Mitigation Plan
Cow Tail Mitigation Project
Columbus County, North Carolina
FINAL VERSION

NCDEQ DMS Project Identification # 100647
NCDEQ DMS Contract # 416888198-01
Lumber River Basin (Cataloging Unit 03040203)
USACE Action ID Number: SAW-2023-00196
Contracted Under RFP # 16-416888198
DWR Project # 20230252

Prepared for:

Environmental Quality

North Carolina Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

March 2024

Prepared by:

WATER & LAND SOLUTIONS
7721 SIX FORKS ROAD, SUITE 130, RALEIGH, NC 27615
(919) 614 - 5111 | waterlandsolutions.com

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

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

These documents govern NCDEQ Division of Mitigation Services operations and procedures for the delivery of compensatory mitigation.

Kayne M. Van Stell
Vice President, Ecosystem Design
Water & Land Solutions, LLC
7721 Six Forks Road, Suite 130
Raleigh, NC 27615
Mobile: (919) 818-8481
Email: kayne@waterlandsolutions.com

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

March 22, 2024

Regulatory Division

SUBJECT: NCIRT Review and USACE Approval of the NCDMS Cow Tail Mitigation Site / Columbus County, Action ID SAW-2023-00196

Mr. Jeremiah Dow
North Carolina Division of Mitigation Services
217 West Jones St.
Raleigh, NC 27603

Dear Mr. Dow:

The purpose of this letter is to provide the North Carolina Division of Mitigation Services (NCDMS) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the Cow Tail Draft Mitigation Plan, which closed on December 6, 2023. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan, which is considered approved with this correspondence. However, several minor issues were identified, as described in the attached comment memo and March 2024 email correspondence, which must be addressed in the Final Mitigation Plan.

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

Thank you for your prompt attention to this matter. Please note that this electronic copy provided to you via email is your official copy. Should you wish to receive a paper copy of this correspondence, please contact us. Thank you for your time and cooperation. If you have any questions, please contact me by email at todd.j.tugwell@usace.army.mil or by phone at (919) 210-6265.

Sincerely,

Todd J Tugwell

Todd Tugwell
Chief, Mitigation Branch

Enclosure

cc (by email):
NCIRT Distribution List

February 5th, 2024

US Army Corps of Engineers: Wilmington District
Raleigh Regulatory Field Office
Attn: Todd Tugwell
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

RE: WLS Responses to NCIRT Review Comments Regarding the NCDMS Cow Tail Mitigation Site Final Draft Mitigation Plan, USACE AID# SAW-2023-00196, Lumber River Basin, Cataloging Unit 03040203, Columbus County, NC

Mr. Tugwell:

Water & Land Solutions, LLC (WLS) is pleased to provide our written responses to the North Carolina Interagency Review Team (NCIRT) review comments dated January 5th, 2024, regarding the Final Draft Mitigation Plan for the DMS Cow Tail Mitigation Project. We are providing our written responses to the NCIRT's review comments below, which includes editing and updating the Final Mitigation Plan and associated deliverables accordingly. The responses also include the discussion with USACE, DWR, and DMS on January 12th, 2024, providing additional clarification. Each of the NCIRT review comments is copied below in bold text, followed by the appropriate response from WLS in regular text:

DWR Comments (Maria Polizzi):

1. Is there any concern about hydrologic trespass? It appears that hydric soils sometimes extend past the easement boundary, and proposed wetland credit areas approach or touch the CE boundary in various locations. The IRT recommends a 50 ft. buffer around wetlands, when possible, to avoid trespass and protect the wetland hydrology inside the easement.
Response: As described in Sections 3.7.4 and 3.7.5, a flood inundation model and lateral effect analysis was done to ensure post-restoration flooding and groundwater saturation will be contained within the project properties. Hydrologic trespass is always a concern when raising local groundwater table and activating relic floodplains, especially in flatter coastal plain settings. Expanding the buffer 50 feet around wetlands and/or hydric soils demarcation would increase the easement area approximately 5-10 acres. The landowner does not wish to extend the easement boundary and the site hydrology must exit at the southern property line at the downstream terminus of lower Cow Branch.

2. Response to DMS Comment #2 under Plan Sheets: I may be misunderstanding this response, but for future projects please make your best effort to limit items in the key to structures that are proposed on the project. It is helpful to see a list of the proposed structure types, so an accurate key is useful to get this quick overview.

Response: Noted. The project keymap legend has been updated to only show proposed structures, however the note regarding other existing standard items is intended to maintain consistency for plan set generation.

3. It is helpful context to see the total stream and wetland credits proposed alongside the contracted total. Thank you for including this info.
Response: Noted.

4. Is there concern about vegetation establishment in areas that were previously ditched or roadbed locations? These areas are often considered to be wetland creation due to their extra limitations and slower re-establishment. Similarly, the area of wetland grading along Cow Branch were grading depth exceeds 12 inches must be proposed as creation due to the removal of the surface soil horizon(s) in this location.
Response: WLS is not concerned about vegetation establishment in areas that were previously ditched or roadbeds. WLS will grade areas as necessary, and rip and/or stockpile suitable soil as needed before planting. Based on the proposed grading plan, lateral drainage effect from ditches to remain open, and the flood model results, the proposed wetland boundaries have been revised to accommodate excavation depths that exceed 12 inches. No wetland creation is proposed and any areas with grading depths greater than 12 inches have been removed from creditable wetland area.

5. Thank you for the inclusion of the keymap on the plan sheets. This is very helpful.
Response: Noted.

6. Plan Sheet 13: There is a callout on the ditch above S100 that says it will be regraded to existing ground elevation while also stating that the ditch shall remain open to ensure flow connection. Please clarify the plan for this area, as those statements seem contradictory.
Response: There are numerous spoil piles along the existing ditches and stream channels. The spoil material along S100 will be removed alongside the ditch banks and regraded to the existing natural ground elevations. The callout language has been revised along with proposed spot elevations for more clarification.

7. Plan Sheet 20: A spec for a permanent culvert crossing is shown, but I do not see a crossing shown on the plans. Section 3.7.9 also states that there are no stream crossings. Please confirm that no stream crossings are proposed and remove the culvert crossing spec from the plan, or update text and figures to clearly show the location of a crossing.
Response: The two permanent culvert crossings are now shown on plan sheet 13 and the callout text has been added/revised. The culvert crossings are located at non-jurisdictional ditches outside of the conservation easement and creditable areas. Section 3.7.9 and plan sheet 13 have been revised for clarification.

8. Plan Sheet 21, Erosion Control Matting Spec: Is it standard to use a galvanized roofing nail in the installation of EC matting? Generally, it is preferable to use fully biodegradable materials for temporary BMPs like matting. Is there an alternative option, like a notched stake

that may offer the same function? It appears this is also proposed in the Toe Wood spec as well.
Response: The nail is added to the large stakes so the erosion control matting will not slide past the exposed end of the stake after installation. This erosion control matting specification is a common industry practice because it has proven more effective than just stake notching.

9. Plan Sheet 22, Log Step Pool Spec: "Stone backfill or suitable soil material" is proposed for this structure, but "stone" is not defined in terms of size or percentage of fill. It is helpful to the reviewers to be able to see this information as excessive or large stone has been an issue on coastal sites in the past.
Response: The stone sizing is typically provided in the technical specifications and contains a well graded mix of Class A (4") and #57 (0.5") stone, or as directed by the Engineer. Typically, adequate stone is placed in structures when on-site alluvium is not suitable or compactable backfill. WLS understands the concern of using larger and/or excessive stone in the coastal plain and will limit the stone placement in locations with higher gradient/shear stress, crossings (outside the easement), or other areas susceptible to concentrated erosion. Stone sizing has been added to the detail sheet 22 for further clarification.

10. Page 49, Section 8.4: Change the word "approximately" in the first sentence to "at least".
Response: Changed.

11. The outline of the LSS determined hydric soils is a helpful visual. It does appear that there are a few locations where the "potential wetland reestablishment" layer extends past a non-hydric soil boring. Can you provide more information about how this boundary line was generated and why there are non-hydric soil borings within this area? See examples in borings 120, 123, 66 and 76.
Response: From the LSS: Borings were completed in two phases, a preliminary evaluation with limited details (pt #s 1 through 79), and a detailed evaluation where soil boundaries were determined. The initial boring notes often classify the boring as non-hydric due to a conservative interpretation where later borings indicate the point should be classified as hydric within the landscape. The #120 and #123 borings are within a cultivated field near excavated ditch/drainage. The borings have marginal indicators and show soils that are intensively disturbed from tillage and spoil from ditching. The points were included within the boundary due to being located within a suitable landscape/elevation and the presence of nearby borings within the same landscape exhibiting appropriate hydric soil indicators (124, 122, 60, and 121). The common indicators occur in this area are upper surface horizon and appeared altered/destroyed with some indicators buried under soils from spoil. The lack of strong, clear hydric indicators resulted in the call as non-hydric. The local soil has dark surface indicators and in sandy soil are easily destroyed by tillage and drainage within the field, especially where the dark surface naturally thins toward the edges. Also, due to downslope surface movement of soils on tilled slopes, the historic boundary was likely larger in the area delineated.

The #76 boring was from the initial site evaluation and lacks extensive detail. The hydric soil boundary was based on the later, more intensive work of a detailed evaluation. The point (76) may have been an anomaly or could have marginal indicators. It is surrounded by dark surface indicators used to delineate the soil boundary. The #66 boring is shown as hydric.

USACE Comments (Erin Davis):

1. Page 11, Section 3.1.4 – Did all project reaches have low NC SAM scores? If not, please briefly describe reasons for the different scores. Please show NC SAM and NC WAM sample points on Figure 6.
Response: This was a typo in Section 3.1.4 and Cow Branch upper and S100 scored 'medium'. This section has been corrected. Cow Branch upper is wooded and has adjacent wetlands, which scores 'medium' in that short section. S100 only scores 'medium' due to the existing successional vegetation width. This scores as the >100 ft buffer width, even though it's not mature buffer as there is no distinction. If we moved to the next buffer width down, it would score 'low'. NCSAM and NCWAM locations have been added to Figure 6.

2. Page 19, Section 3.7.4 – What does the hydraulic model show for a 100-yr storm event? Also, please discuss observations of beaver presence and related considerations for potential trespass during long-term management.
Response: The conservation easement area considers the proposed restoration limits and creditable areas to minimize flood extents and prevent hydrologic trespass. As described in Sections 3.7.4, 3.7.5 and 6.6.4, a flood inundation model was calculated for the bankfull, 10-yr, 25 yr-storm events to ensure post-restoration flooding will be contained within the project properties. We have added a hydraulic model in the appendix to show the 100-yr storm event for both the post-restoration conditions and if a hypothetical 2.0' tall beaver dam is built along upper Cow Branch after project regulatory closeout. Additional language has been added in Section 3.7.4 describing the model results.

3. Page 19, Section 3.7.5 – Please provide the results of DRAINMOD using the 12% performance standard criteria instead of the minimum 14-day hydroperiod on ditches proposed to remain open along the conservation easement boundary. Please add ditch lines to Figures 9 and 10 to show any ditches proposed to remain open or be partially filled to allow for positive drainage.
Response: The NC DRAINMOD input parameters only allow for 14-day wetland hydroperiod or minimum 5% of the growing season. The ditch locations, and proposed grading activity (fill/partial fill, remain open) have been added to Figure 9 to correspond with the lateral effect summary outputs located in Appendix 2.

4. Page 20, Section 4 & Table 6 – This section appears to be a standard stream project insert. There is no discussion of the functional uplift potential of headwater valley or wetland resources, which are major components of this project. Please provide a more project-specific discussion of proposed functional uplift potential.
Response: This section is focused on a brief summary of the project benefits using the stream functions pyramid. We have added a summary of the wetland goals and objectives and added wetlands to Table 6.

5. Page 21, Section 4.1.1 – Please clarify that the physiochemical and biological categories are not proposed be assessed as part of this project.
Response: Added language to clarify that the physiochemical and biological categories are not proposed be assessed as part of this project.

6. Page 28, Cow Branch Upper – The small impoundment was not mentioned in the existing conditions section. Please provide a brief description of the impoundment and information on the proposed removal process.
Response: Added a brief description of the small impoundment and the removal as noted on plan sheet 5 and Figure 9.

7. Pages 29 – 30, Cow Branch Upper, S100 & S200 – Each of these sections include a variation of "small headwater channel", "construct small channel", or "construct defined channel". The IRT has expressed concerns in the past about creating (either by excavation or not fully backfilling an existing ditch) a straight pilot channel, typically ranging 0.4 to 1 foot deep, through a headwater valley credit area. The primary concern is that the channel will act as a shallow ditch and not promote the development of multiple flow paths and wetland recharge within the wider valley as typically seen in reference quality coastal stream-wetland complexes. Additional monitoring, such as cross-sections and groundwater gauges along the valley, will be required to demonstrate functional uplift.
Response: WLS understands this concern and has revised the design reach summaries in Section 6.1.2 to clarify proposed stream restoration approaches. All reaches will be designed and constructed as single-thread channels except for upper Cow Branch (station 10+00-15+00). This upper section of Cow Branch is being proposed as non-creditable stream length. The drainage areas and slopes will support this channel type and WLS has concerns that constructing a headwater stream valley only may create a prolonged backwater condition and excess volume within the stream channel. This was also discussed on the January 12th IRT/WLS call and the performance monitoring has been adjusted to not include headwater valley monitoring.

8. Page 30, S100 & S200 – These sections discuss filling channels using woody material. Please briefly explain why this is proposed and what it will look like. Does woody material include logs and brush? Will the woody material be layered? Is it meant to be permeable?
Response: Removed reference to filling channel with woody material to avoid confusion. To clarify, small woody/brush material generated onsite will be used for in-stream structures such as brushy riffles and toe wood. Large or coarse woody debris, as described in Section 6.6.2, will be used for floodplain improvement features to mimic tree throws commonly found in natural riparian systems. These features also provide habitat and water storage depressions within the floodplain.

9. Page 30, S200 – As previously discussed on another project, excavating a floodplain bench to create a headwater valley is not appropriate for this mitigation credit type. We do not support a Priority II/III approach for headwater valley restoration. Please reassess the suitability of site conditions for the upper section of S200 to provide potential stream verse wetland credit.

Response: WLS understands and agrees that Priority Level II restoration is not an appropriate mitigation type for headwater stream valley restoration and the intent of the CP headwater guidance. As noted in response comment #7, all reaches will be designed as single-thread channels, except for upper Cow Branch (station 10+00-15+00) in the non-creditable stream section.

10. Page 39, Table 16 – To enhance diversity, please cap a single species live stake at 60 percent.

Response: Noted/Updated Table. No single live stake species planted shall exceed 60 percent.

11. Page 40, Section 6.6.1 –

a. Please estimate the total acreage of proposed wetland credit area that is anticipated to be graded greater than 12 inches along the lower section of Cow Branch. Is there any concern that the Priority 2 stream restoration could have a drainage effect on the abutting wetland reestablishment credit area?

Response: As noted in DWR response comment #4, the proposed wetland boundaries have been revised to omit credit areas where Priority Level II excavation depths exceed 12 inches. The estimated wetland areas within the PII excavation total approximately 3.3 acres, and this is not included in creditable acreage. WLS acknowledges the concern that the Priority Level II tie-in along lower Cow Branch and lateral drainage effect from open ditches will limit the success of restoring wetland hydrology.

b. Are adjacent upland areas noted as a source of fill/plug material located outside of the project easement but within the project property? Is any floodplain excavation proposed for the purpose of generating fill?

Response: Yes, adjacent upland areas noted as a source of fill/plug material located outside of the project easement are within the project property. As noted, any excess material generated from the existing spoil/berms and floodplain excavation that is unsuitable for ditch fill or a soil base for vegetation, will be spread across upland areas outside of the easement boundary and jurisdictional WOTUS. WLS has confirmed these areas with the landowner, however we do not expect excess spoil as a result of restoration grading activities. The proposed floodplain excavation is considered shallow (average 8”-10” depth) across the site, with exception to the increased depths along upper S200 and lower Cow Branch. The proposed floodplain elevations were designed to consider the hydric soils delineation, soil profiles, and to limit potential wetland creation areas and prevent hydrologic trespass.

12. Page 41, Section 6.6.1 – Please confirm that all depressional areas will be less than 12 inches deep.

Response: Yes, all depressional areas will be less than 12 inches deep as shown in the detail on plan sheet 20. Added language to Section 6.6.1 to clarify.

13. Page 41 – Section 6.6.2 – Discussion of the floodplain improvement features was appreciated.

Response: Noted.

14. Page 44, Section 7.2 – Please note that 30 consecutive days of flow annually is the <u>minimum</u> performance standard.

Response: Noted.

15. Page 44, Section 7.3 – A separate 10% hydroperiod wetland credit area is not shown on Figure 10. Please clarify if a 10% hydroperiod performance standard is being proposed. The outer fringe of wetland credit areas should be represented in groundwater gauge distribution.
Response: This is now Section 7.2 and the 10% hydroperiod reference has been removed and the entire site will be a 12% hydroperiod. Groundwater gauges will be representative of the creditable area, including areas near the boundary.

16. Pages 46 – 48, Section 8.3 – Please specify the total number of cross-sections, pressure transducers, and flow gauges proposed for this project.
Response: These numbers have been added to Section 8.3 and Figure 10.

17. Page 49, Sections 8.4 & 8.5 – In the final plan please remove "approximately" for the total number of groundwater gauges and veg plots.
Response: Removed 'approximately' in these sections.

18. Page 49, Section 8.5 – If no random plots are proposed within W01 due to difficulty of finding planted trees, could the three random monitoring transects potentially cover areas supplementally planted? Note, random plots only require identification of stem species and height (without distinguishing between planted and volunteered). Please include at least three random plots within W01.
Response: All of the fixed plots in W01 will be installed in areas that receive full planting and the number of fixed plots is based on the two percent of that planted area. This will allow us to monitor the planted vegetation. The three monitoring transects originally were for monitoring non-planted areas, but these three transects will now cover the areas supplementally planted and/or natural regeneration in W01. Therefore, W01 will have 15 fixed plots and three random plots.

19. Page 50, Table 18 – Please specify four bankfull events under the hydraulics performance standard.
Response: Specified four bankfull events in Table 18 under the hydraulics performance standard.

20. Figure 10

a. Please use different line colors to distinguish between headwater valley and single stem channel restoration.
Response: As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area. The line color will be the same now for all restoration reaches.

b. It would be helpful to specify all credit ratios in the legend.
Response: Added all credit ratios in the legend for clarification.

c. Please change the color of the green re-establishment hatching so that proposed veg plots and wetland gauges are visible.
Response: The color of the monitoring devices has been changed for better visibility.

d. Please show all ditches proposed to remain open or partially filled located within or abutting the project easement.
Response: Added ditches to remain open or partially filled located within or abutting the project easement for visibility.
e. With a total of 36.5 acres of wetland credit area, additional gauges are needed to provide representative cover of the outer fringe (along the western CE boundary) and immediately adjacent to the Cow Branch Lower P2 section. Please add two wetland gauges for a total of 10 gauges within proposed wetland credit areas.
Response: One of the proposed wetland gauges has been moved to Cow Branch lower PII section, and two additional wetland gauges have been added to the western wetland boundary.
f. Please confirm that the Zone 2 random plots will also be distributed within the headwater valley and streamside planted areas. Please shift a fixed veg plot to the P2 cut area on Cow Branch Lower.
Response: Zone 2 vegetation plots have been distributed to monitor streamside planted areas as well. A fixed vegetation plot on lower Cow Branch has been moved to the PII cut area.
g. Please add a transect of groundwater gauges within the S100 and S200 headwater valleys.
Response: As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area.

21. Design Plan General Comment – Please double check that plan sheets orientation match north arrows. Also, the plan view background as well as many features were not visible on the printed hardcopy. This review had to be done from the digital version.
Response: The north arrow orientation has been corrected on all plan & profile sheets. The design plan set has been reprinted at a higher print resolution to ensure all plan features are visible.

22. Sheet 3 – Please update the keymap to match sheets 14 and 15.
Response: The keymap sheets have been updated/corrected accordingly.

23. Sheet 4 – Please explain the typical sections for S100, S200 and Cow Branch Upper. Are riffles, pools and bankfull features proposed for these headwater valley reaches?
Response: The typical sections and morphology parameters shown on plan sheet 4 are correct. We have added the stationing for upper Cow Branch to distinguish between headwater stream valley (no credit length) and single-thread channel restoration. As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, except for upper Cow Branch in a non-creditable area from station 10+00-15+00 and S200 from station 10+00-14+50.

24. Sheets 5 – 12 – Please refer to above comments related to headwater valley design. Installing in-stream structures like log step pools and constructed riffles typically used in single stem channels is contrary to the intent of developing a multiple flow path stream-wetland complex.
Response: WLS agrees with this comment and apologizes for any confusion. As noted/clarified in previous response comments, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area from station 10+00-15+00. The top of bank line

has been removed from upper Cow Branch stationing 10+00-15+00 and a note has been added to plan sheet 5 for further clarification.

25. Sheet 9 – Please callout the existing ditch top of bank along the southern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage placement and allowable activity language in the conservation easement agreement. Also, what is the distance between the wetland credit area and the ditch? Does this buffer width account for the lateral drainage effect?
Response: Added a callout to the existing ditch top of banks on sheet 9. Yes, the existing ditch along the southern property line will remain open to ensure positive drainage off the property. Added a note to sheet 9 and grading sheet 15. Easement signs will be placed on the ditch top of bank inside the easement boundary on the project landowner's property since the property line is the centerline of the ditch. DMS stated this is how their projects have been marked. Ditch maintenance language regarding the open ditches will be included in the conservation easement deed per DMS and SPO. Ditch maintenance language has also been added to Section 6.1.3 and Figure 9. The distance between the proposed wetland credit area and existing ditches along the property line ranges from 103' to 126' and the proposed wetland areas have been adjusted accordingly.

26. Sheet 10 – Please callout the existing farm road crossing. Will this area be regraded and decompacted?
Response: Added a callout to the abandoned farm road crossing that describes area to be regraded and scarified.

27. Sheets 13 – 15

a. This Wetland Grading Plan is very busy and was challenging to review. Please consider using a bold border or another alternative to pattern fill for the credit areas.
Response: WLS apologizes for the confusion and has revised the hatch patterns for more clarity.

b. It was difficult to follow existing contour lines, particularly with only the 110' contour line being labeled. It would be helpful to see spot elevations across the site to provide a better landscape perspective.
WLS apologizes for the confusion and has added minor contour labels as well as proposed spot elevations throughout the grading plan. As noted in Section 6.1, the site has low topographic relief and the existing 1' contours were created from a UAS LiDAR survey. The proposed contours did not plot correctly and have been darkened for more legibility.

c. The only proposed grading contour lines appear to be connected to the stream and headwater valley construction. What about roadbed, field crown and spoil berm removals within wetland credit areas? Please clearly callout areas proposed to be greater than 12 inches.
Response: For more clarity, WLS has revised the proposed contour lines and added callouts for excavation greater than 12 inches.

d. It would be helpful to have existing ditches called out as to be filled, partially filled, or remain open. Do all of the ditches shown in Figure 6 appear on the design sheets? Are depression areas only proposed within in the footprint of existing ditches?

Response: WLS has added callout language to more clearly distinguish ditch fill areas and design intent. The ditch areas shown on Figure 6 are approximate centerline locations and the ditches shown on the plan sheets have been surveyed. The depressional areas shown are proposed within the footprint of existing ditches to account for future settling, balancing earthwork, and reducing the unnecessary over excavation with the restored channel and floodplain areas.

28. Sheet 13 – If the western ditch will be modified to ensure positive drainage, please provide proposed dimensions (including max. depth). Also, please callout the existing culvert and farm road running along the northern project boundary.
Response: Ditch dimension locations and callouts have been added to the grading plan. Added callout to the existing farm path (to remain).

29. Sheet 14 – Please provide proposed dimensions (including max. depth) for the ditch proposed to be partially filled to ensure positive drainage. Please callout the existing ditch top of bank along the eastern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage and allowable activity language in the easement agreement.
Response: Ditch dimension locations and callouts have been added to the grading plan. The ditch along the eastern property line will remain open for the future and maintenance since it is along the existing property line. Any allowable activity language will be included in the easement deed per DMS and SPO review.

30. Sheet 15 - Please callout the existing ditch top of bank along the eastern easement boundary. Please address project boundary signage and allowable activity language for ditch maintenance in the easement agreement.
Response: Ditch dimension locations and callouts have been added to the grading plan. The ditch along the eastern property line will remain open for the future since it is along the existing property line. Any allowable activity language will be included in the easement deed per DMS and SPO review.

31. Sheet 16 – Why are the two planting zones both called riparian buffer when the project planting area includes wetland and headwater habitats? The planting legend includes three items, yet the following sheets show four different patterned areas. Since headwater valleys do not have streambanks, if live stakes are proposed in these areas how will they be distributed?
Response: The term 'buffer' has been removed and the planting zones are labeled as Zone 1 Restoration Planting (50% minimum shrubs), Zone 1 Cleared Lanes (12 ft) and Restoration Planting (50% minimum shrubs), and Zone 2 Restoration (70% minimum trees). The sheets were meant to show the three different types in the legend (Zone 1, Zone 2, forested), but were confusing. The Zone 1 planting plan had the solid green rows to show the areas to be cleared (12 ft paths spaced 48' apart) and planted. This is now labeled in the legend, but is still part of Zone 1. Also, the two zones are now different colors to differentiate. As noted in previous responses, the proposed creditable stream restoration approach is PI and PII and live stakes will be installed as along the stream banks per the typical spacing and practices.

32. Appendix 2 – The completed existing vegetation inventory and conditions assessment was comprehensive and informative for review of the proposed revegetation plan.
Response: Noted.

Please contact me if you have any additional questions or comments.

Sincerely,

Water & Land Solutions, LLC

Cara Conder

Cara Conder
Sr. Project Manager
Mobile: (843) 446-2312
Email: cara@waterlandsolutions.com

From:	Davis, Erin B CIV USARMY CESAW (USA)
To:	Cara Conder
Cc:	Tugwell, Todd J CIV USARMY CESAW (USA); Polizzi, Maria; Wilson, Travis W.; Friedman-Herring, Andrew; Kayne Van Stell; Dunnigan, Emily; Dow, Jeremiah J
Subject:	RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.
Date:	Wednesday, March 13, 2024 10:46:00 AM
Attachments:	image001.png

Hi Cara,

Good question. While I would never discourage additional data collection, the intent of the performance standard is to demonstrate biology indicative of intermittent flow in restored stream channels post-construction. The standard is not meant to be a comparison of pre-restoration and post-restoration stream biology. Since existing channels are disturbed, modified and often relocated during construction, pre-construction data may not provide the most informative baseline. MY1 sampling is required, pre-construction sampling is optional.

Thanks,
Erin

From: Cara Conder <cara@waterlandsolutions.com>
Sent: Tuesday, March 12, 2024 5:43 PM
To: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Kayne Van Stell <kayne@waterlandsolutions.com>; Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Thanks Erin. We had planned to get baseline sampling of pre-restoration conditions between April 1st to June 30th before construction this summer. Would the IRT rather have MY1 collection vs. pre-construction? I know your email says MY1, but we do have time to get the samples this spring still.

Thanks,
Cara

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Tuesday, March 12, 2024 4:38 PM
To: Cara Conder <cara@waterlandsolutions.com>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Kayne Van Stell <kayne@waterlandsolutions.com>; Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hi Cara,

Since WLS is willing to use one of the two site-specific performance standards proposed by the IRT, please include descriptions of both in the Cow Tail Final Mitigation Plan under Section 7 Performance Standards and Section 8 Monitoring Plan. This standard only applies to the S100 reach for this project.

For clarity, the options are either 90-days of consecutive flow or 30-days of consecutive flow plus macrobenthos monitoring. Regarding the 30-days consecutive days flow plus macrobenthos monitoring performance standard, benthic macroinvertebrate sampling must occur during monitoring year 1 to establish baseline conditions. Subsequent sampling should occur during monitoring years 3, 5, and 7. Sampling should be conducted within appropriate habitat near the upper end of the reach, preferably in close proximity to the flow gauge. The purpose of this monitoring is to document the presence of benthic macroinvertebrates in the intermittent reach proposed for credit, but this is not intended to be as intensive as the optional macroinvertebrate monitoring requirements discussed in Section 7 of the 2016 NCIRT Mitigation Guidance.

If monitoring of macrobenthos fails to show species indicative of intermittent flow and the annual consecutive flow data is less than 90 days but more than 30 days (average during monitoring period), credit will be reduced by 50% for the reach. If the reach exceeds 90 days consecutive flow annually, then the documentation of macrobenthos will not be required to obtain full stream credits. However, less than 30 days consecutive flow annually will result in no reach credit (regardless of benthic data).

Apologies for the delayed response. Please don't hesitate to reach out with any questions.

Thank you,
Erin

From: Cara Conder <cara@waterlandsolutions.com>
Sent: Monday, March 4, 2024 5:27 PM
To: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>; Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>
Cc: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Kayne Van Stell <kayne@waterlandsolutions.com>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hi Erin,

Yes, WLS is willing to use a 90-day consecutive flow metric or 30-days consecutive flow plus biology/macrobenthos monitoring. We would monitor biology/macrobenthos in MY3 and MY7, unless you have other guidance.

Also, just to confirm, this new stream uplift metric only applies to S100, correct? And the other two reaches will remain at least 30 consecutive days?

Thanks,
Cara

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Monday, March 4, 2024 10:48 AM
To: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Cc: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>
Subject: RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Emily and Cara,

Thank you for providing the Cow Tail response to IRT comments and revised draft mitigation plan. Based on discussions from the January 12th meeting and review of the submitted documents, we are satisfied that the significant concerns have been addressed. We still question whether S100 will have sufficient flow to maintain channel characteristics and provide stream functional uplift long-term. To address these site-specific concerns is WLS willing to use a 90-day consecutive flow metric or 30-days consecutive flow plus biology/macrobenthos monitoring as performance indicators to demonstrate solid stream functional uplift? If this is agreeable, we would be ready to move forward with issuing the notice of intent to approve the project mitigation plan. Please let us know if you have any questions.

Thank you,
Erin

From: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>
Sent: Tuesday, February 6, 2024 3:39 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Cc: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Kichefski, Steven L CIV USARMY CESAW (USA) <Steven.L.Kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; kathryn_matthews@fws.gov; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>; Cara Conder <cara@waterlandsolutions.com>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hello IRT,

WLS has completed responding to your comments on the Cow Tail Final Draft Mitigation Plan. Please see the response to comments attached. I attempted to upload the Final MP to RIBITS, but RIBITS isn't working at the moment. I did upload the Final MP dated 2024 to the DMS/IRT SharePoint folder.

Let me know if you have any questions.
Thank you,
Emily

NORTH CAROLINA
Department of Environmental Quality

Emily Dunnigan (she/her)
Project Manager – Eastern Region
Division of Mitigation Services
217 West Jones St., Raleigh, NC 27603
Cell: 919-817-6534

From: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>
Sent: Friday, January 5, 2024 2:45 PM
To: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Cc: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>; Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>; Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Steve Kichefski <Steven.l.kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; kathryn_matthews@fws.gov; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>
Subject: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Jeremiah & Cara,

We have completed our review of the Draft Mitigation Plan for the NCDMS Cow Tail Mitigation Site (SAW-2023-00196). Please see the attached memo, which includes all NCIRT comments that were received during the review process along with additional comments provided by Wilmington District staff following our review.

We have evaluated the comments generated during the review period and determined that there are concerns raised for which we would like to review responses to comments prior to the moving to the Final mitigation plan. As you will note in the attached memo, there were quite a few requested changes, but most importantly please consider the issues identified with the headwater valley stream approaches. We have had the opportunity to review a number of similar systems in the field recently and have serious concerns with the results of systems that used an approach similar to what is proposed in the draft plan. Specifically, headwater valley systems should not be constructed as PII/III streams with pilot channels, and they should not include construction of structures, or preformed pools and riffles, which is what appears to have been proposed in the Cow Tail plan. Please review the attached comments contact me if you have questions or wish to discuss further. Once the concerns outlined in the attached memo have been addressed, please resubmit an updated Draft Mitigation Plan to our office for review.

Thank you,

Todd Tugwell
Chief, Mitigation Branch
Regulatory Division
Wilmington District, USACE
(919) 210-6265

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Thursday, November 2, 2023 7:42 AM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Kichefski, Steven L CIV USARMY CESAW (USA) <Steven.L.Kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; Matthews, Kathryn (kathryn_matthews@fws.gov) <kathryn_matthews@fws.gov>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>
Cc: Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Subject: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Good morning IRT,

The below referenced Draft Mitigation Plan has been posted by NCDMS on the Draft Mitigation Plan Review section of the DMS & IRT SharePoint Site and on RIBITS. Per Section 332.8(g) of the 2008 Mitigation Rule, this review period will remain open for 30 calendar days from this email notification. Please provide comments by 5 PM on the 30-day comment deadline shown below. When providing comments please indicate if your concerns are great enough that you intend to initiate the Dispute Resolution Process described in Section 332.8(3) of the Mitigation Rule. Comments provided after the 30-day comment deadline (shown below) may not be considered. This comment period may be extended at the request of NCDMS if they determine that additional time is necessary to make changes to the Draft Mitigation Plan.

At the conclusion of this comment period, a copy of all comments will be provided to NCDMS and the NCIRT of the District Engineer's intent to approve or disapprove this project. More information, including instructions to access and use the SharePoint Site, and a flow chart detailing the process are included in the updated document attached to this email notice.

Please send comments to the USACE Mitigation Team only. The USACE Project Manager is Todd Tugwell

Table of Contents

Tables

Figures

Appendices

1 Project Introduction

The Cow Tail Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery stream and wetland mitigation project, contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-416888198. The Project will provide stream and wetland mitigation credits in the Lumber River Basin (Cataloging Unit 03040203). The Project is located in Columbus County approximately 3.3 miles northeast of Evergreen (34.424753°, -78.846214°) (Figure 1). The project will focus on improving lost or degraded aquatic resource functions, providing wildlife habitat, and abating stressors identified by DMS' Lumber River Basin Restoration Priority Plan (RBRP). The project is in the Porter Swamp Targeted Local Watershed (03040203190010).

The Project will involve the restoration of approximately 3,583 linear feet of streams and restoration of approximately 40.818 acres of contiguous riparian wetlands. The Project will provide significant ecological improvements and functional uplift through stream and aquatic habitat restoration, and through decreasing nutrient and sediment loads within the watershed. Table 1 provides a summary of contracted project assets and Figure 9 illustrates the project mitigation components.

Table 1. Project Contract Asset Summary – Stream and Wetland

Stream Reach	Type of Mitigation	Proposed Stream Length (LF)	Credit Ratio	Stream Mitigation Credits (SMCs)
Cow Branch (upper)	Stream Restoration (PI)	192	1:1	191.840
Cow Branch (middle)	Stream Restoration (PI)	1,542	1:1	1,542.082
Cow Branch (lower)	Stream Restoration (PI/PII)	827	1:1	827.172
S100	Stream Restoration (PI)	441	1:1	440.830
S200	Stream Restoration (PI/PII)	581	1:1	581.050
	TOTALS	**3,583**		**3,582.974**
		Credits Contracted to DMS		**3,000.000**
Wetland Area	**Type of Mitigation**	**Proposed Wetland Area (AC)**	**Credit Ratio**	**Riparian Wetland Mitigation Credits (RWMCs)**
W01	Wetland Rehabilitation	8.838	2:1	4.419
W01	Wetland Re-establishment	19.485	2:1	9.743
W02	Wetland Re-establishment	12.495	1:1	12.495
	TOTALS	**40.818**		**26.657**
		Credits Contracted to DMS		**21.900**

2 Watershed Approach and Site Selection

The project is situated in the Cow Branch watershed in the Southern Inner Coastal Plain physiographic region. Cow Branch drains into Porter Swamp approximately ten miles southwest of the project area. Porter Swamp is a TLW and is on the 303(d) list for impaired ecological and biological integrity along its entire length and to its confluence with the Lumber River. The land use within the project area is comprised of mostly forest and agriculture, with a small percentage of low-density residential use.

The existing project streams and riparian wetland functions have been degraded or lost due to long-term agricultural and silvicultural practices. The project streams are channelized, with active ditching, channel widening and bank erosion. The streams and riparian wetlands have been completely or partially cleared and lack adequate riparian buffers. The drainage ditches and agricultural activity also act as significant sources of sediment and nutrient contamination to the catchment.

The project meets the general goals outlined in the 2008 Lumber River RBRP, specifically: planting and enhancing riparian buffers, repairing channelized streams, and preserving existing aquatic resources. The project will improve water quality by reducing nutrient and sediment inputs and providing improved hydrologic function. Natural flow regime will be improved within the riparian wetlands and receiving headwater stream channels. Aquatic and wildlife habitat functions will be improved and protected with a permanent conservation easement.

3 Baseline Information and Existing Conditions Assessment

WLS performed an existing conditions assessment for the Project by compiling and analyzing baseline information, aerial photography, and field data. The purpose of this assessment was to determine how aquatic resource functions have been impacted within the catchment area. Watershed information such as drainage patterns, percent impervious cover, controlling vegetation and hydrology (rainfall/runoff relationships) were evaluated, along with the analysis of physiography, local geology, soils, topographic position (basin relief, landforms, valley morphology), and flow regime (discharge, precipitation, sediment supply). The following sub-sections further describe the existing site conditions, degrees of impairment, and primary controls that were considered for developing an appropriate restoration design approach. Table 2 represents the project attribute data and baseline summary information.

Table 2. Project Attribute Data and Baseline Summary Information

Project Information					
Project Name	Cow Tail Mitigation Project				
County	Columbus				
Project Area (acres)	60.37				
Project Coordinates	34.424753°, -78.846214°				
Project Watershed Summary Information					
Physiographic Province	Coastal Plain				
River Basin	Lumber				
USGS Hydrologic Unit	03040203190010				
DWR Sub-basin	03-07-51				
Project Drainage Area (acres)	581				
Project Drainage Area Percentage of Impervious Area	~2.2%				
CGIA Land Use Classification	2.01.03, 7, 3.02, 311, 1.05 (53% crops, 28% forest, 12% managed pine, 5% herbaceous, 2% transportation)				
Reach Summary Information					
Parameters	Cow Branch (upper)	Cow Branch (middle)	Cow Branch (lower)	S100	S200
Length of reach (linear feet)	181	1,312	763	544	620
Valley confinement (Confined, moderately confined, unconfined)	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (acres)	130	462	581	95	288
Perennial, Intermittent, Ephemeral	Intermittent	Intermittent	Intermittent	Intermittent	Intermittent

Parameters	Cow Branch (upper)	Cow Branch (middle)	Cow Branch (lower)	S100	S200
NCDWR Water Quality Classification	C; Sw	C; Sw	C; Sw	C; Sw	C; Sw
Stream Classification (existing)	G5/channelized	G5/channelized	G5/channelized	G5/channelized	G5/channelized
Evolutionary trend (Simon)	II	II	II	II	II
FEMA classification	N/A	N/A	N/A	N/A	N/A

Wetland Summary Information		
Parameters	W01	W02
Pre-project (acres)/Post-project acres	8.838/28.323	0.000/ 12.495
Wetland type	riparian	riparian
Mapped soil series	Torhunta fine sandy loam (TO)	Torhunta fine sandy loam (TO)
Soil hydric status	Hydric, A/D	Hydric, A/D

Regulatory Considerations			
Parameters	Applicable?	Resolved?	Supporting Docs?
Water of the United States - Section 404	Yes	No	PCN
Water of the United States - Section 401	Yes	No	PCN
Endangered Species Act	Yes	Yes	Categorical Exclusion
Historic Preservation Act	Yes	Yes	Categorical Exclusion
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	Appendix 12
Essential Fisheries Habitat	No	N/A	N/A

3.1 Watershed Characterization

3.1.1 Surface Water Classification

Cow Branch is classified by the DWR as a 'C; Sw' (Aquatic Life, Secondary Recreation, Fresh Water; Swamp Water) from source to Porter Swamp. Cow Branch drains into Porter Swamp approximately ten miles southwest of the project area.

3.1.2 Jurisdictional WOTUS

WLS investigated on-site jurisdictional WOTUS using the USACE Routine On-Site Determination Method. This method is defined in the 1987 USACE Wetlands Delineation Manual and subsequent Atlantic and Gulf Coast Plain Regional Supplement (v2.0), Land Resource Region (LRR) P- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region. Stream classification utilized the NCDWQ Stream Identification Form. Potential jurisdictional (JD) wetland areas as well as upland areas were classified using the USACE Wetland Determination Data Form. The results of the on-site field investigation indicated that all Project reaches were determined to be jurisdictional stream channels. In addition, three jurisdictional wetland areas were delineated within the proposed Project area (See Figure 6) and total 14.106 acres (as labeled in JD WA is 5.145 acres, WB is 2.202 acres, and WC is 6.759 acres). WLS submitted a preliminary jurisdictional determination (PJD) application package to the USACE in June 2023 and received a concurrence on September 19, 2023, agreeing with all aquatic features (Appendix 9).

3.1.3 Aquatic Resource Health and Function

WLS reviewed DWR biological and water quality data within the Cow Branch watershed to identify any potential stressors near receiving waters. Currently, no DWR water quality monitoring stations, or benthic or fish monitoring stations exist in the project watershed. At this time, no known DWR monitoring sites are proposed for monitoring use by WLS for this project. It is generally accepted that nutrient loading and sedimentation from streambank erosion is a significant pollutant to water quality and aquatic habitat.

3.1.4 NC SAM and NC WAM

WLS completed stream and wetland assessments using the *NC Wetland Assessment Method* (NC WAM, Version 5.0, 2015) and *NC Stream Assessment Method* (NC SAM, Version 2.1, 2015). WLS evaluated the NC WAM and NC SAM metrics relevant to the Project wetland areas and stream reaches (See Appendix 8). Most of the Project reaches scored 'low' due to incised channels, lack of buffer, and water quality stressors from agriculture. S100 and Cow Branch upper score 'medium' due to existing riparian vegetation widths and no breaks affecting those widths. The vegetation on S100 is successional and Cow Branch upper is forested. Existing wetlands (WA, WB, and WC) rated 'low' due to disturbed conditions and drained wetland hydrology. The ecological assessments also incorporated qualitative and quantitative observations using historic aerials, field evaluations, and detailed topographic survey data collected across the site. The conclusions from these assessments help describe the current stream and wetland conditions and functional ratings, however, these methods are not intended for determining mitigation success on the site.

3.2 Landscape Characteristics and Regional Controls

3.2.1 Physiography and Geology

The project is located in the Southern Inner Coastal Plain physiographic region within the Atlantic Southern Loam Plains Level IV Ecoregion ('65l'). This Ecoregion is characterized by lower, flatter, more gently rolling topography with finer-textured soils than the nearby Sandhills region. This region has the highest concentration of Carolina bays. These bays are defined as shallow, elliptical depressions, often swampy or wet in the middle with dry sandy rims. Carolina bays not drained for agriculture often contain rare or endangered plant and animal species. The geologic unit at the project site is classified as 'Tpy' Yorktown Formation and Duplin Formation, Undivided. This type of sedimentary rock is characterized by underlying fossiliferous clay with varying amounts of fine-grained sand, bluish gray, shell material commonly concentrated in lenses; mainly in area north of Neuse River. The Duplin Formation is characterized by shelly, medium-to coarse-grained sand, sandy marl, and limestone, bluish gray; mainly in area south of Neuse River (NCGS, 1985).

3.2.2 Soils

Soils at the project were initially determined using NRCS soil survey data for Columbus County (NRCS Columbus County Soil Survey). The soils within the project area were verified during on-site field investigations as described in the detailed soils report in Appendix 2. Figure 4 illustrates NRCS soil series throughout the project area and the soil descriptions are provided below in Table 3.

Table 3. Project Soil Type and Descriptions

Soil Name	Hydric	Description
Pantego fine sandy loam (Pa)	Yes	Consists of deep, very poorly drained soils, and marine deposits found on marine terraces and broad interstream divides. Slopes range from 0 to 2 percent.
Stallings sandy loam (St)	No	Consists of deep, somewhat poorly drained, moderately rapidly permeable soils that formed in loamy Coastal Plain sediments. Slopes range from 0 to 3 percent.
Torhunta fine sandy loam (To)	Yes	Consists of very poorly drained soils in upland bays and on stream terraces in Coastal Plain. Slopes range from 0 to 2 percent.

On-site soils investigations were conducted to identify potential hydric soils in April of 2023 by licensed soil scientist (LSS), George K. Lankford, LSS, with George K Lankford, LLC (See Hydric Soils Report in Appendix 2). The findings were based on hand-turned auger borings and indicate the presence of a large, continuous area of hydric soils throughout the floodplain and clear-cut area. George Lankford noted that areas of existing hydric soils have been manipulated by a combination of past and current agricultural and silvicultural practices (i.e., lateral ditching and timber harvesting). The presence of thick dark surfaces and mucky surface textures indicate the site was historically very wet with extended periods of saturation and/or semipermanent flooding. The hydric soils status is based upon the *Field Indicators of Hydric Soils in the United States (USDA, NRCS, 2018, Version 8.2)*. Hydric soil indicators used are valid for the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region*

Version 2.0 within Major Land Resource Area (MLRA) 133A (Southern Coastal Plain) and Land Resource Region (LRR) P- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

3.2.3 Climate

The average growing season for the Project site is 255 days, beginning March 9th and ending November 19th (Whiteville 7 NW WETS table for Columbus County, NC). The average annual precipitation is approximately 47.63 inches with a consistent monthly distribution, except for convective storm events or hurricanes that occur during the summer and fall months.

3.2.4 Existing Vegetation

The current land use adjacent to Cow Branch and S200 is agricultural/crop production. The natural community has been effectively removed through tillage, ditching, agriculture, and silviculture on and directly adjacent to the project area. These practices have removed native vegetation and have altered the hydrology of the site for row-crops to be successful. The isolated and disturbed remnant forest community located adjacent to the property is dominated by loblolly pine, water oak, bay species (*Magnolia virginiana* and *Persea borbonia*) and American holly in the midstory. Doghobble and greenbrier are also prevalent throughout.

The W01 area has been clear-cut within the past seven years and the successional vegetation surrounding S100 and W01 is mostly two bay species with some sweetgum, red maple, and loblolly pine. WLS conducted an existing conditions assessment of the vegetation in W01 to guide the re-vegetation in this area (Appendix 2). Prior to anthropogenic land disturbances, the riparian vegetation community likely consisted of Coastal Plain Small Stream Swamp (Schafale 2012). The existing vegetation on the remainder of the project area consists of a successive understory adjacent to some streams (Table 4). The invasive species vegetation present on the Project site are primarily Chinese privet and multiflora rose.

Table 4. Existing Site Vegetation

	Common Name	Scientific Name
Canopy Vegetation	Red maple	*Acer rubrum*
	Loblolly pine	*Pinus taeda*
	Sweetgum	*Liquidambar styraciflua*
	Water oak	*Quercus nigra*
	Tulip poplar	*Liriodendron tulipifera*
Understory & Woody Shrubs	Sweetgum	*Liquidambar styraciflua*
	Red maple	*Acer rubrum*
	Sweetbay magnolia	*Magnolia virginiana*
	Chinese privet	*Ligustrum sinense*
	Wax myrtle	*Myrica cerifera*
	Black elderberry	*Sambucus nigra*
	Swamp titi	*Cyrilla racemiflora*
	American holly	*Ilex opaca*
	Tag alder	*Alnus serrulata*
	Red bay	*Persea borbonia*

	Common Name	Scientific Name
Herbaceous	Cinnamon fern	*Osmundastrum cinnamomeum*
	Netted chain fern	*Woodwardia areolata*
	Roundleaf greenbrier	*Smilax rotundifolia*
	Southern lady fern	*Athyrium asplenioides*
	Japanese honeysuckle	*Lonicera japonica*
	Muscadine	*Vitis rotundifolia*
	Doghobble	*Leucothoe fontanesiana*
	Sawtooth blackberry	*Rubus argutus*

3.3 Land Use and Development Trends

The USGS 2011 National Land Cover Data GIS Dataset and StreamStats were used to estimate the current impervious cover and land use information for the project catchment area. The entire catchment area has an impervious surface cover of approximately two percent and the dominant land uses are 53% cultivated crops, 28% unmodified forest, and 12% passively managed pine. WLS conducted field reconnaissance to verify the current land use practices within the catchment, which include active agricultural land managed as crop production, clear-cut regrowth (W01, S100, lower Cow Branch) and adjacent forested areas along the left bank of S200 and upper Cow Branch.

Prior to 2015, a majority of the project area was forested with adjacent agricultural fields as illustrated on historic aerials (See Figures 7a-7c). In 2015, the western project area designated as W01 was clear-cut. Over time, the natural stream and wetland processes and aquatic resource functions have been significantly impacted because of these historic anthropogenic disturbances.

3.4 Watershed Disturbance and Response

To determine what actions are needed to restore the riparian corridor structure and lift ecological functions, it is critical to examine the rates and type of disturbances, and how the system responds to those disturbances. Across the Project site, landowners historically cleared large portions of mature forest and manipulated, and/or straightened streams and ditched riparian wetland systems to provide areas for crop production. These activities have caused changes to historic channel patterns, sediment transport, in-stream habitat and restriction of fish movement, thermal regulation, and dissolved oxygen (DO) content.

Cleared portions of the riparian buffer area are shown on historical aerial photographs (See Figures 7a, 7b and 7c). A majority of the Project reaches have been heavily impacted from these historic and current land use practices, including agriculture and silviculture. Within the Project area, approximately 90% of the streambanks have inadequate (less than 50 feet wide) riparian buffers. Across the project site 100 percent of the total stream lengths exhibits channelization or obvious incision. Agricultural practices, including regular ditch/streambank maintenance have drained wetland hydrology and severely impacted the natural flow regime along the project stream reaches. The lack of adequate and high-quality buffer vegetation, past land use disturbances, active channel degradation, minimal impervious cover, and current agricultural practices present a significant opportunity for water quality and ecosystem improvements through the implementation of this project.

3.5 Existing Stream Conditions

The existing streams were labeled as three distinct reaches (Cow Branch, S100, and S200) totaling approximately 4,558 linear feet within the project area. Project reaches were differentiated based on drainage area breaks at confluences, design approach, and/or jurisdictional stream status. Field evaluations and analysis of valley slope and watershed area determined that the project reaches are jurisdictional stream systems. The evaluations of intermittent/perennial stream status were made in late December 2020 normal rainfall conditions. These evaluations were based on *NCDWR's Methodology for Identification of Intermittent and Perennial Streams and Their Origins*, (v4.11, Effective Date: September 1, 2010) stream assessment protocols. Copies of the referenced DWR Stream Identification Forms are included in Appendix 7 and reach condition summaries are provided below.

Cow Branch: Cow Branch begins off the property as a headwater stream that has been channelized and straightened along much of its length and is generally not located within its historic valley. A majority of Cow Branch drains an extensive ditch network that appears to have been dug through historic riparian wetlands and interstream divide wetland flat. Spoil levees/berms are evident inside the woodline and along the southern and eastern property lines. In addition, a small pond was built adjacent to the natural stream valley. The impoundment size (~0.2 acres) and location have remained unchanged for decades and are currently not being used. The valley slope across the site is approximately 0.20 percent and the drainage area is 581 acres at the downstream end. The majority of the drainage area for Cow Branch is active agricultural fields and the upper portions have been recently timbered.

Because the stream has been straightened and channelized, the sinuosity is non-existent (k=1.0). The dimension of Cow Branch is trapezoidal with approximate widths of 11.0 to 14.0 feet, depths 1.6 to 3.0 feet, and <1.5:1 side slopes. The typical Bank Height Ratio (BHR) was measured to be >2.0.

The riparian buffer along Cow Branch consists of a mix of active agricultural fields, with minimal successional woody vegetation, as upper sections of the channel are regularly mowed and maintained. Based on the poor channel conditions and historic anthropogenic disturbances, including channelization and straightening, Cow Branch was classified as a Rosgen 'G5' stream type.

Looking upstream along Cow Branch showing channelized conditions.

Looking upstream along S100 showing channelized stream conditions.

S100: S100 is a small tributary that has been channelized and straightened along its entire length. The valley slope is approximately 0.25 percent and the drainage area is 95 acres. The entire drainage area for this reach is within active agricultural fields. The channel is fed by an extensive ditch network at its upstream end and the natural valley was difficult to determine during site assessment.

S100 drains to its confluence with Cow Branch below an abandoned farm crossing. Multiple spoil levees/berms are evident along the ditch network. Because the stream system has been channelized, the sinuosity is non-existent (k=1.0). The dimension of S100 is trapezoidal with approximate widths of 11.0 to 13.0 feet, depths 3.0 to 4.0 feet, and <1:1 side slopes. The typical BHR was measured to be >2.0.

The riparian buffer along the entire length of S100 consists of mostly herbaceous vegetation with limited woody species and no canopy vegetation. Based on the poor channel conditions and historic anthropogenic disturbances, including channelization and straightening, S100 was classified as a Rosgen 'G5' stream type.

Looking upstream at S200 and channelized conditions lacking riparian buffer vegetation.

S200: S200 flows southwest under the Old Lumberton Road culvert crossing for approximately 2,347 feet before it's confluence with Cow Branch. The drainage area is approximately 288 acres and the upper area is located mostly within mixed forest and managed pine timber. The stream is fed by an extensive drainage network at its upstream end and this area appears to be heavily modified and/or a remnant Carolina bay.

Although S200 has been manipulated and straightened, a small channel has formed with narrow benches on both banks. The reach width is approximately 10.0 feet and the representative BHR is >2.0. The narrow benches within the channel do not provide an adequate floodprone width for a stable stream system and the reach does not contain coarse woody debris required to provide habitat and natural bedform diversity. Similar to S100, the reach consists of mostly herbaceous vegetation and no canopy vegetation. Based on the current channel conditions and historic anthropogenic disturbances, including channelization and straightening, S200 was classified as a Rosgen 'G5' stream type.

3.5.1 *Channel Morphology and Stability Assessment*

WLS conducted geomorphic and ecological assessments for the Project reaches to assess the current stream channel condition and overall lateral and vertical stability. Data collection included five representative riffle cross-sections, longitudinal profiles, and bulk sediment samples. The existing channel morphology is summarized in Table 5 and detailed geomorphic assessment data is included in Appendix 2. Consistent geomorphic indicators of the bankfull stage were difficult to identify in the field given the modified flow regime (i.e., ditching) and channelized stream conditions. Therefore, bankfull cross-sectional areas were initially compared with the published NC Coastal Plain Regional Curve (Sweet and Geratz, 2003). See Appendix 2 for regional curve comparison plots. The BHRs were measured in the field to assess the degree of channel incision. BHR values greater than 1.5 typically indicate the stream channel is disconnected from its floodplain and system wide self-recovery is considered unlikely to occur within a desired timeframe (Rosgen, 2001). Entrenchment Ratios (ER) were also measured to determine the degree of vertical confinement. ERs less than 2.2 illustrate vertical confinement and represent channelization and spoil berms in various locations shown on the topographic mapping.

Table 5. Existing Channel Morphology and Summary

Project Reach Designation	Watershed Drainage Area (Ac)[1]	Entrenchment Ratio (ER)	Width/Depth Ratio (W/D)	Bank Height Ratio (BHR)	Sinuosity (K)	Channel Slope (S, ft/ft)	D_{50} (mm)
Cow Branch (upper)	130	>2.2	22.7	2.2	1.01	0.0059	<2.0
Cow Branch (middle)	462	1.8	7.9	2.1	1.01	0.0017	<2.0
Cow Branch (lower)	581	2.3	7.8	2.3	1.01	0.0019	<2.0
S100	95	1.3	8.6	2.6	1.01	0.0023	<2.0
S200	288	1.4	8.3	>2.0	1.01	0.0021	<2.0

Note 1: Watershed drainage area was approximated based on topographic and LiDAR information and compared with USGS StreamStats at the downstream end of each reach.
Note 2: Representative cross-section locations are shown on Figure 6, Current Conditions Map.
Note 3: Geomorphic parameters are based on best professional judgment and field measurements.
Note 4: Additional values and dimensionless ratios for meander geometry and facet slopes are provided in Appendix 2. The existing channel parameters are compared to stable stream systems in the Coastal Plain Physiographic Region.

3.5.2 *Channel Evolution*

The modified Simon Channel Evolution Model (CEM) describes a predictable sequence of change in a disturbed channel system (Simon, 1989). Channel evolution typically occurs when a stream system begins to change its morphologic condition, which can be a negative or positive trend towards stability. The channel evolution processes and stage have been greatly affected by human alteration and land disturbances. After reviewing the channel dimension, plan form, and longitudinal profile information, WLS concluded that project reaches are classified as stage 'II' as evidenced the straightened/ditched conditions.

3.5.3 Sediment Supply, Delivery and Storage

Representative bed materials were bulk sampled along Cow Branch. The project reaches consist of predominantly fine sand and silt with some mucky mineral observed along all reaches. Much of the parent material, which contains sandy loam particle sizes, are mostly buried and still evident in the bank profiles shown on the soils report. Field investigations suggest that the fine sediment supply is limited and being recruited predominantly from localized streambank erosion along the project stream reaches and ongoing agricultural activities. The streambank erosion along the project stream reaches appears to be localized and recruited during episodic storm flows due to the limited buffer vegetation and rotational crop cover throughout the catchments. Based on the limited sediment supply and proposed restoration conditions, WLS does not anticipate significant aggradation across the project site.

3.6 Existing Wetland Conditions

There is a flat to concave topography that collects surface flows that historically supported a large, extensive wetland across the site. Detailed soil mapping and delineations, conducted by a licensed soil scientist (George Lankford, LSS), determined that this area contained three separate jurisdictional wetlands that have been fragmented from the original wetland community. Two of the wetlands have a mature tree canopy of loblolly pine with sweet gum and red maple. The understory consists of red maple, sweet bay, red bay, and many wet species typical of wetlands in the area.

Ditching across the site and adjacent uplands is relatively extensive and due to the deep sandy nature of the soil, a significant lateral drainage effect is expected from the ditches. In a natural, undrained condition, soils would have very slow runoff and the low gradient landscape would have supported appropriate conditions for lengthy periods of saturation. Due to the moderately high to high internal drainage anticipated in these sandy textured soils, the ditch network lowers groundwater elevations across much of the site for most of the year to manage site trafficability for farm equipment and timber activities. Within the cultivated fields, surface modifications include spreading of spoil/fill from the draining excavation and slight crowning to improve removal of surface water from the fields. These fields appear to be tilled/cultivated annually or biennially.

Within the cut-over area, most ditches appear to have a berm along one or both sides from the excavated material. The forested areas have berms between the wetland and excavated channels graded into an elevated access path with internal drainage ditching limited, maintaining a more appropriate hydroperiod. An excavated pond with adjacent spoil is present within wetland WA as shown on Figure 6. The existing wetlands abut the drained hydric soils and are fragments of the historical wetland that covered this site.

Groundwater was observed within both the forested and cut-over wetlands. Four automated groundwater wells were installed in W01 to evaluate the range of hydrologic conditions for this wetland (Figure 6 and Appendix 2). Two groundwater wells (GW5 and GW6) were installed in a reference quality wetland for comparison during monitoring. This well data will help provide the basis for comparing pre- and post-construction groundwater hydrology. The wells were installed in March 2023 and the data summary is included in Appendix 2. WLS will identify trends in water table depth throughout the pre-restoration monitoring period that reflect seasonal rainfall as well the hydrologic interaction with the disturbed stream. The automated data loggers (HOBO U20L-04) are programmed to record water table levels every 12 hours.

3.7 Potential Site Constraints

3.7.1 *Existing Easements and Right-Of-Ways on the Site*

No existing easement exists within the project site.

3.7.2 *Utility Corridors within the Site*

There are no existing utility crossings within the conservation easement boundary.

3.7.3 *Mineral or Water Rights Assurance*

There are no mineral or water rights issues within or adjacent to the Project properties.

3.7.4 *Hydrologic Trespass*

Riparian stream and wetland restoration activities in flatter valleys can potentially affect site drainage and land use beyond the project property boundaries. The site falls approximately eight feet across the entire project area and distinct topographic breaks were observed between hydric/non-hydric soils. The site relief is shown on LiDAR (Figure 5) and detailed topographic survey. The project was designed to not affect land use or create a flood encroachment outside of the conservation easement boundary. Post restoration, the increase in flood flows will be contained within the project boundary and not expected to impact adjacent landowners. The design elevations were determined using the detailed topographic survey and proposed surface to develop a hydraulic model (GeoHECRAS) for simulating flood flows for the bankfull, 10-yr, 25-yr and 100-yr storm events. The model results indicate the bankfull, 10-yr, 25-yr and 100-yr discharges remain within the channel boundary throughout upper portion of the project (S200 and Cow Branch confluence) from the upstream 48" diameter culvert invert at Old Lumberton Road onto the project boundary. The 100-yr flood event extends into the adjacent field, but does not cause backwater effect over culvert at Old Lumberton Road and flood extents are contained within project properties.

WLS observed the presence of beaver dams along Cow Branch and S200 during site assessments. Any beaver dams will be removed during construction activities and throughout the monitoring period. An additional hydraulic model was developed to illustrate the post-restoration conditions if a hypothetical 2.0' tall beaver dam was built along upper Cow Branch after project regulatory closeout. The flood model results and inundation maps are provided in Appendix 2. Based on the model results, adverse flooding and the potential for hydrologic trespass is not expected given the increased floodplain storage and topographic relief across the site. In addition, WLS has secured conservation easement area beyond the proposed restoration limits and creditable areas to allow for partial ditch filling and gradually raising the profile elevation while redirecting surface flow to the restored natural valley.

3.7.5 *Conditions Affecting Hydrology*

As discussed in Section 3.6, there are several existing ditches throughout the Project area. These ditches were historically used to drain fields and create arable land for farming practices. During construction, many of these ditches will be plugged and graded to restore the natural topography to prevent them from negatively affecting hydrology. For estimation purposes, the lateral effect method developed by Skaggs was used to calculate the distance that existing ditches influence hydrology through drained hydric soil areas (Skaggs, 2005). The distance of influence is defined as the width of a strip adjacent to the ditch that is drained such that it will no longer satisfy the adjacent wetland hydrologic criterion. The method uses inputs of ditch depth, depth to impermeable layer, effective hydraulic conductivity, drainable porosity, T25, and the nondimensional solution to the Boussinesq equation to calculate the lateral effect. Simulation analyses were conducted using DRAINMOD (Skaggs, 2012) to predict the drainage intensity required to satisfy a minimum 14-day or 5% wetland hydroperiod across the primary ditch networks.

The lateral effect analyses included the hydric soils properties, profiles and hydraulic conductivities referenced in the soils report and as published by NRCS. The DRAINMOD results predict a lateral effect along Cow Branch (upper) of 76 ft and 138 ft (lower), 58 ft (D3 near S100 crossing) and up to 158 ft along existing ditches. The existing ditches (Ditch 05 and Ditch 11) along the eastern and southern property lines have a lateral effect of 103 ft and 126 ft respectively. These ditches will remain fully open to reduce saturated groundwater and/or backwater conditions along the adjacent property. The lateral effect summary outputs are located in Appendix 2 and the ditch locations including fill areas are shown on the design plans in Appendix 1 and Figure 9.

3.7.6 *FEMA Compliance*

The proposed project is not within a FEMA regulated floodplain and no floodplain coordination is anticipated.

3.7.7 *Invasive Species Vegetation*

There are currently no substantial communities of invasive plant species within the Project boundaries. Some small, immature Chinese privet plants and multiflora rose were observed within the project area. These areas will be monitored by WLS, and any invasive plants found within the Project boundary will be treated to prevent expansion and establishment of a substantial invasive community.

3.7.8 *Potential Future Land-Use*

Future site constraints include, but are not limited to development, silviculture, and infrastructure maintenance. Historic aerial imagery indicates that the Project has been used extensively for agricultural purposes. The surrounding areas remain in an agricultural community with some neighboring forested property. Due to low development potential, the area will likely remain in agricultural use. While there are some forested areas surrounding the project area, they are not extensive enough for silviculture or logging operations. The project area is not adjacent to any roads that might need future maintenance. Project reaches were designed to be self-maintaining and resilient in a dynamic landscape. Riparian buffers in excess of 50 feet in many areas of the project will protect the project reaches from changes in watershed hydrologic regimes.

3.7.9 *Stream Crossings*

There are no permanent stream crossings or easement breaks proposed across the project area. The two existing culvert crossings to be improved are located at non-jurisdictional ditch features outside of the conservation easement and creditable areas as shown on the design plans and Figure 9.

4 Functional Uplift Potential

Harman et al. (2012) provides a framework for conducting function-based assessments to develop project goals and objectives based on a site's stream restoration potential and functional uplift. The framework is based on the Stream Functions Pyramid (SFP) which is a conceptual model that can be used to help define project goals and objectives by linking them to stream functions. Stream functions are separated into a hierarchy of functions and structural measures, ranging from Level 1 to Level 5 and include the following functional categories: Hydrology (Level 1), Hydraulic (Level 2), Geomorphic (Level 3), Physicochemical (Level 4), and Biological (Level 5). Function-based goals and objectives were considered that relate restoration activities to the appropriate parameters from the SFP framework, which are based on existing conditions, site constraints and overall restoration potential.

The function-based goals and objectives address water quality stressors by reducing nutrient and sediment inputs through stream restoration, riparian buffer restoration, and riparian wetland restoration. A more natural flow regime will be restored to riparian wetlands and floodplain areas by raising the stream bed elevation to reconnect the channels to their active floodplain and plugging existing ditches. The construction techniques will improve hydrology by promoting surface ponding and infiltration, decreasing drainage capacity, and raising water table conditions across the site. To accomplish these site-specific goals, the following functional objectives will be measured to document overall project success as described in Table 6.

Table 6. Function-Based Goals and Design Objectives Summary

Functional Category (Level)	Functional Goal / Parameter	Functional Design Objective
Hydrology (Level 1)	Improve Base Flow	Improve and/or remove existing stream crossings, restore a more natural flow regime, and improve aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Lower BHRs to <1.2 and increase ERs at ≥2.2
Geomorphology (Level 3)	Improve Bedform Diversity	Increase riffle/pool percentage and pool-to-pool spacing ratios.
	Increase Lateral Stability	Improve cross-section values to stable reference conditions.
	Establish Riparian Buffer Vegetation	Plant native species vegetation a minimum 50' wide from the top of the streambanks with a composition/density comparable to reference condition.
Physicochemical (Level 4)	Improve Water Quality	Establish 50 ft wide riparian buffers and re-establish wetlands that will filter excess nutrients.
Biology (Level 5)	Improve Macroinvertebrate Community and Aquatic Species Health	Incorporate native woody debris into restored channels.
Wetlands	Restore natural wetland hydrology and groundwater interactions. Restore wetland vegetation.	Restore hydrologic connectivity through wetland and floodplain connectivity and interaction. Establish a full composition of herbaceous, shrub, and forested vegetative community free of invasive species and consisting of native species.

4.1.1 Restoration Potential

The Project will provide numerous water quality and ecological benefits within the watershed. It is expected the Project will reduce pollutant loads, including sediment and nutrients, improving overall aquatic resource functions. Given the landscape position and catchment size, the stream and wetland restoration activities will likely provide physicochemical and biological functional lift categories, however, these functional categories and performance standards will not be assessed nor required to determine project success and mitigation crediting purposes.

5 Mitigation Project Goals and Objectives

The project mitigation goals and objectives will be based on the current resource condition and functional capacity of the project watershed to improve and protect diverse aquatic resources comparable to stable stream and wetland systems within the inner Coastal Plain Physiographic Province. The project will address watershed stressors and provide numerous water quality and ecological benefits within the upper Cow Branch watershed. The project will meet the general restoration goals and opportunities outlined in the Lumber River Basin RBRP (DMS 2008). More specifically, the project goals are:

- Improve water transport from watershed to the channel in a non-erosive manner in a stable channel.
- Improve flood flow attenuation on site and downstream by allowing for overbanks flows and connection to the active floodplain.
- Improve bedform diversity.
- Improve instream habitat.
- Improve water quality in agricultural areas by reducing sediment and nutrient supply.

To accomplish these project-specific goals, the following objectives will be measured to document overall project success:

- Provide a floodplain connection to the incised Project stream reaches by lowering bank height ratios (BHRs) to less than 1.2, thereby promoting floodplain storage and overbank flood flows.
- Increase scour pool to pool spacing and depth variability.
- Increase native species riparian buffer and wetland vegetation density/composition along streambank and floodplain areas that meet requirements of a minimum 50-foot-wide and 210 stems/acre after the monitoring period.
- Addition of in-stream cover and native woody debris.
- Add in-stream structures and bank stabilization measures to protect restored and enhanced streams.
- Install habitat features such as brush toes, constructed riffles, woody materials, and pools of varying depths to restored and enhanced streams;
- Site protection through a 60.37-acre conservation easement that will protect all streams, wetlands, riparian buffers, and aquatic resources in perpetuity.

The existing conditions site assessment suggests that the proposed mitigation activities will result in a higher functioning aquatic ecosystem. The project goals and objectives address water quality stressors by reducing nutrient and sediment inputs through stream restoration, riparian buffer restoration, and riparian wetland restoration. Hydrologic functions will be improved by raising the local water table. The biologic and habitat functions will be improved by the revegetation of the riparian buffers.

5.1.1 Project Benefits Summary

The project will provide numerous water quality and ecological benefits within the Cow Branch watershed. The expected project benefits and ecological improvements are summarized in Table 7.

Table 7. Project Benefits Summary

Benefits Related to Hydrology (Level 1)	
Rainfall/Runoff	Restoring and enhancing 50-foot forested riparian buffers, re-establishing wetlands, and alleviating concentrated flow points will decrease the volume and intensity of runoff into the system.
Benefits Related to Hydraulics (Level 2)	
Floodplain Connectivity	Restoration practices will restore proper floodplain connection by establishing stable bank height ratios and entrenchment ratios.
Surface Storage and Retention	Floodplain connectivity will allow for more surface area for surface storage and retention.
Groundwater Recharge/ Hyporheic exchange	Raising and reconnecting the restored stream bed will promote higher water table conditions and more hyporheic exchange.
Benefits Related to Geomorphology (Level 3)	
Proper Channel Form	An appropriate channel form for the valley type and slope will allow for a self-sustaining system.
Sediment Transport	Decreasing stream bank erosion, connecting with the floodplain, and removing areas from silviculture will decrease the sediment coming from the restored system.
Riparian Buffer Vegetation	Restoring and enhancing 50-foot forested riparian buffers and wetlands will allow for canopy cover and large woody debris in the system.
Bioengineering Treatments	The use of woody in-stream structures will ensure channel stability while also providing live cuttings and live staking.
Benefits Related to Physicochemical (Level 4) – not monitored	
Nutrient Reduction	Restoration practices will exclude streams from adjacent agricultural and silvicultural use and provide functional riparian buffers of sufficient width to provide nutrient reductions.
Sediment Reduction	Restoration practices will exclude streams from adjacent agricultural and silvicultural use, provide functional riparian buffers of sufficient width, and stabilize stream bank erosion to provide sediment reductions.
DO, NO_3-, DOC Concentration	Restored buffers will also provide shade, reduce water temperatures, and increase dissolved oxygen concentrations. The restored stream bed will promote higher water table conditions and facilitate denitrification.
Benefits Related to Biology (Level 5) – not monitored	
Terrestrial and Aquatic Habitat	Restoration practices will restore appropriate habitats, reduce sediment and nutrient loads, and provide increased shading and organic material inputs for aquatic organisms.

6 Design Approach and Mitigation Work Plan

The Project will involve the restoration of five reaches (Cow Branch upper, Cow Branch middle, Cow Branch lower, S100, and S200) totaling approximately 3,583 linear feet of streams and their associated riparian buffers (Figure 9). This approach will utilize a Priority I/II restoration approach and appropriately address WOTUS, including restoring riparian buffers currently in agricultural use. The project will also restore (re-establish) and rehabilitate 40.818 acres of riparian wetlands, and protect 60.37 acres of conservation easement. The design approach will include multiple mitigation practices to reduce stressors and maximize functional uplift. The mitigation components and proposed credit structure are outlined in Table 8 and the design approach and mitigation work plan are described in the following subsections.

Table 8. Mitigation Components and Proposed Credit Summary

Table 8. Cow Tail Mitigation Site (ID-100647) Project Mitigation Quantities and Credits

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits		Comments
Stream								
Cow Branch (upper)	191.840		Warm	R	1.00000	191.840		Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
Cow Branch (middle)	1,542.082		Warm	R	1.00000	1,542.082		Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
Cow Branch (lower)	827.172		Warm	R	1.00000	827.172		Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
S100	440.830		Warm	R	1.00000	440.830		Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
S200	581.050		Warm	R	1.00000	581.050		Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
					Total:	**3,582.974**		
Wetland								
Wetland 01	8.838		R	RH	2.00000	4.419		Restoring groundwater hydrology through adjacent PI restoration, ditch filling, limited soil manipulation, spoil removal, supplemental planting
Wetland 01	19.485		R	REE	2.00000	9.743		Restoring groundwater hydrology through adjacent PI restoration, ditch filling, limited soil manipulation, spoil removal, supplemental planting
Wetland 02	12.495		R	REE	1.00000	12.495		Restoring groundwater hydrology through adjacent PI restoration, limited soil manipulation, ditch filling, full planting
					Total:	**26.657**		

Project Credits

Restoration Level	Stream			Riparian Wetland	Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold			
Restoration	3,582.974	0.000	0.000	0.000	0.000	0.000
Re-establishment				22.238	0.000	0.000
Rehabilitation				4.419	0.000	0.000
Enhancement				0.000	0.000	0.000
Enhancement I	0.000	0.000	0.000			
Enhancement II	0.000	0.000	0.000			
Creation				0.000	0.000	0.000
Preservation	0.000	0.000	0.000	0.000	0.000	
Totals	**3,582.974**	**0.000**	**0.000**	**26.657**	**0.000**	**0.000**

Total Stream Credit **3,582.974**
Total Wetland Credit **26.657**

Wetland Mitigation Category

CM	Coastal Marsh
R	Riparian
NR	Non-Riparian

Restoration Level

HQP	High Quality Preservation
P	Preservation
E	Wetland Enhancement - Veg and Hydro
EII	Stream Enhancement II
EI	Stream Enhancement I
C	Wetland Creation
RH	Wetland Rehabilitation - Veg and Hydro
REE	Wetland Re-establishment Veg and Hydro
R	Restoration

6.1 Stream Design Approach

As described above in Sections 4 and 5, WLS used function-based assessment methods and data analyses to determine overall restoration potential and functional uplift. The stream design approach generally followed the techniques and methods outlined in the *NRCS Stream Restoration Design–National Engineering Handbook* (NRCS, 2007) and *Hydraulic Design of Stream Restoration Projects* (USACE, 2001). In addition, the natural stable channel design (NCD) procedures outlined in the *Natural Channel Design Review Checklist* (Harman and Starr, 2011) were applied to address specific stream functions lost across the site, while also minimizing disturbances to existing wooded areas and higher functioning resources.

WLS first compiled and assessed watershed information such as drainage areas, historical land use, geologic setting, soil types, sediment inputs and plant communities. Civil and Environmental Consultants, Inc. (CEC) then performed detailed existing conditions topographic and planimetric surveying of the project site and produced a 1-foot contour map, based on survey data (using both conventional ground and UAS methods), to create base mapping and plan sheets (See Appendix 1). Geomorphic surveys were also conducted along the channel and floodplain to determine valley slopes/widths, channel dimensions, longitudinal profile elevations, and to validate the valley signatures shown on the LiDAR imagery (See Figure 5).

Project stream design criteria was developed using a combination of industry sources and applied approaches, including a review of applicable Coastal Plain (CP) reference reach data (analog), evaluation of published regression equations and hydraulic geometry relationships (CP regional curve), monitoring results from successful past projects (empirical), and building a hydraulic model using process-based equations to test design channel geometry and bed stability (analytical). It should be mentioned, while analog and empirical form-based approaches have been proven effective in designing stable stream systems, their application assumes quasi-equilibrium conditions and similar watershed and boundary conditions (i.e., dominant discharge, flow regime, channel roughness, controlling vegetation). Using a static design template that accounts for natural channel variability, especially in CP systems, can be limited by the regional data sets and overlook other local controlling factors such as flow impoundments, woody debris/abundance, and sediment supply (Skidmore, 2001).

Conversely, analytical or process-based approaches rely heavily upon precise data inputs and a more robust level of effort may not be practical or even necessary to replicate channel geometry given the model sensitivity and desired outcome. Designing appropriately sized stream channels requires a detailed assessment of sediment continuity and predicted channel response for a range of smaller flows. Although it is challenging to definitively predict long term hydrologic conditions in the watershed, designing an appropriate stream channel for the valley characteristics (i.e., slope, width, and confinement) is always the preferred design rationale. Therefore, best professional judgment was used when selecting appropriate design criteria for lifting the desired ecological functions.

6.1.1 Proposed Design Parameters

The proposed stream design parameters describe the planimetric (pattern), cross-section dimension, and longitudinal profile as illustrated on the design plans. The stream design approach considered these parameters as conservative guidelines that allow for natural variability in channel form, facet slopes, and bed features caused by flood processes, vegetation establishment, and other watershed influences (Harman, Starr, 2011). The design parameters for the project reaches are based on published CP regional curve data set (Sweet and Geratz, 2003), CP reference reach data, CP monitoring data from successful past projects, and conclusions developed from an analysis of functional riparian stream and wetland systems in the North Carolina CP region (Appendix 2).

The design approach also evaluated site conditions that help predict channel formation in CP headwater stream systems (Tweedy, 2009). The design considered the relationship between drainage area and valley slope that correlate to channel form and maintaining consistent stream features (i.e., bed and bank, OHWM). Under stable conditions (dynamic equilibrium), these poorly defined stream channels are classified as Rosgen 'DA' stream types (Rosgen, 1996). Nanson and Knighton characterized anastomosed channels by having low gradients and low stream power (≤ 10 Wm-2). These flow regimes are often more aggradational, have channel slopes flatter than 0.01 ft/ft, higher width/depth ratios, however channel sinuosity or "transitional patterns" can vary greatly from 1.1 to 1.5 (Nanson and Knighton, 1993). Comparing the information from this study with multiple CP reference sites concluded that the streams are expected to maintain their form as a more defined single thread-channels.

WLS staff have implemented successful mitigation projects in ungaged headwater drainages in the CP hydrophysiographic province of North Carolina. Projects examples that have achieved IRT regulatory closeout include UT to Mill Swamp, UT to Jumping Run Creek, and Duke Swamp. As noted above, monitoring data from these restoration projects and reference information were evaluated and added to the original dataset as a comparison (see channel form comparison in Appendix 2). These data indicate that geomorphic conditions for the project reaches prior to anthropogenic disturbance (ditching and agriculture), would have likely supported a moderately defined headwater streams with variable channel geometry and valley bottom widths, but highly sinuous (K>1.5) single-thread meandering channels are not entirely appropriate in this landscape setting. Providing additional data points for comparison through reference site surveys and literature research also helped to develop these linear relationships. The data set for these CP streams help reduce uncertainty by providing additional reference points and supporting evidence for the selection of bankfull indicators that yield slightly smaller dimensions and flow rates than the published regional curve data set.

Table 9. Proposed Design Parameters

Parameter	Cow Branch (upper)	Cow Branch (middle)	Cow Branch (lower)	S100	S200
Drainage Area, DA (sq mi)	0.203	0.722	0.908	0.148	0.450
Stream Type (Rosgen)	DA/C5	C5	C5	C5	C5
Bankfull Riffle XSEC Area, Abkf (sq ft)	3.4	7.6	9.0	2.5	5.1
Bankfull Mean Velocity, Vbkf (ft/sec)	1.1	1.0	1.1	1.2	1.3
Bankfull Riffle Width, Wbkf (ft)	6.6	9.9	10.8	5.7	8.1
Bankfull Riffle Mean Depth, Dbkf (ft)	0.5	0.8	0.8	0.4	0.6
Width to Depth Ratio, W/D (ft/ft)	13.0	13.0	13.0	13.0	12.9
Width Floodprone Area, Wfpa (ft)	>100	>120	>80	>100	>70
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	>2.2	>2.2	>2.2	>2.2	>2.2
Riffle Max Depth Ratio, Dmax/Dbkf	1.4	1.4	1.3	1.3	1.3
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0	1.0	1.0	1.0	1.0
Meander Length Ratio, Lm/Wbkf	N/A	15.1 – 22.1	13.9 – 20.3	N/A	N/A
Radius of Curvature Ratio, Rc/Wbkf	N/A	2.2 – 3.2	2.3 – 3.2	N/A	N/A
Meander Width Ratio, Wblt/Wbkf	N/A	6.0 – 9.0	4.6 – 7.4	N/A	N/A
Channel Sinuosity, K	1.03	1.11	1.10	1.04	1.02
Channel Slope, Schan (ft/ft)	0.0058	0.0016	0.0017	0.0023	0.0021
Riffle Slope Ratio, Sriff/Schan	1.0 – 1.3	1.3 – 1.6	1.2 – 3.8	1.3 – 1.7	0.2 – 1.2
Pool Slope Ratio, Spool/Schan	0.0 – 0.2	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.2
Pool Width Ratio, Wpool/Wbkf	1.2	1.2	1.2	1.2	1.2
Pool-Pool Spacing Ratio, Lps/Wbkf	6.0 – 12.0	5.0 – 13.1	3.7 – 7.4	5.3 – 8.8	4.9 – 13.6
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.6 – 2.0	1.6 – 2.1	1.9 – 2.2	1.6 – 2.2	1.6 – 2.1

6.1.2 Design Reach Summary

For design purposes, the stream segments were divided into multiple reaches labeled Cow Branch (upper middle, and lower), S100, and S200 as shown in Figure 9. The following narrative summarizes the proposed design approach, rationale and justification for each of stream reaches.

Cow Branch (upper)

The upper section of Cow Branch drains a ditch network that has been historically dug through riparian wetlands and bedded pine rows. The channelization and small impoundment have disrupted the historic flow pattern and natural flood processes. Along the wooded section of upper Cow Branch, work will begin as a headwater stream valley restoration (non-creditable section from station 10+00 to 15+00) by plugging the remnant channel, removing existing berms and a small impoundment, and relocating the channel within its natural valley before reconnecting with S200. The existing pond dam and outlet will be removed and the pond will be drained entirely. The reach will be constructed as a single-thread channel as it transitions into the open field area from approximate station 15+00 to 16+92. An existing berm will be removed and in-stream structures will be incorporated for grade control and habitat diversity. The valley bottom will be graded to restore the natural microtopographic variability that is common within these systems. Larger flood flows will be attenuated and spread out through floodplain depressions, restoring a more natural hydrologic function. The reach will be restored to a Rosgen 'DA' stream type in the non-creditable wooded area and transition to a Rosgen 'C5' stream type at station 15+00 until its confluence with S200.

Cow Branch (middle)

The restoration of Cow Branch will continue below S200 as the valley turns towards the west. Along the middle section, work will involve a Priority Level I Restoration by reconnecting the stream with its relic floodplain to promote more frequent over bank flooding and improve wetland hydrology. A stable stream system will be achieved by constructing a gently meandering single-thread channel across the floodplain. Proposed grading activities will improve natural flow patterns and wetland hydrology by plugging ditches, removing existing bridge crossing, berms and other agricultural land manipulations. The reach will be restored using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the wider/flatter valley slope and width. The reach will be restored to a Rosgen 'C5' stream type, and the sinuosity will be increased by adding riffle-pool sequences and improving bedform diversity. Minimal grade control will be required for the reach, due to the low channel slope and low potential for channel incision.

In-stream structures, such as angled log steps, brush toes, and woody riffles will be included in the channel design to provide natural scour features and improved aquatic habitat. It is expected that over time, these areas will stabilize as native vegetation becomes established along the streambanks. This approach will also improve the hydrological function and hyporheic zone interaction between the stream channel and riparian wetlands. Riparian buffers of at least 50 feet wide will be planted along the entire reach.

Cow Branch (lower)

The lower section of Cow Branch flows south from S100 towards the property line and project boundary. The channel remains oversized throughout the reach and has been historically straightened with extensive berms along the one or both stream banks. Work along Cow Branch lower will continue as a Priority Level I Restoration reconnecting the stream with its relic floodplain to promote more frequent over bank flooding and improve wetland hydrology. A stable stream will be achieved by constructing a single-thread meandering channel before gradually lowering the profile elevation to tie into the existing channel near the property line. Proposed grading activities will restore more natural flow patterns and adjacent wetland hydrology by removing berms/spoil. The reach will transition from a Priority Level I to a Priority Level II Restoration at approximate station 36+00 by gradually lowering the bed elevation and excavating a shallow floodplain bench before reconnecting the stream with the existing bed elevation prior to flowing offsite. The reach will be restored as a Rosgen 'C5' stream type using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the valley slope and width. Any exotic species vegetation will be removed in this area and native riparian species vegetation will be replanted in the resulting disturbed areas.

In-stream structures, such as angled log steps, brush toe, log vanes and woody riffles will be included in the channel design to provide natural scour features and improved aquatic habitat. It is expected that over time, these areas will stabilize as native vegetation becomes established along the streambanks. This approach will also improve the hydrological function and hyporheic zone interaction between the stream channel and riparian wetlands. Riparian buffers of at least 50 feet wide will be planted along the entire reach.

S100

S100 begins at a remnant crossing as a small tributary that has been channelized/straightened along its entire length. Beginning above the reach, the ditches and channelized stream will be filled and graded to the natural valley topography prior to the pre-drained condition. The valley bottom will be graded to restore the natural microtopographic variability. The reach will be constructed as a small single-thread channel and larger flood flows will spread out through floodplain depressions, restoring a more natural hydrologic function. In-stream structures, such as angled log steps, brush toes, and woody riffles will be included in the channel design to provide natural scour features and improved aquatic habitat. The channel will be filled to an elevation sufficient to connect with the Cow Branch floodplain using suitable fill material from adjacent berm/spoil areas. Riparian buffers in excess of 50 feet will be planted and protected along the entire project reach.

S200

S200 has been channelized and straightened along its entire length. The upstream catchment area drains a ditch network and Carolina Bay that has disrupted the historic flow and natural flooding patterns across the site. Along the upper section of S200, work will begin as a Priority Level II Restoration by gradually raising the bed elevation and excavating a floodplain bench before reconnecting the stream with its relic floodplain (Priority Level I), which will promote more frequent over bank flooding. The valley bottom will be graded to restore the natural microtopographic variability. The reach will be constructed as a defined single-thread channel and the base flow will eventually connect with the floodplain elevation near its confluence with Cow Branch. This restoration approach with improve hydrologic function while preventing a hydrologic trespass upstream of the Old Lumberton Road culvert crossing. In-stream structures, such as angled log steps, brush toes, and woody riffles will be included in the channel design to provide natural scour features and improved aquatic habitat. The channel will be filled to a sufficient elevation using fill material from adjacent berm/spoil areas. Riparian buffers in excess of 50 feet will be replanted and protected along the entire project reach.

6.1.3 Ditch Maintenance Zone

The Grantor reserves the right to the areas as shown on the survey plat and Figure 9 for the following purposes (the “Ditch Maintenance Zone”):

Manage, mow and clear vegetation, wood, and other debris from the banks and ditch channels within the Ditch Maintenance Zone. Such management of the Ditch Maintenance Zone for the purposes of maintaining the Property shall be done using best management practices and in a manner that will minimize any negative impacts to the Conservation Easement Area and the purposes of this Conservation Easement.

6.2 Reference Sites

6.2.1 Reference Streams

The morphologic data obtained from reference reach surveys can be a valuable tool for comparison and used as a template for analog design of a stable stream in a similar valley type with similar bed material. To extract the morphological relationships observed in a stable system, dimensionless ratios are developed from a surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type. While reference reach data can be a useful aid in analog design, they are not always necessary and can have limitations in smaller stream systems (Hey, 2006). The flow patterns and channel formation for many reference reach quality streams are often controlled by slope, bed material, drainage areas and larger trees and/or other deep-rooted vegetation. Some meander geometry parameters, such as radius of curvature, are particularly affected by vegetation control. Pattern ratios observed in reference reaches may not be applicable or are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction before the permanent vegetation is established. Often the best reference data is from stable stream reaches that are located within the same watershed.

For comparison purposes, WLS selected reference reaches located in the Coastal Plain (CP) Physiographic region (See Figure 11) and compared them with composite CP reference reach and published regional curve data. The reference reach data set was compiled from the NC reference reach database and reach surveys conducted by Michael Baker Corporation (Harman, 2011). This data set provides typical reference reach ratios for stable streams in NC and can be used to compare a restoration project to the typical reference reach condition for geomorphology. The CP reference reach data represents small "Coastal Plain Stream," with similar valley morphology and slopes that fall within the same climatic, hydrophysiographic and ecological region as the project site. The reference reach data shown on Table 10 helped to determine an appropriate design approach for stream restoration. Additional CP comparison data is provided in Appendix 2. Figure 11 shows the reference site locations as compared to the project site.

Table 10. Reference Reach Data Comparison

Parameter	WLS CP Reference Data[1]	Composite CP Reference Data[2]
Stream Type (Rosgen)	DA, E5, C5	E5, C5
Bankfull Mean Velocity, Vbkf (ft/s)	1.2 – 1.7	1.0 – 1.4
Width to Depth Ratio, W/D (ft/ft)	10.1 – 19.5	8.0 – 16.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	4.3 – 5.8	4.0 – 13.0
Riffle Max Depth Ratio, Dmax/Dbkf	1.4 – 1.8	1.2 – 1.7
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0 - 1.2	1.0 – 1.3
Meander Length Ratio, Lm/Wbkf	4.4 – 7.1	4.0 - 17.0
Radius of Curvature Ratio, Rc/Wbkf	1.3 – 3.1	1.5 – 3.0
Meander Width Ratio, Wblt/Wbkf	2.4 – 6.7	2.0 – 9.0
Sinuosity, K	1.05 – 1.2	1.2 – 1.7
Valley Slope, Sval (ft/ft)	0.0011 – 0.0083	0.0020 – 0.0100
Channel Slope, Schan (ft/ft)	0.0039 – 0.0080	0.0020 – 0.0100
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.4 – 2.5	1.2 – 2.4
Pool Width Ratio, Wpool/Wbkf	0.9 – 1.5	0.8 – 1.4
Pool-Pool Spacing Ratio, Lps/Wbkf	2.5 – 7.9	3.5 – 7.0

Note 1: WLS CP reference reach data was collected at unnamed tributaries to Hornpipe Branch (South Reference Reach), Hollowell (upper UT2-R1) and UT to Mill Swamp (S300).

Note 2: Composite CP reference reach data were compiled from the NC reference reach database, published CP regional curve data and reference reach surveys conducted by Michael Baker Corporation as published in the Natural Channel Design Review Checklist (Harman Starr, 2011).

6.2.2 Reference Wetlands

An existing wetland (WA) that is representative of the riparian wetland system to be restored at the Project site was identified between upper Cow Branch and S200. The reference riparian wetland is an example of a "Coastal Plain small stream swamp," as described by Schafale (2012). These headwater systems exist along the zero- or first-order streams and floodplains of small blackwater or brownwater streams in which separate or consistent fluvial features and associated vegetation are poorly developed to distinguished. The natural hydrology of these systems is palustrine – intermittently, temporarily, or seasonally flooded. Stream flows tend to be highly variable, with floods of short duration, and periods of very low flow. The reference site has experienced minimal disturbances in the recent past. Figure 11 shows the reference site location, and the associated data is in Appendix 2 (groundwater gauges GW5 and GW6). These reference wetlands will be used for comparison purposes only. WLS will utilize the 10 groundwater gauges to be installed in the project wetland areas for wetland hydrology monitoring.

6.3 Flow Regime

A majority of stream miles (>80 percent) in North Carolina are classified as headwater streams (drainage area <3.9 mi^2), however, less than 10 percent of the 284 USGS stream gages in North Carolina are located on headwater streams (EFSAB, 2013). WLS recognizes the importance of these stream flow variables and the ecological role they play in supporting high functioning steam and wetland systems. As such, flow monitoring will be conducted to demonstrate that the restored stream systems exhibit seasonal base flow during a year with normal rainfall conditions. The surface flow documentation methods are further described in Section 9. Table 11 summarizes the basic flow levels and ecological roles the restoration design will provide after Project implementation.

Table 11. Flow Level and Ecological Role

Low Flow (Base Flow): occurs most frequently/seasonally	-Provide year-round habitat for aquatic organisms (drying/inundation pattern) -Maintain suitable conditions for water temperature and dissolved oxygen -Provide water source for riparian plants and animals -Enable movement through stream corridor and refuge from predators -Support hyporheic functions and aquatic organisms
Channel-forming Flow: infrequent, flow duration of a few days per year	-Shape and maintain physical stream channel form -Create and maintain pools, in-stream and refuge habitat -Redistribute and sort fine and coarse sediments -Reduce encroachment of vegetation in channel and establishment of exotic species -Maintain water quality by flushing pollutants -Maintain hyporheic connection by mobilizing bed and fine material -Create in-channel bars for seed colonization of native riparian plants
Flood Flow: very infrequent, flow duration of a few days per decade or century	-Deposition of fine sediment and nutrients on floodplain -Maintain diversity, function, and health of riparian floodplain vegetation -Create streamside habitat, new channels, sloughs, and off-channel rearing habitat through lateral channel migration and avulsion -Recharge floodplain and storage processes -Recruitment of native wood and organic material into channel

6.3.1 Regional Curve Comparison

Regional curves developed by Dunne and Leopold (1978) relate bankfull channel dimensions to drainage area and are based on the channel forming discharge theory, which states that one unique flow can yield the same channel morphology as the full range of flows. A primary purpose for developing regional curves is to aid in identifying bankfull stage and dimension in un-gaged watersheds, as well as to help predict the bankfull dimension and discharge for natural channel designs (Rosgen, 1994). Hydraulic geometry relationships are empirically derived and can be developed for a specific stream or extrapolated to a watershed in the same physiographic region with similar rainfall/runoff relationships (FISRWG, 1998).

Published bankfull regional curves are available for a range of stream types and physiographic provinces. The NC Coastal Plain Regional Curve (Sweet and Geratz, 2003) and NC State University Coastal Plain Regional Curve (Doll et al., 2003) were used for comparison when estimating bankfull discharge. The NC Coastal Plain Regional Curve and bankfull hydraulic geometry equations are shown in Table 12. It's important to note these tributaries are classified as zero and first order streams, and generally smaller headwater streams can be poorly represented on the regional curves. Based on the WLS design staff collective experience surveying numerous small ungaged stream systems, the published NC Rural Coastal

Plain Regional Curve Equations can slightly overestimate discharge and channel dimensions for smaller ungaged streams. Furthermore, estimating bankfull parameters subjectively rather than using deterministic values may encourage designers to make decisions on a range of values and beliefs that the bankfull depths must inherently be within that range (Johnson and Heil, 1996).

