FINAL MITIGATION PLAN
Cool Run Stream and Riparian Wetland Mitigation Site
Brunswick County, NC

Full Delivery Proposal to Provide Stream and Riparian Wetland Mitigation Credits for Cataloging Unit 03040207of the Lumber River Basin

DMS Project ID No. 100142

Full Delivery Contract No. 20190201-01

USACE Action ID No. SAW-2020-01428

DWR Project No. 20200712

RFP #16-20190201 (Issued: 7/16/2019)

Prepared for:

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

September 2022

Follow-up Comments from DWR

DWR Comment #6 Response – The marsh treatment area has not been removed from project plans as stated. Sheet C11 continues to show the marsh treatment as a proposed feature. Please remove this callout and associated design detail from the project plans. However, please note that while a BMP cannot be installed in a jurisdictional area, DWR would support measures to fill or enhance the ditch within the easement as long as it does not increase the risk of hydrologic trespass outside of the project easement and the NS1 temp/perm impact is accounted for in the permit application impact table and figure.

Re: Construction Drawing Sheet C11 has been revised to remove marsh treatment areas (Attached).

DWR Comment #13 Response – A follow-up to our first question, will one subcontractor firm be responsible for performing annual vegetation monitoring (i.e., survey both wetland and stream performance veg plots)? DWR is concerned with potential data inconsistencies if multiple entities are tasked with field data collection and reporting of a single performance standard.

Re: Davey Resources will be performing all vegetation monitoring.

DWR Comment #15 Response – Additional veg plots have not been added to the monitoring figure and table as stated. Please update Table 17 with two additional fixed veg plots and one additional random veg plot for a total of 17 veg plots. If you opt not to show random veg plots on the monitoring figure 9, please add a figure note identifying the total number of random veg plots to be monitored annually.

Re: A note has been added to the Figure 9 legend, stating there will be 17 total veg plots, 14 fixed plots as depicted and 3 random veg plots with placement to be determined (Attached). Table 17 has been updated.

DWR Comment #31 Response – This ditch is still shown as "to be filled" on Figure 6B as an action to support the surrounding wetland reestablishment credit area. If this ditch is not proposed to be filled and will tie-in to the stream restoration as indicated on Sheet C11, then the ditch footprint should be removed from the wetland credit area and additional groundwater gauges should be installed along the ditch to demonstrate that the drainage effect is not impacting abutting proposed wetland credit areas.

Re: Construction Drawing Sheet C09 has been revised to remove marsh treatment areas (Attached).

Since changes to tables, figures and project plans are needed, DWR requests that an updated Final Mitigation Plan be uploaded to the Laserfiche project folder DWR# 20200712 v.1.

If there are any changes to the permit application impact table/figure, DWR will accept an email response submittal of the updated table/figure.

Erin B. Davis, PWS *(she/her/hers)*

Stream & Wetland Mitigation Coordinator

Division of Water Resources

NC Department of Environmental Quality

Clearwater Mitigation
SOLUTIONS

September 9, 2022

Mr. Jeremiah Dow
NCDEQ Division of Mitigation Services
217 W. Jones Street, Suite 3000
Raleigh, NC 27603

Re: Cool Run– Mitigation Plan – Response to IRT Comments (DMS Project No. 100142)
USACE Action ID No. SAW-2020-01428 / DWR Project No. 20200712

Dear Mr. Dow,

Please find below the response to comments on the Cool Run Mitigation Plan provided by the IRT July 12, 2022:

DWR Comments, Erin Davis:

1. Page 7, Section 2 – This section notes that "Cool Run is located within an area subject to some of the highest rates of population growth in the country". This is helpful information to have, and to that end, please include a discussion of projected future watershed and adjacent area land use. DWR encourages the consultation with local/county planning agencies and NCDOT, as well as review of available planning documents (e.g., comprehensive land use plan, community master plan) as due diligence in assessing potential future watershed and adjacent land use changes that may affect the long-term success of the project (e.g., risks of utility/roadway encroachments and influx of sediment/nutrient inputs).

Re: The population of Brunswick County is expected to increase over 20% between 2020 and 2030. Brunswick County is considered to be the fastest growing county in the state of North Carolina (www.census.gov). The population of Brunswick County increased by 32.9% from 2010 to 2019. The Brunswick County Metro Area (which includes Myrtle Beach) is the second fastest growing area in the country. While areas around the Highway 17 corridor are experiencing explosive growth, the areas north of the project are experiencing small to neutral growth. Areas upstream of the project consists of managed agricultural lands or wetland areas associated with the headwaters of the CawCaw Canal. While a northern route to extend Interstate 31 in South Carolina from Little River, SC to Shallotte, NC has been proposed, the final route has not yet been selected and is highly unlikely to affect the project since a conservation easement has already been recorded.

2. Page 23, Table 11C – Would a goal of the project be to protect the resources in perpetuity? If including performance criteria, please include the vigor standard, that bankfull events shall be in separate years, and 30 consecutive days' flow for the intermittent reach. Also, please address the "to be determined" column for the final mitigation plan.

Re: Table 10C has been updated to include vigor standard, bankfull events. To be determined column has been removed as this is to be determined via annual monitoring which has not yet occurred.

3. Page 26, Section 7.6 – Please clarify the discussion of the landowner in this section. Is the risk of hydrologic trespass not expected because the landowner is ok with increased hydrology beyond the easement on their land? How does the trespass risk change if the property owner changes?

Re:
• A HEC RAS analysis was preformed. Results of the HEC-RAS analysis is provided in Appendix F, and the risk of hydrologic trespass is not expected. There is a transition to non-hydric sandy soil types along most of the conservation easement boundary, adjacent to the agricultural field. There are crowned fields with sloped drainage toward UT-1, as we do not expect these areas outside of the conservation easement to re-establish wetlands due to existing and proposed conditions.
• The project landowner also owns the upstream property and has been an integral member and proponent of the project. The adjacent land owner to the west is also a proponent of the project and has no intention of transferring property in the immediate future.
• However, if the property were to change ownership, and a perimeter ditch along the conservation easement were created, it would likely be a blind ditch with no outlet due the appropriate outlet location being protected in the conservation easement. If a ditch is created by a future owner, CMS will evaluate its affect on adjacent wetland hydrology within the conservation easement boundary and adjust wetland credits, if warranted.

4. Page 27, In-stream Structures –
Log cross-vanes are the only grade control structure proposed for intermittent reach UT-1. DWR has observed log structures on intermittent reaches breaking down before the end of the monitoring period. Are there any concerns about the long-term stability of UT-1?

Re: Log cross-vanes along UT-1 are intended to provide instream habitat and maintain their integrity for a sufficient period of time for vegetation to establish along the banks UT-1. Once vegetation has established along UT-1, it should be sufficiently stable to withstand erosive forces and provide necessary habitat.

5. Log vanes and cross-vanes are the only habitat structures proposed for this project. Will these structures provide sufficient instream habitat enhancement uplift?

While currently there are no instream habitat performance standards, DWR does looks for evidence of instream habitat diversity and uplift during monitoring visits.

Re: Log cross-vanes will provide sufficient instream habitat until vegetation has established. Once vegetation has established suitable leaf pack and debris will be in the stream to provide necessary uplift to instream habitat.

6. Page 28, Table 12 – For UT-1, should the installation of the marsh treatment area be listed?

Re: Kim Browning indicates in her comment #2 that the marsh treatment area should not be installed in an RPW. Marsh treatment areas have been removed from the project plans, figures, and text.

7. Pages 28-29, Sections 8.3 & 8.4 – Please confirm whether any grading is proposed within wetland credit areas beyond ditch filling and stream channel/bench excavation. If so, please include a brief description and proposed wetland grading plan (color-coded to highlight areas to be graded greater than 12 inches).

Re: Grading in wetland areas greater than 12-inches is not proposed beyond ditch filling and stream channel/bench excavation.

8. Page 29, Section 8.7 – Thank you for including this section. Please briefly describe any proposed decompaction and/or surface roughness measures. How will haul roads in proposed wetland credit areas be addressed? Is there any timber bedding onsite? If so, are there any concerns with wetland uplift and seeded/planted vegetation establishment?

Re: Haul roads within the project area will be disked or ripped prior to site planting. There is no timber bedding on-site. There are no concerns with seeded/planted vegetation establishment.

9. Page 30, Section 8.8 – Please use the most updated version available of Schafale.

Re: This has been updated in the text.

10. Page 30, Section 8.8.2 – Please list existing nuisance species observed onsite. Also, a controlled burn was mentioned in the IRT site walk meeting minutes. Is this activity still proposed?

Re: Observed invasive species are listed in the text (i.e. Chinese privet and honeysuckle). Yes, a controlled burn is still proposed in some areas of thick under brush.

11. Page 31, Table 13 – DWR is ok with select species in Zone 1 being proposed at greater than 20 percentage composition. However, please keep Zone 2 species capped at 20 percent, and if need be please add/request substitutions.

Re: Species in Zone 2 are capped at 20 percent.

12. Page 31-32, Table 13A – Please add species wetland indicator status. Are there any concerns with the high percentage of *Juncus effusus* seeding affecting woody stem survival and growth?

Re: Wetland indicator Status has been added to the tables. There are no concerns with *Juncus effusus* affecting woody stem survival. The permanent seed mix is only targeted for use in disturbed/graded areas and not throughout the entire project area. A note has been added to the table for explanation.

13. Page 32, Section 9.0 – Is vegetation monitoring considered wetland or stream monitoring? Who will be responsible for inspecting the easement boundary? With multiple monitoring firms, please take care to QA/QC annual monitoring reports to ensure all required aspects are covered and presented in a consistent and unified manner.

Re: Vegetation monitoring is considered wetland monitoring except in areas where plots are located in non-creditable areas that are tied to stream performance (i.e. within the stream bench and live stakes). DRG and AXE will both inspect the easement boundaries when performing their respective monitoring tasks and will collaborate with each other and with the Sponsor on any identified detriments to the project. Both firms will be sure to collaborate and QA/QC all project deliverables.

14. Page 33, Table 15 –
Restored intermittent reaches must demonstrate a minimum 30 days' consecutive flow annually. Please add a flow gauge within the upper one-third of intermittent reach UT-1.

Re: Flow gauge has been added to the figures and will be implemented during the installation of monitoring devices.

15. Based on my calculations (2% of 22.71 planted acres with 0.0247 acre plots), there should be 18 veg plots proposed. Veg plots are not limited to credit areas. Please add one more fixed plot and two random plots.

Re: Additional plots have been added to the figures and will be implemented during the installation of monitoring plots.

16. Please make a table note of the two Mill Creek reference groundwater gauges proposed for monitoring. Also, DWR requests two additional groundwater gauges and a shifted location of GWG #6 (see figure mark-up). And please confirm that the haul roads shown on Sheet E03E will not impact installed gauges (e.g. #8, #9, #13).

Re: Table note has been added. Gauges have been added and GWG#6 has been shifted. It is not anticipated that the gauges will be impacted, however, if the gauges need to be temporarily removed and re-installed after construction, that will be implemented at the time of construction or prior to site bush hogging or burning.

17. Page 34, Section 9.1 – Please reference the 2016 NCIRT mitigation guidance document.

Re: Reference has been added.

18. Page 35, Section 9.2 – Please note that some of the listed actions will require IRT review as adaptive management and may need USACE/DWR permit authorizations.

Re: The sentence has been updated to: "In the event that stream success criteria are not fulfilled, a mechanism for contingency will be implemented and coordinated with the IRT."

19. Page 36, Beaver – Is there any concern that waiting until fall/winter to trap beaver may result in further loss of vegetation and additional stream problem areas?

Re: CMS will engage a certified trapper to periodically monitor the site for beaver activity and trap them if observed.

20. Page 36, Section 9.2.2 –
IRT consultation and approval will be necessary if any future earthwork is proposed. Depending on the depth of proposed ephemeral pools, the credit ratio may change to reflect wetland creation.

Re: Noted. At this time, no future earthwork is proposed

21. Please discuss potential risks associated with wetland credit extending along the conservation easement boundary (e.g. encroachment, ditch creation immediately adjacent).

Re:

- CMS is in discussions with the land owner to construct a tractor deterrent fence along the western edge of the conservation easement boundary, adjacent to the agriculture field. At a minimum, 5-6" treated post will be installed as a visual barrier and used to attached the Conservation Easement sign..

- If a perimeter ditch along the conservation easement were created, it would likely be a blind ditch with no outlet due the appropriate outlet location being protected in the conservation easement. If a ditch is created by a future owner, CMS will evaluate its affect on adjacent wetland hydrology within the conservation easement boundary and adjust wetland credits, if warranted.

22. Page 37, Section 9.2.3 – We recommend an additional sentence addressing any identified cause for observed veg issue(s) (e.g. beaver trapping, soil amendments, additional signage for encroachments). Also, is there is a risk of any wetland credit area(s) becoming too wet to support tree establishment? If so, please discuss the contingency of a wetland mosaic target with non- standard monitoring and performance criteria for non-forested wetland types.

Re: Sentence updated. It is not anticipated that the site will become too wet to support wetland tree establishment. If this were to occur, remedial action would be coordinated with the IRT.

23. Page 38, Table 17 – Please confirm Table 17 and Table 10C are consistent.

Re: Tables have been updated and are consistent.

24. Page 39, Section 10 – DWR was glad to see a discussion on non-desirable species management. Recolonization by loblolly pine and sweet gum affecting planted stem density/vigor and wetland hydrology is a major concern for this site.

Re: An adaptive management plan will be coordinated with the IRT and implemented if recolonization by early successional species affects the planted stem density/vigor.

25. Figure 6B – Please show the second marsh treatment area called out on Sheet C11.

Re: The second marsh treatment area has been removed from Sheet C11.

26. Sheet C01A – Please confirm whether riprap riffles and fencing are proposed for this project. If so, please add typical details and show on plans.

Re: Rip rap riffles are not included, items removed from symbology sheet. Fence symbology has been removed, however CMS is in discussions with the land owner to construct a tractor deterrent fence along the western edge of the conservation easement boundary, adjacent to the agriculture field.

27. Sheet C02A – Please include a typical detail(s) for live stake and bareroot plant installation.

Re: Details added to planting plan sheet (P-01).

28. Sheet C02C, Floodplain Interceptor – Please briefly describe the function of proposed floodplain interceptors. Will these features be seeded and planted? The minimum length along the stream channel is listed at 3 feet; what is the maximum width into the bankfull bench/floodplain area?

Re: A The function is to provide stable transitions where flow may become concentrated in the overbank floodplains. Floodplain interceptors are typically field located during construction as these spill points are identified. These features will be seeded and planted. The maximum width of 10' will be noted on detail.

29. Sheet C05 – Figure 6A calls out a culvert crossing upgrade. If this activity is being completed as part of this project, please include a typical detail and callout in the design plans.

Re:

- There are no culvert crossing upgrades to be completed as part of this project.

- The adjacent landowner is upgrading an existing culvert and is not a part of this project/permit. The length of the culvert will not change and it is a non-reporting activity.

30. Sheet C06 – Please confirm all existing channels/ditches will be filled to meet surrounding grade. Are proposed contour lines anticipated to follow the same sinuous

pattern of the limits of grading lines?

Re:

• There Existing stream channels that are hatched and labeled as 'Fill Existing Channel' are locations that the proposed stream project construction does not impact the existing channel due to realignment location and the existing channel needs to be filled.

• The proposed contours follow the limits of construction. Many times, the 'long' offset reflects the tie-in from the floodplain elevation to the natural ground being flat, not wanting to put the proposed floodplain on a 'shelf' with the natural ground.

31. Sheet C09 – If there is ditch filling east of Station 21+75, please add a callout.

Re: This ditch will not be filled. The tie-in for the ditch entering the stream restoration will be field adjusted to flow into restoration.

32. Sheets C13-C16 – Please confirm these sheets are just showing the CE line and existing contours.

Re: This is correct. The purpose of C13-C17 is to show the conservation easement that does not show up on the stream design sheets.

33. E02A – Is pond dewatering proposed for this project? Also, please update sheet information to match the native seed mixes and dates included in Table 13A. Fescue is NOT approved for application within the conservation easement.

Re: There is no pond dewatering proposed for this project, note will be removed from construction sequence. An updated seeding table has been provided.

34. E03E – Is vegetation removal proposed beyond the LOD lines on the east side of the project? These areas are shown on Sheet P01 as Planting Zone 2. DWR would be concerned if mature loblolly pines were left within the conservation easement, likely to become seed trees.

Re: There Mature loblolly pines in these areas will be removed and may hydroaxe these areas if they are mostly smaller pines. The limits of disturbance have been adjusted to the conservation easement line on the east side of the project.

35. General Design Comment – Lack of large woody debris was noted in Table 12,

DWR encourages adding LWD to stream and wetland project features for habitat enhancement.

Re: Woody debris will be added to wetlands and floodplains. No woody debris will be added to the stream channel. Woody debris added to stream channels results in erosive forces that, without vegetation, causes bank failures. In channel woody debris will evolve over several years as vegetation and root mats grow within and adjacent to channel banks.

36. DWR appreciates efforts made to enhance the proposed project by first and foremost having no easement breaks (woohoo!), as well as including water quality BMPs, areas of wetland buffer and species diversity over multiple planting zones.

Re: Thank you.

USACE Comments, Kim Browning:

1. Figures 6A and 12: Please ensure that the work being done outside the conservation easement boundaries, upstream and downstream of the project where you propose to tie into existing channels/ditches and upgrade an existing culvert, are included in the PCN impacts.

Re: No work is proposed outside of the Conservation Easement boundaries. The landowner is upgrading an existing culvert and is not a part of this project/permit. The length of the culvert will not change and it is a non-reporting activity.

2. Figure 6B: A marsh treatment area is proposed in the area where there is currently a ditch. If this area is currently a jurisdictional ditch, (i.e., meets the definition of an RPW) it is not appropriate to place a BMP in a jurisdictional feature. Please confirm that this ditch is not jurisdictional.

Re: Marsh treatment areas have been removed from the project plans, figures, and text.

3. Figures 4A and 12: It appears that there is an existing wetland proposed for rehabilitation that is located in the existing channel, on the north-west side of Cool Run Upstream. Will this wetland have impacts due to stream relocation?

Re: This wetland is located in the relic channel and outside of the proposed floodplain bench. No impacts are proposed to this wetland.

4. Please label the stream reaches on Figures 6B, 9 and 12. Additionally, please label each wetland area for easier reference (i.e., use the wetland labels from the PJD).

Re: These figures have been updated.

5. Figure 9:
   a. The random veg plots should capture different wetland enhancement and restoration areas each year. Agreed.
   b. 2-3 additional veg plots should be added to make up 2% of the planted area. These have been added to the figure.
   c. An additional wetland gauge should be placed at the northwest edge of the wetland reestablishment area near the bottom of the project. This has been added to the figure.
   d. Please show locations of fixed photo points. These have been added to the figure.
   e. A flow gauge should be located in the upper 1/3 of UT-1. This has been added to the figure.

6. Table 4: The Regulatory Considerations section of this table should be located in Section 7 to support the categorical exclusion discussion.

Re: This table has been moved to Section 7.

7. CE Documents and Section 7.0: Correspondence with Travis Wilson, WRC, mentions a potential future NCDOT highway project in the area. Are there anticipated future encroachments for this project?

Re: There are no known future encroachments to this project. While there are several routes proposed for the northern extension of I-31, the route has not yet been chosen.

8. Section 3.5.1: It would be helpful to include a table to summarize the gauge data. This will be particularly important in monitoring reports to compare baseline data with current data, to demonstrate hydrologic uplift.

Re: A summary table has been added to the report.

9. Section 4.0: Please describe the vegetation for the reference stream?

Re: Vegetation of the reference stream has been added to the report.

10. Sections 4.2 & 8.8: Please use the updated version of the Guide to the Natural Communities of North Carolina, Fourth Approximation, dated March 2012.

Re: The citation has been updated.

11. Table 10C:

a. Planted stems must have an average height of 7 feet in MY5 and 10 feet in MY7.

Re: The table has been updated.

b. Please indicate where existing drain tile is located and will be removed on existing conditions map.

Re: This was an error and has been removed from the table.

12. Section 7.1:

a. Please include the RCW SLOPES determination key results. If a survey has not been conducted yet, please include the results in the final mitigation plan.

Re: Results have been included in Appendix E.

b. Was a plan survey conducted for the Cooley's Meadowrue and Rough-leaved Loostrife during the appropriate time. Please elaborate in the text. Please note that plant surveys typically have an expiration date of 18 months – 2 years and must be conducted during the appropriate survey window. Please refer to the USFWS NC Imperiled Plant Survey Windows publication.

Re: No it was not. The site has been subject to silvicultural and agricultural management and production for many years. Suitable habitat for these species is not present within the conservation easement.

13. Section 7.6: What is the potential for hydrologic trespass onto adjacent fields? Stream restoration work may have an impact on the hydrology of the adjacent land,

resulting in increased flooding and/or reestablishment of wetlands on those parcels. Given that the soils and topography on the site do not immediately change at the edge of the conservation easement, it seems logical that wetland reestablishment right next to the property line will impact both sides of the boundary. There is also no way of ensuring that the adjacent landowners will not construct new ditches immediately adjacent to your project that would result in drainage of wetlands restored on your site. With no guarantee that the adjacent parcel will not be transferred to a different landowner in the future, this potential site constraint should be discussed in the text.

Re:
- A HEC RAS analysis was preformed. Results of the HEC-RAS analysis is provided in Appendix F, and the risk of hydrologic trespass is not expected. There is a transition to non-hydric sandy soil types along most of the conservation easement boundary, adjacent to the agricultural field. There are crowned fields with sloped drainage toward UT-1, as we do not expect these areas outside of the conservation easement to re-establish wetlands due to existing and proposed conditions.
- The project landowner also owns the upstream property and has been an integral member and proponent of the project. The adjacent land owner to the west is also a proponent of the project and has no intention of transferring property in the immediate future.
- However, if the property were to change ownership, and a perimeter ditch along the conservation easement were created, it would likely be a blind ditch with no outlet due the appropriate outlet location being protected in the conservation easement. If a ditch is created by a future owner, CMS will evaluate its affect on adjacent wetland hydrology within the conservation easement boundary and adjust wetland credits, if warranted.

14. Figures 6A & 9: Please be prepared to provide photo documentation and vegetative transects in the Priority 2 bench areas and the location of the old road during monitoring.

Re: There is no old road present within the site. Bush hog lanes have been installed during initial site recon which may look like a road on aerial photographs. A photo station will be included along the P2 stream channel which will also capture images of the Priority 2 bench area.

15. Section 8.8.1: The text states that planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period. This seems contradictory to the proposed extended growing season in Section 9.1.1, which will presumably begin in early February.

Clearwater Mitigation Solutions
604 Macon Place
Raleigh, NC 27609
919-624-6901
clearwatermitigation@gmail.com

Re: This was a typo from a mitigation plan from the mountains and piedmont region. This has been removed from the text. Given the location of the site in the southeastern portion of the Outer Coastal Plain, it is recognized that growing seasons of this locale are often longer than the generalized March 1 to November 20 growing season dates. Soil temperature data for the Outer Coastal Plain often demonstrate growing seasons beginning in early February and continuing into December. Such observations are consistent with the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plan Region (Version 2.0) which states, "there is evidence that soil temperatures are above 41o F and soil microbial communities are active throughout the year in some portion of the coastal plain region" (USACE 2010). As a result, the Provider will be collecting on-site soil temperature data (via soil probes installed at 12 inches below the soil surface) and will be collecting supplemental data of above-ground growth and development of vascular plants (e.g. bud burst on woody plants, appearance of new growth from vegetative crowns, or emergence of herbaceous plants from the ground). The proposed start date of the growing season will be based upon the presence of either soil temperatures (at 12 inches below the soil surface) above 41o F or evidence of above-ground growth and development of vascular plants (via the indicators identified above).

16. Table 13: It would be preferable to reduce the percent of Sycamore. You may want to update some of the species after consulting the 4th Approximation since this community type has been updated since the 3rd Approximation.

Re: Zone 2 consists of areas higher in elevation and out of the small stream swamp floodplain. It is associated with the edge of the larger floodplain along the small stream. These communities are highly variable, and recognition of variants or subtypes may be appropriate.

17. Table 16, Surface Flow: The text states that continuous surface flow must be documented annually for at least 30 days. This only applies to intermittent streams. The 30-day metric was established to show success in the Coastal Plain Headwater guidance and was not intended to demonstrate success for intermittent flow. Intermittent streams only dry seasonally and therefore should have flow or the presence of water for periods much longer than 30 days. It is recommended that cameras are also used to monitor flow for both consecutive days and cumulative days.

Re: Cameras will be installed to document flow.

18. Section 9.1.1: Once you have established a growing season based on the vegetative indicators and soil temperatures, please stick with those dates throughout the life of the project for consistency. Ideally, this should have been established during pre-monitoring data collection.

Re: Agreed

19. Section 9.2.2: It would be beneficial to add some coarse woody debris to the depressional areas in the buffers and throughout the adjacent wetlands for habitat, and to help store sediment, increase water storage/infiltration, and absorb water energy during overbank events. Additionally, please confirm that ephemeral pools will not exceed 14 inches and will dry seasonally.

Re: Woody debris will be placed throughout the project in depressions. Ephemeral pools will not exceed 14 inches in depth. A sentence has been added to this section.

20. Since this project is adjacent to active agricultural lands, signage will be important in the beginning of the project to establish visual boundaries for the landowner. We recommend the use of horse-tape or some other visual barrier for the first few years of monitoring.

Re: CMS is in discussions with the land owner to construct a tractor deterrent fence along the western edge of the conservation easement boundary, adjacent to the agriculture field. At a minimum, 5-6" treated post will be installed as a visual barrier and used to attached the Conservation Easement sign.

21. Section 9.2.3: This section should discuss contingencies/adaptive management strategies for controlling natural vegetative regeneration, particularly since there is a seed source of red maple, loblolly pine and sweet gum.

Re: A sentence has been added to this section which states: " Refer to Section 10 for specific adaptive management in regards to the recruitment of early successional species such as red maple, sweet gum, and loblolly pine."

Please do not hesitate to contact me with questions at 919-624-6901.

Sincerely,

Kevin Yates

Clearwater Mitigation Solutions
604 Macon Place
Raleigh, NC 27609
919-624-6901
clearwatermitigation@gmail.com

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

REPLY TO
ATTENTION OF:

CESAW-RG/Browning June 27, 2022

MEMORANDUM FOR RECORD

SUBJECT: NCDMS Cool Run Mitigation Project - NCIRT Comments during 30-day Mitigation Plan Review, Brunswick County, NC

PURPOSE: The comments listed below were received during the 30-day comment period in accordance with Section 332.8(g) of the 2008 Mitigation Rule in response to the Notice of NCDMS Mitigation Plan Review.

USACE AID#: SAW-2020-01428
NCDMS #: 100142
NCDWR#: 2020-0712
30-Day Comment Deadline: April 27, 2022

DWR Comments, Erin Davis:

1. Page 7, Section 2 – This section notes that “Cool Run is located within an area subject to some of the highest rates of population growth in the country”. This is helpful information to have, and to that end, please include a discussion of projected future watershed and adjacent area land use. DWR encourages the consultation with local/county planning agencies and NCDOT, as well as review of available planning documents (e.g., comprehensive land use plan, community master plan) as due diligence in assessing potential future watershed and adjacent land use changes that may affect the long-term success of the project (e.g., risks of utility/roadway encroachments and influx of sediment/nutrient inputs).
2. Page 23, Table 10C – Would a goal of the project be to protect the resources in perpetuity? If including performance criteria, please include the vigor standard, that bankfull events shall be in separate years, and 30 consecutive days’ flow for the intermittent reach. Also, please address the “to be determined” column for the final mitigation plan.
3. Page 26, Section 7.6 – Please clarify the discussion of the landowner in this section. Is the risk of hydrologic trespass not expected because the landowner is ok with increased hydrology beyond the easement on their land? How does the trespass risk change if the property owner changes?
4. Page 27, In-stream Structures –
5. Log cross-vanes are the only grade control structure proposed for intermittent reach UT-1. DWR has observed log structures on intermittent reaches breaking down before the end of the monitoring period. Are there any concerns about the long-term stability of UT-1?
6. Log vanes and cross-vanes are the only habitat structures proposed for this project. Will these structures provide sufficient instream habitat enhancement uplift? While currently there are no instream habitat performance standards, DWR does looks for evidence of instream habitat diversity and uplift during monitoring visits.

7. Page 28, Table 12 – For UT-1, should the installation of the marsh treatment area be listed?
8. Pages 28-29, Sections 8.3 & 8.4 – Please confirm whether any grading is proposed within wetland credit areas beyond ditch filling and stream channel/bench excavation. If so, please include a brief description and proposed wetland grading plan (color-coded to highlight areas to be graded greater than 12 inches).
9. Page 29, Section 8.7 – Thank you for including this section. Please briefly describe any proposed decompaction and/or surface roughness measures. How will haul roads in proposed wetland credit areas be addressed? Is there any timber bedding onsite? If so, are there any concerns with wetland uplift and seeded/planted vegetation establishment?
10. Page 30, Section 8.8 – Please use the most updated version available of Schafale.
11. Page 30, Section 8.8.2 – Please list existing nuisance species observed onsite. Also, a controlled burn was mentioned in the IRT site walk meeting minutes. Is this activity still proposed?
12. Page 31, Table 13 – DWR is ok with select species in Zone 1 being proposed at greater than 20 percentage composition. However, please keep Zone 2 species capped at 20 percent, and if need be please add/request substitutions.
13. Page 31-32, Table 13A – Please add species wetland indicator status. Are there any concerns with the high percentage of *Juncus effusus* seeding affecting woody stem survival and growth?
14. Page 32, Section 9.0 – Is vegetation monitoring considered wetland or stream monitoring? Who will be responsible for inspecting the easement boundary? With multiple monitoring firms, please take care to QA/QC annual monitoring reports to ensure all required aspects are covered and presented in a consistent and unified manner.
15. Page 33, Table 15 –
16. Restored intermittent reaches must demonstrate a minimum 30 days' consecutive flow annually. Please add a flow gauge within the upper one-third of intermittent reach UT-1.
17. Based on my calculations (2% of 22.71 planted acres with 0.0247 acre plots), there should be 18 veg plots proposed. Veg plots are not limited to credit areas. Please add one more fixed plot and two random plots.
18. Please make a table note of the two Mill Creek reference groundwater gauges proposed for monitoring. Also, DWR requests two additional groundwater gauges and a shifted location of GWG #6 (see figure mark-up). And please confirm that the haul roads shown on Sheet E03E will not impact installed gauges (e.g. #8, #9, #13).
19. Page 34, Section 9.1 – Please reference the 2016 NCIRT mitigation guidance document.
20. Page 35, Section 9.2 – Please note that some of the listed actions will require IRT review as adaptive management and may need USACE/DWR permit authorizations.
21. Page 36, Beaver – Is there any concern that waiting until fall/winter to trap beaver may result in further loss of vegetation and additional stream problem areas?
22. Page 36, Section 9.2.2 –
23. IRT consultation and approval will be necessary if any future earthwork is proposed. Depending on the depth of proposed ephemeral pools, the credit ratio may change to reflect wetland creation.
24. Please discuss potential risks associated with wetland credit extending along the conservation easement boundary (e.g. encroachment, ditch creation immediately adjacent).
25. Page 37, Section 9.2.3 – We recommend an additional sentence addressing any identified cause for observed veg issue(s) (e.g. beaver trapping, soil amendments, additional signage for encroachments). Also, is there is a risk of any wetland credit area(s) becoming too wet to support tree establishment? If so, please discuss the contingency of a wetland mosaic target with non-standard monitoring and performance criteria for non-forested wetland types.
26. Page 38, Table 17 – Please confirm Table 17 and Table 10C are consistent.
27. Page 39, Section 10 – DWR was glad to see a discussion on non-desirable species management. Recolonization by loblolly pine and sweet gum affecting planted stem density/vigor and wetland hydrology is a major concern for this site.
28. Figure 6B – Please show the second marsh treatment area called out on Sheet C11.

29. Sheet C01A – Please confirm whether riprap riffles and fencing are proposed for this project. If so, please add typical details and show on plans.
30. Sheet C02A – Please include a typical detail(s) for live stake and bareroot plant installation.
31. Sheet C02C, Floodplain Interceptor – Please briefly describe the function of proposed floodplain interceptors. Will these features be seeded and planted? The minimum length along the stream channel is listed at 3 feet; what is the maximum width into the bankfull bench/floodplain area?
32. Sheet C05 – Figure 6A calls out a culvert crossing upgrade. If this activity is being completed as part of this project, please include a typical detail and callout in the design plans.
33. Sheet C06 – Please confirm all existing channels/ditches will be filled to meet surrounding grade. Are proposed contour lines anticipated to follow the same sinuous pattern of the limits of grading lines?
34. Sheet C09 – If there is ditch filling east of Station 21+75, please add a callout.
35. Sheets C13-C16 – Please confirm these sheets are just showing the CE line and existing contours.
36. E02A – Is pond dewatering proposed for this project? Also, please update sheet information to match the native seed mixes and dates included in Table 13A. Fescue is NOT approved for application within the conservation easement.
37. E03E – Is vegetation removal proposed beyond the LOD lines on the east side of the project? These areas are shown on Sheet P01 as Planting Zone 2. DWR would be concerned if mature loblolly pines were left within the conservation easement, likely to become seed trees.
38. General Design Comment – Lack of large woody debris was noted in Table 12, DWR encourages adding LWD to stream and wetland project features for habitat enhancement.
39. DWR appreciates efforts made to enhance the proposed project by first and foremost having no easement breaks (woohoo!), as well as including water quality BMPs, areas of wetland buffer and species diversity over multiple planting zones.

USACE Comments, Kim Browning:

1. Figures 6A and 12: Please ensure that the work being done outside the conservation easement boundaries, upstream and downstream of the project where you propose to tie into existing channels/ditches and upgrade an existing culvert, are included in the PCN impacts.
2. Figure 6B: A marsh treatment area is proposed in the area where there is currently a ditch. If this area is currently a jurisdictional ditch, (i.e., meets the definition of an RPW) it is not appropriate to place a BMP in a jurisdictional feature. Please confirm that this ditch is not jurisdictional.
3. Figures 4A and 12: It appears that there is an existing wetland proposed for rehabilitation that is located in the existing channel, on the north-west side of Cool Run Upstream. Will this wetland have impacts due to stream relocation?
4. Please label the stream reaches on Figures 6B, 9 and 12. Additionally, please label each wetland area for easier reference (i.e., use the wetland labels from the PJD).
5. Figure 9:
    a. The random veg plots should capture different wetland enhancement and restoration areas each year.
    b. 2-3 additional veg plots should be added to make up 2% of the planted area.
    c. An additional wetland gauge should be placed at the northwest edge of the wetland reestablishment area near the bottom of the project.
    d. Please show locations of fixed photo points.
    e. A flow gauge should be located in the upper 1/3 of UT-1.
6. Table 4: The Regulatory Considerations section of this table should be located in Section 7 to support the categorical exclusion discussion.

7. CE Documents and Section 7.0: Correspondence with Travis Wilson, WRC, mentions a potential future NCDOT highway project in the area. Are there anticipated future encroachments for this project?
8. Section 3.5.1: It would be helpful to include a table to summarize the gauge data. This will be particularly important in monitoring reports to compare baseline data with current data, to demonstrate hydrologic uplift.
9. Section 4.0: Please describe the vegetation for the reference stream?
10. Sections 4.2 & 8.8: Please use the updated version of the Guide to the Natural Communities of North Carolina, Fourth Approximation, dated March 2012.
11. Table 10C:
    a. Planted stems must have an average height of 7 feet in MY5 and 10 feet in MY7.
    b. Please indicate where existing drain tile is located and will be removed on existing conditions map.
12. Section 7.1:
    a. Please include the RCW SLOPES determination key results. If a survey has not been conducted yet, please include the results in the final mitigation plan.
    b. Was a plan survey conducted for the Cooley's Meadowrue and Rough-leaved Loostrife during the appropriate time. Please elaborate in the text. Please note that plant surveys typically have an expiration date of 18 months – 2 years and must be conducted during the appropriate survey window. Please refer to the USFWS NC Imperiled Plant Survey Windows publication.
13. Section 7.6: What is the potential for hydrologic trespass onto adjacent fields? Stream restoration work may have an impact on the hydrology of the adjacent land, resulting in increased flooding and/or reestablishment of wetlands on those parcels. Given that the soils and topography on the site do not immediately change at the edge of the conservation easement, it seems logical that wetland reestablishment right next to the property line will impact both sides of the boundary. There is also no way of ensuring that the adjacent landowners will not construct new ditches immediately adjacent to your project that would result in drainage of wetlands restored on your site. With no guarantee that the adjacent parcel will not be transferred to a different landowner in the future, this potential site constraint should be discussed in the text.
14. Figures 6A & 9: Please be prepared to provide photo documentation and vegetative transects in the Priority 2 bench areas and the location of the old road during monitoring.
15. Section 8.8.1: The text states that planting will be performed between December 1 and March 15 to allow plants to stabilize during the dormant period. This seems contradictory to the proposed extended growing season in Section 9.1.1, which will presumably begin in early February.
16. Table 13: It would be preferable to reduce the percent of Sycamore. You may want to update some of the species after consulting the 4th Approximation since this community type has been updated since the 3rd Approximation.
17. Table 16, Surface Flow: The text states that continuous surface flow must be documented annually for at least 30 days. This only applies to intermittent streams. The 30-day metric was established to show success in the Coastal Plain Headwater guidance and was not intended to demonstrate success for intermittent flow. Intermittent streams only dry seasonally and therefore should have flow or the presence of water for periods much longer than 30 days. It is recommended that cameras are also used to monitor flow for both consecutive days and cumulative days.
18. Section 9.1.1: Once you have established a growing season based on the vegetative indicators and soil temperatures, please stick with those dates throughout the life of the project for consistency. Ideally, this should have been established during pre-monitoring data collection.
19. Section 9.2.2: It would be beneficial to add some coarse woody debris to the depressional areas in the buffers and throughout the adjacent wetlands for habitat, and to help store sediment, increase water storage/infiltration, and absorb water energy during overbank events.

Additionally, please confirm that ephemeral pools will not exceed 14 inches and will dry seasonally.

20. Since this project is adjacent to active agricultural lands, signage will be important in the beginning of the project to establish visual boundaries for the landowner. We recommend the use of horse-tape or some other visual barrier for the first few years of monitoring.
21. Section 9.2.3: This section should discuss contingencies/adaptive management strategies for controlling natural vegetative regeneration, particularly since there is a seed source of red maple, loblolly pine and sweet gum.

Kim (Browning) Isenhour
Mitigation Project Manager
Regulatory Division

FINAL MITIGATION PLAN
Cool Run Stream and Riparian Wetland Mitigation Site
Brunswick County, NC

Full Delivery Proposal to Provide Stream and Riparian Wetland Mitigation Credits for Cataloging Unit 03040207 of the Lumber River Basin

DMS Project ID No. 100142

Full Delivery Contract No. 20190201-01

USACE Action ID No. SAW-2020-01428

DWR Project No. 20200712

RFP #16-20190201 (Issued: 7/16/2019)

Clearwater Mitigation Solutions
604 Macon Place
Raleigh, North Carolina
Authorized Representative: Mr. Kevin Yates
Phone: 919-624-6901

CLEARWATER MITIGATION SOLUTIONS

September 2022

"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
- NCDEQ Division of Mitigation Services Mitigation Plan Template and Guidance, June 2017

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

TABLE OF CONTENTS

TABLES

APPENDICES

1.0 PROJECT INTRODUCTION

The Cool Run Stream & Wetland Mitigation Site (hereafter referred to as the "Site") encompasses 25.6 acres of disturbed forest and agricultural fields along Cool Run and Unnamed Tributaries (UTs) to Cool Run. The project is located in Brunswick County, approximately five miles southwest of the city limits of Shallotte, North Carolina and north of State Route 1316 (Old Shallotte Rd NW (Figures 1 and 2, Appendix A).

1.1 Directions to Site

Directions to the Site from Raleigh, North Carolina.

- Head east on I-40 for 137 miles
- Take the US 17 S exit to merge onto US 17 S toward Shallotte/Myrtle Beach
- Continue on US 17 S for 30 miles and then turn right onto Old Shallotte Rd NW
- Continue on Old Shallotte Rd NW for 3.7 miles and the Site will be on your right.
- The Site can be accessed from the dirt road that leads into the agricultural fields.
    - Site Latitude, Longitude
      33.970904, -78.472509

1.2 USGS Hydrologic Unit Code and NCDWR River Basin Designation

The Site is located within a **Targeted Local Watershed** of the Upper Shallotte River 14-digit HUC (03040207020060) of the Lumber River basin (Figure 2, Appendix A). Stream and wetland mitigation areas are located along Cool Run and UTs to Cool Run (North Carolina Division of Water Resources [NCDWR] subbasin number 03-07-59) [Figures 1 and 2, Appendix A]). Cool Run and UTs to Cool Run have been assigned Best Usage Classifications of C; Sw (NCDWR 2013). Cool Run is not listed on the final 2018 303d list (NCDEQ 2021).

1.3 Physiography, Geology, and Land Use

The Site is located within the Carolina Flatwoods of the Middle Atlantic Coastal Plain Ecoregion (63h). In general, this ecoregion is characterized by nearly level coastal plain with less relief and larger areas of poorly drained soils than the adjacent, higher elevation Southeastern Plains to the west. The Carolina Flatwoods were covered by shallow coastal waters during the Pleistocene, and the resultant terraces tend to consist of fine-loamy and coarse-loamy soils, with periodically high water tables. Other areas have clayey, sandy, or organic soils, contributing to the region's plant diversity. The region is a significant center of endemic biota, with high biological diversity and rare species compared to adjacent regions. Artificial drainage for forestry and agriculture is common.

The Site is located within the Waccamaw Formation of the Coastal Plain (NCGS, 1985). The Waccamaw Formation consists of fossiliferous sand with silt and clay. Onsite elevations range from a high of 52 feet National Geodetic Vertical Datum (NGVD) at the upper reaches to a low of approximately 38 feet NGVD at the Site outfall (USGS Shallotte, North Carolina 7.5-minute topographic quadrangle) (Figures 1 and 3, Appendix A).

Based on historic aerial photography, the Site has been in use for agriculture and silviculture since at least the 1950's. Cool Run appears to have been relocated and channelized in the late 1950's, and UT 1 appears to have been channelized prior to 1956.

The Site provides water quality functions to an approximately 1.68-square mile (1,074-acre) watershed at the outfall; UT 1's watershed is approximately 0.20-square mile (125 acres) (Figure 3, Appendix A). The watershed is dominated by silvicultural loblolly pine plantations. Impervious surfaces account for less than 2 percent of the upstream watershed land surface.

Land use at the Site is characterized by silviculture and agriculture. The floodplain of Cool Run has been historically modified and logged over the last several decades. The site was last logged between 2016 and 2018. Riparian zones immediately adjacent to the channel (within 50 feet) are primarily composed of sweetgum and red maple with understory species typical of drained sites such as horse sugar, American beautyberry, dog fennel, and muscadine grape.

1.4 Project Components and Structure

The Site encompasses 25.6 acres of disturbed forest and agricultural fields along Cool Run and its unnamed tributary (UT 1). In its current state, the Site includes 2,270 linear feet of channelized and relocated stream channel (based on the approved PJD dated 02/025/2020), 2.89 acres of degraded wetland, 17.46 acres of drained hydric soil (Figures 4A and 4B, Appendix A).

Proposed restoration activities include the construction of meandering, E/C-type stream channel resulting in 2,028 linear feet of Priority I stream restoration, 592 linear feet of Priority II stream restoration, 14.108 acres of riparian wetland re-establishment, 1.433 acres of riparian wetland rehabilitation, 1.201 acre of riparian wetland enhancement, and 0.492 acre of riparian wetland preservation (Table 1) (Figures 6A-6B, Appendix A).

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

Table 1. Project Components and Mitigation Credits
Cool Run Restoration Site

Project Segment	Existing Footage/ Acreage	Mitigation Plan Footage/ Acreage	Mitigation Category	Restoration Level	Mitigation Ratio	Mitigation Credits	Comment
Cool Run Upstream 1	591	592	Warm	R*	1.500	394.667	
Cool Run Upstream 2	567	427	Warm	R	1.000	427.000	
Cool Run Downstream	776	1000	Warm	R	1.000	1000.000	
UT 1	335	601	Warm	R	1.000	601.000	
Wetland Reestablish	--	14.108	NA	Reestablishment	1.000	14.108	
Wetland Rehabilitation	1.433	1.433	NA	Rehabilitation	1.500	0.955	
Wetland Enhancement	1.201	1.201	NA	Enhancement	3.000	0.400	
Wetland Preservation	0.492	0.492	NA	Preservation	10.000	0.049	

*Cool Run Upstream 1 is Restoration with an adjusted ratio (based on IRT comment and review).

Restoration Level	Stream			Riparian Wetland		Non-riparian wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Nonriverine		
Restoration	2422.667	--	--	--	--	--	--
Re-establishment	--	--	--	14.108	--	--	--
Rehabilitation	--	--	--	0.955	--	--	--
Enhancement	--	--	--	0.400	--	--	--
Enhancement I	--	--	--	--	--	--	--
Enhancement II	--	--	--	--	--	--	--
Enhancement II*	--	--	--	--	--	--	--
Preservation	--	--	--	0.049	--	--	--
Totals	**2422.667**	**--**	**--**	**15.512**	**--**	**--**	**--**

Table 2. Project Activity and Reporting History
Cool Run Restoration Site

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Technical Proposal (RFP No. 16-20190201)	October 2019	October 15, 2019
Institution Date (NCDMS Contract No. 20190201-01)	--	November 13, 2019
Mitigation Plan	--	September 2022
Construction Plans	--	September 2022

Table 3. Project Contacts Table
Cool Run Restoration Site

Full Delivery Provider	Clearwater Mitigation Solutions 604 Macon Place Raleigh, NC 27609 Kevin Yates 919-624-6901
Stream Designer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693
Wetland Designer	Land Management Group/Davey Resource Group 3805 Wrightsville Avenue, Suite 15 Wilmington, NC 28403 Wes Fryar 910-452-0001 x1927

Table 4. Project Attribute Table
Cool Run Restoration Site

Project Information	
Project Name	Cool Run Mitigation Site
Project County	Brunswick County, North Carolina
Project Area (acres)	25.6
Project Coordinates (latitude & latitude)	33.970904, -78.472509
Planted Area (acres)	22.71
Project Watershed Summary Information	
Physiographic Province	Coastal Plain
Project River Basin	Lumber
USGS HUC for Project (14-digit)	03040207020060
NCDWR Sub-basin for Project	03-07-59
Project Drainage Area (acres)	1,074
Percentage of Project Drainage Area that is Impervious	<2%
Land Use	Agriculture/Silviculture/Hardwood Forest

Table 4. Project Attribute Table
Cool Run Restoration Site (continued)

Parameters	Cool Run Upstream of UT 1 confluence	Cool Run Downstream of UT 1 confluence	UT 1
Length of reach (linear feet) Existing/Proposed	1158/1020	776/1000	335/601
Valley Classification & Confinement (A = Alluvial and UC = Unconfined)	A, UC	A, UC	A, UC
Drainage Area (acres)	911	1074	125
NCDWR Stream ID Score	---	---	27.5
Perennial, Intermittent, Ephemeral	Per	Per	Int
NCDWR Water Quality Classification	C, Sw	C, Sw	C, Sw
Stream Thermal Regime	Warm	Warm	Warm
Existing Morphological Description (Rosgen 1996)	E/G 5	Eg 5	Eg 5
Proposed Stream Classification (Rosgen 1996)	C 5	C 5	C 5
Existing Evolutionary Stage (Simon and Hupp 1986)	II	II	II
Underlying Mapped Soils	Muckalee	Muckalee	Lumbee (Goldsboro – NRCS)
Drainage Class	Poorly	Poorly	Poorly (Moderately well)
Hydric Soil Status	Hydric	Hydric	Hydric (Nonhydric with hydric inclusions)
Valley Slope	0.0026	0.0031	0.0103
FEMA Classification	NA	NA	NA
Native Vegetation Community	Coastal Plain Small Stream Forest (Blackwater Subtype)/Bottomland Hardwood Forest		
Watershed Land Use/Land Cover (Site)	87% forest, 11% agricultural land, <2% low density residential/impervious surface		
Watershed Land Use/Land Cover (Cool Run Reference Channel)	100% forest		
Percent Composition of Exotic Invasive Vegetation	<5%		

Table 4. Project Attribute Table
Cool Run Restoration Site (continued)

Wetland Summary Information	
Parameters	**Wetlands**
Wetland acreage (existing)	3.33 acres
Wetland acreage (proposed)	17.2 acres
Wetland Type	Riparian riverine
Mapped Soil Series	Muckalee, Lynchburg, Baymeade, Goldsboro, Rains, Lumbee
Drainage Class	Well drained to Poorly drained
Hydric Soil Status	Non-hydric and Hydric
Source of Hydrology	Groundwater, stream overbank
Hydrologic Impairment	Incised streams and ditches
Native Vegetation Community	Small Stream Swamp/Bottomland Hardwood Forest
% Composition of Exotic Invasive Vegetation	<5%
Restoration Method	Hydrologic and Vegetative
Enhancement Method	Vegetative

2.0 WATERSHED APPROACH AND SITE SELECTION

The Site is located within USGS 14-digit hydrologic unit and Targeted Local Watershed 03040207020060 of the Lumber River basin. The following watershed planning documents were reviewed to determine primary stressors and recommended management strategies within the watershed:

- Lumber River Basinwide Water Quality Plan (2010)
- Lockwoods Folly Local Watershed Plan (2005)
- Lumber River Basin Restoration Priorities (2008)

Lockwoods Folly Watershed exhibits water quality impairments associated with low dissolved oxygen (DO). In addition, surface waters in this area are susceptible to high nutrient concentrations (N and P) that manifest from non-point source loading associated with intensive agricultural and forestry land-use practices. Sediment loading (associated with silvicultural and agricultural drainage) is prevalent throughout the watershed. These impairments tend to be exacerbated by direct disturbances to streams and wetlands (such as prior channelization of streams and historic drainage of wetlands). The cumulative effects of such practices result in diminished nutrient uptake and nutrient/sediment loading to down-gradient waters. Cool Run is located within an area subject to some of the highest rates of population growth in the country. The population of Brunswick County is expected to increase over 20% between 2020 and 2030. Brunswick County is considered to be the fastest growing county in the state of North Carolina (www.census.gov). The population of Brunswick County increased by 32.9% from 2010 to 2019. The Brunswick County Metro Area (which includes Myrtle Beach) is the second fastest growing area in the country. While areas around the Highway 17 corridor are experiencing explosive growth, the areas north of the project are experiencing small to neutral growth. Areas upstream of the project consists of managed agricultural lands or wetland areas associated with the headwaters of the CawCaw Canal. While a northern route to extend Interstate 31 in South

Carolina from Little River, SC to Shallotte, NC has been proposed, the final route has not yet been selected and is highly unlikely to affect the project since a conservation easement has already been recorded. Rapid growth and development have presented a suite of additional stressors to water quality within the watershed, including run-off associated with increased impervious cover. While forest remains the dominant land cover at over 34%, the Long Bay Subbasin is the most impervious subbasin in the Lumber River Basin (NC DENR 2010).

Management strategies suggested by the aforementioned planning documents include:

- encouraging low impact development
- developing strong stormwater BMP requirements
- restoring/stabilizing streams
- protecting and improving existing buffers
- restoring degraded wetlands

Available mapping was used to evaluate land within the watershed and locate properties that exhibited stressors identified in the watershed planning documents. The Site was ultimately selected because it provides an opportunity to protect and restore streams, wetlands, and riparian buffers located on a property that has high potential for continued agricultural and silvicultural use. On-site streams and wetlands are severely degraded due to past human alterations associated with agricultural and silvicultural operations. The proposed mitigation project supports goals and recommendations established in the planning documents by restoring existing degraded streams and wetlands, stabilizing channel banks, and reducing point and non-point source pollution. These actions will reduce pollutant inputs to project streams and wetlands and increase high quality aquatic, semi-aquatic and terrestrial habitat.

Site specific mitigation goals and objectives have been developed through the use of North Carolina Stream Assessment Method (NC SAM) and North Carolina Wetland Assessment Method (NC WAM) and are discussed further in Section 6.0 (Functional Uplift and Project Goals/Objectives).

3.0 BASELINE AND EXISTING CONDITIONS

3.1 Soils and Land Form

Onsite soils consist of very poorly drained loams in drainageways to moderately well-drained loamy sands along convex stream terraces (refer to Figures 10A-10B). Mapped soil series occurring on the site and their associated properties are summarized in Table 5. Areas proposed for stream and riparian wetland mitigation occur within the poorly drained Muckalee loam and Lumbee fine sandy loam soil series. These hydric soils have been effectively drained by stream channel incision and ditching. Profile descriptions of on-site soil borings (prepared by a NC Licensed Soil Scientist) are provided in Appendix A.

Table 5. Summary of Mapped Soil Series

Map Unit Symbol	Series Name	Drainage Class	Landscape Position and Landform	Hydric Soil (Y/N)
BaB	Baymeade fine sand 1 to 6% slopes	Well Drained	Uplands of lower to upper Coastal Plain (1 to 12% slopes)	N
GoA	Goldsboro fine sandy loam	Moderately Well Drained	Marine terraces and uplands of lower to upper Coastal Plain (0 to 2% slopes)	N
Ly	Lynchburg fine sandy loam	Somewhat Poorly Drained	Marine terraces and uplands of lower to upper Coastal Plain (0 to 2% slopes)	N
Mk	Muckalee loam	Poorly Drained	Floodplains of streams in the Coastal Plain (less than 2% slope)	Y
On	Onslow loamy fine sand	Moderately Well Drained	Convex interstream divides in the lower Coastal Plain (0 to 3% slopes)	N
Lu	Lumbee fine sandy loam	Poorly Drained	Stream terraces and flats in the lower and middle coastal plain river valleys (0 to 2% slopes)	Y

3.2 Sediment Model

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

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

Table 6. BEHI and NBS Modeling Summary

Stream Reach	Proposed Mitigation Treatment	Predicted Sediment Contribution (tons/year)
Cool Run	Restoration	7.2
UT 1	Restoration	23.6
	Total Sediment Contribution (tons/year)	**30.8**

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

3.3 Nutrient Model

A preliminary land use nutrient model was developed for the Site. The model uses estimates of nitrogen and phosphorus inputs from livestock (USDA 2015 and USDA 1992), nutrient management for typical fields, pasture, and hay crops in North Carolina (NC State 2016), and nutrient inputs for urban areas (SMRC 2016). Model inputs include Site area, percent land use, rainfall, number and species of livestock, and row-crop type. Using published values of nitrogen and phosphorus, the model predicts the nutrient input of fertilizer and/or waste generated by livestock associated with land use. A copy of the model input and output is presented in Appendix B.

Based on the land use nutrient model, cessation of land use activities at the Site may directly reduce 31 pounds of nitrogen and 54 pounds of phosphorus per year.

3.4 Project Site Streams

Streams targeted for restoration include Cool Run and a UT to Cool Run, which have been cleared, moved to the edge of the floodplain, dredged and straightened, and receive extensive sediment and nutrient inputs from bank erosion and agriculture inputs. Although much of the Site is characterized by dense, primary successional vegetation that provides for bank stabilization, approximately 29 percent of the existing stream channel has been degraded contributing to sediment export from the Site. In addition, streamside wetlands have been cleared and drained by channel downcutting, ditch installation, and land uses. Current Site conditions have resulted in degraded water quality, a loss of aquatic habitat, reduced nutrient and sediment retention, and unstable channel characteristics (loss of horizontal flow vectors that maintain pools and an increase in erosive forces to channel bed and banks). Site restoration activities will restore riffle-pool morphology, aid in energy dissipation, increase aquatic habitat, stabilize channel banks, and greatly reduce sediment loss from channel banks.

Reach Descriptions
Individual reach descriptions are as follows:

Cool Run Upstream from the UT 1 Confluence

The upstream reach of Cool Run has been dredged and straightened through a series of timber tracts. As the dredged channel nears the Site, the ditch extends to approximately 8 feet in depth and drains a relatively mature, but disturbed riparian forest. The channel exits the forest and enters a timbered floodplain flat (last logged in late 2016 or early 2017) that is in the early successional stages of regeneration. The ditched channel enters the Site on the left-hand margins of the floodplain, adjacent to a neighborhood, and then crosses the floodplain to the right-hand margins of the floodplain adjacent to agriculture fields. The channel is approximately 3.5 to 4.0 feet in depth throughout the upper reaches. Spoil from ditch excavation has been cast on the left bank of the ditched channel and currently supports a dirt road in farthest upstream length. A narrow fringe of trees, primarily sweet gum (*Liquidambar styraciflua*) was left adjacent to the canal, presumably as best management practices by the foresters.

Vegetation is primarily characterized by sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), ink berry (*Ilex glabra*), red bay (*persea borbonia*), blackberry (*Rubus argutus*), highbush blueberry (*Vaccinium corymbosum*), red maple (*Acer rubrum*), American holly (*Ilex opaca*), and magnolia bay (*Magnolia virginiana*).

Cool Run Downstream from the UT 1 Confluence
Like the upstream reach, Cool Run downstream from the UT 1 confluence has been dredged and straightened. The valley is relatively wide and flat, and the channel has been pushed to the right margins of the valley. A historic channel meanders down the valley and currently supports jurisdictional wetland pockets within the abandoned depressional feature. The entire floodplain is a dense thicket of successional vegetation that is largely composed of vegetation listed above. The dredged channel is currently 3 to

4 feet in depth and 17 to 20 feet in width at the top of bank. Spoil has been piled adjacent to the dredged channel, isolating hydrology in agriculture fields from the large successional valley.

UT 1

UT 1 starts upstream from the Site as an agriculture field ditch that is approximately 3 feet deep at the Site boundary and extends across the Site, converging with Cool Run at the margins between agriculture fields and successional floodplain. The channel scores as intermittent (NCDWQ Form Score of 27.5). As the channel descends its valley towards its convergence with Cool Run, the depth increases to 4 feet. Both banks are characterized by row crops and are regularly plowed and treated with agriculture chemicals/biosolids.

3.4.1 Existing Conditions Survey

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

Table 7. Essential Morphology Parameters

Parameter	Existing			Reference	Proposed		
	Cool Run Upstream	Cool Run Downstream	UT 1	Cool Run	Cool Run Upstream	Cool Run Downstream	UT 1
Valley Width (ft)	12	24	6	100	100	100	50
Contributing Drainage Area (sq. mi.)	1.42	1.68	0.20	1.23	1.42	1.68	0.20
Channel/Reach Classification	E/G 5	Eg 5	Eg 5	C 5	C 5	C 5	C 5
Design Discharge Width (ft)	6.1–7.8	9.5-10.8	3.1-3.9	12.5-14.7	13.4-14.8	14.2-15.8	5.4-6.2
Design Discharge Depth (ft)	1.7-1.7	1.1-1.3	0.6-0.8	0.7	0.7-0.8	0.8	0.4
Design Discharge Area (ft^2)	10.5	11.9	2.4	9.5	10.5	11.9	2.4
Design Discharge Velocity (ft/s)	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Design Discharge (cfs)	9.9	11.2	2.2	8.9	9.9	11.2	2.2
Water Surface Slope	0.0025	0.0030	0.0101	0.0016	0.0020	0.0024	0.0086
Sinuosity	1.04	1.02	1.02	1.32	1.30	1.30	1.20
Width/Depth Ratio	3.6-5.6	7.3-9.8	3.9-6.5	19.4	19	19	14.0
Bank Height Ratio	1.8-1.9	1.8-2.6	2.9-4.3	1.0	1.0	1.0	1.0
Entrenchment Ratio	1.5-1.8	1.7-3.2	1.3-2.7	7.4	3.7-10.1	3.5-9.5	4.7-12.1
Substrate	Sand	Sand	Sand	Sand	Sand	Sand	Sand

3.4.2 Channel Classification and Morphology

Stream geometry and substrate data have been evaluated to classify existing stream conditions based on a classification utilizing fluvial geomorphic principles (Rosgen 1996). Existing Site reaches are classified as unstable EG-, and Eg-type streams with very low sinuosity. Existing Site reaches are characterized by sand substrate.

3.4.3 Channel Evolution

Site streams targeted for restoration have been ditched and dredged resulting primarily in channels classified as constructed (Stage II) channels throughout the Site (Simon and Hupp 1986). The natural progression of Stage II channels is to proceed through a degradation/downcutting stage (Stage III) and then degradation and widening stage (Stage IV); however, the low slope nature of the Site and dense, successional vegetation appears to have slowed or eliminated further channel evolution.

3.4.4 Valley Classification

Site Streams are situated in Valley Type VIII (Rosgen 1996) which are identified by the presence of multiple river terraces positioned laterally along broad valleys with gentle, down-valley elevation relief. Alluvial terraces and floodplains are the predominant depositional landforms. Site valley slopes are typical for the Coastal Plain region and range from 0.0026 on the upper reaches of Cool Run and 0.0103 on the slopes of UT 1 as it enters the Cool Run floodplain. Typical streams in this region include C- and E-type streams that are slightly entrenched, meandering channels with a riffle-pool sequence.

Geologically, the Site is underlain by the Waccamaw Formation which is composed of fossiliferous sand with loosely consolidated silt and clay. This geologic formation typically promotes alluvial, unconfined valleys that comprised of deep sands.

3.4.5 Discharge

This hydrophysiographic region is characterized by moderate rainfall with precipitation averaging approximately 54.8 inches per year (USDA 1986). Drainage basin sizes range from 0.20-square mile on UT 1 and 1.68 at the Site outfall.

The Site's discharge is dominated by a combination of upstream basin catchment, groundwater flow, and precipitation. Based on indicators of bankfull at reference reaches and on-Site, the designed channel will equal the channel size indicated by Coastal Plain regional curves (Sweet et al. 2003); this is discussed in Section 5.2 (Bankfull Verification). Based on bankfull studies, the bankfull discharge ranges from 2.2 cubic feet per second for UT 1, and 11.2 cubic feet per second for the Site outfall.

3.5 Project Site Wetlands

Jurisdictional wetlands/hydric soils within the Site were delineated in the field following guidelines set forth in the *1987 Corps of Engineers Wetlands Delineation Manual* and subsequent*2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region (Version 2.0).* A jurisdictional wetland delineation was completed and approved by United States Army Corps of Engineers (USACE) representative Jordan Jessup. Written confirmation of the determination is included in Appendix D. Existing jurisdictional wetlands and drained hydric soils are depicted on Figure 4A (Appendix A).

3.5.1 Hydrological Characterization

Based upon mapped soil units and landscape position of the Site, it is likely that much of the Site historically exhibited elevated groundwater levels at or near the surface, particularly in those areas consisting of poorly drained soil series. Based upon field investigations, it is evident that site hydrology has been significantly altered as a result of prior land use practices. Hydrological impairment in drained soils has resulted from lateral draw-down of the water table adjacent to existing, incised stream channels and ditches. The degree of hydrologic impacts varies with location on the property. Portions of the floodplain east and slightly upgradient of Cool Run continue to exhibit wetland hydrology; however, these areas exhibit altered vegetative structure due to previous silvicultural practices. In addition, existing and drained wetlands are also impacted by a toe-slope ditch which intercepts surface water runoff and disconnects wetlands upslope from wetlands in the floodplain.

In addition to the identification and use of field indicators, site hydrologic investigations have included installation and monitoring of 15 shallow groundwater monitoring gauges (Appendix F). These gauges were installed November 4 and November 5 (2020) and have been collecting data continuously since that time (daily intervals). In conjunction with field indicators, hydrologic data from monitoring gauges has been utilized to assist with determining appropriate mitigation types (i.e. preservation, enhancement, or restoration). All pre-construction gauges except for gauge #6 will remain in the same locations post-construction. Gauge #6 will be re-located to the East side of the project per DWR request to avoid being located within the bench of the post-construction channel.

When analyzing recorded gauge data, a concurrent analysis of precipitation normalcy was performed. This analysis is performed using the standardized methodology of the U.S. Army Corps of Engineers Antecedent Precipitation Tool (APT). The APT uses daily rainfall data and calculates running totals for each of the 30-day periods preceding the observation date. For each period, a weighted condition value is assigned by determining whether the 30-day total falls within, above, or below the 30^{th} to 70^{th} percentiles of precipitation totals for the same date range over the preceding 30-years. The APT was ran for each day of recorded gauge data to calculate a final precipitation normalcy index score.

Based upon review of the final APT precipitation normalcy index scores, January 8 (2021) through March 20 (2021) and July 20 (2021) through September 1 (2021) exhibited wetter than normal conditions. Analysis of recorded gauge data from November 6 (2020) to October 4 (2021) indicate that only two gauges (gauges #14 & #15) exceeded the proposed wetland success criteria of 36.36 days (12%) during normal precipitation conditions, which equated to 43 days and 48 days, respectively (Table 8). Both gauges are installed in current wetland areas. Gauges #1, #2, #4, #5, and #6 recorded groundwater data sufficient to meet the proposed wetland success criteria of 36.36 days (12%) but only during periods of wetter than normal APT index scores. During normal precipitation conditions, these wells exhibited hydroperiods of 7-days, 17-days, 6-days, 19-days, and 10-days, respectively. Gauge #5 is installed within a current wetland area.

Table 8. Summary of Hydrologic Monitoring (Nov 6 (2020) – Oct 4 (2021))

Well Number	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Normal Conditions	Dates of Longest Number of Consecutive Days Meeting Wetland Hydrology Criteria (all dates 2021 unless otherwise specified)	Percentage of Growing Season	12% Succes s Criteria (36.36 Days)	>12 - 25%	25 - 75%	>75%
1	7	Sept 21 – Sept 28	2.3%	**No**	--	--	--
2	17	Mar 21 – Apr 6	5.6%	**No**	--	--	--
3	6	Sept 21 – Sept 27	2.0%	**No**	--	--	--
4	5	Sept 21 – Sept 26	1.7%	**No**	--	--	--
5	19	Mar 21 – Apr 8	6.3%	**No**	--	--	--
6	10	Sept 21 – Sept 30	3.3%	**No**	--	--	--
7	1	Nov 13 (2020) & Sept 23 (2021)	0.3%	**No**	--	--	--
8	2	Sept 22 – Sept 23	0.7%	**No**	--	--	--
9	4	Nov 13 (2020) & Nov 16 (2020)	1.3%	**No**	--	--	--
10	1	Sept 23	0.3%	**No**	--	--	--
11	7	Nov 12 – Nov 18 (2020)	2.3%	**No**	--	--	--
12	7	Nov 12 – Nov 18 (2020)	2.3%	**No**	--	--	--
13	6	Nov 12 – Nov 17	2.0%	**No**	--	--	--
14	43*	Mar 21 – May 2	14.2%	**Yes**	**X**	--	--
15	48**	Mar 21 – May 7	15.8%	**Yes**	**X**	--	--

* - the last 13 days of this consecutive period exhibited drier than normal conditions
** - the last 18 days of this period exhibited drier than normal conditions

Site-specific soils information, current drainage conditions, and geomorphological data were used to perform DrainMod computer modeling. DrainMod is a field-scale hydrologic model originally developed for the design of subsurface drainage systems. Its application is now widely used for the purposes of evaluating lateral drainage effects of existing ditches and modeling for wetland restoration purposes. The model incorporates long-term climatological data in conjunction with site-specific model inputs. DrainMod results indicate that approximately 14.11 acres within the Site have been effectively drained and are suitable for wetland reestablishment (as depicted on Figure 6B, Appendix A). Out of the twelve (12) gauges that were modeled (three occur in current wetland areas and were not modeled), none met the target wetland success criteria (12% of the growing season) under current ditched conditions. DrainMod results post-construction show all twelve (12) gauges meeting the target wetland success criteria in at least 16 out of 30 years. The DrainMod results support the current jurisdictional determination and align with the proposed wetland credit areas. Refer to the monitoring gauge hydrographs and DrainMod assessment provided in Appendix F for additional details. Complete DrainMod data is available upon request.

Construction activities are expected to re-establish approximately 14.11 acres of wetlands within drained riparian hydric soils, rehabilitate 1.40 acres of riparian wetlands, and enhance 1.20 acres of cleared riparian wetlands. Areas of the Site targeted for riparian wetlands will receive hydrological input from periodic overbank flooding of restored tributaries; groundwater migration into wetlands; upland/stormwater runoff; and direct precipitation.

3.5.2 Soil Characterization

Soils were mapped on-site by a North Carolina Licensed Soil Scientist as discussed in Section 3.1. Hydric soils exhibited F13 (Umbric Surface), S7 (Dark Surface), F3 (Depleted Matrix), A2 (Histic Epipedon), A9 (1 cm Muck), and A12 (Thick Dark Surface) indicators. The majority of hydric soils on-site are effectively drained due to incised streams and ditches.

3.5.3 Plant Community Characterization

Areas proposed for wetland restoration and enhancement are primarily located within an agricultural field or dominated by early successional forest species such as sweetgum, red maple, and loblolly pine. Loblolly pine was harvested from the forested areas most recently between 2016 and 2018.

4.0 REFERENCE STUDIES

4.1 REFERENCE STREAM

A reach of the Cool Run channel upstream of the Site which remains intact was used as a reference reach. Distinct bankfull indicators were present within the reference reach. In addition, dimension, pattern, and profile variables were measurable in the channel, allowing for assistance with the proposed restoration design parameters (Figure 5, Appendix A). Vegetation along the banks of the reference stream consist mainly of red maple (*Acer rubrum)*, American holly (*Ilex opaca*), coastal dog hobble (*Leucothoe axillaris*), fetterbush (*Lyonia lucida*); and gallberry (*Ilex glabra*).

4.1.1 Watershed Characterization

The Cool Run reference reach is located immediately upstream of the Site in Brunswick County. Alterations, development, and impervious surfaces within the watershed are minimal.

4.1.2 Channel Classification

Stream geometry and substrate data have been evaluated to classify the reference reach based on a classification utilizing fluvial geomorphic principles (Rosgen 1996). This classification stratifies streams into comparable groups based on pattern, dimension, profile, and substrate characteristics. The reference reach is characterized as a C-type, highly sinuosity (1.32) channel with sand-dominated substrate. C-type streams are characterized as slightly to moderately entrenched, riffle-pool channels exhibiting a moderate to high width-depth ratio. C-type streams often occur in wide valleys with moderately-developed alluvial floodplains.

4.1.3 Discharge

The reference stream has an approximately 1.23-square mile watershed and a bankfull discharge of 8.9 cubic feet per second based on bankfull indicators.

4.1.4 Channel Morphology

Stream cross-sections and profiles were measured along the reference stream (Figure 5, Appendix A). The stream reach was transporting its sediment supply while maintaining stable dimension, pattern, and profile. Stream geometry measurements for the reference stream are summarized in the Morphological Stream Characteristics Table (Table B1, Appendix B).

<u>Dimension</u>: Data collected at the reference reach indicates a bankfull cross-sectional area of 9.5 square feet, a bankfull width of 13.6 feet, a bankfull depth of 0.7 feet, and a width-to-depth ratio of 19.4. Regional curves predict that the stream should exhibit a bankfull cross-sectional area of approximately 11.0 square feet for the watershed (Sweet et al. 2003), slightly higher than the 9.5-square feet displayed by channel bankfull indicators identified in the field, but within the range predicted by the curves. For a more detailed discussion on bankfull verification see Section 3.5 (Bankfull Verification).

The reference reach exhibits a bank-height ratio averaging 1.0, which is expected for a C-type channel. In addition, the width of the floodprone area is approximately 100 feet giving the channel an entrenchment ratio of 6.8 to 8.0.

<u>Pattern</u>: In-field measurements of the reference reach have yielded an average sinuosity of 1.32 (thalweg distance/straight-line distance). Other channel pattern attributes include an average pool-to-pool spacing ratio (L_{p-p}/W_{bkf}) of 4.5, a meander wavelength ratio (L_m/W_{bkf}) of 7.5, and a radius of curvature ratio (R_c/W_{bkf}) of 1.3. These variables were measured within a stable, forested reach, which did not exhibit any indications of pattern instability such as shoot cutoffs or oxbows.

<u>Profile</u>: Based on elevational profile surveys, the reference reach is characterized by a valley slope of 0.0021 (rise/run). Ratios of the reference reach riffle, run, pool, and glide slopes to average water surface slope are 1.5, 0.2, 0.4, and 0, respectively.

<u>Substrate</u>: The channel is characterized by a channel substrate dominated by sand-sized particles.

4.2 Reference Wetland

Potential reference wetland sites were evaluated in an effort to identify relatively undisturbed reference conditions for the targeted wetland community type. As indicated previously, the Project Site consists predominantly of Bottomland Hardwood wetlands that transition upslope to Headwater Forest[1]. These wetland types correlate to Coastal Plain Bottomland Hardwood and Small Stream Swamp Forest (blackwater subtypes), respectively (Shafale and Weakley, 2012). Suitable reference wetland sites should be located in similarly situated landscapes and soil types and should exhibit target hydrologic regimes (i.e. unaltered by prior or current site manipulation such as ditching or channelization). Based upon these screening parameters, a suitable reference wetland was identified along Mill Creek, a second order tributary of Indian Creek.

The Mill Creek reference wetland is located just north of Cedar Hill Road in Navassa (Brunswick County, NC). It is situated within poorly drained Muckalee loam soils (consistent with soils of the Project Site). In addition, the hydrology of this area remains unaltered with physical indicators of inundation (from overbank flooding of the adjacent stream channel) and groundwater saturation. Two reference wetland gauges will be installed within this area to provide comparative hydrologic data for monitoring purposes. The reference wetland is located at coordinates: 34.281050 N / -78.281050 E.

5.0 CHANNEL ASSESSMENTS

5.1 Channel Stability Assessment

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

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

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

[1] The Bottomland Hardwood and Headwater Forest wetland types are classified using the NC Dichotomous Key to General North Carolina Wetland Types (accompanying the NC WAM User Manual, Version 4.1).

In order to maintain sediment transport functions of a stable stream system, the proposed channel should exhibit stream power and shear stress values so the channel is neither aggrading nor degrading. Results of the analysis indicate the proposed channel reaches are expected to maintain stream power as a function of width values of approximately 0.09-0.20 and shear stress values of approximately 0.08-0.20 (Table 9).

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

	Bankfull Discharge (ft^3/s)	Water surface Slope (ft/ft)	Total Stream Power (Ω)	Ω/W	Hydraulic Radius	Shear Stress (τ)	Velocity (v)	τ v	τ_{max}
Existing Conditions									
Cool Run Upstream	9.9	0.0025	1.54	**0.22**	2.35	**0.37**	0.41	0.15	0.55
Cool Run Downstream	11.2	0.003	2.10	**0.21**	3.53	**0.66**	0.25	0.17	0.99
UT 1	2.2	0.0101	1.39	**0.43**	5.63	**3.55**	0.08	0.29	5.32
Reference Conditions									
Cool Run-Ref	8.9	0.0016	0.89	**0.07**	0.63	**0.06**	0.94	0.06	0.09
Proposed Conditions									
Cool Run Upstream	9.9	0.002	1.24	**0.09**	0.68	**0.08**	0.94	0.08	0.13
Cool Run Downstream	11.2	0.0024	1.68	**0.11**	0.72	**0.11**	0.94	0.10	0.16
UT 1	2.2	0.0086	1.18	**0.20**	0.36	**0.20**	0.92	0.18	0.29

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

5.2 Bankfull Verification

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

Based on available Coastal Plain regional curves, the predicted bankfull discharge for the reference reach averages approximately 10.3 cubic feet per second (cfs) (Sweet et al. 2003). The USGS regional regression equation for the Coastal Plain region indicates that bankfull discharge for the reference reaches at a 1.3-1.5 year return interval average approximately 7-11 cfs (USGS 2006).

Field indicators of bankfull, primarily topographic breaks identified on the banks, and riffle cross-sections were utilized to obtain an average bankfull cross-sectional area for the reference reach. The Coastal Plain regional curves were then utilized to plot the watershed area and discharge for the reference reach cross-sectional area. Field indicators of bankfull approximate an average discharge of 8.89 cfs for the reference reach, which is 86 percent of that predicted by the regional curves. This is verified by the range approximated by the USGS regional regression equation.

Table 10 summarizes all methods analyzed for estimating bankfull discharge.

Table 10. Reference Reach Bankfull Discharge Analysis

Method	Watershed Area (square miles)	Return Interval (years)	Discharge (cfs)
Cool Run Reference Reach			
Coastal Plain Regional Curves (Sweet et al. 2003)	1.23	1.3-1.5	10.3
Coastal Plain Regional Regression Model (USGS 2006)	1.23	1.3-1.5	7-11
Field Indicators of Bankfull	1.23	1.3-1.5	8.89

After consideration of the above analysis, it was determined that the Coastal Plain regional curves (Sweet et al. 2003) accurately represent discharge and bankfull cross sectional area of Site streams. Therefore, Site discharge will be based on these regional curves. Specific design discharges for each reach are depicted in Table B1, in Appendix B.

6.0 FUNCTIONAL UPLIFT AND PROJECT GOALS/OBJECTIVES

The goals of the proposed Cool Run Stream and Riparian Wetland Mitigation Site are to provide high quality compensatory mitigation for authorized stream and wetland impacts credited through the NC DMS in-lieu-fee program and occurring within the Lumber River Hydrologic Unit Code (HUC) 03040208 and to address the watershed goals identified in the Lumber River Basin Restoration Plan (RBRP) (NCEEP 2008) and Lockwoods Folly Local Watershed Plan (LWP) (NCEEP 2005). Specific HUC 03040208 watershed goals include:

- Promote low impact development.
- Improve and protect riparian buffers.
- Improve management of stormwater runoff to these waters and mitigate impacts resulting from urbanization in the area.

- Prioritize restoration of streams in areas where pine plantations are transitioning to residential development.
- Restore wetlands.

Site specific mitigation goals and objectives have been academically developed through the use of North Carolina Stream Assessment Method (NC SAM) and North Carolina Wetland Assessment Method (NC WAM) analyses of existing stream systems at the Site (NC SFAT 2015 and NC WFAT 2010). Site functional assessment data forms are available upon request; model output is included in Appendix B and is summarized in the following table. Metrics academically targeted to meet the Site's goals and objectives are depicted in bold, within Tables 11A and 11B, below

Table 11A. NC SAM Summary

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

*Cool Run upstream is located in a wooded section of the Site, at the upper end of the restoration reach.

Based on NC SAM output, numerous primary stream functional metrics (Hydrology, Water Quality and Habitat), as well as several sub-metrics are under-performing as exhibited by LOW metric rating (see Figure 4A, Appendix A for NC SAM data reaches). Identified LOW performing metrics are used to help identify functions targeted for uplift through mitigation activities, goals and objectives. These are then used to develop appropriate monitoring parameters and success criteria.

Table 11B. NC WAM Summary

NC WAM Sub-function Rating Summary	WAM 1	WAM 2	WAM 3
Wetland Type	Bottomland Hardwood Forest	Bottomland Hardwood Forest	Bottomland Hardwood Forest
(1) HYDROLOGY	HIGH	**LOW**	**LOW**
(2) Surface Storage & Retention	HIGH	**LOW**	**LOW**
(2) Sub-surface Storage & Retention	MEDIUM	MEDIUM	MEDIUM
(1) WATER QUALITY	HIGH	**LOW**	MEDIUM
(2) Pathogen change	HIGH	**LOW**	**LOW**
(2) Particulate Change	HIGH	**LOW**	MEDIUM
(2) Soluble change	MEDIUM	**LOW**	MEDIUM
(2) Physical Change	HIGH	**LOW**	MEDIUM
(1) HABITAT	**LOW**	**LOW**	**LOW**
(2) Physical Structure	**LOW**	**LOW**	**LOW**
(2) Landscape Patch Structure	**LOW**	**LOW**	**LOW**
(2) Vegetative Composition	**LOW**	**LOW**	**LOW**
OVERALL	**HIGH**	**LOW**	**LOW**

Based on NC WAM output, numerous primary wetland functional metrics (Hydrology, Water Quality, and Habitat), as well as several sub-metrics are under-performing as exhibited by a LOW metric rating.

Stream and wetland metrics targeted for functional uplift, tied to defined Site-specific project goals and objectives are presented in Table 11C, below.

Table 11C. Targeted Functions, Goals, Objectives, and Uplift Evaluation

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the existing floodplain. Remove side cast material from ditch excavation and maintenance.	Dispersion of high flows on the floodplain, increase in biogeochemical cycling within the system, and recharging of riparian wetlands.	Four bankfull events and within monitoring period during separate years and for at least 30-consecutive days.	1 stream gauge (pressure transducer) on Cool Run
Improve stability of stream channels.	Construct stream channels that will maintain stable cross- sections, patterns, and profiles over time.	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.	Bank height ratios remain below 1.2 over the monitoring period. Visual assessments showing progression towards stability.	10 Cross section surveys
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zones and plant appropriate species on streambanks.	Reduction in floodplain sediment inputs from runoff, increased bank stability, increased LWD and organic material in streams	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7. Trees must average 7 feet in height at year 5, and 10 feet in height at year 7 in each plot	18 veg plots
Restore and enhance groundwater hydrology to drained or impacted hydric soil areas.	Reduce channel depth in incised stream reaches, fill drainage ditches, and alleviate soil compaction from agriculture activities.	Particulate and pollution conversion, groundwater storage and reduced downstream flooding, habitat diversification, and vegetative composition conversion.	Groundwater saturation within 12 inches of the soil surface for 12 % of the growing season for reestablishment and improvement of hydrology in rehabilitation areas.	17 groundwater gauges

Note: Groundwater and rain data for each monitoring period.

7.0 SITE DESIGN AND IMPLEMENTATION CONSTRAINTS

The presence of conditions or characteristics that have the potential to hinder restoration activities on the Site was evaluated (Table 12). The evaluation focused primarily on the presence of hazardous materials, utilities and restrictive easements, rare/threatened/endangered species or critical habitats, and the potential for hydrologic trespass. Existing information regarding Site constraints was acquired and reviewed. In addition, any Site conditions that have the potential to restrict the restoration design and implementation were documented during the field investigation.

Table 12 – Regulatory Considerations

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States-Section 401	Yes	No	Preliminary JD (App D)
Waters of the United States-Section 404	Yes	No	Preliminary JD (App D)
Endangered Species Act	Yes	Yes	CE Document (App E)
Historic Preservation Act	Yes	Yes	CE Document (App E)
Coastal Zone Management Act	Yes	Yes	CE Document (App E)
FEMA Floodplain Compliance	No	N/A	Correspondence with Floodplain Manager (App F)
Essential Fisheries Habitat	No	--	N/A

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

7.1 Threatened & Endangered Species

Species with the federal classification of Endangered (E), Threatened (T), or Officially Proposed (P) for such listing are protected under the Endangered Species Act (ESA) of 1973, as amended, and the Bald and Golden Eagle Protection Act. The US Fish and Wildlife Service's website was reviewed to determine federally-protected species that are known to occur in Brunswick County (Table 13). Overall, the proposed mitigation work would not have an adverse effect on any federally-listed plant or animal species. Correspondence with the United States Fish and Wildlife Service (USFWS) is provided in Appendix E.

Table 13. Federally protected endangered and threatened species known to occur near the project area per the USFWS IPaC website, excluding coastal and marine species.

Common Name	Scientific Name	Status		Habitat Description	Habitat Present in Project Area?	Effects Determination
		US	NC			
ANIMALS						
American Alligator	*Alligator mississippiensis*	T (S/A)	T	Freshwater swamps, marshes, rivers, and lakes	No	No Effect
Bald Eagle	*Haliaeetus leucocephalus*	BGPA	T	Nests in large trees near open water	No	No Effect
Magnificent Ramshorn	*Planorbella magnifica*	C	E	Orton Pond and pond on Sand Hill Creek; formerly Greenfield Lake (endemic to North Carolina)	No	No Effect
Northern Long-Eared Bat	*Myotis septentrionalis*	T		Hibernates in caves and mines; roosts underneath bark, in cavities or in crevices of both live trees and snags. They are site generalists and can be found in a range of forested areas.	Yes	Not Likely to Adversely Affect Per Programmatic BO
Red-Cockaded Woodpecker	*Picoides borealis*	E	E	Open pine woodlands and savannas with large old pines	No	No Effect
Wood Stork	*Mycteria americana*	T	E	Freshwater and estuarine wetlands; nest in patches of medium to tall trees, either in standing water or on islands surrounded by open water	Yes	No Effect
PLANTS						
Cooley's Meadowrue	*Thalictrum cooleyi*	E	E	Moist to wet bogs and savannas with neutral soils	No	No Effect
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*	E	E	Ecotones between pine savannas and pocosins, on moist to seasonally saturated sands, on organic soils overlaying sand	No	No Effect

TABLE KEY:

Status	Definition
E	Endangered. A taxon “in danger of extinction throughout all or a significant portion of its range.”
T	Threatened. A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
T(S/A)	Threatened due to similarity of appearance.
BGPA	Protected under the Bald and Golden Eagle Protection Act.

7.2 Cultural Resources

The term “cultural resources” refers to prehistoric or historic archaeological sites, structures, or artifact deposits over 50 years old. “Significant” cultural resources are those that are eligible or potentially eligible for inclusion in the National Register of Historic Places. Evaluations of site significance are made with reference to the eligibility criteria of the National Register (36 CFR 60) and in consultation with the North Carolina State Historic Preservation Office (SHPO). Based on coordination with SHPO on September 29, 2020, no historic resources would be affected by the project (Appendix E).

7.3 FEMA

Inspection of the FEMA Flood Insurance Rate Maps 3720104800J, Panel 1048 and Rate Map 3720106800J, Panel 1068, effective June 2, 2006, indicates that the project is not located within a flood area. Therefore, a “Conditional Letter of Map Revision” (CLOMR) is not necessary for this Site.

7.4 Utilities

No utilities are located on the Site.

7.5 Air Transport Facilities

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

7.6 Hydrologic Trespass

Given the Priority 2 stream restoration approach at the upper reaches of the Site, the amount of stream extending upstream of credit generating areas, and the landowner's possession of land adjacent to and immediately upstream/downstream of the project boundary, and HEC RAS analysis, the risk of hydrologic trespass is not expected. Results of the HEC-RAS analysis is provided in Appendix F. There is a transition to non-hydric sandy soil types along most of the conservation easement boundary, adjacent to the agricultural field. There are crowned fields with sloped drainage toward UT-1, as we do not expect these areas outside of the conservation easement to re-establish wetlands due to existing and proposed conditions.

The project landowner also owns the upstream property and has been an integral member and proponent of the project. The adjacent land owner to the west is also a proponent of the project and has no intention of transferring property in the immediate future. However, if the property were to change ownership, and a perimeter ditch along the conservation easement were created, it would likely be a blind ditch with no outlet due the appropriate outlet location being protected in the conservation easement. If a ditch is created by a future owner, CMS will evaluate its affect on adjacent wetland hydrology within the conservation easement boundary and adjust wetland credits, if warranted.

8.0 DESIGN APPROACH AND MITIGATION WORK PLAN

8.1 Stream Design

On-site streams targeted for restoration have endured significant disturbance from land use activities such as land clearing, straightening and rerouting of channels, ditching within the floodplain, and other anthropogenic maintenance. Site streams will be restored by returning stream flow to the historic, abandoned channel and contouring the channel to as close to natural conditions as possible. A section of intact channel upstream from the Site was utilized as a reference stream (see Section 4.1 Reference Streams) to guide channel contouring on reaches that have been impacted by timber clearing activities and equipment.

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

8.1.1 Stream Restoration

Stream restoration efforts are designed to restore a stable stream that approximates hydrodynamics, stream geometry, and local microtopography relative to reference conditions. Restoration at the Site will be primarily Priority I restoration with a short section of Priority 2 restoration at the upstream tie-in point. Restoration activities will entail tying into the upstream, ditched portion of Cool Run and slowly bringing the channel up to an elevation where stream flows can drain through the historic abandoned channel. At that point, the abandoned channel will be cleared of debris, contoured in areas that have been impacted by Site ditching and timber activities/equipment, and stabilized as necessary with coir matting, structures, temporary and permanent seeding, and willow stakes. At the lower end of the channel, a drop structure will be installed to tie the channel into the ditched, Cool Run channel as it exits the Site.

Similar to Cool Run, UT 1 will be elevated to the floodplain, and constructed using Priority 1 restoration techniques across the abandoned floodplain. The reach of UT 1 will be relatively short and will tie to the restored channel of Cool Run.

<u>In-stream Structures</u>

In-stream structures will be used for grade control, habitat, and to elevate local water surface profiles in the channel, flattening the water energy slope or gradient and directing stream energy into the center of the channel and away from banks. The structures will consist of log cross-vanes or log j-hook vanes; however, at the discretion of the Engineer, rock cross-vanes or rock j-hook vanes may be substituted if dictated by field conditions.

Drop Structure

A drop structure is proposed at the outfall of Cool Run as it discharges from the Site. The drop structure will be constructed as per the construction plans exhibited in Appendix L. The structure will be constructed to resist erosive forces associated with hydraulic drops proposed at the Site.

8.2 Individual Reach Discussions

Mitigation strategies proposed for each reach are presented in Table 14, below.

Table 14. Individual Reach Descriptions and Functional Uplift

Individual Reach	Mitigation Activities	Functional Uplift Provided for Identified Stressors
Cool Run	• Tie to the existing canal upstream from credit generating areas and initiate Priority 2 stream restoration. • Once the channel is at the proper elevation, direct stream flow into the abandoned channel and reconnect overbank hydrology to rehydrate drained hydric soils and improve hydrology of existing wetlands. • Clear debris jams or soil dams from the abandoned channel, install grade control/habitat structures, and stabilize the stream banks, as necessary. • Fill the adjacent ditch/drainage network to restore wetland hydrology adjacent to the restored stream channel. • Treat invasive species. • Plant a vegetative buffer within the entire floodplain. • Tie into existing downstream channel location with a drop structure.	• Non-functioning riparian buffer/wetland vegetation • Sediment • Nutrients • Peak Flows • Ditching/Draining • Limited Bedform Diversity • Absence of Large Woody Debris
UT-1	• Tie to the existing canal ground surface upstream from credit generating areas and begin elevating the stream channel. • Conduct P1 stream restoration along stream alignment • Install grade control/habitat structures. • Reconnect overbank hydrology to rehydrate drained hydric soils and improve hydrology of existing wetlands. • Tie into Cool Run. • Treat invasive species. • Plant a vegetative buffer within the entire floodplain.	• Non-functioning riparian buffer/wetland vegetation • Sediment • Nutrients • Fecal Coliform • Peak Flows • Artificial Barriers • Ditching/Draining • Habitat Fragmentation • Limited Bedform Diversity • Absence of Large Woody Debris

8.3 Wetland Reestablishment

Wetland reestablishment is designed to restore a fully functioning wetland system, which will provide surface water storage, nutrient cycling, increased sediment retention, removal of imported elements and compounds. In addition, restored wetland conditions will promote increased wildlife utilization and diversity.

Portions of the Site proposed for reestablishment have been historically drained through silvicultural and agricultural management activities over the past five decades. Wetland hydrology will be restored by raising channel inverts and reestablishing the natural pattern and profile of Cool Run and UT 1. Existing ditched channels will be abandoned and filled (Figure 12). Restoration of Cool Run and UT 1 will also allow floodwaters to access the adjacent wetlands more frequently, promoting storage and treatment of sediment and nutrients. Native vegetative communities will be restored by removing existing vegetation and replanting with species typical of a Coastal Plain Small Stream Swamp community. These activities will result in the reestablishment of approximately 14.11 acres of jurisdictional riparian wetlands.

8.4 Wetland Rehabilitation

Wetland rehabilitation will include enhancement of wetland hydrology and reestablishment of an appropriate vegetative community. Existing wetlands adjacent to the ditched portions of Cool Run have been impacted by agricultural and silvicultural practices. Groundwater and surface water interaction within these wetlands has been altered through ditching of Cool Run and installation of a toe-slope ditch through the floodplain. The toe-slope ditch intercepts surface water runoff and disconnects wetlands upslope from wetlands in the floodplain. The toe-slope ditch combined with ditching of Cool Run has shortened wetland hydroperiods and reduced floodwater interaction with adjacent wetlands. Wetland hydrology will be enhanced by plugging the toe-slope ditch, raising channel inverts, and reestablishing the natural pattern and profile of Cool Run and UT 1. Restoration of Cool Run and UT 1 will also allow floodwaters to access the adjacent wetlands more frequently, promoting storage and treatment of sediment and nutrients. Plugging and filling the toe-slope ditch will allow surface runoff to reach wetlands in the floodplain and provide for hydrologic connectivity between up-gradient riparian wetlands and downslope bottomland wetlands. Native vegetative communities will be restored by removing existing vegetation and replanting with species typical of a Coastal Plain Small Stream Swamp community. These activities will result in the rehabilitation of approximately 1.4 acres of jurisdictional riparian wetlands.

8.5 Wetland Enhancement

Wetland enhancement is proposed for areas delineated as jurisdictional that exhibit altered vegetative structure and diversity due to prior silvicultural practices. In addition, wetlands proposed for enhancement have been disconnected from wetlands in the floodplain due to a toe-slope ditch that intercepts surface water and diverts it down valley. Wetland enhancement will include filling the toe-slope ditch to reconnect up-gradient wetlands with wetlands in the floodplain and planting with native forest vegetation. Project activities will result in the enhancement of approximately 1.2 acre of jurisdictional wetland.

8.6 Wetland Preservation

Approximately 0.5 acre of jurisdictional wetland in the northern extents of the Site will be preserved. Vegetation and hydrology within this portion of the Site will not be altered during mitigation activities.

8.7 Soil Restoration

Soil grading will occur during stream restoration activities. Topsoil will be stockpiled during construction activities and will be spread on the soil surface once critical subgrade has been established. The replaced topsoil will serve as a viable growing medium for community restoration to provide nutrients, aid in the survival of planted species, and promote rhizomal growth of desired shrub species. Spoils piles will also be removed from wetland reestablishment areas during restoration activities.

8.8 Natural Plant Community Restoration

Restoration of wetlands, floodplain forest and stream-side habitat allows for development and expansion of characteristic species across the landscape. Ecotonal changes between community types contribute to diversity and provide secondary benefits, such as enhanced feeding and nesting opportunities for mammals, birds, amphibians, and other wildlife. Reference wetland data, onsite observations, and community descriptions from *Classification of the Natural Communities of North Carolina* (Schafale and Weakley 2012) were used to develop the primary plant community associations targeted for restoration activities.

8.8.1 Planting Plan

Wetlands and uplands on-site are proposed for vegetative restoration. The planting plan includes restoration of stream side zones and the larger floodplain adjacent to Cool Run and UT 1. Stream-side trees and shrubs include species with high value for sediment stabilization, rapid growth rate, and the ability to withstand hydraulic forces associated with bankfull flow and overbank flood events. Stream-side trees and shrubs will be planted within 15 feet of the channel top of bank throughout the meander belt-width. Shrub species will be planted along the reconstructed stream banks, concentrated along outer bends. Coastal Plain Small Stream Swamp (Blackwater Subtype) is the target community for Site floodplains. This community has been divided into two zones based on hydrologic regime. Zone 1 includes floodplain areas proposed as wetlands. Zone 1 will be planted with hydrophytic species such swamp tupelo and bald cypress. Zone 2 includes upland areas within the Site and will be planted with species more often found in drier portions of floodplains such as Atlantic white cedar, sycamore and water oak. Other species proposed for planting within the floodplain are similar across both zones.

Bare-root seedlings within the Coastal Plain Small Stream Swamp will be planted at a density of approximately 680 stems per acre on 8-foot centers. Shrub and tree species in the stream-side assemblage will be planted at a density of 1,210 stems per acre on 6-foot centers. Live stakes will also be planted along the stream bank approximately every 5-ft in appropriate locations.

Table 15 depicts the total number of stems and species distribution within each vegetation association (Figure 8, Appendix A). Planting will be performed between December 1 and March 15.

8.8.2 Nuisance Species Management

Invasive plant species will be observed and controlled mechanically and/or chemically, as part of this project. Prior to planting, the site will be mowed and sprayed with Roundup to treat invasive species (i.e Chinese privet and honeysuckle) and early successional species (i.e. red maple, sweet gum, and loblolly pine). Inspections for beaver and other potential nuisance species will occur throughout the course of the monitoring period. Appropriate actions may be taken to ameliorate any negative impacts regarding vegetation development and/or water management on an as-needed basis.

8.8.3 Fencing & Easement Boundary Marking

The easement boundary will be identified with standard Conservation Easement signs fastened to fence post as prescribed in the most recent NCDMS Boundary Marking Standards, to deter prohibited activities and compromising vegetation. CMS is in discussions with the land owner to construct a tractor deterrent fence along the western edge of the conservation easement boundary, adjacent to the agriculture field. At a minimum, 5-6” treated post will be installed as a visual barrier and used to attached the Conservation Easement signs.

Table 15. Planting Plan

Vegetation Association	Wetland Indicator Status	Coastal Plain Small Stream Swamp* (Zone 1)		Coastal Plain Small Stream Swamp* (Zone 2)		Stream-side Assemblage**		TOTAL
Area (acres)		15.48		5.10		2.13		22.71
Species		# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	FACW		--		--	515	20	515
Black willow (*Salix nigra*)***	OBL		--		--	515	20	515
Ironwood (*Carpinus caroliniana*)	FAC	526	5		--	260	10	786
River birch (*Betula nigra*)	FACW		--	350	10	260	10	610
Silky dogwood (*Cornus amomum*)***	FACW		--		--	515	20	515
Atlantic white cedar (Chamaecyparis thyoides)	FACW		--	350	10		--	350
Sycamore (*Platanus occidentalis*)	FACW		--	695	20		--	695
Bald cypress (*Taxodium distichum*)	OBL	2,632	25		--	515	20	3,147
Swamp chestnut oak (*Quercus michauxii*)	FACW	1,580	15	695	20		--	2,275
Swamp tupelo (*Nyssa biflora*)	OBL	2,105	20		--		--	2,105
Laurel oak (*Quercus laurifolia*)	FACW	2,105	20	695	20		--	2,800
Overcup oak (*Quercus lyrata*)	OBL	1,055	10		--		--	1,055
American elm (*Ulmus americana*)	FAC		--	350	10		--	350
Water oak (*Quercus nigra*)	FACW	526	5	350	10		--	876
	TOTAL	**10,529**	**100**	**3,485**	**100**	**2,580**	**100**	**16,594**

* Planted at a density of 680 stems/acre.
** Planted at a density of 1210 stems/acre.
*** Live Stake

Table 15A - Permanent Seed Mix*

March 1 – October 31							
Species	**Common Name**	**Wetland Indicator Status**	**Unit Type**	**Stratum**	**% of Total**	**lbs per Acre**
Carex vulpinoidea	Fox sedge	FACW	S	Herb	15	35
Andropogon gerardii	Big bluestem	FAC	S	Herb	15	35
Elymus virgatum	Virginia wildrye	FAC	S	Herb	15	35
Panicum virgatum	Switchgrass	FAC	S	Herb	15	35
Juncus effusus	Soft rush	OBL	S	Herb	20	35
Dichanthelium clandestinum	Deertongue	FACW	S	Herb	20	35
				Total	100	

Table 15A - Permanent Seed Mix*

November 1 – February 28						
Species	**Common Name**	**Wetland Indicator Status**	**Unit Type**	**Stratum**	**% of Total**	**lbs per Acre**
Elymus virgatum	Virginia wildrye	FAC	S	Herb	10	35
Dichanthelium clandestinum	Deertongue	FACW	S	Herb	10	35
Carex vulpinoidea	Fox sedge	FACW	S	Herb	5	35
Agrostis hyemalis	Ticklegrass	FAC	S	Herb	15	35
Agrostis perennans	Autumn Bentgrass	FACU	S	Herb	10	35
Juncus effusus	Soft rush	OBL	S	Herb	15	35
Tripsacum dactyloides	Eastern Gamma Grass	FAC	S	Herb	15	35
Eragrostis curvula	Weeping Lovegrass	UPL	S	Herb	10	35
Panicum amarum var. amarulum	Atlantic Coastal Panicgrass	FAC	S	Herb	10	35
				Total	100	

* Primarily utilized in disturbed/graded areas.

Table 15B - Temporary Herbaceous Seed Schedule

Common Name	Application Rate	Application Dates
Grain Rye[A]	130 lbs. per acre	Year – Round
Brown Top Millet[A]	40 lbs. per acre	May - September
German Millet[B]	25 lbs. per acre	May - September

[A] Primarily utilized on disturbed or stockpiled areas.
[B] Primarily utilized near stream channels and streambanks.

9.0 MONITORING AND SUCCESS CRITERIA

Stream monitoring will be conducted by Axiom Environmental, Inc., and wetland monitoring will be conducted by Land Management Group based on the schedule in Table 16. A summary of monitoring is outlined in Table 17 (Figure 9, Appendix A). Annual monitoring reports will be submitted to the NCDMS by Clearwater Mitigation Solutions no later than December 31 of each monitoring year that data is collected.

