Mitigation Plan
Odell's House Mitigation Project
Johnston County, North Carolina
FINAL VERSION

NCDEQ DMS Project Identification # 100041
NCDEQ DMS Contract # 7420
Neuse River Basin (Cataloging Unit 03020201)
USACE Action ID Number: SAW-2018-00431
Contracted Under RFP # 16-007279
DWR Project # 2018-0200

Prepared for:

Environmental Quality

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

August 2020

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

REPLY TO
ATTENTION OF:

August 26, 2020

Regulatory Division

Re: NCIRT Review and USACE Approval of the NCDMS Odell's House Mitigation Site / Johnston Co./ SAW-2018-00431/ NCDMS Project # 100041

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

Dear Mr. Baumgartner:

The purpose of this letter is to provide the North Carolina Division of Mitigation Services (NCDMS) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the Odell's House Draft Mitigation Plan, which closed on July 1, 2020. These comments are attached for your review.

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

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

Thank you for your prompt attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please call me at 919-554-4884, ext 60.

Sincerely,

Kim Browning
Mitigation Project Manager
for Ronnie Smith

Enclosures

Electronic Copies Furnished:

NCIRT Distribution List
Lindsay Crocker—NCDMS
Catherine Manner, Kayne Van Stell—WLS

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August 26, 2020

US Army Corps of Engineers
Regulatory Division, Wilmington District
Attn: Kim Browning
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

RE: RE: WLS Responses to NCIRT 30-day Review Comments Regarding Task 3 Submittal, Final Mitigation Plan Approval for Odell's House Mitigation Project, USACE AID# SAW-2018-00431, NCDEQ DMS Full-Delivery Project ID #100041, Contract #7420, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Browning:

Water & Land Solutions, LLC (WLS) is pleased to provide our written responses to the North Carolina Interagency Review Team (NCIRT) review comments dated July 21st, 2020 regarding the Final Draft Mitigation Plan for the Odell's House Mitigation Project. We are providing our written responses to the NCIRT's review comments below, which includes editing and updating the Final Mitigation Plan and associated deliverables accordingly. Each of the NCIRT review comments is copied below in bold text, followed by the appropriate response from WLS in regular text:

USACE Comments, Kim Browning:

1. **The three crossings on this project reduce the connectivity of the stream reaches. In future projects, this many crossings on a project this size will be highly discouraged. Generally, the sponsors should work with the landowners early in the process to minimize, and in this case locate, as many crossings as possible.** Response: WLS understands the concerns regarding aquatic resource impacts due to crossings and site connectivity. We work diligently with landowners to reduce easement breaks, crossing proximity and habitat fragmentation. However, we also need to make sure that the mitigation project does not adversely affect the landowners current and future farm operations.
2. **It would have been more beneficial to include the entirety of the wetlands along R7 Upper in the easement.** Response: WLS agrees with this comment and made every effort to include all potential stream and wetland assets within the proposed easement boundary. The easement boundary was developed by using the proposed stream corridor and abutting wetland enhancement areas. The existing fringe riparian wetland areas would have required an additional purchase of approximately 3.0 acres of non-creditable area.
3. **Please place a veg plot along R7 Upper, preferably in W4.** Response: WLS will place a vegetation plot in W4 as requested.
4. **The permanent culvert stream crossing detail shows duel lines while the plan and profile sheets indicate that 50 LF of 36" HDPE will be installed. Please clarify. Installation of a single culvert is preferred to prevent channel flows that typically split and over-widen at the inlets and outlets. Culverts with smooth interior walls, such as those made from HDPE, are discouraged for use on mitigation projects because of the difficulty that certain aquatic species have in moving through the culvert, especially for longer culverts.** Response: The

typical culvert detail shows dual culverts. However, note 1 on the culvert detail sheet indicates that the number, size and length of pipe is dictated by the design plan and technical specifications. Regarding smooth walled culverts, WLS technical specifications will require the contractor to source corrugated HDPE culverts to allow for better aquatic species passage.

5. **Please confirm that valley length was used to calculate credit on R1 and R5.** Response: WLS used the valley length to calculate credits for R1 and R5.
6. **Given that R1 and R5 are proposed for headwater valley restoration through a passive approach, please add performance standards for channel formation during monitoring years 1-4 and years 5-7.** Response: WLS added performance standards for R1 and R5 in the mitigation plan. It should be noted that a small primary or pilot channel will be constructed in the headwater reaches to convey base flow as depicted on the typical section detail sheet 3. The low flow through R1 and R5 will mimic a historic flow patterns through channel depressions, restoring a more natural hydrology function.
7. **Page 35: For small ponds, it's recommended to use a traditional stream restoration approach. Past experience has shown that using a passive approach in these situations has resulted in poorly defined channels that could potentially convert to wetlands. This concern can also be helped by removing accumulated sediments from the pond bed prior to planting vegetation. Ponds with smaller watersheds or intermittent streams have demonstrated that fissures in the soil will likely develop during dry periods which can undermine structures and cause stream flow to become subterranean. The discussion on legacy sediment removal in Section 6.7 is helpful.** Response: WLS understands this concern and has coordinated with the IRT and other providers to evaluate multiple mitigation projects that have utilized various restoration techniques (traditional and passive or 'soft handed' approach) in pond bottoms. We are proposing the same restoration approach that was successfully implemented on nearby projects (Lake Wendell and Edwards-Johnson). The proposed headwater valley restoration in the remnant pond bottoms have similar valley slopes ranging from 0.5% to 1.5% and the contractor will construct a primary or pilot channel to adequately convey the base flow. Any unsuitable soil material for channel and floodplain construction will be removed and replaced with suitable constructible material to maintain cohesive bed and banks.
8. **Where vernal pools are proposed to be constructed within the pond bottom or existing wetlands, the impact must be authorized by the DA permit used to construct the project, and the Mitigation Plan must demonstrate how these features will result in ecological improvements. These areas should have a max depth of between 8-14 inches to allow seasonal drying to prevent colonization of predator species and have gradual side slopes to promote easy access by desired species. These pools should also be limited in size to prevent the formation of gaps within the tree canopy.** Response: WLS understands this comment and has renamed the vernal pools to be floodplain depressions, as these features are not being designed to function as vernal pools with proposed performance standards. These features will be included to create habitat diversity. They will be constructed to have a max depth of no more than 14 inches.
9. **Please include photo points at all crossings in the monitoring reports, in addition to the photos of cross-sections.** Response: Language has been added to Section 8.1 that states photo points will be located at each cross-section and culvert crossings.
10. **Wetland 5 appears to have existing wetland hydrology. Given that only supplemental planting and invasive control will occur, 2.5:1 is a more appropriate ratio.** Response: The growing season for this project area is March 21st though November 3rd. After reviewing the 2019 /2020 groundwater data for well 4 located in wetland 5, the data illustrates extended wetland hydrology in the winter months. The 12% wetland hydrology requirement for 28 consecutive days in the growing season is met in 2020 from March 21st thru May 11th however trending downward in June 2020. WLS is proposing Stream Enhancement Level I in the W5 area by directing flow from the currently ditched channel back into its original stream valley. We believe

this will significantly improve the hydrology in W5. Undesirable vegetation and invasive species will be removed prior to supplemental planting as part of wetland enhancement. Therefore we request to keep the 2:1 ratio instead of the suggested 2.5:1 ratio.

11. **Table 21 Note: Please provide a red-lined list in the MY-0/As-Built report of any substituted species.** Response: WLS added language to the footnote in Table 21 stating that we will red-line any changes/substitutions made to the planted species list in the as-built report.
12. **Section 3.5 should include discussion on the moderate-high potential for adjacent future development, especially since development is currently occurring nearby.** Response: WLS has included a section about future potential risks and uncertainties in section 3.5. It should be noted that the project catchments are almost entirely within the landowner's property. They have no intention on developing the parcel since it contains their main tobacco processing facility and cattle operation.

USACE Comments, Casey Haywood:

1. **Page 5, paragraph 2- states the project totals approximately 4,313 LF of stream, however, Table1 indicates the project total is 4,053 LF. Is this because credits not being generated due to the powerline on R6? Please clarify or add a note to this section.** Response: The discrepancy between restored length and creditable length is due to powerline crossings. Note 1 in Table 1 does indicate that no mitigation credits are calculated outside the conservation easement. WLS has added a sentence in section 1 to further clarify that restoration will occur both within the conservation easement and powerline easement.
2. **Page 5, paragraph 2- states the project totals approximately 3.891 acres of riparian wetland restoration, however, Table 2 indicates 3.890. Please correct if need be.** Response: WLS has revised Page 5, paragraph 2 and Table 2 to match.
3. **Page 24, Section 3.5.5 Invasive Species Vegetation-Please include a performance standard addressing the control of invasive species to less than 5% of the conservation easement.** Response: The USACE 2016 guidance does not provide a specific performance standard for controlling invasive species. However, WLS will treat and remove invasive species during construction and will be monitoring invasive species throughout the monitoring period to control their recurrence.
4. **Page 32, Section 6.1.1 – In the reaches proposed within the existing ponds there is concern that there will be loss of flow given the slope and small drainage areas. It is appreciated that a flow gauge is being installed in the upper 1/3 of the reach.** Response: WLS understands this concern as addressed in USACE Kim Browning comment #7 and we will install a flow gauge in reaches R1 and R5 to monitor flow.

DWR Comments, Erin Davis:

1. **DWR appreciates that WLS is conducting pre- and post-restoration benthic and water quality sampling for this project.** Response: WLS will continue collecting this data, as appropriate, to document biological response and document functional uplift for our mitigation projects.
2. **Page 5, Section 1 – Paragraph two states that the project involves approximately 4,313 LF of stream, but Table 1 states a total of 4,053 LF. If this difference is due to non-credited restoration, please include a table note or add a sentence to the section to address the discrepancy.** Response: Please see response to Note 1 from Casey Haywood from the USACE.
3. **Page 17, R2 – Does the pond east of R2 discharge to the existing stream? If so, will the outlet connection be modified as part of this project?** Response: The pond east of R2 does discharge indirectly to R2 through an earthen spillway via diffuse overland flow. The outlet for this pond is stable and will not be modified as part of this project.
4. **Page 23, Section 3.5 – DWR considers all easement breaks as site constraints since fragmentation impacts the site's potential functional uplift. Please briefly discuss the coordination completed to minimize the quantity and width of proposed stream**

crossings. Response: WLS understands this concern and please see response to comment # 1 from USACE Kim Browning.

5. **Page 34, Section 6.1.2 – As a general comment, DWR is concerned about the duration of flow in the reaches proposed within the existing ponds given the slope and small drainage areas.** Response: WLS understand this concern and will be installing flow gauges in Reach 1 and Reach 5 to monitor flow.
6. **Page 42, Section 6.3.4 – Section 3.3 states "potential for land use change and/or future development in the areas adjacent to the Project site as moderate to high". Additionally, Section 3.4.3 notes upland development as a find sediment source. Were these factors taken into consideration in deciding not to calculate sediment competency?** Response: As described in USACE response comment #12 regarding current land use and future development, the project catchments are almost entirely within the landowner's property. They have no intention on developing the parcel since it contains their main tobacco processing facility and cattle operation. Sediment competency calculations are not calculated in small headwater sand bed streams with limited supply.
7. **Page 43, Section 6.4 – The last sentence is confusing as it references a 5% performance criteria. Later in Section 7.2, a minimum 12% wetland hydroperiod performance standard is noted, which DWR supports for this site.** Response: WLS has removed the "minimum 5%" performance criteria in the last sentence of section 6.4 to clarify the minimum wetland hydroperiod.
8. **Page 44, Section 6.4 – Based on the Well 4 data, which indicates highly saturated soil, how much hydrologic uplift is expected? Is this wetland proposed for supplemental planting only? DWR questions whether a 2.5:1 ratio is more appropriate given current wetland conditions.** Response: Please see the response to Kim Browning's question 10.
9. **Page 47, Section 6.5.2 – DWR appreciates that seed species were selected due to their native occurrence in the county.** Response: WLS appreciates this comment and will continue to use native seed species for our mitigation projects.
10. **Page 48, Section 6.5.2 – While we understand that invasive species management is only required within the conservation easement, if feasible we encourage working with the landowner to treat any bamboo located adjacent to the project site.** Response: Bamboo removal is included in the invasive species management plan. WLS will work with the landowner to eradicate as much of the current stand of bamboo adjacent to the conservation easement and project boundary.
11. **Page 49, Section 6.7 – DWR prefers any proposed depressional areas to be shallow (~6 inches) and proposed vernal pools have a max. depth that is seasonally dry (<14 inches).** Response: WLS understand this comment and has revised the language in Section 6.7. Please see response to comment #8 from Kim Browning with USACE.
12. **Page 51, Section 7.1 –**
    a. **Stream Hydrology - Please rephrase "the stream hydrology monitoring will continue until four bankfull events have been documented in separate years". Hydrology monitoring should continue for 7 years. The bankfull performance standard is met by documenting four bankfull events occurring in separate years.** Response: WLS has revised the language in Section 7.1.
    b. **Jurisdictional Stream Flow – Please add "for each year during the prescribed monitoring period."** Response: WLS has added this language to the jurisdiction stream flow section.
13. **Page 52, Section 7.3 – It may be helpful to rephrase the first sentence to be able to count supplemental plantings (after 2 years) in Year 5 and Year 7.** Response: WLS appreciates this comment and has added the sentence "If supplemental planting is required and the species are on the approved species list, they may be counted towards success criteria only after they have survived for two years" to section 7.3.

14. **Page 52, Section 8 – DWR requests the inclusion of red-line drawings in the baseline monitoring report comparing record drawings to final mitigation plan design sheets.** Response: The as-built redline drawings will be included in the MY0 baseline monitoring report in accordance with the DMS as-built baseline monitoring report requirements.
15. **Page 55, Section 8.2.3 – Please change the first sentence to "during each year with normal rainfall conditions".** Response: This language has been added to section 8.2.3.
16. **Page 58, Section 10 - Please specify an expected maximum duration between "periodic" inspections.** Response: It is our understanding that DMS full-delivery projects will be transferred to the NCDEQ Stewardship Program after project closeout. The DEQ stewardship program determines the inspection frequency which does not typically exceed one year.
17. **Figure 6 – Streamlines are not shown above either of the ponds. Does this mean the project includes the stream origins for both tributaries? If not, please extend the streamline to show the upstream connection to the project. Also in Section 3.4.1, please note whether the project contains the stream origins or describe where/how the stream enters the project site.** Response: The conservation easement contains the stream origins as the stream jurisdiction and discernible features do not extend above the ponds for either tributaries per the PJD approval. Language has been added to Section 3.4.1 stating the project contains the stream origins.
18. **Figure 10 –**
    a. **DWR requests the wetland gauge along R6 be shifted to the reestablishment area and an additional wetland gauge be installed in W5, south of R7 Upper, to demonstrate hydrologic enhancement.** Response: WLS has shifted the gauge to the re-establishment area as well as adding an additional gage in W5, seen on figure 10.
    b. **DWR requests an additional cross section in the middle segment of R7 Upper.** Response: The additional cross section has been added.
    c. **Please show locations of proposed crest gauge/pressure transducers for Bankfull measurements as described in Section 8.2.1.** Response: The location of the crest gauges/ pressure transducers are now shown on figure 10.
    d. **Please confirm whether all the veg plots are fixed. If random plots are proposed, please indicate them as a separate legend item.** Response: All vegetation plots are fixed plots.
    e. **Please show existing onsite non-credit wetland areas.** Response: The non-credit wetland areas have been added to figure 10.
19. **Sheet 6 – DWR appreciates all of the information presented in the Channel Block detail.** Response: WLS will continue to use the channel block detail.
20. **Sheet 13 – Can the plan view please be shifted to show the extent of the cut/fill limits of the pond.** Response: WLS has adjust the view to include the cut/fill limits.
21. **Sheet 18 & 19 – The revegetation plan is a bit confusing, as it appears there are overlapping zones. How do these planting zones correlate with the community types described in the plan? Or are these sheets showing full/overstory verse supplemental/understory zones? How are Understory Buffer Restoration and Riparian Buffer Enhancement different? Is planting proposed in the Riparian Buffer Preservation? If not, then this should not be a planting zone designation. Key information that DWR is looking for in a revegetation plan is (1) distinguishing areas of full verse supplemental planting and (2) distinguishing areas to be planted with different species groupings presented in the corresponding plant list tables (e.g. community type, or wetland/streamside/upland).** Response: WLS has revised sheets 18 and 19 to clarify what areas will be planted and how. We have removed the riparian buffer preservation area as this planting area is not to be disturbed. We have also renamed the planting areas to be more consistent with other WLS projects. WLS intends to plant only understory (low mature height) trees/shrubs within the powerline easement. Typically, powerline easements restrict height of

vegetation. Because WLS is proposing restoring the streams within these areas we intend to protect the stream and buffer as best we can with low height woody species.

USEPA Comments, Todd Bowers:

1. **Table 2/Page 8- Drainage Areas for R7 Lower do not match within the table. (45.6 and 41.8 acres).** Response: WLS has revised the text in the table to be consistent.
2. **Section 3.1.4/Page 10 Benthic Macroinvertebrates and Aquatic Habitat- I am pleased to see that the sponsor is considering sampling benthic macroinvertebrates for this project as a proxy for water quality and biology. I recommend that in addition to the baseline data collected and monitoring during year 3, that the sponsor also consider a final sample prior to site closeout (MY 6 or MY 7) in order to capture the entire monitoring period for improvement.** Response: Language has been added to section 3.1.4. to include benthic macroinvertebrate sampling in MY6 or MY7 prior to project closeout.
3. **Section 4.2/Page 26 Performance Standards and Functional Uplift-The lack of analysis of R1 and R5 is noted due to those reaches being impounded. However, I recommend that in future projects like this, that the ponded area undergo some analysis as there is a high amount of function to be gained and documented as the headwaters transition from lentic to lotic conditions. This should have been done in this case, but the lack of analysis is not crucial to this project moving forward.** Response: WLS will consider further analysis as suggested in future projects that have similar site conditions and restoration approaches and objectives. We appreciate this comment as it acknowledges the limitation of using the SQT to assess functional loss/gain in these impounded headwater systems. We have been coordinating w/ Stream Mechanics and EDF on how to better assess and quantify these functional gains.
4. **Table 13/Page 28-Functional goal of improving water quality has many missing objectives such as planting or improving the riparian buffer vegetation, removing the impoundments, and bank stabilization. All these objectives are likely to improve water quality by providing shade, lowering erosion rates and improving the oxygen and temperature impaired by the dams. Seems this may have been covered in Table 14 in detail, but it seemed lacking here.** Response: We added language in Table 13 Level 5 Design Objectives to also include remove impoundments and plant native vegetation, increase shade, DO and lower water temperature.
5. **Table 14/Page 30- I am a bit troubled by language that states water quality improvements "will be achieved" without any direct and verifiable evidence to support this claim. As far as I can tell there are no plans to directly measure or sample water for DO, NO3, or DOC. I understand this assumption is based on the article cited in the paragraph, however in lieu of data I recommend that the wording is changed to "benefits may be achieved". If macroinvertebrate data is to be used as proxy to support water quality improvements, it should be noted here.** Response: WLS has revised the language in Table 14 to clarify how water quality improvements and pollutant reduction may be achieved by the implementing the restoration project.
6. **Section 6/Page 30 Design Approach- I am curious how a functional uplift from NF to FAR in most of the reaches is considered "maximum functional uplift". I think including the transition of R1 and R5 functional uplift may support this claim more appropriately. If this is the best the sponsor can do given the constraints listed, then achieving anything less than "Functioning" may only be considered "substantial" or "significant" improvement and not "maximum."** Response: WLS understands and agrees with this comments. We have revised the language in Section 6 pg 30 to state "thus providing significant functional uplift and a unique opportunity to implement a watershed approach."
7. **Table 16/Page 33 Proposed Design Parameters- Recommend changing the Drainage Area to acres as these watersheds are very small and this would be consistent with the rest of the document.** Response: WLS has revised the drainage areas to acres as recommended.

8. **Section 6.1.2 (R1)/Page 35- Recommend adding a note that the BMP constructed outside the CE, at the head of R1, will be fenced to restrict cattle access.** Response: WLS has revised the language in section 6.1.2 to indicate that the BMP will be fenced to restrict cattle access.
9. **Section 6.3.4/Page 42 Channel Stability and Sediment Transport-The slopes of the project reaches do not match those listed in Table 16.** Response: WLS has revised section 6.3.4 to be consistent with Table 16.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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Prepared by:

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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 28th, 2010.
- North Carolina Administrative Code (NCAC), "Consolidated Buffer Mitigation Rule", Rule 15A NCAC 02B .0295, Effective November 1, 2015, for all Riparian Buffer Mitigation.

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

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Appendices

1 Project Introduction

The Odell's House Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-007279. The Project will provide stream, riparian wetland, and riparian buffer mitigation credits in the Neuse River Basin (Cataloging Unit 03020201). The project site is located in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge. The Project is located in the Lower Buffalo Creek Priority Sub-watershed 030202011504, study area for the Neuse 01 Regional Watershed Plan Phase II, Final Report (RWP), and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin (Figure 1).

The Project will involve the restoration, enhancement, preservation and permanent protection of 8 stream reaches (R1, R2, R3, R4, R5, R6, R7 upper, and R7 lower) and their riparian buffers, totaling approximately 4,313 linear feet of streams, and 455,670 square feet of riparian buffers. Stream restoration will occur within the conservation easement and the existing powerline easement. The Project will also include riparian wetland restoration (re-establishment and rehabilitation), enhancement and preservation of approximately 3.890 acres. The Project will provide significant ecological improvements and functional uplift through stream and wetland restoration and will decrease nutrient and sediment loads within the watershed. See Section 5 for a detailed benefits summary and Table 1 for a summary of project assets. Figures 9a and 9b illustrate the project mitigation components.

The project streams are unnamed tributaries of Buffalo Creek. Buffalo Creek flows southeast to its confluence with the Little River west of Kenly, North Carolina. Buffalo Creek is listed by the NCDEQ Division of Water Resources as a 'Class C' and Nutrient Sensitive Water (NSW) from a point 200 feet upstream from West Haywood Street near Wendell to its confluence with the Little River. The Project is in the Northern Outer Piedmont ('45f') US Environmental Protection Agency Level IV Ecoregion and the North Carolina Piedmont Physiographic Province (Omernik, 2014).

Table 1. Project Asset Summary

Project Stream Component	Mitigation Type (Priority Level)	Creditable Units (LF)	Mitigation Ratio (X:1)	Stream Mitigation Credits (SMCs)
R1	Stream Restoration (PI/HW)	437	1	437.000
R2	Stream Enhancement II	526	2.5	210.400
R3	Stream Restoration (PI)	1,091	1	1,091.000
R4	Stream Enhancement II	190	3	63.333
R5	Stream Restoration (PI/HW)	340	1	340.000
R6	Stream Restoration (PI)	432	1	432.000
R7 upper	Stream Enhancement I	625	1.5	416.667
R7 lower	Stream Preservation	412	10	41.200
Totals		**4,053**		**3,031.600**

Note 1: No mitigation credits were calculated outside the conservation easement boundaries.

Note 2: R1 and R5 credits are calculated based on headwater valley length.

Project Wetland Component	Mitigation Type	Creditable Units (AC)	Mitigation Ratio (X:1)	Riparian Wetland Mitigation Credits (RWMCs)
W1	Wetland Re-establishment	0.476	1	0.476
W2	Wetland Re-establishment	0.416	1	0.416
W3	Wetland Rehabilitation	0.666	1.5	0.444
W4	Wetland Re-establishment	0.234	1	0.234
W5	Wetland Enhancement	1.654	2.5	0.662
W6	Wetland Preservation	0.444	10	0.044
Totals		**3.890**		**2.276**
Note 1: No mitigation credits were calculated outside the conservation easement boundaries.				

TOTAL AREA OF BUFFER MITIGATION (TABM)		
Mitigation Totals	**Square Feet**	**Credits**
Restoration:	251,113	243,044.758
Enhancement:	100,560	50,280.000
Preservation:	103,997	10,399.700
Total Riparian Buffer:	**455,670**	**294,724.458**
Note 1: No mitigation credits were calculated outside the conservation easement boundaries.		

2 Watershed Approach and Site Selection

In an effort to revise its watershed prioritization process, DMS developed a Regional Watershed Plan (RWP) for the upper Neuse River Basin within Hydrologic Unit (HU) 03020201. The purpose of the Neuse 01 RWP is to identify and prioritize potential mitigation strategies to offset aquatic resource impacts from development and provide mitigation project implementation recommendations to improve ecological uplift within the Neuse 01 subbasin. The recommendations include traditional stream and wetland mitigation, buffer restoration, nutrient offsets, non-traditional mitigation projects such as stormwater and agricultural BMPs, and rare, threatened, or endangered (RTE) species habitat preservation or enhancement (Neuse 01 RWP – Phase II, 2015).

The Project site is situated in the lower Piedmont where potential for future development associated with the I-540 corridor and rapidly growing Johnston County area is imminent, as described in the RWP. The USGS 2011 National Land Cover Data (NLCD, 2011) GIS Dataset was used to estimate the impervious cover and dominant land use information for the project catchment area. The catchment area has an impervious cover of less than one percent and the dominant land uses are pasture, agriculture, and mixed forest. The project will extend the wildlife corridor and protect diverse aquatic and terrestrial habitat in the area through a permanent conservation easement, ahead of the anticipated development.

The proposed in-stream restoration practices will improve habitat diversity (e.g. restore floodplain and riparian wetlands, provide deeper pools and backwater areas) and promote native species propagation throughout the conservation easement (FISRWG, 1998). Additionally, water quality treatment basins will be incorporated to remove direct effluent inputs and pollutant contamination from the Project streams and wetlands.

As cited in the Neuse 01 RWP, the Project site was selected to provide a unique opportunity for implementing “project clusters”, or combinations of different practices or measures, as part of a comprehensive watershed approach to improve and protect aquatic resource functions, as outlined in the DMS Compensation Planning Framework (CPF) and the Federal Mitigation Rule (USACE, 2008). Expected benefits to water quality, ecology, and hydrology functions, as a result of implementing these “project clusters” are further described in the Neuse 01 RWP. Developing specific goals and objectives that directly relate to functional improvement is a critical path for implementing a successful restoration project. The expected functional uplift is discussed further and in more detail under Section 4, and project goals and objectives are further described and discussed under Section 5.

3 Baseline Information and Existing Conditions Assessment

WLS performed an existing conditions assessment for the Project by compiling and analyzing baseline information, aerial photography, and field data. The purpose of this assessment was to determine how aquatic resource functions have been impacted within the catchment area. Watershed parameters such as drainage patterns, percent impervious cover, controlling vegetation and hydrology (rainfall/runoff relationships) were evaluated, along with the analysis of physiography, local geology, soils, topographic position (basin relief, landforms, valley morphology), and flow regime (discharge, precipitation, sediment supply).

Combined with historical context, the processes of hydrology and geomorphology must be linked to evaluate current physical and biological conditions and system responses to human activities within the riparian ecosystem (Montgomery and Bolton, 2003). Identifying the hydrogeomorphic variability, site constraints, and cause-and-effect relationships plays a key role in determining the functional loss and maximizing potential uplift (Harman et al., 2012). The following sub-sections further describe the existing site conditions, degrees of impairment, and primary controls that were considered for developing an appropriate restoration design approach. Table 2 represents the project attribute data and baseline summary information.

Table 2. Project Attribute Data and Baseline Summary Information

Project Information								
Project Name	Odell's House Mitigation Project							
County	Johnston							
Project Area (acres)	15.09							
Project Coordinates (latitude and longitude)	35.715894° N, -78.353453° W							
Project Watershed Summary Information								
Physiographic Province	Piedmont							
River Basin	Neuse							
USGS Hydrologic Unit	03020201180050							
DWR Sub-basin	03-04-06							
Project Drainage Area (acres)	41.8 (R7 lower) and 95.4 (R4) acres							
Project Drainage Area (% of Impervious Area)	< 1%							
CGIA Land Use Classification	2.01.03, 2.01.01, 3.02 (69% cultivated crops/hay, 2% grass/herbaceous, 25% mixed forest, 4% pond)							
Reach Summary Information								
Parameters	R1	R2	R3	R4	R5	R6	R7 upper	R7 lower
Length of Reach (linear feet)	N/A Pond	632	1,169	392	N/A Pond	610	468	412
Valley confinement (Confined, moderately confined, unconfined)	N/A	moderately confined	moderately confined	unconfined	N/A	unconfined	unconfined	unconfined
Drainage Area (acres)	42.9	64	83.2	95.4	19.4	30.7	39.7	41.8
Perennial, Intermittent, Ephemeral	N/A	Perennial	Intermittent	Intermittent	N/A	Intermittent	Intermittent	Intermittent
NCDWR Water Quality Classification	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW
Stream Classification (existing)	N/A Pond	C5	G5	E5	N/A Pond	E5	G5	E5/ DA
Evolutionary Trend (Simon)	N/A	IV/V	III	IV/V	N/A	III	I	I
FEMA Classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A	AE

Table 3. Regulatory Considerations

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

3.1 Watershed Processes and Resource Conditions

3.1.1 Watershed Overview

Spatial and temporal variability of hydrologic and geomorphic processes have influenced the overall system response and stability trends in multiple reach segments across the Project site. Measurable changes in the landscape ecology were first identified upon review of aerial photography, including native buffer vegetation disturbance, impoundments and stream channel alteration. Evidence of these observed changes were documented throughout the watershed as increased channel widths/depths and bank height ratios, decreased riffle-pool frequency and bedform diversity, as well as limited floodplain connectivity and hyporheic zone interaction. Additionally, direct cattle access to the streams and surrounding agricultural fertilization has likely increased fecal coliform bacteria and nutrient levels within the watershed. These ecological impacts have negatively impacted historic stream and wetland functions at the site and have likely increased over the past few decades due to anthropogenic changes within catchment.

3.1.2 Surface Water Classification

Buffalo Creek is classified as Class ‘C’ and Nutrient Sensitive Water (NSW) (Stream Index 27-57-16-(3)) “From a point 200 feet upstream from West Haywood Street near Wendell to Little River”. Class ‘C’ waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses suitable for Class ‘C’. NSW waters is a supplemental classification intended for waters needing additional nutrient management due to being subject to excessive growth of microscopic or macroscopic vegetation.

3.1.3 Aquatic Resource Health and Function

WLS reviewed DWR biological and water quality data within the Upper Buffalo Creek watershed to identify any potential stressors near receiving waters. Currently, one DWR water quality monitoring station exists well upstream of Lake Wendell. However, no benthic or fish monitoring sites are currently active in Upper Buffalo Creek Watershed. A future monitoring site is proposed by DWR within the Lower Buffalo Creek watershed and additional sites may be added by DWR as land use changes (i.e., land development) have direct impacts to water quality throughout the watershed. At this time of this report no DWR monitoring sites are proposed for monitoring use by WLS for this project.

It is generally accepted that nutrient loading and sedimentation from streambank erosion is a significant pollutant to water quality and aquatic habitat. However, there can be data uncertainties and excessive costs for monitoring nutrient levels and sediment delivery in streams (HESS, 2014). Without an extensive nutrient monitoring and management plan, types, application rates, groundwater leaching, and lag times can vary considerably, making it difficult to effectively determine water quality improvements in response to various restoration practices. Additionally, measuring in situ sediments that deposit or collect in ponds/reservoirs over time can often have longer transport times and legacy effects that can mask the water quality improvements and biologic functions related to common stream and wetland restoration activities (Bain, 2012).

3.1.4 Benthic Macroinvertebrates and Aquatic Habitat

WLS will sample benthic macroinvertebrate (BMI) communities and aquatic habitat at two locations. One along R3 and another along R6 within the proposed project area. The sample numbers and location are based on stream condition, watershed position and headwater flow regime. The upper project reaches (R1, R5) lack natural habitat diversity and remain ponded throughout the year. This result is likely due to the backwater conditions from the existing farm ponds, minimal buffer vegetation and lack of substrate habitat (woody debris) within these impounded stream systems. Macroinvertebrates are useful biological monitors because they are found in all aquatic environments, are less mobile than many other groups of organisms, and easily collectable. BMI sampling will be conducted using methods and procedures defined by DWR's "*Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates*" (NCDWR, 2016). Sampling will be conducted before the stream restoration and additional sampling will be conducted again in Spring/Summer during the third year and either year six or seven of post-construction monitoring.

3.1.5 Pollutant Load Considerations

STEPL Model: WLS utilized the Spreadsheet Tool for Estimating Pollutant Loads (STEPL v4.3, 2015) to help quantify how the project may reduce pollutant loads into the Buffalo Creek Watershed. The STEPL model was developed for the United States Environmental Protection Agency (USEPA, Tetra Tech, 2015) and was used to estimate sediment and nutrient load reductions from the implementation of agricultural BMPs, such as wetland detention, and bank stabilization/stream restoration. Model inputs include land use information, Revised Universal Soil Loss Equation (USLE)/runoff curve numbers, eroded streambank length, streambank height, lateral recession rates, soil type/weight, and BMP type/efficiency applicable to the Piedmont area. The summary of total annual pollutant loadings and removal estimates are shown Table 3 below.

Table 4. Total Annual Pollutant Loadings and Removal Estimates from the STEPL Model

Project Watershed (ac)	Existing Stream Length (ft)	Length of Scoured Bank (ft)	Sediment Load (ton/yr)	Nitrogen Load (lb/yr)	Phosphorus Load (lb/yr)	Sediment Reduction w/ BMP (ton/yr, %)	Nitrogen Reduction w/ BMP (lb/yr, %)	Phosphorus Reduction w/ BMP (lb/yr, %)
141	3,271	910	70.2	2,246.5	330.5	44.6, 76.3%	1060.7, 47.2%	120.7, 36.5%
Note 1: Soil Texture Class is predominantly fine sandy loam. *Note 2: Average Bank heights in scour areas ranged 1 to 2 feet.* *Note 3: Lateral Recession Rates (ft/yr) ranged from slight category (0.01 to 0.05) to moderate (0.06 to 0.20)* *Note 4: Agricultural BMP input used for streambank stabilization/restoration and cattle exclusion fencing.*								

Although the STEPL model data is more empirically based, it is intended to be used as a basic planning tool. Inherently, there are certain assumptions and limitations that must be considered when refining model inputs and evaluating the results. For example, water quality calculations and sediment loading are highly dependent on actual BMP efficiencies, sophisticated algorithms, regression analysis, and not calibrated field measurements.

BANCS Method: As a comparison to the STEPL model results for sediment loading, WLS predicted streambank erosion rates and annual sediment yields using the Bank Assessment for Non-point-source Consequences of Sediment (BANCS) method (Rosgen 1996, 2001a) which considers two streambank erodibility estimation tools: The Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS). This rating method is used to describe existing streambank conditions (i.e., bank migration and lateral stability) and quantify the lateral erosion potential of a stream reach in feet per year. The components of the BANCS methodology can be subjective and vary based on the region's climatic condition, geologic controls, and the experience level and professional training of the observers. However, it is a repeatable estimation method and the intent is to be used as a relative comparison for pre- and post-restoration conditions.

WLS used the unpublished NC Piedmont BEHI and NBS ratings curve (personal communication with NRCS, Walker, 2016) to estimate annual sediment loss based on local observations and streambank measurements taken in December 2019. The BEHI/NBS estimates for the existing conditions (pre-construction) predict that the project reaches contribute approximately 55.5 tons of sediment per year to Buffalo Creek, which is 3.0 tons lower than the STEPL Model estimates. The BEHI ratings varied from 'very low' to 'very high', with R2 and R6 average BEHI rating 'very low/low' based on minimal shear stress, stream bed/bank stability and controlling vegetation. R3 contributes the majority of the bank sediment to the system, due to a lack of bank protection. The average 'moderate' to 'high' BEHI ratings and observations are typical of a degraded stream system with active bank erosion. See Table 4 below and Appendix 2 for sediment loading assessment sheets.

Table 5. BANCS Reach Assessment

Project Component	BEHI Range	NBS Range	Sediment Loading (tons/yr)
R1	N/A	N/A	N/A
R2	Very Low/Low	Very Low/Low	2.9
R3	Very Low/Very High	Very Low/ Very High	47.3
R4	Very Low/Mod	Very Low/High	2.3
R5	N/A	N/A	N/A
R6	Very Low/Low	Very Low/Low	1.6
R7 upper	Low	Low	1.4
R7 lower	Very Low	Very Low	-
Note 1: R1 and R5 were not assessed due to their ponded condition.			

Fecal Coliform Bacteria: Pollutant load reduction performance standards for nutrients and fecal coliform bacteria are not proposed nor required for this project; however, WLS is interested in evaluating how the proposed project could reduce pollutant loads into the Buffalo Creek Watershed. Based on DMS referenced studies represented in *Quantifying Benefits to Water Quality from Livestock Exclusion and Riparian Buffer Establishment for Stream Restoration* (DMS, 2016), WLS expects that implementation of this project could reduce Fecal Coliform Bacteria colonies (col), by as much as 42% as shown on Table 6.

Table 6. Pollutant Load Reduction Estimates from Livestock Exclusion and Riparian Buffers

Total Riparian Buffer Area (ac) [1]	Cattle Exclusion: Grazing Pasture (ac)	Nutrient Reduction: TN (lbs/yr) [2]	Nutrient Reduction: TP (lbs/yr) [2]	Fecal Coliform Bacteria from Direct Inputs (col) [3]	Fecal Coliform Bacteria Reduction (col) [4]
15.1	9.5	484.9	40.2	1.12E+12	5.05E+11

Note 1: Applicable for restored buffer widths ranging from 6m to 30m from the top of streambanks.
Note 2: NC Division of Water Quality – Methodology and Calculation (1998) for determining nutrient reductions associated with Riparian Buffer Establishment (DWR, 1998). TN reduction (lbs/yr) = 51.04 (lbs/ac/yr) x Area (ac) and TP reduction (lbs/yr) = 4.23 (lbs/ac/yr) x Area (ac)
Note 3: Fecal Coliform Reduction from Direct Cattle Input (colonies) = 2.2 x 10^11 (col/AU/day) x AU x 0.085 and assumes ~60 black beef cattle (ave. 700 lbs/each)
*Note 4: Fecal Coliform Reduction from Buffer Filtration (colonies) = Runoff's fecal coliform concentration (col/gal) x Runoff volume (Gal) x 0.85 and assumes pastures are under continual grazing year-round (1.894*10^6), composite runoff curve number (CN) for this area was calculated to be ~72 for a 1yr-24hr storm event.*

3.2 Landscape Characteristics and Regional Controls

3.2.1 Physiography and Geology

The Project site is located in the Raleigh Belt region of the eastern Piedmont physiographic province in a transitional zone near the Eastern Slate Belt and Inner Coastal Plain. More specifically, the geologic unit is classified as 'PPmg' (See Figure 2) and lies within the Rolesville batholith (Rg) or pluton, which contains igneous intrusive bedrock formations (USGS, 2016). The lithologic unit is described as foliated to massive granitic rock and exposed outcrops were observed in the project vicinity east of Lake Wendell (USGS, 1998).

The Piedmont province in this transitional zone or 'fall line' is generally characterized by gently rolling, well-rounded hills and low ridges, with elevations near the project site ranging from 230 to 350 feet above sea level. The surface topography and dendritic drainage patterns within these alluvial valleys are consistent along many first order or headwater streams mapped in this region, with average valley slopes ranging from 1 percent to just over 2 percent (Russell, 2008). The narrow valley confinement and steeper side slopes (approximately 8 to 15 percent) typically decrease as the contributing drainage areas increase near the confluence of larger stream systems (i.e., Buffalo Creek).

3.2.2 Soils

Soils at the project site were initially determined using NRCS soil survey data for Johnston County (NRCS Johnston County Soil Survey, 1994). The soils within the project area were verified during on-site field investigations. Figure 4 illustrates soil conditions throughout the project area and the soil descriptions are provided below in Table 7.

Table 7. Project Soil Type and Descriptions

Soil Name	Hydric	Description
Bonneau sand (BoA) (6.4% of easement)	No	Well drained soils formed on flats and ridges on marine terraces that are not frequently flooded. Slopes range from 0 to 3% on landscapes with wooded-mixed hardwoods and pine. Areas are typically cultivated. Loamy sand surface layer and sandy loam subsoil.
Cowarts loamy sand (CoB) (46.4% of easement)	No	Well drained soils formed mainly on ridges of marine terraces in the Coastal Plain Region that are not frequently flooded. Slopes range from 2 to 6% on woodlands dominated by oak and pine. Fine sandy loam surface layer and sandy clay loam subsoil.
Leaf silt loam (Le) (29.8% of easement)	Yes	Poorly drained soils that formed in terraces and flats on broad interstream divides that are not frequently flooded. Slopes range from 0 to 2% on land that is predominantly mixed bottomland hardwoods and pines. Some areas are used for ground corn and small grains. Silt loam surface layer and silty clay subsoil.
Wedowee sandy loam (WoB) (2.3% of easement)	No	Well drained soils formed on narrow ridges and on side slopes of uplands in the Piedmont Region. Slopes range from 2 to 8% within land that is mostly wooded and includes a mix of oak, pine, and hickory species. Some areas are cleared for pasture and cropland. Sandy loam surface layer with clay to clay loam subsoil and underlying material.

The soils within the floodplain and riparian areas are predominantly mapped Cowarts loamy sand (CoB) and Leaf silty loam (Le). The soil properties have been degraded by historic agricultural and silvicultural activities and more recent cattle disturbances (i.e., hoof trampling) have resulted in a significant loss of surface/groundwater interaction, and increased streambank erosion and sedimentation.

3.2.3 Climate

The Project site is located in Johnston County, NC which has a warm humid temperate climate with hot summers, minimal snowfall and no dry season (NRCS, 1994). The average growing season for the Project site is 227 days, beginning on March 21st through November 3rd (NRCS Johnston County Soil Survey, Weather Station: Clayton, NC). As an alternative to using the March 21 published growing season start date, WLS may install a soil temperature probe and correlate soil temperature with bud burst to establish a start date for the growing season. The earliest possible start date used for hydroperiod determination will be March 1. The average annual precipitation in the Project area is approximately 46.95 inches with a consistent monthly distribution, except for convective storm events or hurricanes that occur during the summer and fall months. In 2019, the area received over 54.93 inches as shown on WETS Table 8. Over the past 48 months, the Clayton weather station (COOP 317994) has recorded over 232 inches of rain.

Table 8. Comparison of Monthly Rainfall Amounts vs. Long-term Averages

Month-Year	Observed Monthly Precipitation (in)	WETS Average Monthly Precipitation (in)	Deviation of Observed from Average (in)
Jan-19	4.74	4.24	+0.05
Feb-19	5.11	3.56	+1.55
Mar-19	3.84	4.39	-0.55
Apr-19	8.47	2.97	+5.50
May-19	0.92	3.73	-2.81
Jun-19	6.08	3.74	+2.34
Jul-19	6.35	5.02	+1.33
Aug-19	2.23	4.74	-2.51
Sep-19	2.94	4.74	-1.80
Oct-19	5.18	3.20	+1.98
Nov-19	3.56	3.32	+0.24
Dec-19	5.51	3.30	+2.21
Sum	**54.93**	**46.95**	**+7.98**

Throughout much of the southeastern US, average rainfall often exceeds average evapotranspiration (ET) losses and areas experience a moisture excess during normal years, which is typical of the Project site. Excess water leaves the Project site by groundwater flow, surface runoff, channelized surface flow, or seepage. Annual losses due to seepage, or percolation of water are not considered a significant loss pathway for excess water. However, groundwater flow and the hyporheic exchange is critical in small headwater stream and wetland systems like those at the Project site, as most excess water is lost via surface and shallow subsurface flow.

The Project streams' drainage density relative to the geomorphic/geologic character and hydrologic regime is common given the seasonal rainfall patterns, runoff rates, topographic relief, groundwater recharge, and infiltration capacity/depth to impermeable bedrock layer (USGS, 1998). Further observations of perennial flow frequency, response time to storm events, pond level fluctuations, streambank erosion and groundwater saturation over the past year support this conclusion.

3.2.4 Existing Vegetation

Land use surrounding the Project area has been primarily for agricultural and silvicultural purposes. Prior to anthropogenic land disturbances, the riparian vegetation community likely consisted of Mesic Mixed Forest (Piedmont Subtype) in the uplands with Alluvial Forest and Piedmont Bottomland Forest in the lower areas and floodplains (Schafale 2012). The existing vegetation within the project area consists of pasture and agricultural fields, planted loblolly pine stands, and mixed successional forest. Many of the riparian and upland areas have a narrow tree canopy and lack understory vegetation due to heavy livestock use and grazing. Widespread channel degradation is likely a result of the alteration of natural drainage patterns and the significant removal of native species vegetation. Many of the riparian and upland areas are dominated by invasive species such as Golden bamboo and Chinese privet.

Table 9. Existing Site Vegetation

	Common Name	Scientific Name
Canopy Vegetation	Red maple	*Acer rubrum*
	Tulip-poplar	*Liriodendron tulipifera*
	Loblolly pine	*Pinus taeda*
	Bald cypress	*Taxodium distichum*
	Green ash	*Fraxinus pennsylvanica*
	American sycamore	*Platanus occidentalis*
Understory & Woody Shrubs	Black willow	*Salix nigra*
	Sweetgum	*Liquidambar styraciflua*
	Golden bamboo	*Phyllostachys aurea*
	Chinese privet	*Ligustrum sinense*
	American holly	*Ilex opaca*
	Eastern red cedar	*Juniperus virginiana*
Herbaceous & Vines	Poison ivy	*Toxicodendron radicans*
	Switchcane	*Arundinaria tecta*
	Greenbrier	*Smilax rotundifolia*
	Multiflora rose	*Rosa multiflora*
	Marsh dewflower	*Murdannia keisak*
	Lady fern	*Athyrium filix-femina*
	Japanese stiltgrass	*Microstegium vimineum*
	Soft rush	*Juncus effusus*

3.3 Land Use and Development Trends

The USGS 2011 National Land Cover Data GIS Dataset and StreamStats was used to estimate the current impervious cover and land use information for the project catchment area. The catchment area has an impervious cover of <1% and the dominant land uses are 69% cultivated crops and 25% mixed forest. WLS conducted extensive field reconnaissance to verify the current land use practices within the catchment, which include active agricultural land managed as hay/crop production, pasture for cattle grazing, residential development, and forested areas along the project reaches.

Prior to the 1970s, most of the watershed was a mixed forested area or agricultural land as illustrated on historic aerials (See Figures 7a-d). Over time the natural stream, wetland processes, and aquatic resource functions have been significantly impacted because of these historic anthropogenic disturbances. As described in the Neuse 01 RWP, potential for land use change and/or future development in the areas adjacent to the Project site is moderate to high, given the proximity to current development and growth trends associated with the I-540 corridor and rapidly growing Johnston County areas.

3.4 Watershed Disturbance and Response

To determine what actions are needed to restore the riparian corridor structure and lift ecological functions, it is critical to examine the rates and type of disturbances, and how the system responds to those disturbances. Across the Project site, landowners historically manipulated and/or straightened streams and ditched riparian wetland systems to provide areas for crop production and cattle grazing. The project area was cleared and two small ponds were built along R1 and R5 headwater drainages. The impoundments' size and location have remained unchanged since they were built and are currently used as a source for irrigation. Over time the natural stream and wetland processes and aquatic resource functions have been significantly impacted because of these historic anthropogenic disturbances. These activities have caused changes to channel patterns, sediment transport, in-stream habitat and restriction of fish movement, thermal regulation, and dissolved oxygen (DO) content.

As shown in the historical aerial photographs (See Figures 7a, 7b, 7c, and 7d), the existing riparian buffer area has not been disturbed since the 1960s, yet the landscape adjacent to the riparian buffer indicates the areas have been heavily impacted from historic and current land use practices, including agriculture, silviculture, and development. Historic manipulation of the stream channels has severely impacted the streambanks and natural flow pattern throughout the Project corridor. The main tributary through the middle of the Project area is incised and the floodplain connection has been lost in many locations. The past land use disturbances, active channel degradation, and current land use practices present a significant opportunity for improving water quality and ecosystem functions through the implementation of this project. Figure 7d show the most recent aerial photography depicting several new greenhouses built adjacent to the riparian buffers.

3.4.1 Existing Reach Condition Summary

The streams at the Project site were categorized into eight reaches (R1, R2, R3, R4, R5, R6, R7 upper, and R7 lower) totaling approximately 3,683 linear feet of existing streams. Reach breaks were based on drainage area at confluences, changes in existing condition, restoration/enhancement approaches, and/or changes in intermittent/perennial stream status. Field evaluations conducted by WLS at the proposal stage and during existing conditions assessments determined that Project reach R2 is a perennial stream and reaches R3, R4, R6, and R7 were determined to be intermittent streams. Reaches R1 and R5 were not scored due to ponded conditions, but the stream origins were estimated at the approximate pond locations entering the project site.

Stream determinations were based on *NCDWQ's Methodology for Identification of Intermittent and Perennial Streams and Their Origins*, (NCDWQ v4.11, Effective Date: September 1, 2010) stream assessment protocols. Copies of the referenced DWR Stream Identification Forms are included in Appendix 7 and reach condition summaries are provided below.

Photo of R1 showing a man-made farm pond with cattle wallowing and no riparian buffer vegetation.

R1: R1 is a small headwater tributary that is currently experiencing backwater effects from a man-made farm pond dam located approximately 400 feet down valley before the stream flow exits at a pipe outlet. R1 has a stream valley length of approximately 400 feet and a drainage area of 43 acres.

Prior to the farm pond construction, the natural valley slope in this area was one percent. The pond depth at the upstream base of the dam was measured at approximately eight feet deep. The entire pond perimeter is subject to active water quality stressors, mainly resulting from hoof shear from unrestricted cattle access and riparian buffers less than 10 feet in width. Cattle intrusion and pond excavation have degraded the riparian and aquatic habitat, and poor to no channel definition was observed. The riparian buffer along most of the reach is nonexistent as a result of the removal of riparian vegetation across the floodplain.

R1 is actively subject to water quality stressors, mainly in the form of cattle wallowing and minimal riparian buffer widths. Based on the poor channel conditions and historic anthropogenic disturbances, R1 was not classified along its length.

R2: R2 begins downstream of the pond dam outlet and extends below an existing culvert crossing. The valley slope is approximately 1.8 percent, and the drainage area is 64 acres. R2 below the dam appears to be relatively stable, with minimal bank erosion present and bank height ratios near 1.0. The sinuosity is low (k<1.1), and it is likely the potentially erosive flows and channel instability has been reduced from the impoundment and culvert further downstream.

Looking downstream at stable bed and bank conditions along R2. Note the lack of understory vegetation and the invasive species vegetation (bamboo) along the left stream bank.

R2 appears to have been historically manipulated. This is evidenced by the straightened pattern of the existing channel. The riparian buffer on the right bank consists of limited understory and some large trees within the floodplain. The riparian buffer on the left valley slope consists of some mature trees with little understory vegetation and a dense cluster of golden bamboo species. R2 has mature trees interspersed along the streambanks; any trees of significance will be saved and incorporated as part of the restoration design. Based on the existing conditions and medium sand bed materials, R2 is classified as a Rosgen 'C5' stream type.

R3: R3 begins at an existing headcut downstream of the culvert crossing along R2. Along this reach, the bedform diversity is low, and the degree of incision is high, with bank height around 1.4. R3 has experienced historic cattle intrusion and associated trampling for most of its length.

Photo depicts degraded stream channel conditions and minimal riparian buffer vegetation along R3.

The existing stream appears to be located in center of the valley and has a sinuosity of 1.20. The valley slope is approximately 1.6 percent, and the drainage area is 83 acres. Stream bank erosion and vertical instability were observed throughout the reach, and the stream does not appear to have natural floodplain connection. The entire reach is subject to active water quality stressors, mainly resulting from bank erosion and little to no riparian buffer along the right stream bank. Based on the existing conditions and medium sand bed materials, R3 is classified as a Rosgen 'G5' stream type.

R4 looking downstream towards the bottom of the project limits. Note the lack of adequate riparian buffer along the right floodplain.

R4: R4 continues from R3 to the downstream end of the project limits. The channel flows south for approximately 350 feet before flowing off the property. R4 has an average valley slope of 1.1 percent and a drainage area of 95 acres. R4 is exposed to cattle intrusion along its entire length and the riparian buffer is limited to herbaceous vegetation with a few small and larger trees along its left bank. Although R4 appears to be have been manipulated in the past, it is currently under relatively stable conditions.

The lower end of R4 has poor channel definition resulting from past floodplain excavation, cattle intrusion, and associated trampling and wallowing. R4 is subject to water quality stressors, mainly in the form of cattle access and minimal riparian buffer widths. Based on the existing channel conditions and anthropogenic disturbances, R4 is classified as 'E5' stream type for most of its length.

Looking at man-made pond along R5. Cattle have unrestricted access to this impoundment area.

R5: Similar to R1, R5 is a small headwater tributary that is also currently experiencing backwater effects from a man-made farm pond dam located 360 feet down valley before the stream flow exits at a pipe outlet. R1 has a stream valley length of approximately 400 feet and a small drainage area of 19 acres.

Prior to the farm pond construction, the natural valley slope in the upper catchment was approximately 1.5 percent. The pond depth at the upstream base of the dam was measured at approximately eight feet deep. The entire pond perimeter is subject to active water quality stressors, mainly resulting from hoof shear from unrestricted cattle access and riparian buffers less than 10 feet in width. Cattle intrusion and pond excavation has degraded the riparian and aquatic habitat, and poor to no channel definition was observed. The riparian buffer along most of the reach is nonexistent as a result of the removal of riparian vegetation across the floodplain.

R5 is actively subject to water quality stressors, mainly in the form of cattle wallowing and minimal riparian buffer widths. Based on the poor channel conditions and historic anthropogenic disturbances, R5 was not classified along its length.

Looking downstream at bottom of R6 with channelized conditions and a small farm pond located in the existing floodplain.

R6: R6 begins downstream of the pond dam pipe outlet. The valley slope is approximately 1.5 percent, and the drainage area is 31 acres. R6 below the dam appears to be relatively stable; however, the channel appears to have been straightened and ditched in the past. The sinuosity is low (k<1.15), and the representative BHR is 2.3, however it is likely the potentially erosive flows and channel instability have been reduced from the impoundment and culvert crossing further downstream. A small man-made farm pond is located along the left floodplain, and spoil is located along the pond perimeter.

The riparian buffer along R6 consists of limited understory some large trees within the floodplain. Any trees of significance will be saved and incorporated as part of the restoration design. Based on the existing conditions and medium sand bed materials, R6 is classified as an incised 'E5' stream type.

R7 upper: Upper R7 continues from R6 into a forested area for approximately 467 feet. The stream is channelized along the entire reach with native woody riparian buffer vegetation greater than 50 feet on both sides of the channel. The along this reach, bank erosion is low but the channel has remnant spoil piles and is not located in its natural valley.

Looking at stable conditions along lower R7. Note mature riparian buffer vegetation and natural bed features.

R7 lower: Lower R7 has a drainage area of approximately 42 acres and the channel slope is 1.3 percent. The valley floor widens and flattens in this area and the stream has a natural connection to its floodplain. Relic channel features and multi-thread channels were observed along this reach. Cattle do not have access to this reach, and historically this area has remained relatively undisturbed. The typical bank height ratio ranges from 1.0 to 1.2, and the channel is classified as an 'E5' stream type with infrequent multi-thread segments ('DA' stream type) as it transitions into the Buffalo Creek floodplain.

3.4.2 Channel Morphology and Stability Assessment

WLS conducted geomorphic and ecological assessments for each Project reach to assess the current stream channel condition and overall lateral and vertical stability. Data collection included six representative riffle cross-sections and longitudinal profiles. The existing channel morphology is summarized in Table 10 and detailed geomorphic assessment data is included in Appendix 2. Consistent geomorphic indicators of the bankfull stage were difficult to identify in the field given the modified flow regime and degraded channel conditions. Therefore, bankfull cross-sectional areas were initially compared with the published NC Rural Piedmont Regional Curve (Harman et al., 1999). The surveyed cross-sectional areas were slightly below the regional curve prediction (See Appendix 2 for comparison plots).

Bank Height Ratios (BHR) were measured in the field to assess the degree of channel incision. BHRs ranged from 1.0 (R2) to 2.3 (R6). BHR values greater than 1.5 typically indicate the stream channel is disconnected from its floodplain and system wide self-recovery is considered unlikely to occur within a desired timeframe (Rosgen, 2001). Entrenchment Ratios (ER) were measured to determine the degree of vertical confinement. ERs ranged from 1.0 (R2) to greater than 2.3 (R6) throughout the project area indicating reach segments are slightly-to-moderately entrenched.

Table 10. Existing Channel Morphology Summary

Project Reach Designation	Watershed Drainage Area (Ac)[1]	Entrenchment Ratio (ER)	Width/Depth Ratio (W/D)	Bank Height Ratio (BHR)	Sinuosity (K)	Channel Slope (S, ft/ft)	D_{50} (mm)
R1	42.9	N/A[4]	N/A[4]	N/A[4]	N/A[4]	N/A[4]	N/A[5]
R2	64.0	2.5	33.0	1.0	1.07	0.0168	N/A[5]
R3	83.2	2.0	5.8	1.4	1.20	0.0133	N/A[5]
R4	96.0	7.3	5.4	1.2	1.10	0.0091	N/A[5]
R5	19.4	N/A[4]	N/A[4]	N/A[4]	N/A[4]	N/A[4]	N/A[5]
R6	30.7	12.9	6.8	2.3	1.05	0.0145	N/A[5]
R7 upper	39.7	1.5	4.2	1.3	1.03	0.0153	N/A[5]
R7 lower	41.8	10.4	8.7	1.0	1.08	0.0122	N/A[5]

Note 1: Watershed drainage area was approximated based on topographic and LiDAR information and compared with USGS StreamStats at the downstream end of each reach.
Note 2: Cross-section locations are shown on Figure 6, Current Conditions Map.
Note 3: Geomorphic parameters for project reaches are based on best professional judgment and rapid field measurements.
Note 4: R1 and R5 cross-sections were not measured due to the ponded conditions.
Note 5: No sediment data was collected from R1, R2, R3, R4, R5, R6, and R7. Reach wide sediment was coarse sand (D_{50} <2mm).

WLS also compared historic aerial photographs with BANCS model estimates (Rosgen, 2006) described in Section 3.1.5 to identify areas susceptible to lateral bank erosion or accelerated meander migration. BEHI/NBS rating forms are in Appendix 2. Based on this comparison, most of the laterally unstable reach segments have occurred after riparian buffers where removed over the past few decades. As described in the reach condition summaries, the average valley slopes range from 0.8 to 1.8 percent and channel sinuosity range from 1.05 to 1.20. Most of the vertical grade control along the project reaches appears to be provided by infrequent vegetation root mass and culvert crossings. The surveyed longitudinal profile indicates reaches R3 and R6 have headcuts near the upper segments and have been heavily manipulated.

Many of the reach segments have poor bedform diversity and minimal habitat features with shallow pools and longer/flatter riffles with higher pool-to-pool spacing. Reach R3 and R6 are vertically and laterally unstable throughout the reach with active headcutting and heavy bank erosion. Reach R2 is laterally unstable in some sections, but is vertically stable. Reach R4 has poor channel definition resulting from past floodplain excavation, cattle intrusion, and associated trampling and wallowing. Upper R7 is stable but currently channelized and lower R7 is mostly stable with native woody riparian buffer vegetation greater than 50 feet along the entire length.

NC SAM: WLS completed stream evaluations of the Project reaches using the *NC Stream Assessment Method* (NC SAM, Version 2.1, 2015) developed by the NC Stream Functional Assessment Team (SFAT). The purpose of NC SAM is to provide the public and private sectors with an accurate, consistent, rapid, observational, and science-based field method to determine the level of function of streams within North Carolina. NC SAM can be used as a tool for the consideration of project restoration design and planning, allowing for impacts to be avoided and/or minimized, and to provide information concerning assessed stream characteristics and functions for the regulatory review process.

WLS evaluated the NC SAM metrics relevant to the project assessment reaches, as shown in Appendix 8. The metrics were documented to evaluate various stream functions. The Project reach scores ranged from 'low' to 'high'. Project reaches R3, R4, R6, upper R7 upper scored 'low' due to unstable channel and bank conditions, buffer and water quality stressors from development, and altered stream morphology. Reach R2 scored 'medium' because of improved aquatic habitat, substrate and marginal buffer widths. These channel stability and ecological assessments incorporated qualitative and quantitative observations using historic aerials, field evaluations, and detailed topographic survey data collected across the site. The conclusions from the NC SAM assessments help describe the current stream stability, ecological conditions and functional ratings, however, these methods are not intended to be used for determining mitigation success on constructed stream and wetland sites.

3.4.3 Channel Evolution

The modified Simon Channel Evolution Model (CEM) describes a predictable sequence of change in a disturbed channel system (Simon, 1989). Channel evolution typically occurs when a stream system begins to change its morphologic condition, which can be a negative or positive trend towards stability. The channel evolution processes and stage vary across the Project site and have been greatly affected by anthropogenic disturbances. After reviewing the channel dimension, plan form, and longitudinal profile information, WLS concluded that lower R7 currently exhibits positive trends towards stability or quasi-equilibrium. Project reaches R3 and R6 are considered Class 'III' of the CEM as evidenced by migrating headcuts and will likely continue to degrade and widen. Reaches R2 and R4 are transitioning from Class 'IV' to Class 'V' as evidenced by channel widening and sediment aggradation. The proposed stream restoration approaches described in Section 6.1 are supported by these observations.

3.4.4 Sediment Supply, Delivery and Storage

Visual inspections of the channel substrate materials were conducted for each of the Project stream reaches. No representative bed materials samples were collected due to reachwide persistence of coarse sand. Due to past downcutting associated with headcut migration, most grade control along the project reaches appears to be provided by root matts and existing culverted stream crossings. Much of the parent material, coarse sand particle sizes, are mostly buried and still evident in some of the bank profiles. Field investigations suggest that the fine sediment supply is being recruited predominantly from streambank erosion along the project stream reaches and upland development. The streambank erosion along the project stream reaches appears to be limited during episodic storm flows due to stormwater influences from herbaceous vegetation and rotational crop cover.

3.4.5 Jurisdictional WOTUS

WLS investigated on-site jurisdictional waters of the US (WOTUS) using the US Army Corps of Engineers (USACE) Routine On-Site Determination Method. This method is defined in the 1987 Corps of Engineers Wetlands Delineation Manual and subsequent Eastern Mountain and Piedmont Regional Supplement (USACE, 1987). Determination methods included stream classification utilizing the NCDWQ Stream Identification Form and the USACE Stream Quality Assessment Worksheet. Potential jurisdictional (JD) wetland areas as well as upland areas were classified using the USACE Wetland Determination Data Form. Determination methods for stream classification utilized the NCDWQ Stream Identification Form (v4.11).

The results of the on-site field investigations conducted by WLS indicate that the Project reaches were determined to be jurisdictional stream channels. In addition, seven jurisdictional wetland areas (totaling 7.06 acres, including acreage outside the easement areas) were delineated within the Project area (Figure 6 and Appendix 9). WLS submitted a preliminary jurisdictional determination (PJD) application package to the USACE in July 2018 and an email concurrence was sent August 2018. The final PJD will be provided in the final mitigation plan if available and issued with the NWP 27.

Currently, some of the existing wetland areas located in the floodplain have been impacted by cattle wallowing and past land clearing. After restoration activities, these areas will experience a more natural hydrology and flooding regime, and the riparian buffer area will be planted with native woody vegetation species that is more tolerant of wet conditions. Existing stream profiles will be elevated along various reach sections of R3 and R6 which will improve local water table conditions adjacent to the channels and encourage more frequent flooding of riparian wetland areas. The proposed stream and wetland impacts are considered temporary and will be included with the 401/404 permit application.

3.5 Potential Site Constraints

3.5.1 *Existing Right-Of-Ways on the Site*

No existing ROWs exist within the Project site. R6 and R2 are currently split by a farm access road across existing pond dams with pipe culverts. The R2 pond dam and pipe culvert will be removed and R6 dam will be lowered and replaced with a proposed concrete pipe culvert.

3.5.2 *Utility Corridors within the Site*

There is an existing CP&L power line easement secured for future utility corridor expansion. The power line easement is approximately 180’ wide and intersects the project boundary as shown on the design plan sheets (Appendix 1). The project boundary and proposed mitigation assets exclude these areas within utility easement located along R4 and R6 and W4.

3.5.3 *Mineral or Water Rights Assurance*

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

3.5.4 *Hydrologic Trespass*

The lower portion of R7 proposed for preservation is located within a FEMA regulated floodplain. While it is not anticipated that there will be issues associated with FEMA permitting or documentation, WLS will coordinate with the local floodplain administrator as needed and prepare the required documentation to obtain approval for any FEMA regulated impacts. In addition, the Project will be designed so that any increase in flooding will be contained within the Project boundary and will not impact adjacent landowners; therefore, hydrologic trespass will not be a concern.

3.5.5 *Invasive Species Vegetation*

Chinese privet, multiflora rose, and golden bamboo were observed within the existing riparian buffer areas. These areas will be monitored by WLS, and any invasive plants found within the Project boundary will be treated to prevent expansion and establishment of a substantial invasive community.

3.5.6 *Future Potential Site Risks and Uncertainties*

Future potential site risks include, but are not limited to development, silviculture, and infrastructure maintenance. Many of these potential risks may be unavoidable, however, project reaches are designed to be self-maintaining and resilient in a dynamic landscape. Riparian buffers in excess of 50 feet will protect the project streams and wetlands from anticipated changes in watershed hydrologic regimes.

3.6 Existing Wetland Conditions

Detailed soil mapping, conducted by a licensed soil scientist (Wyatt Brown, LLS with Brown's Environmental Group), determined that hydric soils are present within the stream valleys and adjacent floodplain. The most common observed field indicator of hydric soil was F3-Depleted Matrix. On-site streams were manipulated and/or deepened, and groundwater elevations were altered such that many of the historic riparian wetlands along the floodplain have been drained and lost. These areas have been utilized for silviculture and agricultural production over the past few decades and have lost their historic wetland function. The stream valleys are mapped as containing hydric soils and have a presence of sand and loam throughout the floodplains. As a result of past ditching activities and subsequent groundwater and hydrology impacts, some of these areas are not currently considered to be existing jurisdictional wetlands. However, areas within the Project site where stream sections are not modified maintain the presence of jurisdictional wetlands. Based on assessment of the on-site water features, there are seven existing wetland systems identified within the Project site boundaries. On-site wetlands have been delineated (flagged) and the PJD was submitted in July 2018.

NC WAM: WLS completed wetland evaluations of the Project wetlands using the *NC Wetland Assessment Method* (NC WAM, Version 5, 2016) developed by the NC Wetland Functional Assessment Team (WFAT). The purpose of NC WAM is to provide the public and private sectors with an accurate, consistent, rapid, observational, and science-based field method to determine the level of function of wetlands within North Carolina. NC WAM can be used as a tool for the consideration of project restoration design and planning, allowing for impacts to be avoided and/or minimized, and to provide information concerning assessed wetland characteristics and functions for the regulatory review process.

WLS evaluated the NC WAM metrics relevant to the project wetlands, as shown in Appendix 8. The metrics were documented to evaluate various wetland functions. The Project wetland scores ranged from 'low' to 'high'. Wetlands WF and WG scored 'low' due to altered hydrologic connectivity, water quality, and habitat. Wetlands WA, WB, and WE scored 'medium' due to altered hydrologic connectivity and water quality. Wetlands WC and WD scored 'high' because they are mostly undisturbed. These ecological assessments incorporated qualitative and quantitative observations using historic aerials, field evaluations, and detailed topographic survey data collected across the site. The conclusions from these assessments help describe the current wetland ecological conditions and functional ratings, however, these methods are not intended to be used for determining mitigation success on constructed stream and wetland sites.

4 Functional Uplift Potential

Harman et al. (2012) provides a framework for conducting function-based assessments to develop project goals and objectives based on a site's restoration potential and functional uplift. The framework is based on the Stream Functions Pyramid (SFP) which is a conceptual model that can be used to better define project goals and objectives by linking them to stream functions. Stream functions are separated into a hierarchy of functions and structural measures, ranging from Level 1 to Level 5 and include the following functional categories: Hydrology (Level 1), Hydraulic (Level 2), Geomorphic (Level 3), Physiochemical (Level 4), and Biological (Level 5). Chapter 4 of *A Function-Based Framework* (Harman et al., 2012) provides a more detailed description of the SFP and is illustrated in Appendix 2. The SFP framework is applied below to further describe the functional lift potential based on the existing conditions assessment and proposed restoration design elements.

4.1 Function-Based Parameters and Measurement Methods

Function-based parameters and measurement methods were evaluated using the Stream Functional Lift Quantification Tool (SQT, v3.0) to help assess the existing stream conditions, determine restoration potential and identify risks associated with the project site. The SQT is a qualitative and quantitative resource used to describe the function-based condition of each project reach, as well as evaluate functional capacity and predict the overall proposed lift (Harman and Jones, 2016). WLS applied the SQT to help further define goals and objectives based on the restoration potential. The results of this assessment helped determine the highest level of restoration that may be achieved based on-site constraints and existing conditions. Table 11 shows the function-based condition assessment parameters and measurement methods selected to help quantify and describe each functional category. The complete SQT functional assessment worksheets and summaries are provided in Appendix 2.

Table 11. Existing and Proposed Functional Condition Assessment Summary

Functional Category (Level)	Function-Based Parameters	Measurement Method
Hydrology (Level 1)	Catchment Hydrology	Catchment Assessment/ Curve Number
	Runoff	Curve Number
Hydraulics (Level 2)	Floodplain Connectivity	Bank Height Ratio
		Entrenchment Ratio
Geomorphology (Level 3)	Bank Migration/Lateral Stability	Meander Width Ratio
		Percent Streambank Erosion
	Riparian Vegetation	Left Buffer Width (ft)
		Right Buffer Width (ft)
	Bed Form Diversity	Pool Depth and Spacing Ratio
		Percent Riffle and Pool
	Sinuosity	Planform
	Channel Evolution	Simon Channel Evolution Model

Note 1: Table adapted from Harman et al. (2012).

Note 2: Level 4 and Level 5 Parameters were not evaluated.

4.2 Performance Standards and Functional Capacity

The Pyramid Framework includes performance standards associated with the function-based assessments and measurement methods described above. The performance standards are used to determine the functional capacity and are stratified into three types: *Functioning (F)*, *Functioning-at-Risk (FAR)*, and *Not Functioning (NF)*. The detailed definitions and index value ranges for each type are described further in the SQT (Harman and Jones, 2016). Table 12 summarizes the overall reach scoring and functional lift summary for each project reach.

Table 12. Functional Lift Scoring Summary

Project Reach Designation	Functional Lift Score (PCS-ECS)	Functional Lift (%)	Overall Existing vs. Proposed Condition
R2	0.09	31	NF / FAR
R3	0.15	45	NF / FAR
R4	0.10	31	FAR / FAR
R6	0.22	187	NF / FAR
R7 (upper)	0.14	96	FAR / FAR

Note 1: R1 and R5 were not scored due to ponded headwater conditions.

4.3 Restoration Potential

After completing the function-based assessment, the restoration potential was determined to better define the Project design goals and objectives. It is common for restoration projects to occur at a reach scale that provide minimum functional lift of Level 2 and 3 parameters. However, to achieve goals in Levels 4 and 5, a combination of reach scale restoration and upstream watershed health must be measurable and sustainable. The overall restoration potential was determined at Level 3 (Geomorphology) since the watershed assessment scored 'Fair' and may not fully support biological reference conditions in some of the project reaches given the sediment and nutrient inputs, smaller drainages, intermittent flows, and current watershed conditions. However, it is expected that the implementation of this project will reduce pollutant loads, including sediment and nutrients, improving overall aquatic functions.

The SQT manual recommends that practitioners, stakeholders and regulators collaborate when selecting appropriate parameters for determining whether project goals and objectives are being met or if any performance standards need to be adjusted based on local site conditions. Not all functional categories and parameters and performance standards listed in the SQT will be compared or required to determine project success and stream mitigation credit and debit scenarios. However, selecting applicable monitoring and evaluation methods will help develop a more function-based assessment and improve our project implementation process, thereby advancing the practice of ecosystem restoration.

5 Mitigation Project Goals and Objectives

WLS set mitigation project goals and objectives to provide compensatory mitigation credits to DMS based on the existing condition, functional capacity and restoration potential to improve and protect diverse aquatic resources comparable to stable stream and wetland systems within the Piedmont Physiographic Province. The Project will provide numerous water quality and ecological benefits within the Buffalo Creek Watershed, which drains to the Little River, which eventually drains to the Neuse River. While many of these benefits are focused on the project area, others, such as nutrient removal, sediment reduction, and improved aquatic and terrestrial habitat, have more far-reaching effects extending downstream to the Neuse River. The project will meet the general restoration and protection goals outlined in the 2010 (amended 2018) Neuse River Basin Restoration Priority Plan (RBRP). More specifically, three out of the four functional goals and objectives outlined in the Wake-Johnston Collaborative Local Watershed Plan (LWP) as well as the Neuse 01 RWP will be met by:

- Reducing sediment and nutrient inputs to the Buffalo Creek Watershed.
- Restoring, preserving and protecting wetlands, streams, riparian buffers and aquatic habitat.
- Implementing agricultural BMPs and stream restoration in rural catchments together as “project clusters”.

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

- Restore stream and floodplain interaction and geomorphically stable conditions by reconnecting historic flow paths and promoting more natural flood processes;
- Improve and protect water quality by reducing streambank erosion, nutrient and sediment inputs;
- Restore and protect riparian buffer functions and habitat connectivity in perpetuity by recording a permanent conservation easement; and
- Incorporate water quality improvement features to reduce nonpoint source inputs to receiving waters.

Function-based goals and objectives were considered that relate restoration activities to the appropriate parameters from the SFP framework, which are based on existing conditions, site constraints and overall restoration potential. When developing realistic function-based project goals and design objectives, it is imperative to know why the functions or resources need to be restored (Goal) and what specific restoration activities and measurement methods will be used to validate the predicted results (Objective).

To accomplish these site-specific goals, the following function objectives will be measured to document overall project success as described in Table 13.

Table 13. Function-Based Goals and Design Objectives Summary

Functional Category (Level)	Functional Goal / Parameter	Functional Design Objective
Hydrology (Level 1)	Improve Base Flow	Improve existing stream crossings and restore a more natural flow regime and aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	BHRs to not exceed 1.2 and increase ERs no less than 2.2 for Rosgen 'C' and 'E' stream types and 1.4 for 'B' stream types.
Geomorphology (Level 3)	Improve Bedform Diversity	Increase riffle/pool percentage and pool-to-pool spacing ratios.
	Increase Lateral Stability	Reduce BEHI/NBS streambank erosion rates comparable to downstream reference condition and stable cross-section values.
	Establish Riparian Buffer Vegetation	Plant and protect native species vegetation a minimum 50' wide from the top of the streambanks with a composition/density comparable to reference condition.
Physicochemical (Level 4)	Improve Water Quality	Treat adjacent stormwater and agricultural runoff. Remove impoundments and cattle from riparian corridor. Planting native vegetation and increase shade, DO and lower water temperature.
Biology (Level 5)	Improve Macroinvertebrate Community and Aquatic Species Health	Incorporate native woody debris and refugia into channel.

As described in Section 4, the function-based assessment suggests that the proposed mitigation activities will result in a higher functioning aquatic ecosystem. The project goals and objectives address water quality stressors by reducing nutrient and sediment inputs through stream restoration, riparian wetland restoration and incorporating water quality improvement features. Hydrologic functions will be improved by raising the local water table. A more natural flow regime will be restored to riparian wetlands and floodplain areas by implementing a Priority Level I Restoration. The water quality functions will also be improved by installing permanent cattle exclusion fencing. The biologic and habitat functions will be improved by extending wildlife corridors that connect with wooded areas near the upstream and downstream extents of the project reaches. Additionally, site protection through a conservation easement in excess of 50 feet from the top of banks, will protect all stream reaches and aquatic resources in perpetuity. These mitigation efforts will provide a significant ecological benefit with minimal impacts and constraints during a recovery period that would not otherwise occur through natural processes.

5.1 Project Benefits Summary

The project will provide numerous water quality and ecological benefits within the Buffalo Creek Watershed. While many of these benefits will focus on the project area, others, such as nutrient removal, sediment reduction, and improved aquatic and terrestrial habitat, others have more far-reaching effects that extend downstream. The expected project benefits and ecological improvements are summarized in Table 14.

Table 14. Project Benefits Summary

Benefits Related to Hydrology	
Rainfall/Runoff	Improving existing stream crossings and properly sizing pipe culverts and water quality treatment features will reestablish more natural flow conditions and water transport during various storm events.
Benefits Related to Hydraulics	
Floodplain Connectivity	The restored streams will be raised and reconnected to their active or relic floodplains to spread higher flow energies onto the floodplain thereby increasing retention time and floodplain roughness. Raise water table and hydrate riparian wetlands.
Surface Storage and Retention	Incorporation of depressional areas and other constructed floodplain features will improve flow dynamics by reducing runoff velocities and provide additional surface storage and habitat diversity.
Groundwater Recharge/ Hyporheic exchange	Benefits will be achieved through restoring wetland hydrology, protecting vegetated buffers, which increase groundwater infiltration, surface water interaction, and recharge rates.
Benefits Related to Geomorphology	
Proper Channel Form	Restoring an appropriate dimension, pattern, and profile will efficiently transport and deposit sediment (point bars and floodplain sinks) relative to the stream's power and load that is supplied from banks and uplands. Stream channels that are appropriately sized to convey higher frequency storm flows will greatly improve channel stability by reducing active bank erosion (lateral stability) and bed degradation (vertical stability; i.e. headcuts, downcutting, incision).
Benefits Related to Geomorphology	
Sediment Transport	Boundary conditions, climate, and geologic controls influence stream channel formation and how sediment is transported through its watershed. Adequate channel capacity will ensure sediment supply is distributed such that excessive degradation and aggradation does not occur.
Riparian Buffer Vegetation	Protecting buffer vegetation will improve thermal regulation (stream shading) along the riparian corridor, as well as increase woody root mass and density thereby decreasing bank erosion and sedimentation and increasing organic matter and woody debris.
Bioengineering Treatments	Bioengineering practices such as live staking, brush layering, and vegetated soil lifts will help encourage lateral bank stability and prevent further bank erosion and sedimentation.
Benefits Related to Physicochemical (Water Quality)	
Nutrient Reduction	Benefit may be achieved through the removal of cattle manure in the form of fecal coliform bacteria and excess nutrients through exclusion fencing, filtration and nutrient uptake within the restored wetlands, floodplain and enhanced vegetated buffers.

Sediment Reduction	Benefit will be achieved through stabilization of eroding banks; installation of vegetation buffers; and by dissipating stream energy with increased overbank flows during storm events.
Benefits Related to Physicochemical (Water Quality) Continued…	
DO, NO_3^-, DOC Concentration	Benefits may be achieved through the restoration of more natural stream forms including riffle and pool sequences, which will increase dissolved oxygen (DO) concentrations. In addition, protecting riparian buffers will increase shade and reduce water temperatures and groundwater nitrates (NO_3^-) as well as increase dissolved organic carbon (DOC) (King et al, 2016).
Benefits Related to Biology	
Terrestrial and Aquatic Habitat	Benefits will be achieved through the incorporation of physical structure, removal of invasive species vegetation and returning native vegetation to the restored/enhanced buffer areas. Benefits to aquatic organisms will be achieved through the installation of appropriate in-stream structures. Adequately transporting and depositing fine-grain sediment onto the floodplain will prevent embeddedness and create interstitial habitat, organic food resources and in-stream cover.
Landscape Connectivity	Benefits to landscape connectivity will be achieved by restoring a healthy stream corridor, promoting aquatic and terrestrial species migration and protecting their shared resources in perpetuity.

6 Design Approach and Mitigation Work Plan

The project includes the restoration, enhancement, preservation, and permanent protection of eight stream reaches (R1, R2, R3, R4, R5, R6, R7 upper, and R7 lower) totaling approximately 4,313 linear feet and six wetland areas (W1, W2, W3, W4, W5 and W6) totaling 3.89 acres of riparian wetlands (See Figure 9). The design approach will utilize the entire suite of stream mitigation practices, from Priority Level I Restoration to Preservation, and appropriately addresses all the intermittent and perennial stream reaches at the project site. The project also includes restoring, enhancing, and preserving riparian wetlands along streams as well as improving the existing stream crossings, thus providing significant functional uplift and a unique opportunity to implement a watershed approach. The mitigation components and proposed credit structure is outlined in Table 15 and the design approach and mitigation work plan are described in the following subsections.

All riparian buffer mitigation planting activities will be conducted in concurrence with the approved mitigation plan and will not commence before the proposed stream mitigation activities. Therefore, the locations and limits of the mitigation areas where riparian buffer mitigation credits are proposed to be generated may be altered slightly, depending on the final stream mitigation design. The actual planted riparian buffer areas will be identified during the as-built surveys and documented in the baseline monitoring document and as-built monitoring report.

Table 15. Mitigation Components and Proposed Credit Summary

Project Segment	Existing Footage or Acreage	Mitigation Plan Footage or Acreage	Mitigation Category	Restoration Level	Priority Level	Mitigation Ratio (X:1)		As-Built Footage or Acreage	Comments
Reach 1	N/A	437.000	Warm	R (PI/HW)	1	1.00000			Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
Reach 2	632.000	526.000	Warm	EII	N/A	2.50000			Livestock Exclusion, Invasive Control, Supplemental Planting, Habitat Structures, Permanent Conservation Easement
Reach 3	1169.000	1091.000	Warm	R	1	1.00000			Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
Reach 4	392.000	190.000	Warm	EII	N/A	3.00000			Livestock Exclusion, Invasive Control, Supplemental Planting, Habitat Structures, Permanent Conservation Easement
Reach 5	N/A	340.000	Warm	R (PI/HW)	1	1.00000			Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
Reach 6	610.000	432.000	Warm	R	1	1.00000			Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
Reach 7 upper	468.000	625.000	Warm	EI	N/A	1.50000			Dimension, Pattern and Profile modified, Livestock Exclusion, Supplemental Planting, Permanent Conservation Easement
Reach 7 lower	412.000	412.000	Warm	P	N/A	10.00000			Permanent Conservation Easement
Wetland 1	0.000	0.476	RR	RE		1.00000			Livestock Exclusion, Pond drainage, Limited soil manipulation, and Planting
Wetland 2	0.000	0.416	RR	RE		1.00000			Livestock Exclusion, Pond drainage, Limited soil manipulation, and Planting
Wetland 3	0.840	0.666	RR	RH		1.50000			Limited soil manipulation and Planting
Wetland 4	0.000	0.234	RR	RE		1.00000			Limited soil manipulation, Restored groundwater hydrology and Planting
Wetland 5	1.660	1.654	RR	E		2.50000			Restored hydrology and Planting
Wetland 6	0.440	0.444	RR	P		10.00000			Permanent Conservation Easement

Project Credits

	Stream			Riparian Wetland		Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Riverine	Non-Riv	Wetland	Marsh
Restoration	**2300.000**						
Re-establishment				**1.126**			
Rehabilitation				**0.444**			
Enhancement				**0.662**			
Enhancement I	**416.667**						
Enhancement II	**273.733**						
Creation							
Preservation	**41.200**			**0.044**			
Totals	**3031.600**			**2.276**	**0.000**	**0.000**	

6.1 Stream Design Approach

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

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

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

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

6.1.1 Proposed Design Parameters

A headwater valley restoration approach is proposed for R1 and R5 due to their smaller drainage areas flatter slopes, and restoration within an existing pond bed. It is likely that prior to disturbed conditions, these systems existed as lower gradient headwater stream and wetland complexes within the natural valley, exhibiting moderately defined channels with diffuse flow paths and increased meander lengths before transitioning towards a more well-defined channel with increased sinuosity and bed and bank formations. These shallow drainage ways are commonly observed in this area and typically support headwater stream channels and wetland plant communities.

Headwater stream and wetland restoration activities will include limited excavation of a broader floodplain above the existing bed elevation where appropriate and will seek to restore groundwater hydrology and connection of surface flows. The design concept will address the current channel's dimension, pattern, and profile to create stable conditions. Appropriate use of in-stream structures will consist of hardwood logs and woody materials to provide increased stability (both lateral and vertical) and aquatic habitat.

The design parameters for the headwater reaches are based on reference reach data, monitoring data, and conclusions developed from a study of functional riparian headwater stream systems in the Coastal Plain setting. This study evaluated the conditions that determine channel formation in small headwater systems, and developed relationships between drainage area and valley slope that correlate to channel form. The information gathered from this study can be used to help predict if a natural stream system will likely function as a single or multiple-thread channel (Tweedy, 2009). Under stable conditions (dynamic equilibrium), these multi-thread stream systems are classified as Rosgen 'DA' stream types (Rosgen, 1996). Nanson and Knighton characterized anastomosed channels by having low gradients and low stream power ($\leq 10\ Wm^{-2}$). These flow regimes are often more aggradation, have channel slopes flatter than 0.01

ft/ft, width/depth ratios higher than 20, however channel sinuosity or “transitional patterns” can vary greatly from 1.1 to 1.5 (Nanson and Knighton, 1993).

The proposed design parameters were developed so that plan view layout, cross-section dimensions, and longitudinal profiles could be described for developing construction documents. The design philosophy considers these parameters as conservative guidelines that allow for more natural variability in stream dimension, facet slopes, and bed features to form over long periods of time under the processes of flooding, re-colonization of vegetation, and other watershed influences (Harman, Starr, 2011). Evaluating reference reach information and empirical data from monitoring stable rural Piedmont and Coastal Plain stream restoration projects provided pertinent background information and rationale to determine the appropriate design parameters given the existing conditions and restoration potential. The proposed stream design parameters also considered the *USACE Stream Mitigation Guidelines* issued in April 2003 (rev. October 2005) and the Natural Channel Design Checklist (Harman, 2011).

Table 16. Proposed Design Parameters

Parameter	R1	R3	R5	R6	R7 upper
Drainage Area, DA (acres)	42.9	83.2	19.4	30.7	39.7
Stream Type (Rosgen)	DA/E5	B5	DA/E5	B5c	B5c
Bankfull Riffle XSEC Area, Abkf (sq ft)	3.2	4.8	1.8	2.4	2.4
Bankfull Mean Velocity, Vbkf (ft/sec)	3.5	4.1	5.6	4.2	4.2
Bankfull Riffle Width, Wbkf (ft)	6.0	8.0	5.5	6.0	6.0
Bankfull Riffle Mean Depth, Dbkf (ft)	0.53	0.60	0.33	0.40	0.40
Width to Depth Ratio, W/D (ft/ft)	11.4	13.3	16.8	15.2	15.2
Width Floodprone Area, Wfpa (ft)	52 – 115	25 – 30	49-103	22-40	126-145
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	8.7 – 19.2	3.1 – 3.8	8.9-18.7	3.7-6.7	21-24
Riffle Max Depth Ratio, Dmax/Dbkf	1.3	1.3	1.2	1.3	1.3
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0	1.0	1.0	1.0	1.0
Meander Length Ratio, Lm/Wbkf	N/A	N/A	N/A	N/A	N/A
Radius of Curvature Ratio, Rc/Wbkf	N/A	N/A	N/A	N/A	N/A
Meander Width Ratio, Wblt/Wbkf	N/A	N/A	N/A	N/A	N/A
Channel Sinuosity, K	~1.1	~1.1	~1.1	~1.1	~1.1
Channel Slope, Schan (ft/ft)	0.0089	0.0159	0.0077	0.0135	0.0123
Riffle Slope Ratio, Sriff/Schan	1.5 – 2.0	1.1 – 1.8	1.5 – 2.0	1.1 – 1.8	1.1 – 1.8
Pool Slope Ratio, Spool/Schan	0.0 – 0.2	0.0 – 0.4	0.0 – 0.2	0.0 – 0.4	0.0 – 0.4
Pool Width Ratio, Wpool/Wbkf	1.3 – 1.7	1.1 – 1.5	1.3 – 1.7	1.1 - 1.5	1.1 - 1.5
Pool-Pool Spacing Ratio, Lps/Wbkf	4.0 – 7.0	1.5 – 5.0	4.0 – 7.0	1.5 – 5.0	1.5 – 5.0
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.0 – 3.5	2.0 – 3.5	2.0 – 3.5	2.0 – 3.5	2.0 – 3.5

6.1.2 *Design Reach Summary*

For design purposes, the stream segments were divided into multiple reaches labeled R1, R2, R3, R4, R5, R6, R7 upper, and R7 lower, as shown in Figure 9. The design approach will provide a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is anticipated that the design width/depth ratios for the restored channels will be similar to stable streams in this geologic setting. In-stream structures, such as constructed riffles, log and rock step-pools, log vanes, log weirs and grade control log j-hooks will be used to dissipate flow energy, protect streambanks, prevent future incision, provide aquatic habitat, and increase bedform diversity. Restored streambanks will be graded to stable side slopes and the floodplain will be reconnected to further promote stability and hydrological function. Bioengineering techniques, such as geolifts, toe wood, brush layers, and live stakes, will also be used to protect streambanks and promote woody vegetation growth along the streambanks.

Riparian buffers in excess of 50 feet will be improved and/or protected along all the project reaches. Any mature trees or significant native vegetation will be protected and incorporated into the design. Bioengineering techniques, such as geolifts, toe wood, brush layers, and live stakes, will also be used to protect streambanks and promote woody vegetation growth along the streambanks. The existing unstable channels will be filled to an elevation sufficient to connect the new bankfull channel to its historic floodplain, or an excavated floodplain will be constructed, using suitable fill material from the newly restored channel and remnant spoil piles. Any exotic species vegetation will be removed, and native riparian species vegetation will be replanted in the resulting disturbed areas. These proposed restoration activities will provide the maximum possible functional uplift. The following narrative summarizes the proposed design approach, rationale and justification for each of stream reaches.

Restoration: R1, R3, R5, R6

R1

R1 begins near the top of the existing farm pond. In this area, the existing channel begins experiencing backwater conditions from a man-made earthen dam. The existing farm pond is approximately 1.5 acres in size and serves as a primary watering source and wallowing area in support of the landowner’s cattle operation. The dam and outlet pipe will be removed, and the pond will be drained to reconnect the new stream channel with its geomorphic floodplain. The channel and floodplain excavation in this reach segment will include the removal of shallow legacy sediments to accommodate a new design channel and in-stream structures, as well as a more natural step-pool morphology using grade control structures in the steeper transitional areas.

The reach will be restored as a Rosgen ‘DA’ stream type with conservative meander planform geometry that accommodates the valley slope and width. This approach will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is expected that over time, channel widths will narrow slightly due to fine grain sediment deposition and vegetation growth along the streambanks. The valley bottom within the old pond bed will be graded to restore the natural microtopographic variability that is common within headwater stream and wetland systems. A small pilot channel will be graded to allow diffuse flow paths to maintain a defined channel form over time. The low flow through R1 will mimic a historic flow patterns through channel depressions, restoring a more natural hydrology function. Finally, one agricultural BMP is proposed above R1 to capture, attenuate, and treat concentrated flow that would otherwise enter the riparian buffer as untreated water. The BMP will be constructed outside of the conservation easement but will be fenced to restrict cattle access.

R3

R3 begins at an active headcut below an existing culvert crossing along R2. R3 is severely incised in many locations with BHRs ranging from 2.0 to 3.0. The channel has been historically manipulated, but generally flows through the low point of the valley. Work along R3 will involve a Priority Level I Restoration by raising the bed elevation and reconnecting the stream with its geomorphic floodplain. A majority of the channel will be restored in its current location with minor adjustments to channel planform. This approach will promote more frequent over bank flooding in areas with hydric soils, thereby creating favorable hydrologic conditions for wetland restoration (re-establishment) across the floodplain. The reach will be restored as a Rosgen 'B4' stream type using appropriate step-pool morphology with a minimal meander planform geometry that accommodates the valley slope and width. This approach will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is anticipated that the design width/depth ratio for the channel will be similar to stable headwater streams in this geologic setting.

R5

R5 begins near the top of the existing farm pond. In this area, the existing channel begins experiencing backwater conditions from a man-made earthen dam. The existing farm pond is approximately 2.0 acres in size and serves as a primary watering source and wallowing area in support of the landowner's cattle operation. The earthen dam and outlet pipe will be removed, a new culvert will be installed to accommodate a 10-yr storm flow, and the embankment will be lowered. This will allow landowner access between adjacent pastures. The pond will be drained to reconnect the new stream channel with its geomorphic floodplain. The channel and floodplain excavation in this reach segment will include the removal of shallow legacy sediments to accommodate a new design channel.

The reach will be restored as a Rosgen 'DA' stream type with conservative meander planform geometry that accommodates the valley slope and width. This approach will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is expected that over time, channel width will narrow slightly due to fine grain sediment deposition and vegetation growth along the streambanks. The valley bottom within the old pond bed will be graded to restore the natural microtopographic variability that is common within headwater systems. Similar to R1, a small pilot channel will be graded to allow diffuse flow paths to maintain a defined channel form over time. The low flow through R5 will mimic a historic flow patterns through channel depressions, restoring a more natural hydrology function.

R6

R6 begins at the pipe outlet below R5 and the existing pond dam. The reach currently exhibits some lateral and vertical instability, as shown by an active headcut and moderate bank erosion. Work along R6 will involve a Priority Level I Restoration by raising the bed elevation and reconnecting the stream with its geomorphic floodplain. The majority of this reach will be constructed offline in the low part of the valley.