Table 12. North Carolina Coastal Plain Regional Curve Equations

NC Coastal Plain Regional Curve Equations EcoScience (Sweet and Geratz, 2003)		NC Coastal Plain Regional Curve Equations NCSU (Doll et al., 2003)	
$Q_{bkf} = 8.79\ A_w^{0.76}$	R^2=0.92	$Q_{bkf} = 16.56\ A_w^{0.72}$	R^2=0.90
$A_{bkf} = 9.43\ A_w^{0.74}$	R^2=0.96	$A_{bkf} = 14.52\ A_w^{0.66}$	R^2=0.88
$W_{bkf} = 9.64\ A_w^{0.38}$	R^2=0.95	$W_{bkf} = 10.97\ A_w^{0.36}$	R^2=0.87
$D_{bkf} = 0.98\ A_w^{0.36}$	R^2=0.92	$D_{bkf} = 1.29\ A_w^{0.30}$	R^2=0.74

WLS has implemented numerous projects in ungauged drainages in the Coastal Plain hydrophysiographic province of North Carolina, including nearby projects in surrounding counties. The data set for these small streams help reduce uncertainty by providing additional reference points and supporting evidence for the selection of bankfull indicators, appropriate dimensions and flow rates. Channel geometry, slope, valley shape, sediment supply, as well as information from the USGS regression and Manning's equations were all considered during field data evaluation. The estimated bankfull discharges and surveyed cross-sectional areas were plotted on the NC Coastal Plain Regional Curve and illustrated in Appendix 2.

6.3.2 Channel Forming Discharge

A hydrologic analysis was completed to estimate and validate the design discharge and channel geometry required to provide more frequent overbank flows and floodplain inundation. Cross-sections were identified and surveyed to represent reach-wide conditions. Additional bankfull estimation methods, such as the commonly used Manning's equation, were compared to help interpret and adjust field observations to select the appropriate design criteria and justification for the design approach.

The bankfull flows in gaged watersheds within the NC Rural Coastal Plain study documented return intervals (RI) that range from ~1.0 to 1.3, with a mean of 1.2 years (Sweet and Geratz, 2003). WLS then compared lower flow frequencies in the 1.2-yr to 1.5-yr RI range versus survey data, field measurements, and discharge analysis (See Appendix 2). It should be noted that this best fit approach does not always match the dataset, since it falls at the low end of the curve. Therefore, caution should be used when comparing these lower RIs with additional data sets. Using the rationale described above, the bankfull discharge analyses compared NC Rural Coastal Plain regional curves, Manning's equation discharges calculated from the representative cross-section geometry and USGS regional regression equations.

Table 13. Design Discharge Analysis Summary

Project Reach Designation	Watershed Drainage Area (Ac)	EcoScience NC CP Regional Curve (cfs)[1]	NCSU NC CP Regional Curve (cfs)[2]	Manning's Equation (cfs)[3]	USGS Regression Equation for 1.2-year Recurrence Interval (cfs)[4]	Design Discharge Estimate (cfs)
Cow Branch (upper)	130	2.6	5.2	2.9	2.4	3.7
Cow Branch (middle)	462	6.9	13.1	8.1	7.5	7.8
Cow Branch (lower)	581	8.2	15.4	10.8	8.6	9.8
S100	95	2.1	4.1	2.9	3.9	3.1
S200	288	4.8	9.3	6.9	7.1	6.8

Note 1: Published NC Coastal Plain Regional Curve (Sweet and Geratz, 2003).
Note 2: Published NC Coastal Plain Regional Curve (NCSU, 2003).
Note 3: Bankfull discharge estimates vary based on Manning's Equation for the representative riffle cross-sections. Bankfull stage roughness estimates (n-values) ranged from approximately 0.033 to 0.045 based on channel slopes, depth, bed material size, and vegetation influence.
Note 4: USGS rural regression equation extrapolated for 1.2-year flood recurrence interval (USGS, 2011)

After considering these estimation methods and results (geometry measurements, published regional curves, flow frequency and USGS regional regression equations), WLS estimated the design discharge using values nearest to the published NC Coastal Plain Regional Curve (Sweet and Geratz, 2003) to select the appropriate design dimensions and flows rates that best correspond to the design channel that will convey the 1.2-yr RI. The design discharge analysis summary is provided in Appendix 2.

6.3.3 Channel Stability and Sediment Transport Analysis

To evaluate channel stability and sediment transport relationships, shear stress, stream power, and width-to-depth (W/D) values were plotted against comparable CP sand bed reference stream data (Appendix 2). The design shear stress and stream power values plot within the scatter of data points collected from multiple stable CP reference reaches. This analysis represents a relationship that the shear stresses and stream power predicted for the design channels are within the range of stable values. Therefore, excessive scour of the design channel is not expected as the native vegetation becomes established and W/D decreases.

Alluvial sand bed channels in small Coastal Plain headwater stream systems typically have a low sediment supply with finer grained material (D_{50} < 2mm), therefore a more complex sediment budget or rating curve is not necessary. Sediment transport analyses as described above were not applied to the design reaches. The design for the reaches will involve the construction of a shallow channel along the valley bottom; under natural stable conditions, sediment deposits in these stream systems are more aggradational, due to low flow velocities and scour stresses.

As a design consideration, proposed design riffle slopes that exceed a riffle slope ratio (Sriff/Schan) of 1.5 will be constructed in transitional areas using native wood/brush material to provide additional grade control and bed stability. Any concerns regarding channel degradation and stability will be addressed by installing a combination of grade control structures, such as constructed woody riffles and step-pools in the straighter channel segments (vertical stability) and brush toe and bioengineering (live stakes) in meander bends (vertical stability). In addition, removing the existing stream crossings and restoring a more natural flow regime will facilitate positive adjustments to sediment routing and storage across the wide reconnected floodplain. Table 14 represents the boundary shear stress and stream power values under proposed design conditions for the Project reaches.

Table 14. Boundary Shear Stress and Stream Power

Project Reach Designation	Bankfull Q EcoScience NC CP Regional Curve (cfs) [1]	Bankfull Q Manning's Equation (cfs) [2]	Bankfull Velocity (ft/sec)	Shear Stress (lbs/ft^2)	Stream Power (W/m^2)
Cow Branch	8.2	10.8	1.2	0.091	1.808
S100	2.1	2.9	1.2	0.058	1.117
S200	4.8	6.9	1.3	0.072	1.614

Note 1: Published NC Coastal Plain Regional Curve (Sweet and Geratz, 2003).
Note 2: Manning's Equation for the representative riffle cross-sections. Predicted roughness estimates (n-value = 0.033 to 0.045) was based on channel slopes, depth, bed material size, and vegetation influence.

6.3.4 Hydrologic Modeling

WLS utilized the Wetbud program (Wetbud, 2017) to evaluate the current site hydrology and create a basic water budget scenario to simulate post-restoration conditions. Similar to DRAINMOD, Wetbud is a modeling tool for estimating water budgets using locally available climate data (i.e., long-term precipitation and temperature) and site-specific topographic, soil, vegetation and geohydrologic data, coupled with mass balance mathematics. Wetbud was developed as a planning and design tool where input parameters such as site topography, soil parameters, surface flow and groundwater flow are used to simulate groundwater inputs for the selected wet-normal-dry (W-N-D) years. The model output helps describe the loss pathways for the average annual precipitation ranges, infiltration, drainage area, runoff, and evapotranspiration (ET) over the model simulation period.

Wetbud uses simplified assumptions for estimating water table depths and a basic scenario was modeled for Cow Branch wetland restoration area. The model data and graphs provided in Appendix 2 summarize the average annual amount of precipitation, infiltration, drainage outflow, groundwater, runoff, and ET estimated for proposed wetland restoration area based on a multi-year (1975, 2004, 2012) simulation. The results from this basic scenario show a significant amount of rainfall is lost to evapotranspiration during the summer months, which is typical in the Coastal Plain of North Carolina. Offsite drainage is also a significant loss pathway under the existing ditched conditions. The N (Normal year 1992) model water level output is consistent with the pre-restoration groundwater gauge data provided in Appendix 2 which illustrates the decrease in groundwater depths below 12 inches near May and the response to subsequent rainfall events during the growing season.

As described above, wetland restoration activities will involve filling the network of drainage ditches, raising the stream bottom elevation, and increasing the amount of surface storage and water holding capacity of the site. Therefore, the overall site drainage and runoff will be decreased, and the current water inputs will remain, thus improving wetland hydrology. However, to accurately calibrate the model and better represent the variability in hydrologic, soil, and topographic conditions within the areas targeted for restoration, a more robust data set using gauge data (groundwater and surface flow) and antecedent precipitation from across the site must be further analyzed over multiple years to predict trends or long-term site conditions. It is important to note that this and climatic changes are a limiting factor in the development of the post-restoration hydrology conditions.

6.4 Wetland Design Approach

Degraded and/or drained riparian wetlands were documented within the project boundary. These areas contain approximately 31.98 acres of hydric soils and 8.83 acres of degraded jurisdictional wetlands. Figure 6 illustrates areas where conditions are favorable for improving wetland hydrology and vegetation. The predominant native wetland vegetation communities are largely devoid or not considered reference quality in areas proposed for restoration. On-site investigations of the soils within the project area were conducted in 2020 and 2023 by licensed soil scientist (LSS), George Lankford, LSS, with George K. Lankford, LLC (See Hydric Soils Investigation in Appendix 2). The findings were based on hand-turned auger borings and indicate the presence of hydric soils along the floodplains of many of the project reaches. The hydric soils status is based upon the "*Field Indicators of Hydric Soils in the United States*" (USDA, NRCS, 2018, Version 8.2).

The presence of hydric soil indicators and hydric inclusions within 12 inches of the soil surface was verified and a hydric soil boundary was identified as containing potential jurisdictional hydrology. Hydric indicators typically occur within the upper 18 inches, but selected borings extended to greater than 40 inches in depth to evaluate potential deeper drainage or locate restrictive horizons able to perch a water table. Mr. Lankford noted that areas of existing hydric soils have been manipulated by a combination of agricultural use and silviculture. The indicators suggest this site was historically very wet with long term saturation to semi permanently flooded.

The project lies within an appropriate landscape for wetland restoration and the site evaluation identified a large area of continuous hydric soil. Available sources of hydrology are present as Cow Branch, two unnamed tributaries (S100 and S200), and extensive areas of groundwater discharge along the toe of slope. The soils have dark surfaces that are naturally high in organic matter and many redoximorphic features that were identified as either current or relict. The topographic setting for this landscape indicates a high potential for concentration of both surface and subsurface flows.

Based on the 2016 NCIRT guidance and soil properties, WLS expects an appropriate wetland saturation range and hydroperiod for the Torhunta mapped soil series or with similar taxonomy to be at least 12 percent of the growing season for W01 and W02 (USACE, 2016). Due to the current drainage modifications and the sandy loam subsoil horizons, it may take up to a year for the site to become completely saturated and reach the target hydroperiods. For at least the first year after construction, it may be reasonable to expect a lower hydroperiod, depending on final construction timing and rainfall distribution (assuming average seasonal rainfall, antecedent conditions, and over bank flow frequency).

W02 - Riparian Wetland Re-establishment

These areas contain hydric soil conditions that are favorable for re-establishing historic wetlands and are predominantly situated in the existing agricultural fields. It is anticipated that as a direct result of implementing stream restoration (Priority Level I), plugging and filling ditches, limited soil manipulation, revegetation, and restoration of groundwater hydrology, historic wetlands will regain their lost functions. An overbank flooding regime will be restored throughout these areas by raising the stream bed elevation to reconnect the channels to their active floodplain.

W01 - Riparian Wetland Rehabilitation and Re-establishment

Areas of significantly degraded riparian wetlands (i.e., poorly functioning) were also documented along portions of the project floodplain areas. The existing wetlands will benefit from restoring the local water table by improving connectivity to a larger wetland community and increasing hydroperiods. These poorly functioning wetland areas will be restored as a direct result of implementing a stream restoration approach (Priority Level I), surface roughening, removal of spoil berms, removal of farm roadbed, and planting native vegetation. The groundwater hydrology will be restored and allow the wetland areas to regain their natural or historic functions. The areas proposed for wetland rehabilitation and re-establishment are labeled on Figure 9. A large area of W01 is wetland re-establishment since it is not a jurisdictional wetland, but the crediting of this area will still be 2:1 given the existing successional native vegetation, hydric soils and drained hydrology. This is broken out into its own wetland boundary.

6.5 Revegetation Plan

Riparian buffers will be established a minimum of 50 feet from the top of the streambanks along each of the Project reaches, as well as permanently protecting those buffers with a conservation easement. All proposed wetland mitigation areas will be planted. Many of the proposed riparian buffer widths within the conservation easement are greater than 50 feet along one or both streambanks to provide additional functional uplift. Proposed plantings will be conducted using native tree/shrub species seedlings and live stakes. Zone 1 (W01) revegetation plan will consist of planting graded and disturbed areas required for the stream construction at a target density of 680 stems per acre. Areas undisturbed by construction will be planted within cleared/mulched 12-foot-wide lanes spaced 48 feet apart on-center, resulting in 25 percent planted area. The cleared lanes will be planted with bare root vegetation and will generally be planted at a total target density of 680 stems per acre. Zone 1 will be planted with a shrub dominated community as per the existing successional vegetation in the project area (Table 15). Zone 2 will consist of the current agricultural area and will be planted at a total target density of 680 stems per acre (Table 16) with a majority of tree species.

The proposed plant selection will help to establish an appropriate native vegetation community based on reference conditions and water quality goals. Schafale's (2023) Natural Communities of North Carolina, as well as existing mature species identified throughout the Project area, were referenced during the development of riparian buffer planting plan for the Project site. The closest approximation natural community is Coastal Plain Small Stream Swamp. Typical species found in this community type are swamp black gum (*Nyssa biflora*), water oak (*Quercus nigra*), swamp chestnut oak (*Quercus michauxii*), loblolly pine (*Pinus taeda*), inkberry (*Ilex opaca*), bald cypress (*Taxodium distichum*) and ironwood (*Carpinus caroliniana*).

Table 15. Zone 1 Proposed Riparian Buffer Bare Root Plantings

Scientific Name	Common Name	% Proposed for Planting by species	Wetland Tolerance	Stratum
Riparian Buffer Bare Root Plantings (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)				
Aronia arbutifolia	Red chokeberry	5%	FACW	Shrub
Ilex glabra	Inkberry	10%	FACW	Shrub
Itea virginica	Sweetspire	10%	FACW	Shrub
Lindera benzoin	Spicebush	15%	FACW	Shrub
Sambucus canadensis	Elderberry	10%	FACW	Shrub
Viburnum dentatum	Arrow wood	5%	FAC	Shrub
Cyrilla racemiflora	Swamp titi	15%	FACW	Shrub
Morella cerifera	Wax myrtle	5%	FAC	Tree
Magnolia virginiana	Sweetbay magnolia	5%	FACW	Tree
Quercus nigra	Water oak	5%	FAC	Tree
Taxodium distichum	Bald cypress	5%	OBL	Tree
Alnus serrulata	Smooth alder	5%	FACW	Tree
Betula nigra	River birch	5%	FACW	Tree
Note: WLS will plant a minimum of 10 species from the list with no one shrub species exceeding 15% composition and tree species exceeding 10%. Species mix will be minimum 50% shrubs. Final planting decisions will be made at construction based on availability.				
Riparian Buffer Live Stake Plantings				
Salix nigra	Black Willow	60%	OBL	Tree
Cornus amomum	Silky Dogwood	20%	FACW	Tree
Cephalanthus occidentalis	Buttonbush	20%	OBL	Shrub
Note: WLS will plant a minimum of 2 species from the list, with no single species being over 60% of planted live stakes. Final planting decisions will be made at construction based on availability.				

Table 16. Zone 2 Proposed Riparian Buffer Bare Root Plantings

Scientific Name	Common Name	% Proposed for Planting by species	Wetland Tolerance	Stratum
Riparian Buffer Bare Root Plantings (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)				
Nyssa biflora	Swamp black gum	5%	OBL	Tree
Betula nigra	River birch	10%	FACW	Tree
Platanus occidentalis	Sycamore	10%	FACW	Tree
Quercus michauxii	Swamp chestnut oak	10%	FACW	Tree
Quercus nigra	Water oak	5%	FAC	Tree
Quercus phellos	Willow oak	5%	FACW	Tree
Taxodium distichum	Bald cypress	10%	OBL	Tree
Alnus serrulata	Smooth alder	10%	FACW	Tree
Carpinus caroliniana	American hornbeam	5%	FAC	Tree
Magnolia virginiana	Sweetbay magnolia	5%	FACW	Tree
Viburnum dentatum	Arrow wood	5%	FAC	Shrub
Ilex glabra	Inkberry	5%	FACW	Shrub
Itea virginica	Sweetspire	5%	FACW	Shrub
Lindera benzoin	Spicebush	10%	FACW	Shrub
Note: WLS will plant a minimum of 10 species from the list. Species mix will be minimum 70% trees. Final planting decisions will be made at construction based on availability.				
Riparian Buffer Live Stake Plantings				
Salix nigra	Black Willow	60%	OBL	Tree
Cornus amomum	Silky Dogwood	20%	FACW	Tree
Cephalanthus occidentalis	Buttonbush	20%	OBL	Shrub
Note: WLS will plant a minimum of 2 species from the list, with no single species being over 60% of planted live stakes. Final planting decisions will be made at construction based on availability.				

6.5.1 Planting Materials and Methods

Planting will be conducted during the dormant season, with all trees installed between mid-November and March 9th. The final planting zone limits may be modified based on these observations and comparisons, and the final selection of the location of the planted species will be matched according to the species wetness tolerance and the anticipated wetness of the planting area.

Live Staking and Live Branch Cuttings: Where live staking is proposed on streambanks, live stakes will typically be installed at a minimum of 40 stakes per 1,000 square feet and the stakes will be spaced approximately three feet apart in meander bends and six feet apart in the riffle sections, using a triangular spacing pattern along the streambanks, between the toe of the streambank and bankfull elevation. When bioengineering is proposed, live branch cutting bundles will be installed at five linear feet per bundle approximately two to three branches thick.

Permanent Seeding: Temporary and permanent seeding will be conducted simultaneously at all disturbed areas of the Project site during construction and will be conducted with mechanical broadcast spreaders. Table 17 lists the proposed species, mixtures, and application rates for permanent seeding. The vegetation species proposed for temporary seeding germinate quickly to swiftly establish vegetative ground cover and thus, short term stability. The permanent seed mixture proposed is suitable for streambank, floodplain, and adjacent riparian wetland areas, and the upland transitional areas in the riparian buffer. Beyond the riparian buffer areas, temporary and permanent seeding will also be conducted at all other disturbed areas of the Project site that are susceptible to erosion. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre.

Table 17. Proposed Riparian Buffer Permanent Seeding

Scientific Name	Common Name	% Proposed for Planting by Species	Seeding Rate (lb/acre)	Wetland Tolerance
Andropogon gerardii	Big blue stem	15%	2.5	FAC
Dichanthelium clandestinum	Deer tongue	15%	1.5	FACW
Carex lurida	Shallow sedge	10%	1.0	OBL
Chasmanthium laxum	Slender woodoats	10%	2.0	FACW
Elymus virginicus	Virginia wild rye	10%	2.0	FAC
Juncus effusus	Soft rush	10%	1.5	FACW
Panicum virgatum	Switchgrass	10%	1.5	FACW
Rudbeckia hirta	Black-eyed Susan	10%	1.5	FACU
Scirpus cyperinus	Woolgrass	10%	1.5	FACW
Note: Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of seeding stock.				

Invasive Species: Invasive species vegetation, such as Chinese privet will be treated to allow native plants to become established within the conservation easement. During the Project implementation, invasive species exotic vegetation will be treated both to control its presence and reduce its spread within the conservation easement areas.

6.6 Site Construction Methods

6.6.1 Site Grading and Construction Elements

Much of the grading and excavation across the Project site will be conducted within the existing riparian corridor and conservation easement boundary. Grading in the proposed wetland credit areas will be 12 inches. Areas where grading is greater than 12 inches are not shown as creditable wetland areas, such as a small area along middle Cow Branch and the lower section of Cow Branch as it transitions to the existing channel elevation near the project boundary. The restored streams will be graded within the natural valleys. Suitable fill/plug material will be generated from new channel and floodplain excavation, as well as from adjacent upland areas on the project property. Portions of the existing degraded channels and ditches will be partially to completely filled along their length using compactable material excavated from construction of the restored channels to the proposed grades shown on the design plans. The existing topsoil layer will be stripped in a manner to prevent intermingling with underlying subsoil or other waste materials. The topsoil materials shall be stockpiled separately and shall be spread evenly to a depth of at least 8 inches on top of subsoil material to achieve final grades. The backfill material will be clean and free of debris and compacted in horizontal lifts not exceeding 10 inches and should be compacted with heavy equipment and shall be placed to a compaction standard to that of the surrounding/abutting undisturbed project soils.

The sections of the old stream channel and/or ditches to be abandoned will be filled with on-site soil materials. Soil fill materials shall be placed in the abandoned stream channel and compacted with heavy construction equipment. Areas of the abandoned stream channel and/or ditches to be filled shall have additional soil fill material mounded over the top of the fill to a depth of approximately 6 to 12 inches to offset future settling. Channel block and/or ditch plug areas shall be constructed according to the design plans and technical specifications. Soil fill material used for channel plugs shall have a higher clay content and be free of debris, rocks, trash, etc. and shall consist of compactable soil materials. Soil fill material shall be placed in the channel plugs areas and compacted in lifts of no more than 10 inches. The completed channel plugs shall be free of voids and shall be impermeable to water flow through, around, or under the completed plug. The proposed grades shall be extended and connected to the surrounding undisturbed grades so that upon compaction and subsequent settlement, the resulting grades will be at the proper elevations specified on the construction plans. Compacted soil in the area of tree plantings shall be loosened to a depth of at least 8 inches prior to planting activities.

Floodplain grading activities will focus on restoring pre-disturbance valley topography by removing field crowns and overburden/spoil that were imposed during conversion of the land for agriculture. In general, floodplain grading activities will be minor, with the primary goal of soil scarification, creating depressional areas less than 12 inches deep, water quality and habitat features, and microtopographic crenulations by filling the drainage features at the site back to adjacent ground elevations (Scherrer, 1999). Any excess material not used for ditch plugging or suitable as a soil base for vegetation will be spread across upland areas outside of the easement boundary and jurisdictional WOTUS.

6.6.2 In-stream Structures and Site Improvement Features

Stream improvement features such as in-stream structures and bioengineering techniques are proposed for grade control, streambank protection, and improving bedform diversity and habitat. All in-stream structures will be constructed from materials naturally found in the region such as hardwood trees, trunks/logs, brush/branch materials. WLS will also incorporate bioengineering practices, when appropriate, that use biodegradable materials and fabrics, uncompacted soils, live plant cuttings, and native species vegetation to stabilize streambanks. Bioengineering treatments will provide initial bank stability that allows for the quick establishment of deep-rooted vegetation along the newly restored streambanks. Additionally, floodplain improvement features such as coarse woody debris (CWD) will be installed. This will mimic features like tree throws, snags, stumps, etc. that are commonly found in natural riparian systems. These floodplain improvement features will be added to provide habitat and serve as water storage and sediment sinks throughout the corridor to improve riparian functions (Dooley, 2003).

6.6.3 Construction Feasibility

WLS has field verified that the Project site has adequate, viable construction access, staging, and stockpile areas. Existing Project site access points and features will be used for future access after the completion of construction.

6.6.4 *Future Project Risks and Uncertainties*

Listed below are identified project risks and uncertainties that have been evaluated in the development of design plans for the site, along with methods that have been/will be used to address these concerns.

Land Use Development: There is minimal risk that changes in land use upstream in the project watershed would alter the hydrology or sediment supply enough to damage the project streams after construction. The project area has seen little to no development in recent years, and it is unlikely development will threaten the site.

- Methods to Address: Restoration and reforestation of the site streams will reduce the likelihood of future degradation from watershed changes, as erosive flood flows will spread over a wider reconnected floodplain.

Easement Encroachment: There is potential for landowner encroachment into the permanent conservation easement.

- Methods to Address: WLS has had considerable discussions with the landowners regarding the project requirements and limitations of easement access and is confident that the landowners fully understand and will maintain the easement protections. The easement boundaries will be clearly marked per requirements. Any encroachments that do occur will be remedied by WLS to remedy any damage and provide any other corrections required by the IRT.

Drought and Floods: There is potential for extreme climatic conditions during the monitoring period of the project.

- Methods to Address: WLS will apply adaptive management techniques as necessary to meet the site performance criteria. Such adaptive management may include replanting, channel damage repair, irrigation, or other methods. If adaptive management activities are significant, additional monitoring may be required by the IRT.

Beavers: There is evidence of beaver activity during recent site assessments and there is potential for beavers to affect the site hydrology and hydrologic trespass during and after the monitoring period of the project.

- Methods to Address: WLS will take steps to trap and remove beaver if they threaten Project success during the monitoring period. If beaver eventually return after project closeout, the proposed grading and controlling elevations will ensure that flooding across the site will not impact adjacent landowners unless excess dams, woody debris, or changes in land use (culvert crossings) occur outside of the project area.

Tree Species Diversity: There is potential for pine, sweetgum, and red maple recolonization to affect the composition of the target ecological community.

- Methods to Address: WLS will take steps as needed to thin saplings during the monitoring period. Using data from the vegetation plots as well as visual assessment monitoring, WLS will thin as needed to maintain trajectory towards the target community, Coastal Plain Small Stream Swamp.

Any treatments will be documented and included within annual monitoring reports. It is understood that pines are often present in Coastal Plain Small Stream Swamps based on data from Schafale's Natural Communities of North Carolina but should not be a dominant species in the canopy or understory.

7 Performance Standards

The applied success criteria for the project will follow the approved performance standards and monitoring protocols presented in this mitigation plan, which have been developed in compliance with the *DMS Stream and Wetland Mitigation Plan Template Guidance*, adopted June 2017, as well as the *USACE Wilmington District Stream and Wetland Compensatory Mitigation Update* issued in October 2016, and *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule,* issued in 2008.

In addition, the monitoring success criteria, practices, and corresponding reporting will follow current approved USACE Stream and Wetland Mitigation Guidelines, DMS RFP requirements and templates, and subsequent agency guidance. Monitoring activities will be conducted for a period of seven years with the final duration dependent upon performance trends toward achieving project goals and objectives. Specific success criteria components and evaluation methods are described below.

7.1 Streams

Stream Hydrology**:** Four bankfull flow events must be documented within the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years.

Stream Profiles, Vertical Stability, and Floodplain Access: Stream profiles, as a measure of vertical stability and floodplain access will be evaluated by looking at Bank Height Ratios (BHR). In addition, observed bedforms should be consistent with those observed for channels of the design stream type(s). The BHR shall not exceed 1.2 along the restored Project stream reaches. This standard only applies to restored reaches of the channel where BHRs were corrected through design and construction.

Stream Horizontal Stability: Cross-sections will be used to evaluate horizontal stream stability. There should be little change expected in as-built restoration cross-sections. If significant changes (+/- five percent) do occur, they should be evaluated to determine if the changes represent a movement toward a more unstable condition (e.g., downcutting, erosion) or a movement towards increased stability (e.g., settling, vegetation establishment, deposition along the streambanks, decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen Stream Classification method and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

Jurisdictional Stream Flow: The restored stream systems must be classified as at least intermittent, and intermittent streams must exhibit a minimum 30 days of continuous flow for some portion of the year during a year with normal rainfall conditions for Cow Branch and S200. S100 must either exhibit 90 days of consecutive flow or 30 days of consecutive flow plus macrobenthos monitoring as outlined in Section 8.3.3. Jurisdictional stream flow will be monitored annually. Post restoration gauges will be installed on Cow Branch, S100, and S200.

Photo Documentation: Photographs should illustrate the Project's vegetation and morphological stability on an annual basis. Cross-section photos should demonstrate no excessive erosion or degradation of the banks. Longitudinal photos should indicate the absence of persistent mid-channel bars or vertical incision. Grade control structures should remain stable.

7.2 Wetlands

Wetland Hydrology**:** The performance standard for wetland hydrology will be at least 12 percent (Figure 10). This hydroperiod is based on the suggested wetland saturation thresholds for soils taxonomic subgroups provided by the LSS and IRT. The average growing season for the Project site is 255 days, beginning March 9th and ending November 19th. The proposed success criteria for wetland hydrology will be when the soils are saturated within 12 inches of the soil surface for at least 12 percent (31 days) of the growing season based on WETS data table for Columbus County, NC. The saturated conditions should occur during a period when antecedent precipitation has been normal or drier than normal for a minimum frequency of 5 years in 10 (USACE, 2005 and 2010b).

Precipitation data will be obtained from the Whiteville 7 NW WETS Station, which is approximately five miles south from the Project and a rain gauge will be installed on site. If a normal year of precipitation does not occur during the first seven years of monitoring, WLS will continue to monitor the Project hydrology until the Project has been saturated for the appropriate hydroperiod. If rainfall amounts for any given year during the monitoring period are abnormally low, reference wetland hydrology data will be compared to determine if there is a correlation with the weather conditions and site variability. WLS has installed four wetland gauges in W01 and two wetland gauges in an onsite jurisdictional wetland (WA) prior to restoration to document baseline hydrology in these areas.

For the first year after construction, it may be realistic to expect a shorter hydroperiod. Due to the current drainage modifications and areas with sandy subsoil horizons, it may take up to a year for the site to become completely saturated and reach the target hydroperiods. For at least the first year after construction, it may be reasonable to expect a hydroperiod range between 9 and 12 percent.

7.3 Vegetation

Vegetative restoration success for the Project during the intermediate monitoring years will be based on the survival of at least 320, three-year-old planted stems per acre at the end of Year 3 of the monitoring period; and at least 260, five-year-old, planted stems per acre that must average seven feet in height at the end of Year 5 of the monitoring period. The final vegetative restoration success criteria will be achieving a density of no less than 210, seven-year-old planted stems per acre that must average 10 feet in height in Year 7 of monitoring. For the Zone 1/W01 planting area, the vegetative success will be based on density only using same densities as above and no height criteria (minimum 50% shrub species). WLS will also monitor transects in the supplementally planted and non-cleared areas of W01.

8 Monitoring Plan

In accordance with the approved mitigation plan, the baseline monitoring document and as-built report documenting the mitigation activities will be developed within 90 days of the completion of planting and monitoring device installation at the restored Project. In addition, a period of at least six months will separate the as-built baseline measurements and the first-year monitoring measurements. The baseline monitoring document and as-built monitoring report will include all information required by current DMS templates and guidance, including planimetric (plan view) and elevation (profile view) information, photographs, sampling plot locations, a description of initial vegetation species composition by community type, and location of monitoring stations. The report will include a list of the vegetation species planted, along with the associated planting densities.

WLS will conduct mitigation performance monitoring based on these methods and will submit annual monitoring reports to DMS by December 31st of each monitoring year during which required monitoring is conducted. The annual monitoring reports will organize and present the information resulting from the methods described in detail below. The annual monitoring reports will provide a project data chronology for DMS to document the project status and trends, for population of DMS's databases for analyses, for research purposes, and to assist in decision making regarding project close-out. Project success criteria must be met by the final monitoring year prior to project closeout, or monitoring will continue until unmet criteria are successfully met. Table 17 in Section 8.4 summarizes the monitoring methods and linkage between the goals, parameters, and expected functional lift outcomes. Figure 6 illustrates the pre-construction and Figure 10 illustrates the post-construction monitoring feature types and location.

8.1 Visual Assessment Monitoring

WLS will conduct visual assessments in support of mitigation performance monitoring. Visual assessments of all stream reaches will be conducted at least twice per monitoring year with a minimum of five months in between each site visit throughout the monitoring period. Photographs will be used to visually document system performance and any areas of concern related to streambank and bed stability, condition of in-stream structures, channel migration, active headcuts, live stake mortality, impacts from invasive plant species or animal browsing, easement boundary encroachments, cattle exclusion fence damage, and the general condition of pools and riffles. The monitoring activities will be summarized in DMS's *Visual Stream Morphology Stability Assessment Table* and the *Vegetation Conditions Assessment Table* as well as a *Current Conditions Plan View (CCPV) drawing* formatted to DMS digital drawing requirements, which are used to document and quantify the visual assessment throughout the monitoring period.

A series of photographs over time will be compared to subjectively evaluate channel aggradation (bar formations) or degradation, streambank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures. More specifically, the longitudinal profile photos should indicate the absence of developing bars within the channel or excessive increase in channel depth, while lateral photos should not indicate excessive erosion or continuing degradation of the banks. The photographs will be taken from a height of approximately five feet to ensure that the same locations (and view directions) at the Project site are documented in each monitoring period and will be shown on a plan view map. The results of the visual monitoring assessments will be used to support the development of the annual monitoring document that provides the visual assessment metrics.

8.2 Easement Boundary Monitoring

As part of the visual assessment monitoring, easement boundary monitoring will be conducted at least twice per monitoring year. The entire easement boundary will be walked during these assessments. The visual assessment monitoring will document any easement encroachments and fencing issues if fence is ever installed on site. Any missing signs will be replaced each monitoring year and WLS will ensure the project has adequate easement signs. WLS will immediately address any easement encroachments and document them in in the annual monitoring reports.

8.3 Stream Assessment Monitoring

Hydrologic monitoring will be conducted for all of the Project stream reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Level I and II) approaches, geomorphic monitoring methods will be employed to evaluate the effectiveness of the restoration practices. Visual monitoring will be conducted along these reaches as described herein. The monitoring of these Project reaches will utilize the methods described under visual monitoring.

8.3.1 Hydrologic Monitoring

The occurrence of four required bankfull events within the monitoring period, along with floodplain access by flood flows, will be documented using pressure transducers and/or photography. The pressure transducers will be installed in pools and correlating sensor depth to top of bank elevation. Recorded water depth above the top of bank elevation will document a bankfull event. Corresponding photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits. This hydrologic monitoring will help establish that the restoration objectives of restoring floodplain functions and promoting more natural flood processes are being met. There will be three crest gauges/pressure transducers installed.

8.3.2 Geomorphic Monitoring

Pattern: A planimetric survey will be conducted for the entire length of restored channel immediately after construction to document as-built baseline conditions (Monitoring Year 0). The survey will be tied to a permanent benchmark and measurements will include thalweg, bankfull, and top of banks. The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline documentation (Monitoring Year 0) only. These measurements will demonstrate that the restored stream channel pattern provides more stable planform and associated features than the old channel, which provide improved aquatic habitat and geomorphic function, as per the restoration objectives.

Dimension: Permanent cross-sections will be installed and surveyed at an approximate rate of one cross-section per 20 bankfull widths or an average distance interval (not to exceed 500 LF) of restored stream, with approximately 50% cross-sections located at riffles, and 50% located at pools (10 cross-sections in total). Each cross-section will be monumented on both streambanks to establish the exact transect used and to facilitate repetition each year and easy comparison of year-to-year data. The cross-section surveys will occur in years 0 (as-built), 1, 2, 3, 5, and 7, and will include measurements of bankfull cross-sectional area (Abkf) at low bank height, Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of streambanks, bankfull, inner berm, edge of water, and thalweg, if the features are present.

There should be minimal change in as-built cross-sections. Stable cross-sections will establish that the restoration goal of creating geomorphically stable stream conditions has been met. If changes do take place, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the streambanks, or decrease in width-to-depth ratio). Using the Rosgen Stream Classification System, all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type. Given the smaller channel sizes and meander geometry of the proposed steams, bank pin arrays will not be installed unless monitoring results indicate active lateral erosion at cross-sections occurring in meander bends or an increase of greater than 15% in cross-sectional area, or when visual monitoring indicates potential bank instability.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the streambanks. Photographs will be taken of both streambanks at each cross-section. A survey tape stretched between the permanent cross-section monuments/pins will be centered in each of the streambank photographs. The water elevation will be shown in the lower edge of the frame, and as much of the streambank as possible will be included in each photo. Photographers should attempt to consistently maintain the same area in each photo over time.

Profile: A longitudinal profile will be surveyed for the entire length of restored channel immediately after construction (Monitoring Year 0) to document as-built baseline conditions. The survey will be tied to a permanent benchmark and measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with the intended design stream type. The longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary. Bank height ratios will be measured along the restored reaches using the results of the longitudinal profile.

8.3.3 Flow Duration Monitoring

Jurisdictional Stream Flow Documentation: Monitoring of stream flow will be conducted to demonstrate that the restored stream systems classified as intermittent exhibit surface flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal rainfall conditions for Cow Branch and S200. S100 must either have 90 days of consecutive flow or 30 days of consecutive flow plus macrobenthos monitoring that demonstrates biology indicative of intermittent flow in restored stream channels post-construction. The macrobenthos sampling will occur during monitoring year 1 to establish baseline conditions. Subsequent sampling will occur during monitoring years 3, 5, and 7. Sampling will be conducted within appropriate habitat near the upper end of the reach in close proximity to the flow gauge. To determine if rainfall amounts are normal for the given year, a rainfall gauge will be installed on the site to compare precipitation amounts using tallied data obtained from the Whiteville 7 NW WETS station. If a normal year of precipitation does not occur during the first seven years of monitoring, monitoring of flow conditions on the site will continue until it documents that the intermittent streams have been flowing during the appropriate times of the year.

The proposed monitoring of restored intermittent reaches will include the installation of flow devices (continuous-read pressure transducers) installed in pools and correlating sensor depth to the downstream top of riffle elevation. If the pool water depth is at or above the top of riffle elevation, then the channel will be assumed to have surface flow. The devices will be installed in the upper one-third portion of the reach. In addition, photographic documentation using a continuous series of remote photos over time may be used to subjectively evaluate and document channel flow conditions throughout the year. More specifically, the longitudinal photos should indicate the presence of flow within the channel to illustrate water levels within the pools and riffles. The photographs will be taken from a height of approximately five feet to ensure that the same locations (and view directions) at the Project site are documented in each monitoring period and will be shown on a plan view map. The devices will be inspected on a quarterly basis to document surface hydrology and provide a basis for evaluating flow response to rainfall events and surface runoff throughout the monitoring period. Each reach will have a flow gauge installed for a total of three flow gauges.

For S100 if monitoring of macrobenthos fails to show species indicative of intermittent flow and the annual consecutive flow data is less than 90 days but more than 30 days, credit will be reduced by 50 percent. If S100 exceeds 90 days consecutive flow annually, then the documentation of macrobenthos will not be required to obtain full stream credits. However, less than 30 days consecutive flow annually will result in no reach credit (regardless of benthic data).

8.4 Wetland Monitoring

At least 12 automated groundwater monitoring wells will be installed to document hydrologic conditions of the restored wetland areas to determine hydrologic success criteria are achieved. Ten of the gauges will be in creditable wetlands and two gauges will be located in a reference wetland onsite. Groundwater monitoring wells will be installed to record daily groundwater levels in accordance with the USACE standard methods described in "*Technical Standard for Water Table Monitoring of Potential Wetland Sites*" (ERDC TN-WRAP-05-2, June 2005). The objective for the monitoring well data is to demonstrate that the Project exhibits an increased flood frequency as compared to pre-restoration conditions and on-site reference conditions.

8.5 Vegetation Monitoring

Vegetation-monitoring quadrants or plots will be installed and monitored across the Project in accordance with the *CVS-EEP Level I & II Monitoring Protocol* (CVS, 2008). The vegetation monitoring plots shall comprise two percent of the restoration planted portion (approximately 18 acres in Zone 1 and 19 acres in Zone 2) of the Project site with approximately 30 plots established within the planted riparian buffer areas. Fifteen vegetation plots will be fixed and located in W01; these will be fixed due to difficulty of finding planted trees later in monitoring due to the existing dense regeneration in the disturbed area. Three additional random monitoring transects will also be done in W01 to assess supplementally planted and/or natural regeneration areas. Fifteen of the vegetation plots will be in Zone 2: five plots will be random and 10 plots will be fixed in this planting zone adjacent to streams and in the wetland re-establishment. The location of random plots (GPS coordinates and orientation) will be identified in the annual monitoring reports. The size and location of fixed plots will be 100 square meters (i.e., 10m X 10m or 5m X 20M) for planted stems and may be adjusted based on site conditions after construction activities have been completed. No monitoring quadrants will be established within undisturbed wooded areas, however visual observations will be documented in the annual monitoring reports to describe any changes to the existing vegetation community.

Vegetation monitoring will occur in the fall of each required monitoring year, prior to the loss of leaves. Data will be collected at each individual quadrant and will include specific data for monitored stems on height, species, date planted, and grid location, as well as a collective determination of the survival density within that quadrant. The vegetation monitoring for Zone 1/W01 planting will not have a height criterion, however height data will be collected in Zone 1. Individual planted seedlings will be marked at planting or monitoring baseline setup so that those stems can be found and identified consistently each successive monitoring year. Volunteer species will be noted and if they are on the approved planting list and meet success criteria standards, they will be counted towards success criteria. Other species not included on the list may be considered by the IRT on a case-by-case basis. The presence of invasive species vegetation within the monitoring quadrants will also be noted, as will any wildlife effects. At the end of the first full growing season (from baseline/year 0) or after 180 days, species composition, stem density and survival will be evaluated. For each subsequent year, vegetation plots shall be monitored for seven years in years 1, 2, 3, 5 and 7, and visual monitoring in years 4 and 6, or until the final success criteria are achieved.

Table 18. Proposed Monitoring Plan Summary

Functional Category (Level)	Project Goal / Parameter	Measurement Method	Performance Standard	Potential Functional Uplift
Hydrology (Level 1)	Improve Base Flow Duration and Overbank Flows (i.e., channel forming discharge)	Pressure transducer, regional curve, regression equations, catchment assessment	Maintain seasonal flow on intermittent streams for a minimum of 30 consecutive days during normal annual rainfall. S100 is 90 days or 30 days and macrobenthos.	Create a more natural and higher functioning headwater flow regime and provide aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Bank Height Ratio, Entrenchment Ratio, Crest gauge	Maintain average BHRs ≤1.2 and ERs ≥2.2 and document 4 out of bank/bankfull flow events using pressure transducers or photographs & crest gauges.	Provide temporary water storage and reduce erosive forces (shear stress) in channel during larger flow events.
Geomorphology (Level 3)	Improve Bedform Diversity	Pool to pool spacing, riffle-pool sequence, pool max depth ratio, longitudinal profile	Increase riffle/pool percentage and pool-to-pool spacing ratios compared to reference reach conditions.	Provide a more natural stream morphology, energy dissipation and aquatic habitat/refugia.
	Increase Vertical and Lateral Stability	Cross-sections and longitudinal profile surveys, visual assessment	Decrease streambank erosion rates comparable to reference condition cross-section, pattern and vertical profile values.	Reduce sedimentation, excessive aggradation, and embeddedness to allow for interstitial flow habitat.
	Establish Riparian Buffer Vegetation	CVS Level I & II Protocol Tree Veg Plots (Strata Composition Vigor and Density), visual assessment	Within planted portions of the Project site, a minimum of 320 stems per acre must be present at year three; a minimum of 260 stems per acre must be present at year five; and a minimum of 210 stems per acre must be present at year seven.	Increase woody and herbaceous vegetation will provide channel stability and reduce streambank erosion, runoff rates and exotic species vegetation.
Wetland Performance	Improve wetland hydrology	10 wetland gauges in creditable areas	Wetland hydrology 12% of growing season	Increased flood frequency and water storage
Easement Boundary	Easement Integrity	Site walks, photos, notes	No easement encroachments, replace signs as needed, add signs as needed.	Easement protected in perpetuity

Note: Level 4 and 5 project parameters and monitoring activities are not proposed and are not required to demonstrate success for credit release. S100 will have macrobenthos monitoring for flow purposes as outlined in Section 8.3.3.

9 Adaptive Management Plan

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

There is potential for pine, sweetgum, and red maple recolonization to affect the composition of the target ecological community in W01/cutover area. WLS will take steps as needed to thin saplings during the monitoring period in W01. Using data from the vegetation plots as well as visual assessment monitoring, WLS will thin as needed to maintain trajectory towards the target community. Any treatments will be documented and included within annual monitoring reports.

10 Long-Term Management Plan

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

WLS does not expect that easement compliance and management will require any additional or alternative management planning, strategies or efforts beyond those typically prescribed and followed for DMS full-delivery projects.

11 References

Dooley and Maschhoff, 2003. Functional requirements and design parameters for restocking coarse woody features in restored and enhanced wetlands.

Dunne, T. & Leopold, L.B. (1978): Water in Environmental Planning W.HG. Freeman Co., San Francisco, 818 pp.

Ecological Flows Science Advisory Board (EFSAB). 2013. Recommendations for Estimating Flows to Maintain Ecological Integrity in Streams and Rivers in North Carolina.

Federal Interagency Stream Restoration Working Group (FISRWG). 1998. Stream corridor restoration: Principles, processes and practices. National Technical Information Service. Springfield, VA.

Griffith, G.E., et al. 2002. Ecoregions of North Carolina. Reston, VA. United States Geological Survey.

Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. A function-based framework for developing stream assessments, restoration goals, performance standards and standard operating procedures. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, D.C.

Harman, W., R. Starr. 2011. Natural Channel Design Review Checklist. US Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD and US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Wetlands Division. Washington D.C. EPS 843-B-12-005.

Hey, R.D. 2006. Fluvial Geomorphological Methodology for Natural Stable Channel Design. Journal of American Water Resources Association. April 2006. Vol. 42, No. 2. pp. 357-374. AWRA Paper No. 02094.

Hess, Hydrology and Earth System Sciences. 2014. Flow pathways and nutrient transport mechanisms drive hydrochemical sensitivity to climate change across catchments with different geology and topography. V 18, 5125–5148.

Johnson, P.A., and T.M. Heil, 1996. Uncertainty in Estimating Bankfull Conditions. Journal of the American Water Resources Association 32(6): 1283-1292.

Knighton, D. 1998. Fluvial Forms and Processes – A New Perspective. Arnold Publishers. London.

Kilpatrick, F.A. and H.H. Barnes, Jr. 1964. Channel Geometry of Piedmont Streams as Related to Frequency of Floods. U.S. Geological Survey Professional Paper 422-E. U.S. Government Printing Office. Washington, D.C. 10 pp.

Leopold, Luna B., 1994. A View of the River. Harvard University Press. Cambridge, Mass.

Nixon, M.A. 1959. A study of the bankfull discharges of rivers in England and Wales. Institute of Civil Engineers Proceedings Paper No. 6322, pp. 157-174.

North Carolina Division of Water Quality. 2010. Methodology for Identification of Intermittent and Perennial Streams and Their Origins. Version 4.11, September 2010.

North Carolina Geological Survey, 1985. North Carolina Department of Environment and Natural Resources, Raleigh, NC. Cited from http://www.geology.enr.state.nc.us/usgs/geomap.htm on

July 17, 2023.

North Carolina Stream Functional Assessment Team, 2015. “NC Stream Assessment Method (NC SAM) User Manual”. Version 2.1, August 2015.

North Carolina Wetland Functional Assessment Team, 2010. “NC Wetland Assessment Method (NC WAM) User Manual”. Version 4.1, October 2010.

North Carolina Department of Environmental Quality, 2019. “DWR Surface Water Classifications.”

North Carolina Division of Mitigation Services (NCDMS), 2008. “Lumber River Basin Restoration Priorities (RBRP) 2008.”

North Carolina Division of Water Resources (NCDWR), 2010. “Methodology for Identification of Intermittent and Perennial Streams and Their Origins”, v 4.11.

Rosgen, D. L., 1994. A Classification of Natural Rivers. Catena 22: 169-199.

Schafale, M.P. 2023. Classification of the Natural Communities of North Carolina, Fourth Approximation. North Carolina Natural Heritage Program, NC Department of Natural and Cultural Resources, Raleigh, NC.

Schumm, S.A., 1960. The Shape of Alluvial Channels in Relation to Sediment Type. U.S. Geological Survey Professional Paper 352-B. U.S. Geological Survey. Washington, DC.

Scherrer, E. 1999. Using Microtopography to Restore Wetland Plant Communities in Eastern North Carolina.

Simon, Andrew. 1989. A model of channel response in disturbed alluvial channels. Earth Surface Processes and Landforms. Volume 14, Issue 1, pg 11–26.

Skaggs, R.W., G.M. Chescheir, and B.D. Phillips. 2005. Methods to Determine Lateral Effect of a Drainage Ditch on Wetland Hydrology. Trans. ASAE 48(2): 577-584.

Skaggs, R. W., D. Amatya, R. O. Evans, and J. E. Parsons. 1994. Characterization and evaluation of proposed hydrologic criteria for wetlands. Journal of Soil and Water Conservation 49(5):501- 510.

Skidmore, P.B, Shields, F., Doyle, M., and Miller, D. (2001). A Categorization of Approaches to Natural Channel Design. Wetlands Engineering & River Restoration: pg 1-12.

Stone et al., 2017. Wetbud – A Free Water Budget Modeling Tool for Created Wetland Design. Proceedings of the 8th International Conference on Sustainable Development in the Minerals Industry.

Sweet, W.V. and J.W. Geratz. 2003. Bankfull Hydraulic Geometry Relationships and Recurrence Intervals for North Carolina’s Coastal Plain. Journal of the American Water Resources Association 39(4):861-871.

Tweedy, K. 2008. A Methodology for Predicting Channel Form in Coastal Plain Headwater Systems. Michael Baker Engineering, Inc.

United States Geological Survey. 1998.

United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

United States Army Corps of Engineers. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-RS-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

United States Army Corps of Engineers. 2016. Notification of Issuance of Guidance for Compensatory Stream and Wetland Mitigation Conducted for Wilmington District, October 2016, U.S. Army Corps of Engineers. Wilmington District.

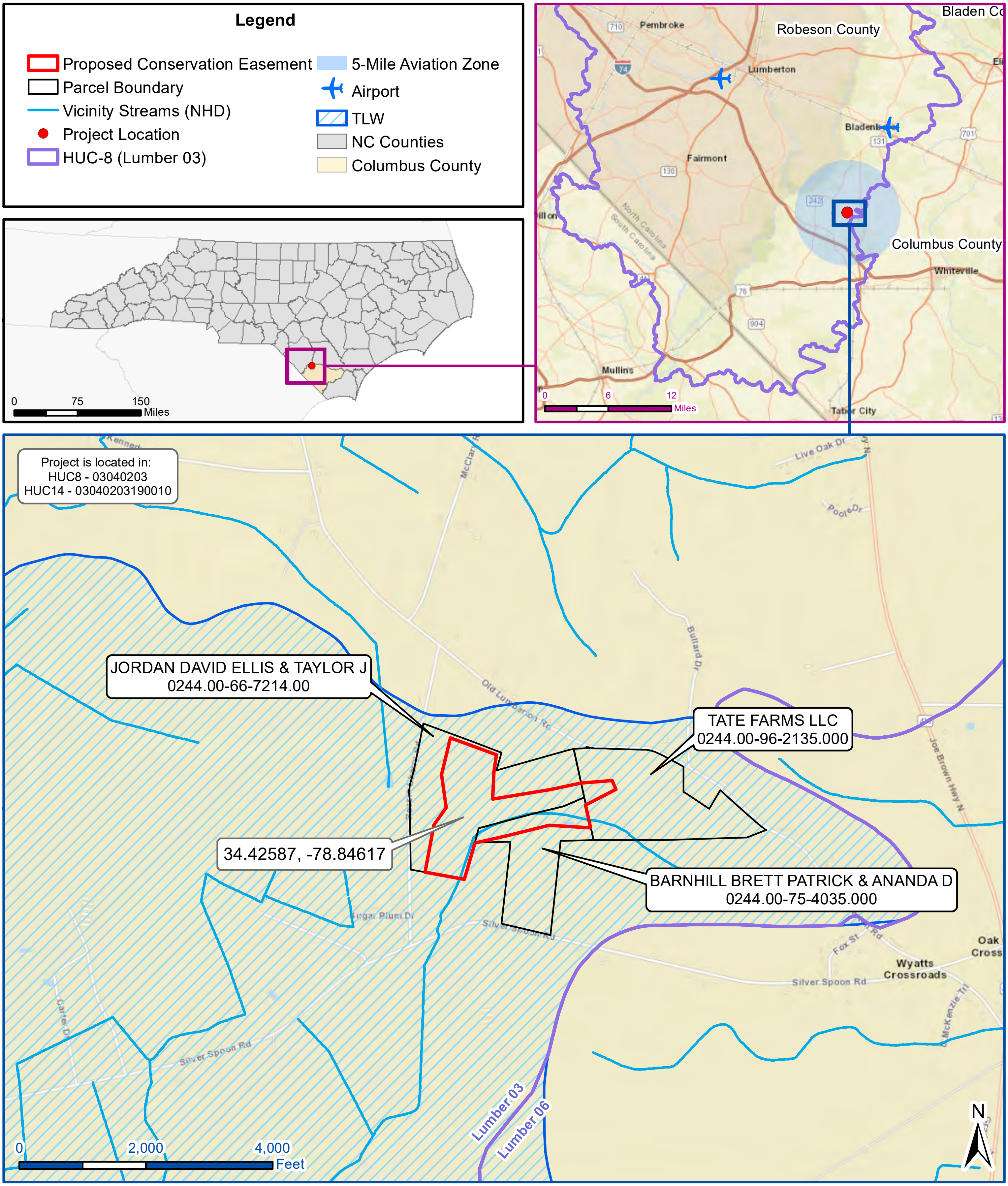
United States Army Corps of Engineers. 2009. Compensatory Mitigation for Losses of Aquatic Resources; Final Rule dated April 10th, 2009 of the Federal Register Vol. 73, No. 70.

United States Department of Agriculture, Natural Resources Conservation Service Soil Survey Division. 2023. Soil Survey of Columbus County, North Carolina.

United States Department of Agriculture, Natural Resources Conservation Service. 2007. Stream Restoration Design Part 654, National Engineering Handbook.

United States Department of Interior, Fish and Wildlife Service (USFWS). Threatened and Endangered Species in North Carolina (County Listing). Columbus County. 2023.

Figures



WATER & LAND SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

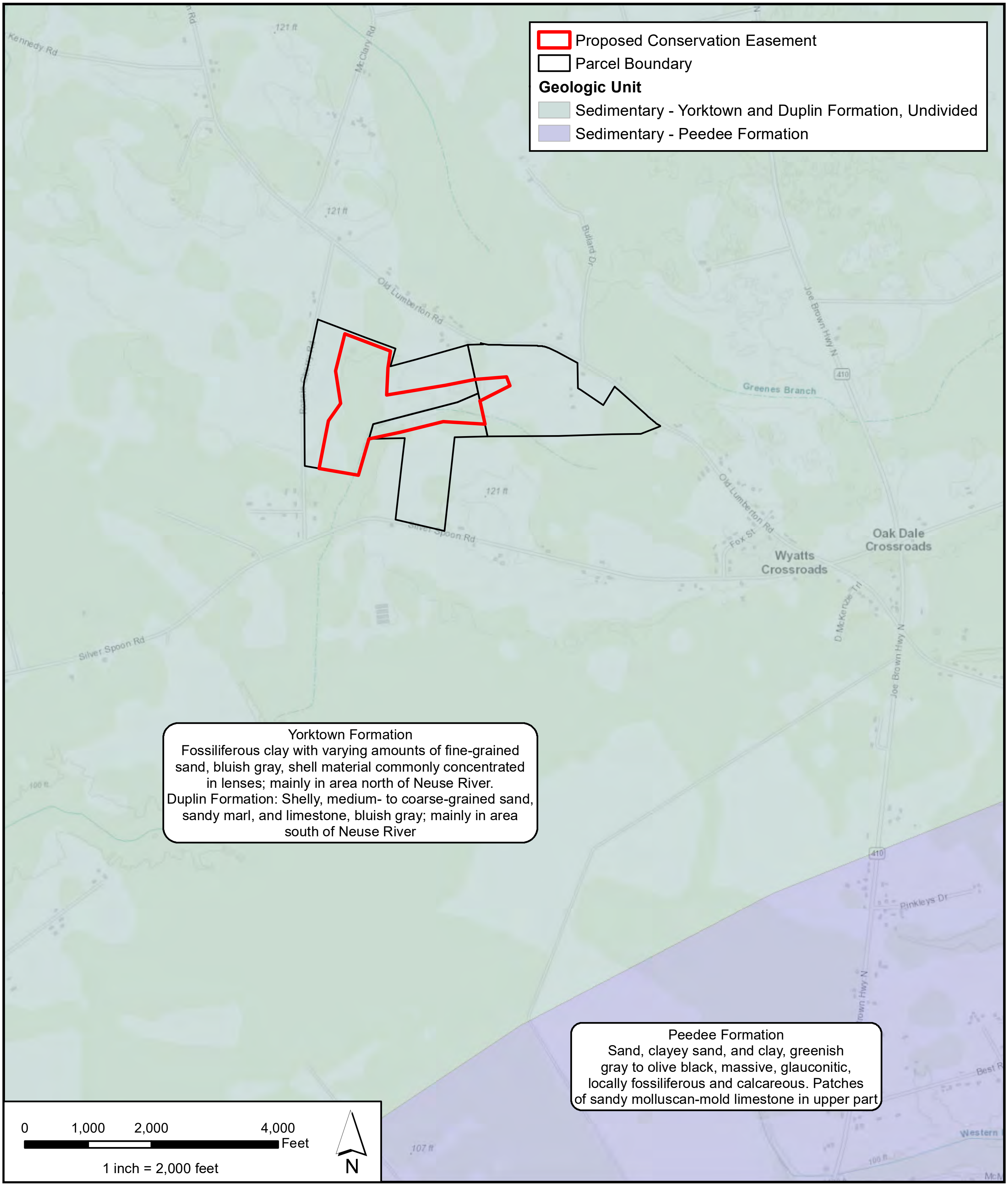
Project Location Map

Figure
1

Map Projection: NAD_1983_StatePlane_NC_FIPS_3200_Feet

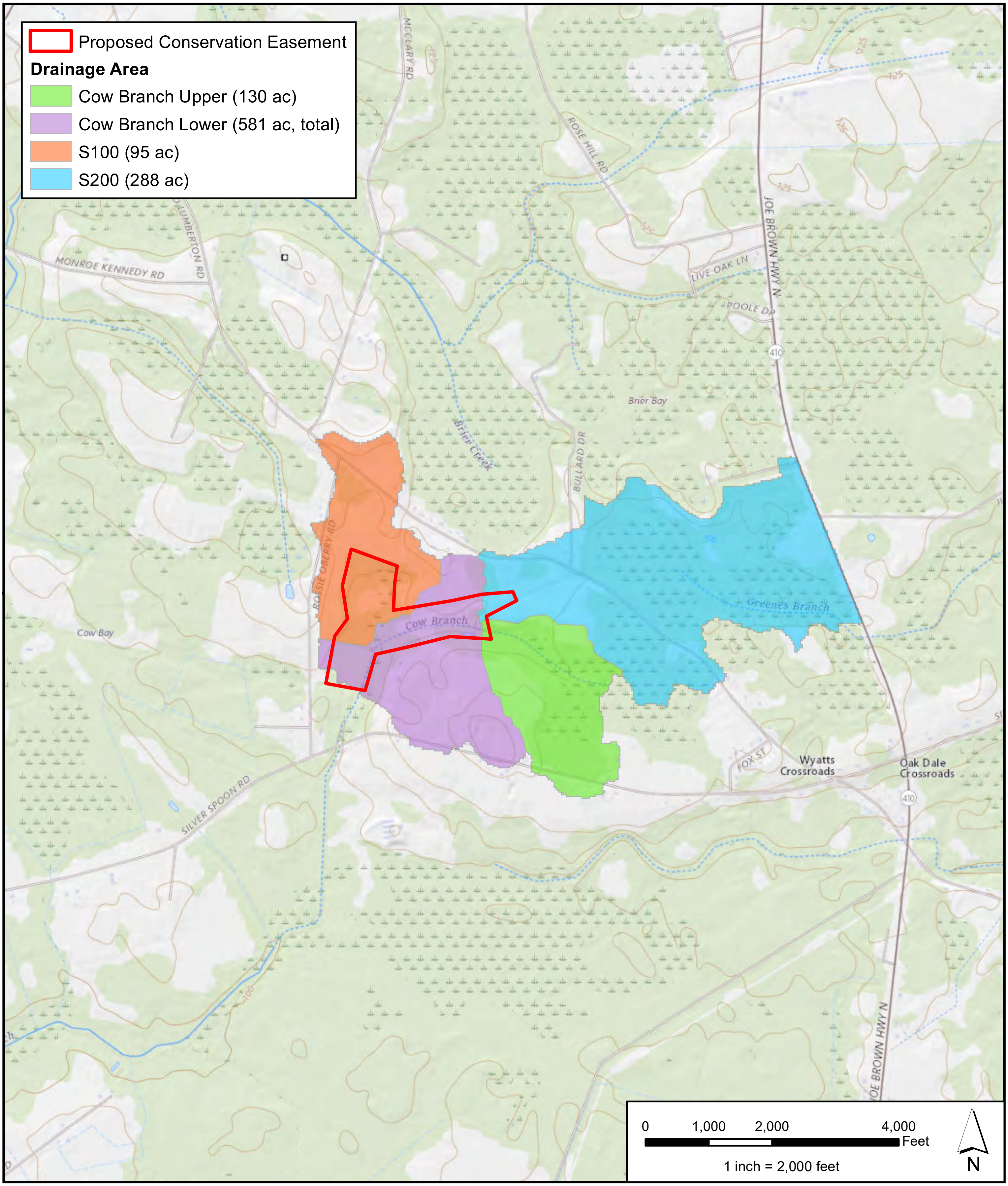
Date: 1/19/2024

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



WATER & LAND™ SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	Existing Geology Map	Figure **2**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 8/1/2023	

Data sources - Soils data source: USDA. Imagery data source: NC One Map



Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

USGS
Topographic Quad
Chadbourn NE

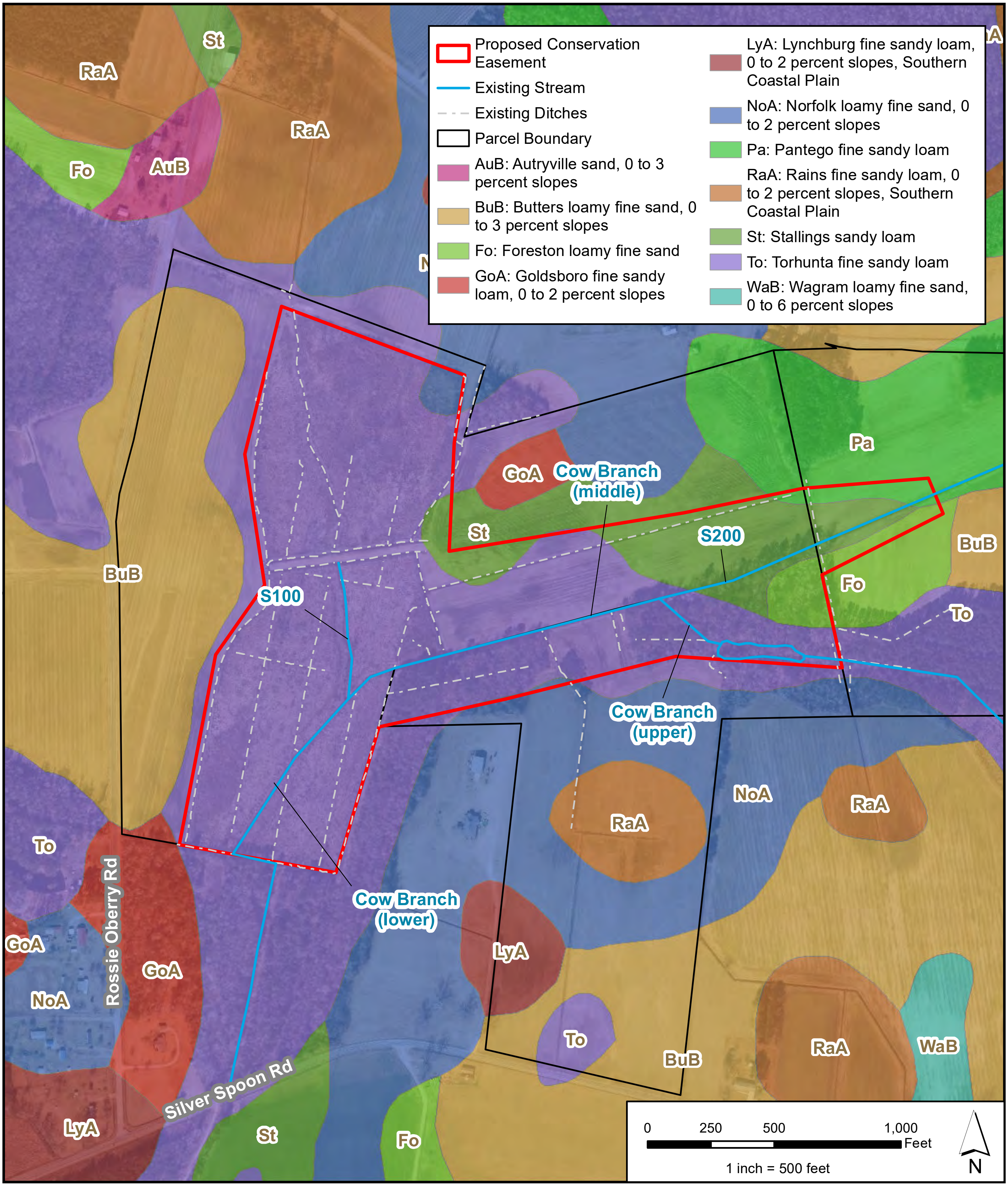
Figure
3

WATER & LAND™ SOLUTIONS

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

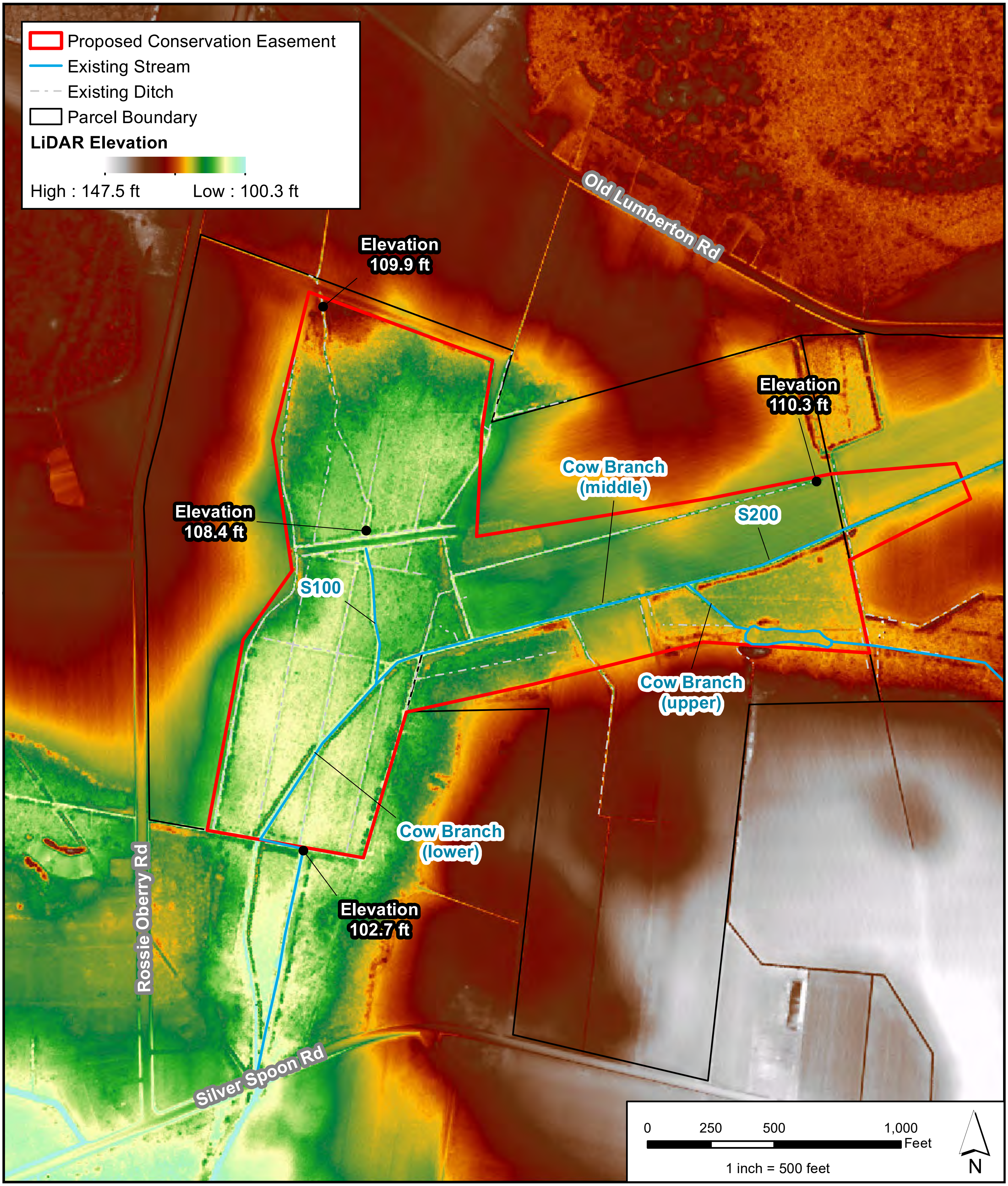
Date: 1/19/2024

Service Layer Credits: USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset;



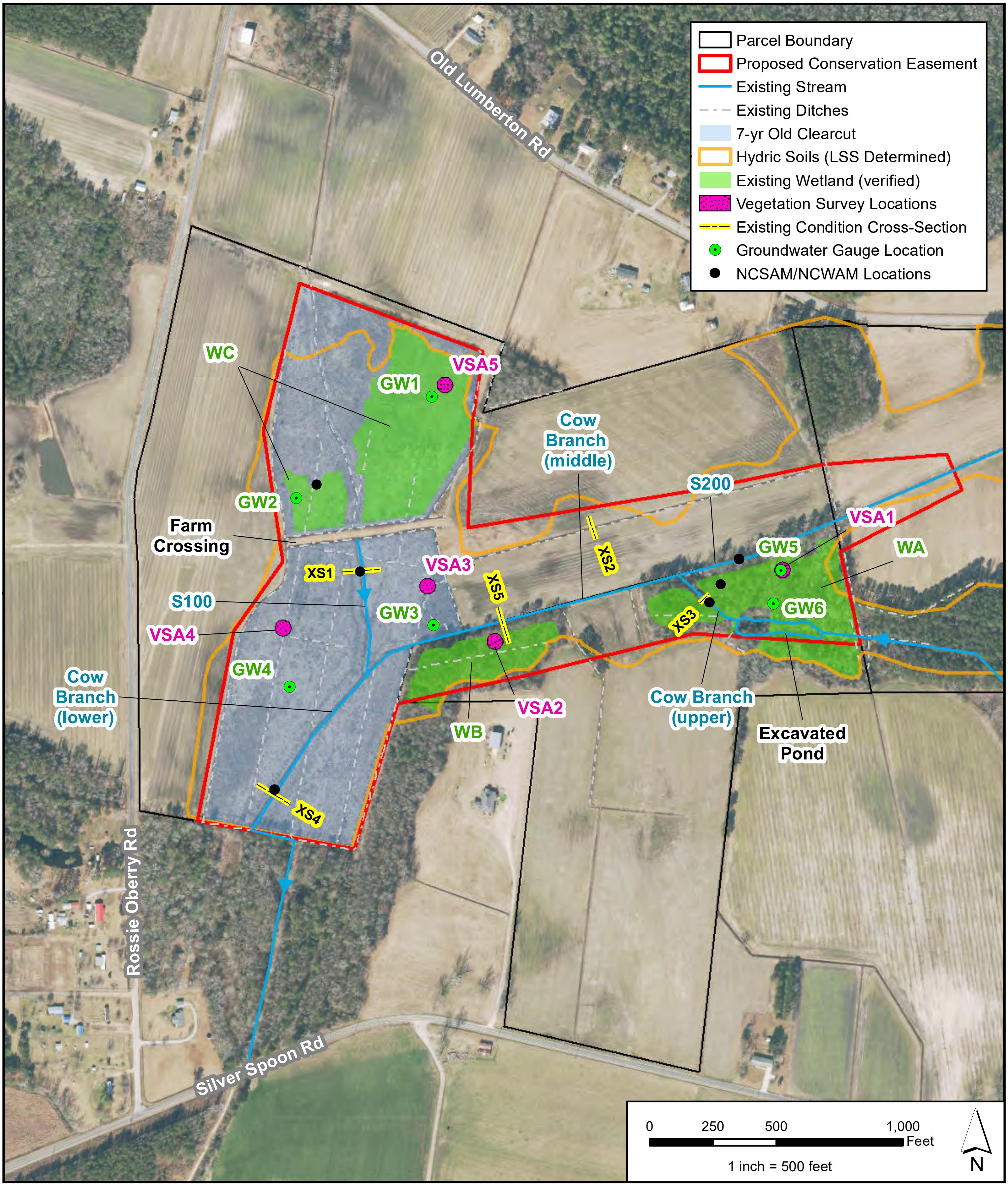
WATER & LAND SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	NRCS Soils Map	Figure **4**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 1/19/2024	

Data sources - Soils data source: USDA. Imagery data source: NC One Map



WATER & LAND SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	LiDAR Map	Figure **5**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 1/19/2024	

Data sources - Elevation data source: NC One Map



WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

Current Conditions Map

Figure
6

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 1/16/2024

Data sources - Stream and wetland data collected during preliminary assessment. Imagery data source: NC One Map

WATER & LAND™ SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	1974 Aerial Source: USGS	Figure **7a**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 1/19/2024	

WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

1999 Aerial
Source: USGS
DOQQ

Figure
7b

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 8/1/2023

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

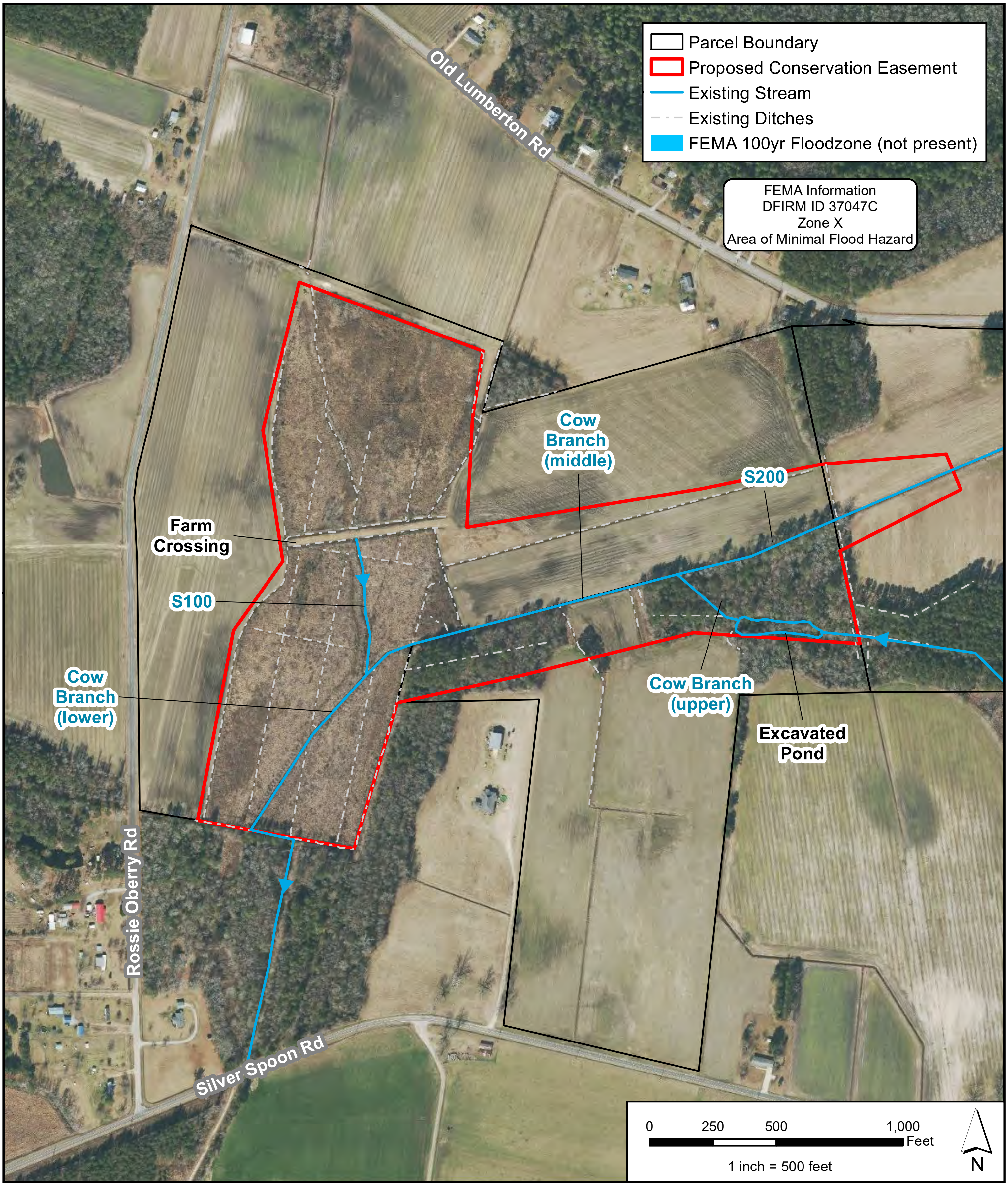
2015 Aerial
Source: Maxar Technologies

Figure
7c

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 1/19/2024

Service Layer Credits:



WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

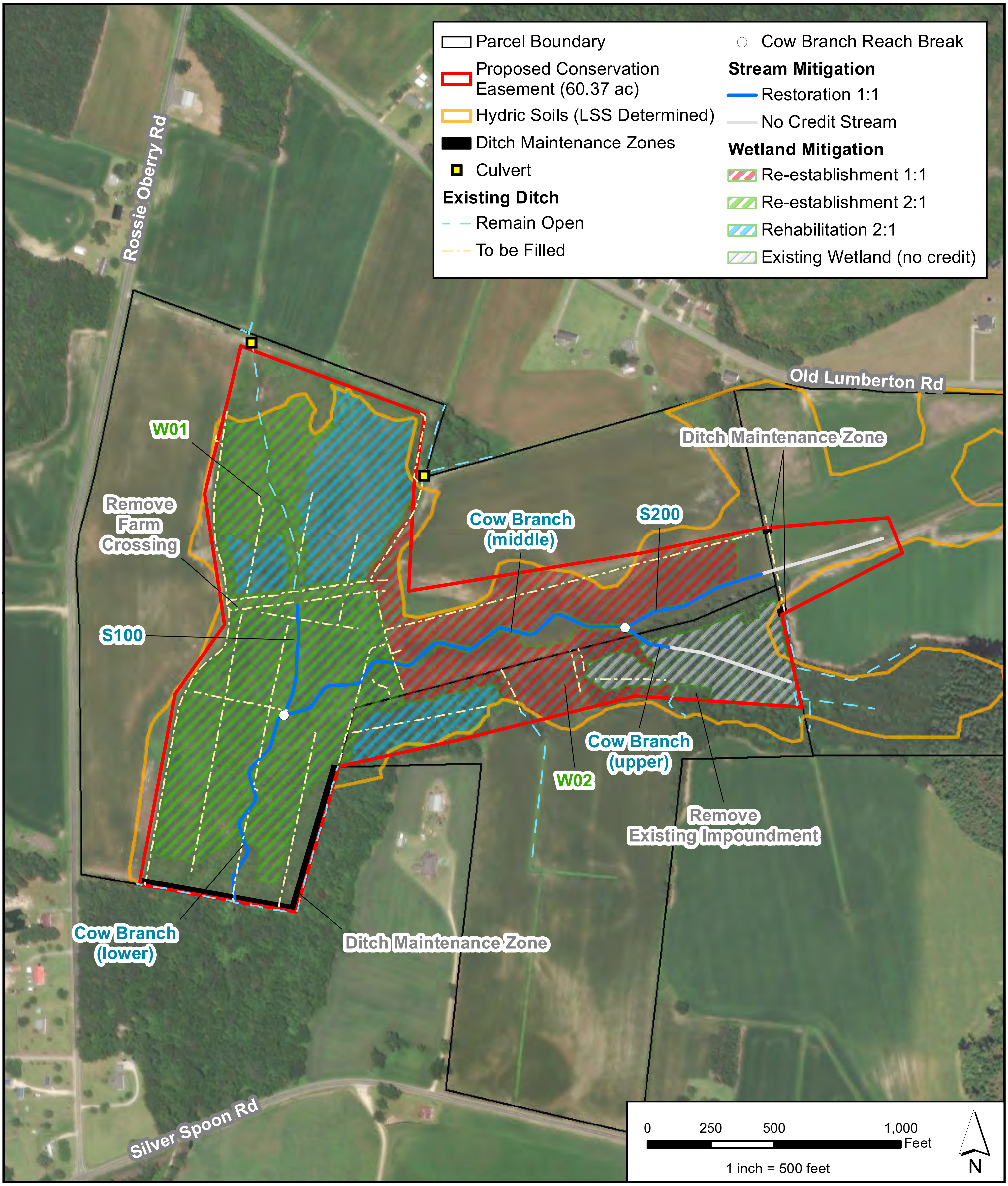
FEMA Floodplain Map

Figure
8

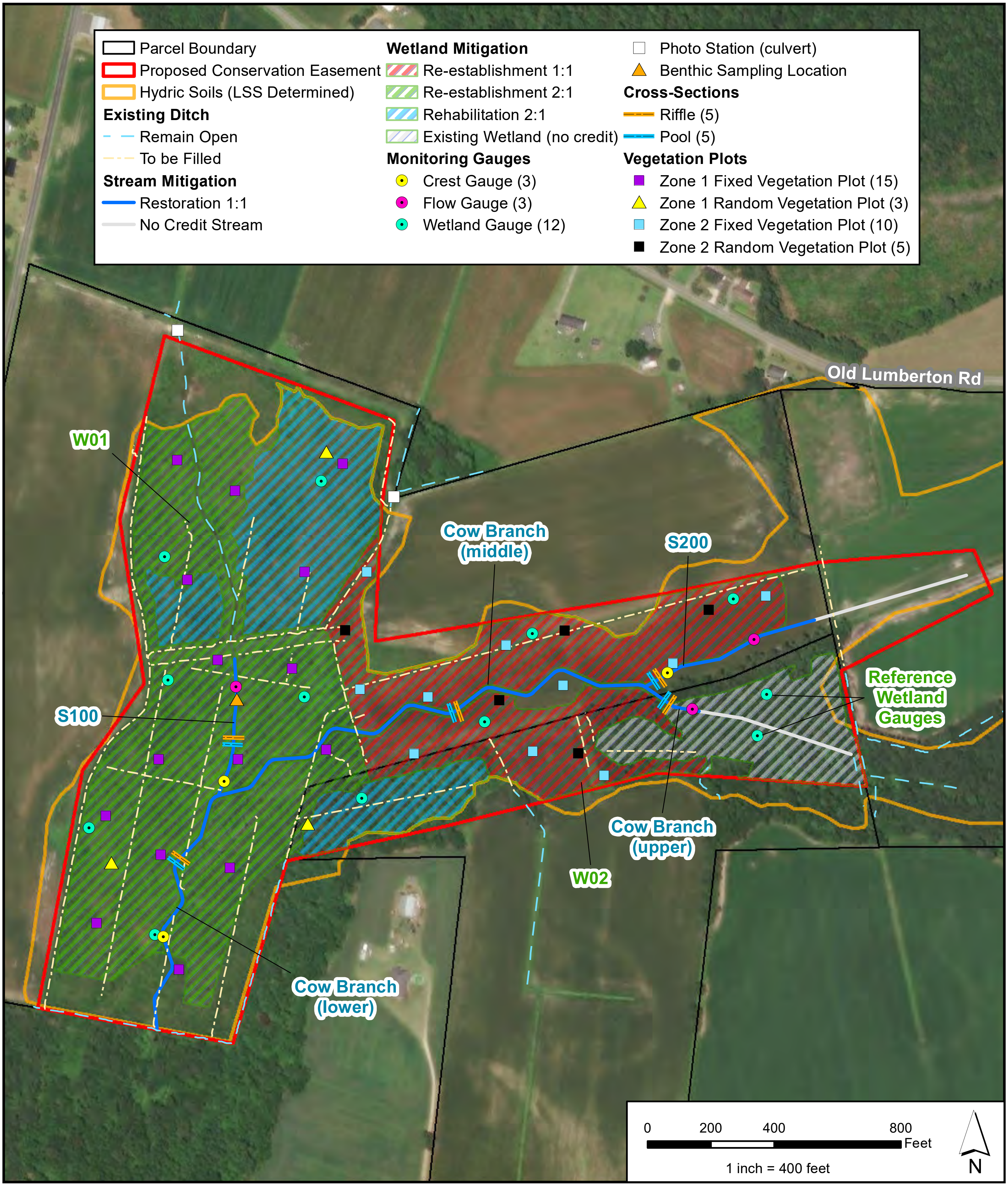
Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 1/19/2024

Data sources - Stream and wetland data collected during preliminary assessment. Imagery data source: NC One Map



Parcel Boundary
Proposed Conservation Easement (60.37 ac)
Hydric Soils (LSS Determined)
Ditch Maintenance Zones
Culvert
Existing Ditch
Remain Open
To be Filled
Cow Branch Reach Break
Stream Mitigation
Restoration 1:1
No Credit Stream
Wetland Mitigation
Re-establishment 1:1
Re-establishment 2:1
Rehabilitation 2:1
Existing Wetland (no credit)
Rossie Oberry Rd
Old Lumberton Rd
Silver Spoon Rd
W01
W02
S100
S200
Remove Farm Crossing
Cow Branch (middle)
Cow Branch (upper)
Cow Branch (lower)
Ditch Maintenance Zone
Ditch Maintenance Zone
Remove Existing Impoundment
0
250
500
1,000
Feet
1 inch = 500 feet
N



WATER & LAND™ SOLUTIONS

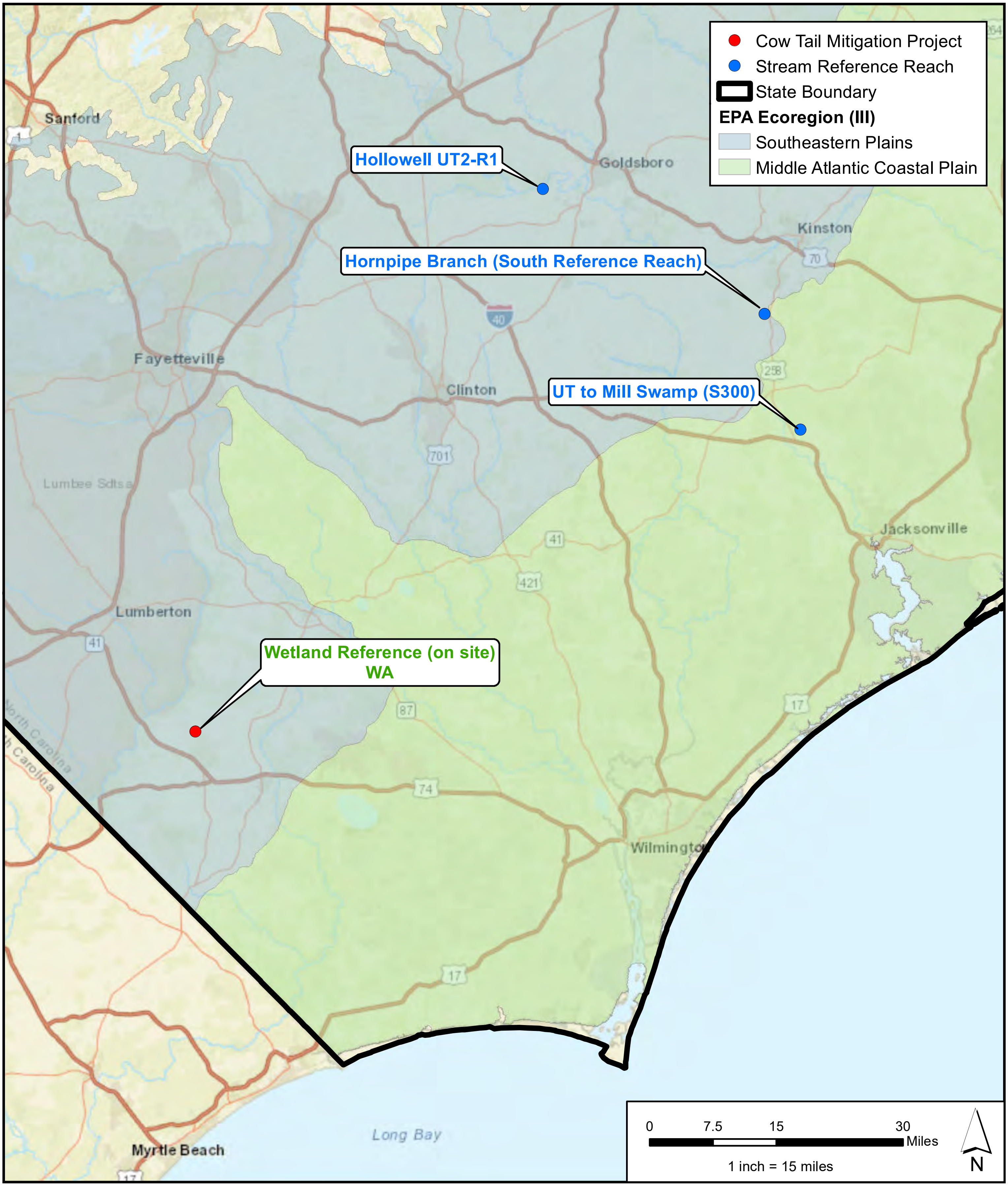
Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

Proposed Monitoring Map

Figure **10**

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 3/13/2024



WATER & LAND™ SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	Reference Site Location Map	Figure **11**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 1/19/2024	

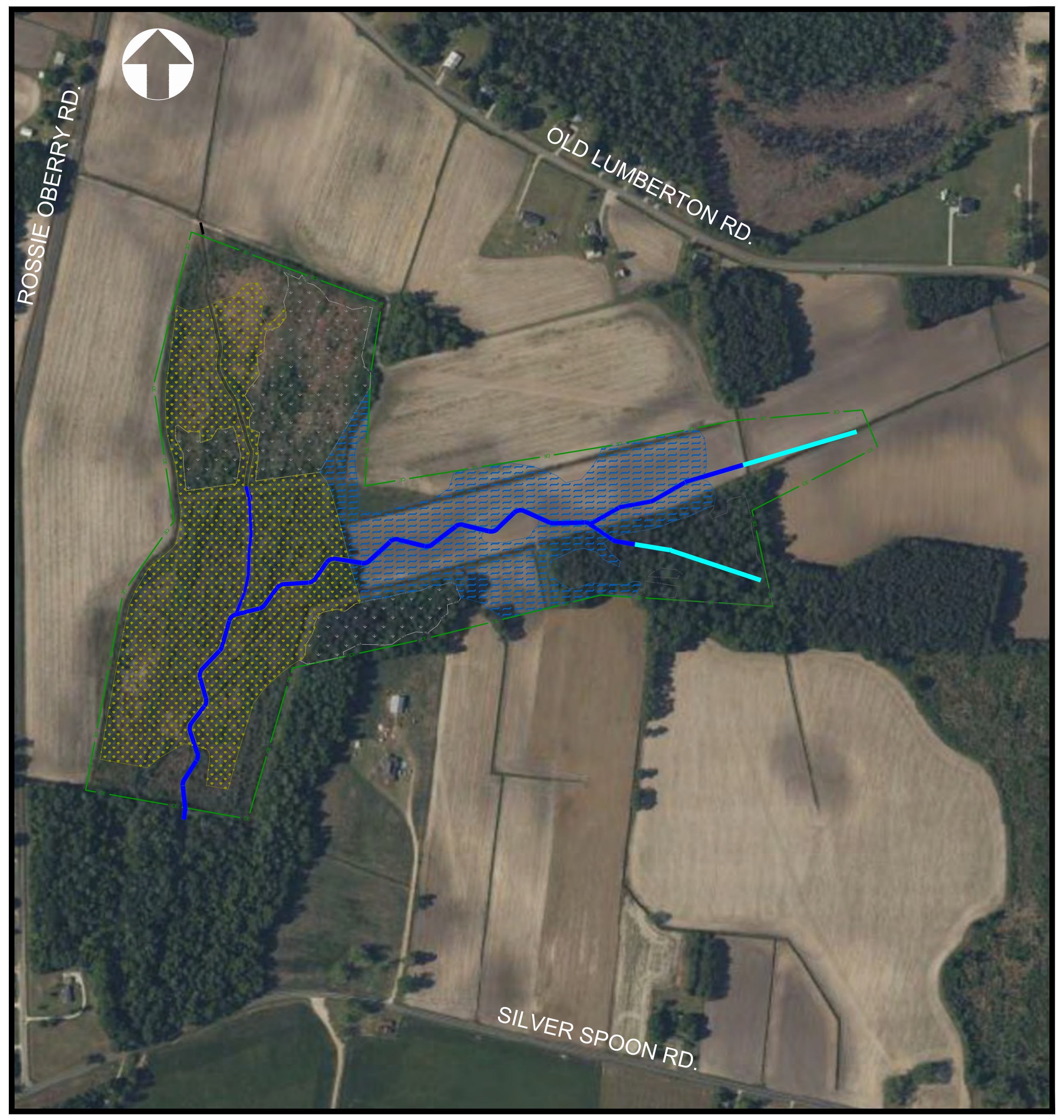
Data sources - Stream and wetland data collected during preliminary assessment. Imagery data source: NC One Map

Appendix 1 – Plan Sheets

COW TAIL MITIGATION PROJECT

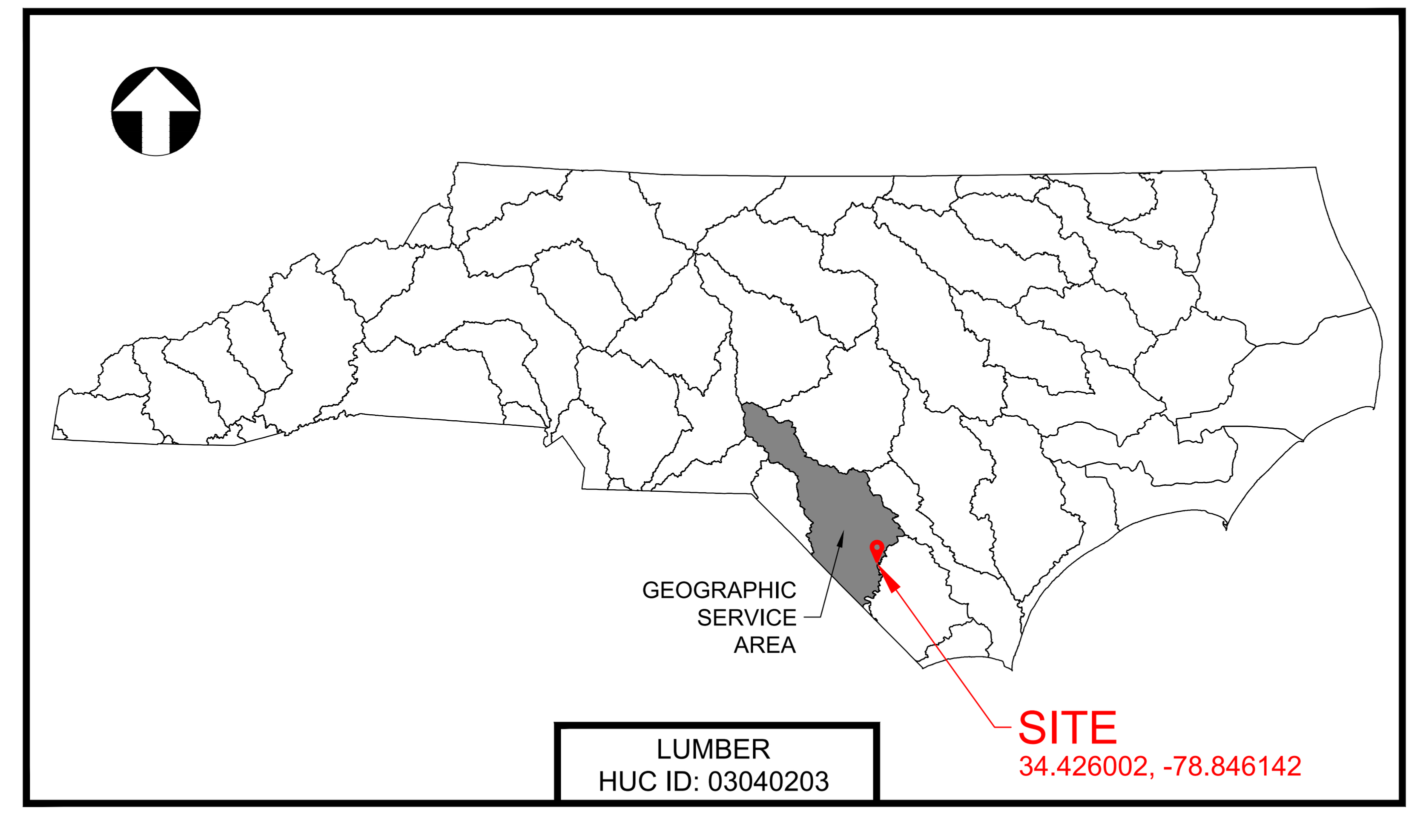
COLUMBUS COUNTY, NORTH CAROLINA

FINAL MITIGATION PLAN
NCDEQ DMS PROJECT IDENTIFICATION # 100647
NCDEQ DMS CONTRACT # 416888198-01
USACE ACTION ID NUMBER: SAW-2023-00196
CONTRACTED UNDER RFP # 16-416888198
NC DWR PROJECT # 20230252
TYPE OF WORK: STREAM & WETLAND MITIGATION

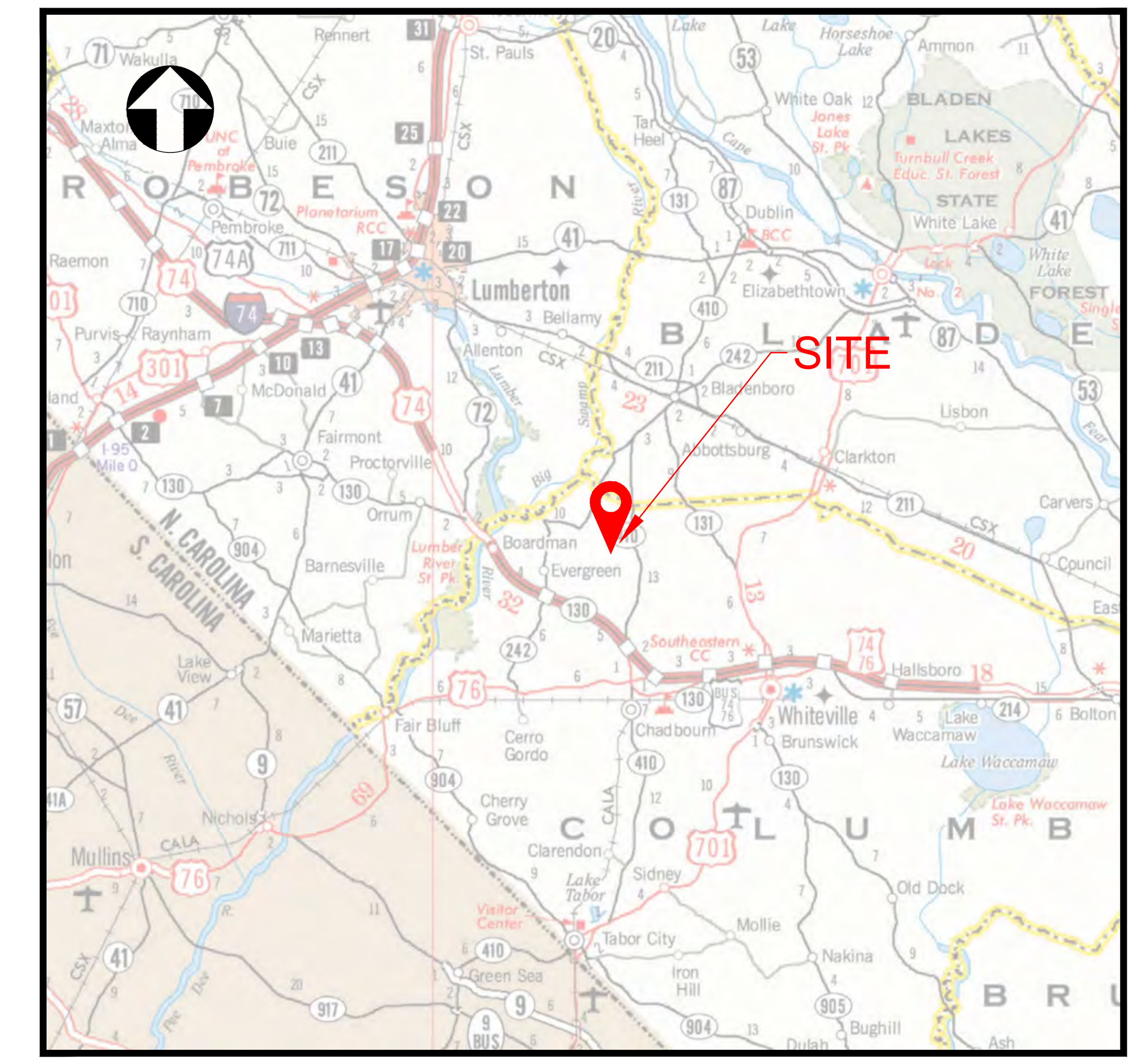


VICINITY MAP

400 200 0 400
SCALE IN FEET



USGS 8-DIGIT HUC BOUNDARY MAP
N.T.S.



