MITIGATION PLAN
BRAHMA SITE
Alamance County, North Carolina

DMS Project ID No. 100092
Full Delivery Contract No. 7743
USACE Action ID No. SAW-2019-00126
NCDWR No. 20190158
RFP No. 16-007571

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 2020

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Prepared by:

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And

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July 2020

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

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

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

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

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Brahma Mitigation Plan IRT Comment Responses:

DWR Comments, Mac Haupt:

1. Section 1.3- Please be sure to design the appropriate sized bmp to treat the water coming from the chicken houses. In addition, if waste management changes at the property, the Adaptive Management Plan should include measures to treat the water at various drainage swales that enter the project.
    - Marsh treatment areas have been sized based on drainage area and impervious surface. Some marsh treatment areas are limited in size due to easement boundary constraints; however, please note marsh treatment areas are not BMPs. They are shallow depressions that attenuate the initial stormwater pulse and are expected to fill with sediment and naturalize over time. At that point, the naturalized marsh treatment area and adjacent wetlands will perform the primary function of treatment.
    - As an additional note, drainage pipes from the chicken houses are not underdrains from the houses and are simply conveying water from impervious surfaces adjacent to the chicken houses.
2. Table 7- Reaches UT3 and UT6 show very small drainage areas. These two tributaries will be at risk for maintaining appropriate channel features. DWR does appreciate that flow gauges will be installed on these reaches.
    - Understood.
3. Section 8.1.1- DWR likes the inclusion of the marsh treatment areas. This property will likely need these treatment areas for upcoming development. DWR believes some of these marsh treatment areas may need to be larger than others. In the future, DWR recommends laying out more specific details in the plan sheets given the contributing drainage area.
    - Please see answer for comment number 1.
4. Section 8.2-UT1 B- existing conditions- this reach does not appear to have a sinuosity of 1.33.
    - Since UT 1B is a relatively short reach of Enhancement (Level II) the sinuosity was lumped with the downstream preservation reach of UT 1C.
5. Table 14- DWR requires that no more than 5% of the site should be planted in Green Ash.
    - The planting table will be updated once trees are ordered in the late summer. Green Ash will be removed or reduced to less than 5% of the planting density.
6. Table 17- DWR concurs with the wetland performance criterion of 12% saturation within the growing season.
    - Understood.
7. Design sheet 5- DWR requires a wetland monitoring gauge at station 8+00 on stream right approximately 40 feet out into the floodplain.
    - A groundwater monitoring gauge has been added at approximately station 8+00, stream right (+/- 40 ft from top of bank). Please note this is a Wetland Enhancement area. No hydrologic functional improvement is being requested in the vicinity of the requested groundwater gauge.
8. Design sheet 6- DWR requires a wetland monitoring gauge at station 13+25 on stream right approximately 60 feet out into the floodplain. Also, is there supposed to be another marsh treatment area (or two?). It appears that on the Monitoring Plan, Figure 10A, shows 3 marsh treatment areas.
    - A groundwater monitoring gauge has been added at approximately station 13+25, stream right (+/- 60 ft from top of bank). Please note this is a Wetland Enhancement area. No hydrologic functional improvement is being requested in the vicinity of the requested groundwater gauge.

9. Design sheets 16 and 17 (perhaps others)- DWR notes some overlap of the wetland re- establishment and enhancement credit areas with marsh treatment areas. These areas should not overlap, given the construction, excavation and outlet (rip rap) construction.
    - Marsh treatment areas are not depicted at the design scale and are typically very shallow

wetland depressions. We believe that these small depressions should not be excluded from wetland credit areas due to their small size and they are expected to fill with sediment and naturalize over time.

10. Design sheet 19- for reach UT6, DWR believes that stream credit should not initiate until station 1+00 or even farther down. DWR believes this upper reach will be at risk for maintenance of appropriate channel flow.
    - We believe the spring for UT6 initiates at the upper reaches of the pond, as depicted in our plan sheets. We will monitor the upper reaches visually and with a camera to ensure stream origin location. At this time, we respectfully request to leave the UT6 origin location at our current stationing.

WRC Comments, Travis Wilson:

1. For stream crossings it would be beneficial to have the culvert invert elevations labeled on the plans
    - a table has been added on Sheet 2, Permanent Crossing, that has centerline stationing, pipe diameter and length, invert information, and bury depth.
2. It would be beneficial to including a cross section detail specific to each culverted stream crossing. That will allow a better assessment of the culvert sizing and configuration within the crossing
    - We are hopefully the table on Sheet 2 will satisfy any concerns.
3. Planting plan has green ash (*Fraxinus pennsylvanica)* at 10% . Due to the increasing presence of Emerald Ash Borer the amount should be reduced to a maximum of 5%
    - The planting table will be updated once trees are ordered in the late summer. Green Ash will be removed or reduced to less than 5% of the planting density.

EPA Comments, Todd Bowers:

1. Section 1.4/Page 13 Project Components and Structure:
    a. Proposed activity for the site is summarized here and refers to Table 1 and Figures 6A and 6B. Several errors were noted throughout the document that do not match the totals for wetland activity listed here and will be addressed below.
        - After review of Table 1 and Figures 6A/6B we have not found any errors.
2. Section 3.5.1/Page 25 Hydrological Characterization:
    a. Wetland acreage activity totals do not match Section 1.4, Table 1 or Figures 6A and 6B. The listed totals do match Figures 10A and 10B. Please confirm and correct.
        - Text in Section 3.5.1 has been updated and corrected.
3. Table 9/Page 27 Reference Forest Ecosystem
    a. Recommend referring to this list to choose an alternate to planting Fraxinus pennsylvanica and for a suitable understory species such as Carpinus caroliniana.
        - The planting table will be updated once trees are ordered in the late summer. Green Ash will be removed or reduced to less than 5% of the planting density.
4. Section 6.0/Page 29 Functional Uplift and Project Goals/Objectives:
    a. "One marsh treatment area will be installed." The location of this singular marsh treatment area is unknown and there are a total of 12 MTAs shown Figures 6A and 6B.
        - Text has been updated.
5. Table 12C/Page 32 Stream/Wetland Targeted Functions, Goals and Objectives.
    a. "Install one marsh treatment area" The location of this singular marsh treatment area is unknown and there are a total of 12 MTAs shown Figures 6A and 6B.
        - Text in Table 12 has been updated.
6. Section 8.1/Page 34: Stream Design
    a. "Construction of a marsh treatment area" The location of this singular marsh treatment area is unknown and there are a total of 12 MTAs shown Figures 6A and 6B.
        - Text has been updated.

7. Section 8.1.1/Page 35: Stream Restoration
    a. Is it possible to get the crossing on UT2 moved upstream to avoid wetland and riparian zone impacts/interference near the confluence with UT1?
        - The crossing location was requested by the landowner.
8. How do the eleven shallow marsh treatment areas differ from the singular MTA referenced above?
        - Text has been updated to indicate that multiple marsh treatment areas are being installed at the Site.
9. Recommend mentioning the new poultry house outfall protection/treatment if the purpose is related to these MTAs.
        - Marsh treatment areas are discussed in Section 8.1.1 and are expected to treat the initial stormwater pulse from agriculture areas. This would include drainage from adjacent to the poultry houses. The pipe outfalls from the poultry houses are not underdrains that remove waste, simply stormwater drainage from impervious surfaces adjacent to the poultry houses.
10. Section 8.2.1/Page 36 UT1
    a. There are only 3 reaches on UT1 (A-C).
        - Text has been updated.
11. UT1C is listed for Enhancement treatment when it should be Preservation.
        - Text has been updated.
12. Section 8.3/Page 42 Wetland Reestablishment
    a. Recommend adding livestock removal and fencing out as part of wetland reestablishment.
        - Text has been updated to include livestock removal through fencing.
13. 4.481 acres of wetland reestablishment does not match Section 1.4, Table 1 or Figures 6A and B.
        - Text has been updated to match Table 1 and associated Figures.
14. Section 8.4/Page 42 Wetland Enhancement
    a. 3.715 acres of wetland enhancement does not match Section 1.4, Table 1 or Figures 6A and B.
        - Text has been updated to match Table 1 and associated Figures.
15. Section 8.6.1/Page 43 Planting Plan
    a. Explain if there are to be two target communities or three? This cites floodplain (Piedmont Alluvial Forest), upland slopes (Dry-Mesic Oak-Hickory Forest) and then there is the "streamside assemblage" which is basically the PAF at a quadruple density. Monitoring for each plant community or landscape position should be ensured. The DMOHF community type is not represented in the planting plan or Figures 9A and B.
        - Dry-Mesic Oak-Hickory Forest has been removed as a planning zone.
16. Table 14: Recommend restricting or removing Green ash (Fraxinus pennsylvanica) from the planting list due to potential for emerald ash borer infestation.
        - The planting table will be updated once trees are ordered in the late summer. Green Ash will be removed or reduced to less than 5% of the planting density.
17. Table 17/Page 46 Success Criteria (Wetland Hydrology)
    a. Recommend adding the growing season listed in Table 16 (March 1- October 22) and number of days to achieve the 12 percent of the growing season just to remove any ambiguity.
        - The growing season length will vary from year to year depending on soil temperature data collected at the Site. The March 1 growing season start will only occur if soil temperature and bud burst criteria are met. Therefore, we are not able to put an absolute day length requirement in the text beyond what has been outlined.
18. Section 9.2.3/Page 47 Vegetation Contingency
    a. Recommend denoting when supplemental planting will occur (Dec-Mar) to avoid planting in May (or later) situations. Denote how long monitoring of supplemental planting will occur before success is achieved.
        - Text has been updated to include planting dates (Dec-Mar) and monitoring verbiage has been added to include IRT approval of supplemental planting.

USACE Comments, Kim Browning:

1. On future projects, please keep the same stream and wetland labels throughout the life of the project. It's difficult to refer to notes from the technical proposal and compare them to the JD and mitigation plan when labels change. It appears that UT1 was split into UT1 and UT7 after the IRT site visit.
    - Understood. To clarify, UT 7 is a small stream that was added during the PJD and UT 1 did not get split.
2. Figure 9A and Table 14: Please limit Green Ash to no more than 5% of the planted species due to the Emerald Ash Borer.
    - The planting table will be updated once trees are ordered in the late summer. Green Ash will be removed or reduced to less than 5% of the planting density.
3. UT4: Though this reach is planned as EII, during the IRT site visit we discussed that this should be treated as a headwater valley and awarded credit based on valley length. Page 28 indicates that this reach is a wetland. Please verify that valley length was used to calculate credits. Additionally, this reach will need to meet headwater stream performance standards in order to receive stream credit.
    - UT 4 is not included in wetland mitigation totals. The stream was credited at valley length, using headwater stream guidance and performance standards.
4. Please add a veg plot on UT6 where the pond sediment is to be removed, random is fine.
    - A vegetation plot has been added in the upper reaches of UT 6, pond bed.
5. UT2: During the IRT site visit this reach was noted to be intermittent and likely dry during summer months. Please install a flow gauge in the upper third of this reach, Providing photo/video documentation of flow on intermittent reaches will be helpful.
    - Although typically, EII reaches do not require flow monitoring, we added a flow gauge in the upper one third of UT 2.
6. Table 4: Please add reach summary data for EI and EII reaches.
    - Table 4 has been updated to include each reach.
7. Section 4.2 and Table 9: Please note that although the reference forest ecosystem and the Schafale and Weakley references list sweetgum as a reference species, sweetgum will not be counted towards meeting vegetative success criteria.
    - Understood.
8. During the IRT site visit it was mentioned that new chicken houses were planned on the property. Please ensure that the conservation easement does not allow for chicken litter to be spread in the buffer.
    - Section 1.3 Physiography and Land Use outlines chicken litter disposal protocols. We have used the most current NCDMS conservation easement (recorded at the Alamance County register of deeds). Part 2, Sections F and J of the recorded conservation easement prohibit these actions.
9. The NCSAM/WAM summary tables 12A and 12B are helpful. It would be helpful to include NCSAM data for all reaches to show the current functional assessment.
    - It is typical for one WAM or SAM form to document similar conditions on multiple reaches. If clarification of which reaches is required, we can accommodate that request. If in the future a single SAM or WAM is required for each stream, we will collect that data.
10. Section 8.1.1, Marsh Treatment Areas: Please ensure that these BMPS are placed outside jurisdictional features. It appears that several of these marsh treatment areas will be placed within wetlands. This is acceptable provided that they remain wetlands when the work is complete. Otherwise please remove these areas from wetland credit and account for the loss in the impact tables.
    - Marsh treatment areas are not depicted at the design scale and are typically very shallow wetland depressions. We believe that these small depressions should not be excluded from wetland credit areas due to their very small size and are expected to fill with sediment and naturalize over time.
11. UT3: The figures show a pipe under the road that will be upgraded and is outside the easement. If it is

simply a replacement and you are not proposing to make it longer or place it in a new location, then it would be exempt. Please note that crossings in new locations on existing tributaries will require a separate permit.

- This crossing is replacing the pipe in place at the same length and location. In addition, the reach is not a jurisdictional feature at the road. Therefore, this action should be exempt.

12. Page 26: UT1C Mitigation treatment should read Preservation.
    - The text has been updated to Preservation.
13. During planting, if species substitutions occur due to availability or refinement, please red-line the As-Built and MY0 report if substitutions occur.
    - Understood. Species substitutions are expected to occur depending on availability. These will be noted on the As-built.
14. Table 17: Continuous surface flow for at least 30 consecutive days is only applicable to intermittent streams.
    a. Volunteer stems that are included in the planting list may be counted after two years.
        - Understood.
    b. Recommend adding a performance standard for visual monitoring, to include permanent photo points (depicted on monitoring map).
        - Permanent photo points are taken at each cross section and vegetation plot, which should be sufficient photographic documentation.
15. Section 9.2: I appreciate the thoughtfulness of this section. It may be beneficial to add discussion on other potential risks, such as adjacent development or logging, beaver, or road/culvert maintenance.
    - Additional text has been added to Section 9.2 to include development/logging, beaver and other nuisance species, and road/culvert maintenance.
16. Please provide a brief description on where the spoil from the bond bottom will be spread, and the method of fescue removal.
    - A note was added to Section 8.2.6 (UT 6) that includes texts that sediment from the pond bottom will be mixed with spoil material and used as backfill for abandoned/reduced channels.

    - Text as added to Section 8.6.2 (Nuisance Species Management) outlining herbicide application to fescue areas.

TABLES

APPENDICES

1.0 PROJECT INTRODUCTION

The Brahma Site (hereafter referred to as the "Site") encompasses 22.7 acres of disturbed forest and livestock pasture along unnamed tributaries to Reedy Branch (warm water streams in the Jordan Lake watershed). The Site is located approximately 2 miles south of Snow Camp, NC, 5 miles northeast of Silk Hope, NC, and southwest of Clark Road (SR 2352) in southern Alamance County (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; travel 1.8 miles,
- Turn left onto Silk Hope Gum Springs Road; travel 12.2 miles,
- Turn right onto Siler City-Snow Camp Road; travel 4.1 miles,
- Turn right onto Clark Road and travel 1.2 miles; the Site is located on the right side of the road.
    - Site Latitude, Longitude
      35.8584ºN, 79.4106ºW (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] subbasin number 03-06-04) [Figures 1 and 2, Appendix A]). Site hydrology drains to Unnamed Tributaries to Reedy Branch (Stream Index Number 16-28-3), which has been assigned a Best Usage Classification of **WS-V; NSW** (NCDWR 2013). Reedy Branch is not listed on the NCDENR final 2016 303(d) list (NCDEQ 2018).

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 645 feet National Geodetic Vertical Datum (NGVD) at the upper reach to a low of 600 feet NGVD at the Site outfall (USGS Crutchfield Crossroads, North Carolina 7.5-minute topographic quadrangle) (Figures 1 and 3, Appendix A).

The Site provides water quality functions to an approximately 0.36-square mile (231-acre) watershed at the outfall; Site tributary watershed sizes range from 0.003-0.09 square miles (2-57 acres) (Figure 3, Appendix A). The watershed is dominated by pasture, agricultural land, forest, and sparse residential development. Impervious surfaces account for less than 2 percent of the upstream watershed land surface.

Land use at the Site is characterized by disturbed forest and livestock pasture. Riparian zones are primarily composed of herbaceous vegetation that is sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities.

During mitigation plan preparation, two Pilgrims Pride chicken houses were being constructed on the property adjacent to the southeast portion of UT 1. The chicken houses were constructed on pads that have a groundwater drainage network leading to two pipes that discharge adjacent to the easement. The pipes do not drain effluent from the chicken houses and discharge clean water. Most drainage from the chicken house facilities drains through a draw that will be treated at the easement boundary and then discharged in wetlands prior to entering Site tributaries.

Chicken waste management is being managed through a Joint Responsibility – Producer/Third-Party Applicator agreement in a manner consistent with requirements set forth by the State of North Carolina in 15A NCAC 02T Section 1400 (Manure Hauler Regulations) and NRCS standard 633 (Waste Utilization). Documentation of the agreement is available upon request. Under the agreement the producer maintains the responsibility for keeping records on the amount of waste generated by the operation and providing the responsible third party with waste analysis records. The third-party applicator is responsible for applying materials at agronomic rates, soil testing, field evaluation, etc.

At present, no waste is to be discharged onto the property adjacent to the Site easement. If waste management changes at the property, there are minimum setbacks for waste management that include 100 feet from perennial waters.

1.4 Project Components and Structure

The Site encompasses 22.7 acres of disturbed forest and livestock pasture along the warm waters of unnamed tributaries to Reedy Branch. In its current state, the Site includes 6888 linear feet of degraded stream channel (based on the approved PJD), 4.427 acres of degraded wetland, 0.29 ac of open water, and 5.157 acres of drained hydric soil (Figure 4, Appendix A).

Proposed Site restoration activities include the construction of meandering, E/C-type stream channel resulting in 740 linear feet of stream restoration, 3034 linear feet of stream enhancement (Level I), 2378 linear feet of stream enhancement (Level II), 911 linear feet of stream preservation, 4.740 acres of riparian wetland reestablishment, 3.709 acres of riparian wetland enhancement, and 0.601 acre of riparian wetland preservation (Table 1) (Figures 6A-6B, 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
Brahma Site

Project Segment	Stream Stationing/ Wetland Type	Existing Footage/ Acreage	Mitigation Plan Footage/ Acreage	Mitigation Category	Restoration Level	Mitigation Ratio	Mitigation Credits	Comment
UT 1A-E1	02+56-34+51	3034	3195-161= 3034	Warm	EI	1.500	2022.667	161 lf is located outside of the easement and therefore is not generating credit
UT 1B-EII	34+51-36+43	192	192	Warm	EII	2.500	76.800	
UT 1C-P	36+43-45+54	911	911	Warm	P	10.000	91.100	
UT 2A-EII	00+00-00+30	35	30		EII	2.500	12.000	
UT 2-EII	00+00-13+84	1354	1384-30= 1354	Warm	EII	2.500	541.600	30 lf is located outside of the easement and therefore is not generating credit
UT 3-R	00+00-02+39	153	239	Warm	R	1.000	239.000	
UT 4-EII	00+00-01+29	NA	129	Warm	EII	2.500	51.600	
UT 5-EII	00+00-06+57	618	657-31= 626	Warm	EII	2.500	250.400	31 lf is located outside of the easement and therefore is not generating credit
UT 6-R	00+00-05+01	110	501	Warm	R	1.000	501.000	
UT 7-EII	00+00-00+47	47	47	Warm	EII	2.500	18.800	
Wetland Reestablish	RR	--	4.740	NA	Reestablish	1.000	4.740	
Wetland Enhancement	RR	4.427	3.709	NA	E	2.000	1.855	
Wetland Preservation	RR	0.601	0.601	NA	P	10.000	0.060	

Table 1. Project Credits (continued)
Brahma Site

Restoration Level	Stream			Riparian Wetland		Non-riparian wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Nonriverine		
Restoration	740.000	--	--	--	--	--	--
Re-establishment	--	--	--	4.740	--	--	--
Rehabilitation	--	--	--	--	--	--	--
Enhancement	--	--	--	1.855	--	--	--
Enhancement I	2022.667	--	--	--	--	--	--
Enhancement II	951.200	--	--	--	--	--	--
Creation	--	--	--	--	--	--	--
Preservation	91.100	--	--	0.060	--	--	--
Benthics 2%	76.099	--	--	--	--	--	--
Totals	3881.066	--	--	6.655	--	--	--

Table 2. Project Activity and Reporting History
Brahma Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal	August 2018	August 2018
Institution Date	--	December 2018
Mitigation Plan	--	April 2020
Construction Plans	--	April 2020

Table 3. Project Contacts Table
Brahma 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
Brahma Site

Project Information	
Project Name	Brahma Site
Project County	Alamance County, North Carolina
Project Area (acres)	22.7
Project Coordinates (latitude & latitude)	35.8540ºN, 79.4106ºW
Planted Area (acres)	17.7
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)	231
Percentage of Project Drainage Area that is Impervious	<2%
CGIA Land Use Classification	Managed Herbaceous Cover & Hardwood Swamps

Table 4. Project Attribute Table
Brahma Site (continued)

Reach Summary Information								
Parameters	**UT 1 (upstream of confluence with UT2)**	**UT 1 (downstream of confluence with UT2)**	**UT 2**	**UT 3**	**UT4**	**UT5**	**UT6**	**UT 7**
Length of reach (linear feet)	1071	3227	1384	239	129	657	501	47
Valley Classification & Confinement	Alluvial, confined – moderately confined							
Drainage Area (acres)	143.9	230.8	57.3	14.6	1.6	26.2	12.3	2.9
NCDWR Stream ID Score	30	30	31.5	30	24.25	34.5	22.5	---
Perennial, Intermittent, Ephemeral	Per	Per	Int/Per	Int	Int	Int/Per	Int	Int
NCDWR Water Quality Classification	C, NSW							
Existing Morphological Description (Rosgen 1996)	G5	Cg 4/5	G4/5	G5	F6	G/F4/5	F5	G5
Proposed Stream Classification (Rosgen 1996)	C/E 4	C/E 4	G4/5	C/E 4	F6	G/F4/5	C/E 4	G5
Existing Evolutionary Stage (Simon and Hupp 1986)	III	III/IV	III	III	V	IV	III/IV	IV
Underlying Mapped Soils	Chewacla loam, Cullen clay loam, Herndon silt loam, Mundale-Secrest complex							
Drainage Class	Somewhat poorly drained, well-drained, well-drained, somewhat poorly drained respectively							
Hydric Soil Status	Nonhydric (may contain hydric inclusions), nonhydric, nonhydric, nonhydric respectively							
Valley Slope	0.0069	0.0084	0.0102	0.018	0.0198	0.0260	0.021	0.037
FEMA Classification	Lower reaches AE floodway	NA	NA	NA	NA	NA	NA	NA
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest							
Watershed Land Use/Land Cover (Site)	15% forest, 83% 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
Brahma Site (continued)

Wetland Summary Information			
Parameters	**Wetlands**		
Wetland acreage	5.157 acre drained & 4.427 acre degraded		
Wetland Type	Riparian riverine		
Mapped Soil Series	Wehadkee		
Drainage Class	Poorly drained		
Hydric Soil Status	Hydric		
Source of Hydrology	Groundwater, stream overbank		
Hydrologic Impairment	Incised streams, compacted soils, livestock, ditches		
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	401 Permit
Waters of the United States-Section 404	Yes	Yes	404 Permit
Endangered Species Act	Yes	Yes	CE Document (App E)
Historic Preservation Act	Yes	Yes	CE Document (App E)
Coastal Zone Management Act	No	--	NA
FEMA Floodplain Compliance	No	Yes	DMS FEMA Checklist (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 livestock pasture. A summary of existing Site characteristics in favor of proposed stream and wetland activities include the following.

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

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

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

Between the 2000 and 2010 censuses, the Cape Fear 02 population increased approximately 17 percent. 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 relate 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.

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 (Section 6.0 Functional Uplift and Project Goals). 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.

3.0 BASELINE AND EXISTING CONDITIONS

3.1 Soils and Land Form

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

Table 5. Web Soil Survey Soils Mapped within the Site

Map Unit Symbol	Map Unit Name (Classification)	Hydric Status	Description
ChA	Chewacla loam (*Fluvaquentic Dystrudepts*)	Non-hydric, but may contain hydric inclusions	This series consists of frequently flooded, somewhat poorly drained soils found on floodplains with 0-2 percent slopes. The parent material is loamy alluvium derived from igneous and metamorphic rock. Depth to the water table is 6-24 inches and depth to restrictive features is more than 80 inches.
CnB2, CnC2	Cullen clay loam (*Typic Hapludults*)	Non-hydric	This series consists of well-drained, moderately eroded soils found on 2-10 percent slopes in interfluves. The parent material is loamy alluvium derived from igneous and metamorphic rock. Depth to the water table and restrictive features is more than 80 inches.
HnC	Herndon silt loam (*Typic Kanhapludults*)	Non-hydric	This series consists of well-drained soils found on 6-10 percent slopes in interfluves. The parent material is residuum weathered from phyllite. Depth to the water table and restrictive features is more than 80 inches.
MaB, MaC	Mandale-Secrest complex (*Aeric Epiaquults*)	Non-hydric	This series consists of somewhat poorly drained soils found on 2-10 percent slopes in depressions, sloughs, drainageways, and flats on interfluves. The parent material is residuum weathered from argillite. Depth to the water table is 12-24 inches and depth to restrictive features is 60-80 inches.

The *Web Soil Survey* (USDA 2017) indicates the Site is mapped as Mandale-Secrest complex, which classified as a non-hydric soil series. However, the *Soil Survey for Alamance County* (USDA 1960) depicts that Site floodplains are primarily underlain by Wehadkee soils. Detailed soil profiles collected by a licensed soil scientist appear to confirm that floodplain soils within the Site are hydric in nature and are characterized by F3 (depleted matrix) hydric soil indicators. The F3 indicator includes soils with 60 percent or more chroma 2 or less within the upper 6 inches or starting within the upper 10 inches of the soil profile. The Site also meets hydric soil indicator F19 (Piedmont floodplain soils); however, this indicator is not suitable for predicting if a Site will rehydrate after mitigation activities are complete.

3.2 Sediment Model

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

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

Table 6. BEHI and NBS Modeling Summary

Stream Reach	Proposed Mitigation Treatment	Predicted Sediment Contribution* (tons/year)
UT 1	Restoration, Enhancement (Level I & II), & Preservation	6.3
UT 2	Enhancement (Level II)	1.7
UT 3	Restoration	0
UT 4	Enhancement (Level II)	0
UT 5	Enhancement (Level II)	0
UT 6	Restoration	0
UT 7	Enhancement (Level II)	0
	Total Sediment Contribution (tons/year)	**8.0**

*Sediment contribution numbers are an estimate of stream bank erosion within the Site boundaries.

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

3.3 Nutrient Model

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

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

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

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

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

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

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

Results of the NCDMS analysis indicate approximately 1020.8 lbs/yr of nitrogen, 84.6 lbs/yr of phosphorus, and 11.2×10^{11} col of fecal coliform/day will be reduced due to exclusion of livestock from the easement area.

3.4 Project Site Streams

Streams targeted for restoration include unnamed tributaries to Reedy Branch, which have been cleared, trampled by livestock, eroded vertically and laterally, and receive extensive sediment and nutrient inputs from livestock. Approximately 44 percent of the existing stream channel has been degraded contributing to sediment export from the Site resulting from mechanical processes from livestock hoof shear. In addition, streamside wetlands have been cleared and drained by channel downcutting and land uses. Current Site conditions have resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

3.4.1 Existing Conditions Survey

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

Table 7. Essential Morphology Parameters

Parameter	Existing				Reference		Proposed			
	UT 1 (Up)	UT 1 (Down)	UT3	UT6	Cedarock Park	Causey Farm	UT 1 (Up)	UT 1 (Down)	UT3	UT6
Valley Width (ft)	50	100	50	50	50-100	150-200	50	100	50	50
Contributing Drainage Area (sq. mi.)	0.22	0.30	0.02	0.02	0.21	0.63	0.22	0.30	0.02	0.02
Channel/Reach Classification	G5	Cg 4/5	G5	F5	Eb4	E5	E/C 4	E/C 4	E/C 4	E/C 4
Design Discharge Width (ft)	5.8-16.0	5.4-16.9	3.1-5.9	3.3-16.3	8.1	11.0	10.1	11.0	4.4	4.4
Design Discharge Depth (ft)	0.5-1.3	0.5-1.6	0.3-0.5	0.1-0.4	0.8	1.4	0.7	0.8	0.3	0.3
Design Discharge Area (ft^2)	7.3	8.7	1.5	1.4	8.0	14.7	7.3	8.7	1.5	1.4
Design Discharge Velocity (ft/s)	3.9	4.0	3.6	3.4	3.6	4.1	3.9	4.0	3.6	3.4
Design Discharge (cfs)	28.2	34.4	5.4	4.8	28.8	60.6	28.2	34.4	5.4	4.8
Water Surface Slope	0.0076	0.0052	0.0170	0.0203	0.0258	0.0053	0.0075	0.0052	0.0173	0.0173
Sinuosity	1.10	1.33	1.06	1.02	1.20	1.46	1.12	1.33	1.12	1.12
Width/Depth Ratio	4.5-32.0	3.4-33.8	6.2-19.7	3.6-163.0	10.1	9.0	14.0	14.0	14.0	14.0
Bank Height Ratio	1.1-1.9	1.2-2.9	2.3-4.0	1.0-5.0	1.0	1.4	1.0	1.0	1.0	1.0
Entrenchment Ratio	0.9-1.0	1.3-13.3	0.8-1.6	1.2-2.7	2.1	12	7.4	9.1	11.3	11.3
Substrate	Sand	Gravel/sand	Sand	Sand	Gravel	Sand	Gravel	Gravel	Gravel	Gravel

3.4.2 Channel Classification and Morphology

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

3.4.3 Channel Evolution

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

3.4.4 Valley Classification

Site Streams are characterized by small stream, headwater, moderately confined to confined, alluvial valleys with approximately 50- to 100-foot floodplain valley widths. Valley slopes are typical for the Piedmont region and range from 0.0084-0.0207. Typical streams in this region include C- and E-type streams with slightly entrenched, meandering channels with a riffle-pool sequence.

3.4.5 Discharge

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 46.6 inches per year (USDA 1960). Drainage basin sizes range from 0.003- to 0.36-square mile on UT1-UT7.

The Site's discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. 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 (Harman et al. 1999); this is discussed in Section 5.2 (Bankfull Verification). Based on bankfull studies, the bankfull discharge ranges from 1.2-39.6 cubic feet per second for UT1-UT7.

3.5 Project Site Wetlands

Jurisdictional wetlands/hydric soils within the Site were delineated in the field following guidelines set forth in the *Corps of Engineers Wetlands Delineation Manual* and subsequent regional supplements and located using GPS technology with reported submeter accuracy (Environmental Laboratory 1987). A jurisdictional wetland delineation was completed and verbally approved by United States Army Corps of Engineers (USACE) representative David Bailey during a field meeting on July 9, 2019. Written confirmation of the determination is included in Appendix D. Existing jurisdictional wetlands are depicted in yellow hatch and drained hydric soils are depicted in blue hatch on Figure 4 (Appendix A).

3.5.1 Hydrological Characterization

Construction activities are expected to restore approximately 4.740 acre of drained riparian hydric soils, enhance 3.709 acres of cleared riparian wetlands, and preserve 0.601 acre of pristine wetlands. Areas of the Site targeted for riparian wetlands will receive hydrological inputs from periodic overbank flooding of restored tributaries, groundwater migration into wetlands, upland/stormwater runoff, and, to a lesser extent, direct precipitation. Hydrological impairment in drained soils has resulted from lateral draw-down of the water table adjacent to existing, incised stream channels.

3.5.2 Soil Characterization

Detailed soil mapping conducted by a North Carolina Licensed Soil Scientist (NCLSS) in August 2018 indicate that the Site is currently underlain by hydric soils of the Wehadkee series (Figure 4, Appendix A). Wetlands have been disturbed by livestock grazing and cleared of vegetation within pastureland. These hydric soils have been effectively drained by stream channel incision or relocation of stream channels to the floodplain margins.

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

Table 8. Profile Description

Depth (inches)	Color	Texture
0 - 2	10 YR 3/2	Silt loam
2 +	10 Y 6/2 Mottles 7.5 YR 5/8 (30%) Mottles 7.5 YR 4/6 (5 %)	Silty clay loam

3.5.3 Plant Community Characterization

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

4.0 REFERENCE STUDIES

4.1 REFERENCE STREAMS

Two reference reaches were identified for the Site. The first reference stream (Cedarock) is located approximately 9 miles north 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 approximately 11 miles west of the Site, immediately east 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.

4.1.1 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 sinuosity channel, due to a lower valley slope, with a sand-dominated substrate.

4.1.2 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.

4.1.3 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.

4.2 Reference Forest Ecosystem

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

The RFE for this project is located 4 miles east 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 9 will be used, in addition to other relevant species in appropriate Schafale and Weakley (1990) and Schafale (2012) community descriptions.

Table 9. Reference Forest Ecosystem

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

5.0 CHANNEL ASSESSMENTS

5.1 Channel Stability Assessment

Stream power and shear stress were estimated for 1) existing dredged and straightened reaches, 2) the reference reaches, and 3) proposed Site conditions. 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 for UT1 and UT3, and lower for UT6 as compared to proposed values. Shear stress values of existing streams are significantly elevated as compared to proposed and reference reach values. Proposed stream power and shear stress values are comparable to Causey Farm reference reach values and appear adequate to mobilize and transport sediment through the Site, without aggradation or erosion on proposed stream banks. Results of the analysis indicate the proposed channel reaches are expected to maintain stream power as a function of width values of approximately 1.01-1.32 lbs/sec^3 and shear stress values of approximately 0.22-0.32 lbs/ft^2 (Table 10).

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

	Bankfull Discharge (ft^3/sec)	Water surface Slope (ft/ft)	Total Stream Power (Ω) (lb-ft /sec^3)	Ω/W (lb/sec^3)	Hydraulic Radius (ft)	Shear Stress (τ) (lb/ft^2)	Velocity (v) (ft/sec)	τ v (lb/ ft-sec)	τ_{max}, (lb/ft^2)
Existing Conditions									
UT 1 – Upstream	28.2	0.0076	13.37	**1.67**	2.56	**1.21**	1.12	1.36	28.2
UT 1 – Downstream	34.4	0.0052	11.16	**1.36**	2.63	**0.85**	1.26	1.07	34.4
UT 3	5.4	0.0170	5.73	**1.51**	1.85	**1.96**	0.64	1.25	5.4
UT 6	4.8	0.0203	6.08	**0.94**	2.26	**2.86**	0.31	0.88	4.8
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									
UT 1 – Upstream	28.2	0.0075	13.20	**1.31**	0.63	**0.30**	3.86	1.15	0.45
UT 1 – Downstream	34.4	0.0052	11.16	**1.01**	0.69	**0.22**	3.95	0.89	0.34
UT 3	5.4	0.0173	5.83	**1.32**	0.30	**0.32**	3.60	1.17	0.49
UT 6	4.8	0.0173	5.18	**1.18**	0.28	**0.30**	3.43	1.04	0.45

5.2 Bankfull Verification

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

Based on available Piedmont regional curves, the predicted bankfull discharge for the reference reaches averages approximately 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 and indicators of bankfull on a cross-section located in

an undisturbed reach located at the Abbey Lamm Mitigation Site (located 2.5 miles north of the Site and currently in its fifth 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. The designed onsite channel restoration area will equal approximately 93 percent of the channel size indicated by Piedmont regional curves. Table 11 summarizes all methods analyzed for estimating bankfull discharge.

Table 11. Reference Reach Bankfull Discharge Analysis

Method	Watershed Area (square miles)	Return Interval (years)	Discharge (cfs)
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

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 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 [Section 3.2] – reduction of 8.0 tons/year after mitigation is complete);
2. Reduce and manage nutrient inputs (nutrient model [Section 3.3] - livestock removal from streams will result in a direct reduction of 1020.8 pounds of nitrogen, 84.6 pounds of phosphorus per year, and 11.2 x 10^{11} colonies of fecal coliform; fertilizer application will be eliminated; and marsh treatment areas will be installed);
3. Protect and augment designated natural heritage areas (NA).

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. Brahma NC SAM Summary

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

Based on NC SAM output, all three primary stream functional metrics (Hydrology, Water Quality, and Habitat), as well as 16 sub-metrics are under-performing as exhibited by a LOW metric rating (see Figure 4, Appendix A for UT locations). 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. Brahma NC WAM Summary

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

Based on NC WAM output, two of the primary wetland functional metrics (Water Quality and Habitat), as well as 5 sub-metrics are under-performing as exhibited by a LOW metric rating. LOW performing metrics are to be targeted for functional uplift through mitigation activities, goals and objectives, as well as, monitoring and success criteria.

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	• 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
(4) Wooded Riparian Buffer		
(4) Microtopography		
(3) Stream Stability	• 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 appropriate substrate • Plant woody riparian buffer • Stabilize stream banks
(4) Sediment Transport		
(4) Stream Geomorphology		
(1) WATER QUALITY		
(2) Streamside Area Vegetation	• 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 and reduce compaction through deep ripping/plowing. • Restore overbank flooding by constructing channels at historic floodplain elevation.
(3) Upland Pollutant Filtration		
(2) Indicators of Stressors		
(2) Aquatic Life Tolerance		
Wetland Particulate Change		
Wetland Physical Change		
(1) HABITAT		
(2) In-stream Habitat	• Improve instream and stream-side habitat.	• Construct stable channels with appropriate substrate • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows • Plant woody riparian buffer • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams • Stabilize stream banks • Install in-stream structures
(3) Substrate		
(3) In-Stream Habitat		
(2) Stream-side Habitat		
(3) Stream-side Habitat		
(3) Thermoregulation		
Wetland Physical Structure		
Wetland Landscape Patch Structure		

7.0 SITE DESIGN AND IMPLEMENTATION CONSTRAINTS

The presence of conditions or characteristics that have the potential to hinder restoration activities on the Site was evaluated. The evaluation focused primarily on the presence of hazardous materials, utilities and restrictive easements, rare/threatened/endangered species or critical habitats, and the potential for hydrologic trespass. Existing information regarding Site constraints was acquired and reviewed. In addition, any Site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

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

7.1 Threatened & Endangered Species

One federally protected species is listed as occurring in Alamance County (USFWS 2018); the following table summarizes potential habitat and a preliminary biological conclusion.

Table 13. Threatened and Endangered Species

Species-Status	Habitat	Potential Habitat at Site	Biological Conclusion
Cape Fear shiner (*Notropis mekistocholas*) Endangered	The Cape Fear shiner is known only from the Cape Fear River watershed. In general, habitat occurs in streams with clean gravel, cobble, or boulder substrates. It is most often observed inhabiting slow pools, riffles, and slow runs associated with water willow (*Justicia americana*) beds, which it uses for cover. Juveniles can be found inhabiting slackwater, among large rock outcrops and in flooded side channels and pools. Spawning occurs May through June, when water temperatures reach 66 degrees Fahrenheit.	No	No Effect

7.2 Cultural Resources

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

Field visits were conducted at the Site in July 2018 and April/May 2019 to ascertain the presence of structures or other features that may be eligible for inclusion on the National Register of Historic Places. No structures were identified within proposed easement boundaries; however, coordination with SHPO will occur prior to construction activities to determine if any significant cultural resources are present.

7.3 North Carolina Natural Heritage Elements

A query of the North Carolina Natural Heritage Program (NCNHP) database indicates there are no records for rare species, important natural communities, natural areas, or conservation/managed areas within the proposed project boundary. Within a one-mile radius of the project boundary

NCNHP lists the Pine Hill Xeric Woodlands natural area 3 miles east of the Site and three NCDMS Mitigation Easements within a 1-mile radius of the Site (Appendix C and Figure D-6, Appendix D).

7.4 FEMA

Inspection of the FEMA Flood Insurance Rate Map 3710876600K, Panel 8766, effective November 11, 2017, indicates that the downstream preservation portion of the project is mapped in the AE floodplain; therefore, the project should not alter FEMA flood zones and a "Conditional Letter of Map Revision" (CLOMR) is not necessary for this Site.

7.5 Utilities

No utilities are located on the Site.

7.6 Air Transport Facilities

No air transport facility is located within 5 miles of the Site.

7.7 IRT Comments

A Site visit with IRT members was conducted on February 26, 2019. Subsequently, post IRT Site visit notes were compiled and distributed to all attendees in a memorandum dated March 14, 2019. USACE representative Kimberly Browning responded to the Site visit notes in an email (attached in Appendix L) and requested to see the expired contract for the cost-shared fence. The expired contract is provided in Appendix L. Site visit notes have been incorporated into the detailed planning effort and Site design.

8.0 DESIGN APPROACH AND MITIGATION WORK PLAN

8.1 Stream Design

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

Primary activities designed to restore Site streams include 1) stream restoration, 2) stream enhancement (Level I), 3) stream enhancement (Level II), 4) stream preservation, 5) wetland restoration, 6) wetland enhancement, 7) wetland preservation, 8) construction of marsh treatment areas, and 9) vegetation planting (Figures 6A-6B, Appendix A).

Areas of shallow bedrock were noted during field reviews. Shallow bedrock contact was most notably identified in the downstream reaches of UT 1 and the upper reaches of UT 3. Shallow bedrock in the downstream reaches of UT 1 are primarily within Enhancement (Level II) areas. In addition, bedrock in the upper reaches of UT 3 are used as tie in elevations for elevating the channel to hinder headcut formation at the Site. Other areas of bedrock contact are located within incised streams that will be connected to the floodplain through Enhancement (Level I) techniques. Incised, Enhancement (Level I) reaches are expected to have the channel bed raised by more than 1 foot and bedrock should not hinder structure installation.

8.1.1 Stream Restoration

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

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

In-stream Structures

The use of in-stream structures for grade control and habitat is essential for successful stream restoration (Figure 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 be placed in relatively straight reaches to provide secondary (perpendicular) flow cells during bankfull events.

Piped and Forded Channel Crossings

Landowner constraints will necessitate the installation of 7 piped crossings within breaks in the easement to allow access to portions of the property isolated by stream restoration activities. The piped 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.

Marsh Treatment Areas

Eleven shallow wetland marsh treatment areas will be excavated in the floodplain to intercept surface waters draining through agricultural areas prior to discharging into Site tributaries. Marsh treatment areas are intended to improve the mitigation project and are not generating mitigation credit. The proposed marsh treatment area locations are depicted on Figures 6A-B (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 areas will fill with sediment and organic matter over time.

8.1.2 Stream Enhancement (Level I)

Stream enhancement (level I) activities include the installation of in-stream structures, providing proper channel dimension and appropriate floodplain width, reducing shear on eroding banks, removing livestock and fencing streams, and planting with native woody vegetation.

8.1.3 Stream Enhancement (Level II)

Stream enhancement (level II) activities include stabilizing streambanks (where necessary), removing livestock and fencing streams, and supplemental planting with riparian forest vegetation.

8.1.4 Stream Preservation

Stream preservation will occur in reaches characterized by channels with mature riparian vegetation, good channel bed substrate, and little bank erosion. The reaches are not accessible by livestock and are included into the project to protect the upstream and downstream ends of the project from future impacts.

8.2 Individual Reach Discussions

Mitigation strategies proposed for each reach are presented below.

8.2.1 UT 1

UT 1 is broken out into 3 reaches (UT 1A to UT 1C) that originate offsite and extend for 4298 linear feet, in its current location. The channel drains into the easement from disturbed forest used by livestock seeking shade. The channel enters pasture and flows through sparsely vegetated, heavily grazed land prior to entering undisturbed forest near the confluence with Reedy Branch. The majority of the channel is slightly impacted by erosion; however, the channel appears relatively stable due to dense thickets of invasive species such as Chinese Privet. Characteristics of each reach is summarized in the following tables.

UT 1A

Existing Conditions	
Flow regime	Perennial
Existing Vegetation	Pasture with patches of disturbed forest
Dredged/Straightened?	No
Livestock Access	Yes
Classification	G-type and Cg-type
Bank Height Ratio	1.1 to 2.9
Entrenchment Ratio	1.0 to 13.3
Sinuosity	1.10 to 1.33
Proposed Conditions	
Mitigation Treatment	Enhancement (Level I)
Mitigation Activity	1) Install structures to elevate stream bed 2) Restore/Enhance hydrology to adjacent drained hydric soils and wetlands 3) Install 3 piped channel crossings 4) Contour channel banks to proper dimension 5) Ease tight meander bends 6) Install riffle bed material 7) Install marsh treatment areas 8) Treat invasive species 9) Fence livestock 10) Plant with native forest vegetation

UT 1 B

Existing Conditions	
Flow regime	Perennial
Existing Vegetation	Mature forest
Dredged/Straightened?	No
Livestock Access	Yes
Classification	Cg-type (based on visual observation)
Bank Height Ratio	Not measured
Entrenchment Ratio	Not measured
Sinuosity	1.33
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II)
Mitigation Activity	1) Treat invasive species 2) Fence livestock 3) Stabilize minor bank erosion

UT 1 C

Existing Conditions	
Flow regime	Perennial
Existing Vegetation	Mature forest
Dredged/Straightened?	No
Livestock Access	No
Classification	Cg-type (based on visual observation)
Bank Height Ratio	Not measured
Entrenchment Ratio	Not measured
Sinuosity	1.33
Proposed Conditions	
Mitigation Treatment	Preservation
Mitigation Activity	1) Treat invasive species

8.2.2 UT 2 and 2A

UT 2 is broken out into 2 reaches (UT 2 to UT 2A) that originate within the Site and extend for 1306.9 and 35.0 linear feet, respectively. UT 2A is a very short, intermittent channel that drains through pasture and is proposed for Enhancement (Level II). UT 2 is entirely encompassed by pasture with scattered mature trees along the stream banks. The channel is characterized by an intermittent flow regime. The majority of the channel is impacted by erosion. However, the intermittent nature of the channel indicates that the reach is most suited for Enhancement (Level II). Characteristics of UT 2 are summarized in the following table.

UT 2

Existing Conditions	
Flow regime	Perennial
Existing Vegetation	Pasture with scattered mature trees
Dredged/Straightened?	No
Livestock Access	Yes
Classification	G-type and F-type
Bank Height Ratio	1.20 to 1.86
Entrenchment Ratio	1.0
Sinuosity	1.10
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II)
Mitigation Activity	1) Install two piped crossings 2) Install a marsh treatment area 3) Connect the downstream reach to the newly constructed UT 1 4) Plant with native forest vegetation 5) Treat invasive species 6) Fence livestock

UT 2A

Existing Conditions	
Flow regime	Intermittent
Existing Vegetation	Pasture
Dredged/Straightened?	No
Livestock Access	Yes
Classification	Not measured
Bank Height Ratio	Not measured
Entrenchment Ratio	Not measured
Sinuosity	1.10
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II)
Mitigation Activity	1) Install a marsh treatment area 2) Plant with native forest vegetation 3) Treat invasive species 4) Fence livestock

8.2.3 UT 3

UT 3 originate at a spring and headcut within the Site boundaries and extend for 153 linear feet in its current location, prior to converging with UT 1. The channel is entirely characterized by pasture and is accessible by livestock. The channel has been dredged/straightened and moved from historic location and exhibits signs of erosion. Characteristics of UT 3 are summarized in the following table.

UT 3

Existing Conditions	
Flow regime	Intermittent
Existing Vegetation	Pasture
Dredged/Straightened?	Yes
Livestock Access	Yes
Classification	G-type
Bank Height Ratio	3.2
Entrenchment Ratio	1.4
Sinuosity	1.06
Proposed Conditions	
Mitigation Treatment	Restoration (Priority 1)
Mitigation Activity	1) Tie to bedrock step 2) Excavate channel to proper dimension, pattern, and profile within the historic floodplain 3) Install structures to reduce scour, create habitat, and fix the stream elevation 4) Install riffle bed material 5) Treat invasive species 6) Fence livestock

8.2.4 UT 4

UT 4 originate at a spring within the Site boundaries and extend for 129 linear feet in its current location, prior to converging with UT 1. The channel was determined to be a wetland during the PJD walkthrough; however, the IRT indicated that the UT would be suitable for headwater, enhancement (level II) using down valley distance to calculate credit. The channel is entirely characterized by pasture and is accessible by livestock. The channel has been dredged/straightened and trampled by livestock. Characteristics of UT 4 are summarized in the following table.

UT 4

Existing Conditions	
Flow regime	Not a Jurisdictional Stream
Existing Vegetation	Pasture
Dredged/Straightened?	Yes
Livestock Access	Yes
Classification	NA
Bank Height Ratio	NA
Entrenchment Ratio	NA
Sinuosity	NA
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II) in a headwater system
Mitigation Activity	1) Plant with native forest vegetation 2) Treat invasive species 3) Fence livestock

8.2.5 UT 5

UT 5 originates upstream of the Site boundaries and enters the Site through a culvert under Clark Road. The UT extends for 618 linear feet, before its confluence with UT 1. UT 5 within the Site is characterized by pasture with scattered mature trees along the stream banks and frequent, dense thickets of invasive species. The channel is characterized by a perennial flow regime. The channel is not extensively eroded, likely due to densely rooted Chinese privet. Channel stability dictates that the reach is most suited for Enhancement (Level II). Characteristics of UT 5 are summarized in the following table.

UT 5

Existing Conditions	
Flow regime	Perennial
Existing Vegetation	Pasture with scattered mature trees
Dredged/Straightened?	Yes
Livestock Access	Yes
Classification	Eg-type
Bank Height Ratio	2.3 to 2.8
Entrenchment Ratio	1.2 to 2.8
Sinuosity	1.05
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II)
Mitigation Activity	1) Install a piped crossing 2) Install a marsh treatment area 3) Connect the downstream reach to the newly constructed UT 1 4) Plant with native forest vegetation 5) Treat invasive species 6) Fence livestock

8.2.6 UT 6

UT 6 originate at an agriculture pond within the Site boundaries. Due to impoundment, the channel was determined to initiate low down in the valley and only extend for 110 linear feet in its current location, prior to converging with UT 5. Once the impoundment has been removed and channel maintain stormwater flows, combined with spring fed discharges, it is presumed that UT 6 will extend for 501 linear feet. The channel is entirely characterized by pasture and is accessible by livestock. The channel has been dredged/straightened and moved from historic location. Due to the suppression of stormwater surges, the channel does not exhibit signs of erosion. Characteristics of UT 6 are summarized in the following table.

UT 6

Existing Conditions	
Flow regime	Intermittent
Existing Vegetation	Pasture
Dredged/Straightened?	Yes
Livestock Access	Yes
Classification	F-type
Bank Height Ratio	3.1
Entrenchment Ratio	1.5
Sinuosity	1.02
Proposed Conditions	
Mitigation Treatment	Restoration (Priority 1)
Mitigation Activity	1) Remove agriculture pond dam 2) Excavate channel to proper dimension, pattern, and profile within the historic floodplain 3) Install structures to reduce scour, create habitat, and fix the stream elevation 4) Install riffle bed material 5) Treat invasive species 6) Fence livestock

Note: sediment from the pond bottom will be mixed with spoil material and used as backfill for abandoned/reduced channels.

8.2.7 UT 7

UT 7 originate at a headcut within the Site boundaries and extends for 45 linear feet in its current location, prior to converging with UT 1. The channel is in a steep draw accessible to, but doesn't seem to be frequented by, livestock. The channel is characterized by pasture with scattered mature trees and dense thickets of invasive species. Characteristics of UT 7 are summarized in the following table.

UT 7

Existing Conditions	
Flow regime	Intermittent
Existing Vegetation	Pasture with scattered mature trees
Dredged/Straightened?	No
Livestock Access	Yes
Classification	NA
Bank Height Ratio	NA
Entrenchment Ratio	NA
Sinuosity	NA
Proposed Conditions	
Mitigation Treatment	Enhancement (Level II)
Mitigation Activity	1) Plant with native forest vegetation 2) Treat invasive species 3) Fence livestock

8.3 Wetland Reestablishment

Wetland reestablishment 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 stream channel incision, vegetative clearing, agriculture plowing, herbicide application, and other land disturbances associated with land use management. Wetland reestablishment will focus on the restoration of vegetative communities, filling incised stream channels, the reestablishment of soil structure and microtopographic variations, removal of livestock through fencing, and redirecting normal surface hydrology from streams back into the Site floodplains. In addition, the construction of (or provisions for) surface water storage depressions (ephemeral pools) will also add an important component to groundwater restoration activities. These activities will result in the restoration of 4.740 acres of jurisdictional riparian riverine wetlands.

Restoration of Historic Groundwater Elevations

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

Hydrophytic Vegetation

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

8.4 Wetland Enhancement

Wetland enhancement will focus on the removal of livestock and restoration of vegetative communities resulting in the enhancement of 3.709 acre of riparian riverine wetland.

8.5 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.

8.6 Natural Plant Community Restoration

Restoration of floodplain forest and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife. Reference Forest Ecosystem (RFE) data, onsite observations, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 1990) were used to develop the primary plant community associations that will be promoted during community restoration activities.

8.6.1 Planting Plan

Stream-side trees 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 will be planted within 15 feet of the channel top of bank throughout the meander belt-width. Piedmont Alluvial Forest is the target community for Site floodplains and side-slopes.

Bare-root seedlings within the Piedmont Alluvial Forests will be planted at a density of approximately 680 stems per acre on 8-foot centers. Tree 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 14 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, herbaceous seed mix will be planted on the Site. Upland areas will receive a diverse mix of pollinator friendly native and naturalized species including both forbs and grasses. Streamside zones and wetlands, including the Marsh Treatment Wetland Areas, will receive a similarly designed mix with an additional component of FACW species (including *Elymus virginicus, Juncus effusus, and Carex* spp.).

Table 14. Planting Plan

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	**13.7**		**4.0**		**17.7**
Species	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	544	5	544
River birch (*Betula nigra*)	932	10	544	5	1476
Silky dogwood (*Cornus amomum*)	932	10	2176	20	3108
Green ash (*Fraxinus pennsylvanica*)	932	10	2176	20	3108
Tulip poplar (*Liriodendron tulipifera*)	932	10	--	--	932
Sycamore (*Platanus occidentalis*)	1863	20	2176	20	4039
Black gum (*Nyssa sylvatica*)	932	10	--	--	932
Water oak (*Quercus nigra*)	1397	15	1088	10	2485
Willow oak (*Quercus phellos*)	1397	15	1088	10	2485
Black willow (*Salix nigra*)	--	--	1088	10	1088
TOTAL	**9316**	**100**	**10880**	**100**	**20196**

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

8.6.2 Nuisance Species Management

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

Fescue will be treated through herbicide application by a North Carolina Certified Herbicide Applicator. Personnel will apply herbicides following manufactures recommended rates and techniques. It is expected that in the fall, prior to planting, glycophosphate (or other similar product) will be applied to dense fescue areas to reduce competition with planted seedlings. Follow up treatment may occur as necessary with backpack sprayers to avoid spray application to desirable species.

9.0 MONITORING AND SUCCESS CRITERIA

Monitoring will be conducted by Axiom Environmental, Inc based on the schedule in Table 15. A summary of monitoring is outlined in Table 16 (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 15. Monitoring Schedule

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

Table 16. Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 12 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern will be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Stream Hydrology	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	3 surface water gauges on UT 3, 5, and 6	Surface water data for each monitoring period
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	3 surface water gauges on UT 3, 5, and 6	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	1 crest gauge on UT 1	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 (on UT 1 upstream and UT 1 downstream); however, the exact locations will be determined at the time pre-construction benthics are collected	Results* will be presented on a site-by-site basis and will include a list of taxa collected, an enumeration of *Ephemeroptera, Plecoptera,* and *Tricopetera* taxa as well as Biotic Index values.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season defined as March 1-October 22	10 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	18 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.

9.1 Success Criteria

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

Table 17. Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Continuous surface flow must be documented each year for at least 30 consecutive days. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • Entrenchment ratio (ER) must be no less than 2.2 at any measured riffle cross-section. • BHR and ER at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period. • The stream project shall remain stable and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.
Wetland Hydrology
• Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 12 percent of the growing season, during average climatic conditions.
Vegetation
• Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5; and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5, and 10 feet in height at year 7 in each plot. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis.

9.2 Contingency

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

9.2.1 Stream Contingency

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

Structure Failure

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

Headcut Migration Through the Site

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

Bank Erosion

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

Beaver and other Invasive Species

Indications of beaver establishment will be monitored throughout the 7-year monitoring period. If beaver are identified in the Site, the location of the dam will be depicted on CCPV mapping and the beaver will be trapped during the following fall/winter. Once beaver have been trapped, the dam will be removed. Removal of the dam is expected to occur by hand to minimized disturbance to the adjacent mitigation areas.

When invasive species controls are required by the IRT, species such as multiflora rose (*Rosa multiflora*), Russian olive (*Eleagnus angustifolium*), Chinese privet (*Ligustrum sinense*), and tree of heaven (*Ailanthus altissima*) will be treated by cutting and directly treating the stump with Garlon 4A to minimize re-sprouting. Appropriate actions to ameliorate any negative impacts regarding vegetation development and/or water management will occur on an as-needed basis. Additional monitoring, or other contingency measures will be determined by consultation with the IRT.

Road/Culvert Maintenance

Observation of road crossings/culverts will occur during regular monitoring visits conducted at the Site. Culverts will be monitored primarily for blockage; however, if erosion is occurring it will also be noted. Roadbeds, culverts, and crossings will be monitored for the seven-year monitoring period to ensure that no additional sediment deposition is occurring within the Site. Once the seven-year monitoring period has expired, maintenance of the crossing will be the responsibility of the landowner.

Development/Logging

Topographic re-entrants discharging into the conservation easement typically are directed into marsh treatment areas that treat the initial stormwater pulse to capture sediment and nutrients from adjacent runoff. These areas will naturalize over time into small wetland depressions. If the property adjacent to the Site is developed, or logged such that excessive sediment enters the Site, the marsh treatment area may be re-excavated to capture additional drainage effluent. Maintenance of the marsh treatment area is not expected to occur over an extended period of time; however, short term maintenance may occur until stabilization of the adjacent landscape features occurs.

9.2.2 Wetland Contingency

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

9.2.3 Vegetation Contingency

If vegetation success criteria are not achieved, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting is expected to occur during the appropriate planting season (December through March). Supplemental planting will be performed as needed until achievement of vegetation success criteria. Monitoring of supplemental planting will occur until IRT approval has been obtained.

9.3 Compatibility with Project Goals

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

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

Goals	Objectives	Success Criteria
(1) HYDROLOGY		
• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers 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 appropriate substrate • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • ER of 2.2 or greater • < 10% change in BHR and ER in any given year • 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 one marsh treatment area • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams • Provide surface roughness and reduce compaction through deep ripping/plowing. • Restore overbank flooding by constructing channels at historic floodplain elevation.	• 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 appropriate substrate • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows • Plant woody riparian buffer • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams • Stabilize stream banks • Install in-stream structures	• Cross-section measurement indicate a stable channel with appropriate substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

10.0 ADAPTIVE MANAGEMENT PLAN

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

11.0 LONG-TERM MANAGEMENT PLAN

The Site will be transferred to the 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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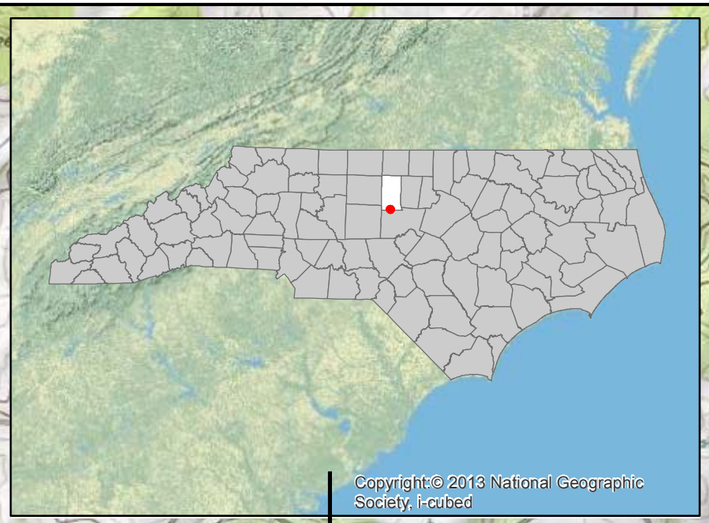
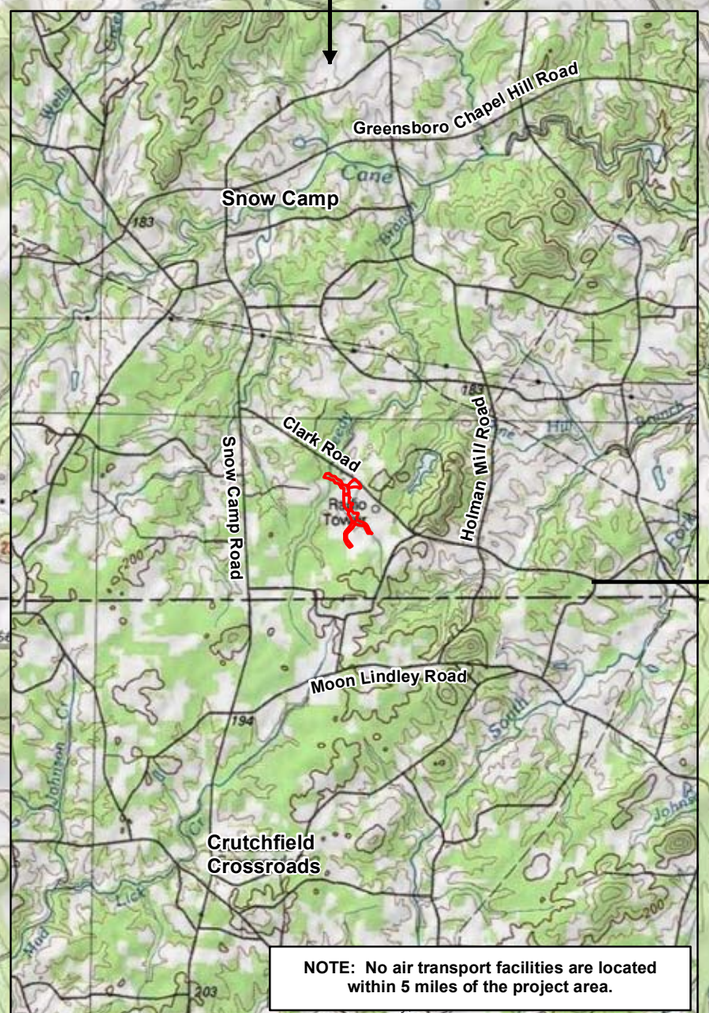
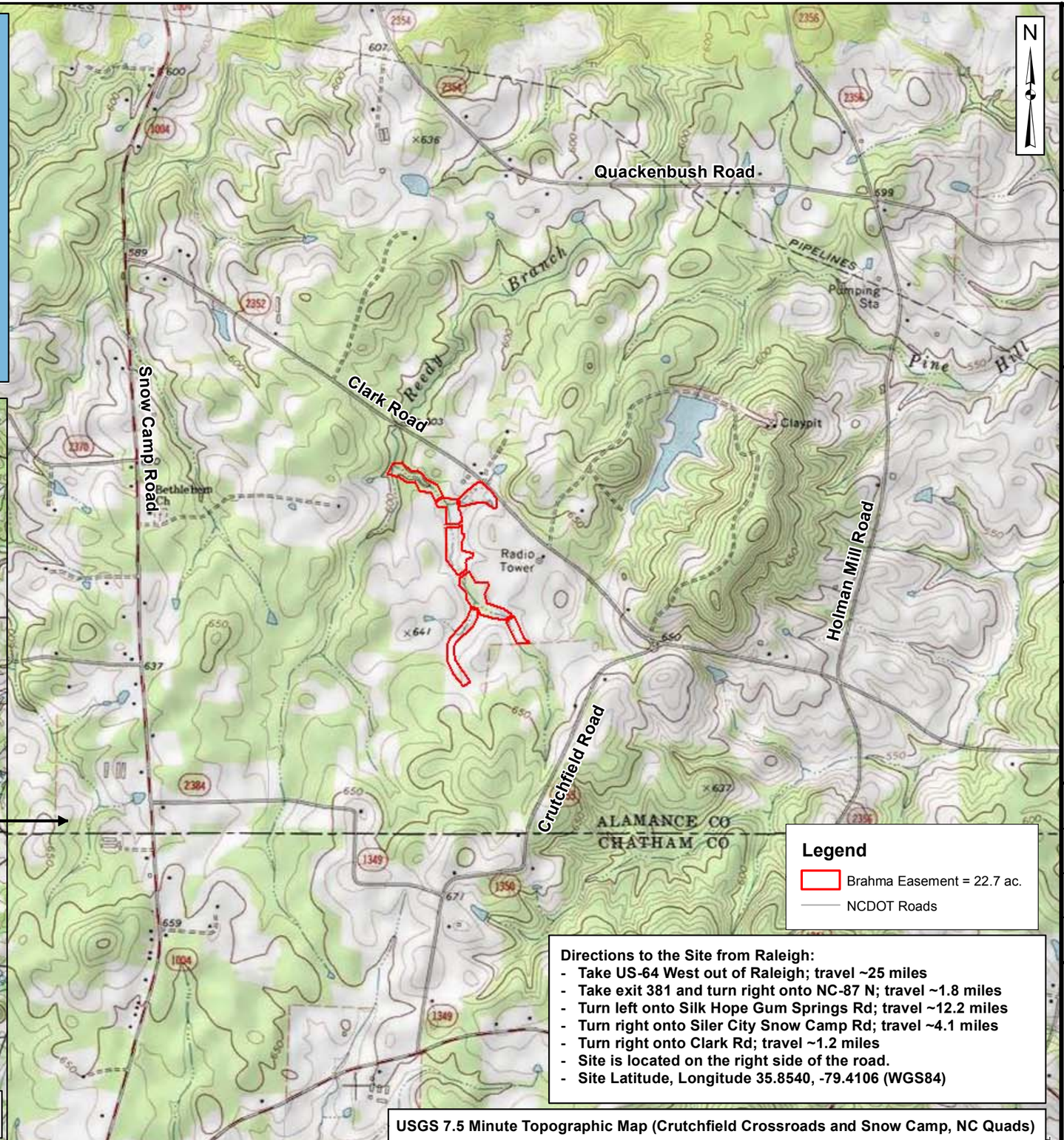
APPENDIX A
FIGURES





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



Legend

- Brahma Easement = 22.7 ac.
- NCDOT Roads

Directions to the Site from Raleigh:

- Take US-64 West out of Raleigh; travel ~25 miles
- Take exit 381 and turn right onto NC-87 N; travel ~1.8 miles
- Turn left onto Silk Hope Gum Springs Rd; travel ~12.2 miles
- Turn right onto Siler City Snow Camp Rd; travel ~4.1 miles
- Turn right onto Clark Rd; travel ~1.2 miles
- Site is located on the right side of the road.
- Site Latitude, Longitude 35.8540, -79.4106 (WGS84)

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

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

SITE LOCATION

Drawn by: KRJ

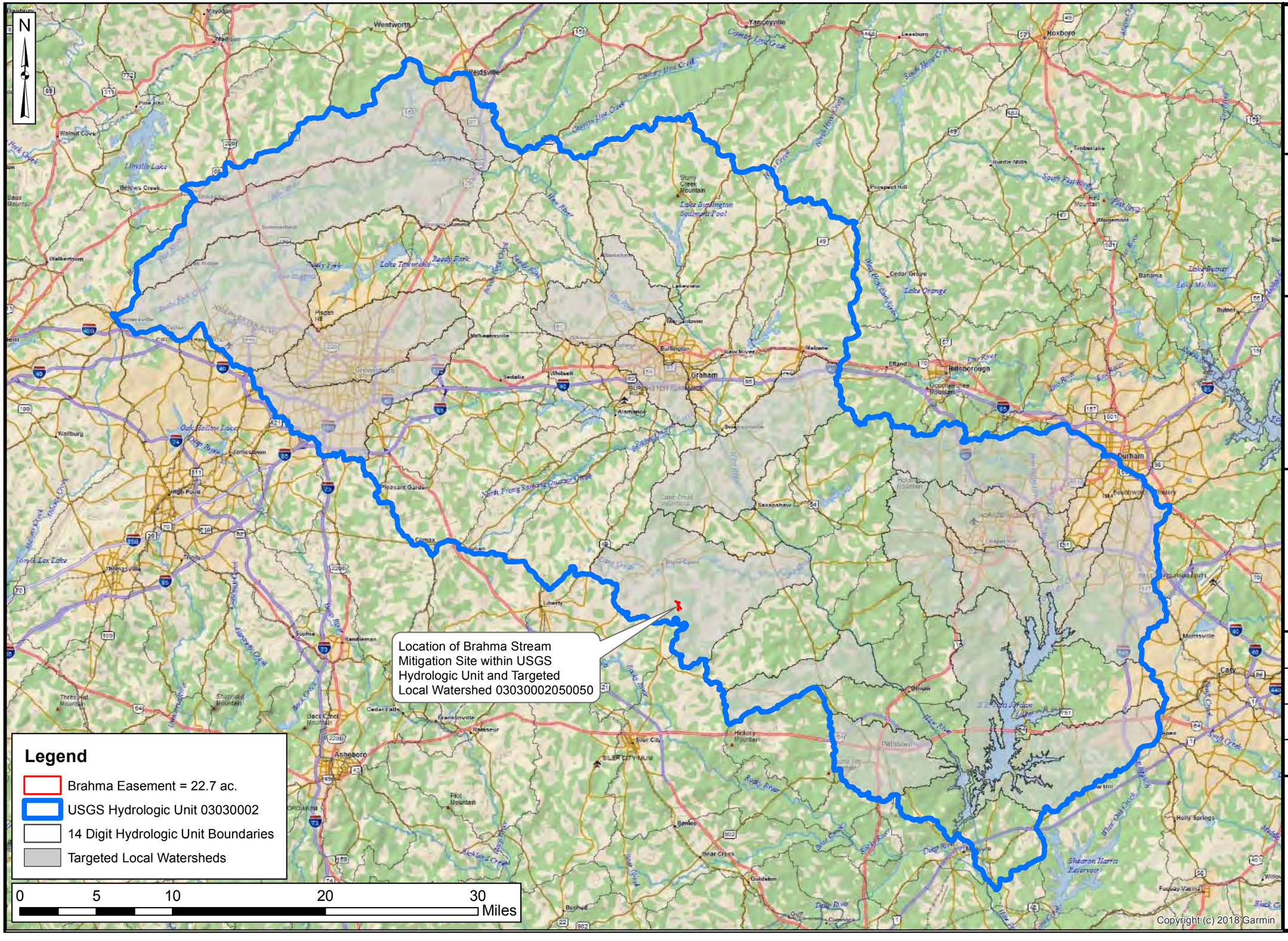
Date: MAY 2019

Scale: 1:20,000

Project No.: 19-006

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: KRJ

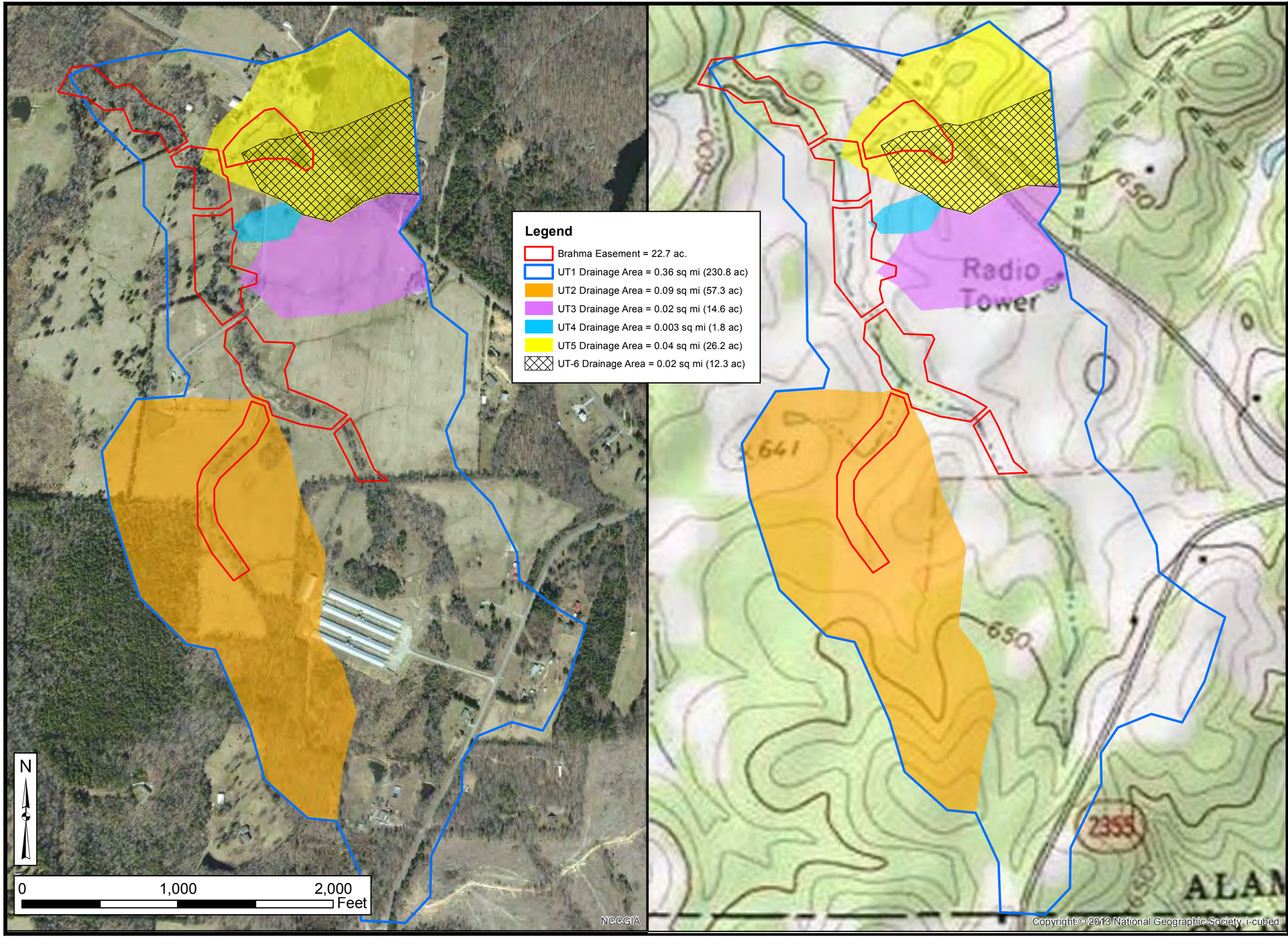
Date: MAY 2019

Scale: 1:375,000

Project No.: 19-006

FIGURE

2



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ

Date: MAY 2019

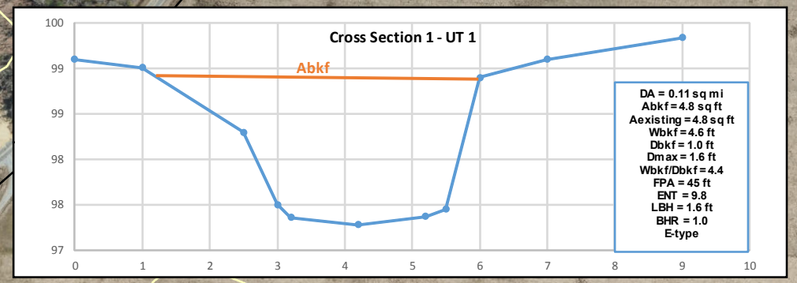
Scale: 1:7.000

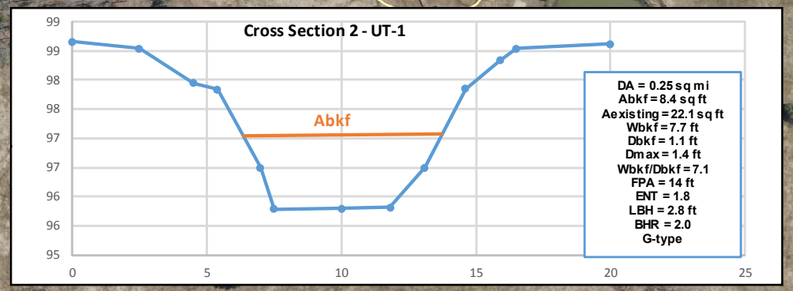
Project No.: 19-006

FIGURE

3

Soil Map Unit	Soil Series
ChA	Chewacla Loam
CnB2, CnC2	Cullen Clay Loam
HnC	Herndon Silt Loam
MaB, MaC	Mandale-Secrest Complex





Clark Road

UT-1 UT-2 UT-2A UT-3 UT-4 UT-5 UT-6 UT-7

XS-1 XS-2

NC SAM Form 1 Score: LOW

NC SAM Form 2 Score: LOW

NC SAM Form 3 Score: LOW

NC WAM Form GA

NC WAM Form GC

Soil Boring A Soil Boring B Soil Boring C Soil Boring D Soil Boring E Soil Boring F Soil Boring G

W

Legend
- Sheet1$ Events
- Brahma Easement = 22.7 ac
- Parcels
- Perennial Streams = 6581 ft
- Intermittent Streams = 307 ft
- Drained Hydric Soils = 5.157 ac
- Existing Wetlands = 4.437 ac
- Existing Open Water = 0.291 ac
- NRCS Soil Boundaries
- Soil Boring Location
- NC WAM Form Locations
- NC SAM Form Locations
- Cross Sections

0 250 500 1,000 Feet

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, I

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

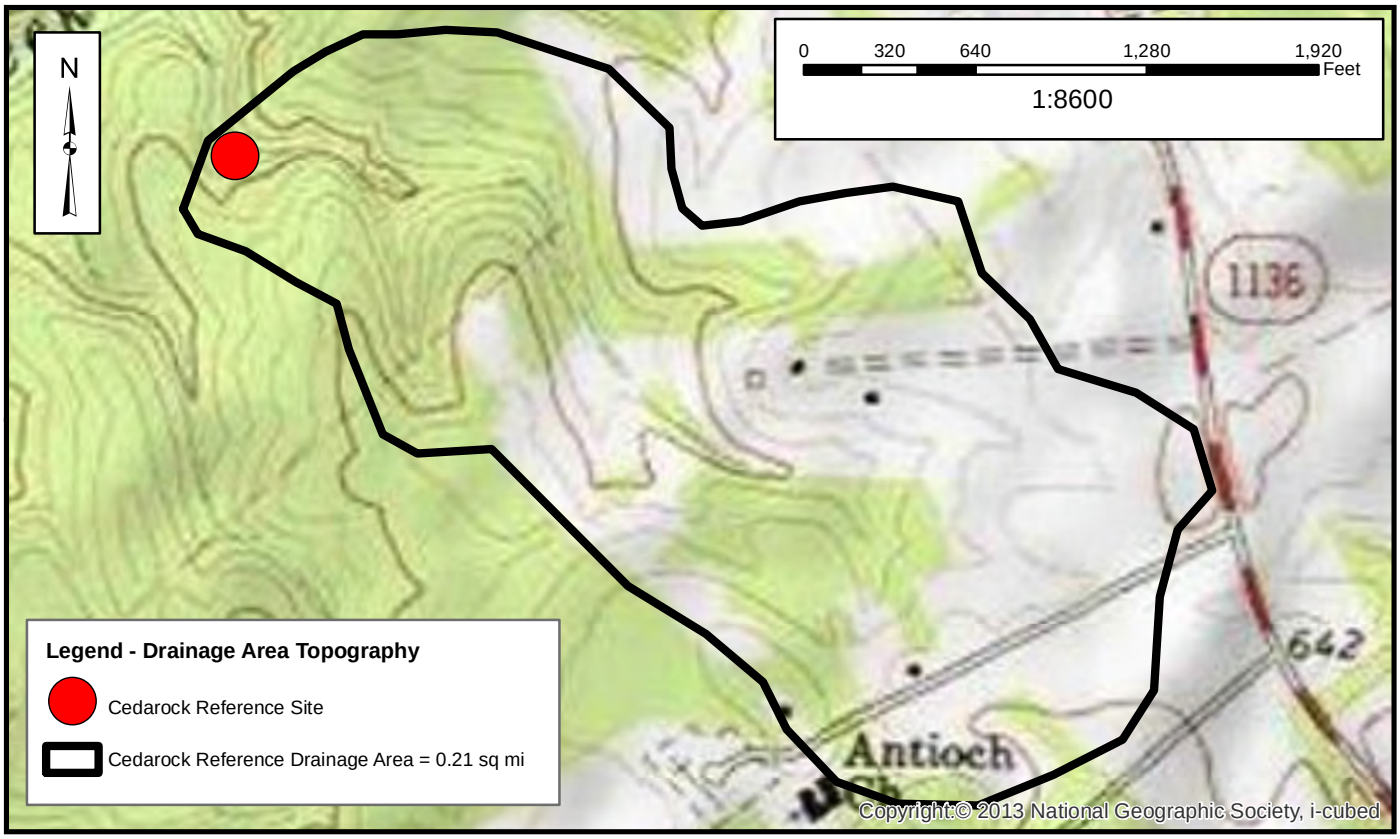
Date: AUG 2019

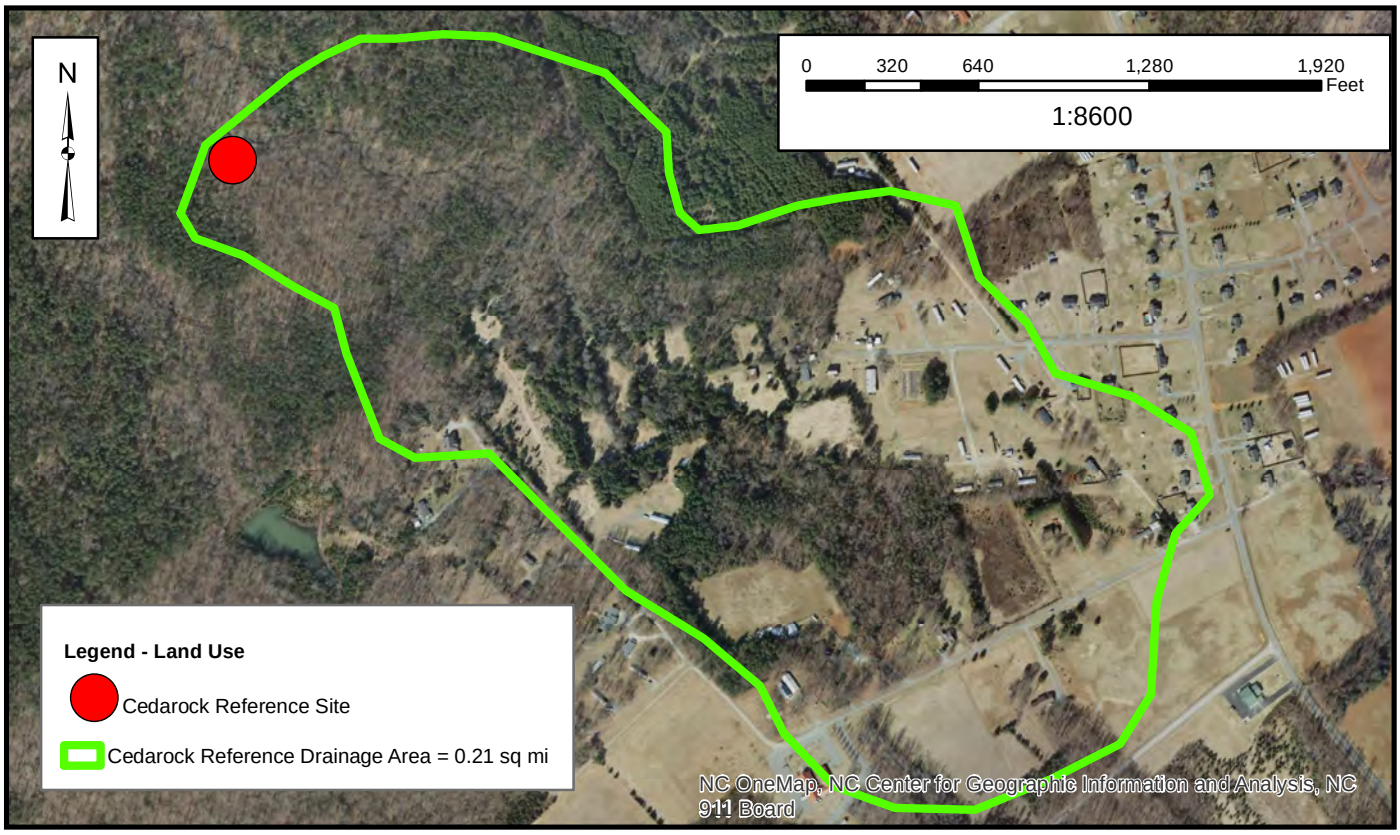
Scale: 1:3100

Project No.: 19-006

FIGURE

4



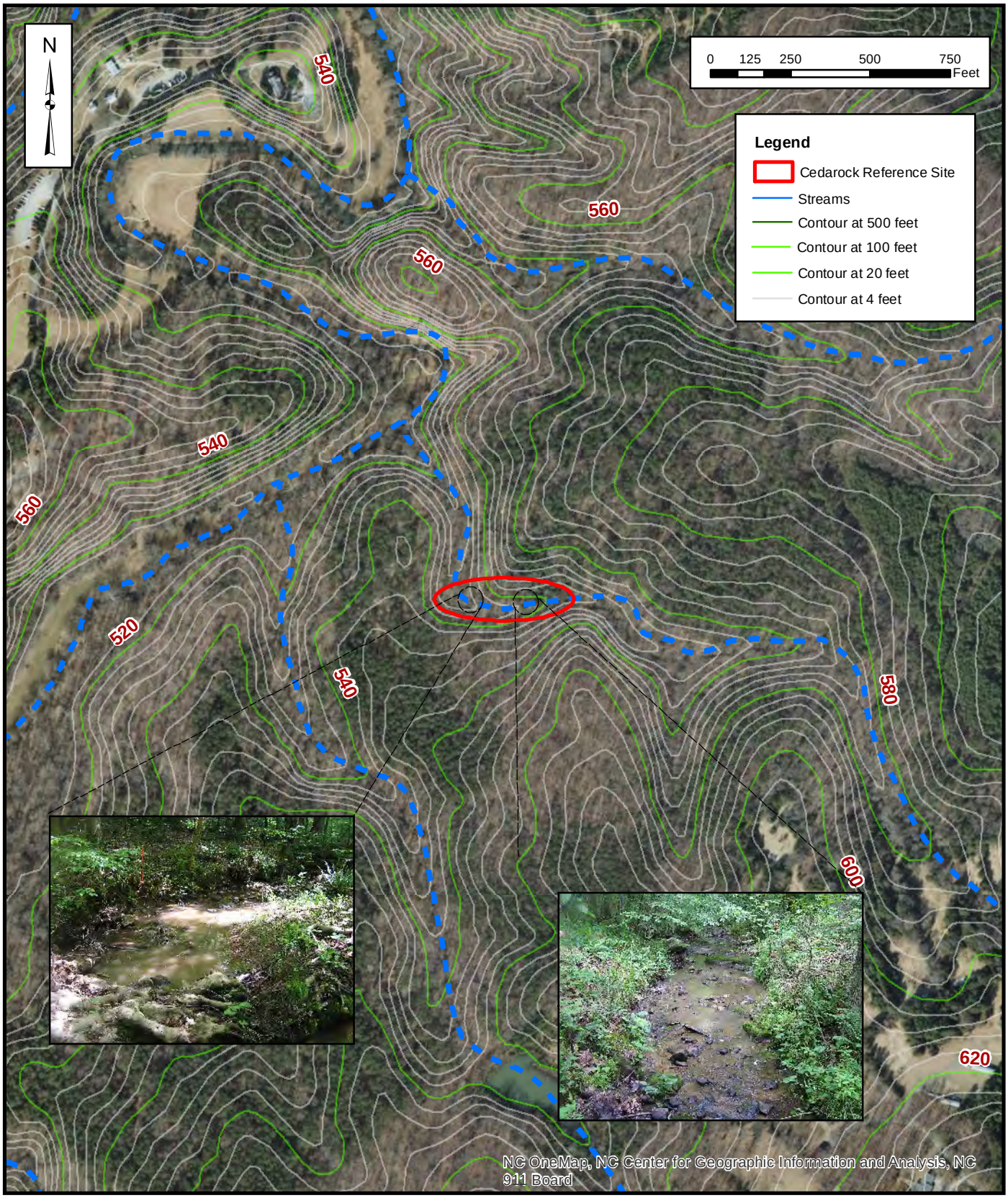


Axiom Environmental, Inc.
Axiom Environmental
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693

CEDAROCK REFERENCE DRAINAGE AREA
BRAHMA MITIGATION SITE
Alamance County, North Carolina

Dwn. by: WGL
Date: July 2019
Project: 19-006

FIGURE
5A



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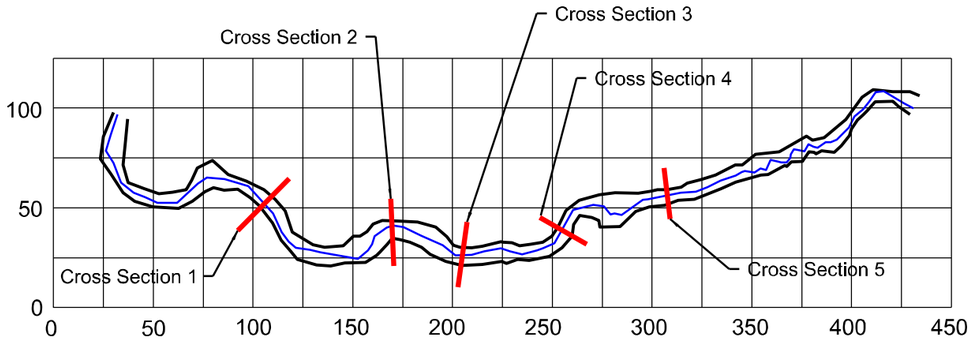
218 Snow Avenue
Raleigh, NC 27603
(919) 215-1693
Axiom Environmental, Inc.