This approach will promote more frequent over bank flooding in areas with hydric soils, thereby creating favorable hydrologic conditions for wetland restoration (re-establishment) across the floodplain. The reach will be restored as a Rosgen 'B4c' stream type using appropriate step-pool morphology with a minimal meander planform geometry that accommodates the valley slope and width. This approach will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is anticipated that the design width/depth ratio for the channel will be similar to stable headwater streams in this geologic setting.

Enhancement Level II: R2, R4

R2

R2 begins at the pipe outlet below the existing pond dam. During site investigations, the channel appears to have been historically manipulated but is relatively stable throughout most of its length. WLS proposes an Enhancement Level II approach along this reach to address the isolated bank erosion and lateral instability. Construction activities will consist of strategic mechanized removal of invasive species along the left stream bank and regrading the stream banks back to the existing stable dimension, installing erosion control matting, and supplemental riparian buffer planting and live stakes. The reach in this section is classified as a Rosgen 'C5' stream type.

R4

R4 begins at the terminus of R3. This area has been historically disturbed through pasture use and agricultural practices, and the channel exhibits poor channel definition in some sections. However, the existing channel has limited bank erosion and channel incision as it near the bottom of the project limits. WLS proposes an Enhancement Level II approach along this reach to address the isolated bank erosion and lateral instability. Construction activities will consist of strategic mechanized removal of invasive species, strategic in-stream structures to stabilize an existing headcut, regrading the stream banks back to the existing stable dimension, installing erosion control matting, and supplemental riparian buffer planting and live stakes. The reach in this section is classified as a Rosgen 'E5' stream type.

Enhancement Level I: R7 upper

The upper section of R7 begins at the terminus of R6. The channel has been historically manipulated and work along this reach will include filling in the existing channel and realigning the channel through the natural valley location. The reach will be constructed as a Rosgen 'DA' stream type. This approach will promote a stable channel form with appropriate bedform diversity, as well as improved ecological function through increased aquatic and terrestrial habitats. It is expected that over time, channel width will maintain a stable form by fine grain sediment deposition and vegetation growth along the streambanks. A small pilot channel will be excavated to allow flow from R6 to be routed through R7 allowing more extensive wetting of the adjacent wetlands as well as allowing diffuse flow paths to form on their own over time. The low flows through R7 upper will be allowed to follow historic flow patterns and spread out through channel depressions, restoring a more natural hydrology function.

Preservation: R7 lower

The downstream section of R7 is currently classified as a Rosgen 'E5' stream type. Preservation is being proposed along this reach since the existing stream and wetland system is mostly stable with a mature riparian buffer due to minimal historic impacts. This approach will extend the wildlife corridor from the Buffalo Creek floodplain boundary throughout a majority of the riparian valley, while providing a natural hydrologic connection and critical habitat linkage within the catchment area.

6.2 Reference Sites

6.2.1 Reference Streams

The morphologic data obtained from reference reach surveys can be a valuable tool for comparison and used as a template for analog design of a stable stream in a similar valley type with similar bed material. To extract the morphological relationships observed in a stable system, dimensionless ratios are developed from the surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type.

While reference reach data can be a useful aid in analog design, they are not always necessary and can have limitations in smaller stream systems (Hey, 2006). The flow patterns and channel formation for many reference reach quality streams are often controlled by slope, bed material, drainage areas and larger trees and/or other deep-rooted vegetation. Some meander geometry parameters, such as radius of curvature, are particularly affected by vegetation control. Pattern ratios observed in reference reaches may not be applicable or are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction or before the permanent vegetation is established. Often the best reference data is from adjacent stable stream reaches or reaches within the same watershed.

For comparison purposes, WLS selected local reference reaches in nearby watersheds and compared them with composite reference data. The reference reach data set represents small "Rural Piedmont Streams," with similar valley morphology and slopes that fall within the same climatic, hydro-physiographic and ecological region as the project site. The data shown on Table 17 helped to determine how the stream system may respond to changes within the watershed. Figure 11 shows the reference site locations as compared to the project site.

Table 17. Reference Reach Data Comparison

Parameter	Local Reference Data			Composite Reference Data	
	LW – R4	PD – R5	EJ – R1		
Stream Type (Rosgen)	E5	E5	C5	E5	C5
Bankfull Mean Velocity, Vbkf (ft/s)	3.8	5.7	6.5	4.0 - 6.0	3.5 - 5.0
Width to Depth Ratio, W/D (ft/ft)	6.2	7.4	14.2	10.0 - 12.0	10.0 - 14.0
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	7.1	8.4	7.3	>2.2	>2.2
Riffle Max Depth Ratio, Dmax/Dbkf	1.8	1.2	1.5	1.1 - 1.3	1.1 - 1.4
Bank Height Ratio, Dtob/Dmax (ft/ft)	0.9	1.0	1.1	1.0 - 1.1	1.0 - 1.1
Meander Length Ratio, Lm/Wbkf	9.3	8.4	6.2	5.0 - 12.0	7.0 - 14.0
Radius of Curvature Ratio, Rc/Wbkf	2.5	1.7	1.6	1.2 - 2.5	2.0 - 3.0
Meander Width Ratio, Wblt/Wbkf	3.9	4.5	4.0	2.0 - 10.0	3.0 - 8.0
Sinuosity, K	1.22	1.17	1.18	1.3 - 1.6	1.2 - 1.5
Valley Slope, Sval (ft/ft)	0.0142	0.0011	0.0145	0.002 - 0.006	0.002 - 0.010
Channel Slope, Schan (ft/ft)	0.0123	0.0084	0.0118	---	---
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.6	2.5	2.9	1.2 - 2.5	1.2 - 2.5
Pool Width Ratio, Wpool/Wbkf	1.5	1.2	1.7	0.7 - 1.5	1.0 - 1.7
Pool-Pool Spacing Ratio, Lps/Wbkf	3.1	3.7	5.0	2.5 - 5.0	3.0 - 7.0

Note 1: Composite reference reach values and ratios were compared using stable stream restoration projects surveyed and monitored in NC as illustrated in the Natural Channel Design Checklist (Harman, 2011).
Note 2: On-site reference reach data was collected at Lake Wendell (Reach R4), Pen Dell (Reach R5), and Edwards-Johnson (Reach R1) DMS full-delivery sites respectively.

6.2.2 Reference Wetlands

A reference wetland that is representative of the riparian wetland system to be restored at the Project site was identified near the project area at the Lake Wendell Mitigation Project, Pen Dell Mitigation Project and Edwards-Johnson Mitigation (collectively named 'Edwards Projects'). The reference wetlands are part of recently completed DMS full-delivery mitigation sites situated adjacent to stream preservation reaches containing mature native species vegetation. The riparian wetland is an example of a Bottomland Hardwood Forest (NC WAM, 2016). Bottomland Hardwood Forests exist in geomorphic floodplains along second-order and larger streams. These wetlands are generally intermittently to seasonally inundated and overbank flooding is the source of groundwater and surface runoff. The existing channel is stable and lightly incised within the wetland area, however the hydrology has higher groundwater table and overbank flooding was observed during the existing conditions assessment and monitoring period (MY2). The soils are described as Wehadkee loam (Wt). A groundwater monitoring well will be installed to document hydrology during the growing season prior to restoration activities and compared with the well data at the Edwards projects.

6.3 Flow Regime

Extensive research demonstrates that a wide range of flows are essential to maintain stable and high functioning habitat across ecological systems. The flow regime has been identified as the primary factor in sustaining the ecological integrity of riparian systems (Poff et al. 1997) and is a key variable in determining the abundance, distribution, and evolution of aquatic and riparian species (Schlosser 1985, Resh et al. 1988, Power et al. 1995, Doyle et al. 2005). The ecological significance of variable stream flows is more relative to flow duration, not necessarily just the flow recurrence interval. Seasonal flow variations correlate to biological relationships and habitat response. The flow conditions can generally be categorized as low flow, channel-forming flow, or flood flows, each with specific ecological significance (Postel and Richter, 2003).

A majority of stream miles (>80 percent) in North Carolina are classified as headwater streams (drainage area <3.9 mi^2), however, less than 10 percent of the 284 USGS stream gages in North Carolina are located on headwater streams (EFSAB, 2013). WLS recognizes the importance of these stream flow variables and the ecological role they play in supporting high functioning headwater steam and wetland systems. As such, flow monitoring will be conducted to demonstrate that the restored headwater stream systems exhibit seasonal base flow during a year with normal rainfall conditions. The stream surface flow documentation methods are further described in Section 8.2. Table 18 summarizes the basic flow levels and ecological roles the restoration design will provide after project implementation.

Table 18. Flow Level and Ecological Role

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

6.3.1 Bankfull Stage and Discharge

Bankfull stage and its corresponding discharge are the primary variables used to develop a natural stable channel design. However, the correct identification of the bankfull stage in the field is difficult and can also be subjective (Williams, 1978; Knighton, 1988; and Johnson and Heil, 1996). Numerous definitions exist of bankfull stage and methods for its identification in the field (Wolman and Leopold, 1957; Nixon, 1959; Schumm, 1960; Kilpatrick and Barnes, 1964; and Williams, 1978). The identification of bankfull stage in the humid Southeast can be especially challenging because of dense understory vegetation and extensive channel modification and subsequent adjustment in channel morphology.

It is generally understood that bankfull stage corresponds with the discharge that fills a channel to the elevation of the active floodplain and represents a breakpoint between processes of channel formation and floodplain development. The bankfull discharge, which also corresponds with the dominant discharge or effective discharge, is the flow that moves the most sediment over time in stable alluvial channels. Field indicators include the back of point bars, significant breaks in slope, changes in vegetation, the highest scour line, or the top of the streambank (Leopold, 1994). The most consistent bankfull indicators for streams in the Piedmont of North Carolina are the backs of point bars, breaks in slope at the front of flat bankfull benches, or the top of the streambanks (Harman et al., 1999).

Upon completion of the field survey and geomorphic assessment, accurate identification of bankfull stage could not be made in all reach sections throughout the site due to incised and impaired channel conditions. Although some field indicators were apparent in segments with lower streambank heights and discernible scour features, the reliability of the indicators was inconsistent due to the altered condition of the stream channels. For this reason, the bankfull stage and discharge were estimated using published regional curve information.

6.3.2 Regional Curve Comparison

Regional curves developed by Dunne and Leopold (1978) relate bankfull channel dimensions to drainage area and are based on the channel forming discharge theory, which states that one unique flow can yield the same channel morphology as the full range of flows. A primary purpose for developing regional curves is to aid in identifying bankfull stage and dimension in un-gaged watersheds, as well as to help predict the bankfull dimension and discharge for natural channel designs (Rosgen, 1994). Gage station analyses throughout the United States have shown that the bankfull discharge has an average return interval of 1.5 years or 66.7% annual exceedance probability on the maximum annual series (Dunne and Leopold, 1978; Leopold, 1994).

Hydraulic geometry relationships are empirically derived and can be developed for a specific river or extrapolated to a watershed in the same physiographic region with similar rainfall/runoff relationships (FISRWG, 1998). Published and unpublished watershed specific bankfull regional curves are available for a range of stream types and physiographic provinces. The NC Rural Piedmont Regional Curve (Harman et al., 1999) and unpublished NC Rural Piedmont Regional Curve developed by the Natural Resources Conservation Service (NRCS, Walker, private communication, 2015) were used for comparison when estimating bankfull discharge. The NC Rural Piedmont Regional Curve and bankfull hydraulic geometry equations are shown in Table 19.

Table 19. North Carolina Rural Piedmont Regional Curve Equations

NC Rural Piedmont Regional Curve Equations (Unpublished Revised NC Rural Piedmont Regional Curve (NRCS, 2015)		NC Rural Piedmont Regional Curve Equations (Published Harman et al., 1999)	
$Q_{bkf} = 55.31\ A_w^{0.79}$	R^2=0.97	$Q_{bkf} = 89.04\ A_w^{0.72}$	R^2=0.91
$A_{bkf} = 19.23\ A_w^{0.65}$	R^2=0.97	$A_{bkf} = 21.43\ A_w^{0.68}$	R^2=0.95
$W_{bkf} = 17.41\ A_w^{0.37}$	R^2=0.79	$W_{bkf} = 11.89\ A_w^{0.43}$	R^2=0.81
$D_{bkf} = 1.09\ A_w^{0.29}$	R^2=0.80	$D_{bkf} = 1.50\ A_w^{0.32}$	R^2=0.88

Project reaches R2, R3, R4, R6 and R7 are classified as first order streams with upstream impoundments and generally these smaller headwater streams can be poorly represented on the regional curves. Based on our experience, the published NC Rural Piedmont Regional Curve Equations can slightly overestimate discharge and channel dimensions for smaller ungaged streams, such as those present at this site. Furthermore, estimating bankfull parameters subjectively rather than using deterministic values may encourage designers to make decisions on a range of values and beliefs that the bankfull depths must inherently be within that range (Johnson and Heil, 1996).

WLS has implemented numerous projects in ungauged drainages in the Piedmont hydrophysiographic province of North Carolina, including nearby projects in Johnston and surrounding counties, and has developed "mini-curves" specific to these projects. The data set on these small stream curves help reduce uncertainty by providing additional reference points and supporting evidence for the selection of bankfull indicators that produce slightly smaller dimensions and flow rates than the published regional curve data set. Channel slope, valley setting, channel geometry, and sediment supply, as well as information from the USGS regression and Manning's equations were all considered during examination of the field data. The estimated bankfull discharges and surveyed cross-sectional areas at the top of bank were plotted on the NC Rural Piedmont Regional Curve and illustrated in Appendix 2.

6.3.3 Channel Forming Discharge

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

The bankfull flows in gaged watersheds within the NC Rural Piedmont study documented return intervals (RI) that ranges from 1.1 to 1.8, with a mean of 1.4 years (Harman et al, 1999). WLS also compared the 2-year flow frequency using the published USGS regression equation for small rural streams (DA ≤3 mi^2) within the Piedmont hydrologic area of North Carolina (USGS, 2014). As expected, these values fall slightly above the published bankfull discharge, but were extrapolated to represent a wider range of flows. WLS then compared lower flow frequencies in the 1.0-yr, 1.2-yr, and 1.5-yr RI range versus survey data and field observations (See Appendix 2). It should be noted that this best fit approach does not always match the dataset, since it falls at the low end of the curve. Therefore, caution should be used when comparing these lower RIs with additional data sets. Using the rationale described above, Table 20 provides the bankfull discharge analyses and comparisons based on the rural Piedmont regional curves, the Manning's equation discharges calculated from the representative cross-section geometry for existing reaches, USGS regional regression equations, and the design discharge estimated based on the proposed design cross-sections for all project reaches.

Table 20. Design Discharge Analysis Summary

Project Reach Designation	Watershed Drainage Area (Ac)	Published NC Rural Piedmont Regional Curve (cfs) [1]	Unpublished NC Rural Piedmont Regional Curve (cfs) [2]	Manning's Equation (cfs) [3]	USGS Regression Equation for 2-year Recurrence Interval (cfs) [4]	USGS Regression Equation for 1.5-year Recurrence Interval (cfs) [5]	USGS Regression Equation for 1.2-year Recurrence Interval (cfs) [5]	Design Discharge Estimate (cfs)
R1	42.9	12.7	6.4	--	24.8	20.7	17.2	11.0
R3	83.2	20.5	11.0	34.1	39.7	31.7	25.6	20.0
R5	19.4	7.2	3.4	--	14.1	12.3	10.6	10.0
R6	30.7	10.6	4.9	11.1	19.5	16.6	14.0	10.0
R7	41.8	12.5	6.3	--	24.3	20.4	17.0	10.0

Note 1: Published NC Piedmont Regional Curve (Harman et al., 1999).

Note 2: Unpublished Revised NC Rural Piedmont Regional Curve developed by NRCS (A. Walker personal communication, 2015).

Note 3: Bankfull discharge estimates vary based on Manning's Equation for the representative riffle cross-sections. Bankfull stage roughness estimates (n-values) ranged from approximately 0.023 to 0.024 based on channel slopes, depth, bed material size, and vegetation influence.

*Note 4: USGS rural regression equation for 2-year flood recurrence interval, Q2 =163(DA)^0.7089*10^(0.0133*(IMPNLCD06)) for small rural streams (USGS, 2011)*

Note 5: NC USGS rural regression equation extrapolated for 1.2- and 1.5-year flood recurrence interval (USGS, 2011)

After considering these estimation methods and results (geometry measurements, regional curves, flow frequency and USGS regional regression equations), WLS estimated the design discharge using values between the published NC Rural Piedmont Regional Curve and Manning's equation to select the appropriate design dimensions and flows rates that best correspond to the design channel that will convey the 1.2-yr to 1.5-yr RI.

6.3.4 Channel Stability and Sediment Transport Analysis

As a design consideration, portions of the bed material may contain particle sizes larger than the D_{84} to achieve vertical stability in steeper sections immediately after construction. The proposed channel slopes throughout the project reaches range from approximately 0.9% to over 1.6%. In general, sections with steeper slopes will be addressed by installing a combination of grade control structures such as log/rock riffles and log/boulders step pools in straighter segments. Incorporating these structures will prevent further channel degradation and embeddedness, promote natural scour and sediment storage, and increase bed/bank stability since shear stress and sediment entrainment are directly affected by factors such flow energy distribution and channel resistance. While it is predicted that the restoration and enhancement efforts will reduce stream bed and bank erosion, the channels must still adequately transport finer bedload material while maintaining vertical and lateral stability.

It should be noted that sediment competency was not calculated and Wolman pebble counts were not analyzed for this sand-bed system; therefore, visual inspection was utilized to characterize the bed material in all the reaches. Most of the site reaches contain coarse sand (D_{50} = 0.5-1.0 mm), with a limited fine gravel bottom due to the parent soil material and the material from the eroding streambanks. A site-specific sediment rating curve and budget was not developed given the limited sediment supply and headwater position in the watershed. This detailed effort requires using on-site monitoring data from documented flow events within the project watershed. However, empirical relationships from stable sand-bed streams were compared to published values and reference streams that have similar characteristics and boundary conditions such as slope, controlling vegetation and bedform morphology.

Based on field observations within the project watershed, the streams receive mostly fine-grained materials directly from streambank erosion with some contributions from the upper catchment area. Further field investigations confirmed that the sediment supply to the project reaches is transported mostly during larger storm events due to small headwater drainage sand influences from dense vegetation cover. The stream channels along reaches R3 and R6 have lost floodplain connectivity and continue to deepen/widen which increases stream power and helps to transport the fine sediment load.

6.4 Wetland Design Approach

Degraded riparian wetlands were documented within the project boundary as well as mapped hydric soils. These areas contain hydric soils indicators and total approximately 2.36 acres of hydric soils and 3.95 acres of degraded jurisdictional wetlands. Figure 6 illustrates areas where conditions are favorable for improving wetland conditions within the conservation easement. The predominant native wetland vegetation communities are largely devoid or not considered reference quality in areas proposed for restoration. On-site investigations of the soils within the project area were conducted in 2017 by licensed soil scientist (LSS), Wyatt Brown, LSS, with Brown's Environmental Group (BEG). The findings were based on hand-turned auger borings and indicate the presence of hydric soils along the floodplains of R2, R3, R6, and R7. The hydric soils status is based upon the "*Hydric Soils of the United States – A Guide for Identifying and Delineating Hydric Soils"* (Version 7.0, 2010). The soils within the project area were categorized as "Hydric", "Non-Hydric over Hydric", and "Non-Hydric" in the hydric soils investigation. The presence of hydric soil indicators and hydric inclusions within 12 inches of the soil surface was verified and soil borings indicate that hydric soils were visually saturated in apparent wetlands, as well as hydric soils along the incised stream reaches that appeared to lack recent hydrology indicators. See Hydric Soils Investigation report in Appendix 2.

Based on these findings and BEG recommendations, combining the proposed stream modifications to incised channels presents a favorable opportunity for meeting riparian wetland restoration criteria and functional uplift potential. It is anticipated that as a direct result of removing cattle and implementing Priority Level I stream restoration, limited overburden soil removal and surface roughening, and revegetation, wetland hydrology will be restored and allow the wetlands to regain their natural/historic functions. The areas proposed for wetland re-establishment, rehabilitation and enhancement are labeled on Figure 9. WLS has compared monitoring data from successful stream and wetland restoration projects in adjacent valleys with the same soil types and expects these areas will likely experience seasonal wetness for prolonged periods and conditions are favorable to support appropriate wetland hydrology. Based on the 2016 NCIRT guidance and detailed hydric soils study, the suggested wetland saturation and hydroperiod range for the Leaf silt loam (Le) soil series is 10-12%.

Riparian Wetland Re-establishment: W1, W2, and W4

Areas of hydric soils were documented along portions of the project floodplains areas. These hydric areas along with areas within the pond impoundments will be restored with high functioning riparian wetlands as a direct result of implementing a Priority Level I restoration, limited soil manipulation and removal (less than 1-foot depth) and planting native vegetation. The groundwater hydrology will be restored and allow the wetland areas to regain their natural or historic functions.

Riparian Wetland Rehabilitation: W3

Areas of significantly degraded riparian wetlands (poorly functioning) were also documented along portions of the project floodplains areas. These poorly functioning wetland areas will be restored as a direct result of implementing a Priority Level I restoration, removal of livestock trampling, limited soil manipulation and removal (less than 1-foot depth) and planting native vegetation. The groundwater hydrology will be restored and allow the wetland areas to regain their natural or historic functions.

Riparian Wetland Enhancement: W5

As described above, the proposed restoration activities will provide significant functional uplift across the project area. The proposed activities will also improve and enhance the hyporheic zone interaction and hydrology to existing wetland areas. Wetland enhancement areas will be planted with native wet tolerant species. Restoration of a natural stream system often requires that the new channel be relocated to the lowest part of the valley, which may result in a temporary disturbance of existing marginal or lower functioning wetlands. In some areas, disturbance of the existing wetlands may be unavoidable to restore a stable and fully functioning wetland and riparian system. However, restoration of the stream channels will also improve areas of adjacent wetlands through higher water table conditions (elevated stream profile) and a more frequent over-bank flooding regime.

Riparian Wetland Preservation: W6

Areas of highly function riparian wetlands were also documented along lower portions of R7 floodplain. These wetland areas will benefit from upstream functional uplift as a direct result of implementing a Priority Level I restoration, removal of livestock and planting native vegetation. The groundwater hydrology will be restored upstream which allow these wetland areas to maintain their natural or historic functions.

6.5 Revegetation Plan

One of the primary project goals includes restoring, enhancing and protecting riparian buffer functions and corridor habitat. This goal includes planting to re-establish native species vegetation along the entire length of the project reaches where the existing riparian corridor is disturbed. This objective will be met by establishing riparian buffers which extend a minimum of 50 feet from the top of the streambanks along each of the project stream reaches, as well as permanently protecting those buffers with a conservation easement. For project stream reaches proposed for restoration and enhancement where the riparian buffer is disturbed, the riparian buffers will be restored through reforestation.

Many of the proposed riparian buffer widths within the conservation easement are greater than 50 feet along one or both streambanks to provide additional functional uplift potential, such as encompassing adjacent wetland areas and areas for riparian buffer mitigation. The riparian buffer zone for the project includes the streambanks, floodplain, riparian wetland, and upland transitional areas. The proposed planting boundaries are shown on the revegetation plans in Appendix 1. The conservation easement areas also may include areas outside of the riparian buffer zone that will be revegetated, including areas that lack vegetation species diversity, or areas otherwise disturbed or adversely impacted by construction. Proposed plantings will be conducted using native species bare-root trees and shrubs, live stakes, and seedlings. Proposed plantings will predominantly consist of bare root vegetation and will generally be planted at a total target density of 680 stems per acre. This planting density has proven successful with the reforestation of past completed mitigation projects, based on successful regulatory project closeout, and including the current USACE regulatory guidelines requiring levels of woody stem survival throughout the monitoring period, with a MY7 final survival rate of 210 stems per acre.

WLS recognizes that riparian buffer conditions at mature reference sites are not reflected at planted or successional buffer sites until the woody species being to establish and compete with herbaceous vegetation. To account for this, we will utilize a successful riparian buffer planting strategy that includes a combination of overstory, or canopy, and understory species. WLS will also consider the supplemental planting of larger and older planting stock to modify species density and type, based on vegetation monitoring results after the first few growing seasons. This consideration will be utilized particularly to increase the rate of buffer establishment and buffer species variety, as well as to decrease the vegetation maintenance costs. An example might include selective supplemental planting of older species as potted stock in later years for increased survivability. The site planting strategy also includes early successional, as well as climax species. The vegetation selections will be mixed throughout the project planting areas so that the early successional species will give way to climax species as they mature over time. The early successional species which have proven successful include river birch and American sycamore. The climax species that have proven successful include oaks (*Quercus spp.*) and tulip-tree (*Liriodendron tulipifera*). The understory and shrub layer species are all considered to be climax species in the riparian buffer community.

6.5.1 Proposed Vegetation Planting

The proposed plant selection will help to establish a natural vegetation community that will include appropriate strata (canopy, understory, shrub, and herbaceous species) based on an appropriate reference community. Schafale's (2012) guidance on vegetation communities for Piedmont Bottomland Forest (mixed riparian community) and Dry-Mesic Oak-Hickory Forest (Piedmont Subtype), the USACE Wetland Research Program (WRP) Technical Note VN-RS-4.1 (1997), as well as existing mature species identified throughout the project area, were referenced during the development of riparian buffer and adjacent riparian wetland plants for the site. The proposed natural vegetation community will include appropriate strata (canopy, understory, shrub, and herbaceous species) based on the appropriate reference community. Within each of the four strata, a variety of species will be planted to ensure an appropriate and diverse plant community.

Tree species selected for restoration and enhancement areas will be weak to tolerant of flooding. Weakly tolerant species can survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species can survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species can survive on sites in which the soil is saturated or flooded for extended periods during the growing season (WRP, 1997). Species proposed for revegetation planting are presented in Table 21.

Table 21. Proposed Riparian Buffer Bare Root and Live Stake Plantings

Scientific Name	Common Name	% Proposed for Planting by Species	Wetland Tolerance
Riparian Buffer Bare Root Plantings – Overstory (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Fraxinus pennsylvanica	Green ash	3%	FACW
Betula nigra	River birch	12%	FACW
Quercus michauxii	Swamp chestnut oak	10%	FACW
Quercus pagoda	Cherrybark oak	10%	FACW
Platanus occidentalis	American sycamore	12%	FACW
Liriodendron tulipifera	Tulip-poplar	12%	FACU
Quercus nigra	Water oak	10%	FAC
Quercus phellos	Willow oak	10%	FACW
Riparian Buffer Bare Root Plantings – Understory (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Diospyros virginiana	Persimmon	4%	FAC
Carpinus caroliniana	Ironwood	3%	FAC
Hamamelis virginiana	Witch-hazel	3%	FACU
Asimina triloba	Paw paw	4%	FAC
Lindera benzoin	Spicebush	4%	FACW
Corylus americana	Hazelnut	3%	FACU
Riparian Buffer Live Stake Plantings – Streambanks (Proposed 2' to 3' Spacing @ Meander Bends and 6' to 8' Spacing @ Riffle Sections)			
Sambucus canadensis	Elderberry	20%	FACW
Salix sericea	Silky Willow	30%	OBL
Salix nigra	Black Willow	10%	OBL
Cornus amomum	Silky Dogwood	40%	FACW
***Note:** Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of plant stock and documented in the as-built report.*			

6.5.2 Planting Materials and Methods

Planting will be conducted during the dormant season, with all trees installed between Mid-November and early March if possible. However, all trees must be installed by the end of April to have the first year of monitoring in that year. Observations will be made during construction of the site regarding the relative wetness of areas to be planted as compared to the revegetation plan. The final planting zone limits may be modified based on these observations and comparisons, and the final selection of the location of the planted species will be matched according the species wetness tolerance and the anticipated wetness of the planting area. It should be noted that smaller tree species planted in the understory, such as ironwood, will unlikely meet the height targets for tree species after seven years.

Plant stock delivery, handling, and installation procedures will be coordinated and scheduled to ensure that woody vegetation can be planted within two days of being delivered to the project site. Soils at the site areas proposed for planting will be prepared by sufficiently loosening prior to planting. Bare root seedlings will be manually planted using a dibble bar, mattock, planting bar, or other approved method. Planting holes prepared for the bare root seedlings will be sufficiently deep to allow the roots to spread outward and downward without "J-rooting." Soil will be loosely re-compacted around each planting, as the last step, to prevent roots from drying out.

Live Staking and Live Branch Cuttings: Where live staking is proposed, live stakes will typically be installed at a minimum of 40 stakes per 1,000 square feet and the stakes will be spaced approximately two to three feet apart in meander bends and six to eight feet apart in the riffle sections, using a triangular spacing pattern along the streambanks, between the toe of the streambank and bankfull elevation. When bioengineering is proposed, live branch cutting bundles comprised of similar live stake species, shall be installed at five linear feet per bundle approximately two to three branches thick. The basal ends of the live branch cuttings, or whips, shall contact the back of the excavated slope and shall extend six inches from the slope face.

Permanent Seeding: Permanent seed mixtures of native species herbaceous vegetation and temporary herbaceous vegetation seed mixtures will be applied to all disturbed areas of the project site. The individual species were specifically selected due to their native occurrence in Johnston County, NC. Temporary and permanent seeding will be conducted simultaneously at all disturbed areas of the site during construction and will conducted with mechanical broadcast spreaders. Simultaneous permanent and temporary seeding activities helps to ensure rapid growth and establishment of herbaceous ground cover and promotes soil stability and riparian habitat uplift.

Table 22 lists the proposed species, mixtures, and application rates for permanent seeding. The vegetation species proposed for permanent seeding are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability. The vegetation species proposed for temporary seeding germinate quickly to swiftly establish vegetative ground cover and thus, short term stability. The permanent seed mixture proposed is suitable for streambank, floodplain, and adjacent riparian wetland areas, and the upland transitional areas in the riparian buffer. Beyond the riparian buffer areas, temporary seeding will also be applied to all other disturbed areas of the site that are susceptible to erosion. These areas include constructed streambanks, access roads, side slopes, and spoil piles. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre.

Table 22. Proposed Riparian Buffer Permanent Seeding

Scientific Name	Common Name	% Proposed for Planting by Species	Seeding Rate (lb/acre)	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Eutrochium fistulosum	Joe-pye-weed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
Note: Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of seeding stock.				

Invasive species vegetation, such as Chinese privet, golden bamboo and multiflora rose will be treated to allow native plants to become established within the conservation easement. Larger native tree species will be preserved and harvested woody material will be utilized to provide bank stabilization cover and/or nesting habitat. Hardwood species will be planted to provide the appropriate vegetation for the restored riparian buffer areas. During the project implementation, invasive species exotic vegetation will be treated both to control its presence and reduce its spread within the conservation easement areas. These efforts will aid in the establishment of native riparian vegetation species within the restored riparian buffer areas.

6.6 Water Quality Treatment Features

Water quality treatment features in the form of small basins or impoundments designed to treat runoff from the surrounding landscape are proposed along reach R4 and the upper part of R1 adjacent to the restored riparian buffer corridor. The small basins will capture overland flow, increase infiltration and groundwater recharge, diffuse flow energies, and allow nutrient uptake within the extended riparian buffer area. The water quality treatment features along R4 will be located within the easement and the feature near R1 will be located outside the conservation easement. Any treatment features outside of the conservation easement will be fenced to exclude cattle. The features are sized to treat storage volumes, which have been calculated by comparing the SCS Curve Number Method and Simple Method. The features are intended to function most similar to a stormwater wetland to temporarily store surface runoff in shallow pools that support emergent and native riparian vegetation. They will be designed and constructed such that it does not require any long-term maintenance.

The features will be excavated along non-jurisdictional flat or depressional areas where ephemeral drainages intersect with the proposed restored stream corridor. The area will be improved by grading flatter side slopes (>3H:1V) and planting appropriate wetland vegetation. Over time, as vegetation becomes established, the areas will function as shallow wetland complexes or depressions. The weir and outlet channels will be constructed with suitable material and stabilized with permanent vegetation and stone that will deliver reduced runoff and prevent headcut migration or erosion into the newly constructed areas. This strategy will allow the feature to function properly with minimal risk and without long-term maintenance requirements. See Appendix 1 design plan sheets for details and feature location.

6.7 Site Construction Methods

6.7.1 Site Grading and Construction Elements

Following initial evaluation of the design criteria, detailed refinements were made to the design plans in the field to accommodate the existing valley characteristics, vegetation influences and channel morphology. This was done to minimize unnecessary disturbance of the riparian area, and to allow for some natural channel adjustments following construction. The design plans and construction elements have been tailored to produce a cost and resource efficient design that is constructible, using a level of detail that corresponds to the tools of construction. A general construction sequence is included on the project design plan sheets located in Appendix 1.

Much of the grading across the site will be conducted within the existing riparian corridor. The restored streams will be excavated within the existing headwater valley. Suitable fill material will be generated from new channel excavation and adjacent upland areas and hauled to ditch fill/plugs or stockpile locations as necessary. Portions of the existing, unstable channels will be partially to completely filled in along their length using compactable material excavated from construction of the restored channels. Wetland and floodplain grading activities will focus on restoring pre-disturbance valley topography by removing field crowns, overburden/spoil, surface drains, and legacy pond sediments that were imposed during conversion of the land for agriculture. In general, floodplain grading activities will be minor, with the primary goal of soil scarification, creating depressional areas, water quality and habitat features, and microtopographic crenulations by filling the drainage features on the site back to natural ground elevations (Scherrer, 1999).

6.7.2 In-stream Structures and Site Improvement Features

A variety of in-stream structures are proposed for the project. Structures including log vanes, constructed log riffles, constructed stone riffles, grade control log j-hook vanes, rootwads, log weirs, stone and log step pools, and log step pools. Geolifts with toe wood, various other bioengineering measures, and native species vegetation transplants will be used to stabilize the restored stream and improve bedform diversity and habitat functions. All in-stream structures will be constructed from native materials such as hardwood trees, trunks/logs, brush/branches, and gravel stone materials. Native woody debris will be harvested on-site during the project construction and incorporated into the stream channel restoration whenever possible. To ensure sustainability of these structures, WLS will use design and construction methods that have proven successful on numerous past projects in the same geographic region and similar site conditions.

Floodplain features such as depressions and tree throws are commonly found in natural riparian systems. These features will be appropriately added to provide additional habitat and serve as water storage and sediment sinks throughout the restoration corridor. When appropriate, these features will be added adjacent to abandoned channel sections and/or strategic locations throughout the floodplain to provide habitat and serve as water storage and sediment sinks throughout the corridor (Metcalf, 2004).

6.7.3 Construction Feasibility

WLS has field verified that the project site has adequate, viable construction access, staging, and stockpile areas. Physical constraints or barriers, such as stream crossings and pond dams, account for only a small percentage of the proposed total stream reach length within the project boundary. Existing site access points and features may be used for future access after the completion of construction. Any potential impacts to existing wetland areas will be avoided whenever possible during construction. Only minimal, temporary impacts will be allowed when necessary for maximized permanent stream, wetland, and riparian buffer functional uplift. The existing farm ponds currently used for water storage will be drained in Summer 2020. The dam material will be eventually lowered prior to the completion of all stream restoration activities, including new channel construction and vegetation planting. The methods used to lower the water surface elevation will include opening the existing drainpipes that extend to the downstream side of the pond dam. The spillway will be stabilized to prevent further erosion until all construction activities have been completed. Next, the drainpipe will be opened and a temporary gravity siphoning system will be installed over the top of dam to further drain the pond. This will allow for the remnant pond area to function as a temporary stilling basin during the construction period and reduce sedimentation downstream and allow for controlled and slower drawdown period.

The existing pond bottom along R1 and R5 currently consists of mostly fine sand and muck. After the ponds are drained down and sufficiently dried, the sand/muck layer will be removed (approximately 8” to 12” in depth) and organic material and topsoil from the adjacent pasture areas will be mixed across the restored floodplain (approximately 12” to 18” depth) to create a more suitable soil base to insure successful vegetation planting, growth, and establishment. Soils across the remnant pond bottom and new floodplain, will be prepared by sufficiently disking and/or loosened prior to new channel excavation, in-stream structure installation and vegetation planting. Finally, the pond dam/embankment will be lowered and removed to the proposed design elevations and a new stream crossing will be installed at R5 after the upstream restoration activities, including new channel and floodplain excavation, are completed and stabilized. WLS will adhere to all applicable NCDEQ DEMLR erosion and sedimentation guidelines and exercise extreme caution to ensure that the pond does not drain too quickly to prevent excess erosion, sedimentation, turbidity, and sloughing due to saturated embankments.

7 Performance Standards

The applied success criteria for the project will follow the approved performance standards and monitoring protocols presented in this mitigation plan, which have been developed in compliance with the *DMS Stream and Wetland Mitigation Plan Template Guidance*, adopted June 2017, as well as the *USACE Wilmington District Stream and Wetland Compensatory Mitigation Update* issued in October 2016, and *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule,* issued in 2008. In addition, the monitoring success criteria, practices, and corresponding reporting will follow *DMS’s Stream and Wetland Mitigation Monitoring Guidelines* issued April 2015, the *As-built Baseline Monitoring Report Format, Data Requirements, and Content Guidance* issued in June 2017, the *Annual Monitoring Report Format, Data Requirements, and Content Guidance*, issued June 2017, and the *NCDMS Closeout Report Template*, Version 2.2, adopted January 2016. Monitoring activities will be conducted for a period of seven years with the final duration dependent upon performance trends toward achieving project goals and objectives. Specific success criteria components and evaluation methods are described below.

7.1 Streams

***Stream Hydrology*:** Four bankfull flow events must be documented within the seven-year monitoring period. The bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until four bankfull events have been documented in separate years. Surface flow for restored intermittent streams will be documented using gauges or automated data loggers.

Stream Profiles, Vertical Stability, and Floodplain Access: Stream profiles, as a measure of vertical stability and floodplain access will be evaluated by looking at Bank Height Ratios (BHR). In addition, observed bedforms should be consistent with those observed for channels of the design stream type(s). The BHR shall not exceed 1.2 along the restored Project stream reaches. This standard only applies to restored reaches of the channel where BHRs were corrected through design and construction. Vertical stability and floodplain access will both be evaluated by looking at Entrenchment Ratios (ER) which is lateral extent of flooding during bankfull. The ER shall be no less than 2.2 (≥1.4 for 'B' stream types) along the restored project stream reaches. This standard only applies to restored reaches of the channel where ERs were corrected through design and construction.

Stream Horizontal Stability: Cross-sections will be used to document stability of stream dimension. There should be minimal change expected in post-restoration cross-sections. If measurable changes do occur, they should be evaluated to determine if the changes represent a movement toward a more unstable condition (e.g., downcutting, erosion) or a movement towards increased stability (e.g., settling, vegetation establishment, deposition along the streambanks, decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen Stream Classification method and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type. In general, BHR and ER at any measured riffle cross-section should not change by more than 10% from the baseline condition during any given monitoring interval.

Streambed Material Condition and Stability: After construction, it anticipated that particle size distributions will migrate to those identified as appropriate for sand dominated supply as part of the design process. Long term trends are anticipated to demonstrate minimal change in the particle size distribution of the streambed materials, over time, given the current watershed conditions and future upstream sediment supply regime. Significant changes in particle size distribution are not expected.

Jurisdictional Stream Flow: The restored stream systems classified as intermittent must exhibit base flow for at least 30 consecutive days of the year during a year under normal rainfall conditions for each year during the prescribed monitoring period.

Channel Formation: Headwater stream channel formation for reaches R1 and R5 within the valley or crenulation must be documented through identification of field indicators consistent with those listed in Section 8. All multi-thread and single-thread channels should maintain jurisdictional features as listed in Section 8.

7.2 Wetlands

***Wetland Hydrology*:** The performance standard for wetland hydrology will be 12% based on the suggested wetland saturation thresholds for soils taxonomic subgroups and wetland reference data. The average growing season for the Project site is 227 days, beginning on March 21st through November 3rd (NRCS

Johnston County Soil Survey, Weather Station: Clayton, NC). As an alternative to using the March 21 published growing season start date, WLS may install a soil temperature probe and correlate soil temperature with bud burst to establish a start date for the growing season. The proposed success criteria for wetland hydrology will be when the soils are saturated within 12 inches of the soil surface no less than 12% (227 days) of the growing season (March through November) based on WETS data table for Johnston County, NC. The saturated conditions should occur during a period when antecedent precipitation has been normal or drier than normal for a minimum frequency of 5 years in 10 (USACE, 2005 and 2010b). Precipitation data will be obtained from a rain gauge on an adjacent mitigation site approximately 0.5 miles south of the Project and compared with the Clayton (CLAY) Research Weather Station, which is approximately 9 miles southeast from the Project site. If a normal year of precipitation does not occur during the first seven years of monitoring, WLS will continue to monitor the Project hydrology until the Project site has been saturated for the appropriate hydroperiod. If rainfall amounts for any given year during the monitoring period are abnormally low, reference wetland hydrology data will be compared to determine if there is a correlation with the weather conditions and site variability.

7.3 Vegetation

Vegetative restoration success for the project during the intermediate monitoring years will be based on the survival of at least 320, three-year-old planted trees per acre at the end of Year 3 of the monitoring period (MY3) and at least 260, five-year-old, planted trees per acre at the end of Year 5 of the monitoring period (MY5). The final vegetative restoration success criteria will be achieving a density of no less than 210, seven-year-old planted stems per acre in Year Seven of monitoring (MY7). In addition, planted trees in each vegetation plot must average 7 feet in height after MY5 and 10 feet in height at MY7 before closeout. If supplemental planting is required and the species are on the approved species list, they may be counted towards success criteria only after they have survived for two years. Vegetation performance criteria specific to Riparian Buffer Mitigation is included under Appendix 13. A separate buffer monitoring report will be submitted to NCDWR as discussed in Appendix 13.

8 Monitoring Plan

In accordance with the approved mitigation plan, the baseline monitoring document and as-built report documenting the mitigation activities will be developed within 60 days of the completion of planting and monitoring device installation at the restored Project. In addition, a period of at least six months will separate the as-built baseline measurements and the first-year monitoring measurements. The baseline monitoring document and as-built monitoring report will include all information required by current DMS templates and guidance reference above, including planimetric (plan view) and elevation (profile view) information, photographs, sampling plot locations, a description of initial vegetation species composition by community type, and location of monitoring stations. The report will include a list of the vegetation species planted, along with the associated planting densities

WLS will conduct mitigation performance monitoring based on these methods and will submit annual monitoring reports to DMS by December 31st of each monitoring year during which required monitoring is conducted. The annual monitoring reports will organize and present the information resulting from the methods described in detail below. The annual monitoring reports will provide a project data chronology for DMS to document the project status and trends, for population of DMS's databases for analyses, for research purposes, and to assist in decision making regarding project close-out. Project success criteria must be met by the final monitoring year prior to project closeout, or monitoring will continue until unmet criteria are successfully met. Table 23 in Section 8.4 summarizes the monitoring methods and linkage between the goals, parameters, and expected functional lift outcomes. Figure 6 illustrates the pre-construction and Figure 10 illustrates the post-construction monitoring feature types and location.

8.1 Visual Monitoring

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

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

8.2 Stream Monitoring

Based on the stream design approaches, different stream monitoring methods are proposed for the various project reaches. Hydrologic monitoring will be conducted for all project stream reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Level I and II) and Enhancement Level I (bed/bank stabilization) approaches, geomorphic monitoring methods that follow those recommended by the *USACE Wilmington District Stream and Wetland Compensatory Mitigation Update*, and NCEEP's *Stream and Wetland Mitigation Monitoring Guidelines,* which are described below, will be employed to evaluate the effectiveness of the restoration practices. Visual monitoring will be conducted along these reaches as described herein. For project reaches involving an Enhancement Level II approach, monitoring efforts will focus primarily on visual inspections, photo documentation, and vegetation assessments, each as described herein. The monitoring of these project reaches will utilize the methods described under visual monitoring. Each of the proposed stream monitoring methods are described in detail below.

8.2.1 Hydrologic Monitoring

The occurrence of four required bankfull events (overbank flows) within the monitoring period, along with floodplain access by flood flows, will be documented using pressure transducers or crest gauges and photography. The crest gauges or pressure transducers will be installed on the floodplain of and across the dimension of the restored single thread-channels as needed for monitoring. The gauges will record the watermark associated with the highest flood stage between monitoring site visits. The gauges will be used to determine if a bankfull or significant flow event has occurred since the previous gauge check. Corresponding photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits. This hydrologic monitoring will help establish that the restoration objectives of restoring floodplain functions and promoting more natural flood processes are being met.

8.2.2 Geomorphic Monitoring

Pattern: A planimetric survey will be conducted for the entire length of restored channel immediately after construction to document as-built baseline conditions (Monitoring Year 0). The survey will be tied to a permanent benchmark and measurements will include thalweg, bankfull, and top of banks. The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline documentation (Monitoring Year 0) only. The described visual monitoring will also document any changes or excessive lateral movement in the plan view of the restored channel. The results of the planimetric survey should show that the restored horizontal geometry is consistent with intended design stream type. These measurements will demonstrate that the restored stream channel pattern provides more stable planform and associated features than the old channel, which provide improved aquatic habitat and geomorphic function, as per the restoration objectives.

Profile: A longitudinal profile will be surveyed for the entire length of restored channel immediately after construction to document as-built baseline conditions for the first year of monitoring only. The survey will be tied to a permanent benchmark and measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. The longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary. These measurements will demonstrate that the restored stream profile provides more bedform diversity than the old channel with multiple facet features (such as scour pools and riffles) that provide improved aquatic habitat, as per the restoration objectives. BHRs will be measured along each of the restored reaches using the results of the longitudinal profile.

Dimension: Permanent cross-sections will be installed and surveyed at an approximate rate of one cross-section per twenty (20) bankfull widths or an average distance interval (not to exceed 500 LF) of restored stream, with approximately four (4) cross-sections located at riffles, and three (3) located at pools. Each cross-section will be monumented on both streambanks to establish the exact transect used and to facilitate repetition each year and easy comparison of year-to-year data. The cross-section surveys will occur in years 0 (as-built), 1, 2, 3, 5, and 7, and will include measurements of bankfull cross-sectional area (Abkf) at low bank height, Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of streambanks, bankfull, inner berm, edge of water, and thalweg, if the features are present.

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

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

8.2.3 Flow Duration Monitoring

During each year with normal rainfall conditions monitoring of stream flow will be conducted to demonstrate that the restored stream systems classified as intermittent exhibit surface flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal rainfall conditions. To determine if rainfall amounts are normal for the given year, a rainfall gauge will be installed on the site to compare precipitation amounts using tallied data obtained from on site and the Clayton WETS station. If a normal year of precipitation does not occur during the first seven years of monitoring, monitoring of flow conditions on the site will continue until it documents that the intermittent streams have been flowing during the appropriate times of the year.

The proposed flow monitoring of reaches R1 and R5 will include the installation of continuous stream stage recorders within the bottom (toe of slope) of the channel towards the upper one-third of the reach. In addition, photographic documentation may be used to subjectively evaluate and document channel flow conditions throughout the year. More specifically, the longitudinal photos should indicate the presence of flow within the channel to illustrate water levels within the pools and riffles. The photographs will be taken from a height of approximately five feet to ensure that the same locations (and view directions) at the site are documented in each monitoring period and will be shown on a plan view map. Monitoring flow gauges (continuous-read pressure transducers) will be installed towards the upper one-third of restored intermittent reaches. The devices will be inspected on a quarterly basis to document surface flow hydrology and provide a basis for evaluating flow response to rainfall events and surface runoff during various water tables levels throughout the monitoring period (KCI, DMS, 2010).

8.2.4 Headwater Stream Monitoring

Continuous Surface Flow: Continuous surface water flow of reaches R1 and R5 within the headwater valley or crenulation must be documented to occur every year for at least 30 consecutive days during the prescribed monitoring period.

Channel Formation: During monitoring years 1 through 4, the preponderance of evidence must demonstrate a concentration of flow indicative of channel formation within the topographic low point of the valley or crenulation as documented by the following indicators:

- Scour (indicating sediment transport by flowing water)
- Sediment deposition (accumulations of sediment and/or formation ripples)
- Sediment sorting (sediment sorting indicated by grain-size distribution within primary flow path)
- Multiple observed flow events (must be documented by gauge data and/or photographs)
- Destruction of terrestrial vegetation
- Presence of litter and debris
- Wracking (deposits of drift material indicating surface water flow)
- Vegetation matted down, bent, or absent (herbaceous or otherwise)
- Leaf litter disturbed or washed away

During monitoring years 5 through 7, the reach must successfully meet the requirements above and the preponderance of evidence must demonstrate the development of stream bed and banks as documented by the following indicators:

- Bed and banks (may include the formation of stream bed and banks, development of channel pattern such as meander bends and/or braiding at natural topographic breaks, woody debris, or plant root systems)
- Natural line impressed on the bank (visible high-water mark)
- Shelving (shelving of sediment depositions indicating transport)
- Water staining (staining of rooted vegetation)
- Change in plant community (transition to species adapted for flow or inundation for a long duration, including hydrophytes)
- Changes in character of soil (texture and/or chroma changes when compared to the soils abutting the primary path of flow).

8.3 Wetland Monitoring

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

8.4 Vegetation Monitoring

Successful restoration of the vegetation at the project site is dependent upon successful hydrologic restoration, active establishment and survival of the planted preferred canopy vegetation species, and volunteer regeneration of the native plant community. To determine if these criteria are successfully achieved, vegetation-monitoring quadrants or plots will be installed and monitored across the restoration site in accordance with the CVS-EEP Level I & II Monitoring Protocol (CVS, 2008) and DMS Stream and Wetland Monitoring Guidelines (DMS, 2014). The vegetation monitoring plots shall be approximately 2% of the planted portion of the site with a minimum of eleven plots established randomly within the planted areas (these vegetation plots are for both the stream/wetland component and the riparian buffer component). The sampling may employ quasi-random plot locations which may vary upon approval from DMS and IRT. Any random plots should comprise no more than 50% of the total required plots, and the location (GPS coordinates and orientation) will identified in the monitoring reports.

No monitoring quadrants will be established within undisturbed wooded areas, however visual observations will be documented in the annual monitoring reports to describe any changes to the existing vegetation community. The size and location of individual quadrants will be 100 square meters (10m X 10m or 5m X 20m) for woody tree species and may be adjusted based on site conditions after construction activities have been completed. Vegetation monitoring specific to Riparian Buffer Mitigation is detailed under Appendix 13. Vegetation monitoring will occur in the fall each required monitoring year, prior to the loss of leaves. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings. Data will be collected at each individual quadrant and will include specific data for monitored stems on diameter, height, species, date planted, and grid location, as well as a collective determination of the survival density within that quadrant. Relative values will be calculated, and importance values will be determined. Individual planted seedlings will be marked at planting or monitoring baseline setup so that those stems can be found and identified consistently each successive monitoring year. Volunteer species will be noted and if they are on the approved planting list and meet success criteria standards, they will be counted towards success criteria. Other species not included on the list may be considered by the IRT on a case-by-case basis. The presence of invasive species vegetation within the monitoring quadrants will also be noted, as will any wildlife effects.

At the end of the first full growing season (from baseline/year 0) or after 180 days, species composition, stem density and survival will be evaluated. For each subsequent year, vegetation plots shall be monitored for seven years in years 1, 2, 3, 5 and 7, and visual monitoring in years 4 and 6, or until the final success criteria are achieved for stream and wetland mitigation. For the riparian buffer component, the vegetation plots, photo reference stations, and visual assessment will be conducted for five consecutive years (see Appendix 13). While measuring species density is the current accepted methodology for evaluating vegetation success on mitigation projects, species density alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success. WLS will provide required remedial action on a case-by-case basis, such as replanting more wet/drought tolerant species vegetation, conducting beaver and beaver dam management/removal, and removing undesirable/invasive species vegetation, and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table, that negatively impact existing forest cover or favorable buffer vegetation.

Table 23. Proposed Monitoring Plan Summary

Functional Category (Level)	Project Goal / Parameter	Measurement Method	Performance Standard	Potential Functional Uplift
Hydrology (Level 1)	Improve Base Flow Duration and Overbank Flows (i.e. channel forming discharge)	Well device (pressure transducer), regional curve, regression equations, catchment assessment	Maintain seasonal flow for a minimum of 30 consecutive days during normal annual rainfall.	Create a more natural and higher functioning headwater flow regime and provide aquatic passage.
Hydraulics (Level 2)	Reconnect Floodplain / Increase Floodprone Area Widths	Bank Height Ratio, Entrenchment Ratio, crest gauge	Maintain average BHRs ≤1.2 and ERs ≥2.2 (1.4 for 'B' stream types) and document out of bank and/or significant flow events using pressure transducers or photographs & crest gauges	Provide temporary water storage and reduce erosive forces (shear stress) in channel during larger flow events.
Geomorphology (Level 3)	Improve Bedform Diversity	Pool to Pool spacing, riffle-pool sequence, pool max depth ratio, Longitudinal Profile	Increase riffle/pool percentage and pool-to-pool spacing ratios compared to reference reach conditions.	Provide a more natural stream morphology, energy dissipation and aquatic habitat/refugia.
	Increase Vertical and Lateral Stability	BEHI / NBS, Cross-sections and Longitudinal Profile Surveys, visual assessment	Decrease streambank erosion rates comparable to reference condition cross-section, pattern and vertical profile values.	Reduce sedimentation, excessive aggradation, and embeddedness to allow for interstitial flow habitat.
	Establish Riparian Buffer Vegetation	CVS Level I & II Protocol Tree Veg Plots (Strata Composition, Vigor, and Density), visual assessment	Within planted portions of the site, a minimum of 320 stems per acre must be present at year three; a minimum of 260 stems per acre must be present at year five; and a minimum of 210 stems per acre and average 10-foot tree heights must be present at year seven.	Increase woody and herbaceous vegetation will provide channel stability and reduce streambank erosion, runoff rates and exotic species vegetation.
Physiochemical (Level 4)	Improve Water Quality	N/A	N/A	Removal of excess nutrients, FC bacteria, and organic pollutants will increase the hyporheic exchange and dissolved oxygen (DO) levels.
Biology (Level 5)	Improve Benthic Macroinvertebrate Communities and Aquatic Health	DWR Small Stream/ Benthic sampling, IBI	N/A	Increase leaf litter and organic matter critical to provide in-stream cover/shade, wood recruitment, and carbon sourcing.

Note: Level 4 and 5 project parameters and monitoring activities will not be tied to performance standards nor required to demonstrate success for credit release.

9 Adaptive Management Plan

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

10 Long-Term Management Plan

The site will be transferred to the NCDEQ Stewardship Program. This party shall serve as conservation easement holder and long-term steward for the property and will conduct periodic inspection of the site to ensure that restrictions required in the conservation easement are upheld. Funding will be supplied by the responsible party on a yearly basis until such time and endowments are established. The NCDEQ Stewardship Program is developing an endowment system within the non-reverting, interest-bearing Conservation Lands Stewardship Endowment Account. The use of funds from the Endowment Account is governed by NC General Statue GS 113A-232(d) (3). Interest gained by the endowment fund may be used only for stewardship, monitoring, stewardship administration, and land transaction costs, if applicable. WLS does not expect that easement compliance and management will require any additional or alternative management planning, strategies or efforts beyond those typically prescribed and followed for DMS full-delivery projects.

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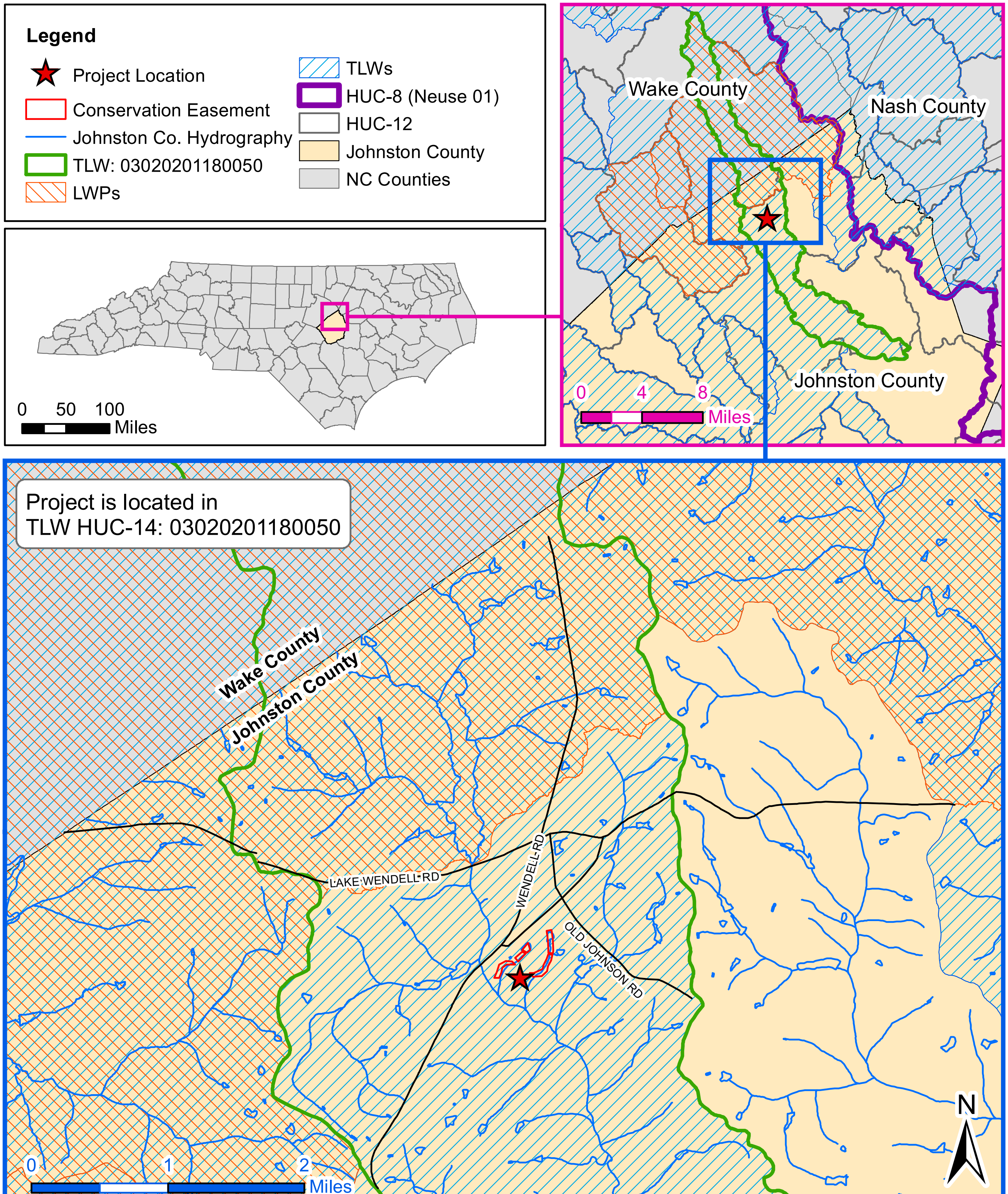
Figures

Odell's House Mitigation Project



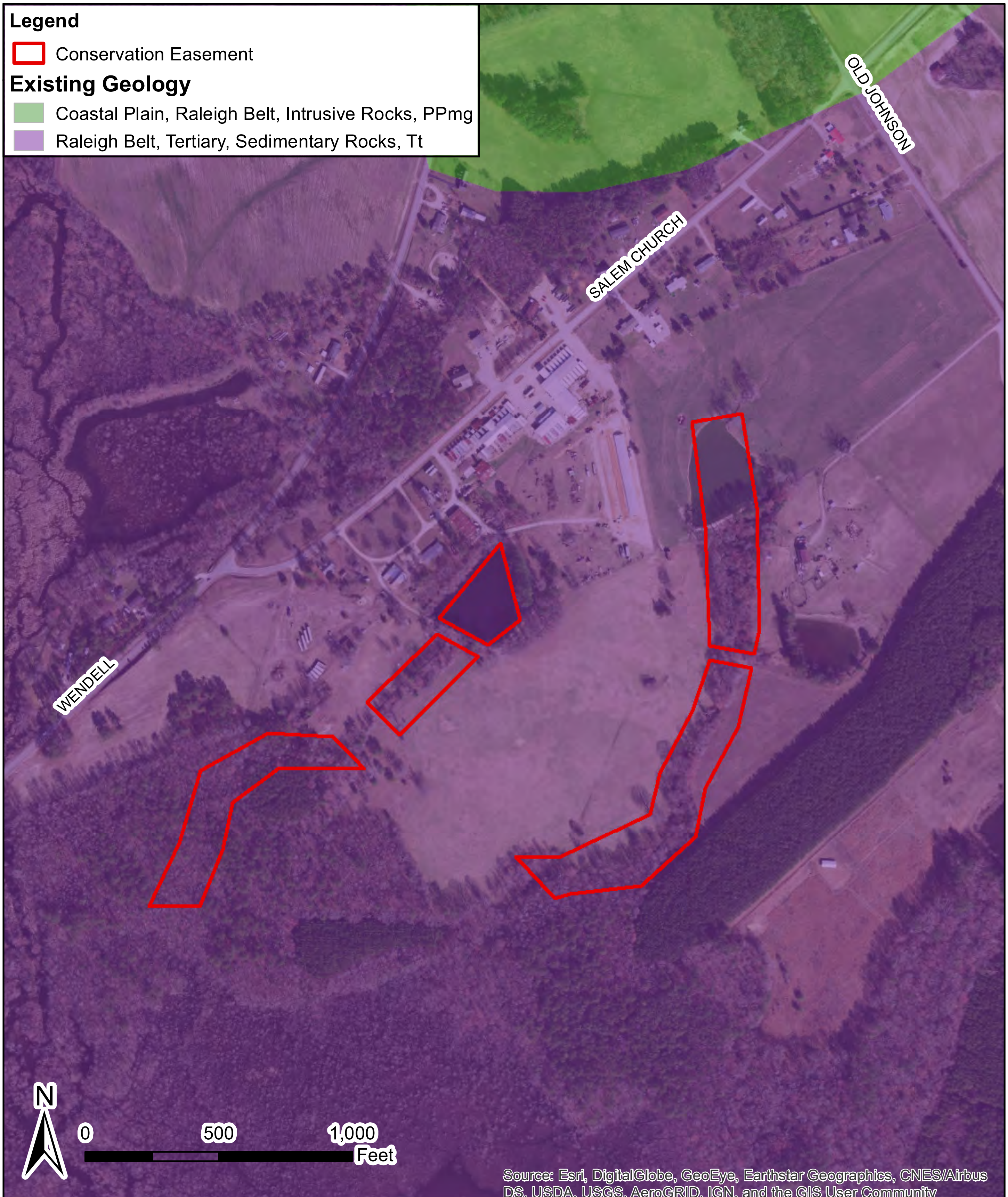
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Project Location

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 1



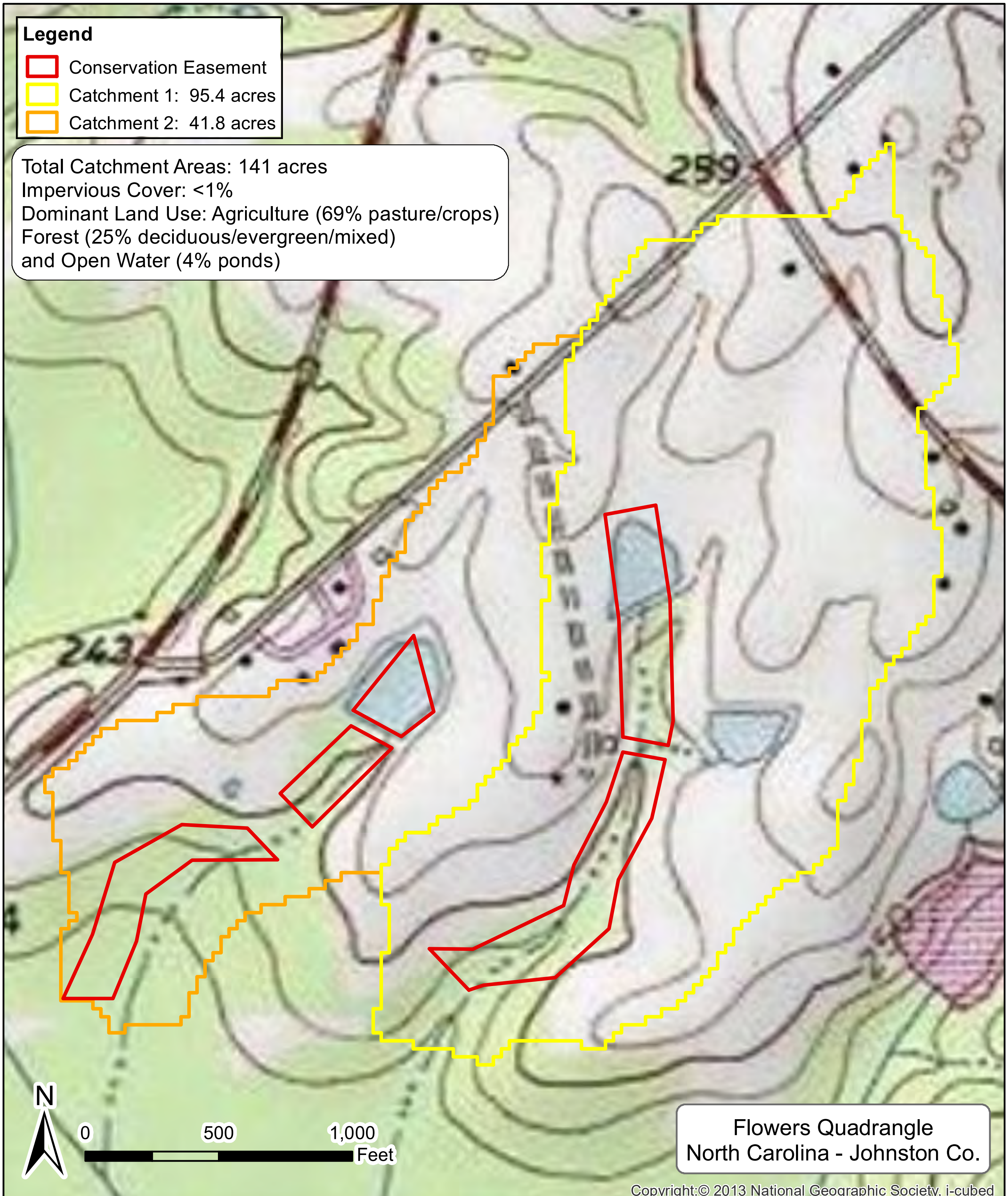
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Existing Geology Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 2



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Odell's House Mitigation Project

USGS Topographic Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

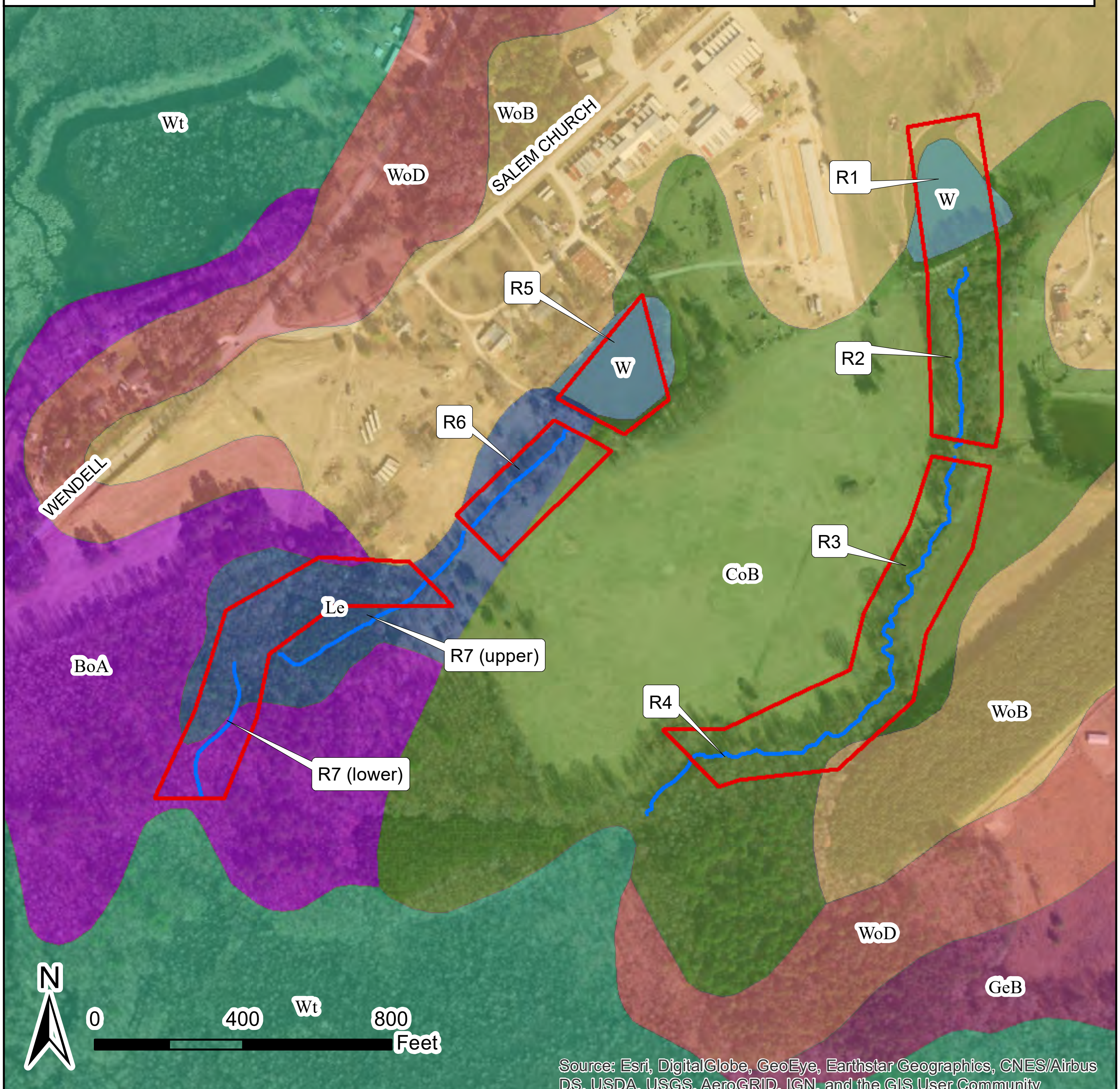
FIGURE 3

Legend

- Conservation Easement
- Existing Stream

Soil Map Units (NRCS Data from Web Soil Survey)

- BoA: Bonneau sand, 0-3% slopes
- CoB: Cowarts loamy sand, 2-6% slopes
- DoA: Dorian fine sandy loam, 0-2% slopes, rarely flooded
- GeB: Gilead sandy loam, 2-8% slopes
- Le: Leaf silt loam, 0-2% slopes (Hydric A)
- W: Water
- WoB: Wedowee sandy loam, 2-8% slopes
- WoD: Wedowee sandy loam, 8-15% slopes
- Wt: Wehadkeee loam, 0-2% slopes, frequently flooded



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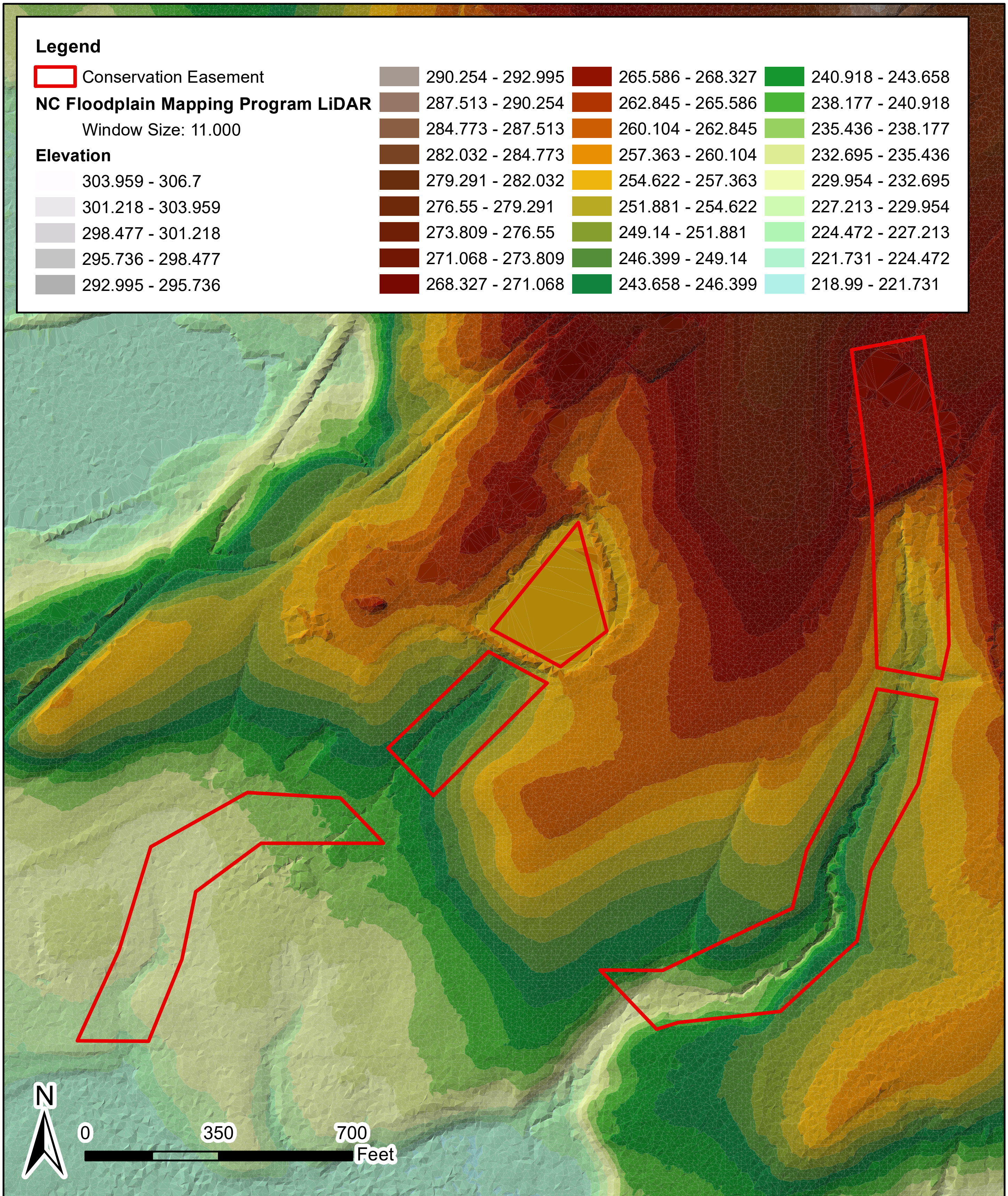
Odell's House Mitigation Project

NRCS Soils Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 4



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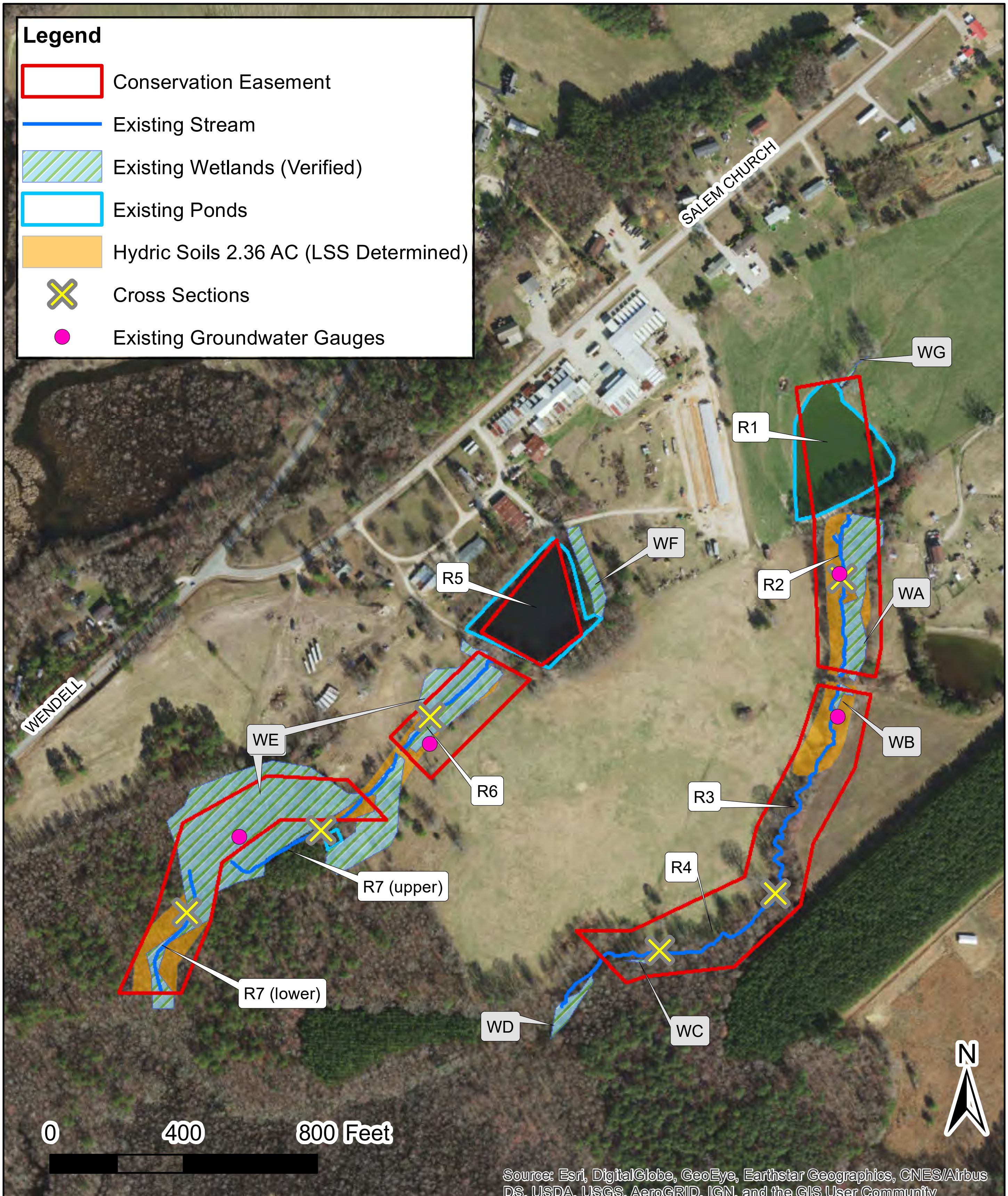
Odell's House Mitigation Project

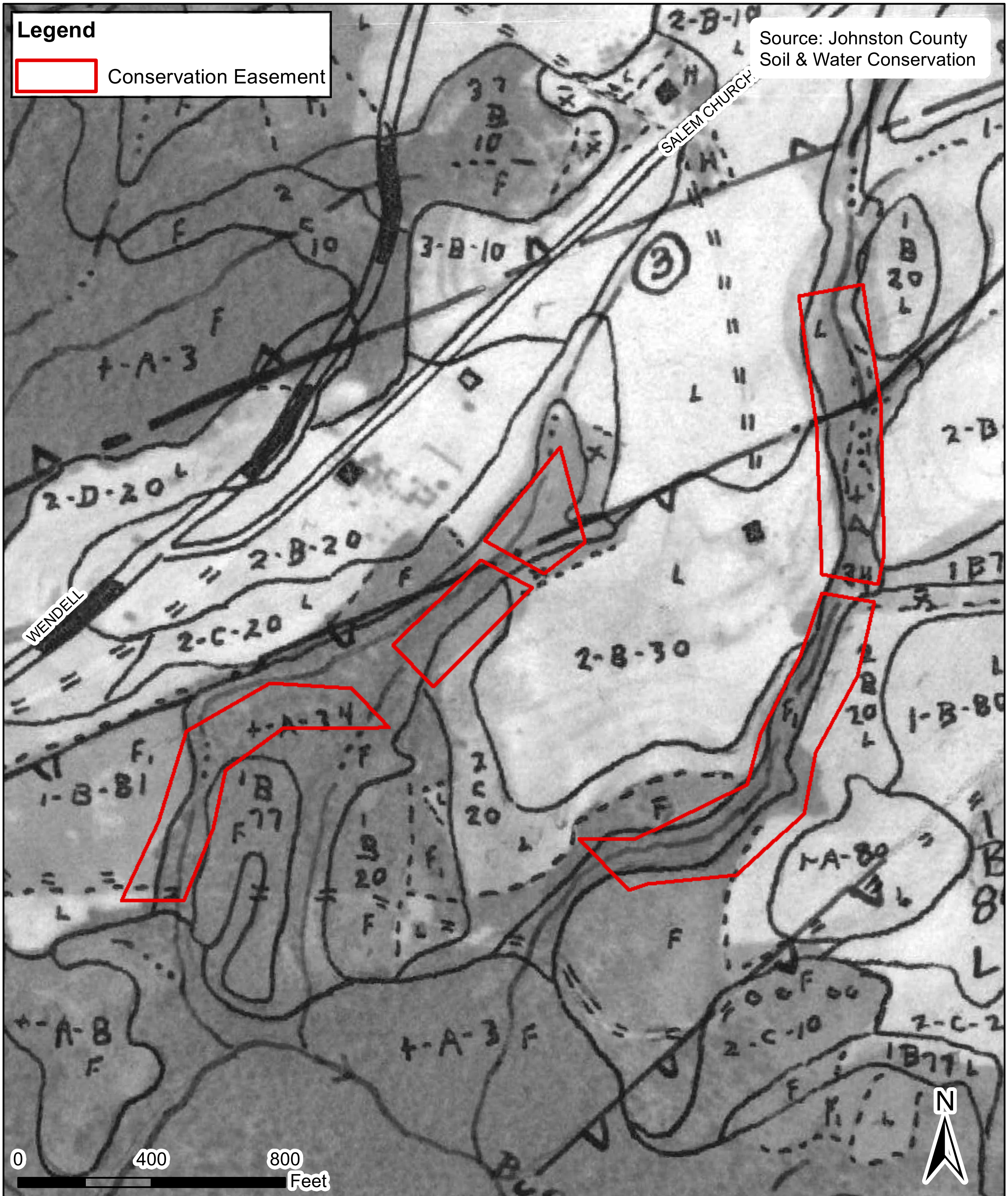
LiDAR Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 5



WATER & LAND™ SOLUTIONS	Odell's House Mitigation Project	Current Conditions NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 6



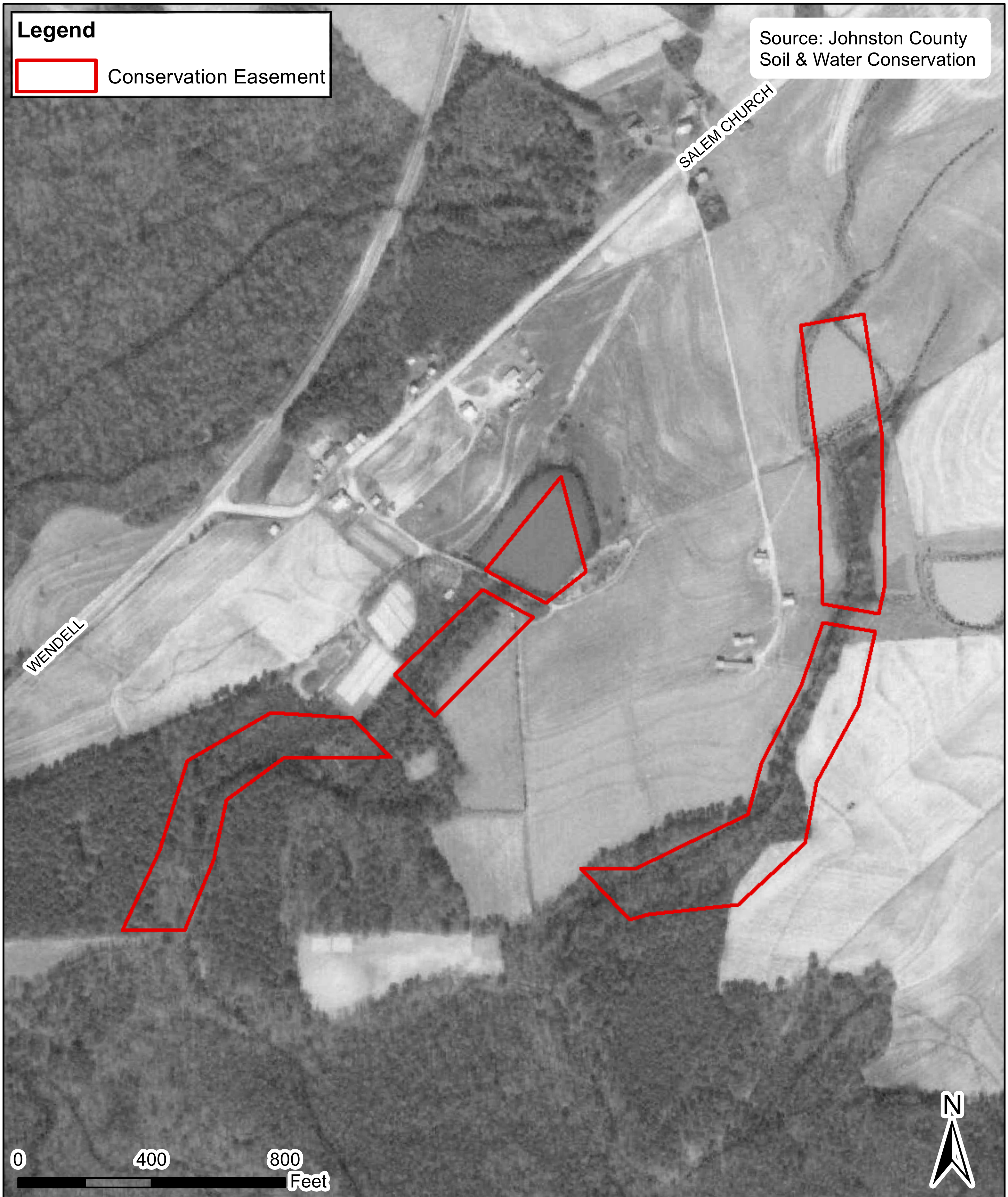
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

1939 Aerial Photograph & Soils Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 7a



WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

1965 Aerial Photograph

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 7b

WATER & LAND SOLUTIONS

Odell's House Mitigation Project

2004 Aerial Photograph

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 7c

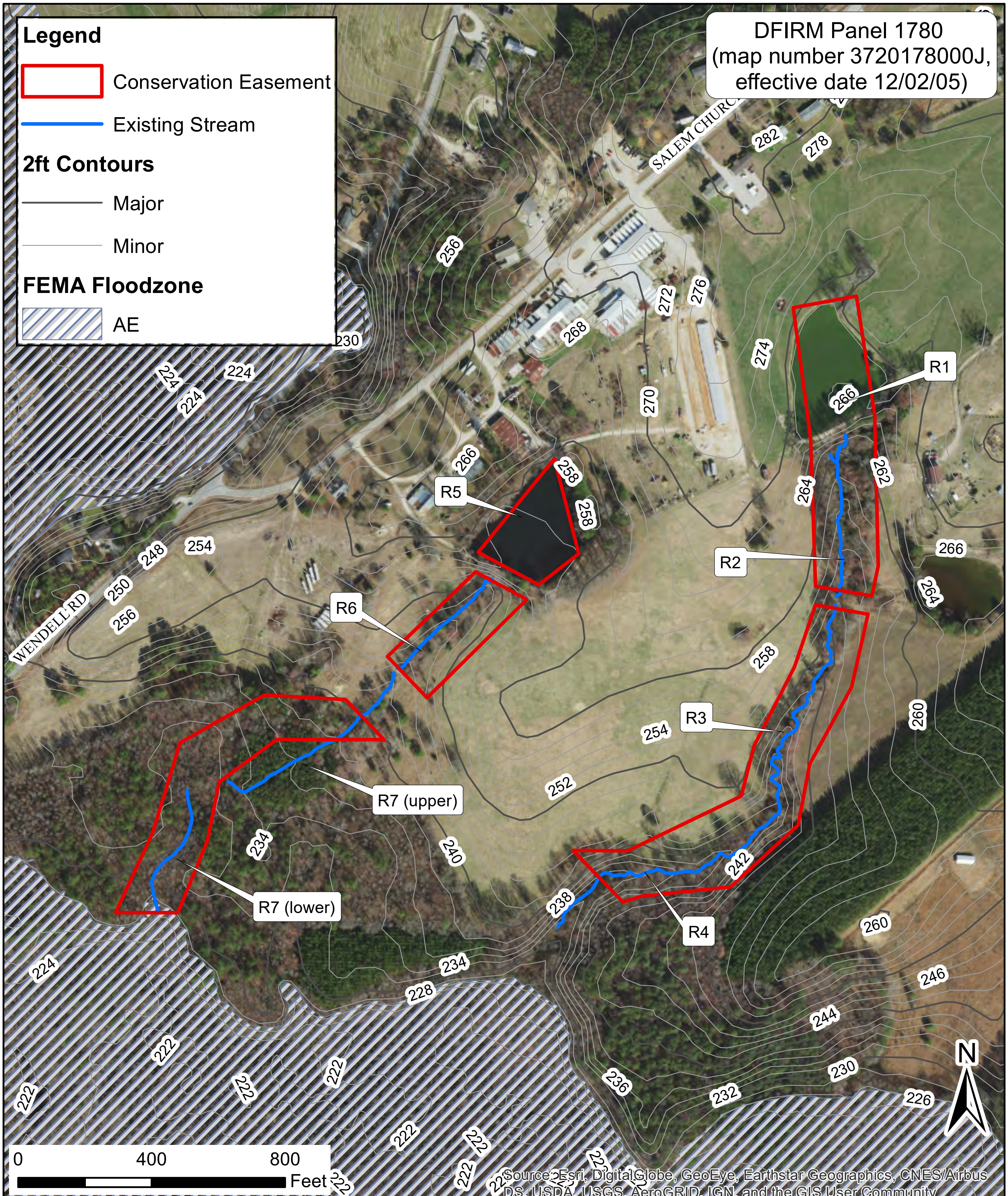
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

2019 Aerial Photograph

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 7d



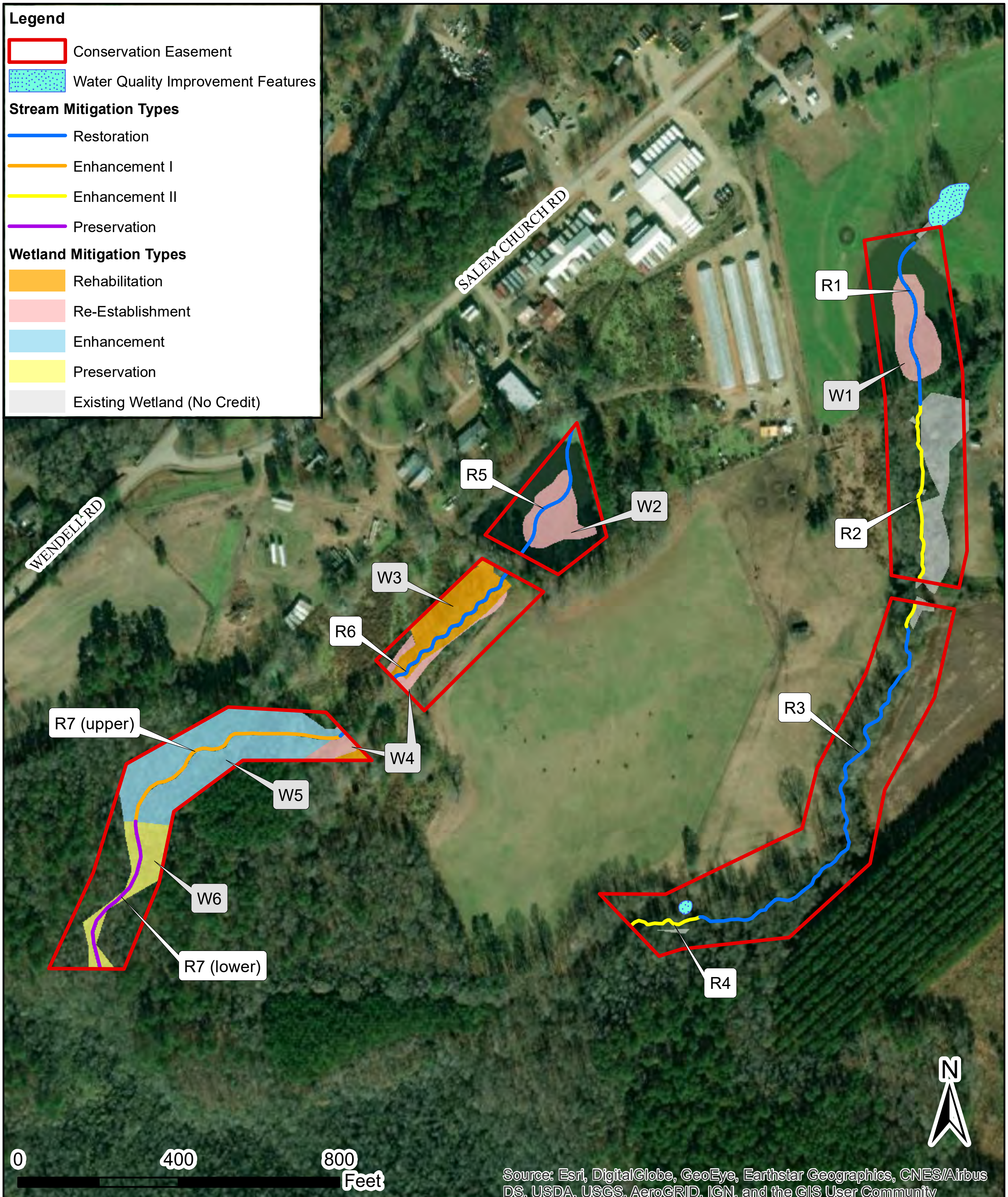
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Floodplain Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 8



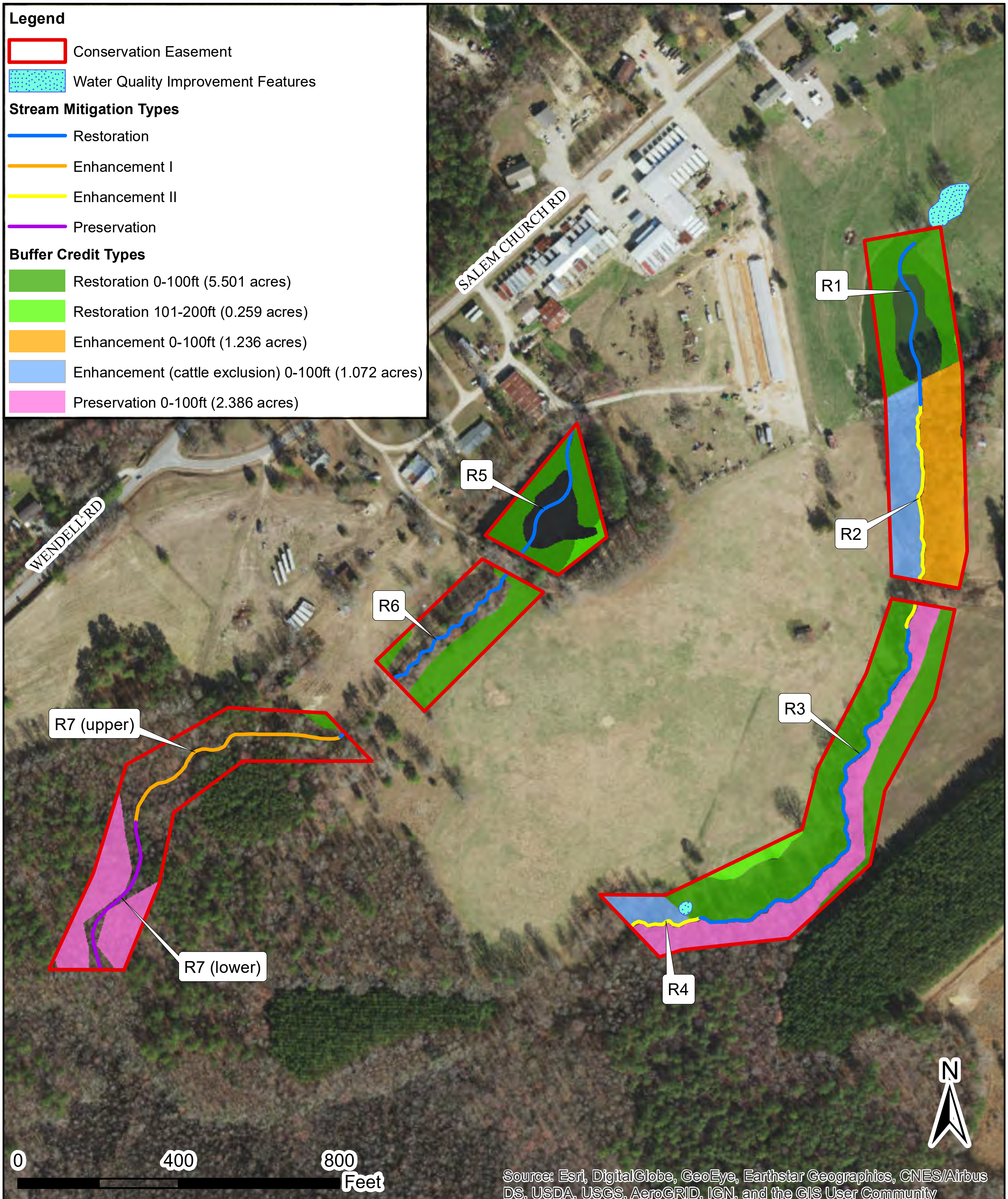
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Stream & Wetland Mitigation Features

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 9a



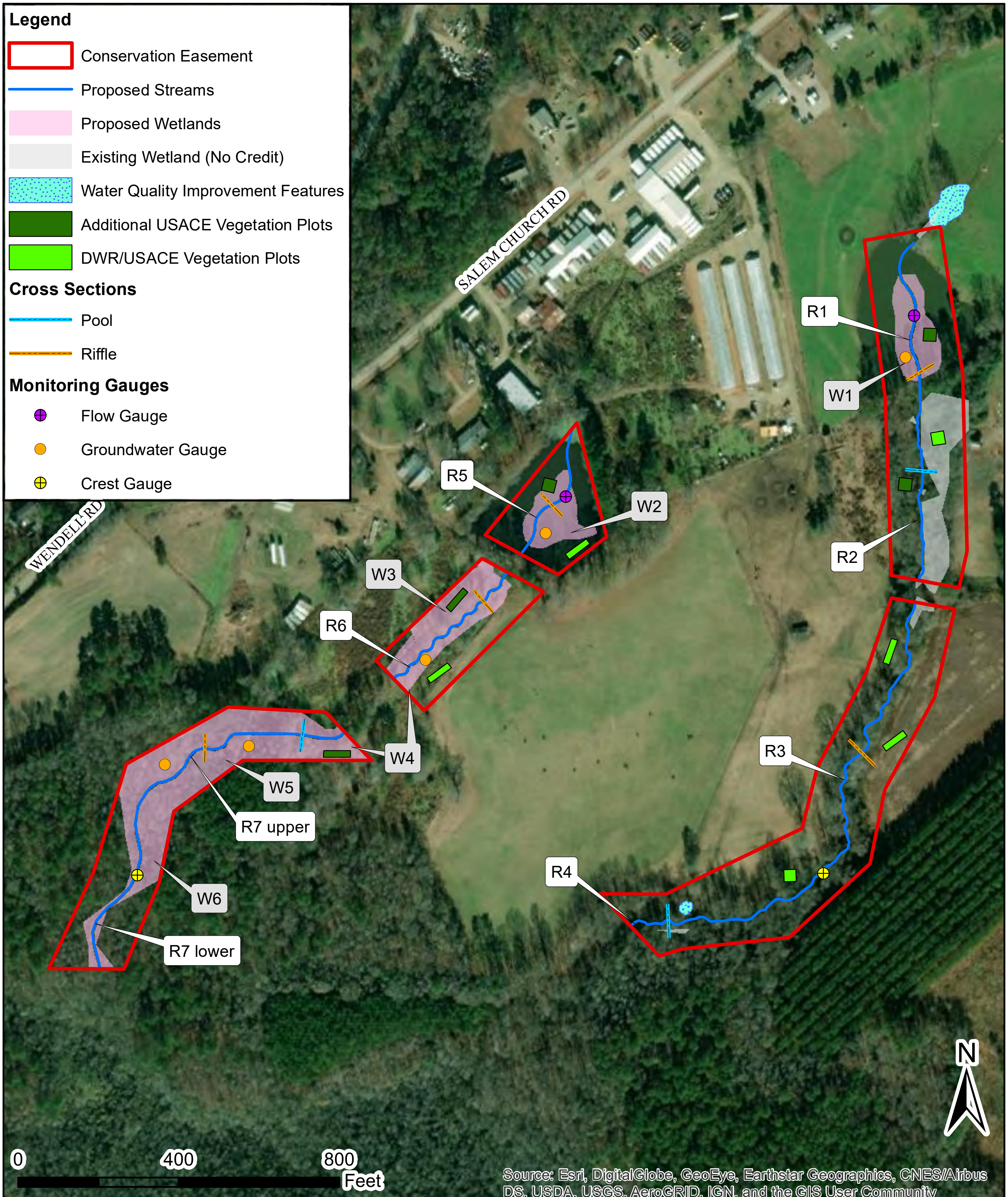
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Buffer Mitigation Features

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 9b



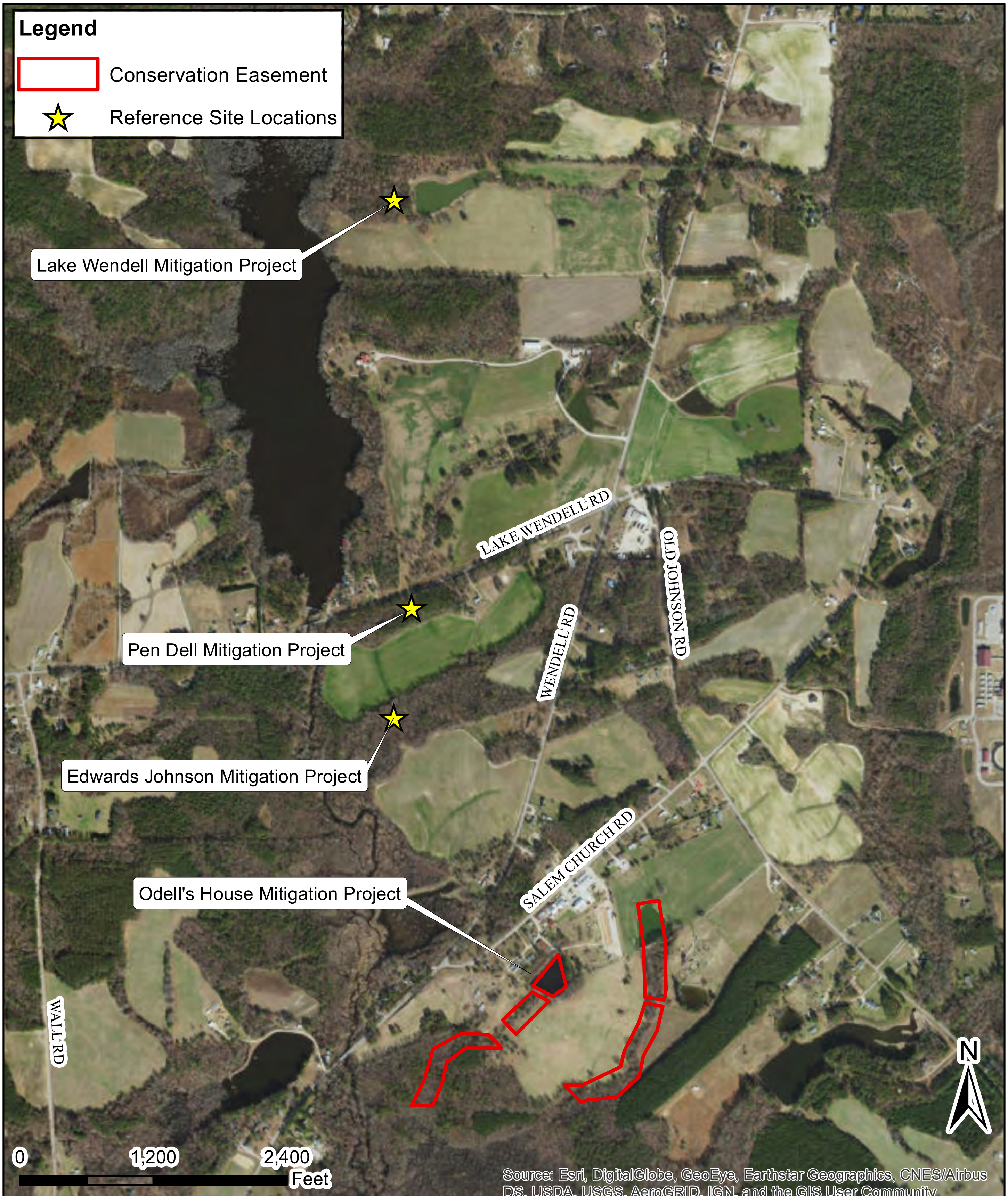
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Monitoring Features

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 10



WATER & LAND™ SOLUTIONS	Odell's House Mitigation Project	Reference Site Location Map NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 11

Appendix 1 – Plan Sheets

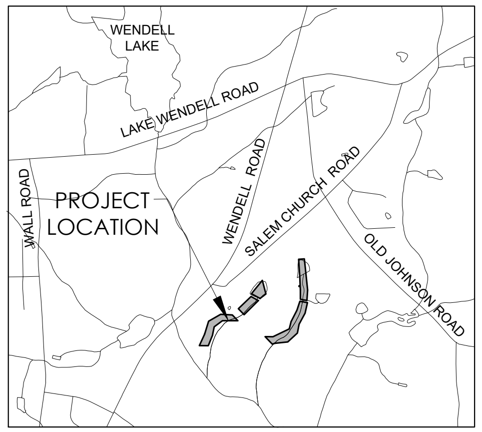
DEPARTMENT OF ENVIRONMENTAL QUALITY - DIVISION OF MITIGATION SERVICES

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NORTH CAROLINA

NCDEQ - DMS PROJECT ID # 100041
NCDEQ - DMS CONTRACT # 7420 UNDER RFP 16-007279
NEUSE RIVER BASIN (CU 03020201)
USACE ACTION ID # SAW - 2018-00431
DWR ID # - 2018-0200
TYPE OF WORK : STREAM, BUFFER AND WETLAND MITIGATION

VICINITY MAP
N.T.S.