LOCATION MAP

8 4 0 8
SCALE IN MILES

DRAWING LIST

1	TITLE SHEET
2	GENERAL & SPECIAL NOTES
3	PROJECT KEYMAP & LEGEND
4	TYPICAL SECTIONS
5-12	PLAN & PROFILE
13-15	WETLAND GRADING PLAN
16	PLANTING PLAN TABLES & NOTES
17-19	PLANTING PLAN
20-22	DETAILS

APPROXIMATE LIMITS OF DISTURBANCE (LOD) = 69.8 AC

LEGEND

CONSERVATION EASEMENT

STREAM MITIGATION

RESTORATION (1:1)

NO-CREDIT

WETLAND MITIGATION

REHABILITATION (2:1)

RE-ESTABLISHMENT (1:1)

RE-ESTABLISHMENT (2:1)

PROJECT SUMMARY

Stream Reach	Type of Mitigation	Proposed Stream Length (LF)	Credit Ratio	Stream Mitigation Credits (SMCs)
Cow Branch (upper)	Stream Restoration (PI)	192	1:1	191.840
Cow Branch (middle)	Stream Restoration (PI)	1,542	1:1	1,542.082
Cow Branch (lower)	Stream Restoration (PI/PII)	827	1:1	827.172
S100	Stream Restoration (PI)	441	1:1	440.830
S200	Stream Restoration (PI/PII)	581	1:1	581.050
	TOTALS	**3,583**		**3,582.974**
Wetland Area	**Type of Mitigation**	**Proposed Wetland Area (AC)**	**Credit Ratio**	**Riparian Wetland Mitigation Credits (RWMCs)**
W01	Wetland Rehabilitation	8.838	2:1	4.419
W01	Wetland Re-establishment	19.485	2:1	9.743
W02	Wetland Re-establishment	12.495	1:1	12.495
	TOTALS	**40.818**		**26.657**

NOTES:
1. THE PLANS HAVE BEEN CREATED ON ANSI D FULL BLEED (22"X34") PAPER. FOR REDUCTIONS, REFER TO GRAPHIC SCALE. WHEN PLOTTED ON 11"X17" PAPER, THIS PLAN SET WILL NOT BE TO SCALE.
2. THE PLANS HAVE BEEN CREATED FOR FULL COLOR PLOTTING. ANY SET OF THE PLANS THAT IS NOT PLOTTED IN FULL COLOR SHALL NOT BE CONSIDERED ADEQUATE FOR CONSTRUCTION PURPOSES. **WARNING**: INFORMATION MAY BE LOST IN COPYING AND/OR GRAY SCALE PLOTTING.

FILENAME: 01_COWTAIL_TITLE.DWG

NORTH CAROLINA PROFESSIONAL SEAL 30916 ENGINEER CHRISTOPHER TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
TITLE SHEET

SHEET NO.
1

CONSTRUCTION SEQUENCE

THE ENGINEER WILL PROVIDE CONSTRUCTION OBSERVATION DURING THE CONSTRUCTION PHASE OF THIS PROJECT. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE USED DURING PROJECT CONSTRUCTION IMPLEMENTATION. PRIOR TO BEGINNING ANY LAND DISTURBING ACTIVITIES, NOTIFICATION OF AND RECEIPT OF THE CERTIFICATE OF APPROVAL MUST BE RECEIVED FROM NCDEQ-LAND QUALITY SECTION (LQS). THE CONTRACTOR SHALL CALL LQS AT 910-796-7215 TO SCHEDULE A PRE-CONSTRUCTION MEETING AT LEAST 72 HOURS PRIOR TO PROJECT ACTIVATION. THE CONTRACTOR SHALL REFER TO THE APPROVED EROSION AND SEDIMENTATION CONTROL PERMIT AND CORRESPONDING PLANS AND TECHNICAL SPECIFICATIONS FOR SPECIFIC CONSTRUCTION SEQUENCING ITEMS AND SHALL BE RESPONSIBLE FOR FOLLOWING THE APPROVED PLANS AND PERMIT CONDITIONS.

1. THE CONTRACTOR SHALL NOTIFY "NC 811" (1-800-632-4949) BEFORE ANY EXCAVATION BEGINS. ANY UTILITIES AND RESPECTIVE EASEMENTS SHOWN ON THE PLANS ARE CONSIDERED APPROXIMATE AND THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES AND ADJOINING EASEMENTS AND SHALL REPAIR OR REPLACE ANY DAMAGED UTILITIES AT HIS/HER OWN EXPENSE.
2. THE CONTRACTOR SHALL PREPARE STABILIZED CONSTRUCTION ENTRANCES, HAUL ROADS AND SHALL MOBILIZE EQUIPMENT, MATERIALS, PREPARE STAGING AREA(S) AND STOCKPILE AREA(S) AS SHOWN ON THE PLANS. HAUL ROADS SHALL BE PROPERLY MAINTAINED AT ALL TIMES DURING CONSTRUCTION.
3. CONSTRUCTION TRAFFIC SHALL BE RESTRICTED TO THE AREA DENOTED AS "LIMITS OF DISTURBANCE" OR "HAUL ROADS" AS SHOWN ON THE PLANS.
4. THE CONTRACTOR SHALL INSTALL TEMPORARY DIVERSIONS AND PUMP-AROUND OPERATIONS AT LOCATIONS INDICATED ON THE PLANS.
5. THE CONTRACTOR SHALL INSTALL TEMPORARY SILT FENCE AROUND THE STAGING AREA(S). TEMPORARY SILT FENCING WILL ALSO BE PLACED AROUND THE TEMPORARY STOCKPILE AREAS AS MATERIAL IS STOCKPILED THROUGHOUT THE CONSTRUCTION PERIOD.
6. THE CONTRACTOR SHALL INSTALL ALL TEMPORARY AND PERMANENT STREAM CROSSINGS AS SHOWN ON THE PLANS IN ACCORDANCE WITH THE APPROVED SEDIMENTATION AND EROSION CONTROL PERMIT. THE EXISTING CHANNEL AND DITCHES ON SITE WILL REMAIN OPEN DURING THE INITIAL STAGES OF CONSTRUCTION TO ALLOW FOR DRAINAGE AND TO MAINTAIN SITE ACCESSIBILITY.
7. THE CONTRACTOR SHALL CONSTRUCT ONLY THE PORTION OF CHANNEL THAT CAN BE COMPLETED AND STABILIZED WITHIN THE SAME DAY. THE CONTRACTOR SHALL APPLY TEMPORARY AND PERMANENT SEED AND MULCH TO ALL DISTURBED AREAS AT THE END OF EACH WORK DAY, WITH THE REQUIREMENT OF ESTABLISHING TEMPORARY AND PERMANENT GROUND COVER THROUGH VEGETATION ESTABLISHMENT.
8. THE CONTRACTOR SHALL CLEAR AND GRUB AN AREA ADEQUATE TO CONSTRUCT THE STREAM CHANNEL AND GRADING OPERATIONS AFTER ALL EROSION AND SEDIMENTATION MEASURES HAVE BEEN INSTALLED AND APPROVED. IN GENERAL, THE CONTRACTOR SHALL WORK FROM UPSTREAM TO DOWNSTREAM AND IN-STREAM STRUCTURES AND CHANNEL FILL MATERIAL SHALL BE INSTALLED USING A PUMP-AROUND OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLANS.
9. CONTRACTOR SHALL BEGIN CHANNEL CONSTRUCTION UPSTREAM AND PROCEED IN A DOWNSTREAM DIRECTION WITH CONSTRUCTION. THE DESIGN CHANNEL SHOULD BE CONSTRUCTED OFFLINE AND/OR IN THE DRY WHENEVER POSSIBLE. THE CONTRACTOR SHALL EXCAVATE AND CONSTRUCT THE PROPOSED CHANNEL TO PROPOSED DESIGN GRADES AND SHALL NOT EXTEND EXCAVATION ACTIVITIES ANY CLOSER THAN WITHIN 10 FEET (HORIZONTALLY) OF THE TOP OF EXISTING STREAM BANKS IN ORDER TO PROTECT THE INTEGRITY OF THE EXISTING STREAM CHANNEL UNTIL ABANDONMENT.
10. THE CONTRACTOR WILL CONTINUE CONSTRUCTION BY EXCAVATING CHANNEL FILL MATERIAL. THE CONTRACTOR MAY FILL NON-JURISDICTIONAL DITCHES WHICH DO NOT CONTAIN ANY WATER DURING THE GRADING OPERATIONS. ALONG STREAM REACHES OR POND AREA, EXCAVATED MATERIAL SHOULD BE STOCKPILED IN AREAS SHOWN ON THE PLANS. IN ANY AREAS WHERE EXCAVATION DEPTHS WILL EXCEED 10 INCHES, TOPSOIL SHALL BE HARVESTED, STOCKPILED AND PLACED BACK OVER THESE AREAS TO A MINIMUM DEPTH OF 8 INCHES TO ACHIEVE DESIGN GRADES AND CREATE A SOIL BASE FOR VEGETATION PLANTING ACCORDING TO THE DESIGN PLANS AND CONSTRUCTION SPECIFICATIONS.
11. AFTER EXCAVATING AND CONSTRUCTING THE PROPOSED CHANNEL TO PROPOSED DESIGN GRADES, INSTALL IN-STREAM STRUCTURES, BIOENGINEERING MEASURES, PERMANENT AND TEMPORARY SEEDING AND ALL REQUIRED AMENDMENTS, MULCHING, VEGETATION TRANSPLANTS, TO COMPLETE CHANNEL CONSTRUCTION AND READY THE CHANNEL TO ACCEPT FLOW PER APPROVAL BY THE ENGINEER.
12. STREAM FLOW WILL BE DIVERTED BACK INTO THE CONSTRUCTED CHANNEL ONCE THE RESTORED STREAM CHANNEL AND ASSOCIATED RIPARIAN AREA HAS BEEN STABILIZED, AS DETERMINED BY THE ENGINEER AND IN COMPLIANCE WITH APPROVED PERMIT REQUIREMENTS. ONCE STREAM FLOW IS RETURNED TO A RESTORED STREAM CHANNEL REACH, THE CONTRACTOR SHALL IMMEDIATELY BEGIN PLUGGING, FILLING, AND GRADING THE ASSOCIATED ABANDONED REACH OF STREAM CHANNEL, AS INDICATED ON PLANS, MOVING IN A DOWNSTREAM DIRECTION TO ALLOW FOR POSITIVE AND ADEQUATE DRAINAGE OF THE ABANDONED CHANNEL REACH. STREAM FLOW SHALL NOT BE DIVERTED INTO ANY SECTION OF RESTORED STREAM CHANNEL PRIOR TO THE COMPLETION OF THE CONSTRUCTION OF THAT REACH OF PROPOSED CHANNEL, INCLUDING, BUT NOT LIMITED TO FINAL GRADING, STABILIZATION WITH TEMPORARY AND PERMANENT SEEDING AND ALL REQUIRED AMENDMENTS, MULCHING, VEGETATION TRANSPLANT INSTALLATION, INSTREAM STRUCTURE INSTALLATION, BIOENGINEERING INSTALLATION, AND COIR FIBER MATTING INSTALLATION.
13. THE RESTORED CHANNEL SECTIONS SHALL REMAIN OPEN AT THEIR DOWNSTREAM END TO ALLOW FOR DRAINAGE DURING RAIN EVENTS.
14. ALL GRADING ACTIVITIES ADJACENT TO THE STREAM CHANNEL AND RIPARIAN WETLAND AREAS SHALL BE COMPLETED PRIOR TO DIVERTING STREAM FLOW INTO THE RESTORED STREAM CHANNEL REACHES. ONCE CONSTRUCTION IS COMPLETED ON A REACH OF PROPOSED STREAM CHANNEL, ADDITIONAL GRADING ACTIVITIES SHALL NOT BE CONDUCTED WITHIN 10 FEET (HORIZONTALLY) OF THE NEWLY RESTORED STREAM CHANNEL BANKS. THE CONTRACTOR SHALL NOT FINALIZE GRADE OR ROUGHEN AREAS WHERE REQUIRED EXCAVATION ACTIVITIES HAVE NOT BEEN COMPLETED UNTIL DIRECTED BY THE ENGINEER.
15. ONCE CONSTRUCTION IS COMPLETE WITHIN A PUMP-AROUND WORK AREA OR CONSTRUCTION WORK LIMIT, THE CONTRACTOR SHALL APPLY TEMPORARY SEEDING TO ANY AREAS DISTURBED DURING CONSTRUCTION WITHIN HOURS. ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY.
16. PERMANENT GROUND COVER SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF CONSTRUCTION. ALL DISTURBED AREAS SHOULD HAVE ESTABLISHED GROUND COVER PRIOR TO DEMOBILIZATION. REMOVE ANY TEMPORARY STREAM CROSSINGS AND TEMPORARY EROSION CONTROL MEASURES. HAUL ROADS TO BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN FOUND PRIOR TO CONSTRUCTION.
17. ALL REMAINING DISTURBED AREAS SHALL BE STABILIZED BY TEMPORARY AND PERMANENT SEEDING AND MULCHING BEFORE CONSTRUCTION CLOSEOUT IS REQUESTED AND DEMOBILIZATION CAN OCCUR. ALL WASTE MATERIAL MUST BE REMOVED FROM THE PROJECT SITE.
18. THE CONTRACTOR SHALL TREAT AREAS OF INVASIVE SPECIES VEGETATION THROUGHOUT THE PROJECT AREA ACCORDING TO THE CONSTRUCTION CONTRACT DOCUMENTS, INCLUDING THE APPROVED PERMIT, PLANS AND TECHNICAL SPECIFICATIONS PRIOR TO DEMOBILIZATION.
19. THE CONTRACTOR COMPLETE ALL REMAINING PLANTING ACTIVITIES, INCLUDING TREE AND SHRUB PLANTING, REMAINING TRANSPLANT INSTALLATION, INSTALLATION OF REMAINING BIOENGINEERING MEASURES, AND LIVE STAKE INSTALLATION, ACCORDING TO THE CONSTRUCTION CONTRACT DOCUMENTS, INCLUDING THE APPROVED PERMIT, PLANS AND TECHNICAL SPECIFICATIONS. THE CONTRACTOR SHALL COMPLETE THE RE-FORESTATION (BARE-ROOT PLANTING) PHASE OF THE PROJECT AND CONDUCT REMAINING PERMANENT SEEDING IN ACCORDANCE WITH THE CONSTRUCTION CONTRACT DOCUMENTS, INCLUDING THE APPROVED PERMIT, PLANS AND TECHNICAL SPECIFICATIONS.
20. THE CONTRACTOR SHALL ENSURE THAT THE SITE IS FREE OF TRASH AND LEFTOVER CONSTRUCTION MATERIALS PRIOR TO DEMOBILIZATION FROM THE SITE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OFF-SITE REMOVAL OF ALL TRASH, EXCESS BACKFILL, AND ANY OTHER INCIDENTAL MATERIALS PRIOR TO DEMOBILIZATION OF EQUIPMENT FROM THE SITE. THE DISPOSAL AND STOCKPILE LOCATIONS SELECTED MUST BE APPROVED TO THE ENGINEER AND ANY FEES SHALL BE PAID FOR BY THE CONTRACTOR.
21. THE CONTRACTOR SHALL CONDUCT SELF-INSPECTIONS OF THE EROSION AND SEDIMENTATION CONTROL MEASURES AND COMPETE THE FOLLOWING COMBINED SELF-INSPECTION FORM FOUND ON THE NCDEMLR WEBSITE *HTTPS://FILES.NC.GOV/NCDEQ/ENERGY%20MINERAL%20AND%20LAND%20RESOURCES/STORMWATER/NPDES%20GENERAL%20PERMITS/DEMLR-CSW-MONITORING -FORM-REV-AUGUST-8-2019.PDF* . TWELVE MONTHS OF COMPLETE INSPECTION FORMS SHALL BE KEPT ON-SITE AND AVAILABLE FOR INSPECTION AT ALL TIMES. IT IS RECOMMENDED A COPY BE KEPT IN A PERMITS BOX." (GS 113A-54.1 (E), 15A NCAC 04B.0131, NCG01 PART III SECTIONS A AND B).
22. WHEN THE PROJECT IS COMPLETE, THE PERMITTEE SHALL CONTACT DEMLR TO CLOSE OUT THE ESC PLAN. AFTER DEMLR INFORMS THE PERMITTEE OF THE PROJECT CLOSE OUT, VIA INSPECTION REPORT, THE PERMITTEE SHALL VISIT *DEQ.NC.GOV/NCG01* TO SUBMIT AN ELECTRONIC NOTICE OF TERMINATION (E-NOT). A $100 ANNUAL GENERAL PERMIT FEE WILL BE CHARGED UNTIL THE E-NOT HAS BEEN FILLED OUT.

GENERAL NOTES

1. THE PROJECT SITE IS LOCATED APPROXIMATELY SEVEN MILES SOUTHWEST OF THE TOWN OF WHITEVILLE IN COLUMBUS COUNTY, NC (34.426002, -78.846142) AS SHOWN ON THE COVER SHEET VICINITY MAP. TO ACCESS THE SITE FROM RALEIGH, NC, GET ON I-40 E/US-64 E FROM N DAWSON ST AND S SAUNDERS ST W FOLLOW I-40 E AND I-95 S TO N ROBERTS AVE IN LUMBERTON. TAKE EXIT 20 FROM I-95 S TAKE OLD WHITEVILLE RD TO ROSSIE OBERRY RD IN COLUMBUS COUNTY.
2. THE PROJECT SITE BOUNDARIES ARE SHOWN ON THE DESIGN PLANS AS THE PROPOSED CONSERVATION EASEMENT. THE CONTRACTOR SHALL PERFORM ALL RELATED WORK ACTIVITIES WITHIN THE PROJECT SITE BOUNDARIES AND/OR WITHIN THE LIMITS OF DISTURBANCE (LOD). THE PROJECT SITE SHALL BE ACCESSED THROUGH THE DESIGNATED ACCESS POINTS SHOWN ON THE ESC PLAN. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING PERMITTED ACCESS THROUGHOUT ALL CONSTRUCTION ACTIVITIES.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS AND MEASURES TO PROTECT ALL PROPERTIES FROM DAMAGE. THE CONTRACTOR SHALL REPAIR ALL DAMAGE CAUSED BY HIS/HER OPERATIONS TO ALL PUBLIC AND PRIVATE PROPERTY AND LEAVE THE PROPERTY IN GOOD CONDITION AND/OR AT LEAST EQUIVALENT TO THE PRE-CONSTRUCTION CONDITIONS. UPON COMPLETION OF ALL CONSTRUCTION ACTIVITIES, THE AREA IS TO BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN FOUND PRIOR TO CONSTRUCTION.
4. THE TOPOGRAPHIC BASE MAP WAS DEVELOPED USING SURVEY DATA COLLECTED BY CIVIL AND ENVIRONMENTAL CONSULTANTS, INC. IN SPRING 2023. THE HORIZONTAL DATUM WAS TIED TO NAD83/2011 NC STATE PLANE COORDINATE SYSTEM, US SURVEY FEET AND NAVD88 VERTICAL DATUM USING VRS NETWORK AND NCGS MONUMENT. IT IS POSSIBLE THAT EXISTING ELEVATIONS AND SITE CONDITIONS MAY HAVE CHANGED SINCE THE ORIGINAL SURVEY WAS COMPLETED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONFIRM EXISTING GRADES AND ADJUST QUANTITIES, EARTHWORK, AND WORK EFFORTS AS NECESSARY.
5. THE CONTRACTOR SHALL VISIT THE CONSTRUCTION SITE AND THOROUGHLY FAMILIARIZE HIM/HERSELF WITH ALL EXISTING CONDITIONS. PRIOR TO BEGINNING CONSTRUCTION. THE CONTRACTOR SHALL VERIFY THE ACCURACY AND COMPLETENESS OF THE CONSTRUCTION SPECIFICATIONS AND DESIGN PLANS REGARDING THE NATURE AND EXTENT OF THE WORK DESCRIBED.
6. THE CONTRACTOR SHALL BRING ANY DISCREPANCIES BETWEEN THE CONSTRUCTION PLANS AND SPECIFICATIONS AND/OR FIELD CONDITIONS TO THE ATTENTION OF THE ENGINEER BEFORE CONSTRUCTION BEGINS.
7. THERE SHALL BE NO CLEARING OR REMOVAL OF ANY NATIVE SPECIES VEGETATION OR TREES OF SIGNIFICANCE, OTHER THAN THOSE INDICATED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.
8. THE CONTRACTOR SHALL EXERCISE CARE DURING GRADING ACTIVITIES IN THE VICINITY OF NATIVE VEGETATION AND TREES OF SIGNIFICANCE AT THE CONSTRUCTION SITE. ALL GRADING IN THE VICINITY OF TREES NOT IDENTIFIED FOR REMOVAL SHALL BE MADE IN A MANNER THAT DOES NOT DISTURB THE ROOT SYSTEM WITHIN THE DRIP LINE OF THE TREE.
9. WORK ACTIVITIES ARE BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PROJECT. THE CONTRACTOR SHALL MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS, PROTECT PUBLIC SAFETY, AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK. ALL AREAS SHALL BE KEPT NEAT, CLEAN, AND FREE OF ALL TRASH AND DEBRIS, AND ALL REASONABLE PRECAUTIONS SHALL BE TAKEN TO AVOID DAMAGE TO EXISTING ROADS, VEGETATION, TURF, STRUCTURES, AND PRIVATE PROPERTY.
10. PRIOR TO START OF WORK, THE CONTRACTOR SHALL SUBMIT THE SOURCE OF MATERIALS, INCLUDING AGGREGATES, EROSION CONTROL MATTING, WOOD AND NATIVE PLANTING MATERIAL TO THE ENGINEER FOR REVIEW AND APPROVAL. NO WORK SHALL BE PERFORMED UNTIL THE SOURCE OF MATERIAL IS APPROVED BY THE ENGINEER.
11. THE CONTRACTOR SHALL BE HELD SOLELY RESPONSIBLE FOR ANY NECESSARY COORDINATION BETWEEN THE VARIOUS COUNTY, STATE OR FEDERAL AGENCIES, UTILITY COMPANIES, HIS/HER SUB-CONTRACTORS, AND THE ENGINEER FOR THE DURATION OF THE PROJECT.
12. PRIOR TO START OF WORK, THE CONTRACTOR SHALL SUBMIT THEIR DETAILED PLANTING SCHEDULE TO THE ENGINEER FOR REVIEW. NO WORK SHALL BE PERFORMED UNTIL THIS SCHEDULE IS APPROVED BY THE ENGINEER. THE DETAILED PLANTING SCHEDULE SHALL CONFORM TO THE PLANTING REVEGETATION PLAN AND SHALL INCLUDE A SPECIES LIST AND TIMING SEQUENCE.
13. THE CONTRACTOR IS REQUIRED TO INSTALL IN-STREAM STRUCTURES AND CULVERT PIPES USING A BACKHOE/EXCAVATOR WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE STRUCTURES AND MATERIALS INCLUDING LOGS, STONE, AND TEMPORARY WOOD MAT STREAM CROSSINGS.

CONTRACTOR SHALL REVIEW ALL APPLICABLE PERMITS FOR THIS PROJECT AND ALL WORK SHALL BE IN STRICT CONFORMANCE WITH THE CONDITIONS OF EACH PERMIT.

GOVERNING SPECIFICATIONS

THE CONSTRUCTION OF THE REALIGNED STREAM(S) SHALL FOLLOW ALL GOVERNING AUTHORITIES' REGULATIONS.

BENCHMARKS

THE CONTRACTOR SHALL BE RESPONSIBLE FOR HOLDING, SETTING, AND MAINTAINING BENCHMARKS LOCATIONS THROUGHOUT THE LIFE OF THE PROJECT. IN THE EVENT THAT A BENCHMARK IS DISTURBED, THE CONTRACTOR AS DIRECTED BY THE ENGINEER, WILL RELOCATE OR REESTABLISH THE BENCHMARK. NO ADDITIONAL PAYMENT OR COMPENSATION WILL BE MADE FOR THIS WORK.

ELEVATIONS

ALL ELEVATIONS SHOWN REFER TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

COORDINATES

THE PROJECT DATUM ON THESE PLANS ARE BASED UPON THE NORTH CAROLINA STATE PLANE SYSTEM. THE HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM OF 1983 (2011) (NAD 83). GRID FACTORS ARE NOT REQUIRED WHEN MAKING FIELD MEASUREMENTS.

VERIFICATION OF DIMENSIONS

THE CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF ALL PLAN AND ELEVATION DIMENSIONS PRIOR TO ORDERING MATERIALS FOR THE CONSTRUCTION OF THE VARIOUS BID ITEMS IN THE CONTRACT.

TREE CLEARING

TREE CLEARING ON THIS PROJECT SHALL BE PERFORMED ONLY TO THE EXTENT AND TO THE LIMITS NECESSARY TO CONSTRUCT AND INSTALL THE MEASURES AS SHOWN ON THESE PLANS.

WASTE MATERIAL

ALL MATERIAL EXCAVATED AND NOT REUSED IN THE CONSTRUCTION OF THIS PROJECT SHALL BE REMOVED FROM THE PROJECT BOUNDARY AND UNUSED WORK MATERIAL DISPOSED OF BY THE CONTRACTOR IN LOCATION(S) APPROVED BY THE ENGINEER.

FILTER FABRIC

NON-WOVEN FILTER FABRIC SHALL BE PLACED AT IN-STREAM STRUCTURES SHOWN IN THE DETAILS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

UTILITIES

THE CONTRACTOR IS RESPONSIBLE FOR THE INVESTIGATION, LOCATION, SUPPORT, PROTECTION, AND RESTORATION OF ALL EXISTING UTILITIES AND APPURTENANCES WHETHER SHOWN ON THESE PLANS OR NOT. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ASCERTAIN THE STATUS AND LOCATION OF EACH UTILITY WHEN PERFORMING WORK WHICH MAY AFFECT THESE FACILITIES, INCLUDING PROBING, EXCAVATION, OR ANY OTHER PRECAUTION REQUIRED TO CONFIRM LOCATION. THE CONTRACTOR SHALL EXPOSE ALL UTILITIES OR STRUCTURES PRIOR TO CONSTRUCTION TO VERIFY THE VERTICAL AND HORIZONTAL EFFECT ON PROPOSED CONSTRUCTION. THE CONTRACTOR SHALL CALL, TOLL FREE, NORTH CAROLINA 811 CENTER (1-800-632-4949) TWO DAYS PRIOR TO CONSTRUCTION AND SHALL NOTIFY ALL UTILITY COMPANIES AT LEAST 48 HOURS PRIOR TO WORK IN THE VICINITY OF THEIR UNDERGROUND LINES. THE CONTRACTOR WILL RE RESPONSIBLE FOR ANY DAMAGE OR DISRUPTION TO UTILITY LINES WHICH ARE KNOWN ACTIVE AND ARE TO REMAIN IN OPERATION.

EROSION AND SEDIMENT CONTROL

EROSION AND SEDIMENT CONTROL MEASURES SHALL BE PERFORMED IN ACCORDANCE WITH THE ESC NOTES AND PLAN SHEETS. IN THE EVENT THAT THE TEMPORARY EROSION AND POLLUTION CONTROL MEASURES ARE ORDERED BY THE ENGINEER DUE TO THE CONTRACTOR'S NEGLIGENCE, CARELESSNESS, OR FAILURE TO INSTALL PERMANENT CONTROLS AS PART OF THE WORK AS SCHEDULED. SUCH WORK SHALL BE PERFORMED BY THE CONTRACTOR AT HIS OWN EXPENSE.

THE FIRST ORDER OF WORK FOR THE CONTRACTOR IS TO INSTALL SEDIMENT CONTROL MEASURES AT THE EARLIEST POSSIBLE DATE. INITIAL CLEARING AND GRUBBING IS ONLY TO BE WHAT IS NECESSARY IN ORDER TO ACCOMPLISH THESE OPERATIONS.

IN ADDITION, THE CONTRACTOR IS TO NAME AN INDIVIDUAL TO REVIEW THE EROSION CONTROL FEATURES AT A MINIMUM OF ONCE A WEEK DURING PERIODS OF HEAVY PRECIPITATION AND/OR ACTIVE CONSTRUCTION TO ASSESS THE SUCCESS OF THE EROSION CONTROL STRUCTURES, REVEGETATION EFFORTS, AND SEE THE REPLACEMENT, CLEANING, AND/OR INSTALLATION OF ADDITIONAL FEATURES IF NECESSARY ARE CARRIED OUT.

SITE CLEANUP

DURING CONSTRUCTION AND PRIOR TO ACCEPTANCE OF ANY PUBLIC IMPROVEMENTS, THE OWNER/DEVELOPER SHALL REMOVE OR CAUSE TO BE REMOVED ALL REFUSE, RUBBISH, UNUSED MATERIALS, EXCESS EARTH, FILL ROCK, DEBRIS, AND FOREIGN MATTER FROM ALL PUBLIC RIGHT OF WAY, IMPROVEMENTS, AND/OR EASEMENTS AS WERE DEPOSITED, LEFT, OR RESULTED FROM THE CONSTRUCTION IMPROVEMENTS OF ANY NATURE WITHIN THE DEVELOPMENT. SUCH REMOVAL SHALL TAKE PLACE WITHIN TWENTY-FOUR (24) HOURS AFTER BEING NOTIFIED BY THE COUNTY ENGINEER AND REGULATING AGENCIES.

THIS WORK SHALL BE PERFORMED IN A MANNER WHICH PREVENTS EROSION AS WELL AS PREVENTS STORM WATER FROM ACCUMULATING OR PONDING ON THE SITE. THE WORK SHALL ALSO BE PERFORMED IN A MANNER THAT PREVENTS DISRUPTING OR IMPEDING SURFACE DRAINAGE FROM ONSITE OR OFFSITE SOURCES AND PREVENTS ANY NEGATIVE EFFECTS ON ADJACENT PROPERTIES.

FEDERAL, STATE, AND LOCAL LAWS AND SAFETY REGULATIONS

THE CONTRACTOR AND ANY SUB-CONTRACTORS SHALL CONFORM TO APPLICABLE OSHA SAFETY REGULATIONS. THE CONTRACTOR AND ANY SUB-CONTRACTORS SHALL BE SOLELY RESPONSIBLE FOR COMPLYING WITH ALL FEDERAL, STATE, AND LOCAL SAFETY REQUIREMENTS TOGETHER WITH EXERCISING PRECAUTIONS AT ALL TIMES FOR THE PROTECTION OF PERSONS INCLUDING EMPLOYEES AND PROPERTY. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR AND SUB-CONTRACTOR TO INITIATE, MAINTAIN, AND SUPERVISE ALL SAFETY REQUIREMENTS, PRECAUTIONS, AND PROGRAMS IN CONNECTION WITH THE WORK.

CLEARING & GRUBBING LIMITS

CLEARING LIMITS SHALL BE EXTENDED TO A MAXIMUM LIMIT NECESSARY FOR CONSTRUCTION MATERIALS AND SHALL NOT EXTEND BEYOND CONSTRUCTION BOUNDARIES WHERE EARTHWORK ACTIVITIES ARE TO BE PERFORMED. GRUBBING SHALL ONLY TAKE PLACE WITHIN THE AREA AS NECESSARY. ALL COSTS ASSOCIATED WITH CLEARINGS & GRUBBING SHALL BE CONSIDERED INCIDENTAL TO BID ITEM CLEARING AND GRUBBING.

GRADING NOTES

1. NO GRADING ACTIVITIES SHALL OCCUR BEYOND THE PROJECT LIMITS OF DISTURBANCE (LOD) AS SHOWN ON THE DESIGN PLANS.
2. ONCE DESIGN GRADES ARE ACHIEVED AS SHOWN ON THE PLAN AND PLAN AND PROFILE, THE WETLAND AND FLOODPLAIN AREAS SHALL BE ROUGHENED USING TECHNIQUES DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS.
3. ALL SUITABLE SOIL MATERIAL REQUIRED TO FILL AND/OR PLUG EXISTING DITCHES AND/OR STREAM CHANNEL SHALL BE GENERATED ON-SITE AS DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS. ANY EXCESS SPOIL MATERIAL SHALL BE STOCKPILED IN DESIGNATED AREAS AND OR HAULED TO AN ON-SITE LOCATION APPROVED BY THE ENGINEER. NO TEMPORARY STOCKPILES OR SPOIL MATERIAL SHALL REMAIN WITHIN FEMA FLOODPLAIN LIMITS AS SHOWN ON THE PLANS.
4. ANY OFFSITE BORROW MATERIAL MUST COME FROM A SITE WITH AN APPROVED ESC PLAN. ANY TRASH/DEBRIS OR WASTE MATERIAL GENERATED BY GRADING ACTIVITIES MUST BE DISPOSED OF AT A REGULATED FACILITY PER DWR RULES AND REGULATIONS (15A NCAC 4B .0110).

SPECIAL NOTES FOR NATURAL STREAM DESIGN

A. AS-BUILT DRAWINGS - DURING CONSTRUCTION, THE CONTRACTOR AND THE ENGINEER SHALL WORK TOGETHER TO MAINTAIN A SET OF PRINTS SHOWING ANY CHANGES OR CORRECTIONS IN RED. THESE PRINTS SHALL BE SUBMITTED TO THE ENGINEER AT THE COMPLETION OF THE WORK.

B. STREAM DESIGN DEFINITIONS

1. BANKFULL ELEVATION - BANKFULL ELEVATION IS THE POINT OF INCIPIENT FLOODING IN AN ALLUVIAL CHANNEL.
2. FLOODPLAIN SILL - A FLOODPLAIN SILL IS THE BURIED EXTENSION OF THE STRUCTURE AND IS LOCATED ACROSS THE BANKFULL BENCH OR FLOODPLAIN.
3. THALWEG - THE THALWEG IS THE LOWEST POINT OF THE BANKFULL CHANNEL ILLUSTRATED BY THE LONGITUDINAL PROFILE. THIS ELEVATION IS THE REFERENCE FOR ALL ELEVATIONS ON OR ALONG THE CHANNEL AND HYDRAULIC STRUCTURES DESCRIBED IN THIS SECTION AND SHOWN IN THE DESIGN DRAWINGS.
4. VANE ANGLE - THE VANE ANGLE IS THE SMALLEST ANGLE MEASURED BETWEEN A VANE AND A LINE TANGENT TO THE BANKFULL ELEVATION AT THE POINT WHERE THE VANE INTERSECTS THE BANK. THE VANE ANGLE SHALL BE BETWEEN TWENTY PERCENT (20%) AND THIRTY PERCENT (30%), OR AS SPECIFIED IN THE DATA TABLE AND/OR DETAILS.
5. VANE LENGTH - THE VANE LENGTH IS THE DISTANCE BETWEEN THE UPSTREAM LIMIT OF THE VANE ARM AT THE CHANNEL BED TO THE DOWNSTREAM INSERTION POINT OF THE VANE ARM INTO THE STREAM BANK.
6. VANE SLOPE - THE VANE SLOPE IS THE SLOPE OF THE VANE ARM FROM THE UPSTREAM LIMIT AT THE CHANNEL BED TO THE DOWNSTREAM INSERTION POINT OF THE VANE ARM INTO THE STREAM BANK. THE VANE SLOPE SHALL BE BETWEEN TWO PERCENT (2%) AND FOUR PERCENT (4%) OR AS SPECIFIED IN THE DATA TABLE OR DETAILS AND THE VANE ARMS SHALL TIE INTO THE BANKS AT HALF TO THREE QUARTERS OF THE BANKFULL ELEVATION OR AS SPECIFIED IN THE DETAILS.
7. SUBSTRATE RESTORATION - SUBSTRATE RESTORATION IS DESIGNED TO REPLACE AND RESTORE APPROPRIATE SUBSTRATE (SAND, GRAVEL, COBBLE, AND BOULDER) TO THE STREAM CHANNEL IN CASES WHERE COARSE SUBSTRATES OR BEDROCK ARE ABSENT FOLLOWING CHANNEL EXCAVATION. THE PURPOSE OF SUBSTRATE RESTORATION IS TO PROVIDE NATURAL SUBSTRATE AND EROSION AND SCOUR PROTECTION IN THE CHANNEL.
8. BASE FLOW - FOR THE PURPOSE OF THE DESIGN SPECIFICATIONS, A FLOW EQUAL TO ONE CUBIC FOOT PER SECOND (CFS) PER SQUARE MILE OF DRAINAGE AREA.

C. FLOODPLAIN AND CHANNEL CONSTRUCTION

1. DEPENDING ON THE SITE CONDITIONS, SOME ADJUSTMENT OF THE STREAM CHANNEL AND STRUCTURES MAY BE NECESSARY. ANY WORK ASSOCIATED WITH CHANGING CHANNEL ALIGNMENT AND STRUCTURE LOCATIONS SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.
2. THE PROPOSED STREAM CHANNEL SHALL BE CONSTRUCTED BY FIRST EXCAVATING THE FLOODPLAIN TO THE ELEVATIONS AND DIMENSIONS SPECIFIED ON THE GRADING PLAN. THE PROPOSED STREAM CHANNEL SHALL THEN BE EXCAVATED TO THE PROPER DEPTHS INDICATED ON THE PROFILE AND CROSS-SECTIONS. THIS SHALL BE DONE AS UNCLASSIFIED EXCAVATION AND IS TYPICALLY ACCOMPLISHED WITH A TRACK EXCAVATOR WITH HYDRAULIC THUMB. ANY STOCKPILING OR DOUBLE-HANDLING OF MATERIALS NECESSARY TO BUILD THE CHANNEL SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.

D. FILTER FABRIC

1. NON-WOVEN FILTER FABRIC SHALL ONLY BE USED WHEN COVERING A STRUCTURE. CONTRACTOR SHALL USE FABRIC AS SPECIFIED IN THE TECHNICAL SPECIFICATIONS OR APPROVED EQUIVALENT.

PRELIMINARY PLANS NOT FOR CONSTRUCTION

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER J. TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
GENERAL & SPECIAL NOTES

SHEET NO.
2

FILENAME: 02_COWTAIL_GENERAL NOTES.DWG

LEGEND

— - - —	EXISTING RIGHT-OF-WAY LINE
— - - —	EXISTING PROPERTY LINE
— — —	EXISTING ACCESS EASEMENT
—100—	EXISTING MAJOR CONTOUR
- -101- -	EXISTING MINOR CONTOUR
—100YR—	EXISTING 100 YEAR FLOOD PLAIN
—500YR—	EXISTING 500 YEAR FLOOD PLAIN
— FP —	EXISTING FEMA FLOODWAY
— OHE —	EXISTING OVERHEAD ELECTRIC
	EXISTING UTILITY POLE
— UGE —	EXISTING UNDERGROUND ELECTRIC
	EXISTING ELECTRIC PEDESTAL
	EXISTING ELECTRIC MARKER
— FO —	EXISTING UNDERGROUND FIBER OPTIC
FO	EXISTING FIBER OPTIC MANHOLE
	EXISTING FIBER OPTIC PEDESTAL
	EXISTING FIBER OPTIC MARKER
— G —	EXISTING GAS MAIN
	EXISTING GAS MAIN MARKER
— SS —	EXISTING SANITARY SEWER MAIN
S	EXISTING SANITARY SEWER MANHOLE
— ST —	EXISTING STORM SEWER MAIN
ST	EXISTING STORM SEWER MANHOLE
— OHT —	EXISTING OVERHEAD TELEPHONE
— UGT —	EXISTING UNDERGROUND TELEPHONE
	EXISTING TELEPHONE PEDESTAL
	EXISTING TELEPHONE MARKER
— W —	EXISTING WATER MAIN
	EXISTING FIRE HYDRANT
	EXISTING WATER MAIN MARKER
	EXISTING STORM PIPE
	EXISTING STORM PIPE TO BE REMOVED
	EXISTING ROAD/FARM PATH
	EXISTING WOODLINE
	EXISTING TREE
	EXISTING FENCE
	EXISTING TOP OF STREAM BANK
	EXISTING STREAM CHANNEL
	EXISTING CENTERLINE (THALWEG)
	EXISTING WETLAND AREA/ WETLAND REHABILITATION
	EXISTING WETLAND AREA (NO CREDIT)
—100—	PROPOSED MAJOR CONTOUR
—101—	PROPOSED MINOR CONTOUR
	PROPOSED TOP OF STREAM BANK
	PROPOSED STREAM CHANNEL
	PROPOSED CENTERLINE (THALWEG)
→→→→→	SURFACE FLOW DIRECTION
→	STREAM FLOW DIRECTION
	PROPOSED OUTLET CHANNEL
— CE —	CONSERVATION EASEMENT
— C/F —	PROPOSED CUT/FILL LIMITS
— LOD —	PROPOSED LIMITS OF DISTURBANCE
	PROPOSED FLOODPLAIN POOL
	PROPOSED FARM PATH
	PROPOSED CHANNEL BLOCK
	PROPOSED CHANNEL FILL
	PROPOSED FLOODPLAIN DEPRESSION
	PROPOSED WATER QUALITY TREATMENT FEATURE
	PROPOSED WETLAND RE-ESTABLISHMENT (1:1)
	PROPOSED WETLAND RE-ESTABLISHMENT (2:1)
	PROPOSED TEMPORARY ROCK CHECK DAM
	PROPOSED PERMANENT STREAM CROSSING
	PROPOSED TEMPORARY STREAM CROSSING
	PROPOSED PUMP-AROUND OPERATION
	PROPOSED TEMPORARY HAUL ROAD
	PROPOSED TEMPORARY STOCK PILE
	PROPOSED EROSION CONTROL MAT
	PROPOSED TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
	PROPOSED COMPACTED FILL (PROFILE)
	PROPOSED EXCAVATION (PROFILE)
	EXISTING GROUND (PROFILE)
	PROPOSED BANKFULL (PROFILE)
	PROPOSED THALWEG (PROFILE)
	TOE WOOD W/ BRUSH LAYERING
	LARGE WOODY DEBRIS
	CONSTRUCTED BRUSHY RIFFLE
	LOG VANE
	LOG STEP POOL

SOME ITEMS SHOWN IN THIS LEGEND MAY NOT ACTUALLY BE PRESENT WITHIN THE PLAN SET

FILENAME: 03_COWTAIL_PROJECT KEYMAP.DWG

PROJECT KEY MAP

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER TOMSIK

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

REVISIONS

WATER & LAND SOLUTIONS

7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

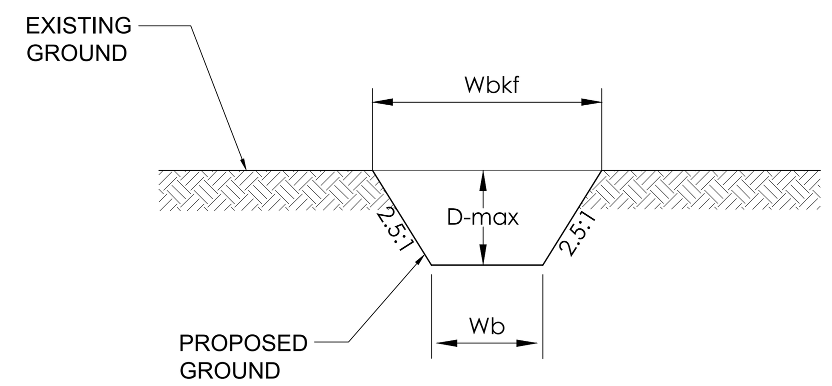
COW TAIL MITIGATION PROJECT

COLUMBUS COUNTY, NORTH CAROLINA

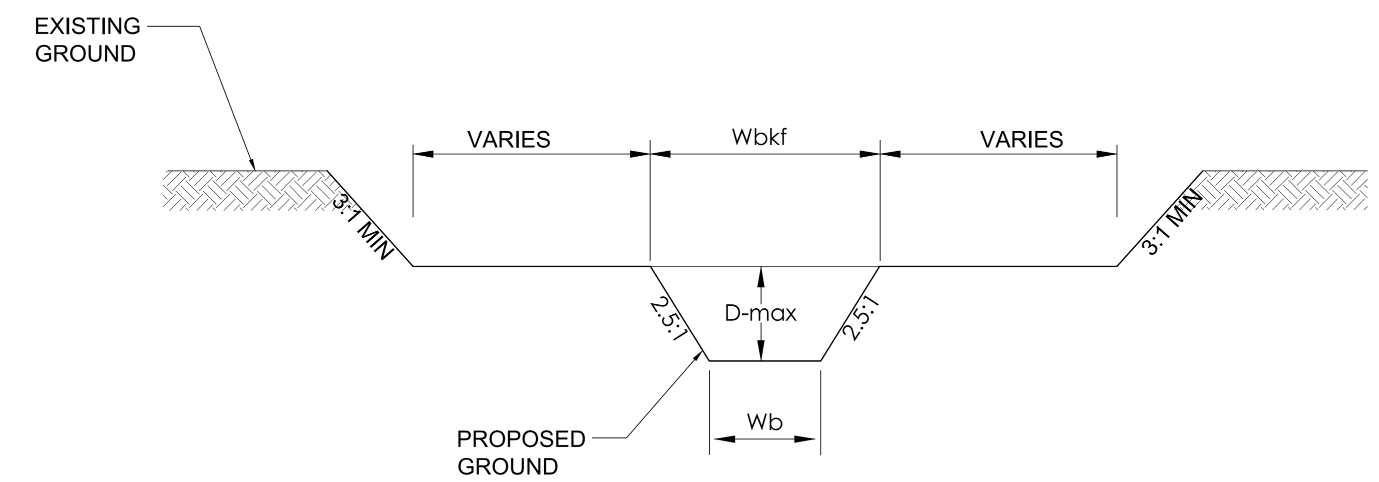
SHEET NAME

PROJECT KEYMAP & LEGEND

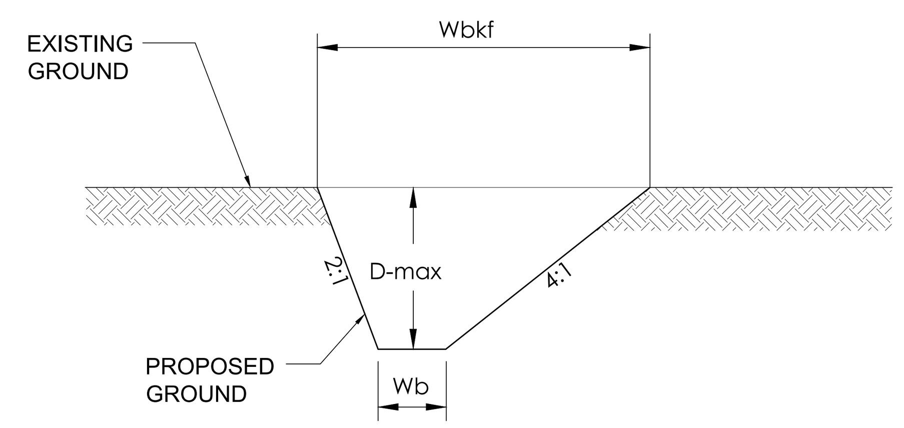
SHEET NO.



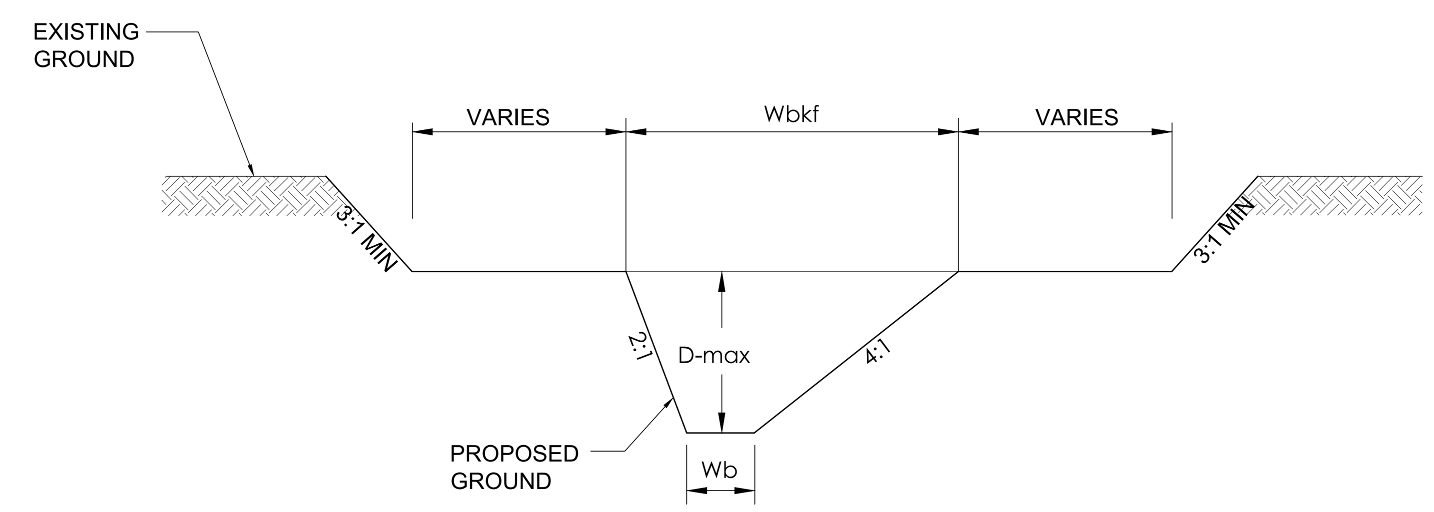
TYPICAL RIFFLE SECTION
N.T.S



TYPICAL RIFFLE SECTION WITH BANKFULL BENCH
N.T.S



TYPICAL POOL SECTION
N.T.S



TYPICAL POOL SECTION WITH BANKFULL BENCH
N.T.S

Reach Name	S100		S200		Cow Branch (upper) STATION 15+00 TO 16+92		Cow Branch (middle)		Cow Branch (lower)	
Feature	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool	Riffle	Pool
Bankfull Width, Wbkf (ft)	5.7	6.8	5.1	9.6	6.6	8.1	9.9	12.0	10.8	13.2
Maximum Depth, D-Max (ft)	0.6	0.8	0.8	1.3	0.7	1.1	1.0	1.5	1.1	1.8
Width to Depth Ratio, bkf W/D	13.0	13.1	12.9	12.4	13.0	12.9	13.0	12.8	13.0	12.0
Bankfull Area, Abkf (sq ft)	2.5	3.5	5.1	7.4	3.4	5.1	7.6	11.3	9.0	14.5
Bottom Width, Wb (ft)	2.9	2.0	4.1	1.8	3.2	2.1	4.8	3.0	5.5	2.9

FILENAME: 04_COWTAIL_TYPICAL SECTIONS.DWG

NORTH CAROLINA PROFESSIONAL SEAL 30916 ENGINEER CHRISTOPHER TOMSIC
PRELIMINARY NOT FOR CONSTRUCTION

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

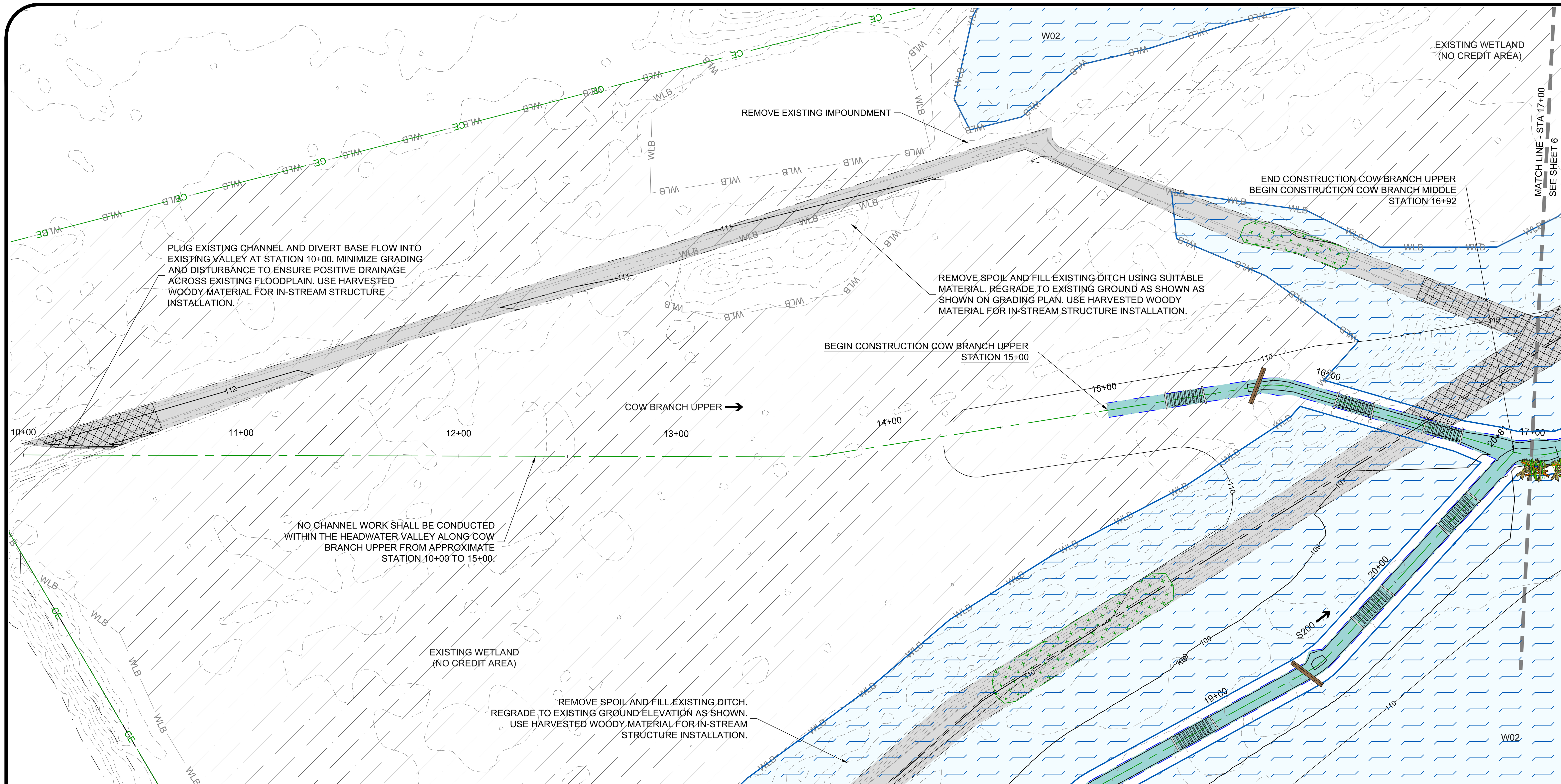
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

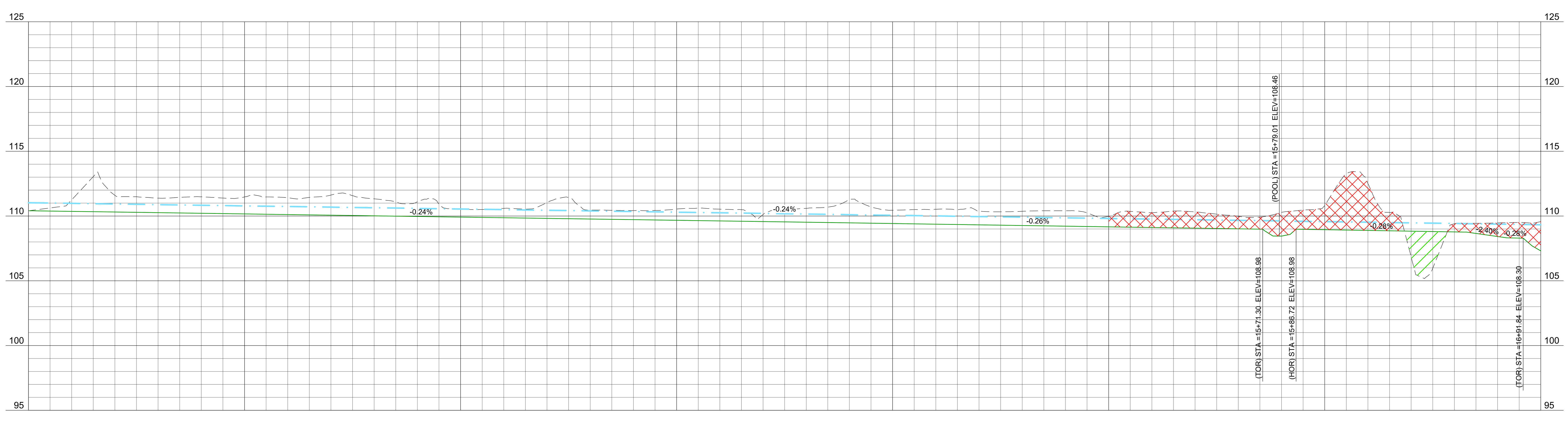
PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
TYPICAL SECTIONS

SHEET NO.
4



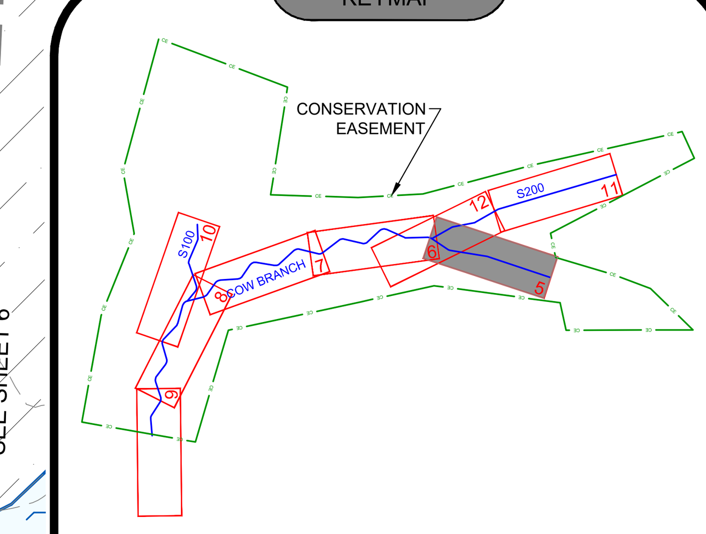
COW BRANCH UPPER



COW BRANCH UPPER

FILENAME: 05_12_COWTAIL_PP.DWG

KEYMAP



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

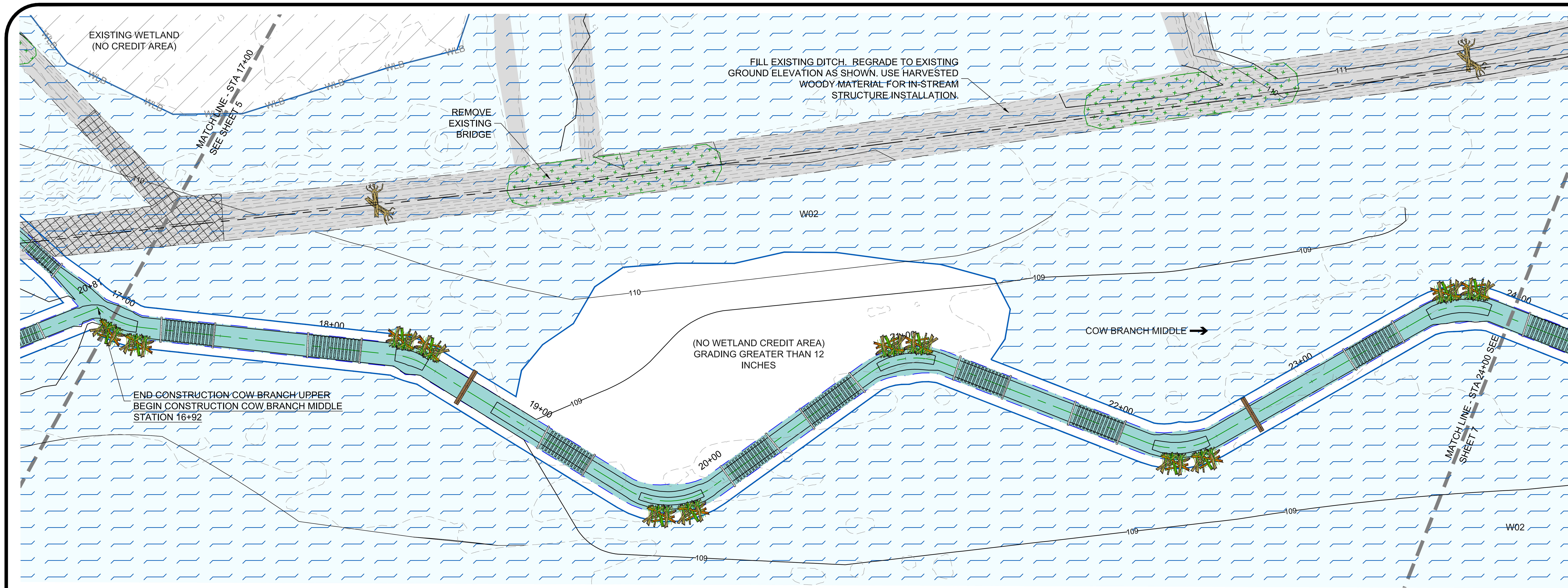
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

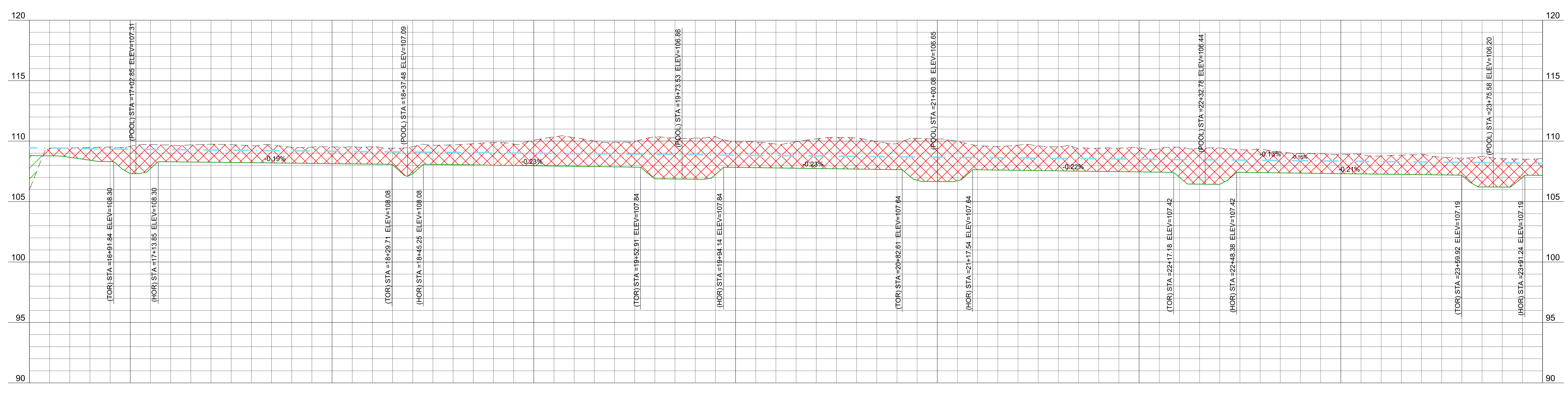
SHEET NAME
PLAN AND PROFILE

SHEET NO.
5



30 15 0 30
SCALE IN FEET
NORTH

COW BRANCH MIDDLE PLAN

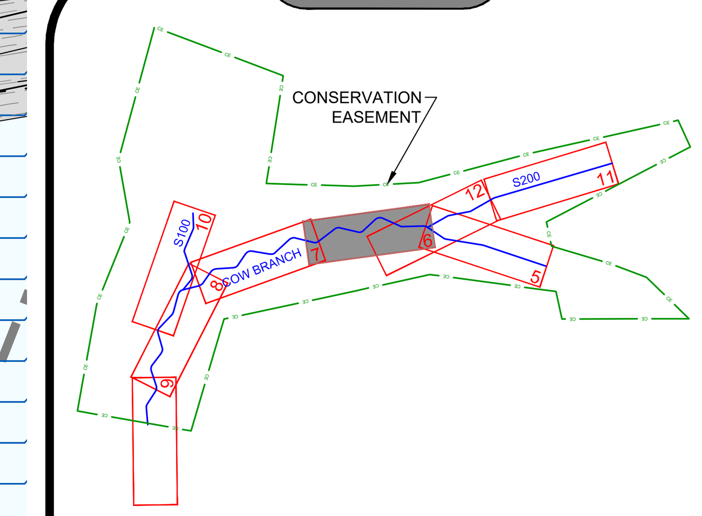


30 15 0 30
HORIZONTAL SCALE IN FEET
5 2.5 0 5
VERTICAL SCALE IN FEET

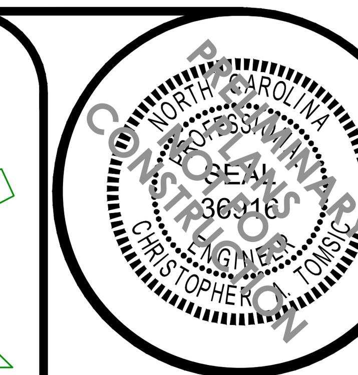
COW BRANCH MIDDLE PROFILE

FILENAME: 05_12_COWTAIL_PP.DWG

KEYMAP



1000 500 0 1000
SCALE IN FEET



REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

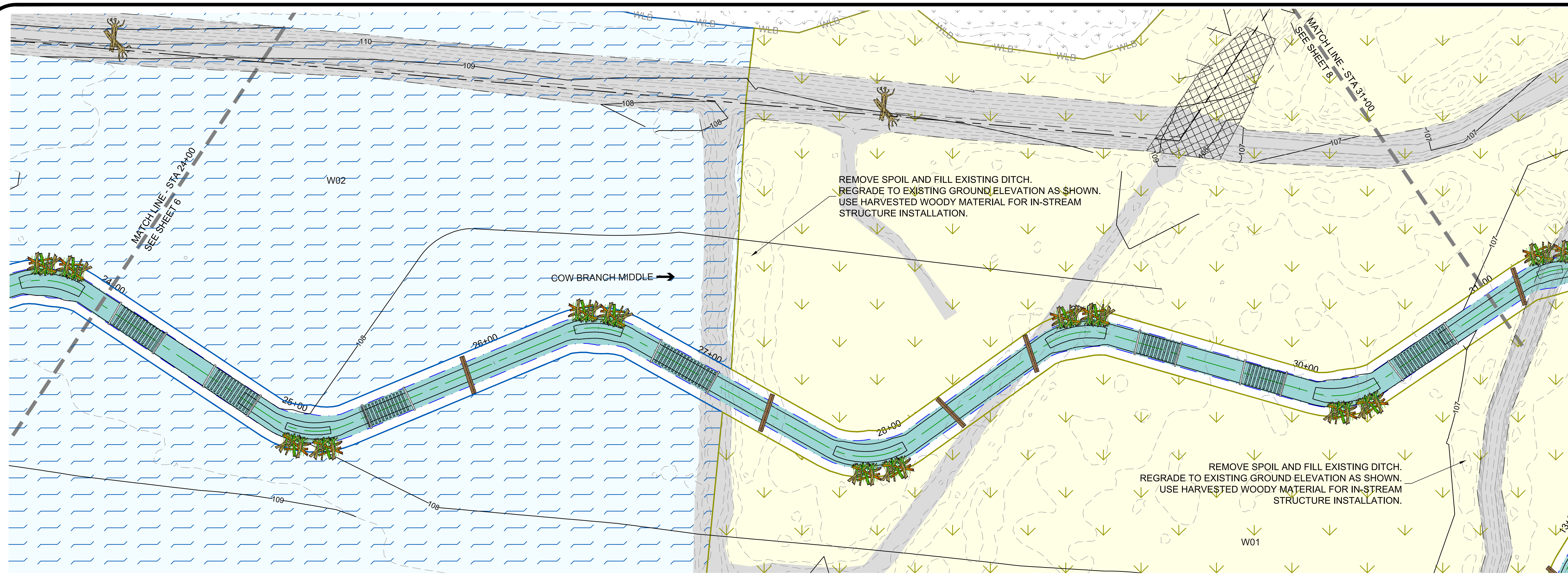
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

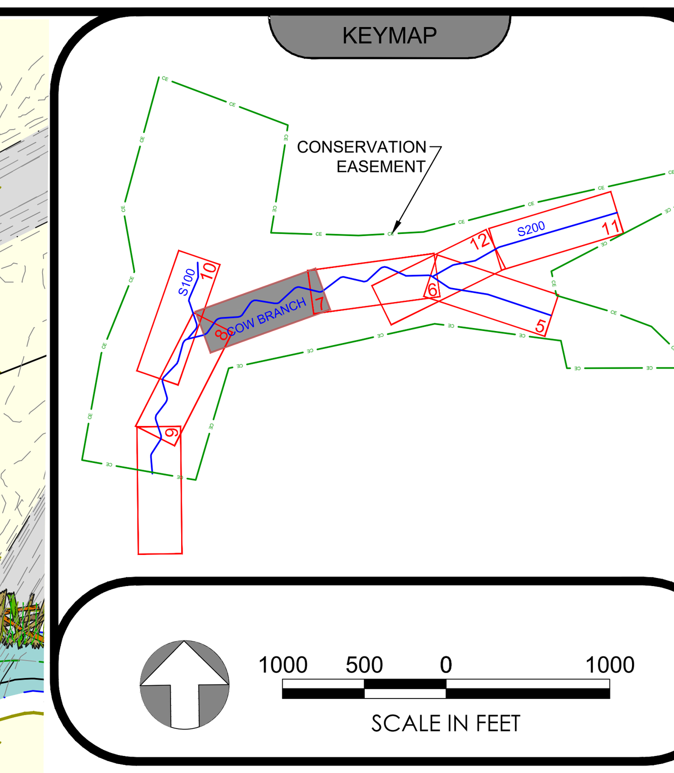
PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

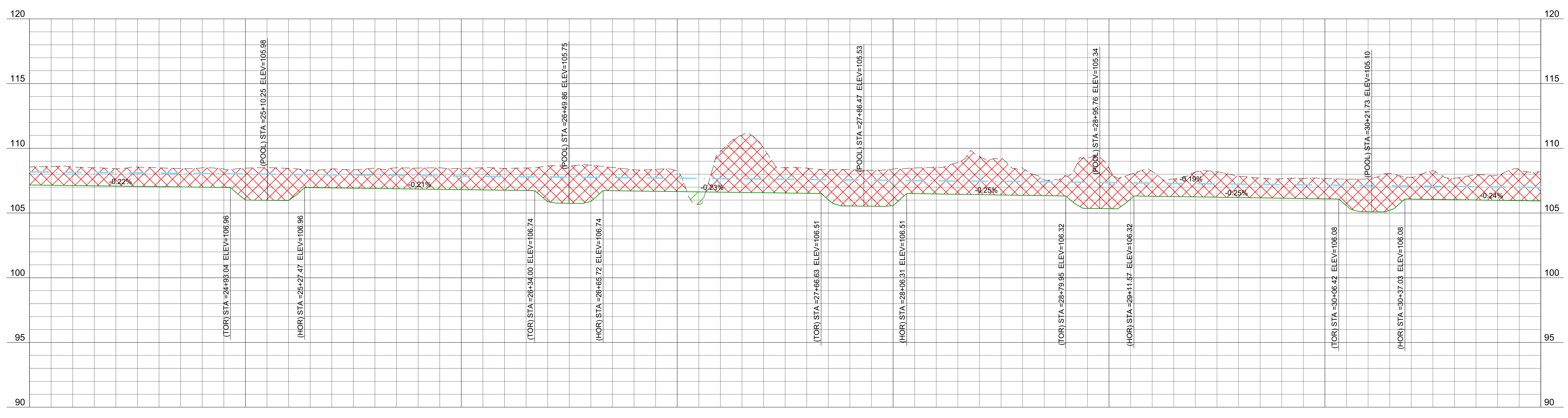
SHEET NAME
PLAN AND PROFILE

SHEET NO.
6



COW BRANCH MIDDLE PLAN





COW BRANCH MIDDLE PROFILE

FILENAME: 05_12_COWTAIL_PP.DWG

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 30916 CHRISTOPHER A. TOMSIK

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

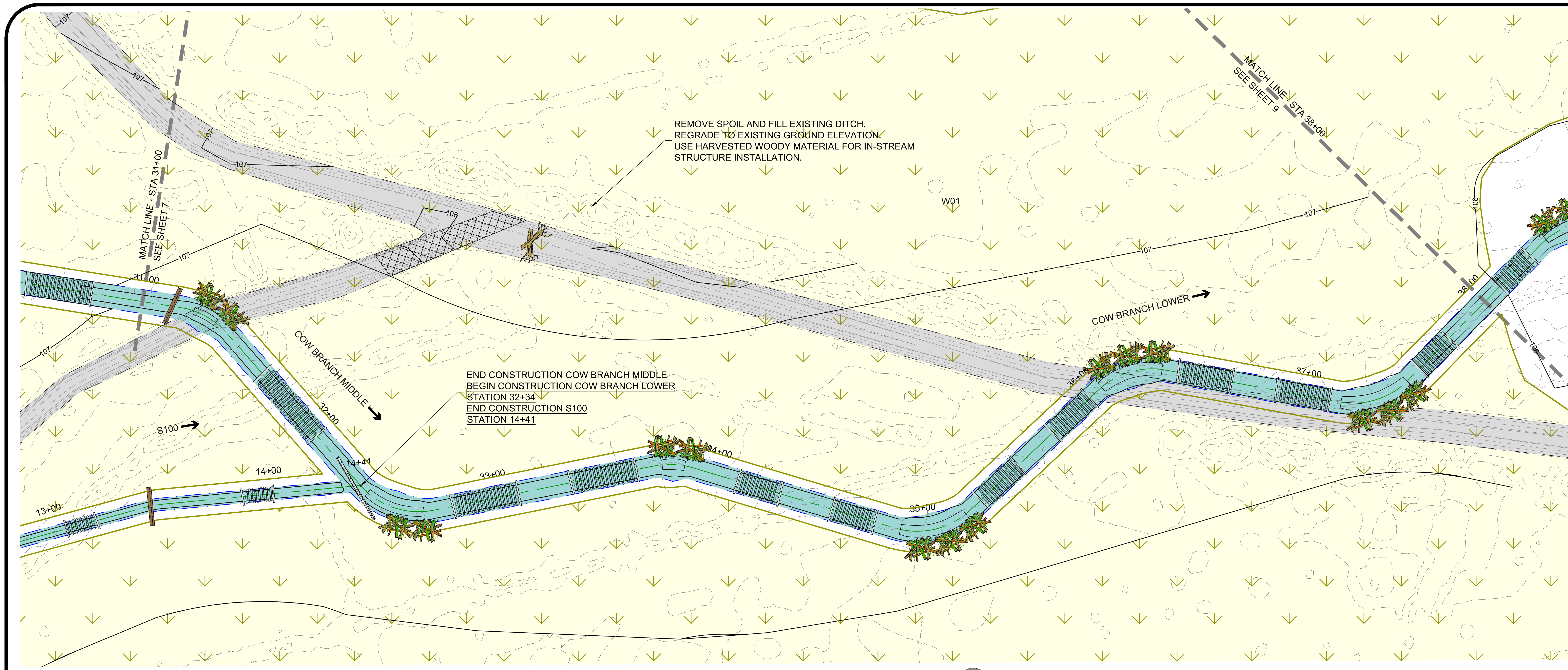
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME

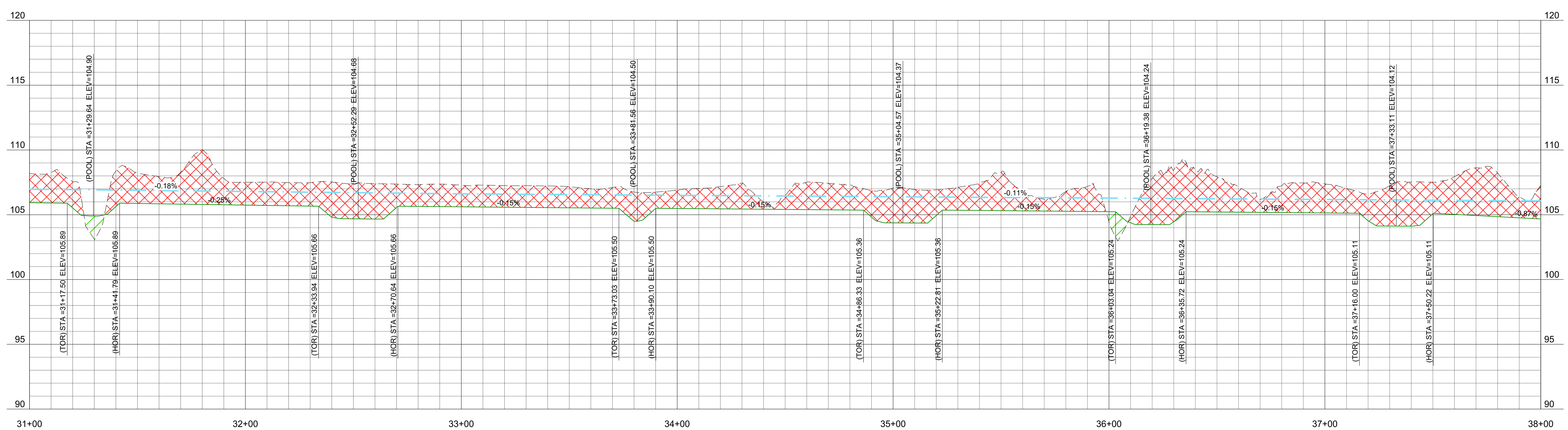
PLAN AND PROFILE

SHEET NO.

7

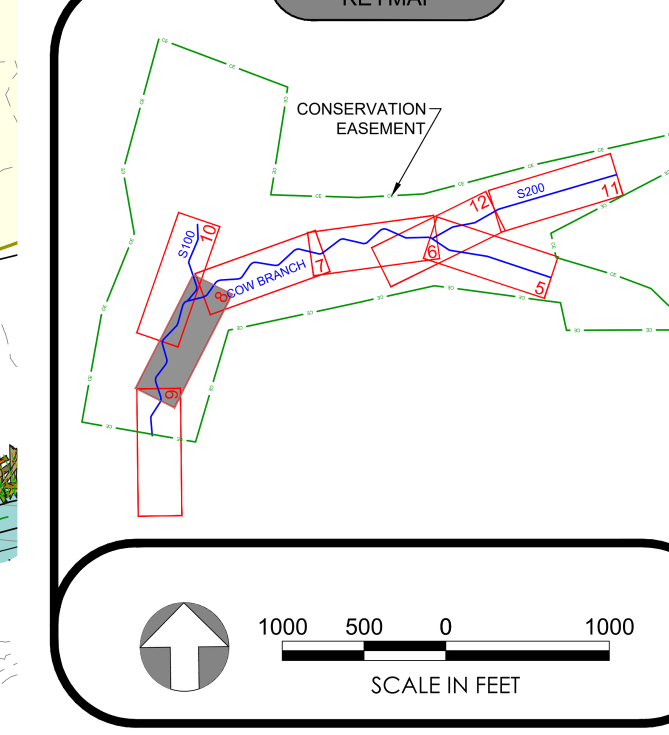


COW BRANCH LOWER PLAN



COW BRANCH LOWER PROFILE

KEYMAP



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER A. TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME

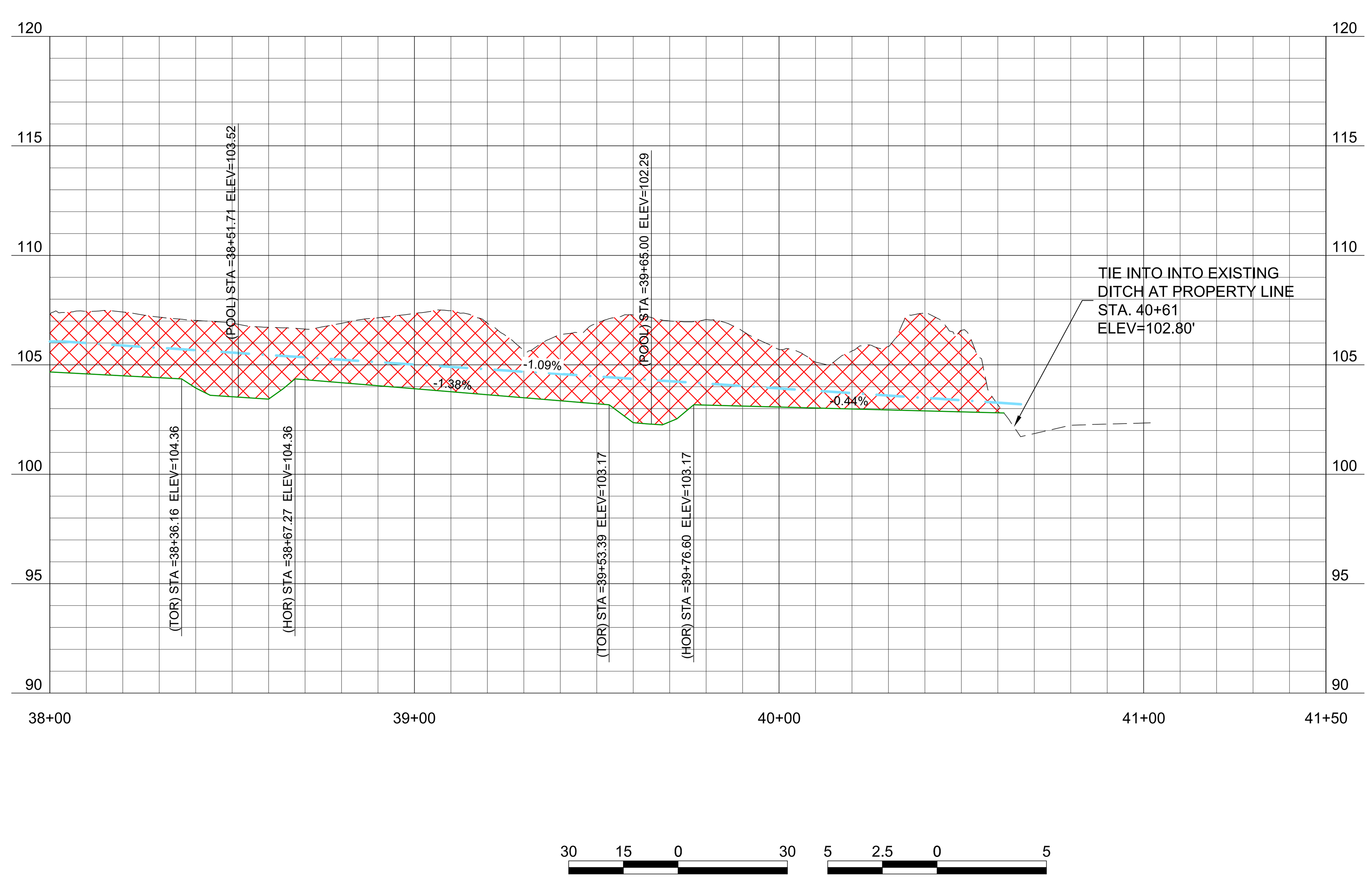
PLAN AND PROFILE

SHEET NO.

