FINAL
AS-BUILT BASELINE
MONITORING REPORT (MY0)

MAJOR HILL STREAM AND WETLAND MITIGATION SITE
Alamance County, North Carolina

DMS Project ID No. 100015
Full Delivery Contract No. 7193
USACE Action ID No. SAW-2017-01472
DWR No. 17-0921
RFP No. 16-006990

Cape Fear River Basin
Cataloging Unit 03030002

Data Collection: September 2018 – January 2019
Submission: March 2019

Prepared for:

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

March 18, 2019

Ms. Lindsay Crocker
NC DEQ – Division of Mitigation Services
1652 Mail Service Center
Raleigh, North Carolina
27699-1652

Subject: Major Hill Stream and Wetland Mitigation Site: As-built Comment Responses
DMS Contract #: 7193; DMS Project ID: 100015; RFP # 16-006990

Electronic Deliverables:

- All GIS files should be projected in NAD 83 State Plane coordinate system. For this project, some of the shapes are in GCS and some are in the required NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet. Make sure these are all in correct projections and resubmit. *All shapefile projections were updated to the correct coordinate system.*
- Need jurisdictional wetland area and planting area shapes added to submittal. Assets should match what is in the As-built report and be broken out by reach and wetland area. *These were added to the digital submittal and the assets match Table 1 in the as-built report.*
- Need CVS database file *CVS database was included in the digital submittal.*
- Wetland asset shapefile: there are significantly more enhancement shapes than there were on the JD, which does not make sense. Many of these shapes are very small. Can you explain what is going on with these small pieces? *The wetland assets were divided by the as-built stream channel, creating several small polygons on either side of the stream.* Is this shape the same one used for the Mitigation Plan? *Yes, this is the same shapefile from the Mitigation Plan, but it has been divided by the as-built stream channel.* The areas on the attribute table need to match the areas on the asset table. You can either break out the areas to add to the asset table, or you can merge the polygons by asset type to create a multi-part polygon that matches the attribute table. *The total areas match the areas on the asset table. The wetlands were merged to show one multi-part polygon for enhancement and one for restoration.*

Asset updates:

- The assets on the MY0 report do not match what is in the Mitigation Plan. This is fine if it accurately reflects what is on the ground, but it is not explained in the report. Add a detailed description of how and why the assets changed in memorandum format for submission to the IRT with the AB report to change the credits. *Please see the attached letter to RS (from Axiom) that provides a description for the asset updates. The letter has been included in the document as Appendix I.*
- Page 2, assets: Add a column on Table 1 that includes 'Mitigation Plan footage/acreage." IRT will want to see this. Also, it appears that most of the changes occurred in the Enhancement II sections of the assets, which should have remained constant from MP-AB and these differences are significant. How and why did these changes occur? *An additional column has been added to Table 1 and is titled Mitigation Plan Footage/Acreage. A description of the credit discrepancies*

has been provided (see the attached letter) and the letter has been included as Appendix I to the document.

- Wetland Asset shapefiles: the enhancement assets don't match what is in the 404 permit as existing wetlands. Where are the enhancement assets from? *Wetland enhancement assets were based on correspondence with David Bailey (USACE) after a mistake was discovered in the final PJD tear sheet (see attached email). The final existing wetlands were 0.52 acres, and with the as-built channel dissecting some of those, the final wetland enhancement acreage is 0.44 acres.*

As-Built Report:

- Suggest reviewing the guidance for this contract on As-Built reports. *We have reviewed the guidance.*
- Add DWR number on cover page. *This was added.*
- It would make much more sense to move section 1.2 in front of section 1.3 and 1.4 for context. *Section 1.2 was moved to the end and became Section 1.4.*
  This section (1.3 and 1.4) should also contain information on actual as-built information. Currently, there is no discussion of as-built conditions, deviations from mitigation plan, fence installation, construction timelines, planting dates, densities, or locations. Please update report to read like an As-Built. Provide description of pond removal, methodology, and any issues. *The following was added to the document. "Additional activities that occurred at the Site included the following.*
    - *Installation of a marsh treatment area to treat drainage prior to entering UT1.*
    - *Fencing the entire conservation easement by leaving some pre-existing fencing, removing fencing, and installing additional fencing.*
    - *Planting 8.11 acres of the Site with 8600 stems (planted species and densities by zone are included in Table 5 [Appendix C]).*
    - *Removing a small, abandoned farm pond by 1) notching the dam to dewater; 2) removal of the dam to the elevation of the adjacent floodplain; 3) excavating sediment that was unsuitable for channel bank construction; 4) backfilling areas of sediment removed with soil suitable for channel construction (as necessary); 5) excavation of the design channel, 6) stabilization of the channel with coir matting, seed, and mulch; and 7) installation of structures.*

  Deviations from the construction plans included not constructing 2 log cross-vanes, constructing 15 structures at the bottom of riffles that were shown at the top of riffle on construction plans, and not constructing the Terracell drop structure; the restoration channel was tied into existing bedrock (Appendix G). No other deviations of significance occurred between construction plans and the as-built condition. In addition, no issues have arisen since construction occurred."
- Move Table 1 up before discussion of success criteria (this table should follow goals and objectives). Also, Table 1 is the same as the Table on Page 9, with one additional column. Merge these tables and just provide one time in the report. *Text was moved after Table 1. In addition, Section 2.4 was removed and the last column of the table was added to Table 1.*
- Section 2.1 remove everything after the table. There is no need to mention pre-construction data if it was already provided in the Mitigation Plan. *All text after the Stream Monitoring Summary Table was removed and the following note was added to the table "Preconstruction data for water quality was included in the Detailed Mitigation Plan and for benthic macroinvertebrates is included in Appendix F."*
- Section 2.1, this first paragraph is pasted from the Mitigation Plan on what RS is going to do. Because this is an As-Built, it should say what you did, not what you are planning to do. Update to reflect as-built. *This was adjusted.*

- Section 2.3, same comment as 2.1. Include planting area, densities and timeline. *The following sentence was added to the beginning of this section "Planting occurred in December 2018-January 2019 within 8.11 acres of the Site and included 8600 stems (planted species and densities by zone are included in Table 5 [Appendix C])." And this sentence was added at the end "). Baseline measurement also included two random sample plots (10-meter by 10-meter). Measurements of all 10 plots resulted in an average of 716 planted stems/acre excluding live stakes (Tables 6-8, Appendix C)."*
- Table 8, these numbers don't match Table 6. Table 8 should also include T-1 and T-2 in the averages. *Table 8 originally pertained to riparian buffer totals which exclude shrubs. Since this information is included in App H, this Table was replaced with a summary of planted stems in the 8 fixed and 2 random plots.*
- Table 2, the RFP issue date is 9/16/2016. Add 404 permit date to table (6/28/2018, see excel table guidance). *This was adjusted/added.*
- Figure 2, CCPV, Please increase text on legend so it is more legible. Show location of fences on CCPV. *Font size in the legend was increased, and fences were added to the CCPV.*
- Table 4, Appendices the stream lengths don't match asset pre-condition lengths. *These were adjusted to match Table 1.*
- Morphology Table. 10c shows that some of the cross sections don't match the design. For instance, Riffle 5 is much wider and has a larger cross-sectional area than proposed. Also, xs-10 is much wider and shallower than designed. These are the types of deviations that should be explained in the As-Built report, and designers need to explain why / how the size of the channel is so different than design which came from regional curve and reference analysis. This is true for x-sections 1, 2, 4, 5, and 10. Also, is there a reason you labeled the cross-sections backwards? *Site construction was completed on September 19th. The Site experienced multiple bankfull events from Hurricane Florence from 9/15 to 9/18. Cross sections were performed just after Florence on 9/19-9/20. While the Site made it through this storm with multiple bankfulls, with minimal damage, there were likely some changes in the post construction cross sectional areas. In addition, the use of sod mats and natural riffle bed material may cause channel dimension variations that are compounded with the small size of the constructed channel. Based on field reviews of the Site, these variations appear to be within an acceptable tolerance for channel stability.*

As-Built Drawings:

- Sheet 5A and 5B appear to be conservation easement plat. This is not required for As-Built, please remove. *The conservation plat has been removed from the plans.*
- Sheet 5A (3 of 20), this should show the different planting areas on the map as differentiated in the Mitigation Plan (ex: Pied/Low Mountain Alluvial Forest type should be one area on the map) along with the planting species table. Also, it appears that RS planted the entire easement, but over half of the easement has existing trees. Update with actual ground-truthed planted area, by planting area type. (Something like Table 2 from page 264 of the Mitigation Plan should be included in the As-Built, along with map). *A planting plan, with different planting areas differentiated on the map has been provided.*
- Sheet 5A (4-7 or 20) are not necessary. *Information from these pages has been transferred into the Construction Drawings, as discussed in the field. These pages have been removed from the document.*
- Your drawings should show the drawings from the Mitigation Plan and red lines where anything deviated from those construction drawings. It should contain at minimum topography, location of structures, stationing. Refer to guidance on As-built drawings. As built profiles should show design elevation lines, with As-Built as a red line (where elevation deviates). *Construction*

Drawings have been updated as discussed in field review and meetings. Red-line alterations have been added to the documents with appropriate notes.

- Sheet 8-10 of 20 (profiles). These elevations should be overlain on the design sheets (6A-6G). *As discussed in the field, profiles are not being added as overlays on this project's as-built. For the purpose of this as built construction plan, the structure elevations (pre and post) have been added as a table to ensure the design channel elevations have been met. Profiles will be provided independently as baseline data for future overlays, as required by the DMS/IRT.*
- Profiles: there shouldn't be survey measurements on profile drawings, the graphs as a stand-alone are fine, that other information should go in your geomorphology excel files. The as-built profiles should overlay the design profile. *Please see the note above.*
- Stationing: why does UT-1 only go out to ~1,675 and UT-2 only go to 28'? Shouldn't you be showing the distances as stationing as in the design? *As discussed in the field, stationing on the profile and stationing of the alignment are independent. The alignment is based on the centerline along the plan view, while the profile is based on field measurements and will inherently be different. The profile is not expected to match the alignment which is used for crediting purposes.*
- There were some structures that were not constructed, but there is no explanation as to why or how the grade was maintained. Please provide text explanation. *A note has been added to the construction drawings to indicate that the structures were removed due to contact with bedrock.*

Riparian Buffer As-Built supplement:

- Add DWR number *This was added.*
- Read through summary and update for As-Built. There are sections that say 'will be' or have strange verb tenses like 'was not be.' *This was adjusted.*
- Table 5 does not match Table 6 for your vegetation counts. *Table 5 summarizes riparian buffer success criteria, which only includes planted hardwood trees and excludes shrubs, pines, vines, or unknown species in CVS. Table 6 includes all planted stems. Both tables are exported from CVS.*
- As-Built report maps. All riparian buffer measurement should be measured in square foot (to the whole square foot) and reported in square foot on the maps. Update Asset maps and As-Built maps with the numbers in square feet and ensure they match the asset table. *All reporting of riparian buffer assets was updated to square feet.*
- Provide a planting map and show by planting zone and acreage (same as wetland and stream report). *A planting map (Figure B) was created with planting zones and acreages.*
- Asset Table: Each Reach ID should be a separate unit (instead of being all labeled as 'Major Hill'). The areas should match the shapefiles and shapefile should identify each reach ID in the attribute table. *Each reach was given a separate ID in the table and shapefile attribute table.*
- Credits changed from Mitigation Plan to As-Built. Please provide explanation for this change in the document. *The final surveyed easement was slightly different resulting in a few changes to assets.*

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APPENDICES

1.0 PROJECT SUMMARY

Restoration Systems, LLC has established the North Carolina Division of Mitigation Services (NCDMS) Major Hill Stream and Wetland Restoration Site (Site).

1.1 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. 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 (reduction of 10.0 tons/year after mitigation is complete);
2. Reduce and manage nutrient inputs (livestock removal from streams, elimination of fertilizer application, and marsh treatment areas may result in a direct reduction of 852.4 pounds of nitrogen and 70.6 pounds of phosphorus per year);
3. Protect and augment designated natural heritage areas.

Site specific mitigation goals and objectives were 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) (see Table 1).

Table 1. Stream/Wetland Targeted Functions, Goals, and Objectives

Targeted Functions	Goals	Objectives	Compatibility of Success Criteria
(1) HYDROLOGY			
(2) Flood Flow (Floodplain Access) (3) Streamside Area Attenuation (4) Wooded Riparian Buffer (4) Microtopography	• Attenuate flood flow across the Site. • Minimize downstream flooding to the maximum extent possible. • Connect streams to functioning wetland systems.	• Construct new channel at historic floodplain elevation to restore overbank flows and restore jurisdictional wetlands • Plant woody riparian buffer • Remove livestock • Deep rip floodplain soils to reduce compaction and increase soil surface roughness • Protect riparian buffers with a perpetual conservation easement	• 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
(3) Stream Stability (4) Channel Stability (4) Sediment Transport	• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Remove livestock • Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • ER of 1.4 or greater • < 10% change in BHR and ER in any given year • Livestock excluded from the easement • Attain Vegetation Success Criteria
(1) WATER QUALITY			
(2) Streamside Area Vegetation (3) Upland Pollutant Filtration (3) Thermoregulation (2) Indicators of Stressors	• 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	• Livestock excluded from the easement • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT			
(2) In-stream Habitat (3) Substrate (3) Stream Stability (3) In-Stream Habitat (2) Stream-side Habitat (3) Stream-side Habitat (3) Thermoregulation Wetland Landscape Patch Structure Wetland Vegetation Composition	• Improve instream and stream-side habitat.	• Construct stable channels with cobble/gravel substrate • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows and plant woody riparian buffer • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams	• Cross-section measurement indicate a stable channel with cobble/gravel substrate • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

1.2 Project Background

The Major Hill Stream and Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 16.7 acres along warm water, unnamed tributaries to Pine Hill Branch. The Site is located approximately 3.5 miles southeast of Snow Camp and 6 miles north of Silk Hope in southern Alamance County near the Chatham County line (Figure 1, Appendix A).

Prior to construction, Site land use consisted of disturbed forest and agricultural land used for livestock grazing and hay production. Livestock had unrestricted access to Site streams, which had been relocated to the floodplain edge, ditched, impounded, trampled by livestock, eroded vertically and laterally, and received extensive sediment and nutrient inputs from stream banks and adjacent pastures. Approximately 60 percent of the stream channel had been degraded contributing to sediment export from the Site resulting from mechanical processes such as livestock hoof shear. In addition, streamside wetlands were cleared and drained by channel downcutting and land uses. Preconstruction Site conditions 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 restored riffle-pool morphology aiding in energy dissipation, increased aquatic habitat, stabilized channel banks, and will greatly reduce sediment loss from channel banks.

1.3 Project Components and Structure

Site restoration activities generated 3058 Stream Mitigation Units (SMUs) and 0.76 Wetland Mitigation Units (WMUs) as the result of the following.

- 1738 linear feet of Priority I stream restoration
- 3299 linear feet of stream enhancement (Level II)
- 0.54 acre of riparian wetland restoration
- 0.44 acre of riparian wetland enhancement

Additional activities that occurred at the Site included the following.

- Installation of a marsh treatment area to treat drainage prior to entering UT1.
- Fencing the entire conservation easement by leaving some pre-existing fencing, removing fencing, and installing additional fencing.
- Planting 8.11 acres of the Site with 8600 stems (planted species and densities by zone are included in Table 5 [Appendix C]).
- Removing a small, abandoned farm pond by 1) notching the dam to dewater; 2) removal of the dam to the elevation of the adjacent floodplain; 3) excavating sediment that was unsuitable for channel bank construction; 4) backfilling areas of sediment removed with soil suitable for channel construction (as necessary); 5) excavation of the design channel, 6) stabilization of the channel with coir matting, seed, and mulch; and 7) installation of structures.

Deviations from the construction plans included not constructing 2 log cross-vanes, constructing 15 structures at the bottom of riffles that were shown at the top of riffle on construction plans, and

not constructing the Terracell drop structure; the restoration channel was tied into existing bedrock (Appendix G). No other deviations of significance occurred between construction plans and the as-built condition. In addition, no issues have arisen since construction occurred.

Site design was completed in February 2018. Construction started on July 25, 2018 and ended within a final walkthrough on September 6, 2018. The Site was planted in December 2018-January 2019. Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 1-4 (Appendix A).

1.4 Success Criteria

Project success criteria have been established per the October 24, 2016 NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*.

1.4.1 Stream Success Criteria

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 vegetation success criteria. The following summarizes stream success criteria.

- 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 1.4 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.

1.4.2 Wetland Success Criteria

The following summarizes wetland success criteria.

- Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 10 percent of the growing season, during average climatic conditions

According to the *Soil Survey of Alamance County*, the growing season for Alamance County is from April 17 – October 22 (USDA 1960). However, the start date for the growing season is not typical for the Piedmont region; therefore, for purposes of this project gauge hydrologic success will be determined using data from March 1 - October 22 to more accurately represent the period of biological activity. Based on growing season information outlined in the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (USACE 2010), this will be confirmed annually by soil temperatures exceeding 41 degrees Fahrenheit at 12 inches depth and/or bud burst.

Target hydrological characteristics include saturation or inundation for 10 percent of the monitored period (March 1-October 22), during average climatic conditions. During years with atypical climatic conditions, groundwater gauges in reference wetlands may be used for comparison to the Site; however, reference gauge data will not be tied to success criteria. These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed. The jurisdictional determination will not supersede monitoring data, or overturn a failure in meeting success criteria; however, this information may be used by the IRT, at the discretion of the IRT, to make a final determination on Site wetland re-establishment success.

1.4.3 Vegetation Success Criteria

The following summarizes vegetation success criteria.

- Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; 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.
- 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.
- Any single species can only account for 50% of the required stems within any vegetation plot.

2.0 METHODS

Monitoring requirements and success criteria outlined in this plan follow the October 24, 2016 NC Interagency Review Team *Wilmington District Stream and Wetland Compensatory Mitigation Update*. Monitoring will be conducted by Axiom Environmental, Inc. Annual monitoring reports of the data collected will be submitted to the NCDMS by Restoration Systems no later than December 31 of each monitoring year data is collected. The monitoring schedule is summarized in the following table.

Monitoring Schedule

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

2.1 Stream Monitoring

Annual monitoring will include development of channel cross-sections and substrate on riffles and pools (Figure 2, Appendix B). Data presented in graphic and tabular format include 1) cross-sectional area, 2) bankfull width, 3) average depth, 4) maximum depth, and 5) width-to-depth ratio. Longitudinal profiles were monitored for as-built; however, profiles will not be measured routinely unless monitoring demonstrates channel bank or bed instability, in which case, longitudinal

profiles may be required by the USACE along reaches of concern to track changes and demonstrate stability.

Stream Monitoring Summary

Parameter	Method	Schedule/Frequency	Number/Extent
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	10 cross-sections
Channel Stability	Visual Assessments	Yearly	All restored stream channels
	Bank Pins	Yearly	Only if instability is documented during monitoring
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring
Stream Hydrology	Continuous monitoring water level gauges and/or trail camera	Continuous recording through monitoring period	Two gauges on UT1 (upstream and downstream) and one trail camera on UT1 (downstream)
Water Quality*	Water samples	Yearly	Two locations
Macroinvertebrates*	Qual 4 sampling	Years 3, 5, and 7	Two locations

*Preconstruction data for water quality was included in the Detailed Mitigation Plan and for benthic macroinvertabrates is included in Appendix F.

2.2 Wetland Monitoring

Six groundwater monitoring gauges were installed within the drained pond area and the remaining wetland restoration areas to take measurements after hydrological modifications were performed at the Site (Figure 2, Appendix B). A detailed soil profile was described adjacent to each installed groundwater gauge (Appendix E). Hydrological sampling will continue throughout the entire year at intervals necessary to satisfy jurisdictional hydrology success criteria. In addition, an on-site rain gauge will document rainfall data for comparison of groundwater conditions with extended drought conditions and a trail camera was installed to confirm overbank flooding events. Growing season soil temperatures will also be documented using a continuously logging soil temperature probe, this data will be provided with wetland hydrology data.

Wetland Monitoring Summary

Parameter	Method	Schedule/Frequency	Number/Extent	Data Collected
Wetland Restoration	Groundwater gauges	As-built, Years 1, 2, 3, 4, 5, 6, and 7	6 gauges spread throughout restored wetlands	Soil temperature at the beginning of each monitoring period, groundwater and rain data for each monitoring period

2.3 Vegetation

Planting occurred in December 2018-January 2019 within 8.11 acres of the Site and included 8600 stems (planted species and densities by zone are included in Table 5 [Appendix C]). After planting was completed, an initial evaluation was performed to verify planting methods and to determine initial species composition and density.

During quantitative vegetation sampling, 8 sample plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008). Baseline measurement also included two random sample plots (10-meter by 10-meter). Measurements of all 10 plots resulted in an average of 716 planted stems/acre excluding livestakes (Tables 6-8, Appendix C).

Vegetation Monitoring Summary

Parameter	Method	Schedule/Frequency	Number/Extent	Data Collected
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	8 plots spread across the Site	Species, height, location, planted vs. volunteer, and age
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	2 plots randomly selected each year	Species and height

3.0 REFERENCES

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Appendix A
Background Tables

Table 1. Project Components and Mitigation Units
Table 2. Project Activity and Reporting History
Table 3. Project Contacts Table
Table 4. Project Attributes Table

Table 1. Project Components and Mitigation Credits
Major Hill Restoration Site

Reach ID	Stream Stationing/ Wetland Type	Existing Footage/ Acreage	Mitigation Plan Footage/ Acreage	Constructed Footage/ Acreage	Restoration Level	Restoration or Restoration Equivalent	Mitigation Ratio	Mitigation Credits	Comment
UT 1	00+00 to 16+99	1829	1699	1699	Restoration	1699	1:1	1699	
UT 1	16+99 to 27+96	1097	1060	1097*	EII	1097	2.5:1	439	
UT 2	00+00 to 01+68	168	168	168	EII	168	2.5:1	67	
UT 2	01+68 to 02+07	39	43	39*	Restoration	39	1:1	39	
UT 3	00+00 to 22+98	2298	2197	2298*	EII	2298-80-144-40=2034	2.5:1	814	80 lf and 40 lf of UT3 are not credit generating due to crossings and drainage easement. 144 lf are not credit generating due to lack of control of south bank and drainage easement.
Wetlands	Riparian Riverine	--	0.54	0.54	Restoration	0.54	1:1	0.54	Wetland Restoration
Wetlands	Riparian Riverine	0.52	0.44	0.44	Enhancement	0.44	2:1	0.22	Wetland Enhancement

*See attached letter (Appendix I) for explanation of credit discrepancies.

Table 1 continued. Project Components and Mitigation Credits
Major Hill Restoration Site

Length & Area Summations by Mitigation Category		
Restoration Level	**Stream (linear footage)**	**Riparian Wetland (acreage)**
Restoration	1738	0.54
Enhancement (Level II)	3299*	--
Enhancement	--	0.44**

* An additional 264 linear feet of stream enhancement (level II) is proposed outside of the easement (at road crossings), or the sponsor controls only one bank of the stream, and is therefore not included in this total or in mitigation credit calculations.
**Approximately 0.08 acre of existing, degraded wetland will not be enhanced as the result of the design channel crossing the wetland area.

Overall Assets Summary	
Asset Category	**Overall Credits**
Stream	**3058**
Riparian Riverine Wetland	**0.76**

Table 2. Project Activity and Reporting History
Major Hill Restoration Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal Issue Date (RFP No. 16-006990)	September 16, 2016	September 16, 2016
Institution Date (NCDMS Contract No. 7193)	--	May 22, 2017
Mitigation Plan	--	February 2018
404 Permit Date	--	June 28, 2018
Construction Plans	--	July 2018
Site Construction	--	July 25-September 6, 2018
Planting	--	December 2018-January 2019

Table 3. Project Contacts Table
Major Hill Restoration Site

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

Table 4. Project Attribute Table
Major Hill Restoration Site

Project Information	
Project Name	Major Hill Restoration Site
Project County	Alamance County, North Carolina
Project Area (acres)	16.7
Project Coordinates (latitude & latitude)	35.873206, -79.360906
Planted Area (acres)	8.11
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)	17 to 445
Percentage of Project Drainage Area that is Impervious	<2%
CGIA Land Use Classification	Managed Herbaceous Cover & Mixed Upland Hardwoods

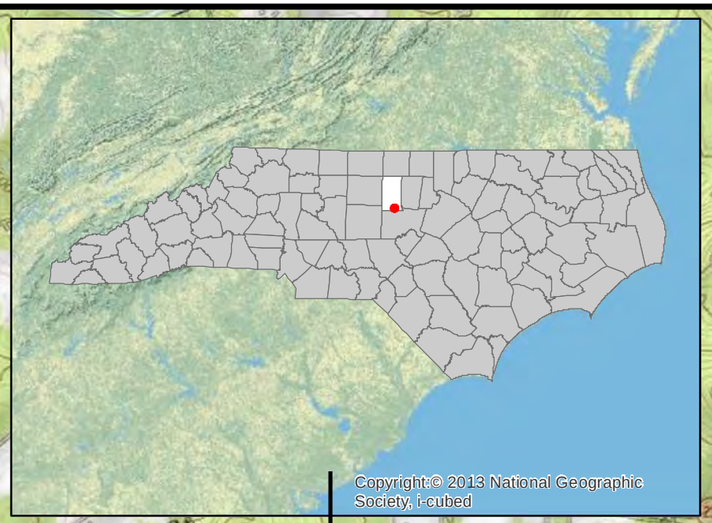
Table 4. Project Attribute Table
Major Hill Restoration Site (continued)

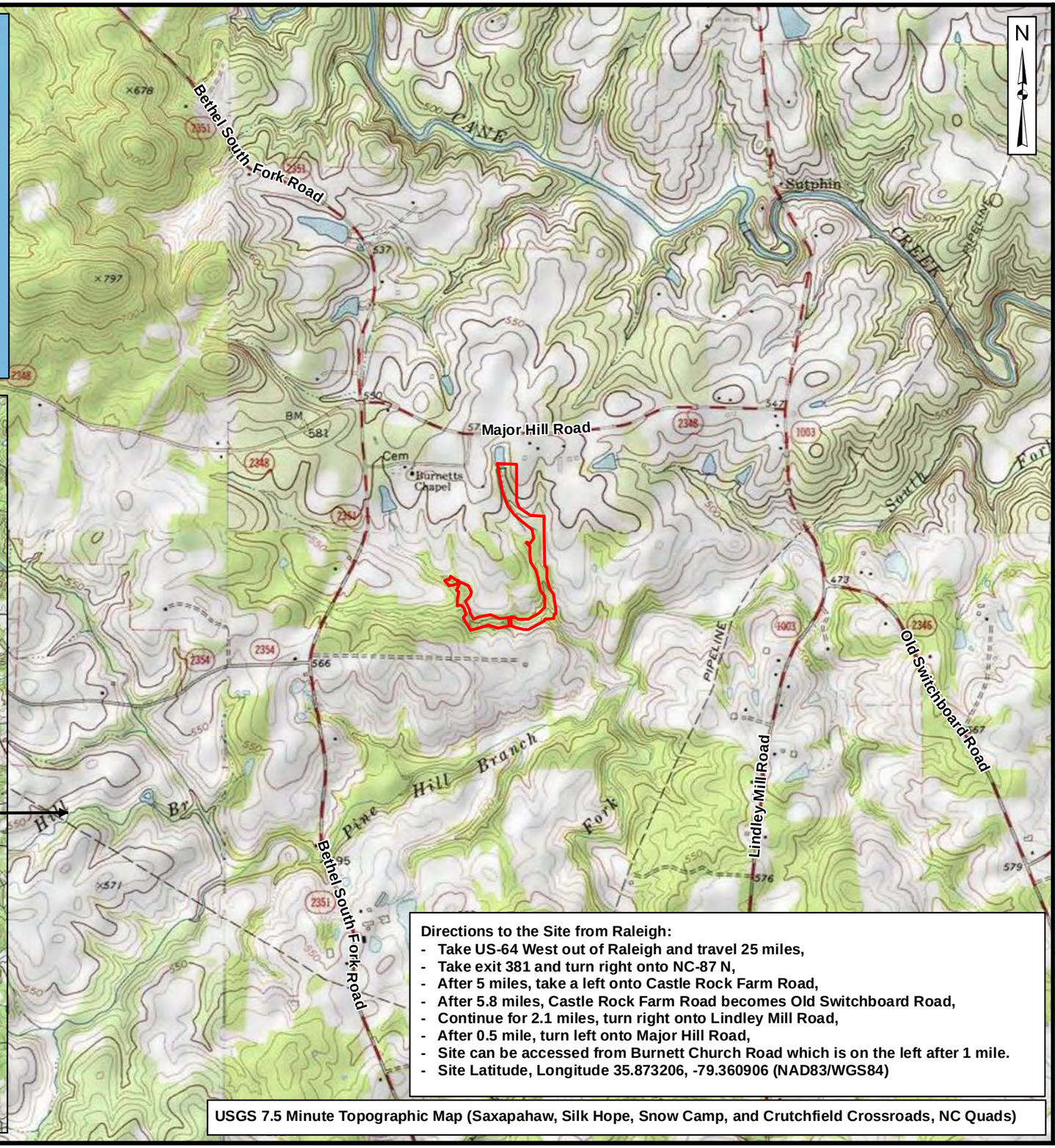
Reach Summary Information			
Parameters	**UT 1**	**UT 2**	**UT 3**
Length of reach (linear feet)	2926	207	2298
Valley Classification & Confinement	Alluvial, moderately confined to confined		
Drainage Area (acres)	71.7	17.2	444.7
NCDWR Stream ID Score	20.25 – 33.5	--	--
Perennial, Intermittent, Ephemeral	Intermittent/Perennial	Intermittent	Perennial
NCDWR Water Quality Classification	WS-V, NSW		
Existing Morphological Description (Rosgen 1996)	Cg5	C4/5	C3
Proposed Stream Classification (Rosgen 1996)	C/E 4	C4/5	C3
Existing Evolutionary Stage (Simon and Hupp 1986)	III/IV	III	I
Underlying Mapped Soils	Efland silt loam, Georgeville silt loam, Herndon silt loam, Orange silt loam, Worsham sandy loam, Local Alluvial Land		
Drainage Class	Well-drained, well-drained, well-drained, poorly drained, well-drained, poorly drained, respectively		
Hydric Soil Status	Nonhydric, nonhydric, nonhydric, nonhydric, hydric, hydric, respectively		
Slope	0.0241	0.0256	0.0130
FEMA Classification	NA		
Native Vegetation Community	Piedmont Alluvial Forest/Dry-Mesic Oak-Hickory Forest		
Watershed Land Use/Land Cover (Site)	45% forest, 35% agricultural land, 20% 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%		

Wetland Summary Information	
Parameters	**Wetlands**
Wetland acreage	0.54 acre drained or impounded & 0.44 acre degraded
Wetland Type	Riparian riverine
Mapped Soil Series	Worsham and Local Alluvial Land
Drainage Class	Poorly drained
Hydric Soil Status	Hydric
Source of Hydrology	Groundwater, stream overbank
Hydrologic Impairment	Incised streams, compacted soils, livestock
Native Vegetation Community	Piedmont/Low Mountain Alluvial Forest
% Composition of Exotic Invasive Vegetation	<5%
Restoration Method	Hydrologic, vegetative
Enhancement Method	Vegetative

Appendix B
Visual Assessment Data

Figure 1. Project Location
Figure 2. Current Conditions Plan View
Vegetation Plot Photographs





Directions to the Site from Raleigh:

- **Take US-64 West out of Raleigh and travel 25 miles,**
- **Take exit 381 and turn right onto NC-87 N,**
- **After 5 miles, take a left onto Castle Rock Farm Road,**
- **After 5.8 miles, Castle Rock Farm Road becomes Old Switchboard Road,**
- **Continue for 2.1 miles, turn right onto Lindley Mill Road,**
- **After 0.5 mile, turn left onto Major Hill Road,**
- **Site can be accessed from Burnett Church Road which is on the left after 1 mile.**
- **Site Latitude, Longitude 35.873206, -79.360906 (NAD83/WGS84)**

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

Axiom Environmental, Inc.

Prepared for:

RESTORATION SYSTEMS | LLC

Project:

MAJOR HILL STREAM AND WETLAND MITIGATION SITE

Alamance County, NC

Title:

PROJECT LOCATION

Drawn by: KRJ

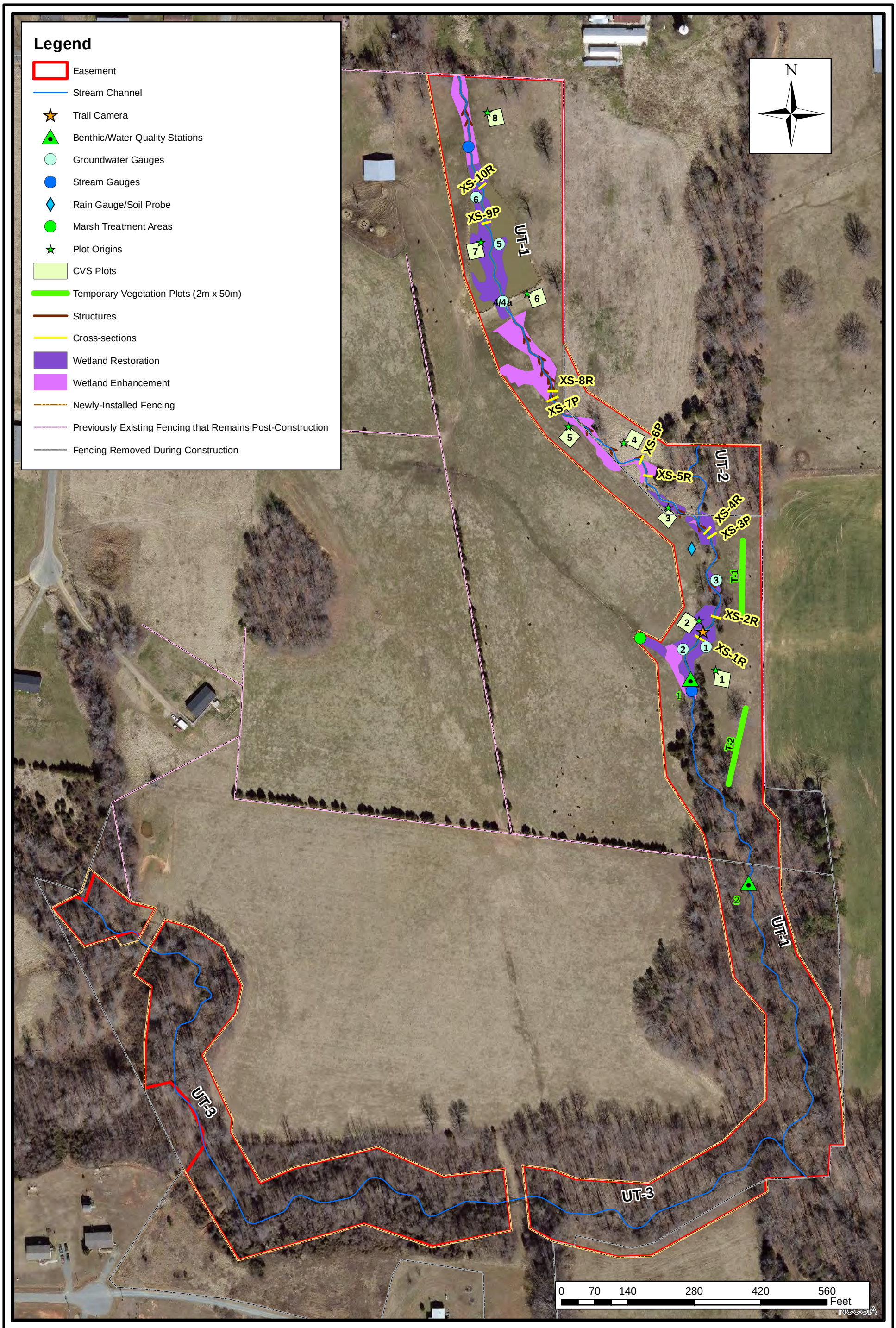
Date: NOV 2017

Scale: 1:20,000

Project No.: 17-009

FIGURE

1



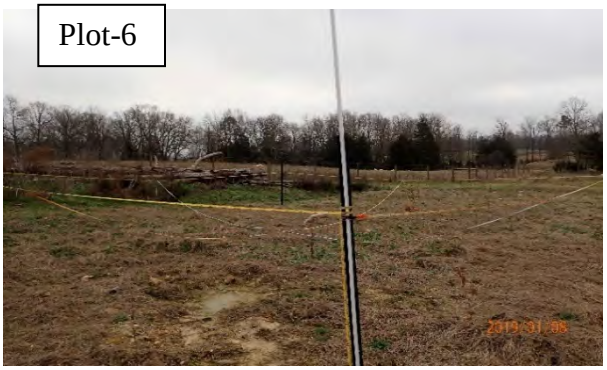
Axiom Environmental
218 Snow Ave
Raleigh, NC 27607
(919) 215-1693
Axiom Environmental, Inc.