NCDEQ-DMS CONTRACT ADMINISTRATOR:
KRISTIE CORSON
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699-1652
PH: 919-707-8935

PROJECT SUMMARY

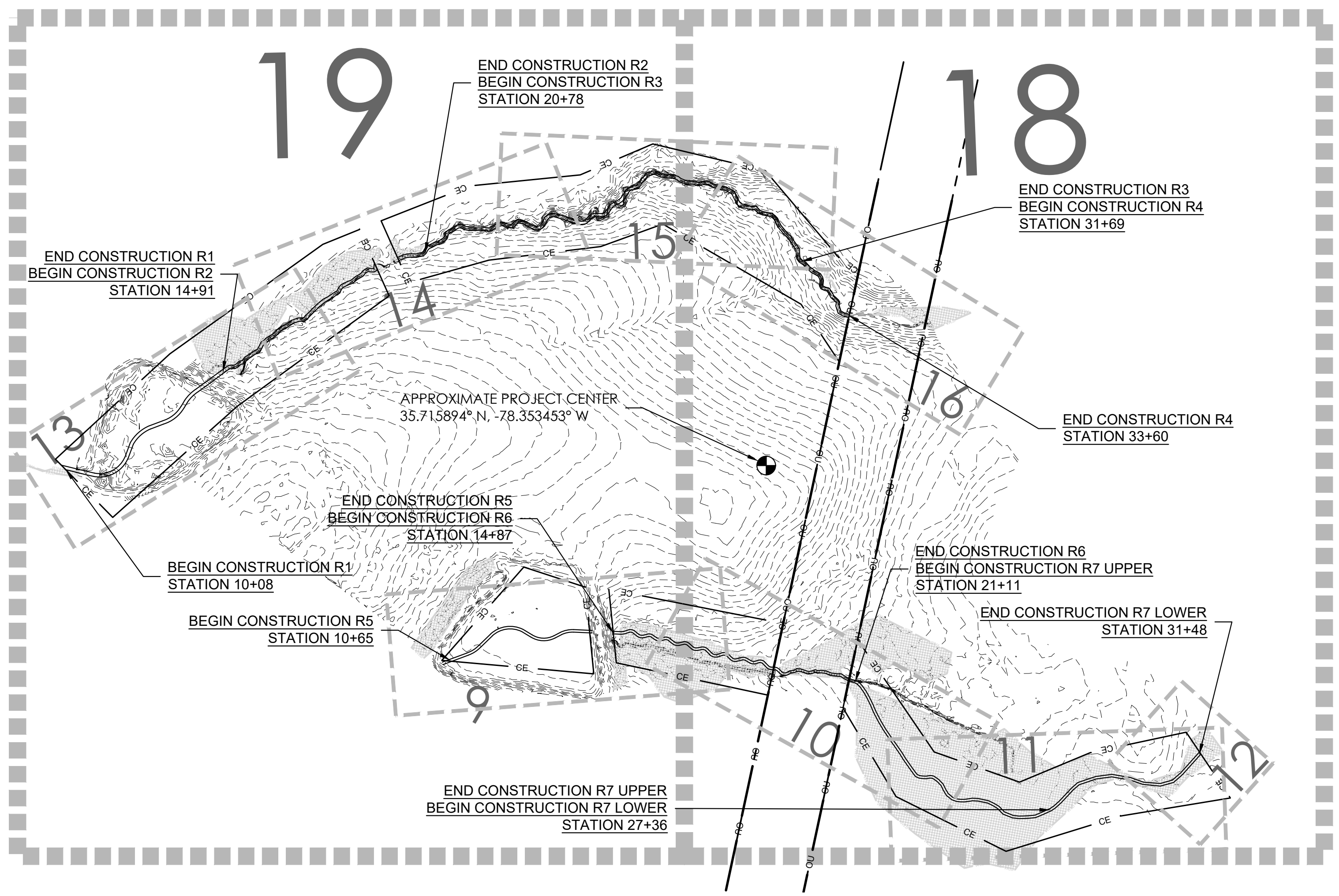
Project Reach Designation	Type of Mitigation	Creditable Units (LF)	Mitigation Ratio (X:1)	Stream Mitigation Credits (SMCs)
R1	Stream Restoration PI/PII	437	1	437.000
R2	Stream Enhancement Level II	526	2.5	210.400
R3	Stream Restoration PI	1,151	1	1,151.000
R4	Stream Enhancement Level I	190	3	63.333
R5	Stream Restoration PI/PII	340	1	340.000
R6	Stream Restoration PI	432	1	432.000
R7 Upper	Stream Enhancement Level I	625	1.5	416.667
R7 Lower	Stream Preservation	412	10	41.200
Total		4,063		3,091.600

Note 1: No mitigation credits were calculated outside the conservation easement boundaries.
Note 2: R1 and R5 credits are calculated based on restoration valley length.

Project Wetland Area	Type of Mitigation	Proposed Wetland Area (AC)	Mitigation Ratio (X:1)	Riparian Wetland Mitigation Credits (WMCs)
W1	Wetland Re-establishment	0.476	1:1	0.476
W2	Wetland Re-establishment	0.416	1:1	0.416
W3	Wetland Rehabilitation	0.666	1:1.5	0.444
W4	Wetland Re-establishment	0.234	1:1	0.234
W5	Wetland Enhancement	1.654	2:1	0.827
W6	Wetland Preservation	0.444	10:1	0.044
Total		3.891		2.441

Note 1: No mitigation credits were calculated outside the conservation easement boundaries.

SHEET INDEX



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

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER A. TOMSIC
PRELIMINARY NOT FOR CONSTRUCTION

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

REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

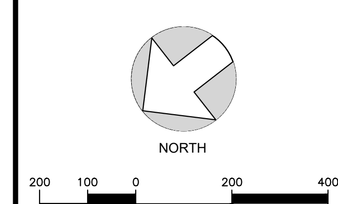
PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-003
FILENAME	01_ODELL'S HOUSE_COVER.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	1" = 400'
VERT. SCALE	N/A



SHEET NAME

COVER SHEET

SHEET NUMBER

1

LEGEND

	ROOTWAD
	LOG VANE
	LOG WEIR
	STONE/LOG STEP-POOL
	CONSTRUCTED STONE RIFFLE
	CONSTRUCTED LOG RIFFLE
	GEOLIFT W/ TOEWOOD
	GRADE CONTROL LOG J-HOOK
	PROPOSED OUTLET CHANNEL
FP — FP	100 YEAR FLOOD PLAIN
OHPL	EXISTING OVERHEAD ELECTRIC
	TEMPORARY STREAM CROSSING
	PERMANENT STREAM CROSSING
CE — CE	PROPOSED CONSERVATION EASEMENT BOUNDARY
100	EXISTING MAJOR CONTOUR
101	EXISTING MINOR CONTOUR
100	PROPOSED MAJOR CONTOUR
101	PROPOSED MINOR CONTOUR
C/F — C/F	CUT/FILL LIMITS
WLB — WLB	EXISTING WETLAND BOUNDARY
	EXISTING HYDRIC SOIL BOUNDARY
	EXISTING WOODLINE
	PROPOSED TOP OF STREAM BANK
	EXISTING PROPERTY BOUNDARY
	EXISTING POWERLINE EASEMENT
	EXISTING FENCE
15+00	PROPOSED CENTERLINE (THALWEG)
X — X	PROPOSED FIELD FENCE
TP — TP	PROPOSED TREE PROTECTION FENCE
	EXISTING FARM PATH
	PROPOSED FARM PATH
	EXISTING TREE
	PROPOSED WATER QUALITY TREATMENT FEATURE
	CHANNEL BLOCK
	CHANNEL FILL
X	PROPOSED GATE
	EXISTING STRUCTURE

CONSTRUCTION SEQUENCE

THE ENGINEER WILL PROVIDE CONSTRUCTION OBSERVATION DURING THE CONSTRUCTION PHASE OF THIS PROJECT. THE GENERAL CONSTRUCTION SEQUENCE SHALL BE USED DURING IMPLEMENTATION OF THE PROPOSED PROJECT CONSTRUCTION. CONTRACTOR SHALL REFER TO THE APPROVED PERMITS FOR SPECIFIC CONSTRUCTION SEQUENCE ITEMS AND SHALL BE RESPONSIBLE FOR FOLLOWING THE APPROVED PLANS AND PERMIT CONDITIONS.

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

GENERAL NOTES

1. THE PROJECT SITE IS LOCATED APPROXIMATELY TWENTY SIX MILES SOUTHEASTOF RALEIGH IN JOHNSTON COUNTY, NC (35.715894°, -78.353453°) AS SHOWN ON THE COVER SHEET VICINITY MAP. TO ACCESS THE SITE FROM RALEIGH, TAKE US 401 SOUTH FOR APPROXIMATELY 3 MILES TO I-440. TAKE I-440/i-40 EASTBOUND FOR APPROXIMATELY 3 MILES. CONTINUE FOR APPROXIMATELY 6 MILES ON I-87. TAKE EXIT 9 FOR SMITHFIELD ROAD. TRAVEL ON SMITHFIELD ROAD FOR APPROXIMATELY 3 MILES. TURN LEFT ONTO LAKE WENDELL RD AND CONTINUE APPROXIMATELY 3 MILES. TURN RIGHT ONTO SALEM CHURCH ROAD. TRAVEL ON SALEM CHURCH ROAD FOR 0.4 MILES AND ARRIVE AT THE SITE ENTRANCE ON THE LEFT.
2. THE PROJECT SITE BOUNDARIES ARE SHOWN ON THE DESIGN PLANS AS THE PROPOSED CONSERVATION EASEMENT. THE CONTRACTOR SHALL PERFORM ALL RELATED WORK ACTIVITIES WITHIN THE PROJECT SITE BOUNDARIES AND/OR WITHIN THE LIMITS OF DISTURBANCE (LOD). THE PROJECT SITE SHALL BE ACCESSED THROUGH THE DESIGNATED ACCESS POINTS SHOWN ON THE PLANS. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING PERMITTED ACCESS THROUGHOUT ALL CONSTRUCTION ACTIVITIES.
3. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS AND MEASURES TO PROTECT ALL PROPERTIES FROM DAMAGE. THE CONTRACTOR SHALL REPAIR ALL DAMAGE CAUSED BY HIS/HER OPERATIONS TO ALL PUBLIC AND PRIVATE PROPERTY AND LEAVE THE PROPERTY IN GOOD CONDITION AND/OR AT LEAST EQUIVALENT TO THE PRE-CONSTRUCTION CONDITIONS. UPON COMPLETION OF ALL CONSTRUCTION ACTIVITIES, THE AREA IS TO BE RESTORED TO A CONDITION EQUAL TO OR BETTER THAN FOUND PRIOR TO CONSTRUCTION.
4. THE TOPOGRAPHIC BASE MAP WAS DEVELOPED USING SURVEY DATA COLLECTED BY WITHERSRAVENEL, INC. (WR) IN THE SUMMER OF 2018. THE HORIZONTAL DATUM WAS TIED TO NAD83 NC STATE PLANE COORDINATE SYSTEM, US SURVEY FEET AND NAVD88 VERTICAL DATUM USING VRS NETWORK AND NCGS MONUMENT. IT IS POSSIBLE THAT EXISTING ELEVATIONS AND SITE CONDTIONS MAY HAVE CHANGED SINCE THE ORIGINAL SURVEY WAS COMPLETED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONFIRM EXISTING GRADES AND ADJUST QUANTITIES, EARTHWORK, AND WORK EFFORTS AS NECESSARY.
5. THE CONTRACTOR SHALL VISIT THE CONSTRUCTION SITE AND THOROUGHLY FAMILIARIZE HIM/HERSELF WITH ALL EXISTING CONDITIONS. PRIOR TO BEGINNING CONSTRUCTION. THE CONTRACTOR SHALL VERIFY THE ACCURACY AND COMPLETENESS OF THE CONSTRUCTION SPECIFICATIONS AND DESIGN PLANS REGARDING THE NATURE AND EXTENT OF THE WORK DESCRIBED.
6. THE CONTRACTOR SHALL BRING ANY DISCREPANCIES BETWEEN THE CONSTRUCTION PLANS AND SPECIFICATIONS AND/OR FIELD CONDITIONS TO THE ATTENTION OF THE SPONSORS ENGINEER BEFORE CONSTRUCTION BEGINS.
7. THERE SHALL BE NO CLEARING OR REMOVAL OF ANY NATIVE SPECIES VEGETATION OR TREES OF SIGNIFICANCE, OTHER THAN THOSE INDICATED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.
8. THE CONTRACTOR SHALL EXERCISE CARE DURING GRADING ACTIVITIES IN THE VICINITY OF NATIVE VEGETATION AND TREES OF SIGNIFICANCE AT THE CONSTRUCTION SITE. ALL GRADING IN THE VICINITY OF TREES NOT IDENTIFIED FOR REMOVAL SHALL BE MADE IN A MANNER THAT DOES NOT DISTURB THE ROOT SYSTEM WITHIN THE DRIP LINE OF THE TREE.
9. WORK ACTIVITIES ARE BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHALL MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS, PROTECT PUBLIC SAFETY, AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK. ALL AREAS SHALL BE KEPT NEAT, CLEAN, AND FREE OF ALL TRASH AND DEBRIS, AND ALL REASONABLE PRECAUTIONS SHALL BE TAKEN TO AVOID DAMAGE TO EXISTING ROADS, VEGETATION, TURF, STRUCTURES, AND PRIVATE PROPERTY.
10. PRIOR TO START OF WORK, THE CONTRACTOR SHALL SUBMIT THE SOURCE OF MATERIALS, INCLUDING AGGREGATES, EROSION CONTROL MATTING, WOOD AND NATIVE PLANTING MATERIAL TO THE ENGINEER FOR REVIEW AND APPROVAL. NO WORK SHALL BE PERFORMED UNTIL THE SOURCE OF MATERIAL IS APPROVED BY THE ENGINEER.
11. THE CONTRACTOR SHALL BE HELD SOLELY RESPONSIBLE FOR ANY NECESSARY COORDINATION BETWEEN THE VARIOUS COUNTY, STATE OR FEDERAL AGENCIES, UTILITY COMPANIES, HIS/HER SUB-CONTRACTORS, AND THE ENGINEER FOR THE DURATION OF THE PROJECT.
12. PRIOR TO START OF WORK, THE CONTRACTOR SHALL SUBMIT THEIR DETAILED PLANTING SCHEDULE TO THE ENGINEER FOR REVIEW. NO WORK SHALL BE PERFORMED UNTIL THIS SCHEDULE IS APPROVED BY THE ENGINEER. THE DETAILED PLANTING SCHEDULE SHALL CONFORM TO THE PLANTING REVEGETATION PLAN AND SHALL INCLUDE A SPECIES LIST AND TIMING SEQUENCE.
13. THE CONTRACTOR IS REQUIRED TO INSTALL IN-STREAM STRUCTURES AND CULVERT PIPES USING A BACKHOE/EXCAVATOR WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE STRUCTURES AND MATERIALS INCLUDING LOGS, STONE, AND TEMPORARY WOOD MAT STREAM CROSSINGS.

GRADING NOTES

1. NO GRADING ACTIVITIES SHALL OCCUR BEYOND THE PROJECT LIMITS OF DISTURBANCE (LOD) AS SHOWN ON THE DESIGN PLANS.
2. ONCE DESIGN GRADES ARE ACHIEVED AS SHOWN ON THE PLAN AND PLAN AND PROFILE, THE HEADWATER VALLEY, STREAM AND WETLAND, AND FLOODPLAIN AREAS SHALL BE ROUGHENED USING TECHNIQUES DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS.
3. ALL SUITABLE SOIL MATERIAL REQUIRED TO FILL AND/OR PLUG EXISTING DITCHES AND/OR STREAM CHANNEL SHALL BE GENERATED ON-SITE AS DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS. ANY EXCESS SPOIL MATERIAL SHALL BE STOCKPILED IN DESIGNATED AREAS AND OR HAULED OFF-SITE AS APPROVED BY THE ENGINEER.

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Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER A. TOMSIC

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

REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

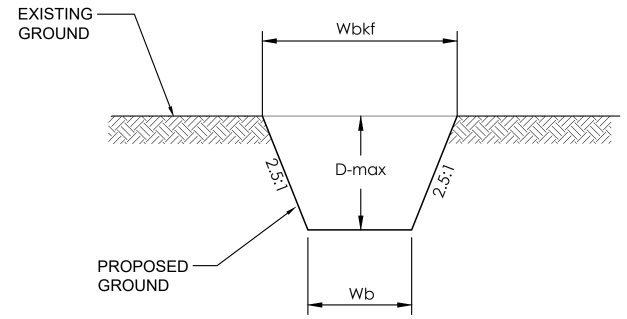
PROJECT NO.	18-003
FILENAME	02_ODELL'S HOUSE_GENERAL NOTES.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	N/A
VERT. SCALE	N/A

SHEET NAME

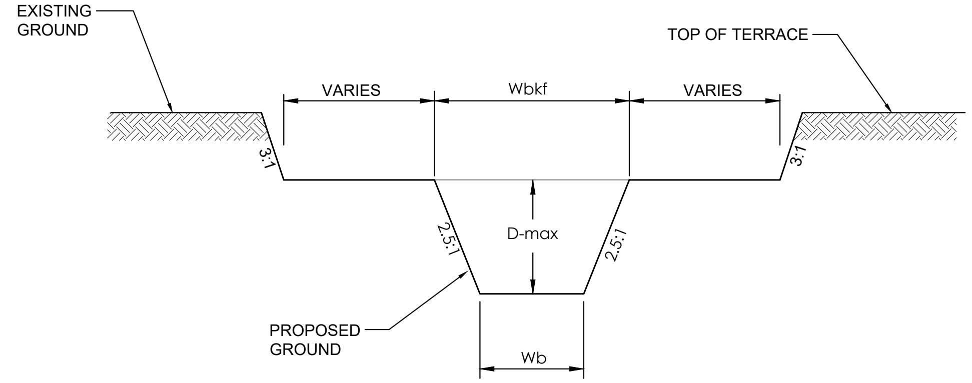
LEGEND/ CONSTRUCTION SEQUENCE/ GENERAL NOTES

SHEET NUMBER

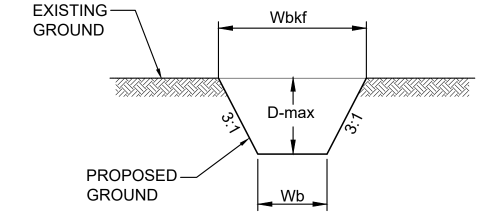
2



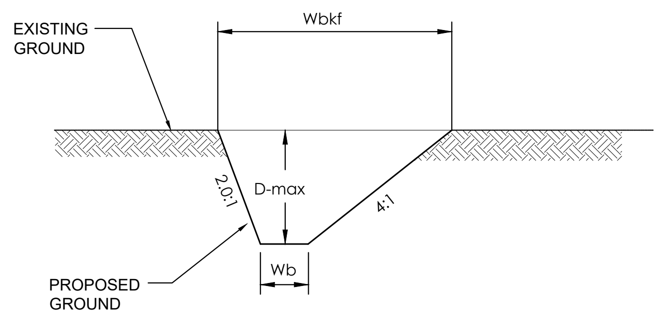
RIFFLE
N.T.S



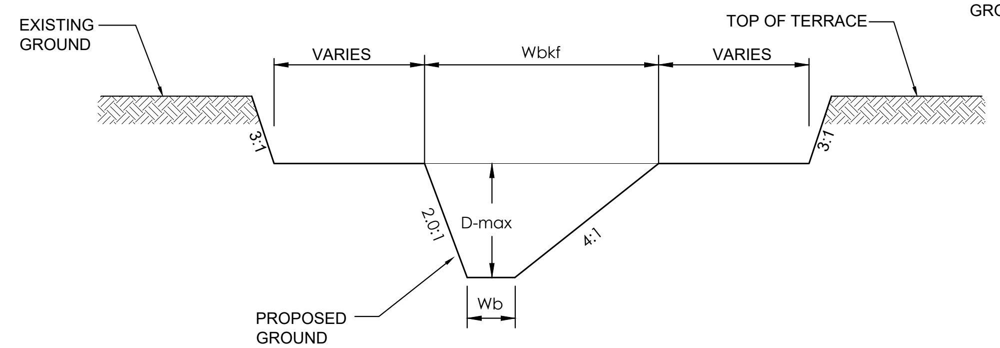
RIFFLE WITH BANKFULL BENCH
N.T.S



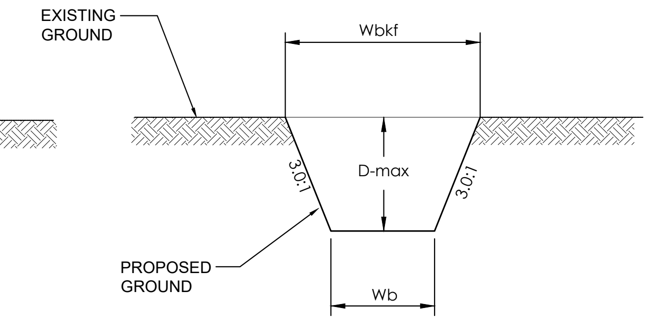
OUTLET CHANNEL
N.T.S



POOL
N.T.S



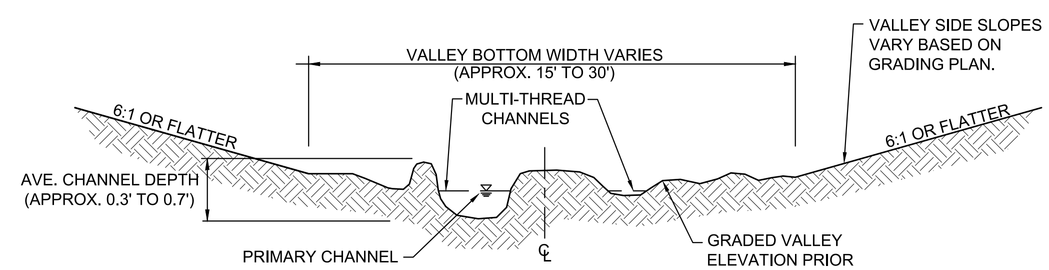
POOL WITH BANKFULL BENCH
N.T.S



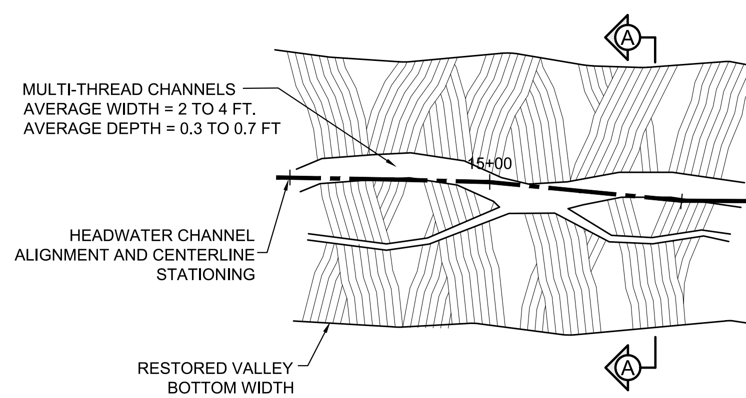
POOL STRAIGHT
N.T.S

SINGLE-THREAD CHANNEL

Reach Name	R3		R6		R7 (upper)		
Feature	Riffle	Pool	Riffle	Pool	Riffle	Pool	Outlet Channel
Width of Bankfull, Wbkf (ft)	8.0	11.0	6.0	8.0	6.0	8.0	3.0
Average Depth, Dbkf (ft)	0.6	0.9	0.4	0.6	0.4	0.6	N/A
Maximum Depth, D-Max (ft)	0.8	1.4	0.5	1.0	0.5	1.0	0.5
Width to Depth Ratio, bkf W/D	13.3	12.8	15.2	12.8	15.2	12.8	N/A
Bankfull Area, Abkf (sq ft)	4.8	9.5	2.4	5.0	2.4	5.0	N/A
Bottom Width, Wb (ft)	4.0	3.0	3.5	2.0	3.5	2.0	N/A



SECTION A-A



PLAN VIEW OF CHANNEL PATTERN

NOTES:

1. GRADE VALLEY AND BOTTOM WIDTH TO DESIGN CONTOURS AS SHOWN ON GRADING PLAN.
2. MICROTOPOGRAPHY IS GRADED USING STANDARD TILLAGE EQUIPMENT TO CREATE MOUNDS AND FURROWS AS DESCRIBED IN THE SPECIFICATIONS. ALTERNATIVE CONSTRUCTION METHODS SHALL BE APPROVED BY THE ENGINEER PRIOR TO CONSTRUCTION.
3. THE HEADWATER CHANNEL ALIGNMENT SHALL BE APPROVED BY ENGINEER FOLLOWING COMPLETION OF THE MICROTOPOGRAPHY ROUGHENING.
4. HEADWATER (MULTI-THREAD) CHANNELS WILL BE SHAPED TO FORM SMOOTH TRANSITIONS.
5. UPON COMPLETION OF THE HEADWATER CHANNEL FEATURES, APPLY MULCH, TEMPORARY SEED AND PERMANENT SEED TO THE CONSTRUCTED VALLEY IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.

HEADWATER (MULTI-THREAD) CHANNEL

NOT TO SCALE

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PROJECT ENGINEER

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FIRM LICENSE NO. P-1480

REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

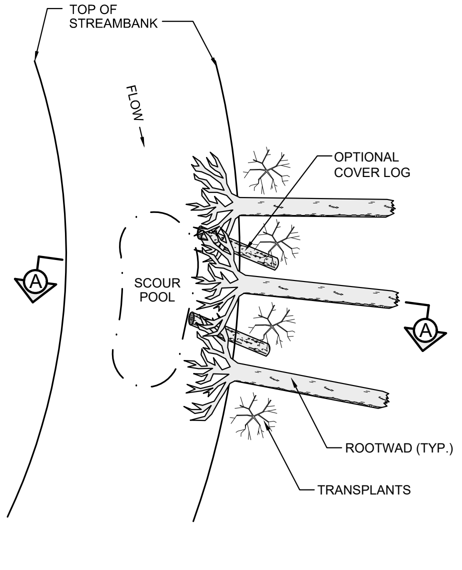
PROJECT NO.	18-003
FILENAME	03_ODELL'S HOUSE_TYPICAL_SECTIONS.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	N.T.S.
VERT. SCALE	N.T.S.

SHEET NAME

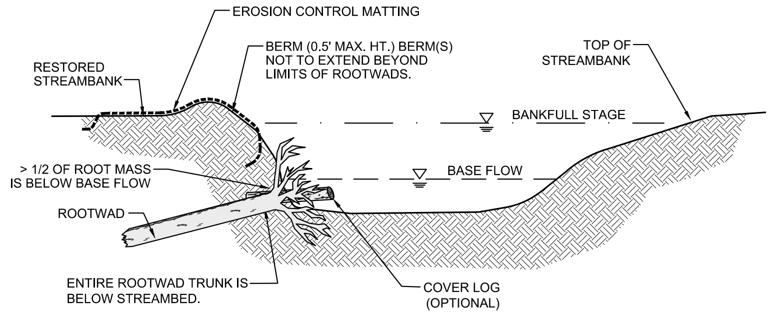
TYPICAL SECTIONS

SHEET NUMBER

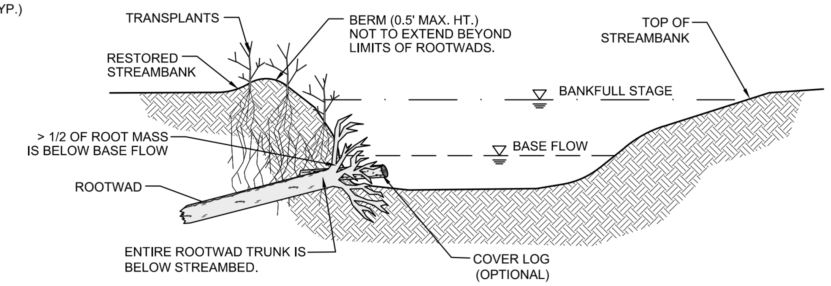
3



PLAN VIEW



SECTION A-A
ROOTWADS WITHOUT TRANSPLANTS

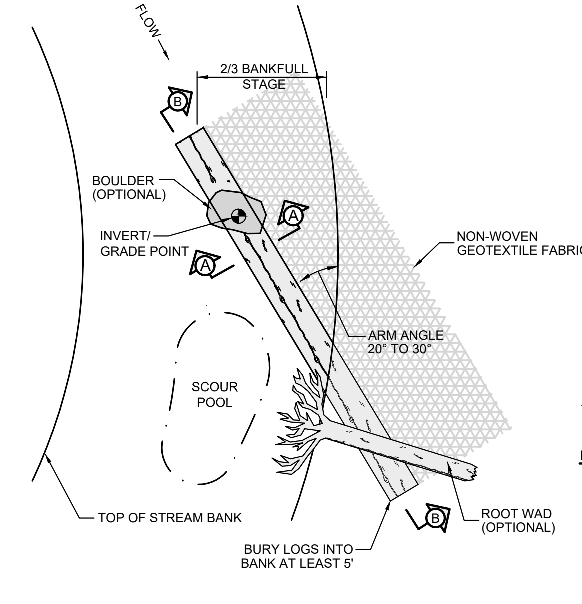


SECTION A-A
ROOTWADS WITH TRANSPLANTS

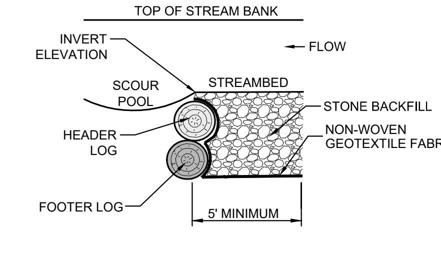
NOTES:
1. THE TRENCHING METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOTWAD. A COVER LOG SHOULD BE INSTALLED UNDERNEATH THE ROOTWAD IN A TRENCH EXCAVATED PERPENDICULAR TO THE BANK AND BELOW THE RESTORED STREAMBED. ONE-THIRD OF THE ROOTWAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.

ROOTWADS

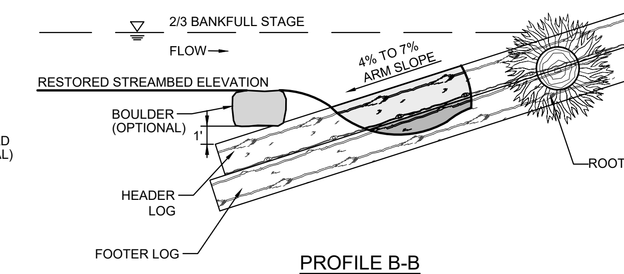
NOT TO SCALE



PLAN VIEW



SECTION A-A

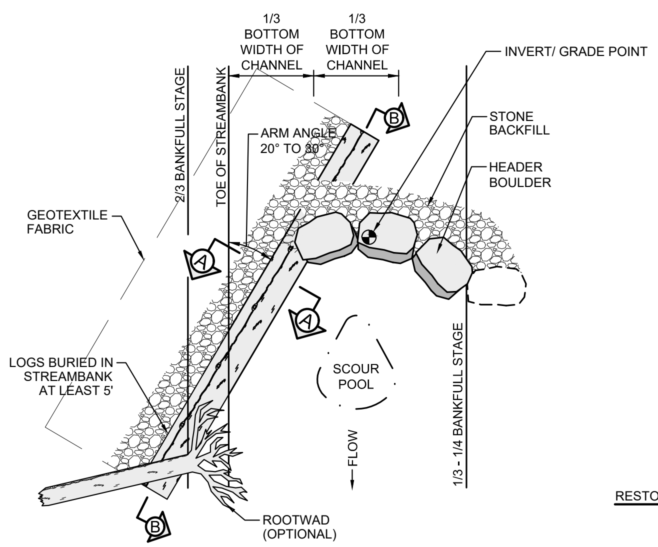


PROFILE B-B

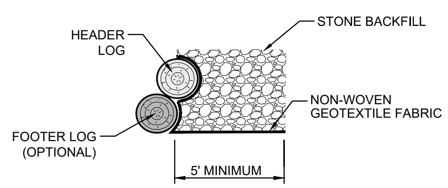
NOTES:
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
3. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
4. BOULDERS OF SUFFICIENT SIZE CAN PLACED ON TOP OF HEADER LOG FOR ANCHORING, PER DIRECTION OF ENGINEER.
5. LOGS SHOULD BE BURIED INTO THE STREAM BED AND BANKS AT LEAST 5 FEET.
6. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
7. TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

LOG VANE

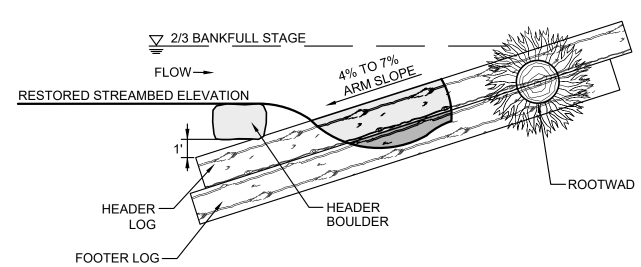
NOT TO SCALE



PLAN VIEW



SECTION A-A

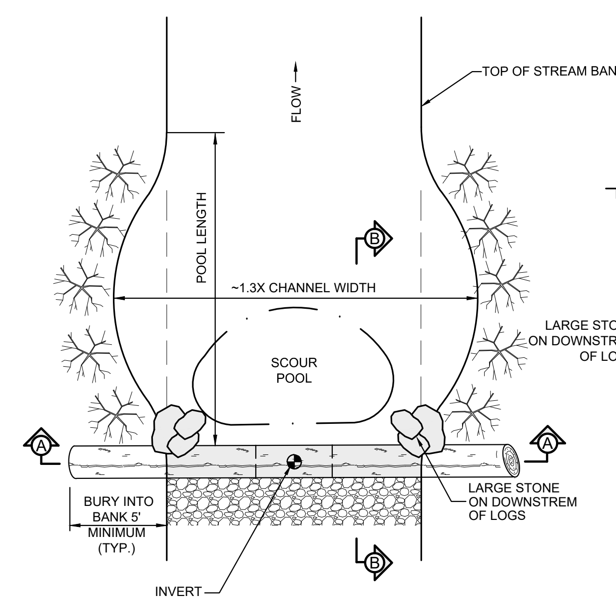


PROFILE B-B

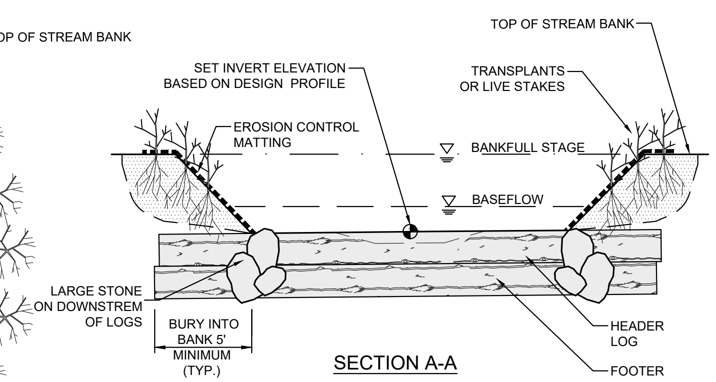
NOTES:
1. LOGS SHOULD BE 12" TO 18" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS SHOULD BE BURIED INTO THE STREAM BED AND BANKS AT LEAST 5 FEET.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. INSTALL GEOTEXTILE FABRIC BEGINNING AT THE TOP OF THE HEADER LOG AND EXTEND DOWNWARD TO THE DEPTH OF THE BOTTOM FOOTER LOG AND THEN UPSTREAM TO A MINIMUM OF FIVE FEET. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
5. EXCAVATE A TRENCH BELOW THE BED FOR FOOTER LOG AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBANK.
6. START AT BANK AND PLACE FOOTER BOULDERS FIRST AND THEN HEADER BOULDERS.
7. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
8. AN OPTIONAL COVER LOG CAN BE PLACED IN SCOUR POOL FOR HABITAT IMPROVEMENT AT DIRECTION OF ENGINEER.
9. USE HAND PLACED STONE TO FILL GAPS ON UPSTREAM SIDE OF HEADER AND FOOTER BOULDERS.
10. AFTER ALL STONE BACKFILL HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER BOULDER AND LOG.
11. VEGETATION TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

GRADE CONTROL LOG J-HOOK VANE

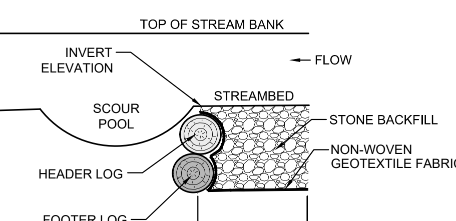
NOT TO SCALE



PLAN VIEW



SECTION A-A



PROFILE B-B

NOTES:
1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG, AT THE DIRECTION OF THE ENGINEER.
3. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG AT A MAXIMUM OF 3 INCHES ABOVE THE INVERT ELEVATION.
4. CUT A NOTCH IN THE HEADER LOG APPROXIMATELY 30% OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION. NOTCH SHALL BE USED TO CENTER FLOW AND NOT EXCEED 3 INCHES IN DEPTH.
5. USE GEOTEXTILE FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
6. INSTALL VEGETATION TRANSPLANTS FROM TOE OF STREAM BANK TO TOP OF STREAM BANK.
7. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.

LOG WEIR

NOT TO SCALE

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PROJECT ENGINEER

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REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

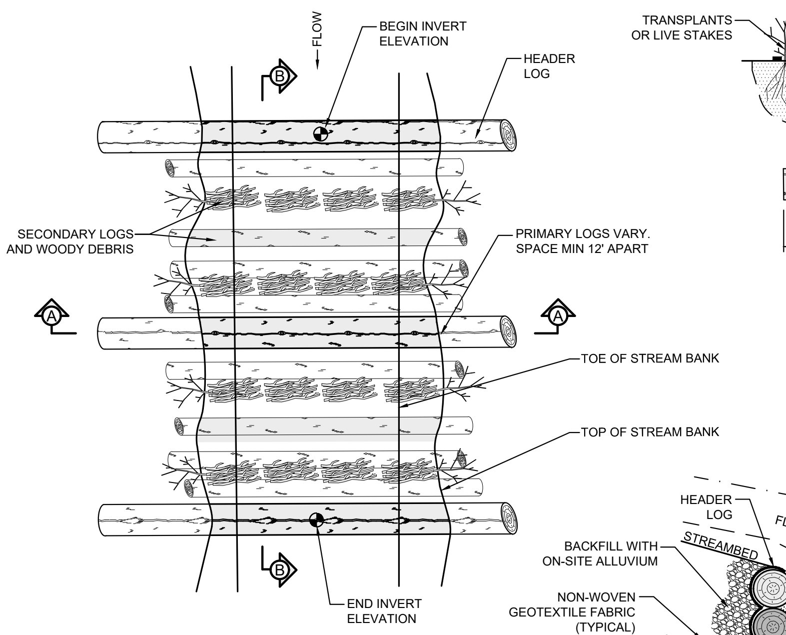
PROJECT NO.	18-003
FILENAME	04-08_ODELL'S HOUSE_DETAIL_SHEETS.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	N.T.S.
VERT. SCALE	N.T.S.

SHEET NAME

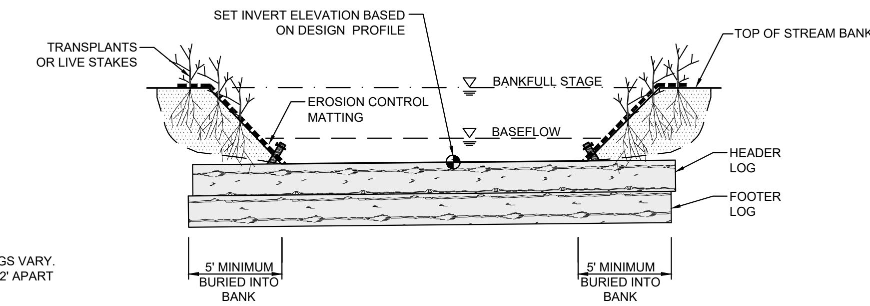
DETAILS

SHEET NUMBER

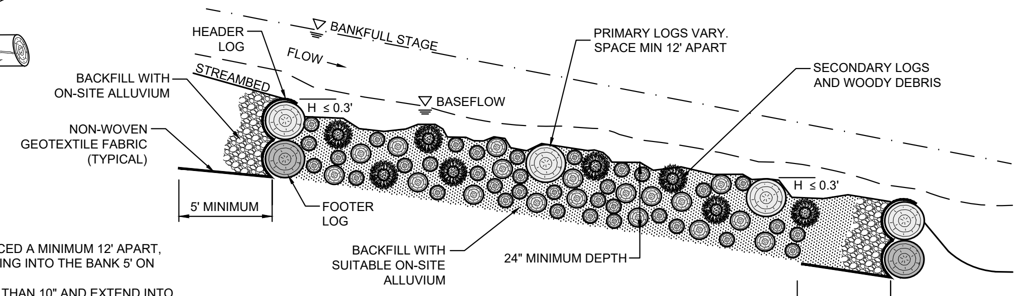
4



PLAN VIEW



SECTION A-A

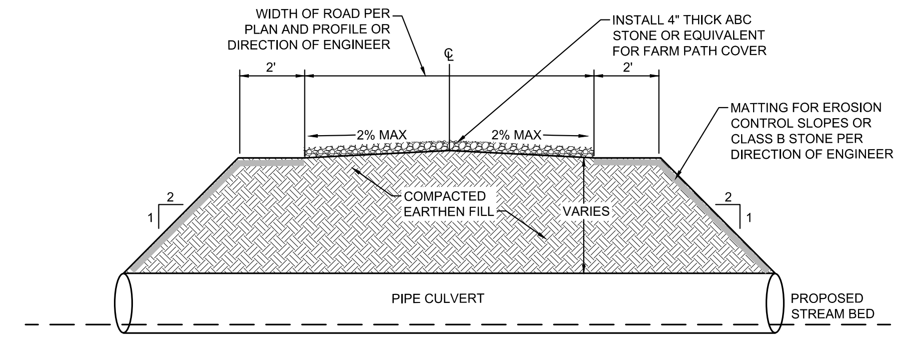


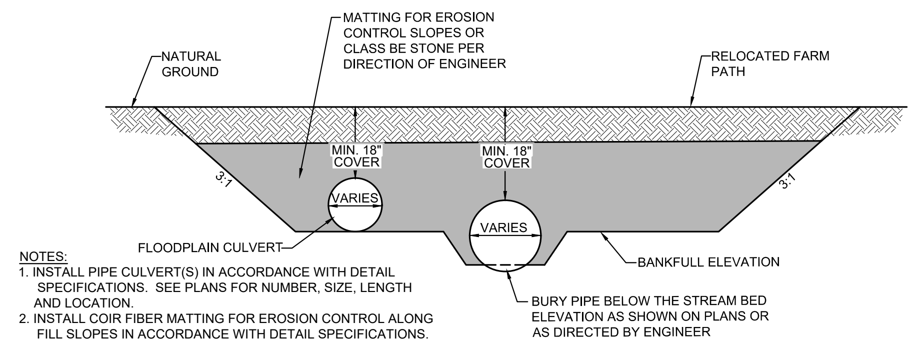
PROFILE B-B

NOTES:
1. PRIMARY LOGS SHOULD BE AT LEAST 12" OR MORE IN DIAMETER AND SPACED A MINIMUM 12' APART, RELATIVELY STRAIGHT, HARDWOOD, RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE OF STREAM BANK.
2. SECONDARY LOGS SHOULD BE AT LEAST 4" IN DIAMETER AND NO LARGER THAN 10" AND EXTEND INTO THE BANK 3' ON EACH SIDE. WOODY DEBRIS MATERIAL SHALL BE VARYING DIAMETER TO ALLOW MATERIAL TO BE COMPACTED.
3. NON-WOVEN GEOTEXTILE FABRIC SHOULD BE NAILED TO THE HEADER LOG BELOW THE BACKFILL.
4. ROOT WADS CAN BE USED INSTEAD OF TRANSPLANTS OR LIVE STAKES PER DIRECTION OF ENGINEER.
5. AFTER TRENCH HAS BEEN EXCAVATED A LAYER OF SECONDARY LOGS AND WOODY DEBRIS SHOULD BE PLACED WITH MINIMAL GAPS. A LAYER OF ON-SITE ALLUVIUM SHOULD BE APPLIED TO FILL VOIDS BETWEEN SECONDARY LOGS BEFORE ADDITIONAL LAYERS ARE PLACED.
6. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.

CONSTRUCTED LOG RIFFLE

NOT TO SCALE

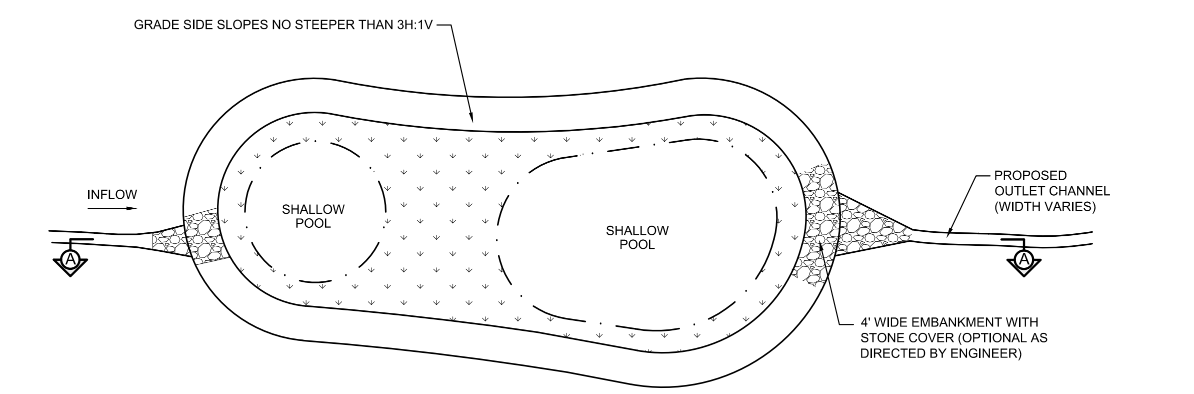




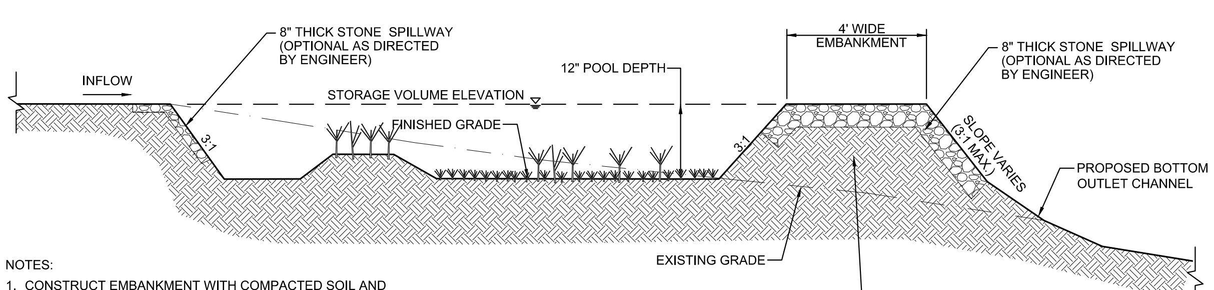
NOTES:
1. INSTALL PIPE CULVERT(S) IN ACCORDANCE WITH DETAIL SPECIFICATIONS. SEE PLANS FOR NUMBER, SIZE, LENGTH AND LOCATION.
2. INSTALL COIR FIBER MATTING FOR EROSION CONTROL ALONG FILL SLOPES IN ACCORDANCE WITH DETAIL SPECIFICATIONS.
3. PIPE CULVERTS ARE TO BE A MINIMUM OF 18" COVER AND SPACING IN ACCORDANCE WITH DETAIL SPECIFICATIONS.

PERMANENT CULVERT STREAM CROSSING

NOT TO SCALE



PLAN VIEW

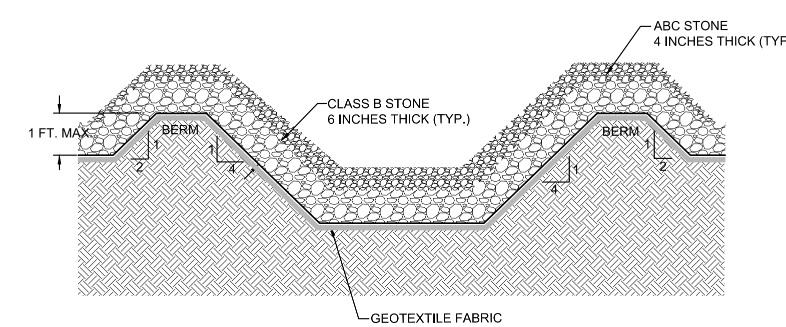


NOTES:
1. CONSTRUCT EMBANKMENT WITH COMPACTED SOIL AND SUITABLE MATERIAL IN ACCORDANCE WITH TECHNICAL SPECIFICATIONS.
2. WATER QUALITY TREATMENT FEATURE VARIES IN SIZE AND SHAPE AS SHOWN ON PLANS.
3. PLANT APPROPRIATE WETLAND SPECIES VEGETATION AS SPECIFIED IN THE PLANTING PLAN.

SECTION A - A

WATER QUALITY TREATMENT FEATURE

NOT TO SCALE



NOTES:
1. CONSTRUCT STREAM CROSSING DURING LOW OR BASE FLOW CONDITIONS.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAM BANKS . DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING PERPENDICULAR TO THE FLOW.
5. GRADE SLOPES TO A 4:1 SLOPE. TRANSPLANT SOD OR VEGETATION FROM ORIGINAL STREAM BANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF FROM THE CONSTRUCTION ACCESS ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF 6 INCHES THICK CLASS B STONE LINED WITH GEOTEXTILE FABRIC FOR DRAINAGE SHALL BE USED OVER THE BERM AND ACCESS SLOPES. ABC STONE APPROXIMATELY 4 INCHES THICK SHALL BE ADDED TO TOP LAYER.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE EQUIPMENT CROSSING THE CHANNEL OR A MINIMUM 12 FEET.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

PERMANENT FORD STREAM CROSSING

NOT TO SCALE

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PROJECT ENGINEER

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REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
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PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

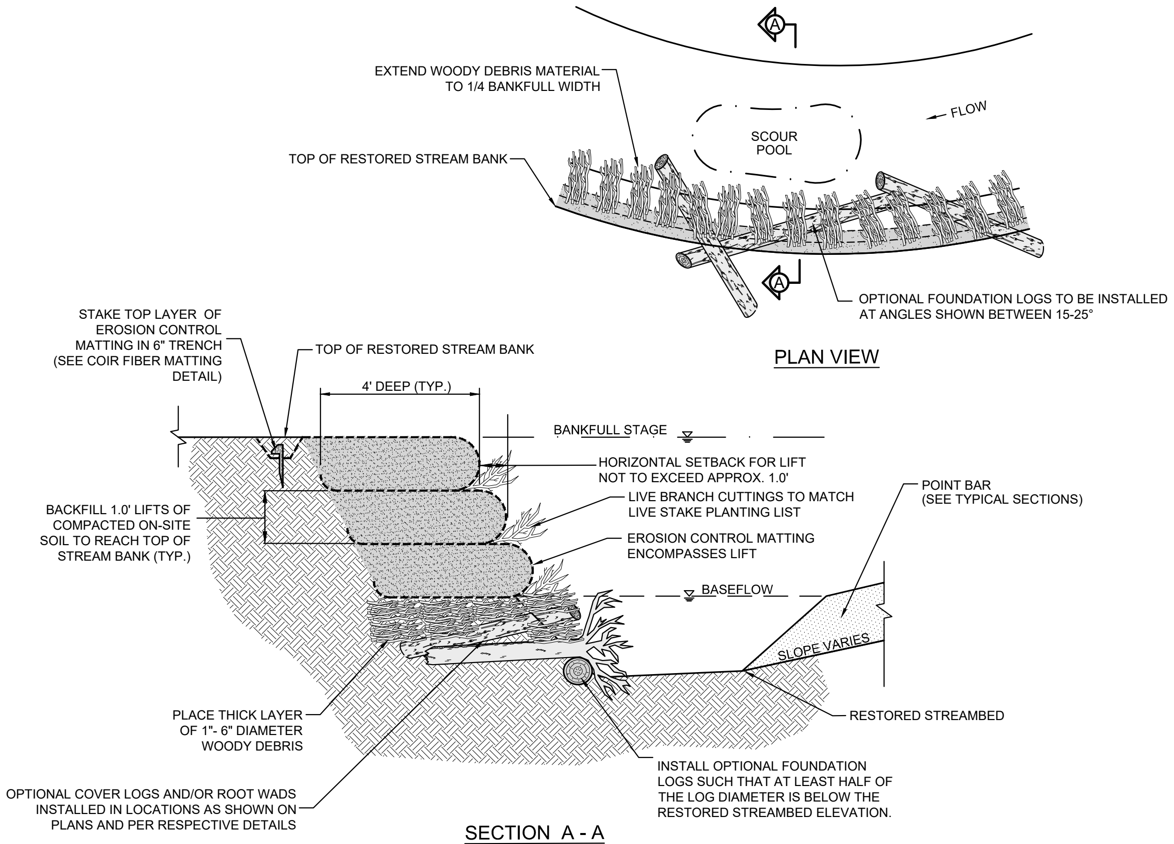
PROJECT NO.	18-003
FILENAME	04-08_ODELL'S HOUSE_DETAIL_SHEETS.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	N.T.S.
VERT. SCALE	N.T.S.

SHEET NAME

DETAILS

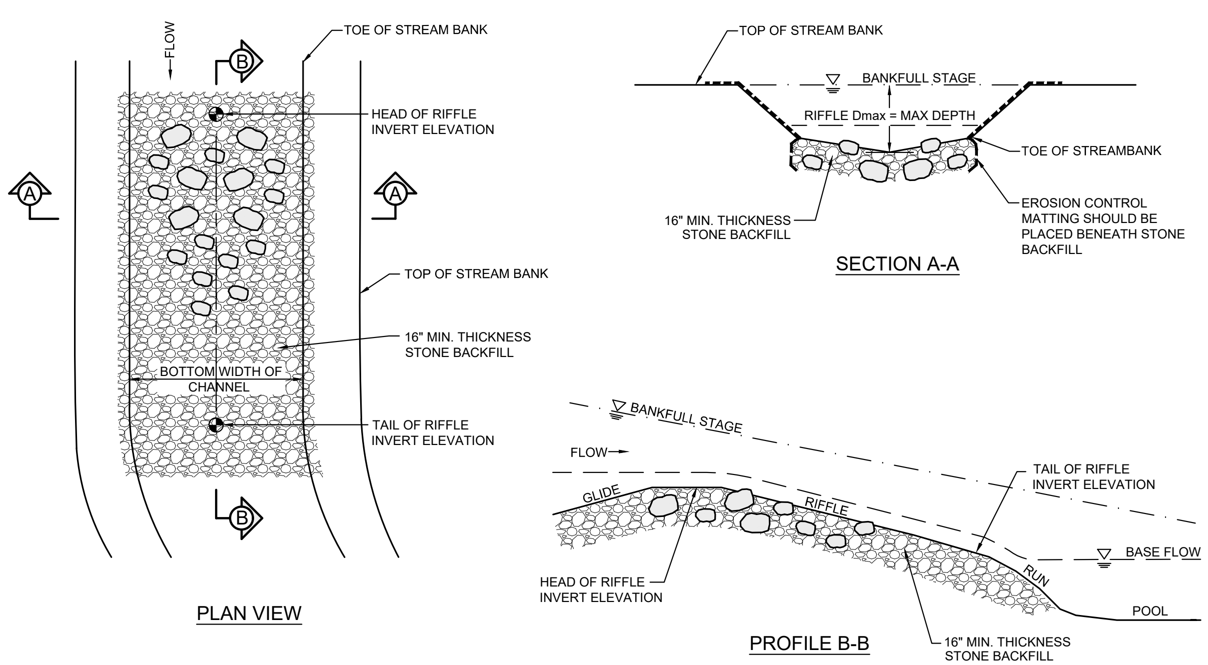
SHEET NUMBER

5



GEOLIFT W/ TOE WOOD

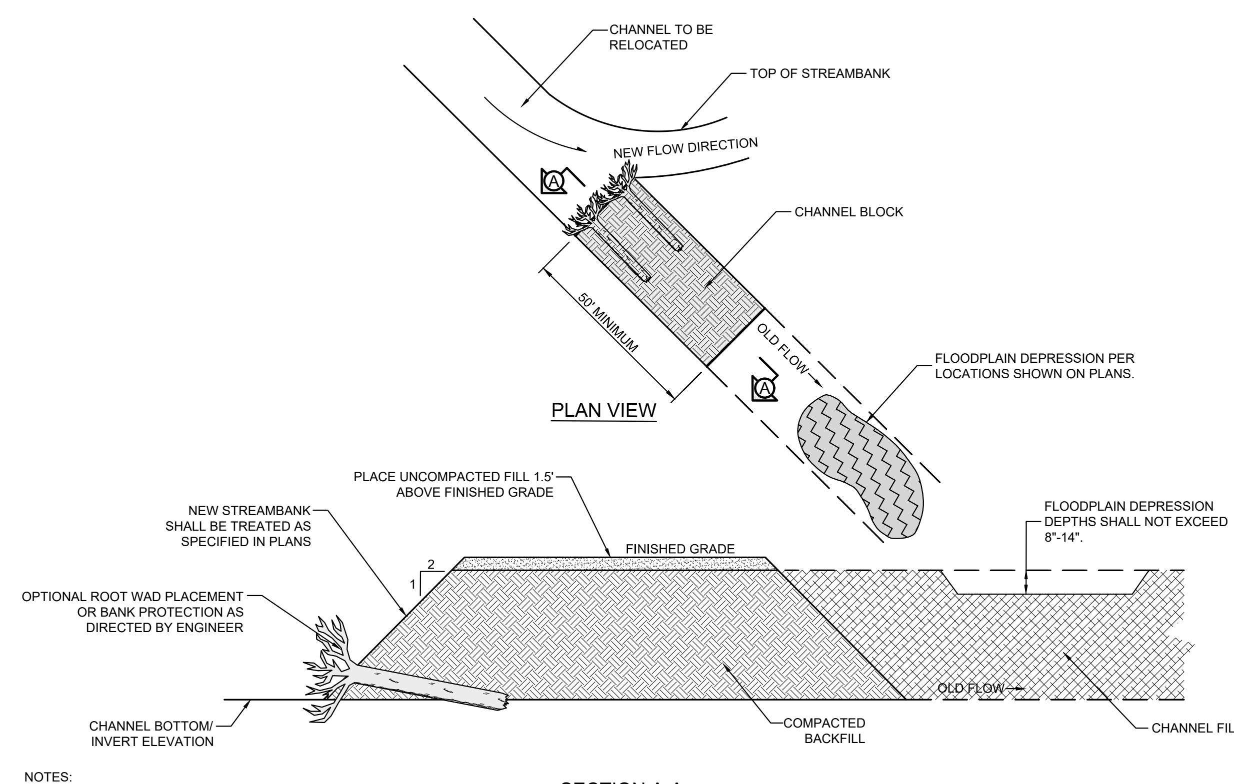
NOT TO SCALE



NOTES:
1. DIG A TRENCH BELOW THE RESTORED STREAMBED FOR THE STONE BACKFILL.
2. FILL TRENCH WITH CLASS "A" AND "B" STONE BACKFILL.

CONSTRUCTED STONE RIFFLE

NOT TO SCALE



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

CHANNEL BLOCK

NOT TO SCALE

WATER & LAND SOLUTIONS
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waterlandsolutions.com

PROJECT ENGINEER

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REVISIONS

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A	DRAFT MIT PLAN	2-24-20
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ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

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FILENAME	04-08_ODELL'S HOUSE_DETAIL_SHEETS.DWG
DESIGNED BY	CAT
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DATE	8-12-20
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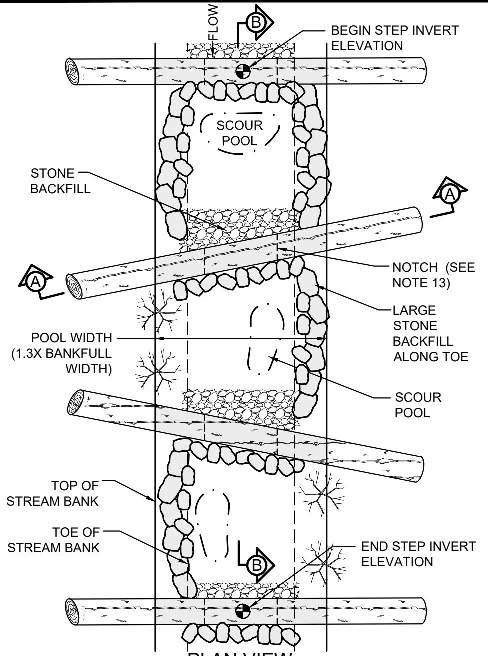
SHEET NAME

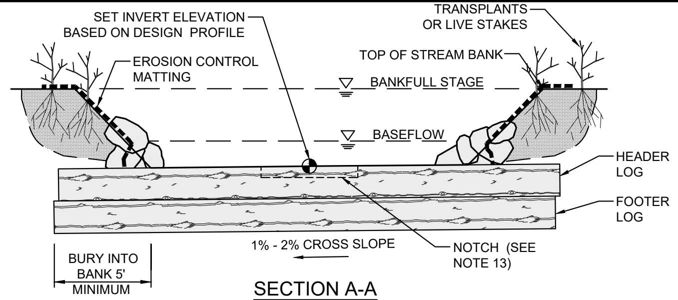
DETAILS

SHEET NUMBER

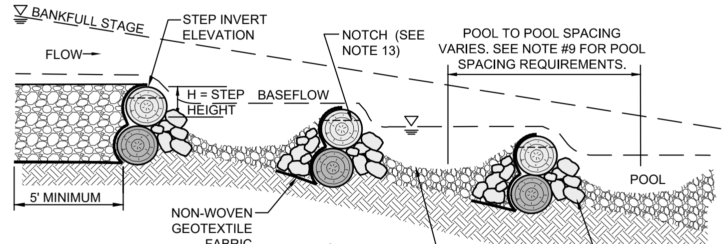
6



PLAN VIEW



SECTION A-A



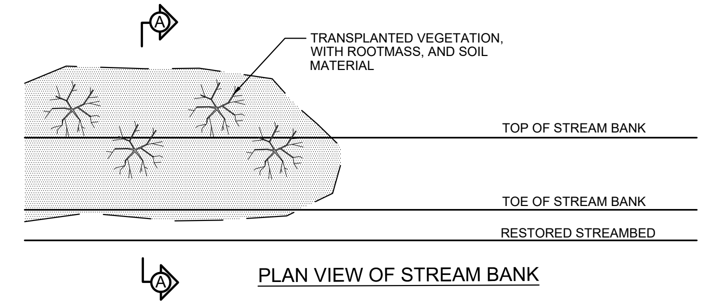
PROFILE B-B

NOTES:

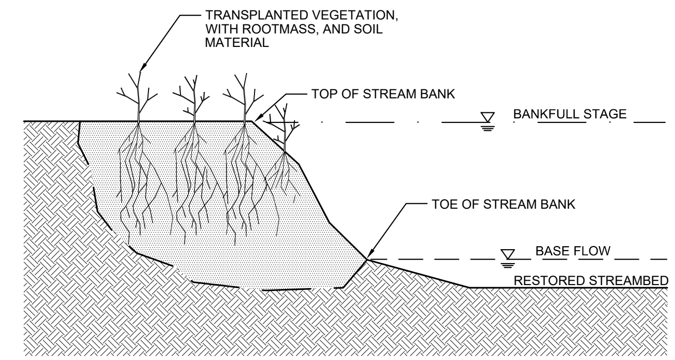
1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG. LOGS SHOULD EXTEND INTO THE BANKS 5' ON EACH SIDE.
3. SOIL SHALL BE WELL COMPACTED AROUND BURIED PORTION OF FOOTER LOGS WITH BUCKET OF TRACK HOE.
4. INSTALL GEOTEXTILE FILTER FABRIC UNDERNEATH LOGS.
5. UNDERCUT POOL BED ELEVATION 8 INCHES TO ALLOW FOR LAYER OF STONE. INSTALL LARGE STONE BACKFILL ALONG SIDE SLOPES.
6. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
7. INSTALL LARGE STONE BACKFILL ALONG SIDE SLOPES.
8. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, COMPACTED, AND CONCAVE, WITH THE ELEVATION OF THE BED APPROXIMATELY 0.5 FT DEEPER IN THE CENTER THAN AT THE EDGES.
9. AVERAGE POOL TO POOL SPACING SHALL BE SHOWN ON THE PROFILE OR SPECIFIED BY ENGINEER BASED ON EXISTING CONDITIONS SUCH AS SLOPE AND SUITABLE FILL MATERIAL. RIFFLE STEP-POOLS OR CASCADE POOLS MAY BE SUBSTITUTED IN AREAS WHERE EXISTING SLOPES EXCEED 10% AS DETERMINED BY THE ENGINEER.
10. INTERIOR LOGS SHOULD BE AT A SLIGHT ANGLE (~70 DEGREES) FROM THE STREAMBANK AND CROSS SLOPES SHOULD BE 1-2%.
11. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG AT A MAXIMUM OF 3 INCHES ABOVE THE INVERT ELEVATION.
12. AVERAGE STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.5 UNLESS SHOWN OTHERWISE.
13. CUT A NOTCH IN THE HEADER LOG APPROXIMATELY 30% OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION. NOTCH SHALL BE USED TO CENTER FLOW AND NOT EXCEED 3 INCHES IN DEPTH.
14. THE NUMBER OF STEPS MAY VARY BETWEEN BEGINNING AND END STATIONING. SEE LONGITUDINAL PROFILE FOR STATION AND ELEVATION.
15. USE GEOTEXTILE FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
16. PLACE VEGETATION TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.
17. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.

STONE AND LOG STEP POOL

NOT TO SCALE



PLAN VIEW OF STREAM BANK



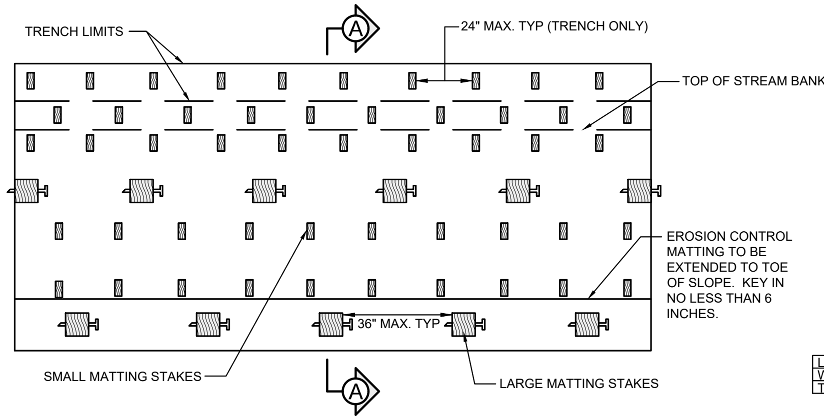
SECTION A-A

NOTES:

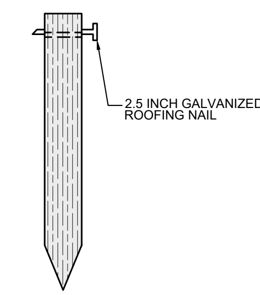
1. EXCAVATE A HOLE IN THE RESTORED STREAM BANK THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLANTED. BEGIN EXCAVATION AT TOE OF THE STREAM BANK.
2. EXCAVATE THE ENTIRE TRANSPLANT ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED AT ONCE, THE TRANSPLANT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

VEGETATION TRANSPLANTS

NOT TO SCALE

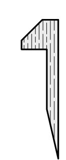


PLAN VIEW OF STREAM BANK



TYPICAL LARGE MATTING STAKE

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

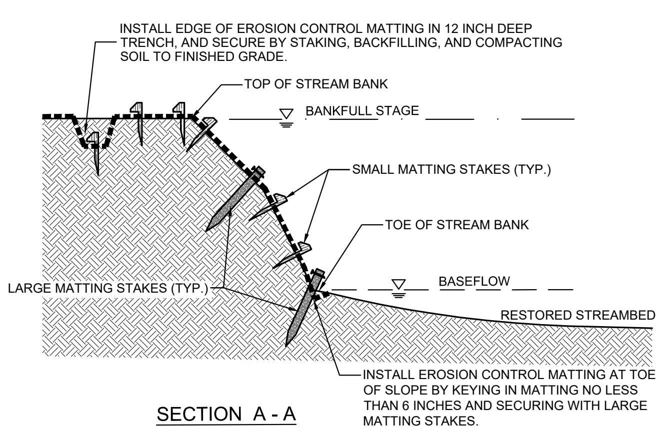


TYPICAL SMALL MATTING STAKE

LEG LENGTH	11.00 IN (27.94 CM)
HEAD WIDTH	1.25 IN (3.18 CM)
HEAD THICKNESS	0.40 IN (1.02 CM)
LEG WIDTH	0.60 IN (1.52 CM) (TAPERED TO POINT)
LEG THICKNESS	0.40 IN (1.02 CM)
TOTAL LENGTH	12.00 IN (30.48 CM)

NOTES:

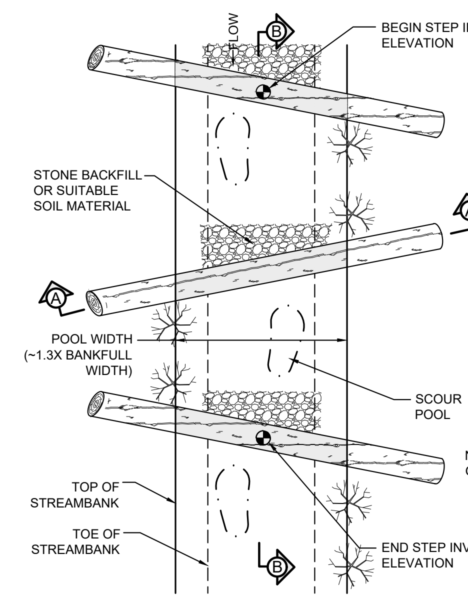
1. RESTORED STREAM BANKS MUST BE SEEDED AND MULCHED PRIOR TO PLACEMENT OF EROSION CONTROL MATTING.
2. SEE TECHNICAL SPECIFICATIONS FOR MATTING STAKE SPACING REQUIREMENTS.
3. PLACE LARGE STAKES ALONG ALL MATTING SEAMS, IN THE CENTER OF STREAM BANK, AND TOE OF SLOPE.



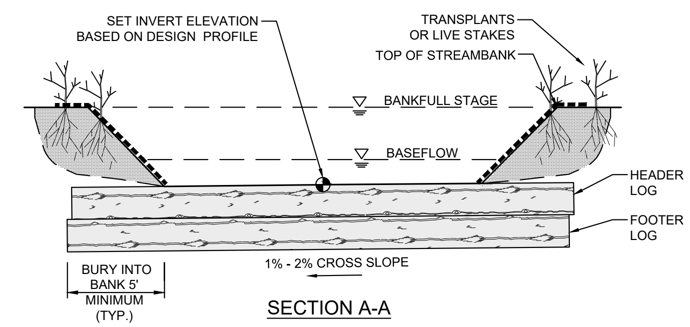
SECTION A - A

EROSION CONTROL MATTING

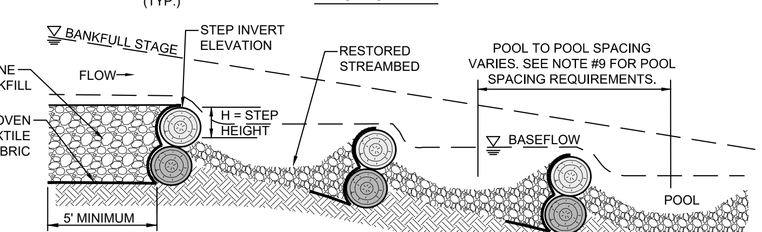
NOT TO SCALE



PLAN VIEW



SECTION A-A



PROFILE B-B

NOTES:

1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT HARDWOOD AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG. LOGS SHOULD EXTEND INTO THE BANKS 5' ON EACH SIDE.
3. SOIL SHALL BE WELL COMPACTED AROUND BURIED PORTION OF FOOTER LOGS WITH BUCKET OF TRACK HOE.
4. INSTALL NON-WOVEN GEOTEXTILE FABRIC UNDERNEATH LOGS.
5. UNDERCUT POOL BED ELEVATION 8 INCHES TO ALLOW FOR LAYER OF STONE. INSTALL STONE BACKFILL OR SUITABLE ALLUVIUM ALONG SIDE SLOPES.
6. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
7. INSTALL STONE BACKFILL OR SUITABLE SOIL MATERIAL ALONG SIDE SLOPES.
8. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, COMPACTED, AND CONCAVE, WITH THE ELEVATION OF THE BED APPROXIMATELY 0.5 FT DEEPER IN THE CENTER THAN AT THE EDGES.
9. AVERAGE POOL TO POOL SPACING SHALL BE SHOWN ON THE PROFILE OR SPECIFIED BY ENGINEER BASED ON EXISTING CONDITIONS SUCH AS SLOPE AND SUITABLE FILL MATERIAL. RIFFLE STEP POOLS OR CASCADE POOLS MAY BE SUBSTITUTED IN AREAS WHERE EXISTING SLOPES EXCEED 10% AS DETERMINED BY THE ENGINEER.
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17. SEE TYPICAL SECTION FOR CHANNEL DIMENSIONS.

LOG STEP POOL

NOT TO SCALE

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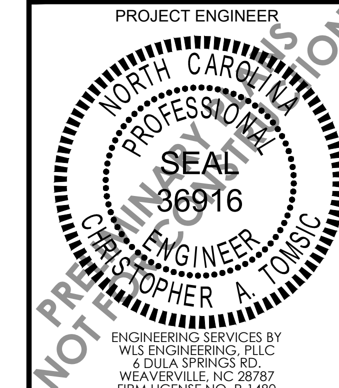

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REVISIONS

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B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

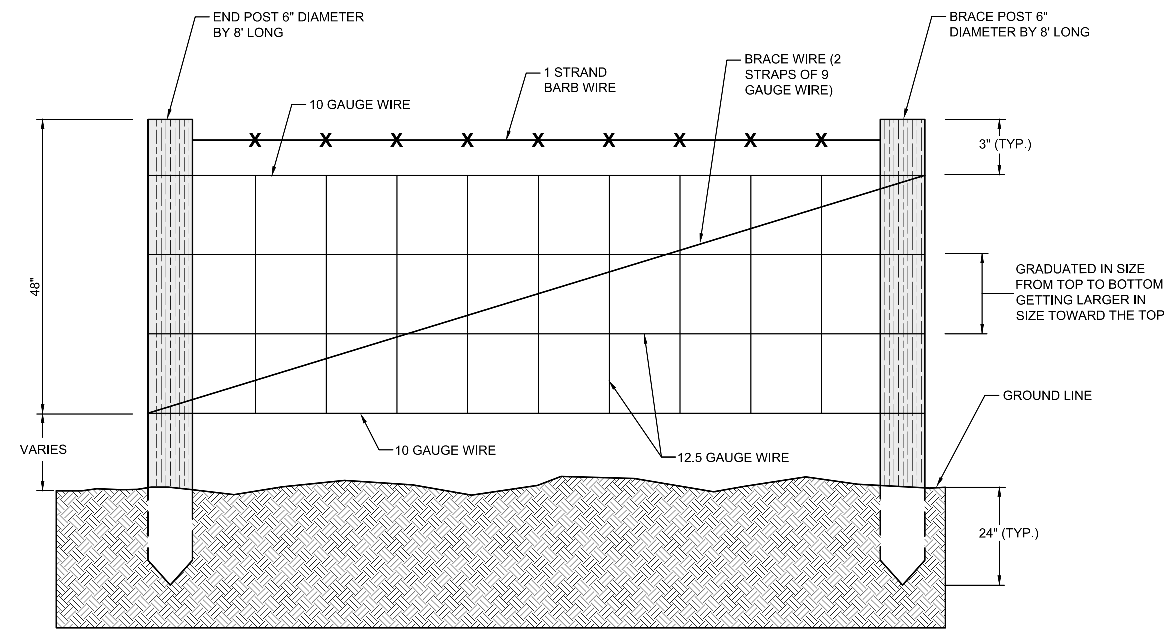
PROJECT NO.	18-003
FILENAME	04-08_ODELL'S HOUSE_DETAIL_SHEETS.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	N.T.S.
VERT. SCALE	N.T.S.

SHEET NAME

DETAILS

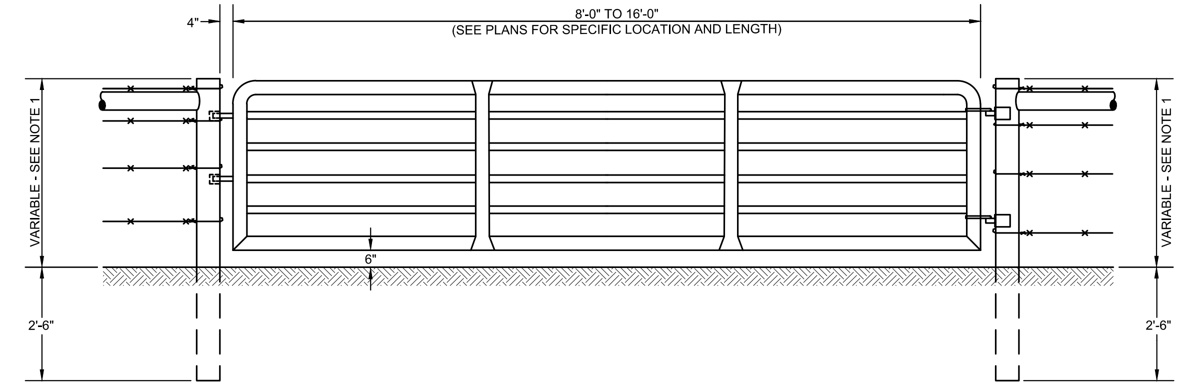
SHEET NUMBER

7



NOTE:
1. STANDARD WOVEN FIELD FENCES SHALL HAVE A MAXIMUM POST SPACING OF 16 FEET. HIGH TENSILE WOVEN WIRE MAXIMUM POST SPACING IS 25 FEET.

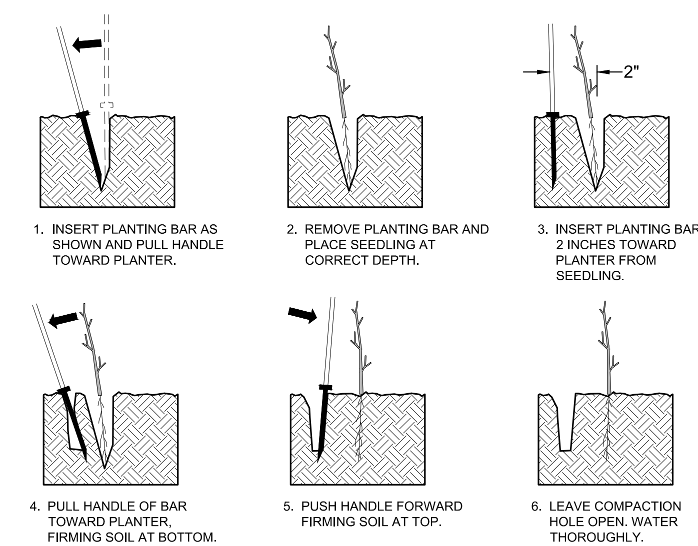
WOVEN FIELD FENCE
NOT TO SCALE



NOTES:
1. POST HEIGHT DIMENSION SHALL BE THE SAME AS REQUIRED FOR THE ADJACENT FENCE.
2. CONSTRUCT ENDS OR STRESS PANELS AS REQUIRED PER THE TECHNICAL SPECIFICATIONS ON EACH SIDE OF THE GATE.
3. HINGES AND LOCKS SHALL BE INSTALLED PER THE TECHNICAL SPECIFICATIONS AS RECOMMENDED BY GATE MANUFACTURER.