Table 16. Monitoring Schedule

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

Table 17. Monitoring Summary

Stream Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Stream Profile	Full longitudinal survey	As-built (unless otherwise required)	All restored stream channels	Graphic and tabular data.
Stream Dimension	Cross-sections	Years 1, 2, 3, 5, and 7	Total of 10 cross-sections on restored channels	Graphic and tabular data.
Channel Stability	Visual Assessments	Yearly	All restored stream channels	Areas of concern will be depicted on a plan view figure with a written assessment and photograph of the area included in the report.
	Additional Cross-sections	Yearly	Only if instability is documented during monitoring	Graphic and tabular data.
Bankfull Events	Continuous monitoring surface water gauges and/or trail camera	Continuous recording through monitoring period	1 stream gauge on Cool Run; 1 stream gauge on UT1	Surface water data for each monitoring period
	Visual/Physical Evidence	Continuous through monitoring period	Periodic Site visits throughout the year.	Visual evidence, photo documentation, and/or rain data.
Wetland Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Wetland Restoration	Groundwater gauges	Years 1, 2, 3, 4, 5, 6, and 7 throughout the year with the growing season[2]	17 gauges spread throughout restored wetlands; one reference gauge at reference wetland site	Groundwater and rain data for each monitoring period
Vegetation Parameters				
Parameter	**Method**	**Schedule/Frequency**	**Number/Extent**	**Data Collected/Reported**
Vegetation establishment and vigor	Permanent vegetation plots 0.0247 acre (100 square meters) in size; *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008)	As-built, Years 1, 2, 3, 5, and 7	14 plots spread across the Site	Species, height, planted vs. volunteer, stems/acre
	Annual random vegetation plots, 0.0247 acre (100 square meters) in size	As-built, Years 1, 2, 3, 5, and 7	3 plots randomly selected each year	Species and height

Note: Photo stations will be taken at all cross sections and at vegetation plot origin points. In addition, photos will be collected across the Site to document a range of different areas.

[2] Refer to discussion of growing season in Section 9.1.

9.1 Success Criteria

Monitoring and success criteria for stream restoration should relate to project goals and objectives identified from on-site NC SAM and NC WAM data collection in addition to guidelines set forth in the 2016 Mitigation Rule. From a mitigation perspective, several of the goals and objectives are assumed to be functionally elevated by restoration activities without direct measurement. Other goals and objectives will be considered successful upon achieving success criteria. The following summarizes the Site success criteria developed for the project.

Table 18. Success Criteria

Streams
• All streams must maintain an Ordinary High-Water Mark (OHWM), per RGL 05-05. • Continuous surface flow must be documented each year for at least 30 consecutive days. • Bank height ratio (BHR) cannot exceed 1.2 at any measured cross-section. • BHR at any measure riffle cross-section should not change by more than 10% from baseline condition during any given monitoring period. • The stream project shall remain stable and all other performance standards shall be met through four separate bankfull events, occurring in separate years, during the monitoring years 1-7.
Wetland Hydrology
• Saturation or inundation within the upper 12 inches of the soil surface for, at a minimum, 12 percent of the growing season (36 days)[3], during normal climatic conditions.
Vegetation
• Within planted portions of the site, a minimum of 320 stems per acre must be present at year 3; a minimum of 260 stems per acre must be present at year 5; and a minimum of 210 stems per acre must be present at year 7. • Trees must average 7 feet in height at year 5, and 10 feet in height at year 7 in each plot. • Planted and volunteer stems are counted, provided they are included in the approved planting list for the site; natural recruits not on the planting list may be considered by the IRT on a case-by-case basis. • Any volunteer species on the approved planting list must be established for at least 2 years to count towards success and will be subject to the average height standard.

As indicated in the table above, hydrologic success criterion is premised on gauge data demonstrating saturation or inundation within the upper 12 inches of the soil surface for a minimum of 12% of the growing season. Given the location of the site in the southeastern portion of the Outer Coastal Plain, it is recognized that growing seasons of this locale are often longer than the generalized March 1 to November 20 growing season dates. Soil temperature data for the Outer Coastal Plain often demonstrate growing seasons beginning in early February and continuing into December. Such observations are consistent with the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plan Region (Version 2.0) which states, "there is evidence that soil temperatures are above 41^{o} F and soil microbial communities are active throughout the year in some portion of the coastal plain region" (USACE 2010). As a result, the Provider will be collecting on-site soil temperature data (via soil probes installed at 12 inches below the soil surface) and will be collecting supplemental data of above-ground growth and development of vascular plants (e.g. bud burst on woody

[3] Refer to discussion of growing season dates in Section 9.1.

plants, appearance of new growth from vegetative crowns, or emergence of herbaceous plants from the ground). The proposed start date of the growing season will be based upon the presence of either soil temperatures (at 12 inches below the soil surface) above 41° F or evidence of above-ground growth and development of vascular plants (via the indicators identified above). The proposed end date of the growing season will be based upon the presence of either soil temperatures (at 12 inches below the soil surface) below 41° F or the prevalence of vascular plant autumnal senescence. For the purpose of this evaluation, autumnal senescence will be defined as the prevalence (>50%) seasonal loss of leaves from three dominant deciduous trees (e.g. red maple, tulip poplar, and sweet gum) occurring on the site. On-site monitoring will be performed at the end of the 2022 growing season and the start of the 2023 growing season. These data will be provided within the initial as-built report for the purpose of identifying an appropriate and science-based growing season for concurrence by the IRT.

9.2 Contingency

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

9.2.1 Stream Contingency

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

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

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

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

Beaver and other Invasive Species
Indications of beaver establishment will be monitored throughout the 7-year monitoring period. If beaver are identified in the Site, the location of the dam will be depicted on CCPV mapping. CMS will engage a certified trapper to periodically monitor the site for beaver activity and trap them if observed. Once beaver have been trapped, the dam will be removed. Removal of the dam is expected to occur by hand to minimized disturbance to the adjacent mitigation areas.

When invasive species controls are required by the IRT, species such as Japanese honeysuckle (*Lonicera japonica*) or Chinese privet (*Ligustrum sinense*) will be treated by foliar application and/or cutting and directly treating the stump with Garlon 4A (or other similar product) to minimize re-sprouting. Appropriate actions to ameliorate any negative impacts regarding vegetation development and/or water management will occur on an as-needed basis. Additional monitoring, or other contingency measures will be determined by consultation with the IRT.

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

9.2.2 Wetland Contingency

Hydrological contingency will require consultation with hydrologists and regulatory agencies if wetland hydrology target criteria are not achieved. Floodplain surface modifications, including construction of ephemeral pools within the filled ditches, represent a likely mechanism to increase the floodplain area in support of jurisdictional wetlands. In addition, woody debris will be added to the depressional areas in the buffers and throughout the adjacent wetlands for habitat, and to help store sediment, increase water storage/infiltration, and absorb water energy during overbank events. Approved contingency measures to increase wetland hydrologic amplitude or duration will be coordinated with the IRT and implemented and monitored until Hydrology Success Criteria are achieved. Future and potential ditch creation along the conservation easement boundary does not present a risk of draining restored wetlands because downstream tie in locations will be protected via a conservation easement and encroachment into these areas will not be allowed.

9.2.3 Vegetation Contingency

If vegetation success criteria are not achieved (i.e stunted growth, beavers, encroachment, nutrient availability), supplemental planting may be performed with tree species approved by the IRT. Supplemental planting and/or soil amendments will be performed as needed until achievement of vegetation success criteria. Refer to Section 10 for specific adaptive management in regards to the recruitment of early successional species such as red maple, sweet gum, and loblolly pine.

9.3 Compatibility with Project Goals

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

Table 19. Compatibility of Performance Criteria to Project Goals and Objectives

Goals	Objectives	Success Criteria
(1) HYDROLOGY		
• Minimize downstream flooding to the maximum extent possible.	• Construct new channel at historic floodplain elevation to restore overbank flows • Plant woody riparian buffer • Protect riparian buffers with a perpetual conservation easement • Construct channels with proper pattern, dimension, and longitudinal profile	• BHR not to exceed 1.2 • Document four overbank events in separate monitoring years for at least 30-consecutive days • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded
• Increase stream stability within the Site so that channels are neither aggrading nor degrading.	• Construct channels with proper pattern, dimension, and longitudinal profile • Cease row crop production within and immediately adjacent to Site wetlands and streams • Construct stable channels • Stabilize stream banks • Plant woody riparian buffer	• Cross-section measurements indicate a stable channel • Visual documentation of stable channels and structures • BHR not to exceed 1.2 • < 10% change in BHR in any given year • Attain Vegetation Success Criteria
(1) WATER QUALITY		
• Remove direct nutrient and pollutant inputs from the Site and reduce contributions to downstream waters.	• Reduce agricultural land/inputs • Plant woody riparian buffer • Restore/enhance jurisdictional wetlands adjacent to Site streams • Provide surface roughness and reduce compaction through deep ripping/plowing • Restore overbank flooding by constructing channels at historic floodplain elevation	• Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria
(1) HABITAT		
• Improve instream and stream-side habitat.	• Construct stable channels with appropriate substrate • Plant woody riparian buffer to provide organic matter and shade • Construct new channel at historic floodplain elevation to restore overbank flows • Protect riparian buffers with a perpetual conservation easement • Restore/enhance jurisdictional wetlands adjacent to Site streams • Stabilize stream banks • Install in-stream structures	• Cross-section measurement indicate a stable channel • Visual documentation of stable channels and in-stream structures. • Attain Wetland Hydrology Success Criteria • Attain Vegetation Success Criteria • Conservation Easement recorded

10.0 ADAPTIVE MANAGEMENT PLAN

In the event the Site or a specific component of the Site fails to achieve the necessary performance standards as specified in the mitigation plan, the provider shall notify the members of the IRT and work with the IRT to develop contingency plans and remedial actions. Problems will be identified during Site monitoring and specified in the subsequent annual monitoring reports. Over the course of the 7-year monitoring period, the recruitment of early successional species such as red maple, sweet gum, and loblolly pine will be monitored. No single volunteer species of red maple, loblolly pine, and sweet gum will comprise more than 50% of the total composition at Year 3. If this occurs, remedial action, as approved by the IRT may be required. During Year 5, no single volunteer species, comprising over 50% of the total composition, may be more than twice the height of the planted trees. If this occurs, remedial action, as approved by the IRT, may be required. The need to conduct additional volunteer sampling after Year 5 will be determined by the IRT. Remedial action will include spot herbicide treatment (as needed) and in extreme situations will involve hand removal of undesirable species by pre-commercial thinning crews.

11.0 LONG-TERM MANAGEMENT PLAN

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

12.0 REFERENCES

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. United States Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. Stream Hydrology: an Introduction for Ecologists. John Wiley & Sons, Ltd. West Sussex, England.

Griffith, G.E., J.M. Omernik, J.A. Comstock, M.P. Schafale, W.H. McNab, D.R. Lenat, T.F. MacPherson, J.B. Glover, and V.B. Shelbourne. 2002. Ecoregions of North Carolina and South Carolina. U.S. Geological Survey, Reston, Virginia.

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

North Carolina Department of Environmental Quality (NCDEQ). 2019. 2018 NC Category 5 Assessment "303(d) List" Final (online). Available: https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/303d/2018/2018-NC-303-d--List-Final.pdf (July 29, 2019).

North Carolina Division of Mitigation Services (NCDMS). 2016. Quantifying Benefits to Water Quality from Livestock Exclusion and Riparian Buffer Establishment for Stream Restoration. June 15, 2016. North Carolina Department of Environmental Quality, Raleigh, North Carolina.

North Carolina Division of Water Resources (NCDWR). 2013. River Basin Classification Schedule: Yadkin-Pee Dee (online). Available: https://files.nc.gov/ncdeq/Water%20Quality/Planning/CSU/Surface%20Water/River%20Basin%20Water%20Quality%20Classifications%20as%20of%20Dec%209%202013/Yadkin_Hydro_order.pdf (July 29, 2019).

North Carolina Ecosystem Enhancement Program (NCEEP). 2005. Local Watershed Plan for the Upper Yadkin River Basin: Upper Uwharrie River Watershed (online). Available: https://ncdenr.s3.amazonaws.com/s3fs-public/Mitigation%20Services/Watershed_Planning/Yadkin_River_Basin/Upper_Uwharrie/Upper_Uwharrie_PFR_aug%2705.pdf (July 30, 2019).

North Carolina Ecosystem Enhancement Program (NCEEP). 2009. Lower Yadkin Pee-Dee River Basin Restoration Priorities (online). Available: https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Yadkin_River_Basin/Lower%20Yadkin_Pee_Dee_RBRP_2009_Final092010.pdf (July 30, 2019).

North Carolina State University (NC State 2016). NC State University and A&T State University Cooperative Extension Resources. 2016 North Carolina Agricultural Chemicals Manual. Available: http://content.ces.ncsu.edu/north-carolina-agricultural-chemicals-manual

North Carolina Stream Functional Assessment Team. (NC SFAT 2015). N.C. Stream Assessment Method (NC SAM) User Manual. Version 2.1.

North Carolina Wetland Functional Assessment Team. (NC WFAT 2010). N.C. Wetland Assessment Method (NC WAM) User Manual. Version 4.1.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology (Publisher). Pagosa Springs, Colorado

Rosgen, D. 2009. A Practical Method of Computing Streambank Erosion Rate (online). Available: http://www.u-s-c.org/html/documents/Erosionrates.pdf.

Rosgen, D. 2011. Estimating Sediment Loads using the Bank Assessment of Non-point source Consequences of Sediment (BANCS). Watershed Assessment of River Stability and Sediment Supply (WARSSS). Hagerstown , Maryland.

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

Schafale, M.P. 2012. Guide to the Natural Communities of North Carolina: Fourth Approximation. North Carolina Natural Heritage Program, North Carolina Department of Environment and Natural Resources. Raleigh, North Carolina.

Simon A, Hupp CR. 1986. Geomorphic and Vegetative Recovery Processes Along Modified Tennessee Streams: An Interdisciplinary Approach to Disturbed Fluvial Systems. Forest Hydrology and Watershed Management. IAHS-AISH Publ.167.

Stormwater Manager's Resource Center (SMRC). 2016. The Simple Method to Calculate Urban Stormwater Loads. Available: http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm

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

United States Department of Agriculture (USDA). 1992. Natural Resources Conservation Service. Agricultural Waste Management Handbook. Available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/dma/?cid=nrcs143_014211.

United States Department of Agriculture (USDA). 2015. Animal Manure Management (NRCS) available at http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nhj/technical/cp/cta/?

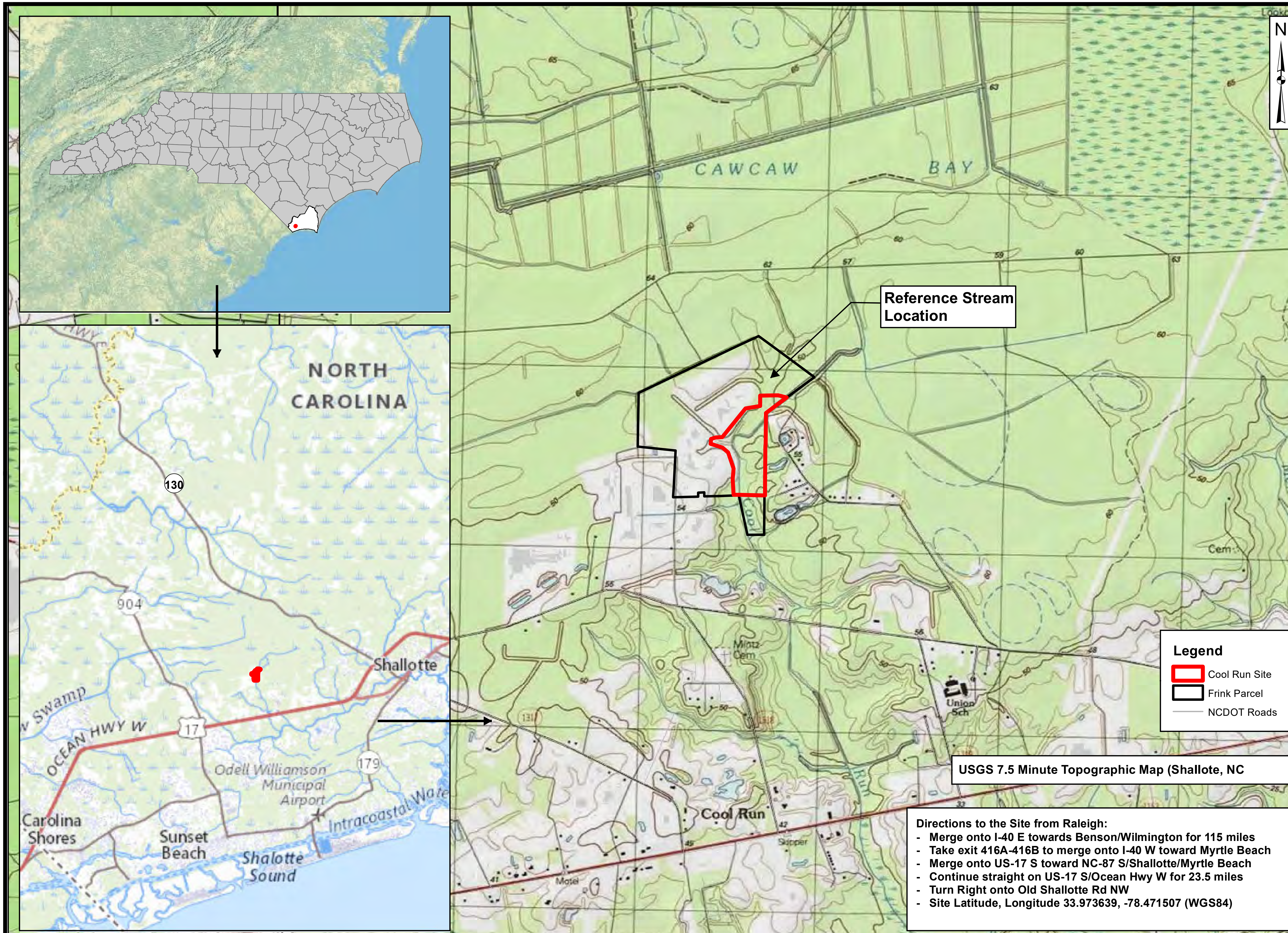
United States Department of Agriculture (USDA). 2019. Web Soil Survey (online). Available: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm [July 30, 2019]. United States Department of Agriculture.

United States Department of Agriculture (USDA). 1986. Soil Survey of Brunswick County, North Carolina. Soil Conservation Service.

United States Fish and Wildlife Service (USFWS). 2018. Endangered Species, Threatened Species, Federal Species of Concern, and Candidate Species, Alamance County, North Carolina (online). Available: https://www.fws.gov/raleigh/species/cntylist/alamance.html [April 10, 2019].

United States Geological Survey (USGS). 2006. Estimating the Magnitude and Frequency of Floods in Rural Basins of North Carolina – Recompiled. USGS Water-Resources Investigations Report 01-4207. Raleigh, North Carolina.

APPENDIX A
FIGURES



Directions to the Site from Raleigh:
- Merge onto I-40 E towards Benson/Wilmington for 115 miles
- Take exit 416A-416B to merge onto I-40 W toward Myrtle Beach
- Merge onto US-17 S toward NC-87 S/Shallotte/Myrtle Beach
- Continue straight on US-17 S/Ocean Hwy W for 23.5 miles
- Turn Right onto Old Shallotte Rd NW
- Site Latitude, Longitude 33.973639, -78.471507 (WGS84)

Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

SITE LOCATION

Drawn by: AEK

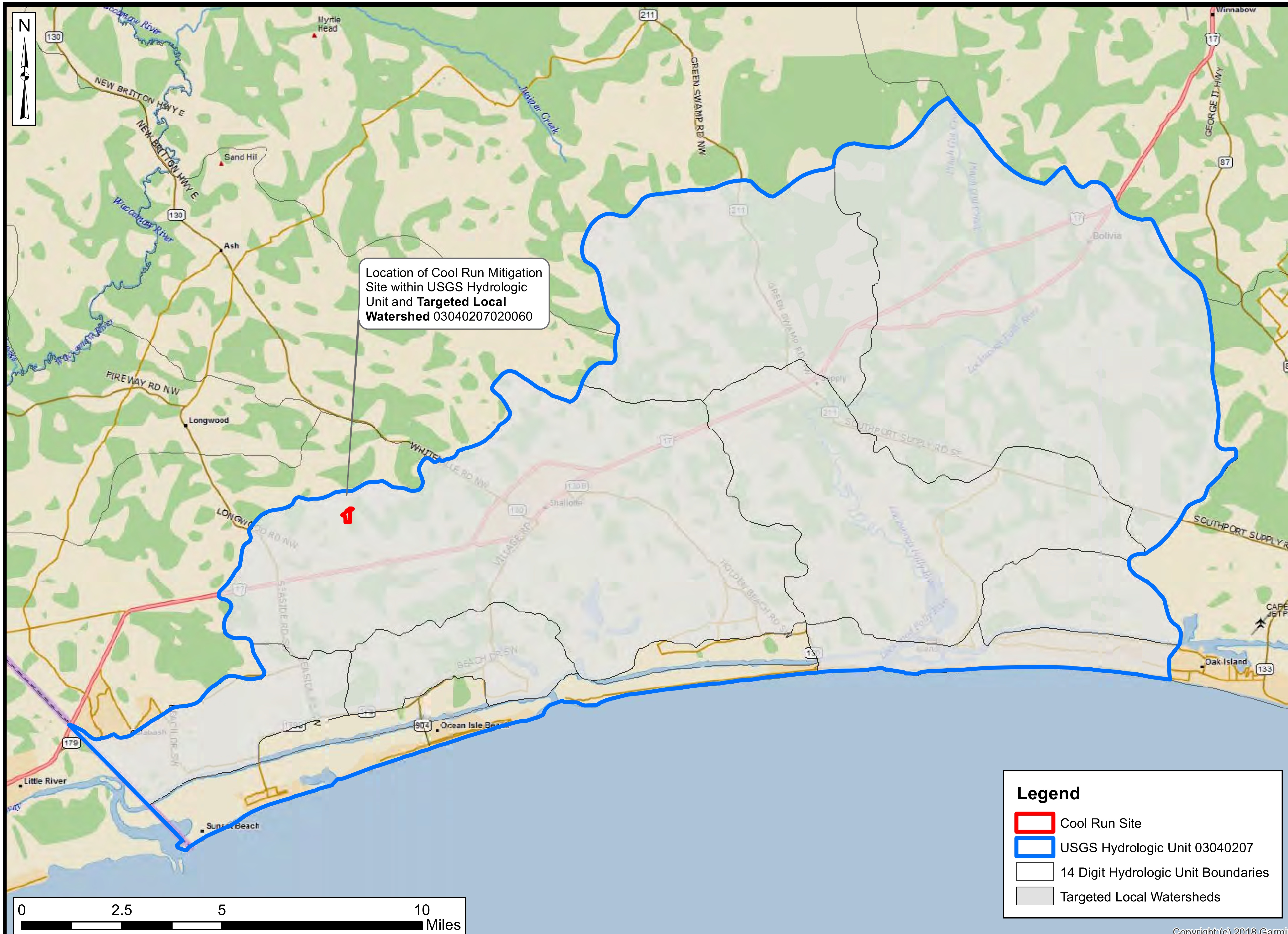
Date: JUNE 2021

Scale: 1:20,000

Project No.: 21-008

FIGURE

1



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

HYDROLOGIC UNIT MAP

Drawn by: AEK

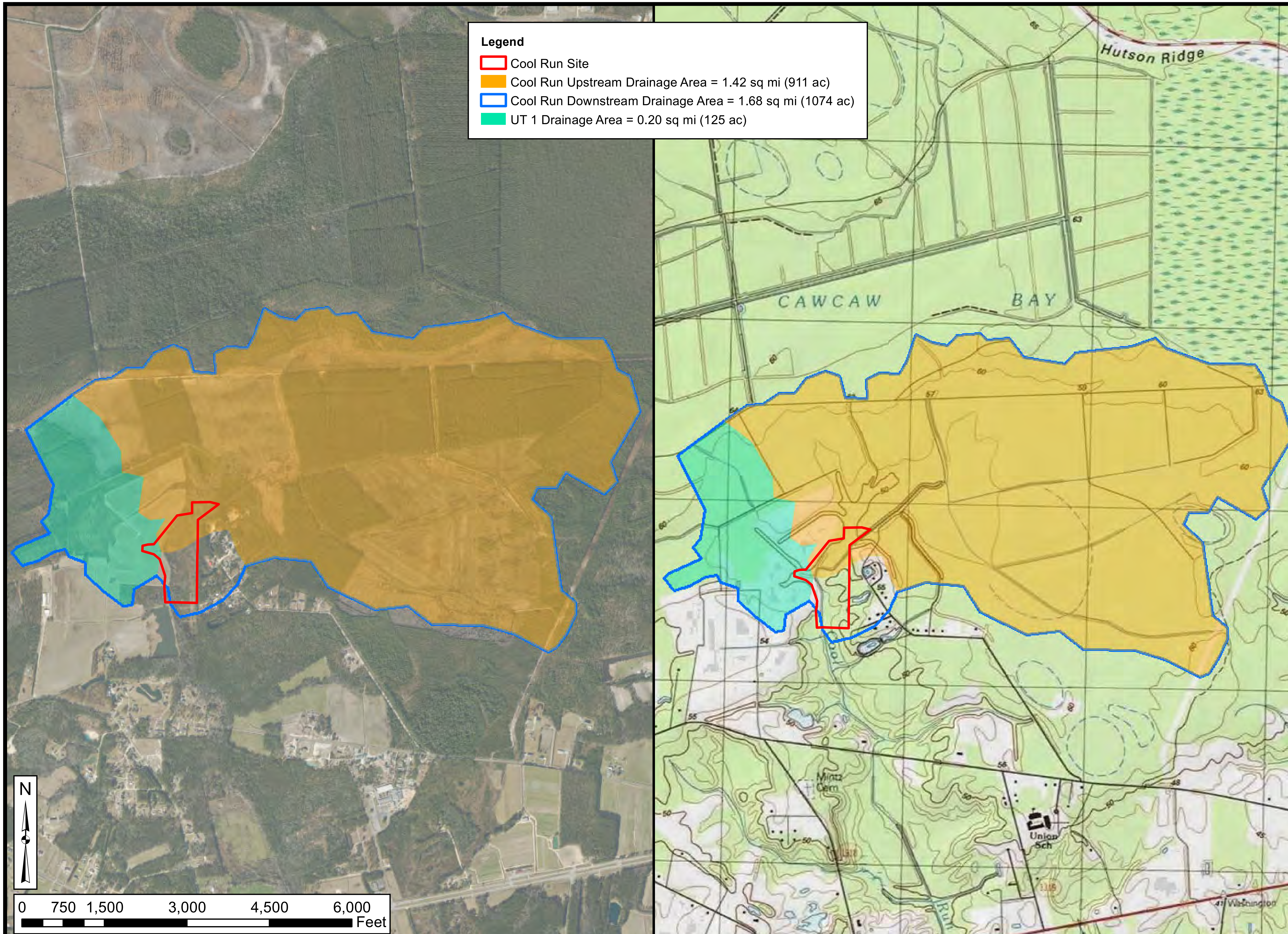
Date: JUNE 2021

Scale: 1:145,000

Project No.: 21-008

FIGURE

2



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: AEK

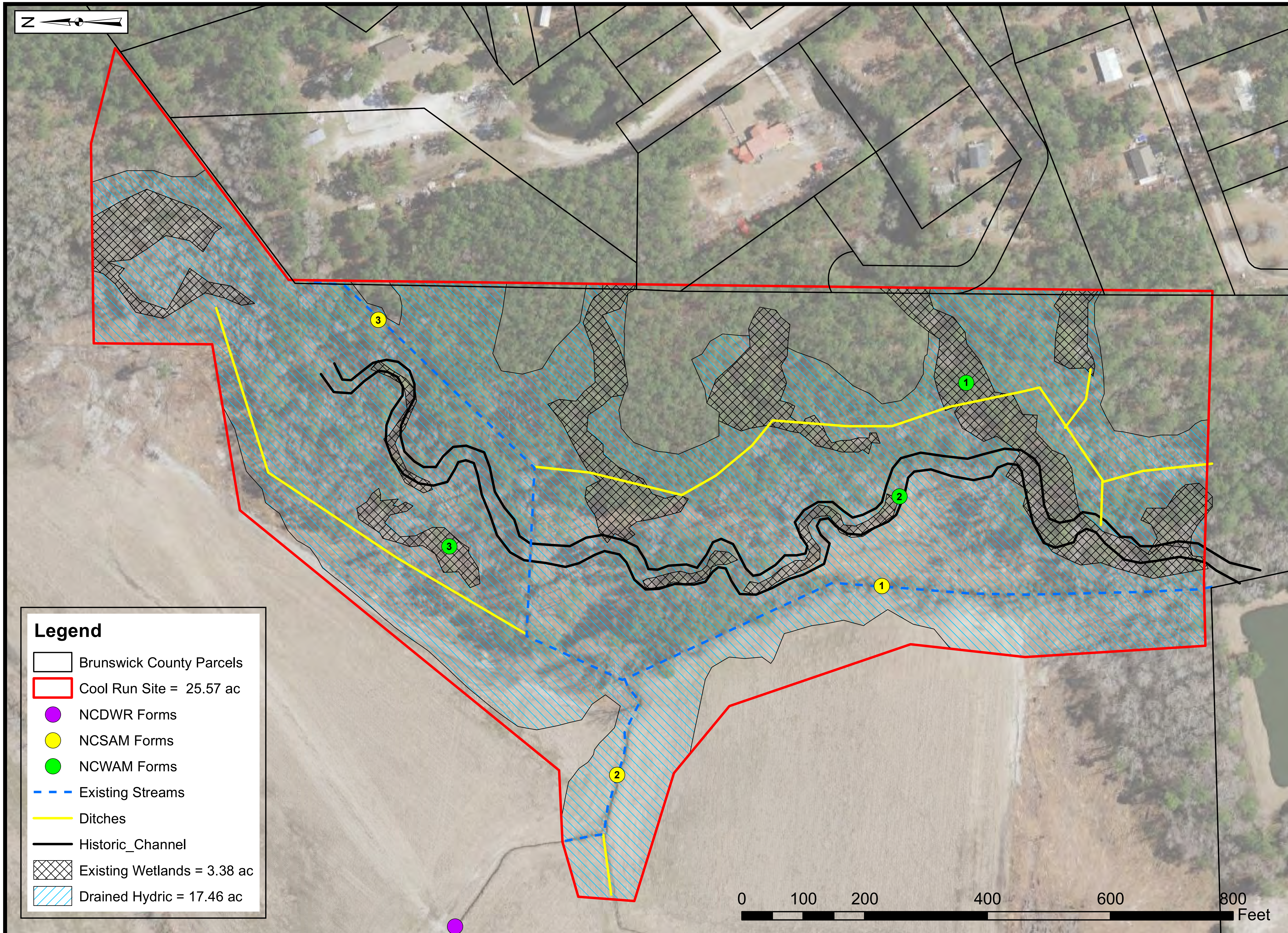
Date: MAR 2021

Scale: 1:20,000

Project No.: 21-008

FIGURE

3



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

EXISTING CONDITIONS

Drawn by: WGL

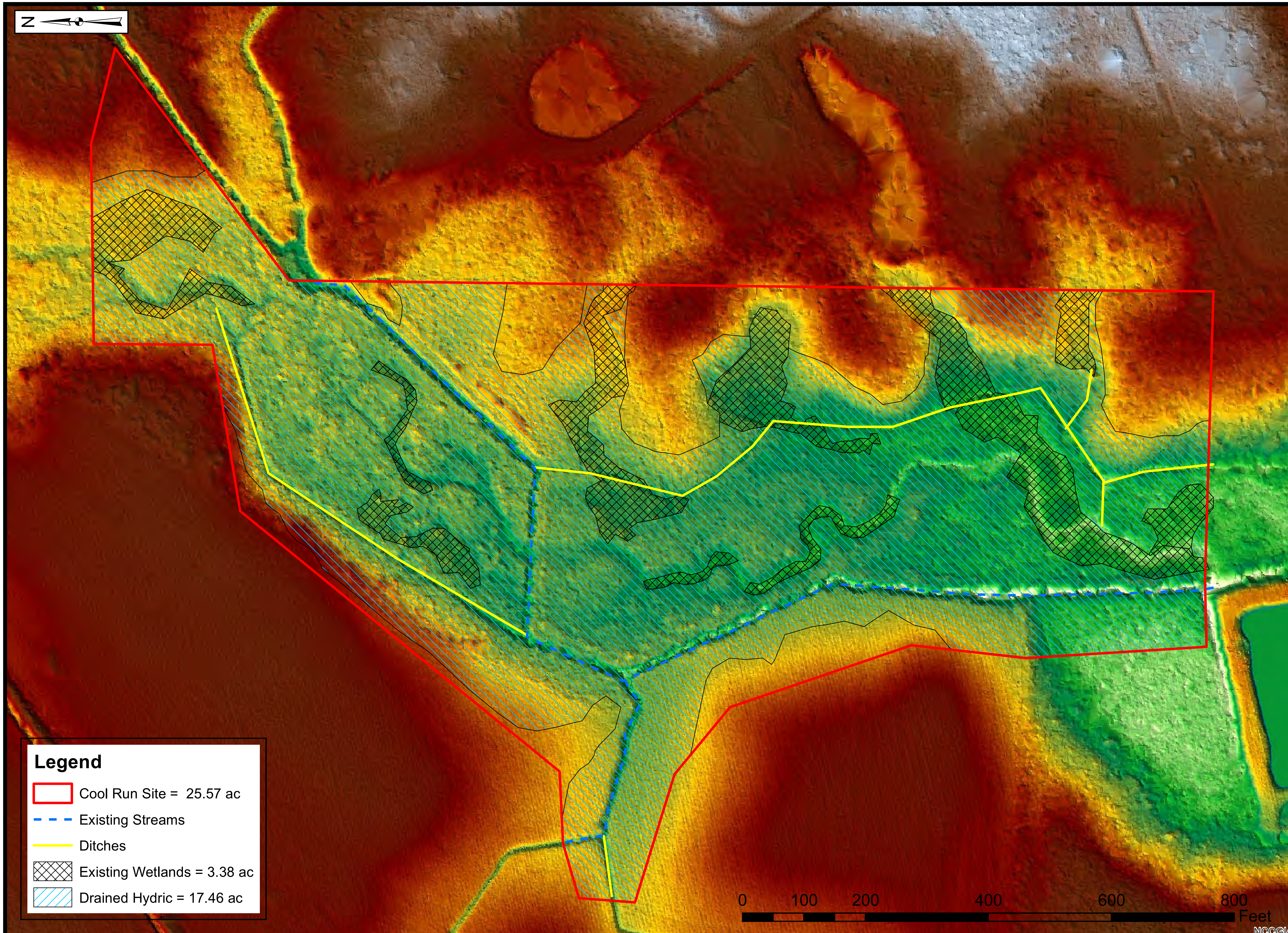
Date: JUNE 2021

Scale: 1:1800

Project No.: 21-008

FIGURE

4A



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

LIDAR

Drawn by: WGL

Date: JUNE 2021

Scale: 1:1800

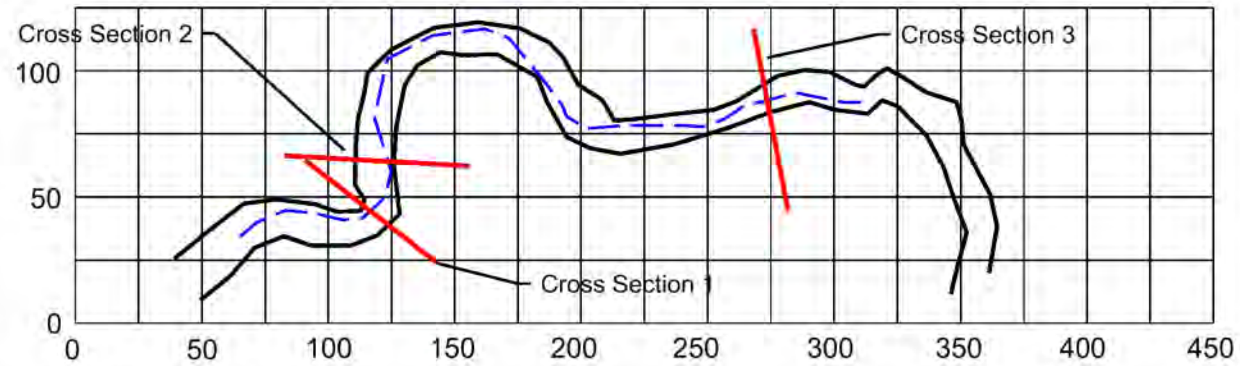
Project No.: 21-008

FIGURE

4B

Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS



Reference Pattern

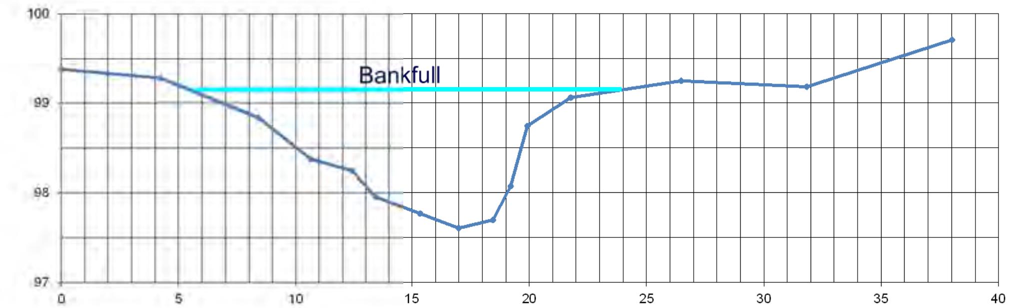
Lp-p = 62 (31 - 93) ft
Lm = 102 (62 - 130) ft
Wbelt = 60 (46 - 74) ft
Rc = 18 (9 - 28) ft
Lp-p/Wbkf = 4.5 (2.3 - 6.9)
Lm/Wbkf = 7.5 (4.5 - 9.6)
Wbelt/Wbkf = 4.4 (3.4 - 5.4)
Rc/Wbkf = 1.3 (0.6 - 2.0)
SIN = 1.32

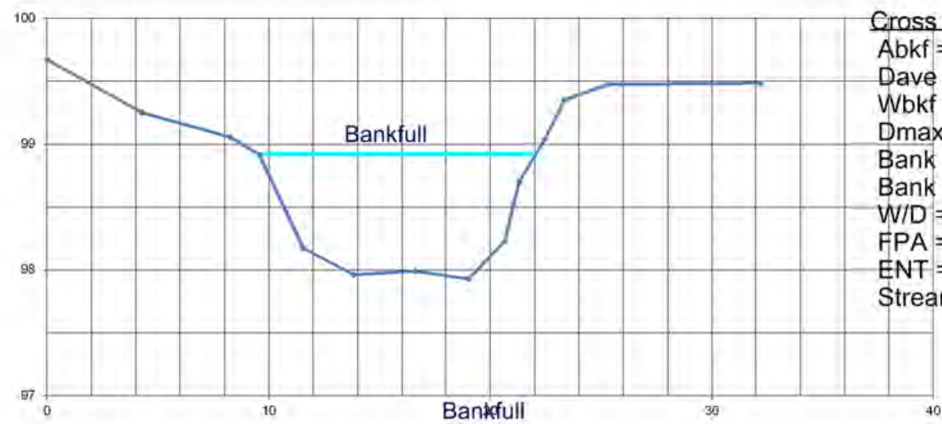
Pattern Legend

- Top of Bank
- Thalweg
- Cross Section

Cross Section 1 - Pool

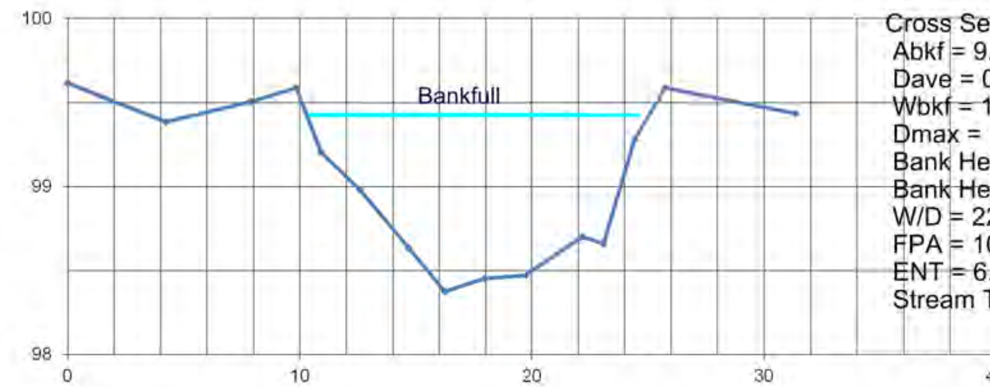
Abkf = 13.9 ft
Wbkf = 19.5 ft
Dmax = 1.6 ft





Cross Section 2 - Riffle

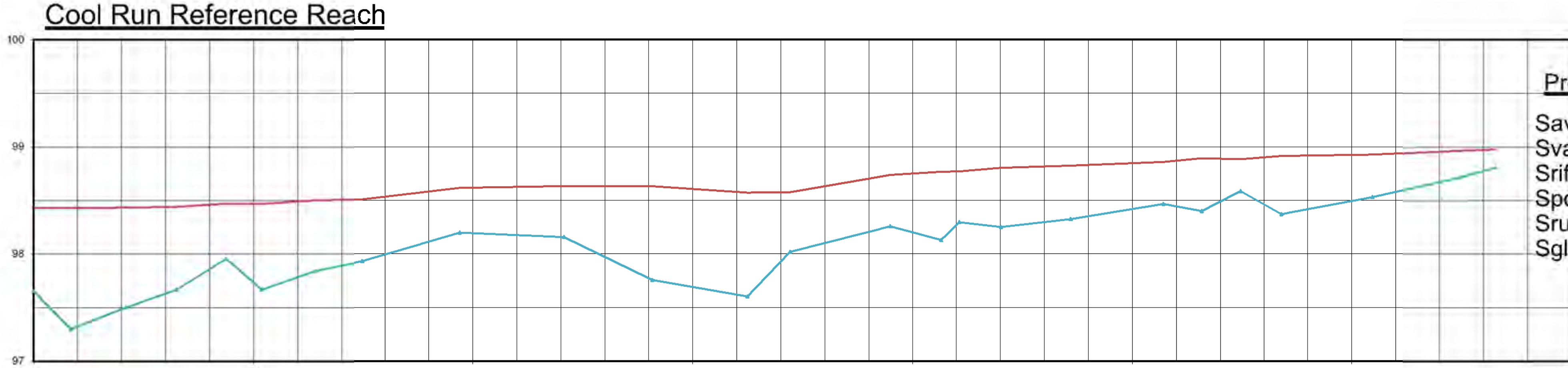
Abkf = 9.4 ft
Dave = 0.7 ft
Wbkf = 12.5 ft
Dmax = 1.0 ft
Bank Height = 1.0 ft
Bank Height Ratio = 1.0
W/D = 16.7
FPA = 100
ENT = 8.0
Stream Type = C



Cross Section 3 - Riffle

Abkf = 9.7 ft
Dave = 0.7 ft
Wbkf = 14.7 ft
Dmax = 1.0 ft
Bank Height = 1.0 ft
Bank Height Ratio = 1.0
W/D = 22.5
FPA = 100
ENT = 6.8
Stream Type = C

Cool Run Reference Reach



Profile (Reference Reach)

Save = 0.0016 rise/run
Svalley = 0.0021 rise/run
Sriffle = 0.0026 (0.0013 - 0.0055) rise/run
Spool = 0.0004 (0 - 0.0034) rise/run
Srun = 0.0006 (0.0004 - 0.0034) rise/run
Sglide = 0 (0 - 0.0039) rise/run

- Water Surface
- Channel Bed

NOTES/REVISIONS

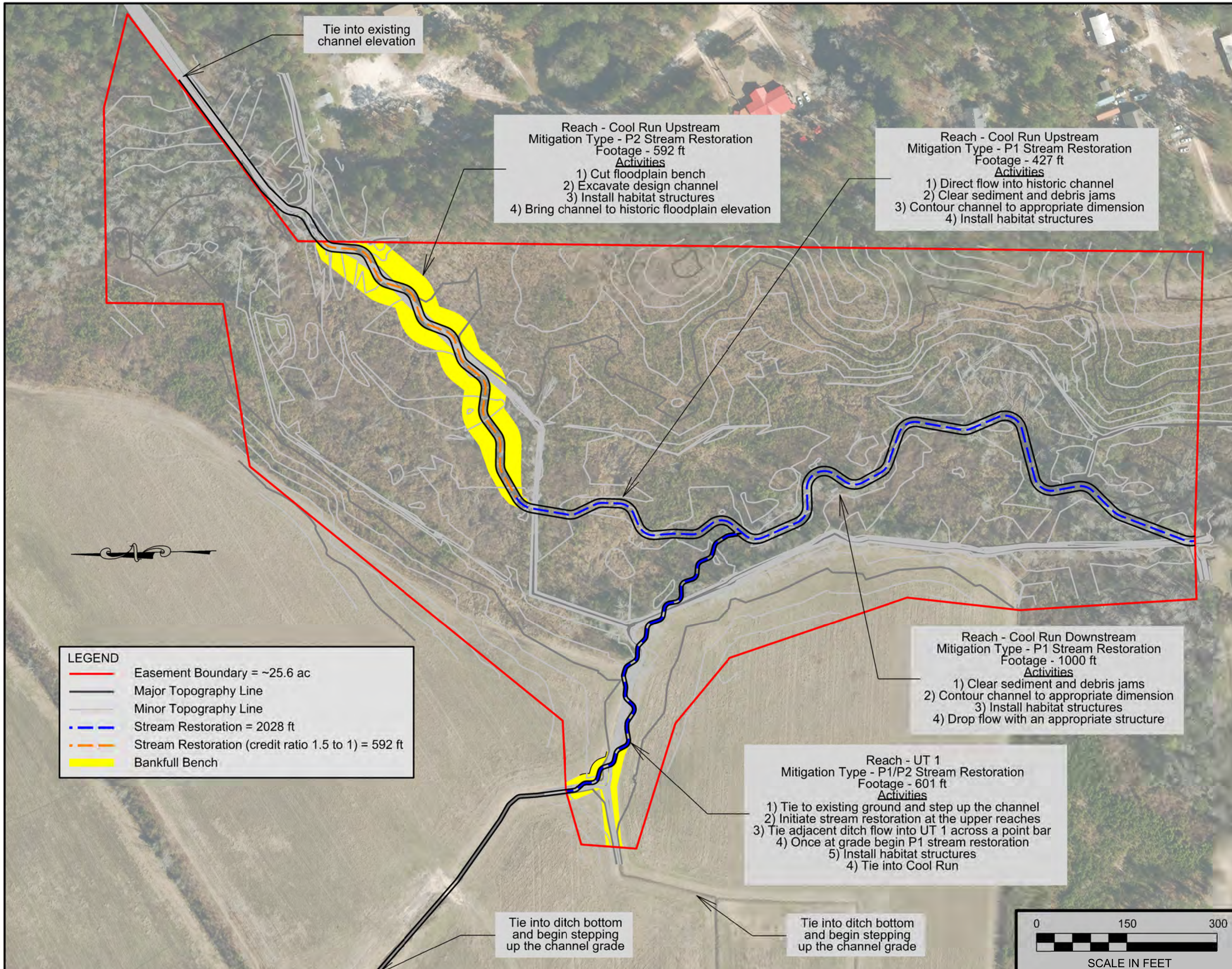
Project:

Cool Run Mitigation Site
Brunswick County
North Carolina

Title:

Cool Run Reference Reach Dimension, Pattern, and Profile

Scale: NA	FIGURE NO. 5
Date: Apr 2021	
Project No.: 21-008	



Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

Project:

Cool Run Mitigation Site
Brunswick County
North Carolina

Title:

Stream Restoration Details

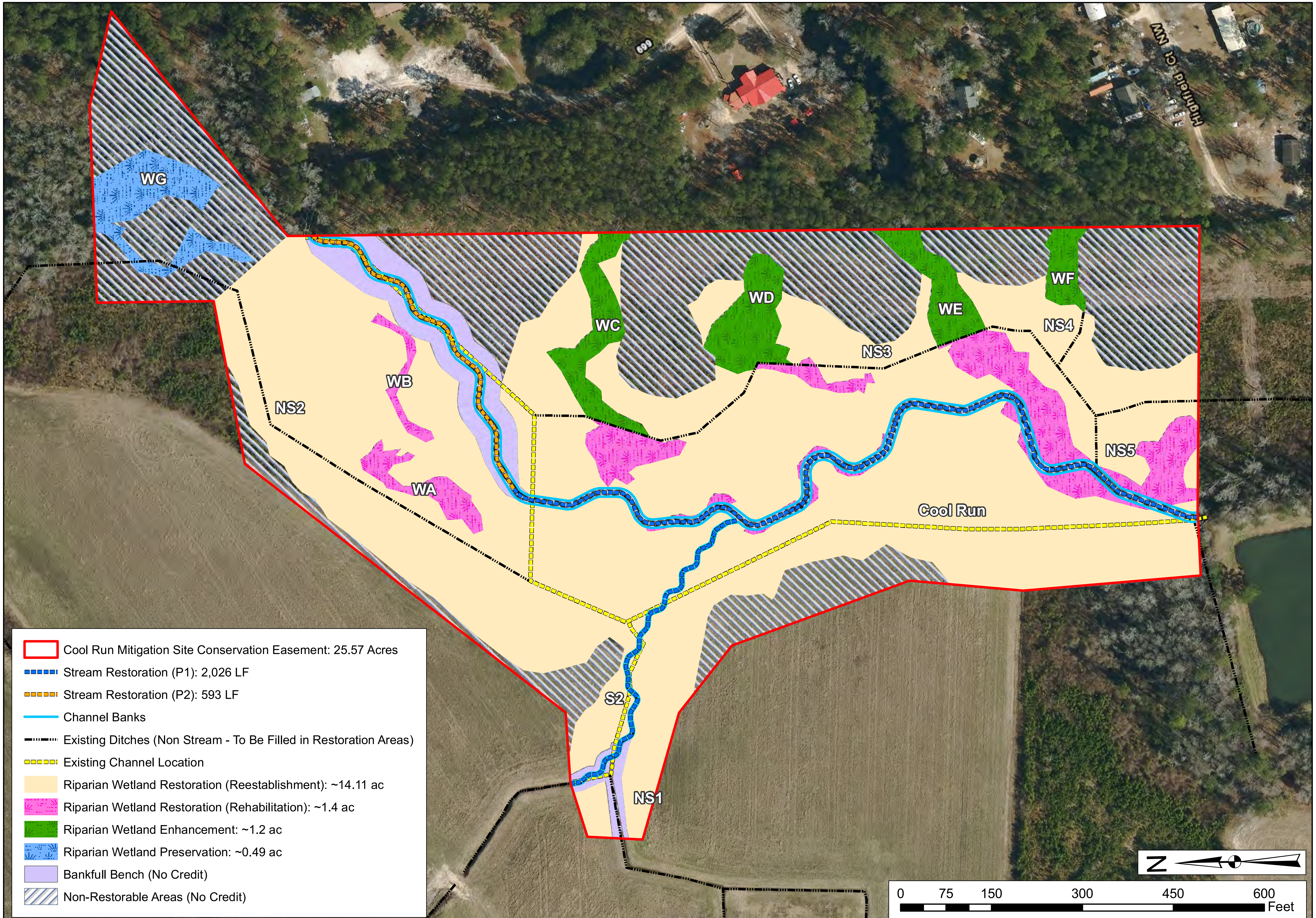
Scale: As Shown

Date: Apr 2021

Project No.: 21-008

FIGURE NO.

6A



DAVEY Resource Group
3805 Wrightsville Avenue
Wilmington, NC 28403
(910) 452-0001

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

Mitigation Layout

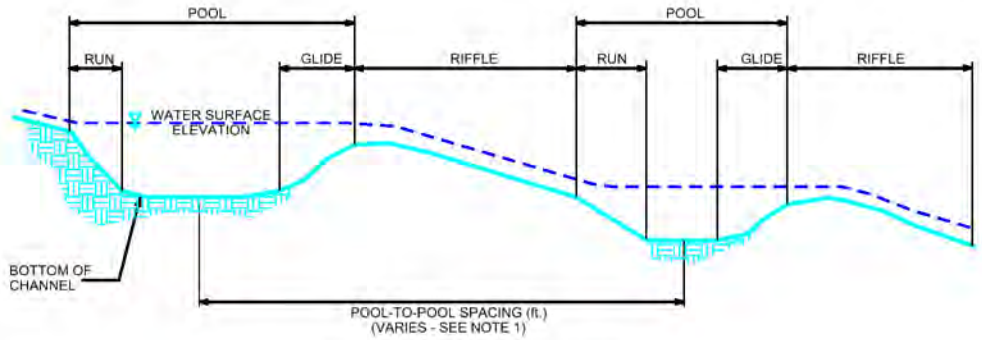
Drawn by: WAF/SH

Date: 8/15/2022

Scale: 1:1800

Project No.: DRGNCW20.248

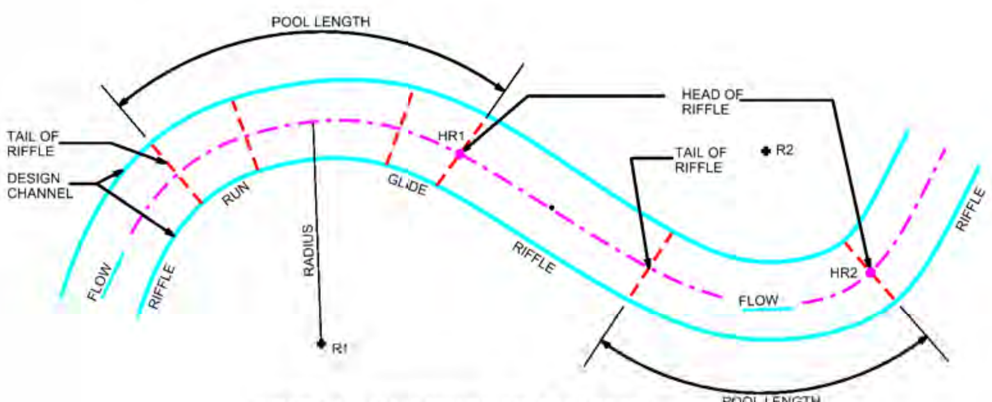
FIGURE **6B**



TYPICAL CHANNEL PROFILE

NOTES:

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

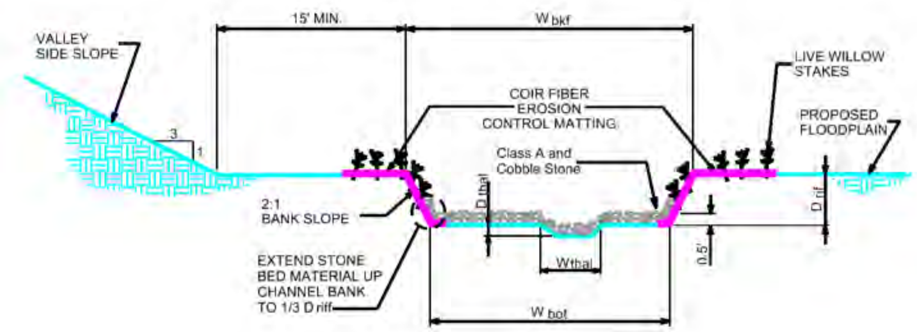


TYPICAL CHANNEL PLAN VIEW

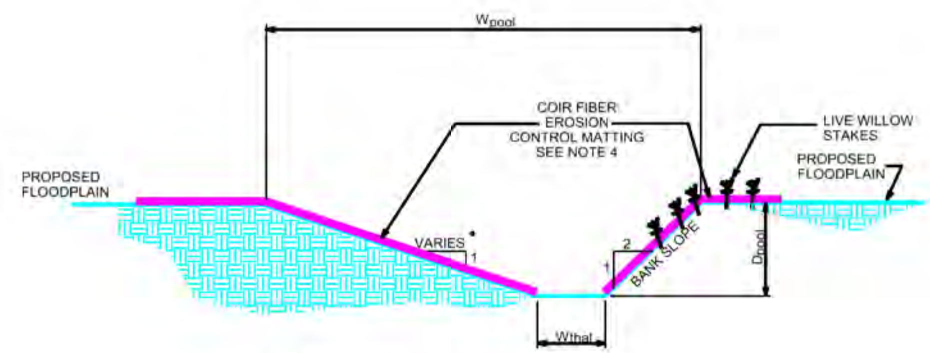
CHANNEL PLAN VIEW NOTES:

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BY LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS SHALL COMPLETE THE LAYOUT OF THE CHANNEL.

2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO SAVE TREES OR AVOID OBSTACLES. THE STAKE-OUT SHALL BE APPROVED BY THE CONSTRUCTION MANAGER BEFORE CONSTRUCTION OF THE CHANNEL.



TYPICAL RIFFLE CROSS-SECTION



* MAX. 1:1 SLOPE

TYPICAL POOL CROSS-SECTION

CHANNEL CONSTRUCTION NOTES:

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

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

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

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
Cool Run Upstream	14.1	10.1	0.9	0.1	1.3	18.4	1.0
Cool Run Downstream	15.0	11.0	0.9	0.1	1.3	19.5	1.0
UT 1	5.8	3.8	0.4	0.1	0.7	7.5	1.0

Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

Project:

Cool Run Mitigation Site
Brunswick County
North Carolina

Title:

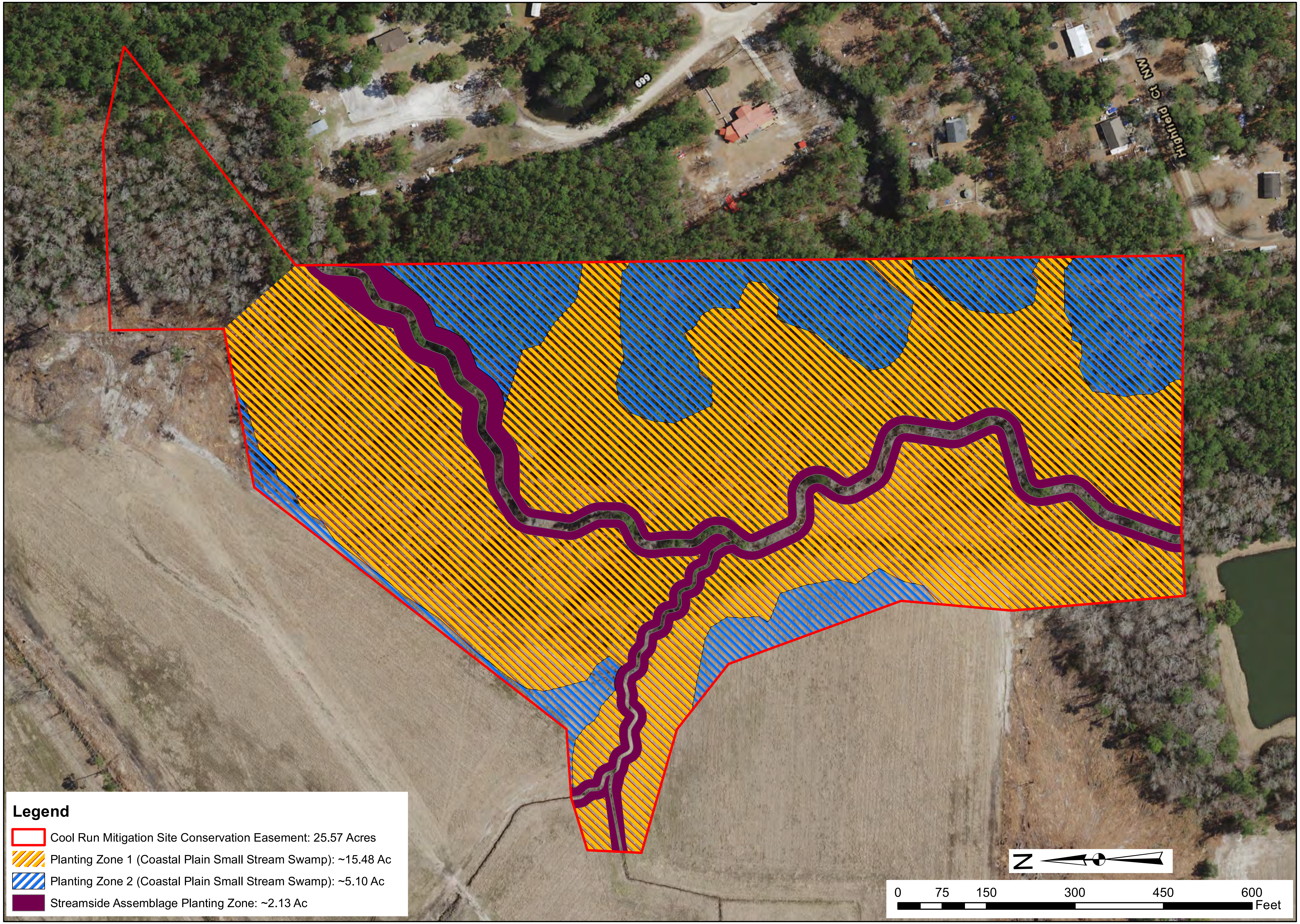
PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Apr 2021

Project No.: 21-008

FIGURE NO. 7



LMG
LAND MANAGEMENT GROUP
a DAVEY company

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

Planting Plan

Drawn by: WAF

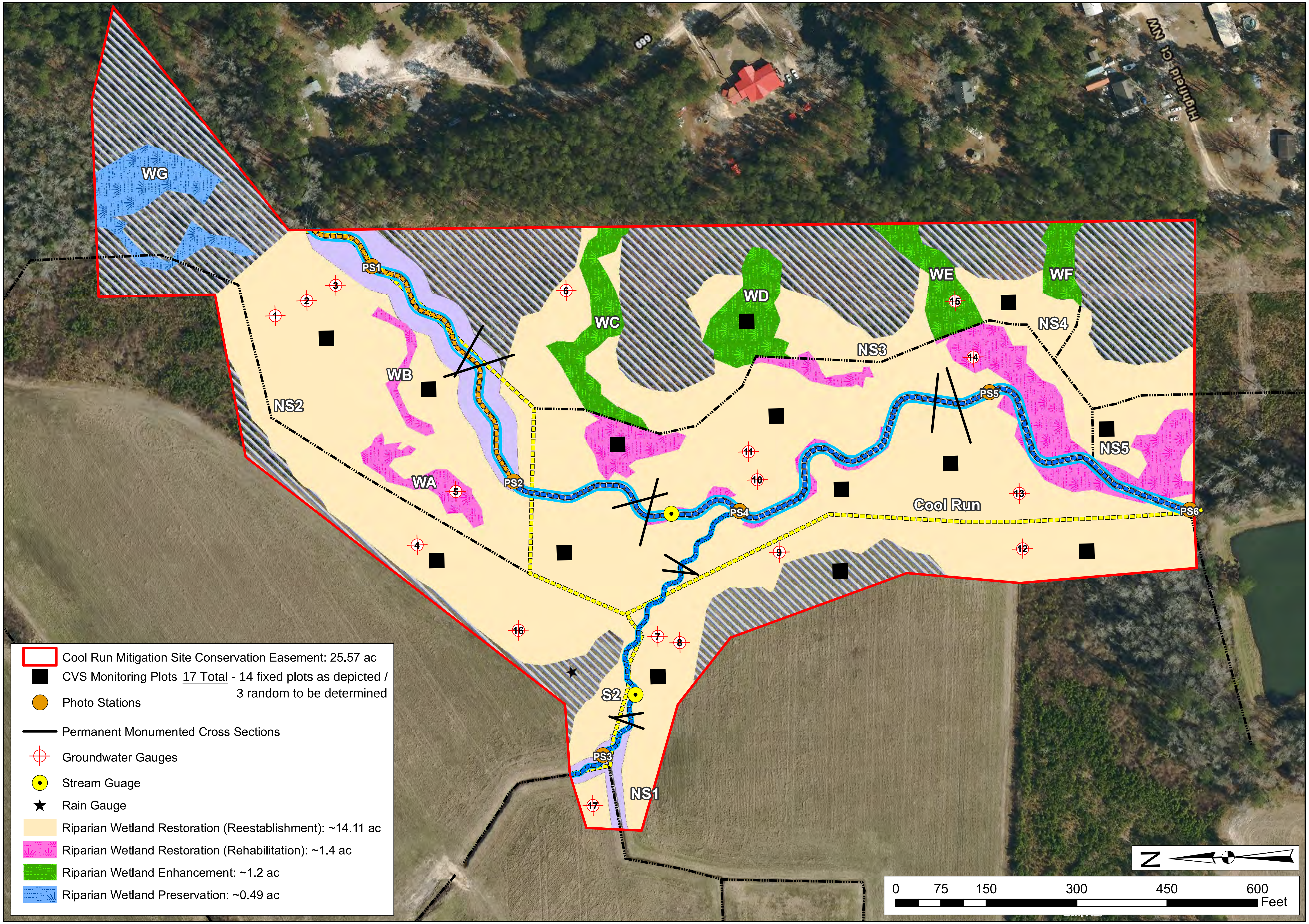
Date: 9/15/21

Scale: 1:1800

Project No.: LMG20.248

FIGURE

8



DAVEY Resource Group
3805 Wrightsville Avenue
Wilmington, NC 28403
(910) 452-0001

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

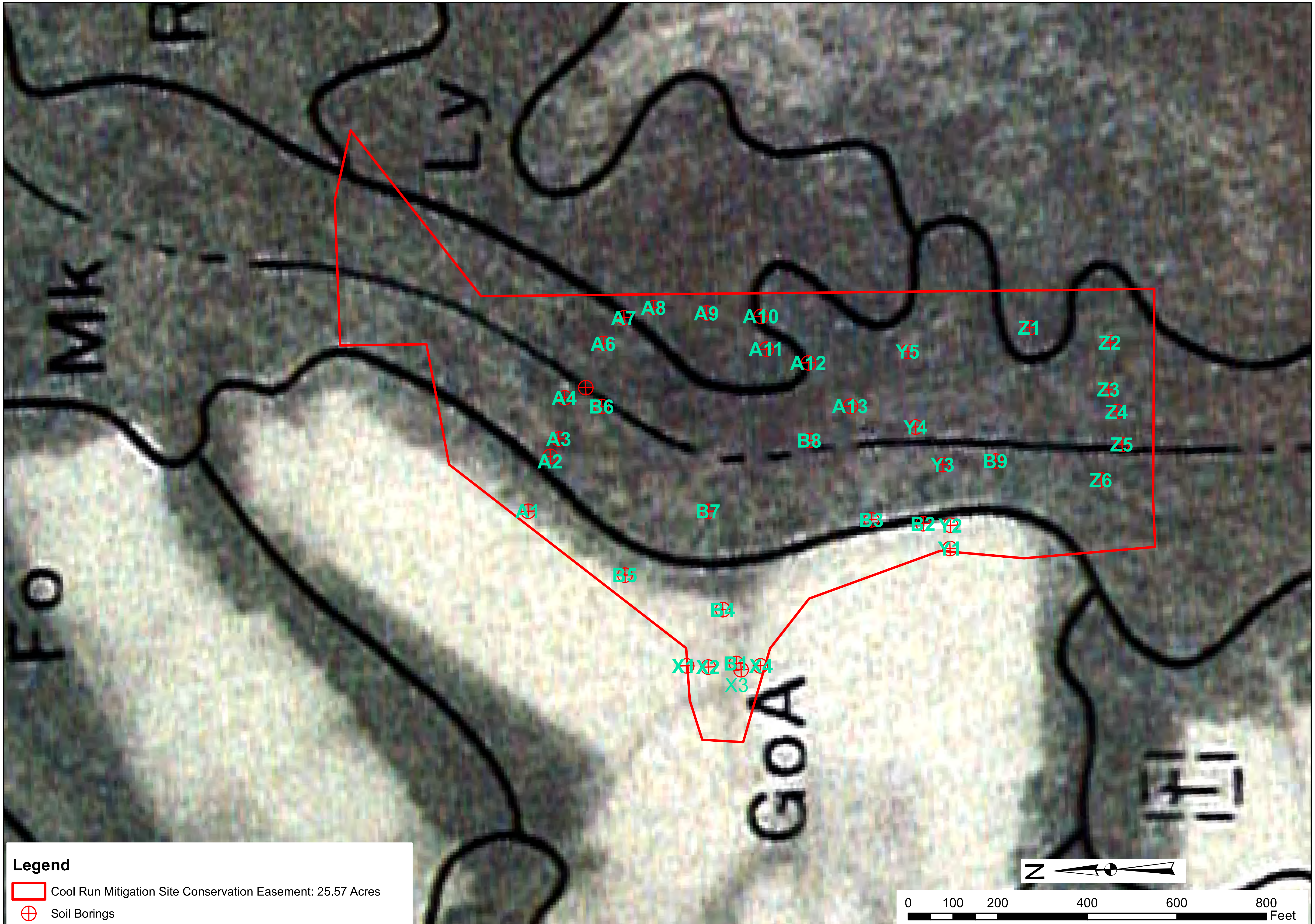
Brunswick County, NC

Title:

Monitoring Plan

Drawn by:	WAF/SH
Date:	8/15/2022
Scale:	1:1800
Project No.:	DRGNCW20.248

FIGURE
9



LMG
LAND MANAGEMENT GROUP
a DAVEY company

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

NRCS Soil Map

Drawn by: WAF

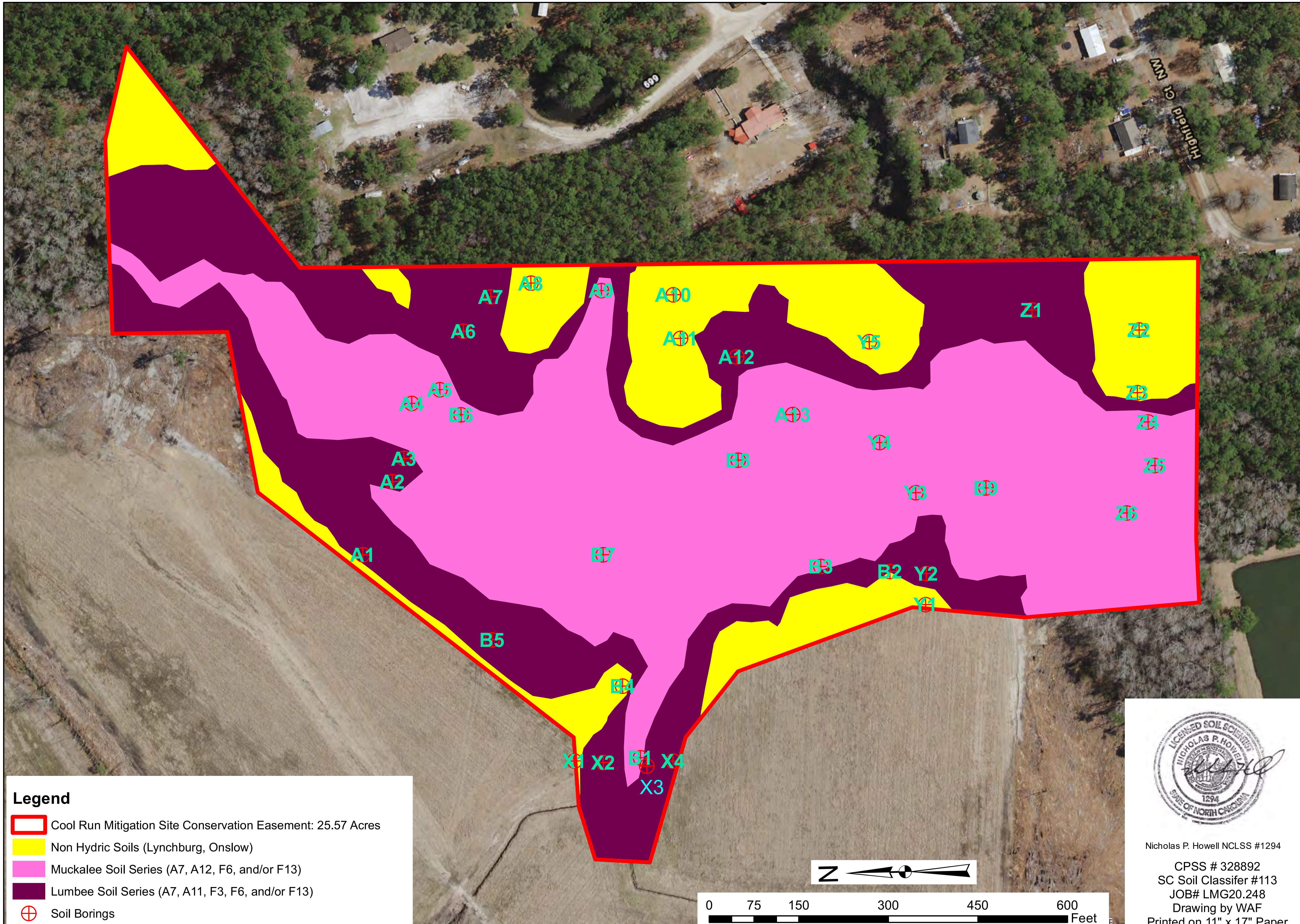
Date: 9/15/21

Scale: 1:1800

Project No.: LMG20.248

FIGURE

10A



LMG
LAND MANAGEMENT GROUP
a DAVEY company

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

Soil Series Map

Drawn by: WAF

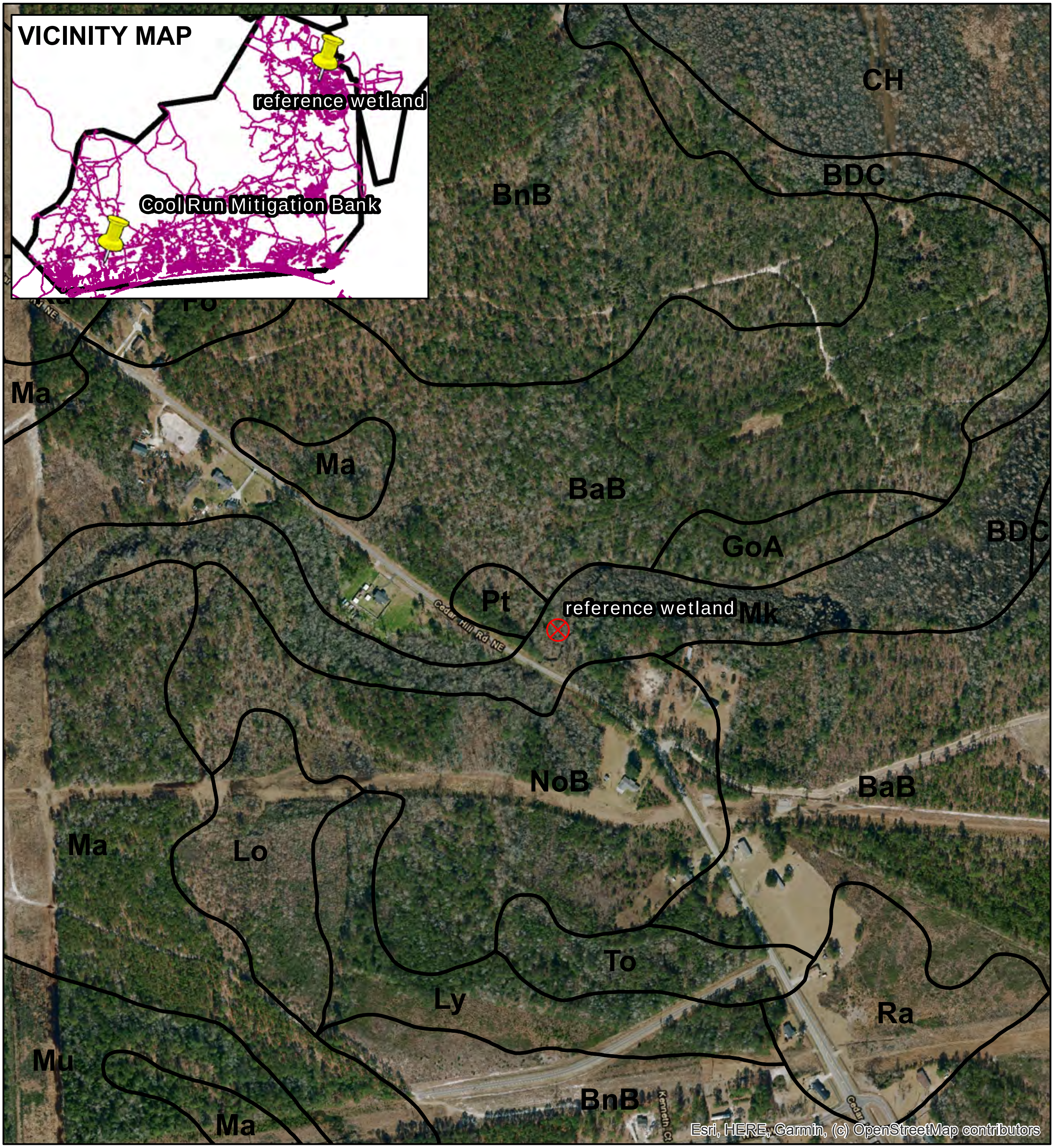
Date: 9/15/21

Scale: 1:1800

Project No.: LMG20.248

FIGURE

10B



Boundaries are approximate and not meant to be absolute.

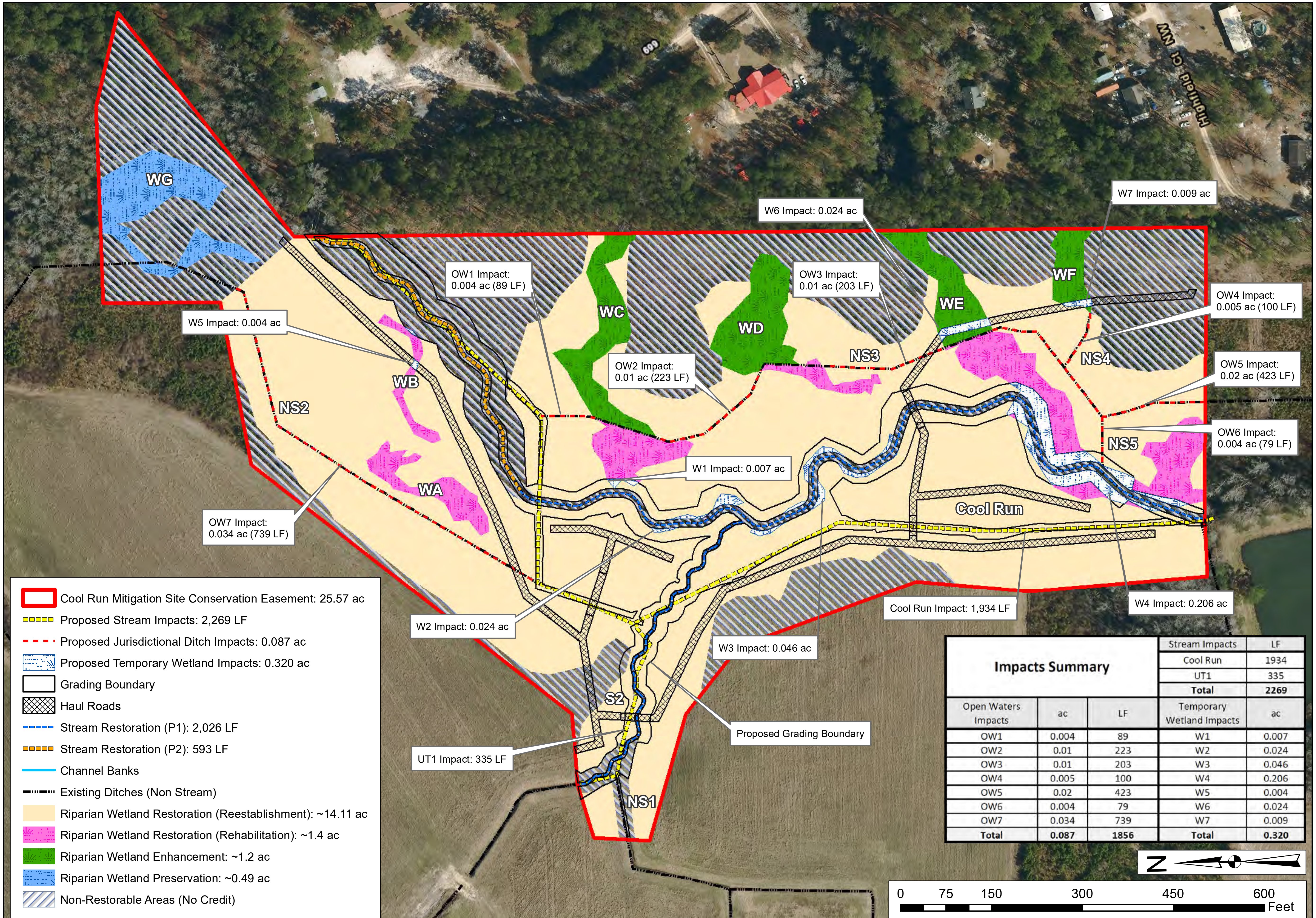
Map Source: 2020 Brunswick County Aerial Imagery

Cool Run Mitigation Site
Clearwater Mitigation Solutions
Brunswick County, NC
LMG20.248

CLEARWATER MITIGATION SOLUTIONS

LMG LAND MANAGEMENT GROUP a DAVEY company

Figure 11
Reference Wetland Location



Impacts Summary

Stream Impacts	LF
Cool Run	1934
UT1	335
Total	**2269**

Open Waters Impacts	ac	LF	Temporary Wetland Impacts	ac
OW1	0.004	89	W1	0.007
OW2	0.01	223	W2	0.024
OW3	0.01	203	W3	0.046
OW4	0.005	100	W4	0.206
OW5	0.02	423	W5	0.004
OW6	0.004	79	W6	0.024
OW7	0.034	739	W7	0.009
Total	**0.087**	**1856**	**Total**	**0.320**

DAVEY Resource Group
3805 Wrightsville Avenue
Wilmington, NC 28403
(910) 452-0001

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

Proposed Impact Map

Drawn by: WAF/SH

Date: 8/31/2022

Scale: 1:1800

Project No.: DRGNCW20.248

FIGURE 12

Appendix B
Existing Stream & Wetland Data

Table B1. Cool Run Morphological Stream Characteristics
Existing Stream Cross-section Data
NC SAM Forms
NC WAM Forms
NCDWQ Stream Forms
BEHI/NBS Data
Nutrient Model Output
Soil Boring Logs

Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

Project:

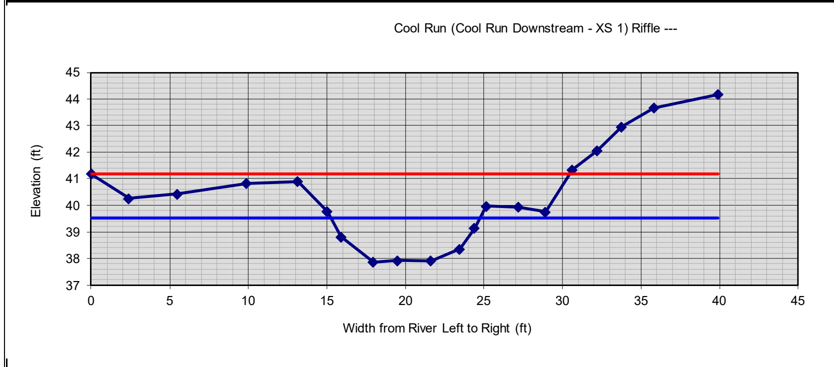
Cool Run Mitigation Site Brunswick County North Carolina

Title:

Existing Conditions Cross Sections

Scale: As Shown	FIGURE NO.
Date: Apr 2021	B1
Project No.: 21-008	

Cross Section



section: **Cool Run (Cool Run Downstream - XS 1)**

Riffle

---

description: **Cool Run (Cool Run Downstream - XS 1)**

height of instrument (ft): **200.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	▪	0	158.8195	41.18049
	▪	2.390699	159.7473	40.25269
	▪	5.498291	159.5695	40.43054
	▪	9.900473	159.1716	40.82836
	▪	13.14413	159.1086	40.89137
	▪	15.035	160.2371	39.76286
	▪	15.89612	161.1804	38.81959
	▪	17.96452	162.1404	37.85962
	▪	19.51122	162.0763	37.92373
	▪	21.62319	162.0891	37.9109
	▪	23.46575	161.6466	38.35337
	▪	24.40483	160.8635	39.1365
	▪	25.1436	160.0323	39.96775
	▪	27.1815	160.0667	39.93335
	▪	28.92036	160.2473	39.75272
	▪	30.62707	158.6552	41.34479
	▪	32.20206	157.9483	42.05167
	▪	33.77049	157.0471	42.95289
	▪	35.82971	156.3388	43.66117
	▪	39.90108	155.8235	44.17647
	▪			
	▪			
	▪			
	▪			
	▪			

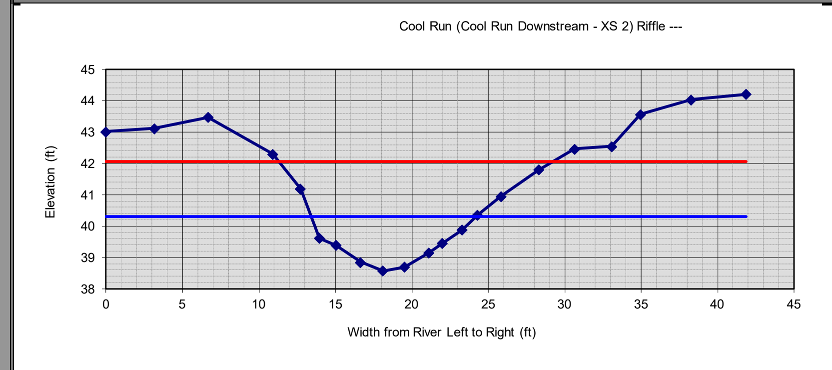
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
160.48	159.11	30.0		
39.52	40.89			

dimensions			
11.9	x-section area	1.3	d mean
9.5	width	10.5	wet P
1.7	d max	1.1	hyd radi
3.0	bank ht	7.6	w/d ratio
30.0	W flood prone area	3.2	ent ratio

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

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

Cross Section



section: **Cool Run (Cool Run Downstream - XS 2)**

Riffle

---

description: **Cool Run (Cool Run Downstream - XS 2)**

height of instrument (ft): **200.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	▪	0	156.9824	43.01757
	▪	3.170342	156.8789	43.12112
	▪	6.677576	156.5295	43.4705
	▪	10.90592	157.7021	42.29787
	▪	12.72009	158.8136	41.18636
	▪	13.9576	160.3803	39.6197
	▪	15.04989	160.6144	39.3856
	▪	16.66554	161.1548	38.84522
	▪	18.11821	161.4226	38.57743
	▪	19.52223	161.3069	38.69307
	▪	21.14225	160.8401	39.15995
	▪	22.00125	160.5529	39.44708
	▪	23.28713	160.1166	39.88344
	▪	24.30875	159.6404	40.35965
	▪	25.84551	159.0443	40.95574
	▪	28.30027	158.2013	41.79873
	▪	30.65248	157.5415	42.45852
	▪	33.08833	157.4588	42.54122
	▪	34.95869	156.4385	43.5615
	▪	38.28694	155.9601	44.03988
	▪	41.88507	155.7872	44.21278
	▪			
	▪			
	▪			
	▪			

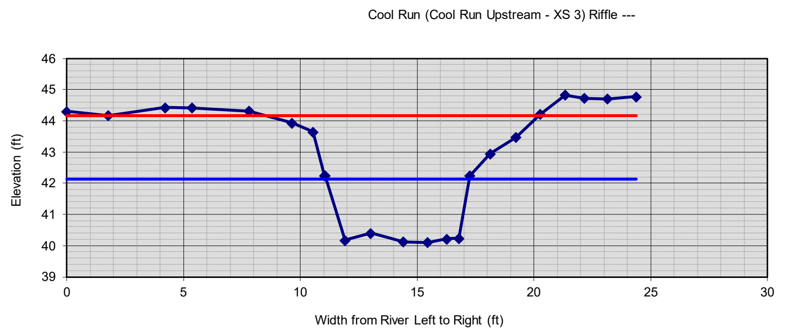
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
159.68	156.88	18.0		
40.32	43.12			

dimensions			
11.9	x-section area	1.1	d mean
10.8	width	11.6	wet P
1.7	d max	1.0	hyd radi
4.5	bank ht	9.8	w/d ratio
18.0	W flood prone area	1.7	ent ratio

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

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

Cross Section



section: Cool Run (Cool Run Upstream - XS 3)

Riffle

---

description: Cool Run (Cool Run Upstream - XS 3)

height of instrument (ft): 200.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	155.703	44.297
		1.79127	155.833	44.167
		4.214711	155.574	44.426
		5.37376	155.592	44.408
		7.815293	155.694	44.306
		9.648591	156.065	43.935
		10.55197	156.36	43.64
		11.03987	157.768	42.232
		11.06797	157.765	42.235
		11.92458	159.83	40.17
		13.02448	159.603	40.397
		14.42665	159.876	40.124
		15.4529	159.893	40.107
		16.26469	159.783	40.217
		16.79478	159.762	40.238
		17.26352	157.767	42.233
		18.12785	157.053	42.947
		19.22369	156.528	43.472
		20.28054	155.794	44.206
		21.34852	155.17	44.83
		22.16354	155.278	44.722
		23.16566	155.297	44.703
		24.39744	155.23	44.77

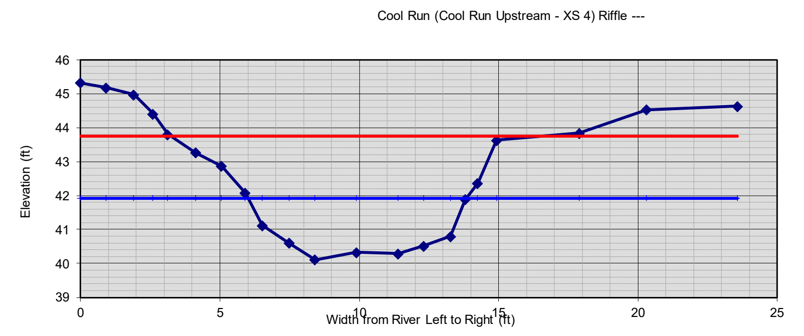
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
157.86	156.36	11.0		
42.14	43.64			

dimensions			
10.6	x-section area	1.7	d mean
6.1	width	9.0	wet P
2.0	d max	1.2	hyd radi
3.5	bank ht	3.5	w/d ratio
11.0	W flood prone area	1.8	ent ratio

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

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

Cross Section



section: Cool Run (Cool Run Upstream - XS 4)

Riffle

---

description: Cool Run (Cool Run Upstream - XS 4)

height of instrument (ft): 200.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	154.677	45.323
		0.906383	154.818	45.182
		1.910561	155.03	44.97
		2.601486	155.593	44.407
		3.131967	156.205	43.795
		4.134634	156.738	43.262
		5.060258	157.131	42.869
		5.910917	157.933	42.067
		6.519846	158.878	41.122
		7.491872	159.406	40.594
		8.41814	159.887	40.113
		9.897708	159.675	40.325
		11.40414	159.709	40.291
		12.31255	159.485	40.515
		13.27095	159.202	40.798
		13.80124	158.121	41.879
		14.25037	157.638	42.362
		14.93803	156.367	43.633
		17.90122	156.16	43.84
		20.30168	155.475	44.525
		23.56721	155.374	44.626

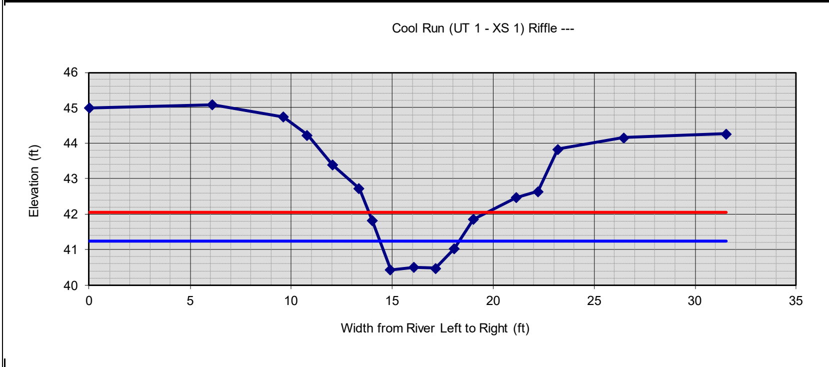
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
158.07	156.37	12.0		
41.93	43.63			

dimensions			
10.6	x-section area	1.4	d mean
7.8	width	9.3	wet P
1.8	d max	1.1	hyd radi
3.5	bank ht	5.8	w/d ratio
12.0	W flood prone area	1.5	ent ratio

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

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

Cross Section



section: Cool Run (UT 1 - XS 1)
Riffle

---
description: Cool Run (UT 1 - XS 1)
height of instrument (ft): 200.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	155.008	44.992
	☐	6.113338	154.913	45.087
	☐	9.616711	155.253	44.747
	☐	10.80394	155.77	44.23
	☐	12.05929	156.612	43.388
	☐	13.36162	157.278	42.722
	☐	14.01447	158.181	41.819
	☐	14.91929	159.564	40.436
	☐	16.09734	159.497	40.503
	☐	17.15818	159.52	40.48
	☐	18.07199	158.976	41.024
	☐	19.01556	158.142	41.858
	☐	21.14826	157.528	42.472
	☐	22.2167	157.363	42.637
	☐	23.20738	156.169	43.831
	☐	26.46584	155.842	44.158
	☐	31.56524	155.735	44.265
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

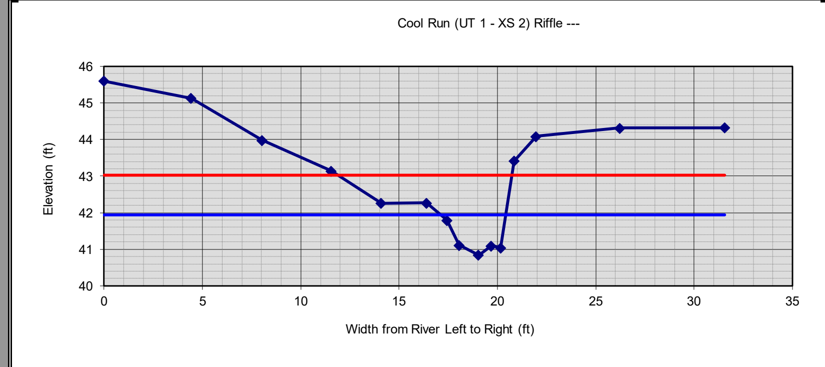
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
158.75	156.17	5.0		
41.25	43.83			

dimensions			
2.4	x-section area	0.6	d mean
3.9	width	4.6	wet P
0.8	d max	0.5	hyd radi
3.4	bank ht	6.4	w/d ratio
5.0	W flood prone area	1.3	ent ratio

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

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

Cross Section



section: Cool Run (UT 1 - XS 2)
Riffle

---
description: Cool Run (UT 1 - XS 2)
height of instrument (ft): 200.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	154.392	45.608
	☐	4.436273	154.872	45.128
	☐	8.026961	156.013	43.987
	☐	11.55001	156.859	43.141
	☐	14.09456	157.737	42.263
	☐	16.39696	157.734	42.266
	☐	17.42903	158.201	41.799
	☐	18.05163	158.884	41.116
	☐	19.03922	159.157	40.843
	☐	19.68792	158.909	41.091
	☐	20.16495	158.954	41.046
	☐	20.84719	156.587	43.413
	☐	21.97493	155.916	44.084
	☐	26.22647	155.683	44.317
	☐	31.5633	155.673	44.327
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			
	☐			

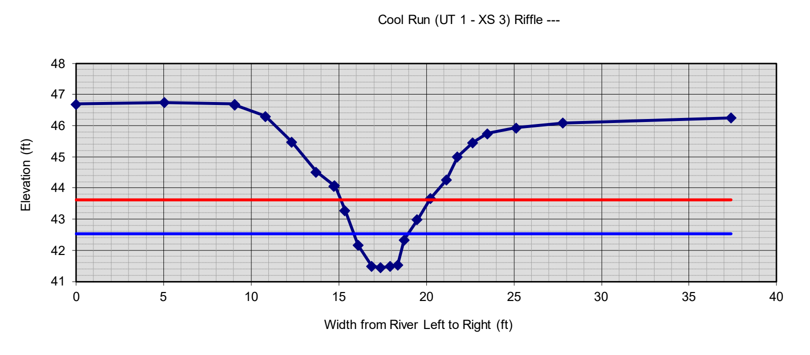
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
158.06	155.92	9.0		
41.94	44.08			

dimensions			
2.4	x-section area	0.7	d mean
3.3	width	4.4	wet P
1.1	d max	0.6	hyd radi
3.2	bank ht	4.5	w/d ratio
9.0	W flood prone area	2.7	ent ratio

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

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

Cross Section



section: **Cool Run (UT 1 - XS 3)**

Riffle

---

description: **Cool Run (UT 1 - XS 3)**

height of instrument (ft): **200.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	■	0	153.312	46.688
	■	5.041733	153.247	46.753
	■	9.057095	153.31	46.69
	■	9.083343	153.344	46.656
	■	10.81706	153.705	46.295
	■	12.31836	154.524	45.476
	■	13.71616	155.485	44.515
	■	14.74294	155.94	44.06
	■	14.78106	155.928	44.072
	■	15.35838	156.73	43.27
	■	16.10311	157.841	42.159
	■	16.8761	158.501	41.499
	■	17.38466	158.547	41.453
	■	17.92424	158.517	41.483
	■	18.36406	158.468	41.532
	■	18.74172	157.662	42.338
	■	19.48689	157.021	42.979
	■	20.23124	156.339	43.661
	■	21.13837	155.745	44.255
	■	21.78908	154.995	45.005
	■	22.65942	154.541	45.459
	■	23.49241	154.25	45.75
	■	25.14604	154.072	45.928
	■	27.80998	153.916	46.084
	■	37.3894	153.755	46.245

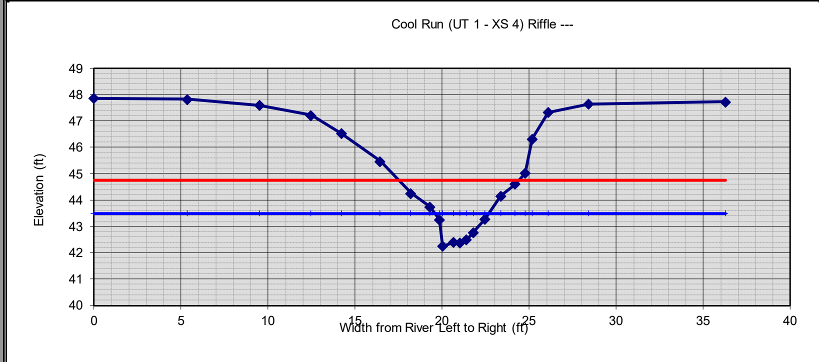
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
157.46	154.54	5.0		
42.54	45.46			

dimensions			
2.4	x-section area	0.8	d mean
3.1	width	4.2	wet P
1.1	d max	0.6	hyd radi
4.0	bank ht	4.0	w/d ratio
5.0	W flood prone area	1.6	ent ratio

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

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

Cross Section



section: **Cool Run (UT 1 - XS 4)**

Riffle

---

description: **Cool Run (UT 1 - XS 4)**

height of instrument (ft): **200.00**

notes	omit pt.	distance (ft)	FS (ft)	elevation
	■	0	152.141	47.859
	■	5.358142	152.18	47.82
	■	9.51815	152.412	47.588
	■	12.47371	152.788	47.212
	■	14.21296	153.483	46.517
	■	16.44217	154.53	45.47
	■	18.2107	155.748	44.252
	■	19.30395	156.263	43.737
	■	19.85441	156.746	43.254
	■	20.02833	157.747	42.253
	■	20.67106	157.603	42.397
	■	21.02458	157.613	42.387
	■	21.40415	157.514	42.486
	■	21.7925	157.224	42.776
	■	22.46641	156.731	43.269
	■	23.38237	155.846	44.154
	■	24.20772	155.4	44.6
	■	24.76289	154.986	45.014
	■	25.18463	153.678	46.322
	■	26.08881	152.676	47.324
	■	28.42199	152.359	47.641
	■	36.27012	152.281	47.719
	■			
	■			
	■			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
156.5	152.79	7.0		
43.5	47.21			

dimensions			
2.4	x-section area	0.8	d mean
3.1	width	4.4	wet P
1.2	d max	0.5	hyd radi
5.0	bank ht	4.1	w/d ratio
7.0	W flood prone area	2.2	ent ratio

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

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

NC SAM FIELD ASSESSMENT RESULTS

Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Frink SAM #1
2. Date of evaluation: 9/30/19
3. Applicant/owner name: Clearwater Mitigation Solutions
4. Assessor name/organization: Jernigan/Axiom
5. County: Brunswick
6. Nearest named water body on USGS 7.5-minute quad: Cool Run
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 33.969691, -78.472136

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM #1, Cool Run DS
10. Length of assessment reach evaluated (feet): 100
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 5 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 9-10
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 and 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:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Frink SAM #1	Date of Assessment	9/30/19
Stream Category	Oa3	Assessor Name/Organization	Jernigan/Axiom

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)	Perennial

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

NC SAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Frink SAM #2
2. Date of evaluation: 9/30/19
3. Applicant/owner name: Clearwater Mitigation Solutions
4. Assessor name/organization: Jernigan/Axiom
5. County: Brunswick
6. Nearest named water body on USGS 7.5-minute quad: Cool Run
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 33.970878, -78.473142

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM #2, UT-1
10. Length of assessment reach evaluated (feet): 200
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 5 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 12
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 LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☐A	☐A	≥ 100 feet wide or extends to the edge of the watershed
☐B	☐B	☐B	☐B	From 50 to < 100 feet wide
☐C	☐C	☐C	☐C	From 30 to < 50 feet wide
☐D	☐D	☐D	☐D	From 10 to < 30 feet wide
☐E	☐E	☒E	☒E	< 10 feet wide or no trees

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Frink SAM #2	Date of Assessment	9/30/19
Stream Category	Oa2	Assessor Name/Organization	Jernigan/Axiom

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

NC SAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Frink SAM #3
2. Date of evaluation: 9/30/19
3. Applicant/owner name: Clearwater Mitigation Solutions
4. Assessor name/organization: Lewis/Axiom
5. County: Brunswick
6. Nearest named water body on USGS 7.5-minute quad: Cool Run
7. River basin: Lumber
8. Site coordinates (decimal degrees, at lower end of assessment reach): 33.971934, -78.470697

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): SAM #3 Cool Run US
10. Length of assessment reach evaluated (feet): 200
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 4 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 15
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] <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 <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	Frink SAM #3	Date of Assessment	9/30/19
Stream Category	Oa3	Assessor Name/Organization	Lewis/Axiom

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)	Perennial

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

NC WAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Cool Run	Date of Evaluation	4/29/21
Applicant/Owner Name	Clearwater Mitigation Solutions	Wetland Site Name	WAM 1
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom
Level III Ecoregion	Middle Atlantic Coastal Plain	Nearest Named Water Body	Cool Run
River Basin	Lumber	USGS 8-Digit Catalogue Unit	03040207
County	Brunswick	NCDWR Region	Wilmington
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	33.969308, -78.471051

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)

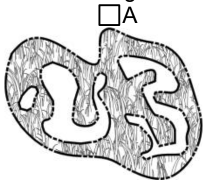
Include both natural debris and man-placed natural debris.