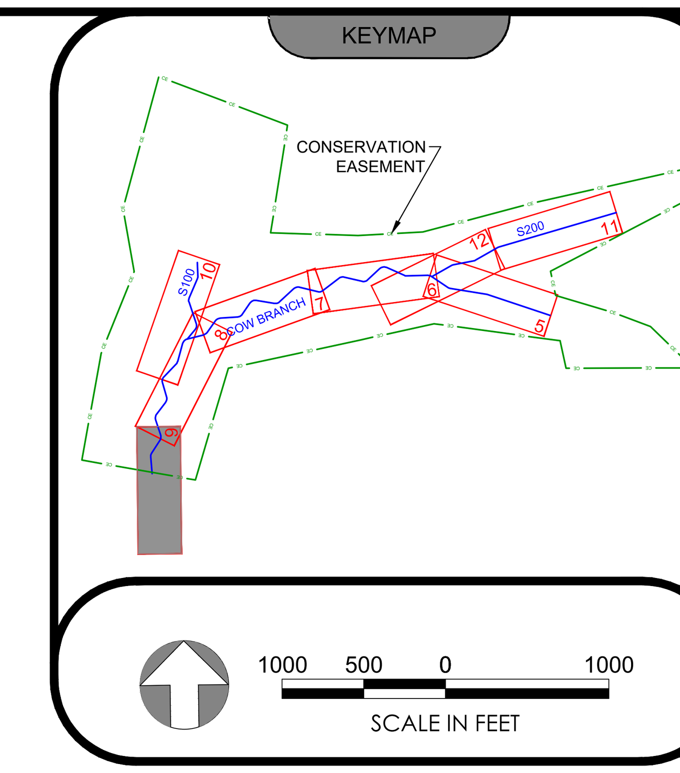
8

FILENAME: 05_12_COWTAIL_PP.DWG

COW BRANCH LOWER PLAN



COW BRANCH LOWER PROFILE



REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

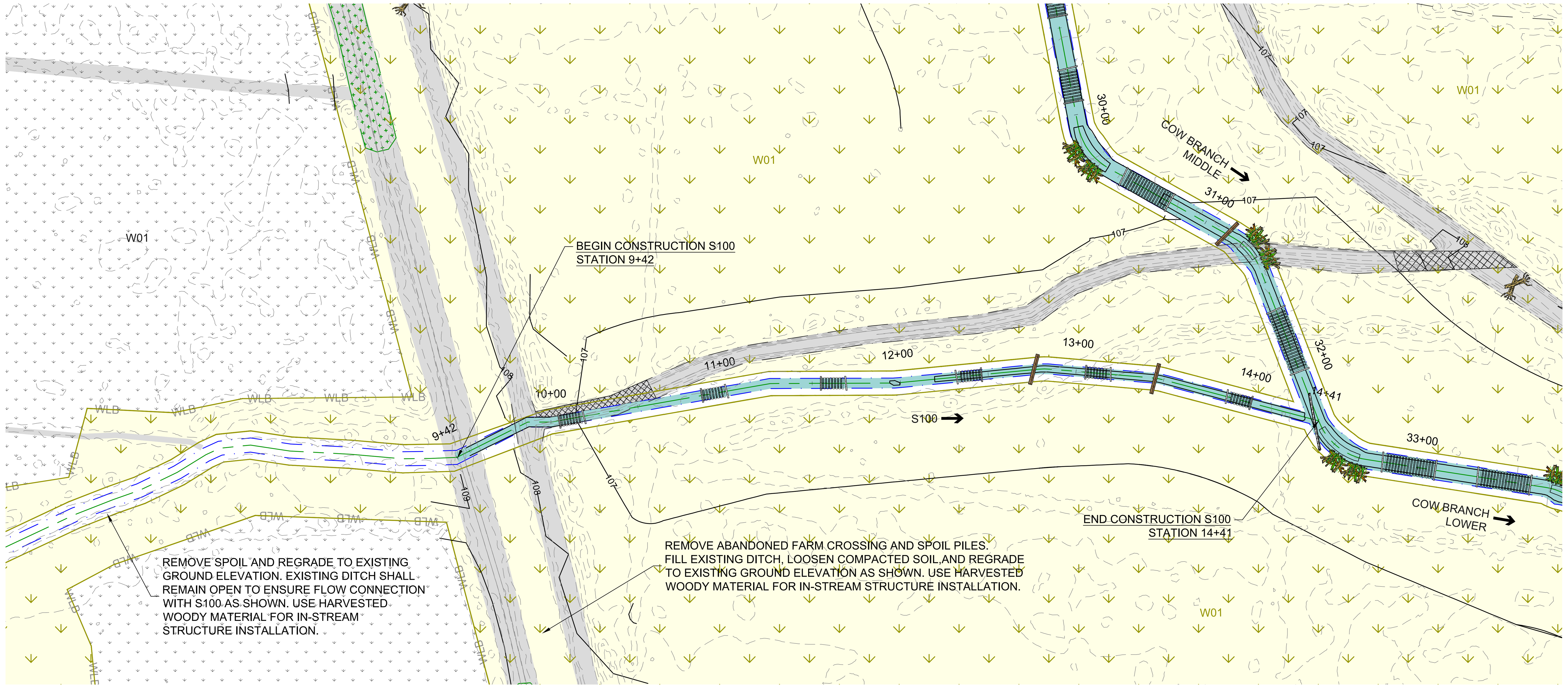
DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

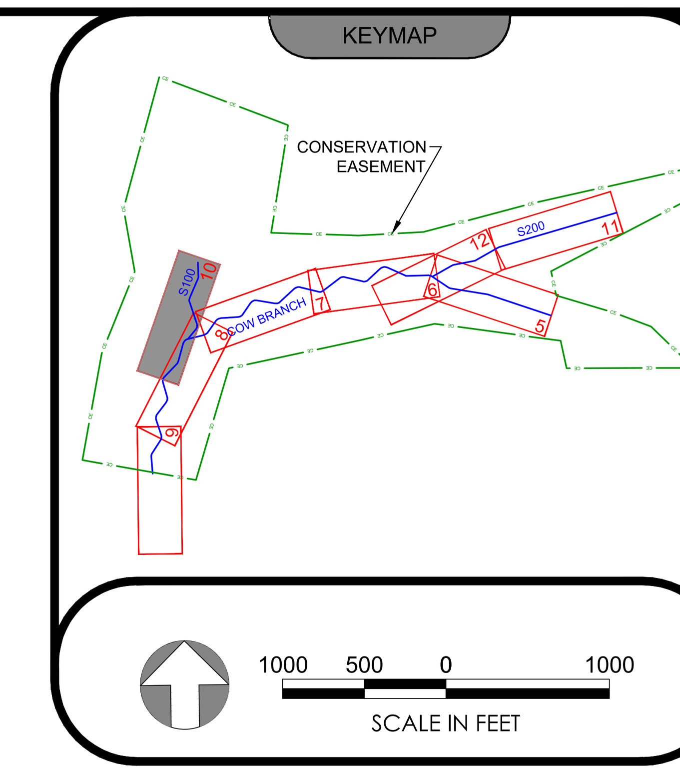
SHEET NAME
PLAN AND PROFILE

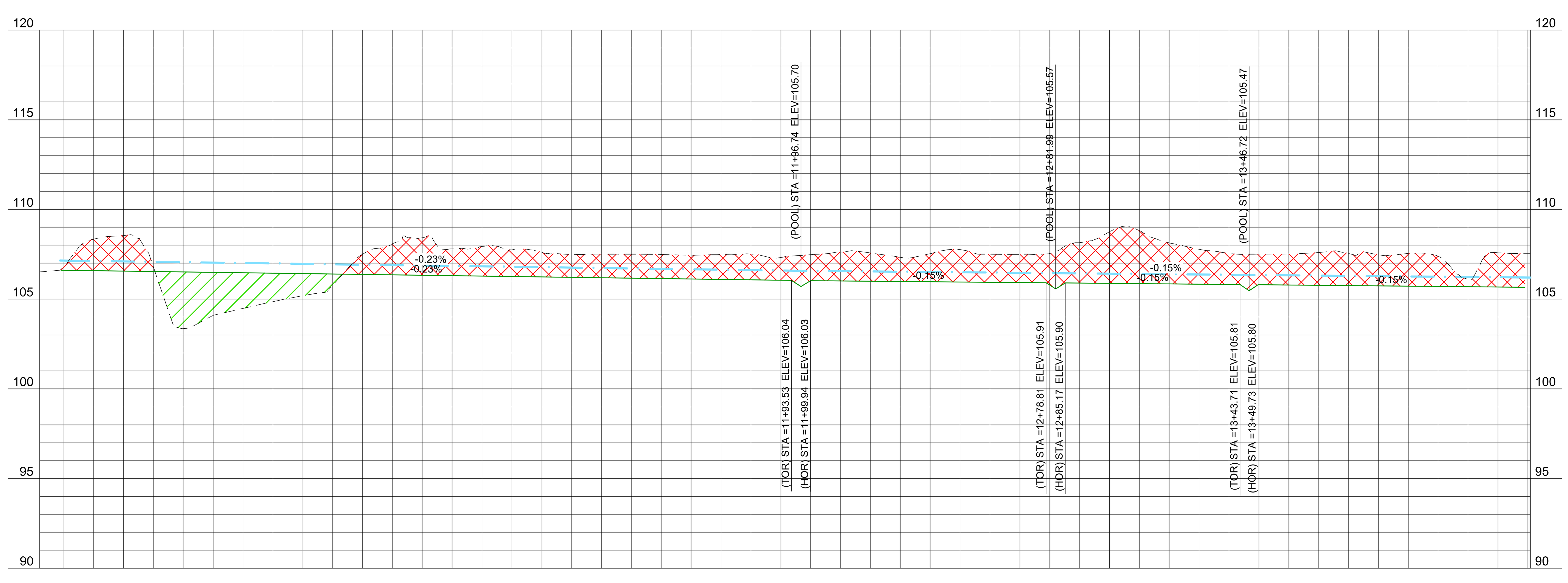
SHEET NO.
9

FILENAME: 05_12_COWTAIL_PP.DWG



S100 PLAN





S100 PROFILE

FILENAME: 05_12_COWTAIL_PP.DWG

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

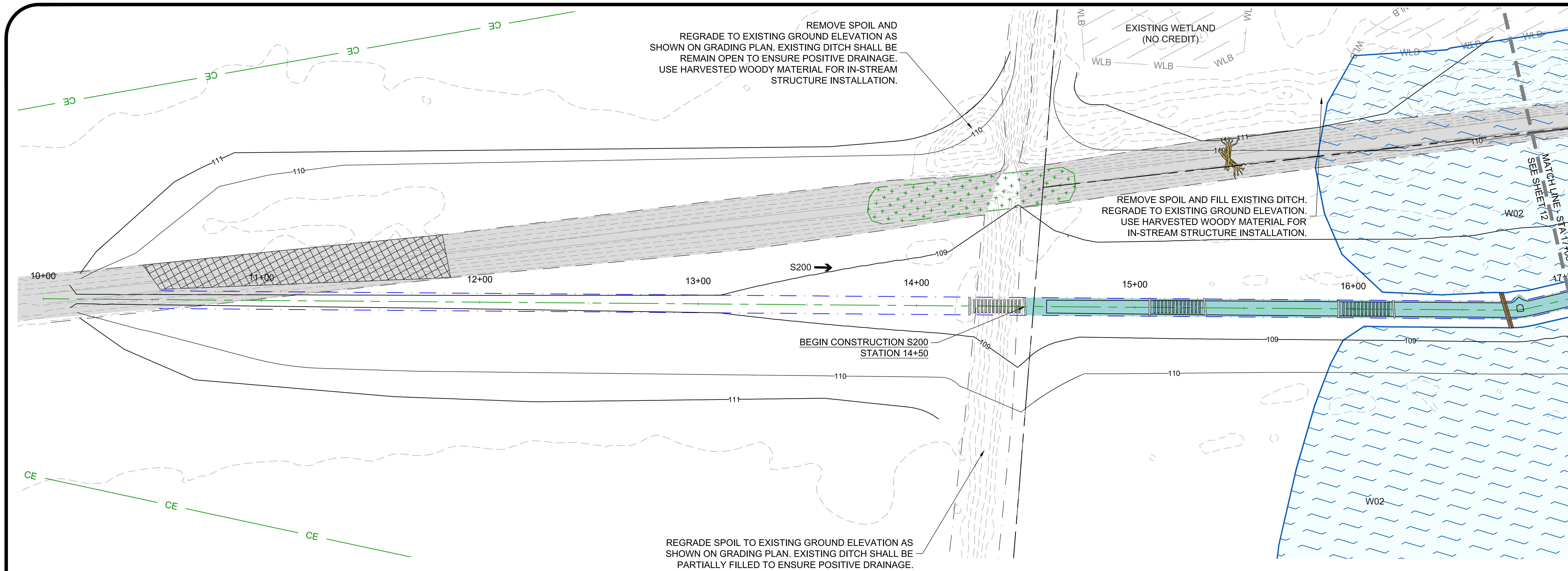
DRAWING INFO

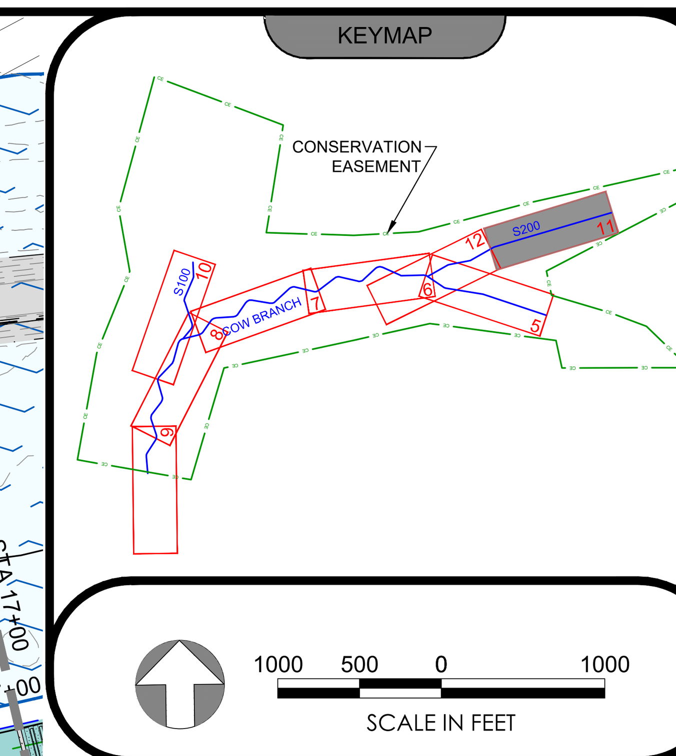
DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
PLAN AND PROFILE

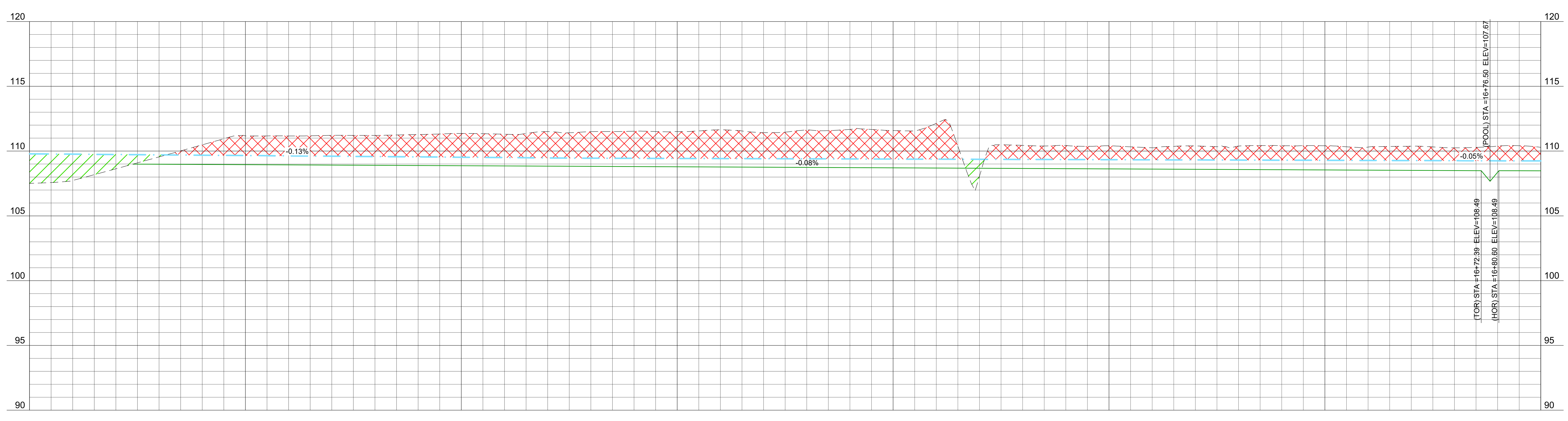
SHEET NO.
10





30 15 0 30
SCALE IN FEET
NORTH

S200 PLAN



30 15 0 30
HORIZONTAL SCALE IN FEET

5 2.5 0 5
VERTICAL SCALE IN FEET

S200 PROFILE

FILENAME: 05_12_COWTAIL_PP.DWG

SEAL 36916

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

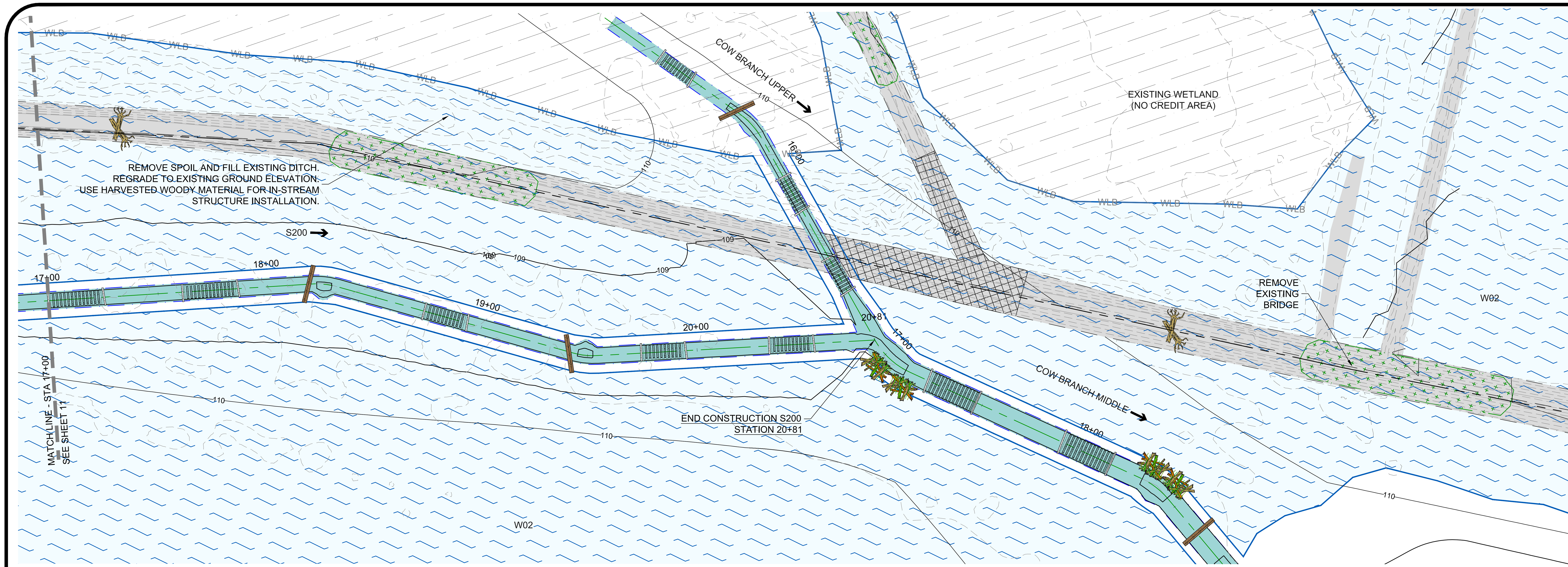
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

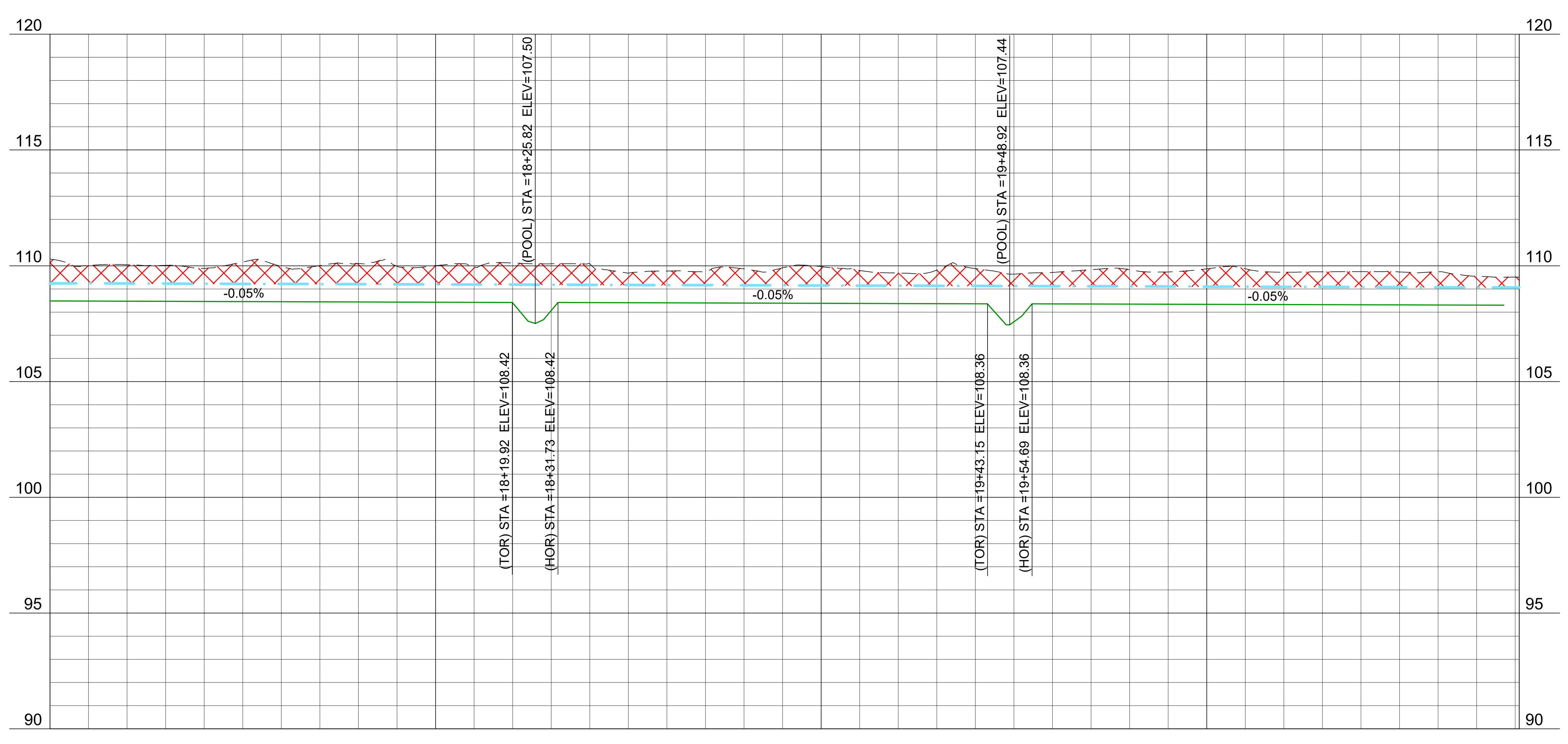
SHEET NAME
PLAN AND PROFILE

SHEET NO.
11



30 15 0 30
SCALE IN FEET
NORTH

S200 PLAN

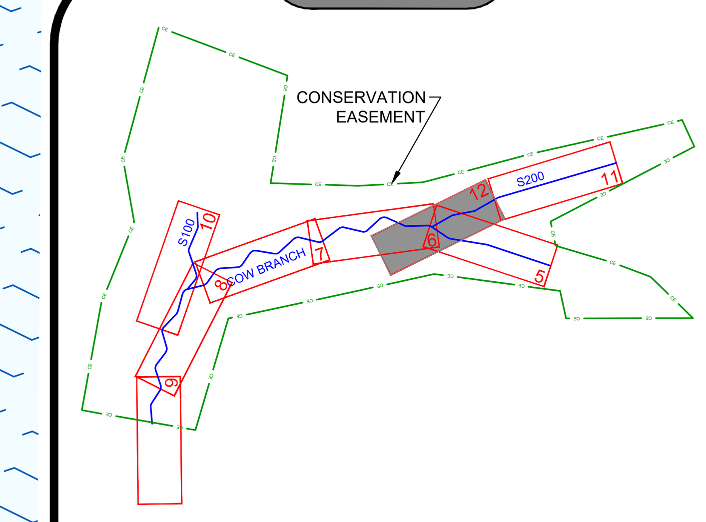


30 15 0 30
SCALE IN FEET
NORTH

S200 PROFILE

FILENAME: 05_12_COWTAIL_PP.DWG

KEYMAP



1000 500 0 1000
SCALE IN FEET

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER ... TOMSIC

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

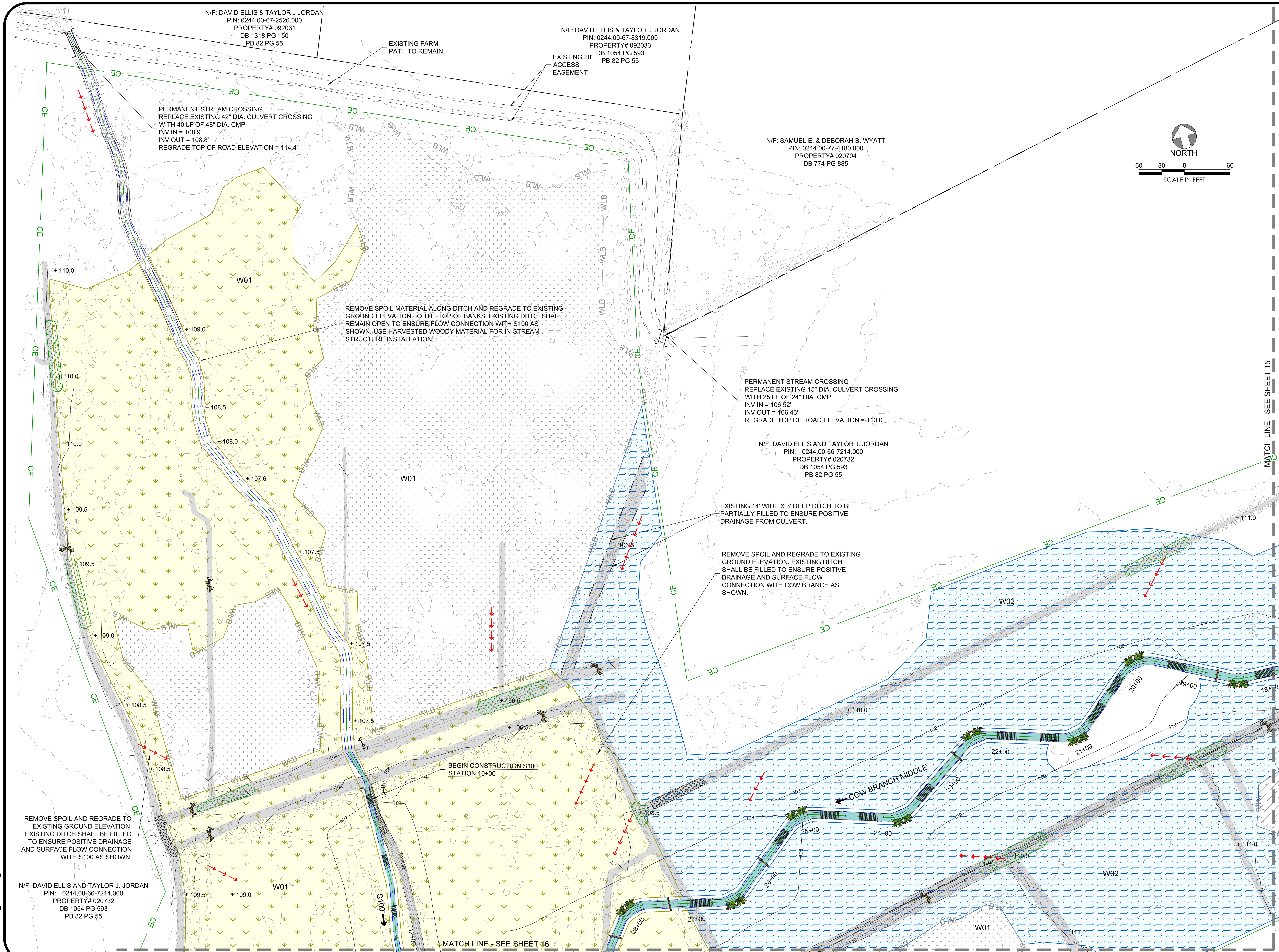
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME

PLAN AND PROFILE

SHEET NO.

12



FILENAME: 13-16_COWTAIL_WETLAND GRADING.DWG

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

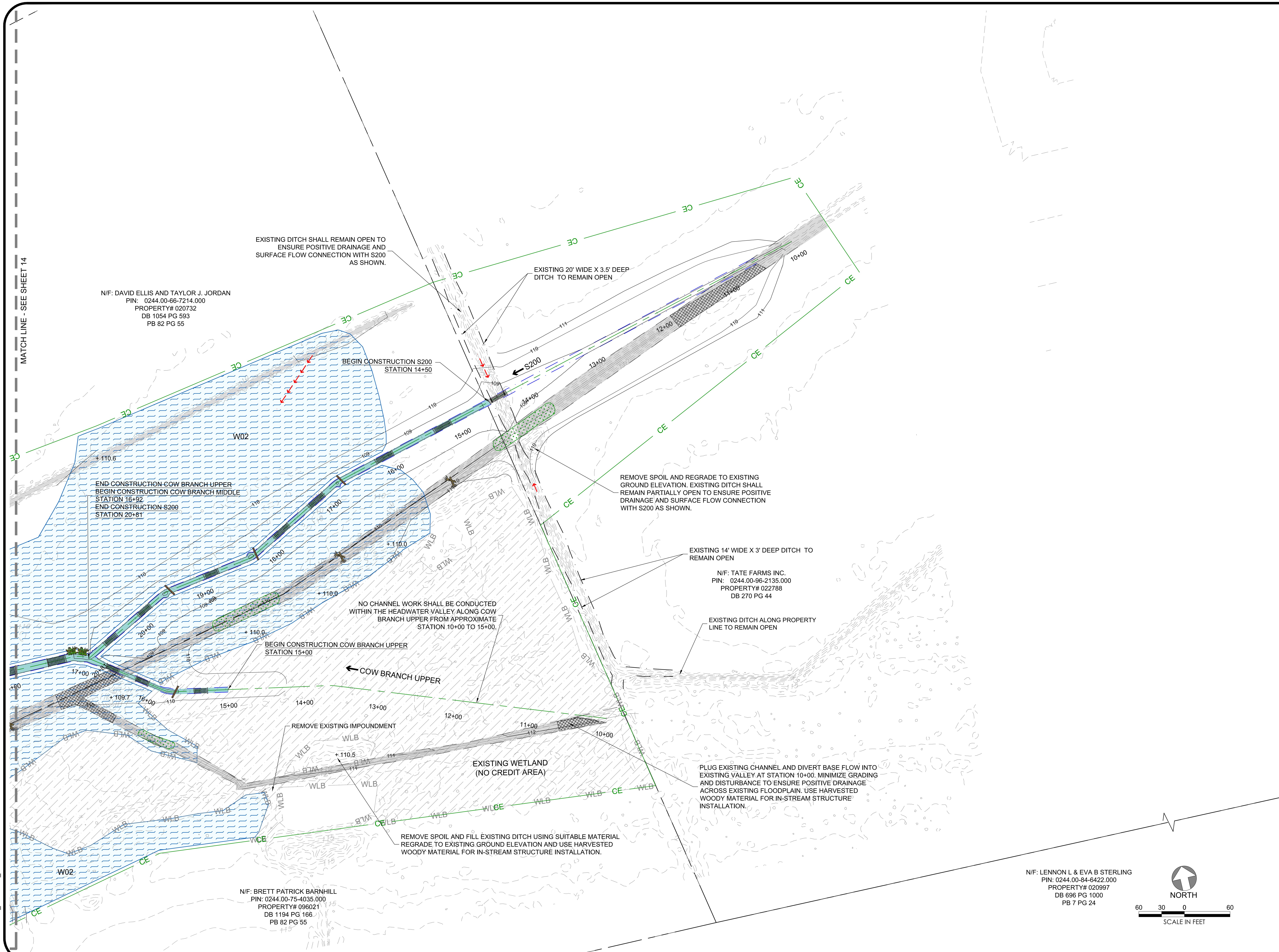
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
WETLAND GRADING PLAN

SHEET NO.
13



NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER TOMSIK
PRELIMINARY NOT FOR CONSTRUCTION

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

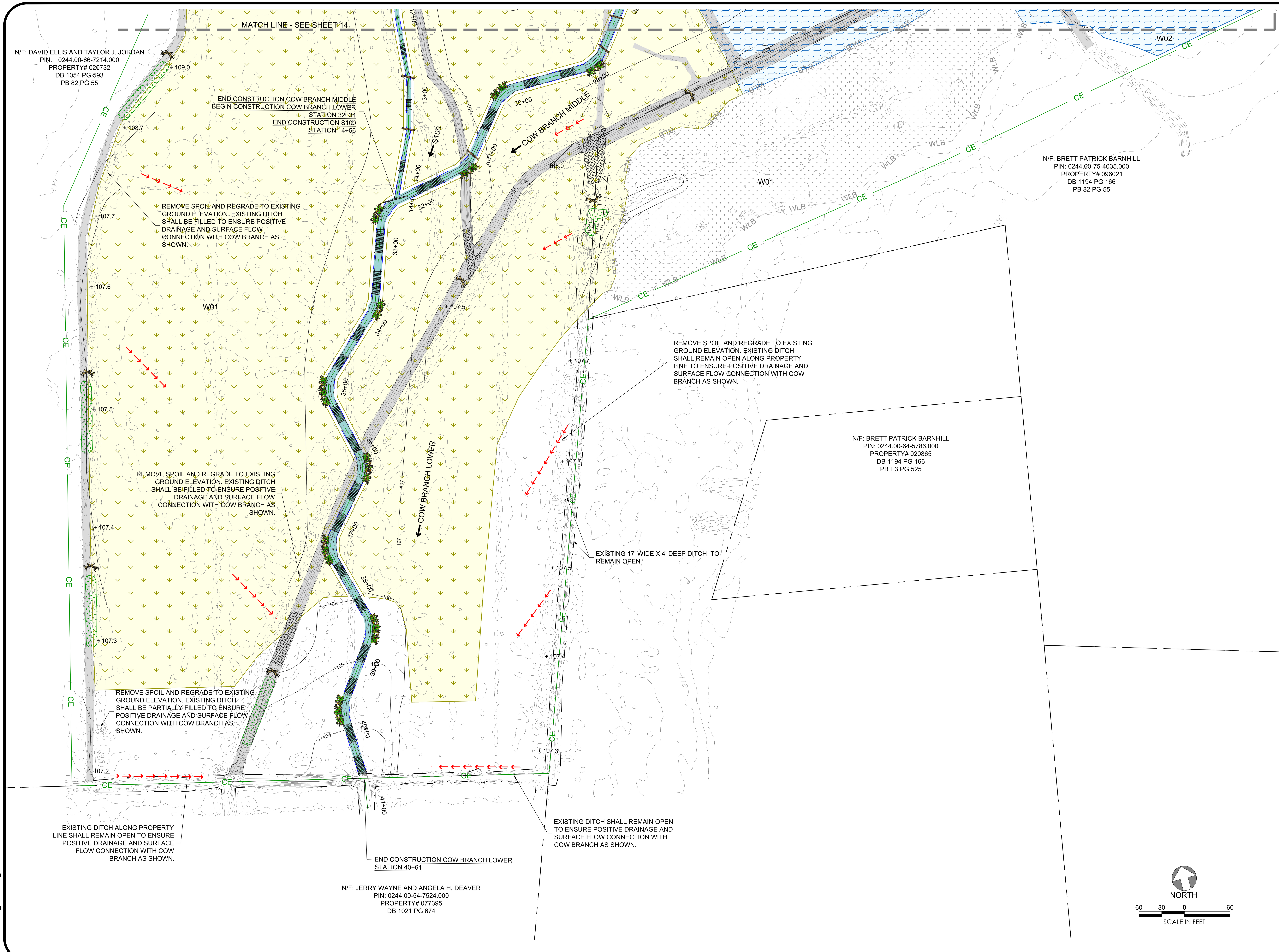
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
WETLAND GRADING PLAN

SHEET NO.
14



FILENAME: 13-16_COWTAIL_WETLAND GRADING.DWG

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER T. TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
WETLAND GRADING PLAN

SHEET NO.
15

PLANTING SCHEDULE

COMMON NAME	SCIENTIFIC NAME	% PLANTED BY SPECIES	WETLAND TOLERANCE	STRATUM
ZONE 1 - RESTORATION PLANTING (bare roots 8' X 8' Spacing @ 680 stems/acre)				
Red chokeberry	*Aronia arbutifolia*	5%	FACW	Shrub
Inkberry	*Ilex glabra*	10%	FACW	Shrub
Sweetspire	*Itea virginica*	10%	FACW	Shrub
Spicebush	*Lindera benzoin*	15%	FACW	Shrub
Elderberry	*Sambucus canadensis*	10%	FACW	Shrub
Arrow wood	*Viburnum dentatum*	5%	FAC	Shrub
Swamp titi	*Cyrilla racemiflora*	15%	FACW	Shrub
Wax myrtle	*Morella cerifera*	5%	FAC	Tree
Sweetbay magnolia	*Magnolia virginiana*	5%	FACW	Tree
Water oak	*Quercus nigra*	5%	FAC	Tree
Bald cypress	*Taxodium distichum*	5%	OBL	Tree
Smooth alder	*Alnus serrulata*	5%	FACW	Tree
River birch	*Betula nigra*	5%	FACW	Tree
	Total	***100%***		
ZONE 2 - RESTORATION PLANTING (bare roots 8' X 8' Spacing @ 680 stems/acre)				
Swamp black gum	*Nyssa biflora*	5%	OBL	Tree
River birch	*Betula nigra*	10%	FACW	Tree
Sycamore	*Platanus occidentalis*	10%	FACW	Tree
Swamp chestnut oak	*Quercus michauxii*	10%	FACW	Tree
Water oak	*Quercus nigra*	5%	FAC	Tree
Willow oak	*Quercus phellos*	5%	FACW	Tree
Bald cypress	*Taxodium distichum*	10%	OBL	Tree
Smooth alder	*Alnus serrulata*	10%	FACW	Tree
American hornbeam	*Carpinus caroliniana*	5%	FAC	Tree
Sweetbay magnolia	*Magnolia virginiana*	5%	FACW	Tree
Arrow wood	*Viburnum dentatum*	5%	FAC	Shrub
Inkberry	*Ilex glabra*	5%	FACW	Shrub
Sweetspire	*Itea virginica*	5%	FACW	Shrub
Spicebush	*Lindera benzoin*	10%	FACW	Shrub
	Total	***100%***		
STREAMBANKS - Live Stake Plantings (average 40 stakes per 1,000 square feet, spaced 3' apart in meander bends and 6' apart in riffles)				
COMMON NAME	**SCIENTIFIC NAME**	**% PLANTED BY SPECIES**	**WETLAND TOLERANCE**	**STRATUM**
Black Willow	*Salix nigra*	60%	OBL	Tree
Silky Dogwood	*Cornus amomum*	20%	FACW	Tree
Buttonbush	*Cephalanthus occidentalis*	20%	OBL	Shrub
	Total	***100%***		
PERMANENT SEEDING (All graded/disturbed areas in stream floodplain and wetland)				
COMMON NAME	**SCIENTIFIC NAME**	**% PLANTED BY SPECIES**	**WETLAND TOLERANCE**	**DENSITY (lbs/ac)**
Big blue stem	*Andropogon gerardii*	15%	FAC	2.5
Deer tongue	*Dichanthelium clandestinum*	15%	FACW	1.5
Shallow sedge	*Carex lurida*	10%	OBL	1.0
Slender woodoats	*Chasmanthium laxum*	10%	FACW	2.0
Virginia wild rye	*Elymus virginicus*	10%	FAC	2.0
Soft rush	*Juncus effusus*	10%	FACW	1.5
Switchgrass	*Panicum virgatum*	10%	FACW	1.5
Black-eyed Susan	*Rudbeckia hirta*	10%	FACU	1.5
Woolgrass	*Scirpus cyperinus*	10%	FACW	1.5
	Total	***100%***		***15.0***
TEMPORARY SEEDING (All graded/disturbed areas in stream floodplain and wetland)				
COMMON NAME	**RATE**	**DATES**		
Annual Rye	130 lbs/acre	September to March (Cool Season)		
Browntop Millet	40 lbs/acre	April to August (Warm Season)		

PLANTING NOTES

1. THE TABLES HEREIN LIST THE PROPOSED VEGETATION SPECIES SELECTION FOR THE PROJECT. THE TOTAL PLANTING AREA IS APPROXIMATELY 37.9 AC AND WILL VARY BASED ON SITE CONDITIONS AND AREAS DISTURBED DURING CONSTRUCTION.
2. FINAL VEGETATION SPECIES SELECTION MAY CHANGE DUE TO REFINEMENT OR SPECIES AVAILABILITY AT THE TIME OF PLANTING. SPECIES SUBSTITUTIONS WILL BE COORDINATED BETWEEN ENGINEER AND PLANTING CONTRACTOR PRIOR TO THE PROCUREMENT OF PLANT/SEED STOCK.
3. IN GENERAL, WOODY SPECIES SHALL BE PLANTED AT A DENSITY OF 680 STEMS PER ACRE AND A MINIMUM OF 50 FEET FROM THE TOP OF ALL STREAM BANKS AND TO THE REVEGETATION LIMITS. EXACT PLACEMENT OF THE SPECIES WILL BE DETERMINED BY THE ENGINEER AND VEGETATION SPECIALIST PRIOR TO SITE PLANTING AND BASED ON THE WETNESS CONDITIONS OF PLANTING LOCATIONS.
4. ANY INVASIVE SPECIES VEGETATION, SUCH AS CHINESE PRIVET (*LIGUSTRUM SINENSE*) AND MULTIFLORA ROSE (*ROSA MULTIFLORA*) WILL BE INITIALLY TREATED AS DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS PRIOR TO PLANTING ACTIVITIES TO ALLOW NATIVE PLANTS TO BECOME ESTABLISHED WITHIN THE CONSERVATION EASEMENT.
5. LARGER NATIVE TREE SPECIES TO BE PRESERVED WILL BE FLAGGED BY THE ENGINEER PRIOR TO CONSTRUCTION ACTIVITIES. ANY TREES HARVESTED FOR WOODY MATERIAL WILL BE UTILIZED TO PROVIDE BED AND BANK STABILIZATION, COVER AND/OR NESTING HABITAT.
6. ALL DISTURBED AREAS WILL BE STABILIZED USING MULCHING AND SEEDING AS DEFINED IN THE TECHNICAL SPECIFICATIONS AND THE APPROVED EROSION & SEDIMENTATION CONTROL PLAN.

PLANTING LEGEND

ZONE 1 - RESTORATION PLANTING (50% MINIMUM SHRUBS)

ZONE 1 - RESTORATION PLANTING (12' WIDE ROWS SPACED 48' APART)

ZONE 2 - RESTORATION PLANTING (70% MINIMUM TREES)

EXISTING FORESTED AREA (6.7 AC)

SEAL 30916

CHRISTOPHER TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

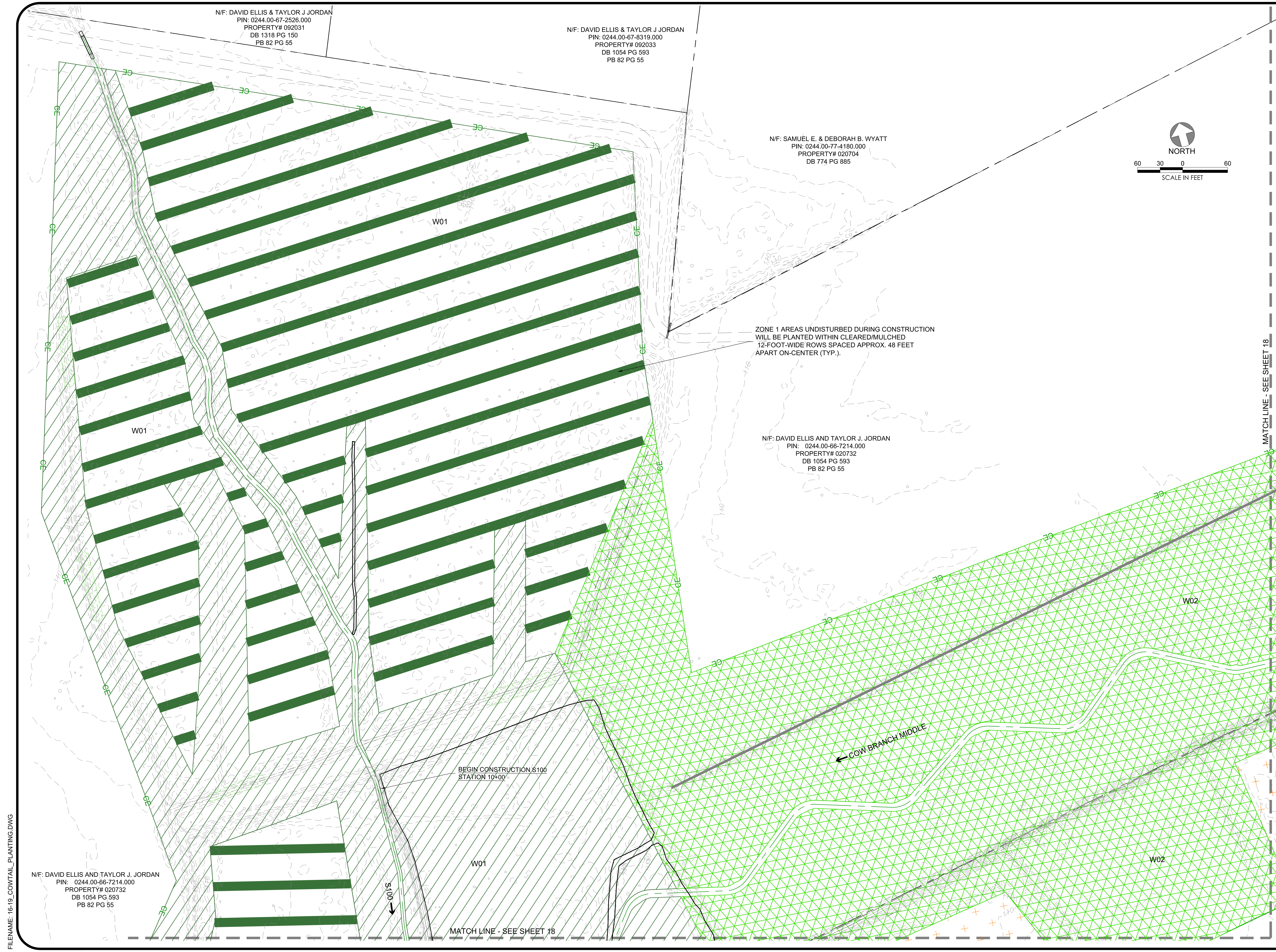
DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
PLANTING TABLES AND NOTES

SHEET NO.
16

FILENAME: 16-19_COWTAIL_PLANTING.DWG



NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

REVISIONS

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

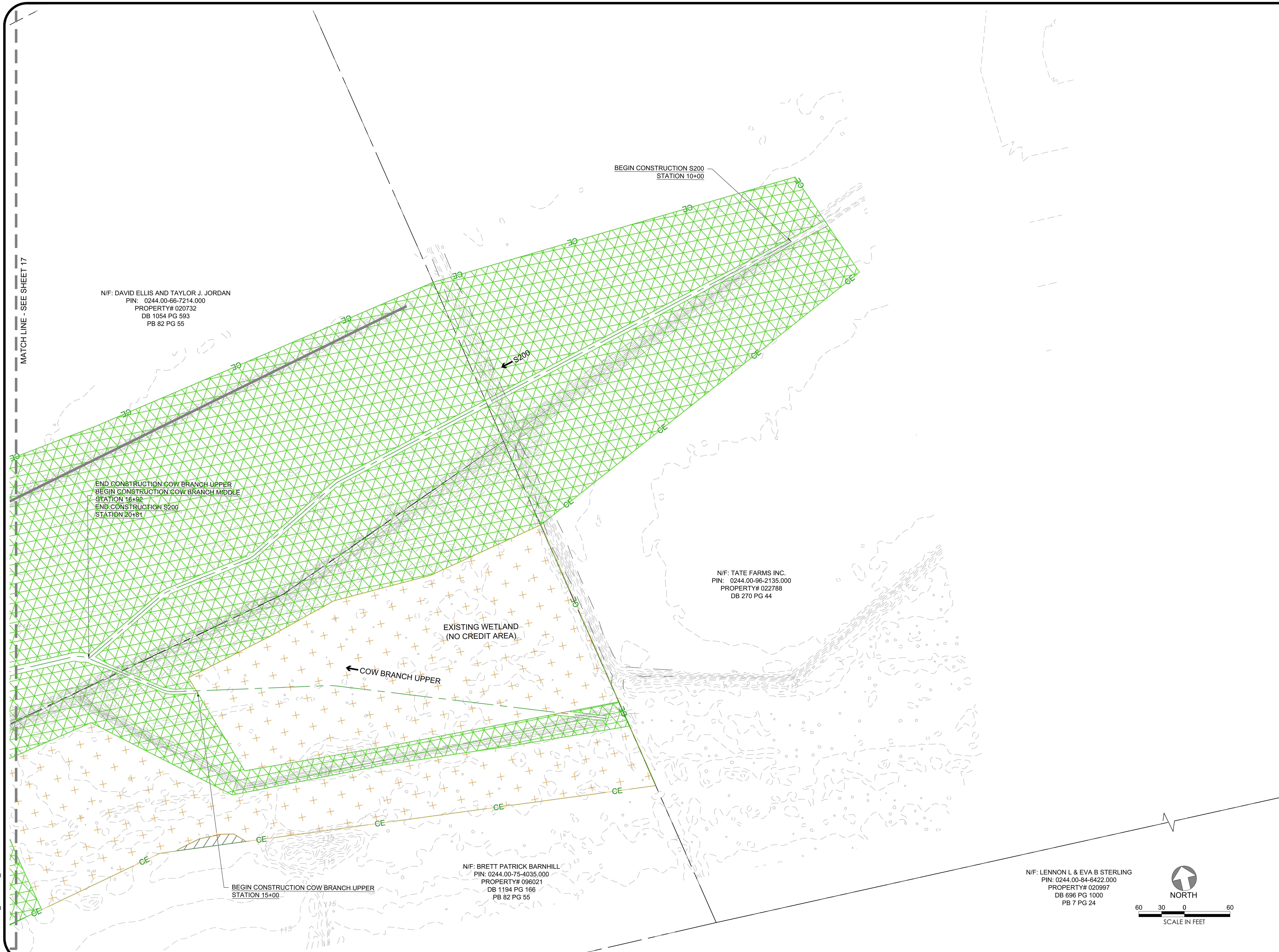
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
PLANTING PLAN

SHEET NO.
17



FILENAME: 16-19_COWTAIL_PLANTING.DWG

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER TOMSIK

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

REVISIONS

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

COW TAIL MITIGATION PROJECT

COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME

PLANTING PLAN

SHEET NO.

18

FILENAME: 16-19_COWTAIL_PLANTING.DWG

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

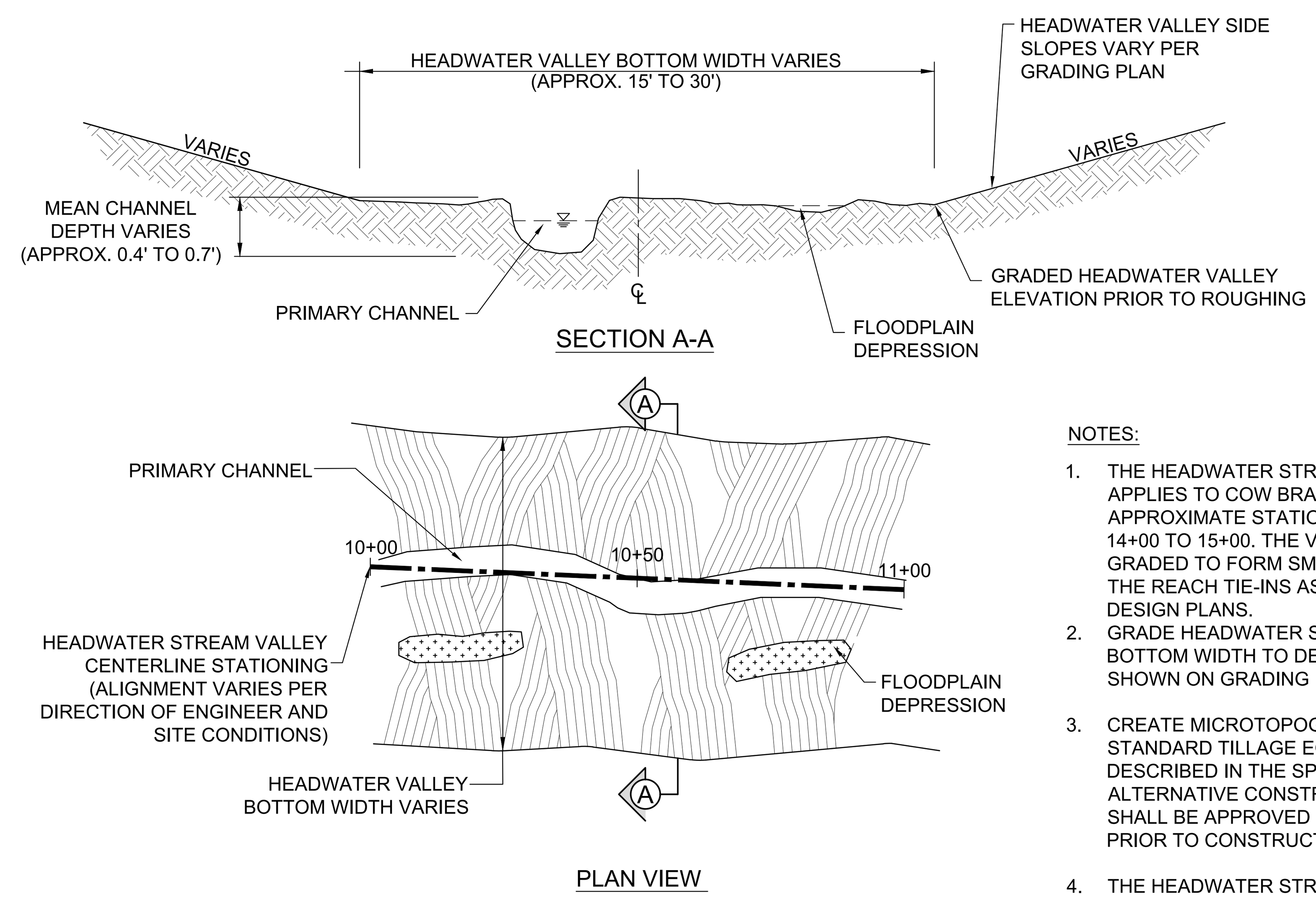
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
PLANTING PLAN

SHEET NO.
19

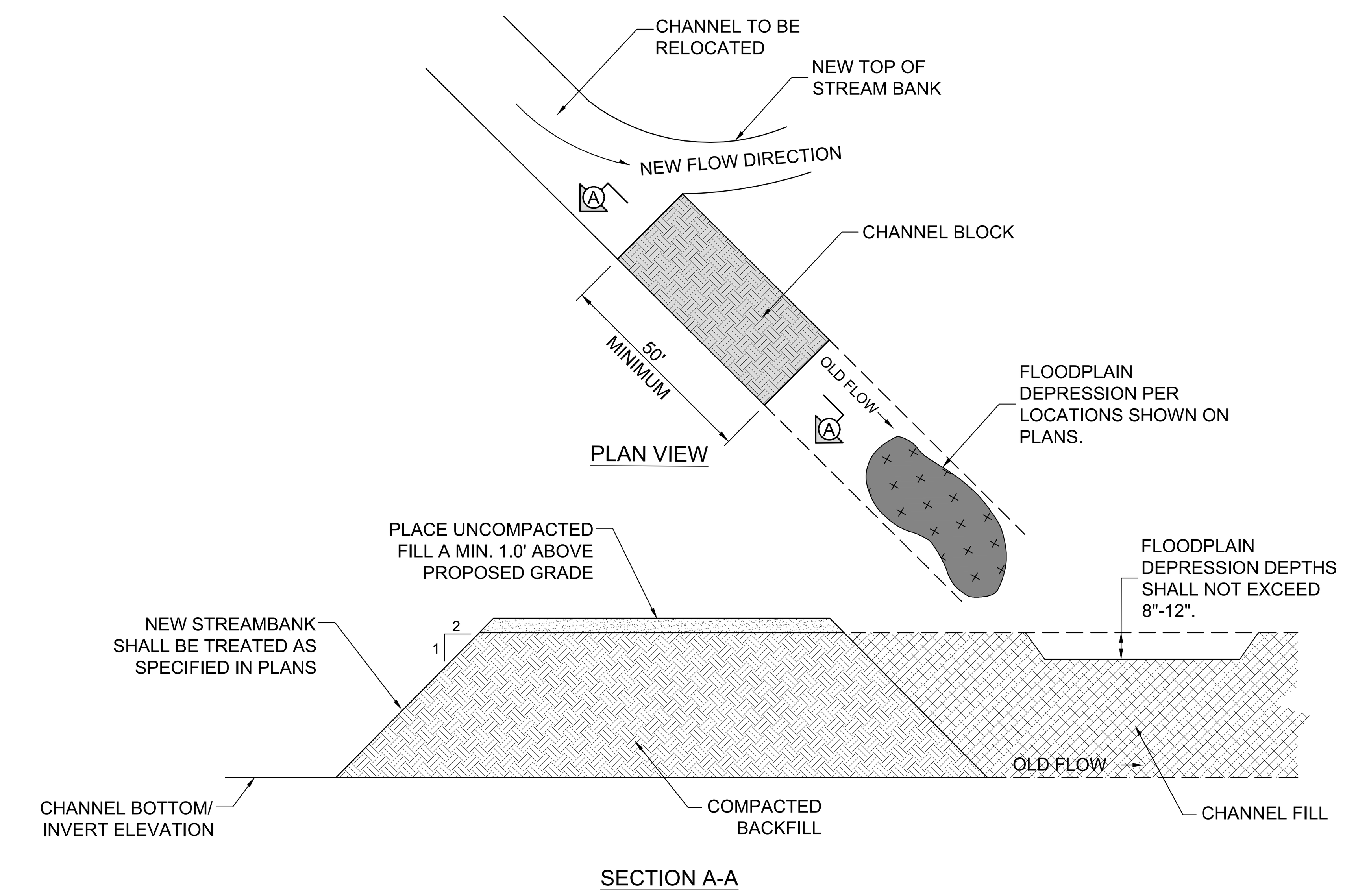


HEADWATER STREAM VALLEY
UPPER COWBRANCH STA. 10+00 TO 15+00

NOT TO SCALE

NOTES:

1. THE HEADWATER STREAM VALLEY ONLY APPLIES TO COW BRANCH UPPER FROM APPROXIMATE STATION 10+00 TO 11+00 AND 14+00 TO 15+00. THE VALLEY SHALL BE GRADED TO FORM SMOOTH TRANSITIONS AT THE REACH TIE-INS AS SHOWN ON THE DESIGN PLANS.
2. GRADE HEADWATER STREAM VALLEY AND BOTTOM WIDTH TO DESIGN CONTOURS AS SHOWN ON GRADING PLAN.
3. CREATE MICROTOPOGRAPHY USING STANDARD TILLAGE EQUIPMENT AS DESCRIBED IN THE SPECIFICATIONS. ALTERNATIVE CONSTRUCTION METHODS SHALL BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.
4. THE HEADWATER STREAM VALLEY GRADING SHALL BE APPROVED BY ENGINEER FOLLOWING COMPLETION OF THE MICROTOPOGRAPHY ROUGHENING.
5. UPON GRADING COMPLETION OF THE HEADWATER STREAM VALLEY, APPLY MULCH, TEMPORARY AND PERMANENT SEED IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.

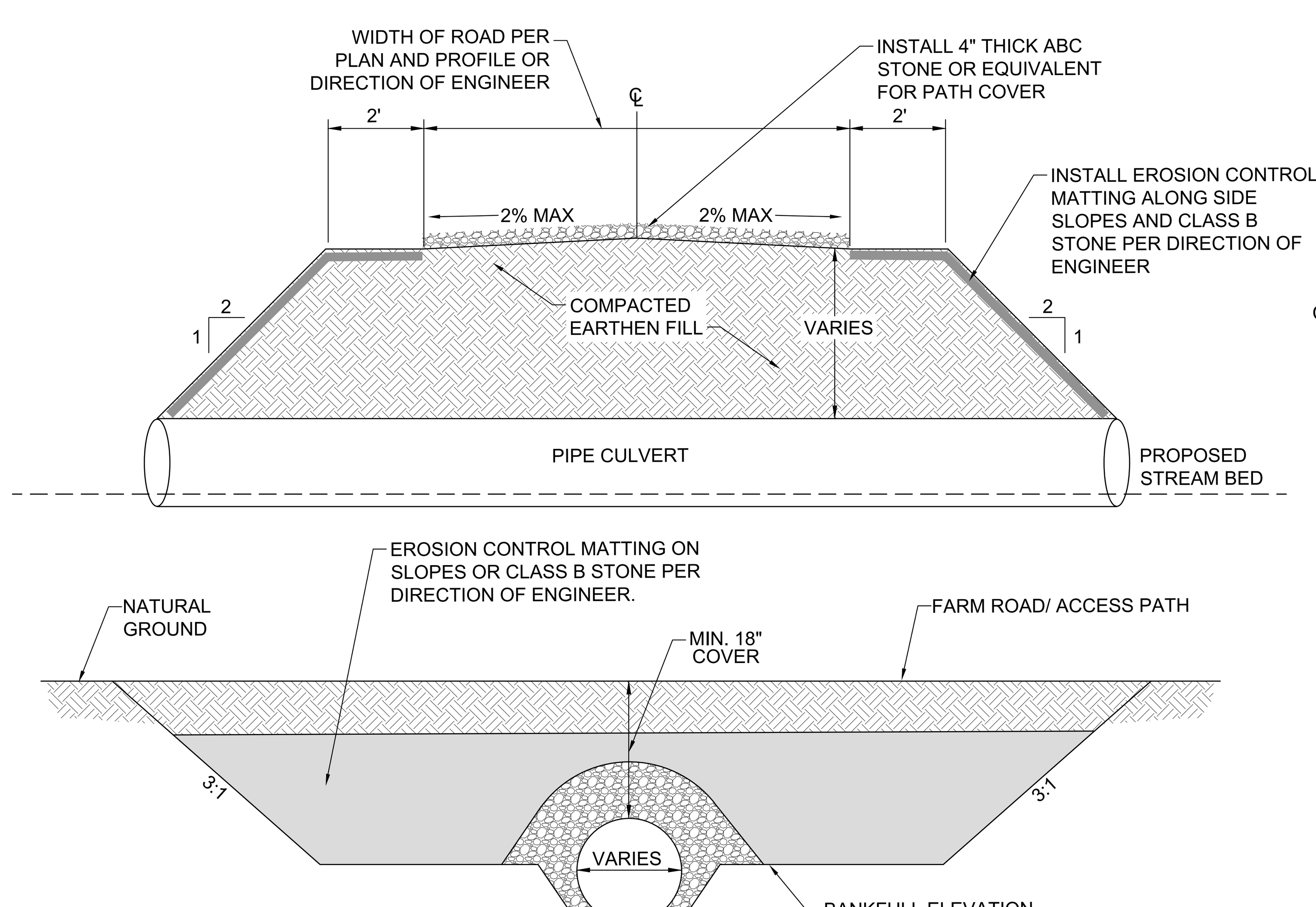


NOTES:

1. COMPACT CHANNEL BLOCK MATERIAL FOR BACKFILL USING HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. CONSTRUCT CHANNEL BLOCK WITH COMPACTED SOIL USING SUITABLE MATERIAL IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.
3. PLACE FILL MATERIAL IN LOCATIONS SHOWN ON PLANS OR AS DIRECTED BY ENGINEER TO ALLOW FOR SETTLING.

CHANNEL BLOCK

NOT TO SCALE

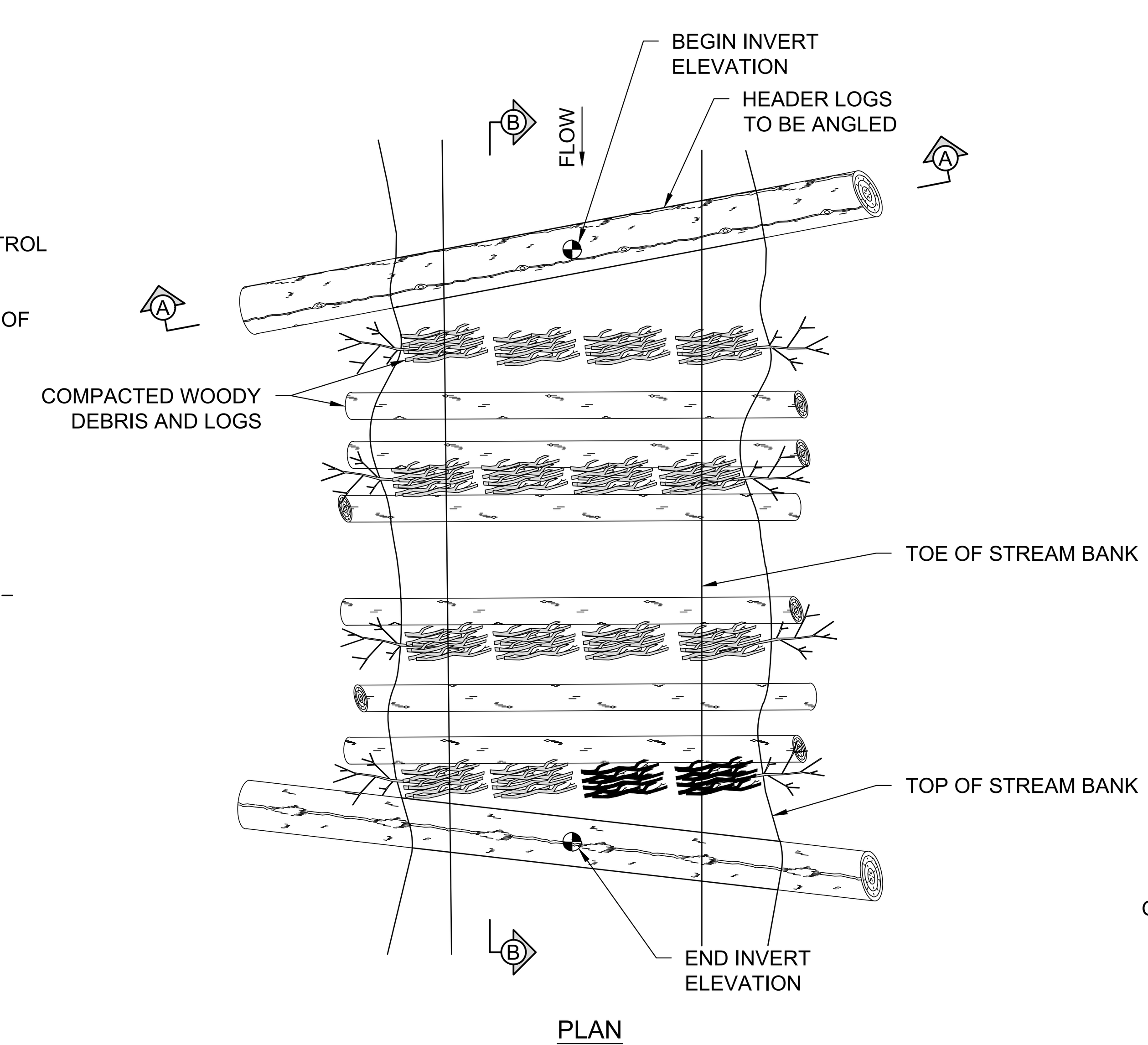


NOTES:

1. INSTALL CORRUGATED PIPE CULVERT(S) IN ACCORDANCE WITH DETAIL AND TECHNICAL SPECIFICATIONS. SEE PLANS FOR PIPE MATERIAL, SIZE, LENGTH AND LOCATIONS AND CLASS B STONE PER THE DIRECTION OF THE ENGINEER
2. INSTALL EROSION CONTROL MATTING ALONG FILL SLOPES IN ACCORDANCE WITH DETAIL AND TECHNICAL SPECIFICATIONS.
3. PIPE CULVERTS ARE TO HAVE A MINIMUM OF 18" COVER AND SPACED IN ACCORDANCE WITH DETAIL AND TECHNICAL SPECIFICATIONS.

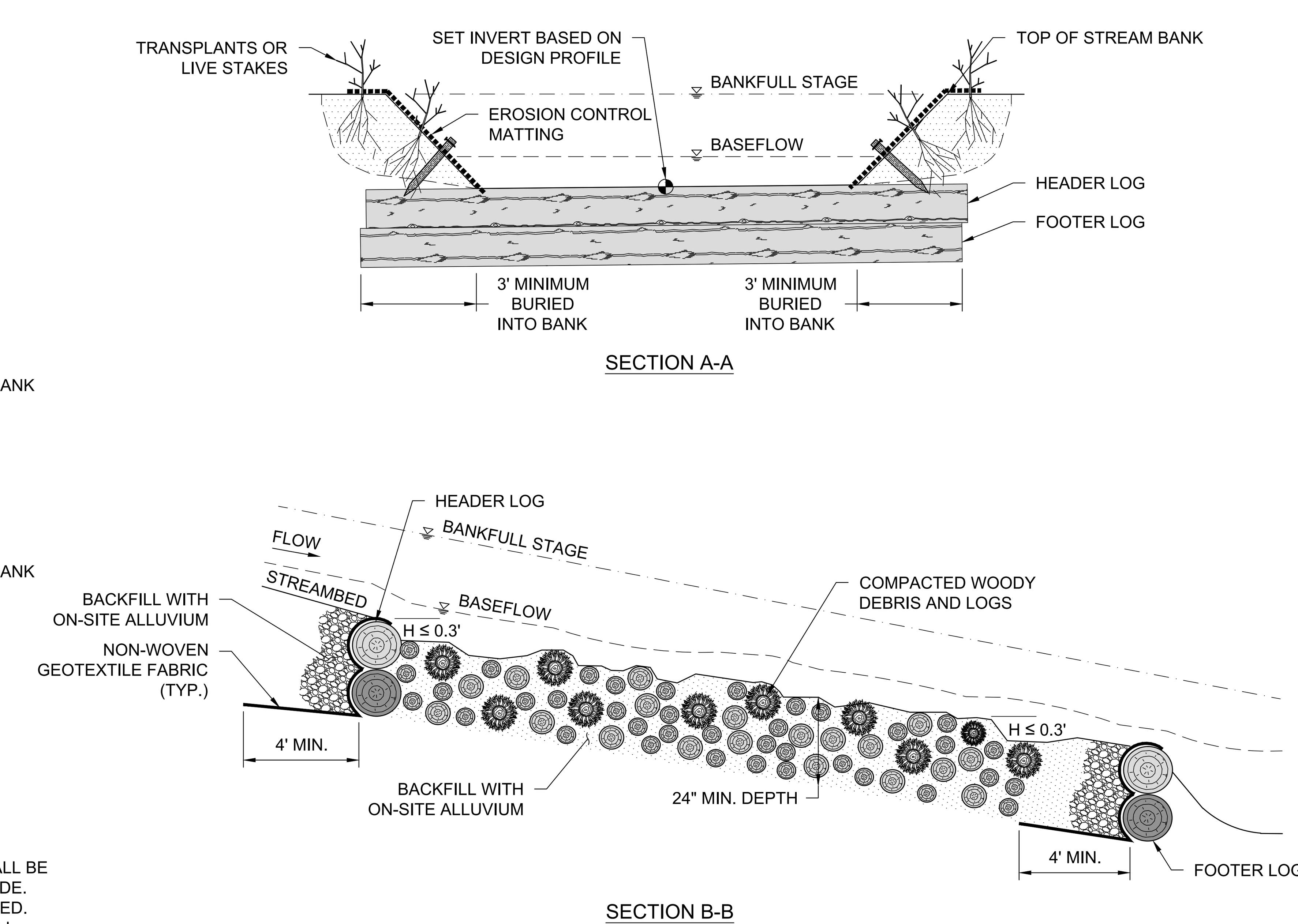
PERMANENT CULVERT CROSSING

NOT TO SCALE



NOTES:

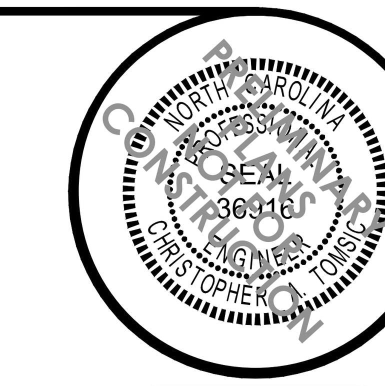
1. WOODY DEBRIS DEPTH SHALL BE NO LESS THAN 24".
2. WOODY DEBRIS MATERIAL SHOULD BE A MIX OF SMALL AND LARGE LIMBS AND LOGS. LOGS SHALL BE AT LEAST 4" IN DIAMETER AND NO LARGER THAN 10" AND EXTEND INTO THE BANK 3' ON EACH SIDE. WOODY DEBRIS MATERIAL SHALL BE VARYING DIAMETER TO ALLOW MATERIAL TO BE COMPACTED.
3. NON-WOVEN GEOTEXTILE FABRIC SHOULD BE NAILED TO THE HEADER LOG BELOW THE BACKFILL.
4. AFTER TRENCH HAS BEEN EXCAVATED LOGS AND WOODY DEBRIS SHOULD BE PLACED WITH MINIMAL GAPS. A LAYER OF ON-SITE ALLUVIUM SHOULD BE APPLIED TO FILL VOIDS BETWEEN LOGS AND WOODY DEBRIS BEFORE ADDITIONAL LAYERS ARE PLACED.
5. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.



CONSTRUCTED BRUSHY RIFFLE

NOT TO SCALE

FILENAME: 20-24_COWTAIL_DETAILS.DWG



REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

COW TAIL MITIGATION PROJECT

COLUMBUS COUNTY, NORTH CAROLINA

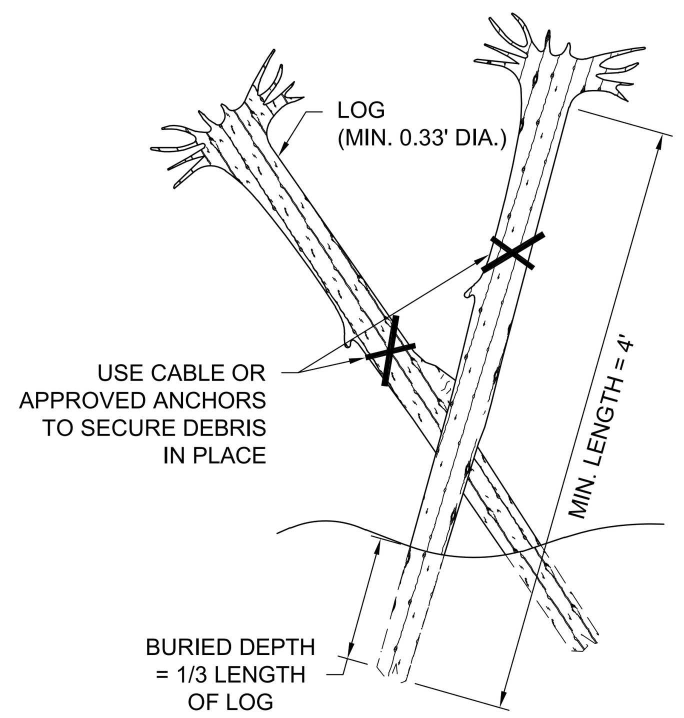
SHEET NAME

DETAILS

SHEET NO.

20

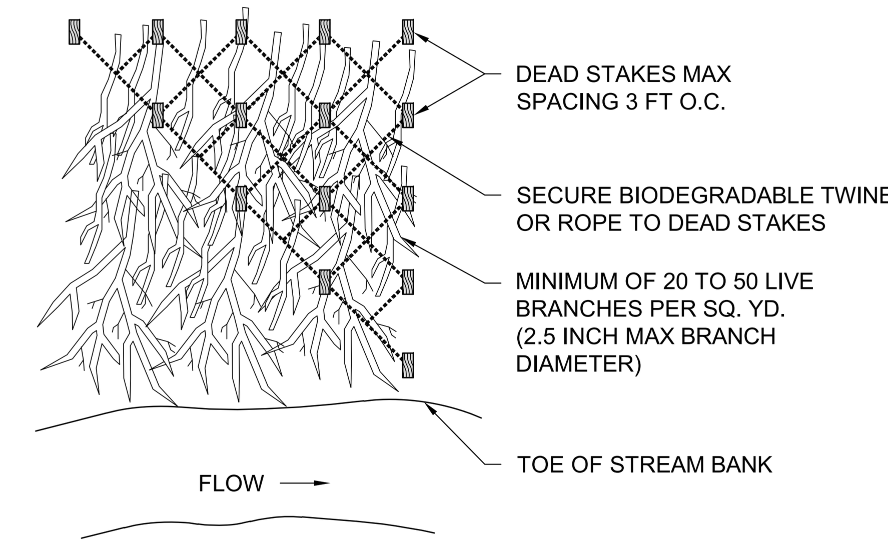
LARGE WOODY DEBRIS



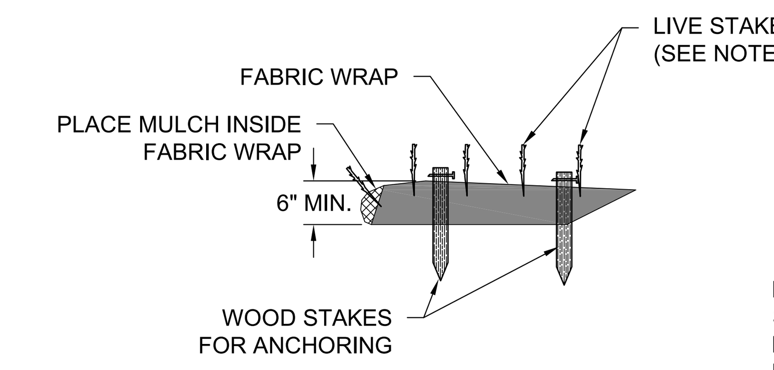
NOTES:

1. LARGE WOOD DEBRIS SHALL BE PLACED OUTSIDE OF THE CONSTRUCTED CHANNEL WITHIN FLOODPLAIN LIMITS.
2. LARGE WOOD DEBRIS SHALL BE ANCHORED TO THE GROUND SURFACE TO WITHSTAND FLOOD FLOWS. CABLE ANCHORS OR APPROVED EQUIVALENT SHOULD BE USED TO HOLD LARGE WOOD DEBRIS IN PLACE. THE UPSTREAM PORTION OF THE LOG SHALL BE BURIED A MINIMUM OF 1/3 THE LENGTH OF THE LOG TO DISCOURAGE MOVEMENT AT FLOOD FLOWS.
3. MINIMUM LOG LENGTH (INCLUDING ROOT WAD/BALL) IS 4 FEET.
4. MINIMUM LOG DIAMETER IS 4 INCHES.
5. LOG SHALL BE RELATIVELY STRAIGHT, HARDWOOD AND RECENTLY HARVESTED.
6. ALL MATERIALS ARE TO BE APPROVED BY THE ENGINEER.

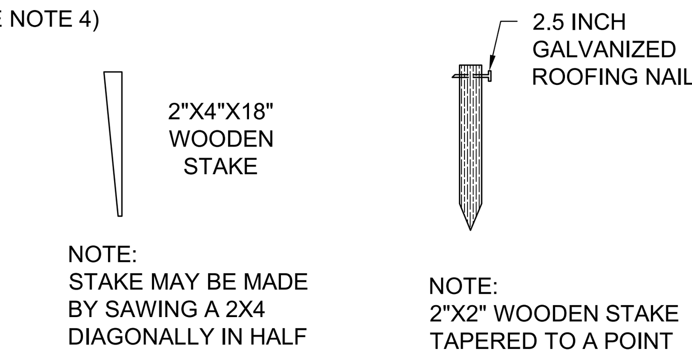
LARGE WOODY DEBRIS
NOT TO SCALE



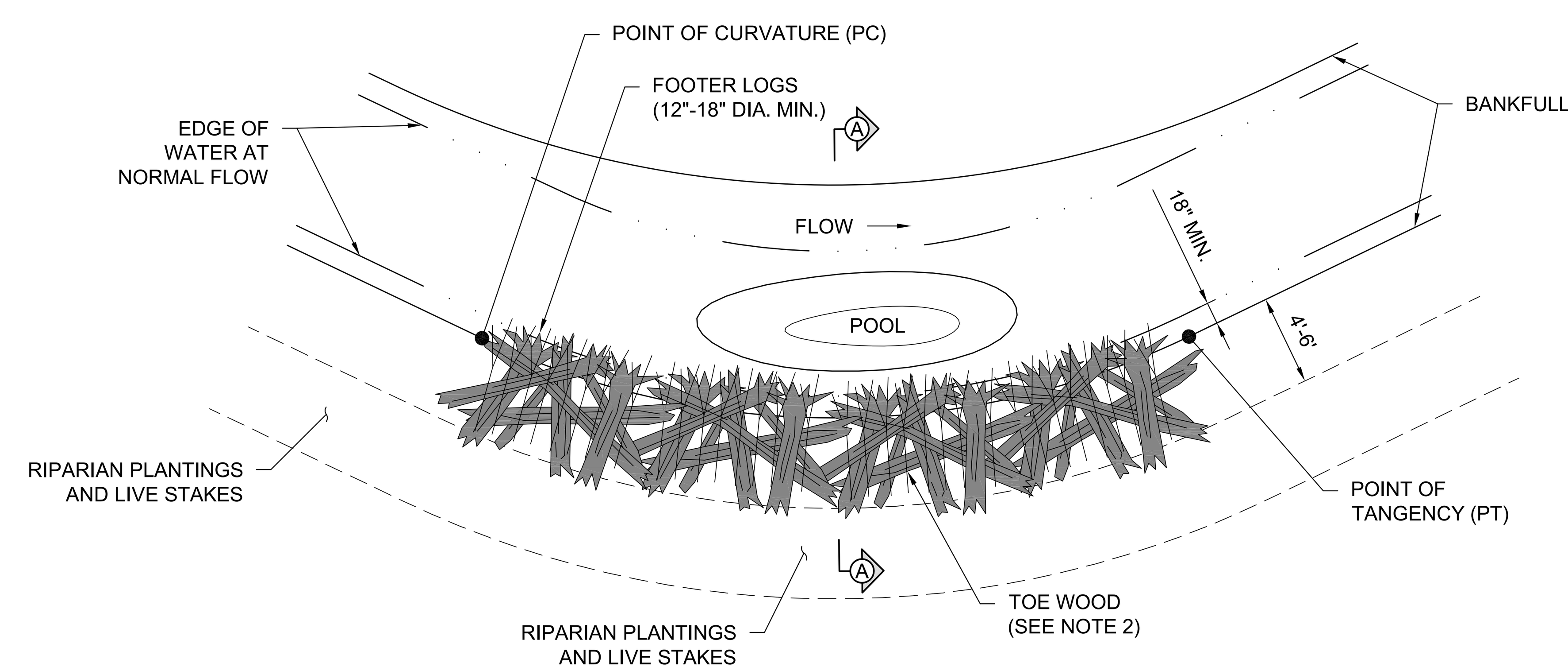
LIVE CUTTINGS



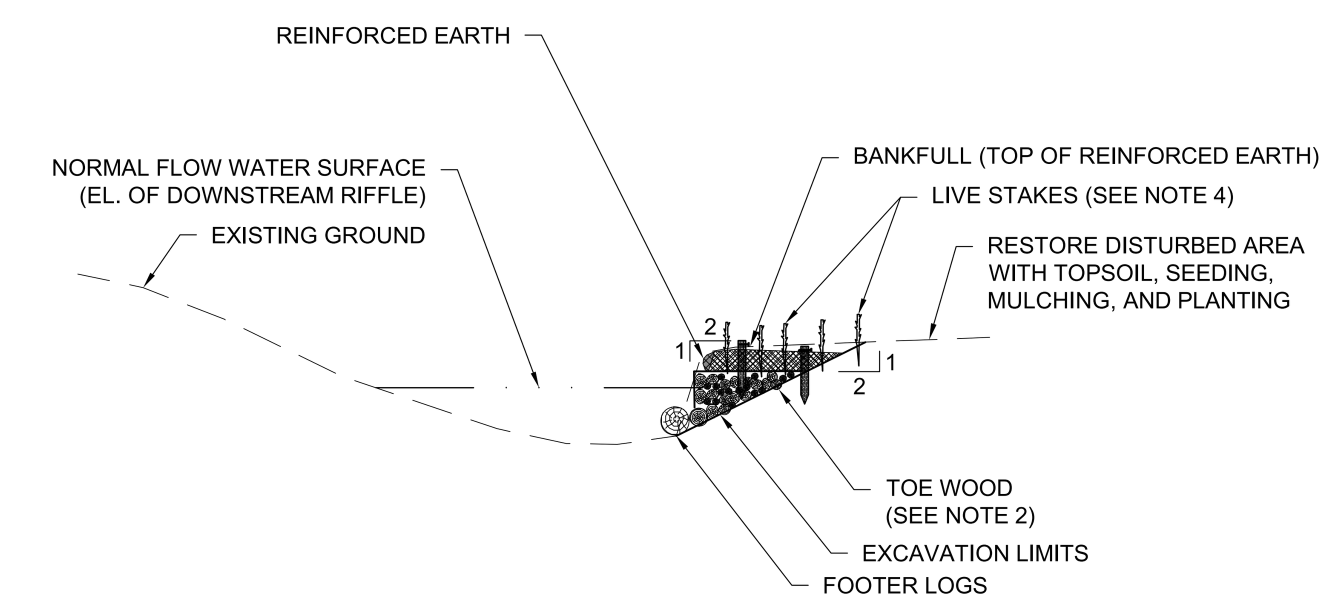
REINFORCED EARTH



WOOD STAKE OPTIONS



PLAN

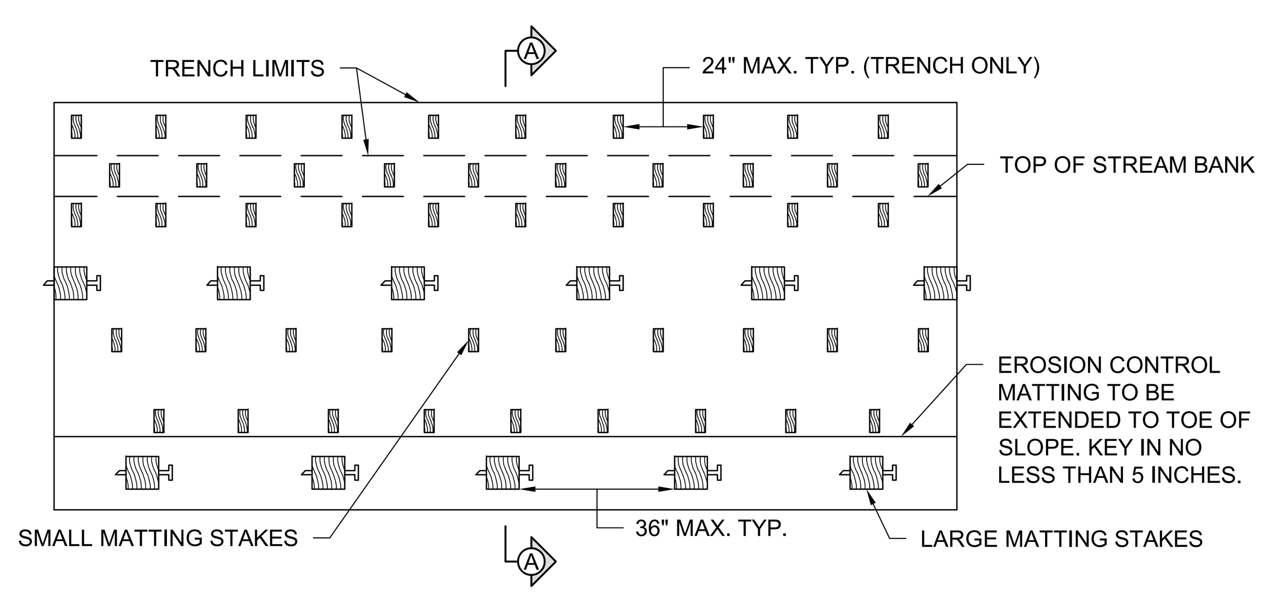


SECTION A-A

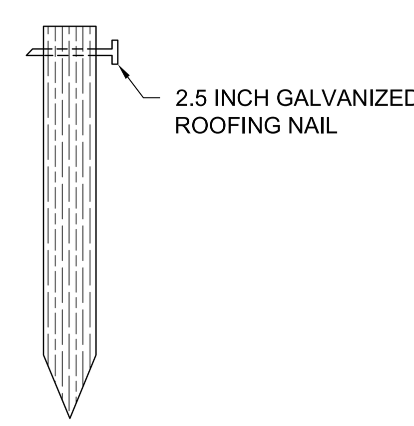
NOTES:

1. IF AN APPROVED ON-SITE SOURCE IS AVAILABLE, SOD MATS LAYERS MAY BE USED INSTEAD OF REINFORCED EARTH. SOD MATS MAY ALSO BE OBTAINED FROM CLEARING AND EXCAVATION WORK ASSOCIATED WITH THE PROJECT. THE NUMBER OF LAYERS OF REINFORCED EARTH OR SOD MATS MAY VARY WITH THE BANK HEIGHT.
2. TOE WOOD CONSISTS OF A MIX OF LOGS, BRANCHES, BRUSH, AND OTHER WOODY VEGETATION INSTALLED AT VARIOUS ANGLE, BUT NOT PARALLEL TO THE FLOW. LAYER THE WOOD WITH LARGER MATERIAL ON THE BOTTOM AND A MAT OF BRANCHES AS THE TOP LAYER. THE TOP LAYER OF TOE WOOD SHALL BE AT THE ESTABLISHED NORMAL FLOW ELEVATION.
3. LAYER REINFORCED EARTH AND CUTTINGS TO BANKFULL.
4. LIVE STAKES SHALL BE USED IN LIEU OF LIVE CUTTINGS IF CONSTRUCTION OCCURS OUTSIDE THE DORMANT PLANTING SEASON. LIVE STAKES SHALL BE INSTALLED AFTER REINFORCED EARTH IS CONSTRUCTED BUT DURING DORMANT PLANTING SEASON.

TOE WOOD WITH BRUSH LAYERING
NOT TO SCALE

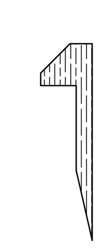


PLAN VIEW OF STREAM BANK



TYPICAL LARGE MATTING STAKE

LENGTH	24.00 IN (60.96 CM) (TAPERED TO POINT)
WIDTH	1.5 IN (3.81 CM)
THICKNESS	1.5 IN (3.81 CM)

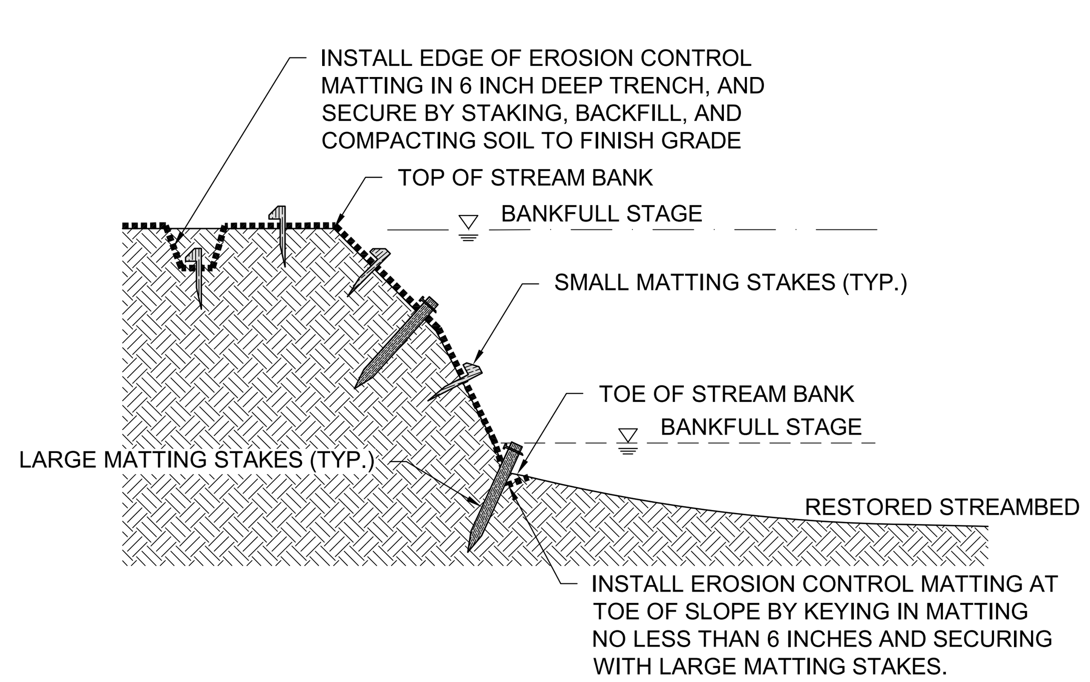


TYPICAL SMALL MATTING STAKE

LEG LENGTH	11.00 IN (27.94 CM)
HEAD WIDTH	1.25 IN (3.16 CM)
HEAD THICKNESS	0.40 IN (1.02 CM)
LEG WIDTH	0.60 IN (1.52 CM) (TAPERED TO POINT)
LEG THICKNESS	0.40 IN (1.02 CM)
TOTAL LENGTH	12.00 IN (30.48 CM)

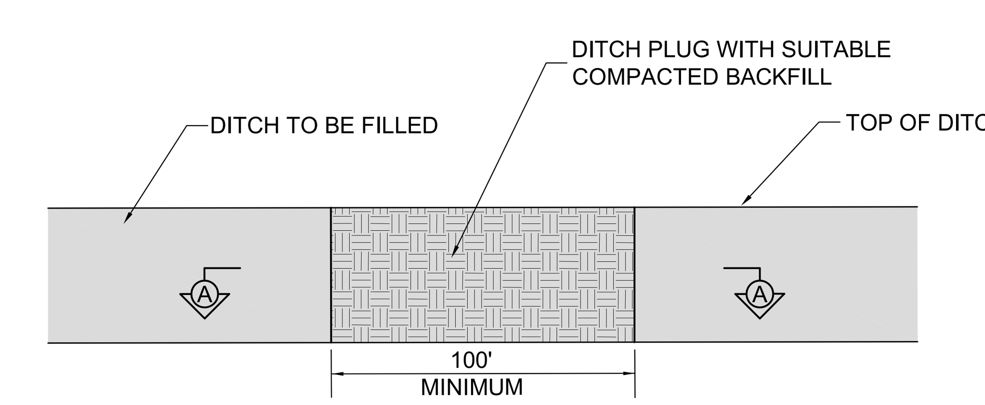
NOTES:

1. RESTORED STREAM BANKS MUST BE SEEDED AND MULCHED PRIOR TO PLACEMENT OF EROSION CONTROL MATTING.
2. SEE TECHNICAL SPECIFICATIONS FOR MATTING STAKE SPACING REQUIREMENTS.
3. PLACE LARGE STAKES ALONG ALL MATTING SEAMS, IN THE CENTER OF STREAM BANK, AND TOE OF SLOPE.

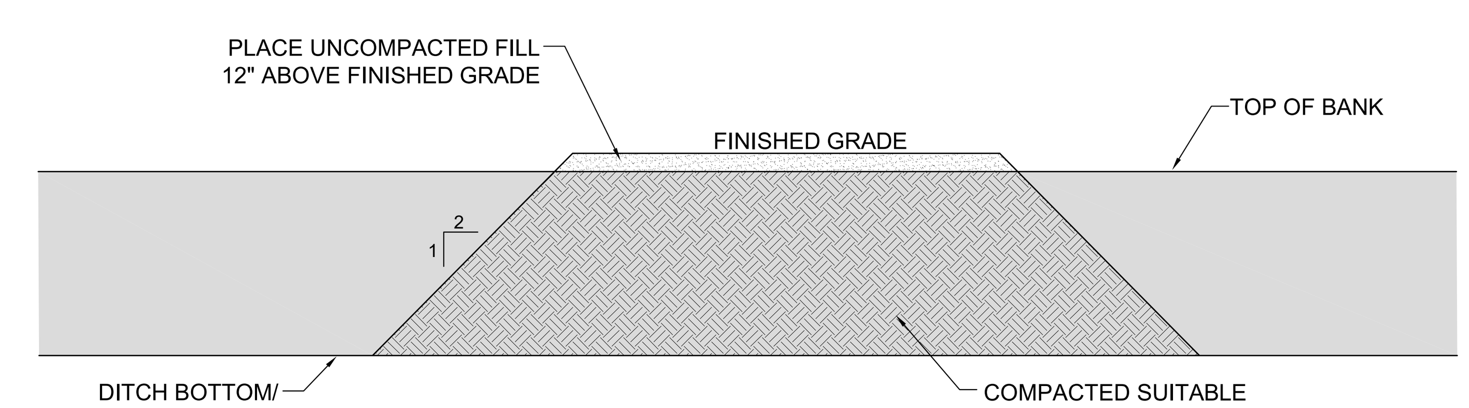


SECTION A-A

EROSION CONTROL MATTING
NOT TO SCALE



PLAN VIEW



SECTION A-A

NOTES:
1. COMPACT DITCH PLUG MATERIAL FOR BACKFILL USING HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. CONSTRUCT DITCH PLUG WITH COMPACTED SOIL USING SUITABLE MATERIAL IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.
3. PLACE FILL MATERIAL IN LOCATIONS SHOWN ON PLANS OR AS DIRECTED BY ENGINEER TO ALLOW FOR SETTLING.