STEEL FRAME GATE
NOT TO SCALE

PLANTING METHOD USING THE PLANTING BAR



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

BARE ROOT PLANTING DETAIL
NOT TO SCALE

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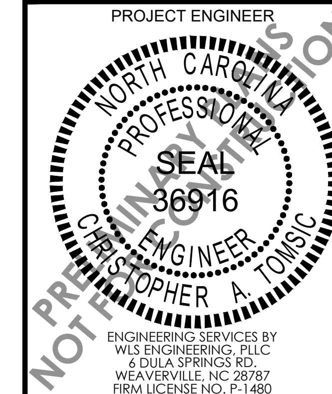

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JOHNSTON COUNTY, NC

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SHEET NAME

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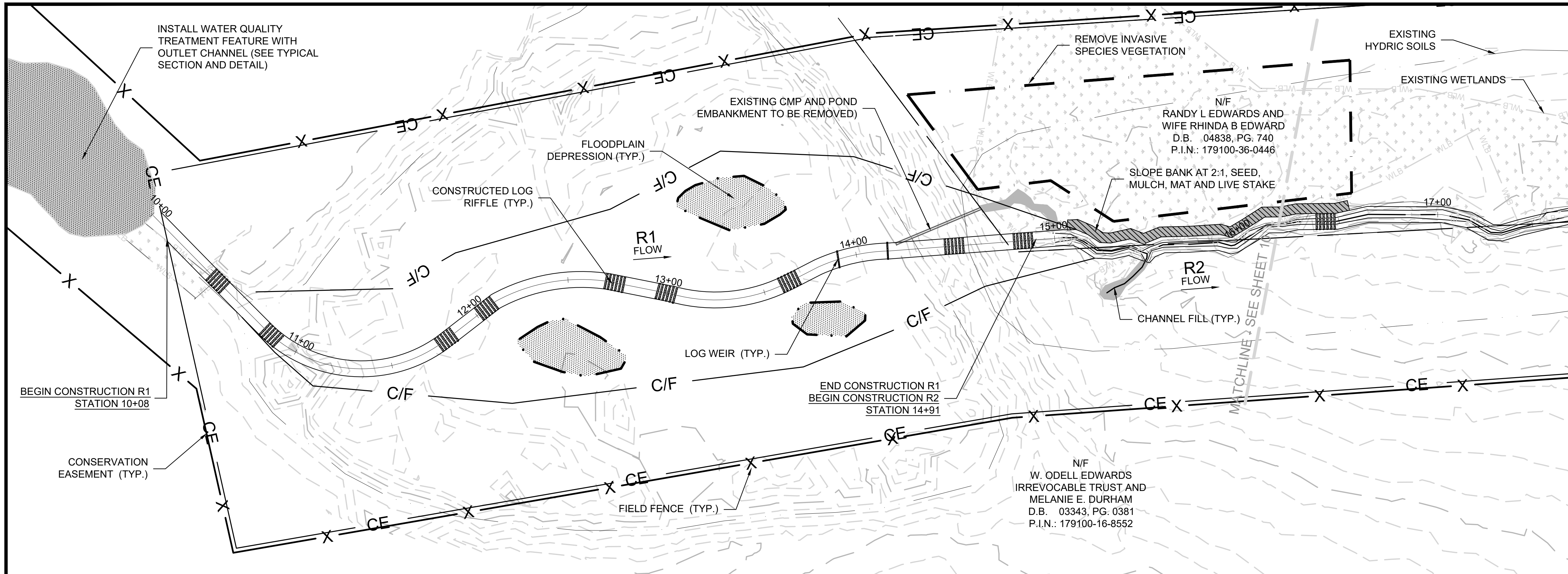
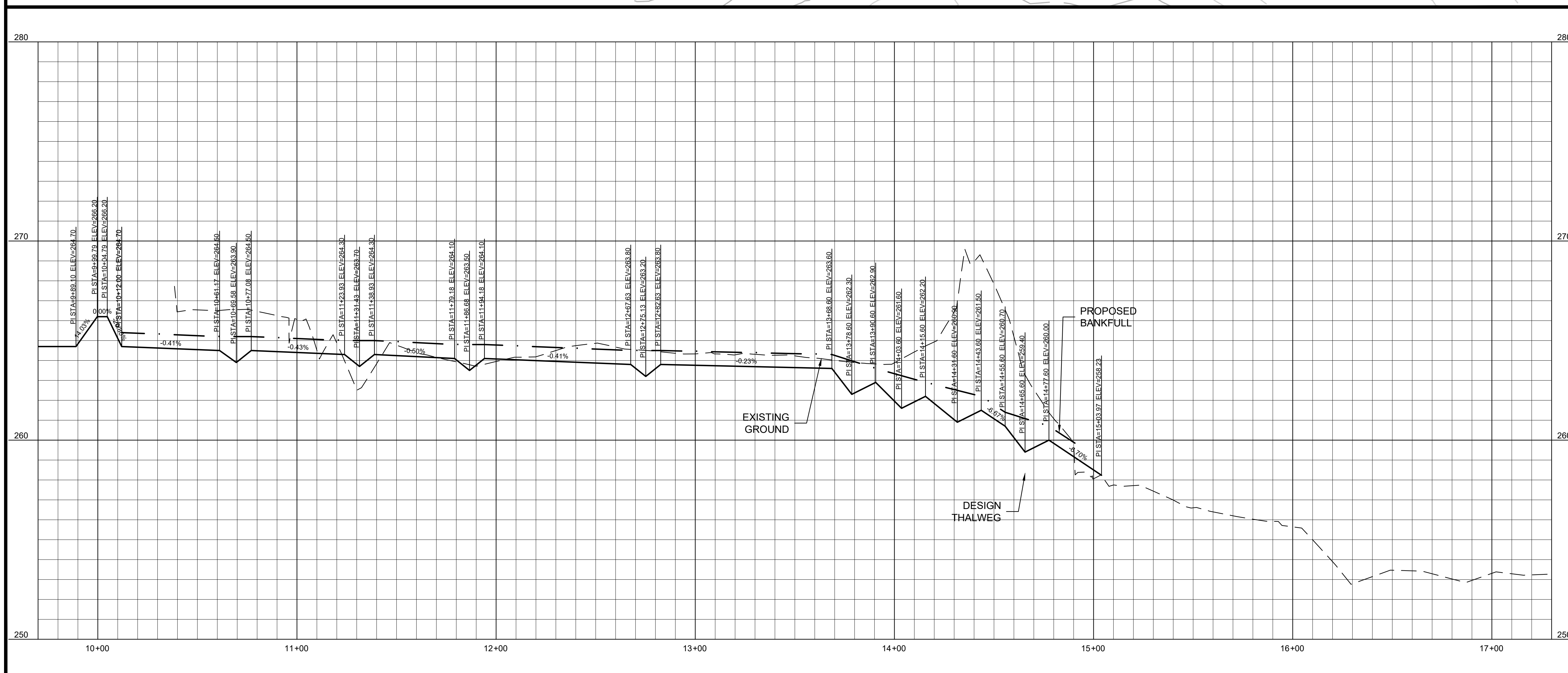
8





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ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-003
FILENAME	09_16_ODELL'S HOUSE_PLAN AND PROFILE.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

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GRAPHIC SCALE

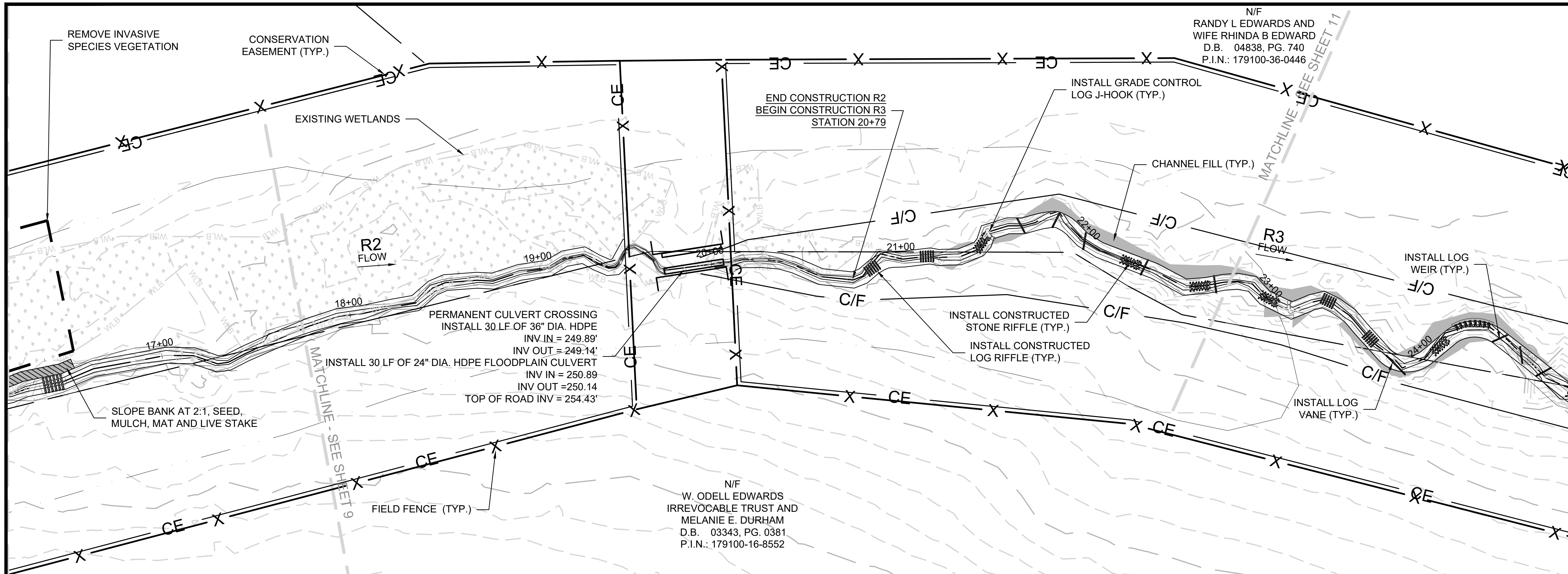
SHEET NAME

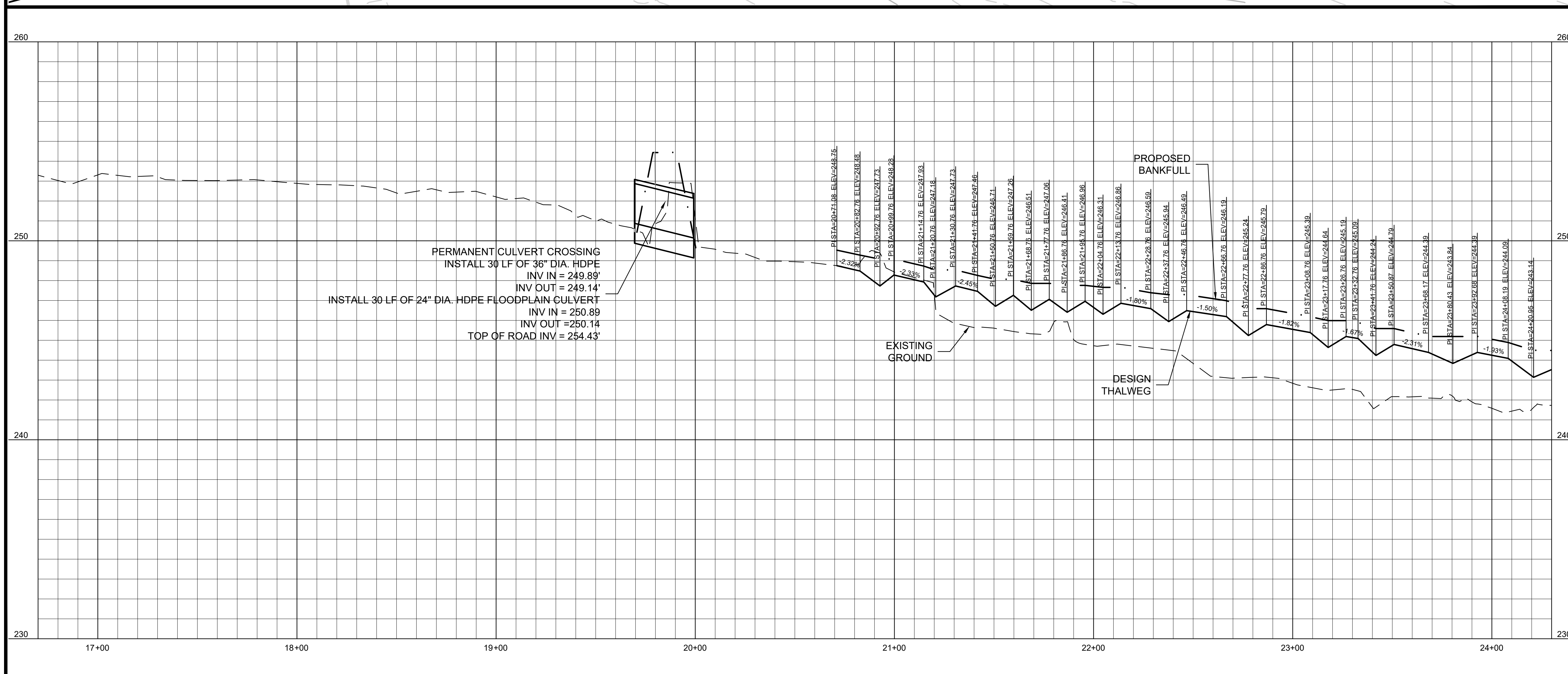
R1&R2

PLAN AND PROFILE

SHEET NUMBER

9





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NORTH

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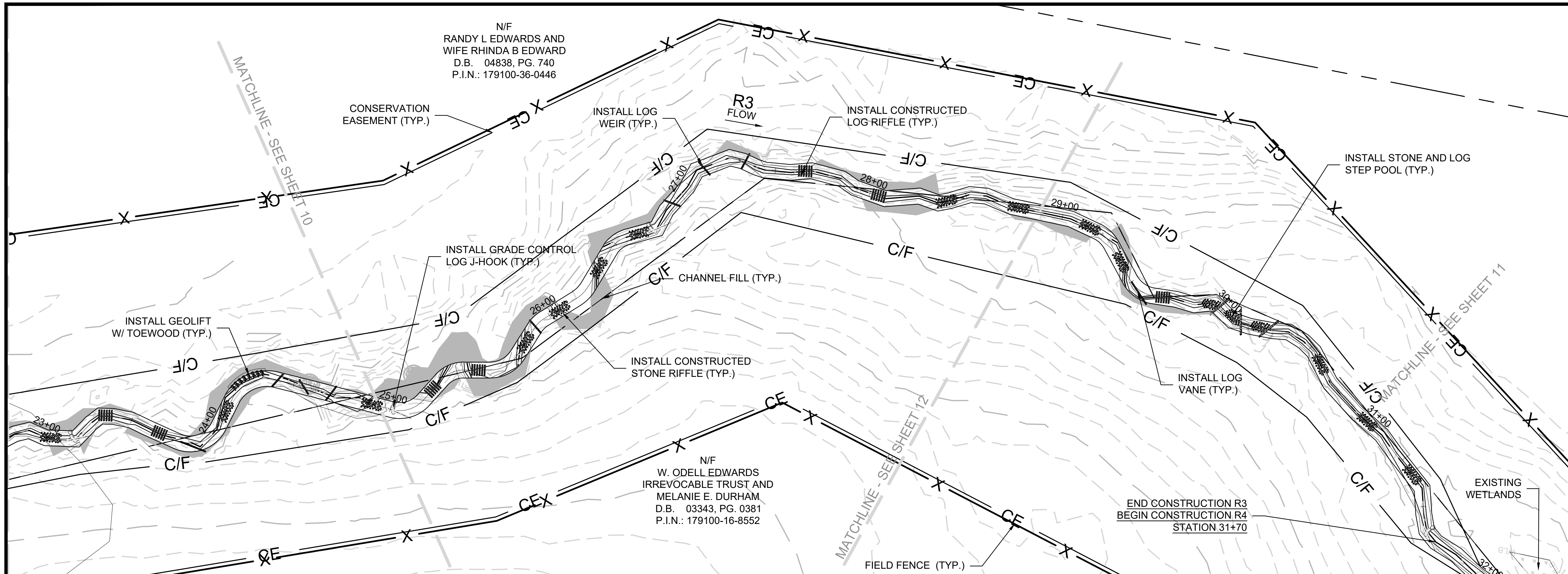
SHEET NAME

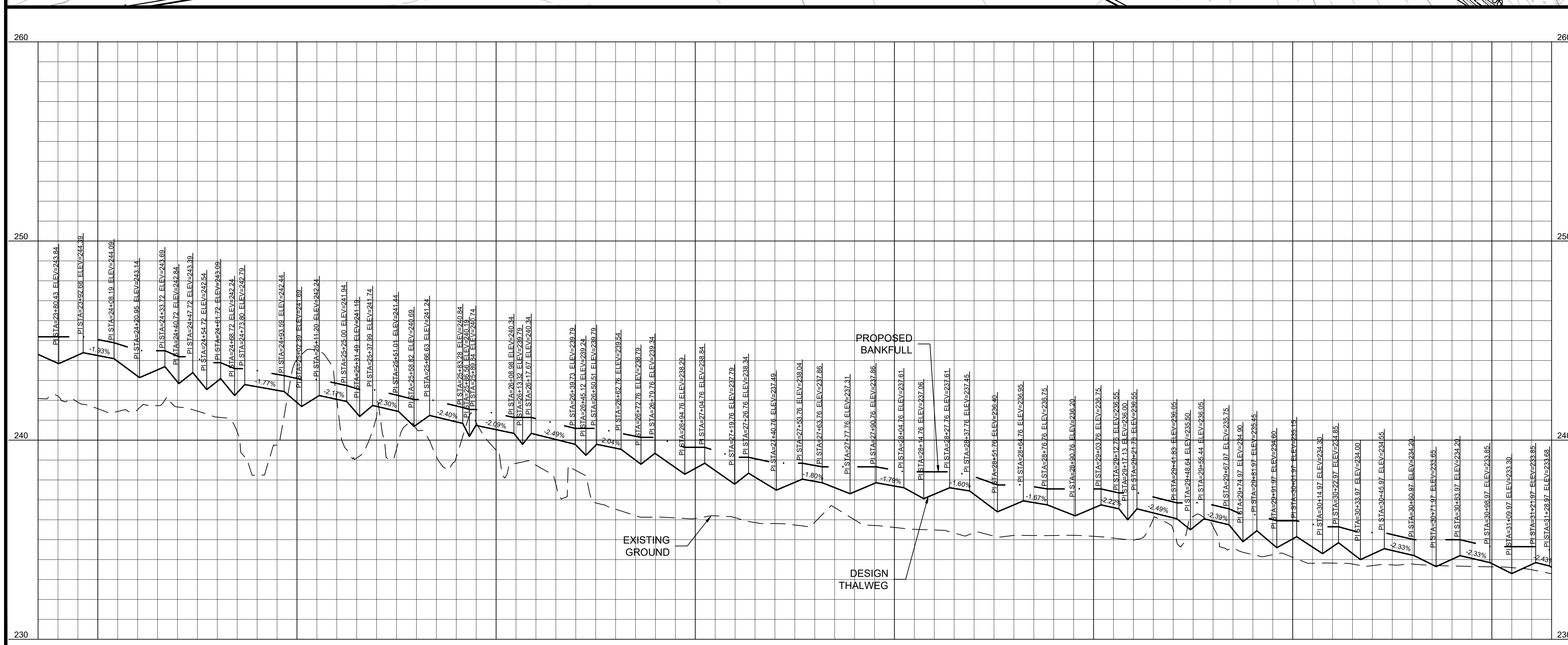
R2&R3

PLAN AND PROFILE

SHEET NUMBER

10





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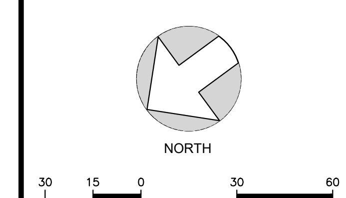

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R3&R4 PLAN AND PROFILE

SHEET NUMBER

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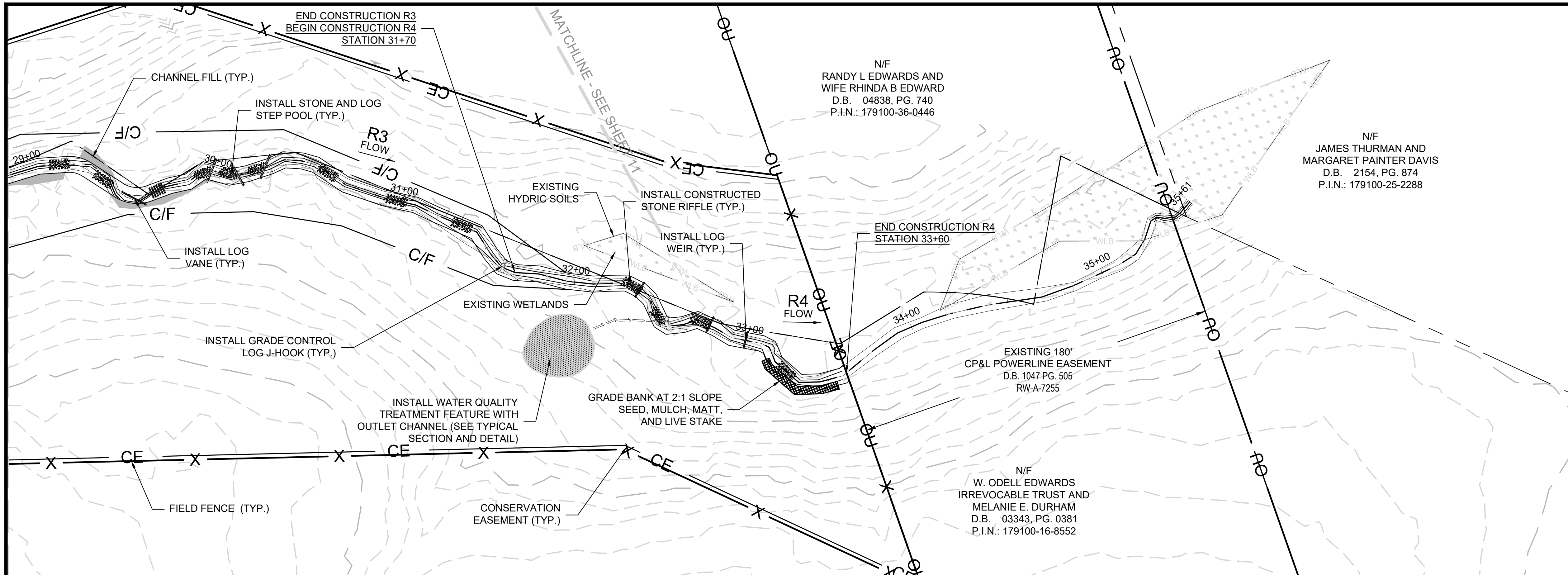

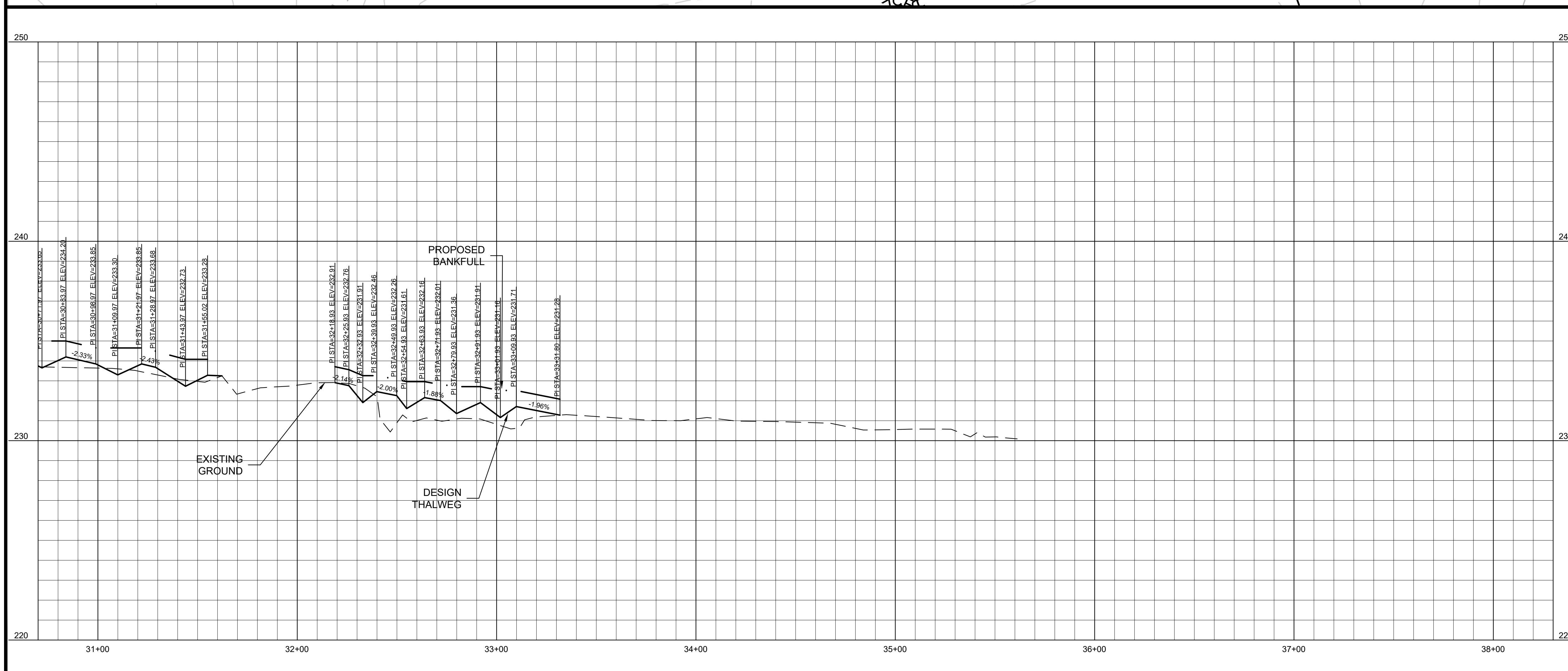

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NORTH

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GRAPHIC SCALE

SHEET NAME

R3&R4

PLAN AND PROFILE

SHEET NUMBER

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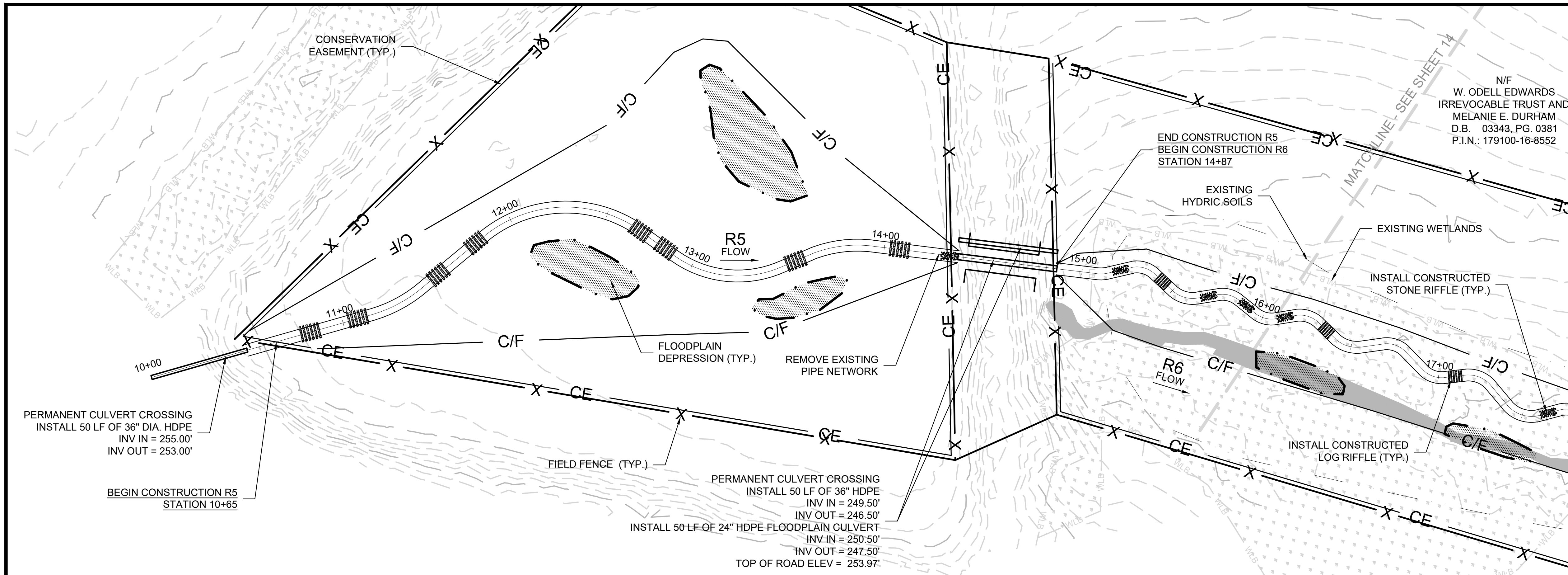

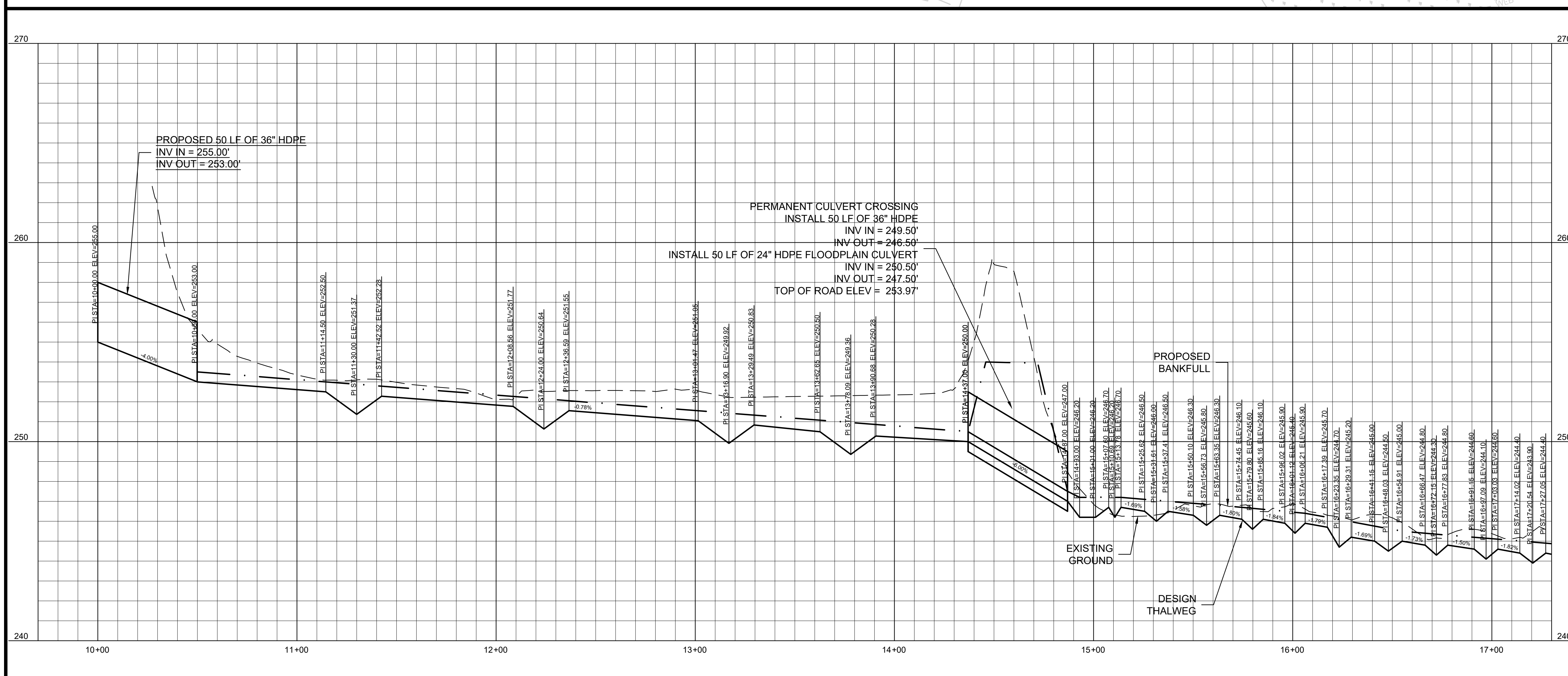

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NORTH

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GRAPHIC SCALE

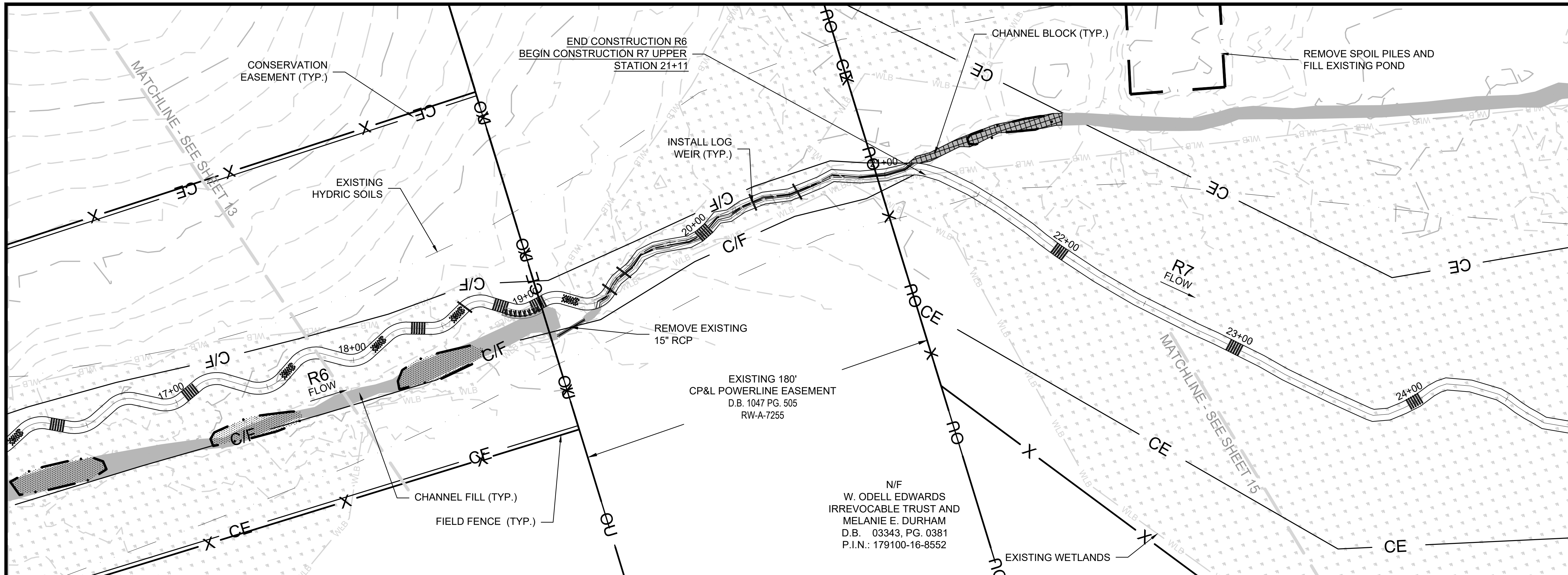
SHEET NAME

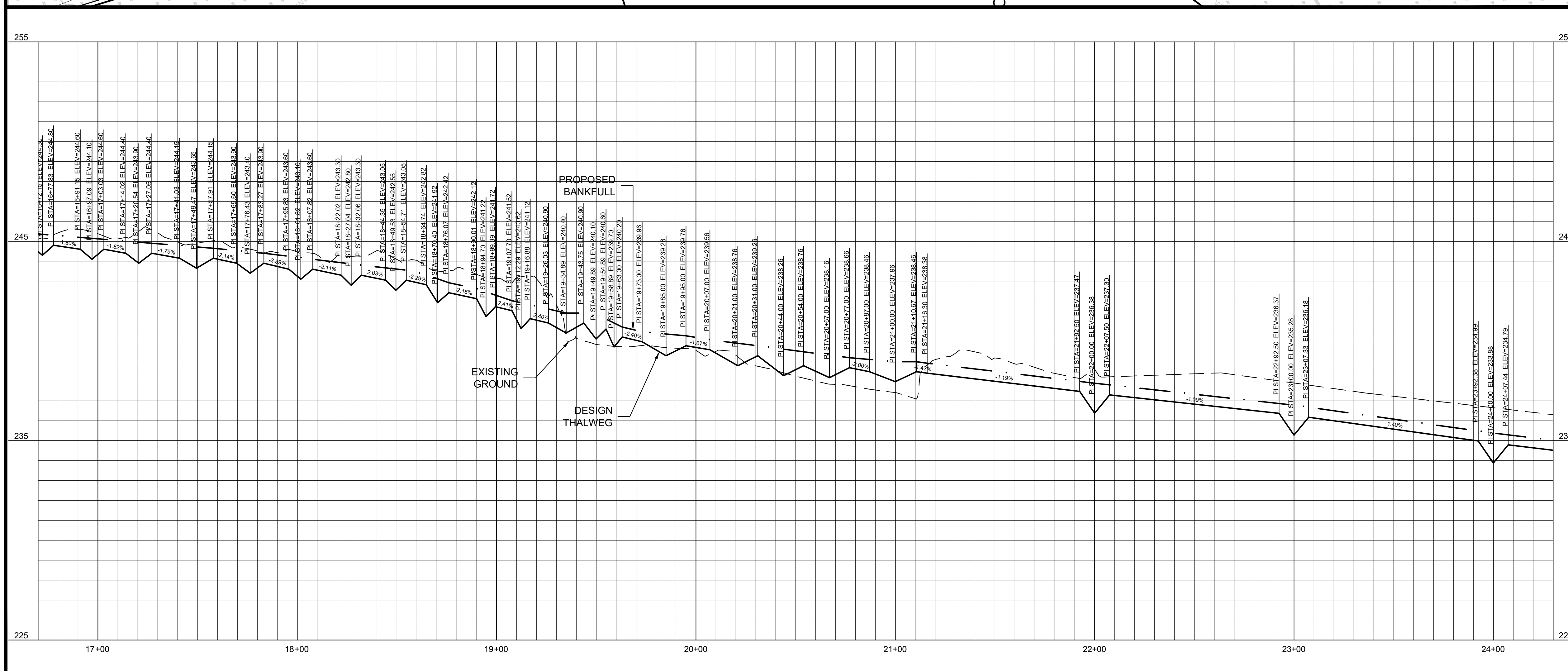
R5&R6

PLAN AND PROFILE

SHEET NUMBER

13





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DATE	8-12-20
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

30 15 0 30 60

GRAPHIC SCALE

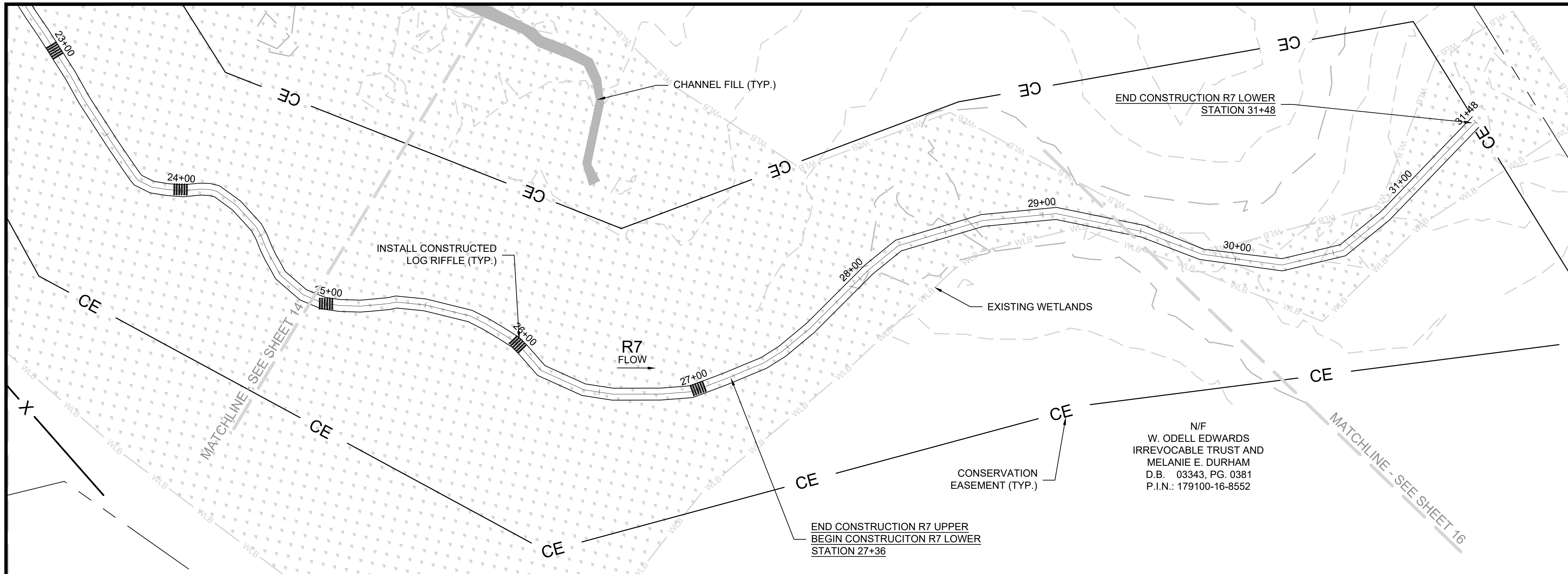
SHEET NAME

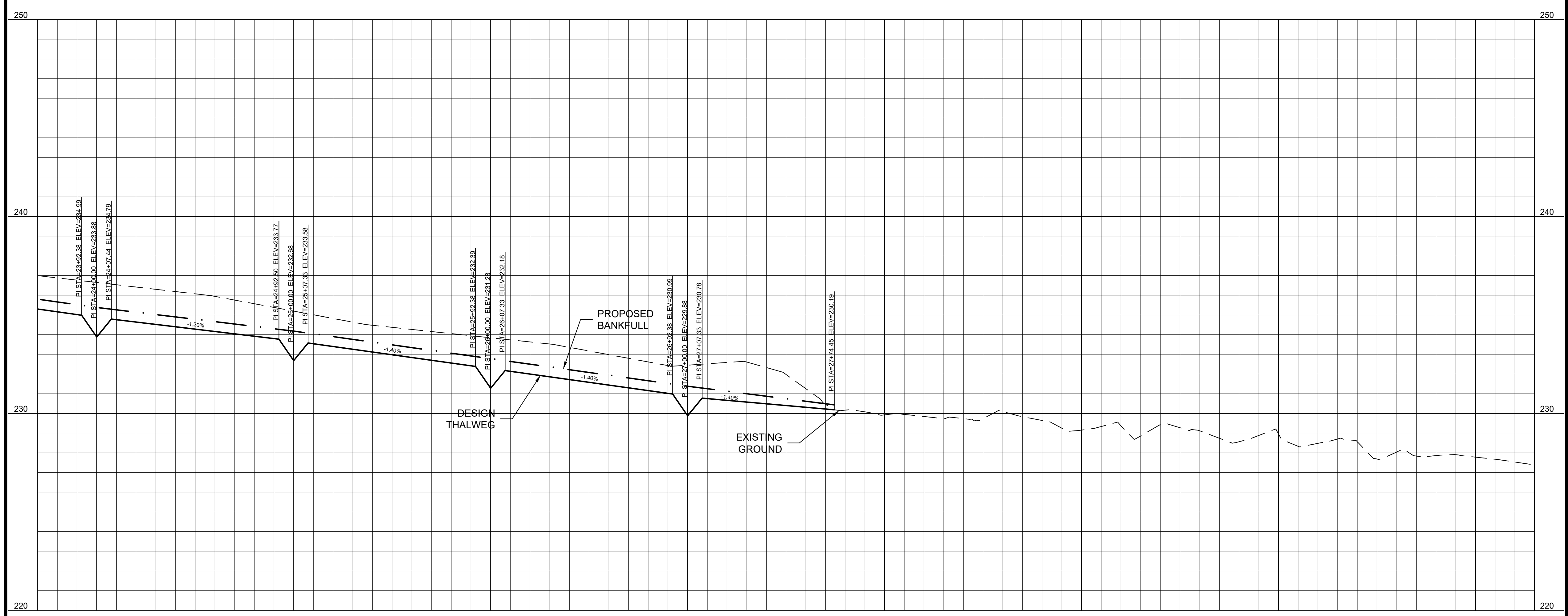
R6&R7

PLAN AND PROFILE

SHEET NUMBER

14





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(919)614-5111
waterlandsolutions.com

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER A. TOMSIC

PRELIMINARY PLANS NOT FOR CONSTRUCTION

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

REVISIONS

NO.	DESCRIPTION	DATE
A	DRAFT MIT PLAN	2-24-20
B	FINAL DRAFT MIT PLAN	5-15-20
C	FINAL MIT PLAN	8-12-20

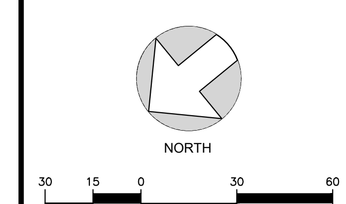
PROJECT NAME

ODELL'S HOUSE MITIGATION PROJECT

JOHNSTON COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-003
FILENAME	09_16_ODELL'S HOUSE_PLAN AND PROFILE.DWG
DESIGNED BY	CAT
DRAWN BY	AL/JNC
DATE	8-12-20
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'



SHEET NAME

R7

PLAN AND PROFILE

SHEET NUMBER

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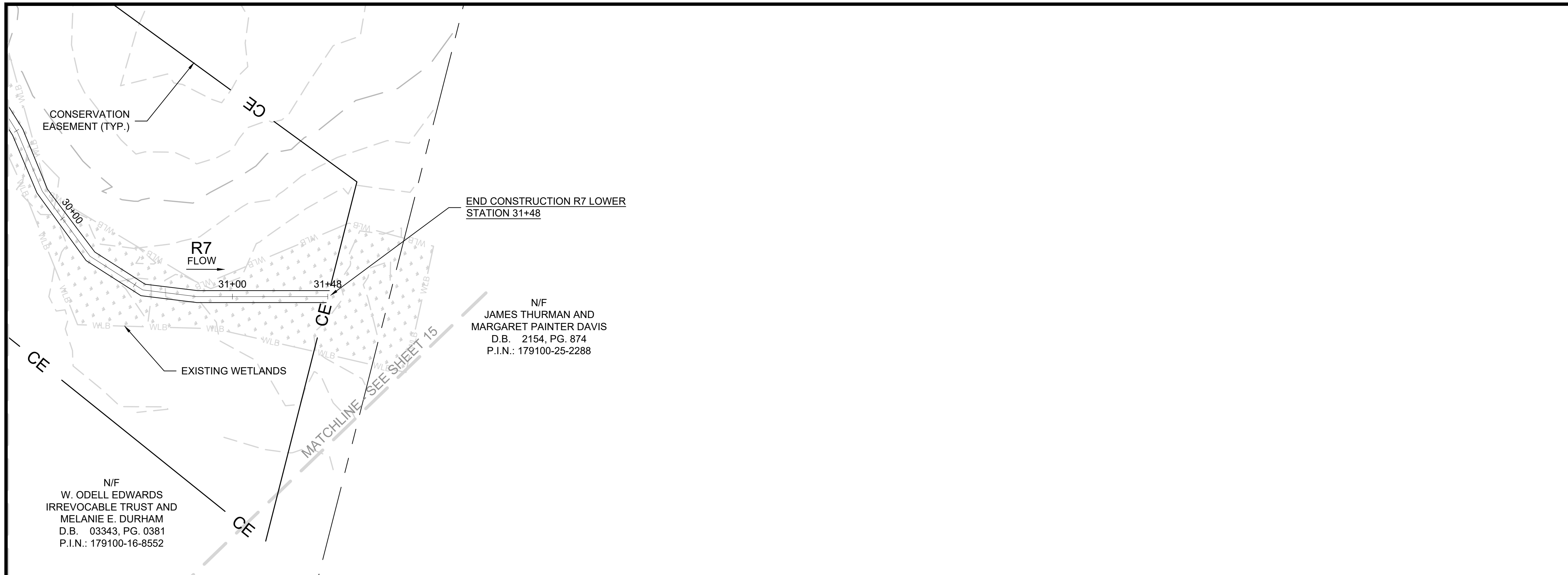

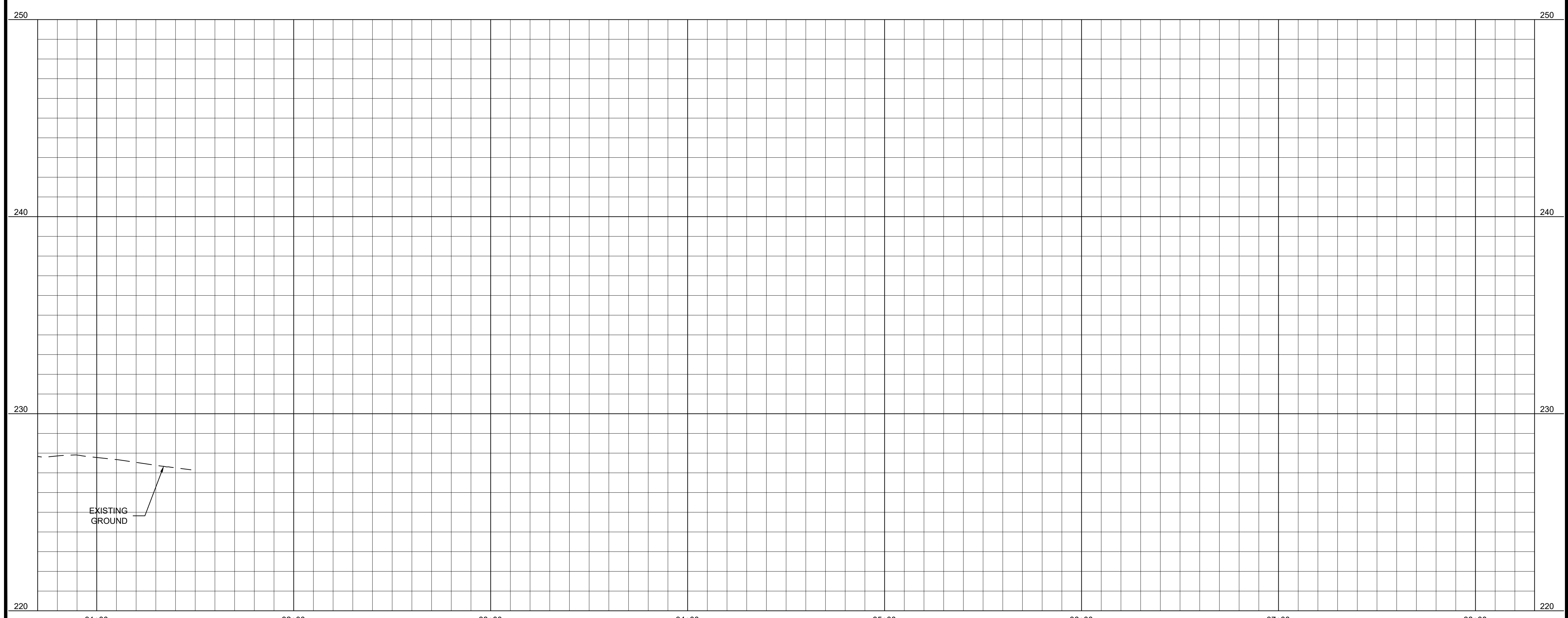

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NORTH

30 15 0 30 60

GRAPHIC SCALE

SHEET NAME

R7

PLAN AND PROFILE

SHEET NUMBER

16

PLANTING NOTES

1. THE FOLLOWING TABLES LIST THE PROPOSED VEGETATION SPECIES SELECTION FOR THE PROJECT REVEGETATION. THE TOTAL PLANTING AREA IS APPROXIMATELY 12.6 ACRES AND WILL VARY BASED ON SITE CONDITIONS AND AREAS DISTRUBED DURING CONSTRUCTION.
2. FINAL VEGETATION SPECIES SELECTION MAY CHANGE DUE TO REFINEMENT OR SPECIES AVAILABILITY AT THE TIME OF PLANTING. SPECIES SUBSTITUTIONS WILL BE COORDINATED BETWEEN ENGINEER AND PLANTING CONTRACTOR PRIOR TO THE PROCUREMENT OF PLANT/SEED STOCK.
3. IN GENERAL, WOODY SPECIES SHALL BE PLANTED AT A DENSITY OF 680 STEMS PER ACRE AND A MINIMUM OF 50 FEET FROM THE TOP OF RESTORED STREAMBANKS AND TO THE REVEGETATION LIMITS. EXACT PLACEMENT OF THE SPECIES WILL BE DETERMINED BY THE CONTRACTOR'S VEGETATION SPECIALIST PRIOR TO SITE PLANTING AND BASED ON THE WETNESS CONDITIONS OF PLANTING LOCATIONS.
4. SUPPLEMENTAL PLANTING ACTIVITIES SHALL BE PERFORMED WITHIN THE CONSERVATION EASEMENT USING NATIVE SPECIES VEGETATION DESCRIBED IN RIPARIAN BUFFER PLANT MIXTURE.
5. ANY INVASIVE SPECIES VEGETATION, SUCH AS CHINESE PRIVET (LIGUSTRUM SINENSE) AND MULTIFLORA ROSE (ROSA MULTIFLORA) WILL BE INITIALLY TREATED AS DESCRIBED IN THE CONSTRUCTION SPECIFICATIONS PRIOR TO PLANTING ACTIVITIES TO ALLOW NATIVE PLANTS TO BECOME ESTABLISHED WITHIN THE CONSERVATION EASEMENT.
6. LARGER NATIVE TREE SPECIES TO BE PRESERVED WILL BE FLAGGED BY THE ENGINEER PRIOR TO CONSTRUCTION ACTIVITIES. ANY TREES HARVESTED FOR WOODY MATERIAL WILL BE UTILIZED TO PROVIDE BED AND BANK STABILIZATION, COVER AND/OR NESTING HABITAT.
7. ALL DISTURBED AREAS WILL BE STABILIZED USING MULCHING AND SEEDING AS DEFINED IN THE CONSTRUCTION SPECIFICATIONS AND THE APPROVED SEDIMENTATION AND EROSION CONTROL PLANS.

PLANTING SCHEDULE

Botanical Name	Common Name	% Proposed for Planting by Species	Wetland Tolerance
Riparian Buffer Bare Root Plantings – Overstory			
(Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Fraxinus pennsylvanica	Green Ash	3%	FACW
Betula niggra	River Birch	8%	FACW
Quercus michauxii	Swamp Chestnut Oak	8%	FACW
Quercus pagoda	Cherrybark oak	7%	FACW
Platanus occidentalis	American sycamore	9%	FACW
Liriodendron tulipifera	Tulip-poplar	9%	FACU
Quercus nigra	Water oak	7%	FAC
Quercus phellos	Willow oak	7%	FACW
Riparian Buffer Bare Root Plantings – Understory			
(Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Diospyros virginiana	Persimmon	6%	FAC
Carpinus caroliniana	Ironwood	6%	FAC
Hamamelis virginiana	Witch-hazel	6%	FACU
Asimina triloba	Pawpaw	6%	FAC
Lindera benzoin	Spicebush	6%	FACW
Alnus serrulata	Hazel alder	6%	OBL
Corylus americana	Hazelnut	6%	FACU
Riparian Buffer Live Stake Plantings - Streambanks			
(Proposed 2'-3' Spacing @ Meander Bends and 6'-8' Spacing @ Riffle Sections)			
Sambucus canadensis	Elderberry	20%	FACW-
Salix sericea	Silky Willow	30%	OBL
Salix nigra	Black Willow	10%	OBL
Cornus amomum	Silky Dogwood	40%	FACW

TEMPORARY SEEDING SCHEDULE

Planting Dates	Botanical Name	Common Name	Application Rate (lbs/acre)
September to March	*Secale cereale*	Rye Grain (Cool Season)	130
April to August	*Urochloa ramosa*	Browntop Millet (Warm Season)	40

PERMANENT SEEDING SCHEDULE

Botanical Name	Common Name	% Proposed for Planting by Species	Seeding Rate (lb/acre)	Wetland Tolerance
Permanent Herbaceous Seed Mixture – Streambank, Floodplain, Wetlands and Riparian Buffer Areas				
(Proposed Seed Rate @ 15 lbs/acre)				
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer tongue	15%	1.50	FACW
Carex crinita	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolum	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wildrye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Eutrochium fistulosum	Joe-Pye Weed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gammagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU

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JOHNSTON COUNTY, NC

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DRAWN BY	AL/JNC
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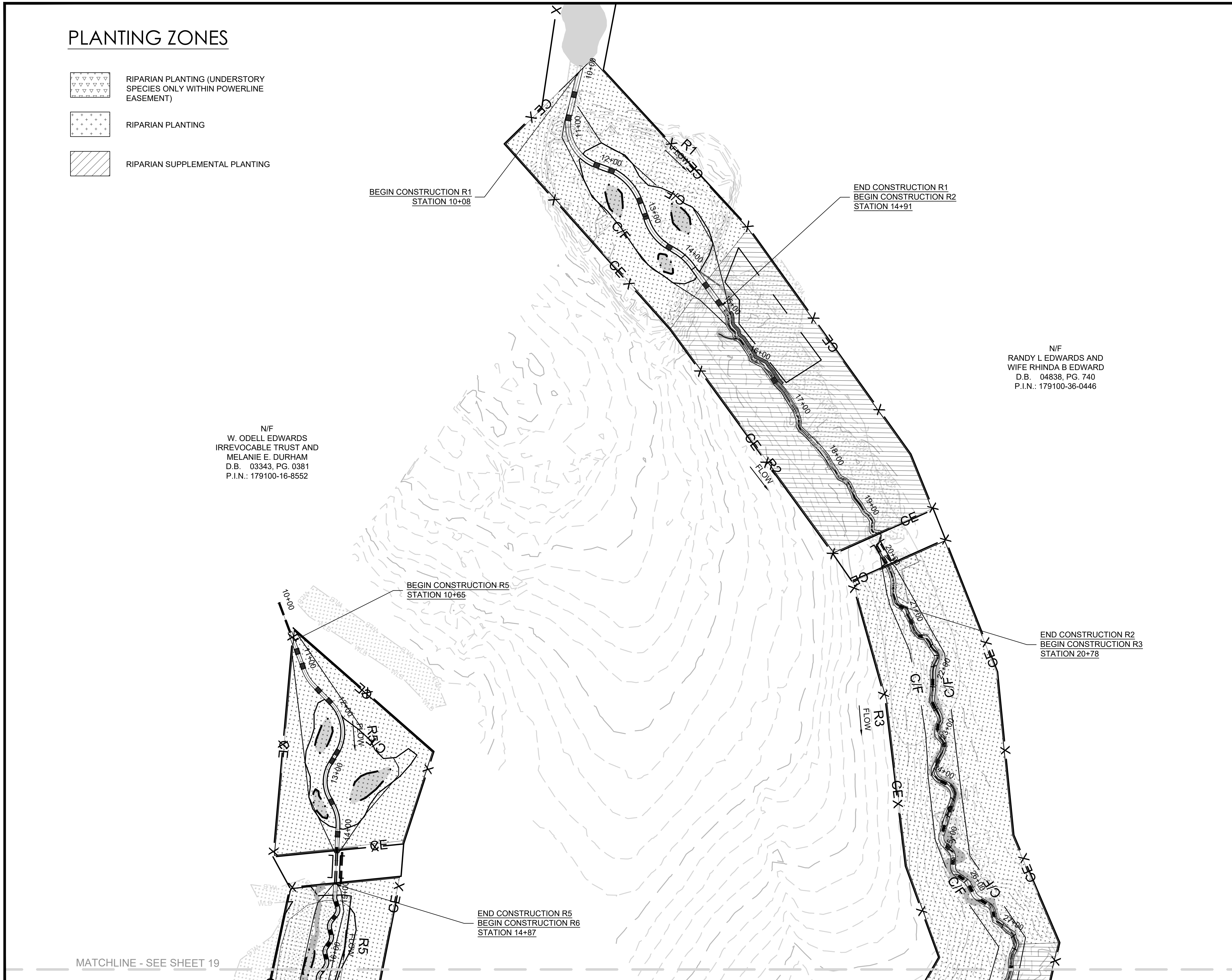
HORIZ. SCALE	N/A
VERT. SCALE	N/A

SHEET NAME

REVEGETATION PLAN

SHEET NUMBER



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NORTH

150 75 0 150 300

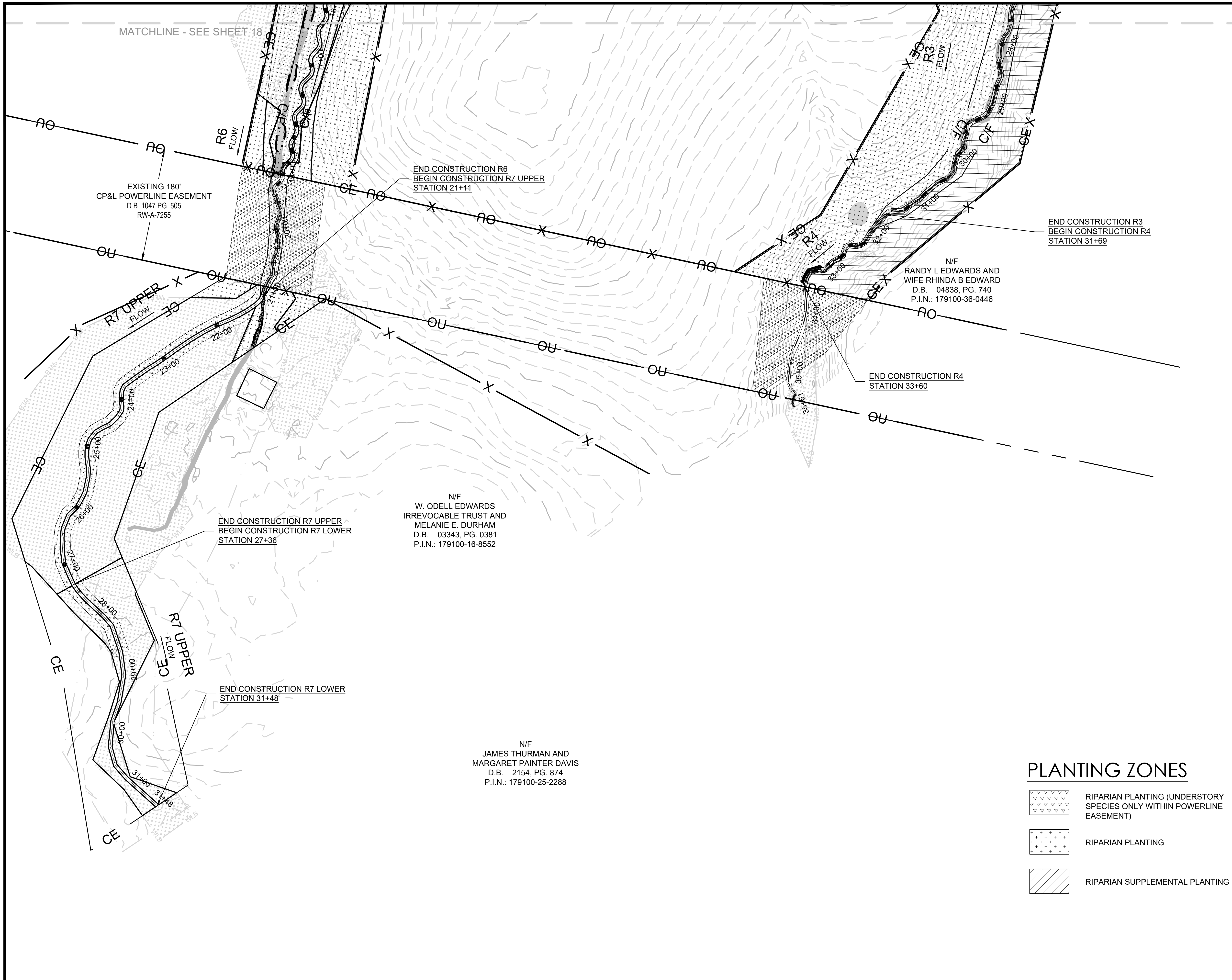
GRAPHIC SCALE

SHEET NAME

REVEGETATION PLAN

SHEET NUMBER

18



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NORTH

150 75 0 150 300

GRAPHIC SCALE

SHEET NAME

REVEGETATION PLAN

SHEET NUMBER

19

Appendix 2 – Site Analysis Data/Supplementary Information

Pre-Construction Gauge Data

Hydric Soils Report

Existing Cross-Sections

BANCS (BEHI/NBS) Method Estimates

Watershed Information and Site Runoff Volume

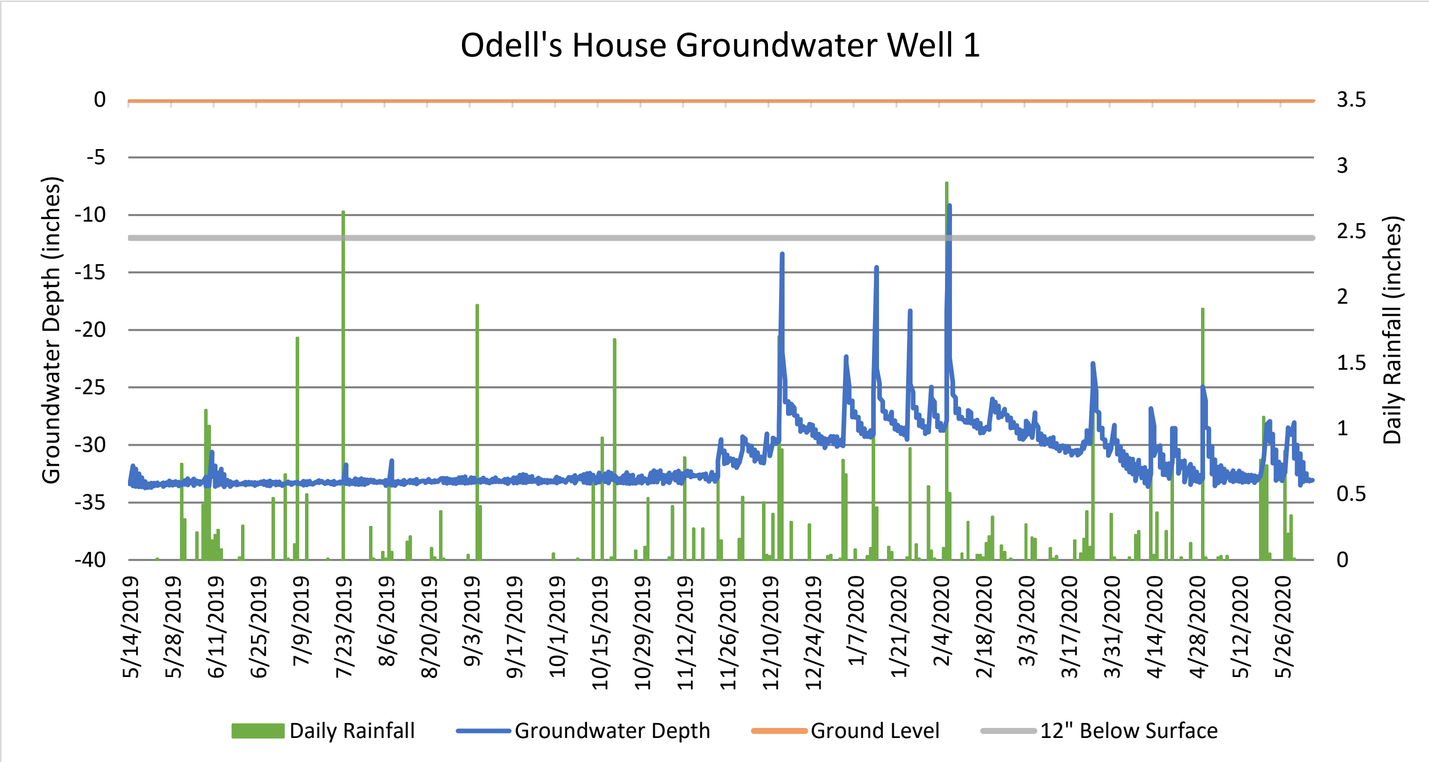
NC Rural Piedmont Regional Curve Comparison

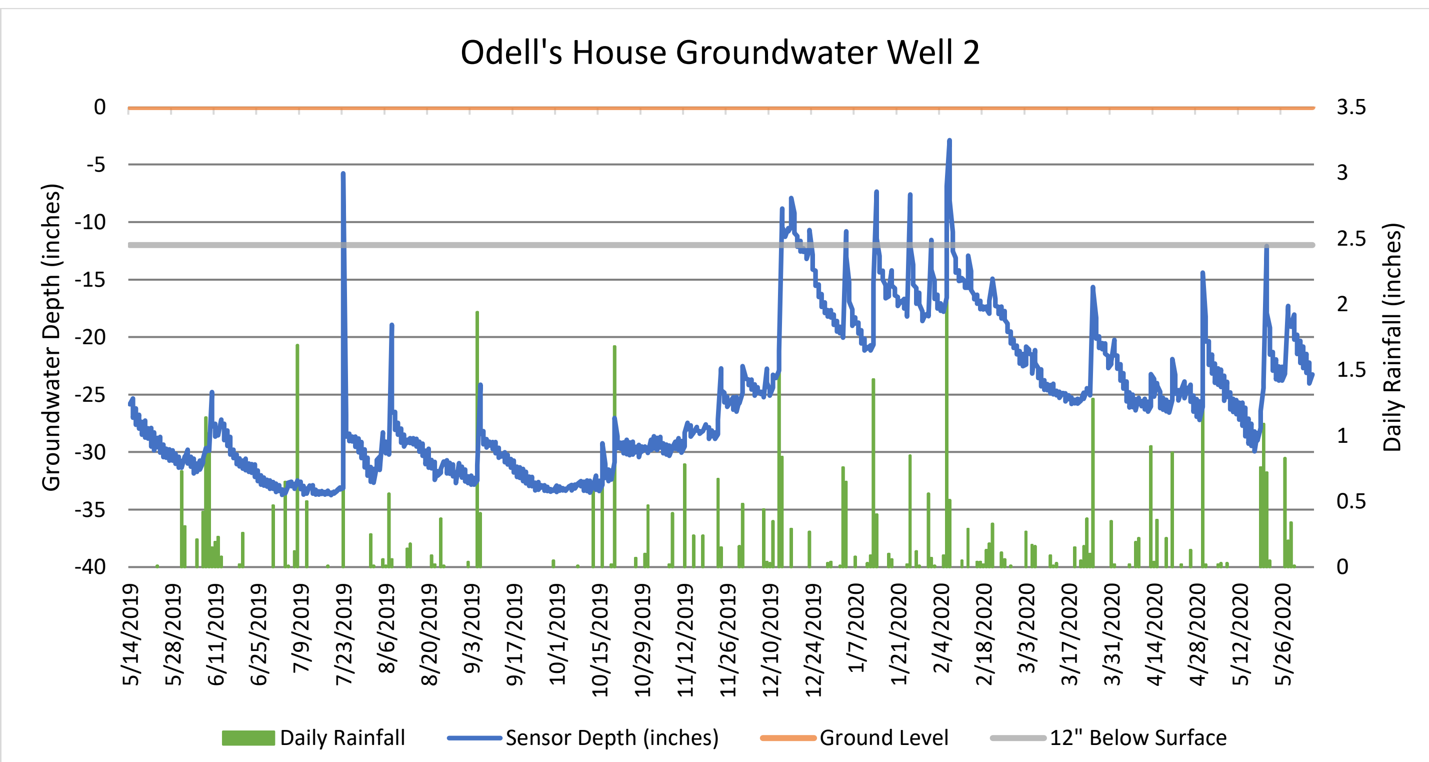
USGS Regression Flow Analysis

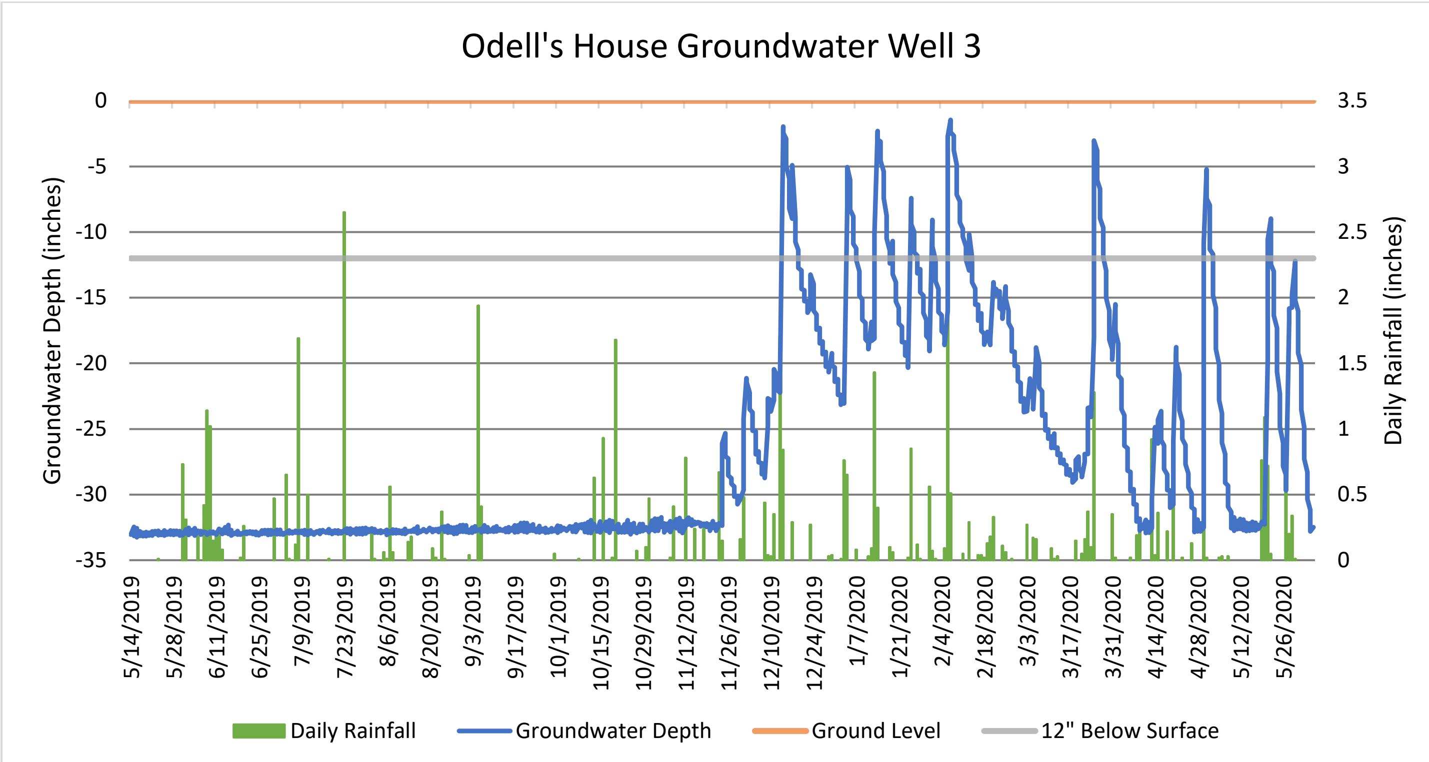
Stream Quantification Tool Reach Summary

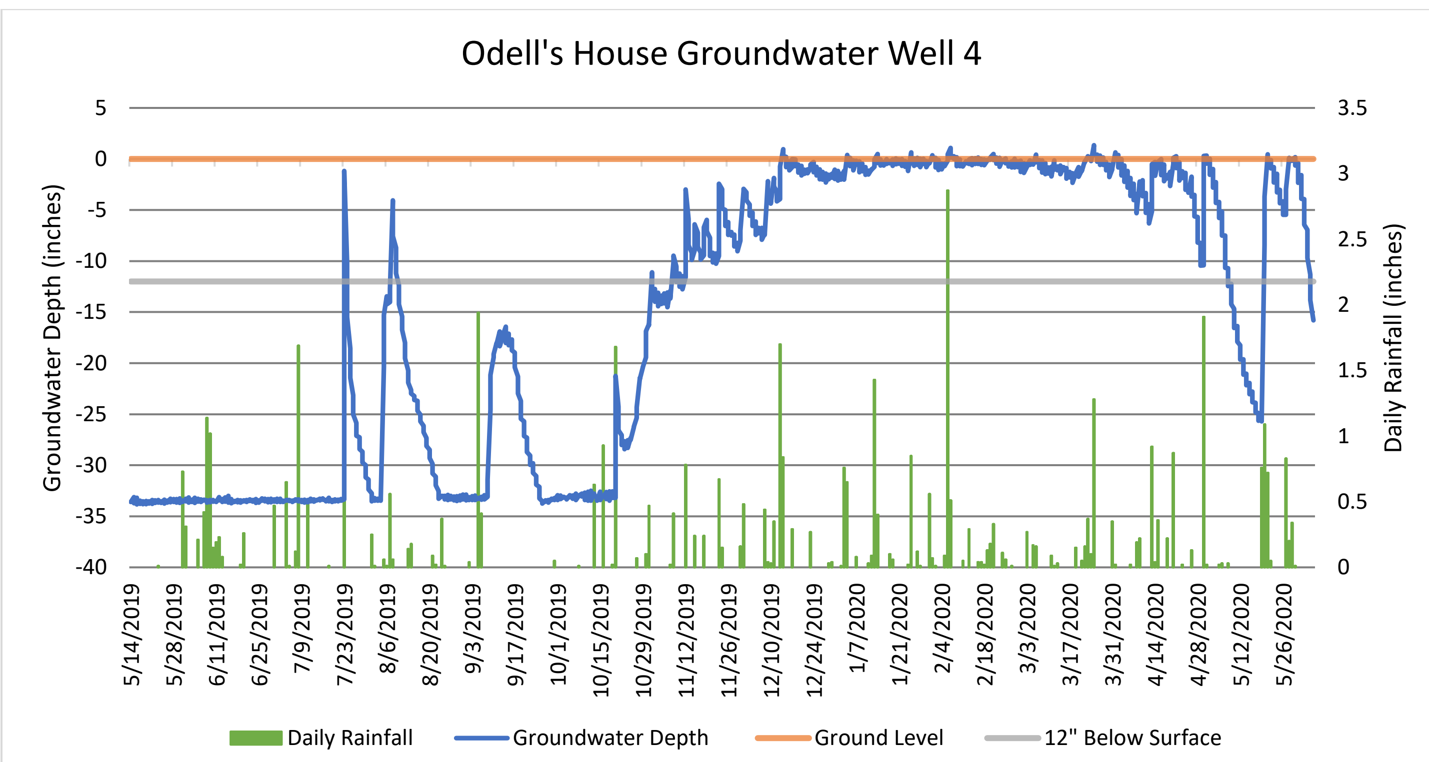
Design Criteria and Stream Morphology Parameters

Site Photographs


Odell's House Groundwater Well 1
Groundwater Depth (inches)
Daily Rainfall (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
5/14/2019
5/28/2019
6/11/2019
6/25/2019
7/9/2019
7/23/2019
8/6/2019
8/20/2019
9/3/2019
9/17/2019
10/1/2019
10/15/2019
10/29/2019
11/12/2019
11/26/2019
12/10/2019
12/24/2019
1/7/2020
1/21/2020
2/4/2020
2/18/2020
3/3/2020
3/17/2020
3/31/2020
4/14/2020
4/28/2020
5/12/2020
5/26/2020
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface


Odell's House Groundwater Well 2
Groundwater Depth (inches)
Daily Rainfall (inches)
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
5/14/2019
5/28/2019
6/11/2019
6/25/2019
7/9/2019
7/23/2019
8/6/2019
8/20/2019
9/3/2019
9/17/2019
10/1/2019
10/15/2019
10/29/2019
11/12/2019
11/26/2019
12/10/2019
12/24/2019
1/7/2020
1/21/2020
2/4/2020
2/18/2020
3/3/2020
3/17/2020
3/31/2020
4/14/2020
4/28/2020
5/12/2020
5/26/2020
Daily Rainfall
Sensor Depth (inches)
Ground Level
12" Below Surface


Odell's House Groundwater Well 3
Groundwater Depth (inches)
Daily Rainfall (inches)
0
-5
-10
-15
-20
-25
-30
-35
3.5
3
2.5
2
1.5
1
0.5
0
5/14/2019
5/28/2019
6/11/2019
6/25/2019
7/9/2019
7/23/2019
8/6/2019
8/20/2019
9/3/2019
9/17/2019
10/1/2019
10/15/2019
10/29/2019
11/12/2019
11/26/2019
12/10/2019
12/24/2019
1/7/2020
1/21/2020
2/4/2020
2/18/2020
3/3/2020
3/17/2020
3/31/2020
4/14/2020
4/28/2020
5/12/2020
5/26/2020
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface


Odell's House Groundwater Well 4
Groundwater Depth (inches)
Daily Rainfall (inches)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
3.5
3
2.5
2
1.5
1
0.5
0
5/14/2019
5/28/2019
6/11/2019
6/25/2019
7/9/2019
7/23/2019
8/6/2019
8/20/2019
9/3/2019
9/17/2019
10/1/2019
10/15/2019
10/29/2019
11/12/2019
11/26/2019
12/10/2019
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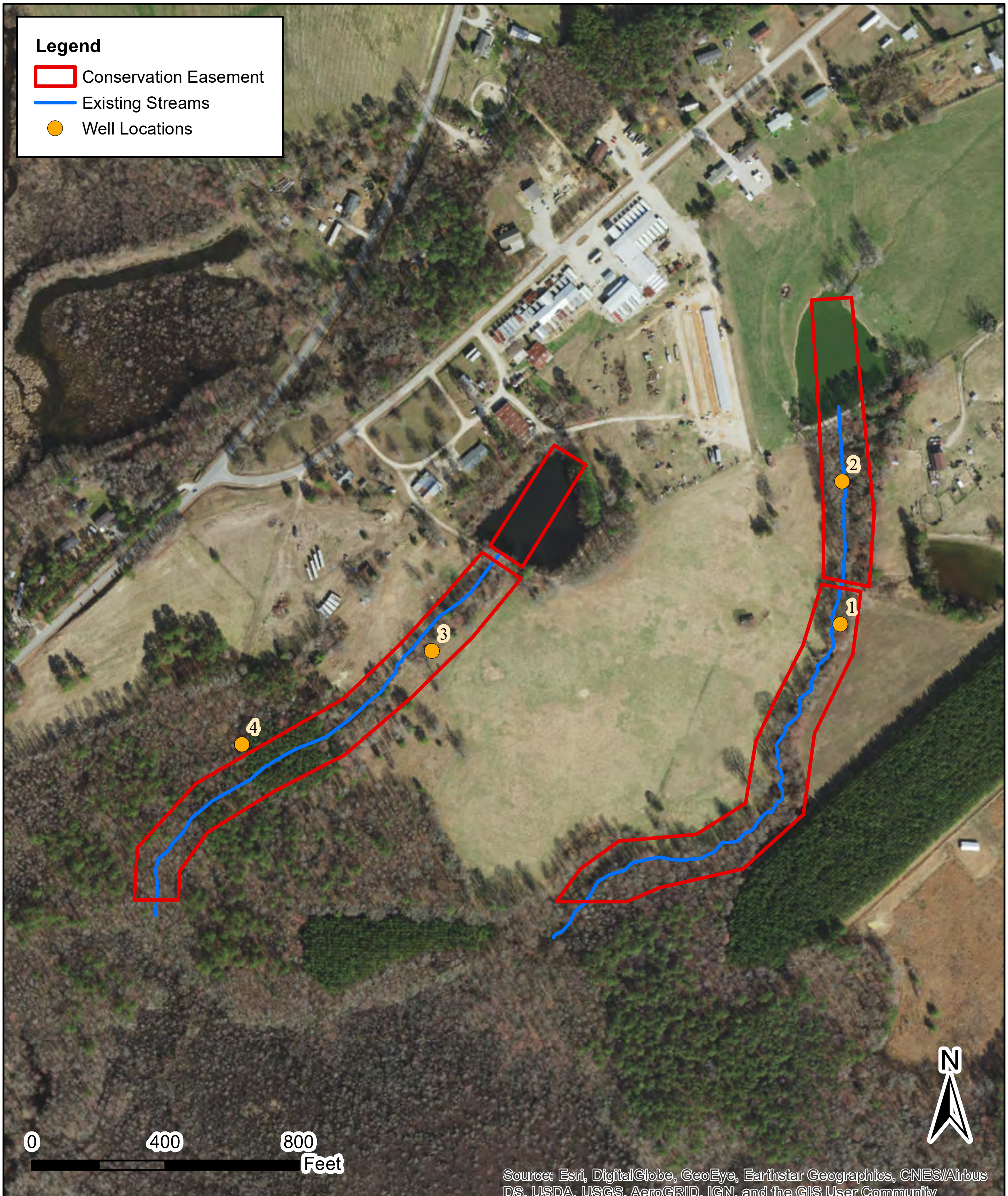
1/7/2020
1/21/2020
2/4/2020
2/18/2020
3/3/2020
3/17/2020
3/31/2020
4/14/2020
4/28/2020
5/12/2020
5/26/2020
Daily Rainfall
Groundwater Depth
Ground Level
12" Below Surface



WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Johnston County, North Carolina

Existing Conditions Well Locations

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 1

Hydric Soils Investigation

Odell's House Mitigation Project
Neuse River Basin (CU 03020201)
Johnston County, North Carolina

Prepared for:

WATER & LAND SOLUTIONS
11030 Raven Ridge Rd, Suite 119, Raleigh, NC 27614
(919) 614-5111 | waterlandsolutions.com

Prepared by:

BROWN'S
ENVIRONMENTAL GROUP, INC.
SELMA, NC

242 Batten Farm Road

Selma, North Carolina 27526

(919) 524-5956

LICENSED SOIL SCIENTIST
WYATT LANE BROWN
1079
STATE OF NORTH CAROLINA

September 18, 2017

Introduction

Water and Land Solutions, LLC (WLS) is investigating the feasibility of stream and wetland mitigation for the Odell's House Mitigation Project, in Johnston County, North Carolina in the Upper Neuse River Basin (Cataloging Unit 03020201). WLS has contracted Brown's Environmental Group's Inc. (BEG) to perform a hydric soils investigation at the project site. The objective of the hydric soils investigation was to identify the soils at the project site and to and determine soil areas suitable for wetland mitigation. The described field investigation was performed on September 5, 2017 by Wyatt Brown, LSS.

The project site is part of the Neuse River Basin in northern Johnston County near the community of Archer Lodge. The project study area is located in natural stream valleys situated with active agricultural areas, including active livestock pastures. The stream systems are mostly incised, being greatly impacted by historic agricultural and silvicultural practices.

Background

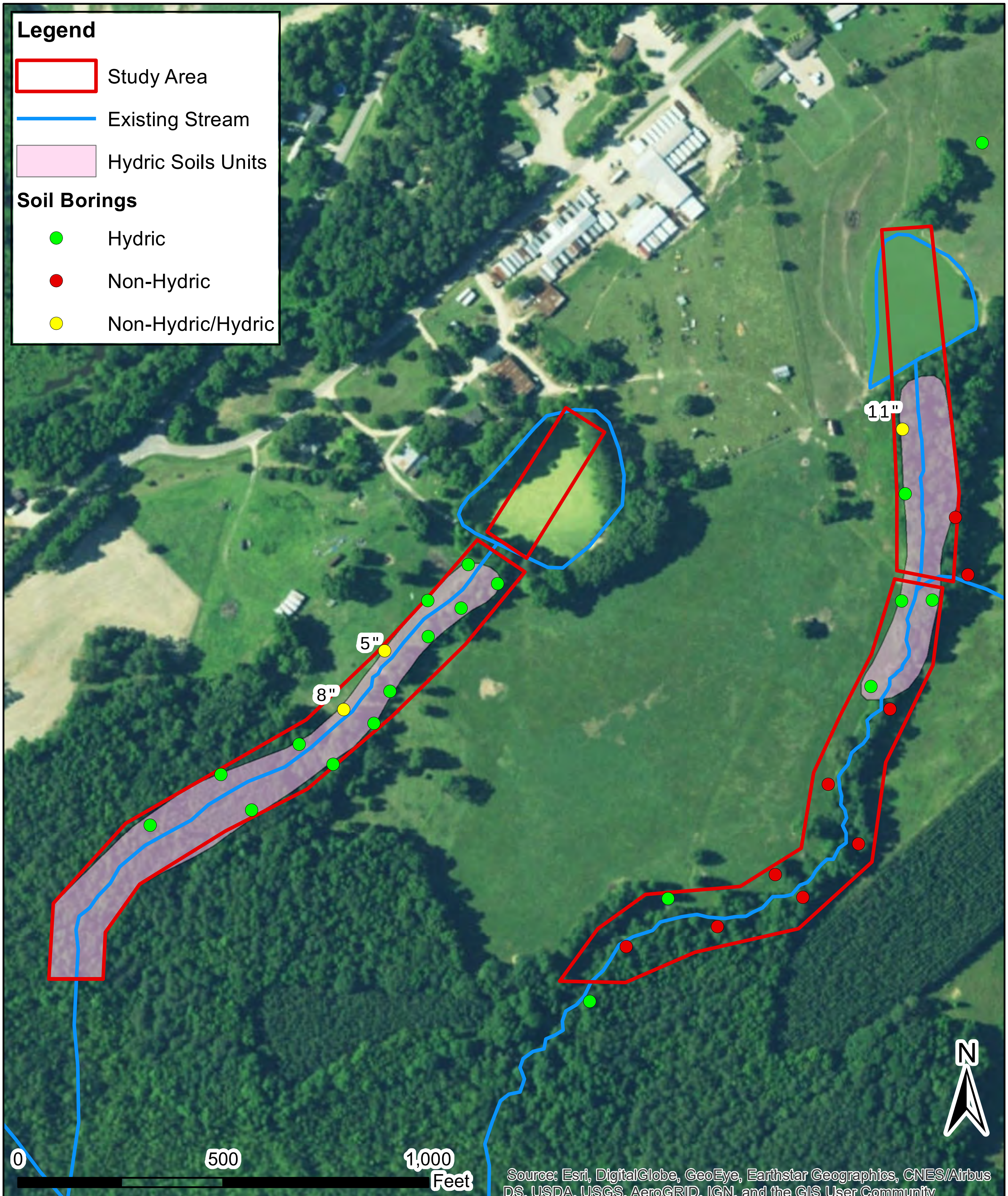
The project area has been mapped as moistly upland soils with hydric soils located along the stream channels. This is common is the lower Piedmont of North Carolina. The publication *Field Indicators of Hydric Soils in the United States, A Guide for Identifying and Delineating Hydric Soils*, *(Version 8.0, 2016)* defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service, 1994). Most hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation for more than a few days. Saturation or inundation, when combined with microbial activity in the soil, causes the depletion of oxygen. This anaerobiosis promotes certain biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in distinctive characteristics that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils in the field (USDA Natural Resources Conservation Service, 2010). This definition is for hydric soils in their natural state receiving adequate hydrology.

Methodology

BEG performed 32 hand auger borings using visual and tactile methods to describe the soil along the stream corridors that make up the project study area. Soil profile descriptions were recorded at the boring locations and the borings were located by GPS. For each boring, BEG confirmed the existing soil mapping and recorded the depth of the seasonal high-water table (SHWT). The depth of the SHWT or soil wetness condition is stated by Rule .1942 (NCAC.2004) as the first occurrence of redox depletions observed in the field as having a low chroma color (< or equal to 2) in Munsell Color Book at (> or equal to 2%) of soil volume.

Discussion and Conclusions

The soil borings found hydric soils that were visually saturated, being found in apparent wetlands, as well as hydric soils along the incised stream reaches that appeared to lack recent hydrology indicators. According to the mitigation strategy proposed for the project, the headwater stream systems will be restored, using Priority Level I Stream Restoration, to raise the proposed streambed back up to its historic location to re-gain floodplain access. For the areas of hydric soils along these incised stream reaches that appear to lack hydrology, it is BEG’s opinion that the described restoration of hydrology to starved hydric soils will support hydric soil restoration and development of hydric soil criteria.