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

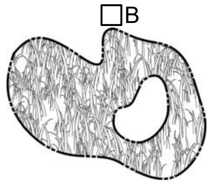
21. Vegetation/Open Water Dispersion – wetland type/open water condition metric (evaluate for Non-Tidal Freshwater Marsh only)

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.

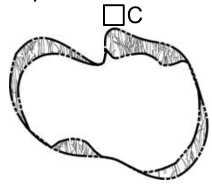
☐A



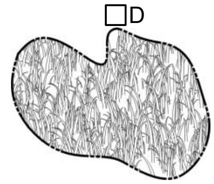
☐B



☐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

Site is in clearcut pine plantation. Cut ~5 years ago and repopulating with sweetgum and pine saplings. Standing water in skidder tracks.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WAM 1	Date of Assessment	4/29/21
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom

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	**HIGH**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence (Y/N)	**YES**
	Soluble Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**HIGH**
		Condition/Opportunity	**HIGH**
		Opportunity Presence (Y/N)	**YES**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**LOW**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

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

Overall Wetland Rating **HIGH**

NC WAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Cool Run	Date of Evaluation	4/29/21
Applicant/Owner Name	Clearwater Mitigation Solutions	Wetland Site Name	WAM 2
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom
Level III Ecoregion	Middle Atlantic Coastal Plain	Nearest Named Water Body	Cool Run
River Basin	Lumber	USGS 8-Digit Catalogue Unit	03040207
County	Brunswick	NCDWR Region	Wilmington
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	33.969436, -78.471638

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

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

Is the assessment area intensively managed? ☒ Yes ☐ No

Regulatory Considerations - Were regulatory considerations evaluated? ☐Yes ☒No If Yes, check all that apply to the assessment area.
☐ Anadromous fish
☐ Federally protected species or State endangered or threatened species
☐ NCDWR riparian buffer rule in effect
☐ Abuts a Primary Nursery Area (PNA)
☐ Publicly owned property
☐ N.C. Division of Coastal Management Area of Environmental Concern (AEC) (including buffer)
☐ Abuts a stream with a NCDWQ classification of SA or supplemental classifications of HQW, ORW, or Trout
☐ Designated NCNHP reference community
☐ Abuts a 303(d)-listed stream or a tributary to a 303(d)-listed stream

What type of natural stream is associated with the wetland, if any? (check all that apply)
☒ Blackwater
☐ Brownwater
☐ Tidal (if tidal, check one of the following boxes) ☐ Lunar ☐ Wind ☐ Both

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Discharge into Wetland – opportunity metric

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Answer for assessment area dominant landform.
☐A Evidence of short-duration inundation (< 7 consecutive days)
☒B Evidence of saturation, without evidence of inundation
☐C Evidence of long-duration inundation or very long-duration inundation (7 to 30 consecutive days or more)

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

Consider recent deposition only (no plant growth since deposition).
☒A Sediment deposition is not excessive, but at approximately natural levels.
☐B Sediment deposition is excessive, but not overwhelming the wetland.
☐C Sediment deposition is excessive and is overwhelming the wetland.

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

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

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

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

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

13. **Connectivity to Other Natural Areas – landscape condition metric**

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

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

13b. **Evaluate for marshes only**.
☐Yes ☐No Wetland type has a surface hydrology connection to open waters/stream or tidal wetlands.

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

May involve a GIS effort with field adjustment. Estimate distance from wetland type boundary to artificial edges. Artificial edges include non-forested areas ≥ 40 feet wide such as fields, development, roads, regularly maintained utility line corridors, and clear-cuts. Consider the eight main points of the compass. Artificial edge occurs within 150 feet in how many directions? If the assessment area is clear cut, select option "C."
☐A 0
☒B 1 to 4
☐C 5 to 8

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

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

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

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

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

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

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

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

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

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

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

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

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

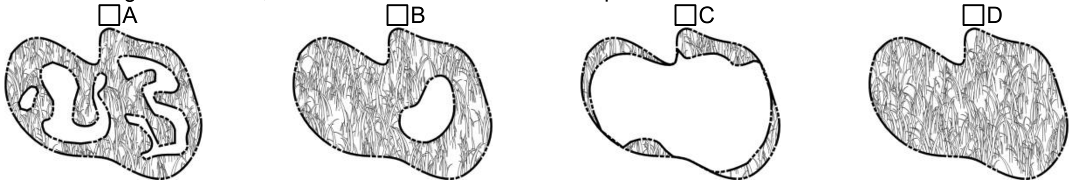
20. Large Woody Debris – wetland type condition metric (skip for all marshes)

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

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

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

☐A ☐B ☐C ☐D



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

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

Notes
Site is not a jurisdictional wetland. Hydric soils were found, but hydrology has been removed by ditching the nearby stream. It is a clear cut pine plantation that was cut ~5 years ago and is repopulating with early successional saplings.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WAM 2	Date of Assessment	4/29/21
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom

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	**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**

NC WAM FIELD ASSESSMENT RESULTS
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Cool Run	Date of Evaluation	4/29/21
Applicant/Owner Name	Clearwater Mitigation Solutions	Wetland Site Name	WAM 3
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom
Level III Ecoregion	Middle Atlantic Coastal Plain	Nearest Named Water Body	Cool Run
River Basin	Lumber	USGS 8-Digit Catalogue Unit	03040207
County	Brunswick	NCDWR Region	Wilmington
☐ Yes ☒ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	33.971623, -78.471913

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)

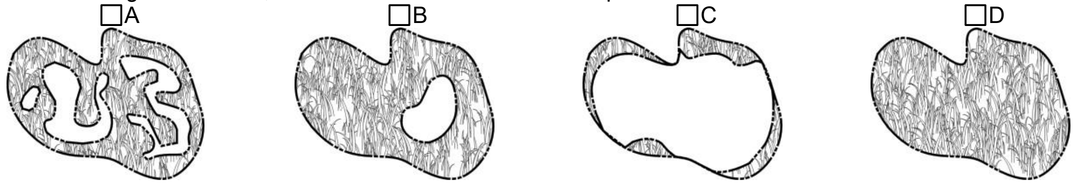
Include both natural debris and man-placed natural debris.

☐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 and overland flow are not severely altered in the assessment area.
☒B Overbank flow is severely altered in the assessment area.
☐C Overland flow is severely altered in the assessment area.
☐D Both overbank and overland flow are severely altered in the assessment area.

Notes

Site is in a clear cut pine plantation. It was cut ~5 years ago and is repopulating with early successional saplings. A nearby ditched stream is negatively affecting hydrology.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WAM 3	Date of Assessment	4/29/21
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Jernigan/Axiom

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	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Soluble Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		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	**MEDIUM**
	Condition/Opportunity	**MEDIUM**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

Form #1

UT-1

NC DWQ Stream Identification Form Version 4.11

Date:	9/30/19	**Project/Site:**	Frink UT-1	**Latitude:**	33.971606
Evaluator:	Jernigan / Axiom	**County:**	Brunswick	**Longitude:**	-78.473951
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30**	27.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial		**Other** *e.g. Quad Name:*	Shallote

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 8.5)				
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: No Benthics Collected

Sketch:

Site	Cool Run Mitigation Site							
Stream	Cool Run				**Bank Length**		4032	
Observers	WGL				**Date**		30-Sep-19	
	Station	**Bank**	**BEHI**	**NBS**	**Erosion Rate**	**Length**	**Bank Height**	**Erosion**
1	159	right	Low	Low	0	159	4.5	0.0
2	262	right	High	Mod	0.15	103	4.5	69.5
3	617	right	Low	Low	0	355	3.5	0.0
4	691	right	Low	Low	0	74	4	0.0
5	935	right	Low	Low	0	244	3.5	0.0
6	977	right	High	Mod	0.15	42	3.5	22.1
7	1205	right	Mod	Low	0.02	228	3.5	16.0
8	1503	right	Low	Low	0	298	4	0.0
9	2123	right	Low	Low	0	620	4.5	0.0
10								
11	399	left	Low	Low	0	399	4.5	0.0
12	437	left	High	Mod	0.15	38	4	22.8
13	886	left	Low	Low	0	449	3.5	0.0
14	1188	left	Low	Low	0	302	4	0.0
15	1289	left	Mod	Mod	0.05	101	4	20.2
16	1909	left	Low	Low	0	620	4.5	0.0
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		150.5
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		5.6
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		7.2
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.002

Site	Cool Run Mitigation Site							
Stream	UT 1				Bank Length		3210	
Observers	WGL				Date		30-Sep-19	
	Station	Bank	BEHI	NBS	Erosion Rate	Length	Bank Height	Erosion
1	175	right	Low	Low	0	175	3	0.0
2	405	right	Mod	Mod	0.05	230	5	57.5
3	470	right	High	Mod	0.15	65	5	48.8
4	545	right	Mod	Mod	0.05	75	5	18.8
5	580	right	High	Mod	0.15	35	5	26.3
6	955	right	Mod	Mod	0.05	375	5	93.8
7	1605	right	Low	Low	0	650	5	0.0
8								
9	175	left	Low	Low	0	175	3	0.0
10	405	left	Mod	Mod	0.05	230	5	57.5
11	470	left	High	Mod	0.15	65	5	48.8
12	545	left	Mod	Mod	0.05	75	5	18.8
13	580	left	High	Mod	0.15	35	5	26.3
14	955	left	Mod	Mod	0.05	375	5	93.8
15	1605	left	Low	Low	0	650	5	0.0
16								
17								
18								
19								
20								
Sum erosion sub-totals for each BEHI/NBS						Total Erosion (ft3/yr)		490.0
Divide total erosion (ft3) by 27						Total Erosion (yd/yr)		18.1
Multiply Total erosion (yard3) by 1.3						Total Erosion (tons/yr)		23.6
Erosion per unit length						Total Erosion (Tons/yr/ft)		0.007

BEHI/NBS Summary

Stream Reach	Erosion Rate (tons/year)
Cool Run	7.2
UT 1	23.6
Total	**30.8**

Land Use Nutrient Model

Stream Length	
Site Buffer Width	
Site Area (Acres)	**25.57**
Site Area (ft sq)	1113829.2

Land Use	%
Pasture	
Woods	88
Row Crop	12
Urban	
must total 100	100

Rainfall	
Annual	

Land Use Characteristics

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

		% Row Crop Area	N inputs lbs/ac/yr	P inputs lbs/ac/yr	Total N	Total P	
Row Crop (Acers)	Corn		20	20	0	0	
3.1	Cotton	50	20	20	31	31	
	Soybeans	50	0	15	0	23	
	Hay Fescue		50	45	0	0	
	Hay Bermuda		70	45	0	0	
	must total 100	100			31	54	Total Row Crop N and P

Woods Minimal Nutrients

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

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

Total Nutrients Removed within Easement

Total N Removed (lbs/yr)	**31**
Total P Removed (lbs/yr)	**54**

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-1		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	42"	**SHWT:**	<6"	**Slope:**	2-3%	**Landscape:**	drainageway (filled/ditched)
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):		F13					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill	0-10	10YR 3/3		SL	gr	fr, ns, np	Colluvium from past farming
Ab	10-28	10YR 2/1		SL	gr	fr, ss, np	High O.M. not Mucky
Cg1	28-44	10YR 4/1	10YR 3/6	SCL/LS	MA	fr, ss, sp	25% Distinct Concentrations
							Thin CoLS strata
Cg2	44-54+	2.5Y 5/2	2.5Y 5/6	CoLS/SL	MA	vfr, ns, np	10% distinct concentrations
			2.5Y 6/1				15% distinct depleations
							Thin SL strata

Comments:	Described By:	Nick Howell - LSS #1294

adjacent to agricultural ditch, fill from past farming activities. Interbedded strata in deeper sediment indicative of higher order stream sediment.

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lynchburg	**Data Point:**	SB-2

Soil Classification: Fine-loamy, siliceous, semiactive, thermic Aeric Paleaquults

OWT:	>36"	**SHWT:**	21"	**Slope:**	2-3%	**Landscape:**	stream terrace
Elevation:	~45 MSL		**Drainage:**	Somewhat poorly		**Permeability:**	Moderate

Vegetation: Corn stalks, panic grass, edge of field

Hydric Soil Indicator(s): None

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill	0-5	10YR 4/3		LS	gr	vfr, ns, np	Colluvium from past farming
A	5-12	10YR 5/2	10YR 6/1	LS	gr	vfr, ns, np	20% distinct depleations
Bw	12-16	10YR 4/4		LS	gr	vfr, ns, np	
E	16-21	10YR 6/4		LS	gr	vfr, ns, np	
Bt	21-36	10YR 6/4	10YR 5/8	SL/SCL	sbk	fr, ss, np	20% prominent concentration
			10YR 6/2				20% distinct depleations

Comments:	Described By:	Nick Howell - LSS #1294

edge of field above drainage ditch and stream floodplain/valley

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-1		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	45"	**SHWT:**	<6"	**Slope:**	2-3%	**Landscape:**	drainageway (filled/ditched)
Elevation:	~43 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):		S7					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill	0-9	10YR 3/3		SL	gr	fr, ns, np	Colluvium from past farming
Ab	9-18	10YR 2/1		LS	gr	fr, ss, np	High O.M. not Mucky
Cg1	18-28	10YR 4/2	10YR 5/6	LS/SL	MA	fr, ss, sp	20% prominent concentration
			2.5Y 6/2				10% distinct depleations
							Thin SL strata
Cg2	28-54+	2.5Y 4/2	2.5Y 5/2	LS/SCL	MA	vfr, ns, np	15% Faint depleations
			2.5Y 3/1				10% distinct om concentration
							Thin SCL Strata

Comments:	Described By:	Nick Howell - LSS #1294
adjacent to agricultural ditch, fill from past farming activities. Interbedded strata in deeper sediment indicative of higher order stream sediment.		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lynchburg	**Data Point:**	SB-4

Soil Classification: Fine-loamy, siliceous, semiactive, thermic Aeric Paleaquults

OWT:	>36"	**SHWT:**	20"	**Slope:**	2-3%	**Landscape:**	stream terrace
Elevation:	~45 MSL		**Drainage:**	Somewhat poorly		**Permeability:**	Moderate

Vegetation: Corn stalks, panic grass, edge of field

Hydric Soil Indicator(s): None

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-11	10YR 3/3		LS	gr	vfr, ns, np	
E	11-20	10YR 6/4		LS	gr	vfr, ns, np	
Bt	20-36	10YR 5/6	10YR 6/4	SCL/LS	sbk	fr, ss, np	20% distinct depleations
			10YR 5/8				5% faint concentrations
			10YR 6/2				15% prominent depleations
							LS strata on ped faces

Comments:	Described By:	Nick Howell - LSS #1294

edge of field above topo break into old stream floodplain

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lu : Lumbee			**Data Point:**	SB-5		
Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults							
OWT:	34"	**SHWT:**	<12"	**Slope:**	2-3%	**Landscape:**	toe slope
Elevation:	~48 MSL		**Drainage:**	poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):		F3					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-6	2.5Y 3/1		SL	gr	vfr, ns, np	
Btg1	6-26	2.5Y 5/2	10YR 5/6	SCL	sbk	fr, ss, sp	25% prominent concentration
			7.5YR 5/8				5% prominent concentrations
Btg2	26-42+	2.5Y 6/2	5Y 6/2	SCL/LS	sbk	fr, ss, sp	10% distinct depleations
			2.5Y 5/6	Thin LS strata			25% distinct concentrations
			10YR 5/6				10% prominent concentration

Comments:	Described By:	Nick Howell - LSS #1294
Footslope above floodplain, quick transition into flood plain soils		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-6		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	40"	**SHWT:**	<6"	**Slope:**	1-2%	**Landscape:**	flood plain
Elevation:	~43 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A7, F13, F3					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-8	10YR 3/1		MuL	gr	fr, ss, np	
Cg1	8-23	10YR 4/2	10YR 3/6	SL	MA	fr, ns, np	20% distinct concentrations
Cg2	23-42+	2.5Y 5/2	2.5Y 5/6	LS/SCL	MA	fr, ns, np	20% distinct concentrations
			2.5Y 6/1				10% distinct depleations
							Interbedded layers LS/SCL

Comments:

Stressed drainage due to proximity to drainage dtich.

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Muckalee	**Data Point:**	SB-7

Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents

OWT:	17"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	flood plain
Elevation:	~43 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate to slow

Vegetation: Dog fennel, loblolly pine, muscidine, bushy bluesteam, blackberry, beauty berry, panic grass

Hydric Soil Indicator(s): A2, A9, F13, A12

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-10	10YR 3/1		Muck	MA	fr, ss, np	
Cg	10-13	2.5Y 5/2		SL	sbk	fr, ns, np	
Oab	13-17	10YR 3/2		Muck	MA	fr, ss, np	
Ab	17-28	10YR 3/1		MuSL	sbk	fr, ss, np	
C'g	28-42+	2.5Y 4/2		SCL	Co sbk	fr, ms, sp	

Comments:	Described By:	Nick Howell - LSS #1294
upper floodplain topography, stressed FAC vegetation present		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-8		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	18"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	flood plain
Elevation:	~42 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate to slow
Vegetation:	Dog fennel, loblolly pine, muscidine, bushy bluesteam, blackberry, beauty berry, panic grass						
Hydric Soil Indicator(s):		A2, A9, F13, A12					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-12	10YR 3/1		Muck	MA	Fr, ss, np	
A	12-33	10YR 4/2		MuSL	SBK	fr, ss, np	
Cg	33-42+	2.5Y 4/2	10YR 5/6	SCL	VCoSBK	fr, ms, sp	10% prominent concentration

Comments:	Described By:	Nick Howell - LSS #1294
upper floodplain topography, stressed FAC vegetation present	LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA	

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Muckalee	**Data Point:**	SB-9

Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents

OWT:	8"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	flood plain
Elevation:	~42 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: gallberry, muscidine, loblolly pine, sweetgum, beauty berry, dog fennel, black berry, panic grass

Hydric Soil Indicator(s): A2, A9, F13, A12

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-13	10YR 3/1		Muck	MA	fr, ss, np	
A	13-28	2.5Y 4/1		MuSL	SBK	fr, ss, np	
Cg	28-42+	2.5Y 5/2	2.5Y 6/1	SCL/LS	MA	fr, ss, np	15% faint depleations
			2.5Y 4/1	Interbedded SCL/LS sediment			15% distinct om concentration

Comments:	Described By:	Nick Howell - LSS #1294
upper floodplain topography, stressed FAC vegetation present		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lu: Lumbee	**Data Point:**	SB-A1

Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults

OWT:	36"	**SHWT:**	<15"	**Slope:**	2-3%	**Landscape:**	concave, linear
Elevation:	~45 MSL		**Drainage:**	poorly drained		**Permeability:**	Moderate

Vegetation: Dog fennel, loblolly pine, muscidine, bushy bluesteam, blackberry, beauty berry, panic grass

Hydric Soil Indicator(s): S7, A7

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-5	10YR 3/1		LS	gr	vfr, ns, np	High O.M. not Mucky, 75% coated
AE	5-8	10YR 4/2		S	gr	vfr, ns, np	High O.M. not Mucky
Bw	8-15	10YR 3/2		LS	sbk	vfr, ns, np	
Ebg	15-30	10YR 6/2	10YR 5/6	sl	sbk	vfr, ns, np	
Btg	30-48+	10YR 6/2	10YR 5/6	SCL	sbk	fr, ss, sp	20% distinct concentrations

Comments:	Described By:	Nick Howell - LSS #1294
w0, Ra soil		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lu: Lumbee			**Data Point:**	SB-A2		
Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults							
OWT:	24"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	depression, concave
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Dog fennel, loblolly pine, muscidine, bushy bluesteam, blackberry, beauty berry, panic grass						
Hydric Soil Indicator(s):		A7, F13, F3					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-9	10YR 2/1		Mu SCL	sbk	fr, ss, np	
EB	9-16	2.5Y 5/2	10YR 5/8	SCL	sbk	fr, ss, sp	20% concentrations
Btg/E	16-23	2.5Y 6/2	10YR 5/8	SCL/SL	sbk	fr, ss, sp	15% concentrations
			10YR 5/4				20% depletions
Btg2/E	23-36+	2.5Y 6/2	10YR 3/2	SCL/LS	sbk	fr, ss, sp	5% concentrations
			2.5Y 6/1				25% depletions

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-A3		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	30"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	depression, concave
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A12, F13					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-7	10YR 3/1		Mu	gr	vfr, ss, np	dry
A	7-12	10YR 3/6		Mu LS	gr	vfr, ss, np	tanic staining
Btg	12-24	10YR 5/2		SL	sbk	fr, ns, np	
Btg2	24-36	10YR 5/2	10YR 3/6	SCL	sbk	fr, ss, sp	15% concentrations

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Muckalee	**Data Point:**	SB-A4

Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents

OWT:	~12"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	old stream channel, concave
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s): A12, F13

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A1	0-6	10YR 3/1		Mu SL	gr	fr, ss, np	
A2	6-15	10YR 3/1		Mu SL	gr	fr, ss, np	
Btg	15-24	10YR 4/2	10YR 5/3	SCL	sbk	fr, ss, np	LS pockets strata

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-A5		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	12"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	drained floodplain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A11, F13					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-7	N 2/0		Mu	gr	fr, ss, np	
AB	7-15	10YR 3/3		Mu SL	gr	fr, ss, np	tanic staining
Btg1	15-28	10YR 4/2		SL	sbk	fr, ns, np	
Btg2/Cg	28-36	2.5Y 5/2	10YR 6/1	SCL/LS	sbk	fr, ss, np	25% depletions
Cg	36-42+	10YR 6/1		LS	lo	fr, ns, np	

Comments:	Described By:	Nick Howell - LSS #1294

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lu: Lumbee	**Data Point:**	SB-A6

Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents

OWT:	>42"	**SHWT:**	6"	**Slope:**	0-1%	**Landscape:**	linear
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s):

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-6	10YR 3/1	10YR 3/6	SL	gr	fr, ns, np	15% concentrations
Btg1	6-21	2.5Y 5/2	10YR 5/8	SCL	sbk	fr, ss, sp	25% concentrations
Btg2	21-42	2.5Y 6/2	10YR 3/8	SCL	sbk	fr, ss, sp	15% concentrations
			10YR 5/6				20% concentrations

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lu: Lumbee	**Data Point:**	SB-A7

Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults

OWT:	> 30"	**SHWT:**	5"	**Slope:**	1-2%	**Landscape:**	topographic low
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s): F3

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-5	10YR 3/1		SL	gr	fr, ns, np	
Btg1	5-16	10YR 6/2	10YR 5/6	SCL	sbk	fr, ss, np	20% concentrations
			10YR 5/8				15% concentrations
Btg2	16-30	10YR 3/3	10YR 5/6	SCL	sbk	fr, ss, sp	25% concentrations
			10YR 5/8				10% concentrations

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	Date:	8/7/2019
County:	Brunswick	Job#:	LMG19.196
Location:	Grissittown	State:	NC
Soil Series:	Lynchburg	Data Point:	SB-A8

Soil Classification: Fine-loamy, siliceous, semiactive, thermic Aeric Paleaquults

OWT:	> 24"	SHWT:	15"	Slope:	1-2%	Landscape:	hillslope
Elevation:	~45 MSL	Drainage:	somewhat poorly drained	Permeability:	Moderate		

Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel
Hydric Soil Indicator(s):	

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-4	10YR 3/1		SL	gr	fr, ns, np	
EB	4-15	10YR 5/4		SL	sbk	fr, ns, np	
Bt	15-24+	10YR 5/4	10YR 6/2	SCL	sbk	fr, ss, np	
			10YR 5/8				

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site		**Date:**	8/7/2019			
County:	Brunswick		**Job#:**	LMG19.196			
Location:	Grissittown		**State:**	NC			
Soil Series:	Muckalee		**Data Point:**	SB-A9			
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	> 21"	**SHWT:**	8"	**Slope:**	0-1%	**Landscape:**	low drain way
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A13, F3					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-8	10YR 2/1		SCL	gr	fr, ss, sp	
Btg1	8-21	2.5Y 5/2	10YR 5/6	SCL	sbk	fr, ss, sp	10% concentrations
Btg2	21-30+	5Y 6/1	10YR 5/6	SCL	sbk	fr, ss, sp	25% concentrations

Comments:	Described By:	Nick Howell - LSS #1294
	LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA	

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site		**Date:**	8/7/2019			
County:	Brunswick		**Job#:**	LMG19.196			
Location:	Grissittown		**State:**	NC			
Soil Series:	Onslow		**Data Point:**	SB-A10			
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Spodic Paleudults							
OWT:	> 30"	**SHWT:**	>30"	**Slope:**	2-3%	**Landscape:**	onslow hilltop, convex, convex
Elevation:	~45 MSL		**Drainage:**	somewhat poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):							

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-6	10YR 5/1		S	gr	vfr, ns, np	
E	6-11	10YR 6/1		S	gr	vfr, ns, np	
Bw	11-13	10YR 3/4		LS	gr	vfr, ns, np	
E'	13-18	10YR 5/3	2.5Y 5/6	S	gr	vfr, ns, np	25% concentrations
2Bt	18-30	7.5YR 5/4	10YR 6/3	CL	sbk	fi, ns, np	20% depletions

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Onslow	**Data Point:**	SB-A11

Soil Classification: Fine-loamy, siliceous, semiactive, thermic Spodic Paleudults

OWT:	28"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	concave floodplain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s):

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-6	10YR 3/1		S	gr	vfr, ns, np	90% coated
Eg	6-9	10YR 5/1		S	gr	vfr, ns, np	
Bw	9-13	10YR 3/2	10YR 6/2	LS	gr	vfr, ns, np	20% depletions
E'g	13-19	10YR 6/2	10YR 5/3	LS	gr	vfr, ns, np	25% depletions
B'tg	19-34+	2.5Y 5/2	10YR 5/6	SCL	sbk	fr, ss, sp	20% concentrations
			10YR 5/8				10% concentrations

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lumbee			**Data Point:**	SB-A12		
Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults							
OWT:	12"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	concave drain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A7					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-10	N 2/0		Mu SCL	ma	fr, ss, sp	
EB	10-19	2.5Y 4/2		SL	sbk	fr, ss, np	
Btg	19-26+	2.5Y 5/2		SCL	sbk	fr, ss, sp	

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-A13		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	28"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	floodplain, concave
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		F6, A7					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-9	N 2/0		Mu	gr	fr, ss, np	
A	9-20	10YR 2/1	10YR 3/6	Mu L	sbk	fr, ss, np	10% concentrations
Cg	20-42+	2.5Y 4/2	10YR 3/6	SCL	sbk	fr, ss, sp	5% concentrations
			2.5Y 6/2				20% depletions

Comments:

Described By: Nick Howell - LSS #1294

LMG LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lynchburg			**Data Point:**	SB-x1		
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Aeric Paleaquults							
OWT:	>34"	**SHWT:**	20"	**Slope:**	0-1%	**Landscape:**	linear
Elevation:	~45 MSL		**Drainage:**	poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):							
Horizon	**Depth (in)**	**Matrix**	**Mottles**	**Texture**	**Structure**	**Consistence**	**Notes**
A	0-7	10YR 3/1		LS	gr	vfr, ns, np	
E	7-13	10YR 3/4		LS	gr	vfr, ns, np	
Bt1	13-20	10YR 5/6		SCL	sbk	fr, ss, sp	
Bt2	20-34+	10YR 5/4	10YR 5/8	SCL	sbk	fr, ss, sp	25% concentrations
			7.5YR 5/8				25% concentrations
			10YR 6/2				15% depletions
Comments:				Described By:		Nick Howell - LSS #1294	

LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lumbee	**Data Point:**	SB-x2

Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults

OWT:	>48"	**SHWT:**	11"	**Slope:**	0-1%	**Landscape:**	linear
Elevation:	~>45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Corn stalks, panic grass, edge of field

Hydric Soil Indicator(s): F6, F3

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
fill	0-11						mixed sandy & loamy fill
A	11-18	10YR 2/1	10YR 3/6	SL	sbk/gr	fr, ns, np	15% concentrations
Bg1	18-37	10YR 6/2	10YR 3/6	SL	sbk	fr, ns, np	15% concentrations
			10YR 3/1				15% concentrations
Btg2	37-48+	10YR 4/2	10YR 5/6	SCL	sbk	fr, ss, sp	25% concentrations
			10YR 5/8				15% depletions

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG LAND MANAGEMENT GROUP a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lumbee			**Data Point:**	SB-x3		
Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults							
OWT:	39"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	linear, filled zero order stream
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):		A7, F13					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
fill	0-13						mixed sandy & loamy fill
A1	13-31	N 2/0		Mu SL	gr	fr, ss, np	
A2	31-37	10YR 2/1	10YR 3/6	SL	gr	fr, ss, np	35% weak concentrations
Btg	37-43	10YR 4/1		SCL	sbk	fr ,ss, np	
B/C	43-48+	10YR 4/2	10YR 6/1	SL/LS	sbk	fr, ns, np	25% depletions

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lumbee	**Data Point:**	SB-x4

Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults

OWT:	>48"	**SHWT:**	<6"	**Slope:**	1-2%	**Landscape:**	filled zero order stream
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Corn stalks, panic grass, edge of field

Hydric Soil Indicator(s): A11

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
fill	0-11						mixed sandy & loamy fill
A	11-15	10YR 2/1		SL	gr	fr, ns, np	
Btg1	15-29	10YR 4/2	10YR 5/6	SCL	sbk	fr, ss, np	25% concentrations
Btg2	29-40	2.5Y 6/1	10YR 5/4	SCL / SL	sbk	fr ,ss, np	20% concentrations
			10YR 5/6				10% concentrations
B/C	40-48+	2.5Y 6/1	2.5Y 5/6	SL / LS	sbk	vfr, ns, np	20% concentrations

Comments:

Described By: Nick Howell - LSS #1294

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lynchburg			**Data Point:**	SB-y1		
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Aeric Paleaquults							
OWT:	> 30"	**SHWT:**	>30"	**Slope:**	1-2%	**Landscape:**	footslope/toeslope
Elevation:	~45 MSL		**Drainage:**	somewhat poorly drained		**Permeability:**	Moderate
Vegetation:	Corn stalks, panic grass, edge of field						
Hydric Soil Indicator(s):							

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-7	10YR 3/3		LS	gr	vrf, ns, np	
AE	7-12	10YR 4/4		LS	gr	vfr, ns, np	
Bt	12-30+	7.5YR 4/6	10YR 5/6	CL	sbk	fi, ns, np	15% concentrations
			10YR 6/4				10% concentrations

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Lumbee	**Data Point:**	SB-y2

Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults

OWT:	> 50"	**SHWT:**	26"	**Slope:**	1-2%	**Landscape:**	toeslope
Elevation:	~45 MSL		**Drainage:**	poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s): S5

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
fill	0-20						sandy fill
A	20-26	10YR 3/1		LS	gr	vfr, ns, np	uncoated, drained
ABg	26-30	10YR 3/3	10YR 3/6	LS	gr	vfr, ns, np	15% concentrations
Btg1	30-39	10YR 5/2	10YR 5/8	SCL	sbk	fr, ss, sp	25% concentrations
			10YR 3/4				35% depletions
Btg2	39-50+	10YR 6/2	10YR 5/8	SCL	sbk	fr, ss, sp	25% concentrations
			10YR 6/4				35% depletions

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-y3		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	36"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	floodplain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		A7, F6					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa1	0-8	N 2/0		Mu	gr	fr, ss, np	
Oa2	8-23	10YR 2/1		Mu	ma	fr, ss, np	
A	23-33	10YR 3/1	10YR 3/6	Mu L	sbk	fr, ss, sp	10% concentrations
Btg	33-42+	2.5Y 3/2		SCL	sbk	fr, ss, sp	

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site		**Date:**	8/7/2019			
County:	Brunswick		**Job#:**	LMG19.196			
Location:	Grissittown		**State:**	NC			
Soil Series:	Muckalee		**Data Point:**	SB-y4			
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	30"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	floodplain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		F6, A7					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-11	N 2/0		Mu	gr	fr, ss, np	
A	11-26	10YR 2/1	10YR 3/6	Mu L	sbk	fr, ss, np	10% concentrations
Btg	26-42+	2.5Y 4/2	10YR 3/6	SCL	sbk	fr, ss, sp	5% concentrations
			2.5Y 6/2				20% depletions

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Onslow			**Data Point:**	SB-y5		
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Spodic Paleudults							
OWT:	>36"	**SHWT:**	11"	**Slope:**	1-2%	**Landscape:**	side slope
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):							
Horizon	**Depth (in)**	**Matrix**	**Mottles**	**Texture**	**Structure**	**Consistence**	**Notes**
A	0-5	10YR 5/1		S	gr	vfr, ns, np	
E	5-8	10YR 5/1		S	gr	vfr, ns, np	
Bw	8-11	10YR 3/3		LS	gr	vfr, ns, np	
E'	11-21	10YR 5/3	10YR 3/4	LS	gr	vfr, ns, np	25% concentrations
			10YR 5/1				10% depletions
Btg	21-36+	10YR 4/2		SL	sbk	vfr, ns, np	
Comments:				Described By:		Nick Howell - LSS #1294	

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Lumbee			**Data Point:**	SB-z1		
Soil Classification: Fine-loamy over sandy or sandy-skeletal, siliceous, subactive, thermic Typic Endoaquults							
OWT:	>30"	**SHWT:**	<6"	**Slope:**	0-1%	**Landscape:**	footslope
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		F3					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-5	10YR 4/2	10YR 3/6	SL	sbk	fr, ss, np	10% concentrations
Btg1	5-13	10YR 5/2	10YR 5/6	CL	sbk	fi, ns, np	25% concentrations
Btg2	13-30	5Y 6/2	10YR 5/6	CL	sbk	fi, vs, vp	25% concentrations

Comments:

Described By: Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Onslow			**Data Point:**	SB-z2		
Soil Classification: Fine-loamy, siliceous, semiactive, thermic Spodic Paleudults							
OWT:	>34"	**SHWT:**	>34"	**Slope:**	1-2%	**Landscape:**	hillslope
Elevation:	~45 MSL		**Drainage:**	somewhat poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):							

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-4	10YR 5/1		S	gr	vfr, ns, np	
Bw	4-8	10YR 3/3		LS	gr	vfr, ns, np	
E	8-19	10YR 6/3	10YR 3/6	S	gr	vfr, ns, np	15% concentrations
			10YR 6/2				10% depletions
Bt	19-34+	10YR 5/6		SCL	sbk	fr, ss, sp	

Comments:	Described By:	Nick Howell - LSS #1294

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Onslow	**Data Point:**	SB-z3

Soil Classification: Fine-loamy, siliceous, semiactive, thermic Spodic Paleudults

OWT:	>36"	**SHWT:**	22"	**Slope:**	1-2%	**Landscape:**	hilltop
Elevation:	~45 MSL		**Drainage:**	somewhat poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s):

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-7	10YR5/2		S	gr	vfr, ns, np	
E	7-12	10YR 5/1		S	gr	vfr, ns, np	
Bw	12-22	10YR 3/2		LS	gr	vfr, ns, np	
Eg	22-27	10YR 6/2	2.5Y 5/6	LS	sbk	fr, ns, np	20% concentrations
Btg	27-36+	2.5Y 5/2	10YR 5/6	SCL	sbk	fr, ss, sp	30% concentrations

Comments:

Described By: Nick Howell - LSS #1294

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site			**Date:**	8/7/2019		
County:	Brunswick			**Job#:**	LMG19.196		
Location:	Grissittown			**State:**	NC		
Soil Series:	Muckalee			**Data Point:**	SB-z4		
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	>36"	**SHWT:**	<6"	**Slope:**	1-2%	**Landscape:**	footslope
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):		S7					

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-6	10YR 3/1		LS	gr	vfr, ns, np	90% coated grains
Eg	6-9	2.5Y 4/2		LS	gr	vfr, ns, np	
Bh	9-21	10YR 3/1		LS	sbk	vfr, ns, np	
Bg	21-34	2.5Y 4/2		LS	sbk	fr, ns, np	
Btg	34-42+	2.5Y 5/2	2.5Y 6/2	SCL/ LS	sbk	fr, ns, np	20% depletions

Comments:	Described By:	Nick Howell - LSS #1294
drained		

LICENSED SOIL SCIENTIST
NICHOLAS P. HOWELL
1294
STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site		**Date:**	8/7/2019			
County:	Brunswick		**Job#:**	LMG19.196			
Location:	Grissittown		**State:**	NC			
Soil Series:	Muckalee		**Data Point:**	SB-z5			
Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents							
OWT:	24"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	toe slope
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate
Vegetation:	Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel						
Hydric Soil Indicator(s):	F6, F13						

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-15	2.5Y 3/1	10YR 3/6	Mu SL	sbk	fr, ss, np	25% concentrations
Cg	15-36	10YR 5/2	10YR 3/1	LS	ma	fr, ns, np	interbedded depletions
			10YR 4/2				interbedded depletions

Comments:	Described By: Nick Howell - LSS #1294
drained	LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA

LMG
LAND MANAGEMENT GROUP
a DAVEY company

Project Site:	Cool Run Stream Site	**Date:**	8/7/2019
County:	Brunswick	**Job#:**	LMG19.196
Location:	Grissittown	**State:**	NC
Soil Series:	Mu: Muckalee	**Data Point:**	SB-z6

Soil Classification: Coarse-loamy, siliceous, superactive, nonacid, thermic Typic Fluvaquents

OWT:	18"	**SHWT:**	<6"	**Slope:**	0%	**Landscape:**	floodplain
Elevation:	~45 MSL		**Drainage:**	Very poorly drained		**Permeability:**	Moderate

Vegetation: Sweetgum, Loblolly Pine, Blackberry, Panic grass, Dogfennel

Hydric Soil Indicator(s): f13

Horizon	Depth (in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Oa	0-8	N 2/0		Mu	gr	fr, ss, np	
A	8-21	10YR 2/1		Mu LS	sbk	fr, ss, np	
Cg	21-27+	2.5Y 3/1	2.5Y 6/2	LS	ma	vfr, ns, np	Stratified Layers

Comments:	Described By: Nick Howell - LSS #1294
drained	LICENSED SOIL SCIENTIST NICHOLAS P. HOWELL 1294 STATE OF NORTH CAROLINA

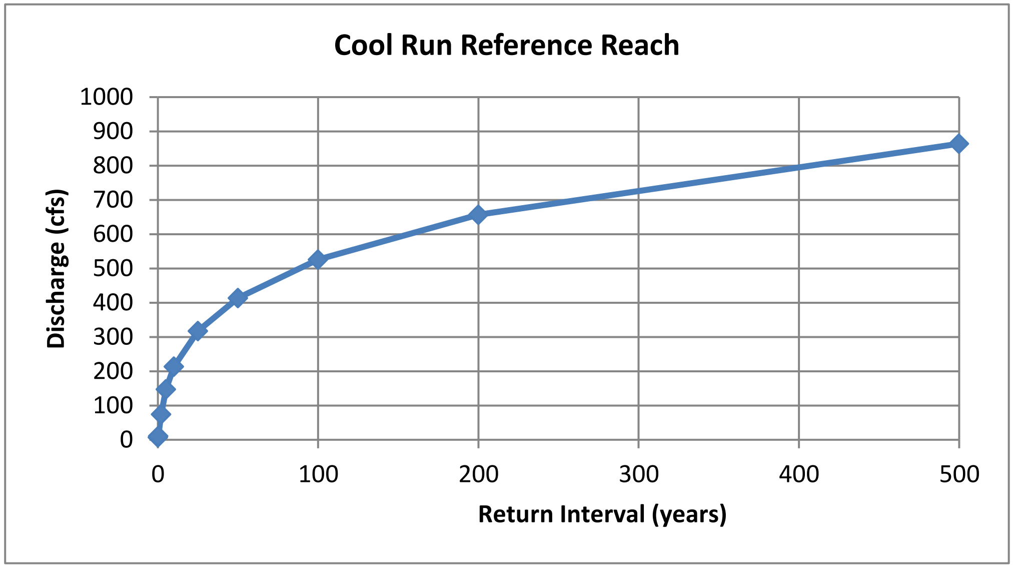
Appendix C

Flood Frequency Analysis Data

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

McRae Land Reference Reach

Return Interval (years)	Discharge (cfs)
0.1	**7**
0.3	**11**
2	74.4
5	147
10	214
25	318
50	414
100	526
200	657
500	864



Note: Bold values are interpolated.

Appendix D

Jurisdictional Determination Info

U.S. ARMY CORPS OF ENGINEERS
WILMINGTON DISTRICT

Action Id. **SAW-2020-1799** County: **Brunswick** U.S.G.S. Quad: **NC-Shallotte**

NOTIFICATION OF JURISDICTIONAL DETERMINATION

Requestor:	**Clearwater Mitigation Solutions** **Kevin Yates**
Address:	**604 Macon Place** **Raleigh, NC 27609**
Telephone Number:	**919-624-6901**
E-mail:	**clearwatermitigation@gmail.com**

Size (acres)	**~25.15**	Nearest Town	**Shallotte**
Nearest Waterway	**Shallotte River**	River Basin	**Lower Pee Dee**
USGS HUC	**03040208**	Coordinates	Latitude: **33.970753** Longitude: **-78.471379**

Location description: **West of Starboard Rd NW, Shallotte, NC 28470**

Indicate Which of the Following Apply:

A. Preliminary Determination

☒ There appear to be **waters, including wetlands** on the above described project area/property, that may be subject to Section 404 of the Clean Water Act (CWA)(33 USC § 1344) and/or Section 10 of the Rivers and Harbors Act (RHA) (33 USC § 403). The **waters, including wetlands** have been delineated, and the delineation has been verified by the Corps to be sufficiently accurate and reliable. The approximate boundaries of these waters are shown on the enclosed delineation map, entitled, "Section 404/401 Delineation Preliminary Sketch, Cool Run Mitigation Site," dated **12/18/2020**. Therefore this preliminary jurisdiction determination may be used in the permit evaluation process, including determining compensatory mitigation. For purposes of computation of impacts, compensatory mitigation requirements, and other resource protection measures, a permit decision made on the basis of a preliminary JD will treat all waters and wetlands that would be affected in any way by the permitted activity on the site as if they are jurisdictional waters of the U.S. This preliminary determination is not an appealable action under the Regulatory Program Administrative Appeal Process (Reference 33 CFR Part 331). However, you may request an approved JD, which is an appealable action, by contacting the Corps district for further instruction.

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

B. Approved Determination

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

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

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

☐ The **waters, including wetlands** on your project area/property have been delineated and the delineation has been verified by the Corps. The approximate boundaries of these waters are shown on the enclosed delineation map dated DATE. We strongly suggest you have this delineation surveyed. Upon completion, this survey should be reviewed and verified by the Corps. Once verified, this survey will provide an accurate depiction of all areas subject to CWA jurisdiction on your property which, provided there is no change in the law or our published regulations, may be relied upon for a period not to exceed five years.

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

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

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

Placement of dredged or fill material within waters of the US, including wetlands, without a Department of the Army permit may constitute a violation of Section 301 of the Clean Water Act (33 USC § 1311). Placement of dredged or fill material, construction or placement of structures, or work within navigable waters of the United States without a Department of the Army permit may constitute a violation of Sections 9 and/or 10 of the Rivers and Harbors Act (33 USC § 401 and/or 403). If you have any questions regarding this determination and/or the Corps regulatory program, please contact **Jordan E. Jessop at 910-251-4810 or Jordan.E.Jessop@usace.army.mil**.

C. Basis For Determination: Basis For Determination: See the preliminary jurisdictional determination form dated 2/5/2020.

D. Remarks: None.

E. Attention USDA Program Participants

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

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

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

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

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

It is not necessary to submit an RFA form to the Division Office if you do not object to the determination in this correspondence.

Corps Regulatory Official: ______ Digitally signed by JESSOP.JORDAN.E.1515090548 Date: 2021.02.05 13:20:03 -05'00'

Date of JD: **2/5/2020** Expiration Date of JD: **Not applicable**

SAW-2020-1799

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 http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0

Copy furnished:

Agent:	**Land Management Group**
	Wes Fryar
Address:	**3805 Wrightsville Ave., Suite 15**
	Wilmington, NC 28403
Telephone Number:	**910.452.0001**
E-mail:	**wfryar@lmgroup.net**

Property Owner:	
	Pearl Frink
Address:	**1758 Frink St. SW**
	Ocean Isle Beach, NC 28469
Telephone Number:	**(843) 241-8902**
E-mail:	**terryfrink@atmc.net**

PRELIMINARY JURISDICTIONAL DETERMINATION (PJD) FORM

BACKGROUND INFORMATION

A. **REPORT COMPLETION DATE FOR PJD:** 2/5/2020

B. **NAME AND ADDRESS OF PERSON REQUESTING PJD:** Clearwater Mitigation Solutions, Kevin Yates, 604 Macon Place, Raleigh, NC 27609

C. **DISTRICT OFFICE, FILE NAME, AND NUMBER:** Wilmington District, Cool Run Mitigation Site, SAW-2020-1799

D. **PROJECT LOCATION(S) AND BACKGROUND INFORMATION:** West of Starboard Rd NW, Shallotte, NC 28470

(USE THE TABLE BELOW TO DOCUMENT MULTIPLE AQUATIC RESOURCES AND/OR AQUATIC RESOURCES AT DIFFERENT SITES)

State: NC County: Brunswick City: Shallotte

Center coordinates of site (lat/long in degree decimal format): Latitude: 33.970753 Longitude: -78.471379

Universal Transverse Mercator: NAD83

Name of nearest waterbody: Shallotte River

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

☒Office (Desk) Determination. Date: 02/05/2021

☒Field Determination. Date(s): 12/18/2020

TABLE OF AQUATIC RESOURCES IN REVIEW AREA WHICH "MAY BE" SUBJECT TO REGULATORY JURISDICTION

Site Number	Latitude (decimal degrees)	Longitude (decimal degrees)	Estimated amount of aquatic resources in review area (acreage and linear feet, if applicable	Type of aquatic resources (i.e., wetland vs. non-wetland waters)	Geographic authority to which the aquatic resource "may be" subject (i.e., Section 404 or Section 10/404)
WG	33.973031	-78.470253	~0.485 ac	wetland	Section 404
WB	33.971811	-78.471224	~0.088 ac	wetland	Section 404
WA	33.971751	-78.471853	~0.196 ac	wetland	Section 404
WC	33.970985	-78.471160	~0.575 ac	wetland	Section 404
WD	33.970245	-78.471041	~0.474 ac	wetland	Section 404
WE	33.969015	-78.471352	~1.006 ac	wetland	Section 404
WF	33.968830	-78.470760	~0.141 ac	wetland	Section 404
NS1	33.970934	-78.473618	~100 L.F.	non-wetland	Section 404
NS2	33.972044	-78.471823	~776 L.F.	non-wetland	Section 404
NS3	33.969672	-78.471285	~1,137 L.F.	non-wetland	Section 404
NS4	33.968777	-78.471131	~107 L.F.	non-wetland	Section 404
NS5	33.96845	-78.47153	~180 L.F.	non-wetland	Section 404
S2	33.970870	-78.473072	~335 L.F.	non-wetland	Section 404
Cool Run	33.970784	-78.472464	~1,935 L.F.	non-wetland	Section 404

1. The Corps of Engineers believes that there may be jurisdictional aquatic resources in the review area, and the requestor of this PJD is hereby advised of his or her option to request and obtain an approved JD (AJD) for that review area based on an informed decision after having discussed the various types of JDs and their characteristics and circumstances when they may be appropriate.
2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre- construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an AJD for the activity, the permit applicant is hereby made aware that: (1) the permit applicant has elected to seek a permit authorization based on a PJD, which does not make an official determination of jurisdictional aquatic resources; (2) the applicant has the option to request an AJD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an AJD could possibly result in less compensatory mitigation being required or different special conditions; (3) the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) undertaking any activity in reliance upon the subject permit authorization without requesting an AJD constitutes the applicant's acceptance of the use of the PJD; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a PJD constitutes agreement that all aquatic resources in the review area affected in any way by that activity will be treated as jurisdictional, and waives any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an AJD or a PJD, the JD will be processed as soon as practicable. Further, an AJD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331. If, during an administrative appeal, it becomes appropriate to make an official determination whether geographic jurisdiction exists over aquatic resources in the review area, or to provide an official delineation of jurisdictional aquatic resources in the review area, the Corps will provide an AJD to accomplish that result, as soon as is practicable. This PJD finds that there *"may be"* waters of the U.S. and/or that there *"may be"* navigable waters of the U.S. on the subject review area, and identifies all aquatic features in the review area that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for PJD (check all that apply) Checked items are included in the administrative record and are appropriately cited:

☒Maps, plans, plots or plat submitted by or on behalf of the PJD requestor:
Map: **"Section 404/401 Delineation Preliminary Sketch," post 12/18/20 USACE field visit**

☒Data sheets prepared/submitted by or on behalf of the PJD requestor. Datasheets:

☒Office concurs with data sheets/delineation report.

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

☐Data sheets prepared by the Corps:___________________

☐Corps navigable waters' study:

☐U.S. Geological Survey Hydrologic Atlas:

☒USGS NHD data: **USGS TNM – National Hydrography Dataset. Data Refreshed January, 2021**

☒USGS 8 and 12 digit HUC maps: **0304020802 Shallotte River**

☒U.S. Geological Survey map(s). Cite scale & quad name: **1:24k Shallotte**

☒Natural Resources Conservation Service Soil Survey. Citation: **NRCS SSURGO Data Layer: Muckalee, Lynchburg fine sandy loam, Goldsboro fine sandy loam**

☒National wetlands inventory map(s). Cite name: **USFWS NWI, PFO**

☐State/local wetland inventory map(s):____________________

☐FEMA/FIRM maps:

☐100-year Floodplain Elevation is:______________ (National Geodetic Vertical Datum of 1929)

☒Photographs: ☒ Aerial (Name & Date): **Google Earth Aerial Imagery dated 6/14/2019**

or ☒ Other (Name & Date): **Corps photos 1-52, of 52, from Dec 18, 2020 site visit.**

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

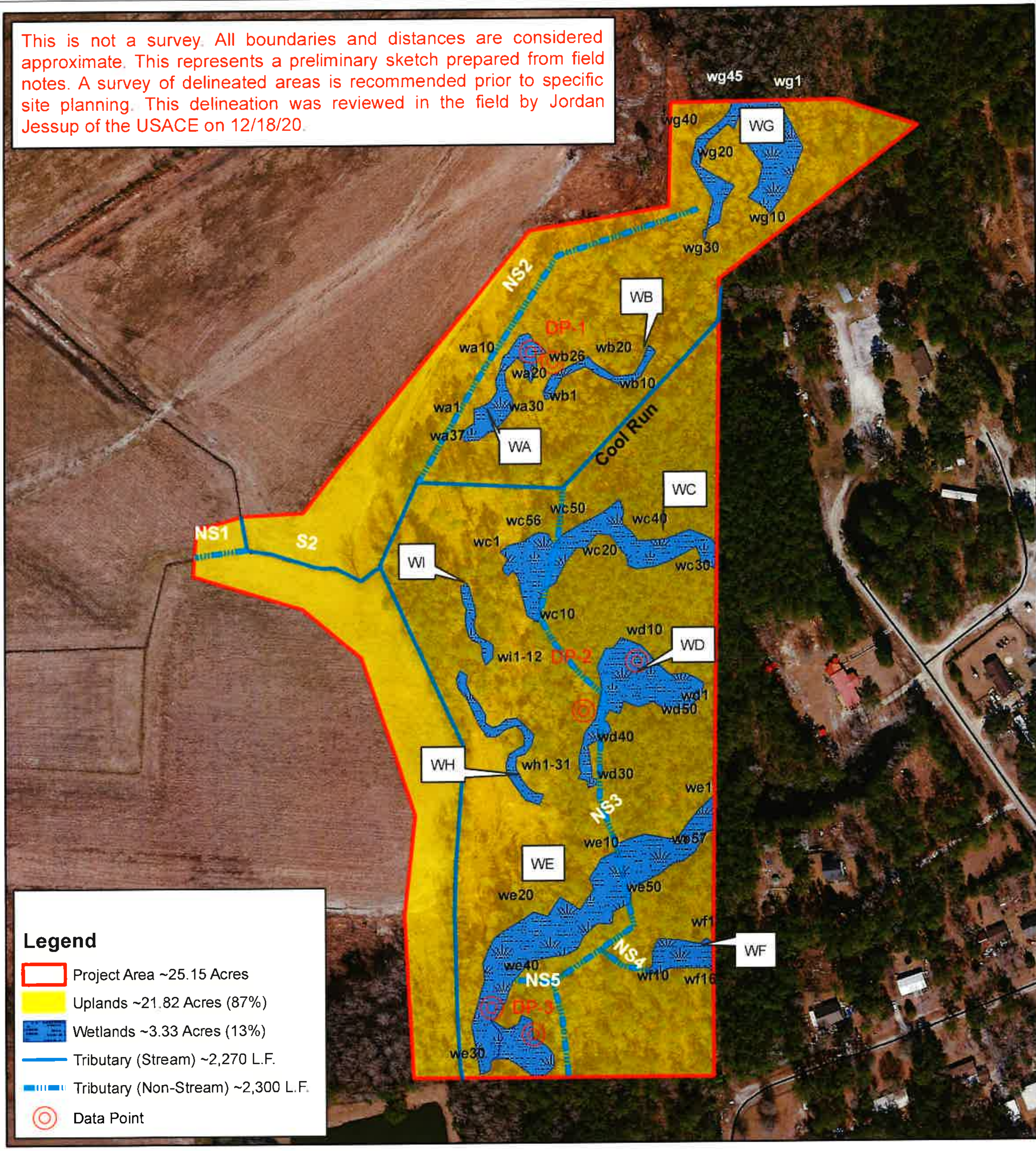
☒Other information (please specify): **Site visit on Dec 18, 2020, NCQL2 LiDAR**

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

Digitally signed by
JESSOP.JORDAN.E.1515090548
Date: 2021 02 05 13:20:33
-05'00'

Signature and date of Regulatory staff member completing PJD 2/5/2020	Signature and date of person requesting PJD (REQUIRED, unless obtaining the signature is impracticable)[1]

[1] Districts may establish timeframes for requester to return signed PJD forms. If the requester does not respond within the established time frame, the district may presume concurrence and no additional follow up is necessary prior to finalizing an action.



L:\ECOSYSTEM SERVICES\2020 ECOSYSTEM SERVICES FILES\
LMG20.248 --- Cool Run Mitigation Bank, CMS\Maps
Boundaries are approximate and not meant to be absolute.
Map Source: 2014 QL2 LiDAR

Cool Run Mitigation Site Clearwater Mitigation Solutions Brunswick County, NC LMG20.248	CLEARWATER MITIGATION SOLUTIONS LMG LAND MANAGEMENT GROUP a DAVEY company	**Section 404/401 Delineation Preliminary Sketch**

Appendix E

Categorical Exclusion Document

Appendix E

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:	Cool Run Mitigation Project
County Name:	Brunswick
DMS Number:	100142
Project Sponsor:	Clearwater Mitigation Solutions
Project Contact Name:	Kevin Yates
Project Contact Address:	604 Macon Place; Raleigh, NC
Project Contact E-mail:	clearwatermitigation@gmail.com
DMS Project Manager:	Mr. Jeremiah Dow

Project Description

Clearwater Mitigation Solutions, LLC plans to provide a full-delivery mitigation project known as the Cool Run Mitigation Project for NC Division of Mitigation Services. The project site is located in Brunswick County, approximately five miles west of the city limits of Shallotte, NC. The project plans to restore a section of Cool Run by redirecting stream flow into the historic abandoned channel. Additionally, an unnamed tributary will be restored by filling existing ditched channels. Riparian wetlands will be restored by raising stream bed elevations and removing spoil piles, planting areas lacking characteristic wetland tree and shrubs, and connecting existing wetlands to the floodplain and stream.

For Official Use Only

Reviewed By:

12/04/2020 — Jeremiah Dow

Date — **DMS Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

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

Final Approval By:

12-3-20 — 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

ATTACHMENT 1
EDR REPORT

Cool Run Mitigation Bank
Highfield Court
Shallotte, NC 28470

Inquiry Number: 6247754.2s
October 30, 2020

The EDR Radius Map™ Report

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

HIGHFIELD COURT
SHALLOTTE, NC 28470

COORDINATES

Latitude (North):	33.9709400 - 33˚ 58' 15.38''
Longitude (West):	78.4714960 - 78˚ 28' 17.38''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	733615.3
UTM Y (Meters):	3761621.0
Elevation:	45 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5946123 SHALLOTTE, NC
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140520
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
HIGHFIELD COURT
SHALLOTTE, NC 28470

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
1	QUARTER HORSE LANE P	6450 QUARTER HORSE L	SHWS	Higher	5011, 0.949, SSW

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
NPL LIENS	Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL	National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY	Federal Facility Site Information listing
SEMS	Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE	Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS	Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF	RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG	RCRA - Large Quantity Generators
RCRA-SQG	RCRA - Small Quantity Generators
RCRA-VSQG	RCRA - Very Small Quantity Generators (Formerly Conditionally Exempt Small Quantity Generators)

Federal institutional controls / engineering controls registries

LUCIS	Land Use Control Information System

EXECUTIVE SUMMARY

US ENG CONTROLS........ Engineering Controls Sites List
US INST CONTROLS....... Institutional Controls Sites List

Federal ERNS list

ERNS........................ Emergency Response Notification System

State- and tribal - equivalent NPL

NC HSDS.................... Hazardous Substance Disposal Site

State and tribal landfill and/or solid waste disposal site lists

SWF/LF..................... List of Solid Waste Facilities
OLI........................... Old Landfill Inventory
DEBRIS..................... Solid Waste Active Disaster Debris Sites Listing
LCID......................... Land-Clearing and Inert Debris (LCID) Landfill Notifications

State and tribal leaking storage tank lists

LUST........................ Regional UST Database
LAST........................ Leaking Aboveground Storage Tanks
INDIAN LUST.............. Leaking Underground Storage Tanks on Indian Land
LUST TRUST.............. State Trust Fund Database

State and tribal registered storage tank lists

FEMA UST.................. Underground Storage Tank Listing
UST.......................... Petroleum Underground Storage Tank Database
AST.......................... AST Database
INDIAN UST............... Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

INST CONTROL........... No Further Action Sites With Land Use Restrictions Monitoring

State and tribal voluntary cleanup sites

INDIAN VCP............... Voluntary Cleanup Priority Listing
VCP.......................... Responsible Party Voluntary Action Sites

State and tribal Brownfields sites

BROWNFIELDS........... Brownfields Projects Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS....... A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

HIST LF..................... Solid Waste Facility Listing

EXECUTIVE SUMMARY

SWRCY	Recycling Center Listing
INDIAN ODI	Report on the Status of Open Dumps on Indian Lands
ODI	Open Dump Inventory
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations
IHS OPEN DUMPS	Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL	Delisted National Clandestine Laboratory Register
US CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
SPILLS	Spills Incident Listing
IMD	Incident Management Database
SPILLS 90	SPILLS 90 data from FirstSearch
SPILLS 80	SPILLS 80 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated
FUDS	Formerly Used Defense Sites
DOD	Department of Defense Sites
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR	Financial Assurance Information
EPA WATCH LIST	EPA WATCH LIST
2020 COR ACTION	2020 Corrective Action Program List
TSCA	Toxic Substances Control Act
TRIS	Toxic Chemical Release Inventory System
SSTS	Section 7 Tracking Systems
ROD	Records Of Decision
RMP	Risk Management Plans
RAATS	RCRA Administrative Action Tracking System
PRP	Potentially Responsible Parties
PADS	PCB Activity Database System
ICIS	Integrated Compliance Information System
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS	Material Licensing Tracking System
COAL ASH DOE	Steam-Electric Plant Operation Data
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
RADINFO	Radiation Information Database
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS	Incident and Accident Data
CONSENT	Superfund (CERCLA) Consent Decrees
INDIAN RESERV	Indian Reservations
FUSRAP	Formerly Utilized Sites Remedial Action Program
UMTRA	Uranium Mill Tailings Sites
LEAD SMELTERS	Lead Smelter Sites

EXECUTIVE SUMMARY

US AIRS	Aerometric Information Retrieval System Facility Subsystem
US MINES	Mines Master Index File
ABANDONED MINES	Abandoned Mines
FINDS	Facility Index System/Facility Registry System
UXO	Unexploded Ordnance Sites
DOCKET HWC	Hazardous Waste Compliance Docket Listing
ECHO	Enforcement & Compliance History Information
FUELS PROGRAM	EPA Fuels Program Registered Listing
AIRS	Air Quality Permit Listing
ASBESTOS	ASBESTOS
COAL ASH	Coal Ash Disposal Sites
DRYCLEANERS	Drycleaning Sites
Financial Assurance	Financial Assurance Information Listing
NPDES	NPDES Facility Location Listing
UIC	Underground Injection Wells Listing
AOP	Animal Operation Permits Listing
MINES MRDS	Mineral Resources Data System
CCB	Coal Ash Structural Fills (CCB) Listing
PCSRP	Petroleum-Contaminated Soil Remediation Permits
SEPT HAULERS	Permitted Septage Haulers Listing

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP	EDR Proprietary Manufactured Gas Plants
EDR Hist Auto	EDR Exclusive Historical Auto Stations
EDR Hist Cleaner	EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

RGA HWS	Recovered Government Archive State Hazardous Waste Facilities List
RGA LF	Recovered Government Archive Solid Waste Facilities List
RGA LUST	Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified in the following databases.

Elevations have been determined from the USGS Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property.
Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

STANDARD ENVIRONMENTAL RECORDS

State- and tribal - equivalent CERCLIS

SHWS: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. The data come from the Department of Environment & Natural Resources' Inactive Hazardous Sites Program.

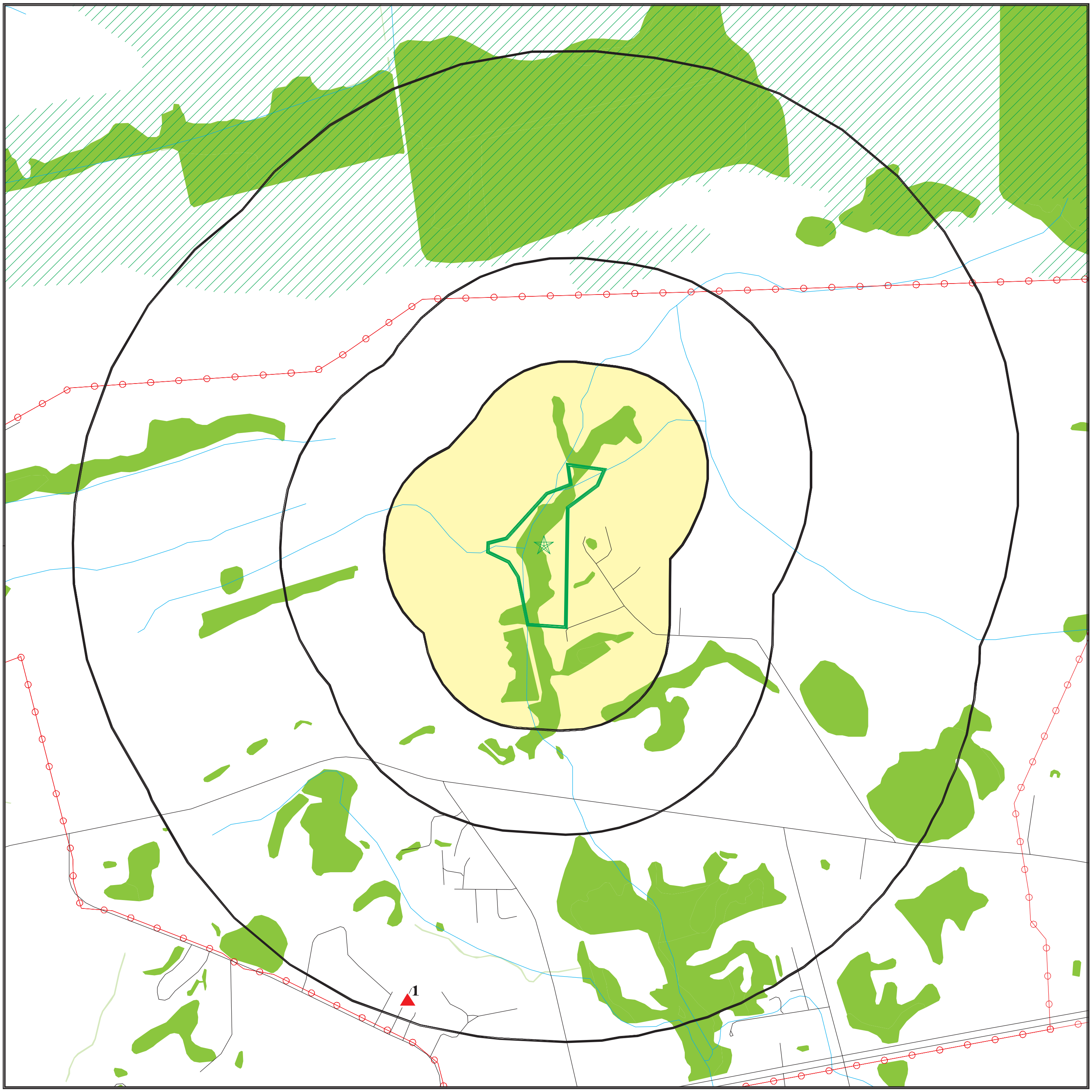
A review of the SHWS list, as provided by EDR, and dated 05/11/2020 has revealed that there is 1 SHWS site within approximately 1 mile of the target property.

Equal/Higher Elevation	Address	Direction / Distance	Map ID	Page
QUARTER HORSE LANE P Facility Id: NONCD0001556	6450 QUARTER HORSE L	SSW 1/2 - 1 (0.949 mi.)	1	8

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 6247754.2S



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Power transmission lines
- Special Flood Hazard Area (1%)
- 0.2% Annual Chance Flood Hazard
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cool Run Mitigation Bank ADDRESS: Highfield Court Shallotte NC 28470 LAT/LONG: 33.97094 / 78.471496	CLIENT: Land Management Group, Inc. CONTACT: Randy Brant INQUIRY #: 6247754.2s DATE: October 30, 2020 10:37 am

DETAIL MAP - 6247754.2S

Target Property
Sites at elevations higher than or equal to the target property
Sites at elevations lower than the target property
Manufactured Gas Plants
Sensitive Receptors
National Priority List Sites
Dept. Defense Sites

Indian Reservations BIA
Power transmission lines
National Wetland Inventory
State Wetlands

Hazardous Substance Disposal Sites

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Cool Run Mitigation Bank ADDRESS: Highfield Court Shallotte NC 28470 LAT/LONG: 33.97094 / 78.471496	CLIENT: Land Management Group, Inc. CONTACT: Randy Brant INQUIRY #: 6247754.2s DATE: October 30, 2020 10:38 am

ATTACHMENT 2

CORRESPONDENCE FROM

NC STATE HISTORIC PRESERVATION OFFICE

North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

September 29, 2020

Kim Williams
Land Management Group
3805 Wrightsville Avenue, Suite 15
Wilmington, NC 28403

kwilliams@lmgroup.net

Re: Cool Run wetland and stream mitigation, Old Shallotte Road NW, Cool Run, Brunswick County, ER 20-1890

Dear Ms. Williams:

Thank you for your email of August 26, 2020, regarding the above-referenced undertaking. We have reviewed the submittal and offer the following comments.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-814-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley
for

Ramona Bartos, Deputy
State Historic Preservation Officer

ATTACHMENT 4

CORRESPONDENCE WITH

US FISH & WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Raleigh Field Office
P.O. Box 33726
Raleigh, NC 27636-3726

Date: 08/26/2020

Self-Certification Letter

Project Name Cool Run Mitigation Project

Dear Applicant:

Thank you for using the U.S. Fish and Wildlife Service (Service) Raleigh Ecological Services online project review process. By printing this letter in conjunction with your project review package, you are certifying that you have completed the online project review process for the project named above in accordance with all instructions provided, using the best available information to reach your conclusions. This letter, and the enclosed project review package, completes the review of your project in accordance with the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (ESA), and the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c, 54 Stat. 250), as amended (Eagle Act). This letter also provides information for your project review under the National Environmental Policy Act of 1969 (P.L. 91-190, 42 U.S.C. 4321-4347, 83 Stat. 852), as amended. A copy of this letter and the project review package must be submitted to this office for this certification to be valid. This letter and the project review package will be maintained in our records.

The species conclusions table in the enclosed project review package summarizes your ESA and Eagle Act conclusions. Based on your analysis, mark all the determinations that apply:

- [x] "no effect" determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- [ ] "may affect, not likely to adversely affect" determinations for proposed/listed species and/or proposed/designated critical habitat; and/or
- [ ] "may affect, likely to adversely affect" determination for the Northern long-eared bat (Myotis septentrionalis) and relying on the findings of the January 5, 2016, Programmatic Biological Opinion for the Final 4(d) Rule on the Northern long-eared bat;
- [x] "no Eagle Act permit required" determinations for eagles.

We certify that use of the online project review process in strict accordance with the instructions provided as documented in the enclosed project review package results in reaching the appropriate determinations. Therefore, we concur with the "no effect" or "not likely to adversely affect" determinations for proposed and listed species and proposed and designated critical habitat; the "may affect" determination for Northern long-eared bat; and/or the "no Eagle Act permit required" determinations for eagles. Additional coordination with this office is not needed. Candidate species are not legally protected pursuant to the ESA. However, the Service encourages consideration of these species by avoiding adverse impacts to them. Please contact this office for additional coordination if your project action area contains candidate species. Should project plans change or if additional information on the distribution of proposed or listed species, proposed or designated critical habitat, or bald eagles becomes available, this determination may be reconsidered. This certification letter is valid for 1 year. Information about the online project review process including instructions, species information, and other information regarding project reviews within North Carolina is available at our website http://www.fws.gov/raleigh/pp.html. If you have any questions, you can write to us at Raleigh@fws.gov or please contact Leigh Mann of this office at 919-856-4520, ext. 10.

Sincerely,

/s/Pete Benjamin

Pete Benjamin
Field Supervisor
Raleigh Ecological Services

Enclosures - project review package

Species Conclusions Table

Project Name: Cool Run Mitigation Site

Date: 08/26/2020

Species / Resource Name	Conclusion	ESA Section 7 / Eagle Act Determination	Notes / Documentation
American Alligator (*Alligator mississippiensis*)	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Bald Eagle (*Haliaeetus leucocephalus)*	Unlikely to disturb nesting bald eagles	No Effect	Per the NC NHP database review, there are no known bald eagle nests within one mile of the site.
Magnificent Ramshorn (*Planorbella magnifica)*	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Northern Long-Eared Bat (*Myotis septentrionalis)*	Suitable habitat present	No Effect	Most of the site has been cleared and minimal tree cutting or removal is proposed.
Red-Cockaded Woodpecker (*Picoides borealis)*	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Wood Stork (*Mycteria americana)*	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Cooley's Meadowrue (*Thalictrum cooleyi)*	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Rough-leaved Loosestrife (*Lysimachia asperulaefolia)*	No suitable habitat present within project area	No Effect	Habitat assessment performed by LMG indicates that the site does not provide suitable habitat for species.
Critical Habitat	No critical habitat present within project area	No Effect	

Acknowledgement: I agree that the above information about my proposed project is true. I used all of the provided resources to make an informed decision about impacts in the immediate and surrounding areas.

K Williams - Section Manager w/ LMG

Signature /Title

08/26/20

Date

DAVEY

Williams, Kimberlee <kwilliams@lmgroup.net>

Re: Fw: DUE DATE: SEPTEMBER 24, 2020 Fw: [EXTERNAL] Cool Run Mitigation Site; Brunswick County; Review Request

1 message

Matthews, Kathryn H <kathryn_matthews@fws.gov> Wed, Sep 2, 2020 at 1:51 PM
To: "Williams, Kim" <kwilliams@lmgroup.net>
Cc: "Mann, Leigh" <leigh_mann@fws.gov>, "Brew, Donnie (FHWA)" <Donnie.Brew@dot.gov>

I don't have any comments.

I am copying FHWA (Donnie Brew) about this, because Federal agencies don't need to consult with us if they have made a "no effect" determinaon (NLEB is c overed by a programmac BO). If y ou must have a le. er so early in the process, please look into prinng y our own letter from our online review process before submbing t o us. The Corps and FHWA are familiar with that process, and should accept those letters, even though they are not signed by a human. We do review those packages that come in from the online review process, and provide comments within 30 days if we do not agree with the determinaons.

Thanks,

Kathy Mahe ws
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
551-F Pylon Drive
Raleigh, NC 27606
919-856-4520, x. 27

From: Williams, Kim <kwilliams@lmgroup.net>
Sent: Wednesday, September 2, 2020 1:01 PM
To: Matthews, Kathryn H <kathryn_matthews@fws.gov>
Cc: Mann, Leigh <leigh_mann@fws.gov>
Subject: Re: Fw: DUE DATE: SEPTEMBER 24, 2020 Fw: [EXTERNAL] Cool Run Mi⍰ga⍰on Site; Brunswick County; Review Request

Hi Kathy
I spoke with the project team about whether you could wait to issue comments until the mitigation plan has been developed. Unfortunately, we need to first complete and submit the CE so that we can continue to move forward with the project. Then we will be able to complete the mitigation plan. Would you be able to issue an email with any comments you may have under this preliminary review given the limited information provided in our letter and figures? We understand that your office will be able to review the project again later on in the process once you have additional project details and that you may have additional comments at that time.

Let me know what you think.

Thanks!
Kim

Kim Williams | Environmental Scientist

Land Management Group | Environmental Consultants

ATTACHMENT 5
FORM AD-1006 &
CORRESPONDENCE WITH
NATURAL RESOURCES CONSERVATION SERVICE

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 08/20/2020
Name of Project Cool Run Mitigation Site	Federal Agency Involved Federal Highway Administration
Proposed Land Use stream and wetland restoration	County and State Brunswick County, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 08/20/2020 / Person Completing Form: Milton Cortes NRCS NC

Does the site contain Prime, Unique, Statewide or Local Important Farmland? *(If no, the FPPA does not apply - do not complete additional parts of this form)*	YES ☑ NO ☐	Acres Irrigated: none	Average Farm Size: 193 acres
Major Crop(s): CORN	Farmable Land In Govt. Jurisdiction — Acres: 55.1 % 303,638 acres	Amount of Farmland As Defined in FPPA — Acres: 44.6 % 245,728 acres	
Name of Land Evaluation System Used: Brunswick County, NC LESA	Name of State or Local Site Assessment System: N/A	Date Land Evaluation Returned by NRCS: August 24, 2020 by eMail	

PART III *(To be completed by Federal Agency)*		Alternative Site Rating			
		Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly		25.15			
B. Total Acres To Be Converted Indirectly		0			
C. Total Acres In Site		25.15			
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		5.90			
B. Total Acres Statewide Important or Local Important Farmland		0.8			
C. Percentage Of Farmland in County Or Local Govt. Unit To Be Converted		0.0027			
D. Percentage Of Farmland in Govt. Jurisdiction With Same Or Higher Relative Value		55.1			
PART V (To be completed by NRCS) Land Evaluation Criterion Relative Value of Farmland To Be Converted (Scale of 0 to 100 Points)		25			
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(Criteria are explained in 7 CFR 658.5 b. For Corridor project use form NRCS-CPA-106)*	**Maximum Points**	Site A	Site B	Site C	Site D
1. Area In Non-urban Use	(15)	15			
2. Perimeter In Non-urban Use	(10)	10			
3. Percent Of Site Being Farmed	(20)	0			
4. Protection Provided By State and Local Government	(20)	20			
5. Distance From Urban Built-up Area	(15)	15			
6. Distance To Urban Support Services	(15)	10			
7. Size Of Present Farm Unit Compared To Average	(10)	0			
8. Creation Of Non-farmable Farmland	(10)	0			
9. Availability Of Farm Support Services	(5)	3			
10. On-Farm Investments	(20)	10			
11. Effects Of Conversion On Farm Support Services	(10)	0			
12. Compatibility With Existing Agricultural Use	(10)	3			
TOTAL SITE ASSESSMENT POINTS	160	86	0	0	0
PART VII ***(To be completed by Federal Agency)***					
Relative Value Of Farmland *(From Part V)*	100	25	0	0	0
Total Site Assessment *(From Part VI above or local site assessment)*	160	86	0	0	0
TOTAL POINTS ***(Total of above 2 lines)***	260	111	0	0	0

Site Selected: Site A	Date Of Selection 9/2/2020	Was A Local Site Assessment Used? YES ☐ NO ☒

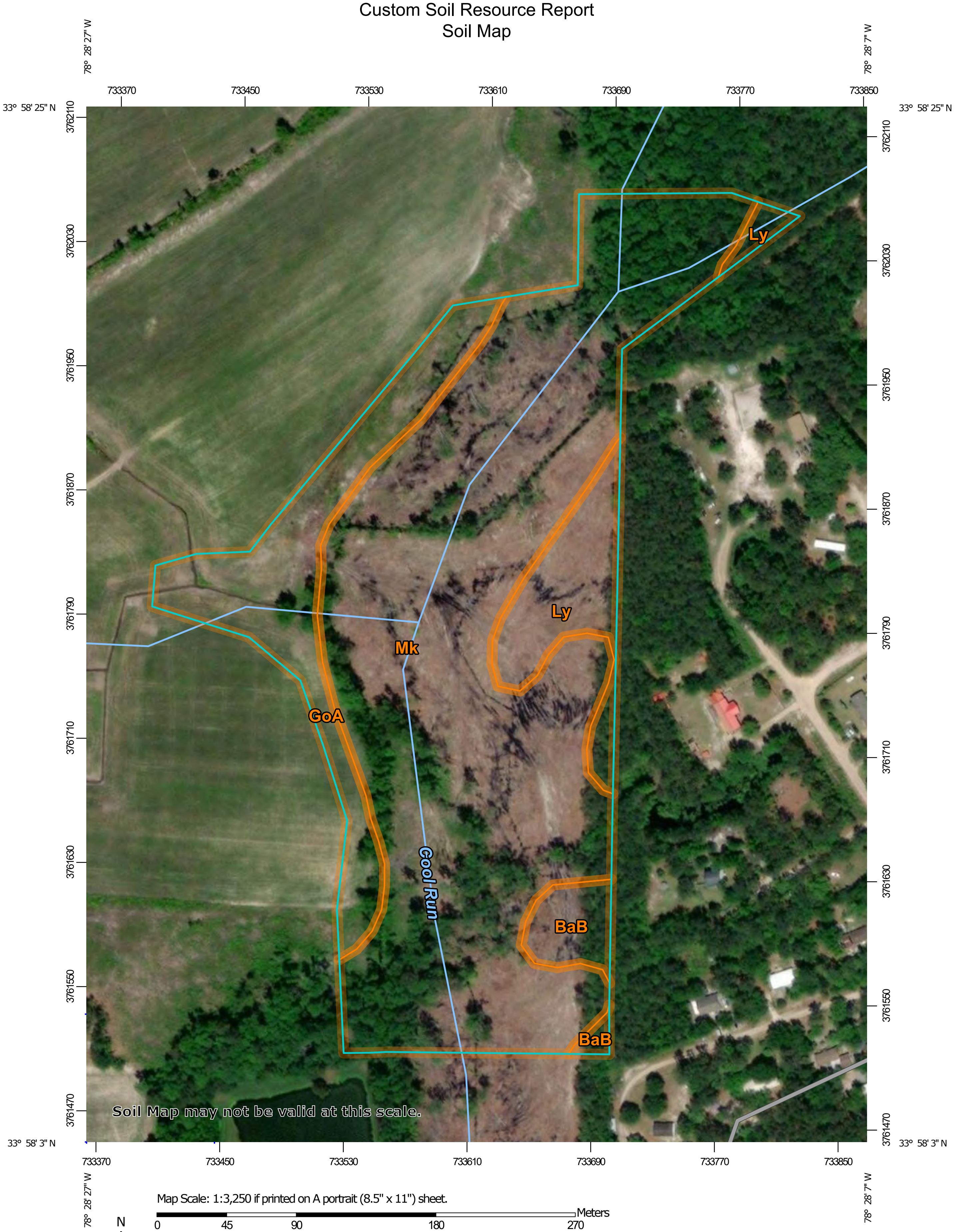
Reason For Selection:

"Site A" is located within existing drainage ways within the farmland, and minimizes impacts to higher valued upland areas which contain higher quality soils for growing agricultural crops. Additionally, "Site A" meets the goals and intent of the proposed project. We believe "Site A" to be consistent with the Farmland Protection Policy Act (FPPA).

Name of Federal agency representative completing this form: Kevin Yates - Clearwater Mitigation Solutions	Date: 9/2/2020

(See Instructions on reverse side) **Form AD-1006 (03-02)**

Custom Soil Resource Report
Soil Map



Map Scale: 1:3,250 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Brunswick County, North Carolina
Survey Area Data: Version 24, Jun 2, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 30, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BaB	Baymeade fine sand, 1 to 6 percent slopes	0.8	3.1%
GoA	Goldsboro fine sandy loam, 0 to 2 percent slopes	3.9	15.3%
Ly	Lynchburg fine sandy loam, 0 to 2 percent slopes, Atlantic Coast Flatwoods	2.0	8.1%
Mk	Muckalee loam	18.5	73.4%
Totals for Area of Interest		**25.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

DAVEY

Williams, Kimberlee <kwilliams@lmgroup.net>

RE: Cool Run Mitigation Site; Brunswick County; Form AD-1006

1 message

Cortes, Milton - NRCS, Raleigh, NC <milton.cortes@usda.gov> Mon, Aug 24, 2020 at 7:07 AM
To: "Williams, Kim" <kwilliams@lmgroup.net>, Kevin Yates <clearwatermitigation@gmail.com>, Wes Fryar <wfryar@lmgroup.net>

Good morning Kim;

Please find attached the FARMLAND CONVERSION IMPACT RATING evaluation for the Cool Run Mitigation Site is located in Brunswick County, NC

If we can be of further assistance, please let us know.

Best Regards

Milton Cortés

State Soil Scientist

Raleigh, North Carolina State Office

Natural Resources Conservation Service

United States Department of Agriculture

Office: 919-873-2171

Cell: 984-365-2201

Milton.Cortes@usda.gov

USDA

"If you always wait for the right time, you might never begin"

From: Williams, Kim <kwilliams@lmgroup.net>
Sent: Friday, August 21, 2020 9:04 AM
To: Cortes, Milton - NRCS, Raleigh, NC <milton.cortes@usda.gov>; Kevin Yates <clearwatermitigation@gmail.com>; Wes Fryar <wfryar@lmgroup.net>
Subject: Cool Run Mitigation Site; Brunswick County; Form AD-1006

Hi Milton

We are working on a full-delivery mitigation site for DMS and need your assistance in filling out the AD-1006 form for the site. The Cool Run Mitigation Site is located in Brunswick County. Attached is a vicinity map, AD-1006 form with sections I and III completed, the NRCS soils report, and the corresponding soils shapefiles.

Let me know if you need anything else to determine if the site contains prime farmland and to complete relevant sections of the form.

Thanks so much!

Kim

Kim Williams | Environmental Scientist

Land Management Group | Environmental Consultants

Direct: 910-452-0001 x 1908 | Cell: 910.471.5035 | Fax: 910.452.0060

3805 Wrightsville Ave., Suite 15 | Wilmington, NC 28403

Email: kwilliams@lmgroup.net | Website: www.lmgroup.net

ATTACHMENT 6

CORRESPONDENCE FROM

NC WILDLIFE RESOURCES COMMISSION

DAVEY

Williams, Kimberlee <kwilliams@lmgroup.net>

RE: [External] Fwd: Cool Run Mitigation Project; Brunswick County

1 message

Wilson, Travis W. <travis.wilson@ncwildlife.org> Wed, Nov 25, 2020 at 10:42 AM
To: "Williams, Kimberlee" <kwilliams@lmgroup.net>
Cc: Kevin Yates <clearwatermitigation@gmail.com>, "Dunn, Maria T." <maria.dunn@ncwildlife.org>

Kim, It sounds like Maria is in the field and I'm sure you are hoping to get this wrapped up before the holiday. I provided comments at the onsite meeting as well as some follow up information with Kevin concerning a potential future NCDOT highway project in the area. Further review of the project area did not identify any additional information or species concerns; therefore we do not have any specific comments to add at this time.

Travis W. Wilson

Eastern Region Highway Project Coordinator

Habitat Conservation Program

NC Wildlife Resources Commission

1718 Hwy 56 West

Creedmoor, NC 27522

Phone: 919-707-0370

Fax: 919-528-2524

Travis.Wilson@ncwildlife.org

From: Williams, Kimberlee <kwilliams@lmgroup.net>
Sent: Wednesday, November 25, 2020 9:30 AM
To: Wilson, Travis W. <travis.wilson@ncwildlife.org>
Cc: Kevin Yates <clearwatermitigation@gmail.com>; Dunn, Maria T. <maria.dunn@ncwildlife.org>
Subject: Re: [External] Fwd: Cool Run Mitigation Project; Brunswick County

Hi Travis and Maria

I wanted to check in on Cool Run. Can you tell me when you anticipate being able to provide comments?

Thanks so much and have a nice Thanksgiving!

Kim

Kim Williams | Environmental Scientist

Land Management Group | Environmental Consultants

Direct: 910-452-0001 x 1908 | Cell: 910.471.5035 | Fax: 910.452.0060

3805 Wrightsville Ave., Suite 15 | Wilmington, NC 28403

Email: kwilliams@lmgroup.net | Website: www.lmgroup.net

On Wed, Nov 18, 2020 at 2:35 PM Wilson, Travis W. <travis.wilson@ncwildlife.org> wrote:

> The project is in Maria Dunn's region so she will be the WRC POC for this project. The information was forwarded to her Monday from our Raleigh office and she reached out to me to get my feedback since I was onsite during the prospectus review. I apologize for the delay, projects that go through Raleigh can get caught in just the mass volume of incoming items particularly mail with limited office staff these days. We will provide a response as soon as possible.
>
> Travis
>
> ---
>
> **From:** Williams, Kimberlee <kwilliams@lmgroup.net>
> **Sent:** Tuesday, November 17, 2020 12:26 PM
> **To:** Wilson, Travis W. <travis.wilson@ncwildlife.org>; Kevin Yates <clearwatermitigation@gmail.com>
> **Subject:** [External] Fwd: Cool Run Mitigation Project; Brunswick County
>
> **CAUTION:** External email. Do not click links or open attachments unless you verify. Send all suspicious email as an attachment to report.spam@nc.gov
>
> Hi Travis
>
> We are working with Clearwater Mitigation Solutions on a full-delivery riparian wetland and stream mitigation project known as the Cool Run Mitigation Site for NC Division of Mitigation Services. The 25.15-acre project site is located in Brunswick County, approximately five miles southwest of the city limits of Shallotte, NC. The project involves the restoration and enhancement of stream channels and wetlands within the site (see attached). As part of the environmental documentation process, I reached out to Shannon Deaton at WRC a couple of times requesting comment, but haven't heard back. Is she the right point of contact? If not, can you point me in the right direction? DMS would like something in writing from WRC (even a quick email stating there are no comments).
>
> Thanks so much for any assistance you can provide!

ATTACHMENT 7

COASTAL CONSISTENCY DETERMINATION FROM

NC DIVISION OF COASTAL MANAGEMENT

DAVEY **Williams, Kimberlee <kwilliams@lmgroup.net>**

RE: [External] Cool Run Mitigation Site; Brunswick County DCM20200040

1 message

Govoni, Daniel <daniel.govoni@ncdenr.gov> Thu, Nov 12, 2020 at 9:12 AM
To: "Williams, Kim" <kwilliams@lmgroup.net>, Kevin Yates <clearwatermitigation@gmail.com>

Hello Kim,

North Carolina's coastal zone management program consists of, but is not limited to, the Coastal Area Management Act, the State's Dredge and Fill Law, Chapter 7 of Title 15A of North Carolina's Administrative Code, and the land use plan of the County and/or local municipality in which the proposed project is located. It is the objective of the Division of Coastal Management (DCM) to manage the State's coastal resources to ensure that proposed federal actions would be compatible with safeguarding and perpetuating the biological, social, economic, and aesthetic values of the State's coastal waters.

DCM has reviewed the submitted information pursuant to the management objectives and enforceable policies of Subchapters 7H and 7M of Chapter 7 in Title 15A of the North Carolina Administrative Code and concurs that the proposed activity is consistent with North Carolina's approved coastal management program.

Prior to the initiation of the activities described, the applicant should obtain any required State approvals or authorizations, including any authorizations required by the N.C. Division of Water Resources. Should the proposed action be modified further, a revised consistency determination could be necessary. This might take the form of either a supplemental consistency determination pursuant to 15 CFR 930.46, or a new consistency determination pursuant to 15 CFR 930.36. Likewise, if further project assessments reveal environmental effects not previously considered, a supplemental consistency certification may be required. If you have any questions, please contact me at (252) 808-2808. Thank you for your consideration of the North Carolina Coastal Management Program.

Daniel

From: Williams, Kim [mailto:kwilliams@lmgroup.net]
Sent: Wednesday, September 16, 2020 1:45 PM
To: Govoni, Daniel <daniel.govoni@ncdenr.gov>; Kevin Yates <clearwatermitigation@gmail.com>
Subject: Re: [External] Cool Run Mi ga on Site; Brunswick County

Hi Daniel
Clearwater Mitigation Solutions, LLC (CMS) and Land Management Group (LMG) plan to provide a full-delivery riparian wetland and stream mitigation project, known as the Cool Run Mitigation Site, for NC Division of Mitigation Services. The site is located in Shallotte, NC (Brunswick County). Because the project is located in a coastal county, we have prepared a Coastal Consistency Determination for your review and concurrence.

Attached is the CCD narrative and site figures. Please review at your convenience and let me know if you have any questions. We look forward to hearing from you.

Thanks!
Kim

Kim Williams | Environmental Scientist

Land Management Group | Environmental Consultants

Direct: 910-452-0001 x 1908 | Cell: 910.471.5035 | Fax: 910.452.0060

3805 Wrightsville Ave., Suite 15 | Wilmington, NC 28403

Email: kwilliams@lmgroup.net | Website: www.lmgroup.net

On Fri, Sep 4, 2020 at 11:26 AM Govoni, Daniel <daniel.govoni@ncdenr.gov> wrote:

> Hello Kim,
>
> Please submit the consistency determina on to me and you may email it. Let me know if you have any other ques ons. Thanks-Daniel
>
> ---
>
> **From:** Williams, Kim [mailto:kwilliams@lmgroup.net]
> **Sent:** Friday, September 4, 2020 11:16 AM
> **To:** Govoni, Daniel <daniel.govoni@ncdenr.gov>
> **Subject:** [External] Cool Run Mi ga on Site; Brunswick County
>
>
>
> Hi Daniel
>
> I hope you are doing well. LMG is working on a stream and wetland restoration project for the NC Division of Mitigation Services called the Cool Run Mitigation Site, which is located in Brunswick County. Because of federal funding, we are

Appendix B – Red-cockaded Woodpecker Effects Determination Key

Note that when the USACE is the lead federal agency for a project, it is responsible for determining (1) the ESA action area for that project and (2) the effects to federally listed species and/or designated critical habitat. Please contact the appropriate USACE representative for any questions as to the action area or the effects determination (for a list of USACE representatives, please see the contact list at http://saw-reg.usace.army.mil/FO/PMList.pdf). The USFWS is available to offer technical assistance to prospective permittees for proposed actions, to include providing guidance on species presence in the action area and how the proposed action is likely to affect the species and/or designated critical habitat.

ORM2 No.: ____ Date ___7/15/22____________________
____

USFWS Reference No. (if applicable):________________

1) Is the action area[1] located within the RCW consultation area (see **Appendix A** and project-specific results from a project-specific IPaC or internal USACE GIS review)?
   a) Yes…………………………………………………………………………………………go to 2
   b) No…………………………………………………………………………………………No effect[2]

2) Is the action area[1] located in the northeastern coastal plain (see **Appendix A**)?
   a) Yes…………………………………………………………………………………………go to 3
   b) No (the project is located in piedmont, sandhills, or southeastern coastal plain)………………go to 4

3) Is the action area[1] located in a forested area with pine trees present in northeast North Carolina (e.g., high pocosin, Atlantic white cedar, nonriverine swamp forests, pond pine woodland, coastal fringe evergreen forest, wet successional pine/pine-hardwood forest, or pine plantation or uplands)? If yes, are the pine trees greater than 30 years of age (if stand age is not readily determined, refer to **Table 1** for a description of the minimum dbh of 30-year-old pines associated with each community type). If the answer to both of these questions is yes, choose Yes below. If the answer to one or both questions is no, then choose No below.
   a) Yes…………………………………………………………………………………………go to 8
   b) No…………………………………………………………………………………………No effect[2]

4) Is the action area[1] located within suitable RCW foraging or nesting habitat (pine or pine/hardwood stands in which 50% or more of the dominant trees are pines and the dominant pine trees are 30 years of age or older or ≥8-inches dbh[5])?
   a) Yes…………………………………………………………………………………………go to 5
   b) No…………………………………………………………………………………………No effect[2]

DRG performed a site assessment of the entire site in 2020. The tract has been managed for silvicultural production for many years and has been recently clear-cut. Some larger hardwoods exist along stream drains, but vegetation is dense in these areas. Other areas that were recently timbered or support young pines, red maple, and sweet gum. Therefore, the site does not appear to provide suitable habitat for the RCW.

5) Will any activity in the action area[1] remove trees equal to or greater than 8 inches dbh; or occur within 200 feet of known RCW cavity trees? If unable to determine the location of a cavity tree with confidence, contact the USFWS Raleigh Ecological Services Field Office.
   a) Yes…………………………………………………………………………………………go to 6

b) No……NLAA[3]

6) Is the action area located in suitable RCW nesting habitat (in the sandhills and piedmont: pine or pine/hardwood stands that contain pines 60 years in age or older or ≥10 inches dbh; in the southeastern coastal plain: pine or pine/hardwood stands that contain pines ≥8 inches dbh, including but not limited to pine flatwoods, pocosin, pine savannah, upland pine/hardwood)?

   a) Yes………go to 9
   b) No……go to 7

7) Does suitable nesting habitat occur within 0.5 miles of suitable foraging habitat that would be impacted by any activity in the action area?
   a) Yes……go to 9
   b) No……NLAA[3]

8) Refer to **Table 1** in the SLOPES for the northeastern North Carolina habitat type in the action area. Are pine trees with a dbh equal to or greater than that shown in **Table 1** proposed to be removed in the action area[1], or is the action area[1] within 200 feet of a cavity tree? If the answer to either of these questions is yes, chose Yes below. If unable to determine the location of a cavity tree with confidence, then contact the USFWS Raleigh Field Office.
   a) Yes……go to 9
   b) No……NLAA[3]

9) Contact the appropriate USACE representative for a pre-application meeting to determine if a survey is necessary (for a list of USACE representatives please see the contact list at http://saw-reg.usace.army.mil/FO/PMList.pdf). Note that project-specific information, such as a delineation of waters of the U.S. and project plans, may be needed for the USACE to determine the action area(s)[1] of the project. If a survey is required and agreed to by the applicant, all suitable RCW nesting habitat within 0.5 miles of the action area should be surveyed according to USFWS protocol for the presence of RCW cavity trees[4]. If the applicant is unwilling or unable to conduct the survey, standard consultation with the USFWS should begin. Such surveys are conducted by running line transects through stands and visually inspecting all medium-sized and large pines for evidence of cavity excavation by RCWs. Transects must be spaced so that all trees are inspected and are run north-south. Was a survey performed?
   a) Yes, a survey was performed, and RCW cavity trees were observed………………………………go to 10
   b) Yes, a survey was performed, no RCW cavity trees were observed, and the USFWS agreed with the survey results……………………………………………………………………………………………………NLAA[3]
   c) No, after conversations with the USFWS the USACE determined that a survey was not necessary………NLAA[3]
   d) No, a survey was not performed…………………………………………………………..Consultation required[5]

10) Does the project involve a disturbance (e.g., seismic activity, percussive activity, all-terrain vehicle or other off-road vehicle use, motorized equipment, forest management or similar disturbance) within the 200-foot cavity tree buffer, and/or removal or damage to RCW cavity trees (e.g., via root compaction, soil compaction)? If yes to either or both then consultation is required.
   a) Yes……….Consultation required[5]
   b) No………go to 11

11) Has a foraging habitat analysis (FHA)[6] been conducted to determine whether enough foraging habitat would remain for each RCW group post-project? For information on how to conduct an FHA, refer to the "Procedures for Determining Foraging Habitat Availability" and the Private Land Guidelines.[7]
    a) Yes, the FHA has been submitted to the USFWS for concurrence[8] and the USFWS concurred that **adequate** amounts of foraging habitat would remain post-project……………………………………NLAA[3]
    b) Yes, and review of the FHA by the USACE along with concurrence from USFWS determined **inadequate** amounts of foraging habitat would remain post-project……….Consultation required[5]
    c) No, an FHA has not been conducted………………………………………………………Consultation required[5]

[1]Please contact the appropriate USACE representative for any questions as to the size of the action area. For a list of USACE representatives please see the contact list at http://saw-reg.usace.army.mil/FO/PMList.pdf.

[2]No effect – The proposed project would result in no effect to this species and/or its federally designated critical habitat (if applicable). Further consultation with the USFWS Raleigh and Asheville Ecological Services field offices is not necessary for the project as described.

[3]NLAA – The proposed project may affect but is not likely to adversely affect this species and/or its designated critical habitat (if applicable). NLAA determinations for projects made pursuant to this key require no further consultation with the USFWS Raleigh and Asheville Ecological Services field offices, therefore, consultation is considered complete for this species. For General Permits, a Pre-Construction Notification will be required for all NLAA determinations.

[4]Follow link to USFWS RCW Recovery Plan, Appendix 4 for additional information on nesting and foraging habitats, and survey protocol (https://www.fws.gov/rcwrecovery/files/RecoveryPlan/survey_protocol.pdf)

[5]Consultation required – Contact the USACE to begin this consultation process. For a list of USACE representatives please see the contact list at http://saw-reg.usace.army.mil/FO/PMList.pdf. Further consultation with the USFWS Raleigh and Asheville Ecological Services field offices is necessary to discern if the activity would result in a "no effect," "not likely to adversely affect," or "likely to adversely affect" determination.

