Memorandum

To: Lindsay Crocker, DMS

From: Catherine Manner

Date: 6/18/2021

Re: As-Built Baseline Report and Drawings for Hornpipe Branch Tributaries Site (#100076)

Lindsay,

Please find attached for review the Final MY0/As-Built Baseline Report for the Hornpipe Branch Tributaries Site.

Please let us know if you need anything else.

Thank you,

Catherine Manner

Catherine Manner

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June 18, 2021

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Lindsay Crocker, Project Manager
217 W. Jones Street, Suite 3000
Raleigh, NC 27609

RE: WLS Responses to NCDEQ DMS Review Comments for Task 6 Submittal, Final Baseline Monitoring Report for the Hornpipe Branch Tributaries Mitigation Project, DMS Full-Delivery Project ID #100076, Contract #7605, Neuse River Basin, Cataloging Unit 03020202, Lenoir County, NC

Dear Ms. Crocker:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Baseline Monitoring Report (including record drawings) for the Hornpipe Branch Tributaries Mitigation Project to the North Carolina Department of Environmental Quality (NCDEQ) Division of Mitigation Services (DMS). Per the DMS review comments, WLS has updated the Final As-Built Baseline Monitoring Report and associated deliverables accordingly. We are providing the electronic deliverables via cloud link. The electronic deliverables are organized under the following folder structure as required under the digital submission requirements:

1. Report PDF
2. Support Files
    1_ Tables
    2_CCPV
    3_Veg
    4_Geomorph
    5_Hydro
    6_Photos

We are providing our written responses to DMS' review comments on the Final As-Built Baseline Report below. Each of the DMS review comments is copied below in **bold** text, followed by the appropriate response from WLS in regular text:

General:

- **The DWR/401 number shown on their website for this project is 2018-1155. Please correct this number on your cover page.** Response: This oversight has been corrected in the report.

- **Page 1 indicates 5,151 feet of stream restoration, but this is just the planned amount. Remove reference to length, describe it as planned, or update to the as-built total (5,242 lf).** Response: Language was added to indicate that 5,151 feet of streams represents the proposed amount.

- **It appears that the flow gages on UT1 and UT2 were moved upstream as shown on the CCPV map and that the gauge is above the stated stationing for credit on UT2 (previously 10+62). This is a good installation choice given the DWR expressed concern during plan stages. Please clarify.** Response: Flow gauges on UT1 and UT2 were moved upstream due to lack of appropriate pools for accurate gauge readings. Language was also added to section 4.5.1 in the report document.

- **Table 2. Summary goals table. One of these cells indicates an 8% hydrology as performance criteria for the two groundwater gages installed. There are no wetland credits or performance criteria established during the Mitigation Plan. Please revise to remove. The gage data is supplementary and not tied to success.** Response: WLS has removed the 8% hydrology performance criteria for the ground water gauges. WLS also added language indicating that the gauge data is only supplementary and not tied to project success criteria.

- **Table 3. Attribute table. The 401 and 404 permits were acquired prior to construction. Revise to update resolved column on those regulatory considerations.** Response: The attribute table is updated to "Yes" in the resolved column for the 401 and 404 permits.

- **Record drawings show that there were 2, 30" culverts installed at the downstream crossing. Comments during the Mitigation Plan indicate that WLS was designing the stream to support one culvert at that crossing based on WRC comments. If this was changed from design please provide a comment to that affect and explanation why the double culvert was installed there.** Response: Based on the IRT response comments, we revised the permanent culvert crossing detail in the final design plans to include one channel culvert and one floodplain culvert(s) with adequate two foot spacing. The floodplain culvert was set slightly lower than the floodplain elevation, however a plunge pool was designed at the downstream pipe invert to provide aquatic passage and prevent split flows and deleterious effects to the stream.

- **Consider showing where headwater stream credit starts for UT1 and UT2 on your CCPV.** Response: The stream sections on UT1 and UT2 that are non-creditable have been segmented and are now added to the legend and attribute table, per comment below.

- **Include any pictures and/or drone videos to assist IRT in visualizing. Response:** Drone footage has been added to the Photos folder in the E-Data.

- **Electronic Deliverables:**

    - **Please segment the stream features so that each record in the attribute table represents an entry in the asset table, and please verify that segment lengths match the as-built lengths in the asset table. Zero credit stream on UT1 and UT2 should be segmented out for context.** Response: The reach segment lengths have been verified to match the asset table and attribute table. The stream sections on UT1 and UT2 that are non-creditable have been segmented and are now added to the legend and attribute table.

    - **Please include the stem counts and densities table in the report.** Response: The stem counts and densities table can be found in the pdf report (Appendix B) and in the e-data support files veg folder.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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MY0 FINAL MONITORING REPORT
Hornpipe Branch Tributaries Mitigation Project
Lenoir County
Neuse River Basin
CU 03020202

DMS Project # 100076
DMS Contract # 7605
Contracted RFP # 16-007401
USACE Action ID Number: SAW-2018-01762
DWR Project # 2018-1155

Calendar Year of Data Collection: 2021

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

Environmental Quality

Table of Contents

LIST OF APPENDICES

1 Project Summary

1.1 Project Location and Description

The Hornpipe Branch Tributaries Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery stream mitigation project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-007401. The Project will provide stream mitigation credits in the Neuse River Basin (Cataloging Unit 03020202). The Project is in Lenoir County, North Carolina, in the Community of Deep Run at coordinates 35.134242° North and -77.655045° West. The project site is in the Targeted Local Watershed 003020202050010 (Warm Water Thermal Regime).

The Project involved the restoration of five stream reaches (MS1, MS2, MS3, UT1, and UT2) and their riparian buffers. Proposed stream lengths total 5,151 linear feet. The Project will provide significant ecological improvements and functional uplift through stream restoration and through decreasing nutrient and sediment loads within the watershed. The mitigation plan provides a detailed project summary and Table 1 provides a summary of project assets. Figure 1 illustrates the project mitigation components and Figure 2 illustrates the reference site location in proximity to the project.

Prior to construction, the project site had been historically ditched to allow for agriculture. The pre-existing vegetation within the project area consisted mostly of agricultural fields. The majority of the riparian and upland areas had no riparian buffer as a result of clearing and ditching for agricultural purposes. The riparian area surrounding MS3 contained a mixed hardwood forest and invasive species, primarily Chinese privet.

1.2 Project Quantities and Credits

The Project mitigation components include Stream Restoration activities as summarized in Table 1 below.