DITCH PLUG
N.T.S

FILENAME: 20-24_COWTAIL_DETAILS.DWG

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 30916 CHRISTOPHER M. TOMSIC

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

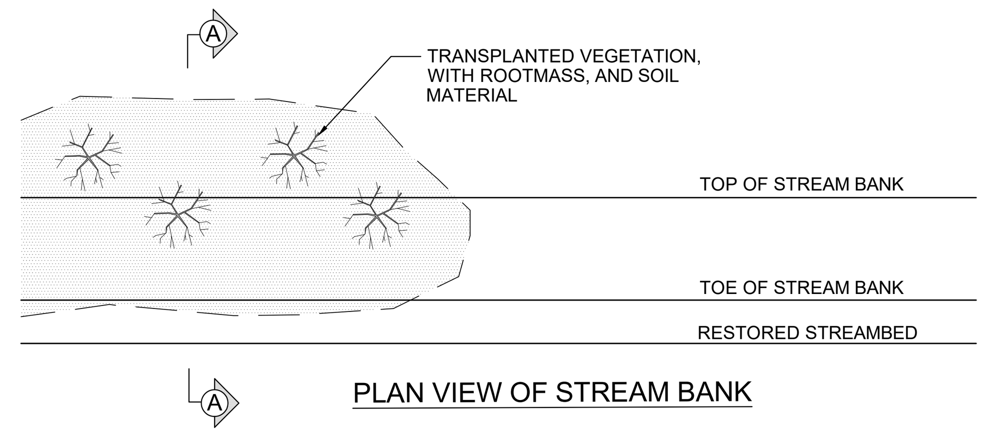
DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

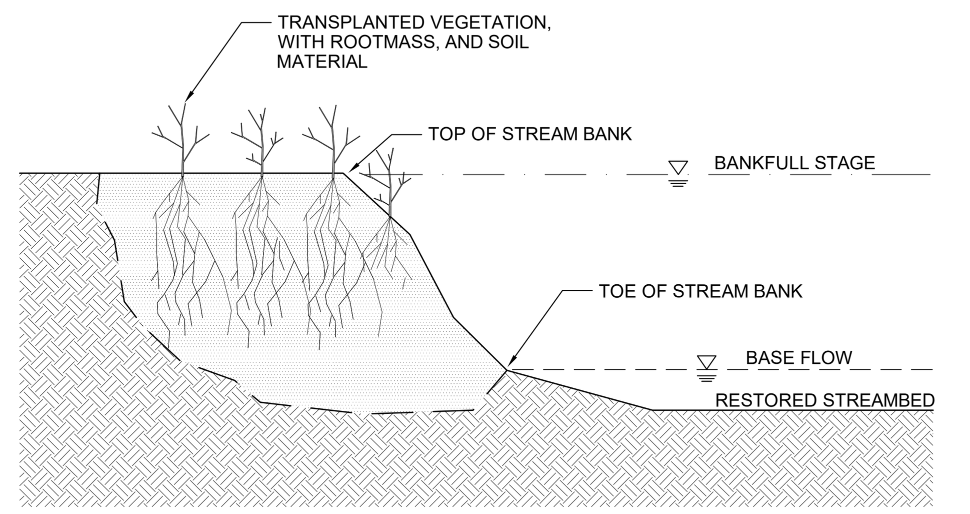
PROJECT NAME
COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME
DETAILS

SHEET NO.
21



PLAN VIEW OF STREAM BANK



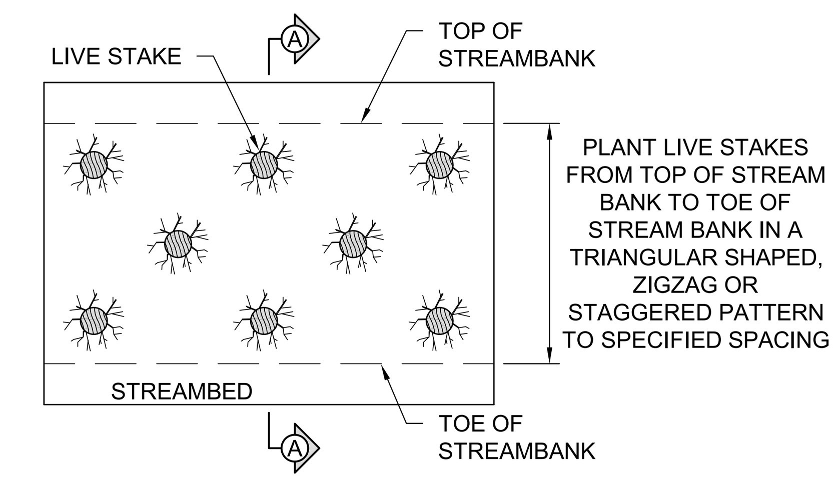
SECTION A-A

NOTES:

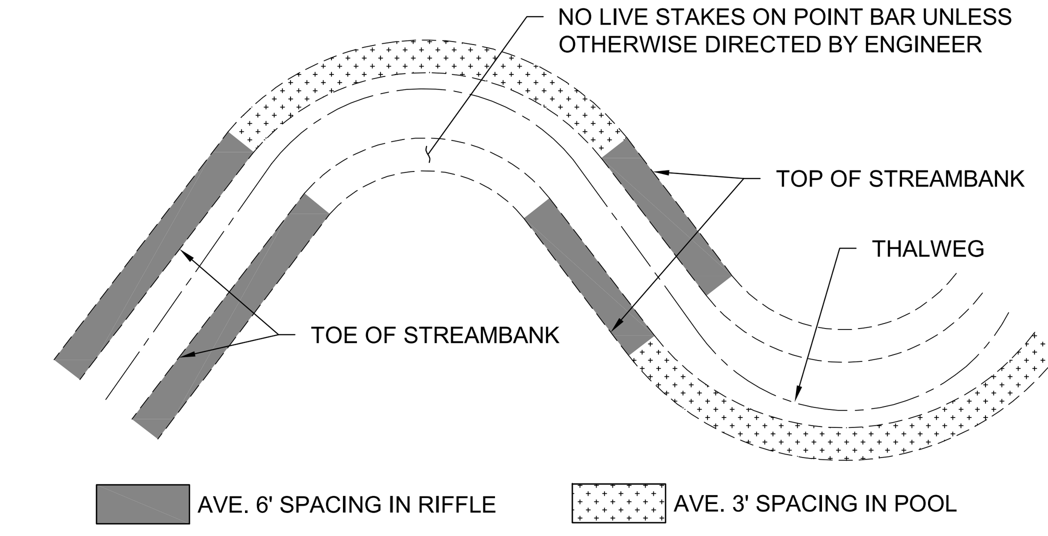
1. EXCAVATE A HOLE IN THE RESTORED STREAM BANK THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLANTED. BEGIN EXCAVATION AT TOE OF THE STREAM BANK.
2. EXCAVATE THE ENTIRE TRANSPLANT ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED AT ONCE, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLANT TRANSPLANT IN THE RESTORED STREAM BANK SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES OR VOIDS AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. WHEN POSSIBLE, PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEIR ROOT MASSES CONTACT.

VEGETATION TRANSPLANTS

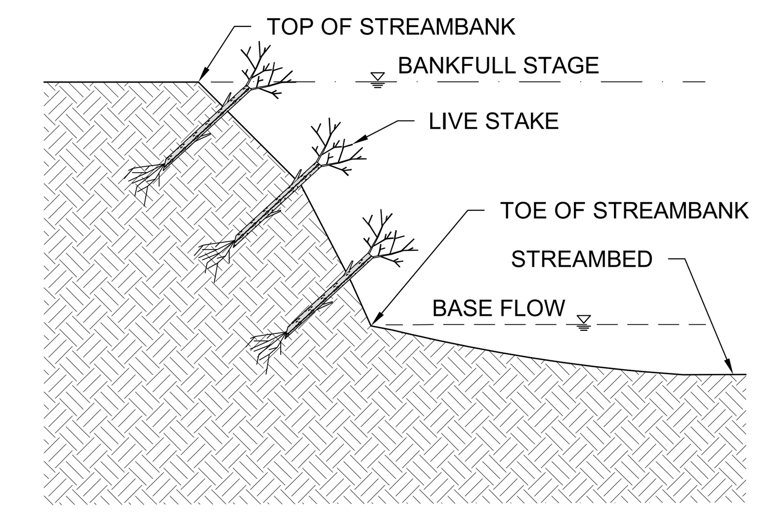
NOT TO SCALE



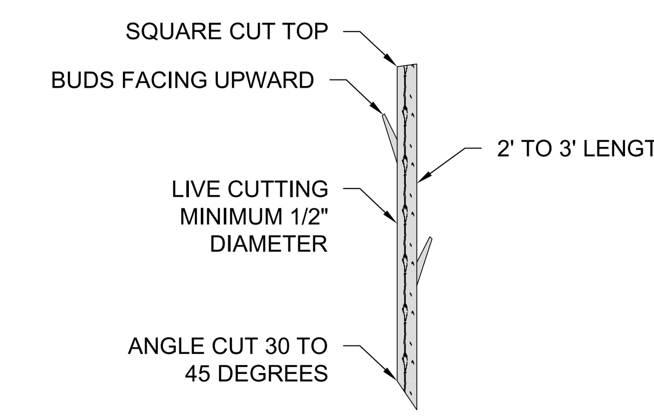
PLAN VIEW OF STREAM BANK



LIVE STAKE SPACING PLAN VIEW



SECTION A-A



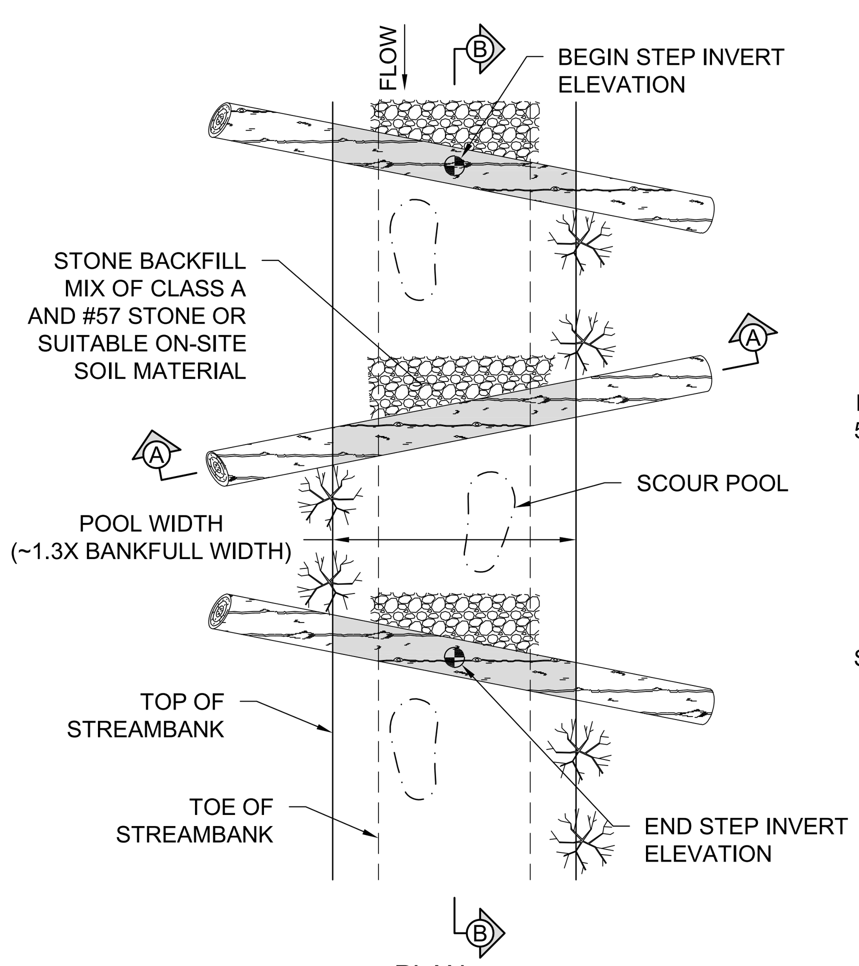
LIVE STAKE DETAIL

NOTES:

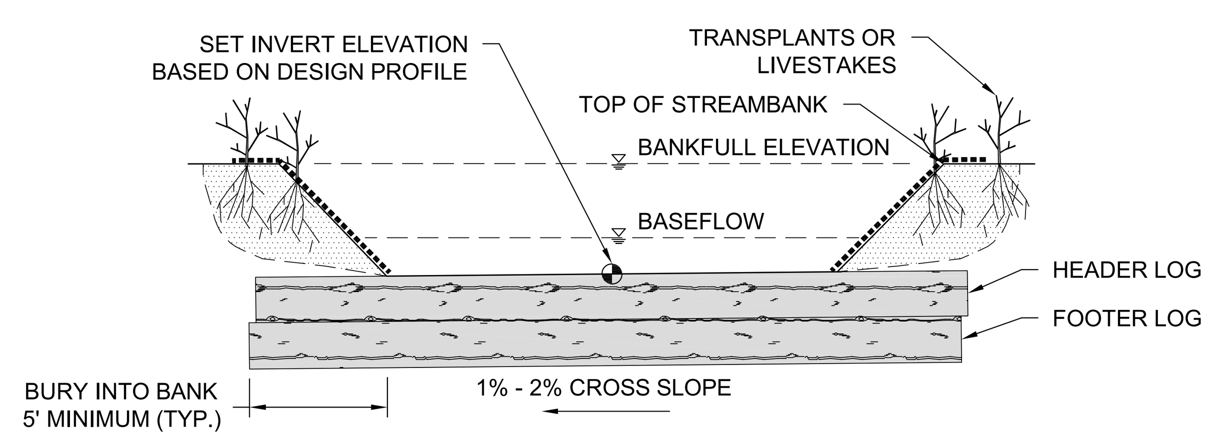
1. LIVE STAKES SHOULD BE HARVESTED IN DORMANT SEASON AND KEPT COOL AND MOIST PRIOR TO INSTALLATION.
2. DO NOT INSTALL LIVE STAKES THAT HAVE BEEN SPLIT.
3. LIVE STAKES SHOULD BE INSTALLED WITH AT LEAST TWO BUDS POINTING UPWARDS ABOVE GROUND.
4. LIVE STAKES SHOULD BE INSTALLED 90 DEGREES PERPENDICULAR TO STREAMBANK .
5. LIVE STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FEET LONG.
6. LIVE STAKES SHOULD BE INSTALLED LEAVING 1/5 OF THE LENGTH OF THE LIVE STAKE ABOVE GROUND.
7. DO NOT INSTALL LIVE STAKES ON POINT BARS INSIDE MEANDER BENDS UNLESS OTHERWISE DIRECTED BY ENGINEER.

LIVE STAKING

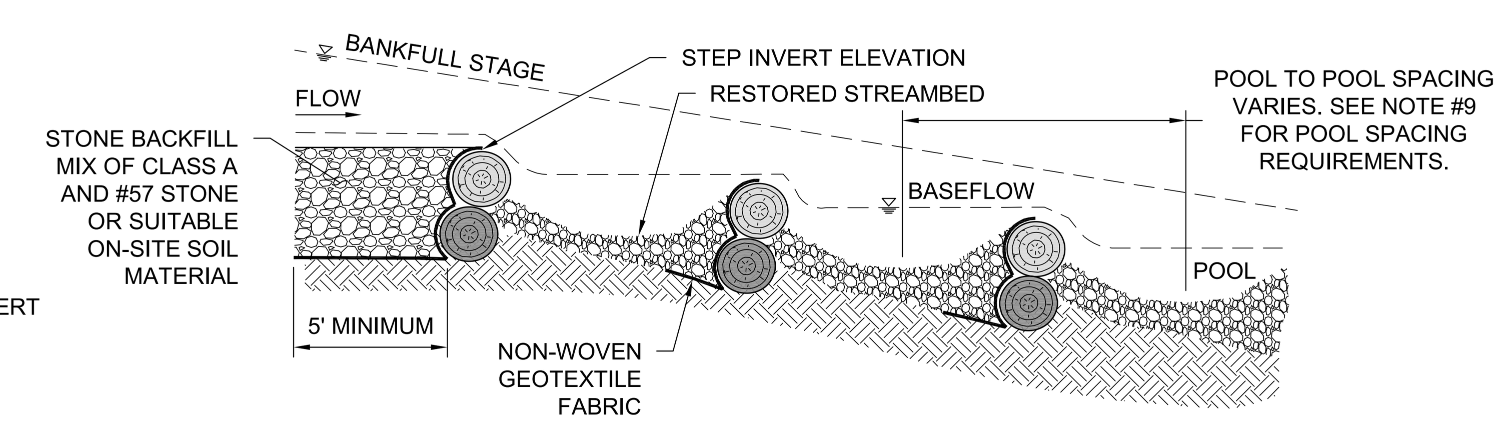
NOT TO SCALE



PLAN



SECTION A-A



SECTION B-B

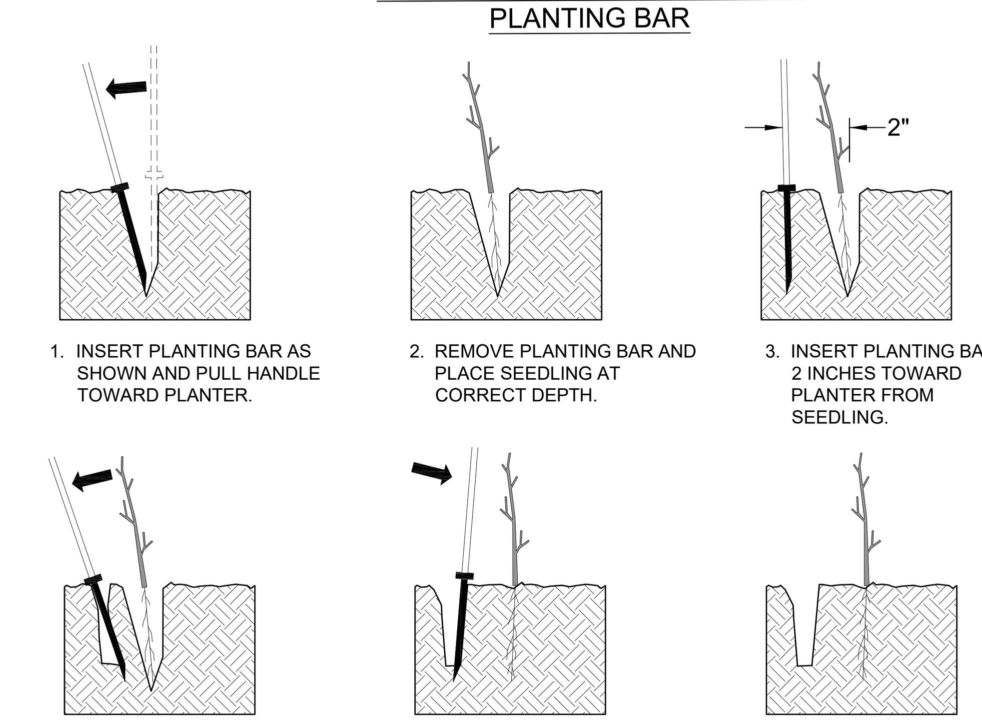
NOTES:

1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG. LOGS SHOULD EXTEND INTO THE BANKS 5' ON EACH SIDE.
3. SOIL SHALL BE WELL COMPACTED AROUND BURIED PORTION OF FOOTER LOGS WITH BUCKET OF TRACK HOE.
4. INSTALL NON-WOVEN GEOTEXTILE FABRIC UNDERNEATH LOGS.
5. UNDERCUT POOL BED ELEVATION 8 INCHES TO ALLOW FOR LAYER OF STONE. INSTALL STONE BACKFILL OR SUITABLE ALLUVIUM ALONG SIDE SLOPES.
6. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
7. INSTALL STONE BACKFILL OR SUITABLE SOIL MATERIAL ALONG SIDE SLOPES.
8. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, COMPACTED, AND CONCAVE, WITH THE ELEVATION OF THE BED APPROXIMATELY 0.5 FT DEEPER IN THE CENTER THAN AT THE EDGES.
9. AVERAGE POOL TO POOL SPACING SHALL BE SHOWN ON THE PROFILE OR SPECIFIED BY ENGINEER BASED ON EXISTING CONDITIONS SUCH AS SLOPE AND SUITABLE FILL MATERIAL. RIFFLE STEP POOLS OR CASCADE POOLS MAY BE SUBSTITUTED IN AREAS WHERE EXISTING SLOPES EXCEED 10% AS DETERMINED BY THE ENGINEER.
10. INTERIOR LOGS SHOULD BE AT A SLIGHT ANGLE (~70 DEGREES) FROM THE STREAMBANK AND CROSS SLOPES SHOULD BE 1-2%.
11. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG AT A MAXIMUM OF 3 INCHES ABOVE THE INVERT ELEVATION.
12. AVERAGE STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.5 UNLESS SHOWN OTHERWISE.
13. THE NUMBER OF STEPS MAY VARY BETWEEN BEGINNING AND END STATIONING. SEE LONGITUDINAL PROFILE FOR STATION AND ELEVATION.
14. USE GEOTEXTILE FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
15. PLACE VEGETATION TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.
16. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.

LOG STEP POOL

NOT TO SCALE

PLANTING METHOD USING THE PLANTING BAR



1. INSERT PLANTING BAR AS SHOWN AND PULL HANDLE TOWARD PLANTER.
2. REMOVE PLANTING BAR AND PLACE SEEDLING AT CORRECT DEPTH.
3. INSERT PLANTING BAR 2 INCHES TOWARD PLANTER FROM SEEDLING.
4. PULL HANDLE OF BAR TOWARD PLANTER, FIRMING SOIL AT BOTTOM.
5. PUSH HANDLE FORWARD FIRMING SOIL AT TOP.
6. LEAVE COMPACTION HOLE OPEN. WATER THOROUGHLY.

NOTES:

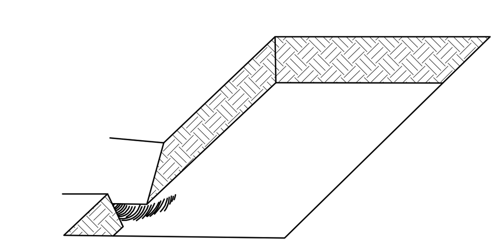
1. PLANT BARE ROOT VEGETATION TO THE WIDTH OF THE BUFFER/PLANTING ZONE AS SHOWN ON THE PLANS.
2. ALLOW FOR 8-15 FEET SPACING BETWEEN PLANTINGS, AS DEFINED IN THE TECHNICAL SPECIFICATIONS.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO THE PROJECT SITE.
8. DURING PLANTING, SEEDLINGS SHALL BE KEPT IN A MOIST CANVAS BAG OR SIMILAR CONTAINER TO PREVENT ROOT SYSTEMS FROM DYING.
9. PLANTING BAR SHALL HAVE A BLADE WITH A TRIANGULAR CROSS SECTION AND SHALL BE 12 INCHES LONG, 4 INCHES WIDE AND 1 INCH THICK AT CENTER.
10. ALL SEEDLINGS SHALL BE PRUNED IF NECESSARY, SO THAT NO ROOTS EXTEND MORE THAN 10 INCHES BELOW THE ROOT COLLAR.

PLANTING BAG

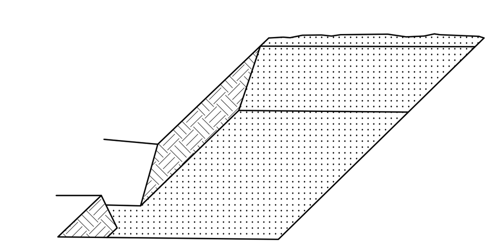
PLANTING BAR

HEALING IN

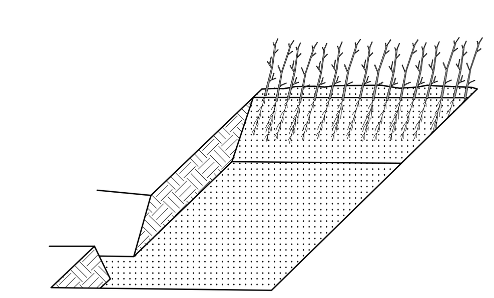
1. LOCATE A HEALING-IN SITE IN A SHADY, WELL PROTECTED AREA.
2. EXCAVATE A FLAT BOTTOM TRENCH 12 INCHES DEEP AND PROVIDE DRAINAGE.



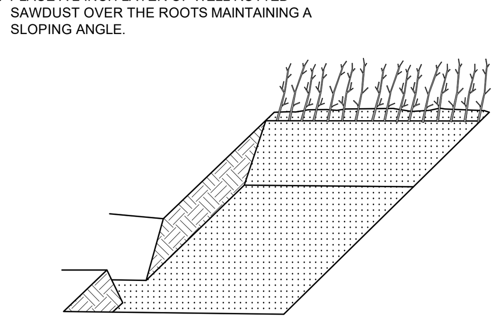
3. BACKFILL TRENCH WITH 2 INCHES WELL ROTTED SAWDUST. PLACE A 2 INCH LAYER OF WELL ROTTED SAWDUST AT A SLOPING ANGLE AT ONE END OF THE TRENCH.



4. PLACE A SINGLE LAYER OF PLANTS AGAINST SLOPING END SO THAT THE ROOT COLLAR IS AT GROUND LEVEL.



5. PLACE A 2 INCH LAYER OF WELL ROTTED SAWDUST OVER THE ROOTS MAINTAINING A SLOPING ANGLE.



6. REPEAT LAYERS OF PLANTS AND SAWDUST AS NECESSARY AND WATER THOROUGHLY.

BARE ROOT PLANTING DETAIL

NOT TO SCALE

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER TOMSIC

WATER & LAND SOLUTIONS
7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919) 614-5111
waterlandsolutions.com

ENGINEERING SERVICES PROVIDED BY
WLS ENGINEERING PLLC
6 DULA SPRINGS RD., WEAVERVILLE, NC 28787
FIRM LICENSE NO. P-1480

REVISIONS

NO.	DESCRIPTION	DATE
1	DRAFT MIT PLAN	8-4-23
2	FINAL DRAFT MIT PLAN	10-19-23
3	FINAL MIT PLAN	2-6-24

DRAWING INFO

DESIGNED BY:	KMV
DRAWN BY:	APL
APPROVED BY:	CAT
SCALE:	AS NOTED
DATE:	2-6-24
PROJECT NO.:	23-002

PROJECT NAME

COW TAIL MITIGATION PROJECT
COLUMBUS COUNTY, NORTH CAROLINA

SHEET NAME

DETAILS

SHEET NO.

22

FILENAME: 20-24_COWTAIL_DETAILS.DWG

Appendix 2 – Site Analysis Data/Supplementary Information

Pre-Construction Gauge Data

Vegetation Survey

Hydric Soils Report

Existing Cross-Sections

Coastal Plain Regional Curve Comparison

USGS Regression Flow and Discharge Analysis

Design Criteria Stream Morphology Parameters

Coastal Plain Headwater Channel Form Comparison

Lateral Effect Summary and Water Budget Simulation

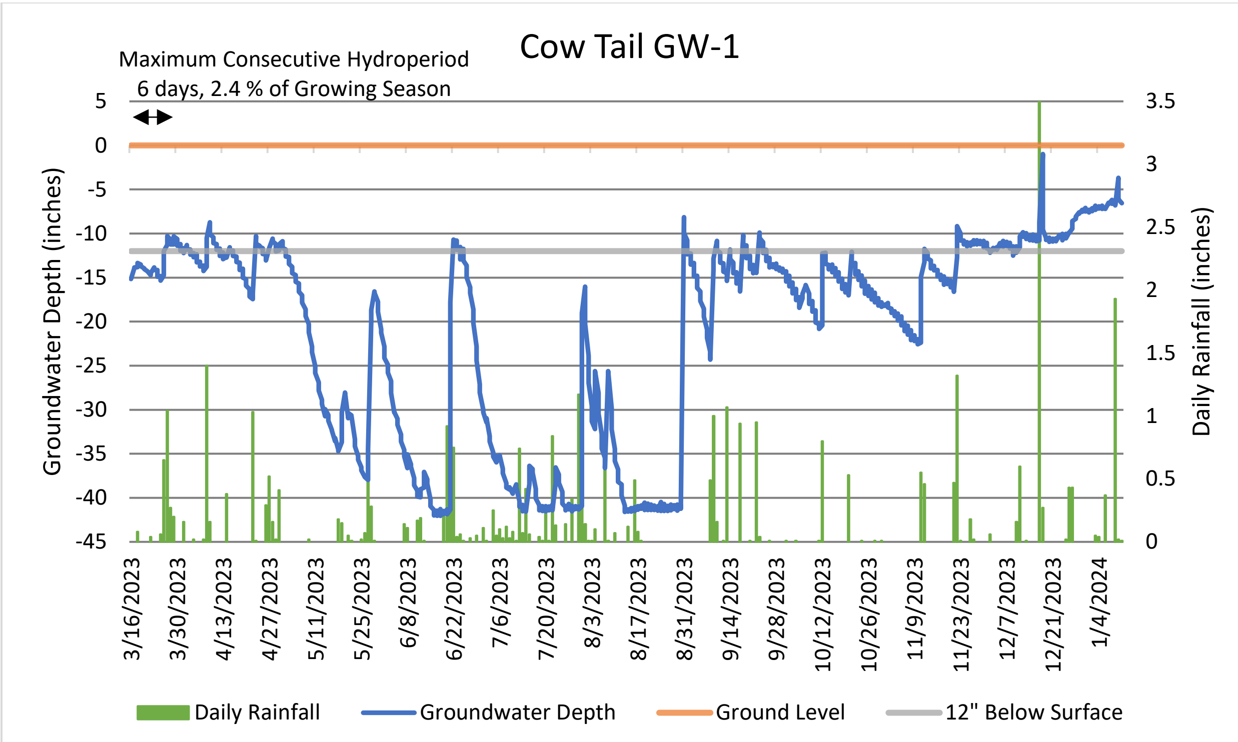
Sediment Transport Analysis

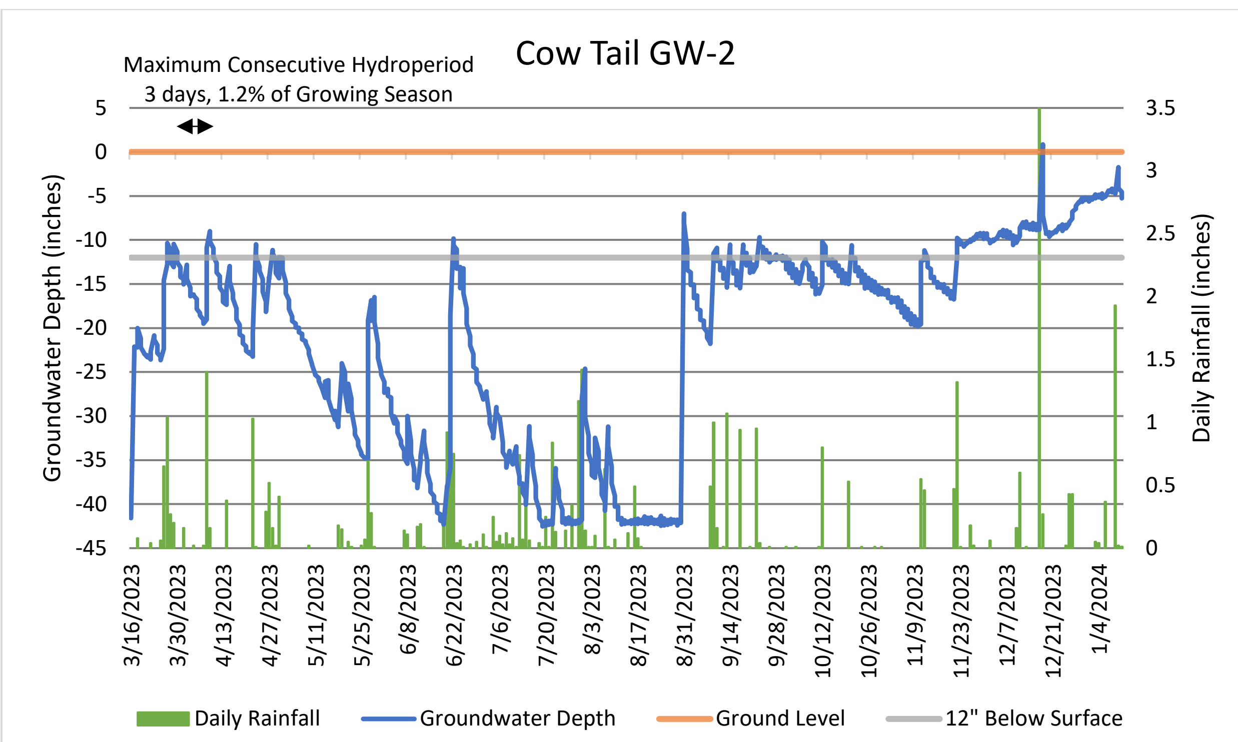
Culvert Analysis

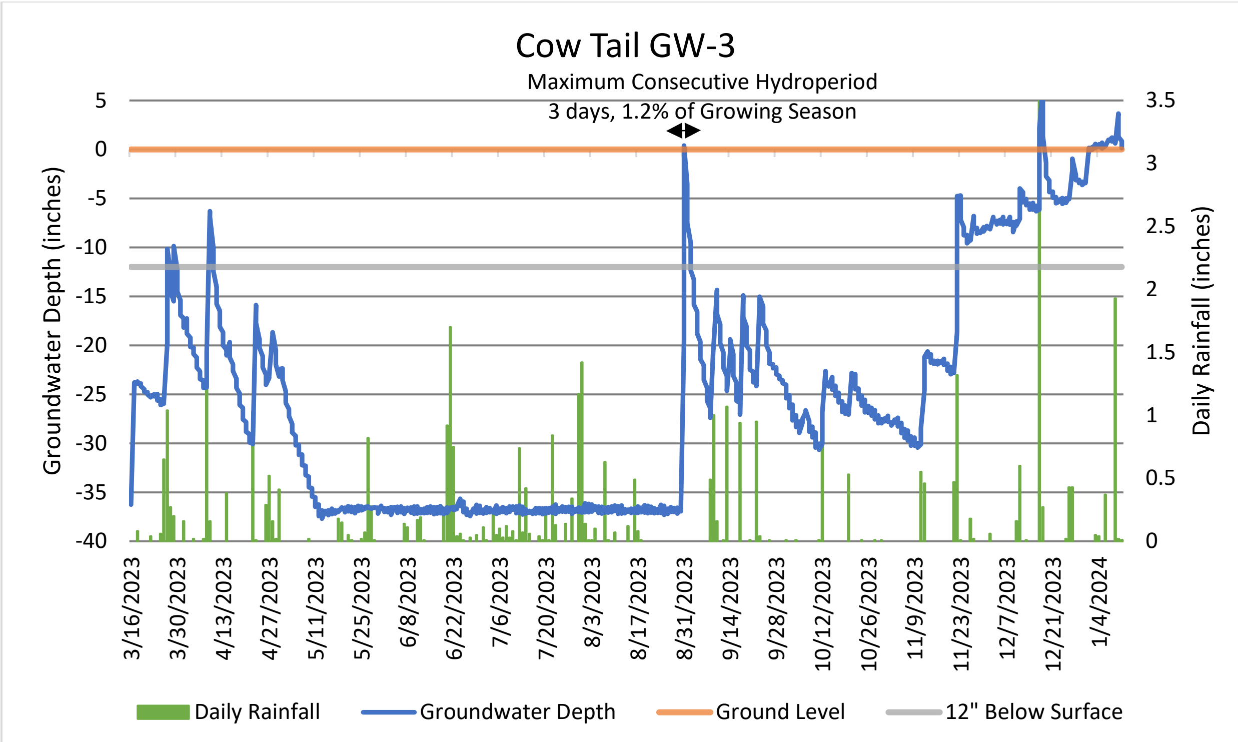
Flood Model Analysis

Site Photographs

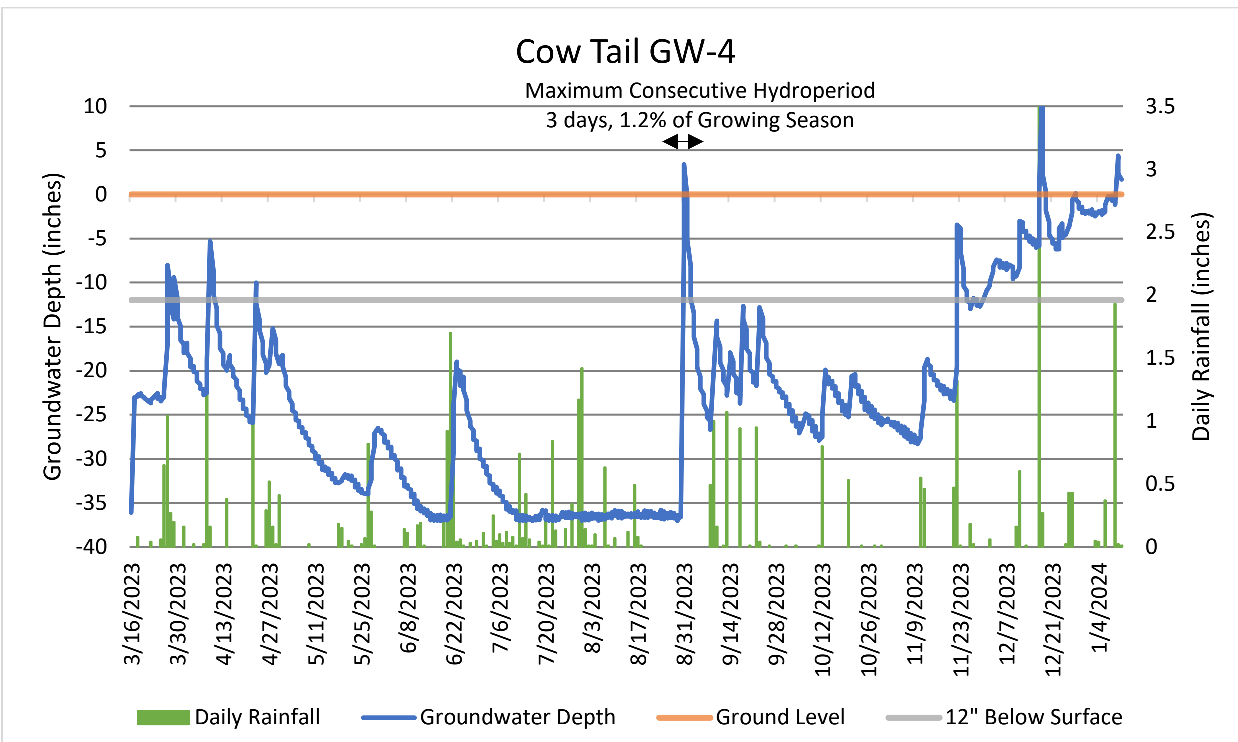
Groundwater Gauge



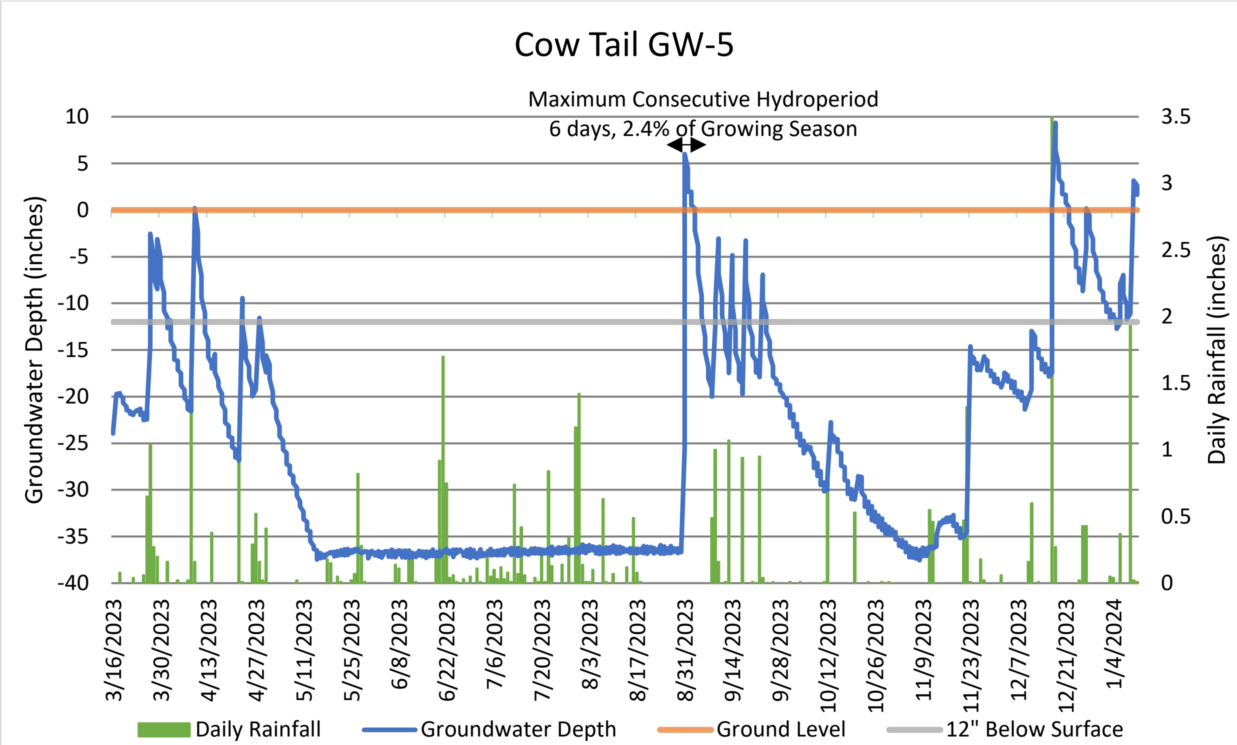




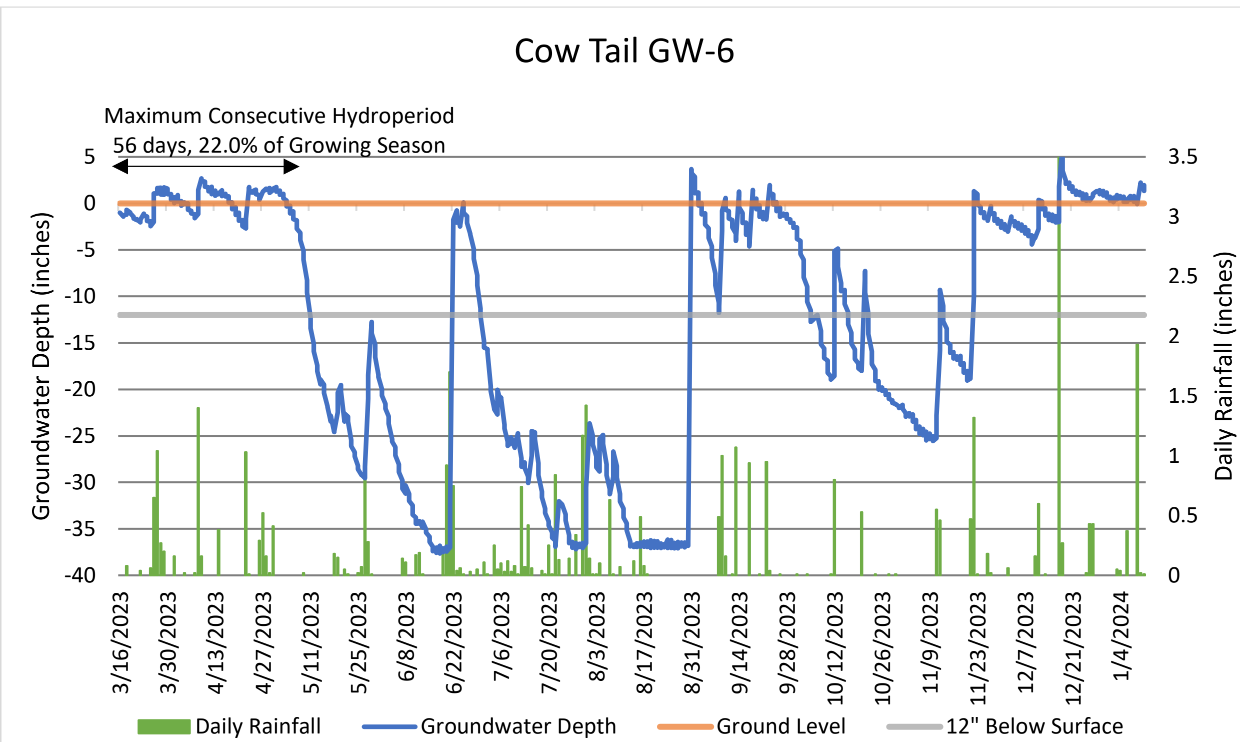
Cow Tail GW-3
Maximum Consecutive Hydroperiod
3 days, 1.2% of Growing Season
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
3/16/2023
3/30/2023
4/13/2023
4/27/2023
5/11/2023
5/25/2023
6/8/2023
6/22/2023
7/6/2023
7/20/2023
8/3/2023
8/17/2023
8/31/2023
9/14/2023
9/28/2023
10/12/2023
10/26/2023
11/9/2023
11/23/2023
12/7/2023
12/21/2023
1/4/2024
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface



Cow Tail GW-4
Maximum Consecutive Hydroperiod
3 days, 1.2% of Growing Season
Groundwater Depth (inches)
Daily Rainfall (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
3/16/2023
3/30/2023
4/13/2023
4/27/2023
5/11/2023
5/25/2023
6/8/2023
6/22/2023
7/6/2023
7/20/2023
8/3/2023
8/17/2023
8/31/2023
9/14/2023
9/28/2023
10/12/2023
10/26/2023
11/9/2023
11/23/2023
12/7/2023
12/21/2023
1/4/2024
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface

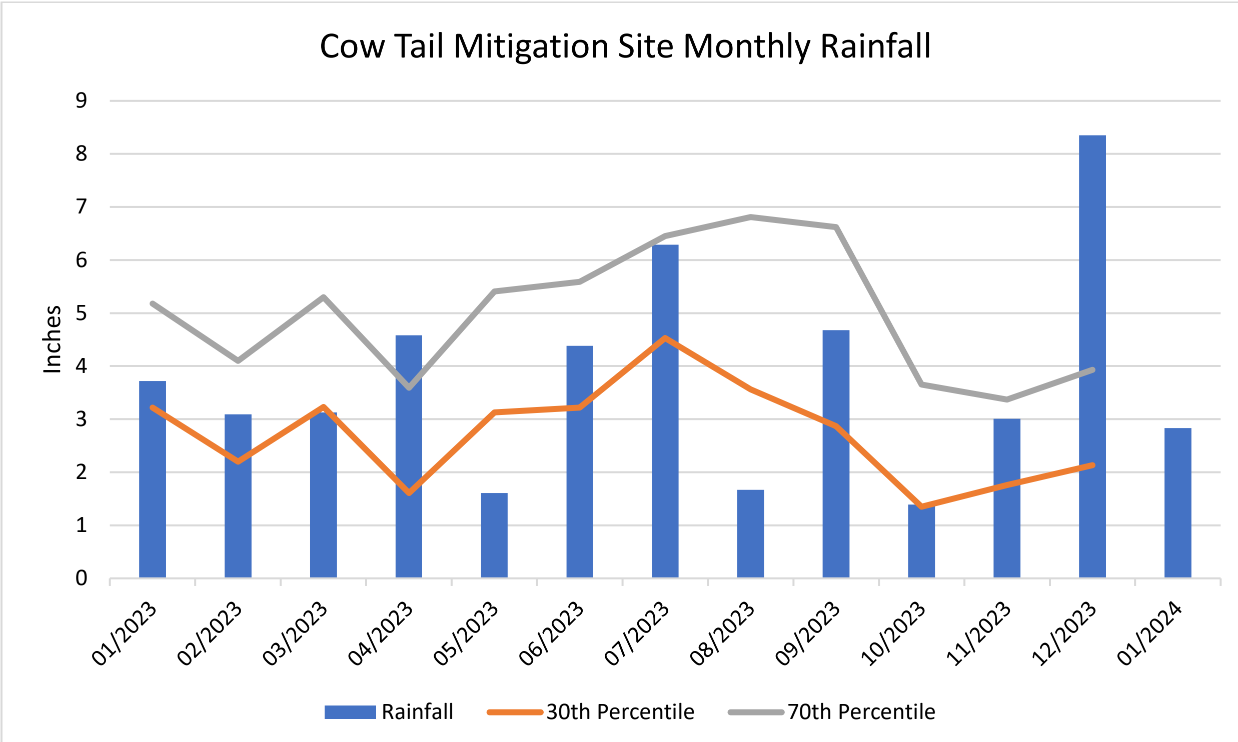


Cow Tail GW-5
Maximum Consecutive Hydroperiod
6 days, 2.4% of Growing Season
Groundwater Depth (inches)
Daily Rainfall (inches)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
3/16/2023
3/30/2023
4/13/2023
4/27/2023
5/11/2023
5/25/2023
6/8/2023
6/22/2023
7/6/2023
7/20/2023
8/3/2023
8/17/2023
8/31/2023
9/14/2023
9/28/2023
10/12/2023
10/26/2023
11/9/2023
11/23/2023
12/7/2023
12/21/2023
1/4/2024
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface

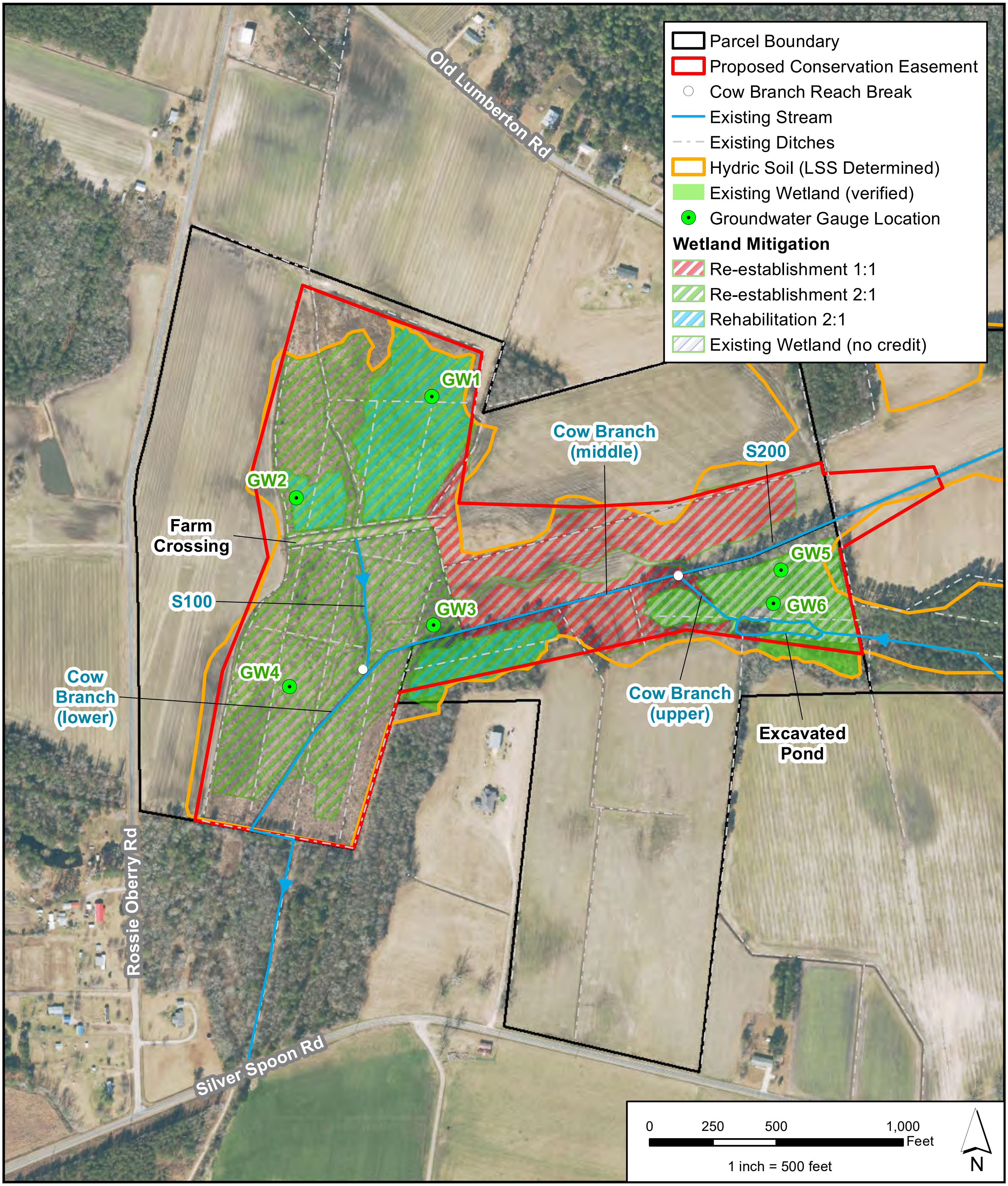


Cow Tail GW-6
Maximum Consecutive Hydroperiod
56 days, 22.0% of Growing Season
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
3/16/2023
3/30/2023
4/13/2023
4/27/2023
5/11/2023
5/25/2023
6/8/2023
6/22/2023
7/6/2023
7/20/2023
8/3/2023
8/17/2023
8/31/2023
9/14/2023
9/28/2023
10/12/2023
10/26/2023
11/9/2023
11/23/2023
12/7/2023
12/21/2023
1/4/2024
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface

Rainfall Data



*Incomplete data for 01/2024



WATER & LAND™ SOLUTIONS	**Cow Tail Mitigation Project** Lumber 03040203 Columbus County, NC	Groundwater Gauge Locations	Figure **GW**
	Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet	**Date:** 1/24/2024	

Data sources - Stream and wetland data collected during preliminary assessment. Imagery data source: NC One Map

Vegetation Survey Methodology

The vegetation survey areas (VSA) consisted of vegetation plots in five areas that were representative of the vegetation on site with four plots being in W01 and the fifth as a reference plot. Vegetation sampling at Cow Tail Mitigation Site occurred on May 30, 2023. Sample plots were accomplished using a 30-ft radius for the canopy, midstory, and saplings/shrubs layers and a 10-ft radius for herbaceous cover, using guidance from the USACE Regional Supplement Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Version. Absolute percent cover for each documented species per strata was estimated within the survey area. Vegetation surveys were completed in these areas in response to IRT comments received during the post contract site visit on February 22, 2023.

Vegetation strata are defined as follows:

1. *Canopy stratum* – Woody plants, excluding vines, approximately 20 ft or more in height and 3 in. or larger DBH.
2. *Midstory stratum* – Consists of woody plants, excluding vines, approximately 10 ft or more in height and less than 3 in. DBH.
3. *Sapling/Shrub stratum* – Consists of woody plants, excluding vines, approximately 3-20 ft in height.
4. *Herbaceous stratum* – Consists of all herbaceous (non-woody) plants, including vines, less than 3 ft in height.

Vegetation Survey Area 1 (Reference) S200/Cow Branch				
	Common Name	Scientific Name	Wetland Status	Percent Cover
Canopy 30' radius	Red Maple	*Acer rubrum*	FAC	10%
	Water Oak	*Quercus nigra*	FAC	5%
	Sweetgum	*Liquidambar styraciflua*	FAC	10%
Saplings and Shrubs 30' radius	Sweetbay Magnolia	*Magnolia virginiana*	FACW	10%
	Loblolly Pine	*Pinus taeda*	FAC	7%
	Sweetgum	*Liquidambar styraciflua*	FAC	5%
	Red Maple	*Acer rubrum*	FAC	10%
	Swamp Titi	*Cyrilla racemiflora*	FACW	3%
	Wax Myrtle	*Myrica cerifera*	FAC	5%
	American Holly	*Ilex opaca*	FAC	5%
	Tag Alder	*Alnus serrulata*	FACW	3%
	Water Oak	*Quercus nigra*	FAC	5%
Herbaceous 10' radius	Cinnamon Fern	*Osmundastrum cinnamomeum*	FACW	5%
	Netted Chain Fern	*Woodwardia areolata*	OBL	10%
	Trumpet Vine	*Campsis radicans*	FAC	2%
	Roundleaf Greenbrier	*Smilax rotundifolia*	FAC	5%

Total Percent Cover in VSA-1	
Canopy Layer	25%
Shrub/Sapling Layer	53%
Herbaceous Layer	22%

Vegetation Survey Area 2 (W01) South of Cow Branch				
	Common Name	Scientific Name	Wetland Status	Percent Cover
Canopy 30' radius	Loblolly Pine	*Pinus taeda*	FAC	10%
	Tulip Poplar	*Liriodendron tulipifera*	FACU	15%
Midstory 30' radius	Sweetgum	*Liquidambar styraciflua*	FAC	5%
	Red Maple	*Acer rubrum*	FAC	5%
	Sweetbay Magnolia	*Magnolia virginiana*	FACW	5%
Saplings and Shrubs 30' radius	Water Oak	*Quercus nigra*	FAC	5%
	Sweetgum	*Liquidambar styraciflua*	FAC	5%
	Loblolly Pine	*Pinus taeda*	FAC	5%
	Swamp Titi	*Cyrilla racemiflora*	FACW	5%
Herbaceous 10' radius	Giant Cane	*Arundinaria gigantea*	FACW	3%
	Netted Chain Fern	*Woodwardia areolata*	OBL	10%
	Southern Lady Fern	*Athyrium asplenioides*	FAC	15%
	Cinnamon Fern	*Osmundastrum cinnamomeum*	FACW	5%
	Roundleaf Greenbrier	*Smilax rotundifolia*	FAC	5%
	Japanese Honeysuckle	*Lonicera japonica*	FACU	2%

Total Percent Cover in VSA-2	
Canopy Layer	25%
Midstory Layer	15%
Shrub/Sapling Layer	20%
Herbaceous Layer	40%

Vegetation Survey Area 3 (W01) Cow Branch (middle)				
	Common Name	Scientific Name	Wetland Status	Percent Cover
Canopy 30' radius	Loblolly Pine	*Pinus taeda*	FAC	8%
	Red Maple	*Acer rubrum*	FAC	8%
Midstory 30' radius	Chinese Privet	*Ligustrum sinense*	FAC	15%
	Red Maple	*Acer rubrum*	FAC	5%
	Wax Myrtle	*Myrica cerifera*	FAC	2%
Saplings and Shrubs 30' radius	Water Oak	*Quercus nigra*	FAC	5%
	Sweetbay Magnolia	*Magnolia virginiana*	FACW	7%
	Sweetgum	*Liquidambar styraciflua*	FAC	25%
	Loblolly Pine	*Pinus taeda*	FAC	5%
	Swamp Titi	*Cyrilla racemiflora*	FACW	5%
Herbaceous 10' radius	Dog Fennel	*Eupatorium capillifolium*	FACU	3%
	Giant Cane	*Arundinaria gigantea*	FACW	2%
	Cinnamon Fern	*Osmundastrum cinnamomeum*	FACW	4%
	Trumpet Vine	*Campsis radicans*	FAC	2%
	Muscadine	*Vitis rotundifolia*	FAC	2%
	Japanese Honeysuckle	*Lonicera japonica*	FACU	2%

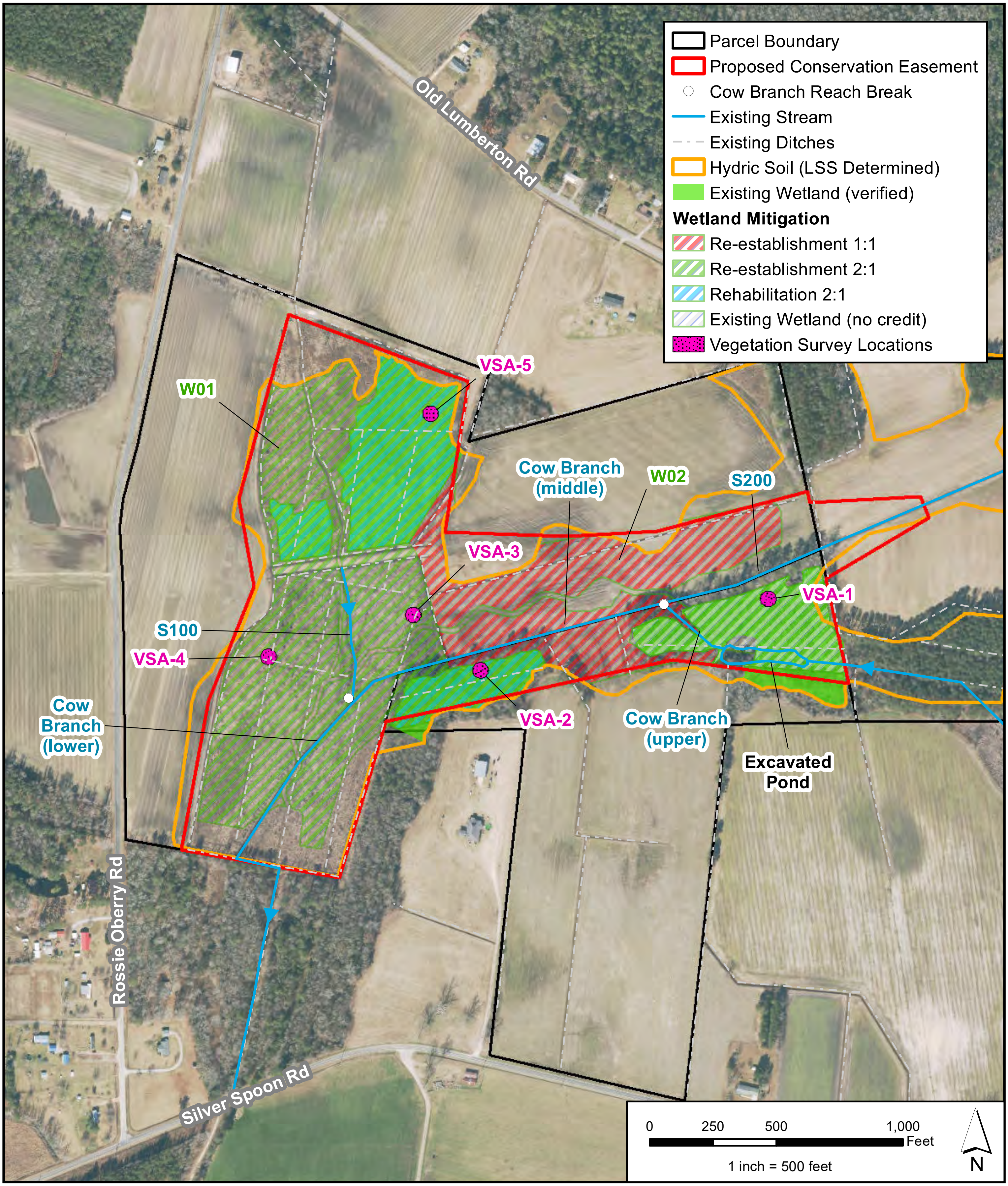
Total Percent Cover in VSA-3	
Canopy Layer	16%
Midstory Layer	22%
Shrub/Sapling Layer	47%
Herbaceous Layer	15%

Vegetation Survey Area 4 (W01/S100) S100				
	Common Name	**Scientific Name**	**Wetland Status**	**Percent Cover**
Canopy 30' radius	Loblolly Pine	*Pinus taeda*	FAC	4%
	Red Maple	*Acer rubrum*	FAC	3%
Midstory 30' radius	Chinese Privet	*Ligustrum sinense*	FAC	8%
	Red Maple	*Acer rubrum*	FAC	5%
	Loblolly Pine	*Pinus taeda*	FAC	10%
Saplings and Shrubs 30' radius	Sweetbay Magnolia	*Magnolia virginiana*	FACW	5%
	Sweetgum	*Liquidambar styraciflua*	FACW	15%
	Loblolly Pine	*Pinus taeda*	FAC	10%
	Swamp Titi	*Cyrilla racemiflora*	FACW	5%
	Wax Myrtle	*Myrica cerifera*	FAC	2%
Herbaceous 10' radius	Black Elderberry	*Sambucus nigra*	FACW	2%
	Dog Fennel	*Eupatorium capillifolium*	FACU	3%
	Wax Myrtle	*Myrica cerifera*	FAC	2%
	Cinnamon Fern	*Osmundastrum cinnamomeum*	FACW	2%
	Muscadine	*Vitis rotundifolia*	FAC	2%
	Japanese Honeysuckle	*Lonicera japonica*	FACU	2%
	Heller's Rosette Grass	*Dichanthelium oligosanthes*	FACU	5%
	Saw-tooth Blackberry	*Rubus argutus*	FAC	15%

Total Percent Cover in VSA-4	
Canopy Layer	7%
Midstory Layer	23%
Shrub/Sapling Layer	37%
Herbaceous Layer	33%

Vegetation Survey Area 5 (W01 North) W01				
	Common Name	**Scientific Name**	**Wetland Status**	**Percent Cover**
Canopy 30' radius	Loblolly Pine	*Pinus taeda*	FAC	6%
	Red Maple	*Acer rubrum*	FAC	3%
Midstory 30' radius	Chinese Privet	*Ligustrum sinense*	FAC	3%
	Red Maple	*Acer rubrum*	FAC	10%
	Loblolly Pine	*Pinus taeda*	FAC	15%
Saplings and Shrubs 30' radius	Sweetbay Magnolia	*Magnolia virginiana*	FACW	5%
	Sweetgum	*Liquidambar styraciflua*	FAC	25%
	Loblolly Pine	*Pinus taeda*	FAC	10%
	Swamp Titi	*Cyrilla racemiflora*	FACW	5%
Herbaceous 10' radius	Black Elderberry	*Sambucus nigra*	FACW	2%
	Dog Fennel	*Eupatorium capillifolium*	FACU	3%
	Wax Myrtle	*Myrica cerifera*	FAC	2%
	Cinnamon Fern	*Osmundastrum cinnamomeum*	FACW	2%
	Muscadine	*Vitis rotundifolia*	FAC	2%
	Japanese Honeysuckle	*Lonicera japonica*	FACU	2%
	Saw-tooth Blackberry	*Rubus argutus*	FAC	5%

Total Percent Cover in VSA-5	
Canopy Layer	9%
Midstory Layer	28%
Shrub/Sapling Layer	45%
Herbaceous Layer	18%



WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

Vegetation Survey Map

Figure **VS**

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 1/24/2024

Data sources - Stream and wetland data collected during preliminary assessment. Imagery data source: NC One Map

VSA-1 representative view

VSA-2 representative view

VSA-3 representative view

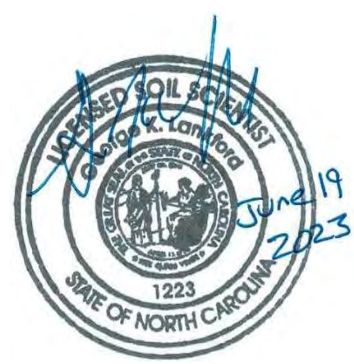
VSA-4 representative view

VSA-5 representative view

FINAL
Detailed Hydric Soils Study
Cow Tail Mitigation Project
Columbus County NC

Prepared for:
    Cara Conder
    Water & Land Solutions
    7721 Six Forks Rd., Suite 130
    Raleigh, NC 27615

Prepared by:
    George K Lankford Soil Scientist, LSS #1223
    George K Lankford, LLC
    238 Shady Grove Rd
    Pittsboro, NC 27312



June 2023 | Soil Scientist Seal

This report describes the results of the soil evaluation performed at the Cow Tail Mitigation Project in Columbus County, NC. Any subsequent transfer of the report by the user shall be made by transferring the complete report, including figures, maps, appendices, all attachments, and disclaimers.

Study Objectives and Scope

The purpose of the study was to evaluate the site soils and delineate the extent of riparian hydric soils potentially suitable for hydrologic restoration and mitigation. Potential for hydrologic restoration is evaluated considering both historic and existing land uses, current management, modifications of hydrology and soils, and an assessment for establishing a hydroperiod suitable for its landscape setting and soils. This evaluation focuses on the use of practical technical solutions to support re-establishment and enhancement of a natural hydrology at this site. The potential for restoration assumes the ability to develop an appropriate design and capability to construct site modifications necessary to restore adequate hydrology.

Practical modifications may include, but are not limited to reversal of drainage modifications such as plugging drainage ditches, removal of fill materials, roughening surfaces, and creation/enhancement of existing depressions. Recommendation for re-establishment and rehabilitation of wetland follows the Principles of Wetland Restoration (USEPA 2000) that promote successful development of a functioning wetland community by restoring ecological integrity by re-establishment of natural structure and function.

Based upon the three criteria for defining wetlands, hydrology, soils, and vegetation, this report focuses on soils and their potential for supporting hydrology and vegetation. A detailed field investigation of soils for the purpose of confirming the presence of and delineating the extent of hydric soil for the suitability for wetland mitigation was conducted at the Cow Tail site. This report describes these findings, conclusions, and recommendations for wetland re-establishment at the Cow Tail site. The observations and opinions stated in this report reflect conditions apparent on the subject property at the time of the site evaluation. My findings, opinions, conclusions, and recommendations are based on professional experience, observed soil morphology, landscape position, drainage patterns, site conditions, and boundaries of the property as evident in the field.

Project Information and Background

The site is in Columbus County approximately 3 miles northeast of Evergreen, NC and east of Rossie Oberry Road (SR 1529). The project area evaluated is approximately 65 acres on the floodplain of Cow Branch (Figure 1). Land use of the contributing watershed community is rural, consisting of agricultural farmland and undeveloped forest land (Figure 2). A site soil evaluation such as described within this report is necessary to determine soil characteristics relevant to the success of the desired land use. The site evaluation and hydric soil delineation included both drained hydric soils and jurisdictional wetlands within the project boundary. At the time of this report the jurisdictional wetland boundaries are awaiting Army Corps of Engineers concurrence.

NRCS Soil Mapping

The NRCS Soil Survey provides county level data that can be used in general planning for farms and larger areas (NRCS). The soil survey provides maps showing soil map units and gives a brief description for each of the major soil types along with their characteristics. Soil mapping units identify areas of soil having similarly defined soil properties and physical characteristics with similar management criteria based upon these properties. Due to mapping scale, these soil map units cannot completely describe a map unit, but provide general information related to management and potential use limitations. Each unit describes a range of soils characteristics that may be found within a landscape or landscape position characteristic of the region. The Soil Survey map units often correlate closely with soils observed at a location, but have limitations because soils represent the natural conditions and gradients that are influenced by geology, slope, and past land management practices. The properties described provide a useful background for interpreting soil that may be encountered at the site and are the starting point for this soil evaluation.

NRCS Map Units

In Inner Coastal Plain area where this project is located, much of the landscape consists of wide ridges interstream divide of nearly level topography and narrow to broad flat stream drainages. These nearly level landscapes are naturally poorly drained. The transition between these two landscapes typically consists of short side slopes that and have moderately well to well drained soils. The NRCS Soil Survey shows three soil map units that characterize soils found within the project limits. Floodplain soils form in material deposited from erosional material derived upland soils of the contributing watershed under varying hydrologic conditions present within the changing landscapes. Higher in the watershed, headwater streams often have less alluvial deposition and are shallow to parent materials. Textures within these soils can vary widely depending on changing depositional patterns and source materials.

At the Cow Tail site, the NRCS soil survey has an extensive map unit of a very poorly drained *Torhunta* (To) on the floodplain and headwaters. Above floodplain are somewhat poorly drained *Stallings* (St) with inclusions of poorly drained *Rains* (Ra) and poorly drained *Woodington*. On steeper and longer side slopes are well drained *Norfolk* (No) and *Butters* (Bu) soils that transition to the broad interstream divides where very poorly drained *Pantego* (Pa) and poorly drained *Rains* (Ra) soils are present. Surrounding the project are small map units of moderately well drained *Foreston* (FoA) and *Goldsboro* (GoA). In this landscape the headwaters gradually transition onto the interstream divide and due to low gradients, it is difficult to determine where alluvial landscapes end.

Within most map units are potential inclusions of better or poorer drained soils, most likely occurring slopes where sandy textures soils increase drainage or areas of groundwater discharge. Within the project, *Torhunta* and *Pantego* soils are classified as hydric by the NRCS. Better drained soils are not classified as hydric, but may contain hydric inclusions. All soils within the project have a very low runoff potential, but have a moderately high to high ability to transmit water (Ksat), providing the potential for effective drainage by ditching and surface contouring. Mapping units in the area generally follow landscape position with a *Torhunta* in the lowest elevation floodplain and transitions to gently sloping *Stallings*, *Norfolk,* and *Butters* on the sandy well drained side slope and shoulders with *Pantego* and *Rains* on the nearly level interstream divides.

Torhunta

The *Torhunta* map unit is locally mapped on the floodplains and headwater streams as well as in upland bay and depressions. If drained, it is classified as Prime Farmland. This soil has a thick, dark surface underlain by depleted, grayish subsoils. Surfaces are loamy textures over more sandy textured horizons with redoximorphic mottles. An uncultivated location often has a mucky surface. They are very poorly drained soils with the water table within 12 inches of the surface for two to six months annually. Although highly permeable, runoff is slow with very poor natural drainage due to its low positions in the landscape and the nearly level landscape position.

Stallings

The *Stallings* map unit is found on the gentle side slopes above the floodplains and in the headwaters as the landscape transitions up toward the broad interstream divide. Often ditched and cultivated it is classified as Farmland of Statewide Importance. Runoff is very low and the water table ranges from 12 to 30 inches depth. The textures are mostly sandy throughout and permeability is high. Surfaces tend to be more concave, concentrating flow from the broad ridges. Within this unit are inclusions of poorly drained *Woodington* and *Rains*. These poorly drained inclusions have dark surfaces and the water table within 12 inches depth. These soils are found in nearly level to shallow depressions, but can be effectively drained, especially when areas are small and have greater slope.

Pantego

The Pantego map unit occurs on the nearly level to slightly depressional flatwoods of the broad interstream divides. If drained, it is classified as Prime Farmland. Runoff is very low and the water table ranges from 12 to 30 inches depth. The thick, dark surface textures are loamy, often having a mucky surface when undisturbed. It is underlain by a clayey loam. Permeability is moderately high to high. Some areas are subject of rare flooding.

Additional upland soil map units are on the slopes surrounding the project. These soils include well drained *Butters*, *Norfolk*, and moderately well drained *Foreston* and *Goldsboro*. These map units do not occur within the project or of small extent. General characteristics of these mapping units are summarized in Table 1.

Table 1. NRCS Hydric Soil Map Units at the Cow Tail Site

<table>
<tr><th>Series</th><th>Taxonomic Class</th><th>Drainage Class</th><th>Hydric (Hydric Rating)</th><th>Landscape setting (down across)</th></tr>
<tr><td colspan="5">Torhunta fine sandy loam (To) (Consociation) Prime farmland if drained
Parent material - sandy and loamy alluvium and/or fluviomarine deposits
Depth to water table – 0 to 12 inches
Flooding – none Ponding - none</td></tr>
<tr><td>Torhunta (90%)</td><td>Typic Humaquepts</td><td>very poorly</td><td>Yes (A/D)</td><td>linear - linear</td></tr>
<tr><td colspan="5">Pantego fine sandy loam (Pa) (Consociation) Prime farmland if drained
Parent material - loamy marine deposits
Depth to water table – 0 to 12 inches
Flooding – rare Ponding - none</td></tr>
<tr><td>Pantego (90%)</td><td>Umbric Paleaquults</td><td>very poorly</td><td>Yes (B/D)</td><td>linear - concave</td></tr>
<tr><td colspan="5">Stallings sandy loam (St) (Consociation) Farmland of statewide importance
Parent material - loamy and sandy marine deposits
Depth to water table – 12 to 30 inches
Flooding – none Ponding - none</td></tr>
<tr><td>Stallings (90%)</td><td>Aeric Paleaquults</td><td>somewhat poorly</td><td>No (A/D)</td><td>concave - linear</td></tr>
<tr><td>Woodington (5%)</td><td rowspan="2">Typic Paleaquults</td><td rowspan="2">poorly</td><td>Yes (A/D)</td><td>linear - concave</td></tr>
<tr><td>Rains (2%)</td><td>Yes (B/D)</td><td>linear - linear</td></tr>
<tr><td colspan="5">Foreston loamy fine sand (Fo) (Consociation) Farmland of statewide importance
Parent material - loamy and sandy marine deposits
Depth to water table – 24 to 42 inches
Flooding – none Ponding - none</td></tr>
<tr><td>Foreston (80%)</td><td>Aquic Paleudults</td><td>moderately well</td><td>No (B)</td><td>linear - convex</td></tr>
<tr><td>Woodington (5%)</td><td>Typic Paleaquults</td><td>poorly</td><td>Yes (A/D)</td><td>linear - concave</td></tr>
</table>

Source-NRCS Web Soil Survey (2023 06 07)

Project Approach

The approach is to improve the biological functions common to riparian wetland systems and improve downstream water quality. The proposed mitigation is to re-establish and enhance the hydroperiod where drainage conditions have been modified to reduce and remove wetland hydrology in hydric soil. The hydric soils should sustain hydroperiods appropriate for the landscape and existing sources. Soils are evaluated on visible morphologic features, landscape position, and hydric soil indicators indicating the occurrence of historical or current hydroperiods common to wetlands. Past land use and modifications to drainage are considered relative to the current hydroperiods and the practicality of removing modifications to restore wetland hydrology. Potentially suitable sources of hydrology are identified and evaluated for ability to construct and provide adequate hydrology. Where the drainage has resulted in the complete loss of wetland hydroperiods, the area is considered suitable for re-establishment and where the modification has reduced and limits a natural hydroperiod, the mitigation is considered suitable for rehabilitation or enhancement.

Methodology

A detailed hydric soil investigation for the Cow Tail site was completed in April of 2022. A series of approximately 191 soil borings were performed across the site to described and verify the presence and estimate the extent of hydric soil. Additionally, drainage modifications and potential for hydrologic modifications were assessed. The site also contains areas with current wetland hydrology that have been delineated. Within appropriate landscapes the soils were evaluated for potential to support a wetland hydrology. Soil boring descriptions are not intended for classification to an individual soil series, but is generally referenced to the local NRCS Soil Mapping Units.

Evaluation Criteria

Hydric soil indicators were evaluated using observed morphologic characteristics following criteria based on "*Field Indicators of Hydric Soils in the United States*" (USDA, NRCS, 2018, Version 8.2). Hydrology was evaluated utilizing observed morphologic features, potential permeability, potential restrictive horizons, current drainage modifications and professional experience. The presence of hydric soil indicators may not reflective the current hydrology where drainage, surface contouring, and tillage have and altered historic hydrologic condition changed soils morphology. This leads to a potentially relict hydric indicator or the loss of indicators. The morphological interpretation of relict indicators follows Vepraskas (1994). A hydroperiod success criteria is proposed based upon Corps mitigation guidelines (US Army Corps of Engineers 2016) along with specific site conditions where appropriate. Hydric soil indicators used are valid for the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0* within Major Land Resource Area (MLRA) 136 (Southern Piedmont) and Land Resource Region (LRR) P- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Soil boring locations examined were approximately located using the Terrain Navigator Pro smart phone application by Trimble and figures were produced from the same software (Figure 3). All boundaries shown are based on the detailed field delineation. Boundary points were located using EOS Arrow 100Pro, a submeter GNSS (Global Navigation Satellite System). An official concurrence with the Corps of Engineers is being sought to verify wetland boundaries.

Soil Evaluation

Hand auger soil borings were utilized to identify current soil characteristics and determine the extent of soil suitable for re-establishment, rehabilitation, and enhancement. Hydric indicators typically occur within the upper 18 inches, but selected borings extended to greater than 40 inches in depth to evaluate potential deeper drainage or locate restrictive horizons able to perch a water table.

The current hydrologic condition was evaluated by:

- an assessment of the existing drainage modifications (both anthropogenic and natural),
- the visible pattern and presentation of soil color and mottles,
- existing vegetation and vegetation patterns,
- the current water table where observed,
- location within the landscape,
- soil surface shape and slope impacting flow paths

Borings can extend beyond the proposed project boundaries to evaluate the wider range of site conditions.

Soils suitable for wetland re-establishment or rehabilitation typically exhibit one or more hydric indicators. These indicators persist and are considered active where hydrology is present and relict where drainage is effective. Under the loss of suitable hydrologic conditions, redevelopment or maintaining visible hydric indicators is difficult. A relict indicator occurs in areas where the historic hydrology has been altered by drainage modifications and land surface disturbances. Hydric indicators are obscured or lost due to long-term drainage conditions, tillage, and other earth work. General conditions and patterns representative of this landscape were observed. Relevant soil characteristics, land management, and current hydrology were noted and modifications that may affect potential hydrologic restoration were evaluated. Representative profiles are described to document the range of characteristics observed (Appendix A). Selected photographs of soils and the landscape are shown in Appendix B.

This report describes these findings, conclusions, and recommendation for wetland mitigation at the Cow Tail site. The discussion identifies the observed relevant soil characteristics, current hydrology, and land management with observed modifications that may affect potential hydrologic restoration. Constraints on stream restoration may limit the extent of potential hydrologic restoration shown (property boundaries, hydrologic trespass, design limitations, and constructability).

Results and Discussion

Landscape Setting

This project is in the Southeastern Plains physiographic region (ecoregion level III) and in the Atlantic Southern Loam Plains level IV ecoregion (65l) where the landscapes have lower relief and consists of broad, nearly level to gently sloping upland ridges that are dissected by a network of intermittent to perennial steams (USEPA 2003). The soils near drainage way are mostly well drained and moderately well drained. Both the interstream divides and floodplain of streams are somewhat poorly to poorly drained with the wetter areas accumulating organic material. The well drained side slopes often have low organic accumulation due to higher rates of oxidation. The uplands also have numerous Carolina Bays that are wet throughout the year unless artificially drained. Soils within this region are finer textured.

Geology within the project and surrounding area is sedimentary rocks of the Duplin Formation. Soil parent material of this geologic formation consists of medium to coarse-grained sand, sandy marl, and limestone from fluviomarine and marine deposits. Soil of the project area are derived from these geologic constituents, forming within this residuum or alluvium from these materials. The dominant soil orders in this Southern Coastal Plain MLRA (133A) are *Ultisols*, *Entisols*, and *Inceptisols*. Soil units mapped on the floodplain at the site are *Entisols* and the surrounding slopes are *Ultisols* (USDA-NRCS 2006)

Site Conditions

The project site lies along the floodplains and adjacent concave slope in the head waters of Cow Branch (Figure 2). East of the project, Cow Branch begins near the edge of a broad, flat ridge near several Carolina Bays. Cow Branch flows through the project in a series of deep, excavated channels before exiting the project in the southwest corner and flowing under Silver Spoon Rd (SR 1003). There are two small tributaries to Cow Branch (S100 and S200) within the project boundary (Figure 2). The S100 tributary begins north of the project within a large concave, bowl shape valley where it appears to have extensive groundwater discharge. The S200 tributary is a small tributary from the northeast near the bottom of a long, shallow valley beginning near Old Lumberton Road.

The site has a network of numerous ditches draining portions of the nearly level landscape along the edge of a broad, flat ridge. Larger channels within the project are three to five feet deep. The ditch network ranges from shallow to relatively deep with some placed to intercept runoff and groundwater discharge that contribute to a lower water table. Ditches are well maintained, especially within the fields, where vegetation is limited to herbaceous species.

Land use for most of the project area and the contributing watershed is in agricultural row crops with patches of undeveloped land. Farm buildings and residential homes are scattered. Within the old clear-cut the trees have not regenerated well. Along the slopes to the south is small areas of mature timber and broad areas of groundwater discharge was also observed. The cultivated fields were observed to have crowning that facilitates surface runoff. The deeper ditches appear to effectively drain these soils, making it suitable for the agricultural uses. The mature timber and portions of the clear-cut have minimal ditching and still have wetland hydrology, primarily from groundwater discharge. There is a flat to concave topography that collects surface flows that historically supported a large, extensive wetland across the site. Currently only three areas of wetlands remain, WA, WB, and WC (Figure 2). These are awaiting jurisdictional confirmation from the US Army Corps of Engineers. Two of the wetlands have a mature tree canopy of loblolly pine (*Pinus taeda*) with sweet gum (*Liquidambar styraciflua*), and red maple (*Acer rubrum*). The understory consists of red maple, sweet bay (*Magnolia virginiana*), red bay (*Persea borbonia*), and many wet species typical of wetlands in the area.

Site Soils

Soils were found to be loamy or sandy textured with thick dark surfaces. The subsoil is loamy or sandy textured with areas of having a clayey, more restrictive subsoil. The central floodplain of Cow Branch and S100 have thick, dark soil that extends to a depth greater that 24 inches, and some extending to a depth greater than 40 inches. The dark surface is underlain by dark gray to gray loams with mottles of yellowish brown redoximorphic concentrations. Mottles of gray depletions are not common, likely due to the high organic content in these soils. Where textures are sandy these soils meet the *A12-Thick Dark Surface* hydric soil indicator. Where the soil is loamy or clayey it also meets the *F13-Umbric Surface* hydric soil indicator. As the landscape transitions from the floodplains up the toe of slope and into better drained upland soils, the dark surface thins and meet the *A11-Depleted Below Dark Surface* indicator. Where the soils are sandy, they may also meet the *S7-Dark Surface* indicator. These dark soils have a high organic content. Where not cultivated, a mucky textural modifier is present that meets the *A7-5cm Mucky Mineral* indicator. The *F6-Redox Dark Surface* indicator was also likely more common prior to cultivation.

The observed soils have a range of characteristics similar to the NRCS mapping unit descriptions of *Torhunta*. The high surface organic content and mucky surface textures is a common feature of the *Torhunta* series. Clayey textured subsoils are characteristic of *Rains* soils, the hydric inclusion expected in the adjacent *Stalling* map unit. The hydric soil was found to follow closely with landscape position and visible topographic relief. Representative soil profiles are shown in Appendix A.

Hydric Soil Indicators

The most common hydric soil indicators across this site are the *A11 – Depleted Below Dark Surface* and *A12 - Thick Dark Surface*. All hydric soil profiles recorded had one of these two indicators. In addition to these indicators, many soil borings exhibited multiple indicators including *A7-5cm Mucky Mineral*, *S7 - Dark Surface*, *F3 - Depleted Matrix*, *F6 - Redox Dark Surface*, and *F13 – Umbric Surface*. Subsoils below the dark surface often exhibited distinct redoximorphic mottles. The deep dark surfaces observed required long periods of saturation or inundation for development.

Current Hydrology and Hydrologic Alterations

Historically, the primary hydrology was a high groundwater table due to the nearly level landscape having poor drainage. A high organic content and the mucky surface textures form under periods of long-term saturation. Extensive areas of groundwater discharge are present and the current groundwater table is significantly impacted by the straightened, dredge streams and ditches. Drainage results in increased aeration and higher soil temperatures that result in microbial reduction of carbon content. Tillage increases the rate of organic losses due to soil mixing. Cultivation can remove indicators such as the *A7* and *F6* indicators by destruction of mottles. Historically mucky textured surfaces were likely more common prior to cultivation. The loss of soil organic material eventually results in a loss of the darker surface color. The indicators suggest this site was historically very wet with long term saturation to semipermanently flooded.

Ditching across the site and adjacent uplands is relatively extensive and due to the deep sandy nature of the soil, a significant lateral drainage effect is expected from the ditches. In a natural, undrained condition, soils would have very slow runoff and the low gradient landscape would have supported appropriate conditions for lengthy periods of saturation. Due to the moderately high to high internal drainage (Ksat) anticipated in these sandy textured soils, the ditch network lowers groundwater elevations across much of the site for most of the year to manage site trafficability for farm equipment and timber activities. Within the cultivated fields, surface modifications include spreading of spoil/fill from the draining excavation and slight crowning to improve removal of surface water from the fields. These fields appear to be tilled/cultivated annually or biennially.

Within the cut-over area, most ditches appear to have a berm along one or both sides from the excavated material. The forested areas have berms between the wetland and excavated channels graded into an elevated access path with internal drainage ditching limited, maintaining a more appropriate hydroperiod. Groundwater was observed within both the forested and cut-over wetlands. An excavated pond with adjacent spoil is present within wetland WA.

Mitigation Potential of Soils

The project lies within an appropriate landscape for hydric soil and the site evaluation identified a large area of continuous hydric soil. Available sources of hydrology are present as Cow Branch, two small unnamed tributaries (S100 and S200), and extensive areas of groundwater discharge along the toe of slope. The soils have dark surfaces that are naturally high in organic matter and many redoximorphic features that were identified as either current or relict. The topographic setting for this landscape indicates a high potential for concentration of both surface and subsurface flows.

A practical approach to restoring hydrology of these soils is readily available through plugging and filling the ditch network and re-establishing the stream beds that raises local groundwater and will provide regular overbank flooding. Much of the existing wetlands can benefit from restoring the local water table by improving connectivity to a larger wetland community and increasing reduced hydroperiods. Removal of spoil berms and the creation/enhancement of depressional areas will provide the appropriate range of conditions typical of landscape. Surface roughening, and creation or enhancement of shallow floodplain depressions will increase storage, increase infiltration, and improve overall functions of these aquatic resources.

Potential Hydroperiod for Restored Soils

The hydric soils at the site are characteristics of the NRCS map unit of the *Torhunta* soil. This soil formed under long periods of saturation or inundation. Using the US Army Corps of Engineers (2016) mitigation guidance for Common Coastal Plain Soil Series (associated with wetlands), the *Torhunta* (*Typic Humaquepts*) is expected to have a natural hydroperiod of between 12 and 16 percent during the growing season where the water table is within 12 inches of the surface (Table 2). Along the edges of the toe of slope soils appear to be most similar to the *Rains* series. Mitigation guidance for the *Rains soil* (*Typic Paleaquults*) is expected to have a natural hydroperiod of between 10 and 12 percent. After restoration, due to natural variations in local topography and internal drainage of soils in the floodplain, a local hydroperiod slightly higher or lower than this guidance is expected. Areas having slightly higher elevations may experience slightly lower hydroperiods while depressional areas should exceed 16 percent. Localized hydroperiods will depend on surface topography, the project design, and construction. Near areas with groundwater discharge, the hydroperiods may also exceed 16 percent depending on the seasonality of the flow. The final location and elevation of tributaries may also significantly influence wetland hydrology and saturation ranges of the surrounding landscape. Areas having existing wetland hydrology may show some increase in hydroperiod, especially near to drainage features. The surrounding upland soils are not anticipated to have significant increases in hydroperiods.

Table 2. Cow Tail Site – Potential Success Criteria for Compensatory Wetland Mitigation

Wetter ←--→ *Drier*

Mapping Unit/Series	Torhunta	Pantego	Woodington	Rains	Stallings
Taxonomic Classification	*Typic Humaquepts*	*Umbric Paleaquults*	*Typic Paleaquults*		*Aeric Paleaquults*
Typical Hydroperiod Range *	12-16%		10-12%**		7-9%**
Drainage Class	very poorly		poorly		somewhat poorly
Seasonal High Water Table	0 to 12 inches				12 to 30 inches
Topographic Slope Setting (down/across)	linear - linear	linear - concave		linear-linear	concave - linear

**Hydroperiod follows US Army Corps of Engineers. 2016. Wilmington District Stream and Wetland Compensatory Mitigation Update. North Carolina Interagency Review Team - October 24, 2016.*
*** Woodington and Stallings estimated from soils having a similar taxonomic classification*

For the first year after construction, it is realistic to expect a shorter hydroperiod within the areas of re-establishment, especially if rainfall patterns are below normal. The deeper soil horizons will take time to become fully saturated and establish a high groundwater table across the floodplain. These potential hydroperiods are subject to factors related to stream design and frequency of flooding, construction practices, local topography, and local drainage inputs construction.

Functional Uplift from Hydric Soil Re-establishment

The stream and wetland mitigation proposed will raise local groundwater in the drained hydric soil, restoring a more natural hydrologic cycle to the floodplain and the associated functional uplift. The watershed is primarily agricultural and sylvicultural land use with potential sediments, nutrients, and pollutants entering Cow Branch. Plugging excavated channels, removal of spoil, and connecting the streams to the floodplain will allow many of the biogeochemical process to be restored across the floodplain. The presence of the fragmented wetlands and widespread drained hydric soil indicates a potential to rapidly restore more natural biological processes and chemical transformations of wetland soils. Successful hydrologic restoration at this site will improve downstream water quality by providing functional uplift related to soils will improve downstream water quality.

Re-establishment of a longer, more natural hydroperiod will restore oxidation-reduction cycling, improve nutrient and chemical transformations (especially nitrates), and potentially immobilize phosphorus. With establishment of an appropriate wetland vegetative community, additional benefits include protection of soil surfaces that limit erosion and improve infiltration. Vegetative cover reduces soil temperatures leading to a slower oxidation of organic matter and cooler water temperature in the stream.

The project will overall increase organic carbon sequestration and diversity of beneficial microbial and fungal populations essential for wetland soil health. Healthy microbial populations in fully functioning wetlands mediate many important biogeochemical processes such as biochemical transformations of ammonia, molecular nitrogen, nitrite and nitrate and other complex organic substances. Large scale benefits are peak flood control, increased and diverse wildlife habitat, and connectivity of the natural aquatic communities along these tributaries. The inclusion of the existing wetland communities within the project provides a readily available pool of appropriate fungal and microbial species, macroinvertebrates, and seeds while increasing habitat connectivity.

Recommendations

This site has excellent potential to restore a more natural hydrology to large areas in this landscape and provides opportunities for *Wetland Re-establishment, Wetland Rehabilitation*, *Wetland Enhancement* and *Wetland Preservation*. Practical methods for hydrologic restoration and enhancement would include raising of local ground water table through relocating and raising the stream beds. Plugging/filling the ditch network, removal of spoil berms, creation of a rough surface and the enhancement/creation of small depressions will further enhance the hydrologic cycling of these floodplains.

Establishing an appropriate vegetative community will provide many additional benefits such as reducing soil temperatures, stabilization of soils, and enhancing soil microbiological diversity and geochemical process. Beyond the spoil no significant areas of fill were identified. Based on the soil properties, a general hydroperiod success criterion of 12 to 16 percent may be expected. A 10 to 12 percent hydroperiod would be appropriate in areas of gentle sloping with the absence of consistent groundwater discharge.

Where possible, all heavy equipment and construction schedules should be limited to dryer periods or the use of tracked equipment to limit compaction, especially within any existing wetland. In the agricultural fields, where spoil is removed or disturbed, shallow ripping to 12 inches along the contours is strongly suggested to improve infiltration and improve planting survival. The wetland and stream design should promote floodplain and stream connectivity with enhancement of surface storage.

Due to the current drainage modifications and areas with sandy subsoil horizons, it may take up to a year for the site to become completely saturated and reach the target hydroperiods. For at least the first year after construction, in the drained soil it may be reasonable to expect a hydroperiod between 9 and 12 percent, depending on timing of final construction and rainfall patterns (assuming at least average seasonal rainfall, antecedent conditions, and over bank flow frequency).

Summary Observations

The Cow Tail Stream and Wetland Mitigation project is located within a suitable landscape position on the floodplain of Cow Branch and two small, unnamed tributaries. A large, contiguous area of hydric soil was delineated. This area contained three separate wetlands that have been fragmented from the original wetland community. At the project site, stream excavation/incision, ditching for agricultural and sylvicultural operations have lowered the water table. Within agricultural fields, crowing and surface modification have improved the rates of runoff. Other observed hydrologic modifications include, shallow ditches that improve surface drainage, spoil berms, and compacted soil surfaces. Drainage appears to be effective due to moderately high to high internal soil drainage across large areas of the project. The existing wetlands abut the drained hydric soil and are fragments of the historical wetland that covered this site.