Prepared For: Water & Land Solutions	Hydric Soil Investigation Odell's House Mitigation Project	Johnston County North Carolina **NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US**	FIGURE 1

Odell's House 9/5/17

Boring #12

A1 0-5" 10YR 3/2 SLoam wcSBK
with 1% 10YR 6/6 mottles

A2 5-8" 10YR 3/2 SCLoam, WmSBK

Ab 8-14" 10YR 3/2 SCLoam
few 1% 10YR 5/6 mottles

Boring #13

Ap 0-3" 10YR 2/1 clay wfSbk

A1 3-7" 10YR 4/1 clay wfsb

A2 7-14" 10YR 4/1 SAND (moist)
10YR 5/6 mottles @ 5%

A3 14+ 10YR 6/1 SAND coarse
1% 10YR 6/4 mottles

RIVERMORPH CROSS SECTION SUMMARY

River Name: Odells House
Reach Name: R2
Cross Section Name: XS4
Survey Date: 11/18/2019

Cross Section Data Entry

BM Elevation: 90 ft
Backsight Rod Reading: 10 ft

TAPE	FS	ELEV	NOTE
0	7.35	92.65	left pin
8	7	93	ground
15	7.1	92.9	ground
18	7.2	92.8	LTB
19	7.65	92.35	LCH
20.7	7.9	92.1	TWG
22.1	7.7	92.3	RCH
25.2	7.55	92.45	back bench
25.6	7.2	92.8	BKF
26.1	6.6	93.4	RTB
30	6.15	93.85	ground
35	5.9	94.1	ground
43	5.75	94.25	ground
50	5.6	94.4	right pin

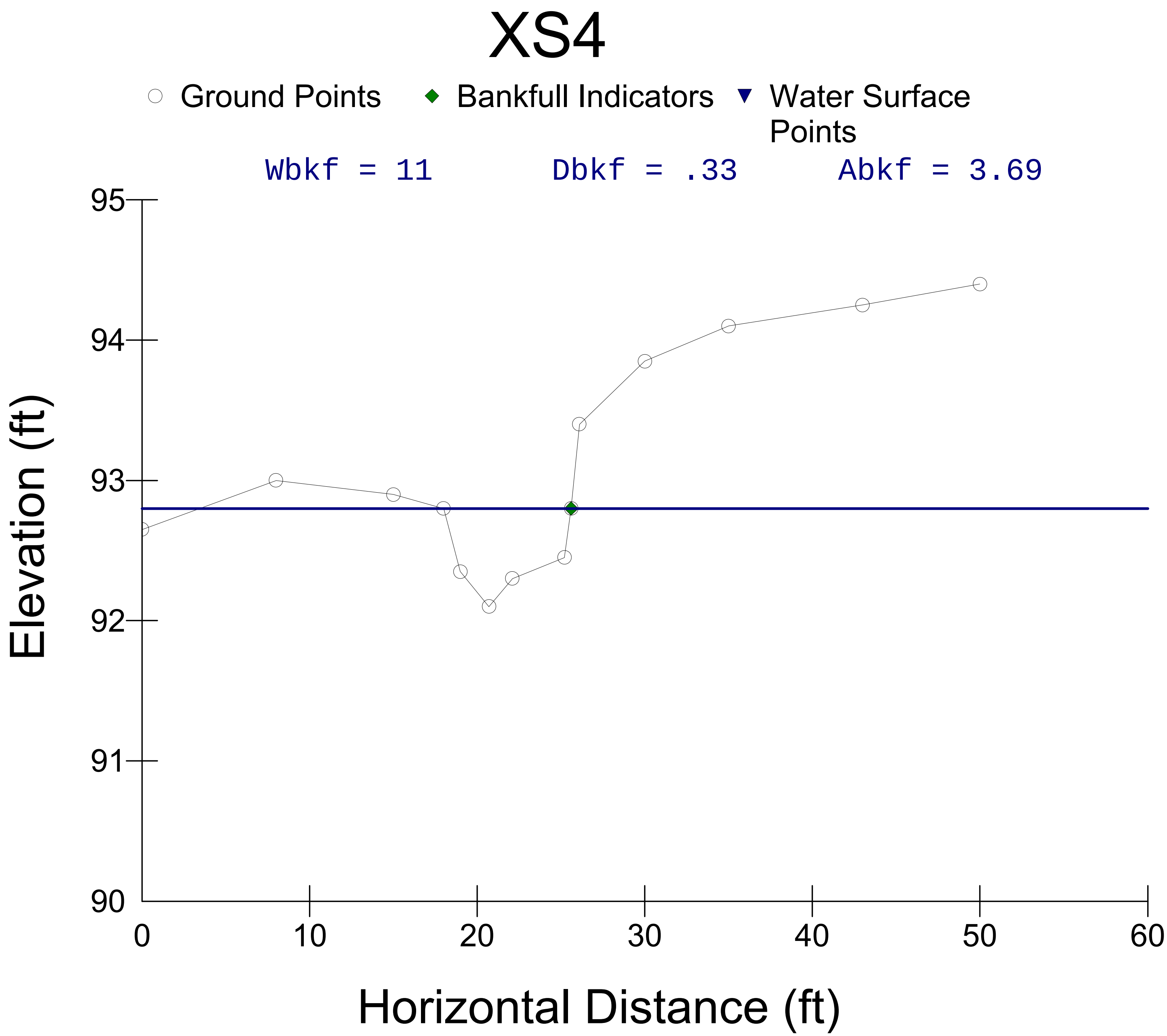
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.5	93.5	93.5
Bankfull Elevation (ft)	92.8	92.8	92.8
Floodprone Width (ft)	26.97	-----	-----
Bankfull Width (ft)	11.03	5.51	20.09
Entrenchment Ratio	2.45	-----	-----
Mean Depth (ft)	0.33	0.07	0.45
Maximum Depth (ft)	0.7	0.15	0.7
Width/Depth Ratio	33.42	73.47	44.64
Bankfull Area (sq ft)	3.69	0.26	3.43
Wetted Perimeter (ft)	11.45	3.58	7.86
Hydraulic Radius (ft)	0.32	0.07	0.44
Begin BKF Station	0	0	18
End BKF Station	25.6	3.43	25.6

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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


XS4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 11
Dbkf = .33
Abkf = 3.69
95
94
93
92
91
90
Elevation (ft)
0
10
20
30
40
50
60
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name:	Odells House
Reach Name:	R3
Cross Section Name:	XS5
Survey Date:	11/18/2019

Cross Section Data Entry

BM Elevation:	90 ft
Backsight Rod Reading:	10 ft

TAPE	FS	ELEV	NOTE
0	3.7	96.3	left pin
11	4.3	95.7	ground
15	6.15	93.85	ground
17	7.5	92.5	ground
18	8.5	91.5	LTB
18.3	9	91	BKF
19	10	90	LCH
21	10.35	89.65	TWG
23	10.05	89.95	RCH
24	9	91	RTB
26	8.35	91.65	ground
28	7.7	92.3	ground
32	7.4	92.6	back bench
34	6.85	93.15	ground
36.5	5.4	94.6	ground
38	4.1	95.9	RTERR
41	3.55	96.45	ground
45	3	97	right pin

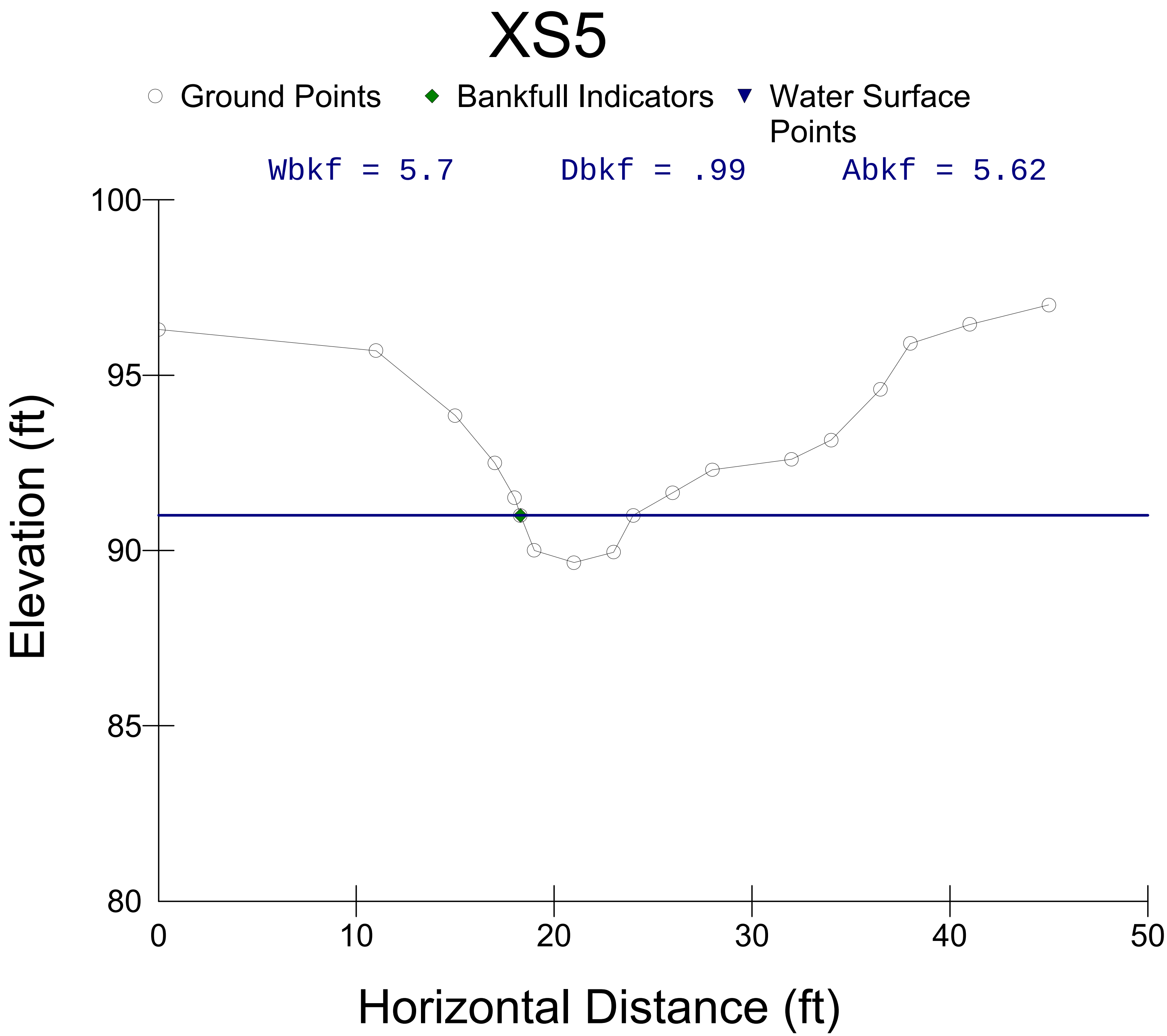
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	92.35	92.35	92.35
Bankfull Elevation (ft)	91	91	91
Floodprone Width (ft)	11.52	-----	-----
Bankfull Width (ft)	5.7	2.85	2.85
Entrenchment Ratio	2.02	-----	-----
Mean Depth (ft)	0.99	1.02	0.96
Maximum Depth (ft)	1.35	1.35	1.33
Width/Depth Ratio	5.76	2.8	2.97
Bankfull Area (sq ft)	5.62	2.9	2.72
Wetted Perimeter (ft)	6.72	4.73	4.65
Hydraulic Radius (ft)	0.84	0.61	0.59
Begin BKF Station	18.3	18.3	21.15
End BKF Station	24	21.15	24

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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


XS5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.7
Dbkf = .99
Abkf = 5.62
100
95
90
85
80
0
10
20
30
40
50
Elevation (ft)
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Odells House
Reach Name: R4
Cross Section Name: XS6
Survey Date: 11/18/2019

Cross Section Data Entry

BM Elevation: 90 ft
Backsight Rod Reading: 10 ft

TAPE	FS	ELEV	NOTE
0	6.2	93.8	left pin
10	6.5	93.5	ground
13	6.8	93.2	ground
17	7	93	ground
18	7	93	LTB
19	8.4	91.6	LCH
21	8.6	91.4	TWG
23	8.4	91.6	RCH
23.7	7.3	92.7	BKF
24	7	93	RTB
25	7	93	ground
30	7.2	92.8	ground
33	7.1	92.9	ground
37	6.9	93.1	ground
40	6.7	93.3	right pin

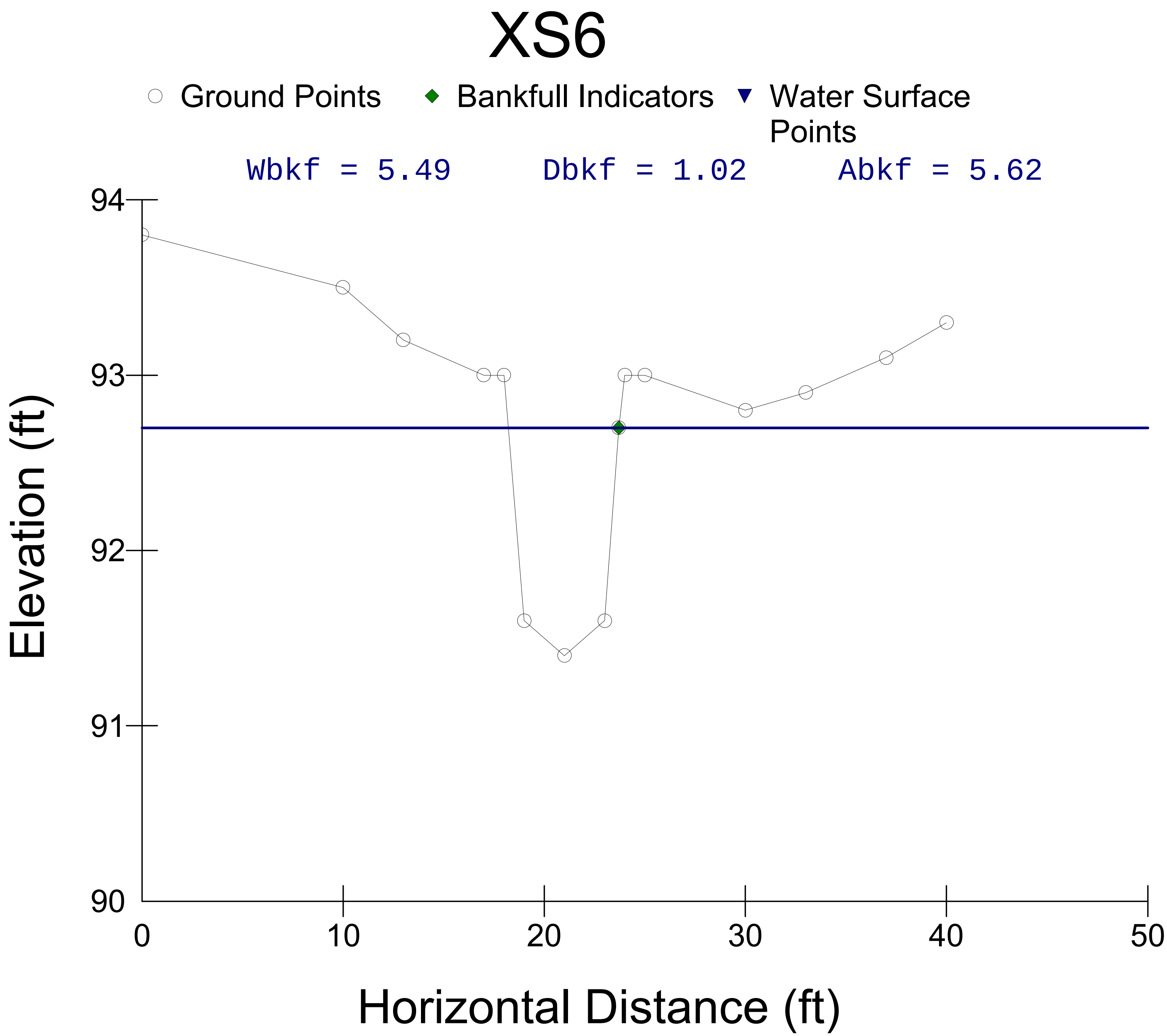
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	94	94	94
Bankfull Elevation (ft)	92.7	92.7	92.7
Floodprone Width (ft)	40	-----	-----
Bankfull Width (ft)	5.49	2.75	2.74
Entrenchment Ratio	7.29	-----	-----
Mean Depth (ft)	1.02	1.01	1.04
Maximum Depth (ft)	1.3	1.3	1.3
Width/Depth Ratio	5.38	2.72	2.63
Bankfull Area (sq ft)	5.62	2.78	2.84
Wetted Perimeter (ft)	6.68	4.62	4.65
Hydraulic Radius (ft)	0.84	0.6	0.61
Begin BKF Station	18.21	18.21	20.96
End BKF Station	23.7	20.96	23.7

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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


XS6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.49
Dbkf = 1.02
Abkf = 5.62
94
93
92
91
90
0
10
20
30
40
50
Elevation (ft)
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Odells House
Reach Name: R6
Cross Section Name: XS1
Survey Date: 11/18/2019

Cross Section Data Entry

BM Elevation: 90 ft
Backsight Rod Reading: 10 ft

TAPE	FS	ELEV	NOTE
0	5.73	94.27	left pin
10	6.1	93.9	ground
20	5.85	94.15	ground
27	6.88	93.12	ground
38	6.54	93.46	ground
46	6.6	93.4	ground
53	6.4	93.6	ground
58.6	7.17	92.83	LTB
60	7.87	92.13	BKF
61.4	8.6	91.4	LCH
62	9	91	TWG
63	8.67	91.33	RCH
64.8	7.38	92.62	break
67	6.07	93.93	RTB
72	5.52	94.48	ground
86	5.25	94.75	ground
100	4.65	95.35	right pin

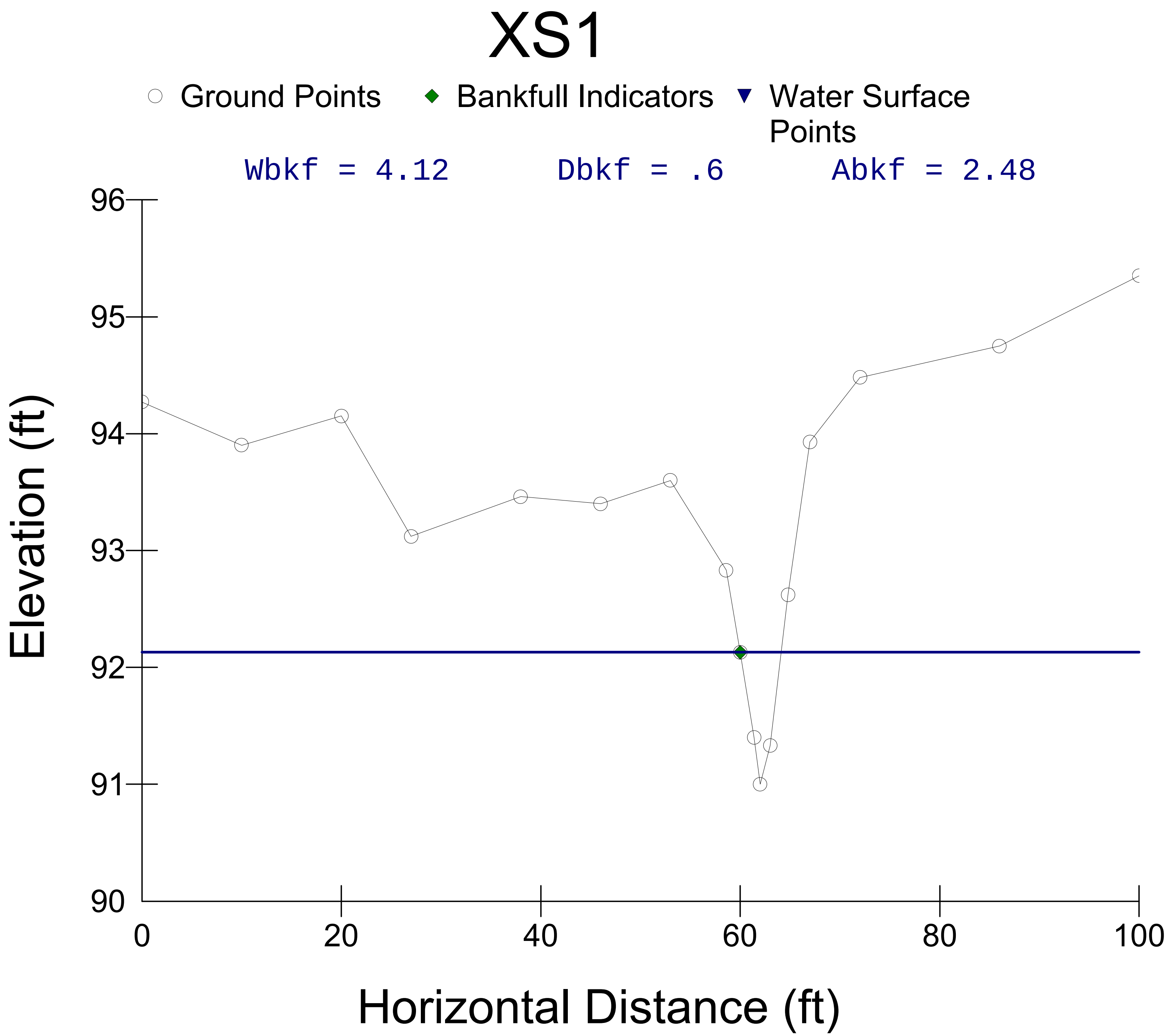
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.26	93.26	93.26
Bankfull Elevation (ft)	92.13	92.13	92.13
Floodprone Width (ft)	15.88	-----	-----
Bankfull Width (ft)	4.12	2.02	2.1
Entrenchment Ratio	3.86	-----	-----
Mean Depth (ft)	0.6	0.54	0.66
Maximum Depth (ft)	1.13	1.13	1.12
Width/Depth Ratio	6.87	3.74	3.18
Bankfull Area (sq ft)	2.48	1.09	1.39
Wetted Perimeter (ft)	4.73	3.44	3.53
Hydraulic Radius (ft)	0.52	0.32	0.39
Begin BKF Station	60	60	62.02
End BKF Station	64.12	62.02	64.12

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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


XS1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 4.12
Dbkf = .6
Abkf = 2.48
Elevation (ft)
96
95
94
93
92
91
90
0
20
40
60
80
100
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Odells House
Reach Name: R7
Cross Section Name: XS2
Survey Date: 11/18/2019

Cross Section Data Entry

BM Elevation: 90 ft
Backsight Rod Reading: 10 ft

TAPE	FS	ELEV	NOTE
0	4.6	95.4	left pin
7	4.7	95.3	ground
10.6	4.75	95.25	BKF
16	5.05	94.95	break
24	5.33	94.67	ground
30	5	95	ground/twg
35	5.1	94.9	ground
41	5.25	94.75	break/flow path
43	5.1	94.9	ground
44.5	4.7	95.3	ground
50	4.23	95.77	ground
58	3.65	96.35	ground
65	3.7	96.3	ground
69.8	3.8	96.2	right pin

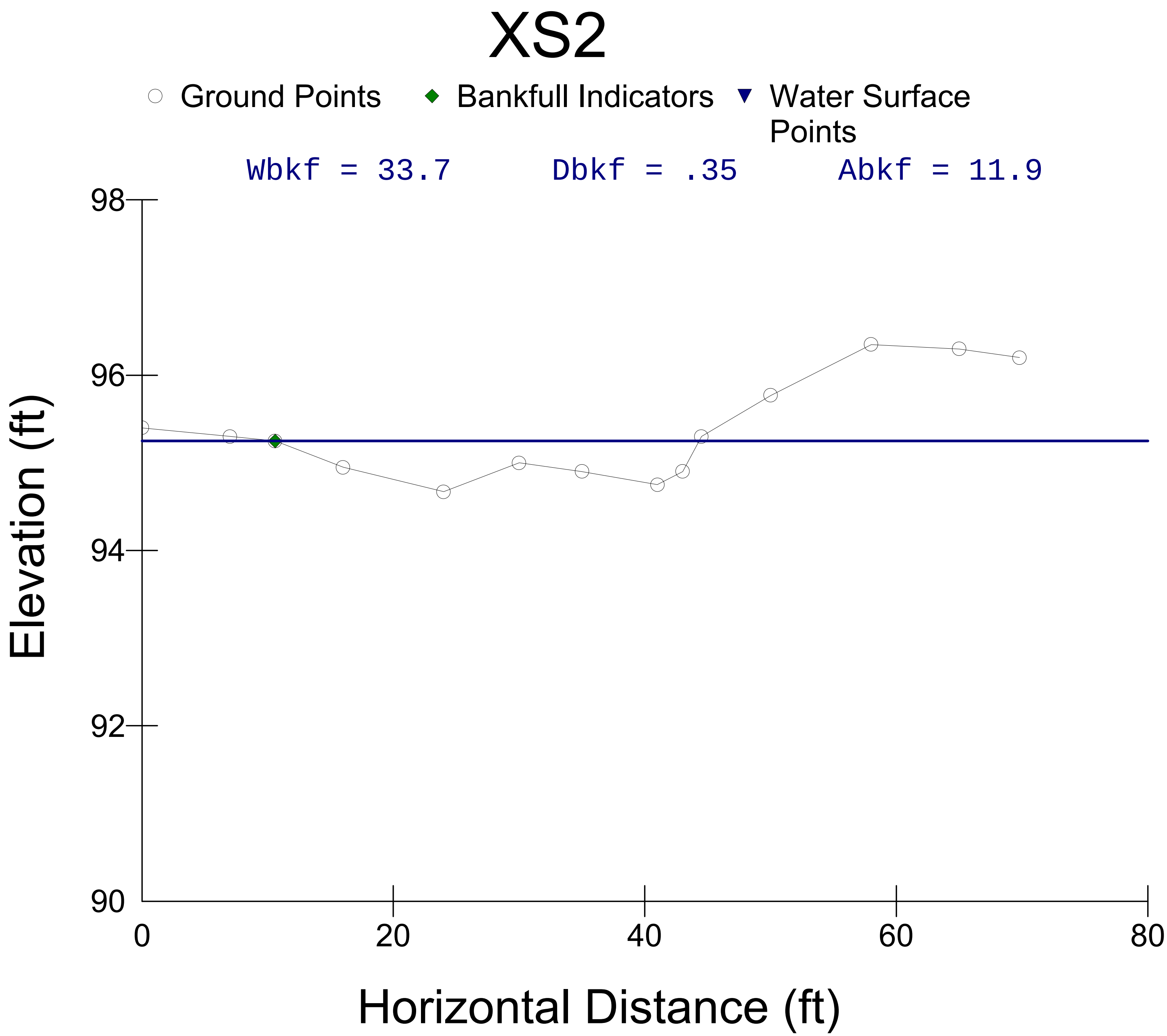
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	95.83	95.83	95.83
Bankfull Elevation (ft)	95.25	95.25	95.25
Floodprone Width (ft)	50.83	-----	-----
Bankfull Width (ft)	33.71	16.86	16.85
Entrenchment Ratio	1.51	-----	-----
Mean Depth (ft)	0.35	0.36	0.35
Maximum Depth (ft)	0.58	0.58	0.5
Width/Depth Ratio	96.31	47.32	48.14
Bankfull Area (sq ft)	11.95	6.01	5.94
Wetted Perimeter (ft)	33.79	17.27	17.3
Hydraulic Radius (ft)	0.35	0.35	0.34
Begin BKF Station	10.6	10.6	27.46
End BKF Station	44.31	27.46	44.31

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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



XS2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 33.7
Dbkf = .35
Abkf = 11.9
Elevation (ft)
98
96
94
92
90
0
20
40
60
80
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Odells House
Reach Name: R7
Cross Section Name: XS3
Survey Date: 11/18/2019

Cross Section Data Entry

BM Elevation: 90 ft
Backsight Rod Reading: 10 ft

TAPE	FS	ELEV	NOTE
0	4.5	95.5	left pin
9	5.15	94.85	ground
16	5.4	94.6	ground
28	6.05	93.95	LTB
28.8	6.6	93.4	LCH
29.6	6.7	93.3	TWG
30.6	6.5	93.5	RCH
32	5.97	94.03	RTB
32	5.97	94.03	BKF
41	5.2	94.8	ground
50	5.57	94.43	ground
55	5.21	94.79	ground
60	4.7	95.3	right pin

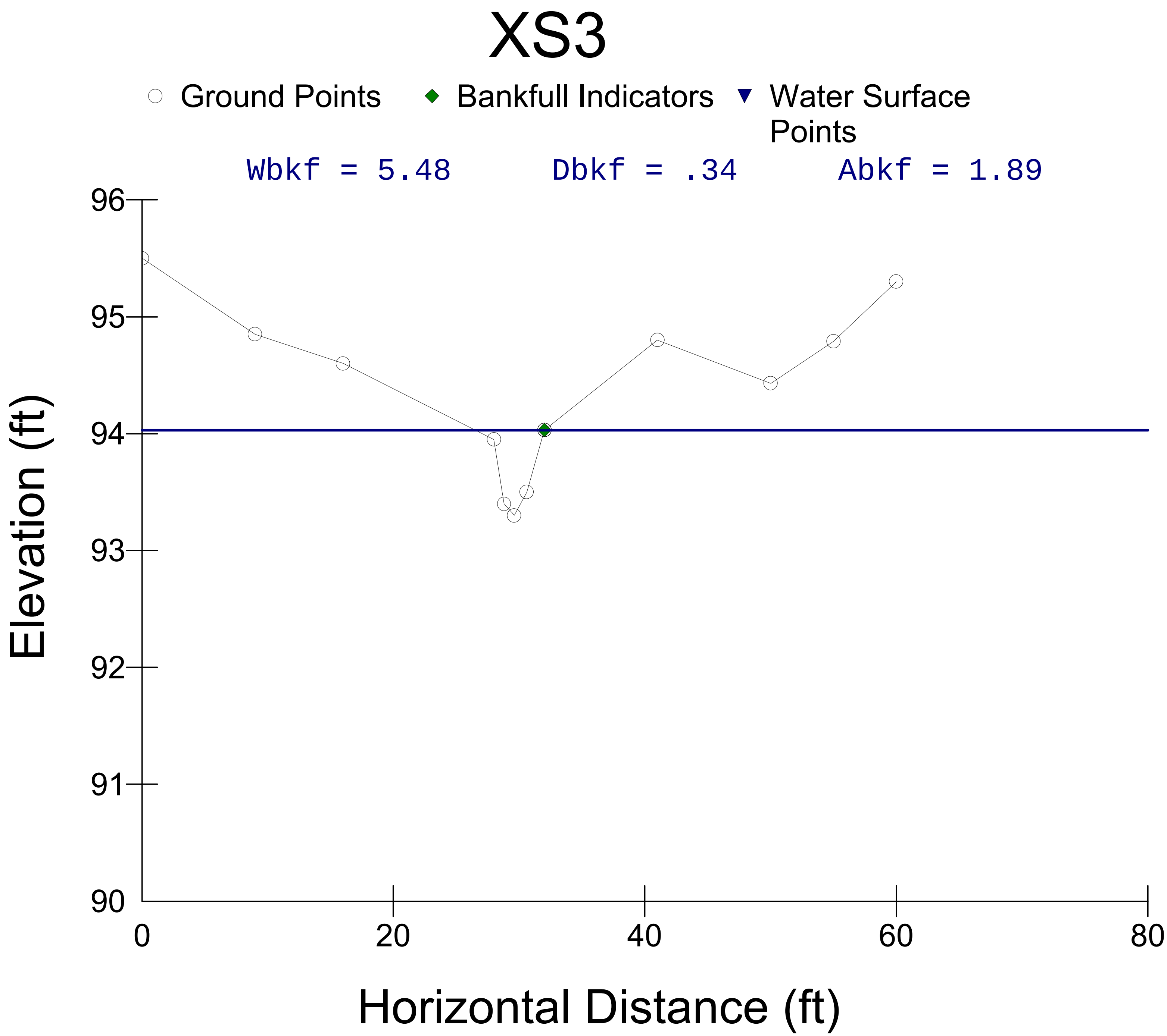
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	94.76	94.76	94.76
Bankfull Elevation (ft)	94.03	94.03	94.03
Floodprone Width (ft)	41.62	-----	-----
Bankfull Width (ft)	5.48	2.74	2.74
Entrenchment Ratio	7.6	-----	-----
Mean Depth (ft)	0.34	0.24	0.45
Maximum Depth (ft)	0.73	0.69	0.73
Width/Depth Ratio	16.12	11.61	6.09
Bankfull Area (sq ft)	1.89	0.65	1.24
Wetted Perimeter (ft)	5.77	3.6	3.55
Hydraulic Radius (ft)	0.33	0.18	0.35
Begin BKF Station	26.52	26.52	29.26
End BKF Station	32	29.26	32

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

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


XS3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.48
Dbkf = .34
Abkf = 1.89
96
95
94
93
92
91
90
Elevation (ft)
0
20
40
60
80
Horizontal Distance (ft)

BANCS Method Calcs Appendix 2

Location:	Odell's House Mitigation Project R2	Field Crew: E. Dunnigan, K. Obermiller	Date:	12/12/2019

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
Low	Low	2.0	0.034	420	28.6	1420
V. Low	V. Low	1.0	0.008	150	1.2	1570
				TOTAL FT³/YR	29.8	
Divide FT³/yr by 27				TOTAL YD³/YR	1.1	
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	1.4	

RIGHT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
Low	Low	2.0	0.034	420	28.6	1420
V. Low	V. Low	1.0	0.008	150	1.2	1570
				TOTAL FT³/YR	29.8	
				TOTAL YD³/YR	1.1	
				TOTAL TONS/YR	1.4	

Total Length	Left	Right
	570	570

North Carolina unpublished curve (Alan Walker, NRCS)

	V. Low	**Low**	**Low-Mod**	**Mod**	**Mod-High**	**High**	**V. High**	**Extreme**	**BEHI**
V. Low	0.008	0.02	0.03	0.035	0.07	0.1	0.2	0.8	
Low	0.02	0.034	0.055	0.09	0.15	0.18	0.18	0.44	
Low-Mod	0.03	0.051	0.078	0.135	0.2	0.24	0.24	0.77	
Mod	0.035	0.068	0.1	0.18	0.25	0.3	0.3	1.1	
Mod-High	0.07	0.1	0.15	0.27	0.3	0.4	0.4	1.8	
High	0.1	0.14	0.25	0.38	0.4	0.5	0.5	2.7	
V. High	0.2	0.28	0.4	0.78	0.8	0.8	0.8	6	
Extreme	0.8	0.52	0.6	1.6	1.5	1.5	1.5	10	
NBS									

Total ft assessed	1140
Total TONS per year	2.9
Tons per ft per year	0.0025
Tons per 1000ft	2.5

BANCS Method Calcs

Appendix 2

Location:	Odell's House Mitigation Project R3	Field Crew: E. Dunnigan, K. Obermiller	Date:	12/12/2019

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A BEHI	B NBS	C STUDY BANK HEIGHT	D FEET/YR (from curve)	E DISTANCE (note station for detailed design needs)	F TOTAL FT³/yr =(C×D×E)	STA
V. Low	V. Low	0.5	0.008	150	0.6	1150
Mod	Low-Mod	3.0	0.135	50	20.3	1200
Mod	High	3.0	0.38	25	28.5	1225
Low	V. Low	1.0	0.02	75	1.5	1300
Mod	High	3.0	0.38	25	28.5	1325
Low	V. Low	1.0	0.02	75	1.5	1400
Mod	High	3.0	0.38	25	28.5	1425
Low	Low	2.0	0.034	25	1.7	1450
Mod	High	4.0	0.38	50	76.0	1500
Low	Low	1.0	0.034	50	1.7	1550
Mod	Mod	3.0	0.18	100	54.0	1650
V. Low	V. Low	1.0	0.008	20	0.2	1670
Low	Mod	3.0	0.068	20	4.1	1690
Low	V. Low	2.0	0.02	25	1.0	1715
Low-Mod	High	3.0	0.25	25	18.8	1740
Low	Low	2.0	0.034	75	5.1	1815
Mod	V. High	4.0	0.78	20	62.4	1835
Mod	Low	4.0	0.09	50	18.0	1885
Low-Mod	Mod	4.0	0.1	50	20.0	1935
Low	Low	2.0	0.034	50	3.4	1985
Mod	Mod	4.0	0.18	25	18.0	2010
Low	Low	1.0	0.034	150	5.1	2160
Low-Mod	Mod	2.0	0.1	20	4.0	2180
Low	Low	1.0	0.034	80	2.7	2260
Low-Mod	Mod	2.0	0.1	20	4.0	2280
V. Low	V. Low	0.5	0.008	80	0.3	2360
				TOTAL FT³/YR	409.8	
Divide FT³/yr by 27				TOTAL YD³/YR	15.2	
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	19.7	

RIGHT BANK

A BEHI	B NBS	C STUDY BANK HEIGHT	D FEET/YR (from curve)	E DISTANCE (note station for detailed design needs)	F TOTAL FT³/yr =(C×D×E)	STA
Mod	High	4.0	0.38	40	60.8	1040
Mod	Low	4.0	0.09	75	27.0	1115
V. Low	Low	2.0	0.02	25	1.0	1140
Mod	Low	3.0	0.09	50	13.5	1190
Mod	High	3.0	0.38	20	22.8	1210
Low	Low	2.0	0.034	70	4.8	1280
Mod	High	3.0	0.38	20	22.8	1300
Low	Low	1.0	0.034	60	2.0	1360
Mod	Low	3.0	0.09	30	8.1	1390
High	High	5.0	0.5	20	50.0	1410
Mod	High	5.0	0.38	50	95.0	1460
Mod	Low	3.0	0.09	25	6.8	1485
High	High	4.0	0.5	25	50.0	1510
Low	Low	1.0	0.034	40	1.4	1550
V. High	High	6.0	0.5	50	150.0	1600
Low	Low	2.0	0.034	75	5.1	1675
Low	Low	1.0	0.034	100	3.4	1775
Mod	Low	4.0	0.09	75	27.0	1850
Low	Low	2.0	0.034	100	6.8	1950
Low	Mod	2.0	0.068	50	6.8	2000
Mod	Low	4.0	0.09	20	7.2	2020
Low	Low	2.0	0.034	20	1.4	2040
				TOTAL FT³/YR	573.6	
				TOTAL YD³/YR	21.2	
				TOTAL TONS/YR	27.6	

Total Length 1360 1040

North Carolina unpublished curve (Alan Walker, NRCS)

	V. Low	**Low**	**Low-Mod**	**Mod**	**Mod-High**	**High**	**V. High**	**Extreme**	**BEHI**
V. Low	0.008	0.02	0.03	0.035	0.07	0.1	0.2	0.8	
Low	0.02	0.034	0.055	0.09	0.15	0.18	0.18	0.44	
Low-Mod	0.03	0.051	0.078	0.135	0.2	0.24	0.24	0.77	
Mod	0.035	0.068	0.1	0.18	0.25	0.3	0.3	1.1	
Mod-High	0.07	0.1	0.15	0.27	0.3	0.4	0.4	1.8	
High	0.1	0.14	0.25	0.38	0.4	0.5	0.5	2.7	
V. High	0.2	0.28	0.4	0.78	0.8	0.8	0.8	6	
Extreme	0.8	0.52	0.6	1.6	1.5	1.5	1.5	10	
NBS									

Total ft assessed	2400
Total TONS per year	47.3
Tons per ft per year	0.0197
Tons per 1000ft	19.7

BANCS Method Calcs

Appendix 2

Location: Odell's House Mitigation Project R4 | Field Crew: E. Dunnigan, K. Obermiller | Date: 12/12/2019

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
V. Low	V. Low	0.5	0.008	80	0.3	1080
Low-Mod	Mod	2.0	0.1	50	10.0	1130
Low	Low	1.0	0.034	50	1.7	1180
V. Low	V. Low	0.3	0.008	200	0.4	1380
				TOTAL FT³/YR	12.4	
Divide FT³/yr by 27				TOTAL YD³/YR	0.5	
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	0.6	

RIGHT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
Low	Mod	2.0	0.068	20	2.7	1020
V. Low	V. Low	0.5	0.008	80	0.3	1100
Mod	High	2.0	0.38	40	30.4	1140
Low	V. Low	1.0	0.02	50	1.0	1190
V. Low	V. Low	0.3	0.008	200	0.4	1390
				TOTAL FT³/YR	34.8	
				TOTAL YD³/YR	1.3	
				TOTAL TONS/YR	1.7	

Total Length 380 390

North Carolina unpublished curve (Alan Walker, NRCS)

	V. Low	**Low**	**Low-Mod**	**Mod**	**Mod-High**	**High**	**V. High**	**Extreme**	**BEHI**
V. Low	0.008	0.02	0.03	0.035	0.07	0.1	0.2	0.8	
Low	0.02	0.034	0.055	0.09	0.15	0.18	0.18	0.44	
Low-Mod	0.03	0.051	0.078	0.135	0.2	0.24	0.24	0.77	
Mod	0.035	0.068	0.1	0.18	0.25	0.3	0.3	1.1	
Mod-High	0.07	0.1	0.15	0.27	0.3	0.4	0.4	1.8	
High	0.1	0.14	0.25	0.38	0.4	0.5	0.5	2.7	
V. High	0.2	0.28	0.4	0.78	0.8	0.8	0.8	6	
Extreme	0.8	0.52	0.6	1.6	1.5	1.5	1.5	10	
NBS									

Total ft assessed	770
Total TONS per year	2.3
Tons per ft per year	0.0030
Tons per 1000ft	3.0

BANCS Method Calcs

Appendix 2

Location: Odell's House Mitigation Project R6 | Field Crew: E. Dunnigan, K. Obermiller | Date: 12/12/2019

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
V. Low	V. Low	1.0	0.008	400	3.2	1400
Low	Low	2.0	0.034	20	1.4	1420
V. Low	V. Low	1.0	0.008	180	1.4	1600
Low	Low	2.0	0.034	100	6.8	1700
				TOTAL FT³/YR	12.8	
Divide FT³/yr by 27				TOTAL YD³/YR	0.5	
Multiply YD³/yr by 1.3				**TOTAL TONS/YR**	0.6	

RIGHT BANK

A	B	C	D	E	F	
BEHI	**NBS**	**STUDY BANK HEIGHT**	**FEET/YR (from curve)**	**DISTANCE (note station for detailed design needs)**	**TOTAL FT³/yr =(C×D×E)**	**STA**
V. Low	V. Low	1.0	0.008	420	3.4	1420
Low	V. Low	2.0	0.02	50	2.0	1470
V. Low	V. Low	1.0	0.008	130	1.0	1600
Low	Low	4.0	0.034	100	13.6	1700
				TOTAL FT³/YR	20.0	
				TOTAL YD³/YR	0.7	
				TOTAL TONS/YR	1.0	

Total Length: 700 (left bank), 700 (right bank)

North Carolina unpublished curve (Alan Walker, NRCS)

	V. Low	**Low**	**Low-Mod**	**Mod**	**Mod-High**	**High**	**V. High**	**Extreme**	**BEHI**
V. Low	0.008	0.02	0.03	0.035	0.07	0.1	0.2	0.8	
Low	0.02	0.034	0.055	0.09	0.15	0.18	0.18	0.44	
Low-Mod	0.03	0.051	0.078	0.135	0.2	0.24	0.24	0.77	
Mod	0.035	0.068	0.1	0.18	0.25	0.3	0.3	1.1	
Mod-High	0.07	0.1	0.15	0.27	0.3	0.4	0.4	1.8	
High	0.1	0.14	0.25	0.38	0.4	0.5	0.5	2.7	
V. High	0.2	0.28	0.4	0.78	0.8	0.8	0.8	6	
Extreme	0.8	0.52	0.6	1.6	1.5	1.5	1.5	10	
NBS									

Total ft assessed	1400
Total TONS per year	1.6
Tons per ft per year	0.0011
Tons per 1000ft	1.1

BANCS Method Calcs

Appendix 2

Location: Odell's House Mitigation Project R7 Field Crew: E. Dunnigan, K. Obermiller Date: 12/12/2019

SEDIMENT LOADING ASSESSMENT SHEET

LEFT BANK							RIGHT BANK						
A	B	C	D	E	F		A	B	C	D	E	F	
BEHI	NBS	STUDY BANK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)	STA	BEHI	NBS	STUDY BANK HEIGHT	FEET/YR (from curve)	DISTANCE (note station for detailed design needs)	TOTAL FT³/yr =(C×D×E)	STA
Low	Low	1.0	0.034	50	1.7	1050	Low	Low	2.0	0.034	20	1.4	1020
Low	Low	2.0	0.034	20	1.4	1070	Low	Low	1.0	0.034	377	12.8	1397
Low	Low	1.0	0.034	327	11.1	1397							

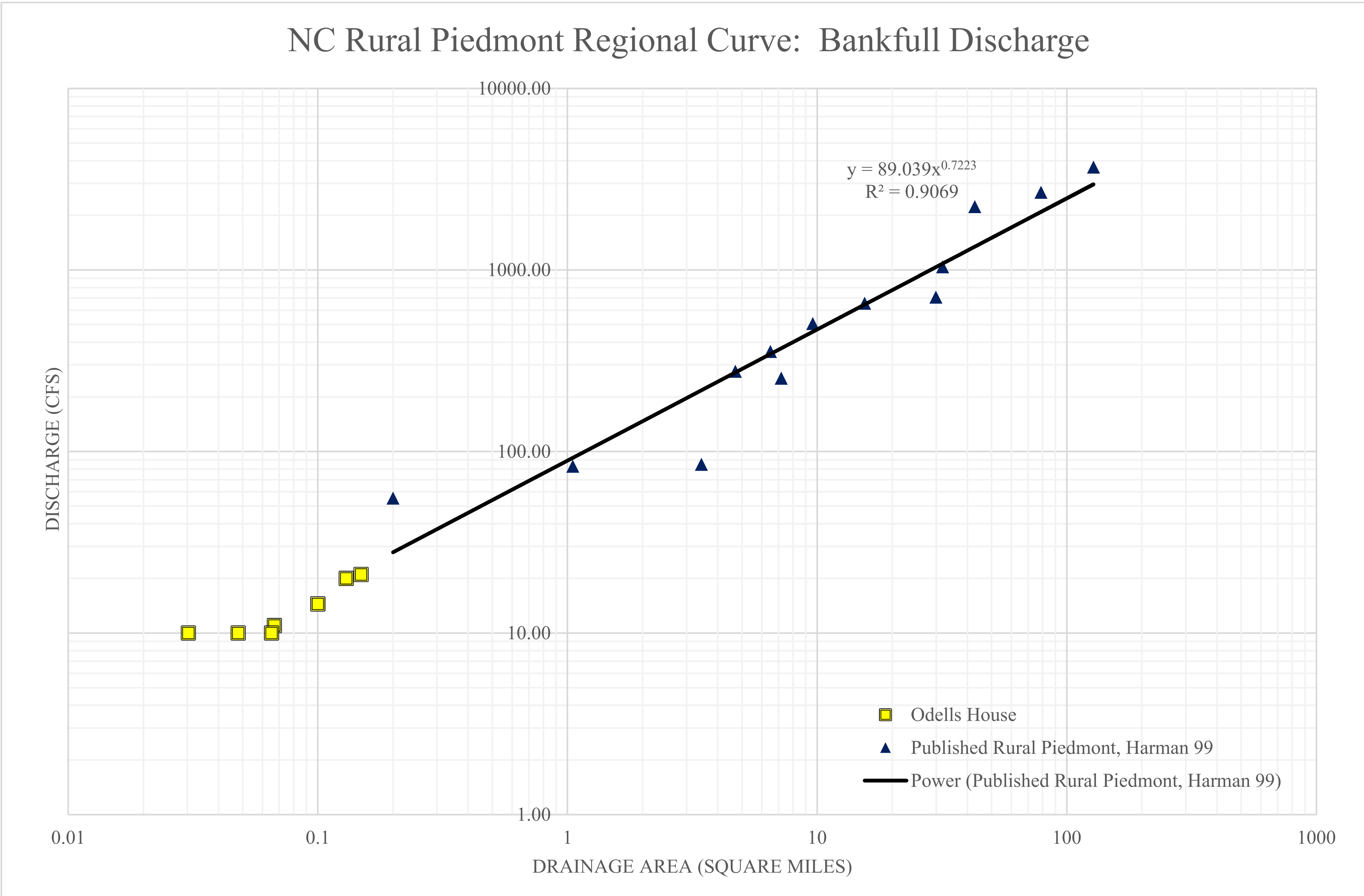
	Left Bank		Right Bank
	TOTAL FT³/YR	14.2	TOTAL FT³/YR 14.2
Divide FT³/yr by 27	TOTAL YD³/YR	0.5	TOTAL YD³/YR 0.5
Multiply YD³/yr by 1.3	**TOTAL TONS/YR**	0.7	**TOTAL TONS/YR** 0.7

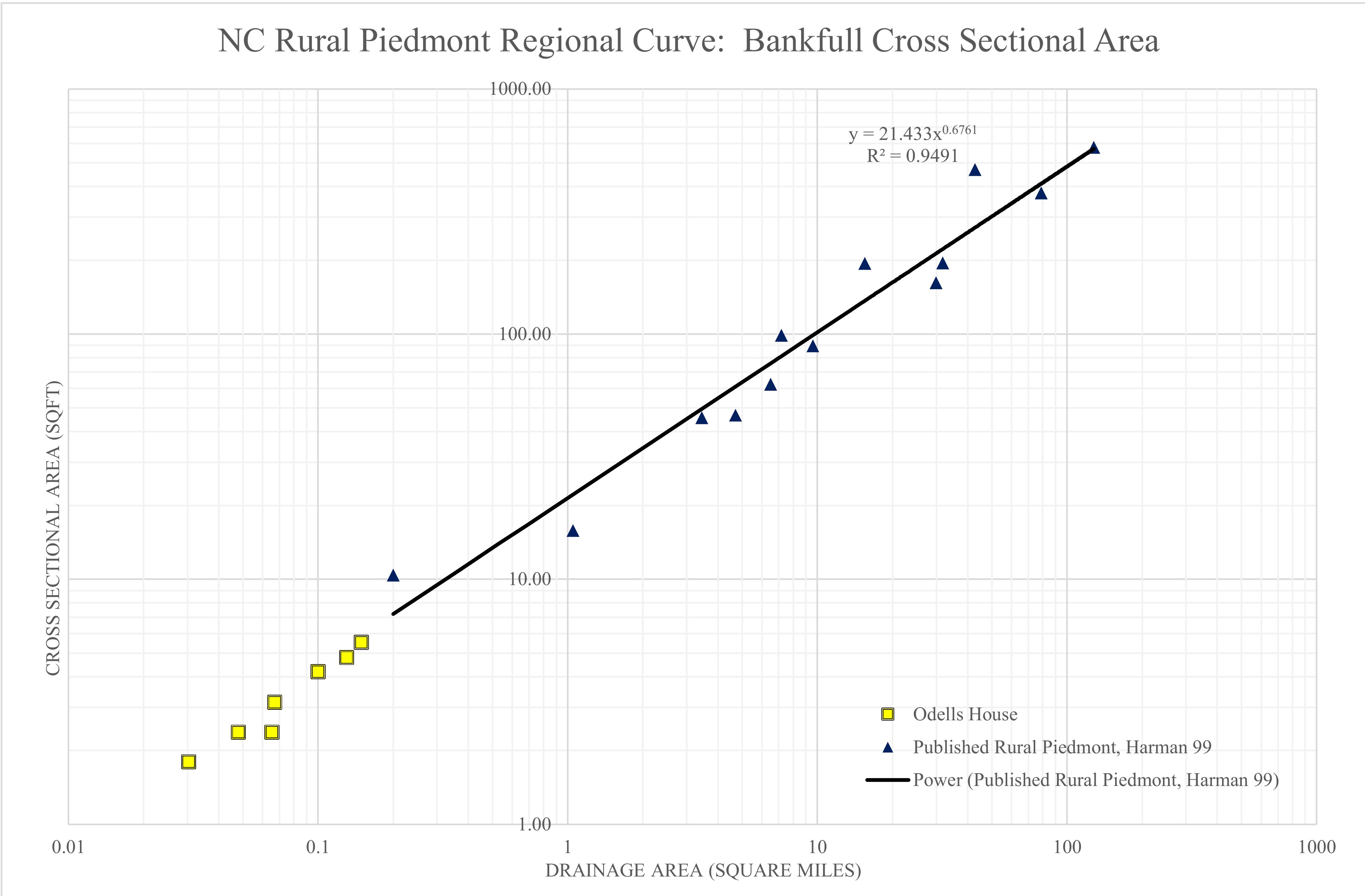
Total Length 397 397

Total ft assessed	794
Total TONS per year	1.4
Tons per ft per year	0.0017
Tons per 1000ft	1.7

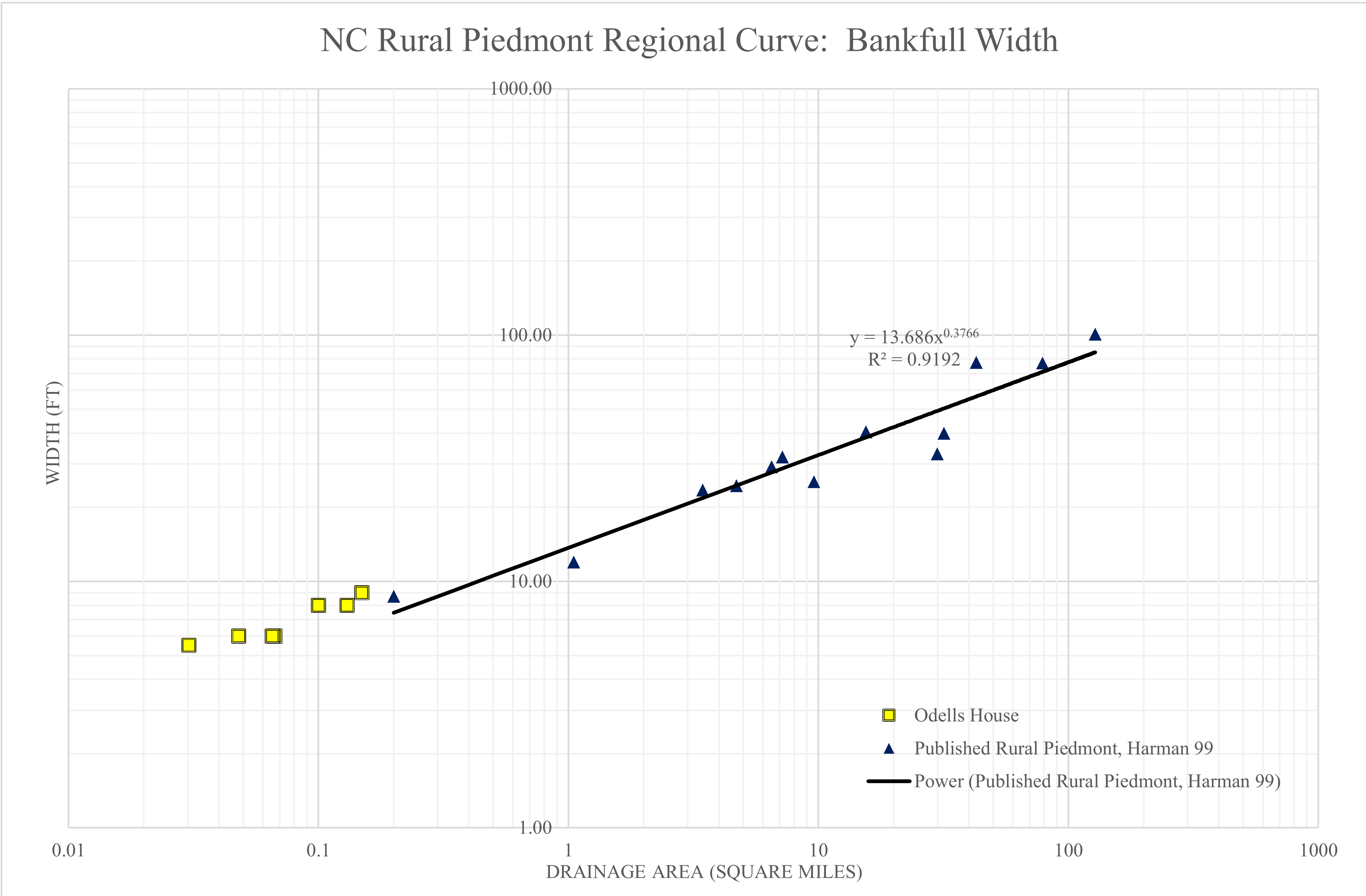
North Carolina unpublished curve (Alan Walker, NRCS)

	V. Low	Low	Low-Mod	Mod	Mod-High	High	V. High	Extreme	BEHI
V. Low	0.008	0.02	0.03	0.035	0.07	0.1	0.2	0.8	
Low	0.02	0.034	0.055	0.09	0.15	0.18	0.18	0.44	
Low-Mod	0.03	0.051	0.078	0.135	0.2	0.24	0.24	0.77	
Mod	0.035	0.068	0.1	0.18	0.25	0.3	0.3	1.1	
Mod-High	0.07	0.1	0.15	0.27	0.3	0.4	0.4	1.8	
High	0.1	0.14	0.25	0.38	0.4	0.5	0.5	2.7	
V. High	0.2	0.28	0.4	0.78	0.8	0.8	0.8	6	
Extreme	0.8	0.52	0.6	1.6	1.5	1.5	1.5	10	
NBS									

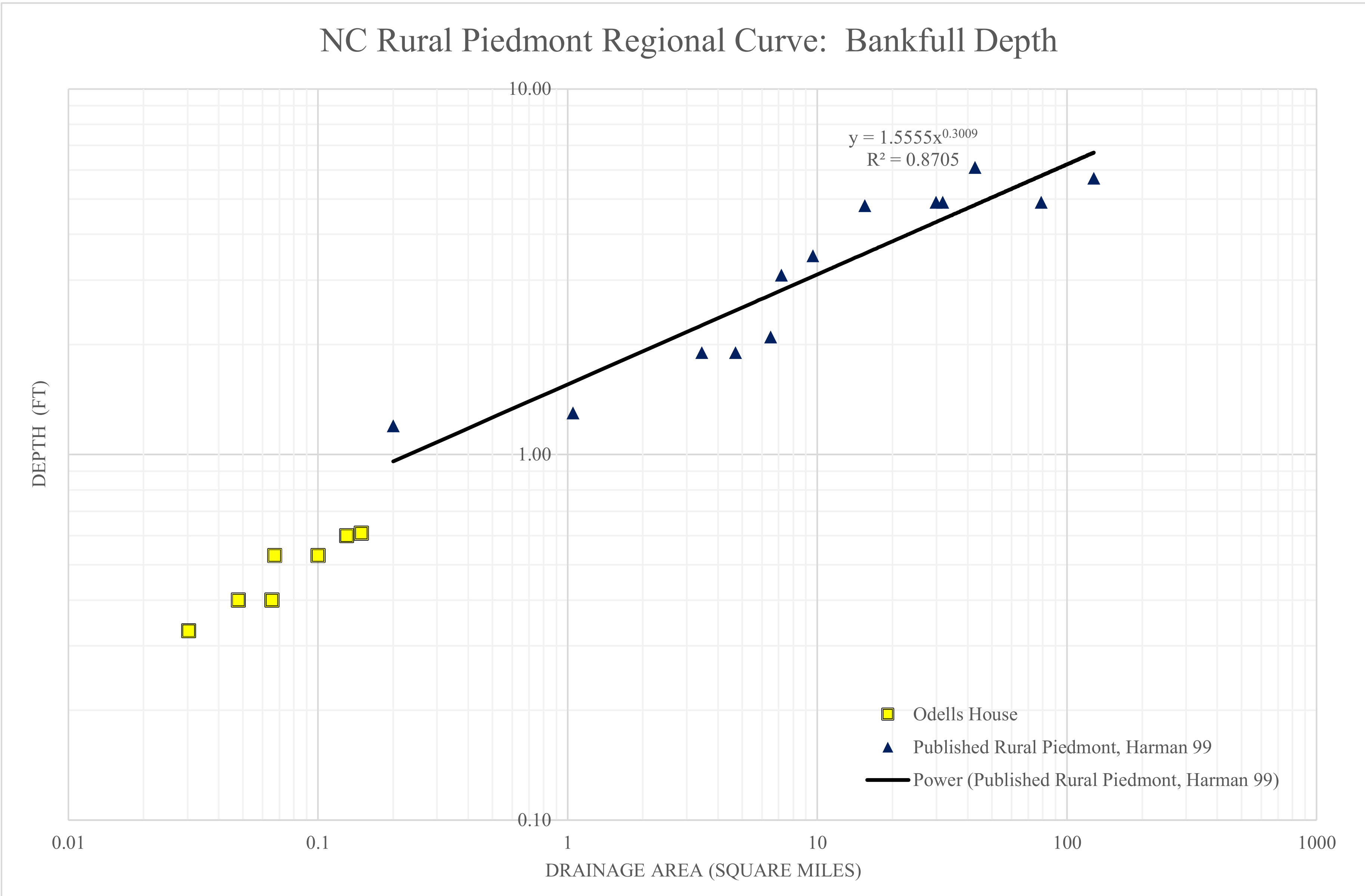

NC Rural Piedmont Regional Curve: Bankfull Discharge
DISCHARGE (CFS)
10000.00
1000.00
100.00
10.00
1.00
0.01
0.1
1
10
100
1000
DRAINAGE AREA (SQUARE MILES)
y = 89.039x^0.7223
R² = 0.9069
Odells House
Published Rural Piedmont, Harman 99
Power (Published Rural Piedmont, Harman 99)



NC Rural Piedmont Regional Curve: Bankfull Cross Sectional Area
y = 21.433x^0.6761
R² = 0.9491
1000.00
100.00
10.00
1.00
0.01
0.1
1
10
100
1000
CROSS SECTIONAL AREA (SQFT)
DRAINAGE AREA (SQUARE MILES)
Odells House
Published Rural Piedmont, Harman 99
Power (Published Rural Piedmont, Harman 99)



NC Rural Piedmont Regional Curve: Bankfull Width
1000.00
100.00
10.00
1.00
0.01
0.1
1
10
100
1000
WIDTH (FT)
DRAINAGE AREA (SQUARE MILES)
$y = 13.686x^{0.3766}$
$R^2 = 0.9192$
Odells House
Published Rural Piedmont, Harman 99
Power (Published Rural Piedmont, Harman 99)



NC Rural Piedmont Regional Curve: Bankfull Depth
y = 1.5555x^0.3009
R² = 0.8705
10.00
1.00
0.10
DEPTH (FT)
0.01
0.1
1
10
100
1000
DRAINAGE AREA (SQUARE MILES)
Odells House
Published Rural Piedmont, Harman 99
Power (Published Rural Piedmont, Harman 99)

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	1345.0	184.6	3534.5	34.3	684.4	72.2	134.6	26.7	660.5	112.4	3399.9	7.6	50.9	39.1	3.8	78.0
W2	901.5	145.9	2001.0	24.2	376.3	48.5	113.8	17.9	525.2	97.4	1887.2	6.3	41.7	33.2	5.7	73.9
Total	2246.5	330.5	5535.5	58.5	1060.7	120.7	248.4	44.6	1185.7	209.9	5287.1	13.9	47.2	36.5	4.5	76.3

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R1

Watershed Characteristics

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

Drainage Area: 0.07 sq mi 42.88 *ac*

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

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	2.44	sf	1.56 sf	2.14 sf
W =	4.15	ft	3.69 ft	3.89 ft
D =	0.57	ft	0.43 ft	0.55 ft
Q =	**2.37**	**cfs**	*4.36 cfs (WCP)*	**5.62 cfs**
			1.88 cfs (ECP)	
			3.12 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	3.59	sf	2.42 sf	1.35 sf	2.13 sf	3.41 sf
W =	5.48	ft	5.15 ft	4.06 ft	4.08 ft	3.72 ft
D =	0.75	ft	0.47 ft	0.33 ft	0.46 ft	0.63 ft
Q =	**13.44**	**cfs**	**10.84 cfs**	**3.39 cfs**	**6.39 cfs**	**12.72 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	3.44 sf	1.73 sf	1.79 sf
W =	7.01 ft	4.22 ft	3.83 ft
D =	0.48 ft	0.41 ft	0.46 ft
Q =	**12.90 cfs**	**2.68 cfs**	**5.06 cfs**

Weighted Average Rural Regional Curve Values				**Weighted w/ Urban Regional Curve Values**	
CSA =	**2.04**	**sf**	*0.00 ft (Observed Value)*	**2.04**	**sf**
W =	**3.91**	**ft**	*0.00 ft (Observed Value)*	**3.91**	**ft**
D =	**0.52**	**ft**	*0.00 ft (Observed Value)*	**0.52**	**ft**
Q =	**4.11**	**cfs**	*0.00 ft (Observed Value)*	**4.11**	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R2

Watershed Characteristics

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

Drainage Area: **0.10** **sq mi** **64.00** ***ac***

Average Field Observed Bankfull ***C.S.A.*** =	3.7	ft
Average Field Observed Bankfull ***Width*** =	11.0	ft
Average Field Observed Bankfull ***Depth*** =	0.3	ft
Mannings Calculated Q =	13.8	ft

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	3.18	sf	2.06 sf	2.76 sf
W =	4.79	ft	4.29 ft	4.50 ft
D =	0.65	ft	0.48 ft	0.61 ft
Q =	**3.16**	**cfs**	*5.84 cfs (WCP)*	**7.14 cfs**
			2.55 cfs (ECP)	
			4.19 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	4.70	sf	3.24 sf	1.85 sf	2.87 sf	4.48 sf
W =	6.33	ft	6.02 ft	4.82 ft	4.85 ft	4.42 ft
D =	0.84	ft	0.54 ft	0.38 ft	0.53 ft	0.72 ft
Q =	**17.86**	**cfs**	**14.69 cfs**	**4.96 cfs**	**8.81 cfs**	**16.97 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	4.51 sf	2.34 sf	2.39 sf
W =	8.13 ft	5.04 ft	4.56 ft
D =	0.54 ft	0.47 ft	0.52 ft
Q =	**17.49 cfs**	**3.91 cfs**	**6.95 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**2.67**	**sf**	*3.69 ft (Observed Value)*
W =	**4.53**	**ft**	*11.00 ft (Observed Value)*
D =	**0.58**	**ft**	*0.33 ft (Observed Value)*
Q =	**5.38**	**cfs**	*13.75 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

2.67	**sf**
4.53	**ft**
0.58	**ft**
5.38	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R3

Watershed Characteristics

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

Drainage Area: 0.13 sq mi 83.20 *ac*

Average Field Observed Bankfull ***C.S.A.*** *=*	*5.6*	ft
Average Field Observed Bankfull ***Width*** *=*	*5.7*	ft
Average Field Observed Bankfull ***Depth*** *=*	*1.0*	ft
Mannings Calculated Q =	*34.1*	ft

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	3.78	sf	2.48 sf	3.26 sf
W =	5.26	ft	4.74 ft	4.96 ft
D =	0.70	ft	0.53 ft	0.66 ft
Q =	**3.81**	**cfs**	*7.07 cfs (WCP)*	**8.35 cfs**
			3.11 cfs (ECP)	
			5.09 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	5.60	sf	3.93 sf	2.28 sf	3.49 sf	5.35 sf
W =	6.96	ft	6.67 ft	5.40 ft	5.43 ft	4.95 ft
D =	0.91	ft	0.59 ft	0.42 ft	0.58 ft	0.78 ft
Q =	**21.52**	**cfs**	**17.94 cfs**	**6.36 cfs**	**10.88 cfs**	**20.49 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	5.40 sf	2.85 sf	2.89 sf
W =	8.95 ft	5.65 ft	5.11 ft
D =	0.59 ft	0.50 ft	0.56 ft
Q =	**21.35 cfs**	**5.00 cfs**	**8.56 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**3.17**	**sf**	*5.62 ft (Observed Value)*
W =	**4.99**	**ft**	*5.70 ft (Observed Value)*
D =	**0.63**	**ft**	*0.99 ft (Observed Value)*
Q =	**6.41**	**cfs**	*34.11 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

3.17	**sf**
4.99	**ft**
0.63	**ft**
6.41	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R4

Watershed Characteristics

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

Drainage Area: 0.15 sq mi 96.00 ac

Average Field Observed Bankfull **C.S.A.** =	5.6	ft
Average Field Observed Bankfull **Width** =	5.5	ft
Average Field Observed Bankfull **Depth** =	1.0	ft
Mannings Calculated Q =	21.0	ft

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	4.15	sf	2.74 sf	3.57 sf
W =	5.54	ft	5.01 ft	5.22 ft
D =	0.73	ft	0.55 ft	0.68 ft
Q =	**4.23**	**cfs**	*7.85 cfs (WCP)*	**9.10 cfs**
			3.46 cfs (ECP)	
			5.66 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	6.17	sf	4.36 sf	2.56 sf	3.88 sf	5.90 sf
W =	7.33	ft	7.05 ft	5.74 ft	5.78 ft	5.26 ft
D =	0.95	ft	0.62 ft	0.44 ft	0.60 ft	0.82 ft
Q =	**23.82**	**cfs**	**20.00 cfs**	**7.28 cfs**	**12.21 cfs**	**22.72 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	5.95 sf	3.17 sf	3.20 sf
W =	9.44 ft	6.02 ft	5.44 ft
D =	0.62 ft	0.53 ft	0.58 ft
Q =	**23.80 cfs**	**5.72 cfs**	**9.59 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**3.49**	**sf**	*5.60 ft (Observed Value)*
W =	**5.26**	**ft**	*5.49 ft (Observed Value)*
D =	**0.65**	**ft**	*1.02 ft (Observed Value)*
Q =	**7.06**	**cfs**	*21.00 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

3.49	**sf**
5.26	**ft**
0.65	**ft**
7.06	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R5

Watershed Characteristics

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

Drainage Area: 0.03 sq mi 19.39 *ac*

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

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	1.44	sf	0.89 sf	1.29 sf
W =	3.12	ft	2.73 ft	2.91 ft
D =	0.45	ft	0.33 ft	0.44 ft
Q =	**1.34**	**cfs**	*2.44 cfs (WCP)*	**3.49 cfs**
			1.03 cfs (ECP)	
			1.73 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	2.11	sf	1.36 sf	0.71 sf	1.18 sf	1.99 sf
W =	4.12	ft	3.78 ft	2.89 ft	2.89 ft	2.64 ft
D =	0.59	ft	0.36 ft	0.24 ft	0.35 ft	0.49 ft
Q =	**7.65**	**cfs**	**5.93 cfs**	**1.60 cfs**	**3.37 cfs**	**7.18 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	2.00 sf	0.96 sf	1.01 sf
W =	5.22 ft	2.98 ft	2.71 ft
D =	0.38 ft	0.32 ft	0.37 ft
Q =	**7.06 cfs**	**1.27 cfs**	**2.69 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**1.21**	**sf**	*0.00 ft (Observed Value)*
W =	**2.92**	**ft**	*0.00 ft (Observed Value)*
D =	**0.41**	**ft**	*0.00 ft (Observed Value)*
Q =	**2.42**	**cfs**	*0.00 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

1.21	**sf**
2.92	**ft**
0.41	**ft**
2.42	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R6

Watershed Characteristics

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

Drainage Area: **0.05** **sq mi** **30.66** ***ac***

Average Field Observed Bankfull ***C.S.A.*** *=*	***2.5***	**ft**
Average Field Observed Bankfull ***Width*** *=*	***4.1***	**ft**
Average Field Observed Bankfull ***Depth*** *=*	***0.6***	**ft**
Mannings Calculated Q =	***10.0***	**ft**

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	1.95	sf	1.23 sf	1.73 sf
W =	3.67	ft	3.25 ft	3.44 ft
D =	0.52	ft	0.38 ft	0.50 ft
Q =	**1.86**	**cfs**	*3.41 cfs (WCP)*	**4.60 cfs**
			1.46 cfs (ECP)	
			2.43 cfs (Average)	

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	2.87	sf	1.90 sf	1.03 sf	1.66 sf	2.71 sf
W =	4.86	ft	4.52 ft	3.52 ft	3.53 ft	3.22 ft
D =	0.68	ft	0.42 ft	0.29 ft	0.41 ft	0.57 ft
Q =	**10.59**	**cfs**	**8.40 cfs**	**2.47 cfs**	**4.88 cfs**	**9.99 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	2.74 sf	1.35 sf	1.40 sf
W =	6.19 ft	3.64 ft	3.31 ft
D =	0.43 ft	0.37 ft	0.42 ft
Q =	**10.00 cfs**	**1.96 cfs**	**3.88 cfs**

Weighted Average Rural Regional Curve Values

CSA =	**1.64**	**sf**	*2.48 ft (Observed Value)*
W =	**3.45**	**ft**	*4.12 ft (Observed Value)*
D =	**0.47**	**ft**	*0.60 ft (Observed Value)*
Q =	**3.29**	**cfs**	*10.00 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

1.64	**sf**
3.45	**ft**
0.47	**ft**
3.29	**cfs**

Bankfull Discharge Regional Curves

Project: 18-003 Odell's House Mitigation Project **Date:** 11/18/2019
Reach: R7

Watershed Characteristics

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

Drainage Area: 0.07 sq mi **41.79** *ac*

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

Rural Coastal Plains Bankfull Regional Curves

	North Carolina Coastal		FWS - MD (CBFO-S03-02)	*USGS -VA, MD (2007-5162)*
CSA =	2.40	sf	1.53 sf	2.10 sf
W =	4.11	ft	3.65 ft	3.85 ft
D =	0.57	ft	0.42 ft	0.54 ft
Q =	**2.32**	**cfs**	*4.28 cfs (WCP)* *1.84 cfs (ECP)* **3.06 cfs (Average)**	**5.53 cfs**

Rural Piedmont Bankfull Regional Curves

	North Carolina Piedmont		FWS - MD (CBFO-S02-01)	*USGS -VA, MD (200*	North Carolina Walker Curves	NCSU NC Piedmont ('99)
CSA =	3.53	sf	2.38 sf	1.32 sf	2.09 sf	3.35 sf
W =	5.43	ft	5.10 ft	4.02 ft	4.03 ft	3.68 ft
D =	0.74	ft	0.47 ft	0.32 ft	0.46 ft	0.63 ft
Q =	**13.20**	**cfs**	**10.63 cfs**	**3.31 cfs**	**6.26 cfs**	**12.48 cfs**

Rural Valley & Ridge Bankfull Regional Curves

	North Carolina V&R	FWS - MD (CBFO-S03-01)	*USGS -VA, MD (2005-5076)*
CSA =	3.38 sf	1.70 sf	1.76 sf
W =	6.94 ft	4.17 ft	3.78 ft
D =	0.48 ft	0.41 ft	0.46 ft
Q =	**12.65 cfs**	**2.62 cfs**	**4.96 cfs**

Weighted Average Rural Regional Curve Values

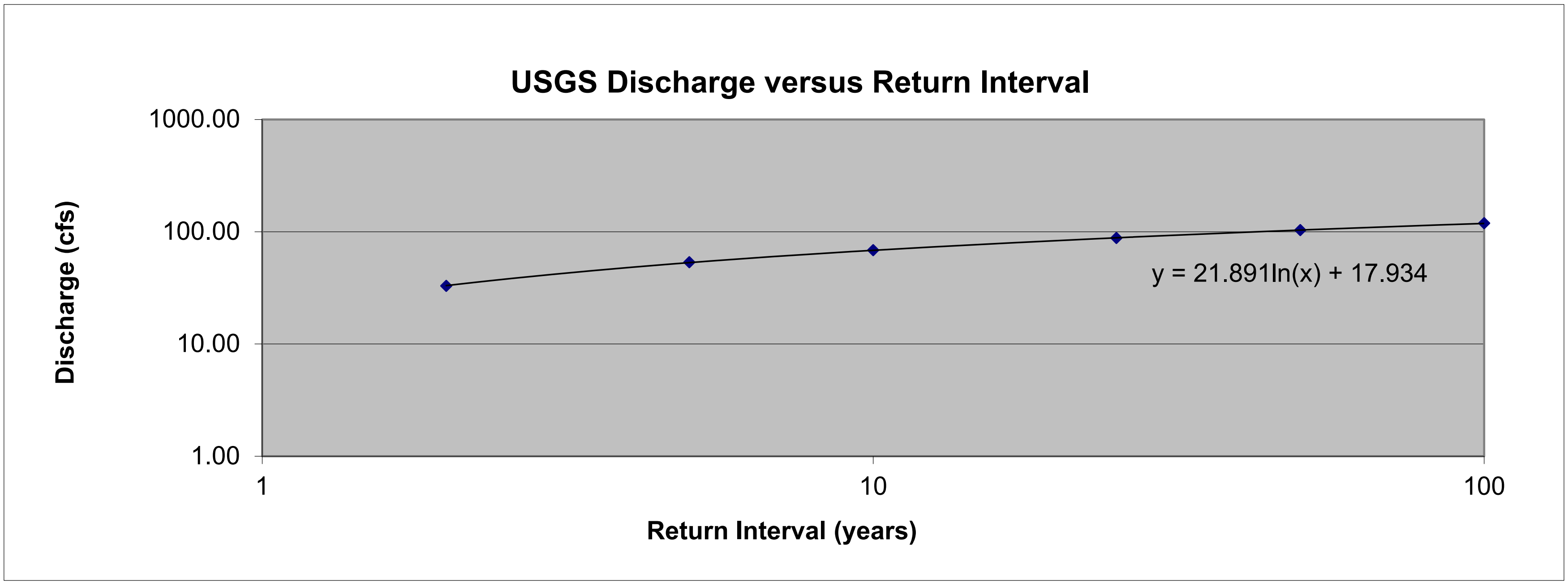
CSA =	**2.01**	**sf**	*0.00 ft (Observed Value)*
W =	**3.87**	**ft**	*0.00 ft (Observed Value)*
D =	**0.51**	**ft**	*0.00 ft (Observed Value)*
Q =	**4.04**	**cfs**	*0.00 ft (Observed Value)*

Weighted w/ Urban Regional Curve Values

2.01	**sf**
3.87	**ft**
0.51	**ft**
4.04	**cfs**

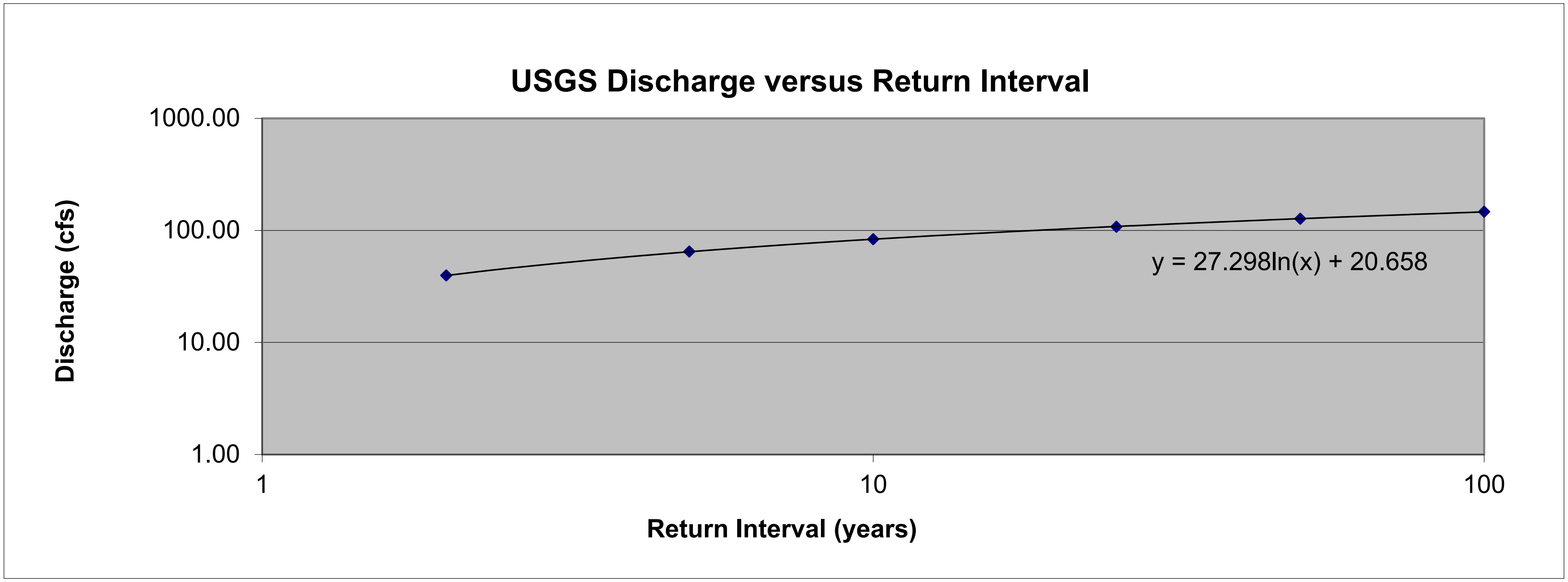
Site Description: Odell's House R2 XS4
Drainage Area = 0.1 mi^2

Retun Interval	Discharge	Notes
1	17.93	extrapolated. Need to use equation generated below.
1.2	21.93	extrapolated. Need to use equation generated below.
1.5	26.81	extrapolated. Need to use equation generated below.
2	32.92	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
5	53.52	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
10	68.46	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
25	88.06	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
50	103.37	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
100	119.00	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)



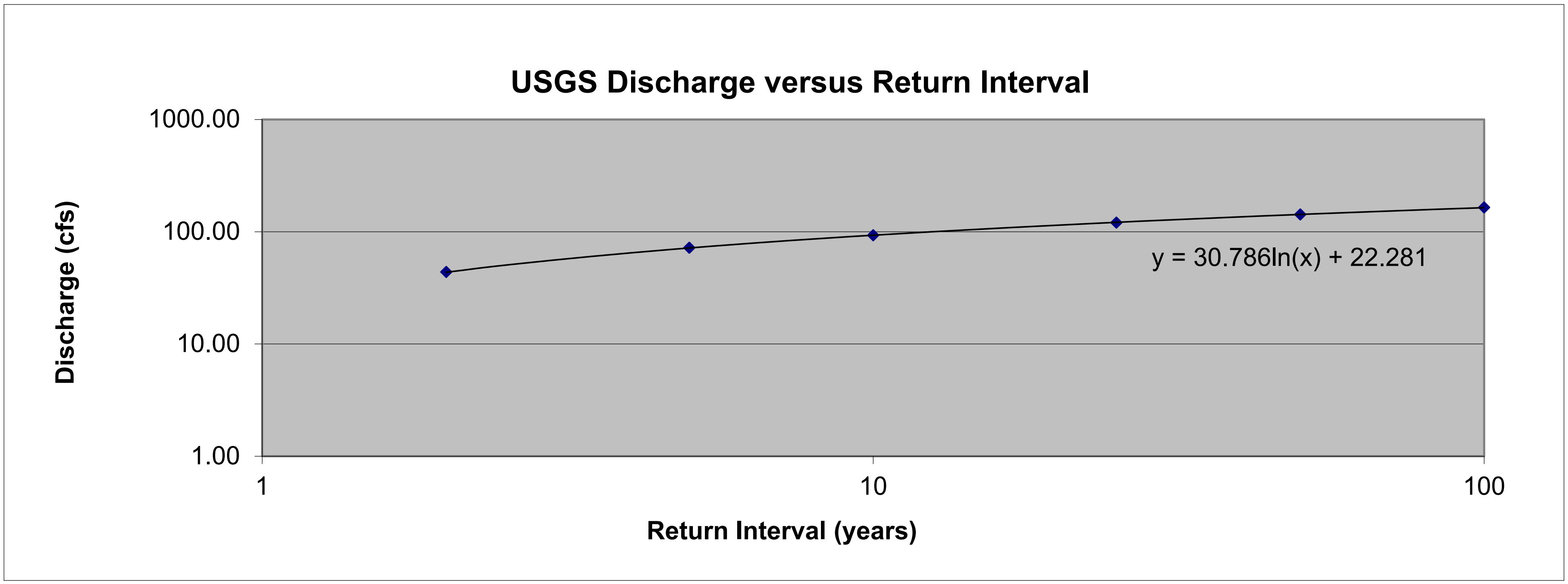
Site Description: Odell's House R3 XS5
Drainage Area = 0.13 mi^2

Retun Interval	Discharge	Notes
1	20.66	extrapolated. Need to use equation generated below.
1.2	25.64	extrapolated. Need to use equation generated below.
1.5	31.73	extrapolated. Need to use equation generated below.
2	39.65	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
5	64.90	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
10	83.43	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
25	107.93	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
50	127.18	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
100	146.94	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)



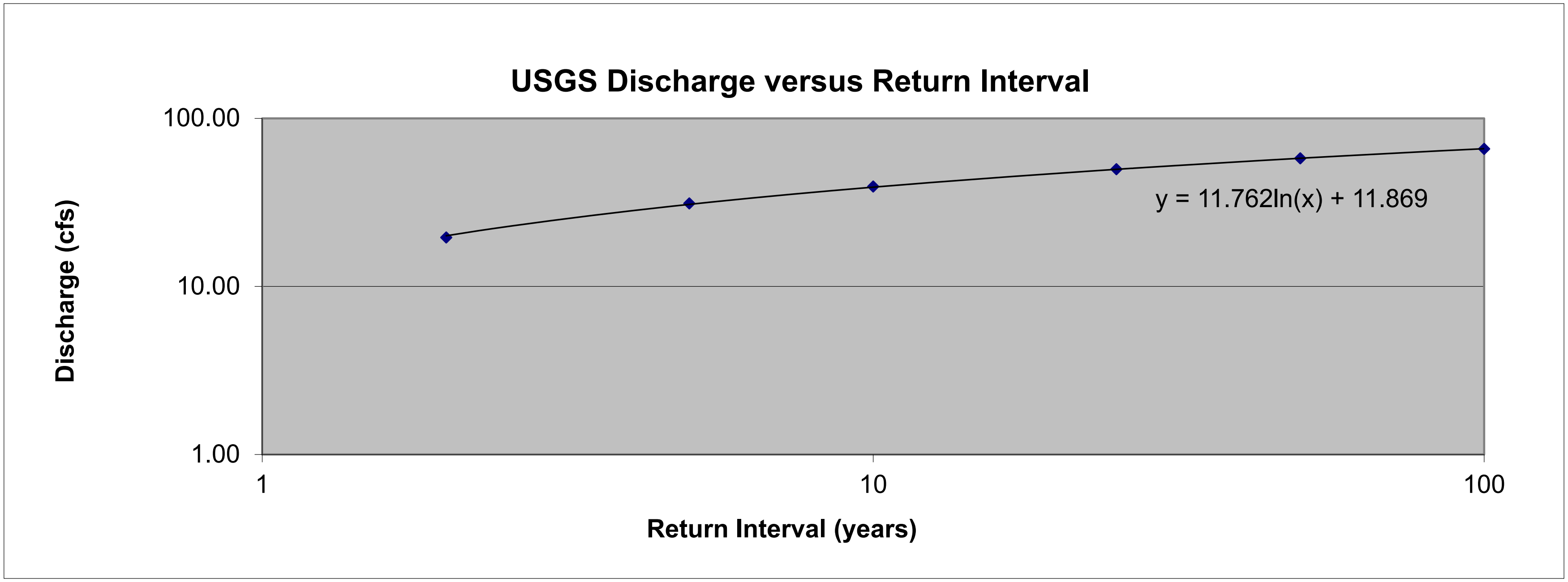
Site Description: Odell's House R4 XS6
Drainage Area = 0.15 mi^2

Retun Interval	Discharge	Notes
1	22.28	extrapolated. Need to use equation generated below.
1.2	27.89	extrapolated. Need to use equation generated below.
1.5	34.76	extrapolated. Need to use equation generated below.
2	43.89	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
5	72.10	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
10	92.93	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
25	120.59	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
50	142.41	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
100	164.86	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)



Site Description: Odell's House R6 XS1
Drainage Area = 0.0479 mi^2

Retun Interval	Discharge	Notes
1	11.87	extrapolated. Need to use equation generated below.
1.2	14.01	extrapolated. Need to use equation generated below.
1.5	16.64	extrapolated. Need to use equation generated below.
2	19.54	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
5	31.15	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
10	39.31	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
25	49.77	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
50	57.78	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)
100	65.86	USGS regional regression, 2011 (small streams, HR1, ≤3 sq. mi.)



Bankfull VELOCITY/DISCHARGE Estimates					
Site	Odell's House R2 XS4		Location	Wendell, NC	
Date	11/18/2019	Stream Type: C5	Valley Type	U-AL-FD	
Observers	NC		HUC (8-digit)	03020201	

Input Variables			Output Variables		
Bankfull Cross-section AREA	3.69	A_{bkf} (sqft)	Bankfull Mean DEPTH	0.33	D_{bkf} (ft)
Bankfull Width	11.03	W_{bkf} (ft)	Wetted PERIMETER ($\sim 2*D_{bkf}+W_{bkf}$)	11.70	W_{Pbkf} (ft)
D84 @Riffle	1	Dia (mm)	D84 mm/304.8 =	0.00	D84 (ft)
Bankfull Slope	0.0168	S (ft/ft)	Hydraulic Radius (A_{bkf}/W_{Pbkf})	0.32	R (ft)
Gravitational Acceleration	32.2	g (ft/sec^2)	Relative Roughness (R(ft)/D84(ft))	96.14	ft/ft
Drainage Area	0.1	DA (sqmi)	Shear Velocity ($u^*=(g*R*S)^{0.5}$)	0.41	u* (ft/sec)

ESTIMATION METHODS		Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor/Relative Roughness u=[2.83+5.66*log{R/D84}]*u*		5.80	ft/sec	21.42	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor/relative roughness. $u=1.4895*R^{2/3}*S^{1/2}/n$; n= (from tables 1 and 2)	input 'n' below 0.024	3.73	ft/sec	13.75	CFS
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n=0.39*S^{0.38}R^{-.16}$	"n"calcuated		ft/sec		CFS
NOTE: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder dominated stream systems; i.e., (A1, A2, A3, B1, B2, B3, C2, and E3)					
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type (Table 3)	input 'n' below 0.05	1.79	ft/sec	6.60	CFS
. Chezy C, etc.)____			ft/sec		CFS
3. Other Methods, i.e. Hydraulic Geometry (Hey, Darcy Weisbach, Chezy C, etc.)____			ft/sec		CFS
4. Continuity Equation: b) USGS Gage Data u=Q/A	1.5 yr Return	7.27	ft/sec	26.81	CFS
4a. Continuity Equation: a) Regional Curves u=Q/A	Old Rural =	4.95	ft/sec	18.28	CFS
Return Period for Bankfull Discharge Q=______	Old Urban =	24.85	ft/sec	91.69	
4b. Continuity Equation: a) Regional Curves u=Q/A	New Rural =	4.84	ft/sec	17.86	CFS
Return Period for Bankfull Discharge Q=______	New Urban =	19.49	ft/sec	71.92	
4c. Continuity Equation: a) Walker Curves u=Q/A	Rural =	2.39	ft/sec	8.81	CFS

Bankfull VELOCITY/DISCHARGE Estimates						
Site	Odell's House R3 XS5			Location	Wendell, NC	
Date	11/18/2019	Stream Type	B5c	Valley Type	C-AL-FD	
Observers	NC			HUC (8-digit)	03020201	

Input Variables			Output Variables		
Bankfull Cross-section AREA	5.62	A_{bkf} (sqft)	Bankfull Mean DEPTH	0.99	D_{bkf} (ft)
Bankfull Width	5.7	W_{bkf} (ft)	Wetted PERIMETER ($\sim 2*D_{bkf}+W_{bkf}$)	7.67	W_{Pbkf} (ft)
D84 @Riffle	1	Dia (mm)	D84 mm/304.8 =	0.00	D84 (ft)
Bankfull Slope	0.0133	S (ft/ft)	Hydraulic Radius (A_{bkf}/W_{Pbkf})	0.73	R (ft)
Gravitational Acceleration	32.2	g (ft/sec^2)	Relative Roughness (R(ft)/D84(ft))	223.28	ft/ft
Drainage Area	0.13	DA (sqmi)	Shear Velocity ($u^*=(g^*R^*S)^{0.5}$	0.56	u* (ft/sec)

ESTIMATION METHODS		Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor/Relative Roughness u=[2.83+5.66*log{R/D84}]*u*		9.03	ft/sec	50.76	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor/relative roughness. $u=1.4895*R^{2/3}*S^{1/2}/n$; n= (from tables 1 and 2)	input 'n' below 0.023	6.07	ft/sec	34.11	CFS
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n=0.39*S^{0.38}R^{-.16}$	"n"calcuated		ft/sec		CFS
NOTE: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder dominated stream systems; i.e., (A1, A2, A3, B1, B2, B3, C2, and E3)					
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type (Table 3)	input 'n' below 0.056	2.49	ft/sec	14.01	CFS
. Chezy C, etc.)____			ft/sec		CFS
3. Other Methods, i.e. Hydraulic Geometry (Hey, Darcy Weisbach, Chezy C, etc.)____			ft/sec		CFS
4. Continuity Equation: b) USGS Gage Data u=Q/A	1.5 yr Return	5.65	ft/sec	31.73	CFS
4a. Continuity Equation: a) Regional Curves u=Q/A	Old Rural =	3.91	ft/sec	21.97	CFS
Return Period for Bankfull Discharge Q=______	Old Urban =	18.95	ft/sec	106.48	
4b. Continuity Equation: a) Regional Curves u=Q/A	New Rural =	3.83	ft/sec	21.52	CFS
Return Period for Bankfull Discharge Q=______	New Urban =	15.10	ft/sec	84.85	
4c. Continuity Equation: a) Walker Curves u=Q/A	Rural =	1.94	ft/sec	10.88	CFS

Bankfull VELOCITY/DISCHARGE Estimates

<table>
<tr><td>Site</td><td colspan="3">Odell's House R4 XS6</td><td>Location</td><td colspan="2">Wendell, NC</td></tr>
<tr><td>Date</td><td>11/18/2019</td><td>Stream Type</td><td>E5</td><td>Valley Type</td><td colspan="2">C-AL-FD</td></tr>
<tr><td>Observers</td><td colspan="3">NC</td><td>HUC (8-digit)</td><td colspan="2">03020201</td></tr>
</table>

Input Variables			Output Variables		
Bankfull Cross-section AREA	5.62	A_{bkf} (sqft)	Bankfull Mean DEPTH	1.02	D_{bkf} (ft)
Bankfull Width	5.49	W_{bkf} (ft)	Wetted PERIMETER (~2*D_{bkf}+W_{bkf})	7.54	W_{Pbkf} (ft)
D84 @Riffle	1	Dia (mm)	D84 mm/304.8 =	0.00	D84 (ft)
Bankfull Slope	0.0091	S (ft/ft)	Hydraulic Radius (A_{bkf}/W_{Pbkf})	0.75	R (ft)
Gravitational Acceleration	32.2	g (ft/sec^2)	Relative Roughness (R(ft)/D84(ft))	227.26	ft/ft
Drainage Area	0.15	DA (sqmi)	Shear Velocity (u*=(g*R*S)$^{0.5}$	0.47	u* (ft/sec)

ESTIMATION METHODS		Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor/Relative Roughness u=[2.83+5.66*log{R/D84}]*u*		7.56	ft/sec	42.47	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor/relative roughness. u=1.4895*R$^{2/3}$*S$^{1/2}$/n; n= (from tables 1 and 2)	input 'n' below 0.023	5.08	ft/sec	28.55	CFS
2. Roughness Coefficient: u=1.4895*R$^{2/3}$*S$^{1/2}$/n b) Manning's 'n' from Jarrett (USGS): n=0.39*S$^{0.38}$R$^{-.16}$	"n"calcuated		ft/sec		CFS
NOTE: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder dominated stream systems; i.e., (A1, A2, A3, B1, B2, B3, C2, and E3)					
2. Roughness Coefficient: u=1.4895*R$^{2/3}$*S$^{1/2}$/n c) Manning's 'n' from Stream Type (Table 3)	input 'n' below 0.047	2.49	ft/sec	13.97	CFS
. Chezy C, etc.)____			ft/sec		CFS
3. Other Methods, i.e. Hydraulic Geometry (Hey, Darcy Weisbach, Chezy C, etc.)____			ft/sec		CFS
4. Continuity Equation: b) USGS Gage Data u=Q/A	1.5 yr Return	6.19	ft/sec	34.76	CFS
4a. Continuity Equation: a) Regional Curves u=Q/A	Old Rural =	4.32	ft/sec	24.28	CFS
Return Period for Bankfull Discharge Q=______	Old Urban =	20.56	ft/sec	115.53	
4b. Continuity Equation: a) Regional Curves u=Q/A	New Rural =	4.24	ft/sec	23.82	CFS
Return Period for Bankfull Discharge Q=______	New Urban =	16.52	ft/sec	92.85	
4c. Continuity Equation: a) Walker Curves u=Q/A	Rural =	2.17	ft/sec	12.21	CFS

Bankfull VELOCITY/DISCHARGE Estimates					
Site	Odell's House R6 XS1		Location	Wendell, NC	
Date	11/18/2019	Stream Type: E5	Valley Type	C-AL-FD	
Observers	NC		HUC (8-digit)	03020201	

Input Variables			Output Variables		
Bankfull Cross-section AREA	2.48	A_{bkf} (sqft)	Bankfull Mean DEPTH	0.60	D_{bkf} (ft)
Bankfull Width	4.12	W_{bkf} (ft)	Wetted PERIMETER ($\sim 2*D_{bkf}+W_{bkf}$)	5.32	W_{Pbkf} (ft)
D84 @Riffle	1	Dia (mm)	D84 mm/304.8 =	0.00	D84 (ft)
Bankfull Slope	0.0145	S (ft/ft)	Hydraulic Radius (A_{bkf}/W_{Pbkf})	0.47	R (ft)
Gravitational Acceleration	32.2	g (ft/sec^2)	Relative Roughness (R(ft)/D84(ft))	141.98	ft/ft
Drainage Area	0.0479	DA (sqmi)	Shear Velocity ($u^*=(g*R*S)^{0.5}$	0.47	u* (ft/sec)

ESTIMATION METHODS		Bankfull VELOCITY		Bankfull DISCHARGE	
1. Friction Factor/Relative Roughness u=[2.83+5.66*log{R/D84}]*u*		7.00	ft/sec	17.36	CFS
2. Roughness Coefficient: a) Manning's 'n' from friction factor/relative roughness. $u=1.4895*R^{2/3}*S^{1/2}/n$; n= (from tables 1 and 2)	input 'n' below 0.024	4.49	ft/sec	11.14	CFS
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ b) Manning's 'n' from Jarrett (USGS): $n=0.39*S^{0.38}R^{-.16}$	"n"calcuated		ft/sec		CFS
NOTE: This equation is for applications involving steep, step-pool, high boundary roughness, cobble-boulder dominated stream systems; i.e., (A1, A2, A3, B1, B2, B3, C2, and E3)					
2. Roughness Coefficient: $u=1.4895*R^{2/3}*S^{1/2}/n$ c) Manning's 'n' from Stream Type (Table 3)	input 'n' below 0.047	2.29	ft/sec	5.69	CFS
. Chezy C, etc.)____			ft/sec		CFS
3. Other Methods, i.e. Hydraulic Geometry (Hey, Darcy Weisbach, Chezy C, etc.)____			ft/sec		CFS
4. Continuity Equation: b) USGS Gage Data u=Q/A	1.5 yr Return	6.71	ft/sec	16.64	CFS
4a. Continuity Equation: a) Regional Curves u=Q/A	Old Rural =	4.40	ft/sec	10.92	CFS
Return Period for Bankfull Discharge Q=______	Old Urban =	24.30	ft/sec	60.27	
4b. Continuity Equation: a) Regional Curves u=Q/A	New Rural =	4.27	ft/sec	10.59	CFS
Return Period for Bankfull Discharge Q=______	New Urban =	18.24	ft/sec	45.23	
4c. Continuity Equation: a) Walker Curves u=Q/A	Rural =	1.97	ft/sec	4.88	CFS

Catchment Assessment Form R2

Rater(s): KMV

Date: 1/17/20

Overall Catchment Condition	**F**
Restoration Potential	**Level 3 - Geomorphology**

Purpose: This form is used to determine the project's restoration potential.