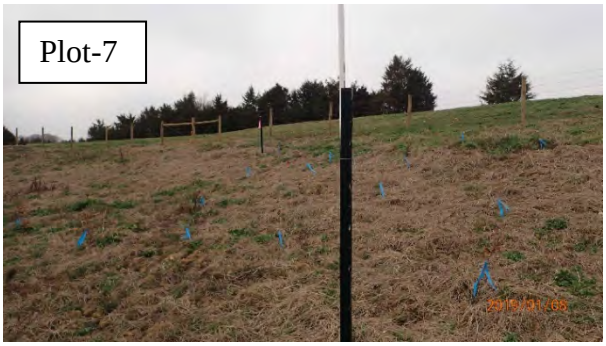
CURRENT CONDITIONS PLAN VIEW
Major Hill Stream and Wetland Mitigation
Alamance County, North Carolina

Dwn. By:	KRJ
Date:	Feb 2019
Project:	17-009

FIGURE
2

Major Hill Asbuilt Vegetation Plots
Photos Taken January 8, 2019





Appendix C
Vegetation Data

Table 5. Planted Bare Root Woody Vegetation
Table 6. Total Stems by Plot and Species
Table 7. Temporary Vegetation Plot Data
Table 8. Riparian Buffer Vegetation Totals

Table 5. Planted Bare Root Woody Vegetation
Major Hill Restoration Site

Species	Piedmont/Low Mountain Alluvial Forest	Dry-Mesic Oak/Hickory Forest	Marsh Treatment Wetland	Streamside Assemblage	Total
Acres	**1.1**	**5.5**	**0.01**	**1.5**	**8.11**
Alnus serrulata			5	20	25
Asimina triloba				200	200
Betula nigra	100			200	300
Carpinus caroliniana		600			600
Cephalanthus occidentalis			5	20	25
Cercis canadensis		500			500
Cornus amomum	95		5	800	900
Diospyros virginiana		450			450
Fraxinus americana		100			100
Fraxinus pennsylvanica	150			750	900
Liriodendron tulipifera	75				75
Nyssa sylvatia		600			600
Platanus occidentalis	120			780	900
Quercus nigra	110	790		500	1,400
Quercus phellos	100	700		400	1,200
*Salix nigra**				400*	400
Sambucus canadensis			11	14	25
TOTALS	750	3,740	26	4,084	**8,600**
Stems/Acre	682	680	2600	2722	**1060**

***Live stakes of *Salix nigra* were planted; all other planted species were planted as bare root plants.

Table 6. Total Stems by Plot and Species
EEP Project Code 17.009. Project Name: Major Hill

			Current Plot Data (MY0 2019)																							Annual Means		
			17.009-01-0001			17.009-01-0002			17.009-01-0003			17.009-01-0004			17.009-01-0005			17.009-01-0006			17.009-01-0007			17.009-01-0008			MY0 (2019)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Asimina triloba	pawpaw	Tree				1	1	1	3	3	3	1	1	1							1	1	1	1	1	1	7	7	7
Betula nigra	river birch	Tree										2	2	2	4	4	4	1	1	1	1	1	1	1	1	1	9	9	9
Carpinus caroliniana	American hornbeam	Tree	1	1	1				2	2	2							2	2	2							5	5	5
Cercis canadensis	eastern redbud	Tree				1	1	1	3	3	3	4	4	4	1	1	1	1	1	1	1	1	1	3	3	3	14	14	14
Cornus amomum	silky dogwood	Shrub				1	1	1																			1	1	1
Diospyros virginiana	common persimmon	Tree										2	2	2				1	1	1				2	2	2	5	5	5
Fraxinus	ash	Tree																						1	1	1	1	1	1
Fraxinus americana	white ash	Tree																3	3	3				2	2	2	5	5	5
Fraxinus pennsylvanica	green ash	Tree										2	2	2	1	1	1										3	3	3
Liriodendron tulipifera	tuliptree	Tree	4	4	4	1	1	1																			5	5	5
Nyssa sylvatica	blackgum	Tree	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1							2	2	2	10	10	10
Platanus occidentalis	American sycamore	Tree				2	2	2							1	1	1	3	3	3	1	1	1				7	7	7
Quercus	oak	Tree	3	3	3	1	1	1	1	1	1	3	3	3	4	4	4	3	3	3	4	4	4	4	4	4	23	23	23
Quercus nigra	water oak	Tree				1	1	1	1	1	1	4	4	4	2	2	2	1	1	1	1	1	1				10	10	10
Quercus phellos	willow oak	Tree				3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	5	5	5	3	3	3	18	18	18
Unknown		Shrub or Tree	1	1	1				1	1	1										2	2	2	2	2	2	6	6	6
		Stem count	11	11	11	13	13	13	15	15	15	21	21	21	16	16	16	16	16	16	16	16	16	21	21	21	129	129	129
		size (ares)	1			1			1			1			1			1			1			1			8		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.20		
		Species count	5	5	5	9	9	9	8	8	8	9	9	9	8	8	8	9	9	9	8	8	8	10	10	10	16	16	16
		Stems per ACRE	445.2	445.2	445.2	526.1	526.1	526.1	607	607	607	849.8	849.8	849.8	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	849.8	849.8	849.8	652.6	652.6	652.6

Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

Table 7. Temporary Vegetation Plot Data
Major Hill Restoration Site

Species	50m x 2m Temporary Plot (Bearing)	
	T-1 (179^0)	T-2 (347^0)
Asimina triloba		1
Betula nigra	2	3
Carpinus caroliniana		3
Cercis canadensis	7	
Diospyros virginiana	1	1
Fraxinus pennsylvanica	2	
Nyssa sylvatia	3	2
Platanus occidentalis		1
Quercus nigra	11	7
Quercus phellos	1	3
Total Stems	**27**	**21**
Total Stems/Acre	**1093**	**850**

Table 8. Planted Vegetation Totals
Major Hill Restoration Site

Plot #	Planted Stems/Acre	Success Criteria Met?
1	445	Yes
2	526	Yes
3	607	Yes
4	850	Yes
5	648	Yes
6	648	Yes
7	648	Yes
8	850	Yes
T-1	1093	Yes
T-2	850	Yes
Average Planted Stems/Acre	**716**	**Yes**

Appendix D
Stream Geomorphology Data

Tables 9A-9B. Baseline Stream Data Summary
Tables 10A-10D. Monitoring Data (Dimensional Morphology Summary & Stream Reach Data Summary)

Table 9a. Baseline Stream Data Summary (UT 1 Upstream)
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Gauge	Regional Curve			Pre-Existing Condition (UT 1 Upstream)					Reference Reach(es) Data					Design (UT 1 Upstream)			Monitoring Baseline (UT 1 Upstream)					
Dimension and Substrate - Riffle Only		**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Max**	**Med**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)					3.8		5.6	6.4		8.0		9.6	12.1		5.6	6.4	6.0	6.0		10.9	11.8		3
Floodprone Width (ft)					11.0		27.0	48.0		15		75	140		20	60	40	23		40	40		3
BF Mean Depth (ft)					0.3		0.5	0.7		0.8		1.1	1.4		0.4	0.5	0.4	0.3		0.5	0.6		3
BF Max Depth (ft)					0.7		0.9	1.3		1.1		1.7	2.0		0.5	0.7	0.6	0.7		0.8	1.1		3
BF Cross Sectional Area (ft^2)					2.6		2.6	2.6		8.0		11.4	14.7		2.6	2.6	2.6	3.0		3.5	7.1		3
Width/Depth Ratio					5.4		13.4	27.0		8.0		9.6	15.1		12.0	16.0	14.0	12.0		19.6	33.9		3
Entrenchment Ratio					1.4		5.8	12.6		1.9		7.1	13.0		3.6	9.3	6.6	3.4		3.7	3.8		3
Bank Height Ratio					1.0		1.4	1.7		1.0		1.2	1.8		1.0	1.3	1.2	1.0		1.0	1.3		3
Profile																							
Riffle length (ft)																		5		16	47		3
Riffle slope (ft/ft)										0.0100		0.0207	0.0576		0.0268	0.0401	0.0357	0.0000		0.0252	0.0539		3
Pool length (ft)																		4.0		13.0	28.0		3
Pool Max depth (ft)										1.5		2.3	2.7		0.6	0.9	0.8	1.3		2.0	2.5		3
Pool spacing (ft)										22.0		40.8	81.0		18.0	48.0	24.0	18.0		24.0	48.0		3
Pattern																							
Channel Beltwidth (ft)										17		26.3	38		18	36	24	18		24	36		
Radius of Curvature (ft)										9		23.6	113		12	60	18	12		18	60		
Rc:Bankfull width (ft/ft)										0.8		2.4	10.3		2	10	3	2		3	10		
Meander Wavelength (ft)										10		65.7	116		36	72	51	36		51	72		
Meander Width ratio										1.5		2.7	4.7		3	6	4	3		4	6		
Transport parameters																							
Reach Shear Stress (competency) lbs/ft^2																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m^2																							
Additional Reach Parameters																							
Rosgen Classification					Cg 5					Eb 5					E/C 4			E/C-type					
Bankfull Velocity (fps)																							
Bankfull Discharge (cfs)					9.5					28.8 - 60.6					9.5			9.5					
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1.07					1.2 - 1.46					1.08			1.08					
Water Surface Slope (ft/ft)					0.0225					0.0053 - 0.0258					0.0223			0.0195					
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Table 9b. Baseline Stream Data Summary (UT 1 Downstream)
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Gauge	Regional Curve			Pre-Existing Condition (UT 1 Downstream)					Reference Reach(es) Data					Design (UT 1 Downstream)			Monitoring Baseline (UT 1 Downstream)					
Dimension and Substrate - Riffle Only		**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Max**	**Med**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)					4.9		6.7	8.7		8.0		9.6	12.1		6.8	7.8	7.3	8.6		10.3	11.8		3
Floodprone Width (ft)					9.0		14.0	21.0		15		75	140		25	75	50	22		40	40		3
BF Mean Depth (ft)					0.4		0.6	0.8		0.8		1.1	1.4		0.4	0.8	0.6	0.4		0.6	0.6		3
BF Max Depth (ft)					0.7		0.9	1.2		1.1		1.7	2.0		0.6	0.8	0.7	0.7		0.9	1.2		3
BF Cross Sectional Area (ft^2)					3.8		3.8	3.8		8.0		11.4	14.7		3.8	3.8	3.8	3.5		5.8	7.5		3
Width/Depth Ratio					6.1		13.1	21.8		8.0		9.6	15.1		12.0	16.0	14.0	18.0		18.0	21.0		3
Entrenchment Ratio					1.4		2.2	4.3		1.9		7.1	13.0		3.7	9.6	6.9	2.6		3.4	3.9		3
Bank Height Ratio					1.6		2.2	2.8		1.0		1.2	1.8		1.0	1.3	1.2	1.0		1.0	1.0		3
Profile																							
Riffle length (ft)																		5		16	47		1
Riffle slope (ft/ft)										0.0100		0.0207	0.0576		0.0000	0.0297	0.0264	0.0000		0.0252	0.0539		1
Pool length (ft)																		4.0		13.0	28.0		1
Pool Max depth (ft)										1.5		2.3	2.7		0.7	1.1	1.0	1.7		1.7	1.7		1
Pool spacing (ft)										22.0		40.8	81.0		21.9	58.4	29.2	18.0		24.0	48.0		1
Pattern																							
Channel Beltwidth (ft)										17		26.3	38		21.9	43.8	29.2	22		29	44		
Radius of Curvature (ft)										9		23.6	113		14.6	72.9	21.9	14		22	73		
Rc:Bankfull width (ft/ft)										0.8		2.4	10.3		2	10	3	2		3	10		
Meander Wavelength (ft)										10		65.7	116		43.8	87.5	62	44		62	88		
Meander Width ratio										1.5		2.7	4.7		3	6	4	3		4	6		
Transport parameters																							
Reach Shear Stress (competency) lbs/ft^2																							
Max part size (mm) mobilized at bankfull																							
Stream Power (transport capacity) W/m^2																							
Additional Reach Parameters																							
Rosgen Classification					Cg 5					Eb 5					E/C 4			E/C-type					
Bankfull Velocity (fps)																							
Bankfull Discharge (cfs)					14.2					28.8 - 60.6					14.2			14.2					
Valley Length (ft)																							
Channel Thalweg Length (ft)																							
Sinuosity					1.26					1.2 - 1.46					1.12			1.12					
Water Surface Slope (ft/ft)					0.0147					0.0053 - 0.0258					0.0165			0.0195					
BF slope (ft/ft)																							
Bankfull Floodplain Area (acres)																							
% of Reach with Eroding Banks																							
Channel Stability or Habitat Metric																							
Biological or Other																							

Table 10a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Cross Section 1 (UT 1 Downstream) Riffle							Cross Section 2 (UT 1 Downstream) Riffle							Cross Section 3 (UT 1 Downstream) Pool							Cross Section 4 (UT 1 Downstream) Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	11.8							8.6							13.0							10.3						
Floodprone Width (ft) (approx)	40.0							22.0							NA							40.0						
BF Mean Depth (ft)	0.6							0.4							0.6							0.6						
BF Max Depth (ft)	1.2							0.7							1.7							0.9						
Low Bank Height	1.2							0.7							1.7							0.9						
BF Cross Sectional Area (ft^2)	7.5							3.5							8.4							5.8						
Width/Depth Ratio	18.6							21.1							NA							18.3						
Entrenchment Ratio	3.4							2.6							NA							3.9						
Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	25.4							25.4							6.0							25.4						

Table 10b. Monitoring Data - Stream Reach Data Summary
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Baseline (UT 1 Downstream)						MY-1 (UT 1 Downstream)						MY-2 (UT 1 Downstream)						MY-3 (UT 1 Downstream)						MY-5 (UT 1 Downstream)						MY-7 (UT 1 Downstream)					
Dimension and Substrate - Riffle Only	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)	8.6		10.3	11.8		3																														
Floodprone Width (ft)	22		40	40		3																														
BF Mean Depth (ft)	0.4		0.6	0.6		3																														
BF Max Depth (ft)	0.7		0.9	1.2		3																														
BF Cross Sectional Area (ft^2)	3.5		5.8	7.5		3																														
Width/Depth Ratio	18.0		18.0	21.0		3																														
Entrenchment Ratio	2.6		3.4	3.9		3																														
Bank Height Ratio	1.0		1.0	1.0		3																														
Profile																																				
Riffle length (ft)	5		16	47		1																														
Riffle slope (ft/ft)	0.0000		0.0252	0.0539		1																														
Pool length (ft)	4.0		13.0	28.0		1																														
Pool Max depth (ft)	1.7		1.7	1.7		1																														
Pool spacing (ft)	18.0		24.0	48.0		1																														
Pattern																																				
Channel Beltwidth (ft)	22		29	44																																
Radius of Curvature (ft)	14		22	73																																
Rc:Bankfull width (ft/ft)	2		3	10																																
Meander Wavelength (ft)	44		62	88																																
Meander Width ratio	3		4	6																																
Additional Reach Parameters																																				
Rosgen Classification	E/C type																																			
Channel Thalweg Length (ft)																																				
Sinuosity	1.12																																			
Water Surface Slope (Channel) (ft/ft)	0.0195																																			
BF slope (ft/ft)																																				
Ri%/RU%P%G%/S%																																				
SC%/SA%/G%/C%/B%BE%																																				
d16/d35/d50/d84/d95																																				
% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Table 10c. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Cross Section 5 (UT 1 Upstream)							Cross Section 6 (UT 1 Upstream)							Cross Section 7 (UT 1 Upstream)							Cross Section 8 (UT 1 Upstream)						
	Riffle							Pool							Pool							Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	11.8							8.9							7.4							6.0						
Floodprone Width (ft) (approx)	40.0							NA							NA							23.0						
BF Mean Depth (ft)	0.6							1.0							1.6							0.5						
BF Max Depth (ft)	1.1							2.0							2.5							0.8						
Low Bank Height	1.1							2.0							2.5							0.8						
BF Cross Sectional Area (ft^2)	7.1							9.1							11.7							3.0						
Width/Depth Ratio	19.6							NA							NA							12.0						
Entrenchment Ratio	3.4							NA							NA							3.8						
Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	25.4							6.0							6.0							25.4						

Parameter	Cross Section 9 (UT 1 Upstream)							Cross Section 10 (UT 1 Upstream)						
	Pool							Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)	7.0							10.9						
Floodprone Width (ft) (approx)	NA							40.0						
BF Mean Depth (ft)	0.7							0.3						
BF Max Depth (ft)	1.3							0.7						
Low Bank Height	1.3							0.7						
BF Cross Sectional Area (ft^2)	4.9							3.5						
Width/Depth Ratio	NA							33.9						
Entrenchment Ratio	NA							3.7						
Bank Height Ratio	1.0							1.0						
d50 (mm)	6.0							25.4						

Table 10d. Monitoring Data - Stream Reach Data Summary
Major Hill Mitigation Project - NCDMS Project Number 100015

Parameter	Baseline (UT 1 Upstream)						MY-1 (UT 1 Upstream)						MY-2 (UT 1 Upstream)						MY-3 (UT 1 Upstream)						MY-5 (UT 1 Upstream)						MY-7 (UT 1 Upstream)					
Dimension and Substrate - Riffle Only	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**	**Min**	**Mean**	**Med**	**Max**	**SD**	**n**
BF Width (ft)	6.0		10.9	11.8		3																														
Floodprone Width (ft)	23		40	40		3																														
BF Mean Depth (ft)	0.3		0.5	0.6		3																														
BF Max Depth (ft)	0.7		0.8	1.1		3																														
BF Cross Sectional Area (ft^2)	3.0		3.5	7.1		3																														
Width/Depth Ratio	12.0		19.6	33.9		3																														
Entrenchment Ratio	3.4		3.7	3.8		3																														
Bank Height Ratio	1.0		1.0	1.3		3																														
Profile																																				
Riffle length (ft)	5		16	47		3																														
Riffle slope (ft/ft)	0.0000		0.0252	0.0539		3																														
Pool length (ft)	4.0		13.0	28.0		3																														
Pool Max depth (ft)	1.3		2.0	2.5		3																														
Pool spacing (ft)	18.0		24.0	48.0		3																														
Pattern																																				
Channel Beltwidth (ft)	18		24	36																																
Radius of Curvature (ft)	12		18	60																																
Rc:Bankfull width (ft/ft)	2		3	10																																
Meander Wavelength (ft)	36		51	72																																
Meander Width ratio	3		4	6																																
Additional Reach Parameters																																				
Rosgen Classification	E/C type																																			
Channel Thalweg Length (ft)																																				
Sinuosity	1.08																																			
Water Surface Slope (Channel) (ft/ft)	0.0195																																			
BF slope (ft/ft)																																				
Ri%/RU%P%G%/S%																																				
SC%/SA%/G%/C%/B%BE%																																				
d16/d35/d50/d84/d95																																				
% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Appendix E
Groundwater Gauge Soil Profiles

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

Axiom Environmental, Inc.

SOIL BORING LOG

Project/Site: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-1** 35.874565, -79.359097

Investigator: Axiom Inc

Notes: Gauge located near old channel, area has been disturbed during construction. Soil profile has been disturbed.

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	10yr 4/3	80	10yr 4/6	20	Silty Clay
4-10	10yr 4/2	90	10yr 4/4	10	Clay
10-24	10yr 4/1	95	10yr 4/6	5	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: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-2** 35.874562, -79.359275

Investigator: Axiom Inc

Notes: Soil saturated at ~8"

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-6	10yr 5/3	70	10yr 5/6	30	Silty Clay
6-8	10yr 5/2	60	10yr 6/6	20	Silty Clay
8-16	10yr 5/2	60	10yr 6/4	5	Silty Clay
16-24	10yr 5/2	85	10yr 6/4	10	Silty Clay some gravel included

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: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-3** 35.875063, -79.359124

Investigator: Axiom Inc

Notes: Saturated ~10"; Soil disturbed during construction

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-3	10yr 5/1	70	10yr 5/6	30	Silty Clay
3-8	10yr 5/2	100			Silty Clay
8-14	10yr 5/3	100		5	Silty Clay
14-20	10yr 4/3	95	10yr 6/4	5	Silty Clay/rocky
20+	-	-	-	-	Rocky

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: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-4/4a** 35.876569, -79.3560568

Investigator: Axiom

Notes: In old pond bed, bench excavated here. Some Fe- at surface. Saturated at 6"

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-2	10yr 6/2	60	10yr 6/6	40	Silty Clay
2-6	10yr 6/2	95	10yr 6/6	5	Silty Clay
6-14	10yr 6/1	90	10yr 6/3	10	Silty Clay
12-20	6/5GY	80	10yr 5/6	20	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: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-5** 35.877017, -79.360568

Investigator: Axiom Inc

Notes: In old pond bed, soil significantly disturbed during construction activities

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-4	6/5gy	100			Silty Clay
4-12	7.5yr 7/1	60	7.5yr 6/6	40	Silty Clay
12-20	7.5yr 8/2	65	7.5yr 7/6	35	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: Major Hill

County, State: Alamance, North Carolina

Sampling Point/ Coordinates: **GW-6** 35.877175, -79.360758

Investigator: Axiom

Notes: In old pond bed, soil significantly disturbed during construction activities

Depth (inches)	Matrix		Mottling		Texture
	Color	%	Color	%	
0-3	10yr 4/4	70	10yr 4/6	30	Silty Clay
3-8	7.5yr 5/1	100			Silty Clay
8-20	6/5GY	80	10yr 4/6	20	Silty Clay

North Carolina Licensed Soil Scientist

Number: 1233

Signature: W Grant Lewis

Name/Print: W. Grant Lewis

Appendix F
Preconstruction Benthic Data

Preconstruction Benthic Results
Habitat Assessment Dataforms

PAI ID NO			51232	51233
STATION			MH-1	MH-2
DATE			4/16/2018	4/16/2018
SPECIES	T.V.	F.F.G.		
PLATYHELMINTHES			2	
ANNELIDA				
Clitellata				
Oligochaeta		CG		
Tubificida				
Enchytraeidae		CG		1
Naididae				
Naidinae		CG		
Dero sp.	9.8	CG		7
Nais sp.	8.7	CG	1	
Slavina appendiculata	8.4	CG	1	1
Tubificinae w.h.c.		CG		1
Tubificinae w.o.h.c.		CG		2
ARTHROPODA				
Crustacea				
Copepoda				
Cyclopoida				
Cyclopidae				
Acanthocyclops sp.				2
Macrocyclops albidus				5
Isopoda				
Asellidae		SH		
Caecidotea sp.	8.4	CG	16	2
Amphipoda		CG		
Crangonyctidae				
Crangonyx sp.	7.2	CG	13	3
Insecta				
Ephemeroptera				
Baetidae		CG		
Baetis flavistriga	6.8	CG	1	
Heptageniidae		SC		
Maccaffertium modestum	5.7	SC	2	
Odonata				
Coenagrionidae		P		
Ischnura sp.	9.5		1	10
Libellulidae		P		
Libellula sp.	9.4	P		1
Plathemis lydia	9.8			1
Plecoptera				
Nemouridae		SH		
Amphinemura sp.	3.8	SH		1

PAI ID NO			51232	51233
STATION			MH-1	MH-2
DATE			4/16/2018	4/16/2018
SPECIES	T.V.	F.F.G.		
Perlidae		P		
Perlesta sp.	2.9	P	1	
Hemiptera				
Belostomatidae				
Belostoma sp.	9.5	P		1
Trichoptera				
Hydropsychidae		FC		
Diplectrona modesta	2.3	FC	4	
Philopotamidae		FC		
Chimarra aterrima	3.3	FC	1	
Coleoptera				
Elmidae		CG		
Optioservus sp.	*2.1*	SC		1
Hydrophilidae		P		
Enochrus sp.	*8.5*	CG		1
Scirtidae		SC		
Scirtes sp.			1	15
Diptera				
Chironomidae				
Chironomus sp.	*9.3*	CG	19	14
Conchapelopia sp.	8.4	P	2	
Cricotopus sp.		CG	1	
Cryptochironomus sp.	*6.4*	P	1	
Micropsectra sp.	*2.4*	CG		1
Microtendipes pedellus gp.	*3.9*	CG		1
Parametriocnemus sp.	*3.9*	CG	7	
Polypedilum sp.		SH	1	
Polypedilum flavum	*5.7*	SH	1	
Procladius sp.	*8.8*	P	1	2
Psectrocladius sp.		SH		2
Zavrelimyia sp.	*8.6*	P	4	8
Culicidae		FC		
Anopheles sp.	*8.6*	FC		2
Culex sp.		FC		1
Simuliidae		FC		
Simulium sp.	*4.9*	FC	3	
TOTAL NO. OF ORGANISMS			**84**	**86**
TOTAL NO. OF TAXA			**22**	**25**
EPT INDEX			**5**	**1**
BIOTIC INDEX-ASSIGNED VALUES			**7.22**	**8.50**

3/06 Revision 6

Station #1 (US)

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ

TOTAL SCORE 44

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 UT-1 to Pine Hill Br. Location/road: Burnett Church Rd. (Road Name) County Alamance

Date 4/16/18 **CC#** 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) KT+KM Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35874619 Longitude -79.359197 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 19.1 °C DO — mg/l Conductivity (corr.) 175.2 µS/cm pH 6.91

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: 10 %Forest ____ %Residential 90 %Active Pasture ____ % Active Crops
____ %Fallow Fields ____ % Commercial ____ %Industrial ____ %Other - Describe: ____

Watershed land use : ☒ Forest ☒ Agriculture ☐ Urban ☒ Animal operations upstream

Width: (meters) Stream 1.0 Channel (at top of bank) 1.5 **Stream Depth**: (m) Avg 0.2 Max 0.6
☐ Width variable ☐ Large river >25m wide

Bank Height (from deepest part of riffle to top of bank-first flat surface you stand on): (m) 0.8

Bank Angle: 75 ° 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: Sun, ~50°F **Photos:** ☐ N ☒ Y ☒ Digital ☐ 35mm

Remarks: Stream is heavily impacted by livestock. Heavy hoof-shear on banks, sediment deposition in stream, and feces odor

#1 (US)

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 _____ Subtotal 3

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 **R**are, **C**ommon, or **A**bundant.

R **Rocks** ___ **Macrophytes** C **Sticks and leafpacks** R **Snags and logs** C **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.

	Score
A. substrate with good mix of gravel, cobble and boulders	
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 1

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 4

☐ Pool bottom boulder-cobble=hard ☐ Bottom sandy-sink as you walk ☒ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 18

#1 (US)

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 7

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 4

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 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

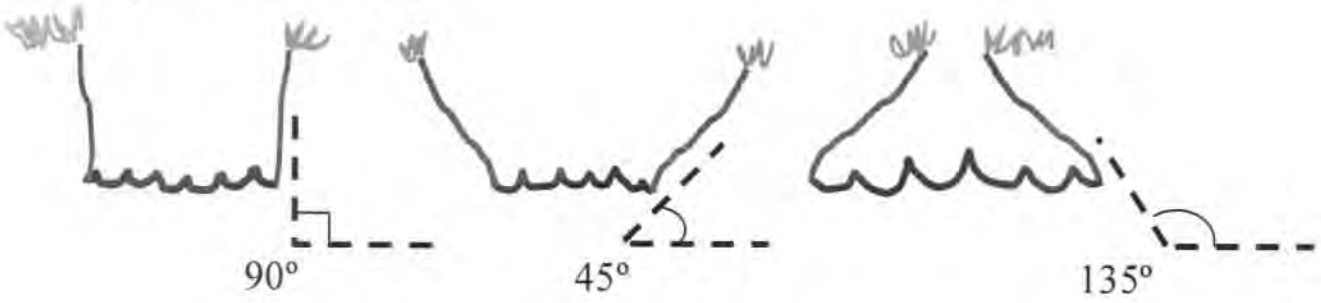
Page Total 26

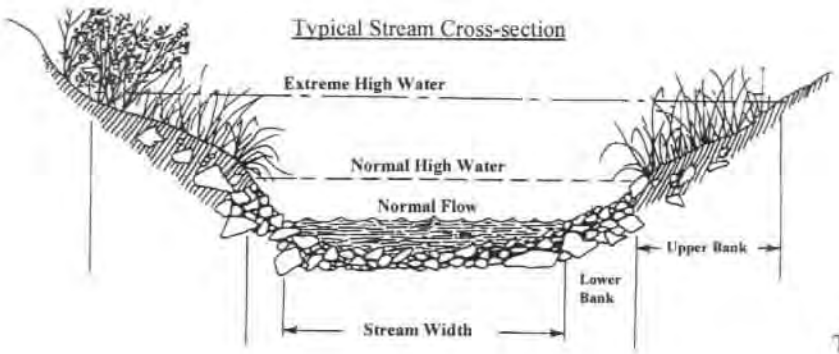
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 44

#1 (US)

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

Other comments: _____

_____

_____

_____

_____

#2 (DS)

3/06 Revision 6

Habitat Assessment Field Data Sheet
Mountain/ Piedmont Streams

Biological Assessment Unit, DWQ **TOTAL SCORE** 98

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 UT-1 to Pine Hill Br. Location/road: Burnett Church Rd (Road Name) County Alamance

Date 4/16/18 **CC#** 03030002 Basin Cape Fear Subbasin 03-06-04

Observer(s) KJ + KM Type of Study: ☐ Fish ☒ Benthos ☐ Basinwide ☐ Special Study (Describe) _____

Latitude 35.827210 Longitude -79.359690 Ecoregion: ☐ MT ☒ P ☐ Slate Belt ☐ Triassic Basin

Water Quality: Temperature 14.6 °C DO — mg/l Conductivity (corr.) 154.9 µS/cm pH 6.84

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: 95 %Forest ____ %Residential 5 %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) 2.5 **Stream Depth**: (m) Avg ____ 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: 100 ° 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: ____ **Photos:** ☒ N ☐ Y ☐ Digital ☐ 35mm

Remarks: Stream reach is in a forested area adjacent to livestock pasture.

#2 (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 _____ Subtotal 4

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 **R**are, **C**ommon, or **A**bundant.

C **Rocks** ___ **Macrophytes** C **Sticks and leafpacks** C **Snags and logs** R **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 16

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.

	Score
A. substrate with good mix of gravel, cobble and boulders	
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 12

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.

	Score
A. Pools present	
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 10

☒ Pool bottom boulder-cobble=hard ☒ Bottom sandy-sink as you walk ☐ Silt bottom ☐ Some pools over wader depth

Remarks _____

Page Total 42

#2 (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 14

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 14

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 10

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
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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
		Total 8

Remarks _____

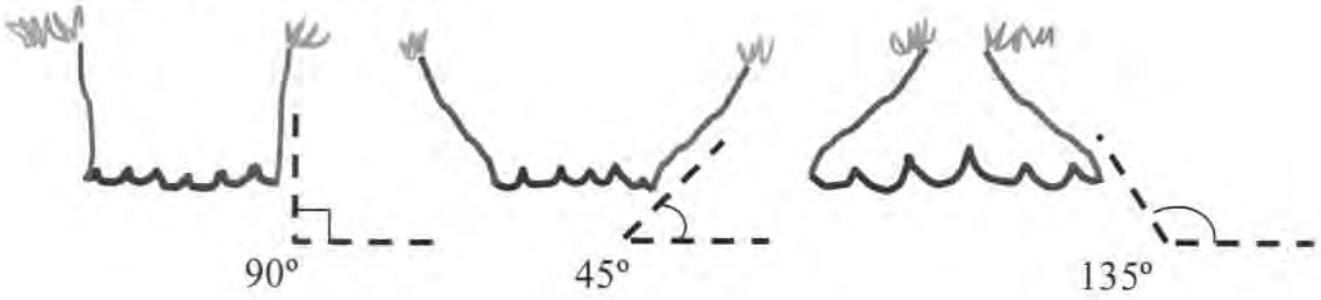
Page Total 46

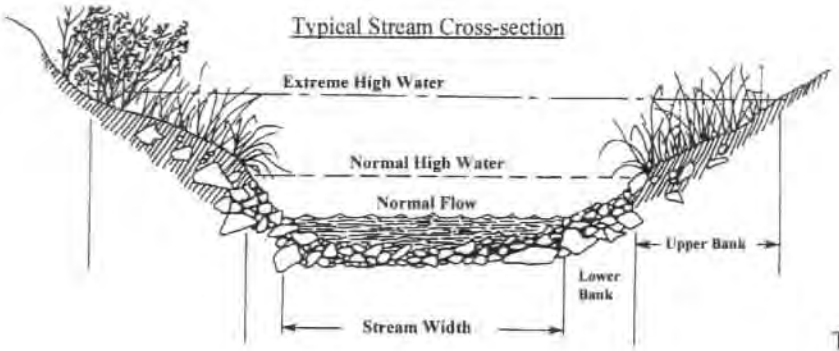
☐ Disclaimer-form filled out, but score doesn't match subjective opinion-atypical stream. **TOTAL SCORE** 88

#2 (DS)

Supplement for Habitat Assessment Field Data Sheet

Diagram to determine bank angle:





This side is 45° bank angle.