The soil surfaces are typically a thick, very dark gray to black surface with a sandy or loamy texture and high in accumulated organic matter. The most common hydric soil indicators observed are the *A11 – Depleted Below Dark Surface* and the *A12 - Thick Dark Surface*. In addition to these indicators, many soil borings exhibited two or more indicators. The dark surfaces typically extend greater than 12 inches and often to more than 24 inches with some greater than 40 inches. Long periods of saturation or inundation are required for the development of the dark surfaces. The subsoils more central to the floodplain have sandy or loamy textures with the surrounding hydric soil having a more restrictive sandy clay loam or sandy clay. The NRCS soil mapping indicates a high potential for the occurrence of hydric soils in this landscape that includes a hydric *Torhunta* and adjacent soils with hydric inclusions. Where a thick dark surface (umbric) is present, the soils are very similar to a hydric *Torhunta* soil. Areas with a thinner dark surface and a clayey subsoil resemble a hydric *Rains* soil that is considered an inclusion in an adjacent upland map unit.

Cow Branch will provide a consistent source of hydrology after the stream restoration and on the gently sloping toe of slope surrounding the site are numerous areas having groundwater discharge. Groundwater was observed mostly within the wetlands with the drained area having a deeper water table or absent during the site evaluation. Some observations of the water tale may have been impacted by recent rain events.

Conclusions

At the Cow Tail Stream and Wetland Mitigation Site, the topographic and landscape setting have a hydric soil appropriate for a successful hydrologic mitigation project. The hydric soil indicators observed across this floodplain reflect historically wet conditions. Stream restoration and other practical drainage modifications can raise the local groundwater. This project can restore lost and degraded aquatic resources to provide significant functional uplift, establishment of natural habitat, and restore this large historical wetland community.

Given the observed hydric soil characteristics within a favorable landscape position, this site is suitable for hydrologic *Wetland Re-establishment, Wetland Rehabilitation*, *Wetland Enhancement*, and *Wetland Preservation* of degraded aquatic resources. Based upon this detailed study of soils and current conditions observed at this site, this appears to be a site with appropriate conditions for Wetland Mitigation.

This report describes the results of the soil evaluation performed at the Cow Tail Stream and Wetland Mitigation Site in Columbus County, NC. Any subsequent transfer of the report by the user shall be made by transferring the complete report, including figures, maps, appendices, all attachments, and disclaimers.

References

NTCHS. 2003. Technical Note 13: Altered Hydric Soils. Deliberation of: National Technical Committee for Hydric Soils.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. *Web Soil Survey*. Available online at the following link: https://websoilsurvey.sc.egov.usda.gov/. Accessed [June/2023].

US Army Corps of Engineers. 2016. *Wilmington District Stream and Wetland Compensatory Mitigation Update*. North Carolina Interagency Review Team - October 24, 2016. SAW-2013-00668-PN http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/

U.S. Army Corps of Engineers. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0), ed.* J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-20. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Swanson, Kratz, Caine, and Woodmansee. 1988. *Landform Effects on Ecosystem Patterns and Processes.* Bioscience -Volume 38: 91-98.

USDA-SCS. 1990. *Soil Survey of Columbus County North Carolina*. July 1990)

USDA-NRCS. 2017. *Soil Survey Manual 4th Edition.* USDA Handbook 18. Soil Survey Division Staff.

USDA-NRCS. 2018. *Field Indicators of Hydric Soils in the United States*, Version 8.2. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils

Vepraskas, M. J. 1994. *Redoximorphic Features for Identifying Aquic Conditions*. Tech. Bulletin 301. North Carolina Ag. Research Service, North Carolina State Univ., Raleigh, North Carolina.

USEPA. 2000. *Principles for the Ecological Restoration of Aquatic Resources.* EPA841-F-00-003. Office of Water (4501F). United States Environmental Protection Agency. Washington, DC. 4 pp. (https://www.epa.gov/wetlands/principles-wetland-restoration).

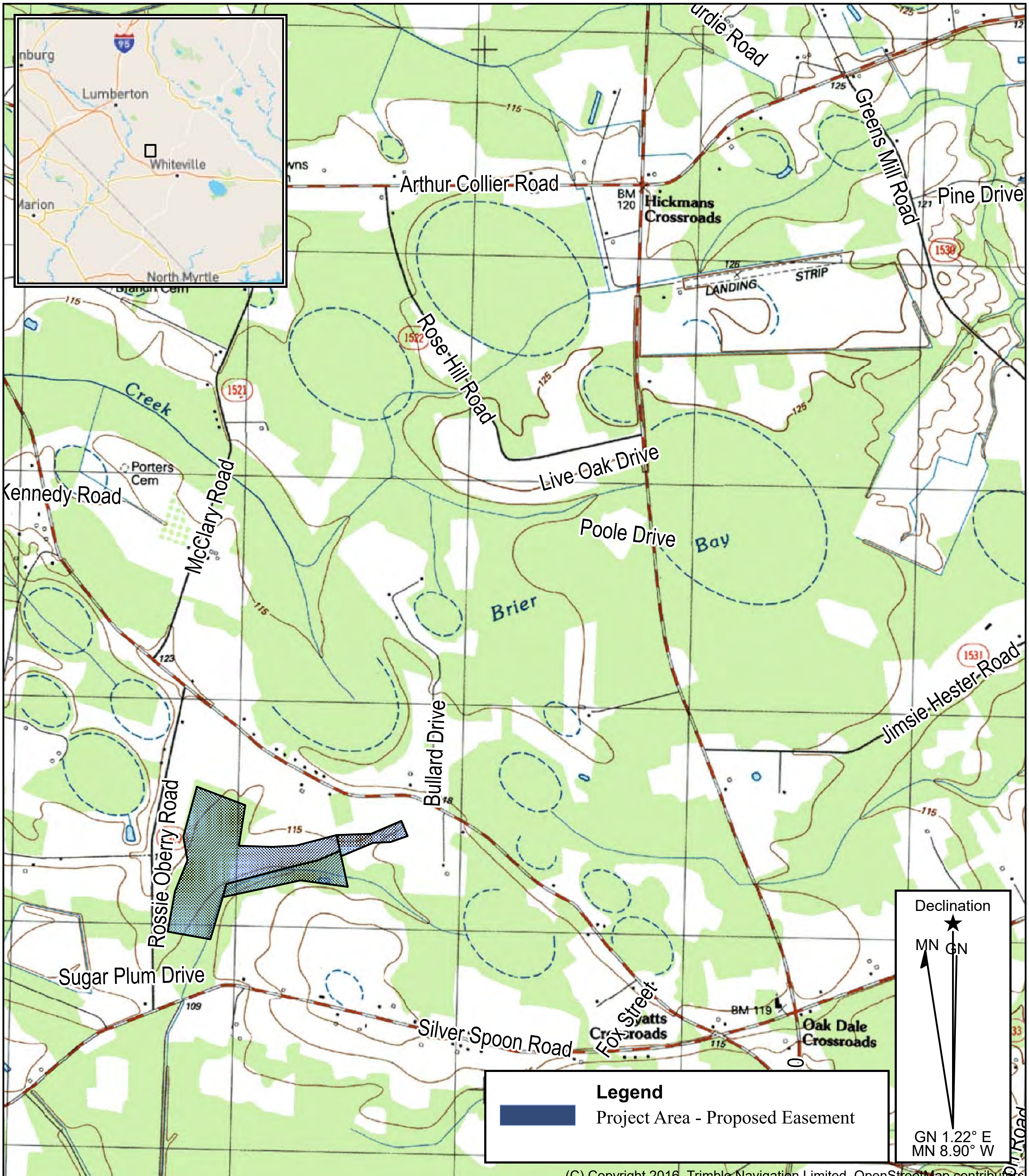
USEPA. 2002. *Ecoregions of North Carolina.* G. E. Griffith et. al. EPA, USDA, NRCS Regional collaborative. Available online at https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-state. August 31, 2002.

FIGURES

APPENDICES

Appendix A Soil Boring Log
Appendix B Photos
Appendix C NRCS Web Soil Survey Report

FIGURES



Map Name: CHADBOURN NE | Scale: 1 inch = 2,000 ft. | Base Map Scale: 24,000

Figure 1. USGS Vicinity Map
Cow Tail Mitigation Project
Columbus County, NC

Prepared for Water and Land Solutions

SCALE 1:24000

0 1000 2000 3000 4000
Feet

0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
Miles

LEGEND

- Proposed Easement
- Stream
- Ditch
- Wetland Jurisdictional
- Potential Wetland Reestablishement
- Pond
- Spoil
- Soil Boring-Profile

Scale: 1 inch = 250 ft.

Horizontal Datum: WGS84

Figure 2. Project Aerial Overview
Cow Tail Mitigation Project
Columbus County, NC

Produced for Water and Land Solutions

SCALE 1:3000

0 — 1000 Feet

0.0 — 0.1 — 0.2 Miles

LEGEND

- Proposed Easement
- Stream
- Ditch
- Wetland Jurisdictional
- Potential Wetland Reestablishement
- Pond
- Spoil
- Soil Boring-Profile
- Soil Boring-Hydric
- Soil Boring-NonHydric

Scale: 1 inch = 250 ft.

Horizontal Datum: WGS84

Figure 3.Soil Boring Location
Cow Tail Mitigation Project
Columbus County, NC

Produced for Water and Land Solutions

SCALE 1:3000

0 — 1000 Feet

0.0 — 0.1 — 0.2 Miles

APPENDIX A

Soil Boring Log

Appendix A

Cow Tail Mitigation Bank, Columbus County NC
Soil Boring Profile Descriptions

Table 2. Representative Soil Profiles at the Cow Tail Mitigation Site

Depth (inches)	Color		Mottle Percentage (Location*)	Texture**	Notes
	Matrix	Mottle			
SB 03 (cutover) **December 29, 2020**			Hydric Indicators WT -11" A7-5cm Mucky Mineral A11-Depleted Below Dark Surface		
0-6	N 2.5/-			mucky SL	
6-10	10 YR 3/1			LS	
10-15	10 YR 4/1			LS	
15-31	2.5 Y 2.5/1			LS	
SB 15 (cultivated field) **December 29, 2020**			Hydric Indicators WT -10" A12-Thick Dark Surface F13-Umbric Surface		
0-22	10 YR 2/1			SL	
22-32	10 YR 3/1	10 YR 3/2	20% (PL)	LS	
32-40	10 YR 4/1	10 YR 3/4	2% (PL)	SCL	restrictive-low permeability
SB 20 (forested-wetland) **December 29, 2020**			Hydric Indicators WT -11" A7-5cm Mucky Mineral A12-Thick Dark Surface		
0-9	N 2.5/-			mucky SL	
9-24	10 YR 2/1	10 YR 4/1	30% (PL)	LS	
SB 62 (cutover) **December 29, 2020**			Hydric Indicators WT -0"(at surface) A7-5cm Mucky Mineral A12-Thick Dark Surface F13-Umbric Surface		
0-8	10 YR 2/1			mucky SL	
8-23	10 YR 2/1			SL	
SB 109 (cultivated field) **March 15, 2023**			Hydric Indicators WT -not observed A11-Depleted Below Dark Surface (relict-buried horizon) S7-Dark Surface (relict-buried horizon)		
0-14	10 YR 3/2			LS	fill from ditch spoil
14-21	10 YR 2/1			LS	historic buried surface
21-28	10 YR 5/1	10 YR 4/6	30% (PL)	S	
SB 115 (cultivated field) **March 15, 2023**			Hydric Indicators WT not observed A11-Depleted Below Dark Surface S7-Dark Surface		
0-5	10 YR 2/1			LS	tillage horizon
5-14	10 YR 6/2			S	
14-25	10 YR 5/2	10 YR 5/8	8% (PL)	SL	

Appendix A
Cow Tail Mitigation Bank, Columbus County NC
Soil Boring Profile Descriptions

Table 2. Representative Soil Profiles at the Cow Tail Mitigation Site

Depth (inches)	Color		Mottle Percentage (Location*)	Texture**	Notes
	Matrix	Mottle			
SB 129 (cut-over) **March 15, 2023**			Hydric Indicators WT -24" A7-5cm Mucky Mineral A11-Depleted Below Dark Surface		
0-3	N 2.5/-			mucky L	
3-6	10 YR 4/1	10 YR 5/1	5% (PL)	S	
6-13	10 YR 5/2	10 YR 3/6	7% (PL)	S	
13-32	10 YR 5/4	10 YR 4/6 10 YR 7/1	20% (PL) 8% (PL)	SL	
SB 141 (cut-over-wetland) **March 15, 2023**			Hydric Indicators WT -11" A7-5cm Mucky Mineral A11-Depleted Below Dark Surface		
0-5	10 YR 2/1			mucky L	
5-30	10 YR 5/1	10 YR 4/4	8% (PL)	LS	
SB 148 (cultivated field) **March 16, 2023**			Hydric Indicators WT -not observed A11-Depleted Below Dark Surface F3- Depleted Matrix F6-Redox Dark Surface		
0-5	10 YR 2/1			SL	tillage horizon
5-8	10 YR 2/1	10 YR 4/6	4% (PL)	SL	
8-13	10 YR 4/1	10 YR 4/6	10% (PL)	SL	
13-27	10 YR 5/1	10 YR 4/6	25% (PL)	SC	
SB 156 (cut-over) **March 16, 2023**			Hydric Indicators WT -34" A12-Thick Dark Surface S7-Dark Surface		
0-10	10 YR 2/1			LS	>90% coated sand grains
10-25	10 YR 2/1			LS	~100% coated sand grains
25-40	10 YR 2/1	10 YR 5/2	10% (PL)	LS	~100% coated sand grains
40-43	10 YR 5/2			S	
SB 162 (cultivated field) **March 16, 2023**			Hydric Indicators WT -not observed A12-Thick Dark Surface S7-Dark Surface		
0-12	10 YR 2/1			LS	
12-18	10 YR 3/1			LS	
18-24	10 YR 4/1	10 YR 3/1	20% (PL)	SCL	restrictive-low permeability

Appendix A

Cow Tail Mitigation Bank, Columbus County NC
Soil Boring Profile Descriptions

Table 2. Representative Soil Profiles at the Cow Tail Mitigation Site

Depth (inches)	Color		Mottle Percentage (Location*)	Texture**	Notes
	Matrix	Mottle			
SB 192 (forested-wetland) **March 29, 2023**			Hydric Indicators WT -7" A12-Thick Dark Surface S7-Dark Surface		
0-16	10 YR 2/1			LS	>90% coated sand grains
16-28	10 YR 2/1	10 YR 5/2	10% (PL)	LS	
28-32	10 YR 2/2			SCL	restrictive-low permeability
32-36	10 YR 2/2	10 YR 4/2	15% (PL)	S	
SB 193 (forested-wetland) **March 29, 2023**			Hydric Indicators WT -not observed A12-Thick Dark Surface S7-Dark Surface		
0-9	10 YR 2/1			LS	
9-28	10 YR 3/2			SL	
28-37	10 YR 3/2	10 YR 5/2	15% (PL)	SCL	restrictive-low permeability
SB 205 (forested-wetland) **March 30, 2023**			Hydric Indicators WT -3" A11-Depleted Below Dark Surface S7-Dark Surface		
0-6	N 2.5/-			LS	>90% coated sand grains
6-9	10 YR 4/1			S	
9-19	10 YR 3/2			S	
19-26	10 YR 3/1	10 YR 4/2	8% (PL)	S	
SB 207 (cut-over-wetland) **March 30, 2023**			Hydric Indicators WT 0 (at surface) A12-Thick Dark Surface F13-Umbric Surface		
0-4	10 YR 2/1			SL	
4-9	10 YR 2/1			CL	
9-31	10 YR 3/1			SCL	restrictive-low permeability
SB 210 (cut-over-wetland) **April 6, 2023**			Hydric Indicators WT -7" A12-Thick Dark Surface F13-Umbric Surface		
0-15	10 YR 2/1			SL	
15-33	10 YR 3/1	10 YR 3/4	20% (PL)	SCL	restrictive-low permeability

Appendix A

Cow Tail Mitigation Bank, Columbus County NC
Soil Boring Profile Descriptions

Table 2. Representative Soil Profiles at the Cow Tail Mitigation Site

Depth (inches)	Color		Mottle Percentage (Location*)	Texture**	Notes
	Matrix	Mottle			
SB 213 (cut-over-wetland) **April 6, 2023**			Hydric Indicators WT -17" A7-5cm Mucky Mineral A12-Thick Dark Surface S7-Dark Surface		
0-4	10 YR 2/1			mucky LS	~100% coated sand grains
4-21	10 YR 2/1	10 YR 4/2	2% (PL)	LS	
21-29	10 YR 2/1			SL	

Hydric Indicators suitable for MLRA 133A/LRR P
WT = observed apparent water table
*PL =pore lining, M = matrix
**Texture (follows USDA textural classification)
S = sand, L = loam, Si = silt, C = clay
f = fine, c = coarse (textural modifiers for sand)

Soil Scientist Seal

APPENDIX B

Photo Log

Appendix B
Cow Tail Mitigation Site – Columbus County, NC
Photo Log

April 2023

1. Hydric profile. Meets the *A11-Depleted Below Dark Surface*, *F3-Depleted Matrix*, and *F6-Redox Dark Surface* indicators. SB#148. 2023 03-19. Photo 2633

2. Landscape in fallow field looking along toe of slope. SB#148. 2023 03-19.

3. Hydric profile. Meets the *A12-Thick Dark* Surface and *F13-Umbric Surface* indicator. SB#15. 2020 12-29.

4. Landscape in fallow corn field. Facing down floodplain. SB#15. 2020 12-29.

Appendix B
Cow Tail Mitigation Site – Columbus County, NC
Photo Log

April 2023

5. Hydric profile. Meets *A7-5cm Mucky Mineral* and *A11-Depleted Below Dark Surface* indicators. SB#129. 2023 03-19.

6. Landscape is clear-cut. Field edge beyond tree line in distance. SB#129. 2023 03-19.

7. Hydric profile (wetland). Meets *A12-Thick Dark Surface* and *F13-Umbric Surface* indicators. SB#210. 2023 04-06.

8. Landscape is clear-cut wetland. Area is concave-concave. Old slash berm in background. SB#210. 2023 04-06.

Appendix B
Cow Tail Mitigation Site – Columbus County, NC
Photo Log

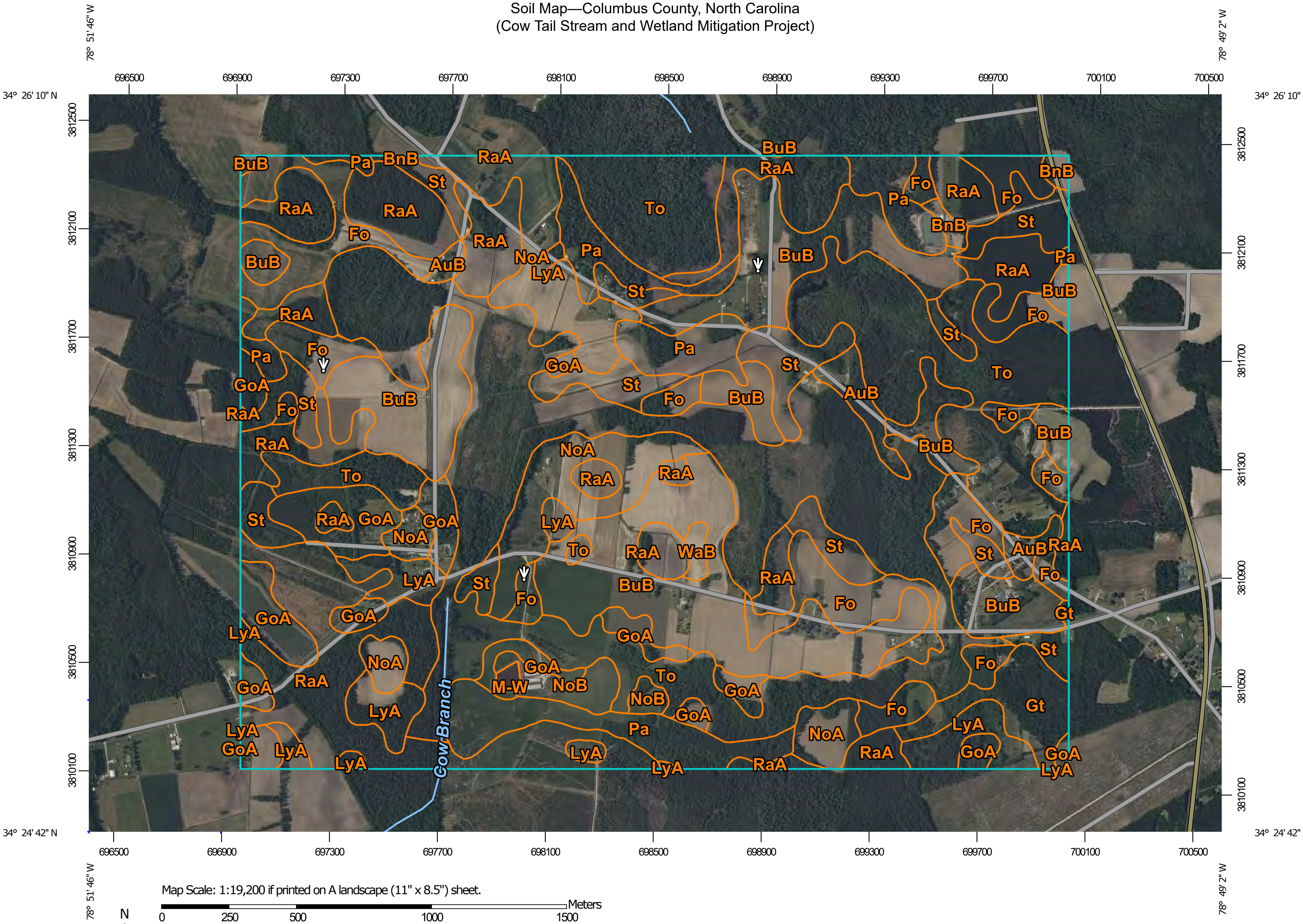
April 2023

9. Hydric profile (wetland). Meets *A12-Thick Dark Surface* and *F13-Umbric Surface* indicators. SB#192. 2023 03-30.

10. Landscape is forested floodplain wetland. Channelized S200 at edge of field with spoil berm to right. SB#192. 2023 03-30.

APPENDIX C
NRCS Web Soil Survey Report

Soil Map—Columbus County, North Carolina
(Cow Tail Stream and Wetland Mitigation Project)



Map Scale: 1:19,200 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Columbus County, North Carolina
Survey Area Data: Version 25, Sep 8, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 11, 2022—May 15, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AuB	Autryville sand, 0 to 3 percent slopes	20.3	1.2%
BnB	Blanton sand, 0 to 6 percent slopes	6.3	0.4%
BuB	Butters loamy fine sand, 0 to 3 percent slopes	273.2	15.9%
Fo	Foreston loamy fine sand	143.8	8.3%
GoA	Goldsboro fine sandy loam, 0 to 2 percent slopes	91.1	5.3%
Gt	Grifton fine sandy loam	28.4	1.6%
LyA	Lynchburg fine sandy loam, 0 to 2 percent slopes, Southern Coastal Plain	53.3	3.1%
M-W	Miscellaneous Water	1.8	0.1%
NoA	Norfolk loamy fine sand, 0 to 2 percent slopes	115.0	6.7%
NoB	Norfolk loamy fine sand, 2 to 6 percent slopes	16.2	0.9%
Pa	Pantego fine sandy loam	106.7	6.2%
RaA	Rains fine sandy loam, 0 to 2 percent slopes, Southern Coastal Plain	273.4	15.9%
St	Stallings sandy loam	104.8	6.1%
To	Torhunta fine sandy loam	484.9	28.1%
WaB	Wagram loamy fine sand, 0 to 6 percent slopes	3.6	0.2%
Totals for Area of Interest		**1,723.0**	**100.0%**

RIVERMORPH CROSS SECTION SUMMARY

River Name: Cow Tail
Reach Name: Cow Tail
Cross Section Name: XS-1, S100 to Cow Branch
Survey Date: 12/30/2020

Cross Section Data Entry

Cross Sectional Geometry

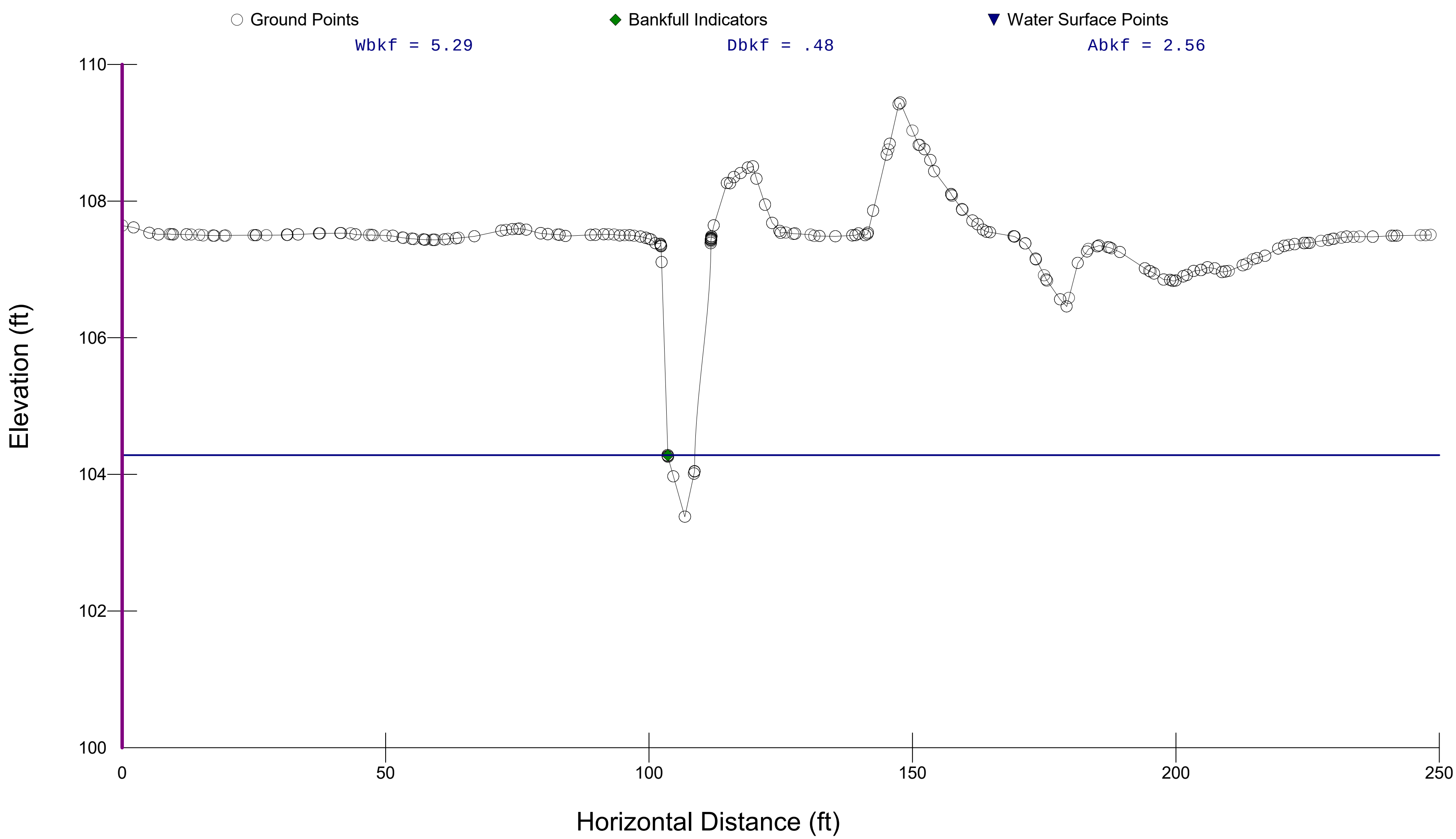
	Channel	Left	Right
Floodprone Elevation (ft)	105.18	105.18	-----
Bankfull Elevation (ft)	104.28	104.28	-----
Floodprone Width (ft)	6.49	-----	-----
Bankfull Width (ft)	5.29	76.43	-----
Entrenchment Ratio	1.23	-----	-----
Mean Depth (ft)	0.48	0.48	-----
Maximum Depth (ft)	0.9	0.9	-----
Width/Depth Ratio	11.02	158.03	-----
Bankfull Area (sq ft)	2.56	2.56	-----
Wetted Perimeter (ft)	5.64	5.64	-----
Hydraulic Radius (ft)	0.45	0.45	-----
Begin BKF Station	103.57	103.57	-----
End BKF Station	108.85	108.85	-----

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

XS-1 S100 to Cow Branch



RIVERMORPH CROSS SECTION SUMMARY

River Name: Cow Tail
Reach Name: Cow Tail
Cross Section Name: XS-2, S200 to Cow Branch
Survey Date: 12/30/2020

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	93.87	Lpin
15	0	93.9	
30	0	93.97	
45	0	93.93	
60	0	94.11	
75	0	93.87	
90	0	93.59	
98	0	93.47	BKF LB
99.5	0	91.5	WS
103	0	90	TW
106	0	90.03	
110	0	93.19	
113	0	93.92	RB
115	0	93.93	
125	0	93.61	
140	0	94	
155	0	94.18	
170	0	94.39	
185	0	94.05	
200	0	94.54	Rpin

Cross Sectional Geometry

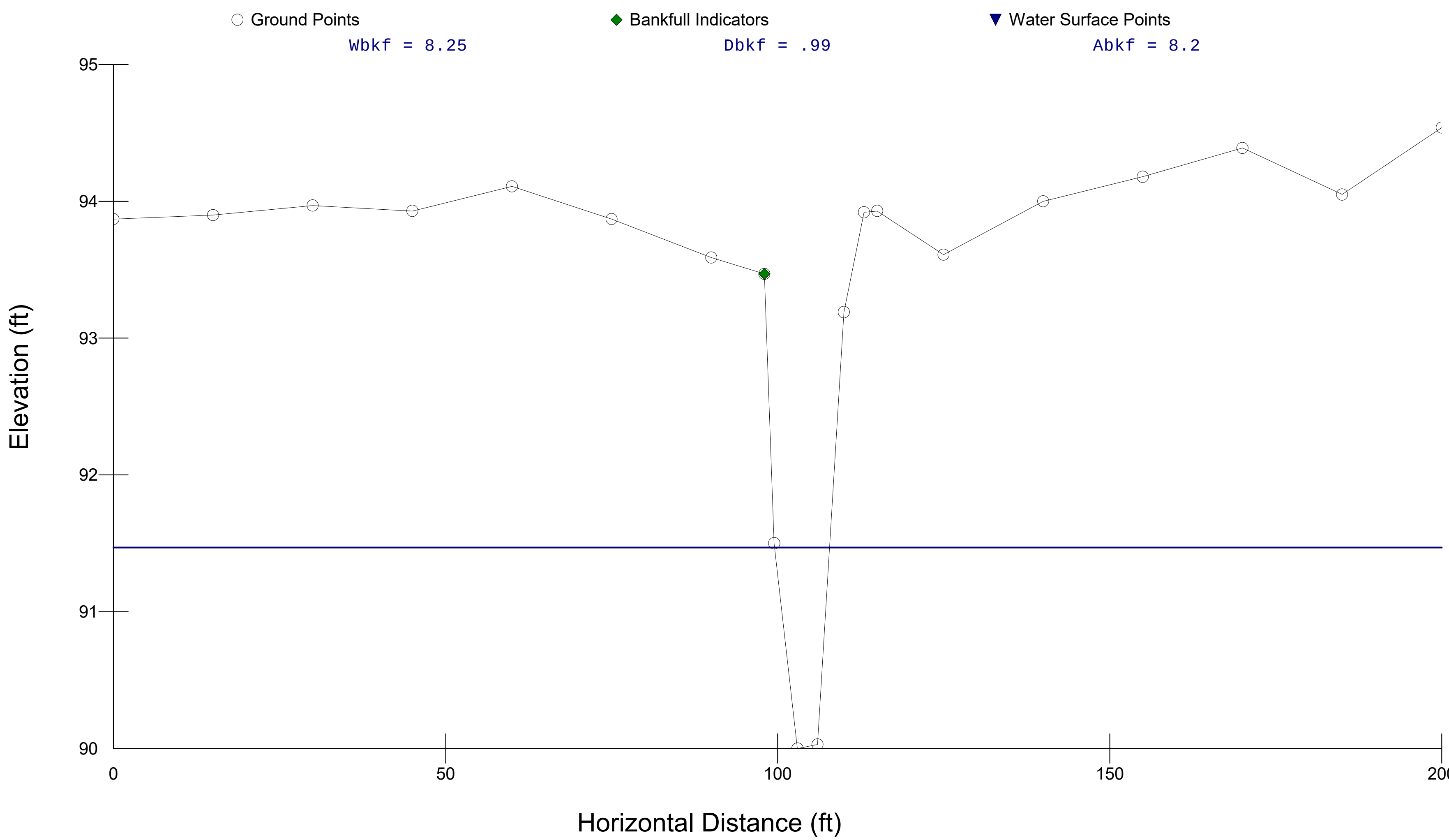
	Channel	Left	Right
Floodprone Elevation (ft)	92.94	92.94	92.94
Bankfull Elevation (ft)	91.47	91.47	91.47
Floodprone Width (ft)	11.28	-----	-----
Bankfull Width (ft)	8.25	4.07	4.18
Entrenchment Ratio	1.37	-----	-----
Mean Depth (ft)	0.99	0.85	1.13
Maximum Depth (ft)	1.47	1.47	1.46
Width/Depth Ratio	8.33	4.79	3.7
Bankfull Area (sq ft)	8.2	3.46	4.74
Wetted Perimeter (ft)	9.05	5.84	6.15
Hydraulic Radius (ft)	0.91	0.59	0.77
Begin BKF Station	99.57	99.57	103.64
End BKF Station	107.82	103.64	107.82

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0

XS-2 S200 to Cow Branch



RIVERMORPH CROSS SECTION SUMMARY

River Name: Cow Tail
Reach Name: Cow Tail
Cross Section Name: XS-3, upper Cow Branch
Survey Date: 12/30/2020

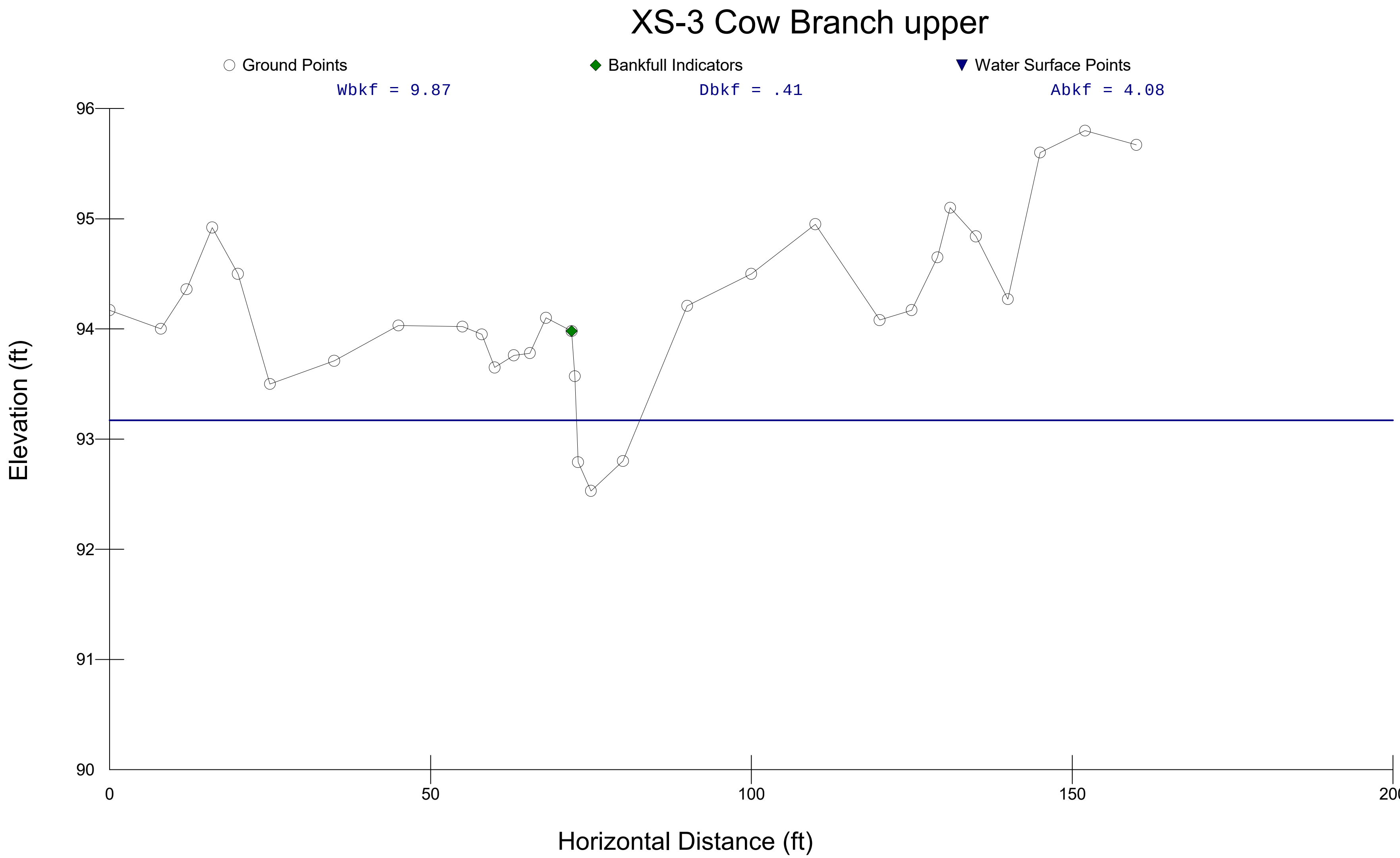
Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	94.17	Lpin
8	0	94	
12	0	94.36	
16	0	94.92	
20	0	94.5	
25	0	93.5	
35	0	93.71	
45	0	94.03	
55	0	94.02	
58	0	93.95	
60	0	93.65	
63	0	93.76	
65.5	0	93.78	
68	0	94.1	
72	0	93.98	bkf
72.5	0	93.57	
73	0	92.79	
75	0	92.53	TW
80	0	92.8	
90	0	94.21	rb
100	0	94.5	
110	0	94.95	
120	0	94.08	
125	0	94.17	
129	0	94.65	
131	0	95.1	
135	0	94.84	
140	0	94.27	
145	0	95.6	
152	0	95.8	
160	0	95.67	Rpin

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.81	93.81	93.81
Bankfull Elevation (ft)	93.17	93.17	93.17
Floodprone Width (ft)	36.43	-----	-----
Bankfull Width (ft)	9.87	4.38	5.48
Entrenchment Ratio	3.69	-----	-----
Mean Depth (ft)	0.41	0.53	0.32
Maximum Depth (ft)	0.64	0.64	0.52
Width/Depth Ratio	24.07	8.3	17.13
Bankfull Area (sq ft)	4.08	2.31	1.76
Wetted Perimeter (ft)	10.13	5.14	6.04
Hydraulic Radius (ft)	0.4	0.45	0.29



XS-3 Cow Branch upper
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.87
Dbkf = .41
Abkf = 4.08
Elevation (ft)
96
95
94
93
92
91
90
0
50
100
150
200
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Cow Tail
Reach Name: Cow Tail
Cross Section Name: XS-4, lower Cow Branch
Survey Date: 08/01/2023

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

Cross Sectional Geometry

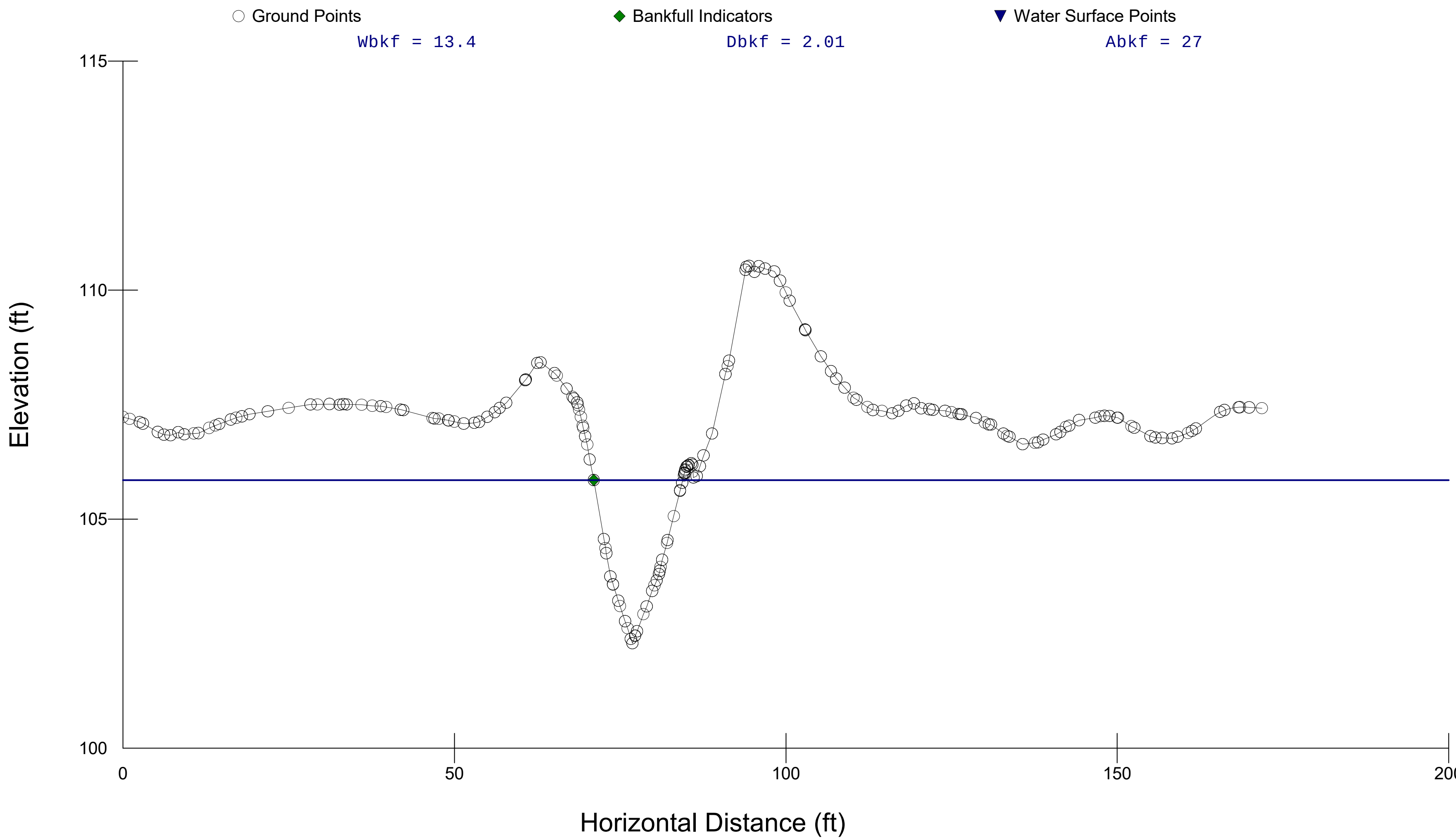
	Channel
Floodprone Elevation (ft)	
Bankfull Elevation (ft)	
Floodprone Width (ft)	
Bankfull Width (ft)	
Entrenchment Ratio	
Mean Depth (ft)	
Maximum Depth (ft)	
Width/Depth Ratio	
Bankfull Area (sq ft)	
Wetted Perimeter (ft)	
Hydraulic Radius (ft)	
Begin BKF Station	
End BKF Station	

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side
Slope		0
Shear Stress (lb/sq ft)		
Movable Particle (mm)		

XS-4, Cow Branch lower



RIVERMORPH CROSS SECTION SUMMARY

River Name: Cow Tail
Reach Name: Cow Tail
Cross Section Name: XS-5 middle Cow Branch
Survey Date: 08/01/2023

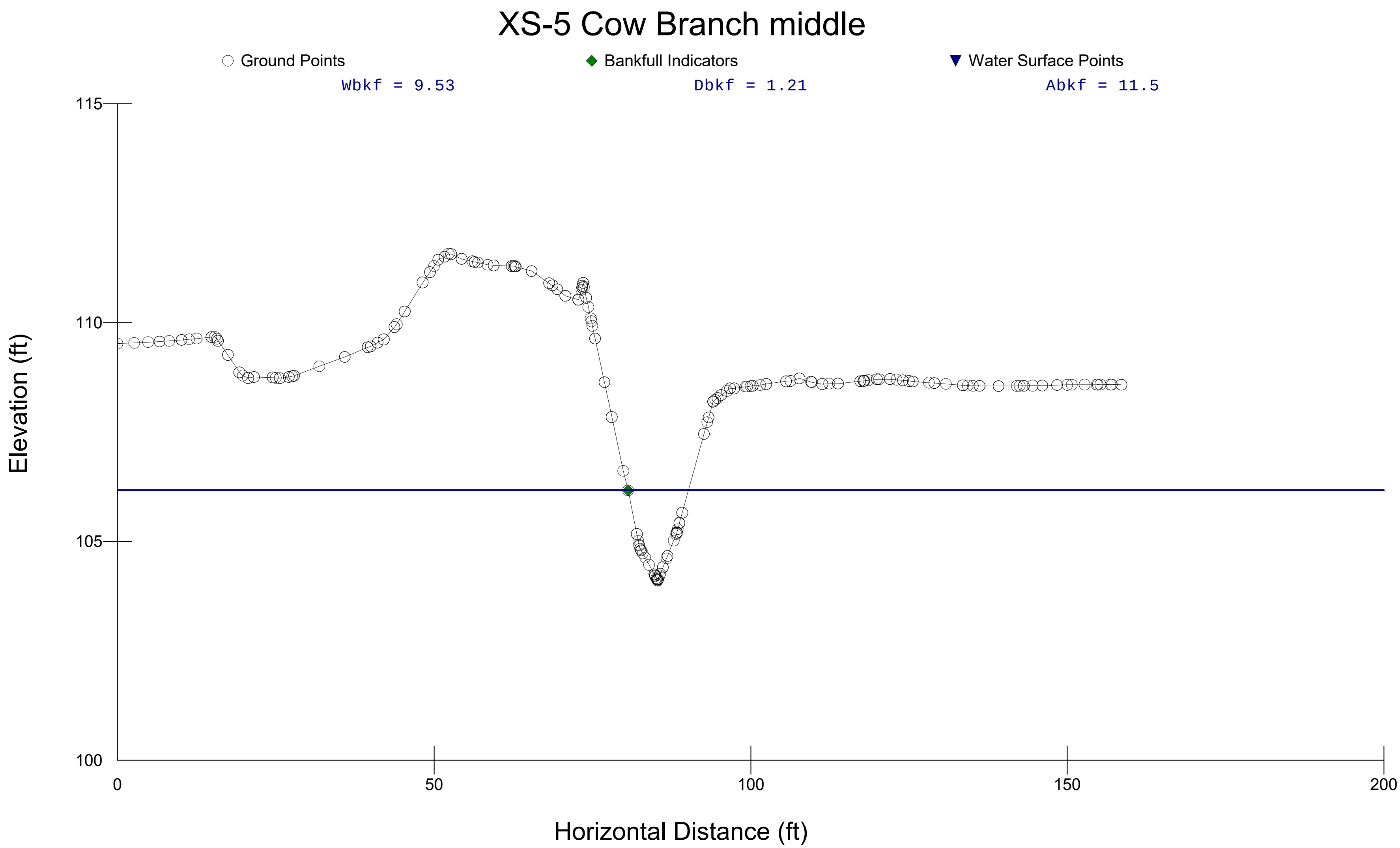
Cross Section Data Entry

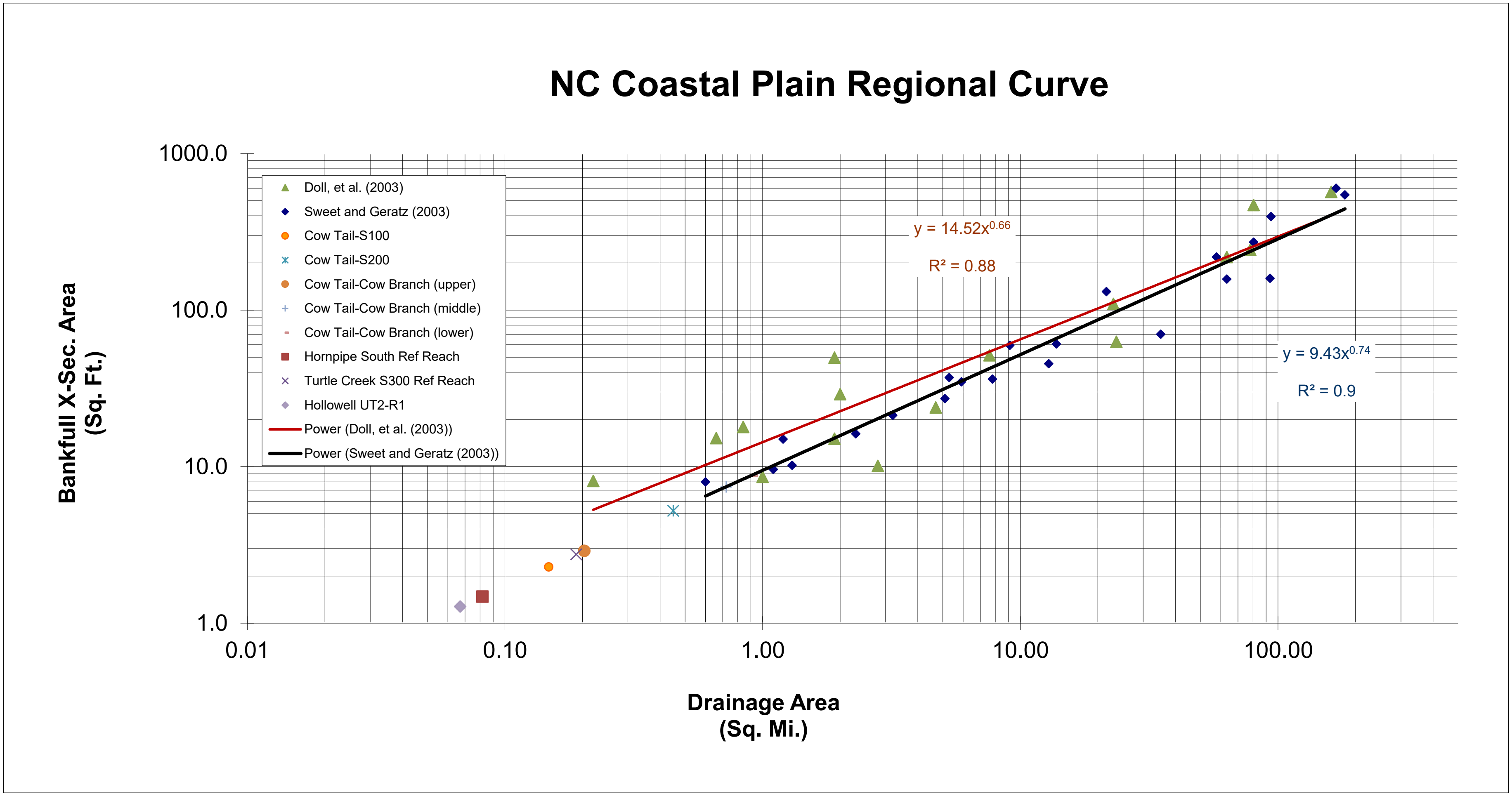
	Channel
Floodprone Elevation (ft)	
Bankfull Elevation (ft)	
Floodprone Width (ft)	
Bankfull Width (ft)	
Entrenchment Ratio	
Mean Depth (ft)	
Maximum Depth (ft)	
Width/Depth Ratio	
Bankfull Area (sq ft)	
Wetted Perimeter (ft)	
Hydraulic Radius (ft)	
Begin BKF Station	
End BKF Station	

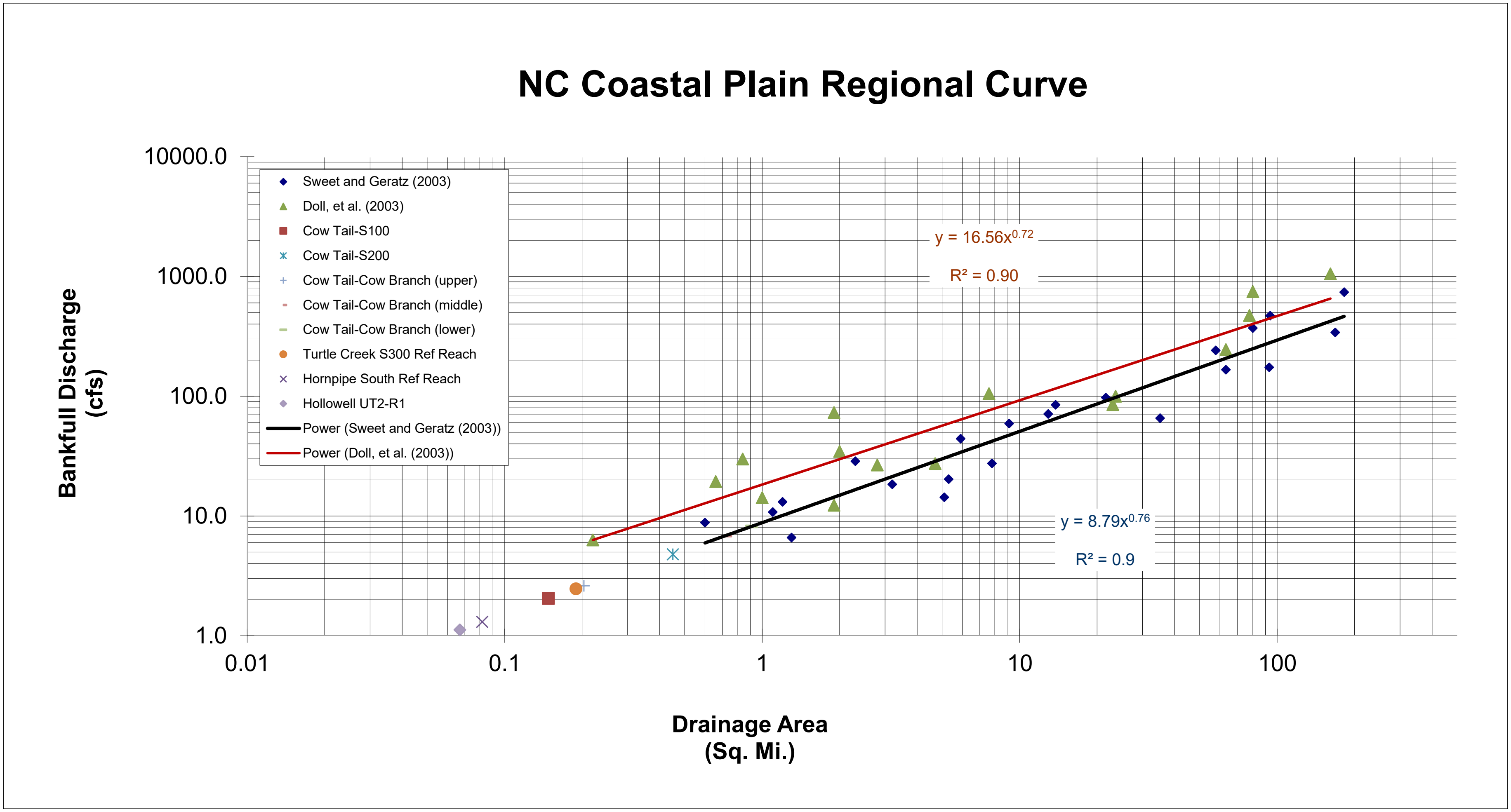
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side
Slope		0
Shear Stress (lb/sq ft)		
Movable Particle (mm)		


XS-5 Cow Branch middle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.53
Dbkf = 1.21
Abkf = 11.5
Elevation (ft)
115
110
105
100
0
50
100
150
200
Horizontal Distance (ft)


NC Coastal Plain Regional Curve
Bankfull X-Sec. Area
(Sq. Ft.)
Drainage Area
(Sq. Mi.)
1000.0
100.0
10.0
1.0
0.01
0.10
1.00
10.00
100.00
Doll, et al. (2003)
Sweet and Geratz (2003)
Cow Tail-S100
Cow Tail-S200
Cow Tail-Cow Branch (upper)
Cow Tail-Cow Branch (middle)
Cow Tail-Cow Branch (lower)
Hornpipe South Ref Reach
Turtle Creek S300 Ref Reach
Hollowell UT2-R1
Power (Doll, et al. (2003))
Power (Sweet and Geratz (2003))
y = 14.52x^0.66
R² = 0.88
y = 9.43x^0.74
R² = 0.9


NC Coastal Plain Regional Curve
10000.0
1000.0
100.0
10.0
1.0
0.01
0.1
1
10
100
Bankfull Discharge
(cfs)
Drainage Area
(Sq. Mi.)
Sweet and Geratz (2003)
Doll, et al. (2003)
Cow Tail-S100
Cow Tail-S200
Cow Tail-Cow Branch (upper)
Cow Tail-Cow Branch (middle)
Cow Tail-Cow Branch (lower)
Turtle Creek S300 Ref Reach
Hornpipe South Ref Reach
Hollowell UT2-R1
Power (Sweet and Geratz (2003))
Power (Doll, et al. (2003))
$y = 16.56x^{0.72}$
$R^2 = 0.90$
$y = 8.79x^{0.76}$
$R^2 = 0.9$

Bankfull Discharge Regional Curves

Project: Cow Tail **Date:** 06/15/2023
Reach: S100

Watershed Characteristics

0%	Valley & Ridge	0%	Piedmont	100%	Coastal	0%	Urban (> 15% Impervious)

Drainage Area: 0.148 sq mi 94.66 *ac*

Average Field Observed Bankfull **C.S.A.** =	N/a	ft
Average Field Observed Bankfull **Width** =	N/a	ft
Average Field Observed Bankfull **Depth** =	N/a	ft
Mannings Calculated Q =	N/a	ft

Rural Coastal Plain Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	2.29	sf	2.71 sf	3.54 sf
W =	4.66	ft	4.98 ft	5.20 ft
D =	0.49	ft	0.55 ft	0.68 ft
Q =	**2.06**	**cfs**	*7.77 cfs (WCP)*	**9.02 cfs**
			3.43 cfs (ECP)	
			5.60 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	6.11	sf	4.32 sf	2.53 sf	3.84 sf	5.84 sf
W =	7.29	ft	7.01 ft	5.71 ft	5.75 ft	5.23 ft
D =	0.94	ft	0.62 ft	0.44 ft	0.60 ft	0.81 ft
Q =	**23.59**	**cfs**	**19.79 cfs**	**7.18 cfs**	**12.07 cfs**	**22.49 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	5.89 sf	3.14 sf	3.17 sf
W =	9.39 ft	5.98 ft	5.41 ft
D =	0.61 ft	0.53 ft	0.58 ft
Q =	**23.55 cfs**	**5.64 cfs**	**9.49 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**2.85**	**sf**	*N/a ft (Observed Value)*
W =	**4.95**	**ft**	*N/a ft (Observed Value)*
D =	**0.57**	**ft**	*N/a ft (Observed Value)*
Q =	**6.28**	**cfs**	*N/a ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

2.85	**sf**
4.95	**ft**
0.57	**ft**
6.28	**cfs**

Bankfull Discharge Regional Curves

Project: Cow Tail **Date:** 06/15/2023
Reach: S200

Watershed Characteristics

0%	Valley & Ridge	0%	Piedmont	100%	Coastal	0%	Urban (> 15% Impervious)

Drainage Area: **0.450** **sq mi** **288.00** *ac*

Average Field Observed Bankfull ***C.S.A.*** *=*	*N/a*	ft
Average Field Observed Bankfull ***Width*** *=*	*N/a*	ft
Average Field Observed Bankfull ***Depth*** *=*	*N/a*	ft
Mannings Calculated Q =	*N/a*	ft

Rural Coastal Plain Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	5.22	sf	5.91 sf	7.20 sf
W =	7.12	ft	7.60 ft	7.80 ft
D =	0.74	ft	0.78 ft	0.92 ft
Q =	**4.79**	**cfs**	*17.50 cfs (WCP)* *7.99 cfs (ECP)* **12.74 cfs (Average)**	**17.56 cfs**

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	12.88	sf	9.73 sf	6.15 sf	8.78 sf	12.45 sf
W =	10.88	ft	10.82 ft	9.20 ft	9.30 ft	8.43 ft
D =	1.30	ft	0.90 ft	0.66 ft	0.88 ft	1.16 ft
Q =	**51.97**	**cfs**	**46.09 cfs**	**20.60 cfs**	**29.54 cfs**	**50.11 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	12.56 sf	7.24 sf	7.08 sf
W =	14.18 ft	9.76 ft	8.78 ft
D =	0.87 ft	0.74 ft	0.80 ft
Q =	**54.85 cfs**	**16.06 cfs**	**22.95 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**6.11**	**sf**	*N/a ft (Observed Value)*
W =	**7.51**	**ft**	*N/a ft (Observed Value)*
D =	**0.81**	**ft**	*N/a ft (Observed Value)*
Q =	**13.28**	**cfs**	*N/a ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

6.11	**sf**
7.51	**ft**
0.81	**ft**
13.28	**cfs**

Bankfull Discharge Regional Curves

Project: Cow Tail **Date:** 06/15/2023
Reach: Cow Branch upper

Watershed Characteristics

0%	Valley & Ridge	0%	Piedmont	100%	Coastal	0%	Urban (> 15% Impervious)

Drainage Area: **0.203** **sq mi** **129.92** ***ac***

*Average Field Observed Bankfull **C.S.A.** =*	*N/a*	ft
*Average Field Observed Bankfull **Width** =*	*N/a*	ft
*Average Field Observed Bankfull **Depth** =*	*N/a*	ft
Mannings Calculated Q =	*N/a*	ft

Rural Coastal Plain Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	2.90	sf	3.39 sf	4.33 sf
W =	5.26	ft	5.62 ft	5.83 ft
D =	0.55	ft	0.61 ft	0.74 ft
Q =	**2.62**	**cfs**	*9.79 cfs (WCP)*	**10.90 cfs**
			4.36 cfs (ECP)	
			7.07 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	7.56	sf	5.44 sf	3.26 sf	4.86 sf	7.25 sf
W =	8.17	ft	7.94 ft	6.54 ft	6.59 ft	5.99 ft
D =	1.03	ft	0.69 ft	0.49 ft	0.67 ft	0.90 ft
Q =	**29.53**	**cfs**	**25.17 cfs**	**9.69 cfs**	**15.57 cfs**	**28.25 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	7.31 sf	3.98 sf	3.98 sf
W =	10.56 ft	6.88 ft	6.21 ft
D =	0.68 ft	0.58 ft	0.63 ft
Q =	**29.95 cfs**	**7.60 cfs**	**12.20 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**3.54**	**sf**	*N/a ft (Observed Value)*
W =	**5.57**	**ft**	*N/a ft (Observed Value)*
D =	**0.63**	**ft**	*N/a ft (Observed Value)*
Q =	**7.77**	**cfs**	*N/a ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

3.54	**sf**
5.57	**ft**
0.63	**ft**
7.77	**cfs**

Bankfull Discharge Regional Curves

Project: Cow Tail
Reach: Cow Branch middle
Date: 06/15/2023

Watershed Characteristics

0%	Valley & Ridge	*0%*	*Piedmont*	*100%*	*Coastal*	*0%*	*Urban (> 15% Impervious)*

Drainage Area: **0.722** **sq mi** **462.08** ***ac***

*Average Field Observed Bankfull **C.S.A.** =*	*N/a*	ft
*Average Field Observed Bankfull **Width** =*	*N/a*	ft
*Average Field Observed Bankfull **Depth** =*	*N/a*	ft
Mannings Calculated Q =	*N/a*	ft

Rural Coastal Plain Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	7.41	sf	8.23 sf	9.74 sf
W =	8.52	ft	9.10 ft	9.27 ft
D =	0.87	ft	0.91 ft	1.05 ft
Q =	**6.86**	**cfs**	*24.72 cfs (WCP)*	**23.30 cfs**
			11.44 cfs (ECP)	
			18.08 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	17.68	sf	13.73 sf	8.97 sf	12.47 sf	17.17 sf
W =	12.90	ft	13.02 ft	11.27 ft	11.41 ft	10.34 ft
D =	1.49	ft	1.06 ft	0.79 ft	1.03 ft	1.35 ft
Q =	**72.70**	**cfs**	**66.02 cfs**	**32.24 cfs**	**43.20 cfs**	**70.43 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	17.32 sf	10.32 sf	9.96 sf
W =	16.89 ft	12.02 ft	10.80 ft
D =	1.00 ft	0.86 ft	0.91 ft
Q =	**78.57 cfs**	**25.05 cfs**	**33.40 cfs**

Weighted Average Rural Regional Curve Values				**Weighted w/ Urban Regional Curve Values**	
CSA =	**8.46**	**sf**	*N/a ft (Observed Value)*	**8.46**	**sf**
W =	**8.96**	**ft**	*N/a ft (Observed Value)*	**8.96**	**ft**
D =	**0.94**	**ft**	*N/a ft (Observed Value)*	**0.94**	**ft**
Q =	**18.29**	**cfs**	*N/a ft (Observed Value)*	**18.29**	**cfs**

Bankfull Discharge Regional Curves

Project: Cow Tail **Date:** 06/15/2023
Reach: Cow Branch middle

Watershed Characteristics

0%	Valley & Ridge	0%	Piedmont	100%	Coastal	0%	Urban (> 15% Impervious)

Drainage Area: 0.908 sq mi 581.12 ac

Average Field Observed Bankfull C.S.A. =	N/a	ft
Average Field Observed Bankfull Width =	N/a	ft
Average Field Observed Bankfull Depth =	N/a	ft
Mannings Calculated Q =	N/a	ft

Rural Coastal Plain Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	USGS -VA, MD (2007-5162)
CSA =	8.78	sf	9.66 sf	11.27 sf
W =	9.29	ft	9.93 ft	10.08 ft
D =	0.95	ft	0.98 ft	1.12 ft
Q =	**8.17**	**cfs**	29.22 cfs (WCP) 13.61 cfs (ECP) **21.42 cfs (Average)**	**26.72 cfs**

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	USGS -VA, MD (200	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	20.61	sf	16.23 sf	10.77 sf	14.79 sf	20.07 sf
W =	14.01	ft	14.23 ft	12.44 ft	12.60 ft	11.41 ft
D =	1.59	ft	1.14 ft	0.86 ft	1.11 ft	1.45 ft
Q =	**85.55**	**cfs**	**78.58 cfs**	**40.06 cfs**	**51.94 cfs**	**83.06 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	USGS -VA, MD (2005-5076)
CSA =	20.24 sf	12.25 sf	11.75 sf
W =	18.38 ft	13.29 ft	11.93 ft
D =	1.08 ft	0.92 ft	0.97 ft
Q =	**93.52 cfs**	**31.07 cfs**	**40.06 cfs**

Weighted Average Rural Regional Curve Values

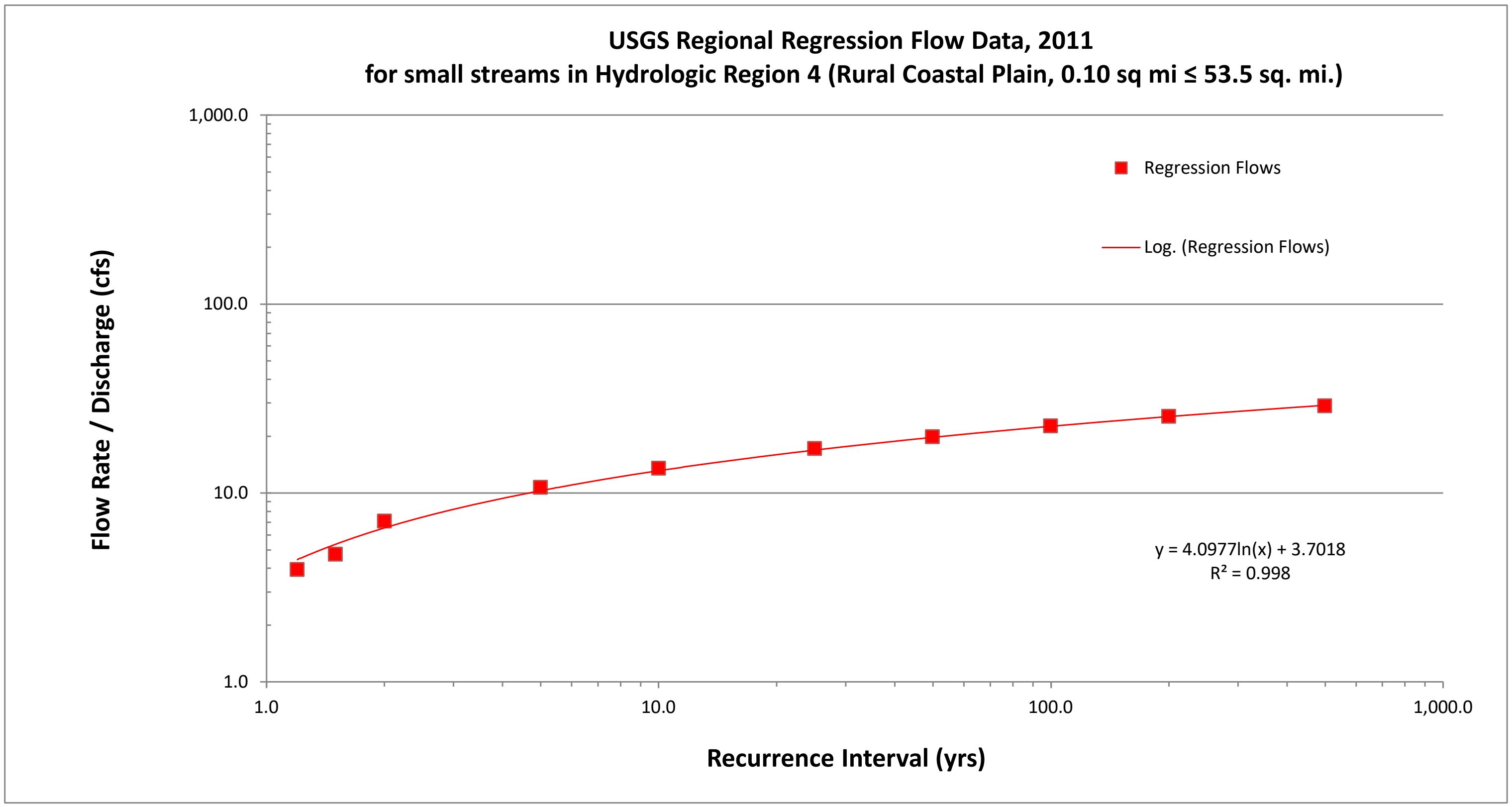
CSA =	**9.91**	**sf**	N/a ft (Observed Value)
W =	**9.77**	**ft**	N/a ft (Observed Value)
D =	**1.01**	**ft**	N/a ft (Observed Value)
Q =	**21.37**	**cfs**	N/a ft (Observed Value)

Weighted w/ Urban Regional Curve Values

9.91	**sf**
9.77	**ft**
1.01	**ft**
21.37	**cfs**

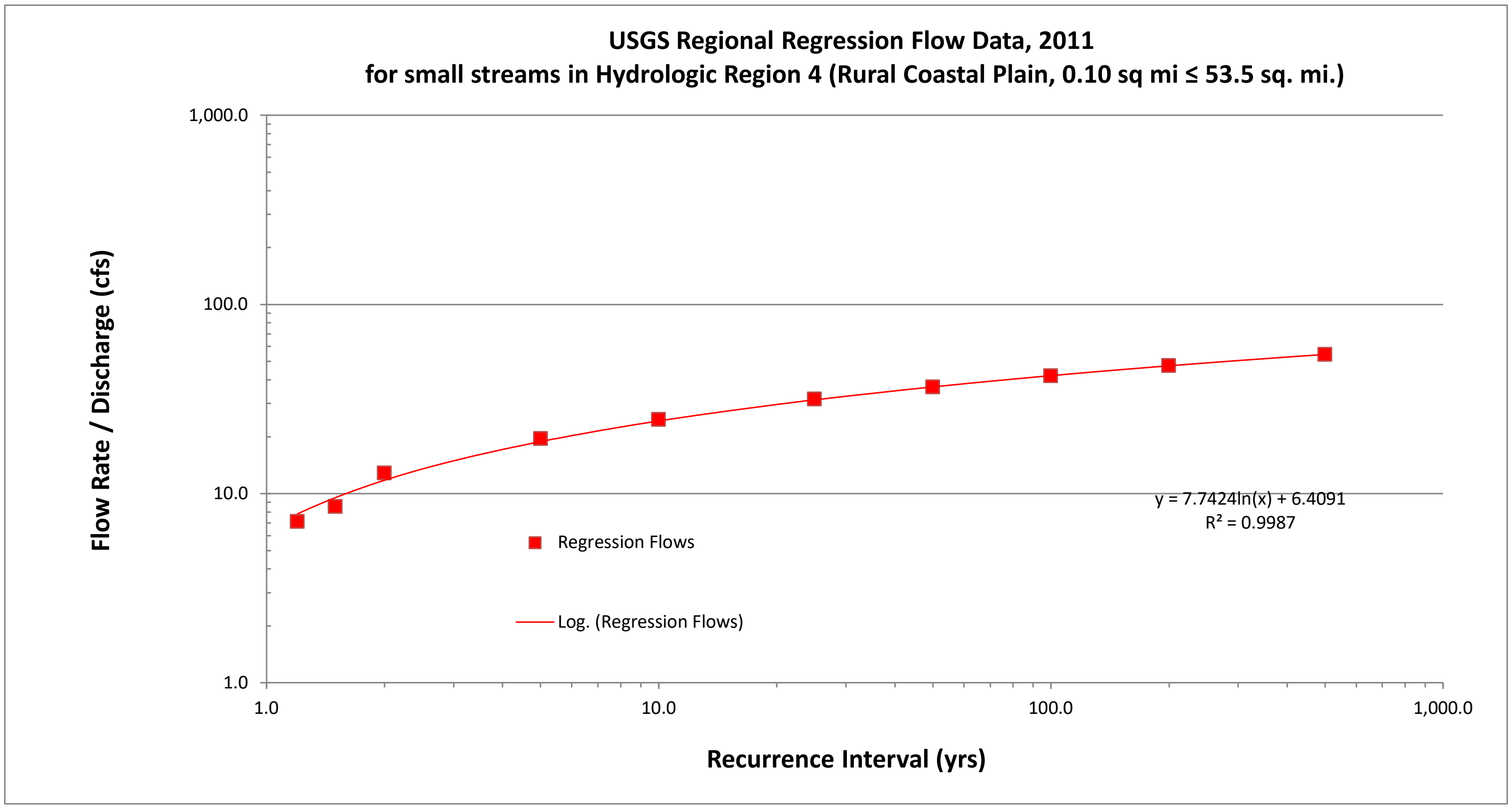
Site Description	DA (sq. mi.)	Impervious %
Cow Tail-S100	0.148	0.8

T-yr recurrence interval	AEP-annual exceedance probability	P-percent annual exceedance probability	Q-discharge estimate (cfs)	Notes
1.2	0.83	83.3%	3.9	extrapolated
1.5	0.67	66.7%	4.7	extrapolated Qgs = 0.66*Q2
2	0.5	50.0%	7.1	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
5	0.2	20.0%	10.7	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
10	0.1	10.0%	13.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
25	0.04	4.0%	17.1	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
50	0.02	2.0%	19.8	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
100	0.01	1.0%	22.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
200	0.005	0.5%	25.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
500	0.002	0.2%	28.9	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)



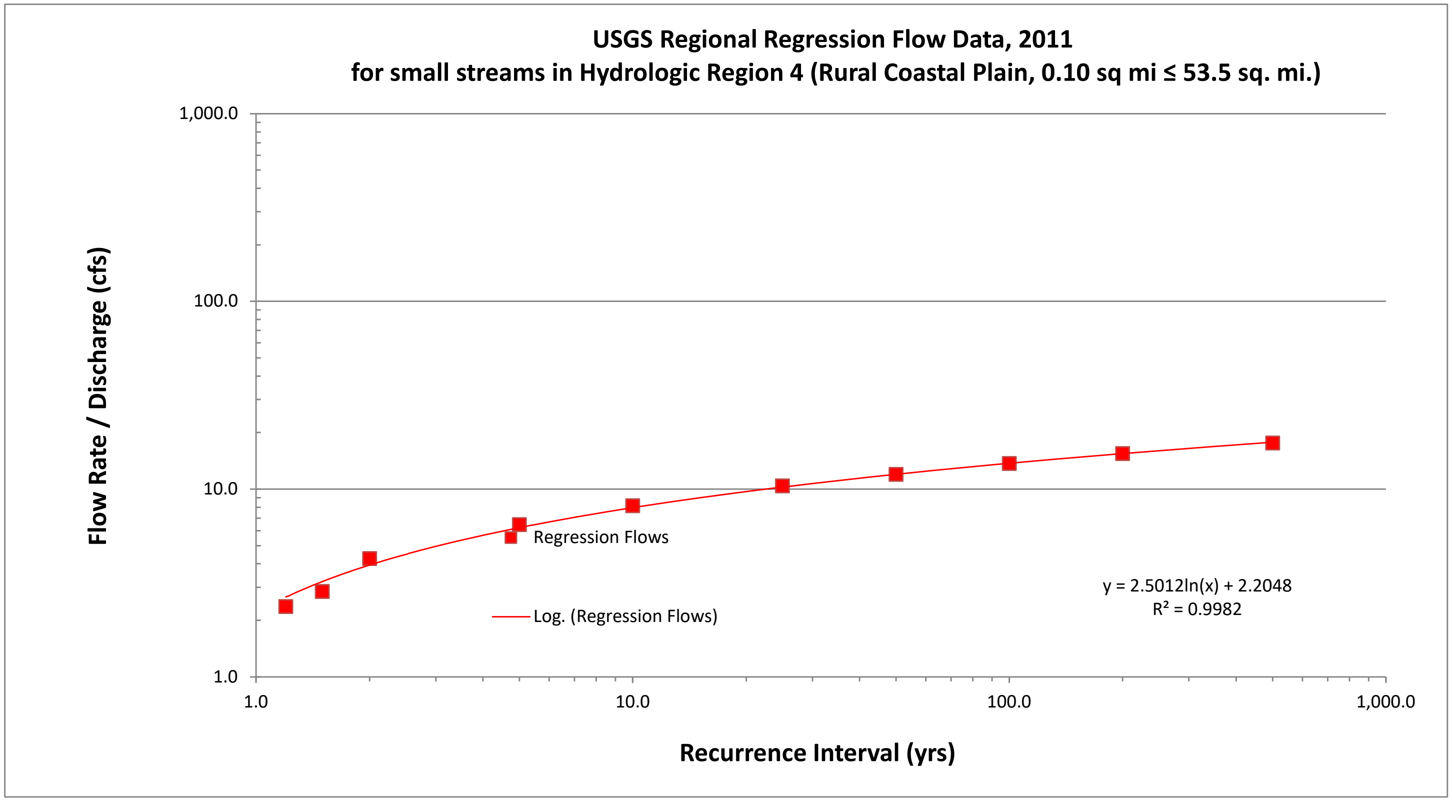
Site Description	DA (sq. mi.)	Impervious %
Cow Tail-S200	0.450	0.8

T-yr recurrence interval	AEP-annual exceedance probability	P-percent annual exceedance probability	Q-discharge estimate (cfs)	Notes
1.2	0.83	83.3%	7.1	extrapolated
1.5	0.67	66.7%	8.5	extrapolated Qgs = 0.66*Q2
2	0.5	50.0%	12.8	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
5	0.2	20.0%	19.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
10	0.1	10.0%	24.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
25	0.04	4.0%	31.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
50	0.02	2.0%	36.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
100	0.01	1.0%	41.9	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
200	0.005	0.5%	47.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
500	0.002	0.2%	54.3	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)



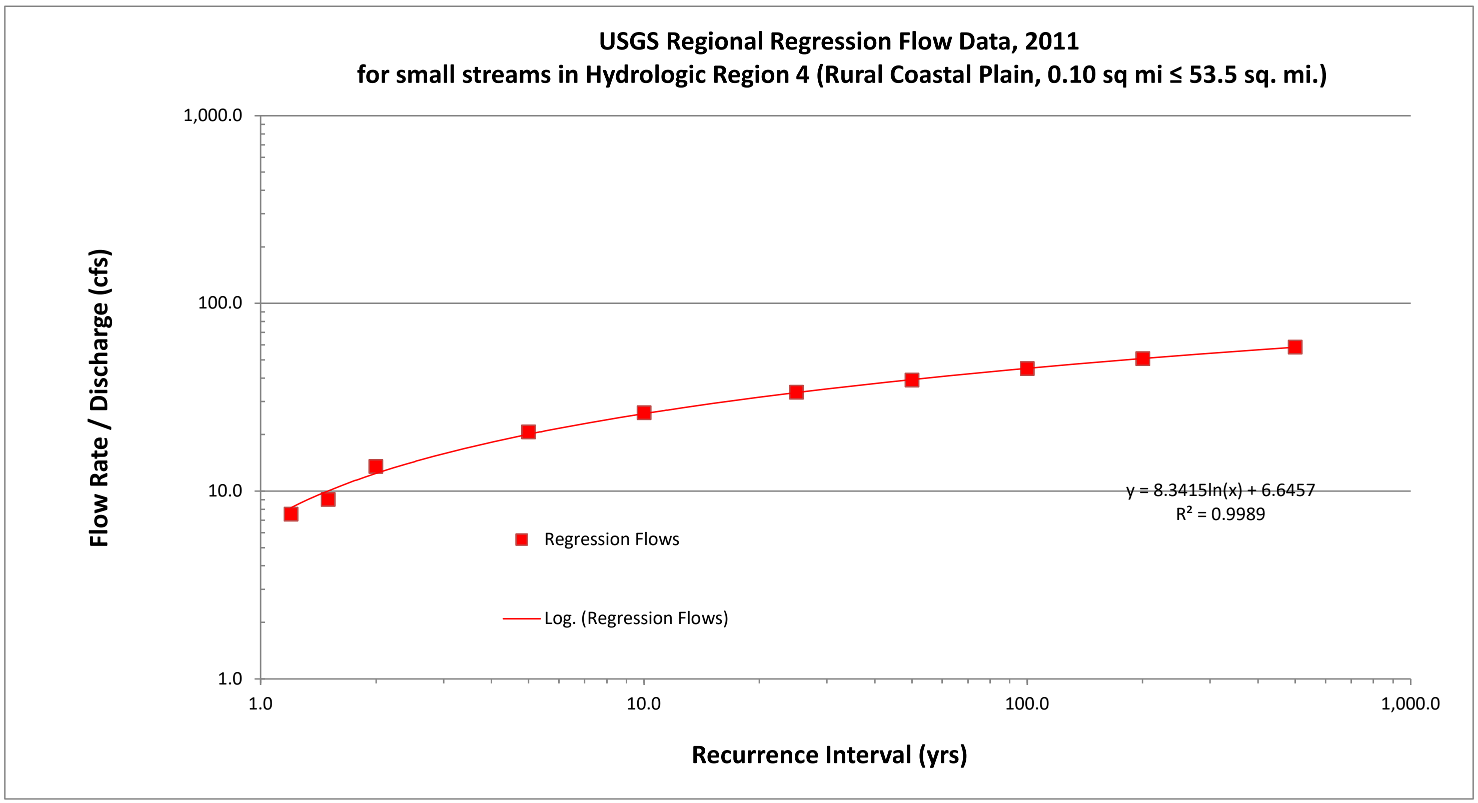
Site Description	DA (sq. mi.)	Impervious %
Cow Tail-Cow Branch upper	0.203	0.4

T-yr recurrence interval	AEP-annual exceedance probability	P-percent annual exceedance probability	Q-discharge estimate (cfs)	Notes
1.2	0.83	83.3%	2.4	extrapolated
1.5	0.67	66.7%	2.8	extrapolated Qgs = 0.66*Q2
2	0.5	50.0%	4.3	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
5	0.2	20.0%	6.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
10	0.1	10.0%	8.1	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
25	0.04	4.0%	10.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
50	0.02	2.0%	12.0	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
100	0.01	1.0%	13.7	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
200	0.005	0.5%	15.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
500	0.002	0.2%	17.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)



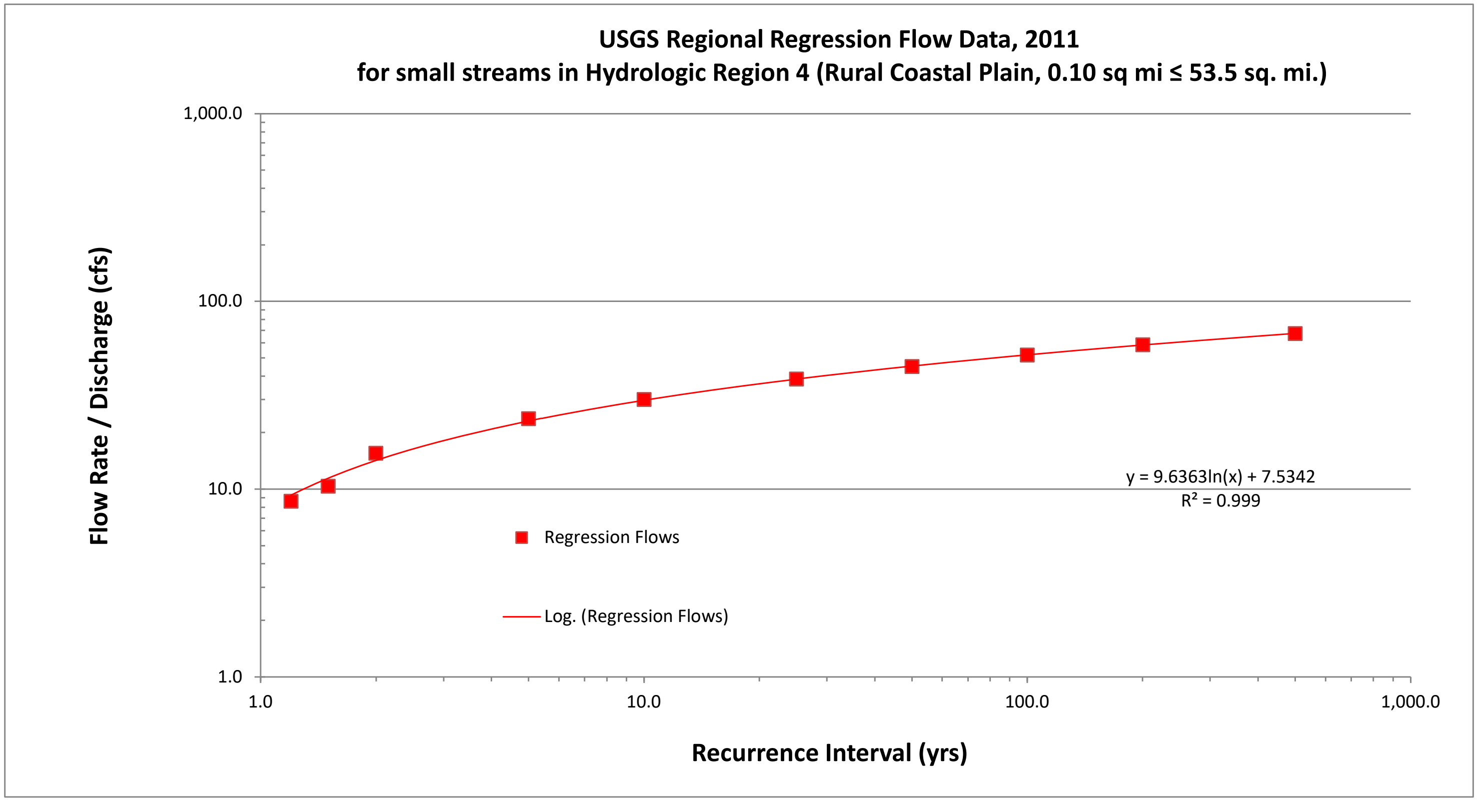
Site Description	DA (sq. mi.)	Impervious %
Cow Tail-Cow Branch middle	0.722	0.6

T-yr recurrence interval	AEP-annual exceedance probability	P-percent annual exceedance probability	Q-discharge estimate (cfs)	Notes
1.2	0.83	83.3%	7.5	extrapolated
1.5	0.67	66.7%	9.0	extrapolated Qgs = 0.66*Q2
2	0.5	50.0%	13.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
5	0.2	20.0%	20.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
10	0.1	10.0%	26.2	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
25	0.04	4.0%	33.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
50	0.02	2.0%	39.1	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
100	0.01	1.0%	44.9	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
200	0.005	0.5%	50.8	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
500	0.002	0.2%	58.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)



Site Description	DA (sq. mi.)	Impervious %
Cow Tail-Cow Branch lower	0.908	0.6

T-yr recurrence interval	AEP-annual exceedance probability	P-percent annual exceedance probability	Q-discharge estimate (cfs)	Notes
1.2	0.83	83.3%	8.6	extrapolated
1.5	0.67	66.7%	10.3	extrapolated Qgs = 0.66*Q2
2	0.5	50.0%	15.5	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
5	0.2	20.0%	23.7	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
10	0.1	10.0%	30.0	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
25	0.04	4.0%	38.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
50	0.02	2.0%	44.9	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
100	0.01	1.0%	51.7	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
200	0.005	0.5%	58.6	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)
500	0.002	0.2%	67.4	USGS regional regression, 2011 (small streams, HR4, 0.10≤53.5 sq. mi.)