Table 1. Hornpipe Branch Tributaries (ID-100076) Project Mitigation Quantities and Credits

Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits	Comments
Stream							
MS1	1,440	1,468	Warm	R	1.00000	1,440.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
MS2	943	940	Warm	R	1.00000	943.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
MS3	1,529	1,521	Warm	R	1.00000	1,529.000	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
UT1	677	677	Warm	R	1.00000	677.000	Headw ater Channel Restoration, Planted Buffer, Permanent Conservation Easement
UT2	562	562	Warm	R	1.00000	562.000	Headw ater Channel Restoration, Planted Buffer, Permanent Conservation Easement
					Total:	**5,151.000**	
Wetland							
					Total:	**0.000**	

Project Credits							
	Stream			Riparian	Non-Rip	Coastal	
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh	
Restoration	5,151.000	0.000	0.000	0.000	0.000	0.000	
Re-establishment				0.000	0.000	0.000	
Rehabilitation				0.000	0.000	0.000	
Enhancement				0.000	0.000	0.000	
Enhancement I	0.000	0.000	0.000				
Enhancement II	0.000	0.000	0.000				
Creation				0.000	0.000	0.000	
Preservation	0.000	0.000	0.000	0.000	0.000		
Totals	**5,151.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	

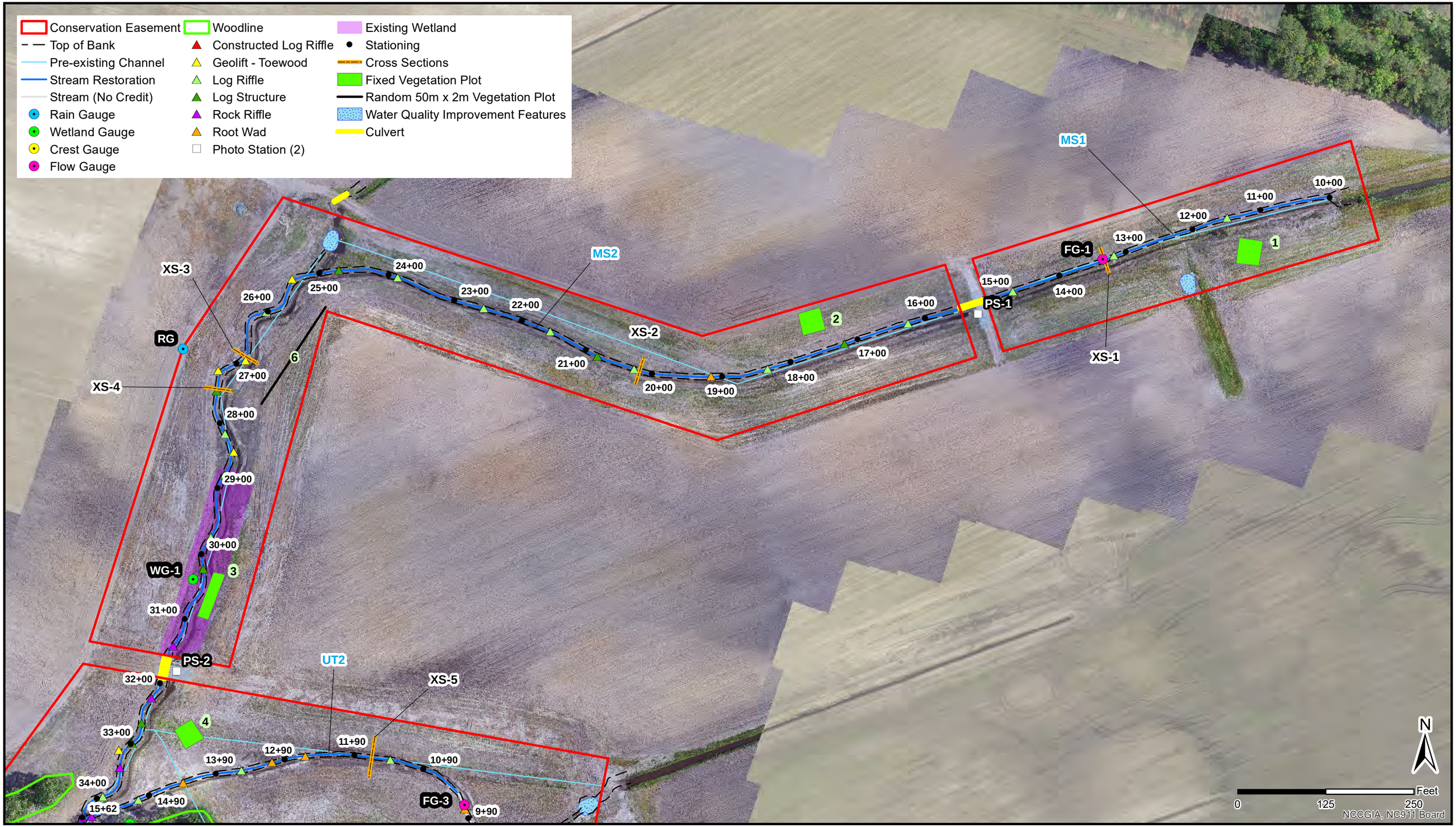
Total Stream Credit	**5,151.000**
Total Wetland Credit	**0.000**

Wetland Mitigation Category		Restoration Level	
CM	Coastal Marsh	HQP	High Quality Preservation
R	Riparian	P	Preservation
NR	Non-Riparian	E	Wetland Enhancement - Veg and Hydro
		EII	Stream Enhancement II
		EI	Stream Enhancement I
		C	Wetland Creation
		RH	Wetland Rehabilitation - Veg and Hydro
		REE	Wetland Re-establishment Veg and Hydro
		R	Restoration

