	left	moderate	low	0.02	288	1.3	7.5
5								0.0
6								0.0
7								0.0
8								0.0
9								0.0
10								0.0
11								0.0
12								0.0
13	125	right	low	low	0	125	0.4	0.0
14	432	right	moderate	low	0.02	307	1.3	8.0
15	493	right	low	low	0	61	1.3	0.0
16	781	right	moderate	low	0.02	288	1.3	7.5
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								0.0
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		30.9
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		1.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		1.5
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.00

Site		Heron Steam and Wetland Mitigation Site						
Stream		UT 8			Bank Length		1493	
Observers		Grant and Kenan			Date		5-Dec-16	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Eronsion
1	60	left	high	low	0.1	60	1.8	10.8
2	220	left	low	low	0	160	0.5	0.0
3	420	left	very high	low	0.15	200	2.8	84.0
4	744	left	moderate	low	0.02	324	3	19.4
5								0.0
6								0.0
7								0.0
8								0.0
9								0.0
10								0.0
11								0.0
12								0.0
13	70	right	moderate	low	0.02	70	1.8	2.5
14	210	right	low	low	0	140	0.8	0.0
15	425	right	high	low	0.1	215	2.8	60.2
16	749	right	moderate	low	0.02	324	3	19.4
17								0.0
18								0.0
19								0.0
20								0.0
21								0.0
22								0.0
23								
24								
Sum eronsion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		196.4
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		7.3
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		9.5
Erosion per unit length						Total Eronsion (Tons/yr/ft)		0.01

BEHI/NBS Summary

Stream Reach	Erosion Rate (tons/year)
UT 1	23.2
UT 2	1.7
UT 3	13.6
UT 4	3.8
UT 5	0.9
UT 6	13.2
UT 7	1.5
UT 8	9.5
Total	**67.3**

Draft NC SAM Stream Rating Sheet
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Stream Site Name	Heron Site (UT 1 lower)	Date of Assessment	12/5/16
Stream Category	Pa2	Assessor Name/Organization	Axiom Environmental

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

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

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Accompanies User Manual Version 2.1

Stream Site Name	Heron Site (UT 1 upper)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

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

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

Draft NC SAM Stream Rating Sheet
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Stream Site Name	Heron Site (UT 4)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

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

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

Draft NC SAM Stream Rating Sheet
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Stream Site Name	Heron Site (UT 5)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	
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	**MEDIUM**	**MEDIUM**
(4) Wooded Riparian Buffer	**LOW**	**LOW**
(4) Microtopography	**LOW**	**LOW**
(3) Stream Stability	**LOW**	**LOW**
(4) Channel Stability	**LOW**	**LOW**
(4) Sediment Transport	**LOW**	**LOW**
(4) Stream Geomorphology	**HIGH**	**HIGH**
(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		
(2) Baseflow	**HIGH**	**HIGH**
(2) Streamside Area Vegetation	**LOW**	**LOW**
(3) Upland Pollutant Filtration	**LOW**	**LOW**
(3) Thermoregulation	**LOW**	**LOW**
(2) Indicators of Stressors	**YES**	**YES**
(2) Aquatic Life Tolerance		**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	**LOW**	**LOW**
(3) In-stream Habitat	**LOW**	**LOW**
(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	NA	NA
Overall		

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Stream Site Name	Heron Site (UT 6)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

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

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

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Heron Site (UT 7)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

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

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

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Heron Site (UT 8)	Date of Assessment	12/5/16
Stream Category	Pa1	Assessor Name/Organization	Axiom Environmental

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

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

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	K1	Date	12/5/2016
Wetland Type	Headwater Forest	Assessor Name/Organization	Jernigan/Axiom

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

Sub-function Rating Summary

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

Function Rating Summary

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

Overall Wetland Rating **HIGH**

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	K2	Date	12/5/2016
Wetland Type	Headwater Forest	Assessor Name/Organization	Jernigan/Axiom

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

Sub-function Rating Summary

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

Function Rating Summary

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

Overall Wetland Rating **LOW**

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	K3	Date	12/5/2016
Wetland Type	Headwater Forest	Assessor Name/Organization	Jernigan/Axiom

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

Sub-function Rating Summary

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

Function Rating Summary

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

Overall Wetland Rating **HIGH**

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	**Project/Site:** Herron UT-1	**Latitude:**
Evaluator: Jernigan	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14.5)	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 = 7.5)				
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 = 8.5)				
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: Multiple Sow bugs + amphipods found

Sketch:

NC DWQ Stream Identification Form Version 4.11

UT 2

Date: 12/5/16	**Project/Site:** Huron Site	**Latitude:**
Evaluator: AXE	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 22.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 16)	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 = 4.5)				
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 = 2)				
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:

UT 3

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	**Project/Site:** Herron UT3	**Latitude:**
Evaluator: Jernigan / Lewis	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 28.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 15)	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 = 6.5)				
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)				
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:

UT4

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	**Project/Site:** Heron UT 4	**Latitude:**
Evaluator: Jennings	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 33.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 18)	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 = 9.5)				
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 = 6)				
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:

UT 5

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	Project/Site: UT5 Herron	Latitude:
Evaluator: Jernigan	County: Alamance	Longitude:
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27.5	Stream Determination (circle one) Ephemeral (Intermittent) Perennial	Other *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14)	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 = 7.5)				
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 = 6)				
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:

UT6

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	**Project/Site:** Herron UT6	**Latitude:**
Evaluator: Jernigan	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	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 = 4)				
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: 2 amphipods + 1 midge found

Sketch:

UT 7 upstream

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

upstream

Date: 12/5/16	**Project/Site:** Herron UT-7	**Latitude:**
Evaluator: Jernigan	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 18.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

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

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

12.5

B. Hydrology (Subtotal = 4.5)					
12. Presence of Baseflow	0	←(1)	2	3	2
13. Iron oxidizing bacteria	(0)	1	2	3	0
14. Leaf litter	1.5	1	(0.5)→	0	1
15. Sediment on plants or debris	(0)	0.5	1	1.5	0.5
16. Organic debris lines or piles	(0)	0.5	1	1.5	0.5
17. Soil-based evidence of high water table?	No = 0		Yes = (3)		3

7

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

5

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

Notes:

Sketch:

24.5

Int.

UT8

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 12/5/16	**Project/Site:** Herron UT-8	**Latitude:**
Evaluator: Jernigan	**County:** Alamance	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 27.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	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 = 8)				
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)				
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: Amphipods found

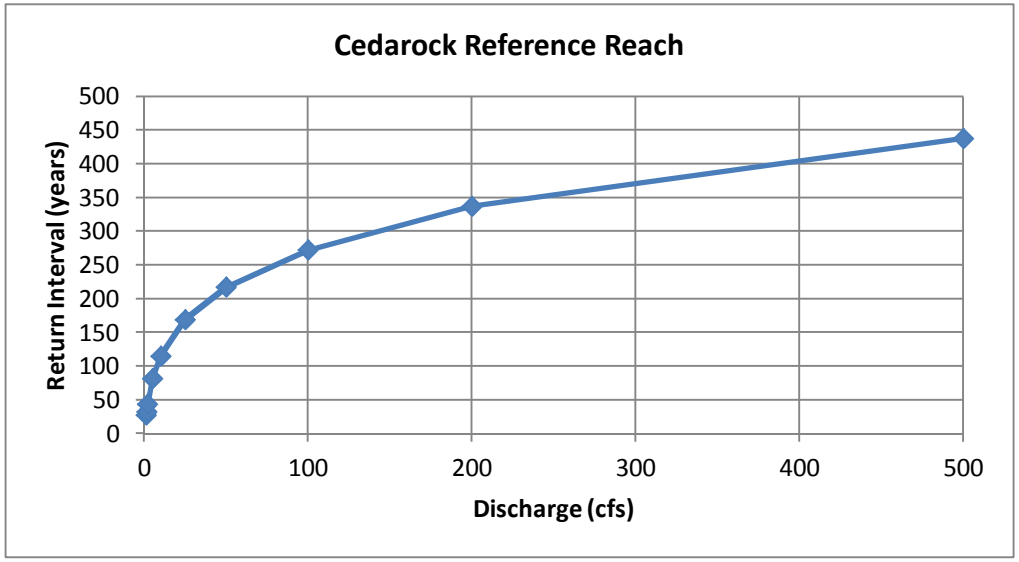
Sketch:

Appendix C
Flood Frequency Analysis Data

Reference Reaches
Flood Frequency Analaysis-Regional Regression Equation (USGS 2004)

Cedarock Reference Reach

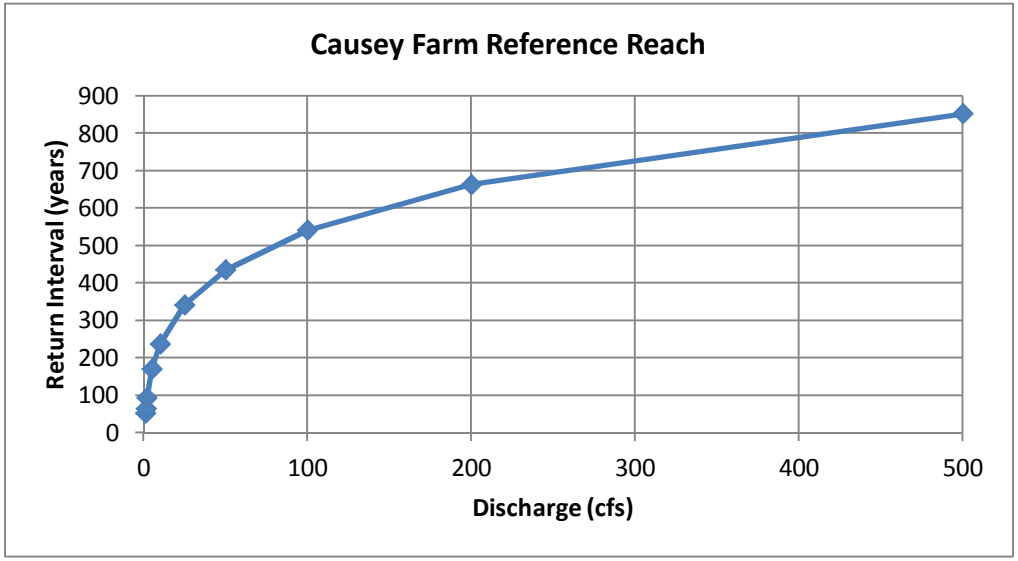
Return Interval (years)	Discharge (cfs)
1.3	**27**
1.5	**32**
2	43.6
5	81.4
10	115
25	169
50	217
100	272
200	337
500	438



Note: Bold values are interpolated.

Causey Farm Reference Reach

Return Interval (years)	Discharge (cfs)
1.3	**53**
1.5	**65**
2	94.3
5	171
10	238
25	342
50	435
100	541
200	663
500	852



Appendix D
Jurisdictional Determination Info

SAW-2017-01471

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2017-01471** County: **Alamance** U.S.G.S. Quad: **NC-Silk Hope**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

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

Size (acres) **~20** Nearest Town **Snow Camp**
Nearest Waterway **South Fork Cane Creek** River Basin **Cape Fear**
USGS HUC **03030002** Coordinates **36.853955 N, -79.363458 W**
Location description: **The project area is located on the east side of Bethel South Fork Road, east of its intersection with Clark Road, on both side of South Fork Cane Creek, near Snow Camp, Alamance County, North Carolina. The Project Area is shown as the "Easement" on the attached Figure 3, titled "Jurisdictional Areas."**

Indicate Which of the Following Apply:

A. Preliminary Determination

☒ **There appear to be waters including wetlands, on the above described project area, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). The waters including wetlands, have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. The approximate boundaries of these waters are shown on the enclosed delineation map dated October 2017. Therefore this preliminary jurisdiction determination may be used in the permit evaluation process, including determining compensatory mitigation. For purposes of computation of impacts, compensatory mitigation requirements, and other resource protection measures, a permit decision made on the basis of a preliminary JD will treat all waters and wetlands that would be affected in any way by the permitted activity on the site as if they are jurisdictional waters of the U.S. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). However, you may request an approved JD, which is an appealable action, by contacting the Corps district for further instruction.**

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

B. Approved Determination

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

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

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

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

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

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

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

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

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

C. Basis For Determination: See the Preliminary Jurisdictional Determination form dated 12/21/2017.

D. Remarks: None.

E. Attention USDA Program Participants

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

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

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

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

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

Corps Regulatory Official: David E Bailey Digitally signed by BAILEY.DAVID.E.1379283736 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=BAILEY.DAVID.E.1379283736 Date: 2017.12.21 14:51:59 -05'00'

Date of JD: **12/21/2017** Expiration Date of JD: **Not applicable**

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

Copy furnished:
Sue Homewood, NCDEQ-DWR, 450 W. Hanes Mill Rd, Suite 300, Winston-Salem, NC 27105

SAW-2017-01471

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **NCDEQ DMS (Attn: Tim Baumgartner)**	File Number: **SAW-2017-01471**	Date: **12/21/2017**

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

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

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

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

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

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

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

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

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

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

SAW-2017-01471

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

For appeals on Initial Proffered Permits send this form to:

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

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

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

ATTACHMENT A
PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): 12/21/2017

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
NCDMS (Attn: Tim Baumgartner)

C. DISTRICT OFFICE, FILE NAME, AND NUMBER:
SAW-2017-01471 (NCDMS ILF - Heron Stream and Wetland Mitigation Site)

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:

(USE THE ATTACHED TABLE TO DOCUMENT MULTIPLE WATERBODIES AT DIFFERENT SITES)

State: NC County/parish/borough: Alamance City: Snow Camp

Center coordinates of site (lat/long in degree decimal format):
Lat. 35.852517 °N; Long. -79.361977 °W.

Universal Transverse Mercator:

Name of nearest waterbody: South Fork

Identify (estimate) amount of waters in the review area:
Non-wetland waters:
~5937 linear feet: 2-15 width (ft) and/or _____ acres.

Cowardin Class: R3UB1/2, R4UB1/2, R3UB2/3, and R4UB2/3

Stream Flow: Perennial and Intermittent

Wetlands: 0.61 acres.

Cowardin Class: PFO1, PSS1

Name of any water bodies on the site that have been identified as Section 10 waters:
Tidal:
Non-Tidal:

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

☐ Office (Desk) Determination. Date: _____

☒ Field Determination. Date(s): 12/21/2017

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☑ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: Aerial, topo, and soils maps (Axiom)

☑ Data sheets prepared/submitted by or on behalf of the applicant/consultant.

☒ Office concurs with data sheets/delineation report.

☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps: _____

☐ Corps navigable waters' study: _____

☐ U.S. Geological Survey Hydrologic Atlas: _____

☐ USGS NHD data

☐ USGS 8 and 12 digit HUC maps

☑ U.S. Geological Survey map(s). Cite scale & quad name: Silk Hope 7.5-minute

☑ USDA Natural Resources Conservation Service Soil Survey. Citation: Soil Survey of Alamance County, NC (1960)

☐ National wetlands inventory map(s). Cite name: _____

☐ State/Local wetland inventory map(s): _____

☐ FEMA/FIRM maps: _____

☐ 100-year Floodplain Elevation is: _____ (National Geodectic Vertical Datum of 1929)

☒ Photographs: ☒ Aerial (Name & Date): 2014 NC OneMap or ☐ Other (Name & Date): _____

☐ Previous determination(s). File no. and date of response letter: _____

☒ Other information (please specify): LiDAR

Site Number/ Feature Name	Latitude	Longitude	Cowardin Class	Estimated amount of aquatic resource in review area	Class of aquatic resources
UT1	35.855734	-79.365621	R3UB1/2	1155 linear feet	Non-section 10 - Non-wetland
UT2	35.854815	-79.365570	R4UB1/2	363 linear feet	Non-section 10 - Non-wetland
UT3	35.856247	-79.366189	R3UB2/3	269 linear feet	Non-section 10 - Non-wetland
UT4	35.852036	-79.362248	R3UB1/2	485 linear feet	Non-section 10 - Non-wetland
UT5	35.852544	-79.361933	R3UB2/3	907 linear feet	Non-section 10 - Non-wetland
UT6	35.853614	-79.360226	R3UB2/3	683 linear feet	Non-section 10 - Non-wetland
UT7	35.854101	-79.358908	R4UB2/3	202 linear feet	Non-section 10 - Non-wetland
UT8	35.847951	-79.360242	R3UB1/1	1221 linear feet	Non-section 10 - Non-wetland
GB Wetland	35.856582	-79.365246	PFO1	0.24 acres	Non-section 10 - Wetland
PB Wetland	35.855694	-79.365906	PSS1	0.06 acres	Non-section 10 - Wetland
PC Wetland	35.854978	-79.366584	PFO1	0.06 acres	Non-section 10 - Wetland
PD Wetland	35.855109	-79.366182	PFO1	0.14 acres	Non-section 10 - Wetland
GE Wetland	35.852517	-79.361977	PSS1	0.09 acres	Non-section 10 - Wetland
GF Wetland	35.854459	-79.359486	PSS1	0.02 acres	Non-section 10 - Wetland
BA Wetland	35.853218	-79.363100	PSS1	0.01 acres	Non-section 10 - Wetland
BB Wetland	35.853134	-79.362693	PSS1	0.02 acres	Non-section 10 - Wetland
BC Wetland	35.853337	-79.359848	PSS1	0.04 acres	Non-section 10 - Wetland
OW-1	35.853411	-79.363295	R3UB2/3	0.10 acres	Non-section 10 - Non-wetland
OW-2	35.854870	-79.359953	R3UB2/3	0.35 acres	Non-section 10 - Non-wetland

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.

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

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

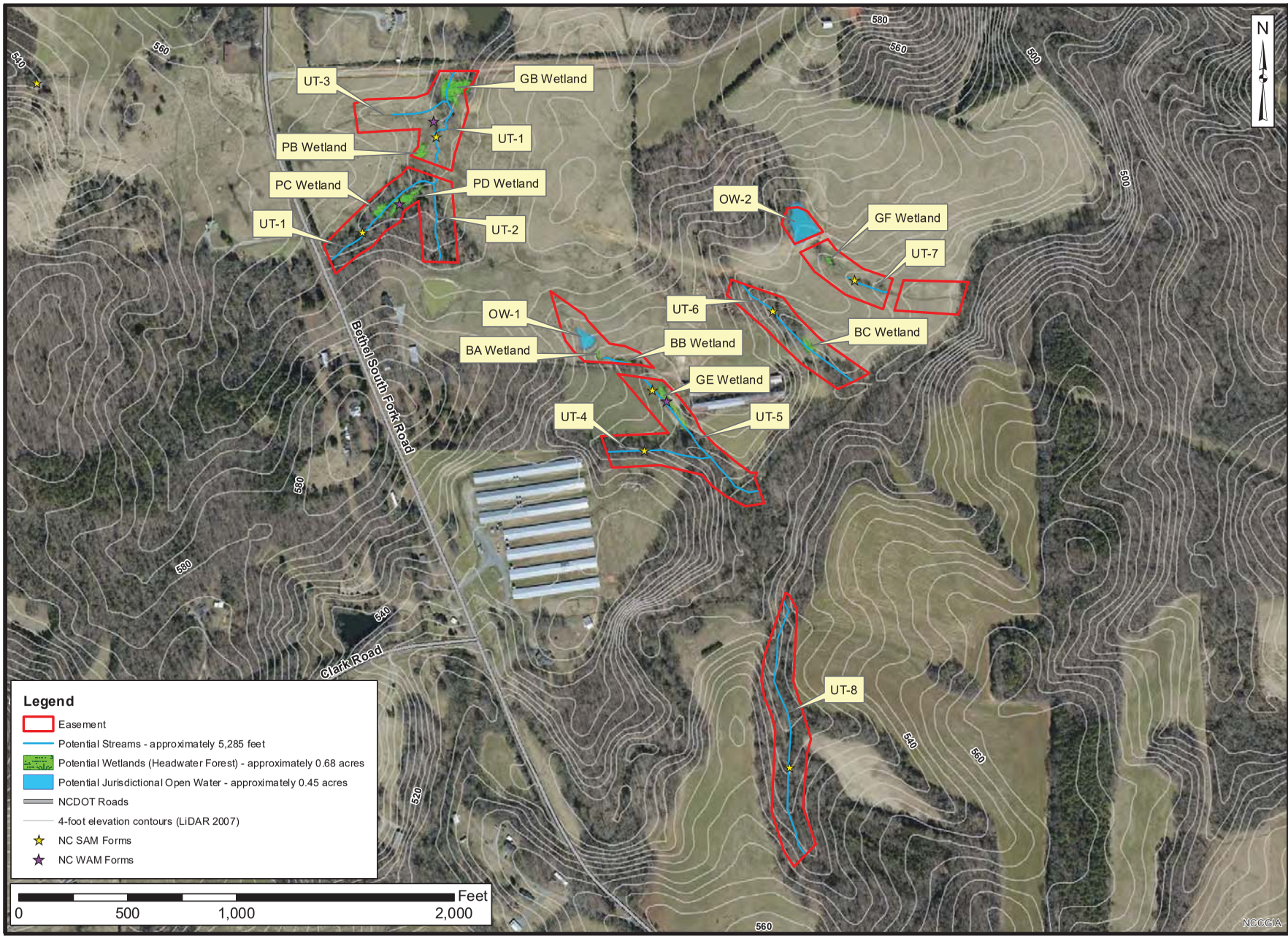
Digitally signed by BAILEY.DAVID.E.1379283736
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=BAILEY.DAVID.E.1379283736
Date: 2017.12.21 14:51:40 -05'00'

Signature and date of
Regulatory Project Manager
(REQUIRED)

W. Grant Lewis

Digitally signed by W. Grant Lewis
DN: cn=W. Grant Lewis, o=Axiom Environmental, Inc., ou, email=glewis@axiomenvironmental.org, c=US
Date: 2017.08.02 10:38:38 -04'00'

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



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

JURISDICTIONAL AREAS

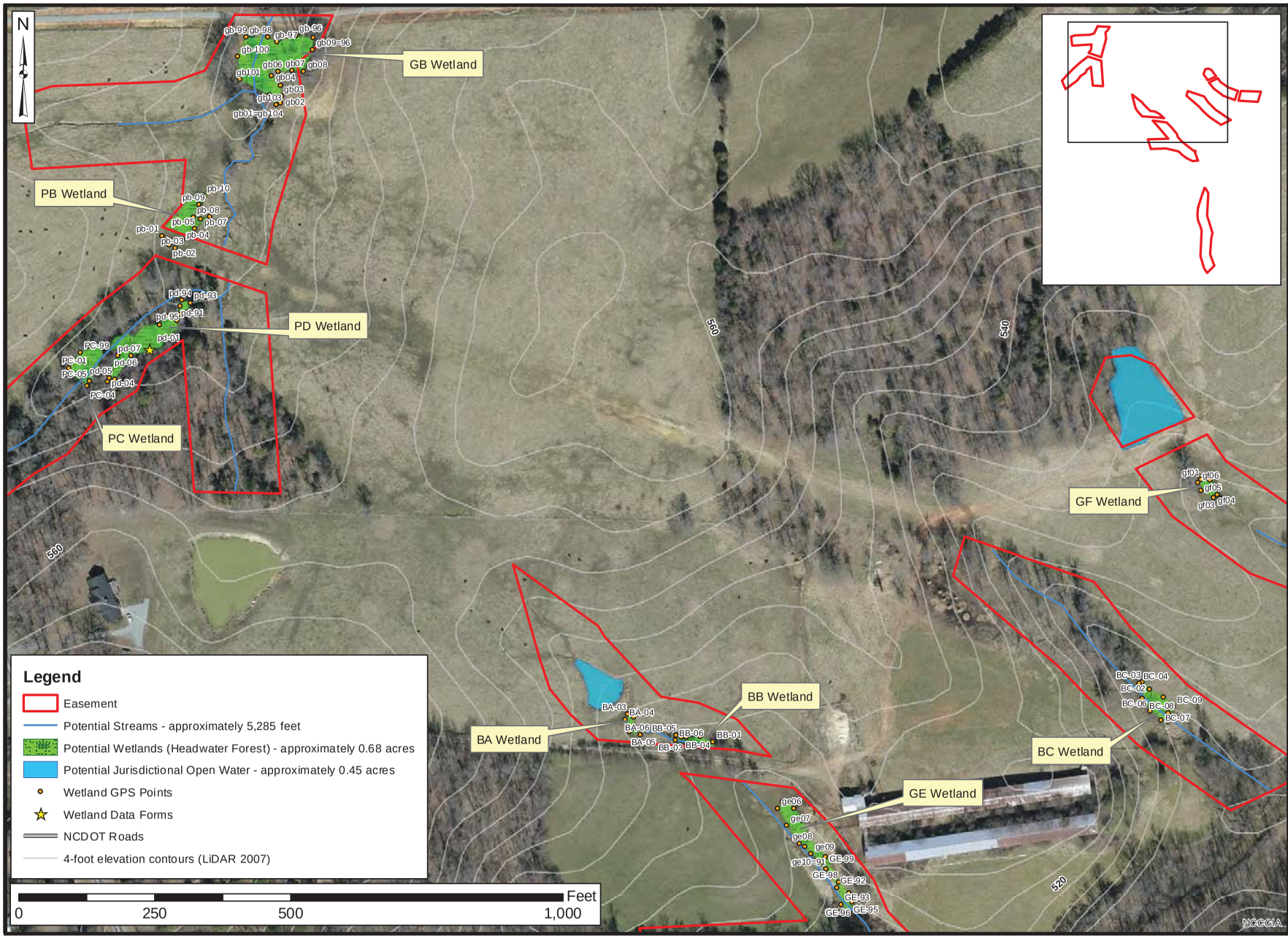
Notes:

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

Drawn by:	KRJ
Date:	NOV 2017
Scale:	1:5000
Project No.:	17-008

FIGURE

3



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

WETLAND DETAIL

Notes:

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

Drawn by:	KRJ
Date:	NOV 2017
Scale:	1:2000
Project No.:	17-008

FIGURE

4

Appendix E
Categorical Exclusion Document

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:	Heron Stream and Wetland Mitigation Site
County Name:	Alamance County
DMS Number:	100014
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	Raymond Holz
Project Contact Address:	1101 Haynes Street, Suite 211 Raleigh, NC 27604
Project Contact E-mail:	rholz@restorationsystems.com
DMS Project Manager:	Lindsay Crocker

Project Description

The Heron encompasses approximately 20 acres of agricultural land used for livestock grazing and hay production. Existing Site streams have been cleared, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally. The project will restore streams and wetlands within the Site for a total of 5928 Stream Mitigation Units (SMUs) and 0.63 Riparian Wetland Mitigation Units (WMUs).

For Official Use Only

Reviewed By:

Date — **DMSProject Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

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

Final Approval By:

9-6-17

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

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 27, 2017

John Gerber, PE, CFM
State NFIP Coordinator
NC Floodplain Management Branch
4218 Mail Service Center
Raleigh, NC 27699-4218

Re: Heron Stream and Wetland mitigation project in Alamance County **17-008**
FEMA Floodplain Requirements Checklist

Dear Mr. Gerber:

The purpose of this letter is to request concurrence from the National Flood Insurance Program (NFIP) concerning a stream and wetland restoration site located in Alamance County. The Site encompasses approximately 20 acres of agricultural land used for livestock grazing and hay production. Existing Site streams have been cleared, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from livestock. Proposed activities at the Site include the restoration of perennial and intermittent stream channels, enhancement of perennial stream channel, and restoration of riparian wetlands.

The project easement is depicted on the attached figures and lengths/priority of restoration are as follows.

Reach	Length	Priority
UT 1	1145	Priority 1 Restoration and Enhancement Level I
UT 2	363	Enhancement Level II
UT 3	438	Priority 1 Restoration
UT 4	485	Priority 1 Restoration and Enhancement Level I
UT 5	931	Priority 1 Restoration
UT 6	683	Priority 1 Restoration and Enhancement Level II
UT 7	707	Priority 1 Restoration and Enhancement Level I
UT 8	1221	Preservation, Priority 1 Restoration, and Enhancement Level II

FEMA mapping was reviewed to determine if the project is located in a FEMA study area (DFIRM panel number 8796). Based on existing floodplain mapping, South Fork is listed as a Flood Zone AE. No earthwork is proposed for South Fork and the project should not alter FEMA flood zones. Therefore, a "Conditional Letter of Map Revision" (CLOMR) is not expected for this project. Please see the attached Project Location Map and Topographic Map for your review. Also please find attached three copies of the NCDMS Floodplain Requirements Checklist for your records.

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.

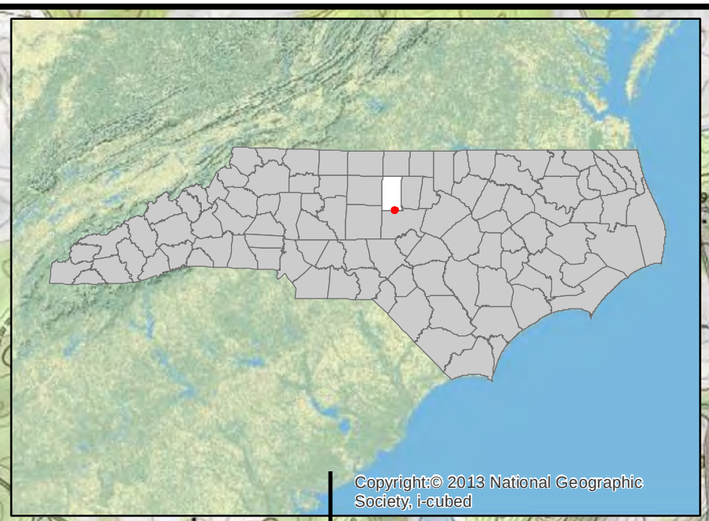
Yours truly,

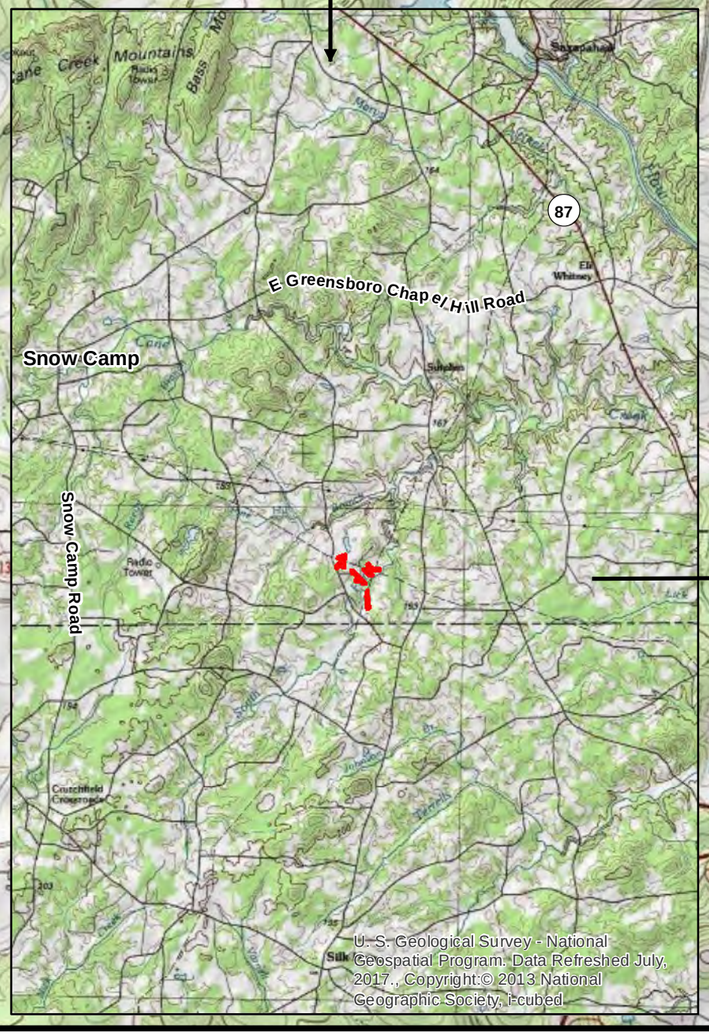
AXIOM ENVIRONMENTAL

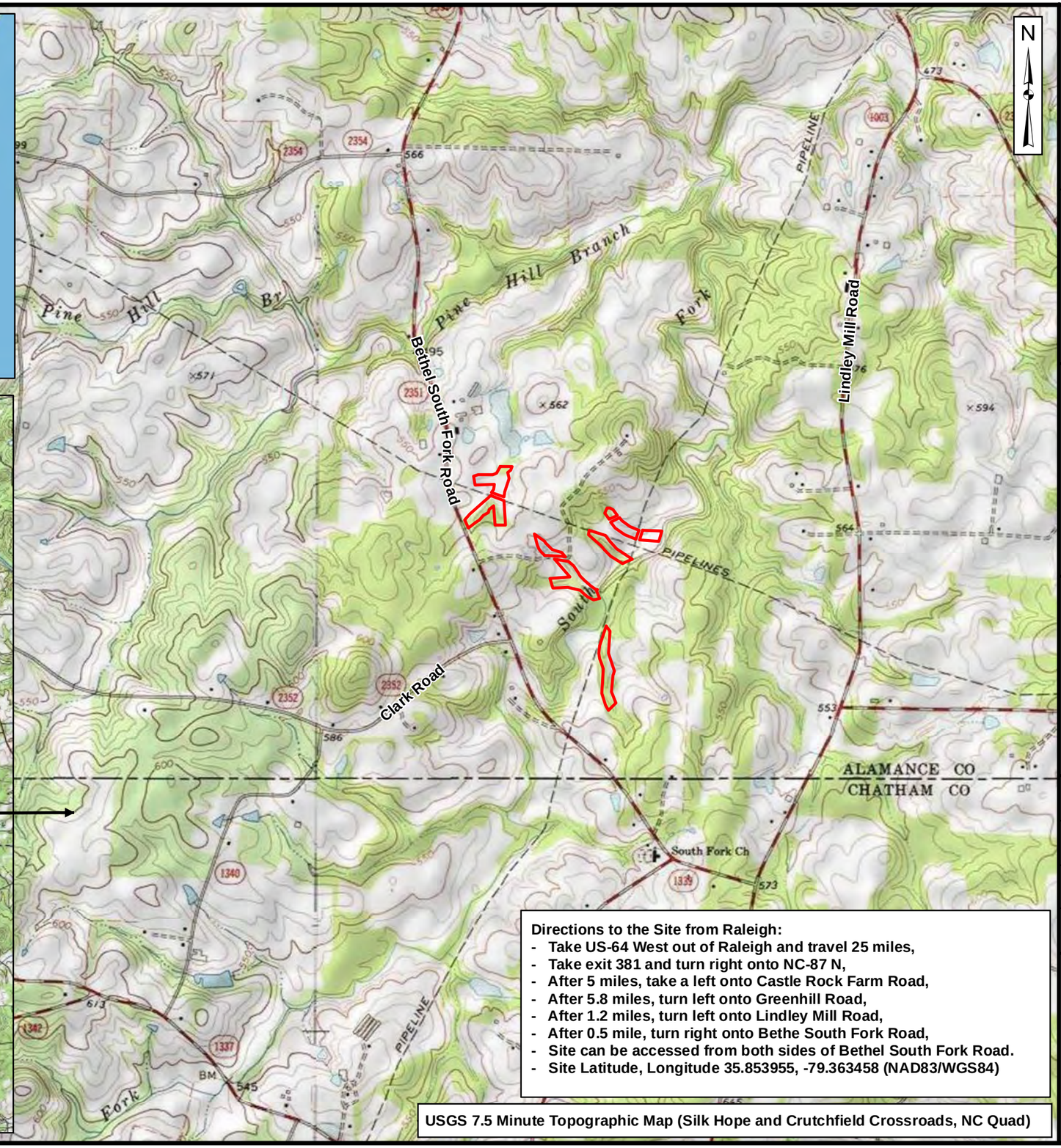
W. Grant Lewis
Senior Project Manager

Attachments

- Figure 1 Project Location and Topography
- Figure 2 Project Reaches
- NCDMS Floodplain Requirements Checklist







Directions to the Site from Raleigh:
- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
- **After 5.8 miles, turn left onto Greenhill Road,**
- **After 1.2 miles, turn left onto Lindley Mill Road,**
- **After 0.5 mile, turn right onto Bethe South Fork Road,**
- **Site can be accessed from both sides of Bethel South Fork Road.**
- **Site Latitude, Longitude 35.853955, -79.363458 (NAD83/WGS84)**

USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

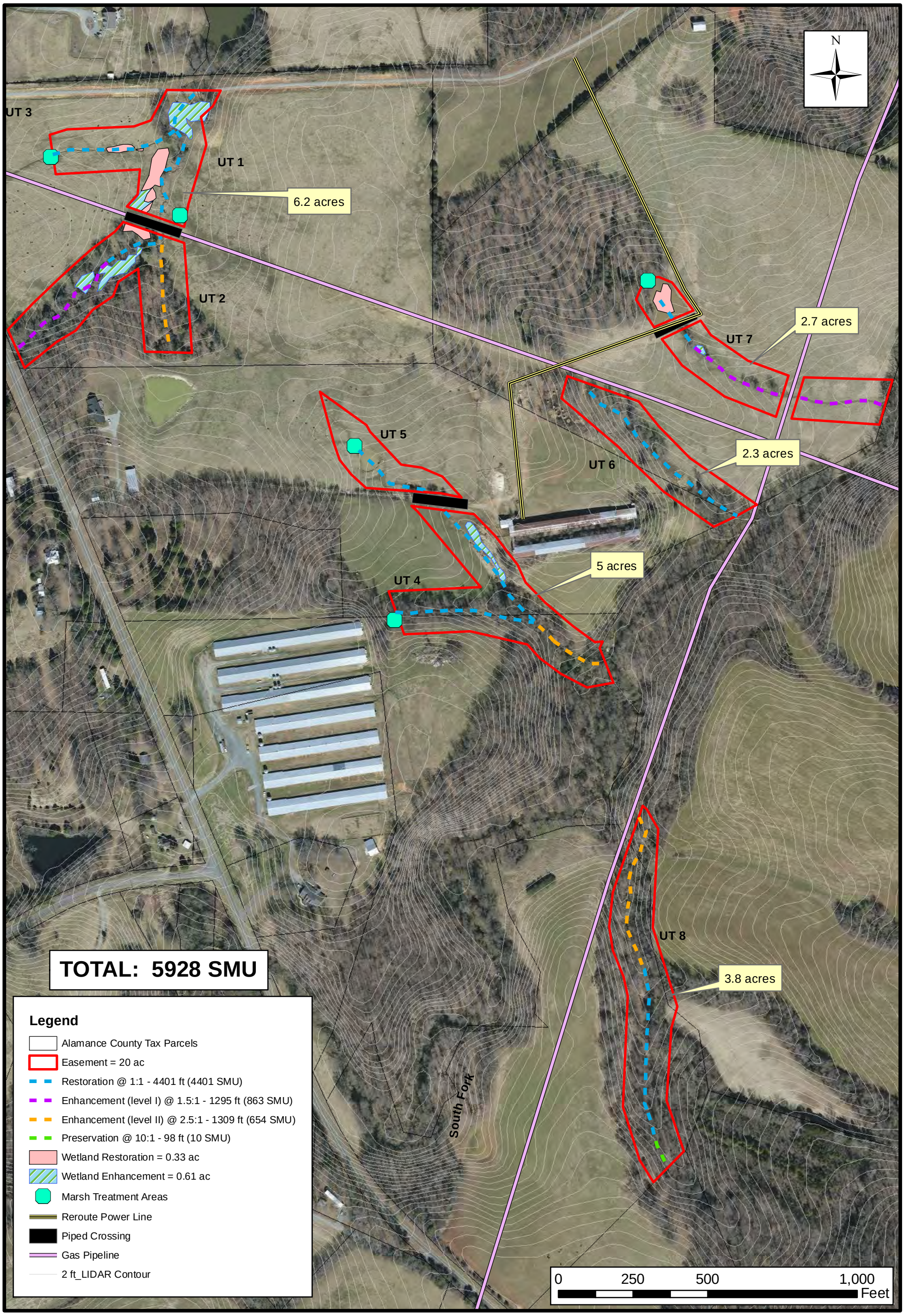
Date: JUL 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1



Axiom Environmental, Inc.
Axiom Environmental
218 Snow Ave
Raleigh, NC 27607
(919) 215-1693

Proposed Conditions
Heron Stream & Wetland Mitigation Site
Alamance County, North Carolina

Dwn. By:	KRJ
Date:	Jul 2017
Project:	17-008
FIGURE	2

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:	Heron Stream and Wetland Restoration Site
Name if stream or feature:	South Fork
County:	Alamance
Name of river basin:	Cape Fear
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Alamance
DFIRM panel number for entire site:	8796
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

South Fork is Zone AE

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

- [ ] Redelineation
- [ ] Detailed Study
- [x] Limited Detail Study
- [ ] Approximate Study
- [ ] Don't know

List flood zone designation:

Check if applies:

- [x] 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: Libby Hodges
Phone Number: 336-570-4052

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: W Grant Lewis

Title: President Date: July 27, 2017

North Carolina Department of Public Safety
Emergency Management

Roy Cooper, Governor
Erik A. Hooks, Secretary

Michael A. Sprayberry, Director

August 1, 2017

Axiom Environmental, Inc.
Attn: W. Grant Lewis
218 Snow Avenue
Raleigh, NC 27603

Subject: Heron Stream and Wetland Mitigation Project 17-008
Major Hill Stream and Wetland Mitigation Project 17-009
Alamance County, North Carolina

Dear Mr. Lewis:

Thank you for the opportunity to review the proposed Heron Stream and Wetland Mitigation Project and the Major Hill Stream and Wetland Mitigation Project. As requested, the North Carolina Department of Public Safety Division of Emergency Management Risk Management reviewed the documents provided and offers the following comments:

1) Based on the documentation provided, the Heron Stream and Wetland Mitigation Project will include areas within the Special Flood Hazard Area (SFHA) of South Fork. Any grading, fill or placement of equipment or materials in the SFHA will require a floodplain development permit issued by Alamance County. Specifically, outlined portions of Unnamed Tributaries 4, 6, 7, and 8 are within the SFHA of South Fork. Please be sure that the Alamance County Floodplain Administrator reviews and issues permits for work within the Special Flood Hazard Area.

2) Based on the documentation provided, the Major Hill Stream and Wetland Mitigation Project does not encroach on any mapped SFHA.

3) Based on the documentation provided, the proposed projects do not appear to encroach on the Non-Encroachment Areas of South Fork nor Pine Hill Branch.

4) The North Carolina Department of Public Safety Division of Emergency Management Risk Management has no objection to the projects as proposed.

MAILING ADDRESS:
4218 Mail Service Center
Raleigh NC 27699-4218
www.ncdps.gov
www.ncfloodmaps.com

An Equal Opportunity Employer

RM OFFICE LOCATION:
4105 Reedy Creek Road
Raleigh, NC 27607
Telephone: (919) 825-2341
Fax: (919) 825-0408

Thank you for your cooperation and consideration. If you have any questions concerning the above comments, please contact me at (919) 825-2300, by email at dan.brubaker@ncdps.gov or at the address shown on the footer of this document.

Sincerely,

John D Brubaker

John D. Brubaker, P.E., CFM
NFIP State Coordinator
Risk Management

cc: Milton Carpenter, NFIP Central Planner

Libby Hodges, Planning Director, Alamance County

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 27, 2017

Shannon Deaton
Habitat Conservation Program Manager
North Carolina Wildlife Resources Commission

Re: Heron Stream and Wetland mitigation project **17-008**
Alamance County, NC

Dear Ms. Deaton:

The purpose of this letter is to request concurrence from the North Carolina Wildlife Resources Commission concerning a stream and wetland restoration site located in Alamance County. The project will restore stream channels through active pastureland. Please review and comment on any possible issues that might emerge with respect to the Fish and Wildlife Coordination Act from the potential wetland and stream restoration project (USGS Silk Hope, North Carolina 7.5-minute topographic quadrangle).

The Heron site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel have been identified as significantly degraded.

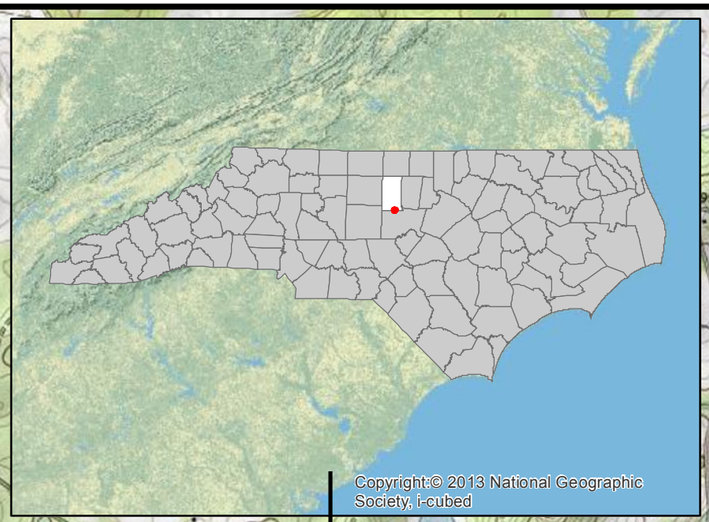
We thank you in advance for your timely response and cooperation. Please feel free to contact me with any questions that you may have concerning the extent of site disturbance associated with this project.

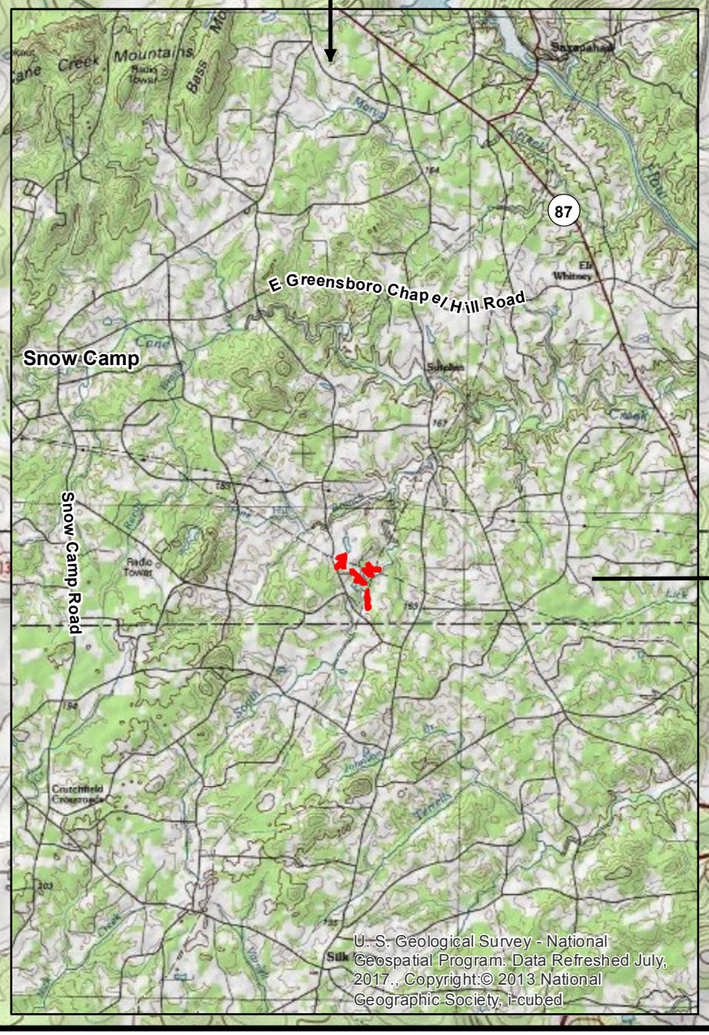
Yours truly,
AXIOM ENVIRONMENTAL, INC.

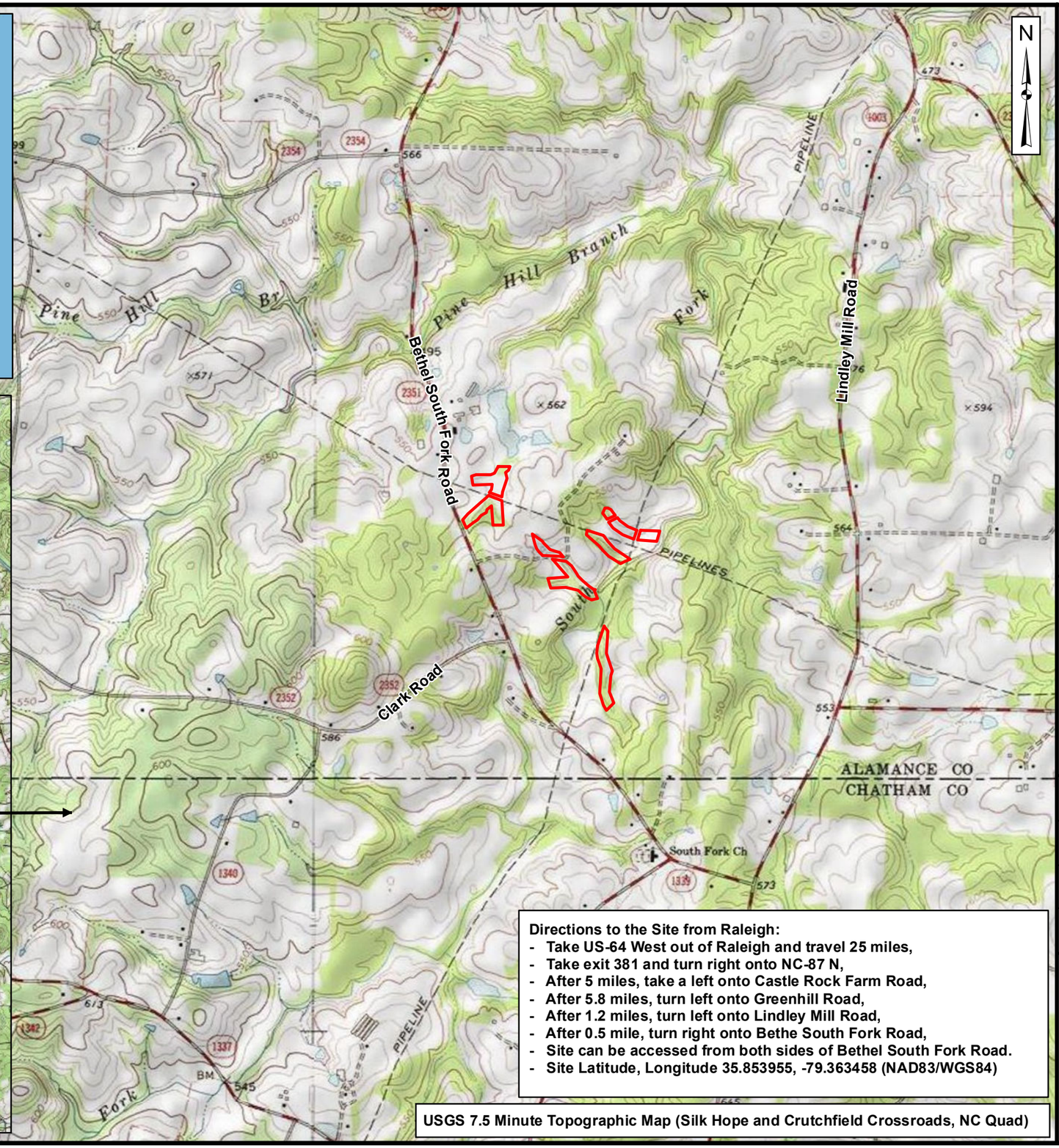
W Grant Lewis

W. Grant Lewis
Senior Project Manager

Attachments







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USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

Date: JUL 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

August 31, 2017

Mr. Grant Lewis
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603

Subject: Request for Environmental Information for the Heron Stream and Wetland Mitigation Project, Alamance County, North Carolina.