[6]Follow links for additional information on conducting FHA (https://www.fws.gov/rcwrecovery/matrix.html) and for determining foraging habitat availability (https://www.fws.gov/ncsandhills/files/fha_data_collection_procedures.pdf).

[7]Follow link for additional information regarding determination for adequate amount of foraging habitat (https://www.fws.gov/rcwrecovery/files/RecoveryPlan/private_lands_guidelines.pdf).

[8] FHA – When an FHA is conducted, the USACE must provide the FHA to USFWS for review and concurrence.

Additional Information ____
____
____
____
____
____
____

Appendix F

FEMA Coordination
HEC-RAS
DrainMod Analysis
Hydrographs/Precipitation Data

From: Grant Lewis
To: john.shirk@brunswickcountync.gov
Cc: Kevin Yates; Fryar, Wesley
Subject: Cool Run Stream Restoration Site FEMA Coordination
Date: Tuesday, July 6, 2021 12:06:00 PM
Attachments: FEMA.pdf

Hello Mr. Shirk;

I am in the early stages of a stream and wetland restoration project near the Town of Shallotte, in Brunswick County. The project is intended to restore ditched and dredged streams along Cool Run and an associated tributary, as well as, adjacent riparian wetlands.

This project is being conducted for the State of North Carolina Division of Mitigation Services (formerly known as the Ecosystem Enhancement Program [EEP]). As part of the project, we are required to obtain confirmation from the local floodplain administrator confirming actions to be conducted with FEMA. Our project is not located in any FEMA flood zones; therefore, I am not expecting to complete a CLOMR or LOMR.

If you could please review the attached information and check/sign the last page of the EEP Floodplain Requirements Checklist I would greatly appreciate it. If you have any questions, please do not hesitate to contact me.

Thank you.
Grant

Grant Lewis
Senior Project Manager
Axiom Environmental, Inc.
218 Snow Avenue
Raleigh, North Carolina 27603
glewis@axiomenvironmental.org
(919) 215-1693 (cell)

Axiom Environmental, Inc.

Axiom Environmental, Inc.

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

July 6, 2021

John Shirk
Brunswick County Floodplain Administrator
75 Courthouse Drive (Building 1)
Bolivia, NC 28422

Re: Cool Run Stream and Wetland mitigation project
Brunswick County **21-008**
FEMA Floodplain Requirements Checklist

Dear Mr. Shirk:

The purpose of this letter is to request concurrence from Brunswick County concerning a stream and wetland restoration site located in near the Town of Shallotte. The Site encompasses approximately 25.6 acres of agriculture land used for row crops and cut over timberland along Cool Run and an unnamed tributary. Proposed activities at the Site include the restoration of stream channels and riparian wetlands.

FEMA mapping was reviewed to determine if the project is in a FEMA study area (DFIRM panel numbers 1048, 1068, 1057, and 1067). Based on existing floodplain mapping, the Site is not overlain by any FEMA mapped zones or floodways. We request guidance from your organization as to how to move forward with the project.

We thank you in advance for your timely response and cooperation. Please feel free to contact me at the above referenced phone number with any questions that you may have with this project.

Yours truly,

AXIOM ENVIRONMENTAL

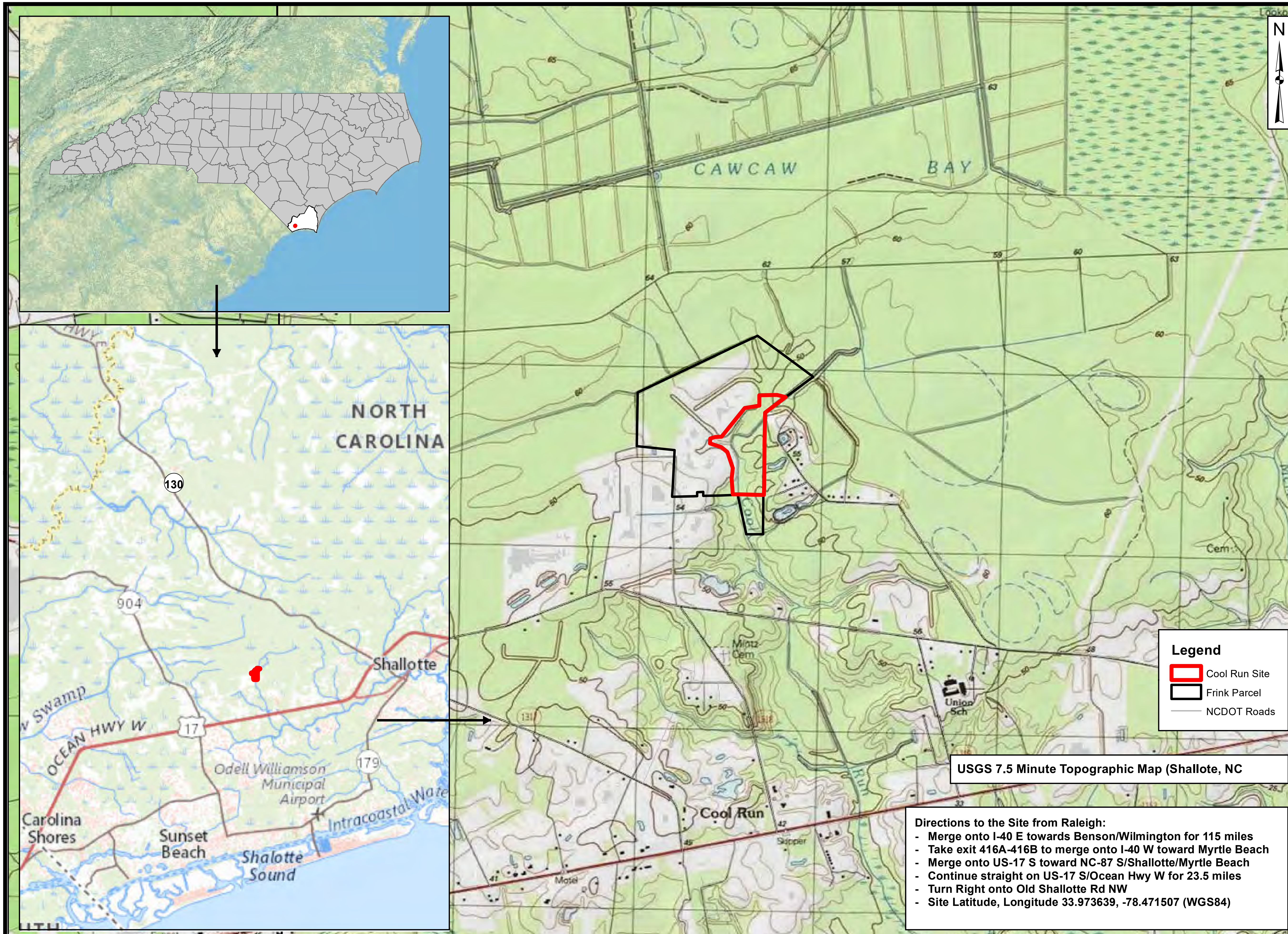
W Grant Lewis

W. Grant Lewis
Senior Project Manager

Attachments

Figure 1 Site Location
Figure 2 Hydrologic Unit Map
Figure 3 Topography and Drainage Area
Figure 4A Existing Conditions
Figure 4B LIDAR
Figure 5 Reference Dimension, Pattern, and Profile
Figure 6 Proposed Conditions
Figure 7 Proposed Dimension, Pattern, and Profile

EEP Floodplain Requirements Checklist



Directions to the Site from Raleigh:

- Merge onto I-40 E towards Benson/Wilmington for 115 miles
- Take exit 416A-416B to merge onto I-40 W toward Myrtle Beach
- Merge onto US-17 S toward NC-87 S/Shallotte/Myrtle Beach
- Continue straight on US-17 S/Ocean Hwy W for 23.5 miles
- Turn Right onto Old Shallotte Rd NW
- Site Latitude, Longitude 33.973639, -78.471507 (WGS84)

Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

SITE LOCATION

Drawn by: AEK

Date: JUNE 2021

Scale: 1:20,000

Project No.: 21-008

FIGURE

1

Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

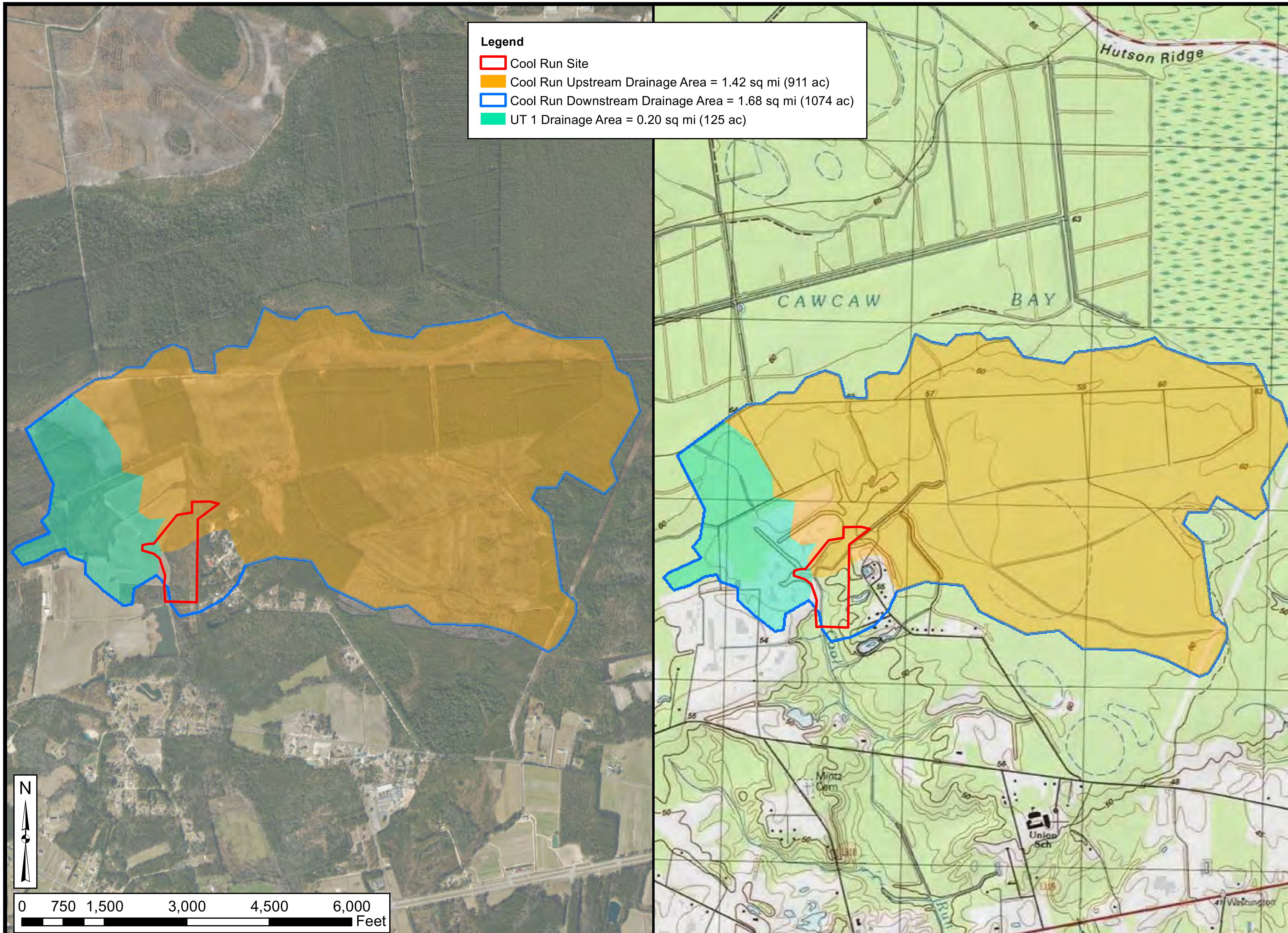
Title:

HYDROLOGIC UNIT MAP

Drawn by:	AEK
Date:	JUNE 2021
Scale:	1:145,000
Project No.:	21-008

FIGURE

2



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

TOPOGRAPHY AND DRAINAGE AREA

Drawn by: AEK

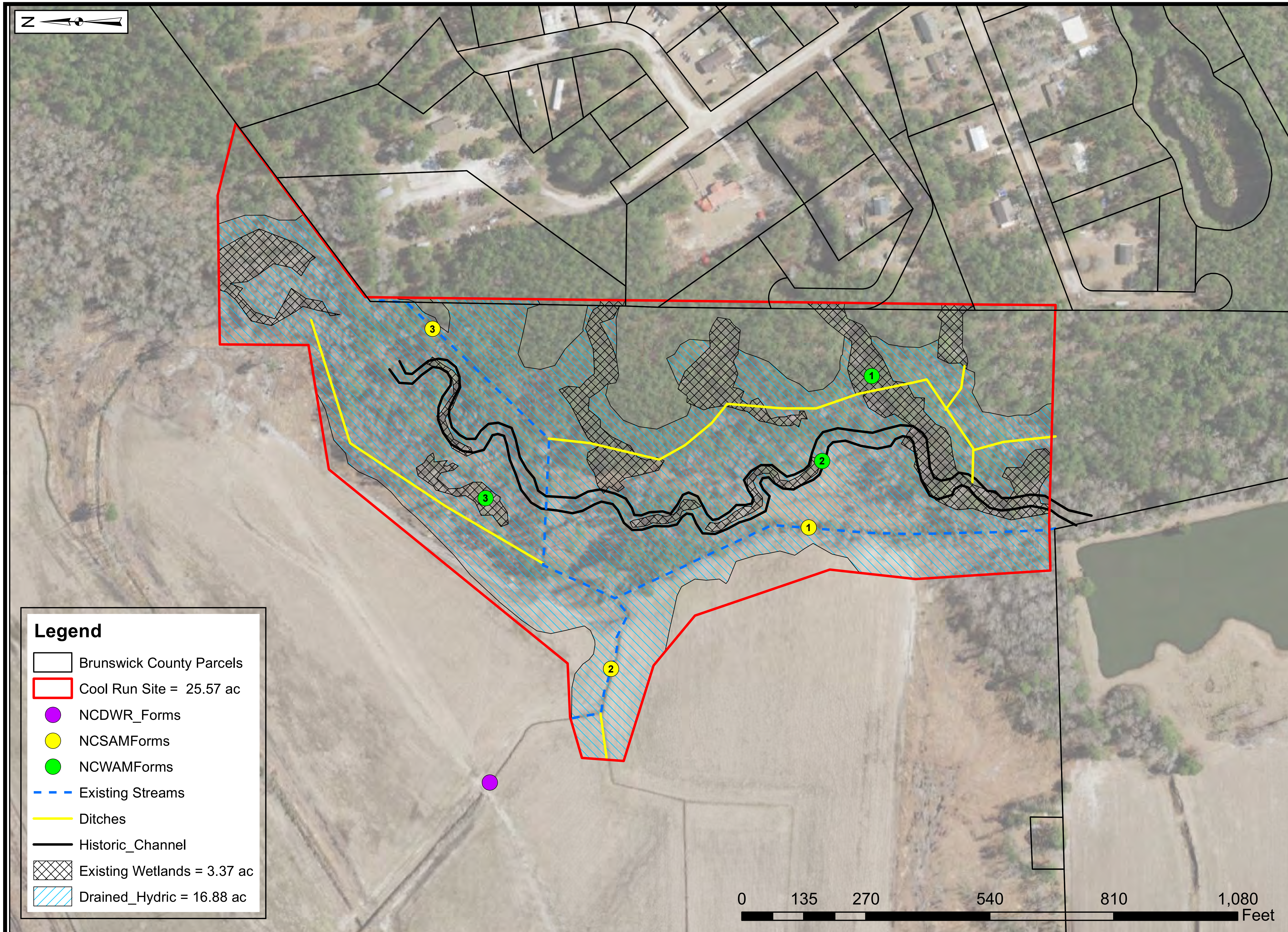
Date: MAR 2021

Scale: 1:20,000

Project No.: 21-008

FIGURE

3



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

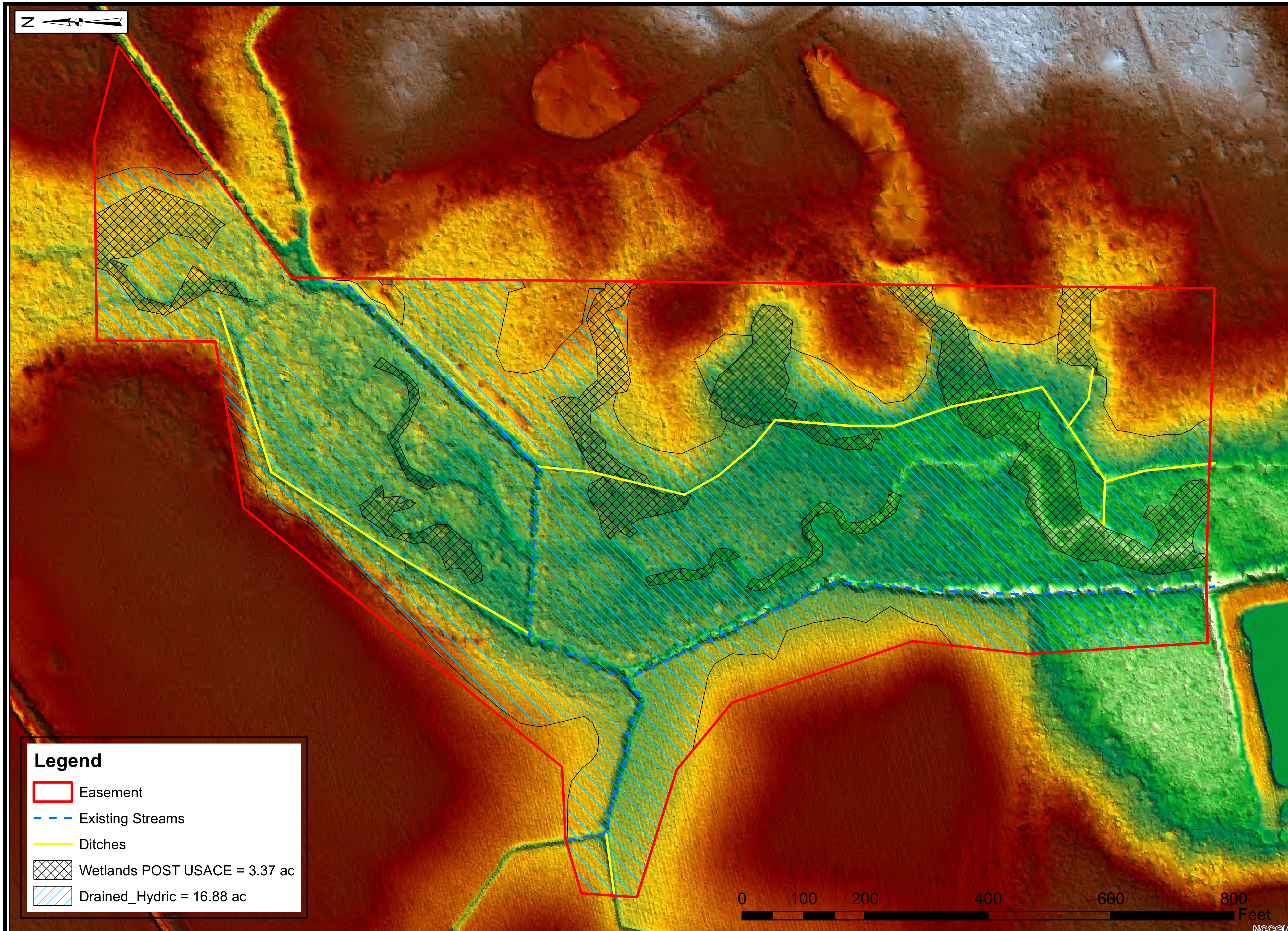
Title:

EXISTING CONDITIONS

Drawn by:	WGL
Date:	JUNE 2021
Scale:	1:1800
Project No.:	21-008

FIGURE

4A



Axiom Environmental, Inc.

Prepared for:

CLEARWATER MITIGATION SOLUTIONS

Project:

COOL RUN MITIGATION SITE

Brunswick County, NC

Title:

LIDAR

Drawn by: WGL

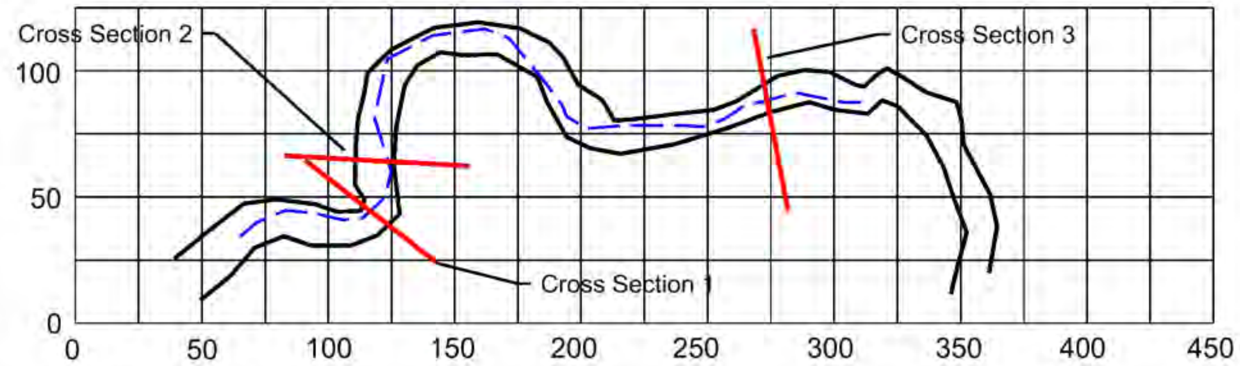
Date: JUNE 2021

Scale: 1:1800

Project No.: 21-008

FIGURE

4B



Reference Pattern

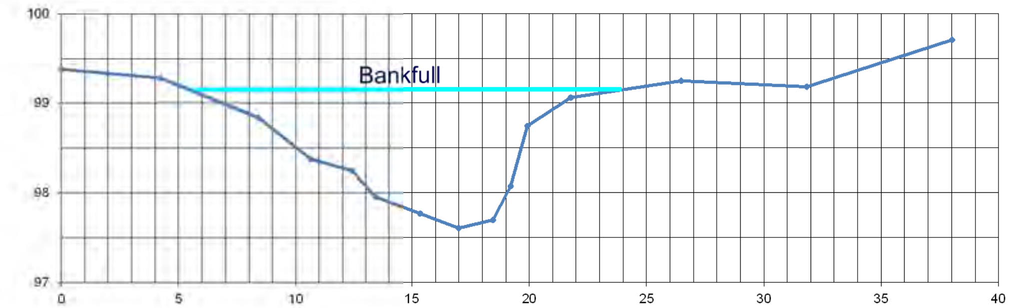
Lp-p = 62 (31 - 93) ft
Lm = 102 (62 - 130) ft
Wbelt = 60 (46 - 74) ft
Rc = 18 (9 - 28) ft
Lp-p/Wbkf = 4.5 (2.3 - 6.9)
Lm/Wbkf = 7.5 (4.5 - 9.6)
Wbelt/Wbkf = 4.4 (3.4 - 5.4)
Rc/Wbkf = 1.3 (0.6 - 2.0)
SIN = 1.32

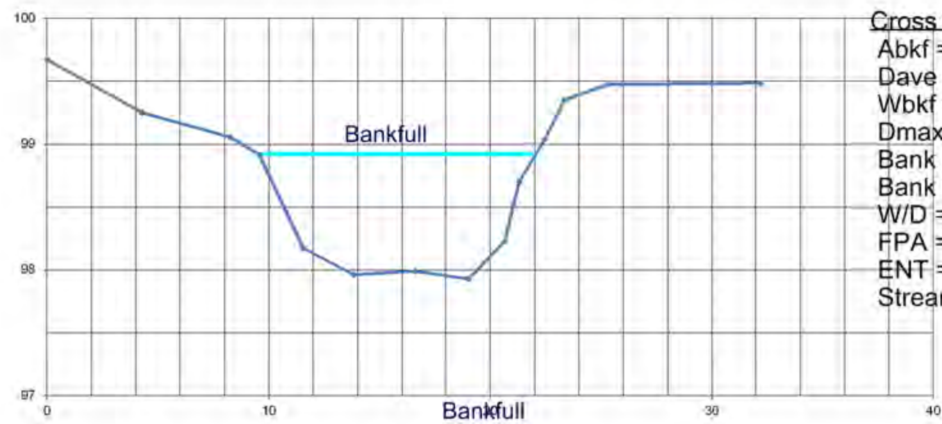
Pattern Legend

- Top of Bank
- Thalweg
- Cross Section

Cross Section 1 - Pool

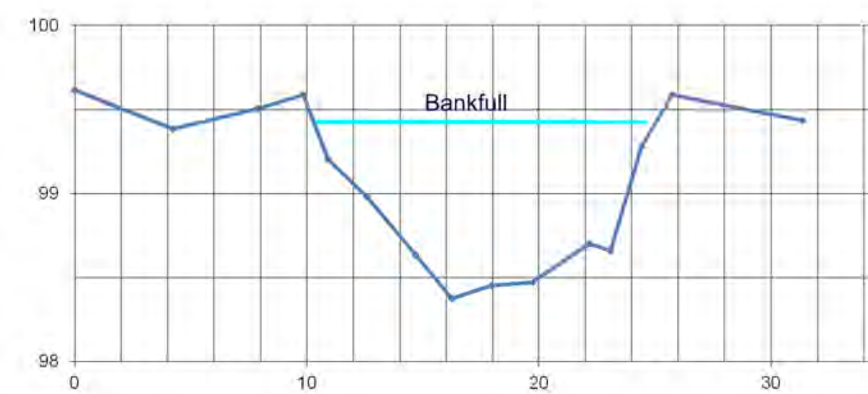
Abkf = 13.9 ft
Wbkf = 19.5 ft
Dmax = 1.6 ft





Cross Section 2 - Riffle

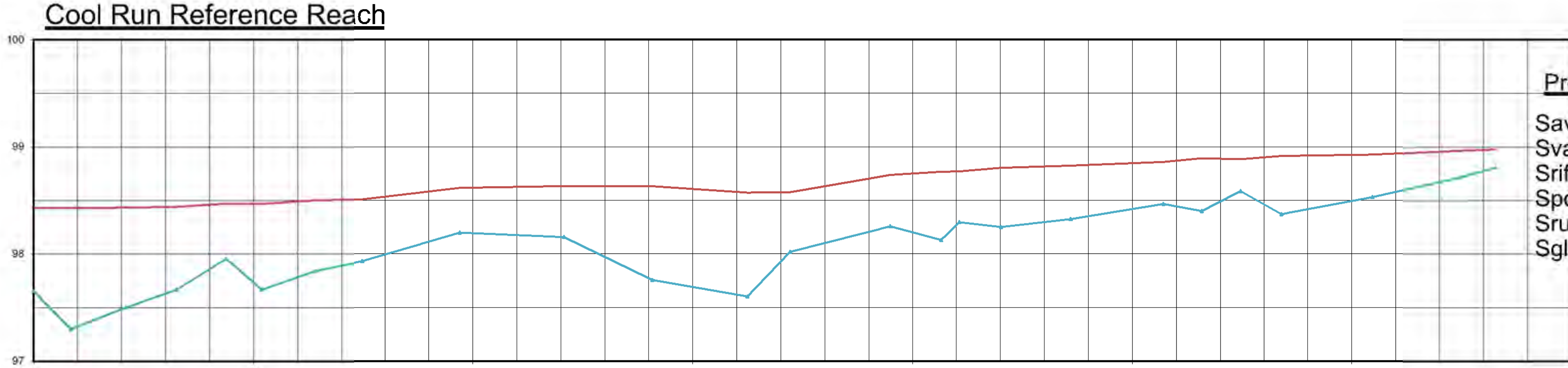
Abkf = 9.4 ft
Dave = 0.7 ft
Wbkf = 12.5 ft
Dmax = 1.0 ft
Bank Height = 1.0 ft
Bank Height Ratio = 1.0
W/D = 16.7
FPA = 100
ENT = 8.0
Stream Type = C



Cross Section 3 - Riffle

Abkf = 9.7 ft
Dave = 0.7 ft
Wbkf = 14.7 ft
Dmax = 1.0 ft
Bank Height = 1.0 ft
Bank Height Ratio = 1.0
W/D = 22.5
FPA = 100
ENT = 6.8
Stream Type = C

Cool Run Reference Reach



Profile (Reference Reach)

Save = 0.0016 rise/run
Svalley = 0.0021 rise/run
Sriffle = 0.0026 (0.0013 - 0.0055) rise/run
Spool = 0.0004 (0 - 0.0034) rise/run
Srun = 0.0006 (0.0004 - 0.0034) rise/run
Sglide = 0 (0 - 0.0039) rise/run

- Water Surface
- Channel Bed

Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

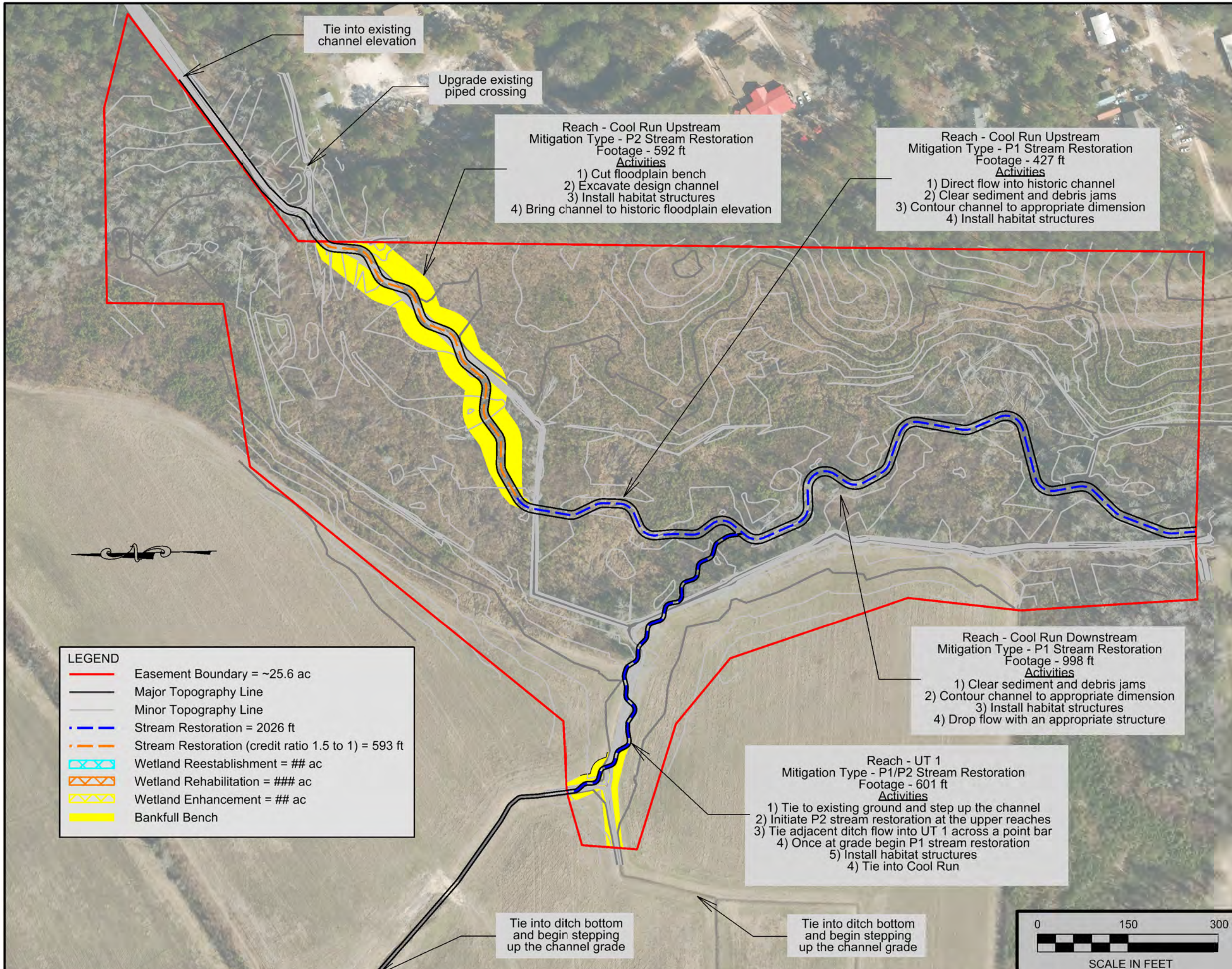
Project:

Cool Run Mitigation Site
Brunswick County
North Carolina

Title:

Cool Run Reference Reach Dimension, Pattern, and Profile

Scale: NA	FIGURE NO. 5
Date: Apr 2021	
Project No.: 21-008	



Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

Project:

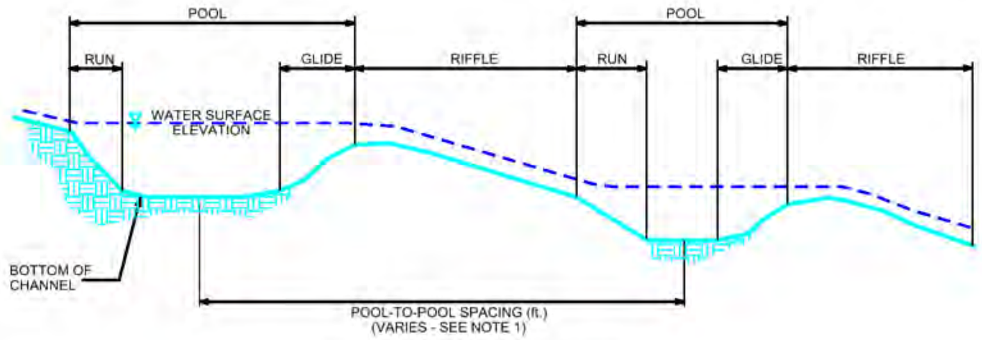
Cool Run Mitigation Site
Brunswick County
North Carolina

Title:

Restoration Plan

Scale: As Shown
Date: Apr 2021
Project No.: 21-008

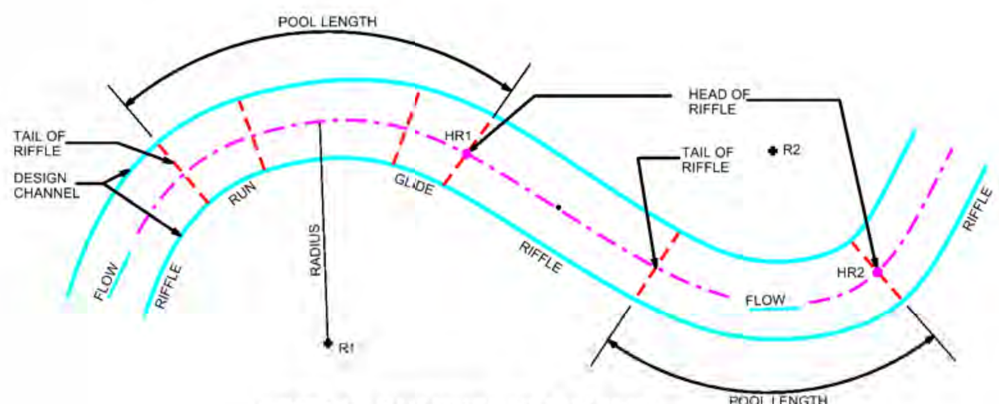
FIGURE NO. 6



TYPICAL CHANNEL PROFILE

NOTES:

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

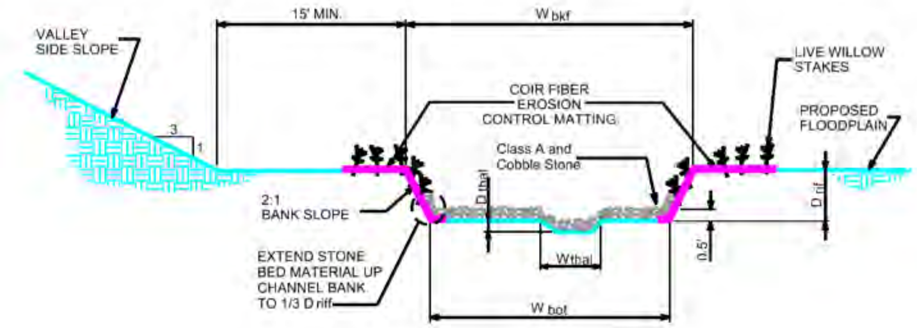


TYPICAL CHANNEL PLAN VIEW

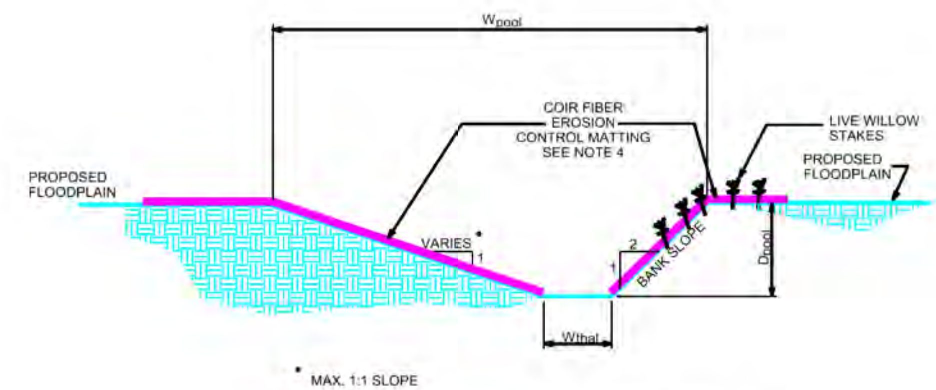
CHANNEL PLAN VIEW NOTES:

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BY LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS SHALL COMPLETE THE LAYOUT OF THE CHANNEL.

2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO SAVE TREES OR AVOID OBSTACLES. THE STAKE-OUT SHALL BE APPROVED BY THE CONSTRUCTION MANAGER BEFORE CONSTRUCTION OF THE CHANNEL.



TYPICAL RIFFLE CROSS-SECTION



* MAX. 1:1 SLOPE

TYPICAL POOL CROSS-SECTION

CHANNEL CONSTRUCTION NOTES:

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

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

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

CROSS-SECTION DIMENSIONS

REACH	Wbkf (ft.)	Wbot (ft.)	Driff (ft.)	Dthal (ft.)	Dpool (ft.)	Wpool (ft.)	Wthal (ft.)
Cool Run Upstream	14.1	10.1	0.9	0.1	1.3	18.4	1.0
Cool Run Downstream	15.0	11.0	0.9	0.1	1.3	19.5	1.0
UT 1	5.8	3.8	0.4	0.1	0.7	7.5	1.0

Axiom Environmental, Inc.

CLEARWATER MITIGATION SOLUTIONS

NOTES/REVISIONS

Project:

Cool Run Mitigation Site Brunswick County North Carolina

Title:

PROPOSED DIMENSION, PATTERN, AND PROFILE

Scale: NA

Date: Apr 2021

Project No.: 21-008

FIGURE NO. 7

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:	Cool Run Site
Name if stream or feature:	Cool Run
County:	Brunswick
Name of river basin:	Lumber
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Shallotte
DFIRM panel number for entire site:	1048, 1068, 1057, and 1067
Consultant name:	Axiom Environmental, Inc.
Phone number:	919-215-1693
Address:	218 Snow Avenue Raleigh, NC 27603

Design Information

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

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

Example

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

Floodplain Information

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

○ Yes ◉ No The lower reaches

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

☐ Redelineation

☐ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☑ Don't know

List flood zone designation:

Check if applies:

☐ AE Zone

- ○ Floodway
- ○ Non-Encroachment
- ◉ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet:

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

○ Yes ◉ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

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

Is community/county participating in the NFIP program?

○ Yes ● No

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

Name of Local Floodplain Administrator: John Shirk
Phone Number: 910-253-2046

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 (CLOMR)

☐ Other Requirements

List other requirements:

Comments:

Name: W. Grant Lewis Signature: W Grant Lewis

Title: President Date: 7/6/2021

HEC-RAS MODELING REPORT

Cool Run Mitigation Site
Brunswick County, NC

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

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

10/13/2021

PREPARED BY:

SUNGATE DESIGN GROUP, P.A.

905 Jones Franklin Road
Raleigh, NC 27606
Engineering Firm License No. C-0890

HEC-RAS Model Report

The Cool Run Mitigation Site is a stream and wetland restoration and enhancement project located on one unnamed tributary to Cool Run in Brunswick County, NC. The site is located in the Lumber River Basin and the project site is not located within a FEMA study area. All cross sections of CR (Cool Run) were modeled and analyzed in HEC-RAS Version 5.0.7.

MicroStation and GEOPAK software was used to create a proposed TIN file based on the stream restoration design. Cross sections were extracted from the TIN file using GEOPAK software and imported in HEC-RAS. Cross Sections were taken from select riffle locations along the stream reach with additional sections added upstream of the project to analyze the impact of the proposed stream restoration project on water surface elevations beyond the project boundary. Existing ground survey data was collected by K2 Design Group, PA and supplemented with QL2 LiDAR data.

The 10, 25, 50, and 100-year storm event discharges were calculated using USGS SIR 2009-5158. Manning's n values were estimated to be 0.045 within the channel and 0.15 for overbank areas for the existing and proposed conditions (after several growing seasons). Normal depth at the downstream section was used as the boundary condition for the storm profiles based on existing downstream channel slope.

Results

The model was run without errors. Water surface elevations (WSEs) were compared between the existing and proposed conditions. See the attached WSE comparison table.

Section 2017 is located at the beginning (upper limit) of the stream restoration project. WSEs decrease for each storm event in the proposed condition. Even though the bed profile is being raised significantly (1.8 ft), the excavation in the floodplain increases the overbank area which offsets any potential increases in WSEs.

Section 2383 is located beyond the stream restoration project limits, but still on the Stanley property. Minor increases in WSEs were noted with a maximum of 0.04 ft in the 50-yr event. However, as noted above, these increases are still located on the Stanley property.

Section 2533 is located at the upstream limit of the Stanley property. WSEs for all storm events matched exactly at this section.

Section 2733, 2933, and 3050 also show no increases to WSEs.

Conclusions

Based on the model results, hydraulic trespass will not occur upstream of the Stanley property limits during the 10, 25, 50, and 100-year storm events as a result of the proposed stream restoration project.

HEC-RAS	River: Cool Run					Date: 10/13/2021
River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Project Impact Prop. - Exist. (ft)
3050	100 YR	Existing	499	43.8	51.35	
3050	100 YR	Proposed	499	43.8	51.35	0.00
3050	50 YR	Existing	407	43.8	50.61	
3050	50 YR	Proposed	407	43.8	50.61	0.00
3050	25 YR	Existing	324	43.8	49.86	
3050	25 YR	Proposed	324	43.8	49.86	0.00
3050	10 YR	Existing	230	43.8	48.87	
3050	10 YR	Proposed	230	43.8	48.87	0.00
2933	100 YR	Existing	499	42.9	50.83	
2933	100 YR	Proposed	499	42.9	50.83	0.00
2933	50 YR	Existing	407	42.9	50.12	
2933	50 YR	Proposed	407	42.9	50.11	-0.01
2933	25 YR	Existing	324	42.9	49.38	
2933	25 YR	Proposed	324	42.9	49.38	0.00
2933	10 YR	Existing	230	42.9	48.44	
2933	10 YR	Proposed	230	42.9	48.44	0.00
2733	100 YR	Existing	499	42.5	49.99	
2733	100 YR	Proposed	499	42.5	49.99	0.00
2733	50 YR	Existing	407	42.5	49.29	
2733	50 YR	Proposed	407	42.5	49.28	-0.01
2733	25 YR	Existing	324	42.5	48.56	
2733	25 YR	Proposed	324	42.5	48.56	0.00
2733	10 YR	Existing	230	42.5	47.67	
2733	10 YR	Proposed	230	42.5	47.67	0.00
2533	100 YR	Existing	499	41.1	49.25	
2533	100 YR	Proposed	499	41.1	49.25	0.00
2533	50 YR	Existing	407	41.1	48.58	
2533	50 YR	Proposed	407	41.1	48.58	0.00
2533	25 YR	Existing	324	41.1	47.89	
2533	25 YR	Proposed	324	41.1	47.89	0.00
2533	10 YR	Existing	230	41.1	47.10	
2533	10 YR	Proposed	230	41.1	47.10	0.00
2383	100 YR	Existing	499	42.1	46.70	
2383	100 YR	Proposed	499	42.1	46.72	0.02
2383	50 YR	Existing	407	42.1	46.32	
2383	50 YR	Proposed	407	42.1	46.36	0.04
2383	25 YR	Existing	324	42.1	46.25	
2383	25 YR	Proposed	324	42.1	46.27	0.02

2383	10 YR	Existing	230	42.1	46.00	
2383	10 YR	Proposed	230	42.1	46.01	0.01
2153	100 YR	Existing	499	41.3	46.41	
2153	100 YR	Proposed	499	41.3	46.36	-0.05
2153	50 YR	Existing	407	41.3	46.17	
2153	50 YR	Proposed	407	41.3	46.11	-0.06
2153	25 YR	Existing	324	41.3	45.92	
2153	25 YR	Proposed	324	41.3	45.87	-0.05
2153	10 YR	Existing	230	41.3	45.59	
2153	10 YR	Proposed	230	41.3	45.54	-0.05
2017	100 YR	Existing	499	41	46.08	
2017	100 YR	Proposed	499	42.76	46.04	-0.04
2017	50 YR	Existing	407	41	45.85	
2017	50 YR	Proposed	407	42.76	45.80	-0.05
2017	25 YR	Existing	324	41	45.61	
2017	25 YR	Proposed	324	42.76	45.56	-0.05
2017	10 YR	Existing	230	41	45.30	
2017	10 YR	Proposed	230	42.76	45.26	-0.04

8/17/99

COOL RUN BRANCH
BRUNSWICK COUNTY

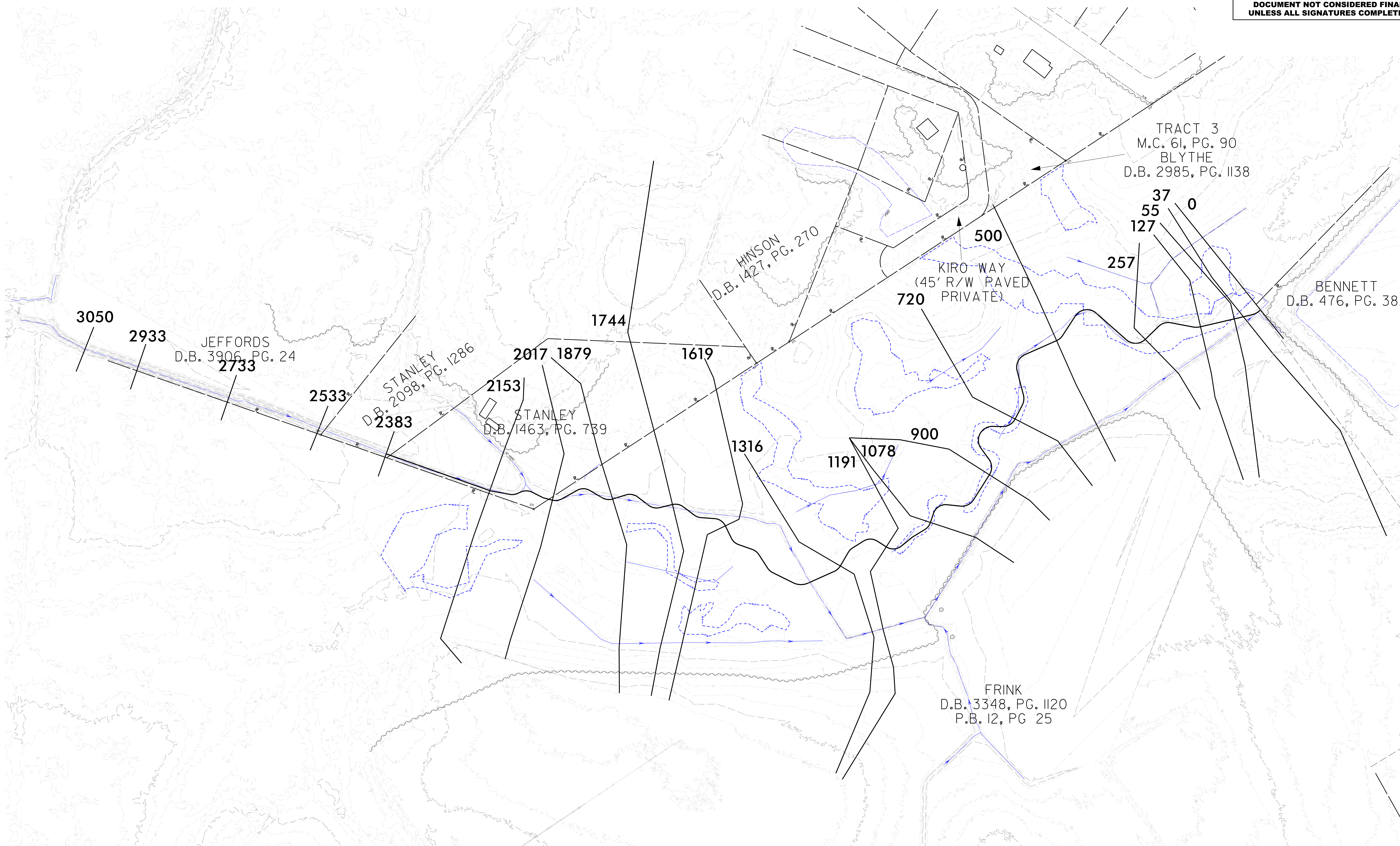
NAD 83

100' 50' 0 100' 200'

SCALE: 1" = 100'

PROJECT REFERENCE NO.	SHEET NO.
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION	

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED



$$$$$SYSTIME$$$$$ $$$$$DGN$$$$$ $$$$$USERNAME$$$$$

COOL RUN MITIGATION SITE
BRUNSWICK COUNTY, NC

DRAINMOD ASSESSMENT

I. Introduction

On behalf of Clearwater Mitigation Solutions, Land Management Group (LMG) has prepared the following DRAINMOD assessment for the Cool Run Mitigation Site (Site). The Site is located north of Old Shallotte Rd (SR 1316), approximately 6.5 miles west of the Shallotte, NC. The site has been historically managed for agriculture and silvicultural production since the 1950's. Intensive site management practices (including the ditching, grading, agricultural row cropping and conversion to loblolly pine plantation) has resulted in the loss and/or degradation of stream and wetland functions on the site.

Site-specific soils information, current drainage conditions, and geomorphological data were used to perform DrainMod computer modeling. DRAINMOD is a field-scale hydrologic model originally developed for the design of subsurface drainage systems. Its application is now widely used for the purposes of evaluating lateral drainage effects of existing ditches and modeling for wetland restoration purposes. The model incorporates long-term climatological data in conjunction with site-specific model inputs. For the Site, the model has been run utilizing field-estimated conductivity rates for the specific soil series identified by licensed soil scientists of LMG. In order to determine the drainage response relative to existing ditch size, multiple DRAINMOD analyses were conducted utilizing various input parameters. These models incorporated typical channel geometry observed for the drainage ditches and channelized streams onsite.

DRAINMOD utilizes Reference Wetland Simulation (RWS) in which typical reference soil and drainage inputs are used to determine minimum hydrology requirements satisfying Section 404 wetland jurisdictional criteria. Separate model runs are then analyzed to determine both current drainage alterations and post-restoration conditions. More detailed information regarding site conditions, model inputs, and results (for both pre- and post-project conditions) are provided below.

II. Site Conditions

The Site (approximately 25.6 acres) consists of degraded streams and riparian wetlands in the Coastal Plain of North Carolina. These resources include Cool Run, UT 1, and adjacent existing and drained wetlands. The western portion of the Site includes an upland buffer ranging from 100 to 200 feet in width. The floodplain and upland buffer were logged between 2016 and 2018 and are currently dominated by early successional species.

The majority of wetlands associated with the tributary of Cool Run were confirmed to consist of the Muckalee loam series. These soils are poorly drained and formed in loamy and sandy alluvium on floodplains of streams in the Coastal Plain. The outer edges of the floodplain were identified to consist of Lumbee loam soils (fine-loamy soils over sands occurring along stream terraces). Approximately 1,934 linear feet of Cool Run and 335 linear feet of UT 1 have been ditched and are currently incised 3 to 4 feet deep. Additional, shallow ditches are also present on-site but were not used in the DRAINMOD analysis, as the incised stream channel is the primary driver influencing groundwater hydrology within the project area.

III. Drainage Modeling

DRAINMOD software, an approved hydrologic modeling tool (USACE, 2008), was utilized to determine the extent of drainage throughout the site (as well as post-restoration conditions). This software models the cumulative effects of parallel drainage features using long-term climate data and user-supplied inputs. The user-supplied inputs allow for site-specific drainage spacings, ditch depths, and soil conductivity rates to be modeled over long-term data sets (i.e. 30 years). This long-term approach provides information on the hydrology of the site in a variety of climatic conditions, which can aid in the determination of the effective lateral drainage distance of a ditch.

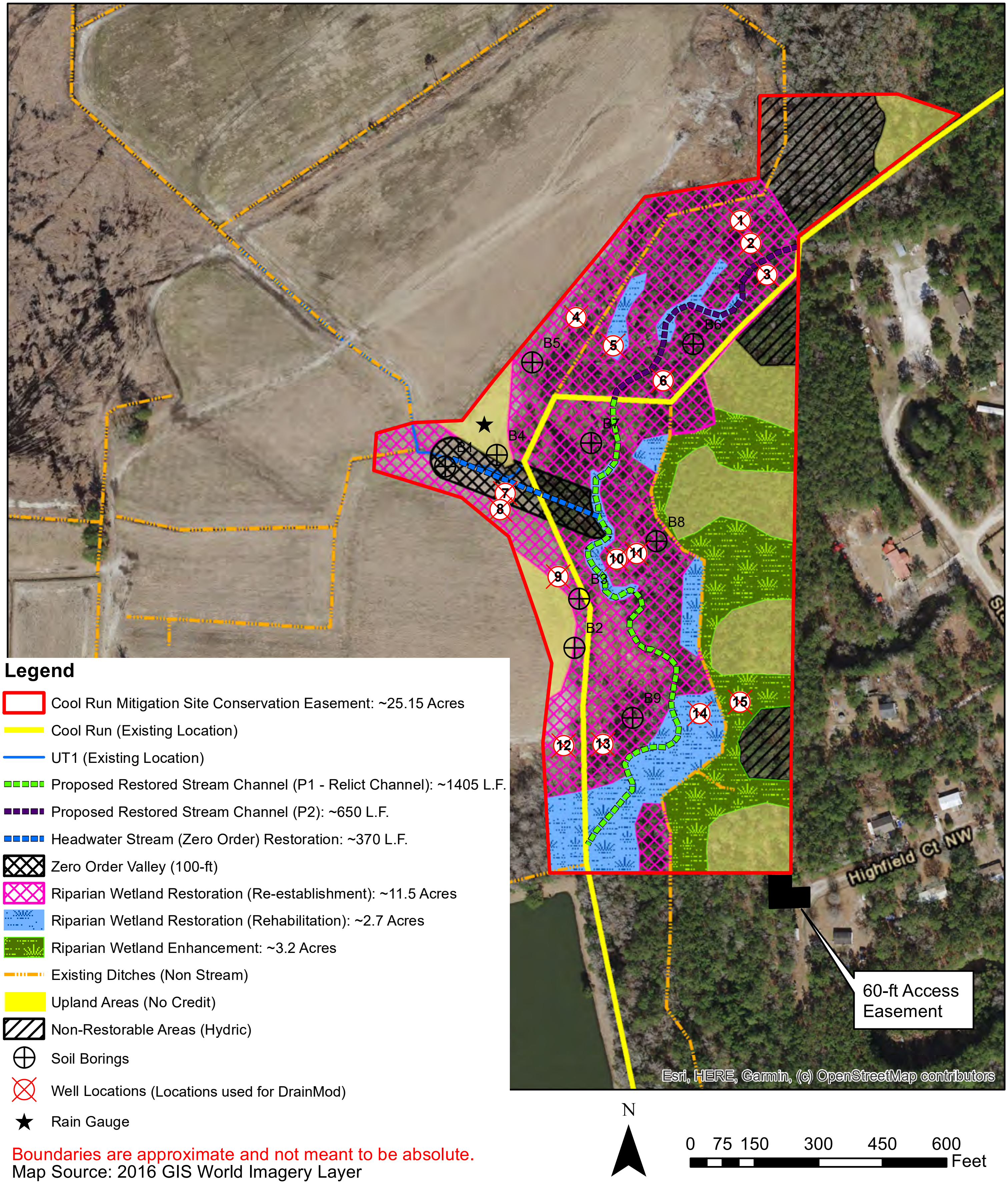
The calibration process consisted of adjusting soil property inputs so that model predictions match, as closely as possible, the measured water table fluctuations in response to measured rainfall and calculated evapotranspiration (ET). Soil properties vary between soil series, and from point to point within a given soil series. Calibration provides a method of determining the field effective soil property values for each observation well. The DRAINMOD model was calibrated separately for each transect location. The calibration of the model utilized site-specific data for soil horizon depths and conductivity rates. Based upon soil temperature and observed bud burst data from other mitigation sites on the Outer Coastal Plain, the growing season for modeling purposes was assumed to be from February 1 through November 30, and the critical period was set at 15 days (approximately 5% of the growing season). Climate data from Wilmington, N.C. were used for modeling input based upon proximity of this weather station to the mitigation site. Threshold settings for each different configuration were based on the number of consecutive days necessary to meet the wetland hydrology criteria. This criteria states that a site must exhibit water table depths within 12 inches of the surface for 15 consecutive days during the growing season. When these conditions are met for >50% of the years during a given study, the site is considered to be jurisdictional wetlands. For the purpose of post-project modeling, a threshold of 36 consecutive days was used to determine if drainage alterations would result in restoration of wetland hydrology (corresponding to the restoration goal of a minimum 12% hydroperiod).

Summary results from the different configurations are presented in Table 1. Based upon these results, a 3- to 5-ft ditch or incised stream effectively lowers the water table for a distance between approximately 130 ft and 300 ft in the Muckalee soils of the site. For the Lumbee series, a 3- to 5-ft ditch/incised stream effectively lowers the water table for a lateral distance of approximately 150 ft to 390 ft. These results are consistent with drainage conditions observed on-site.

Based on the combination of field observations, soil borings, and DRAINMOD results approximately 14 acres of the Site appear to have been effectively drained and are considered suitable for wetland restoration (see Figure 6B of the Wetland Mitigation Plan). Note that the DRAINMOD results above reflect the lateral drainage effects sufficient to remove hydrology. Although areas beyond the identified lateral drainage effect may still maintain water table depths sufficient to meet the wetland hydrology criteria, the lateral drainage influence exerts hydrologic modifications beyond these distances. As a result, areas beyond the identified lateral drainage distances that exhibit field indicators of altered hydrology may be considered suitable for wetland enhancement via stream restoration and removal of on-site ditches.

Table 1. Results from Cool Run DRAINMOD Study

Well	Ditch Depth Pre/Post (ft)	Ditch Spacing (ft)	Soil Unit	Depth to Impermeable Layer (cm)	Drainage Coefficient (cm/day)	Number of Years Meeting Wetland Hydrology	Length of Study (years)	Percentage of Years (>50% = wet)	Status
1	3.5	344	Muckalee	310	0.3	9	30	30%	Drained
	1.8	344	Muckalee	310	0.3	16	30	53%	Restorable
2	Gauge data could not be calibrated								
3	3.1	131	Muckalee	310	0.3	6	30	20%	Drained
	1.4	131	Muckalee	310	0.3	17	30	57%	Restorable
4	5.0	394	Lumbee	310	0.3	10	30	33%	Drained
	1.0	394	Lumbee	310	0.3	26	30	87%	Restorable
5	Well located in existing wetland								
6	2.7	98	Muckalee	310	0.3	11	30	37%	Drained
	1.0	98	Muckalee	310	0.3	26	30	87%	Restorable
7	3.5	148	Lumbee	310	0.3	0	30	0%	Drained
	1.0	148	Lumbee	310	0.3	17	30	57%	Restorable
8	4.5	180	Lumbee	310	0.3	0	30	0%	Drained
	1.5	180	Lumbee	310	0.3	16	30	53%	Restorable
9	3.8	131	Lumbee	310	0.3	0	30	0%	Drained
	1.0	131	Lumbee	310	0.3	21	30	70%	Restorable
10	5.0	164	Muckalee	310	0.3	0	30	0%	Drained
	1.0	164	Muckalee	310	0.3	19	30	63%	Restorable
11	5.0	262	Muckalee	310	0.3	0	30	0%	Drained
	1.0	262	Muckalee	310	0.3	19	30	63%	Restorable
12	4.6	197	Muckalee	310	0.3	1	30	3%	Drained
	1.0	197	Muckalee	310	0.3	18	30	60%	Restorable
13	3.3	131	Muckalee	310	0.3	0	30	0%	Drained
	1.0	131	Muckalee	310	0.3	20	30	67%	Restorable
14	Well located in existing wetland								
15	Well located in existing wetland								



Cool Run Mitigation Site Clearwater Mitigation Solutions Brunswick County, NC Map Date: 10-11-19 LMG19.196	CLEARWATER MITIGATION SOLUTIONS LMG LAND MANAGEMENT GROUP a DAVEY company	**Figure 9** **Proposed Mitigation Layout** **Response to RFP#:16-20190201**

COOL_RUN_CAL_WELL_1.OUT

```
******************************************************************************

                              D R A I N M O D  6.1

                 Copyright 1980-2013 North Carolina State University
                            LAST UPDATE: April 2013
                              LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                    STMAX =  .00 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                    DDRAIN =108. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN =10500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                             HDRAIN =200. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   61.0               6.000
                   61.0 -  107.0                .100
                  107.0 -  310.0                .900
```

```
DEPTH TO DRAIN = 108.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 199.7 CM
DISTANCE BETWEEN DRAINS = 10500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  307.7 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.10

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   4.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   108.0   108.0   108.0   108.0   108.0   108.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   108.0   108.0   108.0   108.0   108.0   108.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
                         COOL_RUN_CAL_WELL_1.OUT
                          9   24        10.0
                          9   25         3.0
                         12   31         3.0



                         WASTEWATER IRRIGATION
                         ********************


     NO WASTEWATER IRRIGATION SCHEDULED:
     -----------------------------------


   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    36




Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00




   Mrank indicator =  1




 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15: 9
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   10500. cm   drain depth =  108.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 909.092
**> End Computations      = 909.092
**> Total simulation time =      .0 seconds.
```

COOL_RUN_CAL_WELL_3.OUT

```
******************************************************************************

                              D R A I N M O D  6.1

                 Copyright 1980-2013 North Carolina State University
                            LAST UPDATE: April 2013
                              LANGUAGE FORTRAN 77/90

             DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
             THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
             DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
             AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
             UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                       CLIMATE INPUTS
                       ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                DRAINAGE SYSTEM DESIGN
                                 *********************

                               *** CONVENTIONAL DRAINAGE ***

         JOB TITLE:

                  Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                  Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                   STMAX =  .20 CM                  SOIL SURFACE
+        __/)____________________________________________________________/)__
               :                                                    :
               :                                                    :
               :                                                    :
               :                                                    :
               :                                                    :
          ADEPTH =310. CM                                   DDRAIN = 95. CM
               :                                                    :
               :                                                    :
               :     O-------------SDRAIN = 4000. CM -----------O  -
               :     *                                              :
               : EFFRAD =**** CM                                    :
               :                                            HDRAIN =206. CM
               :                                                    :
               :                                                    :
         - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
               :
               :
               :
               :                                    IMPERMEABLE LAYER
+        ___________________________________________________________________
         ///////////////////////////////////////////////////////////////////


                     DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                     (CM)                    (CM/HR)

                    .0 -   61.0               4.000
                  61.0 -  107.0                .100
                 107.0 -  310.0                .100
```

```
DEPTH TO DRAIN =  95.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 206.0 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .20 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  301.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .20 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.74

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   9.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    95.0    95.0    95.0    95.0    95.0    95.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    95.0    95.0    95.0    95.0    95.0    95.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

***************************** END OF INPUTS *****************************

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 14:29
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   95.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 869.969
**> End Computations      = 869.969
**> Total simulation time =      .0 seconds.
```

```
******************************************************************************

                         D R A I N M O D  6.1

          Copyright 1980-2013 North Carolina State University
                       LAST UPDATE: April 2013
                         LANGUAGE FORTRAN 77/90

      DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
      THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
      DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
      AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
      UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                    STMAX =  .50 CM                  SOIL SURFACE
 +        __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN =154. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN =12000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =156. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
 +        ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                       DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                       (CM)                   (CM/HR)

                      .0 -   61.0               3.000
                    61.0 -  120.0                .100
                   120.0 -  310.0               2.000
```

```
DEPTH TO DRAIN = 154.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 156.0 CM
DISTANCE BETWEEN DRAINS = 12000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.14

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   154.0   154.0   154.0   154.0   154.0   154.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   154.0   154.0   154.0   154.0   154.0   154.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

***************************** END OF INPUTS *****************************

```
 ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 11:58
input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
parameters:    free drainage              and yields not calculated
              drain spacing =   12000. cm   drain depth =  154.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 718.953
**> End Computations      = 718.954
**> Total simulation time =      .0 seconds.
```

```
*******************************************************************************

                             D R A I N M O D  6.1

                Copyright 1980-2013 North Carolina State University
                             LAST UPDATE: April 2013
                               LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)         1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)         1
 STARTING YEAR OF SIMULATION.................(START YEAR)      2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)        12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX.........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                      DRAINAGE SYSTEM DESIGN
                                       **********************

                                     *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN = 83. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 3000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =211. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   30.0                6.000
                   30.0 -   61.0                 .100
                   61.0 -  310.0                 .050
```

```
DEPTH TO DRAIN =  83.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 211.3 CM
DISTANCE BETWEEN DRAINS =  3000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  294.3 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.36

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    83.0    83.0    83.0    83.0    83.0    83.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    83.0    83.0    83.0    83.0    83.0    83.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
                              COOL_RUN_CAL_WELL_6.OUT
                               9   24        10.0
                               9   25         3.0
                              12   31         3.0



                              WASTEWATER IRRIGATION
                              ********************


     NO WASTEWATER IRRIGATION SCHEDULED:
     -----------------------------------


   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    36




Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00




   Mrank indicator =  1




 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:46
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    3000. cm   drain depth =   83.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 946.215
**> End Computations      = 946.216
**> Total simulation time =      .0 seconds.
```

```
********************************************************************************

                          D R A I N M O D  6.1

            Copyright 1980-2013 North Carolina State University
                        LAST UPDATE: April 2013
                          LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021 ~12 in Fill Removed



                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                                (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                    DRAINAGE SYSTEM DESIGN
                                     *********************

                                   *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021 ~


                    STMAX =  .25 CM                    SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN =107. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 4500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =197. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                     IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                        (CM/HR)

                     .0 -   61.0                3.000
                   61.0 -   95.0                 .100
                   95.0 -  310.0                1.000
```

```
DEPTH TO DRAIN = 107.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 197.2 CM
DISTANCE BETWEEN DRAINS =  4500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  304.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  12.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   107.0   107.0   107.0   107.0   107.0   107.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   107.0   107.0   107.0   107.0   107.0   107.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 12:57
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4500. cm   drain depth =  107.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 777.326
**> End Computations      = 777.326
**> Total simulation time =      .0 seconds.
```

COOL_RUN_CAL_WELL_8.OUT

```
******************************************************************************

                              D R A I N M O D  6.1

                 Copyright 1980-2013 North Carolina State University
                             LAST UPDATE: April 2013
                               LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #8 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021 ~12" Fill Removed



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 -------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #8 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021 ~


                    STMAX =  .25 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN =137. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 5500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =172. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                     DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                     (CM)                   (CM/HR)

                    .0 -   61.0                3.000
                  61.0 -  107.0                 .100
                 107.0 -  310.0                1.250
```

```
DEPTH TO DRAIN = 136.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 172.2 CM
DISTANCE BETWEEN DRAINS =  5500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  308.7 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.77

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   2.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   136.5   136.5   136.5   136.5   136.5   136.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   136.5   136.5   136.5   136.5   136.5   136.5


                                  SOIL INPUTS
                                  ***********



                                    TABLE 1

                                 DRAINAGE TABLE
```

COOL_RUN_CAL_WELL_8.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0



                        WASTEWATER IRRIGATION
                        ********************


     NO WASTEWATER IRRIGATION SCHEDULED:
     -----------------------------------


   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    36




Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00




   Mrank indicator =  1




 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 14:22
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5500. cm   drain depth =  136.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 862.089
**> End Computations      = 862.089
**> Total simulation time =      .0 seconds.
```

COOL_RUN_CAL_WELL_9.OUT

```
****************************************************************************

                           D R A I N M O D  6.1

                Copyright 1980-2013 North Carolina State University
                           LAST UPDATE: April 2013
                             LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021 ~9 in Fill Removed



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                              (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                         DRAINAGE SYSTEM DESIGN
                                          *********************

                                        *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021 ~


                    STMAX =  .50 CM                  SOIL SURFACE
 +        __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                 DDRAIN =118. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 4500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                          HDRAIN =188. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
 +        ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                     (CM/HR)

                     .0 -   61.0                 .500
                   61.0 -  107.0                 .100
                  107.0 -  310.0                1.000
```

```
DEPTH TO DRAIN = 117.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 188.3 CM
DISTANCE BETWEEN DRAINS =  4500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  305.8 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.33

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   117.5   117.5   117.5   117.5   117.5   117.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   117.5   117.5   117.5   117.5   117.5   117.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
   ***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 16:42
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4500. cm   drain depth =  117.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    =1002.601
**> End Computations      =1002.601
**> Total simulation time =      .0 seconds.
```

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
RAINFALL STATION NUMBER.........................	(RAINID)	1	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	1	
STARTING YEAR OF SIMULATION.................	(START YEAR)	2020	YEAR
STARTING MONTH OF SIMULATION...............	(START MONTH)	12	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	2021	YEAR
ENDING MONTH OF SIMULATION..................	(END MONTH)	5	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.47	DEG.MIN
HEAT INDEX...	(HID)	81.00	

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                      DRAINAGE SYSTEM DESIGN
                                       *********************

                                     *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021


                    STMAX =  .30 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN =152. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 5000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =158. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                     IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                      (CM/HR)

                       .0 -   83.0               2.000
                     83.0 -  107.0                .100
                    107.0 -  310.0               1.000
```

DEPTH TO DRAIN = 152.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 158.0 CM
DISTANCE BETWEEN DRAINS = 5000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .30 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
CAN MOVE TO DRAIN = .30 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.10

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 37.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	152.0	152.0	152.0	152.0	152.0	152.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	152.0	152.0	152.0	152.0	152.0	152.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:12
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 672.058
**> End Computations      = 672.058
**> Total simulation time =      .0 seconds.
```

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
RAINFALL STATION NUMBER.........................	(RAINID)	1	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	1	
STARTING YEAR OF SIMULATION.................	(START YEAR)	2020	YEAR
STARTING MONTH OF SIMULATION...............	(START MONTH)	12	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	2021	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	5	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.47	DEG.MIN
HEAT INDEX...	(HID)	81.00	

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to Apr 2021


                    STMAX =  .10 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN =152. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 8000. CM -----------O   -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =158. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   83.0              5.000
                   83.0 -  107.0               .100
                  107.0 -  310.0              1.000
```

```
DEPTH TO DRAIN = 152.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 158.0 CM
DISTANCE BETWEEN DRAINS =  8000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .10 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .10 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.10

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  15.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   152.0   152.0   152.0   152.0   152.0   152.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   152.0   152.0   152.0   152.0   152.0   152.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:54
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    8000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 714.398
**> End Computations      = 714.398
**> Total simulation time =      .0 seconds.
```

```
****************************************************************************

                          D R A I N M O D  6.1

             Copyright 1980-2013 North Carolina State University
                        LAST UPDATE: April 2013
                          LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                    STMAX =  .00 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                     DDRAIN =141. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 6000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                              HDRAIN =169. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                     IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                     (CM/HR)

                     .0 -   61.0                2.000
                   61.0 -  107.0                 .100
                  107.0 -  310.0                1.000
```

```
DEPTH TO DRAIN = 140.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 168.7 CM
DISTANCE BETWEEN DRAINS =  6000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  309.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.86

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  13.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   140.5   140.5   140.5   140.5   140.5   140.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   140.5   140.5   140.5   140.5   140.5   140.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 12:33
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    6000. cm   drain depth =  140.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 753.486
**> End Computations      = 753.486
**> Total simulation time =      .0 seconds.
```

```
******************************************************************************

                              D R A I N M O D  6.1

                  Copyright 1980-2013 North Carolina State University
                              LAST UPDATE: April 2013
                                LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
 Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 -------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       2020   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         12   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2021   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)          5   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.......................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                         DRAINAGE SYSTEM DESIGN
                                          *********************

                                        *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_CAL
                   Onsite Rain Guage with KSUT Temp Data Dec 2020 to May 2021


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                  :
                :                                                  :
                :                                                  :
                :                                                  :
                :                                                  :
           ADEPTH =310. CM                                  DDRAIN =102. CM
                :                                                  :
                :                                                  :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                            :
                : EFFRAD =**** CM                                  :
                :                                           HDRAIN =200. CM
                :                                                  :
                :                                                  :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   61.0              4.000
                   61.0 -  107.0               .100
                  107.0 -  310.0               .500
```

```
DEPTH TO DRAIN = 102.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 200.4 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  302.4 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.94

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  12.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   102.0   102.0   102.0   102.0   102.0   102.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   102.0   102.0   102.0   102.0   102.0   102.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_CAL_WELL_13.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 13:57
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =  102.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 837.677
**> End Computations      = 837.677
**> Total simulation time =      .0 seconds.
```

```
******************************************************************************

                          D R A I N M O D  6.1

               Copyright 1980-2013 North Carolina State University
                           LAST UPDATE: April 2013
                            LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM
 North Wilmington Long Term Weather Data 1991-2020



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                                (VARIABLE)     VALUE   UNIT
 --------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .00 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                  DDRAIN =108. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN =10500. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                           HDRAIN =200. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                      IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   61.0               6.000
                   61.0 -  107.0                .100
                  107.0 -  310.0                .900
```

```
DEPTH TO DRAIN = 108.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 199.7 CM
DISTANCE BETWEEN DRAINS = 10500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  307.7 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.10

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   4.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   108.0   108.0   108.0   108.0   108.0   108.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   108.0   108.0   108.0   108.0   108.0   108.0


                                  SOIL INPUTS
                                  ***********



                                    TABLE 1

                                DRAINAGE TABLE
```

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
                         COOL_RUN_LT_WELL_1.OUT
                          9   24        10.0
                          9   25         3.0
                         12   31         3.0



                         WASTEWATER IRRIGATION
                         ********************


     NO WASTEWATER IRRIGATION SCHEDULED:
     -----------------------------------


   ***** Wetlands Parameter Estimation *****

               Start Day =   32          End Day =  334
               Threshold Water Table Depth (cm) =  30.5
               Threshold Consecutive Days       =    36




Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00




   Mrank indicator =  1




 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15: 9
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =   10500. cm   drain depth =  108.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 909.471
**> End Computations      = 909.478
**> Total simulation time =      .4 seconds.
```

```
                    COOL_RUN_LT_WELL_1.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM
North Wilmington Long Term Weather Data 1991-2020
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15: 9
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   10500. cm   drain depth =  108.0 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   36 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                 0.                      23.
          1992                 0.                      34.
          1993                 1.                      62.
          1994                 0.                      21.
          1995                 2.                      52.
          1996                 0.                      23.
          1997                 0.                      30.
          1998                 1.                      54.
          1999                 0.                      24.
          2000                 0.                      20.
          2001                 0.                      23.
          2002                 0.                      25.
          2003                 1.                      54.
          2004                 1.                      42.
          2005                 0.                      33.
```

COOL_RUN_LT_WELL_1.WET

2006	0.	24.
2007	0.	27.
2008	0.	21.
2009	0.	11.
2010	1.	46.
2011	0.	20.
2012	0.	17.
2013	1.	37.
2014	0.	24.
2015	1.	44.
2016	0.	30.
2017	0.	22.
2018	0.	19.
2019	0.	23.
2020	1.	42.

Number of Years with at least one period = 9. out of 30 years.

```
***************************************************************************

                          D R A I N M O D  6.1

              Copyright 1980-2013 North Carolina State University
                          LAST UPDATE: April 2013
                            LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                              (VARIABLE)     VALUE   UNIT
 -------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)         1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)         1
 STARTING YEAR OF SIMULATION.................(START YEAR)      1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX.........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                DRAINAGE SYSTEM DESIGN
                                 *********************

                               *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Te
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .20 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                    DDRAIN = 95. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                             HDRAIN =206. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   61.0               3.000
                   61.0 -  107.0                .100
                  107.0 -  310.0                .100
```

DEPTH TO DRAIN = 95.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 206.0 CM
DISTANCE BETWEEN DRAINS = 4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .20 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 301.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
CAN MOVE TO DRAIN = .20 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.74

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 9.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	95.0	95.0	95.0	95.0	95.0	95.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

```
         60.000        .200        .570
         80.000        .220        .570
        100.000        .230        .570
        150.000        .410        .570
        200.000        .410        .570
       1000.000        .410        .570
```

TRAFFICABILITY
****

```
                                                                FIRST       SECOND
   REQUIREMENTS                                                 PERIOD      PERIOD
      -MINIMUM AIR VOLUME IN SOIL (CM):                          3.90        3.90
      -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                     1.20        1.20
      -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:      2.00        2.00

   WORKING TIMES
      -DATE TO BEGIN COUNTING WORK DAYS:                         4/ 1       12/32
      -DATE TO STOP COUNTING WORK DAYS:                          5/ 1       12/32
      -FIRST WORK HOUR OF THE DAY:                                8           8
      -LAST WORK HOUR OF THE DAY:                                20          20
```

CROP
****

```
SOIL MOISTURE AT  WILTING POINT =    .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18
```

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

```
NO WASTEWATER IRRIGATION SCHEDULED:
-----------------------------------
```

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

```
   Mrank indicator =  1
```

```
 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 14:28
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    4000. cm   drain depth =   95.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 868.540
**> End Computations      = 868.547
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_3.WET

```
          ----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          ----------------------------------------------------
```

Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 14:28
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   95.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 36 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	31.
1992	0.	19.
1993	1.	36.
1994	0.	19.
1995	1.	44.
1996	0.	20.
1997	0.	16.
1998	0.	34.
1999	0.	23.
2000	0.	16.
2001	0.	21.
2002	0.	18.
2003	1.	47.
2004	1.	41.
2005	0.	24.

COOL_RUN_LT_WELL_3.WET

2006	0.	24.
2007	0.	20.
2008	0.	15.
2009	0.	6.
2010	1.	46.
2011	0.	18.
2012	0.	17.
2013	0.	31.
2014	0.	15.
2015	1.	39.
2016	0.	28.
2017	0.	21.
2018	0.	18.
2019	0.	23.
2020	0.	23.

Number of Years with at least one period = 6. out of 30 years.

```
****************************************************************************

                         D R A I N M O D  6.1

            Copyright 1980-2013 North Carolina State University
                        LAST UPDATE: April 2013
                          LANGUAGE FORTRAN 77/90

        DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
        THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
        DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
        AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
        UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)         1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)         1
 STARTING YEAR OF SIMULATION.................(START YEAR)      1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX.........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                               DRAINAGE SYSTEM DESIGN
                                **********************

                              *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .50 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                  DDRAIN =154. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN =12000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                           HDRAIN =156. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                     DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                     (CM)                   (CM/HR)

                    .0 -   61.0              3.000
                  61.0 -  120.0               .100
                 120.0 -  310.0              2.000
```

```
DEPTH TO DRAIN = 154.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 156.0 CM
DISTANCE BETWEEN DRAINS = 12000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.14

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   154.0   154.0   154.0   154.0   154.0   154.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   154.0   154.0   154.0   154.0   154.0   154.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_WELL_4.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

***************************** END OF INPUTS *****************************

```
 ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 12: 2
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   12000. cm   drain depth =  154.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 722.183
**> End Computations      = 722.191
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_4.WET

```
 ----------------------------------------------------
 *              DRAINMOD version 6.1                *
 * Copyright 1980-2013 North Carolina State University *
 ----------------------------------------------------
```

Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
****

```
  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 12: 2
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   12000. cm   drain depth =  154.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	33.
1992	0.	35.
1993	1.	83.
1994	0.	22.
1995	2.	53.
1996	0.	24.
1997	0.	22.
1998	1.	55.
1999	0.	25.
2000	0.	20.
2001	0.	24.
2002	0.	19.
2003	1.	55.
2004	1.	42.
2005	0.	26.

COOL_RUN_LT_WELL_4.WET

2006	0.	24.
2007	0.	27.
2008	0.	22.
2009	0.	10.
2010	1.	47.
2011	0.	21.
2012	0.	12.
2013	2.	48.
2014	0.	26.
2015	1.	44.
2016	1.	40.
2017	0.	23.
2018	0.	20.
2019	0.	16.
2020	1.	43.

Number of Years with at least one period = 10. out of 30 years.

```
***********************************************************************

                    D R A I N M O D  6.1

       Copyright 1980-2013 North Carolina State University
                    LAST UPDATE: April 2013
                     LANGUAGE FORTRAN 77/90

        DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
        THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
        DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
        AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
        UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                              (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                DRAINAGE SYSTEM DESIGN
                                 *********************

                               *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Te
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                    DDRAIN = 83. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 3000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                             HDRAIN =211. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 30.0	6.000
30.0 - 61.0	.100
61.0 - 310.0	.050

```
DEPTH TO DRAIN =  83.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 211.3 CM
DISTANCE BETWEEN DRAINS =  3000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  294.3 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.36

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    83.0    83.0    83.0    83.0    83.0    83.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    83.0    83.0    83.0    83.0    83.0    83.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

****************************** END OF INPUTS ******************************

```
 ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:46
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    3000. cm   drain depth =   83.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 946.582
**> End Computations      = 946.590
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_6.WET

```
          ------------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          ------------------------------------------------------
```

Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:46
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    3000. cm   drain depth =   83.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 36 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	33.
1992	0.	34.
1993	1.	77.
1994	0.	20.
1995	2.	55.
1996	0.	23.
1997	0.	30.
1998	1.	54.
1999	0.	25.
2000	0.	19.
2001	0.	24.
2002	0.	25.
2003	1.	55.
2004	1.	42.
2005	1.	37.

COOL_RUN_LT_WELL_6.WET

2006	0.	35.
2007	0.	23.
2008	0.	21.
2009	0.	16.
2010	1.	47.
2011	0.	19.
2012	0.	34.
2013	1.	37.
2014	0.	23.
2015	1.	40.
2016	0.	30.
2017	1.	40.
2018	0.	29.
2019	0.	26.
2020	1.	43.

Number of Years with at least one period = 11. out of 30 years.

```
****************************************************************************

                              D R A I N M O D  6.1

                  Copyright 1980-2013 North Carolina State University
                             LAST UPDATE: April 2013
                               LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

                  JOB TITLE:

                           Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                           North Wilmington Long Term Weather Data 1991-2020 ~12 in Fil


                            STMAX =  .25 CM                  SOIL SURFACE
+                 __/)____________________________________________________________/)__
                        :                                                   :
                        :                                                   :
                        :                                                   :
                        :                                                   :
                        :                                                   :
                   ADEPTH =310. CM                                  DDRAIN =107. CM
                        :                                                   :
                        :                                                   :
                        :     O-------------SDRAIN = 4500. CM -----------O  -
                        :     *                                             :
                        : EFFRAD =**** CM                                   :
                        :                                           HDRAIN =197. CM
                        :                                                   :
                        :                                                   :
                  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                        :
                        :
                        :
                        :                                     IMPERMEABLE LAYER
+                 ___________________________________________________________________
                  ///////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	3.000
61.0 - 95.0	.100
95.0 - 310.0	1.000

DEPTH TO DRAIN = 107.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 197.2 CM
DISTANCE BETWEEN DRAINS = 4500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 304.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.07

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH = 12.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	107.0	107.0	107.0	107.0	107.0	107.0

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	107.0	107.0	107.0	107.0	107.0	107.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_WELL_7.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

```
                60.000        .200        .570
                80.000        .220        .570
               100.000        .230        .570
               150.000        .410        .570
               200.000        .410        .570
              1000.000        .410        .570

                          TRAFFICABILITY
                          **************

                                                                FIRST       SECOND
   REQUIREMENTS                                                 PERIOD      PERIOD
      -MINIMUM AIR VOLUME IN SOIL (CM):                          3.90        3.90
      -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                     1.20        1.20
      -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:      2.00        2.00

   WORKING TIMES
      -DATE TO BEGIN COUNTING WORK DAYS:                         4/ 1       12/32
      -DATE TO STOP COUNTING WORK DAYS:                          5/ 1       12/32
      -FIRST WORK HOUR OF THE DAY:                                8           8
      -LAST WORK HOUR OF THE DAY:                                20          20


                                CROP
                                ****

SOIL MOISTURE AT  WILTING POINT =    .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18



                             MO   DAY   ROOTING DEPTH(CM)
                              1     1         3.0
                              4    16         3.0
                              5     4         4.0
                              5    17        15.0
                              6     1        25.0
                              6    20        30.0
                              7    18        30.0
                              8    20        20.0
```

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 13:17
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4500. cm   drain depth =  107.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 797.735
**> End Computations      = 797.743
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_7.WET

```
          ----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          ----------------------------------------------------
```

Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed
****

```
  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 13:17
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4500. cm   drain depth =  107.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	5.
1992	0.	6.
1993	0.	11.
1994	0.	6.
1995	0.	14.
1996	0.	11.
1997	0.	3.
1998	0.	31.
1999	0.	7.
2000	0.	9.
2001	0.	0.
2002	0.	0.
2003	0.	7.
2004	0.	17.
2005	0.	19.

COOL_RUN_LT_WELL_7.WET

2006	0.	8.
2007	0.	9.
2008	0.	5.
2009	0.	0.
2010	0.	19.
2011	0.	12.
2012	0.	2.
2013	0.	6.
2014	0.	5.
2015	0.	15.
2016	0.	18.
2017	0.	1.
2018	0.	15.
2019	0.	5.
2020	0.	21.

Number of Years with at least one period = 0. out of 30 years.

```
******************************************************************************

                          D R A I N M O D  6.1

            Copyright 1980-2013 North Carolina State University
                         LAST UPDATE: April 2013
                           LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                         DRAINAGE SYSTEM DESIGN
                                          **********************

                                        *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020 ~12 in Fil


                    STMAX =  .25 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN =137. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 5500. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =172. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                     (CM/HR)

                     .0 -   61.0                3.000
                   61.0 -   95.0                 .100
                   95.0 -  310.0                1.250
```

DEPTH TO DRAIN = 136.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 172.2 CM
DISTANCE BETWEEN DRAINS = 5500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING = .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 308.7 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) = .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) = 2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
CAN MOVE TO DRAIN = .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.77

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) = .90 : 1.00

INITIAL WATER TABLE DEPTH = 2.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	136.5	136.5	136.5	136.5	136.5	136.5
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	136.5	136.5	136.5	136.5	136.5	136.5

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 14: 8
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5500. cm   drain depth =  136.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 848.512
**> End Computations      = 848.520
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_8.WET

```
----------------------------------------------------
*              DRAINMOD version 6.1                *
* Copyright 1980-2013 North Carolina State University *
----------------------------------------------------
```

Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed
****

```
  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 14: 8
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5500. cm   drain depth =  136.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least 36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	5.
1992	0.	3.
1993	0.	7.
1994	0.	6.
1995	0.	14.
1996	0.	11.
1997	0.	0.
1998	0.	31.
1999	0.	3.
2000	0.	1.
2001	0.	0.
2002	0.	0.
2003	0.	7.
2004	0.	16.
2005	0.	10.

COOL_RUN_LT_WELL_8.WET

2006	0.	6.
2007	0.	9.
2008	0.	0.
2009	0.	0.
2010	0.	19.
2011	0.	0.
2012	0.	0.
2013	0.	3.
2014	0.	3.
2015	0.	14.
2016	0.	18.
2017	0.	0.
2018	0.	11.
2019	0.	0.
2020	0.	10.

Number of Years with at least one period = 0. out of 30 years.

```
*******************************************************************************

                              D R A I N M O D  6.1

                 Copyright 1980-2013 North Carolina State University
                              LAST UPDATE: April 2013
                                LANGUAGE FORTRAN 77/90

             DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
             THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
             DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
             AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
             UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill Removed



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.......................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                      DDRAIN =118. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                               HDRAIN =188. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                     IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                        DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                        (CM)                   (CM/HR)

                       .0 -   61.0                .500
                     61.0 -  107.0                .100
                    107.0 -  310.0               1.000
```

```
DEPTH TO DRAIN = 117.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 187.8 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  305.3 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.33

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
```

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	117.5	117.5	117.5	117.5	117.5	117.5

DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	117.5	117.5	117.5	117.5	117.5	117.5

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON   8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 16:43
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    4000. cm   drain depth =  117.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    =1003.205
**> End Computations      =1003.213
**> Total simulation time =      .5 seconds.
```

```
                          COOL_RUN_LT_WELL_9.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill Removed
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 16:43
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =  117.5 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year
```

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	5.
1992	0.	5.
1993	0.	12.
1994	0.	7.
1995	0.	15.
1996	0.	11.
1997	0.	0.
1998	0.	32.
1999	0.	4.
2000	0.	6.
2001	0.	0.
2002	0.	0.
2003	0.	8.
2004	0.	17.
2005	0.	19.

COOL_RUN_LT_WELL_9.WET

2006	0.	9.
2007	0.	11.
2008	0.	0.
2009	0.	0.
2010	0.	20.
2011	0.	5.
2012	0.	0.
2013	0.	4.
2014	0.	3.
2015	0.	21.
2016	0.	19.
2017	0.	0.
2018	0.	11.
2019	0.	0.
2020	0.	21.

Number of Years with at least one period = 0. out of 30 years.

```
****************************************************************************

                              D R A I N M O D  6.1

                Copyright 1980-2013 North Carolina State University
                            LAST UPDATE: April 2013
                              LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX............................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .30 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN =152. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 5000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =158. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                     (CM/HR)

                     .0 -   83.0               2.000
                   83.0 -  107.0                .100
                  107.0 -  310.0               1.000
```

DEPTH TO DRAIN = 152.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 158.0 CM
DISTANCE BETWEEN DRAINS = 5000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .30 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER = 310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN = .30 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.10

*** SEEPAGE LOSS INPUTS ***

No seepage due to field slope

No seepage due to vertical deep seepage

No seepage due to lateral deep seepage

*** end of seepage inputs ***

WIDTH OF DITCH BOTTOM = 91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH = 37.0 CM

DEPTH OF WEIR FROM THE SURFACE

DATE	1/ 1	2/ 1	3/ 1	4/ 1	5/ 1	6/ 1
WEIR DEPTH	152.0	152.0	152.0	152.0	152.0	152.0
DATE	7/ 1	8/ 1	9/ 1	10/ 1	11/ 1	12/ 1
WEIR DEPTH	152.0	152.0	152.0	152.0	152.0	152.0

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_WELL_10.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

***************************** END OF INPUTS *****************************

```
 ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:10
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 670.958
**> End Computations      = 670.966
**> Total simulation time =      .5 seconds.
```

```
                        COOL_RUN_LT_WELL_10.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                 *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:10
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least   36 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	4.
1992	0.	0.
1993	0.	6.
1994	0.	6.
1995	0.	5.
1996	0.	6.
1997	0.	0.
1998	0.	15.
1999	0.	0.
2000	0.	0.
2001	0.	0.
2002	0.	0.
2003	0.	7.
2004	0.	13.
2005	0.	10.

COOL_RUN_LT_WELL_10.WET

2006	0.	3.
2007	0.	7.
2008	0.	0.
2009	0.	0.
2010	0.	17.
2011	0.	0.
2012	0.	0.
2013	0.	0.
2014	0.	0.
2015	0.	12.
2016	0.	18.
2017	0.	0.
2018	0.	11.
2019	0.	0.
2020	0.	5.

Number of Years with at least one period = 0. out of 30 years.

```
******************************************************************************

                              D R A I N M O D  6.1

                  Copyright 1980-2013 North Carolina State University
                              LAST UPDATE: April 2013
                                LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                        CLIMATE INPUTS
                        ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 -------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .10 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                    DDRAIN =152. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 8000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                             HDRAIN =158. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   83.0               5.000
                   83.0 -  107.0                .100
                  107.0 -  310.0               1.000
```

```
DEPTH TO DRAIN = 152.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 158.0 CM
DISTANCE BETWEEN DRAINS =  8000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .10 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  310.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .10 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 4.10

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  15.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   152.0   152.0   152.0   152.0   152.0   152.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   152.0   152.0   152.0   152.0   152.0   152.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:53
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    8000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 713.556
**> End Computations      = 713.564
**> Total simulation time =      .5 seconds.
```

```
                        COOL_RUN_LT_WELL_11.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:53
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    8000. cm   drain depth =  152.0 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   36 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                   0.                       11.
          1992                   0.                       14.
          1993                   0.                       15.
          1994                   0.                        8.
          1995                   0.                       25.
          1996                   0.                       14.
          1997                   0.                        9.
          1998                   0.                       32.
          1999                   0.                        8.
          2000                   0.                       12.
          2001                   0.                        2.
          2002                   0.                        0.
          2003                   0.                        9.
          2004                   0.                       19.
          2005                   0.                       20.
```

COOL_RUN_LT_WELL_11.WET

2006	0.	9.
2007	0.	11.
2008	0.	8.
2009	0.	0.
2010	1.	44.
2011	0.	14.
2012	0.	2.
2013	0.	14.
2014	0.	6.
2015	0.	22.
2016	0.	24.
2017	0.	3.
2018	0.	16.
2019	0.	3.
2020	0.	22.

Number of Years with at least one period = 1. out of 30 years.

```
*******************************************************************************

                              D R A I N M O D  6.1

                  Copyright 1980-2013 North Carolina State University
                             LAST UPDATE: April 2013
                               LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
 North Wilmington Long Term Weather Data 1991-2020



                       CLIMATE INPUTS
                       ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .00 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN =141. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 6000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =169. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   61.0               2.000
                   61.0 -  107.0                .100
                  107.0 -  310.0               1.000
```

```
DEPTH TO DRAIN = 140.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 168.7 CM
DISTANCE BETWEEN DRAINS =  6000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  309.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.86

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  13.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   140.5   140.5   140.5   140.5   140.5   140.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   140.5   140.5   140.5   140.5   140.5   140.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

```
NO WASTEWATER IRRIGATION SCHEDULED:
-----------------------------------
```

***** Wetlands Parameter Estimation *****

```
            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 12:39
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    6000. cm   drain depth =  140.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 759.039
**> End Computations      = 759.047
**> Total simulation time =      .5 seconds.
```

```
                    COOL_RUN_LT_WELL_12.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 12:39
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    6000. cm   drain depth =  140.5 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   36 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                 0.                      11.
          1992                 0.                      14.
          1993                 0.                      15.
          1994                 0.                       9.
          1995                 0.                      25.
          1996                 0.                      12.
          1997                 0.                       8.
          1998                 0.                      32.
          1999                 0.                       7.
          2000                 0.                       9.
          2001                 0.                       0.
          2002                 0.                       0.
          2003                 0.                       9.
          2004                 0.                      20.
          2005                 0.                      20.
```

COOL_RUN_LT_WELL_12.WET

2006	0.	8.
2007	0.	16.
2008	0.	5.
2009	0.	0.
2010	1.	44.
2011	0.	12.
2012	0.	0.
2013	0.	14.
2014	0.	6.
2015	0.	22.
2016	0.	24.
2017	0.	2.
2018	0.	16.
2019	0.	0.
2020	0.	22.

Number of Years with at least one period = 1. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
RAINFALL STATION NUMBER.........................	(RAINID)	1	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	1	
STARTING YEAR OF SIMULATION..................	(START YEAR)	1991	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION.....................	(END YEAR)	2020	YEAR
ENDING MONTH OF SIMULATION....................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE...................	(TEMP LAT)	34.47	DEG.MIN
HEAT INDEX..	(HID)	81.00	

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               **********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN =102. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 4000. CM -----------O   -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =200. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   61.0              4.000
                   61.0 -  107.0               .100
                  107.0 -  310.0               .500
```

```
DEPTH TO DRAIN = 102.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 200.4 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  302.4 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.94

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  12.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH   102.0   102.0   102.0   102.0   102.0   102.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH   102.0   102.0   102.0   102.0   102.0   102.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

```
NO WASTEWATER IRRIGATION SCHEDULED:
-----------------------------------


   ***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36



Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00



   Mrank indicator =  1



 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 13:55
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =  102.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 835.537
**> End Computations      = 835.544
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_WELL_13.WET

```
           -----------------------------------------------------
           *              DRAINMOD version 6.1                 *
           * Copyright 1980-2013 North Carolina State University *
           -----------------------------------------------------
```

Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assessment
North Wilmington Long Term Weather Data 1991-2020
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 13:55
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =  102.0 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	0.	11.
1992	0.	14.
1993	0.	12.
1994	0.	7.
1995	0.	33.
1996	0.	17.
1997	0.	10.
1998	0.	32.
1999	0.	8.
2000	0.	13.
2001	0.	5.
2002	0.	5.
2003	0.	10.
2004	0.	25.
2005	0.	19.

COOL_RUN_LT_WELL_13.WET

2006	0.	10.
2007	0.	11.
2008	0.	9.
2009	0.	2.
2010	0.	20.
2011	0.	13.
2012	0.	11.
2013	0.	12.
2014	0.	6.
2015	0.	21.
2016	0.	19.
2017	0.	5.
2018	0.	16.
2019	0.	12.
2020	0.	22.

Number of Years with at least one period = 0. out of 30 years.

```
********************************************************************************

                              D R A I N M O D  6.1

                  Copyright 1980-2013 North Carolina State University
                              LAST UPDATE: April 2013
                                LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM_ND_5% GS
 North Wilmington Long Term Weather Data 1991-2020



                        CLIMATE INPUTS
                        ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)      1990   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)      2019   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX..........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM_
                   North Wilmington Long Term Weather Data 1991-2020


                    STMAX =  .00 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN = 56. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN =10500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =243. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   61.0              6.000
                   61.0 -  107.0               .100
                  107.0 -  310.0               .900
```

```
DEPTH TO DRAIN =  56.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 242.7 CM
DISTANCE BETWEEN DRAINS = 10500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  298.7 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 2.04

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   4.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    56.0    56.0    56.0    56.0    56.0    56.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    56.0    56.0    56.0    56.0    56.0    56.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:10
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   10500. cm   drain depth =   56.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 910.249
**> End Computations      = 910.256
**> Total simulation time =      .4 seconds.
```

```
                         COOL_RUN_LT_ND_WELL_1.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #1 Cool Run, LMG20.248, Muckalee Soil Unit_2021_LT SIM_ND_5% GS
North Wilmington Long Term Weather Data 1991-2020
*********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:10
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   10500. cm   drain depth =   56.0 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   36 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1990                 0.                      22.
          1991                 1.                      39.
          1992                 0.                      35.
          1993                 1.                      83.
          1994                 1.                      39.
          1995                 2.                      55.
          1996                 1.                      39.
          1997                 0.                      32.
          1998                 1.                      55.
          1999                 0.                      26.
          2000                 0.                      23.
          2001                 0.                      34.
          2002                 0.                      25.
          2003                 1.                      55.
          2004                 1.                      54.
```

COOL_RUN_LT_ND_WELL_1.WET

2005	1.	55.
2006	0.	35.
2007	1.	36.
2008	1.	43.
2009	0.	15.
2010	1.	47.
2011	0.	21.
2012	0.	34.
2013	1.	99.
2014	0.	31.
2015	1.	45.
2016	1.	42.
2017	2.	39.
2018	0.	29.
2019	0.	23.

Number of Years with at least one period = 16. out of 30 years.