EXISTING CONDITIONS CEDAROCK
REFERENCE REACH
BRAHMA MITIGATION SITE
Alamance County, North Carolina

Dwn. by.	WGL
Date:	July 2019
Project:	19-006

FIGURE
5B

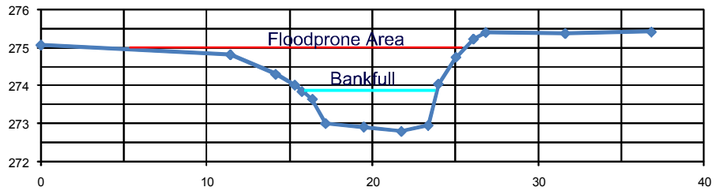


Reference Pattern

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

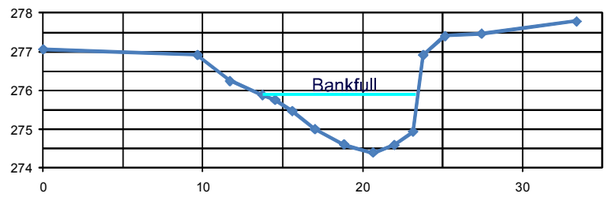
Pattern Legend

- Top of Bank
- Thalweg
- Cross Section



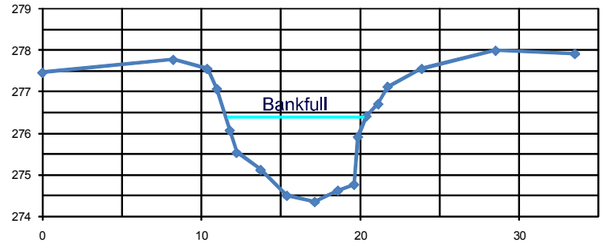
Cross Section 1 - Riffle

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



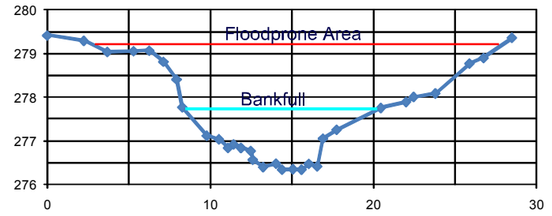
Cross Section 2 - Pool

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



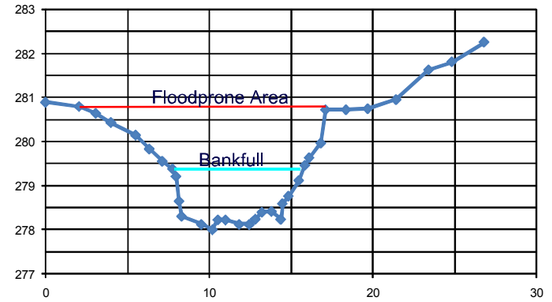
Cross Section 3 - Pool

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



Cross Section 4 - Riffle

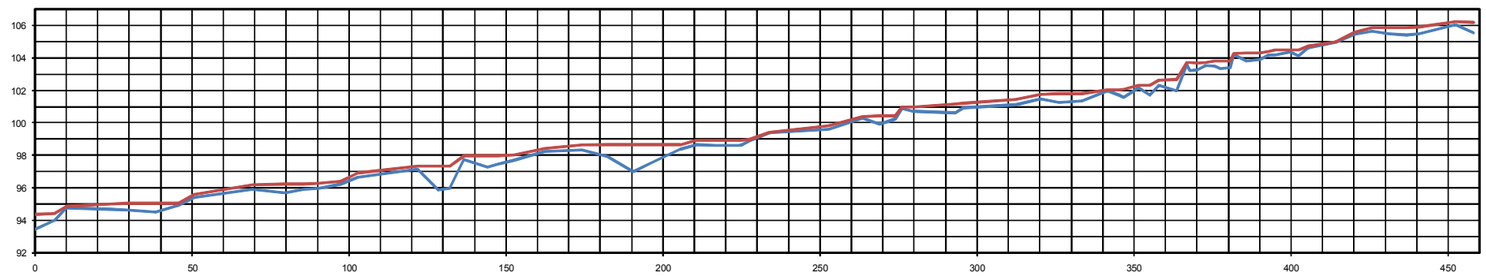
Abkf = 9.6 ft
Dave = 0.8 ft
Wbkf = 12.1 ft
Dmax = 1.4 ft
Bank Height = 1.4 ft
Bank Height Ratio = 1.0
W/D = 15.2
FPA = 25
ENT = 2.1
Stream Type = Eb



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:

Brahma
Stream and Wetland Mitigation Site

Alamance County
North Carolina

Title:

Cedarock Reference Reach Dimension, Pattern, and Profile

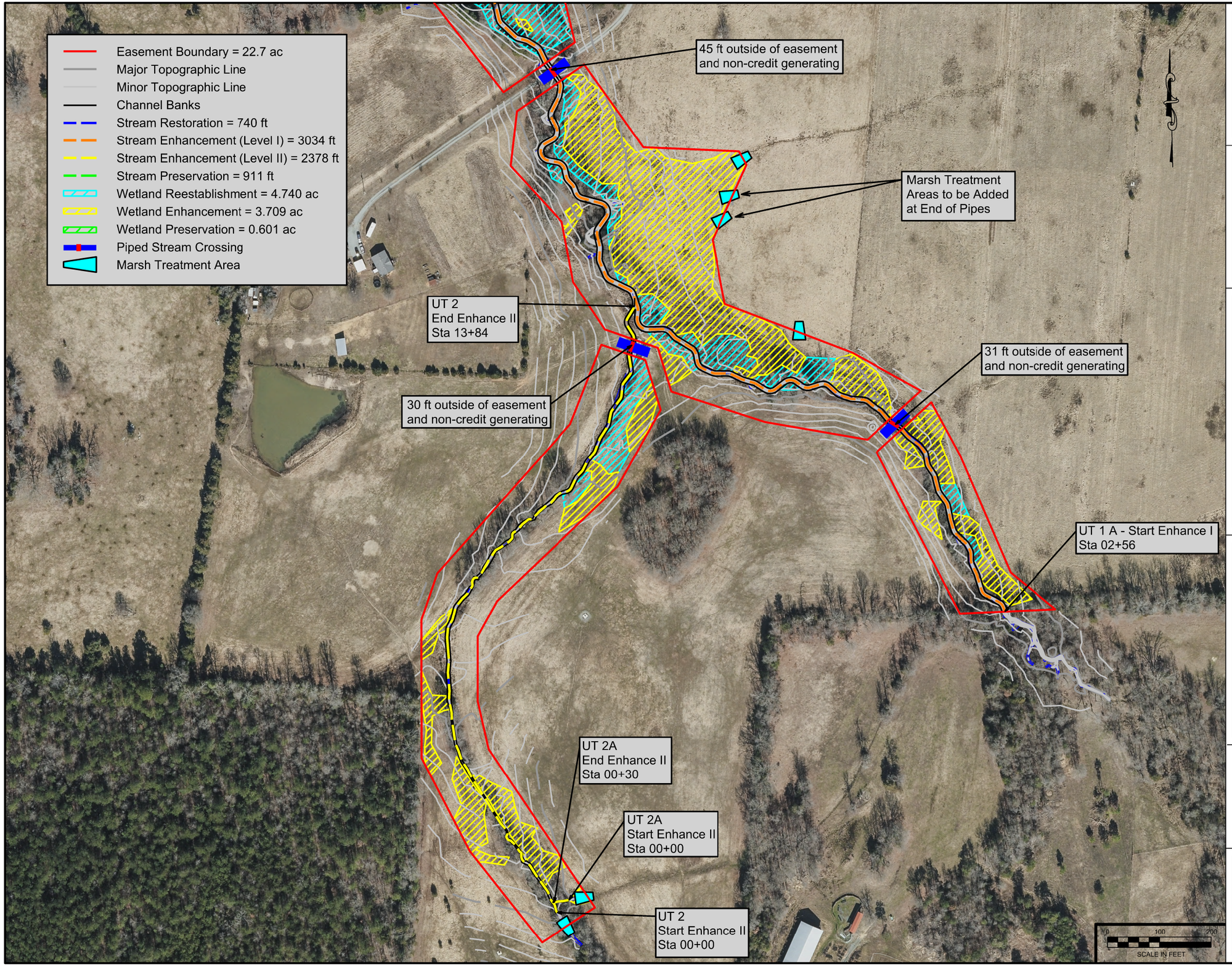
Scale: NA

Date: August 2017

Project No.: 17-009

FIGURE NO.

5C



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

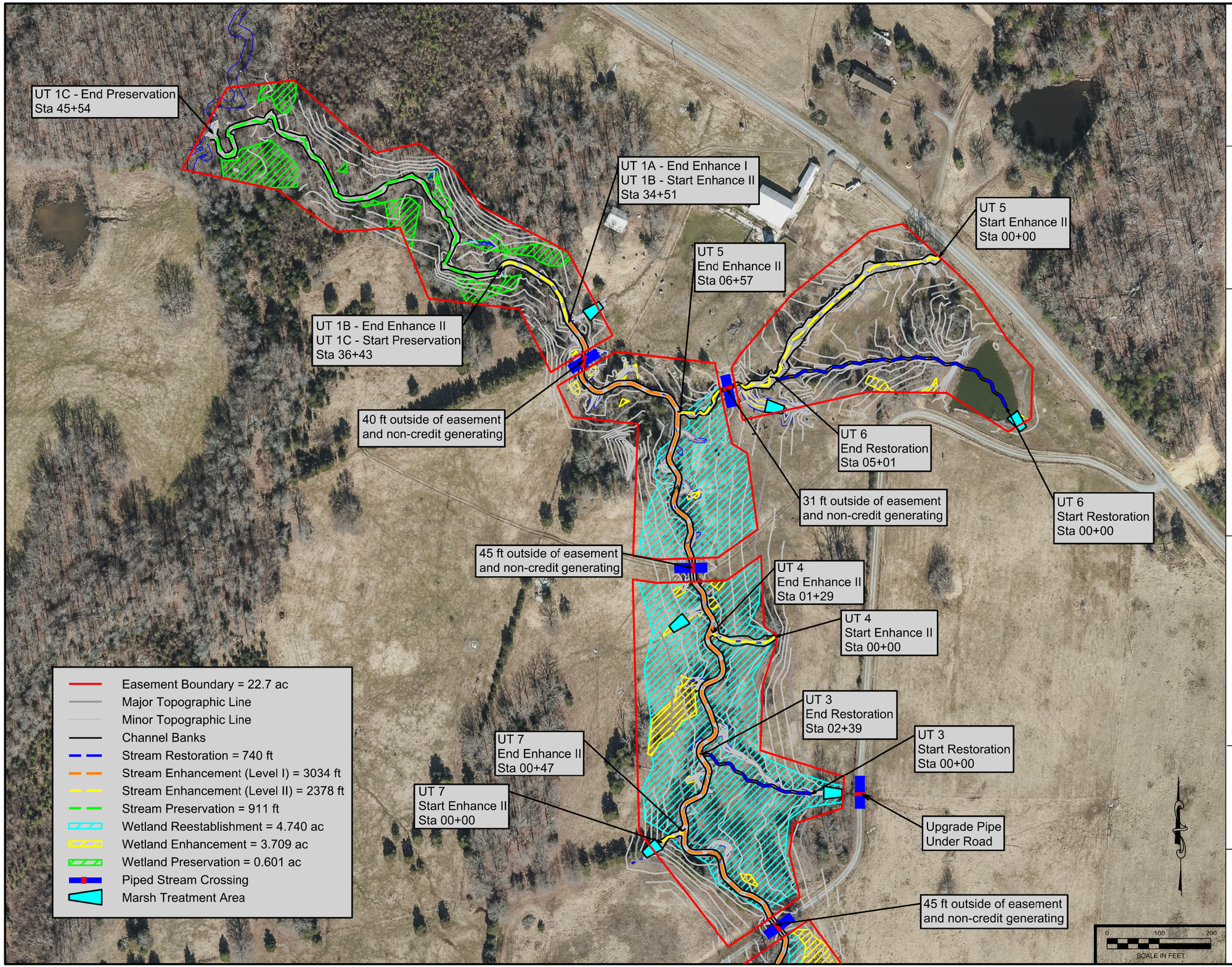
Brahma Mitigation Site

Alamance County North Carolina

Title:

Restoration Plan

Scale:	FIGURE NO.
As Shown	6A
Date: Sept 2019	
Project No.: 19-006	



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

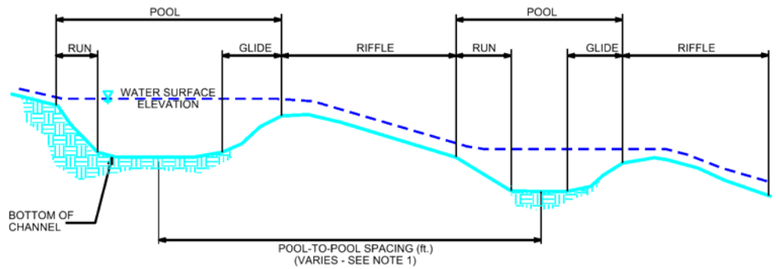
Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Restoration Plan

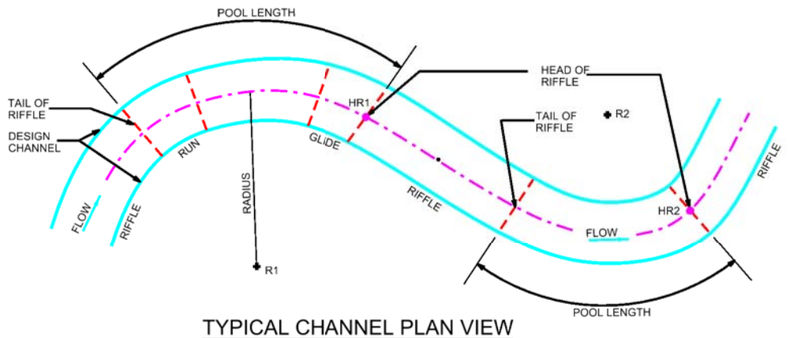
Scale: As Shown	FIGURE NO. 6B
Date: Sept 2019	
Project No.: 19-006	



TYPICAL CHANNEL PROFILE

NOTES:

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

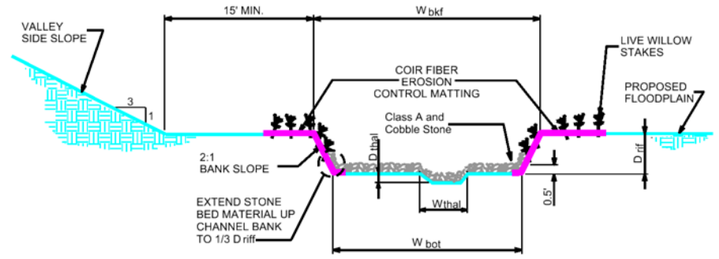


TYPICAL CHANNEL PLAN VIEW

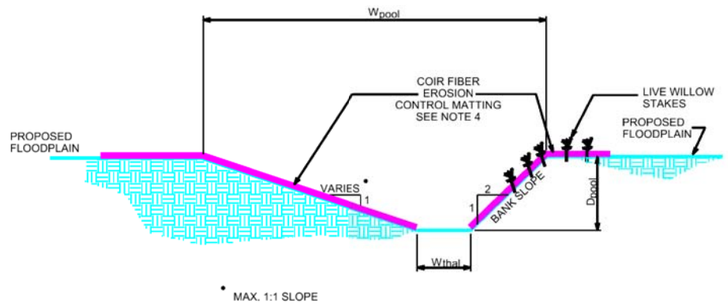
CHANNEL PLAN VIEW NOTES:

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



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 Upstream of UT 2	10.8	6.1	0.9	0.1	1.4	11.1	2.7
UT 1 Downstream of UT 2	11.0	6.6	1.0	0.1	1.5	12.1	3.1
UT 2	7.4	4.6	0.6	0.1	1.0	8.1	2.1
UT 3 and UT 6	4.4	2.4	0.4	0.1	0.6	4.9	1.3

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma Mitigation Site

Alamance County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Sept 2019

Project No.: 19-006

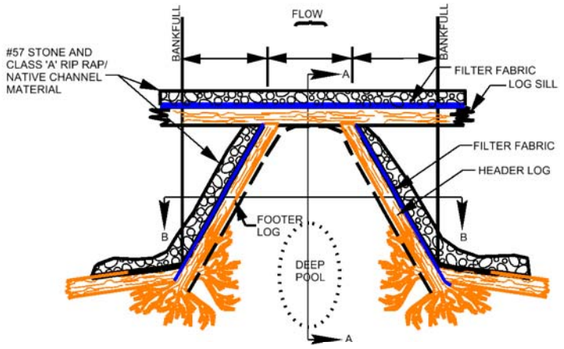
FIGURE NO.

7

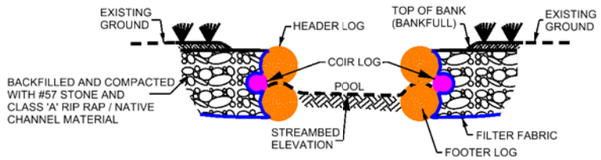
LOG CROSS VANE

SCALE:NTS

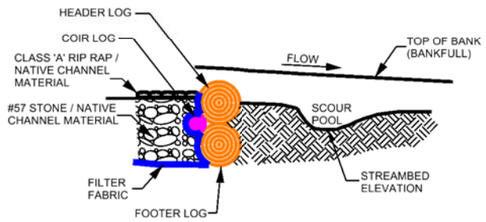
PLAN VIEW



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.



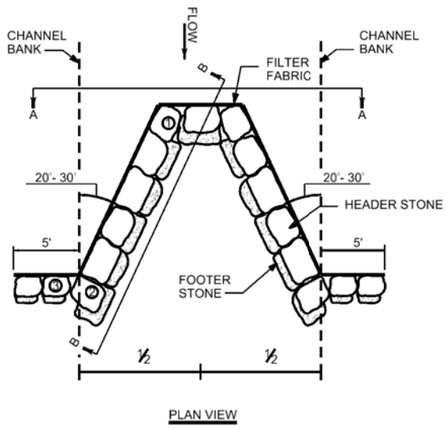
SECTION B-B



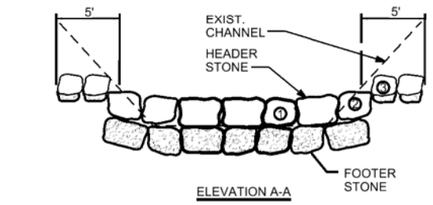
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 1	11	1.0 - 1.1
UT 2, 3, and 6	6	0.4 - 0.6

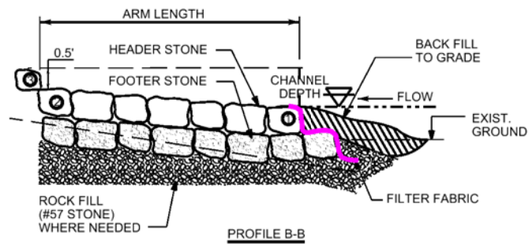
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW

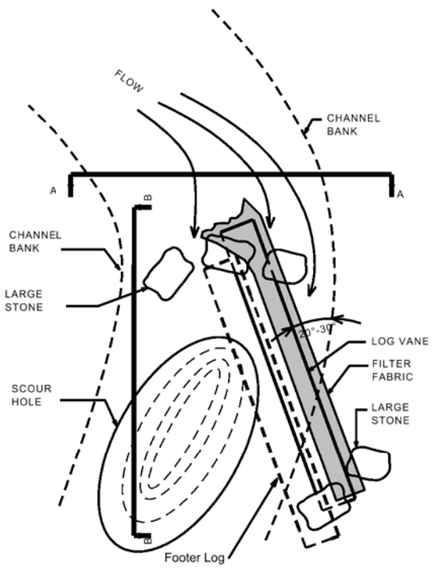


ELEVATION A-A



PROFILE B-B

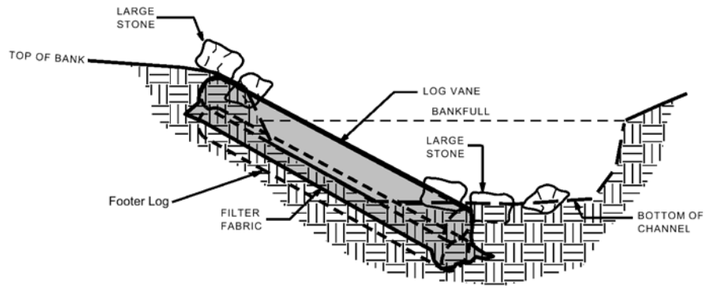
TYPICAL CROSS-VANE



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

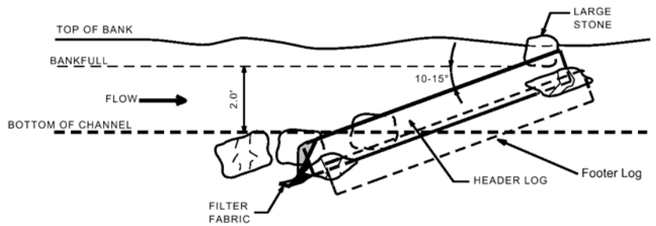
PLAN VIEW

SCALE: N.T.S.



CROSS-SECTION A-A

SCALE: N.T.S.



PROFILE B-B

SCALE: N.T.S.

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

TYPICAL LOG VANE

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NOTES/REVISIONS

Project:

Brahma Mitigation Site

Alamance County North Carolina

Title:

TYPICAL STRUCTURE DETAILS

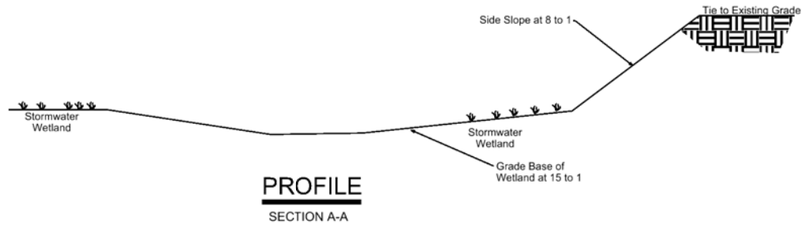
Scale: NO SCALE

Date: Sept 2019

Project No.: 19-006

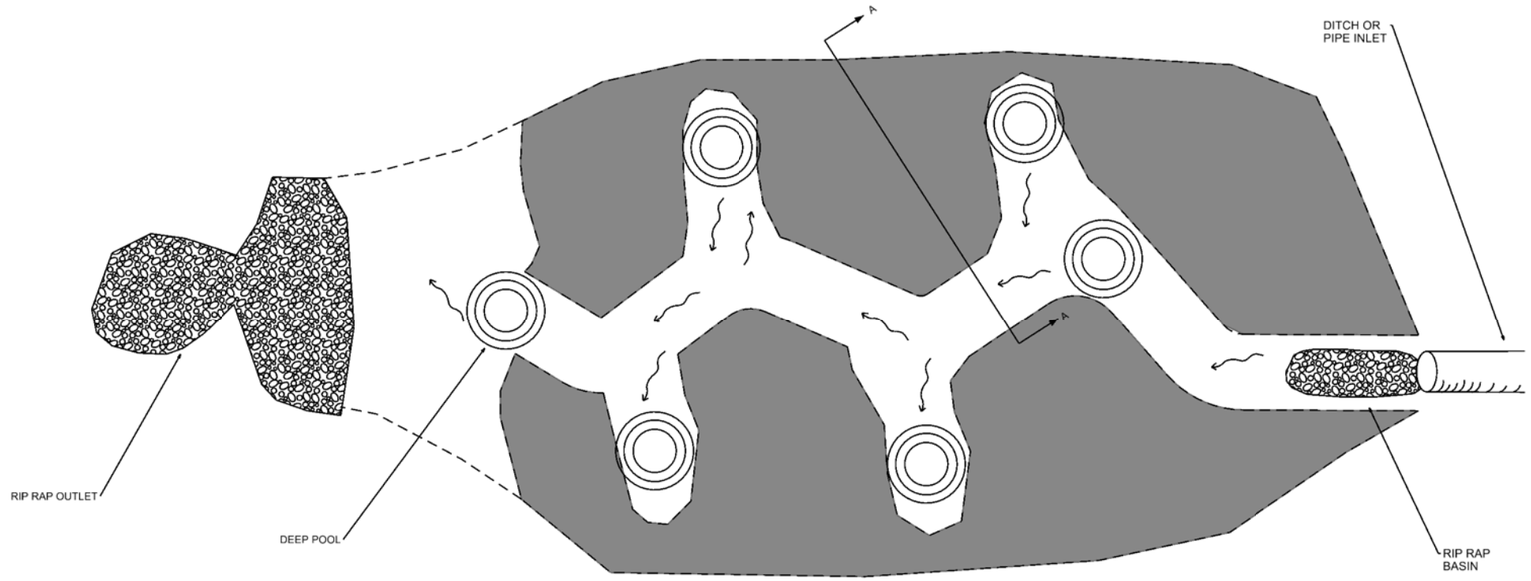
FIGURE NO.

8A



PROFILE

SECTION A-A



MARSH TREATMENT AREA

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

TYPICAL
STRUCTURE
DETAILS

Scale: NO SCALE	FIGURE NO. 8B
Date: Sept 2019	
Project No.: 19-006	

Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	13.7		4.0		17.7
Species	# planted*	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	--	--	544	5	544
River birch (*Betula nigra*)	932	10	544	5	1476
Silky dogwood (*Cornus amomum*)	932	10	2176	20	3108
Green ash (*Fraxinus pennsylvanica*)	932	10	2176	20	3108
Tulip poplar (*Liriodendron tulipifera*)	932	10	--	--	932
Sycamore (*Platanus occidentalis*)	1863	20	2176	20	4039
Black gum (*Nyssa sylvatica*)	932	10	--	--	932
Water oak (*Quercus nigra*)	1397	15	1088	10	2485
Willow oak (*Quercus phellos*)	1397	15	1088	10	2485
Black willow (*Salix nigra*)	--	--	1088	10	1088
TOTAL	9316	100	10880	100	20196

* Planted at a density of 680 stems/acre.

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

Easement Boundary = 22.7 ac
Major Topographic Line
Minor Topographic Line
Channel Banks
Piedmont/Mountain Alluvial Forest = 13.7 ac
Stream-side Assemblage = 4.0 ac

0 100 200
SCALE IN FEET

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Planting Plan

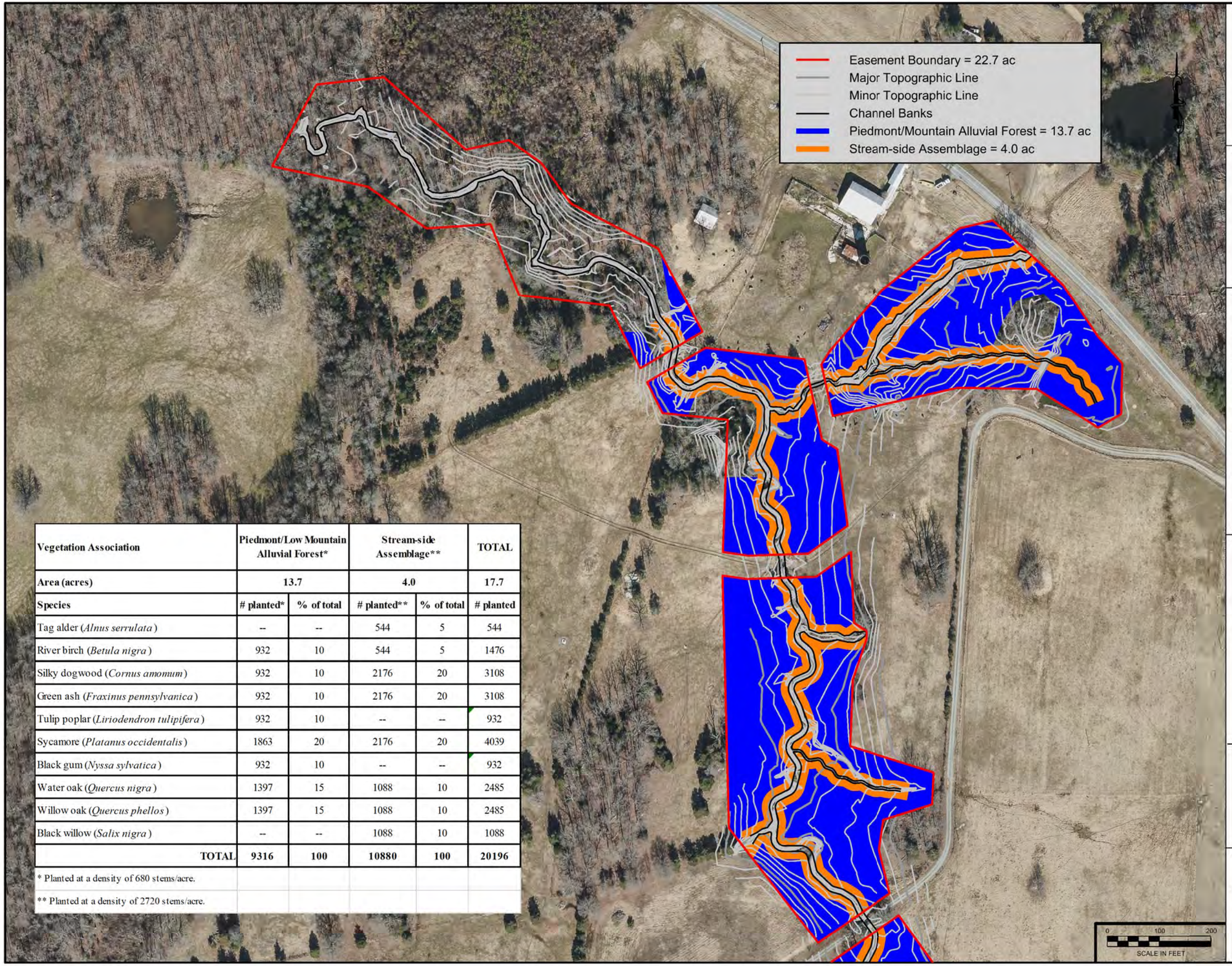
Scale: As Shown

Date: Sept 2019

Project No.: 19-006

FIGURE NO.

9A



Vegetation Association	Piedmont/Low Mountain Alluvial Forest*		Stream-side Assemblage**		TOTAL
Area (acres)	**13.7**		**4.0**		**17.7**
Species	**# planted***	**% of total**	**# planted****	**% of total**	**# planted**
Tag alder (*Alnus serrulata*)	--	--	544	5	544
River birch (*Betula nigra*)	932	10	544	5	1476
Silky dogwood (*Cornus amomum*)	932	10	2176	20	3108
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Black gum (*Nyssa sylvatica*)	932	10	--	--	932
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Black willow (*Salix nigra*)	--	--	1088	10	1088
TOTAL	**9316**	**100**	**10880**	**100**	**20196**

* Planted at a density of 680 stems/acre.

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

Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Planting Plan

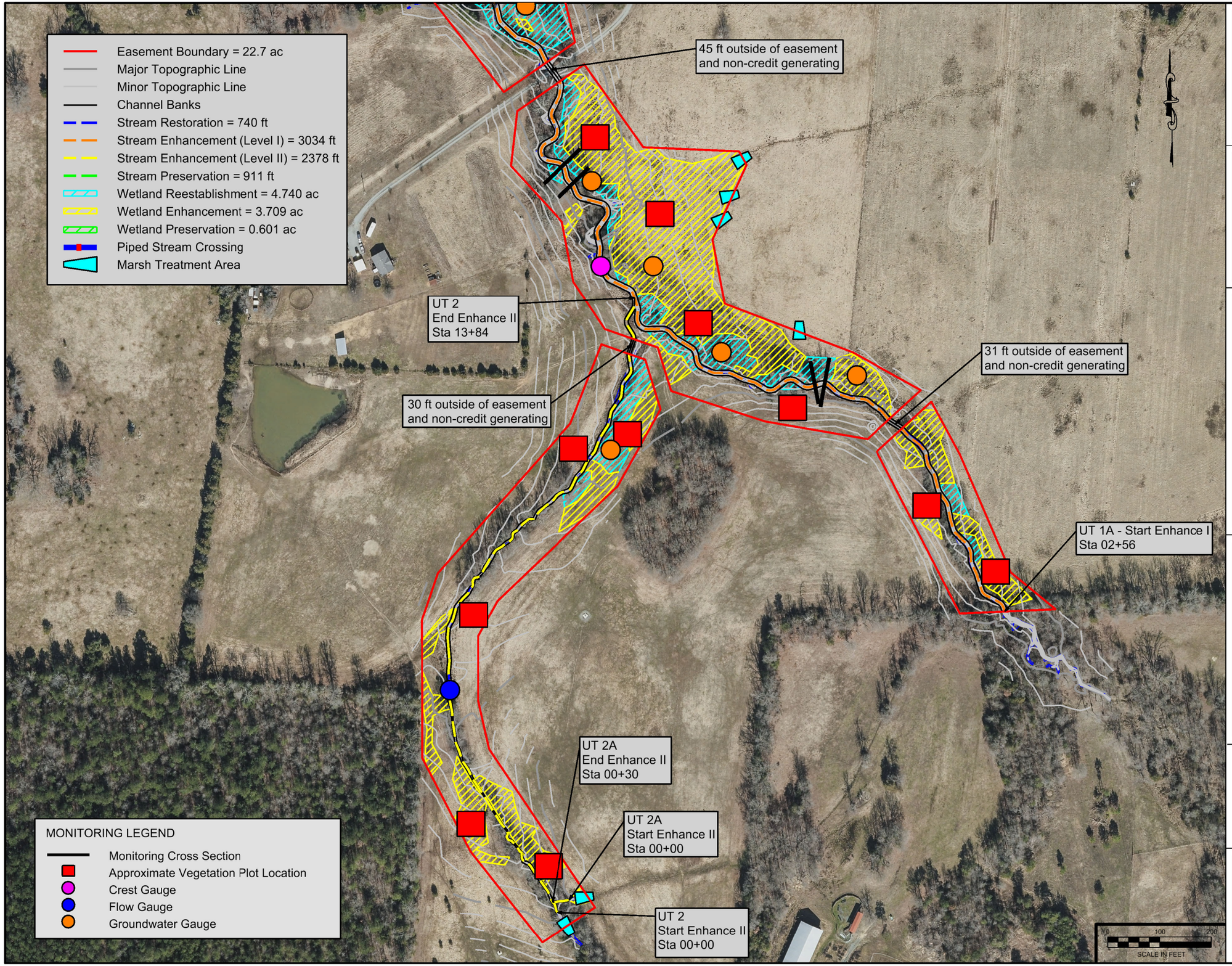
Scale: As Shown

Date: Sept 2019

Project No.: 19-006

FIGURE NO.

9B



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Monitoring Plan

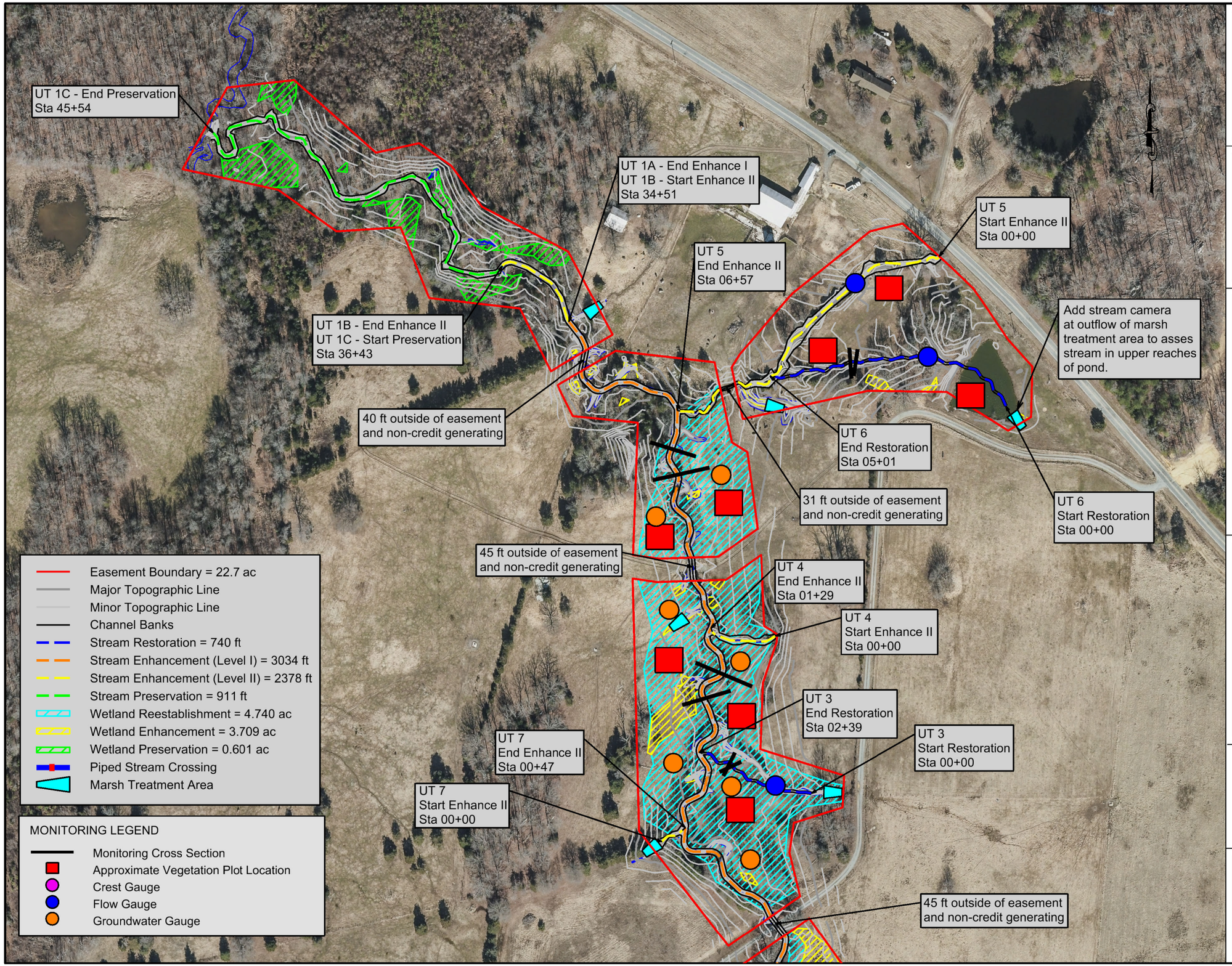
Scale: As Shown

Date: Sept 2019

Project No.: 19-006

FIGURE NO.

10A



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Monitoring Plan

Scale:	FIGURE NO.
As Shown	10B
Date: Sept 2019	
Project No.: 19-006	

Appendix B
Existing Stream & Wetland Data

Table B1. Brahma Morphological Stream Characteristics
Existing Stream Cross-section Data
NC SAM Forms
NC WAM Forms
NCDWQ Stream Forms
BEHI/NBS Data
Soil Boring Logs

Table B1. Brahma Site Morphological Stream Characteristics

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 1 (upstream of confluence with UT 2)	Proposed	Existing UT 1 (downstream of confluence with UT 2)	PROPOSED
Stream Type	Eb 4	E 5	G 5	E/C 4	Cg 4/5	E/C 4
Drainage Area (mi^2)	0.21	0.63	0.22	0.22	0.30	0.30
Bankfull Discharge (cfs)	28.8	60.6	28.2	28.2	34.4	34.4
Dimension Variables						
Bankfull Cross-Sectional Area (A_{bkf})	8.0	14.7	7.3	7.3	8.7	8.7
Existing Cross-Sectional Area at TOB ($A_{existing}$)	8.0	14.7	8.9 -41.3	7.3	13.0 - 41.5	8.7
Bankfull Width (W_{bkf})	Mean: 8.1 Range: 8.0 - 12.1	Mean: 11.0 Range: 10.7 - 11.3	Mean: 8.0 Range: 5.8 to 16.0	Mean: 10.1 Range: 9.4 to 10.8	Mean: 8.2 Range: 5.4 to 16.9	Mean: 11.0 Range: 10.2 to 11.8
Bankfull Mean Depth (D_{bkf})	Mean: 0.8 Range: 0.8 - 1.0	Mean: 1.4 Range: 1.3 - 1.4	Mean: 0.9 Range: 0.5 to 1.3	Mean: 0.7 Range: 0.7 to 0.8	Mean: 1.1 Range: 0.5 to 1.6	Mean: 0.8 Range: 0.7 to 0.9
Bankfull Maximum Depth (D_{max})	Mean: 1.4 Range: 1.1 - 1.4	Mean: 2.0 Range: 1.9 - 2.0	Mean: 1.5 Range: 1.0 to 1.8	Mean: 1.0 Range: 0.9 to 1.2	Mean: 1.6 Range: 0.8 to 2.7	Mean: 1.1 Range: 0.9 to 1.3
Pool Width (W_{pool})	Mean: 9.3 Range: 8.9 - 9.7	Mean: 10.5 Range:	Mean: 9.8 Range: 6.3 to 12.1	Mean: 11.1 Range: 10.1 to 14.2	Mean: 8.9 Range: 6.1 to 10.4	Mean: 12.1 Range: 11.0 to 15.5
Maximum Pool Depth (D_{pool})	Mean: 1.8 Range: 1.5 - 2.1	Mean: 2.7 Range:	Mean: 1.8 Range: 1.7 to 2.0	Mean: 1.4 Range: 0.9 to 1.5	Mean: 1.7 Range: 1.4 to 4.1	Mean: 1.5 Range: 1.0 to 1.7
Width of Floodprone Area (W_{fpa})	Mean: 18 Range: 15 - 25	Mean: 131 Range: 122 - 140	Mean: 8 Range: 6 to 14	Mean: 75 Range: 40 to 100	Mean: 19 Range: 14 to 100	Mean: 100 Range: 50 to 150
Dimension Ratios						
Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: 2.1 Range: 1.9 - 2.2	Mean: 12 Range: 11 - 13	Mean: 1.0 Range: 0.9 to 1.0	Mean: 7.4 Range: 4.3 to 9.3	Mean: 2.4 Range: 1.3 to 13.3	Mean: 9.1 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: 9.1 Range: 4.5 to 32.0	Mean: 14.0 Range: 12.0 to 16.0	Mean: 7.8 Range: 3.4 to 33.8	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: 1.4 to 2.0	Mean: 1.4 Range: 1.2 to 1.5	Mean: 1.6 Range: 1.3 to 3.9	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: 1.5 Range: 1.1 to 1.9	Mean: 1.0 Range: 1.0 to 1.3	Mean: 2.1 Range: 1.2 to 2.9	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:	Mean: 2.0 Range: 1.9 to 2.2	Mean: 1.9 Range: 1.3 to 2.1	Mean: 1.6 Range: 1.3 to 3.9	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: 1.2 Range: 0.8 to 1.5	Mean: 1.1 Range: 1.0 to 1.4	Mean: 1.1 Range: 0.7 to 1.3	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: 1.0 Range: 1.0 to 1.0	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 (upstream of confluence with UT 2)	Proposed	Existing UT 1 (downstream of confluence with UT 2)	PROPOSED
Pattern Variables						
Pool to Pool Spacing (L_{p-p})	Med: 37.2 Range: 25 - 69	Med: 44.3 Range: 22 - 81	Med: 34 Range: 15 to 88	Med: 40.4 Range: 30.3 to 80.9	Med: 46 Range: 18 to 80	Med: 44.1 Range: 33.1 to 88.3
Meander Length (L_m)	Med: 68.4 Range: 44 - 116	Med: 62.9 Range: 10 - 91	Med: 71 Range: 31 to 118	Med: 85.9 Range: 60.7 to 121.3	Med: 66 Range: 39 to 94	Med: 93.8 Range: 66.2 to 132.4
Belt Width (W_{belt})	Med: 22.8 Range: 20 - 38	Med: 29.8 Range: 17 - 36	Med: 17 Range: 6 to 26	Med: 40.4 Range: 30.3 to 60.7	Med: 55 Range: 34 to 88	Med: 44.1 Range: 33.1 to 66.2
Radius of Curvature (R_c)	Med: 16.5 Range: 11 - 27	Med: 30.6 Range: 9 - 113	Med: 11 Range: 5 to 26	Med: 30.3 Range: 20.2 to 101.1	Med: 14 Range: 5 to 47	Med: 33.1 Range: 22.1 to 110.4
Sinuosity (Sin)	1.20	1.46	1.10	1.12	1.33	1.33
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	Med: 4.3 Range: 1.9 to 11.0	Med: 4.0 Range: 3.0 to 8.0	Med: 5.6 Range: 2.2 to 9.8	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: 8.9 Range: 3.9 to 14.8	Med: 8.5 Range: 6.0 to 12.0	Med: 8.0 Range: 4.8 to 11.5	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: 2.1 Range: 0.8 to 3.3	Med: 4.0 Range: 3.0 to 6.0	Med: 6.7 Range: 4.1 to 10.7	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: 1.4 Range: 0.6 to 3.3	Med: 3.0 Range: 2.0 to 10.0	Med: 1.7 Range: 0.6 to 5.7	Med: 3.0 Range: 2.0 to 10.0
Profile Variables						
Average Water Surface Slope (S_{ave})	0.0258	0.0053	0.0076	0.0075	0.0052	0.0052
Valley Slope (S_{valley})	0.0310	0.0077	0.0084	0.0084	0.0069	0.0069
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 channel incision	Mean: 0.0120 Range: 0.0090 to 0.0135	No distinct repetitive pattern of riffles and pools due to channel incision	Mean: 0.0083 Range: 0.0062 to 0.0093
Pool Slope (S_{pool})	Mean: 0.0007 Range: 0 - 0.018	Mean: 0.0006 Range: 0 - 0.004		Mean: 0.0008 Range: 0.0000 to 0.0053		Mean: 0.0005 Range: 0.0000 to 0.0036
Run Slope (S_{run})	Mean: 0.0353 Range: 0 - 0.3565	Mean: Range:		Mean: 0.0030 Range: 0.0000 to 0.0060		Mean: 0.0021 Range: 0.0000 to 0.0042
Glide Slope (S_{glide})	Mean: 0.0029 Range: 0 - 0.0431	Mean: Range:		Mean: 0.0008 Range: 0.0000 to 0.0060		Mean: 0.0006 Range: 0.0000 to 0.0042
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 channel incision	Mean: 1.60 Range: 1.2 to 1.8	No distinct repetitive pattern of riffles and pools due to channel incision	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

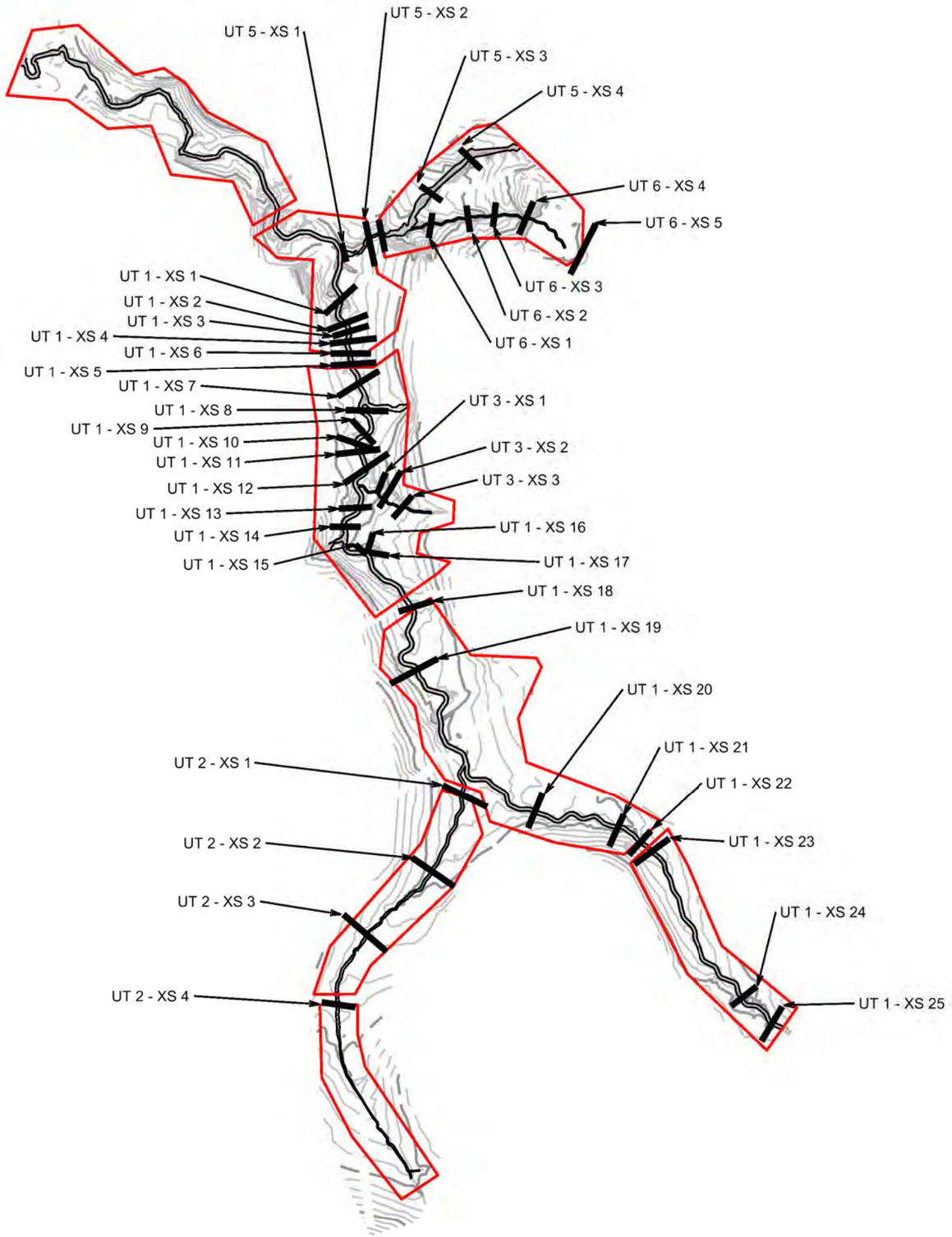
* Causey Farm Reference includes measurments from a Reference Site measured in 2004.

Table B1 continued. Brahma Site Morphological Stream Characteristics

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 3	Existing UT 6	Proposed
Stream Type	Eb 4	E 5	G 5	F 5	E/C 4
Drainage Area (mi^2)	0.21	0.63	0.02	0.02	0.02
Bankfull Discharge (cfs)	28.8	60.6	5.4	4.8	4.8 - 5.4
Dimension Variables					
Bankfull Cross-Sectional Area (A_{bkf})	8.0	14.7	1.5	1.4	1.4
Existing Cross-Sectional Area at TOB ($A_{existing}$)	8.0	14.7	5.4 - 11.6	7.7 -23.5	1.4
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 5.9	Mean: 6.5 Range: 3.3 to 16.3	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: 0.4 Range: 0.3 to 0.5	Mean: 0.2 Range: 0.1 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: 0.6 Range: 0.4 to 0.7	Mean: 0.4 Range: 0.2 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	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: 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: 5 Range: 3 to 8	Mean: 13 Range: 5 to 23	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: 1.4 Range: 0.8 to 1.6	Mean: 1.5 Range: 1.2 to 2.7	Mean: 11.3 Range: 6.1 to 15.8
Width / Depth Ratio (W_{bkf}/D_{bkf})	Mean: 10.1 Range: 8.0 - 15.1	Mean: 9 Range: 8 - 9	Mean: 9.5 Range: 6.2 to 19.7	Mean: 32.5 Range: 3.6 to 163.0	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: 1.4 Range: 1.3 to 1.5	Mean: 2.0 Range: 1.8 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: 3.2 Range: 2.3 to 4.0	Mean: 3.1 Range: 1.0 to 5.0	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
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
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

Variables	REFERENCE - CEDAROCK PARK	REFERENCE - CAUSEY* FARM	Existing UT 3	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: 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: 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: 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: 13.3 Range: 8.9 to 44.3
Sinuosity (Sin)	1.20	1.46	1.06	1.02	1.12
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
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
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
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
Profile Variables					
Average Water Surface Slope (S_{ave})	0.0258	0.0053	0.0170	0.0203	0.0173
Valley Slope (S_{valley})	0.0310	0.0077	0.0180	0.0207	0.0194
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: 0.0276 Range: 0.0207 to 0.0311
Pool Slope (S_{pool})	Mean: 0.0007 Range: 0 - 0.018	Mean: 0.0006 Range: 0 - 0.004			Mean: 0.0017 Range: 0.0000 to 0.0121
Run Slope (S_{run})	Mean: 0.0353 Range: 0 - 0.3565	Mean: Range:			Mean: 0.0069 Range: 0.0000 to 0.0138
Glide Slope (S_{glide})	Mean: 0.0029 Range: 0 - 0.0431	Mean: Range:			Mean: 0.0019 Range: 0.0000 to 0.0138
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
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
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
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

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



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

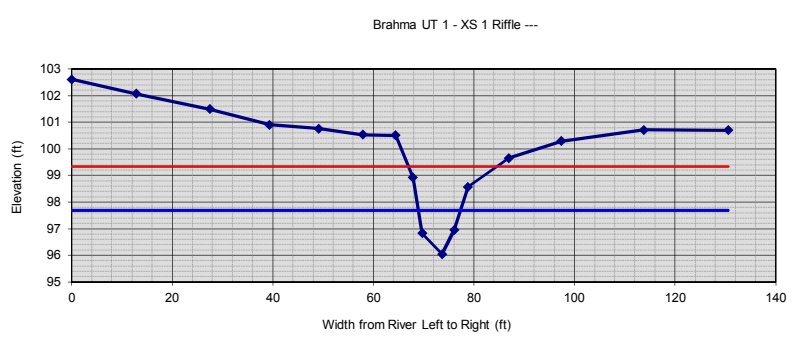
Alamance County
North Carolina

Title:

Cross Section Locations

Scale: NA	FIGURE NO.
Date: Sept 2019	B1
Project No.: 19-006	

Cross Section



section: **Brahma UT 1 - XS 1**
Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.613762	102.6138
	☐	12.85752	-2.073419	102.0734
	☐	27.48776	-1.493432	101.4934
	☐	39.33882	-0.902611	100.9026
	☐	49.105	-0.754265	100.7543
	☐	57.87456	-0.530064	100.5301
	☐	64.45907	-0.501528	100.5015
	☐	67.89161	1.08143	98.91857
	☐	69.68657	3.171854	96.82815
	☐	73.69239	3.951876	96.04812
	☐	76.10898	3.054017	96.94598
	☐	78.83914	1.425272	98.57473
	☐	86.96127	0.349301	99.6507
	☐	97.37927	-0.285982	100.286
	☐	113.8337	-0.714027	100.714
	☐	130.5951	-0.692754	100.6928
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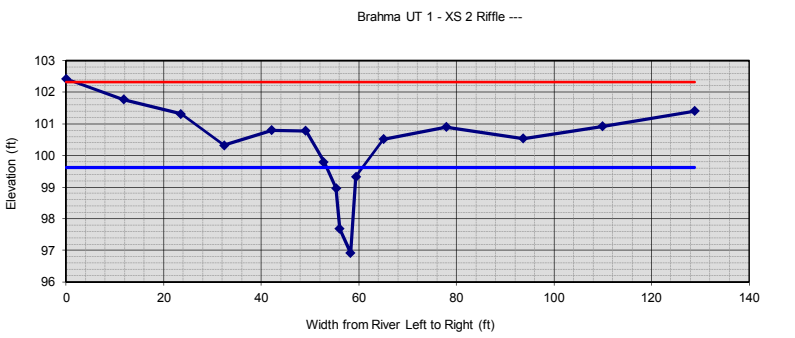
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
2.31	0.34	18.0		
97.69	99.66			

dimensions			
8.7	x-section area	1.0	d mean
8.4	width	9.2	wet P
1.6	d max	0.9	hyd radi
3.6	bank ht	8.1	w/d ratio
18.0	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: **Brahma UT 1 - XS 2**
Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.422311	102.4223
	☐	11.75634	-1.765981	101.766
	☐	23.49972	-1.314945	101.3149
	☐	32.39694	-0.325706	100.3257
	☐	42.12759	-0.798343	100.7983
	☐	49.08378	-0.774614	100.7746
	☐	52.75834	0.198805	99.8012
	☐	55.32687	1.02973	98.97027
	☐	56.08615	2.320455	97.67955
	☐	58.31098	3.078004	96.922
	☐	59.42674	0.66943	99.33057
	☐	65.01761	-0.510657	100.5107
	☐	77.94243	-0.899113	100.8991
	☐	93.7064	-0.539402	100.5394
	☐	109.9621	-0.917703	100.9177
	☐	128.8352	-1.403665	101.4037
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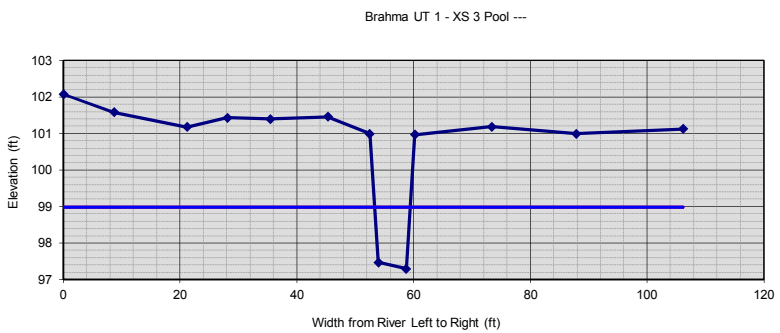
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.38	-0.51	100.0		
99.62	100.51			

dimensions			
8.7	x-section area	1.2	d mean
7.5	width	10.0	wet P
2.7	d max	0.9	hyd radi
3.6	bank ht	6.5	w/d ratio
100.0	W flood prone area	13.4	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: **Brahma UT 1 - XS 3**
Pool

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description: **Brahma UT 1 - XS 3**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.078294	102.0783
	☐	8.721674	-1.580551	101.5806
	☐	21.16447	-1.177306	101.1773
	☐	28.08507	-1.429648	101.4296
	☐	35.47346	-1.399778	101.3998
	☐	45.30339	-1.456428	101.4564
	☐	52.50954	-0.990212	100.9902
	☐	53.97072	2.527447	97.47255
	☐	58.73408	2.706959	97.29304
	☐	60.2509	-0.969283	100.9693
	☐	73.38915	-1.18185	101.1819
	☐	87.83416	-0.997244	100.9972
	☐	106.1585	-1.125494	101.1255
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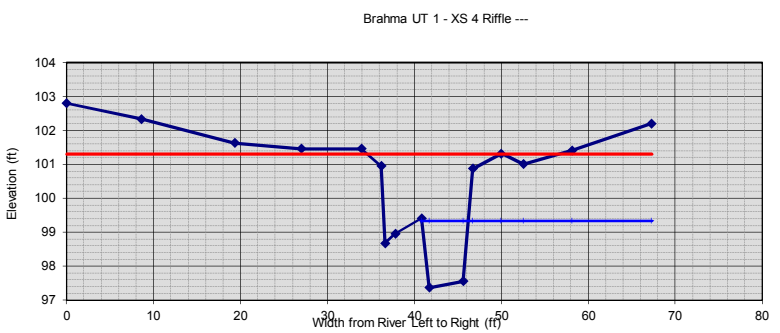
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
1.02	-0.97	7.0		
98.98	100.97			

dimensions			
8.7	x-section area	1.4	d mean
6.1	width	8.2	wet P
1.7	d max	1.1	hyd radi
3.7	bank ht	4.3	w/d ratio
7.0	W flood prone area	1.2	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 4**
Riffle

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description: **Brahma UT 1 - XS 4**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	-2.797507	102.7975
	☑	8.596239	-2.333211	102.3332
	☑	19.34327	-1.623226	101.6232
	☑	27.02636	-1.456281	101.4563
	☑	33.90559	-1.456355	101.4564
	☑	36.21973	-0.945668	100.9457
	☑	36.64667	1.3186	98.6814
	☑	37.83196	1.036399	98.9636
	☐	40.82529	0.590505	99.4095
	☐	41.71278	2.636596	97.3634
	☐	45.61433	2.441493	97.55851
	☐	46.734	-0.875023	100.875
	☐	49.98891	-1.314608	101.3146
	☐	52.55845	-1.009825	101.0098
	☐	58.16216	-1.407193	101.4072
	☐	67.28633	-2.205356	102.2054
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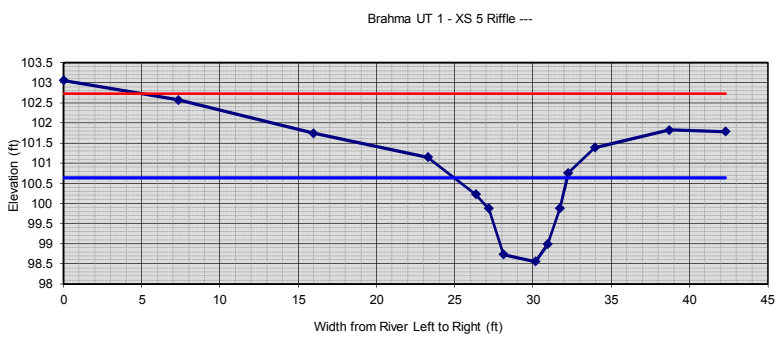
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.67	-1.31	16.0		
99.33	101.31			

dimensions			
8.7	x-section area	1.6	d mean
5.4	width	7.9	wet P
2.0	d max	1.1	hyd radi
3.9	bank ht	3.3	w/d ratio
16.0	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: **Brahma UT 1 - XS 5**
Riffle

---
description: **Brahma UT 1 - XS 5**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.055156	103.0552
	☐	7.335115	-2.574913	102.5749
	☐	15.96113	-1.748583	101.7486
	☐	23.28283	-1.153374	101.1534
	☐	26.34829	-0.229835	100.2298
	☐	27.16777	0.12242	99.87758
	☐	28.10706	1.266704	98.7333
	☐	30.1548	1.444959	98.55504
	☐	30.91616	1.010327	98.98967
	☐	31.71736	0.119233	99.88077
	☐	32.25421	-0.756563	100.7566
	☐	33.94601	-1.388703	101.3887
	☐	38.71581	-1.824529	101.8245
	☐	42.2946	-1.781786	101.7818
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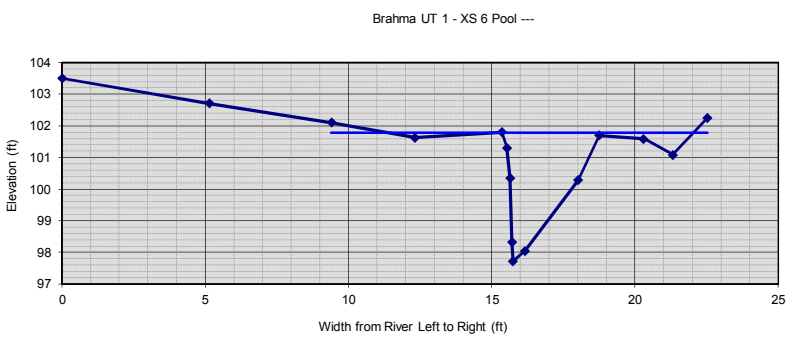
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.64	-1.15	40.0		
100.64	101.15			

dimensions			
8.7	x-section area	1.2	d mean
7.2	width	8.8	wet P
2.1	d max	1.0	hyd radi
2.6	bank ht	6.0	w/d ratio
40.0	W flood prone area	5.6	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: **Brahma UT 1 - XS 6**
Pool

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description: **Brahma UT 1 - XS 6**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☑	0	-3.500615	103.5006
	☑	5.149079	-2.713074	102.7131
	☐	9.403199	-2.096751	102.0968
	☐	12.32478	-1.626217	101.6262
	☐	15.34147	-1.796436	101.7964
	☐	15.52224	-1.306967	101.307
	☐	15.64601	-0.354596	100.3546
	☐	15.69883	1.680082	98.31992
	☐	15.73964	2.281834	97.71817
	☐	16.15432	1.95322	98.04678
	☐	18.00677	-0.277371	100.2774
	☐	18.73912	-1.693766	101.6938
	☐	20.29772	-1.590176	101.5902
	☐	21.32002	-1.075459	101.0755
	☐	22.51126	-2.238925	102.2389
	☐			
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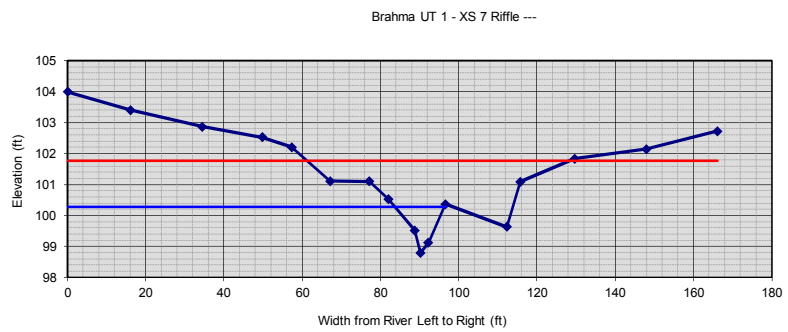
FS bankfull	FS top of bank	~~W fpa (ft)~~	channel slope (%)	~~Manning's "n"~~
-1.78	-1.78	~~16.7~~		
101.78	101.78			

dimensions			
8.7	x-section area	0.8	d mean
10.4	width	16.5	wet P
4.1	d max	0.5	hyd radi
4.1	bank ht	~~12.4~~	~~w/d ratio~~
~~16.7~~	~~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:	Brahma UT 1 - XS 7
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.988856	103.9889
	☐	16.0977	-3.407877	103.4079
	☐	34.47085	-2.869254	102.8693
	☐	49.71002	-2.527819	102.5278
	☐	57.26207	-2.206852	102.2069
	☐	67.15419	-1.106979	101.107
	☐	77.16037	-1.095655	101.0957
	☐	81.96955	-0.53048	100.5305
	☐	88.67275	0.481274	99.51873
	☐	90.22932	1.208668	98.79133
	☐	92.21892	0.87666	99.12334
	☐	96.62188	-0.368326	100.3683
	☑	112.2352	0.364932	99.63507
	☑	115.7299	-1.093332	101.0933
	☑	129.5995	-1.838056	101.8381
	☑	147.9819	-2.143991	102.144
	☑	166.0268	-2.722063	102.7221
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.28	-1.09	70.0		
100.28	101.09			

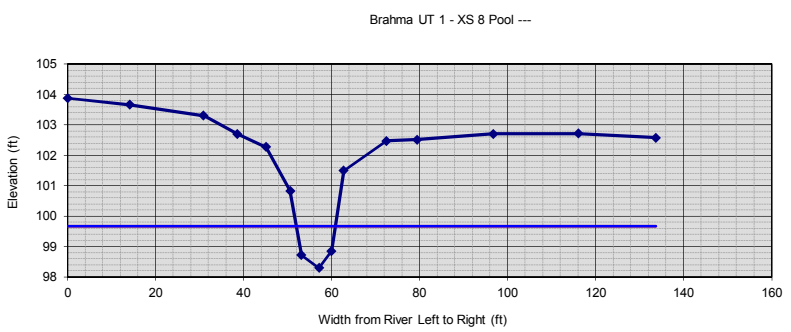
dimensions			
8.7	x-section area	0.7	d mean
12.7	width	13.1	wet P
1.5	d max	0.7	hyd radi
2.3	bank ht	18.5	w/d ratio
70.0	W flood prone area	5.5	ent ratio

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		

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:	Brahma UT 1 - XS 8
	Pool

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.875991	103.876
	☐	14.12622	-3.661424	103.6614
	☐	30.89708	-3.306078	103.3061
	☐	38.55664	-2.690055	102.6901
	☐	45.02354	-2.272723	102.2727
	☐	50.54656	-0.816033	100.816
	☐	53.15809	1.283959	98.71604
	☐	57.15661	1.711423	98.28858
	☐	59.98785	1.146691	98.85331
	☐	62.74539	-1.495474	101.4955
	☐	72.45267	-2.475255	102.4753
	☐	79.47732	-2.510105	102.5101
	☐	96.76687	-2.700783	102.7008
	☐	116.1033	-2.71641	102.7164
	☐	133.6384	-2.579391	102.5794
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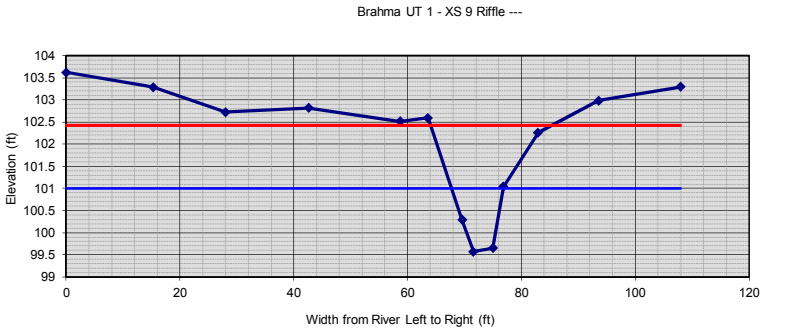
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.33	-1.5	9.4		
99.67	101.5			

dimensions			
8.7	x-section area	1.0	d mean
8.9	width	9.6	wet P
1.4	d max	0.9	hyd radi
3.2	bank ht	9.0	w/d ratio
9.1	W flood prone area	1.0	ent ratio

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

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

Cross Section



section:	Brahma UT 1 - XS 9
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.621053	103.6211
	☐	15.26104	-3.284397	103.2844
	☐	27.97765	-2.721009	102.721
	☐	42.58859	-2.817449	102.8174
	☐	58.67242	-2.515553	102.5156
	☐	63.57564	-2.591025	102.591
	☐	69.62004	-0.287353	100.2874
	☐	71.56263	0.426497	99.5735
	☐	74.96074	0.345909	99.65409
	☐	76.84874	-1.048118	101.0481
	☐	82.93154	-2.258105	102.2581
	☐	93.56901	-2.985698	102.9857
	☐	107.9854	-3.292578	103.2926
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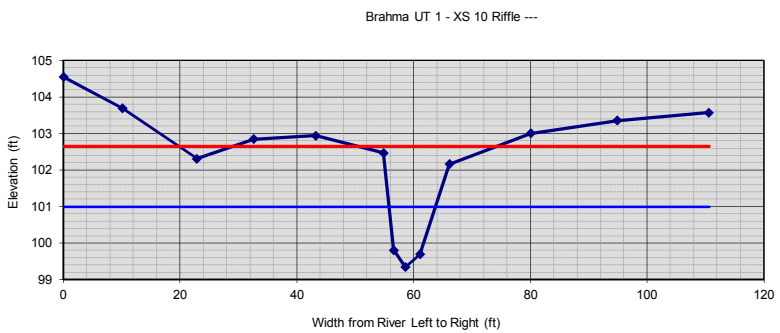
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1	-2.59	22.0		
101	102.59			

dimensions			
8.7	x-section area	1.0	d mean
9.0	width	9.7	wet P
1.4	d max	0.9	hyd radi
3.0	bank ht	9.4	w/d ratio
22.0	W flood prone area	2.4	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 10**

Riffle

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description: **Brahma UT 1 - XS 10**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-4.557455**	104.5575
	☐	**10.1296**	**-3.686229**	103.6862
	☐	**22.90075**	**-2.309852**	102.3099
	☐	**32.57081**	**-2.841133**	102.8411
	☐	**43.20826**	**-2.942251**	102.9423
	☐	**54.86849**	**-2.470351**	102.4704
	☐	**56.63166**	**0.200838**	99.79916
	☐	**58.54947**	**0.667299**	99.3327
	☐	**61.06943**	**0.314451**	99.68555
	☐	**66.15815**	**-2.164364**	102.1644
	☐	**80.04208**	**-3.004703**	103.0047
	☐	**94.86294**	**-3.351673**	103.3517
	☐	**110.6015**	**-3.571534**	103.5715
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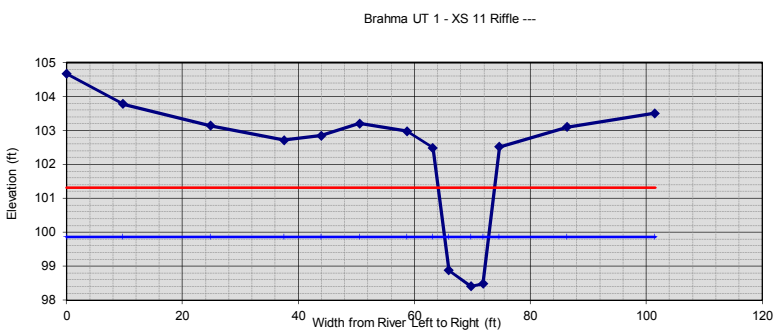
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.99	**-2.16**	**23.0**		
100.99	102.16			

dimensions			
8.7	x-section area	1.1	d mean
7.9	width	8.9	wet P
1.7	d max	1.0	hyd radi
2.8	bank ht	7.2	w/d ratio
23.0	W flood prone area	2.9	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 11**

Riffle

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description: **Brahma UT 1 - XS 11**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-4.666731**	104.6667
	☐	**9.719081**	**-3.780118**	103.7801
	☐	**24.87841**	**-3.13445**	103.1345
	☐	**37.48904**	**-2.710739**	102.7107
	☐	**43.89648**	**-2.848354**	102.8484
	☐	**50.51512**	**-3.205609**	103.2056
	☐	**58.74534**	**-2.974166**	102.9742
	☐	**63.16627**	**-2.486263**	102.4863
	☐	**65.93749**	**1.121991**	98.87801
	☐	**69.77897**	**1.592223**	98.40778
	☐	**71.8673**	**1.52247**	98.47753
	☐	**74.65116**	**-2.514313**	102.5143
	☐	**86.37406**	**-3.099705**	103.0997
	☐	**101.4924**	**-3.499379**	103.4994
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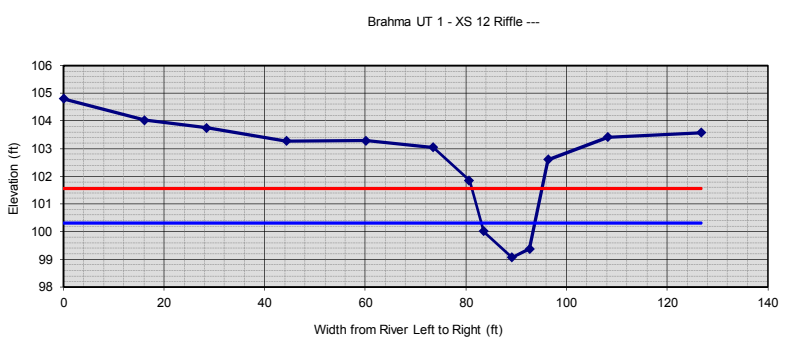
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.14	**-2.51**	**14.0**		
99.86	102.51			

dimensions			
8.7	x-section area	1.1	d mean
7.6	width	8.9	wet P
1.5	d max	1.0	hyd radi
4.1	bank ht	6.7	w/d ratio
14.0	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: **Brahma UT 1 - XS 12**