Dear Mr. Lewis,

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.).

Axiom Environmental, Inc. has developed the Heron Stream and Wetland Mitigation Project in order to provide in-kind mitigation for unavoidable stream channel and wetland impacts. Several areas of the project site have channels that are severely degraded. This project will include stream and wetland restoration and enhancement. The project areas are located east of Bethel South Fork Road, north of its intersection with Lindley Mill Road, east of Snow Camp.

Stream restoration projects often improve water quality and aquatic habitat. Establishing native, forested buffers in riparian areas will help protect water quality, improve aquatic and terrestrial habitats and provide a travel corridor for wildlife species. 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

Gabriela Garrison
Eastern Piedmont Habitat Conservation Coordinator
Habitat Conservation Program

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 27, 2017

Dale Suiter,
Endangered Species Biologist
USFWS Raleigh Field Office
PO Box 33726
Raleigh, North Carolina 27636

Re: Heron Stream and Wetland mitigation project in Alamance County **17-008**
Alamance County, NC

Dear Mr. Suiter:

The purpose of this letter is to request a list of federally protected species in Alamance County as well as any known information for each species in the county. Please review and comment on any possible issues that might emerge with respect to endangered species, and migratory birds from a potential wetland and stream restoration project on the attached site (USGS Silk Hope, North Carolina 7.5-minute topographic quadrangle).

The Heron Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Several sections of channel have been identified as significantly degraded.

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.

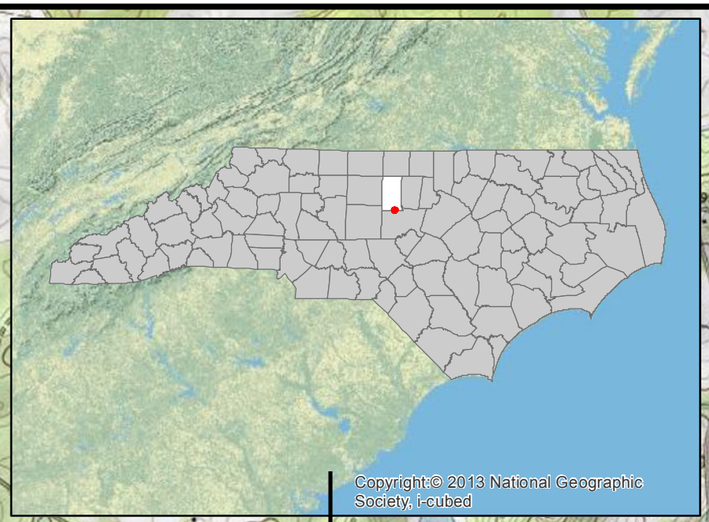
Yours truly,

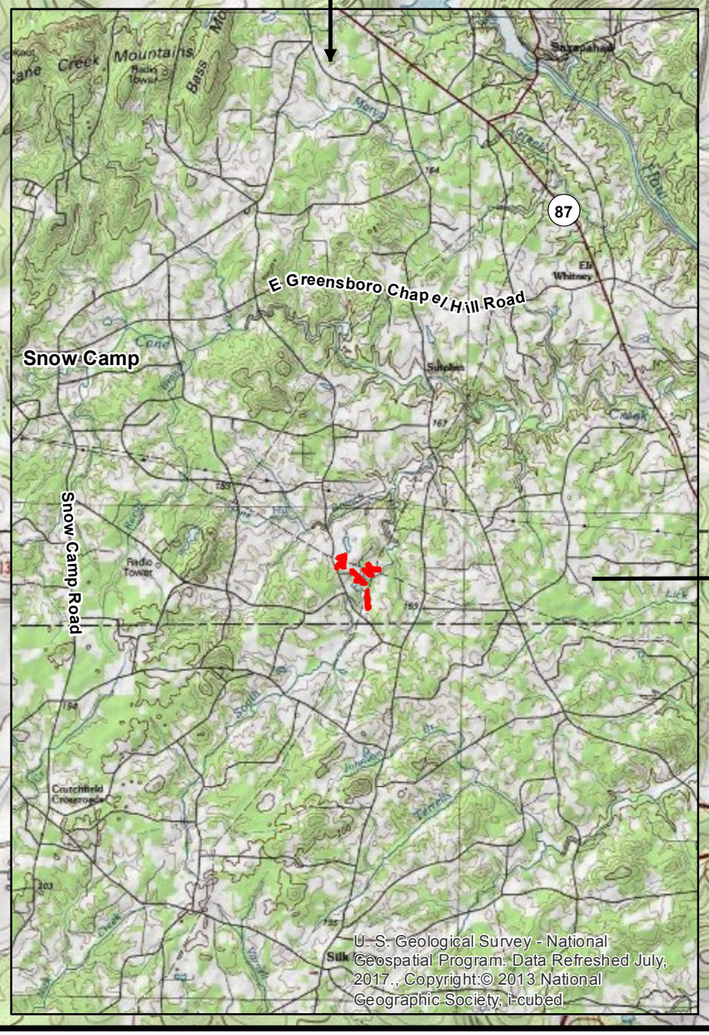
AXIOM ENVIRONMENTAL, INC.

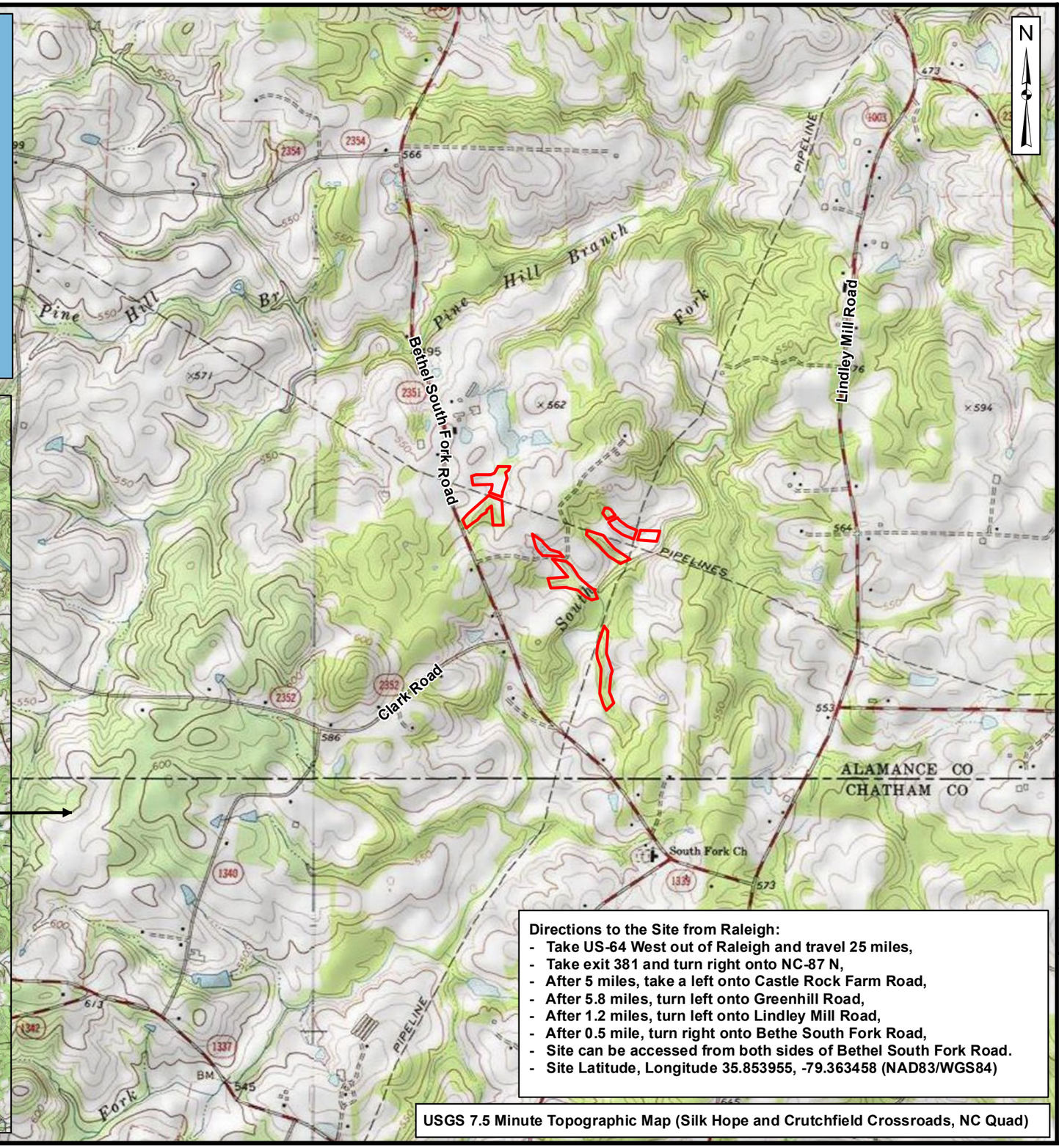
W Grant Lewis

W. Grant Lewis
Senior Project Manager

Attachments







Directions to the Site from Raleigh:
- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
- **After 5.8 miles, turn left onto Greenhill Road,**
- **After 1.2 miles, turn left onto Lindley Mill Road,**
- **After 0.5 mile, turn right onto Bethe South Fork Road,**
- **Site can be accessed from both sides of Bethel South Fork Road.**
- **Site Latitude, Longitude 35.853955, -79.363458 (NAD83/WGS84)**

USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

Date: JUL 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Raleigh ES Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

August 24, 2017

Grant Lewis
Axiom Environmental Inc.
218 Snow Avenue
Raleigh, NC 27603

Re: Heron Stream & Wetland Mitigation – Alamance County, NC

Dear Mr. Lewis:

This letter is to inform you that the Service has established an on-line project planning and consultation process which assists developers and consultants in determining whether a federally-listed species or designated critical habitat may be affected by a proposed project. For future projects, please visit the Raleigh Field Office's project planning website at https://www.fws.gov/raleigh/pp.html. If you are only searching for a list of species that may be present in the project's Action Area, then you may use the Service's Information, Planning, and Consultation System (IPaC) website to determine if any listed, proposed, or candidate species may be present in the Action Area and generate a species list. The IPaC website may be viewed at https://ecos.fws.gov/ipac/. The IPaC web site contains a complete and frequently updated list of all endangered and threatened species protected by the provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act), a list of federal species of concern[1] that are known to occur in each county in North Carolina, and other resources.

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.

[1] The term "federal species of concern" refers to those species which the Service believes might be in need of concentrated conservation actions. Federal species of concern receive no legal protection and their designation does not necessarily imply that the species will eventually be proposed for listing as a federally endangered or threatened species. However, we recommend that all practicable measures be taken to avoid or minimize adverse impacts to federal species of concern.

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.

With regard to the above-referenced project, we offer the following remarks. Our comments are submitted pursuant to, and in accordance with, provisions of the Endangered Species Act.

Based on the information provided and other information available, it appears that the proposed action is not likely to adversely affect any federally-listed endangered or threatened species, their formally designated critical habitat, or species currently proposed for listing under the Act at these sites. We believe that the requirements of section 7(a)(2) of the Act have been satisfied for your project. Please remember that obligations under section 7 consultation must be reconsidered if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered; (2) this action is subsequently modified in a manner that was not considered in this review; or, (3) a new species is listed or critical habitat determined that may be affected by the identified action.

However, the Service is concerned about the potential impacts the proposed action might have on aquatic species. Aquatic resources are highly susceptible to sedimentation. Therefore, we recommend that all practicable measures be taken to avoid adverse impacts to aquatic species, including implementing directional boring methods and stringent sediment and erosion control measures. An erosion and sedimentation control plan should be submitted to and approved by the North Carolina Division of Land Resources, Land Quality Section prior to construction. Erosion and sedimentation controls should be installed and maintained between the construction site and any nearby down-gradient surface waters. In addition, we recommend maintaining natural, vegetated buffers on all streams and creeks adjacent to the project site.

The North Carolina Wildlife Resources Commission has developed a Guidance Memorandum (a copy can be found on our website at (http://www.fws.gov/raleigh) to address and mitigate secondary and cumulative impacts to aquatic and terrestrial wildlife resources and water quality. We recommend that you consider this document in the development of your projects and in completing an initiation package for consultation (if necessary).

We hope you find our web page useful and informative and that following the process described above will reduce the time required, and eliminate the need, for general correspondence for species' lists. If you have any questions or comments, please contact Kathy Matthews of this office at (919) 856-4520 ext. 27.

Sincerely,

Pete Benjamin
Field Supervisor

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

Regulatory review

The IPaC regulatory review process will help evaluate the potential impacts of your project on resources managed by the U.S. Fish and Wildlife Service. We'll walk through regulations covering each protected resource, and offer suggestions and assistance in designing your project.

Endangered species

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

THERE ARE NO ENDANGERED SPECIES EXPECTED TO OCCUR AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[3] and the Bald and Golden Eagle Protection Act[4].

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

- Contact the local U.S. Fish and Wildlife Service field office

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

Facilities

U.S. Fish and Wildlife Service facilities are protected under the National Wildlife Refuge System Administration Act[5] and the National Fish Hatchery System[6].

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[7], or other State/Federal statutes.

THERE ARE NO KNOWN WETLANDS AT THIS LOCATION.

1. The Endangered Species Act (ESA) of 1973.
2. The Migratory Birds Treaty Act of 1918.
3. The Bald and Golden Eagle Protection Act of 1940.
4. The National Wildlife Refuge System Administration Act of 1966.
5. The National Fish Hatchery System.
6. Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands.

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 27, 2017

Brian Loadholt
Natural Resources Conservation Services
209 N. Graham-Hopedale Rd.
Burlington, NC 27217

Re: Heron Stream and Wetland mitigation project **17-008**
Alamance County, NC

Dear Mr. Loadholt:

The purpose of this letter is to request concurrence from the Natural Resources Conservation Service concerning a stream and wetland restoration site located in Alamance County. The Site encompasses approximately 20 acres of agricultural land used for livestock grazing and hay production. Existing Site streams have been cleared, dredged of cobble substrate, trampled by livestock, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from livestock. Proposed activities at the Site include the restoration of perennial and intermittent stream channels, enhancement of perennial stream channel, and restoration of riparian wetlands. In support of this effort, the entire easement will be planted with native forest vegetation; thereby, removing the area within the easement from active pasture.

Please review and comment on any possible issues that might emerge with respect to the Farmland Conversion. You will find attached to this letter information including a location map, a map depicting soil types and acreages to be converted, and Form AD-1006.

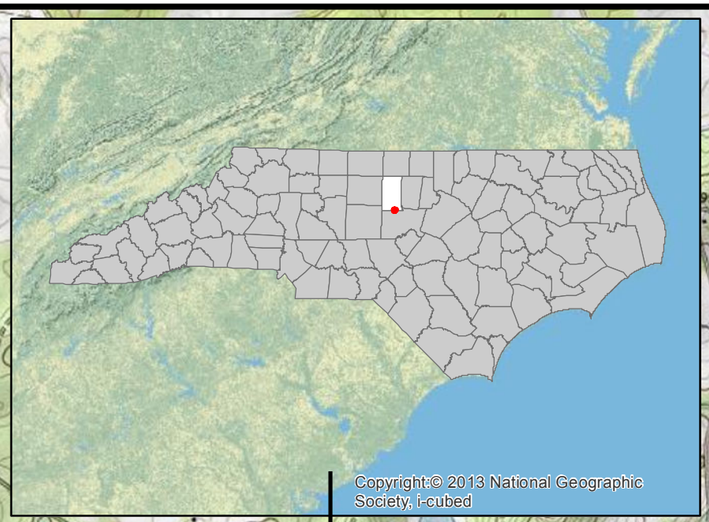
We thank you in advance for your timely response and cooperation. Please feel free to contact me with any questions that you may have concerning the extent of site disturbance associated with this project.

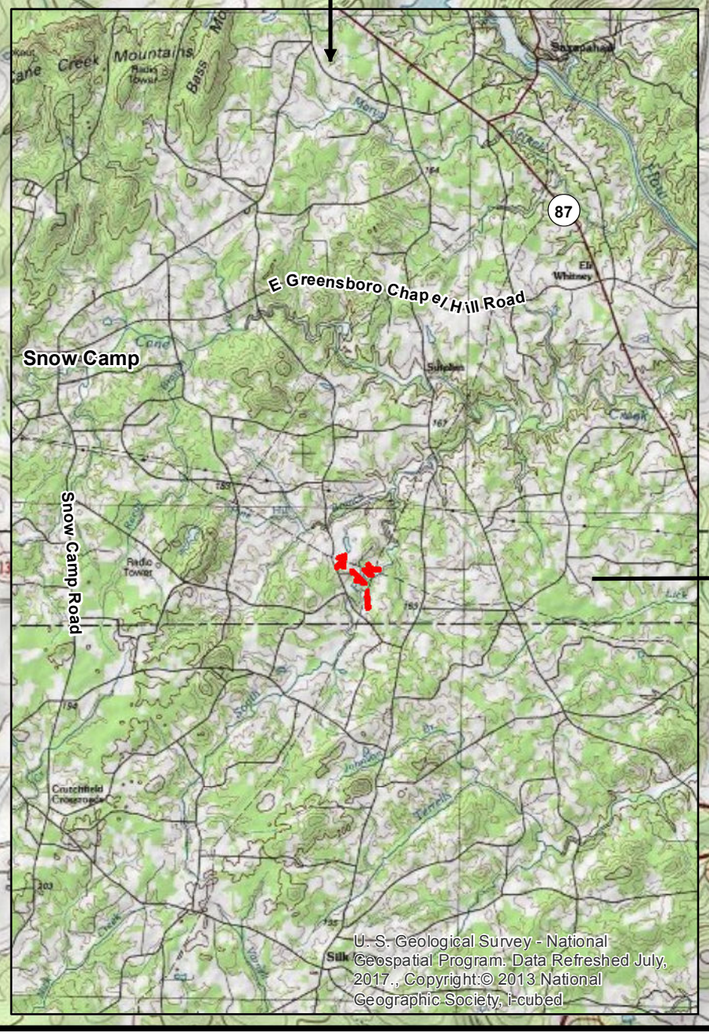
Yours truly,

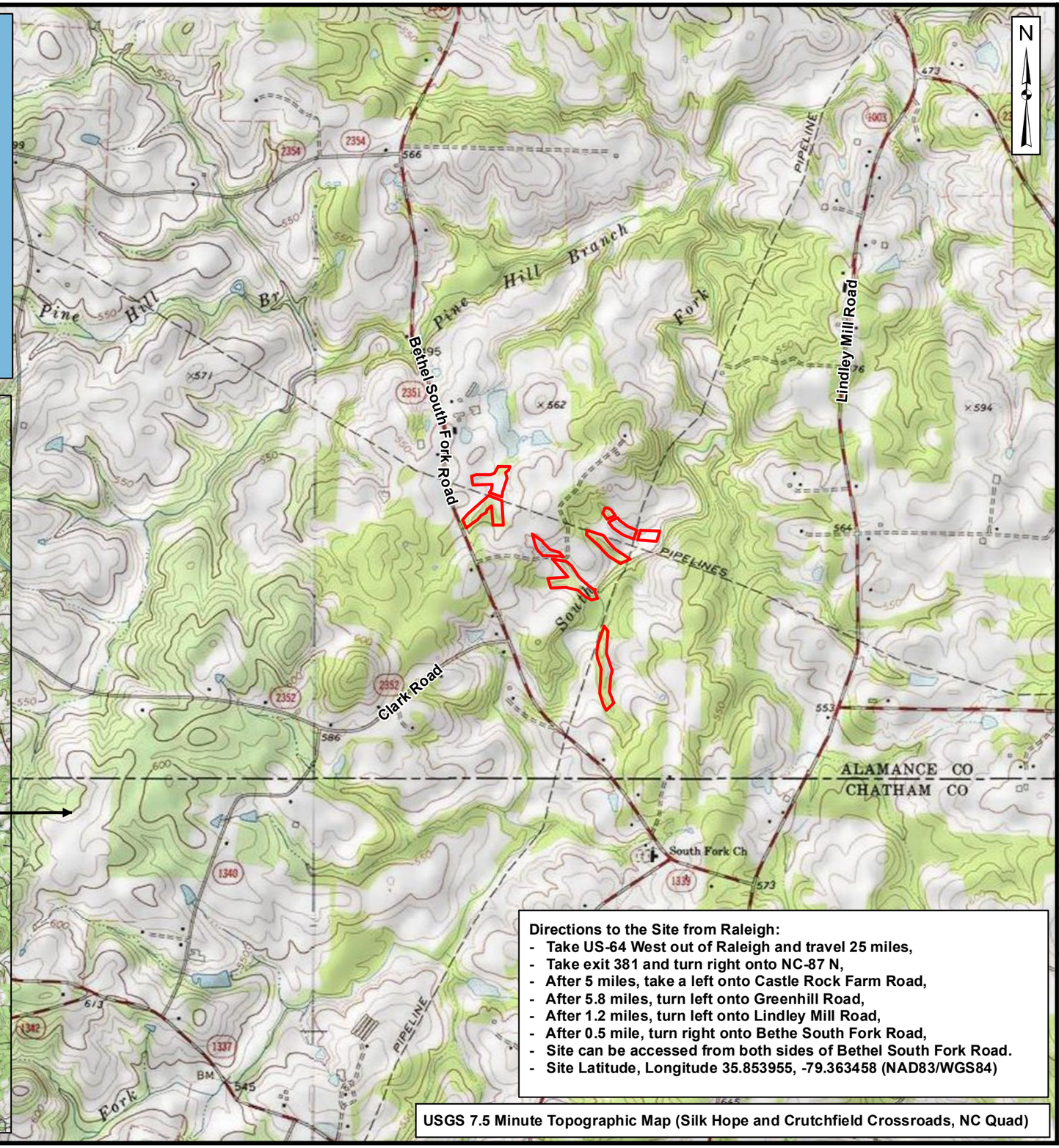
W Grant Lewis

AXIOM ENVIRONMENTAL, INC.
W. Grant Lewis
Senior Project Manager

Attachments







Directions to the Site from Raleigh:
- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
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USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

Date: JUL 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1

Map Unit Symbol	Map Unit Name	Acreage In Easement	Acreage Converted
AaB	Alamance Silt Loam	2.33	2.33
GaC2	Georgeville Silt Loam	0.03	0
GcE	Goldston Slaty Silt Loam	0.41	0.27
HdC & HdC2	Herndon Silt Loam	4.36	4.36
Lc	Local Alluvial Land, Poorly Drained	6.75	6.46
ObB	Orange Silt Loam	2.38	2.38
Wd	Worsham Sandy Loam	3.69	3.69

N

Legend

Easement = 20 ac

NRCS Soil Map Unit

0 250 500 1,000 Feet

Axiom Environmental
218 Snow Ave
Raleigh, NC 27607
(919) 215-1693
Axiom Environmental, Inc.

Existing Conditions
Heron Stream & Wetland Mitigation Site
Alamance County, North Carolina

Dwn. By:	WGL
Date:	Jul 2017
Project:	17-008
FIGURE	2

USDA
United States Department of Agriculture

Natural Resources
Conservation Service

North Carolina
State Office

4407 Bland Road
Suite 117
Raleigh, NC 27609
Voice 919-873-2171
Fax (844) 325-2156

August 10, 2017

Grant Lewi
Senior Project Manager
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603

Dear Grant Lewis

Thank you for your letter dated August 1, 2017, Subject: Heron Stream and Wetland Restoration Site in Alamance Co. North Carolina. The following guidance is provided for your information.

Projects are subject to the Farmland Protection Policy Act (FPPA) requirements if they may irreversibly convert farmland (directly or indirectly) to non-agricultural use and are completed by a federal agency or with assistance from a federal agency. Farmland means prime or unique farmlands as defined in section 1540(c)(1) of the FPPA or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary of Agriculture to be farmland of statewide local importance.

For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to FPPA requirements does not have to be currently used for cropland. It can be forestland, pastureland, cropland, or other land, but not water or urban built-up land.

Farmland does not include land already in or committed to urban development or water storage. Farmland *already in* urban development or water storage includes all such land with a density of 30 structures per 40-acre area. Farmland already in urban development also includes lands identified as *urbanized area* (UA) on the Census Bureau Map, or as urban area mapped with a *tint overprint* on the United States Geological Survey (USGS) topographical maps, or as *urban-built-up* on the United States Department of Agriculture (USDA) Important Farmland Maps.

The area in question meets one or more of the above criteria for Farmland. Farmland area will be affected or converted. Enclosed is the Farmland Conversion Impact Rating form AD1006 with PARTS II, IV and V completed by NRCS. The corresponding agency will need to complete the evaluation, according to the Code of Federal Regulation 7CFR 658, Farmland Protection Policy Act.

If you have any questions, please contact Milton Cortes, Assistant State Soil Scientist at 919-873-2171 or by email: milton.cortes@nc.usda.gov.

Again, thank you for inquiry. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,

Milton Cortes

Milton Cortes
Assistant State Soil Scientist

cc:
Kent Clary, State Soil Scientist, NRCS, Raleigh, NC

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request: August 1, 2017
Name Of Project: Heron Stream and Wetland Restoration Site	Federal Agency Involved: Federal Highway Administration
Proposed Land Use: Stream and Wetland Restoration	County And State: Alamance, NC
PART II *(To be completed by NRCS)*	Date Request Received By NRCS: August 10, 2017

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: 114 acres
Major Crop(s): CORN	Farmable Land In Govt. Jurisdiction: Acres: 240, 623 acres % 86		Amount Of Farmland As Defined in FPPA: Acres: 179, 301 acres % 64	
Name Of Land Evaluation System Used: Alamance Co, NC LESA	Name Of Local Site Assessment System: N/A		Date Land Evaluation Returned By NRCS: August 10, 2017 By eMail	

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	19.5			
B. Total Acres To Be Converted Indirectly	0.5			
C. Total Acres In Site	20.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	2.3			
B. Total Acres Statewide And Local Important Farmland	6.8			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.00510			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	86.0			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	33	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		20			
2. Perimeter In Nonurban Use		20			
3. Percent Of Site Being Farmed		20			
4. Protection Provided By State And Local Government		0			
5. Distance From Urban Builtup Area		15			
6. Distance To Urban Support Services		10			
7. Size Of Present Farm Unit Compared To Average		9			
8. Creation Of Nonfarmable Farmland		0			
9. Availability Of Farm Support Services		5			
10. On-Farm Investments		9			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		0			
TOTAL SITE ASSESSMENT POINTS	160	108	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	33	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	108	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	141	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)

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Natural Resources Conservation Service (NRCS) local field office and retain copy D for their files. (Note: NRCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the NRCS State Conservationist in each state).

Step 3 – NRCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step '4 – In cases where farmland covered by the FPPA will be converted by the proposed project, NRCS field offices will complete Parts II, IV and V of the form.

Step 5 – NRCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for NRCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in § 658.5 (b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will, be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned relative adjustments must be made to maintain the maximum total weight points at l60.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points, and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

Site Assessment Scoring for the Twelve Factors Used in FPPA

The Site Assessment criteria used in the Farmland Protection Policy Act (FPPA) rule are designed to assess important factors other than the agricultural value of the land when determining which alternative sites should receive the highest level of protection from conversion to non agricultural uses.

Twelve factors are used for Site Assessment and ten factors for corridor-type sites. Each factor is listed in an outline form, without detailed definitions or guidelines to follow in the rating process. The purpose of this document is to expand the definitions of use of each of the twelve Site Assessment factors so that all persons can have a clear understanding as to what each factor is intended to evaluate and how points are assigned for given conditions.

In each of the 12 factors a number rating system is used to determine which sites deserve the most protection from conversion to non-farm uses. The higher the number value given to a proposed site, the more protection it will receive. The maximum scores are 10, 15 and 20 points, depending upon the relative importance of each particular question. If a question significantly relates to why a parcel of land should not be converted, the question has a maximum possible protection value of 20, whereas a question which does not have such a significant impact upon whether a site would be converted, would have fewer maximum points possible, for example 10.

The following guidelines should be used in rating the twelve Site Assessment criteria:

1. How much land is in non-urban use within a radius of 1.0 mile from where the project is intended?

More than 90 percent:	15 points
90-20 percent:	14 to 1 points
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the area within one mile of the proposed site is non-urban area. For purposes of this rule, "non-urban" should include:

- Agricultural land (crop-fruit trees, nuts, oilseed)
- Range land
- Forest land
- Golf Courses
- Non paved parks and recreational areas
- Mining sites
- Farm Storage
- Lakes, ponds and other water bodies
- Rural roads, and through roads without houses or buildings
- Open space
- Wetlands
- Fish production
- Pasture or hayland

Urban uses include:

- Houses (other than farm houses)
- Apartment buildings
- Commercial buildings
- Industrial buildings
- Paved recreational areas (i.e. tennis courts)
- Streets in areas with 30 structures per 40 acres
- Gas stations

- Equipment, supply stores
- Off-farm storage
- Processing plants
- Shopping malls
- Utilities/Services
- Medical buildings

In rating this factor, an area one-mile from the outer edge of the proposed site should be outlined on a current photo; the areas that are urban should be outlined. For rural houses and other buildings with unknown sizes, use 1 and 1/3 acres per structure. For roads with houses on only one side, use one half of road for urban and one half for non-urban.

The purpose of this rating process is to insure that the most valuable and viable farmlands are protected from development projects sponsored by the Federal Government. With this goal in mind, factor S1 suggests that the more agricultural lands surrounding the parcel boundary in question, the more protection from development this site should receive. Accordingly, a site with a large quantity of non-urban land surrounding it will receive a greater
number of points for protection from development. Thus, where more than 90 percent of the area around the proposed site (do not include the proposed site in this assessment) is non-urban, assign 15 points. Where 20 percent or less is
non-urban, assign 0 points. Where the area lies between 20 and 90 percent non-urban, assign appropriate points from 14 to 1, as noted below.

Percent Non-Urban Land within 1 mile	**Points**
90 percent or greater	15
85 to 89 percent	14
80 to 84 percent	13
75 to 79 percent	12
70 to 74 percent	11
65 to 69 percent	10
60 to 64 percent	9
55 to 59 percent	8
50 to 54 percent	7
45 to 49 percent	6
40 to 44 percent	5
35 to 39 percent	4
30 to 24 percent	3
25 to 29 percent	2
21 to 24 percent	1
20 percent or less	0

2. How much of the perimeter of the site borders on land in non-urban use?

More than 90 percent:	l0 points
90 to 20 percent:	9 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the land adjacent to the proposed site is non-urban use. Where factor #1 evaluates the general location of the proposed site, this factor evaluates the immediate perimeter of the site. The definition of urban and non-urban uses in factor #1 should be used for this factor.

In rating the second factor, measure the perimeter of the site that is in non-urban and urban use. Where more than 90 percent of the perimeter is in non-urban use, score this factor 10 points. Where less than 20 percent, assign 0 points. If a road is next to the perimeter, class the area according to the

use on the other side of the road for that area. Use 1 and 1/3 acre per structure if not otherwise known. Where 20 to 90 percent of the perimeter is non-urban, assign points as noted below:

Percentage of Perimeter Bordering Land	Points
90 percent or greater	10
82 to 89 percent	9
74 to 81 percent	8
65 to 73 percent	7
58 to 65 percent	6
50 to 57 percent	5
42 to 49 percent	4
34 to 41 percent	3
27 to 33 percent	2
21 to 26 percent	1
20 percent or Less	0

3. How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last ten years?

More than 90 percent:	20 points
90 to 20 percent:	19 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the proposed conversion site has been used or managed for agricultural purposes in the past 10 years.

Land is being farmed when it is used or managed for food or fiber, to include timber products, fruit, nuts, grapes, grain, forage, oil seed, fish and meat, poultry and dairy products.

Land that has been left to grow up to native vegetation without management or harvest will be considered as abandoned and therefore not farmed. The proposed conversion site should be evaluated and rated according to the percent, of the site farmed.

If more than 90 percent of the site has been farmed 5 of the last 10 years score the site as follows:

Percentage of Site Farmed	Points
90 percent or greater	20
86 to 89 percent	19
82 to 85 percent	18
78 to 81 percent	17
74 to 77 percent	16
70 to 73 percent	15
66 to 69 percent	14
62 to 65 percent	13
58 to 61 percent	12
54 to 57 percent	11
50 to 53 percent	10
46 to 49 percent	9
42 to 45 percent	8
38 to 41 percent	7
35 to 37 percent	6
32 to 34 percent	5
29 to 31 percent	4
26 to 28 percent	3

23 to 25 percent	2
20 to 22 percent percent or Less	1
Less than 20 percent	0

4. Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected:	20 points
Site is not protected:	0 points

This factor is designed to evaluate the extent to which state and local government and private programs have made efforts to protect this site from conversion.

State and local policies and programs to protect farmland include:

State Policies and Programs to Protect Farmland

1. Tax Relief:

   A. Differential Assessment: Agricultural lands are taxed on their agricultural use value, rather than at market value. As a result, farmers pay fewer taxes on their land, which helps keep them in business, and therefore helps to insure that the farmland will not be converted to nonagricultural uses.

      1. Preferential Assessment for Property Tax: Landowners with parcels of land used for agriculture are given the privilege of differential assessment.

      2. Deferred Taxation for Property Tax: Landowners are deterred from converting their land to nonfarm uses, because if they do so, they must pay back taxes at market value.

      3. Restrictive Agreement for Property Tax: Landowners who want to receive Differential Assessment must agree to keep their land in - eligible use.

   B. Income Tax Credits

   Circuit Breaker Tax Credits: Authorize an eligible owner of farmland to apply some or all of the property taxes on his or her farmland and farm structures as a tax credit against the owner's state income tax.

   C. Estate and Inheritance Tax Benefits

   Farm Use Valuation for Death Tax: Exemption of state tax liability to eligible farm estates.

2. "Right to farm" laws:

   Prohibits local governments from enacting laws which will place restrictions upon normally accepted farming practices, for example, the generation of noise, odor or dust.

3. Agricultural Districting:

   Wherein farmers voluntarily organize districts of agricultural land to be legally recognized geographic areas. These farmers receive benefits, such as protection from annexation, in exchange for keeping land within the district for a given number of years.

4. Land Use Controls: Agricultural Zoning.

Types of Agricultural Zoning Ordinances include:

A. Exclusive: In which the agricultural zone is restricted to only farm-related dwellings, with, for example, a minimum of 40 acres per dwelling unit.

B. Non-Exclusive: In which non-farm dwellings are allowed, but the density remains low, such as 20 acres per dwelling unit.

Additional Zoning techniques include:

A. Slidinq Scale: This method looks at zoning according to the total size of the parcel owned. For example, the number of dwelling units per a given number of acres may change from county to county according to the existing land acreage to dwelling unit ratio of surrounding parcels of land within the specific area.

B. Point System or Numerical Approach: Approaches land use permits on a case by case basis.

LESA: The LESA system (Land Evaluation-Site Assessment) is used as a tool to help assess options for land use on an evaluation of productivity weighed against commitment to urban development.

C. Conditional Use: Based upon the evaluation on a case by case basis by the Board of Zoning Adjustment. Also may include the method of using special land use permits.

5. Development Rights:

A. Purchase of Development Rights (PDR): Where development rights are purchased by Government action.

Buffer Zoning Districts: Buffer Zoning Districts are an example of land purchased by Government action. This land is included in zoning ordinances in order to preserve and protect agricultural lands from non-farm land uses encroaching upon them.

B. Transfer of Development Rights (TDR): Development rights are transferable for use in other locations designated as receiving areas. TDR is considered a locally based action (not state), because it requires a voluntary decision on the part of the individual landowners.

6. Governor's Executive Order: Policy made by the Governor, stating the importance of agriculture, and the preservation of agricultural lands. The Governor orders the state agencies to avoid the unnecessary conversion of important farmland to nonagricultural uses.

7. Voluntary State Programs:

A. California's Program of Restrictive Agreements and Differential Assessments: The California Land Conservation Act of 1965, commonly known as the Williamson Act, allows cities, counties and individual landowners to form agricultural preserves and enter into contracts for 10 or more years to insure that these parcels of land remain strictly for agricultural use. Since 1972 the Act has extended eligibility to recreational and open space lands such as scenic highway corridors, salt ponds and wildlife preserves. These contractually restricted lands may be taxed differentially for their real value. One hundred-acre districts constitute the minimum land size eligible.

Suggestion: An improved version of the Act would state that if the land is converted after the contract expires, the landowner must pay the difference in the taxes between market value for the land and the agricultural tax value which he or she had been

paying under the Act. This measure would help to insure that farmland would not be converted after the 10 year period ends.

B. Maryland Agricultural Land Preservation Program: Agricultural landowners within agricultural districts have the opportunity to sell their development rights to the Maryland Land Preservation Foundation under the agreement that these landowners will not subdivide or develop their land for an initial period of five years. After five years the landowner may terminate the agreement with one year notice.

   As is stated above under the California Williamson Act, the landowner should pay the back taxes on the property if he or she decides to convert the land after the contract expires, in order to discourage such conversions.

C. Wisconsin Income Tax Incentive Program: The Wisconsin Farmland Preservation Program of December 1977 encourages local jurisdictions in Wisconsin to adopt agricultural preservation plans or exclusive agricultural district zoning ordinances in exchange for credit against state income tax and exemption from special utility assessment. Eligible candidates include local governments and landowners with at least 35 acres of land per dwelling unit in agricultural use and gross farm profits of at least $6.000 per year, or $18,000 over three years.

8. Mandatory State Programs:

A. The Environmental Control Act in the state of Vermont was adopted in 1970 by the Vermont State Legislature. The Act established an environmental board with 9 members (appointed by the Governor) to implement a planning process and a permit system to screen most subdivisions and development proposals according to specific criteria stated in the law. The planning process consists of an interim and a final Land Capability and Development Plan, the latter of which acts as a policy plan to control development. The policies are written in order to:

   - prevent air and water pollution;
   - protect scenic or natural beauty, historic sites and rare and irreplaceable natural areas; and
   - consider the impacts of growth and reduction of development on areas of primary agricultural soils.

B. The California State Coastal Commission: In 1976 the Coastal Act was passed to establish a permanent Coastal Commission with permit and planning authority The purpose of the Coastal Commission was and is to protect the sensitive coastal zone environment and its resources, while accommodating the social and economic needs of the state. The Commission has the power to regulate development in the coastal zones by issuing permits on a case by case basis until local agencies can develop their own coastal plans, which must be certified by the Coastal Commission.

C. Hawaii's Program of State Zoning: In 1961, the Hawaii State Legislature established Act 187, the Land Use Law, to protect the farmland and the welfare of the local people of Hawaii by planning to avoid “unnecessary urbanization”. The Law made all state lands into four districts: agricultural, conservation, rural and urban. The Governor appointed members to a State Land Use Commission, whose duties were to uphold the Law and form the boundaries of the four districts. In addition to state zoning, the Land Use Law introduced a program of Differential Assessment, wherein agricultural landowners paid taxes on their land for its agricultural use value, rather than its market value.

D. The Oregon Land Use Act of 1973: This act established the Land Conservation and Development Commission (LCDC) to provide statewide planning goals and guidelines.

Under this Act, Oregon cities and counties are each required to draw up a comprehensive plan, consistent with statewide planning goals. Agricultural land preservation is high on the list of state goals to be followed locally.

If the proposed site is subject to or has used one or more of the above farmland protection programs or policies, score the site 20 points. If none of the above policies or programs apply to this site, score 0 points.

5. How close is the site to an urban built-up area?

The site is 2 miles or more from an urban built-up area	15 points
The site is more than 1 mile but less than 2 miles from an urban built-up area	10 points
The site is less than 1 mile from, but is not adjacent to an urban built-up area	5 points
The site is adjacent to an urban built-up area	0 points

This factor is designed to evaluate the extent to which the proposed site is located next to an existing urban area. The urban built-up area must be 2500 population. The measurement from the built-up area should be made from the point at which the density is 30 structures per 40 acres and with no open or non-urban land existing between the major built-up areas and this point. Suburbs adjacent to cities or urban built-up areas should be considered as part of that urban area.

For greater accuracy, use the following chart to determine how much protection the site should receive according to its distance from an urban area. See chart below:

Distance From Perimeter of Site to Urban Area	Points
More than 10,560 feet	15
9,860 to 10,559 feet	14
9,160 to 9,859 feet	13
8,460 to 9,159 feet	12
7,760 to 8,459 feet	11
7,060 to 7,759 feet	10
6,360 to 7,059 feet	9
5,660 to 6,359 feet	8
4,960 to 5,659 feet	7
4,260 to 4,959 feet	6
3,560 to 4,259 feet	5
2,860 to 3,559 feet	4
2,160 to 2,859 feet	3
1,460 to 2,159 feet	2
760 to 1,459 feet	1
Less than 760 feet (adjacent)	0

6. How close is the site to water lines, sewer lines and/or other local facilities and services whose capacities and design would promote nonagricultural use?

None of the services exist nearer than 3 miles from the site	15 points
Some of the services exist more than one but less than 3 miles from the site	10 points
All of the services exist within 1/2 mile of the site	0 points

This question determines how much infrastructure (water, sewer, etc.) is in place which could facilitate nonagricultural development. The fewer facilities in place, the more difficult it is to develop an area. Thus, if a proposed site is further away from these services (more than 3 miles distance away), the site should be awarded the highest number of points (15). As the distance of the parcel of land to services decreases, the number of points awarded declines as well. So, when the site is equal to or further than 1 mile but less than 3 miles away from services, it should be given 10 points. Accordingly, if this distance is 1/2 mile to less than 1 mile, award 5 points; and if the distance from land to services is less than 1/2 mile, award 0 points.

Distance to public facilities should be measured from the perimeter of the parcel in question to the nearest site(s) where necessary facilities are located. If there is more than one distance (i.e. from site to water and from site to sewer), use the average distance (add all distances and then divide by the number of different distances to get the average).

Facilities which could promote nonagricultural use include:

- Water lines
- Sewer lines
- Power lines
- Gas lines
- Circulation (roads)
- Fire and police protection
- Schools

7. Is the farm unit(s) containing the site (before the project) as large as the average-size farming unit in the county? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger:	10 points
Below average: Deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more is below average	9 to 0 points

This factor is designed to determine how much protection the site should receive, according to its size in relation to the average size of farming units within the county. The larger the parcel of land, the more agricultural use value the land possesses, and vice versa. Thus, if the farm unit is as large or larger than the county average, it receives the maximum number of points (10). The smaller the parcel of land compared to the county average, the fewer number of points given. Please see below:

Parcel Size in Relation to Average County Size	Points
Same size or larger than average (l00 percent)	10
95 percent of average	9
90 percent of average	8
85 percent of average	7
80 percent of average	6
75 percent of average	5
70 percent of average	4
65 percent of average	3
60 percent of average	2
55 percent of average	1
50 percent or below county average	0

State and local Natural Resources Conservation Service offices will have the average farm size information, provided by the latest available Census of Agriculture data

8. If this site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	10 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project	9 to 1 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

This factor tackles the question of how the proposed development will affect the rest of the land on the farm The site which deserves the most protection from conversion will receive the greatest number of points, and vice versa. For example, if the project is small, such as an extension on a house, the rest of the agricultural land would remain farmable, and thus a lower number of points is given to the site. Whereas if a large-scale highway is planned, a greater portion of the land (not including the site) will become non-farmable, since access to the farmland will be blocked; and thus, the site should receive the highest number of points (10) as protection from conversion

Conversion uses of the Site Which Would Make the Rest of the Land Non-Farmable by Interfering with Land Patterns

Conversions which make the rest of the property nonfarmable include any development which blocks accessibility to the rest of the site Examples are highways, railroads, dams or development along the front of a site restricting access to the rest of the property.

The point scoring is as follows:

Amount of Land Not Including the Site Which Will Become Non-Farmable	Points
25 percent or greater	10
23 - 24 percent	9
21 - 22 percent	8
19 - 20 percent	7
17 - 18 percent	6
15 - 16 percent	5
13 - 14 percent	4
11 - 12 percent	3
9 - 11 percent	2
6 - 8 percent	1
5 percent or less	0

9. Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

This factor is used to assess whether there are adequate support facilities, activities and industry to keep the farming business in business. The more support facilities available to the agricultural

landowner, the more feasible it is for him or her to stay in production. In addition, agricultural support facilities are compatible with farmland. This fact is important, because some land uses are not compatible; for example, development next to farmland cam be dangerous to the welfare of the agricultural land, as a result of pressure from the neighbors who often do not appreciate the noise, smells and dust intrinsic to farmland. Thus, when all required agricultural support services are available, the maximum number of points (5) are awarded. When some services are available, 4 to 1 point(s) are awarded; and consequently, when no services are available, no points are given. See below:

Percent of Services Available	Points
100 percent	5
75 to 99 percent	4
50 to 74 percent	3
25 to 49 percent	2
1 to 24 percent	1
No services	0

10. Does the site have substantial and well-maintained on farm investments such as barns, other storage buildings, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment	20 points
Moderate amount of non-farm investment	19 to 1 point(s)
No on-farm investments	0 points

This factor assesses the quantity of agricultural facilities in place on the proposed site. If a significant agricultural infrastructure exists, the site should continue to be used for farming, and thus the parcel will receive the highest amount of points towards protection from conversion or development. If there is little on farm investment, the site will receive comparatively less protection. See-below:

Amount of On-farm Investment	Points
As much or more than necessary to maintain production (100 percent)	20
95 to 99 percent	19
90 to 94 percent	18
85 to 89 percent	17
80 to 84 percent	16
75 to 79 percent	15
70 to 74 percent	14
65 to 69 percent	13
60 to 64 percent	12
55 to 59 percent	11
50 to 54 percent	10
45 to 49 percent	9
40 to 44 percent	8
35 to 39 percent	7
30 to 34 percent	6
25 to 29 percent	5
20 to 24 percent	4
15 to 19 percent	3
10 to 14 percent	2
5 to 9 percent	1
0 to 4 percent	0

11. Would the project at this site, by converting farmland to nonagricultural use, reduce the support for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is converted	10 points
Some reduction in demand for support services if the site is converted	9 to 1 point(s)
No significant reduction in demand for support services if the site is converted	0 points

This factor determines whether there are other agriculturally related activities, businesses or jobs dependent upon the working of the pre-converted site in order for the others to remain in production. The more people and farming activities relying upon this land, the more protection it should receive from conversion. Thus, if a substantial reduction in demand for support services were to occur as a result of conversions, the proposed site would receive a high score of 10; some reduction in demand would receive 9 to 1 point(s), and no significant reduction in demand would receive no points.

Specific points are outlined as follows:

Amount of Reduction in Support Services if Site is Converted to Nonagricultural Use	**Points**
Substantial reduction (100 percent)	10
90 to 99 percent	9
80 to 89 percent	8
70 to 79 percent	7
60 to 69 percent	6
50 to 59 percent	5
40 to 49 percent	4
30 to 39 percent	3
20 to 29 percent	2
10 to 19 percent	1
No significant reduction (0 to 9 percent)	0

12. Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of the surrounding farmland to nonagricultural use?

Proposed project is incompatible with existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable of existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points

Factor 12 determines whether conversion of the proposed agricultural site will eventually cause the conversion of neighboring farmland as a result of incompatibility of use of the first with the latter. The more incompatible the proposed conversion is with agriculture, the more protection this site receives from conversion. Therefor-, if the proposed conversion is incompatible with agriculture, the site receives 10 points. If the project is tolerable with agriculture, it receives 9 to 1 points; and if the proposed conversion is compatible with agriculture, it receives 0 points.

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor-type site or design alternative for protection as farmland along with the land evaluation information.

For Water and Waste Programs, corridor analyses are not applicable for distribution or collection networks. Analyses are applicable for transmission or trunk lines where placement of the lines are flexible.

(1) How much land is in nonurban use within a radius of 1.0 mile form where the project is intended?

(2)	More than 90 percent	(3)	15 points
(4)	90 to 20 percent	(5)	14 to 1 point(s).
(6)	Less than 20 percent	(7)	0 points

(2) How much of the perimeter of the site borders on land in nonurban use?

(3)	More than 90 percent	(4)	10 point(s)
(5)	90 to 20 percent	(6)	9 to 1 points
(7)	less than 20 percent	(8)	0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?

(4)	More than 90 percent	(5)	20 points
(6)	90 to 20 percent	(7)	19 to 1 point(s)
(8)	Less than 20 percent	(9)	0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected	20 points
Site is not protected	0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger	10 points
Below average deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average	9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	25 points
Acreage equal to between 25 and 5 percent of the acres directly convened by the project	1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment	20 points
Moderate amount of on-farm investment	19 to 1 point(s)
No on-farm investment	0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is convened	25 points
Some reduction in demand for support services if the site is convened	1 to 24 point(s)
No significant reduction in demand for support services if the site is converted	0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?