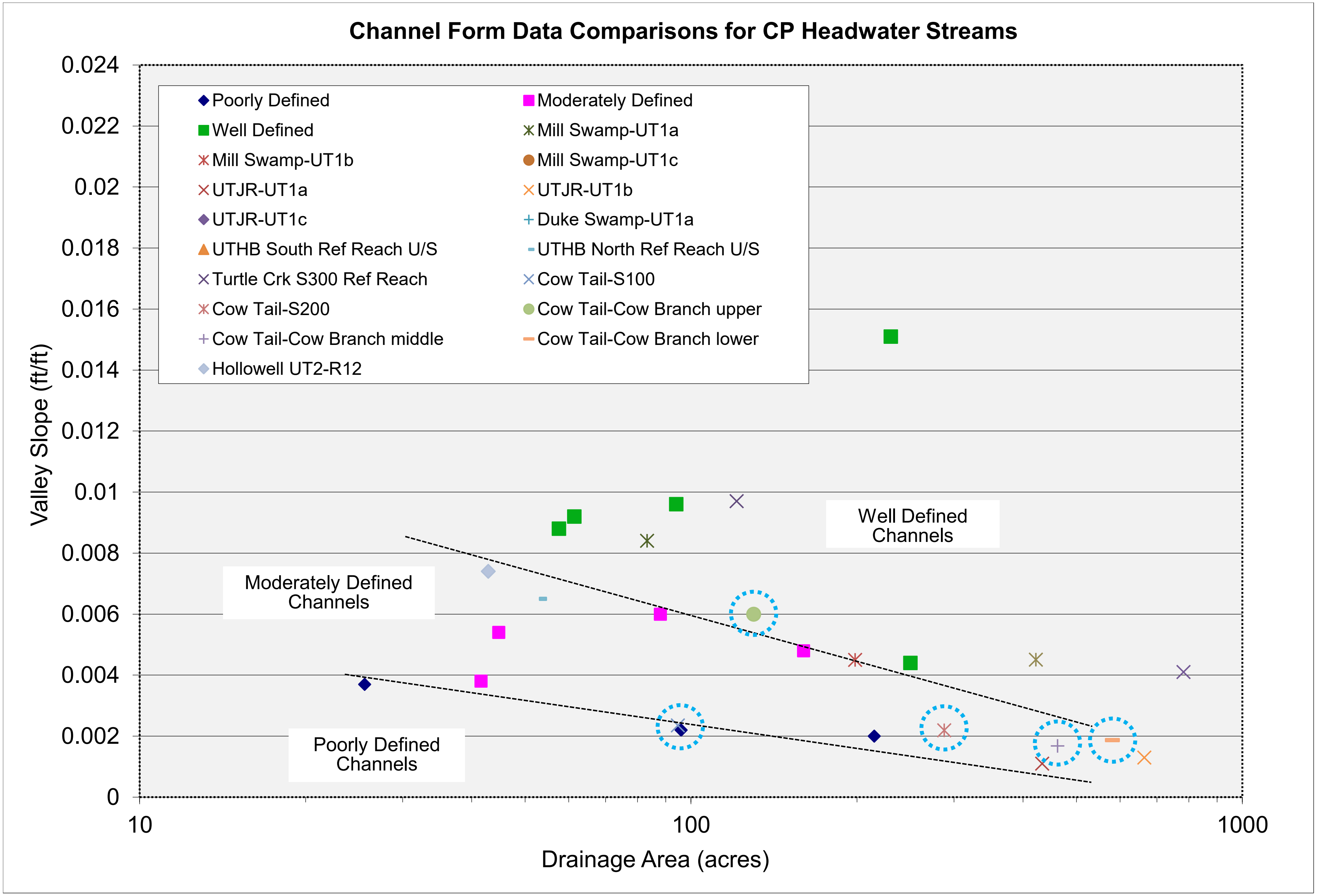
Stream Reach: Cow Branch upper (above S200 confl)	Existing Stream Values		Composite Reference Values		Proposed Design Values	
Parameter	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**	**MAX**
Drainage Area, DA (sq mi)	0.203		---		0.203	
Stream Type (Rosgen)	G5 (channelized)		DA/C5		DA/C5	
Bankfull Discharge, Qbkf (cfs)	3.7		---		3.7	
Bankfull Riffle XSEC Area, Abkf (sq ft)	7.4	11.1	---		3.4	
Bankfull Mean Velocity, Vbkf (ft/s)	0.5		---	---	1.1	
Bankfull Riffle Width, Wbkf (ft)	7.5	9.6	---	---	6.6	
Bankfull Riffle Mean Depth, Dbkf (ft)	0.6	1.0	---	---	0.5	
Width to Depth Ratio, W/D (ft/ft)	12.4	20.7	10.0	15.0	13.0	
Width Floodprone Area, Wfpa (ft)	100.0	220.0	---	---	100.0	200.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	>2.2	>2.2	>2.2	>2.2	15.0	30.1
Riffle Max Depth @ bkf, Dmax (ft)	0.9	1.4	---	---	0.7	
Riffle Max Depth Ratio, Dmax/Dbkf	1.5	1.4	1.1	1.5	1.4	1.4
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.1	2.3	1.0	1.1	1.0	1.1
Meander Length, Lm (ft)	N/A	N/A	---	---	N/A	N/A
Meander Length Ratio, Lm/Wbkf	N/A	N/A	4.0	17.0	N/A	N/A
Radius of Curvature, Rc (ft)	N/A	N/A	---	---	N/A	N/A
Rc Ratio, Rc/Wbkf	N/A	N/A	1.3	3.1	N/A	N/A
Belt Width, Wblt (ft)	N/A	N/A	---	---	N/A	N/A
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	2.0	9.0	N/A	N/A
Sinuosity, K	1.01		---	---	1.03	
Valley Slope, Sval (ft/ft)	0.0059		0.0050	0.0150	0.0059	
Channel Slope, Schan (ft/ft)	0.0061		---	---	0.0030	
Slope Riffle, Sriff (ft/ft)	0.0050	0.0080	---	---	0.0030	0.0040
Riffle Slope Ratio, Sriff/Schan	0.8	1.3	1.2	1.5	1.0	1.3
Slope Pool, Spool (ft/ft)	0.0000	0.0088	---	---	0.0000	0.0007
Pool Slope Ratio, Spool/Schan	0.0	1.4	0.0	0.2	0.0	0.2
Pool Max Depth, Dmaxpool (ft)	1.2	1.6	---	---	0.8	1.0
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.0	1.6	1.3	2.5	1.6	2.0
Pool Width, Wpool (ft)	7.9	9.6	---	---	8.0	10.0
Pool Width Ratio, Wpool/Wbkf	1.1	1.0	0.9	1.5	1.2	1.5
Pool-Pool Spacing, Lps (ft)	66.0	113.0	---	---	40.0	60.0
Pool-Pool Spacing Ratio, Lps/Wbkf	8.8	11.8	3.0	8.0	6.0	9.0

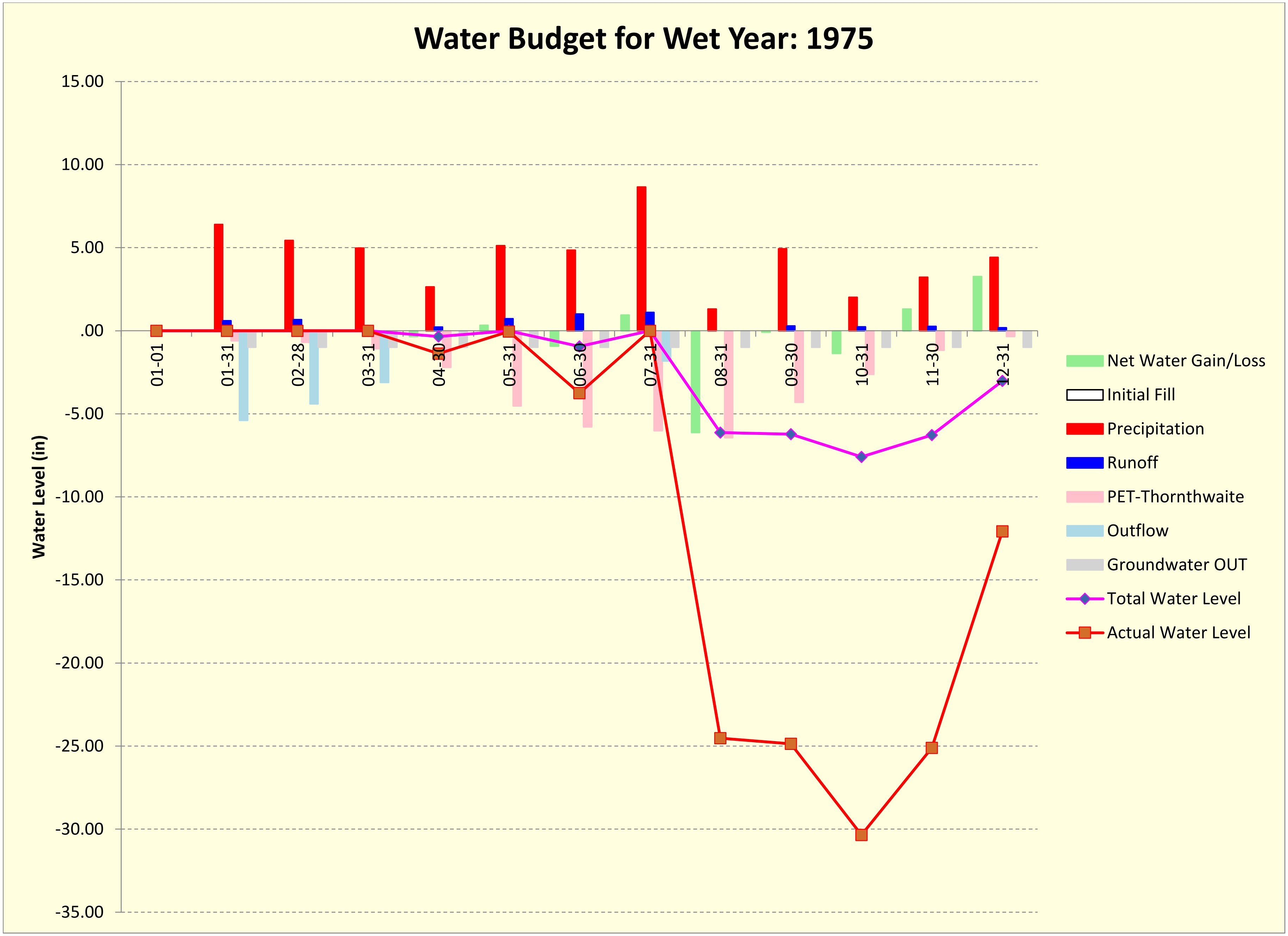
Stream Reach: Cow Branch middle (below S200 confl)	Existing Stream Values		Composite Reference Values		Proposed Design Values	
Parameter	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**	**MAX**
Drainage Area, DA (sq mi)	0.722		---		0.722	
Stream Type (Rosgen)	G5 (channelized)		E5/C5		C5	
Bankfull Discharge, Qbkf (cfs)	7.8		---		7.8	
Bankfull Riffle XSEC Area, Abkf (sq ft)	21.2	31.6	---		7.6	
Bankfull Mean Velocity, Vbkf (ft/s)	0.4		---	---	1.0	
Bankfull Riffle Width, Wbkf (ft)	14.9	20.3	---	---	9.9	
Bankfull Riffle Mean Depth, Dbkf (ft)	1.4	1.5	---	---	0.8	
Width to Depth Ratio, W/D (ft/ft)	7.9	9.2	10.0	15.0	13.0	
Width Floodprone Area, Wfpa (ft)	100.0	300.0	---	---	120.0	200.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.8	>2.2	>2.2	>2.2	12.1	20.1
Riffle Max Depth @ bkf, Dmax (ft)	1.3	2.3	---	---	1.0	
Riffle Max Depth Ratio, Dmax/Dbkf	1.0	1.5	1.1	1.5	1.4	1.4
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.4	2.2	1.0	1.1	1.0	1.1
Meander Length, Lm (ft)	N/A	N/A	---	---	150.0	220.0
Meander Length Ratio, Lm/Wbkf	N/A	N/A	7.0	17.0	15.1	22.1
Radius of Curvature, Rc (ft)	N/A	N/A	---	---	22.0	32.0
Rc Ratio, Rc/Wbkf	N/A	N/A	1.3	3.1	2.2	3.2
Belt Width, Wblt (ft)	N/A	N/A	---	---	50.0	80.0
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	2.0	9.0	6.0	9.0
Sinuosity, K	1.01		1.2	1.4	1.11	
Valley Slope, Sval (ft/ft)	0.0017		0.0050	0.0150	0.0017	
Channel Slope, Schan (ft/ft)	0.0018		---	---	0.0016	
Slope Riffle, Sriff (ft/ft)	0.0018	0.0022	---	---	0.0020	0.0028
Riffle Slope Ratio, Sriff/Schan	1.0	1.2	1.2	1.5	1.3	1.8
Slope Pool, Spool (ft/ft)	0.0000	0.0010	---	---	0.0000	0.0005
Pool Slope Ratio, Spool/Schan	0.0	0.6	0.0	0.2	0.0	0.3
Pool Max Depth, Dmaxpool (ft)	1.2	1.6	---	---	1.2	1.6
Pool Max Depth Ratio, Dmaxpool/Dbkf	0.9	1.1	1.3	2.5	1.6	2.1
Pool Width, Wpool (ft)	7.9	9.6	---	---	12.0	12.0
Pool Width Ratio, Wpool/Wbkf	0.5	0.5	0.9	1.5	1.2	1.2
Pool-Pool Spacing, Lps (ft)	61.0	171.0	---	---	50.0	130.0
Pool-Pool Spacing Ratio, Lps/Wbkf	4.1	8.4	3.5	7.0	5.0	13.1

Stream Reach: Cow Branch lower (below S100 confl)	Existing Stream Values		Composite Reference Values		Proposed Design Values	
Parameter	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**	**MAX**
Drainage Area, DA (sq mi)	0.908		---		0.908	
Stream Type (Rosgen)	G5 (channelized)		E5/C5		C5	
Bankfull Discharge, Qbkf (cfs)	9.8		---		9.8	
Bankfull Riffle XSEC Area, Abkf (sq ft)	14.2	26.8	---		9.0	
Bankfull Mean Velocity, Vbkf (ft/s)	0.7				1.1	
Bankfull Riffle Width, Wbkf (ft)	10.2	15.4	---	---	10.8	
Bankfull Riffle Mean Depth, Dbkf (ft)	1.4	1.8	---	---	0.8	
Width to Depth Ratio, W/D (ft/ft)	7.4	8.8	10.0	15.0	13.0	
Width Floodprone Area, Wfpa (ft)	100.0	200.0	---	---	80.0	150.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.9	>2.2	>2.2	>2.2	7.4	13.9
Riffle Max Depth @ bkf, Dmax (ft)	1.7	2.3	---	---	1.1	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2	1.3	1.1	1.5	1.3	1.3
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.4	3.3	1.0	1.1	1.0	1.1
Meander Length, Lm (ft)	N/A	N/A	---	---	150.0	220.0
Meander Length Ratio, Lm/Wbkf	N/A	N/A	7.0	17.0	13.9	20.3
Radius of Curvature, Rc (ft)	N/A	N/A	---	---	25.0	35.0
Rc Ratio, Rc/Wbkf	N/A	N/A	1.3	3.1	2.3	3.2
Belt Width, Wblt (ft)	N/A	N/A	---	---	50.0	80.0
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	2.0	9.0	4.6	7.4
Sinuosity, K	1.01		1.2	1.4	1.10	
Valley Slope, Sval (ft/ft)	0.0019		0.0050	0.0150	0.0019	
Channel Slope, Schan (ft/ft)	0.0019		---	---	0.0017	
Slope Riffle, Sriff (ft/ft)	0.0019	0.0022	---	---	0.0020	0.0065
Riffle Slope Ratio, Sriff/Schan	1.0	1.2	1.2	1.5	1.2	3.8
Slope Pool, Spool (ft/ft)	0.0000	0.0010	---	---	0.0000	0.0005
Pool Slope Ratio, Spool/Schan	0.0	0.5	0.0	0.2	0.0	0.3
Pool Max Depth, Dmaxpool (ft)	1.1	1.5	---	---	1.8	1.8
Pool Max Depth Ratio, Dmaxpool/Dbkf	0.8	0.8	1.5	2.5	2.2	2.2
Pool Width, Wpool (ft)	14.3	17.6	---	---	13.2	13.2
Pool Width Ratio, Wpool/Wbkf	1.4	1.1	0.9	1.5	1.2	1.2
Pool-Pool Spacing, Lps (ft)	59.0	168.0	---	---	40.0	80.0
Pool-Pool Spacing Ratio, Lps/Wbkf	5.8	10.9	3.5	7.0	3.7	7.4

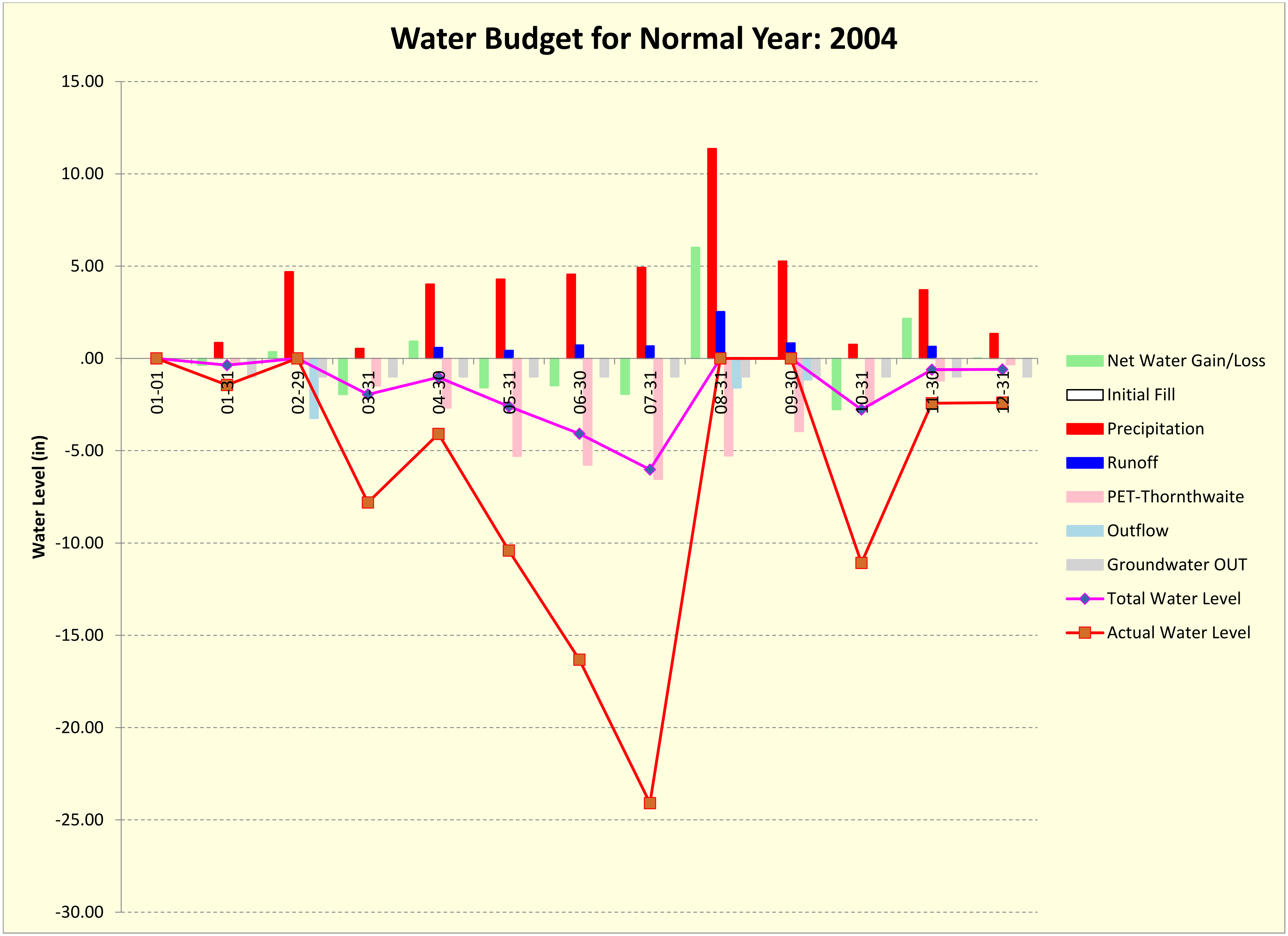
Stream Reach: S100	Existing Stream Values		Composite Reference Values		Proposed Design Values	
Parameter	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**	**MAX**
Drainage Area, DA (sq mi)	0.148		---		0.148	
Stream Type (Rosgen)	G5 (channelized)		E5/C5		C5	
Bankfull Discharge, Qbkf (cfs)	3.1		---		3.1	
Bankfull Riffle XSEC Area, Abkf (sq ft)	9.9	25.1	---		2.5	
Bankfull Mean Velocity, Vbkf (ft/s)	0.3		---	---	1.2	
Bankfull Riffle Width, Wbkf (ft)	5.3	9.7	---	---	5.7	
Bankfull Riffle Mean Depth, Dbkf (ft)	0.5	1.6	---	---	0.4	
Width to Depth Ratio, W/D (ft/ft)	4.7	11.2	10.0	15.0	13.0	
Width Floodprone Area, Wfpa (ft)	100.0	300.0	---	---	100.0	160.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.3	>2.2	>2.2	>2.2	17.5	28.1
Riffle Max Depth @ bkf, Dmax (ft)	0.9	1.6	---	---	0.6	
Riffle Max Depth Ratio, Dmax/Dbkf	1.8	1.3	1.1	1.5	1.3	1.3
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.7	2.6	1.0	1.1	1.0	1.1
Meander Length, Lm (ft)	N/A	N/A	---	---	N/A	N/A
Meander Length Ratio, Lm/Wbkf	N/A	N/A	7.0	17.0	N/A	N/A
Radius of Curvature, Rc (ft)	N/A	N/A	---	---	N/A	N/A
Rc Ratio, Rc/Wbkf	N/A	N/A	1.3	3.1	N/A	N/A
Belt Width, Wblt (ft)	N/A	N/A	---	---	N/A	N/A
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	2.0	9.0	N/A	N/A
Sinuosity, K	1.01		1.2	1.4	1.04	
Valley Slope, Sval (ft/ft)	0.0024		0.0050	0.0150	0.0024	
Channel Slope, Schan (ft/ft)	0.0024		---	---	0.0023	
Slope Riffle, Sriff (ft/ft)	0.0017	0.0072	---	---	0.0020	0.0050
Riffle Slope Ratio, Sriff/Schan	0.7	3.0	1.2	1.5	0.9	2.2
Slope Pool, Spool (ft/ft)	0.0000	0.0010	---	---	0.0000	0.0007
Pool Slope Ratio, Spool/Schan	0.0	0.4	0.0	0.2	0.0	0.3
Pool Max Depth, Dmaxpool (ft)	0.7	1.3	---	---	0.7	1.0
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.4	0.8	1.3	2.5	1.6	2.3
Pool Width, Wpool (ft)	11.9	14.1	---	---	6.0	8.0
Pool Width Ratio, Wpool/Wbkf	2.2	1.5	0.9	1.5	1.1	1.4
Pool-Pool Spacing, Lps (ft)	58.0	87.0	---	---	30.0	50.0
Pool-Pool Spacing Ratio, Lps/Wbkf	10.9	9.0	3.5	7.0	5.3	8.8

Stream Reach: S200	Existing Stream Values		Composite Reference Values		Proposed Design Values	
Parameter	**MIN**	**MAX**	**MIN**	**MAX**	**MIN**	**MAX**
Drainage Area, DA (sq mi)	0.450		---		0.450	
Stream Type (Rosgen)	G5/channelized		E5/C5		C5	
Bankfull Discharge, Qbkf (cfs)	6.8		---		6.8	
Bankfull Riffle XSEC Area, Abkf (sq ft)	15.6	25.1	---		5.1	
Bankfull Mean Velocity, Vbkf (ft/s)	0.4		---	---	1.3	
Bankfull Riffle Width, Wbkf (ft)	9.4	13.2	---	---	8.1	
Bankfull Riffle Mean Depth, Dbkf (ft)	1.7	2.2	---	---	0.6	
Width to Depth Ratio, W/D (ft/ft)	5.9	8.1	10.0	15.0	12.9	
Width Floodprone Area, Wfpa (ft)	100.0	200.0	---	---	70.0	120.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	1.4	>2.2	>2.2	>2.2	8.6	14.8
Riffle Max Depth @ bkf, Dmax (ft)	1.2	3.1	---	---	0.8	
Riffle Max Depth Ratio, Dmax/Dbkf	0.7	1.3	1.1	1.5	1.3	1.3
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.6	2.6	1.0	1.1	1.0	1.1
Meander Length, Lm (ft)	N/A	N/A	---	---	N/A	N/A
Meander Length Ratio, Lm/Wbkf	N/A	N/A	7.0	17.0	N/A	N/A
Radius of Curvature, Rc (ft)	N/A	N/A	---	---	N/A	N/A
Rc Ratio, Rc/Wbkf	N/A	N/A	1.3	3.1	N/A	N/A
Belt Width, Wblt (ft)	N/A	N/A	---	---	N/A	N/A
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	2.0	9.0	N/A	N/A
Sinuosity, K	1.01		1.2	1.4	1.02	
Valley Slope, Sval (ft/ft)	0.0022		0.0050	0.0150	0.0022	
Channel Slope, Schan (ft/ft)	0.0022		---	---	0.0021	
Slope Riffle, Sriff (ft/ft)	0.0050	0.0080	---	---	0.0005	0.0025
Riffle Slope Ratio, Sriff/Schan	2.3	3.6	1.2	1.5	0.2	1.2
Slope Pool, Spool (ft/ft)	0.0000	0.0010	---	---	0.0000	0.0005
Pool Slope Ratio, Spool/Schan	0.0	0.5	0.0	0.2	0.0	0.2
Pool Max Depth, Dmaxpool (ft)	1.1	1.3	---	---	1.0	1.3
Pool Max Depth Ratio, Dmaxpool/Dbkf	0.6	0.6	1.3	2.5	1.6	2.1
Pool Width, Wpool (ft)	14.1	17.4	---	---	9.6	9.6
Pool Width Ratio, Wpool/Wbkf	1.5	1.3	0.9	1.5	1.2	1.2
Pool-Pool Spacing, Lps (ft)	55.0	133.0	---	---	40.0	110.0
Pool-Pool Spacing Ratio, Lps/Wbkf	5.9	10.1	3.5	7.0	4.9	13.6

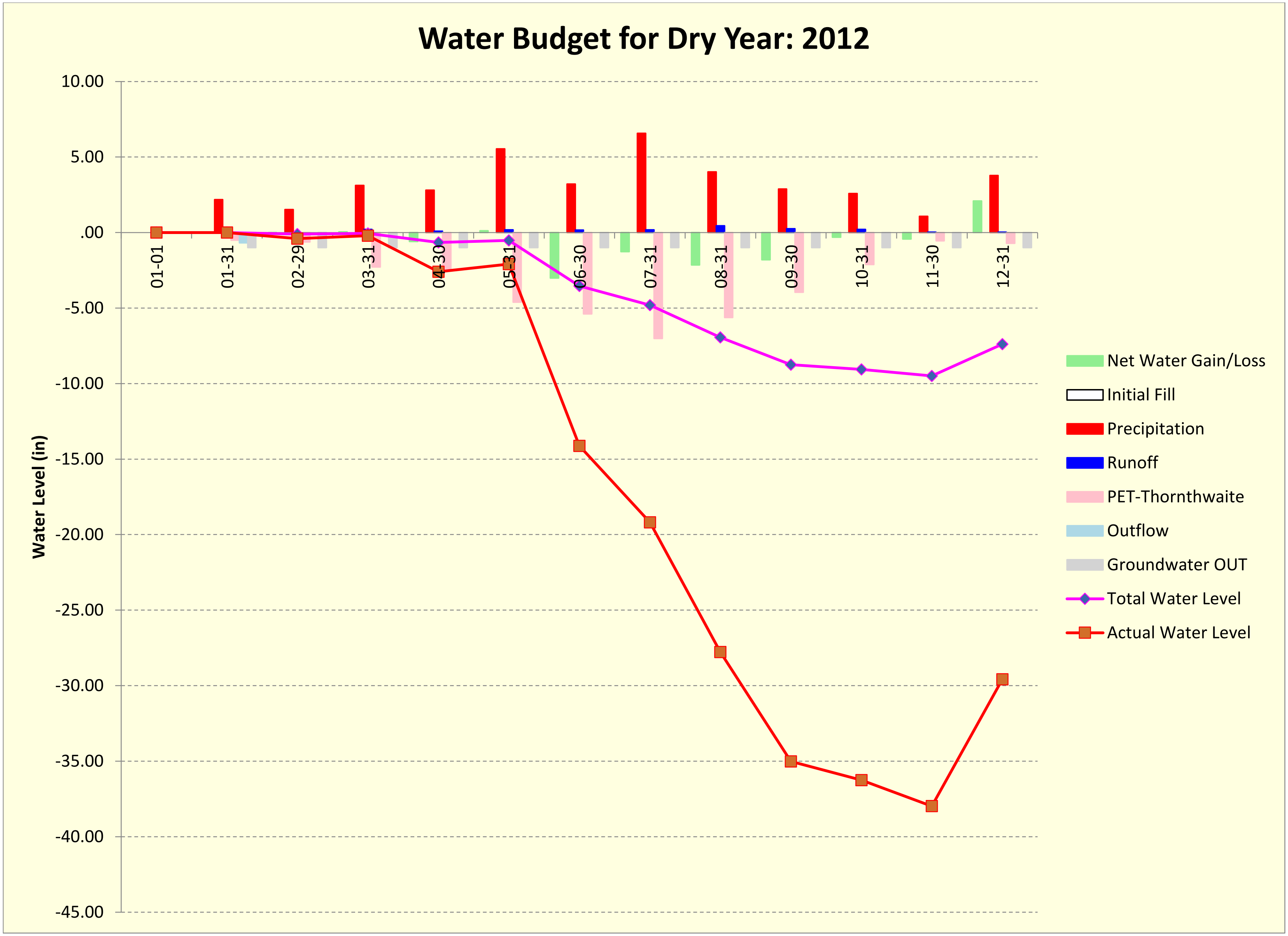

Channel Form Data Comparisons for CP Headwater Streams
Poorly Defined
Moderately Defined
Well Defined
Mill Swamp-UT1a
Mill Swamp-UT1b
Mill Swamp-UT1c
UTJR-UT1a
UTJR-UT1b
UTJR-UT1c
Duke Swamp-UT1a
UTHB South Ref Reach U/S
UTHB North Ref Reach U/S
Turtle Crk S300 Ref Reach
Cow Tail-S100
Cow Tail-S200
Cow Tail-Cow Branch upper
Cow Tail-Cow Branch middle
Cow Tail-Cow Branch lower
Hollowell UT2-R12
Well Defined Channels
Moderately Defined Channels
Poorly Defined Channels
Valley Slope (ft/ft)
Drainage Area (acres)
0.024
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
10
100
1000



Water Budget for Wet Year: 1975
Water Level (in)
15.00
10.00
5.00
.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
01-01
01-31
02-28
03-31
04-30
05-31
06-30
07-31
08-31
09-30
10-31
11-30
12-31
Net Water Gain/Loss
Initial Fill
Precipitation
Runoff
PET-Thornthwaite
Outflow
Groundwater OUT
Total Water Level
Actual Water Level



Water Budget for Normal Year: 2004
Water Level (in)
15.00
10.00
5.00
.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
01-01
01-31
02-29
03-31
04-30
05-31
06-30
07-31
08-31
09-30
10-31
11-30
12-31
Net Water Gain/Loss
Initial Fill
Precipitation
Runoff
PET-Thornthwaite
Outflow
Groundwater OUT
Total Water Level
Actual Water Level


Water Budget for Dry Year: 2012
Water Level (in)
10.00
5.00
.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
-40.00
-45.00
01-01
01-31
02-29
03-31
04-30
05-31
06-30
07-31
08-31
09-30
10-31
11-30
12-31
Net Water Gain/Loss
Initial Fill
Precipitation
Runoff
PET-Thornthwaite
Outflow
Groundwater OUT
Total Water Level
Actual Water Level

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/18/2023 3:36:17 PM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D1-SB 109, 115

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2 ft
Depth to Restrictive Layer: 3 ft
Drainable Porosity: 0.04

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 7.7185 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	14	1.98	5.95	3.968496
Layer 2	21	1.98	5.95	3.968496
Layer 3	36	5.95	19.98	12.968478

Lateral Effect: 93.7 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/18/2023 3:32:42 PM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****
Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D2 upper S100-SB 207, S210

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.7 ft
Depth to Restrictive Layer: 2.7 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 12.72 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 10.4685 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6	1.98	5.95	3.968496
Layer 2	9	1.98	5.95	3.968496
Layer 3	32.4	5.95	19.98	12.968478

Lateral Effect: 115.2 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/18/2023 3:25:20 PM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****
Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D3-SB 141, 148

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.1 ft
Depth to Restrictive Layer: 2.5 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.76 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 3.9685 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	30	1.98	5.95	3.968496

Lateral Effect: 58.2 ft

----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/31/2023 8:47:11 AM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****
Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D4-SB 156

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.2 ft
Depth to Restrictive Layer: 2.7 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.92 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 22.8889 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6	3	9	6.00
Layer 2	9	6	12	9.00
Layer 3	32.4	19	39	29.00

Lateral Effect: 158.2 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/24/2023 3:42:13 PM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****
Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.423784, -78.845966

Soil ID: Torhunta

Notes: EX D5-SB 65

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2 ft
Depth to Restrictive Layer: 3 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 8.6572 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	13	1.98	5.95	3.968496
Layer 3	25	5.95	9.95	7.95
Layer 4	36	9.95	19.98	14.97

Lateral Effect: 103.2 ft

```
*********************************************************************************
----Lateral Effect Program Summary----
Application of Skaggs Method
Copyright 2006-2014. Brian D Phillips, R Wayne Skaggs, G M Chescheir
North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/18/2023 3:09:39 PM
Output Filename:  C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

*********************************************************************************

Project Information
-------------------------------------------------------------------
Project :  Cow Tail
User:  Kayne
Company / Agency:  WLS
Department:  Ecosystem Restoration

Project Location:  Columbus County
Project Coordinates:  34.429414, -78.847936

Soil ID:  Stallings

Notes: EX D6-SB 15, 162

Site Parameters
-------------------------------------------------------------------
State:  North_Carolina
County / Parish:  Columbus

Surface Storage:  1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface:  2.5 ft
Depth to Restrictive Layer:  3 ft
Drainable Porosity:  0.04

Hydroperiod:  14 days

User defined T25 or Default T25:  DEFAULT
T25 value:  12.4 days

User Conductivity or Soil Survey Conductivity:  SOIL SURVEY
Weighted Hydraulic Conductivity:  6.9685 in/hr

Hydraulic Conductivity Data by Layer for Soil: St__Stallings__undrained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

     Bottom Depth in      Low K in/hr          High K in/hr        Average K in/hr
Layer 1   8.00                5.95                19.98               12.968478
Layer 2   12.00               5.95                19.98               12.968478
Layer 3   36.00               1.98                5.95                3.968496

 ----------------------------------------------
 Lateral Effect: 101.6 ft
 ----------------------------------------------
```

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/18/2023 3:46:58 PM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D7-SB 74, 205

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.1 ft
Depth to Restrictive Layer: 2.8 ft
Drainable Porosity: 0.04

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.76 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 15.0297 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6.00	1.98	5.95	3.968496
Layer 2	9.00	1.98	5.95	3.968496
Layer 3	19.00	5.95	19.98	12.968478
Layer 4	33.6	19.98	26.54	23.26

Lateral Effect: 125.4 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 7/19/2023 8:38:55 AM
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.429414, -78.847936

Soil ID: Torhunta

Notes: EX D8-SB 206

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.0 ft
Depth to Restrictive Layer: 2.4 ft
Drainable Porosity: 0.04

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 13.7028 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6	1.98	5.95	3.968496
Layer 2	10	1.98	5.95	3.968496
Layer 3	18	5.95	19.98	12.968478
Layer 4	28.8	19.98	26.54	23.26

Lateral Effect: 95.9 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/16/2024 04:30
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426029, -78.839961

Soil ID: Torhunta

Notes: EX D9-SB 198, 199

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.2 ft
Depth to Restrictive Layer: 3.1 ft
Drainable Porosity: 0.04

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.92 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 15.5784 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6	1.98	5.95	3.968496
Layer 2	9	1.98	5.95	3.968496
Layer 3	19	5.95	19.98	12.968478

Layer 4	36	19.98	26.54	23.26

Lateral Effect: 141.9 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 10:37
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426754, -78.840074

Soil ID: Torhunta

Notes: EX 10-SB 56, 78

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2.1 ft
Depth to Restrictive Layer: 3.5 ft
Drainable Porosity: 0.04

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.76 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 16.6757 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	6	1.98	5.95	3.968496
Layer 2	9	1.98	5.95	3.968496
Layer 3	19	5.95	19.98	12.968478

Layer 4	42	19.98	26.54	23.26

Lateral Effect: 165.7 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 11:23
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.423112, -78.847982

Soil ID: Torhunta

Notes: EX D11-SB 18

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2 ft
Depth to Restrictive Layer: 3.5 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 9.5591 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	13	1.98	5.95	3.968496
Layer 3	25	5.95	9.95	7.95

Layer 4	42	9.95	19.98	14.97

Lateral Effect: 125.6 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 11:47
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426278, -78.846713

Soil ID: Torhunta

Notes: EX D12-SB 112

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2 ft
Depth to Restrictive Layer: 4 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 10.2354 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	13	1.98	5.95	3.968496
Layer 3	25	5.95	9.95	7.95

Layer 4	48	9.95	19.98	14.97

Lateral Effect: 145.7 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 11:50
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426182, -78.846668

Soil ID: Torhunta

Notes: EX D13-SB 112

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 2 ft
Depth to Restrictive Layer: 4 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.6 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 10.2354 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	13	1.98	5.95	3.968496
Layer 3	25	5.95	9.95	7.95

Layer 4	48	9.95	19.98	14.97

Lateral Effect: 145.7 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 11:53
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426933, -78.846822

Soil ID: Torhunta

Notes: EX D14-SB211

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 1 ft
Depth to Restrictive Layer: 1 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.7 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 8.2992 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	6	1.98	5.95	3.968496
Layer 3	8	5.95	9.95	7.95

Layer 4	12	9.95	19.98	14.97

Lateral Effect: 3.6 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/17/2024 11:57
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.427075, -78.846176

Soil ID: Torhunta

Notes: EX D15-SB207

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 1 ft
Depth to Restrictive Layer: 1 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.7 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 8.2992 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	6	1.98	5.95	3.968496
Layer 3	8	5.95	9.95	7.95

Layer 4	12	9.95	19.98	14.97

Lateral Effect: 4.5 ft

****
----Lateral Effect Program Summary----
Application of Skaggs Method

North Carolina State University Dept of Biological & Agricultural Engineering
Version: 2.8.1.0
Project Run Date and Time: 01/31/2024 15:22:17
Output Filename: C:\LateralEffect\outputs\Lateral_Effect_Summary.txt

****

Project Information

Project : Cow Tail
User: Kayne
Company / Agency: WLS
Department: Ecosystem Restoration

Project Location: Columbus County
Project Coordinates: 34.426758° -78.845560°

Soil ID: Torhunta

Notes: EX D16-SB04

Site Parameters

State: North_Carolina
County / Parish: Columbus

Surface Storage: 1_inch_(2.5_cm)
Ditch Depth or Depth to Water Surface: 1 ft
Depth to Restrictive Layer: 1 ft
Drainable Porosity: 0.037

Hydroperiod: 14 days

User defined T25 or Default T25: DEFAULT
T25 value: 11.7 days

User Conductivity or Soil Survey Conductivity: SOIL SURVEY
Weighted Hydraulic Conductivity: 8.2992 in/hr

Hydraulic Conductivity Data by Layer for Soil: To__Torhunta__drained
Weighted Hydraulic Conductivity Calculated Using: Average K Values

	Bottom Depth in	Low K in/hr	High K in/hr	Average K in/hr
Layer 1	5	1.98	5.95	3.968496
Layer 2	6	1.98	5.95	3.968496
Layer 3	8	5.95	9.95	7.95
Layer 4	12	9.95	19.98	14.97

Lateral Effect: 3.6 ft

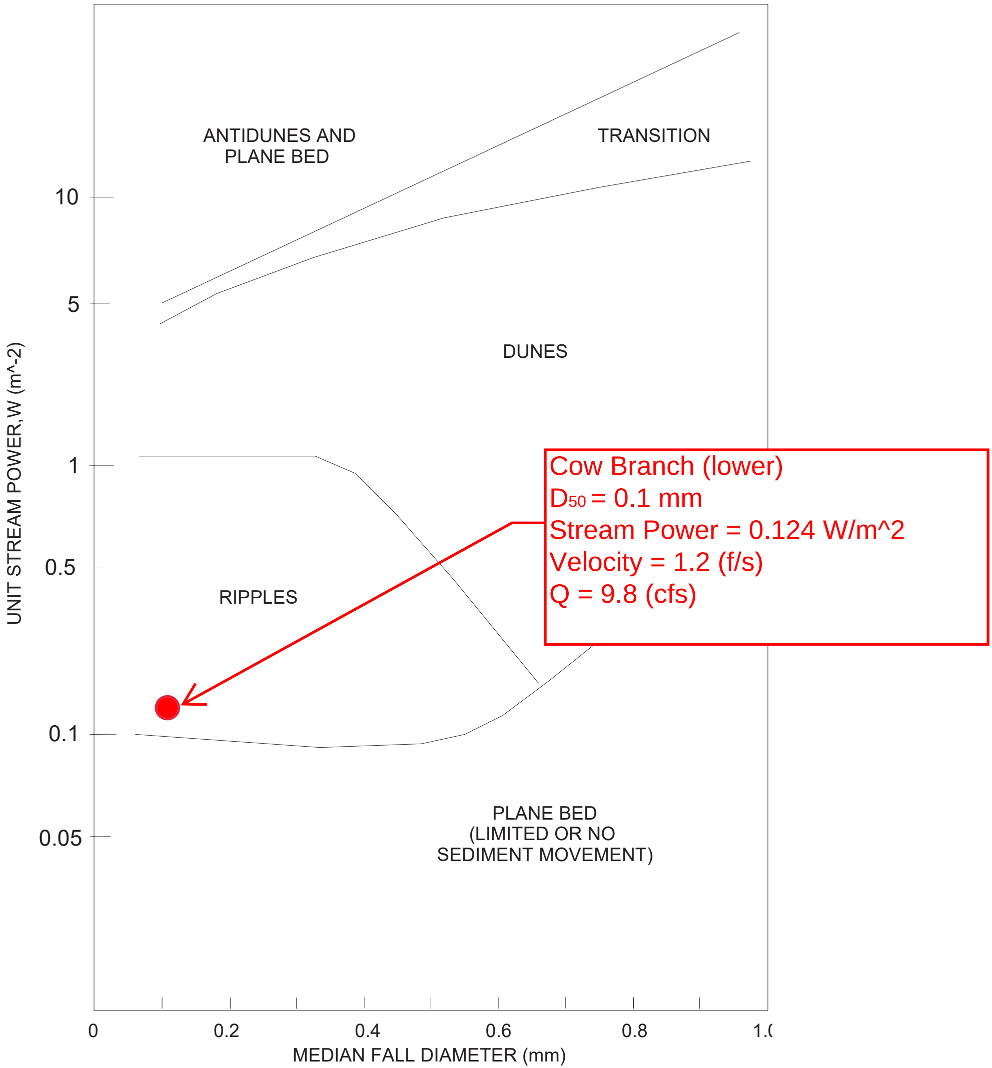
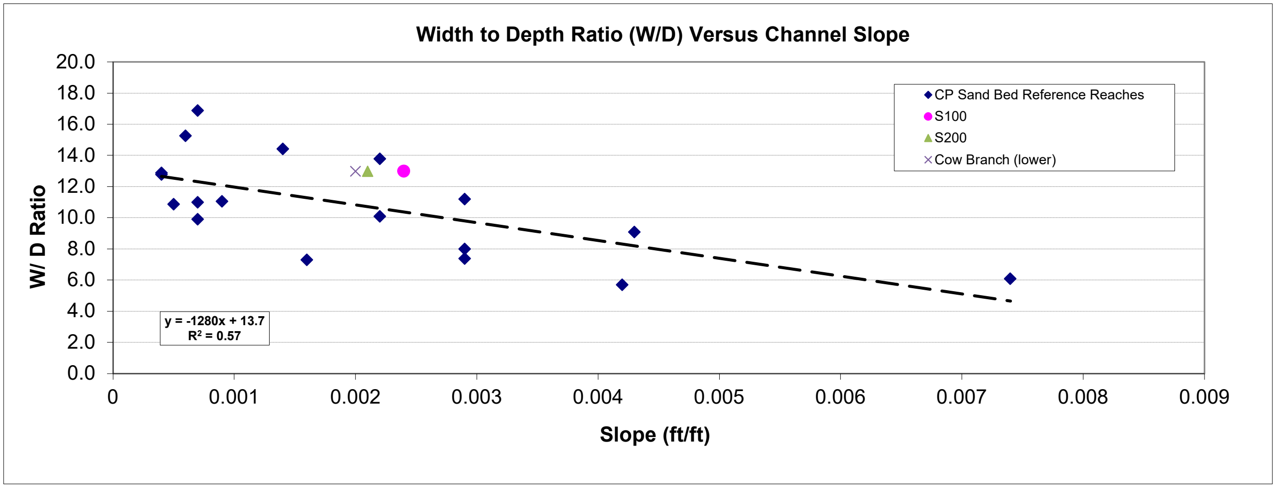
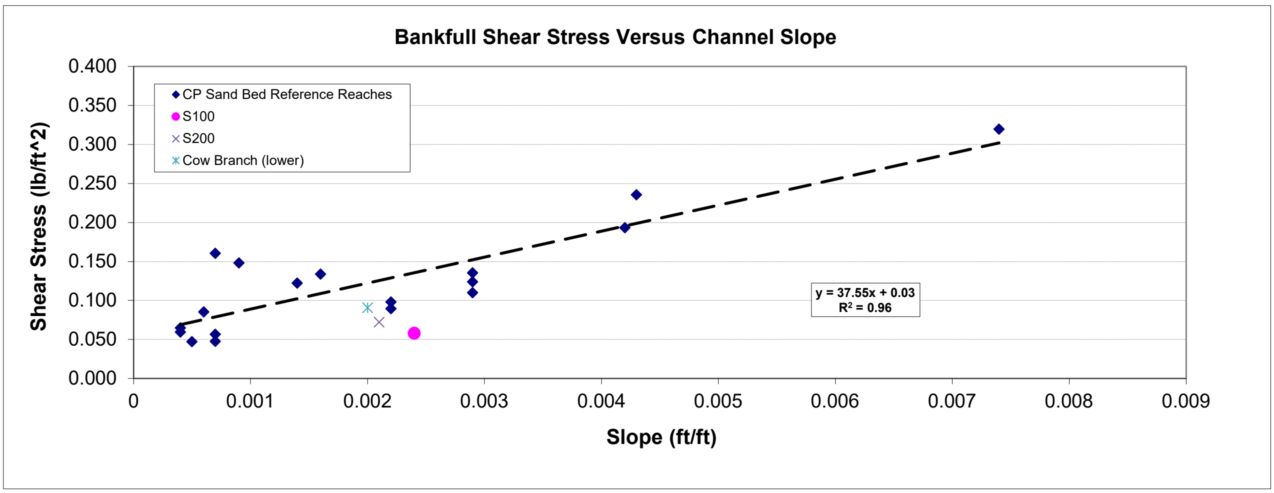
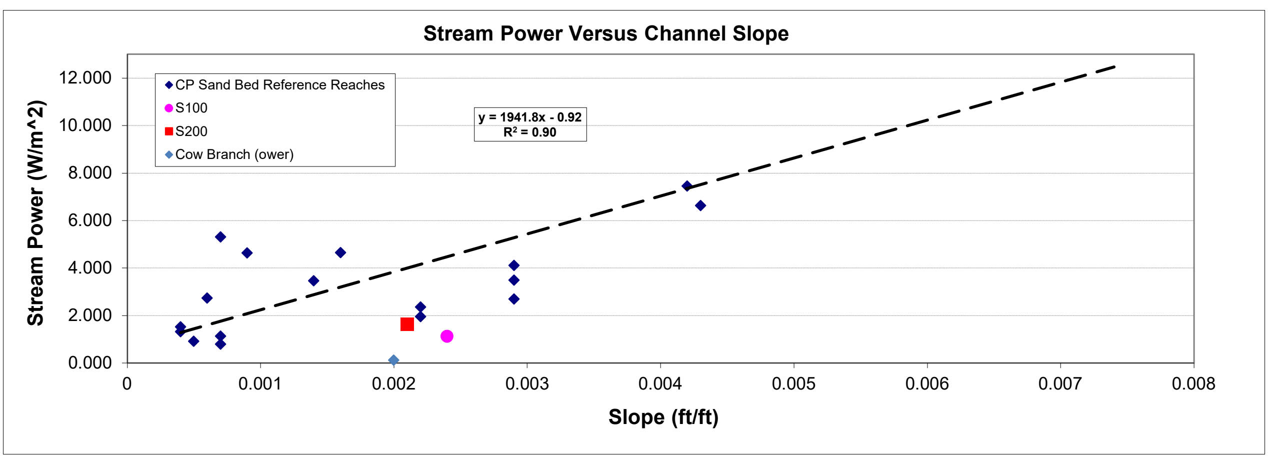


Figure 1.1 Median Fall Diameter versus Unit Stream Power for Sand Bed Forms (after Knighton ,1998, and Simons and Richardson, 1966).

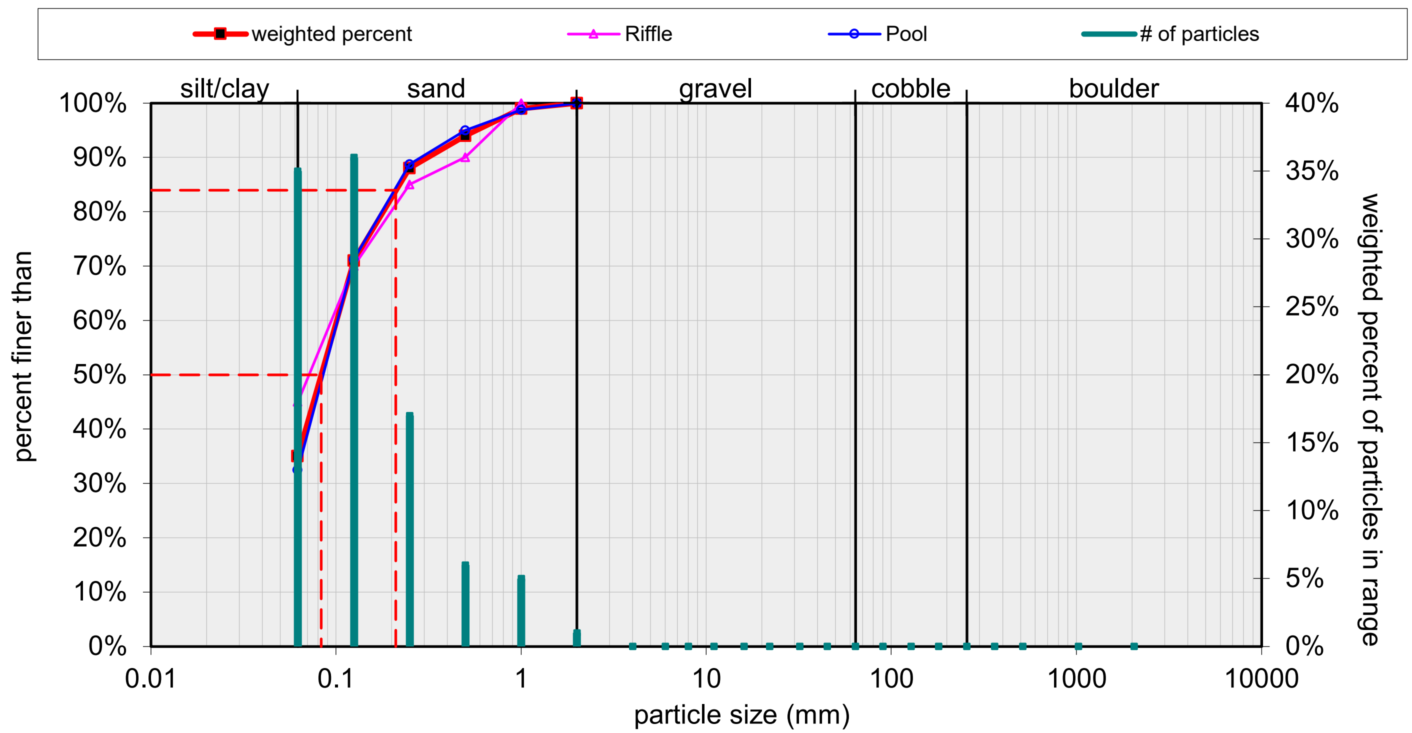

Width to Depth Ratio (W/D) Versus Channel Slope
W/ D Ratio
Slope (ft/ft)
CP Sand Bed Reference Reaches
S100
S200
Cow Branch (lower)
y = -1280x + 13.7
R^2 = 0.57
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009


Bankfull Shear Stress Versus Channel Slope
Shear Stress (lb/ft^2)
Slope (ft/ft)
CP Sand Bed Reference Reaches
S100
S200
Cow Branch (lower)
y = 37.55x + 0.03
R^2 = 0.96
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009


Stream Power Versus Channel Slope
Stream Power (W/m^2)
Slope (ft/ft)
CP Sand Bed Reference Reaches
S100
S200
Cow Branch (ower)
y = 1941.8x - 0.92
R^2 = 0.90
12.000
10.000
8.000
6.000
4.000
2.000
0.000
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008

Weighted pebble count by bed features - Cow Branch

20% riffle 80% pool



Size (mm)	
D16	0.062
D35	0.062
D50	0.083
D65	0.11
D84	0.21
D95	0.57

Size Distribution	
mean	0.1
dispersion	1.9
skewness	0.19

Type	
silt/clay	35%
sand	65%
gravel	0%
cobble	0%
boulder	0%

Culvert Report

Proposed 48 inch Culvert 1

Invert Elev Dn (ft)	=	108.80
Pipe Length (ft)	=	40.00
Slope (%)	=	0.25
Invert Elev Up (ft)	=	108.90
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

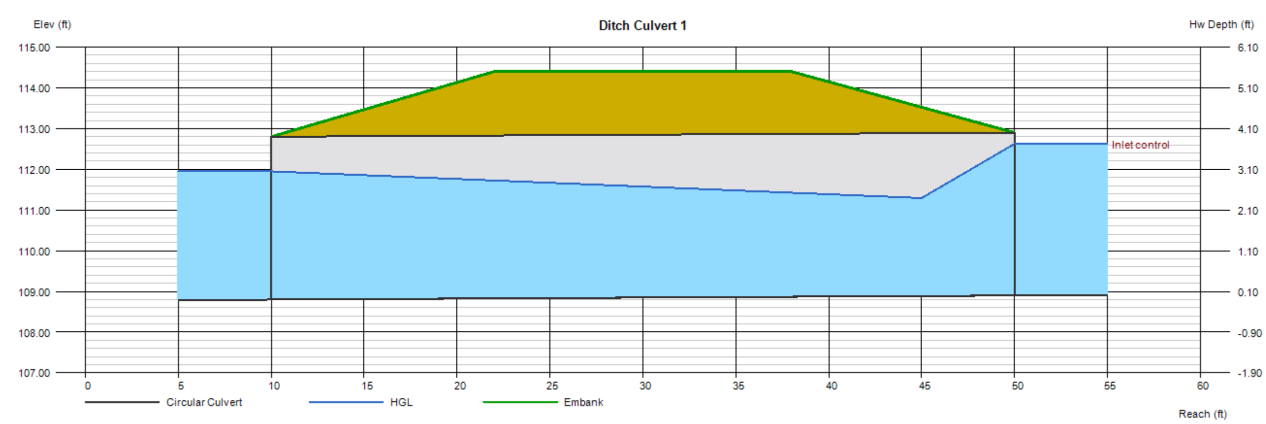
Top Elevation (ft)	=	114.40
Top Width (ft)	=	16.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	58.40
Qmax (cfs)	=	139.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	58.40
Qpipe (cfs)	=	58.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.50
Veloc Up (ft/s)	=	7.81
HGL Dn (ft)	=	111.95
HGL Up (ft)	=	111.20
Hw Elev (ft)	=	112.62
Hw/D (ft)	=	0.93
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 11 2024

Proposed 24 inch Culvert 2 in NE corner of Project

Invert Elev Dn (ft)	=	106.43
Pipe Length (ft)	=	25.00
Slope (%)	=	0.36
Invert Elev Up (ft)	=	106.52
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

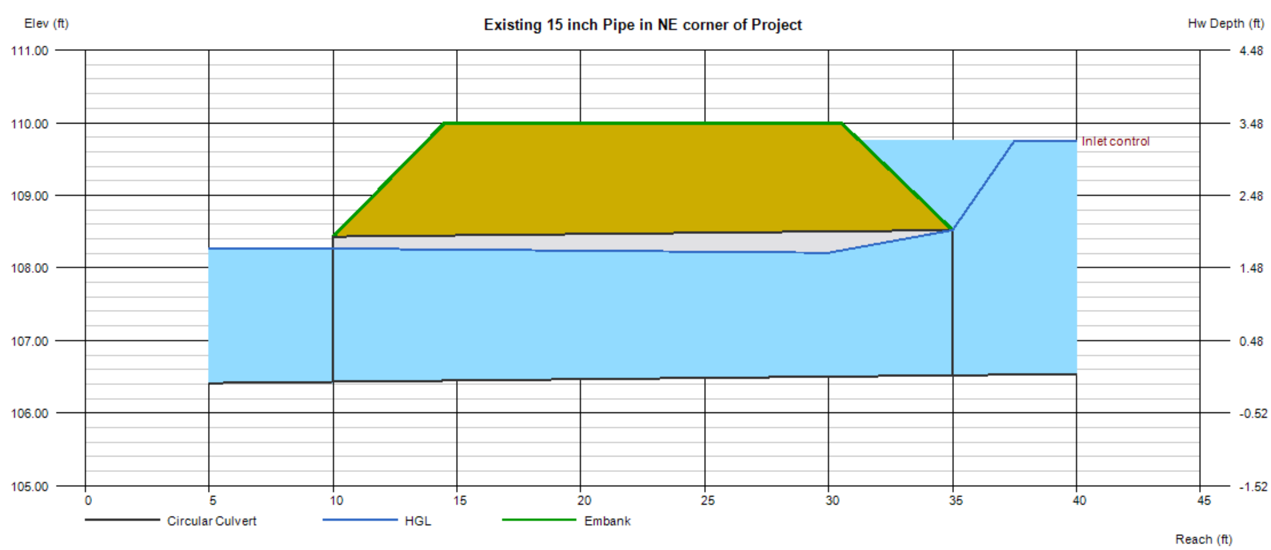
Top Elevation (ft)	=	110.00
Top Width (ft)	=	16.00
Crest Width (ft)	=	40.00

Calculations

Qmin (cfs)	=	7.10
Qmax (cfs)	=	22.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	22.00
Qpipe (cfs)	=	22.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.28
Veloc Up (ft/s)	=	7.84
HGL Dn (ft)	=	108.27
HGL Up (ft)	=	108.19
Hw Elev (ft)	=	109.76
Hw/D (ft)	=	1.62
Flow Regime	=	Inlet Control



BANKFULL DISCHARGE = 7.8 CFS
WSF ELEV @ XSECT 3551 = 110.44’
48” DIA. CULVERT INV. @ LUMBERTON RD. = 110.35’
LUMBERTON RD. TOP OF ROAD ELEV = 116.16’

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS

10 YR DISCHARGE = 26.2 CFS
WSF ELEV @ XSECT 3551 = 111.18’’
48” DIA. CULVERT INV. @ LUMBERTON RD. = 110.35’
LUMBERTON RD. TOP OF ROAD ELEV = 116.16’

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS

25 YR DISCHARGE = 33.6 CFS
WSF ELEV @ XSECT 3551 = 111.36''
48" DIA. CULVERT INV. @ LUMBERTON RD. = 110.35'
LUMBERTON RD. TOP OF ROAD ELEV = 116.16'

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS

100 YR DISCHARGE = 44.9 CFS
WSF ELEV @ XSECT 3551 = 111.59''
48" DIA. CULVERT INV. @ LUMBERTON RD. = 110.35'
LUMBERTON RD. TOP OF ROAD ELEV = 116.16'

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS

BANKFULL DISCHARGE = 7.8 CFS
WSF ELEV @ XSECT 3551 = 110.44'
48" DIA. CULVERT INV. @ LUMBERTON RD. = 110.35'
LUMBERTON RD. TOP OF ROAD ELEV = 116.16'

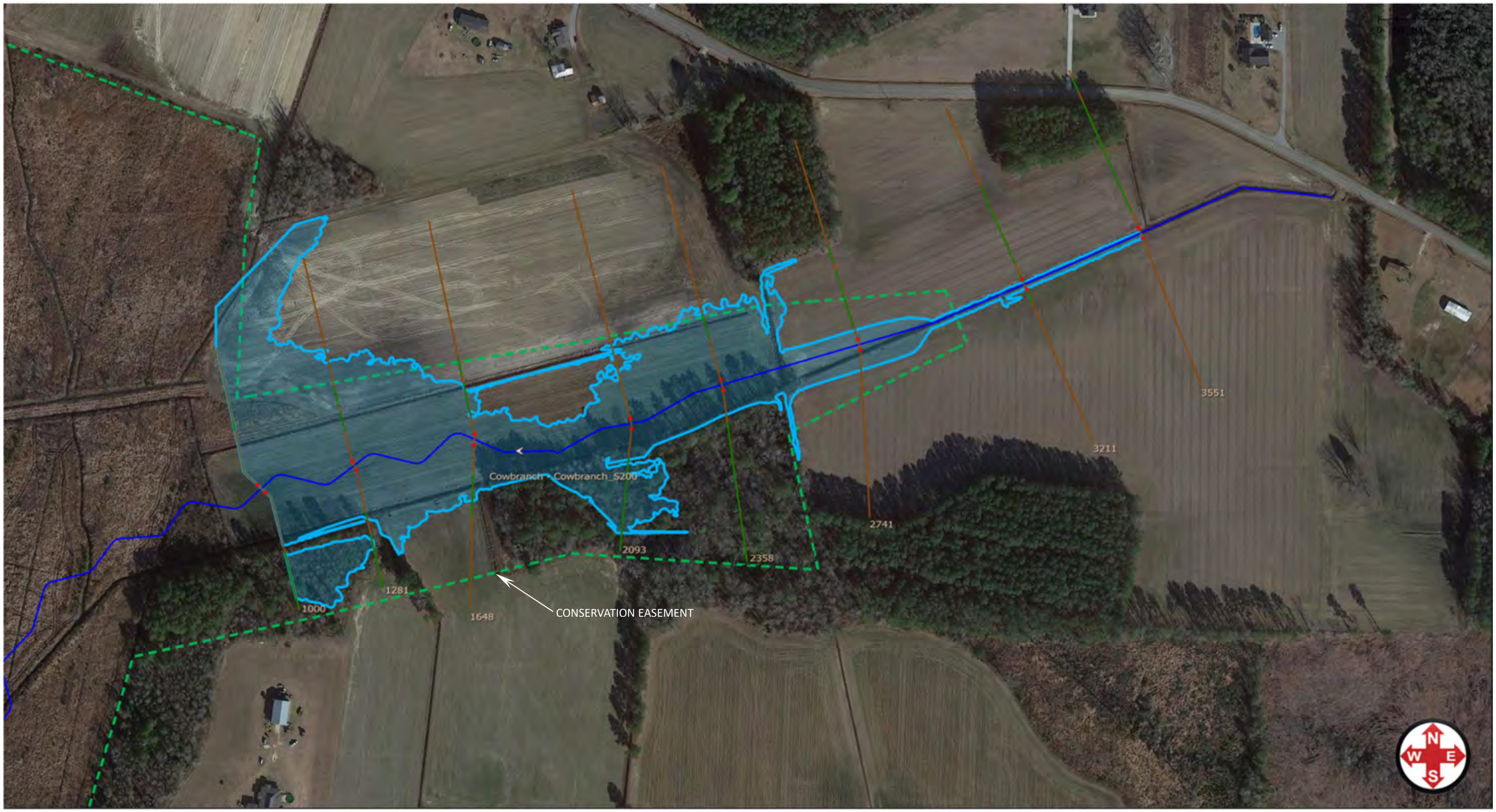
COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS
WITH HYPOTHETICAL 2' TALL BEAVERDAM @ XSECT 1000

10 YR DISCHARGE = 26.2 CFS
WSF ELEV @ XSECT 3551 = 111.15’’
48” DIA. CULVERT INV. @ LUMBERTON RD. = 110.35’
LUMBERTON RD. TOP OF ROAD ELEV = 116.16’

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS
WITH HYPOTHETICAL 2' TALL BEAVERDAM @ XSECT 1000

25 YR DISCHARGE = 33.6 CFS
WSF ELEV @ XSECT 3551 = 111.33’’
48” DIA. CULVERT INV. @ LUMBERTON RD. = 110.35’
LUMBERTON RD. TOP OF ROAD ELEV = 116.16’

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS
WITH HYPOTHETICAL 2' TALL BEAVERDAM @ XSECT 1000



100 YR DISCHARGE = 44.9 CFS
WSF ELEV @ XSECT 3551 = 111.57''
48" DIA. CULVERT INV. @ LUMBERTON RD. = 110.35'
LUMBERTON RD. TOP OF ROAD ELEV = 116.16'

COW TAIL FLOOD MODEL ANALYSIS PROPOSED CONDITIONS
WITH HYPOTHETICAL 2' TALL BEAVERDAM @ XSECT 1000

Cow Branch (upper) - Looking upstream

Cow Branch (lower) - Looking upstream showing channelized conditions

S100 - Looking upstream showing channelized stream conditions

S200 - Looking upstream showing channelized conditions and lack of riparian buffer vegetation


W01 - Typical channelized ditch conditions and drained wetland hydrology near edge of agricultural field area

W01 - Typical vegetation in clearcut area


W02 - Ditching, lack of riparian buffer vegetation, and drained wetland hydrology in agricultural field area

Appendix 3 – Site Protection Instrument

WLS is in the process of obtaining a conservation easement from the current landowners for the project area. The easement deed and survey plat will be submitted to DMS and State Property Office (SPO) for approval and will be held by the State of North Carolina. Once recorded, the secured easement will allow WLS to proceed with the project development and protect the mitigation assets in perpetuity. The Table below includes the draft Site Protection Instrument information.

Table 3-1. Site Protection Instrument Information

Owner of Record N/F	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
David Ellis & Taylor Jordan	0244-66-7214	Columbus	Conservation Easement	Book: 154 Page:593	46.312
Brett Patrick Barnhill	0244-75-4035	Columbus	Conservation Easement	Book: 1194 Page: 166	11.166
Tate Farms, Inc.	0244-96-2135	Columbus	Conservation Easement	Book: 270 Page: 44	2.896

Appendix 4 – Credit Release Schedule

All credit releases will be based on the total credit generated as reported in the approved final mitigation plan, unless there are major discrepancies and then a mitigation plan addendum will be submitted. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (DA) authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the NC Interagency Review Team (NCIRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described in the Tables below.

Table 4-1. Credit Release Schedule – Stream Credits

Credit Release Milestone	Credit Release Activity	Interim Release	Total Release
1	Site Establishment (includes all required criteria stated below)	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable and performance standards have been met	10%	90% (100%**)

**Please note that vegetation and channel stability data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the IRT.*
***10% reserve of credits to be held back until the bankfull event performance standard has been met.*

Table 4-2. Credit Release Schedule – Wetland Credits

Credit Release Milestone	Credit Release Activity	Interim Release	Total Release
1	Site Establishment (includes all required criteria stated below)	0%	0%
2	Completion of all initial physical and biological improvement made pursuant to the Mitigation Plan	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%

**Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the IRT.*

Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the NCDEQ DMS without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the Final Mitigation Plan
b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan. Per the NCDEQ DMS Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as- built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.
d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after four bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than four bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, DMS will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

Appendix 5 – Financial Assurance

Pursuant to Section IV H and Appendix III of the NCDEQ DMS (formerly Ecosystem Enhancement Program) In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environmental Quality (NCDEQ) has provided the USACE-Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCDEQ DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.

Appendix 6 – Maintenance Plan

The site will be monitored on a regular basis and a physical inspection of the site will take place at least once a year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Routine Maintenance Components Cow Tail Mitigation Project – NCDEQ DMS Project No. 100647	
Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent bank failures and head-cutting. Stream maintenance activities will be documented and reported in annual monitoring reports.
Wetland	Routine wetland maintenance and repair activities may include supplemental installations of target vegetation within the wetland. Areas where stormwater and floodplain flows intercept the wetland may also require maintenance to prevent scour that adversely and persistently threatens wetland habitat or function.
Vegetation	Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, thinning (pine, sweetgum, red maple) and fertilizing. Exotic invasive plant species will be treated by mechanical and/or chemical methods. Any vegetation requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. Vegetation maintenance activities will be documented and reported in annual monitoring reports.
Site Boundary	Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis. Easement monitoring and staking/signage maintenance will continue in perpetuity as a stewardship activity.
Beaver Management	Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dewatering/dam removal. Beaver management will be implemented using accepted trapping and removal methods only within the recorded Conservation Easement.

Appendix 7 – DWR Stream Identification Forms

The streams at the project site were categorized into three reaches (Cow Tail, S100, and S200) totaling approximately 4,501 linear feet of jurisdictional streams within the project area. Field evaluations conducted at the proposal stage and during existing conditions assessments determined that all the reaches are intermittent streams. Determinations were based on NCDWQ's Methodology for Identification of Intermittent and Perennial Streams and Their Origins, (v4.11, Effective Date: September 1, 2010) stream assessment protocols. Copies of the supporting field forms are included herein.

Table 7-1. Summary of Field Investigations to Determine Intermittent/Perennial Status

Project Reach Designation	Existing Project Reach Length (ft)	NCDWQ Stream Classification Form Score	Watershed Drainage Area (acres)[1]	Stream Status Based on Field Analyses
Cow Branch	2,836	21.5-24.5[2]	581	Intermittent
S100	549	21.0	100	Intermittent
S200	1,116	23.5	282	Intermittent

Note 1: Watershed drainage area was approximated based on topographic and LiDAR information and compared with USGS StreamStats at the downstream end of each reach.
Note 2: The first score is the upper section of the reach and the second score is the lower section.

NC DWQ Stream Identification Form Version 4.11 upper COW BRANCH, XS-3

Date: 12/29/20	**Project/Site:** Cow Tail	**Latitude:** 34.425511
Evaluator: ED / DI	**County:** COLUMBUS	**Longitude:** -78.841662
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 21.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** CHAD BOURN *e.g. Quad Name:*

A. Geomorphology (Subtotal = 8.5)	Absent	Weak	Moderate	Strong
1[a.] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

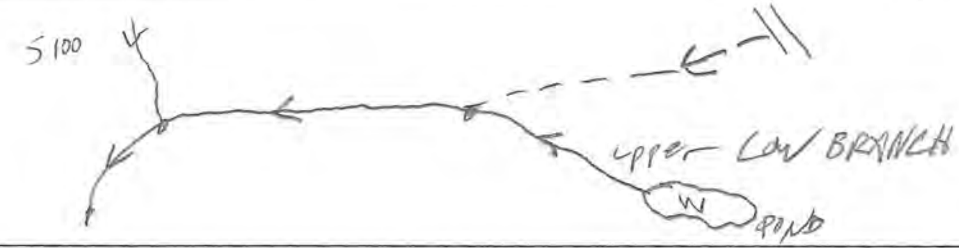
B. Hydrology (Subtotal = 6.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

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

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

Notes: CHANNELIZED W/ VALLEY

Sketch:



lower COW BRANCH, XS-4

NC DWQ Stream Identification Form Version 4.11

Date: 12/29/20	Project/Site: Cow Tail	Latitude: 34.4234
Evaluator: KMV / KO	County: Columbus	Longitude: -78.8473
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 24.5	Stream Determination (circle one) Ephemeral Intermittent Perennial	Other CHADBOURN *e.g. Quad Name:*

A. Geomorphology (Subtotal = 9.0)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

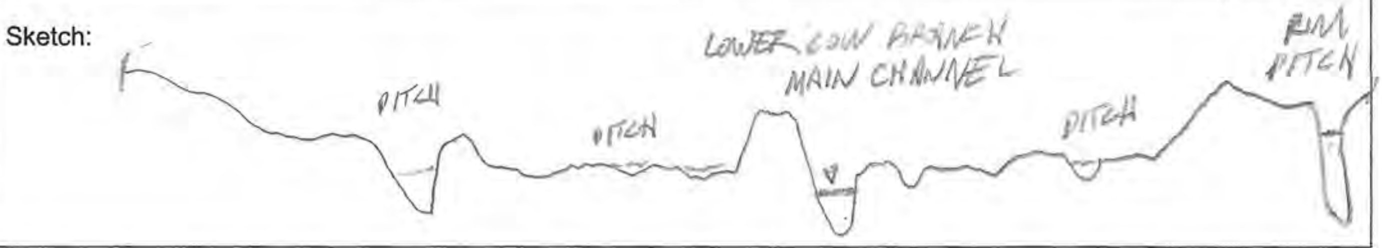
B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 5.0)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: CHANNELIZED w/ MULTIPLE DITCHES IN HW VALLEY

Sketch:



NC DWQ Stream Identification Form Version 4.11 S100, XS-1

Date: 12/29/20	**Project/Site:** Cow Tail	**Latitude:** 34.425848
Evaluator: ED / DI	**County:** COLUMBUS	**Longitude:** -78.846235
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 21.0	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name*: CHADBOURN

A. Geomorphology (Subtotal = 6.0)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 7.5)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

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

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

Notes: CHANNELIZED NW/ VALLEY

Sketch:

S200

NC DWQ Stream Identification Form Version 4.11

Date: 30 June 2022	Project/Site: Cow Tail	Latitude: 34.426710
Evaluator: Daniel Ingram	County: Columbus	Longitude: -78.841454
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

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

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

B. Hydrology (Subtotal = 7.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

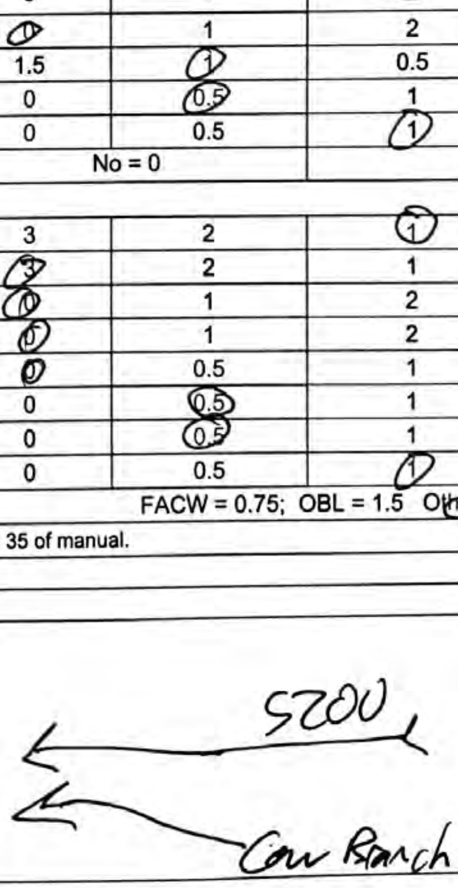
C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes:

Sketch:

- channelized field ditch



Appendix 8 – USACE District Assessment Methods/Forms

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Cow Tail Mitigation Project
2. Date of evaluation: 12/29/2020
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Emily Dunnigan/WLS
5. County: Columbus
6. Nearest named water body on USGS 7.5-minute quad: Cow Branch
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.425511, -78.841662

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Cow Branch upper
10. Length of assessment reach evaluated (feet): 300
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1.6 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 10.1
13. Is assessment reach a swamp steam? ☐Yes ☒No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☐ Piedmont (P) ☒ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☒A 
(more sinuous stream, flatter valley slope)

☐B 
(less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☒Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

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

☐Section 10 water
☐Classified Trout Waters
☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat
☐Primary Nursery Area
☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property
☐NCDWR Riparian buffer rule in effect
☐Nutrient Sensitive Waters
☐Anadromous fish
☐303(d) List
☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

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

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

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

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

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

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

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

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

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

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

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

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

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

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

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

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

Check for Tidal Marsh Streams Only

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☒A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

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

13. Streamside Area Ground Surface Condition – streamside area metric (skip for Tidal Marsh Streams and B valley types)

Consider for the Left Bank (LB) and the Right Bank (RB). Consider storage capacity with regard to both overbank flow and upland runoff.

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

14. Streamside Area Water Storage – streamside area metric (skip for Size 1 streams, Tidal Marsh Streams, and B valley types)

Consider for the Left Bank (LB) and the Right Bank (RB) of the streamside area.

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

15. Wetland Presence – streamside area metric (skip for Tidal Marsh Streams)

Consider for the Left Bank (LB) and the Right Bank (RB). Do not consider wetlands outside of the streamside area or within the normal wetted perimeter of assessment reach.

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

16. Baseflow Contributors – assessment reach metric (skip for Size 4 streams and Tidal Marsh Streams)

Check all contributors within the assessment reach or within view of <u>and</u> draining to the assessment reach.

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

17. Baseflow Detractors – assessment area metric (skip for Tidal Marsh Streams)

Check all that apply.

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

18. Shading – assessment reach metric (skip for Tidal Marsh Streams)

Consider aspect. Consider "leaf-on" condition.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Cow Branch upper

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Cow Tail Mitigation Project	Date of Assessment	12/29/2020
Stream Category	Ia2	Assessor Name/Organization	Emily Dunnigan/WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Cow Tail Mitigation Project
2. Date of evaluation: 12/29/2020
Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Emily Dunnigan/WLS
5. County: Columbus
6. Nearest named water body on USGS 7.5-minute quad: Cow Branch
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.423489°, -78.847361°

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): Cow Branch lower
10. Length of assessment reach evaluated (feet): 2070
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 4.6 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 15.3
13. Is assessment reach a swamp steam? ☐Yes ☒No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☐ Piedmont (P) ☒ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☒A  (more sinuous stream, flatter valley slope)

☐B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☒Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

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

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

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

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

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

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

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

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

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

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

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

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

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

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

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

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

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

Check for Tidal Marsh Streams Only

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☐A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☒C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Cow Branch lower

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Cow Tail Mitigation Project	Date of Assessment	12/29/2020
Stream Category	Ia3	Assessor Name/Organization	Emily Dunnigan/WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Cow Tail Mitigation Project
2. Date of evaluation: 12/29/2020
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Emily Dunnigan/WLS
5. County: Columbus
6. Nearest named water body on USGS 7.5-minute quad: Cow Branch
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.425848, -78.846235

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): S100, UT Cow Branch
10. Length of assessment reach evaluated (feet): 540
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 5.5 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 11.7
13. Is assessment reach a swamp steam? ☐Yes ☒No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☐ Piedmont (P) ☒ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☒A 
(more sinuous stream, flatter valley slope)

☐B 
(less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi²) ☒Size 2 (0.1 to < 0.5 mi²) ☐Size 3 (0.5 to < 5 mi²) ☐Size 4 (≥ 5 mi²)

ADDITIONAL INFORMATION:

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

☐Section 10 water ☐Classified Trout Waters ☐Water Supply Watershed (☐I ☐II ☐III ☐IV ☐V)
☐Essential Fish Habitat ☐Primary Nursery Area ☐ High Quality Waters/Outstanding Resource Waters
☐Publicly owned property ☐NCDWR Riparian buffer rule in effect ☐Nutrient Sensitive Waters
☐Anadromous fish ☐303(d) List ☐CAMA Area of Environmental Concern (AEC)
☐Documented presence of a federal and/or state listed protected species within the assessment area.
List species:
☐Designated Critical Habitat (list species)

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

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

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

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

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

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☒A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☐C > 25% of channel unstable

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

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

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

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

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

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

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

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

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

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

Check for Tidal Marsh Streams Only

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☒A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Cow Tail Mitigation Project	Date of Assessment	12/29/2020
Stream Category	Ia2	Assessor Name/Organization	Emily Dunnigan/WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

INSTRUCTIONS: Attach a sketch of the assessment area and photographs. Attach a copy of the USGS 7.5-minute topographic quadrangle, and circle the location of the stream reach under evaluation. If multiple stream reaches will be evaluated on the same property, identify and number all reaches on the attached map, and include a separate form for each reach. See the NC SAM User Manual for detailed descriptions and explanations of requested information. Record in the "Notes/Sketch" section if any supplementary measurements were performed. See the NC SAM User Manual for examples of additional measurements that may be relevant.
NOTE EVIDENCE OF STRESSORS AFFECTING THE ASSESSMENT AREA (do not need to be within the assessment area).

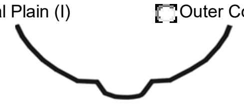
PROJECT / SITE INFORMATION:
1. Project name (if any): Cow Tail Mitigation Project
2. Date of evaluation: 6/30/22
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Daniel Ingram/WLS
5. County: Columbus
6. Nearest named water body on USGS 7.5-minute quad: Cow Branch
7. River Basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 34.425980, -78.841304

STREAM INFORMATION: (depth and width can be approximations)
9. Site number (show on attached map): S200
10. Length of assessment reach evaluated (feet): 300
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 3.9 ☐ Unable to assess channel depth.
12. Channel width at top of bank (feet): 10.1
13. Is assessment reach a swamp stream? ☐ Yes ☒ No
14. Feature type: ☐ Perennial flow ☒ Intermittent flow ☐ Tidal Marsh Stream

STREAM RATING INFORMATION:
15. NC SAM Zone: ☐ Mountains (M) ☐ Piedmont (P) ☒ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape **(skip for Tidal Marsh Stream):**

☒ a (more sinuous stream, flatter valley slope)



☐ b (less sinuous stream, steeper valley slope)

17. Watershed size: **(skip for Tidal Marsh Stream)** ☐ Size 1 (< 0.1 mi^2) ☒ Size 2 (0.1 to < 0.5 mi^2) ☐ Size 3 (0.5 to < 5 mi^2) ☐ Size 4 (≥ 5 mi^2)

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

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

1. Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)
- ☐ A Water throughout assessment reach.
- ☒ B No flow, water in pools only.
- ☐ C No water in assessment reach.

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

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

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

5. Signs of Active Instability – assessment reach metric
Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
- ☐ A < 10% of channel unstable
- ☒ B 10 to 25% of channel unstable
- ☐ C > 25% of channel unstable

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

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

7. Water Quality Stressors – assessment reach/intertidal zone metric
Check all that apply.
- ☐ A Discolored water in stream or intertidal zone (milky white, blue, unnatural water discoloration, oil sheen, stream foam)
- ☐ B Excessive sedimentation (burying of stream features or intertidal zone)

- [ ] C Noticeable evidence of pollutant discharges entering the assessment reach <u>and</u> causing a water quality problem
- [ ] D Odor (not including natural sulfide odors)
- [ ] E Current published or collected data indicating degraded water quality in the assessment reach. Cite source in the "Notes/Sketch" section.
- [ ] F Livestock with access to stream or intertidal zone
- [ ] G Excessive algae in stream or intertidal zone
- [ ] H Degraded marsh vegetation in the intertidal zone (removal, burning, regular mowing, destruction, etc.)
- [ ] I Other: ______________________ (explain in "Notes/Sketch" section)
- [x] J Little to no stressors

8. Recent Weather – watershed metric

For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.

- ( ) A Drought conditions <u>and</u> no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ( ) B Drought conditions <u>and</u> rainfall exceeding 1 inch within the last 48 hours
- (•) C No drought conditions

9 Large or Dangerous Stream – assessment reach metric

( ) Yes (•) No Is stream is too large or dangerous to assess? **If Yes, skip to Metric 13 (Streamside Area Ground Surface Condition)**.

10. Natural In-stream Habitat Types – assessment reach metric

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

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

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

Check for Tidal Marsh Streams only

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

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

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

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

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

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

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

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

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

12. Aquatic Life – assessment reach metric (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)

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

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

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

☐ ☐ Worms/leeches

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23. Continuity of Vegetated Buffer – streamside area metric (skip for Tidal Marsh Streams)

Consider whether vegetated buffer is continuous along stream (parallel). Breaks are areas lacking vegetation > 10-feet wide.

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

24. Vegetative Composition – First 100 feet of streamside area metric (skip for Tidal Marsh Streams)

Evaluate the dominant vegetation within 100 feet of each bank or to the edge of the watershed (whichever comes first) as it contributes to assessment reach habitat.

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

25. Conductivity – assessment reach metric (skip for all Coastal Plain streams)

25a. ☐Yes ☒No Was a conductivity measurement recorded?

If No, select one of the following reasons. ☐No Water ☒Other: no equipment

25b. Check the box corresponding to the conductivity measurement (units of microsiemens per centimeter).

☐A <46 ☐B 46 to < 67 ☐C 67 to < 79 ☐D 79 to < 230 ☐E ≥ 230

Notes/Sketch:

NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name Cow Tail Mitigation Project — Date of Evaluation 6/30/22
Stream Category Ia2 — Assessor Name/Organization Daniel Ingram/WLS

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

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

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Cow Tail Mitigation Project	Date of Evaluation	12/29/2020
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WA and WB
Wetland Type	Riverine Swamp Forest	Assessor Name/Organization	Kyle Obermiller - WLS
Level III Ecoregion	Southeastern Plains	Nearest Named Water Body	Cow Branch
River Basin	Lumber	USGS 8-Digit Catalogue Unit	03040203
County	Columbus	NCDWR Region	Washington
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	34.425704, -78.841516

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

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

Is the assessment area intensively managed? ☒ Yes ☐ No

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

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

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Discharge into Wetland – opportunity metric

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Answer for assessment area dominant landform.

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

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

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

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

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

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

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

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

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

13. **Connectivity to Other Natural Areas – landscape condition metric**

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

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

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

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

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

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

☐A 0
☐B 1 to 4
☒C 5 to 8

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

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

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

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

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

17a. Is vegetation present?

☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

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

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

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

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

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

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

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

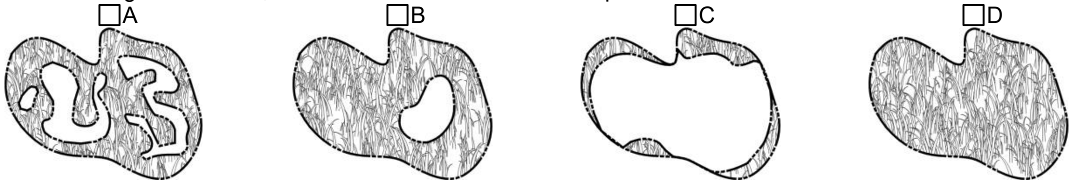
Include both natural debris and man-placed natural debris.

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

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

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

☐A ☐B ☐C ☐D



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

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.

☐A Overbank <u>and</u> overland flow are not severely altered in the assessment area.
☐B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☒D Both overbank <u>and</u> overland flow are severely altered in the assessment area.

Notes

WA and WB are forested wetlands along heavily ditched portions of the site.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WA and WB	Date of Assessment	12/29/2020
Wetland Type	Riverine Swamp Forest	Assessor Name/Organization	Kyle Obermiller - WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**MEDIUM**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**HIGH**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**LOW**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**MEDIUM**

Overall Wetland Rating **LOW**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Cow Tail Mitigation Project	Date of Evaluation	12/29/2020
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WC
Wetland Type	Headwater Forest	Assessor Name/Organization	Kyle Obermiller - WLS
Level III Ecoregion	Southeastern Plains	Nearest Named Water Body	Cow's Branch
River Basin	Lumber	USGS 8-Digit Catalogue Unit	03040203
County	Columbus	NCDWR Region	Washington
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	34.426795, -78.846803

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

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

Is the assessment area intensively managed? ☒ Yes ☐ No

Regulatory Considerations - Were regulatory considerations evaluated? ☒Yes ☐No If Yes, check all that apply to the assessment area.
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWR riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

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

Is the assessment area's surface water storage capacity or duration substantially altered by beaver? ☐ Yes ☒ No
Does the assessment area experience overbank flooding during normal rainfall conditions? ☐ Yes ☒ No

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Discharge into Wetland – opportunity metric

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Answer for assessment area dominant landform.

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

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

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

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

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

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

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

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

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

13. **Connectivity to Other Natural Areas – landscape condition metric**

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

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

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

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

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

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

☐A 0
☒B 1 to 4
☐C 5 to 8

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

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

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

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

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

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

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

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

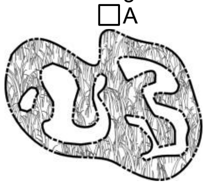
	AA	WT	
Canopy	☐A	☐A	Canopy closed, or nearly closed, with natural gaps associated with natural processes
	☐B	☐B	Canopy present, but opened more than natural gaps
	☒C	☒C	Canopy sparse or absent
Mid-Story	☐A	☐A	Dense mid-story/sapling layer
	☐B	☐B	Moderate density mid-story/sapling layer
	☒C	☒C	Mid-story/sapling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

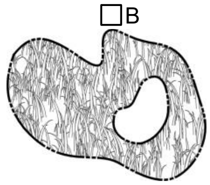
18. Snags – wetland type condition metric (skip for all marshes)
☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

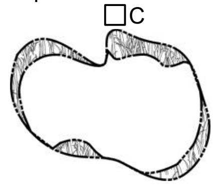
19. Diameter Class Distribution – wetland type condition metric (skip for all marshes)
☐A Majority of canopy trees have stems > 6 inches in diameter at breast height (DBH); many large trees (> 12 inches DBH) are present.
☐B Majority of canopy trees have stems between 6 and 12 inches DBH, few are > 12 inch DBH.
☒C Majority of canopy trees are < 6 inches DBH or no trees.

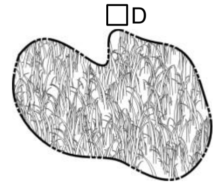
20. Large Woody Debris – wetland type condition metric (skip for all marshes)
Include both natural debris and man-placed natural debris.
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).
☒B Not A

21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)
Select the figure that best describes the amount of interspersion between vegetation and open water in the growing season. Patterned areas indicate vegetated areas, while solid white areas indicate open water.

☐A


☐B


☐C


☐D


22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands and Salt/Brackish Marsh only)
Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.
☐A Overbank <u>and</u> overland flow are not severely altered in the assessment area.
☐B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☒D Both overbank <u>and</u> overland flow are severely altered in the assessment area.

Notes
Assessment area above UT to Cow's Branch, flowing water in ditches throughout area. Area clearcut within past 4 years, no canopy present.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WC	Date of Assessment	12/29/2020
Wetland Type	Headwater Forest	Assessor Name/Organization	Kyle Obermiller - WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-surface Storage and Retention	Condition	**LOW**
Water Quality	Pathogen Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**LOW**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating LOW

Appendix 9 – WOTUS Information

Cara Conder

From: Charles, Thomas P CIV USARMY CESAW (USA) <thomas.p.charles@usace.army.mil>
Sent: Tuesday, September 19, 2023 1:00 PM
To: Kyle Obermiller
Subject: SAW-2023-00196 (NCDMS ILF- Cow Tail Mitigation Site)
Attachments: SAW-2023-00196.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Dear, Brett Patrick Barnhill, David Ellis &Taylor J. Jordan and Tate Farms, Inc

Reference is made to ORM ID SAW-2023-00196, please reference this number on any correspondence regarding this action located, Rossie O'Berry Rd, Whiteville, Columbus County, NC .
(Parcel ID `s 0244-66-7214, 0244-75-4035 & 0244-96-2135 (59.6-acres) Coordinates: (34.7621, -77.1162).
On 9/13/2023, we received information from you requesting the Wilmington District, Regulatory Division review and concur with the boundaries of an aquatic resource delineation. A desk top review was conducted on 8/11/2023 using information obtained from the consultant (Kyle Obermiller ,Water & Land Solutions) and from Corps Maps.
We have reviewed the information provided by you concerning the aquatic resources, and by copy of this e-mail, are confirming that the aquatic resources delineation has been verified by the Corps to be sufficiently accurate and reliable for permitting actions and the determination of compensatory mitigation requirements. The boundaries of these aquatic resources are shown on Cow Tail Mitigation Project Lumber 03040203 Columbus County, NC, Preliminary Jurisdictional Waters Map , Figure 4, Date:6/6/2023 .

Regulatory Guidance Letter (RGL) 16-01
https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll9/id/1256 provides guidance for Jurisdictional Determinations (JD) and states “The Corps generally does not issue a JD of any type where no JD has been requested”. At this time, we are only verifying the delineation. This delineation may be relied upon for use in the permit evaluation process, including determining compensatory mitigation. This delineation verification is not an Approved Jurisdictional Determination (AJD) and is not an appealable action under the Regulatory Program Administrative Appeal Process (33 CFR Part 331). However, you may request an AJD, which is an appealable action. If you wish to receive a Preliminary Jurisdictional Determination (PJD), or an Approved Jurisdictional Determination (AJD) please respond accordingly, otherwise nothing further is required and we will not provide any additional documentation.
Please contact me if you have any questions about this project or about the USACE Regulatory Program.
Respectfully,

Thomas Charles (Tom)
thomas.p.charles@usace.army.mil
Regulatory Specialist
910-251-4101 cell 910-465-7602
https://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Permits/2017-Nationwide-Permits/

E-PCN-Submittal
https://edocs.deq.nc.gov/Forms/Pre-Construction_Notification_Form

PJDs`, Wetland Delineation Concurrence & JD`s. http://saw-reg.usace.army.mil/JD/FINALSAW-JD-REQUEST-FORM-20170508.pdf
Submittal You may submit requests via e-mail in PDF format to
WilmingtonNCREG@usace.army.mil

The Wilmington District is committed to providing the highest level of support to the public.
To help us ensure we continue to do so, please complete the Customer Satisfaction Survey located at:
https://regulatory.ops.usace.army.mil/customer-service-survey/

From: Kyle Obermiller <kyle@waterlandsolutions.com>
Sent: Wednesday, September 13, 2023 9:28 AM
To: Charles, Thomas P CIV USARMY CESAW (USA) <thomas.p.charles@usace.army.mil>
Subject: [Non-DoD Source] RE: SAW-2023-00196 (NCDMS ILF- Cow Tail Mitigation Site)

Thank you for the reply, I believe we could accept a concurrence report for the short term, but NC DMS projects do require an approved PJD for the final mitigation plan. We would prefer to move forward with this option.

On Sep 13, 2023 7:10 AM, "Charles, Thomas P CIV USARMY CESAW (USA)" <thomas.p.charles@usace.army.mil> wrote:
Can you take a delineation concurrence?

Thomas Charles (Tom)
thomas.p.charles@usace.army.mil
Regulatory Specialist
910-251-4101 cell 910-465-7602
https://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Permits/2017-Nationwide-Permits/

E-PCN-Submittal
https://edocs.deq.nc.gov/Forms/Pre-Construction_Notification_Form

PJDs`, Wetland Delineation Concurrence & JD`s. http://saw-reg.usace.army.mil/JD/FINALSAW-JD-REQUEST-FORM-20170508.pdf
Submittal You may submit requests via e-mail in PDF format to
WilmingtonNCREG@usace.army.mil

The Wilmington District is committed to providing the highest level of support to the public.
To help us ensure we continue to do so, please complete the Customer Satisfaction Survey located at:
https://regulatory.ops.usace.army.mil/customer-service-survey/

From: Kyle Obermiller <kyle@waterlandsolutions.com>
Sent: Tuesday, September 12, 2023 7:26 PM
To: Charles, Thomas P CIV USARMY CESAW (USA) <thomas.p.charles@usace.army.mil>
Subject: [Non-DoD Source] Re: SAW-2023-00196 (NCDMS ILF- Cow Tail Mitigation Site)

> Hello Tom,
>
> The PJD for the Cow Tail Mitigation Site was forwarded back on June 14th, and I wanted to check in as we are beyond 60 days to see if you need any additional information or want to schedule a site visit. We need the PJD to move forward

WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

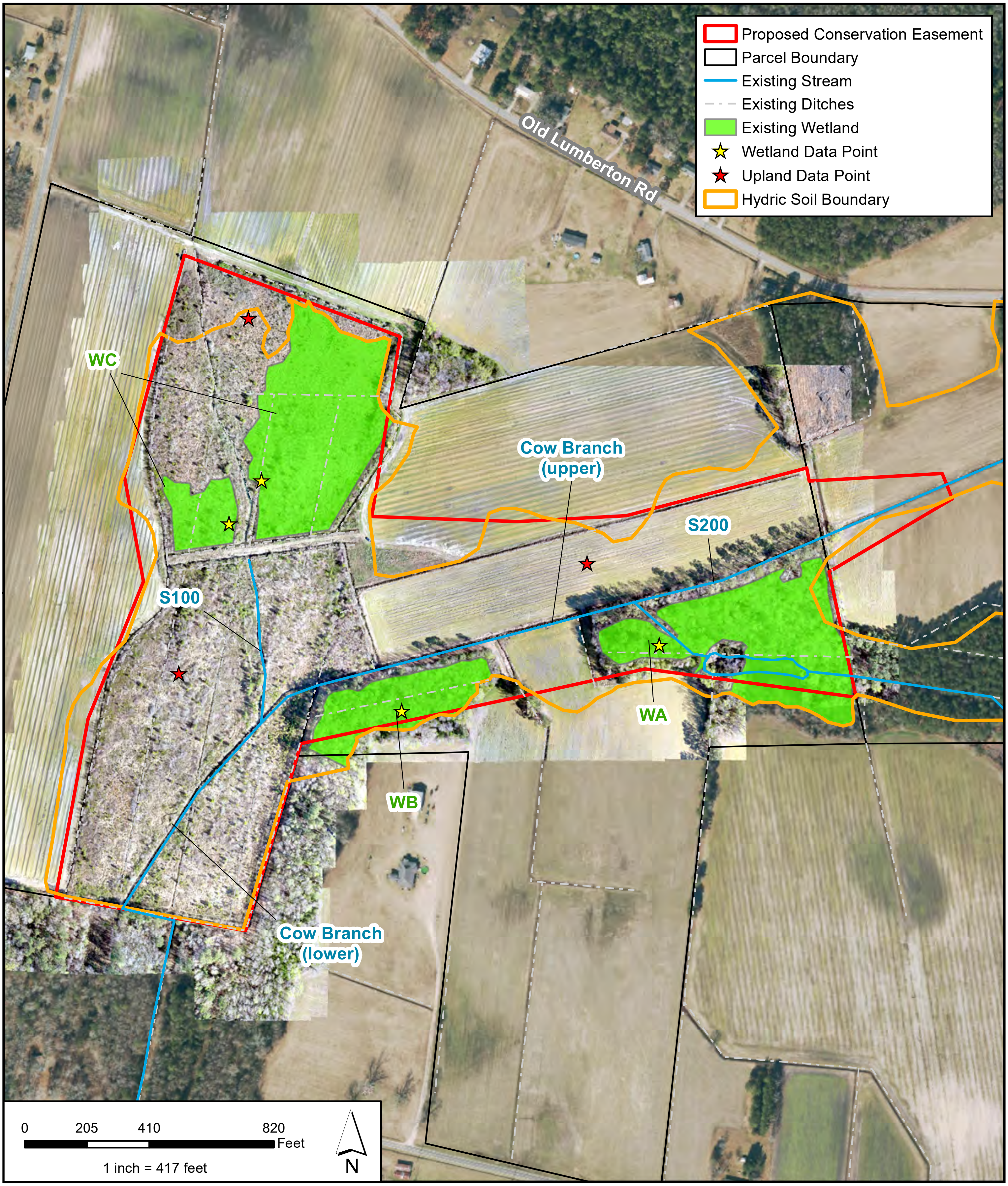
Preliminary Jurisdictional Waters Map

Figure **4**

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 6/6/2023

Data sources - Soils data source: USDA. Imagery data source: NC One Map



WATER & LAND™ SOLUTIONS

Cow Tail Mitigation Project
Lumber 03040203
Columbus County, NC

Preliminary Jurisdictional Waters Map

Figure **4**

Map Projection: NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet

Date: 9/15/2023

Data sources - Soils data source: USDA. Imagery data source: NC One Map

Appendix 10 – Invasive Species Plan

WLS will treat invasive species vegetation within the project area and provide remedial action on a case by-case basis. Common invasive species vegetation, such as Chinese privet (*Ligustrum sinense*) and multiflora rose (*Rosa multiflora*), will be removed to allow native plants to become established within the conservation easement. Invasive species vegetation will be treated by approved mechanical and/or chemical methods such that the percent composition of exotic/ invasive species vegetation is less than 5% of the total riparian buffer area. Any control methods requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. If necessary, these removal treatments (i.e., cutting and/or spraying) will continue until the corrective actions demonstrate that the site is trending towards or meeting the standard monitoring requirement.