Site Sketch:

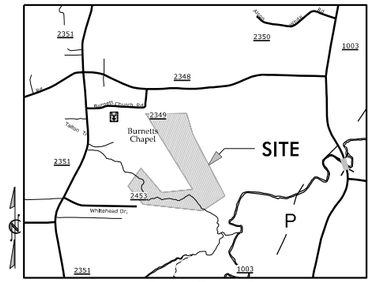
Other comments:

Appendix G
As-built Plan Sheets

09/08/95

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	MAJOR HILL SITE	1	

AS–BUILT PLANS
MAJOR HILL SITE



VICINITY MAP
Not to Scale

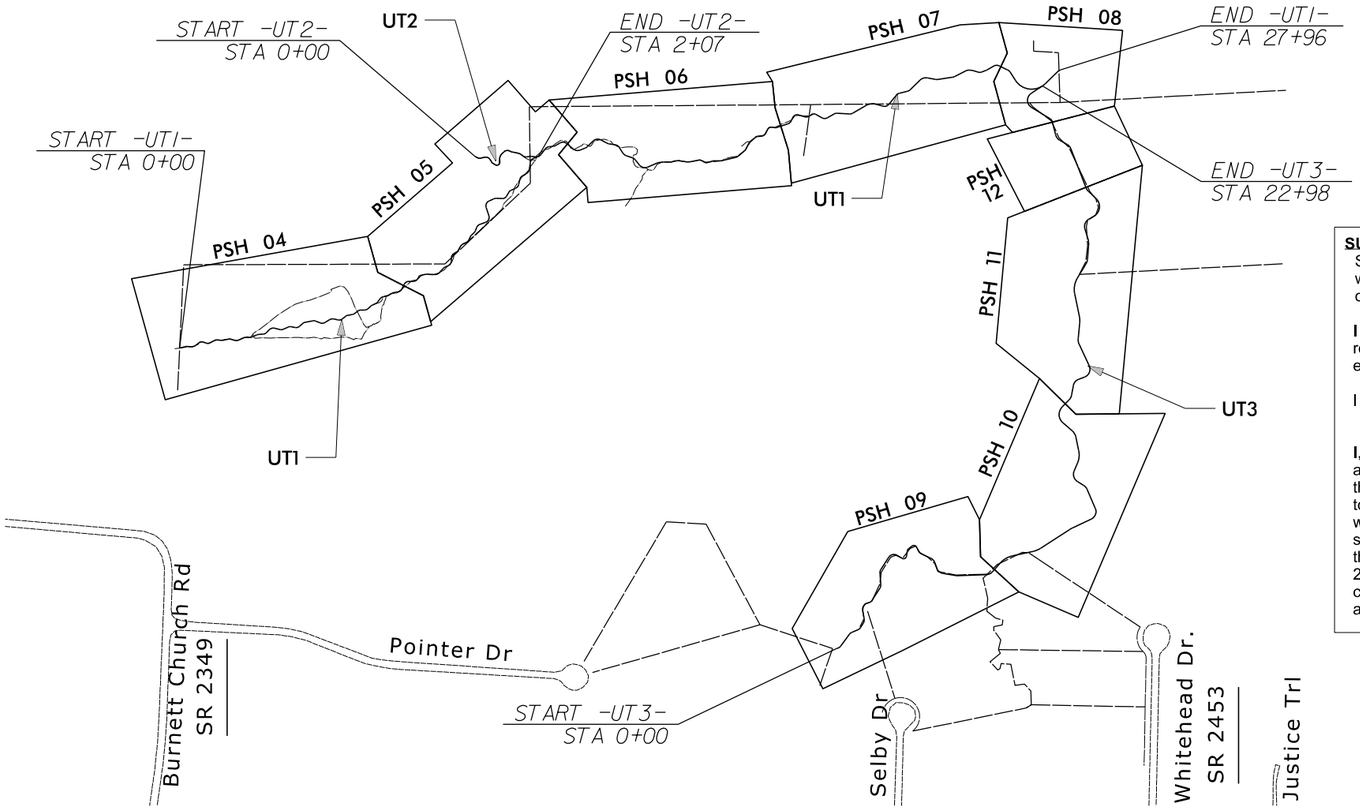
LOCATION: ALAMANCE COUNTY, NORTH CAROLINA

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

MARCH 11, 2019

THE STATE OF NORTH CAROLINA,
DIVISION OF MITIGATION SERVICES
DMS PROJECT ID NO. 10015
SPO FILE NUMBERS 01–BA, 01–BB,
01–BC & 01–BD
NC DMS CONTRACT# 7193
RFP# 16–006990
LATITUDE 35.873206
LONGITUDE –79.360906 (WGS84)

INDEX OF SHEETS



LIMITS OF CONSTRUCTION:
3.5 ACRES

SURVEYORS CERTIFICATION(S)

Surveyor's disclaimer: No attempt was made to locate any cemeteries , wetlands, hazardous material sites, underground or aboveground utilities or any other features above, or below ground other than those shown.

I certify that the survey is of another category (as-built survey), such as the recombination of existing parcels, a court-ordered survey, or other exception to the definition of subdivision.

I certify that this plat does not meet G.S. 47-30 as amended.

I, John A. Rudolph, certify that this project was completed under my direct and responsible charge from an actual survey made under my supervision; that this As-built survey was performed at the 95 percent confidence level to meet Federal Geographic Data Committee Standards; that this survey was performed to meet the requirements for a topographic/planimetric survey to the accuracy of Class B and vertical accuracy when applicable to the Class B standard, and that the original data was obtained in December, 2015; that the survey was completed on December 5, 2018; and all coordinates are based on NC Grid 'NAO '83(2011) and all elevations are assumed elevations.

DocuSigned by:
John Rudolph
1E9D7380B9B645D...

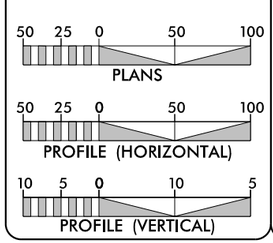
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

3/14/2019

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

CONTRACT: MAJOR HILL SITE

GRAPHIC SCALES



PROPOSED LENGTH OF UT1 = 2796 LF
PROPOSED LENGTH OF UT2 = 207 LF
PROPOSED LENGTH OF UT3 = 2298 LF
TOTAL STREAM LENGTH = 5301 LF

RESTORATION LEVEL	STREAM (linear footage)	RIPARIAN WETLAND (acreage)	NONRIPARIAN WETLAND (acreage)
RESTORATION	1738	0.54	–
ENHANCEMENT	3563	0.44	–
TOTALS	5301	0.98	–
MITIGATION UNITS	3058 SMUs	0.76 RIPARIAN WMUs	– NONRIPARIAN WMUs

Designed By:

Axiom Environmental, Inc.
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

DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

3/14/2019
Major Hill_Hyd_AB_PSH_01.dgn
jharvey

CONVENTIONAL PLAN SHEET SYMBOLS

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

SHEET NAME	SHEET NUMBER
SYMBOLOGY	01A
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin (EIP)
- Computed Property Corner
- Property Monument (ECM)
- Parcel/Sequence Number (123)
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- 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

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.)

AS-BUILT:

- Stream Gauge
- Groundwater Gauge (#)
- Benthic & Water Quality Station (1)
- Origin Point on CVS Plots
- CVS Plots (#)
- Cross Section (XS-10R)
- Adjusted Stream Structure
- Not Constructed
- Riffle Rip Rap

3/14/2018
M:\Major Hill_Hyd_AB_PSH_01A.dgn
bgarvey

DocuSign Envelope ID: 57AB4840-5904-4DBD-B50F-B29DC0807CF3

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 1	3

PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE

COUNTY: ALAMANCE DATE: 2018

Axiom Environmental, Inc.

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

DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

C-1
PI Sta 0+01.06
Δ = 7° 07' 53.5" (LT)
D = 337° 02' 02.4"
L = 2.12'
T = 1.06'
R = 17.00'

C-2
PI Sta 0+16.33
Δ = 17° 25' 00.0" (RT)
D = 477° 27' 53.4"
L = 3.65'
T = 1.84'
R = 12.00'

C-3
PI Sta 0+38.01
Δ = 37° 38' 57.5" (LT)
D = 337° 02' 02.4"
L = 11.17'
T = 5.80'
R = 17.00'

C-4
PI Sta 0+60.74
Δ = 52° 55' 07.4" (RT)
D = 477° 27' 53.4"
L = 11.08'
T = 5.97'
R = 12.00'

C-5
PI Sta 0+80.79
Δ = 44° 51' 24.6" (LT)
D = 409° 15' 20.0"
L = 10.96'
T = 5.78'
R = 14.00'

C-6
PI Sta 1+01.92
Δ = 34° 05' 12.6" (RT)
D = 409° 15' 20.0"
L = 8.33'
T = 4.29'
R = 14.00'

C-7
PI Sta 1+20.60
Δ = 17° 46' 35.0" (LT)
D = 409° 15' 20.0"
L = 4.34'
T = 2.19'
R = 14.00'

C-8
PI Sta 1+39.83
Δ = 27° 39' 39.9" (RT)
D = 409° 15' 20.0"
L = 6.76'
T = 3.45'
R = 14.00'

C-9
PI Sta 1+58.83
Δ = 41° 16' 19.2" (LT)
D = 477° 27' 53.4"
L = 8.64'
T = 4.52'
R = 12.00'

C-10
PI Sta 1+78.97
Δ = 26° 31' 59.6" (RT)
D = 409° 15' 20.0"
L = 6.48'
T = 3.30'
R = 14.00'

C-11
PI Sta 1+97.12
Δ = 24° 44' 51.5" (LT)
D = 409° 15' 20.0"
L = 6.05'
T = 3.07'
R = 14.00'

C-12
PI Sta 2+15.92
Δ = 18° 45' 46.8" (RT)
D = 477° 27' 53.4"
L = 3.93'
T = 1.98'
R = 12.00'

C-13
PI Sta 2+36.54
Δ = 39° 45' 57.1" (LT)
D = 409° 15' 20.0"
L = 9.72'
T = 5.06'
R = 14.00'

C-14
PI Sta 2+60.03
Δ = 58° 31' 57.5" (RT)
D = 409° 15' 20.0"
L = 14.30'
T = 7.85'
R = 14.00'

C-15
PI Sta 2+86.79
Δ = 39° 24' 21.6" (LT)
D = 477° 27' 53.4"
L = 8.25'
T = 4.30'
R = 12.00'

C-16
PI Sta 3+08.40
Δ = 36° 15' 58.9" (RT)
D = 477° 27' 53.4"
L = 7.60'
T = 3.93'
R = 12.00'

C-17
PI Sta 3+30.22
Δ = 50° 52' 28.6" (LT)
D = 477° 27' 53.4"
L = 10.66'
T = 5.71'
R = 12.00'

C-18
PI Sta 3+51.50
Δ = 29° 48' 29.2" (RT)
D = 409° 15' 20.0"
L = 7.28'
T = 3.73'
R = 14.00'

C-19
PI Sta 3+78.67
Δ = 31° 33' 42.2" (RT)
D = 477° 27' 53.4"
L = 6.61'
T = 3.39'
R = 12.00'

C-20
PI Sta 4+02.62
Δ = 51° 30' 58.4" (LT)
D = 409° 15' 20.0"
L = 12.59'
T = 6.76'
R = 14.00'

C-21
PI Sta 4+29.17
Δ = 42° 45' 33.0" (RT)
D = 409° 15' 20.0"
L = 10.45'
T = 5.48'
R = 14.00'

C-22
PI Sta 4+52.32
Δ = 50° 14' 11.7" (LT)
D = 477° 27' 53.4"
L = 10.52'
T = 5.63'
R = 12.00'

C-23
PI Sta 4+72.60
Δ = 28° 41' 33.7" (RT)
D = 477° 27' 53.4"
L = 6.01'
T = 3.07'
R = 12.00'

C-24
PI Sta 4+90.84
Δ = 28° 26' 05.6" (LT)
D = 477° 27' 53.4"
L = 5.96'
T = 3.04'
R = 12.00'

C-25
PI Sta 5+08.78
Δ = 36° 31' 13.9" (RT)
D = 477° 27' 53.4"
L = 7.65'
T = 3.96'
R = 12.00'

C-26
PI Sta 5+28.88
Δ = 41° 02' 47.1" (LT)
D = 477° 27' 53.4"
L = 8.60'
T = 4.49'
R = 12.00'

C-27
PI Sta 5+45.75
Δ = 18° 03' 33.0" (RT)
D = 477° 27' 53.4"
L = 3.78'
T = 1.91'
R = 12.00'

C-28
PI Sta 5+60.95
Δ = 28° 35' 01.0" (LT)
D = 477° 27' 53.4"
L = 5.99'
T = 3.06'
R = 12.00'

C-29
PI Sta 5+60.95
Δ = 28° 35' 01.0" (LT)
D = 477° 27' 53.4"
L = 5.99'
T = 3.06'
R = 12.00'

C-30
PI Sta 5+98.53
Δ = 14° 45' 43.7" (LT)
D = 477° 27' 53.4"
L = 3.09'
T = 1.55'
R = 12.00'

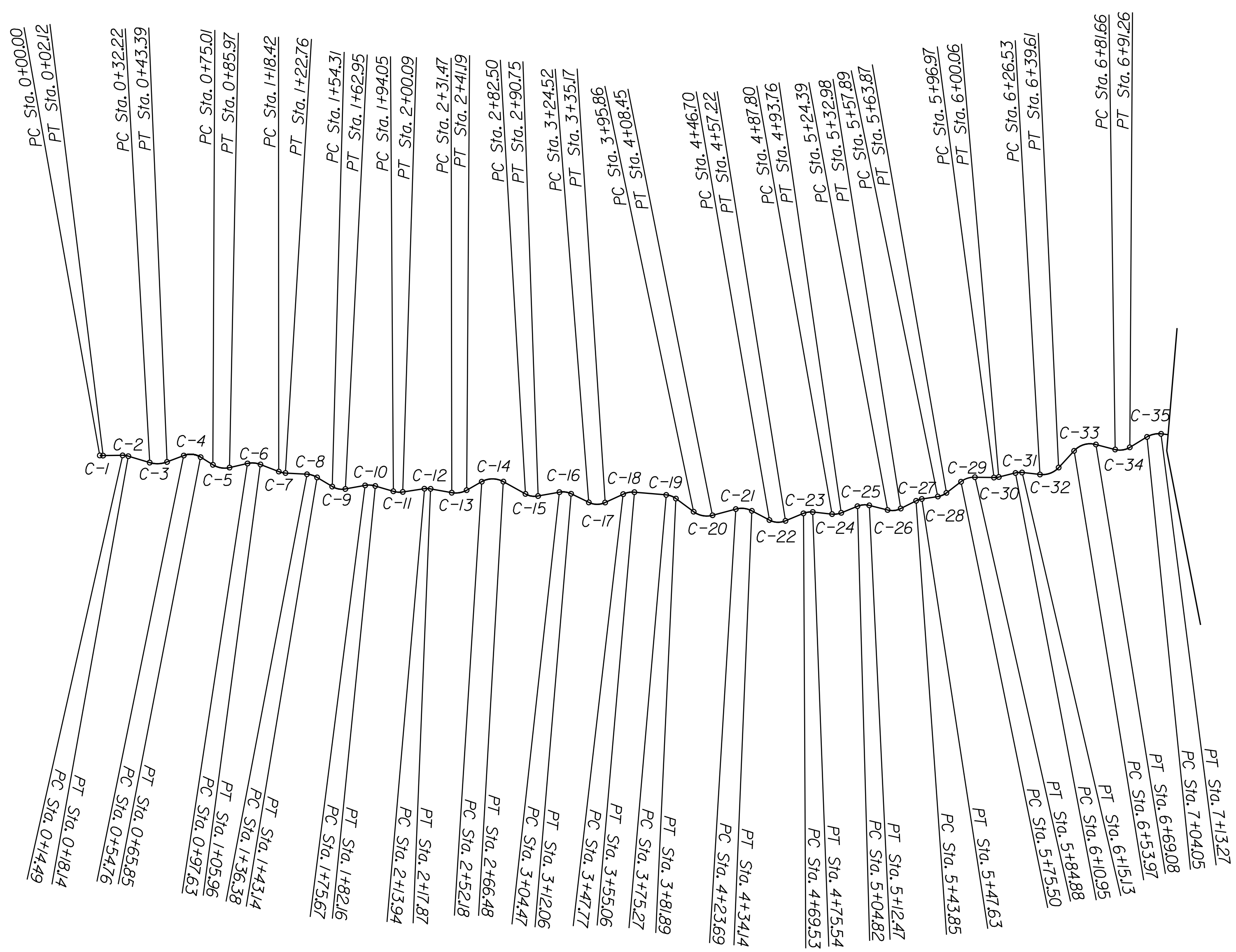
C-31
PI Sta 6+13.06
Δ = 19° 58' 46.8" (RT)
D = 477° 27' 53.4"
L = 4.18'
T = 2.11'
R = 12.00'

C-32
PI Sta 6+33.59
Δ = 53° 32' 41.2" (LT)
D = 409° 15' 20.0"
L = 13.08'
T = 7.06'
R = 14.00'

C-33
PI Sta 6+62.36
Δ = 61° 52' 01.3" (RT)
D = 409° 15' 20.0"
L = 15.12'
T = 8.39'
R = 14.00'

C-34
PI Sta 6+86.73
Δ = 45° 49' 42.1" (LT)
D = 477° 27' 53.4"
L = 9.60'
T = 5.07'
R = 12.00'

C-35
PI Sta 7+08.83
Δ = 37° 44' 09.3" (RT)
D = 409° 15' 20.0"
L = 9.22'
T = 4.78'
R = 14.00'



-UT1- STREAM ALIGNMENT DATA

STATION	LENGTH		NORTHING	EASTING
0+00		POC	774,638.8942	1,893,088.5694
CH1	2.00		S12°36'39"E	
L1	12.37		S16°19'34"E	
CH2	3.63		S07°37'04"E	
L2	14.08		S01°05'26"W	
CH3	10.97		S17°44'03"E	
L3	11.37		S36°33'31"E	
CH4	10.69		S10°05'58"E	
L4	9.16		S16°21'36"W	
CH5	10.68		S06°04'06"E	
L5	11.66		S28°29'49"E	
CH6	8.21		S11°27'12"E	
L6	12.45		S05°35'24"W	
CH7	4.33		S03°17'53"E	
L7	13.62		S12°11'11"E	
CH8	6.69		S01°38'39"W	
L8	11.17		S15°28'29"W	
CH9	8.46		S05°09'41"E	
L9	12.72		S25°47'50"E	
CH10	6.43		S12°31'50"E	
L10	11.89		S00°44'09"W	
CH11	6.00		S11°38'16"E	
L11	13.84		S24°00'42"E	
CH12	3.91		S14°37'49"E	
L12	13.61		S05°14'55"E	
CH13	9.52		S25°07'54"E	
L13	10.99		S45°00'52"E	
CH14	13.69		S15°44'54"E	
L14	16.01		S13°31'05"W	
CH15	8.09		S06°11'06"E	
L15	13.72		S25°53'17"E	
CH16	7.47		S07°45'17"E	
L16	12.45		S10°22'42"W	
CH17	10.31		S15°03'32"E	
L17	12.60		S40°29'46"E	
CH18	7.20		S25°35'32"E	
L18	20.22		S10°41'17"E	
CH19	6.53		S05°05'34"W	

-UT1- STREAM ALIGNMENT DATA

STATION	LENGTH		NORTHING	EASTING
L19	13.98		S20°52'25"W	
CH20	12.17		S04°53'04"E	
L20	15.24		S30°38'33"E	
CH21	10.21		S09°15'47"E	
L21	12.56		S12°07'00"W	
CH22	10.19		S13°00'06"E	
L22	12.31		S38°07'12"E	
CH23	5.95		S23°46'25"E	
L23	12.26		S09°25'38"E	
CH24	5.89		S23°38'41"E	
L24	11.06		S37°51'44"E	
CH25	7.52		S19°36'07"E	
L25	11.92		S01°20'30"E	
CH26	8.41		S21°51'54"E	
L26	10.87		S42°23'17"E	
CH27	3.77		S33°21'31"E	
L27	10.26		S24°19'44"E	
CH28	5.92		S38°37'15"E	
L28	11.63		S52°54'45"E	
CH29	9.20		S33°43'12"E	
L29	12.09		S14°31'38"E	
CH30	3.08		S21°54'30"E	
L30	10.88		S29°17'22"E	
CH31	4.16		S19°17'59"E	
L31	11.40		S09°18'35"E	
CH32	12.61		S36°04'56"E	
L32	14.36		S62°51'16"E	
CH33	14.39		S31°55'16"E	
L33	12.58		S00°59'15"E	
CH34	9.34		S23°54'06"E	
L34	12.79		S46°48'57"E	
CH35	9.05		S27°56'53"E	
L35	8.99		S09°04'48"E	

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C-36
PI Sta 7+23.53
△ = 12° 09' 10.7" (RT)
D = 477° 27' 53.4"
L = 2.55'
T = 1.28'
R = 12.00'

C-37
PI Sta 7+51.51
△ = 51° 31' 17.9" (LT)
D = 337° 02' 02.4"
L = 15.29'
T = 8.20'
R = 17.00'

C-38
PI Sta 7+74.65
△ = 22° 19' 09.0" (RT)
D = 409° 15' 20.0"
L = 5.45'
T = 2.76'
R = 14.00'

C-39
PI Sta 7+96.54
△ = 60° 33' 25.1" (LT)
D = 477° 27' 53.4"
L = 12.68'
T = 7.01'
R = 12.00'

C-40
PI Sta 8+20.01
△ = 56° 40' 28.0" (RT)
D = 477° 27' 53.4"
L = 11.87'
T = 6.47'
R = 12.00'

C-41
PI Sta 8+37.17
△ = 29° 49' 30.6" (LT)
D = 477° 27' 53.4"
L = 6.25'
T = 3.20'
R = 12.00'

C-42
PI Sta 8+57.66
△ = 36° 33' 49.6" (RT)
D = 409° 15' 20.0"
L = 8.93'
T = 4.63'
R = 14.00'

C-43
PI Sta 8+75.77
△ = 42° 11' 05.7" (LT)
D = 477° 27' 53.4"
L = 8.84'
T = 4.63'
R = 12.00'

C-44
PI Sta 8+92.09
△ = 20° 52' 47.7" (RT)
D = 409° 15' 20.0"
L = 5.10'
T = 2.58'
R = 14.00'

C-45
PI Sta 9+07.68
△ = 22° 19' 05.4" (LT)
D = 477° 27' 53.4"
L = 4.67'
T = 2.37'
R = 12.00'

C-46
PI Sta 9+26.88
△ = 47° 12' 12.9" (RT)
D = 409° 15' 20.0"
L = 11.53'
T = 6.12'
R = 14.00'

C-47
PI Sta 9+62.16
△ = 88° 54' 58.2" (LT)
D = 409° 15' 20.0"
L = 21.73'
T = 13.74'
R = 14.00'

C-48
PI Sta 10+05.35
△ = 83° 36' 05.7" (RT)
D = 409° 15' 20.0"
L = 20.43'
T = 12.52'
R = 14.00'

C-49
PI Sta 10+30.40
△ = 27° 02' 37.8" (RT)
D = 409° 15' 20.0"
L = 6.61'
T = 3.37'
R = 14.00'

C-50
PI Sta 10+57.42
△ = 61° 50' 22.8" (LT)
D = 477° 27' 53.4"
L = 12.95'
T = 7.19'
R = 12.00'

C-51
PI Sta 10+79.62
△ = 35° 38' 34.8" (RT)
D = 477° 27' 53.4"
L = 7.47'
T = 3.86'
R = 12.00'

C-52
PI Sta 11+03.90
△ = 52° 09' 08.1" (LT)
D = 409° 15' 20.0"
L = 12.74'
T = 6.85'
R = 14.00'

C-53
PI Sta 11+30.78
△ = 45° 52' 00.8" (RT)
D = 477° 27' 53.4"
L = 9.61'
T = 5.08'
R = 12.00'

C-54
PI Sta 11+56.21
△ = 51° 38' 26.6" (LT)
D = 409° 15' 20.0"
L = 12.62'
T = 6.77'
R = 14.00'

C-55
PI Sta 11+88.46
△ = 61° 07' 34.5" (RT)
D = 409° 15' 20.0"
L = 14.94'
T = 8.27'
R = 14.00'

C-56
PI Sta 12+12.93
△ = 32° 33' 51.9" (LT)
D = 381° 58' 18.7"
L = 8.53'
T = 4.38'
R = 15.00'

C-57
PI Sta 12+41.56
△ = 46° 20' 25.7" (RT)
D = 381° 58' 18.7"
L = 12.13'
T = 6.42'
R = 15.00'

C-58
PI Sta 12+62.41
△ = 22° 40' 12.4" (LT)
D = 381° 58' 18.7"
L = 5.94'
T = 3.01'
R = 15.00'

C-59
PI Sta 12+89.53
△ = 69° 04' 05.1" (RT)
D = 381° 58' 18.7"
L = 18.08'
T = 10.32'
R = 15.00'

C-60
PI Sta 13+30.69
△ = 60° 00' 46.3" (LT)
D = 318° 18' 35.6"
L = 18.85'
T = 10.39'
R = 18.00'

C-61
PI Sta 13+57.00
△ = 23° 32' 16.8" (LT)
D = 381° 58' 18.7"
L = 6.16'
T = 3.13'
R = 15.00'

C-62
PI Sta 13+94.90
△ = 72° 37' 31.7" (RT)
D = 318° 18' 35.6"
L = 22.82'
T = 13.23'
R = 18.00'

C-63
PI Sta 14+24.26
△ = 18° 37' 16.7" (LT)
D = 318° 18' 35.6"
L = 5.85'
T = 2.95'
R = 18.00'

C-64
PI Sta 14+51.68
△ = 48° 14' 17.5" (RT)
D = 381° 58' 18.7"
L = 12.63'
T = 6.72'
R = 15.00'

C-65
PI Sta 14+80.21
△ = 37° 17' 13.0" (LT)
D = 318° 18' 35.6"
L = 11.71'
T = 6.07'
R = 18.00'

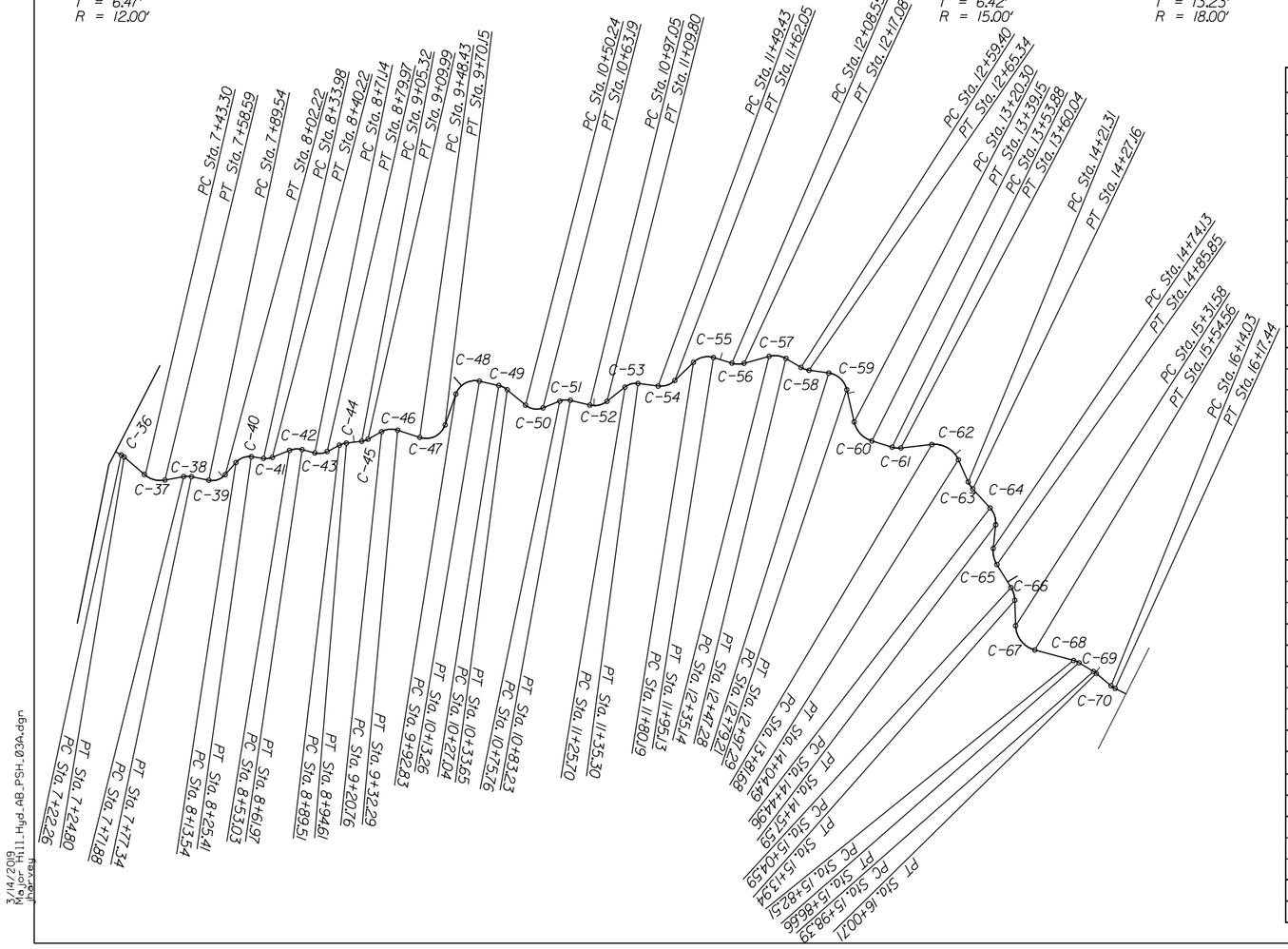
C-66
PI Sta 15+09.37
△ = 29° 44' 19.2" (RT)
D = 318° 18' 35.6"
L = 9.34'
T = 4.78'
R = 18.00'

C-67
PI Sta 15+44.93
△ = 73° 08' 20.9" (LT)
D = 318° 18' 35.6"
L = 22.98'
T = 13.35'
R = 18.00'

C-68
PI Sta 15+84.60
△ = 15° 50' 06.8" (RT)
D = 381° 58' 18.7"
L = 4.15'
T = 2.09'
R = 15.00'

C-69
PI Sta 15+99.55
△ = 8° 50' 32.5" (RT)
D = 381° 58' 18.7"
L = 2.31'
T = 1.16'
R = 15.00'

C-70
PI Sta 16+15.74
△ = 12° 59' 53.9" (LT)
D = 381° 58' 18.7"
L = 3.40'
T = 1.71'
R = 15.00'



-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L35	8.99		S09°04'48"E	
CH36	2.54		S03°00'13"E	
L36	18.50		S03°04'23"W	
CH37	14.78		S22°41'16"E	
L37	13.30		S48°26'55"E	
CH38	5.42		S37°17'21"E	
L38	12.20		S26°07'46"E	
CH39	12.10		S56°24'29"E	
L39	11.32		S86°41'11"E	
CH40	11.39		S58°20'57"E	
L40	8.57		S30°00'43"E	
CH41	6.18		S44°55'29"E	
L41	12.81		S59°50'14"E	
CH42	8.78		S41°33'19"E	
L42	9.17		S23°16'24"E	
CH43	8.64		S44°21'57"E	
L43	9.54		S65°27'30"E	
CH44	5.07		S55°01'06"E	
L44	10.70		S44°34'42"E	
CH45	4.64		S55°44'15"E	
L45	10.77		S66°53'48"E	
CH46	11.21		S43°17'41"E	
L46	16.13		S19°41'35"E	
CH47	19.61		S64°09'04"E	
L47	22.68		N71°23'27"E	
CH48	18.66		S66°48'30"E	
L48	13.78		S25°00'27"E	
CH49	6.55		S11°29'08"E	
L49	16.59		S02°02'10"W	
CH50	12.33		S28°53'01"E	
L50	12.57		S59°48'12"E	
CH51	7.35		S41°58'55"E	
L51	13.83		S24°09'38"E	
CH52	12.31		S50°14'12"E	
L52	15.90		S76°18'46"E	
CH53	9.35		S53°22'45"E	
L53	14.13		S30°26'45"E	
CH54	12.20		S56°15'58"E	

-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L35	8.99		S09°04'48"E	
CH36	2.54		S03°00'13"E	
L36	18.50		S03°04'23"W	
CH37	14.78		S22°41'16"E	
L37	13.30		S48°26'55"E	
CH38	5.42		S37°17'21"E	
L38	12.20		S26°07'46"E	
CH39	12.10		S56°24'29"E	
L39	11.32		S86°41'11"E	
CH40	11.39		S58°20'57"E	
L40	8.57		S30°00'43"E	
CH41	6.18		S44°55'29"E	
L41	12.81		S59°50'14"E	
CH42	8.78		S41°33'19"E	
L42	9.17		S23°16'24"E	
CH43	8.64		S44°21'57"E	
L43	9.54		S65°27'30"E	
CH44	5.07		S55°01'06"E	
L44	10.70		S44°34'42"E	
CH45	4.64		S55°44'15"E	
L45	10.77		S66°53'48"E	
CH46	11.21		S43°17'41"E	
L46	16.13		S19°41'35"E	
CH47	19.61		S64°09'04"E	
L47	22.68		N71°23'27"E	
CH48	18.66		S66°48'30"E	
L48	13.78		S25°00'27"E	
CH49	6.55		S11°29'08"E	
L49	16.59		S02°02'10"W	
CH50	12.33		S28°53'01"E	
L50	12.57		S59°48'12"E	
CH51	7.35		S41°58'55"E	
L51	13.83		S24°09'38"E	
CH52	12.31		S50°14'12"E	
L52	15.90		S76°18'46"E	
CH53	9.35		S53°22'45"E	
L53	14.13		S30°26'45"E	
CH54	12.20		S56°15'58"E	

SHEET NAME		SHEET NUMBER
-CURVE DATA- UT 1		3A
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE		
	COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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

DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

3/14/2019
Major Hill_Hyd_AB_PSH_03A.dgn
jhaney

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 1	3B
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L35	8.99		S09°04'48"E	
CH36	2.54		S03°00'13"E	
L36	18.50		S03°04'23"W	
CH37	14.78		S22°41'16"E	
L37	13.30		S48°26'55"E	
CH38	5.42		S37°17'21"E	
L38	12.20		S26°07'46"E	
CH39	12.10		S56°24'29"E	
L39	11.32		S86°41'11"E	
CH40	11.39		S58°20'57"E	
L40	8.57		S30°00'43"E	
CH41	6.18		S44°55'29"E	
L41	12.81		S59°50'14"E	
CH42	8.78		S41°33'19"E	
L42	9.17		S23°16'24"E	
CH43	8.64		S44°21'57"E	
L43	9.54		S65°27'30"E	
CH44	5.07		S55°01'06"E	
L44	10.70		S44°34'42"E	
CH45	4.64		S55°44'15"E	
L45	10.77		S66°53'48"E	
CH46	11.21		S43°17'41"E	
L46	16.13		S19°41'35"E	
CH47	19.61		S64°09'04"E	
L47	22.68		N71°23'27"E	
CH48	18.66		S66°48'30"E	
L48	13.78		S25°00'27"E	
CH49	6.55		S11°29'08"E	
L49	16.59		S02°02'10"W	
CH50	12.33		S28°53'01"E	
L50	12.57		S59°48'12"E	
CH51	7.35		S41°58'55"E	
L51	13.83		S24°09'38"E	
CH52	12.31		S50°14'12"E	
L52	15.90		S76°18'46"E	
CH53	9.35		S53°22'45"E	
L53	14.13		S30°26'45"E	
CH54	12.20		S56°15'58"E	

-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L35	8.99		S09°04'48"E	
CH36	2.54		S03°00'13"E	
L36	18.50		S03°04'23"W	
CH37	14.78		S22°41'16"E	
L37	13.30		S48°26'55"E	
CH38	5.42		S37°17'21"E	
L38	12.20		S26°07'46"E	
CH39	12.10		S56°24'29"E	
L39	11.32		S86°41'11"E	
CH40	11.39		S58°20'57"E	
L40	8.57		S30°00'43"E	
CH41	6.18		S44°55'29"E	
L41	12.81		S59°50'14"E	
CH42	8.78		S41°33'19"E	
L42	9.17		S23°16'24"E	
CH43	8.64		S44°21'57"E	
L43	9.54		S65°27'30"E	
CH44	5.07		S55°01'06"E	
L44	10.70		S44°34'42"E	
CH45	4.64		S55°44'15"E	
L45	10.77		S66°53'48"E	
CH46	11.21		S43°17'41"E	
L46	16.13		S19°41'35"E	
CH47	19.61		S64°09'04"E	
L47	22.68		N71°23'27"E	
CH48	18.66		S66°48'30"E	
L48	13.78		S25°00'27"E	
CH49	6.55		S11°29'08"E	
L49	16.59		S02°02'10"W	
CH50	12.33		S28°53'01"E	
L50	12.57		S59°48'12"E	
CH51	7.35		S41°58'55"E	
L51	13.83		S24°09'38"E	
CH52	12.31		S50°14'12"E	
L52	15.90		S76°18'46"E	
CH53	9.35		S53°22'45"E	
L53	14.13		S30°26'45"E	
CH54	12.20		S56°15'58"E	