Proposed project is incompatible to existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 27, 2017

Renee Gledhill-Earley
Environmental Review Coordinator
North Carolina State Historic Preservation Office
4617 Mail Service Center
Raleigh, NC 27699-4617

Re: Heron Stream and Wetland mitigation project in Alamance County **17-008**
Alamance County, NC

Dear Renee:

The purpose of this letter is to request written concurrence from the State Historic Preservation Office (SHPO) for the Heron Stream and Wetland Mitigation Project in Alamance County. Please review and comment on any possible issues that might emerge with respect to SHPO from a potential wetland and stream restoration project depicted on the attached mapping (USGS Silk Hope, North Carolina 7.5-minute topographic quadrangle).

Field visits were conducted in November and December 2016 to ascertain the presence of structures or features that may be eligible for the National Register of Historic Places. No structures were identified within the proposed Site boundary. In addition, the SHPO website was evaluated for known occurrences of sites eligible for the historic register. Based on the website review, two surveyed structures are located on Bethel South Fork Road near the Site (AM0180 J.W. Hadley House and AM0179 Alec Hadley House); however, neither structure appears eligible for the National Register, and the structures will not be disturbed during mitigation activities.

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.

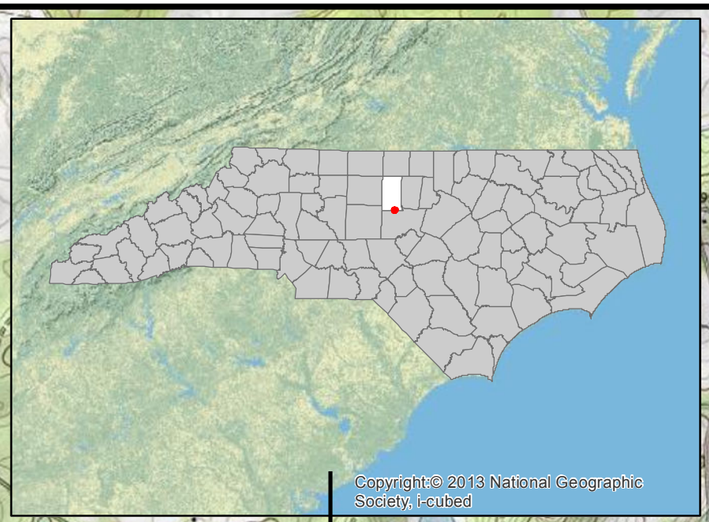
Yours truly,

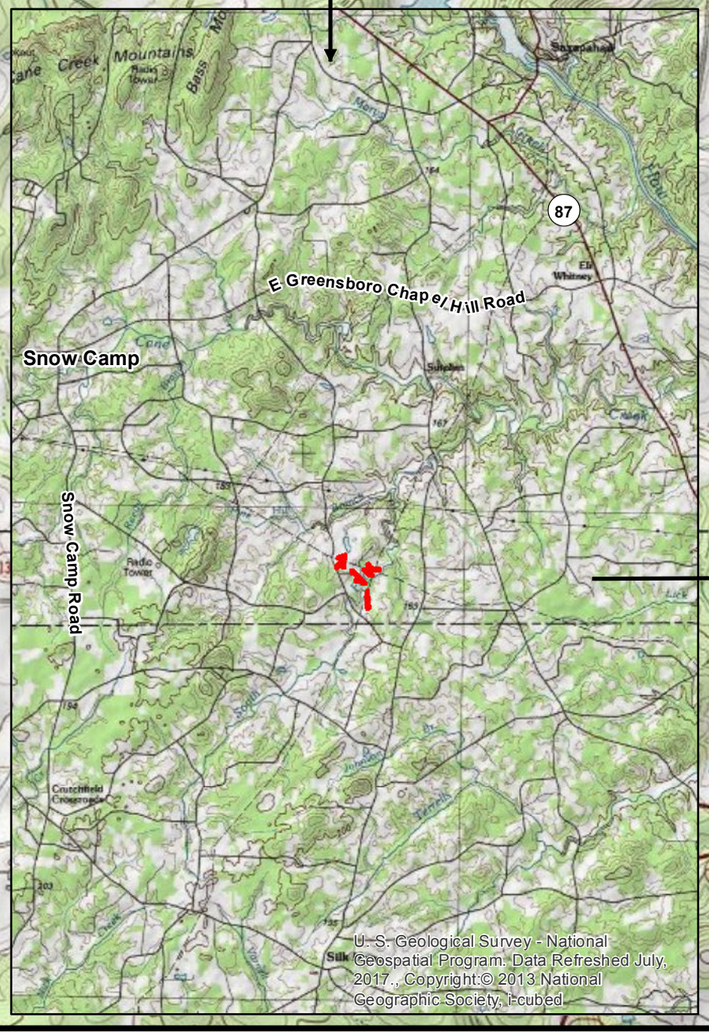
AXIOM ENVIRONMENTAL, INC.

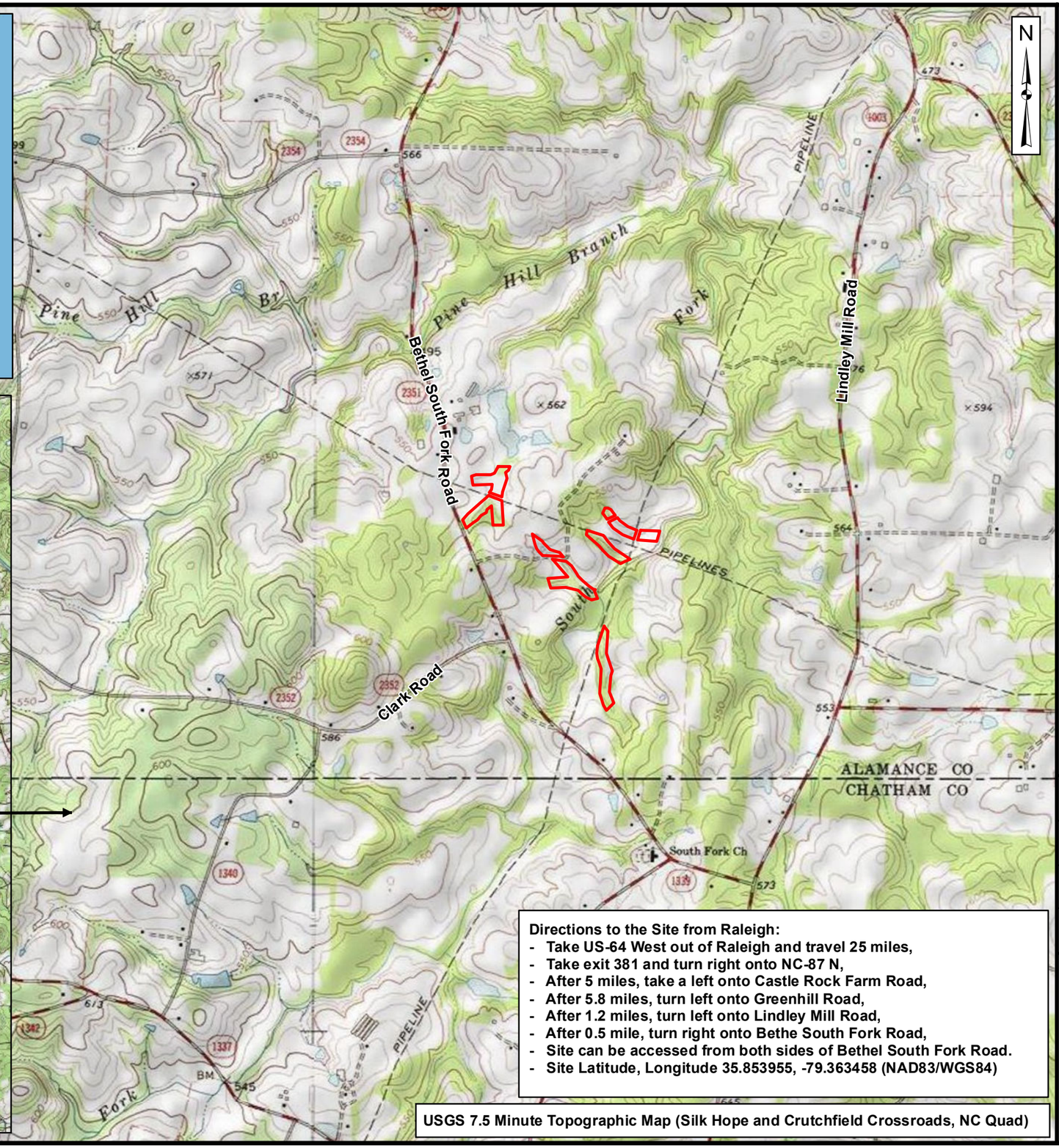
W Grant Lewis

W. Grant Lewis
Senior Project Manager

Attachments







Directions to the Site from Raleigh:
- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
- **After 5.8 miles, turn left onto Greenhill Road,**
- **After 1.2 miles, turn left onto Lindley Mill Road,**
- **After 0.5 mile, turn right onto Bethe South Fork Road,**
- **Site can be accessed from both sides of Bethel South Fork Road.**
- **Site Latitude, Longitude 35.853955, -79.363458 (NAD83/WGS84)**

USGS 7.5 Minute Topographic Map (Silk Hope and Crutchfield Crossroads, NC Quad)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

HERON STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

Date: JUL 2017

Scale: 1:20000

Project No.: 17-008

FIGURE

1

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

August 22, 2017

W. Grant Lewis glewis@axiomenvironmental.org
Project Manager
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603

Re: Heron Stream and Wetland mitigation project, Alamance County, ER 17-1359

Dear Mr. Lewis:

Thank you for your letter of July 27, 2017, 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, please contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or renee.gledhill-earley@ncdcr.gov. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Ramona M. Bartos

Heron Stream and Wetland Mitigation Site
9080 Bethel South Fork Road
Snow Camp, NC 27349

Inquiry Number: 5005690.2s
July 27, 2017

The EDR Radius Map™ Report with GeoCheck®

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

TABLE OF CONTENTS

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

EXECUTIVE SUMMARY

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

TARGET PROPERTY INFORMATION

ADDRESS

9080 BETHEL SOUTH FORK ROAD
SNOW CAMP, NC 27349

COORDINATES

Latitude (North):	35.8535100 - 35° 51' 12.63''
Longitude (West):	79.3615860 - 79° 21' 41.70''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	647948.9
UTM Y (Meters):	3968740.0
Elevation:	554 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5945591 SILK HOPE, NC
Version Date:	2013
Southwest Map:	5945515 CRUTCHFIELD CROSSROADS, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140827, 20140619
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
9080 BETHEL SOUTH FORK ROAD
SNOW CAMP, NC 27349

Click on Map ID to see full detail.

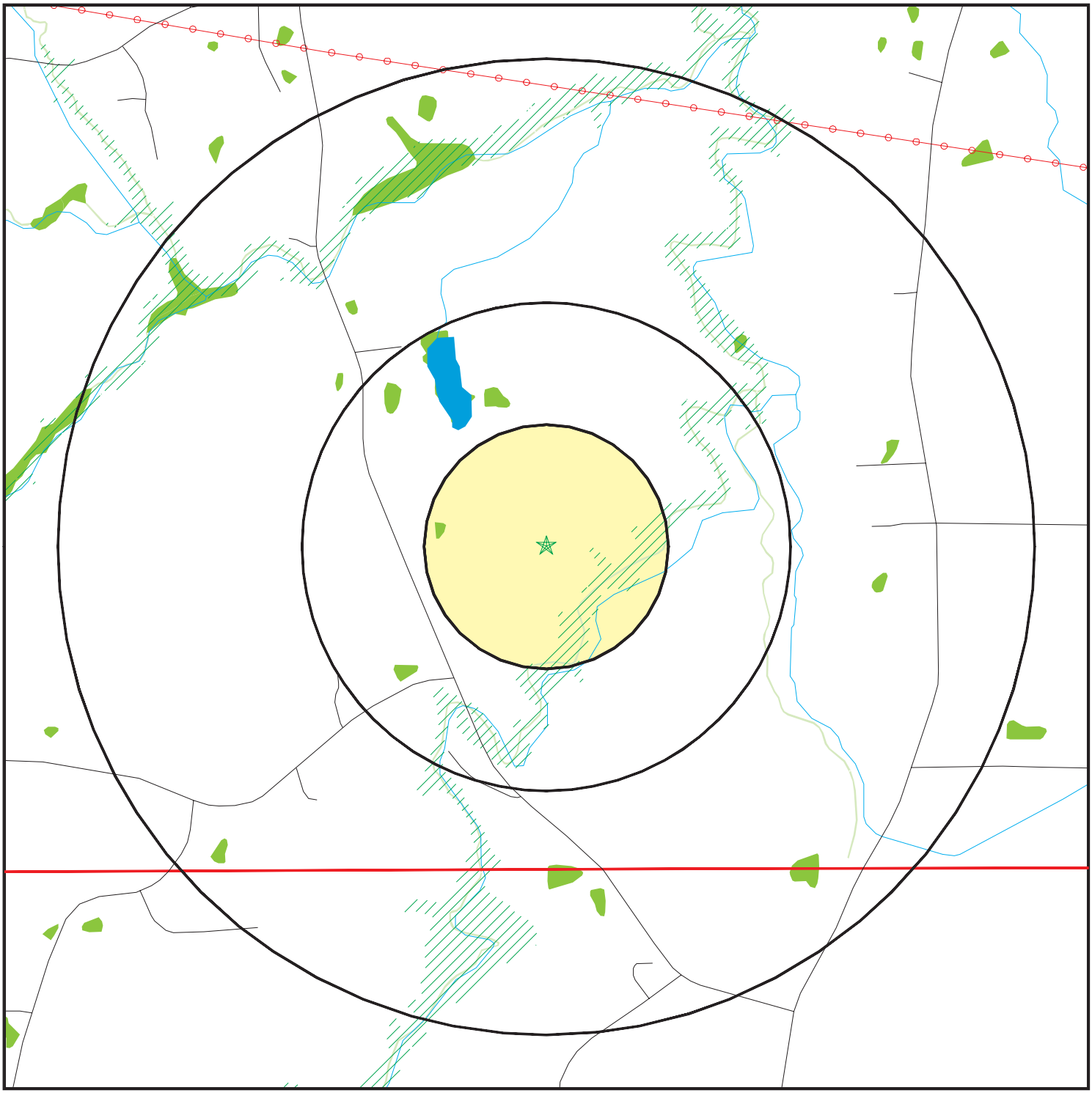
MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION

NO MAPPED SITES FOUND

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 5005690.2S



- 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

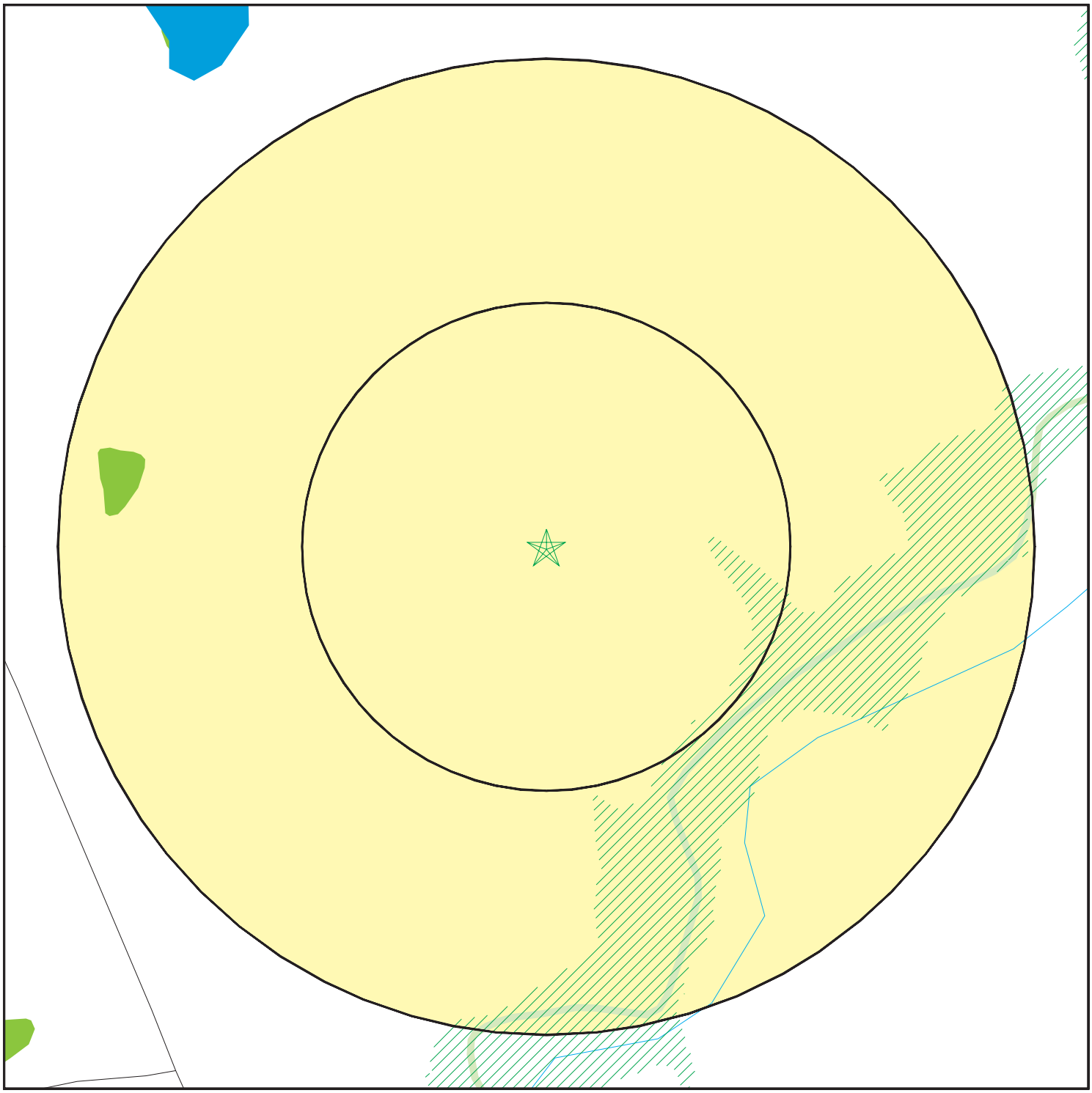
0 1/4 1/2 1 Miles

- Indian Reservations BIA
- County Boundary
- Power transmission lines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Upgradient Area
- Hazardous Substance Disposal Sites

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

SITE NAME:	Heron Stream and Wetland Mitigation Site	CLIENT:	Axiom Environmental
ADDRESS:	9080 Bethel South Fork Road Snow Camp NC 27349	CONTACT:	Kenan Jernigan
LAT/LONG:	35.85351 / 79.361586	INQUIRY #:	5005690.2s
		DATE:	July 27, 2017 1:47 pm

DETAIL MAP - 5005690.2S



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites

0 1/16 1/8 1/4 Miles

- Indian Reservations BIA
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

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: Heron Stream and Wetland Mitigation Site ADDRESS: 9080 Bethel South Fork Road Snow Camp NC 27349 LAT/LONG: 35.85351 / 79.361586	CLIENT: Axiom Environmental CONTACT: Kenan Jernigan INQUIRY #: 5005690.2s DATE: July 27, 2017 1:49 pm

Appendix F
Financial Assurances

Per the NC EEP RFP #: 16-006990, Restoration Systems will provide financial assurance in one of the following forms:

1) Performance Bonding – The Offeror must provide security in the form of acceptable performance bonds as described in the following paragraph to guarantee delivery of the maximum number of originally contracted Mitigation Units. The performance bonds must be obtained from a company licensed in North Carolina as shown in the Federal Treasury Listing of Approved Sureties (Circular 570). The maximum allowable amount provided by a surety may not exceed the "underwriting limitation" for the surety as identified in the Federal Treasury Listing. Although this RFP is a request for mitigation and not construction, the performance bonds shall follow the prescribed wording provided in N.C.G.S. § 44A-33. The Offeror must provide two performance bonds. The first bond must be for 100% of the total value of the contract and must be in effect and submitted with the Task 3 deliverable (see Section 8. SCOPE OF WORK – Task 3) before EEP will authorize payment for that deliverable. The bond must remain in effect until the Offeror has received written notification from the EEP that the requirements of Task 6 (submittal of baseline monitoring report) have been met. After the successful completion of Task 6, the bond can be retired and a second bond must be substituted for the first. The second bond must be for 40% of the value of the contract, which covers the monitoring period. The Monitoring Phase Performance Bond can be reduced yearly concurrent with the payment schedule once the yearly deliverable is approved by EEP and credits are released by the IRT.

2) Letters of Credit- LOCs must be drawn from a reputable Bank identified by the FDIC as "Well Capitalized" or "Adequately Capitalized" and follow the submittal timing, contract amounts and schedules for reduction as those described above for the performance bonds. Evergreen or irrevocable Letters of Credit shall be required to provide a 120 day notice of cancellation, termination or non-renewal.

3) Casualty Insurance on underlying performance of Credits or Units of Restoration – Must follow the same submittal timing, contract amounts and reduction schedules as those described above in performance bonds. The insurance must contain the following information.
    a) The "NC DENR" must be named as the "Regulatory Body". NC DENR shall have the sole right to place a claim against the policy. NC DENR shall have the sole right and obligation as the responsible "regulatory body" to approve any claim settlement.
    b) Initial insurance must be for a 10 year period.

The process of evaluating these options is underway. Once obtained, RS will provide digital and hard copies of the assurance of distribution to IRT members.

Appendix G
Site Protection Instrument

STATE OF NORTH CAROLINA **DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT**

_____ COUNTY

SPO File Number:
DMS Project Number:

Prepared by: Office of the Attorney General
Property Control Section
Return to: NC Department of Administration
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this _____day of _____, 20__, by _____ *Landowner name goes here* , ("**Grantor**"), whose mailing address is _____ *Landowner address goes here* _____, to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Division of Mitigation Services (formerly known as the Ecosystem Enhancement Program and Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the

protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between *(insert name and address of full delivery contract provider)* and the North Carolina Department of Environmental Quality, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environmental Quality Purchase and Services Contract Number _____.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Division of Mitigation Services (formerly Ecosystem Enhancement Program) is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Division of Mitigation Services (formerly Ecosystem Enhancement Program) with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Division of Mitigation Services in the Department of Environmental Quality, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in _____ Township, _____ County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately _____ acres and being conveyed to the Grantor by deed as recorded in **Deed Book _____ at Page ____** of the _____ County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of ***if known, insert name of stream, branch, river or waterway here***.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access.

The Conservation Easement Area consists of the following:

Tracts Number _____ containing a total of _____ **acres** as shown on the plats of survey entitled "Final Plat, Conservation Easement for North Carolina Division of Mitigation Services, Project Name: _____, SPO File No._____, EEP Site No. _____, Property of _____," dated _____, 20__ by *name of surveyor*, PLS Number _____ and recorded in the _____ County, North Carolina Register of Deeds at **Plat Book _____ Pages _____.**

See attached "**Exhibit A**", Legal Description of area of the Property hereinafter referred to as the "Conservation Easement Area"

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat**.**

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. **Damage to Vegetation.** Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. **Roads and Trails.** There shall be no construction or maintenance of new roads, trails, walkways, or paving in the Conservation Easement.

All existing roads, trails and crossings within the Conservation Easement Area shall be shown on the recorded survey plat.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the Division of Mitigation Services, 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities on the property to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. Conservation Easements are purchased to protect the investments by the State (Grantee) in natural resources. Livestock within conservations easements damages the investment and can result in reductions in natural resource value and mitigation credits which would cause financial harm to the State. Therefore, Landowners (Grantor) with livestock are required to restrict livestock access to the Conservation Easement area. Repeated failure to do so may result in the State (Grantee) repairing or installing livestock exclusion devices (fences) within the conservation area for the purpose of restricting livestock access. In such cases, the landowner (Grantor) must provide access to the State (Grantee) to make repairs.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the

power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the

obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Division of Mitigation Services Program Manager
NC State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

_____ (SEAL)

NORTH CAROLINA
COUNTY OF _____

I, _____, a Notary Public in and for the County and State aforesaid, do hereby certify that _____, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the _____ day of _____, 20__.

_____
Notary Public

My commission expires:

_____

Exhibit A

[INSERT LEGAL DESCRIPTION]

Appendix H
Credit Release Schedule

Table 3 – Schedule of Monitoring Events

Monitoring Event	Monitoring Activities Required	
	Streams	**Wetlands**
Pre-Construction	• Water Quality (Section VII(A)) • Macroinvertebrate & Fish (Section VII(B-C))*	• Per Mitigation Plan
Year 0 (As-Built)	• As-built Survey (includes longitudinal profile and sampling point locations)	• As-built Survey
Year 1	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 2	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 3	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A))* • Macroinvertebrate & Fish (Section VII(B-C))* • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 4	• Water Quality (Section VII(A)) * • Visual, two times (Section X)	• Visual (Section X) • Wetland Hydrology (Section IX)
Year 5	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A)) * • Macroinvertebrate & Fish (Section VII(B-C)) * • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 6	• Water Quality (Section VII(A)) * • Visual, two times (Section X)	• Wetland Hydrology (Section IX) • Visual, two times (Section X)
Year 7	• Vegetation (Section V) • Stream Channel Stability/Hydrology (Section VI) • Water Quality (Section VII(A)) * • Macroinvertebrate & Fish (Section VII(B-C)) * • Visual, two times (Section X)	• Vegetation (Section V) • Wetland Hydrology (Section IX) • Visual, two times (Section X)

*Indicates optional monitoring activities

XIV. Credit Release Schedules

The standard release schedule for mitigation bank and ILF credits generated through stream and wetland mitigation projects has been modified to meet the new standards for the monitoring timeframes provided in this guidance document. For mitigation banks, the first credit release (15% of the bank's total stream restoration and/or enhancement credits) will occur upon establishment of the mitigation bank, and upon completion following criteria:

1) Execution of the MBI or UMBI by the Sponsor and the USACE
2) Approval of the final Mitigation Plan

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

For mitigation sites that include preservation-only credits, 100% of the preservation credits will be released with the completion of the six criteria stated above.

For ILF sites (including all NCDMS projects), no initial release of credits (Milestone 1) is provided because ILF programs utilized advance credits, so no initial release is necessary to help fund site construction. To account for this, the 15% credit release associated with the first milestone (bank establishment) is held until the second milestone, so that the total credits release at the second milestone is 30%. In order for NCDMS to receive the 30% release (shown in the schedules as Milestone 2), they must comply with the credit release requirements stated in Section IV(I)(3) of the approved NCDMS Instrument.

The following conditions apply to the credit release schedules:

A. A reserve of 10% of a site's total stream credits will be released after four bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than four bankfull events occur during the monitoring period, release of these reserve credits is at the discretion of the NCIRT.

B. For mitigation banks, implementation of the approved Mitigation Plan must be initiated no later than the first full growing season after the date of the first credit transaction (credit sale).

C. After the second milestone, the credit releases are scheduled to occur on an annual basis, assuming that the annual monitoring report has been provided to the USACE in accordance with Section IV (General Monitoring Requirements) of this document, and that the monitoring report demonstrates that interim performance standards are being met and that no other concerns have been identified on-site during the visual monitoring. All credit releases require written approval from the USACE.

D. The credits associated with the final credit release milestone will be released only upon a determination by the USACE, in consultation with the NCIRT, of functional success as defined in the Mitigation Plan.

The schedules below list the updated credit release schedules for stream and wetland mitigation projects developed by bank and ILF sites in North Carolina:

Credit Release Schedule and Milestones for Wetlands					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%	10%	100%

*Please note that vegetation plot data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

Credit Release Schedule and Milestones for Coastal Marsh Wetlands					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	15%	55%	15%	55%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	20%	75%	20%	75%
6	Year 4 monitoring report demonstrates that interim performance standards have been met	10%	85%	10%	85%
7	Year 5 monitoring report demonstrates that performance standards have been met	15%	100%	15%	100%

Credit Release Schedule and Milestones for Streams					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable, performance standards have been met	10%	90% (100%**)	10%	90% (100%**)

*Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

**10% reserve of credits to be held back until the bankfull event performance standard has been met.

Appendix I
Maintenance Plan

Maintenance Plan

The Site shall be monitored on a regular basis and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Beaver	Beaver and associated dams are to be removed as they colonize and until the project is closed.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree- blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Terracell Drop Structure	Routine maintenance and repair activities may include removal of debris and supplemental installation of live stakes and other target vegetation along the channel. Undermining of the structure may require repair or replacement.

Appendix J
Randolph Electric Membership Corporation
Utility Work Agreement

Utility Work Agreement

Rev 7-17-08

This agreement, made this 27th day of January , 2016 by and between Russell B Hadley , (hereinafter referred to as the **Member)** and **Randolph Electric Membership Corporation**, (hereinafter referred to as **REMC).**

WITNESSETH:

NOW, THEREFORE, in order to facilitate the orderly and expeditious completion of requested work, the **Member** and **REMC** have agreed to the following:

1. That the scope, description and location of the work to be undertaken by REMC is as follows: Relocate overhead primary power line and install secondary service to a meter base that serves a well. Located at 8922 Bethel South Fork Rd.

2. That **REMC** will prepare an estimate, detailing the cost of labor, construction, materials, supplies, handling charges, transportation, equipment, rights of way, preliminary engineering and construction engineering, including an itemization of appropriate credits for salvage, betterments and accrued depreciation, all in sufficient detail to provide the **Member** a reasonable basis for analysis.

3. That in the event it is determined there are changes in the scope of the work, the duration of the work, extra work, or major changes from the statement of work covered by this agreement, reimbursement shall be limited to the same rate as below. Trucks and other equipment needed in the above mentioned work will be billed as follows: N/A

4. The member will be billed at a cost of $ N/A per hour, with an estimated N/A hours needed to complete the work. The above mentioned equipment will be assigned to this job for N/A hours. For all jobs with an expected duration time of 2 hours or less, the REMC crews and all needed equipment will remain at the job site. **The total estimated cost of the work proposed herein is estimated to be $ *10,260*. We will bill actual cost.**

IN WITNESS WHEREOF, the parties hereby have affected their names by their duly authorized officers that day and year first above written.

Member

By: _____

Title: _____

Randolph Electric Membership Corporation

By: David Rich

Title: Staking Specialist

Appendix K
City of Burlington
Map Modification for Land Application

Grant Lewis

From: Worth Creech <worth@restorationsystems.com>
Sent: Monday, July 02, 2018 1:55 PM
To: Grant Lewis
Subject: FW: Easement

fyi

Worth Creech | Restoration Systems LLC
1101 Haynes St. Suite 211 | Raleigh, NC 27604
office: 919-334-9114 | mobile: 919-389-3888
web: www.restorationsystems.com

From: Shane Fletcher <SFletcher@burlingtonnc.gov>
Sent: Monday, July 02, 2018 1:54 PM
To: Worth Creech <worth@restorationsystems.com>
Subject: Easement

The City of Burlington will modify our maps for NC-AM-16 (Michael Hadley) and not land apply in any stream restoration easements.

Shane Fletcher

Residuals Management Coordinator

City of Burlington NC

Cell - 336-675-5927

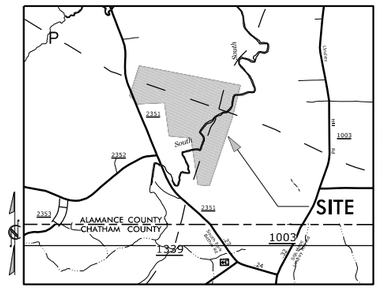
Office - 336-570-6138

sfletcher@ci.burlington.nc.us

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	HERON SITE	1	

CONSTRUCTION PLANS
HERON SITE

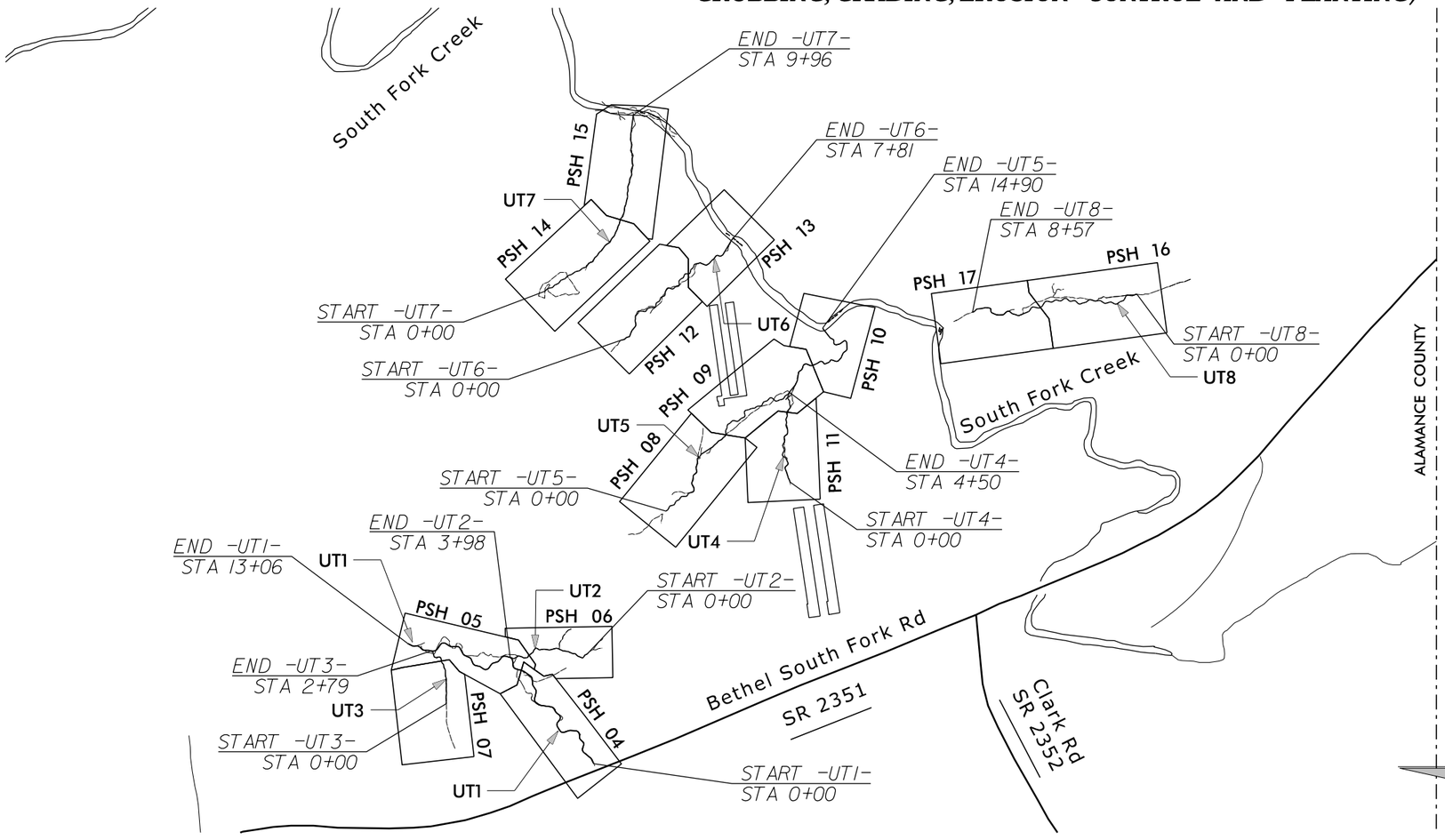
60% PLANS



VICINITY MAP
Not to Scale

LOCATION: ALAMANCE COUNTY, NORTH CAROLINA

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



LIMITS OF CONSTRUCTION:
7.8 ACRES

INDEX OF SHEETS

SHEET NUMBER	SHEET
01	Title Sheet
02A THRU 02D	Typicals
03	Control Points and Location Map
03A	Easement Map
04 THRU 17	Plan and Profile Sheets
E-02 THRU E-02B	Erosion Control Notes
E-03 THRU E-03E	Erosion Control Details
E-03F	Haul Road Locations
E-04 THRU E-17	Erosion Control Plan Sheets
P-02	Planting Notes
P-03 THRU P-03A	Planting Typicals
P-04 THRU P-17	Planting Plan Sheets

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GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

10 5 0 10 5
PROFILE (VERTICAL)

PROPOSED LENGTH OF UT1 = 1306 LF
PROPOSED LENGTH OF UT2 = 398 LF
PROPOSED LENGTH OF UT3 = 279 LF
PROPOSED LENGTH OF UT4 = 450 LF
PROPOSED LENGTH OF UT5 = 1490 LF
PROPOSED LENGTH OF UT6 = 781 LF
PROPOSED LENGTH OF UT7 = 996 LF
PROPOSED LENGTH OF UT8 = 857 LF

TOTAL STREAM LENGTH = 6557 LF

RESTORATION LEVEL	STREAM (linear footage)	RIPARIAN WETLAND (acreage)	NONRIPARIAN WETLAND (acreage)
RESTORATION	4183	0.35	–
ENHANCEMENT	1234	–	–
TOTALS	1131	0.61	–
MITIGATION UNITS	5264 SMUs	0.66 RIPARIAN WMUs	– NONRIPARIAN WMUs

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

Restoration Systems
1101 Haynes St.
Suite 211
Raleigh, NC 27604
RESTORATION SYSTEMS LLC
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

DocuSigned by:
Joshua G. Dalton
1080AD8C14994C3...

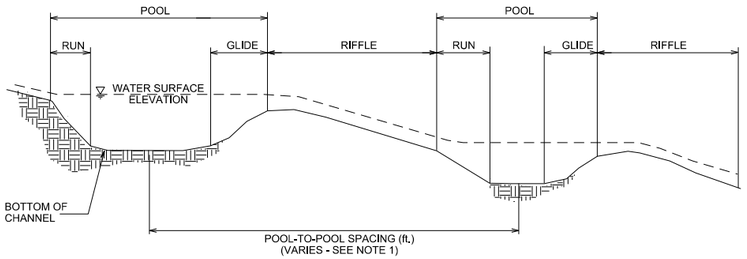
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

7/17/2018 9:21:42 AM EDT
DATE:

CONTRACT: HERON SITE

7/16/2018
Heron_psh_01.dgn
BSmith

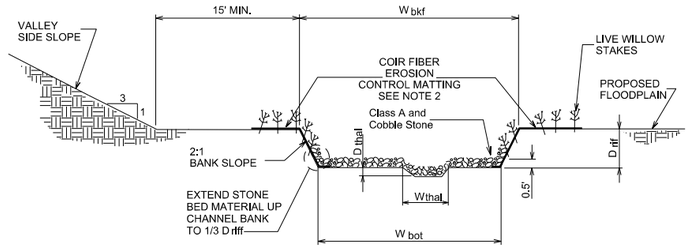
09/08/



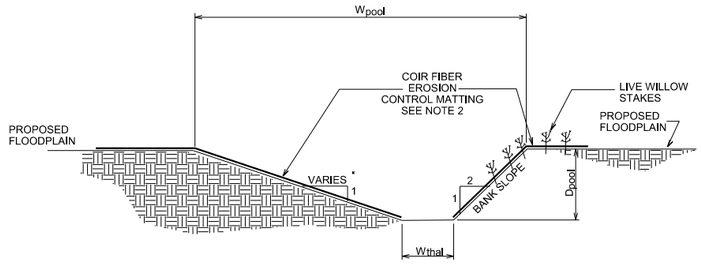
TYPICAL CHANNEL PROFILE

NOTES:

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



TYPICAL RIFFLE CROSS-SECTION



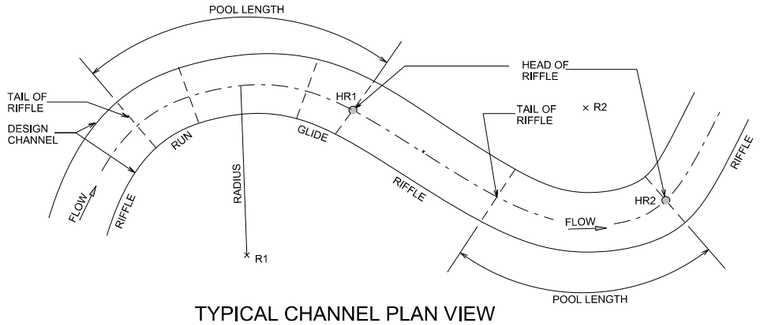
TYPICAL POOL CROSS-SECTION

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.



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.

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
UT 1	8.4	5.2	0.7	0.1	1.1	9.3	2.5
UT 3	4.4	2.8	0.3	0.1	0.6	4.9	1.0
UT 4, 5, and 6	4.8	3.2	0.4	0.1	0.6	5.2	1.5
UT 7	5.3	3.7	0.3	0.1	0.7	5.8	1.0
UT 8	5.9	4.3	0.3	0.1	0.8	6.5	1.5

SHEET NAME		SHEET NUMBER
TYPICALS		2A
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

7/17/2018 9:21:42 AM EDT
DATE:

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7/16/2018
Heron_psh_02A.dgn
BSmith

SHEET NAME		SHEET NUMBER
TYPICALS		2B
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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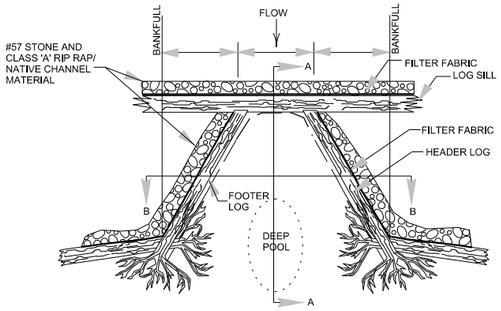
ENG FIRM LICENSE NO. C-890

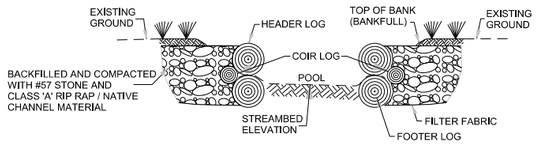
LOG CROSS VANE

SCALE:NTS

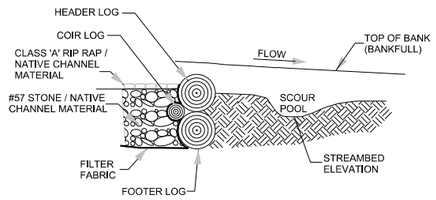
PLAN VIEW



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



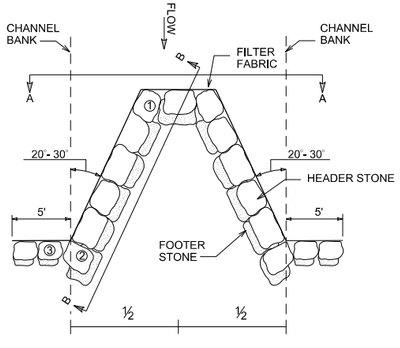
SECTION B-B



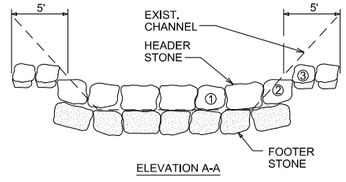
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 3, 4, 5, 6, 7, and 8	7	0.4 - 0.5
UT 1	10	0.8

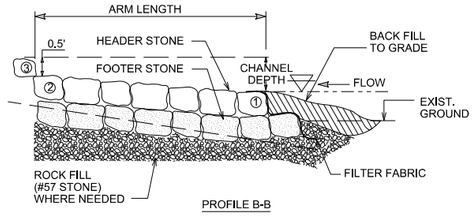
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW



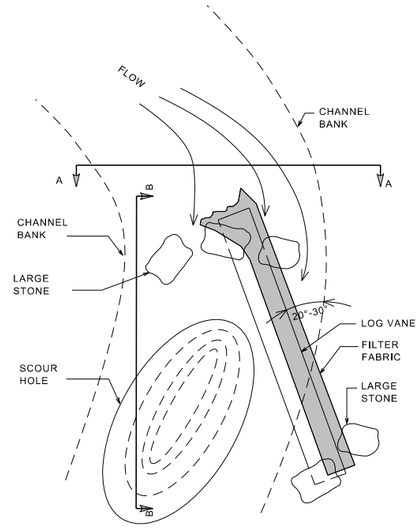
ELEVATION A-A



PROFILE B-B

TYPICAL CROSS-VANE

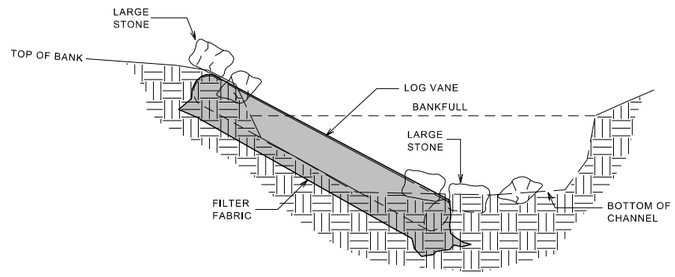
TYPICAL LOG VANE



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

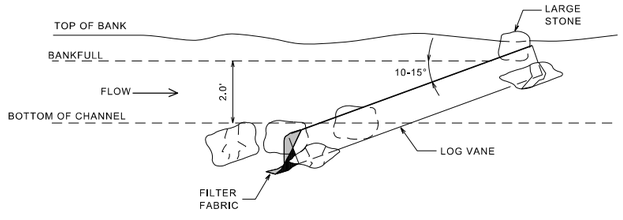
PLAN VIEW

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.

7/16/2018
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BSmith

SHEET NAME		SHEET NUMBER
TYPICALS		2C
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.
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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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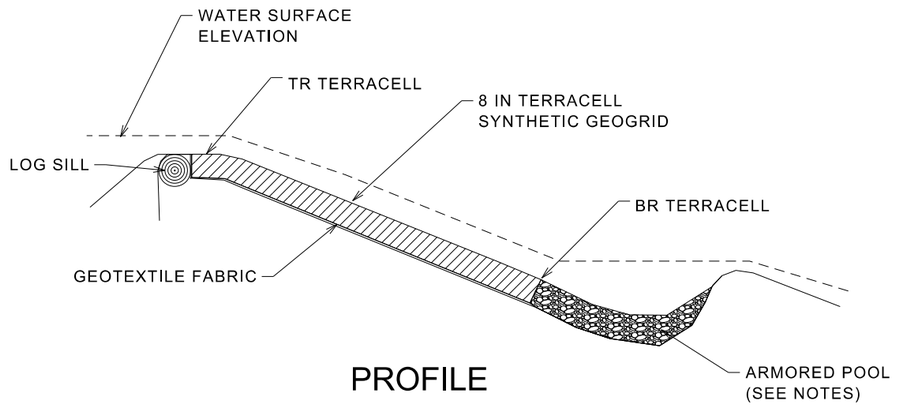
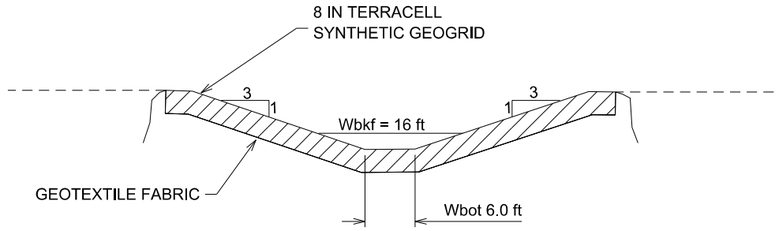
DROP STRUCTURE - TERRACELL



PROFILE

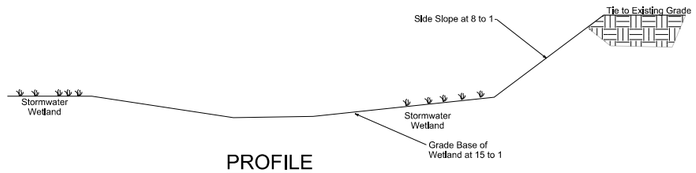
TERRACELL STRUCTURE NOTES:
1. CONTRACTOR WILL INSTALL 8-INCH TERRACELL SYNTHETIC GEOGRID AS PER THE MANUFACTURER'S SPECIFICATIONS.
2. THE POOL AT THE BOTTOM OF THE DROP STRUCTURE WILL BE ARMORED WITH GEOTEXTILE FABRIC AND SUITABLE NATURAL BED MATERIAL.
3. NATURAL BED MATERIAL IS DEFINED AS MATERIAL OBTAINED FROM STOCKPILES AT THE SITE RANGING IN SIZE FROM 5" - 17" AVERAGE DIAMETER WITH THE MAJORITY OF MATERIAL HAVING 10" AVERAGE DIAMETER, OR EQUIVALENT MATERIAL.



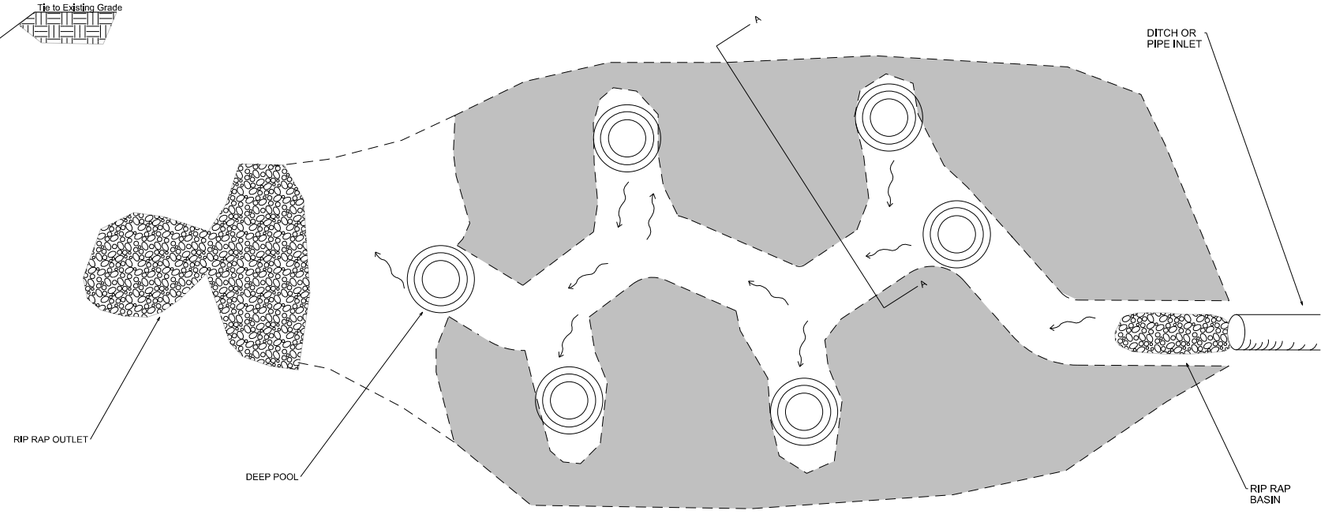
CROSS-SECTION

TERRACELL STRUCTURE NOTES:
1. CONTRACTOR WILL INSTALL 8-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*).