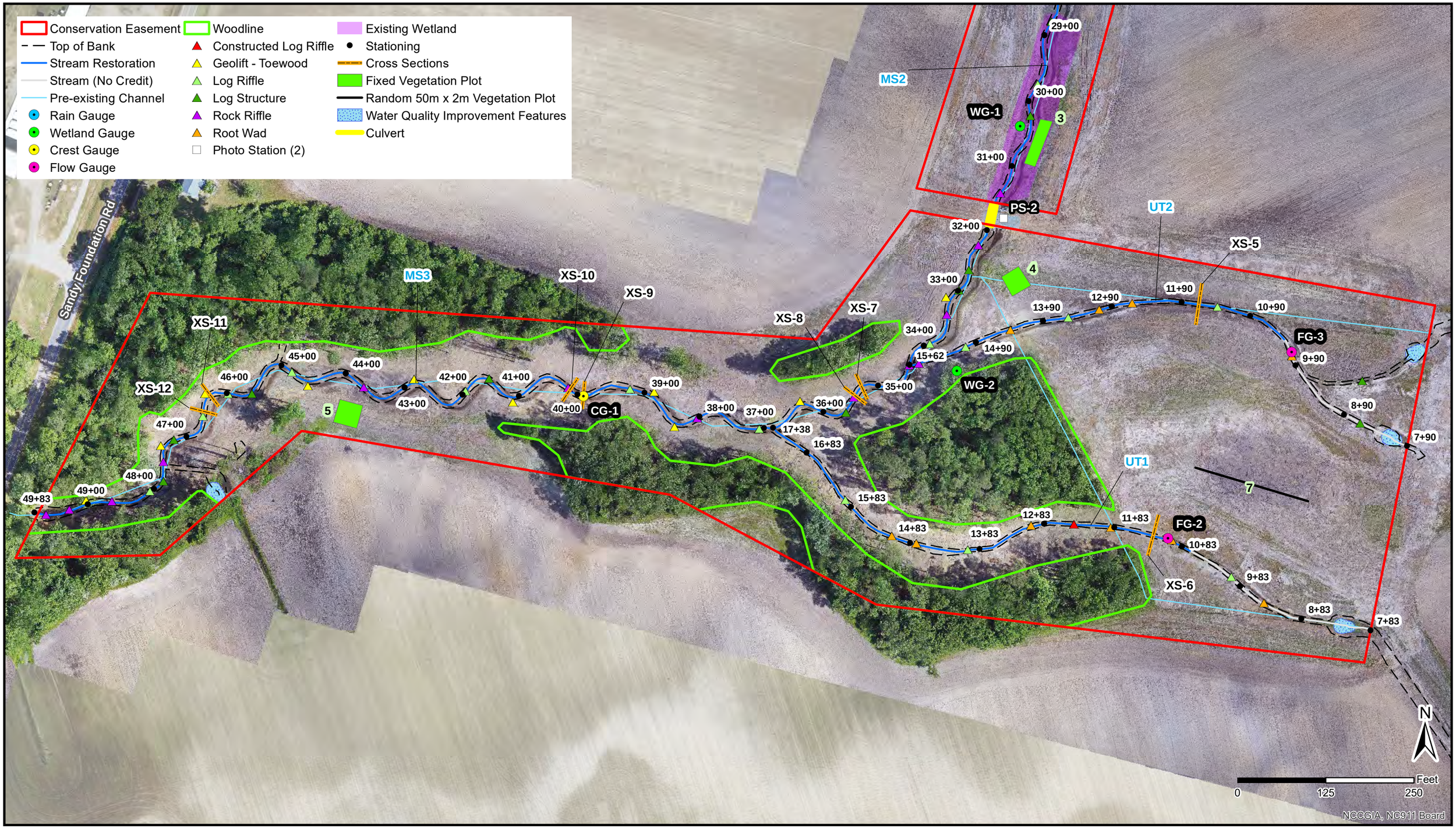
1.3 Current Condition Plan View

The following pages present the Current Condition Plan View (CCPV).

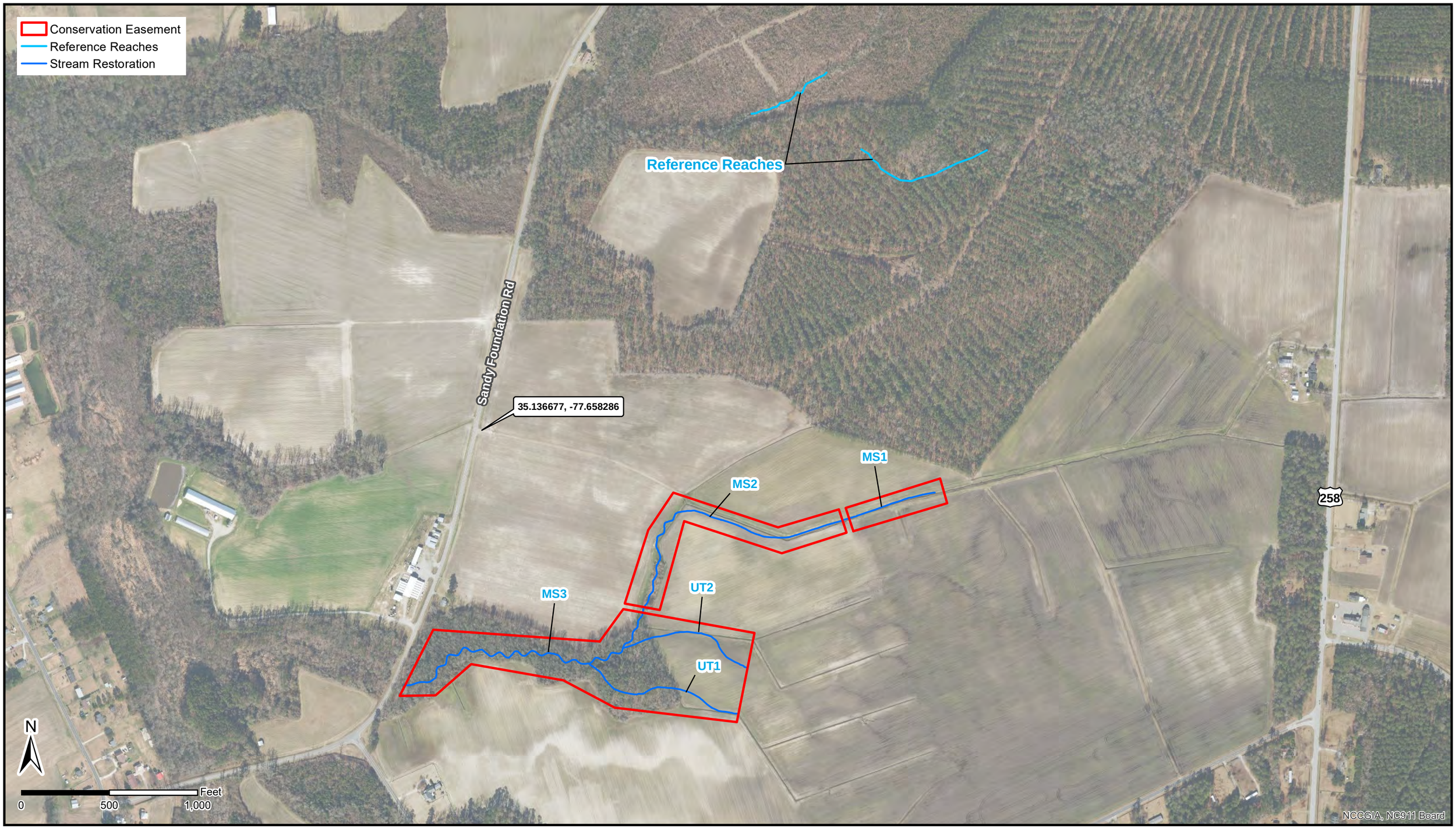
WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Hornpipe Branch Tributaries Mitigation Project Lenoir County, North Carolina**	USACE Action ID Number: SAW-2018-01762 Data Collection Date: 04/29/2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1a



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Hornpipe Branch Tributaries Mitigation Project Lenoir County, North Carolina**	USACE Action ID Number: SAW-2018-01762 Data Collection Date: 04/29/2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1b



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Hornpipe Branch Tributaries Mitigation Project Lenoir County, North Carolina**	USACE Action ID Number: SAW-2018-01762 Data Collection Date: 04/29/2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1c



WATER & LAND™ SOLUTIONS	NC Mitigation Services ENVIRONMENTAL QUALITY	**Hornpipe Branch Tributaries Mitigation Project Lenoir County, North Carolina**	USACE Action ID Number: SAW-2018-01762 Data Collection Date: 04/29/2021 MY0	Reference Site Map NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 2

2 Goals, Performance Criteria, and Functional Improvements

2.1 Project Goals and Objectives

The Project will meet the goals and objectives described in the Hornpipe Branch Tributaries Final Approved Mitigation Plan and will address general restoration goals and opportunities outlined in the 2010 (amended 2018) Neuse River Basin Watershed Restoration Priorities (RBRP). More specifically, the functional goals and objectives outlined in the RBRP will be met:

- Reducing sediment and nutrient inputs to the Southwest Creek Watershed.
- Restoring and protecting streams, wetlands, riparian buffers and aquatic habitat.
- Implementing agricultural BMPs and stream restoration in nutrient sensitive watersheds.

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.