Riffle

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description: **Brahma UT 1 - XS 12**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.800149	104.8001
	☐	16.12385	-4.024046	104.024
	☐	28.45173	-3.748284	103.7483
	☐	44.32919	-3.279055	103.2791
	☐	60.06072	-3.288383	103.2884
	☐	73.49631	-3.038992	103.039
	☐	80.64133	-1.853572	101.8536
	☐	83.48919	-0.012376	100.0124
	☐	89.15598	0.937237	99.06276
	☐	92.61961	0.625072	99.37493
	☐	96.35365	-2.607503	102.6075
	☐	108.2041	-3.414004	103.414
	☐	126.7169	-3.571793	103.5718
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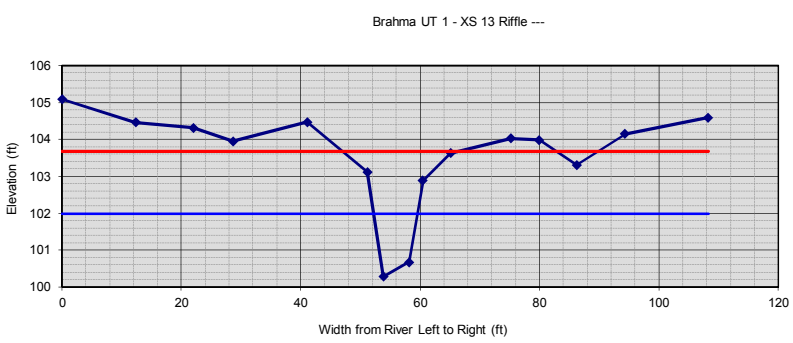
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.31	-2.6	14.0		
100.31	102.6			

dimensions			
8.7	x-section area	0.8	d mean
10.7	width	11.2	wet P
1.2	d max	0.8	hyd radi
3.5	bank ht	13.0	w/d ratio
14.0	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: **Brahma UT 1 - XS 13**

Riffle

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description: **Brahma UT 1 - XS 13**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-5.090569	105.0906
	☐	12.3161	-4.456053	104.4561
	☐	21.97684	-4.312105	104.3121
	☐	28.67712	-3.950293	103.9503
	☐	41.10719	-4.472153	104.4722
	☐	51.19942	-3.119206	103.1192
	☐	53.86096	-0.28371	100.2837
	☐	58.13505	-0.665729	100.6657
	☐	60.43699	-2.87713	102.8771
	☐	65.09677	-3.622823	103.6228
	☐	75.13755	-4.027981	104.028
	☐	79.94192	-3.978018	103.978
	☐	86.20325	-3.305775	103.3058
	☐	94.3199	-4.14977	104.1498
	☐	108.243	-4.586244	104.5862
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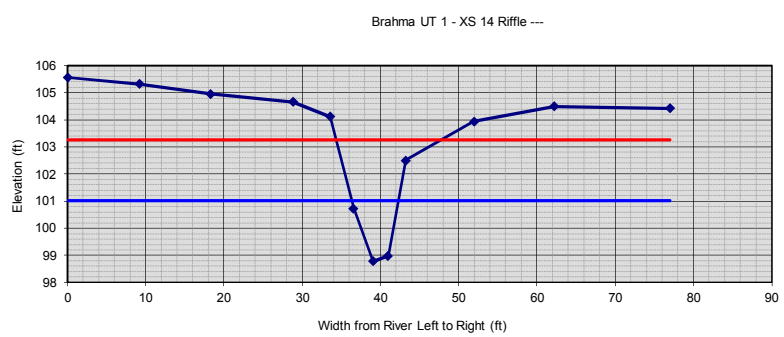
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.98	-3.6	18.0		
101.98	103.6			

dimensions			
8.7	x-section area	1.2	d mean
7.2	width	8.5	wet P
1.7	d max	1.0	hyd radi
3.3	bank ht	6.0	w/d ratio
18.0	W flood prone area	2.5	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:	Brahma UT 1 - XS 14
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-5.558682	105.5587
	☐	9.207117	-5.319823	105.3198
	☐	18.28575	-4.952634	104.9526
	☐	28.81923	-4.656957	104.657
	☐	33.55578	-4.115418	104.1154
	☐	36.54399	-0.733733	100.7337
	☐	39.00958	1.221953	98.77805
	☐	40.95434	1.022211	98.97779
	☐	43.22969	-2.50462	102.5046
	☐	51.95846	-3.935827	103.9358
	☐	62.16637	-4.497152	104.4972
	☐	76.98917	-4.420638	104.4206
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.02	-3.9	14.0		
101.02	103.9			

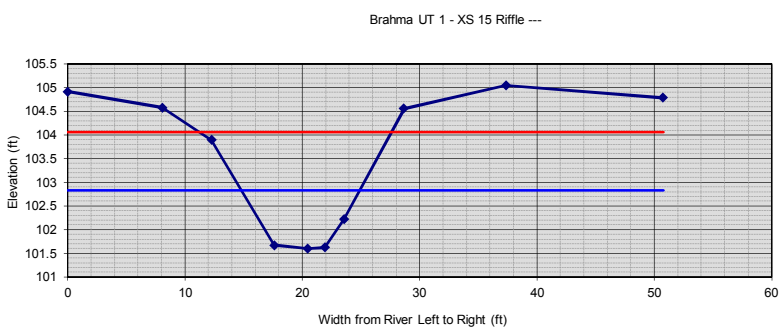
dimensions			
8.7	x-section area	1.4	d mean
6.0	width	7.9	wet P
2.2	d max	1.1	hyd radi
5.1	bank ht	4.1	w/d ratio
14.0	W flood prone area	2.3	ent ratio

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		

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:	Brahma UT 1 - XS 15
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.91454	104.9145
	☐	8.052394	-4.576446	104.5764
	☐	12.24743	-3.896874	103.8969
	☐	17.61643	-1.671933	101.6719
	☐	20.46657	-1.598396	101.5984
	☐	21.91702	-1.620438	101.6204
	☐	23.56256	-2.217334	102.2173
	☐	28.63946	-4.555596	104.5556
	☐	37.36343	-5.045014	105.045
	☐	50.74845	-4.784184	104.7842
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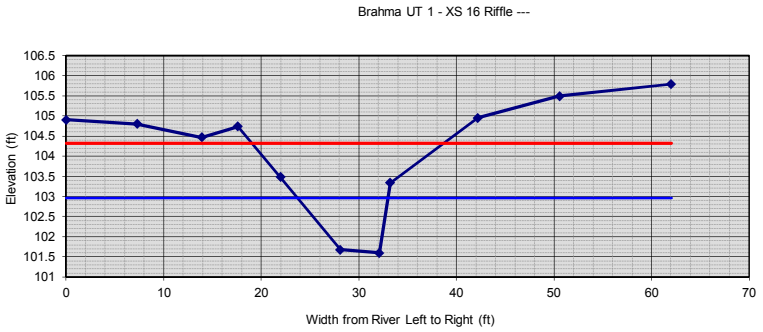
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.83	-4.57	16.0		
102.83	104.57			

dimensions			
8.7	x-section area	0.9	d mean
10.1	width	10.5	wet P
1.2	d max	0.8	hyd radi
3.0	bank ht	11.7	w/d ratio
16.0	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:	Brahma UT 1 - XS 16
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.904712	104.9047
	☐	7.259369	-4.798169	104.7982
	☐	13.88956	-4.464691	104.4647
	☐	17.59897	-4.737112	104.7371
	☐	21.97851	-3.480703	103.4807
	☐	28.08738	-1.67909	101.6791
	☐	32.09626	-1.598217	101.5982
	☐	33.22453	-3.340876	103.3409
	☐	42.20269	-4.952761	104.9528
	☐	50.54836	-5.489395	105.4894
	☐	62.02458	-5.792181	105.7922
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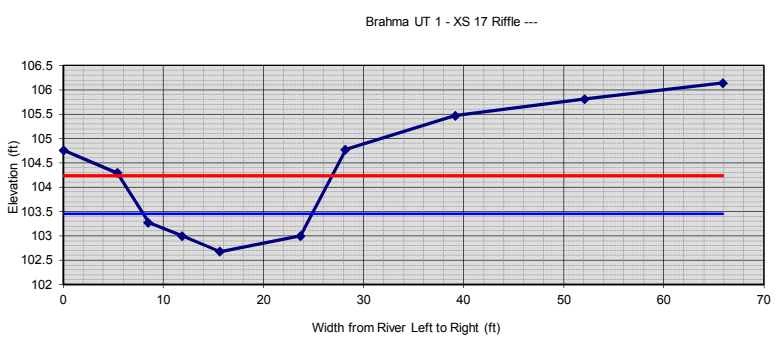
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.96	-4.73	20.0		
102.96	104.73			

dimensions			
8.7	x-section area	0.9	d mean
9.2	width	10.2	wet P
1.4	d max	0.9	hyd radi
3.1	bank ht	9.8	w/d ratio
20.0	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: **Brahma UT 1 - XS 17**

Riffle

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description: **Brahma UT 1 - XS 17**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.755736	104.7557
	☐	5.385361	-4.291919	104.2919
	☐	8.491571	-3.272404	103.2724
	☐	11.87528	-2.998533	102.9985
	☐	15.61796	-2.672794	102.6728
	☐	23.66259	-2.997946	102.9979
	☐	28.1926	-4.768203	104.7682
	☐	39.15257	-5.465193	105.4652
	☐	52.1193	-5.812724	105.8127
	☐	65.90446	-6.141771	106.1418
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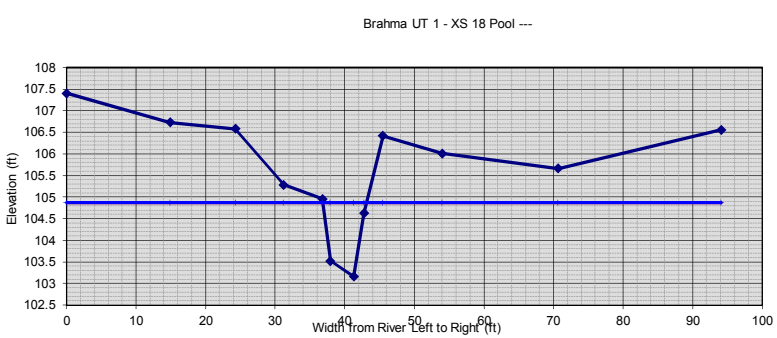
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-3.455	-4.29	22.0		
103.455	104.29			

dimensions			
8.7	x-section area	0.5	d mean
16.9	width	17.0	wet P
0.8	d max	0.5	hyd radi
1.6	bank ht	32.8	w/d ratio
22.0	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: **Brahma UT 1 - XS 18**

Pool

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description: **Brahma UT 1 - XS 18**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-7.40427	107.4043
	☐	14.86694	-6.725212	106.7252
	☐	24.2963	-6.583327	106.5833
	☐	31.21806	-5.282644	105.2826
	☐	36.78338	-4.954909	104.9549
	☐	37.93301	-3.521902	103.5219
	☐	41.26712	-3.159919	103.1599
	☐	42.74374	-4.62779	104.6278
	☐	45.46783	-6.415279	106.4153
	☐	54.00869	-6.007919	106.0079
	☐	70.66957	-5.658642	105.6586
	☐	94.12928	-6.555615	106.5556
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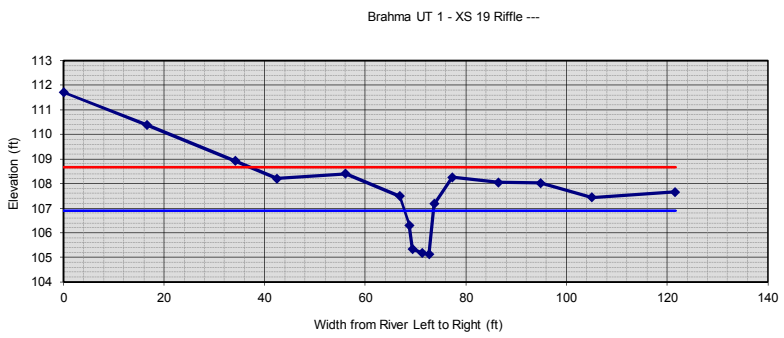
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-4.87	-6.41	~~5.0~~		
104.87	106.41			

dimensions			
7.3	x-section area	1.2	d mean
6.3	width	7.6	wet P
1.7	d max	1.0	hyd radi
3.3	bank ht	~~5.4~~	w/d ratio
~~5.0~~	W flood prone area	~~0.8~~	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: **Brahma UT 1 - XS 19**
Riffle

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description: **Brahma UT 1 - XS 19**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-11.70506**	111.7051
	☐	**16.6488**	**-10.37287**	110.3729
	☐	**34.17288**	**-8.91435**	108.9144
	☐	**42.36793**	**-8.20978**	108.2098
	☐	**56.06893**	**-8.398255**	108.3983
	☐	**66.79663**	**-7.491642**	107.4916
	☐	**68.76624**	**-6.301637**	106.3016
	☐	**69.39867**	**-5.348748**	105.3487
	☐	**71.30225**	**-5.17652**	105.1765
	☐	**72.68304**	**-5.131545**	105.1315
	☐	**73.74107**	**-7.172981**	107.173
	☐	**77.23602**	**-8.251646**	108.2516
	☐	**86.4128**	**-8.050831**	108.0508
	☐	**94.85002**	**-8.026213**	108.0262
	☐	**105.0541**	**-7.435249**	107.4352
	☐	**121.6086**	**-7.652208**	107.6522
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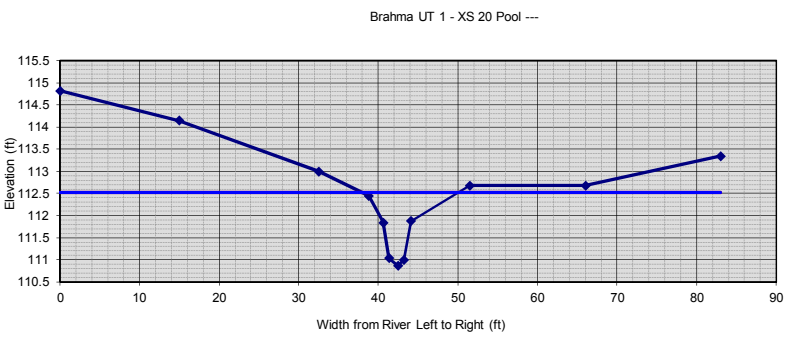
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-6.9	**-8.25**	**6.0**		
106.9	108.25			

dimensions			
7.3	x-section area	1.3	d mean
5.8	width	7.6	wet P
1.8	d max	1.0	hyd radi
3.1	bank ht	4.6	w/d ratio
6.0	W flood prone area	1.0	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 20**
Pool

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description: **Brahma UT 1 - XS 20**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-14.8192**	114.8192
	☐	**14.95399**	**-14.14581**	114.1458
	☐	**32.47182**	**-12.992**	112.992
	☐	**38.80443**	**-12.44503**	112.445
	☐	**40.6198**	**-11.83519**	111.8352
	☐	**41.35979**	**-11.03653**	111.0365
	☐	**42.44163**	**-10.86442**	110.8644
	☐	**43.17922**	**-11.00254**	111.0025
	☐	**44.08181**	**-11.87429**	111.8743
	☐	**51.48403**	**-12.67692**	112.6769
	☐	**65.99908**	**-12.67352**	112.6735
	☐	**82.9754**	**-13.33826**	113.3383
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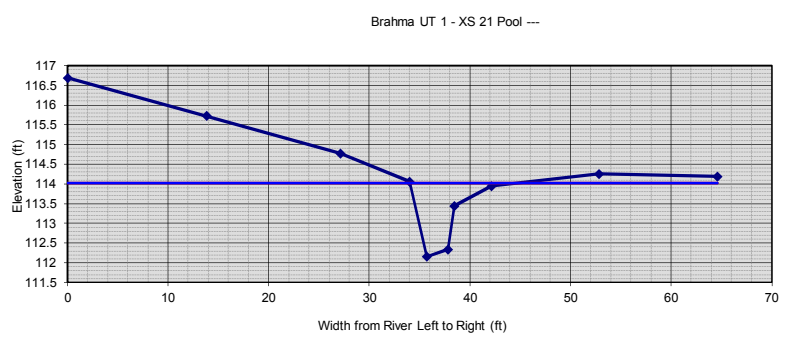
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-12.52	**-12.67**			
112.52	112.67			

dimensions			
7.3	x-section area	0.6	d mean
12.1	width	13.0	wet P
1.7	d max	0.6	hyd radi
1.8	bank ht	~~20.1~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

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

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

Cross Section



section:	Brahma UT 1 - XS 21
	Pool

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description:	Brahma UT 1 - XS 21
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-16.68767	116.6877
	☐	13.81939	-15.72045	115.7205
	☐	27.11934	-14.76808	114.7681
	☐	33.98231	-14.0586	114.0586
	☐	35.69929	-12.15251	112.1525
	☐	37.79604	-12.3367	112.3367
	☐	38.4448	-13.43966	113.4397
	☐	42.10557	-13.94789	113.9479
	☐	52.8345	-14.25089	114.2509
	☐	64.59506	-14.18748	114.1875
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-14.02	-14.25			
114.02	114.25			

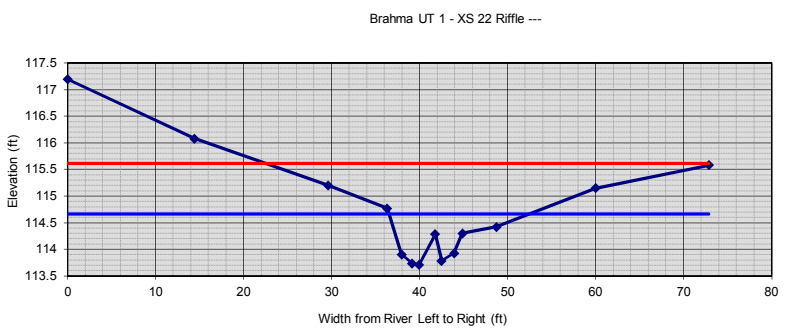
dimensions			
7.3	x-section area	0.7	d mean
10.6	width	12.1	wet P
1.9	d max	0.6	hyd radi
2.1	bank ht	~~15.5~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

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

bed d (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: **Brahma UT 1 - XS 22**

Riffle

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description: **Brahma UT 1 - XS 22**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-17.19386**	117.1939
	☐	**14.41165**	**-16.07953**	116.0795
	☐	**29.57999**	**-15.20372**	115.2037
	☐	**36.32349**	**-14.76525**	114.7653
	☐	**37.93886**	**-13.90038**	113.9004
	☐	**39.15504**	**-13.73239**	113.7324
	☐	**39.90979**	**-13.70407**	113.7041
	☐	**41.77394**	**-14.28407**	114.2841
	☐	**42.48512**	**-13.77908**	113.7791
	☐	**43.91879**	**-13.92551**	113.9255
	☐	**44.85099**	**-14.29615**	114.2961
	☐	**48.72411**	**-14.41683**	114.4168
	☐	**59.99613**	**-15.14767**	115.1477
	☐	**72.86974**	**-15.57748**	115.5775
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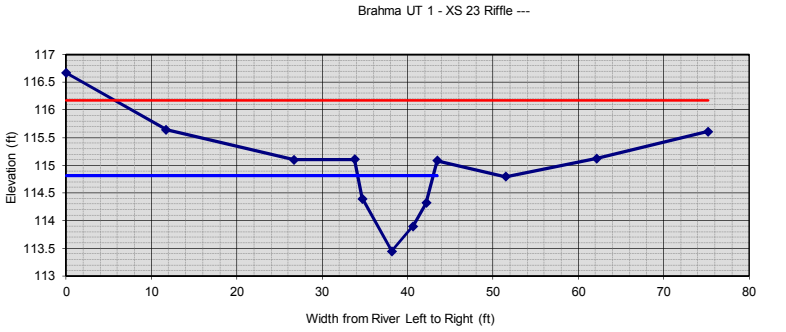
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-14.66	**-14.76**	**14.0**		
114.66	114.76			

dimensions			
7.3	x-section area	0.5	d mean
16.0	width	16.5	wet P
1.0	d max	0.4	hyd radi
1.1	bank ht	35.0	w/d ratio
14.0	W flood prone area	0.9	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: **Brahma UT 1 - XS 23**

Riffle

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description: **Brahma UT 1 - XS 23**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-16.67105**	116.671
	☐	**11.65934**	**-15.64583**	115.6458
	☐	**26.66815**	**-15.09953**	115.0995
	☐	**33.79579**	**-15.10829**	115.1083
	☐	**34.68369**	**-14.39306**	114.3931
	☐	**38.16338**	**-13.44585**	113.4459
	☐	**40.62411**	**-13.89796**	113.898
	☐	**42.18377**	**-14.32302**	114.323
	☐	**43.46828**	**-15.08091**	115.0809
	☑	**51.47345**	**-14.79571**	114.7957
	☑	**62.18787**	**-15.12193**	115.1219
	☑	**75.17648**	**-15.60871**	115.6087
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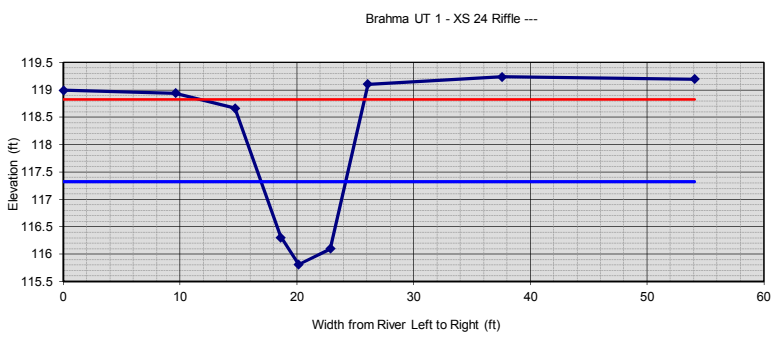
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-14.81	**-15.1**	**9.0**		
114.81	115.1			

dimensions			
7.3	x-section area	0.8	d mean
8.8	width	9.3	wet P
1.4	d max	0.8	hyd radi
1.7	bank ht	10.7	w/d ratio
9.0	W flood prone area	1.0	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 24**
Riffle

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description: **Brahma UT 1 - XS 24**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-18.99409	118.9941
	☐	9.593899	-18.94232	118.9423
	☐	14.70566	-18.66252	118.6625
	☐	18.63414	-16.30044	116.3004
	☐	20.12535	-15.81275	115.8127
	☐	22.86233	-16.09621	116.0962
	☐	26.08541	-19.10265	119.1026
	☐	37.59857	-19.23822	119.2382
	☐	54.06829	-19.19675	119.1967
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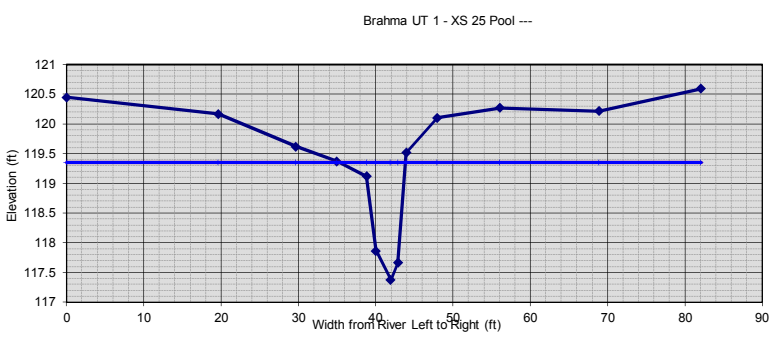
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-17.32	-18.66	7.0		
117.32	118.66			

dimensions			
7.3	x-section area	1.0	d mean
7.2	width	8.1	wet P
1.5	d max	0.9	hyd radi
2.8	bank ht	7.2	w/d ratio
7.0	W flood prone area	1.0	ent ratio

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

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

Cross Section



section: **Brahma UT 1 - XS 25**
Pool

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description: **Brahma UT 1 - XS 25**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-20.44511	120.4451
	☐	19.59556	-20.16531	120.1653
	☐	29.68017	-19.61813	119.6181
	☐	34.95602	-19.36893	119.3689
	☐	38.8381	-19.11801	119.118
	☐	40.02413	-17.86024	117.8602
	☐	41.91011	-17.37639	117.3764
	☐	42.86144	-17.66622	117.6662
	☐	43.97303	-19.51323	119.5132
	☐	47.97617	-20.10435	120.1044
	☐	56.07878	-20.26765	120.2677
	☐	68.86709	-20.21633	120.2163
	☐	82.08557	-20.59029	120.5903
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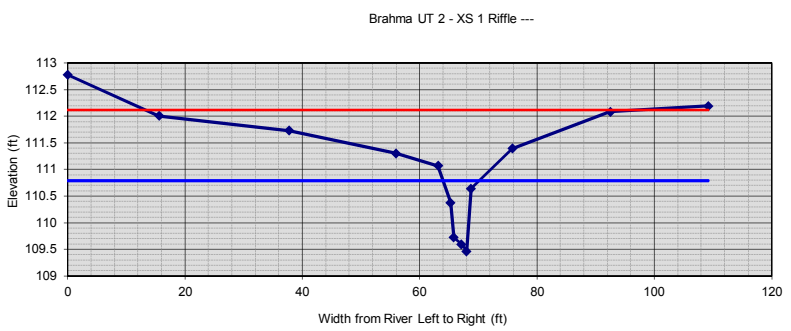
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-19.35	-19.51			
119.35	119.51			

dimensions			
7.3	x-section area	0.8	d mean
8.6	width	10.2	wet P
2.0	d max	0.7	hyd radi
2.1	bank ht	~~10.2~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

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

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

Cross Section



section: **Brahma UT 2 - XS 1**

Riffle

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description: **Brahma UT 2 - XS 1**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-12.78024	112.7802
	☐	15.56262	-12.00706	112.0071
	☐	37.75825	-11.72609	111.7261
	☐	55.91463	-11.30462	111.3046
	☐	63.11541	-11.06824	111.0682
	☐	65.27982	-10.37767	110.3777
	☐	65.79169	-9.723659	109.7237
	☐	67.13889	-9.59522	109.5952
	☐	67.99685	-9.464611	109.4646
	☐	68.73773	-10.6433	110.6433
	☐	75.78283	-11.39479	111.3948
	☐	92.50254	-12.08449	112.0845
	☐	109.2003	-12.19416	112.1942
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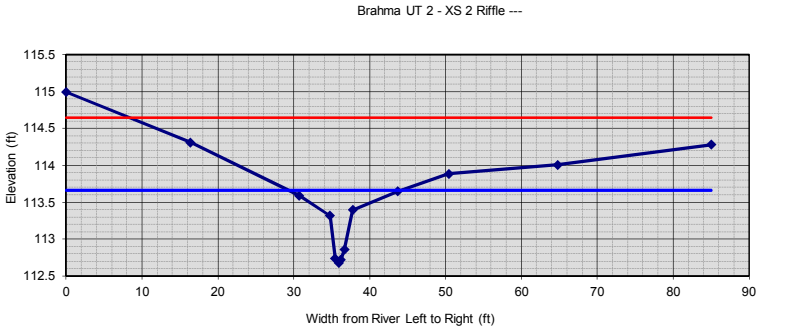
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-10.79	-11.17	6.0		
110.79	111.17			

dimensions			
3.9	x-section area	0.6	d mean
6.1	width	7.2	wet P
1.3	d max	0.5	hyd radi
1.7	bank ht	9.6	w/d ratio
6.0	W flood prone area	1.0	ent ratio

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

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

Cross Section



section: **Brahma UT 2 - XS 2**

Riffle

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description: **Brahma UT 2 - XS 2**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-14.99092	114.9909
	☐	16.40084	-14.30971	114.3097
	☐	30.70774	-13.58759	113.5876
	☐	34.77231	-13.31778	113.3178
	☐	35.45159	-12.73563	112.7356
	☐	35.95298	-12.67504	112.675
	☐	36.20747	-12.72295	112.723
	☐	36.65478	-12.85713	112.8571
	☐	37.78087	-13.39216	113.3922
	☐	43.65993	-13.64635	113.6463
	☐	50.4161	-13.88589	113.8859
	☐	64.77694	-14.00614	114.0061
	☐	84.98077	-14.2806	114.2806
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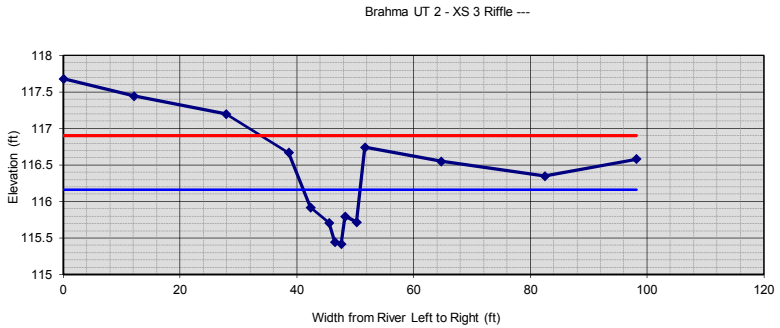
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-13.66	-13.88	12.0		
113.66	113.88			

dimensions			
3.9	x-section area	0.3	d mean
14.8	width	15.2	wet P
1.0	d max	0.3	hyd radi
1.2	bank ht	56.4	w/d ratio
12.0	W flood prone area	0.8	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: **Brahma UT 2 - XS 3**
Riffle

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description: **Brahma UT 2 - XS 3**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-17.68102	117.681
	☐	12.12782	-17.44408	117.4441
	☐	27.86265	-17.19885	117.1989
	☐	38.65485	-16.66649	116.6665
	☐	42.32308	-15.91706	115.9171
	☐	45.51557	-15.70986	115.7099
	☐	46.49034	-15.44326	115.4433
	☐	47.58871	-15.41573	115.4157
	☐	48.2369	-15.79345	115.7935
	☐	50.22832	-15.71642	115.7164
	☐	51.66911	-16.74207	116.7421
	☐	64.75361	-16.55052	116.5505
	☐	82.50941	-16.34839	116.3484
	☐	98.18815	-16.57868	116.5787
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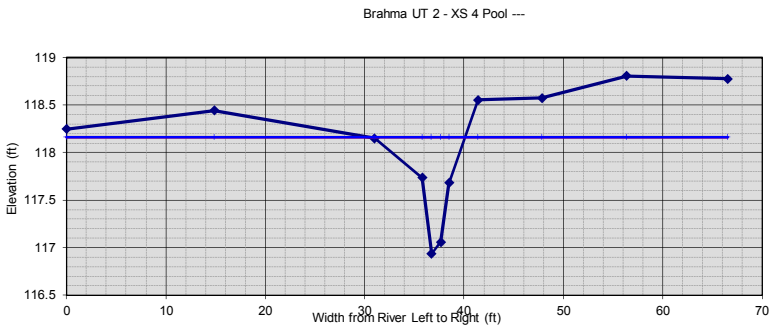
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-16.16	-16.74	10.0		
116.16	116.74			

dimensions			
3.9	x-section area	0.4	d mean
9.7	width	10.0	wet P
0.7	d max	0.4	hyd radi
1.3	bank ht	24.0	w/d ratio
10.0	W flood prone area	1.0	ent ratio

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

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

Cross Section



section: **Brahma UT 2 - XS 4**
Pool

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description: **Brahma UT 2 - XS 4**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-18.24555	118.2456
	☐	14.88462	-18.44375	118.4438
	☐	30.98677	-18.14975	118.1497
	☐	35.80551	-17.73427	117.7343
	☐	36.73644	-16.93515	116.9351
	☐	37.648	-17.05911	117.0591
	☐	38.51891	-17.68529	117.6853
	☐	41.39023	-18.55387	118.5539
	☐	47.84044	-18.57239	118.5724
	☐	56.36056	-18.80515	118.8051
	☐	66.53139	-18.77517	118.7752
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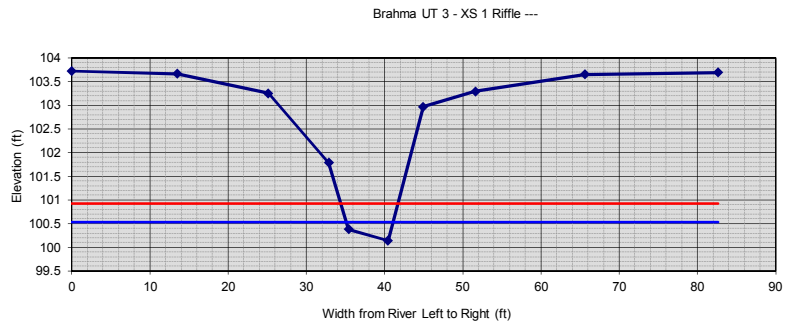
FS bankfull	FS top of bank	~~W fpa (ft)~~	channel slope (%)	~~Manning's "n"~~
-18.16	-18.44	~~9.5~~		
118.16	118.44			

dimensions			
3.9	x-section area	0.4	d mean
9.7	width	10.3	wet P
1.2	d max	0.4	hyd radi
1.5	bank ht	~~23.7~~	~~w/d ratio~~
~~9.5~~	~~W flood prone area~~	~~1.0~~	~~ent ratio~~

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

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

Cross Section



section: **Brahma UT 3 - XS 1**

Riffle

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description: **Brahma UT 3 - XS 1**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-3.722093	103.7221
	☐	13.51273	-3.665294	103.6653
	☐	25.13953	-3.25653	103.2565
	☐	32.85992	-1.785645	101.7856
	☐	35.40765	-0.377218	100.3772
	☐	40.44029	-0.136796	100.1368
	☐	44.9463	-2.967072	102.9671
	☐	51.60155	-3.295736	103.2957
	☐	65.57743	-3.652995	103.653
	☐	82.59543	-3.690249	103.6902
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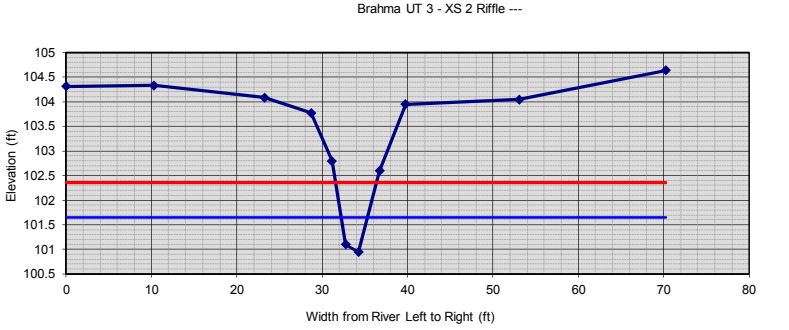
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-0.53	-1.785	8.0		
100.53	101.785			

dimensions			
1.5	x-section area	0.3	d mean
5.9	width	6.1	wet P
0.4	d max	0.2	hyd radi
1.6	bank ht	23.2	w/d ratio
8.0	W flood prone area	1.3	ent ratio

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

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

Cross Section



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

Riffle

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

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.315444	104.3154
	☐	10.24575	-4.331095	104.3311
	☐	23.24117	-4.088497	104.0885
	☐	28.68007	-3.770253	103.7703
	☐	31.13788	-2.800554	102.8006
	☐	32.75442	-1.097286	101.0973
	☐	34.25741	-0.942331	100.9423
	☐	36.71812	-2.59345	102.5935
	☐	39.77044	-3.947629	103.9476
	☐	53.05458	-4.043015	104.043
	☐	70.2562	-4.635463	104.6355
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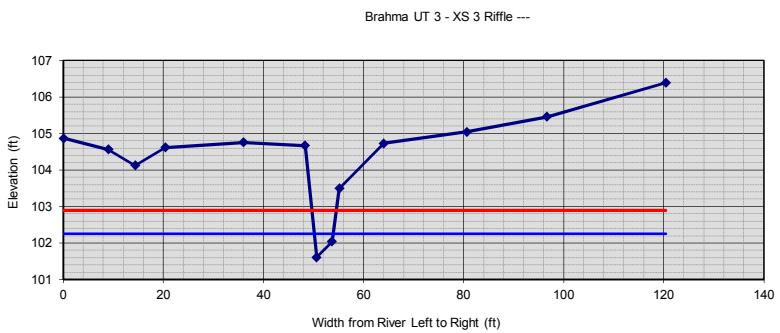
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-1.65	-2.59	5.0		
101.65	102.59			

dimensions			
1.5	x-section area	0.5	d mean
3.1	width	3.5	wet P
0.7	d max	0.4	hyd radi
1.6	bank ht	6.5	w/d ratio
5.0	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:	Brahma UT 3 - XS 3
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-4.869001	104.869
	☐	8.982187	-4.565048	104.565
	☐	14.38685	-4.122258	104.1223
	☐	20.40946	-4.619372	104.6194
	☐	36.05779	-4.758239	104.7582
	☐	48.33056	-4.667785	104.6678
	☐	50.6153	-1.607943	101.6079
	☐	53.69656	-2.03617	102.0362
	☐	55.12601	-3.491021	103.491
	☐	64.06647	-4.728486	104.7285
	☐	80.6691	-5.048075	105.0481
	☐	96.67894	-5.455177	105.4552
	☐	120.4201	-6.38971	106.3897
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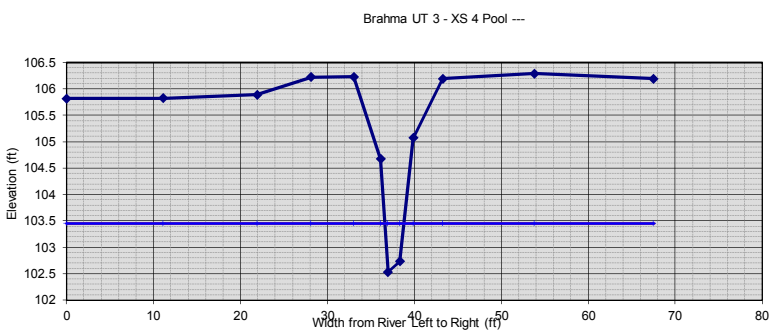
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-2.25	-3.49	3.0		
102.25	103.49			

dimensions			
1.5	x-section area	0.4	d mean
3.8	width	4.2	wet P
0.6	d max	0.4	hyd radi
1.9	bank ht	9.5	w/d ratio
3.0	W flood prone area	0.8	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:	Brahma UT 3 - XS 4
	Pool

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description:	Brahma UT 3 - XS 4
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-5.819944	105.8199
	☐	11.12916	-5.824679	105.8247
	☐	21.91838	-5.887292	105.8873
	☐	28.13114	-6.224236	106.2242
	☐	33.04623	-6.230711	106.2307
	☐	36.12116	-4.671685	104.6717
	☐	36.97831	-2.53214	102.5321
	☐	38.35448	-2.731546	102.7315
	☐	39.85189	-5.073096	105.0731
	☐	43.25417	-6.195589	106.1956
	☐	53.76649	-6.291871	106.2919
	☐	67.51829	-6.194783	106.1948
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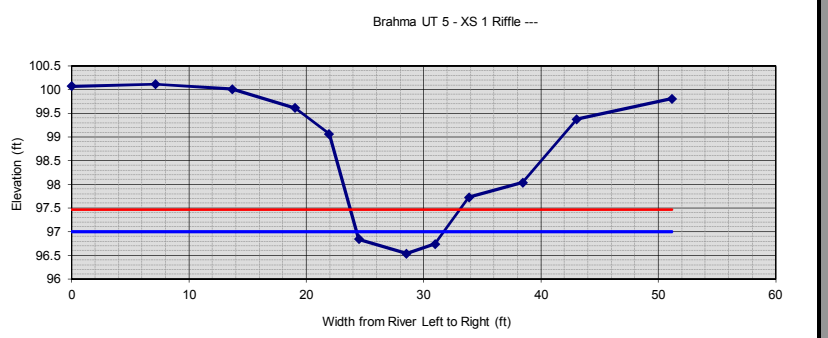
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-3.45	-4.67	~~9.5~~		
103.45	104.67			

dimensions			
1.5	x-section area	0.7	d mean
2.2	width	3.2	wet P
0.9	d max	0.5	hyd radi
2.1	bank ht	~~3.3~~	w/d ratio
~~9.5~~	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: **Brahma UT 5 - XS 1**
Riffle

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description: **Brahma UT 5 - XS 1**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-0.072784**	100.0728
	☐	**7.126357**	**-0.114216**	100.1142
	☐	**13.68071**	**-0.013342**	100.0133
	☐	**19.05905**	**0.387835**	99.61217
	☐	**21.95307**	**0.933245**	99.06676
	☐	**24.47205**	**3.158776**	96.84122
	☐	**28.54586**	**3.464515**	96.53549
	☐	**30.97345**	**3.266656**	96.73334
	☐	**33.86676**	**2.274535**	97.72547
	☐	**38.44475**	**1.965348**	98.03465
	☐	**43.04829**	**0.627109**	99.37289
	☐	**51.14462**	**0.194242**	99.80576
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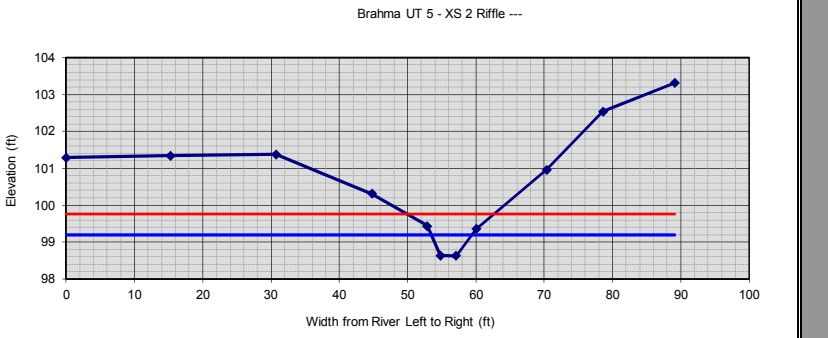
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
3	**2.27**	**9.0**		
97	97.73			

dimensions			
2.3	x-section area	0.3	d mean
7.5	width	7.6	wet P
0.5	d max	0.3	hyd radi
1.2	bank ht	24.5	w/d ratio
9.0	W flood prone area	1.2	ent ratio

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

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

Cross Section



section: **Brahma UT 5 - XS 2**
Riffle

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description: **Brahma UT 5 - XS 2**
height of instrument (ft): **100.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-1.284087**	101.2841
	☐	**15.27692**	**-1.33647**	101.3365
	☐	**30.70779**	**-1.378095**	101.3781
	☐	**44.75854**	**-0.306793**	100.3068
	☐	**52.88866**	**0.563688**	99.43631
	☐	**54.8147**	**1.367776**	98.63222
	☐	**57.0903**	**1.377079**	98.62292
	☐	**60.06984**	**0.64214**	99.35786
	☐	**70.35901**	**-0.958595**	100.9586
	☐	**78.601**	**-2.535093**	102.5351
	☐	**89.12889**	**-3.311221**	103.3112
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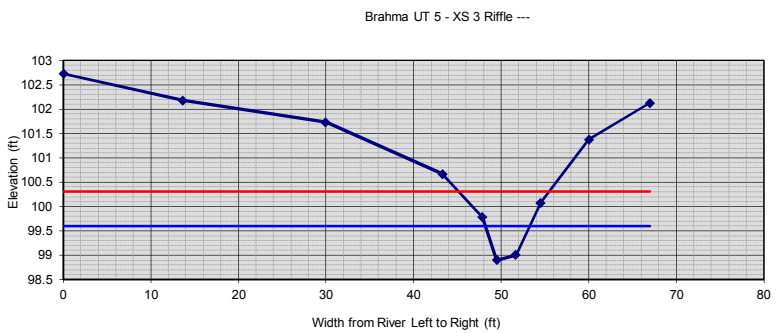
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.81	**-0.3**	**13.0**		
99.19	100.3			

dimensions			
2.3	x-section area	0.4	d mean
5.9	width	6.1	wet P
0.6	d max	0.4	hyd radi
1.7	bank ht	15.2	w/d ratio
13.0	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: **Brahma UT 5 - XS 3**

Riffle

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description: **Brahma UT 5 - XS 3**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-2.728378	102.7284
	☐	13.6428	-2.179609	102.1796
	☐	29.96105	-1.730962	101.731
	☐	43.31212	-0.663979	100.664
	☐	47.85478	0.221854	99.77815
	☐	49.48943	1.10489	98.89511
	☐	51.64991	0.996078	99.00392
	☐	54.45369	-0.068449	100.0684
	☐	60.03188	-1.378976	101.379
	☐	66.9673	-2.126382	102.1264
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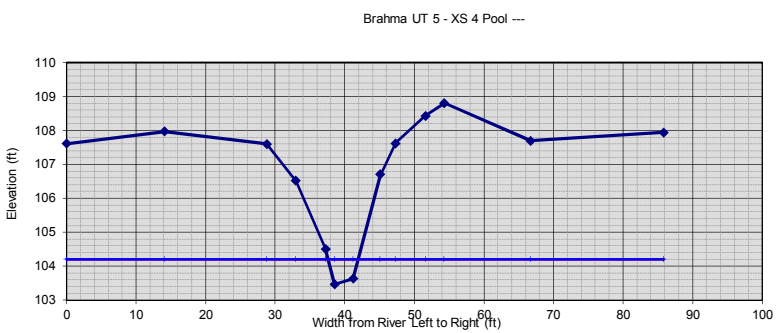
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0.4	-0.66	11.0		
99.6	100.66			

dimensions			
2.3	x-section area	0.5	d mean
5.0	width	5.3	wet P
0.7	d max	0.4	hyd radi
1.8	bank ht	10.9	w/d ratio
11.0	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: **Brahma UT 5 - XS 4**

Pool

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description: **Brahma UT 5 - XS 4**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-7.611158	107.6112
	☐	14.10388	-7.963331	107.9633
	☐	28.79939	-7.601697	107.6017
	☐	32.94107	-6.525688	106.5257
	☐	37.25511	-4.50043	104.5004
	☐	38.53076	-3.469631	103.4696
	☐	41.18574	-3.634772	103.6348
	☐	45.10129	-6.707154	106.7072
	☐	47.26952	-7.622293	107.6223
	☐	51.57648	-8.430526	108.4305
	☐	54.29879	-8.794347	108.7943
	☐	66.66919	-7.69556	107.6956
	☐	85.84578	-7.941683	107.9417
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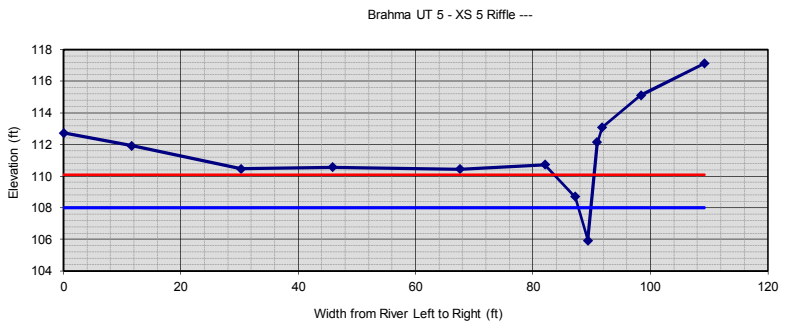
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
~~-4.2~~	~~-7.6~~	~~9.5~~		
104.2	107.6			

dimensions			
2.3	x-section area	0.5	d mean
4.3	width	4.7	wet P
0.7	d max	0.5	hyd radi
4.1	bank ht	~~8.1~~	w/d ratio
~~9.5~~	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: **Brahma UT 5 - XS 5**

Riffle

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description: **Brahma UT 5 - XS 5**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-12.72277**	112.7228
	☐	**11.6493**	**-11.92146**	111.9215
	☐	**30.21502**	**-10.45377**	110.4538
	☐	**45.83397**	**-10.56883**	110.5688
	☐	**67.5058**	**-10.43468**	110.4347
	☐	**82.00845**	**-10.71555**	110.7156
	☐	**87.12079**	**-8.701166**	108.7012
	☐	**89.32007**	**-5.923641**	105.9236
	☐	**90.91534**	**-12.1365**	112.1365
	☐	**91.73927**	**-13.07937**	113.0794
	☐	**98.41726**	**-15.1115**	115.1115
	☐	**109.1735**	**-17.13271**	117.1327
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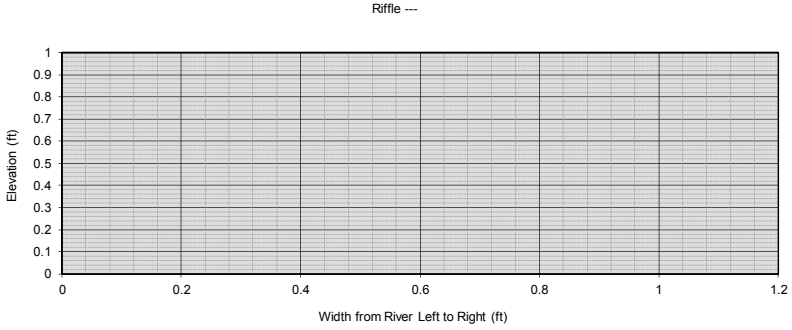
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-8	**-10.7**	**6.0**		
108	110.7			

dimensions			
2.3	x-section area	1.0	d mean
2.2	width	4.8	wet P
2.1	d max	0.5	hyd radi
4.8	bank ht	2.1	w/d ratio
6.0	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:

Riffle

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description:

height of instrument (ft):

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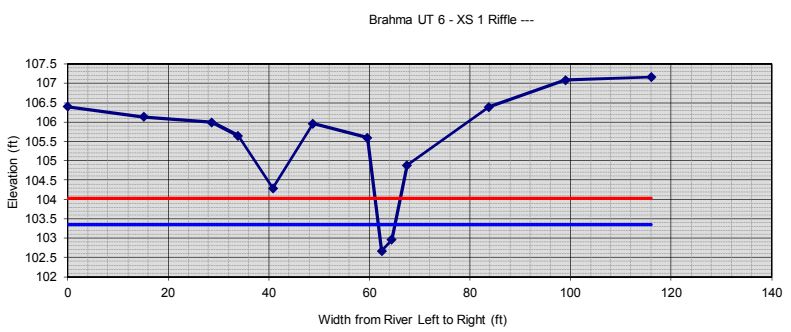
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
0	---			

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

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

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

Cross Section



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

Riffle

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

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-6.397605	106.3976
	☐	15.09474	-6.131706	106.1317
	☐	28.69727	-5.994131	105.9941
	☐	33.87795	-5.647849	105.6478
	☐	40.7967	-4.290266	104.2903
	☐	48.79703	-5.95636	105.9564
	☐	59.61111	-5.592575	105.5926
	☐	62.47801	-2.669038	102.669
	☐	64.44529	-2.956221	102.9562
	☐	67.51055	-4.88581	104.8858
	☐	83.78548	-6.385864	106.3859
	☐	99.0211	-7.082656	107.0827
	☐	116.0593	-7.164724	107.1647
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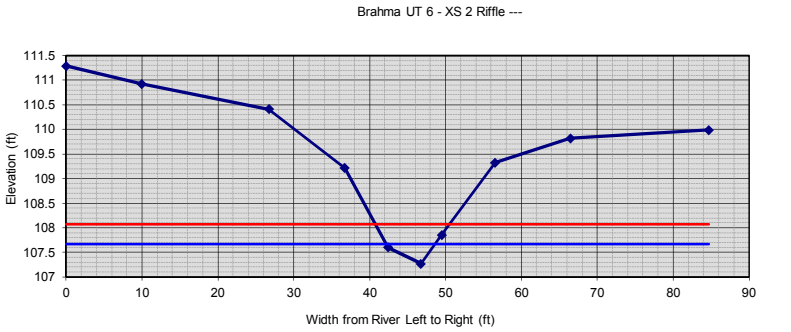
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-3.35	-4.88	5.0		
103.35	104.88			

dimensions			
1.4	x-section area	0.4	d mean
3.3	width	3.7	wet P
0.7	d max	0.4	hyd radi
2.2	bank ht	7.6	w/d ratio
5.0	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: **Brahma UT 6 - XS 2**

Riffle

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description: **Brahma UT 6 - XS 2**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-11.28856	111.2886
	☐	9.928993	-10.92104	110.921
	☐	26.70923	-10.40747	110.4075
	☐	36.65353	-9.220729	109.2207
	☐	42.39933	-7.600348	107.6003
	☐	46.76153	-7.270412	107.2704
	☐	49.5024	-7.855372	107.8554
	☐	56.53924	-9.321218	109.3212
	☐	66.44558	-9.817513	109.8175
	☐	84.6715	-9.986727	109.9867
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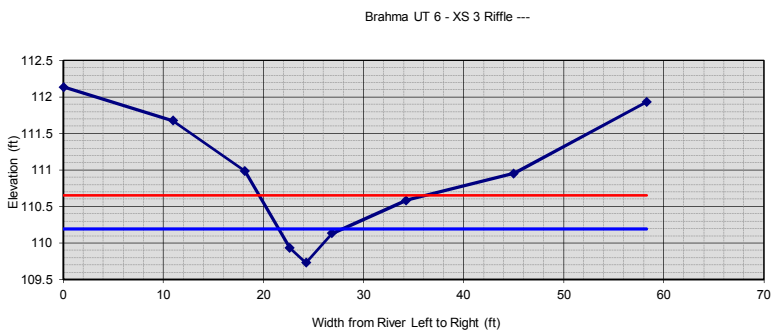
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-7.67	-9.32	10.0		
107.67	109.32			

dimensions			
1.4	x-section area	0.2	d mean
6.5	width	6.5	wet P
0.4	d max	0.2	hyd radi
2.0	bank ht	29.9	w/d ratio
10.0	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:	Brahma UT 6 - XS 3
	Riffle

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-12.13715	112.1372
	☐	10.93874	-11.67649	111.6765
	☐	18.10672	-10.98685	110.9869
	☐	22.57419	-9.936494	109.9365
	☐	24.23932	-9.729016	109.729
	☐	26.84654	-10.13499	110.135
	☐	34.26196	-10.58374	110.5837
	☐	45.00113	-10.95196	110.952
	☐	58.29756	-11.93046	111.9305
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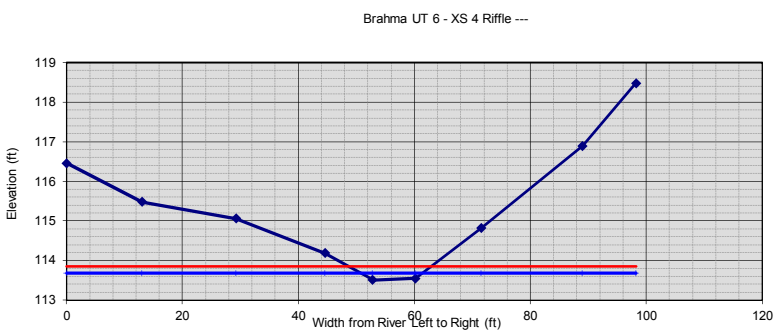
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-10.19	-10.98	17.0		
110.19	110.98			

dimensions			
1.4	x-section area	0.2	d mean
6.3	width	6.3	wet P
0.5	d max	0.2	hyd radi
1.3	bank ht	27.4	w/d ratio
17.0	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:	Brahma UT 6 - XS 4
	Riffle

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description:	Brahma UT 6 - XS 4
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	-16.46102	116.461
	☐	13.02546	-15.48047	115.4805
	☐	29.19982	-15.06115	115.0612
	☐	44.58933	-14.18948	114.1895
	☐	52.80938	-13.50825	113.5082
	☐	60.19545	-13.54773	113.5477
	☐	71.5442	-14.81662	114.8166
	☐	89.02573	-16.89702	116.897
	☐	98.22105	-18.47478	118.4748
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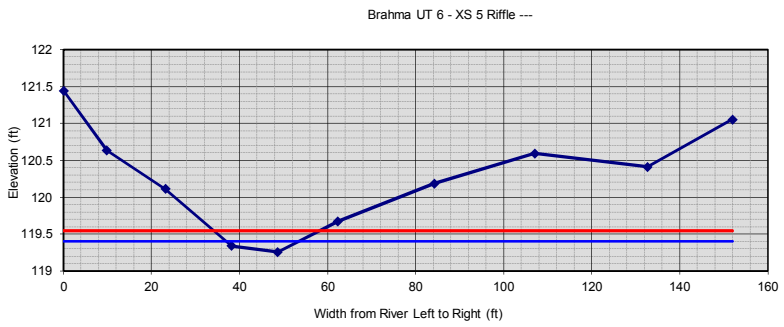
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-13.68	-14.18	13.0		
113.68	114.18			

dimensions			
1.4	x-section area	0.1	d mean
10.6	width	10.7	wet P
0.2	d max	0.1	hyd radi
0.7	bank ht	82.1	w/d ratio
13.0	W flood prone area	1.2	ent ratio

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

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

Cross Section



section: **Brahma UT 6 - XS 5**

Riffle

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description: **Brahma UT 6 - XS 5**

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

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	**0**	**-21.44334**	121.4433
	☐	**9.813337**	**-20.63461**	120.6346
	☐	**23.16406**	**-20.11146**	120.1115
	☐	**38.19932**	**-19.33896**	119.339
	☐	**48.56296**	**-19.25725**	119.2573
	☐	**62.34426**	**-19.67347**	119.6735
	☐	**84.23639**	**-20.18371**	120.1837
	☐	**107.0399**	**-20.59305**	120.5931
	☐	**132.7125**	**-20.41116**	120.4112
	☐	**151.9892**	**-21.05188**	121.0519
	☐			
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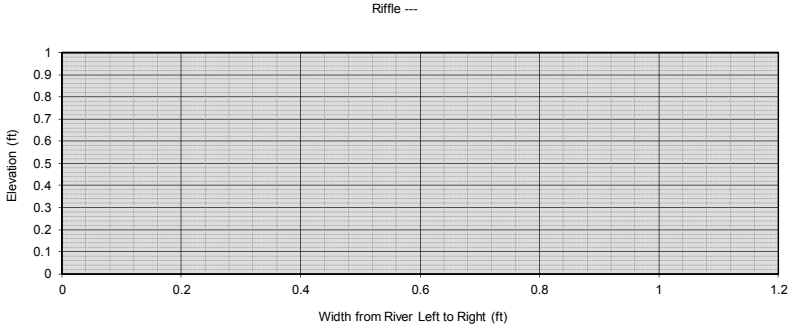
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
-19.4	**-19.67**	**23.0**		
119.4	119.67			

dimensions			
1.4	x-section area	0.1	d mean
16.3	width	16.3	wet P
0.1	d max	0.1	hyd radi
0.4	bank ht	185.4	w/d ratio
23.0	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:

Riffle

---

description:

height of instrument (ft):

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

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

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

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

NC SAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Brahma Site-SAM 1
2. Date of evaluation: 7/25/18
3. Applicant/owner name: Restoration Systems
4. Assessor name/organization: AXE/WGL
5. County: Alamance
6. Nearest named water body on USGS 7.5-minute quad: Reedy Branch
7. River basin: Cape Fear 02
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.8539, -79.5710

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM 1
10. Length of assessment reach evaluated (feet): 450
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 2.8 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 6
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)
16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):
☒A  (more sinuous stream, flatter valley slope)
☐B  (less sinuous stream, steeper valley slope)
17. Watershed size: **(skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☒Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.

☐Section 10 water	☐Classified Trout Waters	☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☒V)
☐Essential Fish Habitat	☐Primary Nursery Area	☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property	☒NCDWR Riparian buffer rule in effect	☒Nutrient Sensitive Waters
☐Anadromous fish	☐303(d) List	☐CAMA Area of Environmental Concern (AEC)

☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

☒A Water throughout assessment reach.
☐B No flow, water in pools only.
☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
☒B Not A

3. Feature Pattern – assessment reach metric

☐A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
☒B Not A

4. Feature Longitudinal Profile – assessment reach metric

☐A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
☒B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

☒A < 10% of channel unstable
☐B 10 to 25% of channel unstable
☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☐A	☐A	Little or no evidence of conditions that adversely affect reference interaction
☒B	☒B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B Excessive sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
- ☒F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: _____ (explain in "Notes/Sketch" section)
- ☐J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric
10a. ☐Yes ☐No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☒C Multiple snags and logs (including lap trees)
- ☒D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only

- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

************************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

- ☒A Riffle-run section **(evaluate 11c)**
- ☐B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☐	☒	☐	☐	☐	Boulder (256 – 4096 mm)
☐	☒	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☒	☐	☐	☐	Silt/clay (< 0.062 mm)
☐	☒	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☒Yes ☐No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: _____

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☒	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☒	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☒	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☒	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☒A	☒A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☐C	☐C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☒B	☒B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☐C	☐C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☐Y	☒Y	Are wetlands present in the streamside area?
☒N	☐N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☒A	Streams and/or springs (jurisdictional discharges)
☐B	Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C	Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D	Evidence of bank seepage or sweating (iron in water indicates seepage)
☒E	Stream bed or bank soil reduced (dig through deposited sediment if present)
☐F	None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A	Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B	Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C	Urban stream (≥ 24% impervious surface for watershed)
☐D	Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E	Assessment reach relocated to valley edge
☒F	None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☐A	Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☒B	Degraded (example: scattered trees)
☐C	Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☐A	☐A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☒D	☒D	From 10 to < 30 feet wide
☐E	☐E	☐E	☐E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☐A	☐A	Mature forest
☒B	☒B	Non-mature woody vegetation or modified vegetation structure
☐C	☐C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☐

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☐D	☐D	☒D	☒D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☐A	☒A	Medium to high stem density
☒B	☐B	Low stem density
☐C	☐C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☐A	☐A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☒C	☒C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: _____

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Brahma Site-SAM 1	Date of Assessment	7/25/18
Stream Category	Pa1	Assessor Name/Organization	AXE/WGL

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

Function Class Rating Summary	USACE/ All Streams	NCDWR Intermittent
(1) Hydrology	**LOW**	
(2) Baseflow	**HIGH**	
(2) Flood Flow	**LOW**	
(3) Streamside Area Attenuation	**MEDIUM**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**LOW**	
(4) Microtopography	**LOW**	
(3) Stream Stability	**LOW**	
(4) Channel Stability	**HIGH**	
(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	**LOW**	
(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	**LOW**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**LOW**	
(2) In-stream Habitat	**LOW**	
(3) Baseflow	**HIGH**	
(3) Substrate	**LOW**	
(3) Stream Stability	**MEDIUM**	
(3) In-stream Habitat	**LOW**	
(2) Stream-side Habitat	**LOW**	
(3) Stream-side Habitat	**LOW**	
(3) Thermoregulation	**LOW**	
(2) Tidal Marsh In-stream Habitat	NA	
(3) Flow Restriction	NA	
(3) Tidal Marsh Stream Stability	NA	
(4) Tidal Marsh Channel Stability	NA	
(4) Tidal Marsh Stream Geomorphology	NA	
(3) Tidal Marsh In-stream Habitat	NA	
(2) Intertidal Zone	NA	
Overall	**LOW**	

NC SAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Brahma Site-SAM 2 (UT1 xsect1)
2. Date of evaluation: 7/25/18
3. Applicant/owner name: Restoration Systems
4. Assessor name/organization: AXE/WGL
5. County: Alamance
6. Nearest named water body on USGS 7.5-minute quad: Reedy Branch
7. River basin: Cape Fear 02
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.8522, -79.4086

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM 2 (UT1 xsect1)
10. Length of assessment reach evaluated (feet): 500
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1.5 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 4
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)
16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**): ☒A  (more sinuous stream, flatter valley slope) ☐B  (less sinuous stream, steeper valley slope)
17. Watershed size: **(skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☒Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.
    - ☐Section 10 water
    - ☐Classified Trout Waters
    - ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☒V)
    - ☐Essential Fish Habitat
    - ☐Primary Nursery Area
    - ☐ High Quality Waters/Outstanding Resource Waters
    - ☐Publicly owned property
    - ☒NCDWR Riparian buffer rule in effect
    - ☒Nutrient Sensitive Waters
    - ☐Anadromous fish
    - ☐303(d) List
    - ☐CAMA Area of Environmental Concern (AEC)
    - ☐Documented presence of a federal and/or state listed protected species within the assessment area. List species:
    - ☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

- ☒A Water throughout assessment reach.
- ☐B No flow, water in pools only.
- ☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

- ☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
- ☒B Not A

3. Feature Pattern – assessment reach metric

- ☒A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
- ☐B Not A

4. Feature Longitudinal Profile – assessment reach metric

- ☒A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
- ☐B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

- ☒A < 10% of channel unstable
- ☐B 10 to 25% of channel unstable
- ☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B Excessive sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
- ☒F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: _____ (explain in "Notes/Sketch" section)
- ☐J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric
10a. ☐Yes ☐No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☐B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☐C Multiple snags and logs (including lap trees)
- ☐D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☒E Little or no habitat

Check for Tidal Marsh Streams Only

- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

************************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS****************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

- ☒A Riffle-run section **(evaluate 11c)**
- ☐B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☒	☐	☐	☐	☐	Cobble (64 – 256 mm)
☐	☐	☒	☐	☐	Gravel (2 – 64 mm)
☐	☐	☐	☐	☐	Sand (.062 – 2 mm)
☐	☐	☐	☒	☐	Silt/clay (< 0.062 mm)
☐	☒	☐	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☒Yes ☐No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: _____

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☒	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☒	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☒C	☒C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C	☒C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☒Y	☒Y	Are wetlands present in the streamside area?
☐N	☐N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☒A	Streams and/or springs (jurisdictional discharges)
☐B	Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C	Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D	Evidence of bank seepage or sweating (iron in water indicates seepage)
☒E	Stream bed or bank soil reduced (dig through deposited sediment if present)
☐F	None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A	Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B	Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C	Urban stream (≥ 24% impervious surface for watershed)
☐D	Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E	Assessment reach relocated to valley edge
☒F	None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☐A	Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☐B	Degraded (example: scattered trees)
☒C	Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☐A	☐A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☒E	☒E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☐A	☐A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☒C	☒C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☐

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☒D	☒D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☐A	☐A	Medium to high stem density
☐B	☐B	Low stem density
☒C	☒C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☐A	☐A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☒C	☒C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: _____

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Brahma Site-SAM 2 (UT1 xsect1)	Date of Assessment	7/25/18
Stream Category	Pa1	Assessor Name/Organization	AXE/WGL

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	NO
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	**MEDIUM**	**MEDIUM**
(4) Floodplain Access	**HIGH**	**HIGH**
(4) Wooded Riparian Buffer	**LOW**	**LOW**
(4) Microtopography	**LOW**	**LOW**
(3) Stream Stability	**LOW**	**LOW**
(4) Channel Stability	**HIGH**	**HIGH**
(4) Sediment Transport	**LOW**	**LOW**
(4) Stream Geomorphology	**LOW**	**LOW**
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**LOW**	**LOW**
(2) Baseflow	**HIGH**	**HIGH**
(2) Streamside Area Vegetation	**LOW**	**LOW**
(3) Upland Pollutant Filtration	**LOW**	**LOW**
(3) Thermoregulation	**MEDIUM**	**MEDIUM**
(2) Indicators of Stressors	**YES**	**YES**
(2) Aquatic Life Tolerance	**LOW**	**NA**
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**LOW**	**LOW**
(2) In-stream Habitat	**LOW**	**MEDIUM**
(3) Baseflow	**HIGH**	**HIGH**
(3) Substrate	**LOW**	**LOW**
(3) Stream Stability	**MEDIUM**	**MEDIUM**
(3) In-stream Habitat	**LOW**	**HIGH**
(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	**LOW**	**LOW**

NC SAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.

NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

PROJECT/SITE INFORMATION:

1. Project name (if any): Brahma Site-SAM 3 (UT2 upstream)
2. Date of evaluation: 7/25/18
3. Applicant/owner name: Restoration Systems
4. Assessor name/organization: AXE/WGL
5. County: Alamance
6. Nearest named water body on USGS 7.5-minute quad: Reedy Branch
7. River basin: Cape Fear 02
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.85092, -79.41151

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM 3 (UT2 upstream)
10. Length of assessment reach evaluated (feet): 350
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 3
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)
16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):
☒A  (more sinuous stream, flatter valley slope)
☐B  (less sinuous stream, steeper valley slope)
17. Watershed size: **(skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

18. Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.
☐Section 10 water ☐Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☒V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☒Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)
19. Are additional stream information/supplementary measurements included in "Notes/Sketch" section or attached? ☐Yes ☒No

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)

☐A Water throughout assessment reach.
☒B No flow, water in pools only.
☐C No water in assessment reach.

2. Evidence of Flow Restriction – assessment reach metric

☐A At least 10% of assessment reach in-stream habitat or riffle-pool sequence is severely affected by a flow restriction or fill to the point of obstructing flow or a channel choked with aquatic macrophytes or ponded water or impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
☒B Not A

3. Feature Pattern – assessment reach metric

☒A A majority of the assessment reach has altered pattern (examples: straightening, modification above or below culvert).
☐B Not A

4. Feature Longitudinal Profile – assessment reach metric

☒A Majority of assessment reach has a substantially altered stream profile (examples: channel down-cutting, existing damming, over widening, active aggradation, dredging, and excavation where appropriate channel profile has not reformed from any of these disturbances).
☐B Not A

5. Signs of Active Instability – assessment reach metric

Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).

☒A < 10% of channel unstable
☐B 10 to 25% of channel unstable
☐C > 25% of channel unstable

6. Streamside Area Interaction – streamside area metric
Consider for the Left Bank (LB) and the Right Bank (RB).

LB	RB	
☒A	☒A	Little or no evidence of conditions that adversely affect reference interaction
☐B	☐B	Moderate evidence of conditions (examples: berms, levees, down-cutting, aggradation, dredging) that adversely affect reference interaction (examples: limited streamside area access, disruption of flood flows through streamside area, leaky or intermittent bulkheads, causeways with floodplain constriction, minor ditching [including mosquito ditching])
☐C	☐C	Extensive evidence of conditions that adversely affect reference interaction (little to no floodplain/intertidal zone access [examples: causeways with floodplain and channel constriction, bulkheads, retaining walls, fill, stream incision, disruption of flood flows through streamside area] or too much floodplain/intertidal zone access [examples: impoundments, intensive mosquito ditching]) or floodplain/intertidal zone unnaturally absent or assessment reach is a man-made feature on an interstream divide

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.

- ☐A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐B Excessive sedimentation (burying of stream features or intertidal zone)
- ☐C Noticeable evidence of pollutant discharges entering the assessment reach and causing a water quality problem
- ☐D Odor (not including natural sulfide odors)
- ☐E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in "Notes/Sketch" section.
- ☒F Livestock with access to stream or intertidal zone
- ☐G Excessive algae in stream or intertidal zone
- ☐H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc)
- ☐I Other: _____ (explain in "Notes/Sketch" section)
- ☐J Little to no stressors

8. Recent Weather – watershed metric (skip for Tidal Marsh Streams)
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

9. Large or Dangerous Stream – assessment reach metric
☐Yes ☒No Is stream is too large or dangerous to assess? If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition).

10. Natural In-stream Habitat Types – assessment reach metric
10a. ☐Yes ☐No Degraded in-stream habitat over majority of the assessment reach (examples of stressors include excessive sedimentation, mining, excavation, in-stream hardening [for example, rip-rap], recent dredging, and snagging) **(evaluate for Size 4 Coastal Plain streams only, then skip to Metric 12)**

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**

- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☒B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☐C Multiple snags and logs (including lap trees)
- ☐D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☐E Little or no habitat

Check for Tidal Marsh Streams Only

- ☐F 5% oysters or other natural hard bottoms
- ☐G Submerged aquatic vegetation
- ☐H Low-tide refugia (pools)
- ☐I Sand bottom
- ☐J 5% vertical bank along the marsh
- ☐K Little or no habitat

**************************************REMAINING QUESTIONS ARE NOT APPLICABLE FOR TIDAL MARSH STREAMS*********************************

11. Bedform and Substrate – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

11a. ☐Yes ☒No Is assessment reach in a natural sand-bed stream? **(skip for Coastal Plain streams)**

11b. Bedform evaluated. **Check the appropriate box(es).**

- ☒A Riffle-run section **(evaluate 11c)**
- ☐B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but ≤ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

NP	R	C	A	P	
☒	☐	☐	☐	☐	Bedrock/saprolite
☒	☐	☐	☐	☐	Boulder (256 – 4096 mm)
☒	☐	☐	☐	☐	Cobble (64 – 256 mm)
☐	☒	☐	☐	☐	Gravel (2 – 64 mm)
☐	☐	☒	☐	☐	Sand (.062 – 2 mm)
☐	☐	☐	☒	☐	Silt/clay (< 0.062 mm)
☐	☐	☒	☐	☐	Detritus
☒	☐	☐	☐	☐	Artificial (rip-rap, concrete, etc.)

11d. ☒Yes ☐No Are pools filled with sediment? (**skip for Size 4 Coastal Plain streams and Tidal Marsh Streams**)

12. Aquatic Life – assessment reach metric (skip for Tidal Marsh Streams)

12a. ☒Yes ☐No Was an in-stream aquatic life assessment performed as described in the User Manual?
If No, select one of the following reasons and skip to Metric 13. ☐No Water ☐Other: _____

12b. ☒Yes ☐No Are aquatic organisms present in the assessment reach (look in riffles, pools, then snags)? If Yes, check all that apply. If No, skip to Metric 13.

1	>1	Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.
☐	☐	Adult frogs
☐	☐	Aquatic reptiles
☐	☐	Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐	☒	Beetles
☐	☐	Caddisfly larvae (T)
☐	☐	Asian clam (*Corbicula*)
☐	☐	Crustacean (isopod/amphipod/crayfish/shrimp)
☐	☐	Damselfly and dragonfly larvae
☐	☐	Dipterans
☐	☐	Mayfly larvae (E)
☐	☐	Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐	☐	Midges/mosquito larvae
☐	☐	Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea*)
☐	☐	Mussels/Clams (not *Corbicula*)
☐	☐	Other fish
☐	☐	Salamanders/tadpoles
☐	☐	Snails
☐	☐	Stonefly larvae (P)
☐	☐	Tipulid larvae
☐	☐	Worms/leeches

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

LB	RB	
☐A	☐A	Little or no alteration to water storage capacity over a majority of the streamside area
☐B	☐B	Moderate alteration to water storage capacity over a majority of the streamside area
☒C	☒C	Severe alteration to water storage capacity over a majority of the streamside area (examples: ditches, fill, soil compaction, livestock disturbance, buildings, man-made levees, drainage pipes)

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)
Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

LB	RB	
☐A	☐A	Majority of streamside area with depressions able to pond water ≥ 6 inches deep
☐B	☐B	Majority of streamside area with depressions able to pond water 3 to 6 inches deep
☒C	☒C	Majority of streamside area with depressions able to pond water < 3 inches deep

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)
Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

LB	RB	
☒Y	☒Y	Are wetlands present in the streamside area?
☐N	☐N	

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)
Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

☒A	Streams and/or springs (jurisdictional discharges)
☐B	Ponds (include wet detention basins; do not include sediment basins or dry detention basins)
☐C	Obstruction passing flow during low-flow periods within the assessment area (beaver dam, leaky dam, bottom-release dam, weir)
☐D	Evidence of bank seepage or sweating (iron in water indicates seepage)
☒E	Stream bed or bank soil reduced (dig through deposited sediment if present)
☐F	None of the above

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)
Check all that apply.

☐A	Evidence of substantial water withdrawals from the assessment reach (includes areas excavated for pump installation)
☐B	Obstruction not passing flow during low-flow periods affecting the assessment reach (ex: watertight dam, sediment deposit)
☐C	Urban stream (≥ 24% impervious surface for watershed)
☐D	Evidence that the streamside area has been modified resulting in accelerated drainage into the assessment reach
☐E	Assessment reach relocated to valley edge
☒F	None of the above

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)
Consider aspect. Consider "leaf-on" condition.

☐A	Stream shading is appropriate for stream category (may include gaps associated with natural processes)
☒B	Degraded (example: scattered trees)
☐C	Stream shading is gone or largely absent

19. Buffer Width – streamside area metric (skip for Tidal Marsh Streams)
Consider "vegetated buffer" and "wooded buffer" separately for left bank (LB) and right bank (RB) starting at the top of bank out to the first break.

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☐A	☐A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☒E	☒E	< 10 feet wide or no trees

20. Buffer Structure – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Vegetated" Buffer Width).

LB	RB	
☐A	☐A	Mature forest
☐B	☐B	Non-mature woody vegetation or modified vegetation structure
☒C	☒C	Herbaceous vegetation with or without a strip of trees < 10 feet wide
☐D	☐D	Maintained shrubs
☐E	☐E	Little or no vegetation

21. Buffer Stressors – streamside area metric (skip for Tidal Marsh Streams)
Check all appropriate boxes for left bank (LB) and right bank (RB). Indicate if listed stressor abuts stream (Abuts), does not abut but is within 30 feet of stream (< 30 feet), or is between 30 to 50 feet of stream (30-50 feet).
If none of the following stressors occurs on either bank, check here and skip to Metric 22: ☐

Abuts LB	Abuts RB	< 30 feet LB	< 30 feet RB	30-50 feet LB	30-50 feet RB	
☐A	☐A	☐A	☐A	☐A	☐A	Row crops
☐B	☐B	☐B	☐B	☐B	☐B	Maintained turf
☐C	☐C	☐C	☐C	☐C	☐C	Pasture (no livestock)/commercial horticulture
☒D	☒D	☐D	☐D	☐D	☐D	Pasture (active livestock use)

22. Stem Density – streamside area metric (skip for Tidal Marsh Streams)
Consider for left bank (LB) and right bank (RB) for Metric 19 ("Wooded" Buffer Width).

LB	RB	
☐A	☐A	Medium to high stem density
☐B	☐B	Low stem density
☒C	☒C	No wooded riparian buffer or predominantly herbaceous species or bare ground

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)
Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10 feet wide.

LB	RB	
☒A	☒A	The total length of buffer breaks is < 25 percent.
☐B	☐B	The total length of buffer breaks is between 25 and 50 percent.
☐C	☐C	The total length of buffer breaks is > 50 percent.

24. Vegetative Composition – streamside area metric (skip for Tidal Marsh Streams)
Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

LB	RB	
☐A	☐A	Vegetation is close to undisturbed in species present and their proportions. Lower strata composed of native species, with non-native invasive species absent or sparse.
☐B	☐B	Vegetation indicates disturbance in terms of species diversity or proportions, but is still largely composed of native species. This may include communities of weedy native species that develop after clear-cutting or clearing or communities with non-native invasive species present, but not dominant, over a large portion of the expected strata or communities missing understory but retaining canopy trees.
☒C	☒C	Vegetation is severely disturbed in terms of species diversity or proportions. Mature canopy is absent or communities with non-native invasive species dominant over a large portion of expected strata or communities composed of planted stands of non-characteristic species or communities inappropriately composed of a single species or no vegetation.

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)
25a. ☐Yes ☒No Was conductivity measurement recorded?
If No, select one of the following reasons. ☐No Water ☐Other: _____

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).
☐A < 46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Brahma Site-SAM 3 (UT2 upstream)	Date of Assessment	7/25/18
Stream Category	Pa1	Assessor Name/Organization	AXE/WGL

Notes of Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	YES
Additional stream information/supplementary measurements included (Y/N)	NO
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	**MEDIUM**	**MEDIUM**
(4) Floodplain Access	**HIGH**	**HIGH**
(4) Wooded Riparian Buffer	**LOW**	**LOW**
(4) Microtopography	**LOW**	**LOW**
(3) Stream Stability	**LOW**	**LOW**
(4) Channel Stability	**HIGH**	**HIGH**
(4) Sediment Transport	**LOW**	**LOW**
(4) Stream Geomorphology	**LOW**	**LOW**
(2) Stream/Intertidal Zone Interaction	NA	NA
(2) Longitudinal Tidal Flow	NA	NA
(2) Tidal Marsh Stream Stability	NA	NA
(3) Tidal Marsh Channel Stability	NA	NA
(3) Tidal Marsh Stream Geomorphology	NA	NA
(1) Water Quality	**LOW**	**LOW**
(2) Baseflow	**HIGH**	**HIGH**
(2) Streamside Area Vegetation	**LOW**	**LOW**
(3) Upland Pollutant Filtration	**LOW**	**LOW**
(3) Thermoregulation	**MEDIUM**	**MEDIUM**
(2) Indicators of Stressors	**YES**	**YES**
(2) Aquatic Life Tolerance	**LOW**	**NA**
(2) Intertidal Zone Filtration	NA	NA
(1) Habitat	**LOW**	**LOW**
(2) In-stream Habitat	**LOW**	**MEDIUM**
(3) Baseflow	**HIGH**	**HIGH**
(3) Substrate	**LOW**	**LOW**
(3) Stream Stability	**MEDIUM**	**MEDIUM**
(3) In-stream Habitat	**LOW**	**HIGH**
(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	**LOW**	**LOW**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Brahma	Date of Evaluation	July 25, 2018
Applicant/Owner Name	Restoration Systems	Wetland Site Name	GA
Wetland Type	Headwater Forest	Assessor Name/Organization	A. Baldwin/RS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Reedy Branch
River Basin	Cape Fear	USGS 8-Digit Catalogue Unit	03030002
County	Alamance	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.854109/-79.410760

Evidence of stressors affecting the assessment area (may not be within the assessment area)

Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☒ Yes ☐ No

Regulatory Considerations - Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.

☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWR riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)

☐ Blackwater
☒ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No

Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☒A	☐A	Not severely altered
☐B	☒B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐A	☒A	Water storage capacity and duration are not altered.
☒B	☐B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric (skip for all marshes)

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☐B	☐B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☐C	☐C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☒D	☒D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☒C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric (skip for all marshes)

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a.
- ☐A Sandy soil
- ☒B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
- ☐C Loamy or clayey soils not exhibiting redoximorphic features
- ☐D Loamy or clayey gleyed soil
- ☐E Histosol or histic epipedon

4b.
- ☒A Soil ribbon < 1 inch
- ☐B Soil ribbon ≥ 1 inch

4c.
- ☒A No peat or muck presence
- ☐B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☐A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☒B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric (skip for non-riparian wetlands)

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☐A	☐A	☐A	≥ 10% impervious surfaces
☒B	☒B	☒B	Confined animal operations (or other local, concentrated source of pollutants
☒C	☒C	☒C	≥ 20% coverage of pasture
☐D	☐D	☐D	≥ 20% coverage of agricultural land (regularly plowed land)
☐E	☐E	☐E	≥ 20% coverage of maintained grass/herb
☐F	☐F	☐F	≥ 20% coverage of clear-cut land
☐G	☐G	☐G	Little or no opportunity to improve water quality. Lack of opportunity may result from little or no disturbance in the watershed or hydrologic alterations that prevent drainage and/or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric (skip for non-riparian wetlands)

7a. Is assessment area within 50 feet of a tributary or other open water?
☒Yes ☐No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? (Wetland buffer need only be present on one side of the .water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.)
- ☐A ≥ 50 feet
- ☐B From 30 to < 50 feet
- ☐C From 15 to < 30 feet
- ☐D From 5 to < 15 feet
- ☒E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☒≤ 15-feet wide ☐> 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☐Yes ☒No

7e. Is stream or other open water sheltered or exposed?
☒Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate WT for all marshes and Estuarine Woody Wetland only; evaluate WC for Bottomland Hardwood Forest, Headwater Forest, and Riverine Swamp Forest only)

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐A	☐A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☒C	☒C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☐G	☐G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. Inundation Duration – assessment area condition metric (skip for non-riparian wetlands)

Answer for assessment area dominant landform.

☒A Evidence of short-duration inundation (< 7 consecutive days)
☐B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric (skip for non-riparian wetlands and all marshes)

Consider recent deposition only (no plant growth since deposition).

☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☐A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☒I	☒I	☐I	From 0.1 to < 0.5 acre
☐J	☐J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☒K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☐A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☐E	< 10 acres
☒F	☒F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric (skip for all marshes and Estuarine Woody Wetland)

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass. Artificial edge occurs within 150 feet in how many directions? If the assessment area is clear cut, select option "C."

☐A 0
☐B 1 to 4
☒C 5 to 8

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
☒B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
☐C Vegetation severely altered from reference in composition, or expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species), or exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
☒B Vegetation diversity is low or has > 10% to 50% cover of exotics.
☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☐B	☐B	Canopy present, but opened more than natural gaps
	☒C	☒C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☐B	☐B	Moderate density mid-story/sapling layer
	☒C	☒C	Mid-story/sapling layer sparse or absent
Shrub	☐A	☐A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☒C	☒C	Shrub layer sparse or absent
Herb	☒A	☒A	Dense herb layer
	☐B	☐B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric (skip for all marshes)

☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric (skip for all marshes)

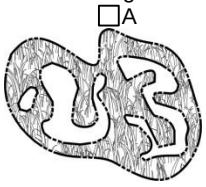
☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☒C Majority of canopy trees are < 6 inches DBH or no trees.

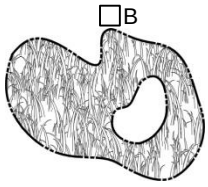
20. Large Woody Debris – wetland type condition metric (skip for all marshes)

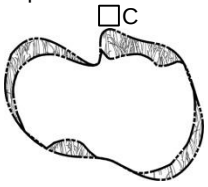
Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

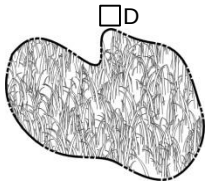
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A 

☐B 

☐C 

☐D 

22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands and Salt/Brackish Marsh only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.
☒A Overbank and overland flow are not severely altered in the assessment area.
☐B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank and overland flow are severely altered in the assessment area.

Notes

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	GA	Date of Assessment	July 25, 2018
Wetland Type	Headwater Forest	Assessor Name/Organization	A. Baldwin/RS

Notes on Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
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)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	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	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**HIGH**
	Opportunity Presence (Y/N)	**YES**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Brahma	Date of Evaluation	July 25, 2018
Applicant/Owner Name	Restoration Systems	Wetland Site Name	GC
Wetland Type	Headwater Forest	Assessor Name/Organization	A. Baldwin/RS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Reedy Branch
River Basin	Cape Fear	USGS 8-Digit Catalogue Unit	03030002
County	Alamance	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.850629/-79.411657

Evidence of stressors affecting the assessment area (may not be within the assessment area)

Please circle and/or make note on the last page if evidence of stressors is apparent. Consider departure from reference, if appropriate, in recent past (for instance, within 10 years). Noteworthy stressors include, but are not limited to the following.

- Hydrological modifications (examples: ditches, dams, beaver dams, dikes, berms, ponds, etc.)
- Surface and sub-surface discharges into the wetland (examples: discharges containing obvious pollutants, presence of nearby septic tanks, underground storage tanks (USTs), hog lagoons, etc.)
- Signs of vegetation stress (examples: vegetation mortality, insect damage, disease, storm damage, salt intrusion, etc.)
- Habitat/plant community alteration (examples: mowing, clear-cutting, exotics, etc.)

Is the assessment area intensively managed? ☒ Yes ☐ No

Regulatory Considerations - Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.

☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWR riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)

☐ Blackwater
☒ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

Is the assessment area on a coastal island? ☐ Yes ☒ No

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No

Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

1. Ground Surface Condition/Vegetation Condition – assessment area condition metric

Check a box in each column. Consider alteration to the ground surface (GS) in the assessment area and vegetation structure (VS) in the assessment area. Compare to reference wetland if applicable (see User Manual). If a reference is not applicable, then rate the assessment area based on evidence an effect.

GS	VS	
☒A	☐A	Not severely altered
☐B	☒B	Severely altered over a majority of the assessment area (ground surface alteration examples: vehicle tracks, excessive sedimentation, fire-plow lanes, skidder tracks, bedding, fill, soil compaction, obvious pollutants) (vegetation structure alteration examples: mechanical disturbance, herbicides, salt intrusion [where appropriate], exotic species, grazing, less diversity [if appropriate], hydrologic alteration)

2. Surface and Sub-Surface Storage Capacity and Duration – assessment area condition metric

Check a box in each column. Consider surface storage capacity and duration (Surf) and sub-surface storage capacity and duration (Sub). Consider both increase and decrease in hydrology. A ditch ≤ 1 foot deep is considered to affect surface water only, while a ditch > 1 foot deep is expected to affect both surface and sub-surface water. Consider tidal flooding regime, if applicable.

Surf	Sub	
☐A	☒A	Water storage capacity and duration are not altered.
☒B	☐B	Water storage capacity or duration are altered, but not substantially (typically, not sufficient to change vegetation).
☐C	☐C	Water storage capacity or duration are substantially altered (typically, alteration sufficient to result in vegetation change) (examples: draining, flooding, soil compaction, filling, excessive sedimentation, underground utility lines).

3. Water Storage/Surface Relief – assessment area/wetland type condition metric (skip for all marshes)

Check a box in each column. Select the appropriate storage for the assessment area (AA) and the wetland type (WT).

	AA	WT	
3a.	☐A	☐A	Majority of wetland with depressions able to pond water > 1 deep
	☐B	☐B	Majority of wetland with depressions able to pond water 6 inches to 1 foot deep
	☐C	☐C	Majority of wetland with depressions able to pond water 3 to 6 inches deep
	☒D	☒D	Depressions able to pond water < 3 inches deep

3b. ☐A Evidence that maximum depth of inundation is greater than 2 feet
☐B Evidence that maximum depth of inundation is between 1 and 2 feet
☒C Evidence that maximum depth of inundation is less than 1 foot

4. Soil Texture/Structure – assessment area condition metric (skip for all marshes)

Check a box from each of the three soil property groups below. Dig soil profile in the dominant assessment area landscape feature. Make soil observations within the top 12 inches. Use most recent National Technical Committee for Hydric Soils guidance for regional indicators.

4a.
- ☐A Sandy soil
- ☒B Loamy or clayey soils exhibiting redoximorphic features (concentrations, depletions, or rhizospheres)
- ☐C Loamy or clayey soils not exhibiting redoximorphic features
- ☐D Loamy or clayey gleyed soil
- ☐E Histosol or histic epipedon

4b.
- ☒A Soil ribbon < 1 inch
- ☐B Soil ribbon ≥ 1 inch

4c.
- ☒A No peat or muck presence
- ☐B A peat or muck presence

5. Discharge into Wetland – opportunity metric

Check a box in each column. Consider surface pollutants or discharges (Surf) and sub-surface pollutants or discharges (Sub). Examples of sub-surface discharges include presence of nearby septic tank, underground storage tank (UST), etc.

Surf	Sub	
☐A	☒A	Little or no evidence of pollutants or discharges entering the assessment area
☒B	☐B	Noticeable evidence of pollutants or discharges entering the wetland and stressing, but not overwhelming the treatment capacity of the assessment area
☐C	☐C	Noticeable evidence of pollutants or discharges (pathogen, particulate, or soluble) entering the assessment area and potentially overwhelming the treatment capacity of the wetland (water discoloration, dead vegetation, excessive sedimentation, odor)

6. Land Use – opportunity metric (skip for non-riparian wetlands)

Check all that apply (at least one box in each column). Evaluation involves a GIS effort with field adjustment. Consider sources draining to assessment area within entire upstream watershed (WS), within 5 miles and within the watershed draining to the assessment area (5M), and within 2 miles and within the watershed draining to the assessment area (2M).

WS	5M	2M	
☐A	☐A	☐A	≥ 10% impervious surfaces
☒B	☒B	☒B	Confined animal operations (or other local, concentrated source of pollutants
☐C	☐C	☐C	≥ 20% coverage of pasture
☐D	☐D	☐D	≥ 20% coverage of agricultural land (regularly plowed land)
☐E	☐E	☐E	≥ 20% coverage of maintained grass/herb
☐F	☐F	☐F	≥ 20% coverage of clear-cut land
☐G	☐G	☐G	Little or no opportunity to improve water quality. Lack of opportunity may result from little or no disturbance in the watershed or hydrologic alterations that prevent drainage and/or overbank flow from affecting the assessment area.

7. Wetland Acting as Vegetated Buffer – assessment area/wetland complex condition metric (skip for non-riparian wetlands)

7a. Is assessment area within 50 feet of a tributary or other open water?
☒Yes ☐No If Yes, continue to 7b. If No, skip to Metric 8.
Wetland buffer need only be present on one side of the water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.

7b. How much of the first 50 feet from the bank is wetland? (Wetland buffer need only be present on one side of the .water body. Make buffer judgment based on the average width of wetland. Record a note if a portion of the buffer has been removed or disturbed.)
- ☐A ≥ 50 feet
- ☐B From 30 to < 50 feet
- ☐C From 15 to < 30 feet
- ☐D From 5 to < 15 feet
- ☒E < 5 feet or buffer bypassed by ditches

7c. Tributary width. If the tributary is anastomosed, combine widths of channels/braids for a total width.
☒≤ 15-feet wide ☐> 15-feet wide ☐ Other open water (no tributary present)

7d. Do roots of assessment area vegetation extend into the bank of the tributary/open water?
☐Yes ☒No

7e. Is stream or other open water sheltered or exposed?
☒Sheltered – adjacent open water with width < 2500 feet and no regular boat traffic.
☐Exposed – adjacent open water with width ≥ 2500 feet or regular boat traffic.

8. Wetland Width at the Assessment Area – wetland type/wetland complex condition metric (evaluate WT for all marshes and Estuarine Woody Wetland only; evaluate WC for Bottomland Hardwood Forest, Headwater Forest, and Riverine Swamp Forest only)

Check a box in each column for riverine wetlands only. Select the average width for the wetland type at the assessment area (WT) and the wetland complex at the assessment area (WC). See User Manual for WT and WC boundaries.

WT	WC	
☐A	☐A	≥ 100 feet
☐B	☐B	From 80 to < 100 feet
☒C	☒C	From 50 to < 80 feet
☐D	☐D	From 40 to < 50 feet
☐E	☐E	From 30 to < 40 feet
☐F	☐F	From 15 to < 30 feet
☐G	☐G	From 5 to < 15 feet
☐H	☐H	< 5 feet

9. Inundation Duration – assessment area condition metric (skip for non-riparian wetlands)

Answer for assessment area dominant landform.

☒A Evidence of short-duration inundation (< 7 consecutive days)
☐B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

10. Indicators of Deposition – assessment area condition metric (skip for non-riparian wetlands and all marshes)

Consider recent deposition only (no plant growth since deposition).

☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

11. Wetland Size – wetland type/wetland complex condition metric

Check a box in each column. Involves a GIS effort with field adjustment. This metric evaluates three aspects of the wetland area: the size of the wetland type (WT), the size of the wetland complex (WC), and the size of the forested wetland (FW) (if applicable, see User Manual). See the User Manual for boundaries of these evaluation areas. If assessment area is clear-cut, select "K" for the FW column.

WT	WC	FW (if applicable)	
☐A	☐A	☐A	≥ 500 acres
☐B	☐B	☐B	From 100 to < 500 acres
☐C	☐C	☐C	From 50 to < 100 acres
☐D	☐D	☐D	From 25 to < 50 acres
☐E	☐E	☐E	From 10 to < 25 acres
☐F	☐F	☐F	From 5 to < 10 acres
☐G	☐G	☐G	From 1 to < 5 acres
☐H	☐H	☐H	From 0.5 to < 1 acre
☐I	☐I	☐I	From 0.1 to < 0.5 acre
☒J	☒J	☐J	From 0.01 to < 0.1 acre
☐K	☐K	☒K	< 0.01 acre or assessment area is clear-cut

12. Wetland Intactness – wetland type condition metric (evaluate for Pocosins only)

☐A Pocosin is the full extent (≥ 90%) of its natural landscape size.
☐B Pocosin type is < 90% of the full extent of its natural landscape size.

13. Connectivity to Other Natural Areas – landscape condition metric

13a. **Check appropriate box(es) (a box may be checked in each column).** Involves a GIS effort with field adjustment. This metric evaluates whether the wetland is well connected (Well) and/or loosely connected (Loosely) to the landscape patch, the contiguous naturally vegetated area and open water (if appropriate). Boundaries are formed by four-lane roads, regularly maintained utility line corridors the width of a four-lane road or wider, urban landscapes, maintained fields (pasture and agriculture), or open water > 300 feet wide.

Well	Loosely	
☐A	☐A	≥ 500 acres
☐B	☐B	From 100 to < 500 acres
☐C	☐C	From 50 to < 100 acres
☐D	☐D	From 10 to < 50 acres
☐E	☒E	< 10 acres
☒F	☐F	Wetland type has a poor or no connection to other natural habitats

13b. **Evaluate for marshes only**.

☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

14. Edge Effect – wetland type condition metric (skip for all marshes and Estuarine Woody Wetland)

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass. Artificial edge occurs within 150 feet in how many directions? If the assessment area is clear cut, select option "C."

☐A 0
☐B 1 to 4
☒C 5 to 8

15. Vegetative Composition – assessment area condition metric (skip for all marshes and Pine Flat)

☐A Vegetation is close to reference condition in species present and their proportions. Lower strata composed of appropriate species, with exotic plants absent or sparse within the assessment area.
☒B Vegetation is different from reference condition in species diversity or proportions, but still largely composed of native species characteristic of the wetland type. This may include communities of weedy native species that develop after clearcutting or clearing. It also includes communities with exotics present, but not dominant, over a large portion of the expected strata.
☐C Vegetation severely altered from reference in composition, or expected species are unnaturally absent (planted stands of non-characteristic species or at least one stratum inappropriately composed of a single species), or exotic species are dominant in at least one stratum.

16. Vegetative Diversity – assessment area condition metric (evaluate for Non-tidal Freshwater Marsh only)

☐A Vegetation diversity is high and is composed primarily of native species (< 10% cover of exotics).
☒B Vegetation diversity is low or has > 10% to 50% cover of exotics.
☐C Vegetation is dominated by exotic species (> 50 % cover of exotics).

17. Vegetative Structure – assessment area/wetland type condition metric

17a. Is vegetation present?
☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.
☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

17c. **Check a box in each column for each stratum**. Evaluate this portion of the metric **for non-marsh wetlands**. Consider structure in airspace above the assessment area (AA) and the wetland type (WT) separately.

	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☐B	☐B	Canopy present, but opened more than natural gaps
	☒C	☒C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☐B	☐B	Moderate density mid-story/sapling layer
	☒C	☒C	Mid-story/sapling layer sparse or absent
Shrub	☐A	☐A	Dense shrub layer
	☐B	☐B	Moderate density shrub layer
	☒C	☒C	Shrub layer sparse or absent
Herb	☒A	☒A	Dense herb layer
	☐B	☐B	Moderate density herb layer
	☐C	☐C	Herb layer sparse or absent

18. Snags – wetland type condition metric (skip for all marshes)

☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

19. Diameter Class Distribution – wetland type condition metric (skip for all marshes)

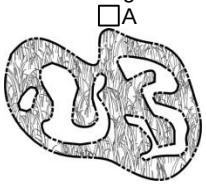
☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☒C Majority of canopy trees are < 6 inches DBH or no trees.

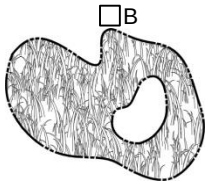
20. Large Woody Debris – wetland type condition metric (skip for all marshes)

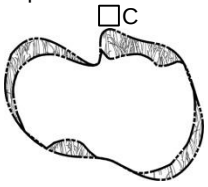
Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

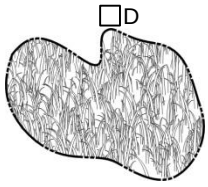
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A 

☐B 

☐C 

☐D 

22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands and Salt/Brackish Marsh only)

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.
☒A Overbank and overland flow are not severely altered in the assessment area.
☐B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank and overland flow are severely altered in the assessment area.

Notes

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	GC	Date of Assessment	July 25, 2018
Wetland Type	Headwater Forest	Assessor Name/Organization	A. Baldwin/RS

Notes on Field Assessment Form (Y/N)	NO
Presence of regulatory considerations (Y/N)	NO
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)	NO
Assessment area is on a coastal island (Y/N)	NO

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	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)	**NO**
	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	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**HIGH**
	Opportunity Presence (Y/N)	**YES**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** Broadway UT1	**Latitude:** 35.851548
Evaluator: Radecki / Axiom	**County:** Alamance	**Longitude:** -79.408083
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* Crutchfield Crossroads

A. Geomorphology (Subtotal = 15.5)	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)				
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:

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** UT2	**Latitude:** 35.850374
Evaluator: Radecki / Ariam	**County:** Alamance	**Longitude:** -79.411321
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 21.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** e.g. Quad Name: Crutchfield Crossroads

A. Geomorphology (Subtotal = 13.5)	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 = 10)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	(1) →	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

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

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** Brahma UT3	**Latitude:** 35.855272
Evaluator: Radecki Axiom	**County:** Alamance	**Longitude:** -79.411196
Total Points: 30 *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:* Crutchfield Crossroads

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 = 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 = 5.5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	3	(2)	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	0	0.5	1	(1.5)
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

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

Notes:

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** Brahma UT 4	**Latitude:** 35.855923
Evaluator: Radecki / Axiom	**County:** Alamance	**Longitude:** -79.411186
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 24.25	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* Crutchfield Crossroads

A. Geomorphology (Subtotal = 10)	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 = 7.25)				
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:

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** Brookman UT 5	**Latitude:** 35.857958
Evaluator: RADECKI / AXIOM	**County:** Alamance	**Longitude:** -79.410295
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 34.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** e.g. Quad Name: Crutchfield Crossroads

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 = 11.5)				
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:

NC DWQ Stream Identification Form Version 4.11

Date: 5-3-2019	**Project/Site:** HT6	**Latitude:** 35 857408
Evaluator: RADEUD / Axiom	**County:** Alamance	**Longitude:** -79.410441
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:* Crutchfield Crossroads

A. Geomorphology (Subtotal = 11)	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 = 5)				
18. Fibrous roots in streambed	3	2	(1)	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	(0)	0.5	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	0	0.5	(1)	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

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

Notes:

Sketch:

Site		Brahma Steam Mitigation Site						
Stream		UT 1 Up from Drive (Left Bank)			Bank Length		1545	
Observers		WGL			Date		25-Jul-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	445	left	Mod	Low	0.02	445	2.8	24.9
2	480	left	Low	Low	0	35	2	0.0
3	515	left	Mod	Low	0.02	35	2.5	1.8
4	560	left	Low	Low	0	45	1.5	0.0
5	580	left	Mod	Mod	0.06	20	2	2.4
6	670	left	Low	Low	0	90	1.5	0.0
7	730	left	Mod	Low	0.02	60	2	2.4
8	860	left	Low	Low	0	130	2	0.0
9	920	left	Mod	Low	0.02	60	3	3.6
10	965	left	Low	Low	0	45	2	0.0
11	1000	left	Mod	Low	0.02	35	2.5	1.8
12	1320	left	Low	Low	0	320	1.5	0.0
13	1395	left	Mod	Low	0.02	75	1.5	2.3
14	1425	left	Low	Low	0	30	1	0.0
15	1545	left	Mod	Low	0.02	120	1.5	3.6
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		42.7
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		1.6
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		2.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.001

Site		Brahma Steam Mitigation Site						
Stream		UT 1 Up from Drive (Right Bank)			Bank Length		1300	
Observers		WGL			Date		25-Jul-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	100	right	Mod	Low	0.02	100	2.8	5.6
2	480	right	Low	Low	0	380	2	0.0
3	540	right	Low	Low	0	60	2	0.0
4	600	right	Mod	Mod	0.06	60	2	7.2
5	620	right	Low	Low	0	20	2	0.0
6	710	right	Mod	Low	0.02	90	2	3.6
7	800	right	Low	Low	0	90	1.5	0.0
8	820	right	Mod	Low	0.02	20	1.5	0.6
9	860	right	Mod	Mod	0.06	40	1.5	3.6
10	910	right	Mod	Mod	0.06	50	2	6.0
11	950	right	Mod	Mod	0.06	40	3	7.2
12	1030	right	High	High	0.2	80	3	48.0
13	1040	right	Mod	Low	0.02	10	3	0.6
14	1140	right	Mod	Low	0.02	100	1.5	3.0
15	1220	right	Low	Low	0	80	1	0.0
16	1300	right	Mod	Low	0.02	80	2	3.2
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		88.6
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		3.3
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		4.3
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.003

Site		Brahma Steam Mitigation Site						
Stream		UT 2 -Left Bank			Bank Length		1277	
Observers		WGL			Date		25-Jul-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	75	left	Mod	Low	0.02	75	1	1.5
2	415	left	Low	Low	0	340	1	0.0
3	445	left	Mod	Low	0.02	30	1.5	0.9
4	545	left	Low	Low	0	100	1	0.0
5	595	left	Mod	Low	0.02	50	1.5	1.5
6	675	left	Mod	Low	0.02	80	2	3.2
7	1277	left	Low	Low	0	602	1	0.0
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		7.1
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.3
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.3
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.000

Site		Brahma Steam Mitigation Site						
Stream		UT 2 -Right Bank			Bank Length		1802	
Observers		WGL			Date		25-Jul-18	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	70	right	Mod	Low	0.02	70	1	1.4
2	140	right	Low	Low	0	70	1	0.0
3	400	right	Mod	Low	0.02	260	1	5.2
4	420	right	Low	Low	0	20	1	0.0
5	490	right	Low	Low	0.02	70	0.5	0.7
6	790	right	Mod	Low	0.02	300	1	6.0
7	850	right	Low	Low	0	60	1	0.0
8	950	right	Low	Low	0	100	1.5	0.0
9	1100	right	Mod	Mod	0.06	150	1.5	13.5
10	1200	right	Low	Mod	0.02	100	1	2.0
11	1802	right	Low	Low	0	602	1	0.0
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		28.8
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		1.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		1.4
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.001

Site		Brahma Steam Mitigation Site						
Stream		UT 3 (Both Banks)			Bank Length		155	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	155	left	Mod	Low	0.02	155	3	9.3
2	155	right	Mod	Low	0.02	155	3	9.3
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		18.6
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 Erosion (Tons/yr/ft)		0.006

Site		Brahma Steam Mitigation Site						
Stream		UT 4 (Both Banks)			Bank Length		55	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	55	left	Low	Low	0	55	1	0.0
2	55	right	Low	Low	0	55	1	0.0
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		0.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.0
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.0
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.000

Site		Brahma Steam Mitigation Site						
Stream		UT 5 -Left Bank			Bank Length		615	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	100	left	High	Low	0.08	100	1	8.0
2	175	left	Mod	Low	0.02	75	1	1.5
3	250	left	Low	Low	0	75	1	0.0
4	615	left	Mod	Low	0.02	365	1	7.3
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		16.8
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.6
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.8
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.001

Site		Brahma Steam Mitigation Site						
Stream		UT 5 -Right Bank			Bank Length		615	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	100	right	High	Low	0.08	100	1	8.0
2	175	right	Mod	Low	0.02	75	1	1.5
3	250	right	Low	Low	0	75	1	0.0
4	615	right	Mod	Low	0.02	365	1	7.3
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		16.8
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.6
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.8
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.001

Site		Brahma Steam Mitigation Site						
Stream		UT 6 -Left Bank			Bank Length		235	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	100	left	Mod	Low	0.02	100	1	2.0
2	235	left	Low	Low	0	135	1	0.0
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		2.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.000

Site		Brahma Steam Mitigation Site						
Stream		UT 6 -Right Bank			Bank Length		235	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	100	right	Mod	Low	0.02	100	1	2.0
2	235	right	Low	Low	0	135	1	0.0
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		2.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.000

Site		Brahma Steam Mitigation Site						
Stream		UT 7 (Both Banks)			Bank Length		75	
Observers		WGL			Date		15-Aug-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	75	left	Mod	Low	0.02	75	1	1.5
2	75	right	Mod	Low	0.02	75	1	1.5
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		3.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		0.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		0.1
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.002

BEHI/NBS Summary

Stream Reach	Erosion Rate (tons/year)
UT 1 LB	2.05
UT 1 RB	4.27
UT 2 LB	0.34
UT 2 RB	1.39
UT 3	0.01
UT 4	0.00
UT 5 LB	0.00
UT 5 RB	0.00
UT 6 LB	0.00
UT 6 RB	0.00
UT 7	0.00
Total	**8.0**

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 8/17/2018

Project/Site: Brahma Mitigation Site

County, State: Alamance County, NC

Sampling Point/
Coordinates: Soil Profile A (35.853795, -79.410413)

Investigator: W. Grant Lewis

Soil Series: Chewacla Loam

Notes: Location is shown on Figure 4.

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-2	10 YR 3/2	100			silt loam
2+	2.5 Y 6/2	65	7.5 YR 5/8	30	silty clay loam
			7.5 YR 4/6	5	

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 8/17/2018

Project/Site: Brahma Mitigation Site

County, State: Alamance County, NC

Sampling Point/
Coordinates: Soil Profile B (35.852229, -79.410635)

Investigator: W. Grant Lewis

Soil Series: Mandale-Secrest Complex

Notes: Location is shown on Figure 4.

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-3	7.5 YR 4/2	100			silt loam
3-8	7.5 YR 5/2	85	7.5 YR 5/6	15	loamy clay
8-20	7.5 YR 7/2	80	7.5 YR 5/6	20	loamy clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Date: 8/17/2018

Project/Site: Brahma Mitigation Site

County, State: Alamance County, NC

Sampling Point/
Coordinates: Soil Profile C (35.858734, -79.414330)

Investigator: W. Grant Lewis

Soil Series: Chewacla Loam

Notes: Location is shown on Figure 4.

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	7.5 YR 6/2	70	7.5 YR 5/3	30	loamy clay
4-8	7.5 YR 6/2	90	7.5 YR 5/6	10	loamy clay
8-20	7.5 YR 6/1	80	10 YR 5/6	20	loamy clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Brahma Mitigation Site

County, State: Alamance, North Carolina

Sampling Point/
Coordinates: Soil Profile D (35.854690, -79.411166)

Investigator: PHP

Notes: location shown on Figure-4

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	7.5yr 7/2	95	7.5yr 5/6	5	Silt Loam
4-10	2.5y 8/2	100	-	-	Silt Loam
10-25	2.5y 8/2	90	2.5yr 5/6	10	Silt Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Brahma Mitigation Site

County, State: Alamance, North Carolina

Sampling Point/
Coordinates: Soil Profile E (35.855074, -79.411788)

Investigator: PHP

Notes: Location shown on Figure-4

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-6	10yr 6/2	96	10yr 5/6	4	Silt Loam
6-15	10yr 8/1	90	10yr 5/6	10	Silt Loam
15-20	10yr 7/2	85	10yr 5/6	15	Clay Loam
20-25	2.5yr 7/2	80	10yr 5/6	20	Silt Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

AXIOM ENVIRONMENTAL, INC

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

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Brahma Mitigation Site

County, State: Alamance, North Carolina

Sampling Point/
Coordinates: Soil Profile F (35.855923, -79.411691)

Investigator: PHP

Notes: Location shown on Figure-4

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-3	10yr 4/3	100	-	-	Loam
3-6	10yr 6/3	95	10yr 5/6	5	Clay Loam
6-10	2.5yr 6/2	90	2.5r 5/6	10	Clay Loam
10-20	2.5y 7/2	80	2.5y 5/6	20	Clay Loam

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

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

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Brahma Mitigation Site

County, State: Alamance, North Carolina

Sampling Point/
Coordinates: Soil Profile G (35.856777, -79.411449)

Investigator: PHP

Notes: Location shown on Figure-4

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-5	10yr 6/3	90	10yr 5/6	10	Silt Loam
5-8	10yr 7/2	95	10yr 5/6	5	Silt Loam
8-20	10yr 6/2	80	10yr 7/2	15-D	Clay Loam
			10yr 5/6	5-C	

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

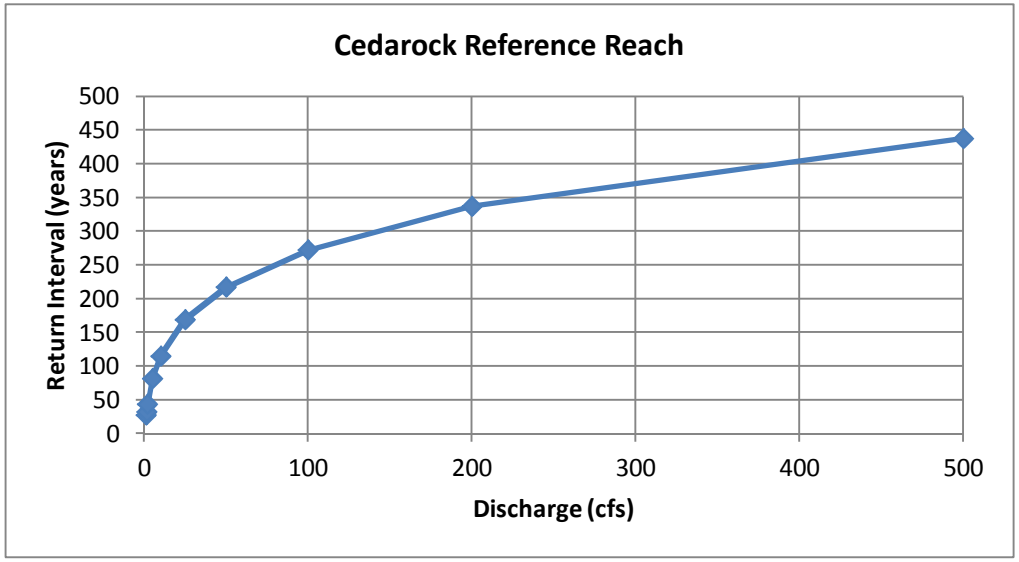
Name/Print: W. Grant Lewis

Appendix C
Flood Frequency Analysis Data

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

Cedarock Reference Reach

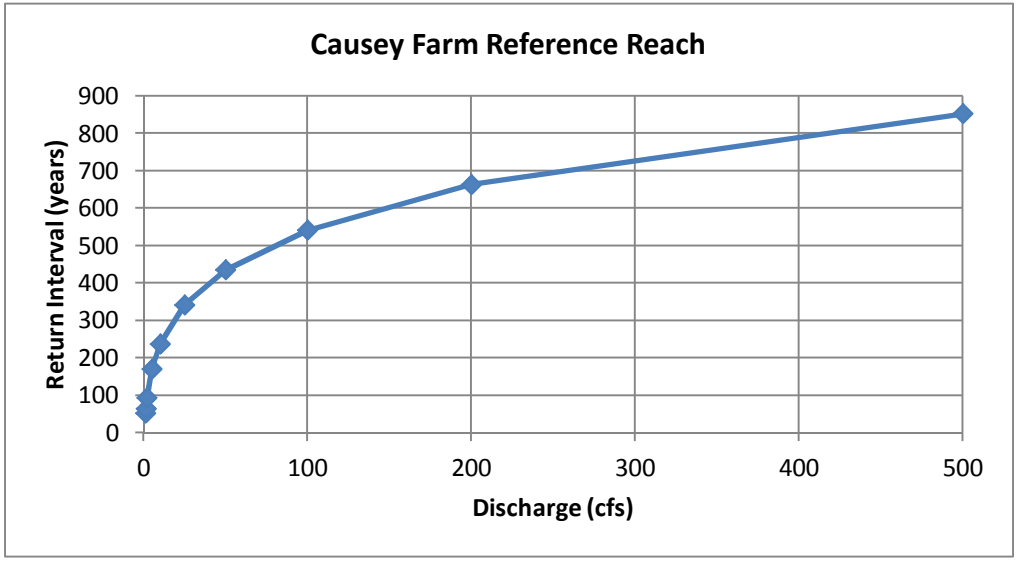
Return Interval (years)	Discharge (cfs)
1.3	**27**
1.5	**32**
2	43.6
5	81.4
10	115
25	169
50	217
100	272
200	337
500	438



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-2019-00126

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2019-00126** County: **Alamance** U.S.G.S. Quad: **NC-Crutchfield Crossroads**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Property Owner: **Axiom Environmental**
Attn: Grant Lewis
Address: **218 Snow Avenue**
Raleigh, NC 27603

Size (acres) **~21** Nearest Town **Snow Camp**
Nearest Waterway **Reedy Branch** River Basin **Cape Fear**
USGS HUC **03030002** Coordinates **35.854859 N, -79.411459 W**
Location description: **The project area is located along unnamed tributaries to Reedy Branch, on the south side of Clark Road approximately 0.7 mile west of its intersection with Crutchfield Road, near Snow Camp, Alamance County, North Carolina. The Project Area is shown as the "Brahma Mitigation Site Easement" on the attached Figures 3, 3A, and 3B, titled "Potential 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 August 2018. Therefore this preliminary jurisdiction determination may be used in the permit evaluation process, including determining compensatory mitigation. For purposes of computation of impacts, compensatory mitigation requirements, and other resource protection measures, a permit decision made on the basis of a preliminary JD will treat all waters and wetlands that would be affected in any way by the permitted activity on the site as if they are jurisdictional waters of the U.S. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). However, you may request an approved JD, which is an appealable action, by contacting the Corps district for further instruction.**

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

B. Approved Determination

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

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

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

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

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

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

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

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

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

C. Basis For Determination: See the Preliminary Jurisdictional Determination form dated 12/12/2019.

D. Remarks: None.

E. Attention USDA Program Participants

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

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

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

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

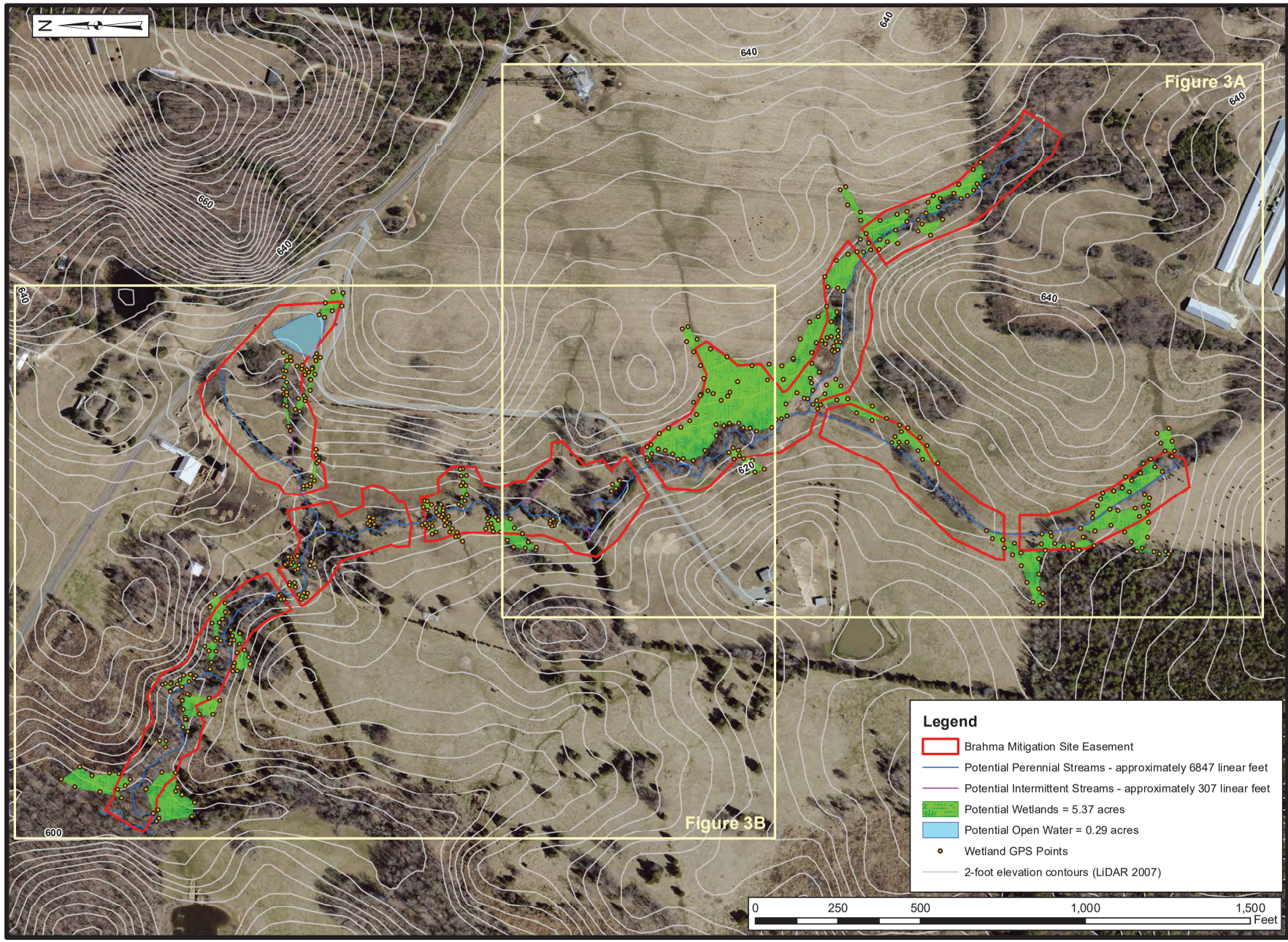
In order for an RFA to be accepted by the Corps, the Corps must determine that it is complete, that it meets the criteria for appeal under 33 CFR part 331.5, and that it has been received by the Division Office within 60 days of the date of the NAP. Should you decide to submit an RFA form, it must be 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: _____ Date: 2019.12.12 16:21:23 -05'00'

Date of JD: **12/12/2019** Expiration Date of JD: **Not applicable**

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

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



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

POTENTIAL JURISDICTIONAL AREAS OVERVIEW

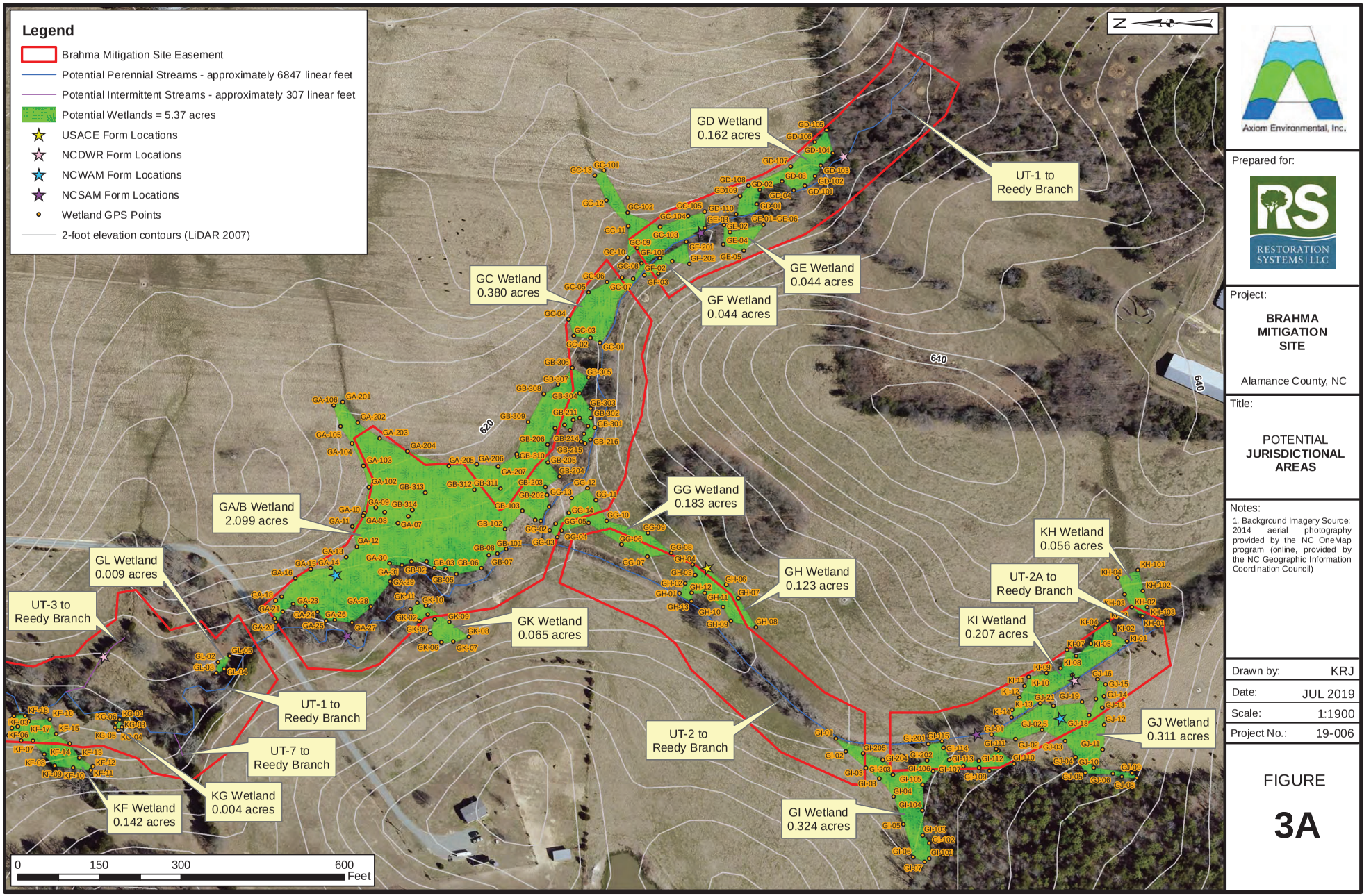
Notes:

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

Drawn by:	KRJ
Date:	JUL 2019
Scale:	1:3300
Project No.:	19-006

FIGURE

3



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

POTENTIAL **JURISDICTIONAL AREAS**

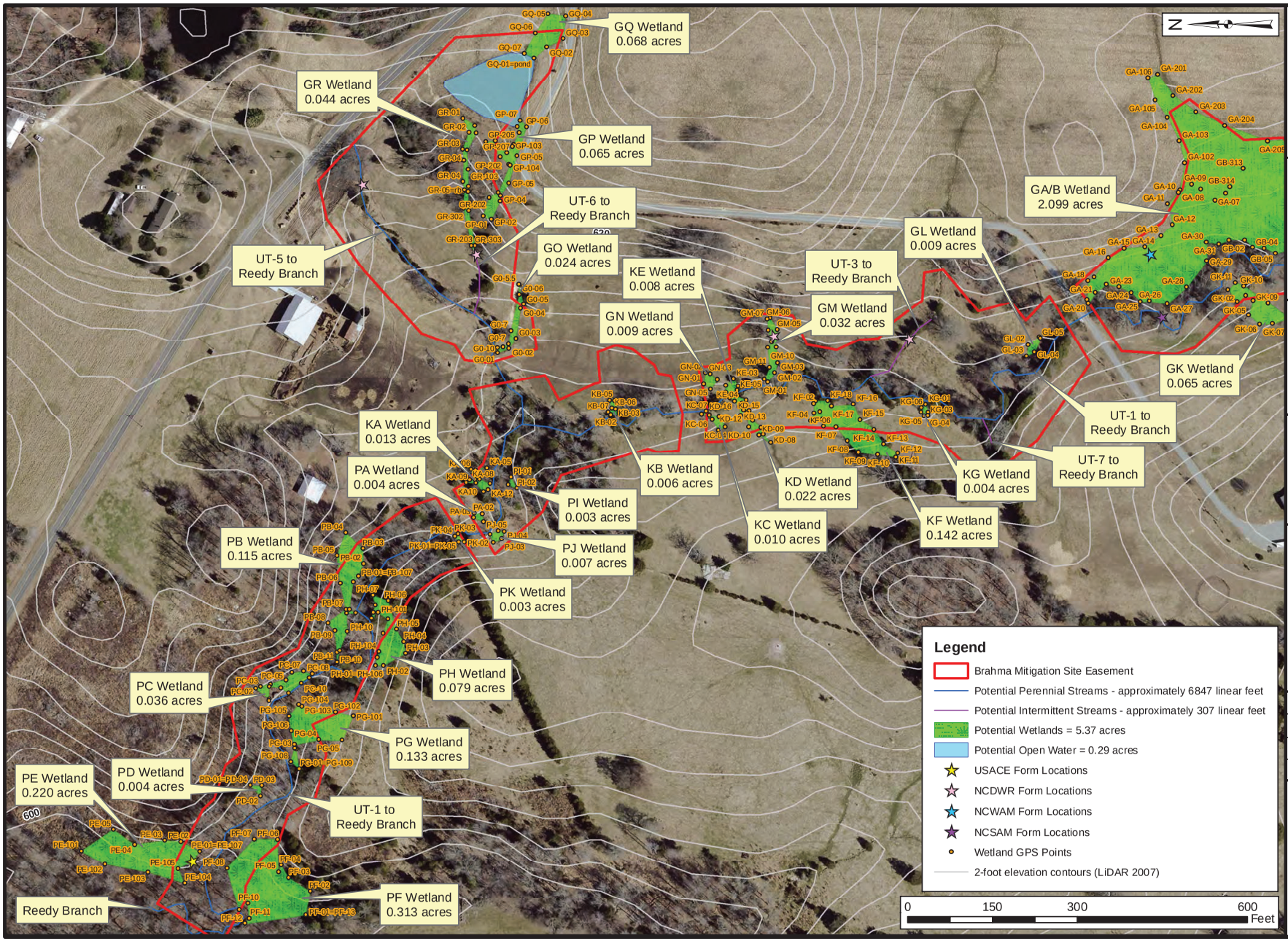
Notes:

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

Drawn by:	KRJ
Date:	JUL 2019
Scale:	1:1900
Project No.:	19-006

FIGURE

3A



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

POTENTIAL **JURISDICTIONAL AREAS**

Notes:

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

Drawn by:	KRJ
Date:	JUL 2019
Scale:	1:1900
Project No.:	19-006

FIGURE

3B

SAW-2019-00126

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: **Axiom Environmental (Attn: Grant Lewis)**	File Number: **SAW-2019-00126**	Date: **12/12/2019**

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

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

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

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

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

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

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

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

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

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

SAW-2019-00126

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. Phillip Shannin, Administrative Appeal Review Officer** **CESAD-PDO** **U.S. Army Corps of Engineers, South Atlantic Division** **60 Forsyth Street, Room 10M15** **Atlanta, Georgia 30303-8801** **Phone: (404) 562-5137**
RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Engineers personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15 day notice of any site investigation, and will have the opportunity to participate in all site investigations.	
_____ Signature of appellant or agent.	Date: / Telephone number:

For appeals on Initial Proffered Permits send this form to:

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

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

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

Appendix 2 - PRELIMINARY JURISDICTIONAL DETERMINATION (PJD) FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PJD: 12/12/2019

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

C. DISTRICT OFFICE, FILE NAME, AND NUMBER: SAW-2019-00126 (NCDMS ILF - Brahma Mitigation Site)

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

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

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

Lat.: 35.8540 Long.: -79.4106

Universal Transverse Mercator:

Name of nearest waterbody: Reedy Branch

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

☐ Office (Desk) Determination. Date:

☒ Field Determination. Date(s): 7/9/2019

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

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

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

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

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

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

- [■] Maps, plans, plots or plat submitted by or on behalf of the PJD requestor:
  Map: Figures 1, 2, 3, & 3A-3B.
- [■] Data sheets prepared/submitted by or on behalf of the PJD requestor.
  - [X] Office concurs with data sheets/delineation report.
  - [ ] Office does not concur with data sheets/delineation report. Rationale: _____.
- [ ] Data sheets prepared by the Corps: _____.
- [ ] Corps navigable waters' study: _____.
- [ ] U.S. Geological Survey Hydrologic Atlas: _____.
  - [ ] USGS NHD data.
  - [ ] USGS 8 and 12 digit HUC maps.
- [■] U.S. Geological Survey map(s). Cite scale & quad name: 1:30,000 Cruchfield Crossroads & Snow Camp.
- [■] Natural Resources Conservation Service Soil Survey. Citation: Alamance County 1960.
- [ ] National wetlands inventory map(s). Cite name: _____.
- [ ] State/local wetland inventory map(s): _____.
- [ ] FEMA/FIRM maps: _____.
- [ ] 100-year Floodplain Elevation is: _____.(National Geodetic Vertical Datum of 1929)
- [■] Photographs: [■] Aerial (Name & Date): NC One Map 2014 Orthoimagery.
  or [ ] Other (Name & Date): _____.
- [ ] Previous determination(s). File no. and date of response letter: _____.
- [X] Other information (please specify): LiDAR (NC Floodmaps).

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

Date: 2019.12.12 16:08:26 -05'00'

Signature and date of Regulatory staff member completing PJD

W. Grant Lewis Digitally signed by W. Grant Lewis DN: cn=W. Grant Lewis, o=Axiom Environmental, Inc., ou, email=wglewis@axiomenvironmental.org, c=US Date: 2017.12.14 09:24:59 -05'00'

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

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

Brahma Stream & Wetland Mitigation Site

Summary of Aquatic Resources which "May Be" Subject to Regulatory Jurisdiction

Site Name	Latitude	Longitude	Estimated amount of aquatic resource in review area	Type of aquatic resources	Geographic authority to which the aquatic resource "may be"
GA/B	35.8535920	-79.4102680	2.099 ac	Wetland	Section 404
GC	35.8526340	-79.4087471	0.380 ac	Wetland	Section 404
GD	35.8518178	-79.4081920	0.162 ac	Wetland	Section 404
GE	35.8520647	-79.4085831	0.044 ac	Wetland	Section 404
GF	35.8524177	-79.4087237	0.044 ac	Wetland	Section 404
GG	35.8527315	-79.4103753	0.183 ac	Wetland	Section 404
GH	35.8521763	-79.4107963	0.123 ac	Wetland	Section 404
GI	35.8511576	-79.4119755	0.324 ac	Wetland	Section 404
GJ	35.8503974	-79.4116223	0.311 ac	Wetland	Section 404
GK	35.8535741	-79.4109917	0.065 ac	Wetland	Section 404
GL	35.8546646	-79.4112380	0.009 ac	Wetland	Section 404
GM	35.8559300	-79.4112612	0.032 ac	Wetland	Section 404
GN	35.8562315	-79.4114487	0.009 ac	Wetland	Section 404
GO	35.8571812	-79.4111174	0.024 ac	Wetland	Section 404
GP	35.8572290	-79.4101920	0.065 ac	Wetland	Section 404
GQ	35.8570276	-79.4093917	0.068 ac	Wetland	Section 404
GR	35.8574080	-79.4102480	0.044 ac	Wetland	Section 404
PA	35.8573492	-79.4122657	0.004 ac	Wetland	Section 404
PB	35.8579882	-79.4126731	0.115 ac	Wetland	Section 404
PC	35.8582765	-79.4132617	0.036 ac	Wetland	Section 404
PD	35.8584168	-79.4138930	0.004 ac	Wetland	Section 404
PE	35.8589691	-79.4142908	0.220 ac	Wetland	Section 404
PF	35.8583735	-79.4144606	0.313 ac	Wetland	Section 404
PG	35.8581309	-79.4135197	0.133 ac	Wetland	Section 404
PH	35.8577860	-79.4129722	0.079 ac	Wetland	Section 404
PI	35.8571880	-79.4120658	0.003 ac	Wetland	Section 404
PJ	35.8572599	-79.4123801	0.007 ac	Wetland	Section 404
PK	35.8574438	-79.4123959	0.003 ac	Wetland	Section 404
KA	35.8573465	-79.4120539	0.013 ac	Wetland	Section 404
KB	35.8566979	-79.4116161	0.006 ac	Wetland	Section 404
KC	35.8562022	-79.4116877	0.010 ac	Wetland	Section 404
KD	35.8560409	-79.4116632	0.022 ac	Wetland	Section 404
KE	35.8561247	-79.4114833	0.008 ac	Wetland	Section 404
KF	35.8555428	-79.4117270	0.142 ac	Wetland	Section 404
KG	35.8551877	-79.4116236	0.004 ac	Wetland	Section 404
KH	35.8500732	-79.4107677	0.056 ac	Wetland	Section 404
KI	35.8503960	-79.4112408	0.207 ac	Wetland	Section 404
UT1	35.8549995	-79.4116627	4666.2 lf	Non-wetland	Section 404
UT2	35.8516171	-79.4116337	1306.9 lf	Non-wetland	Section 404
UT2A	35.8500259	-79.4109798	35.0 lf	Non-wetland	Section 404
UT3	35.8553031	-79.4112591	152.9 lf	Non-wetland	Section 404
UT5	35.8575670	-79.4109067	618.0 lf	Non-wetland	Section 404
UT6	35.8573491	-79.4108761	109.7 lf	Non-wetland	Section 404
UT7	35.8548830	-79.4117365	44.9 lf	Non-wetland	Section 404
Reedy Branch	35.8587557	-79.4147211	220.5 lf	Non-wetland	Section 404
Open Water	35.857267	-79.409727	0.294 ac	Non-wetland	Section 404

Appendix E
Categorical Exclusion Document

MEMORANDUM
March 14, 2019

RE: Brahma Stream & Wetland Mitigation Site
Post - IRT Site Visit Notes
Contract No. 7743 / RFP # 16-007571 / DMS Project ID: 100092

Attendees:

USACE – Todd Tugwell, Kim Browning
NCDMS – Lindsay Crocker, Jeff Schaffer
DWR – Mac Haupt
NCWRC – Olivia Munzer
Restoration Systems (RS) –Worth Creech
Axiom Environmental (Axiom) – Grant Lewis

On February 26, 2019, a site visit was conducted with members of the NC Inter-agency Review Team (IRT) to review and discuss the merits of the proposed Brahma Mitigation Site (Site). The ~20.6-acre Site includes six Unnamed Tributaries (UTs) to Reedy Branch and is located at longitude 35.8540, -79.4106. The IRT reviewed approximately 7160 linear feet of degraded stream channel and multiple degraded/drained wetland areas. Provided below is a list of comments discussed during the walkthrough.

Overall, IRT members agreed with the mitigation approach proposed in the Technical Proposal with minor alterations as discussed below. Stream reaches, credit ratios, and wetland restoration/enhancement areas were generally approved in the field as depicted on attached mapping.

1) **Wetlands**: Overall, general wetland areas rehabilitation and reestablishment areas were agreed upon, with the expectation that there will be larger areas of wetlands than are currently depicted in the Technical Proposal. The IRT agreed that a Jurisdictional Determination will be completed at the Site that will outline the final areas and extent of wetlands for the Detailed Mitigation Plan. In addition, wetland gauges will be required to be installed to verify wetland reestablishment areas, specifically adjacent to UT 3.

2) **Stream Flow Gauges**: Several of the UTs have small drainage areas and will require flow gauges to determine the number of consecutive days of flow. These reaches will also need to exhibit stream characteristics outlined in current stream mitigation guidelines (2016).

3) **UT 4**: UT 4 currently discharges at a spring head and exhibits a dendritic flow pattern down a narrow valley. IRT members agreed that this stream should be treated as a headwater system and stream credit should be calculated down valley as Enhancement (Level II).

4) **Crossings:** There was a discussion about limiting the number of crossings on the Site. Every effort will be made to reduce crossings through discussions with the landowner prior to the Mitigation Plan development.

5) **Expired EQIP Agreement:** The prior landowner, John C. Allen and his tenant farmer (participant Chris McPherson) were enrolled in an EQIP program contract that paid for fencing and cattle drinkers at various locations on the Site parcel. The signed agreement between the past Participant, Christopher W McPherson and the Resources Conservation Service expired on 9/30/2014. The expired Agreement will be in the Draft Mitigation Plan.

6) **Nutrient Management:** Three chicken laying houses are scheduled to be constructed on the landowner's parcel outside of the proposed Site conservation easement. The use of appropriate setbacks for the houses and waste management from the houses will be detailed in the Mitigation Plan as a reference for RS, DMS, the IRT, and the landowner. In addition, any drainages downstream of the houses will receive a marsh treatment area before entering the Site's streams or wetlands.

7) **UT 5:** DWR requests that the project designer explore adding benching along UT 5 while formulating the mitigation plan.

8) **Design Sheet Layout:** DWR requests that design sheets will be formatted with the plan view and the profile view on the same page. The scale is requested to be scaled in order to accommodate showing bedform (elevations) changes. This request is due to the E1 being proposed, involves filling the existing channel.

Thank you,

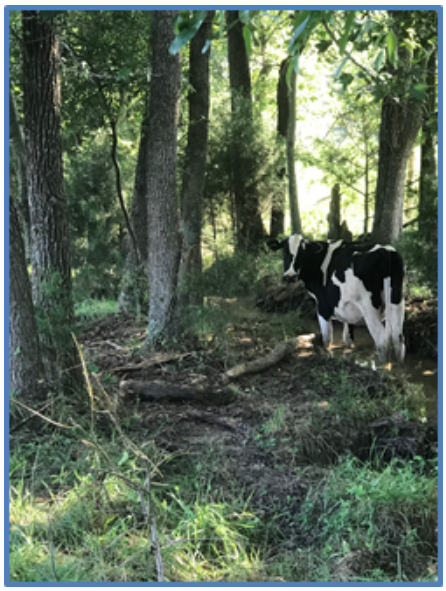
Worth Creech
Restoration Systems

Brahma Stream and Wetland Mitigation Site

Alamance County, North Carolina

DMS Project No. 100092

Categorical Exclusion/ERTR



Prepared for:

North Carolina Department of Environmental Quality

Division of Mitigation Services

1652 Mail Service Center

Raleigh, NC 27699-1652

Feb 2019

TASK 1 b.) Categorical Exclusion Summary:

Part 1: General Project Information

(Attached) Part 2: All Projects

Regulation/Questions

Coastal Zone Management Act
Not applicable – project is not located within a CAMA county.

CERCLA
No Issue – please see the attached Executive Summary from a Limited Phase 1 Site Assessment performed by Environmental Data Resources, Inc. on Feb. 20th 2019.

National Historic Preservation Act (Section 106)
No Issue – please see attached letter from Ramona M. Bartos- State of the Historic Preservation Office dated Feb. 22nd, 2019

Uniform Act
Please see the attached letter, sent to the landowner on Feb. 8th 2019.

Part 3: Ground-Disturbing Activates Regulation/Questions

American Indian Religious Freedom Act (AIRFA)
Not applicable – project is not located in a county claimed as "territory" by the Eastern Band of Cherokee Indians.

Antiquities Act (AA)
Not applicable – project is not located on Federal land.

Archaeological Resources Protection Act (ARPA)
Not applicable – project is not located on federal or Indian lands.

Endangered Species Act (ESA)
There is one (Cape Fear Shiner) known federally protected species occurring in Alamance County, NC and our summary is of NO anticipated effects due to the project. A biological conclusion letter was sent to USFWS Raleigh Field Office on Feb 8th, 2019 and they had no comments documented via email exchange. The NCWRC also determind that it is unlikely that stream and wetland mitigation will adversely affect any federal or state-listed species. Their recommendations will be followed during the contructions of the site.

Executive Order 13007 (Indian Sacred Sites)

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

Farmland Protection Policy Act (FPPA)

Please find the attached Form AD-1006 dated Feb 7th, 2019 and letter from Milton Cortes of the NRCS.

Fish and Wildlife Coordination Act (FWCA)

Please find the attached letter to the USFWS. A biological survey indicated the project is to have "NO affect any federally-listed endangered or threatened species."

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

Not applicable

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

Not applicable – project is not located within an estuarine system

Migratory Bird Treaty Act (MBTA)

USFWS has no recommendation with the project relative to the MBTA

Wilderness Act

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

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Part 1: General Project Information	
Project Name:	Brahma Stream and Wetland Mitigation Site
County Name:	Alamance County, NC
EEP Number:	Contract # 7743
Project Sponsor:	Restoration Systems, LLC
Project Contact Name:	Worth Creech
Project Contact Address:	1101 Haynes Street, Suite 207, Raleigh, NC 27607
Project Contact E-mail:	worth@restorationsystems.com
EEP Project Manager:	Lindsey Crocker lindsay.crocker@ncdenr.gov

Project Description

Project site land use consists of disturbed forest and livestock pasture. The proposed conservation easement area contains approximately 20.6 acres. Existing Site streams have been impounded, cleared, trampled by livestock, eroded vertically and laterally before the site hydrology drains to warm, unnamed tributaries to Reedy Branch. The site will restore, enhance, and preserve 7,094 linear feet of stream and 3.4 acres of wetlands by returning the natural hydrology back into its historic locations. Riparian buffers will also be replanted in native woody vegitation up to a minimum of fifty feet from the top of stream banks.

For Official Use Only

Reviewed By:

4/8/2019 — Date

LHCrocker — EEP Project Manager

Conditional Approved By:

Date — For Division Administrator FHWA

☐ Check this box if there are outstanding issues

Final Approval By:

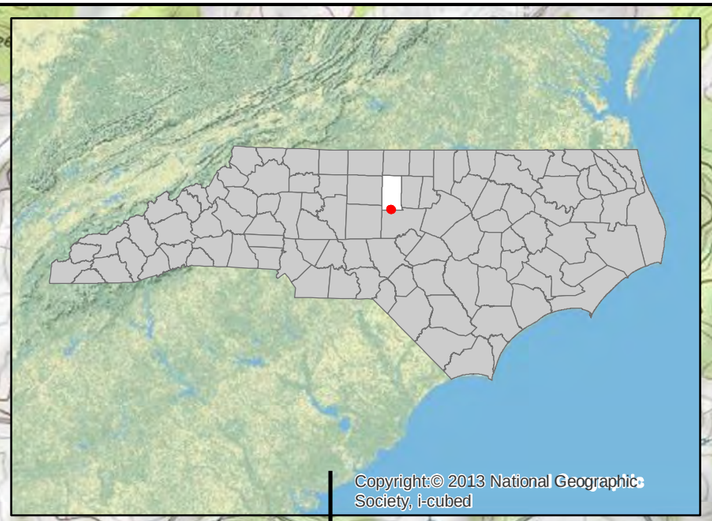
4-8-19 — Date

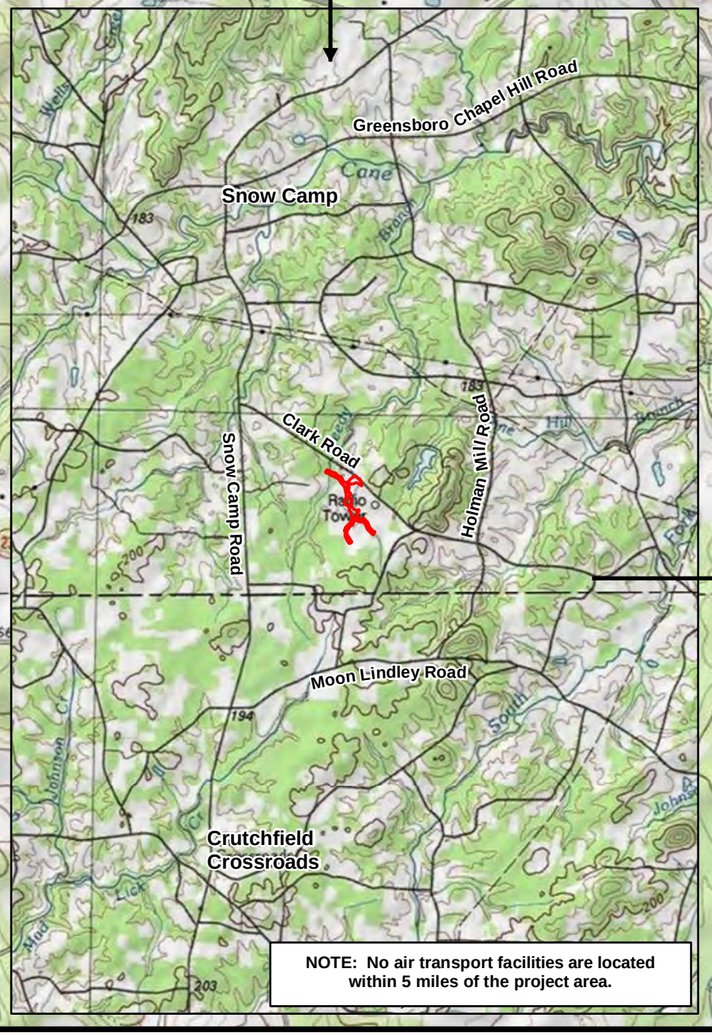
For Division Administrator FHWA

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

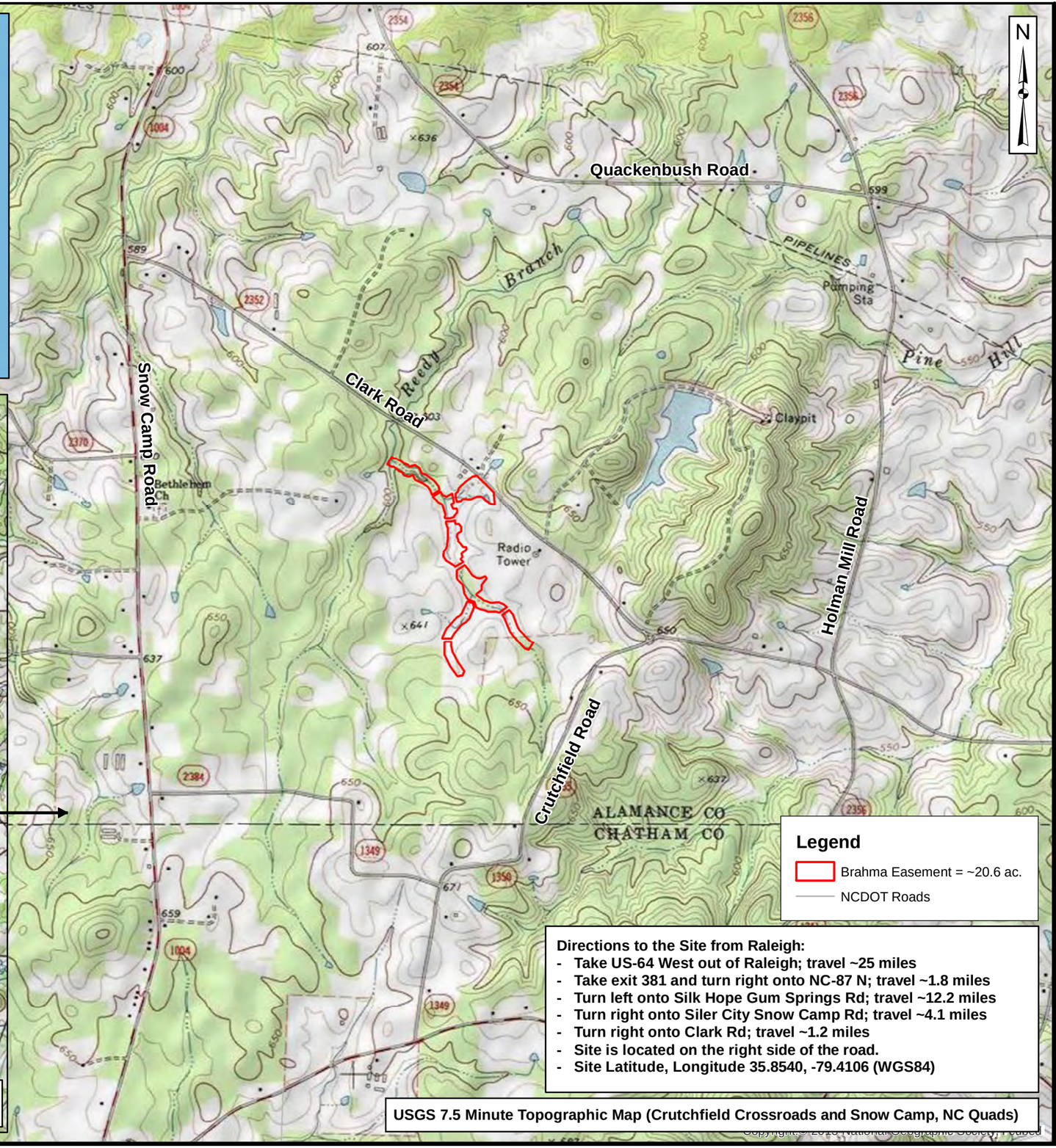
Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A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

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





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



Legend

- Brahma Easement = ~20.6 ac.
- NCDOT Roads

Directions to the Site from Raleigh:

- **Take US-64 West out of Raleigh; travel ~25 miles**
- **Take exit 381 and turn right onto NC-87 N; travel ~1.8 miles**
- **Turn left onto Silk Hope Gum Springs Rd; travel ~12.2 miles**
- **Turn right onto Siler City Snow Camp Rd; travel ~4.1 miles**
- **Turn right onto Clark Rd; travel ~1.2 miles**
- **Site is located on the right side of the road.**
- **Site Latitude, Longitude 35.8540, -79.4106 (WGS84)**

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

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

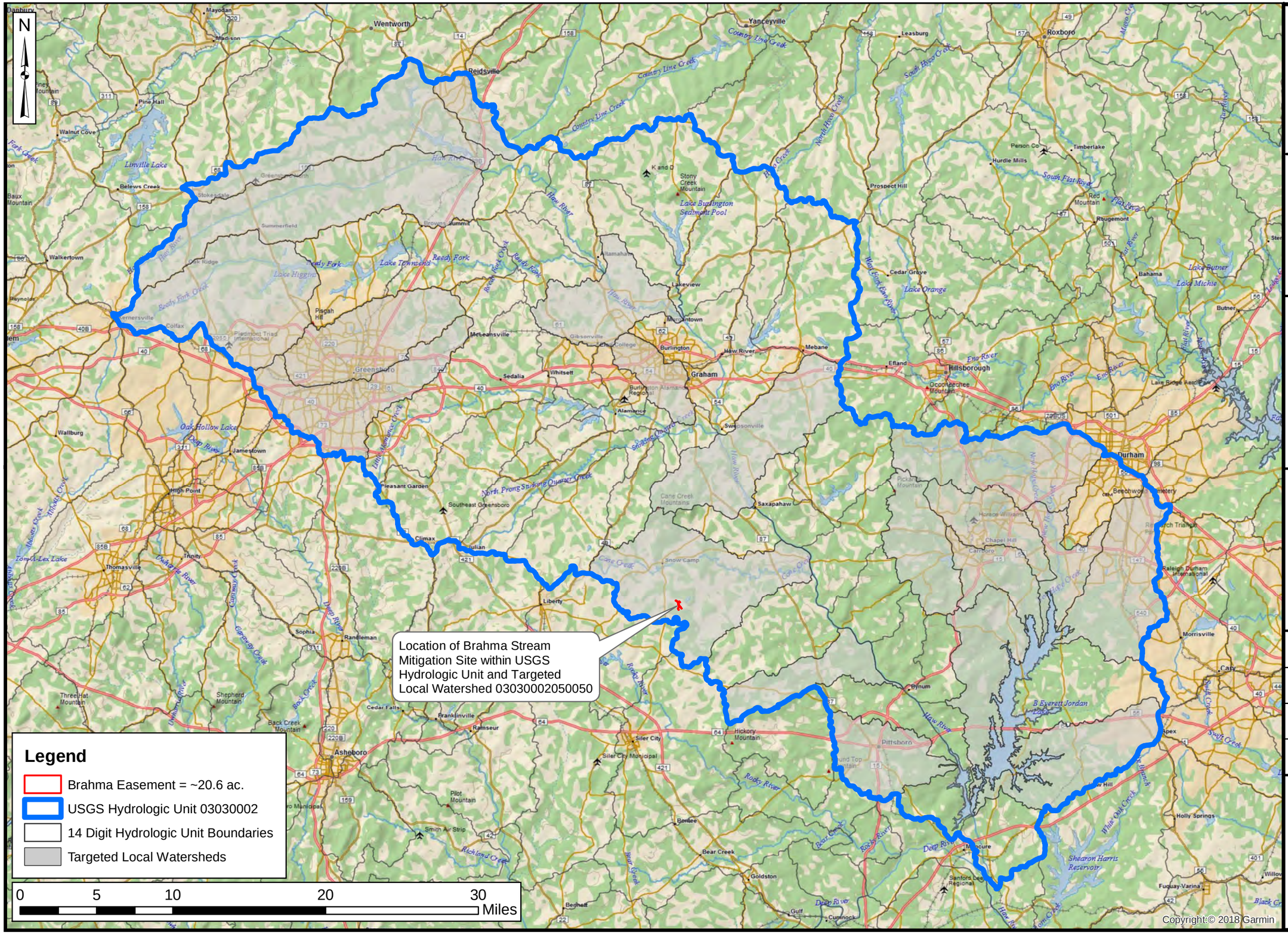
Title:

SITE LOCATION

Drawn by:	KRJ
Date:	JUL 2018
Scale:	1:20,000
Project No.:	18-002

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

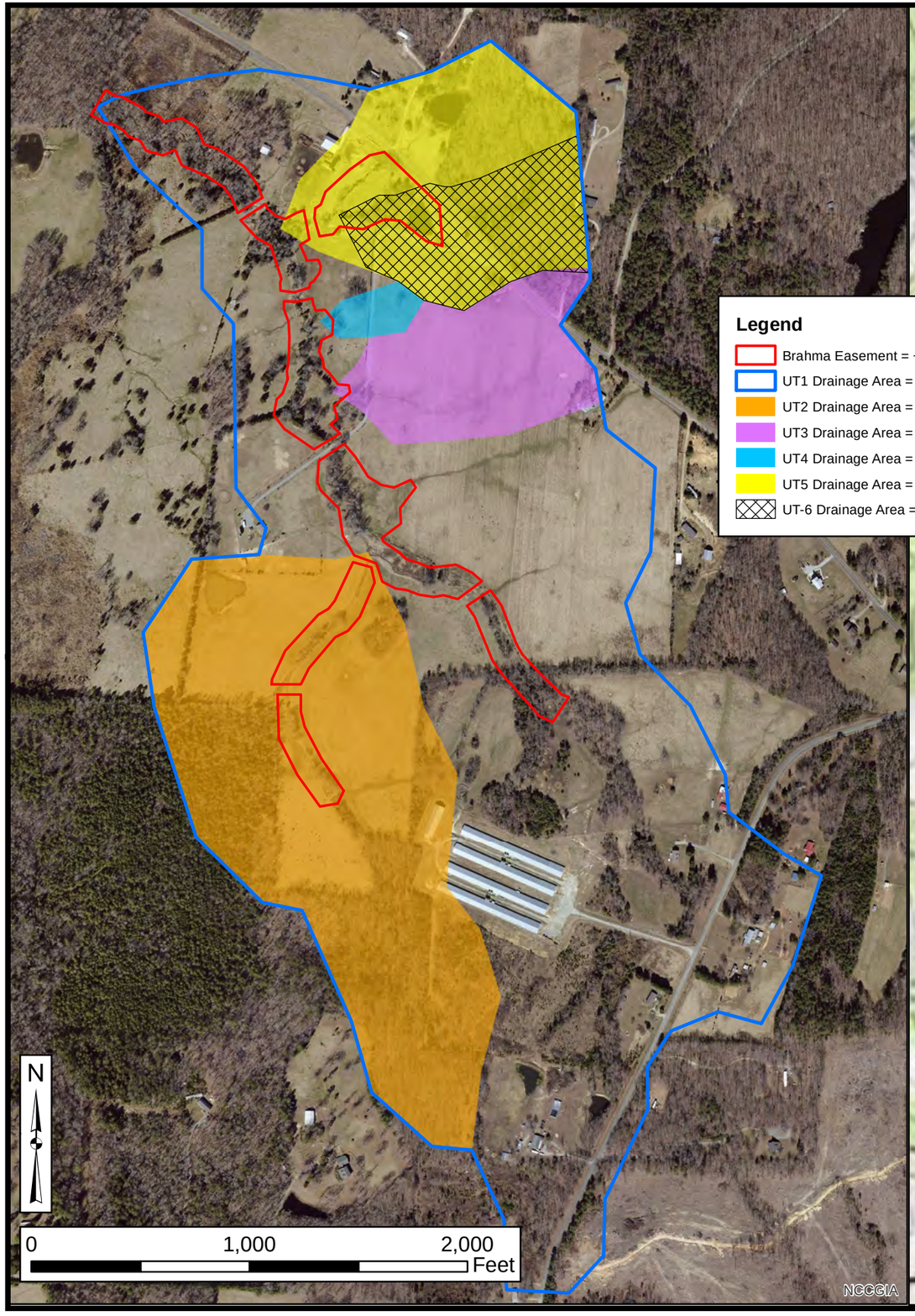
Title:

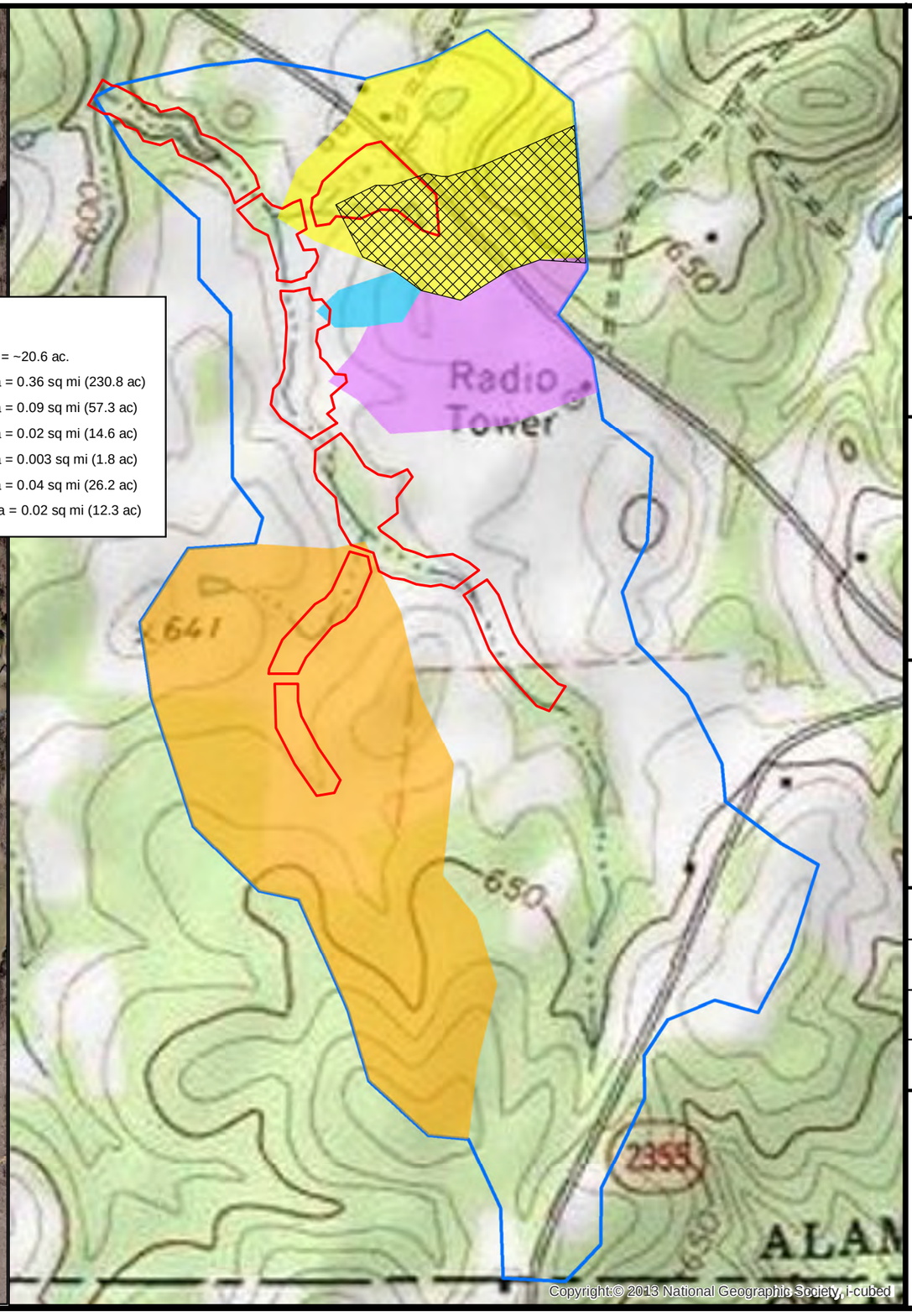
HYDROLOGIC UNIT MAP

Drawn by:	KRJ
Date:	JUL 2018
Scale:	1:375,000
Project No.:	18-002

FIGURE

2





Legend

- Brahma Easement = ~20.6 ac.
- UT1 Drainage Area = 0.36 sq mi (230.8 ac)
- UT2 Drainage Area = 0.09 sq mi (57.3 ac)
- UT3 Drainage Area = 0.02 sq mi (14.6 ac)
- UT4 Drainage Area = 0.003 sq mi (1.8 ac)
- UT5 Drainage Area = 0.04 sq mi (26.2 ac)
- UT-6 Drainage Area = 0.02 sq mi (12.3 ac)

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ

Date: JUL 2018

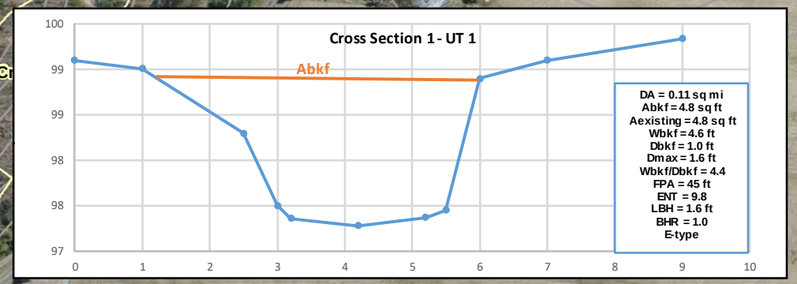
Scale: 1:7.000

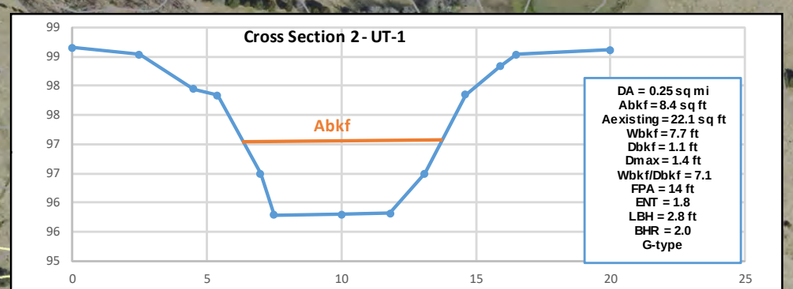
Project No.: 18-002

FIGURE

3

Soil Map Unit	Soil Series
ChA	Chewacla Loam
CnB2, CnC2	Cullen Clay Loam
HnC	Herndon Silt Loam
MaB, MaC	Mandale-Secrest Complex





XS-1
NC SAM Form 2
Score: LOW
UT-1
NC WAM Form GA
Score: LOW
XS-2
NC SAM Form 1
Score: LOW
NC SAM Form 3
Score: LOW
NC WAM Form GC
Score: LOW
Clark Road
UT-6
UT-5
UT-4
UT-3
UT-2
W
HrB2
MaC
CnB2
CnC2
CnD2
MaB
HrC2
ChA
HnB
HnC

Legend
- Brahma Easement = 20.6 ac
- Existing Streams = 7160 ft
- Existing Wetlands = 1.45 ac
- Drained Hydric Soils = 1.95 ac
- Cross Sections
- NC WAM Form Locations
- NC SAM Form Locations
- Soil Boring Location
- NRCS Soil Boundaries

0 250 500 1,000 1,500 Feet

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

EXISTING CONDITIONS AND SOILS

Drawn by: KRJ

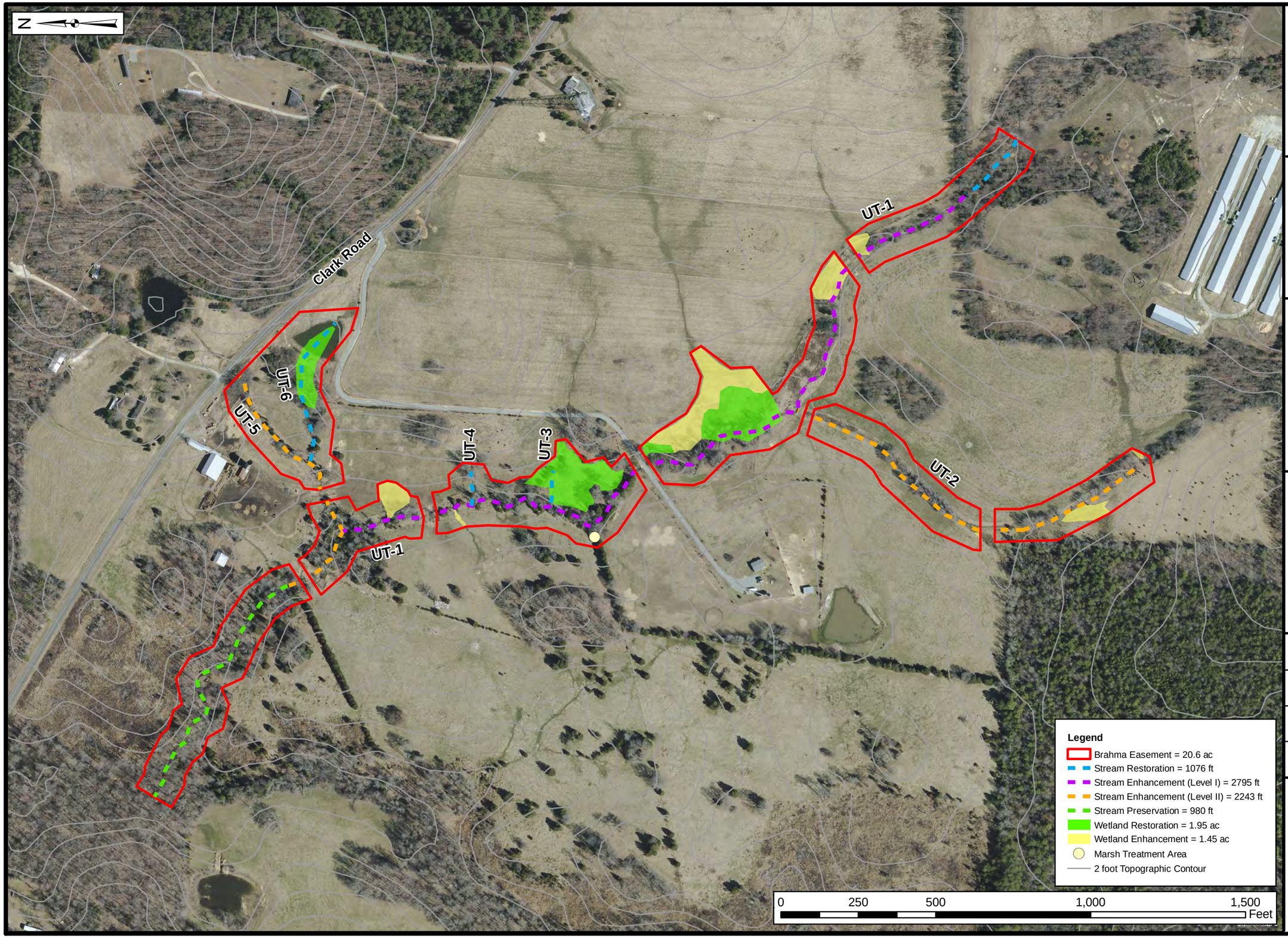
Date: AUG 2018

Scale: 1:3500

Project No.: 18-002

FIGURE

4



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

PROPOSED CONDITIONS

Drawn by: KRJ

Date: AUG 2018

Scale: 1:3500

Project No.: 18-002

FIGURE

5

February 7th, 2019

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

Re: Brahma Stream and Wetland Mitigation Project, Alamance County, NC

Dear Renee,

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

Project Name:	Brahma Stream and Wetland Mitigation Project
Project Location:	Site Latitude, Longitude 35.8540, -79.4106 (WGS84)
Project Contact:	JD Hamby, Restoration Systems LLC, 1101 Haynes St. Suite 211, Raleigh, NC 27604

Project Description: The project has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel and wetland impacts. Permits from the NC DWR and USACE will be obtained to restore waters of the US. Soil and erosion control permits will also be obtained. The project encompasses 30 acres of drain hydric soils, currently used for cattle pasture. Several thousand feet of stream and several acres of wetlands will be restored.