MARSH TREATMENT AREA



PROFILE
SECTION A-A



7/16/2018
Heron_psh_02C.dgn
BSmith

SHEET NAME		SHEET NUMBER
TYPICALS		2D
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
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Joshua G. Dalton
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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

7/17/2018 9:21:42 AM EDT

DATE:

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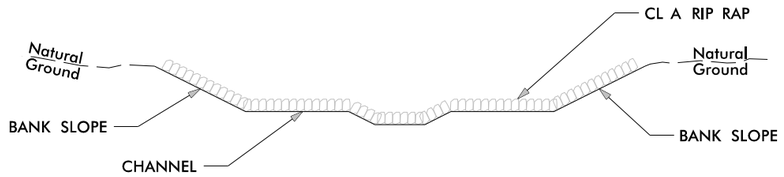
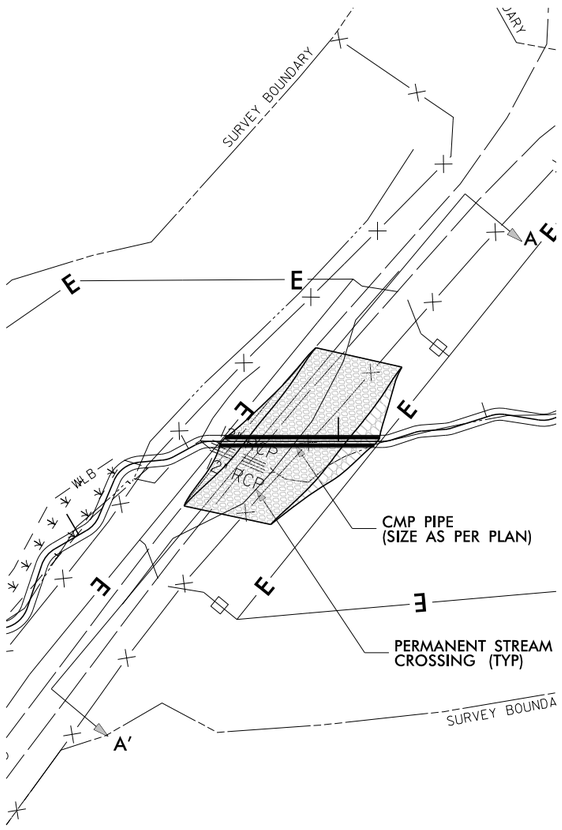
ENGINEERED RIFFLE

SCALE: N.T.S.



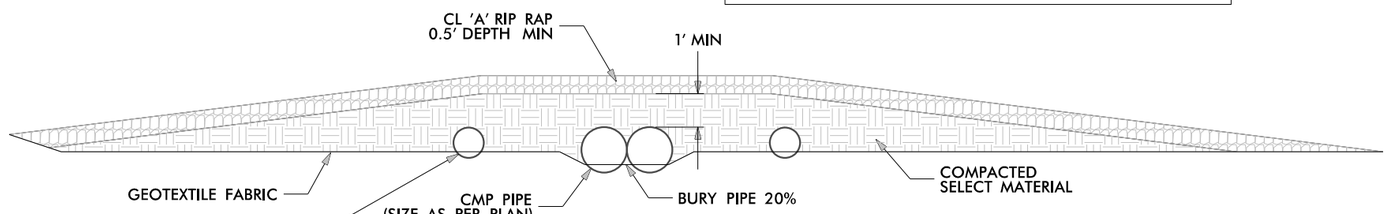
NOTES:
1) PLACE CLASS A RIP RAP IN CHANNEL AND ON BANK SLOPES.
2) RIP RAP SIZE MAY BE ADJUSTED BASED ON FIELD CONDITIONS AS DIRECTED BY ENGINEER OR DESIGNER.



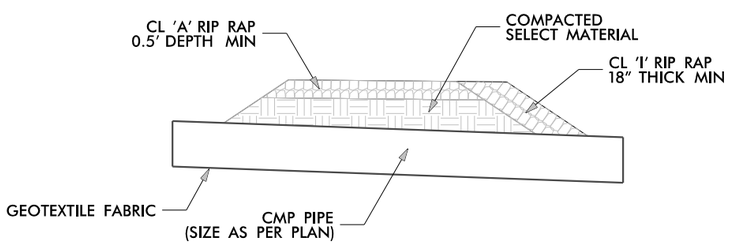
PERMANMENT CROSSING

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 IF INDICATED ON PLANS.



SECTION A-A'



SECTION B-B'

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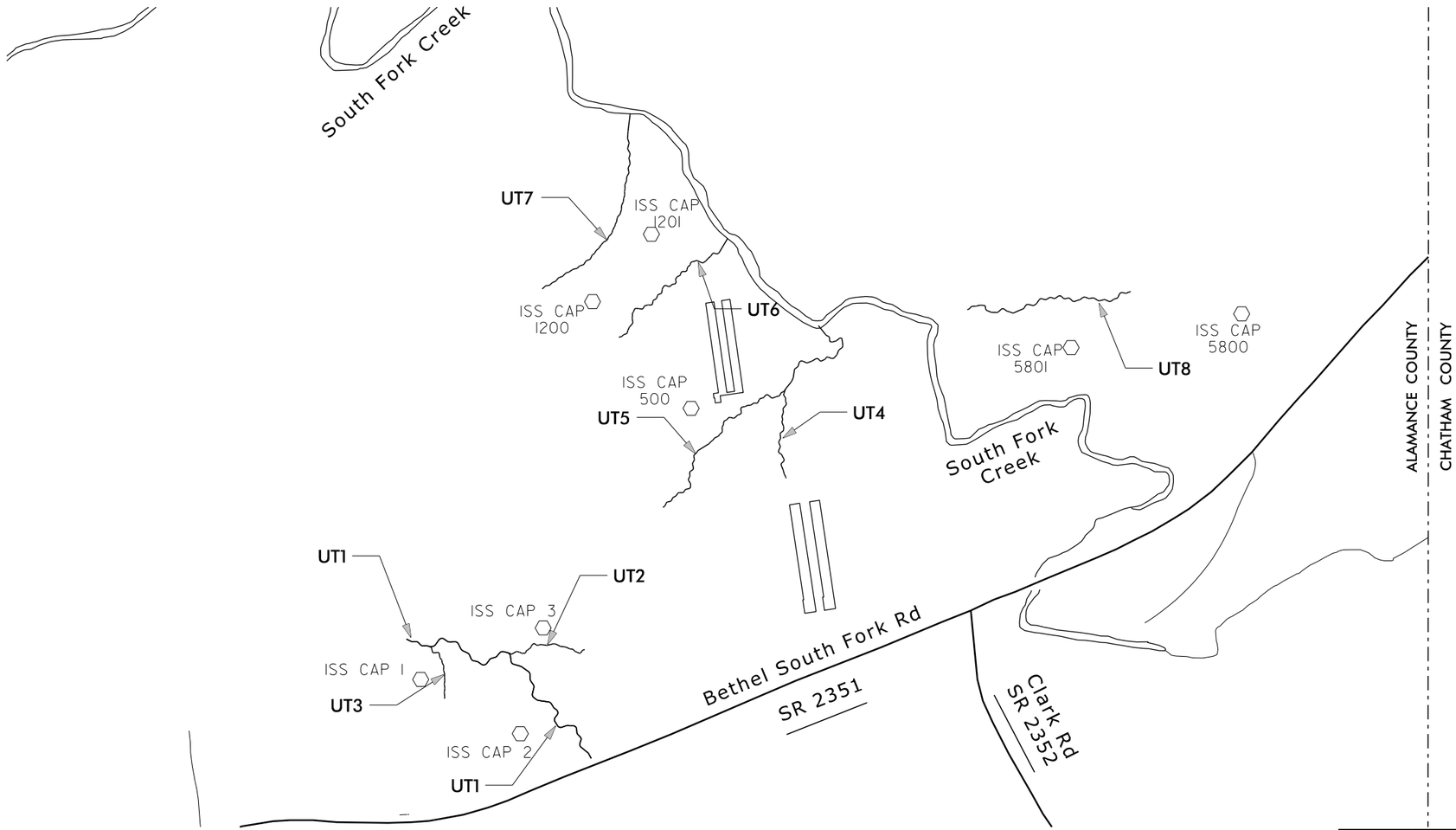
Heron_psh_02D.dgn
BSmith

SHEET NAME		SHEET NUMBER
CONTROL POINTS		3
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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

300′ 150′ 0 300′ 600′
SCALE: 1″ = 600′



Heron Control Points

Pt ##	Northing	Easting	Elevation	Type
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ISS-2	766422.000	1891276.231	552.39	ISS CAP
ISS-3	766317.450	1891759.946	547.12	ISS CAP
ISS-500	765640.240	1892765.077	533.73	ISS CAP
ISS-1200	766091.429	1893253.248	528.88	ISS CAP
ISS-1201	765822.117	1893561.790	518.40	ISS CAP
ISS-5800	763119.383	1893197.061	553.67	ISS CAP
ISS-1203	763900.423	1893043.101	536.50	ISS CAP

7/16/2018
Heron_psh_03.dgn
ESmith

SHEET NAME		SHEET NUMBER
EASEMENT		3A
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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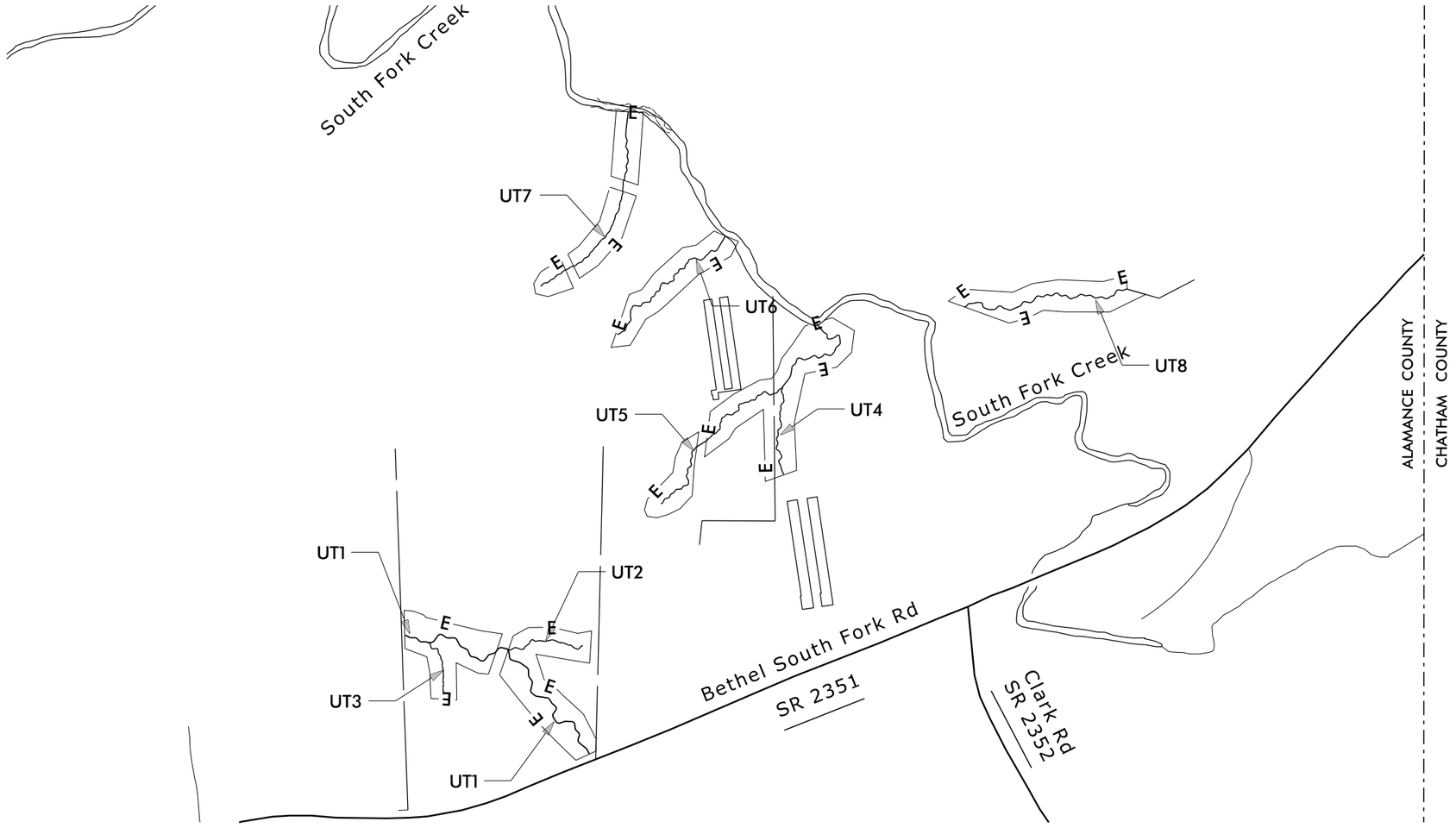
300′ 150′ 0 300′ 600′
SCALE: 1″ = 600′



7/16/2018
Heron_psh_03A.dgn
BSmith

-UT 1- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
CROSS VANE	0+22.85	0	766,108.03	1,891,183.25
CROSS VANE	1+03.86	0	766,144.65	1,891,245.34
CROSS VANE	2+11.09	0	766,204.67	1,891,313.78
LOG VANE	2+39.88	0	766,232.23	1,891,305.89
CROSS VANE	2+84.05	0	766,263.45	1,891,331.23
CROSS VANE	3+58.02	0	766,266.53	1,891,393.09
CROSS VANE	4+43.93	0	766,338.06	1,891,428.24
LOG VANE	4+70.15	0	766,360.45	1,891,441.29

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND RESTORATION

SHEET NAME		SHEET NUMBER
STRUCTURES		4
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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ENG FIRM LICENSE NO. C-890

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Joshua G. Dalton
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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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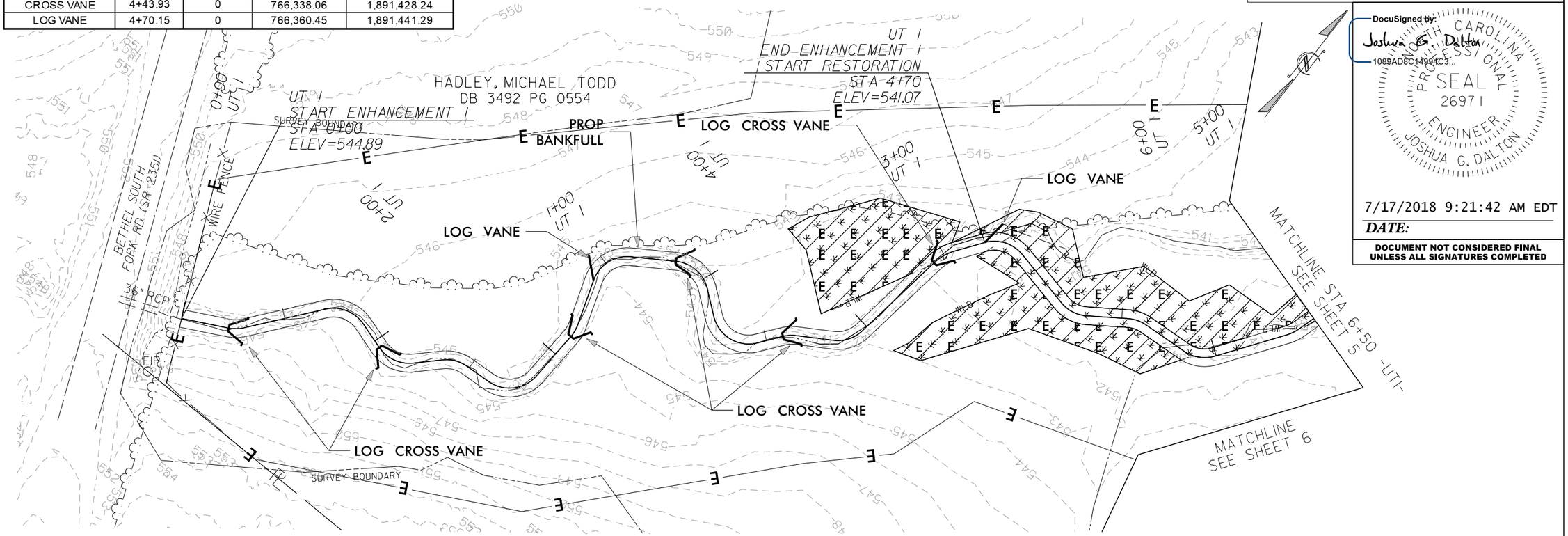
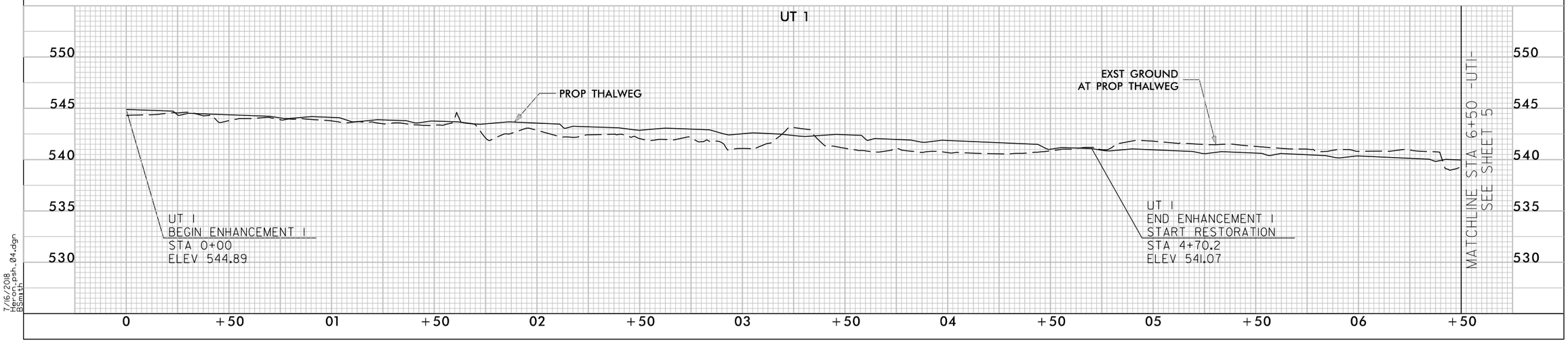


TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



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BSmith

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND RESTORATION

DENOTES MARSH TREATMENT AREA

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

-UT 1- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	6+75.34	0	766,452.31	1,891,593.76
LOG CROSS VANE	7+20.26	0	766,467.95	1,891,632.92
LOG CROSS VANE	8+58.08	0	766,576.02	1,891,597.62
LOG CROSS VANE	9+24.55	0	766,635.80	1,891,609.53
LOG CROSS VANE	10+34.12	0	766,705.60	1,891,687.27
LOG CROSS VANE	10+77.36	0	766,745.33	1,891,695.63
LOG CROSS VANE	11+07.99	0	766,772.09	1,891,709.50
LOG CROSS VANE	11+58.60	0	766,809.35	1,891,685.06
LOG CROSS VANE	12+20.05	0	766,867.09	1,891,678.42
LOG CROSS VANE	12+74.10	0	766,914.68	1,891,697.04

SHEET NAME		SHEET NUMBER
STRUCTURES		5
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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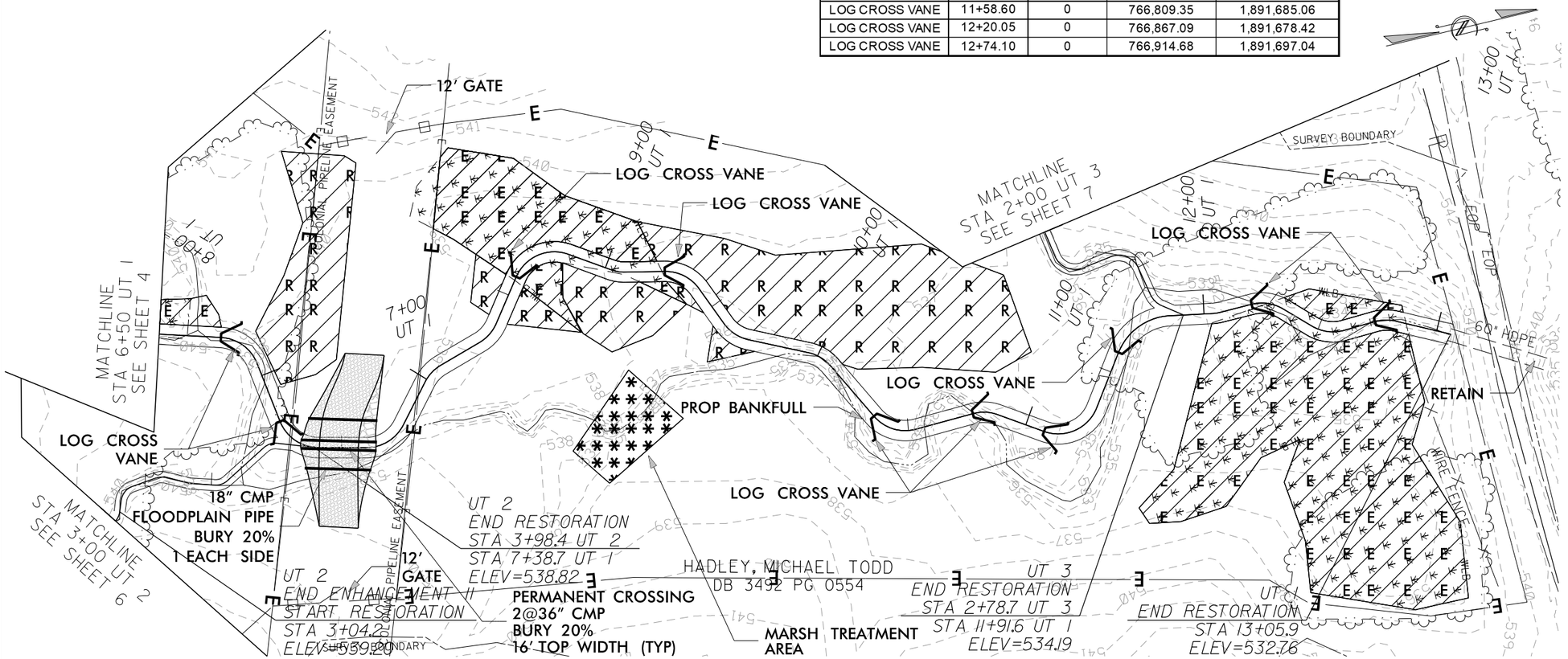
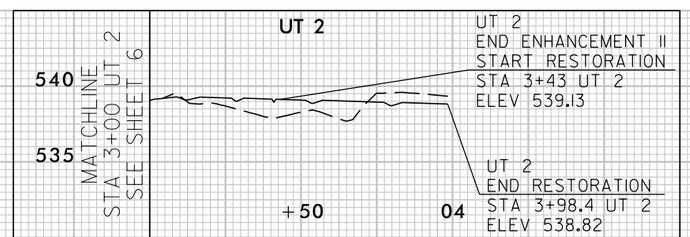
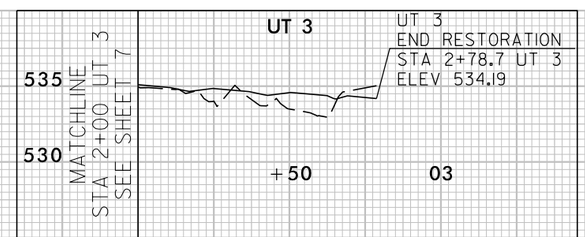
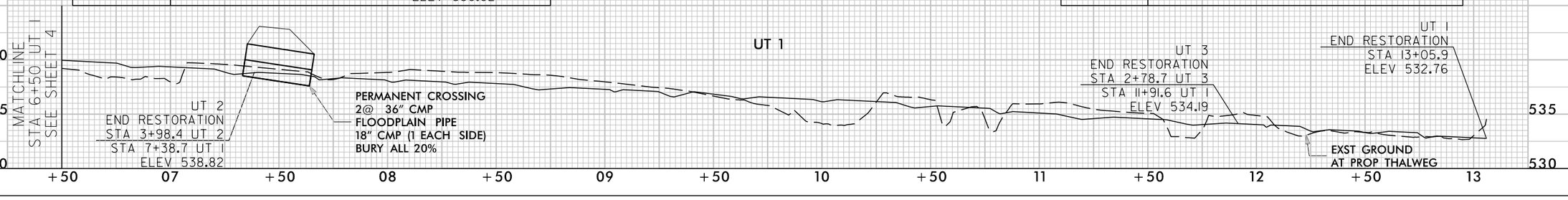


TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR







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ALL EXISTING WIRE FENCE
WITHIN EASEMENT TO BE REMOVED

SHEET NAME		SHEET NUMBER
STRUCTURES		6
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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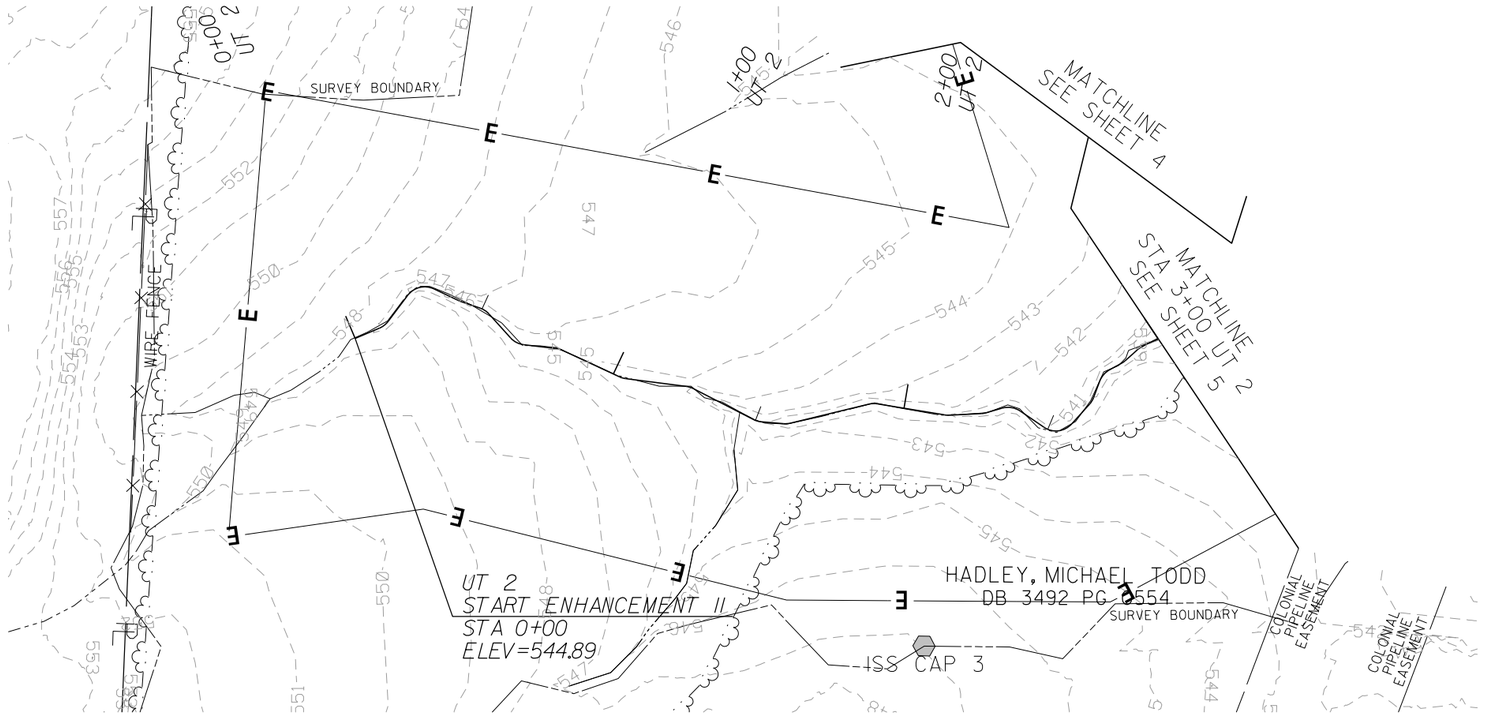
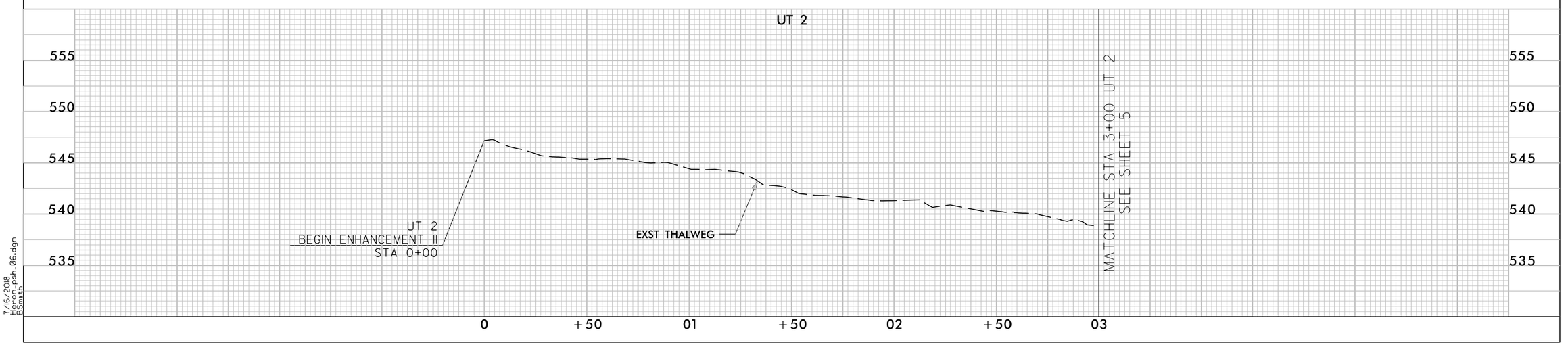


TOPOGRAHY OUTSIDE
OF SURVEY LIMITS BASED ON
NC SPATIAL DATA QL2 LIDAR



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Bsmith

SHEET NAME		SHEET NUMBER
STRUCTURES		7
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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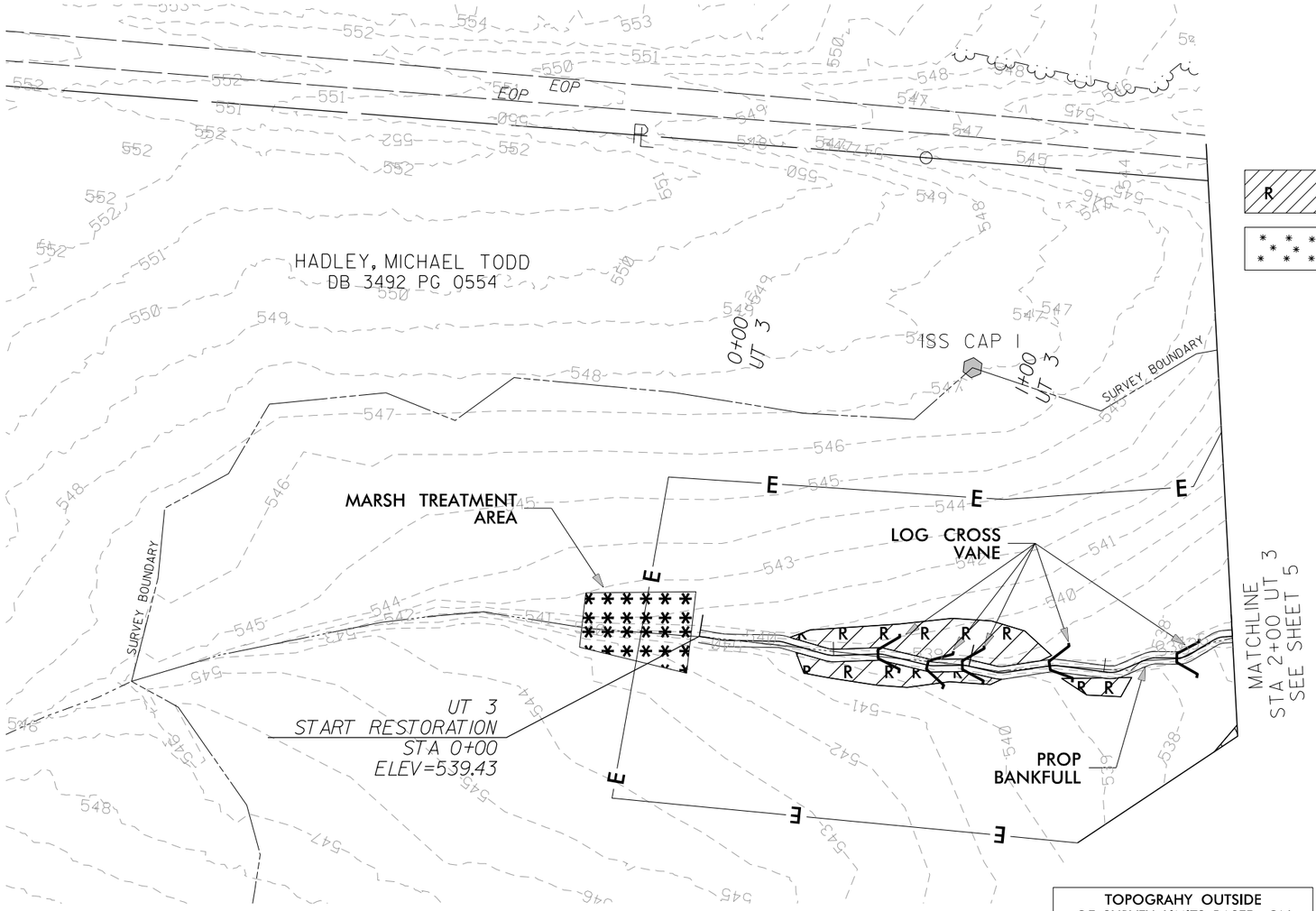

R R DENOTES WETLAND RESTORATION

DENOTES MARSH TREATMENT AREA

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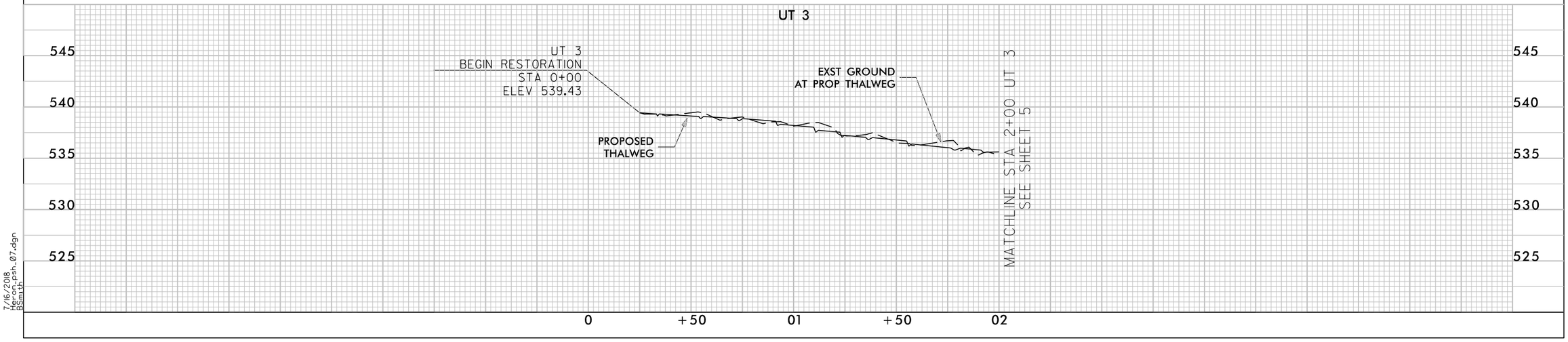
TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

-UT 3- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	0+66.23	0	766,769.98	1,891,501.82
LOG CROSS VANE	0+84.75	0	766,768.07	1,891,520.22
LOG CROSS VANE	0+97.55	0	766,769.44	1,891,532.93
LOG CROSS VANE	1+29.99	0	766,772.93	1,891,564.68
LOG CROSS VANE	1+77.71	0	766,781.03	1,891,610.62



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SHEET NAME		SHEET NUMBER
STRUCTURES		8
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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ENG FIRM LICENSE NO. C-890

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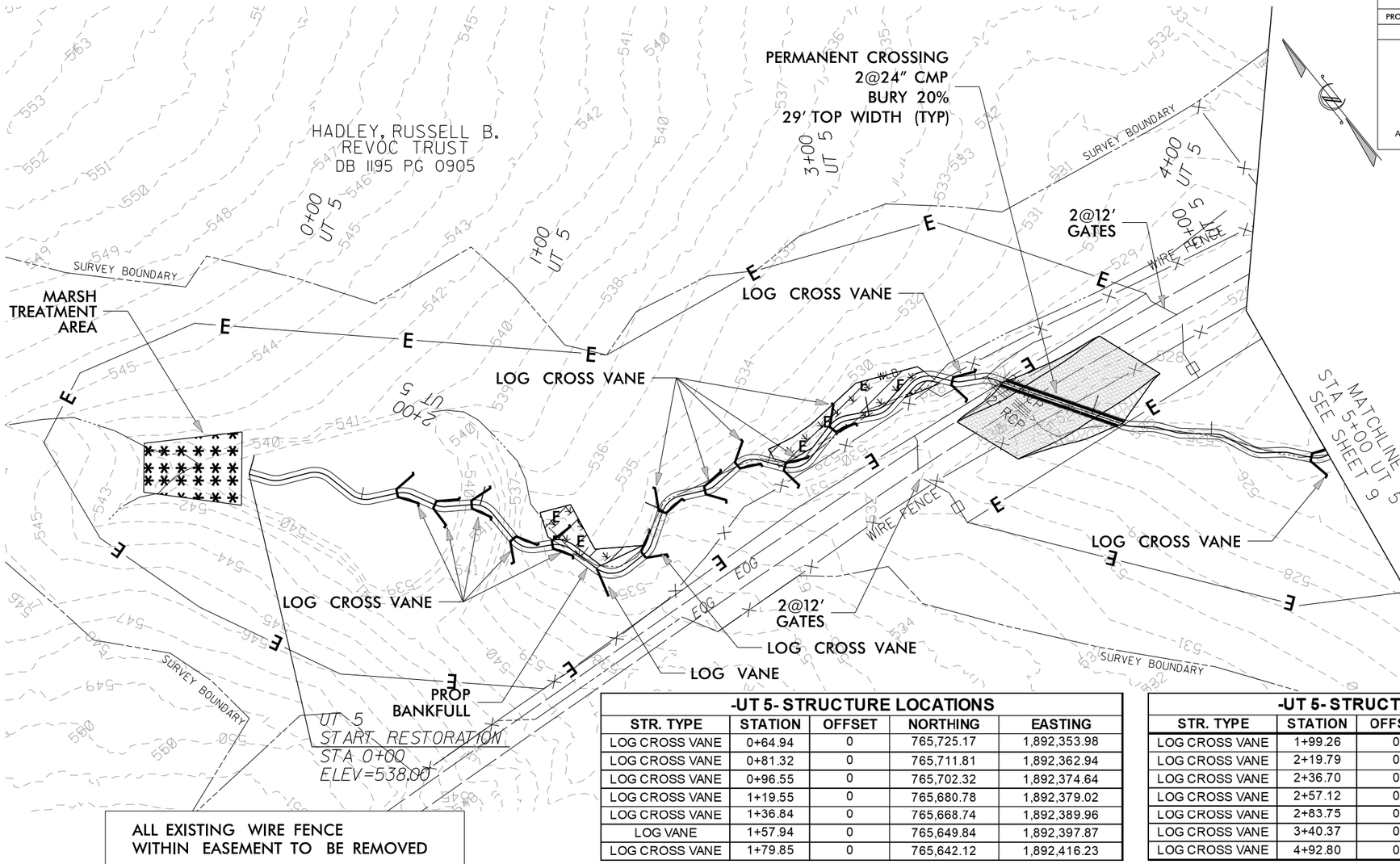


ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

E E DENOTES WETLAND ENHANCEMENT

DENOTES MARSH TREATMENT AREA

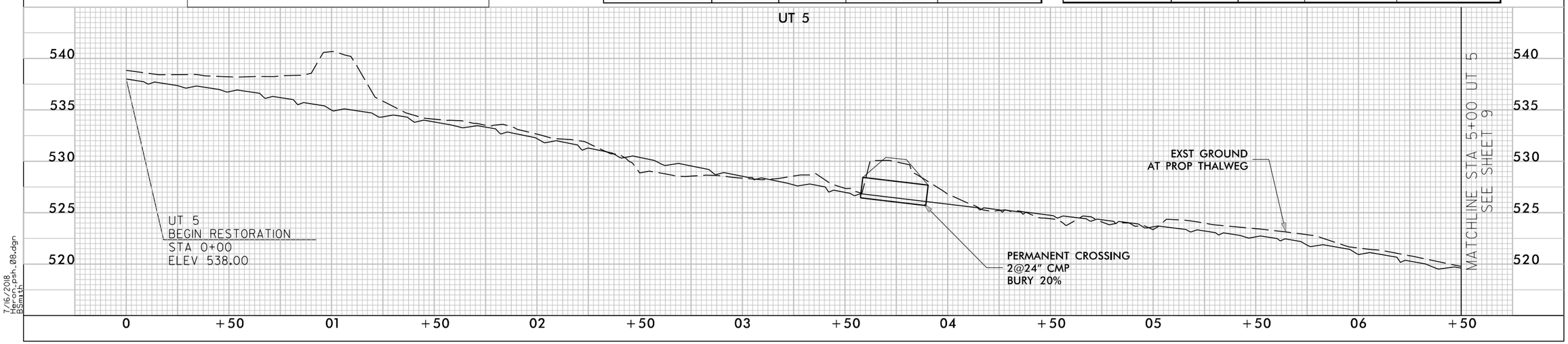
TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

-UT 5- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	0+64.94	0	765,725.17	1,892,353.98
LOG CROSS VANE	0+81.32	0	765,711.81	1,892,362.94
LOG CROSS VANE	0+96.55	0	765,702.32	1,892,374.64
LOG CROSS VANE	1+19.55	0	765,680.78	1,892,379.02
LOG CROSS VANE	1+36.84	0	765,668.74	1,892,389.96
LOG VANE	1+57.94	0	765,649.84	1,892,397.87
LOG CROSS VANE	1+79.85	0	765,642.12	1,892,416.23

-UT 5- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	1+99.26	0	765,650.83	1,892,433.31
LOG CROSS VANE	2+19.79	0	765,646.69	1,892,452.32
LOG CROSS VANE	2+36.70	0	765,646.21	1,892,469.06
LOG CROSS VANE	2+57.12	0	765,633.55	1,892,483.75
LOG CROSS VANE	2+83.75	0	765,633.04	1,892,508.61
LOG CROSS VANE	3+40.37	0	765,617.53	1,892,558.98
LOG CROSS VANE	4+92.80	0	765,502.04	1,892,654.76



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BSmith

-UT 4- STRUCTURE LOCATIONS				
STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	4+18.34	0	765,207.36	1,892,798.42
LOG CROSS VANE	4+18.34	0	765,214.50	1,892,822.95

SHEET NAME		SHEET NUMBER
STRUCTURES		9
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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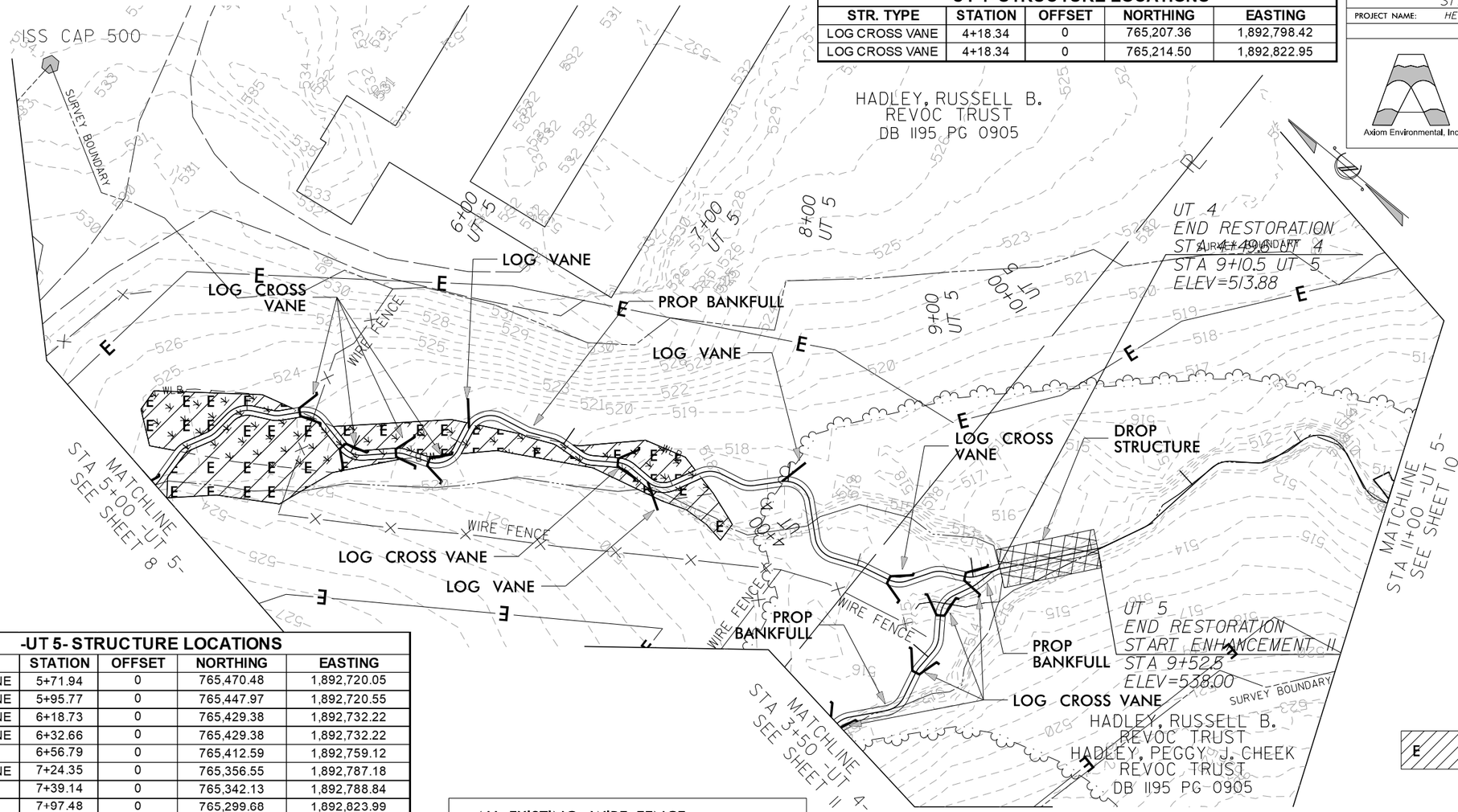
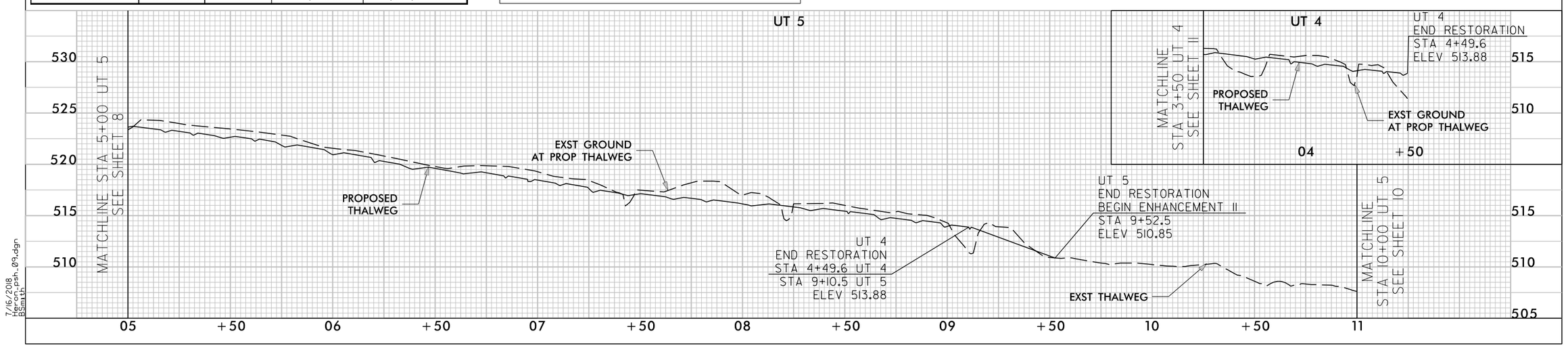


-UT 5- STRUCTURE LOCATIONS				
STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	5+71.94	0	765,470.48	1,892,720.05
LOG CROSS VANE	5+95.77	0	765,447.97	1,892,720.55
LOG CROSS VANE	6+18.73	0	765,429.38	1,892,732.22
LOG CROSS VANE	6+32.66	0	765,429.38	1,892,732.22
LOG VANE	6+56.79	0	765,412.59	1,892,759.12
LOG CROSS VANE	7+24.35	0	765,356.55	1,892,787.18
LOG VANE	7+39.14	0	765,342.13	1,892,788.84
LOG VANE	7+97.48	0	765,299.68	1,892,823.99
LOG CROSS VANE	8+64.24	0	765,240.24	1,892,820.73
LOG CROSS VANE	8+96.66	0	765,216.88	1,892,841.67