Table 2: Summary: Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve Stream Base Flow Duration	Improve and/or remove existing stream crossings and restore a more natural flow regime and aquatic passage.	Create a more natural and higher functioning headwater flow regime and provide aquatic passage; re-establish appropriate wetland hydroperiods and provide hydrologic storage	Maintain seasonal flow on intermittent stream for a minimum of 30 consecutive days during normal annual rainfall	3 Flow gauges (MS1, UT1, UT2)	Data in MY1
Reconnect channels with floodplains and riparian wetlands to allow a natural flooding regime.	Design 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.	Provide temporary water storage and reduce erosive forces (shear stress) in channel during larger flow events.	Minimum of four bankfull events in separate years. Wetland hydrology data is supplementary and is not tied to project success criteria.	Minimum of four bankfull events in separate years. Wetland hydrology data is supplemanetary. Wetlands are not tied to project success. Criteria.A1:H6	Data in MY1
Improve stabilty of stream channels	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Reduction in sediment inputs from bank erosion, reduction of shear stress, and improved overall hydraulic function.	Bank height ratios remain below 1.2 over the monitoring period. Visual assessments showing progression towards stability.	12 Cross section surveys	all cross sections BHR<1.2.
Establish Riparian Buffer Vegetation	Plant native species vegetation a minimum 30' wide from the top of the streambanks with a composition/density comparable to downstream reference condition.	Increase woody and herbaceous vegetation will provide channel stability and reduce streambank erosion, runoff rates and exotic species vegetation.	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 eight foot tree heights must be present at year seven.	Tree data for 5 fixed veg plots and 2 random plots (species & height), visual assessment	7/7 veg plots met - 2021

2.2 Project Success Criteria

The success criteria for the Project will follow the approved performance standards and monitoring protocols from the final approved mitigation plan; which was developed in compliance with the USACE October 2016 Guidance, USACE Stream Mitigation Guidelines (April 2003 and October 2005), and 2008 Compensatory Mitigation Final Rule. Cross-section and vegetation plot data will be collected in Years 0, 1, 2, 3, 5, and 7. Stream hydrology data and visual monitoring will be reported annually. Specific success criteria components and evaluation methods are described below.

2.2.1 Single-Thread Streams

***Stream Hydrology*:** Four separate bankfull or over bank events must be documented within the seven-year monitoring period and the stream hydrology monitoring will continue until four bankfull events have been documented in separate years. Stream hydrology monitoring will be accomplished with pressure transducers installed in pools and correlating sensor depth to top of bank elevation. Recorded water depth above the top of bank elevation will document a bankfull event. The devices will record water depth hourly and will be inspected quarterly.

The stage recorders include an automatic pressure transducer (HOBO Water Level (13 ft) Logger) set in PVC piping in the channel. The elevation of the bed and top of bank at each stage recorder location will be recorded to be able to document presence of water in the channel and out of bank events. Visual observations (i.e. wrack or debris lines) and traditional cork crest gauges will also be used to document out of bank events.

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 will be evaluated with visual assessment, cross sections and, if directed by the IRT, longitudinal profile.

Stream Horizontal Stability: Cross-sections will be used to evaluate horizontal stream stability on restored streams. There should be little change expected in as-built 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.

Stream cross-section monitoring will be conducted using a Topcon RL-H5 Laser Level. Three-dimensional coordinates associated with cross-section data will be collected in the field (NAD83 State Plane feet PIPS 3200). Morphological data will be collected at 12 cross-sections. Survey data will be imported into Microsoft Excel® and DMS Shiny App for data processing and analysis.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the streambanks. Photographs will be taken of both streambanks at each cross-section. A survey tape stretched between the permanent cross-section monuments/pins will be centered in each of the streambank photographs. The water elevation will be

shown in the lower edge of the frame, and as much of the streambank as possible will be included in each photo. Photographers will attempt to consistently maintain the same area in each photo over time.

Streambed Material Condition and Stability: Streambed material is expected to have minimal changes over time and any significant changes (e.g., aggradation, degradation, embeddedness) will be noted after streambank vegetation becomes established and a minimum of two bankfull flows or greater have been documented. If significant changes are observed within stable riffles and pools, additional sediment transport analyses may be required.

Jurisdictional Stream Flow: Monitoring of stream flow will be conducted to demonstrate that the restored stream systems classified as intermittent and/or ephemeral exhibit base flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal rainfall conditions. Stream flow monitoring will be accomplished with pressure transducers installed in pools and correlating sensor depth to the downstream top of riffle elevation (see appendix D for installation diagrams). If the pool water depth is at or above the top of riffle elevation, then the channel will be assumed to have surface flow. The devices will record water elevation twice per day and will be inspected quarterly to document surface hydrology and provide a basis for evaluating flow response to rainfall events.

2.2.2 Headwater Streams

Continuous Surface Flow: 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. Additional monitoring maybe required if surface water flow cannot be documented due to abnormally dry conditions.

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).

2.2.3 Vegetation

Vegetation monitoring will occur in the fall each required monitoring year, prior to leaf drop. Plots will be monitored in years 1, 2, 3, 5, and 7. Vegetative success for the Project during the intermediate monitoring years will be based the survival of at least 320, three-year-old planted trees per acre at the end of Year 3 of the monitoring period; and at least 260, five-year-old, planted trees per acre that must average six feet in height at the end of Year 5 of the monitoring period. The final vegetative restoration success criteria will be achieving a density of no less than 210, seven-year-old planted stems per acre that must average eight feet in height in Year 7 of monitoring.

Vegetation success is being monitored at a total of five permanent vegetation plots and two random transects. Vegetation plot monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data are processed using the NCDMS ShinyApp. For each plot the origin was marked with a PVC pole and the other three corners were marked with rebar. Tree species and height will be recorded for each planted stem and photos of each plot are to be taken from the origin each monitoring year.

2.2.4 Visual Assessment

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, invasive plant species or animal browsing, easement boundary encroachments, and general streambed conditions. Permanent photo points will be at the cross-sections and culvert crossings.

3 Project Attributes

3.1 Design Approach

3.1.1 Stream

The Project stream design approach included a combination of stream restoration activities. Priority Level I, II and III restoration approaches were incorporated with the design of a single-thread meandering channel and headwater stream valley, with parameters based on reference site comparisons, published empirical relationships, NC Coastal Plain Regional Curves, and hydrologic and hydraulic analyses. All non-vegetated areas within the conservation easement were planted with native vegetation and any areas of invasive species were removed and/or treated.

Restoration: MS1, MS2, MS3, UT1, UT2

- **MS1 –** MS1 is a headwater tributary that was previously channelized along its entire length. Along the upper section of MS1, a Priority Level II/III Restoration was implemented by gradually raising the bed elevation and excavating a floodplain bench before reconnecting the stream with its geomorphic floodplain to promote more frequent over bank flooding. A shallow flow path was constructed as a moderately-defined pilot channel and base flow will follow the historic flow pattern and valley morphology, restoring a more natural hydrologic function.

- **MS2 –** MS2 continued below MS1 as the valley turns to the southwest. Along this section of MS2, work included Priority Level I/II Restoration by raising the bed elevation and reconnecting the stream with its geomorphic floodplain, to promote more frequent over bank flooding. A stable stream system was achieved by constructing a well-defined single-thread meandering channel across the floodplain. Grading activities restored a more natural flow pattern and improved existing wetland hydrology by removing berms and other agricultural land manipulations. The reach was restored using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the valley slope and width. As MS2 flattened along its lower half and flowed into the remnant in-line agricultural BMP, the channelized stream was graded to the natural valley topography prior to the backwater condition. The existing stream crossing was improved at the same location near the downstream end of MS2. At the installed permanent stream crossing, a failing/perched pipe culvert was replaced to improve aquatic passage and the existing channel was filled slightly to an elevation sufficient to connect the channel to its floodplain using native woody material and suitable fill material.