COOL_RUN_LT_ND_WELL_3.OUT

```
*******************************************************************************

                              D R A I N M O D  6.1

                Copyright 1980-2013 North Carolina State University
                             LAST UPDATE: April 2013
                               LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                         TITLE OF RUN
                         ************


 Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Asses, No Drain
 North Wilmington Long Term Weather Data 1991-2020 No Drain



                        CLIMATE INPUTS
                        ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 -------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                        DRAINAGE SYSTEM DESIGN
                                         *********************

                                       *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Te
                   North Wilmington Long Term Weather Data 1991-2020 No Drain


                    STMAX =  .20 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                   DDRAIN = 43. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                            HDRAIN =212. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   61.0               4.000
                   61.0 -  107.0                .100
                  107.0 -  310.0                .100
```

```
DEPTH TO DRAIN =  43.0 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 212.1 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .20 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  255.1 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .20 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 = 3.13

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   9.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    43.0    43.0    43.0    43.0    43.0    43.0

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    43.0    43.0    43.0    43.0    43.0    43.0
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_ND_WELL_3.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

```
      60.000       .200       .570
      80.000       .220       .570
     100.000       .230       .570
     150.000       .410       .570
     200.000       .410       .570
    1000.000       .410       .570

                TRAFFICABILITY
                **************

                                                           FIRST       SECOND
   REQUIREMENTS                                            PERIOD      PERIOD
      -MINIMUM AIR VOLUME IN SOIL (CM):                     3.90        3.90
      -MAXIMUM ALLOWABLE DAILY RAINFALL(CM):                1.20        1.20
      -MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:  2.00        2.00

   WORKING TIMES
      -DATE TO BEGIN COUNTING WORK DAYS:                    4/ 1       12/32
      -DATE TO STOP COUNTING WORK DAYS:                     5/ 1       12/32
      -FIRST WORK HOUR OF THE DAY:                           8           8
      -LAST WORK HOUR OF THE DAY:                           20          20


                     CROP
                     ****

SOIL MOISTURE AT  WILTING POINT =    .17

HIGH WATER STRESS:  BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18
                    CROP IS IN STRESS WHEN WATER TABLE IS ABOVE  30.0 CM

DROUGHT STRESS:     BEGIN STRESS PERIOD ON   4/10
                    END STRESS PERIOD ON     8/18


                         MO   DAY   ROOTING DEPTH(CM)
                          1     1         3.0
                          4    16         3.0
                          5     4         4.0
                          5    17        15.0
                          6     1        25.0
                          6    20        30.0
                          7    18        30.0
                          8    20        20.0
```

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    35
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 14:30
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   43.0 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 870.395
**> End Computations      = 870.402
**> Total simulation time =      .4 seconds.
```

```
                      COOL_RUN_LT_ND_WELL_3.WET
         -----------------------------------------------------
         *              DRAINMOD version 6.1                 *
         * Copyright 1980-2013 North Carolina State University *
         -----------------------------------------------------

Well #3 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Asses, No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 14:30
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
              drain spacing =    4000. cm   drain depth =   43.0 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   35 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   35 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                 1.                     35.
          1992                 1.                     35.
          1993                 1.                     83.
          1994                 1.                     39.
          1995                 2.                     55.
          1996                 1.                     38.
          1997                 0.                     31.
          1998                 1.                     55.
          1999                 0.                     27.
          2000                 0.                     22.
          2001                 0.                     25.
          2002                 0.                     25.
          2003                 1.                     55.
          2004                 2.                     54.
          2005                 1.                     38.
```

COOL_RUN_LT_ND_WELL_3.WET

2006	1.	35.
2007	0.	34.
2008	0.	22.
2009	0.	19.
2010	1.	47.
2011	0.	21.
2012	0.	34.
2013	2.	53.
2014	0.	30.
2015	1.	45.
2016	1.	41.
2017	1.	41.
2018	0.	29.
2019	0.	26.
2020	1.	44.

Number of Years with at least one period = 17. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain

CLIMATE INPUTS
******* ******

```
     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
-----------------------------------------------------------------------------
FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
RAINFALL STATION NUMBER.........................(RAINID)          1
TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                  DRAINAGE SYSTEM DESIGN
                                   **********************

                                 *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020  No Drain


                    STMAX =  .50 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                   DDRAIN = 31. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN =12000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                            HDRAIN =266. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                     (CM/HR)

                     .0 -   61.0                3.000
                   61.0 -  120.0                 .100
                  120.0 -  310.0                2.000
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 266.1 CM
DISTANCE BETWEEN DRAINS = 12000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  296.6 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 12: 3
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   12000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 723.226
**> End Computations      = 723.234
**> Total simulation time =      .5 seconds.
```

COOL_RUN_LT_ND_WELL_4.WET

```
----------------------------------------------------
*              DRAINMOD version 6.1               *
* Copyright 1980-2013 North Carolina State University *
----------------------------------------------------
```

Well #4 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
****

```
 ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 12: 3
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =   12000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	2.	53.
1992	1.	73.
1993	1.	85.
1994	1.	66.
1995	2.	55.
1996	3.	51.
1997	0.	34.
1998	1.	58.
1999	0.	35.
2000	0.	27.
2001	1.	37.
2002	1.	47.
2003	2.	59.
2004	2.	57.
2005	2.	60.

COOL_RUN_LT_ND_WELL_4.WET

2006	1.	54.
2007	1.	41.
2008	1.	57.
2009	2.	42.
2010	1.	51.
2011	1.	63.
2012	1.	61.
2013	1.	102.
2014	1.	67.
2015	2.	74.
2016	1.	44.
2017	2.	46.
2018	1.	36.
2019	0.	26.
2020	2.	47.

Number of Years with at least one period = 26. out of 30 years.

COOL_RUN_LT_ND_WELL_6.OUT

```
****************************************************************************

                            D R A I N M O D  6.1

                 Copyright 1980-2013 North Carolina State University
                            LAST UPDATE: April 2013
                              LANGUAGE FORTRAN 77/90

             DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
             THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
             DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
             AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
             UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Asses, No Drain
 North Wilmington Long Term Weather Data 1991-2020 No Drain



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Te
                   North Wilmington Long Term Weather Data 1991-2020 No Drain


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                DDRAIN = 31. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 3000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                         HDRAIN =231. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                  IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   30.0              3.000
                   30.0 -   61.0               .100
                   61.0 -  310.0               .050
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 230.8 CM
DISTANCE BETWEEN DRAINS =  3000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  261.3 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_ND_WELL_6.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24       10.0
 9   25        3.0
12   31        3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    36



Fixed Monthly Pet Values

    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00



   Mrank indicator =  1



 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:48
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    3000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 948.168
**> End Computations      = 948.175
**> Total simulation time =      .4 seconds.
```

COOL_RUN_LT_ND_WELL_6.WET

```
 ----------------------------------------------------
 *              DRAINMOD version 6.1                *
 * Copyright 1980-2013 North Carolina State University *
 ----------------------------------------------------
```

Well #6 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Asses, No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 15:48
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    3000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	2.	52.
1992	1.	72.
1993	1.	84.
1994	1.	51.
1995	2.	55.
1996	2.	51.
1997	0.	33.
1998	1.	58.
1999	0.	34.
2000	0.	25.
2001	1.	37.
2002	1.	47.
2003	2.	59.
2004	2.	57.
2005	2.	60.

COOL_RUN_LT_ND_WELL_6.WET

2006	1.	54.
2007	1.	39.
2008	1.	56.
2009	2.	41.
2010	1.	51.
2011	1.	61.
2012	1.	61.
2013	1.	101.
2014	1.	66.
2015	1.	74.
2016	1.	43.
2017	2.	46.
2018	1.	36.
2019	0.	26.
2020	2.	47.

Number of Years with at least one period = 26. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Asses No Drain
North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed No Drain

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D			
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D			
RAINFALL STATION NUMBER.........................	(RAINID)	1	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	1	
STARTING YEAR OF SIMULATION..................	(START YEAR)	1991	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION......................	(END YEAR)	2020	YEAR
ENDING MONTH OF SIMULATION...................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE..................	(TEMP LAT)	34.47	DEG.MIN
HEAT INDEX...	(HID)	81.00	

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                          DRAINAGE SYSTEM DESIGN
                                           *********************

                                         *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020 ~12 in Fil


                    STMAX =  .25 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN = 31. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 4500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =246. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                      IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                    (CM/HR)

                     .0 -   61.0                3.000
                   61.0 -   95.0                 .100
                   95.0 -  310.0                1.000
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 245.6 CM
DISTANCE BETWEEN DRAINS =  4500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  276.1 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  12.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_ND_WELL_7.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT = .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON 4/10
END STRESS PERIOD ON 8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
 9   24        10.0
 9   25         3.0
12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

***************************** END OF INPUTS *****************************

```
 ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 13:19
input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
parameters:    free drainage             and yields not calculated
              drain spacing =    4500. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 799.197
**> End Computations      = 799.204
**> Total simulation time =      .4 seconds.
```

```
                    COOL_RUN_LT_ND_WELL_7.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                 *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #7 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Asses No Drain
North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed No Drain
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 13:19
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4500. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm for at least 36 days. Counting starts on day 32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	1.	40.
1992	1.	70.
1993	1.	83.
1994	1.	40.
1995	2.	55.
1996	1.	47.
1997	0.	32.
1998	1.	56.
1999	0.	29.
2000	0.	23.
2001	0.	34.
2002	0.	25.
2003	2.	55.
2004	2.	55.
2005	1.	56.

COOL_RUN_LT_ND_WELL_7.WET

2006	0.	35.
2007	0.	35.
2008	1.	43.
2009	0.	29.
2010	1.	48.
2011	0.	21.
2012	0.	34.
2013	1.	100.
2014	0.	31.
2015	1.	48.
2016	1.	42.
2017	2.	42.
2018	0.	33.
2019	0.	26.
2020	1.	44.

Number of Years with at least one period = 17. out of 30 years.

COOL_RUN_LT_ND_WELL_8.OUT

```
****************************************************************************

                          D R A I N M O D  6.1

              Copyright 1980-2013 North Carolina State University
                          LAST UPDATE: April 2013
                            LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assess No Drain
 North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed No Drain



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ---------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\Juniper Tract DRAINMOD\D
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020 ~12 in Fil


                    STMAX =  .25 CM                  SOIL SURFACE
+         __/)___________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                 DDRAIN = 46. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 5500. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                          HDRAIN =248. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                        (CM/HR)

                     .0 -   61.0                3.000
                   61.0 -   95.0                 .100
                   95.0 -  310.0                1.250
```

```
DEPTH TO DRAIN =  45.8 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 248.4 CM
DISTANCE BETWEEN DRAINS =  5500.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .25 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  294.1 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .25 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .51

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   2.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    45.8    45.8    45.8    45.8    45.8    45.8

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    45.8    45.8    45.8    45.8    45.8    45.8
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
   ***** Wetlands Parameter Estimation *****

             Start Day =   32          End Day =  334
             Threshold Water Table Depth (cm) =  30.5
             Threshold Consecutive Days       =    33
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

```
   Mrank indicator =  1
```

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 14: 7
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5500. cm   drain depth =   45.8 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 847.067
**> End Computations      = 847.075
**> Total simulation time =      .5 seconds.
```

```
                     COOL_RUN_LT_ND_WELL_8.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                 *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #8 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 ~12 in Fill Removed No Drain
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 14: 7
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5500. cm   drain depth =   45.8 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   33 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   33 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                 1.                       34.
          1992                 1.                       34.
          1993                 1.                       83.
          1994                 0.                       21.
          1995                 2.                       55.
          1996                 0.                       24.
          1997                 0.                       30.
          1998                 1.                       55.
          1999                 0.                       26.
          2000                 0.                       20.
          2001                 0.                       25.
          2002                 0.                       25.
          2003                 2.                       55.
          2004                 2.                       43.
          2005                 1.                       38.
```

COOL_RUN_LT_ND_WELL_8.WET

2006	1.	35.
2007	0.	28.
2008	0.	21.
2009	0.	16.
2010	1.	47.
2011	0.	20.
2012	1.	34.
2013	2.	38.
2014	0.	30.
2015	1.	44.
2016	1.	40.
2017	1.	39.
2018	0.	29.
2019	0.	26.
2020	1.	43.

Number of Years with at least one period = 16. out of 30 years.

COOL_RUN_LT_ND_WELL_9.OUT

```
******************************************************************************

                               D R A I N M O D  6.1

                   Copyright 1980-2013 North Carolina State University
                               LAST UPDATE: April 2013
                                 LANGUAGE FORTRAN 77/90

            DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
            THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
            DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
            AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
            UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment No Drain
 North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill Removed No Drain



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ----------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)         1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)         1
 STARTING YEAR OF SIMULATION.................(START YEAR)      1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX.........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                              DRAINAGE SYSTEM DESIGN
                               *********************

                             *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term
                   North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill


                    STMAX =  .50 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                 DDRAIN = 31. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                          HDRAIN =242. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////
```

DEPTH (CM)	SATURATED HYDRAULIC CONDUCTIVITY (CM/HR)
.0 - 61.0	.500
61.0 - 107.0	.100
107.0 - 310.0	1.000

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 241.7 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  272.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =   1.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_ND_WELL_9.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

```
***** Wetlands Parameter Estimation *****

            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 16:44
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    =1004.323
**> End Computations      =1004.331
**> Total simulation time =      .5 seconds.
```

```
                      COOL_RUN_LT_ND_WELL_9.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #9 Cool Run, LMG20.248, Lumbee Soil Unit_2021_Long Term Assessment No Drain
North Wilmington Long Term Weather Data 1991-2020 ~9 in Fill Removed No Drain
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 8/2021  @ 16:44
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	1.	41.
1992	1.	71.
1993	1.	84.
1994	1.	50.
1995	2.	55.
1996	2.	50.
1997	0.	33.
1998	1.	57.
1999	0.	31.
2000	0.	24.
2001	0.	35.
2002	0.	25.
2003	2.	58.
2004	2.	56.
2005	2.	56.

COOL_RUN_LT_ND_WELL_9.WET

2006	1.	54.
2007	1.	37.
2008	1.	56.
2009	0.	35.
2010	1.	51.
2011	1.	38.
2012	0.	34.
2013	1.	100.
2014	0.	34.
2015	1.	72.
2016	1.	43.
2017	2.	45.
2018	1.	36.
2019	0.	26.
2020	2.	47.

Number of Years with at least one period = 21. out of 30 years.

```
****************************************************************************

                         D R A I N M O D  6.1

              Copyright 1980-2013 North Carolina State University
                         LAST UPDATE: April 2013
                           LANGUAGE FORTRAN 77/90

          DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
          THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
          DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
          AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
          UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
 North Wilmington Long Term Weather Data 1991-2020 No Drain



                       CLIMATE INPUTS
                       ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)         1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)         1
 STARTING YEAR OF SIMULATION..................(START YEAR)      1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)         1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)      2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)        12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)     34.47   DEG.MIN
 HEAT INDEX...........................................(HID)     81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                   DRAINAGE SYSTEM DESIGN
                                    *********************

                                  *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020 No Drain


                    STMAX =  .30 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                    DDRAIN = 31. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 5000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                             HDRAIN =249. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                        DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                        (CM)                   (CM/HR)

                       .0 -   83.0               2.000
                     83.0 -  107.0                .100
                    107.0 -  310.0               1.000
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 248.7 CM
DISTANCE BETWEEN DRAINS =  5000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .30 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  279.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .30 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  37.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

	FIRST PERIOD	SECOND PERIOD
REQUIREMENTS		
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:23
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 683.162
**> End Computations      = 683.170
**> Total simulation time =      .5 seconds.
```

```
                    COOL_RUN_LT_ND_WELL_10.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #10 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
********************************************************************************
```

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:23
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    5000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	1.	41.
1992	1.	71.
1993	1.	84.
1994	1.	50.
1995	2.	55.
1996	1.	47.
1997	0.	33.
1998	1.	57.
1999	0.	30.
2000	0.	24.
2001	0.	34.
2002	0.	25.
2003	2.	56.
2004	2.	56.
2005	2.	56.

COOL_RUN_LT_ND_WELL_10.WET

2006	1.	54.
2007	1.	37.
2008	1.	55.
2009	0.	30.
2010	1.	50.
2011	0.	23.
2012	0.	34.
2013	1.	100.
2014	0.	32.
2015	1.	48.
2016	1.	42.
2017	2.	44.
2018	0.	33.
2019	0.	26.
2020	2.	46.

Number of Years with at least one period = 19. out of 30 years.

****

D R A I N M O D 6.1

LAST UPDATE: April 2013
LANGUAGE FORTRAN 77/90

DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
UNDER THE DIRECTION OF R. W. SKAGGS.

****

DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
Cream selector (0=no, 1=yes) = 0

TITLE OF RUN
****

Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain

CLIMATE INPUTS
******* ******

DESCRIPTION	(VARIABLE)	VALUE	UNIT
FILE FOR RAINDATA ....C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W			
RAINFALL STATION NUMBER.........................	(RAINID)	1	
TEMPERATURE/PET STATION NUMBER..................	(TEMPID)	1	
STARTING YEAR OF SIMULATION..................	(START YEAR)	1991	YEAR
STARTING MONTH OF SIMULATION................	(START MONTH)	1	MONTH
ENDING YEAR OF SIMULATION......................	(END YEAR)	2020	YEAR
ENDING MONTH OF SIMULATION....................	(END MONTH)	12	MONTH
TEMPERATURE STATION LATITUDE...................	(TEMP LAT)	34.47	DEG.MIN
HEAT INDEX..	(HID)	81.00	

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                         DRAINAGE SYSTEM DESIGN
                                          *********************

                                        *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020  No Drain


                    STMAX =  .10 CM                   SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN = 31. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 8000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =260. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ___________________________________________________________________
          ///////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   83.0               5.000
                   83.0 -  107.0                .100
                  107.0 -  310.0               1.000
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 259.7 CM
DISTANCE BETWEEN DRAINS =  8000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .10 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  290.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .10 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  15.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ***************************** END OF INPUTS *****************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:56
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage             and yields not calculated
               drain spacing =    8000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 716.699
**> End Computations      = 716.706
**> Total simulation time =      .4 seconds.
```

COOL_RUN_LT_ND_WELL_11.WET

```
----------------------------------------------------
*              DRAINMOD version 6.1                *
* Copyright 1980-2013 North Carolina State University *
----------------------------------------------------
```

Well #11 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 11:56
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    8000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

Number of periods with water table closer than 30.50 cm
for at least   36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	1.	39.
1992	1.	71.
1993	1.	83.
1994	1.	40.
1995	2.	55.
1996	1.	45.
1997	0.	33.
1998	1.	56.
1999	0.	30.
2000	0.	24.
2001	0.	34.
2002	0.	25.
2003	2.	55.
2004	2.	56.
2005	1.	59.

COOL_RUN_LT_ND_WELL_11.WET

2006	1.	54.
2007	1.	37.
2008	1.	55.
2009	0.	29.
2010	1.	48.
2011	0.	23.
2012	0.	34.
2013	1.	99.
2014	0.	31.
2015	1.	48.
2016	1.	42.
2017	2.	40.
2018	0.	35.
2019	0.	26.
2020	1.	44.

Number of Years with at least one period = 19. out of 30 years.

```
******************************************************************************

                        D R A I N M O D  6.1

          Copyright 1980-2013 North Carolina State University
                       LAST UPDATE: April 2013
                        LANGUAGE FORTRAN 77/90

        DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
        THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
        DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
        AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
        UNDER THE DIRECTION OF R. W. SKAGGS.

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


 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
 North Wilmington Long Term Weather Data 1991-2020  No Drain



                       CLIMATE INPUTS
                       ******* ******

     DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION..................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION................(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION......................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION....................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE...................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.........................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                      DRAINAGE SYSTEM DESIGN
                                       *********************

                                     *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020  No Drain


                    STMAX =  .00 CM                  SOIL SURFACE
+         __/)____________________________________________________________/)__
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
                :                                                   :
           ADEPTH =310. CM                                   DDRAIN = 31. CM
                :                                                   :
                :                                                   :
                :     O-------------SDRAIN = 6000. CM -----------O  -
                :     *                                             :
                : EFFRAD =**** CM                                   :
                :                                            HDRAIN =253. CM
                :                                                   :
                :                                                   :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
+         ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                      DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                      (CM)                   (CM/HR)

                     .0 -   61.0              2.000
                   61.0 -  107.0               .100
                  107.0 -  310.0              1.000
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 253.5 CM
DISTANCE BETWEEN DRAINS =  6000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .00 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  284.0 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .00 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  13.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5
```

SOIL INPUTS
****

TABLE 1

DRAINAGE TABLE

COOL_RUN_LT_ND_WELL_12.OUT

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
            Start Day =   32          End Day =  334
            Threshold Water Table Depth (cm) =  30.5
            Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 12:41
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    6000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 761.976
**> End Computations      = 761.983
**> Total simulation time =      .4 seconds.
```

```
                   COOL_RUN_LT_ND_WELL_12.WET
          -----------------------------------------------------
          *              DRAINMOD version 6.1                 *
          * Copyright 1980-2013 North Carolina State University *
          -----------------------------------------------------

Well #12 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020  No Drain
********************************************************************************



  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 12:41
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    6000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------



                    DRAINMOD --- WET PERIOD EVALUATION
                    ****** Version 6.1 ******

          Number of periods with water table closer than  30.50 cm
                for at least   36 days.  Counting starts on day
                 32 and ends on day  334 of each year


          YEAR          Number of Periods       Longest Consecutive
                        of   36 days or           Period in Days
                          more with WTD
                             < 30.50 cm
                        ------------------      --------------------

          1991                 1.                       39.
          1992                 1.                       70.
          1993                 1.                       83.
          1994                 1.                       40.
          1995                 2.                       55.
          1996                 1.                       47.
          1997                 0.                       33.
          1998                 1.                       56.
          1999                 0.                       29.
          2000                 0.                       24.
          2001                 0.                       34.
          2002                 0.                       25.
          2003                 2.                       56.
          2004                 2.                       55.
          2005                 1.                       59.
```

COOL_RUN_LT_ND_WELL_12.WET

2006	0.	35.
2007	1.	37.
2008	1.	43.
2009	0.	23.
2010	1.	48.
2011	0.	22.
2012	0.	34.
2013	1.	99.
2014	0.	32.
2015	1.	48.
2016	1.	42.
2017	2.	40.
2018	0.	35.
2019	0.	26.
2020	1.	44.

Number of Years with at least one period = 18. out of 30 years.

```
*******************************************************************************

                          D R A I N M O D  6.1

              Copyright 1980-2013 North Carolina State University
                         LAST UPDATE: April 2013
                           LANGUAGE FORTRAN 77/90

           DRAINMOD IS A FIELD-SCALE HYDROLOGIC MODEL DEVELOPED FOR
           THE DESIGN OF SUBSURFACE DRAINAGE SYSTEMS. THE MODEL WAS
           DEVELOPED BY RESEARCHERS AT THE DEPT. OF BIOLOGICAL AND
           AGRICULTURAL ENGINEERING, NORTH CAROLINA STATE UNIVERSITY
           UNDER THE DIRECTION OF R. W. SKAGGS.

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



 DATA READ FROM INPUT FILE: C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 Cream selector (0=no, 1=yes) =  0

                        TITLE OF RUN
                        ************


 Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
 North Wilmington Long Term Weather Data 1991-2020 No Drain



                       CLIMATE INPUTS
                       ******* ******

      DESCRIPTION                               (VARIABLE)     VALUE   UNIT
 ------------------------------------------------------------------------------
 FILE FOR RAINDATA ..............C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 FILE FOR TEMPERATURE/PET DATA ..C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\W
 RAINFALL STATION NUMBER.........................(RAINID)          1
 TEMPERATURE/PET STATION NUMBER..................(TEMPID)          1
 STARTING YEAR OF SIMULATION.................(START YEAR)       1991   YEAR
 STARTING MONTH OF SIMULATION...............(START MONTH)          1   MONTH
 ENDING YEAR OF SIMULATION.....................(END YEAR)       2020   YEAR
 ENDING MONTH OF SIMULATION...................(END MONTH)         12   MONTH
 TEMPERATURE STATION LATITUDE..................(TEMP LAT)      34.47   DEG.MIN
 HEAT INDEX.......................................(HID)      81.00
```

```
 ET MULTIPLICATION FACTOR FOR EACH MONTH
    2.01  2.32  2.10  1.72  1.23  1.00   .86   .82   .92  1.05  1.22  1.44


                                       DRAINAGE SYSTEM DESIGN
                                        *********************

                                      *** CONVENTIONAL DRAINAGE ***

          JOB TITLE:

                   Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long T
                   North Wilmington Long Term Weather Data 1991-2020 No Drain


                    STMAX =  .50 CM                  SOIL SURFACE
 +        __/)____________________________________________________________/)__
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
                :                                                    :
           ADEPTH =310. CM                                    DDRAIN = 31. CM
                :                                                    :
                :                                                    :
                :     O-------------SDRAIN = 4000. CM -----------O  -
                :     *                                              :
                : EFFRAD =**** CM                                    :
                :                                             HDRAIN =242. CM
                :                                                    :
                :                                                    :
          - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
                :
                :
                :
                :                                    IMPERMEABLE LAYER
 +        ____________________________________________________________________
          ////////////////////////////////////////////////////////////////////


                        DEPTH      SATURATED HYDRAULIC CONDUCTIVITY
                        (CM)                    (CM/HR)

                       .0 -   61.0               4.000
                     61.0 -  107.0                .100
                    107.0 -  310.0                .500
```

```
DEPTH TO DRAIN =  30.5 CM
EFFECTIVE DEPTH FROM DRAIN TO IMPERMEABLE LAYER = 241.7 CM
DISTANCE BETWEEN DRAINS =  4000.0 CM
MAXIMUM DEPTH OF SURFACE PONDING =   .50 CM
EFFECTIVE DEPTH TO IMPERMEABLE LAYER =  272.2 CM
DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET) =   .30 CM/DAY
MAXIMUM PUMPING CAPACITY (SUBIRRIGATION MODE) =   2.50 CM/DAY
ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER = 310.0 CM
SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER
  CAN MOVE TO DRAIN =  .50 CM
FACTOR -G- IN KIRKHAM EQ. 2-17 =  .07

  *** SEEPAGE LOSS INPUTS ***

   No seepage due to field slope

   No seepage due to vertical deep seepage

   No seepage due to lateral deep seepage

 *** end of seepage inputs ***

WIDTH OF DITCH BOTTOM =  91.4 CM
SIDE SLOPE OF DITCH (HORIZ:VERT) =   .90 : 1.00

INITIAL WATER TABLE DEPTH =  12.0 CM


    DEPTH OF WEIR FROM THE SURFACE
    ------------------------------
DATE         1/  1   2/  1   3/  1   4/  1   5/  1   6/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5

DATE         7/  1   8/  1   9/  1   10/  1  11/  1  12/  1
WEIR DEPTH    30.5    30.5    30.5    30.5    30.5    30.5


                                  SOIL INPUTS
                                  ***********



                                    TABLE 1

                                 DRAINAGE TABLE
```

VOID VOLUME (CM)	WATER TABLE DEPTH (CM)
.0	.0
1.0	19.1
2.0	29.1
3.0	37.3
4.0	44.9
5.0	51.9
6.0	58.9
7.0	65.3
8.0	71.6
9.0	77.7
10.0	83.7
11.0	89.6
12.0	95.2
13.0	100.8
14.0	106.3
15.0	111.8
16.0	117.4
17.0	122.8
18.0	128.0
19.0	133.2
20.0	138.5
21.0	143.7
22.0	148.9
23.0	153.9
24.0	158.7
25.0	163.6
26.0	168.5
27.0	173.3
28.0	178.2
29.0	183.1
30.0	188.0
35.0	211.2
40.0	233.5
45.0	255.7
50.0	277.9
60.0	322.3
70.0	366.7
80.0	411.2
90.0	455.6

1 TABLE 2

SOIL WATER CHARACTERISTIC VS VOID VOLUME VS UPFLUX

HEAD (CM)	WATER CONTENT (CM/CM)	VOID VOLUME (CM)	UPFLUX (CM/HR)
.0	.5090	50.00	.5000

10.0	.4460	.32	.0387
20.0	.4199	1.08	.0093
30.0	.3938	2.10	.0038
40.0	.3786	3.34	.0020
50.0	.3680	4.73	.0013
60.0	.3574	6.16	.0008
70.0	.3485	7.75	.0006
80.0	.3424	9.38	.0004
90.0	.3362	11.06	.0003
100.0	.3300	12.86	.0002
110.0	.3265	14.67	.0002
120.0	.3230	16.47	.0001
130.0	.3195	18.38	.0001
140.0	.3160	20.30	.0000
150.0	.3125	22.21	.0000
160.0	.3090	24.26	.0000
170.0	.3055	26.31	.0000
180.0	.3020	28.37	.0000
190.0	.2985	30.42	.0000
200.0	.2950	32.47	.0000
210.0	.2929	34.72	.0000
220.0	.2908	36.97	.0000
230.0	.2887	39.22	.0000
240.0	.2866	41.47	.0000
250.0	.2845	43.73	.0000
260.0	.2824	45.98	.0000
270.0	.2803	48.23	.0000
280.0	.2782	50.48	.0000
290.0	.2761	52.73	.0000
300.0	.2740	54.98	.0000
350.0	.2680	66.24	.0000
400.0	.2620	77.49	.0000
450.0	.2560	88.74	.0000
500.0	.2500	100.00	.0000
600.0	.2420	100.00	.0000
700.0	.2340	100.00	.0000
800.0	.2260	100.00	.0000
900.0	.2180	100.00	.0000

GREEN AMPT INFILTRATION PARAMETERS

W.T.D. (CM)	A (CM)	B (CM)
.000	.000	.570
10.000	.080	.570
20.000	.120	.570
40.000	.170	.570

60.000	.200	.570
80.000	.220	.570
100.000	.230	.570
150.000	.410	.570
200.000	.410	.570
1000.000	.410	.570

TRAFFICABILITY
****

REQUIREMENTS	FIRST PERIOD	SECOND PERIOD
-MINIMUM AIR VOLUME IN SOIL (CM):	3.90	3.90
-MAXIMUM ALLOWABLE DAILY RAINFALL(CM):	1.20	1.20
-MINIMUM TIME AFTER RAIN BEFORE TILLING CAN CONTINUE:	2.00	2.00
WORKING TIMES		
-DATE TO BEGIN COUNTING WORK DAYS:	4/ 1	12/32
-DATE TO STOP COUNTING WORK DAYS:	5/ 1	12/32
-FIRST WORK HOUR OF THE DAY:	8	8
-LAST WORK HOUR OF THE DAY:	20	20

CROP
****

SOIL MOISTURE AT WILTING POINT =   .17

HIGH WATER STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18
CROP IS IN STRESS WHEN WATER TABLE IS ABOVE 30.0 CM

DROUGHT STRESS: BEGIN STRESS PERIOD ON   4/10
END STRESS PERIOD ON   8/18

MO	DAY	ROOTING DEPTH(CM)
1	1	3.0
4	16	3.0
5	4	4.0
5	17	15.0
6	1	25.0
6	20	30.0
7	18	30.0
8	20	20.0

```
  9   24        10.0
  9   25         3.0
 12   31         3.0
```

WASTEWATER IRRIGATION
****

NO WASTEWATER IRRIGATION SCHEDULED:

***** Wetlands Parameter Estimation *****

```
Start Day =   32          End Day =  334
Threshold Water Table Depth (cm) =  30.5
Threshold Consecutive Days       =    36
```

Fixed Monthly Pet Values

```
    1 1.00    2 1.00    3 1.00    4 1.00    5 1.00    6 1.00    7 1.00    8 1.00
9 1.00   10 1.00   11 1.00   12 1.00
```

Mrank indicator = 1

```
 ****************************** END OF INPUTS ******************************

  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 13:59
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

```
**> Computational Statistics       <**
**> Start Computations    = 839.950
**> End Computations      = 839.957
**> Total simulation time =      .4 seconds.
```

COOL_RUN_LT_ND_WELL_13.WET

```
          ----------------------------------------------------
          *              DRAINMOD version 6.1                *
          * Copyright 1980-2013 North Carolina State University *
          ----------------------------------------------------
```

Well #13 Cool Run, LMG20.248, Muckalee Soil Unit_2021_Long Term Assess No Drain
North Wilmington Long Term Weather Data 1991-2020 No Drain
****

```
  ----------RUN STATISTICS ----------          time:  9/ 9/2021  @ 13:59
 input file:   C:\Users\nh0016\Desktop\2021 Cool Run DrainMod\I
 parameters:    free drainage              and yields not calculated
               drain spacing =    4000. cm   drain depth =   30.5 cm
------------------------------------------------------------------------
```

DRAINMOD --- WET PERIOD EVALUATION
****** Version 6.1 ******

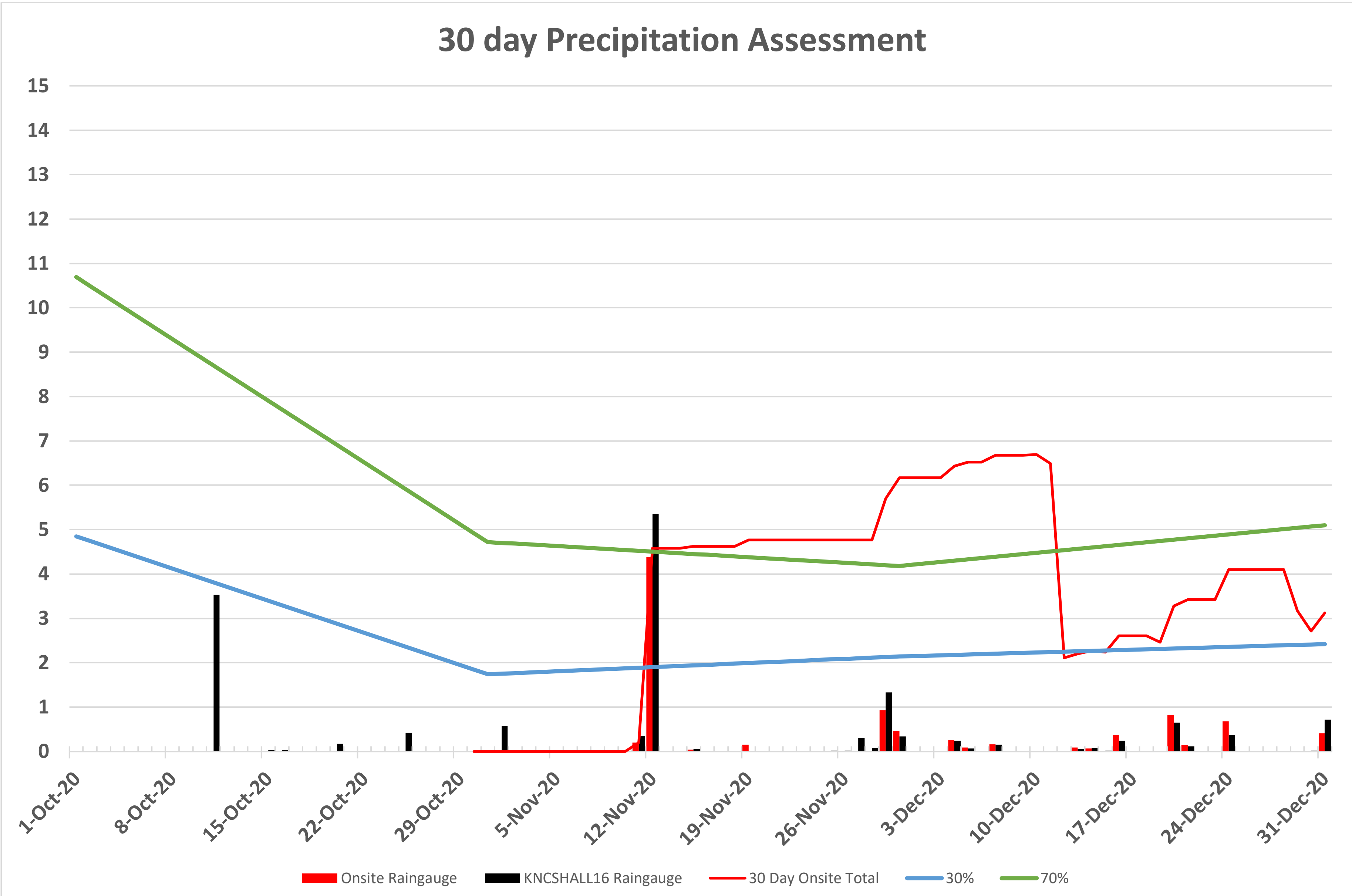
Number of periods with water table closer than 30.50 cm
for at least 36 days. Counting starts on day
32 and ends on day 334 of each year

YEAR	Number of Periods of 36 days or more with WTD < 30.50 cm	Longest Consecutive Period in Days
1991	1.	41.
1992	1.	70.
1993	1.	84.
1994	1.	50.
1995	2.	55.
1996	2.	50.
1997	0.	32.
1998	1.	57.
1999	0.	30.
2000	0.	23.
2001	0.	34.
2002	0.	25.
2003	2.	56.
2004	2.	55.
2005	2.	56.

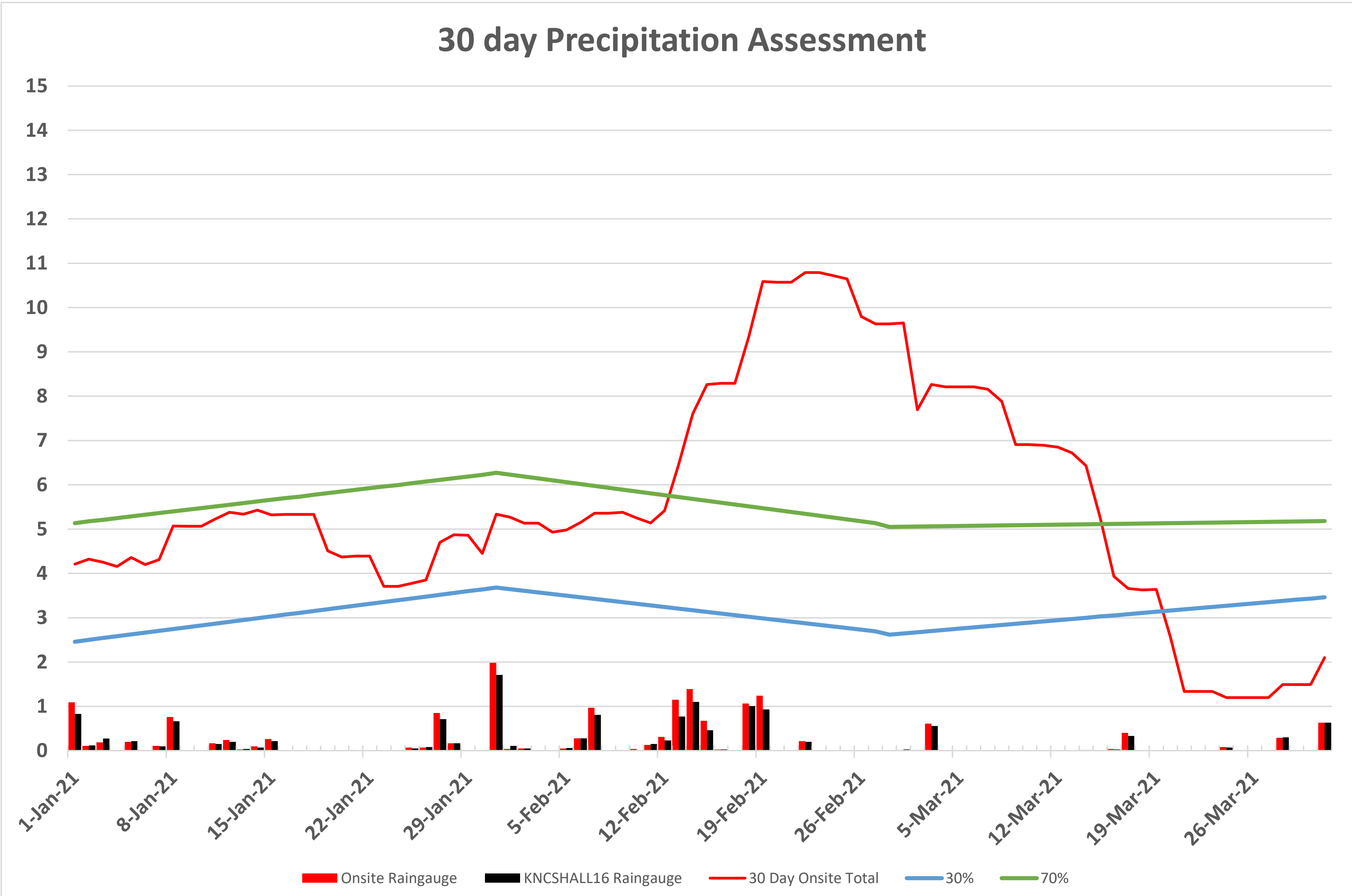
COOL_RUN_LT_ND_WELL_13.WET

2006	1.	54.
2007	1.	36.
2008	1.	43.
2009	0.	30.
2010	1.	50.
2011	0.	22.
2012	0.	34.
2013	1.	100.
2014	0.	32.
2015	1.	48.
2016	1.	42.
2017	2.	45.
2018	1.	36.
2019	0.	26.
2020	2.	46.

Number of Years with at least one period =   20. out of   30 years.

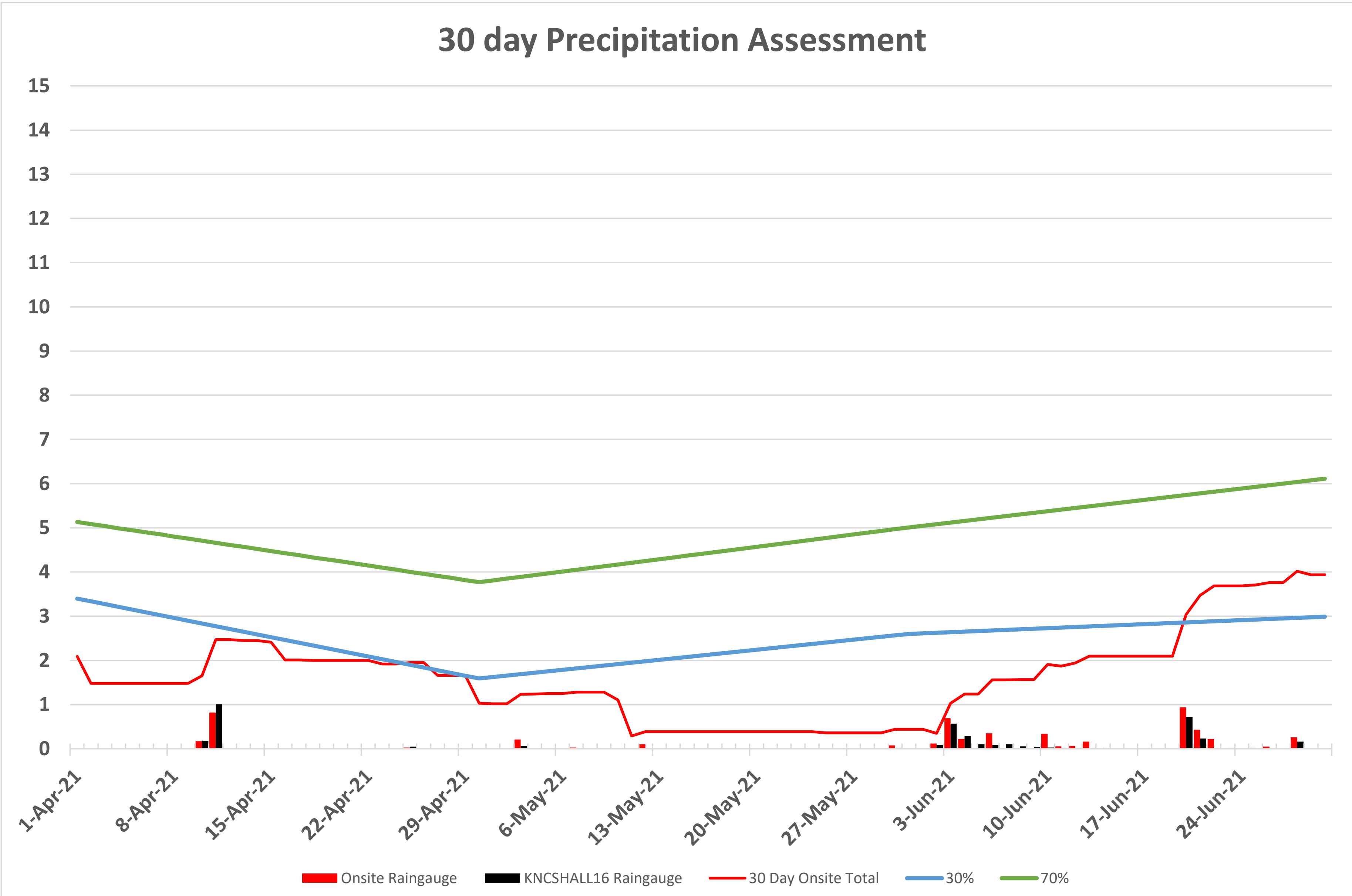


Precipitation Data Obtained from: Onsite Raingauge and Comparison Station KNCSHALL16 (weatherunderground PWS)
30% and 70% precipitation normals obtained from: WETS Station WILLARD 4 SW, NC9423 1971-2000 (wcc.nrcs.usda.gov)



LMG LAND MANAGEMENT GROUP a DAVEY company

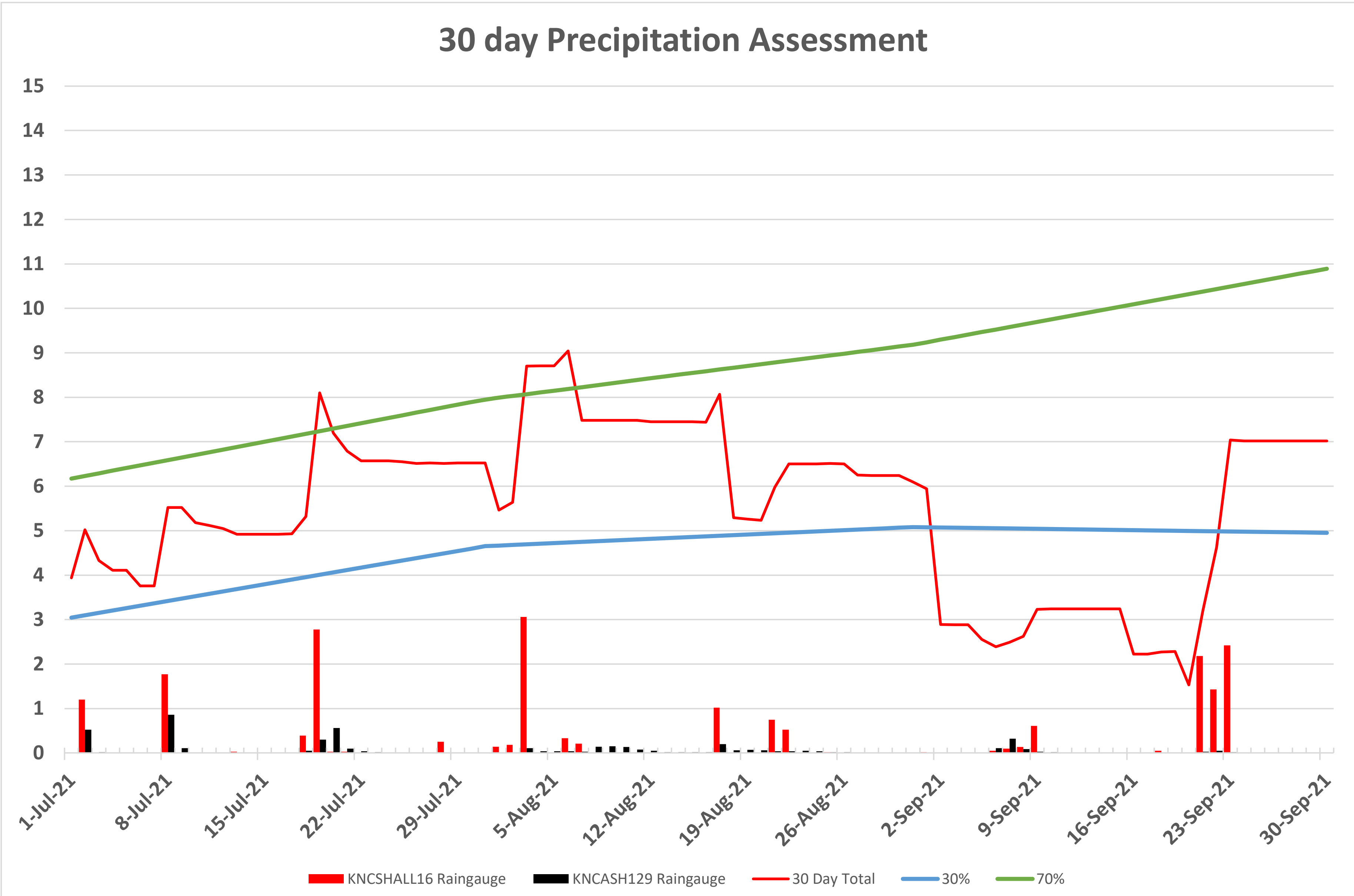
Precipitation Data Obtained from: Onsite Raingauge and Comparison Station KNCSHALL16 (weatherunderground PWS)
30% and 70% precipitation normals obtained from: WETS Station WILLARD 4 SW, NC9423 1971-2000 (wcc.nrcs.usda.gov)



Precipitation Data Obtained from: Onsite Raingauge and Comparison Station KNCSHALL16 (weatherunderground PWS)
30% and 70% precipitation normals obtained from: WETS Station WILLARD 4 SW, NC9423 1971-2000 (wcc.nrcs.usda.gov)

*Onsite raingauge malfunction - data replaced with KNCSHALL16

September 2021

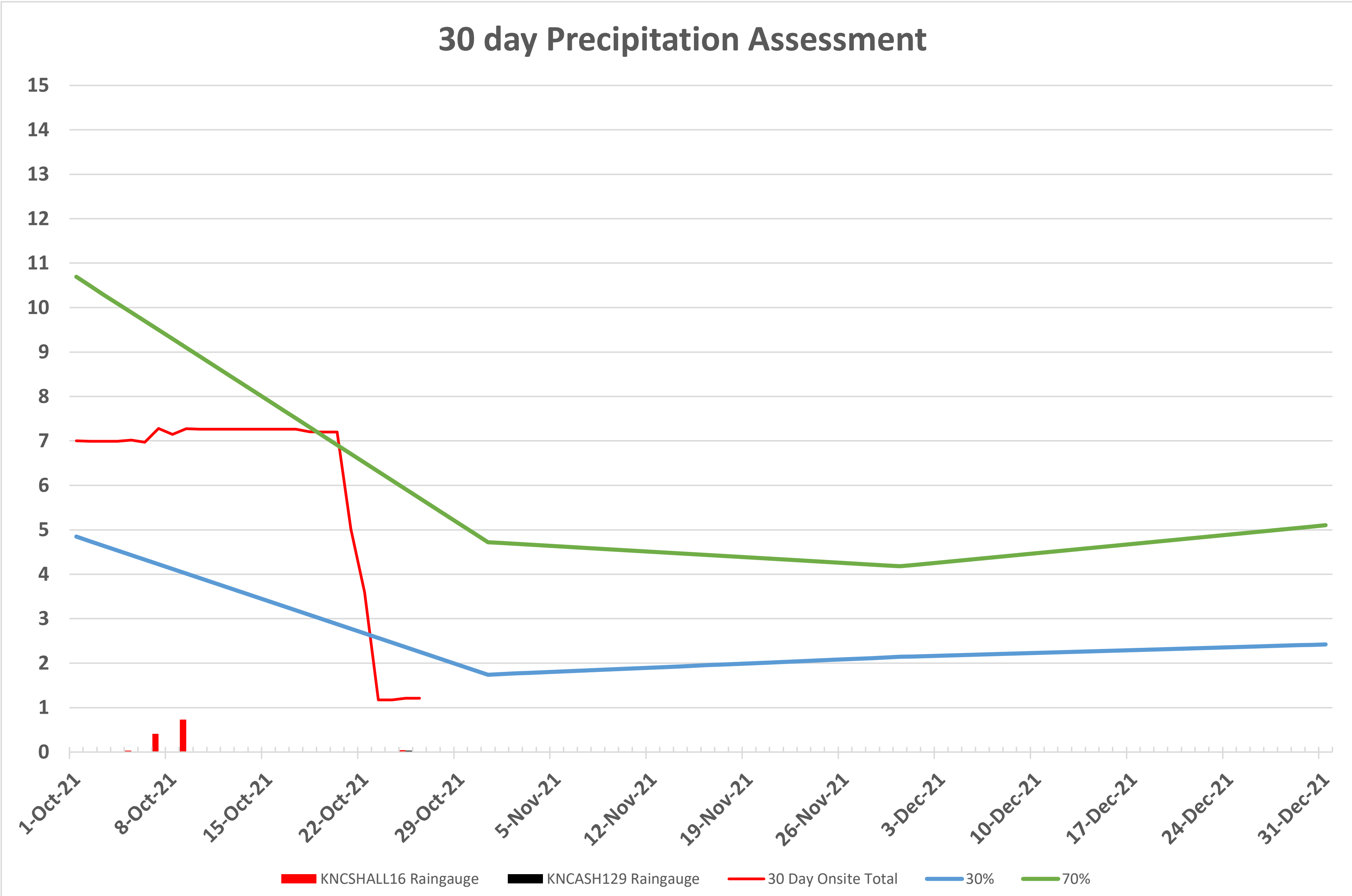


LMG LAND MANAGEMENT GROUP a DAVEY company

Precipitation Data Obtained from: Onsite Raingauge and Comparison Station KNCASH129 (weatherunderground PWS)
30% and 70% precipitation normals obtained from: WETS Station WILLARD 4 SW, NC9423 1971-2000 (wcc.nrcs.usda.gov)

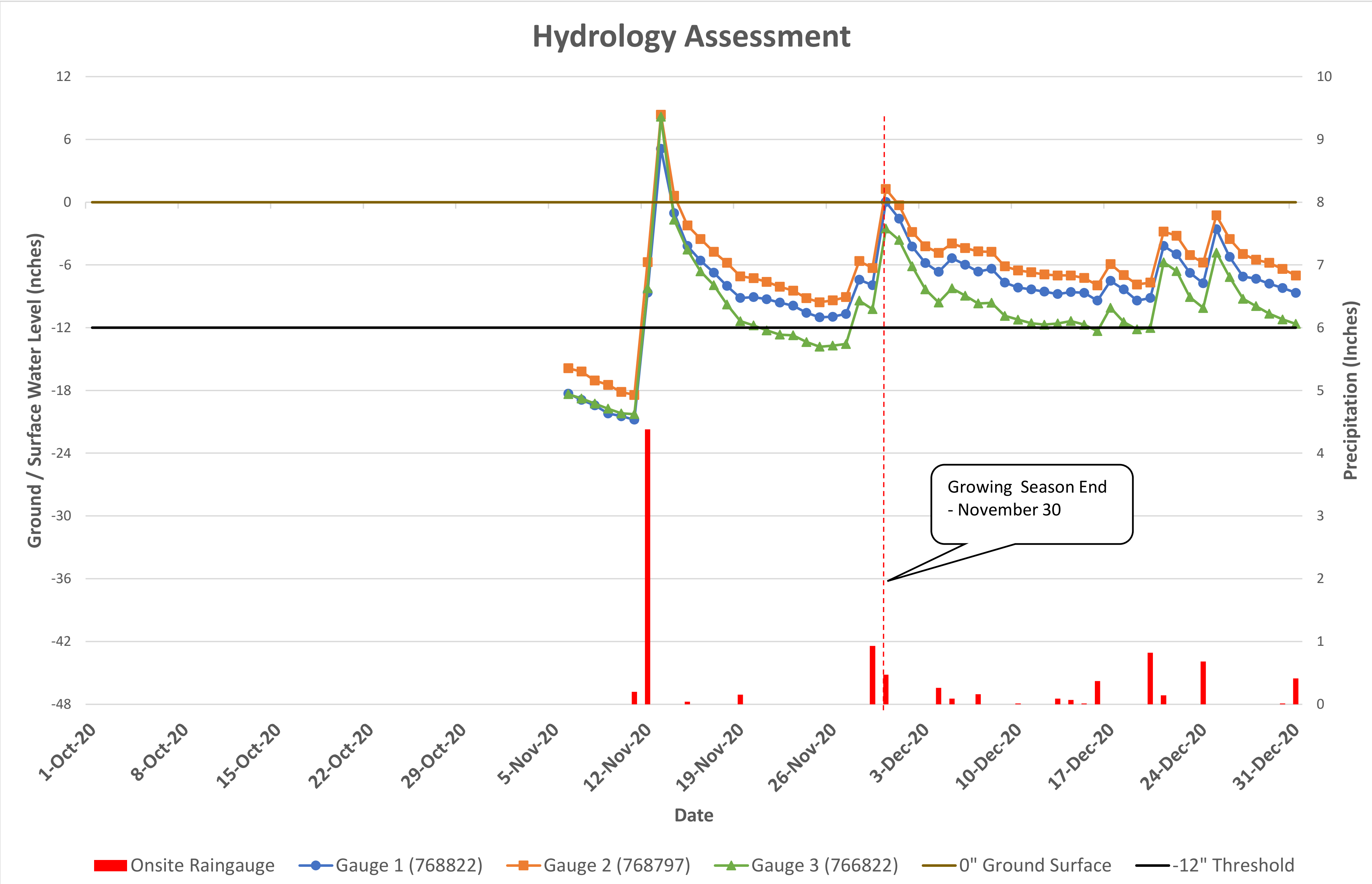
*Onsite raingauge malfunction - data replaced with KNCSHALL16

December 2021



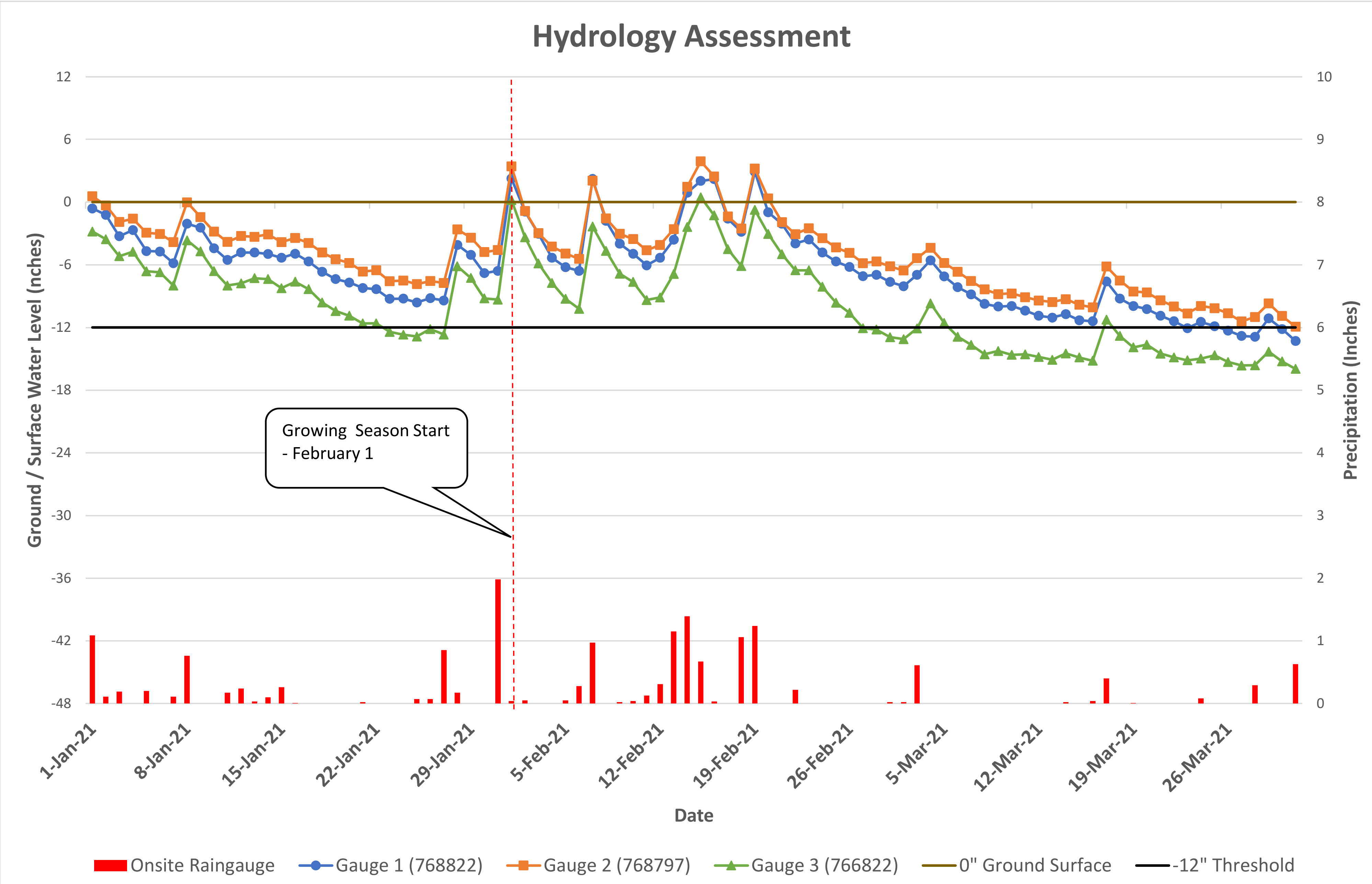
LMG LAND MANAGEMENT GROUP a DAVEY company

Precipitation Data Obtained from: Onsite Raingauge and Comparison Station KNCASH129 (weatherunderground PWS)
30% and 70% precipitation normals obtained from: WETS Station WILLARD 4 SW, NC9423 1971-2000 (wcc.nrcs.usda.gov)



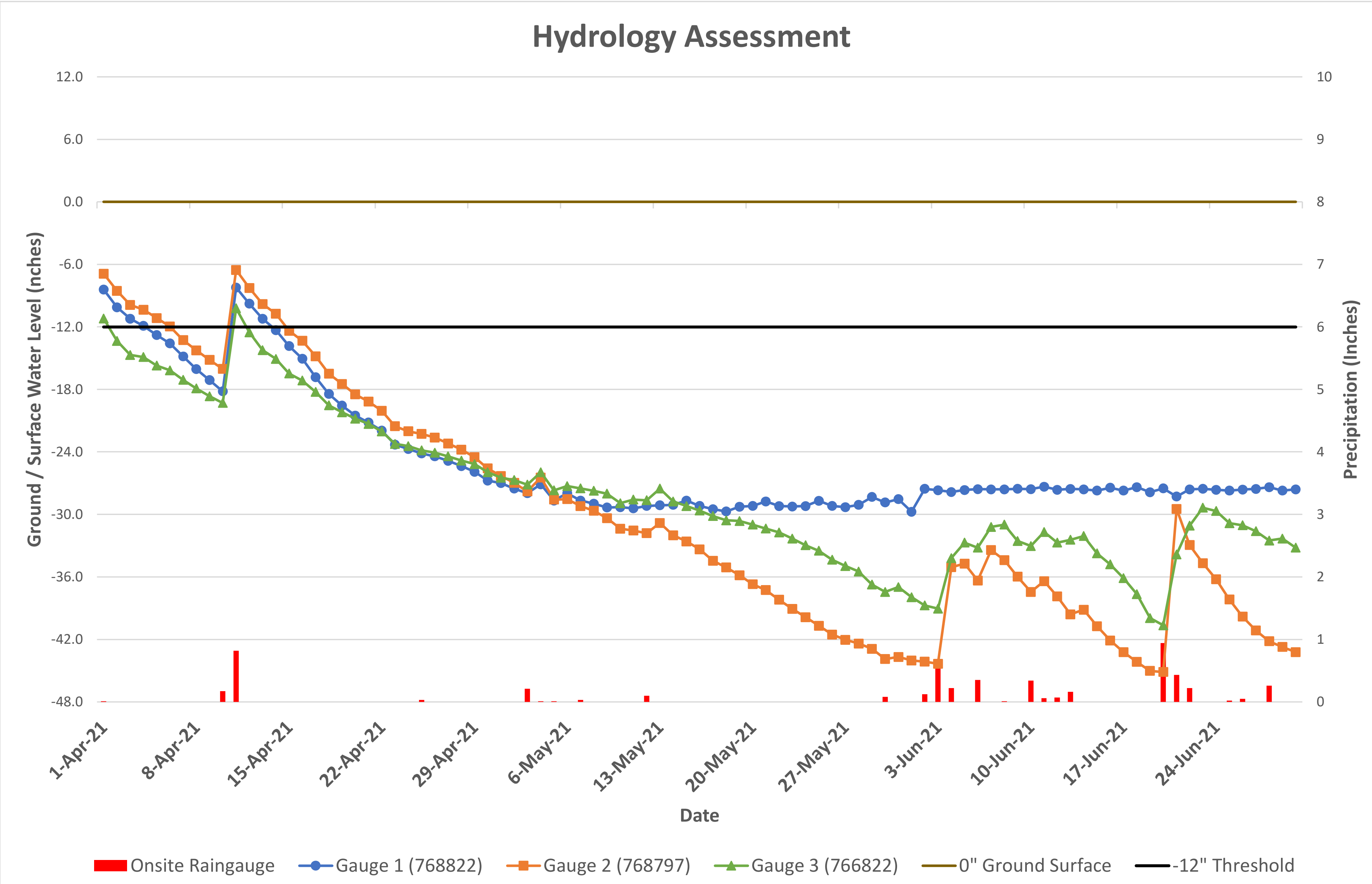
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 1, 2, 3 - Rugged Trolls - <u>October 1, 2020 to December 31, 2020</u> - One reading per day at 7:00 am



Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

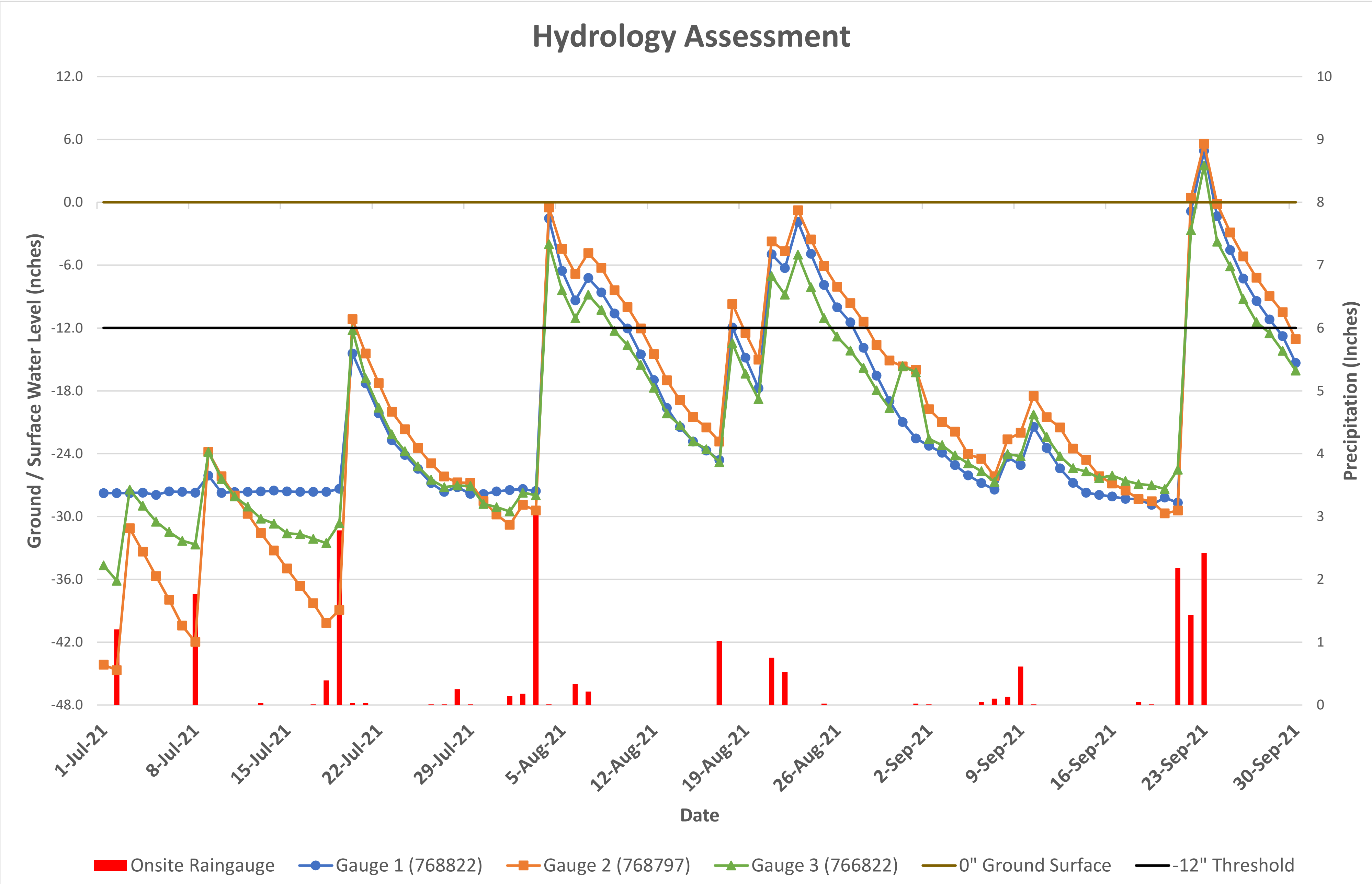
Gauges 1, 2, 3 - Rugged Trolls - January 1, 2021 to March 31, 2021 - One reading per day at 7:00 am



LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

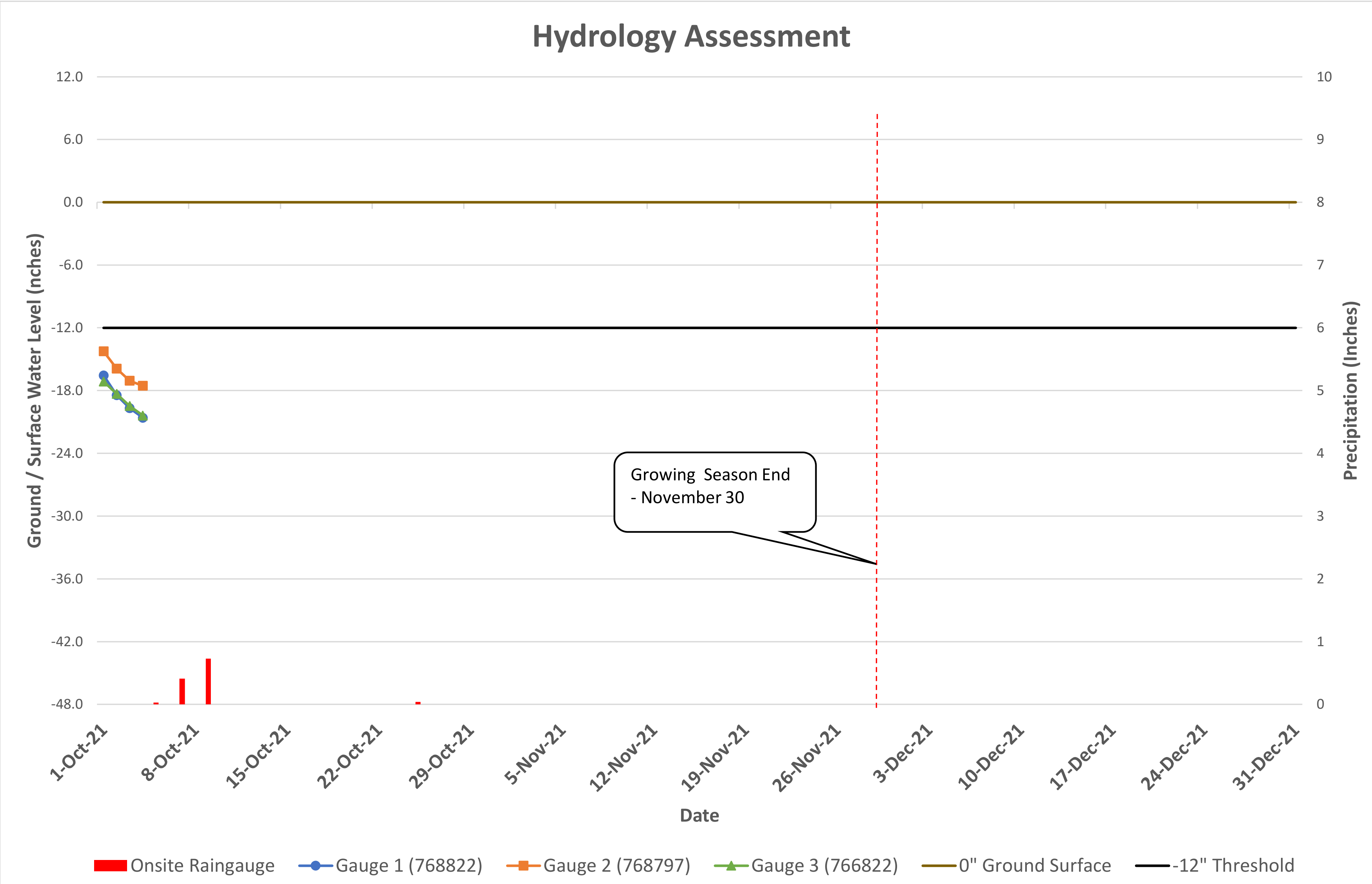
Gauges 1, 2, 3 - Rugged Trolls - April 1, 2021 to June 30, 2021 - One reading per day at 7:00 am



LMG LAND MANAGEMENT GROUP a DAVEY company

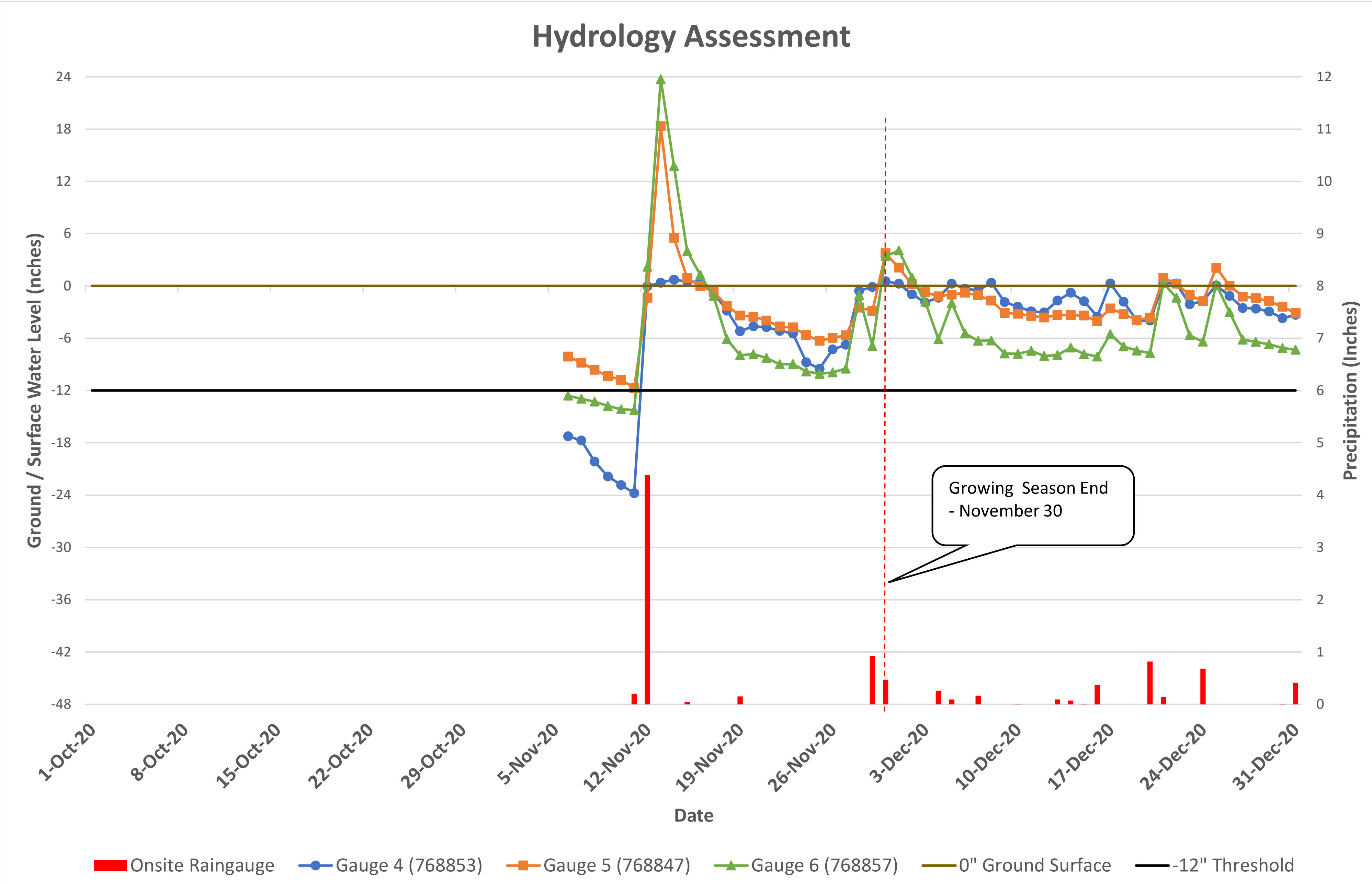
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

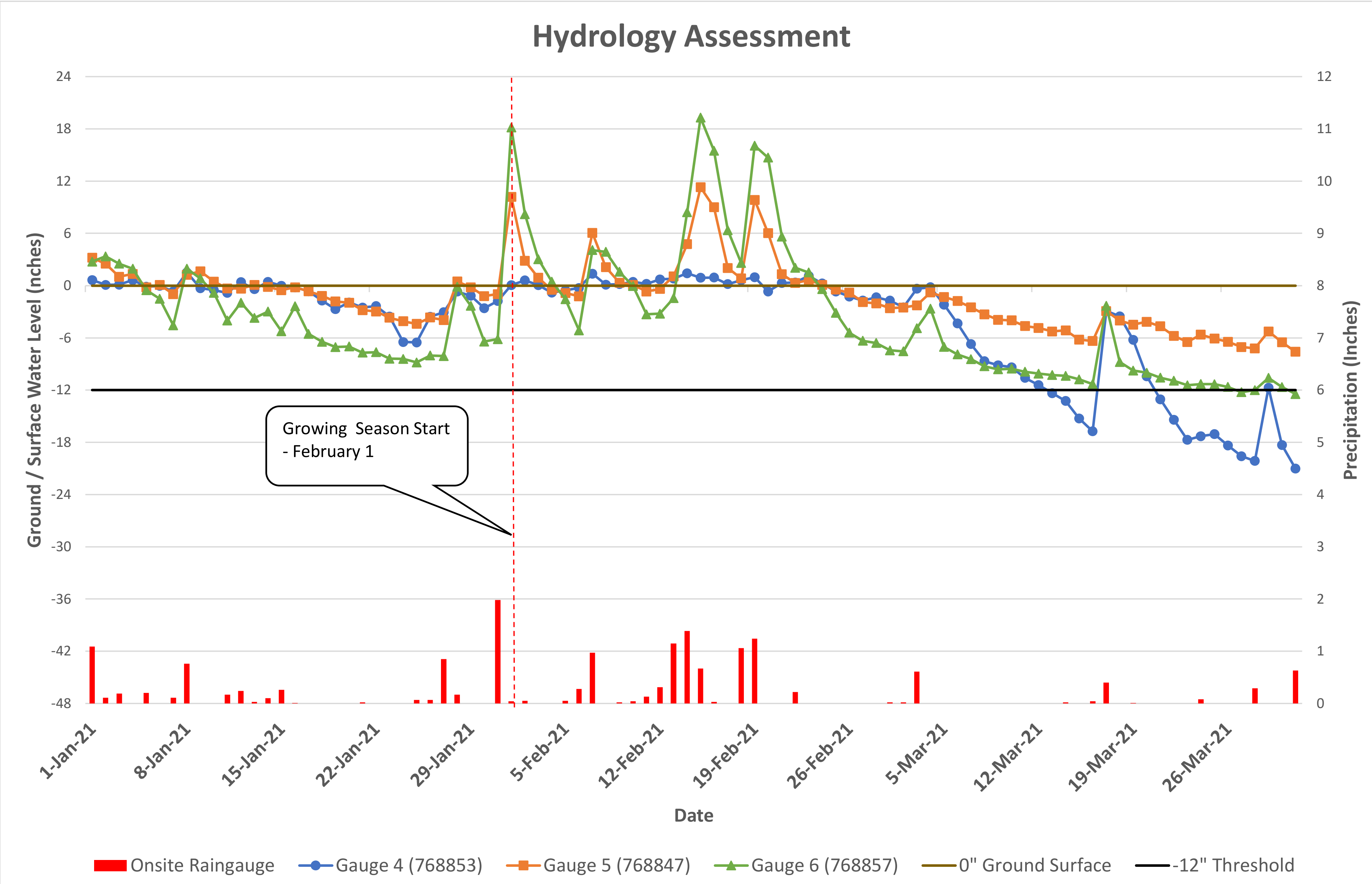
Gauges 1, 2, 3 - Rugged Trolls - July 1, 2021 to September 30, 2021 - One reading per day at 7:00 am



Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 1, 2, 3 - Rugged Trolls - October 1, 2021 to December 31, 2021 - One reading per day at 7:00 am

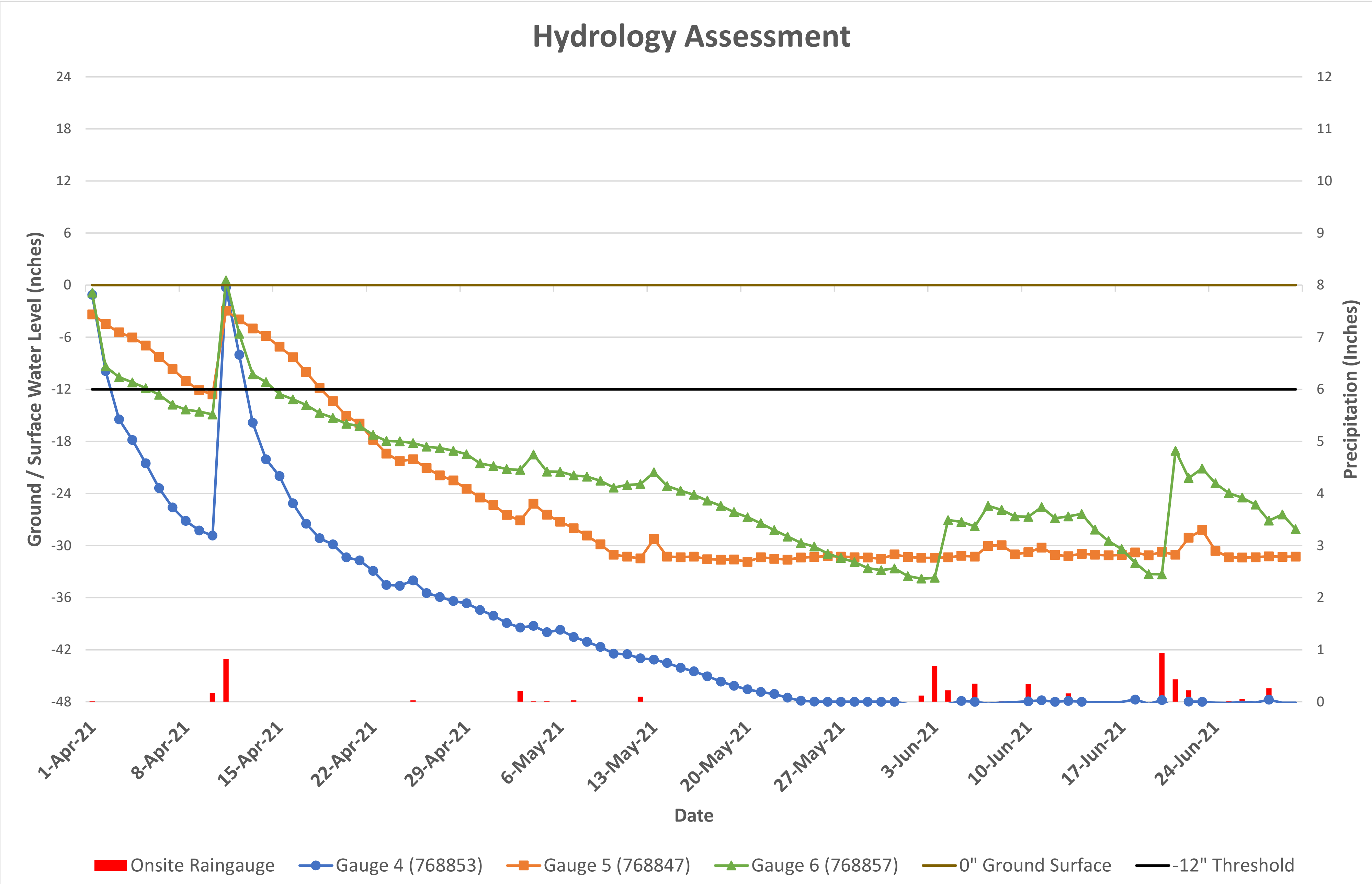

Hydrology Assessment
Ground / Surface Water Level (inches)
Precipitation (Inches)
24
18
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
12
11
10
9
8
7
6
5
4
3
2
1
0
Growing Season End - November 30
1-Oct-20
8-Oct-20
15-Oct-20
22-Oct-20
29-Oct-20
5-Nov-20
12-Nov-20
19-Nov-20
26-Nov-20
3-Dec-20
10-Dec-20
17-Dec-20
24-Dec-20
31-Dec-20
Date
Onsite Raingauge
Gauge 4 (768853)
Gauge 5 (768847)
Gauge 6 (768857)
0" Ground Surface
-12" Threshold



LMG LAND MANAGEMENT GROUP a DAVEY company

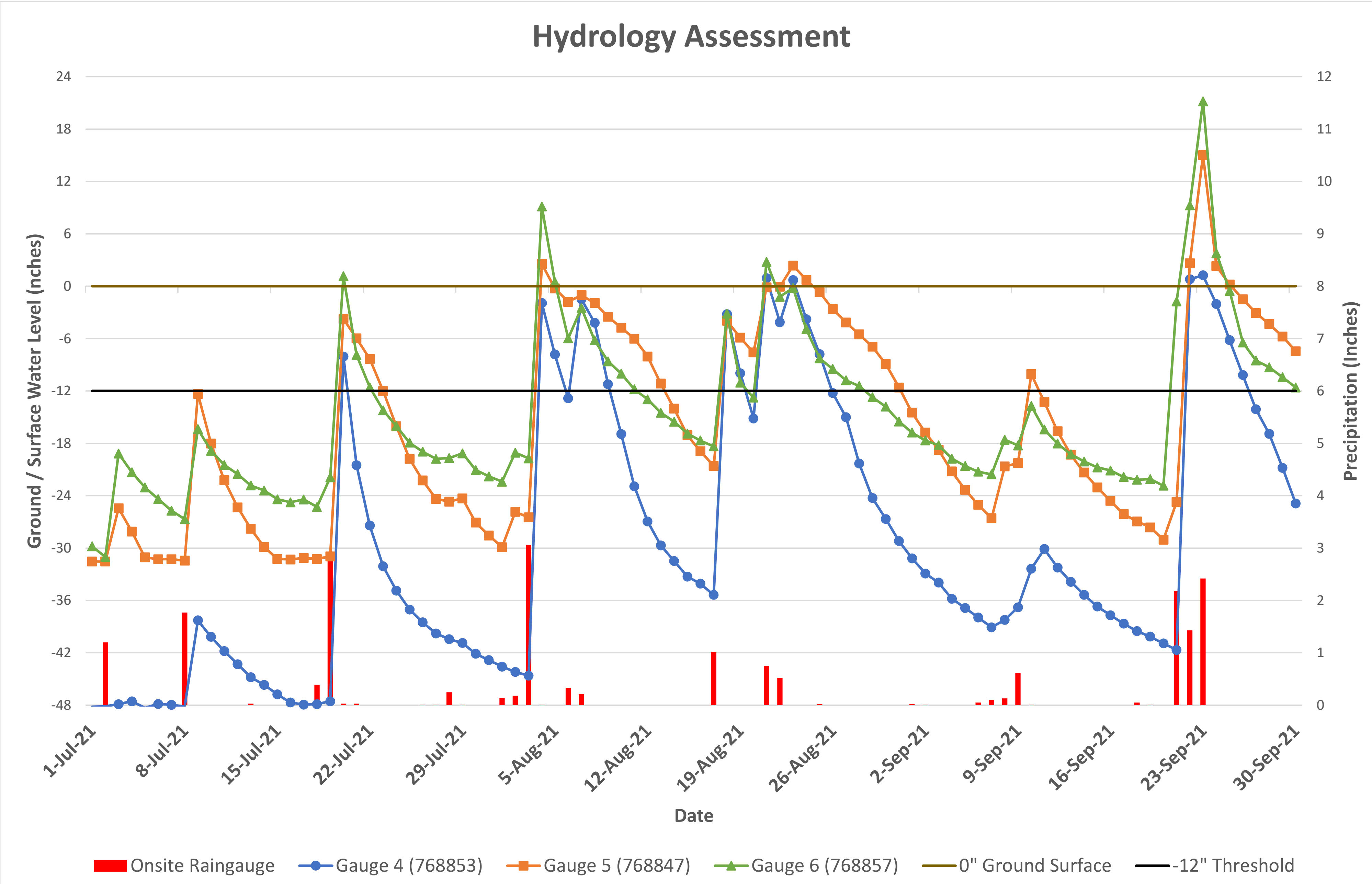
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 4, 5, 6 - Rugged Trolls - <u>January 1, 2021 to March 31, 2021</u> - One reading per day at 7:00 am



Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

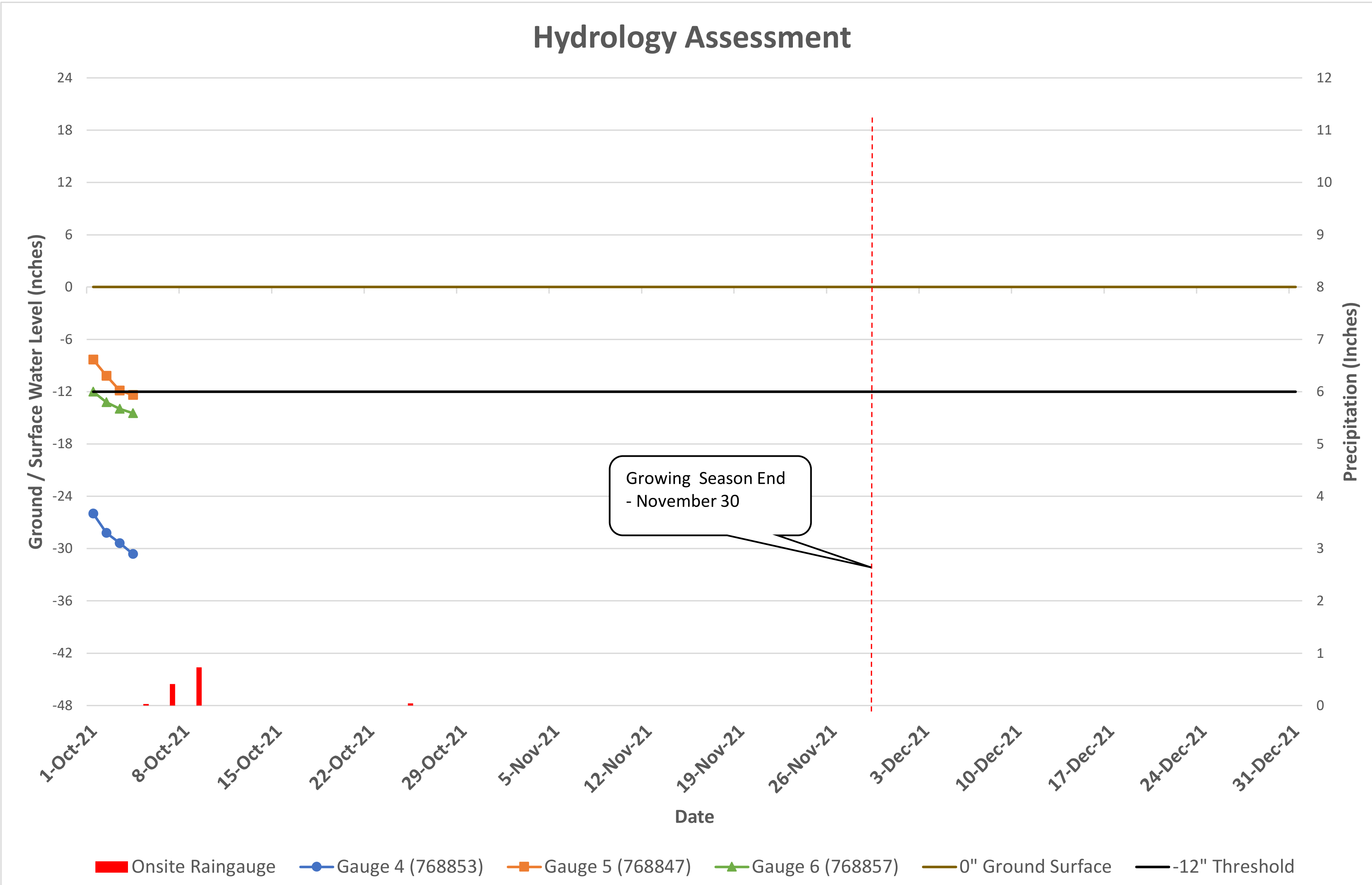
Gauges 4, 5, 6 - Rugged Trolls - April 1, 2021 to June 30, 2021 - One reading per day at 7:00 am



LMG LAND MANAGEMENT GROUP a DAVEY company

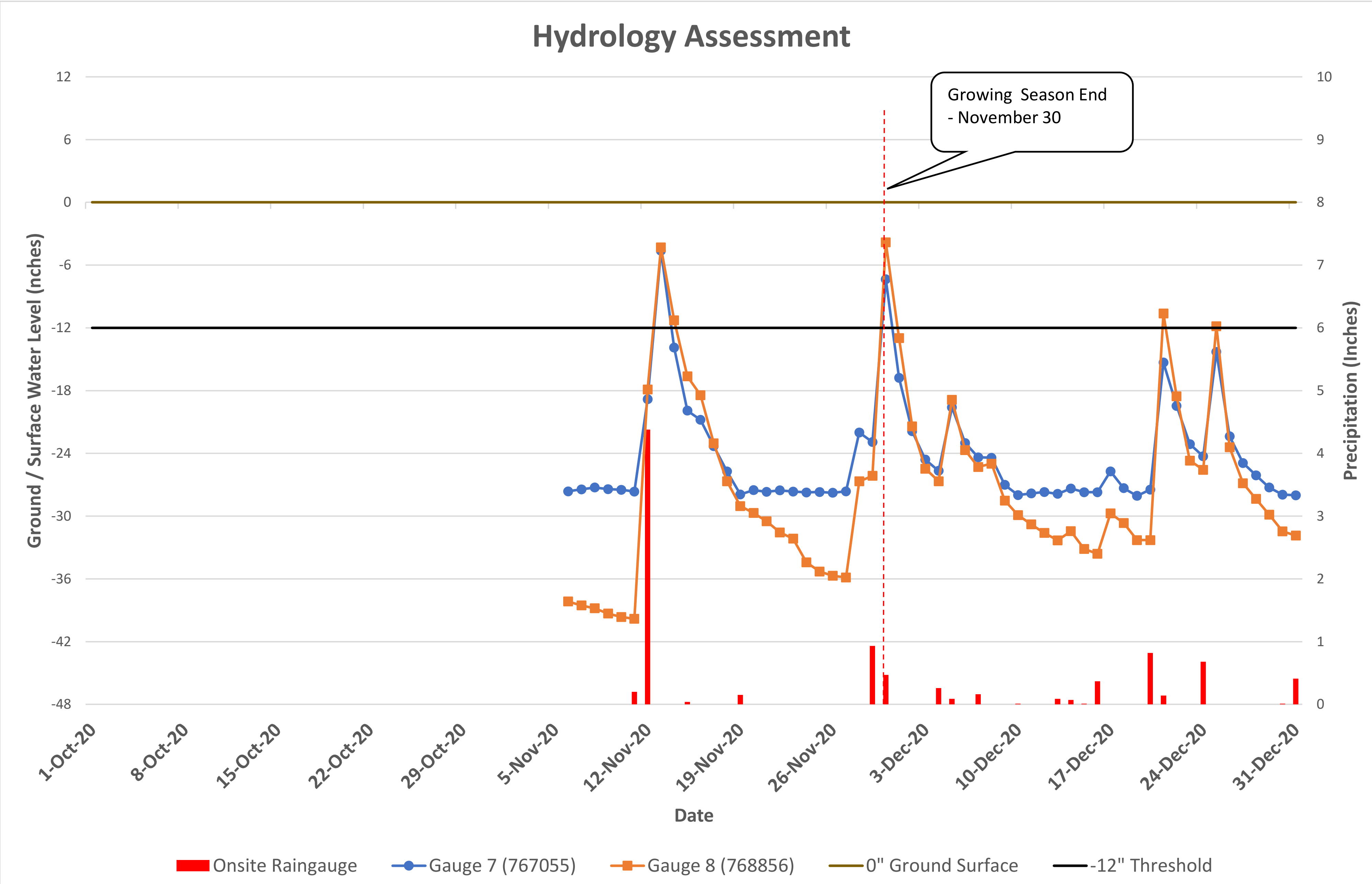
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 4, 5, 6 - Rugged Trolls - <u>July 1, 2021 to September 30, 2021</u> - One reading per day at 7:00 am



Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

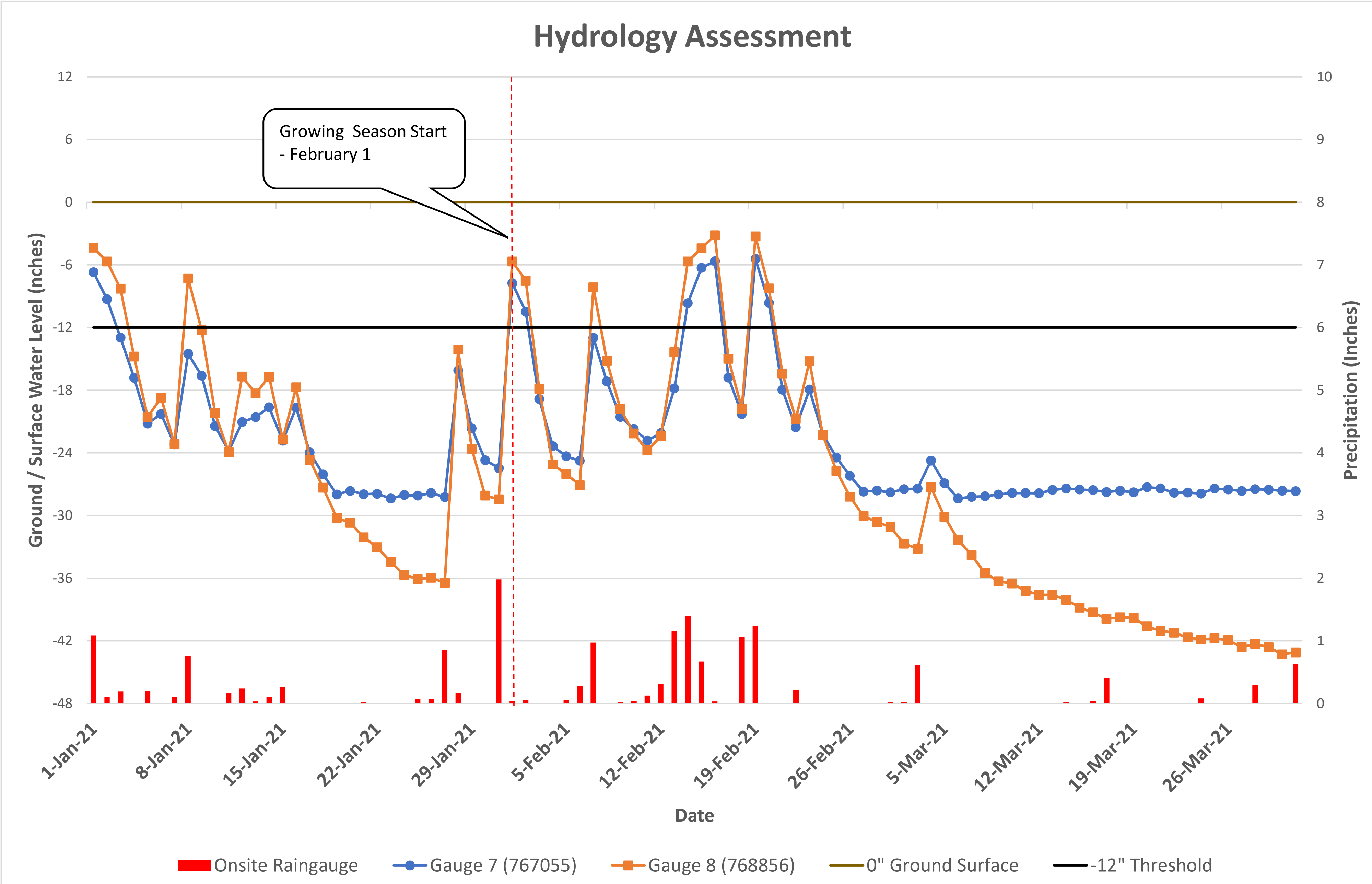
Gauges 4, 5, 6 - Rugged Trolls - <u>October 1, 2021 to December 31, 2021</u> - One reading per day at 7:00 am



LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

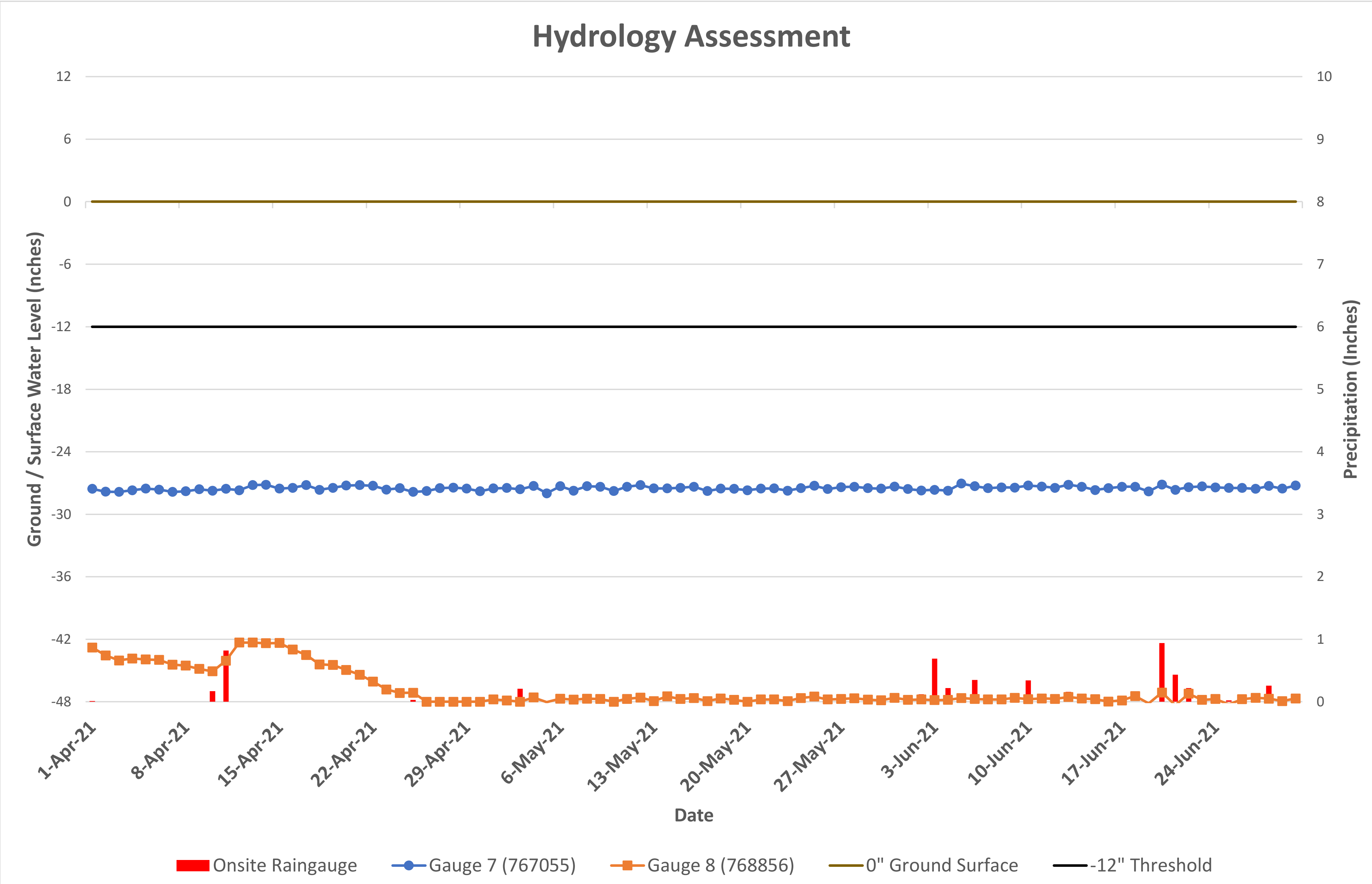
Gauges 7, 8 - Rugged Trolls - October 1, 2020 to December 31, 2020 - One reading per day at 7:00 am



LMG LAND MANAGEMENT GROUP a DAVEY company

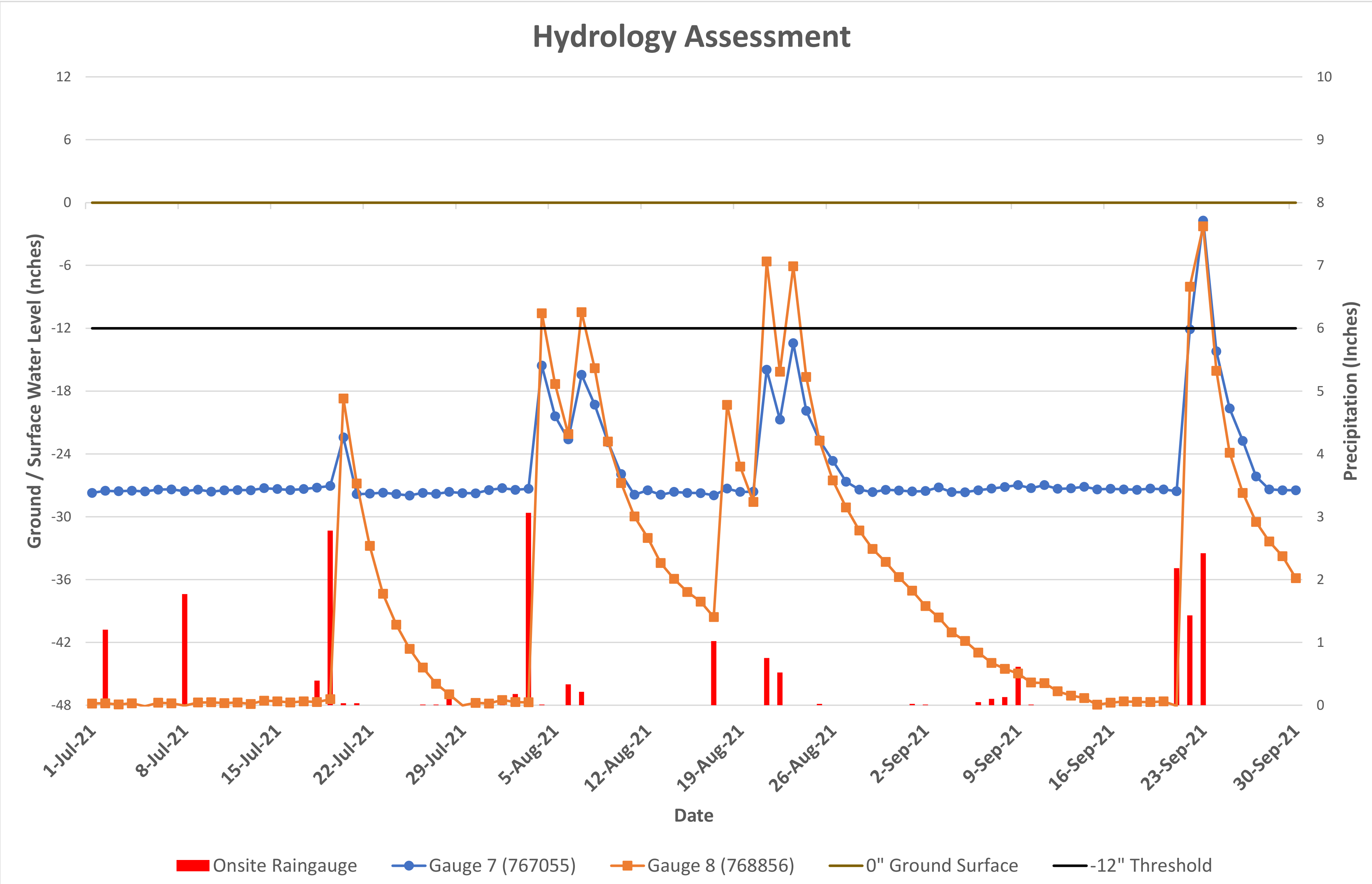
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 7, 8 - Rugged Trolls - January 1, 2021 to March 31, 2021 - One reading per day at 7:00 am

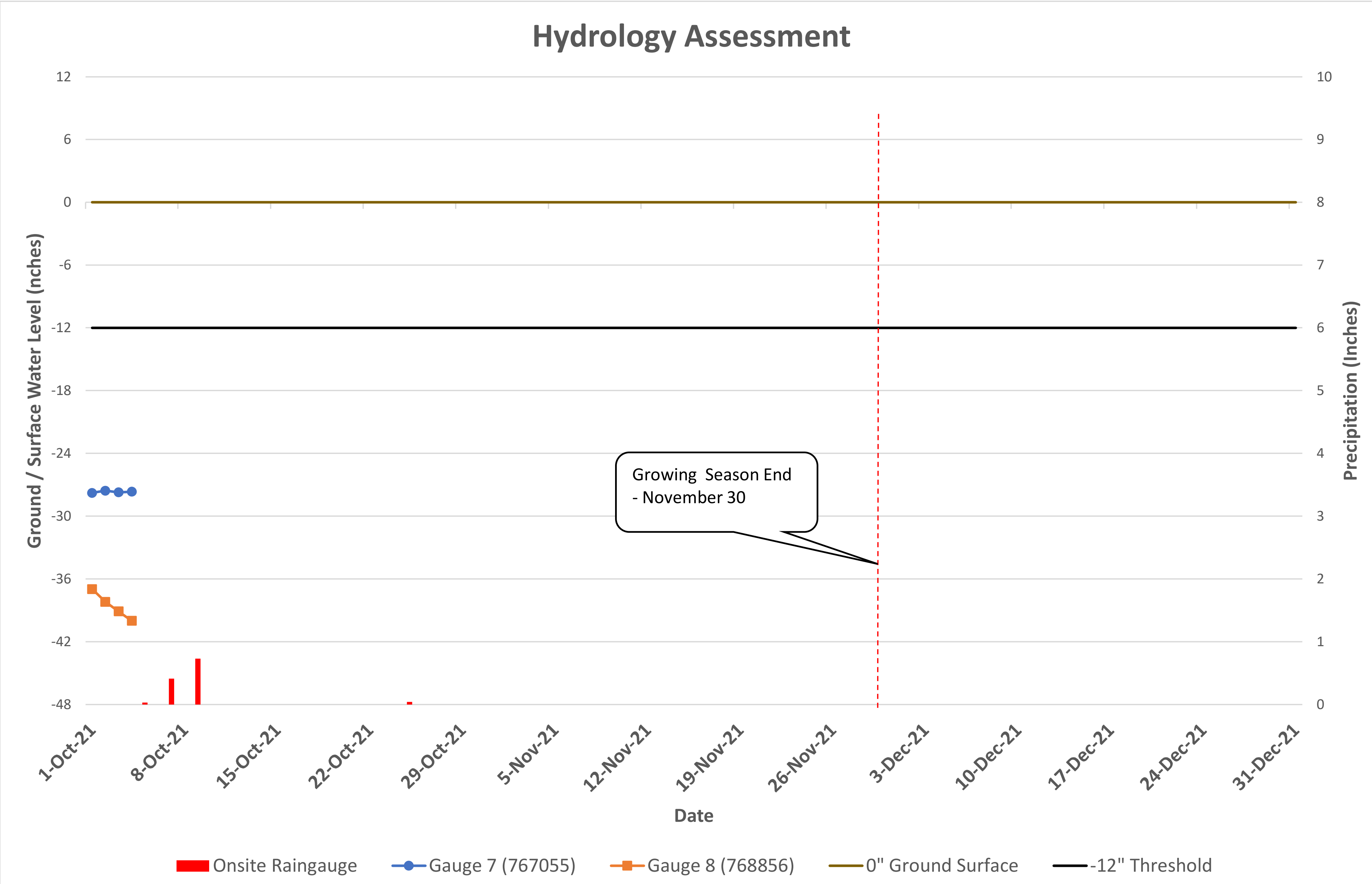


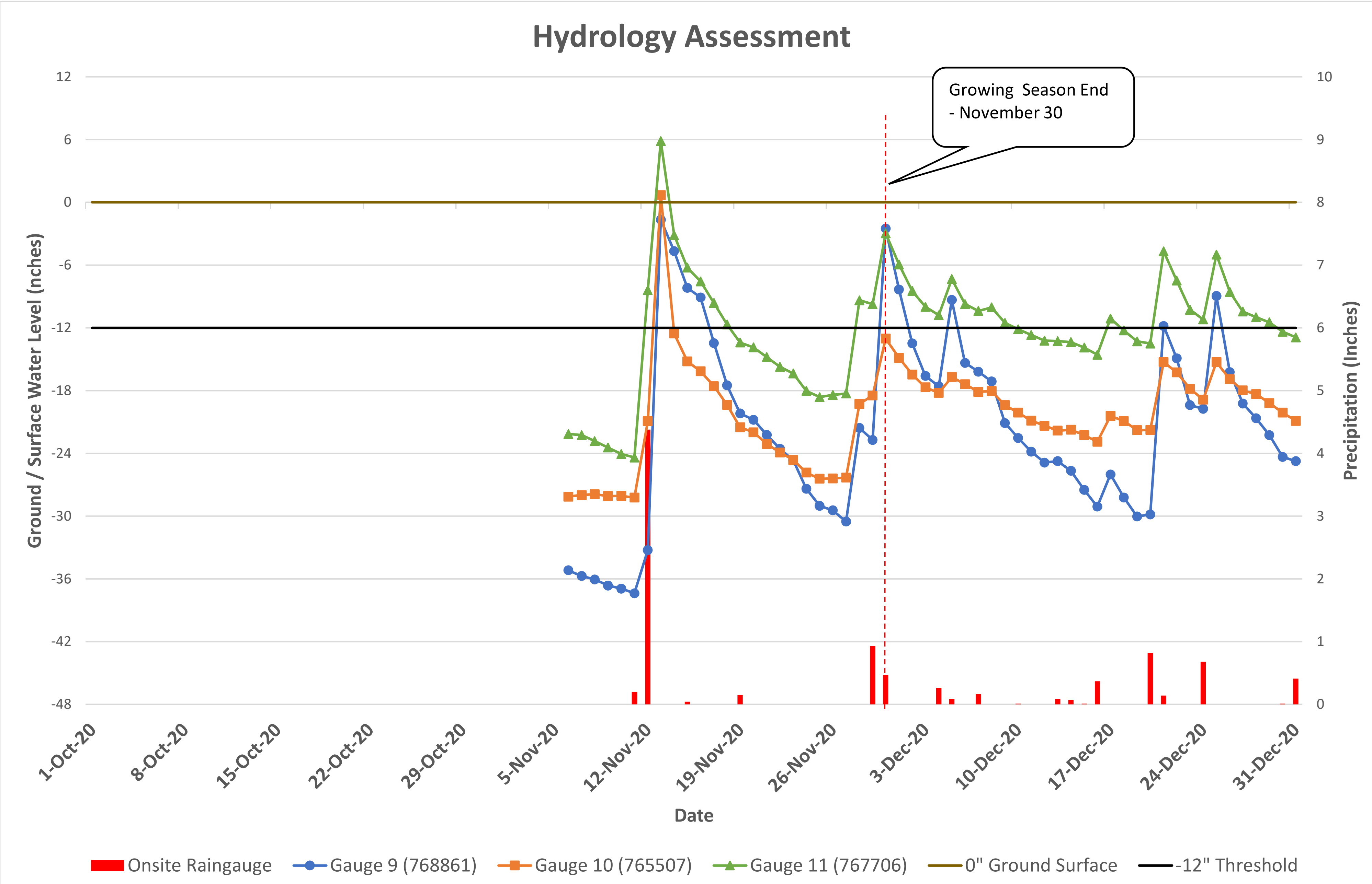
Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 7, 8 - Rugged Trolls - April 1, 2021 to June 30, 2021 - One reading per day at 7:00 am



Hydrology Assessment
Ground / Surface Water Level (Inches)
Precipitation (Inches)
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
10
9
8
7
6
5
4
3
2
1
0
1-Jul-21
8-Jul-21
15-Jul-21
22-Jul-21
29-Jul-21
5-Aug-21
12-Aug-21
19-Aug-21
26-Aug-21
2-Sep-21
9-Sep-21
16-Sep-21
23-Sep-21
30-Sep-21
Date
Onsite Raingauge
Gauge 7 (767055)
Gauge 8 (768856)
0" Ground Surface
-12" Threshold

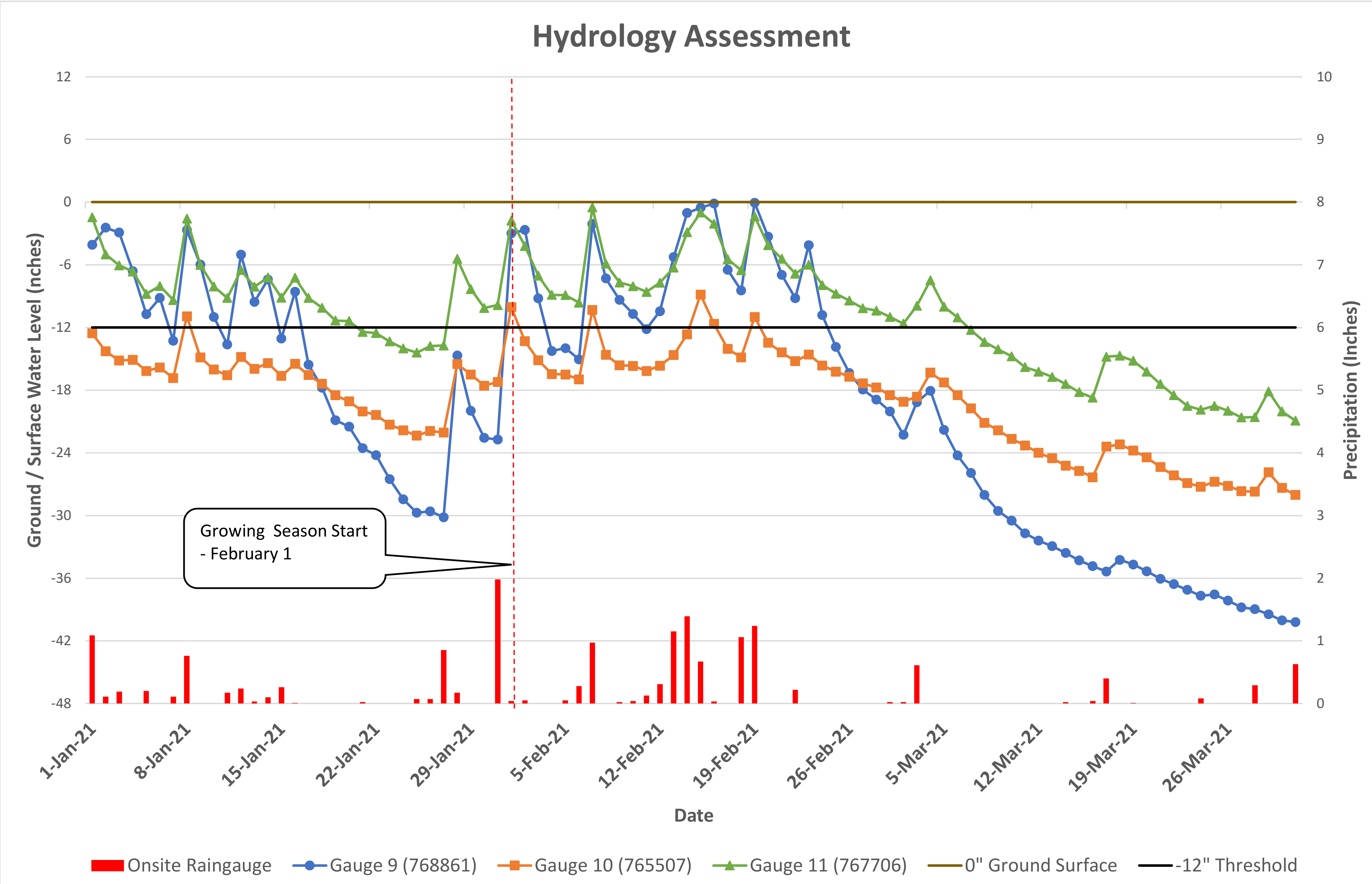

Hydrology Assessment
Ground / Surface Water Level (inches)
Precipitation (Inches)
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
10
9
8
7
6
5
4
3
2
1
0
Growing Season End - November 30
1-Oct-21
8-Oct-21
15-Oct-21
22-Oct-21
29-Oct-21
5-Nov-21
12-Nov-21
19-Nov-21
26-Nov-21
3-Dec-21
10-Dec-21
17-Dec-21
24-Dec-21
31-Dec-21
Date
Onsite Raingauge
Gauge 7 (767055)
Gauge 8 (768856)
0" Ground Surface
-12" Threshold



LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 9, 10, 11 - Rugged Trolls - October 1, 2020 to December 31, 2020 - One reading per day at 7:00 am

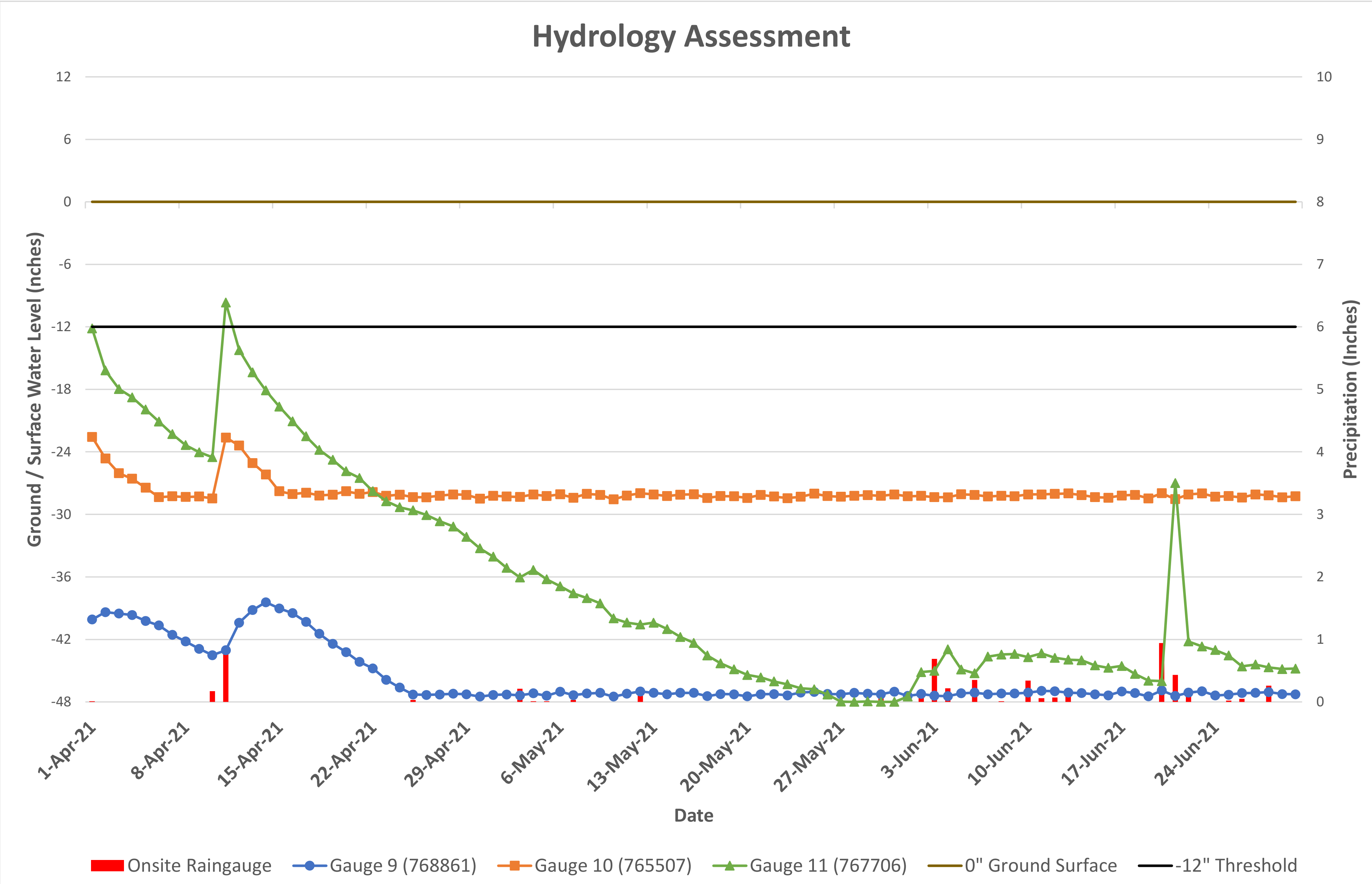


LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 9, 10, 11 - Rugged Trolls - <u>January 1, 2021 to March 31, 2021</u> - One reading per day at 7:00 am

June 2021

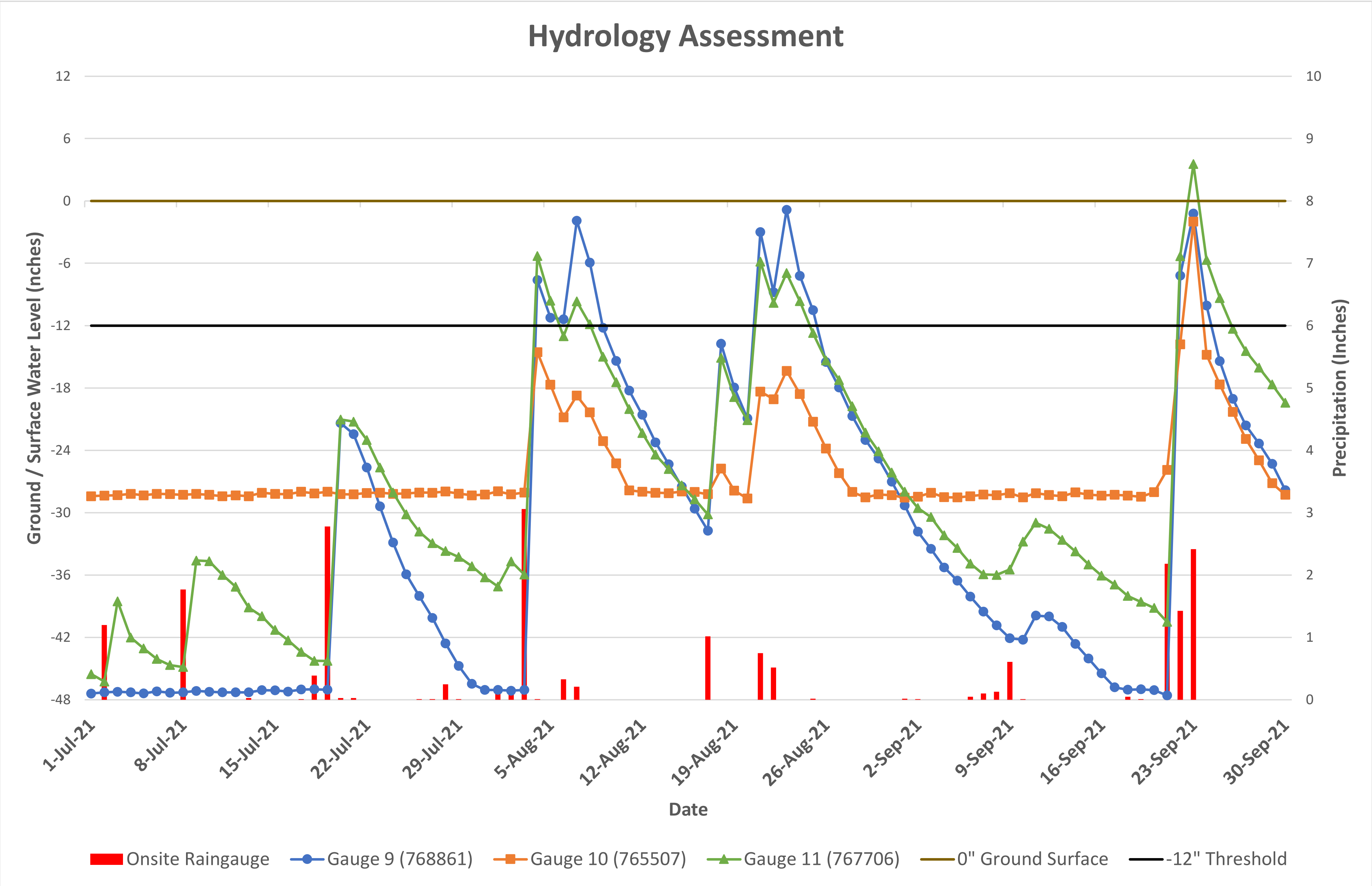


LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 9, 10, 11 - Rugged Trolls - April 1, 2021 to June 30, 2021 - One reading per day at 7:00 am

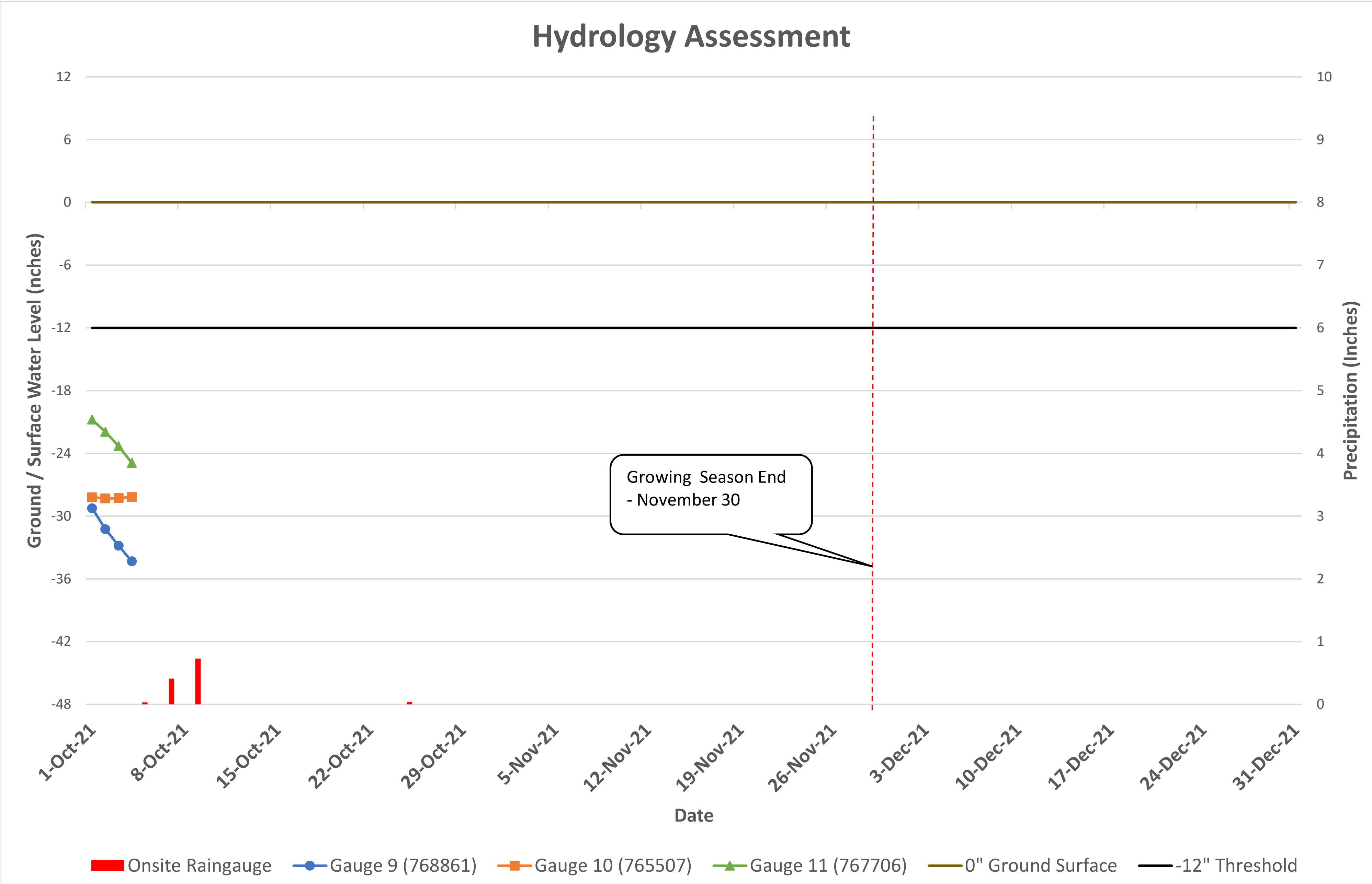
September 2021

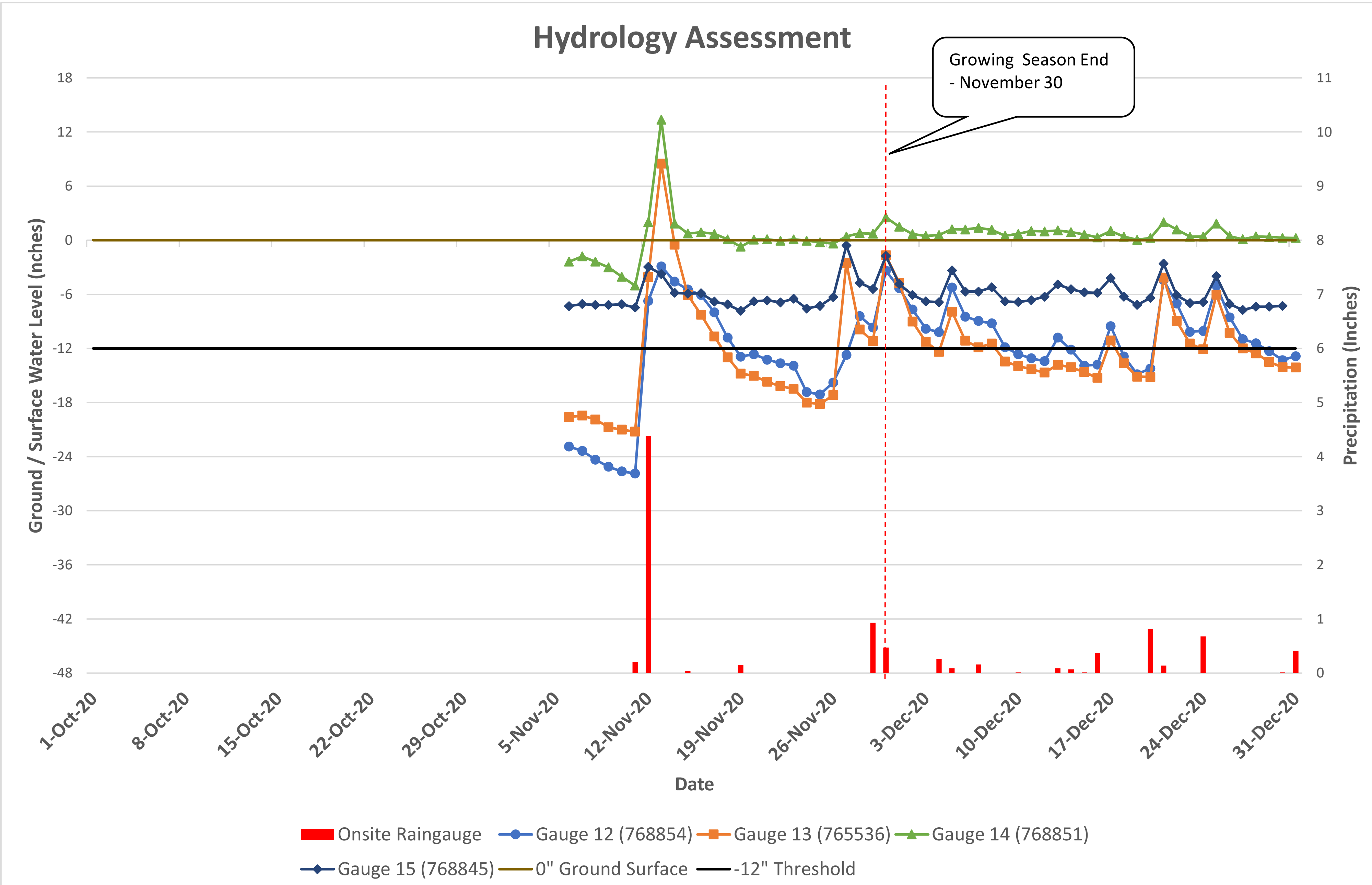


LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 9, 10, 11 - Rugged Trolls - July 1, 2021 to September 30, 2021 - One reading per day at 7:00 am

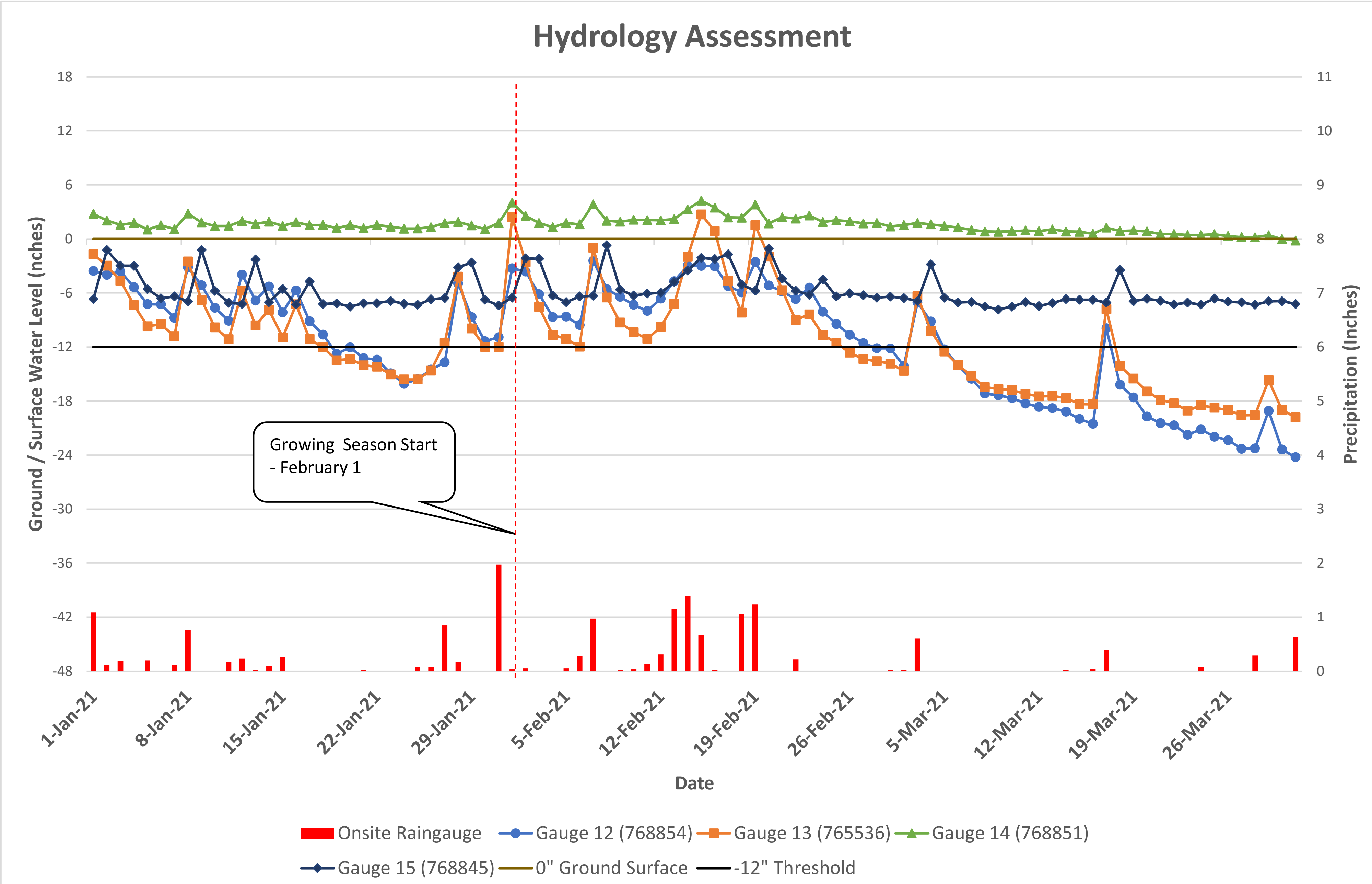

Hydrology Assessment
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
10
9
8
7
6
5
4
3
2
1
0
Ground / Surface Water Level (Inches)
Precipitation (Inches)
Growing Season End - November 30
1-Oct-21
8-Oct-21
15-Oct-21
22-Oct-21
29-Oct-21
5-Nov-21
12-Nov-21
19-Nov-21
26-Nov-21
3-Dec-21
10-Dec-21
17-Dec-21
24-Dec-21
31-Dec-21
Date
Onsite Raingauge
Gauge 9 (768861)
Gauge 10 (765507)
Gauge 11 (767706)
0" Ground Surface
-12" Threshold



LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

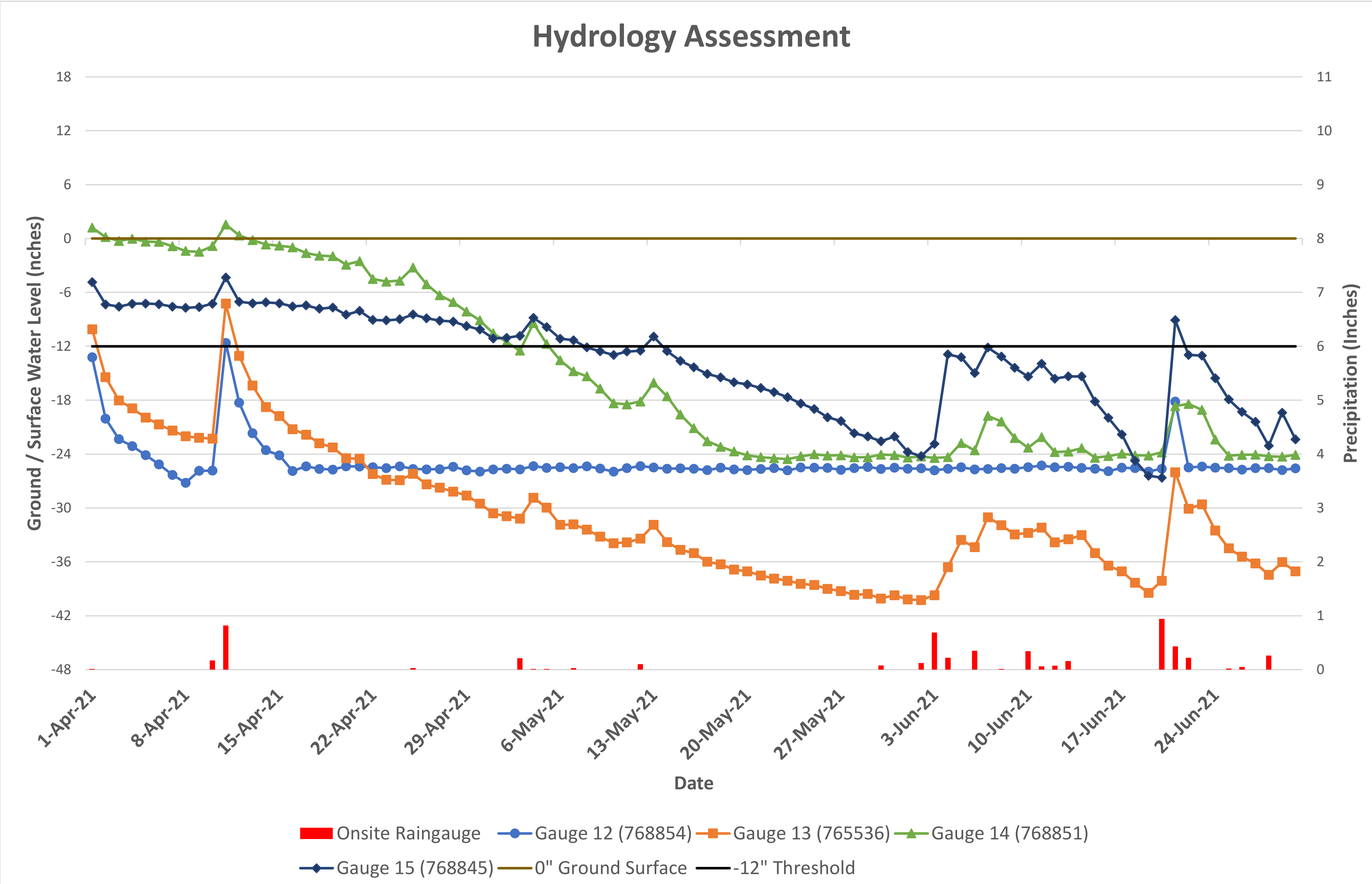
Gauges 12, 13, 14, 15 - Rugged Trolls - October 1, 2020 to December 31, 2020 - One reading per day at 7:00 am



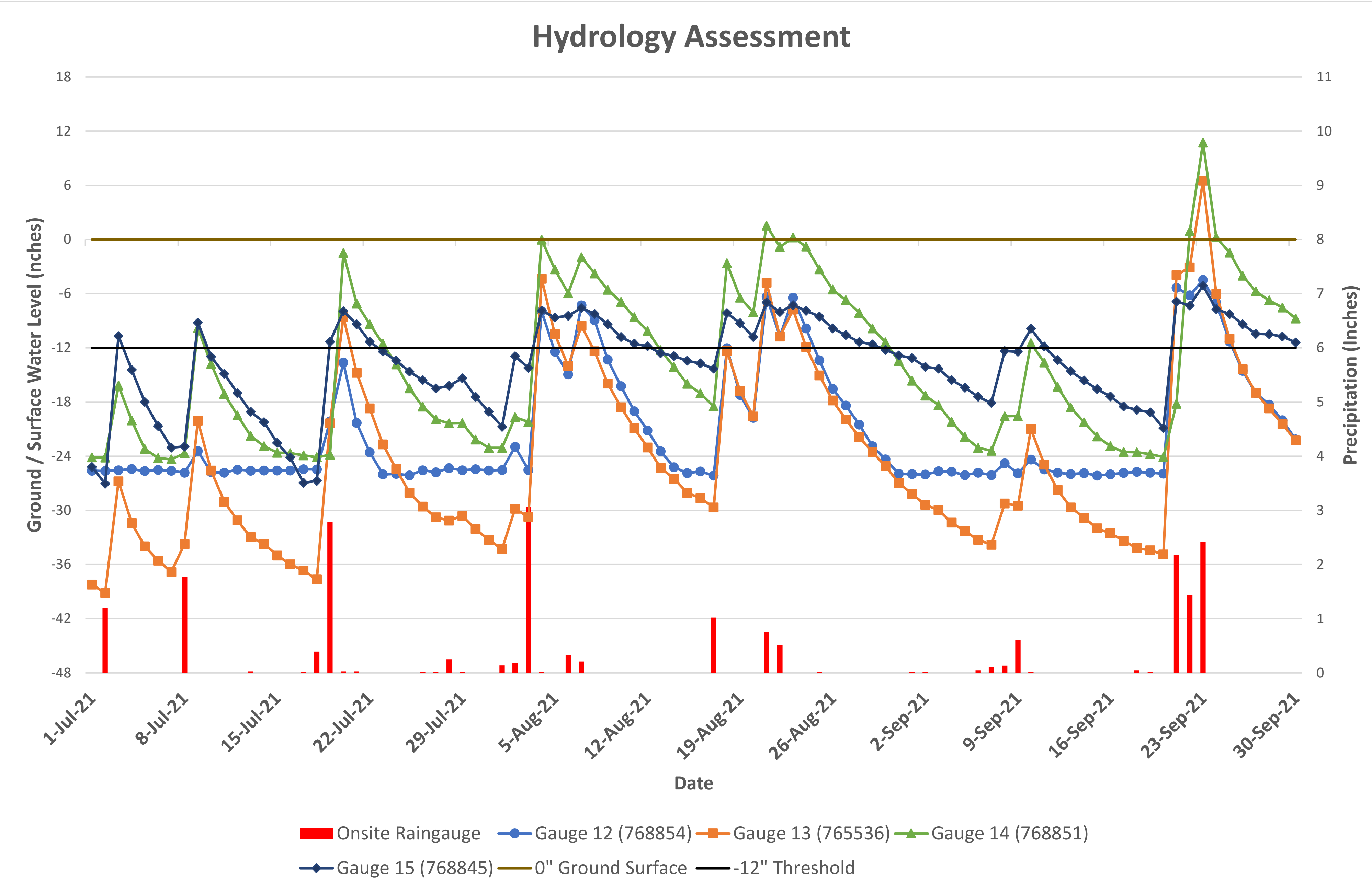
LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 12, 13, 14, 15 - Rugged Trolls - January 1, 2021 to March 31, 2021 - One reading per day at 7:00 am



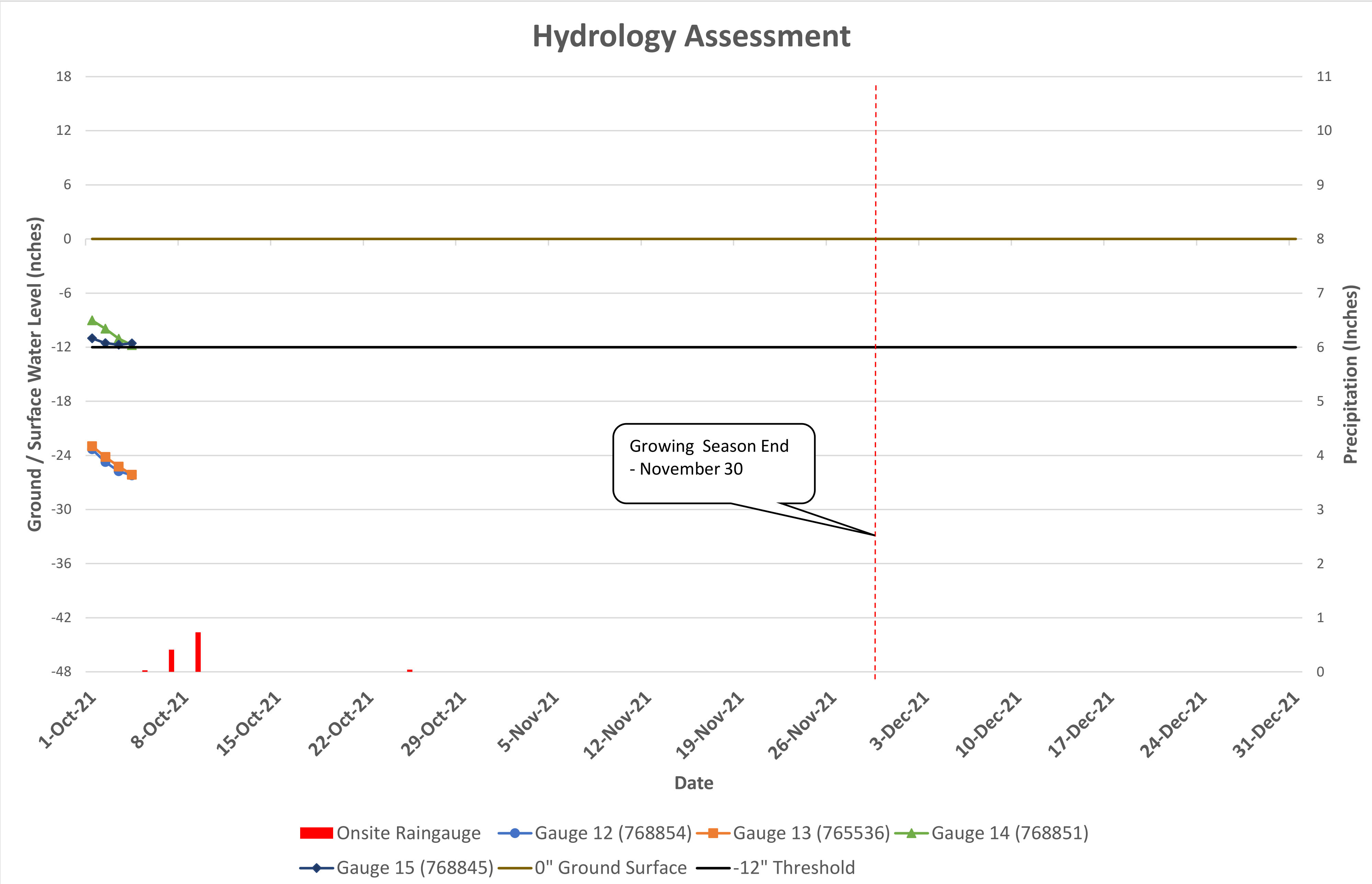
Hydrology Assessment
Ground / Surface Water Level (inches)
Precipitation (Inches)
18
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
11
10
9
8
7
6
5
4
3
2
1
0
1-Apr-21
8-Apr-21
15-Apr-21
22-Apr-21
29-Apr-21
6-May-21
13-May-21
20-May-21
27-May-21
3-Jun-21
10-Jun-21
17-Jun-21
24-Jun-21
Date
Onsite Raingauge
Gauge 12 (768854)
Gauge 13 (765536)
Gauge 14 (768851)
Gauge 15 (768845)
0" Ground Surface
-12" Threshold



LMG LAND MANAGEMENT GROUP a DAVEY company

Cool Run Mitigation Site (LMG20.248 Ecosystem Services)

Gauges 12, 13, 14, 15 - Rugged Trolls - July 1, 2021 to September 30, 2021 - One reading per day at 7:00 am



Hydrology Assessment
Ground / Surface Water Level (inches)
Precipitation (Inches)
18
12
6
0
-6
-12
-18
-24
-30
-36
-42
-48
11
10
9
8
7
6
5
4
3
2
1
0
Growing Season End - November 30
1-Oct-21
8-Oct-21
15-Oct-21
22-Oct-21
29-Oct-21
5-Nov-21
12-Nov-21
19-Nov-21
26-Nov-21
3-Dec-21
10-Dec-21
17-Dec-21
24-Dec-21
31-Dec-21
Date
Onsite Raingauge
Gauge 12 (768854)
Gauge 13 (765536)
Gauge 14 (768851)
Gauge 15 (768845)
0" Ground Surface
-12" Threshold

Appendix G

Financial Assurances

Per the NC DMS RFP #16-20190201, Clearwater Mitigation Solutions will provide financial assurance in one of the following forms:

1) Performance Bonding – The Offeror must provide security in the form of acceptable performance bonds as described in the following paragraph to guarantee delivery of the maximum number of originally contracted Mitigation Units. The performance bonds must be obtained from a company licensed in North Carolina as shown in the Federal Treasury Listing of Approved Sureties (Circular 570). The maximum allowable amount provided by a surety may not exceed the "underwriting limitation" for the surety as identified in the Federal Treasury Listing. Although this RFP is a request for mitigation and not construction, the performance bonds shall follow the prescribed wording provided in N.C.G.S. § 44A-33. The Offeror must provide two performance bonds. The first bond must be for 100% of the total value of the contract and must be in effect and submitted with the Task 3 deliverable (see Section 8. SCOPE OF WORK – Task 3) before NC DMS will authorize payment for that deliverable. The bond must remain in effect until the Offeror has received written notification from the NC DMS that the requirements of Task 6 (submittal of baseline monitoring report) have been met. After the successful completion of Task 6, the bond can be retired, and a second bond must be substituted for the first. The second bond must be for 40% of the value of the contract, which covers the monitoring period. The Monitoring Phase Performance Bond can be reduced yearly concurrent with the payment schedule once the yearly deliverable is approved by NC DMS and credits are released by the IRT.

2) Letters of Credit- LOCs must be drawn from a reputable Bank identified by the FDIC as "Well Capitalized" or "Adequately Capitalized" and follow the submittal timing, contract amounts and schedules for reduction as those described above for the performance bonds. Evergreen or irrevocable Letters of Credit shall be required to provide a 120 day notice of cancellation, termination or non-renewal.

3) Casualty Insurance on underlying performance of Credits or Units of Restoration – Must follow the same submittal timing, contract amounts and reduction schedules as those described above in performance bonds. The insurance must contain the following information.
   a) The "NC DENR" must be named as the "Regulatory Body". NC DENR shall have the sole right to place a claim against the policy. NC DENR shall have the sole right and obligation as the responsible "regulatory body" to approve any claim settlement.
   b) Initial insurance must be for a 10 year period.

The process of evaluating these options is underway. Once obtained, Clearwater will provide digital and hard copies of the assurance of distribution to IRT members.

Per the NC DMS RFP #: 16-20190201, Clearwater Mitigation Solutions will provide financial assurance in one of the following forms:

1) Performance Bonding – The Offeror must provide security in the form of acceptable performance bonds as described in the following paragraph to guarantee delivery of the maximum number of originally contracted Mitigation Units. The performance bonds must be obtained from a company licensed in North Carolina as shown in the Federal Treasury Listing of Approved Sureties (Circular 570). The maximum allowable amount provided by a surety may not exceed the "underwriting limitation" for the surety as identified in the Federal Treasury Listing. Although this RFP is a request for mitigation and not construction, the performance bonds shall follow the prescribed wording provided in N.C.G.S. § 44A-33. The Offeror must provide two performance bonds. The first bond must be for 100% of the total value of the contract and must be in effect and submitted with the Task 3 deliverable (see Section 8. SCOPE OF WORK – Task 3) before NC DMS will authorize payment for that deliverable. The bond must remain in effect until the Offeror has received written notification from the NC DMS that the requirements of Task 6 (submittal of baseline monitoring report) have been met. After the successful completion of Task 6, the bond can be retired, and a second bond must be substituted for the first. The second bond must be for 40% of the value of the contract, which covers the monitoring period. The Monitoring Phase Performance Bond can be reduced yearly concurrent with the payment schedule once the yearly deliverable is approved by NC DMS and credits are released by the IRT.

2) Letters of Credit- LOCs must be drawn from a reputable Bank identified by the FDIC as "Well Capitalized" or "Adequately Capitalized" and follow the submittal timing, contract amounts and schedules for reduction as those described above for the performance bonds. Evergreen or irrevocable Letters of Credit shall be required to provide a 120 day notice of cancellation, termination or non-renewal.

3) Casualty Insurance on underlying performance of Credits or Units of Restoration – Must follow the same submittal timing, contract amounts and reduction schedules as those described above in performance bonds. The insurance must contain the following information.
    a) The "NC DENR" must be named as the "Regulatory Body". NC DENR shall have the sole right to place a claim against the policy. NC DENR shall have the sole right and obligation as the responsible "regulatory body" to approve any claim settlement.
    b) Initial insurance must be for a 10 year period.

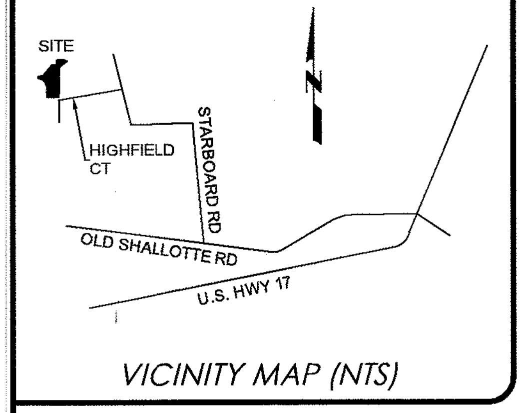
The process of evaluating these options is underway. Once obtained, Clearwater will provide digital and hard copies of the assurance of distribution to IRT members.

Appendix H

Site Protection Instrument

Map Cabinet 126 Pg 53 2/12/2021 Rue

126/53



CURVE DATA

CURVE	ARC LENGTH	RADIUS	DELTA ANGLE	CHORD BEARING	CHORD LENGTH
C1	35.68'	30.00'	68°08'08"	N34°30'12"E	33.61'
C2	34.77'	30.00'	66°23'47"	S78°14'11"E	32.85'

DEED REFERENCE(S):

BEING A PORTION OF THE PROPERTY RECORDED IN D.B. 3348, PG. 1120 OF THE BRUNSWICK COUNTY REGISTER OF DEEDS.

MAP REFERENCE(S):

BEING A PORTION OF THE PROPERTY RECORDED IN P.B. 12, PG. 25 OF THE BRUNSWICK COUNTY REGISTER OF DEEDS.

M.C. M, PG. 124
M.C. 24, PG. 160
M.C. 21, PG. 526
M.C. R, PG. 357
M.C. 23, PG. 12
M.C. M, PG. 149
M.C. 26, PG. 129
M.C. 2, PG. 145
M.C. 81, PG. 75
M.C. 61, PG. 90
M.C. O, PG. 34
M.C. 45, PG. 92

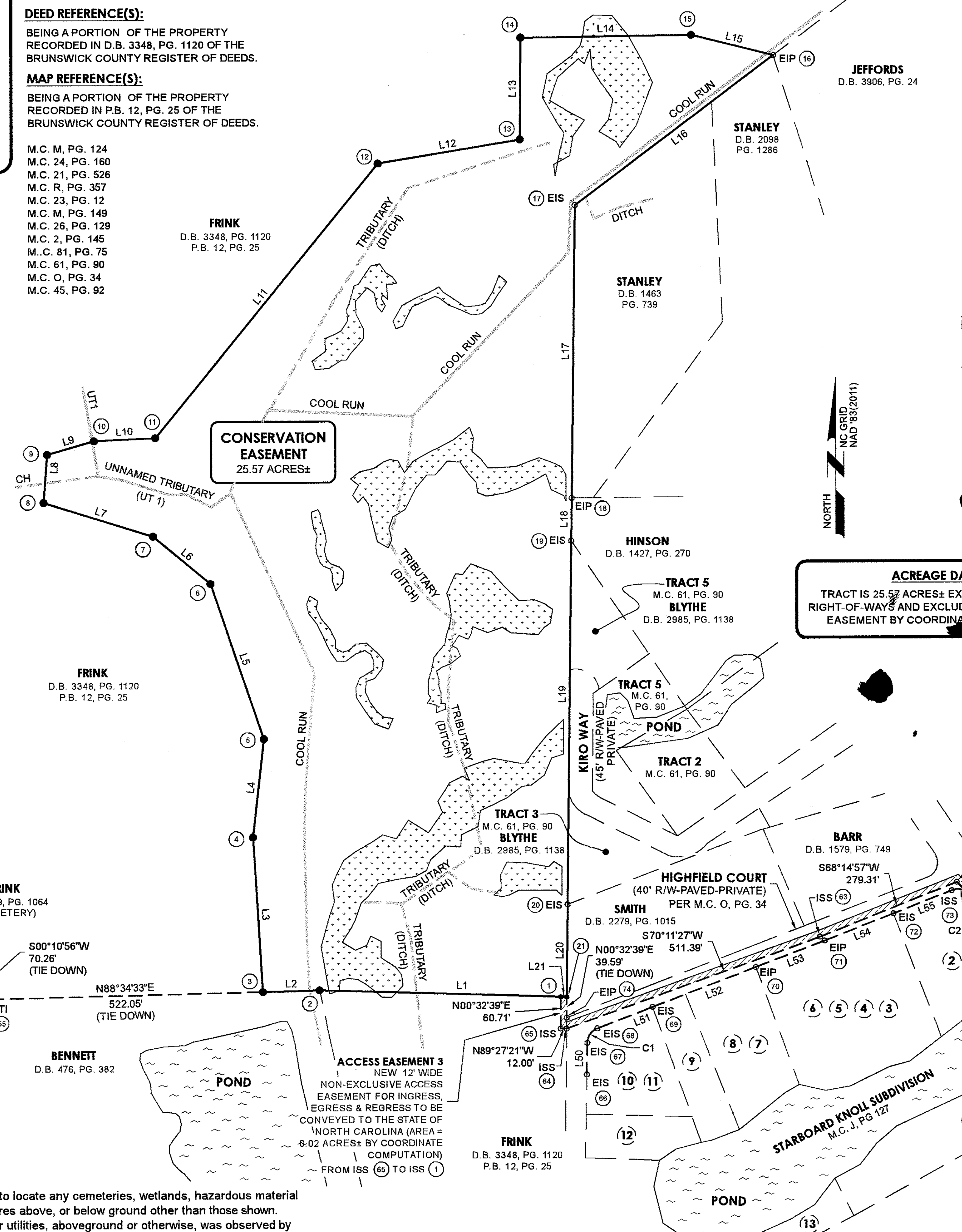
COORDINATES ALONG CONSERVATION EASMENTS

CORNER	NORTHING	EASTING
1	79848.0348	2160541.2403
2	79861.3059	2160083.7499
3	79858.6426	2159976.6353
4	80152.0647	2159958.3686
5	80338.9000	2159979.1281
6	80633.9062	2159878.7233
7	80724.1165	2159769.8695
8	80788.6676	2159561.9931
9	80879.9364	2159568.8382
10	80905.5666	2159657.9868
11	80911.1088	2159774.3729
12	81430.7759	2160196.6049
13	81475.7869	2160466.2669
14	81668.6457	2160467.9411
15	81672.9860	2160792.3768
16	81634.0698	2160947.9751
17	81351.3573	2160570.8438
18	80795.2771	2160564.1358
19	80714.1256	2160563.2146
20	80023.1432	2160554.9043
21	79847.6868	2160553.2375

NOTE: ONLY CORNER # 50 IS A TRUE NORTH CAROLINA STATE PLANE GRID COORDINATE. COORDINATES SHOWN ARE BASED ON GROUND DISTANCES TO MATCH PLAT. SEE DATUM DESCRIPTION, SHEET 1 OF 1

FEMA FLOOD STATEMENT:

THE AREA REPRESENTED BY THIS PLAT IS LOCATED IN A FLOOD HAZARD BOUNDARY ACCORDING TO FEMA MAP NUMBER(S) 3720106800J ZONE(S): X, DATED: JUNE 2, 2006.



STATE OF NORTH CAROLINA
COUNTY OF BRUNSWICK

Filed for registration at__________ M.__________ , 2021 in the Register of Deeds

Office. Recorded in P.B. __________ , PG.__________.

Register of Deeds   By

STATE OF NORTH CAROLINA
COUNTY OF BRUNSWICK

I, Connie Marlowe , Review Officer of Brunswick County, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

12 Feb 21   Connie Marlowe
Date   Review Officer

CERTIFICATION OF EXEMPTION:

I (We) hereby certify that I am (We are) the Owner(s) of the properties shown and described hereon, which was conveyed to me (us) by deeds recorded in Deed Book 3348, Page 1120, and that I (we) hereby adopt the plan of conservation easement shown on this plat and that the conservation easement shown is an exception to the Subdivision Ordinance of Brunswick County, North Carolina.

02/12/2021   Pearl D. Frink
Date   Pearl D. Frink

LINE DATA ALONG THE CONSERVATION EASEMENT AREA

LINE	BEARING	DISTANCE
L1	N88°20'18"W	457.68'
L2	S88°34'33"W	107.15'
L3	N03°33'44"W	293.99'
L4	N06°20'25"E	187.99'
L5	N18°47'45"W	311.62'
L6	N50°21'02"W	141.38'
L7	N72°44'57"W	217.67'
L8	N04°17'21"E	91.53'
L9	N73°57'36"E	92.76'
L10	N87°16'25"E	116.52'
L11	N39°05'38"E	669.58'
L12	N80°31'26"E	273.39'
L13	N00°29'50"E	192.87'
L14	N89°14'01"E	324.46'
L15	S75°57'29"E	160.39'
L16	S53°08'36"W	471.33'
L17	S00°41'28"W	556.12'
L18	S00°39'01"W	81.16'
L19	S00°41'21"W	691.03'
L20	S00°32'39"W	175.46'
L21	N88°20'18"W	12.00'

LINE DATA ALONG TIE DOWN LINES

L50	N00°46'57"E	60.00'
L51	N68°58'05"E	112.47'
L52	N69°02'53"E	209.99'
L53	N68°59'01"E	140.11'
L54	N68°33'55"E	139.91'
L55	N68°33'55"E	119.03'

LEGEND:

ISS - IRON STAKE SET
ECM - EXISTING CONCRETE MARKER
EIP - EXISTING IRON PIPE
ERRR - EXISTING RAILROAD RAIL
PTI - PINCHED TOP IRON
EA - EXISTING AXLE
EDS - EXISTING DRIVE SHAFT
EMN - EXISTING MAG NAIL
CMP - CORRUGATED METAL PIPE
O.D. - OUTSIDE DIAMETER
RPS - RANGE POLE SET
EMN - EXISTING MAG NAIL
MNS - MAG NAIL SET
EIS - EXISTING IRON STAKE
EPP - EXISTING PUMP PIPE
PPS - PUMP PIPE SET
NMC - NON-MONUMENTED CORNER
R/W - RIGHT OF WAY
EOP - EDGE OF PAVEMENT
PB - PLAT BOOK
D.B. - DEED BOOK
PG. - PAGE
o - NON-MONUMENTED CORNER UNLESS OTHERWISE NOTED
● No. 5 REBAR, 30" IN LENGTH FLUSH WITH GRADE WITH AN ALUMINUM 3 1/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"
CONSERVATION EASEMENT LINE
TIE DOWN LINE
ADJOINER OR R/W LINE
TRIBUTARY
TRIBUTARY (DITCH)
ACCESS EASEMENT
WETLANDS

CORNER DESCRIPTIONS

CORNER #	DESCRIPTION
1 THRU 15	No. 5 REBAR FLUSH WITH GRADE WITH AN ALUMINUM 3 1/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"
16	1.0" O.D. IRON PIPE 1.6' ABOVE GRADE
17	No. 3 REBAR 0.3' ABOVE GRADE
18	1.5" O.D. IRON PIPE 0.8' ABOVE GRADE
19	No. 3 REBAR 0.4' BELOW GRADE
20	No. 3 REBAR 0.5' ABOVE GRADE
21	No. 5 REBAR FLUSH WITH GRADE WITH AN ALUMINUM 3 1/4" CAP INSCRIBED: "STATE OF NORTH CAROLINA CONSERVATION EASEMENT"
50	No. 5 REBAR FLUSH WITH GRADE GRADE INSCRIBED WITH "K2 DESIGN CONTROL POINT" SUITABLE FOR GNSS OBSERVATION
51	1.5" O.D. IRON PIPE 0.8' ABOVE GRADE
52	1.5" O.D. IRON PIPE 1.0' BELOW GRADE
53	1.0" O.D. IRON PIPE, BENT FLUSH WITH GRADE
54	1.0" O.D. PINCHED-TOP IRON 0.4' BELOW GRADE
55	1.0" O.D. PINCHED-TOP IRON, BENT FLUSH WITH GRADE
56	No. 3 REBAR 0.1' BELOW GRADE
57	1.0" O.D. IRON PIPE 0.4' ABOVE GRADE
58	No. 3 REBAR FLUSH WITH GRADE SET IN DITCH BANK
59	No. 3 REBAR 0.4' BELOW GRADE
60	No. 3 REBAR 0.3' BELOW GRADE
61 THRU 65	No. 5 REBAR FLUSH WITH GRADE
66	No. 3 REBAR 0.4' BELOW GRADE
67	No. 3 REBAR 0.3' BELOW GRADE
68	No. 3 REBAR 0.5' BELOW GRADE
69	No. 3 REBAR 0.5' ABOVE GRADE
70	1.0" O.D. IRON PIPE 1.9' ABOVE GRADE
71	1.0" O.D. IRON PIPE 1.0' ABOVE GRADE
72	No. 3 REBAR 0.3' BELOW GRADE
73	No. 5 REBAR FLUSH WITH GRADE
74	No. 3 REBAR SET IN CONCRETE 0.2' ABOVE GRADE
75	1.0" O.D. IRON PIPE, BENT FLUSH WITH GRADE
76	No. 3 REBAR 0.1' ABOVE GRADE

ACREAGE DATA

TRACT IS 25.57 ACRES± EXCLUDING ALL ROAD RIGHT-OF-WAYS AND EXCLUDING NEW 12' ACCESS EASEMENT BY COORDINATE COMPUTATION

DATUM DESCRIPTION

THE COORDINATE SYSTEM USED FOR THIS PLAT IS BASED ON NORTH CAROLINA STATE PLANE COORDINATES ESTABLISHED BY USING THE NORTH CAROLINA REAL TIME NETWORK (VRS).

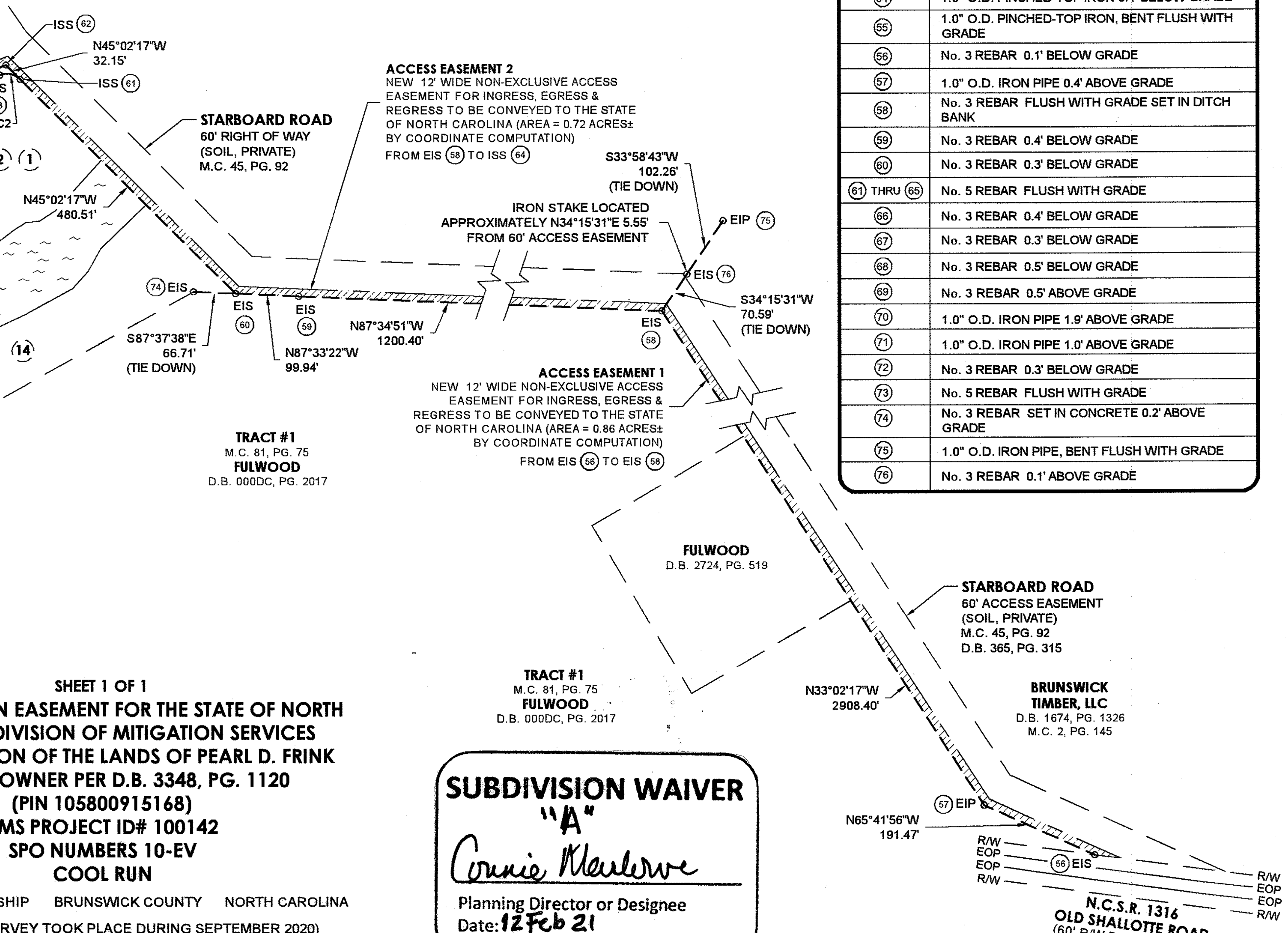
ISS (50) NC GRID COORDINATES NAD 83 (2011)
N = 80,019.9283'
E = 2,158,905.3015'

THE AVERAGE COMBINED GRID FACTOR IS 0.99987649 (GROUND TO GRID) OR 1.00012351 (GRID TO GROUND). THE N.C. LAMBERT GRID BEARING AND GRID DISTANCE FROM

ISS (50) TO EIP (52) IS S 51°14'28" E 290.77 FEET.

ALL LINEAR DIMENSIONS ARE GRID DISTANCES.

GEOID-2012B CONUS
GNSS RECEIVER - TOPCON HIPER HR WITH MINIMUM TIME OF 240 SECONDS COMPLETED DURING SEPTEMBER 2020.



SURVEYORS CERTIFICATION(S)

Surveyor's disclaimer: No attempt was made to locate any cemeteries, wetlands, hazardous material sites, underground utilities or any other features above, or below ground other than those shown. However, no visible evidence of cemeteries or utilities, aboveground or otherwise, was observed by the undersigned (other than those shown).

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

I, JOHN A. RUDOLPH, certify that this plat was drawn under my supervision from an actual survey made under my supervision (deed description recorded in Book SEE , Page REFS , etc.) (other); that the boundaries not surveyed are clearly indicated as drawn from information found in Book_____, page____; that the ratio of precision or positional accuracy as calculated is 1/10,000+; that this plat was prepared in accordance with G.S. 47-30 as amended. Witness my original signature, license number and seal this 15th day of January, A.D., 2021.

SEAL OR STAMP   L-4194
Professional Land Surveyor   License Number

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

GENERAL NOTES:

NO HORIZONTAL CONTROL EXISTS WITHIN 2000 FEET.

NOTE: NO ABSTRACT OF TITLE, NOR TITLE COMMITMENT, OR RESULTS OF TITLE SEARCH WERE FURNISHED TO THE SURVEYOR. ALL DOCUMENTS OF RECORD REVIEWED ARE NOTED HEREON (SEE REFERENCES). THERE MAY EXIST OTHER DOCUMENTS OF RECORD THAT MAY AFFECT THIS SURVEYED PARCEL.

ALL DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES.

WETLANDS, TRIBUTARIES AND PONDS WERE PROVIDED BY LAND MANAGEMENT GROUP, NOT SURVEYED.

FIRM LICENSE No. C-2111 K2 DESIGN GROUP, P.A. CORPORATE SEAL 2000 NORTH CAROLINA

SHEET 1 OF 1

CONSERVATION EASEMENT FOR THE STATE OF NORTH CAROLINA DIVISION OF MITIGATION SERVICES OVER A PORTION OF THE LANDS OF PEARL D. FRINK CURRENT OWNER PER D.B. 3348, PG. 1120 (PIN 105800915168) DMS PROJECT ID# 100142 SPO NUMBERS 10-EV COOL RUN

SHALLOTTE TOWNSHIP   BRUNSWICK COUNTY   NORTH CAROLINA

(THE FIELD SURVEY TOOK PLACE DURING SEPTEMBER 2020)

200 100 0 200 400 600
GRAPHIC SCALE 1" = 200'

SUBDIVISION WAIVER "A"

Connie Marlowe
Planning Director or Designee
Date: 12 Feb 21

DRAWN BY: FGR	k2 design group	774 S. Beston Road La Grange, NC 28551 252.582.3097 www.k2designgroup.com	
DATE: 01/15/21			
DWG. NO.: CMC394MR19			
SURVEYED BY: J.A.R.			

B4548 P0092 02-12-2021 14:56:14.001
Brunswick County, NC Register of Deeds Brenda M. Clemmons page 1 of 13 PROP

Brenda M. Clemmons Register of Deeds
02-12-2021 14:56:14.001 Brunswick County, NC
NC REVENUE STAMP: $614.00 (#735873)

This certifies that there are no delinquent ad valorem taxes, fees, assessments or other liens which the Brunswick County Tax Collector is charged with collecting, that are a lien on: Parcel Number 19600016 as notated by the Brunswick County Assessor's Office. This is not a certification that the parcel number matches the deed description.

2/12/21 [signature]
Date (Asst) Tax Col. / Del. Tax Spec.

Return to Kevin Yates Type Mail
Total 26 Rev 614 Int.
13 Ck $ 78 Ck # 6563 Cash $
Refund Cash $ Finance

- Portions of document are illegible due to condition of original.
- Document contains seals verified by original instrument that cannot be reproduced or copied.

STATE OF NORTH CAROLINA

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT

BRUNSWICK COUNTY

RIS F614.00

SPO File Number: 10-EV
DMS Project Number: 100142

Prepared by: Office of the Attorney General, Blane Rice
Property Control Section
Return to: NC Department of Administration
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this 12 day of February, 2021, by Pearl D. Frink ("**Grantor**"), whose mailing address is 1758 Frink Street SW, Ocean Isle Beach, NC 28669, to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Division of Mitigation Services (formerly known as the Ecosystem Enhancement Program and Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Clearwater Mitigation Solutions, LLC, a North Carolina Limited Liability Company, 604 Macon Place, Raleigh, North Carolina, 27609 and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number 20190201-01.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Division of Mitigation Services (formerly Ecosystem Enhancement Program) is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Division of Mitigation Services (formerly Ecosystem Enhancement Program) with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Division of Mitigation Services in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in Shallotte Township, Brunswick County, North Carolina (the "**Property**"), and being more particularly described as that certain parcel of land containing approximately 135.12 acres Parcel Identification Number (PIN) 105800915168 and being conveyed to the Grantor by deed as recorded in **Deed Book 3348 at Page 1120** of the Brunswick County Registry, North Carolina; and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of Cool Run, a tributary to the Shallotte River.,

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement and Right of Access together with an access easement to and from the Conservation Easement Area described below.

The Conservation Easement Area consists of the following:

Conservation Easement Area containing a total of 25.57 **acres** as shown on the plats of survey entitled "Final Plat, Conservation Easement for North Carolina Division of Mitigation Services, Project Name: "Cool Run", SPO File No 10-EV , DMS Site No. 100142 , Property of Pearl D. Frink," dated February 12th, 2021 by K2 Design Group, PLS Number L-4194 and recorded in the Brunswick County, North Carolina Register of Deeds at **Plat Book 0126 Pages 0053.**

See attached "**Exhibit A**", Legal Description of area of the Property hereinafter referred to as the "Conservation Easement Area"

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. ACCESS EASEMENT

Grantor hereby grants and conveys unto Grantee, its employees, agents, successors and assigns, a perpetual, non-exclusive easement for ingress and egress over and upon the Property at all reasonable times and at the location more particularly described on **Exhibit B** ("Access Easement") attached hereto and incorporated herein by this reference, to access the Conservation Easement Area for the purposes set forth herein. This grant of easement shall not vest any rights in the public and shall not be construed as a public dedication of the Access Easement. Grantor covenants, represents and warrants that it is the sole owner of and is seized of the Property in fee simple and has the right to grant and convey this Access Easement.

III. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. **Recreational Uses.** Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. **Motorized Vehicle Use.** Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat.

C. **Educational Uses.** The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. Damage to Vegetation. Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of new roads, trails, walkways, or paving in the Conservation Easement.

All existing roads, trails and crossings within the Conservation Easement Area shall be shown on the recorded survey plat.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of nonnative plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the Division of Mitigation Services, 1652 Mail Services Center, Raleigh, NC 27699-1652.

IV. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees, agents, successors and assigns, shall have a perpetual Right of Access over and upon the Conservation Easement Area to undertake or engage in any activities necessary to construct, maintain, manage, enhance, repair, restore, protect, monitor and inspect the stream, wetland and any other riparian resources in the Conservation Easement Area for the purposes set forth herein or any long-term management plan for the Conservation Easement Area developed pursuant to this Conservation Easement.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. Conservation Easements are purchased to protect the investments by the State (Grantee) in natural resources. Livestock within conservations easements damages the investment and can result in reductions in natural resource value and mitigation credits which would cause financial harm to the State. Therefore, Landowners (Grantor) with livestock are required to restrict livestock access to the Conservation Easement area. Repeated failure to do so may result in the State (Grantee) repairing or installing livestock exclusion devices (fences) within the conservation area for the purpose of restricting livestock access. In such cases, the landowner (Grantor) must provide access to the State (Grantee) to make repairs.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

V. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. **No Waiver.** Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

VI. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Division of Mitigation Services Program Manager
NC State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VII. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of the Property in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY, WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

Pearl D. Frink (Seal)
Pearl D. Frink

NORTH CAROLINA
COUNTY OF Randolph

I, Traci J McDaniel, a Notary Public in and for the County and State aforesaid, do hereby certify that Pearl D. Frink, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS, WHEREOF, I have hereunto set my hand and Notary Seal this the 12th day of February, 2021.

Traci J McDaniel
Notary Public

My commission expires:

01-18-2025

TRACI J. McDANIEL
NOTARY PUBLIC
RANDOLPH COUNTY, NC

Exhibit A

CONSERVATION EASEMENT
COOL RUN MITIGATION SITE
BRUNSWICK COUNTY

All of the conservation easement of the Cool Run Site over a portion of the land of the Brunswick Timber, LLC Tract (D.B. 1674, Pg. 325), lying and being situated in Shallotte Township, Brunswick County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 3 and being the Southwestern most corner of the Conservation Easement Area and being located South 81°26'19" East 1083.41 feet from an iron stake with a blue cap (Point No. 50) with N.C. Grid Coordinates N=80,019.9283', E=2,158,905.3015' (NAD '83, 2011).

Thence from the Point of Beginning (Point No.3), North 03°33'44" West 293.99' to an iron stake; thence North 06°20'25" East 187.99' to an iron stake; thence North 18°47'45" West 311.62' to an iron stake; thence North 50°21'02" West 141.38' to an iron stake; thence North 72°44'57" West 217.67' to an iron stake; thence North 04°17'21" East 91.53' to an iron stake; thence North 73°57'36" East 92.76' to an iron stake; thence North 87°16'25" East 116.52' to an iron stake; thence North 39°05'38" East 669.58' to an iron stake; thence North 80°31'26" East 273.39' to an iron stake; thence North 00°29'50" East 192.87' to an iron stake; thence North 89°14'01" East 324.46' to an iron stake; thence South 75°57'29" East 160.39' to an iron pipe; thence South 53°08'36" West 471.33' to an iron stake; thence South 00°41'28" West 556.12' to an iron pipe; thence South 00°39'01" West 81.16' to an iron stake; thence South 00°41'21" West 691.03' to an iron stake; thence South 00°32'39" West 175.46' to an iron stake; thence North 88°20'18" West 12.00' to an iron stake; thence North 88°20'18" West 457.68' to an iron stake; thence South 88°34'33" West 107.15' to an iron stake, which is the Point of Beginning (Point No. 3), having an area of 25.57 acres.

Exhibit B

Access Easement

COOL RUN MITIGATION SITE
BRUNSWICK COUNTY

Access Easement 1

All of the Access Easement 1, described as New 12' Wide Non-exclusive Access Easement for ingress, egress & regress to be conveyed to the State of North Carolina of the Cool Run Site over a portion of the land of the Brunswick Timber, LLC Tract (D.B. 1674, Pg. 1326), lying and being situated in Shallotte Township, Brunswick County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 56 and being located on the Northern right of way of Old Shallotte Road (NCSR 1316) and being located South 63°33'11" East 6489.09 feet from an iron stake with a blue cap (Point No. 50) with N.C. Grid Coordinates N=80,019.9283', E=2,158,905.3015' (NAD '83, 2011).

Access Easement 1 being located adjacent to and North of the below described lines:

Thence from the Point of Beginning (Point No. 56) and along the Southern right of way of Starboard Road (Private), the following bearings and distances: North 65°41'56" West 191.47' to an iron pipe (Point No. 57); thence continuing along the Southern right of way of Starboard Road (Private) North 33°02'17" West 2908.40' to an iron stake (Point No. 58), the Point of Ending of said easement, having a total area of 0.86 acres.

Access Easement 2

All of the Access Easement 2, described as New 12' Wide Non-exclusive Access Easement for ingress, egress & regress to be conveyed to the State of North Carolina of the Cool Run Site, lying and being situated in Shallotte Township, Brunswick County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 58 and being located on the Southern right of way of Starboard Road (Private) and being and being located South 84°44'11" East 4066.99 feet from an iron stake with a blue cap (Point No. 50) with N.C. Grid Coordinates N=80,019.9283', E=2,158,905.3015' (NAD '83, 2011).

Access Easement 2 being located adjacent to and North of the below described lines:

Thence from the Point of Beginning (Point No. 58) and along the Southern right of way of Starboard Road (Private), the following bearings and distances: North 87°34'51" West 1200.40' to an iron stake

(Point No. 59); thence continuing along the Southern right of way of Starboard Road (Private) North 87°33'22" West 99.94' to an iron stake (Point No. 60), thence continuing along the Southern right of way of Starboard Road (Private) North 45°02'17" West 480.51' to an iron stake (Point No. 61), thence leaving the Southern right of way of Starboard Road (Private) North 45°02'17" West 32.15' to an iron stake (Point No. 62), thence South 68°14'57" West 279.31' to an iron stake (Point No. 63), thence South 70°11'27" West 511.39' iron stake (Point No. 64), located in the Frink property line (D.B. 3348, Pg. 1120) the Point of Ending of said easement, having a total area of 0.72 acres.

Access Easement 3

All of the Access Easement 3, described as New 12' Wide Non-exclusive Access Easement for ingress, egress & regress to be conveyed to the State of North Carolina of the Cool Run Site over a portion of the land of the Frink Tract (D.B. 3348, Pg. 1120), lying and being situated in Shallotte Township, Brunswick County, North Carolina and particularly described as follows (all distances are ground distances unless otherwise noted):

Beginning at an iron stake (Point of Beginning) labeled as Point No. 64 and being and being located South 81°57'34" East 1663.72 feet from an iron stake with a blue cap (Point No. 50) with N.C. Grid Coordinates N=80,019.9283', E=2,158,905.3015' (NAD '83, 2011).

Access Easement 3 being located adjacent to, and Northeast of the below described lines:

Thence from the Point of Beginning (Point No. 64) the following bearings and distances: North 89°27'21" West 12.00' to an iron stake (Point No. 65); thence North 00°32'39" East 60.71' to an iron stake (Point No. 1) located in the Southern Boundary of a New Conservation Easement, the Point of Ending, said easement, having a total area of 0.02 acres.

Appendix I

Credit Release Schedule

The schedules below list the updated credit release schedules for stream and wetland mitigation projects developed by bank and ILF sites in North Carolina:

Credit Release Schedule and Milestones for Wetlands					
Credit Release Milestone	Release Activity	Banks		ILF/NCDMS	
		Interim Release	Total Released	Interim Release	Total Released
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%	10%	100%

*Please note that vegetation plot data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.

Credit Release Schedule and Milestones for Streams					
Credit Release Milestone	Release Activity	Banks		ILF/NCDMS	
		Interim Release	Total Released	Interim Release	Total Released
1	Site Establishment (includes all required criteria stated above)	15%	15%	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	15%	30%	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable, performance standards have been met	10%	90% (100%**)	10%	90% (100%**)

*Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the NCIRT.
**10% reserve of credits to be held back until the bankfull event performance standard has been met.

Appendix J

Maintenance Plan

Maintenance Plan

The Site shall be monitored on a regular basis and a physical inspection of the site shall be conducted a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation along the channel. Areas where stormwater and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-cutting.
Vegetation	Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Beaver	Beaver and associated dams are to be removed as they colonize and until the project is closed.
Site Boundary	Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree- blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.

Appendix K

IRT Site Visit Notes

May 28, 2020

MEETING MINUTES

COOL RUN - Post Contract IRT Site Visit
Brunswick County
Lumber 03040207

DMS Project No. 100142
RFP No. 16-20190201
Site Visit Date: 05/19/2020

On May 19, 2020 the regulatory agencies, NCDMS staff, and members of the Clearwater Mitigation Solutions team convened, on-site, at 10:45am to review the 25.15- acre proposed Cool Run DMS mitigation site. Below is a list of attendees and general site visit notes.

Attendees:

NC WRC	Travis Wilson
USACE	Todd Tugwell
NCDWR	Mac Haupt
NCDWR	Erin Davis
NC DMS	Jeremiah Dow
Clearwater	Kevin Yates
Axiom	Grant Lewis
LMG	Wes Fryar

Site Visit Notes:

During walk of west side of project, discussion was had regarding the rehabilitation wetlands and how to justify the 1.5:1 credit ratio. Justification for rehab was improved hydroperiod and planting desirable native canopy vegetation. IRT stressed that pre-construction groundwater gauge data will be important to demonstrate an improved hydroperiod.

- At the north end of the project strategies were discussed to reduce the amount of P2 restoration on Cool Run as much as is feasible by raising the stream bed in the non-credit generating north end of the project. IRT understood that the extent of P2 was a conservative estimate in the technical proposal and would change moving forward. A topographic survey is needed to more accurately assess the amount of P2 that will be required.
- On the east side of project, the IRT asked about how rehab was being achieved. Response was that hydrology will be improved in part by filling hill slope toe ditch and directing drainage to the floodplain. IRT again stressed the importance of demonstrating hydrologic improvement in monitoring versus pre-construction data.
- Also, a discussion was had regarding filling of existing channel and remaining vernal pool depths. The vernal pools need to be shallow enough so that they are seasonally dry and do not stay inundated.
- Todd pointed out that UT1 could potentially be constructed as a single thread channel, rather than a threaded channel.

Wrap up discussion:

Erin

- JD will be important for determining more precise wetland boundaries.

- Pre-construction groundwater gauge data will be important to justify uplift on rehabilitation/re-establishment wetland areas.
- Requested a detailed soils report that contains a map of all soil pits and representative profiles.
- Stressed need for detailed discussion in the mit plan for monitoring vegetation due to uplift being heavily tied to vegetation.
- Given the amount of sweet gum/red maple/pine (undesirable species) incorporate an active adaptive management plan for thinning/control into the mitigation plan.
- Inquired about adding a buffer on the wetland areas adjacent to agricultural fields, specifically the NW part of the project.

Todd

- Echoed Erin that the JD will be important.
- Make sure we understand what the performance standards and monitoring requirements will be and tie them to demonstrating uplift.
- Discussed the wetland enhancement areas and thought the 3:1 credit ratio was appropriate.
- Detail the functional uplift for enhancement areas and provide explanation for the ratios proposed.
- Stressed that there will be strict veg monitoring requirements, i.e., no sweet gum counting toward success.
- Requested a well-marked boundary adjacent to ag field to prevent encroachment.
- Wants to see a detailed target vegetation community discussion in the mit plan that is tailored to this specific site. (i.e., no generic copy/paste language). Explain the vegetative uplift and how that will enhance the site.
- Todd asked about what kind of bed habitat in the relic channel is proposed for the stream. Grant responded that there would be a lot of brush and typical structures.

Travis

- Stressed that Brunswick County natural vegetation regeneration can come on extremely strong and fast and be very difficult to control, affecting planted species. Because of this he stressed the importance of the adaptive management plan in the mit plan.

Kevin

- Stated site prep will likely include hydroxing, controlled burning, and pre-emergent/herbicidal treatment.

Kevin Yates
Principal

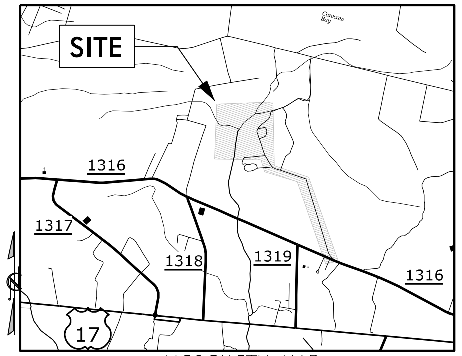
604 Macon Pl.
Raleigh, NC 27609
919-624-6901

Appendix L

Construction Plans

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	COOL RUN SITE	1	

NC DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF MITIGATION SERVICES
CONSTRUCTION PLANS
COOL RUN SITE



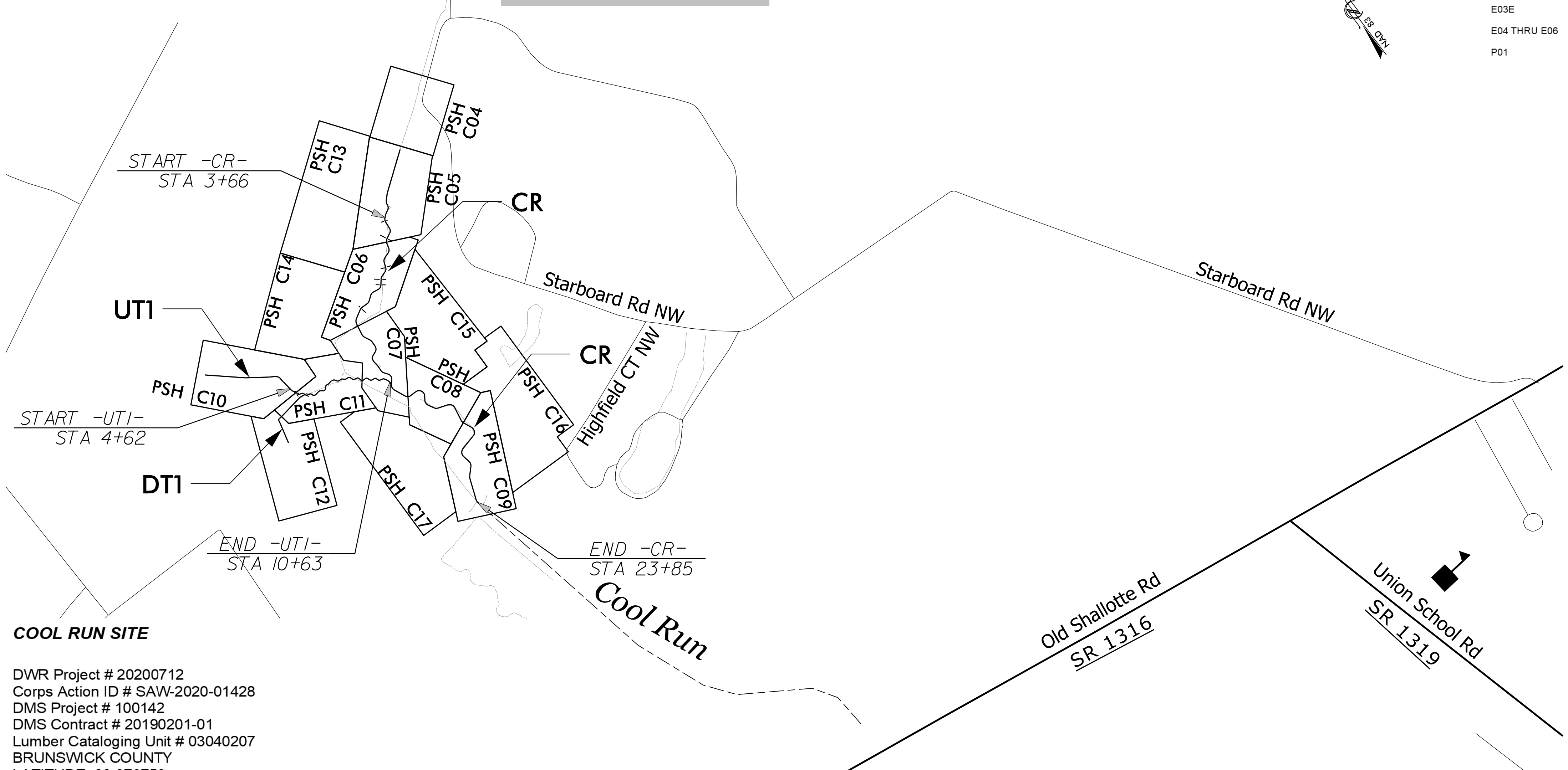
VICINITY MAP
Not to Scale

LOCATION: BRUNSWICK COUNTY, NORTH CAROLINA

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

100% SUBMITTAL PLANS

INDEX OF SHEETS



COOL RUN SITE

DWR Project # 20200712
Corps Action ID # SAW-2020-01428
DMS Project # 100142
DMS Contract # 20190201-01
Lumber Cataloging Unit # 03040207
BRUNSWICK COUNTY
LATITUDE: 33.970753
LONGITUDE: -78.471379 (WGS84)

LIMITS OF DISTURBANCE: 24.59 AC

GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

10 5 0 10 5
PROFILE (VERTICAL)

PROPOSED LENGTH OF -CR- =	2019			
PROPOSED LENGTH OF -UT 1- =	601			
	TOTAL STREAM LENGTHS (LF) =		2620	
RESTORATION LEVEL	STREAM (linear footage)		RIPARIAN WETLAND (acreage)	NONRIPARIAN WETLAND (acreage)
RESTORATION (Ratio 1:1)	2028		14.108 (Reestablishment)	0.000
RESTORATION (Ratio 1.5:1)	592		1.433 (Rehabilitation)	0.000
ENHANCEMENT	0		1.201	0.000
PRESERVATION	0		0.492	
CREATION	0		0.351	
TOTALS	2620		17.234	0.000
MITIGATION UNITS	2422.667	SMU	15.512 RIPARIAN WMUs	NONRIPARIAN WMUs

Axiom Environmental
218 Snow Ave
Raleigh, NC 27603
Axiom Environmental, Inc.