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

E E DENOTES WETLAND ENHANCEMENT

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



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BSmith

ALL EXISTING WIRE FENCE
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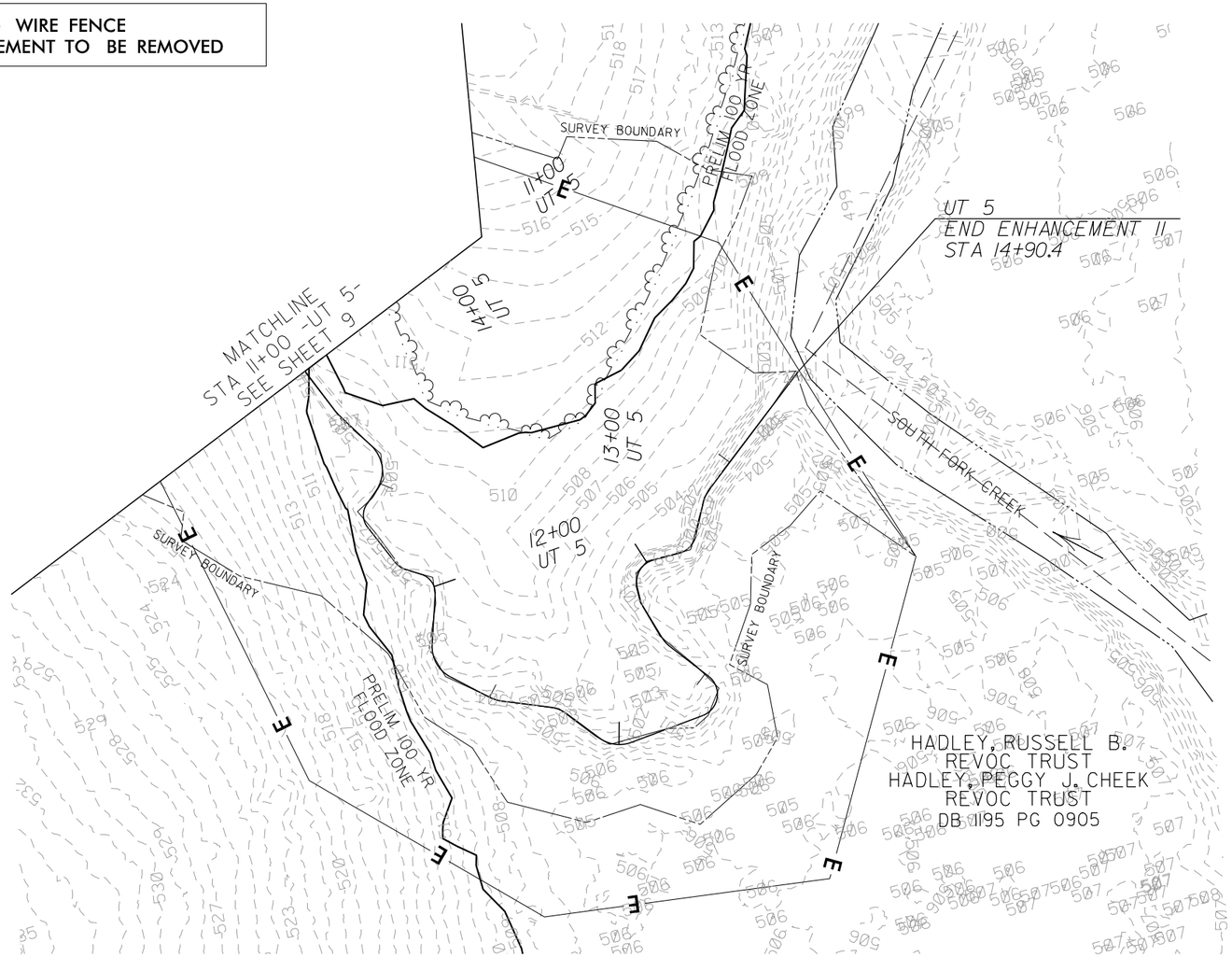
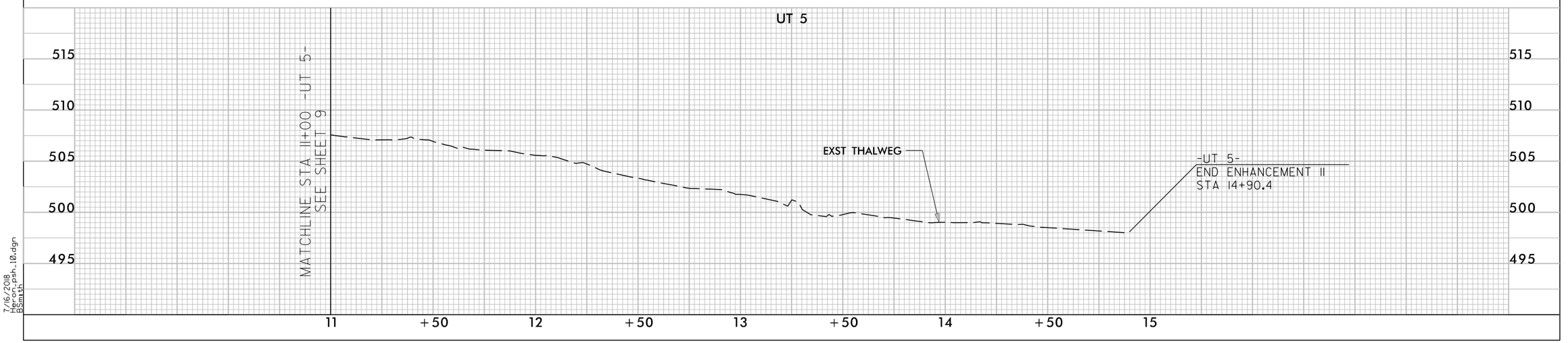


TOPOGRAHY OUTSIDE
OF SURVEY LIMITS BASED ON
NC SPATIAL DATA QL2 LIDAR



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Heron_psh_10.dgn
BSmith

SHEET NAME		SHEET NUMBER
STRUCTURES		10
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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SHEET NAME		SHEET NUMBER
STRUCTURES		11
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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905 JONES FRANKLIN ROAD
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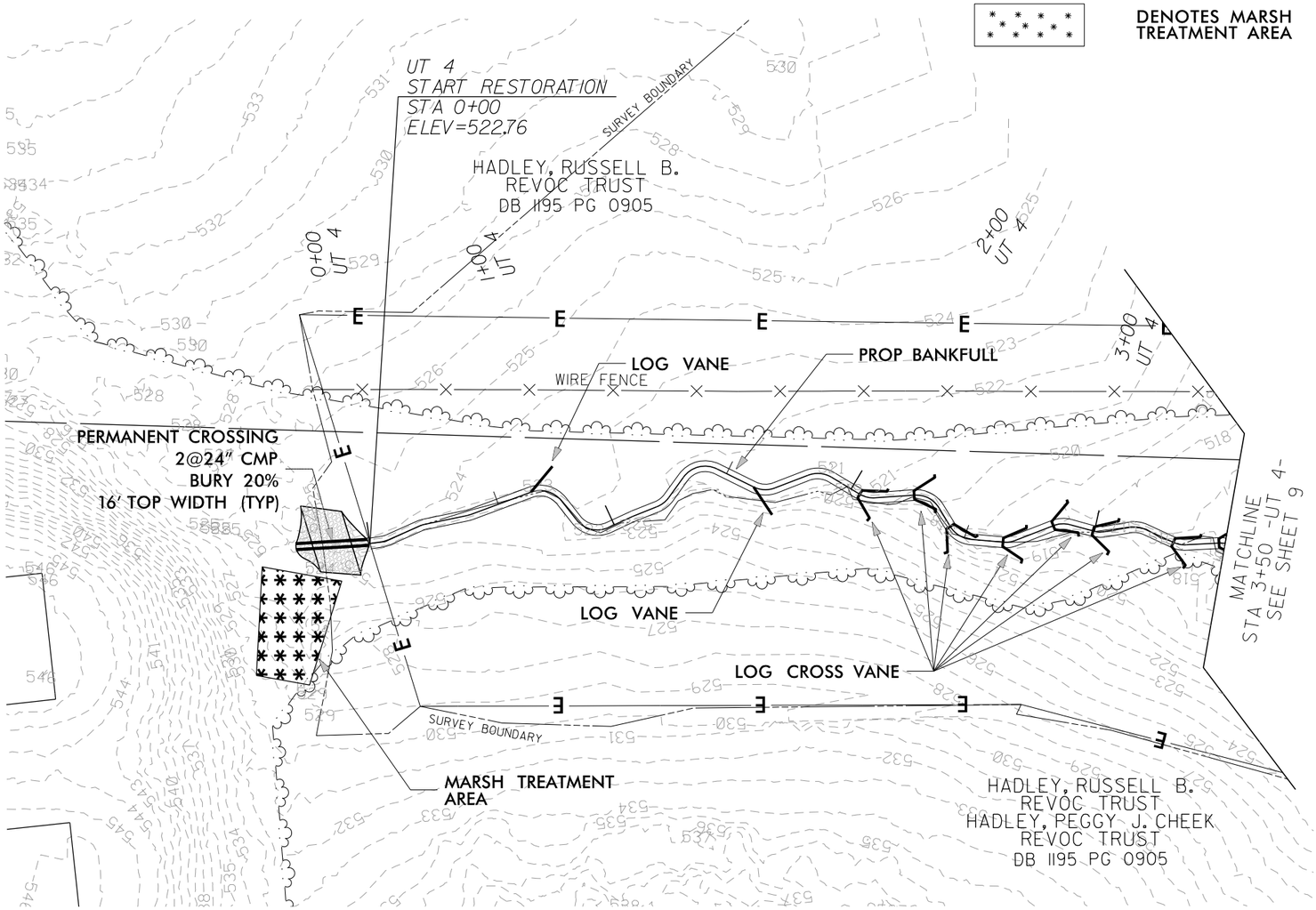

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

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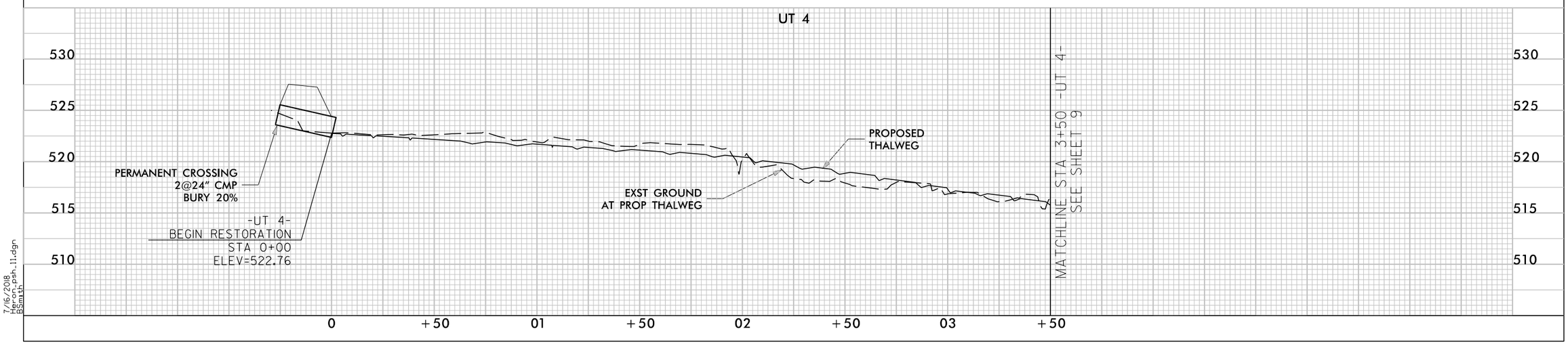
ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

-UT 4- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG VANE	0+62.88	0	765,227.40	1,892,503.65
LOG VANE	1+61.16	0	765,232.78	1,892,586.08
LOG CROSS VANE	2+03.78	0	765,231.74	1,892,625.59
LOG CROSS VANE	2+24.21	0	765,232.22	1,892,645.73
LOG CROSS VANE	2+43.20	0	765,221.14	1,892,659.61
LOG CROSS VANE	2+64.53	0	765,216.10	1,892,679.41
LOG CROSS VANE	2+84.31	0	765,223.04	1,892,697.79
LOG CROSS VANE	2+99.49	0	765,221.66	1,892,712.61
LOG CROSS VANE	3+30.63	0	765,218.66	1,892,742.54
LOG CROSS VANE	3+47.73	0	765,219.10	1,892,759.48



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SHEET NAME		SHEET NUMBER
STRUCTURES		12
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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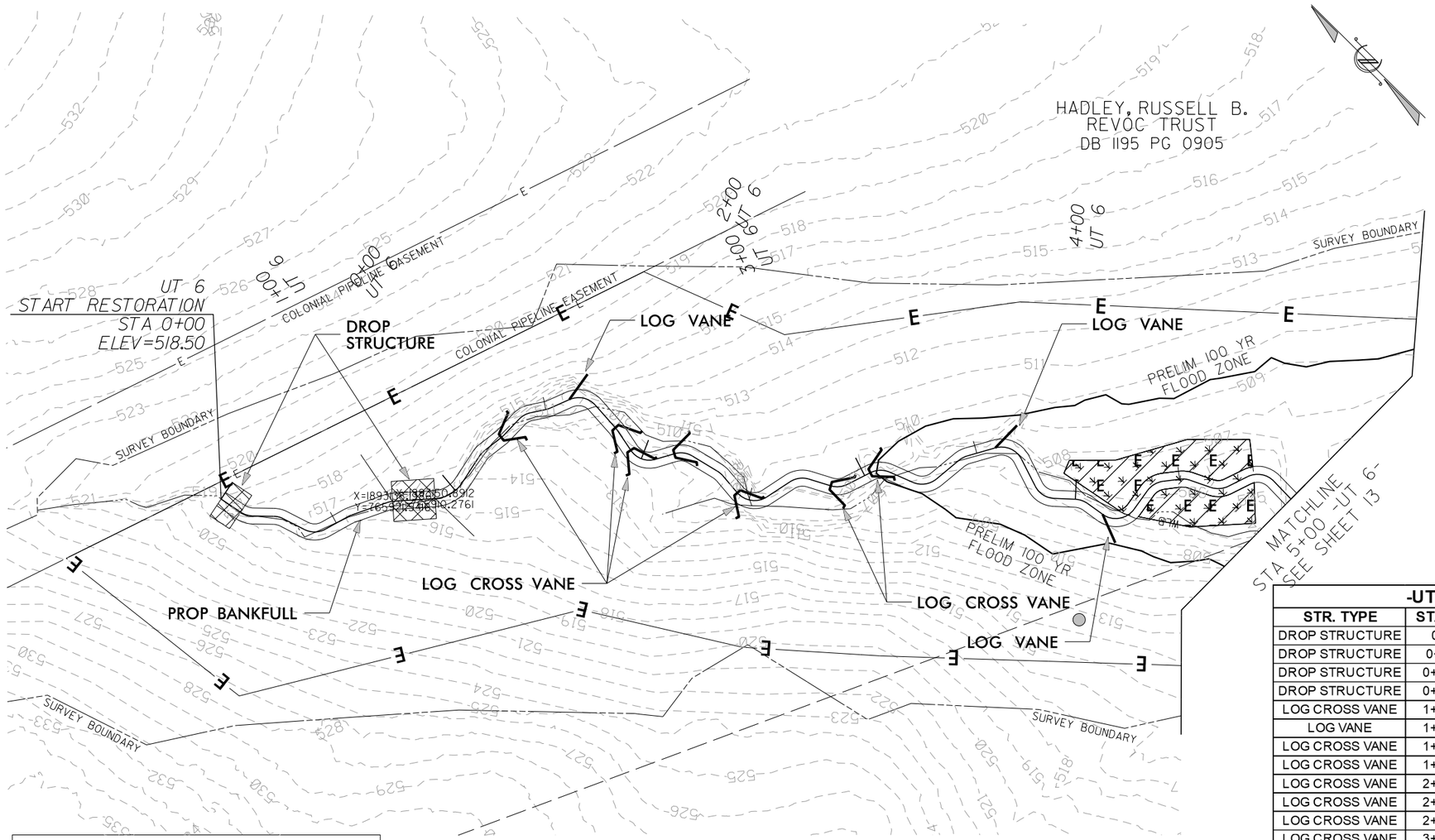
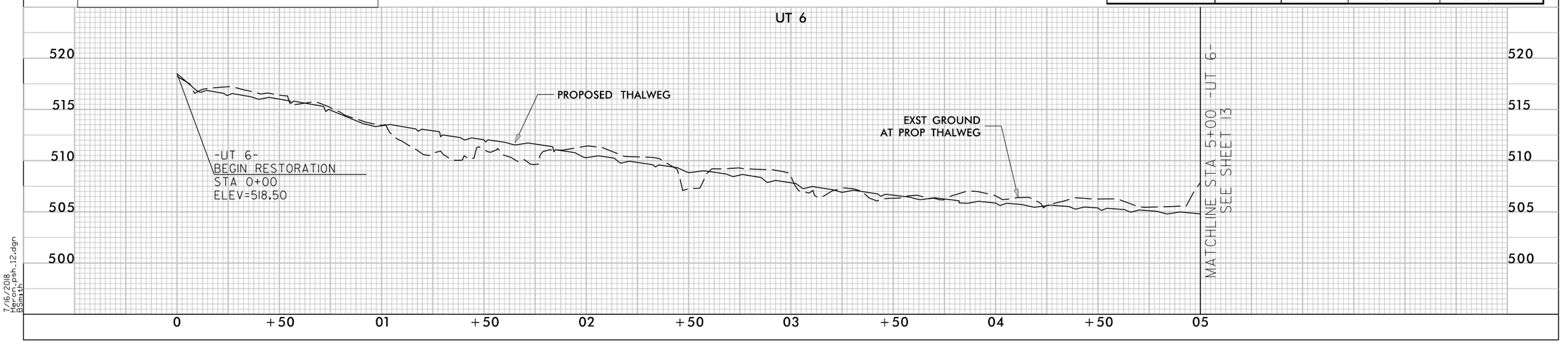


TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

-UT 6- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
DROP STRUCTURE	0+00	0	765,970.74	1,893,090.66
DROP STRUCTURE	0+9.35	0	765,961.56	1,893,092.44
DROP STRUCTURE	0+74.13	0	765,921.54	1,893,138.14
DROP STRUCTURE	0+91.15	0	765,910.28	1,893,150.89
LOG CROSS VANE	1+28.33	0	765,908.72	1,893,186.84
LOG VANE	1+60.17	0	765,900.12	1,893,216.59
LOG CROSS VANE	1+83.60	0	765,879.15	1,893,221.59
LOG CROSS VANE	1+94.44	0	765,868.51	1,893,219.52
LOG CROSS VANE	2+13.55	0	765,855.16	1,893,230.78
LOG CROSS VANE	2+44.45	0	765,826.36	1,893,237.45
LOG CROSS VANE	2+85.45	0	765,801.85	1,893,265.67
LOG CROSS VANE	3+02.49	0	765,794.35	1,893,280.45
LOG VANE	3+57.68	0	765,765.93	1,893,322.62
LOG VANE	4+12.57	0	765,716.91	1,893,333.92



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SHEET NAME		SHEET NUMBER
STRUCTURES		13
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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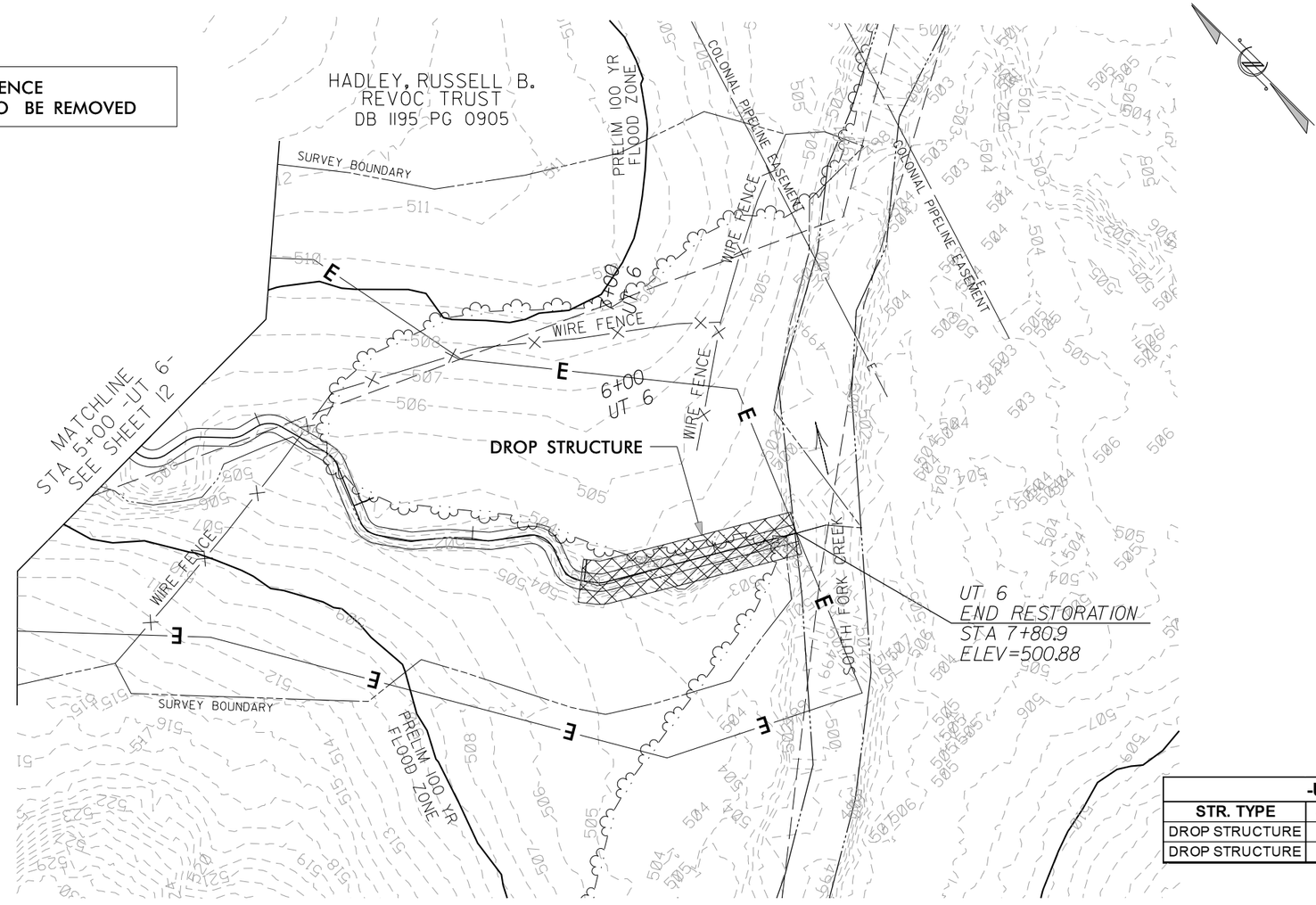
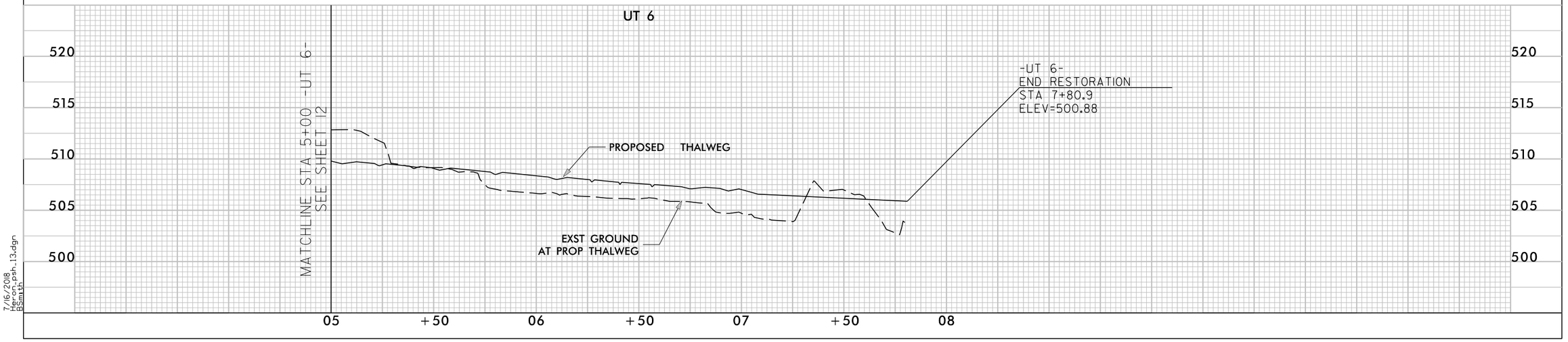


-UT 6- STRUCTURE LOCATIONS				
STR. TYPE	STATION	OFFSET	NORTHING	EASTING
DROP STRUCTURE	6+98.76	0	765,517.13	1,893,473.41
DROP STRUCTURE	7+80.86	0	765,472.94	1,893,542.07

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



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BSmith

SHEET NAME		SHEET NUMBER
STRUCTURES		14
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND RESTORATION

DENOTES MARSH TREATMENT AREA

HADLEY, RUSSELL B.
REVOC TRUST
DB 1195 PG 0905

0+00 UT 7

1+00 UT 7

2+00 UT 7

3+00 UT 7

4+00 UT 7

MARSH TREATMENT AREA

SURVEY BOUNDARY

LOG CROSS VANE
12' GATE

PERMANENT CROSSING
2@24" CMP
BURY 20%
16' TOP WIDTH (TYP)

LOG CROSS VANE

SURVEY BOUNDARY

MATCHLINE STA 5+00 -UT 7-
SEE SHEET 15

UT 7
START ENHANCEMENT I
STA 0+00
ELEV=525.74

SURVEY BOUNDARY

LOG CROSS VANE

PROP BANKFULL

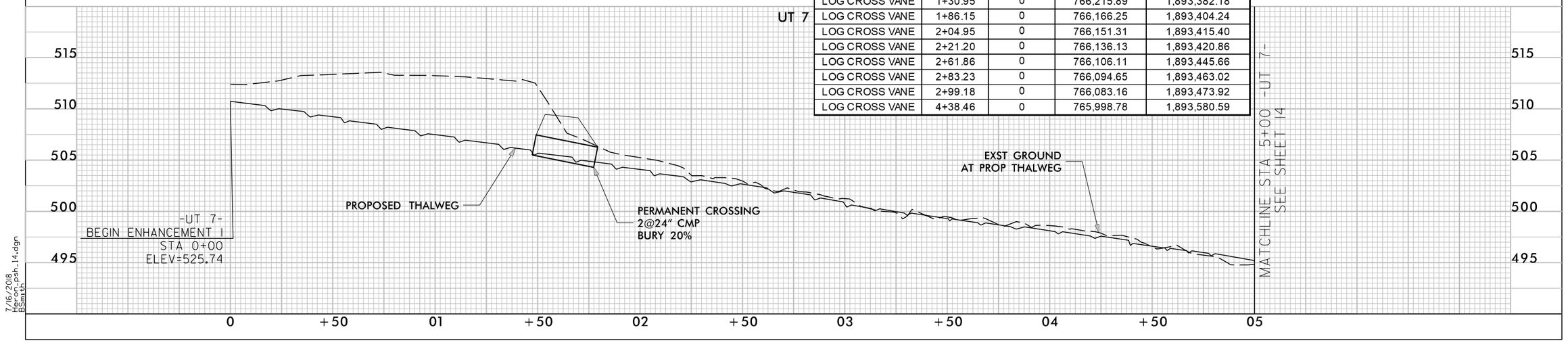
SURVEY BOUNDARY

12' GATE

-UT 7- STRUCTURE LOCATIONS				
STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	0+16.88	0	766,309.23	1,893,323.09
LOG CROSS VANE	0+35.91	0	766,291.10	1,893,327.79
LOG CROSS VANE	0+53.93	0	766,277.19	1,893,338.69
LOG CROSS VANE	0+71.37	0	766,261.60	1,893,346.33
LOG CROSS VANE	0+90.17	0	766,249.02	1,893,360.07
LOG CROSS VANE	1+09.38	0	766,231.68	1,893,367.73
LOG CROSS VANE	1+30.95	0	766,215.89	1,893,382.18
LOG CROSS VANE	1+86.15	0	766,166.25	1,893,404.24
LOG CROSS VANE	2+04.95	0	766,151.31	1,893,415.40
LOG CROSS VANE	2+21.20	0	766,136.13	1,893,420.86
LOG CROSS VANE	2+61.86	0	766,106.11	1,893,445.66
LOG CROSS VANE	2+83.23	0	766,094.65	1,893,463.02
LOG CROSS VANE	2+99.18	0	766,083.16	1,893,473.92
LOG CROSS VANE	4+38.46	0	765,998.78	1,893,580.59

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

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



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SHEET NAME		SHEET NUMBER
STRUCTURES		15
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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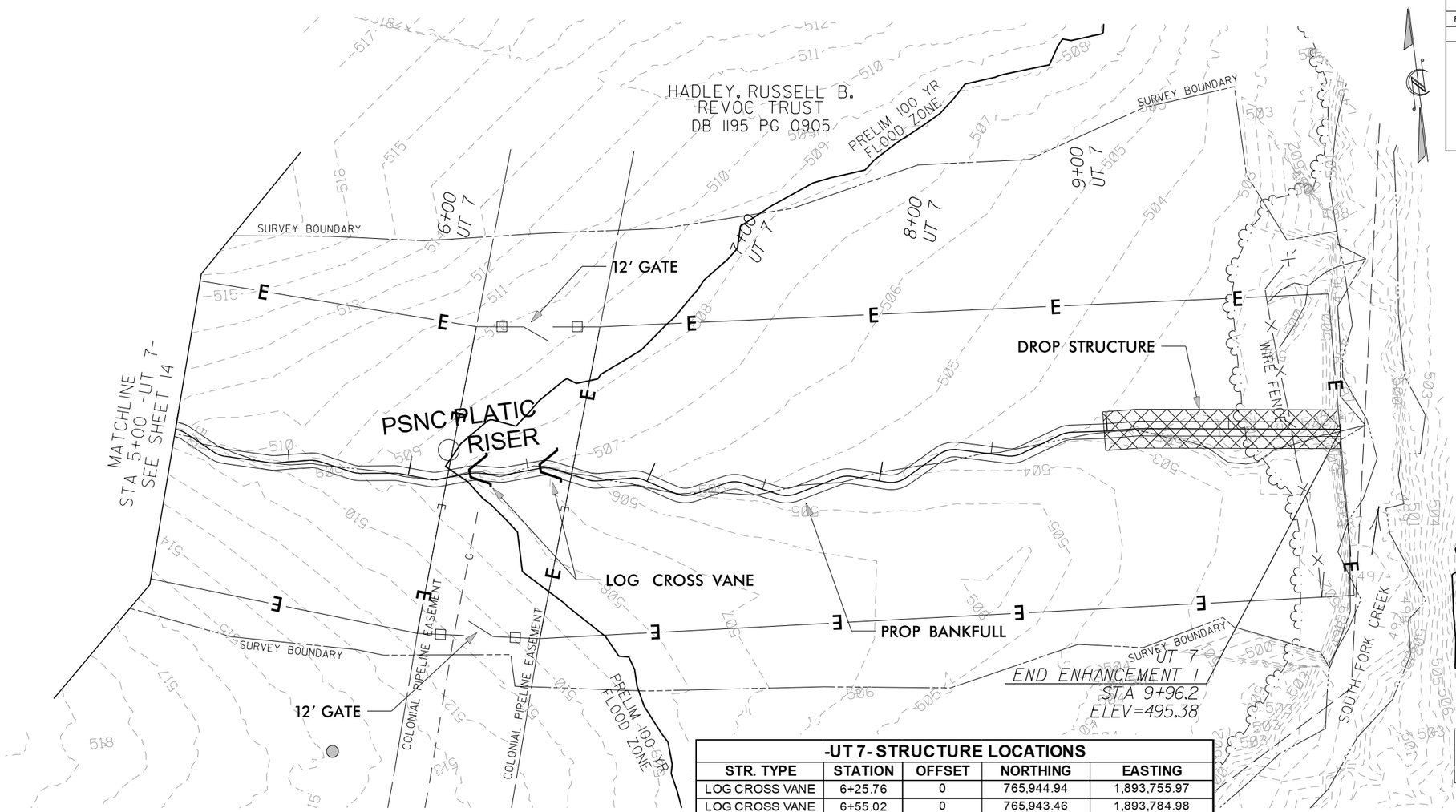
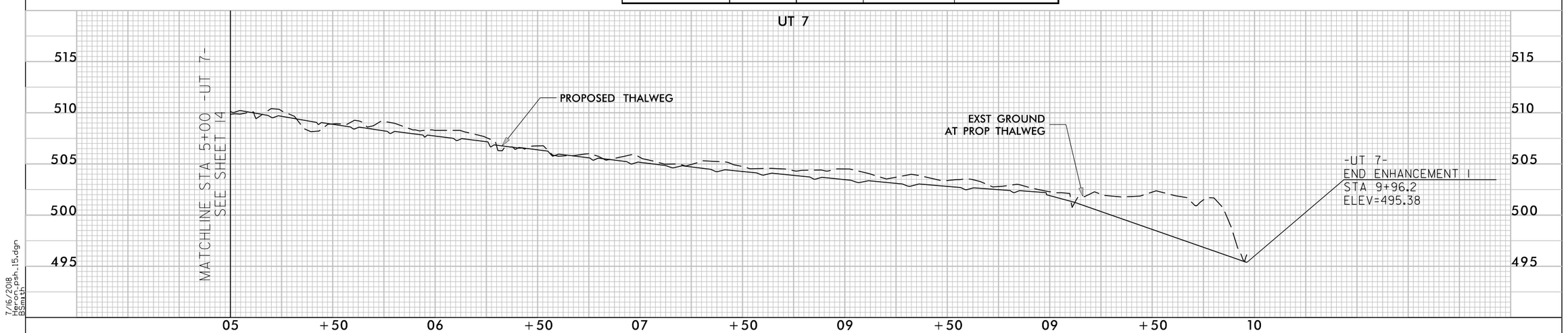


-UT 7- STRUCTURE LOCATIONS				
STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG CROSS VANE	6+25.76	0	765,944.94	1,893,755.97
LOG CROSS VANE	6+55.02	0	765,943.46	1,893,784.98
DROP STRUCTURE	8+98.72	0	765,929.93	1,894,017.21
DROP STRUCTURE	9+96.21	0	765,918.69	1,894,114.01

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

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



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SHEET NAME		SHEET NUMBER
STRUCTURES		16
PROJECT NAME:	HERON STREAM AND WETLAND RESTORATION SITE	
	COUNTY: ALAMANCE	DATE: 2018

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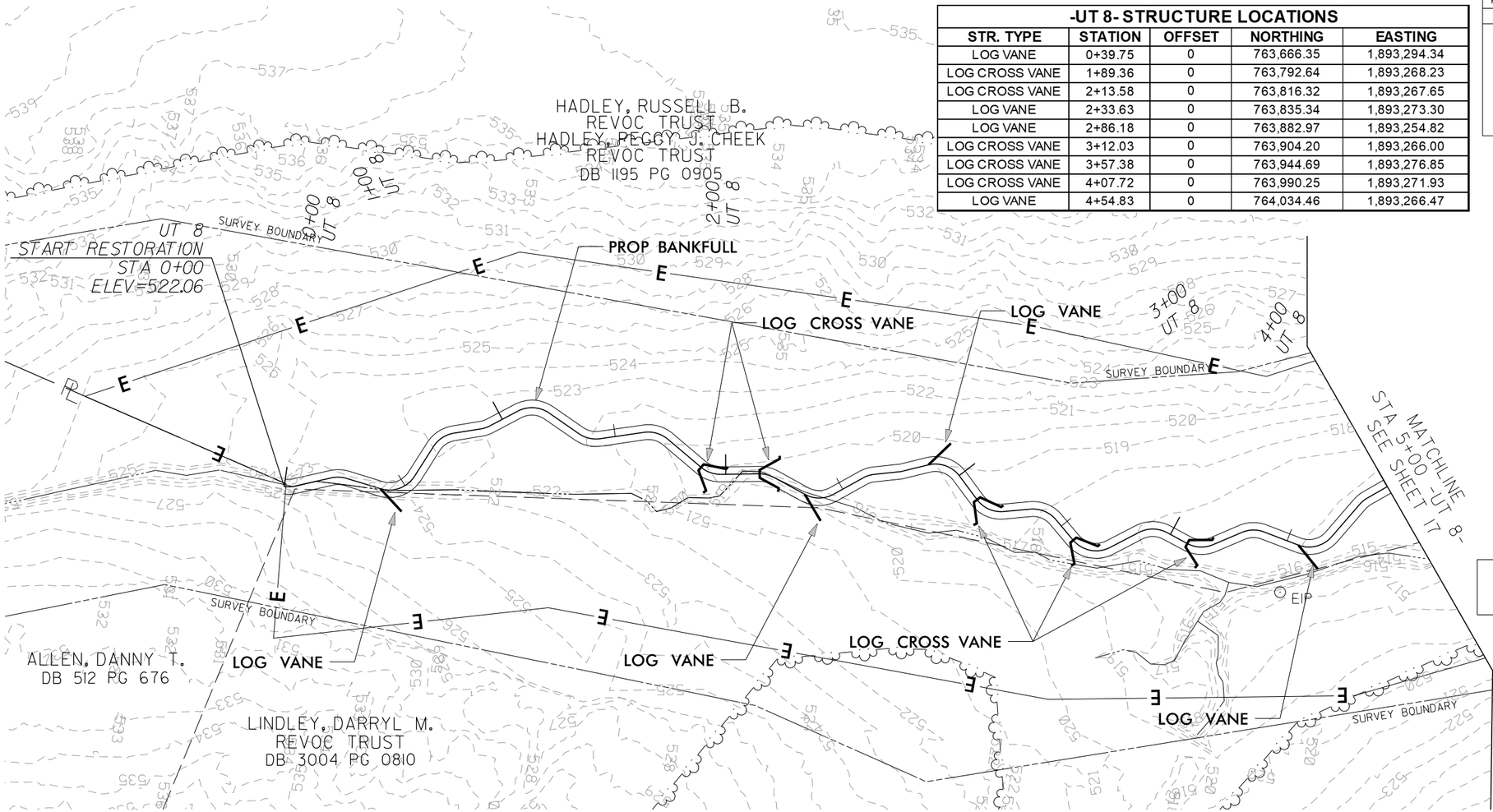
-UT 8- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
LOG VANE	0+39.75	0	763,666.35	1,893,294.34
LOG CROSS VANE	1+89.36	0	763,792.64	1,893,268.23
LOG CROSS VANE	2+13.58	0	763,816.32	1,893,267.65
LOG VANE	2+33.63	0	763,835.34	1,893,273.30
LOG VANE	2+86.18	0	763,882.97	1,893,254.82
LOG CROSS VANE	3+12.03	0	763,904.20	1,893,266.00
LOG CROSS VANE	3+57.38	0	763,944.69	1,893,276.85
LOG CROSS VANE	4+07.72	0	763,990.25	1,893,271.93
LOG VANE	4+54.83	0	764,034.46	1,893,266.47



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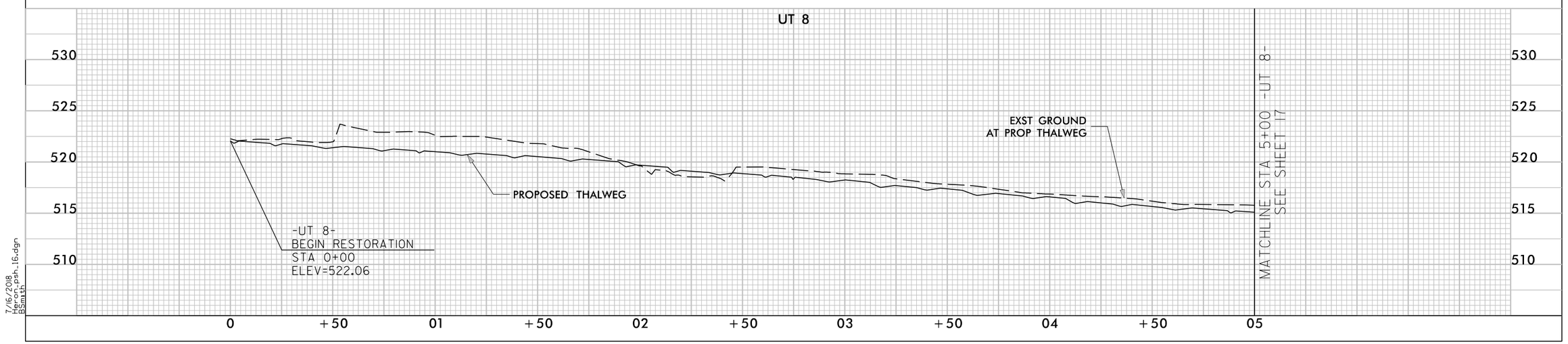
TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR



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SHEET NAME		SHEET NUMBER
STRUCTURES		17
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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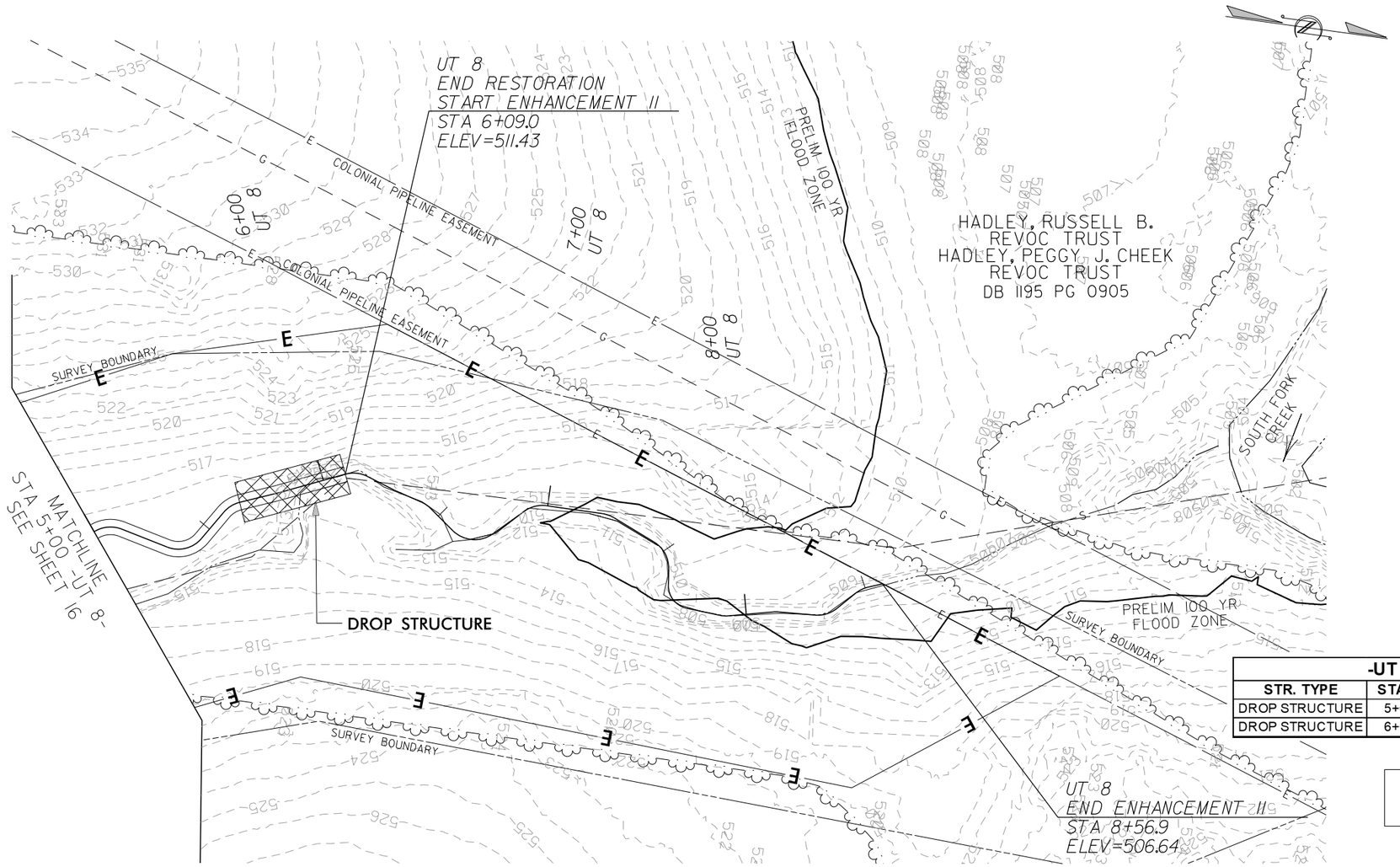
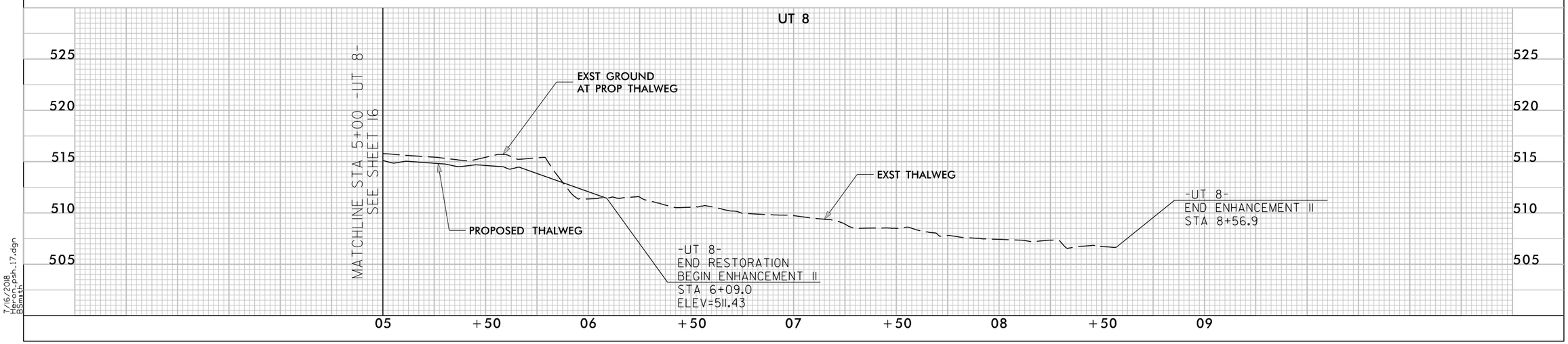


-UT 8- STRUCTURE LOCATIONS

STR. TYPE	STATION	OFFSET	NORTHING	EASTING
DROP STRUCTURE	5+66.15	0	764,121.60	1,893,219.14
DROP STRUCTURE	6+09.00	0	764,161.11	1,893,202.56

ALL EXISTING WIRE FENCE WITHIN EASEMENT TO BE REMOVED

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



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SHEET NAME	SHEET NUMBER
EROSION CONTROL	E-2
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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EROSION CONTROL NOTES

CONSTRUCTION SEQUENCE

Construction Notes:

1. Staging areas, stockpile areas, construction entrances and access roads will be identified and located according to the Erosion Control Plans and landowner agreements. Variances will be allowed assuming both the Contractor and Designer verbally agree.

2. A construction entrance (as shown on the Erosion Control Plans) from Secondary Road 2351 (Bethel South Fork Road) will be installed for access to the UT1, UT2, UT3, UT4, UT5, UT6, and UT7 as shown on the Erosion Control Plans. An additional construction entrance from Secondary Road 2351 (Bethel South Fork Road) will be installed for access to UT8.

3. The Contractor will install silt fencing, as noted on the Erosion Control Plans, at applicable staging and stockpile areas.

4. The proposed stream alignment and structure locations will be staked for each reach (UT1, UT2, UT3, UT4, UT5, UT6, UT7, and UT8). Staking will be restricted to riffle elevations only in order to establish and maintain grade for the entire system. Pools will be excavated once structures are installed.

5. The Contractor will begin stockpiling materials in a designated staging area. General details associated with all sections include:

    a. Sediment bags will be used to filter the groundwater and placed within areas of newly excavated channel that are offline from the existing flow. These bags will be utilized as the contractor or designer deem necessary.
    b. Temporary and permanent seed mixes, including applicable mulching, will be applied to the streambanks and disturbed areas at the end of each working day as definable sections are completed. Erosion control matting will be installed on top of the seed and straw in accordance with the Erosion Control Construction Sequence.
    c. Excavated material that is stockpiled will follow erosion and sediment control guidelines as they relate to material storage and stockpiling.
    d. All remaining disturbed areas are to be seeded and covered according to the Erosion Control Construction Sequence.
    e. Riprap aprons will be constructed to impede any erosion of the channel and streambanks by the water diverted from the pump-around procedure.

7. Boulders and materials used for stream structures will be delivered through the primary construction entrance and stockpiled in the appropriate area.

8. This project will require pumping water around the channels during construction. Work will generally proceed from upstream to downstream.

9. Adjust haul roads and associated silt fence as necessary when permanent stream crossings are installed.

Construction Sequence

1. The Contractor will excavate the proposed channel and modify portions of the existing channel based on riffle elevations in sections no greater than 300’ in length at a time (except where longer sections are necessary to maintain constructability) in an upstream to downstream fashion. Impervious dikes will be installed upstream and downstream of the current work section before work on the section is initiated unless noted otherwise (see Table 1 on sheet E-2A for suggested work section stations and progression). Water will be diverted around the current work section through the use of a pump and temporary flexible hose. The current work section will be dewatered using an additional pump and a sediment bag. Work sections that involve the construction of a confluence of two reaches may require the use of two pump-around operations. Structures will be installed according to the details presented in the Construction Plans. Excavate only a portion of the channel that can be completed and stabilized within the same day. All excavated material will be placed in an appropriate stockpile area. Pools will be established once structures and channel alignments have been completed locally. Permanent stream crossings will be installed while the working section containing the crossing has been dewatered.

   Grading of some portions of the proposed floodplain may need to be delayed until after work in subsequent sections has been completed, especially near confluences. Haul roads and temporary silt fence may also need to be removed before the proposed floodplain can be completed and/or unused existing channel can be filled.