- **MS3** – MS3 begins near the existing wood line near the confluence of UT2 and MS2. Work along MS3 continued as a Priority Level I Restoration by raising the bed elevation and reconnecting the stream with its geomorphic floodplain to promote more frequent over bank flooding. A stable stream was achieved by constructing a well-defined single-thread meandering channel across the geomorphic floodplain. Grading activities restored the natural flow pattern by removing berms and other agricultural land manipulations. The lower section of MS3 transitioned to a Priority Level II Restoration by gradually lowering the bed elevation and excavation of a floodplain bench before reconnecting the stream with the existing bed elevation prior to flowing into an existing culvert crossing. The reach was restored using appropriate riffle-pool morphology with in-stream structures and a conservative meander planform geometry that accommodates the valley slope and width. Exotic species were removed in this area and native riparian species were replanted.

- **UT1 and UT2 –** UT1 and UT2 are small headwater tributaries that had been channelized. Beginning above the stream origins, the existing ditches were filled slightly and graded to the natural valley topography. The restored headwater reaches were relocated to the low point of the valley from the existing agricultural field to their confluence with MS2 and MS3. The valley bottoms were graded to restore the natural microtopographic variability that is common within headwater systems. A shallow flow path was constructed as a small pilot channel similar to the adjacent reference site. The restored headwater streams flow across constructed features such as floodplain depressions and woody debris/structures (i.e. tree throws), restoring a more natural hydrology function. At the lower reach locations, the headwater channels transition into a single-

thread channel. The existing channels were filled to an elevation sufficient to connect the headwater channels to their natural floodplain using suitable fill material.

3.2 Project Attributes

See Table 3 below for Project Attributes.

Table 3. Project Attribute Table					
Project Name	Hornpipe Branch Tributaries Mitigation Project				
County	Lenoir				
Project Area (acres)	23.43				
Project Coordinates (latitude and longitude decimal degrees)	35.134242°, -77.655045°				
Project Watershed Summary Information					
Physiographic Province	Coastal Plain				
River Basin	Neuse River				
USGS Hydrologic Unit 8-	3020202				
DWR Sub-basin	3/4/2005				
Project Drainage Area (acres)	331				
Project Drainage Area Percentage of Impervious Area	2.00%				
Land Use Classification	2.01.03, 2.01.01, 3.02 (78% cultivated crops, 16% evergreen/mixed forest)				
Reach Summary Information					
Parameters	**Reach MS1**	**Reach MS2**	**Reach MS3**	**Reach UT1**	**Reach UT2**
Pre-project length (feet)	1,493	774	1,548	498	644
Post-project (feet)	1,468	940	1,521	677	562
Valley confinement (Confined, moderately confined, unconfined)	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (acres)	183	222	331	46	32
Perennial, Intermittent, Ephemeral	Intermittent	Perennial	Perennial	Intermittent	Ephemeral
NCDWR Water Quality Classification	C, NSW	C, NSW	C, NSW	C, NSW	C, NSW
Dominant Stream Classification (existing)	N/A (channelized ditch)	N/A (channelized ditch)	F5	N/A (channelized ditch)	N/A (channelized ditch)
Dominant Stream Classification (proposed)	DA/E5	C5/E5	C5/E5	DA	DA
Dominant Evolutionary class (Simon) if applicable	IV	IV	III/IV	IV	IV
Regulatory Considerations					
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**		
Water of the United States - Section 404	Yes	Yes	404 Permit		
Water of the United States - Section 401	Yes	Yes	401 Permit		
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		
Essential Fisheries Habitat	No	N/A	Categorical Exclusion		

4 Monitoring Year 0 Assessment and Results

4.1 As-built Survey

An as-built survey conducted under the responsible charge of a North Carolina Professional Land Surveyor (Christopher Paderick, PLS, Matrix East, PLLC), was utilized to document the as-built or baseline condition of the Project post-construction. The Project construction and planting were completed in March 2021 and as-built survey was completed in May 2021. Baseline monitoring activities occurred in March and April of 2021.

4.2 As-Built Plans/ Record Drawings

The results of the as-built survey establish and document post-construction or baseline conditions and will be used for comparing annual post-construction monitoring data. The as-built plans or record drawings were developed utilizing the final construction plans as the "background", and then overlaying the as-built survey information on the plan and profile sheets. Any significant adjustments or deviations made to the final construction plans during construction are shown as redline mark-ups or callouts on the as-built survey plan sheets. The as-built plans/record drawings were submitted separately.

4.3 As-Built/ Baseline Assessment

No significant deviations were documented between the final construction plans and the as-built condition that may affect channel performance, channel lengths, or changes in vegetation species planted. No major issues or mitigating factors were observed immediately after construction which require consideration or remedial action.

4.4 Morphological Assessment

Morphological data for the as-built profile was collected in March 2020. Refer to Appendices A and C for summary data tables, morphological plots, and stream photographs.

4.4.1 Stream Horizontal Pattern & Longitudinal Profile

The MY0 stream channel pattern and longitudinal profiles closely match the profile design parameters. The MY0 plan form geometry or pattern fell within acceptable ranges of the design parameters for all restored reaches. Minor channel adjustments in riffle slopes, pool depths and pattern do not present a stability concern or indicate a need for remedial action and will be assessed visually during the annual assessments.

4.4.2 Stream Horizontal Dimension

The MY0 channel dimensions generally match the design parameters and are within acceptable and stable ranges of tolerance. It is expected that over time that some pools may accumulate fine sediment and organic matter, however, this is not an indicator of channel instability. Maximum riffle depths are also expected to fluctuate slightly throughout the monitoring period as the channels adjust to the new flow regime and catchment conditions.

4.5 Stream Hydrology

4.5.1 Stream Flow

Three pressure transducers (flow gauges) were installed in March 2021 on reaches MS1, UT1, and UT2 to document baseflow conditions. The flow gauge locations are within the upper one-third of the project

reaches as shown on Figures 1 and data will be included in the Monitoring Year 1 Report. Gauges on UT1 and UT2 were moved upstream of where they were proposed due to lack of appropriate pools for accurate gauge readings. See appendix D for the pressure transducer installation diagram.

4.5.2 Bankfull Events

One crest gauge was installed in March 2021 to document bankfull events. WLS installed a conventional cork crest gauge, along with a pressure transducer to validate flood status on MS3. Stream hydrology data will be included in the Monitoring Year 1 Report in this section and in the appendices. Recorder locations are shown on Figure 1.

4.5.3 Headwater Stream 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 indicators listed in section 2.2.2. This evidence will be addressed in the Monitoring Year 1 Report.

4.5.4 Wetlands

Wetland mitigation credits are not contracted or proposed for this project. Two groundwater wells were installed in March 2021 in an existing jurisdictional wetland on MS-2 and adjacent to UT2 to monitor groundwater levels in the project. No performance standards for wetland hydrology success were proposed in the Mitigation Plan and therefore wetland mitigation monitoring is not included in the project. Groundwater well locations are shown on the CCPVs and the data will be included subsequent monitoring reports.