CATCHMENT ASSESSMENT

	Categories	Description of Catchment Condition			Rating (P/F/G)
		Poor	Fair	Good	
1	Concentrated Flow (Hydrology)	Potential for concentrated flow/impairments immediately upstream of the project and no treatments are in place	Some potential for concentrated flow/impairments to reach restoration site, however, measures are in place to protect resources	No potential for concentrated flow/impairments from adjacent land use	F
2	Impervious cover (Hydrology)	Greater than 25%	Between 10% and 25%	Less than 10%	G
3	Land Use Change (Hydrology)	Rapidly urbanizing/urban	Single family homes/suburban	Rural communities/slow growth or primarily forested	G
4	Distance to Roads (Hydrology)	Roads located in or adjacent to project reach and/or major roads proposed in 10 year DOT plans	No roads in or adjacent to project reach. No more than one major road proposed in 10 year DOT plans.	No roads in or adjacent to project reach. No proposed roads in 10 year DOT plans.	F
5	Percent Forested (Hydrology)	<= 20%	>20% and <70%	>=70%	F
6	Riparian Vegetation (Geomorphology)	<50% of contributing stream length has > 25 ft corridor width	50-80% of contributing stream length has > 25 ft corridor width	>80% of contributing stream length has > 25 ft corridor width	F
7	Sediment Supply (Geomorphology)	High sediment supply from upstream bank erosion and surface runoff	Moderate sediment supply from upstream bank erosion and surface runoff	Low sediment supply. Upstream bank erosion and surface runoff is minimal	F
8	Located on or downstream of a 303(d) listed stream TMDL list (Physicochemical)	On, upstream, or downstream of 303(d) and no TMDL/WS Mgmt plan to address deficiencies	On, upstream, or downstream of 303(d) and TMDL/WS Mgmt plan addressing deficiencies	Not on 303(d) list	G
9	Agricultural Land Use (Physicochemical)	Livestock access to stream and/or intensive cropland immediately upstream of project reach.	Livestock access to stream and/or intensive cropland upstream of project reach. A sufficient reach of stream is between Ag. land use and project reach.	There is little to no agricultural land uses or the livestock or cropland is far enough away from project reach to cause no impact to water quality or biology.	P
10	NPDES Permits (Physicochemical)	Many NPDES permits within catchment or some within one mile of project reach	A few NPDES permits within catchment and none within one mile of project reach	No NPDES permits within catchment and none within one mile of project reach	G
11	Specific Conductance (uS/cm at 25oC) (Physicochemical)	Piedmont = >229; Blue Ridge = >66	Piedmont = 78-229; Blue Ridge = 41-66	Piedmont = <78; Blue Ridge = <41	-
12	Watershed impoundments (Biology)	Impoundment(s) located within 1 mile upstream or downstream of project area and/or has a negative effect on project area and fish passage	No impoundment within 1 mile upstream or downstream of project area OR impoundment does not adversely affect project area but a blockage could exist outside of 1 mile and impact fish passage	No impoundment upstream or downstream of project area OR impoundment provides beneficial effect on project area and allows for fish passage	P
13	Organism Recruitment (Biology)	Channel immediately upstream or downstream of project reach is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach has native bed and bank material, but is impaired.	Channel immediately upstream or downstream of project reach has native bed and bank material.	F
14	Percent of Catchment being Enhanced or Restored	Less than 40% of the total catchment area is draining to the project reach.	40 to 60% of the total catchment area is draining to the project reach.	Greater than 60% of the total catchment area is draining to the project reach.	G
15	Other				

Site Information and Performance Standard Stratification

Project Name:	Odells House
Reach ID:	R2
Restoration Potential:	Level 3 - Geomorphology
Existing Stream Type:	C
Proposed Stream Type:	C
Region:	Piedmont
Drainage Area (sqmi):	0.1
Proposed Bed Material:	Sand
Existing Stream Length (ft)	593
Proposed Stream Length (ft):	593
Stream Slope (%):	1.8
Flow Type:	Perennial
River Basin:	Neuse
Stream Temperature:	Warmwater
Data Collection Season:	Fall
Valley Type:	Confined Alluvial

Notes

1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY

Exisiting Condition Score (ECS)	0.29
Proposed Condition Score (PCS)	0.38
Change in Functional Condition (PCS - ECS)	0.09
Percent Condition Change	31%
Existing Stream Length (ft)	593
Proposed Stream Length (ft)	593
Additional Stream Length (ft)	0
Existing Functional Foot Score (FFS)	172
Proposed Functional Foot Score (FFS)	225
Proposed FFS - Existing FFS	53
Functional Change (%)	31%

BMP FUNCTIONAL CHANGE SUMMARY

Existing BMP Functional Feet Score (FFS)	0
Proposed BMP Functional Feet Score (FFS)	0
Proposed BMP FFS - Existing BMP FFS	0
Functional Change (%)	

FUNCTIONAL FEET (FF) SUMMARY

Existing Stream FFS + Existing BMP FFS	172
Proposed Stream FFS + Proposed BMP FFS	225
Total Proposed FFS - Total Existing FFS	53
Functional Change (%)	31%

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydrology	Catchment Hydrology	0.30	0.30
	Reach Runoff	0.30	0.30
Hydraulics	Floodplain Connectivity	0.77	0.85
Geomorphology	Large Woody Debris		1.00
	Lateral Stability	0.82	1.00
	Riparian Vegetation	0.17	0.76
	Bed Material		
	Bed Form Diversity	0.48	1.00
	Plan Form	0.00	0.00
Physicochemical	Temperature		
	Bacteria		
	Organic Matter		
	Nitrogen		
	Phosphorus		
Biology	Macros		
	Fish		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydrology	0.30	0.30	0.00
Hydraulics	0.77	0.85	0.08
Geomorphology	0.37	0.75	0.38
Physicochemical			
Biology			

EXISTING CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.29	Not Functioning
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1.1	0.84	0.77	0.77	Functioning		
		Entrenchment Ratio	2.4	0.7					
Geomorphology	Large Woody Debris	LWD Index				0.37	Functioning At Risk		
		# Pieces							
	Lateral Stability	Erosion Rate (ft/yr)			0.82				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	10	0.64					
	Riparian Vegetation	Left Canopy Coverage (%)			0.17				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	30	0.3					
		Right Buffer Width (ft)	10	0.03					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			0.48				
		Pool Depth Ratio	1.2	0.65					
		Percent Riffle	80	0.3					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.07	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

PROPOSED CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.38	Functioning At Risk
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	0.85	0.85	Functioning		
		Entrenchment Ratio	2.4	0.7					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.75	Functioning		
		# Pieces	30	1					
	Lateral Stability	Erosion Rate (ft/yr)			1.00				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	5	1					
	Riparian Vegetation	Left Canopy Coverage (%)			0.76				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	65	0.76					
		Right Buffer Width (ft)	65	0.76					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			1.00				
		Pool Depth Ratio	2	1					
		Percent Riffle	70	1					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.1	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

Catchment Assessment Form R3

Rater(s): KMV

Date: 1/17/20

Overall Catchment Condition	**F**
Restoration Potential	**Level 3 - Geomorphology**

Purpose: This form is used to determine the project's restoration potential.

CATCHMENT ASSESSMENT

	Categories	**Description of Catchment Condition**			**Rating (P/F/G)**
		Poor	**Fair**	**Good**	
1	Concentrated Flow (Hydrology)	Potential for concentrated flow/impairments immediately upstream of the project and no treatments are in place	Some potential for concentrated flow/impairments to reach restoration site, however, measures are in place to protect resources	No potential for concentrated flow/impairments from adjacent land use	F
2	Impervious cover (Hydrology)	Greater than 25%	Between 10% and 25%	Less than 10%	G
3	Land Use Change (Hydrology)	Rapidly urbanizing/urban	Single family homes/suburban	Rural communities/slow growth or primarily forested	G
4	Distance to Roads (Hydrology)	Roads located in or adjacent to project reach and/or major roads proposed in 10 year DOT plans	No roads in or adjacent to project reach. No more than one major road proposed in 10 year DOT plans.	No roads in or adjacent to project reach. No proposed roads in 10 year DOT plans.	G
5	Percent Forested (Hydrology)	<= 20%	>20% and <70%	>=70%	F
6	Riparian Vegetation (Geomorphology)	<50% of contributing stream length has > 25 ft corridor width	50-80% of contributing stream length has > 25 ft corridor width	>80% of contributing stream length has > 25 ft corridor width	P
7	Sediment Supply (Geomorphology)	High sediment supply from upstream bank erosion and surface runoff	Moderate sediment supply from upstream bank erosion and surface runoff	Low sediment supply. Upstream bank erosion and surface runoff is minimal	F
8	Located on or downstream of a 303(d) listed stream TMDL list (Physicochemical)	On, upstream, or downstream of 303(d) and no TMDL/WS Mgmt plan to address deficiencies	On, upstream, or downstream of 303(d) and TMDL/WS Mgmt plan addressing deficiencies	Not on 303(d) list	G
9	Agricultural Land Use (Physicochemical)	Livestock access to stream and/or intensive cropland immediately upstream of project reach.	Livestock access to stream and/or intensive cropland upstream of project reach. A sufficient reach of stream is between Ag. land use and project reach.	There is little to no agricultural land uses or the livestock or cropland is far enough away from project reach to cause no impact to water quality or biology.	P
10	NPDES Permits (Physicochemical)	Many NPDES permits within catchment or some within one mile of project reach	A few NPDES permits within catchment and none within one mile of project reach	No NPDES permits within catchment and none within one mile of project reach	G
11	Specific Conductance (uS/cm at 25oC) (Physicochemical)	Piedmont = >229; Blue Ridge = >66	Piedmont = 78-229; Blue Ridge = 41-66	Piedmont = <78; Blue Ridge = <41	-
12	Watershed impoundments (Biology)	Impoundment(s) located within 1 mile upstream or downstream of project area and/or has a negative effect on project area and fish passage	No impoundment within 1 mile upstream or downstream of project area OR impoundment does not adversely affect project area but a blockage could exist outside of 1 mile and impact fish passage	No impoundment upstream or downstream of project area OR impoundment provides beneficial effect on project area and allows for fish passage	F
13	Organism Recruitment (Biology)	Channel immediately upstream or downstream of project reach is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach has native bed and bank material, but is impaired.	Channel immediately upstream or downstream of project reach has native bed and bank material.	F
14	Percent of Catchment being Enhanced or Restored	Less than 40% of the total catchment area is draining to the project reach.	40 to 60% of the total catchment area is draining to the project reach.	Greater than 60% of the total catchment area is draining to the project reach.	G
15	Other				

Site Information and Performance Standard Stratification	
Project Name:	Odells House
Reach ID:	R3
Restoration Potential:	Level 3 - Geomorphology
Existing Stream Type:	G
Proposed Stream Type:	C
Region:	Piedmont
Drainage Area (sqmi):	0.13
Proposed Bed Material:	Sand
Existing Stream Length (ft)	1169
Proposed Stream Length (ft):	1091
Stream Slope (%):	1.6
Flow Type:	Perennial
River Basin:	Neuse
Stream Temperature:	Warmwater
Data Collection Season:	Fall
Valley Type:	Confined Alluvial

Notes
1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Exisiting Condition Score (ECS)	0.27
Proposed Condition Score (PCS)	0.42
Change in Functional Condition (PCS - ECS)	0.15
Percent Condition Change	56%
Existing Stream Length (ft)	1169
Proposed Stream Length (ft)	1091
Additional Stream Length (ft)	-78
Existing Functional Foot Score (FFS)	316
Proposed Functional Foot Score (FFS)	458
Proposed FFS - Existing FFS	143
Functional Change (%)	45%

BMP FUNCTIONAL CHANGE SUMMARY	
Existing BMP Functional Feet Score (FFS)	0
Proposed BMP Functional Feet Score (FFS)	0
Proposed BMP FFS - Existing BMP FFS	0
Functional Change (%)	

FUNCTIONAL FEET (FF) SUMMARY	
Existing Stream FFS + Existing BMP FFS	316
Proposed Stream FFS + Proposed BMP FFS	458
Total Proposed FFS - Total Existing FFS	142
Functional Change (%)	45%

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydrology	Catchment Hydrology	0.30	0.30
	Reach Runoff	0.30	0.30
Hydraulics	Floodplain Connectivity	0.65	0.89
Geomorphology	Large Woody Debris		1.00
	Lateral Stability	0.40	1.00
	Riparian Vegetation	0.03	0.75
	Bed Material		
	Bed Form Diversity	0.48	1.00
	Plan Form	0.76	0.70
Physicochemical	Temperature		
	Bacteria		
	Organic Matter		
	Nitrogen		
	Phosphorus		
Biology	Macros		
	Fish		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydrology	0.30	0.30	0.00
Hydraulics	0.65	0.89	0.24
Geomorphology	0.42	0.89	0.47
Physicochemical			
Biology			

EXISTING CONDITION ASSESSMENT					Roll Up Scoring				
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.27	Not Functioning
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	0.65	0.65	Functioning At Risk		
		Entrenchment Ratio	2	0.3					
Geomorphology	Large Woody Debris	LWD Index				0.42	Functioning At Risk		
		# Pieces							
	Lateral Stability	Erosion Rate (ft/yr)			0.40				
		Dominant BEHI/NBS	M/M	0.5					
		Percent Streambank Erosion (%)	25	0.3					
	Riparian Vegetation	Left Canopy Coverage (%)			0.03				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	10	0.03					
		Right Buffer Width (ft)	10	0.03					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			0.48				
		Pool Depth Ratio	1.2	0.65					
		Percent Riffle	80	0.3					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.2	0.76	0.76				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

PROPOSED CONDITION ASSESSMENT					Roll Up Scoring				
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.42	Functioning At Risk
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	0.89	0.89	Functioning		
		Entrenchment Ratio	3	0.77					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.89	Functioning		
		# Pieces	30	1					
	Lateral Stability	Erosion Rate (ft/yr)			1.00				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	5	1					
	Riparian Vegetation	Left Canopy Coverage (%)			0.75				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	60	0.75					
		Right Buffer Width (ft)	60	0.75					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			1.00				
		Pool Depth Ratio	2	1					
		Percent Riffle	60	1					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.15	0.7	0.70				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

Catchment Assessment Form R4

Rater(s): KMV

Date: 1/17/20

Overall Catchment Condition	**F**
Restoration Potential	**Level 3 - Geomorphology**

Purpose: This form is used to determine the project's restoration potential.

CATCHMENT ASSESSMENT

Categories		Description of Catchment Condition			Rating
		Poor	**Fair**	**Good**	**(P/F/G)**
1	Concentrated Flow (Hydrology)	Potential for concentrated flow/impairments immediately upstream of the project and no treatments are in place	Some potential for concentrated flow/impairments to reach restoration site, however, measures are in place to protect resources	No potential for concentrated flow/impairments from adjacent land use	F
2	Impervious cover (Hydrology)	Greater than 25%	Between 10% and 25%	Less than 10%	G
3	Land Use Change (Hydrology)	Rapidly urbanizing/urban	Single family homes/suburban	Rural communities/slow growth or primarily forested	G
4	Distance to Roads (Hydrology)	Roads located in or adjacent to project reach and/or major roads proposed in 10 year DOT plans	No roads in or adjacent to project reach. No more than one major road proposed in 10 year DOT plans.	No roads in or adjacent to project reach. No proposed roads in 10 year DOT plans.	G
5	Percent Forested (Hydrology)	<= 20%	>20% and <70%	>=70%	F
6	Riparian Vegetation (Geomorphology)	<50% of contributing stream length has > 25 ft corridor width	50-80% of contributing stream length has > 25 ft corridor width	>80% of contributing stream length has > 25 ft corridor width	P
7	Sediment Supply (Geomorphology)	High sediment supply from upstream bank erosion and surface runoff	Moderate sediment supply from upstream bank erosion and surface runoff	Low sediment supply. Upstream bank erosion and surface runoff is minimal	F
8	Located on or downstream of a 303(d) listed stream TMDL list (Physicochemical)	On, upstream, or downstream of 303(d) and no TMDL/WS Mgmt plan to address deficiencies	On, upstream, or downstream of 303(d) and TMDL/WS Mgmt plan addressing deficiencies	Not on 303(d) list	G
9	Agricultural Land Use (Physicochemical)	Livestock access to stream and/or intensive cropland immediately upstream of project reach.	Livestock access to stream and/or intensive cropland upstream of project reach. A sufficient reach of stream is between Ag. land use and project reach.	There is little to no agricultural land uses or the livestock or cropland is far enough away from project reach to cause no impact to water quality or biology.	P
10	NPDES Permits (Physicochemical)	Many NPDES permits within catchment or some within one mile of project reach	A few NPDES permits within catchment and none within one mile of project reach	No NPDES permits within catchment and none within one mile of project reach	G
11	Specific Conductance (uS/cm at 25oC) (Physicochemical)	Piedmont = >229; Blue Ridge = >66	Piedmont = 78-229; Blue Ridge = 41-66	Piedmont = <78; Blue Ridge = <41	-
12	Watershed impoundments (Biology)	Impoundment(s) located within 1 mile upstream or downstream of project area and/or has a negative effect on project area and fish passage	No impoundment within 1 mile upstream or downstream of project area OR impoundment does not adversely affect project area but a blockage could exist outside of 1 mile and impact fish passage	No impoundment upstream or downstream of project area OR impoundment provides beneficial effect on project area and allows for fish passage	F
13	Organism Recruitment (Biology)	Channel immediately upstream or downstream of project reach is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach has native bed and bank material, but is impaired.	Channel immediately upstream or downstream of project reach has native bed and bank material.	F
14	Percent of Catchment being Enhanced or Restored	Less than 40% of the total catchment area is draining to the project reach.	40 to 60% of the total catchment area is draining to the project reach.	Greater than 60% of the total catchment area is draining to the project reach.	G
15	Other				

Site Information and Performance Standard Stratification	
Project Name:	Odells House
Reach ID:	R4
Restoration Potential:	Level 3 - Geomorphology
Existing Stream Type:	G
Proposed Stream Type:	C
Region:	Piedmont
Drainage Area (sqmi):	0.15
Proposed Bed Material:	Sand
Existing Stream Length (ft)	341
Proposed Stream Length (ft):	341
Stream Slope (%):	1.1
Flow Type:	Perennial
River Basin:	Neuse
Stream Temperature:	Warmwater
Data Collection Season:	Fall
Valley Type:	Confined Alluvial

Notes
1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Exisiting Condition Score (ECS)	0.32
Proposed Condition Score (PCS)	0.42
Change in Functional Condition (PCS - ECS)	0.10
Percent Condition Change	31%
Existing Stream Length (ft)	341
Proposed Stream Length (ft)	341
Additional Stream Length (ft)	0
Existing Functional Foot Score (FFS)	109
Proposed Functional Foot Score (FFS)	143
Proposed FFS - Existing FFS	34
Functional Change (%)	31%

BMP FUNCTIONAL CHANGE SUMMARY	
Existing BMP Functional Feet Score (FFS)	0
Proposed BMP Functional Feet Score (FFS)	0
Proposed BMP FFS - Existing BMP FFS	0
Functional Change (%)	

FUNCTIONAL FEET (FF) SUMMARY	
Existing Stream FFS + Existing BMP FFS	109
Proposed Stream FFS + Proposed BMP FFS	143
Total Proposed FFS - Total Existing FFS	34
Functional Change (%)	31%

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydrology	Catchment Hydrology	0.30	0.30
	Reach Runoff	0.30	0.30
Hydraulics	Floodplain Connectivity	0.85	0.89
Geomorphology	Large Woody Debris		1.00
	Lateral Stability	0.82	1.00
	Riparian Vegetation	0.50	0.88
	Bed Material		
	Bed Form Diversity	0.48	1.00
	Plan Form	0.00	0.70
Physicochemical	Temperature		
	Bacteria		
	Organic Matter		
	Nitrogen		
	Phosphorus		
Biology	Macros		
	Fish		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydrology	0.30	0.30	0.00
Hydraulics	0.85	0.89	0.04
Geomorphology	0.45	0.92	0.47
Physicochemical			
Biology			

EXISTING CONDITION ASSESSMENT					Roll Up Scoring				
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.32	Functioning At Risk
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1.2	0.7	0.85	0.85	Functioning		
		Entrenchment Ratio	7.3	1					
Geomorphology	Large Woody Debris	LWD Index				0.45	Functioning At Risk		
		# Pieces							
	Lateral Stability	Erosion Rate (ft/yr)			0.82				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	10	0.64					
	Riparian Vegetation	Left Canopy Coverage (%)			0.50				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	150	1					
		Right Buffer Width (ft)	5	0					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			0.48				
		Pool Depth Ratio	1.2	0.65					
		Percent Riffle	80	0.3					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.1	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

PROPOSED CONDITION ASSESSMENT					Roll Up Scoring				
Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.42	Functioning At Risk
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	0.89	0.89	Functioning		
		Entrenchment Ratio	3	0.77					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.92	Functioning		
		# Pieces	30	1					
	Lateral Stability	Erosion Rate (ft/yr)			1.00				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	5	1					
	Riparian Vegetation	Left Canopy Coverage (%)			0.88				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	150	1					
		Right Buffer Width (ft)	60	0.75					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			1.00				
		Pool Depth Ratio	2	1					
		Percent Riffle	60	1					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.15	0.7	0.70				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

Catchment Assessment Form R6

Rater(s): KMV

Date: 1/17/20

Overall Catchment Condition	**F**
Restoration Potential	**Level 3 - Geomorphology**

Purpose: This form is used to determine the project's restoration potential.

CATCHMENT ASSESSMENT

	Categories	Description of Catchment Condition			Rating
		Poor	**Fair**	**Good**	**(P/F/G)**
1	Concentrated Flow (Hydrology)	Potential for concentrated flow/impairments immediately upstream of the project and no treatments are in place	Some potential for concentrated flow/impairments to reach restoration site, however, measures are in place to protect resources	No potential for concentrated flow/impairments from adjacent land use	F
2	Impervious cover (Hydrology)	Greater than 25%	Between 10% and 25%	Less than 10%	G
3	Land Use Change (Hydrology)	Rapidly urbanizing/urban	Single family homes/suburban	Rural communities/slow growth or primarily forested	G
4	Distance to Roads (Hydrology)	Roads located in or adjacent to project reach and/or major roads proposed in 10 year DOT plans	No roads in or adjacent to project reach. No more than one major road proposed in 10 year DOT plans.	No roads in or adjacent to project reach. No proposed roads in 10 year DOT plans.	F
5	Percent Forested (Hydrology)	<= 20%	>20% and <70%	>=70%	F
6	Riparian Vegetation (Geomorphology)	<50% of contributing stream length has > 25 ft corridor width	50-80% of contributing stream length has > 25 ft corridor width	>80% of contributing stream length has > 25 ft corridor width	P
7	Sediment Supply (Geomorphology)	High sediment supply from upstream bank erosion and surface runoff	Moderate sediment supply from upstream bank erosion and surface runoff	Low sediment supply. Upstream bank erosion and surface runoff is minimal	F
8	Located on or downstream of a 303(d) listed stream TMDL list (Physicochemical)	On, upstream, or downstream of 303(d) and no TMDL/WS Mgmt plan to address deficiencies	On, upstream, or downstream of 303(d) and TMDL/WS Mgmt plan addressing deficiencies	Not on 303(d) list	G
9	Agricultural Land Use (Physicochemical)	Livestock access to stream and/or intensive cropland immediately upstream of project reach.	Livestock access to stream and/or intensive cropland upstream of project reach. A sufficient reach of stream is between Ag. land use and project reach.	There is little to no agricultural land uses or the livestock or cropland is far enough away from project reach to cause no impact to water quality or biology.	P
10	NPDES Permits (Physicochemical)	Many NPDES permits within catchment or some within one mile of project reach	A few NPDES permits within catchment and none within one mile of project reach	No NPDES permits within catchment and none within one mile of project reach	G
11	Specific Conductance (uS/cm at 25oC) (Physicochemical)	Piedmont = >229; Blue Ridge = >66	Piedmont = 78-229; Blue Ridge = 41-66	Piedmont = <78; Blue Ridge = <41	-
12	Watershed impoundments (Biology)	Impoundment(s) located within 1 mile upstream or downstream of project area and/or has a negative effect on project area and fish passage	No impoundment within 1 mile upstream or downstream of project area OR impoundment does not adversely affect project area but a blockage could exist outside of 1 mile and impact fish passage	No impoundment upstream or downstream of project area OR impoundment provides beneficial effect on project area and allows for fish passage	P
13	Organism Recruitment (Biology)	Channel immediately upstream or downstream of project reach is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach has native bed and bank material, but is impaired.	Channel immediately upstream or downstream of project reach has native bed and bank material.	F
14	Percent of Catchment being Enhanced or Restored	Less than 40% of the total catchment area is draining to the project reach.	40 to 60% of the total catchment area is draining to the project reach.	Greater than 60% of the total catchment area is draining to the project reach.	G
15	Other				

Site Information and Performance Standard Stratification	
Project Name:	Odells House
Reach ID:	R6
Restoration Potential:	Level 3 - Geomorphology
Existing Stream Type:	E
Proposed Stream Type:	E
Region:	Piedmont
Drainage Area (sqmi):	0.05
Proposed Bed Material:	Sand
Existing Stream Length (ft)	821
Proposed Stream Length (ft):	1091
Stream Slope (%):	1.5
Flow Type:	Perennial
River Basin:	Neuse
Stream Temperature:	Warmwater
Data Collection Season:	Fall
Valley Type:	Confined Alluvial

Notes
1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Exisiting Condition Score (ECS)	0.19
Proposed Condition Score (PCS)	0.41
Change in Functional Condition (PCS - ECS)	0.22
Percent Condition Change	116%
Existing Stream Length (ft)	821
Proposed Stream Length (ft)	1091
Additional Stream Length (ft)	270
Existing Functional Foot Score (FFS)	156
Proposed Functional Foot Score (FFS)	447
Proposed FFS - Existing FFS	291
Functional Change (%)	187%

BMP FUNCTIONAL CHANGE SUMMARY	
Existing BMP Functional Feet Score (FFS)	0
Proposed BMP Functional Feet Score (FFS)	0
Proposed BMP FFS - Existing BMP FFS	0
Functional Change (%)	

FUNCTIONAL FEET (FF) SUMMARY	
Existing Stream FFS + Existing BMP FFS	156
Proposed Stream FFS + Proposed BMP FFS	447
Total Proposed FFS - Total Existing FFS	291
Functional Change (%)	187%

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydrology	Catchment Hydrology	0.30	0.30
	Reach Runoff	0.30	0.30
Hydraulics	Floodplain Connectivity	0.50	1.00
Geomorphology	Large Woody Debris	0.02	1.00
	Lateral Stability	0.52	1.00
	Riparian Vegetation	0.07	0.75
	Bed Material		
	Bed Form Diversity	0.15	1.00
	Plan Form	0.00	0.00
Physicochemical	Temperature		
	Bacteria		
	Organic Matter		
	Nitrogen		
	Phosphorus		
Biology	Macros		
	Fish		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydrology	0.30	0.30	0.00
Hydraulics	0.50	1.00	0.50
Geomorphology	0.15	0.75	0.60
Physicochemical			
Biology			

EXISTING CONDITION ASSESSMENT / **Roll Up Scoring**

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.19	Not Functioning
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	2.3	0	0.50	0.50	Functioning At Risk		
		Entrenchment Ratio	12.9	1					
Geomorphology	Large Woody Debris	LWD Index			0.02	0.15	Not Functioning		
		# Pieces	3	0.02					
	Lateral Stability	Erosion Rate (ft/yr)			0.52				
		Dominant BEHI/NBS	M/L	0.6					
		Percent Streambank Erosion (%)	15	0.44					
	Riparian Vegetation	Left Canopy Coverage (%)			0.07				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	15	0.07					
		Right Buffer Width (ft)	15	0.07					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			0.15				
		Pool Depth Ratio	1	0					
		Percent Riffle	80	0.3					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.05	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

PROPOSED CONDITION ASSESSMENT / **Roll Up Scoring**

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	70	0.3	0.30	0.30	Functioning At Risk	0.41	Functioning At Risk
	Reach Runoff	Curve Number	70	0.3	0.30				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	1.00	1.00	Functioning		
		Entrenchment Ratio	5	1					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.75	Functioning		
		# Pieces	30	1					
	Lateral Stability	Erosion Rate (ft/yr)			1.00				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	5	1					
	Riparian Vegetation	Left Canopy Coverage (%)			0.75				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	60	0.75					
		Right Buffer Width (ft)	60	0.75					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			1.00				
		Pool Depth Ratio	2	1					
		Percent Riffle	70	1					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.12	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

Catchment Assessment Form R7 upper

Rater(s): KMV

Date: 1/17/20

Overall Catchment Condition	**F**
Restoration Potential	**Level 3 - Geomorphology**

Purpose: This form is used to determine the project's restoration potential.

CATCHMENT ASSESSMENT

	Categories	Description of Catchment Condition: Poor	Fair	Good	Rating (P/F/G)
1	Concentrated Flow (Hydrology)	Potential for concentrated flow/impairments immediately upstream of the project and no treatments are in place	Some potential for concentrated flow/impairments to reach restoration site, however, measures are in place to protect resources	No potential for concentrated flow/impairments from adjacent land use	G
2	Impervious cover (Hydrology)	Greater than 25%	Between 10% and 25%	Less than 10%	G
3	Land Use Change (Hydrology)	Rapidly urbanizing/urban	Single family homes/suburban	Rural communities/slow growth or primarily forested	G
4	Distance to Roads (Hydrology)	Roads located in or adjacent to project reach and/or major roads proposed in 10 year DOT plans	No roads in or adjacent to project reach. No more than one major road proposed in 10 year DOT plans.	No roads in or adjacent to project reach. No proposed roads in 10 year DOT plans.	G
5	Percent Forested (Hydrology)	<= 20%	>20% and <70%	>=70%	G
6	Riparian Vegetation (Geomorphology)	<50% of contributing stream length has > 25 ft corridor width	50-80% of contributing stream length has > 25 ft corridor width	>80% of contributing stream length has > 25 ft corridor width	G
7	Sediment Supply (Geomorphology)	High sediment supply from upstream bank erosion and surface runoff	Moderate sediment supply from upstream bank erosion and surface runoff	Low sediment supply. Upstream bank erosion and surface runoff is minimal	G
8	Located on or downstream of a 303(d) listed stream TMDL list (Physicochemical)	On, upstream, or downstream of 303(d) and no TMDL/WS Mgmt plan to address deficiencies	On, upstream, or downstream of 303(d) and TMDL/WS Mgmt plan addressing deficiencies	Not on 303(d) list	G
9	Agricultural Land Use (Physicochemical)	Livestock access to stream and/or intensive cropland immediately upstream of project reach.	Livestock access to stream and/or intensive cropland upstream of project reach. A sufficient reach of stream is between Ag. land use and project reach.	There is little to no agricultural land uses or the livestock or cropland is far enough away from project reach to cause no impact to water quality or biology.	F
10	NPDES Permits (Physicochemical)	Many NPDES permits within catchment or some within one mile of project reach	A few NPDES permits within catchment and none within one mile of project reach	No NPDES permits within catchment and none within one mile of project reach	G
11	Specific Conductance (uS/cm at 25oC) (Physicochemical)	Piedmont = >229; Blue Ridge = >66	Piedmont = 78-229; Blue Ridge = 41-66	Piedmont = <78; Blue Ridge = <41	-
12	Watershed impoundments (Biology)	Impoundment(s) located within 1 mile upstream or downstream of project area and/or has a negative effect on project area and fish passage	No impoundment within 1 mile upstream or downstream of project area OR impoundment does not adversely affect project area but a blockage could exist outside of 1 mile and impact fish passage	No impoundment upstream or downstream of project area OR impoundment provides beneficial effect on project area and allows for fish passage	G
13	Organism Recruitment (Biology)	Channel immediately upstream or downstream of project reach is concrete, piped, or hardened.	Channel immediately upstream or downstream of project reach has native bed and bank material, but is impaired.	Channel immediately upstream or downstream of project reach has native bed and bank material.	F
14	Percent of Catchment being Enhanced or Restored	Less than 40% of the total catchment area is draining to the project reach.	40 to 60% of the total catchment area is draining to the project reach.	Greater than 60% of the total catchment area is draining to the project reach.	G
15	Other				

Site Information and Performance Standard Stratification	
Project Name:	Odells House
Reach ID:	R7 upper
Restoration Potential:	Level 3 - Geomorphology
Existing Stream Type:	G
Proposed Stream Type:	Bc
Region:	Piedmont
Drainage Area (sqmi):	0.063
Proposed Bed Material:	Sand
Existing Stream Length (ft)	461
Proposed Stream Length (ft):	623
Stream Slope (%):	1.2
Flow Type:	Perennial
River Basin:	Neuse
Stream Temperature:	Warmwater
Data Collection Season:	Fall
Valley Type:	Unconfined Alluvial

Notes
1. Users input values that are highlighted based on restoration potential
2. Users select values from a pull-down menu
3. Leave values blank for field values that were not measured

FUNCTIONAL CHANGE SUMMARY	
Exisiting Condition Score (ECS)	0.31
Proposed Condition Score (PCS)	0.45
Change in Functional Condition (PCS - ECS)	0.14
Percent Condition Change	45%
Existing Stream Length (ft)	461
Proposed Stream Length (ft)	623
Additional Stream Length (ft)	162
Existing Functional Foot Score (FFS)	143
Proposed Functional Foot Score (FFS)	280
Proposed FFS - Existing FFS	137
Functional Change (%)	96%

BMP FUNCTIONAL CHANGE SUMMARY	
Existing BMP Functional Feet Score (FFS)	0
Proposed BMP Functional Feet Score (FFS)	0
Proposed BMP FFS - Existing BMP FFS	0
Functional Change (%)	

FUNCTIONAL FEET (FF) SUMMARY	
Existing Stream FFS + Existing BMP FFS	143
Proposed Stream FFS + Proposed BMP FFS	280
Total Proposed FFS - Total Existing FFS	137
Functional Change (%)	96%

FUNCTION BASED PARAMETERS SUMMARY

Functional Category	Function-Based Parameters	Existing Parameter	Proposed Parameter
Hydrology	Catchment Hydrology	0.45	0.45
	Reach Runoff	0.45	0.45
Hydraulics	Floodplain Connectivity	0.62	1.00
Geomorphology	Large Woody Debris		1.00
	Lateral Stability	0.82	1.00
	Riparian Vegetation	1.00	1.00
	Bed Material		
	Bed Form Diversity	0.00	1.00
	Plan Form	0.00	0.00
Physicochemical	Temperature		
	Bacteria		
	Organic Matter		
	Nitrogen		
	Phosphorus		
Biology	Macros		
	Fish		

FUNCTIONAL CATEGORY REPORT CARD

Functional Category	ECS	PCS	Functional Change
Hydrology	0.45	0.45	0.00
Hydraulics	0.62	1.00	0.38
Geomorphology	0.46	0.80	0.34
Physicochemical			
Biology			

EXISTING CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	65	0.45	0.45	0.45	Functioning At Risk	0.31	Functioning At Risk
	Reach Runoff	Curve Number	65	0.45	0.45				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1.5	0.31	0.62	0.62	Functioning At Risk		
		Entrenchment Ratio	2	0.93					
Geomorphology	Large Woody Debris	LWD Index				0.46	Functioning At Risk		
		# Pieces							
	Lateral Stability	Erosion Rate (ft/yr)			0.82				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	10	0.64					
	Riparian Vegetation	Left Canopy Coverage (%)			1.00				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	100	1					
		Right Buffer Width (ft)	100	1					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			0.00				
		Pool Depth Ratio	1	0					
		Percent Riffle	90	0					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.02	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

PROPOSED CONDITION ASSESSMENT / Roll Up Scoring

Functional Category	Function-Based Parameters	Measurement Method	Field Value	Index Value	Parameter	Category	Category	Overall	Overall
Hydrology	Catchment Hydrology	Curve Number	65	0.45	0.45	0.45	Functioning At Risk	0.45	Functioning At Risk
	Reach Runoff	Curve Number	65	0.45	0.45				
		Concentrated Flow Points							
		Soil Compaction							
Hydraulics	Floodplain Connectivity	Bank Height Ratio	1	1	1.00	1.00	Functioning		
		Entrenchment Ratio	5	1					
Geomorphology	Large Woody Debris	LWD Index			1.00	0.80	Functioning		
		# Pieces	30	1					
	Lateral Stability	Erosion Rate (ft/yr)			1.00				
		Dominant BEHI/NBS	L/L	1					
		Percent Streambank Erosion (%)	5	1					
	Riparian Vegetation	Left Canopy Coverage (%)			1.00				
		Right Canopy Coverage (%)							
		Left Buffer Width (ft)	100	1					
		Right Buffer Width (ft)	100	1					
		Left Basal Area (sq.ft/acre)							
		Right Basal Area (sq.ft/acre)							
		Left Stem Density (stems/acre)							
		Right Stem Density (stems/acre)							
	Bed Material Characterization	Size Class Pebble Count Analyzer (p-value							
	Bed Form Diversity	Pool Spacing Ratio			1.00				
		Pool Depth Ratio	2	1					
		Percent Riffle	70	1					
		Aggradation Ratio							
	Plan Form	Sinuosity	1.1	0	0.00				
Physicochemical	Temperature	Summer Daily Maximum (°F)							
	Bacteria	Fecal Coliform (Cfu/100 ml)							
	Organic Carbon	Leaf Litter Processing Rate							
		Percent Shredders							
	Nitrogen	Total Nitrogen (mg/L)							
	Phosphorus	Total Phosphorus (mg/L)							
Biology	Macros	Biotic Index							
		EPT Taxa Present							
	Fish	North Carolina Index of Biotic Integrity							

Odells House R1	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	429	
Drainage Area, DA (sq mi)	0.0670	
Stream Type (Rosgen)	C4	
Bankfull Discharge, Qbkf (cfs)	11.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	3.15	
Bankfull Mean Velocity, Vbkf (ft/s)	3.49	
Bankfull Riffle Width, Wbkf (ft)	6.00	
Bankfull Mean Depth, Dbkf (ft)	0.53	
Width to Depth Ratio, W/D (ft/ft)	11.43	
Width of Floodprone Area, Wfpa (ft)	52.00	115.00
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	8.67	19.17
Riffle Max Depth @ bkf, Dmax (ft)	0.70	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.33	
Max Depth @ tob, Dmaxtob (ft)	0.70	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	42.00	72.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	12.00	18.00
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	21.00	48.00
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	3.50	8.00
Sinuosity, K (Sval/Schan)	1.08	
Valley Slope, Sval (ft/ft)	0.0096	
Channel Slope, Schan (ft/ft)	0.0089	
Riffle Slope, Srif	0.0134	0.0178
Riffle Slope Ratio, Srif/Schan	1.50	2.00
Pool Slope, Spool (ft/ft)	0.0000	0.0018
Pool Slope Ratio, Spool/Schan	0.00	0.20
Pool Max Depth @ bkf, Dmaxpool (ft)	1.05	1.84
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	7.80	10.20
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.30	1.70
Pool Spacing, Lps (ft)	24.00	42.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	4.00	7.00

Existing Geomorphic Stream Characteristics

Odells House R2	**Existing Stream Values-Riffle Cross Section XS4**	
Parameter	**MIN**	**MAX**
Stream Length (ft)	593	
Drainage Area, DA (sq mi)	0.1000	
Stream Type (Rosgen)	C5	
Bankfull Discharge, Qbkf (cfs)	14.46	
Bankfull Riffle XSEC Area, Abkf (sq ft)	3.69	
Bankfull Mean Velocity, Vbkf (ft/s)	3.92	
Bankfull Riffle Width, Wbkf (ft)	11.03	
Bankfull Mean Depth, Dbkf (ft)	0.33	
Width to Depth Ratio, W/D (ft/ft)	32.97	
Width of Floodprone Area, Wfpa (ft)	26.97	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	2.45	
Riffle Max Depth @ bkf, Dmax (ft)	0.70	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	2.09	
Max Depth @ tob, Dmaxtob (ft)	0.70	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)	NA	NA
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)	NA	NA
Radius of Curvature, Rc (ft)	3.80	13.20
Rc Ratio, Rc/Wbkf (ft/ft)	0.34	1.20
Belt Width, Wblt (ft)	17.00	24.70
Meander Width Ratio, Wblt/Wbkf (ft/ft)	1.54	2.24
Sinuosity, K (Sval/Schan)	1.07	
Valley Slope, Sval (ft/ft)	0.0179	
Channel Slope, Schan (ft/ft)	0.0168	
Riffle Slope, Srif	0.0083	0.0161
Riffle Slope Ratio, Srif/Schan	0.49	0.96
Pool Slope, Spool (ft/ft)	0.0000	0.0000
Pool Slope Ratio, Spool/Schan	0.00	0.00
Pool Max Depth @ bkf, Dmaxpool (ft)	0.90	2.30
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.69	6.88
Pool Width, Wpool (ft)	3.20	5.50
Pool Width Ratio, Wpool/Wbkf (ft/ft)	0.29	0.50
Pool Spacing, Lps (ft)	24.00	58.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	2.18	5.26
d16 (mm)[4]	coarse sand	
d35 (mm)[4]	coarse sand	
d50 (mm)[4]	coarse sand	
d84 (mm)$_4$	coarse sand	
d95 (mm)[4]	coarse sand	

Odells House R2	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	658	
Drainage Area, DA (sq mi)	0.1000	
Stream Type (Rosgen)	C5	
Bankfull Discharge, Qbkf (cfs)	14.46	
Bankfull Riffle XSEC Area, Abkf (sq ft)	4.20	
Bankfull Mean Velocity, Vbkf (ft/s)	3.44	
Bankfull Riffle Width, Wbkf (ft)	8.00	
Bankfull Mean Depth, Dbkf (ft)	0.53	
Width to Depth Ratio, W/D (ft/ft)	15.24	
Width of Floodprone Area, Wfpa (ft)	NA	NA
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	NA	NA
Riffle Max Depth @ bkf, Dmax (ft)	0.70	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.33	
Max Depth @ tob, Dmaxtob (ft)	0.70	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	NA	NA
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	NA	NA
Radius of Curvature, Rc (ft)*	NA	NA
Rc Ratio, Rc/Wbkf (ft/ft)*	NA	NA
Belt Width, Wblt (ft)*	NA	NA
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	NA	NA
Sinuosity, K (Sval/Schan)	1.18	
Valley Slope, Sval (ft/ft)	0.0179	
Channel Slope, Schan (ft/ft)	0.0151	
Riffle Slope, Srif	0.0227	0.0302
Riffle Slope Ratio, Srif/Schan	1.50	2.00
Pool Slope, Spool (ft/ft)	0.0000	0.0030
Pool Slope Ratio, Spool/Schan	0.00	0.20
Pool Max Depth @ bkf, Dmaxpool (ft)	1.05	1.84
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	10.40	13.60
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.30	1.70
Pool Spacing, Lps (ft)	32.00	56.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	4.00	7.00

Odells House R3	Existing Stream Values-Riffle Cross Section XS5	
Parameter	**MIN**	**MAX**
Stream Length (ft)	1106	
Drainage Area, DA (sq mi)	0.1300	
Stream Type (Rosgen)	B5c	
Bankfull Discharge, Qbkf (cfs)	20.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	5.62	
Bankfull Mean Velocity, Vbkf (ft/s)	3.56	
Bankfull Riffle Width, Wbkf (ft)	5.70	
Bankfull Mean Depth, Dbkf (ft)	0.99	
Width to Depth Ratio, W/D (ft/ft)	5.78	
Width of Floodprone Area, Wfpa (ft)	11.52	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	2.02	
Riffle Max Depth @ bkf, Dmax (ft)	1.35	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.37	
Max Depth @ tob, Dmaxtob (ft)	1.35	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)	34.00	61.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)	5.96	10.70
Radius of Curvature, Rc (ft)	3.60	20.30
Rc Ratio, Rc/Wbkf (ft/ft)	0.63	3.56
Belt Width, Wblt (ft)	22.30	43.60
Meander Width Ratio, Wblt/Wbkf (ft/ft)	3.91	7.65
Sinuosity, K (Sval/Schan)	1.20	
Valley Slope, Sval (ft/ft)	0.0159	
Channel Slope, Schan (ft/ft)	0.0133	
Riffle Slope, Srif	0.0100	0.0320
Riffle Slope Ratio, Srif/Schan	0.75	2.40
Pool Slope, Spool (ft/ft)	0.0000	0.0000
Pool Slope Ratio, Spool/Schan	0.00	0.00
Pool Max Depth @ bkf, Dmaxpool (ft)	1.50	3.80
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	1.52	3.85
Pool Width, Wpool (ft)	4.70	7.70
Pool Width Ratio, Wpool/Wbkf (ft/ft)	0.82	1.35
Pool Spacing, Lps (ft)	33.00	90.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	5.79	15.79
d16 (mm)[4]	coarse sand	
d35 (mm)[4]	coarse sand	
d50 (mm)[4]	coarse sand	
d84 (mm)[4]	coarse sand	
d95 (mm)[4]	coarse sand	

Odells House R3	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	1091	
Drainage Area, DA (sq mi)	0.1300	
Stream Type (Rosgen)	B4	
Bankfull Discharge, Qbkf (cfs)	20.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	4.80	
Bankfull Mean Velocity, Vbkf (ft/s)	4.17	
Bankfull Riffle Width, Wbkf (ft)	8.00	
Bankfull Mean Depth, Dbkf (ft)	0.60	
Width to Depth Ratio, W/D (ft/ft)	13.33	
Width of Floodprone Area, Wfpa (ft)	25.00	30.00
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	3.13	3.75
Riffle Max Depth @ bkf, Dmax (ft)	0.80	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.33	
Max Depth @ tob, Dmaxtob (ft)	0.80	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	56.00	96.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	16.00	24.00
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	28.00	64.00
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	3.50	8.00
Sinuosity, K (Sval/Schan)	1.12	
Valley Slope, Sval (ft/ft)	0.0159	
Channel Slope, Schan (ft/ft)	0.0142	
Riffle Slope, Srif	0.0156	0.0256
Riffle Slope Ratio, Srif/Schan	1.10	1.80
Pool Slope, Spool (ft/ft)	0.0000	0.0057
Pool Slope Ratio, Spool/Schan	0.00	0.40
Pool Max Depth @ bkf, Dmaxpool (ft)	1.20	2.10
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	8.80	12.00
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.10	1.50
Pool Spacing, Lps (ft)	12.00	40.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	1.50	5.00

Odells House R4	Existing Stream Values-Riffle Cross Section XS6	
Parameter	**MIN**	**MAX**
Stream Length (ft)	440	
Drainage Area, DA (sq mi)	0.1500	
Stream Type (Rosgen)	E5	
Bankfull Discharge, Qbkf (cfs)	21.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	5.62	
Bankfull Mean Velocity, Vbkf (ft/s)	3.74	
Bankfull Riffle Width, Wbkf (ft)	5.49	
Bankfull Mean Depth, Dbkf (ft)	1.02	
Width to Depth Ratio, W/D (ft/ft)	5.36	
Width of Floodprone Area, Wfpa (ft)	40.00	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	7.29	
Riffle Max Depth @ bkf, Dmax (ft)	1.30	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.27	
Max Depth @ tob, Dmaxtob (ft)	1.60	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.23	
Meander Wavelength, Lm (ft)	NA	NA
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)	NA	NA
Radius of Curvature, Rc (ft)	7.80	20.40
Rc Ratio, Rc/Wbkf (ft/ft)	1.42	3.72
Belt Width, Wblt (ft)	11.50	22.70
Meander Width Ratio, Wblt/Wbkf (ft/ft)	2.09	4.13
Sinuosity, K (Sval/Schan)	1.10	
Valley Slope, Sval (ft/ft)	0.0101	
Channel Slope, Schan (ft/ft)	0.0091	
Riffle Slope, Srif	0.0060	0.0205
Riffle Slope Ratio, Srif/Schan	0.66	2.24
Pool Slope, Spool (ft/ft)	0.0000	0.0000
Pool Slope Ratio, Spool/Schan	0.00	0.00
Pool Max Depth @ bkf, Dmaxpool (ft)	1.60	2.60
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	1.56	2.54
Pool Width, Wpool (ft)	4.40	8.60
Pool Width Ratio, Wpool/Wbkf (ft/ft)	0.80	1.57
Pool Spacing, Lps (ft)	65.00	77.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	11.84	14.03
d16 (mm)[4]	coarse sand	
d35 (mm)[4]	coarse sand	
d50 (mm)[4]	coarse sand	
d84 (mm)[4]	coarse sand	
d95 (mm)[4]	coarse sand	

Odells House R4	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	341	
Drainage Area, DA (sq mi)	0.1500	
Stream Type (Rosgen)	B4c	
Bankfull Discharge, Qbkf (cfs)	21.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	5.53	
Bankfull Mean Velocity, Vbkf (ft/s)	3.80	
Bankfull Riffle Width, Wbkf (ft)	9.00	
Bankfull Mean Depth, Dbkf (ft)	0.61	
Width to Depth Ratio, W/D (ft/ft)	14.66	
Width of Floodprone Area, Wfpa (ft)		
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	0.00	0.00
Riffle Max Depth @ bkf, Dmax (ft)	0.85	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.38	
Max Depth @ tob, Dmaxtob (ft)	0.85	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	63.00	108.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	18.00	27.00
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	31.50	72.00
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	3.50	8.00
Sinuosity, K (Sval/Schan)	1.12	
Valley Slope, Sval (ft/ft)	0.0101	
Channel Slope, Schan (ft/ft)	0.0090	
Riffle Slope, Srif	0.0099	0.0162
Riffle Slope Ratio, Srif/Schan	1.10	1.80
Pool Slope, Spool (ft/ft)	0.0000	0.0036
Pool Slope Ratio, Spool/Schan	0.00	0.40
Pool Max Depth @ bkf, Dmaxpool (ft)	1.23	2.15
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	9.90	13.50
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.10	1.50
Pool Spacing, Lps (ft)	13.50	45.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	1.50	5.00

Odells House R5	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	364	
Drainage Area, DA (sq mi)	0.0303	
Stream Type (Rosgen)	DA	
Bankfull Discharge, Qbkf (cfs)	10.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	1.80	
Bankfull Mean Velocity, Vbkf (ft/s)	5.56	
Bankfull Riffle Width, Wbkf (ft)	5.50	
Bankfull Mean Depth, Dbkf (ft)	0.33	
Width to Depth Ratio, W/D (ft/ft)	16.81	
Width of Floodprone Area, Wfpa (ft)	49.00	103.00
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	8.91	18.73
Riffle Max Depth @ bkf, Dmax (ft)	0.40	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.22	
Max Depth @ tob, Dmaxtob (ft)	0.40	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	38.50	66.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	11.00	16.50
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	19.25	44.00
p	3.50	8.00
Sinuosity, K (Sval/Schan)	1.08	
Valley Slope, Sval (ft/ft)	0.0083	
Channel Slope, Schan (ft/ft)	0.0077	
Riffle Slope, Srif	0.0115	0.0154
Riffle Slope Ratio, Srif/Schan	1.50	2.00
Pool Slope, Spool (ft/ft)	0.0000	0.0015
Pool Slope Ratio, Spool/Schan	0.00	0.20
Pool Max Depth @ bkf, Dmaxpool (ft)	0.65	1.15
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	1.30	1.70
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.30	1.70
Pool Spacing, Lps (ft)	22.00	38.50
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	4.00	7.00

Odells House R6	Existing Stream Values-Riffle Cross Section XS1	
Parameter	**MIN**	**MAX**
Stream Length (ft)	821	
Drainage Area, DA (sq mi)	0.0479	
Stream Type (Rosgen)	E5	
Bankfull Discharge, Qbkf (cfs)	10.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	2.48	
Bankfull Mean Velocity, Vbkf (ft/s)	4.03	
Bankfull Riffle Width, Wbkf (ft)	4.12	
Bankfull Mean Depth, Dbkf (ft)	0.60	
Width to Depth Ratio, W/D (ft/ft)	6.84	
Width of Floodprone Area, Wfpa (ft)	53.32	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	12.94	
Riffle Max Depth @ bkf, Dmax (ft)	1.13	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.88	
Max Depth @ tob, Dmaxtob (ft)	2.59	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	2.29	
Meander Wavelength, Lm (ft)	NA	NA
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)	NA	NA
Radius of Curvature, Rc (ft)	NA	NA
Rc Ratio, Rc/Wbkf (ft/ft)	NA	NA
Belt Width, Wblt (ft)	NA	NA
Meander Width Ratio, Wblt/Wbkf (ft/ft)	NA	NA
Sinuosity, K (Sval/Schan)	1.05	
Valley Slope, Sval (ft/ft)	0.0152	
Channel Slope, Schan (ft/ft)	0.0145	
Riffle Slope, Srif	0.0071	0.0207
Riffle Slope Ratio, Srif/Schan	0.49	1.43
Pool Slope, Spool (ft/ft)	0.0000	0.0000
Pool Slope Ratio, Spool/Schan	0.00	0.00
Pool Max Depth @ bkf, Dmaxpool (ft)	1.30	1.60
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.16	2.66
Pool Width, Wpool (ft)	2.70	6.70
Pool Width Ratio, Wpool/Wbkf (ft/ft)	0.66	1.63
Pool Spacing, Lps (ft)	106.00	164.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	25.73	39.81
d16 (mm)[4]	coarse sand	
d35 (mm)[4]	coarse sand	
d50 (mm)[4]	coarse sand	
d84 (mm)[4]	coarse sand	
d95 (mm)[4]	coarse sand	

Odells House R6	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	1091	
Drainage Area, DA (sq mi)	0.0479	
Stream Type (Rosgen)	B4c	
Bankfull Discharge, Qbkf (cfs)	10.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	2.38	
Bankfull Mean Velocity, Vbkf (ft/s)	4.21	
Bankfull Riffle Width, Wbkf (ft)	6.00	
Bankfull Mean Depth, Dbkf (ft)	0.40	
Width to Depth Ratio, W/D (ft/ft)	15.16	
Width of Floodprone Area, Wfpa (ft)	22.00	40.00
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	3.67	6.67
Riffle Max Depth @ bkf, Dmax (ft)	0.50	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.26	
Max Depth @ tob, Dmaxtob (ft)	0.50	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	42.00	72.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	12.00	18.00
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	21.00	48.00
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	3.50	8.00
Sinuosity, K (Sval/Schan)	1.12	
Valley Slope, Sval (ft/ft)	0.0152	
Channel Slope, Schan (ft/ft)	0.0135	
Riffle Slope, Srif	0.0149	0.0244
Riffle Slope Ratio, Srif/Schan	1.10	1.80
Pool Slope, Spool (ft/ft)	0.0000	0.0054
Pool Slope Ratio, Spool/Schan	0.00	0.40
Pool Max Depth @ bkf, Dmaxpool (ft)	0.79	1.39
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	6.60	9.00
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.10	1.50
Pool Spacing, Lps (ft)	9.00	30.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	1.50	5.00

Odells House R7	Proposed Stream Values (Restoration)	
Parameter	**MIN**	**MAX**
Stream Length (ft)	623	
Drainage Area, DA (sq mi)	0.0653	
Stream Type (Rosgen)	B5c	
Bankfull Discharge, Qbkf (cfs)	10.00	
Bankfull Riffle XSEC Area, Abkf (sq ft)	2.38	
Bankfull Mean Velocity, Vbkf (ft/s)	4.21	
Bankfull Riffle Width, Wbkf (ft)	6.00	
Bankfull Mean Depth, Dbkf (ft)	0.40	
Width to Depth Ratio, W/D (ft/ft)	15.16	
Width of Floodprone Area, Wfpa (ft)	126.00	145.00
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	21.00	24.17
Riffle Max Depth @ bkf, Dmax (ft)	0.50	
Riffle Max Depth Ratio, Dmax/Dbkf (ft/ft)	1.26	
Max Depth @ tob, Dmaxtob (ft)	0.50	
Bank Height Ratio, Dmaxtob/Dmax (ft/ft)	1.00	
Meander Wavelength, Lm (ft)*	42.00	72.00
Meander Wavelength Ratio, Lm/Wbkf (ft/ft)*	7.00	12.00
Radius of Curvature, Rc (ft)*	12.00	18.00
Rc Ratio, Rc/Wbkf (ft/ft)*	2.00	3.00
Belt Width, Wblt (ft)*	21.00	48.00
Meander Width Ratio, Wblt/Wbkf (ft/ft)*	3.50	8.00
Sinuosity, K (Sval/Schan)	1.07	
Valley Slope, Sval (ft/ft)	0.0132	
Channel Slope, Schan (ft/ft)	0.0123	
Riffle Slope, Srif	0.0136	0.0222
Riffle Slope Ratio, Srif/Schan	1.10	1.80
Pool Slope, Spool (ft/ft)	0.0000	0.0049
Pool Slope Ratio, Spool/Schan	0.00	0.40
Pool Max Depth @ bkf, Dmaxpool (ft)	0.79	1.39
Pool Max Depth Ratio, Dmaxpool/Dbkf (ft/ft)	2.00	3.50
Pool Width, Wpool (ft)	6.60	9.00
Pool Width Ratio, Wpool/Wbkf (ft/ft)	1.10	1.50
Pool Spacing, Lps (ft)	9.00	30.00
Pool-Pool Spacing Ratio, Lps/Wbkf (ft/ft)	1.50	5.00

Culvert Report

R2 CULVERT

Invert Elev Dn (ft)	=	249.25
Pipe Length (ft)	=	50.00
Slope (%)	=	1.66
Invert Elev Up (ft)	=	250.08
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

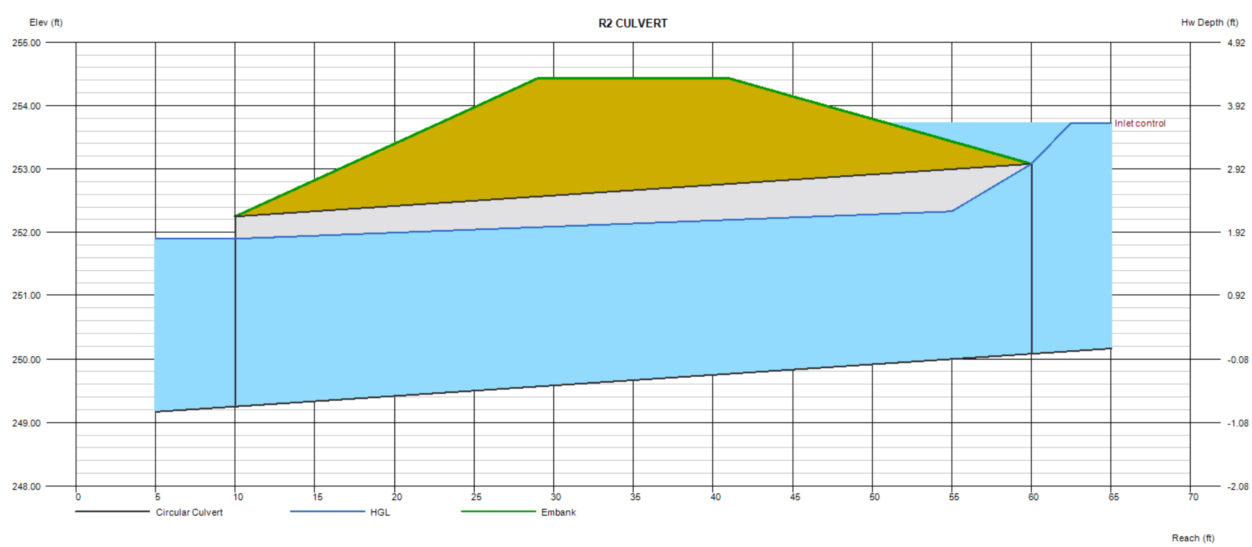
Top Elevation (ft)	=	254.43
Top Width (ft)	=	12.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	1.00
Qmax (cfs)	=	50.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	50.00
Qpipe (cfs)	=	50.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.57
Veloc Up (ft/s)	=	8.60
HGL Dn (ft)	=	251.90
HGL Up (ft)	=	252.38
Hw Elev (ft)	=	253.73
Hw/D (ft)	=	1.22
Flow Regime	=	Inlet Control



Culvert Report

R5 CULVERT

Invert Elev Dn (ft)	=	253.00
Pipe Length (ft)	=	50.00
Slope (%)	=	4.00
Invert Elev Up (ft)	=	255.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

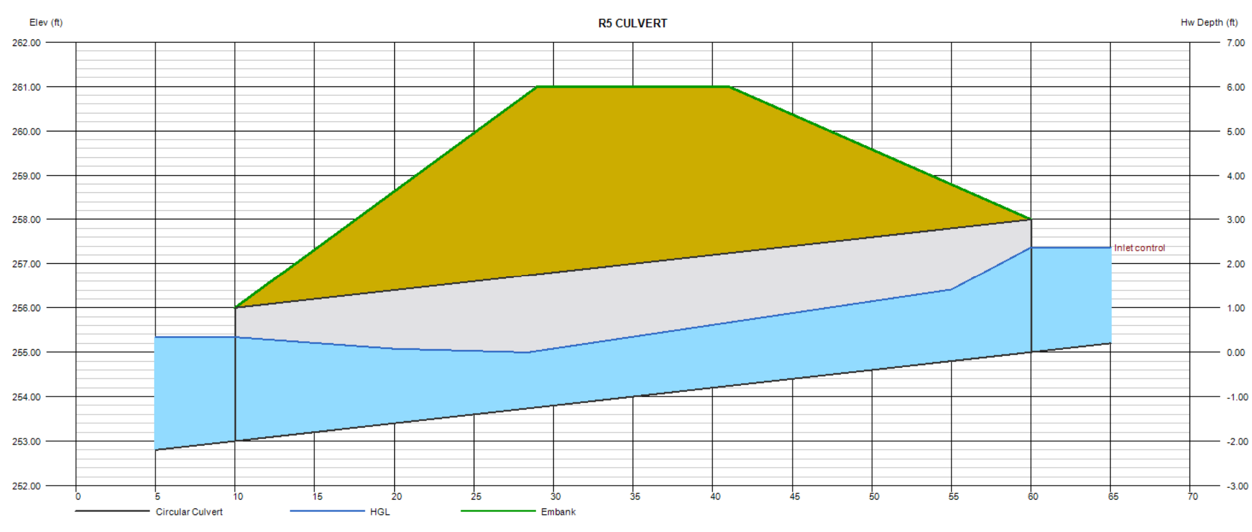
Top Elevation (ft)	=	261.00
Top Width (ft)	=	12.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	1.00
Qmax (cfs)	=	27.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	27.00
Qpipe (cfs)	=	27.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.57
Veloc Up (ft/s)	=	6.64
HGL Dn (ft)	=	255.34
HGL Up (ft)	=	256.68
Hw Elev (ft)	=	257.37
Hw/D (ft)	=	0.79
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Tuesday, Jan 21 2020

Proposed R5/R6 Culvert

Invert Elev Dn (ft)	= 256.00
Pipe Length (ft)	= 50.00
Slope (%)	= 2.00
Invert Elev Up (ft)	= 257.00
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

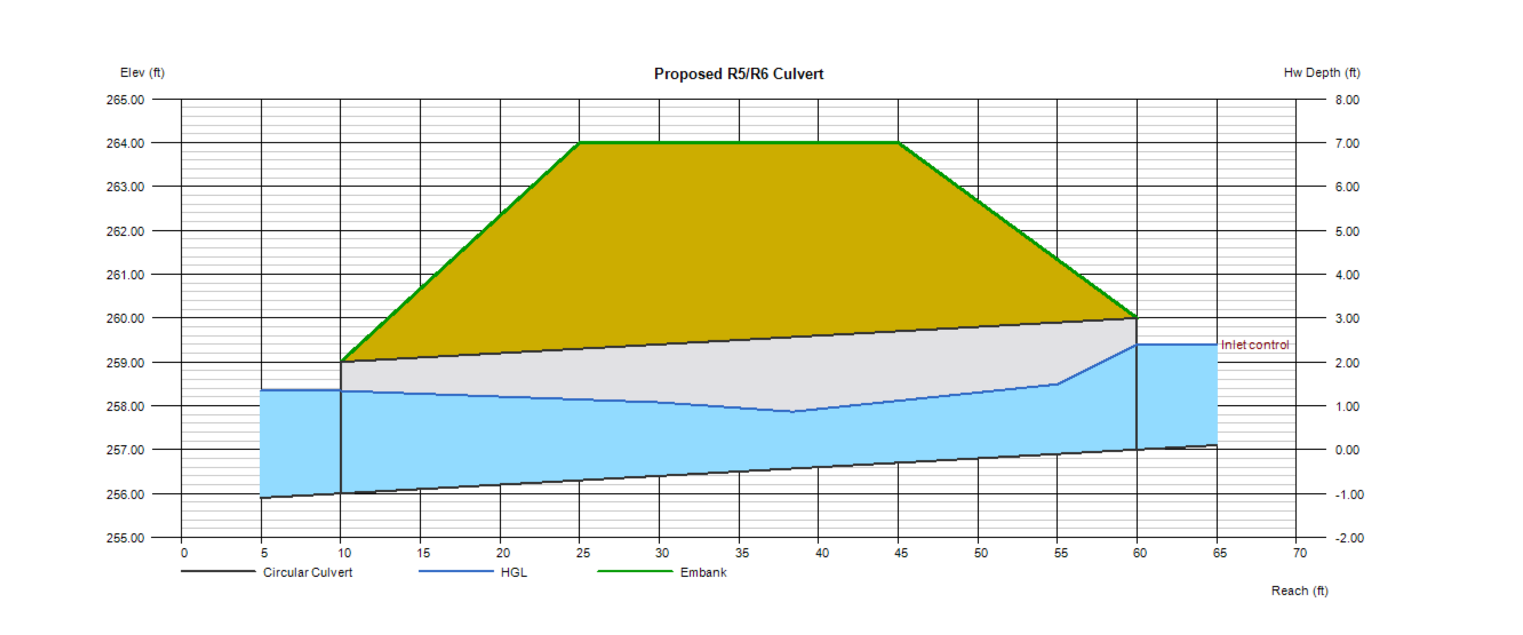
Top Elevation (ft)	= 264.00
Top Width (ft)	= 20.00
Crest Width (ft)	= 100.00

Calculations

Qmin (cfs)	= 1.00
Qmax (cfs)	= 27.90
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 27.00
Qpipe (cfs)	= 27.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.57
Veloc Up (ft/s)	= 6.64
HGL Dn (ft)	= 258.34
HGL Up (ft)	= 258.68
Hw Elev (ft)	= 259.40
Hw/D (ft)	= 0.80
Flow Regime	= Inlet Control



Reach R1 – Pond with cattle access. Excessive nutrient pollutants.

Reach R1 – Pond with excessive nutrient pullutants.

Reach R2 – Upstream, sedimentation and invasive bamboo in buffer.

Reach R2 – disturbed buffer with livestock access.

Reach R3 – Incised channel.

Reach R3 – Incised channel with limited vegetation cover.

Reach R3 - Top of reach just below culvert crossing.

Reach R4 – Eroding banks on meander bend.

Reach R4 – Excessive sedimentation and loss of channel form.

Reach R5 – Crossing between R5 (pond) and R6.

Reach R5 – Pond with excessive nutrient pollutants.

Reach R5 – Pond with cattle access and hoof shear on banks.


Reach R6 - Straightened channel, small pond on left.


Upper Reach R7 - Straightened/Incised channel.


Lower Reach R7 - Preservation section.


Lower Reach R7 - Preservation section.

Appendix 3 – Site Protection Instrument

WLS is in the process of obtaining a conservation easement from the current landowners for the project area. The easement deed and survey plat will be submitted to DMS and State Property Office (SPO) for approval and will be held by the State of North Carolina. Once recorded, the secured easement will allow WLS to proceed with the project development and protect the mitigation assets in perpetuity. The Table below includes the draft Site Protection Instrument information.

Table 3-1. Site Protection Instrument Information

Owner of Record N/F	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
Randy L. Edwards and Rhonda B. Edwards	179100-36-0446	Johnston	Conservation Easement	Book: 04838 Page: 0740	3.73
W. Odell Edwards Irrevocable Trust and Melanie E. Durham	179100-16-8552	Johnston	Conservation Easement	Book: 03343 Page: 0381	11.36

Appendix 4 – Credit Release Schedule

All credit releases will be based on the total credit generated as reported in the approved final mitigation plan, unless there are major discrepancies and then a mitigation plan addendum will be submitted. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (DA) authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the NC Interagency Review Team (NCIRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described in the Tables below.

Table 4-1. Credit Release Schedule – Stream Credits

Credit Release Milestone	Credit Release Activity	Interim Release	Total Release
1	Site Establishment (includes all required criteria stated above)	0%	0%
2	Completion of all initial physical and biological improvements made pursuant to the Mitigation Plan	30%	30%
3	Year 1 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	40%
4	Year 2 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	50%
5	Year 3 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	60%
6*	Year 4 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	65% (75%**)
7	Year 5 monitoring report demonstrates that channels are stable and interim performance standards have been met	10%	75% (85%**)
8*	Year 6 monitoring report demonstrates that channels are stable and interim performance standards have been met	5%	80% (90%**)
9	Year 7 monitoring report demonstrates that channels are stable and performance standards have been met	10%	90% (100%**)

**Please note that vegetation and channel stability data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the IRT.*

***10% reserve of credits to be held back until the bankfull event performance standard has been met.*

Table 4-2. Credit Release Schedule – Wetland Credits

Credit Release Milestone	Credit Release Activity	Interim Release	Total Release
1	Site Establishment (includes all required criteria stated below)	0%	0%
2	Completion of all initial physical and biological improvement made pursuant to the Mitigation Plan	30%	30%
3	Year 1 monitoring report demonstrates that interim performance standards have been met	10%	40%
4	Year 2 monitoring report demonstrates that interim performance standards have been met	10%	50%
5	Year 3 monitoring report demonstrates that interim performance standards have been met	15%	65%
6*	Year 4 monitoring report demonstrates that interim performance standards have been met	5%	70%
7	Year 5 monitoring report demonstrates that interim performance standards have been met	15%	85%
8*	Year 6 monitoring report demonstrates that interim performance standards have been met	5%	90%
9	Year 7 monitoring report demonstrates that performance standards have been met	10%	100%

**Please note that vegetation data may not be required with monitoring reports submitted during these monitoring years unless otherwise required by the Mitigation Plan or directed by the IRT.*

Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the NCDEQ DMS without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the Final Mitigation Plan
b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property.
c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCDEQ DMS Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.
d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the IRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after four bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than four bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the IRT. As projects approach milestones associated with credit release, DMS will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

Appendix 5 – Financial Assurance

Pursuant to Section IV H and Appendix III of the NCDEQ DMS (formerly Ecosystem Enhancement Program) In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environmental Quality (NCDEQ) has provided the USACE-Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCDEQ DMS. This commitment provides financial assurance for all mitigation projects implemented by the program.

Appendix 6 – Maintenance Plan

The site will be monitored on a regular basis and a physical inspection of the site will take place at least once a year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include the following:

Routine Maintenance Components **Odell's House Mitigation Project – NCDEQ DMS Project No. 100041**	
Component/Feature	**Maintenance through project close-out**
Stream	Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent bank failures and head-cutting. Stream maintenance activities will be documented and reported in annual monitoring reports.
Wetland	Routine wetland maintenance and repair activities may include supplemental installations of target vegetation within the wetland. Areas where stormwater and floodplain flows intercept the wetland may also require maintenance to prevent scour that adversely and persistently threatens wetland habitat or function.
Vegetation	Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, and fertilizing. Exotic invasive plant species will be treated by mechanical and/or chemical methods. Any vegetation requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. Vegetation maintenance activities will be documented and reported in annual monitoring reports.
Site Boundary	Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis. Easement monitoring and staking/signage maintenance will continue in perpetuity as a stewardship activity.
Stream Crossing	The stream crossing(s) within the site may be maintained only as allowed by the recorded Conservation Easement, deed restrictions, rights of way, or corridor agreements. Crossings in easement breaks are the responsibility of the landowner to maintain.
Beaver Management	Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dewatering/dam removal. Beaver management will be implemented using accepted trapping and removal methods only within the recorded Conservation Easement.
Livestock Fencing	Livestock fencing is to be placed outside the easement limits. Maintenance of fencing is the responsibility of the landowner.

Appendix 7 – DWR Stream Identification Forms

The streams at the project site were categorized into eight reaches (R1, R2, R3, R4, R5, R6, R7 upper, and R7 lower) totaling approximately 3,683 linear feet of existing streams. Reach breaks were based on drainage area breaks at confluences, changes in restoration/enhancement approaches, and/or changes in intermittent/perennial stream status. Field evaluations conducted at the proposal stage and during existing conditions assessments determined that Reaches R2 and R3 are perennial streams, and Reaches R4, R6, and R7 were determined to be an intermittent stream. Determinations were based on NCDWQ's Methodology for Identification of Intermittent and Perennial Streams and Their Origins, (v4.11, Effective Date: September 1, 2010) stream assessment protocols. Copies of the supporting field forms are included herein.

Table 7-1. Summary of Field Investigations to Determine Intermittent/Perennial Status

Project Reach Designation	Existing Project Reach Length (ft)	NCDWQ Stream Classification Form Score[1]	Watershed Drainage Area (acres)[1]	Stream Status Based on Field Analyses
R1	N/A	--	42.9	N/A (Pond)
R2	632	32.25	64.0	Perennial
R3	1,169	29.25[3]	83.2	Perennial
R4	392	23.5	95.4	Perennial/Intermittent[2]
R5	N/A	--	19.4	N/A (Pond)
R6	610	26.25	30.7	Perennial/Intermittent[2]
R7 upper	468	19.5	39.7	Intermittent
R7 lower	412	19.5	41.8	Intermittent

Note 1: Watershed drainage area was approximated based on topographic and LiDAR information and compared with USGS StreamStats at the downstream end of each reach.
Note 2: Indicates that the lower section of the reach was classified as perennial and upper stream reach was classified as intermittent.
Note 3: Stream form score was taken during drought conditions and the reach is perennial.

NC DWQ Stream Identification Form Version 4.11

Date: 9.23.15	Project/Site: Odell's (SITE4) R2	Latitude: 35°43'03.66"N
Evaluator: K. VAN STELL	County: JOHNSTON	Longitude: -78°21'01.29"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 32.25	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 17.0)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts GRADE CONTROL @ DAM / XING	0	1	2	3
9. Grade control " "	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

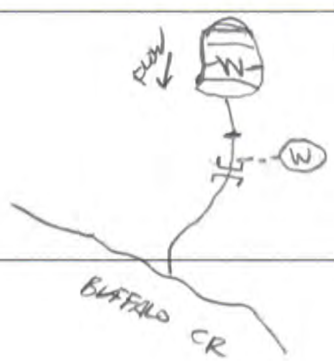
B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 5.75)				
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 WOODWARDIA AREOLATA	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: STREAM FLOW OBSERVED AND APPEARS TO BE SPRING FED FROM U/S POND.

Sketch:



NC DWQ Stream Identification Form Version 4.11

Date: 9.23.15	**Project/Site:** ODELLS (SITE 4) R3	**Latitude:** 35°42'56.84"N
Evaluator: K. VAN STELLE	**County:** JOHNSTON	**Longitude:** -78°21'04.21"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 29.25	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 6.0)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow * DROUGHT (MOD)	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 2.75)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed IMPATIENS CAP.	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: SURFACE FLOW ONLY IN POOLS, MODERATE DROUGHT CONDITIONS, CHANNEL HAS INCISED AND SUBSURFACE HYDROLOGY IS PRESENT

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 9/23/15	**Project/Site:** ODELLS - R4	**Latitude:** 35°42'52.65"N
Evaluator: K. VAN STELL	**County:** JOHNSTON	**Longitude:** 78°21.11.12"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 13.0)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 6.0)				
12. Presence of Baseflow * DROUGHT (MOD)	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 4.5)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: WATER OBSERVED IN POOLS ONLY. CHANNEL HAS BEEN EXCAVATED AND CATTLE HAVE TRAMPLED BANKS / POORLY DEFINED CHANNEL GEOMETRY

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 9/1/15	Project/Site: ODELLS - R6	Latitude: 35°42'59.59" N
Evaluator: K. VAN STELL	County: JOHNSTON	Longitude: -78°21'17.76" W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 26.25	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 11.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

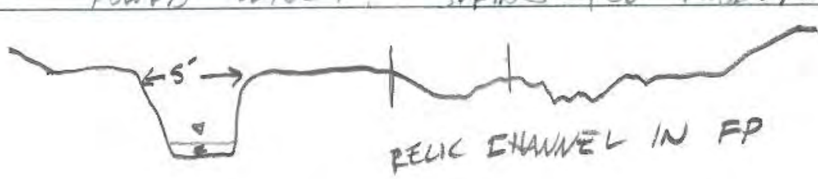
B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 6.25)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed CAREX (SEDGE)	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: AQUATIC VEG THROUGHOUT REACH. OBSERVED MINIMAL BASEFLOW FROM POND OUTLET. SPRING FED POND. REMNANT CHANNEL IN FP.

Sketch:



NC DWQ Stream Identification Form Version 4.11

Date: 9/1/15	Project/Site: ODELLS - R7	Latitude: 35°42'54.71"N
Evaluator: K. VAN STELL	County: JOHNSTON	Longitude: -78°21'25.32"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 13.0)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

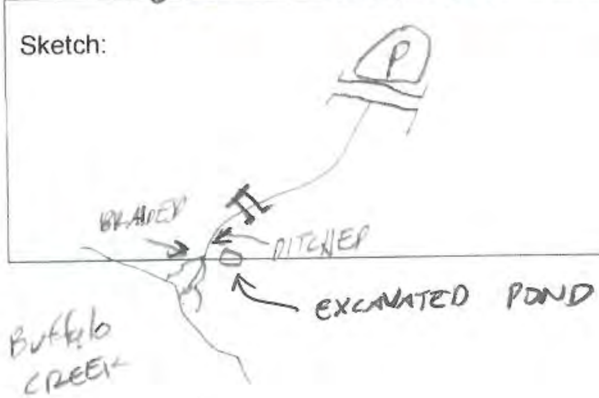
B. Hydrology (Subtotal = 3.5)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 3.0)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians (IN POND ONLY)	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: OBSERVED BRAIDED CHANNELS D/S OF POND WITH SPOIL ABUNDANT CRAYFISH HOLES. SEASONAL/PERIODIC FLOW AND INUNDATION

Sketch:



Appendix 8 – USACE District Assessment Methods/Forms

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Odell's House Mitigation Project
2. Date of evaluation: 12-5-2019
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Emily Dunnigan - WLS
5. County: Johnston
6. Nearest named water body on USGS 7.5-minute quad: Buffalo Creek
7. River basin: Neuse
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.71728, -78.350423

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): R2
10. Length of assessment reach evaluated (feet): 534
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 2
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 $\leq$ 10%, Common (C) = > 10-40%, Abundant (A) = > 40-70%, Predominant (P) = > 70%. Cumulative percentages should not exceed 100% for each assessment reach.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Odell's House Mitigation Project	Date of Assessment	12-5-2019
Stream Category	Pa2	Assessor Name/Organization	Emily Dunnigan - WLS

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

Function Class Rating Summary	**USACE/ All Streams**	**NCDWR Intermittent**
(1) Hydrology	**HIGH**	
(2) Baseflow	**MEDIUM**	
(2) Flood Flow	**HIGH**	
(3) Streamside Area Attenuation	**HIGH**	
(4) Floodplain Access	**HIGH**	
(4) Wooded Riparian Buffer	**MEDIUM**	
(4) Microtopography	**LOW**	
(3) Stream Stability	**MEDIUM**	
(4) Channel Stability	**HIGH**	
(4) Sediment Transport	**LOW**	
(4) Stream Geomorphology	**MEDIUM**	
(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	**MEDIUM**	
(2) Streamside Area Vegetation	**HIGH**	
(3) Upland Pollutant Filtration	**HIGH**	
(3) Thermoregulation	**HIGH**	
(2) Indicators of Stressors	**YES**	
(2) Aquatic Life Tolerance	**HIGH**	
(2) Intertidal Zone Filtration	NA	
(1) Habitat	**LOW**	
(2) In-stream Habitat	**LOW**	
(3) Baseflow	**MEDIUM**	
(3) Substrate	**LOW**	
(3) Stream Stability	**HIGH**	
(3) In-stream Habitat	**LOW**	
(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 SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Odell's House Mitigation Project
2. Date of evaluation: 12-5-2019
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Emily Dunnigan - WLS
5. County: Johnston
6. Nearest named water body on USGS 7.5-minute quad: Buffalo Creek
7. River basin: Neuse
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.714961, -78.351981

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): R3
10. Length of assessment reach evaluated (feet): 1024
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): 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 <u>or</u> fill to the point of obstructing flow <u>or</u> a channel choked with aquatic macrophytes <u>or</u> ponded water <u>or</u> impoundment on flood or ebb within the assessment reach (examples: undersized or perched culverts, causeways that constrict the channel, tidal gates, debris jams, beaver dams).
   - ☒B Not A

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

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

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☐A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☒C > 25% of channel unstable

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

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

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

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
- ☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
- ☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
- ☒C No drought conditions

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

10. **Natural In-stream Habitat Types – assessment reach metric**

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

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
- ☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
- ☐B Multiple sticks and/or leaf packs and/or emergent vegetation
- ☐C Multiple snags and logs (including lap trees)
- ☐D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
- ☒E Little or no habitat

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
- ☒A Riffle-run section **(evaluate 11c)**
- ☐B Pool-glide section **(evaluate 11d)**
- ☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

11c. In riffle sections, check all that occur below the normal wetted perimeter of the assessment reach – whether or not submerged. **Check at least one box in each row (skip for Size 4 Coastal Plain streams and Tidal Marsh Streams)**. Not Present (NP) = absent, Rare (R) = present but $\leq$ 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	Odell's House Mitigation Project	Date of Assessment	12-5-2019
Stream Category	Pa2	Assessor Name/Organization	Emily Dunnigan - WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Odell's House Mitigation Project 2. Date of evaluation: 12-5-2019
3. Applicant/owner name: Water & Land Solutions 4. Assessor name/organization: Emily Dunnigan- WLS
5. County: Johnston 6. Nearest named water body
7. River basin: Neuse on USGS 7.5-minute quad: Buffalo Creek
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.714642, -78.353018

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): R4 10. Length of assessment reach evaluated (feet): 350
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 3 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 5 13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☒Perennial flow ☐Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☒A  (more sinuous stream, flatter valley slope)

☐B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☐Size 1 (< 0.1 mi^2) ☒Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

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

1. **Channel Water – assessment reach metric (skip for Size 1 streams and Tidal Marsh Streams)**
   - ☒A Water throughout assessment reach.
   - ☐B No flow, water in pools only.
   - ☐C No water in assessment reach.

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

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

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

5. **Signs of Active Instability – assessment reach metric**
   Consider only current instability, not past events from which the stream has currently recovered. Examples of instability include active bank failure, active channel down-cutting (head-cut), active widening, and artificial hardening (such as concrete, gabion, rip-rap).
   - ☐A < 10% of channel unstable
   - ☐B 10 to 25% of channel unstable
   - ☒C > 25% of channel unstable

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

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

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

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

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

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

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

10. **Natural In-stream Habitat Types – assessment reach metric**

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

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

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

Check for Tidal Marsh Streams Only

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☒A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☐C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Vegetated LB	Vegetated RB	Wooded LB	Wooded RB	
☒A	☒A	☒A	☒A	≥ 100 feet wide 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	Odell's House Mitigation Project	Date of Assessment	12-5-2019
Stream Category	Pa2	Assessor Name/Organization	Emily Dunnigan- WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Odell's House Mitigation Project
2. Date of evaluation: 12-5-2019
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Kyle Obermiller - WLS
5. County: Johnston
6. Nearest named water body on USGS 7.5-minute quad: Buffalo Creek
7. River basin: Neuse
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.71684, -78.35446

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): R6
10. Length of assessment reach evaluated (feet): 624
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 3
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☐A  (more sinuous stream, flatter valley slope)

☒B  (less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

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

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

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

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

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

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

2. Evidence of Flow Restriction – assessment reach metric

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

3. Feature Pattern – assessment reach metric

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

4. Feature Longitudinal Profile – assessment reach metric

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

5. Signs of Active Instability – assessment reach metric

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

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

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

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

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

8. **Recent Weather – watershed metric (skip for Tidal Marsh Streams)**
For Size 1 or 2 streams, D1 drought or higher is considered a drought; for Size 3 or 4 streams, D2 drought or higher is considered a drought.
☐A Drought conditions and no rainfall or rainfall not exceeding 1 inch within the last 48 hours
☐B Drought conditions and rainfall exceeding 1 inch within the last 48 hours
☒C No drought conditions

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

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

10b. **Check all that occur** (occurs if > 5% coverage of assessment reach) **(skip for Size 4 Coastal Plain streams)**
☐A Multiple aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐B Multiple sticks and/or leaf packs and/or emergent vegetation
☐C Multiple snags and logs (including lap trees)
☐D 5% undercut banks and/or root mats and/or roots in banks extend to the normal wetted perimeter
☒E Little or no habitat

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☐A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☒C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes/Sketch:

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Odell's House Mitigation Project	Date of Assessment	12-5-2019
Stream Category	Pb1	Assessor Name/Organization	Kyle Obermiller - WLS

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

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

NC SAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 2.1

USACE AID #: NCDWR #:

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

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

PROJECT/SITE INFORMATION:

1. Project name (if any): Odell's House Mitigation Project
2. Date of evaluation: 12-5-2019
3. Applicant/owner name: Water & Land Solutions
4. Assessor name/organization: Kyle Obermiller - WLS
5. County: Johnston
6. Nearest named water body on USGS 7.5-minute quad: Buffalo Creek
7. River basin: Neuse
8. Site coordinates (decimal degrees, at lower end of assessment reach): 35.71595, -78.35544

STREAM INFORMATION: (depth and width can be approximations)

9. Site number (show on attached map): R7
10. Length of assessment reach evaluated (feet): 330
11. Channel depth from bed (in riffle, if present) to top of bank (feet): 1 ☐Unable to assess channel depth.
12. Channel width at top of bank (feet): 4
13. Is assessment reach a swamp steam? ☐Yes ☐No
14. Feature type: ☐Perennial flow ☒Intermittent flow ☐Tidal Marsh Stream

STREAM CATEGORY INFORMATION:

15. NC SAM Zone: ☐ Mountains (M) ☒ Piedmont (P) ☐ Inner Coastal Plain (I) ☐ Outer Coastal Plain (O)

16. Estimated geomorphic valley shape (**skip for Tidal Marsh Stream**):

☒A 
(more sinuous stream, flatter valley slope)

☐B 
(less sinuous stream, steeper valley slope)

17. Watershed size: (**skip for Tidal Marsh Stream**) ☒Size 1 (< 0.1 mi^2) ☐Size 2 (0.1 to < 0.5 mi^2) ☐Size 3 (0.5 to < 5 mi^2) ☐Size 4 (≥ 5 mi^2)

ADDITIONAL INFORMATION:

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

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

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

2. Evidence of Flow Restriction – assessment reach metric

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

3. Feature Pattern – assessment reach metric

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

4. Feature Longitudinal Profile – assessment reach metric

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

5. Signs of Active Instability – assessment reach metric

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

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

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

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

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

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

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

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

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

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

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

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

Check for Tidal Marsh Streams Only

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

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

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

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

11b. Bedform evaluated. **Check the appropriate box(es).**
☐A Riffle-run section **(evaluate 11c)**
☐B Pool-glide section **(evaluate 11d)**
☒C Natural bedform absent **(skip to Metric 12, Aquatic Life)**

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

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

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

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

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

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

1 >1 Numbers over columns refer to "individuals" for Size 1 and 2 streams and "taxa" for Size 3 and 4 streams.

☐ ☐Adult frogs
☐ ☐Aquatic reptiles
☐ ☐Aquatic macrophytes and aquatic mosses (include liverworts, lichens, and algal mats)
☐ ☐Beetles
☐ ☐Caddisfly larvae (T)
☐ ☐Asian clam (*Corbicula*)
☐ ☒Crustacean (isopod/amphipod/crayfish/shrimp)
☐ ☐Damselfly and dragonfly larvae
☐ ☐Dipterans
☐ ☐Mayfly larvae (E)
☐ ☐Megaloptera (alderfly, fishfly, dobsonfly larvae)
☐ ☐Midges/mosquito larvae
☐ ☒Mosquito fish (*Gambusia*) or mud minnows (*Umbra pygmaea)*
☐ ☐Mussels/Clams (not *Corbicula*)
☐ ☐Other fish
☐ ☐Salamanders/tadpoles
☐ ☐Snails
☐ ☐Stonefly larvae (P)
☐ ☐Tipulid larvae
☐ ☐Worms/leeches

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

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

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

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

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

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

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

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

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

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

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

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

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

Vegetated 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:
Invasives are dominant and canopy is managed pine. Stream straightened into floodplain of Buffalo Creek, historically was braided channel.