EROSION CONTROL NOTES

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E-2A
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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CONSTRUCTION SEQUENCE (CONTINUED)

Table 1. - Working Sections

Order of Progress	Pump Station #	Reach	Begin Station	End Station	Construction Notes
1	P-1	**UT1**	0+00	2+29	
2	P-2	**UT1**	2+29	4+36	
3	P-3	**UT1**	4+36	7+04	Fill exst. channel between impervious dikes.
4	P-4	**UT1**	7+04	7+73	Operate pump stations P-4 and P-5 simultaneously to build confluence of UT1 and UT2, permanent crossing. Fill exst. channel between impervious dikes.
	P-5	**UT2**	3+04 (UT2)	7+73 (UT1)	
5	P-6	**UT1**	7+73	10+11	Fill exst. channel between impervious dikes.
6	P-7	**UT1**	10+11	11+69	Fill exst. channel between impervious dikes.
7	P-8	**UT3**	0+00	2+59	
8	P-9	**UT1**	11+69	13+06	Operate pump stations P-9 and P-10 simultaneously to build confluence of UT1 and UT3. Fill exst. channel between impervious dikes.
	P-10	**UT3**	2+59 (UT3)	11+06 (UT1)	
9	P-11	**UT5**	0+00	2+31	Dewater pond before installing downstream impervious dike. Do not rely solely on DTM/TIN model for constructing proposed channel through existing pond. Field adjustments will be necessary and shall be approved by engineer or designer.
10	P-12	**UT5**	2+31	4+89	Install permanent crossing.
11	P-13	**UT5**	4+89	7+39	Fill exst. channel between impervious dikes.
12	P-14	**UT4**	U/S of crossing	2+59	Install permanent crossing.
13	P-15	**UT4**	2+59	3+67	
14	P-16	**UT4**	3+67	9+53	Operate pump stations P-16 and P-17 simultaneously to build confluence of UT4 and UT5. Fill exst. channel
	P-17	**UT5**	7+39	9+53	
15	P-18	**UT6**	0+00	3+14	
16	P-19	**UT6**	3+14	5+68	
17	P-20	**UT6**	5+68	7+81	
18	P-21	**UT7**	0+00	1+98	
19	P-22	**UT7**	1+98	4+74	
20	P-23	**UT7**	4+74	7+28	
21	P-24	**UT7**	7+28	9+96	
22	P-25	**UT8**	0+00	2+29	
23	P-26	**UT8**	2+29	6+09	Fill exst. channel between impervious dikes.

2. Ponds shall be dewatered prior to dam removal using the following methods:

   -For ponds with an outlet structure, open the outlet structure to dewater the pond at a rate that does not cause excessive erosion downstream of the dam.

   -For ponds without an outlet structure or that require supplemental drawdown, use a pump and temporary flexible hose to dewater the pond into the downstream channel. A rip rap dissipation pad shall be used at the outlet of the temporary flexible hose. Dewater at a rate that does not cause excessive erosion downstream of the discharge point.

3. At the end of each working day, the Contractor will be responsible for the application of seed and straw, as applicable, to newly established streambanks and disturbed areas. Erosion control matting will be installed on top of the seed and straw in accordance with the Erosion Control Construction Sequence.

Post-Construction

After all channel work has been completed:

1. All remaining disturbed areas are to be seeded and mulched in accordance with the Erosion Control Construction Sequence.

2. Live staking can begin on all completed sections of channel (UT1, UT2, UT3, UT4, UT5, UT6, UT7, and UT8) in accordance with the Planting Plans.

3. Once channel construction and seeding has been complete, bare-rooted seedlings will be installed.

EROSION CONTROL NOTES

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E-2B
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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EROSION CONTROL CONSTRUCTION SEQUENCE

1) Obtain grading permit.
2) Install temporary construction entrances, silt fencing, access roads, and other measures shown on the approved erosion and sedimentation control plan.
3) Install rain gage on site. Contractor shall provide a log book at the project site and shall read and record rain amounts at the same time each day.
4) Contact local Soil Erosion Authority or State for on-site inspection by Environmental Inspector and obtain certificate of compliance.
5) Begin clearing - maintain devices as necessary.
6) Begin channel construction - stockpile waste material in designated spoil areas and surround with silt fencing.
7) Temporary or permanent ground cover stabilization shall occur within 7 calendar days from the last land-disturbing activity, with the following exceptions in which temporary or permanent ground cover shall be provided within 14 calendar days from the last land-disturbing activity:

    - Slopes between 2:1 and 3:1, with a slope length of 10 feet or less
    - Slopes 3:1 or flatter, with a slope length of 50 feet or less
    - Slopes 4:1 or flatter

8) All graded stream banks must be seeded, mulched, and matted at the end of each day. For this reason, daily disturbance is limited to the length of stream that can be completed within daily work hours.
9) Once a newly constructed channel section is stabilized, impervious dikes and pump around stations may be removed, and water may be reintroduced to the channel.
10) When construction is complete and all areas are stabilized completely, call for inspection by Environmental Inspector.
11) If site is approved, remove silt fencing, access roads, etc. and seed out any resulting bare areas.
12) When vegetation has been established, call for final site inspection by Environmental Inspector.

SEEDING SCHEDULE

TEMPORARY HERBACEOUS SEED

Common Name	Scientific Name	Application Rate	Application Dates
Grain Rye [A]	*Secale cereale*	130 lbs. per acre (3 lbs. per 1,000 ft^2)	Year-round
Orchard Grass [B]	*Dactylis glomerata*	15 lbs per acre (0.35 lbs. per 1,000 ft^2)	September - March
Brown Top Millet [B]	*Panicum ramosum*	40 lbs. per acre (1.0 lbs. per 1,000 ft^2)	May – September
German Millet [B]	*Setaria italica*	25 lbs. per acre (0.5 lbs. per 1,000 ft^2)	May – September

[A] Primarily utilized on disturbed or stockpiled areas.
[B] Primarily utilized near stream channels and streambanks.

SOIL AMENDMENTS

In lieu of a soil test:

Fertilizer	10 – 10 -10 1000 lb./acre

Mulch

Small grain mulch must be applied at a rate of 2 tons/acre to all seeded areas.

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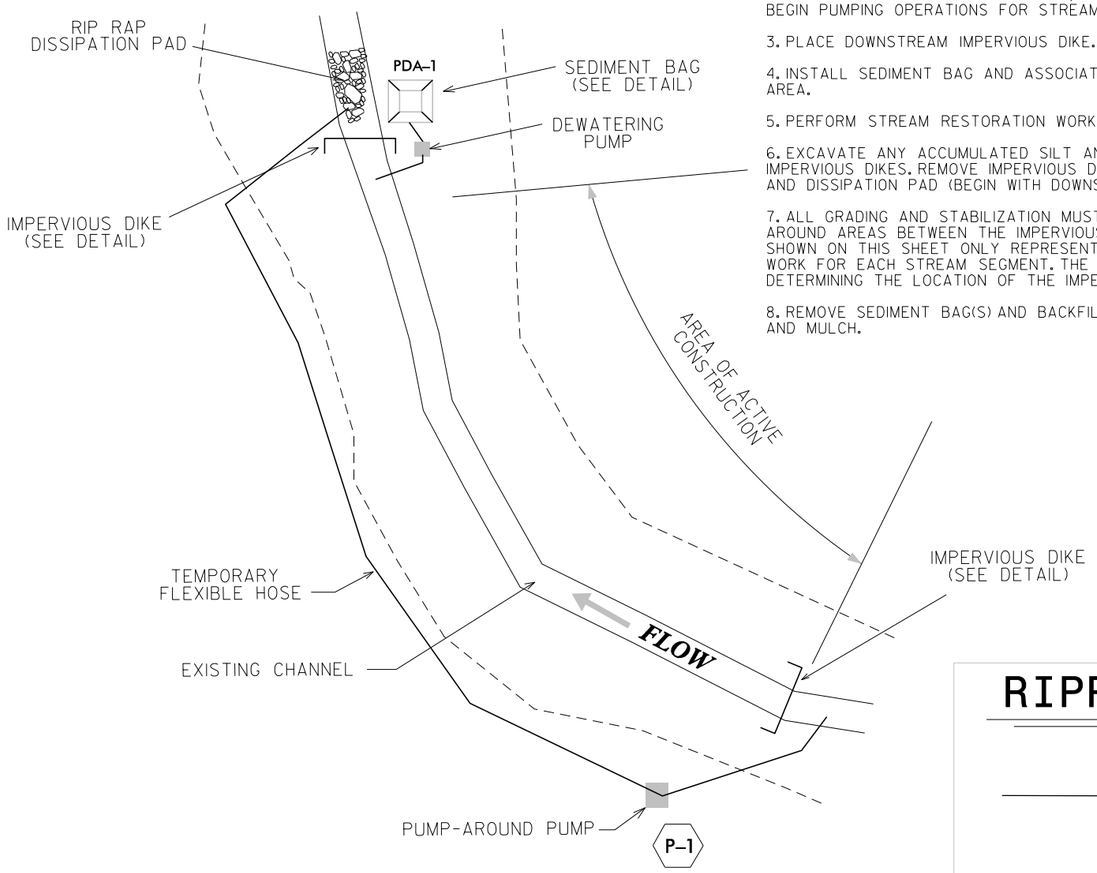

CONSTRUCTION SEQUENCE FOR TYPICAL PUMP-AROUND:

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

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Joshua G. Dalton
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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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DATE:

SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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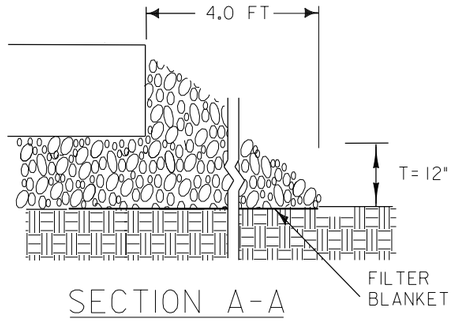
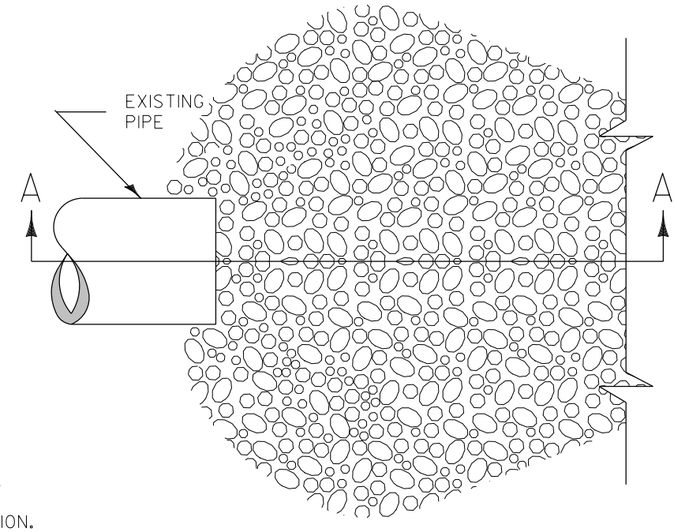
RIPRAP DISSIPATION PAD



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

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SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3A
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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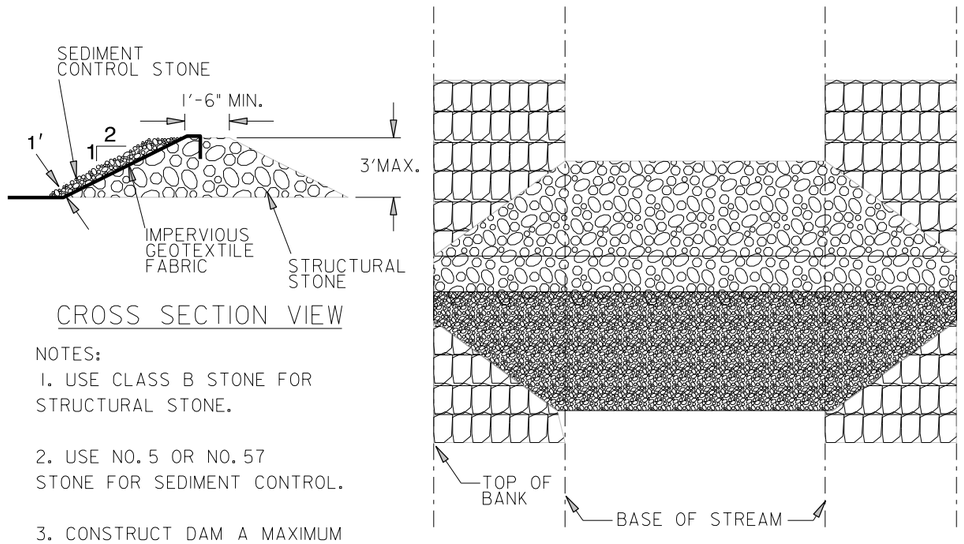
IMPERVIOUS DIKE



CROSS SECTION VIEW

NOTES:

1. USE CLASS B STONE FOR STRUCTURAL STONE.

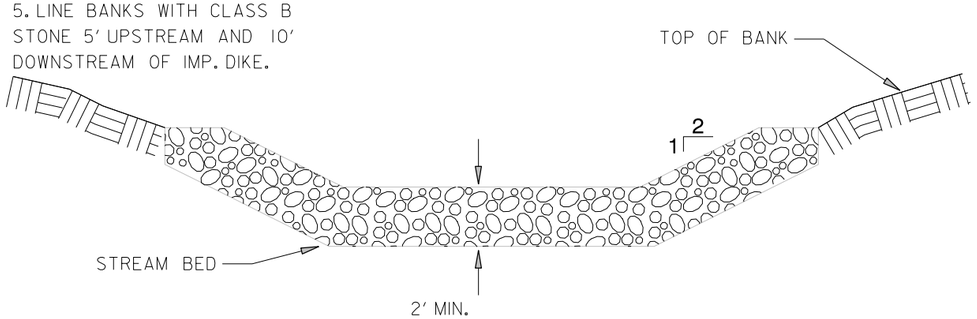
2. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL.

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

4. TOE IN IMPERVIOUS MATERIAL

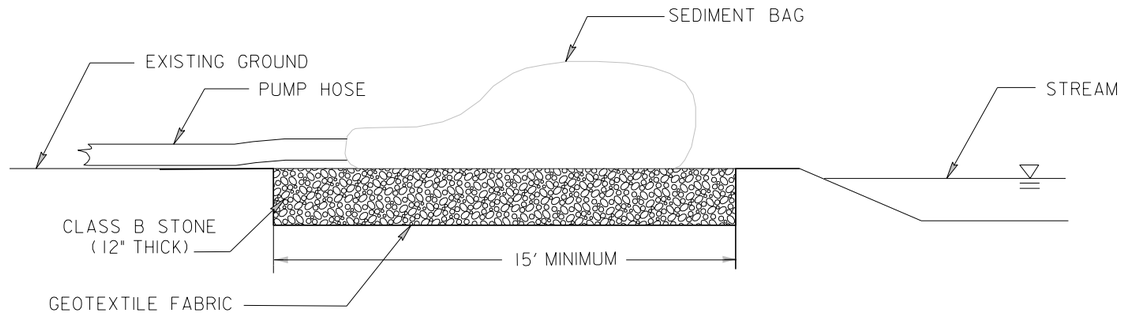
5. LINE BANKS WITH CLASS B STONE 5' UPSTREAM AND 10' DOWNSTREAM OF IMP. DIKE.

TOP VIEW



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.

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SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3B
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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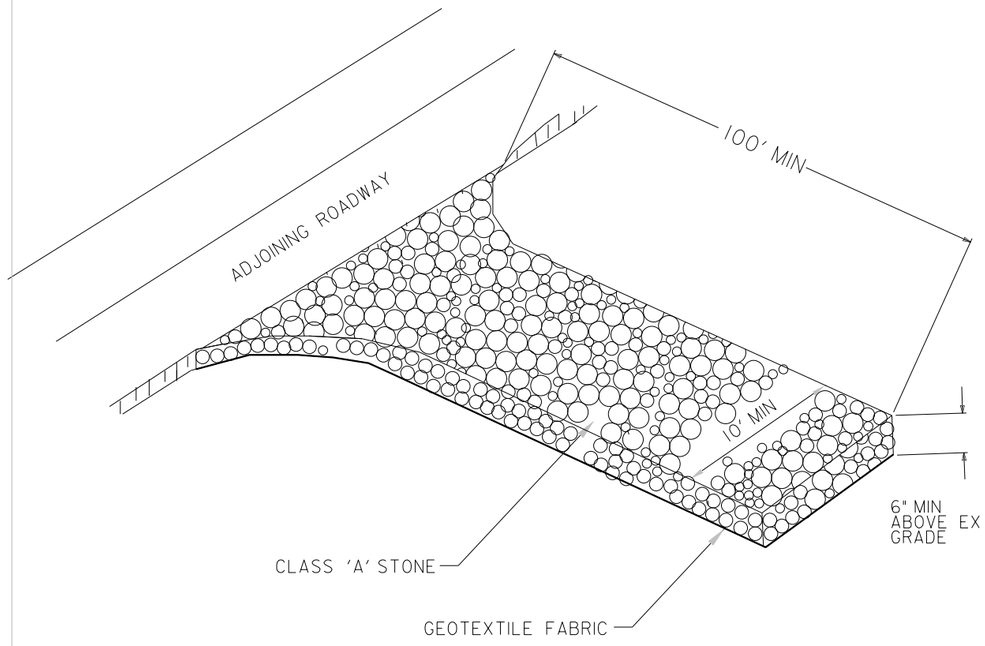
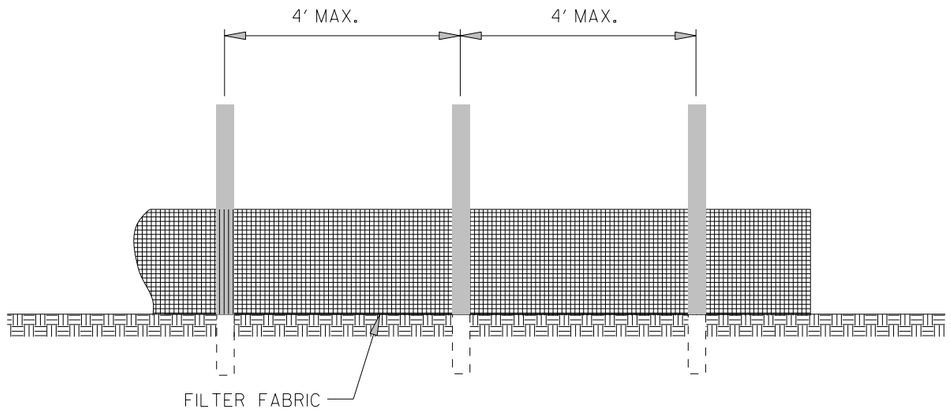
NOTES:

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.

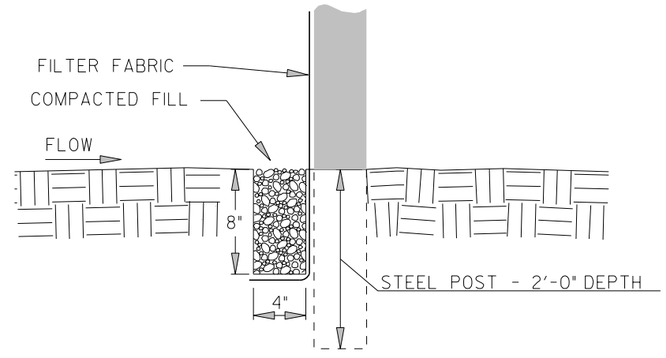


TEMPORARY CONSTRUCTION ENTRANCE/EXIT



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

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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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DATE:

SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3C
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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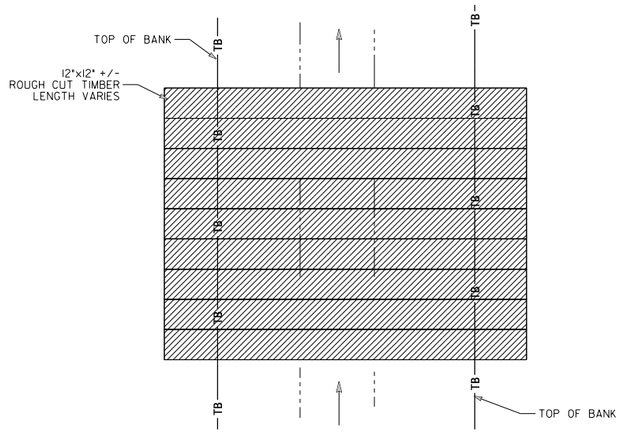
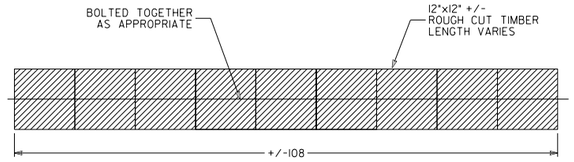
LOG MAT BRIDGE

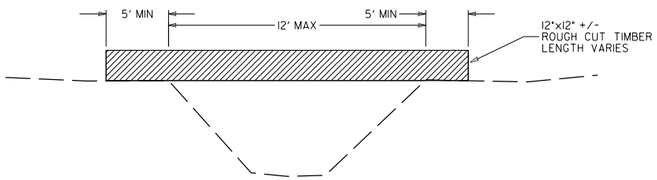


PLAN VIEW

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



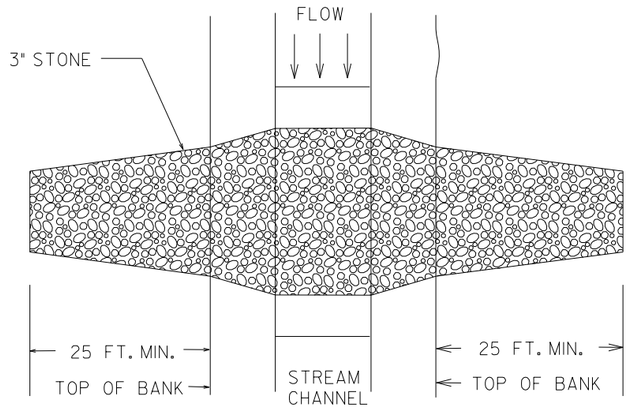
SECTION THROUGH LOG MAT BRIDGE



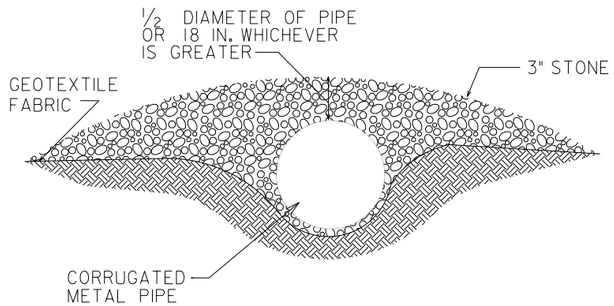
CROSS SECTION VIEW

TEMPORARY CULVERTED STREAM CROSSING

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



PLAN VIEW



PROFILE VIEW

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BSmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3D
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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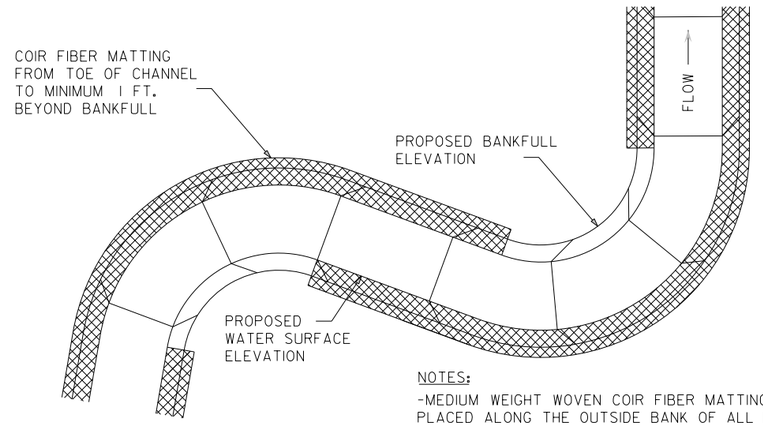
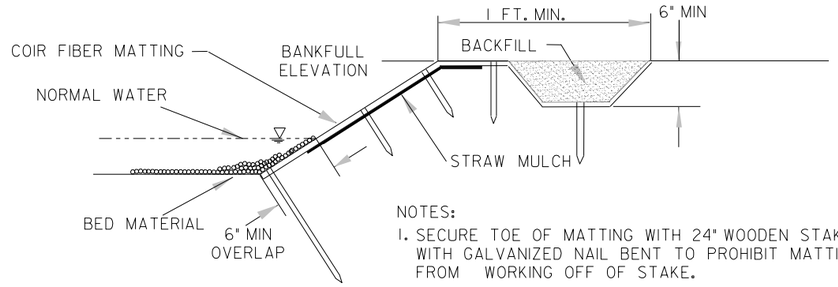
TYPICAL MATTING LOCATION



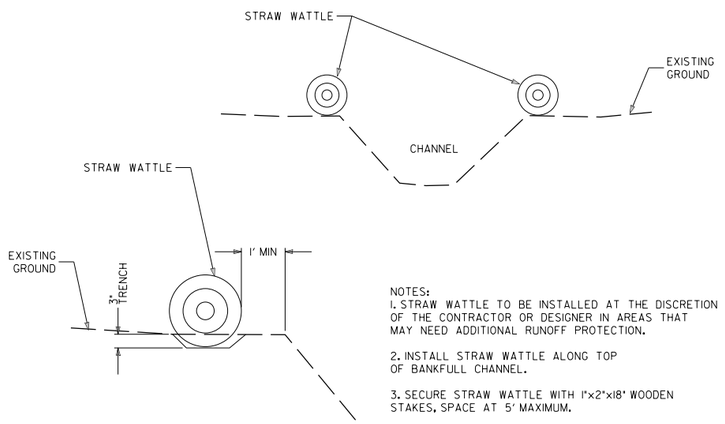
NOTES:
-MEDIUM WEIGHT WOVEN COIR FIBER MATTING SHALL BE PLACED ALONG THE OUTSIDE BANK OF ALL BENDS AND ALONG BOTH SIDES OFTHE CHANNEL IN TANGENT AREAS.
-FIELD ADJUSTMENTS TO MATTING LOCATION MAY BE MADE AT THE DESIGNERS OR CONTRACTORS DISCRETION AS NECESSARY.

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.

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.

SHEET NAME		SHEET NUMBER
EROSION CONTROL TYPICAL		E-3E
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
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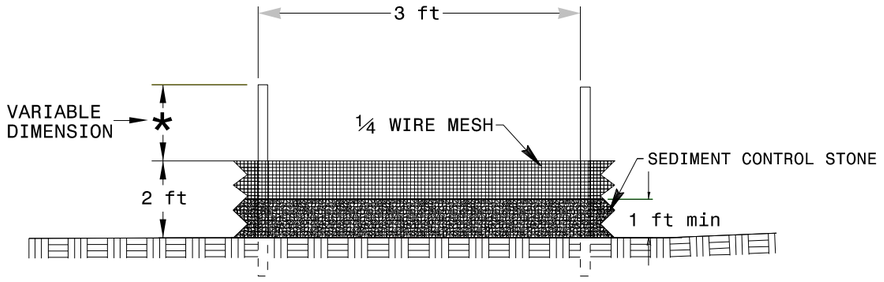
SPECIAL SEDIMENT CONTROL FENCE BREAK

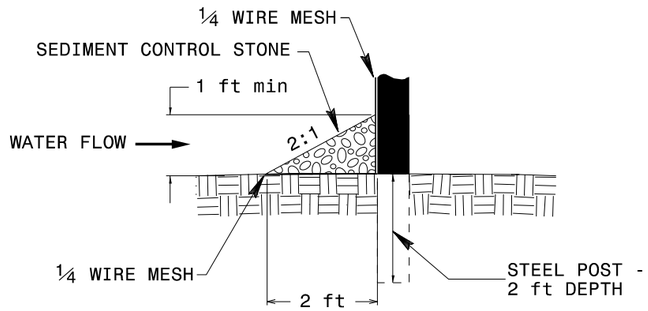


NOTE:

-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.



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SHEET NAME		SHEET NUMBER
HAUL ROADS		E-3F
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
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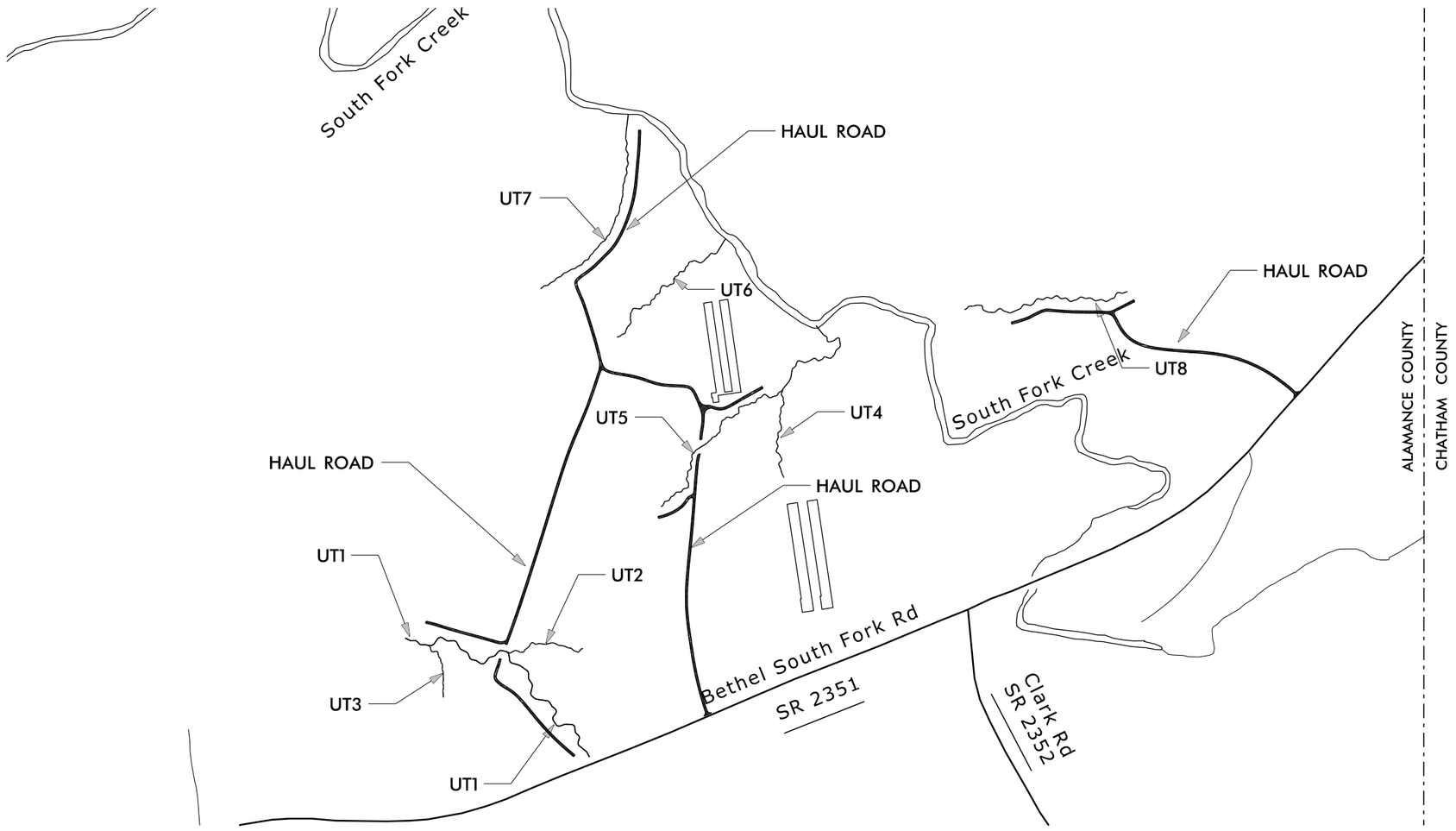

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BSmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E4
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
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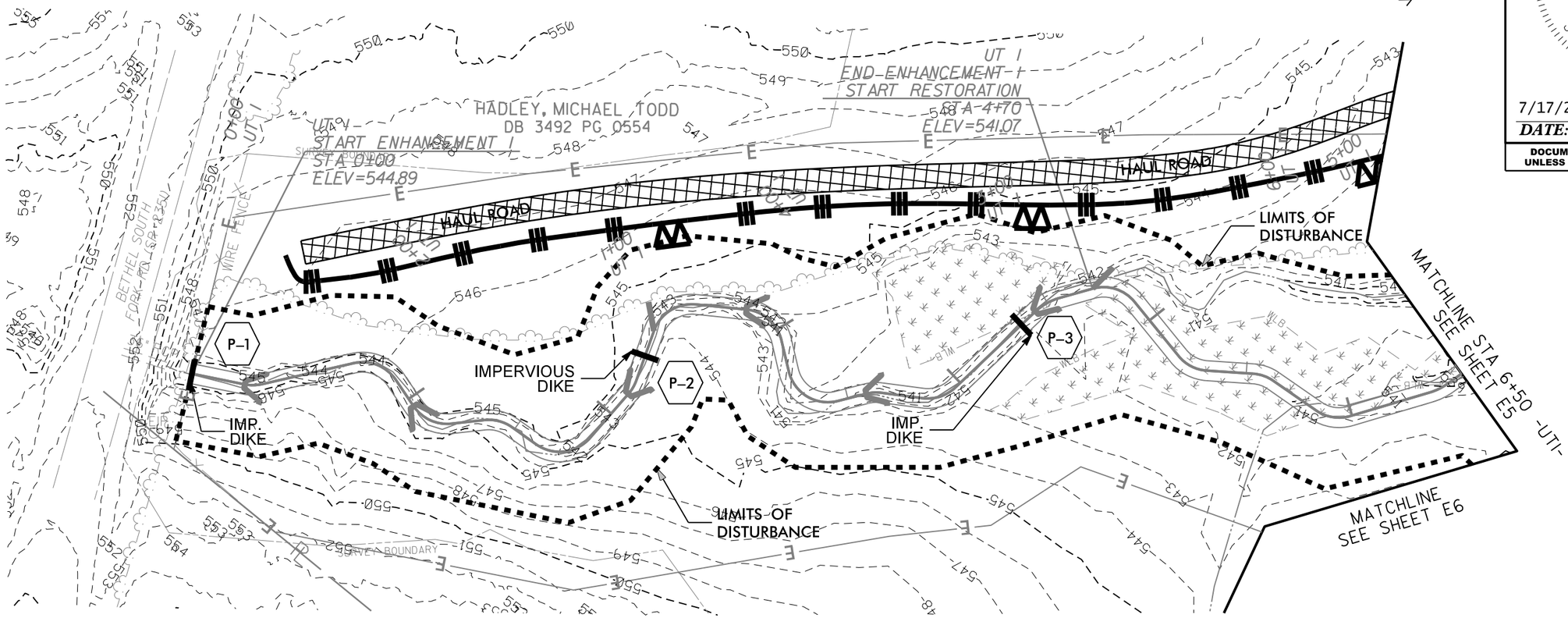
LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK



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

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Heron_psh_E04.dgn
ESmith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E5
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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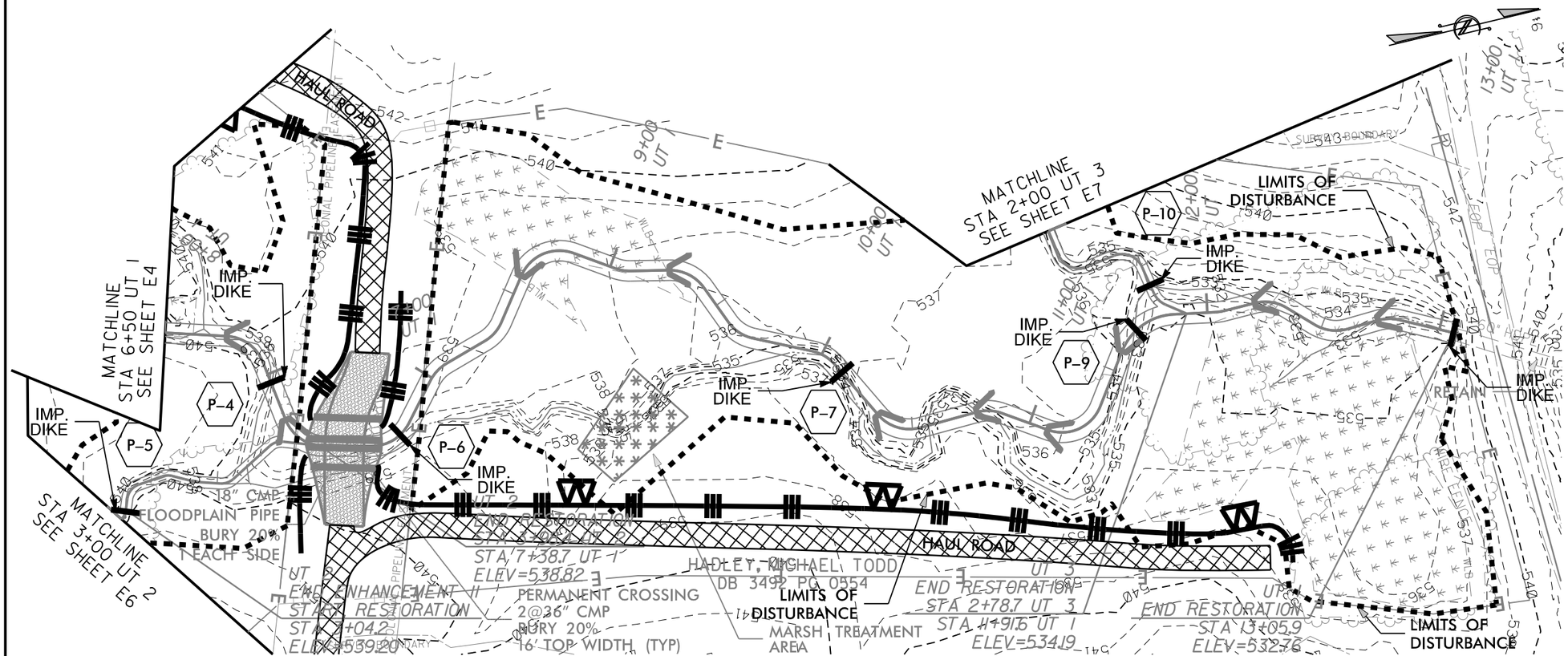
- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK



7/16/2018
Heron_psh_E05.dgn
PSmith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E6
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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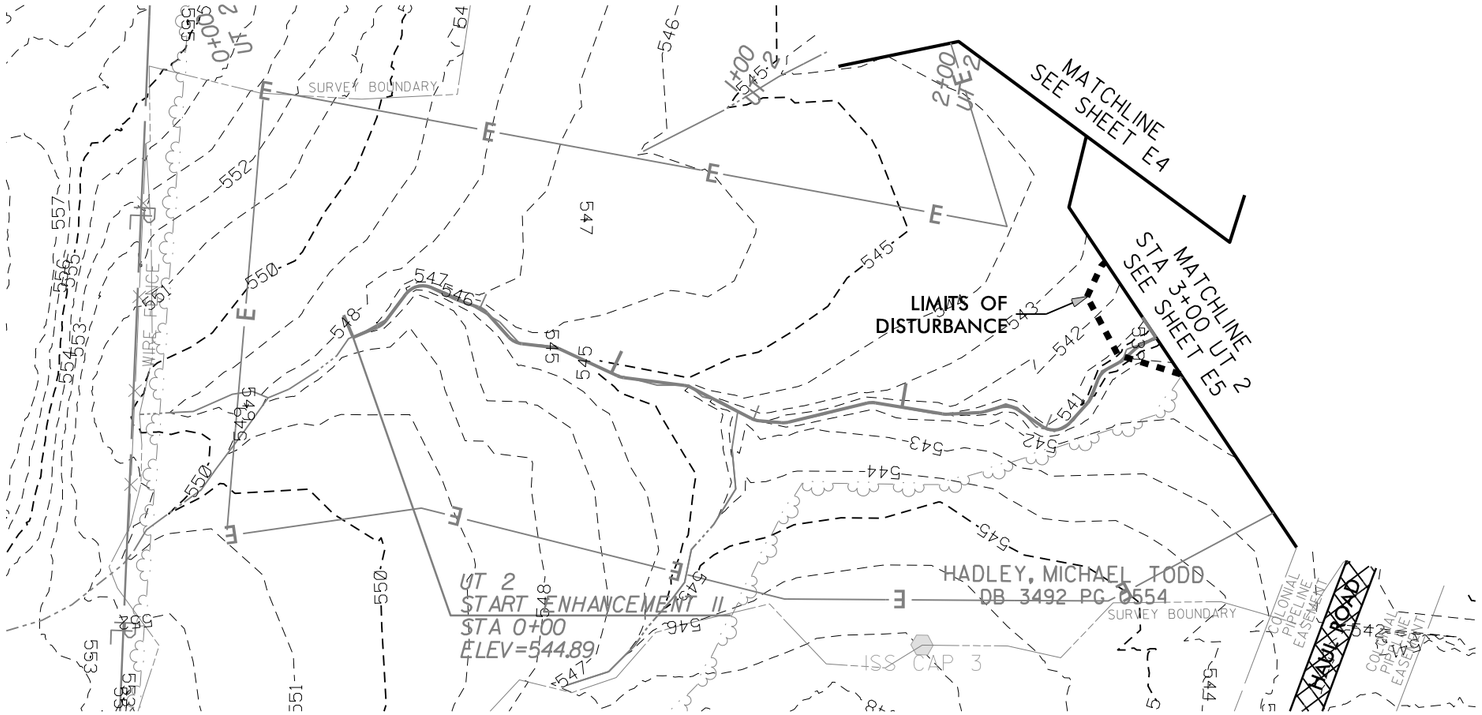
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK



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

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Heron_psh_E06.dgn
Bsmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E7
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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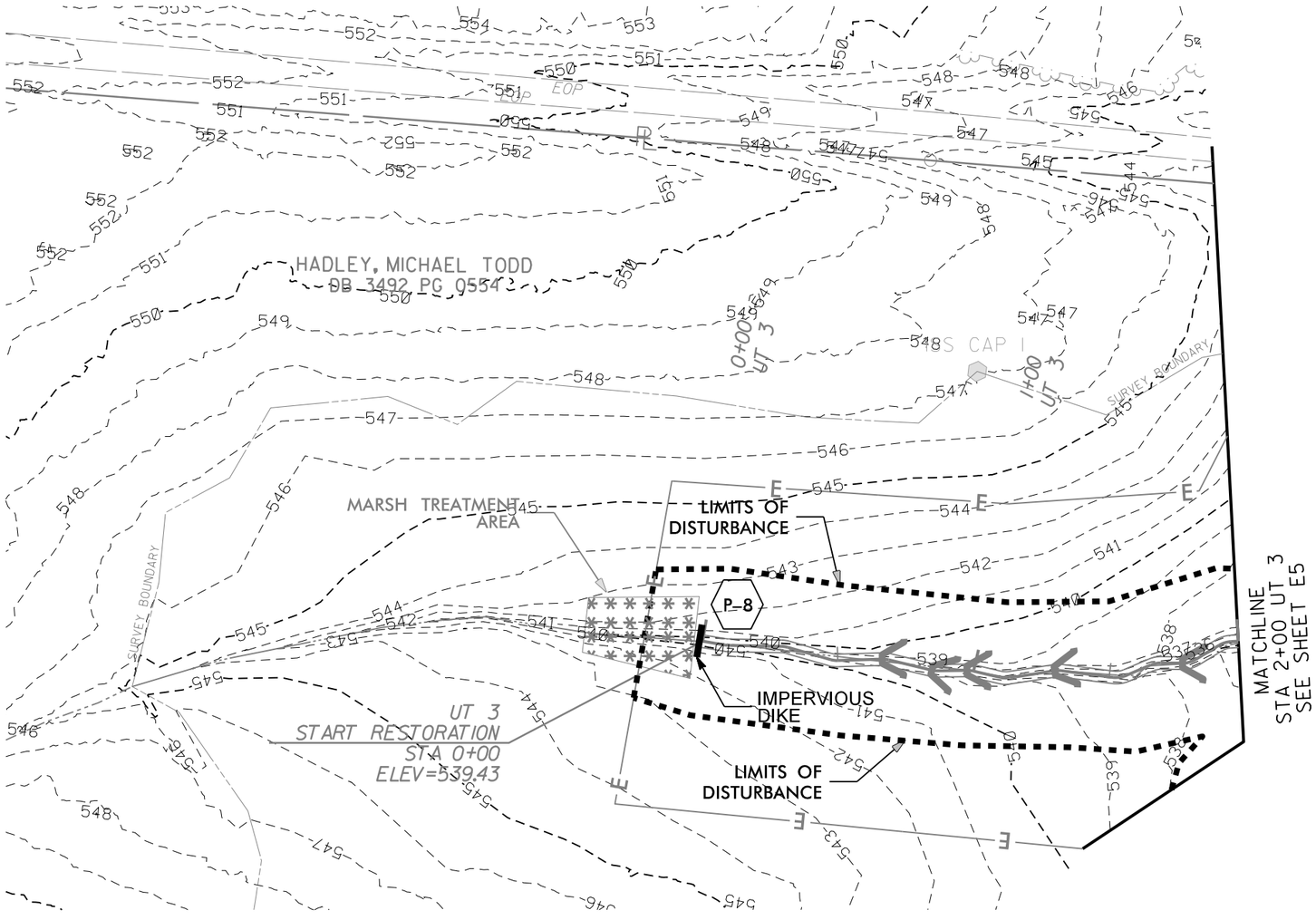

LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E07.dgn
Smith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E8
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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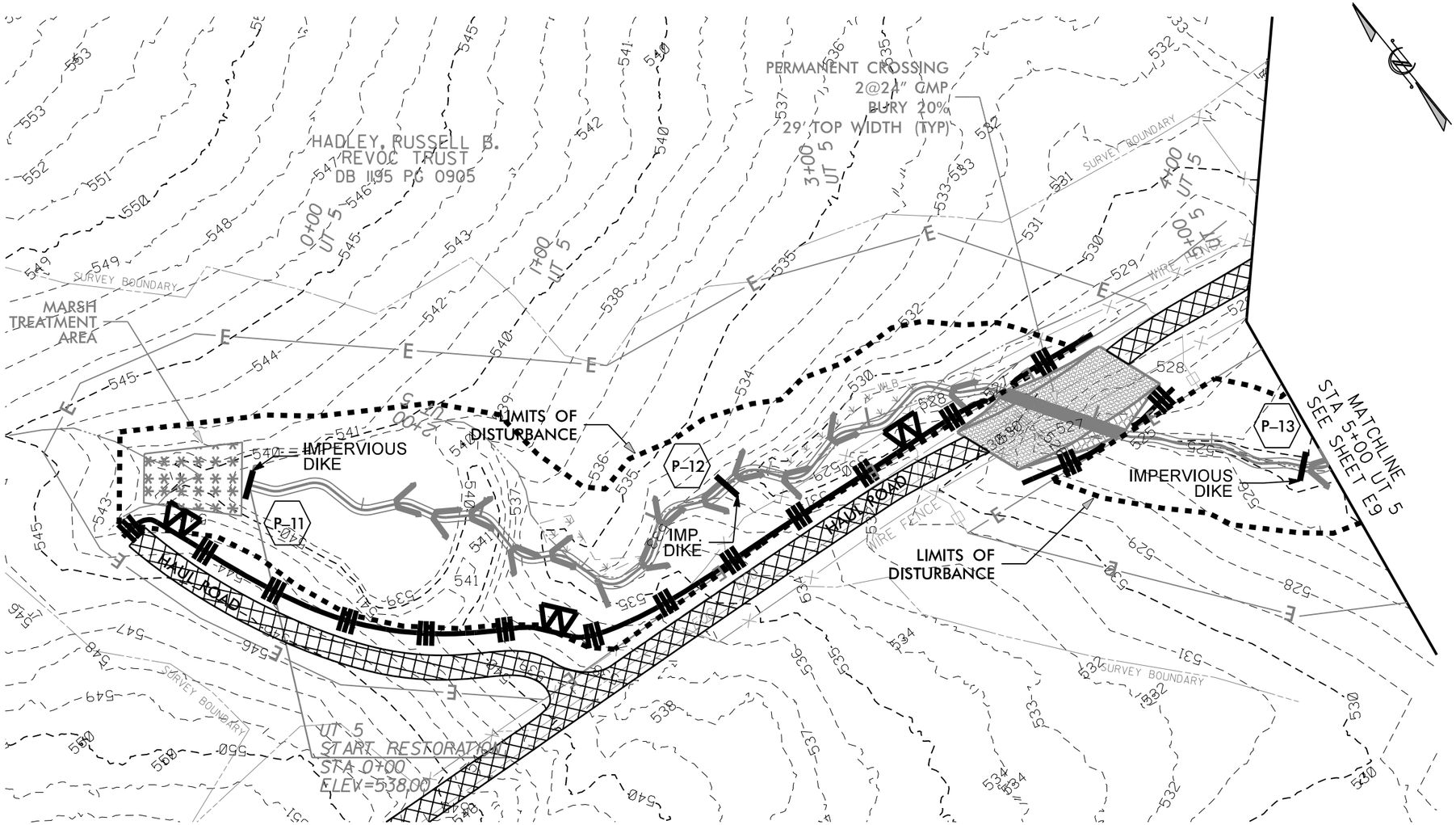

LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E08.dgn
BSmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E9
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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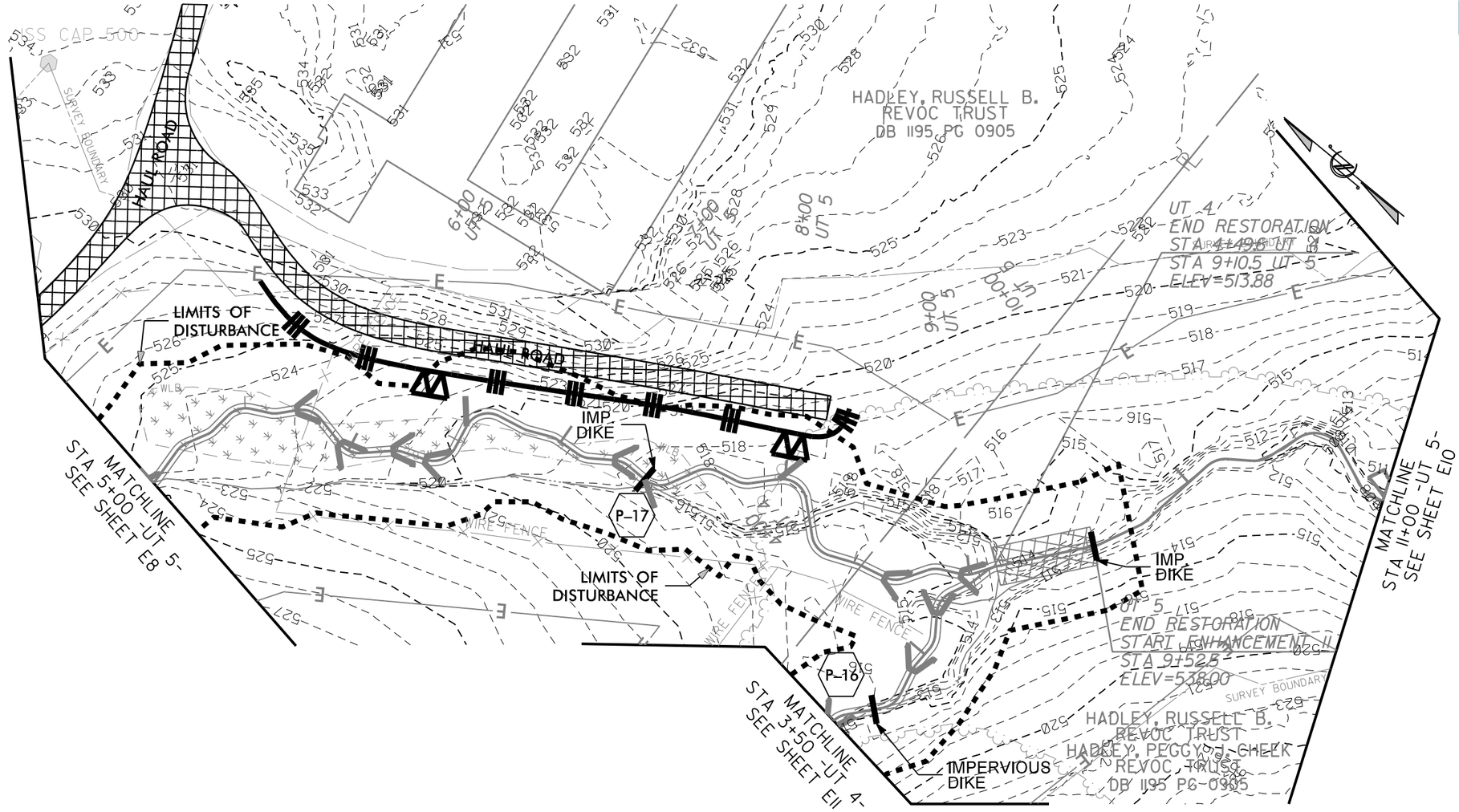