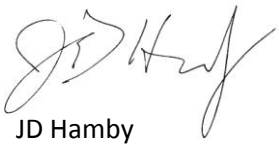
The term “cultural resources” refers to prehistoric or historic archaeological sites, structures, or artifact deposits over 50 years old. “Significant” cultural resources are those that are eligible or potentially eligible for inclusion in the National Register of Historic Places. Evaluations of site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

Field visits were conducted in Fall 2019 to conduct evaluations for presence of structures or features that may be eligible for the National Register of Historic Places. No structures were identified within the Site boundaries that may be eligible for the National Register. In addition to field reviews for historically relevant structures, a records search was conducted at the SHPO office to determine if documented occurrences of historic structures or artifacts occur within, or adjacent to the Site. The SHPO records identify no features within the Site boundaries and no features within a 1/2 mile radius of the Site.

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

Yours truly,

RESTORATION SYSTEMS, LLC



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

Attachments – USGS Map, Existing Conditions

North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

February 22, 2019

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

Re: Brahma Stream and Wetland Mitigation Project, Alamance County, ER 19-0778

Dear Mr. Hamby:

Thank you for your letter of February 7, 2019, concerning the above project.

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

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

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

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

February 7th, 2019

Olivia Munzer
Western Piedmont Coordinator
1718 NC Hwy 56 West
Creedmoor, NC
27522

Re: Brahma Stream and Wetland Mitigation Project, Alamance County, NC

Dear Ms. Munzer:

The purpose of this letter is to request concurrence from the North Carolina Wildlife Recourse Commission concerning a stream restoration project located in Alamance County for the N.C. Division of Mitigation Services. The project will restore streams and riparian wetlands in existing livestock pastures and forested areas. Please review and comment on any possible issues that might emerge with respect to the Fish and Wildlife Coordination Act from the potential stream restoration project. Attached is a USGS base map with the projects 20.6 acre footprint identified. The Site is located within Targeted Local Watershed (TLW) 03030002050050 and subbasin 03-06-04. The site sits approximately 2 miles south of Snow Camp, NC, 5 miles northeast of Silk Hope, NC, and southwest of Clark Road.

The Site is proposed to include 20.6 acres of restored stream channels, riparian buffer, and riparian wetlands. Site alterations include the cessation of cattle and poultry production within the site, restoration of wetlands, and planting native, woody vegetation within the entire 20.6-acre Site easement. Mitigation outlined in this report will result in net gains in hydrology, water quality, and habitat functions, and are designed to provide 3907 Stream Mitigation Units and 2.68 Riparian Wetland Mitigation Units.

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

Yours truly,

Restoration Systems, LLC

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

Attachments: Location and USGS Map

North Carolina Wildlife Resources Commission

Gordon Myers, Executive Director

04 March 2019

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

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

Dear Mr. Hamby,

Biologists with the North Carolina Wildlife Resource Commission (NCWRC) received your letter on 07 February 2019 requesting review and comment on any possible concerns regarding the Brahma Stream & Wetland Mitigation Site. Biologists with NCWRC have reviewed the provided documents. Comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) and North Carolina General Statutes (G.S. 113-131 et seq.).

The Brahma Stream & Mitigation Site is located at 849 Clark Road in Snow Camp, Alamance County, North Carolina. The 20.6-ac site occurs within an existing livestock pasture and forested area. The project will provide in-kind mitigation for unavoidable impacts to streams and wetlands within the Cape Fear River Basin (HUC 03030002050050). The project will restore portions of Reedy Branch and its unnamed tributaries, as well as adjacent wetlands that are currently impacted by livestock. Reedy Branch is classified as a Water Supply V and Nutrient Sensitive Water by the N.C. Division of Water Resources (NCDWR). The project will restore stream channels, riparian buffer, and riparian wetlands to provide 3,907 stream mitigation units and 2.68 riparian wetland mitigation units.

We have records for the state special concern Carolina darter (*Etheostoma collis*) and state significantly rare Carolina ladle crayfish (*Cambarus davidi*) within the vicinity of the site. The Carolina ladle crayfish is an endemic species found in the Neuse and Cape Fear drainages. The Pine Hill Xeric Woodlands Natural Heritage Natural Area, in which occurs a Dry Oak-Hickory Forest Natural Community, is located near the site. The lack of records from the site does not imply or confirm the absence of federal or state-listed species.

Based upon the information provided to NCWRC, it is unlikely that stream and wetland mitigation will adversely affect any federal or state-listed species. However, we recommend leaving snags and mature trees or if necessary, remove tees outside the maternity roosting season for bats (May 15 – August 15).

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

We recommend that riparian buffers are as wide as possible, given site constraints and landowner needs. NCWRC generally recommends a woody buffer of 100 feet on perennial streams to maximize the benefits of buffers, including bank stability, stream shading, treatment of overland runoff, and wildlife habitat. Due to the potential for state-protected species to occur downstream of the site, we request stringent sediment and erosion control measures. The use of biodegradable and wildlife-friendly sediment and erosion control devices is strongly recommended. 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 that has been reinforced with plastic or metal mesh should be avoided as it impedes 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.

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

Thank you for the opportunity to provide comments. If I can be of additional assistance, please call (919) 707-0364 or email olivia.munzer@ncwildlife.org.

Sincerely,

Olivia Munzer
Western Piedmont Habitat Conservation Coordinator
Habitat Conservation Program

February 8, 2019

Mrs. Caroline Hinshaw
717 Clark Road
Snow Camp, NC
27349

Dear Mrs. Hinshaw,

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

If you have any questions, please feel free to call me at 919-334-9122

Sincerely,

JD Hamby
Project Manager

Species determinations

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

Fishes

NAME	DETERMINATION
Cape Fear Shiner CH Notropis mekistocholas	None

Critical habitats

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636-3726

Date: 2/8/2019

Self-Certification Letter

Project Name Brahma

Dear Applicant:

Thank you for using the U.S. Fish and Wildlife Service (Service) Raleigh Ecological Services online project review process. By printing this letter in conjunction with your project review package, you are certifying that you have completed the online project review process for the project named above in accordance with all instructions provided, using the best available information to reach your conclusions. This letter, and the enclosed project review package, completes the review of your project in accordance with the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA), and the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c, 54 Stat. 250), as amended (Eagle Act). This letter also provides information for your project review under the National Environmental Policy Act of 1969 (P.L. 91-190, 42 U.S.C. 4321-4347, 83 Stat. 852), as amended. A copy of this letter and the project review package must be submitted to this office for this certification to be valid. This letter and the project review package will be maintained in our records.

The species conclusions table in the enclosed project review package summarizes your ESA and Eagle Act conclusions. Based on your analysis, mark all the determinations that apply:

- [x] "no effect" determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- [ ] "may affect, not likely to adversely affect" determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- [ ] "may affect, likely to adversely affect" determination for the Northern long-eared bat (Myotis septentrionalis) and relying on the findings of the January 5, 2016, Programmatic Biological Opinion for the Final 4(d) Rule on the Northern long-eared bat;
- [x] "no Eagle Act permit required" determinations for eagles.

We certify that use of the online project review process in strict accordance with the instructions provided as documented in the enclosed project review package results in reaching the appropriate determinations. Therefore, we concur with the "no effect" or "not likely to adversely affect" determinations for proposed and listed species and proposed and designated critical habitat; the "may affect" determination for Northern long-eared bat; and/or the "no Eagle Act permit required" determinations for eagles. Additional coordination with this office is not needed. Candidate species are not legally protected pursuant to the ESA. However, the Service encourages consideration of these species by avoiding adverse impacts to them. Please contact this office for additional coordination if your project action area contains candidate species. Should project plans change or if additional information on the distribution of proposed or listed species, proposed or designated critical habitat, or bald eagles becomes available, this determination may be reconsidered. This certification letter is valid for 1 year. Information about the online project review process including instructions, species information, and other information regarding project reviews within North Carolina is available at our website http://www.fws.gov/raleigh/pp.html. If you have any questions, you can write to us at Raleigh@fws.gov or please contact Leigh Mann of this office at 919-856-4520, ext. 10.

Sincerely,

/s/Pete Benjamin

Pete Benjamin
Field Supervisor
Raleigh Ecological Services

Enclosures - project review package

Species Conclusions Table

Project Name: Brahma #100092

Date: 2/8/2019

Species / Resource Name	Conclusion	ESA Section 7 / Eagle Act Determination	Notes / Documentation
Cape Fear shiner (Notropis mekistocholas) Endangered	No suitable habitat	No Effect	*See memo prepared by Three Oaks Engineering

BRAMHA MITIGATION SITE

1.0 NOTROPIS MEKISTOCHOLAS (CAPE FEAR SHINER)

1.1 Characteristics

The Cape Fear Shiner is a small, moderately stocky Cyprinid described by Snelson (1971). The fish's body is flushed pale silvery yellow, with a black band running along the side. The fins are yellowish and somewhat pointed. The upper lip is black, and the lower lip bears a thin black bar along its margin.

The Cape Fear Shiner is distinguished from all other *Notropis* by having an elongated alimentary tract with two convolutions crossing the intestinal bulb. This is believed to be an adaptation for herbivorous feeding, although the species is known to be omnivorous based on gut content analysis (Snelson 1971, USFWS 1988). This adaptation is believed to be useful in that when insectivorous fish populations are high and animal material is correspondingly low, the Cape Fear Shiner is able to thrive by shifting to herbivorous feeding habits (USFWS 2011).

The Cape Fear Shiner is usually found in low numbers in schools with other shiner species such as Highfin Shiner (*Notropis altipinnis*), Swallowtail Shiner (*Notropis procne*), White Shiner (*Luxilus albeolus*), Sandbar Shiner (*Notropis scepticus*), Spottail Shiner (*Notropis hudsonius*), Comely Shiner (*Notropis amoenus*), Satinfin Shiner (*Cyprinella analostana*), and Whitefin Shiner (*Cyprinella nivea*) (Pottern 2009).

1.2 Distribution and Habitat Requirements

The Cape Fear Shiner is most often found in rocky pools, runs, and riffles with substrates containing gravel, cobble, and/or boulder components. These areas are typical of streams in the Carolina Slatebelt and Raleigh Belt with wide, shallow sections, an open forest canopy, and abundant American water willow (*Justicia americana*), riverweed (*Podostemum* sp.), stream mosses (*Fontinalis* sp.), and filamentous algae. The species may be found in lower-gradient sections of rivers with sand dominated substrate, but usually only in low numbers, presumably as they move between more rocky sections (Pottern 2009). Gravel substrate has been shown to be important for Cape Fear Shiner in feeding and spawning (USFWS 2011). In comparing shiner density with substrate type, Howard (2003) found low shiner density in areas with less gravel availability.

Endemic to the upper Cape Fear River Basin in the Central Piedmont region of North Carolina, Cape Fear Shiner occupies the tributaries and mainstems of the Cape Fear, Deep, Haw and Rocky Rivers in Chatham, Harnett, Lee, Moore, and Randolph counties. Specifically, the current known range extends from SR 1545 (Chicken Bridge Rd) of the Haw River in Chatham County and from Coleridge Dam on the Deep River in Randolph County downstream to Erwin on the mainstem Cape Fear River. Including major tributaries such as the Rocky River, this is a range of approximately 135 RM (Pottern 2009). The lower five miles of the Rocky River and the Deep River between High Falls and Coleridge area known to have the highest densities of

the minnow. The species is known to occupy tributaries to these mainstem rivers but is typically only found within two miles of the confluence (Pottern 2009).

1.0 BIOLOGICAL CONCLUSION

The streams within the project area are relatively low-flow headwater streams that have too small and with too little flow to provide habitat for the Cape Fear Shiner. Given the 25-river mile distance of the project from the known range of the Cape Fear Shiner (Figure 1), the lack of habitat within the project site, and the nature of the proposed activities, it is expected that the project will have No Effect on the Cape Fear Shiner.

2.0 LITERATURE CITED

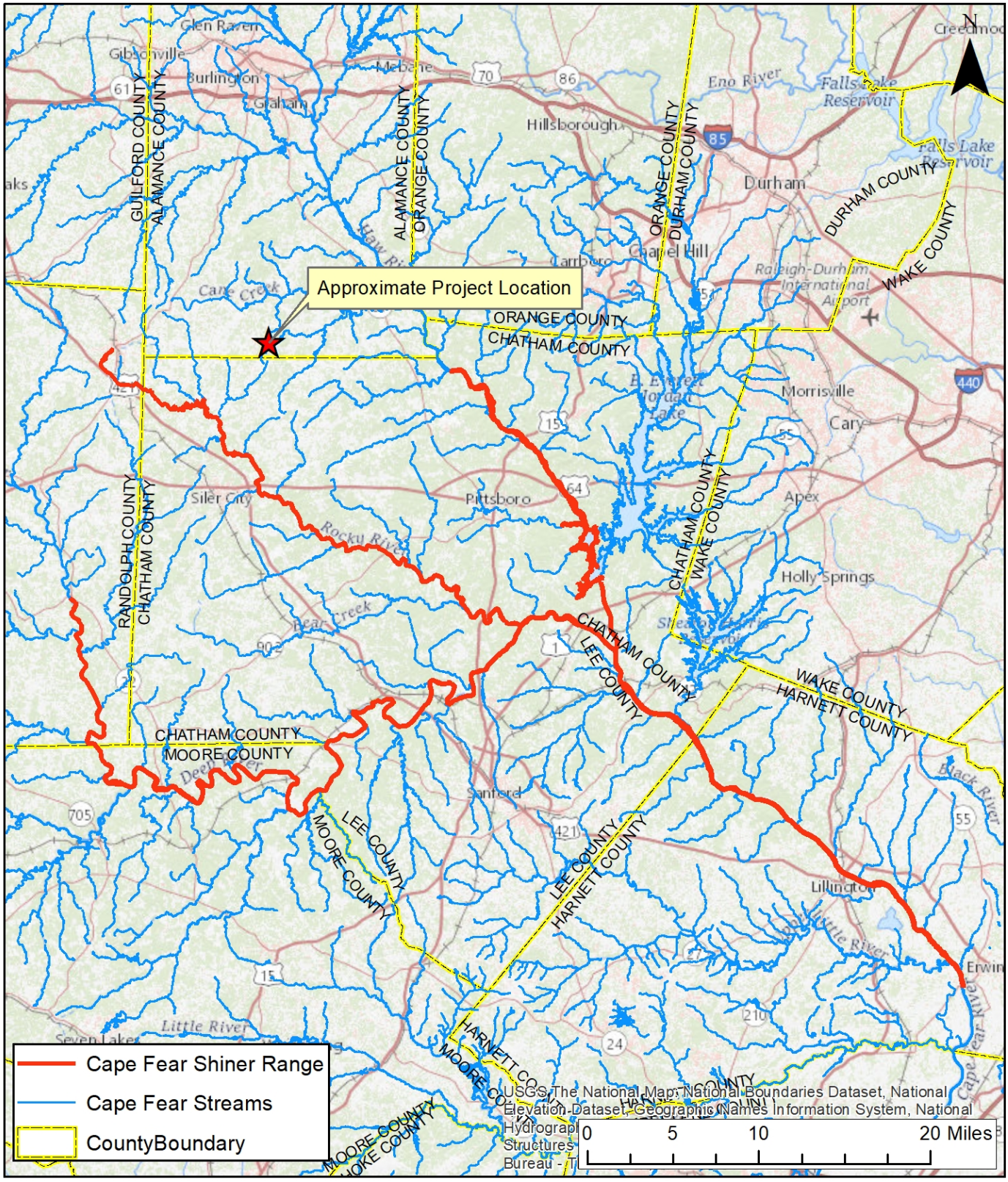
Howard, A.K. 2003. Influence of instream physical habitat and water quality on the survival and occurrence of the endangered Cape Fear shiner. M.S. Thesis. North Carolina State University, Raleigh, NC. 133 pp.

Pottern, G.B. 2009. 2007 Status update of the Cape Fear shiner *Notropis mekistocholas.* Report to the North Carolina Wildlife Resources Commission. 27 pp.

Snelson, F.F., Jr. 1971. *Notropis mekistocholas*, a new herbivorous cyprinid fish endemic to the Cape Fear River Basin, North Carolina. Copeia 1971(3): 449-462.

U.S. Fish and Wildlife Service (USFWS). 1988. Cape Fear Shiner Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, GA. 18 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Draft Cape Fear Shiner (*Notropis mekistocholas*) Strategic Habitat Conservation Framework, Raleigh, NC, 27 pp.



Prepared For:

Brahma Stream and Wetland Mitigation Site

Cape Fear Shiner Range

Alamance, Chatham, Harnett, Lee, Moore, and Randolph Counties, North Carolina

Date:	February 2019
Scale:	As Shown
Job No.:	None
Drawn By:	KMS
Checked By:	MW

Figure

1

United States Department of the Interior

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

In Reply Refer To:
Consultation Code: 04EN2000-2019-SLI-0295
Event Code: 04EN2000-2019-E-00707
Project Name: Brahma

February 05, 2019

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

To Whom It May Concern:

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

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

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

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

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

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

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

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

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

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

Attachment(s):

- Official Species List

Official Species List

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

This species list is provided by:

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

Project Summary

Consultation Code: 04EN2000-2019-SLI-0295

Event Code: 04EN2000-2019-E-00707

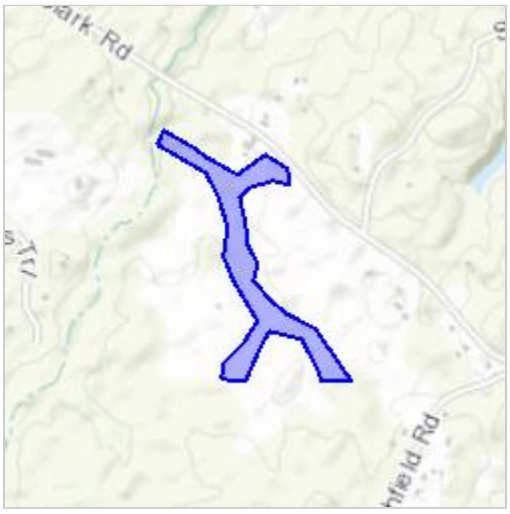
Project Name: Brahma

Project Type: LAND - RESTORATION / ENHANCEMENT

Project Description: Stream and wetland restoration project that will follow all existing guidance as to construction and planting timelines.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/35.85490477867489N79.41141727944134W



Counties: Alamance, NC

Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

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

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

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

---

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

Fishes

NAME	STATUS
Cape Fear Shiner *Notropis mekistocholas*	Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/6063

Critical habitats

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

John Hamby

From: Raleigh, FW4 <raleigh@fws.gov>
Sent: Wednesday, February 13, 2019 11:15 AM
To: John Hamby
Subject: Confirmation of Project Receipt Re: [EXTERNAL] Brahma Stream and Wetland ESA Conclusions

Thank you for submitting your online project package. We will review your package within 30 days of receipt. If you have submitted an online **project review request letter**, expect our response within 30 days. If you have submitted an online **project review certification letter**, you will typically not receive a response from us since the certification letter is our official response. However, if we have additional questions or we do not concur with your determinations, we will contact you during the review period.

John Hamby

From: leigh_mann@fws.gov on behalf of Raleigh, FW4 <raleigh@fws.gov>
Sent: Wednesday, March 13, 2019 4:08 PM
To: John Hamby
Subject: Re: Confirmation of Project Receipt Re: [EXTERNAL] Brahma Stream and Wetland ESA Conclusions

Yes, everything is fine and the biologist that reviewed your project had no comments to your self certification packet.

Respectfully,

Leigh Mann

On Wed, Mar 13, 2019 at 12:18 PM John Hamby <jhamby@restorationsystems.com> wrote:

> Good Afternoon,
>
> I am just following up on my online project package review that was sent on February 13th to see if the Service had any comments on the Brahma Stream Restoration Project.
>
> Thank you for your time,
>
> JD
>
> ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
>
> **John *"JD"* Hamby** | Project Manager
>
> 1101 Haynes St. Suite 211 | Raleigh, NC 27604
>
> tel: 919.334.9111 | cell: 919.801.4754 | fax: 919.755.9492
>
> email: jhamby@restorationsystems.com
>
> 
>

February 7th, 2019

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

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

Restoration Systems, LLC (RS), of Raleigh, NC has been awarded a contract by DMS to provide Stream and Wetland Mitigation Units at the Brahma Stream and Wetland Mitigation Site in Alamance County, North Carolina.
One of the earliest tasks to be performed by RS is completion of an environmental screening and preparation/submittal of a Categorical Exclusion (CE) document. This document is specifically required by the Federal Highway Administration (FHWA) to ensure compliance with various federal environmental laws and regulations. DMS must demonstrate that its projects comply with federal mandates as a precondition to FHWA reimbursement of compensatory mitigation costs borne by the North Carolina Department of Transportation to offset its projects' unavoidable impacts to streams and wetlands.

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

Project Location & Description

The Site is characterized by agricultural fields utilized for pastureland for cattle and forested areas. All Site hydrology drains to the south through a ditch network to Core Creek, located less than 1 mile south of the Site. The approximately 20.6-acre Site has been ditched, cleared of vegetation, and is maintained for cattle pasture. The Site is located in the Carolina Slate Belt portion of the Piedmont ecoregion of North Carolina. Regional physiography is characterized by dissected, irregular plains with moderate to steep slopes and low to moderate gradient streams over boulder and cobble-dominated substrate (Griffith et al. 2002). Onsite elevations range from a high of 645 feet National Geodetic Vertical Datum (NGVD) at the upper reaches to a low of approximately 600 feet NGVD at the Site outfall (USGS Crutchfield Crossroads, North Carolina 7.5- minute topographic quadrangle)

Restoration Means & Methods

The Site is located within **Targeted Local Watershed (TLW) 03030002050050** and subbasin 03-06-04. According to the *Cape Fear River Basinwide Water Quality Plan* (NCDWQ 2005), all land uses and discharges of wastewater and storm water in 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 include areas with water quality problems associated with excessive plant

growth resulting from nutrient enrichment. The proposed mitigation activities will reduce sediment and nutrient levels, and improve water quality within the Site and downstream watersheds.

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.

Reduce and control sediment inputs (sediment model [Section 1.2.3] – reduction of 8.0 tons/year after mitigation is complete);
Reduce and manage nutrient inputs (nutrient model [Section 1.2.4]- livestock removal from streams will result in a direct reduction of 1051.4 lbs/yr of nitrogen, 87.1 lbs/yr of phosphorus, and 11.2 x 10^{11} col of fecal coliform/day; elimination of fertilizer application; and installation of one marsh treatment area); and
Protect and augment designated natural heritage areas (NA).

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.

Bare-root seedlings will be planted at a density of approximately 680 stems per acre on 8-foot centers. Planting will be performed between November 15 and March 15 to allow plants to stabilize during the dormant period and set root during the spring season. Potential species planted within the Site may include the following.

Should you have any questions or if any additional information is needed to complete the form, please feel free to contact me at the office 919.334.9111. If we do not hear from you within 30 days, we will assume you have no comments on the project. Your valuable time and cooperation are much appreciated.

Yours truly,

JD Hamby
Project Manager -RESTORATION SYSTEMS, LLC
jhamby@restorationsytems.com
919-334-9111

Attachments-
Location, Soil, and Condition Maps
AD-1006 Form

John Hamby

From: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>
Sent: Wednesday, February 27, 2019 2:30 PM
To: John Hamby
Subject: RE: Brahma Stream and Wetland Mitigation Site
Attachments: AD1006_Brahma_Stream_&_Wetland_Mitigation.pdf; MAP_Brahma_Stream_&_Wetland_Mitigation.pdf

Importance: High

Follow Up Flag: Follow up
Flag Status: Completed

John:

Please find attached the Farmland Conversion Impact Rating evaluation for the Brahma Stream and Wetland Mitigation Site.

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

Best Regards;

Milton Cortes
Acting State Soil Scientist
USDA NRCS
4407 Bland Rd, Suite 117
Raleigh. NC 27549
Voice: 919-873-2171
milton.cortes@usda.gov

From: John Hamby <jhamby@restorationsystems.com>
Sent: Tuesday, February 26, 2019 10:27 AM
To: Cortes, Milton - NRCS, Raleigh, NC <Milton.Cortes@nc.usda.gov>
Subject: RE: Brahma Stream and Wetland Mitigation Site

Milton,

Attached you will find the files needed to complete your analysis.

Thank you for your help,

JD

John *"JD"* Hamby | Project Manager
1101 Haynes St. Suite 211 | Raleigh, NC 27604
tel: 919.334.9111 | cell: 919.801.4754 | fax: 919.755.9492
email: jhamby@restorationsystems.com

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*		Date Of Land Evaluation Request February 26, 2019	
Name of Project Brahma Stream and Wetland Mitigation Site		Federal Agency Involved FHWA	
Proposed Land Use Wetland Mitigation		County and State Alamance County. North Carolina	
PART II *(To be completed by NRCS)*		Date Request Received By NRCS February 26, 2019	Person Completing Form: Milton Cortes, NRCS, NC
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 86.4%	Amount of Farmland As Defined in FPPA Acres: 179,301 acres 64.4 %	
Name of Land Evaluation System Used Alamance County, NC LESA	Name of State or Local Site Assessment System N/A	Date Land Evaluation Returned by NRCS February 27, 2019 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	20.49			
B. Total Acres To Be Converted Indirectly	-			
C. Total Acres In Site	20.49			
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0.80			
B. Total Acres Statewide Important or Local Important Farmland	19.60			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted	0.0114			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value	45.4			
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points)	64			

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)*	**Maximum Points**	Site A	Site B	Site C	Site D
1. Area In Non-urban Use	(15)	15			
2. Perimeter In Non-urban Use	(10)	10			
3. Percent Of Site Being Farmed	(20)	19			
4. Protection Provided By State and Local Government	(20)	0			
5. Distance From Urban Built-up Area	(15)	15			
6. Distance To Urban Support Services	(15)	10			
7. Size Of Present Farm Unit Compared To Average	(10)	6			
8. Creation Of Non-farmable Farmland	(10)	0			
9. Availability Of Farm Support Services	(5)	4			
10. On-Farm Investments	(20)	10			
11. Effects Of Conversion On Farm Support Services	(10)	0			
12. Compatibility With Existing Agricultural Use	(10)	1			
TOTAL SITE ASSESSMENT POINTS	160	90	0	0	0
PART VII ***(To be completed by Federal Agency)***					
Relative Value Of Farmland *(From Part V)*	100	64	0	0	0
Total Site Assessment *(From Part VI above or local site assessment)*	160	90	0	0	0
TOTAL POINTS ***(Total of above 2 lines)***	260	154	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? YES ☐ NO ☐

Reason For Selection:

Name of Federal agency representative completing this form:	Date:

(See Instructions on reverse side) **Form AD-1006 (03-02)**

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 - Federal agencies (or Federally funded projects) 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. For Corridor type projects, the Federal agency shall use form NRCS-CPA-106 in place of form AD-1006. The Land Evaluation and Site Assessment (LESA) process may also be accessed by visiting the FPPA website, http://fppa.nrcs.usda.gov/lesa/.

Step 2 - Originator (Federal Agency) will send one original copy of the form together with appropriate scaled maps indicating location(s)of project site(s), to the Natural Resources Conservation Service (NRCS) local Field Office or USDA Service Center and retain a copy for their files. (NRCS has offices in most counties in the U.S. The USDA Office Information Locator may be found at http://offices.usda.gov/scripts/ndISAPI.dll/oip_public/USA_map**,** or the offices can usually be found in the Phone Book under U.S. Government, Department of Agriculture. A list of field offices is available from the NRCS State Conservationist and State Office in each State.)

Step 3 - NRCS will, within 10 working days after receipt of the completed form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland. (When a site visit or land evaluation system design is needed, NRCS will respond within 30 working days.

Step 4 - For sites where farmland covered by the FPPA will be converted by the proposed project, NRCS will complete Parts II, IV and V of the form.

Step 5 - NRCS will return the original copy of the form to the Federal agency involved in the project, and retain a file copy for NRCS records.

Step 6 - The Federal agency involved in the proposed project will complete Parts VI and VII of the form and return the form with the final selected site to the servicing NRCS office.

Step 7 - The Federal agency providing financial or technical assistance to the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

(For Federal Agency)

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

Part III: When 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 or other major change in the ability to use the land for agriculture.
2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities planned build out capacity) that will cause a direct conversion.

Part VI: Do not complete Part VI using the standard format if a State or Local site assessment is used. With local and NRCS assistance, use the local Land Evaluation and Site Assessment (LESA).

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

2. Federal agencies may assign relative weights among the 12 site assessment criteria other than those shown on the FPPA rule after submitting individual agency FPPA policy for review and comment to NRCS. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total points at 160. For project sites where the total points equal or exceed 160, consider alternative actions, as appropriate, that could reduce adverse impacts (e.g. Alternative Sites, Modifications or Mitigation).

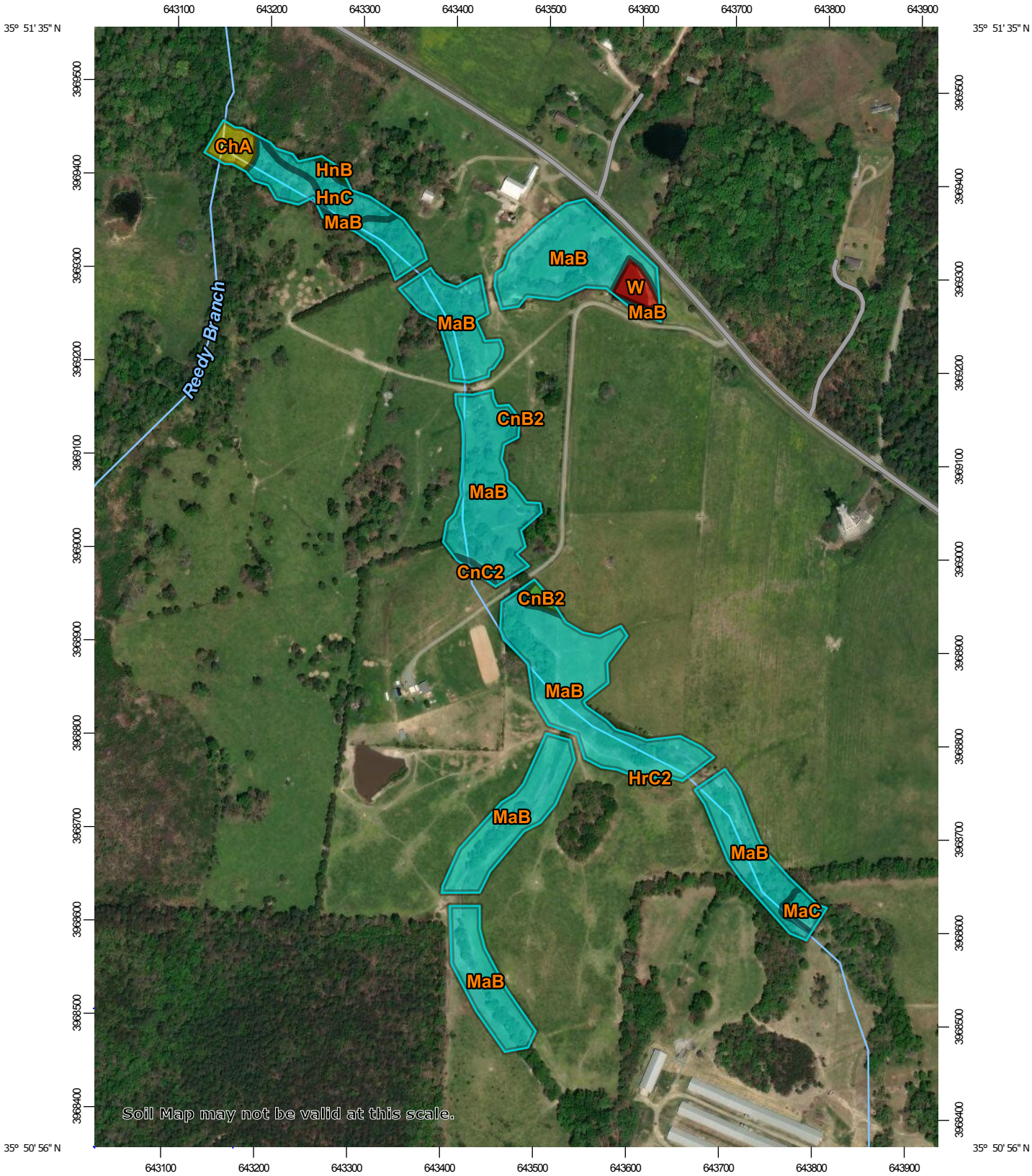
Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, convert the site assessment points to a base of 160.
Example: if the Site Assessment maximum is 200 points, and the alternative Site "A" is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

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

For assistance in completing this form or FPPA process, contact the local NRCS Field Office or USDA Service Center.

NRCS employees, consult the FPPA Manual and/or policy for additional instructions to complete the AD-1006 form.

Farmland Classification—Alamance County, North Carolina
(Brahma Stream and Wetland Mitigation Site)



Map Scale: 1:5,850 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Lines

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Points

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
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- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Water Features

MAP INFORMATION

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Alamance County, North Carolina
Survey Area Data: Version 17, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 15, 2015—Dec 9, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Farmland Classification

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ChA	Chewacla loam, 0 to 2 percent slopes, frequently flooded	Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season	0.5	2.3%
CnB2	Cullen clay loam, 2 to 6 percent slopes, moderately eroded	All areas are prime farmland	0.2	0.7%
CnC2	Cullen clay loam, 6 to 10 percent slopes, moderately eroded	Farmland of statewide importance	0.1	0.4%
HnB	Herndon silt loam, 2 to 6 percent slopes	All areas are prime farmland	0.1	0.4%
HnC	Herndon silt loam, 6 to 10 percent slopes	Farmland of statewide importance	0.8	4.0%
HrC2	Herndon clay loam, 6 to 10 percent slopes, moderately eroded	Farmland of statewide importance	0.0	0.0%
MaB	Mandale-Secrest complex, 2 to 6 percent slopes	Farmland of statewide importance	18.3	88.9%
MaC	Mandale-Secrest complex, 6 to 10 percent slopes	Farmland of statewide importance	0.3	1.4%
W	Water	Not prime farmland	0.4	1.8%
Totals for Area of Interest			**20.6**	**100.0%**

Description

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Rating Options

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Brahma
717 Clark Road
Snow Camp, NC 27349

Inquiry Number: 5567318.2s
February 20, 2019

The EDR Radius Map™ Report with GeoCheck®

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

TABLE OF CONTENTS

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

EXECUTIVE SUMMARY

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

TARGET PROPERTY INFORMATION

ADDRESS

717 CLARK ROAD
SNOW CAMP, NC 27349

COORDINATES

Latitude (North):	35.8540000 - 35° 51' 14.40''
Longitude (West):	79.4106000 - 79° 24' 38.16''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	643521.6
UTM Y (Meters):	3968721.2
Elevation:	621 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5945515 CRUTCHFIELD CROSSROADS, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140827
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
717 CLARK 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

TARGET PROPERTY SEARCH RESULTS

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

DATABASES WITH NO MAPPED SITES

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

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

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

Federal Delisted NPL site list

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

Federal CERCLIS list

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

Federal CERCLIS NFRAP site list

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

Federal RCRA CORRACTS facilities list

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

Federal RCRA non-CORRACTS TSD facilities list

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

Federal RCRA generators list

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

Federal institutional controls / engineering controls registries

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

US INST CONTROL ---------- Sites with Institutional Controls

Federal ERNS list

ERNS ---------- Emergency Response Notification System

State- and tribal - equivalent NPL

NC HSDS ---------- Hazardous Substance Disposal Site

State- and tribal - equivalent CERCLIS

SHWS ---------- Inactive Hazardous Sites Inventory

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

SWF/LF ---------- List of Solid Waste Facilities
OLI ---------- Old Landfill Inventory
DEBRIS ---------- Solid Waste Active Disaster Debris Sites Listing
LCID ---------- Land-Clearing and Inert Debris (LCID) Landfill Notifications

State and tribal leaking storage tank lists

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

State and tribal registered storage tank lists

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

State and tribal institutional control / engineering control registries

INST CONTROL ---------- No Further Action Sites With Land Use Restrictions Monitoring

State and tribal voluntary cleanup sites

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

State and tribal Brownfields sites

BROWNFIELDS ---------- Brownfields Projects Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ---------- A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

SWRCY ---------- Recycling Center Listing

HIST LF	Solid Waste Facility Listing
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
ODI	Open Dump Inventory
IHS OPEN DUMPS	Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

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

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

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

Other Ascertainable Records

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

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

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

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

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

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

SURROUNDING SITES: SEARCH RESULTS

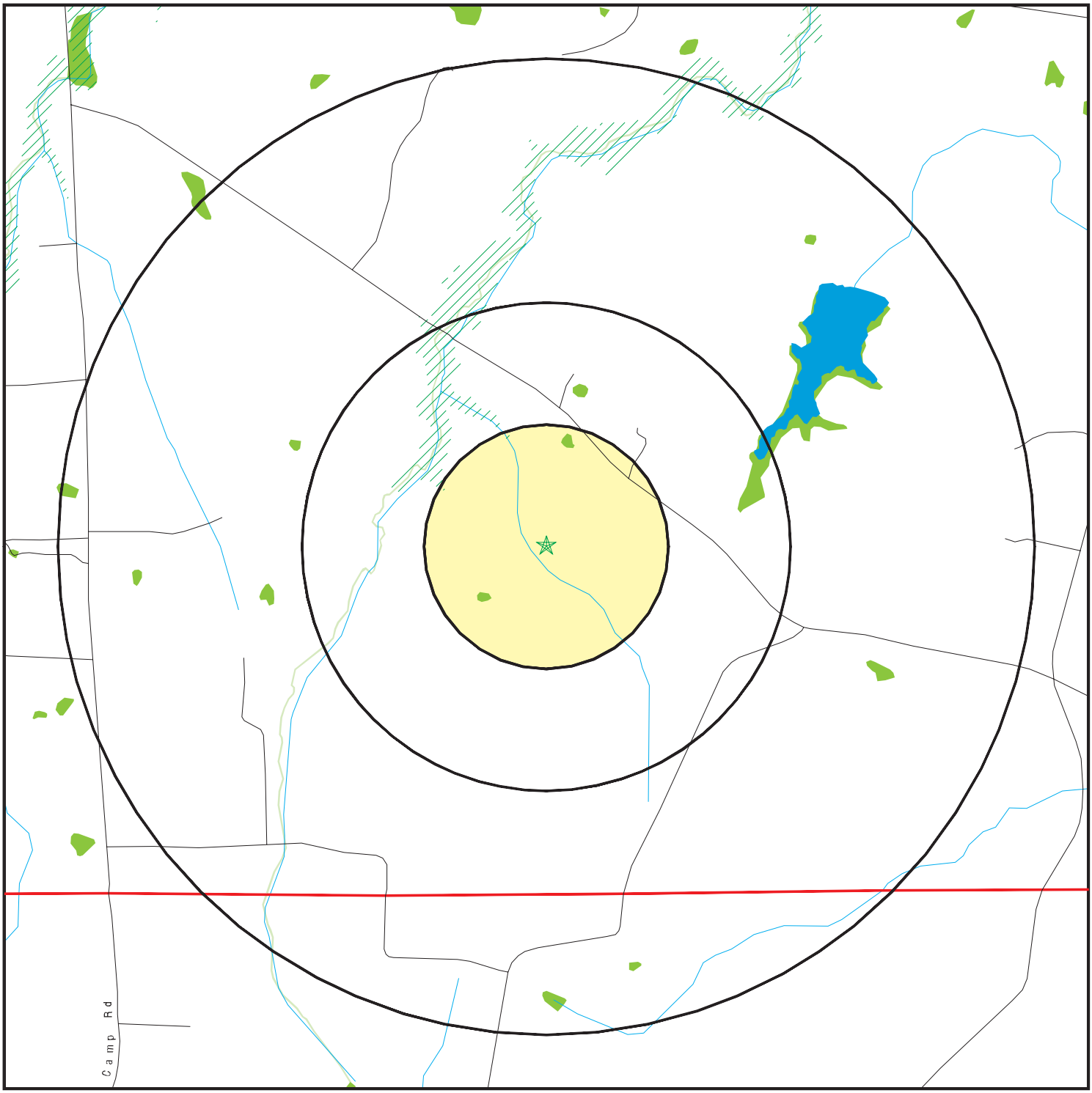
Surrounding sites were not identified.

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

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 5567318.2S



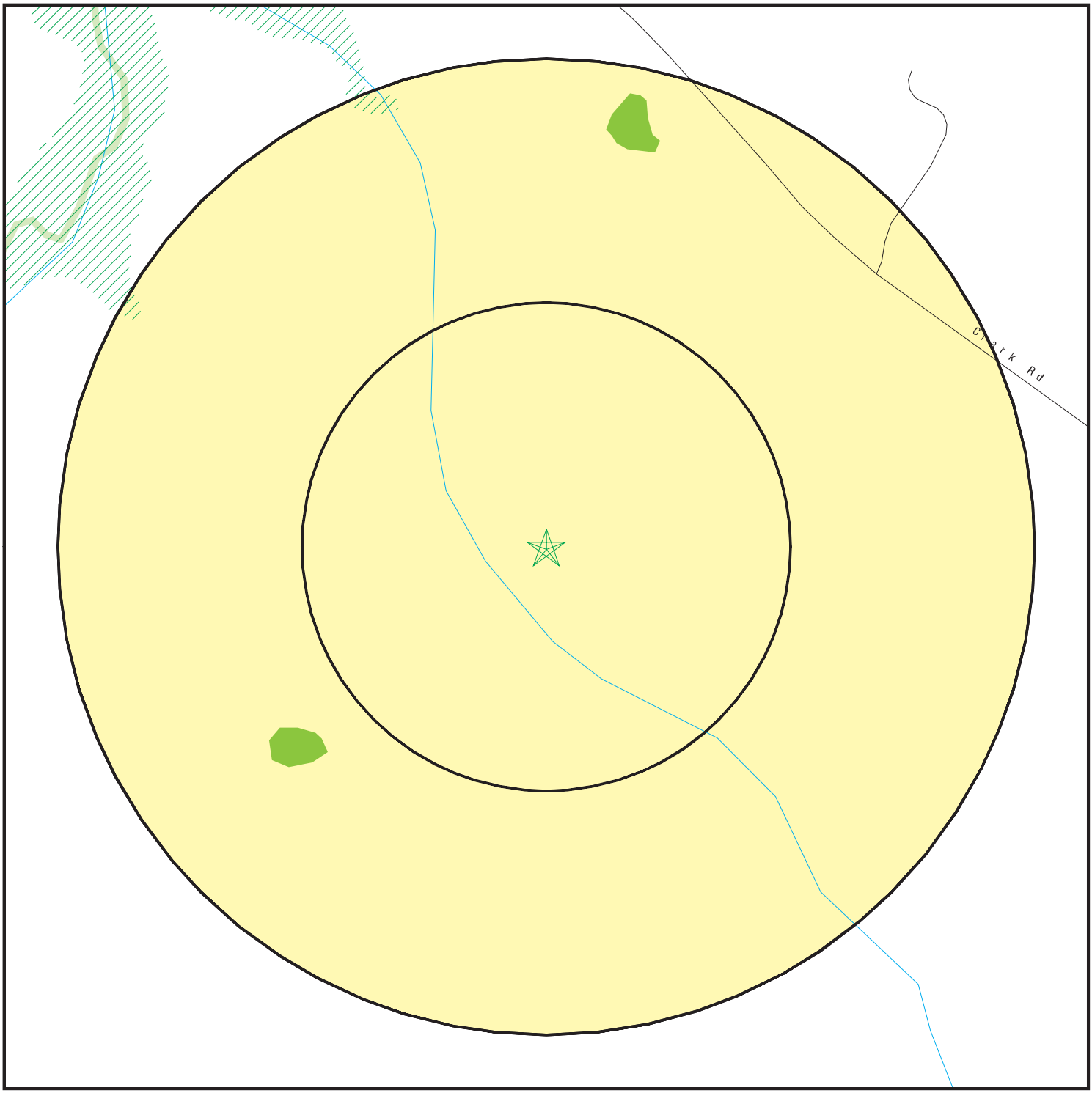
0 1/4 1/2 1 Miles

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

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

SITE NAME: Brahma	CLIENT: Restoration Systems, LLC
ADDRESS: 717 Clark Road Snow Camp NC 27349	CONTACT: JD Hamby
LAT/LONG: 35.854 / 79.4106	INQUIRY #: 5567318.2s DATE: February 20, 2019 12:36 pm

DETAIL MAP - 5567318.2S



0 1/16 1/8 1/4 Miles

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

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: Brahma	CLIENT: Restoration Systems, LLC
ADDRESS: 717 Clark Road Snow Camp NC 27349	CONTACT: JD Hamby
LAT/LONG: 35.854 / 79.4106	INQUIRY #: 5567318.2s DATE: February 20, 2019 12:37 pm

Appendix F
FEMA Coordination

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

August 12, 2019

Robert Key
Alamance County Local Floodplain Administrator
201 West Elm Street
Graham, NC 27253

Re: Brahma Stream and Wetland mitigation project Alamance County **19-006**
FEMA Floodplain Requirements Checklist

Dear Mr. Key:

The purpose of this letter is to request concurrence from the Alamance County concerning a stream and wetland restoration site located in Alamance County. The Site encompasses approximately 23.5 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.

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

Reach	**Length**	**Priority**
UT 1	4666	Priority 1 Restoration, Enhancement (Level I and II) and Preservation
UT 2	1307	Enhancement (Level II)
UT 2A	35	Enhancement (Level II)
UT 3	153	Priority 1 Restoration
UT 4	NA*	Enhancement (Level II)
UT 5	618	Enhancement (Level II)
UT 6	110	Priority 1 Restoration
UT 7	45	Enhancement (Level II)

*Not called a jurisdictional stream during the Preliminary Jurisdictional Determination.

FEMA mapping was reviewed to determine if the project is located in a FEMA study area (DFIRM panel number 8766). Based on existing floodplain mapping, the lower reaches of the Site are located in Special Flood Hazard Area. However, this portion of the Site is proposed for Stream Enhancement (Level I and II) and will not have fill placed on the floodplain. Therefore, a "Conditional Letter of Map Revision" (CLOMR), and a subsequent "Letter of Map Revision" (LOMR) are not expected for the project.

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

Yours truly,

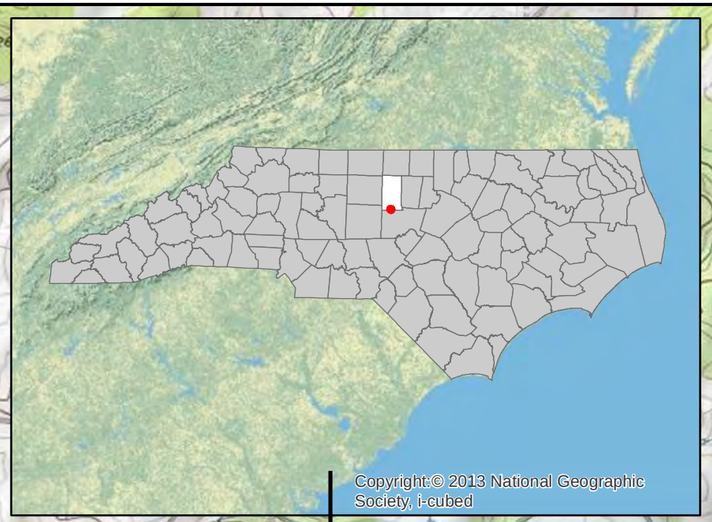
AXIOM ENVIRONMENTAL

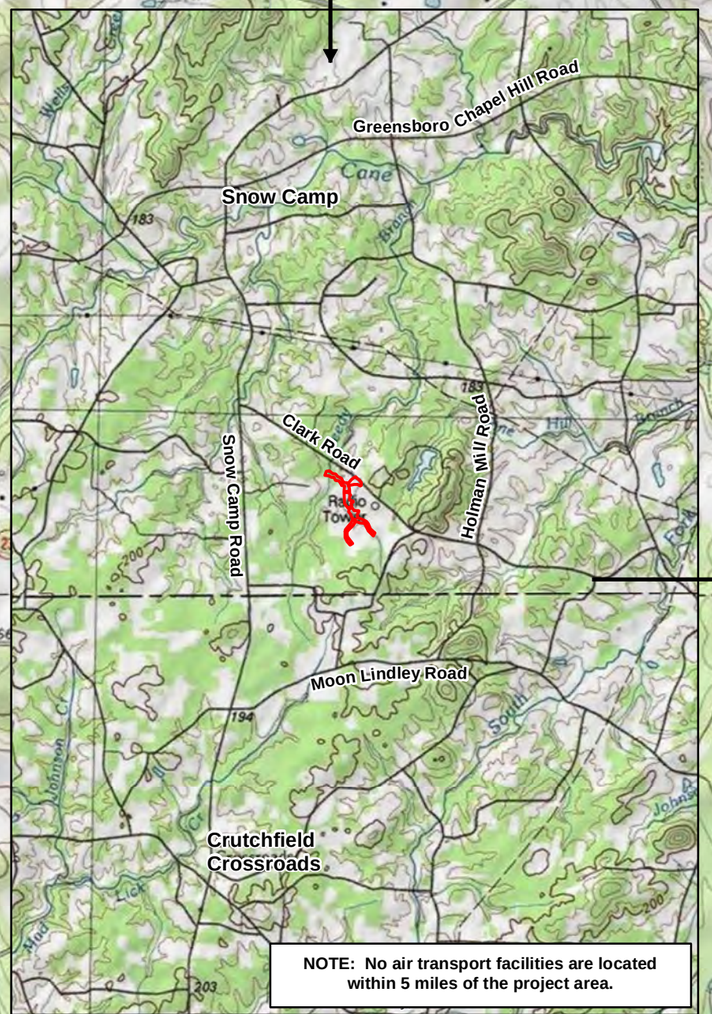
W. Grant Lewis
Senior Project Manager

Attachments

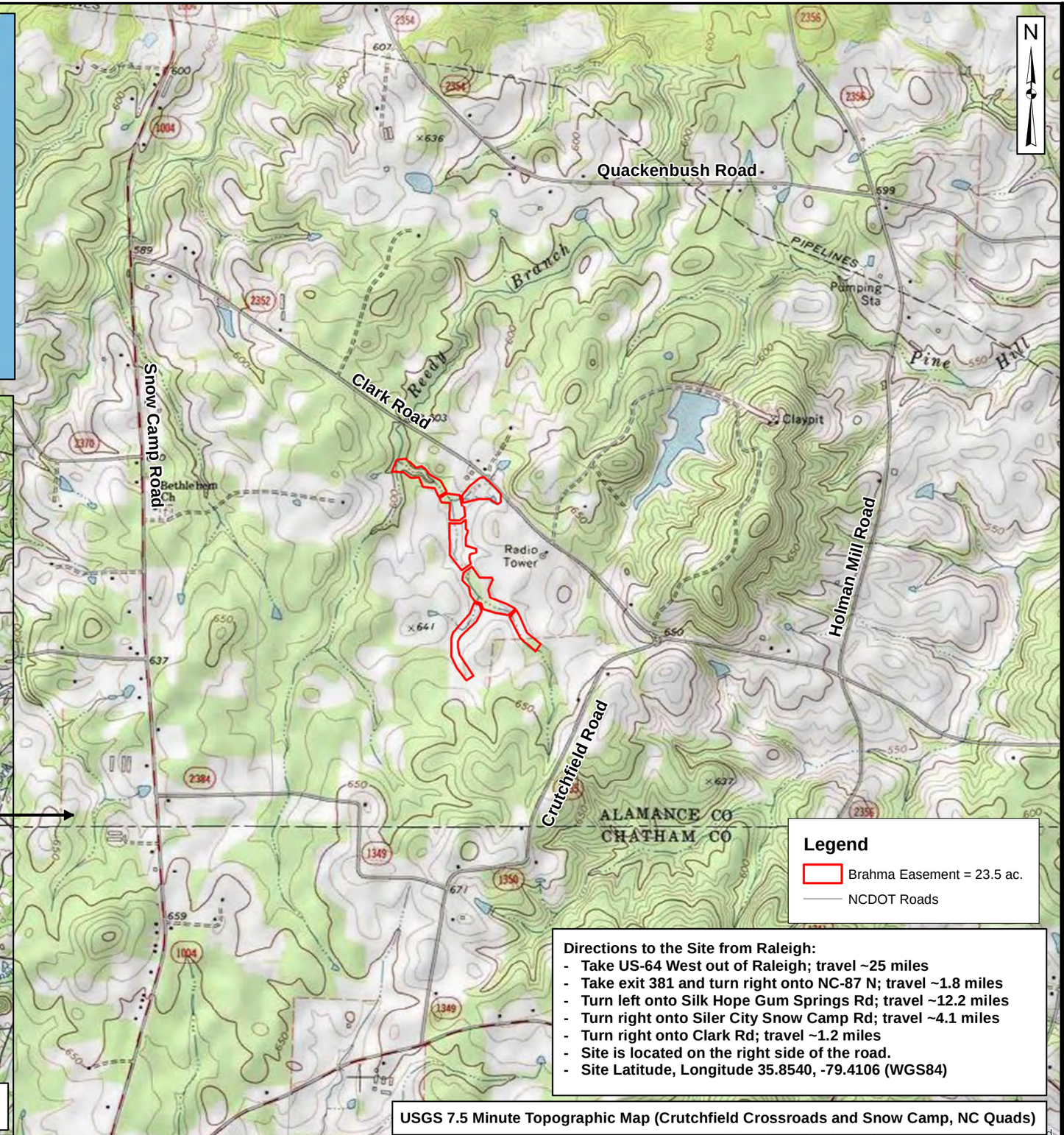
- Figure 1 Project Location
- Figure 2 Topography and Drainage Area
- Figure 3A and 3B Restoration Plan
- EEP Floodplain Requirements Checklist

Cc Worth Creech
Jeff Schaffer
Jeremiah Dow





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



Legend

- Brahma Easement = 23.5 ac.
- NCDOT Roads

Directions to the Site from Raleigh:

- Take US-64 West out of Raleigh; travel ~25 miles
- Take exit 381 and turn right onto NC-87 N; travel ~1.8 miles
- Turn left onto Silk Hope Gum Springs Rd; travel ~12.2 miles
- Turn right onto Siler City Snow Camp Rd; travel ~4.1 miles
- Turn right onto Clark Rd; travel ~1.2 miles
- Site is located on the right side of the road.
- Site Latitude, Longitude 35.8540, -79.4106 (WGS84)

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

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

SITE LOCATION

Drawn by: KRJ

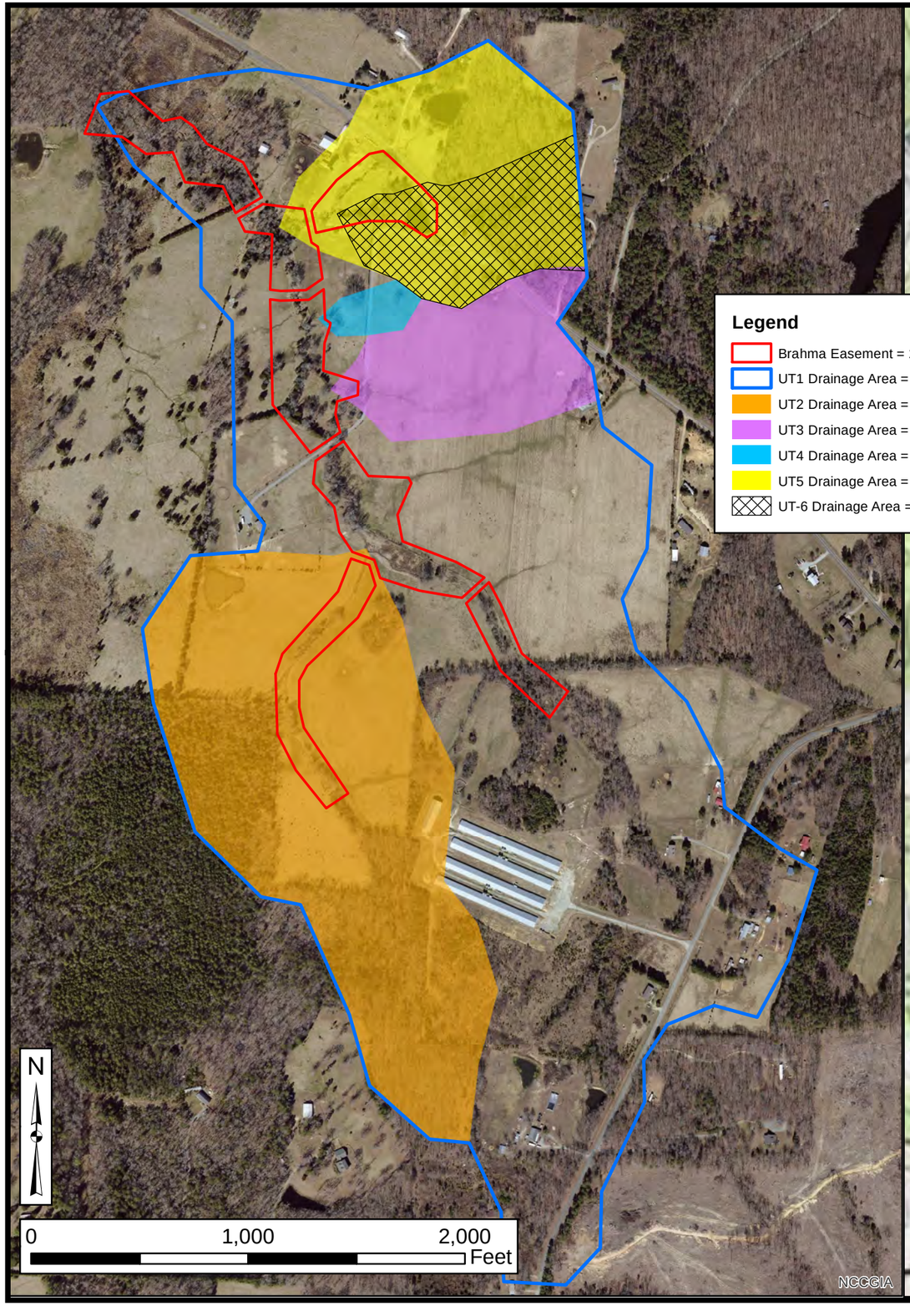
Date: MAY 2019

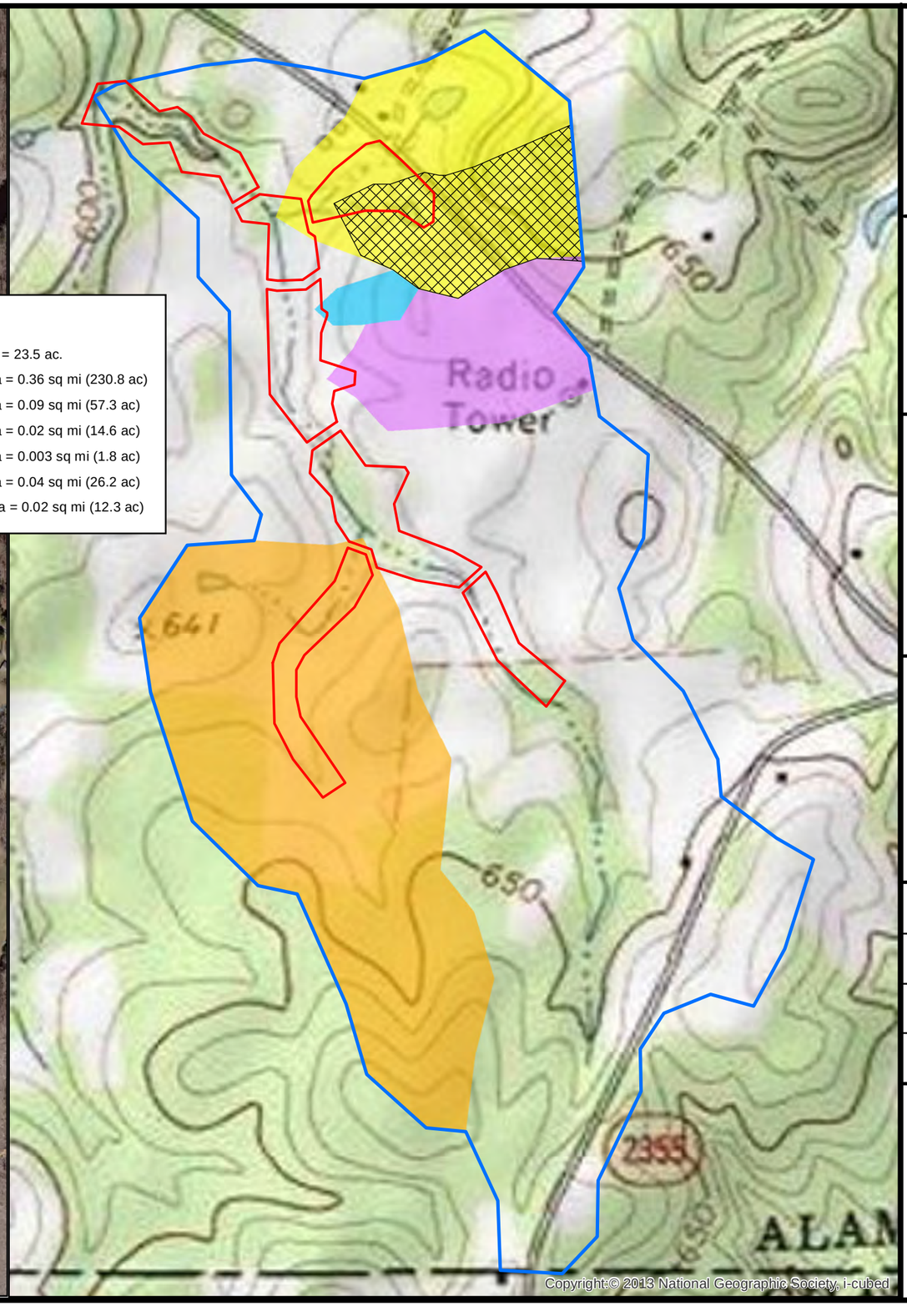
Scale: 1:20,000

Project No.: 19-006

FIGURE

1





Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: KRJ

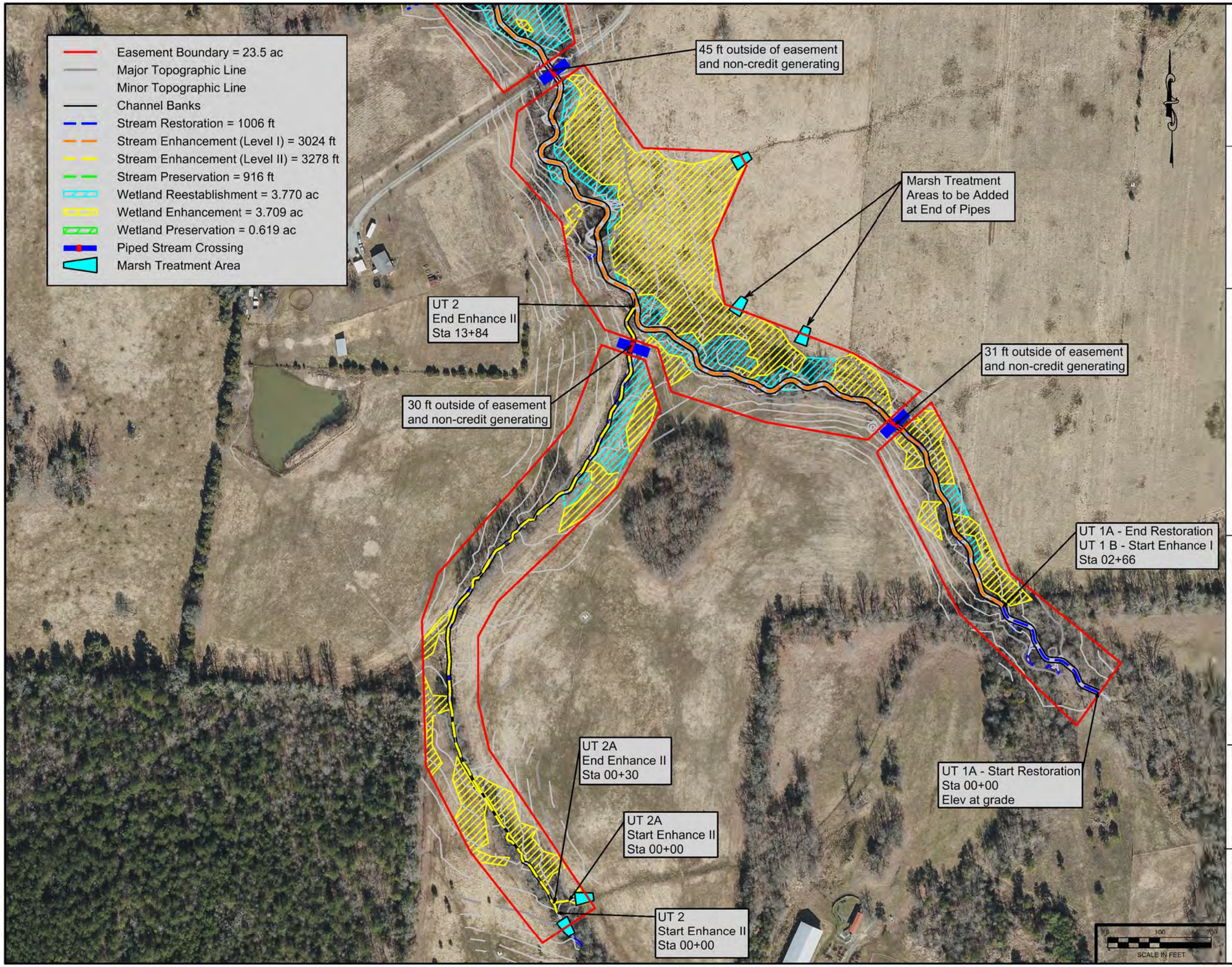
Date: MAY 2019

Scale: 1:7.000

Project No.: 19-006

FIGURE

2



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

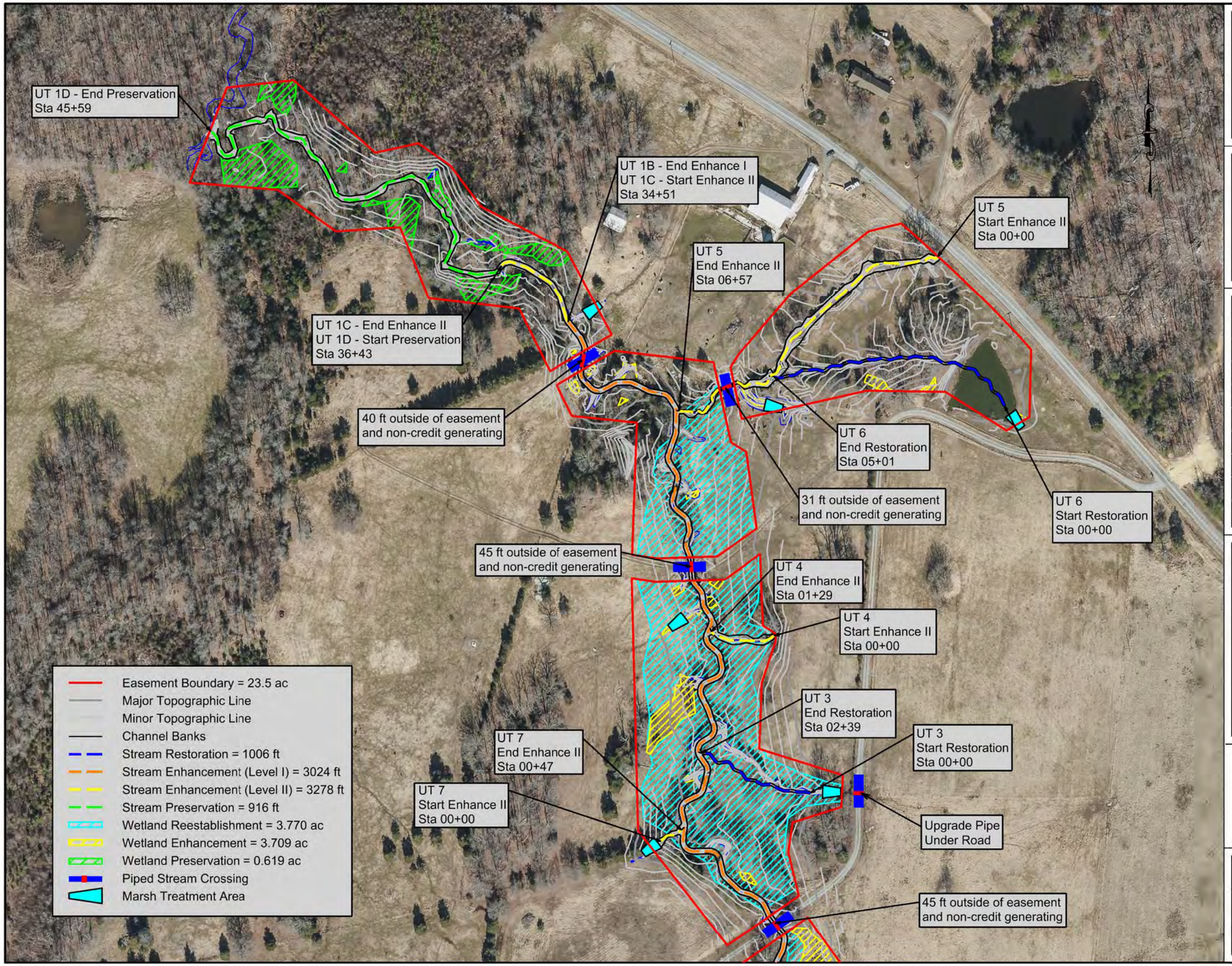
Brahma Mitigation Site

Alamance County North Carolina

Title:

Restoration Plan

Scale:	FIGURE NO.
As Shown	3A
Date: Sept 2019	
Project No.: 19-006	



Axiom Environmental, Inc.

RESTORATION SYSTEMS | LLC

NOTES/REVISIONS

Project:

Brahma
Mitigation Site

Alamance County
North Carolina

Title:

Restoration Plan

Scale:	FIGURE NO.
As Shown	3B
Date: Sept 2019	
Project No.: 19-006	

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:	Brahma Stream and Wetland Restoration Site
Name if stream or feature:	UTs to Reedy Branch
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:	8766
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

The lower Enhancement reaches

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: Robert Key
Phone Number: 336-570-4060

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: 8/12/19

Appendix G
Financial Assurances

Per the NC DMS RFP #: 16-007571, 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 NC DMS will authorize payment for that deliverable. The bond must remain in effect until the Offeror has received written notification from the NC DMS 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 NC DMS 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 H
Site Protection Instrument

FILED ELECTRONICALLY
ALAMANCE COUNTY NC
HUGH WEBSTER

FILED	May 28, 2020
AT	11:29:04 AM
BOOK	04003
START PAGE	0200
END PAGE	0213
INSTRUMENT #	09137
EXCISE TAX	$0.00

This instrument prepared by: Manning Fulton & Skinner, P.A., a licensed North Carolina attorney,
Delinquent taxes, if any, to be paid by the closing attorney to the County Tax Collector upon disbursement of closing proceeds.

STATE OF NORTH CAROLINA

ALAMANCE COUNTY

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT

SPO File Number: 01-BM
DMS Project Number: 100092

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 27th day of May, 2020, by Caroline A. Hinshaw, unmarried, ("**Grantor**"), whose mailing address is 717 Clark Road, Snow Camp, NC 27349, 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 Restoration Systems, LLC, a North Carolina limited liability company, 1101 Haynes St., Suite 211, Raleigh, NC 27604-1499 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 **7743**.

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 Newlin Township, Alamance County, North Carolina (the "**Property**"), and being more

particularly described as that certain parcel of land containing approximately 210.4 acres and being conveyed to the Grantor by deed as recorded in **Deed Book 3705 at Page 67** of the Alamance 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 **Reedy Branch**.

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:

BEING ALL of Conservation Easement Area 1 containing a total of **3.48 acres**; Conservation Easement Area 2 containing a total of **3.09 acres**; Conservation Easement Area 3 containing a total of **2.07 acres**; Conservation Easement Area 4 containing a total of **4.13 acres**; Conservation Easement Area 5 containing a total of **4.90 acres**; Conservation Easement Area 6 containing a total of **3.76 acres**; and Conservation Easement Area 7 containing a total of **1.25 acres**; as shown on the plat of survey titled "Conservation Easement Survey for the State of North Carolina, Division of Mitigation Services, DMS Project ID No. 100092, SPO File Number 01-BM, of Brahma Mitigation Site over and across the Lands of Carolina A. Hinshaw per D.B. 3705, Pg. 67 (a Portion of PIN # 8776769067), Newlin Township, Alamance County, North Carolina" dated April 28, 2020, by John A. Rudolph, PLS Number L-4194, K2 Design Group, and recorded in **Plat Book 81, Pages 140-141**, Alamance County Register of Deeds.

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.

Carolina A. Hinshaw (SEAL)
Carolina A. Hinshaw, unmarried

NORTH CAROLINA
COUNTY OF Alamance

I, Donna G Dent, a Notary Public in and for the County and State aforesaid, do hereby certify that Carolina A. Hinshaw, 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 27th day of May, 2020.

Donna G Dent
Notary Public

My commission expires:

8/8/22

Donna G. Dent Notary Public Alamance County, NC

Donna G. Dent Notary Public Alamance County, NC

Exhibit A

Conservation Easement Area 1

ALL OF Conservation Easement Area 1 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 1 and being a Northwestern corner of the Conservation Easement Area 1 and being located North 63°19'44" West 1538.79 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No.1), North 83°43'57" East 129.21' to an iron stake thence South 48°25'53" East 210.64' to an iron stake; thence North 77°37'24" East 85.05' to an iron stake; thence South 54°59'49" East 75.36' to an iron stake; thence South 36°52'18" East 98.95' to an iron stake; thence South 62°38'54" East 188.05' to an iron stake; thence South 28°00'12" East 182.33' to an iron stake; thence South 59°31'40" West 139.04' to an iron stake; thence North 26°11'36" West 134.85' to an iron stake; thence North 83°25'32" West 175.76' to an iron stake; thence North 21°56'27" West 148.00' to an iron stake; thence South 86°17'40" West 123.73' to an iron stake; thence North 54°29'10" West 137.94' to an iron stake; thence North 77°52'07" West 189.10' to an iron pipe; thence North 28°56'34" East 179.89' to an iron stake; which is the Point of Beginning (Point No. 1), having an area of approximately 3.48 acres.

Conservation Easement Area 2

ALL OF Conservation Easement Area 2 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No.16 and being the Western most corner of the Conservation Easement Area 2 and being located North 69°31'55" West 430.28 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 16), North 31°52'49" East 29.34' to an iron stake; thence North 40°38'25" East 156.47' to an iron stake; thence North 51°19'13" East 191.11' to an iron stake; thence North 76°46'36" East 65.59' to an iron stake; thence South 48°34'30" East 42.91' to an iron stake; thence South 47°33'51" East 84.55' to an iron stake; thence South 45°59'43" East 57.51' to an iron stake; thence South 33°54'20" East 119.59' to an iron stake; thence South 41°55'46" East 69.50' to an iron stake; thence South 01°20'51" West 97.36' to an iron stake; thence South 59°10'06" West 51.21' to an iron stake; thence North 57°45'02" West 139.57' to an iron stake; thence North 89°06'29" West 152.23' to an iron stake; thence South 77°17'50" West 247.39' to an iron stake; thence North 12°18'50" West 101.75' to an iron stake; which is the Point of Beginning (Point No. 16), having an area of approximately 3.09 acres.

Conservation Easement Area 3

ALL OF Conservation Easement Area 3 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 31 and being the Northern most corner of the Conservation Easement Area 3 and being located North 73°46'40" West 652.25 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 31), South 83°25'25" East 191.59' to an iron stake; thence South 12°18'50" East 158.06' to an iron stake; thence South 57°51'31" East 34.89' to an iron stake; thence South 07°41'43" East 149.02' to an iron stake; thence South 54°42'18" West 93.09' to an iron stake; thence South 88°05'09" West 115.41' to an iron stake; thence North 81°47'15" West 49.31' to an iron stake; thence North 02°03'34" East 254.92' to an iron stake; thence North 84°06'40" West 126.17' to an iron stake; thence North 26°21'54" West 66.28' to an iron stake; thence North 59°31'40" East 130.38' to an iron stake; which is the Point of Beginning (Point No. 31), having an area of approximately 2.07 acres.

Conservation Easement Area 4

ALL OF Conservation Easement Area 4 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 42 and being the Northern most corner of the Conservation Easement Area 4 and being located South 58°39'09" West 405.38 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 42), South 02°21'42" East 137.61' to an iron stake; thence South 57°07'16" East 29.62' to an iron stake; thence South 02°02'39" West 14.77' to an iron stake; thence South 18°40'26" West 83.19' to an iron stake; thence South 02°09'04" West 127.79' to an iron stake; thence South 72°31'53" East 169.14' to an iron stake; thence South 02°56'02" West 61.28' to an iron stake; thence South 72°27'31" West 98.38' to an iron stake; thence South 08°26'16" West 58.02' to an iron stake; thence South 13°41'52" East 83.22' to an iron stake; thence South 54°21'56" West 169.16' to an iron stake; thence North 37°50'59" West 280.03' to an iron stake; thence North 01°26'55" West 486.84' to an iron stake; thence South 81°47'15" East 47.57' to an iron stake; thence North 88°05'09" East 132.89' to an iron stake; thence North 54°42'18" East 82.75' to an iron stake; which is the Point of Beginning (Point No. 42), having an area of approximately 4.13 acres.