GRANT LEWIS
PROJECT DESIGNER

CLEARWATER MITIGATION SOLUTIONS
Clearwater Mitigation Solutions
604 Macon Place
Raleigh, NC 27609

KEVIN YATES
SITE CONSTRUCTION MANAGER

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

JOSHUA G. DALTON, P.E.
PROJECT ENGINEER

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

CONTRACT: COOL RUN SITE

9/2/2022
CoolRun_Rdy_psh_C01.dgn
meadwards

CONVENTIONAL PLAN SHEET SYMBOLS

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

BOUNDARIES AND PROPERTY:

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

BUILDINGS AND OTHER CULTURE:

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

HYDROLOGY:

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

RIGHT OF WAY & PROJECT CONTROL:

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

ROADS AND RELATED FEATURES:

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

VEGETATION:

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

EXISTING STRUCTURES:

MAJOR:

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

MINOR:

- Head and End Wall — CONC HW
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB — CB
- Paved Ditch Gutter
- Storm Sewer Manhole — S
- Storm Sewer — S

UTILITIES:

POWER:

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

TELEPHONE:

- Existing Telephone Pole

WATER:

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

GAS:

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

SANITARY SEWER:

- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer
- SS Forced Main Line LOS B (S.U.E.*) — FSS
- SS Forced Main Line LOS C (S.U.E.*) — FSS
- SS Forced Main Line LOS D (S.U.E.*) — FSS

MISCELLANEOUS:

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

- Log Vane
- Log Cross Vane
- Step Pool Structure — Begin / End
- Stream Plug
- Floodplain Interceptor
- Limits of Disturbance — LOD

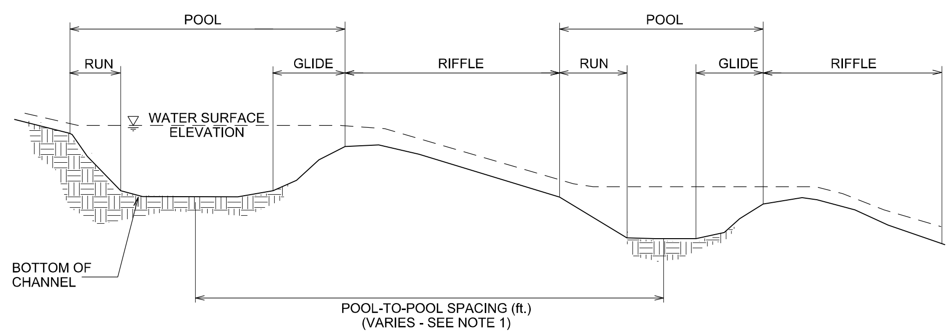
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
SYMBOLOGY

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C01A
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. C01A

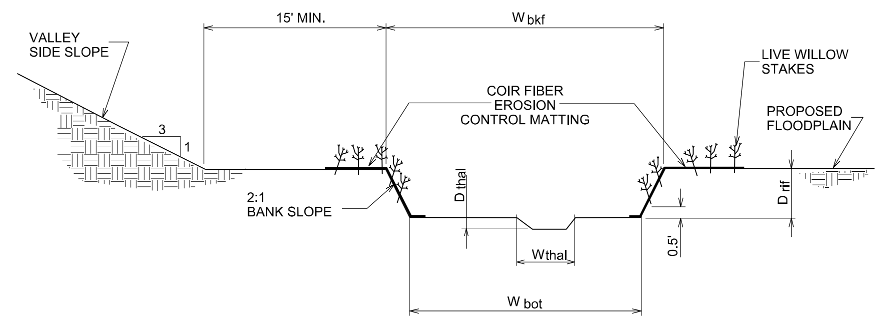
9/2/2022
Cool_Run_Rdy_PSH_C01a.dgn
medwards



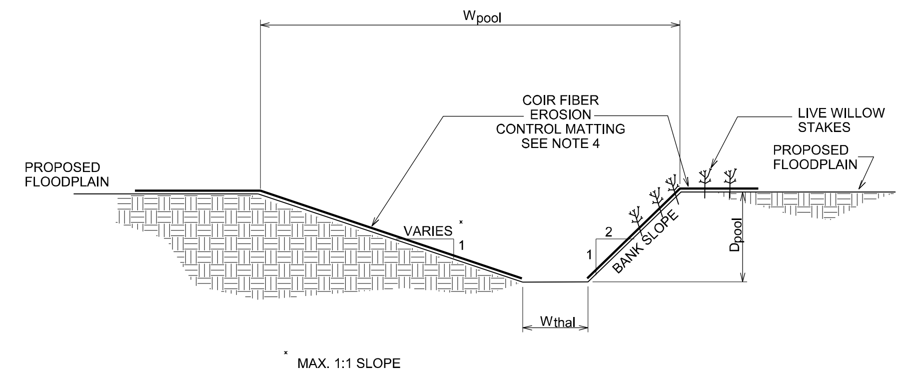
TYPICAL CHANNEL PROFILE

NOTES:

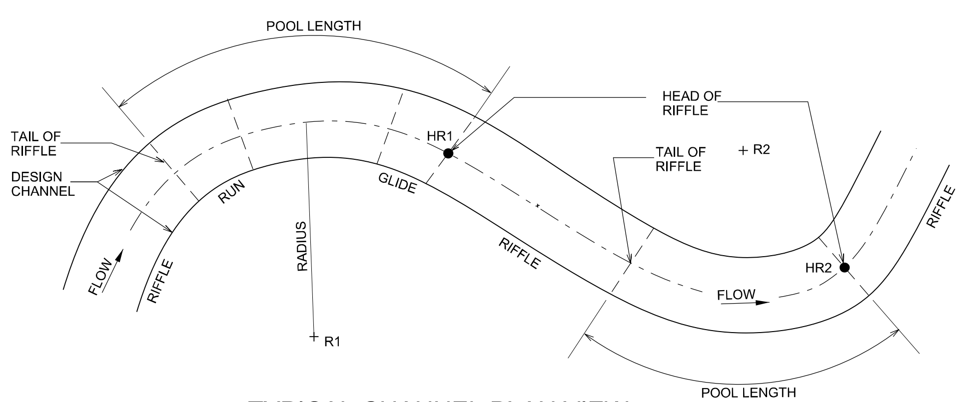
1. POOL-TO-POOL SPACING IS MEASURED FROM CENTER OF POOL BEND TO CENTER OF POOL BEND.



TYPICAL RIFFLE CROSS-SECTION



TYPICAL POOL CROSS-SECTION



TYPICAL CHANNEL PLAN VIEW

CHANNEL CONSTRUCTION NOTES:

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

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

3. THE CONTRACTOR SHALL SUPPLY BED MATERIAL FOR THE ENTIRE BED LENGTH OF EACH RIFFLE SECTION.

CHANNEL PLAN VIEW NOTES:

1. THE CONTRACTOR SHALL LAYOUT THE CHANNEL ALIGNMENT BY LOCATING THE RADII AND SCRIBING THE CENTER LINE FOR EACH POOL BEND. THE CONNECTING TANGENT SECTIONS SHALL COMPLETE THE LAYOUT OF THE CHANNEL.

2. FIELD ADJUSTMENTS OF THE ALIGNMENT MAY BE REQUIRED TO SAVE TREES OR AVOID OBSTACLES. THE STAKE-OUT SHALL BE APPROVED BY THE CONSTRUCTION MANAGER BEFORE CONSTRUCTION OF THE CHANNEL.

Cross Section Dimensions

Stream Name	Stationing	W bkf (ft)	W bot (ft)	D riff (ft)	D thal (ft)	D pool (ft)	W pool (ft)	W thal (ft)
CR UP 1*	3+59 to 9+57	14.1	10.1	0.9	0.1	1.3	18.4	1.0
CR UP 2	9+57 to 13+89.5	14.1	10.1	0.9	0.1	1.3	18.4	1.0
CR Down	13+89.5 to 23+85	15.0	11.0	0.9	0.1	1.3	19.5	1.0
UT1-1*	4+62 to 5+97	5.8	3.8	0.4	0.1	0.7	7.5	1.0
UT1-2	5+97 to 10+63	5.8	3.8	0.4	0.1	0.7	7.5	1.0

* CR UP 1 AND UT1-1:
- NO CHANGES IN THE CHANNEL DESIGNS.
- PROPOSED FLOODPLAIN WIDTHS VERY AND VALLEY SIDE SLOPES ARE 5:1.
- WIDTHS ARE BASED ON FLOODPLAIN BENCH DESIGN SHOWN ON PLANS (LIMITS OF CONSTRUCTION), USING THE 5:1 SLOPE TO THE DESIGN Wbkf ELEVATION.

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

SUNGATE DESIGN GROUP, P.A.

Axiom Environmental, Inc.

COOL RUN

BRUNSWICK COUNTY, NC

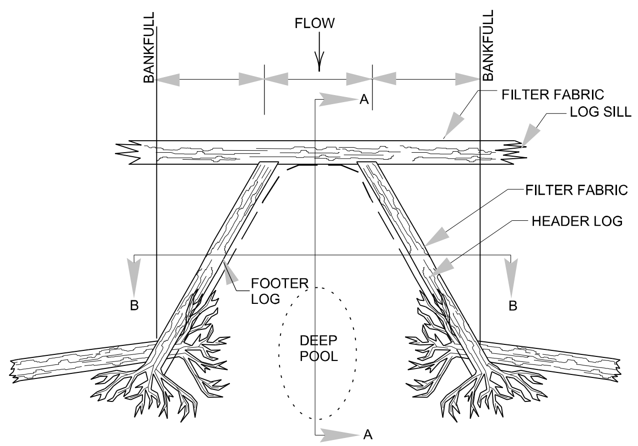
TYPICALS

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C02
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. C02

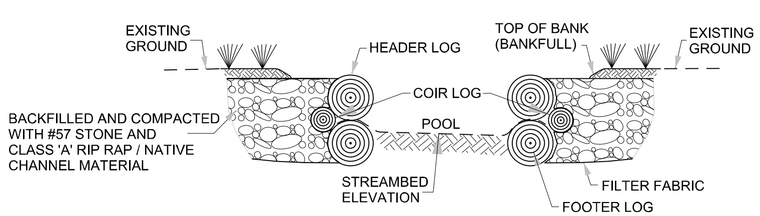
9/2/2022
Cool Run_Rdy_psh_C02.dgn

LOG CROSS VANE
SCALE:NTS

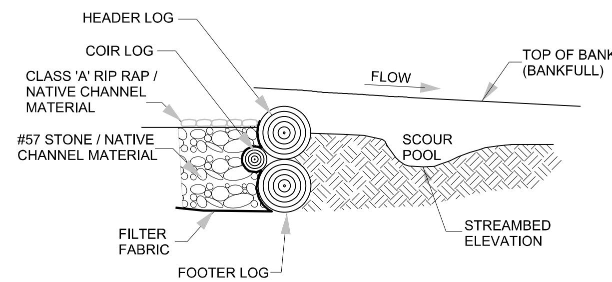
PLAN VIEW



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

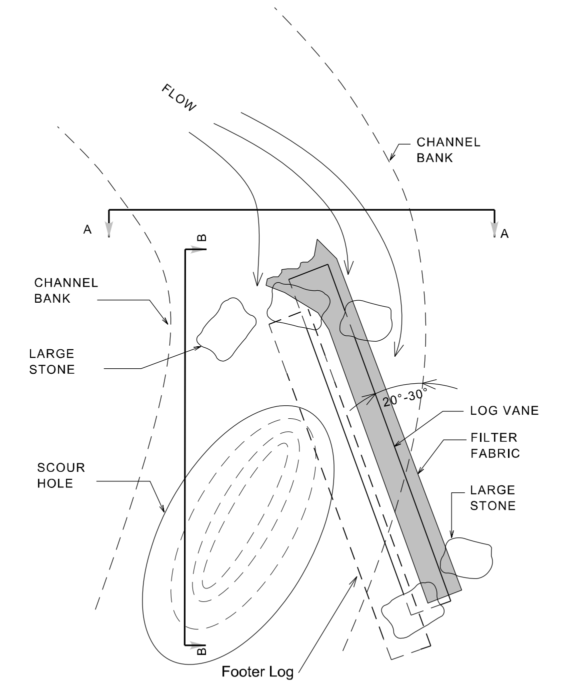


SECTION B-B



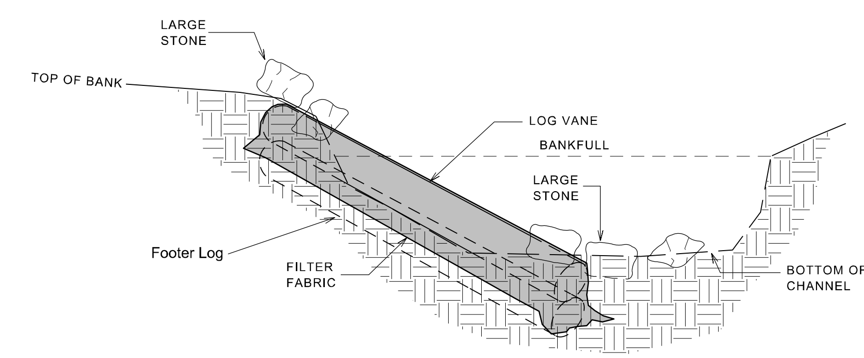
SECTION A-A

REACH	ARM LENGTH (FT.)	CHANNEL DEPTH (FT.)
Cool Run	11	0.9 - 1.3
UT 1	6	0.5 - 0.7

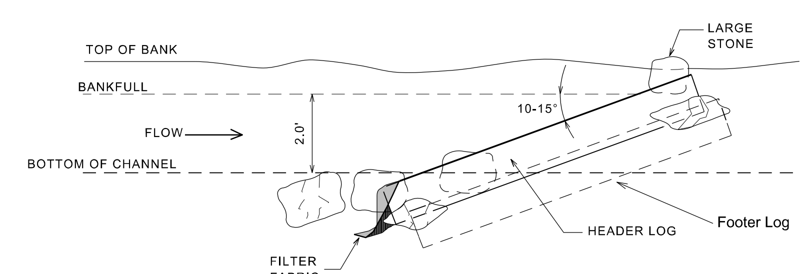


NOTE:
FILTER FABRIC TOED IN AND DRAPED ON UPSTREAM SIDE OF LOG VANE PRIOR TO BACKFILL.

PLAN VIEW
SCALE: N.T.S.



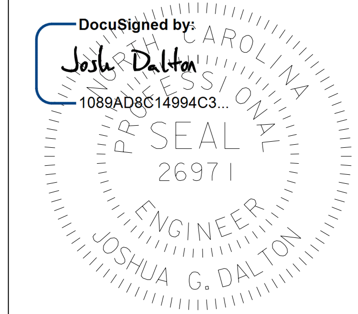
CROSS-SECTION A-A
SCALE: N.T.S.



PROFILE B-B
SCALE: N.T.S.

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

TYPICAL LOG VANE



9/2/2022
DATE:

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

Axiom Environmental, Inc.

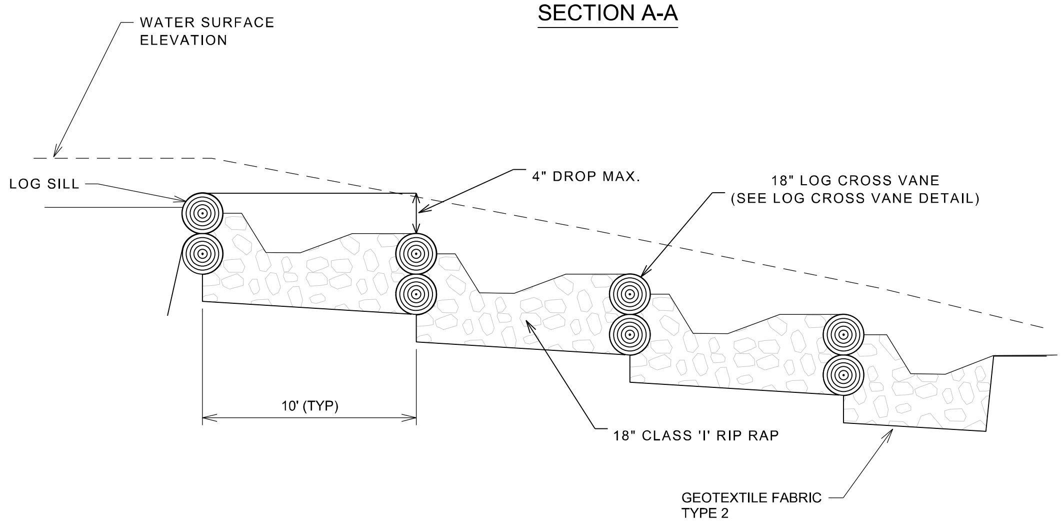
COOL RUN
BRUNSWICK COUNTY, NC
DETAILS

PROJECT # : 122-21015
DRAWING NAME: COOL RUN PSH C02A
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. C02A

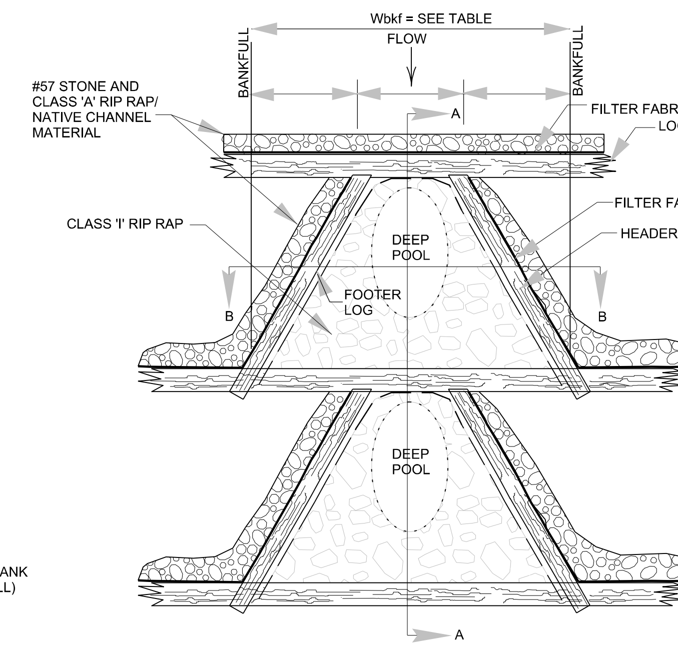
9/2/2022
Cool Run_Rdy_psh_C02a.dgn
medwards

DROP STRUCTURE

SECTION A-A

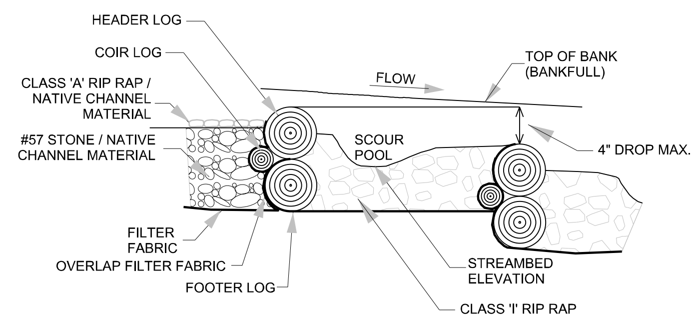


PLAN VIEW



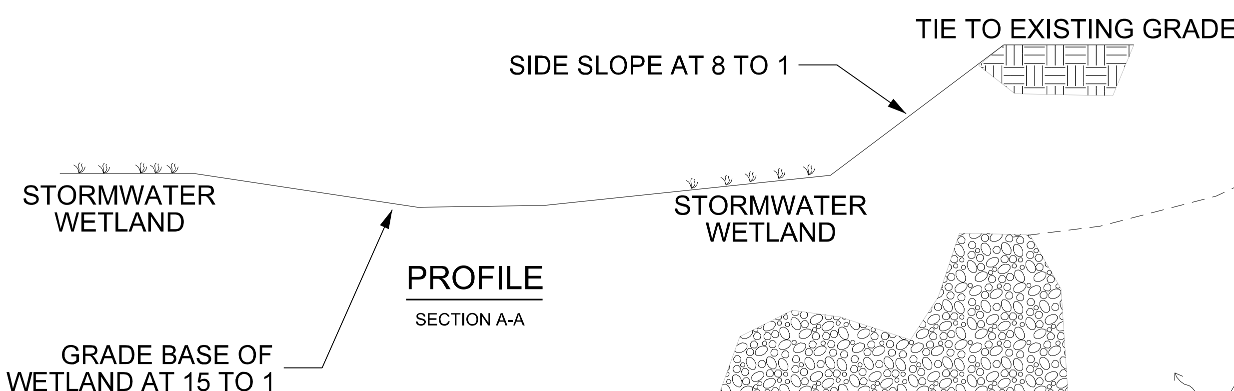
STRUCTURE NOTES:
1. FILL CLASS '1' RIP RAP VOIDS WITH CLASS 'A'
RIP RAP/ #57 STONE/ NATIVE CHANNEL MATERIAL MIXTURE.

STEP POOL ENLARGEMENT

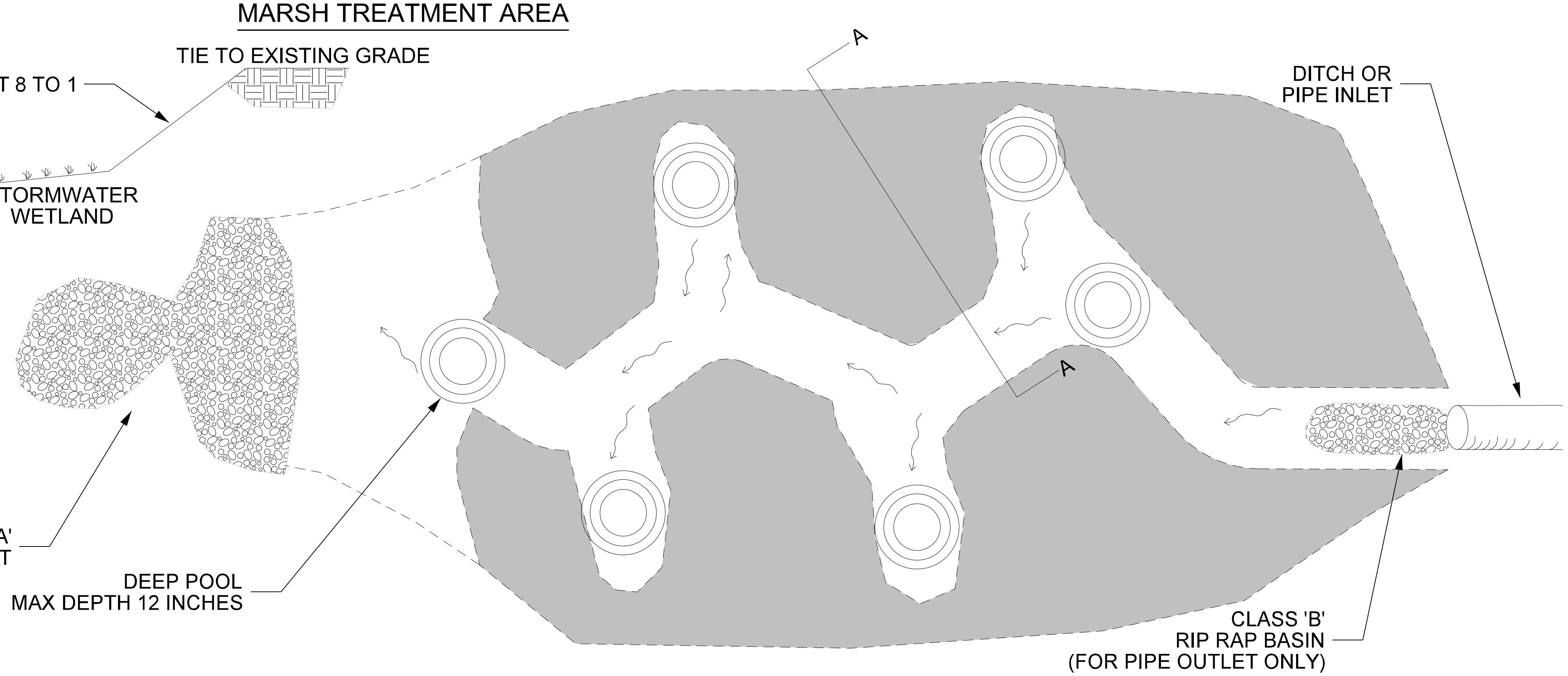


CROSS-SECTION DIMENSIONS		
REACH	Wbkf (ft.)	Distance between Drops
COOL RUN	15.0	8.5'

MARSH TREATMENT AREA



PROFILE
SECTION A-A



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

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

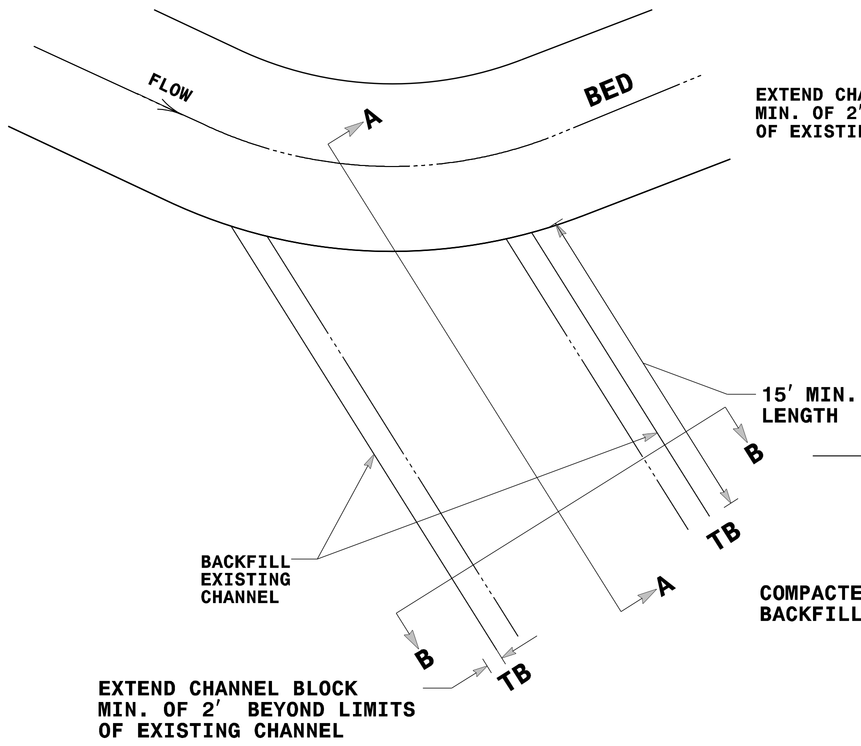
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
DETAILS

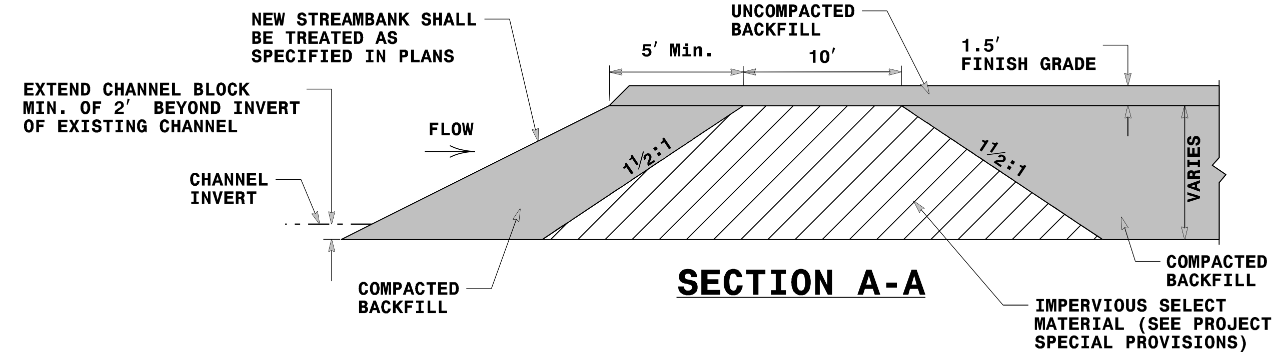
PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C02B
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO.
C02B

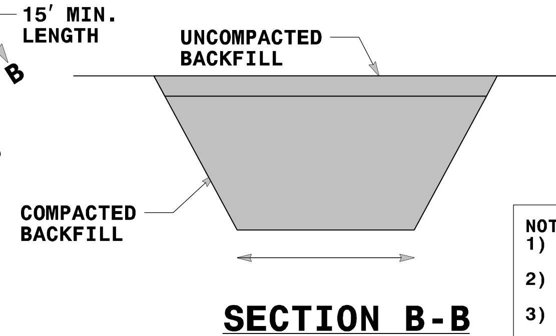
9/2/2022
Cool Run_Rdy_psh_C02b.dgn
mmedwards



PLAN VIEW



SECTION A-A

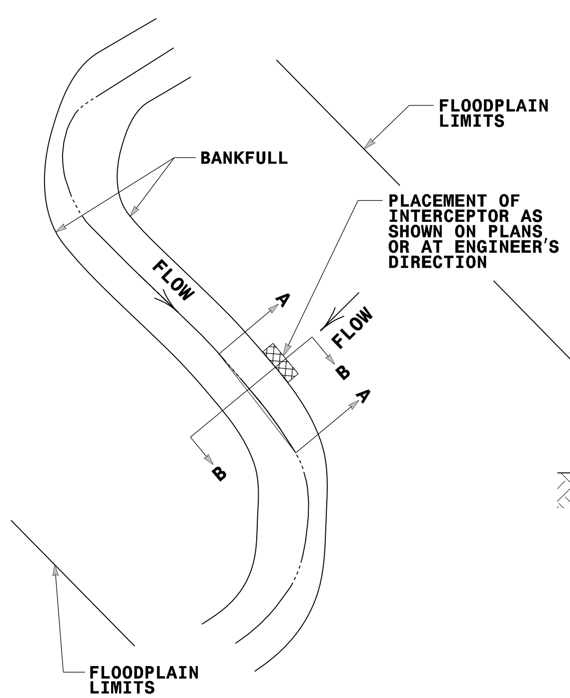


SECTION B-B

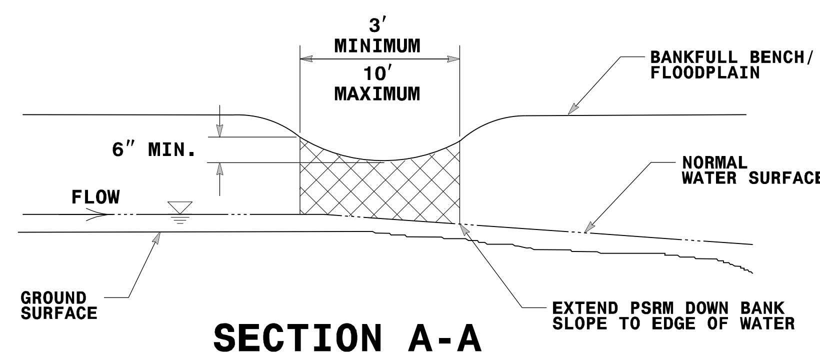
STREAM PLUG

NOT TO SCALE

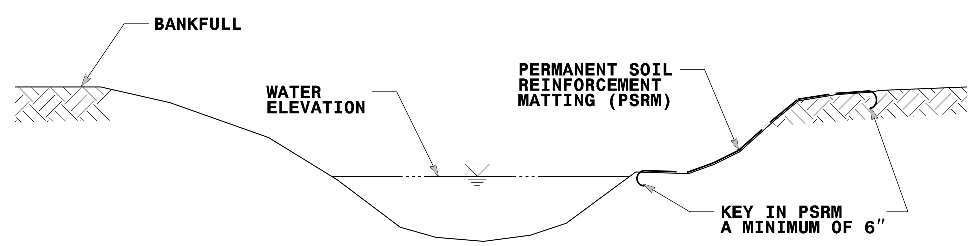
NOTES:
1) CHANNEL BLOCK SHALL BE INSTALLED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2) BLOCK SHOULD BE INSTALLED AT THE INTERFACE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL.
3) BOTTOM OF BLOCK SHOULD BE A MINIMUM OF 2′ BELOW THE INVERT OF THE EXISTING CHANNEL.
4) BLOCK SHOULD EXTEND A MINIMUM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



PLAN VIEW



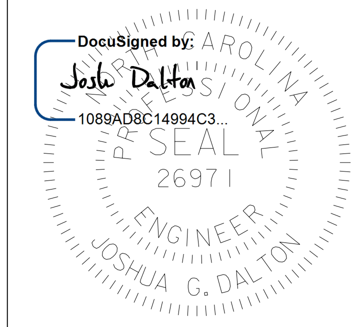
SECTION A-A



SECTION B-B

FLOODPLAIN INTERCEPTOR DETAIL

NOT TO SCALE



9/2/2022

DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
DETAILS

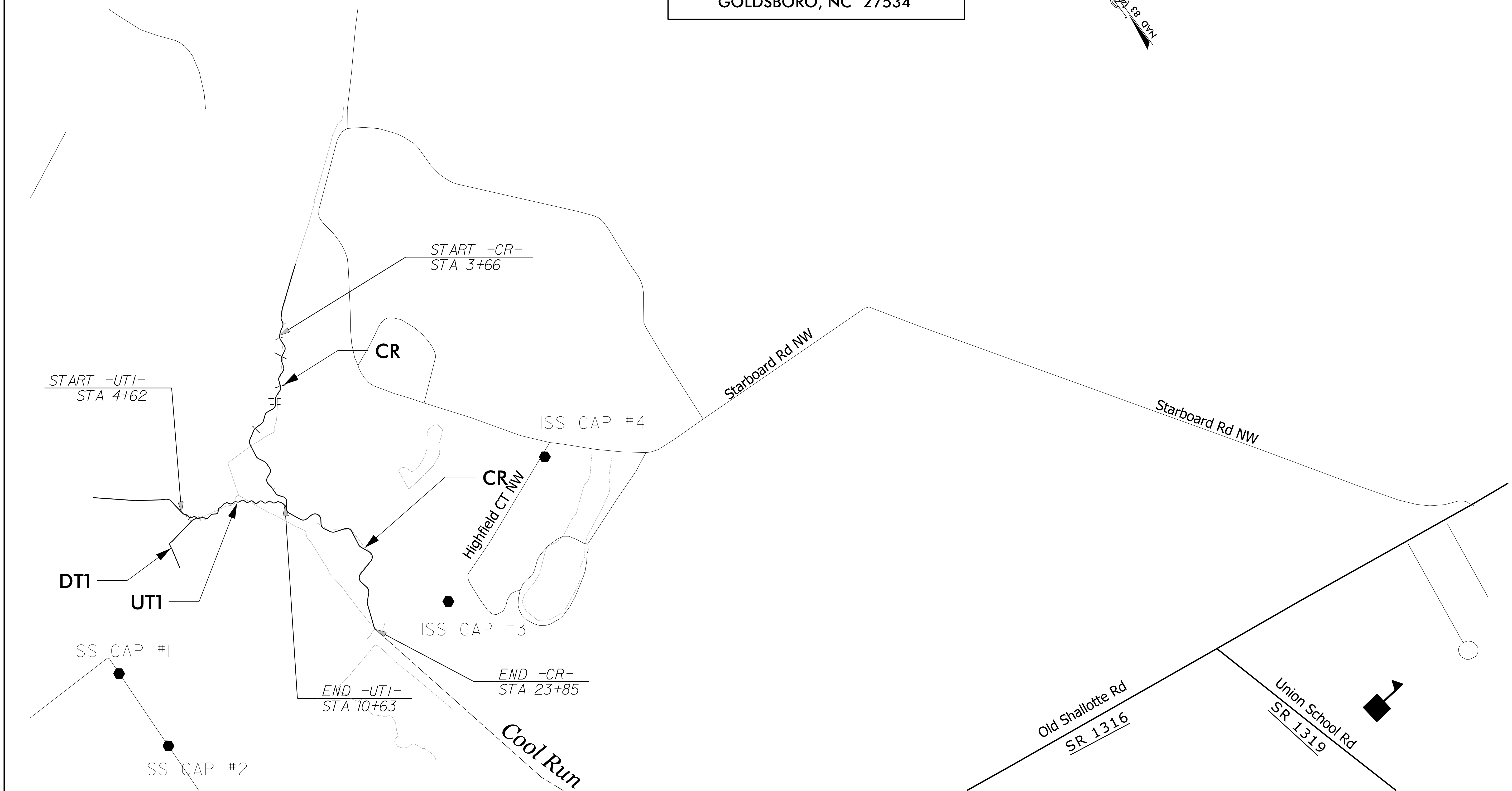
PROJECT #:	1221-21015
DRAWING NAME:	COOL RUN PSH C02C
DATE:	2022
DRAWN BY:	JRH
REVIEWED BY:	JGD
REVISIONS:	
SHEET NO.	C02C

9/2/2022
Cool Run_Rdy_psh_C02c.dgn
medwards

Cool Run Control Points				
Pt ##	Northing	Easting	Elevation	Type
1	80451.93	2158925.84	52.32	ISS CAP
2	80019.93	2158905.30	55.87	ISS CAP
3	79757.56	2160438.85	48.76	ISS CAP
4	80041.47	2161249.26	57.67	ISS CAP

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

250' 125' 0 250' 500'
SCALE: 1" = 500'
NAD 83



HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

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

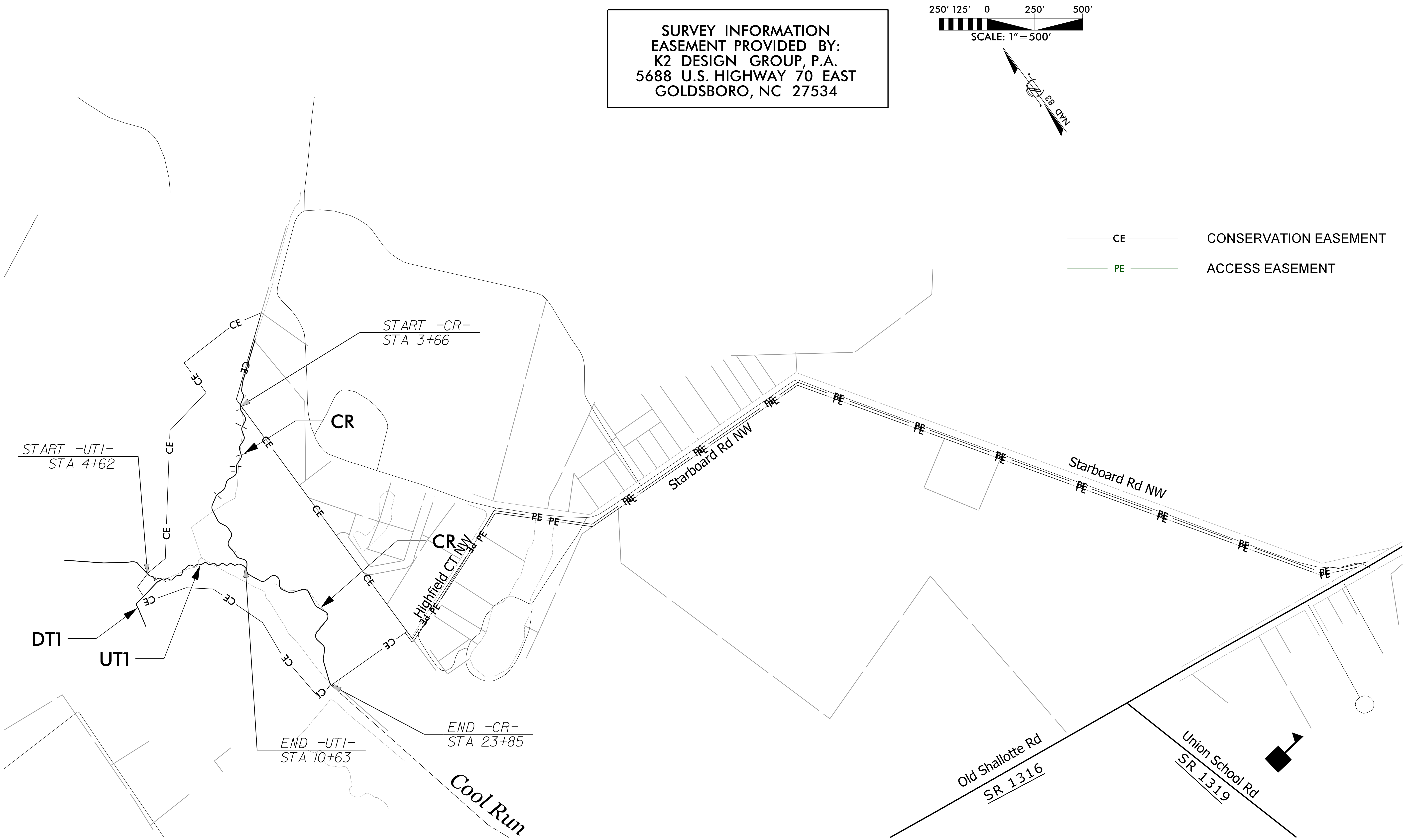
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
CONTROL POINTS

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C03
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. C03

9/2/2022
Cool_Run_Rdy_psh_C03.dgn

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



CE CONSERVATION EASEMENT

PE ACCESS EASEMENT

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

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

Axiom Environmental, Inc.

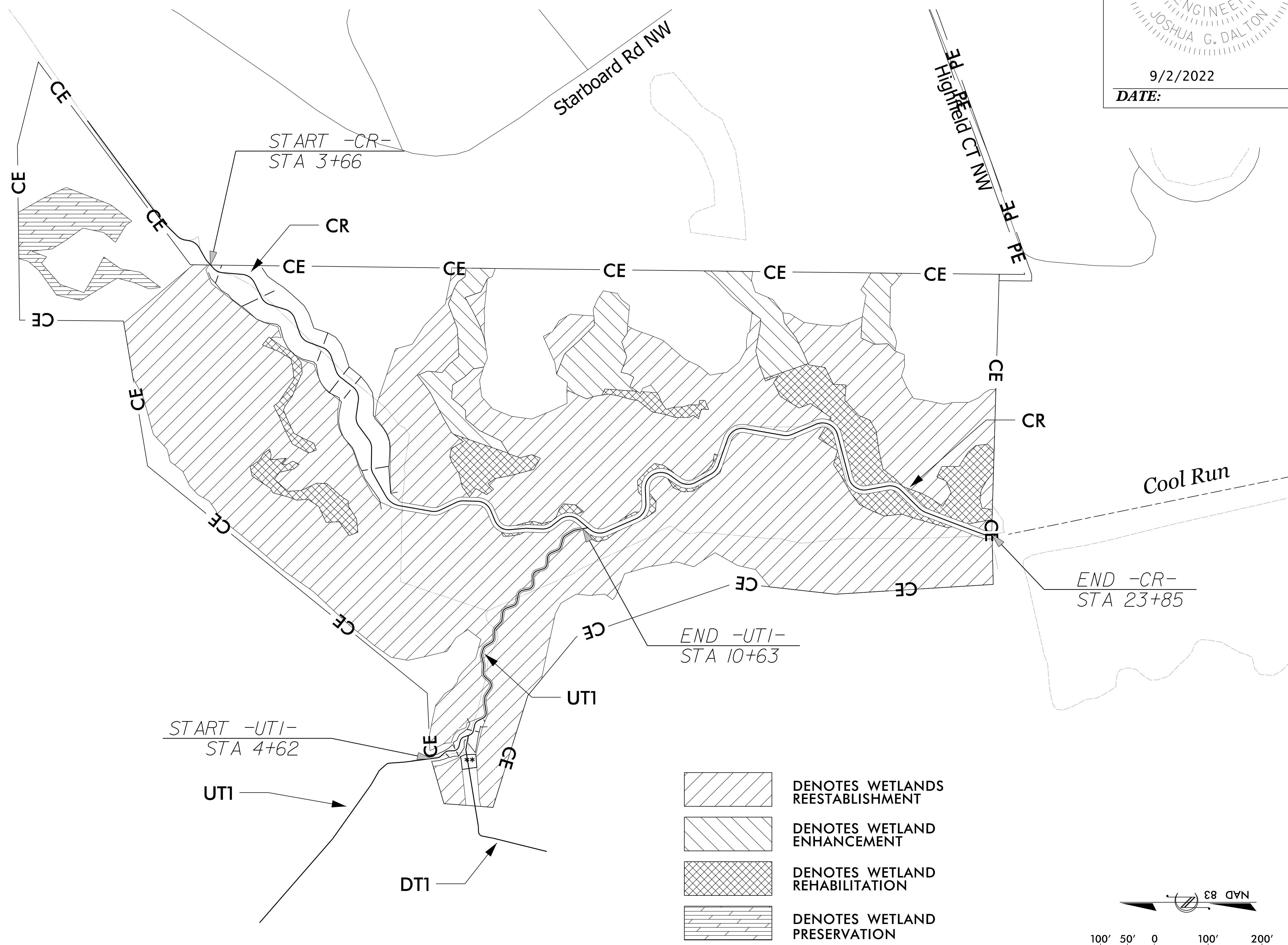
COOL RUN
BRUNSWICK COUNTY, NC

CONSERVATION EASEMENT

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C03A
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. C03A

9/2/2022
Cool Run_Rdy_psh_C03A.dgn
medwards



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

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

Axiom Environmental, Inc.

COOL RUN

BRUNSWICK COUNTY, NC

WETLAND REESTABLISHMENT

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C03B
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. C03B

9/2/2022
Cool_Run_Rdy_psh_C03B.dgn

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

NAD 83

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

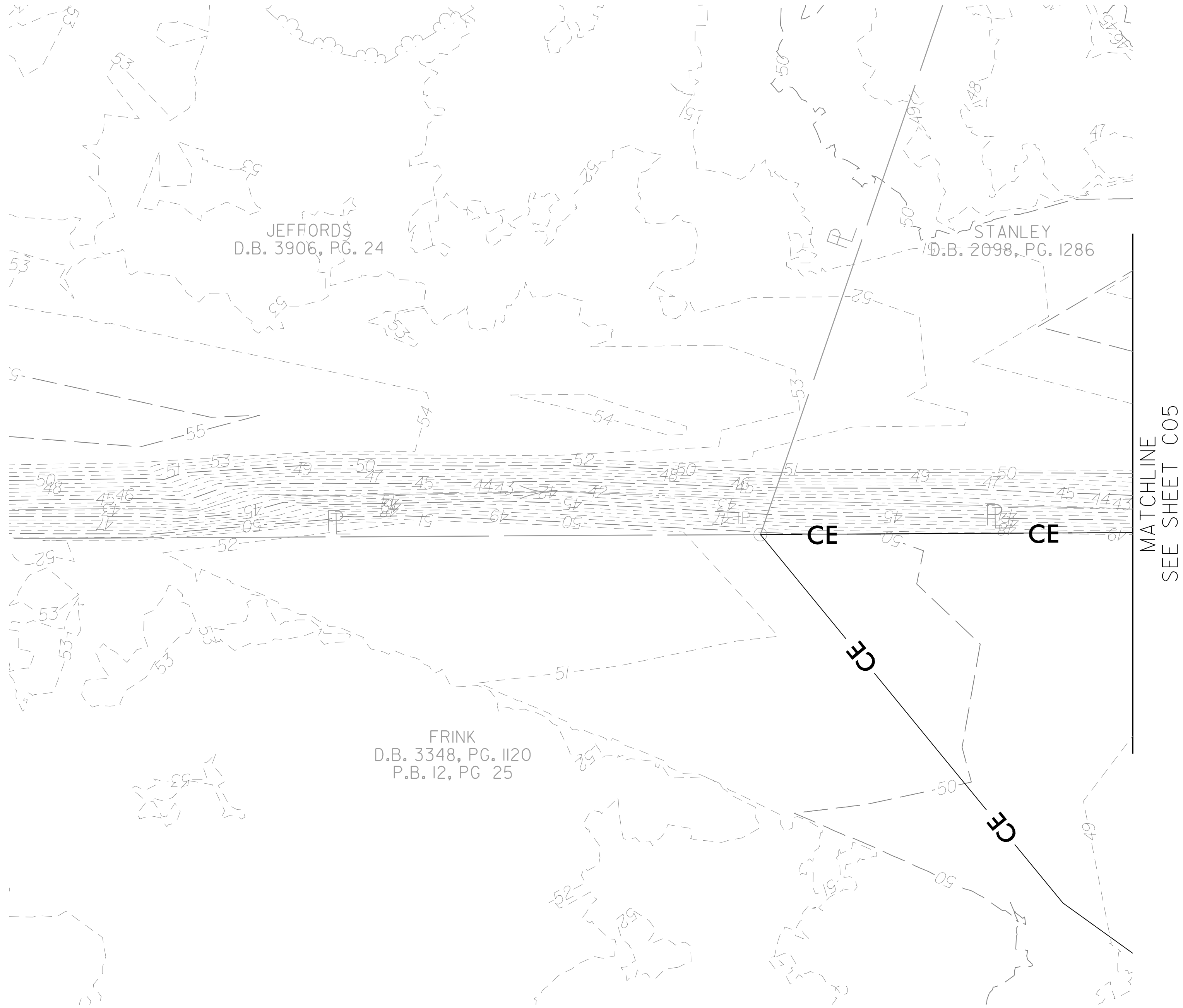
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

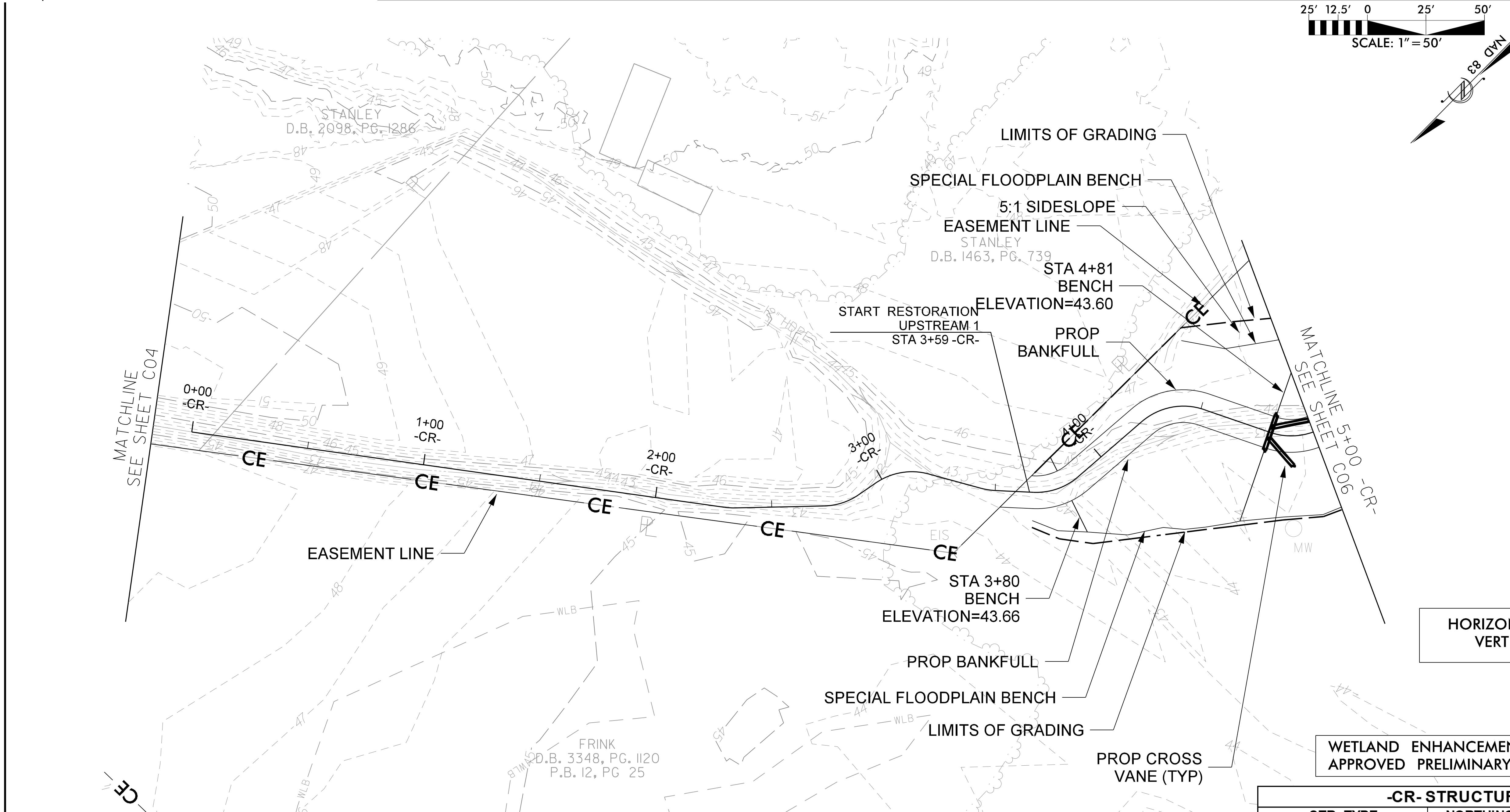


WETLAND ENHANCEMENT AREAS DERIVED FROM
APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT # :	1221-21015
DRAWING NAME:	COOL RUN PSH C04
DATE:	2022
DRAWN BY:	JRH
REVIEWED BY:	JGD
REVISIONS:	
SHEET NO.	**C04**

9/2/2022
Cool_Run_Rdy_psh_C04.dgn
medwards

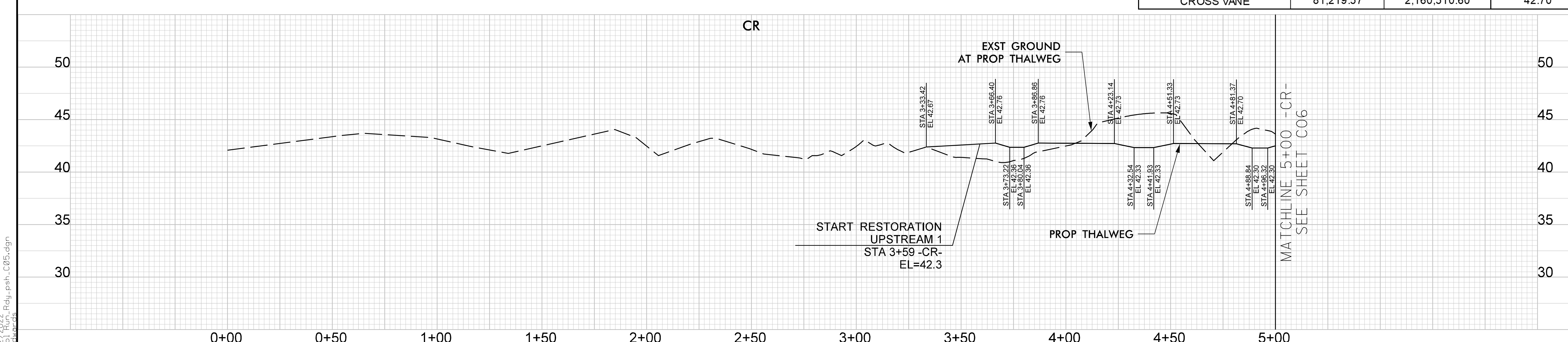


HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-CR- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	81,219.57	2,160,510.60	42.70



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C05
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. **C05**

9/2/2022
Cool_Run_Rdy_psh_C05.dgn
mpedwards

-CR- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	81,105.83	2,160,417.05	42.61
CROSS VANE	81,049.16	2,160,343.57	42.51

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

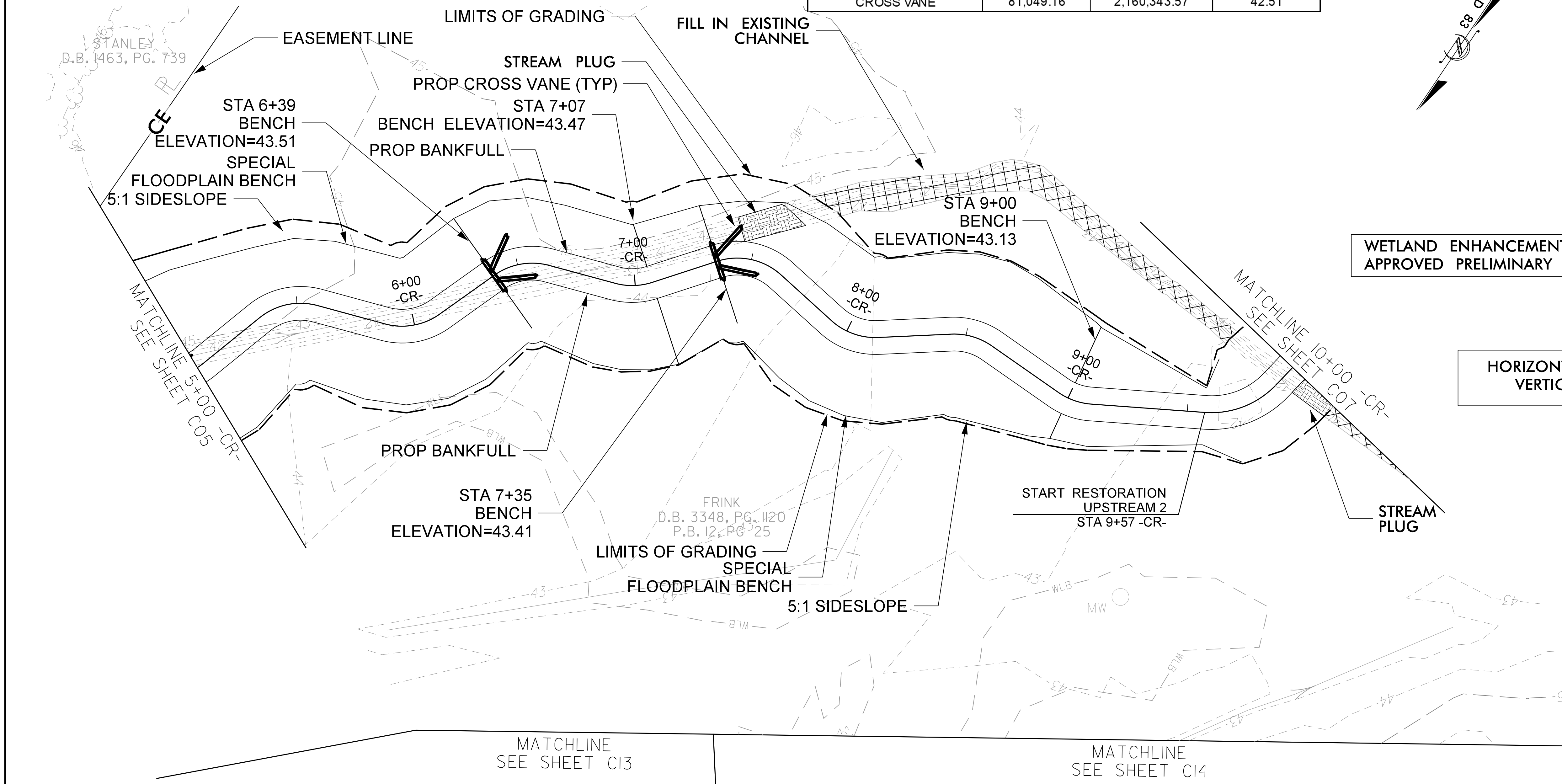
NAD 83

DocuSigned by: Josh Dalton 1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

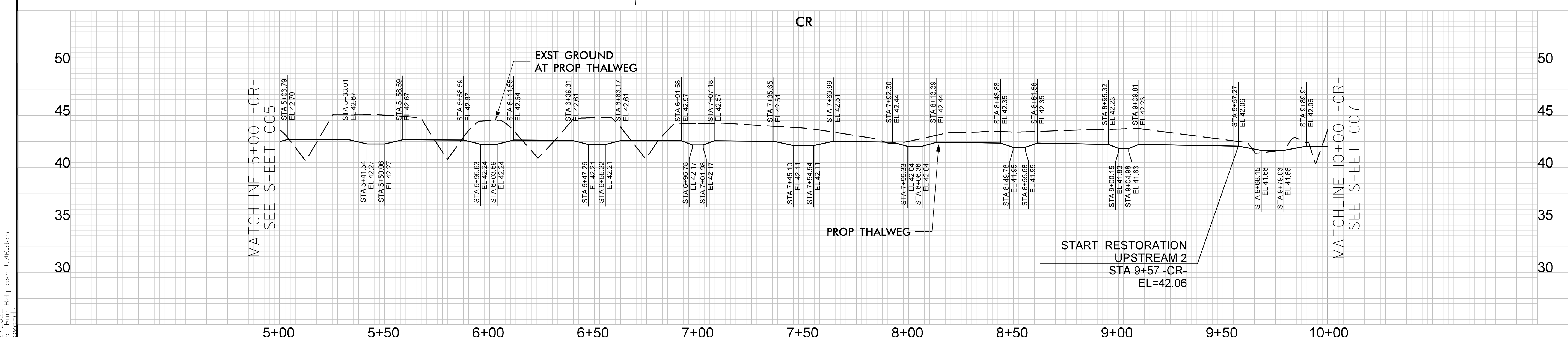
9/2/2022

DATE:



WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988



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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C06
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. C06

9/2/2022 Cool_Run_Rdy_psh_C06.dgn

-CR- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	80,902.84	2,160,112.59	41.85
LOG VANE	80,817.46	2,160,131.07	41.55
CROSS VANE	80,608.66	2,160,078.76	41.02

-UT1- STRUCTURE LOCATIONS			
STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	80,714.46	2,159,990.89	41.96
CROSS VANE	80,695.83	2,160,005.23	41.77
CROSS VANE	80,669.00	2,160,040.08	41.61
CROSS VANE	80,639.68	2,160,076.23	41.34

25' 12.5' 0 25' 50'
SCALE: 1" = 50'
NAD 83

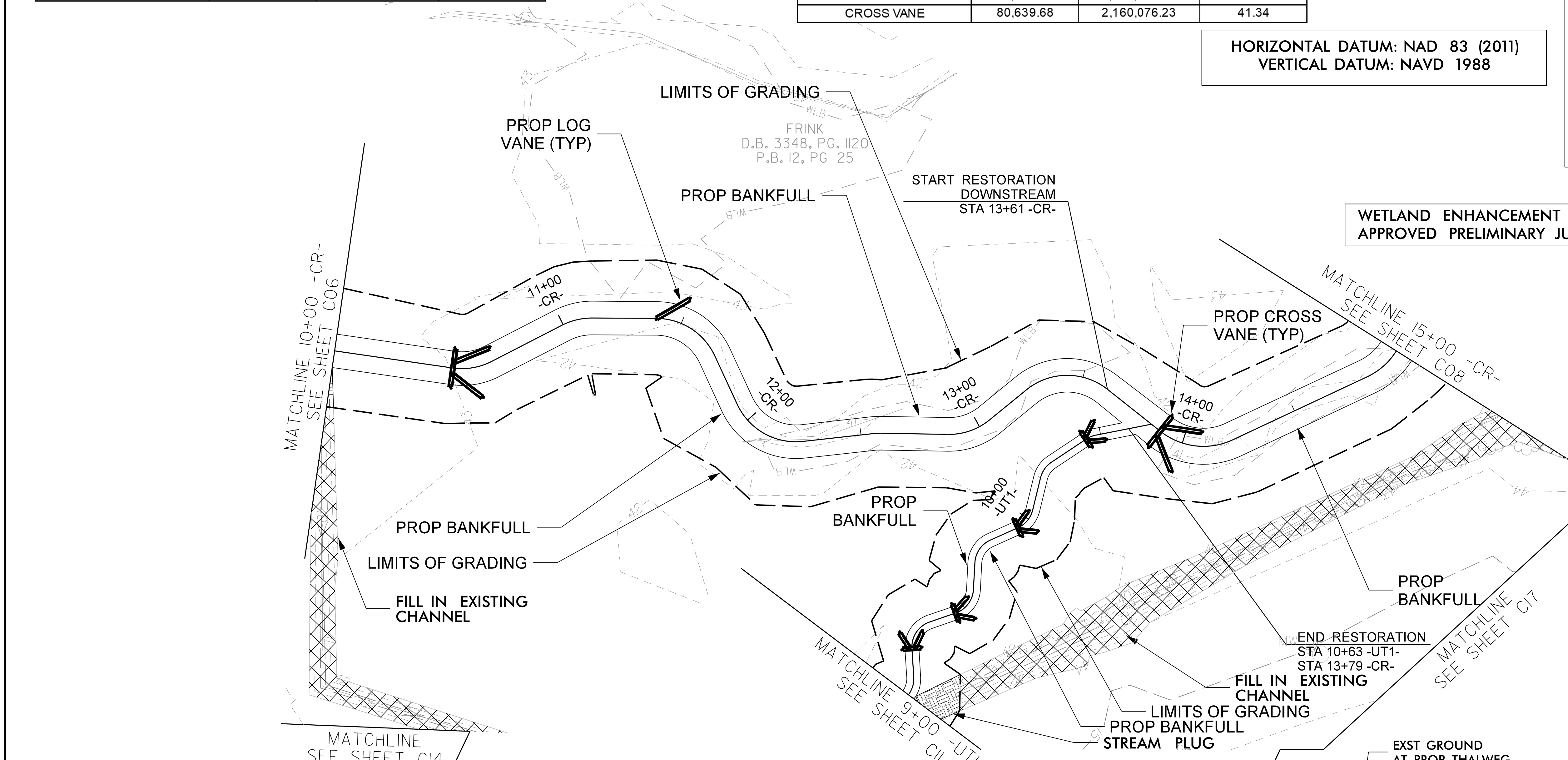
HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

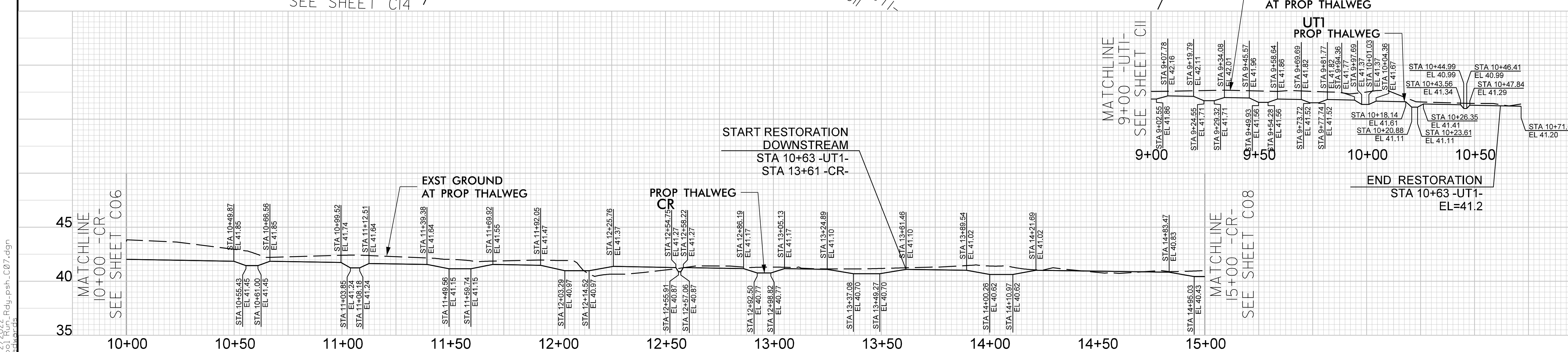
DocuSigned by: Josh Dalton 1089AD8C14994C3...
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON
9/2/2022
DATE:

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

Axiom Environmental, Inc.

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION



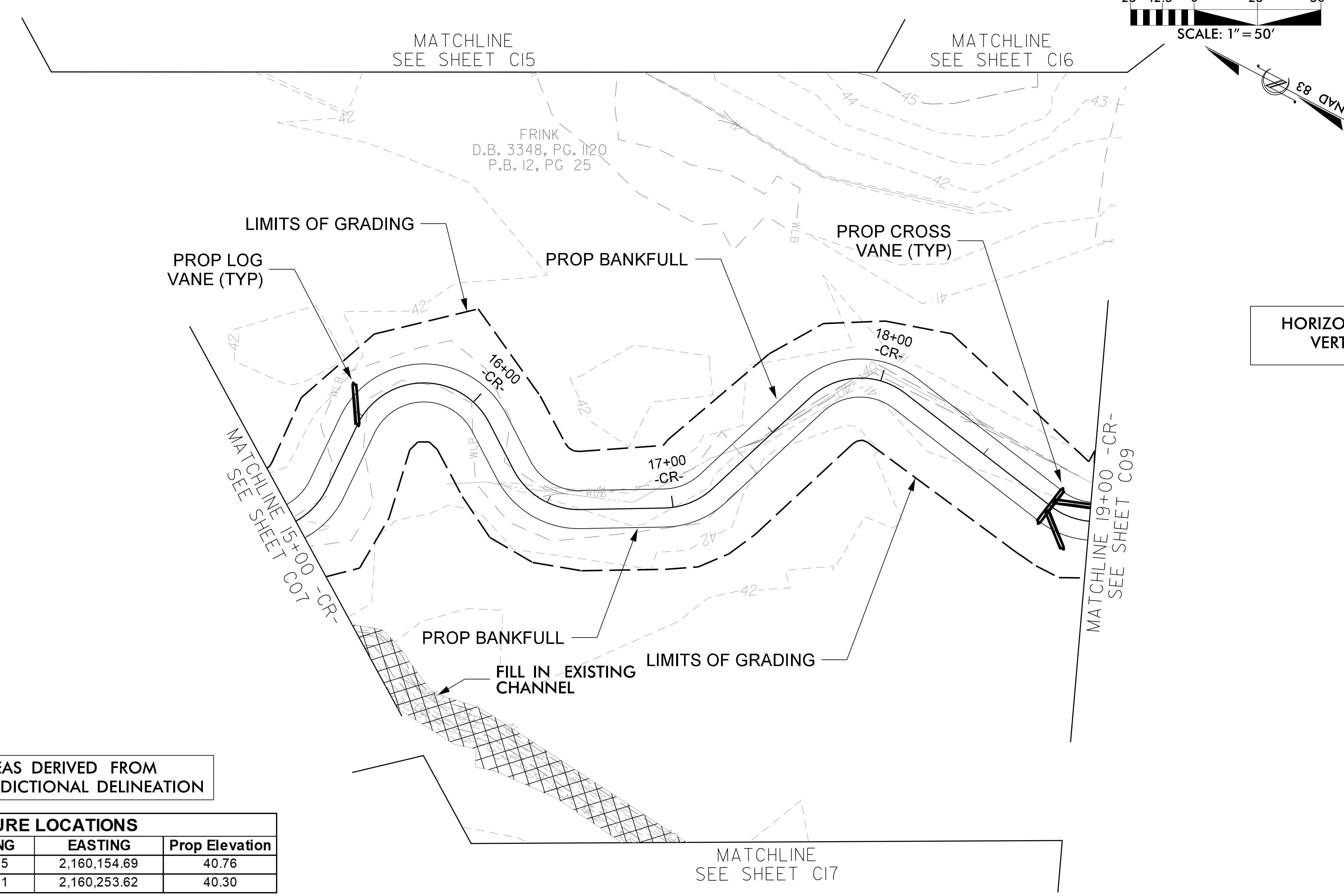


PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C07
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

SHEET NO. C07

9/2/2022 Cool Run_Rdy_psh_C07.dgn

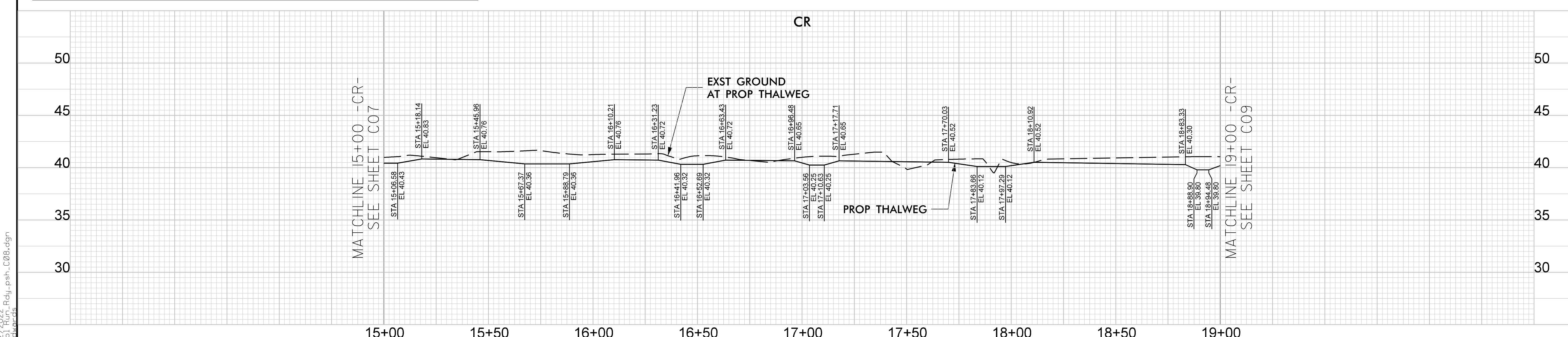


HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-CR- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG VANE	80,505.55	2,160,154.69	40.76
CROSS VANE	80,248.91	2,160,253.62	40.30



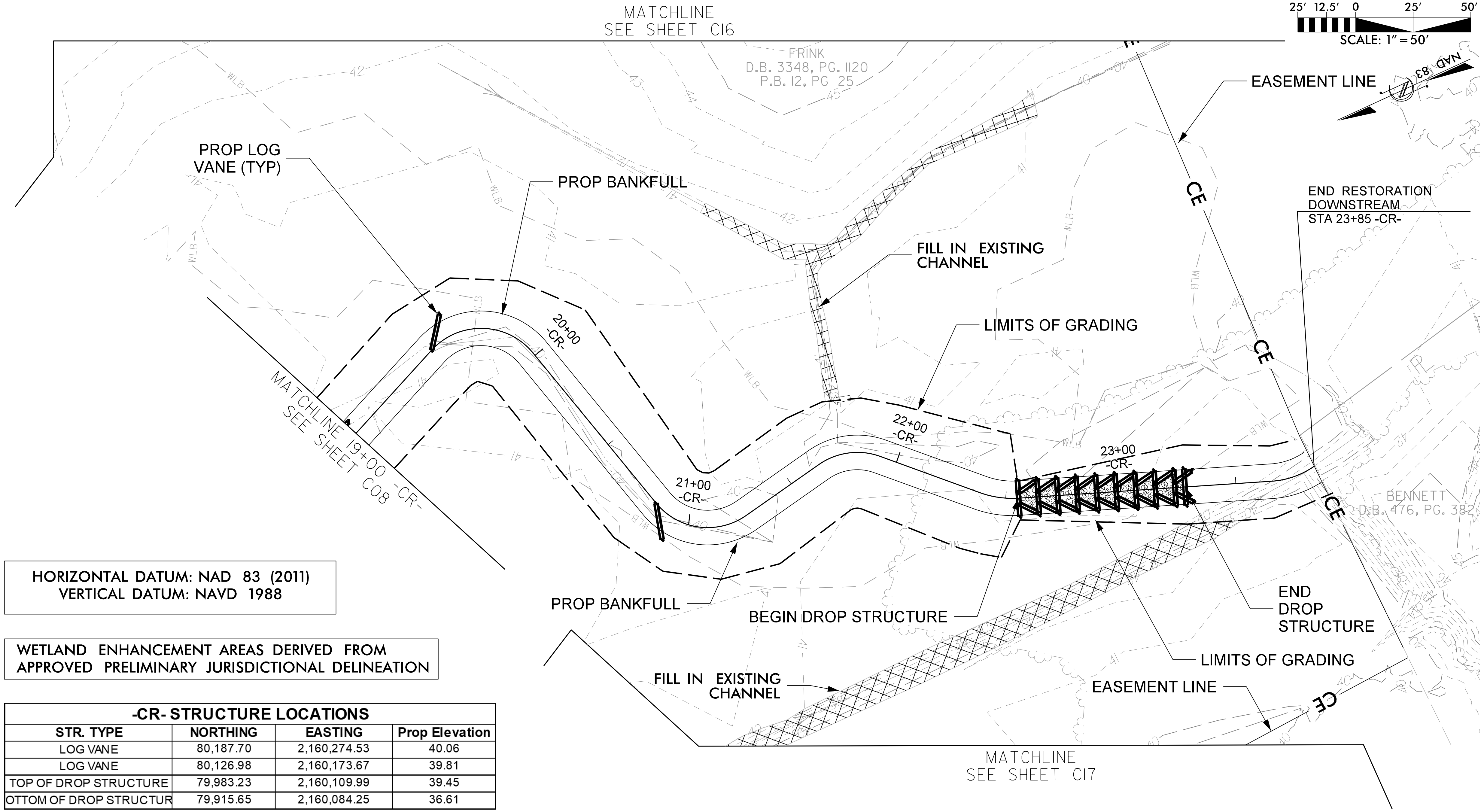
DocuSigned by: Josh Dalton 1089AD8C14994C3...
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON
9/2/2022
DATE:

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

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C08
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **C08**

9/2/2022 Cool_Run_Rdy_psh_C08.dgn

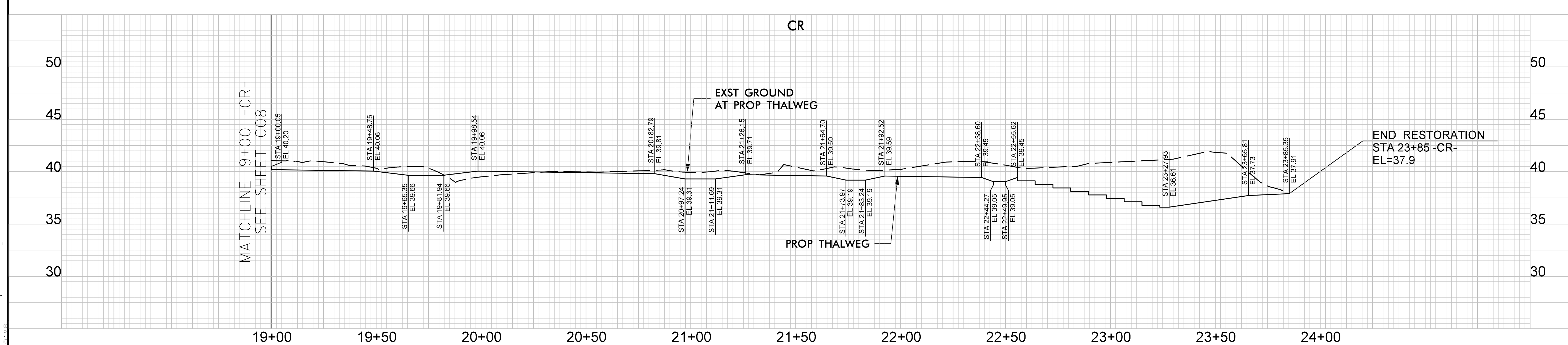


HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-CR- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
LOG VANE	80,187.70	2,160,274.53	40.06
LOG VANE	80,126.98	2,160,173.67	39.81
TOP OF DROP STRUCTURE	79,983.23	2,160,109.99	39.45
OTTOM OF DROP STRUCTUR	79,915.65	2,160,084.25	36.61



DocuSigned by: Josh Dalton 1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

11/4/2022

DATE:

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

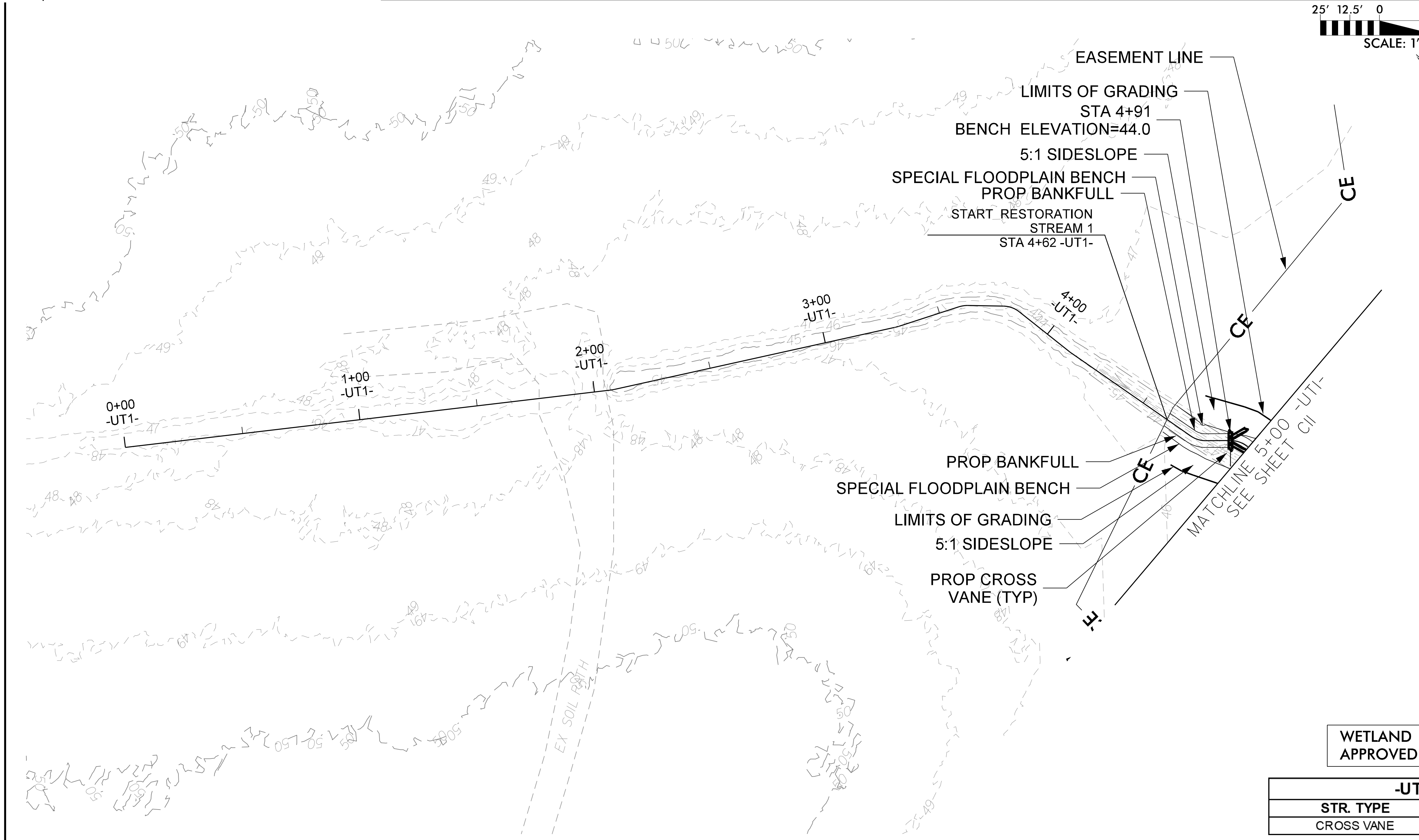
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C09
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS: 11-1-22: FILL IN CHANNEL ADDED

SHEET NO. **C09**

11/4/2022 Cool_Run_Rdy_psh_C09.dgn



DocuSigned by:
Joshua Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

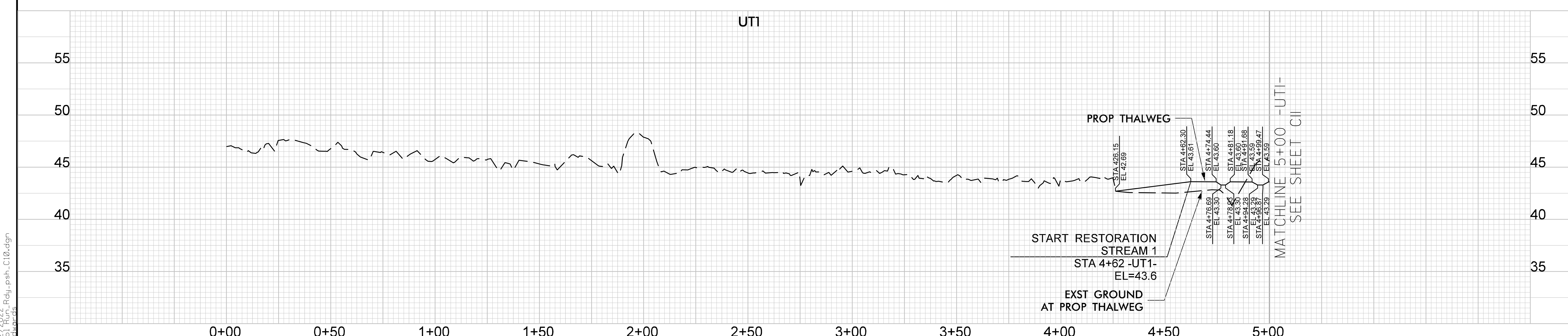
DATE:

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	80,878.22	2,159,664.09	42.70



9/2/2022
Cool Run_Rdy_psh_C10.dgn
mmedwards

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC

PLAN AND PROFILE

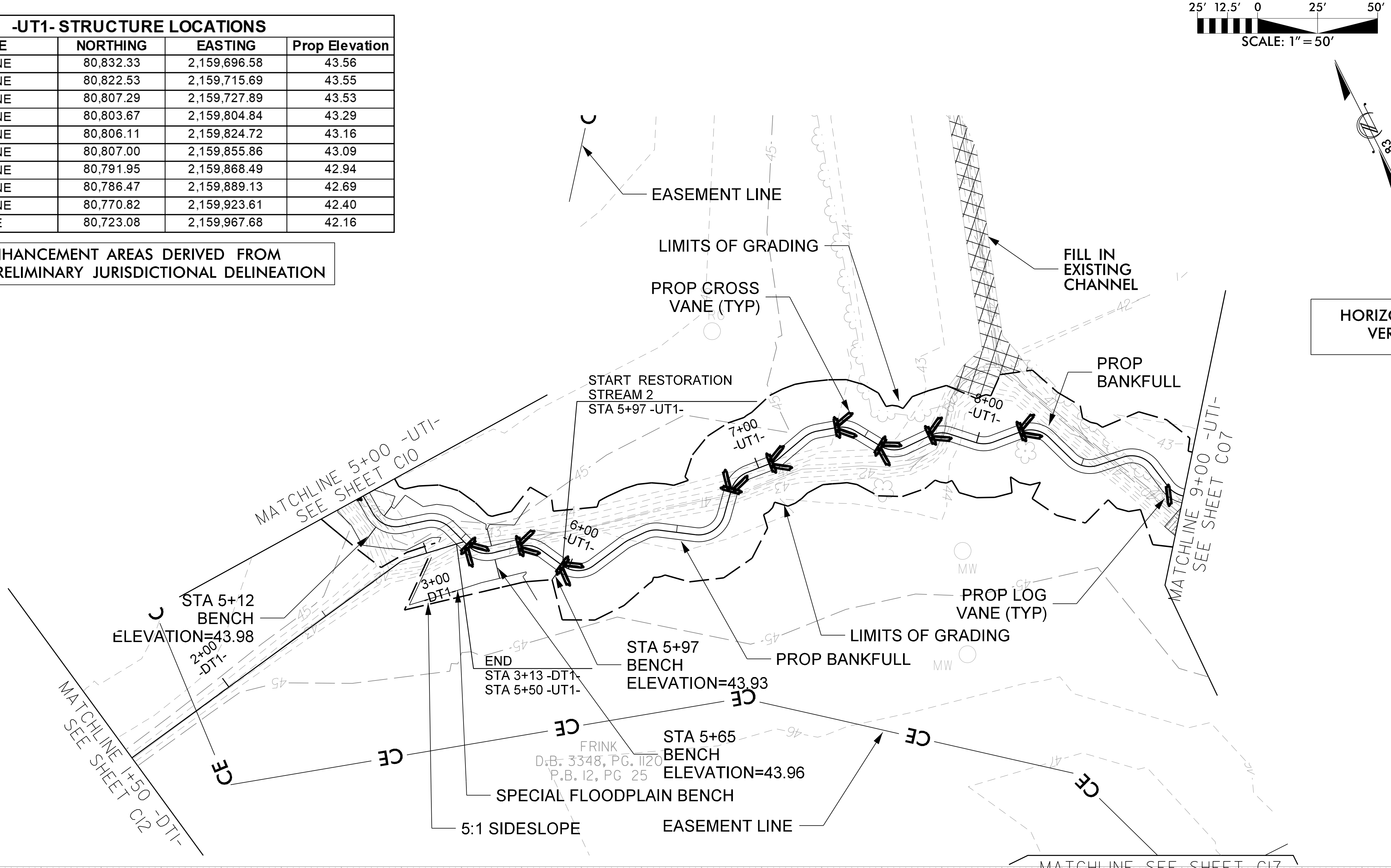
PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C10
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. **C10**

-UT1- STRUCTURE LOCATIONS

STR. TYPE	NORTHING	EASTING	Prop Elevation
CROSS VANE	80,832.33	2,159,696.58	43.56
CROSS VANE	80,822.53	2,159,715.69	43.55
CROSS VANE	80,807.29	2,159,727.89	43.53
CROSS VANE	80,803.67	2,159,804.84	43.29
CROSS VANE	80,806.11	2,159,824.72	43.16
CROSS VANE	80,807.00	2,159,855.86	43.09
CROSS VANE	80,791.95	2,159,868.49	42.94
CROSS VANE	80,786.47	2,159,889.13	42.69
CROSS VANE	80,770.82	2,159,923.61	42.40
LOG VANE	80,723.08	2,159,967.68	42.16

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION



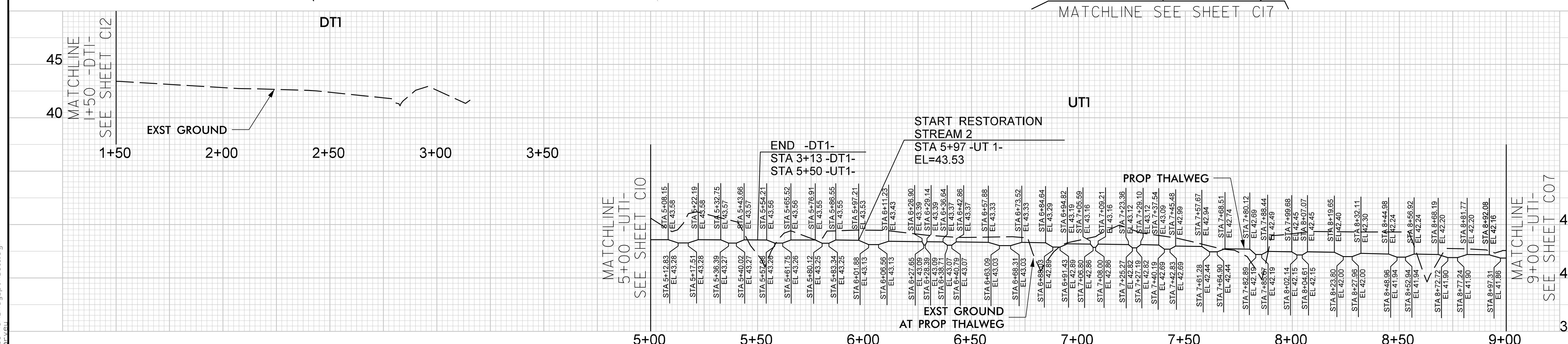
DocuSigned by: Josh Dalton 1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

11/4/2022

DATE:

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988



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

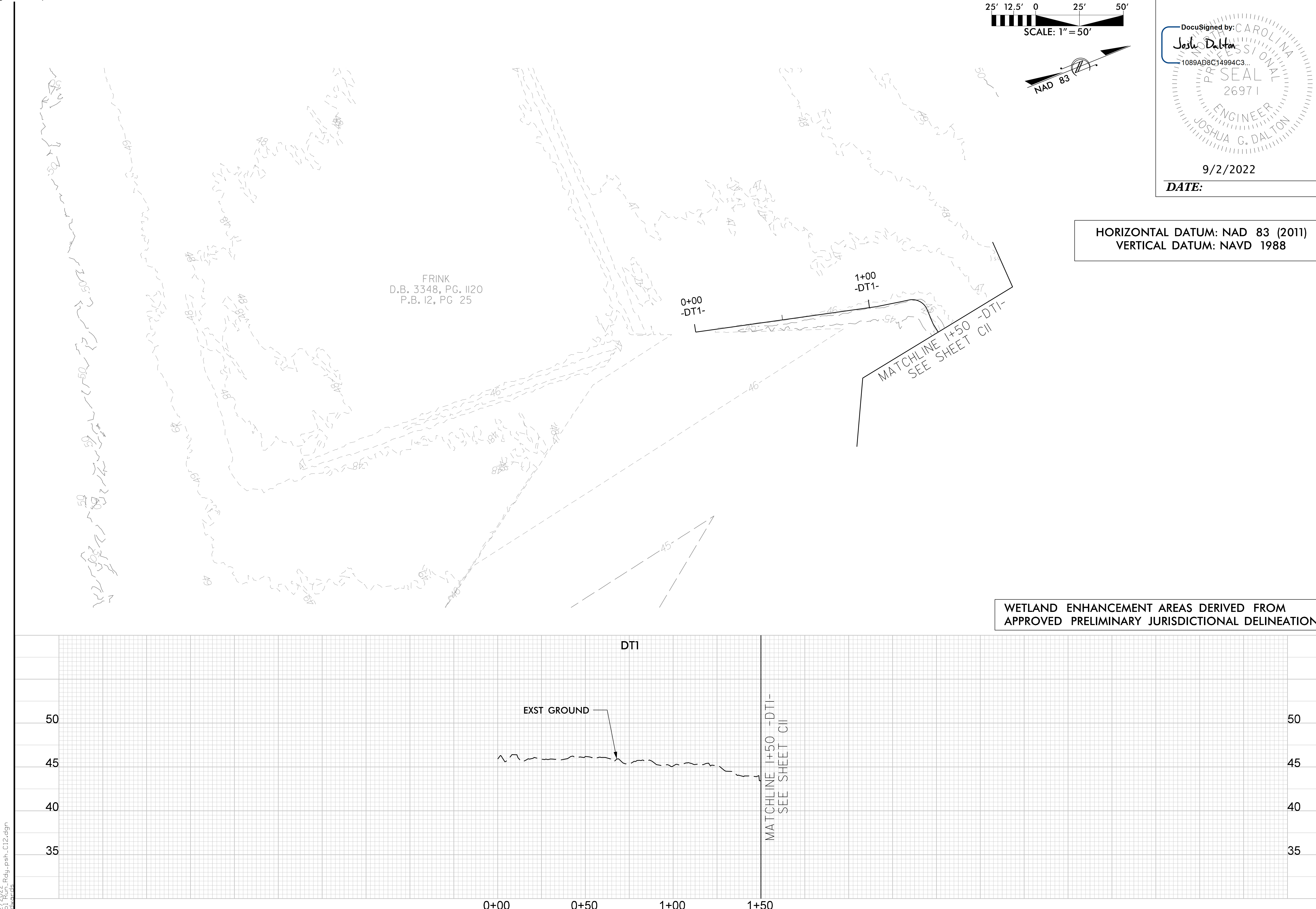
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C11
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS: 11-1-22: REMOVED MARSH TREATMENT AREAS

SHEET NO. C11

11/4/2022 Cool_Run_Rdy_psh_C11.dgn



DocuSigned by: Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

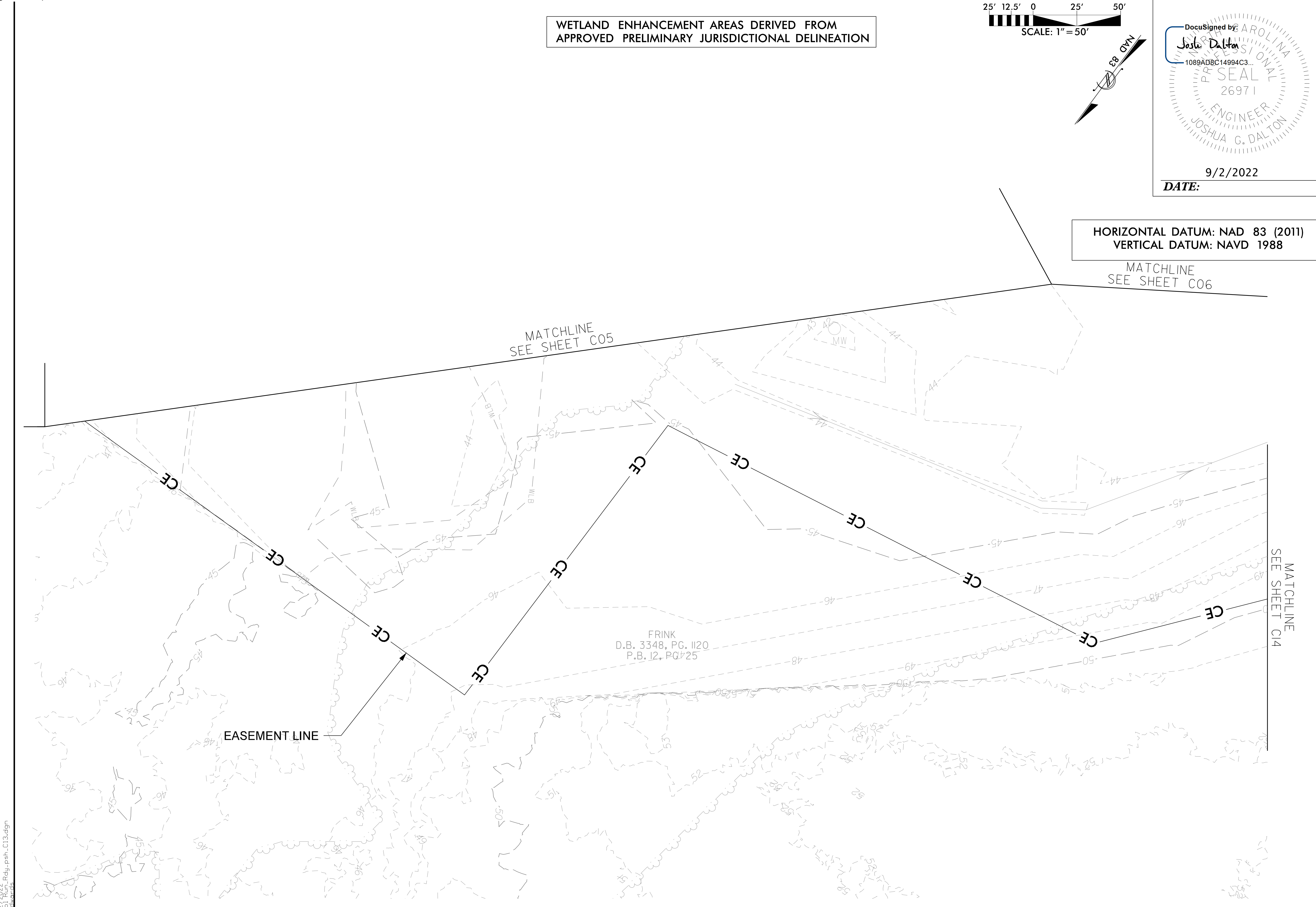
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD
RALEIGH, NORTH CAROLINA 27606
TEL (919) 859-2243
ENG FIRM LICENSE NO. C-890

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN AND PROFILE

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C12
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **C12**

9/2/2022
Cool Run_Rdy-psh_C12.dgn
mrdwards



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

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

Axiom Environmental, Inc.