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E09.dgn
ESmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E10
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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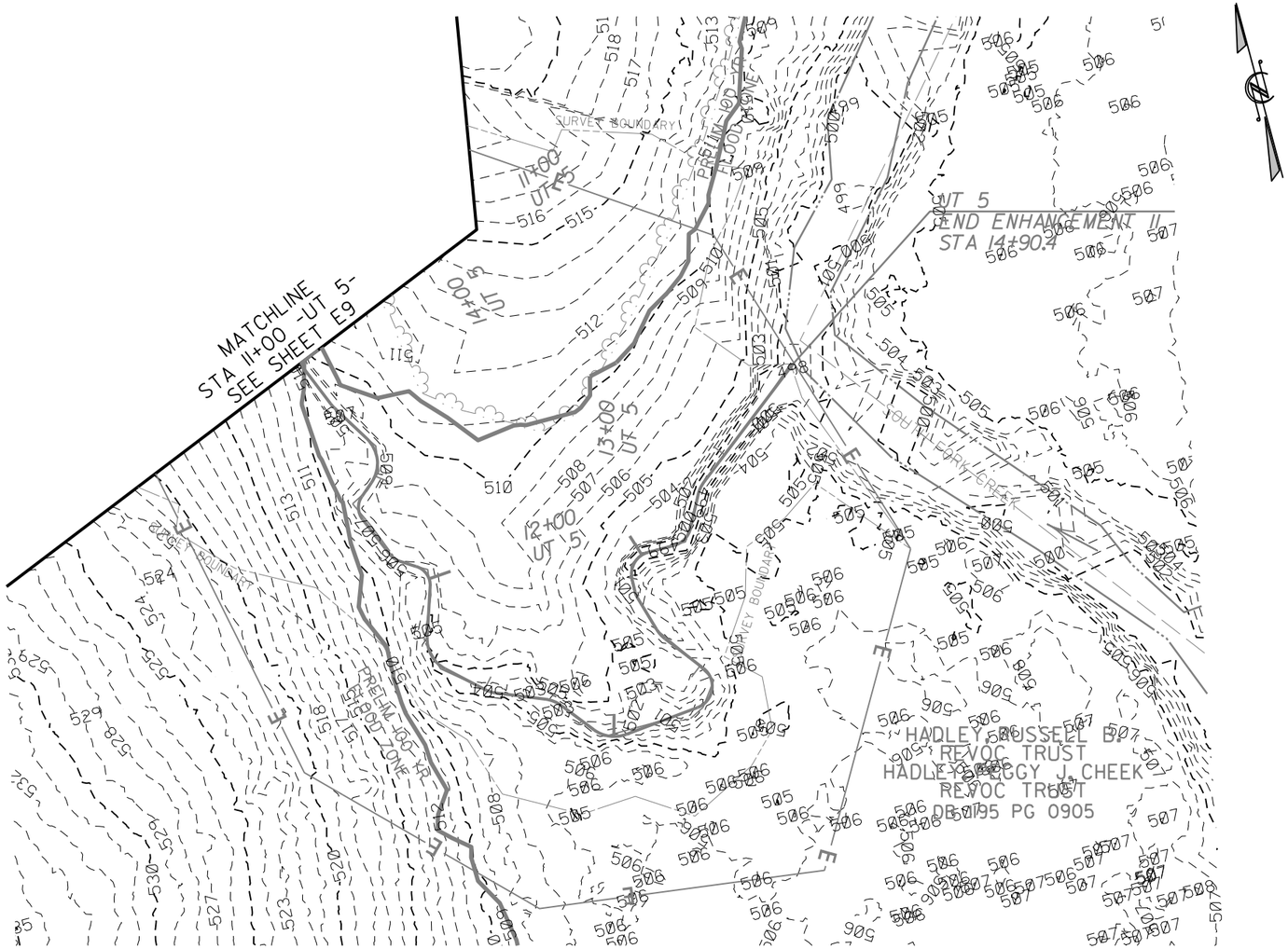

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

7/16/2018
Heron_psh_E10.dgn
RSmith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E11
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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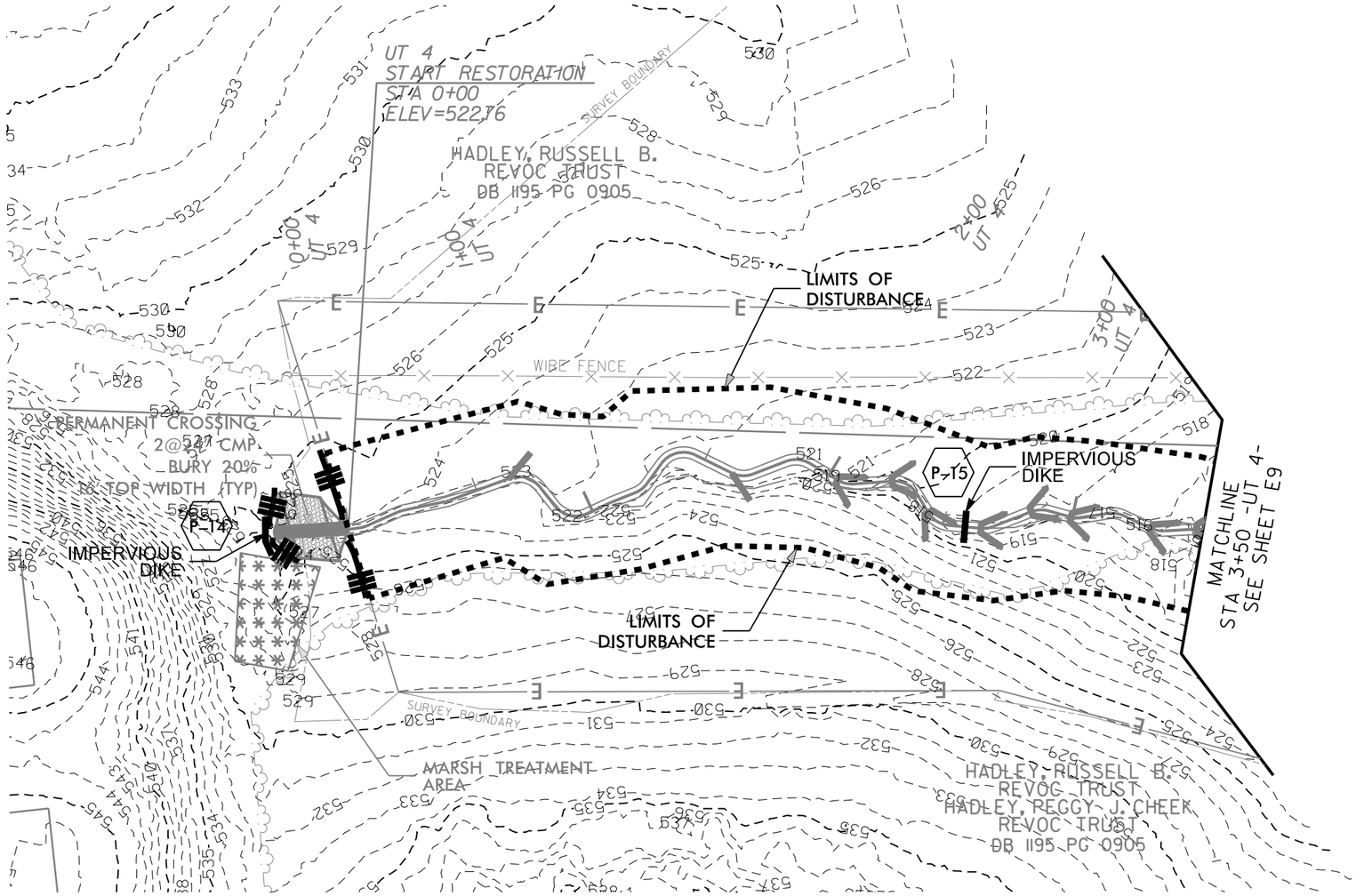

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E11.dgn
Bsmith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E12
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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DATE:

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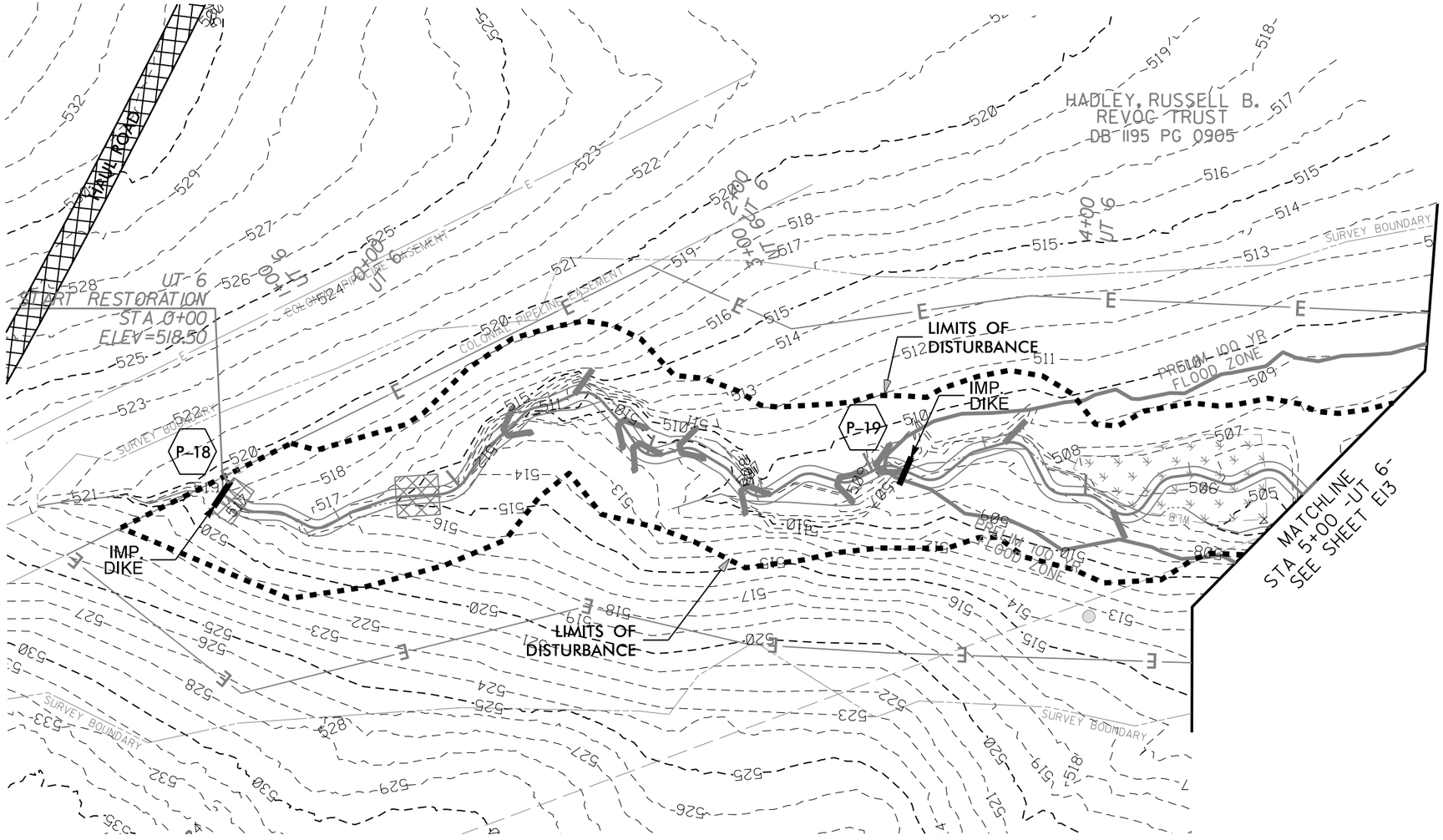

▪▪▪▪▪	LIMITS OF DISTURBANCE
═╫═	TEMPORARY SILT FENCE
▨	HAUL ROAD
▽	SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E12.dgn
RSmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E13
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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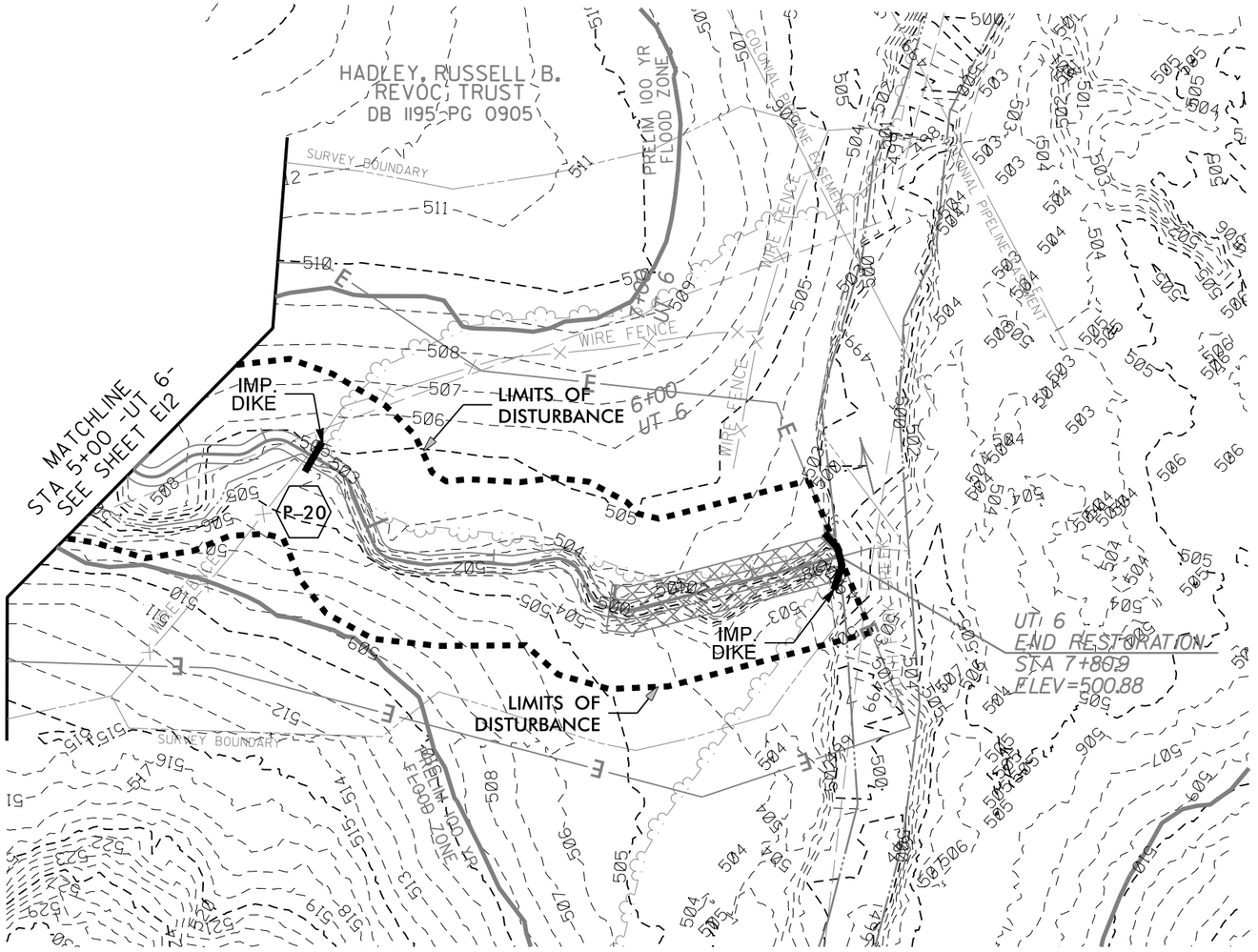

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E13.dgn
Bsmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E14
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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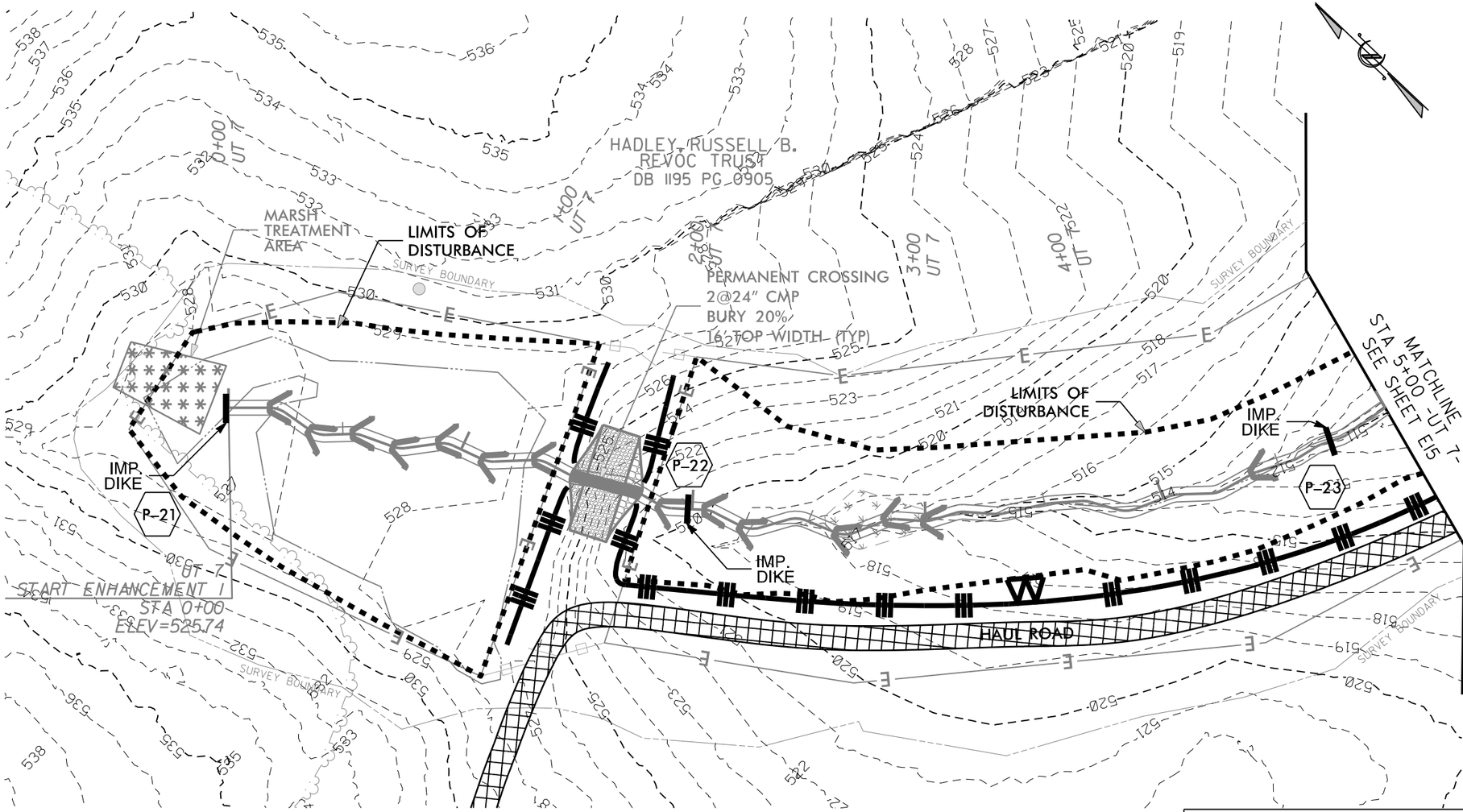

TOPOGRAHY OUTSIDE OF SURVEY LIMITS BASED ON NC SPATIAL DATA QL2 LIDAR

7/16/2018
Heron_psh_E14.dgn
Smith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E15
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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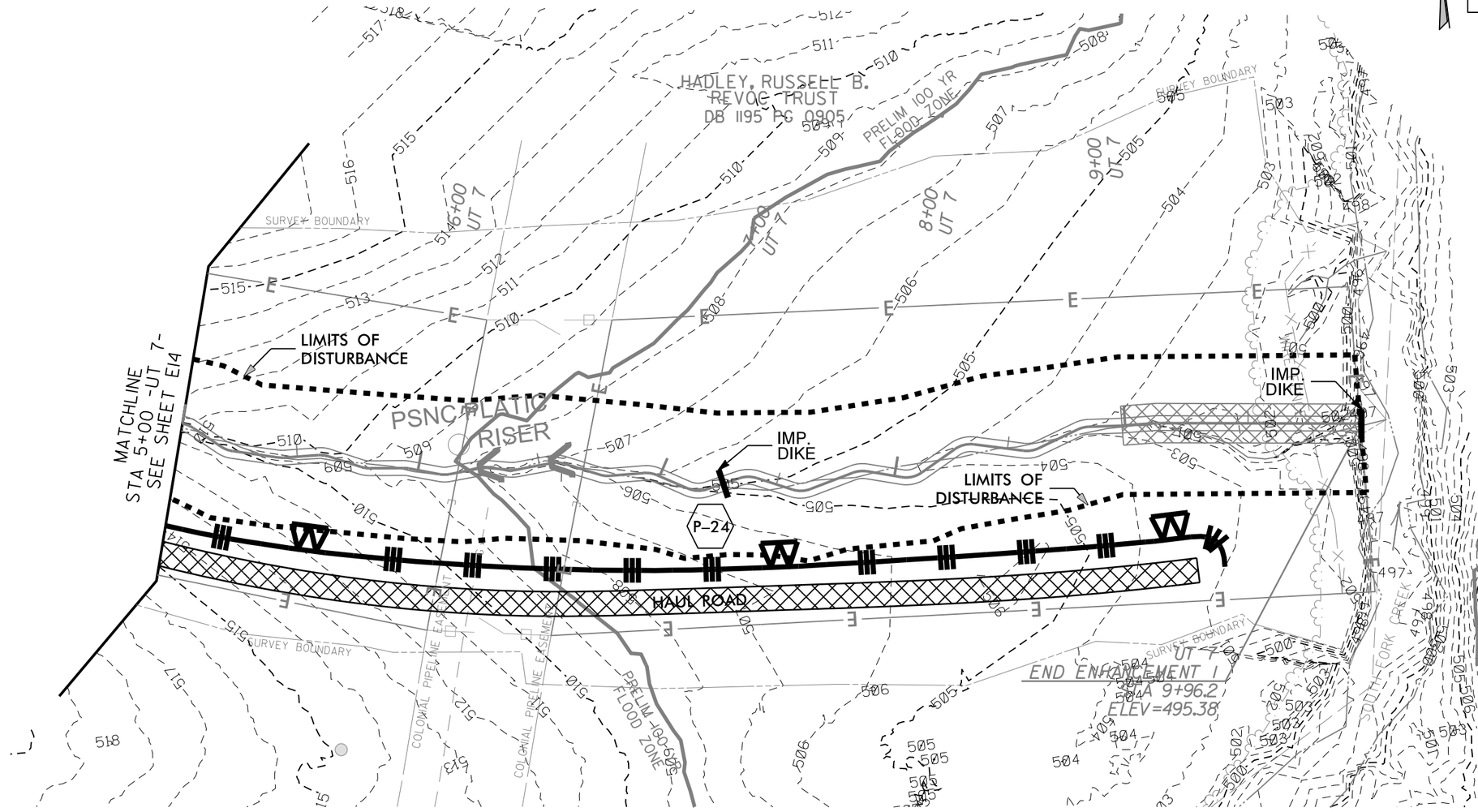

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron-psh-E15.dgn
RSmith

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E16
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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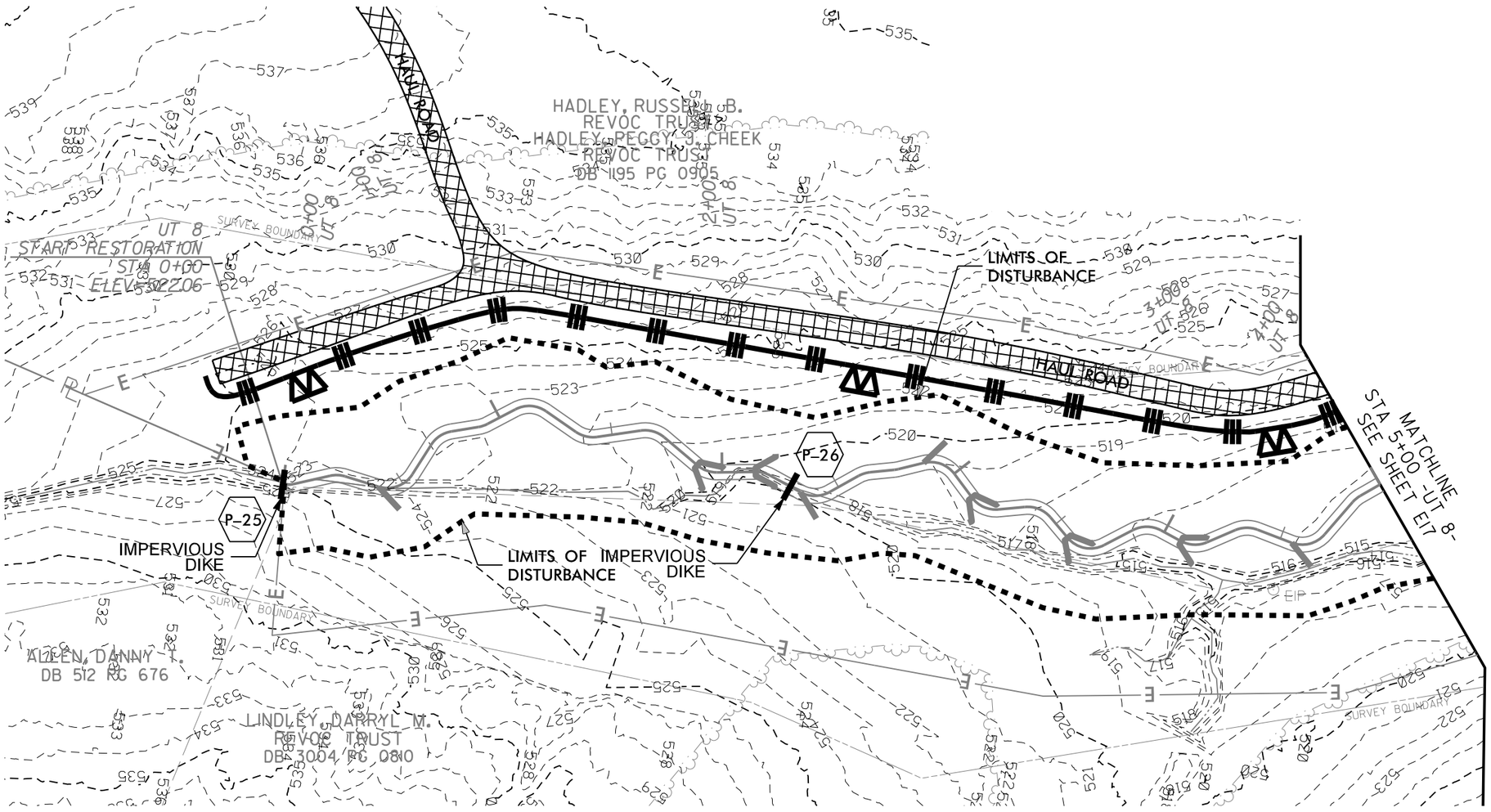

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E16.dgn
dsmith

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E17
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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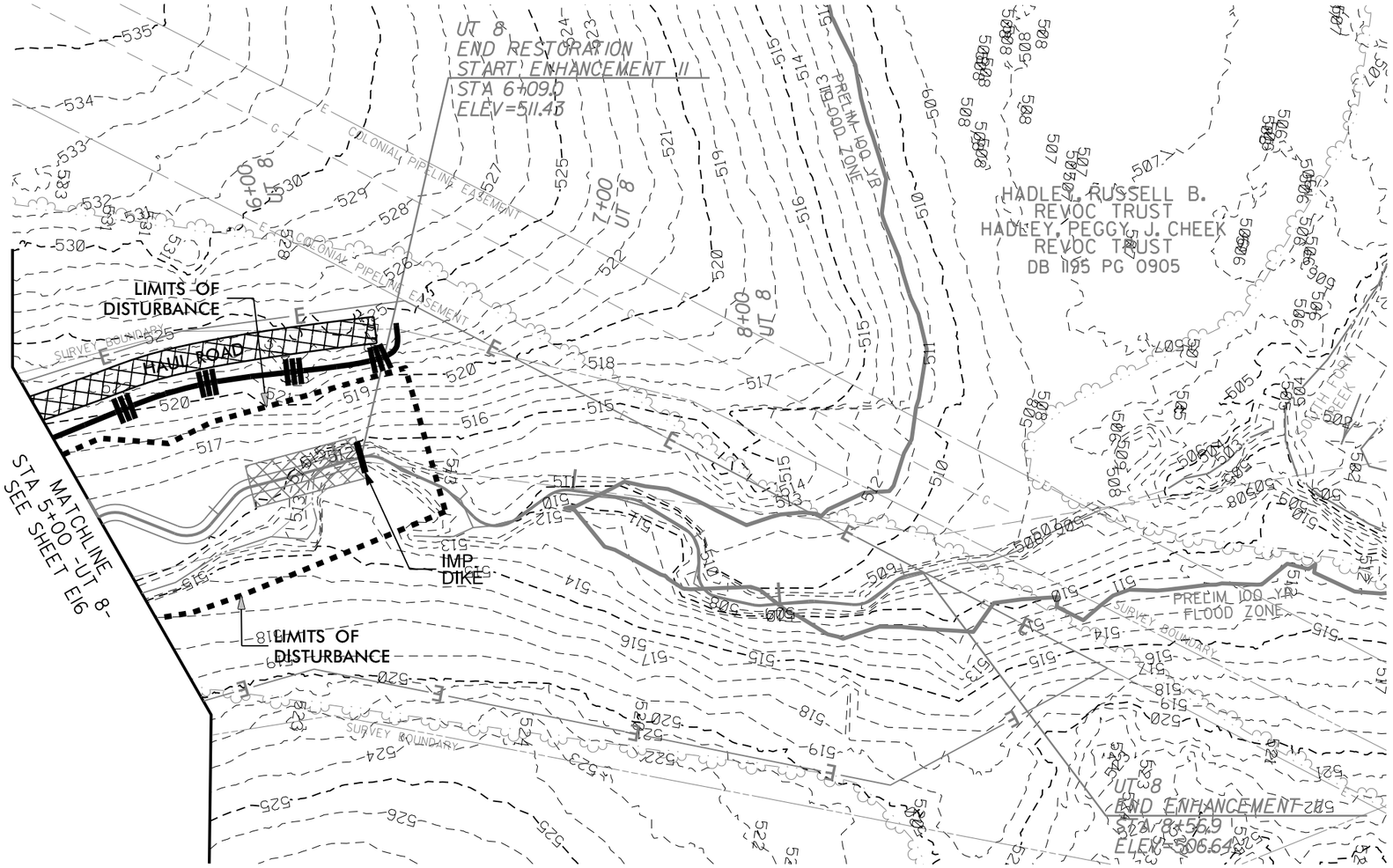

- LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

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

7/16/2018
Heron_psh_E17.dgn
Psmith

SHEET NAME		SHEET NUMBER
PLANTING NOTES		P-2
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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BARE ROOT SEEDLINGS

Plant Selection

- Species listed for the project should be grown from stock that corresponds to the same physiographic province in which they will be used.
- The designer reserves the right to reject any plant stock due to inferior qualities.

Planting & Handling

- Bare root seedlings will be planted according to vegetation details or as directed by the designer.
- All vegetation will be planted during the dormant season (December to March). Temperatures ranging from 36 to 60 degrees Fahrenheit are ideal for planting. Planting will not take place during periods exceeding this range of temperature. Planting will not take place during excessively windy conditions or other extreme conditions which may reduce vigor of the planting material.
- The designer reserves the right to reject any bare root seedling due to inferior quality. The designer also reserves the right to have any plant replanted due to improper planting techniques.
- All vegetation designated for a particular planting zone will be culled for inferior quality before being loaded into planting bags. Furthermore, these species will be thoroughly mixed prior to loading the planting bag, such that each planting zone will be planted in a random manner.
- All vegetation will be reviewed by the designer to ensure the highest quality of planting material throughout the entire process.

Storage

- Plant stock will be stored at temperatures between 36 to 40 degrees Fahrenheit in appropriate bags supplied by the plant producer when long-term storage is necessary.
- Only the necessary quantities of plant stock will be transported to the site on a daily basis. Large quantities of planting material will not be stored on-site during the planting process unless proper refrigeration is provided by the planting contractor.

WITHIN BANKFULL CHANNEL

A seed mix containing an equal mix of at least three (3) grasses and two (2) herbs will be used on the side slopes below the bankfull stage except on the inside of meanders on pool cross sections at a rate of 25 lb/acre.

Common Name	Scientific Name	Application Rate	Application Dates
Grass			
Deertongue	*Panicum clandestinum*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Bottle-brush Grass	*Hystrix patula*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Switch Grass	*Panicum virgatum*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
River Oats	*Chasmanthium latifolium*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Herb			
Joe-Pye Weed	*Eupatorium fistulosum*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Cardinal Flower	*Lobelia cardinalis*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Tall Coreopsis	*Coreopsis tripteris*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Bee Balm	*Monarda didyma*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Iron Weed	*Vernonia sp.*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June
Touch Me Not	*Impatiens capensis*	25 lbs. per acre (0.5 lbs per 1000 ft²)	April - June

TRANSPLANT VEGETATION

Selection & Handling

- Transplant vegetation will be selected and flagged by the designer for use on the project site. The designer reserves the right to select any vegetation for transplant during any point of the project.
- Transplant vegetation will be planted within 1 day of being moved from its original location. If planting in desired location is not feasible, the transplant will be replanted or stored in a manner as to ensure its long-term survival. The designer will provide guidance throughout the process.

LIVE STAKING

Plant Selection

- All plant species used for live staking should conform to the specifications set forth in the vegetation details.
- Plant species listed for use as live stakes will be selected from plants found on the project site or as directed by the designer.
- Plant species used as live stakes will be collected during the dormant season (December to March) and during normal average daily temperatures for this period.

Preparation & Handling

- Plant species will be collected to conform to sizes specified in the vegetation details.
- Live stakes will be prepared by making a straight cut at the narrow end of the plant material forming a blunt end. The thicker end (toward the trunk) of the plant will be formed into a point.
- Live stake preparation will be done according to vegetation details unless otherwise specified by the designer.

Planting

- Live stakes should be prepared and planted immediately following collection. Proper storage techniques should be followed to ensure the highest rate of survival.
- Live stakes will be planted with the point of the live stake going into the soil and the blunt end facing up.
- Live stakes will be placed as deep as possible and as close to the water table as possible.
- Live staking will be done according to the vegetation details unless otherwise specified by the designer. The designer reserves the right to reject any live stake due to inferior quality. Likewise, any improperly planted live stake will be corrected by the planting contractor.

Storage

- Live stakes will be bundled and stored completely submerged in the stream channel in the event immediate staking is not permissible. Temporary storage will not exceed a three week period.

BANKFULL TO END OF BUFFER

A seed mix containing an equal mix of at least three (3) forbes and two (2) grasses will be used from the edge of the bankfull channel to the limits of the riparian buffer at minimum rate of 30lb/acre. Also use this mixture at the same rate to plant the staging and stockpile areas, all other areas within the riparian buffer that will be planted with trees, and any other areas as directed by the designer.

Common Name	Scientific Name	Application Rate	Application Dates
Forbe			
Balck-eyed Susan	*Rudbeckia hirta*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Lance-leaved Coreopsis	*Coreopsis lanceolata*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Purple Cone Flower	*Echinacea purpurea*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Bur-marigold	*Bidens aristosa*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Narrow-leaved Sunflower	*Helianthus angustifolius*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Threadleaf Coreopsis	*Coreopsis verticillata*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Grass			
Big Bluestem	*Andropogon gerardii*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Indiangrass	*Sorghastrum nutans*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Little Bluestem	*Schizachyrium scoparium*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June
Switchgrass	*Panicum virgatum*	30 lbs. per acre (0.7 lbs per 1000 ft²)	April - June

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SHEET NAME		SHEET NUMBER
PLANTING TYPICALS		P-3
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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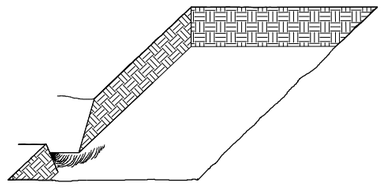
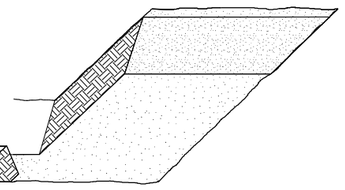
BAREROOTED SEEDLINGS

HEELING IN

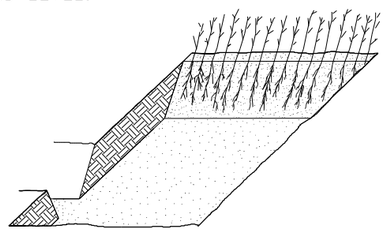
1. LOCATE A HEELING-IN SITE IN A SHADY, WELL PROTECTED AREA.
2. EXCAVATE A FLAT BOTTOM TRENCH 12 INCHES DEEP AND PROVIDE DRAINAGE.



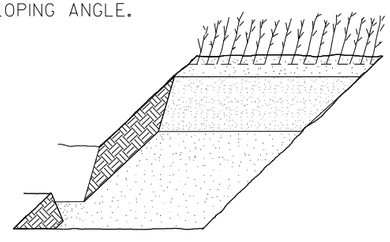
3. BACKFILL THE TRENCH WITH 2 INCHES WELL ROTTED SAWDUST. PLACE A 2 INCH LAYER OF WELL ROTTED SAWDUST AT A SLOPING ANGLE AT ONE END OF THE TRENCH.



4. PLACE A SINGLE LAYER OF PLANTS AGAINST THE SLOPING END SO THAT THE ROOT COLLAR IS AT HIGHER GROUND LEVEL.



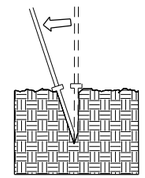
5. PLACE A 2 INCH LAYER OF WELL ROTTED SAWDUST OVER THE ROOTS MAINTAINING A SLOPING ANGLE.



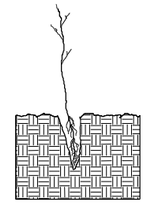
6. REPEAT LAYERS OF PLANTS AND SAWDUST AS NECESSARY AND WATER THOROUGHLY.

DIBBLE PLANTING METHOD

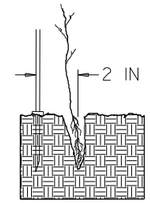
(USING THE KBC PLANTING BAR)



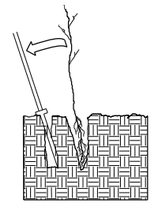
1. INSERT PLANTING BAR AS SHOWN AND PULL HANDLE TOWARDS PLANTER.



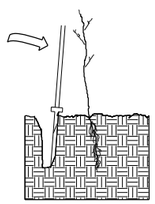
2. REMOVE PLANTING BAR AND PLACE SEEDLING AT CORRECT DEPTH.



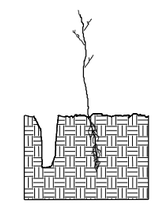
3. INSERT PLANTING BAR 2 INCHES TOWARD PLANTER FROM SEEDLING.



4. PULL HANDLE OF BAR TOWARDS PLANTER, FIRMING SOIL AT BOTTOM.



5. PUSH HANDLE FORWARD FIRMING SOIL AT TOP.



6. LEAVE COMPACTION HOLE OPEN. WATER THOROUGHLY.

NOTES:

PLANTING BAG

1. DURING PLANTING, SEEDLINGS SHALL BE KEPT IN A MOIST CANVAS BAG OR SIMILAR CONTAINER TO PREVENT THE ROOT SYSTEMS FROM DRYING.

KBC PLANTING BAR

2. PLANTING BAR SHALL HAVE A BLADE WITH A TRIANGULAR CROSS SECTION, AND SHALL BE 12 INCHES LONG, 4 INCHES WIDE AND 1 INCH THICK AT CENTER.

ROOT PRUNING

3. ALL SEEDLINGS SHALL BE ROOT PRUNED, IF NECESSARY, SO THAT NO ROOTS EXTEND MORE THAN 10 INCHES BELOW THE ROOT COLLAR.

REFORESTATION

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Dry-Mesic Oak-Hickory Forest*		Marsh Treatment Wetland**		Stream-side Assemblage**		TOTAL
Area (acres)	9.7		3.3		0.1		3.8		16.9
Species	# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	--	--	--	--	27	10	517	5	544
River birch (*Betula nigra*)	660	10	--	--	--	--	517	5	1176
Ironwood (*Carpinus caroliniana*)	--	--	449	20	--	--	--	--	449
Buttonbush (*Cephalanthus occidentalis*)	--	--	--	--	54	20	--	--	54
Red bud (*Cercis canadensis*)	--	--	337	15	--	--	--	--	337
Sweet pepperbush (*Clethra alnifolia*)	--	--	--	--	41	15	--	--	41
Silky dogwood (*Cornus amomum*)	660	10	--	--	41	15	2067	20	2768
Persimmon (*Diospyros virginiana*)	--	--	224	10	--	--	--	--	224
White ash (*Fraxinus americana*)	--	--	112	5	--	--	--	--	112
Green ash (*Fraxinus pennsylvanica*)	1319	20	--	--	--	--	2067	20	3386
Blueberry (Vaccinium corymbosum)	--	--	--	--	27	10	--	--	27
Tulip poplar (*Liriodendron tulipifera*)	660	10	--	--	--	--	--	--	660
Sycamore (*Platanus occidentalis*)	1319	20	--	--	--	--	2067	20	3386
Black gum (*Nyssa sylvatica*)	--	--	337	15	--	--	--	--	337
Water oak (*Quercus nigra*)	989	15	449	20	--	--	1034	10	2472
Willow oak (*Quercus phellos*)	989	15	337	15	--	--	1034	10	2360
Black willow (*Salix nigra*)	--	--	--	--	--	--	1034	10	1034
Elderberry (*Sambucus canadensis*)	--	--	--	--	54	20	--	--	54
Possumhaw (*Viburnum nudum*)	--	--	--	--	27	10	--	--	27
TOTAL	**6596**	**100**	**2244**	**100**	**272**	**100**	**10336**	**100**	**19448**

* Planted at a density of 680 stems/acre.

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

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SHEET NAME		SHEET NUMBER
PLANTING TYPICALS		P-3A
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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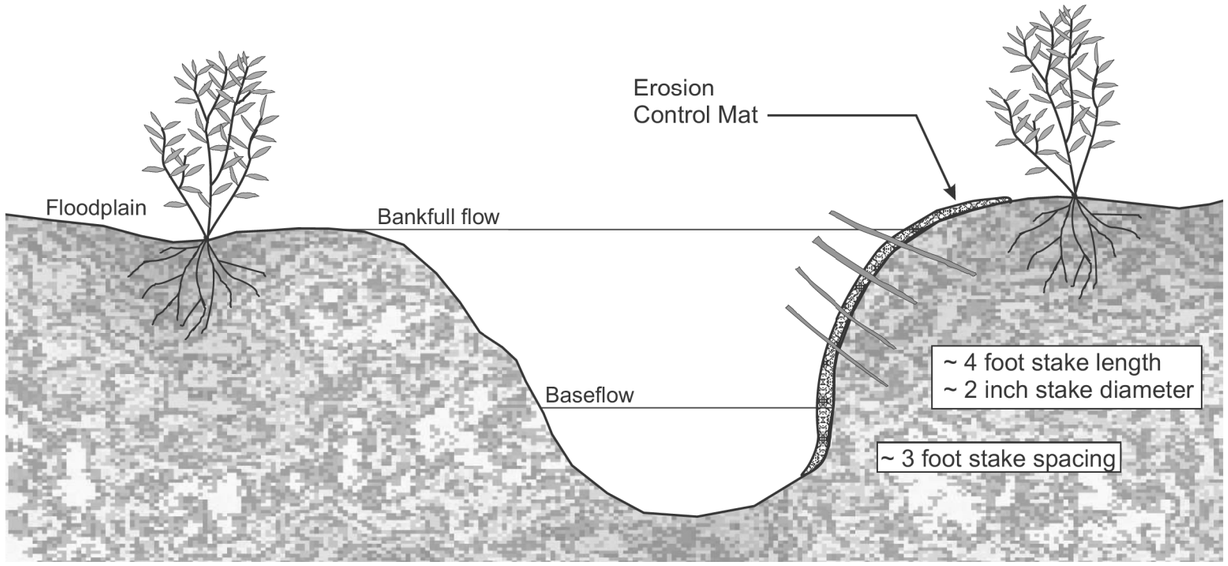
LIVE STAKES

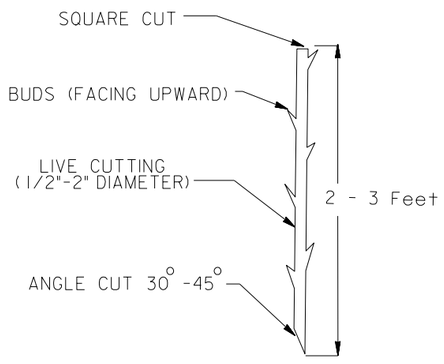
NOTES:

1. STREAMBANK REFORESTATION USING LIVE STAKES AND TUBLINGS SHALL BE PLANTED 2 FT. TO 4 FT. ON CENTER, RANDOM SPACING, AVERAGING 3 FT. ON CENTER, APPROXIMATELY 4840 PLANTS PER ACRE.

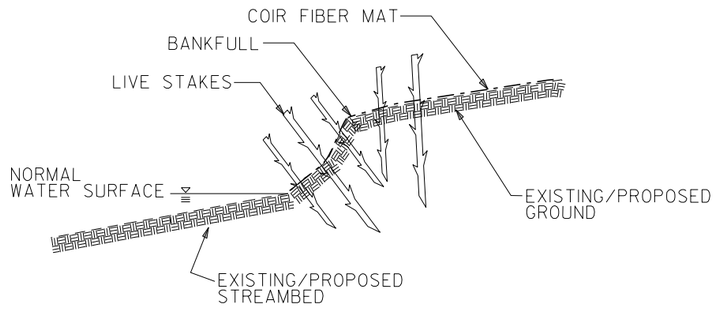
2. STREAMBANK REFORESTATION USING BARE ROOTED SEEDLINGS SHALL BE PLANTED 6 FT. TO 10 FT. ON CENTER, RANDOM SPACING, AVERAGING 8 FT. ON CENTER, APPROXIMATELY 680 PLANTS PER ACRE.