-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L54	18.14		S82°05'11"E	
CH55	14.24		S51°31'24"E	
L55	13.42		S20°57'37"E	
CH56	8.41		S37°14'33"E	
L56	18.07		S53°31'29"E	
CH57	11.80		S30°21'16"E	
L57	12.12		S07°11'03"E	
CH58	5.90		S18°31'09"E	
L58	13.87		S29°51'16"E	
CH59	17.01		S04°40'47"W	
L59	23.01		S39°12'49"W	
CH60	18.00		S09°12'26"W	
L60	14.73		S20°47'57"E	
CH61	6.12		S32°34'05"E	
L61	21.64		S44°20'14"E	
CH62	21.32		S08°01'28"E	
L62	16.82		S28°17'18"W	
CH63	5.82		S18°58'40"W	
L63	17.80		S09°40'02"W	
CH64	12.26		S33°47'10"W	
L64	16.54		S57°54'19"W	
CH65	11.51		S39°15'42"W	
L65	18.75		S20°37'06"W	
CH66	9.24		S35°29'16"W	
L66	17.64		S50°21'25"W	
CH67	21.45		S13°47'15"W	
L67	27.95		S22°46'56"E	
CH68	4.13		S14°51'52"E	
L68	11.74		S06°56'49"E	
CH69	2.31		S02°31'33"E	
L69	13.33		S01°53'44"W	
CH70	3.40		S04°36'13"E	
L70	16.852		S11°06'10"E	

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 1	3C
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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

DocuSigned by:
Joshua G. Dalton
1089AD8C1A094C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

C-71
PI Sta 16+38.07
△ = 19° 30' 47.1" (RT)
D = 260° 26' 07.3"
L = 7.49'
T = 3.78'
R = 22.00'

C-72
PI Sta 16+64.57
△ = 19° 04' 54.3" (LT)
D = 260° 26' 07.3"
L = 7.33'
T = 3.70'
R = 22.00'

C-73
PI Sta 16+97.42
△ = 41° 52' 20.9" (RT)
D = 381° 58' 18.7"
L = 10.96'
T = 5.74'
R = 15.00'

C-74
PI Sta 17+13.80
△ = 48° 33' 07.5" (LT)
D = 520° 52' 14.6"
L = 9.32'
T = 4.96'
R = 11.00'

C-75
PI Sta 17+33.73
△ = 18° 31' 47.4" (RT)
D = 381° 58' 18.7"
L = 4.85'
T = 2.45'
R = 15.00'

C-76
PI Sta 17+52.51
△ = 13° 42' 39.1" (LT)
D = 381° 58' 18.7"
L = 3.59'
T = 1.80'
R = 15.00'

C-77
PI Sta 17+96.81
△ = 26° 21' 00.4" (LT)
D = 381° 58' 18.7"
L = 6.90'
T = 3.51'
R = 15.00'

C-78
PI Sta 18+25.11
△ = 24° 22' 17.0" (LT)
D = 381° 58' 18.7"
L = 6.38'
T = 3.24'
R = 15.00'

C-79
PI Sta 18+50.32
△ = 25° 33' 57.1" (RT)
D = 381° 58' 18.7"
L = 6.69'
T = 3.40'
R = 15.00'

C-80
PI Sta 18+73.48
△ = 34° 00' 50.9" (RT)
D = 381° 58' 18.7"
L = 8.90'
T = 4.59'
R = 15.00'

C-81
PI Sta 19+94.03
△ = 59° 49' 16.7" (LT)
D = 424° 24' 47.5"
L = 14.10'
T = 7.77'
R = 13.50'

C-82
PI Sta 19+20.32
△ = 73° 43' 31.2" (RT)
D = 520° 52' 14.6"
L = 14.15'
T = 8.25'
R = 11.00'

C-83
PI Sta 19+35.39
△ = 27° 53' 08.8" (LT)
D = 520° 52' 14.6"
L = 5.35'
T = 2.73'
R = 11.00'

C-84
PI Sta 19+76.72
△ = 49° 29' 35.1" (LT)
D = 381° 58' 18.7"
L = 12.96'
T = 6.91'
R = 15.00'

C-85
PI Sta 20+02.76
△ = 83° 43' 32.7" (RT)
D = 424° 24' 47.5"
L = 19.73'
T = 12.10'
R = 13.50'

C-86
PI Sta 20+34.94
△ = 55° 22' 12.2" (LT)
D = 381° 58' 18.7"
L = 14.50'
T = 7.87'
R = 15.00'

C-87
PI Sta 20+52.80
△ = 67° 25' 02.1" (RT)
D = 520° 52' 14.6"
L = 12.94'
T = 7.34'
R = 11.00'

C-88
PI Sta 20+85.47
△ = 58° 30' 31.4" (LT)
D = 381° 58' 18.7"
L = 15.32'
T = 8.40'
R = 15.00'

C-89
PI Sta 21+15.99
△ = 32° 44' 36.5" (RT)
D = 381° 58' 18.7"
L = 8.57'
T = 4.41'
R = 15.00'

C-90
PI Sta 21+57.80
△ = 32° 42' 40.8" (LT)
D = 381° 58' 18.7"
L = 8.56'
T = 4.40'
R = 15.00'

C-91
PI Sta 22+08.69
△ = 18° 47' 24.0" (RT)
D = 381° 58' 18.7"
L = 4.92'
T = 2.48'
R = 15.00'

C-92
PI Sta 22+21.87
△ = 26° 21' 41.1" (RT)
D = 381° 58' 18.7"
L = 6.90'
T = 3.51'
R = 15.00'

C-93
PI Sta 22+58.85
△ = 65° 55' 40.1" (LT)
D = 381° 58' 18.7"
L = 17.26'
T = 9.73'
R = 15.00'

C-94
PI Sta 23+02.63
△ = 36° 14' 33.6" (RT)
D = 381° 58' 18.7"
L = 9.49'
T = 4.91'
R = 15.00'

C-95
PI Sta 23+34.14
△ = 29° 49' 38.0" (LT)
D = 381° 58' 18.7"
L = 7.81'
T = 4.00'
R = 15.00'

C-96
PI Sta 23+85.57
△ = 54° 43' 46.7" (RT)
D = 260° 26' 07.3"
L = 21.01'
T = 11.39'
R = 22.00'

C-97
PI Sta 24+20.42
△ = 18° 59' 49.0" (LT)
D = 260° 26' 07.3"
L = 7.29'
T = 3.68'
R = 22.00'

C-98
PI Sta 24+64.08
△ = 18° 10' 45.0" (LT)
D = 260° 26' 07.3"
L = 6.98'
T = 3.52'
R = 22.00'

C-99
PI Sta 25+05.87
△ = 30° 45' 17.9" (RT)
D = 381° 58' 18.7"
L = 8.05'
T = 4.13'
R = 15.00'

C-100
PI Sta 25+19.56
△ = 12° 47' 52.6" (RT)
D = 520° 52' 14.6"
L = 2.46'
T = 1.23'
R = 11.00'

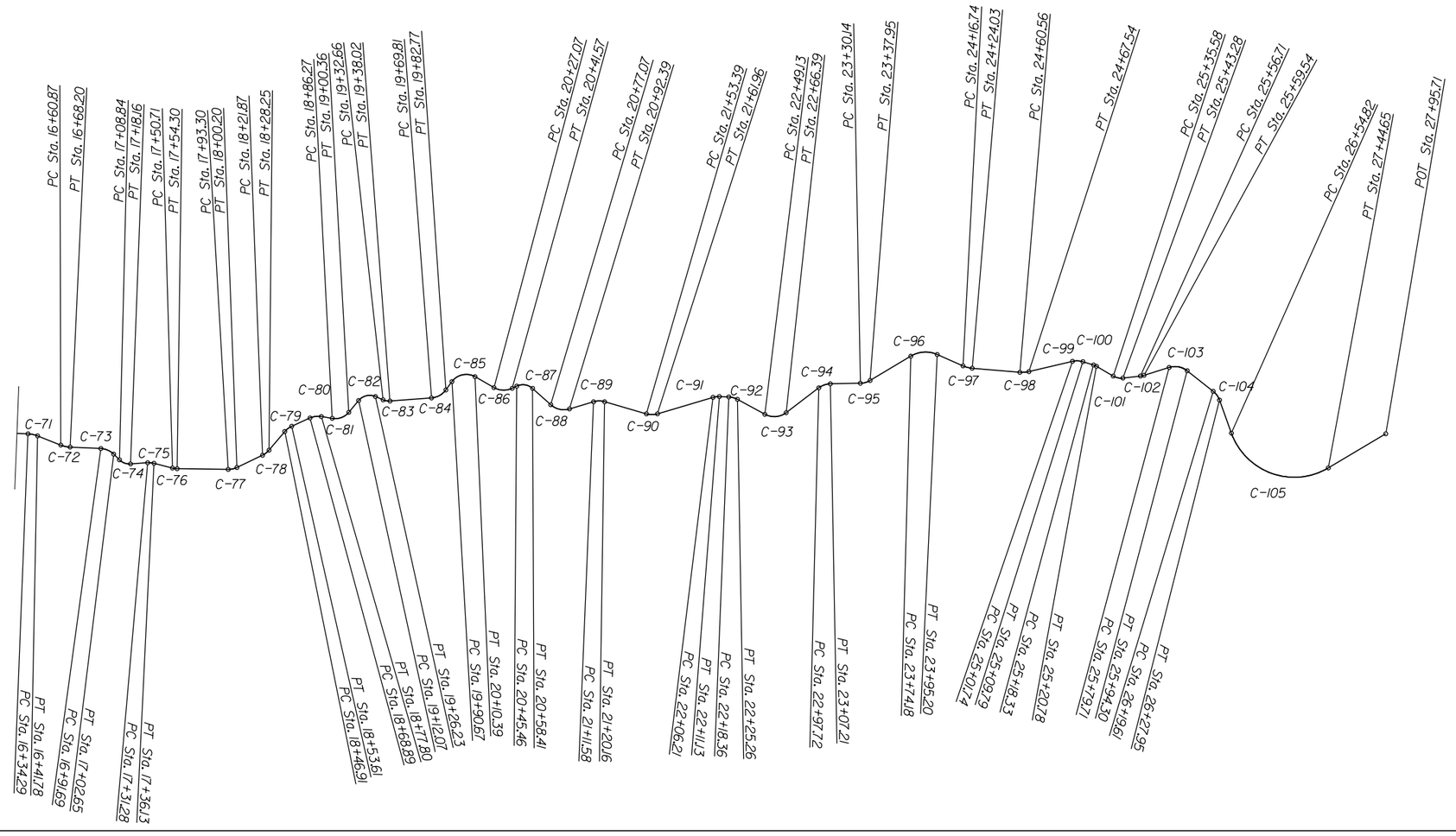
C-101
PI Sta 25+39.56
△ = 36° 46' 33.4" (LT)
D = 477° 27' 53.4"
L = 7.70'
T = 3.99'
R = 12.00'

C-102
PI Sta 25+58.13
△ = 10° 49' 53.9" (LT)
D = 381° 58' 18.7"
L = 2.84'
T = 1.42'
R = 15.00'

C-103
PI Sta 25+87.64
△ = 55° 45' 13.2" (RT)
D = 381° 58' 18.7"
L = 14.60'
T = 7.93'
R = 15.00'

C-104
PI Sta 26+23.89
△ = 31° 51' 13.0" (RT)
D = 381° 58' 18.7"
L = 8.34'
T = 4.28'
R = 15.00'

C-105
PI Sta 27+16.61
△ = 100° 55' 43.4" (LT)
D = 112° 20' 40.8"
L = 89.84'
T = 61.79'
R = 51.00'



3/14/2019
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hdarsey

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 1	3D
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
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ENG FIRM LICENSE NO. C-890

DocuSigned by:
Joshua G. Dalton
1089AD8C74994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

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-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L70	16.85		S11°06'10"E	
CH71	7.46		S01°20'47"E	
L71	19.09		S08°24'37"W	
CH72	7.29		S01°07'50"E	
L72	23.49		S10°40'17"E	
CH73	10.72		S10°15'53"W	
L73	6.20		S31°12'03"W	
CH74	9.04		S06°55'30"W	
L74	13.12		S17°21'04"E	
CH75	4.83		S08°05'10"E	
L75	14.58		S01°10'43"W	
CH76	3.58		S05°40'36"E	
L76	39.00		S12°31'56"E	
CH77	6.84		S25°42'26"E	
L77	21.68		S38°52'56"E	
CH78	6.33		S51°04'05"E	
L78	18.66		S63°15'13"E	
CH79	6.64		S50°28'14"E	
L79	15.29		S37°41'16"E	
CH80	8.77		S20°40'50"E	
L80	8.47		S03°40'25"E	
CH81	11.42		S37°24'46"E	
L81	11.71		S63°29'42"E	
CH82	13.20		S26°37'56"E	
L82	6.44		S10°13'49"W	
CH83	5.30		S03°42'45"E	
L83	31.79		S17°39'19"E	
CH84	12.56		S42°24'07"E	
L84	7.90		S67°08'54"E	
CH85	18.02		S25°17'08"E	
L85	16.68		S16°34'38"W	
CH86	13.94		S11°06'28"E	
L86	3.89		S38°47'34"E	
CH87	12.21		S05°05'03"E	
L87	18.66		S28°37'28"W	
CH88	14.66		S00°37'47"E	
L88	19.20		S29°53'03"E	
CH89	8.46		S13°30'45"E	

-UT1- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L89	33.24		S02°51'33"W	
CH90	8.45		S13°29'47"E	
L90	44.25		S29°51'07"E	
CH91	4.90		S20°27'25"E	
L91	7.23		S11°03'43"E	
CH92	6.84		S02°07'07"W	
L92	23.86		S15°17'58"W	
CH93	16.32		S17°39'52"E	
L93	31.33		S50°37'42"E	
CH94	9.33		S32°30'26"E	
L94	22.94		S14°23'09"E	
CH95	7.72		S29°17'58"E	
L95	36.23		S44°12'47"E	
CH96	20.22		S16°50'54"E	
L96	21.54		S10°31'00"W	
CH97	7.26		S01°01'05"W	
L97	36.52		S08°28'49"E	
CH98	6.95		S17°34'12"E	
L98	34.20		S26°39'34"E	
CH99	7.96		S11°16'55"E	
L99	8.53		S04°05'44"W	
CH100	2.45		S10°29'40"W	
L100	14.79		S16°53'36"W	
CH101	7.57		S01°29'40"E	
L101	13.43		S19°52'57"E	
CH102	2.83		S25°17'54"E	
L102	20.16		S30°42'51"E	
CH103	14.03		S02°50'14"E	
L103	25.31		S25°02'22"W	
CH104	8.23		S40°57'59"W	
L104	26.86		S56°53'35"W	
CH105	78.67		S06°25'44"W	
L105	51.052		S44°02'08"E	
27+95.71		POT	772316.9272	1893822.256

C-1
PI Sta 0+11.66
△ = 38° 28' 46.4" (LT)
D = 716° 11' 50.1"
L = 5.37'
T = 2.79'
R = 8.00'

C-2
PI Sta 0+35.61
△ = 68° 01' 06.9" (RT)
D = 477° 27' 53.4"
L = 14.25'
T = 8.10'
R = 12.00'

C-3
PI Sta 0+53.58
△ = 24° 25' 18.9" (LT)
D = 716° 11' 50.1"
L = 3.41'
T = 1.73'
R = 8.00'

C-4
PI Sta 0+78.66
△ = 125° 26' 27.1" (LT)
D = 716° 11' 50.1"
L = 17.51'
T = 15.51'
R = 8.00'

C-5
PI Sta 0+96.12
△ = 49° 10' 21.4" (RT)
D = 381° 58' 18.7"
L = 12.87'
T = 6.86'
R = 15.00'

C-6
PI Sta 1+19.74
△ = 64° 48' 22.0" (RT)
D = 477° 27' 53.4"
L = 13.57'
T = 7.62'
R = 12.00'

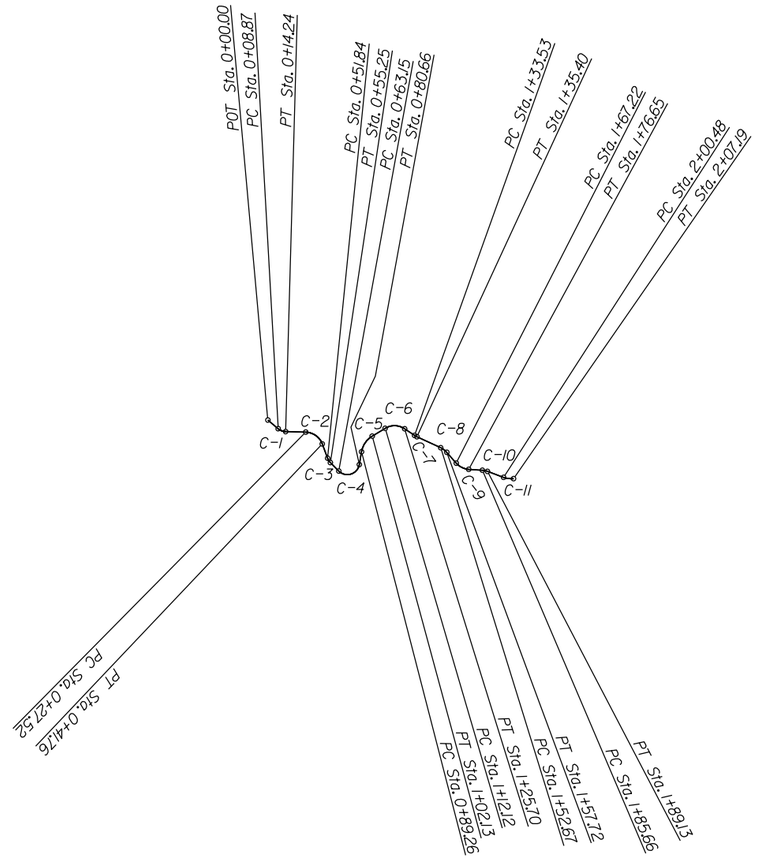
C-7
PI Sta 1+34.47
△ = 8° 55' 19.6" (LT)
D = 477° 27' 53.4"
L = 1.87'
T = 0.94'
R = 12.00'

C-8
PI Sta 1+55.23
△ = 24° 04' 54.3" (RT)
D = 477° 27' 53.4"
L = 5.04'
T = 2.56'
R = 12.00'

C-9
PI Sta 1+72.20
△ = 45° 02' 57.3" (LT)
D = 477° 27' 53.4"
L = 9.44'
T = 4.98'
R = 12.00'

C-10
PI Sta 1+87.41
△ = 16° 33' 56.2" (RT)
D = 477° 27' 53.4"
L = 3.47'
T = 1.75'
R = 12.00'

C-11
PI Sta 2+03.89
△ = 25° 37' 04.9" (LT)
D = 381° 58' 18.7"
L = 6.71'
T = 3.41'
R = 15.00'



-UT2- STREAM ALIGNMENT DATA

STATION	LENGTH		NORTHING	EASTING
0+00		POC	773,858.8047	1,893,594.7002
L1	8.87		S26°45'20"W	
CH1	5.27		S07°30'57"W	
L2	13.28		S11°43'26"E	
CH2	13.42		S22°17'07"W	
L3	10.08		S56°17'41"W	
CH3	3.38		S44°05'01"W	
L4	7.90		S31°52'22"W	
CH4	14.22		S30°50'52"E	
L5	8.59		N86°25'55"E	
CH5	12.48		S68°58'55"E	
L6	9.99		S44°23'44"E	
CH6	12.86		S11°59'33"E	
L7	7.84		S20°24'38"W	
CH7	1.87		S15°56'58"W	
L8	17.27		S11°29'19"W	
CH8	5.01		S23°31'46"W	
L9	9.50		S35°34'13"W	
CH9	9.19		S13°02'44"W	
L10	9.01		S09°28'44"E	
CH10	3.46		S01°11'46"E	
L11	11.35		S07°05'12"W	
CH11	6.65		S05°43'21"E	
2+07.19		POT	773,692.0730	1,893,594.4306

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 2	3E
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

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3/14/2019
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jharvey

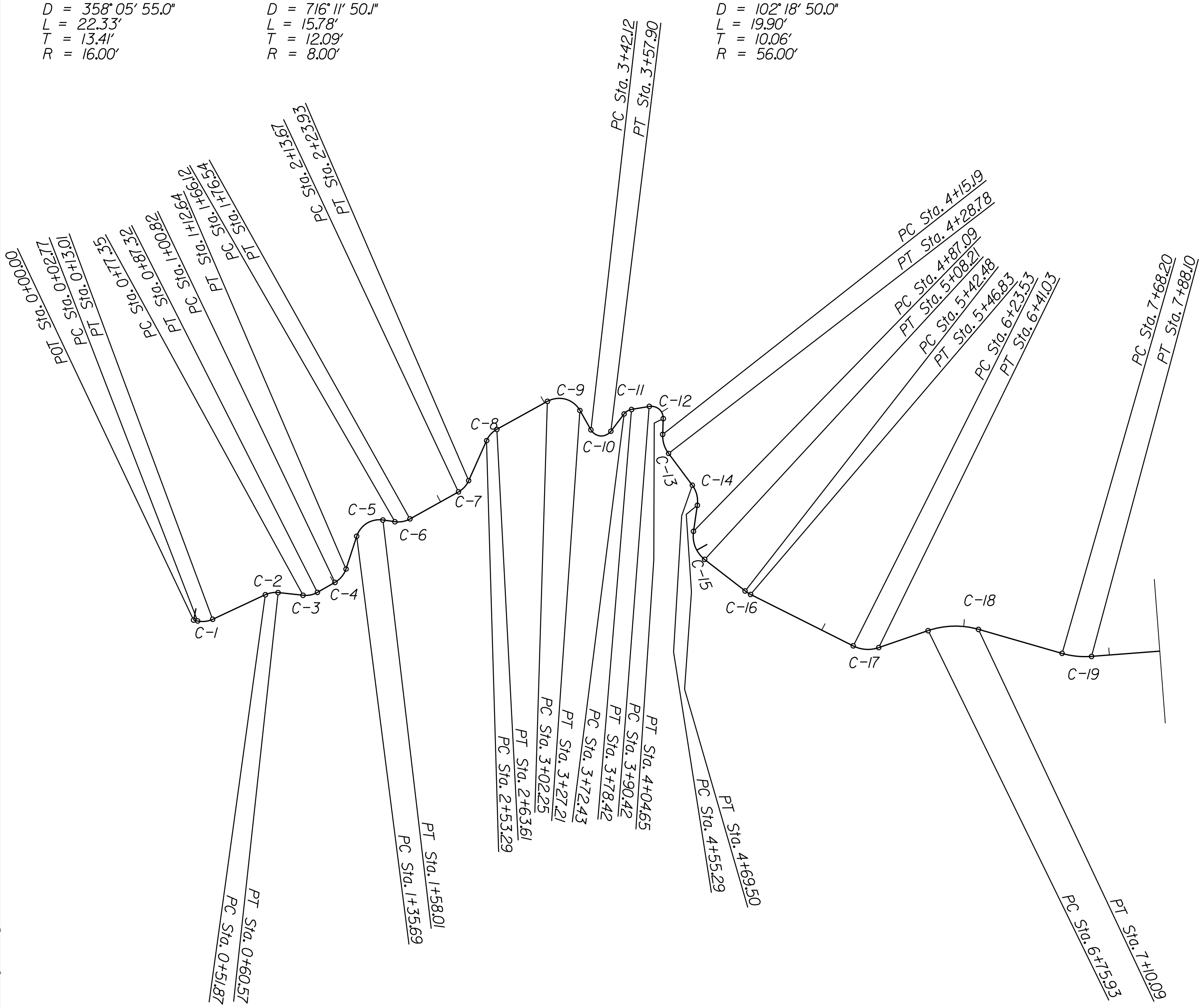
C-1	C-6	C-11	C-15
PI Sta 0+08.07	PI Sta 1+71.52	PI Sta 3+75.57	PI Sta 4+98.75
△ = 36° 41' 07.7" (LT)	△ = 37° 17' 00.2" (LT)	△ = 42° 53' 04.6" (RT)	△ = 60° 30' 39.2" (LT)
D = 358° 05' 55.0"	D = 358° 05' 55.0"	D = 716° 11' 50.1"	D = 286° 28' 44.0"
L = 10.24'	L = 10.41'	L = 5.99'	L = 21.12'
T = 5.30'	T = 5.40'	T = 3.14'	T = 11.67'
R = 16.00'	R = 16.00'	R = 8.00'	R = 20.00'

C-2	C-7	C-12	C-16
PI Sta 0+56.33	PI Sta 2+18.99	PI Sta 4+00.29	PI Sta 5+44.66
△ = 31° 09' 20.4" (RT)	△ = 36° 44' 23.2" (LT)	△ = 101° 55' 49.8" (RT)	△ = 11° 20' 04.8" (LT)
D = 358° 05' 55.0"	D = 358° 05' 55.0"	D = 716° 11' 50.1"	D = 260° 26' 07.3"
L = 8.70'	L = 10.26'	L = 14.23'	L = 4.35'
T = 4.46'	T = 5.31'	T = 9.87'	T = 2.18'
R = 16.00'	R = 16.00'	R = 8.00'	R = 22.00'

C-3	C-8	C-13	C-17
PI Sta 0+82.50	PI Sta 2+58.64	PI Sta 4+22.26	PI Sta 6+32.77
△ = 35° 41' 59.4" (LT)	△ = 36° 55' 30.0" (RT)	△ = 38° 55' 53.3" (LT)	△ = 45° 34' 19.9" (LT)
D = 358° 05' 55.0"	D = 358° 05' 55.0"	D = 286° 28' 44.0"	D = 260° 26' 07.3"
L = 9.97'	L = 10.31'	L = 13.59'	L = 17.50'
T = 5.15'	T = 5.34'	T = 7.07'	T = 9.24'
R = 16.00'	R = 16.00'	R = 20.00'	R = 22.00'

C-4	C-9	C-14	C-18
PI Sta 1+07.02	PI Sta 3+18.08	PI Sta 4+62.79	PI Sta 6+93.56
△ = 42° 20' 54.6" (LT)	△ = 89° 24' 34.2" (RT)	△ = 45° 12' 40.8" (RT)	△ = 34° 56' 40.3" (RT)
D = 358° 05' 55.0"	D = 358° 05' 55.0"	D = 318° 18' 35.6"	D = 102° 18' 50.0"
L = 11.83'	L = 24.97'	L = 14.20'	L = 34.15'
T = 6.20'	T = 15.84'	T = 7.49'	T = 17.63'
R = 16.00'	R = 16.00'	R = 18.00'	R = 56.00'

C-5	C-10		C-19
PI Sta 1+49.10	PI Sta 3+54.21		PI Sta 7+78.25
△ = 79° 56' 52.0" (RT)	△ = 113° 00' 11.5" (LT)		△ = 20° 21' 43.3" (LT)
D = 358° 05' 55.0"	D = 716° 11' 50.1"		D = 102° 18' 50.0"
L = 22.33'	L = 15.78'		L = 19.90'
T = 13.41'	T = 12.09'		T = 10.06'
R = 16.00'	R = 8.00'		R = 56.00'



-UT3- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
0+00		POC	772,904.4473	1,892,295.3742
L1	2.77		S16°46'46"E	
CH1	10.07		S35°07'20"E	
L2	38.86		S53°27'53"E	
CH2	8.59		S37°53'13"E	
L3	16.78		S22°18'33"E	
CH3	9.81		S40°09'33"E	
L4	13.50		S58°00'32"E	
CH4	11.56		S79°11'00"E	
L5	23.04		N79°38'33"E	
CH5	20.56		S60°23'01"E	
L6	8.11		S20°24'35"E	
CH6	10.23		S39°03'05"E	
L7	37.14		S57°41'35"E	
CH7	10.08		S76°03'47"E	
L8	29.36		N85°34'02"E	
CH8	10.13		S75°58'13"E	
L9	38.64		S57°30'28"E	
CH9	22.51		S12°48'11"E	
L10	14.91		S31°54'06"W	
CH10	13.34		S24°36'00"E	
L11	14.53		S81°06'06"E	
CH11	5.85		S59°39'33"E	
L12	12.00		S38°13'01"E	
CH12	12.428		S12°44'54"W	
L13	10.538		S63°42'49"W	
CH13	13.329		S44°14'52"W	
L14	26.511		S24°46'55"W	
CH14	13.837		S47°23'16"W	
L15	17.589		S69°59'36"W	
CH15	20.154		S39°44'16"W	
L16	34.269		S09°28'57"W	
CH16	4.345		S03°48'54"W	
L17	76.696		S01°51'08"E	
CH17	17.04		S24°38'18"E	
L18	34.906		S47°25'28"E	
CH18	33.627		S29°57'08"E	
L19	58.109		S12°28'47"E	
CH19	19.797		S22°39'39"E	
L20	91.347		S32°50'31"E	

SHEET NAME: -CURVE DATA- UT 3
SHEET NUMBER: 3F
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE
COUNTY: ALAMANCE
DATE: 2018

Axiom Environmental, Inc.

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

DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

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jharvey

C-20
PI Sta 8+83.23
△ = 7° 43' 39.5" (RT)
D = 102° 18' 50.0"
L = 7.55'
T = 3.78'
R = 56.00'

C-21
PI Sta 9+64.34
△ = 88° 21' 37.2" (LT)
D = 260° 26' 07.3"
L = 33.93'
T = 21.38'
R = 22.00'

C-22
PI Sta 10+38.75
△ = 35° 26' 27.1" (LT)
D = 260° 26' 07.3"
L = 13.61'
T = 7.03'
R = 22.00'

C-23
PI Sta 10+83.48
△ = 81° 22' 47.3" (RT)
D = 260° 26' 07.3"
L = 31.25'
T = 18.92'
R = 22.00'

C-24
PI Sta 11+37.25
△ = 34° 31' 42.2" (LT)
D = 102° 18' 50.0"
L = 33.75'
T = 17.40'
R = 56.00'

C-25
PI Sta 11+99.84
△ = 37° 29' 18.5" (LT)
D = 197° 34' 18.0"
L = 18.97'
T = 9.84'
R = 29.00'

C-26
PI Sta 12+72.08
△ = 93° 55' 45.3" (RT)
D = 197° 34' 18.0"
L = 47.54'
T = 31.06'
R = 29.00'

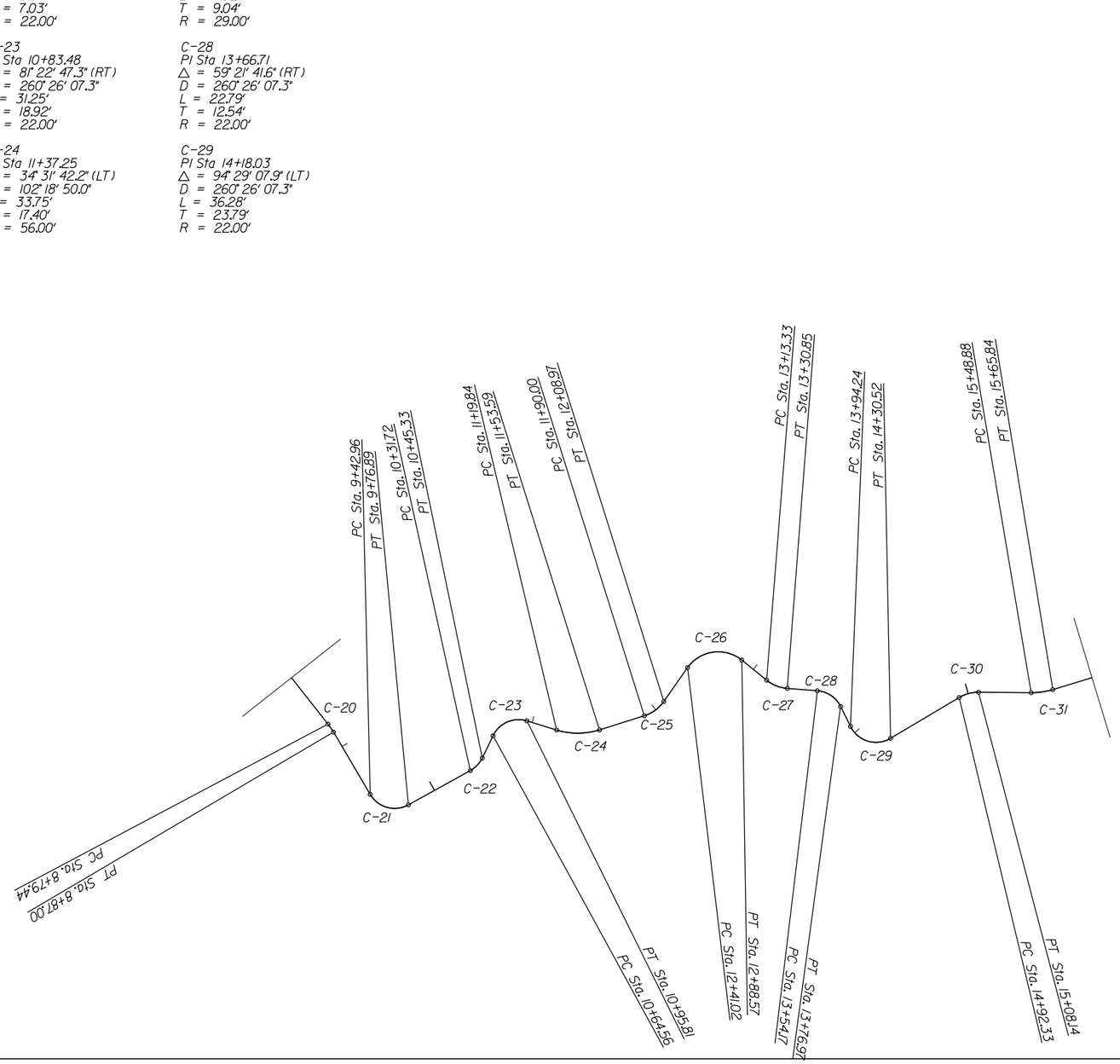
C-27
PI Sta 13+22.37
△ = 34° 37' 21.3" (LT)
D = 197° 34' 18.0"
L = 17.52'
T = 9.04'
R = 29.00'

C-28
PI Sta 13+66.71
△ = 59° 21' 41.6" (RT)
D = 260° 26' 07.3"
L = 22.79'
T = 12.54'
R = 22.00'

C-29
PI Sta 14+18.03
△ = 94° 29' 07.9" (LT)
D = 260° 26' 07.3"
L = 36.28'
T = 23.79'
R = 22.00'

C-30
PI Sta 15+00.44
△ = 31° 13' 51.6" (RT)
D = 197° 34' 18.0"
L = 15.81'
T = 8.11'
R = 29.00'

C-31
PI Sta 15+57.43
△ = 17° 21' 11.6" (LT)
D = 102° 18' 50.0"
L = 16.96'
T = 8.55'
R = 56.00'



-UT3- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L20	91.35		S32°50'31"E	
C20	7.55		S28°58'41"E	
L21	55.96		S25°06'51"E	
C21	30.66		S69°17'40"E	
L22	54.83		N66°31'32"E	
C22	13.39		N48°48'18"E	
L23	19.23		N31°05'04"E	
C23	28.69		N71°46'28"E	
L24	24.03		S67°32'08"E	
C24	33.24		S84°47'59"E	
L25	36.41		N77°56'10"E	
C25	18.64		N59°11'30"E	
L26	32.05		N40°26'51"E	
C26	42.39		N87°24'44"E	
L27	24.76		S45°37'24"E	
C27	17.26		S62°56'04"E	
L28	23.32		S80°14'45"E	
C28	21.79		S50°33'54"E	
L29	17.27		S20°53'03"E	
C29	32.31		S68°07'37"E	
L30	61.81		N64°37'49"E	
C30	15.61		N80°14'45"E	
L31	40.74		S84°08'20"E	
C31	16.90		N87°11'05"E	
L32	63.41		N78°30'29"E	

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 3	3G
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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3/14/2019
DATE:

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hgarvey

SHEET NAME	SHEET NUMBER
-CURVE DATA- UT 3	3H

PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE

COUNTY: ALAMANCE DATE: 2018

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3/14/2019

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C-32
PI Sta 16+51.34
△ = 43° 02′ 43.8″ (RT)
D = 102° 18′ 50.0″
L = 42.07′
T = 22.08′
R = 56.00′