COOL RUN

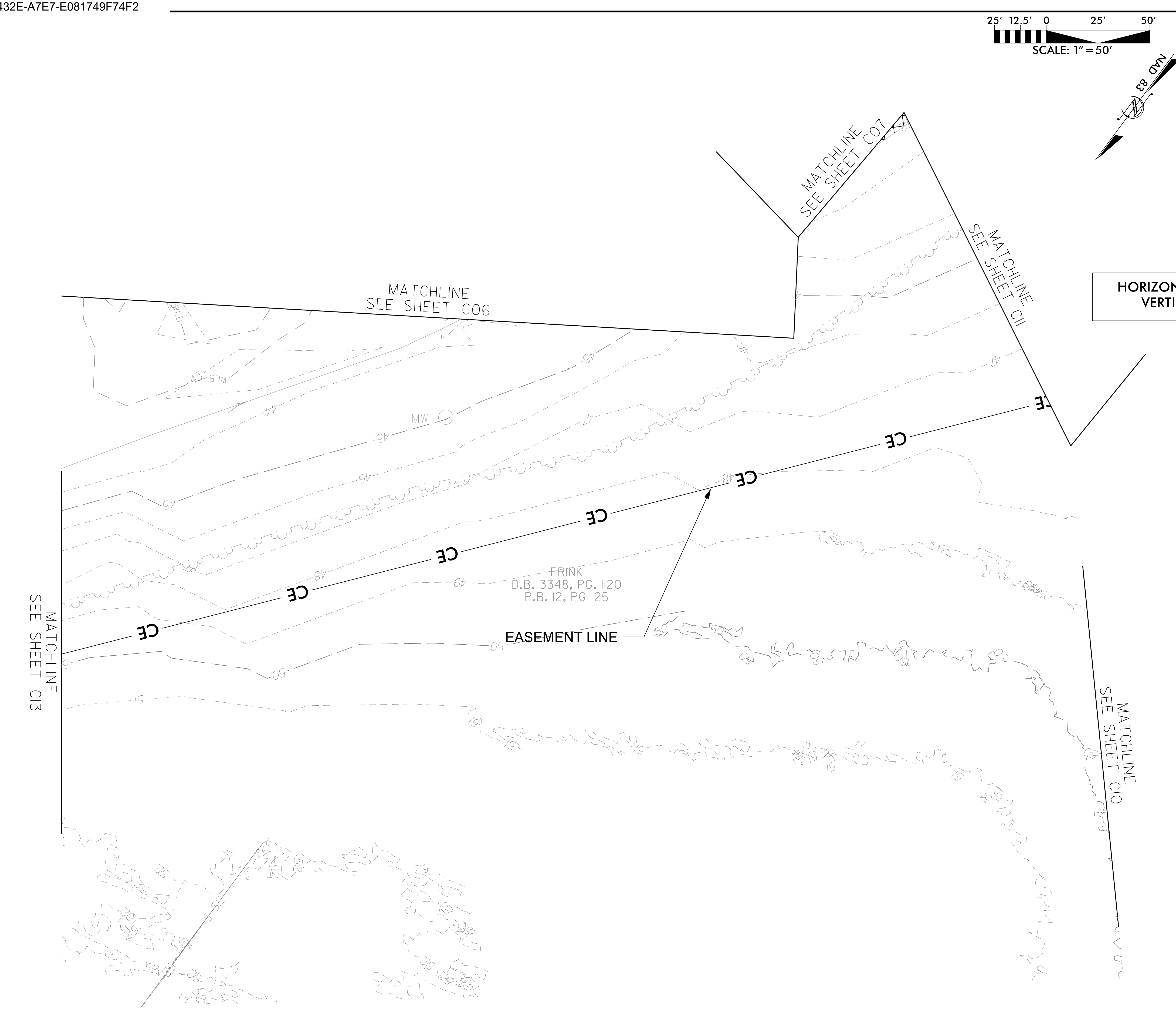
BRUNSWICK COUNTY, NC

PLAN

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C13
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. **C13**

9/2/2022
Cool_Run_Rdy_psh_C13.dgn
medwards



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
PLAN

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH C14
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **C14**

9/2/2022
Cool_Run_Rdy_psh_C14.dgn
medwards

25' 12.5' 0 25' 50'
SCALE: 1" = 50'

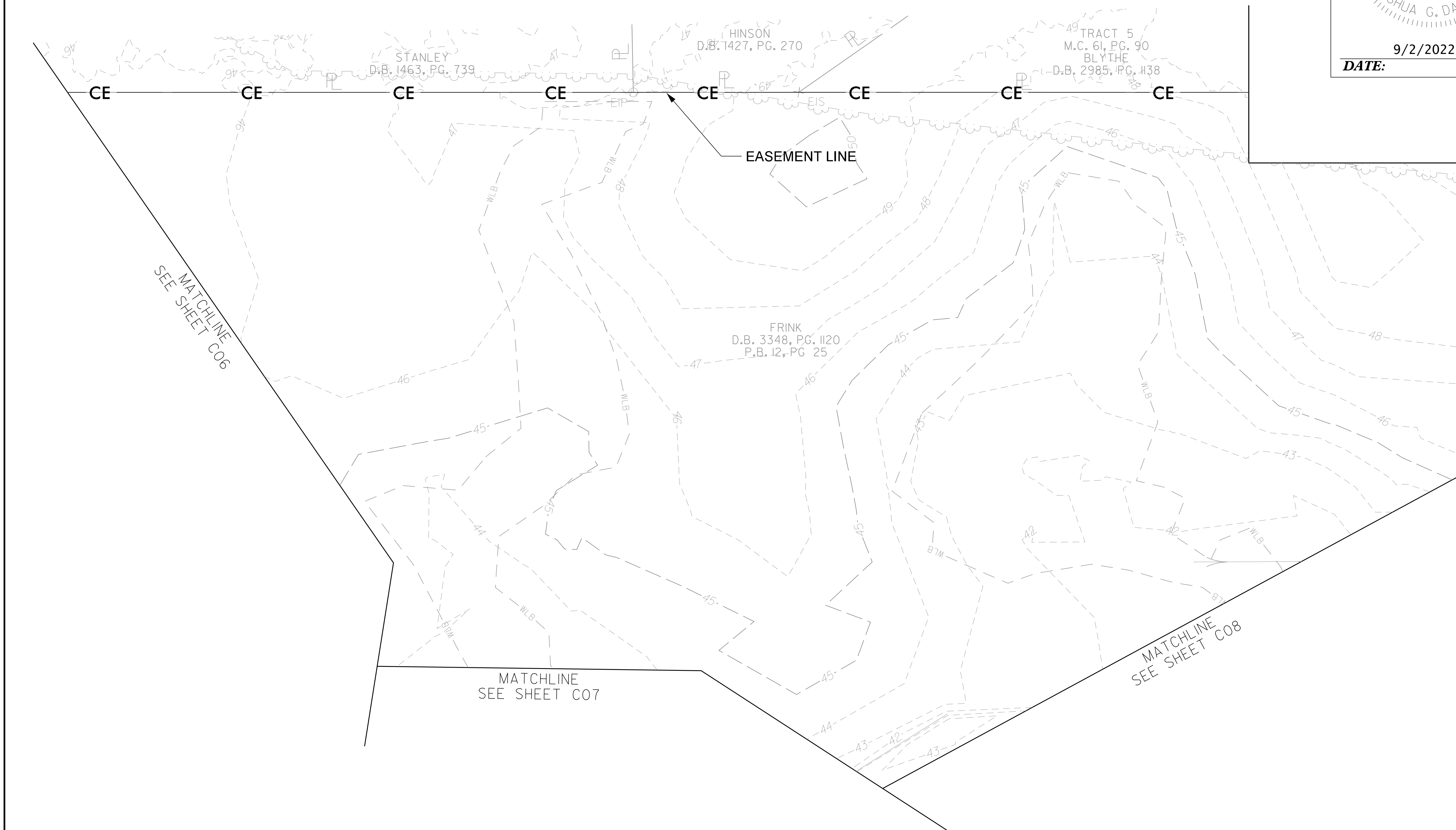
NAD 83

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA
PROFESSIONAL
SEAL
026971
ENGINEER
JOSHUA G. DALTON

9/2/2022
DATE:



WETLAND ENHANCEMENT AREAS DERIVED FROM
APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

9/2/2022
Cool Run_Rdy-psh_C15.dgn
mcedwards

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

Axiom Environmental, Inc.

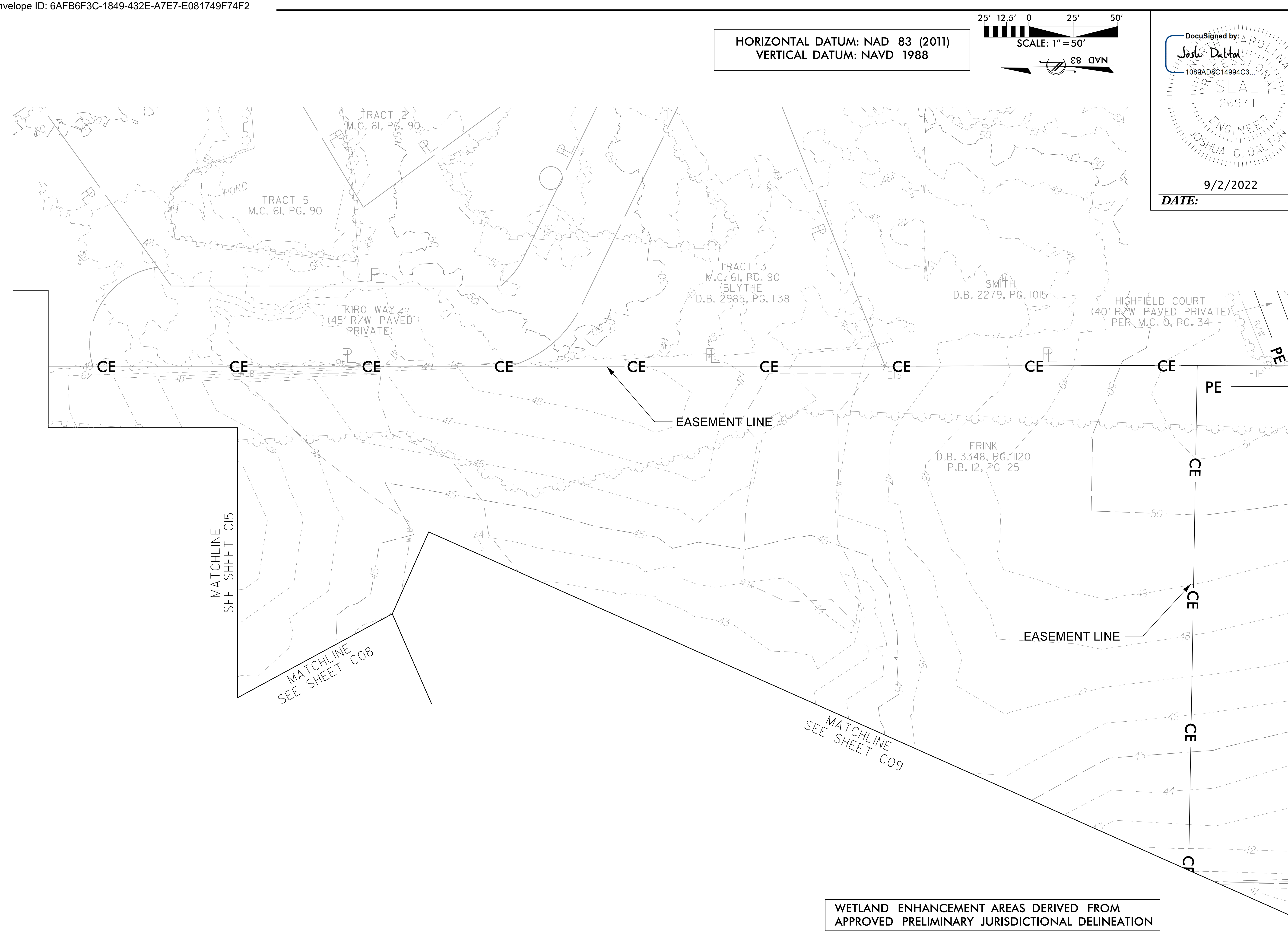
COOL RUN
BRUNSWICK COUNTY, NC

PLAN

PROJECT #:	1221-21015
DRAWING NAME:	COOL RUN PSH C15
DATE:	2022
DRAWN BY:	JRH
REVIEWED BY:	JGD
REVISIONS:	
SHEET NO.	C15

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

SCALE: 1" = 50'



WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

DATE: 9/2/2022

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC

PLAN

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C16
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. **C16**

9/2/2022
Cool_Run_Rdy_psh_C16.dgn
medwards

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

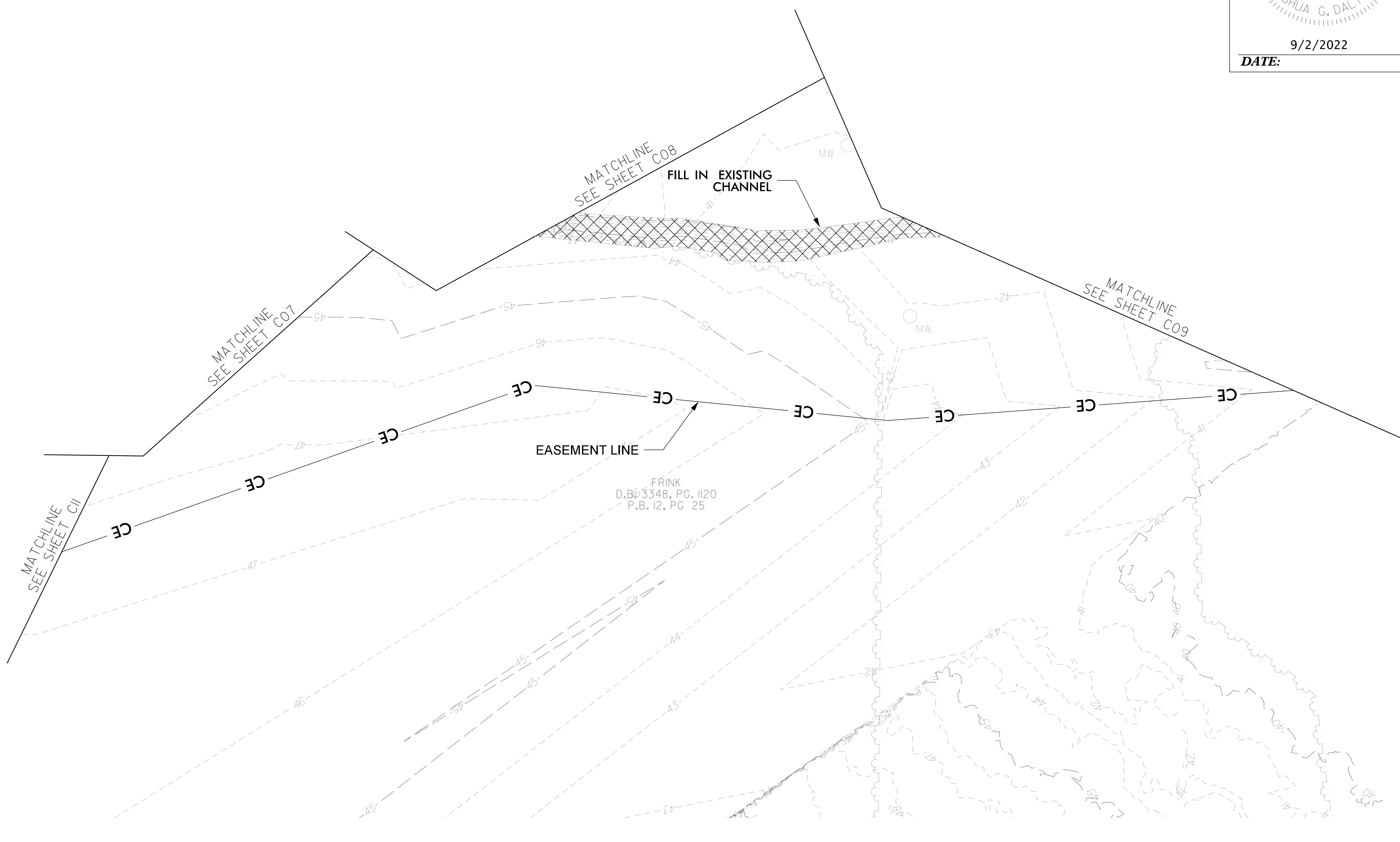
25' 12.5' 0 25' 50'
SCALE: 1" = 50'

WETLAND ENHANCEMENT AREAS DERIVED FROM APPROVED PRELIMINARY JURISDICTIONAL DELINEATION

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

DATE: 9/2/2022



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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC

PLAN

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH C17
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. C17

9/2/2022
Cool_Run_Rdy_psh_C17.dgn
medwards

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

CONSTRUCTION SEQUENCE

Construction Notes:

1. Staging areas, stockpile areas, construction entrances and access roads will be identified and located according to the Erosion Control Plans and landowner agreements. Variances will be allowed assuming both the Contractor and Designer verbally agree.

2. A construction entrance (as shown on sheet E03E) from Secondary Road 1315 (Russtown Rd NW) will be installed for access to CR and UT1 as shown on the Erosion Control Plans.

3. The Contractor will install silt fencing, as noted on the Erosion Control Plans, at applicable staging and stockpile areas.

4. The proposed stream alignment and structure locations will be staked for each reach (CR and UT1). Staking will be restricted to riffle elevations only in order to establish and maintain grade for the entire system. Pools will be excavated once structures are installed.

5. The Contractor will begin stockpiling materials in a designated staging area. General details associated with all sections include:

   a. Sediment bags will be used to filter the groundwater and placed within areas of newly excavated channel that are offline from the existing flow. These bags will be utilized as the contractor or designer deem necessary.
   b. Temporary and permanent seed mixes, including applicable mulching, will be applied to the streambanks and disturbed areas at the end of each working day as definable sections are completed. Erosion control matting will be installed on top of the seed and straw in accordance with the Erosion Control Construction Sequence.
   c. Excavated material that is stockpiled will follow erosion and sediment control guidelines as they relate to material storage and stockpiling.
   d. All remaining disturbed areas are to be seeded and covered according to the Erosion Control Construction Sequence.
   e. Riprap aprons will be constructed to impede any erosion of the channel and streambanks by the water diverted from the pump-around procedure.

6. Boulders and materials used for stream structures will be delivered through the primary construction entrance and stockpiled in the appropriate area.

7. This project will require pumping water around the channels during construction. Work will generally proceed from upstream to downstream.

8. Adjust haul roads and associated silt fence as necessary when permanent stream crossings are installed.

Construction Sequence

1. Schedule a pre-conference with DEQ-DEMLR Wilmington Regional Office prior to the commencement of land disturbing activities on the site. Contact DEQ-DEMLR Wilmington Regional Office at 910-796-7215.

2. The Contractor will excavate the proposed channel and modify portions of the existing channel based on riffle elevations in sections no greater than 300' in length at a time (except where longer sections are necessary to maintain constructability) in an upstream to downstream fashion. Impervious dikes will be installed upstream and downstream of the current work section before work on the section is initiated unless noted otherwise (see Table 1.-Working Sections below for suggested work section stations and progression). Water will be diverted around the current work section through the use of a pump and temporary flexible hose. The current work section will be dewatered using an additional pump and a sediment bag. Work sections that involve the construction of a confluence of two reaches may require the use of two pump-around operations. Structures will be installed according to the details presented in the Construction Plans. Excavate only a portion of the channel that can be completed and stabilized within the same day. All excavated material will be placed in an appropriate stockpile area. Pools will be established once structures and channel alignments have been completed locally. Permanent stream crossings will be installed while the working section containing the crossing has been dewatered.

   Grading of some portions of the proposed floodplain may need to be delayed until after work in subsequent sections has been completed, especially near confluences. Haul roads and temporary silt fence may also need to be removed before the proposed floodplain can be completed and/or unused existing channel can be filled.

Table 1. - Working Sections

Order of Progress	Pump Station #	Reach	Begin Station	End Station	Construction Notes
1	P-1	CR	3+66	6+50	
2	P-2	CR	6+50	9+50	
3	P-3	CR	9+50	12+50	
4	P-4	UT1	4+62	7+00	
5	P-5	UT1	7+00	10+00	
6	P-6	UT1	10+00	10+62	Operate pump stations P-6 and P-7 simultaneously to build confluence of CR and UT1.
7	P-7	CR	12+50	14+00	
8	P-8	CR	14+00	17+00	
9	P-9	CR	17+00	20+00	
10	P-10	CR	20+00	22+00	
11	P-11	CR	22+00	23+83	Construct Drop Structure.

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL NOTES

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E02
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **E02**

CONSTRUCTION SEQUENCE (CONTINUED)

2. At the end of each working day, the Contractor will be responsible for the application of seed and straw, as applicable, to newly established streambanks and disturbed areas. Erosion control matting will be installed on top of the seed and straw in accordance with the Erosion Control Construction Sequence.

Post-Construction
After all channel work has been completed:

1. All remaining disturbed areas are to be seeded and mulched in accordance with the Erosion Control Construction Sequence.
2. Live staking can begin on all completed sections of channel (CR and UT1) in accordance with the Planting Plans.
3. Once channel construction and seeding has been complete, bare-rooted seedlings will be installed.
4. All haul road locations to be restored to pre-construction conditions.

SOIL AMENDMENTS

In lieu of a soil test:

Fertilizer	10 – 10 -10 1000 lb./acre

Mulch

Small grain mulch must be applied at a rate of 2 tons/acre to all seeded areas.

Table 15A - Permanent Seed Mix*

March 1 – October 31						
Species	**Common Name**	**Wetland Indicator Status**	**Unit Type**	**Stratum**	**% of Total**	**lbs per Acre**
Carex vulpinoidea	Fox sedge	FACW	S	Herb	15	35
Andropogon gerardii	Big bluestem	FAC	S	Herb	15	35
Elymus virgatum	Virginia wildrye	FAC	S	Herb	15	35
Panicum virgatum	Switchgrass	FAC	S	Herb	15	35
Juncus effusus	Soft rush	OBL	S	Herb	20	35
Dichanthelium clandestinum	Deertongue	FACW	S	Herb	20	35
				Total	100	

Table 15A - Permanent Seed Mix*

November 1 – February 28						
Species	**Common Name**	**Wetland Indicator Status**	**Unit Type**	**Stratum**	**% of Total**	**lbs per Acre**
Elymus virgatum	Virginia wildrye	FAC	S	Herb	10	35
Dichanthelium clandestinum	Deertongue	FACW	S	Herb	10	35
Carex vulpinoidea	Fox sedge	FACW	S	Herb	5	35
Agrostis hyemalis	Ticklegrass	FAC	S	Herb	15	35
Agrostis perennans	Autumn Bentgrass	FACU	S	Herb	10	35
Juncus effusus	Soft rush	OBL	S	Herb	15	35
Tripsacum dactyloides	Eastern Gamma Grass	FAC	S	Herb	15	35
Eragrostis curvula	Weeping Lovegrass	UPL	S	Herb	10	35
Panicum amarum var. amarulum	Atlantic Coastal Panicgrass	FAC	S	Herb	10	35
				Total	100	

* Primarily utilized in disturbed/graded areas.

Table 15B - Temporary Herbaceous Seed Schedule

Common Name	Application Rate	Application Dates
Grain Rye[A]	130 lbs. per acre	Year – Round
Brown Top Millet[A]	40 lbs. per acre	May - September
German Millet[B]	25 lbs. per acre	May - September

[A] Primarily utilized on disturbed or stockpiled areas.
[B] Primarily utilized near stream channels and streambanks.

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL NOTES

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E02A
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. E02A

9/2/2022 Cool Run_Rdy_psh_E02a.dgn

GROUND STABILIZATION AND MATERIALS HANDLING PRACTICES FOR COMPLIANCE WITH THE NCG01 CONSTRUCTION GENERAL PERMIT

Implementing the details and specifications on this plan sheet will result in the construction activity being considered compliant with the Ground Stabilization and Materials Handling sections of the NCG01 Construction General Permit (Sections E and F, respectively). The permittee shall comply with the Erosion and Sediment Control plan approved by the delegated authority having jurisdiction. All details and specifications shown on this sheet may not apply depending on site conditions and the delegated authority having jurisdiction.

SECTION E: GROUND STABILIZATION

Required Ground Stabilization Timeframes

Site Area Description	Stabilize within this many calendar days after ceasing land disturbance	Timeframe variations
(a) Perimeter dikes, swales, ditches, and perimeter slopes	7	None
(b) High Quality Water (HQW) Zones	7	None
(c) Slopes steeper than 3:1	7	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed
(d) Slopes 3:1 to 4:1	14	-7 days for slopes greater than 50' in length and with slopes steeper than 4:1 -7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones -10 days for Falls Lake Watershed
(e) Areas with slopes flatter than 4:1	14	-7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones -10 days for Falls Lake Watershed unless there is zero slope

Note: After the permanent cessation of construction activities, any areas with temporary ground stabilization shall be converted to permanent ground stabilization as soon as practicable but in no case longer than 90 calendar days after the last land disturbing activity. Temporary ground stabilization shall be maintained in a manner to render the surface stable against accelerated erosion until permanent ground stabilization is achieved.

GROUND STABILIZATION SPECIFICATION

Stabilize the ground sufficiently so that rain will not dislodge the soil. Use one of the techniques in the table below:

Temporary Stabilization	Permanent Stabilization
• Temporary grass seed covered with straw or other mulches and tackifiers • Hydroseeding • Rolled erosion control products with or without temporary grass seed • Appropriately applied straw or other mulch • Plastic sheeting	• Permanent grass seed covered with straw or other mulches and tackifiers • Geotextile fabrics such as permanent soil reinforcement matting • Hydroseeding • Shrubs or other permanent plantings covered with mulch • Uniform and evenly distributed ground cover sufficient to restrain erosion • Structural methods such as concrete, asphalt or retaining walls • Rolled erosion control products with grass seed

POLYACRYLAMIDES (PAMS) AND FLOCCULANTS

1. Select flocculants that are appropriate for the soils being exposed during construction, selecting from the *NC DWR List of Approved PAMS/Flocculants*.
2. Apply flocculants at or before the inlets to Erosion and Sediment Control Measures.
3. Apply flocculants at the concentrations specified in the *NC DWR List of Approved PAMS/Flocculants* and in accordance with the manufacturer's instructions.
4. Provide ponding area for containment of treated Stormwater before discharging offsite.
5. Store flocculants in leak-proof containers that are kept under storm-resistant cover or surrounded by secondary containment structures.

EQUIPMENT AND VEHICLE MAINTENANCE

1. Maintain vehicles and equipment to prevent discharge of fluids.
2. Provide drip pans under any stored equipment.
3. Identify leaks and repair as soon as feasible, or remove leaking equipment from the project.
4. Collect all spent fluids, store in separate containers and properly dispose as hazardous waste (recycle when possible).
5. Remove leaking vehicles and construction equipment from service until the problem has been corrected.
6. Bring used fuels, lubricants, coolants, hydraulic fluids and other petroleum products to a recycling or disposal center that handles these materials.

LITTER, BUILDING MATERIAL AND LAND CLEARING WASTE

1. Never bury or burn waste. Place litter and debris in approved waste containers.
2. Provide a sufficient number and size of waste containers (e.g dumpster, trash receptacle) on site to contain construction and domestic wastes.
3. Locate waste containers at least 50 feet away from storm drain inlets and surface waters unless no other alternatives are reasonably available.
4. Locate waste containers on areas that do not receive substantial amounts of runoff from upland areas and does not drain directly to a storm drain, stream or wetland.
5. Cover waste containers at the end of each workday and before storm events or provide secondary containment. Repair or replace damaged waste containers.
6. Anchor all lightweight items in waste containers during times of high winds.
7. Empty waste containers as needed to prevent overflow. Clean up immediately if containers overflow.
8. Dispose waste off-site at an approved disposal facility.
9. On business days, clean up and dispose of waste in designated waste containers.

PAINT AND OTHER LIQUID WASTE

1. Do not dump paint and other liquid waste into storm drains, streams or wetlands.
2. Locate paint washouts at least 50 feet away from storm drain inlets and surface waters unless no other alternatives are reasonably available.
3. Contain liquid wastes in a controlled area.
4. Containment must be labeled, sized and placed appropriately for the needs of site.
5. Prevent the discharge of soaps, solvents, detergents and other liquid wastes from construction sites.

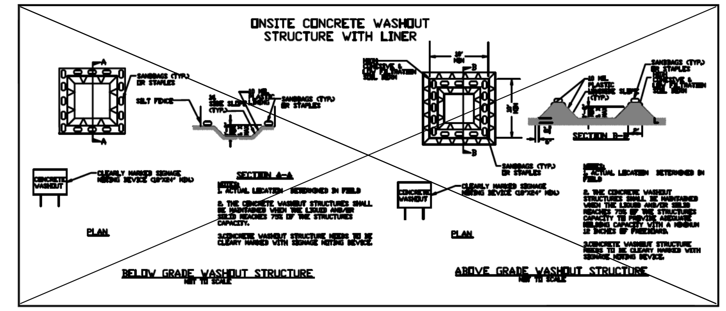
PORTABLE TOILETS

1. Install portable toilets on level ground, at least 50 feet away from storm drains, streams or wetlands unless there is no alternative reasonably available. If 50 foot offset is not attainable, provide relocation of portable toilet behind silt fence or place on a gravel pad and surround with sand bags.
2. Provide staking or anchoring of portable toilets during periods of high winds or in high foot traffic areas.
3. Monitor portable toilets for leaking and properly dispose of any leaked material. Utilize a licensed sanitary waste hauler to remove leaking portable toilets and replace with properly operating unit.

EARTHEN STOCKPILE MANAGEMENT

1. Show stockpile locations on plans. Locate earthen-material stockpile areas at least 50 feet away from storm drain inlets, sediment basins, perimeter sediment controls and surface waters unless it can be shown no other alternatives are reasonably available.
2. Protect stockpile with silt fence installed along toe of slope with a minimum offset of five feet from the toe of stockpile.
3. Provide stable stone access point when feasible.
4. Stabilize stockpile within the timeframes provided on this sheet and in accordance with the approved plan and any additional requirements. Soil stabilization is defined as vegetative, physical or chemical coverage techniques that will restrain accelerated erosion on disturbed soils for temporary or permanent control needs.

NORTH CAROLINA
Environmental Quality



CONCRETE WASHOUTS

1. Do not discharge concrete or cement slurry from the site.
2. Dispose of, or recycle settled, hardened concrete residue in accordance with local and state solid waste regulations and at an approved facility.
3. Manage washout from mortar mixers in accordance with the above item and in addition place the mixer and associated materials on impervious barrier and within lot perimeter silt fence.
4. Install temporary concrete washouts per local requirements, where applicable. If an alternate method or product is to be used, contact your approval authority for review and approval. If local standard details are not available, use one of the two types of temporary concrete washouts provided on this detail.
5. Do not use concrete washouts for dewatering or storing defective curb or sidewalk sections. Stormwater accumulated within the washout may not be pumped into or discharged to the storm drain system or receiving surface waters. Liquid waste must be pumped out and removed from project.
6. Locate washouts at least 50 feet from storm drain inlets and surface waters unless it can be shown that no other alternatives are reasonably available. At a minimum, install protection of storm drain inlet(s) closest to the washout which could receive spills or overflow.
7. Locate washouts in an easily accessible area, on level ground and install a stone entrance pad in front of the washout. Additional controls may be required by the approving authority.
8. Install at least one sign directing concrete trucks to the washout within the project limits. Post signage on the washout itself to identify this location.
9. Remove leavings from the washout when at approximately 75% capacity to limit overflow events. Replace the tarp, sand bags or other temporary structural components when no longer functional. When utilizing alternative or proprietary products, follow manufacturer's instructions.
10. At the completion of the concrete work, remove remaining leavings and dispose of in an approved disposal facility. Fill pit, if applicable, and stabilize any disturbance caused by removal of washout.

HERBICIDES, PESTICIDES AND RODENTICIDES

1. Store and apply herbicides, pesticides and rodenticides in accordance with label restrictions.
2. Store herbicides, pesticides and rodenticides in their original containers with the label, which lists directions for use, ingredients and first aid steps in case of accidental poisoning.
3. Do not store herbicides, pesticides and rodenticides in areas where flooding is possible or where they may spill or leak into wells, stormwater drains, ground water or surface water. If a spill occurs, clean area immediately.
4. Do not stockpile these materials onsite.

HAZARDOUS AND TOXIC WASTE

1. Create designated hazardous waste collection areas on-site.
2. Place hazardous waste containers under cover or in secondary containment.
3. Do not store hazardous chemicals, drums or bagged materials directly on the ground.

NCG01 GROUND STABILIZATION AND MATERIALS HANDLING | EFFECTIVE: 04/01/19

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL NOTES

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH E02B
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. **E02B**

9/2/2022
Cool Run_Rdy_psh_E02b.dgn
mpdwards

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION A: SELF-INSPECTION

Self-inspections are required during normal business hours in accordance with the table below. When adverse weather or site conditions would cause the safety of the inspection personnel to be in jeopardy, the inspection may be delayed until the next business day on which it is safe to perform the inspection. In addition, when a storm event of equal to or greater than 1.0 inch occurs outside of normal business hours, the self-inspection shall be performed upon the commencement of the next business day. Any time when inspections were delayed shall be noted in the Inspection Record.

Inspect	Frequency (during normal business hours)	Inspection records must include:
(1) Rain gauge maintained in good working order	Daily	Daily rainfall amounts. If no daily rain gauge observations are made during weekend or holiday periods, and no individual-day rainfall information is available, record the cumulative rain measurement for those un-attended days (anc this will determine if a site inspection is needed). Days on which no rainfall occurred shall be recorded as "zero." The permittee may use another rain-monitoring device approved by the Division.
(2) E&SC Measures	At least once per 7 calendar days and within 24 hours of a rain event $\geq$ 1.0 inch in 24 hours	1. Identification of the measures inspected, 2. Date and time of the inspection, 3. Name of the person performing the inspection, 4. Indication of whether the measures were operating properly, 5. Description of maintenance needs for the measure, 6. Description, evidence, and date of corrective actions taken.
(3) Stormwater discharge outfalls (SDCs)	At least once per 7 calendar days and within 24 hours of a rain event $\geq$ 1.0 inch in 24 hours	1. Identification of the discharge outfalls inspected, 2. Date and time of the inspection, 3. Name of the person performing the inspection, 4. Evidence of indicators of stormwater pollution such as oil sheen, floating or suspended solids or discoloration, 5. Indication of visible sediment leaving the site, 6. Description, evidence, and date of corrective actions taken.
(4) Perimeter of site	At least once per 7 calendar days and within 24 hours of a rain event $\geq$ 1.0 inch in 24 hours	If visible sedimentation is found outside site limits, then a record of the following shall be made: 1. Actions taken to clean up or stabilize the sediment that has left the site limits, 2. Description, evidence, and date of corrective actions taken, and 3. An explanation as to the actions taken to control future releases.
(5) Streams or wetlands onsite or offsite (where accessible)	At least once per 7 calendar days and within 24 hours of a rain event $\geq$ 1.0 inch in 24 hours	If the stream or wetland has increased visible sedimentation or a stream has visible increased turbidity from the construction activity, then a record of the following shall be made: 1. Description, evidence and date of corrective actions taken, and 2. Records of the required reports to the appropriate Division Regional Office per Part III, Section C, Item (2)(a) of this permit.
(6) Ground stabilization measures	After each phase of grading	1. The phase of grading (installation of perimeter E&SC measures, clearing and grubbing, installation of storm drainage facilities, completion of all land-disturbing activity, construction or redevelopment, permanent ground cover). 2. Documentation that the required ground stabilization measures have been provided within the required timeframe or an assurance that they will be provided as soon as possible.

NOTE: The rain inspection resets the required 7 calendar day inspection requirement.

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION B: RECORDKEEPING

1. E&SC Plan Documentation

The approved E&SC plan as well as any approved deviation shall be kept on the site. The approved E&SC plan must be kept up-to-date throughout the coverage under this permit. The following items pertaining to the E&SC plan shall be kept on site and available for inspection at all times during normal business hours.

Item to Document	Documentation Requirements
(a) Each E&SC measure has been installed and does not significantly deviate from the locations, dimensions and relative elevations shown on the approved E&SC plan.	Initial and date each E&SC measure on a copy of the approved E&SC plan or complete, date and sign an inspection report that lists each E&SC measure shown on the approved E&SC plan. This documentation is required upon the initial installation of the E&SC measures or if the E&SC measures are modified after initial installation.
(b) A phase of grading has been completed.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate completion of the construction phase.
(c) Ground cover is located and installed in accordance with the approved E&SC plan.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate compliance with approved ground cover specifications.
(d) The maintenance and repair requirements for all E&SC measures have been performed.	Complete, date and sign an inspection report.
(e) Corrective actions have been taken to E&SC measures.	Initial and date a copy of the approved E&SC plan or complete, date and sign an inspection report to indicate the completion of the corrective action.

2. Additional Documentation to be Kept on Site

In addition to the E&SC plan documents above, the following items shall be kept on the site and available for inspectors at all times during normal business hours, unless the Division provides a site-specific exemption based on unique site conditions that make this requirement not practical:

(a) This General Permit as well as the Certificate of Coverage, after it is received.

(b) Records of inspections made during the previous twelve months. The permittee shall record the required observations on the Inspection Record Form provided by the Division or a similar inspection form that includes all the required elements. Use of electronically-available records in lieu of the required paper copies will be allowed if shown to provide equal access and utility as the hard-copy records.

3. Documentation to be Retained for Three Years

All data used to complete the e-NOI and all inspection records shall be maintained for a period of three years after project completion and made available upon request. [40 CFR 122.41]

PART III
SELF-INSPECTION, RECORDKEEPING AND REPORTING

SECTION C: REPORTING

1. Occurrences that Must be Reported

Permittees shall report the following occurrences:

(a) Visible sediment deposition in a stream or wetland.

(b) Oil spills if:

- They are 25 gallons or more,
- They are less than 25 gallons but cannot be cleaned up within 24 hours,
- They cause sheen on surface waters (regardless of volume), or
- They are within 100 feet of surface waters (regardless of volume).

(c) Releases of hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (Ref: 40 CFR 110.3 and 40 CFR 117.3) or Section 102 of CERCLA (Ref: 40 CFR 302.4) or G.S. 143-215.85.

(d) Anticipated bypasses and unanticipated bypasses.

(e) Noncompliance with the conditions of this permit that may endanger health or the environment.

2. Reporting Timeframes and Other Requirements

After a permittee becomes aware of an occurrence that must be reported, he shall contact the appropriate Division regional office within the timeframes and in accordance with the other requirements listed below. Occurrences outside normal business hours may also be reported to the Department's Environmental Emergency Center personnel at (800) 858-0368.

Occurrence	Reporting Timeframes (After Discovery) and Other Requirements
(a) Visible sediment deposition in a stream or wetland	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days***, a report that contains a description of the sediment and actions taken to address the cause of the deposition. Division staff may waive the requirement for a written report on a case-by-case basis. • If the stream is named on the NC 303(d) list as impaired for sediment-related causes, the permittee may be required to perform additional monitoring, inspections or apply more stringent practices if staff determine that additional requirements are needed to assure compliance with the federal or state impaired-waters conditions.
(b) Oil spills and release of hazardous substances per Item 1(b)-(c) above	• ***Within 24 hours***, an oral or electronic notification. The notification shall include information about the date, time, nature, volume and location of the spill or release.
(c) Anticipated bypasses [40 CFR 122.41(m)(3)]	• ***A report at least ten days before the date of the bypass, if possible***. The report shall include an evaluation of the anticipated quality and effect of the bypass.
(d) Unanticipated bypasses [40 CFR 122.41(m)(3)]	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days,*** a report that includes an evaluation of the quality and effect of the bypass.
(e) Noncompliance with the conditions of this permit that may endanger health or the environment[40 CFR 122.41(l)(7)]	• ***Within 24 hours***, an oral or electronic notification. • ***Within 7 calendar days***, a report that contains a description of the noncompliance, and its causes; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time noncompliance is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. [40 CFR 122.41(l)(6). • Division staff may waive the requirement for a written report on a case-by-case basis.

PART II, SECTION G, ITEM (4)
DRAW DOWN OF SEDIMENT BASINS FOR MAINTENANCE OR CLOSE OUT

Sediment basins and traps that receive runoff from drainage areas of one acre or more shall use outlet structures that withdraw water from the surface when these devices need to be drawn down for maintenance or close out unless this is infeasible. The circumstances in which it is not feasible to withdraw water from the surface shall be rare (for example, times with extended cold weather). Non-surface withdrawals from sediment basins shall be allowed only when all of the following criteria have been met:

(a) The E&SC plan authority has been provided with documentation of the non-surface withdrawal and the specific time periods or conditions in which it will occur. The non-surface withdrawal shall not commence until the E&SC plan authority has approved these items,

(b) The non-surface withdrawal has been reported as an anticipated bypass in accordance with Part III, Section C, Item (2)(c) and (d) of this permit,

(c) Dewatering discharges are treated with controls to minimize discharges of pollutants from stormwater that is removed from the sediment basin. Examples of appropriate controls include properly sited, designed and maintained dewatering tanks, weir tanks, and filtration systems,

(d) Vegetated, upland areas of the sites or a properly designed stone pad is used to the extent feasible at the outlet of the dewatering treatment devices described in Item (c) above,

(e) Velocity dissipation devices such as check dams, sediment traps, and riprap are provided at the discharge points of all dewatering devices, and

(f) Sediment removed from the dewatering treatment devices described in Item (c) above is disposed of in a manner that does not cause deposition of sediment into waters of the United States.

NORTH CAROLINA
Environmental Quality

NCG01 SELF-INSPECTION, RECORDKEEPING AND REPORTING

EFFECTIVE: 04/01/19

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA
PROFESSIONAL
SEAL
26971
ENGINEER
JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

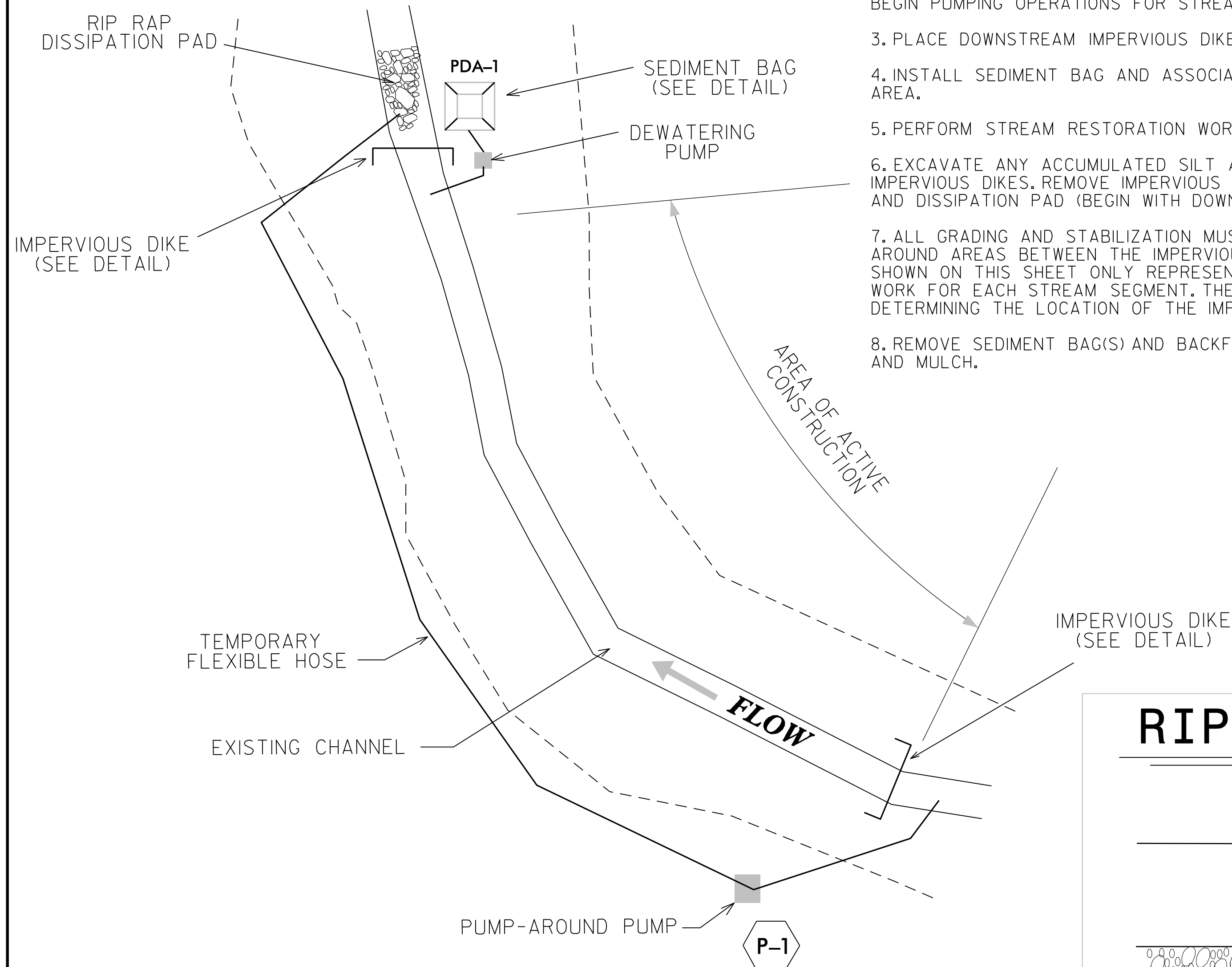
COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL NOTES

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E02C
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. E02C

CONSTRUCTION SEQUENCE FOR TYPICAL PUMP-AROUND:

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

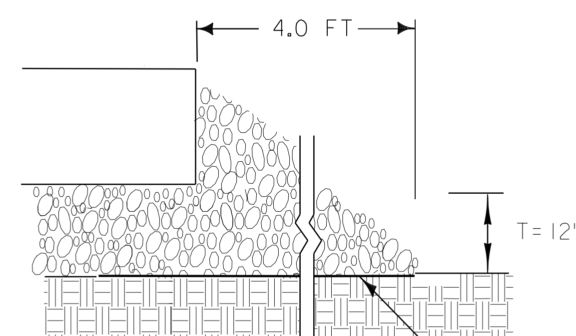


NOTES:

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

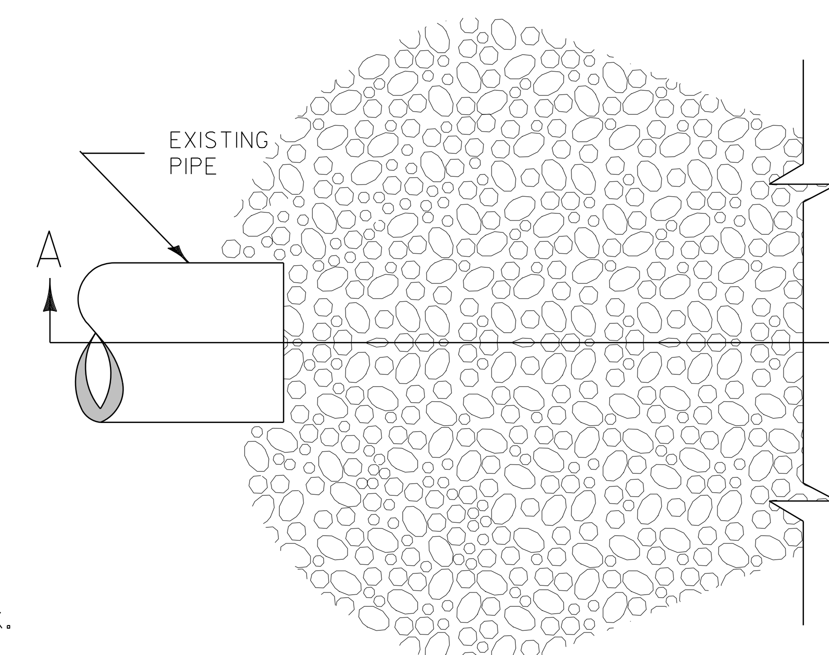
TYPICAL PUMP-AROUND OPERATION

RIPRAP DISSIPATION PAD



SECTION A-A

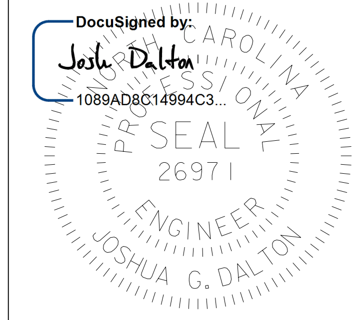
PLAN VIEW



NOTES:

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

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



9/2/2022

DATE:

SUNGATE DESIGN GROUP, P.A.

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

Axiom Environmental, Inc.

COOL RUN

BRUNSWICK COUNTY, NC

EROSION CONTROL DETAILS

PROJECT #: 1221-21015

DRAWING NAME: COOL RUN PSH E03

DATE: 2022

DRAWN BY: JRH

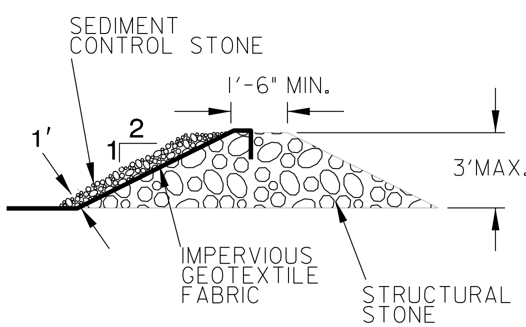
REVIEWED BY: JGD

REVISIONS:

SHEET NO. E03

9/2/2022 Cool Run_Rdy_psh_E03.dgn

IMPERVIOUS DIKE



CROSS SECTION VIEW

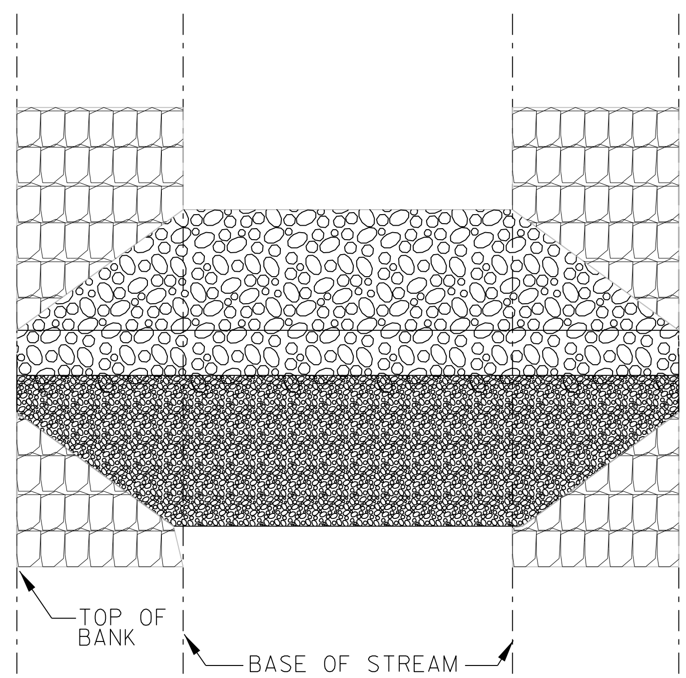
NOTES:
1. USE CLASS B STONE FOR STRUCTURAL STONE.

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

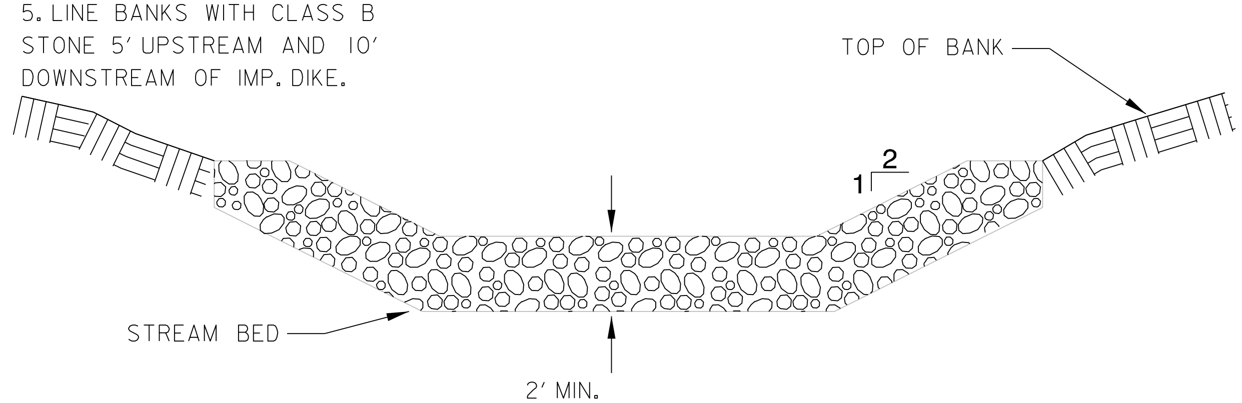
3. CONSTRUCT DAM A MAXIMUM OF 1 FT. ABOVE NORMAL FLOW DEPTH.

4. TOE IN IMPERVIOUS MATERIAL

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

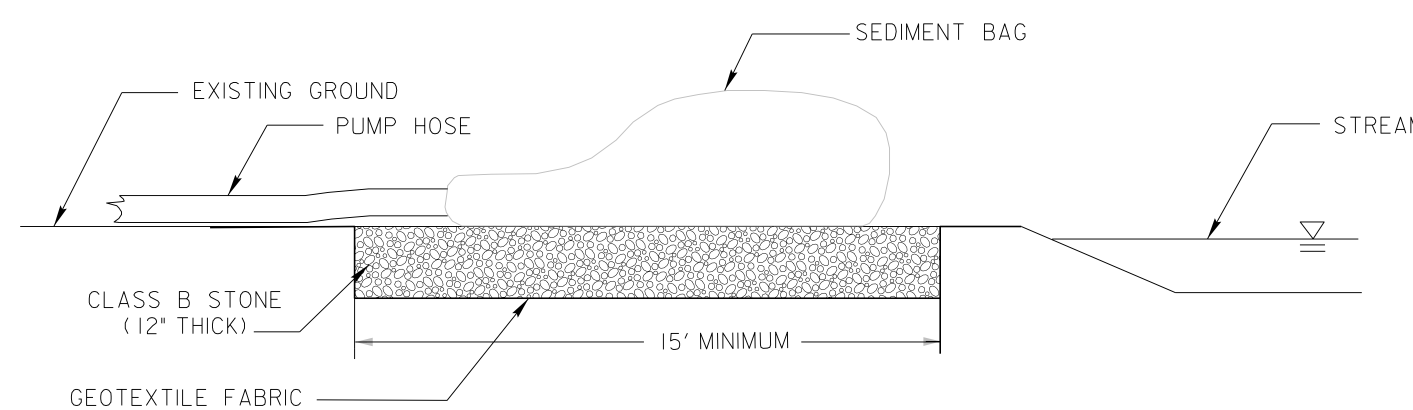


TOP VIEW



FRONT VIEW

SEDIMENT BAG



INSTALLATION:

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

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

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

4. REFER TO DETAIL REGARDING GEOTEXTILE FABRIC ATTRIBUTES.

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL DETAILS

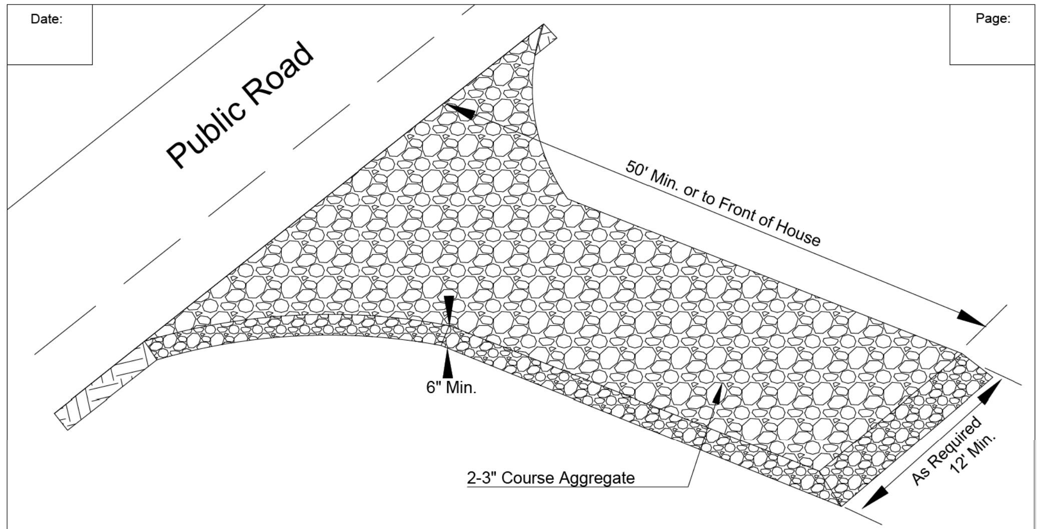
PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E03A
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO.
E03A

9/2/2022
Cool_Run_Rdy_psh_E03a.dgn
mpdwards

Date:

Page:



Construction:
1. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade it.
2. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.
3. Provide drainage to carry water to a sediment trap or other suitable outlet.
4. Use geotextile fabrics in order to improve stability of the foundation in locations subject to seepage or high water table.

Maintenance:
1. Per NCG-01 inspect at least once a week and after each 1 inch or greater rainfall; make any required repairs immediately.
2. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2 inch stone.
3. Immediately remove all objectionable materials spilled, washed or tracked onto public roadways.

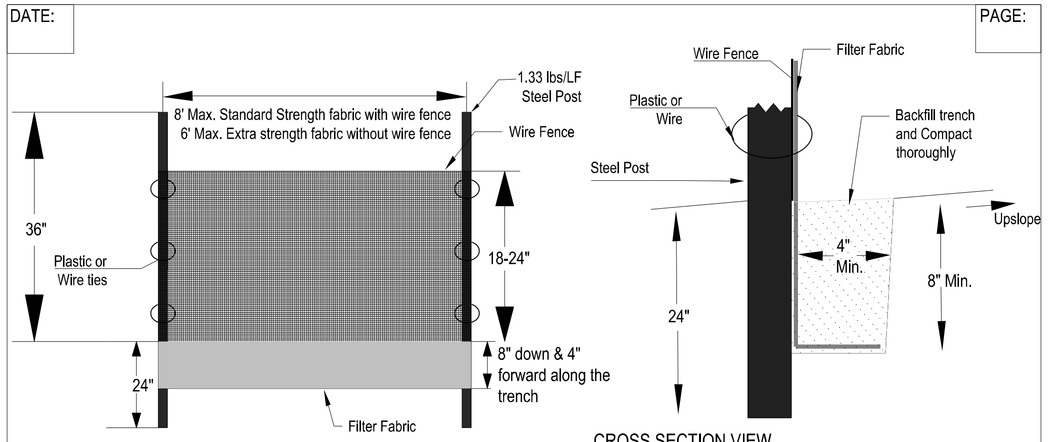
NORTH CAROLINA Environmental Quality

EFFECTIVE DATE: 11/12/2020

CONSTRUCTION ENTRANCE / EXIT

DATE:

PAGE:



CROSS SECTION VIEW

SCALE: N.T.S.

Construction:
1. Construct the sediment barrier of standard strength or extra strength synthetic filter fabrics.
2. Ensure that the height of the sediment fence does not exceed 24 inches above the ground. (Higher fences may impound volumes of water sufficient to cause failure of the structure)
3. Construct the filter fabric from a continuous roll cut to the length of the barrier to avoid joints. When joints are necessary, securely fasten the filter cloth only at a support post with 4 feet minimum overlap to the next post.
4. Support standard strength filter fabric by wire mesh fastened securely to the upslope side of the posts. Extend the wire mesh support to the bottom of the trench. Fasten the wire reinforcement, then fabric on the upslope side of the fence post. Wire or plastic zip ties should have a minimum 50 pound tensile strength.
5. When a wire mesh support fence is used, space posts a maximum of 8 feet apart. Supports should be driven securely into the ground a minimum of 24 inches.
6. Extra strength filter fabric with 6 foot post spacing does not require a wire mesh support fence. Securely fasten the filter fabric directly to posts. Wire or plastic zip ties should have a minimum of 50 pound tensile strength.
7. Excavate the trench approximately 4 inches wide and 8 inches deep along the proposed line of the posts and upslope from the barrier.
8. Place 12 inches of fabric along the bottom and side of the trench.
9. Backfill the trench with soil placed over the filter fabric and compact. Thorough compaction of the backfill is critical to silt fence performance.
10. Do not attach filter fabric to existing trees.

Maintenance:
1. Inspect sediment fences at least once a week and after each 1 inch or greater rainfall. Make any required repairs immediately.
2. Should the fabric of a sediment fence collapse, tear, decompose, or become ineffective, replace it promptly.
3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and reduce pressure on the fence. Take care to avoid undermining the fence during cleanouts.
4. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized.

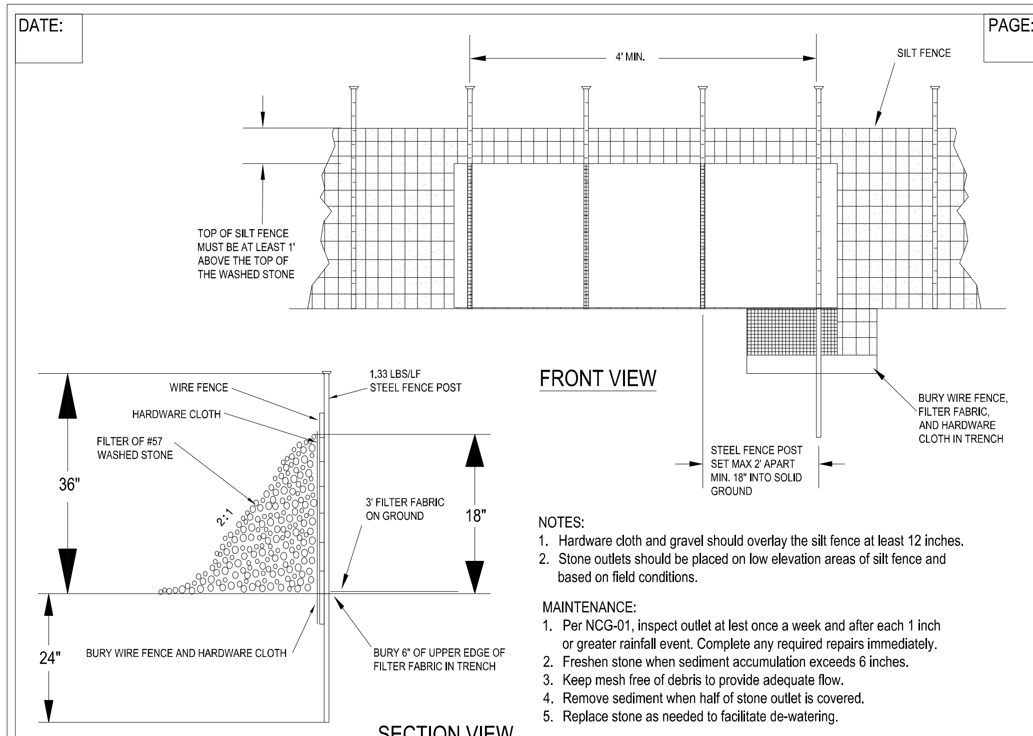
NORTH CAROLINA Environmental Quality

EFFECTIVE DATE: 11/12/2020

SILT FENCE

DATE:

PAGE:



FRONT VIEW

SECTION VIEW

NOTES:
1. Hardware cloth and gravel should overlay the silt fence at least 12 inches.
2. Stone outlets should be placed on low elevation areas of silt fence and based on field conditions.

MAINTENANCE:
1. Per NCG-01, inspect outlet at lest once a week and after each 1 inch or greater rainfall event. Complete any required repairs immediately.
2. Freshen stone when sediment accumulation exceeds 6 inches.
3. Keep mesh free of debris to provide adequate flow.
4. Remove sediment when half of stone outlet is covered.
5. Replace stone as needed to facilitate de-watering.

NORTH CAROLINA Environmental Quality

EFFECTIVE DATE: 11/12/2020

SILT FENCE OUTLET

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

SUNGATE DESIGN GROUP, P.A.

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

Axiom Environmental, Inc.

COOL RUN

BRUNSWICK COUNTY, NC

EROSION CONTROL DETAILS

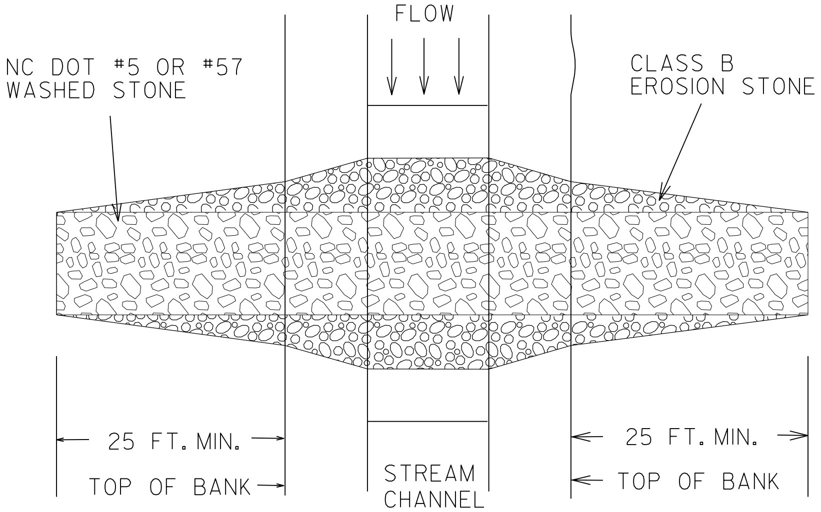
PROJECT # :	1221-21015
DRAWING NAME:	COOL RUN PSH E03B
DATE:	2022
DRAWN BY:	JRH
REVIEWED BY:	JGD
REVISIONS:	
SHEET NO.	E03B

9/2/2022
Cool Run_Rdy_psh_E03b.dgn
medwards

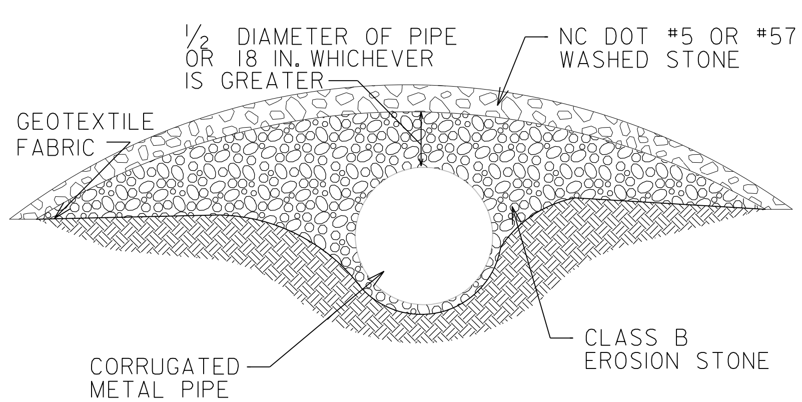
DocuSign Envelope ID: 6AFB6F3C-1849-432E-A7E7-E081749F74F2

TEMPORARY CULVERTED STREAM CROSSING

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

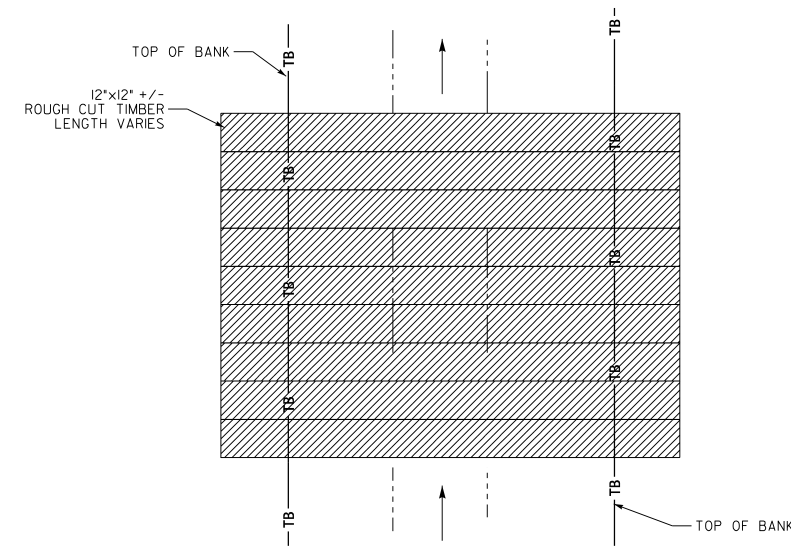


PLAN VIEW



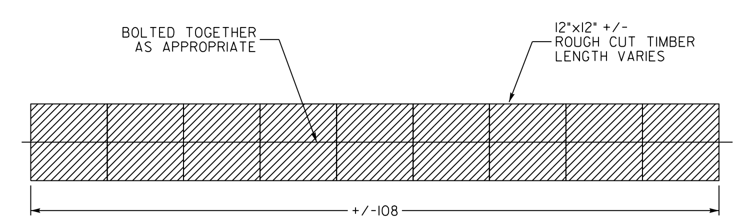
PROFILE VIEW

LOG MAT BRIDGE

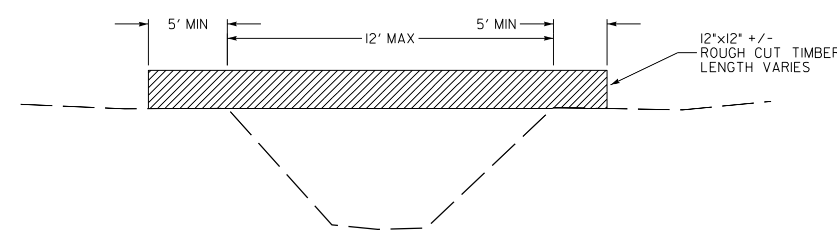


PLAN VIEW

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



SECTION THROUGH LOG MAT BRIDGE



CROSS SECTION VIEW

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

SUNGATE DESIGN GROUP, P.A.

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

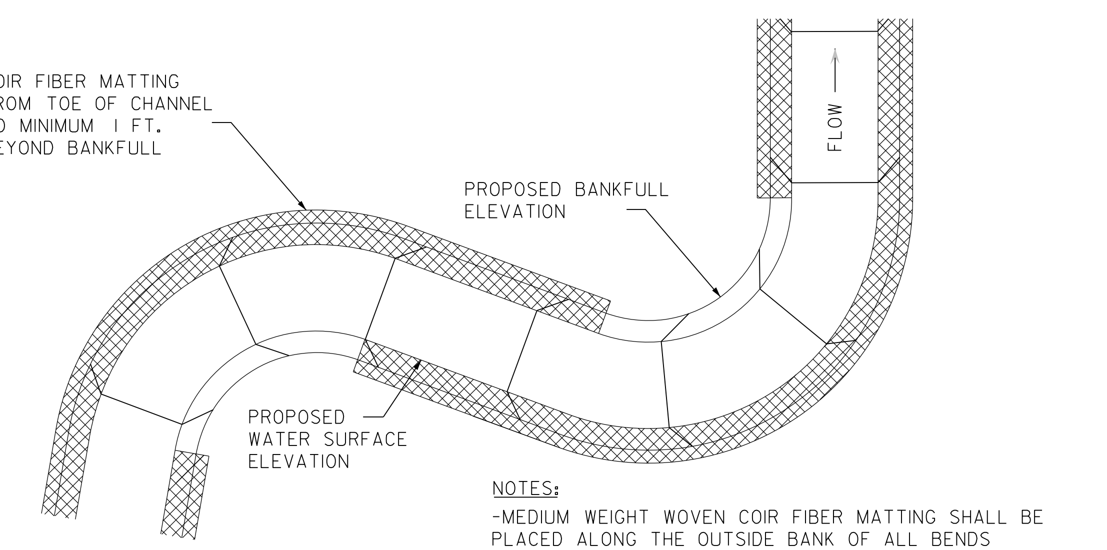
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL DETAILS

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH E03C
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **E03C**

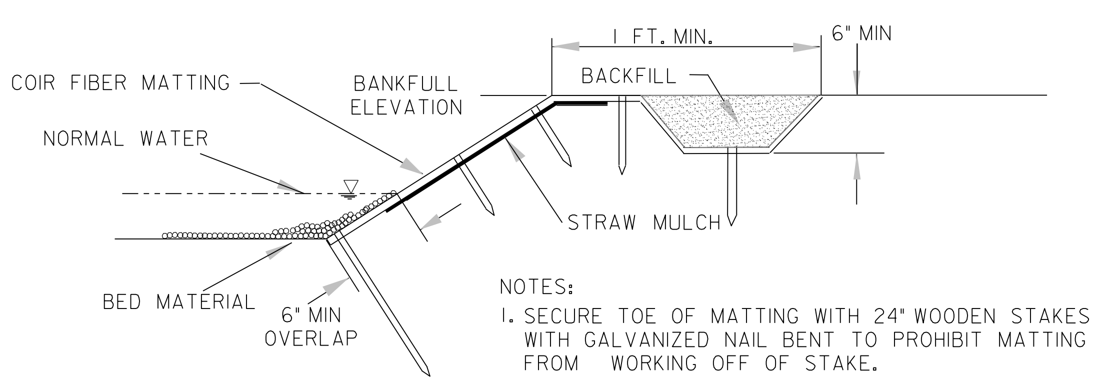
9/2/2022
Cool Run_Rdy_psh_E03c.dgn
medwards

TYPICAL MATTING LOCATION



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

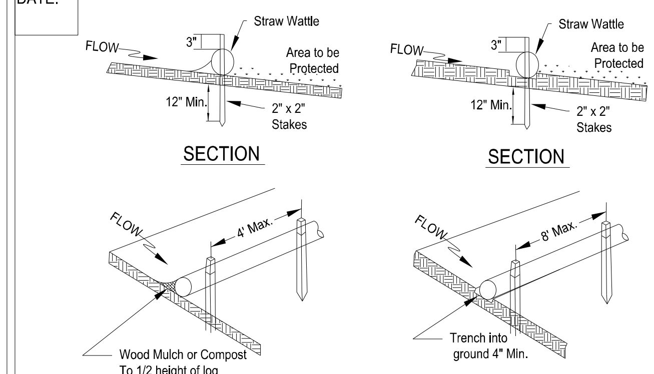
COIR MATTING CROSS SECTION



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

DATE:

PAGE:

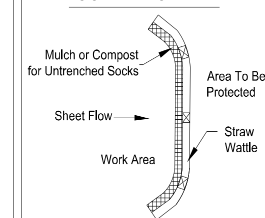


UNTRENCHED INSTALLATION

ENTRENCHED INSTALLATION*

*THIS APPLICATION MAY NOT BE USED WITH STRAW WATTLES SMALLER THAN 12".

ISOMETRIC VIEW



STRAW WATTLE INITIAL FLOW RATES					
Straw Wattle Design Diameter	8 Inch (200 nm)	12 Inch (300 nm)	18 Inch (450 nm)	24 Inch (600 nm)	32 Inch (750 nm)
Maximum Slope Length (<2%)	600 Feet (183 m)	750 Feet (229 m)	1,000 Feet (305 m)	1,300 Feet (396 m)	1,650 Feet (500 m)
Hydraulic Flow Through Rate	7.5 gpm/ft (94 l/m/m)	11.3 gpm/ft (141 l/m/m)	15.0 gpm/ft (188 l/m/m)	22.5 gpm/ft (281 l/m/m)	30.0 gpm/ft (374 l/m/m)

NOTE:
1. Other materials providing equivalent protection against erosive velocities may be substituted for use in straw wattles.
2. Fill straw wattle netting uniformly with compost to the desired length such that logs do not deform.
3. Straw wattle(s) should be installed parallel to and a minimum of 10 feet beyond the toe of a graded slope. Straw wattle(s) located below flat areas should be located at the edge of the land disturbance. The ends of the straw wattle(s) should be turned slightly upslope to prevent runoff from going around the end of the straw wattle(s).
4. Oak or other durable hardwood stakes with a 2 inch x 2 inch cross section should be driven vertically plumb, through the center of the straw wattle. Stakes should be placed at a maximum interval of 4 feet or a maximum interval of 8 feet if the straw wattle is placed in a 4 inch trench.
5. In the event staking is not possible (ie. when straw wattles are used on pavement) heavy concrete blocks shall be used behind the straw wattle to hold it in place during runoff events.

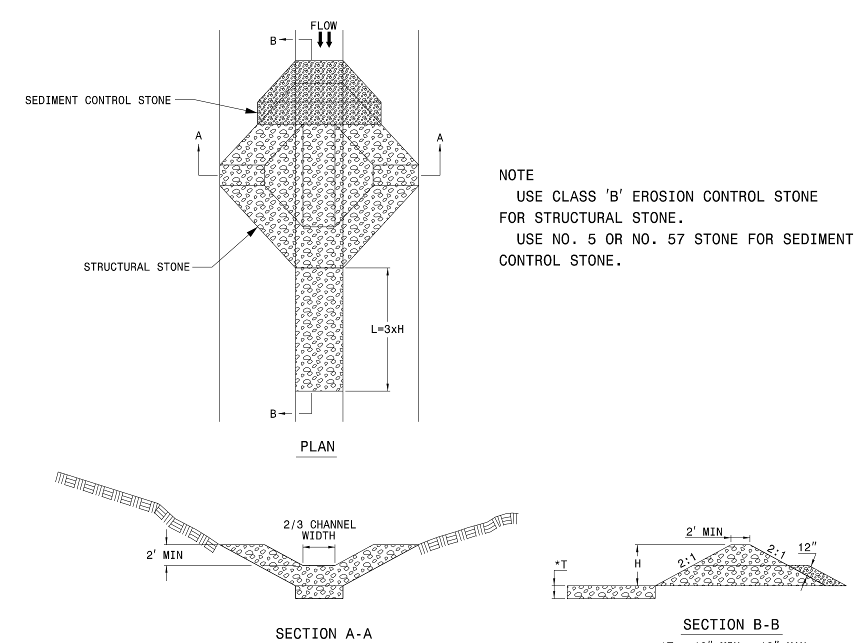
MAINTENANCE:
1. Inspect straw wattle at least weekly and after each 1 inch or greater rainfall. Remove accumulated sediment and any debris as needed to allow for adequate flow.
2. Straw wattle must be replaced if clogged or torn.
3. If ponding becomes excessive, the straw wattle may need to be replaced with a larger diameter or a different measure.
4. Reinstall if damaged or dislodged.
5. Straw wattles shall be inspected until land disturbance is compete and the area above the measure has been permanently stabilized.

EFFECTIVE DATE: 11/12/2020

STRAW WATTLE FOR PERIMETER AND INLET PROTECTION

STATE OF
NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH STANDARD DRAWING FOR
TEMPORARY ROCK SILT CHECK TYPE 'A'



NOTE
USE CLASS 'B' EROSION CONTROL STONE FOR STRUCTURAL STONE.
USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL STONE.

SHEET 1 OF 1
1633.01

STATE OF
NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH STANDARD DRAWING FOR
TEMPORARY ROCK SILT CHECK TYPE 'A'

SHEET 1 OF 1
1633.01

DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA
PROFESSIONAL
SEAL
26971
ENGINEER
JOSHUA G. DALTON

9/2/2022
DATE:

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

Axiom Environmental, Inc.

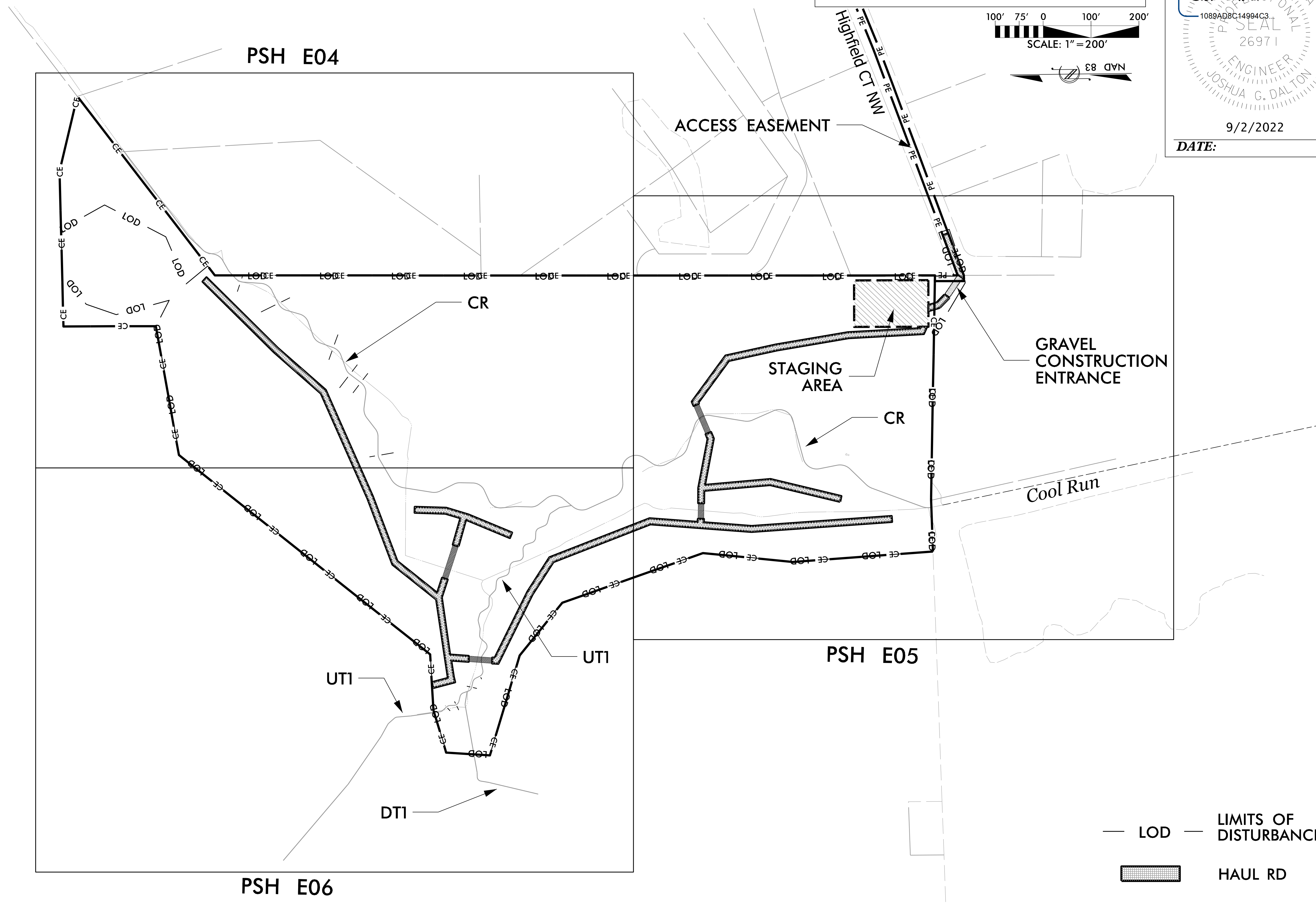
COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL DETAILS

PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E03D
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO.
E03D

9/2/2022
Cool Run_Rdy_psh_E03D.dgn
medwards

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988



DocuSigned by: Josh Dalton 1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
HAUL ROADS

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH E03E
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO.
E03E

9/2/2022
Cool_Run_Rdy_psh_E03e.dgn
mgdwards

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

SCALE: 1" = 100'

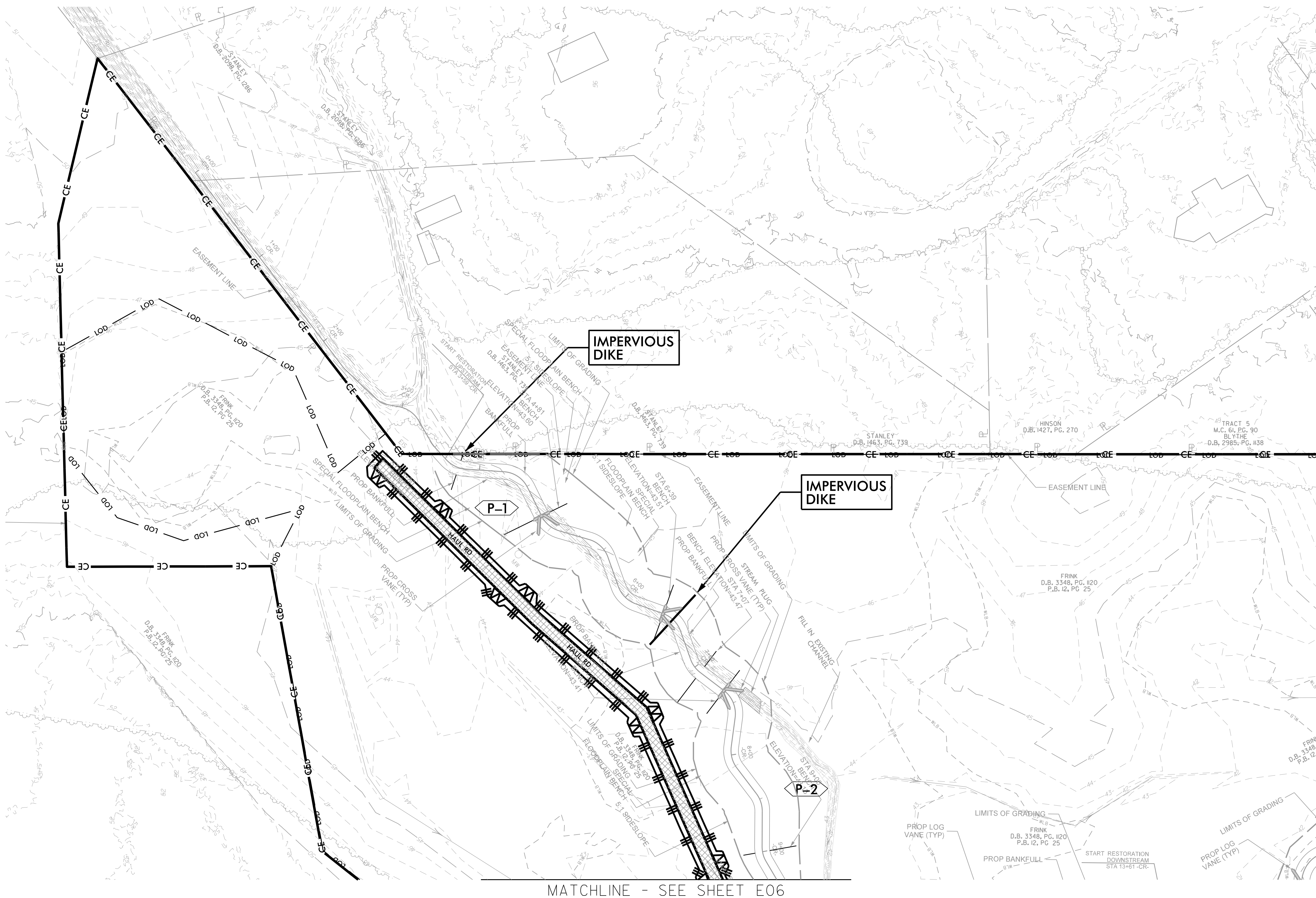
HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

DocuSigned by: Josh Dalton 1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:



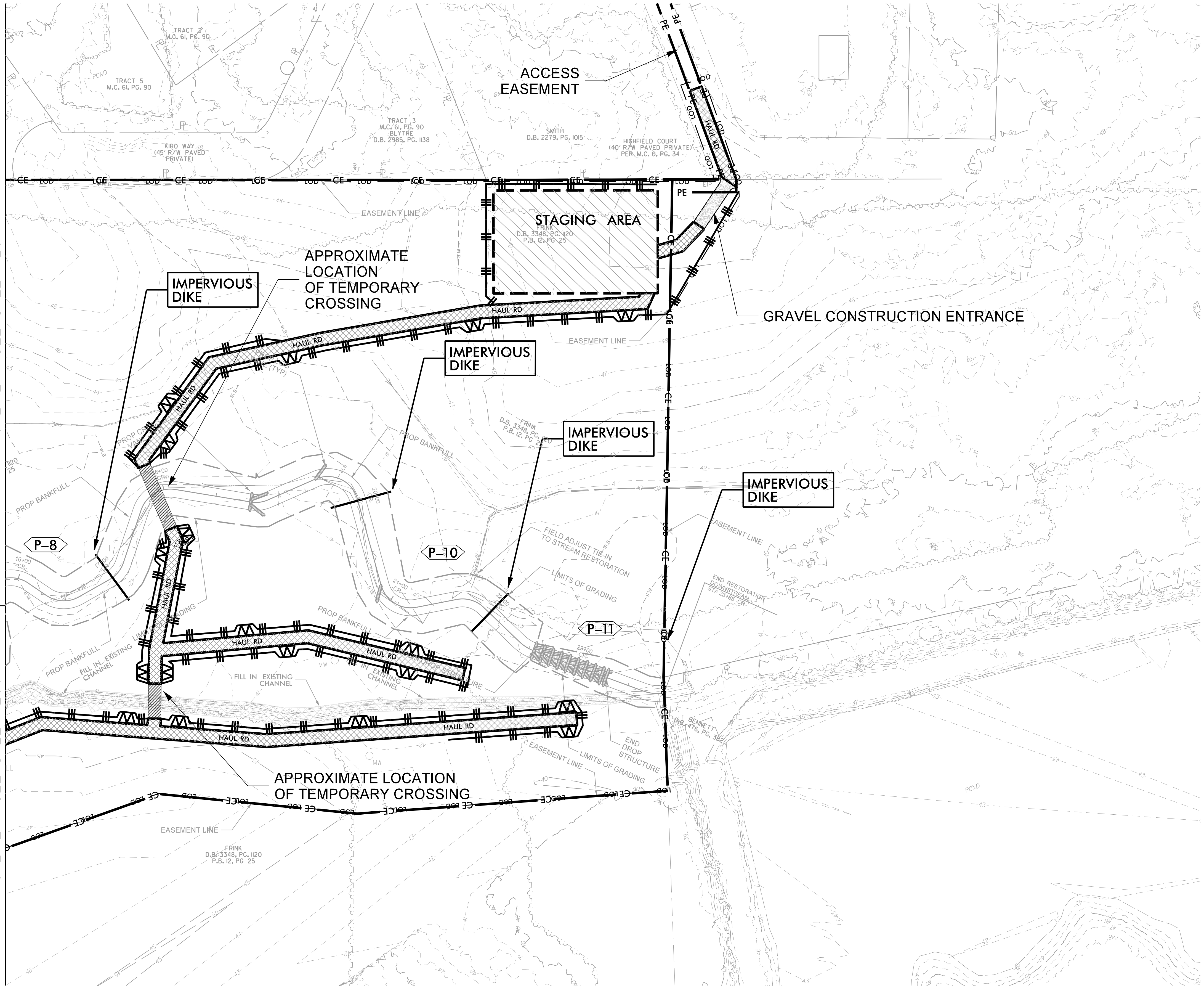
SUNGATE DESIGN GROUP, P.A.
905 JONES FRANKLIN ROAD RALEIGH, NORTH CAROLINA 27606 TEL (919) 859-2243 ENG FIRM LICENSE NO. C-890

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH E04
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. E04

9/2/2022 Cool Run_Rdy_psh_E04.dgn



DocuSigned by:
Josh Dalton
1089AD8C14994C3...

NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON

9/2/2022

DATE:

50' 25' 0 50' 100'
SCALE: 1"=100'

NAD 83

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988

— LOD —	LIMITS OF DISTURBANCE
	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL

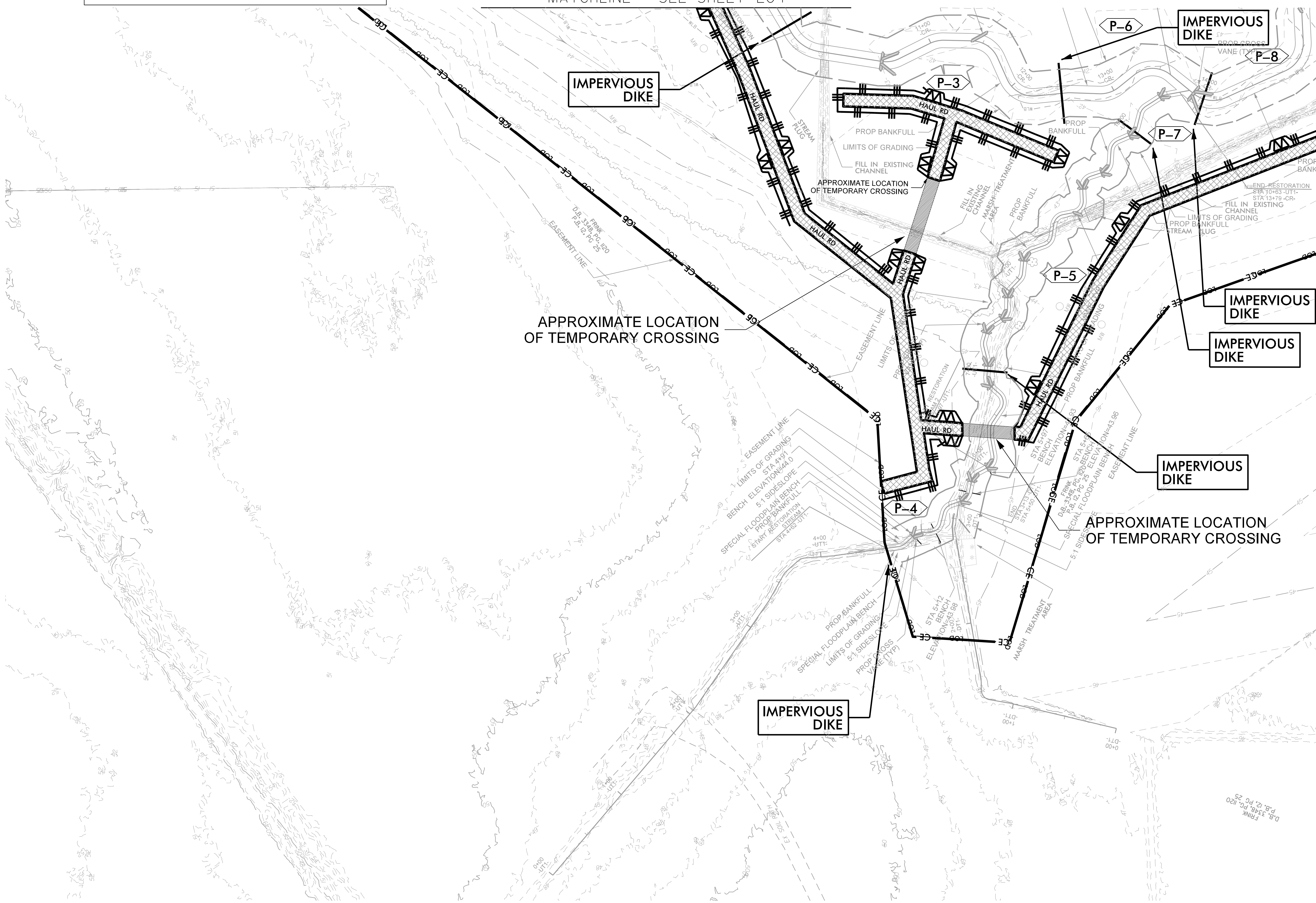
PROJECT # : 1221-21015
DRAWING NAME: COOL RUN PSH E05
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **E05**

9/2/2022
Cool_Run_Rdy_psh_E05.dgn

— LOD —	LIMITS OF DISTURBANCE
—‖‖—	TEMPORARY SILT FENCE
	HAUL ROAD
	SPECIAL SEDIMENT CONTROL FENCE BREAK

SCALE: 1" = 100'

HORIZONTAL DATUM: NAD 83 (2011)
VERTICAL DATUM: NAVD 1988



DocuSigned by:
Josh Dalton
1089AD8C14994C3...
NORTH CAROLINA PROFESSIONAL SEAL 26971 ENGINEER JOSHUA G. DALTON
9/2/2022
DATE:

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

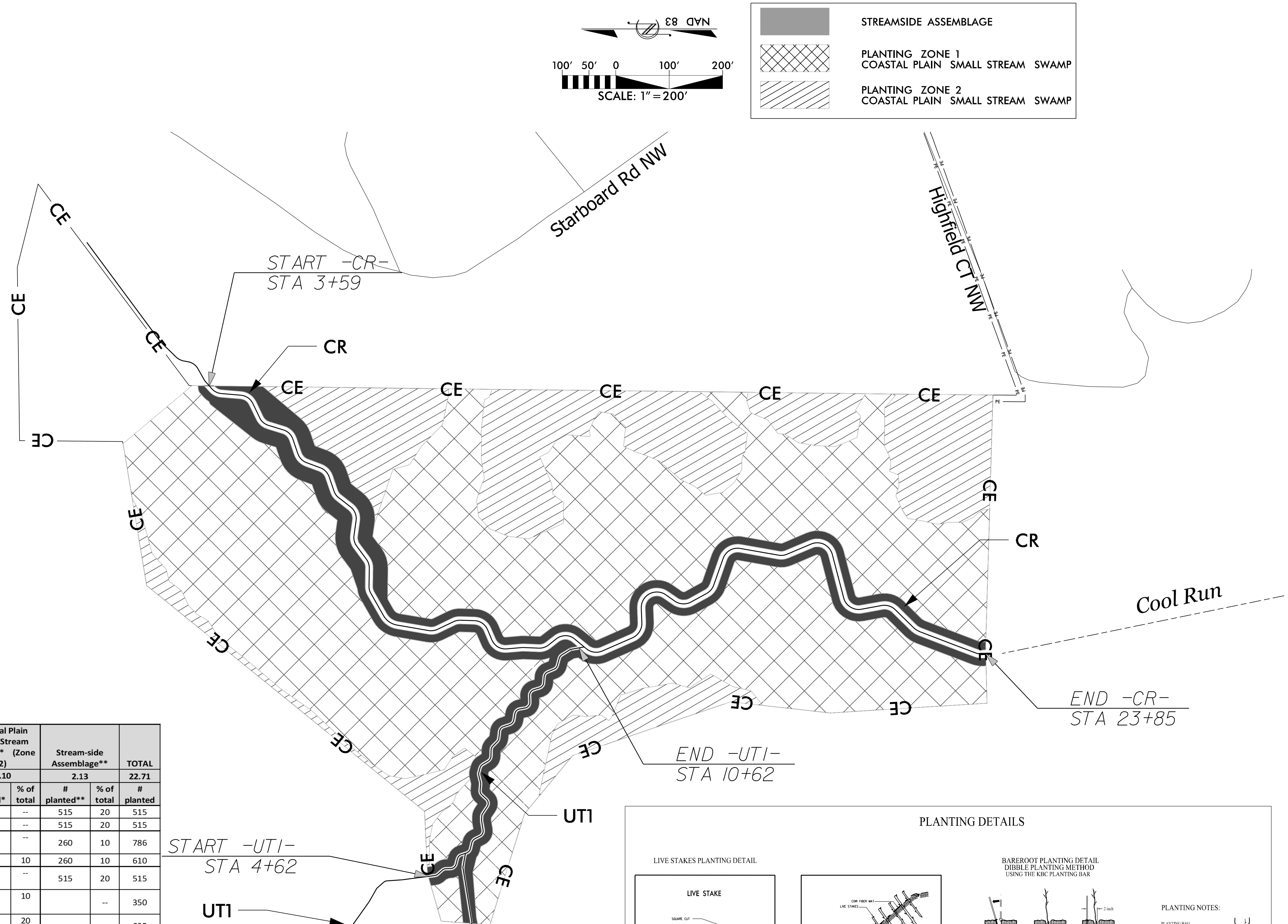
Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC
EROSION CONTROL

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH E06
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:

SHEET NO. E06

9/2/2022
Cool_Run_Rdy_psh_E06.dgn

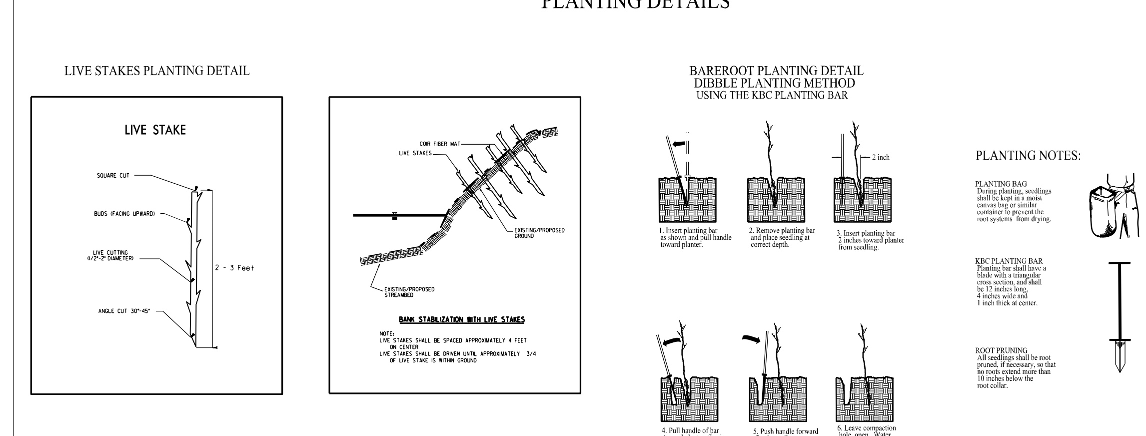


Vegetation Association	Wetland Indicator Status	Coastal Plain Small Stream Swamp* (Zone 1)		Coastal Plain Small Stream Swamp* (Zone 2)		Stream-side Assemblage**		TOTAL
Area (acres)		15.48		5.10		2.13		22.71
Species		# planted*	% of total	# planted*	% of total	# planted**	% of total	# planted
Tag alder (*Alnus serrulata*)	FACW		--		--	515	20	515
Black willow (*Salix nigra*)***	OBL		--		--	515	20	515
Ironwood (*Carpinus caroliniana*)	FAC	526	5		--	260	10	786
River birch (*Betula nigra*)	FACW		--	350	10	260	10	610
Silky dogwood (*Cornus amomum*)***	FACW		--		--	515	20	515
Atlantic white cedar (Chamaecyparis thyoides)	FACW		--	350	10		--	350
Sycamore (*Platanus occidentalis*)	FACW		--	695	20		--	695
Bald cypress (*Taxodium distichum*)	OBL	2,632	25		--	515	20	3,147
Swamp chestnut oak (*Quercus michauxii*)	FACW	1,580	15	695	20		--	2,275
Swamp tupelo (*Nyssa biflora*)	OBL	2,105	20		--		--	2,105
Laurel oak (*Quercus laurifolia*)	FACW	2,105	20	695	20		--	2,800
Overcup oak (*Quercus lyrata*)	OBL	1,055	10		--		--	1,055
American elm (*Ulmus americana*)	FAC		--	350	10		--	350
Water oak (*Quercus nigra*)	FACW	526	5	350	10		--	876
TOTAL		**10,529**	**100**	**3,485**	**100**	**2,580**	**100**	**16,594**

* Planted at a density of 680 stems/acre.
** Planted at a density of 1210 stems/acre.
*** Live Stake

9/2/2022
Cool Run_Rdy_psh_P01.dgn
medwards

PLANTING DETAILS



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

Axiom Environmental, Inc.

COOL RUN
BRUNSWICK COUNTY, NC

PLANTING

PROJECT #: 1221-21015
DRAWING NAME: COOL RUN PSH P01
DATE: 2022
DRAWN BY: JRH
REVIEWED BY: JGD
REVISIONS:
SHEET NO. **P01**