Draft NC SAM Stream Rating Sheet
Accompanies User Manual Version 2.1

Stream Site Name	Odell's House Mitigation Project	Date of Assessment	12-5-2019
Stream Category	Pa1	Assessor Name/Organization	Kyle Obermiller - WLS

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

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

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WA
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.718258, -78.350250

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.

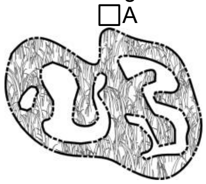
20. Large Woody Debris – wetland type condition metric (skip for all marshes)

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

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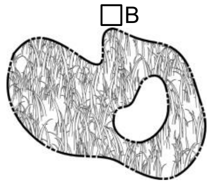
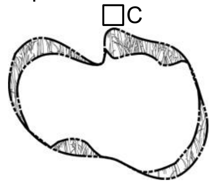

☐C

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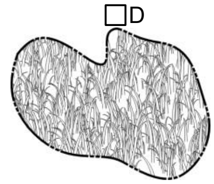


22. Hydrologic Connectivity – assessment area condition metric (evaluate for riparian wetlands and Salt/Brackish Marsh only)

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

water draining from pond is highly polluted and bright green. Pond dam altered overland flow

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WA	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	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	**HIGH**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**MEDIUM**
	Condition/Opportunity	**MEDIUM**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **MEDIUM**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WB
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.717083, -78.350415

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

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

Is the assessment area intensively managed? ☐ Yes ☒ No

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Discharge into Wetland – opportunity metric

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Answer for assessment area dominant landform.

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

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

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

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

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

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

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

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

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

13. Connectivity to Other Natural Areas – landscape condition metric

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

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

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

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

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

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

☐A 0
☐B 1 to 4
☒C 5 to 8

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

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

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

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

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

17a. Is vegetation present?

☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

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

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

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

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

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

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

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

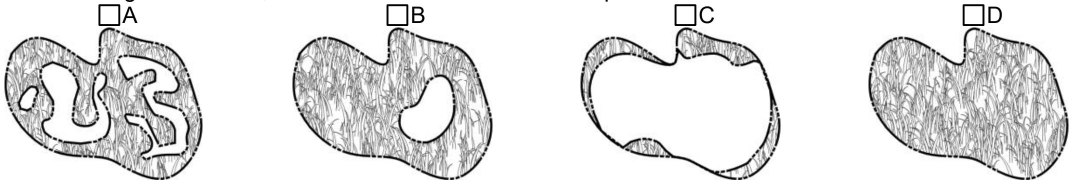
Include both natural debris and man-placed natural debris.

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

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

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

☐A ☐B ☐C ☐D



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

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.

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

Notes

Crossing and pond dam impacting overland flow.

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WB	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	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	**HIGH**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**MEDIUM**
	Condition/Opportunity	**MEDIUM**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **MEDIUM**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Banner Branch	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WC
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.714874, -78.352420

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.

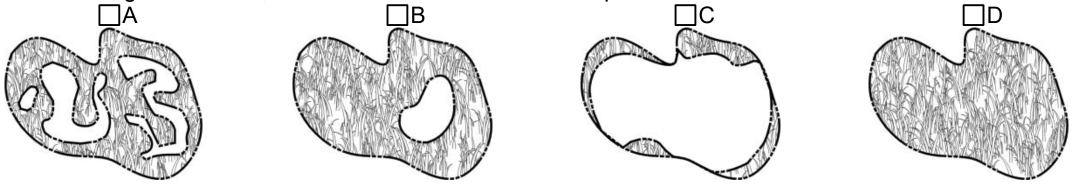
☐A Large logs (more than one) are visible (> 12 inches in diameter, or large relative to species present and landscape stability).

☒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

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WC	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

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

Function Rating Summary

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

Overall Wetland Rating **HIGH**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WD
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.714480, -78.353256

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)

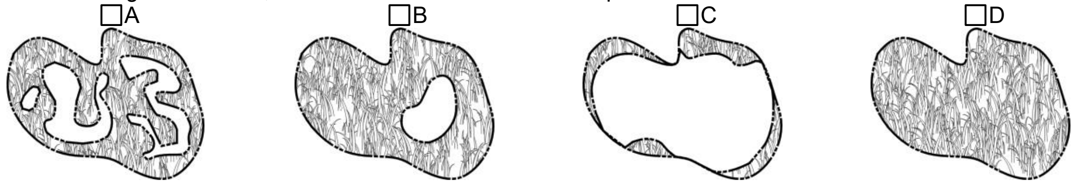
Include both natural debris and man-placed natural debris.

☐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

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WD	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

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

Function Rating Summary

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

Overall Wetland Rating **HIGH**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WE (north end)
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.717060, -78.354347

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.

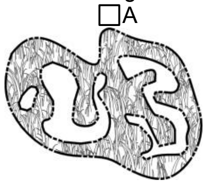
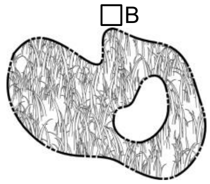
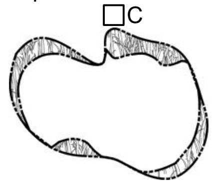
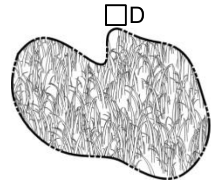
20. Large Woody Debris – wetland type condition metric (skip for all marshes)

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
culvert from pond

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WE (north end)	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	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	**HIGH**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**MEDIUM**
	Condition/Opportunity	**MEDIUM**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**HIGH**

Overall Wetland Rating **MEDIUM**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WE (south end)
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.717060, -78.354347

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

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

Is the assessment area intensively managed? ☐ Yes ☒ No

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Discharge into Wetland – opportunity metric

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Answer for assessment area dominant landform.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

☐A 0
☒B 1 to 4
☐C 5 to 8

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

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

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

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

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

17a. Is vegetation present?

☒Yes ☐No If Yes, continue to 17b. If No, skip to Metric 18.

17b. Evaluate percent coverage of assessment area vegetation **for all marshes only**. Skip to 17c for non-marsh wetlands.

☐A ≥ 25% coverage of vegetation
☐B < 25% coverage of vegetation

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

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

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

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

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

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

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

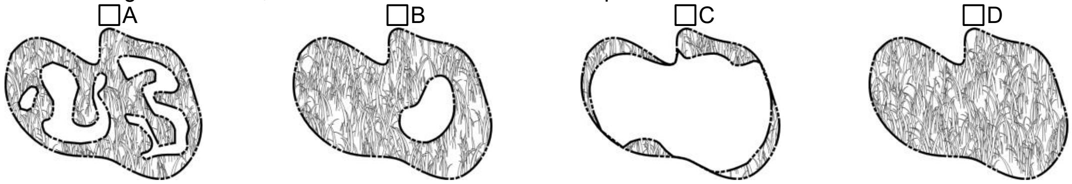
Include both natural debris and man-placed natural debris.

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

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

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

☐A ☐B ☐C ☐D



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

Examples of activities that may severely alter hydrologic connectivity include intensive ditching, fill, sedimentation, channelization, diversion, man-made berms, beaver dams, and stream incision. Documentation required if evaluated as B, C, or D.

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

Notes
culvert from pond

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WE (south end)	Date of Assessment	12/5/2019
Wetland Type	Bottomland Hardwood Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**LOW**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		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	**HIGH**
	Landscape Patch Structure	Condition	**HIGH**
	Vegetation Composition	Condition	**MEDIUM**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**MEDIUM**
Water Quality	Condition	**MEDIUM**
	Condition/Opportunity	**MEDIUM**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**HIGH**

Overall Wetland Rating **MEDIUM**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WF
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.717950, -78.352867

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)

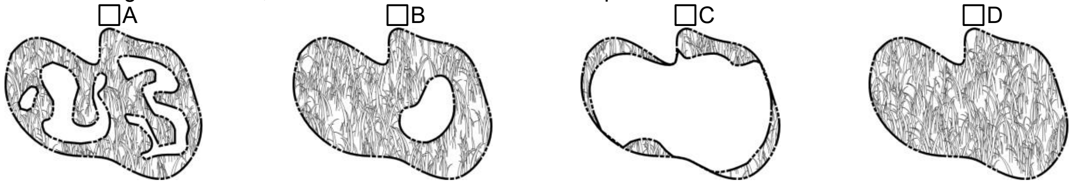
Include both natural debris and man-placed natural debris.

☐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
pond berm

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WF	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

Notes on Field Assessment Form (Y/N)	YES
Presence of regulatory considerations (Y/N)	NO
Wetland is intensively managed (Y/N)	NO
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	**MEDIUM**
	Sub-surface Storage and Retention	Condition	**HIGH**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**MEDIUM**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	Soluble Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Physical Change	Condition	**LOW**
		Condition/Opportunity	**LOW**
		Opportunity Presence (Y/N)	**NO**
	Pollution Change	Condition	NA
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
Habitat	Physical Structure	Condition	**HIGH**
	Landscape Patch Structure	Condition	**LOW**
	Vegetation Composition	Condition	**LOW**

Function Rating Summary

Function	Metrics	Rating
Hydrology	Condition	**HIGH**
Water Quality	Condition	**LOW**
	Condition/Opportunity	**LOW**
	Opportunity Presence (Y/N)	**NO**
Habitat	Condition	**LOW**

Overall Wetland Rating **LOW**

NC WAM FIELD ASSESSMENT FORM
Accompanies User Manual Version 5.0

USACE AID #		NCDWR#	
Project Name	Odells House	Date of Evaluation	12/5/2019
Applicant/Owner Name	Water & Land Solutions	Wetland Site Name	WG
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS
Level III Ecoregion	Piedmont	Nearest Named Water Body	Buffalo Creek
River Basin	Neuse	USGS 8-Digit Catalogue Unit	03020201
County	Johnston	NCDWR Region	Raleigh
☒ Yes ☐ No	Precipitation within 48 hrs?	Latitude/Longitude (deci-degrees)	35.717950, -78.352867

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

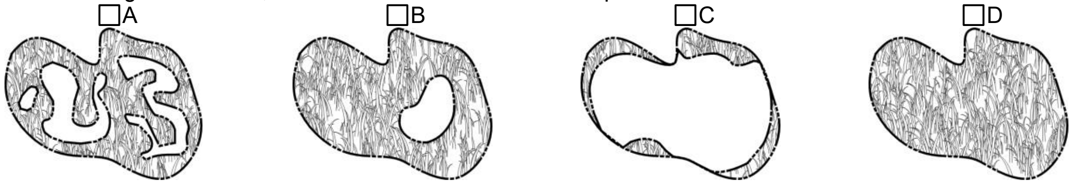
18. Snags – wetland type condition metric (skip for all marshes)
☐A Large snags (more than one) are visible (> 12 inches DBH, or large relative to species present and landscape stability).
☒B Not A

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
cow access, pond altering overland

NC WAM Wetland Rating Sheet
Accompanies User Manual Version 5.0

Wetland Site Name	WG	Date of Assessment	12/5/2019
Wetland Type	Headwater Forest	Assessor Name/Organization	Emily Dunnigan/WLS

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

Sub-function Rating Summary

Function	Sub-function	Metrics	Rating
Hydrology	Surface Storage and Retention	Condition	**LOW**
	Sub-surface Storage and Retention	Condition	**MEDIUM**
Water Quality	Pathogen Change	Condition	**MEDIUM**
		Condition/Opportunity	**MEDIUM**
		Opportunity Presence (Y/N)	**NO**
	Particulate Change	Condition	**LOW**
		Condition/Opportunity	NA
		Opportunity Presence (Y/N)	NA
	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**

Appendix 9 – WOTUS Information

Sullivan, Roscoe L III CIV (US)

From:	Sullivan, Roscoe L III CIV (US)
Sent:	Wednesday, August 1, 2018 12:05 PM
To:	'Christopher Sheats'
Cc:	stephanie.goss@ncdenr.gov
Subject:	RE: Odell's House Stream and Wetland Mitigation Project, Wendell, NC
Attachments:	FINALSAW-JD-REQUEST-FORM-20170508.pdf

Chris,

I have reviewed the information provided by you and have determined that the delineation map (Figure 3: Jurisdictional Waters Map) provided accurately depicts the limits of potentially jurisdictional waters within the project area based on my field notes and memory from the IRT site visit conducted on 2/21/2018. Therefore, I do not need to conduct an additional site visit to verify the delineation.

I noticed that you did not include a completed Jurisdictional Determination Request Form (see attached) with your request. Please complete this document and return to me at your earliest convenience.

I will issue the Preliminary Jurisdictional Determination (PJD) for this project in the order that it was received once I receive the completed Jurisdictional Determination Request Form. Please note that I have a substantial backlog of permits and JDs to work through at this time and it may take several months for me to issue this PJD.

Please feel free to contact me with any questions.

Sincerely,

Ross

Ross Sullivan, PWS, ISA Certified Arborist
Regulatory Specialist
Raleigh Regulatory Field Office
U.S. Army Corps of Engineers - Wilmington District
Wake Forest, North Carolina 27587
Office #: 919-554-4884. Ext. 25
Email: roscoe.l.sullivan@usace.army.mil

-----Original Message-----
From: Christopher Sheats [mailto:Chris@waterlandsolutions.com]
Sent: Tuesday, July 24, 2018 3:05 PM
To: Sullivan, Roscoe L III CIV (US) <Roscoe.L.Sullivan@usace.army.mil>
Cc: stephanie.goss@ncdenr.gov
Subject: [Non-DoD Source] Odell's House Stream and Wetland Mitigation Project, Wendell, NC

Ross,

Jurisdictional Determination Request

US Army Corps of Engineers
Wilmington District

This form is intended for use by anyone requesting a jurisdictional determination (JD) from the U.S. Army Corps of Engineers, Wilmington District (Corps). Please include all supporting information, as described within each category, with your request. You may submit your request via mail, electronic mail, or facsimile. Requests should be sent to the appropriate project manager of the county in which the property is located. A current list of project managers by assigned counties can be found on-line at: http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/Contact/CountyLocator.aspx, by calling 910-251-4633, or by contacting any of the field offices listed below. Once your request is received you will be contacted by a Corps project manager.

ASHEVILLE & CHARLOTTE REGULATORY FIELD OFFICES
US Army Corps of Engineers
151 Patton Avenue, Room 208
Asheville, North Carolina 28801-5006
General Number: (828) 271-7980
Fax Number: (828) 281-8120

RALEIGH REGULATORY FIELD OFFICE
US Army Corps of Engineers
3331 Heritage Trade Drive, Suite 105
Wake Forest, North Carolina 27587
General Number: (919) 554-4884
Fax Number: (919) 562-0421

WASHINGTON REGULATORY FIELD OFFICE
US Army Corps of Engineers
2407 West Fifth Street
Washington, North Carolina 27889
General Number: (910) 251-4610
Fax Number: (252) 975-1399

WILMINGTON REGULATORY FIELD OFFICE
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403
General Number: 910-251-4633
Fax Number: (910) 251-4025

INSTRUCTIONS:

All requestors must complete Parts A, B, C, D, E, F and G.

NOTE TO CONSULTANTS AND AGENCIES: If you are requesting a JD on behalf of a paying client or your agency, please note the specific submittal requirements in **Part H**.

NOTE ON PART D – PROPERTY OWNER AUTHORIZATION: Please be aware that all JD requests must include the current property owner authorization for the Corps to proceed with the determination, which may include inspection of the property when necessary. This form must be signed by the current property owner(s) or the owner(s) authorized agent to be considered a complete request.

NOTE ON PART D - NCDOT REQUESTS: Property owner authorization/notification for JD requests associated with North Carolina Department of Transportation (NCDOT) projects will be conducted according to the current NCDOT/USACE protocols.

NOTE TO USDA PROGRAM PARTICIPANTS: A Corps approved or preliminary JD 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 also request a certified wetland determination from the local office of the Natural Resources Conservation Service, prior to starting work.

A. PARCEL INFORMATION

Street Address: 100 Salem Church Rd

City, State: Wendell, NC

County: Johnston

Parcel Index Number(s) (PIN): 179100-16-8552

B. REQUESTOR INFORMATION

Name: Chris Sheats-Water and Land Solutions

Mailing Address: 10940 Raven Ridge Road
Raleigh, NC 27614

Telephone Number: 919-614-5111

Electronic Mail Address: chris@waterlandsolutions.com

Select one:

- ☐ I am the current property owner.
- ☑ I am an Authorized Agent or Environmental Consultant[1]
- ☐ Interested Buyer or Under Contract to Purchase
- ☐ Other, please explain. ________________________

C. PROPERTY OWNER INFORMATION[2]

Name: W. Odell Edwards Irrevocable Trust, Melanie E. Durham, Trustee

Mailing Address: 337 Jackson Rd
Four Oaks, NC 27524

Telephone Number: 919-915-1561

Electronic Mail Address: melaniedurham@centurylink.net

[1] Must provide completed Agent Authorization Form/Letter.
[2] Documentation of ownership also needs to be provided with request (copy of Deed, County GIS/Parcel/Tax Record).

D. PROPERTY ACCESS CERTIFICATION[3,4]

By signing below, I authorize representatives of the Wilmington District, U.S. Army Corps of Engineers (Corps) to enter upon the property herein described for the purpose of conducting on-site investigations, if necessary, and issuing a jurisdictional determination pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act of 1899. I, the undersigned, am either a duly authorized owner of record of the property identified herein, or acting as the duly authorized agent of the owner of record of the property.

Chris Sheats
Print Name

Capacity: ☐ Owner ☑ Authorized Agent[5]

8-1-18
Date

Chris M. Sheats
Signature

E. REASON FOR JD REQUEST: (Check as many as applicable)

☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all aquatic resources.

☐ I intend to construct/develop a project or perform activities on this parcel which would be designed to avoid all jurisdictional aquatic resources under Corps authority.

☐ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps, and the JD would be used to avoid and minimize impacts to jurisdictional aquatic resources and as an initial step in a future permitting process.

☐ I intend to construct/develop a project or perform activities on this parcel which may require authorization from the Corps; this request is accompanied by my permit application and the JD is to be used in the permitting process.

☐ I intend to construct/develop a project or perform activities in a navigable water of the U.S. which is included on the district Section 10 list and/or is subject to the ebb and flow of the tide.

☑ A Corps JD is required in order obtain my local/state authorization.

☐ I intend to contest jurisdiction over a particular aquatic resource and request the Corps confirm that jurisdiction does/does not exist over the aquatic resource on the parcel.

☐ I believe that the site may be comprised entirely of dry land.

☐ Other:____

[3] For NCDOT requests following the current NCDOT/USACE protocols, skip to Part E.

[4] If there are multiple parcels owned by different parties, please provide the following for each additional parcel on a continuation sheet.

[5] Must provide agent authorization form/letter signed by owner(s).

F. JURISDICTIONAL DETERMINATION (JD) TYPE (Select One)

☑ I am requesting that the Corps provide a preliminary JD for the property identified herein.

A Preliminary Jurisdictional Determination (PJD) provides an indication that there may be "waters of the United States" or "navigable waters of the United States"on a property. PJDs are sufficient as the basis for permit decisions. For the purposes of permitting, all waters and wetlands on the property will be treated as if they are jurisdictional "waters of the United States". PJDs cannot be appealed (33 C.F.R. 331.2); however, a PJD is "preliminary" in the sense that an approved JD can be requested at any time. PJDs do not expire.

☐ I am requesting that the Corps provide an approved JD for the property identified herein.

An Approved Jurisdictional Determination (AJD) is a determination that jurisdictional "waters of the United States" or "navigable waters of the United States" are either present or absent on a site. An approved JD identifies the limits of waters on a site determined to be jurisdictional under the Clean Water Act and/or Rivers and Harbors Act. Approved JDs are sufficient as the basis for permit decisions. AJDs are appealable (33 C.F.R. 331.2). The results of the AJD will be posted on the Corps website. A landowner, permit applicant, or other "affected party" (33 C.F.R. 331.2) who receives an AJD may rely upon the AJD for five years (subject to certain limited exceptions explained in Regulatory Guidance Letter 05-02).

☐ I am unclear as to which JD I would like to request and require additional information to inform my decision.

G. ALL REQUESTS

☑ Map of Property or Project Area. This Map must clearly depict the boundaries of the review area.

☑ Size of Property or Review Area 97.81 acres.

☑ The property boundary (or review area boundary) is clearly physically marked on the site.

H. REQUESTS FROM CONSULTANTS

☑ Project Coordinates (Decimal Degrees): Latitude: North 35.717006°
Longitude: West -78.350453°

☑ A legible delineation map depicting the aquatic resources and the property/review area. Delineation maps must be no larger than 11x17 and should contain the following: (Corps signature of submitted survey plats will occur after the submitted delineation map has been reviewed and approved).[6]

- North Arrow
- Graphical Scale
- Boundary of Review Area
- Date
- Location of data points for each Wetland Determination Data Form or tributary assessment reach.

For Approved Jurisdictional Determinations:

- Jurisdictional wetland features should be labeled as Wetland Waters of the US, 404 wetlands, etc. Please include the acreage of these features.
- Jurisdictional non-wetland features (i.e. tidal/navigable waters, tributaries, impoundments) should be labeled as Non-Wetland Waters of the US, stream, tributary, open water, relatively permanent water, pond, etc. Please include the acreage or linear length of each of these features as appropriate.
- Isolated waters, waters that lack a significant nexus to navigable waters, or non-jurisdictional upland features should be identified as Non-Jurisdictional. Please include a justification in the label regarding why the feature is non-jurisdictional (i.e. “Isolated”, “No Significant Nexus”, or “Upland Feature”). Please include the acreage or linear length of these features as appropriate.

For Preliminary Jurisdictional Determinations:

- Wetland and non-wetland features should not be identified as Jurisdictional, 404, Waters of the United States, or anything that implies jurisdiction. These features can be identified as Potential Waters of the United States, Potential Non-wetland Waters of the United States, wetland, stream, open water, etc. Please include the acreage and linear length of these features as appropriate.

☑ Completed Wetland Determination Data Forms for appropriate region
(at least one wetland and one upland form needs to be completed for each wetland type)

[6] Please refer to the guidance document titled “Survey Standards for Jurisdictional Determinations” to ensure that the supplied map meets the necessary mapping standards. http://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Jurisdiction/

- [x] Completed appropriate Jurisdictional Determination form
  - **PJDs,** please complete a Preliminary Jurisdictional Determination Form[7] and include the Aquatic Resource Table
  - **AJDs,** please complete an Approved Jurisdictional Determination Form[8]
- [ ] Vicinity Map
- [x] Aerial Photograph
- [x] USGS Topographic Map
- [ ] Soil Survey Map
- [ ] Other Maps, as appropriate (e.g. National Wetland Inventory Map, Proposed Site Plan, previous delineation maps, LIDAR maps, FEMA floodplain maps)
- [ ] Landscape Photos (if taken)
- [ ] NCSAM and/or NCWAM Assessment Forms and Rating Sheets
- [x] NC Division of Water Resources Stream Identification Forms
- [ ] Other Assessment Forms

[7] www.saw.usace.army.mil/Portals/59/docs/regulatory/regdocs/JD/RGL_08-02_App_A_Prelim_JD_Form_fillable.pdf
[8] Please see http://www.saw.usace.army.mil/Missions/Regulatory-Permit-Program/Jurisdiction/

Principal Purpose: The information that you provide will be used in evaluating your request to determine whether there are any aquatic resources within the project area subject to federal jurisdiction under the regulatory authorities referenced above.
Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public, and may be made available as part of a public notice as required by federal law. Your name and property location where federal jurisdiction is to be determined will be included in the approved jurisdictional determination (AJD), which will be made available to the public on the District's website and on the Headquarters USAGE website.
Disclosure: Submission of requested information is voluntary; however, if information is not provided, the request for an AJD cannot be evaluated nor can an AJD be issued.

July 24, 2018

US Army Corps of Engineers
Raleigh Regulatory Field Office
Attn: Ross Sullivan
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

Subject: **Odell's House Stream and Wetland Mitigation Project, Preliminary Jurisdictional Determination Concurrence Request, Johnston County, NC**

Dear Ross:

Please find the attached Preliminary Jurisdictional Determination Request attached for the Odell's House Stream and Wetland Mitigation Project. The project is located in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge. Attached you will find the following:

- Preliminary Jurisdictional Determination (PJD) Form
- North Carolina Division of Mitigation Services Landowner Authorization Form
- Three Maps: Project Vicinity Map, USGS Topographic Map, and Preliminary Jurisdictional Waters Map.
- Army Corps of Engineers Wetland Determination Forms
- NC DWR Stream Identification Forms

If you need any additional information, please feel free to contact me directly.

Sincerely,

Chris Sheats

10940 Raven Ridge Road, Suite 200
Raleigh, NC 27614
Office Phone: (919)614-5111
Mobile Phone: (919) 417-2732
Email: chris@waterlandsolution.com

Appendix 2 - PRELIMINARY JURISDICTIONAL DETERMINATION (PJD) FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PJD: 7-11-18

B. NAME AND ADDRESS OF PERSON REQUESTING PJD: Chris Sheats, 10940 Raven Ridge Road, Suite 200, Raleigh, NC 27614

C. DISTRICT OFFICE, FILE NAME, AND NUMBER:

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:
(USE THE TABLE BELOW TO DOCUMENT MULTIPLE AQUATIC RESOURCES AND/OR AQUATIC RESOURCES AT DIFFERENT SITES)

State: NC County/parish/borough: Johnston City: Wendell

Center coordinates of site (lat/long in degree decimal format):

Lat.: 35.71836 Long.:

Universal Transverse Mercator: 17

Name of nearest waterbody: Buffalo Creek

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

☐ Office (Desk) Determination. Date: 8-1-18

☐ Field Determination. Date(s):

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

Site number	Latitude (decimal degrees)	Longitude (decimal degrees)	Estimated amount of aquatic resource in review area (acreage and linear feet, if applicable)	Type of aquatic resource (i.e., wetland vs. non-wetland waters)	Geographic authority to which the aquatic resource "may be" subject (i.e., Section 404 or Section 10/404)
		See	Attached	Table	

1) The Corps of Engineers believes that there may be jurisdictional aquatic resources in the review area, and the requestor of this PJD is hereby advised of his or her option to request and obtain an approved JD (AJD) for that review area based on an informed decision after having discussed the various types of JDs and their characteristics and circumstances when they may be appropriate.

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

SUPPORTING DATA. Data reviewed for PJD (check all that apply)

Checked items should be included in subject file. Appropriately reference sources below where indicated for all checked items:

- [x] Maps, plans, plots or plat submitted by or on behalf of the PJD requestor:
  Map: ________________________.
- [x] Data sheets prepared/submitted by or on behalf of the PJD requestor.
  - [ ] Office concurs with data sheets/delineation report.
  - [ ] Office does not concur with data sheets/delineation report. Rationale: ____________.
- [ ] Data sheets prepared by the Corps: ________________________.
- [ ] Corps navigable waters' study: ________________________.
- [ ] U.S. Geological Survey Hydrologic Atlas: ________________________.
  - [ ] USGS NHD data.
  - [ ] USGS 8 and 12 digit HUC maps.
- [x] U.S. Geological Survey map(s). Cite scale & quad name: 1:24,000 Flowers.
- [x] Natural Resources Conservation Service Soil Survey. Citation: 1994 Johnston County Soil Survey.
- [ ] National wetlands inventory map(s). Cite name: ________________________.
- [ ] State/local wetland inventory map(s): ________________________.
- [ ] FEMA/FIRM maps: ________________________.
- [ ] 100-year Floodplain Elevation is: ____________.(National Geodetic Vertical Datum of 1929)
- [ ] Photographs: [ ] Aerial (Name & Date): ________________________.
  or [ ] Other (Name & Date): ________________________.
- [ ] Previous determination(s). File no. and date of response letter: ____________.
- [ ] Other information (please specify): ________________________.

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.

________________________	*Chris M. Sheats*
Signature and date of Regulatory staff member completing PJD	Signature and date of person requesting PJD (REQUIRED, unless obtaining the signature is impracticable)[1]

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

Site #	Latitude	Longitude	Estimated amount of resource in review area (acreage and linear ft, if applicable)	Type of aquatic resource (i.e. wetland vs. non-wetland waters)	Geographic authority to which the aquatic resource “may be” subject (i.e. Section 404 or Section 10/401)
WA	35.71836	-78.35045	0.77 ac	Wetland	Section 404/401
WB	35.71706	-78.35041	0.45 ac	Wetland	Section 404/401
WC	35.71488	-78.35246	0.011 ac	Wetland	Section 404/401
WD	35.71495	-78.35319	0.14 ac	Wetland	Section 404/401
WE	35.71614	-78.35592	5.14 ac	Wetland	Section 404/401
WF	35.71809	-78.35295	0.24 ac	Wetland	Section 404/401
WG	35.71966	-78.35034	0.31 ac	Wetland	Section 404/401
SA	35.71784	-78.35037	2040 lf	Non-wetland	Section 404/401
SB	35.71698	-78.35443	1490 lf	Non-wetland	Section 404/401
Pond 1	35.717758	-78.35351	1.82 ac	Non-wetland	Section 404/401
Pond 2	35.71902	-78.35044	1.63 ac	Non-wetland	Section 404/401
Pond 3	35.71590	-78.35556	0.045 ac	Non-wetland	Section 401/404

NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM
LANDOWNER AUTHORIZATION FORM

PROPERTY LEGAL DESCRITION:

Deed Book: ________ **Page:** ________ **County:** Johnston

Parcel ID Number: 179100-16-8552, containing 97.81 acres, more or less

Street Address: 100 Salem Church Road

Wendell, NC 27591

Property Owner (please print): W. Odell Edwards Irrevocable Trust, Melanie E. Durham, Trustee

Property Owner (please print): N/A

The undersigned, registered property owner(s) of the above property, do hereby authorize

Water & Land Solutions, LLC

Full Delivery Provider[1], the NC Department of Environment and Natural Resources, and the US Army Corps of Engineers, their employees, agents or assigns to have reasonable access to the above referenced property for the evaluation of the property as a potential stream, wetland and/or riparian buffer mitigation project, including conducting stream and/or wetland determinations and delineations, as well as issuance and acceptance of any required permit(s) or certification(s).

Property Owners(s) Address: 337 Jackson Road
(if different from above)

Four Oaks, NC 27524-9031

Property Owner Telephone Number: 919-915-1561

Property Owner Telephone Number: N/A

I/We hereby certify the above information to be true and accurate to the best of my/our knowledge.

Melanie E. Durham, Trustee 1/23/2018

(Property Owner Authorized Signature) **(Date)**

N/A

(Property Owner Authorized Signature) **(Date)**

[1]Name of full delivery company

NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM
LANDOWNER AUTHORIZATION FORM

PROPERTY LEGAL DESCRITION:

Deed Book: 04838 **Page:** 0740 **County:** Johnston

Parcel ID Number: 179100-36-0446, containing 23.15 acres, more or less

Street Address: N/A

Property Owner (please print): Randy L. Edwards

Property Owner (please print): Rhonda B. Edwards

The undersigned, registered property owner(s) of the above property, do hereby authorize

Water & Land Solutions, LLC

Full Delivery Provider[1], the NC Department of Environment and Natural Resources, and the US Army Corps of Engineers, their employees, agents or assigns to have reasonable access to the above referenced property for the evaluation of the property as a potential stream, wetland and/or riparian buffer mitigation project, including conducting stream and/or wetland determinations and delineations, as well as issuance and acceptance of any required permit(s) or certification(s).

Property Owners(s) Address: 2505 Wendell Road
(if different from above)
Wendell, NC 27591-8691

Property Owner Telephone Number: 919-449-6437

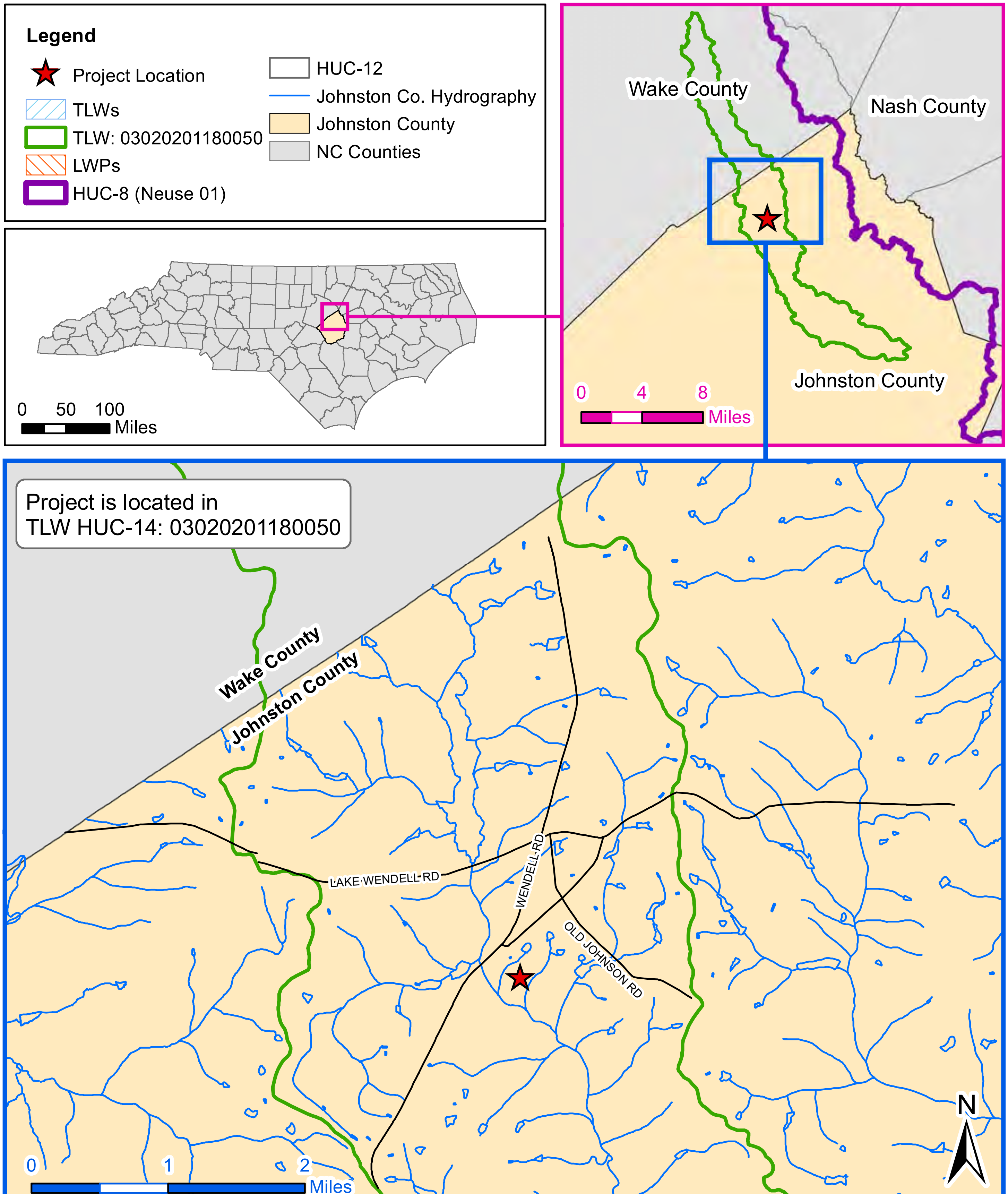
Property Owner Telephone Number: N/A

I/We hereby certify the above information to be true and accurate to the best of my/our knowledge.

Randy L Edwards 1-23-18
(Property Owner Authorized Signature) **(Date)**

Rhonda B Edwards 1-23-18
(Property Owner Authorized Signature) **(Date)**

[1]Name of full delivery company



WATER & LAND SOLUTIONS

Odell's House
Mitigation Project

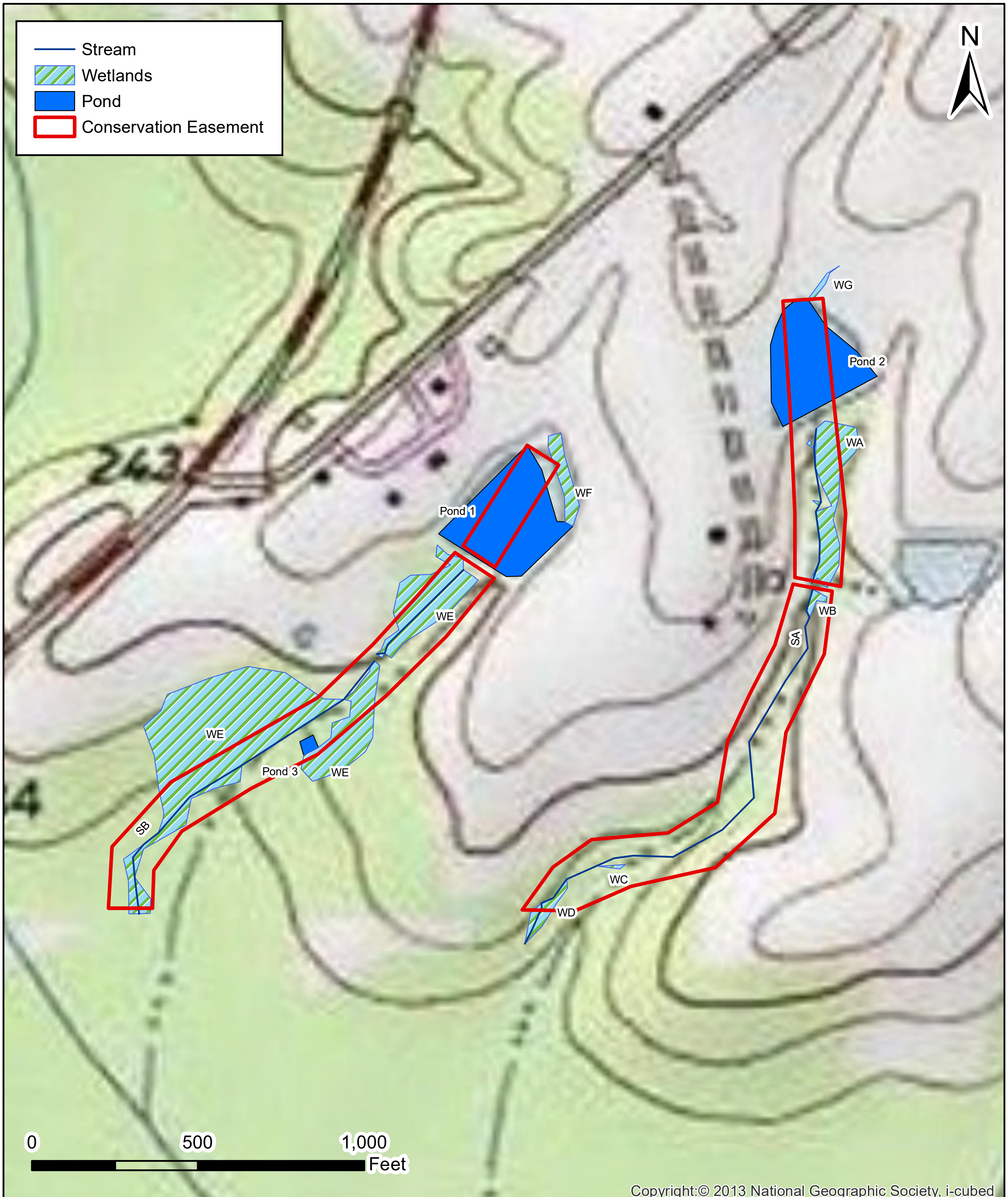
Johnston County, North Carolina

Project Location

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE

1



WATER & LAND SOLUTIONS

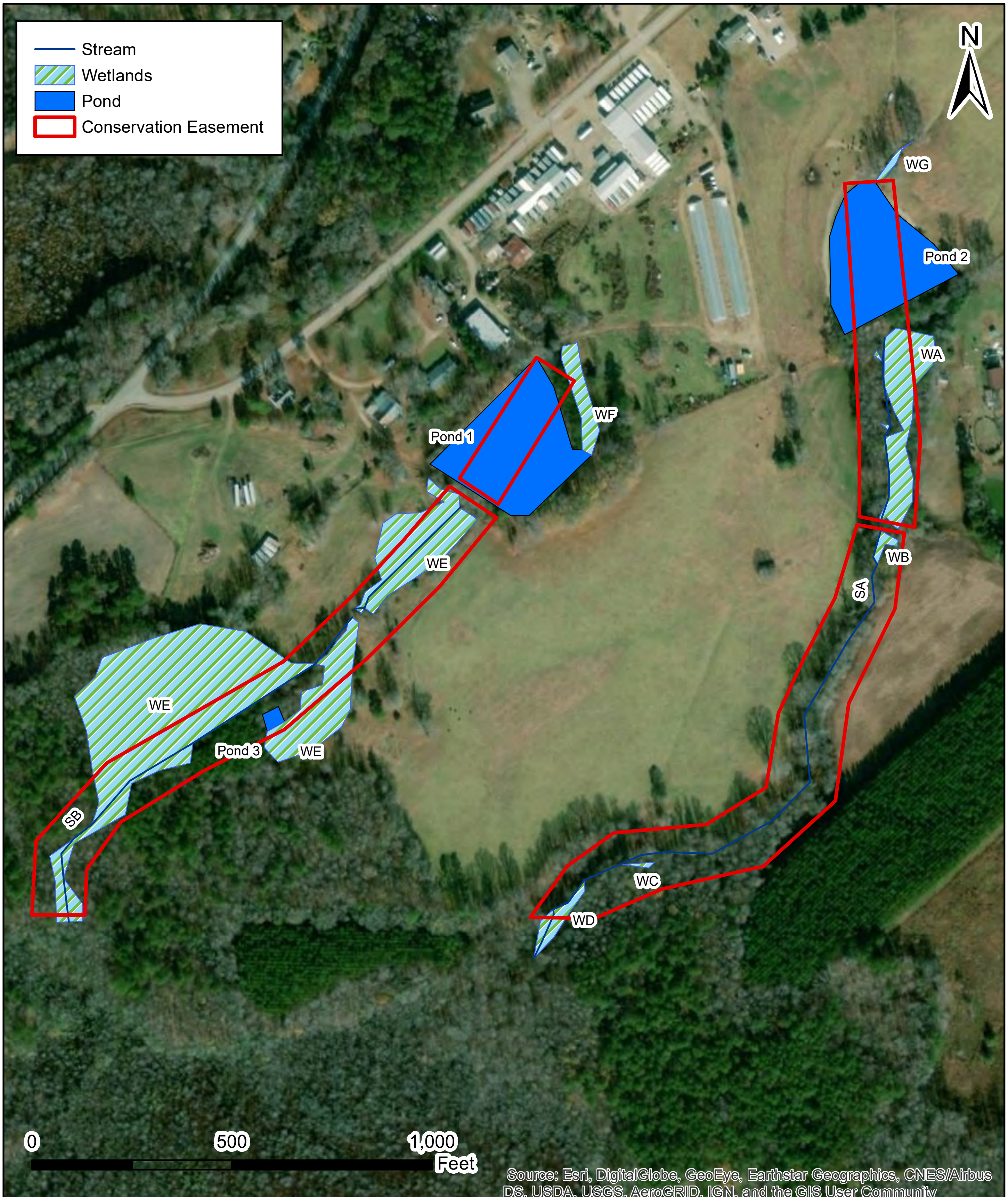
Odell's House Mitigation Project

Johnston County, North Carolina

USGS Topographic Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 2



WATER & LAND SOLUTIONS

Odell's House Mitigation Project

Johnston County, North Carolina

Jurisdictional Waters Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 3

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Odell's House Stream and Wetland Mitigation Project City/County: Johnston Sampling Date: 4-27-18

Applicant/Owner: Water and Land Solutions State: NC Sampling Point: WA-9

Investigator(s): Chris Sheats Section, Township, Range: Wendell

Landform (hillside, terrace, etc.): floodplain Local relief (concave, convex, none): concave Slope (%): 0-1

Subregion (LRR or MLRA): LRR P, MLRA 136 Lat: 35.71809 Long: -78.35012 Datum: NAD 83

Soil Map Unit Name: Cowarts Loamy sand NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation No , Soil No , or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation No , Soil No , or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	

Remarks:
Wetlands WA, WB, WC, WD, and WE share similar characteristics and are represented here in this form. Data for this form was collected from Wetland WA.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ True Aquatic Plants (B14)	
X High Water Table (A2)	___ Hydrogen Sulfide Odor (C1)	
x Saturation (A3)	x Oxidized Rhizospheres on Living Roots (C3)	
___ Water Marks (B1)	___ Presence of Reduced Iron (C4)	
___ Sediment Deposits (B2)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Drift Deposits (B3)	___ Thin Muck Surface (C7)	
___ Algal Mat or Crust (B4)	___ Other (Explain in Remarks)	
___ Iron Deposits (B5)		
___ Inundation Visible on Aerial Imagery (B7)		
x Water-Stained Leaves (B9)		
___ Aquatic Fauna (B13)		

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
x Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
x Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
x Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 10
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 4

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants.

Sampling Point: WA-9

Tree Stratum (Plot size: 30ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	55	Yes	FAC
2. *Fraxinus pennsylvanica*	30	Yes	FACW
3. *Ulmus rubra*	20	No	FAC
4.			
5.			
6.			
7.			
	105	=Total Cover	
50% of total cover: 53		20% of total cover:	21

Sapling/Shrub Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	45	Yes	FAC
2. *Ulmus rubra*	25	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	70	=Total Cover	
50% of total cover: 35		20% of total cover:	14

Herb Stratum (Plot size: 20)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Saururus cernuus*	40	Yes	OBL
2. *Woodwardia areolata*	20	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	60	=Total Cover	
50% of total cover: 30		20% of total cover:	12

Woody Vine Stratum (Plot size: 20)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Smilax rotundifolia*	10	Yes	FAC
2.			
3.			
4.			
5.			
	10	=Total Cover	
50% of total cover: 5		20% of total cover:	2

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
Sampling point located upslope from wetland boundary.

SOIL

Sampling Point: WA-9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 2/1	100					Loamy/Clayey	
4-10	10YR 4/2	90	10yr 5/6	10	c	m	Loamy/Clayey	Prominent redox concentrations
10-16	10YR 5/2	75	10yr 5/6	25	c	m	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
_X_ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Mucky Mineral (F1) **(MLRA 136)**
___ Loamy Gleyed Matrix (F2)
_X_ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 122, 136)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks:
This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Odell's House Stream and Wetland Mitigation Project City/County: Johnston Sampling Date: 4-27-18

Applicant/Owner: Water and Land Solutions State: NC Sampling Point: WF-3

Investigator(s): Chris Sheats Section, Township, Range: Wendell

Landform (hillside, terrace, etc.): depression Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR or MLRA): LRR P, MLRA 136 Lat: 35.71813 Long: -78.35284 Datum: NAD 83

Soil Map Unit Name: Cowarts Loamy sand NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation No , Soil No , or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation No , Soil No , or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	

Remarks:
Wetlands WF and WG share similar characteristics and are represented here in this form. Data for this form was collected from Wetland WF.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ True Aquatic Plants (B14)
___ High Water Table (A2)	___ Hydrogen Sulfide Odor (C1)
x Saturation (A3)	x Oxidized Rhizospheres on Living Roots (C3)
___ Water Marks (B1)	___ Presence of Reduced Iron (C4)
___ Sediment Deposits (B2)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Drift Deposits (B3)	___ Thin Muck Surface (C7)
___ Algal Mat or Crust (B4)	___ Other (Explain in Remarks)
___ Iron Deposits (B5)	
___ Inundation Visible on Aerial Imagery (B7)	
x Water-Stained Leaves (B9)	
___ Aquatic Fauna (B13)	

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
x Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
x Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 4

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: WF-3

Tree Stratum (Plot size: 30ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Taxodium distichum*	35	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
	35	=Total Cover	
50% of total cover: 18		20% of total cover:	7

Sapling/Shrub Stratum (Plot size: 30ft)			
1. *Taxodium distichum*	45	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	45	=Total Cover	
50% of total cover: 23		20% of total cover:	9

Herb Stratum (Plot size: 10ft)			
1. *Murdannia keisak*	20	Yes	OBL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	20	=Total Cover	
50% of total cover: 10		20% of total cover:	4

Woody Vine Stratum (Plot size: 10ft)			
1.			
2.			
3.			
4.			
5.			
		=Total Cover	
50% of total cover:		20% of total cover:	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
Sampling point located upslope from wetland boundary.

SOIL

Sampling Point: WF-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-3	10yr 2/1	100					Loamy/Clayey	
3-14	10yr 4/1	85	10yr 5/6	15	c	m	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
X Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Mucky Mineral (F1) **(MLRA 136)**
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 122, 136)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):
Type: ___
Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:
This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

WETLAND DETERMINATION DATA SHEET – Eastern Mountains and Piedmont Region

Project/Site: Odell's House Stream and Wetland Mitigation Project City/County: Johnston Sampling Date: 4-27-18

Applicant/Owner: Water and Land Solutions State: NC Sampling Point: WA-9

Investigator(s): Chris Sheats Section, Township, Range: Wendell

Landform (hillside, terrace, etc.): hillside Local relief (concave, convex, none): slope Slope (%): 20

Subregion (LRR or MLRA): LRR P, MLRA 136 Lat: 35.71815 Long: -78.35003 Datum: NAD 83

Soil Map Unit Name: Cowarts loam sand NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation No , Soil No , or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation No , Soil No , or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes ___	No X	

Remarks:
The uplands adjacent to wetlands WA, WB, WC, WD, and WE share similar characteristics and are represented on this form. Information for this data form was collected within Wetland WA.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ True Aquatic Plants (B14)
___ High Water Table (A2)	___ Hydrogen Sulfide Odor (C1)
___ Saturation (A3)	___ Oxidized Rhizospheres on Living Roots (C3)
___ Water Marks (B1)	___ Presence of Reduced Iron (C4)
___ Sediment Deposits (B2)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Drift Deposits (B3)	___ Thin Muck Surface (C7)
___ Algal Mat or Crust (B4)	___ Other (Explain in Remarks)
___ Iron Deposits (B5)	
___ Inundation Visible on Aerial Imagery (B7)	
___ Water-Stained Leaves (B9)	
___ Aquatic Fauna (B13)	

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Sparsely Vegetated Concave Surface (B8)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Four Strata) – Use scientific names of plants. Sampling Point: WA-9

Tree Stratum (Plot size: 30ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	40	Yes	FAC
2. *Fraxinus pennsylvanica*	20	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	60	=Total Cover	
50% of total cover:	30	20% of total cover:	12
Sapling/Shrub Stratum (Plot size: 30ft)			
1. *Acer rubrum*	20	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
	20	=Total Cover	
50% of total cover:	10	20% of total cover:	4
Herb Stratum (Plot size: 30ft)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
		=Total Cover	
50% of total cover:		20% of total cover:	
Woody Vine Stratum (Plot size: 30ft)			
1. *Smilax rotundifolia*	25	Yes	FAC
2.			
3.			
4.			
5.			
	25	=Total Cover	
50% of total cover:	13	20% of total cover:	5

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Four Vegetation Strata:

Tree – Woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants, excluding vines, less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody Vine – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
Sampling point located upslope from wetland boundary.

SOIL

Sampling Point: WA-9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 4/4	100					Loamy/Clayey	
4-12	10YR 5/4	100					Loamy/Clayey	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10) **(LRR N)**
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
___ Thin Dark Surface (S9) **(MLRA 147, 148)**
___ Loamy Mucky Mineral (F1) **(MLRA 136)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
___ Umbric Surface (F13) **(MLRA 122, 136)**
___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
___ Red Parent Material (F21) **(MLRA 127, 147, 148)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) **(MLRA 147)**
___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
___ Red Parent Material (F21) **(outside MLRA 127, 147, 148)**
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
This data sheet is revised from Eastern Mountains and Piedmont Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 8.0, 2016.

NC DWQ Stream Identification Form Version 4.11

Date: 9.23.15	Project/Site: Odell's (SITE4) R2	Latitude: 35° 43' 03.66" N
Evaluator: K. VAN STELL	County: JOHNSTON	Longitude: -78° 21' 01.29" W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 32.25	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 17.0)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts GRADE CONTROL @ DAM/XING	0	1	2	3
9. Grade control " "	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

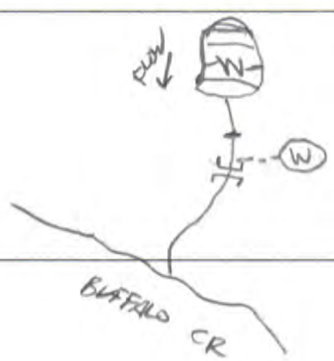
B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 5.75)				
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 WOODWARDIA AREOLATA	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: STREAM FLOW OBSERVED AND APPEARS TO BE SPRING FED FROM U/S POND.

Sketch:



NC DWQ Stream Identification Form Version 4.11

Date: 9.23.15	**Project/Site:** ODELLS (SITE 4) R3	**Latitude:** 35°42'56.84"N
Evaluator: K. VAN STEELE	**County:** JOHNSTON	**Longitude:** -78°21'04.21"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 29.25	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 20.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 6.0)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow * DROUGHT (MOD)	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 2.75)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed IMPATIENS CAP.	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: SURFACE FLOW ONLY IN POOLS, MODERATE DROUGHT CONDITIONS, CHANNEL HAS INCISED AND SUBSURFACE HYDROLOGY IS PRESENT

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 9/23/15	**Project/Site:** ODELLS - R4	**Latitude:** 35°42'52.65" N
Evaluator: K. VAN STELL	**County:** JOHNSTON	**Longitude:** 78°21.11.12" W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 13.0)	Absent	Weak	Moderate	Strong
1[a.] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

B. Hydrology (Subtotal = 6.0)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow * DROUGHT (MOD)	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 4.5)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: WATER OBSERVED IN POOLS ONLY. CHANNEL HAS BEEN EXCAVATED AND CATTLE HAVE TRAMPLED BANKS / POORLY DEFINED CHANNEL GEOMETRY

Sketch:

NC DWQ Stream Identification Form Version 4.11

Date: 9/1/15	Project/Site: ODELLS - R6	Latitude: 35°42'59.59" N
Evaluator: K. VAN STELL	County: JOHNSTON	Longitude: -78°21'17.76" W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 26.25	**Stream Determination (circle one)** **Ephemeral Intermittent Perennial**	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 11.5)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

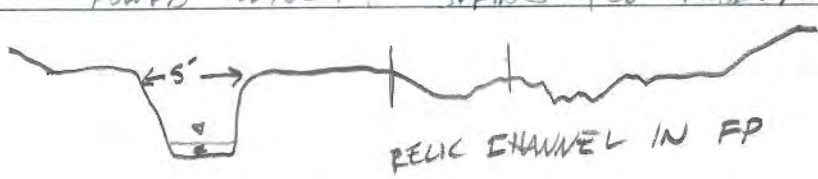
B. Hydrology (Subtotal = 8.5)				
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 6.25)				
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians	0	0.5	1	1.5
25. Algae	0	0.5	1	1.5
26. Wetland plants in streambed CAREX (SEDGE)	FACW = 0.75; OBL = 1.5 Other = 0			

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

Notes: AQUATIC VEG THROUGHOUT REACH. OBSERVED MINIMAL BASEFLOW FROM POND OUTLET. SPRING FED POND. REMNANT CHANNEL IN FP.

Sketch:



NC DWQ Stream Identification Form Version 4.11

Date: 9/1/15	**Project/Site:** ODELLS - R7	**Latitude:** 35°42'54.71"N
Evaluator: K. VAN STELL	**County:** JOHNSTON	**Longitude:** -78°21'25.32"W
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 19.5	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:* FLOWERS

A. Geomorphology (Subtotal = 13.0)	Absent	Weak	Moderate	Strong
1[a] Continuity of channel bed and bank	0	1	2	3
2. Sinuosity of channel along thalweg	0	1	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	1	2	3
4. Particle size of stream substrate	0	1	2	3
5. Active/relict floodplain	0	1	2	3
6. Depositional bars or benches	0	1	2	3
7. Recent alluvial deposits	0	1	2	3
8. Headcuts	0	1	2	3
9. Grade control	0	0.5	1	1.5
10. Natural valley	0	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

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

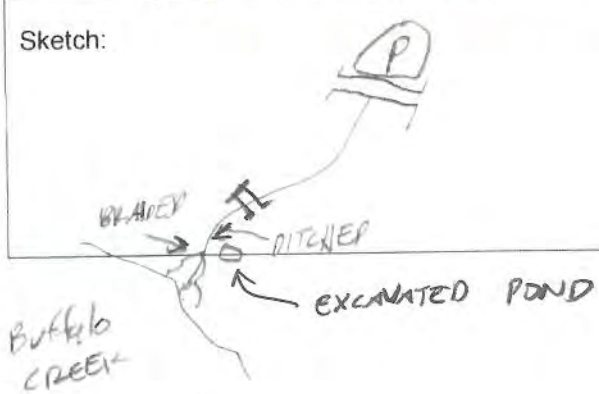
B. Hydrology (Subtotal = 3.5)	Absent	Weak	Moderate	Strong
12. Presence of Baseflow	0	1	2	3
13. Iron oxidizing bacteria	0	1	2	3
14. Leaf litter	1.5	1	0.5	0
15. Sediment on plants or debris	0	0.5	1	1.5
16. Organic debris lines or piles	0	0.5	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 3.0)	Absent	Weak	Moderate	Strong
18. Fibrous roots in streambed	3	2	1	0
19. Rooted upland plants in streambed	3	2	1	0
20. Macrobenthos (note diversity and abundance)	0	1	2	3
21. Aquatic Mollusks	0	1	2	3
22. Fish	0	0.5	1	1.5
23. Crayfish	0	0.5	1	1.5
24. Amphibians (IN POND ONLY)	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: OBSERVED BRAIDED CHANNELS D/S OF POND WITH SPOIL ABUNDANT CRAYFISH HOLES. SEASONAL/PERIODIC FLOW AND INUNDATION

Sketch:



Appendix 10 – Invasive Species Plan

WLS will treat invasive species vegetation within the project area and provide remedial action on a case by-case basis. Common invasive species vegetation, such as Chinese privet (*Ligustrum sinense*), golden bamboo (*Phyllostachys aurea)*, and multiflora rose (*Rosa multiflora*), will be removed to allow native plants to become established within the conservation easement. Invasive species vegetation will be treated by approved mechanical and/or chemical methods such that the percent composition of exotic/invasive species vegetation is less than 5% of the total riparian buffer area. Any control methods requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations. If necessary, these removal treatments (i.e., cutting and/or spraying) will continue until the corrective actions demonstrate that the site is trending towards or meeting the standard monitoring requirement.

Appendix 11 – Approved FHWA Categorical Exclusion Form

WATER & LAND SOLUTIONS
10940 RAVEN RIDGE ROAD, SUITE 200, RALEIGH, NC 27614
(919) 614 - 5111 | waterlandsolutions.com

July 26, 2018

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Lindsay Crocker, Project Manager
217 West Jones Street, Suite 3000-A
Raleigh, NC 27603

RE: Categorical Exclusion for Odell's House Mitigation Project, NCDEQ DMS Full-Delivery Project ID #100041, Contract #7420, Neuse River Basin, Cataloging Unit 03020201, Johnston County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Categorical Exclusion (CE) for the Odell's House Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). Please find enclosed two (2) hard copies of the CE as required. The project site is located in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge. In addition, the project is located in the NCDEQ (formerly NCDENR) Sub-basin 03-04-06, in the Lower Buffalo Creek Priority Sub-watershed 030202011504 study area for the Neuse 01 Regional Watershed Plan (RWP), and in the Targeted Local Watershed 03020201180050, all of the Neuse River Basin.

The Odell's House Mitigation Project is a full-delivery project for the NCDEQ Division of Mitigation Services (DMS) identified and contracted to provide stream mitigation credits for permitted, unavoidable impacts in the Neuse River Basin, Cataloging Unit 03020201. The project will involve restoration, enhancement, and preservation of stream, riparian buffer and riparian wetland functions along unnamed tributaries to Buffalo Creek, a tributary to the Little River, which is a tributary to the Neuse River. The project will involve the potential restoration, enhancement, preservation, and permanent protection of unnamed headwater tributaries (Reaches R1, R2, R3, R4, R5, R6, and R7), totaling approximately 3,646 linear feet of existing streams. In addition, approximately 2.7 acres of degraded riparian wetlands will be returned to their natural function, utilizing wetland restoration (rehabilitation) and enhancement approaches by implementing Priority Level I Stream Restoration, limited removal of overburden soil above the hydric soils, and re-vegetation. The entire restored corridor will be protected by a permanent conservation easement, approximately 13.2 acres in size, to be held by the State of North Carolina. The project site consists of a degraded headwater stream and riparian wetland system that flows through active cattle pastures, into the mature bottomland hardwood floodplain adjacent to Buffalo Creek. The proposed restoration project not only has the potential to provide at least 2,819 stream mitigation credits, and 1.9 Riparian wetland mitigation credits, but will also provide significant ecological improvements and functional uplift through habitat restoration, and through decreasing nutrient and sediment loads from the project watershed.

Based on the review of the United States Fish and Wildlife Service (USFWS) county list (6-27-18), the following species are considered federally-listed in Johnson County:

Species Type	Scientific Name	Common Name	Federal Status Code
Vertebrate	*Picoides borealis*	Red-cockaded woodpecker	E
Invertebrate	*Alasmidonta heterodon*	Dwarf wedgemussel	E
Invertebrate	*Elliptio steinstansana*	Tar River spinymussel	E
Invertebrate	*Elliptio lanceolata*	Yellow lance	T
Vascular Plant	*Rhus michauxii*	Michaux's sumac	E

Definitions of Federal Status Codes:

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."

(Federal status information referenced from http://www.fws.gov/raleigh/species/cntylist/johnston.html)

Vertebrates

Red-cockaded woodpecker (*Picoides borealis)*

Federal Status: Endangered

Habitat Description: The red-cockaded woodpecker (RCW) typically occupies open, mature stands of southern pines, particularly longleaf pine (*Pinus palustris*), for foraging and nesting/roosting habitat. The RCW excavates cavities for nesting and roosting in living pine trees, aged 60 years or older, which are contiguous with pine stands at least 30 years of age to provide foraging habitat. The foraging range of the RCW is normally no more than 0.5 miles.

Suitable habitat for the red-cockaded woodpecker does not exist in the study area. Forests in the study area are comprised of canopy hardwood forests along streams and sheltered slopes. Where loblolly and shortleaf pines occur within the study area, the age or stand density exclude them from being used for either foraging or nesting habitat. Therefore, a half mile survey was not conducted.

Biological Conclusion: No Effect

Suitable nesting (open to semi-open pine stands 60 years or greater in age) and foraging (open to semi-open pine stands 30 years or greater in age) habitat for the red-cockaded woodpecker was not observed in the study area. Forests in the study area are comprised of a mix of deciduous riparian canopy species. Surveys were conducted by WLS staff on April 30, 2018, and RCW's were not observed. A review of the April 2018 NCNHP database indicates no known RCW occurrence within 1.0 mile of the study area.

Invertebrates

Dwarf wedgemussel *(Alasmidonta heterodon)*

Federal Status: Endangered

Habitat: In North Carolina, the dwarf wedgemussel is known from the Neuse and Tar River drainages. The mussel inhabits creek and river areas with a slow to moderate current and sand, gravel, or firm silt bottoms. Water in these areas must be well oxygenated. Stream banks in these areas are generally stable with extensive root systems holding soils in place.

Biological Conclusion: No Effect

Streams were assessed for the presence of freshwater mussels and none nor their associates (e.g. Asian clams) were observed during the stream investigations. Due to the small size and landscape position of the headwater stream systems that comprise the project, suitable habitat was not observed within the project area. A review of the April 2018 NCNHP database indicates no known occurrence within 1.0 mile of the study area.

Tar River spinymussel *(Elliptio steinstansana)*

Federal Status: Endangered

Habitat: The Tar River spinymussel is endemic to the Tar and Neuse River drainage basins in North Carolina. This mussel requires a stream with fast flowing, well-oxygenated, circumneutral pH water. The bottom should be composed of unconsolidated gravel and coarse sand. The water needs to be relatively silt-free, and stream banks should be stable, typically with many roots from adjacent riparian trees and shrubs.

Biological Conclusion: No Effect

Streams were assessed for the presence of freshwater mussels and none nor their associates (e.g. Asian clams) were observed during the stream investigations. Due to the small size and landscape position of the headwater stream systems that comprise the project, suitable habitat was not observed within the project area. A review of the April 2018 NCNHP database indicates no known occurrence within 1.0 mile of the study area.

Yellow lance (*Elliptio lanceolata*)

Federal Status: Threatened

Habitat: In North Carolina, the yellow lance is known from the Neuse and Tar River drainages. This species has been found in multiple physiographic provinces, from the foothills of the Appalachian Mountains, through the Piedmont and into the Coastal Plain, in small streams to large rivers, in substrates primarily consisting of clean sand, occasionally gravel, with a high dissolved oxygen.

Biological Conclusion: No Effect

Streams were assessed for the presence of freshwater mussels and none nor their associates (e.g. Asian clams) were observed during the stream investigations. Due to the small size and landscape position of the headwater stream systems that comprise the project, suitable habitat was not observed within the project area. A review of the April 2018 NCNHP database indicates no known occurrence within 1.0 mile of the study area.

Vascular Plants

Michaux's sumac *(Rhus michauxii)*

Federal Status: Endangered

Habitat: Michaux's sumac, endemic to the inner Coastal Plain and lower Piedmont, grows in sandy or rocky, open, upland woods on acidic or circumneutral, well-drained sands or sandy loam soils with low cation exchange capacities. The species is also found on sandy or submesic loamy swales and depressions in the fall line Sandhills region as well as in openings along the rim of Carolina bays; maintained railroad, roadside, power line, and utility rights-of-way; areas where forest canopies have been opened up by blowdowns and/or storm damage; small wildlife food plots; abandoned building sites; under sparse to moderately dense pine or pine/hardwood canopies; and in and along edges of other artificially maintained clearings undergoing natural succession. In the central Piedmont, it occurs on clayey soils derived from mafic rocks. The plant is shade intolerant and, therefore, grows best where disturbance (*e.g.*, mowing, clearing, grazing, periodic fire) maintains its open habitat.

Biological Conclusion: No Effect

Marginal habitat is present for this species along some of the upland forest ecotones. Michaux's sumac currently retains a status of "Historic" in Johnston County. Marginal habitats observed were surveyed for Michaux's sumac and none were found. In addition, a review of the April 2018 NCNHP records indicates no known Michaux's sumac occurrences within 1.0 mile of the study area.

The implementation of the Odell's House Mitigation Project is considered a "Ground-disturbing Activity", and therefore the required "Appendix A, Categorical Exclusion Form for Ecosystem Enhancement Program Projects, Version 1.4" "Checklist" (Parts 1 through 3) has been completed and is attached. Copies of required correspondence and supporting documentation, including the following are also attached:

- Project figures and photolog sent to each of the review/regulatory agencies
    - Figure 1 Project Location
    - Figure 2 USGS Topographic Map
    - Figure 3 NRCS Soils Map
    - Figure 4 LiDAR Map
    - Odell's House Mitigation Project Pre-Restoration Photo Log
- Environmental Data Resources, Inc. (EDR) Environmental Risk Review Report
- Copy of correspondence with and resulting minimal comments from the USFWS
- Copy of correspondence with and resulting minimal comments from the NCWRC
- Copy of correspondence with and resulting finding of "no comment" from the North Carolina State Historic Preservation Office (NCSHPO) due to their finding of no historic resources that would be affected by the project
- NCSHPO Map of Records
- Copy of correspondence with and resulting finding regarding farmland conversion from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)
- USDA Farmland Conversion Impact Rating Worksheet (Form AD-1006)
- Copy of written landowner correspondence required under the Uniform Relocation Assistance and Real Property Acquisition Policies Act

Submission of this Categorical Exclusion document fulfills the environmental documentation requirements mandated under the National Environmental Policy Act (NEPA; 40 CFR Parts 1500-1508).

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

Sincerely,

Water & Land Solutions, LLC

William "Scott" Hunt, III, PE
Vice President of Technical Operations
10940 Raven Ridge Road, Suite 200
Raleigh, NC 27614
Office Phone: (919) 614-5111
Mobile Phone: (919) 270-4646
Email: scott@waterlandsolutions.com

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Odell's House Mitigation Project
County Name:	Johnston County
EEP Number:	DMS Proj. #100041, DMS Contract #7420
Project Sponsor:	Water & Land Solutions, LLC
Project Contact Name:	William "Scott" Hunt, III, PE
Project Contact Address:	10940 Raven Ridge Road, Ste. 200, Raleigh, NC 27614
Project Contact E-mail:	scott@waterlandsolutions.com
DMS Project Manager:	Lindsay Crocker

Project Description

The Odell's House Mitigation Project is a full-delivery project for the NCDEQ Division of Mitigation Services (DMS) identified and contracted to provide stream mitigation credits for permitted, unavoidable impacts in the Neuse River Basin, Cataloging Unit 03020201. The project will involve restoration, enhancement, and preservation of stream, riparian buffer and riparian wetland functions along unnamed tributaries to Buffalo Creek, a tributary to the Little River, which is a tributary to the Neuse River. The project will involve the potential restoration, enhancement, preservation, and permanent protection of unnamed headwater tributaries (Reaches R1, R2, R3, R4, R5, R6, and R7), totaling approximately 3,646 linear feet of existing streams. In addition, approximately 2.7 acres of degraded riparian wetlands will be returned to their natural function, utilizing wetland restoration (rehabilitation) and enhancement approaches by implementing Priority Level I Stream Restoration, limited removal of overburden soil above the hydric soils, and re-vegetation. Combinations of different measures or "project clusters", will be implemented collectively, along with the stream restoration, for a combined effect, to include riparian wetland restoration, riparian buffer restoration, water quality improvement features, and agricultural best management practices (BMPs). The proposed restoration project will provide significant ecological improvements and functional uplift through habitat restoration, and through decreasing nutrient and sediment loads from the project watershed. The project site is located in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge.

For Official Use Only

Reviewed By:

7/30/2018 — **Date**

LHCrocker — **DMS Project Manager**

Conditional Approved By:

Date

For Division Administrator FHWA

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

Final Approval By:

7-30-18 — **Date**

[signature] — **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

Appendix 12 – Agency Correspondence & Floodplain Checklist

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:	Odell's House Mitigation Project
Name if stream or feature:	Unnamed tributaries to Buffalo Creek
County:	Johnston
Name of river basin:	Neuse
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Johnston County
DFIRM panel number for entire site:	1780 (map number 3720178000J, effective date 12/02/05)
Consultant name:	Water & Land Solutions, LLC
Phone number:	919-614-5111
Address:	7721 Six Forks Road, Suite 130 Raleigh, NC 27615

Design Information

The Odell's House Mitigation Project (Project) is located in Johnston County between the Community of Archer Lodge and the Town of Wendell within a rural watershed in Johnston County, within the Neuse River Basin and USGS 14-digit HUC 03020201180050. The Project proposes to restore, enhance, and preserve approximately 4,453 linear feet of stream, and provide a water quality benefit for a 141 acre drainage area. The purpose of the project is to restore, preserve and/or enhance stream, wetland and riparian buffer functions to impaired channels that flow through the site. The project will provide numerous water quality and ecological benefits within the Buffalo Creek watershed and the Neuse River Basin. The stream mitigation components are summarized in the table below.

Reach Name	Length (feet)	Mitigation Type
R1	429	Stream Restoration (PI)
R2	568	Stream Enhancement Level I
R3	1,091	Stream Restoration (PI)
R4	341	Stream Enhancement Level II
R5	364	Stream Restoration (PI)
R6	623	Stream Restoration (PI)
R7 (upper)	625	Stream Enhancement Level II
R7 (lower)	412	Stream Preservation

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

◉ Yes ○ No

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

☐ Redelineation

☑ Detailed Study

☐ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation: Portion of R7 in Zone AE

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: Johnston County Planning Director, Berry Gray, Phone Number: 919-989-5150

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:
N/a

Comments:
Approximately 52 feet of lower R7 is in Zone AE, however, this reach is proposed for preservation and no channel activities are proposed that will modify the existing floodplain elevation and/or channel profile, therefore no FEMA floodplain impacts are anticipated as a result of the project.

Name: KAYNE VANSTELL Signature: Kayne VanStell

Title: VP, ECOSYSTEM DESIGN Date: 1.22.20

2180000 FEET | 78°23'30"W | 78°23'0"W | 78°22'30"W | 78°22'0"W | 78°21'30"W | 78°21'0"W | 78°20'30"W | 78°20'0"W | 2200000 FEET

720000 FEET

700000 FEET

78°23'30"W | 78°23'0"W | 78°22'30"W | 78°22'0"W | 78°21'30"W | 78°21'0"W | 78°20'30"W | 78°20'0"W

2180000 FEET | 2200000 FEET

NORTH CAROLINA Cooperating Technical State — FEMA'S COOPERATING TECHNICAL PARTNER

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://FRIS.NC.GOV/FRIS

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A,V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
OTHER AREAS	Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Accredited or Provisionally Accredited Levee, Dike, or Floodwall
	Non-accredited Levee, Dike, or Floodwall
	BM5510 North Carolina Geodetic Survey bench mark
	BM5510 National Geodetic Survey bench mark
	BM5510 Contractor Est. NCFMP Survey bench mark
	012 — 18.2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
OTHER FEATURES	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at http://www.ncfloodmaps.com, or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the North Carolina Floodplain Mapping Program (NCFMP). The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/habitatconservation/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area | Otherwise Protected Area

SCALE

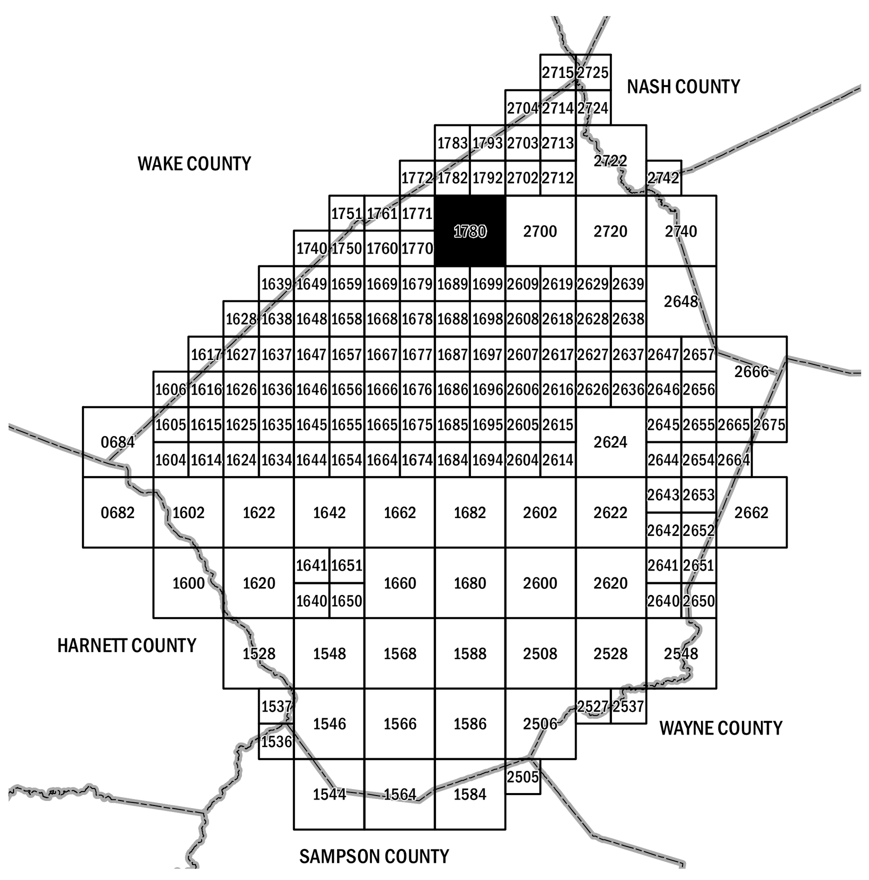
Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 1,000 feet | 1:12,000

0 500 1,000 2,000 Feet

0 150 300 600 Meters

PANEL LOCATOR



FEMA
National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 1780

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
JOHNSTON COUNTY	370138	1780	J

MAP NUMBER
3720178000J

MAP REVISED
12/02/05

WATER & LAND SOLUTIONS

Meeting Minutes

Neuse 03020201 DMS Full-Delivery Project:

Odell's House Mitigation Project (DMS Contract #7420, Proj. ID# 100041)

Subject: NCIRT Post-Contract Site Meeting

Date Prepared: March 31st, 2018

Meeting Date and Time: February 21, 2018 @ 1300

Meeting Location: On-site (Johnston County, NC)

Recorded By: Catherine Manner**,** Kayne VanStell, and Scott Hunt

Attendees: USACE: Henry Wicker (NCIRT), Ross Sullivan

NCDEQ DWR: Mac Haupt (NCIRT) and Katie Merritt

NCDEQ DMS: Jeff Schaffer

NCWRC: Travis Wilson (NCIRT)

WLS: Catherine Manner, Kayne VanStell, and Scott Hunt

These meeting minutes document notes and discussion points from the North Carolina Interagency Review Team (NCIRT) Post-Contract Site Meeting for the Odell's House Mitigation Project (Neuse River Basin, CU 03020201). This full-delivery project was contracted on January 11th, 2018, by the North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS), with Water & Land Solutions, LLC (WLS), under RFP 16-007279. The project site is located in Johnston County, near Wendell, North Carolina.

The Odell's House Mitigation Project site visit began after lunch circa 1300 directly after the Buffalo Creek Tributaries site visit. The meeting started with a general summary of the overall project concepts. After the project introduction and overview, attendees toured the project site to review existing conditions and proposed mitigation types, strategies, and design concepts. The project site review notes are presented below in the order they were visited.

1. The group began at R1 and discussing the pond dam removal. Mac suggested being conservative with where WLS start their jurisdictional stream call. There was discussion on the best approach for restoring the stream through the pond bottom, excavating a new channel was highly recommended. Everyone agreed with WLS that removing the dam and constructing a new channel was the appropriate restoration approach.
2. Mac and Travis had concerns with how much work it would take to remove all the bamboo invasive species vegetation. Mac noted Enhancement Level I would be acceptable for the level of effort to remove the dense bamboo ticket and regrade the stream banks. The group generally agreed with the approach. WLS noted the comment and will adjust proposed credits in the mitigation plan accordingly.
3. Ross had concerns about W2 and if it had wetland hydrology. Kayne noted that removing the pond dam and raising the downstream bed elevation will improve the natural flow regime and wetland hydrology.
4. The group observed the head cut below the existing culvert crossing and agreed with WLS Priority Level I restoration approach along R3.
5. The group discussed R4 mitigation credit and Mac stated that the planting was mostly needed on the right bank and typically a 3:1 ratio was given on comparable sites and not 2.5:1 ratio. WLS noted the comment and will adjust proposed credits in the mitigation plan accordingly.
6. Group then walked to across the site to R7. The group generally agreed with stream preservation, but Mac and Ross wanted to observe the transition from R6 (restoration) and R7 (preservation). Both Mac and Ross noted the area in its current condition is more of a flowing linear wetland than a stream and wetland complex. Kayne and Scott explained that WLS is planning on turning the water from the current ditch along R6 into R7 which would result in there being more flow. Mac suggested that this approach would be worthy of Enhancement, however WLS would need to provide flow data to demonstrate that the historic stream is flowing in its natural valley and not just functioning as a wetland. WLS noted the comment and will adjust proposed credits and design rationale in the mitigation plan accordingly.
7. The group then walked up to R6 where everyone agreed with WLS restoration approach. Kayne showed the group what was likely the old stream channel. WLS noted the restoration approach was to remove the exiting pond dam and return the flow back into this remnant channel feature. The group agreed with removing the existing pond dam and the overall restoration approach.
8. Site visit ended with some group members looking at R1 conditions above the existing pond. Katie Merritt noted that the channel upstream of R1 pond is likely ephemeral and a conveyance, therefore available for nutrient offset crediting. DWR will need to conduct stream verifications for riparian buffer mitigation crediting viability along R1. Katie Merritt also suggested that WLS coordinate with both DWR and the USACE for stream verifications in order to ensure consensus on said calls. Katie Merritt further explained that she is comfortable with awarding riparian buffer mitigation credits for reaches that the USACE is approving for stream mitigation credits. This

decision satisfies Katie Merritt requirement for USACE "concurrence" for reaches that are eligible for riparian buffer mitigation credit generation.

Concluding Comments

The above minutes represents Water & Land Solutions' interpretation and understanding of the meeting discussion and actions. If recipients of these minutes should find any information contained in these minutes to be in error, incomplete, please notify the author with appropriate corrections and/or additions within five (5) business days to allow adequate time for correction and redistribution.

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
S. DANIEL SMITH
Director

NORTH CAROLINA
Environmental Quality

October 30, 2020

Division of Mitigation Services
Attn: Jeremiah Dow
(via electronic mail: jeremiah.dow@ncdenr.gov)

Re: **Odell's House Riparian Buffer Mitigation Plan Approval**

Dear Mr. Dow,

The Division of Water Resources (DWR) received a draft Mitigation Plan (Plan) from the Division of Mitigation Services (DMS) for the Odell's House site (Site) in 2020. Appendix 13 of this Plan was the Riparian Buffer Mitigation Plan (Buffer Plan) submitted to DWR for review and approval under 15A NCAC 02B .0295 to be used primarily as a buffer mitigation project. DMS prefers flexibility to use this Site for either buffer mitigation or nutrient offset depending on the need, therefore, DWR also reviewed the Buffer Plan for compliance under 15A NCAC 02B .0703. DWR reviewed the Buffer Plan and provided comments and recommendations. DMS submitted a revised Buffer Plan that addressed all comments and recommendations provided by DWR. The table below summarizes the timeline of the Buffer Plan:

Project Site Name	DWR Project ID #	Initial Mitigation Plan Received	Revised Buffer Plan Received (Final Draft)	Location/HUC
Odell's House	2018-0200	May 21, 2020	September 15, 2020	Neuse 03020201 (excluding Falls Watershed)

By copy of this letter, the Final Draft of the Buffer Plan is *approved.* A copy of the final draft can be found online at:
https://edocs.deq.nc.gov/WaterResources/DocView.aspx?id=1291205&dbid=0&repo=WaterResources

Please feel free to call (919) 707-3637 if you have any questions regarding this correspondence.

Sincerely,

DocuSigned by:
Katie Merritt
A43C72700BD543E...

Katie Merritt
401 & Buffer Permitting Branch

cc: DWR File Copy (Katie Merritt & Erin Davis)

Buffer Mitigation Plan Memo

Odell's House Riparian Buffer Mitigation Plan:

DWR #2018-0200v1

NCDEQ DMS Project ID #100041

Date Prepared: September 14, 2020

This memo addresses comments from Katie Merritt with DWR dated 8/26/20 regarding the Odell's House Riparian Buffer Mitigation Plan submittal.

Page 3:

General Comments:

R1 and R5 are proposed as Headwater Stream Restoration and therefore will be reviewed under 0295 (o)(2). Therefore, this plan needs to be edited to address the buffer mitigation areas and credits that are proposed adjacent to R1 and R5. Things to be addressed include the following:
*** buffer credits are measured differently**
***monitoring expectations are different**
***monitoring reports must include details regarding whether performance standards are being achieved for the stream restoration**
***buffer credits are dependent on the streams meeting performance standards as set out in the Stream Mitigation Plan**
***nutrient offset is not viable adjacent to Coastal HW mitigation sites and therefore the Asset Table needs to show "NO" for convertible to nutrient offset**
***Here is the 0295 (o)(2) Rule text:**
"Wooded buffers planted along Outer Coastal Plain headwater stream mitigation sites may also be approved as riparian buffer mitigation credit if the site meets all applicable requirements of Paragraph (n) of this Rule. In addition, all success criteria specified in the approval of the stream mitigation site by the Division shall be met. The area of the buffer shall be measured perpendicular to the length of the valley being restored. The area within the proposed buffer mitigation site shall not also be used as wetland mitigation."
Response: WLS has addressed all of these general comments as they are outlined in the Comments below.

DWR will need to know how WLS/DMS addresses the comments above within the revised Mit Plan. Response: If there are any changes to the mitigation plan per a DWR comment, then that will be specified in the comment response.

Comments:

1. **Add another Figure titled "Nutrient Offset Conceptual Map" and add clarification that this Figure only represents areas that are viable for nutrient offsets if ever DMS converted the RBCs. This table should match the Table 5.0 for what is deemed convertible to Nutrient Offset. see edits on table.** Response: Figure 6A "Nutrient Offset Conceptual Map" has been created to show the areas viable for nutrient offset credit if DMS ever converted the RBCs that are viable for conversion. Table 5 has been updated also.

Page 5:

2. **Add a statement about the Coastal HW Stream mitigation here with rule reference 0295 (o)(2) and indicate the specific section where it will be discussed.** Response: WLS is not proposing Coastal HW Stream mitigation as the project site is not located in the Coastal Plain. The headwater valley restoration approach is similar as we are constructing a small pilot channel within the drained pond bottom. Although the site is located in the Piedmont physiographic province, WLS understands that it will need to follow the Coastal Headwater stream mitigation rule 0295 (o)(2) based on the proposed approach. This statement has been added to page 5 and is discussed further in Section 3.4.
3. **It should be noted that WLS did not acknowledge their intent to perform HW Restoration on R1 and R5 and therefore the site viability letter did not address it.** Response: WLS understands that at the time of the site viability letter WLS didn't mention the headwater restoration because we were not designing it as a coastal headwater stream, but now understand that we must follow the coastal headwater guidance for the headwater reaches R1 and R5 and Rule 0295 (o)(2) is referenced in the Buffer Plan.
4. **Usually there is a section on Regulatory Considerations or something similarly titled. It is preferred that this Plan have a section where information is included on how the provider's mitigation plan complies with the mitigation proposed under 0295 (o) on this site. (Preservation, Coastal HW, Cattle Exclusion Enhancement)...The rules have specific guidelines that must be complied with to use these alternative mitigation options for buffer credits and the Site viability letter is only a piece of that compliance.** Response: In Section 2 Existing Conditions, the regulatory considerations are discussed. We have added a coastal headwater section under Section 3.4. In Section 3.3 Riparian Buffer Enhancement, we have added language to clarify that the riparian buffer enhancement is alternative mitigation and referenced the rule.

Page 9:

5. **With the addition of the 180' power line easement, DWR does not understand why the 55' crossing below R5 is now necessary. Explain why this crossing could not be combined with the CP&L utility crossing or be relocated to be above the site.** Response: WLS understands the concerns regarding aquatic resource impacts due to crossings and site connectivity. WLS works diligently with landowners to reduce easement breaks, crossing proximity and habitat fragmentation. However, we also need to ensure the mitigation project does not adversely affect the landowners current and future farm operations. The Odell's House landowner specifically requested this crossing location at the earliest stages of the project (easement option contract). The utility crossing was unanticipated and identified only during the title work.
6. **Add specifics about R1 and R5 being HW restoration.** Response: Specifics have been given in section 3.4 about R1 and R5.
7. **What efforts will be taken to minimize sediment loss and turbidity downstream when removing the dam?** Response: Sediment loss and turbidity downstream of the dam removal will be minimized by dewatering the pond prior to dam breach. The sediment in the pond will be allowed to dry out enough to allow for proper access by equipment. If soils are not conducive for channel construction, they will be excavated and replaced with suitable soil to allow for a stable channel to be constructed. Project construction will follow the approved sediment control plan developed by a professional engineer.

Page 10:

8. **Parcel preparation should include the dewatering efforts of the two ponds. Explain those efforts and the timeline between dewatering/breaching and project construction. If those efforts are described in the stream mitigation plan, please reference those applicable sections.** Response: Pond dewatering will occur prior to any channel construction. Any flow into the ponds will be routed around the pond through a pump around-operation. Pond soils will be allowed to dry out to allow for proper access and stable channel construction. If soils are deemed not suitable for final channel construction the soils will be removed and replaced with suitable soil. See section 6.5.7 of the Mitigation Plan.
9. **With the riparian areas mostly in compact pasture soils and dense in fescue vegetation, a plan to address how fescue will be treated before initial planting efforts should be included in this section.** Response: WLS does not believe that herbicide treatment of fescue is appropriate for this site due to the adverse environmental impacts. The site preparation includes clearing and grubbing which will help reduce fescue

pressure. Grading activities will also remove much of the fescue seed/root source. The combination of these two techniques will help control fescue regeneration. If fescue becomes pervasive within the conservation easement, WLS will take corrective action during monitoring.

10. **Indicate that no top soil will be removed from the riparian areas slated for riparian restoration. The source of fill material for stream mitigation activities should come from another part of the site where buffer credits are not being sought. It is not clear in this paragraph, that riparian areas will be protected from any topsoil removal.** Response: Topsoil will not be removed from riparian restoration areas where buffer credits are being sought.
11. **It says diffused flow will be maintained. Please explain where and how.** Response: WLS has added a sentence to the second paragraph under Parcel Preparation to address how diffuse flow will be maintained. Diffuse flow will be maintained in the riparian buffers by constructing flat broad floodplains that drain back to the restored stream with little to no concentrated flow.
12. **It is not acceptable to use mechanical equipment periodically within any areas proposed for buffer mitigation. Please expand on what you intend to use as "mechanical". The conservation easement is supposed to restrict this activity to only once if I'm not mistaken. Please revisit the easement language and modify this text where appropriate.** Response: WLS has revised the third paragraph under Parcel Preparation regarding mechanical clearing, which was referring to mowing. In general it is WLS's intent not to use mechanical clearing of invasive species within the conservation easement unless absolutely necessary and approved by DWR.
13. **In reviewing the Plan Sheets it was observed that vernal pools are proposed along R1 and R5. There is no mentioning of vernal pools within this restoration plan. Add those details here and reference those corresponding plan sheets. (Note: The Cover Sheet on Plan Sheet #1 incorrectly references R5 and R1. R5 is actually represented on Plan Sheet #13 (not 9) and R1 is actually represented on Plan Sheet #9 (not 13). When reviewing the revegetation plan sheets (17-19), it is difficult to see whether the vernal pools are included in the "Planted Area". Unless planted with hardwoods and vegetated, the area of the vernal pools cannot be included in the total area for buffer mitigation and must be excluded from credit during the As-Built. Please acknowledge that this is understood and will be handled at As-Built.** Response: Vernal pools are not being proposed as part of the mitigation plan. Areas of "floodplain depression" will be constructed within the old channel and ponds to create a more diverse riparian corridor, provide natural sediment storage and surface flow attenuation, and to balance cut/fill material. WLS has also revised the cover sheet with the correct reach references.
14. **Even though it isn't spelled out here, I appreciate the use of pollinator species in your seed mixes (Plan Sheets 17-19). Please call this out in the text within this section.** Response: WLS has added a sentence in Section 3.2 addressing the use of pollinator species in the seed mixes.

Page 11:

15. **Correct rule reference to .0295 (o)(6) and reference Figure 6 as well as plan sheet #8.** Response: The rule has been updated to reference the correct rule.
16. **Add: Buffer Enhancement via Cattle Exclusion can only generate buffer mitigation credit and is not transferrable into nutrient offset credits.** Response: This statement has been added to section 3.3.
17. **The viability letter indicated that there must be a rigorous management plan proposed to control the invasive bamboo through the entire monitoring period in order to get Enhancement credit. I did not see where this plan was included or described. Add details to comply with the site viability letter. It may be more appropriate to add to the Monitoring sections.** Response: More detailed bamboo eradication discussions have been added to Section 3.3 and Section 4.5. These include the treatment area description, initial removal, and subsequent monitoring/treatment.
18. **Add the percentage of the site in Preservation being used for credit.** Response: The preservation area as a percentage of the total area of buffer mitigation credit is 22.2%. This has been added to Section 3.5.
19. **Revegetation Plan on plan sheets 16-18 is confusing. The areas are shown as Buffer Restoration, Buffer Enhancement & Buffer Preservation. Explain. I noticed that the IRT also made comments similar to this on**

the Stream Mitigation Plan comments. Response: WLS has revised the planting plan to be more clear on areas of buffer restoration and supplemental planting.

20. **What is the proposed minimum planting density you intend to plant? Noting, that 260 should not be the minimum.** Response: The proposed planting density is 680 stems/acre.
21. **What will be in the seed mixes?** Response: Seed mixtures will include species shown on Sheet 17 of the construction plans.

Page 12:

22. **Remove tag alder from the Planting Plan. These trees are proposed to be planted within areas receiving buffer credit and DWR does not support including these in this planting plan.** Response: Tag Alder is removed from the planting plan. Although this is an appropriate native species for this setting and region WLS understands the concern regarding N fixing species.
23. **Any species substitutions will need to also be coordinated with the IRT prior to implementation.** Response: WLS will coordinate with the IRT about species substitutions.
24. **Update the monitoring plan to comply with 0295 (o)(2) for buffer areas adjacent to R1 and R5. These areas will have a minimum of 7 years of monitoring according the IRT. This section should include what all the performance standards will be in order for the riparian areas to be able to generate buffer credits.** Response: Section 4 has been updated to include the monitoring standards applicable to headwater restoration.
25. **Add a vegetation plot to the riparian areas of R1.** Response: A vegetation plot has been added to this area.

Page 13-14:

26. **Add details about the HW areas of R5 and R1 in sections 4.2-4.4.** Response: Details about R5 and R1 have been added into Sections 4.2 – 4.4 regarding performance standards for single-thread channels and headwater channels.