C-33
PI Sta 17+20.77
△ = 26° 20′ 34.2″ (LT)
D = 197° 34′ 18.0″
L = 13.33′
T = 6.79′
R = 29.00′

C-34
PI Sta 17+74.43
△ = 22° 59′ 02.0″ (LT)
D = 102° 18′ 50.0″
L = 22.46′
T = 11.39′
R = 56.00′

C-35
PI Sta 18+27.01
△ = 77° 06′ 09.0″ (RT)
D = 260° 26′ 07.3″
L = 29.61′
T = 17.53′
R = 22.00′

C-36
PI Sta 18+94.32
△ = 105° 42′ 03.3″ (LT)
D = 197° 34′ 18.0″
L = 53.50′
T = 38.28′
R = 29.00′

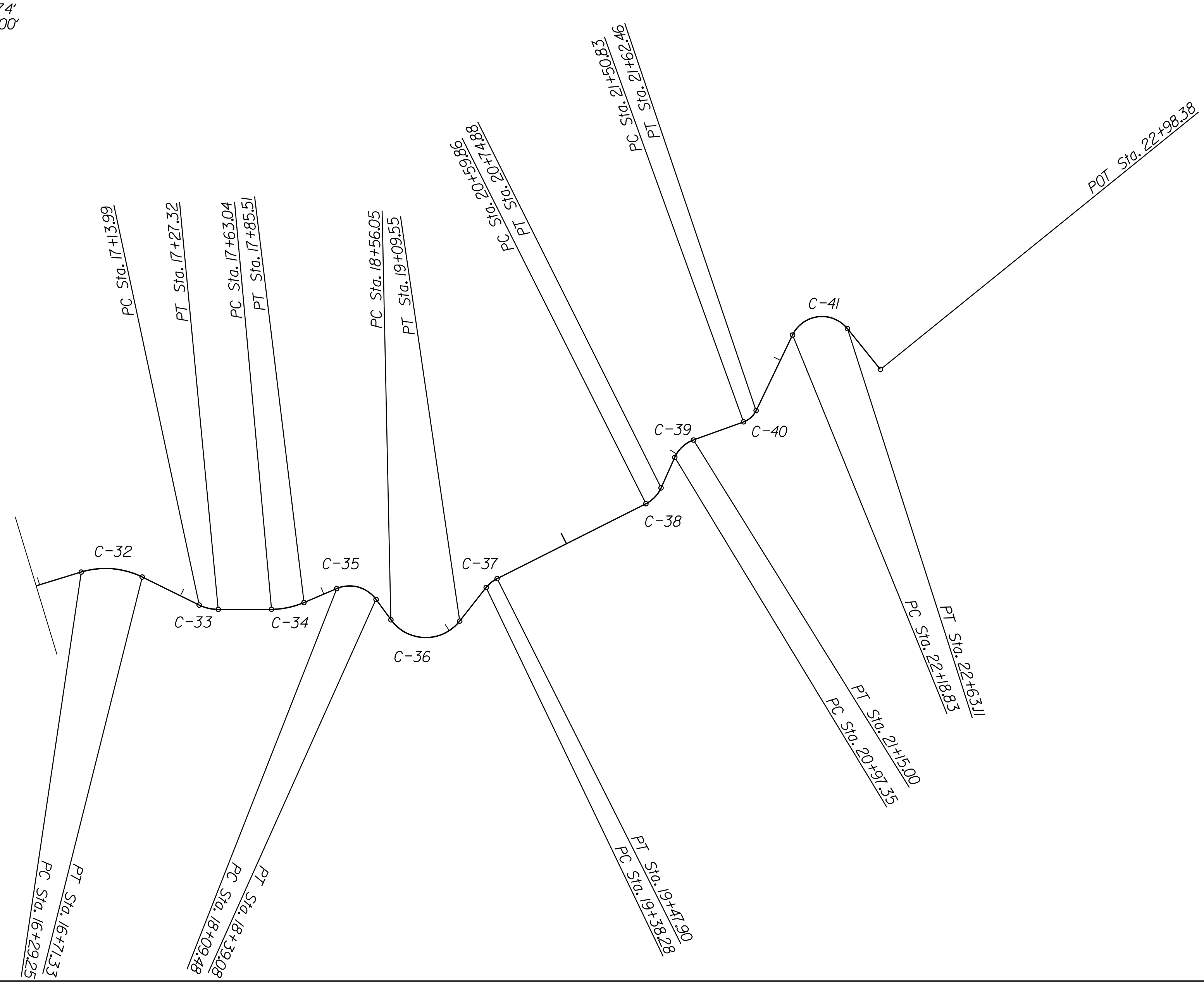
C-37
PI Sta 19+43.17
△ = 25° 02′ 27.1″ (RT)
D = 260° 26′ 07.3″
L = 9.62′
T = 4.89′
R = 22.00′

C-38
PI Sta 20+67.68
△ = 39° 07′ 23.1″ (LT)
D = 260° 26′ 07.3″
L = 15.02′
T = 7.82′
R = 22.00′

C-39
PI Sta 21+06.68
△ = 45° 57′ 48.5″ (RT)
D = 260° 26′ 07.3″
L = 17.65′
T = 9.33′
R = 22.00′

C-40
PI Sta 21+56.96
△ = 44° 24′ 39.4″ (LT)
D = 381° 58′ 18.7″
L = 11.63′
T = 6.12′
R = 15.00′

C-41
PI Sta 22+53.57
△ = 115° 19′ 00.4″ (RT)
D = 260° 26′ 07.3″
L = 44.28′
T = 34.74′
R = 22.00′



-UT3- STREAM ALIGNMENT DATA				
STATION	LENGTH		NORTHING	EASTING
L32	63.41		N78°30'29"E	
C32	41.09		S79°58'09"E	
L33	42.66		S58°26'47"E	
C33	13.22		S71°37'04"E	
L34	35.72		S84°47'22"E	
C34	22.31		N83°43'07"E	
L35	23.97		N72°13'36"E	
C35	27.42		S69°13'19"E	
L36	16.96		S30°40'15"E	
C36	46.23		S83°31'16"E	
L37	28.73		N43°37'42"E	
C37	9.54		N56°08'56"E	
L38	111.96		N68°40'09"E	
C38	14.73		N49°06'28"E	
L39	22.47		N29°32'46"E	
C39	17.18		N52°31'41"E	
L40	35.83		N75°30'35"E	
C40	11.34		N53°18'15"E	
L41	56.37		N31°05'55"E	
C41	37.17		N88°45'26"E	
L42	35.27		S33°35'04"E	
22+98.38		POT	772,360.8681	1,893,780.9470

3/14/2019
Major_Hill_Hyd_AB_PSH_03H.dgn
jharvey

Station	Structure Locations	Design Channel Elevation	Survey Channel Elevation
0+75.01	Cross Vane	544.36	544.78
0+97.63	Cross Vane	543.61	543.85
5+96.97	Cross Vane	533.09	533.37

STRUCTURE LOCATION AND ELEVATIONS BASED ON SURVEY DATA PROVIDED BY K2 DESIGN GROUP, P.A. ON 9-19-2018.

CONSTRUCTION PLANS DATED 07-23-2018 INCORRECTLY SHOWED SEVERAL STRUCTURES AT THE HEAD OF A RIFFLE. THESE STRUCTURES WERE FIELD ADJUSTED AND CONSTRUCTED AT THE TAIL OF RIFFLE/HEAD OF POOL.

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	4
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

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

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Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

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TINNIN, ANDREW M
DEED BK 2514
DEED PG 0756

LAMM, JAMES D
AND CAROL L
DEED BK 2789
DEED PG 0896

TINNIN, ANDREW M
DEED BK 2514
DEED PG 0756

LOG CROSS VANE NOT CONSTRUCTED DUE TO BEDROCK CONTACT

REMOVE PIPE

REMOVE DRAINAGE STRUCTURE

12" PVC OUTLET

12" HDPE

XS-10R

XS-9P

0+00 -UTI-

1+00 -UTI-

2+00 -UTI-

3+00 -UTI-

4+00 -UTI-

5+00 -UTI-

6+00 -UTI-

-UTI- BEGIN RESTORATION
STA 0+00 -UTI-
ELEV=546.29

EIP

MATCHLINE STA 6+50 -UTI-
SEE SHEET 5

UT 1

-UT 1-
BEGIN RESTORATION
STA 0+00
ELEV= 546.29

EXST GROUND AT PROP THALWEG

REMOVE STRUCTURE

PROP THALWEG

REMOVE PIPE

MATCHLINE STA 6+50 -UTI-
SEE SHEET 5

550
545
540
535
530

00 +50 01 +50 02 +50 03 +50 04 +50 05 +50 06 +50

3/14/2019
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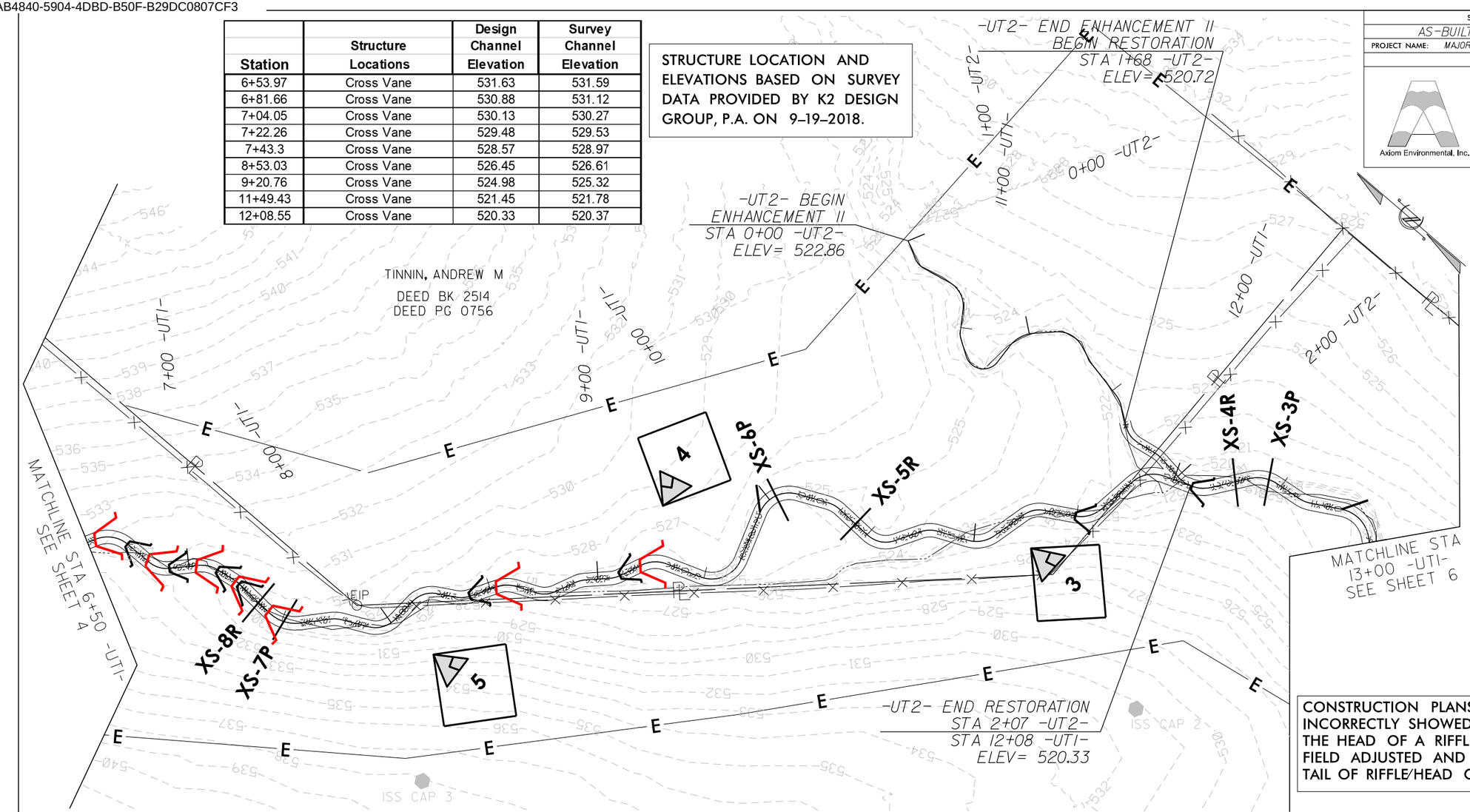
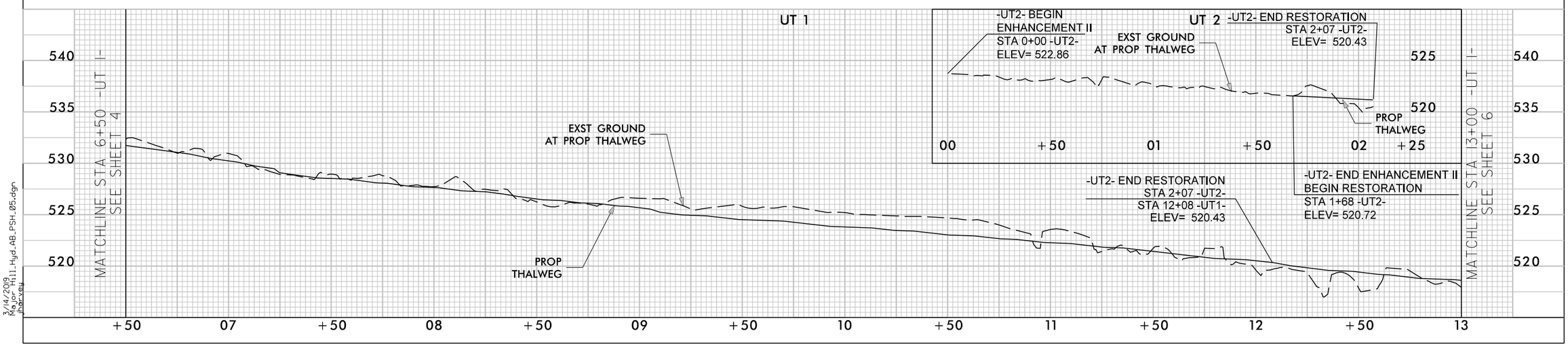
bgarvey

Station	Structure Locations	Design Channel Elevation	Survey Channel Elevation
6+53.97	Cross Vane	531.63	531.59
6+81.66	Cross Vane	530.88	531.12
7+04.05	Cross Vane	530.13	530.27
7+22.26	Cross Vane	529.48	529.53
7+43.3	Cross Vane	528.57	528.97
8+53.03	Cross Vane	526.45	526.61
9+20.76	Cross Vane	524.98	525.32
11+49.43	Cross Vane	521.45	521.78
12+08.55	Cross Vane	520.33	520.37

STRUCTURE LOCATION AND ELEVATIONS BASED ON SURVEY DATA PROVIDED BY K2 DESIGN GROUP, P.A. ON 9–19–2018.



CONSTRUCTION PLANS DATED 07–23–2018 INCORRECTLY SHOWED SEVERAL STRUCTURES AT THE HEAD OF A RIFFLE. THESE STRUCTURES WERE FIELD ADJUSTED AND CONSTRUCTED AT THE TAIL OF RIFFLE/HEAD OF POOL.



SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	5
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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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 SEAL 26971 ENGINEER JOSHUA G. DALTON

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jbarney

Station	Structure Locations	Design Channel Elevation	Survey Channel Elevation
13+53.88	Cross Vane	517.52	517.88

STRUCTURE LOCATION AND ELEVATIONS BASED ON SURVEY DATA PROVIDED BY K2 DESIGN GROUP, P.A. ON 9-19-2018.

CONSTRUCTION PLANS DATED 07-23-2018 INCORRECTLY SHOWED SEVERAL STRUCTURES AT THE HEAD OF A RIFFLE. THESE STRUCTURES WERE FIELD ADJUSTED AND CONSTRUCTED AT THE TAIL OF RIFFLE/HEAD OF POOL.

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	6
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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Joshua G. Dalton
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NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

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DATE:

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LOG CROSS VANE NOT CONSTRUCTED DUE TO BEDROCK CONTACT

DROP STRUCTURE NOT CONSTRUCTED DUE TO BEDROCK CONTACT

WILLIARD ENTERPRISES, LLC
DEED BK 3413
DEED PG 0270

MATCHLINE STA 13+00 -UT1- SEE SHEET 5

MATCHLINE STA 19+50 -UT1- SEE SHEET 7

14+00 -UT1-
15+00 -UT1-
16+00 -UT1-
17+00 -UT1-
18+00 -UT1-
19+00 -UT1-

XS-2R
XS-1R

LAMM, JAMES D
AND CAROL L
DEED BK 2789
DEED PG 0896

-UT1- END RESTORATION
BEGIN ENCHANCEMENT II
STA 16+99 -UT1-
ELEV= 511.16

UT 1

EXST GROUND AT PROP THALWEG

PROP THALWEG

-UT1- END RESTORATION
BEGIN ENHANCEMENT II
STA 16+99 -UT1-
ELEV= 511.16

520
515
510
505
500

13 +50 14 +50 15 +50 16 +50 17 +50 18 +50 19 +50

3/14/2019
Major Hill_Hyd_AB_PSH_06.dgn
jharvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	7
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

SUNGATE DESIGN GROUP, P.A.
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ENG FIRM LICENSE NO. C-890

DocuSigned by:
Joshua G. Dalton
1089AD8C14894C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

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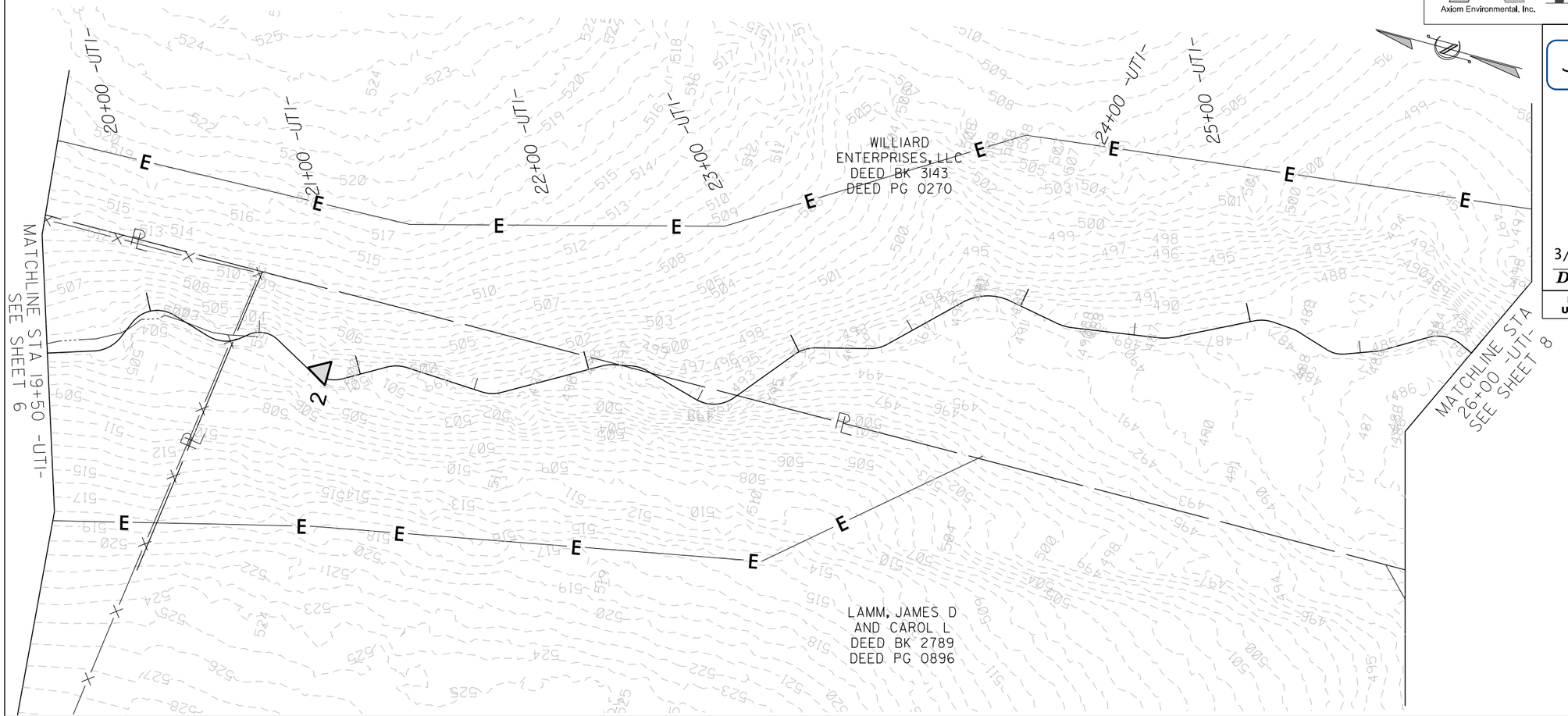

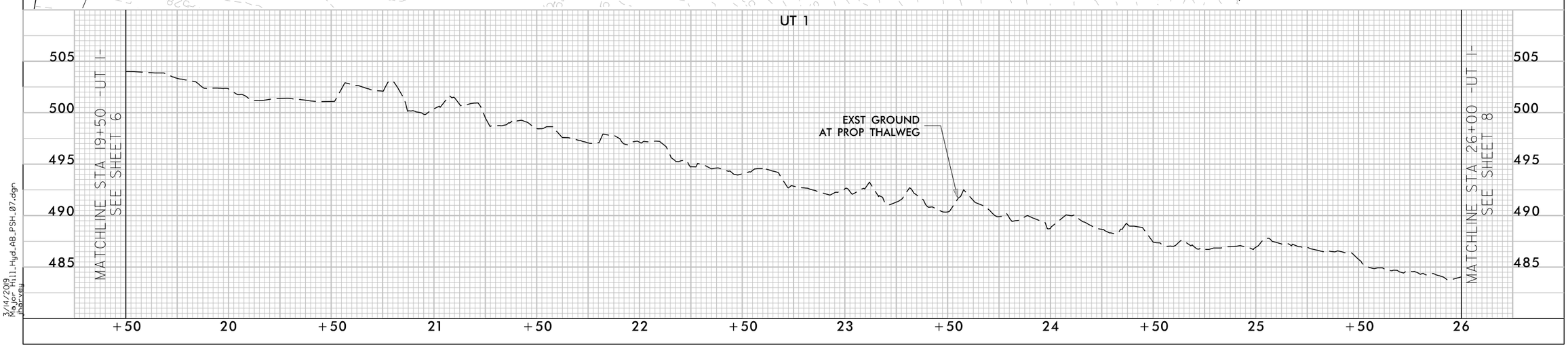

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jsgarvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	8
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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DATE:

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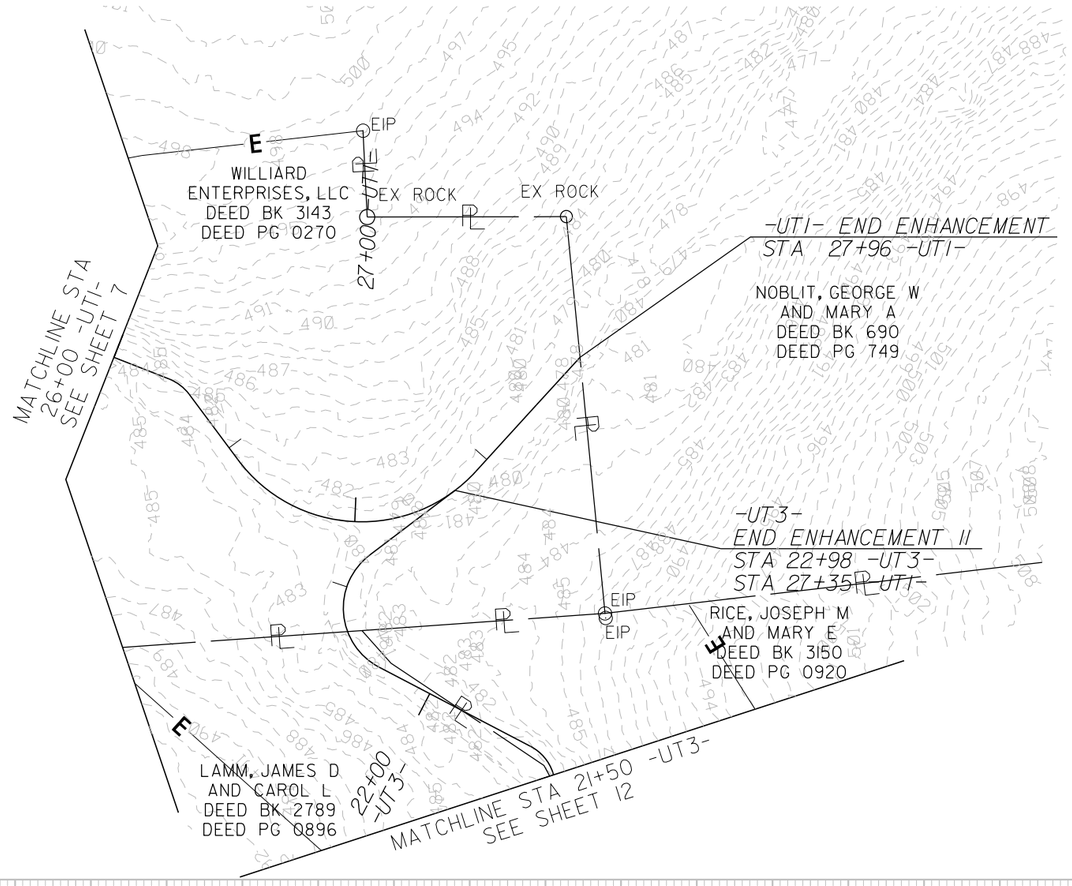


3/14/2019
M:\07\111_Hyd_AB_PSH_08.dgn
harvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	9
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

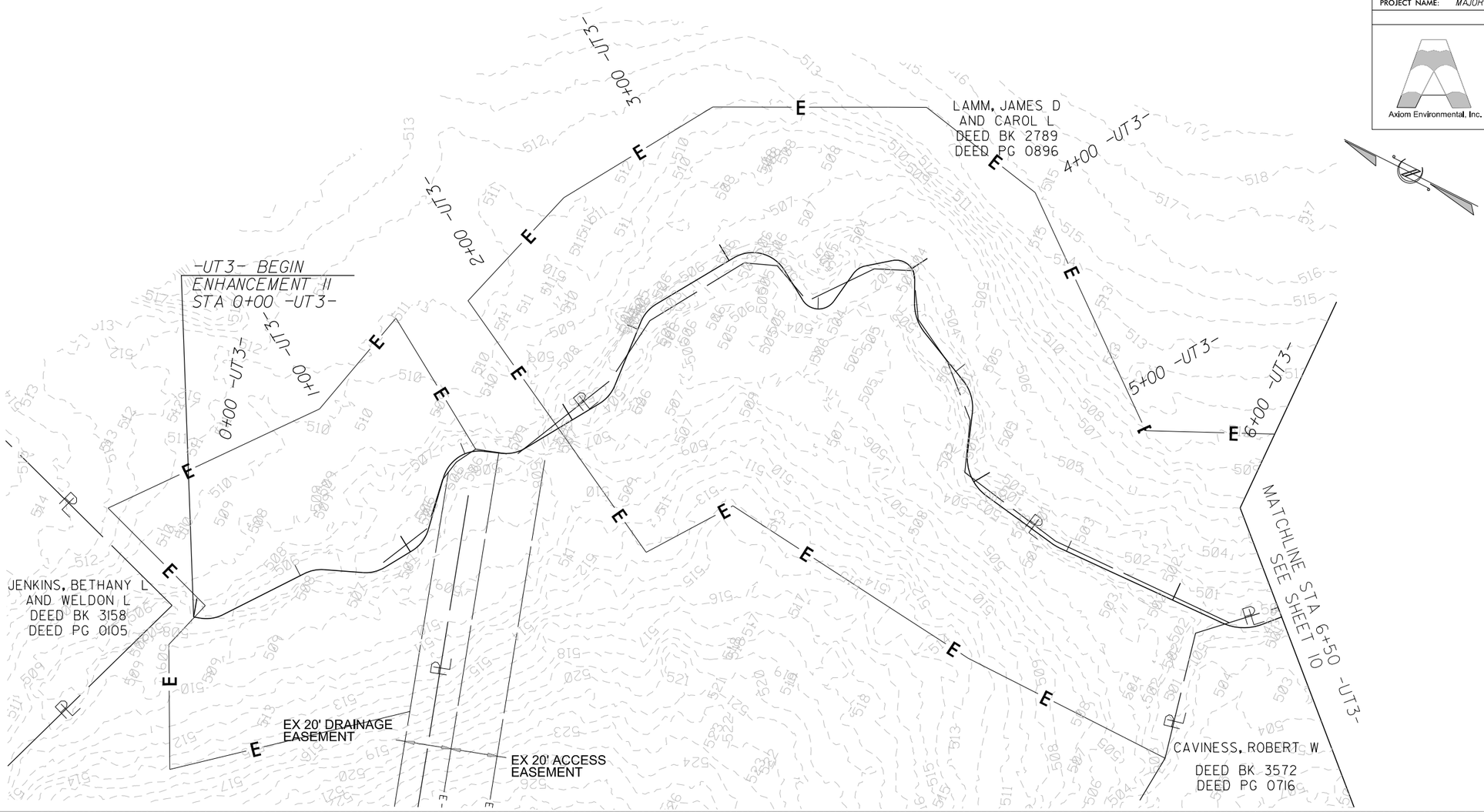
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

DocuSigned by:
Joshua G. Dalton
1989AD8C14494C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



3/14/2019
M:\projects\111_Hyd_AB_PSH_09.dgn
jharvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	10
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

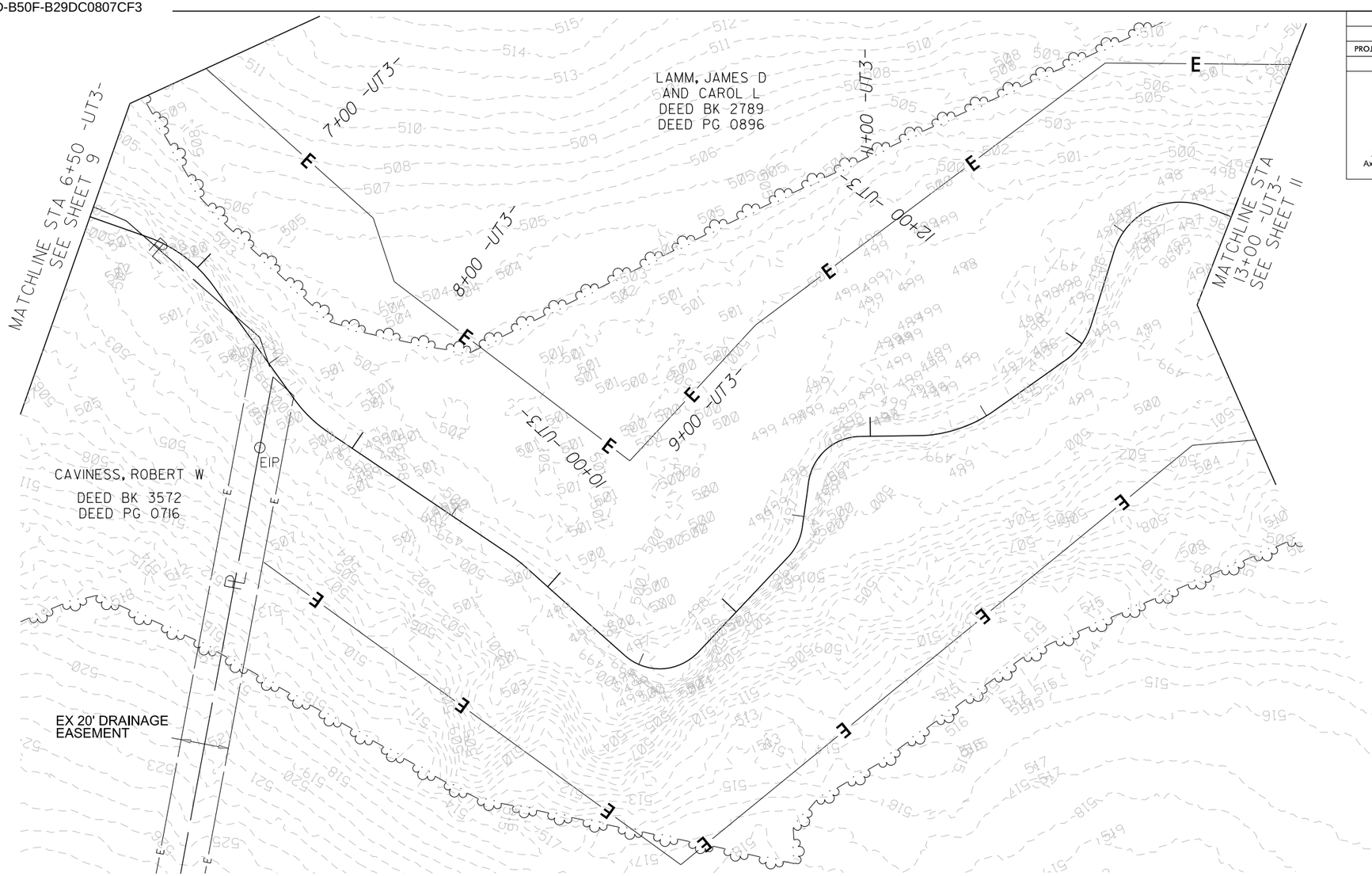
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

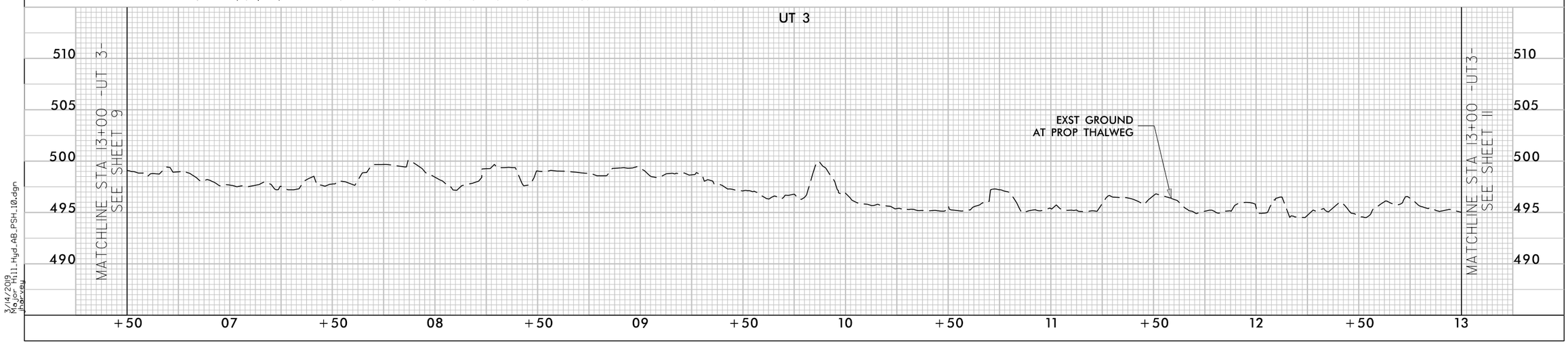
DocuSigned by:
Joshua G. Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED





3/14/2019
Model: 11_Hyd_AB_PSH_10.dgn
jharvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	11
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

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

DocuSigned by:
Joshua G. Dalton
1089ADBC1494C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

LAMM, JAMES D
AND CAROL L
DEED BK 2789
DEED PG 0896

MATCHLINE STA 13+00 -UT3-
SEE SHEET 10

15+00 -UT3-
16+00 -UT3-
14+00 -UT3-
17+00 -UT3-
18+00 -UT3-
19+00 -UT3-

MATCHLINE STA 19+50 -UT3-
SEE SHEET 12

RICE, JOSEPH M
AND MARY E
DEED BK 3150
DEED PG 0920

UT 3

EXST GROUND
AT PROP THALWEG

PERMANENT CROSSING
2@60" CMP
BURY 1.0'

500
495
490
485
480

13 +50 14 +50 15 +50 16 +50 17 +50 18 +50 19 +50

3/14/2019
Model: 11_Hyd_AB_PSH_11.dgn
jharvey

SHEET NAME	SHEET NUMBER
AS-BUILT STRUCTURES	12
PROJECT NAME: MAJOR HILL STREAM AND WETLAND RESTORATION SITE	
COUNTY: ALAMANCE	DATE: 2018

Axiom Environmental, Inc.