Appendix 11 – Approved FHWA Categorical Exclusion Form

Categorical Exclusion Form for Division of Mitigation Services Projects
Version 2

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

Part 1: General Project Information	
Project Name:	Cow Tail
County Name:	Columbus
DMS Number:	100647
Project Sponsor:	Water & Land Solutions, LLC
Project Contact Name:	Cara Conder
Project Contact Address:	7721 Six Forks Rd., Suite 130, Raleigh, NC 27615
Project Contact E-mail:	cara@waterlandsolutions.com
DMS Project Manager:	Emily Dunnigan

Project Description

Cow Tail is being developed to provide stream and riparian wetland mitigation within the Lumber River Basin. The project includes the restoration of streams and the re-establishment and rehabilitation of wetlands. Site stressors include channelization, active ditching, bank erosion and channel widening, and lack of riparian buffers. The majority of the site is surrounded by active agriculture use. The project design will be developed to restore and enhance native floodplain vegetation, create stable stream banks, improve stream habitat and wetland resources, and protect the site in perpetuity through a conservation easement.

For Official Use Only

Reviewed By:

3/7/2023 — Emily Dunnigan

Date — **DMS Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

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

Final Approval By:

3-7-23 — Donald W Brew

Date — **For Division Administrator FHWA**

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

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

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

Cow Tail Mitigation Site Categorical Exclusion Summary

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment.

As the Cow Tail Mitigation Site is a full-delivery project, an EDR Radius Map Report with Geocheck was ordered for the site through Environmental Data Resources, Inc. on January 30, 2023. No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records on the target property or within the search radius around the target property in any of the Federal, State, or Tribal environmental databases searched by the EDR. The EDR report is included in Appendix A.

National Historic Preservation Act (Section 106)

The National Historic Preservation Act declares a national policy of historic preservation to protect, rehabilitate, restore, and reuse districts, sites, buildings, structures, and objects significant in American architecture, history, archaeology, and culture, and Section 106 mandates that federal agencies take into account the effect of an undertaking on a property that is included in, or is eligible for inclusion in, the National Register of Historic Places.

A scoping letter was submitted to the State Historic Preservation Office (SHPO) requesting comment on the Cow Tail Mitigation Site on January 30, 2023. SHPO has reviewed the project and is not aware of any historical resources which would be affected by the project. All correspondence related to Section 106 is included in Appendix B.

Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)

These acts, collectively known as the Uniform Act, provide for uniform and equitable treatment of persons displaced from their homes, businesses, non-profit associations, or farms by federal and federally-assisted programs, and establish uniform and equitable land acquisition policies.

The Cow Tail Mitigation Site is a full-delivery project that includes land acquisition. Notification of the fair market value of the project property and the lack of condemnation authority by WLS was included in the signed option agreement for the project properties. A copy of the relevant section of each of the option agreement are included in Appendix B.

Endangered Species Act (ESA)

Section 7 of the ESA requires federal agencies, in consultation with and with the assistance of the Secretary of the Interior or of Commerce, as appropriate, to ensure that actions they authorize, fund or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of critical habitat for these species.

The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation database (IPaC) list of endangered species for the site includes the following species: red-cockaded woodpecker (*Picoides borealis*), wood stork (*Mycteria americana*), American alligator (*Alligator mississippiensis*), Cooley's meadowrue (*Thalictrum cooleyi*), Monarch butterfly (*Danaus plexippus*), and the tri-colored bat (*Perimyotis subflavus*). The USFWS does not currently list any Critical Habitat Designations for the Federally listed species within the project site.

Results from pedestrian surveys conducted on June 30, 2022, indicated that the project area provides areas of suitable habitat for the wood stork (foraging habitat only), Cooley's meadowrue, American alligator, and the tri-colored bat. No species were found, and the project is not disturbing any mature deciduous trees. No other suitable habitat was found on site and no individuals of the federally listed species were identified.

To meet regulatory requirements, a scoping letter requesting comment from the USFWS was sent on February 10, 2023. The USFWS responded that they concur with WLS' biological determinations and do not have any concerns with the project. Please refer to Appendix B for all USFWS correspondence and biological determinations.

Farmland Protection Policy Act (FPPA)

The FPPA requires that, before taking or approving any federal action that would result in conversion of farmland, the agency must examine the effects of the action using the criteria set forth in the FPPA, and, if there are adverse effects, must consider alternatives to lessen them.

The Cow Tail Mitigation Site includes the conversion of prime farmland. As such, Form AD-1006 was completed and submitted to the Natural Resources Conservation Service (NRCS) on February 15, 2023. The completed form and correspondence documenting its submittal is included in Appendix B.

Fish and Wildlife Coordination Act (FWCA)

The FWCA requires consultation with the USFWS and the appropriate state wildlife agency on projects that alter or modify a water body. Reports and recommendations prepared by these agencies document project effects on wildlife and identify measures that may be adopted to prevent loss or damage to wildlife resources.

WLS requested comment on the project from both the USFWS and the North Carolina Wildlife Resources Commission (NCWRC) on February 10, 2023 and February 6, 2023 respectively. Neither the NCWRC nor the USFWS have any concerns with this project. All correspondence with the two agencies is included in Appendix B.

Migratory Bird Treaty Act (MBTA)

The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird. The indirect killing of birds by destroying their nests and eggs is covered by the MBTA, so construction in nesting areas during nesting seasons can constitute a taking.

WLS requested comment on the Cow Tail Mitigation Site from the USFWS in regard to migratory birds on February 10, 2023. The USFWS responded that they concur with WLS' biological determinations and do not have any concerns with the project. All correspondence with USFWS is included in Appendix B.

Appendix 12 – Agency Correspondence & Floodplain Checklist

Meeting Minutes

Cow Tail Mitigation Project

DMS ID 100647, USACE Action ID 2023-00196

Subject: NCIRT Post Contract Site Visit

Date Prepared: February 24th, 2023

Meeting Date and Time: February 22nd, 2023 @ 11:30 am

Meeting Location: On Site (Columbus County, NC)

Attendees: USACE: Todd Tugwell, Erin Davis (NCIRT)

DWR: Mac Haupt (NCIRT)

DMS: Emily Dunnigan, Jeremiah Dow

WLS: Kayne VanStell, Cara Conder, Daniel Ingram

George Lankford, LSS

Recorded By: Cara Conder

These meeting minutes document notes and discussion points from the North Carolina Interagency Review Team (NCIRT) Post-Contract Site Meeting for the Cow Tail Mitigation Project (project, site). This full-delivery project was contracted on January 5, 2023, by the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS), with Water & Land Solutions, LLC (WLS), under RFP 16-416888198. The project site is located within the Lumber River Basin (CU 03040203) in Columbus County, near Whiteville, North Carolina. The meeting began at 11:30 am with a general summary of the overall project concepts and site background. After the site overview, attendees toured the project site to review existing conditions, proposed mitigation types, design concepts and approaches. In general, the project site review notes are presented below in the order they were visited.

General/Before Site Walk

- Erin/USACE asked if WLS would be installing pre-restoration wetland gauges and WLS responded yes.
- Erin/USACE asked how much control WLS has over ditches on the boundary. WLS responded that we won't be doing any work outside the conservation easement and will be filling and partially filling ditches within the easement. If there is a ditch on the boundary and it is the same property owner WLS has the ability to possibly extend the conservation easement to include necessary ditches. Erin noted to call out any maintained ditches in permitting/site impacts, and conservation easement.
- Erin/USACE confirmed the wetland rehabilitation is 2:1 ratio. WLS confirmed and stated the uplift will be hydrologic and vegetation planting. Daniel/WLS noted that there are likely non-

jurisdictional areas in W01 which would qualify for re-establishment, but WLS took a conservative approach on the proposal.

- Todd/USACE noted to plant wetter species than what is re-establishing on site in the cut-over area.
- Todd/USACE asked several questions regarding hydrologic trespass and the importance of anticipating aggradation and debris causing controlling elevations above the grading plan.

S200

- The group drove to the top of S200 within proposed easement near the crediting/non-crediting stream break. S200 is jurisdictional beyond the conservation easement.
- The IRT agreed with the headwater design approach and noted that S200 would be relocated from its current ditched location to the low point of the valley.
- Todd/USACE noted that existing pine trees will be removed on the berm area when the stream restoration work is done.

Cow Branch (upper)

- The group then walked to upper Cow Branch in the forested section of the project.
- WLS explained that they are starting the headwater stream channel work in this area, and no other work is proposed in the wooded area. There are likely wetlands in this area, but WLS is not proposing any wetland work or mitigation credit.
- Todd/USACE noted to be aware of the backwater effect and flooding upstream due to the project. Lateral drainage effect information should be provided in the draft mitigation plan to demonstrate that proposed credit areas will not be adversely influenced by any open ditches located within or adjacent to the project area. Kayne/WLS said there have been beaver dams on site that did not adversely affect the drainage. Kayne said WLS can do a 2D model to simulate saturated conditions and prolonged inundation.
- Todd/USACE noted that most the pines are on the perimeter of the forested area and will be cleared during the stream construction.
- Daniel/WLS stated all privet within the conservation easement will be treated.
- The group discussed potential wetland crediting in the forested stand, despite not including any wetland credits in the proposal.
- Erin/USACE stated that potential long-term (beyond the monitoring period) beaver presence/impact should be discussed in the draft mitigation plan.

W02

- Todd/USACE said there were no concerns with the wetland re-establishment areas.

W01 near farm crossing

- The group walked along the farm crossing in W01. WLS restated that W01 is rehabilitation at a 2:1 ratio and will be hydrologic and vegetation uplift. Daniel/WLS noted that there is likely wetland re-establishment in W01 also.
- Todd/USACE noted that the JD results will determine jurisdictional wetlands.
- The group discussed the re-vegetation plan for W01. Daniel stated that WLS conceptually could clear 8 ft paths every 20 ft and plant those areas with 4x4 spacing, and this would allow some of the preferred native species (i.e. bay) to remain. Todd/USACE recommended focusing clearing and planting in a targeted way based on topography.
- Erin/USACE requested WLS do pre-restoration vegetation surveys.
- Erin and Todd/USACE stated the performance criteria could be adjusted to account for a non-standard vegetation strategy.
- Erin/USACE requested to have some natural vegetation plots during monitoring to assess those areas.
- Erin/USACE noted that adaptive management will be important for species diversity and that performance standards might need adjusted based on final planting plan. Pine/maple/sweet gum management would be needed within the cutover area proposed for wetland credit in order to improve diversity and allow planted stems to establish.

<u>Cow Branch (lower)</u>

- The group walked through lower W01 to lower Cow Branch. The IRT agreed with the design approach for lower Cow Branch and W01. Todd/USACE requested pre-restoration wetland gauges and a reference wetland gauge be installed on site if possible. If having a reference wetland gauge onsite isn't feasible, USACE recommends looking for an appropriate reference site nearby. A reference groundwater gauge is a helpful tool to have during monitoring period data reviews, particularly during abnormal rainfall years.
- Todd/USACE stated to make sure the wetlands on the boundary of the project don't affect adjacent property. To address the concern of project wetlands potentially affecting adjacent property the group discussed the possible opportunity to extend the easement out as additional buffer, particularly if the perimeter ditch is filled or partially filled in this area.
- Group discussed the benefit to groundwater gauge transects to demonstrate groundwater recharge across the headwater valley during monitoring.

<u>Summary Notes</u>

- USACE did connect with Mickey Sugg regarding the previous bank prospectus at this location. Moving forward with the DMS project based on the currently proposed design will not conflict with past USACE remarks or decisions. A JD will be the next critical step.
- W01 will likely be wetland rehabilitation and re-establishment based on the jurisdictional determination. WLS will document uplift accordingly in the mitigation plan.

- USACE would encourage potential site credits be realized, if feasible, in order maximize the site's potential functional uplift.

The above minutes represent Water & Land Solutions' interpretation and understanding of the meeting discussion and actions. If recipients of these minutes should find any information contained in these minutes to be in error, incomplete, please notify the author with appropriate corrections and/or additions within five (5) business days to allow adequate time for correction and redistribution.

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
MARC RECKTENWALD
Director

NORTH CAROLINA
Environmental Quality

August 28, 2023

Cara Conder
Water & Land Solutions, LLC
7721 Six Forks Road, Suite 130
Raleigh, NC 27615

Subject: Task 3 Draft Mitigation Plan Comments – Cow Tail Mitigation Project (DMS #100647)
Lumber River 03040203; Columbus County, NC
Contract No. 416888198-01

Dear Mrs. Conder:

On August 4, 2023, DMS received the Draft Mitigation Plan for the Cow Tail Mitigation Project from Water & Land Solutions, LLC (WLS). DMS has completed our review of the Draft Mitigation Plan and has the following comments:

Report:

1. Please use the 2020 version of the Quantities and Credits Table and Project Attribute Table. The most up to date version can be found on the DMS templates and guidelines page via the "Mitigation Plan Tables 10/1/2020" link.

2. Page 7, Table 1: Please break Cow Branch into upper, middle, and lower in the table.

3. Page 7, Table 1: Based on the proposal and maps there are portions of Cow Branch (upper) and S200 not proposed for credit, please clarify and update credits if necessary.

4. Page 7, Table 1: Wetland rehabilitation can only be performed in existing wetlands. Please break out any re-establishment areas in W01 at 2:1 crediting within the table and update anywhere applicable.

5. Page 7, Table 1: Please round stream feet to the nearest whole foot and carry credits to 3 decimal places.

6. Page 8, Table 2: The proportional and qualitative features that differ between Cow Branch upper, mid, and low warrants discreet reaches for these in this table. Please include.

7. Page 8, Table 2: Please include the wetland information in the table.

8. Page 8, Table 2, Land Use Classification: Is the 2% transportation figure inclusive of residential coverage?

9. Page 9, Table 2, Existing stream classification: The challenge with classifying these types of channels is understood, but a design target had to be developed for Cow Branch Mid and Low at minimum. Please provide a BPJ of the stream type and footnote to this effect.

10. Page 9, Section 3.1.1: Does this DWR classification apply this high up in the watershed? Please reply or revise as appropriate.

11. Page 10, Section 3.1.2: Please include USACE's decision on the preliminary JD in the final mitigation plan.

12. Page 11, Section 3.2.3: Strike or modify first sentence since it applies to anywhere globally in mid-latitudes.

13. Page 13, Section 3.4, last sentence: Was minimal impervious cover intended in this sentence? Please revise or reply as appropriate.

14. Page 16, Section 3.5.3: Limited sediment supply seems unlikely due to all the agriculture in the watershed. Please reply or revise as appropriate.

15. Page 17, Section 3.6, 2nd paragraph: How was groundwater observed?

16. Page 17, Section 3.6, 2nd paragraph: Please cite a figure for Wetland WA.

17. Page 17, Section 3.6, 3rd paragraph: Please check if citation to Figure 7 is correct and identify the reference wetland gauges by number when the appropriate Figure is cited.

18. Page 20, Section 4.1.1, last sentence: This is a difficult assertion absent measurement and a Land Use and Land cover map (LULC). Reply or revise as appropriate. Examine section 5.1.1.

19. Section 5: Some of the objectives and goals here appear reversed or misplaced. Some of the objective bullets are larger overriding goals (e.g. improve floodplain connection) the objectives (actions/methods) to achieve that goal are implementing stream restoration and repairing channelized streams. Examine the 2017 Mitigation Plan guidance and the table in the 2020 DMS Monitoring Report template for establishing these linkages and hierarchy.

20. Page 24, Table 8: Please refer to the exact quantities and credits table in the DMS templates and modify to include the legend/footnotes.

21. Page 24, Table 8: Please footnote that the Mitigation Plan footage or acreage is the result of a length calculation for the valley axis given the HWV design. A reader could be confused by the fact that we are addressing the straightening of channels in the existing condition but producing nearly the same or in some cases lesser quantities in the design.

22. Page 26, Section 6.1.1, 2nd paragraph: Does the small drainage argument in this paragraph still apply to Cow Branch (lower), which is the better part of a square mile? Please reply or revise as appropriate.

23. Page 26, Section 6.1.1, 2nd paragraph: Please cite the data in the report/appendices to support the following sentence: "This restoration approach is supported by on-site hydric soils investigation, surface flow observations, topography, and comparing extensive reference site data."

24. Page 26, Section 6.1.1, 3rd paragraph, first sentence: Given the variable nature of CP headwater restoration, please provide some project examples of where WLS provided successful BPJ in these settings in this paragraph. This will help support the assertion.

25. Page 28, Section 6.1.2: The draft mitigation plan indicated that a minimum 50-feet of riparian buffer would be established along the restored Cow Branch (lower and middle), S100, and S200. However, the draft mitigation plan (Table 7) stated a 100-feet of riparian buffer would be established along most of the restored reaches. Please make necessary changes.

26. Page 28, Section 6.2.1, 2nd paragraph, first sentence: Isn't the Geratz data set more suited for channels of this size in this setting? Please reply or revise as appropriate.

27. Page 30, Table 10: Why do the headwater velocities demonstrate a higher distribution than the composite distribution?

28. Page 41, Section 6.6.4: Please use the same format for "Tree Species Diversity".

29. Page 42, Section 7.1 Stream Horizontal Stability: What percent change is considered measurable? Please clarify.

30. Section 8: As a reminder, providers are responsible during the monitoring period for annually checking (and reporting on) the easement integrity across the project site for encroachments, missing markers, adequate signage, fence breaks, etc. Please add these details to the mitigation plan monitoring section and table and summarize how WLS plans to check the easement compliance and boundary marking integrity throughout the monitoring period.

31. Page 48, Section 8.4: Please expand/clarify the reasoning for not using random plots to monitor vegetation in W01.

32. Page 49, Table 18: Please include wetland performance standards in this table.

33. Page 50, Section 10: Please remove the last sentence regarding long-term beaver management.

Figures

1. Figure 6: Please label all monitoring features.

2. Figures 9 & 10 indicate large portions of S200 and Cow Branch (upper) are not proposed for credit yet Table 1 indicates that much of these are proposed for credit. Please clarify and update the table and figures as necessary.

3. Figure 10: Please ensure no wetland gauges will be installed within the footprint of a filled ditch.

4. Figure 10: Flow gauges are proposed to be installed above the crediting areas on both S200 and Cow Branch (upper). Please keep in mind that if these gauges fail to meet performance criteria additional gauges may need to be installed.

Plan Sheets

1. Please list the total disturbed acreage on the title sheet.

2. Are log riffles and constructed stone riffles going to be used in this project? If they are, please include details in the plan. If they are not, please remove them from the legend.

3. Are toewood w/ Geolifts and large woody debris going to be used in this project? If they are, please include details in the plan. If they are not, please remove them from the legend.

4. Sheet 1: Please add a summary table with proposed stream lengths, wetland areas, SMCs, and RWMCs.

5. Sheet 16: The live stake planting schedule does not match Table 16, please update.

6. Sheet 16: The permanent seeding schedule does not match Table 17, please update.

Appendix

1. Appendix 2, Rainfall Data: Please label the y-axis.

2. Please number the figures in Appendix 2.

3. Appendix 2, Groundwater Gauge Figure X: Stream labels do not match other maps (cow branch upper and cow branch middle), please update.

4. Appendix 2, Groundwater Gauge Figure X: Please update the wetland layer with the most current proposed mitigation.

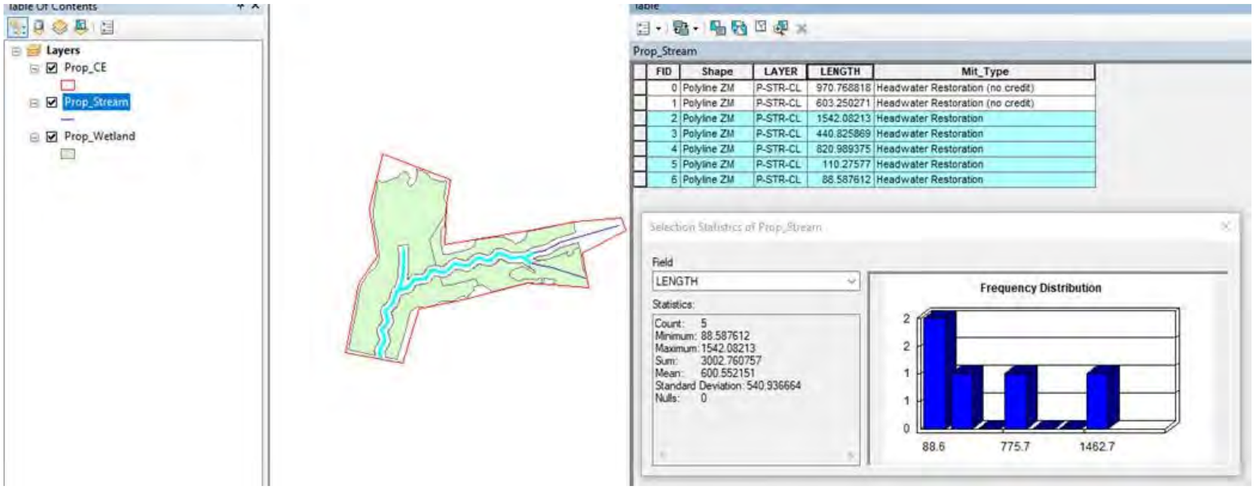
5. Appendix 9: The PJD has wetlands labeled differently than in the Mitigation Plan, please maintain consistency between how features are labeled throughout the course of the project.

Digital Deliverables

1. Please re-submit the project GIS files. The stream component attribute table must list the project segments as they appear in the Mitigation Quantities and Credits Table and the linear feet be within 5 linear feet of the reported assets for each reach. As submitted, the segments are not labeled, and the five segments listed as credited in the attribute table sum to 3002.76 linear feet, the report indicates a total of 4388.530. Please note all stream credits should be calculated using valley length. Please see attribute table, summary statistics and map below.

2. The wetland attribute table is missing segment labels and there is a conflict of existing wetlands and rehabilitation wetlands as submitted. The rehabilitation wetlands must exist in the footprint of existing JD wetlands. The existing wetlands reported in the attribute table and files totals 4.401 non-credited acres; the rehabilitation acreage is 26.696. Please see map below.

Streams:



Wetlands:

Please make the requested revisions and provide one (1) pdf copy of the revised Mitigation Plan, the updated digital files, and a response to comments letter for DMS review. The comment response letter should be included in the revised plan and included after the plan cover page.

If you have any questions, please contact me at any time. I can be reached at (919) 817-6534 or email me at emily.dunnigan@deq.nc.gov.

Sincerely,

Emily Dunnigan

Emily Dunnigan
Project Manager
NCDEQ - Division of Mitigation Services

217 West Jones St., Raleigh, NC 27603
Raleigh, NC 27603
919-817-6534

WATER & LAND SOLUTIONS

October 19, 2023

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Emily Dunnigan, Project Manager
217 West Jones Street
Raleigh, NC 27603

RE: Task 3 Submittal, Final Draft Mitigation Plan for the Cow Tail Mitigation Project, NCDEQ DMS Full-Delivery Project ID #100647, Contract #416888198-01, Lumber River Basin, Cataloging Unit 03040203, Columbus County, NC

Dear Ms. Dunnigan:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Draft Mitigation Plan for the Cow Tail Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). Per the DMS review comments, WLS has updated the Final Draft Mitigation Plan and associated deliverables accordingly. We are providing the electronic deliverables via a file transfer. The electronic deliverables are organized under the following folder structure as required under the digital submission requirements for mitigation plans:

1. Report PDF
2. Background Tables
3. Permitting Info
4. Existing Conditions Data
    - Data Tables
    - Map Data
    - Model Data
    - Photos
5. Design Data

Once the Final Draft Mitigation Plan is approved by NCDEQ DMS, we will provide the required financial assurance, hard copies (if requested) and a digital (.pdf) copy of the Final Draft Mitigation Plan, to be posted for review by the NC Interagency Review Team (IRT) to start their review period. We are providing our written responses to NCDEQ DMS's review comments on the Draft Mitigation Plan below. Each of the DMS review comments is copied below in bold text, followed by the appropriate response from WLS in regular text:

REPORT

1. Please use the 2020 version of the Quantities and Credits Table and Project Attribute Table. The most up to date version can be found on the DMS templates and guidelines page via the "Mitigation Plan Tables 10/1/2020" link.
Response: The excel tables have been revised to use these templates and are in the electronic submittal.

2. Page 7, Table 1: Please break Cow Branch into upper, middle, and lower in the table.
Response: The table has been revised with the Cow Branch reach breaks.

3. Page 7, Table 1: Based on the proposal and maps there are portions of Cow Branch (upper) and S200 not proposed for credit, please clarify and update credits if necessary.
Response: Table 1 originally had shown all linear feet within the conservation easement boundary. Table 1 has been corrected to show only linear feet of creditable stream where full stream restoration work is being done. The stream segments listed as 'no credit' are above the S200/Cow Branch upper tie-in areas where there is limited stream channel grading, structure, and raising the profile to match the floodplain elevation at the S200/Cow Branch upper confluence. The work in these areas would not warrant a full 1:1 stream restoration credit and this approach was discussed as 'no credit' during the IRT site visit and in the proposal. The final draft mitigation plan currently proposes 3,523 stream credits which is above the contracted value. These 'no credit' segments could be at risk of full stream credit generation and the intent was never to include them as creditable lengths.

4. Page 7, Table 1: Wetland rehabilitation can only be performed in existing wetlands. Please break out any re-establishment areas in W01 at 2:1 crediting within the table and update anywhere applicable.
Response: Table 1 has been updated to show W01 as wetland rehabilitation for the existing wetland areas and wetland re-establishment at 2:1 crediting for the rest of W01. Section 6.4, Table 8, and the mitigation map have been updated as well.

5. Page 7, Table 1: Please round stream feet to the nearest whole foot and carry credits to 3 decimal places.
Response: The table has revised accordingly.

6. Page 8, Table 2: The proportional and qualitative features that differ between Cow Branch upper, mid, and low warrants discreet reaches for these in this table. Please include.
Response: Table 2 has been updated to reflect Cow Branch upper, middle, and lower in the table and applicable report sections.

7. Page 8, Table 2: Please include the wetland information in the table.
Response: The table has revised with wetland information accordingly.

8. Page 8, Table 2, Land Use Classification: Is the 2% transportation figure inclusive of residential coverage?
Response: Yes. WLS verified the estimated impervious area includes roadways and residential coverage.

9. Page 9, Table 2, Existing stream classification: The challenge with classifying these types of channels is understood, but a design target had to be developed for Cow Branch Mid and Low at minimum. Please provide a BPJ of the stream type and footnote to this effect.
Response: WLS updated the Table 2 existing stream classification to most closely resemble channelized Rosgen G5 stream types. The existing stream conditions in Section 3.5 and reach parameter tables have been updated accordingly.

10. Page 9, Section 3.1.1: Does this DWR classification apply this high up in the watershed? Please reply or revise as appropriate.
Response: Yes, per the online DWR Surface Water Classifications map website Cow Branch is classified 'C;Sw' from within the project boundary source to Porter Swamp.

11. Page 10, Section 3.1.2: Please include USACE's decision on the preliminary JD in the final mitigation plan.
Response: WLS received a concurrence on 9/19/23 and the USACE agreed with all aquatic features. "*We have reviewed the information provided by you concerning the aquatic resources, and by copy of this e-mail, are confirming that the aquatic resources delineation has been verified by the Corps to be sufficiently accurate and reliable for permitting actions and the determination of compensatory mitigation requirements. The boundaries of these aquatic resources are shown on Cow Tail Mitigation Project Lumber 03040203 Columbus County, NC, Preliminary Jurisdictional Waters Map, Figure 4, Date:6/6/2023.*"

We did request a PJD that included updated wetland labels, but have not received one at the time of this response letter. Todd Tugwell directed us to include our map with updated labels with the concurrence since no LF or acreages changed.

12. Page 11, Section 3.2.3: Strike or modify first sentence since it applies to anywhere globally in mid-latitudes.
Response: Corrected/sentence deleted.

13. Page 13, Section 3.4, last sentence: Was minimal impervious cover intended in this sentence? Please revise or reply as appropriate.
Response: Yes, minimal impervious cover was intended in this sentence because of the direct correlation between the amount of impervious surface and pollutant runoff. The impervious cover model

demonstrates the relationship between increases in impervious cover increases water quality impairments and therefore decreases restoration potential and overall ecosystem health.

14. Page 16, Section 3.5.3: Limited sediment supply seems unlikely due to all the agriculture in the watershed. Please reply or revise as appropriate.
Response: As summarized in Table 2, the land use within the project catchment is approximately 50% agriculture and 40% wooded (28% forested and 12% managed pine). Given the drainage inputs, landscape position, flat topographic relief of the headwater tributaries, straightened channels with low near bank stress/erosion, and observed minimal sediment accretion in the oversized channels, WLS does not have evidence to suggest that the system is receiving a moderate to high sediment load.

15. Page 17, Section 3.6, 2nd paragraph: How was groundwater observed?
Response: As noted in Section 3.6, second paragraph, groundwater was observed visually and from soil borings from the licensed soil scientist, which indicate the site was historically very wet with long term saturation. The groundwater table is affected by the extensive ditch network and dredging. As described in the remaining paragraph, four automated groundwater wells were installed in W01 to evaluate the range of hydrologic conditions for the existing wetland. In addition, two groundwater wells were installed in a reference wetland for comparison during performance monitoring. This well data will help provide the basis for comparing pre- and post-construction groundwater hydrology. The sentence in third paragraph was moved to avoid confusion and provide more context.

16. Page 17, Section 3.6, 2nd paragraph: Please cite a figure for Wetland WA.
Response: Figure 6 has been referenced to show Wetland WA.

17. Page 17, Section 3.6, 3rd paragraph: Please check if citation to Figure 7 is correct and identify the reference wetland gauges by number when the appropriate Figure is cited.
Response: Figure 7 citation corrected to Figure 6 and wetland gauges have been labels accordingly as shown in Figure 6 and Appendix 2 Pre-Construction Gauge Data information.

18. Page 20, Section 4.1.1, last sentence: This is a difficult assertion absent measurement and a Land Use and Land cover map (LULC). Reply or revise as appropriate. Examine section 5.1.1.
Response: Revised last sentence, as well as section 5.1.1 to remove Level 4 and 5 functional lift assumption since these levels will not be monitored for project success.

19. Section 5: Some of the objectives and goals here appear reversed or misplaced. Some of the objective bullets are larger overriding goals (e.g. improve floodplain connection) the objectives (actions/methods) to achieve that goal are implementing stream restoration and repairing channelized streams. Examine the 2017 Mitigation Plan guidance and the table in the 2020 DMS Monitoring Report template for establishing these linkages and hierarchy.

Response: The wording was likely confusing because it stated, “goals would be accomplished by” and then listed specific items, but not clear goals. This section has been revised to make the goals and objectives clearer.

20. Page 24, Table 8: Please refer to the exact quantities and credits table in the DMS templates and modify to include the legend/footnotes.
Response: Table 8 has been revised and includes the legend.

21. Page 24, Table 8: Please footnote that the Mitigation Plan footage or acreage is the result of a length calculation for the valley axis given the HWV design. A reader could be confused by the fact that we are addressing the straightening of channels in the existing condition but producing nearly the same or in some cases lesser quantities in the design.
Response: A footnote has been added to Table 8 for valley length calculation for S100, S200, and upper Cow Branch.

22. Page 26, Section 6.1.1, 2nd paragraph: Does the small drainage argument in this paragraph still apply to Cow Branch (lower), which is the better part of a square mile? Please reply or revise as appropriate.
Response: The paragraph in this section has been revised to clarify proposed reaches S100, S200 and Cow Branch upper are proposed for headwater stream restoration (Rosgen DA stream type) and Cow Branch middle and lower is proposed as a ‘moderate to well defined’ single-thread channel (Rosgen C5 stream type).

23. Page 26, Section 6.1.1, 2nd paragraph: Please cite the data in the report/appendices to support the following sentence: “This restoration approach is supported by on-site hydric soils investigation, surface flow observations, topography, and comparing extensive reference site data.”
Response: Added clarification to cite data in Appendix 2.

24. Page 26, Section 6.1.1, 3rd paragraph, first sentence: Given the variable nature of CP headwater restoration, please provide some project examples of where WLS provided successful BPJ in these settings in this paragraph. This will help support the assertion.
Response: Successful WLS project examples that have achieved regulatory closeout have been included in this section.

25. Page 28, Section 6.1.2: The draft mitigation plan indicated that a minimum 50-feet of riparian buffer would be established along the restored Cow Branch (lower and middle), S100, and S200. However, the draft mitigation plan (Table 7) stated a 100-feet of riparian buffer would be established along most of the restored reaches. Please make necessary changes.

WATER & LAND SOLUTIONS

Response: The stream buffer will be 50 ft, but the streams are all surrounded by wetland areas that will also be planted. The stream zone will be considered 50 ft and all references to a 100 ft stream buffer have been removed.

26. Page 28, Section 6.2.1, 2nd paragraph, first sentence: Isn't the Geratz data set more suited for channels of this size in this setting? Please reply or revise as appropriate.
Response: Yes, WLS compared published CP regional curve hydraulic geometry data set (Sweet and Geratz, 2003) when developing appropriate stream design geometry and selected flow rates that best correspond to the proposed design channels. The sentence has been revised to include and clarify this distinction.

27. Page 30, Table 10: Why do the headwater velocities demonstrate a higher distribution than the composite distribution?
Response: This is likely due to the small sample size and variable channel geometry, Mannings 'n ' and headwater channel slopes. The velocities are well within an expected normal range and consistent with the common CP HW streams from the data set (average velocity ~1.5 ft/s).

28. Page 41, Section 6.6.4: Please use the same format for "Tree Species Diversity".
Response: Tree Species Diversity has been reformatted to match.

29. Page 42, Section 7.1 Stream Horizontal Stability: What percent change is considered measurable? Please clarify.
Response: This sentence has been reworded to: "If significant changes (+/- five percent) do occur…"

30. Section 8: As a reminder, providers are responsible during the monitoring period for annually checking (and reporting on) the easement integrity across the project site for encroachments, missing markers, adequate signage, fence breaks, etc. Please add these details to the mitigation plan monitoring section and table and summarize how WLS plans to check the easement compliance and boundary marking integrity throughout the monitoring period.
Response: WLS has added a Section 8.2 Easement Boundary Monitoring to the mitigation plan and updated Table 18.

31. Page 48, Section 8.4: Please expand/clarify the reasoning for not using random plots to monitor vegetation in W01.
Response: In our experience in similar wetland conditions, it is extremely difficult to locate the planted trees in random plots in years 1-3. There is a lot of existing regeneration in the disturbed wetland area. This sentence in Section 8.5 has been revised to: "Fifteen vegetation plots will be fixed and located in W01; these will be fixed due to difficulty of finding planted trees later in monitoring due to the existing dense regeneration in the disturbed area."

WATER & LAND SOLUTIONS

32. Page 49, Table 18: Please include wetland performance standards in this table.
Response: Wetland performance standards have been added to Table 18.

33. Page 50, Section 10: Please remove the last sentence regarding long-term beaver management.
Response: This sentence has been removed.

FIGURES

1. Figure 6: Please label all monitoring features.
Response: Figure 6 has been revised.

2. Figures 9 & 10 indicate large portions of S200 and Cow Branch (upper) are not proposed for credit yet Table 1 indicates that much of these are proposed for credit. Please clarify and update the table and figures as necessary.
Response: Please see Response #3. Table 1 now only lists creditable areas. None of the light blue stream (no credit) is included in the Table 1 or Table 8 numbers now. As stated in Response #3 these are tie-in sections and not much work is being done, and these were discussed as no credit during the IRT site visit.

3. Figure 10: Please ensure no wetland gauges will be installed within the footprint of a filled ditch.
Response: WLS has ensured that no wetland gauges will be installed within the footprint of a filled ditch.

4. Figure 10: Flow gauges are proposed to be installed above the crediting areas on both S200 and Cow Branch (upper). Please keep in mind that if these gauges fail to meet performance criteria additional gauges may need to be installed.
Response: Correct, flow gauges are supposed to be in the upper third of the reach, which in this case falls in a non-crediting section for Cow Branch upper. If the gauges fail to meet performance criteria WLS will install additional gauges, but do not foresee flow being an issue.

PLAN SHEETS

1. Please list the total disturbed acreage on the title sheet.
Response: The approximate limits of disturbance (LOD) has been added to the title sheet. The final total disturbed acreage and associated erosion control measures and practices will be included with the separate Sedimentation and & Erosion Control Plan permit application submittal to NC DEQ-DEMLR.

2. Are log riffles and constructed stone riffles going to be used in this project? If they are, please include details in the plan. If they are not, please remove them from the legend.

Response: Constructed brushy riffles will be used, however larger log riffles and constructed stone riffles will not be used for this project. As noted in the legend, some items shown may not actually be present within the plan set. The legend has been updated to only show relevant structures, however the note is intended to maintain consistency for plan set generation.

3. Are toewood w/ geolifts and large woody debris going to be used in this project? If they are, please include details in the plan. If they are not, please remove them from the legend.
Response: Geolifts will not be used for this project. Large woody debris will be placed in floodplain depressions and ditch fill locations as shown on the plans. The details have been updated on plan sheets accordingly.

4. Sheet 1: Please add a summary table with proposed stream lengths, wetland areas, SMCs, and RWMCs.
Response: A credit summary table has been added to Sheet 1.

5. Sheet 16: The live stake planting schedule does not match Table 16, please update.
Response: Updated/Corrected.

6. Sheet 16: The permanent seeding schedule does not match Table 17, please update.
Response: Updated/Corrected.

APPENDIX

1. Appendix 2, Rainfall Data: Please label the y-axis.
Response: The y-axis has been labeled.

2. Please number the figures in Appendix 2.
Response: There are only two figures that correspond to the first two items in Appendix 2, the Existing Conditions Gauge Data and the Vegetation Survey. WLS prefers to label these figures 'X' in these instances when it's one figure and the main figures are all numbered. We have renamed these two maps: GW (for groundwater) and VS (vegetation survey).

3. Appendix 2, Groundwater Gauge Figure X: Stream labels do not match other maps (cow branch upper and cow branch middle), please update.
Response: This figure has been updated to reflect the stream names.

4. Appendix 2, Groundwater Gauge Figure X: Please update the wetland layer with the most current proposed mitigation.
Response: This figure has been updated with the current wetland proposed mitigation.

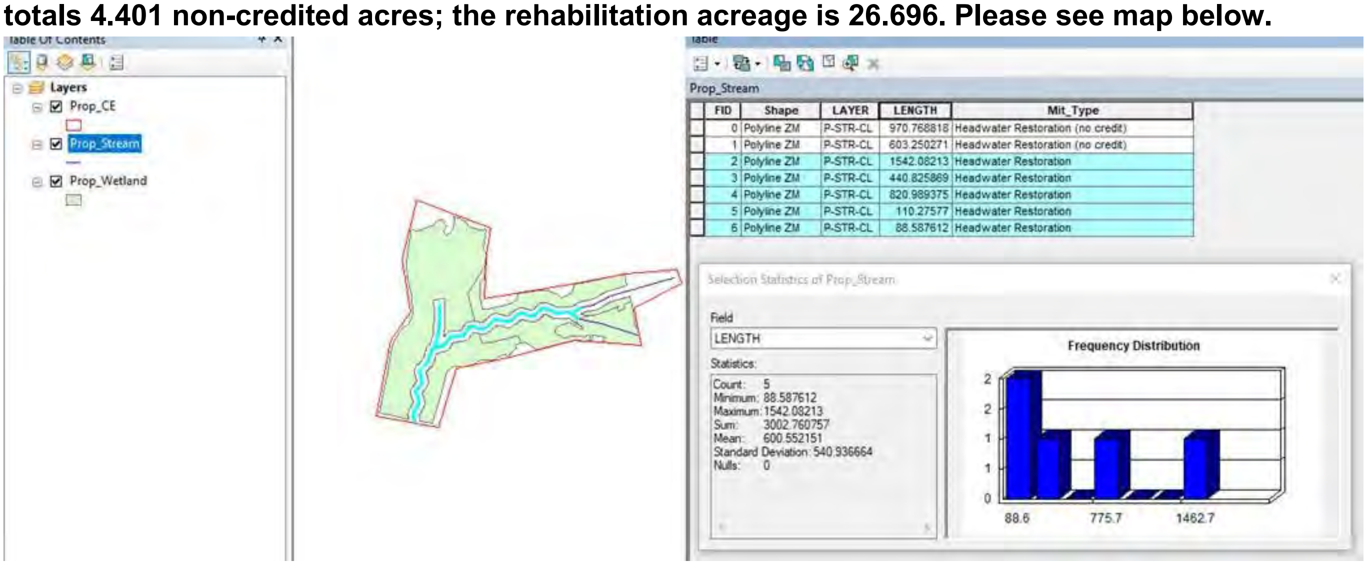
5. Appendix 9: The PJD has wetlands labeled differently than in the Mitigation Plan, please

maintain consistency between how features are labeled throughout the course of the project.
Response: Understood and after receiving this comment, WLS tried to get the PJD revised with the labels that match the mitigation plan. We received a concurrence using the original labels of 1, 2, etc., but Todd Tugwell said we could include our revised map with the concurrence since no footprints of aquatic resources changed. The last map in the concurrence has wetland labels that match the mitigation plan.

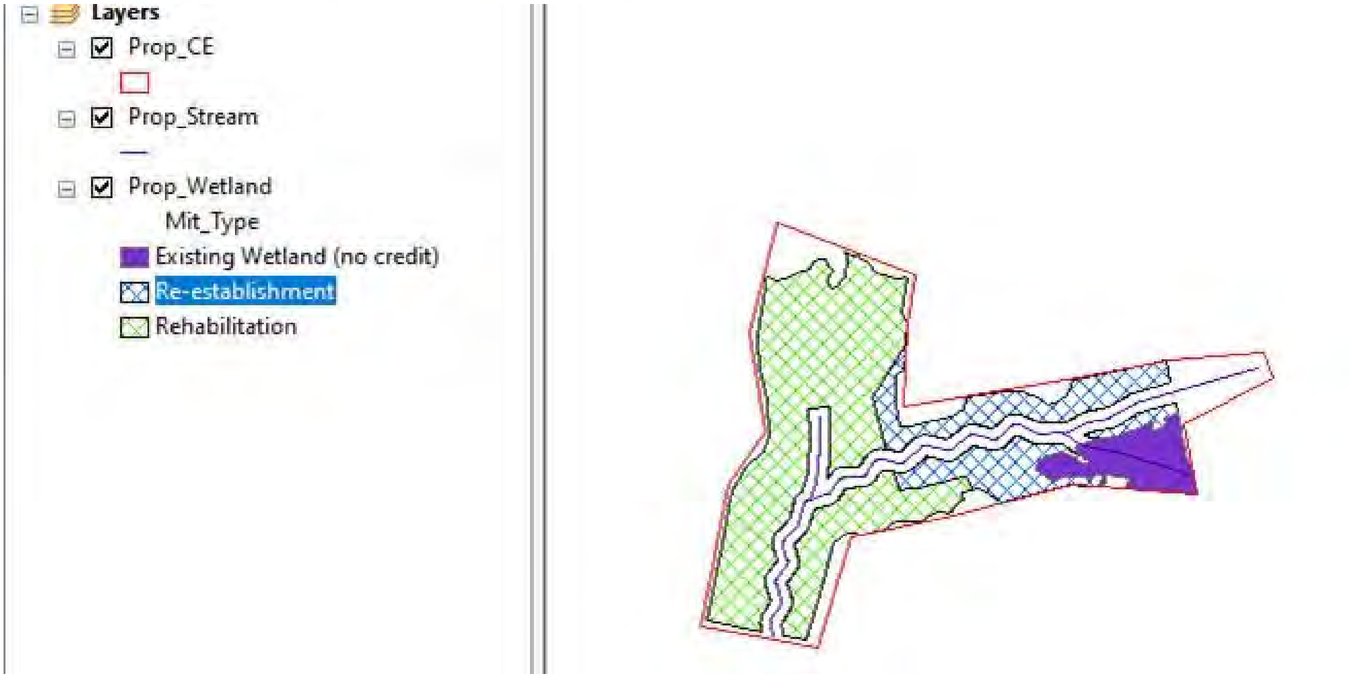
DIGITAL DELIVERABLES

1. Please re-submit the project GIS files. The stream component attribute table must list the project segments as they appear in the Mitigation Quantities and Credits Table and the linear feet be within 5 linear feet of the reported assets for each reach. As submitted, the segments are not labeled, and the five segments listed as credited in the attribute table sum to 3002.76 linear feet, the report indicates a total of 4388.530. Please note all stream credits should be calculated using valley length. Please see attribute table, summary statistics and map below.
Response: The GIS files have been updated with correct creditable lengths. Cow Branch middle and lower are priority I/II restoration and should not be calculated using valley length. All updated GIS files are included.

2. The wetland attribute table is missing segment labels and there is a conflict of existing wetlands and rehabilitation wetlands as submitted. The rehabilitation wetlands must exist in the footprint of existing JD wetlands. The existing wetlands reported in the attribute table and files totals 4.401 non-credited acres; the rehabilitation acreage is 26.696. Please see map below.



FID	Shape	LAYER	LENGTH	Mit_Type
0	Polyline ZM	P-STR-CL	970.768818	Headwater Restoration (no credit)
1	Polyline ZM	P-STR-CL	603.250271	Headwater Restoration (no credit)
2	Polyline ZM	P-STR-CL	1542.08213	Headwater Restoration
3	Polyline ZM	P-STR-CL	440.825869	Headwater Restoration
4	Polyline ZM	P-STR-CL	820.989375	Headwater Restoration
5	Polyline ZM	P-STR-CL	110.27577	Headwater Restoration
6	Polyline ZM	P-STR-CL	88.587612	Headwater Restoration



Response: The wetland GIS files and attribute table have been updated.

Please contact me if you have any additional questions or comments.

Sincerely,

Water & Land Solutions, LLC

Cara Conder
Sr. Project Manager
Mobile Phone: (843) 446-2312
Email : cara@waterlandsolutions.com

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

January 5, 2024

CESAW-RGM/Tugwell

MEMORANDUM FOR RECORD

SUBJECT: NCDMS Cow Tail Mitigation Site (USACE AID # SAW-2023-00196) NCIRT Comments during 30-day Mitigation Plan Review, Columbus County, NC

The comments listed below were received from the NCIRT during the 30-day comment period in accordance with Section 332.8(d)(7) of the 2008 Mitigation Rule.

Maria Polizzi, DWR:

1. Is there any concern about hydrologic trespass? It appears that hydric soils sometimes extend past the easement boundary, and proposed wetland credit areas approach or touch the CE boundary in various locations. The IRT recommends a 50 ft. buffer around wetlands, when possible, to avoid trespass and protect the wetland hydrology inside the easement.
2. Response to DMS Comment #2 under Plan Sheets: I may be misunderstanding this response, but for future projects please make your best effort to limit items in the key to structures that are proposed on the project. It is helpful to see a list of the proposed structure types, so an accurate key is useful to get this quick overview.
3. It is helpful context to see the total stream and wetland credits proposed alongside the contracted total. Thank you for including this info.
4. Is there concern about vegetation establishment in areas that were previously ditched or roadbed locations? These areas are often considered to be wetland creation due to their extra limitations and slower re-establishment. Similarly, the area of wetland grading along Cow Branch were grading depth exceeds 12 inches must be proposed as creation due to the removal of the surface soil horizon(s) in this location.
5. Thank you for the inclusion of the keymap on the plan sheets. This is very helpful.
6. Plan Sheet 13: There is a callout on the ditch above S100 that says it will be regraded to existing ground elevation while also stating that the ditch shall remain open to ensure flow connection. Please clarify the plan for this area, as those statements seem contradictory.
7. Plan Sheet 20: A spec for a permanent culvert crossing is shown, but I do not see a crossing shown on the plans. Section 3.7.9 also states that there are no

stream crossings. Please confirm that no stream crossings are proposed and remove the culvert crossing spec from the plan, or update text and figures to clearly show the location of a crossing.

8. Plan Sheet 21, Erosion Control Matting Spec: Is it standard to use a galvanized roofing nail in the installation of EC matting? Generally, it is preferable to use fully biodegradable materials for temporary BMPs like matting. Is there an alternative option, like a notched stake that may offer the same function? It appears this is also proposed in the Toe Wood spec as well.
9. Plan Sheet 22, Log Step Pool Spec: “Stone backfill or suitable soil material” is proposed for this structure, but “stone” is not defined in terms of size or percentage of fill. It is helpful to the reviewers to be able to see this information as excessive or large stone has been an issue on coastal sites in the past.
10. Page 49, Section 8.4: Change the word “approximately” in the first sentence to “at least”.
11. The outline of the LSS determined hydric soils is a helpful visual. It does appear that there are a few locations where the “potential wetland reestablishment” layer extends past a non-hydric soil boring. Can you provide more information about how this boundary line was generated and why there are non-hydric soil borings within this area? See examples in borings 120, 123, 66 and 76.

Erin Davis, USACE:

1. Page 11, Section 3.1.4 – Did all project reaches have low NC SAM scores? If not, please briefly describe reasons for the different scores. Please show NC SAM and NC WAM sample points on Figure 6.
2. Page 19, Section 3.7.4 – What does the hydraulic model show for a 100-yr storm event? Also, please discuss observations of beaver presence and related considerations for potential trespass during long-term management.
3. Page 19, Section 3.7.5 – Please provide the results of DRAINMOD using the 12% performance standard criteria instead of the minimum 14-day hydroperiod on ditches proposed to remain open along the conservation easement boundary. Please add ditch lines to Figures 9 and 10 to show any ditches proposed to remain open or be partially filled to allow for positive drainage.
4. Page 20, Section 4 & Table 6 – This section appears to be a standard stream project insert. There is no discussion of the functional uplift potential of headwater valley or wetland resources, which are major components of this project. Please provide a more project-specific discussion of proposed functional uplift potential.
5. Page 21, Section 4.1.1 – Please clarify that the physiochemical and biological categories are not proposed be assessed as part of this project.
6. Page 28, Cow Branch Upper – The small impoundment was not mentioned in the existing conditions section. Please provide a brief description of the impoundment and information on the proposed removal process.
7. Pages 29 – 30, Cow Branch Upper, S100 & S200 – Each of these sections include a variation of “small headwater channel”, “construct small channel”, or “construct defined channel”. The IRT has expressed concerns in the past about creating (either by excavation or not fully backfilling an existing ditch) a straight pilot

channel, typically ranging 0.4 to 1 foot deep, through a headwater valley credit area. The primary concern is that the channel will act as a shallow ditch and not promote the development of multiple flow paths and wetland recharge within the wider valley as typically seen in reference quality coastal stream-wetland complexes. Additional monitoring, such as cross-sections and groundwater gauges along the valley, will be required to demonstrate functional uplift.

8. Page 30, S100 & S200 – These sections discuss filling channels using woody material. Please briefly explain why this is proposed and what it will look like. Does woody material include logs and brush? Will the woody material be layered? Is it meant to be permeable?
9. Page 30, S200 – As previously discussed on another project, excavating a floodplain bench to create a headwater valley is not appropriate for this mitigation credit type. We do not support a Priority II/III approach for headwater valley restoration. Please reassess the suitability of site conditions for the upper section of S200 to provide potential stream verse wetland credit.
10. Page 39, Table 16 – To enhance diversity, please cap a single species live stake at 60 percent.
11. Page 40, Section 6.6.1 –
    a. Please estimate the total acreage of proposed wetland credit area that is anticipated to be graded greater than 12 inches along the lower section of Cow Branch. Is there any concern that the Priority 2 stream restoration could have a drainage effect on the abutting wetland reestablishment credit area?
    b. Are adjacent upland areas noted as a source of fill/plug material located outside of the project easement but within the project property? Is any floodplain excavation proposed for the purpose of generating fill?
12. Page 41, Section 6.6.1 – Please confirm that all depressional areas will be less than 12 inches deep.
13. Page 41 – Section 6.6.2 – Discussion of the floodplain improvement features was appreciated.
14. Page 44, Section 7.2 – Please note that 30 consecutive days of flow annually is the minimum performance standard.
15. Page 44, Section 7.3 – A separate 10% hydroperiod wetland credit area is not shown on Figure 10. Please clarify if a 10% hydroperiod performance standard is being proposed. The outer fringe of wetland credit areas should be represented in groundwater gauge distribution.
16. Pages 46 – 48, Section 8.3 – Please specify the total number of cross-sections, pressure transducers, and flow gauges proposed for this project.
17. Page 49, Sections 8.4 & 8.5 – In the final plan please remove “approximately” for the total number of groundwater gauges and veg plots.
18. Page 49, Section 8.5 – If no random plots are proposed within W01 due to difficulty of finding planted trees, could the three random monitoring transects potentially cover areas supplementally planted? Note, random plots only require identification of stem species and height (without distinguishing between planted and volunteered). Please include at least three random plots within W01.

19. Page 50, Table 18 – Please specify four bankfull events under the hydraulics performance standard.
20. Figure 10
    a. Please use different line colors to distinguish between headwater valley and single stem channel restoration.
    b. It would be helpful to specify all credit ratios in the legend.
    c. Please change the color of the green re-establishment hatching so that proposed veg plots and wetland gauges are visible.
    d. Please show all ditches proposed to remain open or partially filled located within or abutting the project easement.
    e. With a total of 36.5 acres of wetland credit area, additional gauges are needed to provide representative cover of the outer fringe (along the western CE boundary) and immediately adjacent to the Cow Branch Lower P2 section. Please add two wetland gauges for a total of 10 gauges within proposed wetland credit areas.
    f. Please confirm that the Zone 2 random plots will also be distributed within the headwater valley and streamside planted areas. Please shift a fixed veg plot to the P2 cut area on Cow Branch Lower.
    g. Please add a transect of groundwater gauges within the S100 and S200 headwater valleys.
21. Design Plan General Comment – Please double check that plan sheets orientation match north arrows. Also, the plane view background as well as many features were not visible on the printed hardcopy. This review had to be done from the digital version.
22. Sheet 3 – Please update the keymap to match sheets 14 and 15.
23. Sheet 4 – Please explain the typical sections for S100, S200 and Cow Branch Upper. Are riffles, pools and bankfull features proposed for these headwater valley reaches?
24. Sheets 5 – 12 – Please refer to above comments related to headwater valley design. Installing in-stream structures like log step pools and constructed riffles typically used in single stem channels is contrary to the intent of developing a multiple flow path stream-wetland complex.
25. Sheet 9 – Please callout the existing ditch top of bank along the southern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage placement and allowable activity language in the conservation easement agreement. Also, what is the distance between the wetland credit area and the ditch? Does this buffer width account for the lateral drainage effect?
26. Sheet 10 – Please callout the existing farm road crossing. Will this area be regraded and decompacted?
27. Sheets 13 – 15
    a. This Wetland Grading Plan is very busy and was challenging to review. Please consider using a bold border or another alternative to pattern fill for the credit areas.

   b. It was difficult to follow existing contour lines, particularly with only the 110' contour line being labeled. It would be helpful to see spot elevations across the site to provide a better landscape perspective.
   c. The only proposed grading contour lines appear to be connected to the stream and headwater valley construction. What about roadbed, field crown and spoil berm removals within wetland credit areas? Please clearly callout areas proposed to be greater than 12 inches.
   d. It would be helpful to have existing ditches called out as to be filled, partially filled, or remain open. Do all of the ditches shown in Figure 6 appear on the design sheets? Are depression areas only proposed within in the footprint of existing ditches?

28. Sheet 13 – If the western ditch will be modified to ensure positive drainage, please provide proposed dimensions (including max. depth). Also, please callout the existing culvert and farm road running along the northern project boundary.
29. Sheet 14 – Please provide proposed dimensions (including max. depth) for the ditch proposed to be partially filled to ensure positive drainage. Please callout the existing ditch top of bank along the eastern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage and allowable activity language in the easement agreement.
30. Sheet 15 - Please callout the existing ditch top of bank along the eastern easement boundary. Please address project boundary signage and allowable activity language for ditch maintenance in the easement agreement.
31. Sheet 16 – Why are the two planting zones both called riparian buffer when the project planting area includes wetland and headwater habitats? The planting legend includes three items, yet the following sheets show four different patterned areas. Since headwater valleys do not have streambanks, if live stakes are proposed in these areas how will they be distributed?
32. Appendix 2 – The completed existing vegetation inventory and conditions assessment was comprehensive and informative for review of the proposed revegetation plan.

Sincerely,

Todd Tugwell
Chief, Mitigation Branch

Electronic Copies Furnished:
NCIRT Distribution List

February 5th, 2024

US Army Corps of Engineers: Wilmington District
Raleigh Regulatory Field Office
Attn: Todd Tugwell
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

RE: WLS Responses to NCIRT Review Comments Regarding the NCDMS Cow Tail Mitigation Site Final Draft Mitigation Plan, USACE AID# SAW-2023-00196, Lumber River Basin, Cataloging Unit 03040203, Columbus County, NC

Mr. Tugwell:

Water & Land Solutions, LLC (WLS) is pleased to provide our written responses to the North Carolina Interagency Review Team (NCIRT) review comments dated January 5th, 2024, regarding the Final Draft Mitigation Plan for the DMS Cow Tail Mitigation Project. We are providing our written responses to the NCIRT's review comments below, which includes editing and updating the Final Mitigation Plan and associated deliverables accordingly. The responses also include the discussion with USACE, DWR, and DMS on January 12th, 2024, providing additional clarification. Each of the NCIRT review comments is copied below in bold text, followed by the appropriate response from WLS in regular text:

DWR Comments (Maria Polizzi):

1. Is there any concern about hydrologic trespass? It appears that hydric soils sometimes extend past the easement boundary, and proposed wetland credit areas approach or touch the CE boundary in various locations. The IRT recommends a 50 ft. buffer around wetlands, when possible, to avoid trespass and protect the wetland hydrology inside the easement.
Response: As described in Sections 3.7.4 and 3.7.5, a flood inundation model and lateral effect analysis was done to ensure post-restoration flooding and groundwater saturation will be contained within the project properties. Hydrologic trespass is always a concern when raising local groundwater table and activating relic floodplains, especially in flatter coastal plain settings. Expanding the buffer 50 feet around wetlands and/or hydric soils demarcation would increase the easement area approximately 5-10 acres. The landowner does not wish to extend the easement boundary and the site hydrology must exit at the southern property line at the downstream terminus of lower Cow Branch.

2. Response to DMS Comment #2 under Plan Sheets: I may be misunderstanding this response, but for future projects please make your best effort to limit items in the key to structures that are proposed on the project. It is helpful to see a list of the proposed structure types, so an accurate key is useful to get this quick overview.

Response: Noted. The project keymap legend has been updated to only show proposed structures, however the note regarding other existing standard items is intended to maintain consistency for plan set generation.

3. It is helpful context to see the total stream and wetland credits proposed alongside the contracted total. Thank you for including this info.
Response: Noted.

4. Is there concern about vegetation establishment in areas that were previously ditched or roadbed locations? These areas are often considered to be wetland creation due to their extra limitations and slower re-establishment. Similarly, the area of wetland grading along Cow Branch were grading depth exceeds 12 inches must be proposed as creation due to the removal of the surface soil horizon(s) in this location.
Response: WLS is not concerned about vegetation establishment in areas that were previously ditched or roadbeds. WLS will grade areas as necessary, and rip and/or stockpile suitable soil as needed before planting. Based on the proposed grading plan, lateral drainage effect from ditches to remain open, and the flood model results, the proposed wetland boundaries have been revised to accommodate excavation depths that exceed 12 inches. No wetland creation is proposed and any areas with grading depths greater than 12 inches have been removed from creditable wetland area.

5. Thank you for the inclusion of the keymap on the plan sheets. This is very helpful.
Response: Noted.

6. Plan Sheet 13: There is a callout on the ditch above S100 that says it will be regraded to existing ground elevation while also stating that the ditch shall remain open to ensure flow connection. Please clarify the plan for this area, as those statements seem contradictory.
Response: There are numerous spoil piles along the existing ditches and stream channels. The spoil material along S100 will be removed alongside the ditch banks and regraded to the existing natural ground elevations. The callout language has been revised along with proposed spot elevations for more clarification.

7. Plan Sheet 20: A spec for a permanent culvert crossing is shown, but I do not see a crossing shown on the plans. Section 3.7.9 also states that there are no stream crossings. Please confirm that no stream crossings are proposed and remove the culvert crossing spec from the plan, or update text and figures to clearly show the location of a crossing.
Response: The two permanent culvert crossings are now shown on plan sheet 13 and the callout text has been added/revised. The culvert crossings are located at non-jurisdictional ditches outside of the conservation easement and creditable areas. Section 3.7.9 and plan sheet 13 have been revised for clarification.

8. Plan Sheet 21, Erosion Control Matting Spec: Is it standard to use a galvanized roofing nail in the installation of EC matting? Generally, it is preferable to use fully biodegradable materials for temporary BMPs like matting. Is there an alternative option, like a notched stake

that may offer the same function? It appears this is also proposed in the Toe Wood spec as well.**
Response: The nail is added to the large stakes so the erosion control matting will not slide past the exposed end of the stake after installation. This erosion control matting specification is a common industry practice because it has proven more effective than just stake notching.

9. Plan Sheet 22, Log Step Pool Spec: "Stone backfill or suitable soil material" is proposed for this structure, but "stone" is not defined in terms of size or percentage of fill. It is helpful to the reviewers to be able to see this information as excessive or large stone has been an issue on coastal sites in the past.
Response: The stone sizing is typically provided in the technical specifications and contains a well graded mix of Class A (4") and #57 (0.5") stone, or as directed by the Engineer. Typically, adequate stone is placed in structures when on-site alluvium is not suitable or compactable backfill. WLS understands the concern of using larger and/or excessive stone in the coastal plain and will limit the stone placement in locations with higher gradient/shear stress, crossings (outside the easement), or other areas susceptible to concentrated erosion. Stone sizing has been added to the detail sheet 22 for further clarification.

10. Page 49, Section 8.4: Change the word "approximately" in the first sentence to "at least".
Response: Changed.

11. The outline of the LSS determined hydric soils is a helpful visual. It does appear that there are a few locations where the "potential wetland reestablishment" layer extends past a non-hydric soil boring. Can you provide more information about how this boundary line was generated and why there are non-hydric soil borings within this area? See examples in borings 120, 123, 66 and 76.
Response: From the LSS: Borings were completed in two phases, a preliminary evaluation with limited details (pt #s 1 through 79), and a detailed evaluation where soil boundaries were determined. The initial boring notes often classify the boring as non-hydric due to a conservative interpretation where later borings indicate the point should be classified as hydric within the landscape. The #120 and #123 borings are within a cultivated field near excavated ditch/drainage. The borings have marginal indicators and show soils that are intensively disturbed from tillage and spoil from ditching. The points were included within the boundary due to being located within a suitable landscape/elevation and the presence of nearby borings within the same landscape exhibiting appropriate hydric soil indicators (124, 122, 60, and 121). The common indicators occur in this area are upper surface horizon and appeared altered/destroyed with some indicators buried under soils from spoil. The lack of strong, clear hydric indicators resulted in the call as non-hydric. The local soil has dark surface indicators and in sandy soil are easily destroyed by tillage and drainage within the field, especially where the dark surface naturally thins toward the edges. Also, due to downslope surface movement of soils on tilled slopes, the historic boundary was likely larger in the area delineated.

The #76 boring was from the initial site evaluation and lacks extensive detail. The hydric soil boundary was based on the later, more intensive work of a detailed evaluation. The point (76) may have been an anomaly or could have marginal indicators. It is surrounded by dark surface indicators used to delineate the soil boundary. The #66 boring is shown as hydric.

WATER & LAND SOLUTIONS
EMPOWERING PEOPLE.
RESTORING THE ENVIRONMENT.

<u>USACE Comments (Erin Davis):</u>

1. Page 11, Section 3.1.4 – Did all project reaches have low NC SAM scores? If not, please briefly describe reasons for the different scores. Please show NC SAM and NC WAM sample points on Figure 6.
Response: This was a typo in Section 3.1.4 and Cow Branch upper and S100 scored ‘medium’. This section has been corrected. Cow Branch upper is wooded and has adjacent wetlands, which scores ‘medium’ in that short section. S100 only scores ‘medium’ due to the existing successional vegetation width. This scores as the >100 ft buffer width, even though it’s not mature buffer as there is no distinction. If we moved to the next buffer width down, it would score ‘low’. NCSAM and NCWAM locations have been added to Figure 6.

2. Page 19, Section 3.7.4 – What does the hydraulic model show for a 100-yr storm event? Also, please discuss observations of beaver presence and related considerations for potential trespass during long-term management.
Response: The conservation easement area considers the proposed restoration limits and creditable areas to minimize flood extents and prevent hydrologic trespass. As described in Sections 3.7.4, 3.7.5 and 6.6.4, a flood inundation model was calculated for the bankfull, 10-yr, 25 yr-storm events to ensure post-restoration flooding will be contained within the project properties. We have added a hydraulic model in the appendix to show the 100-yr storm event for both the post-restoration conditions and if a hypothetical 2.0' tall beaver dam is built along upper Cow Branch after project regulatory closeout. Additional language has been added in Section 3.7.4 describing the model results.

3. Page 19, Section 3.7.5 – Please provide the results of DRAINMOD using the 12% performance standard criteria instead of the minimum 14-day hydroperiod on ditches proposed to remain open along the conservation easement boundary. Please add ditch lines to Figures 9 and 10 to show any ditches proposed to remain open or be partially filled to allow for positive drainage.
Response: The NC DRAINMOD input parameters only allow for 14-day wetland hydroperiod or minimum 5% of the growing season. The ditch locations, and proposed grading activity (fill/partial fill, remain open) have been added to Figure 9 to correspond with the lateral effect summary outputs located in Appendix 2.

4. Page 20, Section 4 & Table 6 – This section appears to be a standard stream project insert. There is no discussion of the functional uplift potential of headwater valley or wetland resources, which are major components of this project. Please provide a more project-specific discussion of proposed functional uplift potential.
Response: This section is focused on a brief summary of the project benefits using the stream functions pyramid. We have added a summary of the wetland goals and objectives and added wetlands to Table 6.

Water & Land Solutions, L.L.C
+1 (919) 614–5111 • info@waterlandsolutions.com
7721 Six Forks Road, Suite 130, Raleigh, NC 27615, United States
www.waterlandsolutions.com

5. Page 21, Section 4.1.1 – Please clarify that the physiochemical and biological categories are not proposed be assessed as part of this project.
Response: Added language to clarify that the physiochemical and biological categories are not proposed be assessed as part of this project.

6. Page 28, Cow Branch Upper – The small impoundment was not mentioned in the existing conditions section. Please provide a brief description of the impoundment and information on the proposed removal process.
Response: Added a brief description of the small impoundment and the removal as noted on plan sheet 5 and Figure 9.

7. Pages 29 – 30, Cow Branch Upper, S100 & S200 – Each of these sections include a variation of "small headwater channel", "construct small channel", or "construct defined channel". The IRT has expressed concerns in the past about creating (either by excavation or not fully backfilling an existing ditch) a straight pilot channel, typically ranging 0.4 to 1 foot deep, through a headwater valley credit area. The primary concern is that the channel will act as a shallow ditch and not promote the development of multiple flow paths and wetland recharge within the wider valley as typically seen in reference quality coastal stream-wetland complexes. Additional monitoring, such as cross-sections and groundwater gauges along the valley, will be required to demonstrate functional uplift.
Response: WLS understands this concern and has revised the design reach summaries in Section 6.1.2 to clarify proposed stream restoration approaches. All reaches will be designed and constructed as single-thread channels except for upper Cow Branch (station 10+00-15+00). This upper section of Cow Branch is being proposed as non-creditable stream length. The drainage areas and slopes will support this channel type and WLS has concerns that constructing a headwater stream valley only may create a prolonged backwater condition and excess volume within the stream channel. This was also discussed on the January 12th IRT/WLS call and the performance monitoring has been adjusted to not include headwater valley monitoring.

8. Page 30, S100 & S200 – These sections discuss filling channels using woody material. Please briefly explain why this is proposed and what it will look like. Does woody material include logs and brush? Will the woody material be layered? Is it meant to be permeable?
Response: Removed reference to filling channel with woody material to avoid confusion. To clarify, small woody/brush material generated onsite will be used for in-stream structures such as brushy riffles and toe wood. Large or coarse woody debris, as described in Section 6.6.2, will be used for floodplain improvement features to mimic tree throws commonly found in natural riparian systems. These features also provide habitat and water storage depressions within the floodplain.

9. Page 30, S200 – As previously discussed on another project, excavating a floodplain bench to create a headwater valley is not appropriate for this mitigation credit type. We do not support a Priority II/III approach for headwater valley restoration. Please reassess the suitability of site conditions for the upper section of S200 to provide potential stream verse wetland credit.

Response: WLS understands and agrees that Priority Level II restoration is not an appropriate mitigation type for headwater stream valley restoration and the intent of the CP headwater guidance. As noted in response comment #7, all reaches will be designed as single-thread channels, except for upper Cow Branch (station 10+00-15+00) in the non-creditable stream section.

10. Page 39, Table 16 – To enhance diversity, please cap a single species live stake at 60 percent.
Response: Noted/Updated Table. No single live stake species planted shall exceed 60 percent.

11. Page 40, Section 6.6.1 –

a. Please estimate the total acreage of proposed wetland credit area that is anticipated to be graded greater than 12 inches along the lower section of Cow Branch. Is there any concern that the Priority 2 stream restoration could have a drainage effect on the abutting wetland reestablishment credit area?

Response: As noted in DWR response comment #4, the proposed wetland boundaries have been revised to omit credit areas where Priority Level II excavation depths exceed 12 inches. The estimated wetland areas within the PII excavation total approximately 3.3 acres, and this is not included in creditable acreage. WLS acknowledges the concern that the Priority Level II tie-in along lower Cow Branch and lateral drainage effect from open ditches will limit the success of restoring wetland hydrology.

b. Are adjacent upland areas noted as a source of fill/plug material located outside of the project easement but within the project property? Is any floodplain excavation proposed for the purpose of generating fill?

Response: Yes, adjacent upland areas noted as a source of fill/plug material located outside of the project easement are within the project property. As noted, any excess material generated from the existing spoil/berms and floodplain excavation that is unsuitable for ditch fill or a soil base for vegetation, will be spread across upland areas outside of the easement boundary and jurisdictional WOTUS. WLS has confirmed these areas with the landowner, however we do not expect excess spoil as a result of restoration grading activities. The proposed floodplain excavation is considered shallow (average 8”-10” depth) across the site, with exception to the increased depths along upper S200 and lower Cow Branch. The proposed floodplain elevations were designed to consider the hydric soils delineation, soil profiles, and to limit potential wetland creation areas and prevent hydrologic trespass.

12. Page 41, Section 6.6.1 – Please confirm that all depressional areas will be less than 12 inches deep.
Response: Yes, all depressional areas will be less than 12 inches deep as shown in the detail on plan sheet 20. Added language to Section 6.6.1 to clarify.

13. Page 41 – Section 6.6.2 – Discussion of the floodplain improvement features was appreciated.
Response: Noted.

14. Page 44, Section 7.2 – Please note that 30 consecutive days of flow annually is the <u>minimum</u> performance standard.
Response: Noted.

15. Page 44, Section 7.3 – A separate 10% hydroperiod wetland credit area is not shown on Figure 10. Please clarify if a 10% hydroperiod performance standard is being proposed. The outer fringe of wetland credit areas should be represented in groundwater gauge distribution.

Response: This is now Section 7.2 and the 10% hydroperiod reference has been removed and the entire site will be a 12% hydroperiod. Groundwater gauges will be representative of the creditable area, including areas near the boundary.

16. Pages 46 – 48, Section 8.3 – Please specify the total number of cross-sections, pressure transducers, and flow gauges proposed for this project.

Response: These numbers have been added to Section 8.3 and Figure 10.

17. Page 49, Sections 8.4 & 8.5 – In the final plan please remove "approximately" for the total number of groundwater gauges and veg plots.

Response: Removed 'approximately' in these sections.

18. Page 49, Section 8.5 – If no random plots are proposed within W01 due to difficulty of finding planted trees, could the three random monitoring transects potentially cover areas supplementally planted? Note, random plots only require identification of stem species and height (without distinguishing between planted and volunteered). Please include at least three random plots within W01.

Response: All of the fixed plots in W01 will be installed in areas that receive full planting and the number of fixed plots is based on the two percent of that planted area. This will allow us to monitor the planted vegetation. The three monitoring transects originally were for monitoring non-planted areas, but these three transects will now cover the areas supplementally planted and/or natural regeneration in W01. Therefore, W01 will have 15 fixed plots and three random plots.

19. Page 50, Table 18 – Please specify four bankfull events under the hydraulics performance standard.

Response: Specified four bankfull events in Table 18 under the hydraulics performance standard.

20. Figure 10

> **a. Please use different line colors to distinguish between headwater valley and single stem channel restoration.**
>
> Response: As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area. The line color will be the same now for all restoration reaches.
>
> **b. It would be helpful to specify all credit ratios in the legend.**
>
> Response: Added all credit ratios in the legend for clarification.
>
> **c. Please change the color of the green re-establishment hatching so that proposed veg plots and wetland gauges are visible.**
>
> Response: The color of the monitoring devices has been changed for better visibility.

d. Please show all ditches proposed to remain open or partially filled located within or abutting the project easement.
Response: Added ditches to remain open or partially filled located within or abutting the project easement for visibility.

e. With a total of 36.5 acres of wetland credit area, additional gauges are needed to provide representative cover of the outer fringe (along the western CE boundary) and immediately adjacent to the Cow Branch Lower P2 section. Please add two wetland gauges for a total of 10 gauges within proposed wetland credit areas.
Response: One of the proposed wetland gauges has been moved to Cow Branch lower PII section, and two additional wetland gauges have been added to the western wetland boundary.

f. Please confirm that the Zone 2 random plots will also be distributed within the headwater valley and streamside planted areas. Please shift a fixed veg plot to the P2 cut area on Cow Branch Lower.
Response: Zone 2 vegetation plots have been distributed to monitor streamside planted areas as well. A fixed vegetation plot on lower Cow Branch has been moved to the PII cut area.

g. Please add a transect of groundwater gauges within the S100 and S200 headwater valleys.
Response: As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area.

21. Design Plan General Comment – Please double check that plan sheets orientation match north arrows. Also, the plan view background as well as many features were not visible on the printed hardcopy. This review had to be done from the digital version.
Response: The north arrow orientation has been corrected on all plan & profile sheets. The design plan set has been reprinted at a higher print resolution to ensure all plan features are visible.

22. Sheet 3 – Please update the keymap to match sheets 14 and 15.
Response: The keymap sheets have been updated/corrected accordingly.

23. Sheet 4 – Please explain the typical sections for S100, S200 and Cow Branch Upper. Are riffles, pools and bankfull features proposed for these headwater valley reaches?
Response: The typical sections and morphology parameters shown on plan sheet 4 are correct. We have added the stationing for upper Cow Branch to distinguish between headwater stream valley (no credit length) and single-thread channel restoration. As noted/clarified in response comments above, all reaches are being proposed for single-thread channel restoration, except for upper Cow Branch in a non-creditable area from station 10+00-15+00 and S200 from station 10+00-14+50.

24. Sheets 5 – 12 – Please refer to above comments related to headwater valley design. Installing in-stream structures like log step pools and constructed riffles typically used in single stem channels is contrary to the intent of developing a multiple flow path stream-wetland complex.
Response: WLS agrees with this comment and apologizes for any confusion. As noted/clarified in previous response comments, all reaches are being proposed for single-thread channel restoration, expect for upper Cow Branch in a non-creditable area from station 10+00-15+00. The top of bank line

has been removed from upper Cow Branch stationing 10+00-15+00 and a note has been added to plan sheet 5 for further clarification.

25. Sheet 9 – Please callout the existing ditch top of bank along the southern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage placement and allowable activity language in the conservation easement agreement. Also, what is the distance between the wetland credit area and the ditch? Does this buffer width account for the lateral drainage effect?

Response: Added a callout to the existing ditch top of banks on sheet 9. Yes, the existing ditch along the southern property line will remain open to ensure positive drainage off the property. Added a note to sheet 9 and grading sheet 15. Easement signs will be placed on the ditch top of bank inside the easement boundary on the project landowner's property since the property line is the centerline of the ditch. DMS stated this is how their projects have been marked. Ditch maintenance language regarding the open ditches will be included in the conservation easement deed per DMS and SPO. Ditch maintenance language has also been added to Section 6.1.3 and Figure 9. The distance between the proposed wetland credit area and existing ditches along the property line ranges from 103' to 126' and the proposed wetland areas have been adjusted accordingly.

26. Sheet 10 – Please callout the existing farm road crossing. Will this area be regraded and decompacted?

Response: Added a callout to the abandoned farm road crossing that describes area to be regraded and scarified.

27. Sheets 13 – 15

> **a. This Wetland Grading Plan is very busy and was challenging to review. Please consider using a bold border or another alternative to pattern fill for the credit areas.**
> Response: WLS apologizes for the confusion and has revised the hatch patterns for more clarity.
>
> **b. It was difficult to follow existing contour lines, particularly with only the 110' contour line being labeled. It would be helpful to see spot elevations across the site to provide a better landscape perspective.**
> WLS apologizes for the confusion and has added minor contour labels as well as proposed spot elevations throughout the grading plan. As noted in Section 6.1, the site has low topographic relief and the existing 1' contours were created from a UAS LiDAR survey. The proposed contours did not plot correctly and have been darkened for more legibility.
>
> **c. The only proposed grading contour lines appear to be connected to the stream and headwater valley construction. What about roadbed, field crown and spoil berm removals within wetland credit areas? Please clearly callout areas proposed to be greater than 12 inches.**
> Response: For more clarity, WLS has revised the proposed contour lines and added callouts for excavation greater than 12 inches.
>
> **d. It would be helpful to have existing ditches called out as to be filled, partially filled, or remain open. Do all of the ditches shown in Figure 6 appear on the design sheets? Are depression areas only proposed within in the footprint of existing ditches?**

Response: WLS has added callout language to more clearly distinguish ditch fill areas and design intent. The ditch areas shown on Figure 6 are approximate centerline locations and the ditches shown on the plan sheets have been surveyed. The depressional areas shown are proposed within the footprint of existing ditches to account for future settling, balancing earthwork, and reducing the unnecessary over excavation with the restored channel and floodplain areas.

28. Sheet 13 – If the western ditch will be modified to ensure positive drainage, please provide proposed dimensions (including max. depth). Also, please callout the existing culvert and farm road running along the northern project boundary.
Response: Ditch dimension locations and callouts have been added to the grading plan. Added callout to the existing farm path (to remain).

29. Sheet 14 – Please provide proposed dimensions (including max. depth) for the ditch proposed to be partially filled to ensure positive drainage. Please callout the existing ditch top of bank along the eastern easement boundary. Will this ditch remain open with maintenance allowed in the future? If so, please address project boundary signage and allowable activity language in the easement agreement.
Response: Ditch dimension locations and callouts have been added to the grading plan. The ditch along the eastern property line will remain open for the future and maintenance since it is along the existing property line. Any allowable activity language will be included in the easement deed per DMS and SPO review.

30. Sheet 15 - Please callout the existing ditch top of bank along the eastern easement boundary. Please address project boundary signage and allowable activity language for ditch maintenance in the easement agreement.
Response: Ditch dimension locations and callouts have been added to the grading plan. The ditch along the eastern property line will remain open for the future since it is along the existing property line. Any allowable activity language will be included in the easement deed per DMS and SPO review.

31. Sheet 16 – Why are the two planting zones both called riparian buffer when the project planting area includes wetland and headwater habitats? The planting legend includes three items, yet the following sheets show four different patterned areas. Since headwater valleys do not have streambanks, if live stakes are proposed in these areas how will they be distributed?
Response: The term 'buffer' has been removed and the planting zones are labeled as Zone 1 Restoration Planting (50% minimum shrubs), Zone 1 Cleared Lanes (12 ft) and Restoration Planting (50% minimum shrubs), and Zone 2 Restoration (70% minimum trees). The sheets were meant to show the three different types in the legend (Zone 1, Zone 2, forested), but were confusing. The Zone 1 planting plan had the solid green rows to show the areas to be cleared (12 ft paths spaced 48' apart) and planted. This is now labeled in the legend, but is still part of Zone 1. Also, the two zones are now different colors to differentiate. As noted in previous responses, the proposed creditable stream restoration approach is PI and PII and live stakes will be installed as along the stream banks per the typical spacing and practices.

Water & Land Solutions, L.L.C
+1 (919) 614–5111 • info@waterlandsolutions.com
7721 Six Forks Road, Suite 130, Raleigh, NC 27615, United States
www.waterlandsolutions.com

32. Appendix 2 – The completed existing vegetation inventory and conditions assessment was comprehensive and informative for review of the proposed revegetation plan.
Response: Noted.

Please contact me if you have any additional questions or comments.

Sincerely,

Water & Land Solutions, LLC

Cara Conder
Sr. Project Manager
Mobile: (843) 446-2312
Email: cara@waterlandsolutions.com

From:	Davis, Erin B CIV USARMY CESAW (USA)
To:	Cara Conder
Cc:	Tugwell, Todd J CIV USARMY CESAW (USA); Polizzi, Maria; Wilson, Travis W.; Friedman-Herring, Andrew; Kayne Van Stell; Dunnigan, Emily; Dow, Jeremiah J
Subject:	RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.
Date:	Wednesday, March 13, 2024 10:46:00 AM
Attachments:	image001.png

Hi Cara,

Good question. While I would never discourage additional data collection, the intent of the performance standard is to demonstrate biology indicative of intermittent flow in restored stream channels post-construction. The standard is not meant to be a comparison of pre-restoration and post-restoration stream biology. Since existing channels are disturbed, modified and often relocated during construction, pre-construction data may not provide the most informative baseline. MY1 sampling is required, pre-construction sampling is optional.

Thanks,
Erin

From: Cara Conder <cara@waterlandsolutions.com>
Sent: Tuesday, March 12, 2024 5:43 PM
To: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Kayne Van Stell <kayne@waterlandsolutions.com>; Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Thanks Erin. We had planned to get baseline sampling of pre-restoration conditions between April 1st to June 30th before construction this summer. Would the IRT rather have MY1 collection vs. pre-construction? I know your email says MY1, but we do have time to get the samples this spring still.

Thanks,
Cara

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Tuesday, March 12, 2024 4:38 PM
To: Cara Conder <cara@waterlandsolutions.com>
Cc: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Kayne Van Stell <kayne@waterlandsolutions.com>; Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hi Cara,

Since WLS is willing to use one of the two site-specific performance standards proposed by the IRT, please include descriptions of both in the Cow Tail Final Mitigation Plan under Section 7 Performance Standards and Section 8 Monitoring Plan. This standard only applies to the S100 reach for this project.

For clarity, the options are either 90-days of consecutive flow or 30-days of consecutive flow plus macrobenthos monitoring. Regarding the 30-days consecutive days flow plus macrobenthos monitoring performance standard, benthic macroinvertebrate sampling must occur during monitoring year 1 to establish baseline conditions. Subsequent sampling should occur during monitoring years 3, 5, and 7. Sampling should be conducted within appropriate habitat near the upper end of the reach, preferably in close proximity to the flow gauge. The purpose of this monitoring is to document the presence of benthic macroinvertebrates in the intermittent reach proposed for credit, but this is not intended to be as intensive as the optional macroinvertebrate monitoring requirements discussed in Section 7 of the 2016 NCIRT Mitigation Guidance.

If monitoring of macrobenthos fails to show species indicative of intermittent flow and the annual consecutive flow data is less than 90 days but more than 30 days (average during monitoring period), credit will be reduced by 50% for the reach. If the reach exceeds 90 days consecutive flow annually, then the documentation of macrobenthos will not be required to obtain full stream credits. However, less than 30 days consecutive flow annually will result in no reach credit (regardless of benthic data).

Apologies for the delayed response. Please don't hesitate to reach out with any questions.

Thank you,
Erin

From: Cara Conder <cara@waterlandsolutions.com>
Sent: Monday, March 4, 2024 5:27 PM
To: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>; Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>
Cc: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Kayne Van Stell <kayne@waterlandsolutions.com>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hi Erin,

Yes, WLS is willing to use a 90-day consecutive flow metric or 30-days consecutive flow plus biology/macrobenthos monitoring. We would monitor biology/macrobenthos in MY3 and MY7, unless you have other guidance.

Also, just to confirm, this new stream uplift metric only applies to S100, correct? And the other two reaches will remain at least 30 consecutive days?

Thanks,
Cara

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Monday, March 4, 2024 10:48 AM
To: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Cc: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Friedman-Herring, Andrew <andrew.friedmanherring@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>
Subject: RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Emily and Cara,

Thank you for providing the Cow Tail response to IRT comments and revised draft mitigation plan. Based on discussions from the January 12th meeting and review of the submitted documents, we are satisfied that the significant concerns have been addressed. We still question whether S100 will have sufficient flow to maintain channel characteristics and provide stream functional uplift long-term. To address these site-specific concerns is WLS willing to use a 90-day consecutive flow metric or 30-days consecutive flow plus biology/macrobenthos monitoring as performance indicators to demonstrate solid stream functional uplift? If this is agreeable, we would be ready to move forward with issuing the notice of intent to approve the project mitigation plan. Please let us know if you have any questions.

Thank you,
Erin

From: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>
Sent: Tuesday, February 6, 2024 3:39 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Cc: Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Kichefski, Steven L CIV USARMY CESAW (USA) <Steven.L.Kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; kathryn_matthews@fws.gov; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>; Cara Conder <cara@waterlandsolutions.com>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>
Subject: [Non-DoD Source] RE: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Hello IRT,

WLS has completed responding to your comments on the Cow Tail Final Draft Mitigation Plan. Please see the response to comments attached. I attempted to upload the Final MP to RIBITS, but RIBITS isn't working at the moment. I did upload the Final MP dated 2024 to the DMS/IRT SharePoint folder.

Let me know if you have any questions.
Thank you,
Emily

NORTH CAROLINA
Department of Environmental Quality

Emily Dunnigan (she/her)
Project Manager – Eastern Region
Division of Mitigation Services
217 West Jones St., Raleigh, NC 27603
Cell: 919-817-6534

From: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>
Sent: Friday, January 5, 2024 2:45 PM
To: Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Cc: Dunnigan, Emily <Emily.Dunnigan@deq.nc.gov>; Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>; Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Steve Kichefski <Steven.l.kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; kathryn_matthews@fws.gov; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>
Subject: [External] RE: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Jeremiah & Cara,

We have completed our review of the Draft Mitigation Plan for the NCDMS Cow Tail Mitigation Site (SAW-2023-00196). Please see the attached memo, which includes all NCIRT comments that were received during the review process along with additional comments provided by Wilmington District staff following our review.

We have evaluated the comments generated during the review period and determined that there are concerns raised for which we would like to review responses to comments prior to the moving to the Final mitigation plan. As you will note in the attached memo, there were quite a few requested changes, but most importantly please consider the issues identified with the headwater valley stream approaches. We have had the opportunity to review a number of similar systems in the field recently and have serious concerns with the results of systems that used an approach similar to what is proposed in the draft plan. Specifically, headwater valley systems should not be constructed as PII/III streams with pilot channels, and they should not include construction of structures, or preformed pools and riffles, which is what appears to have been proposed in the Cow Tail plan. Please review the attached comments contact me if you have questions or wish to discuss further. Once the concerns outlined in the attached memo have been addressed, please resubmit an updated Draft Mitigation Plan to our office for review.

Thank you,

Todd Tugwell
Chief, Mitigation Branch
Regulatory Division
Wilmington District, USACE
(919) 210-6265

From: Davis, Erin B CIV USARMY CESAW (USA) <Erin.B.Davis@usace.army.mil>
Sent: Thursday, November 2, 2023 7:42 AM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Isenhour, Kimberly T CIV USARMY CESAW (USA) <Kimberly.T.Isenhour@usace.army.mil>; Kichefski, Steven L CIV USARMY CESAW (USA) <Steven.L.Kichefski@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Bowers, Todd <bowers.todd@epa.gov>; Matthews, Kathryn (kathryn_matthews@fws.gov) <kathryn_matthews@fws.gov>; Polizzi, Maria <maria.polizzi@deq.nc.gov>; Wilson, Travis W. <travis.wilson@ncwildlife.org>; fritz.rohde@noaa.gov; Twyla Cheatwood <twyla.cheatwood@noaa.gov>
Cc: Dunnigan, Emily <emily.dunnigan@deq.nc.gov>; Dow, Jeremiah J <jeremiah.dow@deq.nc.gov>; Cara Conder <cara@waterlandsolutions.com>
Subject: Notice of NCDMS Mitigation Plan Review / Cow Tail/ SAW-2023-00196/ Columbus Co.

Good morning IRT,

The below referenced Draft Mitigation Plan has been posted by NCDMS on the Draft Mitigation Plan Review section of the DMS & IRT SharePoint Site and on RIBITS. Per Section 332.8(g) of the 2008 Mitigation Rule, this review period will remain open for 30 calendar days from this email notification. Please provide comments by 5 PM on the 30-day comment deadline shown below. When providing comments please indicate if your concerns are great enough that you intend to initiate the Dispute Resolution Process described in Section 332.8(3) of the Mitigation Rule. Comments provided after the 30-day comment deadline (shown below) may not be considered. This comment period may be extended at the request of NCDMS if they determine that additional time is necessary to make changes to the Draft Mitigation Plan.

At the conclusion of this comment period, a copy of all comments will be provided to NCDMS and the NCIRT of the District Engineer's intent to approve or disapprove this project. More information, including instructions to access and use the SharePoint Site, and a flow chart detailing the process are included in the updated document attached to this email notice.

Please send comments to the USACE Mitigation Team only. The USACE Project Manager is Todd Tugwell

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

March 22, 2024

Regulatory Division

SUBJECT: NCIRT Review and USACE Approval of the NCDMS Cow Tail Mitigation Site / Columbus County, Action ID SAW-2023-00196

Mr. Jeremiah Dow
North Carolina Division of Mitigation Services
217 West Jones St.
Raleigh, NC 27603

Dear Mr. Dow:

The purpose of this letter is to provide the North Carolina Division of Mitigation Services (NCDMS) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the Cow Tail Draft Mitigation Plan, which closed on December 6, 2023. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan, which is considered approved with this correspondence. However, several minor issues were identified, as described in the attached comment memo and March 2024 email correspondence, which must be addressed in the Final Mitigation Plan.

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

Thank you for your prompt attention to this matter. Please note that this electronic copy provided to you via email is your official copy. Should you wish to receive a paper copy of this correspondence, please contact us. Thank you for your time and cooperation. If you have any questions, please contact me by email at todd.j.tugwell@usace.army.mil or by phone at (919) 210-6265.

Sincerely,

Todd J Tugwell

Todd Tugwell
Chief, Mitigation Branch

Enclosure

cc (by email):
NCIRT Distribution List

EEP Floodplain Requirements Checklist

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

Project Location

Name of project:	Cow Tail Mitigation Project
Name if stream or feature:	Cow Branch and unnamed tributaries
County:	Columbus
Name of river basin:	Lumber
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Columbus County
DFIRM panel number for entire site:	370305 (map number 3720024400J, effective date 1/5/2007)
Consultant name:	Water & Land Solutions
Phone number:	843-446-2312
Address:	7721 Six Forks Road, Suite 130 Raleigh, NC 27615

Design Information

The Cow Tail Mitigation Project (Project) is located within a rural watershed in Columbus County, within the Lumber River Basin and USGS 14-digit HUC 03040203190010. The Project proposes to restore over 4,500 linear feet of stream, and provide a water quality benefit for a 581-acre drainage area. The stream mitigation components are summarized in the table below. The purpose of the Project is to meet water quality improvements described in the River Basin Restoration Priorities and improve overall aquatic resource health.

Reach Name	Length (feet)	Mitigation Type
Cow Branch	2,836	Stream Restoration/HWV
S100	549	Stream Restoration/HWV
S200	1,116	Stream Restoration/HWV

Floodplain Information

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

○ Yes ◉ No

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

☐ Redelineation

☐ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: Zone X Minimal Flood Risk

Check if applies:

☐ AE Zone

- ○ Floodway
- ○ Non-Encroachment
- ◉ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet:
Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks? ☐ Yes ☒ No
Land Acquisition (Check) ☐ State owned (fee simple) ☐ Conservation easment (Design Bid Build) ☑ Conservation Easement (Full Delivery Project) Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)
Is community/county participating in the NFIP program? ☐ Yes ☒ No Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, 919-715-8000
Name of Local Floodplain Administrator: Columbus County Planning, Gary Lanier Phone Number: 910-640-6608

Floodplain Requirements

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

☑ No Action

☐ No Rise

☐ Letter of Map Revision

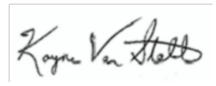
☐ Conditional Letter of Map Revision

☐ Other Requirements

List other requirements: N/a

Comments: Project is not in a FEMA zone

Name: Kayne VanStell

Signature: 

Title: Vice President Ecosystem Design

Date: 8/1/23

National Flood Hazard Layer FIRMette

FEMA

78°51'16"W 34°25'50"N

78°50'39"W 34°25'21"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/31/2023 at 4:26 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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