Conservation Easement Area 5

ALL OF Conservation Easement Area 5 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 58 and being the Northern most corner of the Conservation Easement Area 5 and being located South 15°32'54" West 945.81 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 58), South 35°29'11" East 198.95' to an iron stake; thence South 87°31'38" East 184.45' to an iron stake; thence South 29°25'21" East 29.71' to an iron stake; thence South 24°29'13" West 158.50' to an iron stake; thence South 10°50'30" East 126.08' to an iron stake; thence South 69°10'01" East 264.13' to an iron stake; thence South 61°00'02" East 150.17' to an iron stake; thence South 47°32'57" West 139.55' to an iron stake; thence North 80°13'16" West 200.32' to an iron stake; thence North 72°04'21" West 190.30' to an iron stake; thence North 17°11'03" West 87.74' to an iron stake; thence North 70°46'49" West 107.94' to an iron stake; thence North 33°35'01" West 109.72' to an iron stake; thence North 10°55'11" West 118.26' to an iron stake; thence North 42°31'35" West 145.67' to an iron stake; thence North 06°30'49" East 106.85' to an iron stake; thence North 54°21'56" East 157.64' to an iron stake; which is the Point of Beginning (Point No. 58), having an area of approximately 4.90 acres.

Conservation Easement Area 6

ALL OF Conservation Easement Area 6 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 75 and being the Northeastern corner of the Conservation Easement Area 6 and being located South 03°52'00" West 1579.89 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 75), South 29°09'24" West 169.25' to an iron stake; thence South 46°23'10" West 320.80' to an iron stake; thence South 28°44'02" West 77.85' to an iron stake; thence South 00°01'01" West 125.02' to an iron stake; thence South 12°51'18" East 94.57' to an iron stake; thence South 33°55'23" East 367.23' to an iron stake; thence South 56°28'02" West 122.55' to an iron stake; thence North 38°18'18" West 224.28' to an iron stake; thence North 27°18'33" West 201.56' to an iron stake; thence North 01°32'17" East 130.13' to an iron stake; thence North 01°40'27" West 136.14' to an iron stake; thence North 18°42'12" East 94.91' to an iron stake; thence North 41°34'51" East 385.64' to an iron stake; thence North 21°29'56" East 163.83' to an iron stake; thence South 70°46'49" East 89.31' to an iron stake; thence South 17°11'03" East 100.13' to an iron stake; which is the Point of Beginning (Point No. 75), having an area of approximately 3.76 acres.

Conservation Easement Area 7

ALL OF Conservation Easement Area 7 of the Brahma Mitigation Site over a portion of the land of Caroline A. Hinshaw with PIN No. 8776769067, lying and being situated in Newlin Township, Alamance County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 91 and being the Northern most corner of the Conservation Easement Area 7 and being located South 14°54'17" East 1616.04 feet from an iron stake with a blue cap (Point No. 101) with N.C. Grid Coordinates N=767,081.0347', E=1,878,506.8269' (NAD '83, 2011).

Thence from the Point of Beginning (Point No. 91), South 28°22'32" East 116.09' to an iron stake; thence South 23°19'12" East 246.74' to an iron stake; thence South 50°33'14" East 111.74' to an iron stake; thence South 87°27'43" West 69.38' to an iron stake; thence South 87°28'00" West 115.13' to an iron pipe; thence North 27°11'07" West 350.31' to an iron stake; thence North 47°32'57" East 142.63' to an iron stake; which is the Point of Beginning (Point No. 91), having an area of approximately 1.25 acres.

ALL OF THE FOREGOING CONSERVATION EASEMENT AREAS as shown on plat of survey titled "Conservation Easement Survey for the State of North Carolina, Division of Mitigation Services, DMS Project ID No. 100092, SPO File Number 01-BM, of Brahma Mitigation Site over and across the Lands of Carolina A. Hinshaw per D.B. 3705, Pg. 67 (a Portion of PIN # 8776769067), Newlin Township, Alamance County, North Carolina" dated April 28, 2020, by John A. Rudolph, PLS Number L-4194, K2 Design Group, and recorded in Plat Book 81, Pages 140-141, Alamance County Register of Deeds.

ALL SUCH CONSERVATION EASEMENT AREAS TOGETHER WITH that certain new thirty (30) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 1, that certain new thirty (30) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 2, that certain new forty-five (45) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 3, that certain new forty-five (45) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 4, that certain new thirty (30) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 5, and that certain new thirty (30) foot-wide non-exclusive access easement labeled as Access Easement and Crossing 6, all for ingress, egress, and regress and all as shown on the foregoing described plat of survey recorded in Plat Book 81, Pages 140-141, Alamance County Register of Deeds.

Appendix I
Credit Release Schedule

The schedules below list the updated credit release schedules for stream and wetland mitigation projects developed by bank and ILF sites in North Carolina:

Credit Release Schedule and Milestones for Wetlands					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%	10%	100%

*Please note that vegetation plot data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

Credit Release Schedule and Milestones for Streams					
Credit Release Milestone	**Release Activity**	**Banks**		**ILF/NCDMS**	
		Interim Release	**Total Released**	**Interim Release**	**Total Released**
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable, performance standards have been met	10%	90% (100%**)	10%	90% (100%**)

*Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

**10% reserve of credits to be held back until the bankfull event performance standard has been met.

Appendix J
Maintenance Plan

Maintenance Plan

The Site shall be monitored on a regular basis and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Beaver	Beaver and associated dams are to be removed as they colonize and until the project is closed.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree- blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Road Crossing	Road crossings within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.
Terracell Drop Structure	Routine maintenance and repair activities may include removal of debris and supplemental installation of live stakes and other target vegetation along the channel. Undermining of the structure may require repair or replacement.

Appendix K
NHP Report

North Carolina Department of Natural and Cultural Resources
Natural Heritage Program

Governor Roy Cooper | Secretary Susi H. Hamilton

NCNHDE-6578

July 30, 2018

Kenan Jernigan
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, NC 27603
RE: Brahma Mitigation site

Dear Kenan Jernigan:

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

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

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

If a Federally-listed species is found within the project area or is indicated within a one-mile radius of the project area, the NCNHP recommends contacting the US Fish and Wildlife Service (USFWS) for guidance. Contact information for USFWS offices in North Carolina is found here: https://www.fws.gov/offices/Directory/ListOffices.cfm?statecode=37.

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

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

If you have questions regarding the information provided in this letter or need additional assistance, please contact Rodney A. Butler at rodney.butler@ncdcr.gov or 919-707-8603.

Sincerely,
NC Natural Heritage Program

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

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

LOCATION:
121 West Jones Street
Raleigh, NC 27603

Natural Heritage Element Occurrences, Natural Areas, and Managed Areas Within a One-mile Radius of the Project Area
Brahma Mitigation site
July 30, 2018
NCNHDE-6578

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

Taxonomic Group	EO ID	Scientific Name	Common Name	Last Observation Date	Element Occurrence Rank	Accuracy	Federal Status	State Status	Global Rank	State Rank
Butterfly	34484	Neonympha helicta	Helicta Satyr	1980-Pre	H	5-Very Low	---	Significantly Rare	G3G4	S1?
Crustacean	37377	Cambarus davidi	Carolina Ladle Crayfish	2016-04-20	E	3-Medium	---	Significantly Rare	G3	S3
Freshwater Fish	37275	Etheostoma collis	Carolina Darter	2016-04-20	E	3-Medium	---	Special Concern	G3	S3
Natural Community	24215	Dry Oak--Hickory Forest (Piedmont Subtype)	---	2010	B?	2-High	---	---	G4G5	S4

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

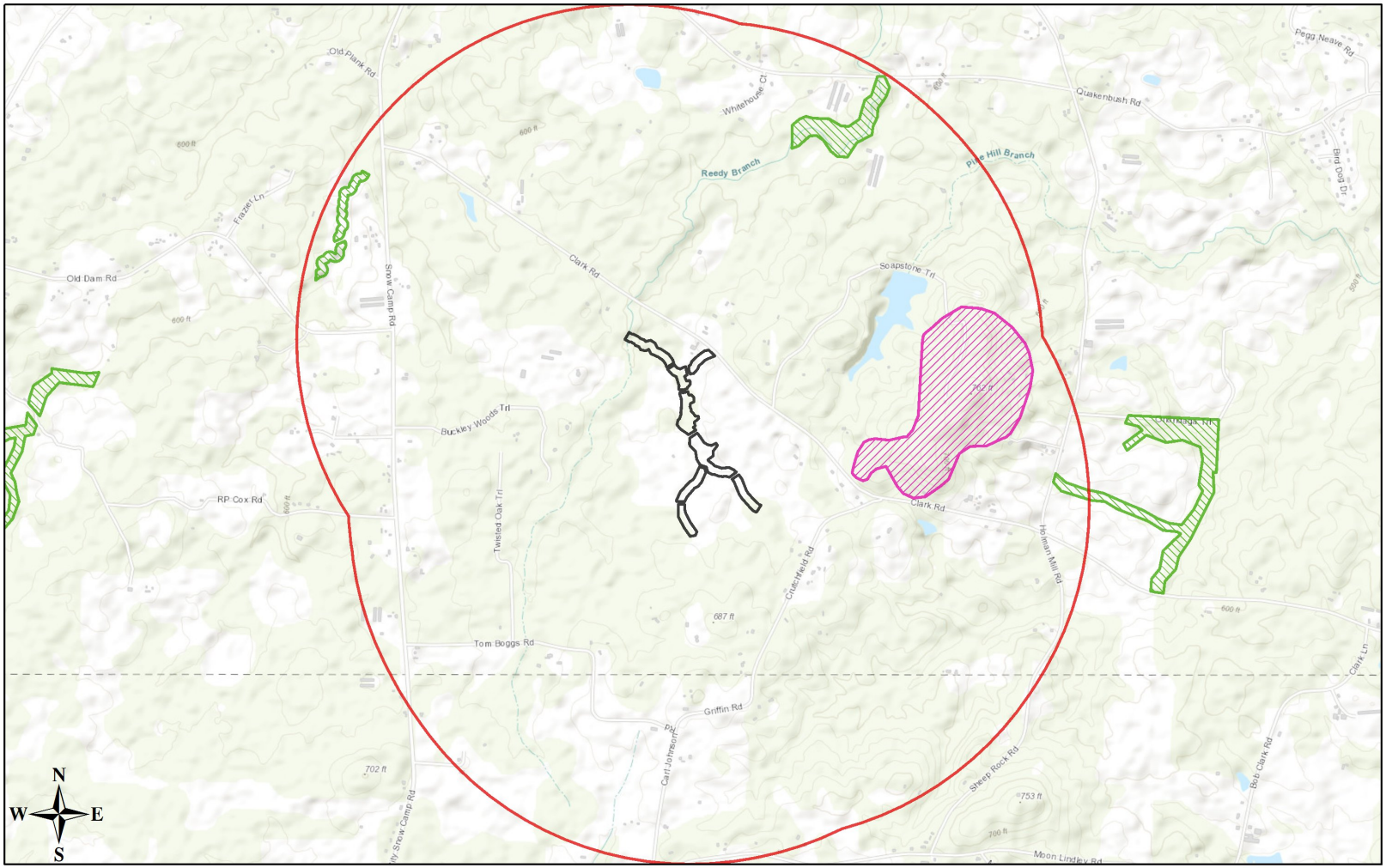
Site Name	Representational Rating	Collective Rating
Pine Hill Xeric Woodlands	R5? (General?)	C5 (General)

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

Managed Area Name	Owner	Owner Type
NC Division of Mitigation Services Easement	NC DEQ, Division of Mitigation Services	State

Definitions and an explanation of status designations and codes can be found at https://ncnhde.natureserve.org/content/help. Data query generated on July 30, 2018; source: NCNHP, Q3 July 2018. Please resubmit your information request if more than one year elapses before project initiation as new information is continually added to the NCNHP database.

NCNHDE-6578: Brahma Mitigation site



July 30, 2018

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

1:26,581

0 0.225 0.45 0.9 mi

0 0.35 0.7 1.4 km

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

Appendix L
Cost Share Fence Contract

John Hamby

From: Worth Creech
Sent: Thursday, March 14, 2019 1:24 PM
To: John Hamby
Subject: FW: Brahma Site Post visit Memo (UNCLASSIFIED)

-----Original Message-----
From: Browning, Kimberly D CIV USARMY CESAW (US) <Kimberly.D.Browning@usace.army.mil>
Sent: Thursday, March 14, 2019 11:44 AM
To: Worth Creech <worth@restorationsystems.com>
Subject: RE: Brahma Site Post visit Memo (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Looks good, thanks

Kim Browning
Mitigation Project Manager, Regulatory Division I U.S. Army Corps of Engineers
3331 Heritage Trade Dr, Ste. 105 I Wake Forest, NC 27587 I 919.554.4884 x60

BUILDING STRONG ®

-----Original Message-----
From: Worth Creech [mailto:worth@restorationsystems.com]
Sent: Thursday, March 14, 2019 11:09 AM
To: Browning, Kimberly D CIV USARMY CESAW (US) <Kimberly.D.Browning@usace.army.mil>; olivia.munzer@ncwildlife.org; Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>; 'Haupt, Mac' <mac.haupt@ncdenr.gov>
Cc: Crocker, Lindsay <Lindsay.Crocker@ncdenr.gov>; John Hamby <jhamby@restorationsystems.com>
Subject: [Non-DoD Source] RE: Brahma Site Post visit Memo (UNCLASSIFIED)

Good morning, Kim and I spoke about her comments, so here is the latest Memo for Brahma. Please let me know if you are good with this for the record. Thanks, Worth

Worth Creech I Restoration Systems LLC
1101 Haynes St. Suite 211 I Raleigh, NC 27604
office: 919-334-9114 I mobile: 919-389-3888
web: www.restorationsystems.com

-----Original Message-----

From: Browning, Kimberly D CIV USARMY CESAW (US) <Kimberly.D.Browning@usace.army.mil>
Sent: Friday, March 08, 2019 9:49 AM
To: Worth Creech <worth@restorationsystems.com>; olivia.munzer@ncwildlife.org; Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>; 'Haupt, Mac' <mac.haupt@ncdenr.gov>
Cc: Crocker, Lindsay <Lindsay.Crocker@ncdenr.gov>; John Hamby <jhamby@restorationsystems.com>
Subject: RE: Brahma Site Post visit Memo (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Hi Worth
The only additional comments I would add is that we'd like to see the expired contract for the cost-shared fence (I believe this was mostly along UT1) included in the documentation in the draft mit plan, and also to ensure that with the new chicken houses being built that the conservation easement language does not allow for chicken litter to be spread in the buffer. In fact, I would recommend at least a 50' setback from the easement.

Have a good weekend
Kim

Kim Browning
Mitigation Specialist, Regulatory Division I U.S. Army Corps of Engineers
3331 Heritage Trade Dr, Ste. 105 I Wake Forest, NC 27587 I 919.554.4884 x60

BUILDING STRONG (r)

-----Original Message-----
From: Worth Creech [mailto:worth@restorationsystems.com]
Sent: Thursday, March 07, 2019 11:22 AM
To: olivia.munzer@ncwildlife.org; Tugwell, Todd J CIV USARMY CESAW (US) <Todd.J.Tugwell@usace.army.mil>; Browning, Kimberly D CIV USARMY CESAW (US) <Kimberly.D.Browning@usace.army.mil>; 'Haupt, Mac' <mac.haupt@ncdenr.gov>
Cc: Crocker, Lindsay <Lindsay.Crocker@ncdenr.gov>; John Hamby <jhamby@restorationsystems.com>
Subject: [Non-DoD Source] Brahma Site Post visit Memo

Hello,

Attached is the draft Memorandum for the DMS Brahma Site post award site visit. Contract No. 7743 / RFP # 16-007571 / DMS Project ID: 100092

Let me know if you have any comments or would like to discuss.

Please send me a concurrence email if you are ok with the Memo so we can begin the Draft Mit Plan.

Thank you, Worth

Worth Creech I Restoration Systems LLC

1101 Haynes St. Suite 211 I Raleigh, NC 27604

office: 919-334-9114 I mobile: 919-389-3888

web: BlockedBlockedwww.restorationsystems.com <BlockedBlockedhttp://www.restorationsystems.com>

CLASSIFICATION: UNCLASSIFIED

CLASSIFICATION: UNCLASSIFIED

CONSERVATION PROGRAM CONTRACT

Participant: CHRISTOPHER W MCPHERSON	**Program and Contract Number:** EQIP 2002 744532080NE
County and State: ALAMANCE County, NC	**Subaccount:** Alamance 2008 Ranking
Watershed: Haw	This agreement is effective on the date signed by the Natural Resources Conservation Service approving official and extends through **9/30/2014**

1. The undersigned participants enter into this contract with the Natural Resources Conservation Service (NRCS) to implement and or maintain specific conservation practices, as set forth in the Conservation Plan or Schedule of Operations (NRCS-CPA-1155), on the property as identified on the plan map. In consideration for the implementation and or maintenance of the practices, the NRCS will make payments to the participant(s) in the amount(s) described in the Schedule of Operations as outlined in the appendix.
2. This agreement is comprised of this Conservation Program Contract form NRCS-CPA-1202, NRCS-CPA-1202 Appendix; NRCS-CPA-1155 Conservation Plan or Schedule of Operations and plan map which are fully incorporated by reference into this document and are binding upon the participant(s). The NRCS-CPA-1155 may be modified (NRCS-CPA-1156) upon agreement of NRCS and the participant and becomes a part of the contract when signed by the NRCS approval official.
3. The participant(s) agree: A) to implement and maintain conservation practices for the life of this agreement on the plan map in compliance with the plan or schedule of operations and in accordance with the standards, specifications, and other special program criteria obtained from the local field office of the NRCS; B) to forfeit further payments under this agreement and refund the United States, in amounts determined by (3 A) NRCS, payments received hereunder upon NRCS determination that participant(s) have violated the material terms of this agreement or accept such payment adjustments as NRCS may deem appropriate if NRCS decides that the participant's violation does not warrant termination of the agreement; and C) to forfeit all rights to further payments under the agreement and refund to the United States, in amounts determined by NRCS, payments received hereunder if the subject land is transferred to a non-participant during the term of this agreement, unless the third party agrees to assume this agreement, and (3 B) the NRCS consents to the modification.

4. CONTRACT PARTICIPANTS

Name, Address, Telephone CHRISTOPHER W MCPHERSON 76 ROCKY TOP TRAIL SILER CITY , NC 27344	**SSN or TAX ID if applicable** *****3471
Signature Christopher W. McPherson **Date** 2-7-08	**Payment Shares** 100.00%
Signature required for modifications ✓ **Yes** ☐ **No**	**Signature acceptable for payments** ✓ **Yes** ☐ **No**

5. CONTRACT OBLIGATIONS

2008	2009	2010	2011	2012	2013					Total
$17,602	$32,963	$6,934	$1,679	$7,579	$1,679					$68,436
										$68,436

6. NRCS APPROVING OFFICIALS

Application Approval **Joseph Roderic Bailey** **USDA electronic signature; manual signature not required.** **Date:** **2/7/2008**	**Contract Obligation** L Bruce Jr **Date:**

CONSERVATION PROGRAM CONTRACT

Participant:	Program and Contract Number:
CHRISTOPHER W MCPHERSON	EQIP 2002 744532080NE

4. CONTRACT PARTICIPANTS (continued)

Name, Address, Telephone	SSN or TAX ID if applicable
JOHN C ALLEN 717 CLARK RD SNOW CAMP , NC 27349	*****6445
Signature John C. Allen **Date** 2-7-2008	**Payment Shares** 0%
Signature required for modifications ☐ Yes ✓ No	**Signature acceptable for payments** ☐ Yes ✓ No

OMB DISCLOSURE STATEMENT

According to the Paper Work Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0578-0013. The time required to complete this information collection is estimated to average 0.69 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

PRIVACY ACT STATEMENT

The above statements are made in accordance with the Privacy Act of 1974 (U.S.C. 522a). Furnishing this information is voluntary; however, failure to furnish correct, complete information will result in the withholding or withdrawal of such technical or financial assistance. The information may be furnished to other USDA agencies, the Internal Revenue Service, the Department of Justice, or other state or federal law enforcement agencies, or in response to orders of a court, magistrate, or administrative tribunal.

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Appendix M
Preconstruction Benthic Data

3/06 Revision 6

Brahma Util US

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

53

Biological Assessment Unit, DWQ **TOTAL SCORE**

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

Stream Brahma Util US Location/road: SnowCamp NC (Road Name Clark) County Alamance

Date 190701 **CC#** 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) P.P.D.C Type of Study: ☐ Fish ☑ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35.852042 Longitude -79.408454 Ecoregion: ☐ MT ☐ P ☒ Slate Belt ☐ Triassic Basin

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

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

Visible Land Use: 20 %Forest _____ %Residential 80 %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial _____ %Other - Describe: _____

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

Width: (meters) Stream 1.5 Channel (at top of bank) _____ **Stream Depth:** (m) Avg .1 Max ____
☐ Width variable ☐ Large river >25m wide

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

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

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

Channel Flow Status
Useful especially under abnormal or low flow conditions.

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

Weather Conditions: hot - dry **Photos:** ☐ N ☒ Y ☐ Digital ☐ 35mm

Remarks: Proposed stream and wetland mitigation site. Livestock has unrestricted access to entire stream

Brahma UL 145

I. Channel Modification

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

☐ Evidence of dredging ☐Evidence of desnagging=no large woody debris in stream ☒Banks of uniform shape/height 3

Remarks _____ Subtotal ___

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

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

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

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

☐ No woody vegetation in riparian zone Remarks _____ Subtotal 9

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

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

Remarks Riffles are sand/gravel Subtotal 4

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

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

Subtotal 8

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

Remarks _____

Page Total 25

Brahma_47.1-45

V. Riffle Habitats

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

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

Channel Slope: ☒Typical for area ☐Steep=fast flow ☐Low=like a coastal stream Subtotal 3

VI. Bank Stability and Vegetation

FACE UPSTREAM	Left Bank Score	Rt. Bank Score
A. Banks stable		
1. little evidence of erosion or bank failure(except outside of bends), little potential for erosion..	7	7
B. Erosion areas present		
1. diverse **trees**, shrubs, grass; plants healthy with good root systems.....	6	6
2. few trees or small trees and **shrubs**; vegetation appears generally healthy.....	(5)	(5)
3. sparse **mixed** vegetation; plant types and conditions suggest poorer soil binding.....	3	3
4. mostly **grasses**, few if any trees and shrubs, high erosion and failure potential at high flow..	2	2
5. little or no bank vegetation, mass erosion and bank failure evident.....	0	0
		Total 10

Remarks _____

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

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

Remarks _____ Subtotal 7

VIII. Riparian Vegetative Zone Width

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

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

Remarks Mixed successional forest, minimal invasive species Total 8

Page Total 28

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 53

Brahma UT1_DS

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE**

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

Stream Brahma UT-1 DS Location/road: Snow Camp NC (Road Name Clark) County Alamance

Date 19070 **CC#** 03030002 Basin Cape Fear Subbasin 03-06-04

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

Latitude 35.857212 Longitude -79.411824 Ecoregion: ☐ MT ☐ P ☐ Slate Belt ☒ Triassic Basin

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

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

Visible Land Use: 20 %Forest _____ %Residential 80 %Active Pasture _____ % Active Crops
_____ %Fallow Fields _____ % Commercial _____ %Industrial _____ %Other - Describe: _____

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

Width: (meters) Stream 2 Channel (at top of bank) 2 **Stream Depth:** (m) Avg .1 Max .3
☐ Width variable ☐ Large river >25m wide
Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 1.5

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

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

Channel Flow Status
Useful especially under abnormal or low flow conditions.

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

Weather Conditions: Dry **Photos:** ☐ N ☒ Y ☒ Digital ☐ 35mm

Remarks: Livestock have unrestricted access to entire stream

Brahma MT-1 DS

I. Channel Modification Score

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

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

Remarks good slow velocity, but w/cover Subtotal 5

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

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

AMOUNT OF REACH FAVORABLE FOR COLONIZATION OR COVER

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

☐ No woody vegetation in riparian zone Remarks Subtotal 10

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

A. substrate with good mix of gravel, cobble and boulders **Score**

1. embeddedness <20% (very little sand, usually only behind large boulders)..... 15
2. embeddedness 20-40%..... 12
3. embeddedness 40-80%..... 8
4. embeddedness >80%..... 3

B. substrate gravel and cobble

1. embeddedness <20%..... 14
2. embeddedness 20-40%..... (11)
3. embeddedness 40-80%..... 6
4. embeddedness >80%..... 2

C. substrate mostly gravel

1. embeddedness <50%..... 8
2. embeddedness >50%..... 4

D. substrate homogeneous

1. substrate nearly all bedrock..... 3
2. substrate nearly all sand..... 3
3. substrate nearly all detritus..... 2
4. substrate nearly all silt/ clay..... 1

Remarks Subtotal 11

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

A. Pools present Score

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

B. Pools absent..... 0

Subtotal 8

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

Remarks

Page Total 34

Brahma UT-1 DS

V. Riffle Habitats

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

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

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

Subtotal 16

VI. Bank Stability and Vegetation

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

Total 10

Remarks _____

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

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

Remarks _____ Subtotal 8

VIII. Riparian Vegetative Zone Width

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

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

Remarks _____ Total 8

Page Total 42

☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 74

PAI ID NO			52714	52715
STATION			UT-1-US	UT-1-DS
DATE			7/1/2019	7/1/2019
SPECIES	T.V.	F.F.G.		
MOLLUSCA				
Gastropoda				
Basommatophora				
Physidae				
Physella sp.	8.7	CG	2	1
ANNELIDA				
Clitellata				
Hirudinea		P		
Rhynchobdellida				
Batrachobdella phalera		P	2	
Helobdella triserialis	9.3	P		1
ARTHROPODA				
Crustacea				
Isopoda				
Asellidae		SH		
Lirceus sp.	7.4	CG	1	
Insecta				
Odonata				
Aeshnidae		P		
Aeshna sp.		P		1
Coenagrionidae		P		
Ischnura sp.	9.5		1	3
Hemiptera				
Corixidae		PI	1	
Megaloptera				
Corydalidae		P		
Chauliodes pectinicornis			2	
Coleoptera				
Scirtidae		SC		
Scirtes sp.			8	
Diptera				
Chironomidae				
Psectrotanypus dyari	*10*	P	3	1
Culicidae		FC		
Anopheles sp.	*8.6*	FC		1
Culex sp.		FC	1	
TOTAL NO. OF ORGANISMS			21	8
TOTAL NO. OF TAXA			9	6
EPT TAXA			0	0
BIOTIC INDEX ASSIGNED VALUES			9.27	9.30

Appendix N
Post Contract Review Notes

MEMORANDUM
March 14, 2019

RE: Brahma Stream & Wetland Mitigation Site
Post - IRT Site Visit Notes
Contract No. 7743 / RFP # 16-007571 / DMS Project ID: 100092

Attendees:

USACE – Todd Tugwell, Kim Browning
NCDMS – Lindsay Crocker, Jeff Schaffer
DWR – Mac Haupt
NCWRC – Olivia Munzer
Restoration Systems (RS) –Worth Creech
Axiom Environmental (Axiom) – Grant Lewis

On February 26, 2019, a site visit was conducted with members of the NC Inter-agency Review Team (IRT) to review and discuss the merits of the proposed Brahma Mitigation Site (Site). The ~20.6-acre Site includes six Unnamed Tributaries (UTs) to Reedy Branch and is located at longitude 35.8540, -79.4106. The IRT reviewed approximately 7160 linear feet of degraded stream channel and multiple degraded/drained wetland areas. Provided below is a list of comments discussed during the walkthrough.

Overall, IRT members agreed with the mitigation approach proposed in the Technical Proposal with minor alterations as discussed below. Stream reaches, credit ratios, and wetland restoration/enhancement areas were generally approved in the field as depicted on attached mapping.

1) **Wetlands**: Overall, general wetland areas rehabilitation and reestablishment areas were agreed upon, with the expectation that there will be larger areas of wetlands than are currently depicted in the Technical Proposal. The IRT agreed that a Jurisdictional Determination will be completed at the Site that will outline the final areas and extent of wetlands for the Detailed Mitigation Plan. In addition, wetland gauges will be required to be installed to verify wetland reestablishment areas, specifically adjacent to UT 3.

2) **Stream Flow Gauges**: Several of the UTs have small drainage areas and will require flow gauges to determine the number of consecutive days of flow. These reaches will also need to exhibit stream characteristics outlined in current stream mitigation guidelines (2016).

3) **UT 4**: UT 4 currently discharges at a spring head and exhibits a dendritic flow pattern down a narrow valley. IRT members agreed that this stream should be treated as a headwater system and stream credit should be calculated down valley as Enhancement (Level II).

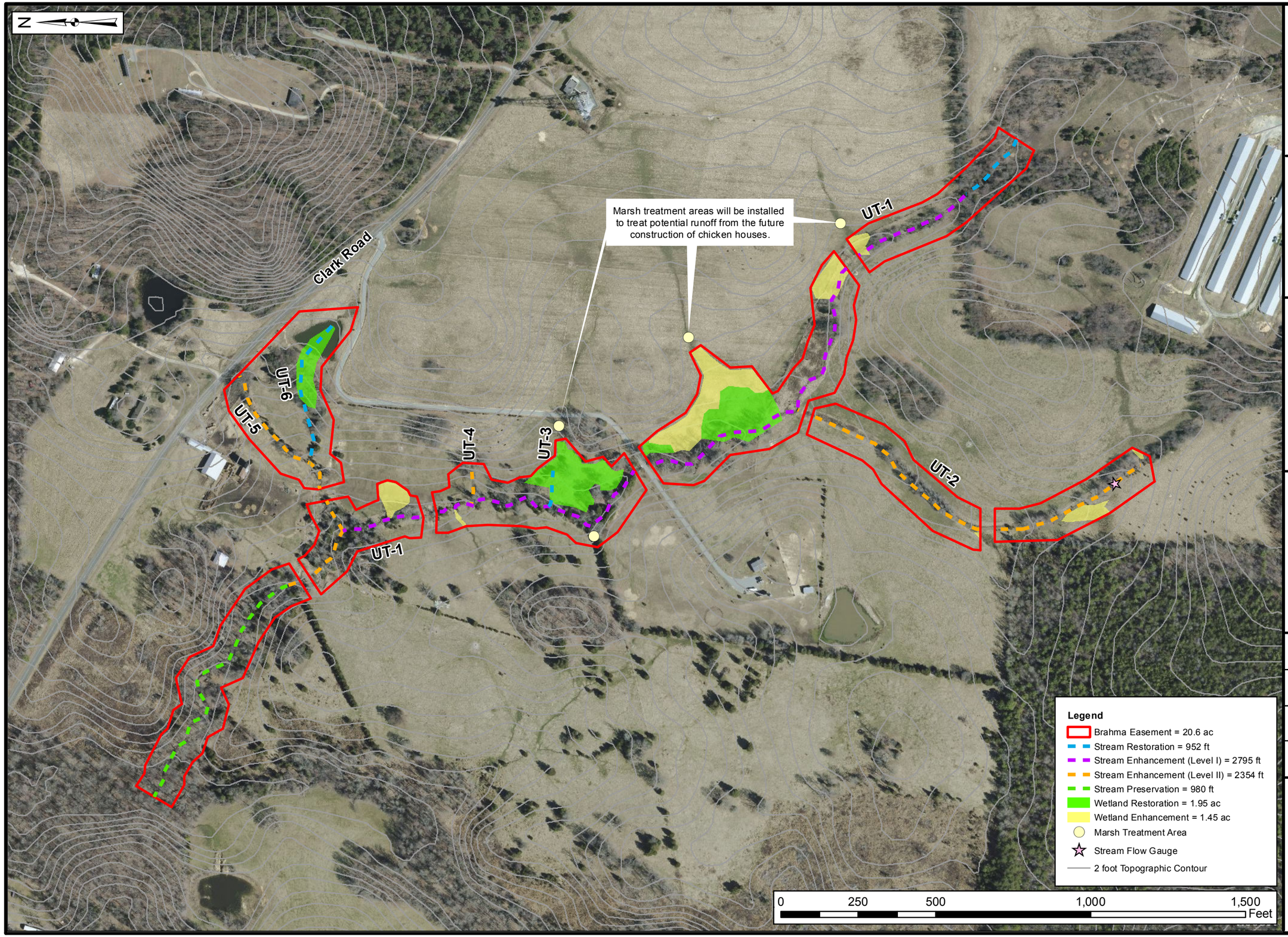
4) **Crossings:** There was a discussion about limiting the number of crossings on the Site. Every effort will be made to reduce crossings through discussions with the landowner prior to the Mitigation Plan development.

5) **Expired EQIP Agreement:** The prior landowner, John C. Allen and his farm lessee (participant Chris McPherson) were enrolled in an EQIP program contract that paid for fencing and cattle drinkers at various locations on the Site parcel. The signed agreement between the past Participant, Christopher McPherson and the Resources Conservation Service expired on 9/30/2014. The expired Agreement will be in the Draft Mitigation Plan.

6) **Nutrient Management:** Three chicken laying houses are scheduled to be constructed on the landowner's parcel outside of the proposed Site conservation easement. The use of appropriate setbacks for the houses and waste management from the houses will be detailed in the Mitigation Plan as a reference for RS, DMS, the IRT, and the landowner. In addition, any drainages downstream of the houses will receive a marsh treatment area before entering the Site's streams or wetlands.

Thank you,

Worth Creech
Restoration Systems



Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

BRAHMA MITIGATION SITE

Alamance County, NC

Title:

PROPOSED CONDITIONS

Drawn by: KRJ

Date: MAR 2019

Scale: 1:3500

Project No.: 18-002

FIGURE

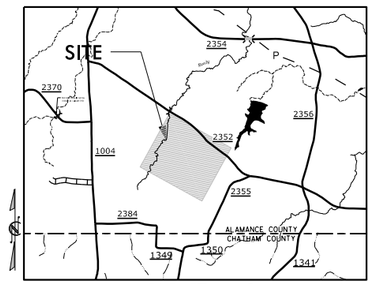
5

Appendix O
Construction Plans

09/08/09

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
CONSTRUCTION PLANS
BRAHMA SITE

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BRAHMA SITE	1	

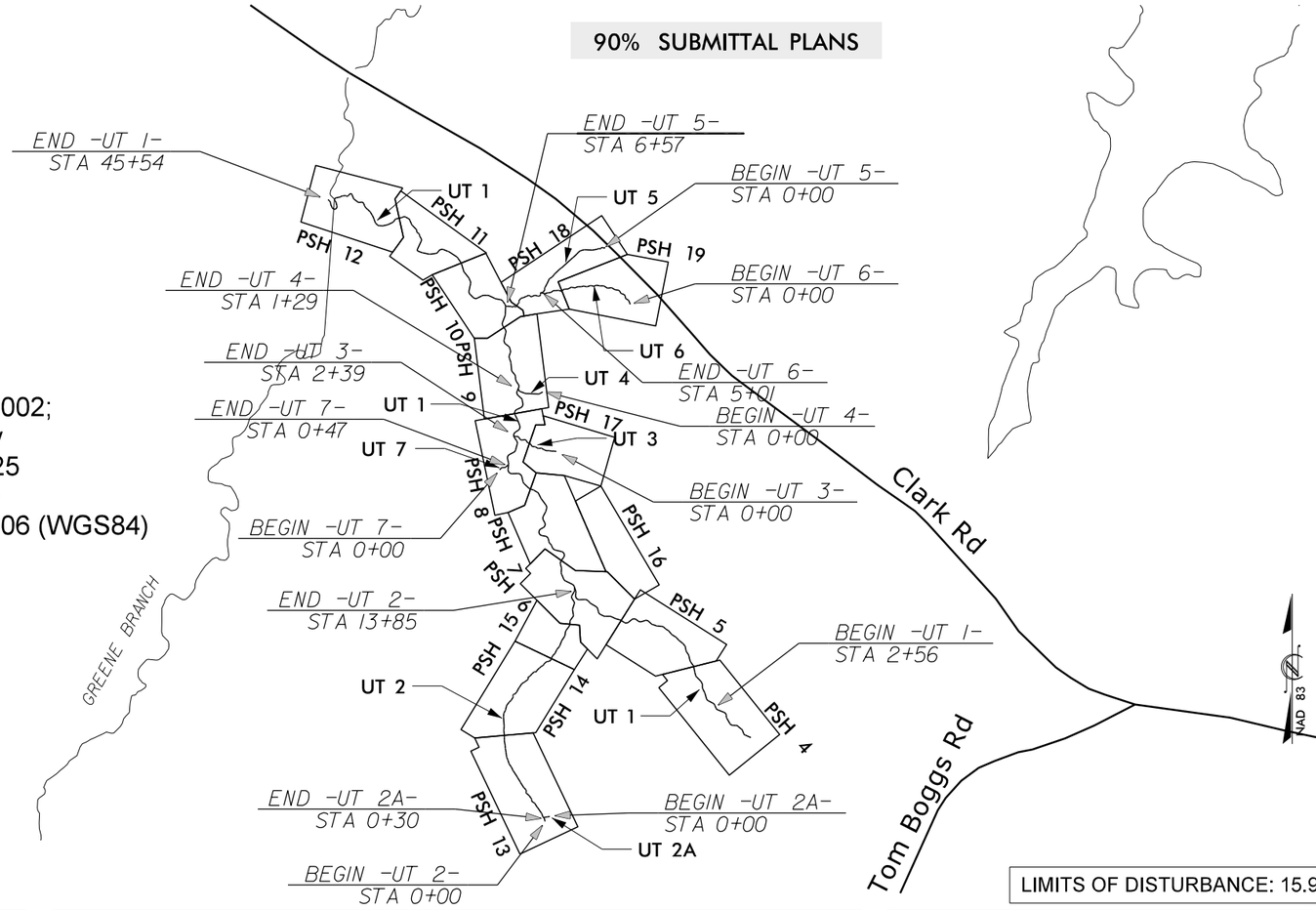


VICINITY MAP
Not to Scale

LOCATION: ALAMANCE COUNTY, NORTH CAROLINA

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

90% SUBMITTAL PLANS



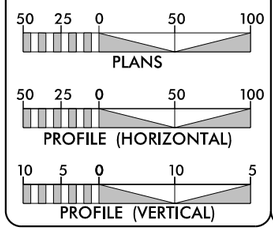
Brahma Site
Site #100058
Cape Fear 03030002;
Alamance County
Contract #0007525
Latitude: 35.8540
Longitude: -79.4106 (WGS84)

INDEX OF SHEETS

SHEET NUMBER	SHEET
01	Title Sheet
01A	Symbology
02	Typicals
02A THRU 02C	Details
03	Control Points and Location Map
03A	Easement
04 THRU 19	Plan and Profile Sheets
E-02 THRU E-02D	Erosion Control Notes
E-03 THRU E-03D	Erosion Control Details
E-03E	Haul Road Locations
E-04 THRU E-19	Erosion Control Plan Sheets

CONTRACT: BRAHMA SITE

GRAPHIC SCALES



PROPOSED LENGTH OF -UT 1- = 4298	PROPOSED LENGTH OF -UT 4- = 129
PROPOSED LENGTH OF -UT 2- = 1385	PROPOSED LENGTH OF -UT 5- = 657
PROPOSED LENGTH OF -UT 2A- = 30	PROPOSED LENGTH OF -UT 6- = 501
PROPOSED LENGTH OF -UT 3- = 239	PROPOSED LENGTH OF -UT 7- = 47

TOTAL STREAM LENGTHS (LF) = 7286

RESTORATION LEVEL	STREAM (linear footage)	RIPARIAN WETLAND (acreage)	NONRIPARIAN WETLAND (acreage)
RESTORATION	740	4.740	0.000
ENHANCEMENT I	3034	3.709	0.000
ENHANCEMENT II	2378	0.000	0.000
PRESERVATION	911	0.601	0.000
TOTALS	7063	9.050	0.000
MITIGATION UNITS	3881.066 SMUs	6.655 RIPARIAN WMUs	NONRIPARIAN WMUs

LIMITS OF DISTURBANCE: 15.96 AC

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

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

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

JOSHUA G. DALTON, P.E.
PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26674 JOSHUA G. DALTON

DATE:

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

7/8/2020
Brahma_Rdy_PSH_01.dgn
jharvey

CONVENTIONAL PLAN SHEET SYMBOLS

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

SHEET NAME		SHEET NUMBER
SYMBOLOGY		1A
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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BOUNDARIES AND PROPERTY:

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

BUILDINGS AND OTHER CULTURE:

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

HYDROLOGY:

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

RIGHT OF WAY & PROJECT CONTROL:

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

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

ROADS AND RELATED FEATURES:

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

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard (Vineyard)

EXISTING STRUCTURES:

MAJOR:
- Bridge, Tunnel or Box Culvert (CONC)
- Bridge Wing Wall, Head Wall and End Wall (CONC WW)

MINOR:
- Head and End Wall (CONC HW)

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

UTILITIES:

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

TELEPHONE:
- Existing Telephone Pole

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

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

SANITARY SEWER:
- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line (SS)
- Above Ground Sanitary Sewer (A/G Sanitary Sewer)

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

MISCELLANEOUS:
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box (S)
- Utility Unknown U/G Line LOS B (S.U.E.*) (?UTL)
- U/G Tank; Water, Gas, Oil
- Underground Storage Tank, Approx. Loc. (UST)
- A/G Tank; Water, Gas, Oil
- Geoenvironmental Boring
- U/G Test Hole LOS A (S.U.E.*)
- Abandoned According to Utility Records (AATUR)
- End of Information (E.O.I.)
- Riffle Rip Rap
- Wetted Perimeter
- Log Vane
- Log Cross Vane
- Stream Plug
- Floodplain Interceptor
- Limits of Disturbance (LOD)

SHEET NAME	SHEET NUMBER
TYPICALS	2
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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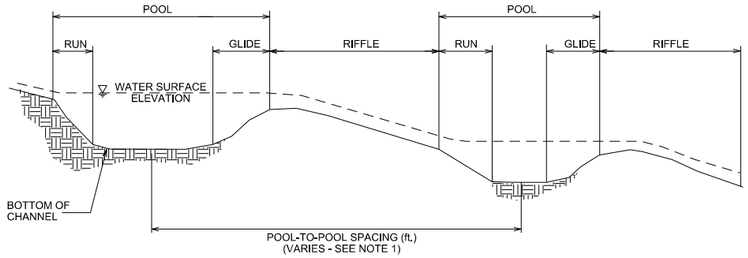
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29660 JOSHUA C. DALTON

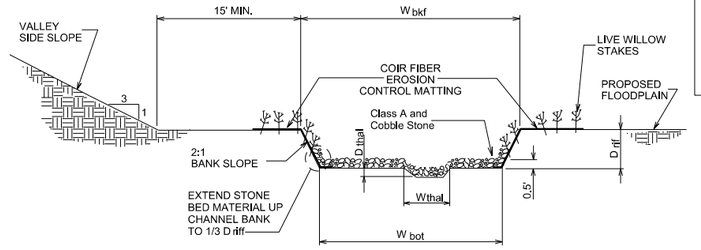
DATE:



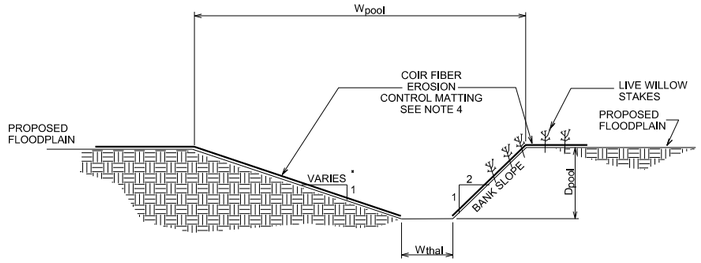
TYPICAL CHANNEL PROFILE

NOTES:

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

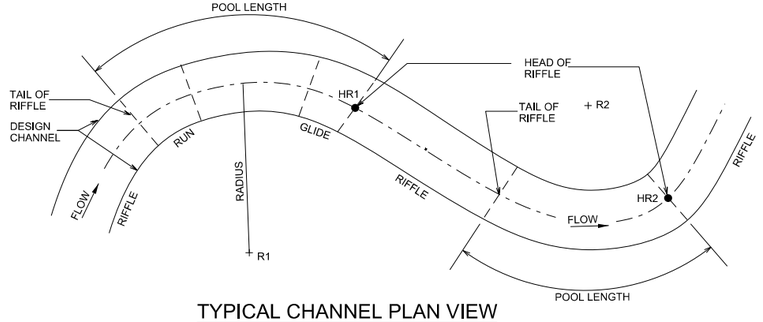


TYPICAL RIFFLE CROSS-SECTION



* MAX. 1:1 SLOPE

TYPICAL POOL CROSS-SECTION



TYPICAL CHANNEL PLAN VIEW

CHANNEL PLAN VIEW NOTES:

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

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

CHANNEL CONSTRUCTION NOTES:

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

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

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 Upstream of UT 2	10.8	6.1	0.9	0.1	1.4	11.1	2.7
UT 1 Downstream of UT 2	11.0	6.6	1.0	0.1	1.5	12.1	3.1
UT 2	7.4	4.6	0.6	0.1	1.0	8.1	2.1
UT 3 and UT 6	4.4	2.4	0.4	0.1	0.6	4.9	1.3

7/1/2020
Brandy.psh_02.dgn
harvey

SHEET NAME	SHEET NUMBER
DETAILS	2A
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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ENG FIRM LICENSE NO. C-890

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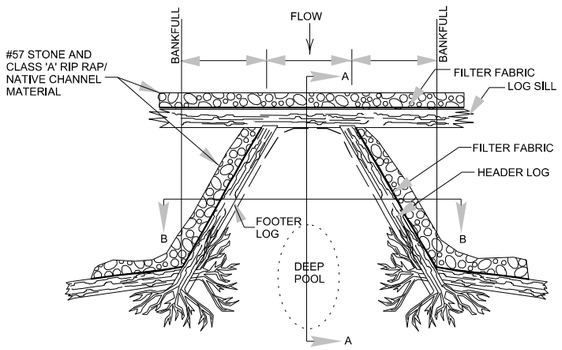
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29660 JOSHUA C. DALTON

DATE:

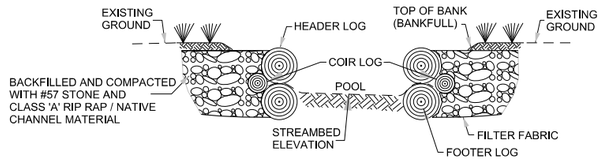
LOG CROSS VANE

SCALE:NTS

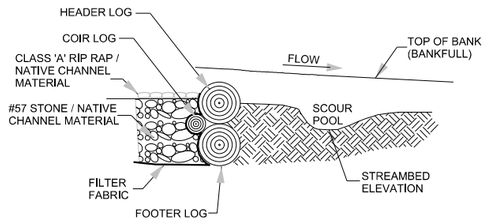
PLAN VIEW



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



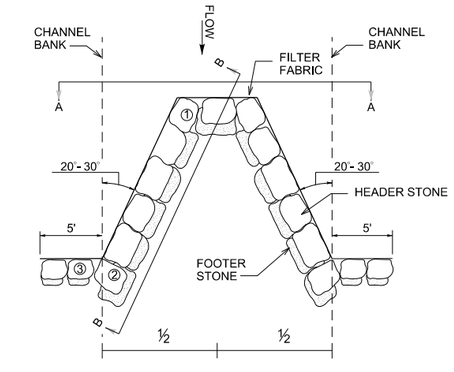
SECTION B-B



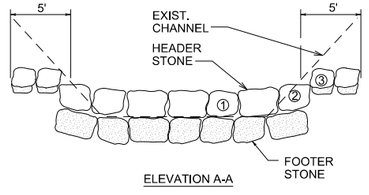
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
UT 1	11	1.0 - 1.1
UT 2, 3, and 6	6	0.4 - 0.6

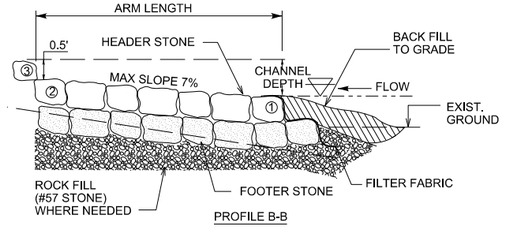
NOTE:
HEADER AND FOOTER STONES ARE LARGE, ANGULAR BOULDERS MEASURING A MINIMUM OF 24" ALONG THE SHORTEST DIMENSION.



PLAN VIEW

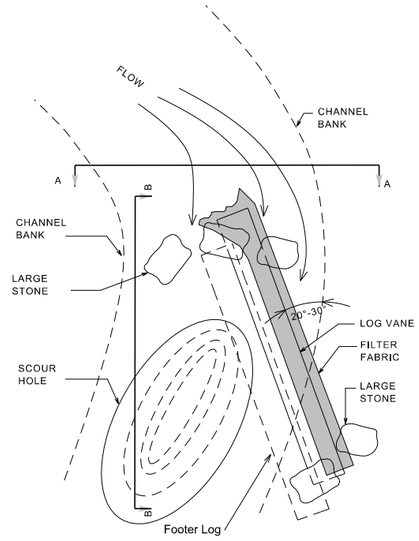


ELEVATION A-A



PROFILE B-B

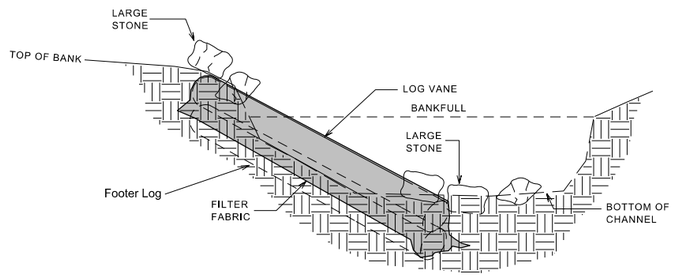
TYPICAL CROSS-VANE



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

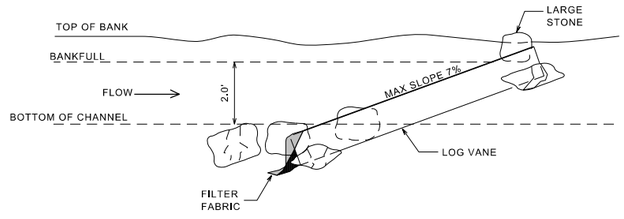
PLAN VIEW

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

7/1/2020
Brandy.psh_02a.dgn
harvey

SHEET NAME	SHEET NUMBER
DETAILS	2B
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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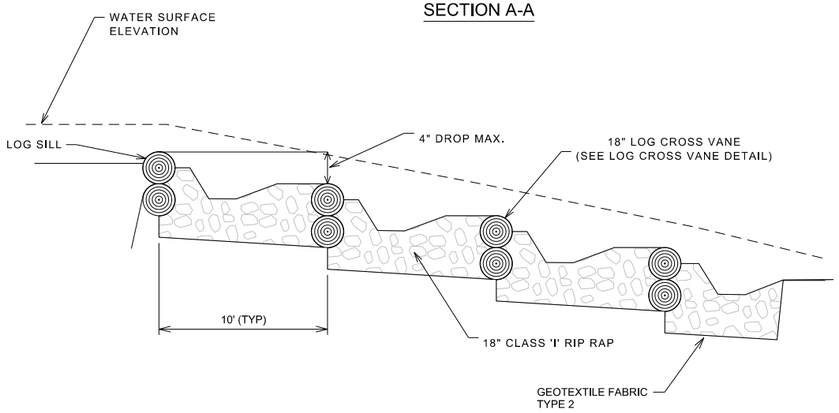
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29001 JOSHUA C. DALTON

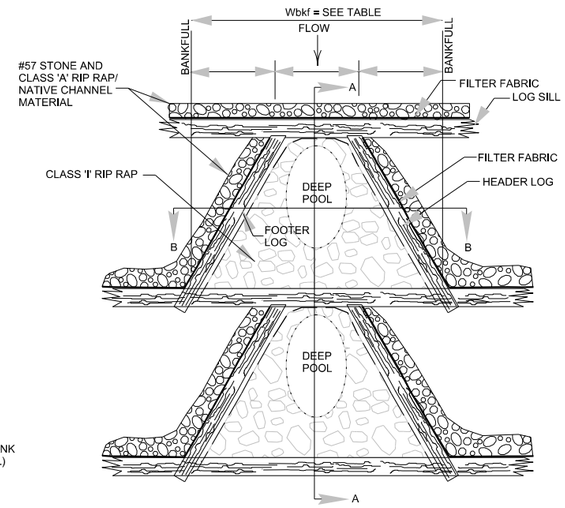
DATE:

STEP POOL STRUCTURE

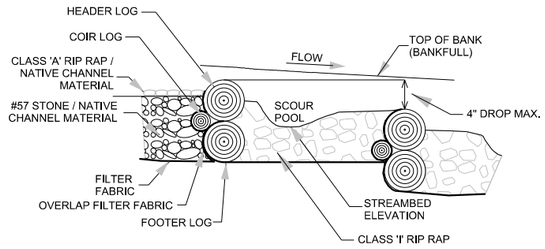
SECTION A-A



PLAN VIEW



STEP POOL ENLARGEMENT



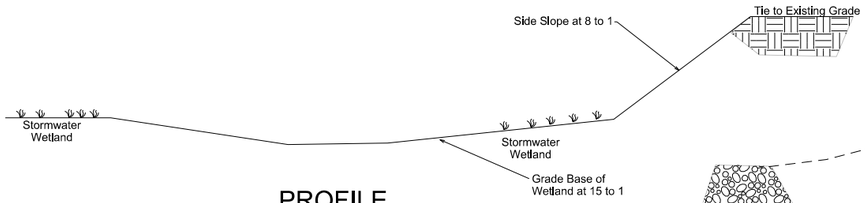
STRUCTURE NOTES:
1. FILL CLASS '1' RIP RAP VOIDS WITH CLASS 'A' RIP RAP/ #57 STONE/ NATIVE CHANNEL MATERIAL MIXTURE.

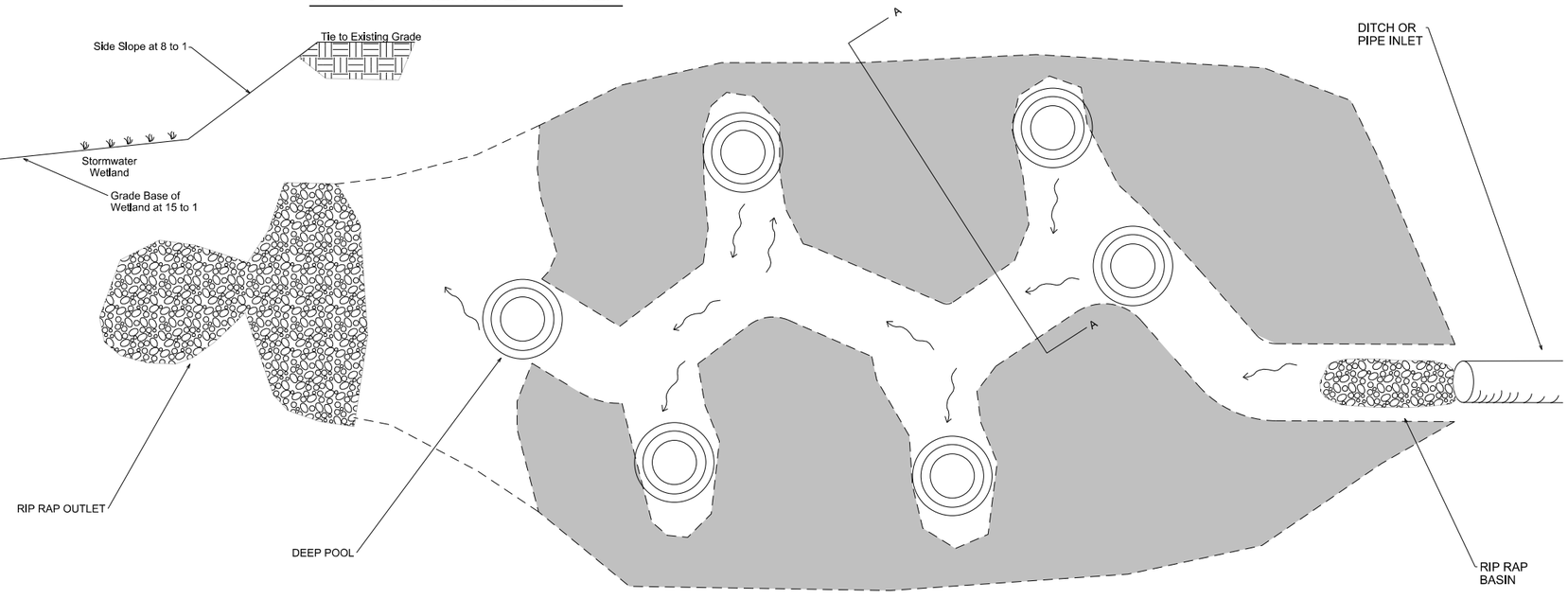
CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)
UT 1	11.0
UT 2	7.4
UT 6	4.4

MARSH TREATMENT AREA

PROFILE
SECTION A-A





7/7/2020
Brahma_dg_psh_02b.dgn
jharvey

SHEET NAME		SHEET NUMBER
DETAILS		2C
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
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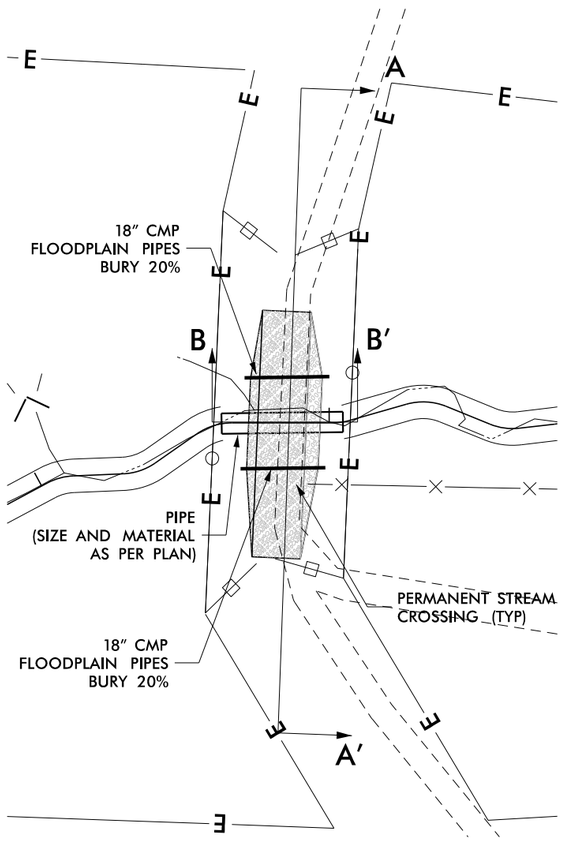
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSEPH T. DALTON

DATE:

PERMANENT CROSSING

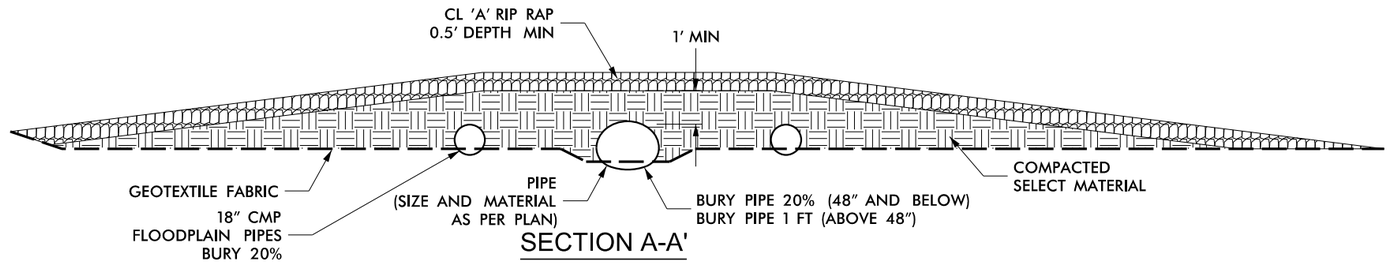
SCALE: N.T.S.



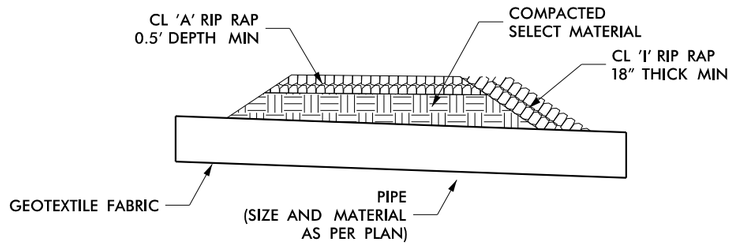
Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
6+93 -UT1-	1 at 66"x51" CSPA	39	618.3	618.1	1.0
19+04 -UT1-	1 at 66"x51" CSPA	39	609.6	609.4	1.0
27+85 -UT1-	1 at 81"x59" CSPA	42	604.1	603.9	1.0
33+66 -UT1-	1 at 81"x59" CSPA	42	600.2	599.8	1.0
12+98 -UT2-	1 at 66"x51" CSPA	39	615.3	615.1	1.0
5+34 -UT5-	1 at 42" CSP	36	603.5	603.3	0.7

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



SECTION A-A'



SECTION B-B'

7/1/2020
Brandy.Harvey
C:\Users\Brandy.Harvey\Documents\Brandy_psh_02c.dgn

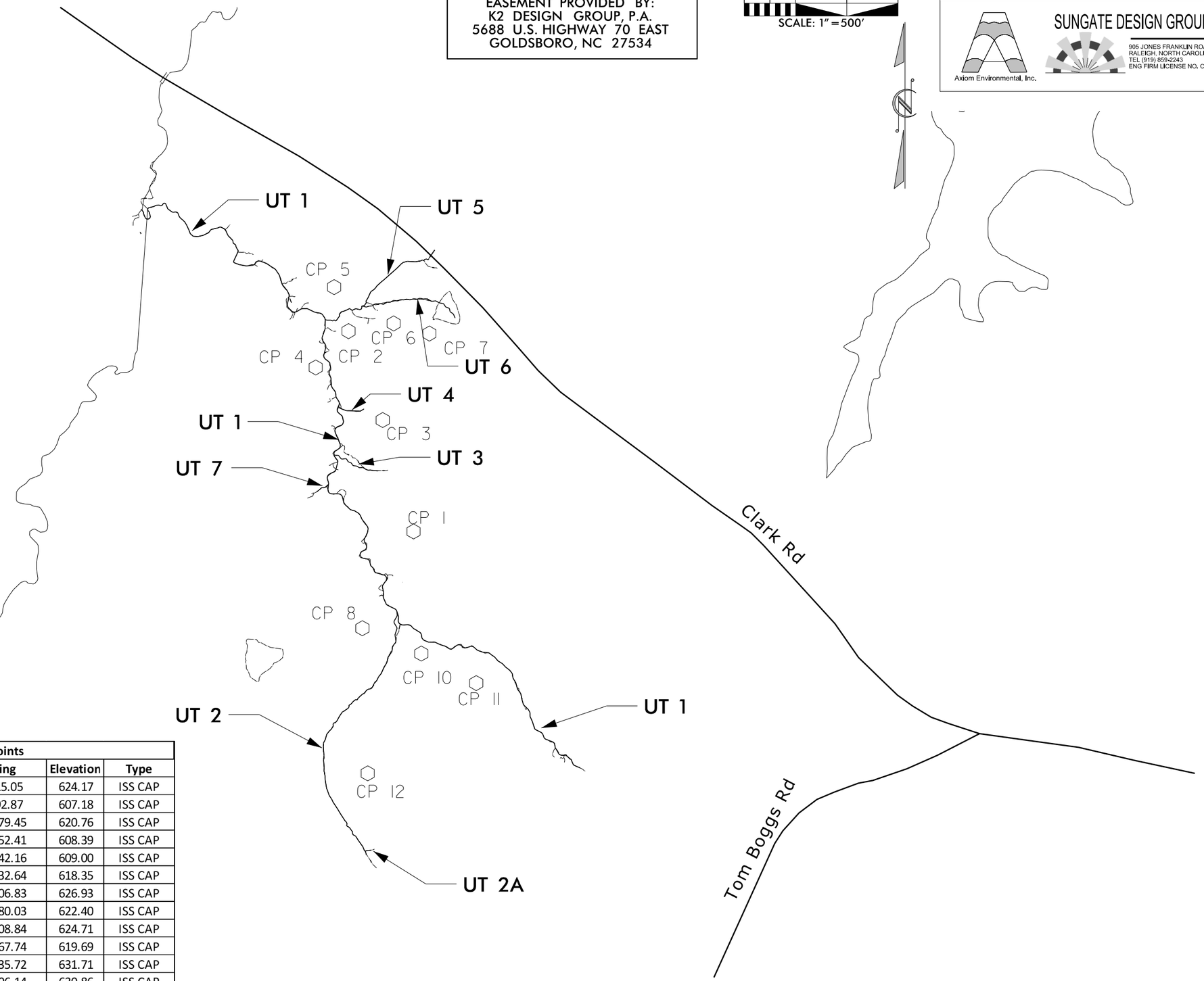
SHEET NAME		SHEET NUMBER
CONTROL POINTS		3
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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.

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

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



Brahma Control Points				
Pt ##	Northing	Easting	Elevation	Type
CP 1	1878429.90	766115.05	624.17	ISS CAP
CP 2	1878112.33	767092.87	607.18	ISS CAP
CP 3	766658.86	1878279.45	620.76	ISS CAP
CP 4	766915.68	1877952.41	608.39	ISS CAP
CP 5	767307.80	1878042.16	609.00	ISS CAP
CP 6	767130.41	1878332.64	618.35	ISS CAP
CP 7	767081.12	1878506.83	626.93	ISS CAP
CP 8	765642.87	1878180.03	622.40	ISS CAP
CP 9	765282.65	1878008.84	624.71	ISS CAP
CP 10	765519.03	1878467.74	619.69	ISS CAP
CP 11	765374.90	1878735.72	631.71	ISS CAP
CP 12	764934.43	1878206.14	630.86	ISS CAP

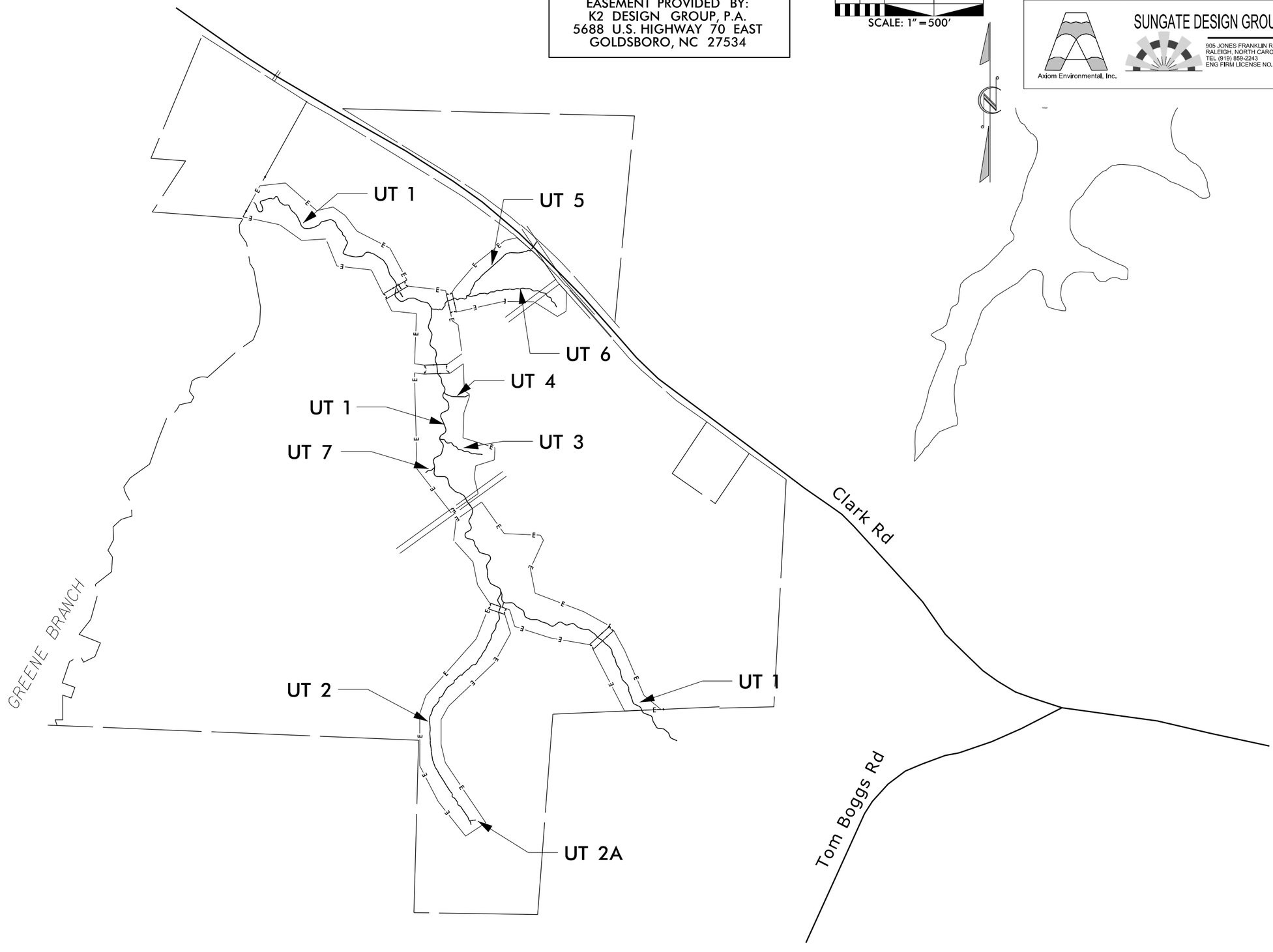
SHEET NAME		SHEET NUMBER
EASEMENT		3A
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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

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



7/7/2020
Brandon.Reddy_PSH.03A.dgn
harvey

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

SHEET NAME		SHEET NUMBER
PLAN AND PROFILE		4
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29651 JOSEPH TIMOTHY DALTON

DATE:

JIMMY LEE BROWN
& HELEN W BROWN
PIN: 8776942340
DEED BOOK: 1646
PAGE: 0865

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

0+00 -UT1-
1+00 -UT1-
2+00 -UT1-
3+00 -UT1-
4+00 -UT1-

CROSS VANE (TYP)

PROPOSED BANKFUL

LIMITS OF CONSTRUCTION

LOD

ER

PROPOSED BANKFUL
START ENHANCEMENT I
STA 2+56 -UT1-

LIMITS OF CONSTRUCTION

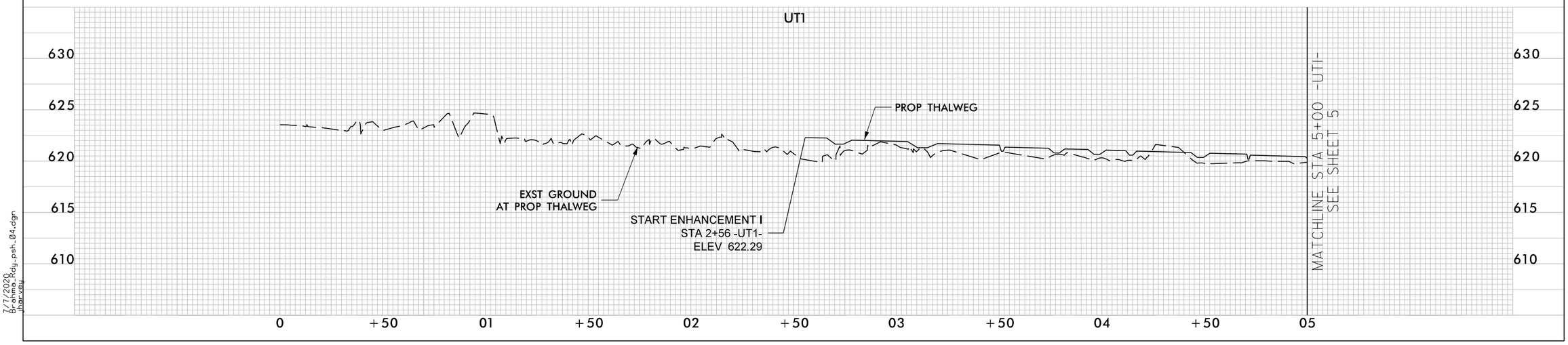
MATCHLINE STA 5+00 -UT1-
SEE SHEET 5

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	765,125.13	1,879,060.30	622.25
CROSS VANE	765,146.24	1,879,028.05	621.91
CROSS VANE	765,186.00	1,879,010.22	621.56
CROSS VANE	765,291.17	1,878,959.69	620.68



7/7/2020
BRAHMA Ready_psh_04.dgn
jhervey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	5
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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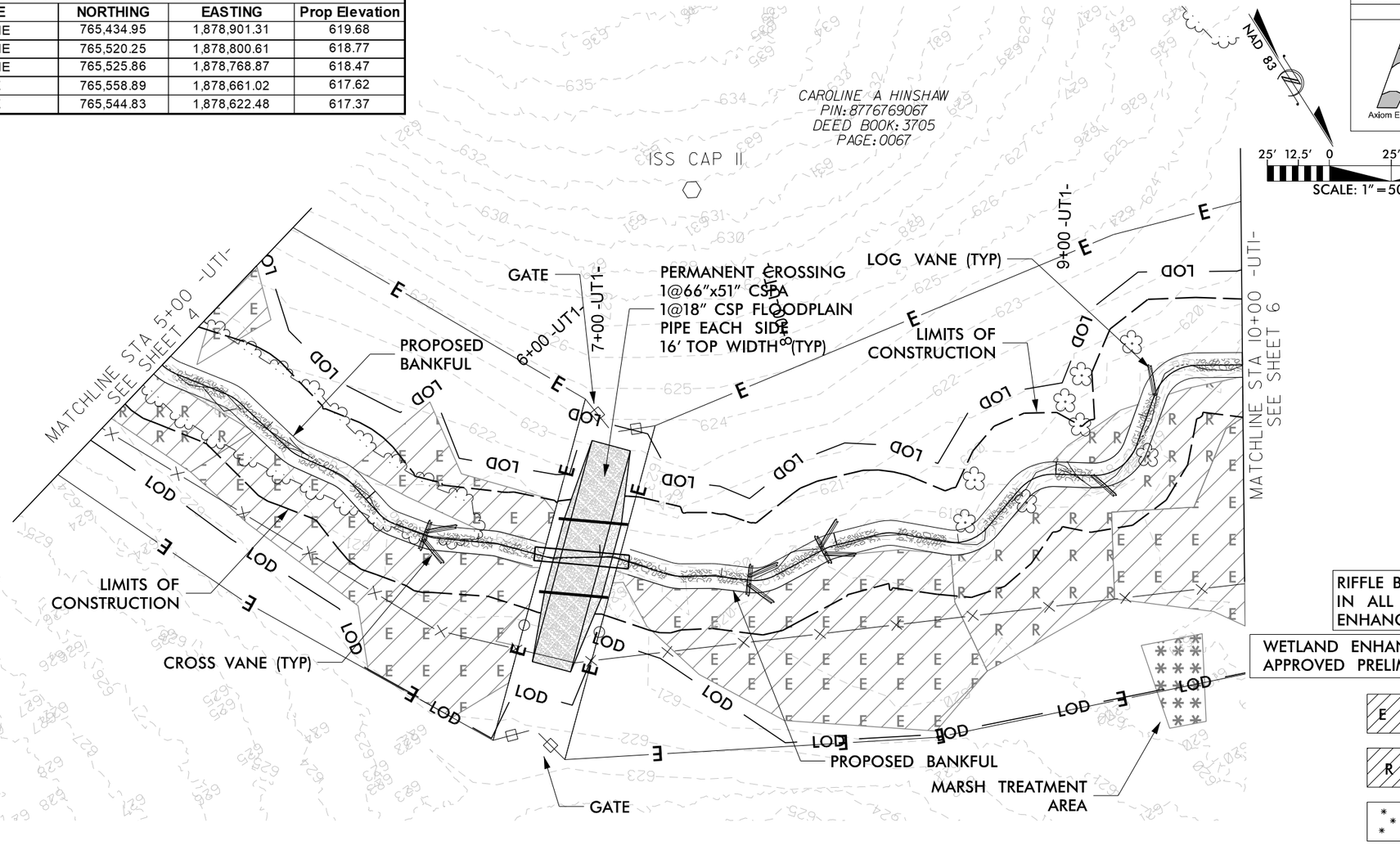
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	765,434.95	1,878,901.31	619.68
CROSS VANE	765,520.25	1,878,800.61	618.77
CROSS VANE	765,525.86	1,878,768.87	618.47
LOG VANE	765,558.89	1,878,661.02	617.62
LOG VANE	765,544.83	1,878,622.48	617.37



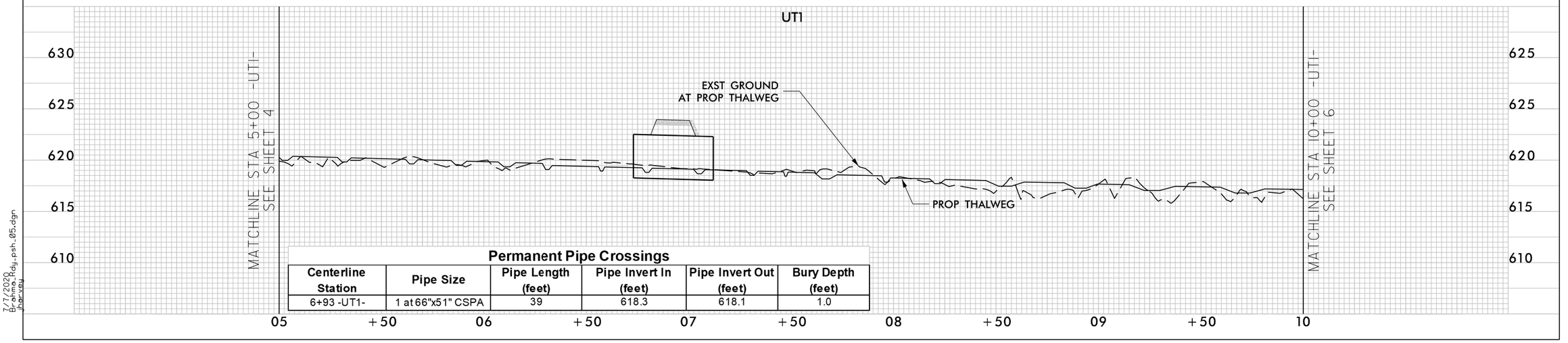
RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT



Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
6+93 -UT1-	1 at 66"x51" CSPA	39	618.3	618.1	1.0

7/7/2020
By: chorvay
I:\projects\Brahma\dgn\Brahma_psh_05.dgn
chorvay

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	6
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
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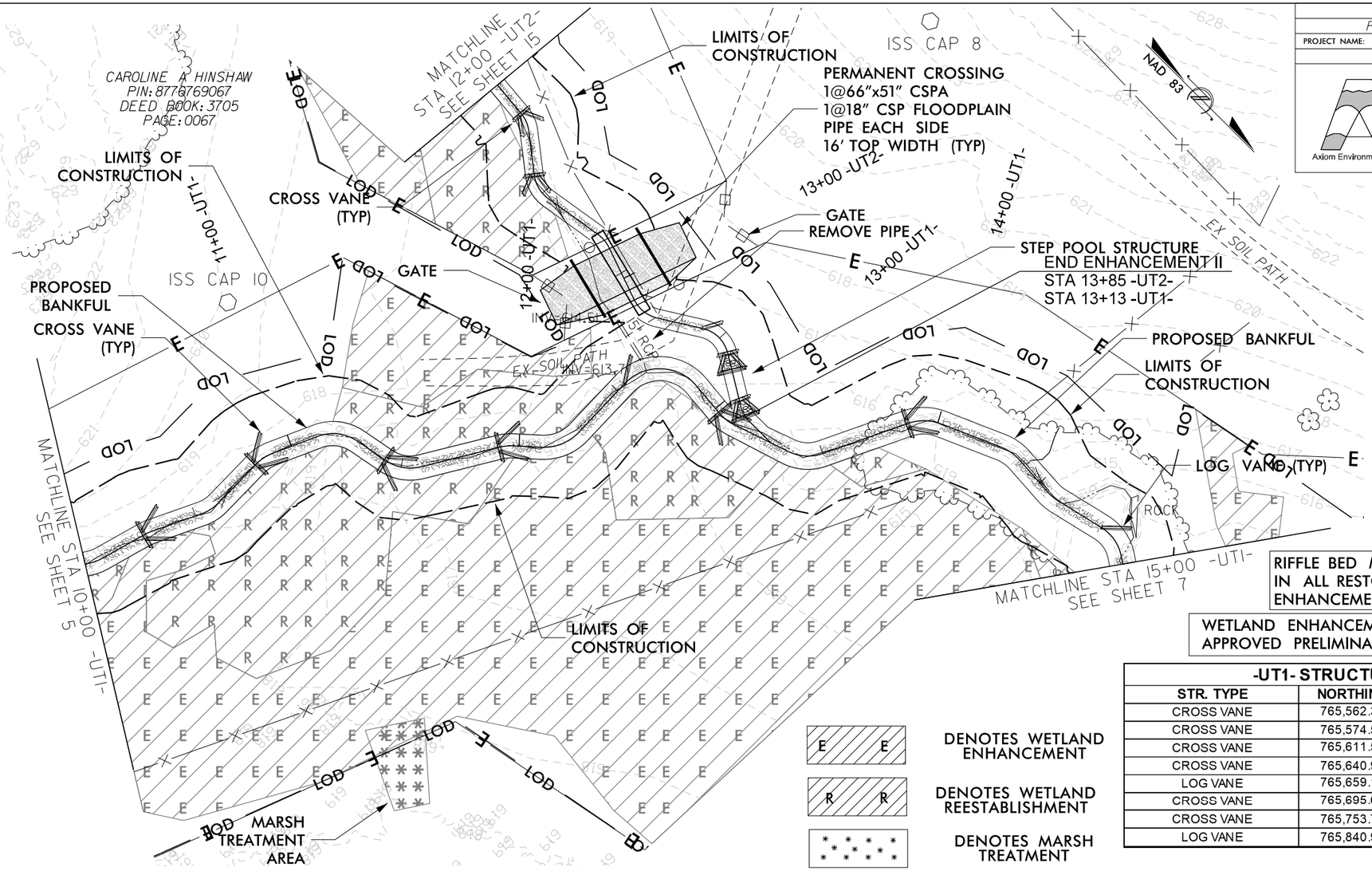
ENG FIRM LICENSE NO. C-890

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29161 JOSEPH C. DALTON

DATE:



25' 12.5' 0 25' 50'
SCALE: 1" = 50'