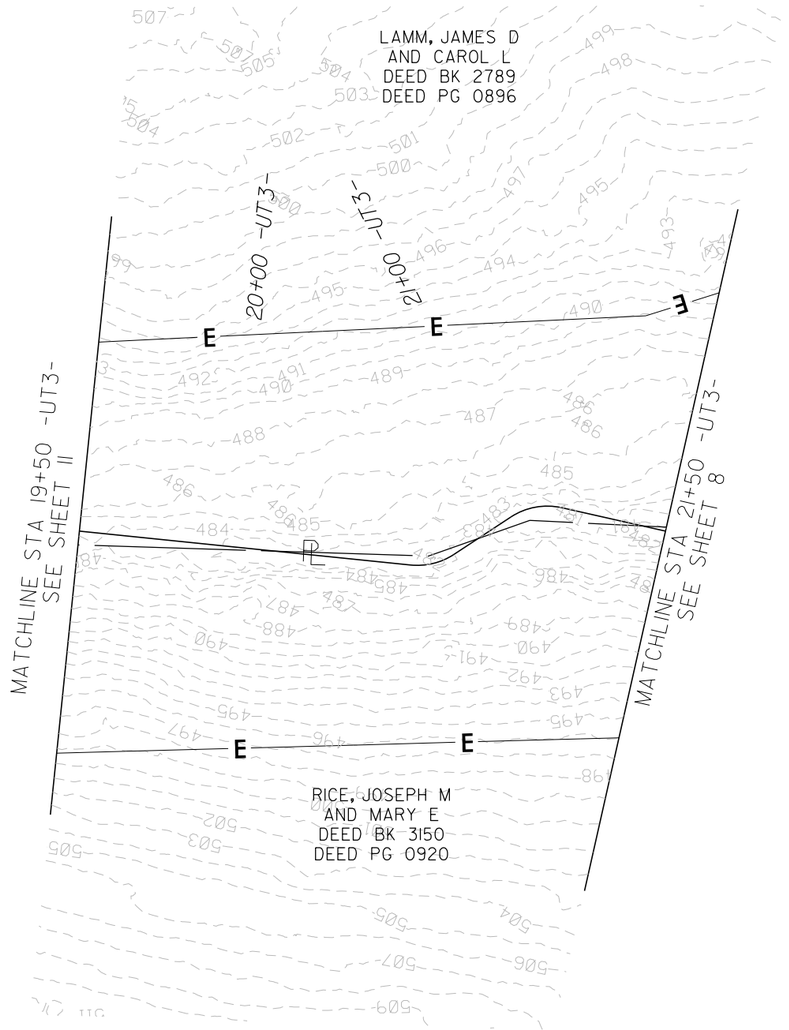
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

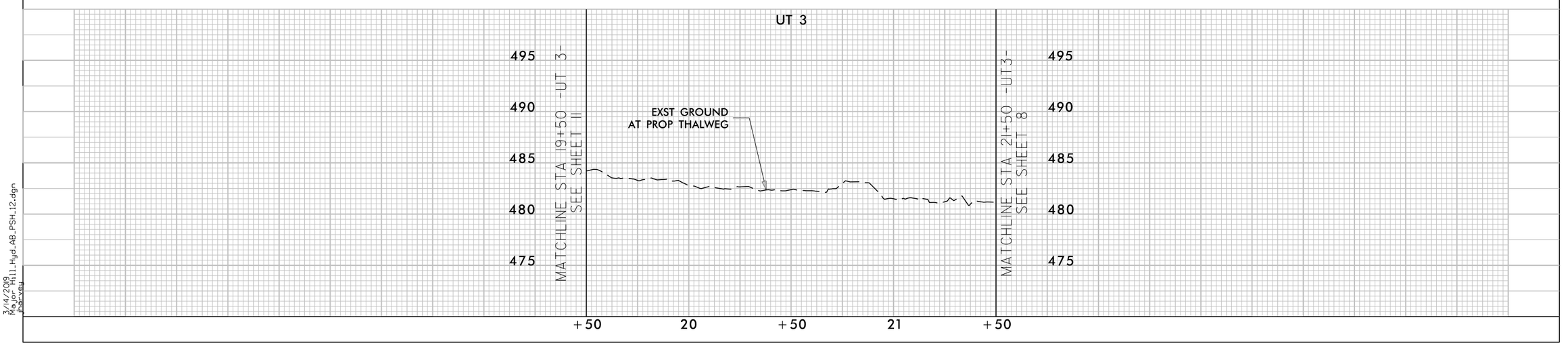
DocuSigned by:
Joshua G. Dalton
1089AD8C14984C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

3/14/2019
DATE:

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED





3/14/2019
Major Hill_Hyd_AB_PSH_12.dgn
hargray

PLANTING SCHEDULE

ALL PLANTS WERE PLANTED
BY 12/31/18

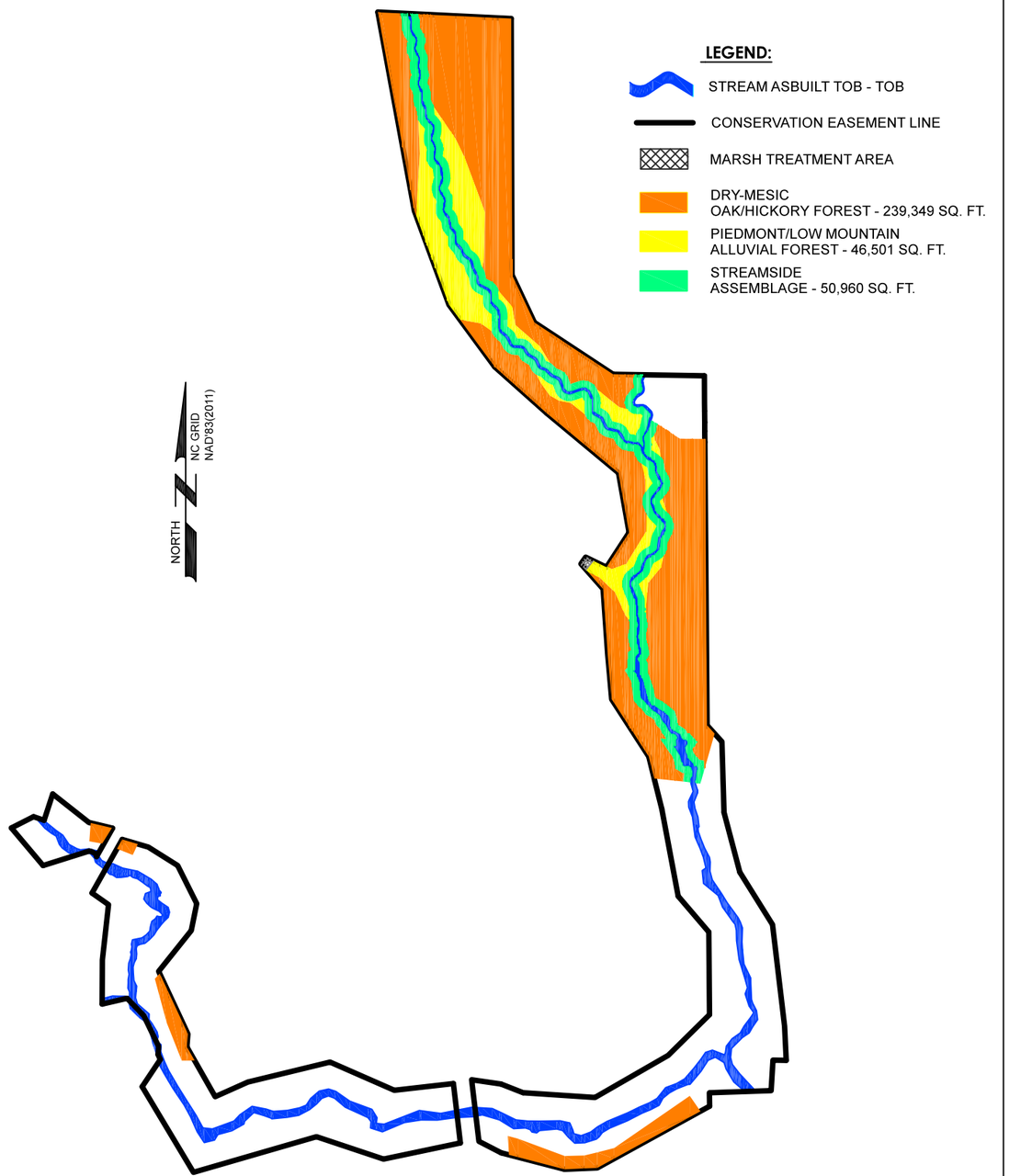
Planted Bare Root Woody Vegetation
Major Hill Restoration Site

Species	Piedmont/Low Mountain Alluvial Forest	Dry-Mesic Oak/Hickory Forest	Marsh Treatment Wetland	Streamside Assemblage	Total
Alnus serrulata			5	20	25
Asimina triloba				200	200
Betula nigra	100			200	300
Carpinus caroliniana		600			600
Cephalanthus occidentalis			5	20	25
Cercis canadensis		500			500
Cornus amomum	95		5	800	900
Diospyros virginiana		450			450
Fraxinus americana		100			100
Fraxinus pennsylvanica	150			750	900
Liriodendron tulipifera	75				75
Nyssa sylvatia		600			600
Platanus occidentalis	120			780	900
Quercus nigra	110	790		500	1,400
Quercus phellos	100	700		400	1,200
*Salix nigra**				400*	400
Sambucus canadensis			11	14	25
TOTALS	750	3,740	26	4,084	**8,600**

*Live stakes of *Salix nigra* were planted; all other planted species were planted as bare root plants.

(PLANTING SCHEDULE PROVIDED BY AXIOM ENVIRONMENTAL)

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH



AS-BUILT PLANTING PLAN

0 150 300 600

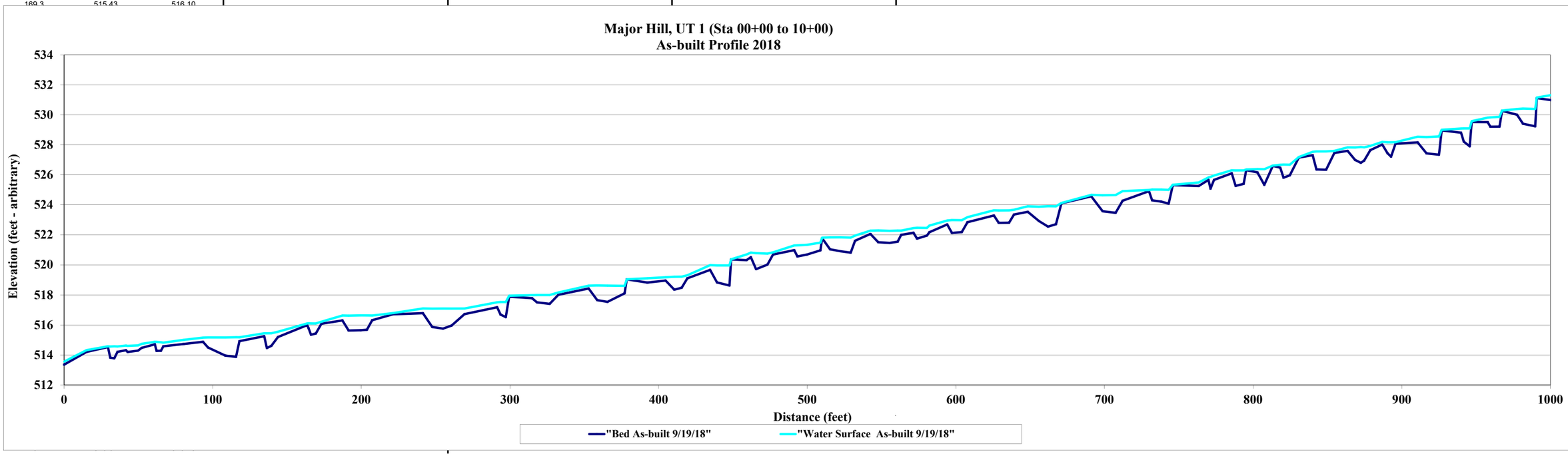
1" = 300'

Project Name	Major Hill - As-built (2018) Profile
Reach	UT 1 (Sta 00+00 to 10+00)
Feature	Profile
Date	9/19/18
Crew	Perkinson, Radecki

Station	2018 As-built Survey Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation
0.0	513.35	513.55									
15.1	514.20	514.32									
29.5	514.53	514.58									
31.0	513.82	514.56									
33.8	513.77	514.57									
35.9	514.21	514.56									
41.6	514.31	514.62									
42.8	514.20	514.60									
49.7	514.29	514.63									
52.2	514.47	514.74									
61.1	514.71	514.87									
62.2	514.27	514.87									
65.2	514.28	514.85									
66.8	514.57	514.82									
80.5	514.73	515.00									
93.5	514.87	515.15									
96.9	514.49	515.17									
108.5	513.95	515.16									
115.7	513.87	515.18									
118.0	514.92	515.18									
134.6	515.25	515.44									
136.4	514.46	515.44									
139.4	514.60	515.44									
143.9	515.19	515.55									
163.6	515.99	516.10									
164.5	515.78	516.11									
166.1	515.35	516.10									
169.3	515.43	516.10									

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

	As-built	As needed		
Avg. Water Surface Slope	0.0195			
Riffle Length	16			
Avg. Riffle Slope	0.0252			
Pool Length	13			

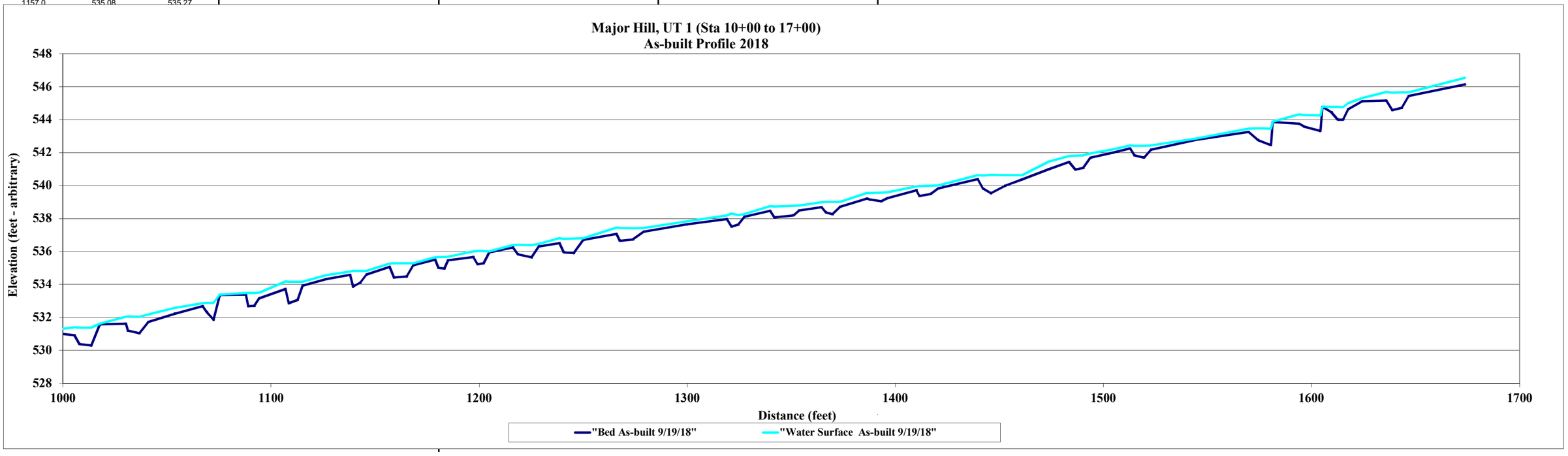


Project Name	Major Hill - As-built (2018) Profil
Reach	UT 1 (Sta 10+00 to 17+00
Feature	Profile
Date	9/19/18
Crew	Perkinson, Radeck

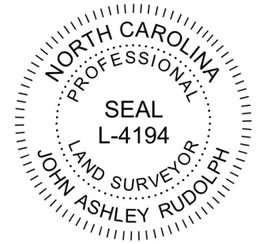
Station	2018 As-built Survey Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation	Station	As needed Bed Elevation	Water Elevation
990.8	531.12	531.16									
1005.5	530.92	531.40									
1007.8	530.39	531.40									
1013.6	530.29	531.39									
1017.7	531.59	531.63									
1030.3	531.63	532.06									
1031.3	531.20	532.07									
1036.7	531.04	532.05									
1041.0	531.72	532.19									
1053.8	532.24	532.59									
1067.2	532.69	532.88									
1069.1	532.32	532.88									
1072.4	531.87	532.89									
1075.4	533.37	533.39									
1087.9	533.38	533.50									
1089.1	532.68	533.49									
1092.0	532.71	533.48									
1094.4	533.17	533.51									
1106.9	533.73	534.18									
1108.5	532.88	534.17									
1112.7	533.08	534.16									
1115.2	533.93	534.16									
1126.5	534.33	534.56									
1137.9	534.59	534.79									
1139.5	533.87	534.84									
1142.9	534.12	534.84									
1145.9	534.61	534.83									
1157.0	535.08	535.27									

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

	As-built	As needed		
Avg. Water Surface Slope	0.0195			
Riffle Length	16			
Avg. Riffle Slope	0.0252			
Pool Length	13			



2018 As-built Survey			2018 As-built Survey			2018 As-built Survey			2018 As-built Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	513.35	513.55	297.2	516.52	517.53	582.1	522.18	522.62	863.6	527.60	527.84
15.1	514.20	514.32	299.4	517.88	517.95	594.2	522.70	522.96	868.6	527.00	527.83
29.5	514.53	514.58	314.9	517.78	517.98	597.3	522.13	522.99	872.5	526.81	527.86
31.0	513.82	514.56	318.1	517.50	517.99	604.0	522.19	522.98	874.7	526.95	527.84
33.8	513.77	514.57	326.7	517.40	517.99	607.8	522.85	523.18	878.9	527.65	527.94
35.9	514.21	514.56	332.6	518.01	518.16	625.6	523.30	523.64	886.9	528.03	528.20
41.6	514.31	514.62	352.9	518.43	518.61	628.8	522.80	523.63	890.4	527.45	528.18
42.8	514.20	514.60	358.7	517.65	518.63	635.8	522.81	523.63	892.8	527.22	528.17
49.7	514.29	514.63	365.6	517.54	518.62	639.1	523.36	523.68	895.8	528.08	528.18
52.2	514.47	514.74	377.1	518.10	518.60	648.4	523.54	523.91	910.7	528.17	528.55
61.1	514.71	514.87	378.6	519.04	519.04	655.8	522.93	523.88	916.7	527.43	528.52
62.2	514.27	514.87	392.4	518.82	519.11	662.0	522.55	523.92	925.0	527.35	528.56
65.2	514.28	514.85	404.7	518.96	519.18	667.4	522.71	523.91	926.9	528.97	529.01
66.8	514.57	514.82	410.5	518.35	519.21	671.0	524.10	524.13	939.9	528.81	529.09
80.5	514.73	515.00	415.5	518.48	519.22	691.1	524.57	524.67	941.7	528.22	529.10
93.5	514.87	515.15	419.3	519.11	519.31	698.8	523.58	524.64	945.7	527.91	529.10
96.9	514.49	515.17	434.7	519.67	519.98	707.5	523.47	524.66	947.1	529.53	529.59
108.5	513.95	515.16	439.3	518.83	519.96	712.2	524.28	524.92	957.8	529.52	529.82
115.7	513.87	515.18	447.7	518.63	519.97	729.9	524.92	524.99	959.6	529.21	529.83
118.0	514.92	515.18	448.8	520.37	520.37	732.0	524.31	525.02	965.8	529.22	529.87
134.6	515.25	515.44	459.1	520.32	520.70	738.2	524.22	525.02	967.5	530.27	530.29
136.4	514.46	515.44	462.1	520.52	520.82	743.2	524.09	525.00	977.5	530.01	530.39
139.4	514.60	515.44	465.6	519.72	520.78	746.0	525.32	525.34	981.5	529.41	530.42
143.9	515.19	515.55	473.2	520.02	520.75	763.3	525.26	525.49	989.8	529.24	530.40
163.6	515.99	516.10	477.0	520.69	520.84	769.9	525.67	525.83	990.8	531.12	531.16
164.5	515.78	516.11	491.2	520.98	521.30	771.3	525.08	525.87	1005.5	530.92	531.40
166.1	515.35	516.10	493.4	520.56	521.30	773.7	525.67	525.96	1007.8	530.39	531.40
169.3	515.43	516.10	499.8	520.69	521.34	785.6	526.11	526.31	1013.6	530.29	531.39
173.1	516.08	516.21	508.8	520.97	521.48	788.2	525.27	526.30	1017.7	531.59	531.63
187.3	516.30	516.63	510.0	521.78	521.82	793.6	525.40	526.30	1030.3	531.63	532.06
191.4	515.63	516.62	515.4	521.04	521.84	795.3	526.32	526.36	1031.3	531.20	532.07
199.6	515.65	516.63	522.5	520.91	521.84	802.9	526.17	526.39	1036.7	531.04	532.05
203.8	515.68	516.63	529.2	520.82	521.82	807.5	525.34	526.38	1041.0	531.72	532.19
207.3	516.31	516.63	532.2	521.61	521.95	813.3	526.61	526.62	1053.8	532.24	532.59
221.2	516.71	516.79	542.5	522.06	522.28	818.2	526.48	526.67	1067.2	532.69	532.88
241.4	516.78	517.10	547.8	521.51	522.30	820.4	525.81	526.69	1069.1	532.32	532.88
247.7	515.86	517.09	555.5	521.47	522.27	824.7	525.97	526.68	1072.4	531.87	532.89
255.0	515.75	517.09	560.8	521.55	522.29	830.7	527.15	527.19	1075.4	533.37	533.39
260.7	515.95	517.09	563.2	522.00	522.29	840.1	527.31	527.54	1087.9	533.38	533.50
269.4	516.72	517.09	571.5	522.14	522.45	842.6	526.36	527.56	1089.1	532.68	533.49
291.4	517.18	517.51	573.9	521.75	522.47	849.1	526.34	527.57	1092.0	532.71	533.48
293.7	516.69	517.53	580.6	521.96	522.46	854.6	527.46	527.60	1094.4	533.17	533.51

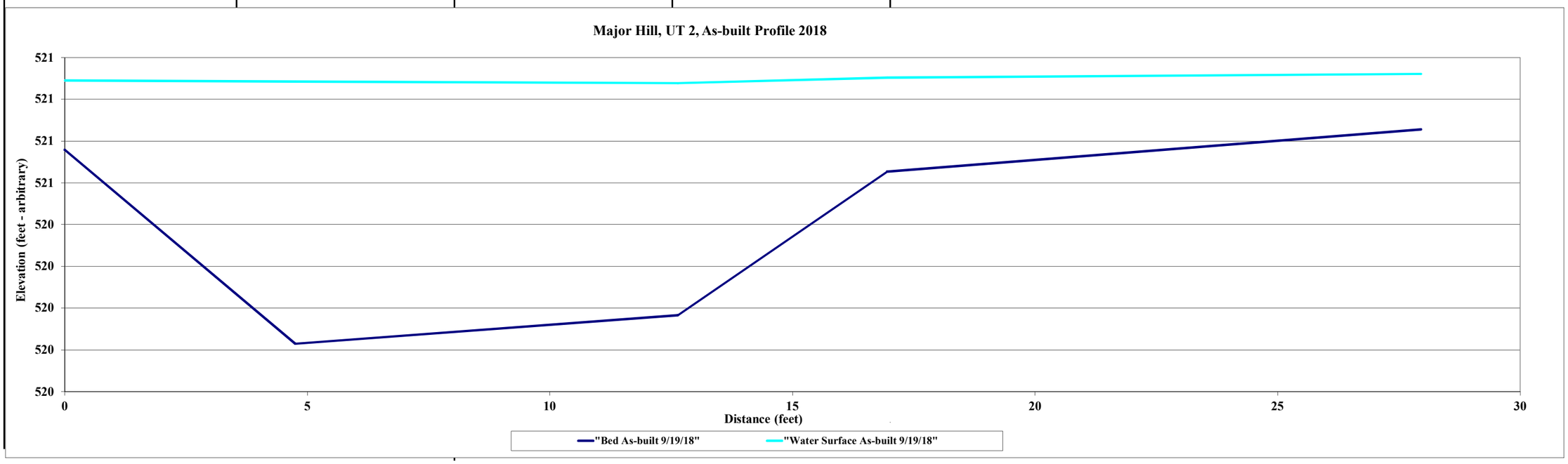


2018 As-built Survey			2018 As-built Survey			2018 As-built Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
1106.9	533.73	534.18	1364.6	538.69	539.00	1638.8	544.59	545.63
1108.5	532.88	534.17	1366.6	538.38	539.01	1643.4	544.71	545.65
1112.7	533.08	534.16	1369.8	538.28	539.02	1646.7	545.44	545.66
1115.2	533.93	534.16	1373.4	538.72	539.01	1673.7	546.13	546.54
1126.5	534.33	534.56	1386.4	539.22	539.55			
1137.9	534.59	534.79	1387.9	539.16	539.56			
1139.5	533.87	534.84	1393.2	539.05	539.57			
1142.9	534.12	534.84	1396.1	539.24	539.60			
1145.9	534.61	534.83	1410.1	539.72	539.96			
1157.0	535.08	535.27	1411.6	539.38	539.98			
1159.1	534.43	535.29	1417.2	539.50	540.00			
1165.2	534.49	535.29	1420.7	539.83	540.01			
1168.4	535.17	535.29	1439.6	540.39	540.64			
1178.9	535.51	535.65	1442.1	539.82	540.63			
1180.5	535.00	535.67	1446.0	539.54	540.65			
1183.2	534.98	535.67	1452.9	540.00	540.64			
1185.0	535.48	535.68	1460.8	540.38	540.64			
1197.3	535.67	536.02	1473.7	541.00	541.47			
1199.2	535.22	536.03	1483.5	541.44	541.81			
1202.2	535.29	536.03	1486.5	540.97	541.83			
1204.9	535.96	536.01	1490.3	541.07	541.83			
1216.2	536.25	536.40	1493.9	541.69	541.96			
1218.6	535.84	536.41	1504.4	541.99	542.20			
1225.2	535.65	536.40	1512.7	542.26	542.43			
1228.8	536.32	536.47	1514.9	541.84	542.42			
1238.5	536.51	536.82	1519.5	541.70	542.42			
1240.7	535.96	536.77	1522.8	542.19	542.44			
1245.5	535.91	536.80	1544.5	542.79	542.86			
1250.1	536.71	536.81	1569.7	543.26	543.45			
1265.9	537.06	537.45	1574.3	542.77	543.47			
1267.5	536.66	537.42	1580.5	542.47	543.46			
1273.9	536.74	537.42	1581.3	543.85	543.89			
1279.3	537.22	537.43	1594.0	543.75	544.31			
1299.8	537.65	537.83	1596.5	543.58	544.28			
1319.1	537.97	538.20	1604.2	543.32	544.26			
1321.2	537.52	538.31	1605.2	544.78	544.80			
1324.4	537.63	538.22	1609.6	544.44	544.79			
1327.5	538.10	538.27	1612.6	544.01	544.79			
1339.8	538.48	538.75	1615.2	544.01	544.77			
1341.9	538.08	538.74	1617.5	544.63	545.00			
1351.1	538.20	538.78	1624.5	545.12	545.31			
1353.8	538.49	538.80	1635.8	545.16	545.68			

Project Name	Major Hill - As-built (2018) Profile
Reach	UT 2
Feature	Profile
Date	9/19/18
Crew	Perkinson, Radecki

2018 As-built Survey			As needed			As needed			As needed		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	520.8	521.1									
4.7	519.8	521.1									
12.6	520.0	521.1									
17.0	520.7	521.1									
28.0	520.9	521.1									

	As-built	As needed		
Avg. Water Surface Slope	0.0011			
Riffle Length	NA			
Avg. Riffle Slope	NA			
Pool Length	17			

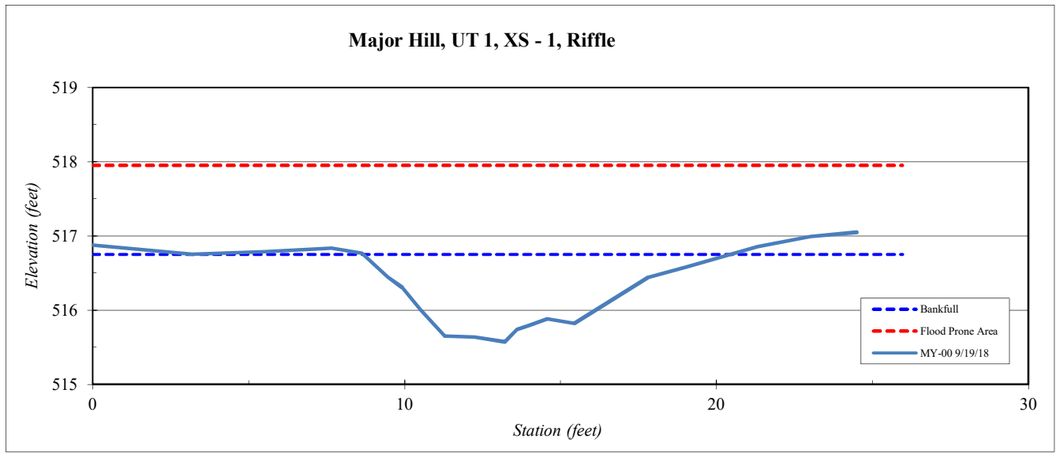


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 1, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	516.88
3.2	516.76
5.5	516.79
7.7	516.83
8.6	516.76
9.4	516.45
9.9	516.30
10.5	516.00
11.3	515.65
12.2	515.64
13.2	515.57
13.6	515.74
14.0	515.79
14.6	515.89
15.4	515.82
16.6	516.12
17.8	516.44
19.1	516.58
21.3	516.85
23.0	516.99
24.5	517.05
26.0	517.3

SUMMARY DATA	
Bankfull Elevation:	516.8
Bankfull Cross-Sectional Area:	7.5
Bankfull Width:	11.8
Flood Prone Area Elevation:	518.0
Flood Prone Width:	40.0
Max Depth at Bankfull:	1.2
Low Bank Height:	1.2
Mean Depth at Bankfull:	0.6
W / D Ratio:	18.6
Entrenchment Ratio:	3.4
Bank Height Ratio:	1.0

Stream Type	C/E

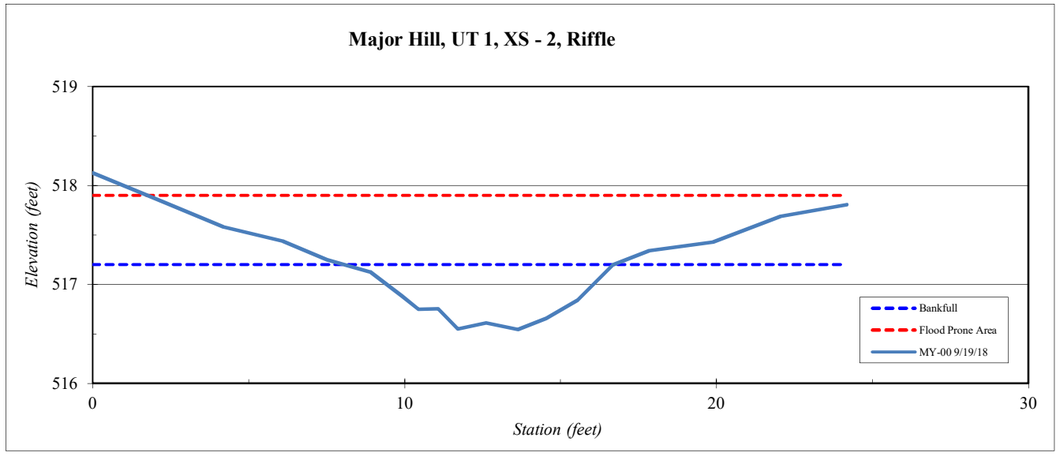


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 2, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	518.12
2.1	517.86
4.2	517.58
6.1	517.44
7.5	517.25
8.9	517.12
9.9	516.88
10.4	516.75
11.1	516.76
11.7	516.55
12.6	516.61
13.6	516.54
14.5	516.65
15.5	516.84
16.7	517.20
17.9	517.34
19.9	517.43
22.1	517.69
24.2	517.80

SUMMARY DATA	
Bankfull Elevation:	517.2
Bankfull Cross-Sectional Area:	3.5
Bankfull Width:	8.6
Flood Prone Area Elevation:	517.9
Flood Prone Width:	22.0
Max Depth at Bankfull:	0.7
Low Bank Height:	0.7
Mean Depth at Bankfull:	0.4
W / D Ratio:	21.1
Entrenchment Ratio:	2.6
Bank Height Ratio:	1.0

Stream Type	C/E



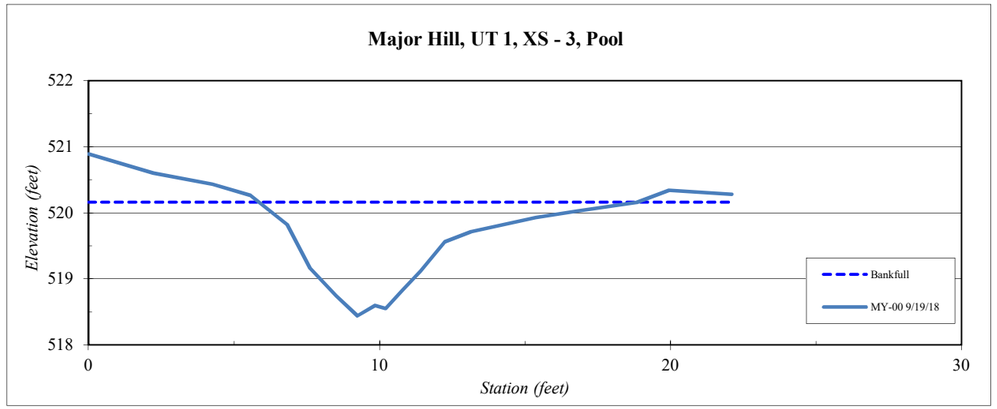
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 3, Pool
Feature	Pool
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	520.9
2.2	520.6
4.3	520.4
5.6	520.3
6.8	519.8
7.6	519.2
8.5	518.7
9.2	518.4
9.8	518.6
10.2	518.6
10.8	518.8
11.4	519.1
12.2	519.6
13.1	519.7
15.4	519.9
16.8	520.0
18.8	520.2
20.0	520.3
22.1	520.3

SUMMARY DATA	
Bankfull Elevation:	520.2
Bankfull Cross-Sectional Area:	8.4
Bankfull Width:	13.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.7
Low Bank Height:	1.7
Mean Depth at Bankfull:	0.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