4.5.5 Vegetation

Monitoring of the five permanent vegetation plots and two random transects was completed during the first week of April 2021. Vegetation data and photos can be found in Appendix B. The MY0 average planted density is 717 stems per acre, which exceeds the interim measure of vegetative success of at least 320 planted stems per acre at the end of the third monitoring year. Each vegetation plot is meeting the interim measure requirements and has 607 - 850 stems per acre. Volunteer species were not noted at baseline monitoring but are expected to establish in upcoming years.

Visual assessment of vegetation outside of the monitoring plots indicates that the herbaceous vegetation is becoming well established throughout the project.

A significant population of privet (*Ligustrum sinense*) was located along MS3 and the wooded areas of UT1 and UT2 prior to construction. Construction activities included removing existing privet within the easement. These areas will be closely monitored, and re-sprouts will be treated as needed to prevent further establishment. Any future treatments will be documented and included in subsequent monitoring reports.

Appendix A:
Visual Assessment Data

Visual Stream Morphology Stability Assessment Table
Vegetation Condition Assessment Table
Photos: Cross Section Photos
Photos: Stream Photo Points (Culvert Crossings)

Visual Stream Stability Assessment

Reach	MS1, MS2, MS3, UT1, UT2
Assessed Stream Length	5,690
Assessed Bank Length	11,386.54

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
Bank	Surface Scour/Bare Bank	Bank lacking vegetative cover resulting simply from poor growth and/or surface scour			0	100%
	Toe Erosion	Bank toe eroding to the extent that bank failure appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	100%
	Bank Failure	Fluvial and geotechnical - rotational, slumping, calving, or collapse			0	100%
				Totals	0	100%
Structure	Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	62	62		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in DMS monitoring guidance document)	20	20		100%

Visual Vegetation Assessment

Planted acreage **17.7**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10 acres	0.00	0.0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10acres	0.00	0.0%
		Total	0.00	0.0%
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10 acres	0.00	0.0%
		Cumulative Total	0.00	0.0%

Easement Acreage **23.43 ac**

Vegetation Category	Definitions	Mapping Threshold	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Invasives may occur outside of planted areas and within the easement and will therefore be calculated against the total easement acreage. Include species with the potential to directly outcompete native, young, woody stems in the short-term or community structure for existing communities. Species included in summation above should be identified in report summary.	0.10 acres	0.00	0.0%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0.00	

MS1, XS1, Upstream (MY-00)

MS1, XS1, Left Bank (MY-00)

MS1, XS1, Downstream (MY-00)

MS1, XS1, Right Bank (MY-00)

MS1, XS2, Upstream (MY-00)

MS1, XS2, Left Bank (MY-00)

MS1, XS2, Downstream (MY-00)

MS1, XS2, Right Bank (MY-00)

MS2, XS3, Upstream (MY-00)

MS2, XS3, Left Bank (MY-00)

MS2, XS3, Downstream (MY-00)

MS2, XS3, Right Bank (MY-00)

MS2, XS4, Upstream (MY-00)

MS2, XS4, Left Bank (MY-00)

MS2, XS4, Downstream (MY-00)

MS2, XS4, Right Bank (MY-00)

UT2, XS5, Upstream (MY-00)

UT2, XS5, Left Bank (MY-00)

UT2, XS5, Downstream (MY-00)

UT2, XS5, Right Bank (MY-00)

UT1, XS6, Upstream (MY-00)

UT1, XS6, Left Bank (MY-00)

UT1, XS6, Downstream (MY-00)

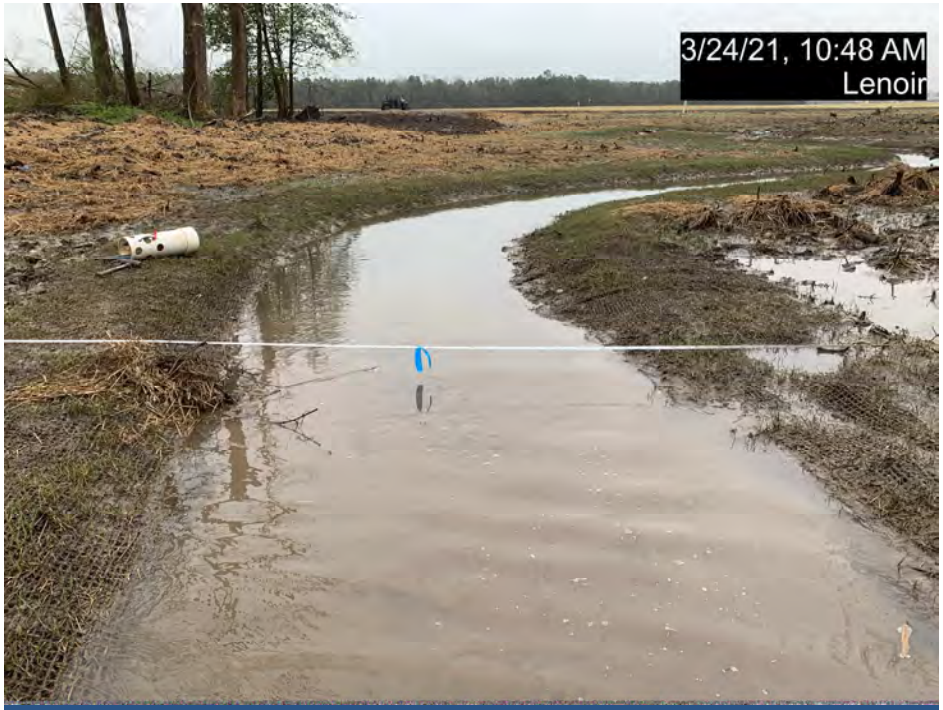
UT1, XS6, Right Bank (MY-00)

MS3, XS7, Upstream (MY-00)

MS3, XS7, Left Bank (MY-00)

MS3, XS7, Downstream (MY-00)

MS3, XS7, Right Bank (MY-00)



MS3, XS8, Upstream (MY-00)

MS3, XS8, Left Bank (MY-00)

MS3, XS8, Downstream (MY-00)

MS3, XS8, Right Bank (MY-00)

MS3, XS9, Upstream (MY-00)

MS3, XS9, Left Bank (MY-00)

MS3, XS9, Downstream (MY-00)

MS3, XS9, Right Bank (MY-00)

MS3, XS10, Upstream (MY-00)

MS3, XS10, Left Bank (MY-00)

MS3, XS10, Downstream (MY-00)

MS3, XS10, Right Bank (MY-00)

MS3, XS11, Upstream (MY-00)

MS3, XS11, Left Bank (MY-00)

MS3, XS11, Downstream (MY-00)

MS3, XS11, Right Bank (MY-00)

MS3, XS12, Upstream (MY-00)

MS3, XS12, Left Bank (MY-00)

MS3, XS12, Downstream (MY-00)

MS3, XS12, Right Bank (MY-00)

PS-1 – MS1, Culvert Crossing, Upstream (MY-00)

PS-1 – MS1, Culvert Crossing, Downstream (MY-00)

PS-2 – MS2, Culvert Crossing, Upstream (MY-00)

PS-2 – MS2, Culvert Crossing, Downstream (MY-00)

Appendix B:
Vegetation Plot Data

Redline Plant List
Final Plant List
Vegetation Performance Standards Summary Table
Vegetation Plot Counts and Densities Table
Veg Plot Maps
Photos: Vegetation Plot Photos

Hornpipe Mitigation Project Planting List			
Species	**Common Name**	**# Planted**	**% Planted**
Fraxinus pennsylvanica	Green Ash	700	5.56%
Betula nigra	River birch	1800	14.29%
Quercus michauxii	Swamp chestnut oak	700	5.56%
Quercus bicolor	Swamp white oak	700	5.56%
Platanus occidentalis	American sycamore	1700	13.49%
Quercus nigra	Water Oak	1500	11.90%
Liriodendron tulipifera	Tulip Poplar	1400	11.11%
Quercus phellos	Willow Oak	1700	13.49%
Nyssa biflora	Swamp black gum	700	5.56%
Quercus alba	White Oak	600	4.76%
Carpinus caroliniana	Ironwood	700	5.56%
Persea palustris	Red bay	200	1.59%
Ilex verticillata	Winterberry	200	1.59%
Total		**12,600**	**100.00%**

Note: Planting species and quantities are for the entire site, including stream and wetland areas.