SEE PLAN SHEETS FOR AREAS TO BE PLANTED





LIVE STAKE SCHEMATIC



CROSS SECTIONAL VIEW

BANK STABILIZATION WITH LIVE STAKES

NOTES:

1. LIVE STAKES SHALL BE SPACED APPROXIMATELY 4 FEET ON CENTER

2. LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY 3/4 OF LIVE STAKE IS WITHIN GROUND

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BSmith

SHEET NAME		SHEET NUMBER
PLANTING		P-4
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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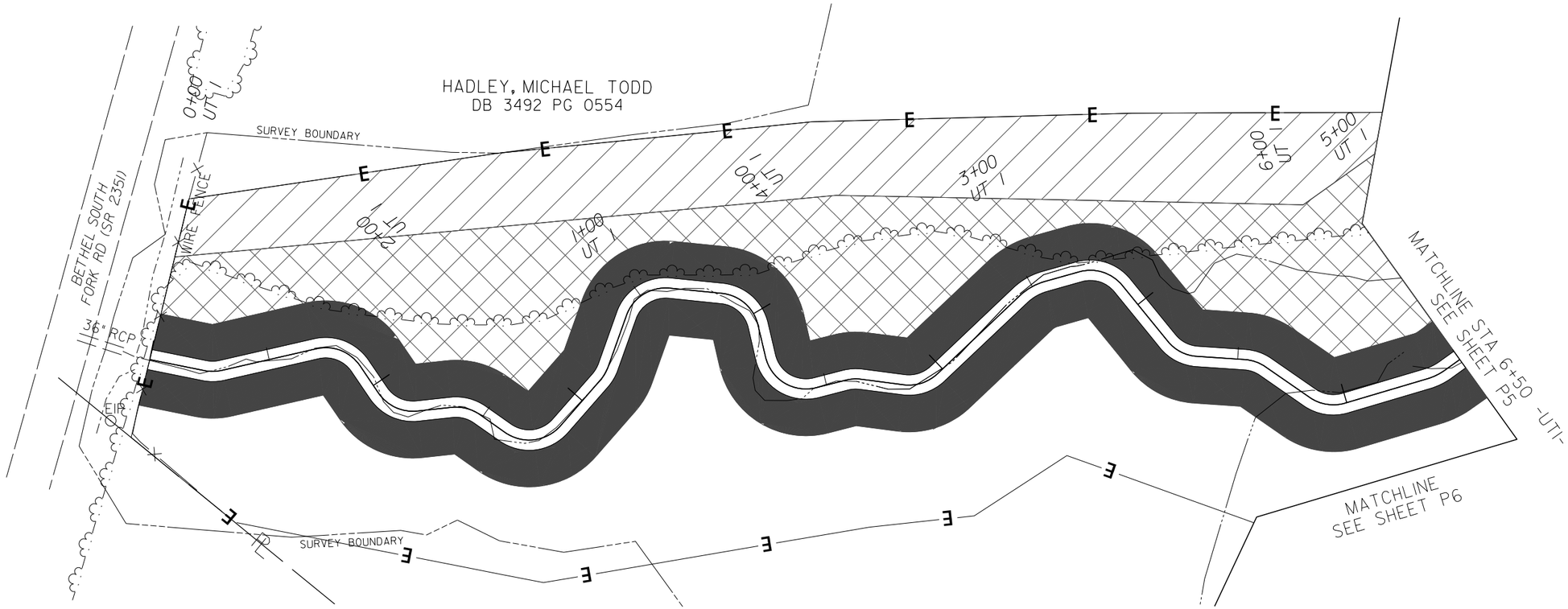
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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SHEET NAME		SHEET NUMBER
PLANTING		P-5
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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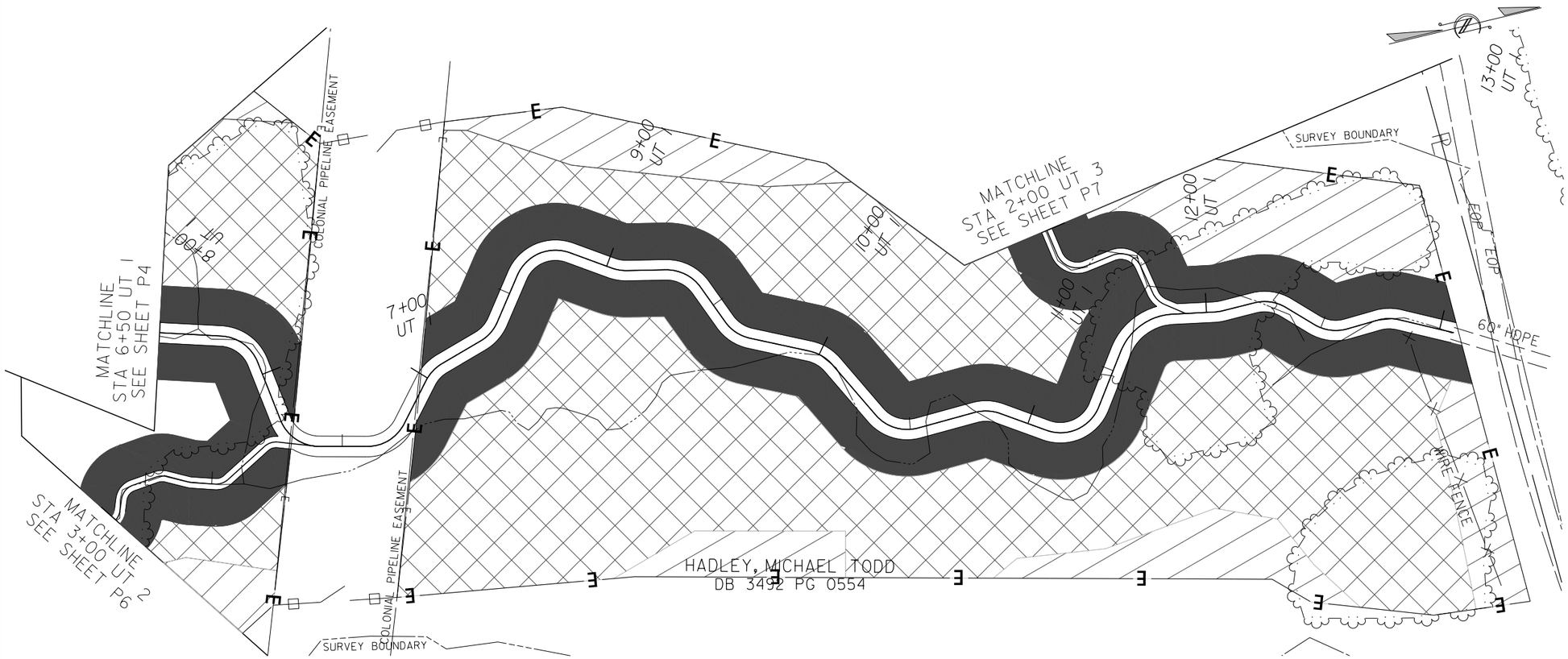
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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BSmith

SHEET NAME		SHEET NUMBER
PLANTING		P-6
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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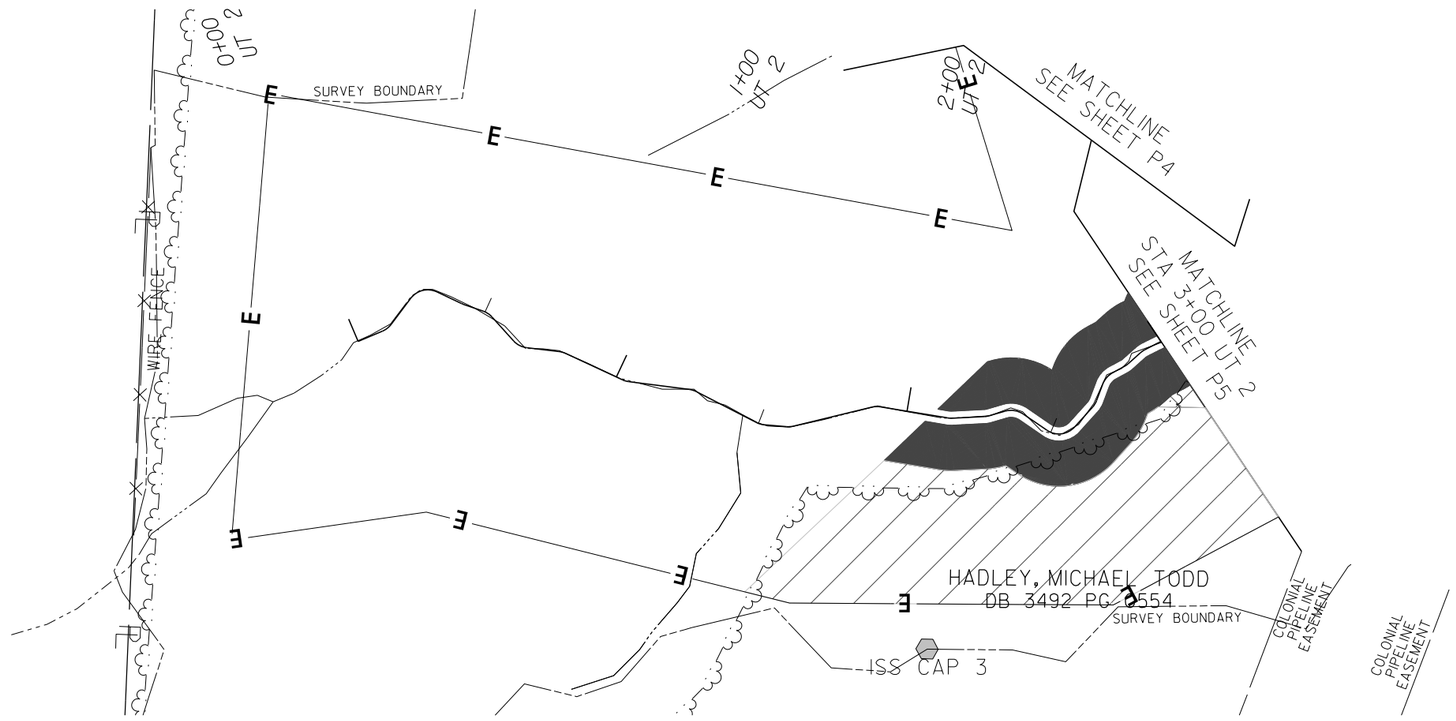
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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BSmith

SHEET NAME		SHEET NUMBER
PLANTING		P-7
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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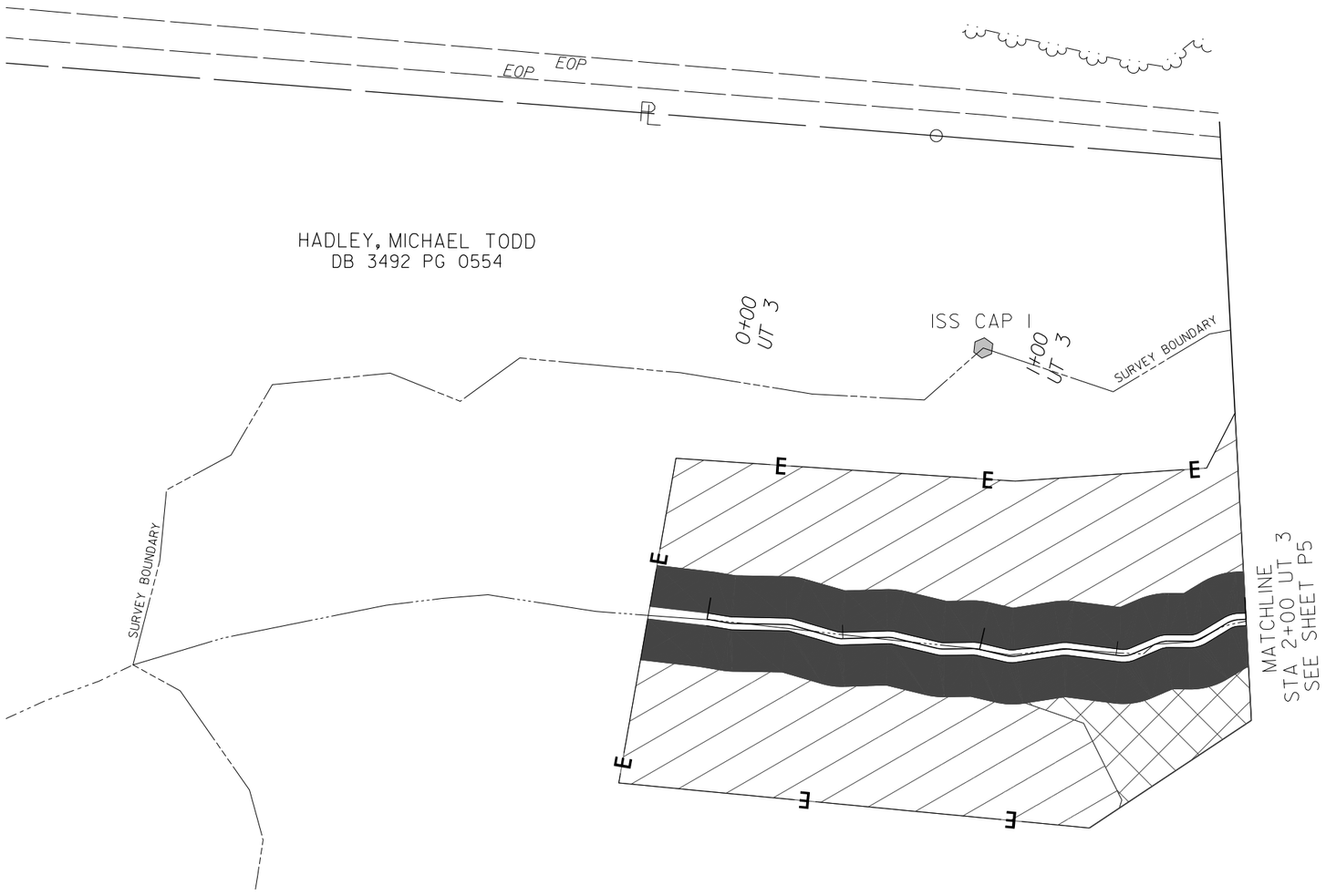
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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SHEET NAME	SHEET NUMBER
PLANTING	P-8
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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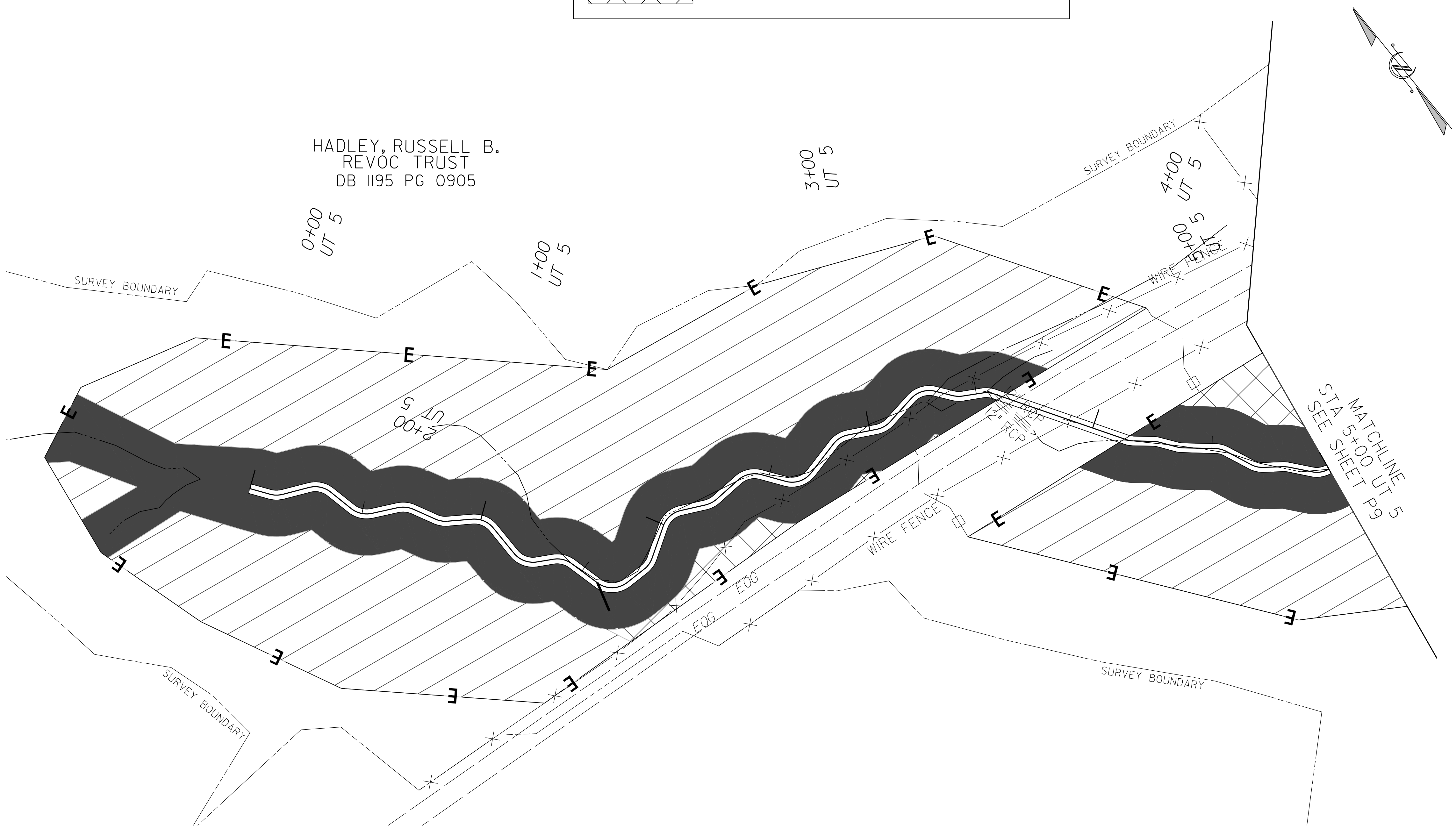
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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SHEET NAME		SHEET NUMBER
PLANTING		P-9
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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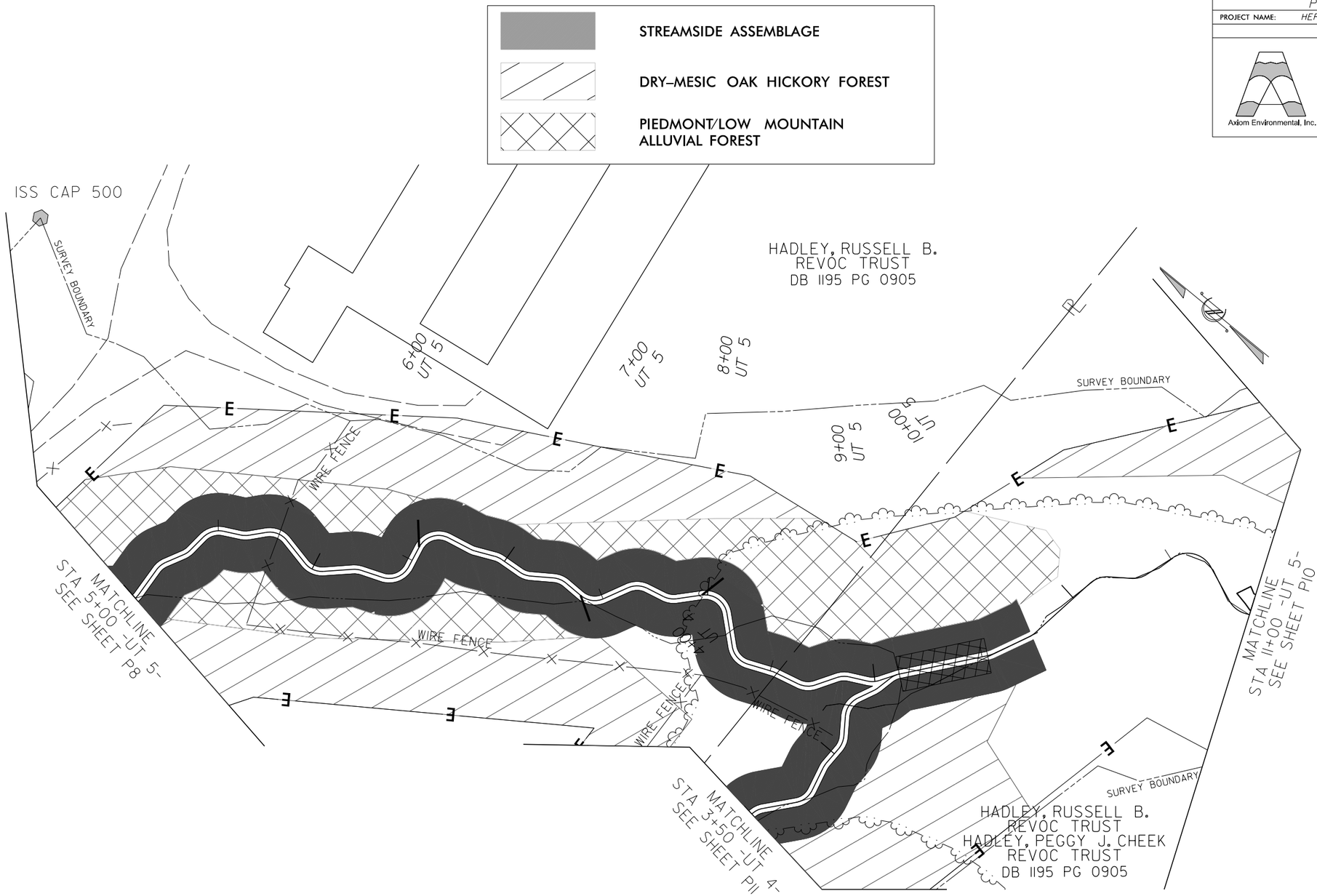

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SHEET NAME		SHEET NUMBER
PLANTING		P-10
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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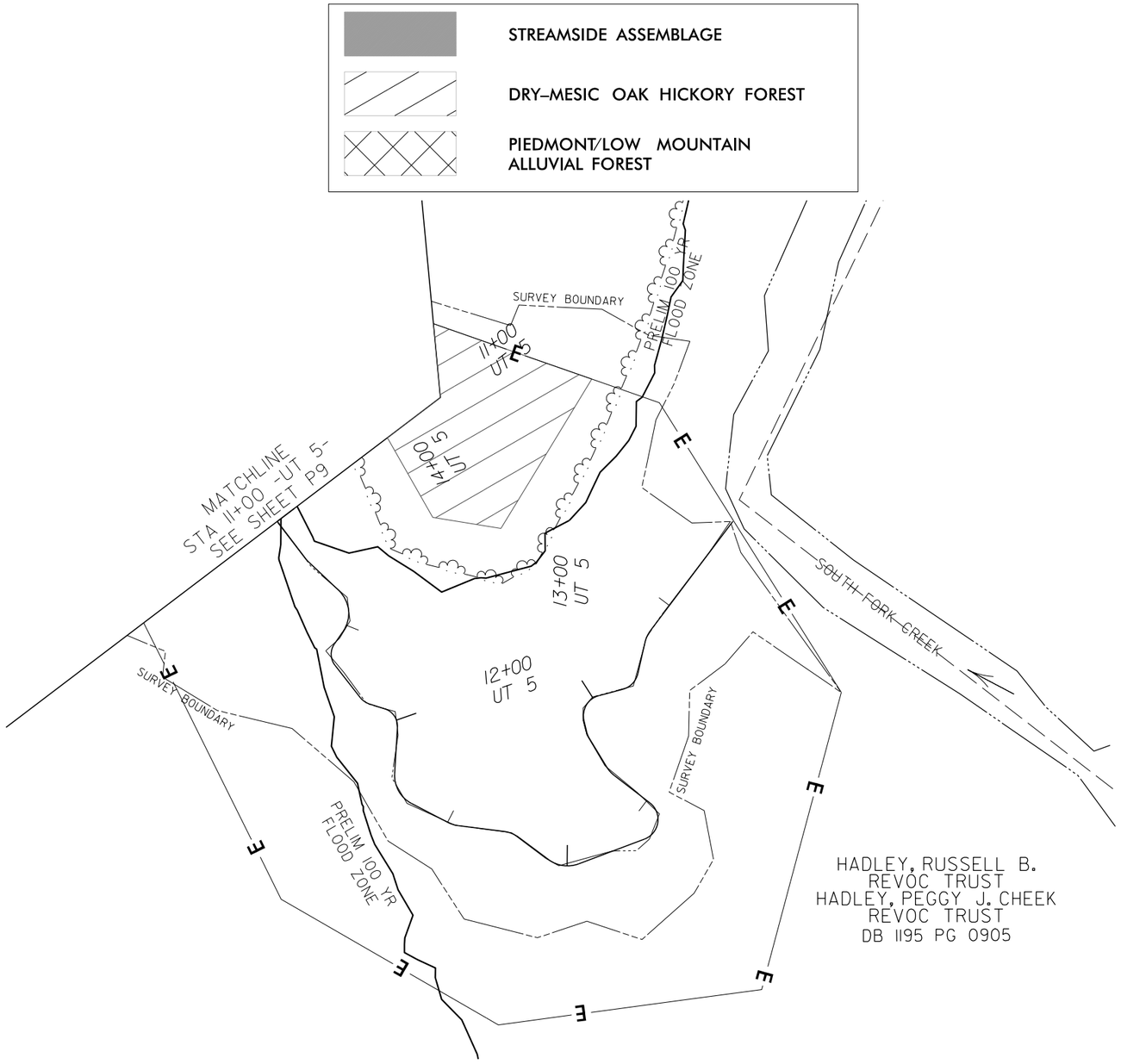

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SHEET NAME		SHEET NUMBER
PLANTING		P-11
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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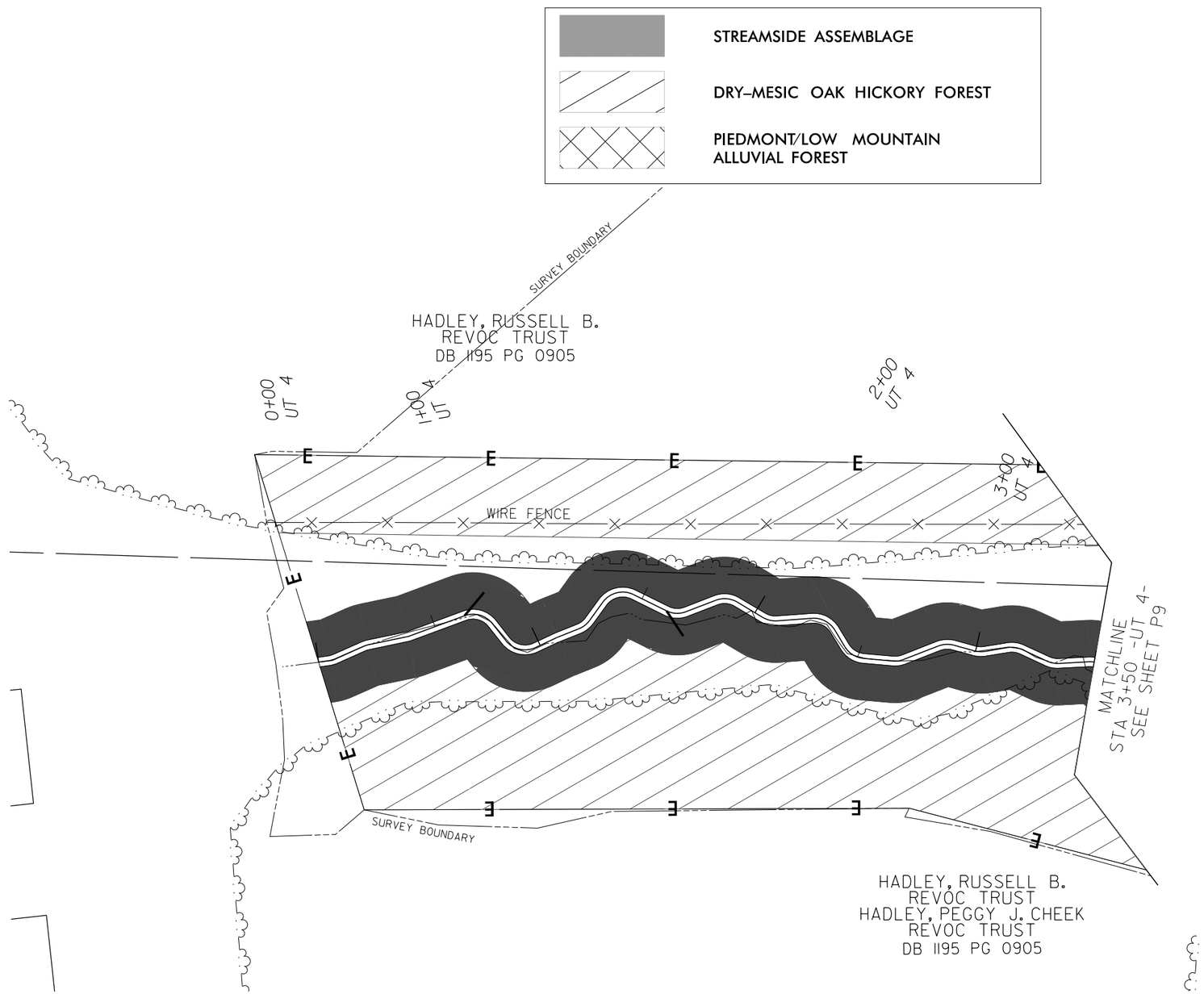

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SHEET NAME		SHEET NUMBER
PLANTING		P-12
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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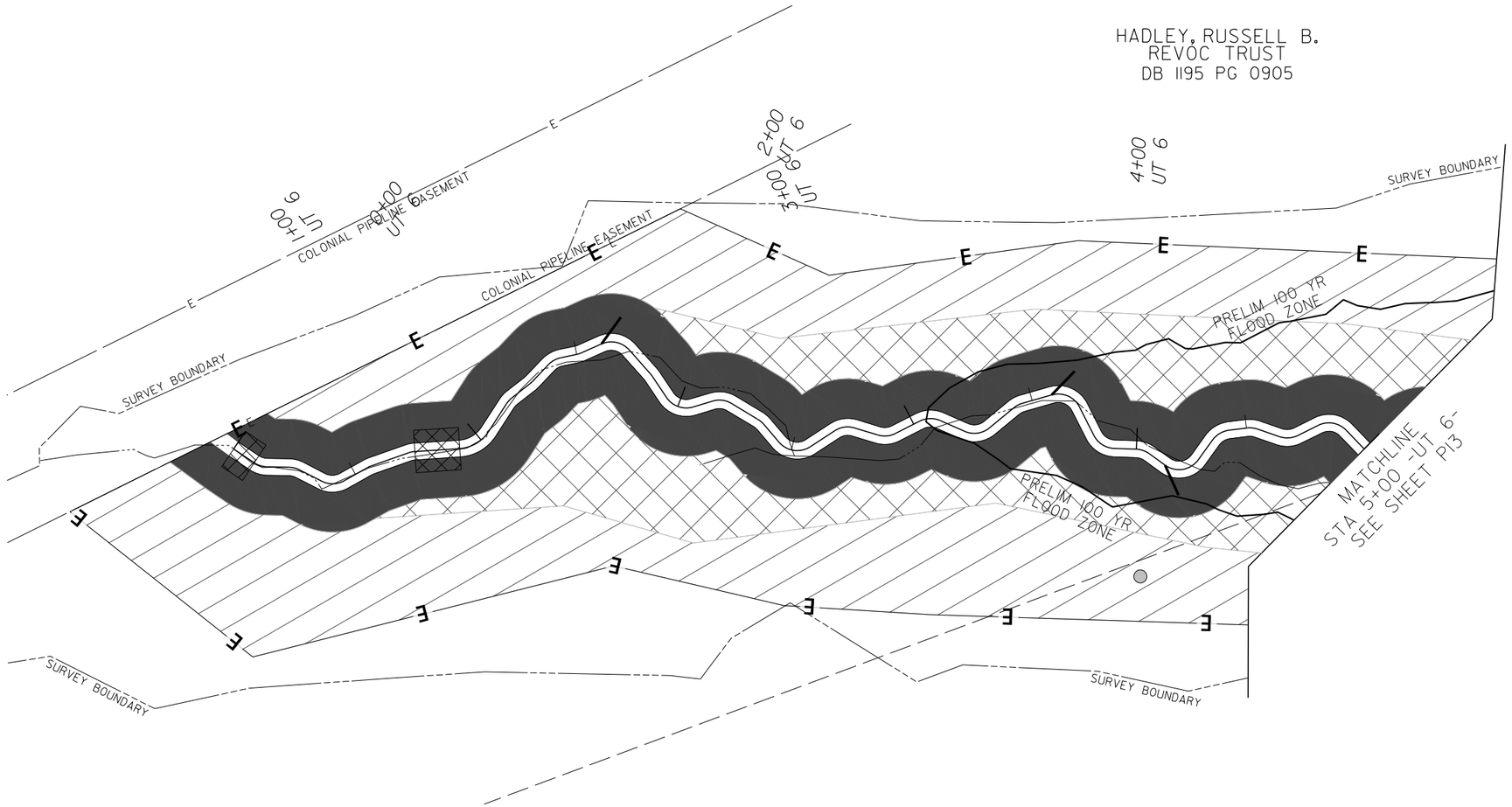
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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Heron_psh_P12.dgn
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SHEET NAME		SHEET NUMBER
PLANTING		P-13
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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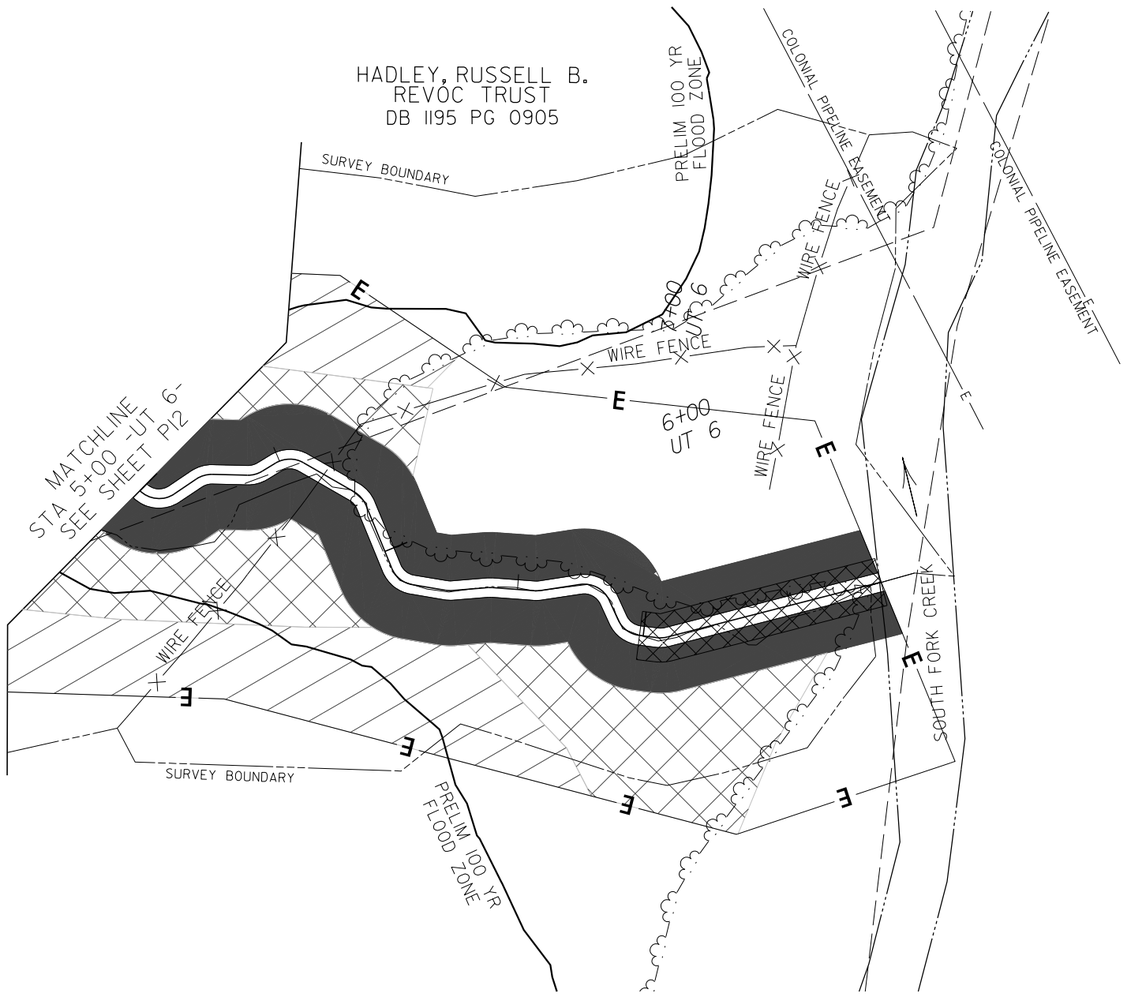
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



SHEET NAME		SHEET NUMBER
PLANTING		P-14
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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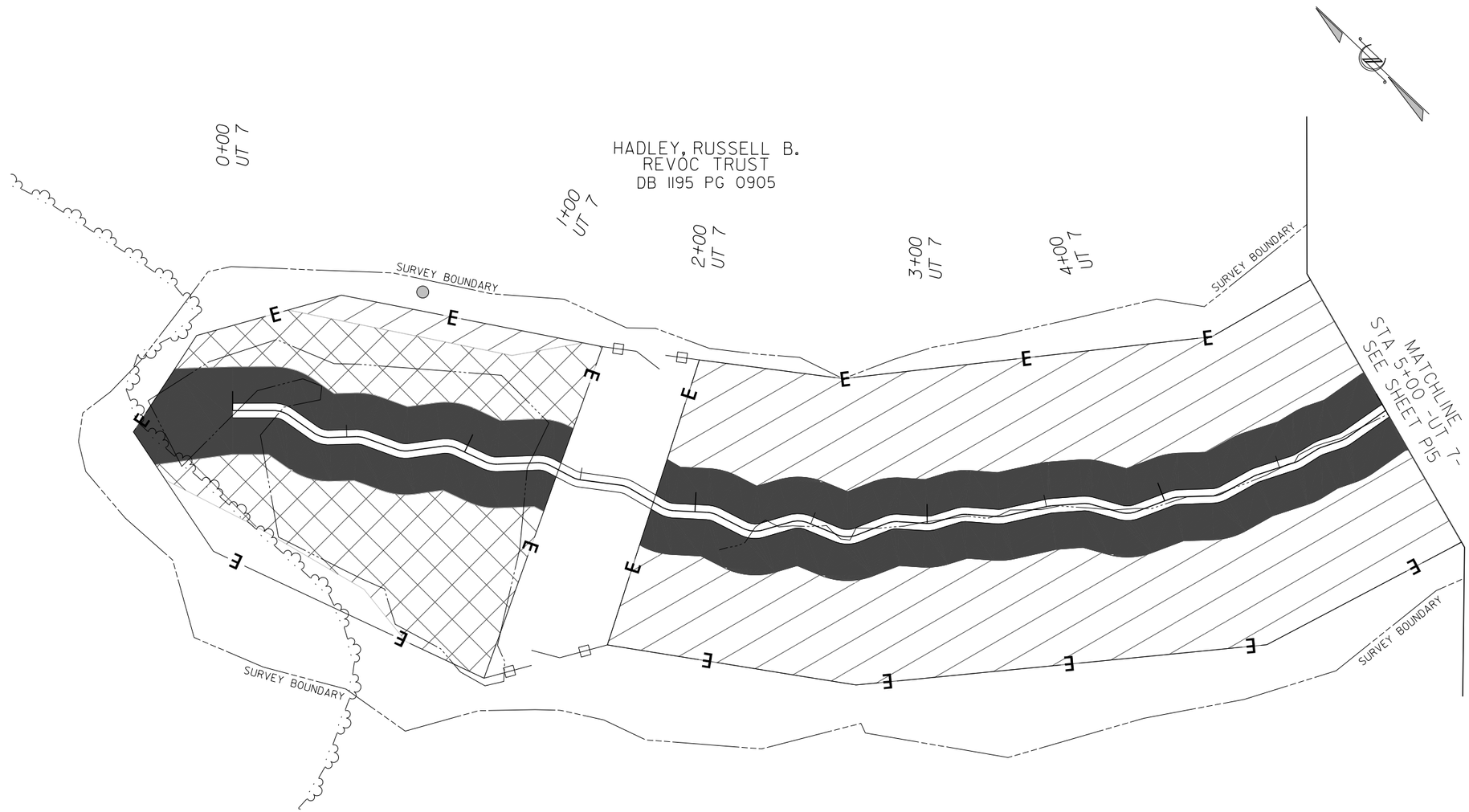
STREAMSIDE ASSEMBLAGE

DRY–MESIC OAK HICKORY FOREST

PIEDMONT/LOW MOUNTAIN ALLUVIAL FOREST



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SHEET NAME		SHEET NUMBER
PLANTING		P-15
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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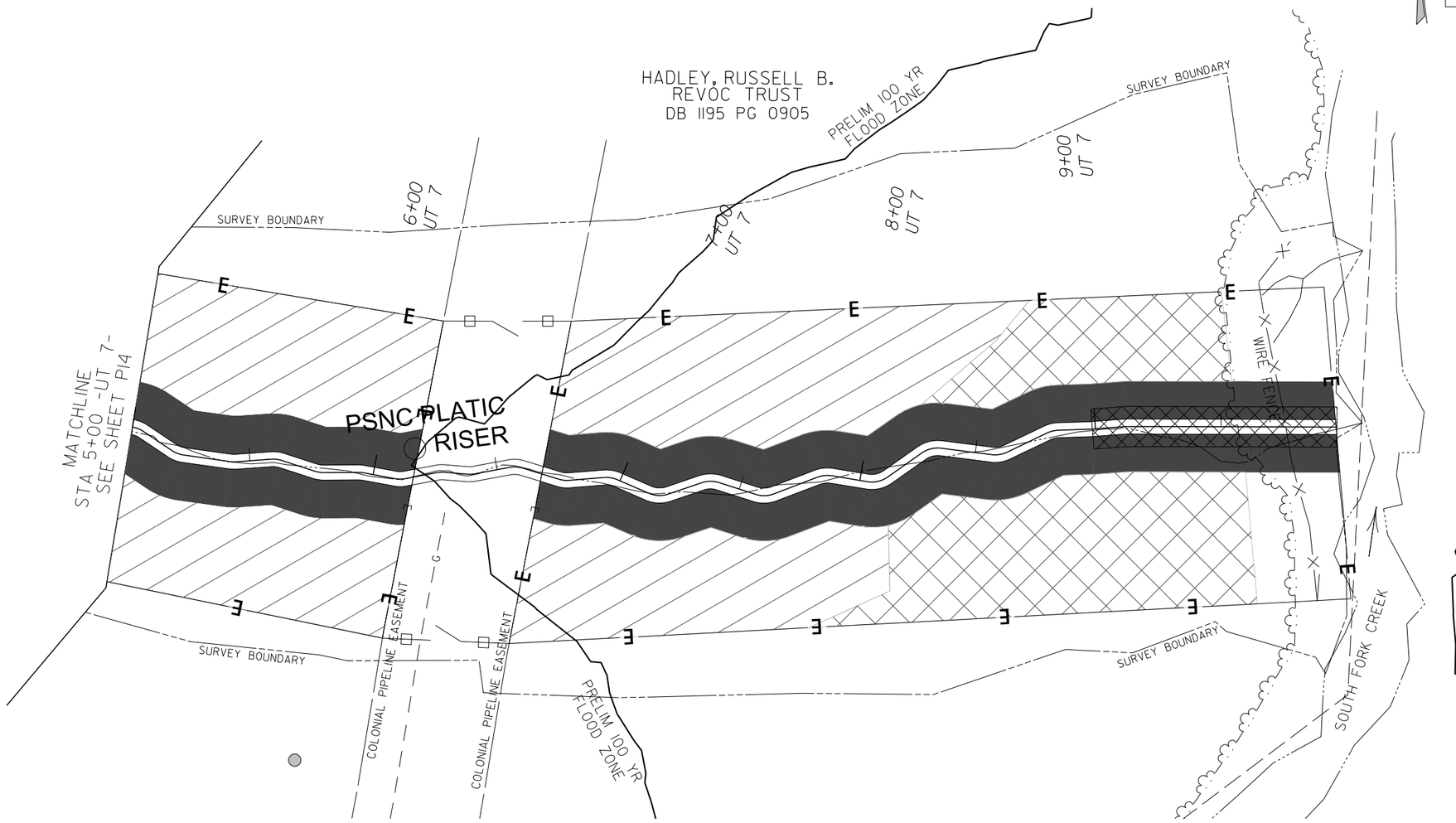

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BSmith

SHEET NAME		SHEET NUMBER
PLANTING		P-16
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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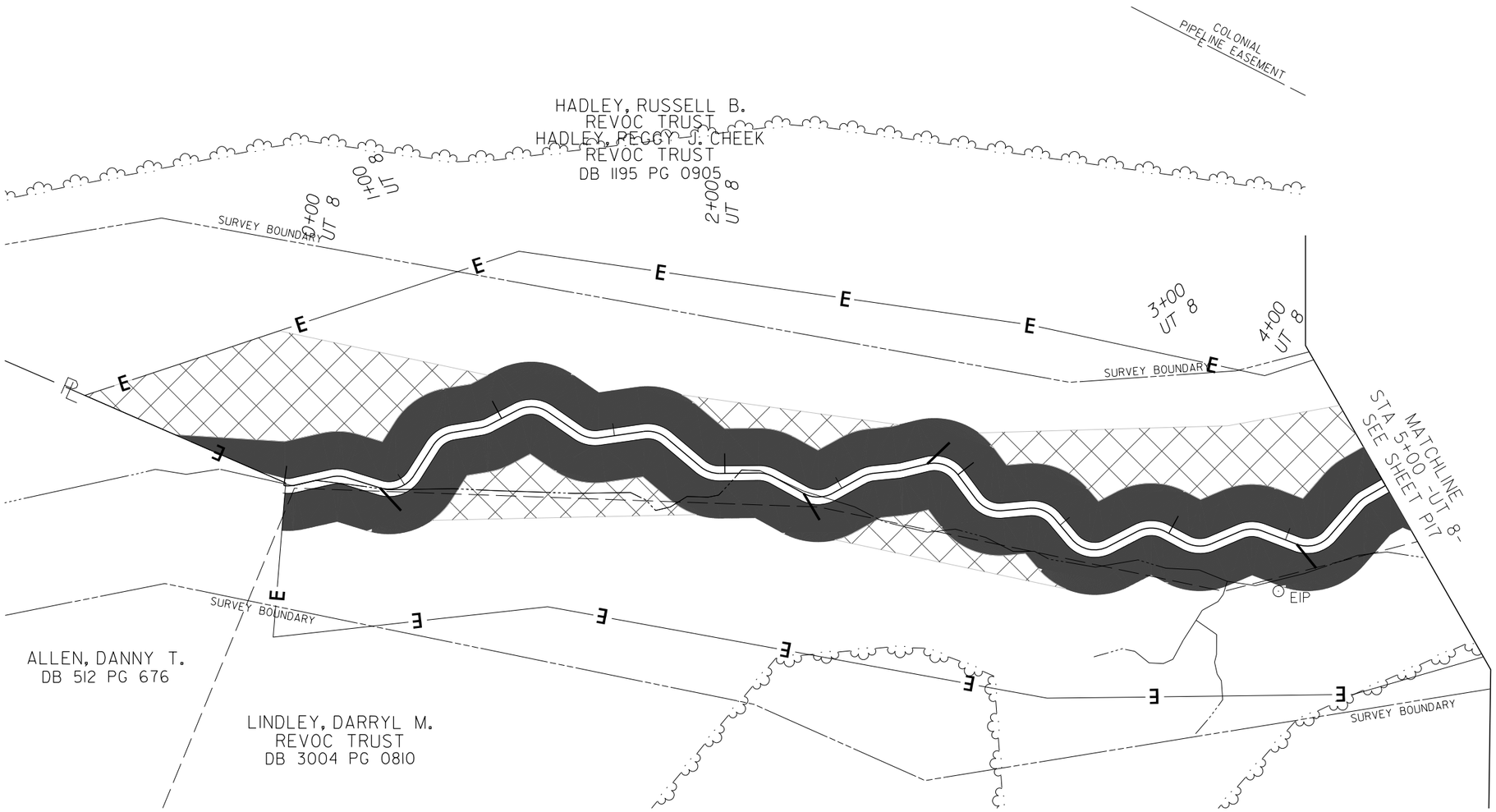

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Heron_psh_P16.dgn
BSmith

SHEET NAME		SHEET NUMBER
PLANTING		P-17
PROJECT NAME: HERON STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

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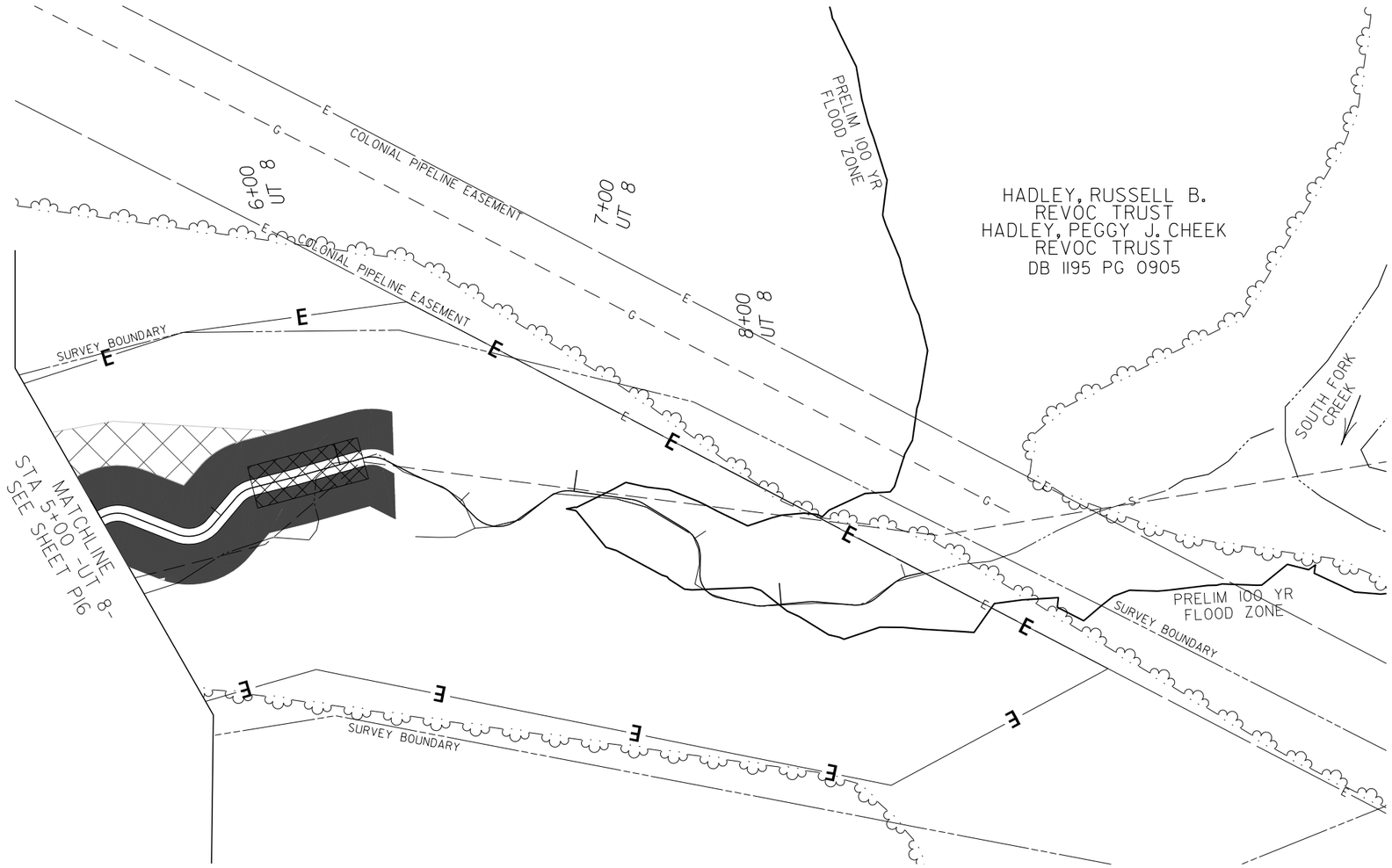

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