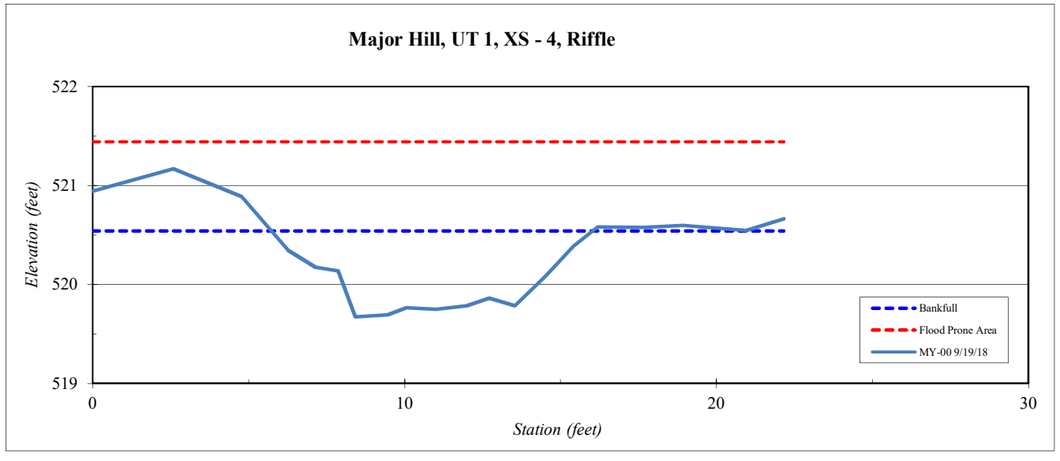


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 4, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	520.94
2.6	521.17
4.8	520.89
6.3	520.35
7.2	520.17
7.9	520.14
8.4	519.67
9.5	519.69
10.1	519.76
11.0	519.75
12.0	519.78
12.7	519.86
13.5	519.78
14.5	520.09
15.4	520.39
16.2	520.58
17.6	520.57
18.9	520.60
20.9	520.54
22.2	520.66

SUMMARY DATA	
Bankfull Elevation:	520.5
Bankfull Cross-Sectional Area:	5.8
Bankfull Width:	10.3
Flood Prone Area Elevation:	521.4
Flood Prone Width:	40.0
Max Depth at Bankfull:	0.9
Low Bank Height:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	18.3
Entrenchment Ratio:	3.9
Bank Height Ratio:	1.0

Stream Type	C/E



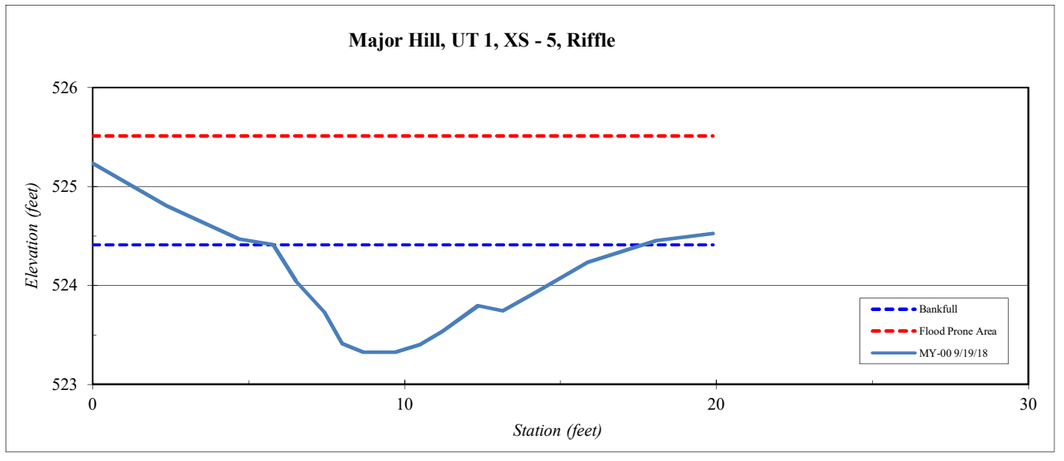
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 5, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	525.23
2.4	524.81
4.7	524.47
5.8	524.41
6.5	524.04
7.4	523.73
8.0	523.41
8.7	523.32
9.7	523.33
10.5	523.40
11.2	523.53
12.4	523.80
13.1	523.74
14.1	523.91
15.9	524.23
18.1	524.45
19.9	524.53

SUMMARY DATA	
Bankfull Elevation:	524.4
Bankfull Cross-Sectional Area:	7.1
Bankfull Width:	11.8
Flood Prone Area Elevation:	525.5
Flood Prone Width:	40.0
Max Depth at Bankfull:	1.1
Low Bank Height:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	19.6
Entrenchment Ratio:	3.4
Bank Height Ratio:	1.0

Stream Type	C/E



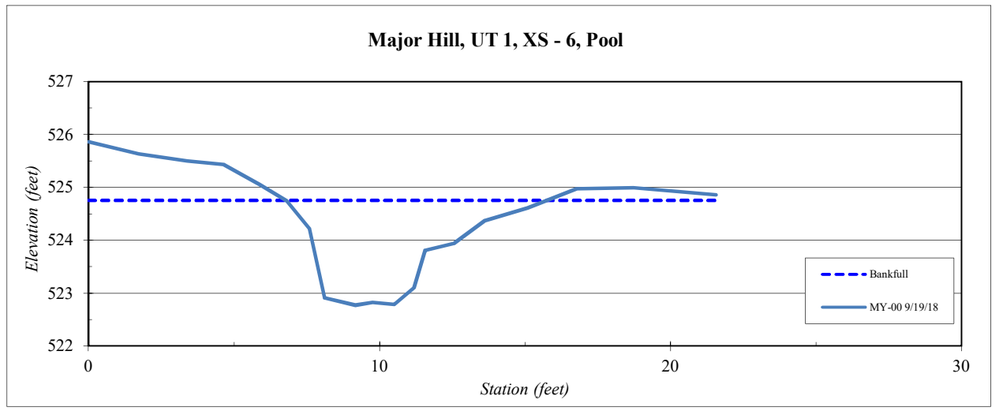
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 6, Pool
Feature	Pool
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	525.9
1.7	525.6
3.4	525.5
4.6	525.4
5.9	525.0
6.8	524.7
7.6	524.2
8.1	522.9
9.2	522.8
9.8	522.8
10.5	522.8
11.2	523.1
11.6	523.8
12.6	523.9
13.6	524.4
15.1	524.6
16.8	525.0
18.7	525.0
21.6	524.9

SUMMARY DATA	
Bankfull Elevation:	524.8
Bankfull Cross-Sectional Area:	9.1
Bankfull Width:	8.9
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.0
Low Bank Height:	2.0
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

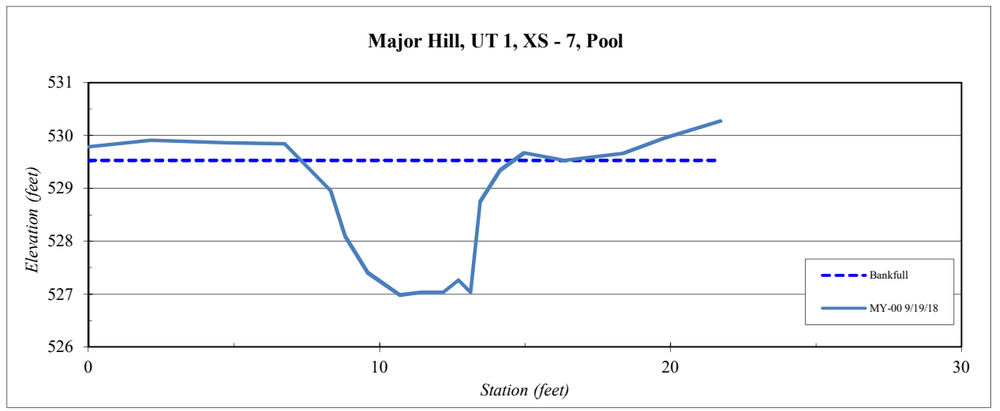


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 7, Pool
Feature	Pool
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	529.8
2.1	529.9
4.7	529.9
6.7	529.8
8.3	529.0
8.8	528.1
9.6	527.4
10.7	527.0
11.4	527.0
12.2	527.0
12.7	527.3
13.1	527.0
13.5	528.7
14.1	529.3
15.0	529.7
16.4	529.5
18.4	529.7
19.8	530.0
21.7	530.3

SUMMARY DATA	
Bankfull Elevation:	529.5
Bankfull Cross-Sectional Area:	11.7
Bankfull Width:	7.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.5
Low Bank Height:	2.5
Mean Depth at Bankfull:	1.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

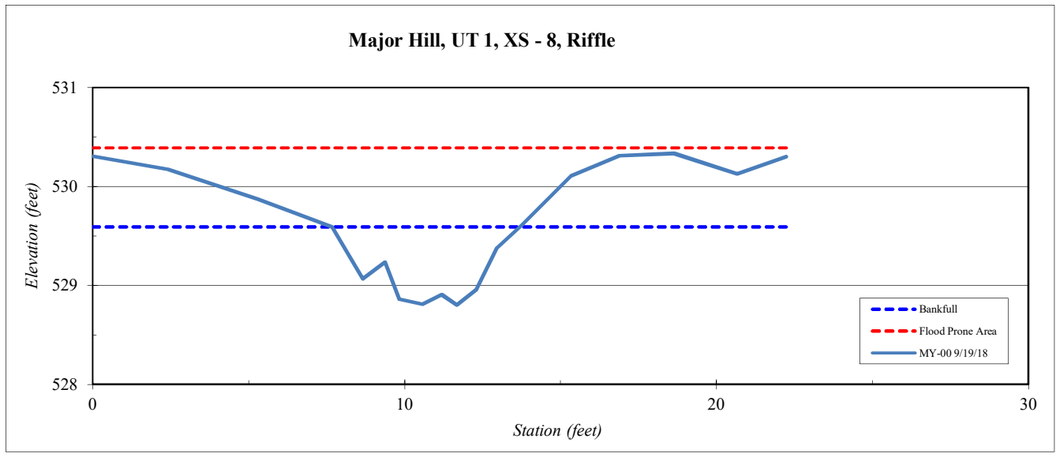


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 8, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	530.31
2.4	530.17
5.3	529.87
7.7	529.59
8.7	529.06
9.4	529.24
9.8	528.86
10.6	528.81
11.2	528.91
11.7	528.80
12.3	528.95
13.0	529.38
13.7	529.61
15.3	530.11
16.9	530.31
18.6	530.33
20.7	530.13
22.2	530.30

SUMMARY DATA	
Bankfull Elevation:	529.6
Bankfull Cross-Sectional Area:	3.0
Bankfull Width:	6.0
Flood Prone Area Elevation:	530.4
Flood Prone Width:	23.0
Max Depth at Bankfull:	0.8
Low Bank Height:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	12.0
Entrenchment Ratio:	3.8
Bank Height Ratio:	1.0

Stream Type	C/E



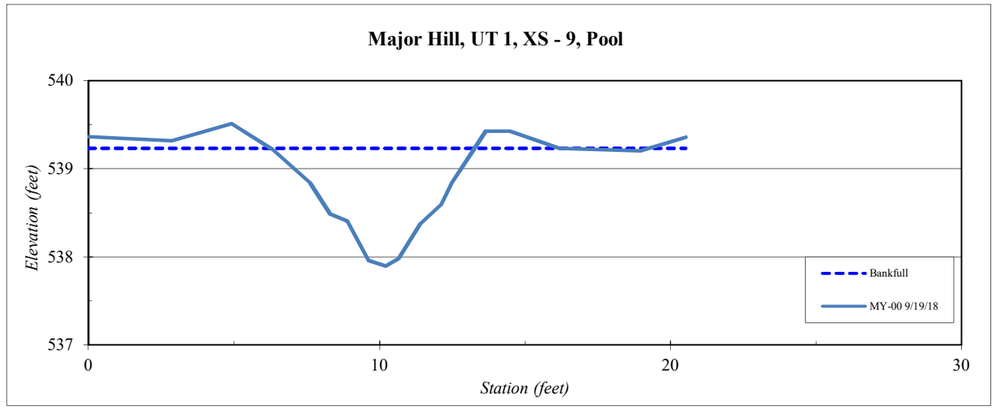
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 9, Pool
Feature	Pool
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	539.4
2.9	539.3
4.9	539.5
6.3	539.2
7.6	538.8
8.3	538.5
8.9	538.4
9.6	538.0
10.2	537.9
10.7	538.0
11.4	538.4
12.1	538.6
12.5	538.8
13.2	539.2
13.7	539.4
14.5	539.4
16.2	539.2
19.0	539.2
20.5	539.4

SUMMARY DATA	
Bankfull Elevation:	539.2
Bankfull Cross-Sectional Area:	4.9
Bankfull Width:	7.0
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	1.3
Low Bank Height:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

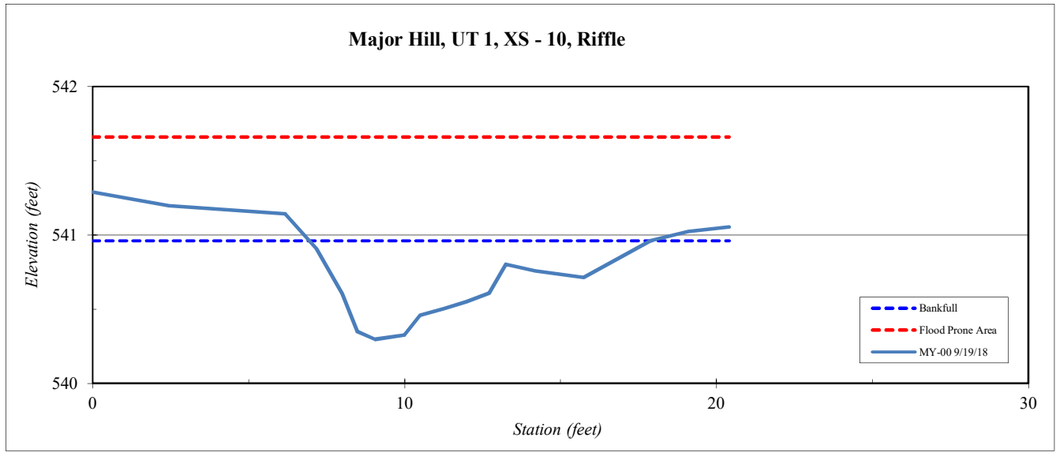


Site	Major Hill
Watershed:	Cape Fear, 0303002
XS ID	UT 1, XS - 10, Riffle
Feature	Riffle
Date:	9/19/2018
Field Crew:	Perkinson, Radecki

Station	Elevation
0.0	541.29
2.4	541.20
6.2	541.14
7.2	540.91
8.0	540.60
8.5	540.35
9.1	540.30
10.0	540.33
10.5	540.46
11.3	540.50
12.0	540.55
12.7	540.61
13.2	540.80
14.2	540.76
15.7	540.71
17.9	540.96
19.1	541.02
20.4	541.05

SUMMARY DATA	
Bankfull Elevation:	541.0
Bankfull Cross-Sectional Area:	3.5
Bankfull Width:	10.9
Flood Prone Area Elevation:	541.7
Flood Prone Width:	40.0
Max Depth at Bankfull:	0.7
Low Bank Height:	0.7
Mean Depth at Bankfull:	0.3
W / D Ratio:	33.9
Entrenchment Ratio:	3.7
Bank Height Ratio:	1.0

Stream Type	C/E



NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

Appendix H.
Riparian Buffer Asbuilt Baseline Report

RIPARIAN BUFFER ASBUILT BASELINE REPORT
MAJOR HILL MITIGATION SITE
Alamance County, North Carolina

DMS Project ID No. 100015
Full Delivery Contract No. 7193
USACE Action ID No. SAW-2017-01472
DWR No. 17-0921
RFP No. 16-006990

Cape Fear River Basin – Haw River Arm
Cataloging Unit 03030002

Prepared for:

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

March 2019

This project with conforms with theNorth Carolina consolidated buffer mitigation rule 15A NCAC 02B .0295, effective November 1, 2015 and the Jordan Lake Buffer Protection Rule (15A NCAC 02B .0267 & 15A NCAC 02B .0268)

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Attachments

1.0 MITIGATION PROJECT SUMMARY

The Major Hill Stream and Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 16.7 acres along warm water, unnamed tributaries to Pine Hill Branch. The Site is located approximately 3.5 miles southeast of Snow Camp and 6 miles north of Silk Hope in southern Alamance County near the Chatham County line. Project attributes are included in the following table.

Table 1. Buffer Project Attributes

Project Name	Major Hill
Hydrologic Unit Code	3030002050050
River Basin	Cape Fear
Geographic Location (Lat, Long)	35.873206, -79.360906
Site Protection Instrument (DB, PG)	(2789, 896), (2514, 756), (3143, 270), (3150, 920)
Total Credits (BMU)	402,837
Types of Credits	Riparian Buffer Restoration, Enhancement, & Preservation
Mitigation Plan Date	Apr-18
Initial Planting Date	Dec 2018-Jan 2019
Baseline Report Date	Mar-19
MY1 Report Date	
MY2 Report Date	
MY3 Report Date	
MY4 Report Date	
MY5 Report Date	

The Site drainage area is primarily composed of pasture, forest, agriculture land, and sparse residential property. Impervious surfaces account for less than five percent of the upstream land surface.

Prior to construction, Site land use consisted of pasture, hayfields, disturbed forest, and agricultural land used for livestock grazing and hay production. Livestock had unrestricted access to Site streams, and stream banks were eroded vertically and laterally and received extensive sediment and nutrient inputs. Riparian zones in the upper reaches of UT 1 were primarily composed of herbaceous vegetation that was sparse and disturbed due to livestock grazing, bush hogging, and regular land-management activities. The downstream reaches of UT 1 and all of UT 3 were primarily wooded with livestock disturbance to stream channels. UT 2 was the lone tributary not subject to continuous, unrestricted livestock access. Riparian areas immediately adjacent to UT 2 were forested with a fence to protect this area from livestock access.

The riparian areas were restored in concurrence with the Major Hill Stream and Wetland Mitigation Site (NC DMS Project ID 10015, SAW-2017-01472) and involved restoring riparian buffers adjacent to restored streams to help reduce non-point source contaminant discharges to downstream waters in the Haw River sub-watershed of Jordan Lake. All riparian areas were assessed by DWR (Katie Merritt and Sue Homewood) during an onsite visit February 20th, 2018 to determine viability for buffer mitigation.

The Site is protected with a permanent conservation easement. Riparian restoration, enhancement, and preservation area widths adjacent to restored streams extend out to a maximum of 200 feet from the top of stream banks with a minimum width of 50 from the top of banks. Riparian buffer enhancement and preservation credits generated on this Site are allowed pursuant to 15A NCAC 02B .0295 (o). No riparian restoration areas that are less than 20 feet wide from Top of Banks are used to generate riparian buffer credit.

Riparian buffer mitigation credit was not generated in areas that are generating wetland mitigation credit.

2.0 REGULATORY CONSIDERATIONS

Credit determination for this Site follows the North Carolina consolidated buffer mitigation rule 15A NCAC 02B .0295, effective November 1, 2015 (see Table 2 on the following page and Figure A, Attachment 1).

3.0 RIPARIAN RESTORATION, ENHANCEMENT, & PRESERVATION PLAN

This Site was also proposed as a stream and wetland mitigation project; therefore, restoration of riparian areas was accomplished through the goals and methods outlined by the *Major Hill Stream and Wetland Mitigation Plan*. All applicable federal, state, and local documentation, permits, and/or authorizations were acquired as part of implementing the above-mentioned mitigation plan.

Primary goals focused on 1) improving water quality, 2) enhancing flood attenuation and hydrology, 3) improving aquatic resources, and 4) restoring riparian habitat. Completed mitigation provides floodplain connectivity, floodplain resistance, stream stability, sediment transport, surface and subsurface storage and retention, in-stream habitat, riparian habitat and structure, thermal regulation, floodplain biogeochemical processing, and pollutant filtration as well as remove sources of pollutants. The riparian area will be restored through the revegetation of native plant communities.

3.1 Riparian Area Restoration Activities

3.1.1 Site Preparation

Soil grading occurred during stream restoration activities. Topsoils were stockpiled during construction activities and spread on the soil surface once critical subgrade was 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.

Farm Pond Removal

To complete the stream and wetland restoration activities and subsequent riparian buffer restoration, the removal of a small farm pond, ~0.58 acres occurred. Stream, wetland and riparian area restoration within the abandoned pond included 1) notching the dam to dewater; 2) removal of the dam to the elevation of the adjacent floodplain; 3) excavating sediment that is unsuitable for channel bank construction; 4) backfilling areas of sediment removed with soil suitable for channel construction (as necessary); 5) excavation of the design channel, 6) stabilization of the channel with coir matting, seed, and mulch; and 7) installation of structures.

Table 2. Buffer Project Areas and Assets

RIPARIAN BUFFER (15A NCAC 02B.0295)

Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)	Convertible to Nutrient Offset (Yes or No)	If Converted to Nutrient Offset: Nutrient Offset: N (lbs)	If Converted to Nutrient Offset: Nutrient Offset: P (lbs)
Rural	Subject & Nonsubject	Restoration	1	0-100	213,290	1	100%	1.00000	213,290.000	Yes	11129.775	716.842
Rural	Subject & Nonsubject	Restoration	2	101-200	40,976	1	33%	3.03030	13,522.094	Yes	2138.186	137.715
Rural	Subject	Enhancement	3	0-100	341,433	2	100%	2.00000	170,716.500	No	0.000	0.000
				SUBTOTALS	**595,699**				**397,528.594**		**13,267.960**	**854.558**

			ELIGIBLE PRESERVATION AREA		**198,566**

Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)
Rural	Nonsubject	Preservation	4	0-100	25,614	5	100%	5.00000	5,122.800
Rural	Nonsubject	Preservation	5	101-200	2,814	5	33%	15.15152	185.724
				SUBTOTALS	**28,428**				**5,308.524**
				TOTALS	**624,127**				**402,837.117**

**Area eligible for preservation may be no more than 25% of total area, where total area is back-calculated with the equation R+E/0.75.*

**Buffers must be at minimum 20' wide for riparian buffer credit, buffers must be 50' wide for nutrient offset credit*

**When preservation areas exceed the total eligible preservation area, select the areas with the best credit ratios as the creditable areas.*

3.1.2 Planting

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

Table 3. Planted Bare Root Woody Vegetation

Species	Piedmont/Low Mountain Alluvial Forest	Dry-Mesic Oak/Hickory Forest	Marsh Treatment Wetland	Streamside Assemblage	Total
Alnus serrulata			5	20	25
Asimina triloba				200	200
Betula nigra	100			200	300
Carpinus caroliniana		600			600
Cephalanthus occidentalis			5	20	25
Cercis canadensis		500			500
Cornus amomum	95		5	800	900
Diospyros virginiana		450			450
Fraxinus americana		100			100
Fraxinus pennsylvanica	150			750	900
Liriodendron tulipifera	75				75
Nyssa sylvatia		600			600
Platanus occidentalis	120			780	900
Quercus nigra	110	790		500	1,400
Quercus phellos	100	700		400	1,200
*Salix nigra**				400*	400
Sambucus canadensis			11	14	25
TOTALS	750	3,740	26	4,084	**8,600**

*Live stakes of *Salix nigra* were planted; all other planted species were planted as bare root plants.

3.2 Riparian Buffer Enhancement via Cattle Exclusion Activities

Riparian buffer enhancement included permanently protecting existing riparian buffer from livestock via exclusionary fencing, cutting, clearing, filling, grading, and any similar activities that would affect the functionality of the riparian buffer. These areas are defined primarily as disturbed mixed hardwoods. Buffer credits sought in the enhancement area are allowed under 15A NCAC 02B .0295 (o)(6). The enhancement area extends a maximum of 200 feet from the top of the bank with a minimum width of 20 from top of banks.

A small portion of UT-3 is generating riparian buffer enhancement credit from only one side of the stream. Prior to construction, cattle had access to the entire area; however, the only access point was from the pasture on the northern side of the stream, the Parcel owned by Mr. Lamm.

Once fencing was installed to prevent cattle access from Mr. Lamm's parcel to the stream, cattle will no longer be able to access the south side of the stream. This action will result in compliance with 15A NCAC 02B .0295 (o)(6), which states that the permanent exclusion of grazing livestock must be done such that the livestock are fenced out of the stream and its adjacent buffer. The southern parcel, which is not apart of the conservation easement, is owned by the Caviness family and is a single-family home. Cattle will not be grazing within their parcel post construction.

3.3 Riparian Buffer Preservation Activities

Riparian buffer preservation includes permanently protecting existing riparian buffers from cutting, clearing, filling, grading, and any similar activities that would affect the functionality of the riparian buffer. Areas specified for Preservation at the Site, in accordance with 15A NCAC 02B .0295, are defined primarily as mixed hardwoods, with the number of high-value species above 200 per acre. They are areas where livestock were fenced out prior to construction with little or no historical livestock access.

3.4 Marsh Treatment Area

A marsh treatment area was constructed to intercept surface waters draining through agricultural areas before discharging into UT1. The marsh treatment area is excluded from credit calculations.

4.0 ANNUAL MONITORING

4.1 Monitoring

Eight vegetation monitoring plots (10-meter by 10-meter) were installed within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008); this covers 3.4% of the area generating riparian buffer restoration credit. Vegetation monitoring will occur annually in the fall (between September and November), prior to the loss of leaves for a period of five monitoring years following planting. Parameters to be monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph. In addition, inspections for beaver and other potential nuisance species will occur throughout the course of the monitoring period.

The following table outlines riparian buffer monitoring for this project; monitoring parameter descriptions follow.

Table 4. Riparian Buffer Monitoring

Required	Parameter	Quantity	Frequency	Notes
Yes	Vegetation	Eight (8) plots located across all restored buffer zones.	Annual	Vegetation will be monitored for five years or until performance standards are met. Visual monitoring of the site will be done all five years. Analysis of vegetation will be recorded using level 2 CVS Monitoring protocol.
Yes	Project Boundary	NA	Annual	Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped.

4.2 Performance Standards

Performance standards were established to verify that the vegetation component supports community elements necessary for forest development and the maintenance of diffuse flow through the riparian buffer in accordance with North Carolina Division of Water Resources Administrative Code 15A NCAC 02B.0295 (Mitigation Program Requirements for Protection and Maintenance of Riparian Buffers). Performance standards are dependent upon the density and growth of at least four native hardwood tree species where no one species is greater than 50% of the stems. After five years of monitoring, an average density of 260 woody stems per acre, including planted shrubs (silky dogwood and blueberry), must be surviving, and diffuse flow maintained. 15A NCAC 02b .0295 (2)(E) dictates that monitoring for planted stems would also include the health of planted stems. Level 2 CVS monitoring protocol requires the vigor, a determinant of health, of a monitored stem be recorded. If requested, RS will make available during the monitoring years, planted stem health, e.g. vigor.

4.3 Results and Discussion

Based on the number of stems counted, average densities were measured at 617 planted hardwood tree stems per acre (excluding livestakes, shrubs, pines, and vines) at asbuilt (MY0). In addition, each individual plot met success criteria. The following Table 5 summarizes riparian buffer success criteria and Table 6 summarizes all vegetation data by species, plot, and year. Vegetation plot photographs are included in Appendix B of the *Major Hill Stream and Wetland Mitigation Site Asbuilt Baseline Monitoring Report*.

Table 5. Riparian Buffer Vegetation Totals

Plot #	Riparian Buffer Stems[1]/Acre	Success Criteria Met?
1	405	Yes
2	486	Yes
3	567	Yes
4	850	Yes
5	647	Yes
6	647	Yes
7	567	Yes
8	769	Yes
Total Riparian Buffer Stems/Acre	**617**	**Yes**

1-Buffer Stems include native planted hardwood trees. Does not include shrubs, pines, or vines.

4.4 Maintenance and Management

No maintenance or management activities are currently planned for the coming year, and no remedial action activities are necessary at this time.

Table 6. Total Stems by Plot and Species
EEP Project Code 17.009. Project Name: Major Hill

			Current Plot Data (MY0 2019)																							Annual Means		
			17.009-01-0001			17.009-01-0002			17.009-01-0003			17.009-01-0004			17.009-01-0005			17.009-01-0006			17.009-01-0007			17.009-01-0008			MY0 (2019)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Asimina triloba	pawpaw	Tree				1	1	1	3	3	3	1	1	1							1	1	1	1	1	1	7	7	7
Betula nigra	river birch	Tree										2	2	2	4	4	4	1	1	1	1	1	1	1	1	1	9	9	9
Carpinus caroliniana	American hornbeam	Tree	1	1	1				2	2	2							2	2	2							5	5	5
Cercis canadensis	eastern redbud	Tree				1	1	1	3	3	3	4	4	4	1	1	1	1	1	1	1	1	1	3	3	3	14	14	14
Cornus amomum	silky dogwood	Shrub				1	1	1																			1	1	1
Diospyros virginiana	common persimmon	Tree										2	2	2				1	1	1				2	2	2	5	5	5
Fraxinus	ash	Tree																						1	1	1	1	1	1
Fraxinus americana	white ash	Tree																3	3	3				2	2	2	5	5	5
Fraxinus pennsylvanica	green ash	Tree										2	2	2	1	1	1										3	3	3
Liriodendron tulipifera	tuliptree	Tree	4	4	4	1	1	1																			5	5	5
Nyssa sylvatica	blackgum	Tree	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1							2	2	2	10	10	10
Platanus occidentalis	American sycamore	Tree				2	2	2							1	1	1	3	3	3	1	1	1				7	7	7
Quercus	oak	Tree	3	3	3	1	1	1	1	1	1	3	3	3	4	4	4	3	3	3	4	4	4	4	4	4	23	23	23
Quercus nigra	water oak	Tree				1	1	1	1	1	1	4	4	4	2	2	2	1	1	1	1	1	1				10	10	10
Quercus phellos	willow oak	Tree				3	3	3	2	2	2	2	2	2	2	2	2	1	1	1	5	5	5	3	3	3	18	18	18
Unknown		Shrub or Tree	1	1	1				1	1	1										2	2	2	2	2	2	6	6	6
		Stem count	11	11	11	13	13	13	15	15	15	21	21	21	16	16	16	16	16	16	16	16	16	21	21	21	129	129	129
		size (ares)	1			1			1			1			1			1			1			1			8		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.20		
		Species count	5	5	5	9	9	9	8	8	8	9	9	9	8	8	8	9	9	9	8	8	8	10	10	10	16	16	16
		Stems per ACRE	445.2	445.2	445.2	526.1	526.1	526.1	607	607	607	849.8	849.8	849.8	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	647.5	849.8	849.8	849.8	652.6	652.6	652.6

Color for Density
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

PnoLS = Planted excluding livestakes
P-all = Planting including livestakes
T = All planted and natural recruits including livestakes
T includes natural recruits

5.0 REFERENCES

Jordan Lake Water Supply Watershed Buffer Rules 15A NCAC 02B .0267, 15A NCAC 02B .0268, and 15A NCAC 02B .0295

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Level 1-2 Plot Version 4.2. Ecosystem Enhancement Program, North Carolina Department of Environment and Natural Resources.

Schafale, M.P. and A.S. Weakley. 1990. *Classification of the Natural Communities of North Carolina: Third Approximation*. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health, and Natural Resources. Raleigh, North Carolina.

ATTACHMENT 1

Figure A. Riparian Buffer Asset Map
Figure B. Riparian Buffer Planting Map

Legend

- Easement
- New Fencing Installed for Cattle Exclusion
- Existing Fencing Left in Place for Cattle Exclusion
- Fencing Removed/Reworked for Cattle Exclusion
- Stream Asbuilt TOB-TOB
- Marsh Treatment Area
- Plot Origins
- CVS Plots Meeting Success Criteria MY0
- Wetland Restoration
- Wetland Enhancement

Riparian Buffer Mitigation Type

- TOB - 100 ft. Restoration (1:1) - 213,290 sq ft
- 101 ft. - 200 ft. Restoration (1:1 but 33% credit per Rule) - 40,976 sq ft
- TOB - 100 ft. Enhancement (2:1 Cattle Ex. per Rule) - 341,433 sq ft
- TOB - 100 ft. Preservation (Non-Subject Stream 5:1) - 25,614 sq ft
- 101 ft. - 200 ft. Preservation (Non-Subject Stream 5:1 and 33% Credit per Rule) - 2,814 sq ft
- Non Credit Generating (Less than 20 ft.)
- TOB to 50 feet
- 100 foot line
- 150 foot line
- 200 foot line

N

8
7
6
5
4
3
2
1

UT-1
UT-2
UT-3

No credit is being generated within the Marsh Treatment Area.

This area is located outside of the easement and is not generating credit.

0 70 140 280 420 560 Feet

NCCGIA

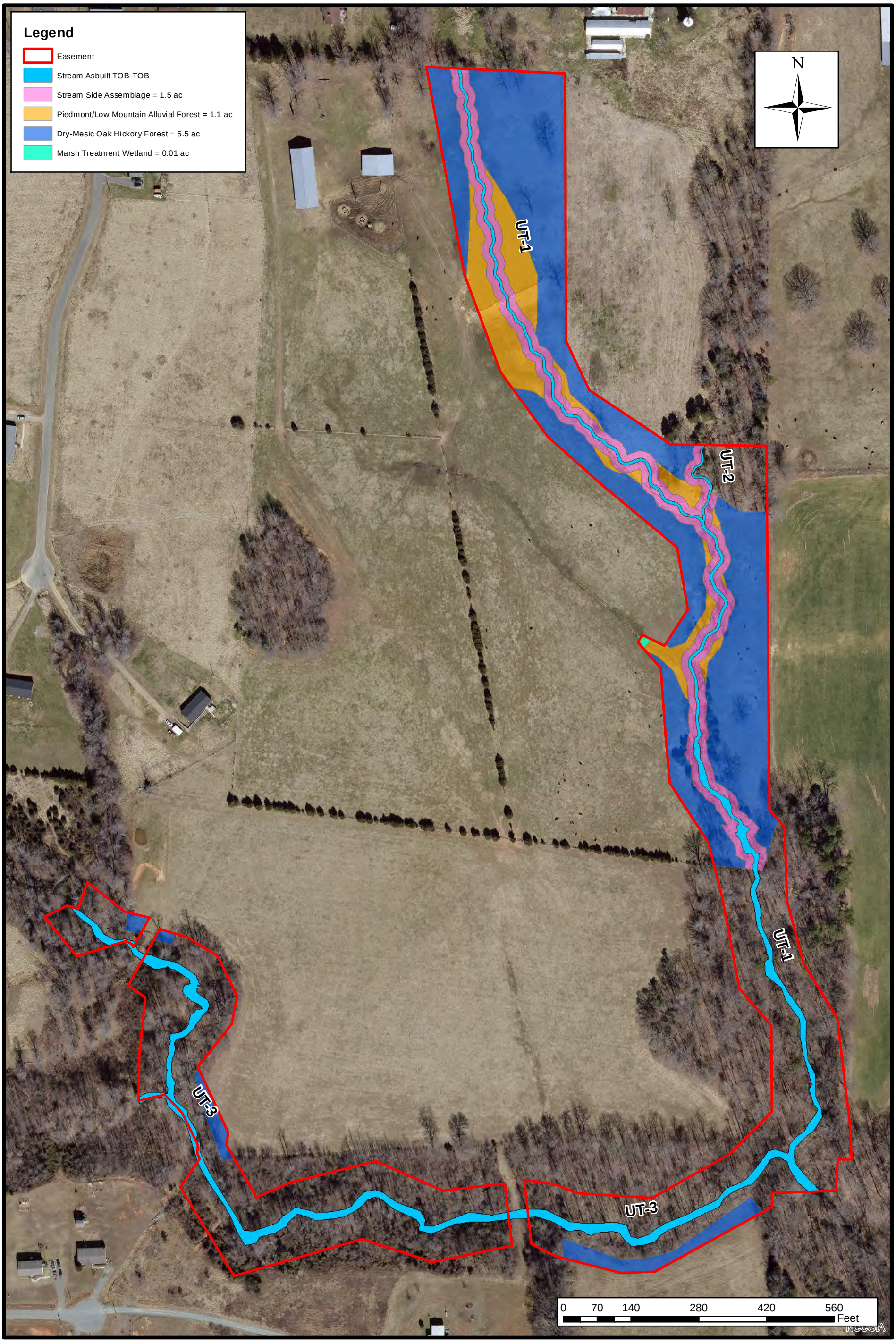
Axiom Environmental
218 Snow Ave
Raleigh, NC 27607
(919) 215-1693

Axiom Environmental, Inc.