Hornpipe Mitigation Project Red-line Planting List				
Species	**Common Name**	**Stems**	**% Planted**	**Mitigation Plan %**
Fraxinus pennsylvanica	Green Ash	700	5.56%	3%
Betula nigra	River birch	1800	14.29%	10%
Quercus michauxii	Swamp chestnut oak	700	5.56%	8%
Quercus bicolor	Swamp white oak	700	5.56%	8%
Platanus occidentalis	American sycamore	1700	13.49%	10%
Quercus nigra	Water Oak	1500	11.90%	8%
Liriodendron tulipifera	Tulip Poplar	1400	11.11%	10%
Quercus phellos	Willow Oak	1700	13.49%	8%
Nyssa biflora	Swamp black gum	700	5.56%	8%
Quercus alba	White Oak	600	4.76%	6%
~~***Clethra alnifolia***~~	~~Sweet pepperbush~~	~~0~~	~~0.00%~~	3%
Carpinus caroliniana	Ironwood	700	5.56%	3%
Persea palustris	Red bay	200	1.59%	3%
Ilex verticillata	Winterberry	200	1.59%	0%
~~***Eubotrys racemosus***~~	~~Swamp doghobble~~	~~0~~	~~0.00%~~	3%
~~***Magnolia virginiana***~~	~~Sweetbay magnolia~~	~~0~~	~~0.00%~~	3%
~~***Cyrilla racimiflora***~~	~~Titi~~	~~0~~	~~0.00%~~	3%
~~***Itea virginica***~~	~~Sweetspire~~	~~0~~	~~0.00%~~	3%
Total		**12,600**	**100%**	

* changes from mitigation plan in red

Vegetation Performance Standards Summary Table (Data Collection 4/6/2021)												
	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1												
Monitoring Year 0	688		7	0	607		8	0	850		10	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot Group 6 R			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1												
Monitoring Year 0	850		10	0	648		10	0	607		9	0
	Veg Plot Group 7 R											
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives								
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1												
Monitoring Year 0	769		9	0								

*Each monitoring year represents a different plot for the random vegetation plot "groups". Random plots are denoted with an R, and fixed plots with an F.

Stem Counts and Densities Table	
Planted Acreage	17.7
Date of Initial Plant	2021-03-31
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-04-06
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F		Veg Plot 6 R	Veg Plot 7 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW	1	1	1	1	3	3	2	2	1	1	1	
	Carpinus caroliniana	American hornbeam	Tree	FAC	1	1	1	1	3	3	4	4	2	2	1	2
	Fraxinus pennsylvanica	green ash	Tree	FACW			4	4	2	2	1	1	1	1		2
	Liriodendron tulipifera	tuliptree	Tree	FACU			4	4	5	5			1	1		3
	Nyssa biflora	swamp tupelo	Tree	OBL	3	3			1	1	1	1	4	4	3	2
	Persea palustris	swamp bay	Shrub	FACW							2	2	2	2		
	Platanus occidentalis	American sycamore	Tree	FACW	4	4			1	1	2	2	2	2	2	2
	Quercus alba	white oak	Tree	FACU			1	1			2	2	1	1	1	1
	Quercus bicolor	swamp white oak	Tree	FACW	1	1	1	1	3	3	1	1	1	1		1
	Quercus michauxii	swamp chestnut oak	Tree	FACW					1	1	4	4			1	2
	Quercus nigra	water oak	Tree	FAC	2	2	2	2					1	1	2	
	Quercus phellos	willow oak	Tree	FACW	5	5	1	1	2	2	2	2			4	4
Sum	Performance Standard				17	17	15	15	21	21	21	21	16	16	15	19
Post Mitigation Plan Species	Ilex verticillata	common winterberry	Tree	FACW					1	1					1	
Sum	Proposed Standard				17	17	15	15	22	22	21	21	16	16	16	19
Mitigation Plan Performance Standard	Current Year Stem Count					17		15		21		21		16	15	19
	Stems/Acre					688		607		850		850		648	607	769
	Species Count					7		8		9		10		10	8	9
	Dominant Species Composition (%)					29		27		23		19		25	25	21
	Average Plot Height					1		1		1		1		2	2	1
	% Invasives					0		0		0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					17		15		22		21		16	16	19
	Stems/Acre					688		607		891		850		648	648	769
	Species Count					7		8		10		10		10	9	9
	Dominant Species Composition (%)					29		27		23		19		25	25	21
	Average Plot Height					1		1		1		1		2	2	1
	% Invasives					0		0		0		0		0	0	0

1). Bolded species are proposed for the current monitoring year, italicized species are not approved, and a regular font indicates that the species has been approved.
2). The "Species Included in Approved Mitigation Plan" section contains only those species that were included in the original approved mitigation plan. The "Post Mitigation Plan Species" section includes species that are being proposed through a mitigation plan addendum for the current monitoring year (bolded) , species that have been approved in prior monitoring years through a mitigation plan addendum (regular font), and species that are not approved (italicized).
3). The "Mitigation Plan Performance Standard" section is derived only from stems included in the original mitigation plan, whereas the "Post Mitigation Plan Performance Standard" includes data from mitigation plan approved, post mitigation plan approved, and proposed stems.

Fixed Veg Plot 1 (MY-00)

Fixed Veg Plot 3 (MY-00)

Fixed Veg Plot 2 (MY-00)

Fixed Veg Plot 4 (MY-00)

Fixed Veg Plot 5 (MY-00)

Random Veg Plot 6, Facing Southwest (MY-00)

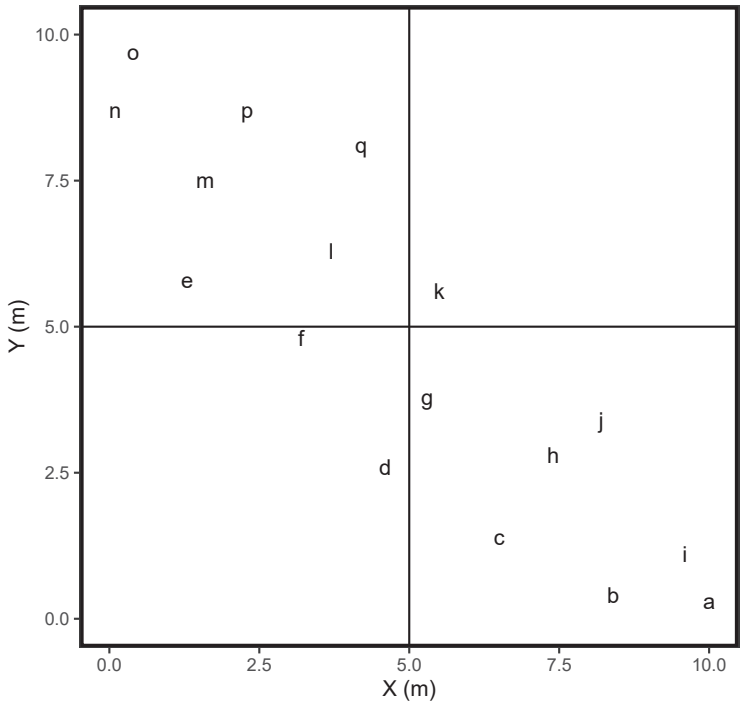
Random Veg Plot 6, Facing Northeast (MY-00)