Page 15:

27. **Adjust this section after making edits to the table.** Response: This section has been updated.
28. **Add how many will be Coastal HW Buffer credits.** Response: There will be 71,424.076 headwater buffer credits.

Page 16:

29. **Is this Table 1 or Table 5?** Response: This is table 5.
30. **Check NO for Coastal HW features.** Response: This has been updated in the table.
31. **Check YES in this column when Buffer Credit is chosen as the Credit Type.** Response: This has been updated in the table.
32. **Change Feature Type for R1 and R5 to Coastal HW.** Response: This has been updated in the table.
33. **Do not see this width 101-200 along R1 shown in Figure 8. Explain.** Response: When calculating the buffer credits by valley length on R1 and R5 the area of 101-200 has changed and can been seen on the figure.
34. **If expecting to have the flexibility to convert to nutrient offset as indicated by this table, please add text below the table that speaks to that. If DMS wants to have the flexibility of these credits, DWR needs to see a Nutrient Offset Concept Map added to the figures showing where Nutrient Offset credit is viable. Make sure to exclude the Cattle & Bamboo areas and Coastal HW areas, as well as any areas less than 50'.** Response: DMS would like to have the flexibility to convert to nutrient offset credit and a note has been added below the table. Figure 6A has been added to show the areas where nutrient offset credit is viable the map is titled Nutrient Offset Concept Map.

Figure 1:

35. **Remove the Falls Watershed from this service area. Neither nutrient offset nor Buffer mitigation below Falls can be used to offset mitigation requirements in the Falls. Add "Nutrient Offset" service area since the Table 5 shows the desire for DMS to have the flexibility to convert credits depending on the need.** Response: Figure 1 has been updated. Figure 6A has been added and is called Nutrient Offset Concept Map.

Figure 6:

36. **Add a label for Coastal HW areas.** Response: Labels have been added to the headwater stream areas.

37. **This figure should be titled Buffer Mitigation Conceptual Plan. Please correct.** Response: The figure has been renamed to Buffer Mitigation Conceptual Plan.

Figure 8:

38. **I'd add "Bamboo Management Area" here.** Response: The bamboo management area has been called out on Figure 8.
39. **Add a plot to R1. The data in plots along both R1 and R5 will be performed for 7 years, not 5.** Response: A vegetation plot has been added to R1 and can been seen on Figure 8.

Odell's House Riparian Buffer Mitigation Plan

Riparian Buffer Mitigation Plan

NCDEQ DMS Project ID #100041

DWR #2018-0200v1

Johnston County, North Carolina

Neuse River Basin (HUC 03020201)

Final September 2020

Prepared by:

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1 Introduction

The Odell's House Mitigation Site ("Site") is a riparian buffer mitigation project in conjunction with a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) stream and wetland mitigation project. The Site shall be planned and designed according to the Consolidated Buffer Mitigation Rule 15A NCAC 02B .0295, which became effective on November 1, 2015. The Buffer Mitigation Plan ("Plan") will be designed in concurrence with the Odell's House Mitigation Site (SAW #2018-00431). The draft mitigation plan for the Site has been submitted to the DMS and a categorical exclusion has been approved.

This Site is proposed to provide riparian buffer mitigation credits for unavoidable impacts due to development in the Neuse River Basin, United States Geologic Survey (USGS) 8-digit Hydrologic Unit Code (HUC) 03020201. The Site's buffer mitigation service area is depicted in Figure 1.

The project will meet the general restoration and protection goals outlined in the 2010 Neuse River Basin Restoration Priority Plan (RBRP). More specifically, three out of the four functional goals and objectives outlined in the Wake-Johnston Collaborative Local Watershed Plan (LWP) as well as the Neuse 01 Regional Watershed Plan (RWP) will be met by:

- Reducing sediment and nutrient inputs to the Buffalo Creek Watershed.
- Restoring, preserving and protecting wetlands, streams, riparian buffers and aquatic habitat.
- Implementing agricultural BMPs and stream restoration in rural catchments together as "project clusters".

1.1 Project Location

The Site (35.716526 N, -78.349830W) is located in Johnston County, North Carolina, between the Town of Wendell and the Community of Archer Lodge (Figure 2). The site boundary is within the 8-digit HUC 03020201, in the NCDEQ sub-basin 03-04-06 (Warm Water Thermal Regime) and is located in the Targeted Local Watershed 03020201180050. To access the site from Raleigh, NC, follow US Interstate 540 East towards Wendell/Zebulon. Take Exit 26B towards US Highway 64 East/US Highway 264 East toward Wilson and Rocky Mount. Continue for approximately 2.8 miles and take exit 9 for Smithfield Road. Follow Smithfield Road and Lake Wendell Road to Salem Church Road, and the site entrance will be on the right.

1.2 Project Description

The Site encompasses land along unnamed tributaries to Buffalo Creek in Johnston County, NC, and is characterized by active pastures, fields, and woodlands. Historically, the project stream reaches have been straightened, the streambanks have been impacted by cattle, and there are two in-line farm ponds. This disturbance has resulted in active headcut migration and associated channel widening and bank erosion. Most of the project stream reaches have been completely or partially cleared with some areas of forested or successional riparian buffer. Currently, the project reaches act as significant sources of sediment and nutrient contamination to the project watershed and the Neuse River.

The project will involve the restoration of Neuse buffers and other riparian areas in order to help reduce non-point source discharge of contaminants into streams within the Neuse River basin. The project area is comprised of two easements and is approximately 15.09 acres, which includes the stream and wetland mitigation areas. The Site streams drain to Buffalo Creek which is listed as 'Class C' and Nutrient Sensitive Waters (C; NSW), according to the North Carolina Division of Water Resources (DWR) (2019). Buffalo Creek flows southeast to its confluence with the Little River near Micro, North Carolina. The Little River drains southeast to its confluence with the Neuse River in Goldsboro, North Carolina.

Within the 15.09-acre conservation easement, 3.835 acres will be restored for Neuse buffer credit, 1.928 acres will be restored using headwater buffer restoration, 2.308 acres will be enhanced (1.236 acres of enhancement and 1.072 acres of enhancement via cattle exclusion), and 2.386 acres will be buffer preservation. In general, Neuse buffer widths will extend a minimum width of 50 feet from top of stream banks. At the time of the site viability letter WLS didn't mention the headwater restoration because we were not designing it as a coastal headwater stream, but now understand that the buffer restoration credit adjacent to headwater stream mitigation (R1 and R5) is classified as alternative mitigation under Rule 15A NCAC 02B .0295 (o)(2) and is discussed in Section 3.4. The buffer preservation credit is classified as alternative mitigation under Rule .0295 (o) and is discussed in Section 3.5. The DWR performed an onsite Site Viability for Buffer Mitigation and Nutrient Offset on February 1, 2018 (letter dated February 26, 2018) for the Site (Appendix A). On January 28, 2020 WLS requested two amendments to the previous letter. The first was the extension of the viability assessment be extended through August 26, 2020 and secondly that the riparian land use condition and mitigation type determination along feature 1-R2 be modified to enhancement, if the bamboo is fully removed and treated per rule 15A NCAC 02B (n). The updated viability letter is dated February 19, 2020 (Appendix A).

2 Project Area - Existing Conditions

2.1 Reach Descriptions

The streams at the Site are broken down into eight reaches (R1, R2, R3, R4, R5, R6, R7 upper and R7 lower) totaling approximately 3,683 linear feet of existing streams. Project reaches were differentiated based on drainage area breaks at confluences, changes in restoration/enhancement approaches, and/or changes in intermittent/perennial stream status.

R1 is a small headwater tributary that is currently experiencing backwater effects from a man-made impoundment located 400 feet down valley before the stream flow exits at a pipe outlet. Prior to the farm pond excavation and dam installation, the natural valley slope in this area was approximately one percent. The pond depth at the upstream base of the dam was measured at approximately 8 feet deep. The entire pond perimeter is subject to active water quality stressors, mainly resulting from hoof shear from unrestricted cattle access and riparian buffers less than 10 feet in width. Cattle intrusion and pond excavation have degraded the riparian and aquatic habitat, and poor to no channel definition was observed. The riparian buffer along most of the reach is nonexistent as a result of the removal of riparian vegetation across the floodplain. R1 is actively subject to water quality stressors, mainly in the form of cattle wallowing and minimal riparian buffer widths.

R2 appears to have been historically manipulated. This is evidenced by the straightened pattern of the existing channel. The riparian buffer on the right bank consists of limited understory and some large trees within the floodplain. The riparian buffer on the left valley slope consists of some mature trees with little understory vegetation and a dense cluster of bamboo species.

R3 begins at an existing headcut downstream of the culvert crossing along R2. R3 has experienced historic cattle intrusion and associated trampling for most of its length. Stream bank erosion and vertical instability were observed throughout the reach, and the stream does not appear to have natural floodplain connection. The entire reach is subject to active water quality stressors, mainly resulting from bank erosion and little to no riparian buffer along the right stream bank.

R4 continues from R3 to the downstream end of the project limits. The channel flows south for approximately 350 feet before flowing off the property. R4 is exposed to cattle intrusion along its entire length and the riparian buffer is limited to herbaceous vegetation with a few small and larger trees along its left bank. Although R4 appears to be have been manipulated in the past, it is currently under relatively stable conditions. The lower end of R4 has poor channel definition resulting from past floodplain excavation, cattle intrusion, and associated trampling and wallowing. R4 is subject to water quality stressors, mainly in the form of cattle access and minimal riparian buffer widths.

R5 is a small headwater tributary that is also currently experiencing backwater effects from a man-made impoundment located 360 feet down valley before the stream flow exits at a pipe outlet. The entire pond perimeter is subject to active water quality stressors, mainly resulting from hoof shear from unrestricted cattle access and riparian buffers less than 10 feet in width. Cattle intrusion and pond excavation has degraded the riparian and aquatic habitat, and poor to no channel definition was observed. The riparian buffer along most of the reach is nonexistent as a result of the removal of riparian vegetation across the floodplain. R5 is actively subject to water quality stressors, mainly in the form of cattle wallowing and minimal riparian buffer widths.

R6 begins downstream of the pond dam pipe outlet. R6 below the dam appears to be relatively stable; however, the channel appears to have been straightened and ditched in the past. A small man-made farm pond is located along the left floodplain, and spoil is located along the pond perimeter. The riparian buffer along R6 consists of limited understory some large trees within the floodplain.

R7 upper and lower is mostly stable along the entire reach with native woody riparian buffer vegetation corridor greater than 50 feet on both sides of the channel. Cattle do not have access to this reach, and historically this area has remained relatively undisturbed.

2.2 Existing Wetlands

Based on preliminary site investigations, including hand augered soil borings, it was determined that degraded jurisdictional wetlands are present throughout the headwater tributary systems. After on-site streams were ditched, straightened and/or deepened, groundwater elevations were altered such that many of the historic riparian wetlands along the relic floodplain were drained and lost. These areas have been utilized for agricultural use over the past 60 years and have lost the majority of their historic wetland function. Areas within the site that were cleared or where stream sections were not severely modified maintain the presence of jurisdictional wetlands. A preliminary jurisdictional determination package is provided in Appendix 9 of the Stream and Wetland Mitigation Plan.

2.3 Soils

The Site is in the Northern Outer Piedmont ('45f') US Environmental Protection Agency Level IV Ecoregion and the North Carolina Piedmont Physiographic Province. The Site is in the Raleigh Belt region of the eastern Piedmont physiographic province in a transitional zone near the Eastern Slate Belt and Inner Coastal Plain. As shown on the NRCS Soils Map (Figure 3), there are four main soil types on the Site: Bonneau sand, Cowarts loamy sand, Leaf silt loam, and Wedowee sandy loam. The soils within the floodplain and riparian areas are predominantly mapped Cowarts loamy sand (CoB, Hydric C) and Leaf silty loam (Le, Hydric D).

Table 1. Project Soil Types

Soil Name	Hydric	Description
Bonneau sand (BoA) (6.4% of easement)	No	Well drained soils formed on flats and ridges on marine terraces that are not frequently flooded. Slopes range from 0 to 3% on landscapes with wooded-mixed hardwoods and pine. Areas are typically cultivated. Loamy sand surface layer and sandy loam subsoil.
Cowarts loamy sand (CoB) (46.4% of easement)	No	Well drained soils formed mainly on ridges of marine terraces in the Coastal Plain Region that are not frequently flooded. Slopes range from 2 to 6% on woodlands dominated by oak and pine. Fine sandy loam surface layer and sandy clay loam subsoil.
Leaf silt loam (Le) (29.8% of easement)	Yes	Poorly drained soils that formed in terraces and flats on broad interstream divides that are not frequently flooded. Slopes range from 0 to 2% on land that is predominantly mixed bottomland hardwoods and pines. Some areas are used for ground corn and small grains. Silt loam surface layer and silty clay subsoil.
Wedowee sandy loam (WoB) (2.3% of easement)	No	Well drained soils formed on narrow ridges and on side slopes of uplands in the Piedmont Region. Slopes range from 2 to 8% within land that is mostly wooded and includes a mix of oak, pine, and hickory species. Some areas are cleared for pasture and cropland. Sandy loam surface layer with clay to clay loam subsoil and underlying material.

2.4 Existing Vegetative Communities

Land use surrounding the project area has been primarily for agricultural purposes. Prior to anthropogenic land disturbances, the riparian vegetation community likely consisted of Mesic Mixed Forest (Piedmont Subtype) in the uplands with Alluvial Forest and Piedmont Bottomland Forest in the lower areas and floodplains (Schafale 2012). The existing vegetation within the project area consists of pasture and agricultural fields, planted loblolly pine stands, and mixed successional forest. Many of the riparian and upland areas have a narrow tree canopy and lack understory vegetation due to heavy livestock use and grazing. Widespread channel degradation is likely a result of the alteration of natural drainage patterns and the significant removal of native species vegetation. Many of the riparian and upland areas are dominated by invasive species such as Golden bamboo and Chinese privet.

Table 2. Existing Site Vegetation

	Common Name	Scientific Name
Canopy Vegetation	Red maple	*Acer rubrum*
	Tulip-poplar	*Liriodendron tulipifera*
	Loblolly pine	*Pinus taeda*
	Bald cypress	*Taxodium distichum*
	Green ash	*Fraxinus pennsylvanica*
	American sycamore	*Platanus occidentalis*
Understory & Woody Shrubs	Black willow	*Salix nigra*
	Sweetgum	*Liquidambar styraciflua*
	Golden bamboo	*Phyllostachys aurea*
	Chinese privet	*Ligustrum sinense*
	American holly	*Ilex opaca*
	Eastern red cedar	*Juniperus virginiana*
Herbaceous & Vines	Poison ivy	*Toxicodendron radicans*
	Switchcane	*Arundinaria tecta*
	Greenbrier	*Smilax rotundifolia*
	Multiflora rose	*Rosa multiflora*
	Marsh dewflower	*Murdannia keisak*
	Lady fern	*Athyrium filix-femina*
	Japanese stiltgrass	*Microstegium vimineum*
	Soft rush	*Juncus effusus*

2.5 Threatened and Endangered Species

Based on a review of the US Fish and Wildlife Service (USFWS) database, there are currently five federally-listed threatened and endangered species known to occur in Johnston County: (E) Red-cockaded woodpecker (*Picoides borealis)*, (E) Dwarf wedgemussel (*Alasmidonta heterodon*), (E) Tar river spinymussel (*Parvaspina steinstansana*), (T) Yellow lance (*Elliptio lanceolata*), and (E) Michaux's sumac (*Rhus michauxii)*. Based on coordination with USFWS, project implementation is not anticipated to have a negative impact on these species. WLS requested review and comments from the United States Fish and Wildlife Service on June 26, 2018 in respect to the Odell's House Mitigation Site and its potential impacts on threatened or endangered species. USFWS responded on July 5, 2018 and stated the "proposed action is not likely to adversely affect any federally listed endangered or threatened species, their formally designated critical habitat or species currently proposed for listing under the Act". The approved Categorical Exclusion can be found in Appendix 11 of the Odell's House Stream & Wetland Mitigation Plan.

2.6 Cultural Resources

In accordance with the National Historic Preservation Act, WLS investigated and confirmed that the proposed project area and property do not contain nor are they adjacent to any properties listed in the

National Register of Historic Places or the North Carolina State Historic Preservation Office (NCSHPO). There is a survey only site (Anderson House, JT0650) located 0.12 miles northwest of R1. It is not currently listed in the National Register of Historic Places nor will there be any ground disturbing activities near this site. SHPO was contacted in a letter dated June 26, 2018 and had no concerns on the project site. The approved Categorical Exclusion can be found in Appendix 11 of the Odell's House Stream & Wetland Mitigation Plan.

2.7 Constraints

There is an existing CP&L power line easement secured for future utility corridor expansion. The power line easement is approximately 180' wide and intersects the project boundary as shown on the design plan sheets and figures. The project boundary and proposed mitigation assets exclude these areas within utility easement located along R4 and R6 and W4.

The proposed stream crossings will be culverted (R5 and R3), and the pipe(s) will be correctly sized to the appropriate design storm to ensure proper hydraulic function and stream stability, as well as to promote aquatic passage. The proposed crossings will be 55 feet wide on R5 and 55 feet wide on R2 to accommodate and maintain needed farm equipment access.

2.8 FEMA Floodplain / Floodway Mapping

Approximately 50 feet of R7 is within a FEMA regulated floodplain (Zone 'AE'); however, this reach is proposed for preservation and no channel work will be conducted. While it is not anticipated that there will be issues associated with FEMA permitting or documentation, WLS will coordinate with the local floodplain administrator as needed and prepare the required documentation to obtain approval for any FEMA regulated impacts. In addition, the project will be designed so that any increase in flooding will be contained within the project boundary and will not impact adjacent landowners; therefore, hydrologic trespass will not be a concern.

3 Proposed Neuse Buffer Restoration Plan

Riparian buffer restoration adjacent to streams and ponds, as well as riparian enhancement and preservation in forested areas was approved by the DWR in their letter dated February 26, 2018 and in their updated letter dated February 19, 2020 (Attachment A). This site is also being proposed as a stream and wetland site for DMS, and restoration of riparian buffer areas will be accomplished through the goals and methods outlined by the Odell's House Mitigation Plan (SAW-2018-00431) and the Odell's House Riparian Buffer Mitigation Plan. All riparian buffer restoration mitigation activities along channels will begin from the tops of the banks and extend a maximum of 200 feet perpendicular to the stream channel where possible pursuant to 15A NCAC 02B .0295 (effective November 1, 2015).

Stream restoration is proposed for R3, R6, and a small portion of R2, headwater restoration is proposed for R1 and R5. Restoration activities will include removing the dam and pipe outlet to the ponds and reconnect the new stream channel with its geomorphic floodplain on R1 and R5. Sediment loss and turbidity downstream of the dam removal will be minimized by dewatering the pond prior to dam breach. The sediment in the pond will be allowed to dry out enough to allow for proper access by equipment. See section 6.7.3 Construction Feasibility of the Mitigation Plan for more information on the dewatering efforts of the ponds. Work along R3 and R6 will involve a Priority Level I Restoration by raising the bed elevation and reconnecting the stream with its geomorphic floodplain. All restoration reaches will include livestock exclusion. Enhancement Level II is proposed for R2 and R4, which includes addressing isolated bank erosion, bamboo removal on R2, riparian buffer planting and livestock exclusion. Enhancement Level I is proposed for the upper section of R7 and preservation for the lower section. Figure 6 depicts the buffer restoration plan based on existing conditions and Figure 7 depicts the stream and wetland conceptual plan. The Odell's House Mitigation Plan, Mitigation Plan Figure 9a and 9b, and Design Sheets (Appendix 1 Mitigation Plan) provide additional details on the project.

All applicable federal, state, and local documentation, permits, and/or authorizations will be acquired as part of implementing the above-mentioned mitigation plan and will be provided to DWR as part of the As-Built Report, including Section 401, Section 404 and Sediment and Erosion Control permits. The restoration of the Site will require converting existing agriculture land use practices within riparian areas adjacent to mitigated streams into a dense and diverse vegetated riparian forest. The riparian areas will be replanted with appropriate native tree species. The restoration of the riparian buffer will provide stabilization and improve water quality to tributaries that drain directly to Buffalo Creek.

3.1 Parcel Preparation

The current land uses adjacent to the streams and ponds proposed for riparian restoration are primarily active pasture with some forested areas (Figure 5). The riparian restoration areas will require limited site preparation in addition to the stream and wetland construction. Stream restoration activities will include excavating a broader floodplain at or slightly above the existing bed elevation and will seek to restore groundwater hydrology and connection of surface flows. The design concept will address the current channel's dimension, pattern, and profile to create stable conditions. Wetland restoration activities will include minimal grading and blending of microtopography.

After construction activities, the subsoil will be roughened and the topsoil placed back over the site as needed. Site preparation might also include select and strategic herbicide treatments and mechanical clearing (mowing) to remove undesirable underbrush or invasive species before initial planting. Fescue will not be treated during site preparation but will be monitored after construction. Diffuse flow will be maintained in the buffers by constructing flat broad floodplains that drain back to the restored stream with little to no concentrated flow. No topsoil will be removed in the proposed riparian buffer areas as part of parcel preparation.

WLS will utilize herbicide and hand pruning to control invasive species and other undesirable vegetation during the monitoring period to promote growth of the target community and achieve success criteria. WLS will visually inspect the bamboo eradication area at least twice annually for re-sprouts and treatment. Initial plant maintenance may include a onetime mowing, prior to initial planting to remove undesirable species. Generally, mowing will not take place within the first 30 feet (Zone A) of restored buffer after planting. If mowing is deemed necessary by WLS during the monitoring period, WLS must receive approval by DMS and DWR prior to any mowing activities to ensure that no buffer violations have been performed. If necessary, WLS will develop a species - specific control plan.

3.2 Riparian Buffer Restoration

Riparian restoration is proposed for part of the right bank on R2, R3, and R6. The revegetation plan for the entire riparian restoration area will include permanent seeding, planting bare root trees, live stakes, and controlling invasive species growth (See Mitigation Plan Design Sheets, Revegetation Plan pages 17-19). If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre. The permanent seed mix will consist of a riparian and wetland seed mix. These seed mixes will include plant species to enhance pollinator habitat. The riparian restoration efforts along the project streams will be adjacent to reconstructed stream banks and will extend perpendicular from tops of banks a minimum of 50 feet to a maximum of 200 feet.

The riparian restoration activities will occur at the same time as the stream mitigation activities and not before. Therefore, the mitigation area where riparian restoration is being performed may be altered slightly depending on the implementation of the Odell's House Mitigation Site. The riparian restoration areas will be surveyed and information provided in the As-Built report and As-Built Survey. The As-Built report will also include any deviations that were made to the approved Plan.

3.3 Riparian Buffer Enhancement

Cattle will be excluded using permanent cattle exclusion fencing in the buffer enhancement areas as alternative buffer mitigation as followed by 15A NCAC 02B .0295(o)(6). The enhancement area will be protected in perpetuity under a conservation easement. Planting isn't anticipated except where required in the stream mitigation planting plan (Mitigation Plan, Appendix 1, page 17-19). Riparian enhancement via cattle exclusion is proposed for the right bank of R2 and the right bank of R4. Buffer enhancement via cattle exclusion can only generate buffer mitigation credit and is not transferrable into nutrient offset credit.

The left bank of R4 is forested with bamboo, and the bamboo will be removed and replanted with native vegetation from Table 3.0 for riparian buffer enhancement. Bamboo roots and rhizomes will be mechanically removed during the construction phase throughout the approximately 0.3 acres of bamboo area (Figure 8). A thorough effort will be made to completely remove all parts of the bamboo plants during this process. Following mechanical removal the area will be site prepped as described above, stabilized, and planted. It is expected some remnant bamboo sprouts will occur and WLS will aggressively remove these using hand tools. Herbicide treatments may also be used following mechanical removal and in conjunction with physical removal of re-sprouts.

3.4 Coastal Headwater Restoration

Although the site is located in the Piedmont physiographic province, the buffer restoration credit adjacent to R1 and R5 will be considered coastal headwater stream mitigation, and is classified as alternative mitigation under Rule 15A NCAC 02B .0295 (o)(2). Headwater stream restoration activities will include removing man-made farm ponds and excavating a broader floodplain at or slightly above the existing bed elevation and will seek to restore groundwater hydrology and connection of surface flows. A shallow flow path or pilot cannel will be connected to allow initial flow of water toward R2 and R6, which will gradually transition into well-defined single thread channels. Figure 6 depicts the buffer restoration plan based on proposed conditions and Figure 7 depicts the stream and wetland conceptual plan. The Odell's House Mitigation Plan, Mitigation Plan Figure 10, and Design Sheets 9 and 13 provide additional details on the coastal headwater restoration. The riparian buffer credits that are located adjacent to coastal headwater valley restoration will be based on the centerline of the valley length and will be reported in the As-Built Report. These credits will be withheld until the As-Built survey has been finalized.

3.5 Riparian Preservation

Riparian buffer preservation will include permanently protecting existing forested riparian areas with a conservation easement. This will include a small section of the left bank of R2, the left bank of R3, the left bank of R4, and R7. The preservation area as a percentage of the total area of buffer mitigation credit is 22.2 percent.

No more than 25 percent of the total area of buffer mitigation will be used for preservation credit pursuant to 15A NCAC 0295 (o)(5) and 15A NCAC 0295 (o)(4), and preservation buffer areas in excess will be protected in the conservation easement and not applied for credit. Buffer preservation can only generate buffer mitigation credit and is not transferrable into nutrient offset credits.

3.6 Planting

The specific buffer vegetation species composition to be planted was selected based on the community type, observation of occurrence of species in riparian buffers adjacent to the Site, and best professional judgement on species establishment and anticipated site conditions in the early years following project implementation.

Trees will be planted at a density sufficient to meet the performance standards outlined in the Rule 15A NCAC 02B 0295 of 260 hardwood trees per acre at the end of five years. Proposed plantings will predominantly consist of bare root vegetation and will generally be planted at a total target density of 680 stems per acre. No one tree species will be greater than 50 percent of the established stems. An appropriate riparian seed mix will also be applied to provide temporary ground cover for soil stabilization and reduction of sediment loss during rain events in areas disturbed by stream and wetland construction, as necessary. This will be followed by an appropriate permanent seed mixture. Planting is scheduled for Winter 2021 and the list of species proposed are shown in Table 3; however, the actual planting list will be provided in the As-Built report.

Table 3. Tree Planting List

Scientific Name	Common Name	% Proposed for Planting by Species	Wetland Tolerance
Riparian Buffer Bare Root Plantings – Overstory (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Fraxinus pennsylvanica	Green ash	3%	FACW
Betula nigra	River birch	12%	FACW
Quercus michauxii	Swamp chestnut oak	10%	FACW
Quercus pagoda	Cherrybark oak	10%	FACW
Platanus occidentalis	American sycamore	12%	FACW
Liriodendron tulipifera	Tulip-poplar	12%	FACU
Quercus nigra	Water oak	10%	FAC
Quercus phellos	Willow oak	10%	FACW
Riparian Buffer Bare Root Plantings – Understory (Proposed 8' x 8' Planting Spacing @ 680 Stems/Acre)			
Diospyros virginiana	Persimmon	4%	FAC
Carpinus caroliniana	Ironwood	3%	FAC
Hamamelis virginiana	Witch-hazel	3%	FACU
Asimina triloba	Paw paw	4%	FAC
Lindera benzoin	Spicebush	4%	FACW
Corylus americana	Hazelnut	3%	FACU
Riparian Buffer Live Stake Plantings – Streambanks (Proposed 2' to 3' Spacing @ Meander Bends and 6' to 8' Spacing @ Riffle Sections)			
Sambucus canadensis	Elderberry	20%	FACW
Salix sericea	Silky Willow	30%	OBL
Salix nigra	Black Willow	10%	OBL
Cornus amomum	Silky Dogwood	40%	FACW
Note: Final species selection may change due to refinement or availability at the time of planting. Species substitutions will be coordinated between WLS and planting contractor prior to the procurement of plant stock and documented in the as-built report.			

4 Monitoring and Maintenance Plan

The performance criteria for the Site follows approved performance criteria presented in the guidance documents outlined in RFP 16-007279 and the Consolidated Buffer Rule (15A NCAC 02B .0295). Annual monitoring and semi-annual site visits will be conducted to assess the condition of the finished project. The riparian restoration project has been assigned specific performance criteria components for vegetation. Performance criteria will be evaluated throughout the five-year post-construction monitoring. An outline of the performance criteria components is below.

4.1 Monitoring Protocol

Permanent vegetation monitoring plots will be installed and evaluated within the buffer restoration areas to measure the survival of the planted trees. Riparian buffer vegetation monitoring will be based on the *Carolina Vegetation Survey-Ecosystem Enhancement Program Protocol for Recording Vegetation: Level 1-2 Plot Sampling Only Version 4.2*. Annual vegetation monitoring will occur each year for a minimum of five years on the riparian buffer restoration and enhancement areas and seven years on the headwater buffer restoration areas and will be conducted during the fall season with the first year occurring at least five months from initial planting. Seven vegetation monitoring plots will be installed, and will be 100 meters squared in size, and will cover at least two percent of the 8.3 acres of riparian buffer restoration and enhancement (bamboo) area. Plots will be randomly placed throughout the planted riparian areas. The approximate location of the plots is shown on Figure 8. Photos will be taken from all photo points each monitoring year and provided in the annual reports. All planted stems will be marked with flagging tape and recorded. All of the vegetation plots in Figure 8 will be monitored for both the buffer and the stream/wetland project. There will be additional vegetation plots for the stream/wetland project.

The following data will be recorded for all trees in the plots: species, common name, height, planting date (or volunteer), and grid location. The total number of volunteer woody stems will also be documented and reported. Appropriate native volunteer stems of native hardwood tree species may be included to meet the performance standards upon DWR approval.

4.2 Performance Standards for Vegetation Adjacent to Single-Thread Streams

The measures of vegetative success for the Parcel will be the survival of at least four native hardwood tree species, where no one species is greater than 50 percent of the established stems, established at a density of at least 260 planted trees per acre at the end of Year 5. Appropriate native volunteer stems of native hardwood tree species may be included to meet the performance standards upon DWR approval. WLS shall submit the annual monitoring report to DWR by December 31st of each year for five consecutive years.

4.3 Performance Standards for Vegetation Adjacent to Headwater Streams

The measures of vegetative success for the Parcel will be the survival of at least four native hardwood tree species, where no one species is greater than 50 percent of the established stems, established at a density of at least 260 planted trees per acre at the end of Year 5 and 210 hardwood trees per acre at the end of Year 7 for riparian restoration areas adjacent to headwater stream restoration. The seven years of monitoring only applies to the areas receiving credit under Rule 15A NCAC 02B .0295 (o)(2) for buffer mitigation. Appropriate native volunteer stems of native hardwood tree species may be included to meet the performance standards upon DWR approval. WLS shall submit the annual monitoring report to DWR by December 31st of each year for seven consecutive years.

4.4 Performance Standard for Headwater Streams

The performance standards for the coastal headwater streams will be detailed in the Stream Mitigation Plan in Section 8.2. Performance standards must be met each monitoring year for a minimum of seven years to comply with 15A NCAC 02B .0295 (o)(2) for buffer mitigation. Confirmation from the USACE that stream performance standards have been met will need to be provided to DWR by DMS prior to issuance of credit releases for riparian buffer credit along the headwater streams. The success criteria for the headwater streams include channel formation within the valley or crenulation that must be documented through identification of field indicators consistent with those listed below, and continuous surface water flow within the valley or crenulation must be documented to occur every year for at least 30 consecutive days during the prescribed monitoring period.

Headwater Stream Monitoring

Channel Formation: During monitoring years 1 through 4, the preponderance of evidence must demonstrate a concentration of flow indicative of channel formation within the topographic low point of the valley or crenulation as documented by the following indicators:

- Scour (indicating sediment transport by flowing water)
- Sediment deposition (accumulations of sediment and/or formation ripples)
- Sediment sorting (sediment sorting indicated by grain-size distribution with the primary path of flow)
- Multiple observed flow events (must be documented by gage data and/or photographs)
- Destruction of terrestrial vegetation
- Presence of litter and debris
- Wracking (deposits of drift material indicating surface water flow)
- Vegetation matted down, bent, or absent (herbaceous or otherwise)
- Leaf litter disturbed or washed away

During monitoring years 5 through 7, the stream must successfully meet the requirements above and the preponderance of evidence must demonstrate the development of stream bed and banks as documented by the following indicators:

- Bed and banks (may include the formation of stream bed and banks, development of channel pattern such as meander bends and/or braiding at natural topographic breaks, woody debris, or plant root systems)
- Natural line impressed on the bank (visible high-water mark)
- Shelving (shelving of sediment depositions indicating transport)
- Water staining (staining of rooted vegetation)
- Change in plant community (transition to species adapted for flow or inundation for a long duration, including hydrophytes)
- Changes in character of soil (texture and/or chroma changes when compared to the soils abutting the primary path of flow).

4.5 Bamboo Management Plan

Following mechanical removal and restoration during construction, the bamboo area will be monitored at least twice annually by qualified staff. It is expected some remnant bamboo sprouts will occur and these will be aggressively removed using hand tools. Herbicide treatments may also be used following physical removal of re-sprouts. The bamboo management area is depicted on Figure 8.

4.6 Photo Reference Stations

Photographs will be taken within the project area once a year to visually document stability for five years following construction. Permanent markers will be established and located with GPS equipment so that the same locations and view directions on the Site are photographed each year. Visual inspections and photos will be taken to ensure that preservation and enhancement areas are being maintained and compliant.

4.7 Visual Assessment

Visual assessments should support the specific performance standards for each metric as described above. Visual assessments will be performed within the Site on a semi-annual basis during the five-year monitoring period. Problem areas with vegetative health will be noted (e.g. low stem density, vegetation mortality, invasive species or encroachment). Areas of concern will be mapped and photographed accompanied by a written description in the annual report. Problem areas with be re-evaluated during each subsequent visual assessment. Should remedial actions be required, recommendations will be provided in the annual monitoring report. To ensure compliance with 0295 (0) (6): A visual assessment of the cattle exclusion and preservation areas within the conservation easement will also be performed each year to confirm:

- Fencing is in good condition throughout the site; no cattle access within the conservation easement area; no encroachment has occurred; diffuse flow is being maintained in the conservation easement area; and there has not been any cutting, clearing, filling, grading, or similar activities that would negatively affect the functioning of the riparian area.
- Any issues identified during the visual assessment of the cattle exclusion and preservation areas will be photographed and mapped as part of the annual monitoring report with remedial efforts proposed or documented.

4.8 Reporting Performance Criteria

Using the most recent DMS Riparian Buffer Baseline and Annual Monitoring Report Template, a baseline monitoring document and as-built record drawings of the project will be developed for the constructed Site. Complete monitoring reports will be prepared in the fall of each monitoring year and submitted to DMS. Annual monitoring reports will be based on the most recent DMS Template. The monitoring period will extend five years beyond completion of construction or until performance criteria have been met.

4.9 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 approved Plan, WLS shall notify and coordinate with DMS and DWR to develop a remedial action plan. The remedial action plan should describe the source or reason for the failure, a concise description of the corrective measures that are proposed, and a time frame for the implementation of the corrective measures.

4.10 Conservation Easement and Long-Term Management Plan

The Site will be transferred to the North Carolina Department of Environmental Quality (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. 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 Statue GS 113A-232(d)(3). Interest gained by the endowment fund may be used for stewardship, monitoring, stewardship administration, and land transaction costs, if applicable.

The Stewardship Program may periodically install signage as needed to identify boundary markings as needed. Any future livestock or associated fencing or permanent crossings will be the responsibility of the owner of the underlying fee to maintain.

Conservation easement boundaries will be identified in the field to ensure clear distinction between the 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. Boundaries will be marked with signs identifying the property as a mitigation site and will include the name of the long-term steward. All boundary markers will be installed prior to submittal of the As-Built report. The easement boundary will be checked annually as part of monitoring activities, and the conditions as well as any maintenance performed will be reported in the annual monitoring reports.

The land required for riparian area planting, management, and stewardship of the mitigation project includes portions of the parcels listed in Table 4. An option agreement for the project area has been signed by the property owner and a Memorandum of Option has been recorded at the Johnston County Register of Deeds. The proposed conservation easement on this property has not yet been recorded.

Table 4. Existing Site Vegetation

Owner of Record N/F	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
Randy L. Edwards and Rhonda B. Edwards	179100-36-0446	Johnston	Conservation Easement	Book: 04838 Page: 0740	3.73
W. Odell Edwards Irrevocable Trust and Melanie E. Durham	179100-16-8552	Johnston	Conservation Easement	Book: 03343 Page: 0381	11.36

5 Mitigation Potential

Out of 15.09 acres that will be protected with a permanent conservation easement, 3.835 acres (167,107 ft^2) are proposed to generate riparian buffer restoration credits, 1.928 acres (84,006 ft^2) are proposed to generated riparian buffer headwater restoration credits, 2.308 acres (100,560 ft^2) are proposed to generate riparian buffer enhancement credits, and 2.386 acres (103,997 ft^2) are proposed to generate riparian buffer preservation credits. The remaining acres within the Conservation Easement, will be used for wetland and stream mitigation pursuant to the Odell's House Mitigation Site. The total potential riparian buffer that the Site will generate is summarized in Table 5 and is 455,670 square feet which yields 294,724.458 buffer credits.

Table 5. Proposed Mitigation Credits

Table 5. Odell's House Mitigation Site, DWR #2018-0200v1, Project Credits

Neuse 03020201 - Outside Falls Lake	**Project Area**
19.16394	**N Credit Conversion Ratio (ft^2/pound)**
N/A	**P Credit Conversion Ratio (ft^2/pound)**

Credit Type	Location	Subject? (enter NO if ephemeral or ditch [1])	Feature Type	Mitigation Activity	Min-Max Buffer Width (ft)	Feature Name	Total Area (ft^2)	Total (Creditable) Area of Buffer Mitigation (ft^2)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Convertible to Riparian Buffer?	Riparian Buffer Credits	Convertible to Nutrient Offset?	Delivered Nutrient Offset: N (lbs)	Delivered Nutrient Offset: P (lbs)
Buffer	Rural	Yes	Coastal Headwater	Restoration	0-100	R1	36,960	36,960	1	100%	1.00000	N/A	36,960.000	No	—	—
Buffer	Rural	Yes	I / P	Enhancement via Cattle Exclusion	0-100	R2 (right bank)	36,090	36,090	2	100%	2.00000	N/A	18,045.000	No	—	—
Buffer	Rural	Yes	I / P	Enhancement	0-100	R2 (left bank)	53,840	53,840	2	100%	2.00000	N/A	26,920.000	No	—	—
Buffer	Rural	Yes	I / P	Restoration	0-100	R3	121,490	121,490	1	100%	1.00000	N/A	121,490.000	Yes	6,339.511	—
Buffer	Rural	Yes	I / P	Enhancement via Cattle Exclusion	0-100	R4 (right bank)	10,630	10,630	2	100%	2.00000	N/A	5,315.000	No	—	—
Buffer	Rural	Yes	Coastal Headwater	Restoration	0-100	R5	28,267	28,267	1	100%	1.00000	N/A	28,267.000	No	—	—
Buffer	Rural	Yes	Coastal Headwater	Restoration	101-200	R5	8,498	8,498	1	33%	3.03030	N/A	2,804.343	No	—	—
Buffer	Rural	Yes	I / P	Restoration	0-100	R6	33,271	33,271	1	100%	1.00000	N/A	33,271.000	Yes	1,736.146	—
Buffer	Rural	Yes	I / P	Restoration	0-100	R2	5,650	5,650	1	100%	1.00000	N/A	5,650.000	Yes	294.825	—
Buffer	Rural	Yes	Coastal Headwater	Restoration	101-200	R1	10,281	10,281	1	33%	3.03030	N/A	3,392.733	No	—	—
Buffer	Rural	Yes	I / P	Restoration	101-200	R3	6,696	6,696	1	33%	3.03030	N/A	2,209.682	Yes	349.406	—
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													—		—	—
													—		—	—
							Totals: 351,673	351,673								

Enter Preservation Credits Below

Eligible for Preservation (ft^2): 117,224

Credit Type	Location	Subject?	Feature Type	Mitigation Activity	Min-Max Buffer Width (ft)	Feature Name	Total Area (sf)	Total (Creditable) Area for Buffer Mitigation (ft^2)	Initial Credit Ratio (x:1)	% Full Credit	Final Credit Ratio (x:1)	Riparian Buffer Credits
Buffer	Rural	Yes	I / P	Preservation	0-100	R2	3,467	3,467	10	100%	10.00000	346.700
	Rural	Yes	I / P		0-100	R3 (left bank)	48,510	48,510	10	100%	10.00000	4,851.000
	Rural	Yes	I / P		0-100	R4 (left bank)	9,062	9,062	10	100%	10.00000	906.200
	Rural	Yes	I / P		0-100	R7	42,958	42,958	10	100%	10.00000	4,295.800
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Preservation Area Subtotal (ft^2):	103,997
Preservation as % Total Area of Buffer Mitigation:	22.2%
Ephemeral Reaches as % Total Area of Buffer Mitigation:	0.0%

TOTAL AREA OF BUFFER MITIGATION (TABM)

Mitigation Totals	Square Feet	Credits
Restoration:	251,113	234,044.758
Enhancement:	100,560	50,280.000
Preservation:	103,997	10,399.700
Total Riparian Buffer:	455,670	294,724.458

TOTAL NUTRIENT OFFSET MITIGATION

Mitigation Totals		Square Feet	Credits
Nutrient Offset:	Nitrogen:	0	0.000
	Phosphorus:		0.000

1. The Randleman Lake buffer rules allow some ditches to be classified as subject according to 15A NCAC 02B .0250 (5)(a).

DMS would like to have the flexibility to convert to nutrient offset credit if needed.

8 Citations

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Schafale, M.P. 2012. Guide to the Natural Communities of North Carolina, Fourth Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, NCDENR, Raleigh, NC.

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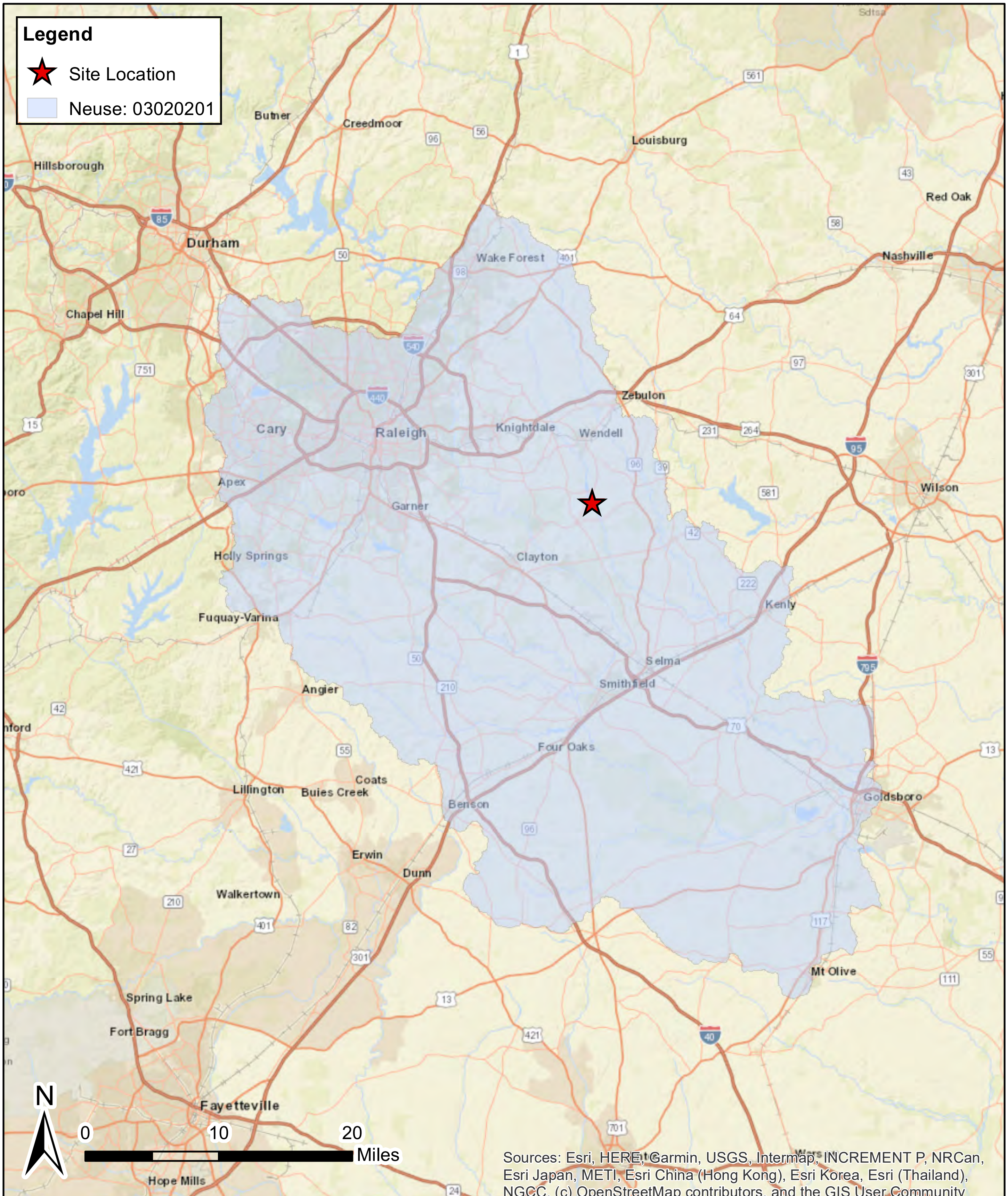


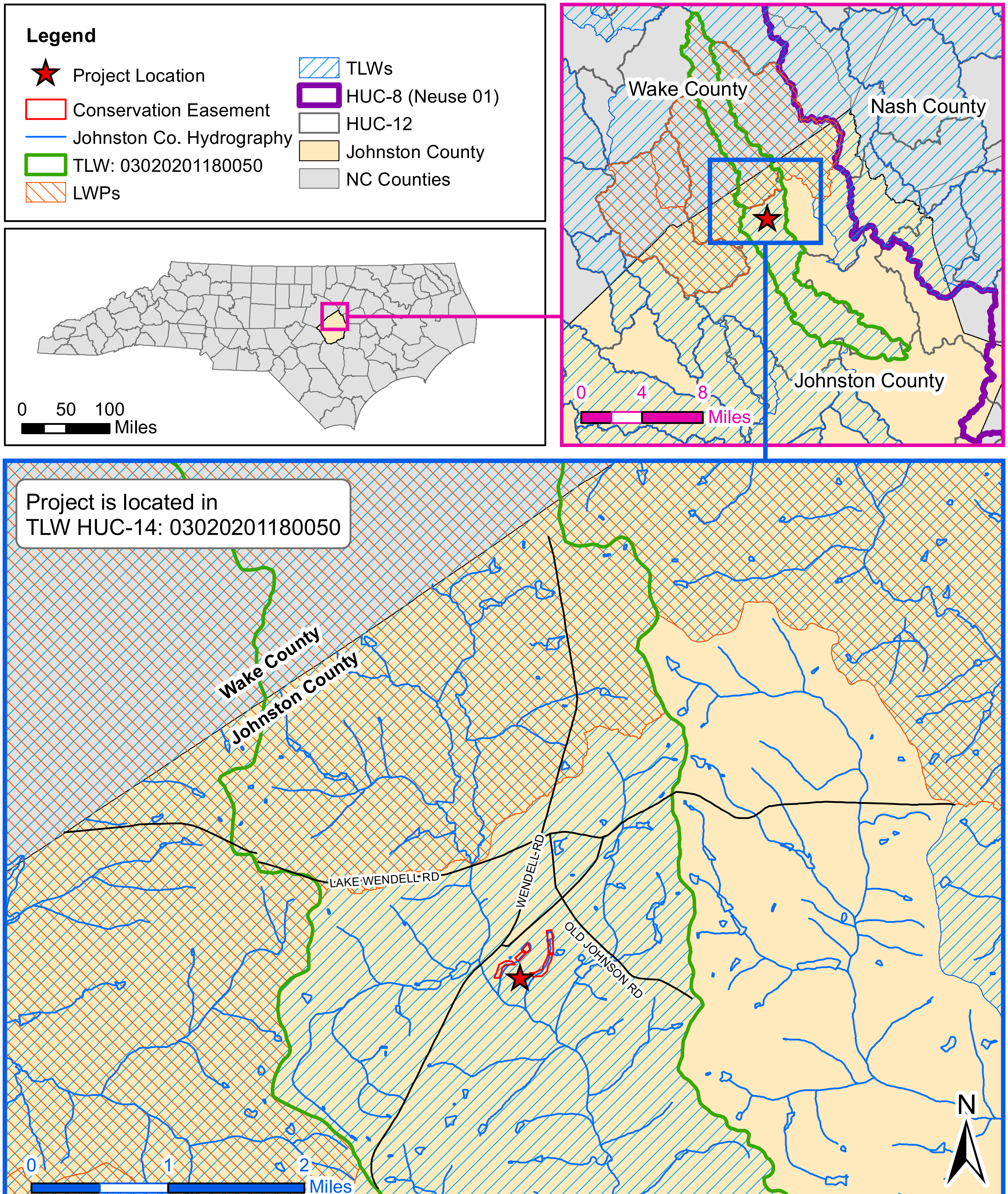
WATER & LAND SOLUTIONS

Odell's House Mitigation Project

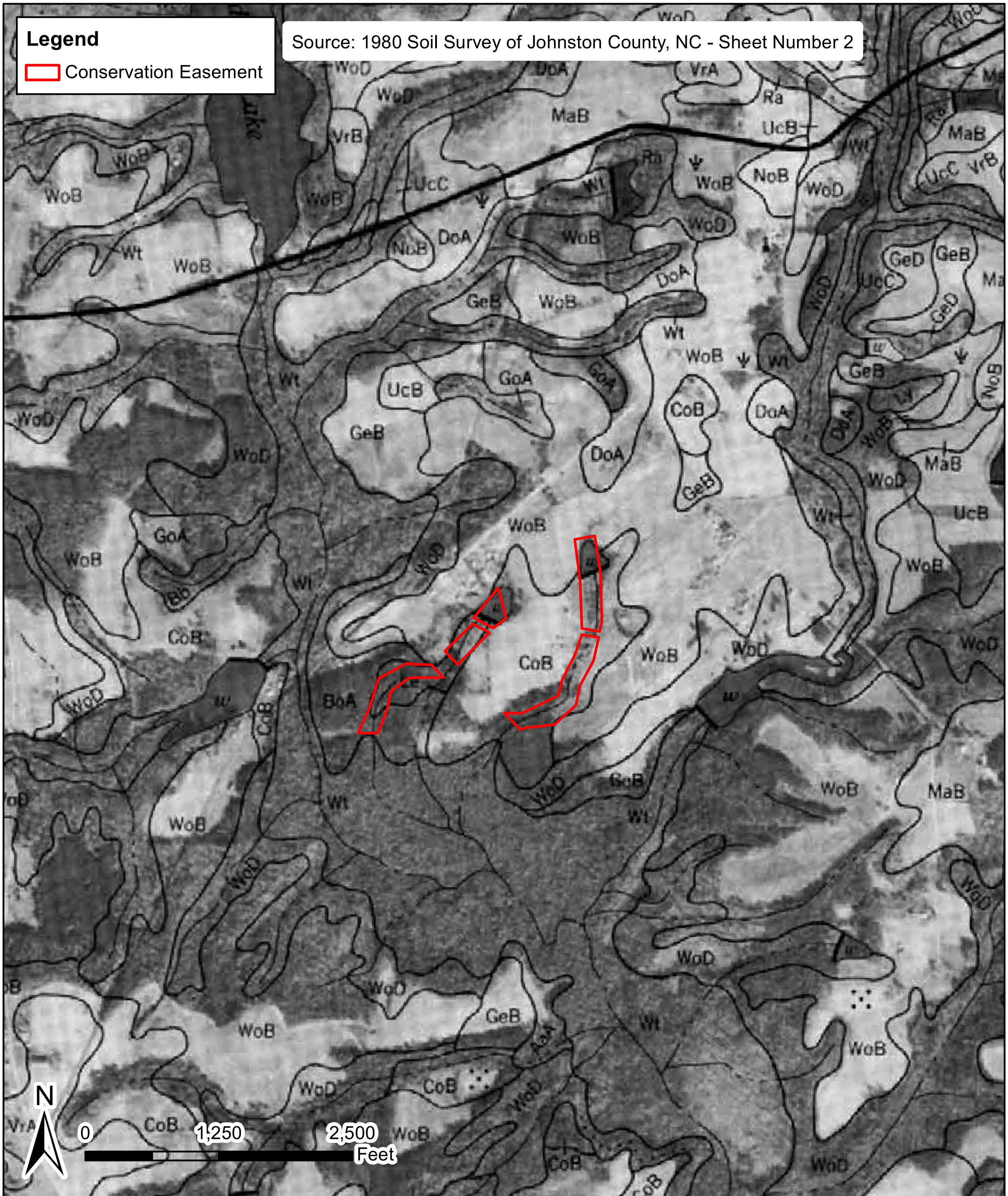
Service Area Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 1



WATER & LAND™ SOLUTIONS	Odell's House Mitigation Project	Project Location NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 2



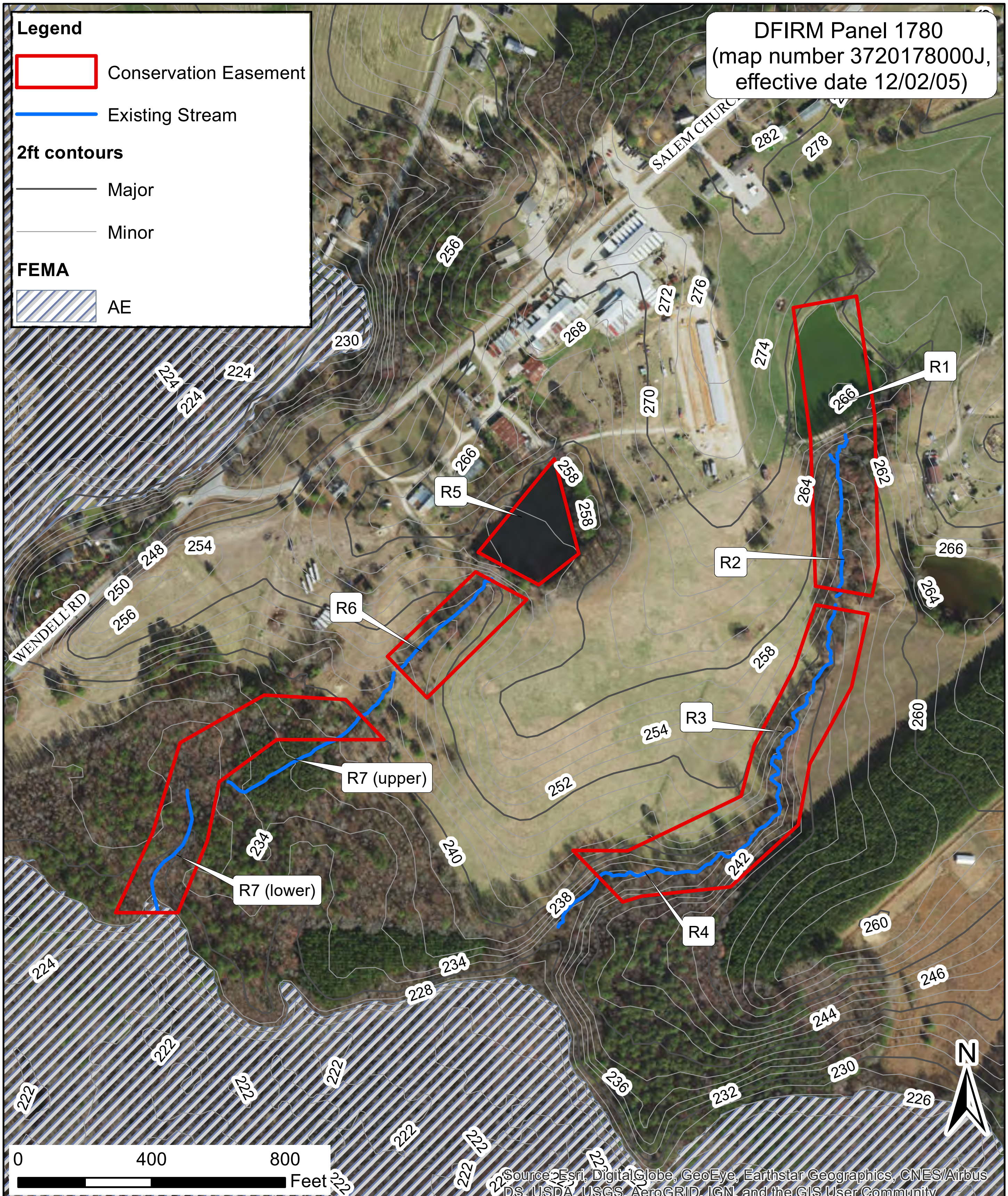
WATER & LAND SOLUTIONS

Odell's House Mitigation Project

NRCS Soils Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 3



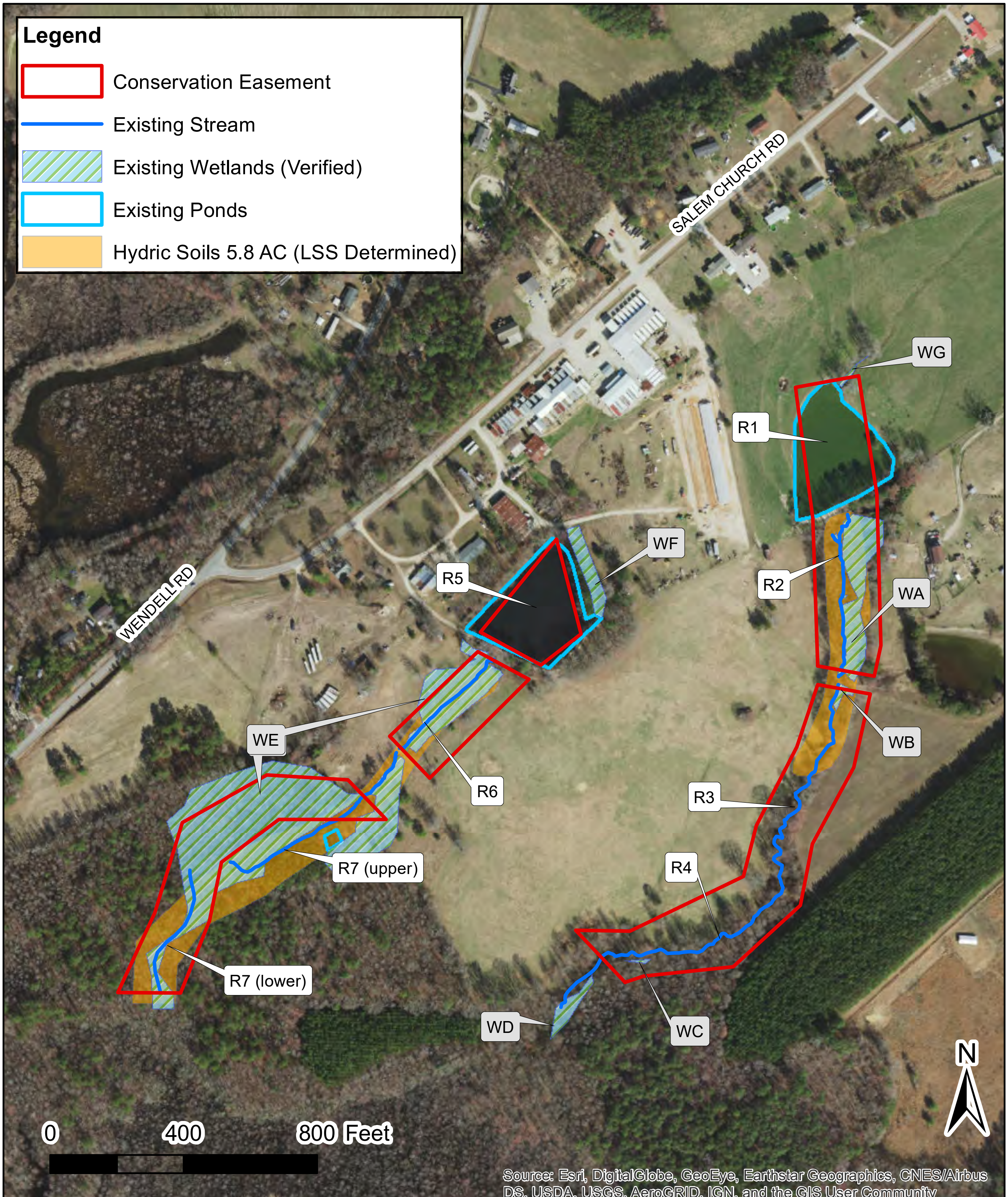
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Floodplain Map

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 4



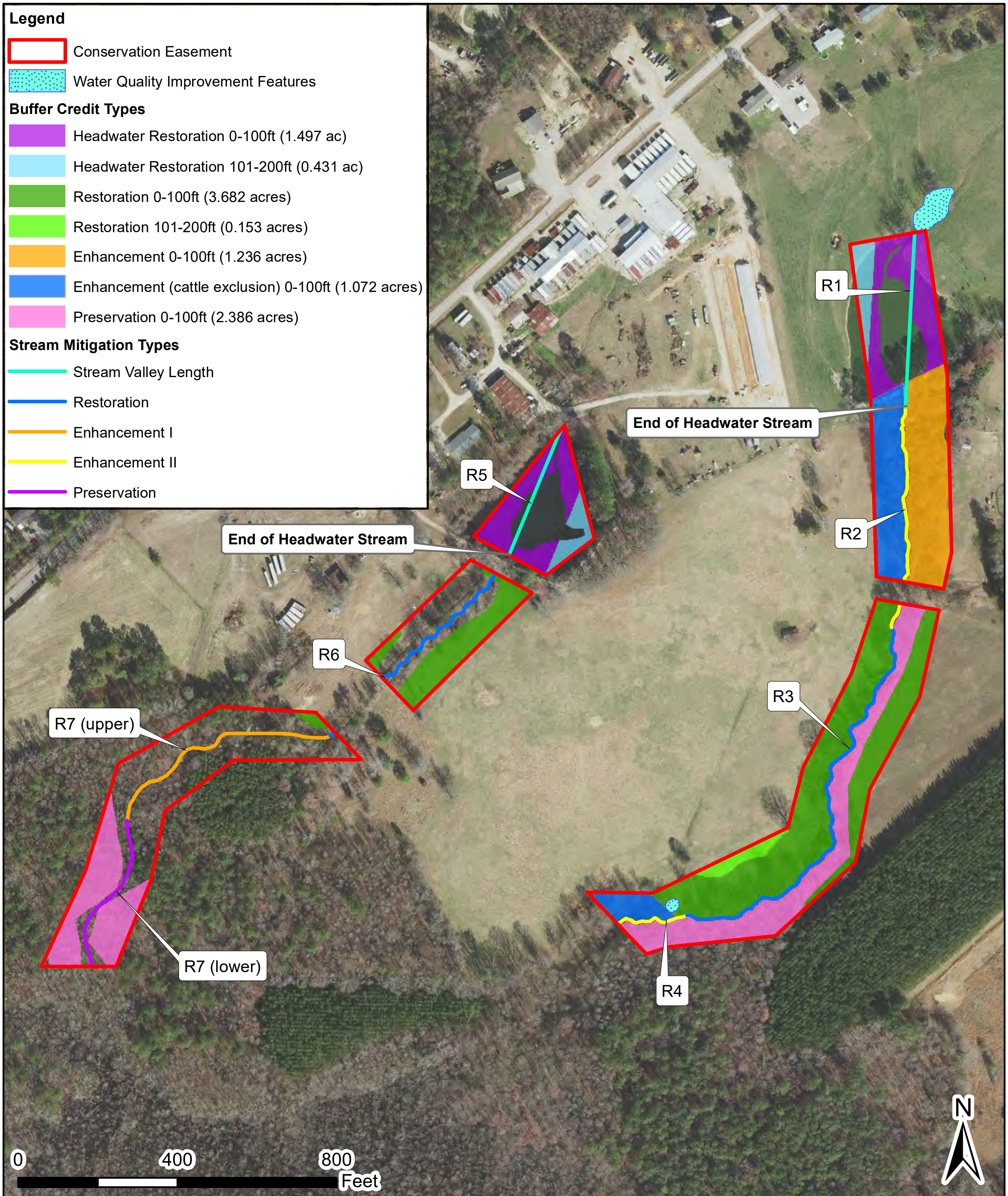
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Current Conditions

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 5



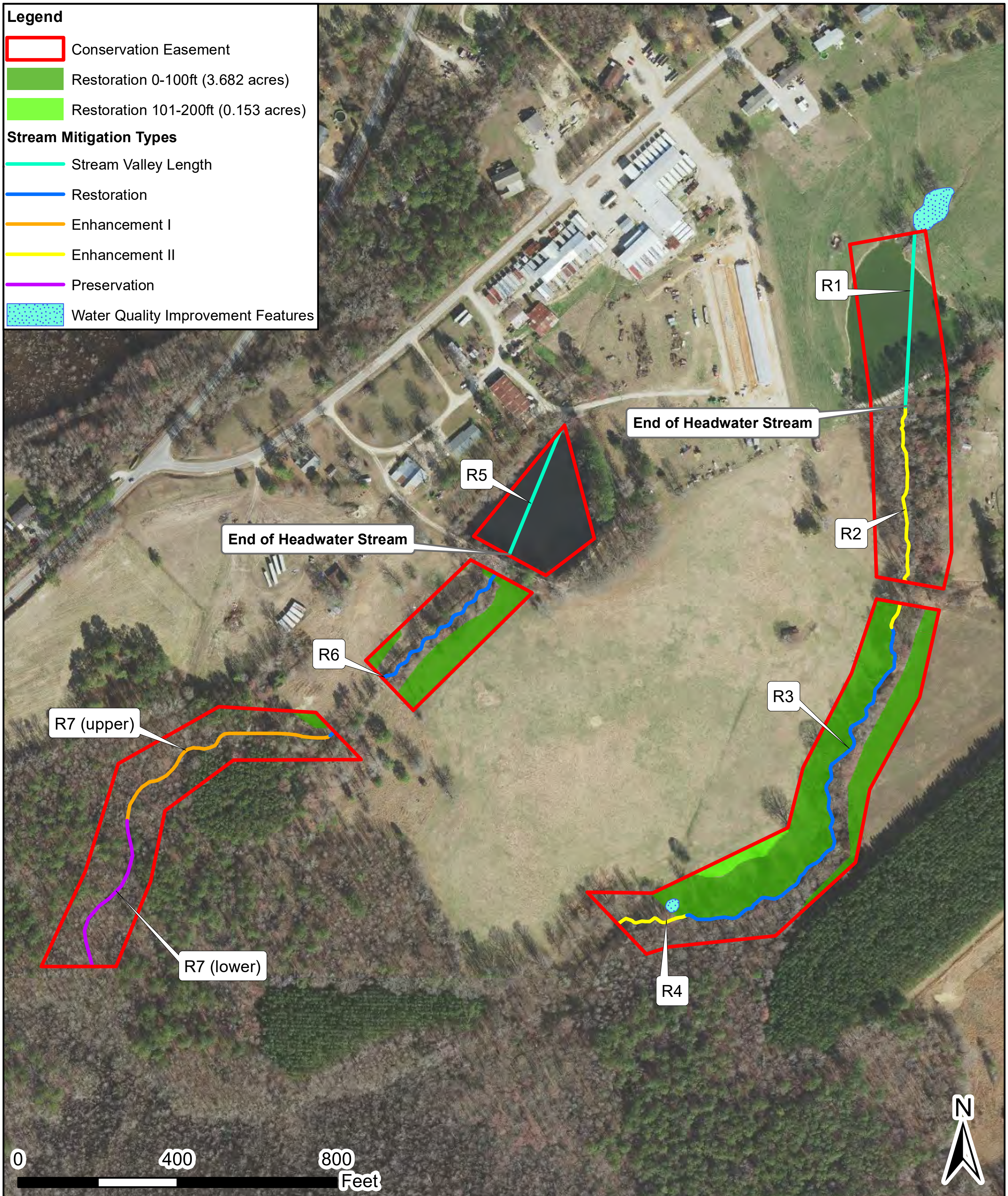
WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

Buffer Mitigation Conceptual Plan

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE 6



WATER & LAND™ SOLUTIONS

Odell's House Mitigation Project

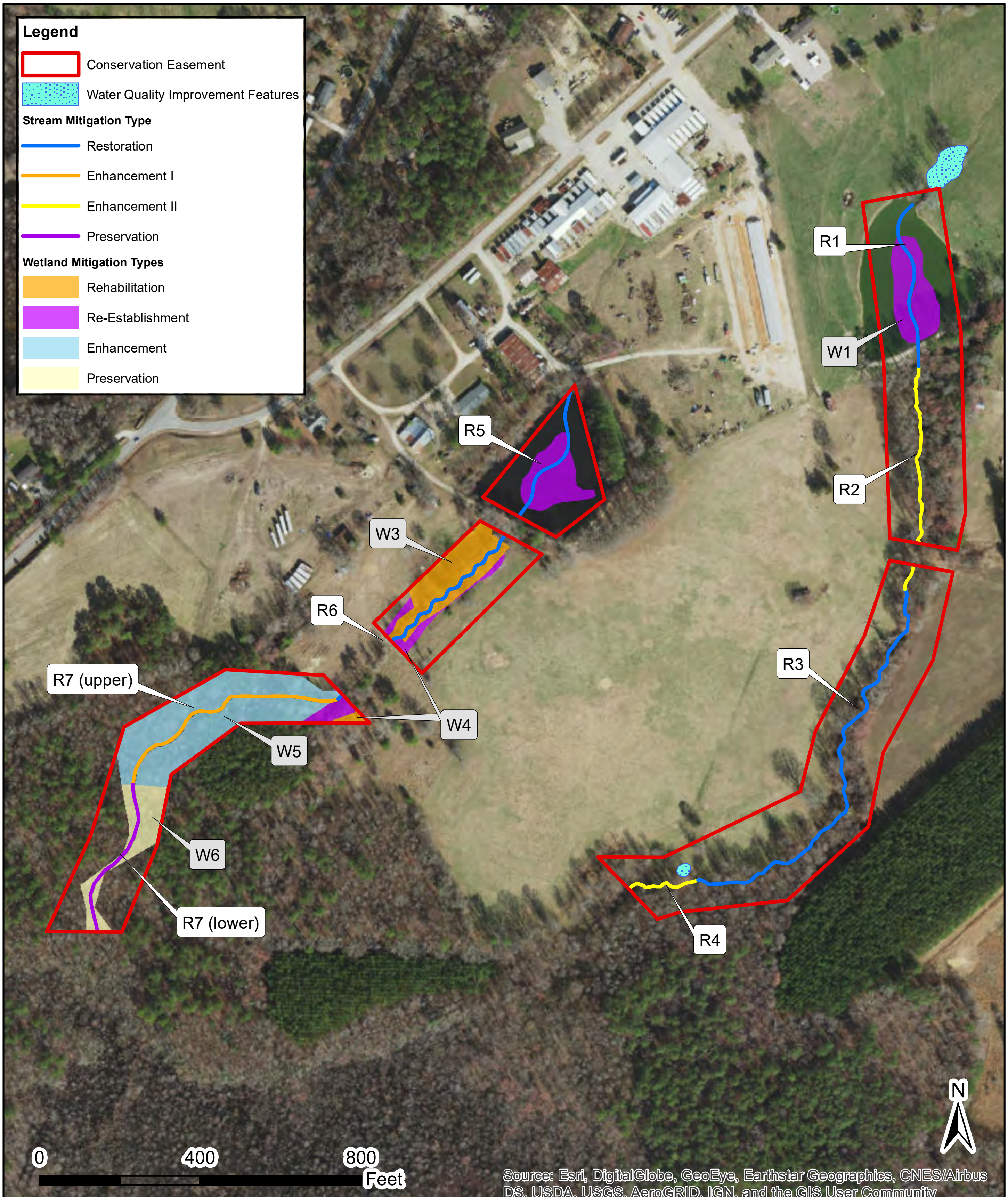
Nutrient Offset Concept Map

(Areas that are viable for nutrient offset conversion)

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE

6A



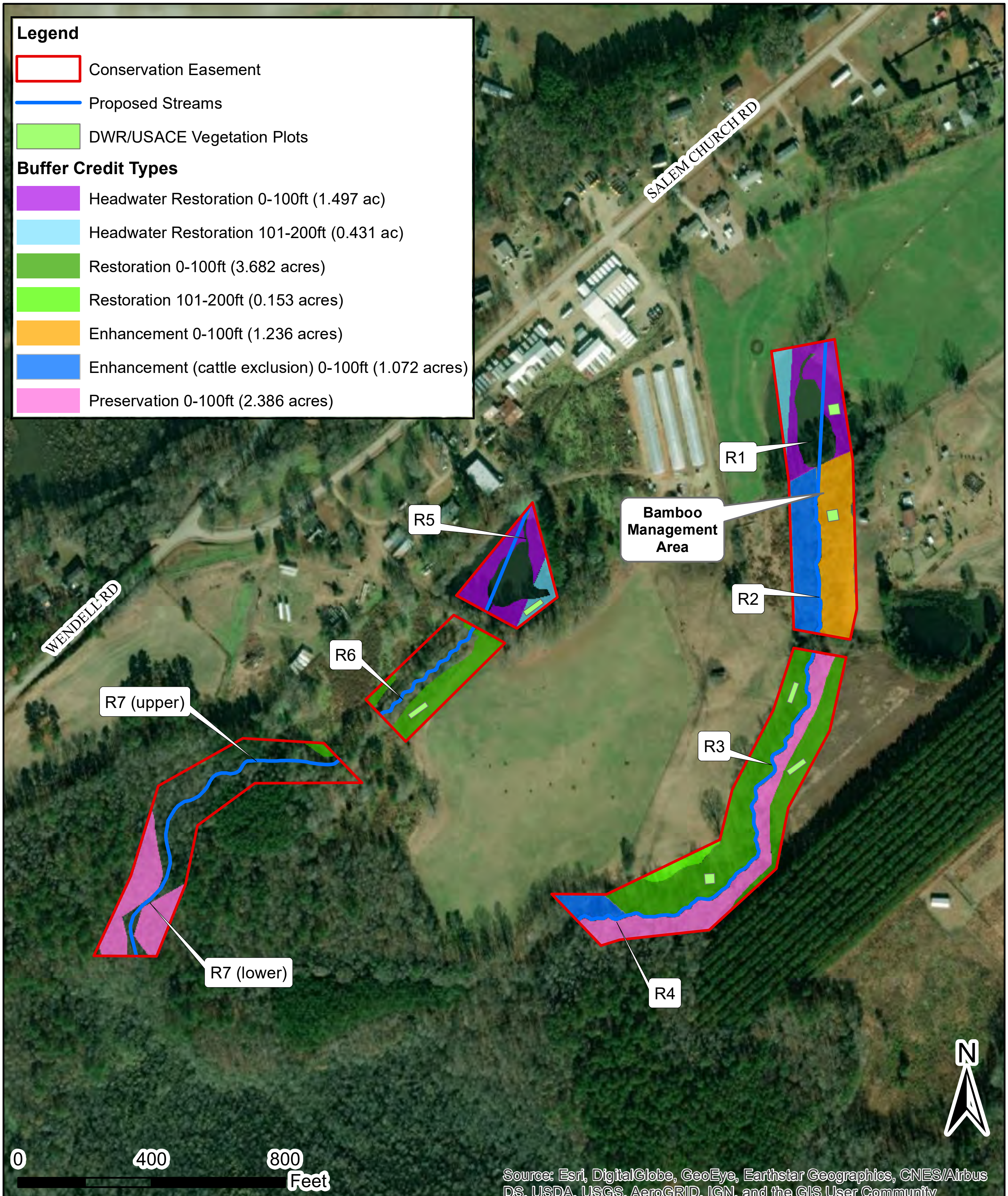
WATER & LAND™ SOLUTIONS

Odell's House
Mitigation Project

Stream and
Wetland Mitigation
Conceptual Plan

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
7



WATER & LAND™ SOLUTIONS	Odell's House Mitigation Project	Proposed Monitoring Map NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 8

Attachment A – DWR Determination and Viability

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
S. DANIEL SMITH
Director

NORTH CAROLINA
Environmental Quality

February 19, 2020

DWR ID# 2018-0200
Johnston County

Water & Land Solutions, LLC
Attn: Mr. ~~Scott Hunt~~ Cara Conder
11030 Raven Ridge Road, Suite 119
Raleigh, NC 27614
(via electronic mail: scott@waterlandsolutions.com)

Re: Site Viability for Buffer Mitigation & Nutrient Offset – Odell's House Site
Near Salem Church Rd, Wendell, NC
Johnston County

Dear Ms. ~~Hunt,~~ Conder,

On February 26, 2018, DWR issued a site viability letter for the Odell' House Site. On January 28, 2020, Cara Conder with Water & Land Solutions, LLC, requested two amendments be considered to the previous letter. Upon DWR review of documentation provided by Ms. Conder, this letter replaces the previous letter with the following amendments only:

1. Expiration date for the viability assessment is extended through August 26, 2020.
2. Riparian land use conditions & Mitigation Type Determination along Feature 1-R2 are modified as follows:

Feature	Classification	[1]Subject to Buffer Rule	Riparian Land uses adjacent to Feature (0-200')	Buffer Credit Viable	[2]Nutrient Offset Viable	Mitigation Type Determination w/in riparian areas
Feature 1-R2	Stream I	Yes	Left Bank = partially forested with invasive bamboo Right Bank = combination of forested and non-forested pasture grazed by cattle	Yes[4]	Yes (*non-forested fields only*)	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) **Partially Forested (Left Bank)**- Enhancement Site per 15A NCAC 02B (n) if bamboo is fully removed, treated and areas replanted with native species. A rigorous management plan must be proposed to control bamboo through the entire monitoring period **Forested Areas (Right Bank)** - Enhancement Site per 15A NCAC 02B .0295 (o) (6)

[1]Subjectivity calls for this feature were determined using the 1:24,000 scale quadrangle topographic map prepared by USGS and the most recent printed version of the soil survey map prepared by the NRCS

[2] *NC Division of Water Resources - Methodology and Calculations for determining Nutrient Reductions associated with Riparian Buffer Establishment*

[3]The area of preservation credit within a buffer mitigation site shall comprise of no more than 25 percent (25%) of the total area of buffer mitigation per 15A NCAC 0295 (o)(5) and 15A NCAC 0295 (o)(4). Site cannot be a Preservation only site to comply with this rule.

[4]The area described as an Enhancement Site was assessed and determined to comply with all of 15A NCAC 02B .0295(o)(6).

This viability assessment will now expire on August 26, 2020 or upon the submittal of an As-Built Report to the DWR, whichever comes first. Please contact Katie Merritt at (919) 707-3637 if you have any questions regarding this correspondence.

Sincerely,

Mac Haupt

Mac Haupt, Acting Supervisor
401 and Buffer Permitting Branch

MH/*km*
Attachments: Site Viability Letter dated February 26, 2018

cc: File Copy (Katie Merritt)
DMS – Jeremiah Dow (via electronic mail)

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
LINDA CULPEPPER
Interim Director

February 26, 2018

DWR ID# 2018-0200
Johnston County

Water & Land Solutions, LLC
Attn: Mr. Scott Hunt
11030 Raven Ridge Road, Suite 119
Raleigh, NC 27614
(via electronic mail: scott@waterlandsolutions.com)

Re: Site Viability for Buffer Mitigation & Nutrient Offset – Odell's House Site
Near Salem Church Rd, Wendell, NC
Johnston County

Dear Mr. Hunt ,

On February 1, 2018, Katie Merritt, with the Division of Water Resources (DWR), assisted you and others from Water & Land Solutions, LLC at the proposed Odell's House Mitigation Site (Site) in Wendell, NC. The Site is located in the Neuse River Basin within the 8-digit Hydrologic Unit Code 03020201. The Site is being proposed as part of a full-delivery stream restoration project for the Division of Mitigation Services (RFP #16-007279). Members of the Interagency Review Team (IRT) and Division of Mitigation Services were also present onsite. At your request, on February 21, 2018, Ms. Merritt performed an onsite assessment of riparian land uses adjacent to streams and ponds onsite, which are shown on the attached map labeled "Figure 10".

Ms. Merritt's evaluation of the features onsite and their associated mitigation determination for the riparian areas are provided in the table below. This evaluation was made from Top of Bank (TOB) out to 200' from each feature for buffer mitigation pursuant to 15A NCAC 02B .0295 (effective November 1, 2015) and for nutrient offset credits pursuant to 15A NCAC 02B .0240.

Feature	Classification	[1]Subject to Buffer Rule	Riparian Land uses adjacent to Feature (0-200')	Buffer Credit Viable	[2]Nutrient Offset Viable at 2,273 lbs/acre	Mitigation Type Determination w/in riparian areas
A	Ephemeral	No	Non-forested pasture grazed by cattle	Yes*	Yes	**Nutrient Offset - Restoration Site** per 15A NCAC 02B .0295 (n) ***Buffer Mitigation Note**: *Must meet additional requirements under .0295 (o)(7) to be viable for buffer mitigation.*

Feature	Classification	[1]Subject to Buffer Rule	Riparian Land uses adjacent to Feature (0-200')	Buffer Credit Viable	[2]Nutrient Offset Viable at 2,273 lbs/acre	Mitigation Type Determination w/in riparian areas
Pond A	In-line pond *(proposed to Be restored Into a Stream)*	Yes	Non-forested pasture grazed by cattle	Yes	Yes	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) If stream channel is restored through the pond, the new riparian areas will be viable as a Restoration Site
Feature 1-R2	Stream	Yes	Left Bank = Forested Right Bank = combination of forested and non-forested pasture grazed by cattle	Yes[3,4]	Yes *(non-forested fields only)*	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) **Forested Areas (Left Bank)**- Preservation Site per 15A NCAC 02B (o)(5) **Forested Areas (Right Bank)** - Enhancement Site per 15A NCAC 02B .0295 (o) (6)
Pond B	Not in-line	No	N/A	N/A	N/A	N/A
Feature 1-R3	Stream	Yes	Left Bank = combination of forested areas along the stream banks & field crops Right Bank = non-forested pasture	Yes[3]	Yes *(non-forested fields only)*	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) **Forested Areas (Left Bank)**- Preservation Site per 15A NCAC 02B (o)(5)
Feature 1-R4	Stream	Yes	Left Bank = forested with a mix of hardwoods and pines Right Bank = combination of forested and non-forested pasture	Yes[3,4]	Yes *(non-forested fields only)*	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) **Forested Areas (Left Bank)**- Preservation Site per 15A NCAC 02B (o)(5) **Forested Areas (Right Bank)** - Enhancement Site per 15A NCAC 02B .0295 (o) (6)
Pond C	In-line pond *(proposed to Be restored Into a Stream)*	Yes	Combination of forested pasture and non-forested pasture	Yes[4]	Yes *(non-forested fields only)*	**Fields** - Restoration Site per 15A NCAC 02B .0295 (n) **Forested Areas** - Enhancement Site per 15A NCAC 02B .0295 (o) (6) If stream channel is restored through the pond, the new riparian areas will be viable as a Restoration Site
Feature 2-R6	Stream	Yes	Non-forested ag land	Yes	Yes	Restoration Site per 15A NCAC 02B .0295 (n)

Feature	Classification	[1]Subject to Buffer Rule	Riparian Land uses adjacent to Feature (0-200')	Buffer Credit Viable	[2]Nutrient Offset Viable at 2,273 lbs/acre	Mitigation Type Determination w/in riparian areas
Feature 2-R7	Stream & Wetland complex	Yes (where Stream is restored)	Forested and not in agriculture	Yes[3]	No	Preservation Site per 15A NCAC 02B (o)(5)

[1]Subjectivity calls for this feature were determined using the 1:24,000 scale quadrangle topographic map prepared by USGS and the most recent printed version of the soil survey map prepared by the NRCS

[2] *NC Division of Water Resources - Methodology and Calculations for determining Nutrient Reductions associated with Riparian Buffer Establishment*

[3]The area of preservation credit within a buffer mitigation site shall comprise of no more than 25 percent (25%) of the total area of buffer mitigation per 15A NCAC 0295 (o)(5) and 15A NCAC 0295 (o)(4). Site cannot be a Preservation only site to comply with this rule.

[4] The area described as an Enhancement Site was assessed and determined to comply with all of 15A NCAC 02B .0295(o)(6).

The attached map (Figure 10) showing the project site and features was provided by Water & Land Solutions and was initialed by Ms. Merritt on February 26, 2018. This letter should be provided in any future stream, wetland, buffer and/or nutrient offset mitigation plans for this Site.

This letter does not constitute an approval of this site to generate mitigation credits. Pursuant to 15A NCAC 02B .0295, a mitigation proposal and a mitigation plan shall be submitted to DWR for written approval **prior** to conducting any mitigation activities in riparian areas and/or surface waters for buffer mitigation credit. Pursuant to 15A NCAC 02B .0240, a proposal regarding a proposed nutrient load-reducing measure for nutrient offset credit shall be submitted to DWR for approval prior to any mitigation activities in riparian areas and/or surface waters.

All vegetative plantings, performance criteria and other mitigation requirements for riparian restoration, enhancement and preservation must follow the requirements in 15A NCAC 02B .0295 to be eligible for buffer and/or nutrient offset mitigation credits. For any areas depicted as not being viable for nutrient offset credit above, one could propose a different measure, along with supporting calculations and sufficient detail to support estimates of load reduction, for review by the DWR to determine viability for nutrient offset in accordance with 15A NCAC 02B .0240. For any areas generating wetland mitigation credit, no buffer or nutrient offset credit can be generated.

This viability assessment will expire on February 26, 2020 or upon the submittal of an As-Built Report to the DWR, whichever comes first. Please contact Katie Merritt at (919)-807-6371 if you have any questions regarding this correspondence.

Sincerely,

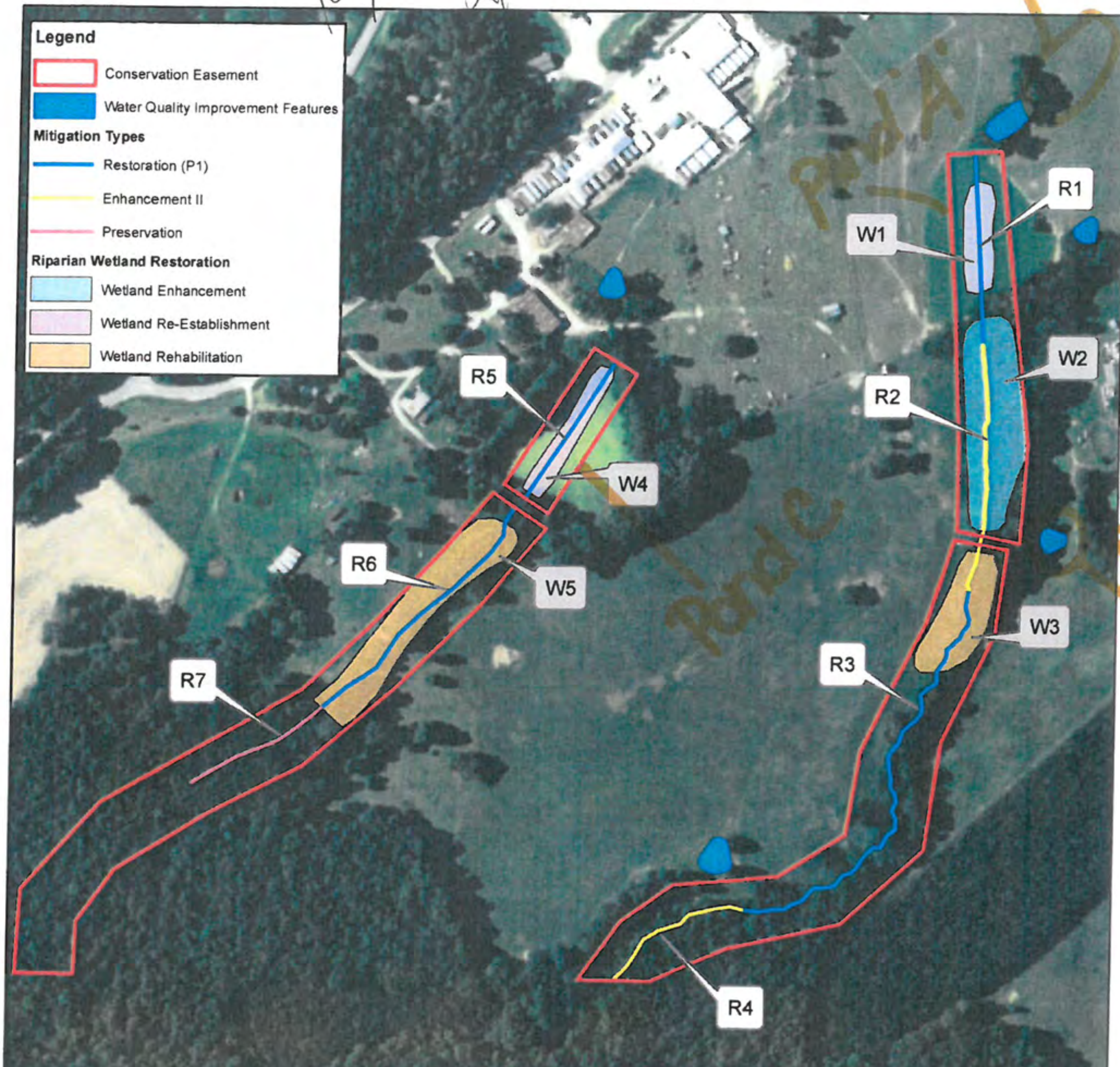
Karen Higgins

Karen Higgins, Supervisor
401 and Buffer Permitting Branch

KAH/*km*
Attachments: Figure 10

cc: File Copy (Katie Merritt)
DMS – Jeff Schaffer (via electronic mail)

2/26/18 'A'



Option 1 - Mitigation Credit Summary

Stream Restoration	Stream Enhancement Level I	Stream Enhancement Level II	Stream Preservation	Riparian Wetland Re-establishment	Riparian Wetland Rehabilitation	Riparian Wetland Enhancement	Total Stream Mitigation Credits (SMCs)	Total Riparian Wetland Mitigation Credits (WMCs)
2,432	0	354	33	0.6	1.0	0.3	**2,819**	**1.9**

WATER & LAND SOLUTIONS

Odell's House Mitigation Project

Proposed Mitigation Features

NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US

FIGURE **10**

Attachment B – Photo Log

Reach R1 – Pond with cattle access. Excessive nutrient pollutants.

Reach R1 – Pond with excessive nutrient pullutants.

Reach R2 – Upstream, sedimentation and invasive bamboo in buffer.

Reach R2 – disturbed buffer with livestock access.

Photos August 2017

Reach R3 – Incised channel.

Reach R3 – Incised channel with limited vegetation cover.

Reach R3 - Top of reach just below culvert crossing.

Reach R4 – Eroding banks on meander bend.

Photos August 2017


Reach R4 – Excessive sedimentation and loss of channel form.


Reach R5 – Crossing between R5 (pond) and R6.


Reach R5 – Pond with excessive nutrient pollutants.


Reach R5 – Pond with cattle access and hoof shear on banks.

Photos August 2017

Reach R6 - Straightened channel, small pond on left.

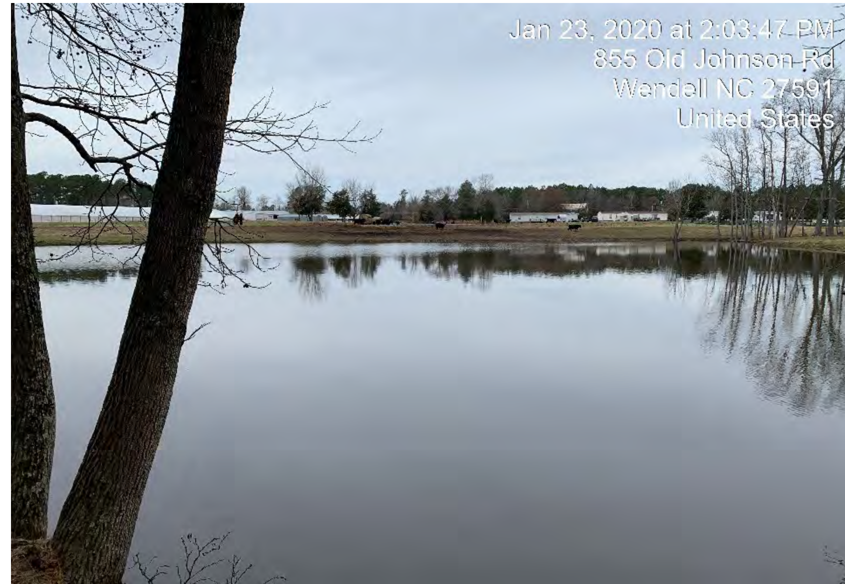
Reach R6 - Incised channel.

Reach R7 - Preservation section.

Reach R7 - Preservation section.

Photos August 2017

'A' – 01/23/20



Pond A - 01/23/20

Pond B - 01/23/20

Pond C - 01/23/20

R2 – Left Bank - 01/23/20


R2 – Right Bank - 01/23/20

R3 – Left Bank - 01/23/20


R3 – Right Bank - 01/23/20

R4 – Left Bank - 01/23/20

R4 – Right Bank - 01/23/20

R6 – Left Bank - 01/23/20

R6 – Right Bank - 01/23/20

R7 – Left Bank - 01/23/20

R7 – Right Bank - 01/23/20