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT

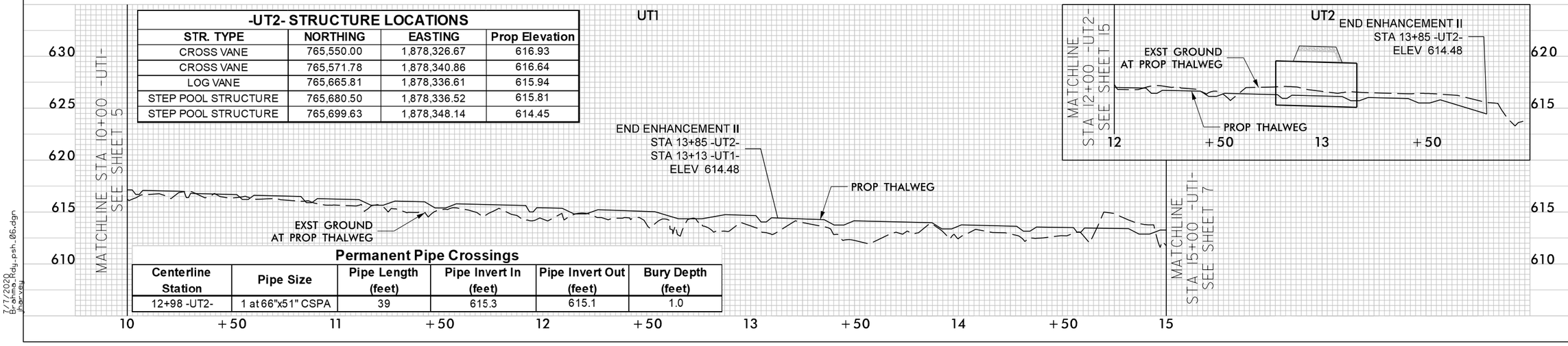
DENOTES MARSH TREATMENT

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	765,562.36	1,878,560.27	616.99
CROSS VANE	765,574.56	1,878,506.75	616.50
CROSS VANE	765,611.54	1,878,467.91	615.99
CROSS VANE	765,640.94	1,878,430.75	615.62
LOG VANE	765,659.10	1,878,375.67	615.03
CROSS VANE	765,695.61	1,878,356.54	614.65
CROSS VANE	765,753.72	1,878,304.49	613.97
LOG VANE	765,840.94	1,878,278.34	613.40

-UT2- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	765,550.00	1,878,326.67	616.93
CROSS VANE	765,571.78	1,878,340.86	616.64
LOG VANE	765,665.81	1,878,336.61	615.94
STEP POOL STRUCTURE	765,680.50	1,878,336.52	615.81
STEP POOL STRUCTURE	765,699.63	1,878,348.14	614.45



Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
12+98 -UT2-	1 at 66"x51" CSPA	39	615.3	615.1	1.0

7/7/2020
By dmoore
Rdy_psh_06.dgn
hp-xw

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	7
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH T. DALTON

DATE:

-UT1- STRUCTURE LOCATIONS

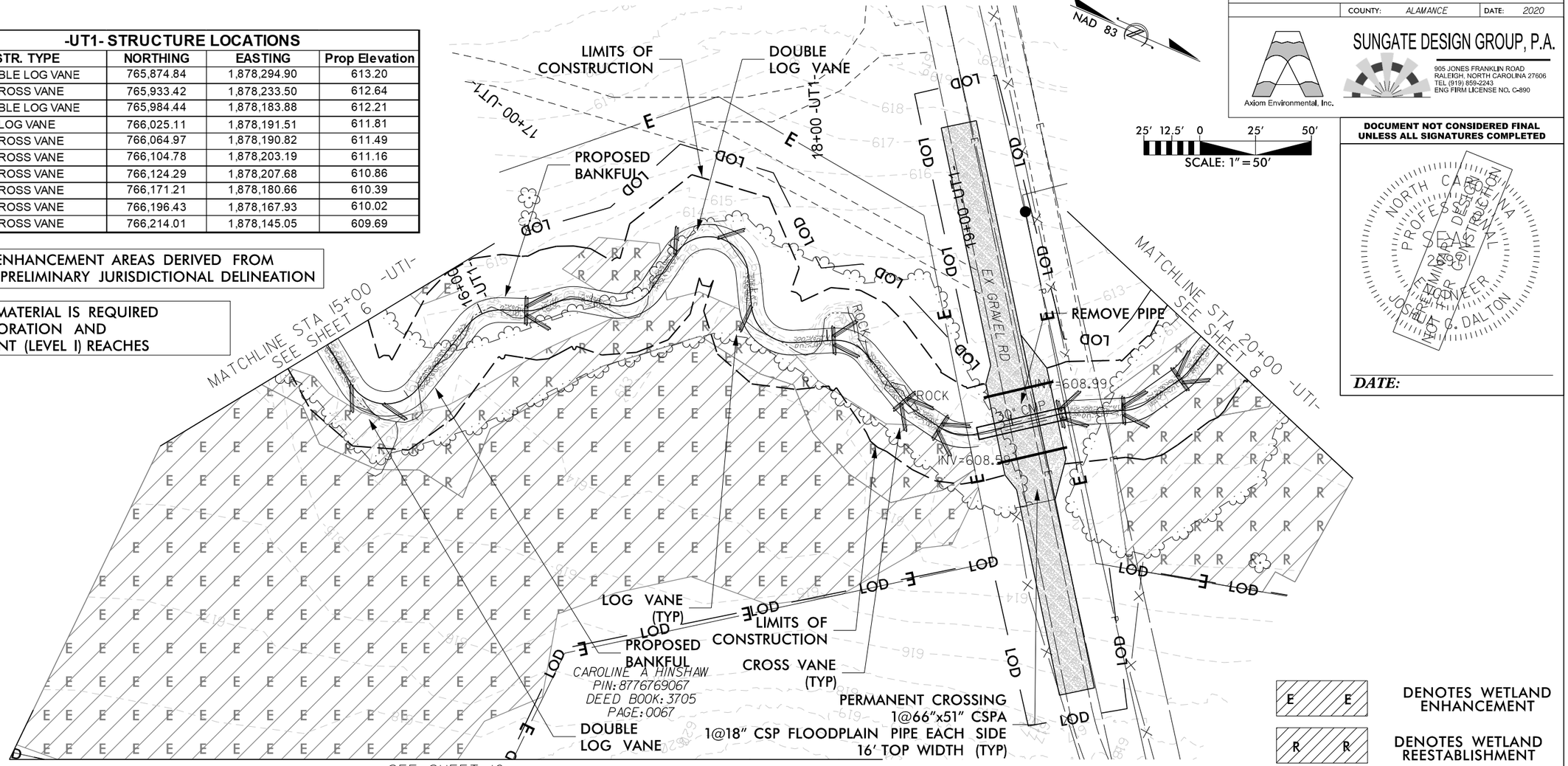
STR. TYPE	NORTHING	EASTING	Prop Elevation
DOUBLE LOG VANE	765,874.84	1,878,294.90	613.20
CROSS VANE	765,933.42	1,878,233.50	612.64
DOUBLE LOG VANE	765,984.44	1,878,183.88	612.21
LOG VANE	766,025.11	1,878,191.51	611.81
CROSS VANE	766,064.97	1,878,190.82	611.49
CROSS VANE	766,104.78	1,878,203.19	611.16
CROSS VANE	766,124.29	1,878,207.68	610.86
CROSS VANE	766,171.21	1,878,180.66	610.39
CROSS VANE	766,196.43	1,878,167.93	610.02
CROSS VANE	766,214.01	1,878,145.05	609.69

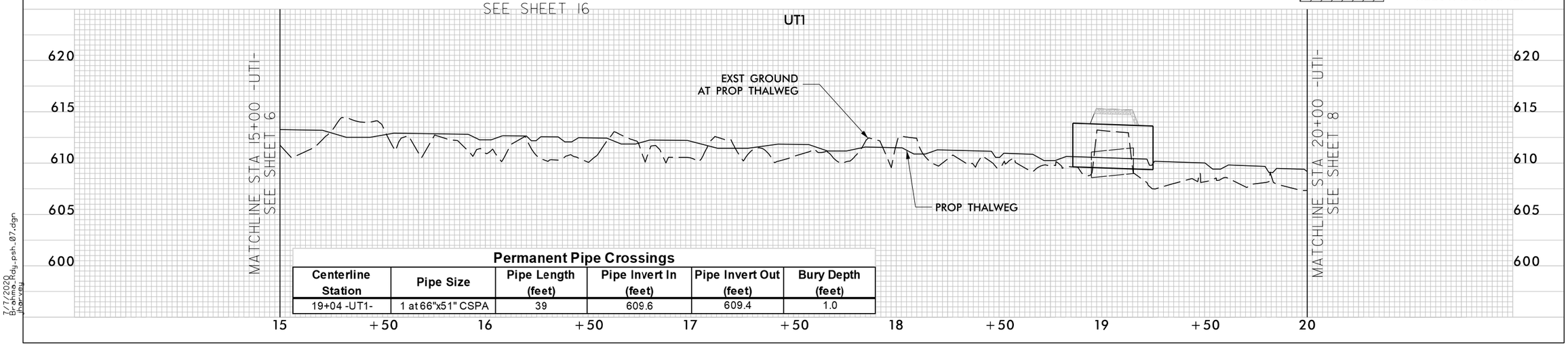
WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

NAD 83

25' 12.5' 0 25' 50'
SCALE: 1" = 50'





Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
19+04 -UT1-	1 at 66"x51" CSPA	39	609.6	609.4	1.0

7/1/2020
By: chris.hardy
J:\brahma\dwg\brahma_psh_07.dgn

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	8
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

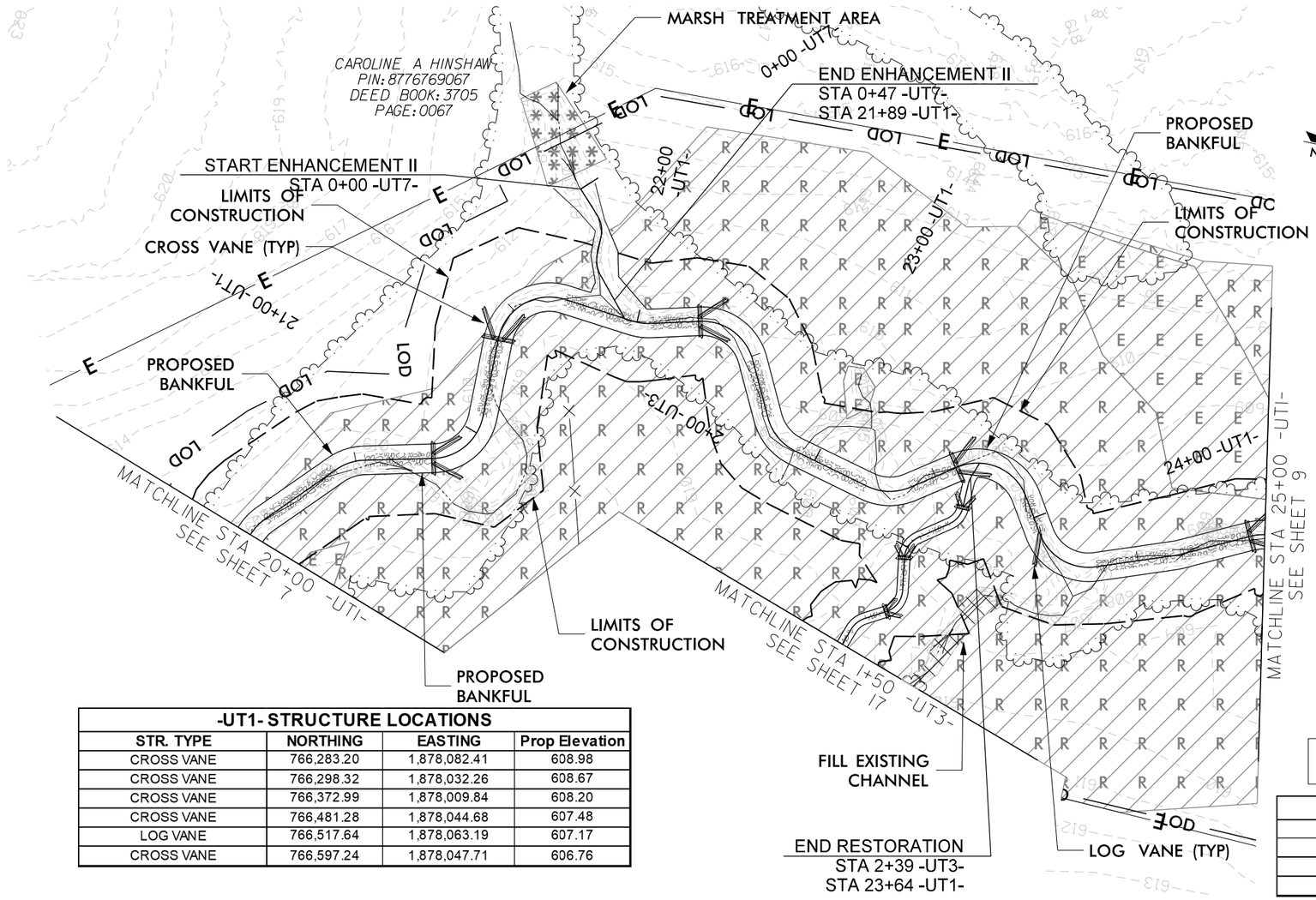
Axiom Environmental, Inc.

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

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH T. DALTON

DATE:



NAD 83

25′ 12.5′ 0 25′ 50′

SCALE: 1″ = 50′

-UT1- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	766,283.20	1,878,082.41	608.98
CROSS VANE	766,298.32	1,878,032.26	608.67
CROSS VANE	766,372.99	1,878,009.84	608.20
CROSS VANE	766,481.28	1,878,044.68	607.48
LOG VANE	766,517.64	1,878,063.19	607.17
CROSS VANE	766,597.24	1,878,047.71	606.76

E E DENOTES WETLAND ENHANCEMENT

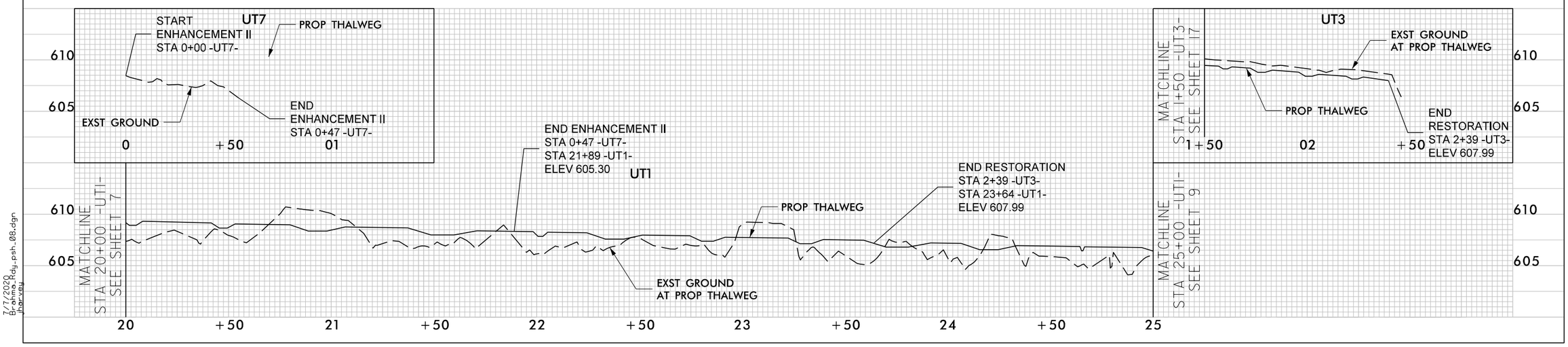
R R DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-UT3- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	766,465.95	1,878,104.62	609.20
CROSS VANE	766,468.51	1,878,082.92	608.81
CROSS VANE	766,486.64	1,878,059.38	608.34



7/1/2020
B:\Brahma\dy_psh_08.dgn
jharvey

SHEET NAME		SHEET NUMBER
PLAN AND PROFILE		9
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

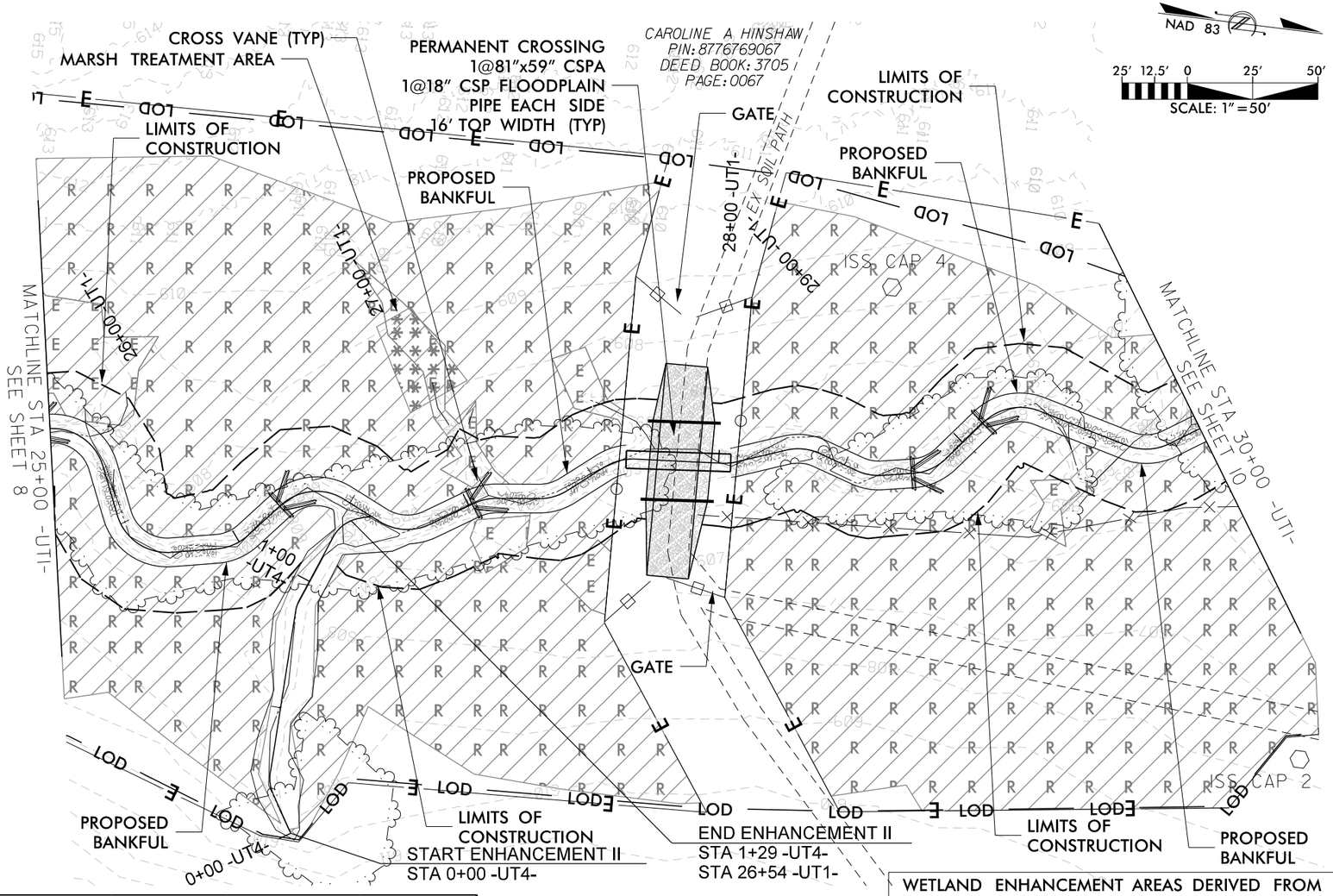
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29661 JOSEPH C. DALTON

DATE:

NAD 83

25' 12.5' 0 25' 50'

SCALE: 1" = 50'



RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

DENOTES WETLAND ENHANCEMENT

DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT

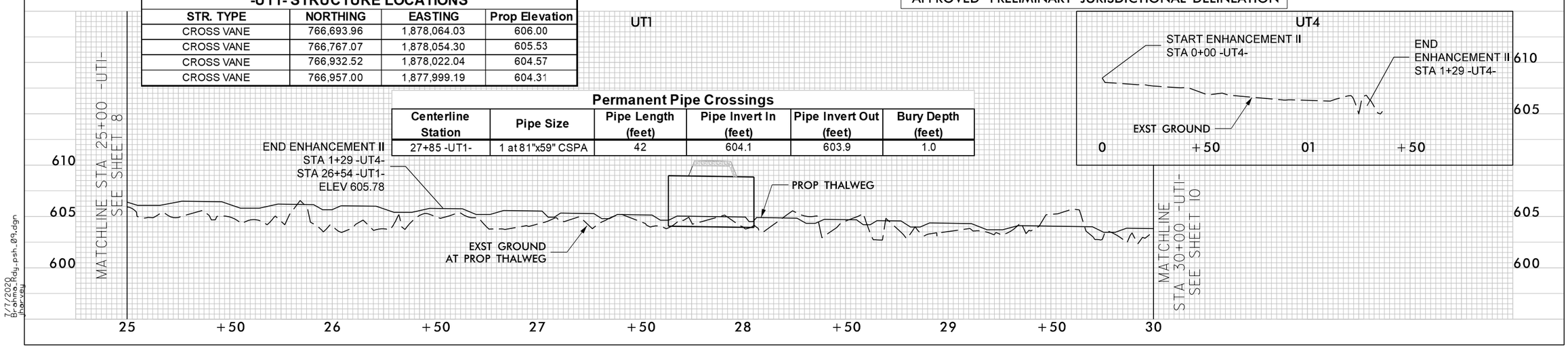
WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	766,693.96	1,878,064.03	606.00
CROSS VANE	766,767.07	1,878,054.30	605.53
CROSS VANE	766,932.52	1,878,022.04	604.57
CROSS VANE	766,957.00	1,877,999.19	604.31

Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
27+85 -UT1-	1 at 81"x59" CSPA	42	604.1	603.9	1.0



7/7/2020
By:chris.roy
Xref:Roy_psh_09.dgn
User:chris.harvey

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	10
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

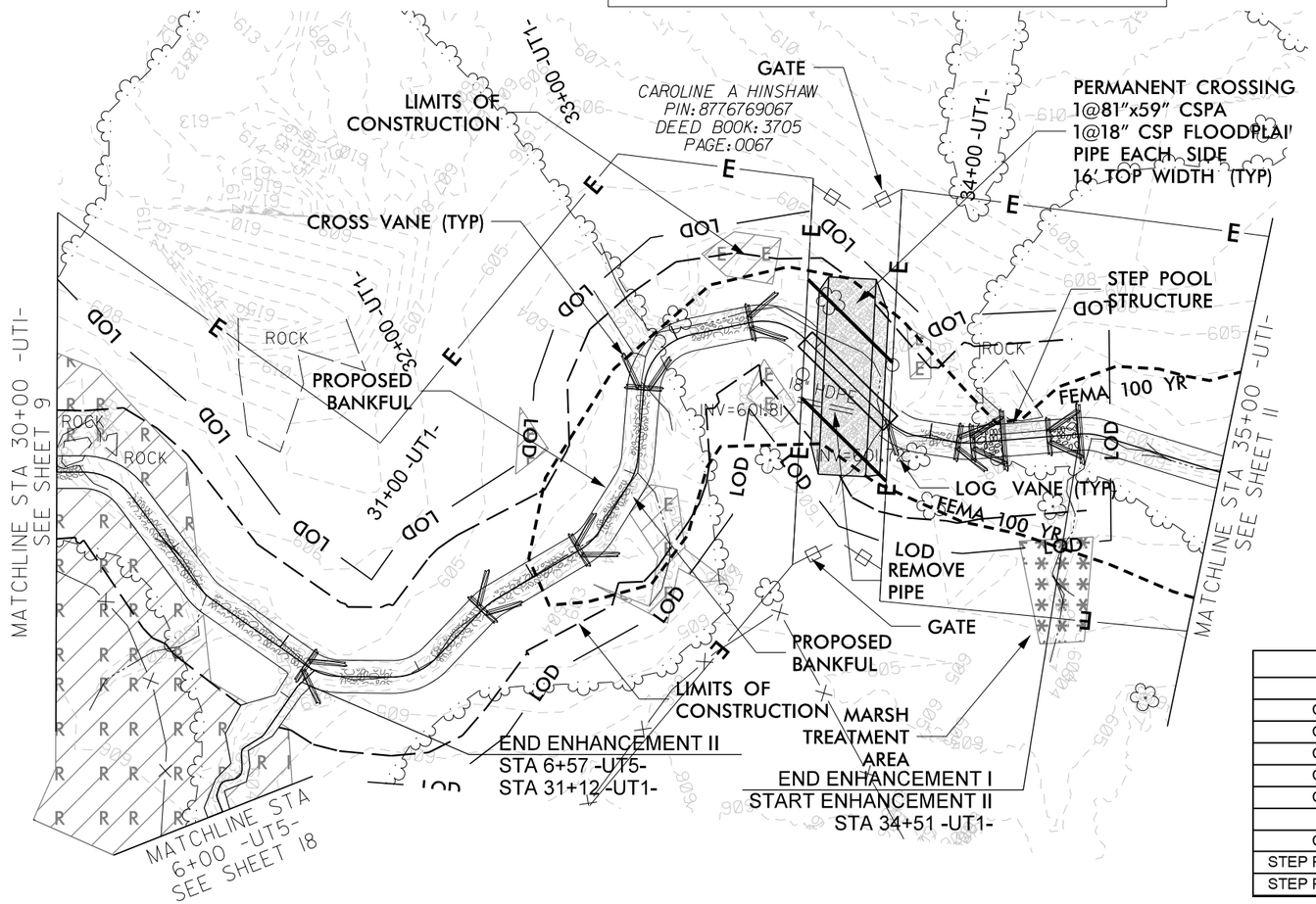
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

NAD 83

25' 12.5' 0 25' 50'
SCALE: 1" = 50'



E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT

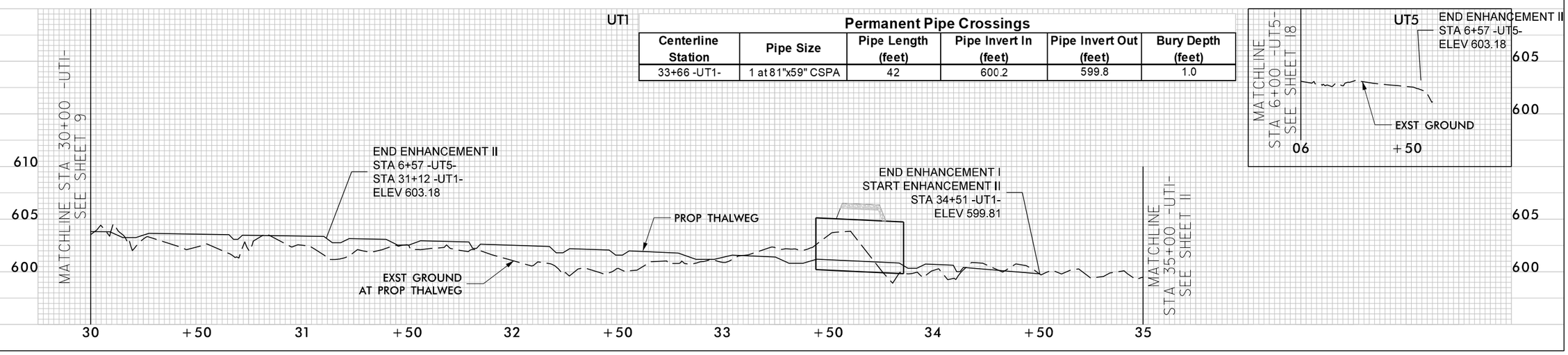
-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	767,145.52	1,877,999.38	603.36
CROSS VANE	767,184.57	1,877,950.80	602.83
CROSS VANE	767,200.70	1,877,916.10	602.40
CROSS VANE	767,188.59	1,877,858.56	601.78
CROSS VANE	767,206.36	1,877,820.32	601.40
LOG VANE	767,262.89	1,877,822.30	600.84
CROSS VANE	767,287.08	1,877,815.34	600.62
STEP POOL STRUCTURE	767,291.13	1,877,812.86	600.42
STEP POOL STRUCTURE	767,319.65	1,877,790.33	599.81

UT1

Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
33+66 -UT1-	1 at 81"x59" CSPA	42	600.2	599.8	1.0



7/1/2020
B:\brahma\dy_psh_10.dgn
jharvey

SHEET NAME		SHEET NUMBER
PLAN AND PROFILE		11
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
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ENG FIRM LICENSE NO. C-890

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

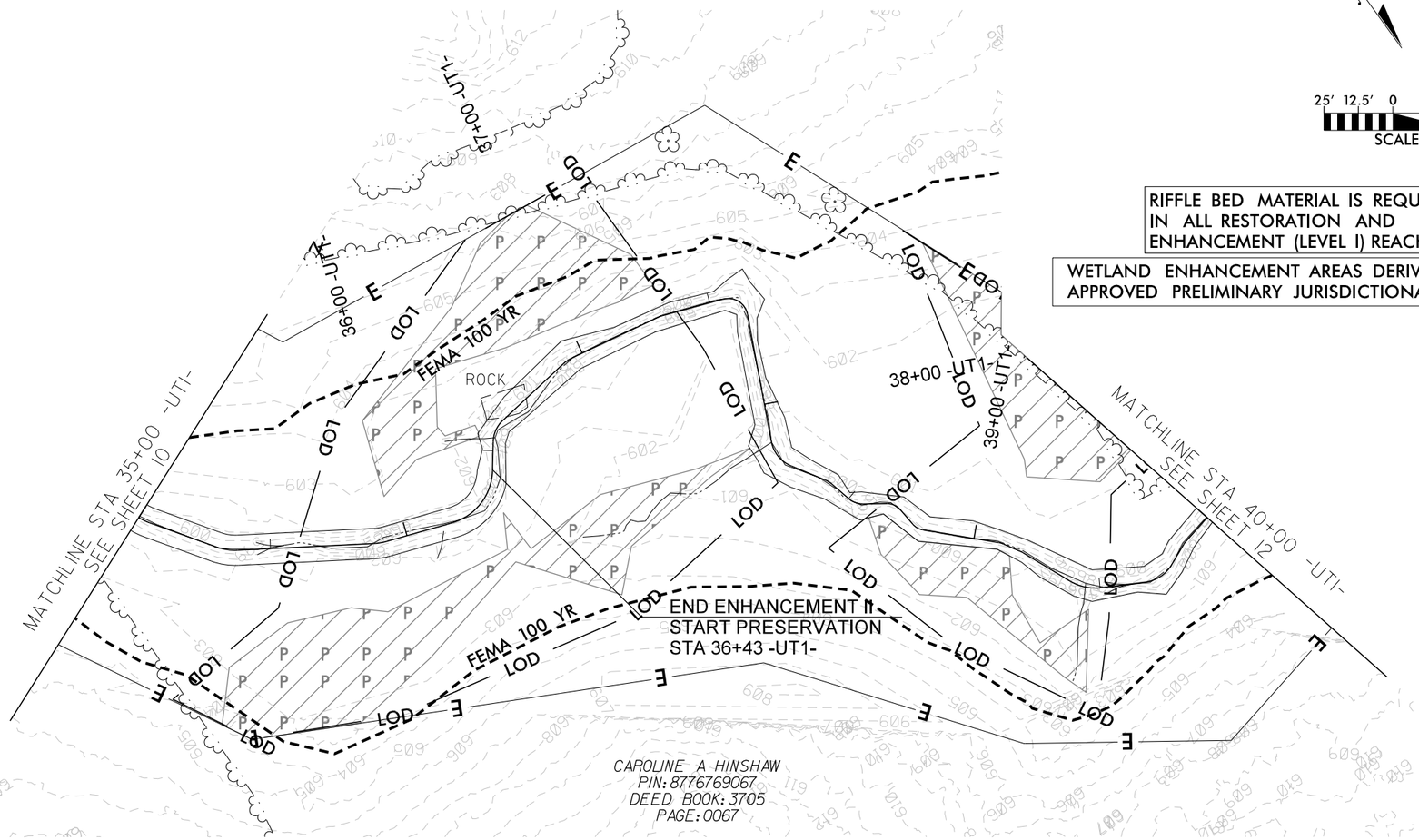
NAD 83

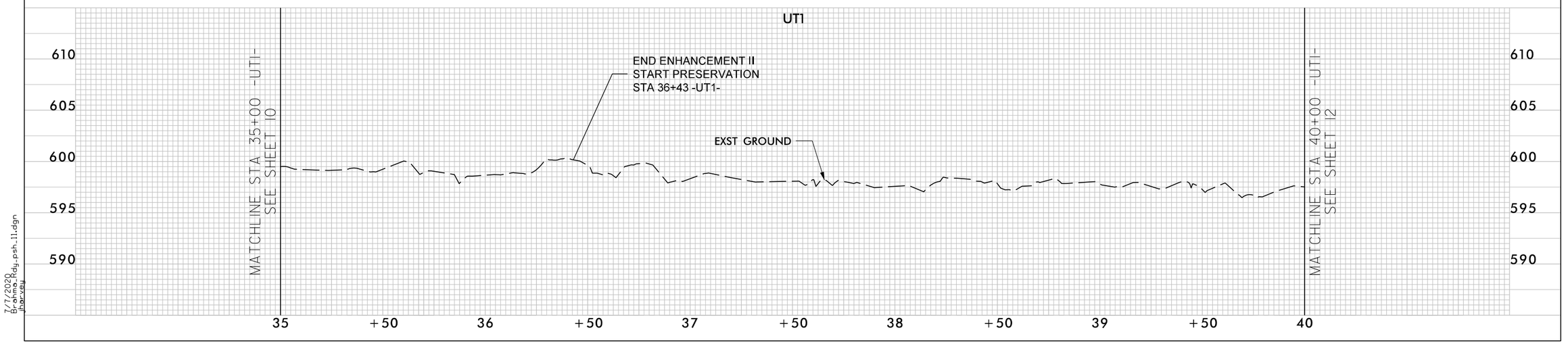
25' 12.5' 0 25' 50'
SCALE: 1" = 50'

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

P P DENOTES WETLAND PRESERVATION





7/1/2020
Brandy.Harvey
Brandy_psh_11.dgn

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	12
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH TIMOTHY DALTON

DATE:

SCALE: 1" = 50'

25' 12.5' 0 25' 50'

NAD 83

CAROLINE A HINSHAW
PIN: 8776689043
DEED BOOK: 2648
PAGE: 80

ROBERT L COOPER & SANDRA P
PIN: 8776578225
DEED BOOK: 0551
PAGE: 0579

DAVID & LISA KIME
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

41+00 -UT1-
42+00 -UT1-
43+00 -UT1-
44+00 -UT1-
45+00 -UT1-

FEMA 100 YR

LOD

E

P

ROCK

GREEN BRANCH

MATCHLINE STA 40+00 -UT1-
SEE SHEET 11

END PRESERVATION
STA 45+54 -UT1-

P P DENOTES WETLAND PRESERVATION

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

UT1

EXST GROUND

605
600
595
590
585

40 +50 41 +50 42 +50 43 +50 44 +50 45 +50

7/7/2020
brahma_dy_psh_12.dgn
jharvey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	13
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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RALEIGH, NORTH CAROLINA 27606
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ENG FIRM LICENSE NO. C-890

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29654 JOSEPH TERRY DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

ISLEY L SHOFFNER
PIN: 8776648106
DEED BOOK: 1162
PAGE: 0307

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

LIMITS OF CONSTRUCTION

PROPOSED BANKFUL

MARSH TREATMENT AREA

START ENHANCEMENT II
STA 0+00 -UT2-

0+00 -UT2-

1+00 -UT2-

2+00 -UT2-

3+00 -UT2-

4+00 -UT2-

0+00 -UT2A-

END ENHANCEMENT II
STA 0+30 -UT2A-
STA 0+20 -UT2-

START ENHANCEMENT II
STA 0+00 -UT2A-

MARSH TREATMENT AREA

BEGIN CHANNEL ENHANCEMENT
STA 4+73 -UT2-

PROPOSED BANKFUL

LIMITS OF CONSTRUCTION

EX SOIL PATH

MATCHLINE STA 5+00 -UT2-
SEE SHEET 14

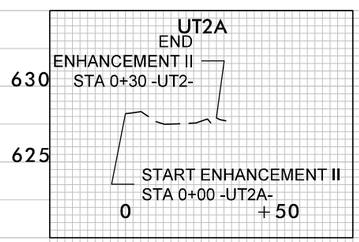
E E DENOTES WETLAND ENHANCEMENT

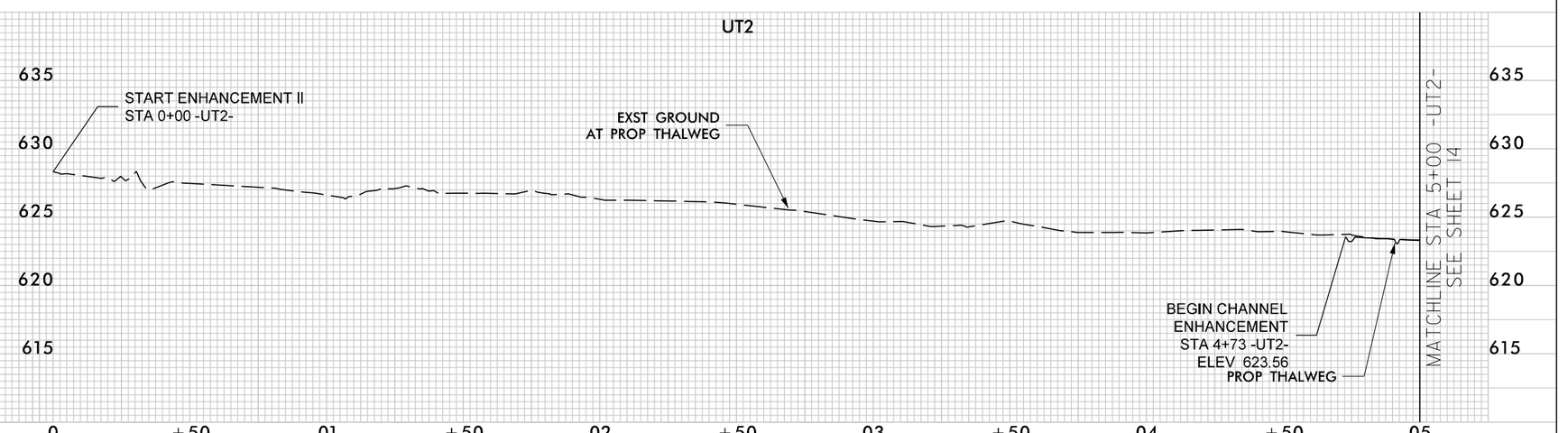
R R DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION





7/7/2020
BGrimes
Brahma_Ready_psh_13.dgn
profile_view

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	14
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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RALEIGH, NORTH CAROLINA 27606
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ENG FIRM LICENSE NO. C-890

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

ISS CAP 9

7+00 -UT2-

8+00 -UT2-

9+00 -UT2-

6+00 -UT2-

EX SOIL PATH

LIMITS OF CONSTRUCTION

PROPOSED BANKFUL

LOD

E

MATCHLINE STA 5+00 -UT2- SEE SHEET 13

CROSS VANE (TYP)

PROPOSED BANKFUL

LIMITS OF CONSTRUCTION

END CHANNEL ENHANCEMENT STA 7+07 -UT2-

BEGIN CHANNEL ENHANCEMENT STA 4+73 -UT2-

LIMITS OF CONSTRUCTION

PROPOSED BANKFUL

MATCHLINE STA 10+00 -UT2- SEE SHEET 15

R

DENOTES WETLAND ENHANCEMENT

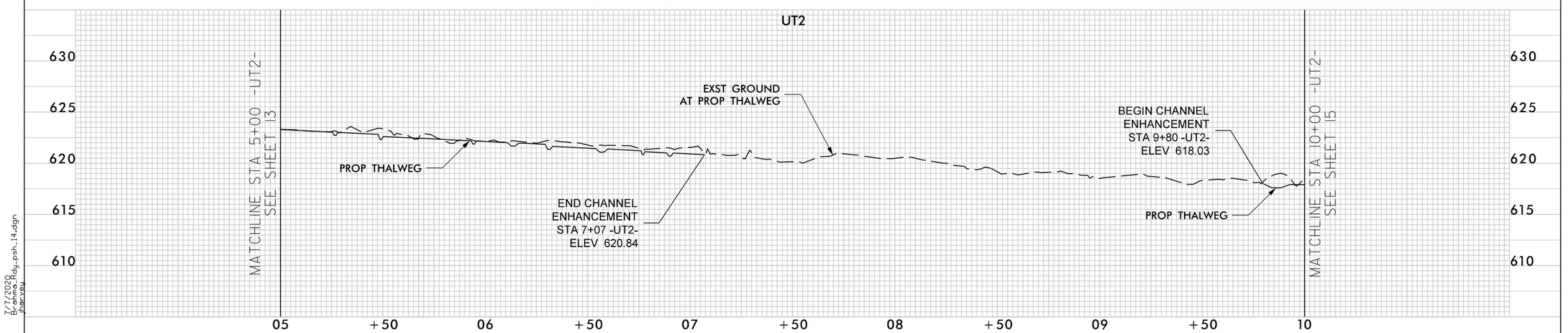
DENOTES WETLAND REESTABLISHMENT

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

-UT2- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	765,018.52	1,877,992.78	622.82
CROSS VANE	765,097.82	1,877,998.75	621.85
CROSS VANE	765,139.58	1,878,017.91	621.23

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION



7/7/2020
Brahma_rdy_psh_14.dgn
jharvey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	15
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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

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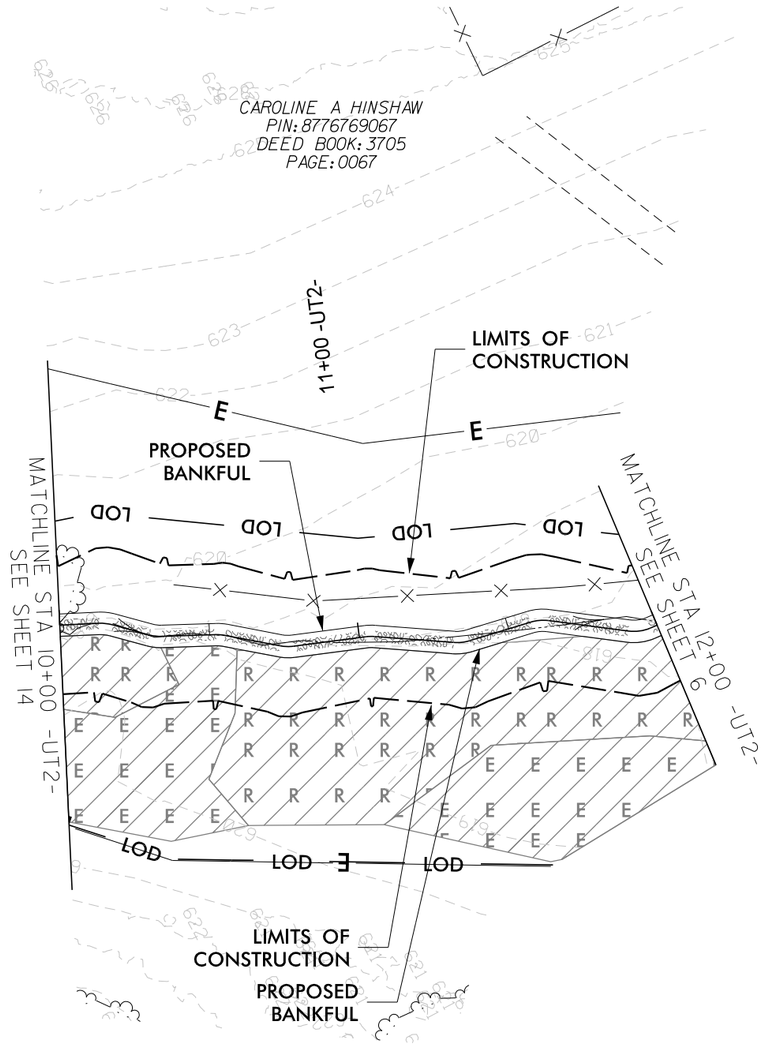
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25461 JOSEPH C. DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'
NAD 83

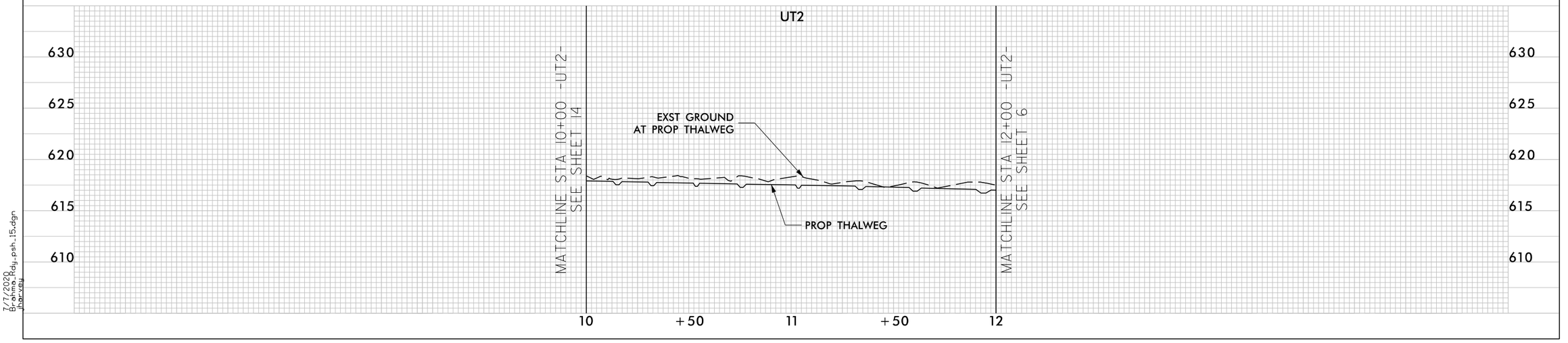


RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT



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jhar-veu

SHEET NAME		SHEET NUMBER
PLAN AND PROFILE		16
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

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

Axiom Environmental, Inc.

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26861 JOSEPH T. DALTON

DATE:

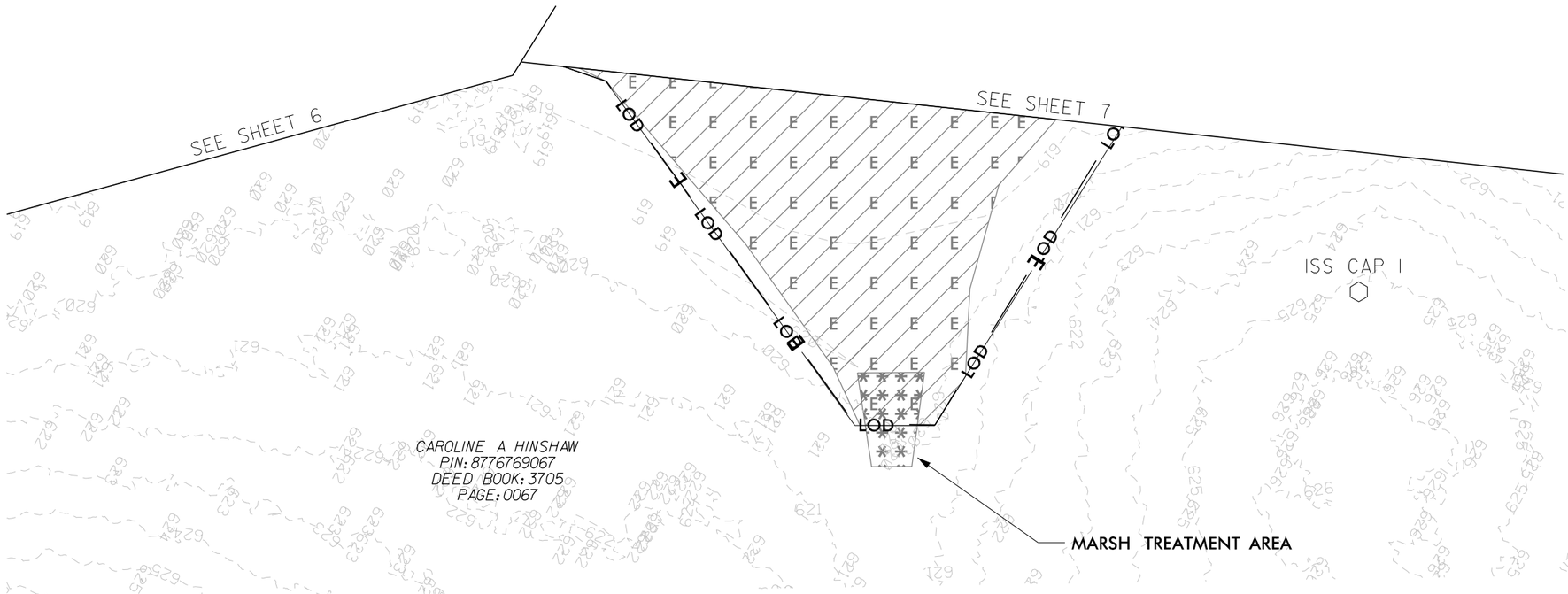
DENOTES MARSH TREATMENT

DENOTES WETLAND ENHANCEMENT

NAD 83

25′ 12.5′ 0 25′ 50′

SCALE: 1″ = 50′



WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

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jharvey
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SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	17
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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.

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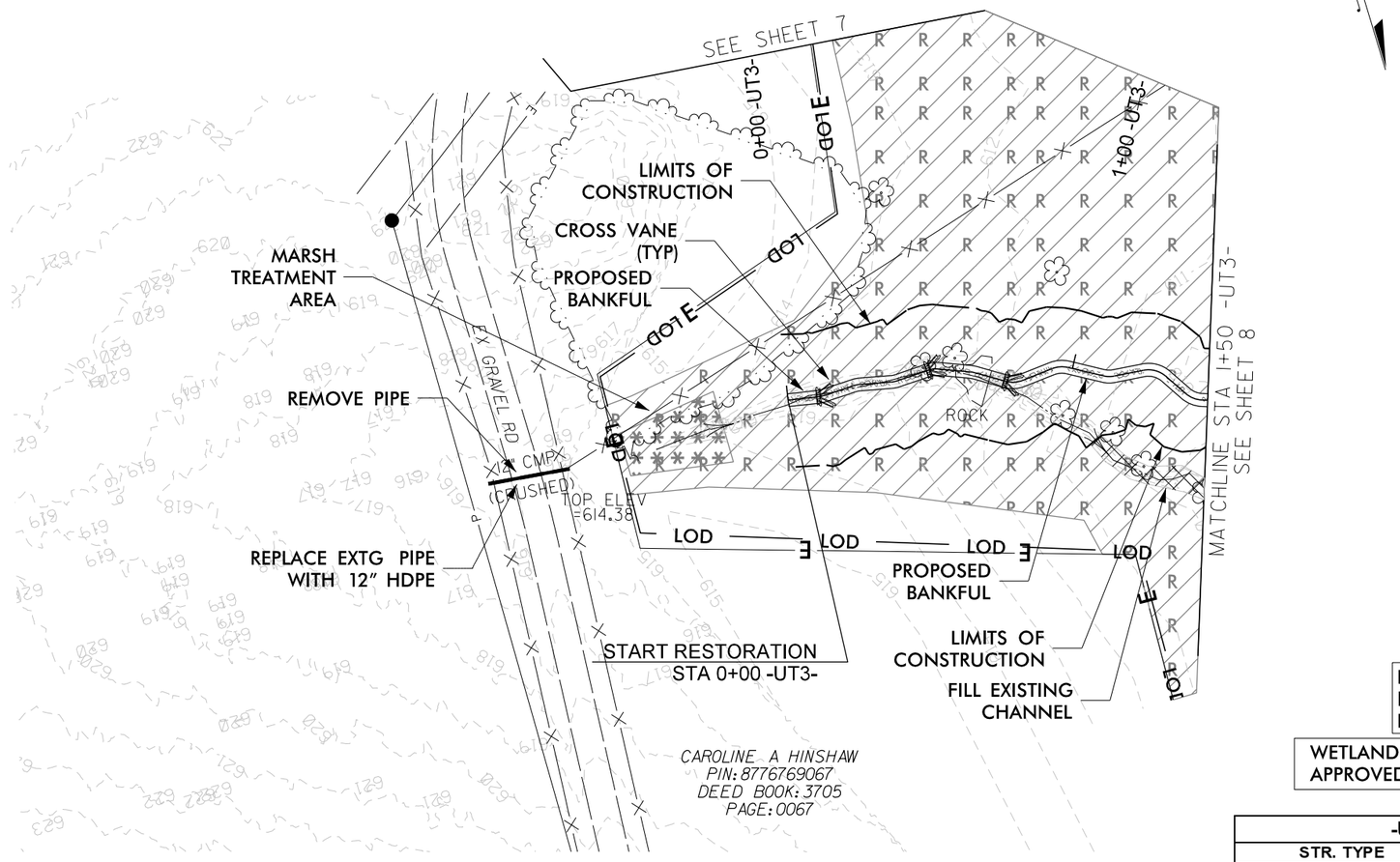
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83



R R DENOTES WETLAND REESTABLISHMENT

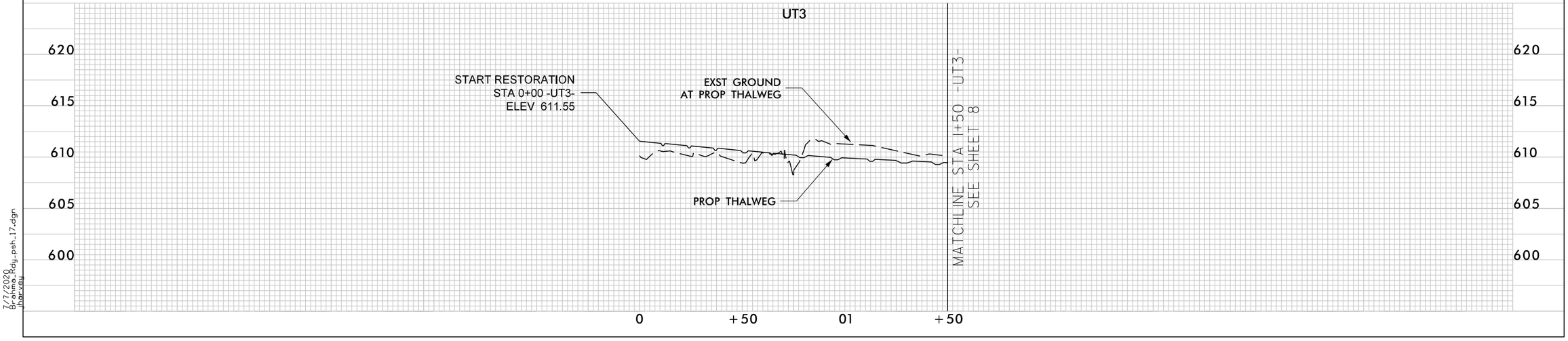
DENOTES MARSH TREATMENT

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-UT3- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	766,412.52	1,878,247.26	611.34
CROSS VANE	766,414.63	1,878,208.85	610.64
CROSS VANE	766,425.85	1,878,184.62	610.19



7/1/2020
Brandy.Harvey
C:\Users\brandy.harvey\Documents\Projects\Brahma\Plan_Sheets\brandy_psh_17.dgn

-UT6- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	767,226.16	1,878,256.47	610.76
STEP POOL STRUCTURE	767,211.32	1,878,196.28	609.17
STEP POOL STRUCTURE	767,214.52	1,878,177.81	606.71

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

E E DENOTES WETLAND ENHANCEMENT

R R DENOTES WETLAND REESTABLISHMENT

DENOTES MARSH TREATMENT

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	18
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH C. DALTON

DATE:

END RESTORATION
STA 5+01 -UT6-
STA 4+60 -UT5-

MATCHLINE STA 4+00 -UT6- SEE SHEET 19

SEE SHEET 19

SEE SHEET 9

MATCHLINE STA 6+00 -UT5- SEE SHEET 10

0+00 -UT5-

1+00 -UT5-

2+00 -UT5-

3+00 -UT5-

4+00 -UT5-

5+00 -UT6-

SR 2352 (CLARK RD)

R/W

50' RCP

INV=616.36

CROSS VANE (TYP)

LIMITS OF CONSTRUCTION

PROPOSED BANKFUL

STEP POOL STRUCTURE

MARSH TREATMENT AREA

ROCK

LOD

EX SOIL RD

PERMANENT PIPE CROSSING
1@42" CSP

START ENHANCEMENT II
STA 0+00 -UT5-

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

ISS CAP 5

UT5

EXST GROUND

START ENHANCEMENT II
STA 0+00 -UT5-

END RESTORATION
STA 5+01 -UT6-
STA 4+60 -UT5-
ELEV 606.71

620
615
610
605
600

0 +50 01 +50 02 +50 03 +50 04 +50 05 +50 06

UT6

EXST GROUND AT PROP THALWEG

PROP THALWEG

END RESTORATION
STA 5+01 -UT6-
ELEV 608.72

MATCHLINE STA 4+00 -UT6- SEE SHEET 19

MATCHLINE STA 6+00 -UT5- SEE SHEET 10

610
605

04 +50 05

Permanent Pipe Crossings

Centerline Station	Pipe Size	Pipe Length (feet)	Pipe Invert In (feet)	Pipe Invert Out (feet)	Bury Depth (feet)
5+34 -UT5-	1 at 42" CSP	36	603.5	603.3	0.7

7/7/2020
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jharvey

SHEET NAME	SHEET NUMBER
PLAN AND PROFILE	19
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

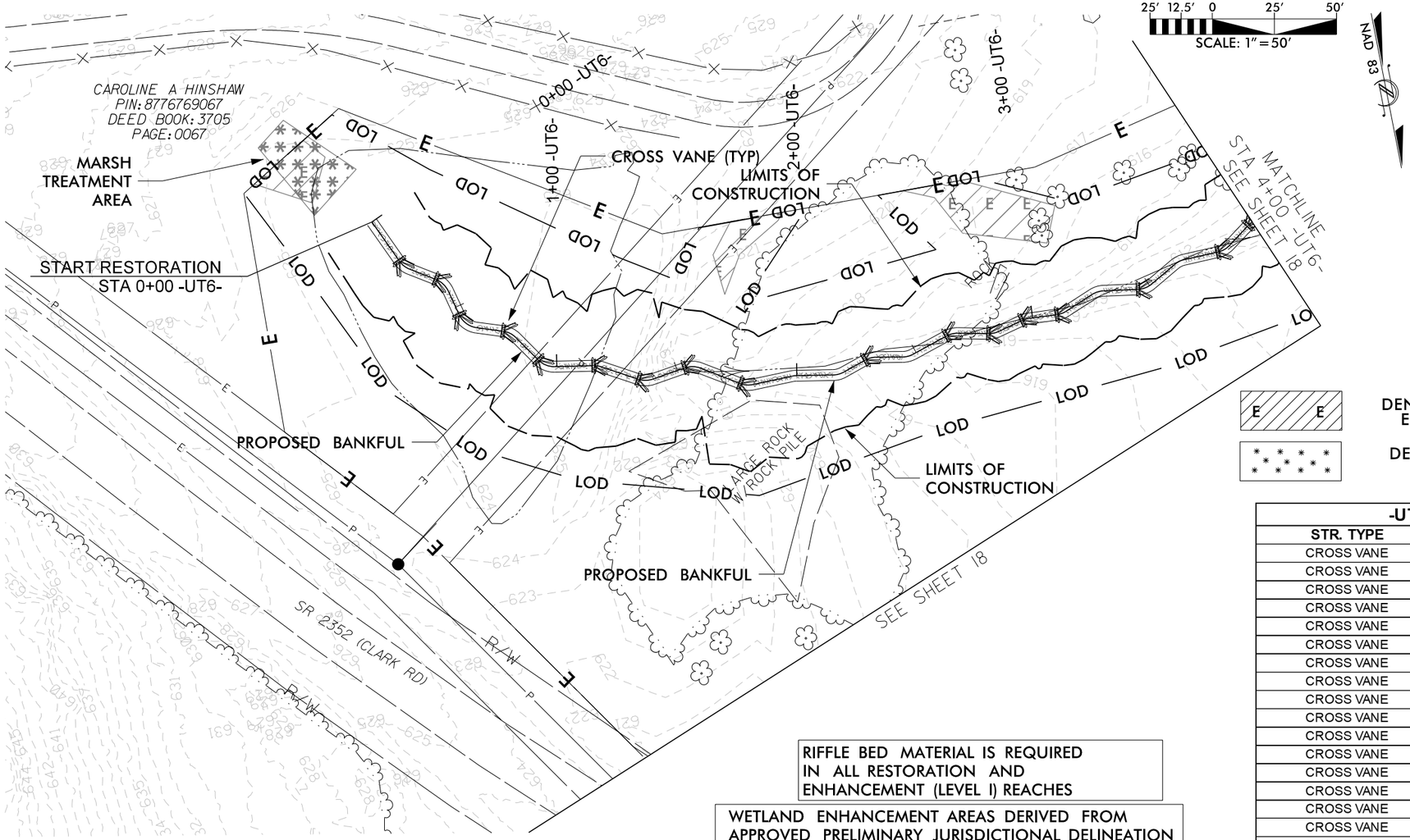
Axiom Environmental, Inc.

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

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25451 JOSEPH C. DALTON

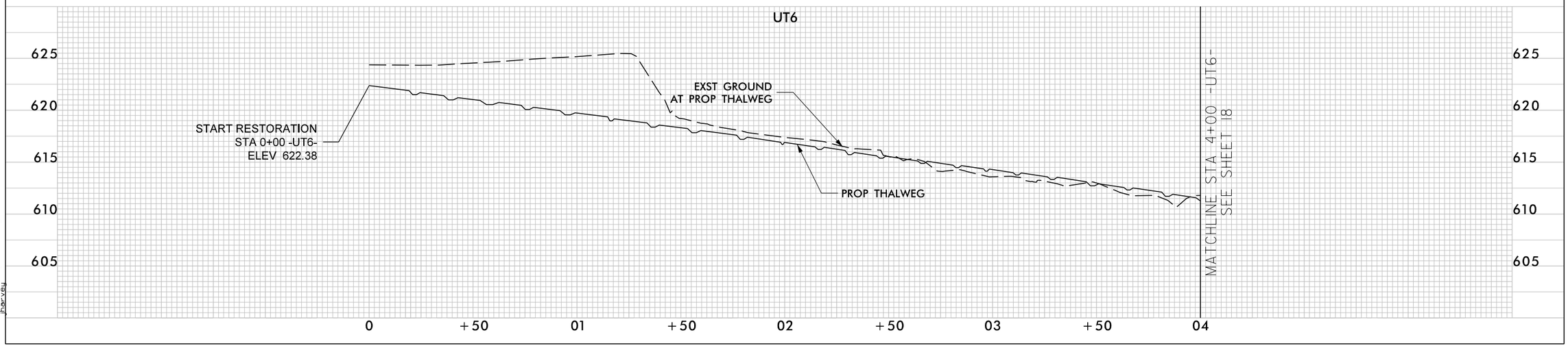
DATE:



-UT6- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	767,174.58	1,878,624.76	621.90
CROSS VANE	767,184.61	1,878,611.75	621.41
CROSS VANE	767,200.41	1,878,605.30	620.95
CROSS VANE	767,210.24	1,878,589.25	620.48
CROSS VANE	767,224.38	1,878,577.54	619.96
CROSS VANE	767,230.86	1,878,556.18	619.37
CROSS VANE	767,239.65	1,878,539.53	618.78
CROSS VANE	767,238.75	1,878,520.34	618.24
CROSS VANE	767,249.22	1,878,499.62	617.60
CROSS VANE	767,249.58	1,878,448.52	616.13
CROSS VANE	767,246.33	1,878,414.57	615.11
CROSS VANE	767,248.68	1,878,397.88	614.71
CROSS VANE	767,246.05	1,878,383.56	614.35
CROSS VANE	767,246.46	1,878,369.40	613.99
CROSS VANE	767,242.71	1,878,335.38	613.12
CROSS VANE	767,234.16	1,878,301.06	612.11
CROSS VANE	767,225.97	1,878,287.00	611.57

RIFFLE BED MATERIAL IS REQUIRED IN ALL RESTORATION AND ENHANCEMENT (LEVEL I) REACHES

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION



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8/6/2020
phavey
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SHEET NAME	SHEET NUMBER
EROSION CONTROL NOTES	E2
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26601 JOSHUA C. DALTON

DATE:

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 sheet E03E) from Secondary Road 1414 (Braswell Road) will be installed for access to the UT1and UT2 as shown on the Erosion Control Plans.

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 and UT2). 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.

6. Boulders and materials used for stream structures will be delivered through the primary construction entrance and stockpiled in the appropriate area.

7. This project will require pumping water around the channels during construction. Work will generally proceed from upstream to downstream.

8. Adjust haul roads and associated silt fence as necessary when permanent stream crossings are installed.

SHEET NAME	SHEET NUMBER
EROSION CONTROL NOTES	E2A
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26601 JOSHUA C. DALTON

DATE:

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.-Working Sections below 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.

Table 1. - Working Sections

Order of Progress	Pump Station #	Reach	Begin Station	End Station	Construction Notes
1	P-1	**UT1**	2+56	5+50	
2	P-2	**UT1**	5+50	8+50	Construct Stream Crossing.
3	P-3	**UT1**	8+50	11+50	
4	P-4	**UT1**	11+50	12+85	
5	P-5	**UT2**	4+73	7+07	Perform UT2A enhancements.
6	P-6	**UT2**	9+79	12+50	
7	P-7	**UT2**	12+50	13+85	Operate pump stations P-7 and P-8 simultaneously to build confluence of UT1 and UT2. Construct Stream Crossing.
8	P-8	**UT1**	12+85	14+50	
9	P-9	**UT1**	14+50	17+50	
10	P-10	**UT1**	17+50	20+50	Construct Stream Crossing.
11	P-11	**UT1**	20+50	23+50	Perform UT7 enhancements.
12	P-12	**UT3**	0+00	2+39	Operate pump stations P-12 and P-13 simultaneously to build confluence of UT1 and UT3.
13	P-13	**UT1**	23+50	24+00	
14	P-14	**UT1**	24+00	26+00	
15	P-15	**UT1**	26+00	27+50	Perform UT4 enhancements.
16	P-16	**UT1**	27+50	30+50	Construct Stream Crossing.
17	P-17	**UT6**	0+00	3+00	
18	P-18	**UT6**	3+00	5+01	Operate pump stations P-18 and P-19 simultaneously to build confluence of UT5 and UT6. Construct Step Pool Structure. No restoration on UT5.
19	P-19	**UT5**	4+15	4+50	
19	P-20	**UT1**	30+50	32+50	
20	P-21	**UT1**	32+50	34+51	Construct Stream Crossing and Step Pool Structure.

CONSTRUCTION SEQUENCE (CONTINUED)

1. Ponds shall be dewatered prior to dam removal using the following methods:

   a. 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.

   b. 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.

2. 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, UT2A, UT3, UT4, UT5, UT6, and UT7) in accordance with the Planting Plans.

3. Once channel construction and seeding has been complete, bare-rooted seedlings will be installed.

4. All haul road locations to be restored to pre-construction conditions.

SHEET NAME	SHEET NUMBER
EROSION CONTROL NOTES	E2B
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26601 JOSHUA D. DALTON

DATE:

EROSION CONTROL CONSTRUCTION SEQUENCE

1. Obtain grading permit.
2. Install temporary construction entrance, 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:
   a. Slopes between 2:1 and 3:1, with a slope length of 10 feet or less
   b. Slopes 3:1 or flatter, with a slope length of 50 feet or less
   c. 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.

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.

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.

7/7/2020
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SHEET NAME	SHEET NUMBER
EROSION CONTROL NOTES	E2C
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29611 JOSHUA O. DALTON

DATE:

GROUND STABILIZATION AND MATERIALS HANDLING PRACTICES FOR COMPLIANCE WITH THE NCG01 CONSTRUCTION GENERAL PERMIT

Implementing the details and specifications on this plan sheet will result in the construction activity being considered compliant with the Ground Stabilization and Materials Handling sections of the NCG01 Construction General Permit (Sections E and F, respectively). The permittee shall comply with the Erosion and Sediment Control plan approved by the delegated authority having jurisdiction. All details and specifications shown on this sheet may not apply depending on site conditions and the delegated authority having jurisdiction.

SECTION E: GROUND STABILIZATION

Required Ground Stabilization Timeframes

Site Area Description	Stabilize within this many calendar days after ceasing land disturbance	Timeframe variations
(a) Perimeter dikes, swales, ditches, and perimeter slopes	7	None
(b) High Quality Water (HQW) Zones	7	None
(c) Slopes steeper than 3:1	7	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed
(d) Slopes 3:1 to 4:1	14	-7 days for slopes greater than 50' in length and with slopes steeper than 4:1 -7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones -10 days for Falls Lake Watershed
(e) Areas with slopes flatter than 4:1	14	-7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones -10 days for Falls Lake Watershed unless there is zero slope

Note: After the permanent cessation of construction activities, any areas with temporary ground stabilization shall be converted to permanent ground stabilization as soon as practicable but in no case longer than 90 calendar days after the last land disturbing activity. Temporary ground stabilization shall be maintained in a manner to render the surface stable against accelerated erosion until permanent ground stabilization is achieved.

GROUND STABILIZATION SPECIFICATION

Stabilize the ground sufficiently so that rain will not dislodge the soil. Use one of the techniques in the table below:

Temporary Stabilization	Permanent Stabilization
• Temporary grass seed covered with straw or other mulches and tackifiers • Hydroseeding • Rolled erosion control products with or without temporary grass seed • Appropriately applied straw or other mulch • Plastic sheeting	• Permanent grass seed covered with straw or other mulches and tackifiers • Geotextile fabrics such as permanent soil reinforcement matting • Hydroseeding • Shrubs or other permanent plantings covered with mulch • Uniform and evenly distributed ground cover sufficient to restrain erosion • Structural methods such as concrete, asphalt or retaining walls • Rolled erosion control products with grass seed

POLYACRYLAMIDES (PAMS) AND FLOCCULANTS

1. Select flocculants that are appropriate for the soils being exposed during construction, selecting from the *NC DWR List of Approved PAMS/Flocculants*.
2. Apply flocculants at or before the inlets to Erosion and Sediment Control Measures.
3. Apply flocculants at the concentrations specified in the *NC DWR List of Approved PAMS/Flocculants* and in accordance with the manufacturer's instructions.
4. Provide ponding area for containment of treated Stormwater before discharging offsite.
5. Store flocculants in leak-proof containers that are kept under storm-resistant cover or surrounded by secondary containment structures.

EQUIPMENT AND VEHICLE MAINTENANCE

1. Maintain vehicles and equipment to prevent discharge of fluids.
2. Provide drip pans under any stored equipment.
3. Identify leaks and repair as soon as feasible, or remove leaking equipment from the project.
4. Collect all spent fluids, store in separate containers and properly dispose as hazardous waste (recycle when possible).
5. Remove leaking vehicles and construction equipment from service until the problem has been corrected.
6. Bring used fuels, lubricants, coolants, hydraulic fluids and other petroleum products to a recycling or disposal center that handles these materials.

LITTER, BUILDING MATERIAL AND LAND CLEARING WASTE

1. Never bury or burn waste. Place litter and debris in approved waste containers.
2. Provide a sufficient number and size of waste containers (e.g dumpster, trash receptacle) on site to contain construction and domestic wastes.
3. Locate waste containers at least 50 feet away from storm drain inlets and surface waters unless no other alternatives are reasonably available.
4. Locate waste containers on areas that do not receive substantial amounts of runoff from upland areas and does not drain directly to a storm drain, stream or wetland.
5. Cover waste containers at the end of each workday and before storm events or provide secondary containment. Repair or replace damaged waste containers.
6. Anchor all lightweight items in waste containers during times of high winds.
7. Empty waste containers as needed to prevent overflow. Clean up immediately if containers overflow.
8. Dispose waste off-site at an approved disposal facility.
9. On business days, clean up and dispose of waste in designated waste containers.

PAINT AND OTHER LIQUID WASTE

1. Do not dump paint and other liquid waste into storm drains, streams or wetlands.
2. Locate paint washouts at least 50 feet away from storm drain inlets and surface waters unless no other alternatives are reasonably available.
3. Contain liquid wastes in a controlled area.
4. Containment must be labeled, sized and placed appropriately for the needs of site.
5. Prevent the discharge of soaps, solvents, detergents and other liquid wastes from construction sites.

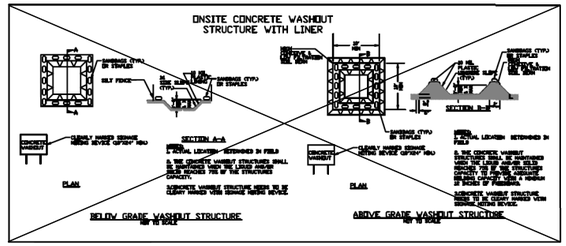
PORTABLE TOILETS

1. Install portable toilets on level ground, at least 50 feet away from storm drains, streams or wetlands unless there is no alternative reasonably available. If 50 foot offset is not attainable, provide relocation of portable toilet behind silt fence or place on a gravel pad and surround with sand bags.
2. Provide staking or anchoring of portable toilets during periods of high winds or in high foot traffic areas.
3. Monitor portable toilets for leaking and properly dispose of any leaked material. Utilize a licensed sanitary waste hauler to remove leaking portable toilets and replace with properly operating unit.

EARTHEN STOCKPILE MANAGEMENT

1. Show stockpile locations on plans. Locate earthen-material stockpile areas at least 50 feet away from storm drain inlets, sediment basins, perimeter sediment controls and surface waters unless it can be shown no other alternatives are reasonably available.
2. Protect stockpile with silt fence installed along toe of slope with a minimum offset of five feet from the toe of stockpile.
3. Provide stable stone access point when feasible.
4. Stabilize stockpile within the timeframes provided on this sheet and in accordance with the approved plan and any additional requirements. Soil stabilization is defined as vegetative, physical or chemical coverage techniques that will restrain accelerated erosion on disturbed soils for temporary or permanent control needs.

NORTH CAROLINA *Environmental Quality*



CONCRETE WASHOUTS

1. Do not discharge concrete or cement slurry from the site.
2. Dispose of, or recycle settled, hardened concrete residue in accordance with local and state solid waste regulations and at an approved facility.
3. Manage washout from mortar mixers in accordance with the above item and in addition place the mixer and associated materials on impervious barrier and within lot perimeter silt fence.
4. Install temporary concrete washouts per local requirements, where applicable. If an alternate method or product is to be used, contact your approval authority for review and approval. If local standard details are not available, use one of the two types of temporary concrete washouts provided on this detail.
5. Do not use concrete washouts for dewatering or storing defective curb or sidewalk sections. Stormwater accumulated within the washout may not be pumped into or discharged to the storm drain system or receiving surface waters. Liquid waste must be pumped out and removed from project.
6. Locate washouts at least 50 feet from storm drain inlets and surface waters unless it can be shown that no other alternatives are reasonably available. At a minimum, install protection of storm drain inlet(s) closest to the washout which could receive spills or overflow.
7. Locate washouts in an easily accessible area, on level ground and install a stone entrance pad in front of the washout. Additional controls may be required by the approving authority.
8. Install at least one sign directing concrete trucks to the washout within the project limits. Post signage on the washout itself to identify this location.
9. Remove leavings from the washout when at approximately 75% capacity to limit overflow events. Replace the tarp, sand bags or other temporary structural components when no longer functional. When utilizing alternative or proprietary products, follow manufacturer's instructions.
10. At the completion of the concrete work, remove remaining leavings and dispose of in an approved disposal facility. Fill pit, if applicable, and stabilize any disturbance caused by removal of washout.

HERBICIDES, PESTICIDES AND RODENTICIDES

1. Store and apply herbicides, pesticides and rodenticides in accordance with label restrictions.
2. Store herbicides, pesticides and rodenticides in their original containers with the label, which lists directions for use, ingredients and first aid steps in case of accidental poisoning.
3. Do not store herbicides, pesticides and rodenticides in areas where flooding is possible or where they may spill or leak into wells, stormwater drains, ground water or surface water. If a spill occurs, clean area immediately.
4. Do not stockpile these materials onsite.

HAZARDOUS AND TOXIC WASTE

1. Create designated hazardous waste collection areas on-site.
2. Place hazardous waste containers under cover or in secondary containment.
3. Do not store hazardous chemicals, drums or bagged materials directly on the ground.

NCG01 GROUND STABILIZATION AND MATERIALS HANDLING

EFFECTIVE: 04/01/19

7/7/2020
By:Joshua Dalton
harvey
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SHEET NAME	SHEET NUMBER
EROSION CONTROL NOTES	E2D
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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DATE:

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION A: SELF-INSPECTION

Self-inspections are required during normal business hours in accordance with the table below. When adverse weather or site conditions would cause the safety of the inspection personnel to be in jeopardy, the inspection may be delayed until the next business day on which it is safe to perform the inspection. In addition, when a storm event of equal to or greater than 1.0 inch occurs outside of normal business hours, the self-inspection shall be performed upon the commencement of the next business day. Any time when inspections were delayed shall be noted in the Inspection Record.

Inspect	Frequency (during normal business hours)	Inspection records must include:
(1) Rain gauge maintained in good working order	Daily	Daily rainfall amounts. If no daily rain gauge observations are made during weekend or holiday periods, and no individual-day rainfall information is available, record the cumulative rain measurement for those un-attended days (anc this will determine if a site inspection is needed). Days on which no rainfall occurred shall be recorded as "zero." The permittee may use another rain-monitoring device approved by the Division.
(2) E&SC Measures	At least once per 7 calendar days and within 24 hours of a rain event ≥ 1.0 inch in 24 hours	1. Identification of the measures inspected, 2. Date and time of the inspection, 3. Name of the person performing the inspection, 4. Indication of whether the measures were operating properly, 5. Description of maintenance needs for the measure, 6. Description, evidence, and date of corrective actions taken.
(3) Stormwater discharge outfalls (SDCs)	At least once per 7 calendar days and within 24 hours of a rain event ≥ 1.0 inch in 24 hours	1. Identification of the discharge outfalls inspected, 2. Date and time of the inspection, 3. Name of the person performing the inspection, 4. Evidence of indicators of stormwater pollution such as oil sheen, floating or suspended solids or discoloration, 5. Indication of visible sediment leaving the site, 6. Description, evidence, and date of corrective actions taken.
(4) Perimeter of site	At least once per 7 calendar days and within 24 hours of a rain event ≥ 1.0 inch in 24 hours	If visible sedimentation is found outside site limits, then a record of the following shall be made: 1. Actions taken to clean up or stabilize the sediment that has left the site limits, 2. Description, evidence, and date of corrective actions taken, and 3. An explanation as to the actions taken to control future releases.
(5) Streams or wetlands onsite or offsite (where accessible)	At least once per 7 calendar days and within 24 hours of a rain event ≥ 1.0 inch in 24 hours	If the stream or wetland has increased visible sedimentation or a stream has visible increased turbidity from the construction activity, then a record of the following shall be made: 1. Description, evidence and date of corrective actions taken, and 2. Records of the required reports to the appropriate Division Regional Office per Part III, Section C, Item (2)(a) of this permit.
(6) Ground stabilization measures	After each phase of grading	1. The phase of grading (installation of perimeter E&SC measures, clearing and grubbing, installation of storm drainage facilities, completion of all land-disturbing activity, construction or redevelopment, permanent ground cover). 2. Documentation that the required ground stabilization measures have been provided within the required timeframe or an assurance that they will be provided as soon as possible.

NOTE: The rain inspection resets the required 7 calendar day inspection requirement.

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION B: RECORDKEEPING

1. E&SC Plan Documentation

The approved E&SC plan as well as any approved deviation shall be kept on the site. The approved E&SC plan must be kept up-to-date throughout the coverage under this permit. The following items pertaining to the E&SC plan shall be kept on site and available for inspection at all times during normal business hours.

Item to Document	Documentation Requirements
(a) Each E&SC measure has been installed and does not significantly deviate from the locations, dimensions and relative elevations shown on the approved E&SC plan.	Initial and date each E&SC measure on a copy of the approved E&SC plan or complete, date and sign an inspection report that lists each E&SC measure shown on the approved E&SC plan. This documentation is required upon the initial installation of the E&SC measures or if the E&SC measures are modified after initial installation.
(b) A phase of grading has been completed.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate completion of the construction phase.
(c) Ground cover is located and installed in accordance with the approved E&SC plan.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate compliance with approved ground cover specifications.
(d) The maintenance and repair requirements for all E&SC measures have been performed.	Complete, date and sign an inspection report.
(e) Corrective actions have been taken to E&SC measures.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate the completion of the corrective action.

2. Additional Documentation to be Kept on Site

In addition to the E&SC plan documents above, the following items shall be kept on the site and available for inspectors at all times during normal business hours, unless the Division provides a site-specific exemption based on unique site conditions that make this requirement not practical:

(a) This General Permit as well as the Certificate of Coverage, after it is received.

(b) Records of inspections made during the previous twelve months. The permittee shall record the required observations on the Inspection Record Form provided by the Division or a similar inspection form that includes all the required elements. Use of electronically-available records in lieu of the required paper copies will be allowed if shown to provide equal access and utility as the hard-copy records.

3. Documentation to be Retained for Three Years

All data used to complete the e-NOI and all inspection records shall be maintained for a period of three years after project completion and made available upon request. [40 CFR 122.41]

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION C: REPORTING

1. Occurrences that Must be Reported

Permittees shall report the following occurrences:

(a) Visible sediment deposition in a stream or wetland.

(b) Oil spills if:
- They are 25 gallons or more,
- They are less than 25 gallons but cannot be cleaned up within 24 hours,
- They cause sheen on surface waters (regardless of volume), or
- They are within 100 feet of surface waters (regardless of volume).

(c) Releases of hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (Ref: 40 CFR 110.3 and 40 CFR 117.3) or Section 102 of CERCLA (Ref: 40 CFR 302.4) or G.S. 143-215.85.

(d) Anticipated bypasses and unanticipated bypasses.

(e) Noncompliance with the conditions of this permit that may endanger health or the environment.

2. Reporting Timeframes and Other Requirements

After a permittee becomes aware of an occurrence that must be reported, he shall contact the appropriate Division regional office within the timeframes and in accordance with the other requirements listed below. Occurrences outside normal business hours may also be reported to the Department's Environmental Emergency Center personnel at (800) 858-0368.