Riparian Buffer Asset Map
Major Hill Mitigation Site
Alamance County, North Carolina

Dwn. By:	CLF
Date:	Jan 2019
Project:	17-009

FIGURE
A



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

Riparian Buffer Planting Map
Major Hill Mitigation Site
Alamance County, North Carolina

Dwn. By:	KRJ
Date:	Feb 2019
Project:	17-009

FIGURE
B

ATTACHMENT 2

Riparian Buffer Sealed Survey

Table 2. Buffer Project Areas and Assets

RIPARIAN BUFFER (15A NCAC 02B.0295)

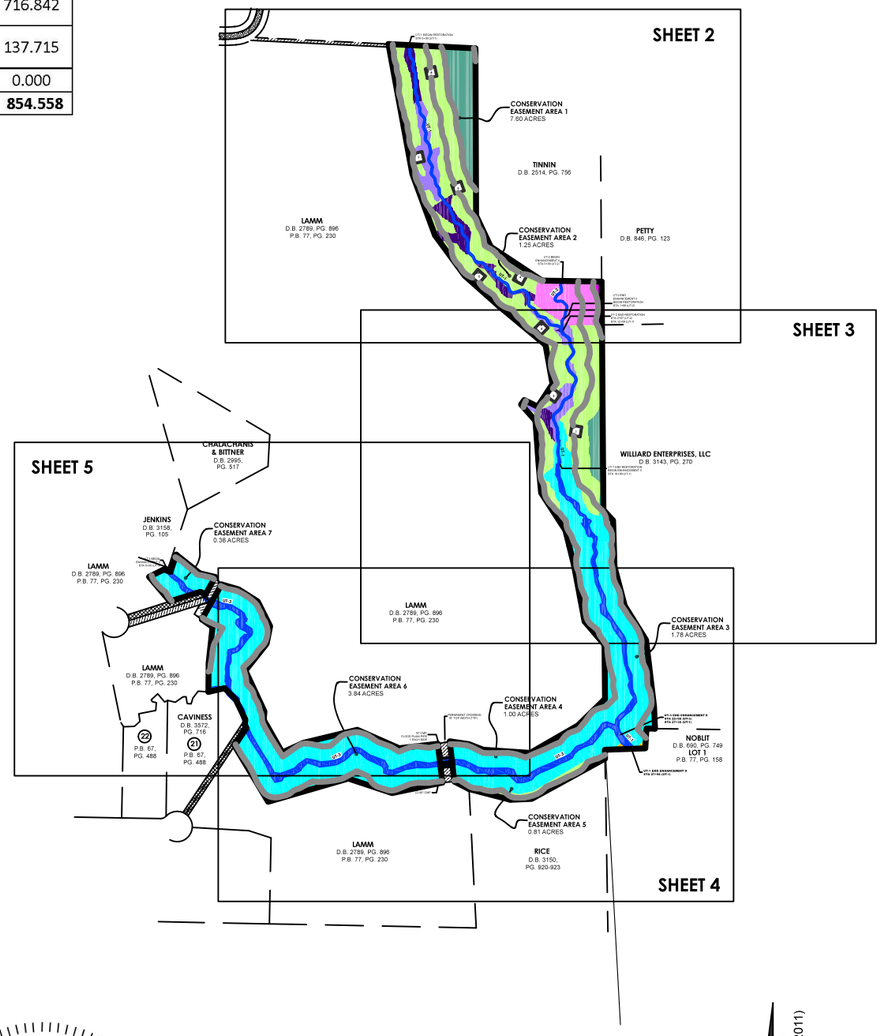
Location	Jurisdictional Streams	Restoration Type	Reach ID/ Component	Buffer Width (ft)	Creditable Area (sf)*	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits (BMU)	Convertible to Nutrient Offset (Yes or No)	If Converted to Nutrient Offset: Nutrient Offset: N (lbs)	If Converted to Nutrient Offset: Nutrient Offset: P (lbs)
Rural	Subject & Nonsubject	Restoration	1	0-100	213,290	1	100%	1.00000	213,290.000	Yes	11129.775	716.842
Rural	Subject & Nonsubject	Restoration	2	101-200	40,976	1	33%	3.03030	13,522.094	Yes	2138.186	137.715
Rural	Subject	Enhancement	3	0-100	341,433	2	100%	2.00000	170,716.500	No	0.000	0.000
				SUBTOTALS	**595,699**				**397,528.594**		**13,267.960**	**854.558**
			ELIGIBLE PRESERVATION AREA		**198,566**							
Location	**Jurisdictional Streams**	**Restoration Type**	**Reach ID/ Component**	**Buffer Width (ft)**	**Creditable Area (sf)***	**Initial Credit Ratio (x:1)**	**% Full Credit**	**Final Credit Ratio (x:1)**	**Riparian Buffer Credits (BMU)**			
Rural	Nonsubject	Preservation	4	0-100	25,614	5	100%	5.00000	5,122.800			
Rural	Nonsubject	Preservation	5	101-200	2,814	5	33%	15.15152	185.724			
				SUBTOTALS	**28,428**				**5,308.524**			
				TOTALS	**624,127**				**402,837.117**			

**Area eligible for preservation may be no more than 25% of total area, where total area is back-calculated with the equation R+E/0.75.*
**Buffers must be at minimum 20' wide for riparian buffer credit, buffers must be 50' wide for nutrient offset credit*
**When preservation areas exceed the total eligible preservation area, select the areas with the best credit ratios as the creditable areas.*

(PROVIDED BY AXIOM ENVIRONMENTAL, INC)

REVISIONS: (03/15/19)
1 - ALL BUFFER AREAS MEASURED IN SQ. FT.
2 - CONSERVATION PLAT REMOVED & PAGES RENUMBERED
3 - REVISED PLANTING AREAS
4 - REVISED TABLES
5 - ADDED NOTES WHERE NO CREDIT IS GENERATED
6 - ADDED DWR NUMBER

NOTE:
RESTORATION AND ENHANCEMENT AREAS WERE PROVIDED BY AXIOM ENVIRONMENTAL, INC.



LEGEND:

- STREAM ASBUILT TOB - TOB
- ORIGIN POINT ON CVS PLOTS
- # CVS PLOTS MEETING SUCCESS CRITERIA MY0
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- MARSH TREATMENT AREA
- CONSERVATION EASEMENT LINE

CVS PLOTS COORDINATE TABLE (COORDINATE AT THE PLOT ORIGIN ▲)

CVS PLOT	NORTHING	EASTING
1	773384.9763	1893626.6861
2	773487.7063	1893589.7412
3	773727.6476	1893526.7350
4	773864.2494	1893433.7282
5	773898.3702	1893316.6978
6	774178.0237	1893229.9873
7	774280.3598	1893100.6160
8	774560.4220	1893143.3643

RIPARIAN BUFFER MITIGATION TYPE

- TOB - 100 FT. RESTORATION (1:1) - 213,290 SQ. FT.
- 101 FT. - 200 FT. RESTORATION (1:1 BUT 33% CREDIT PER RULE) - 40,976 SQ. FT.
- TOB - 100 FT. ENHANCEMENT (2:1 CATTLE EX. PER RULE) - 341,433 SQ. FT.
- TOB - 100 FT. PRESERVATION (NON-SUBJECT STREAM 5:1) - 25,614 SQ. FT.
- 101 FT. - 200 FT. PRESERVATION (NON-SUBJECT STREAM 5:1 AND 33% CREDIT PER RULE) - 2,814 SQ. FT.
- NON CREDIT GENERATING (LESS THAN 20 FT.)
- DISTANCES FROM TOB

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

AS-BUILT CREDIT AREA PLAN INDEX SHEET

0 250 500 1000
1" = 500'

NORTH
NC GRID
NAD'83(2011)

5688 U.S. Hwy. 70 East
Goldsboro, NC 27534
919.751.0075
k2design@suddenlink.net
Firm license no.: C-2111
k2 design group

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

Client
RESTORATION SYSTEMS, LLC
1101 HAYNES STREET
SUITE 211
RALEIGH, NC 27604
RESTORATION SYSTEMS LLC

Project
MAJOR HILL STREAM AND WETLAND MITIGATION
Newlin Township,
Alamance County, NC

Title
COVER PAGE
AS-BUILT SURVEY FOR
THE STATE OF NORTH CAROLINA,
DIVISION OF MITIGATION SERVICES
DMS PROJECT ID No. 100015
SPO FILE NUMBERS 01-BA, 01-BB,
01-BC & 01-BD

DRAWN BY:	FGR
DATE:	03/15/19
SURVEYED BY:	J.A.R.
DWG. NO.	RSS771AB19
SHEET	1 OF 6

LEGEND:

- STREAM ASBUILT TOB - TOB
- ORIGIN POINT ON CVS PLOTS
- # CVS PLOTS MEETING SUCCESS CRITERIA MY0
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- MARSH TREATMENT AREA
- CONSERVATION EASEMENT LINE

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- NON CREDIT GENERATING (LESS THAN 20 FT.)
- DISTANCES FROM TOB

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

AS-BUILT
CREDIT AREA PLAN
SHEET 2 OF 6

0 50 100 200

1" = 100'

LEGEND:

- STREAM ASBUILT TOB - TOB
- ORIGIN POINT ON CVS PLOTS
- # CVS PLOTS MEETING SUCCESS CRITERIA MY0
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
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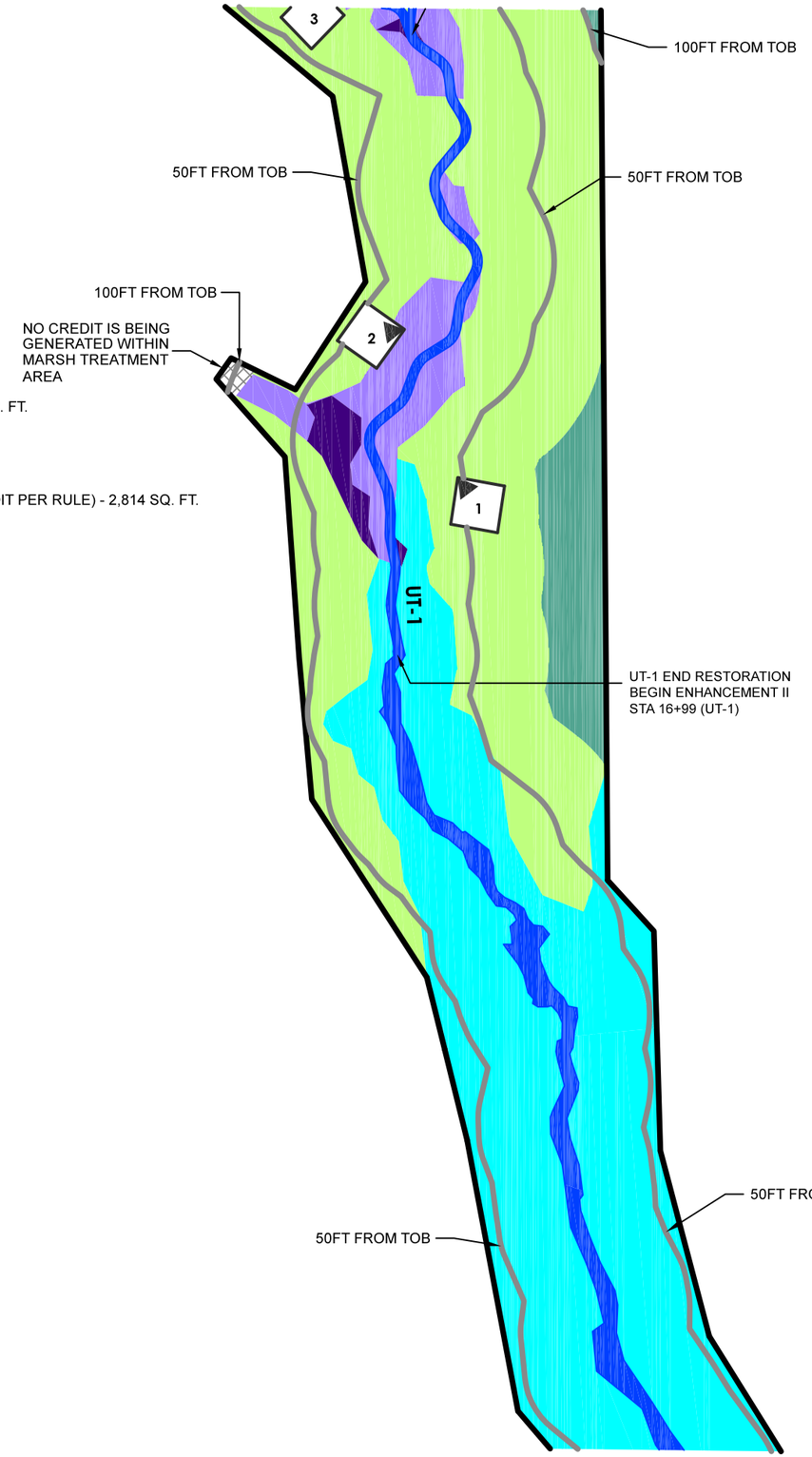
- NON CREDIT GENERATING (LESS THAN 20 FT.)
- DISTANCES FROM TOB



NORTH
NC GRID
NAD83(2011)

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

AS-BUILT
CREDIT AREA PLAN
SHEET 3 OF 6

0 50 100 200

1" = 100'

LEGEND:

- STREAM ASBUILT TOB - TOB
- ORIGIN POINT ON CVS PLOTS
- # CVS PLOTS MEETING SUCCESS CRITERIA MY0
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
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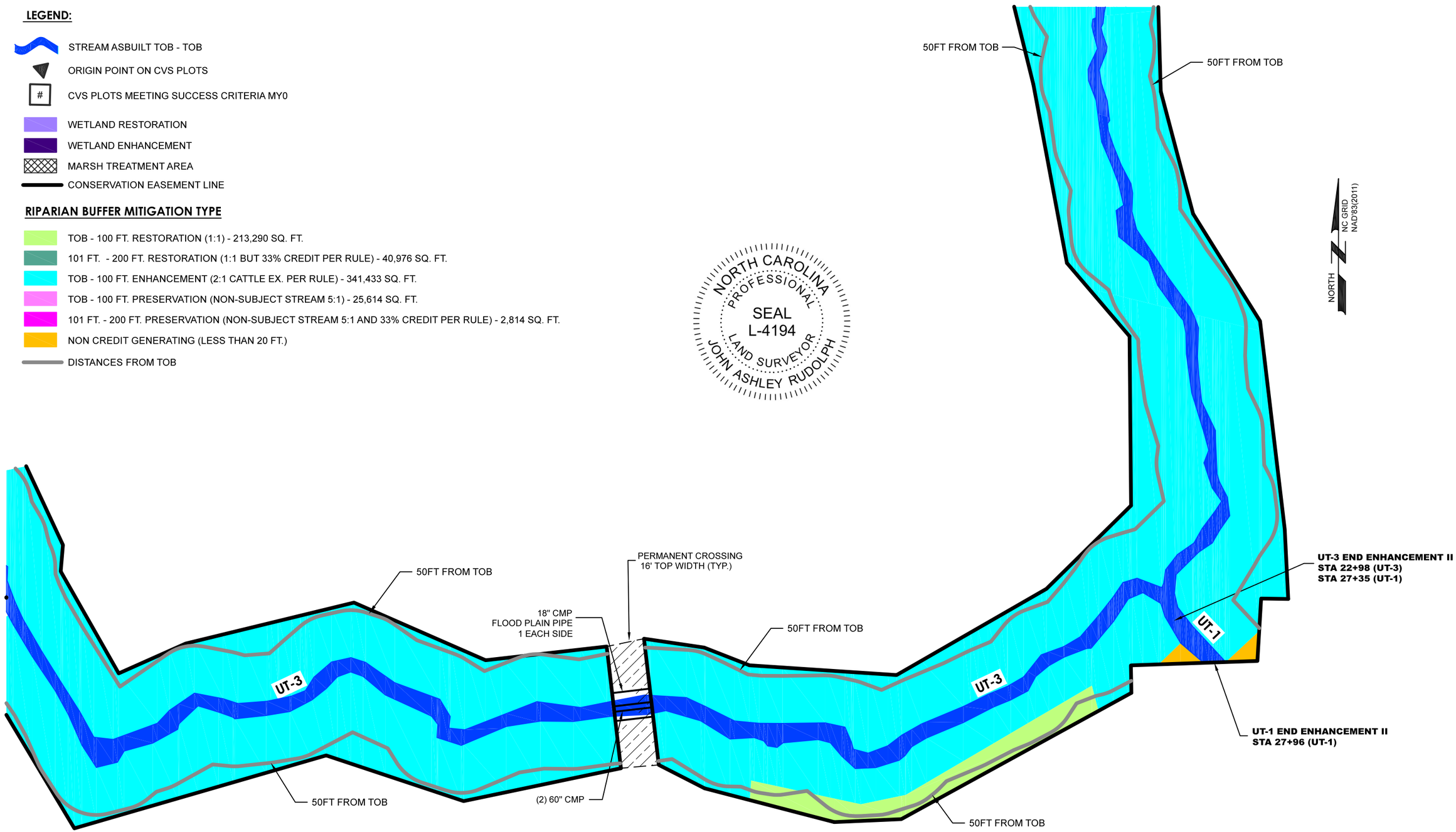
- NON CREDIT GENERATING (LESS THAN 20 FT.)
- DISTANCES FROM TOB

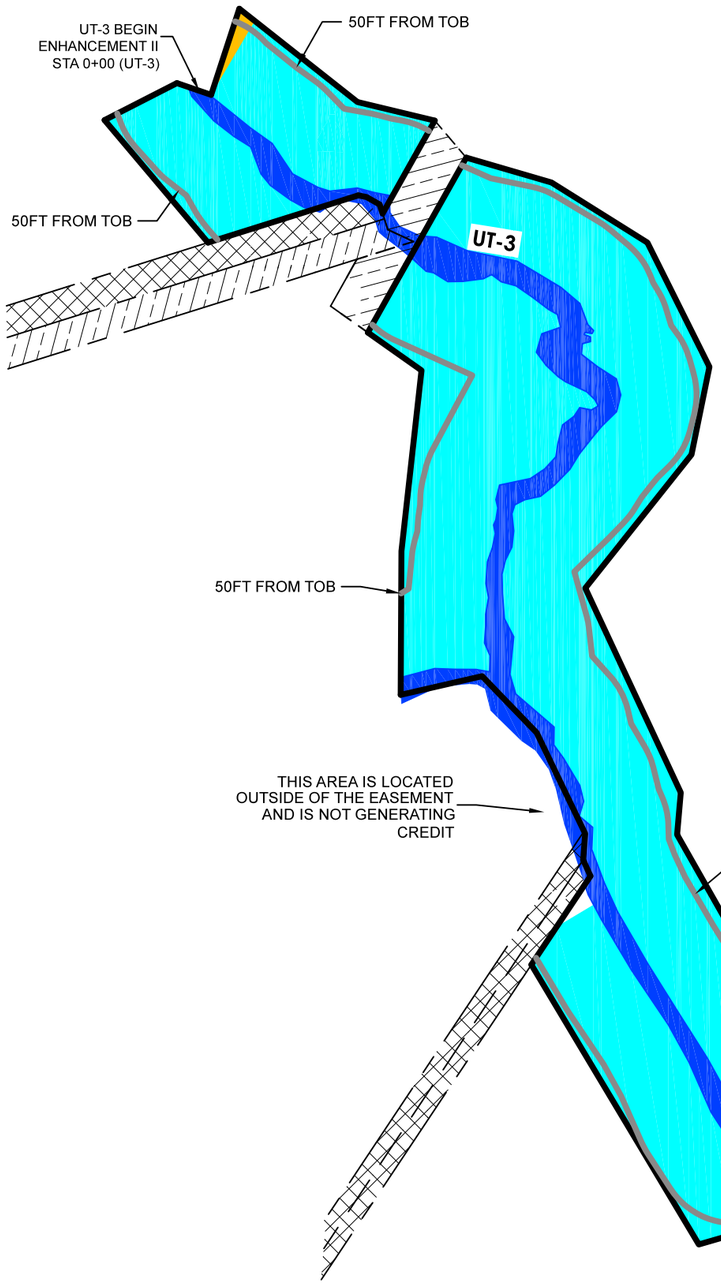
NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

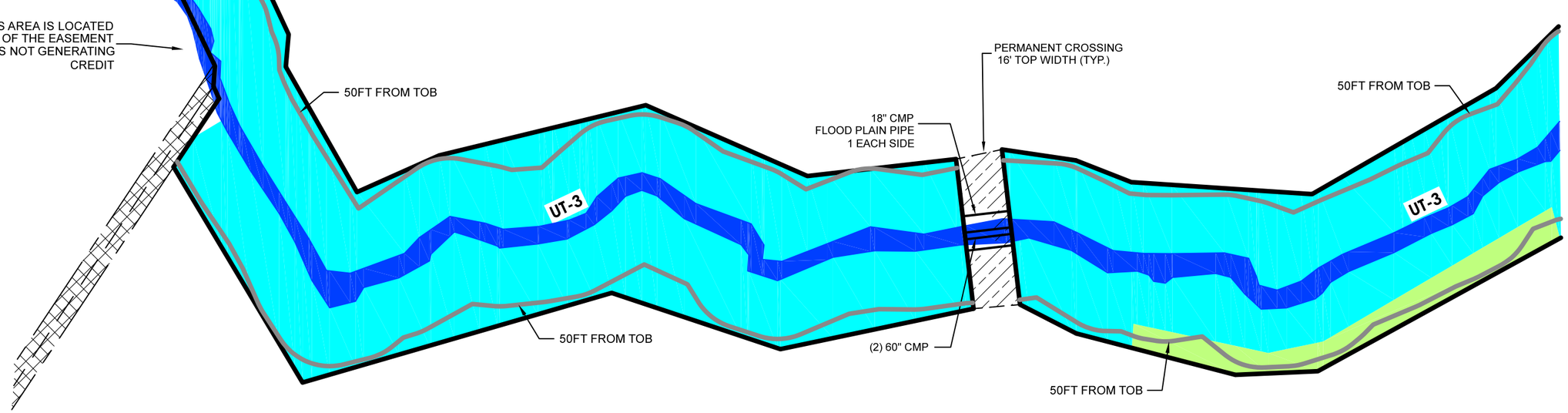


AS-BUILT
CREDIT AREA PLAN
SHEET 4 OF 6

0 50 100 200

1" = 100'





LEGEND:

- STREAM ASBUILT TOB - TOB
- ORIGIN POINT ON CVS PLOTS
- # CVS PLOTS MEETING SUCCESS CRITERIA MY0
- WETLAND RESTORATION
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NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH

NORTH
NC GRID
NAD83(2011)

AS-BUILT
CREDIT AREA PLAN
SHEET 5 OF 6

0 50 100 200

1" = 100'

PLANTING SCHEDULE

ALL PLANTS WERE PLANTED
BY 12/31/18

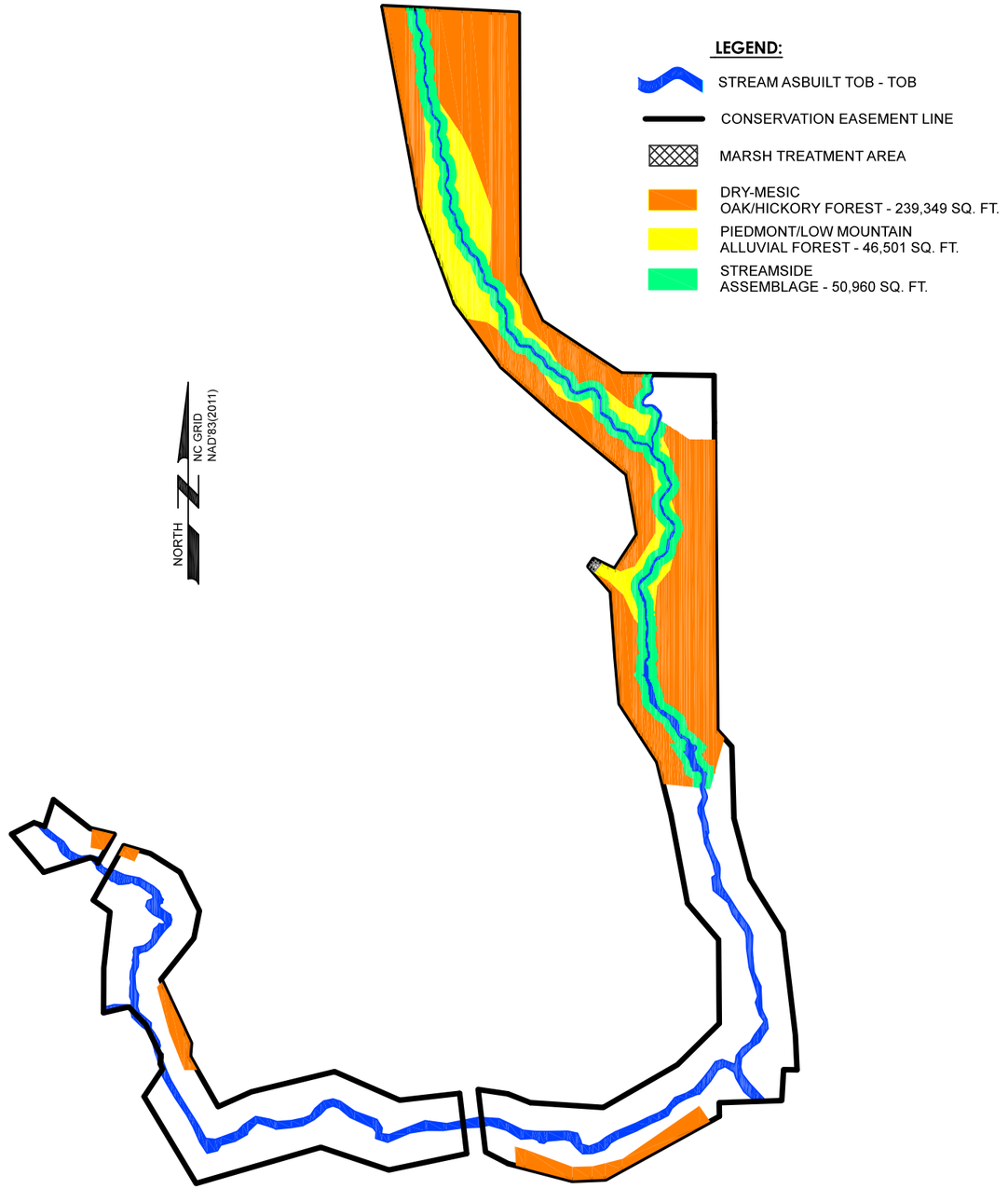
Planted Bare Root Woody Vegetation
Major Hill Restoration Site

Species	Piedmont/Low Mountain Alluvial Forest	Dry-Mesic Oak/Hickory Forest	Marsh Treatment Wetland	Streamside Assemblage	Total
Alnus serrulata			5	20	25
Asimina triloba				200	200
Betula nigra	100			200	300
Carpinus caroliniana		600			600
Cephalanthus occidentalis			5	20	25
Cercis canadensis		500			500
Cornus amomum	95		5	800	900
Diospyros virginiana		450			450
Fraxinus americana		100			100
Fraxinus pennsylvanica	150			750	900
Liriodendron tulipifera	75				75
Nyssa sylvatia		600			600
Platanus occidentalis	120			780	900
Quercus nigra	110	790		500	1,400
Quercus phellos	100	700		400	1,200
*Salix nigra**				400*	400
Sambucus canadensis			11	14	25
TOTALS	750	3,740	26	4,084	**8,600**

*Live stakes of *Salix nigra* were planted; all other planted species were planted as bare root plants.

(PLANTING SCHEDULE PROVIDED BY
AXIOM ENVIRONMENTAL)

NORTH CAROLINA PROFESSIONAL SEAL L-4194 LAND SURVEYOR JOHN ASHLEY RUDOLPH



SHEET 6 OF 6
AS-BUILT
PLANTING PLAN

0 150 300 600

1" = 300'

Appendix I
Credit Discrepancy Letter

Axiom Environmental, Inc.

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

March 5, 2019

Mr. Worth Creech
Restoration Systems, L.L.C.
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604

RE: Major Hill Stream and Wetland Restoration Site - Asbuilt Discrepancies **17-009**

Dear Worth:

During preparation of the As-built Construction Plans and Baseline Document for the Major Hill Stream and Wetland Restoration Site it became apparent that a stationing discrepancy occurred during detailed planning. Stationing discrepancies are listed in the following table and are depicted on the following page.

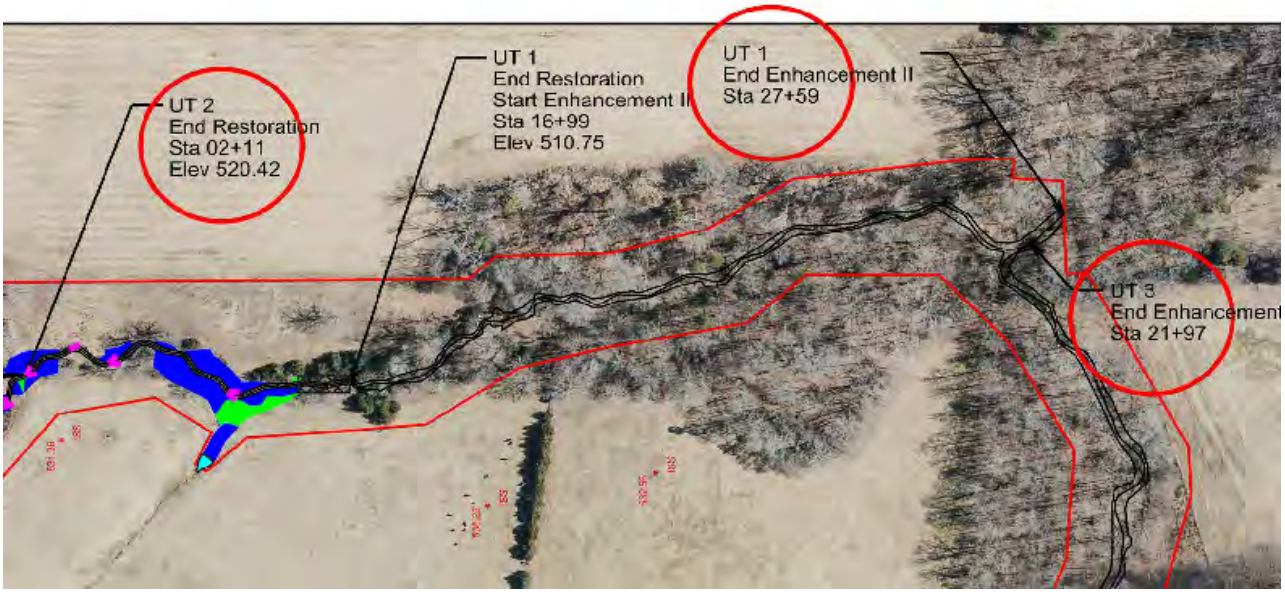
UT Number	Detailed Plan End Station	Construction Plan End Station	As-built Plan End Station
UT 1	27+59	27+96	27+96
UT 2	02+11	02+07	02+07
UT 3	21+97	22+98	22+98

Please note, Construction Plan and As-built stationing are consistent. The discrepancy between the Detailed Restoration Plan and Construction Plans are not certain, but likely result from easement boundary changes between Detailed Plan figure development and Construction Plan preparation, GIS conversion errors, and/or typographical error. These problems are being resolve for future submissions.

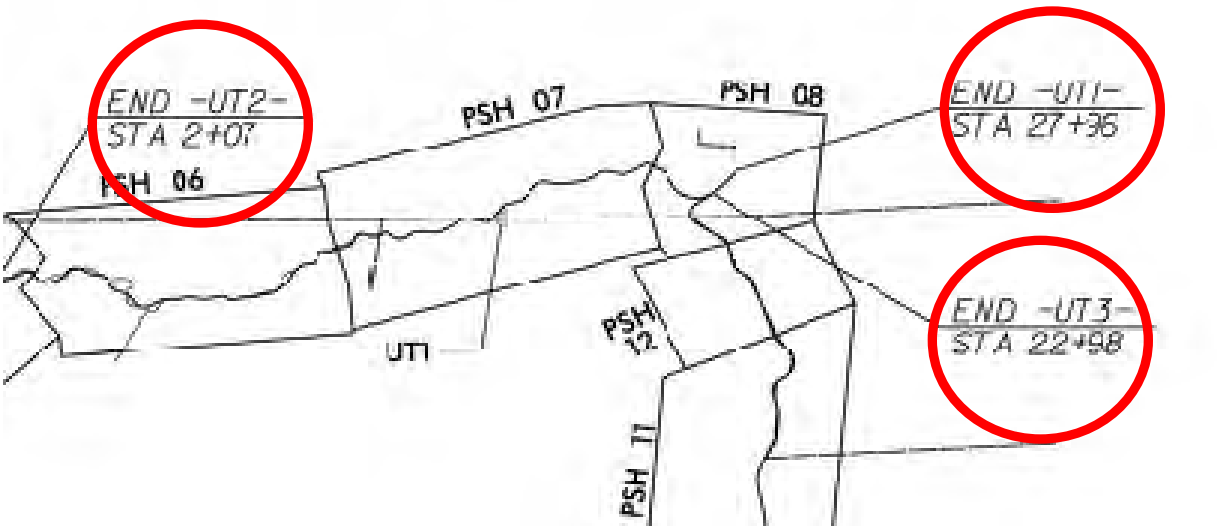
The final Asbuilt stationing matches the Construction Plans and depict what was constructed/enhanced at the Site.

The original SMU total calculated for the Detailed Restoration Plan was 3006 SMUs. The Asbuilt SMU total calculated for the Asbuilt Construction Plans and Baseline document is 3058 SMUs.

Detailed Plan – Figure 6 (Restoration Plan) Stationing



Construction Plan – Sheet 1 Stationing



Based on information provided above we request a credit alteration at the Site. The credit alteration results from stationing discrepancies from the Detailed Restoration Plan and Construction Plans. The alteration is in the amount of 52 SMUs and represents what was constructed/enhanced at the Site.

Yours truly,
Axiom Environmental, Inc.

W. Grant Lewis
President

ADDENDUM TO MITIGATION PLAN

Table 1. Project Components and Mitigation Credits Major Hill Restoration Site

Reach ID	Stream Stationing/ Wetland Type	Existing Footage/ Acreage	Mitigation Plan Footage/ Acreage	Constructed Footage/ Acreage	Restoration Level	Restoration or Restoration Equivalent	Mitigation Ratio	Mitigation Credits	Comment
UT 1	00+00 to 16+99	1829	1699	1699	Restoration	1699	1:1	1699	
UT 1	16+99 to 27+96	1097	1060	1097*	EII	1097	2.5:1	439	
UT 2	00+00 to 01+68	168	168	168	EII	168	2.5:1	67	
UT 2	01+68 to 02+07	39	43	39*	Restoration	39	1:1	39	
UT 3	00+00 to 22+98	2298	2197	2298*	EII	2298-80-144-40=2034	2.5:1	814	80 lf and 40 lf of UT3 are not credit generating due to crossings and drainage easement. 144 lf are not credit generating due to lack of control of south bank and drainage easement.
Wetlands	Riparian Riverine	--	0.54	0.54	Restoration	0.54	1:1	0.54	Wetland Restoration
Wetlands	Riparian Riverine	0.52	0.44	0.44	Enhancement	0.44	2:1	0.22	Wetland Enhancement

Overall Assets Summary: Amended Mitigation Plan

Stream **3058 SMU**
Riparian Riverine Wetland : **0.760 WMU**

*UT1, UT2, and UT3 discrepancies between Mitigation Plan and As-built tables are the result of errors between detailed plan stationing and surveyed construction plan stationing. They are specifically attributed to typographical error, GIS to CAD conversion error, and easement boundary changes between detailed plan development and construction plans. Construction Plan information is consistent from Mitigation Plan to As-Built, and the As-Built table reflects Construction Plan measurement accuratly.