Occurrence	Reporting Timeframes [After Discovery) and Other Requirements
(a) Visible sediment deposition in a stream or wetland	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days***, a report that contains a description of the sediment and actions taken to address the cause of the deposition. Division staff may waive the requirement for a written report on a case-by-case basis. • If the stream is named on the NC 303(d) list as impaired for sediment-related causes, the permittee may be required to perform additional monitoring, inspections or apply more stringent practices if staff determine that additional requirements are needed to assure compliance with the federal or state impaired-waters conditions.
(b) Oil spills and release of hazardous substances per Item 1(b)-(c) above	• ***Within 24 hours***, an oral or electronic notification. The notification shall include information about the date, time, nature, volume and location of the spill or release.
(c) Anticipated bypasses [40 CFR 122.41(m)(3)]	• ***A report at least ten days before the date of the bypass, if possible***. The report shall include an evaluation of the anticipated quality and effect of the bypass.
(d) Unanticipated bypasses [40 CFR 122.41(m)(3)]	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days,*** a report that includes an evaluation of the quality and effect of the bypass.
(e) Noncompliance with the conditions of this permit that may endanger health or the environment[40 CFR 122.41(l)(7)]	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days***, a report that contains a description of the noncompliance, and its causes; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time noncompliance is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. [40 CFR 122.41(l)(6). • Division staff may waive the requirement for a written report on a case-by-case basis.

PART II, SECTION G, ITEM (4)
DRAW DOWN OF SEDIMENT BASINS FOR MAINTENANCE OR CLOSE OUT

Sediment basins and traps that receive runoff from drainage areas of one acre or more shall use outlet structures that withdraw water from the surface when these devices need to be drawn down for maintenance or close out unless this is infeasible. The circumstances in which it is not feasible to withdraw water from the surface shall be rare (for example, times with extended cold weather). Non-surface withdrawals from sediment basins shall be allowed only when all of the following criteria have been met:

(a) The E&SC plan authority has been provided with documentation of the non-surface withdrawal and the specific time periods or conditions in which it will occur. The non-surface withdrawal shall not commence until the E&SC plan authority has approved these items,
(b) The non-surface withdrawal has been reported as an anticipated bypass in accordance with Part III, Section C, Item (2)(c) and (d) of this permit,
(c) Dewatering discharges are treated with controls to minimize discharges of pollutants from stormwater that is removed from the sediment basin. Examples of appropriate controls include properly sited, designed and maintained dewatering tanks, weir tanks, and filtration systems,
(d) Vegetated, upland areas of the sites or a properly designed stone pad is used to the extent feasible at the outlet of the dewatering treatment devices described in Item (c) above,
(e) Velocity dissipation devices such as check dams, sediment traps, and riprap are provided at the discharge points of all dewatering devices, and
(f) Sediment removed from the dewatering treatment devices described in Item (c) above is disposed of in a manner that does not cause deposition of sediment into waters of the United States.

NORTH CAROLINA *Environmental Quality*

NCG01 SELF-INSPECTION, RECORDKEEPING AND REPORTING

EFFECTIVE: 04/01/19

7/1/2020
B:\Brahma\dy_PSH_E02d.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

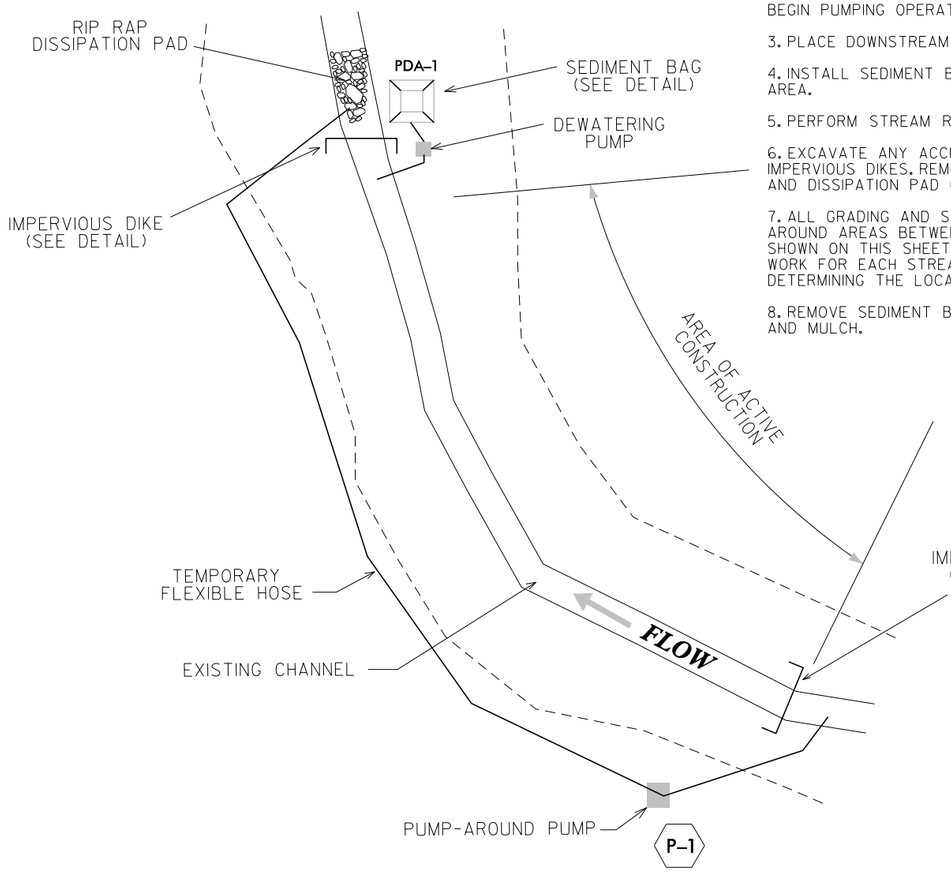
Axiom Environmental, Inc.

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

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSHUA C. DALTON

DATE:



CONSTRUCTION SEQUENCE FOR TYPICAL PUMP-AROUND:

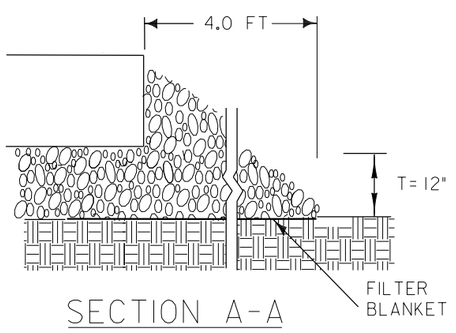
1. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
2. PLACE UPSTREAM IMPERVIOUS DIKE, DOWNSTREAM RIP RAP DISSIPATION PAD, AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
3. PLACE DOWNSTREAM IMPERVIOUS DIKE.
4. INSTALL SEDIMENT BAG AND ASSOCIATED PUMP. DEWATER THE ENTRAPPED AREA.
5. PERFORM STREAM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

NOTES:

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

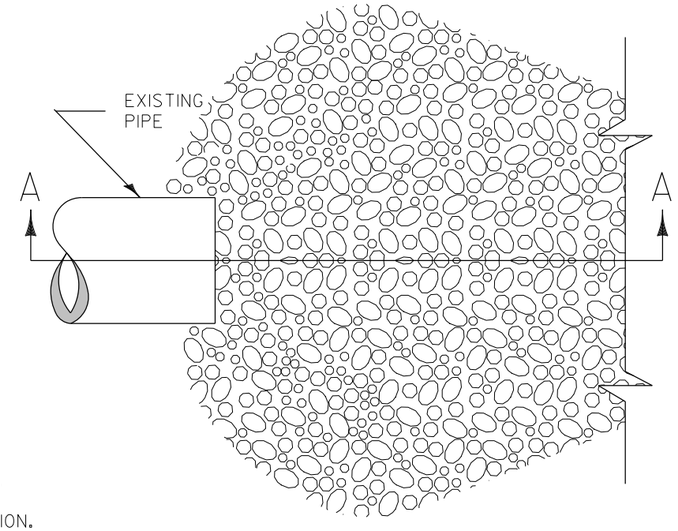
TYPICAL PUMP-AROUND OPERATION

RIPRAP DISSIPATION PAD



SECTION A-A

PLAN VIEW



NOTES:

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

RIP RAP DISIPATION PAD SPECIFICATIONS

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

7/7/2020
Brahma_Rdy_PSH_E03.dgn
harvey

SHEET NAME		SHEET NUMBER
EROSION CONTROL DETAILS		E3A
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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

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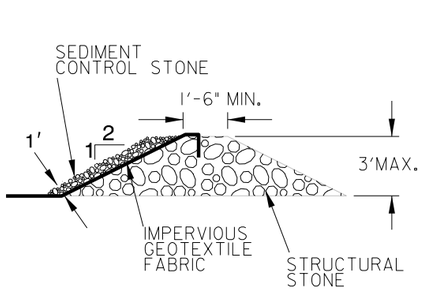
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26611 JOSEPH C. DALTON

DATE:

IMPERVIOUS DIKE



CROSS SECTION VIEW

NOTES:

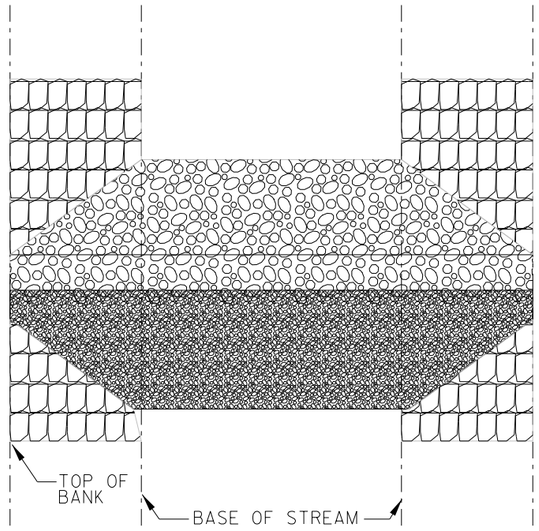
1. USE CLASS B STONE FOR STRUCTURAL STONE.

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

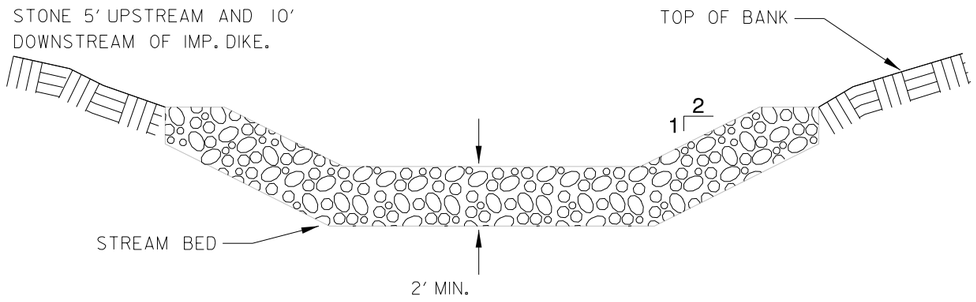
3. CONSTRUCT DAM A MAXIMUM OF 1 FT. ABOVE NORMAL FLOW DEPTH.

4. TOE IN IMPERVIOUS MATERIAL

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

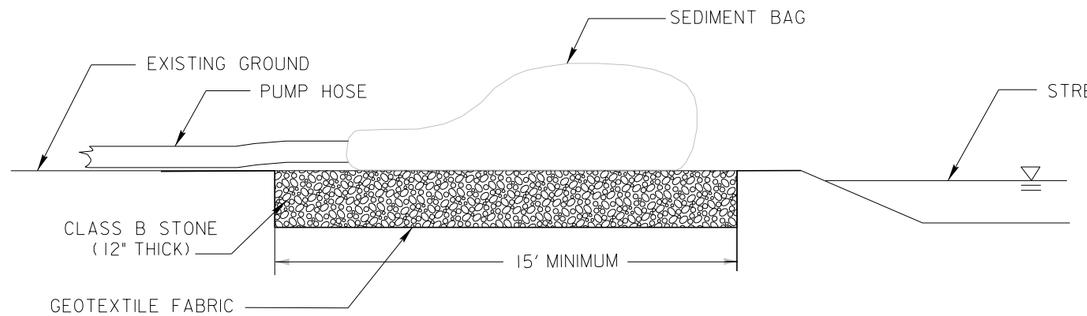


TOP VIEW



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.

7/1/2020
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jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3B
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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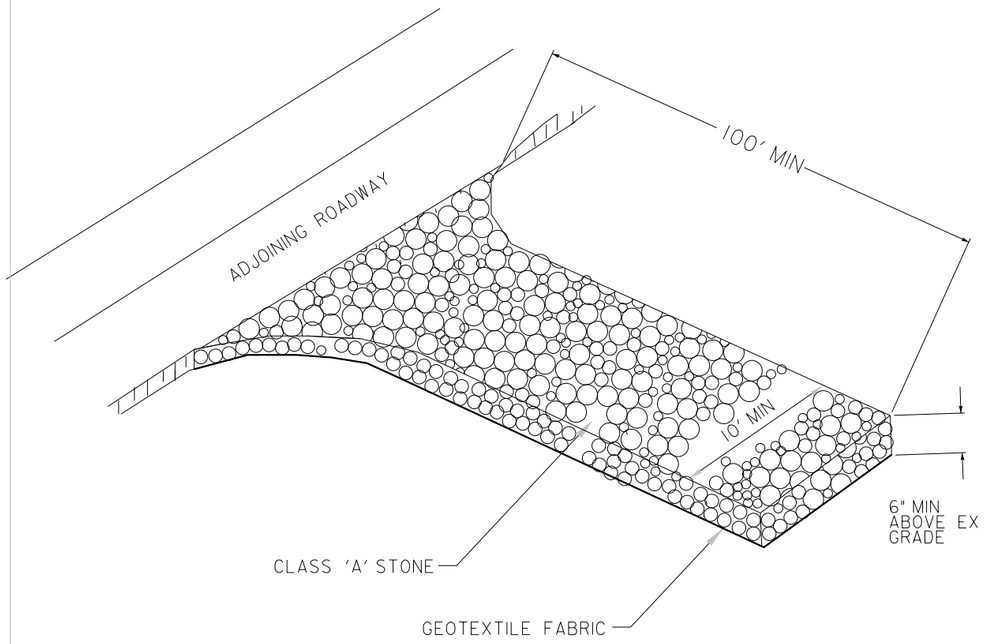
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26601 JOSHUA D. DALTON

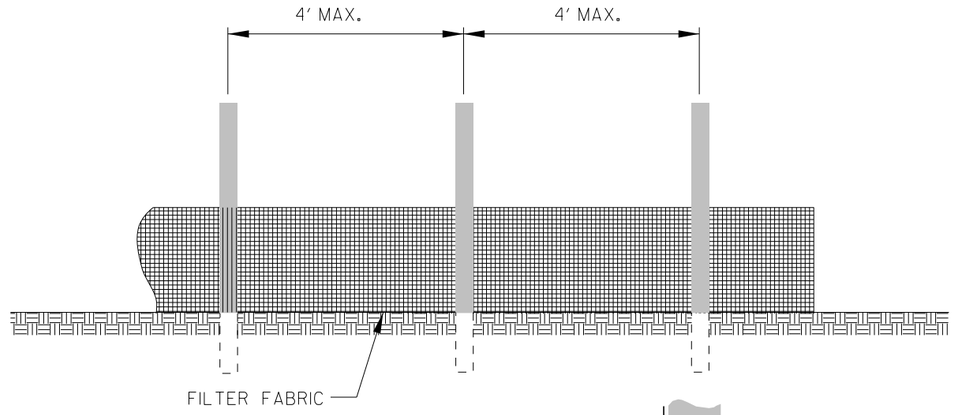
DATE:

NOTES:

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

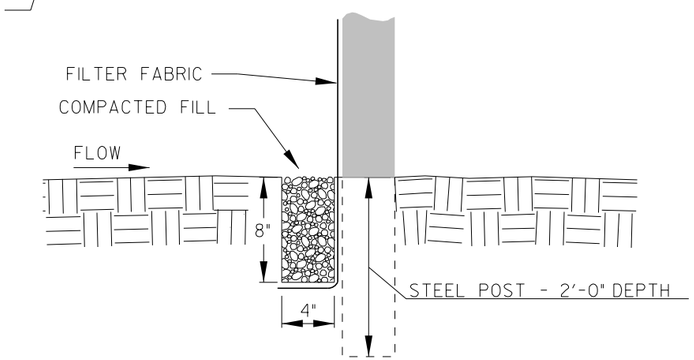


TEMPORARY CONSTRUCTION ENTRANCE/EXIT



NOTES:

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



SILT FENCE

7/1/2020
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jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL DETAILS	E3C
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

Axiom Environmental, Inc.

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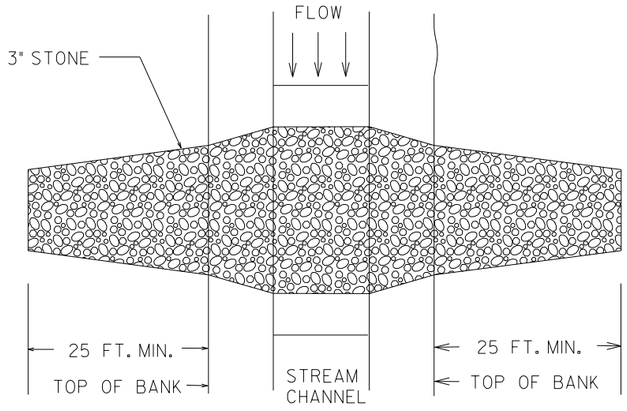
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29601 JOSHUA D. DALTON

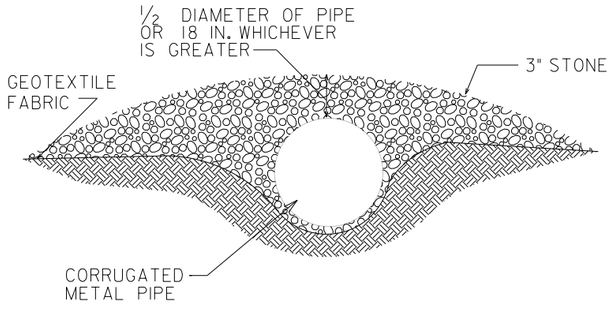
DATE:

TEMPORARY CULVERTED STREAM CROSSING

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

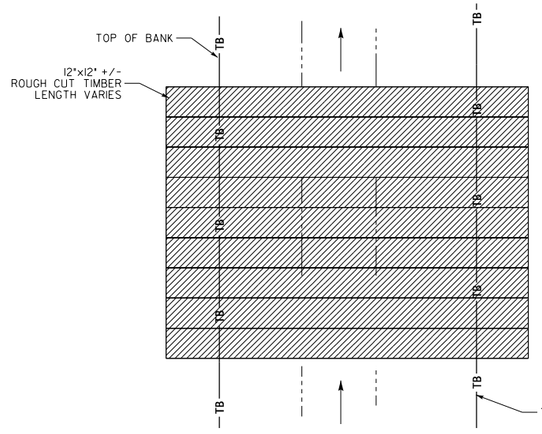


PLAN VIEW



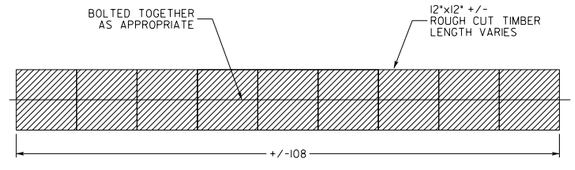
PROFILE VIEW

LOG MAT BRIDGE

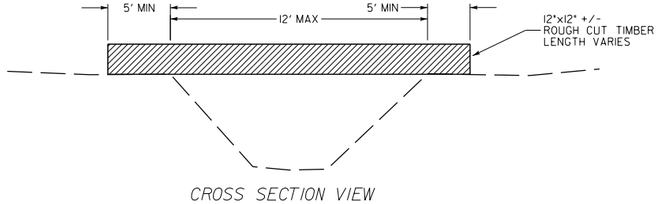


PLAN VIEW

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



SECTION THROUGH LOG MAT BRIDGE



CROSS SECTION VIEW

7/1/2020
brandy.PSH.E03c.dgn
brandy
Harvey

SHEET NAME		SHEET NUMBER
EROSION CONTROL DETAILS		E3D
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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

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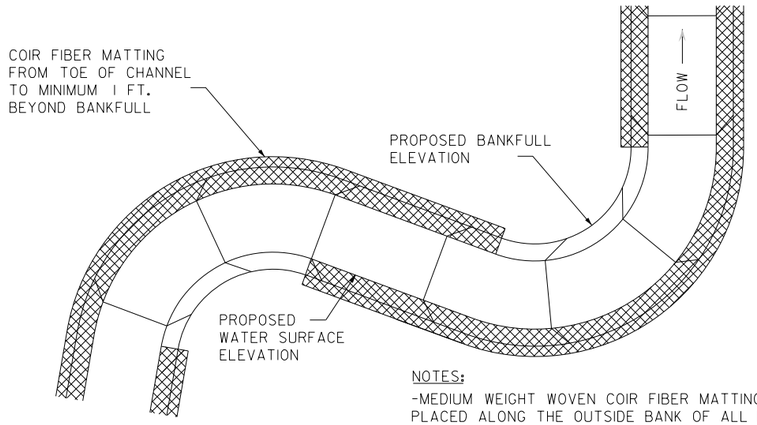
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSEPH C. DALTON

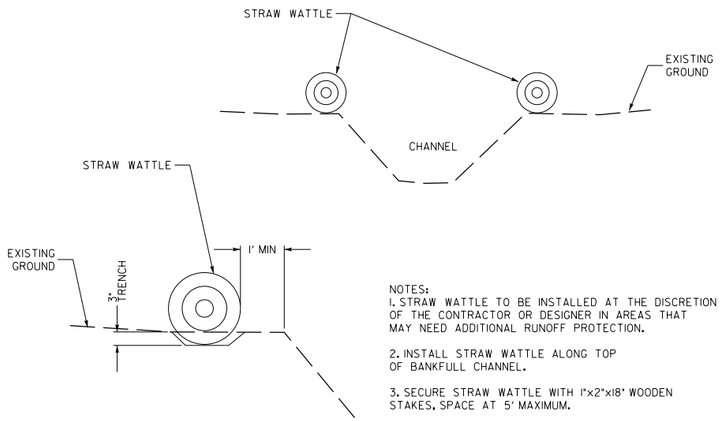
DATE:

TYPICAL MATTING LOCATION



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

STRAW WATTLE



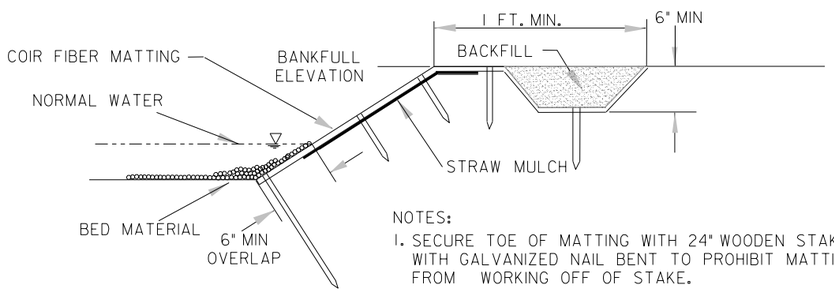
NOTES:
1. STRAW WATTLE TO BE INSTALLED AT THE DISCRETION OF THE CONTRACTOR OR DESIGNER IN AREAS THAT MAY NEED ADDITIONAL RUNOFF PROTECTION.

2. INSTALL STRAW WATTLE ALONG TOP OF BANKFULL CHANNEL.

3. SECURE STRAW WATTLE WITH 1"x2"x18" WOODEN STAKES, SPACE AT 5' MAXIMUM.

4. STRAW SHALL BE CERTIFIED WEED FREE.

COIR MATTING CROSS SECTION

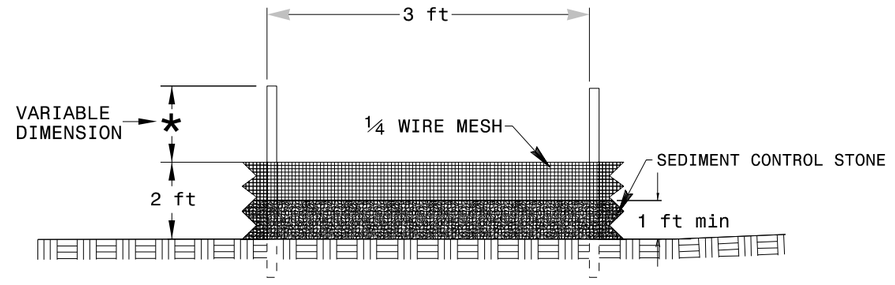


NOTES:
1. SECURE TOE OF MATTING WITH 24" WOODEN STAKES WITH GALVANIZED NAIL BENT TO PROHIBIT MATTING FROM WORKING OFF OF STAKE.

2. USE 12" WOODEN STAKES ON 5' CENTERS OR AS DIRECTED BY MANUFACTURER'S RECOMMENDATIONS.

3. MINIMUM 1' WIDE, 6" DEEP TRENCH OVER TOP OF BANK WITH MATTING LAID FLAT AND STAKED. TRENCH TO BE BACKFILLED WITH EXCAVATED MATERIAL.

SPECIAL SEDIMENT CONTROL FENCE BREAK

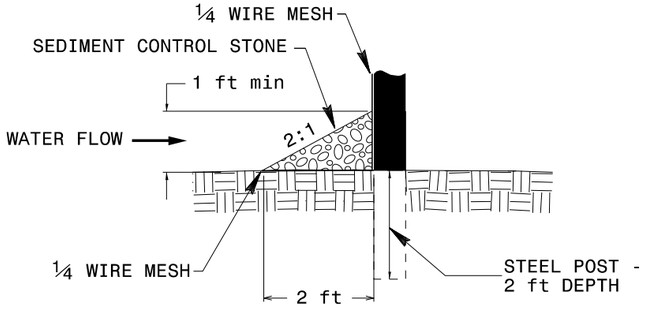


NOTE:

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

CONSTRUCTION NOTES:

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



7/7/2020
By:chris.harvey
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SHEET NAME		SHEET NUMBER
HAUL ROADS		E3E
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

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

Axiom Environmental, Inc.

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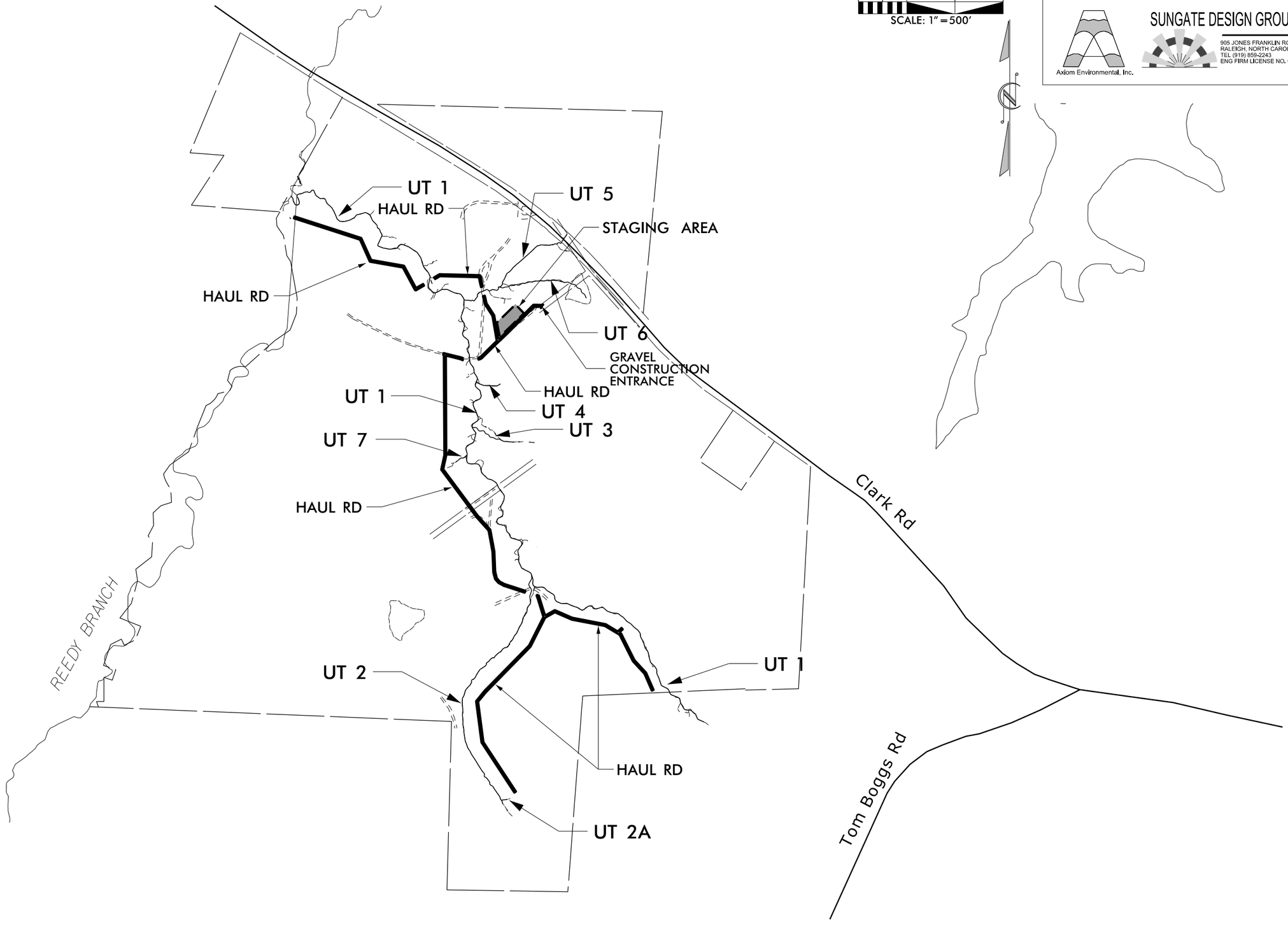
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890



7/7/2020
By:chris.harvey
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SHEET NAME	SHEET NUMBER
EROSION CONTROL	E4
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29615 JOSEPH T. DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'
NAD 83

LOD — LIMITS OF DISTURBANCE
TEMPORARY SILT FENCE
HAUL ROAD
SPECIAL SEDIMENT CONTROL FENCE BREAK

JIMMY LEE BROWN & HELEN W BROWN
PIN: 8776942340
DEED BOOK: 1646
PAGE: 0865

CROSS VANE (TYP)
PROPOSED BANKFUL
HAUL RD
LIMITS OF CONSTRUCTION
LOD
P-1
PROPOSED BANKFUL
START ENHANCEMENT I
STA 2+56 -UT1-
LIMITS OF CONSTRUCTION
IMPERVIOUS DIKE
MATCHLINE STA 5+00 -UT1-
SEE SHEET E5

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

0+00 -UT1-
1+00 -UT1-
2+00 -UT1-
3+00 -UT1-
4+00 -UT1-

7/7/2020
Brandon Rdy_esh_E04.dgn
harvey

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E5
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

SUNGATE DESIGN GROUP, P.A.
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29651 ENGINEERING CONSTRUCTION JOSEPH C. DALTON

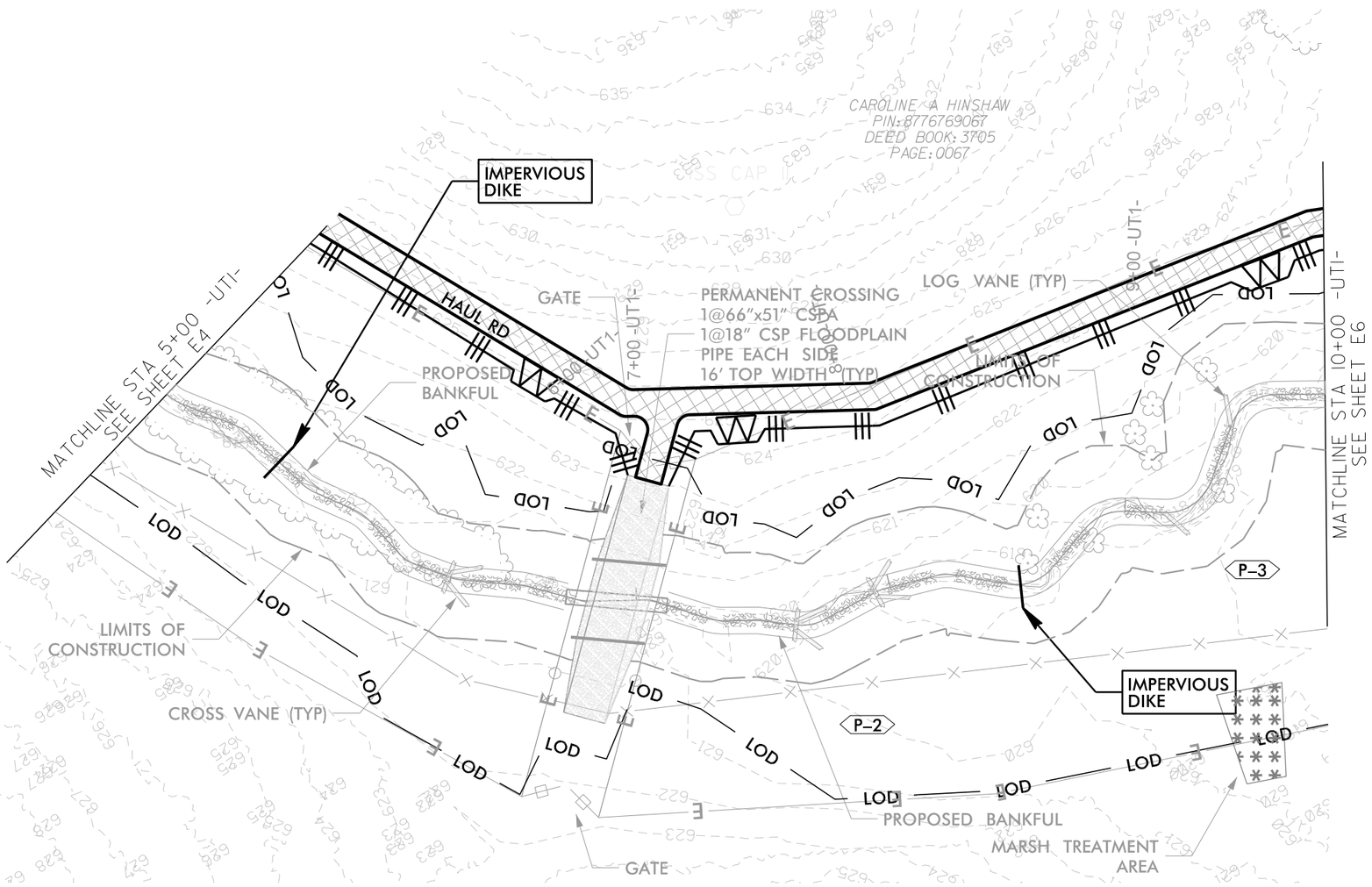
DATE:

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

NAD 83

25' 12.5' 0 25' 50'

SCALE: 1" = 50'



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SHEET NAME		SHEET NUMBER
EROSION CONTROL		E6
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

SUNGATE DESIGN GROUP, P.A.
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Axiom Environmental, Inc.

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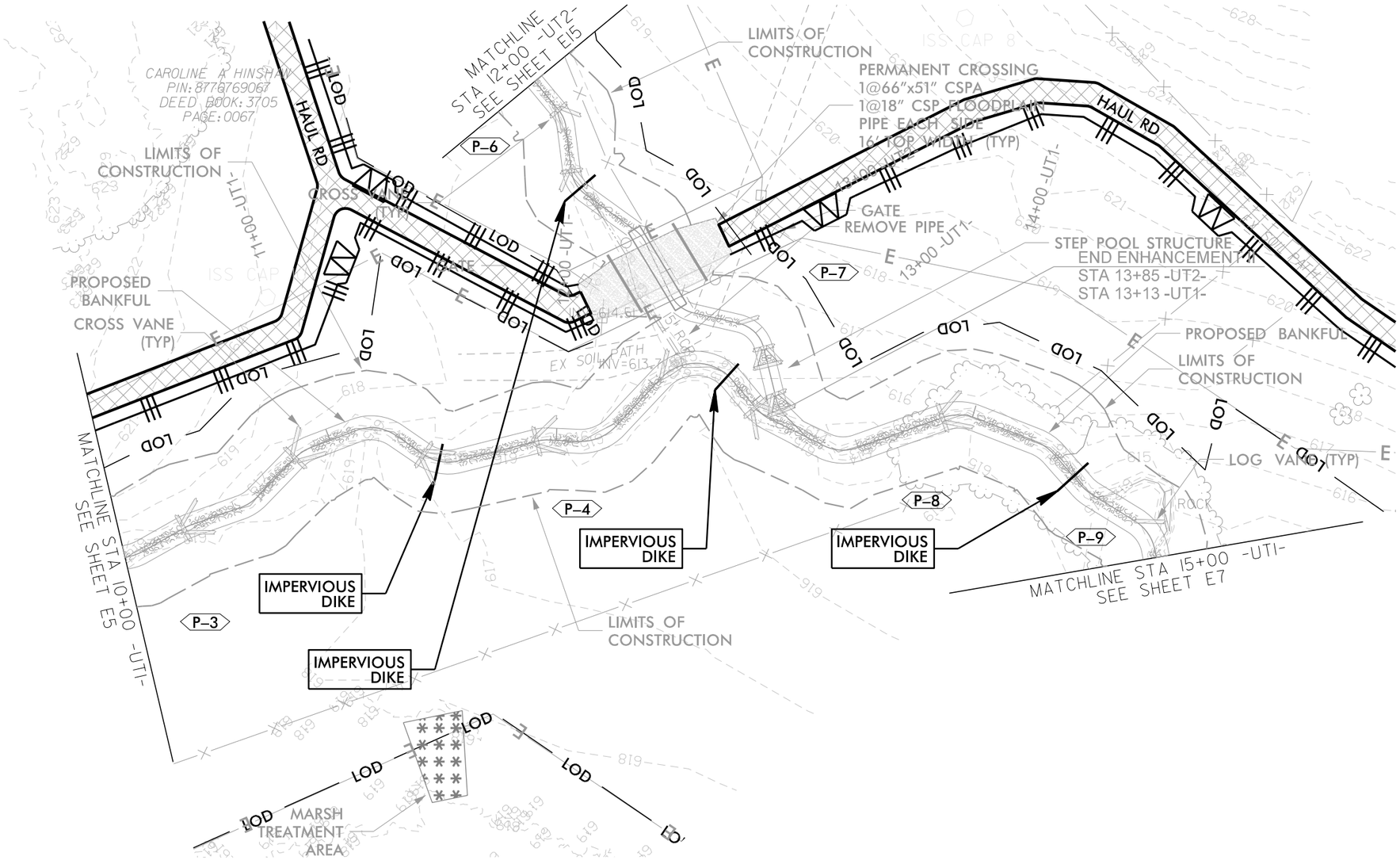
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25451 JOSEPH C. DALTON

DATE:

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

NAD 83

25' 12.5' 0 25' 50'
SCALE: 1" = 50'



7/1/2020
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jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E7
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 ENGINEERING CORPORATION JOSEPH C. DALTON

DATE:

NAD 83

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

LOD — LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK

LIMITS OF CONSTRUCTION

DOUBLE LOG VANE

HAUL RD

PROPOSED BANKFUL

MATCHLINE STA 15+00 -UTI- SEE SHEET E6

MATCHLINE STA 20+00 -UTI- SEE SHEET E8

P–9

IMPERVIOUS DIKE

EX GRAVEL RD

REMOVE PIPE

ROCK

INV=608.99

30" CMP

INV=608.59

P–10

LOG VANE (TYP)

LIMITS OF CONSTRUCTION

PROPOSED BANKFUL

CROSS VANE (TYP)

CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

DOUBLE LOG VANE

PERMANENT CROSSING
1@66"x51" CSPA
1@18" CSP FLOODPLAIN PIPE EACH SIDE
16' TOP WIDTH (TYP)

SEE SHEET E16

7/7/2020
Brahma Rdy.psh.E07.dgn
jhar-veu

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E8
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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ENG FIRM LICENSE NO. C-890

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSEPH C. DALTON

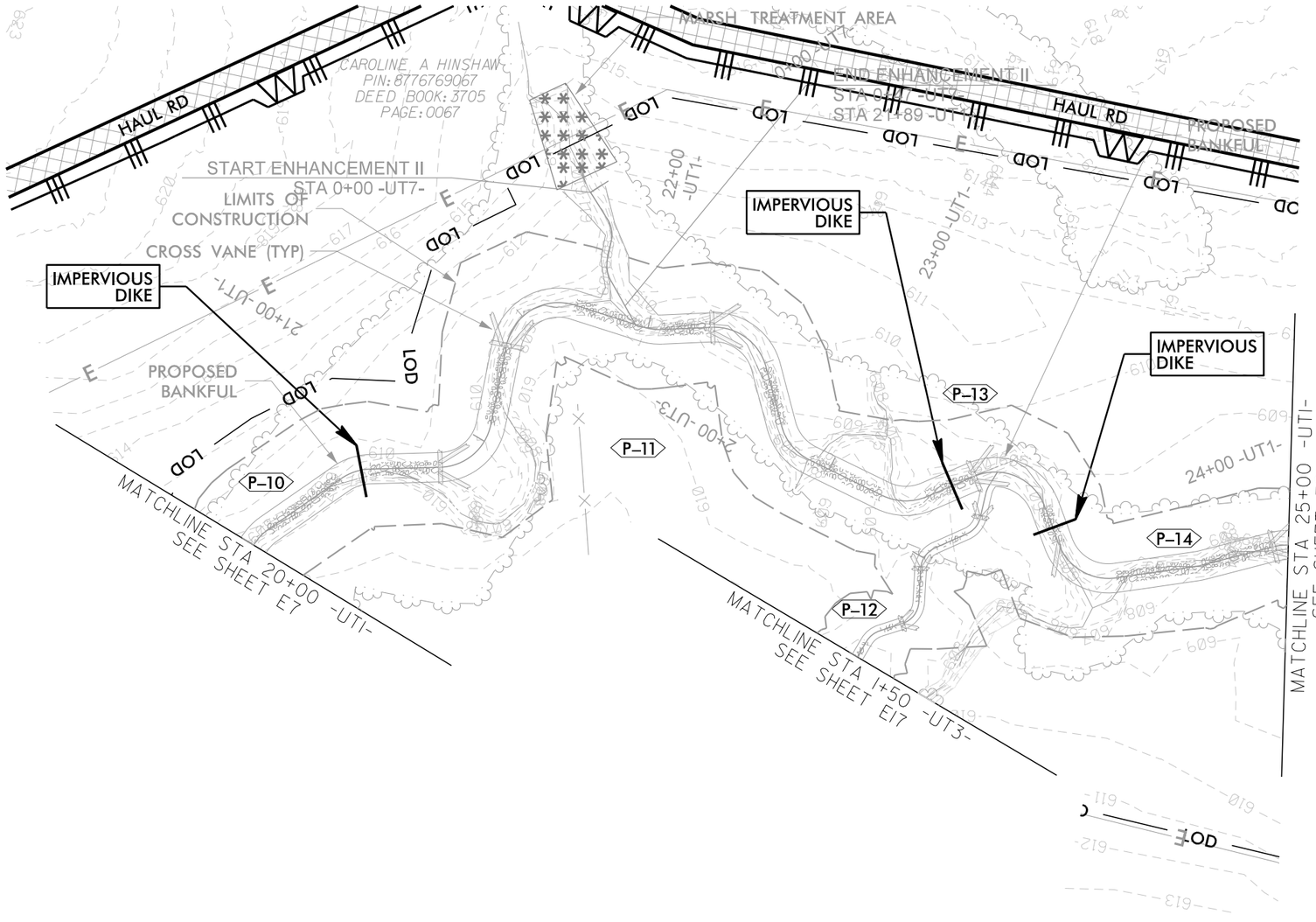
DATE:

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

NAD 83

25' 12.5' 0 25' 50'

SCALE: 1" = 50'



7/7/2020
Brahma_Rdy_psh_E08.dgn
jhar-veu

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E9
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29661 JOSEPH C. DALTON

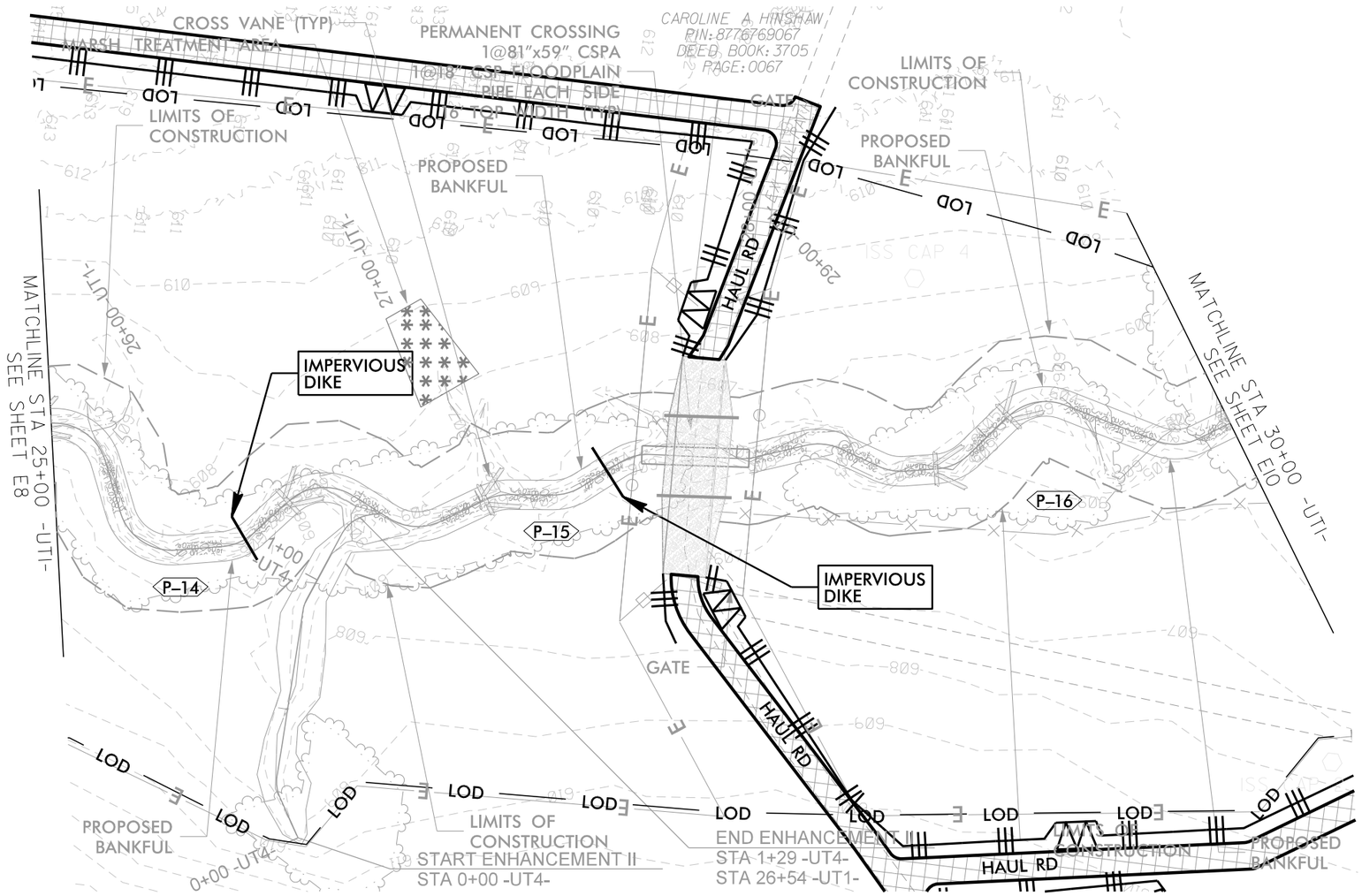
DATE:

NAD 83

25' 12.5' 0 25' 50'

SCALE: 1" = 50'

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK



7/1/2020
BY:Andy
J:\pr\...\dy_psh_E09.dgn
jbr.vsy

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E10
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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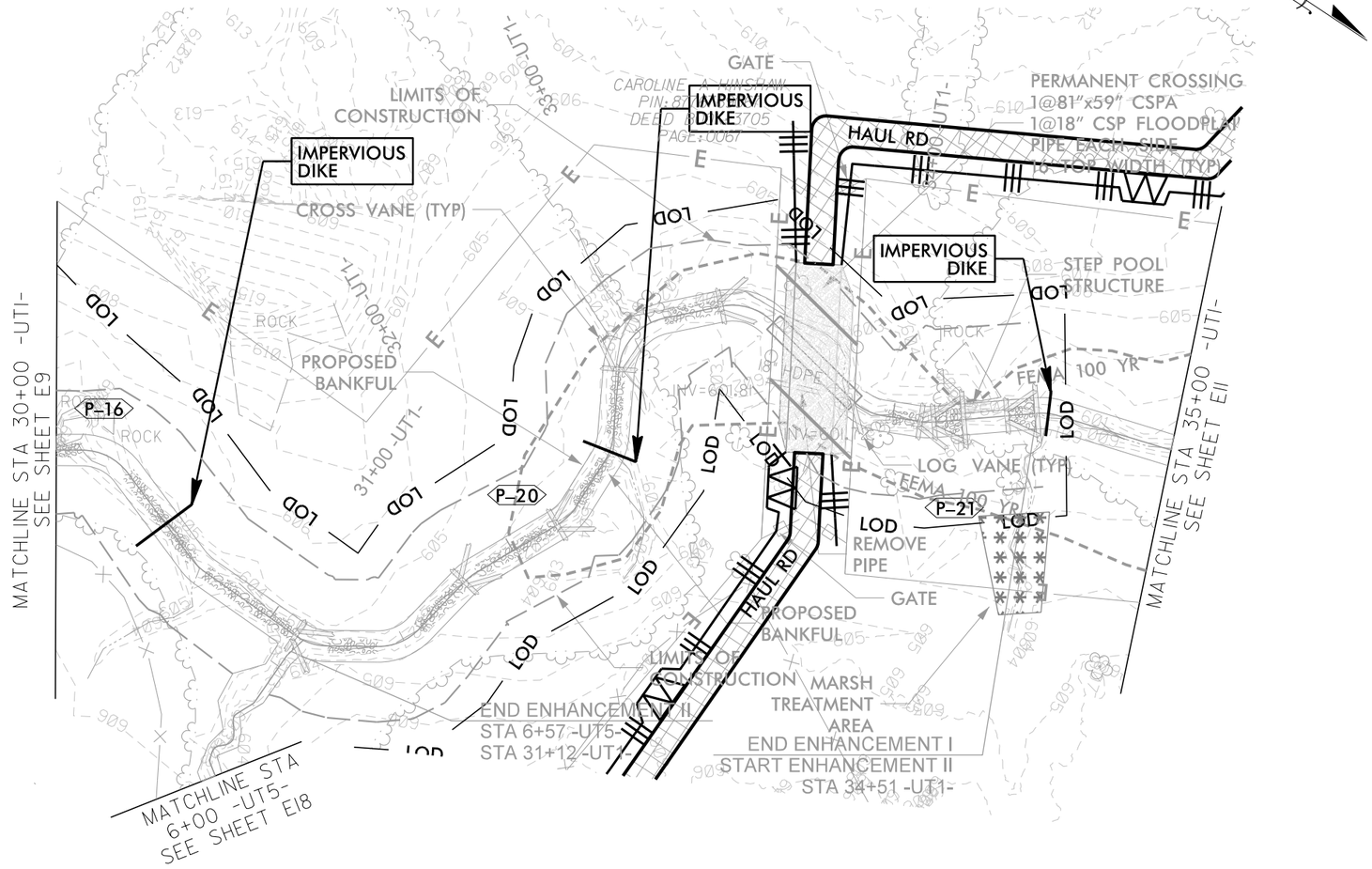
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29651 JOSEPH C. DALTON

DATE:

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83



7/7/2020
By:brandon.ray.pish_E10.dgn
jhar-vay

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E11
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25641 JOSEPH C. DALTON

DATE:

NAD 83 (NSRS 2011)

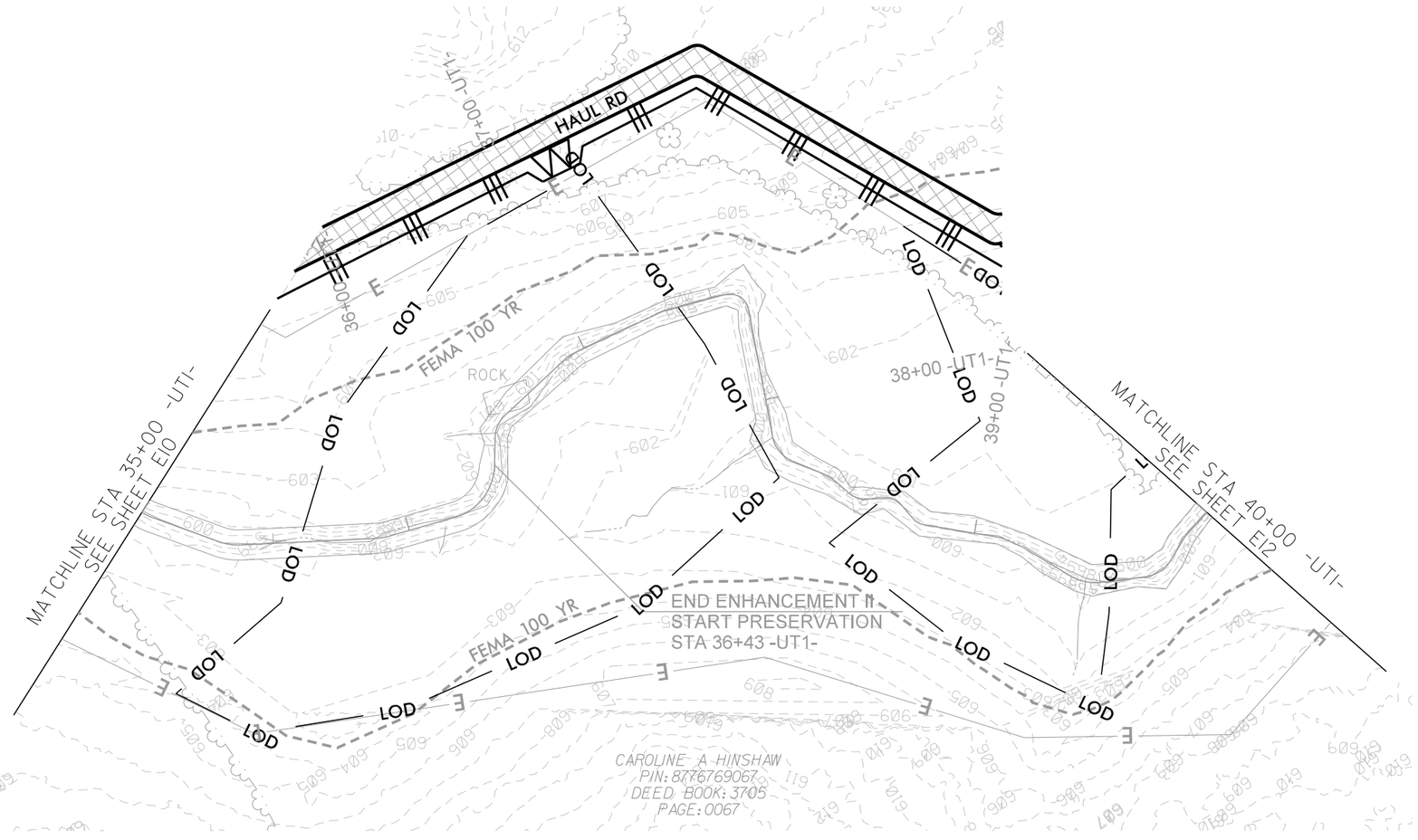
25' 12.5' 0 25' 50'
SCALE: 1" = 50'

— LOD — LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK



7/7/2020
brahmaRdy_psh_E11.dgn
jhar-veu

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E12
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

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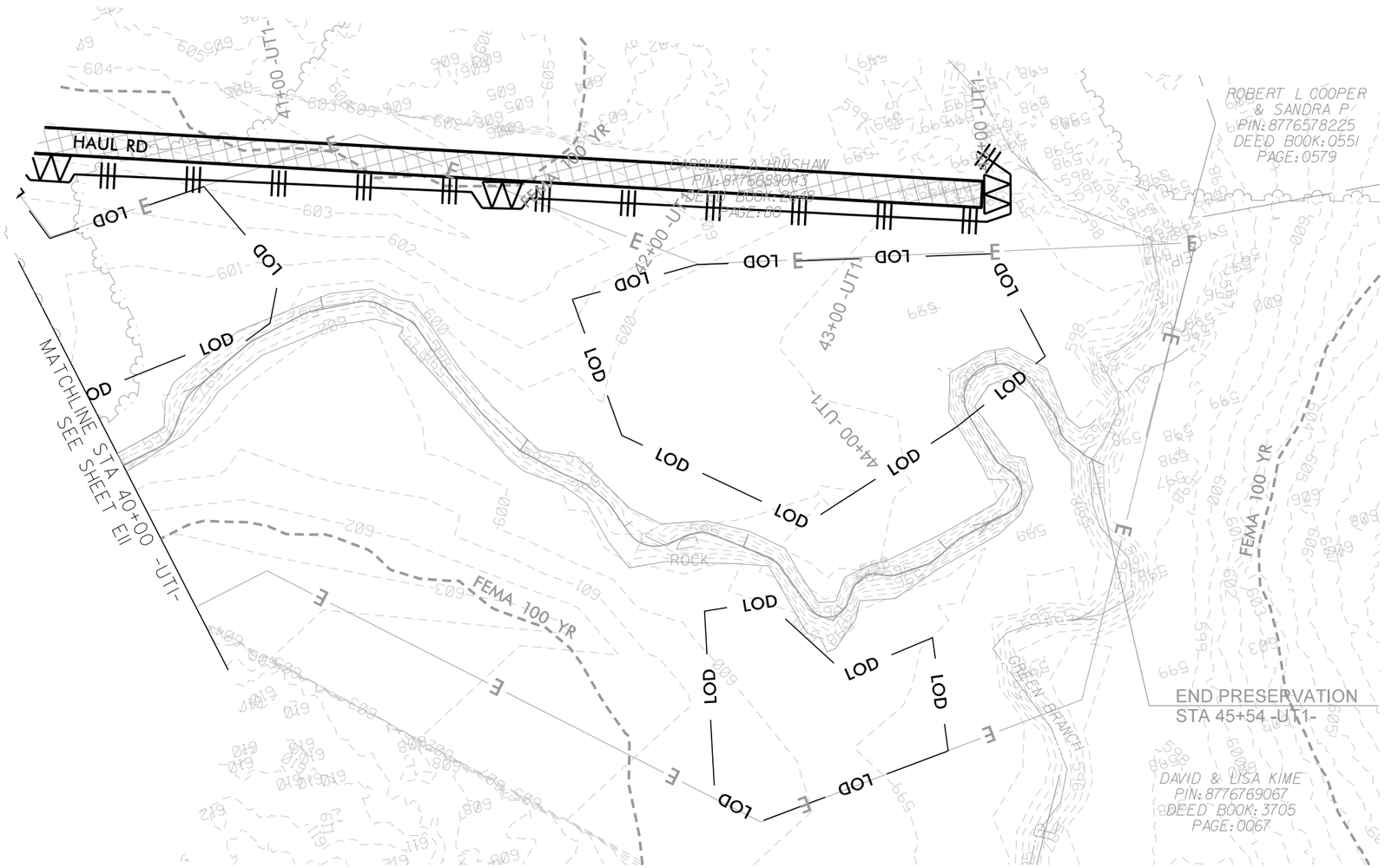
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSHUA C. DALTON

DATE:

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83



7/7/2020
8:47:20 AM
jharvey
G:\Projects\Brahma\dy_psh_E12.dgn

SHEET NAME	SHEET NUMBER
EROSION CONTROL	EI3
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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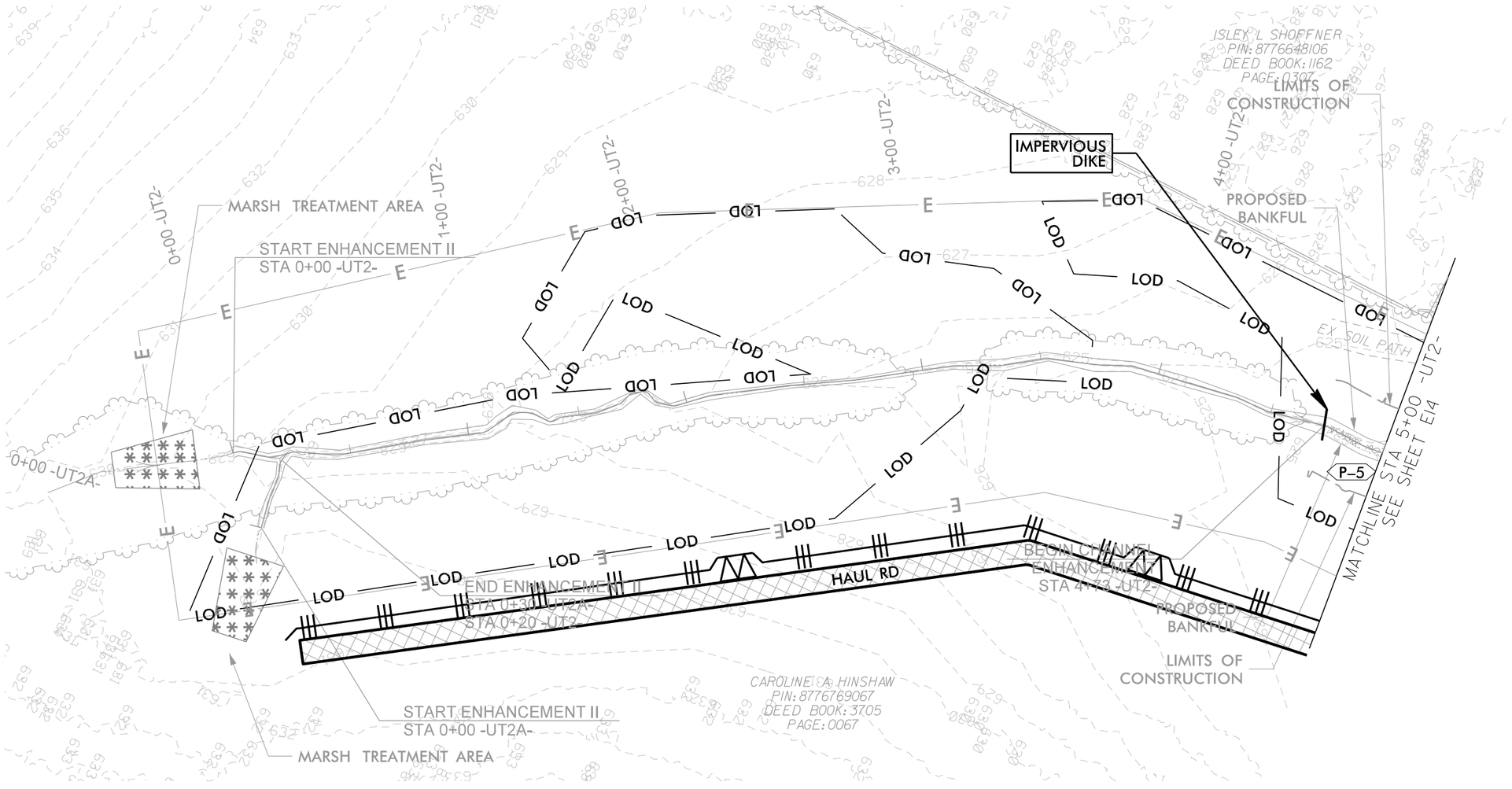
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25681 JOSEPH C. DALTON

DATE:

- LOD — LIMITS OF DISTURBANCE
- TEMPORARY SILT FENCE
- HAUL ROAD
- SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83



7/1/2020
Brandon Hardy.psh_EI3.dgn
jharvey

SHEET NAME	SHEET NUMBER
EROSION CONTROL	E14
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25611 JOSEPH C. DALTON

DATE:

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

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

IMPERVIOUS DIKE
LIMITS OF CONSTRUCTION
PROPOSED BANKFUL
EX. SOIL PATCH
6+00 -UT2-
7+00 -UT2-
8+00 -UT2-
9+00 -UT2-
ISS CAP
P-5
P-6
MATCHLINE STA 5+00 -UT2- SEE SHEET E13
MATCHLINE STA 10+00 -UT2- SEE SHEET E15
HAUL RD
CROSS VANE (TYP)
END CHANNEL ENHANCEMENT STA 7+07 -UT2-
BEGIN CHANNEL ENHANCEMENT STA 4+73 -UT2-
CAROLINE A HINSHAW
PIN: 8776769067
DEED BOOK: 3705
PAGE: 0067

7/7/2020
Brahma_Rdy_psh_E14.dgn
harvey

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'

SCALE: 1" = 50'

NAD 83

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E15
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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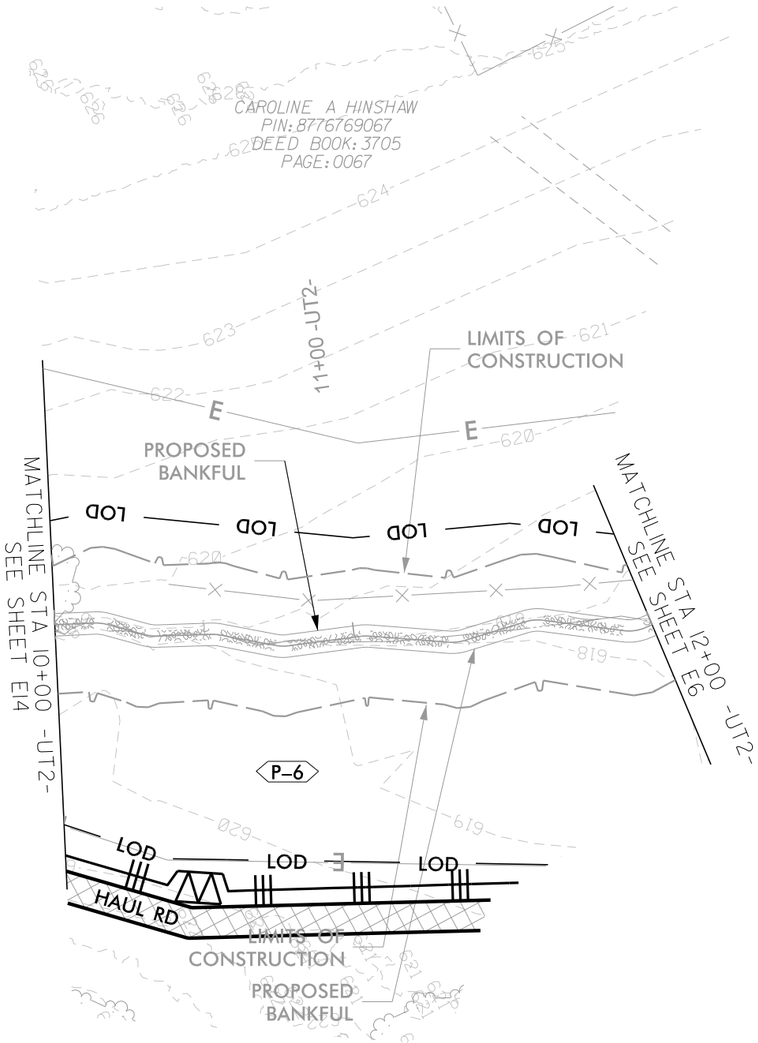
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29681 JOSHUA D. DALTON

DATE:



SHEET NAME	SHEET NUMBER
EROSION CONTROL	E16
PROJECT NAME: BRAHMA SITE	
COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 26611 JOSHUA C. DALTON

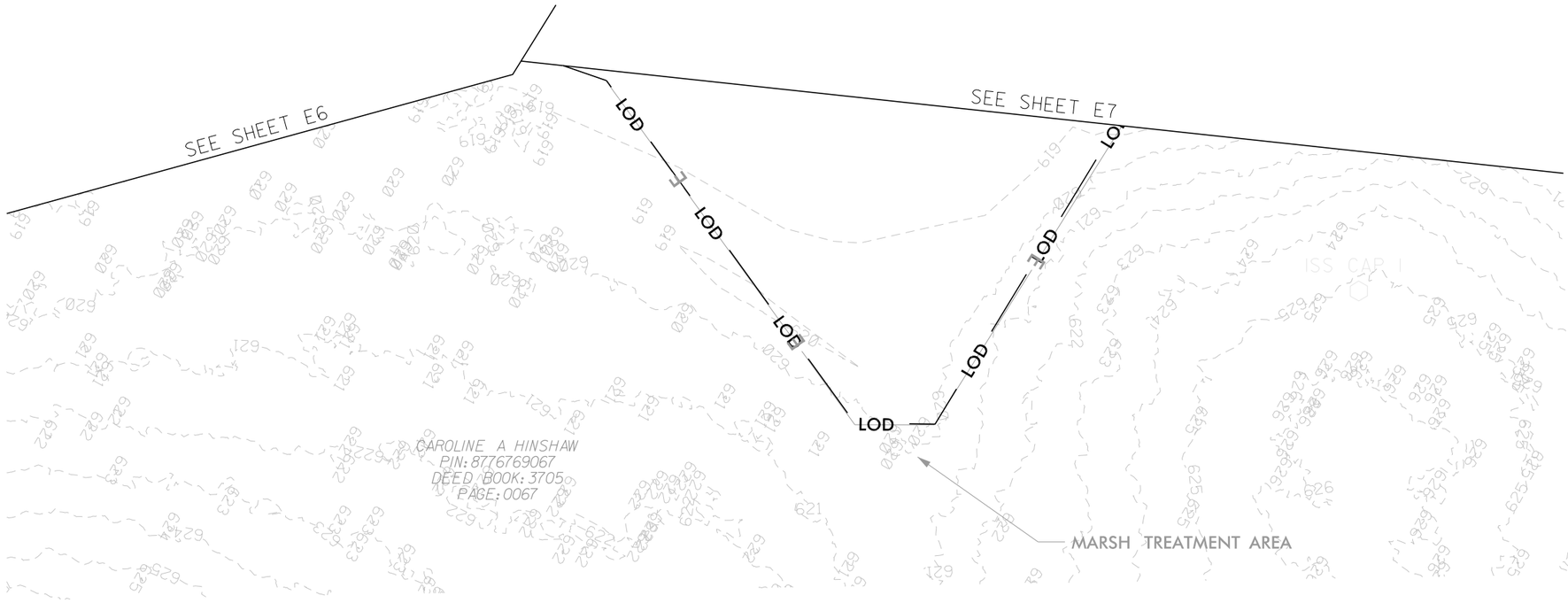
DATE:

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

NAD 83

25′ 12.5′ 0 25′ 50′

SCALE: 1″ = 50′



7/7/2020
By: johnvau
jhar-vau
C:\Users\johnvau\Desktop\dgn\Brahma_Grading_psh.E16.dgn

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E17
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25641 JOSEPH C. DALTON

DATE:

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

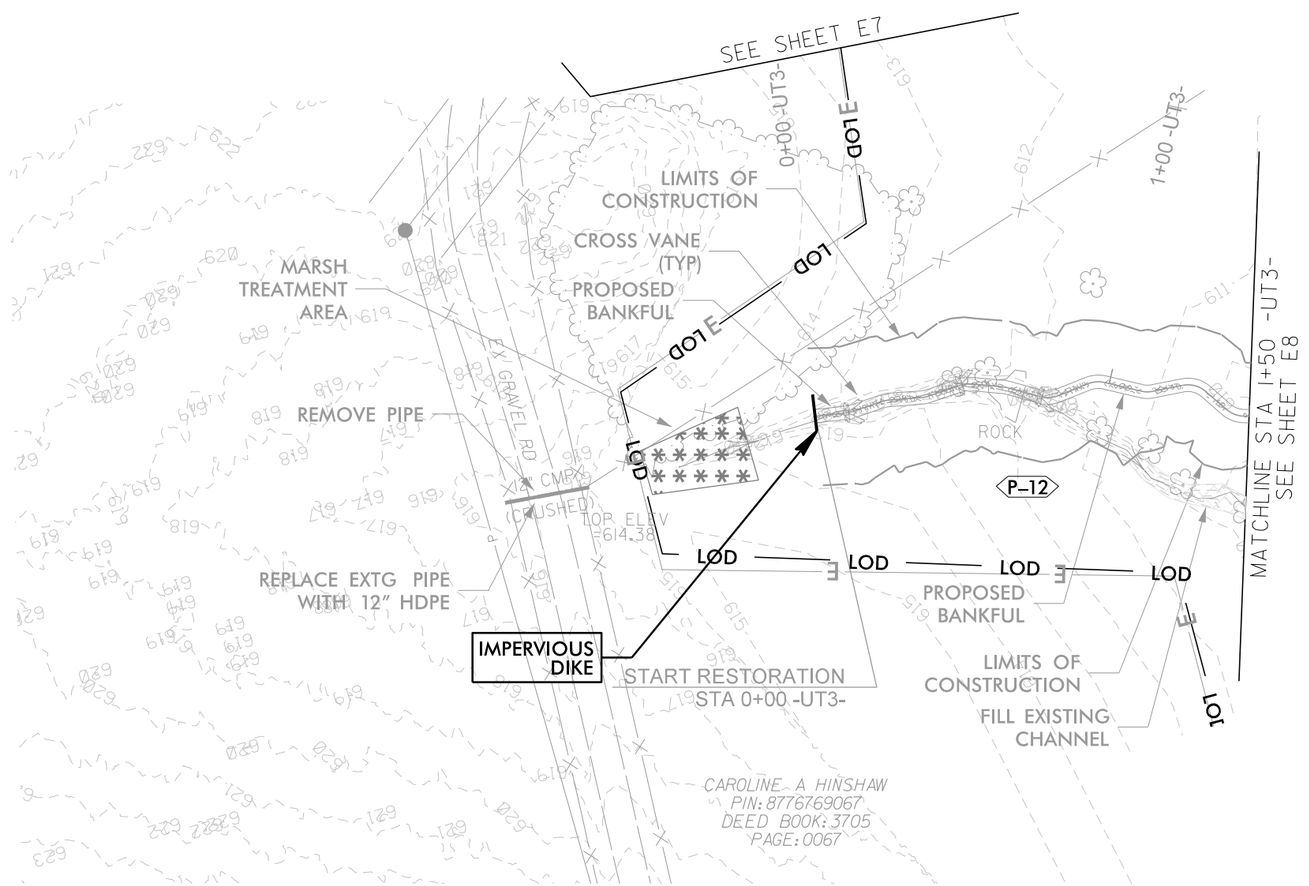
NAD 83

— LOD — LIMITS OF DISTURBANCE

TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK



7/7/2020
By chris.roby
J:\har-veu\...\E17.dgn

SHEET NAME		SHEET NUMBER
EROSION CONTROL		EI8
PROJECT NAME: BRAHMA SITE		
	COUNTY: ALAMANCE	DATE: 2020

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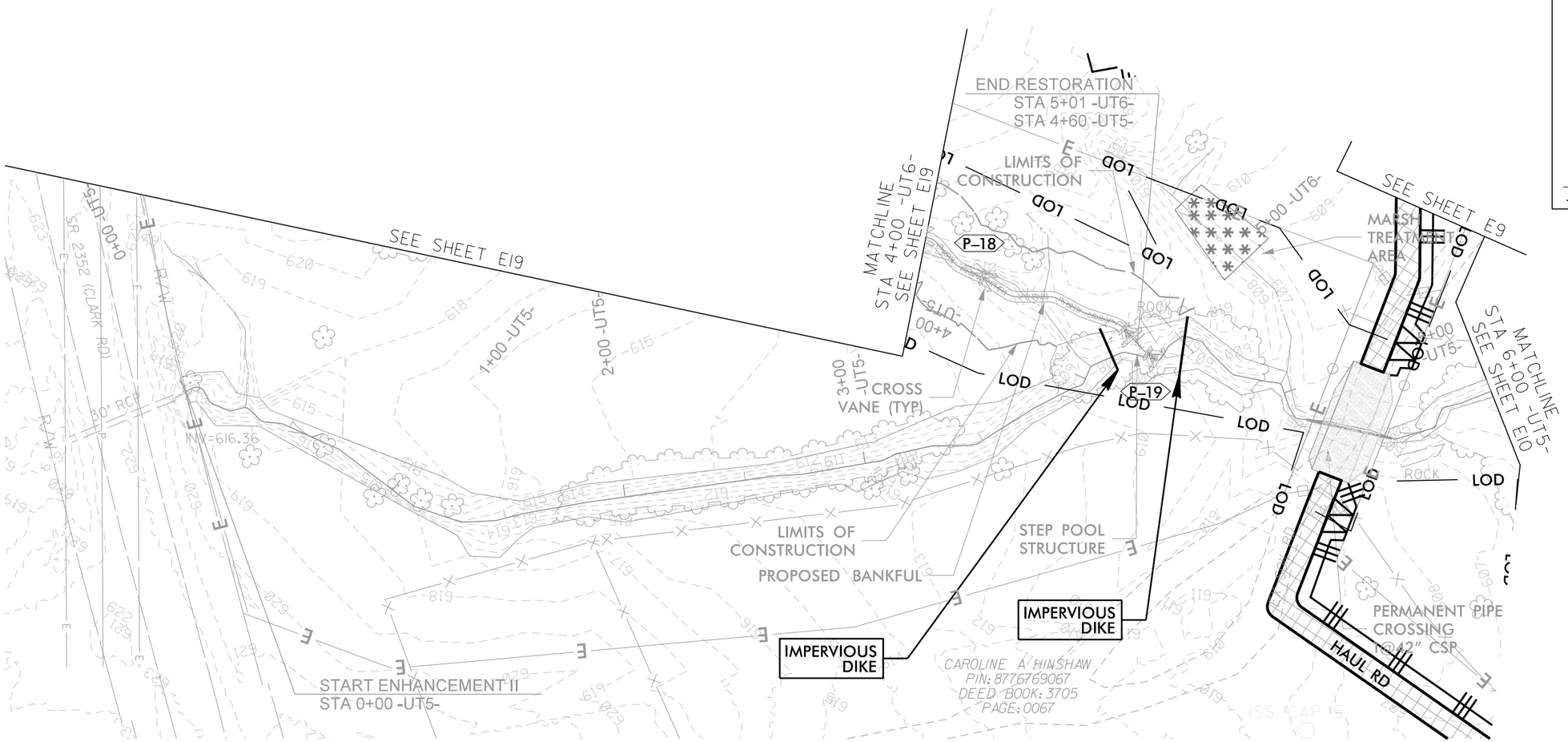
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25651 JOSEPH T. DALTON

DATE:

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'
SCALE: 1" = 50'
NAD 83



7/1/2020
Brahma_dy_psh_EI8.dgn
jharvey

SHEET NAME		SHEET NUMBER
EROSION CONTROL		E19
PROJECT NAME:	BRAHMA SITE	
	COUNTY: ALAMANCE	DATE: 2020

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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 25661 JOSEPH C. DALTON

DATE:

LOD — LIMITS OF DISTURBANCE

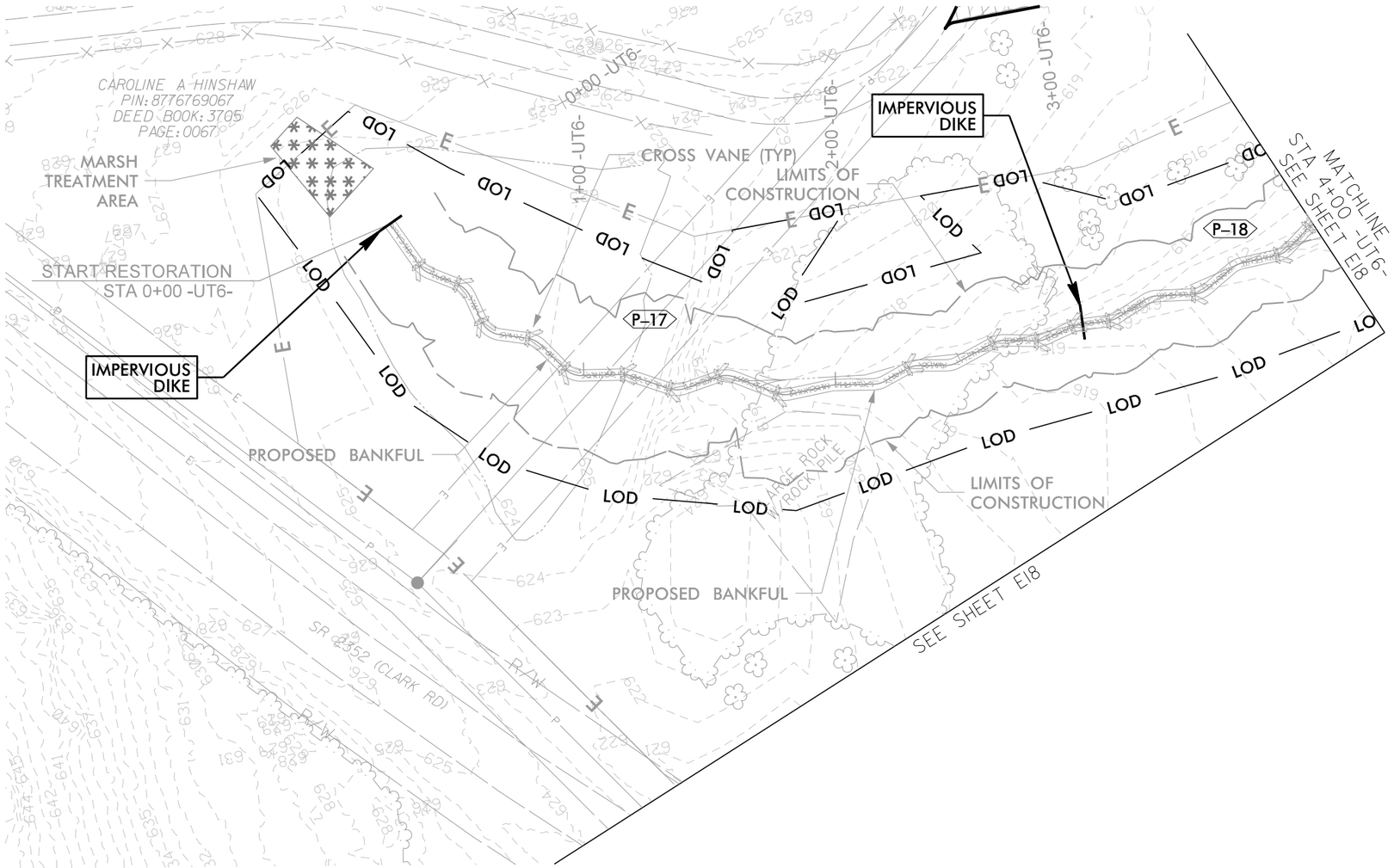
TEMPORARY SILT FENCE

HAUL ROAD

SPECIAL SEDIMENT CONTROL FENCE BREAK

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83



7/7/2020
Brahma Rdy_psh_E19.dgn
jharvey