Random Veg Plot 7, Facing West (MY-00)

Random Veg Plot 7, Facing East (MY-00)

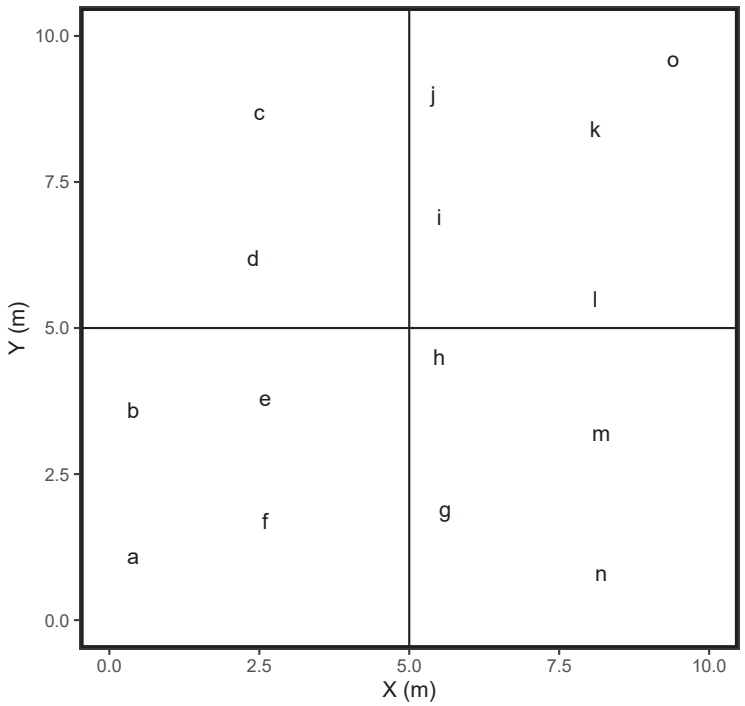
Fixed Vegetation Plot Stem Location Maps
Data Collected 4/6/2021

Plot 1



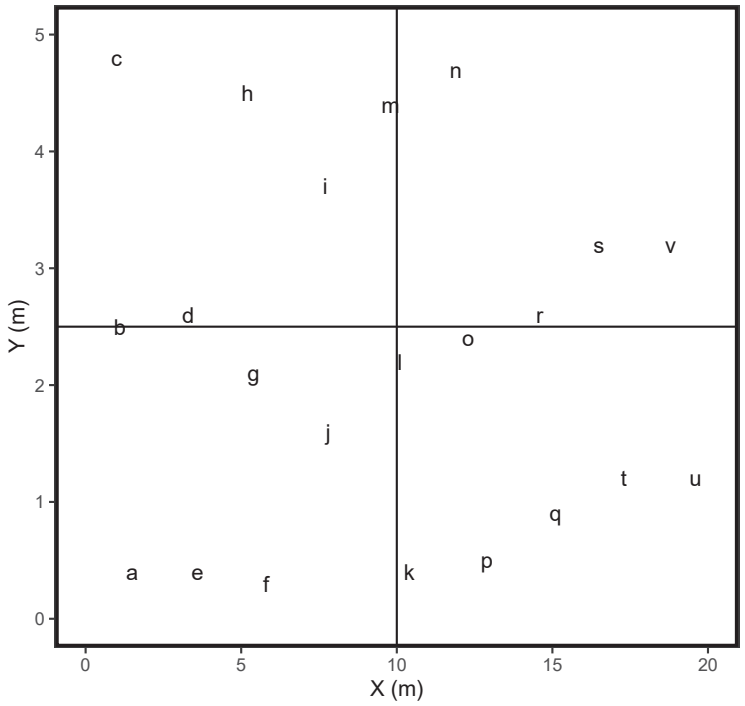
PLOT ID	Scientific Name	Common Name	Map ID
1	Carpinus caroliniana	American hornbeam	a
1	Nyssa biflora	swamp tupelo	b
1	Quercus phellos	willow oak	c
1	Quercus phellos	willow oak	d
1	Quercus nigra	water oak	e
1	Quercus phellos	willow oak	f
1	Quercus bicolor	swamp white oak	g
1	Quercus phellos	willow oak	h
1	Platanus occidentalis	American sycamore	i
1	Platanus occidentalis	American sycamore	j
1	Platanus occidentalis	American sycamore	k
1	Platanus occidentalis	American sycamore	l
1	Quercus nigra	water oak	m
1	Quercus phellos	willow oak	n
1	Betula nigra	river birch	o
1	Nyssa biflora	swamp tupelo	p
1	Nyssa biflora	swamp tupelo	q

Plot 2



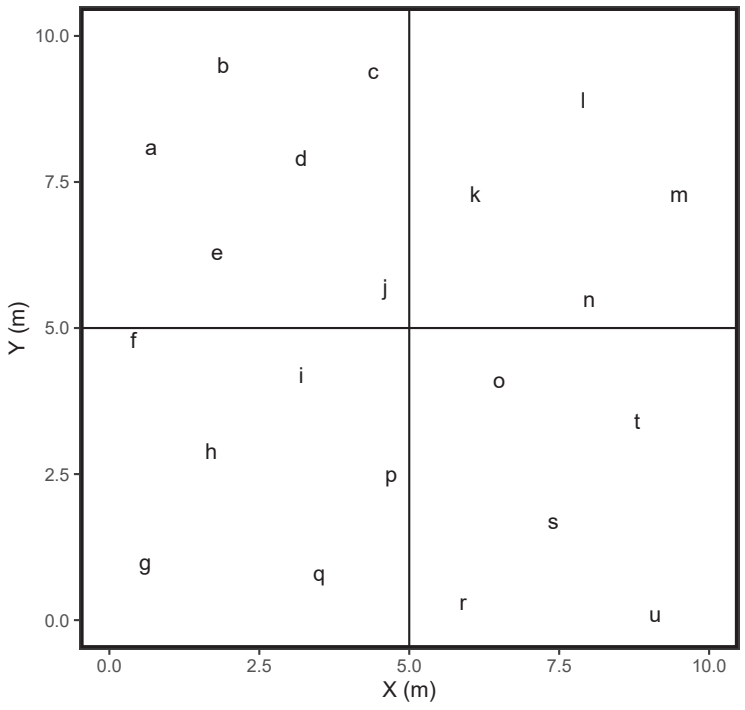
Plot ID	Scientific Name	Common Name	Map ID
2	Fraxinus pennsylvanica	green ash	a
2	Betula nigra	river birch	b
2	Quercus nigra	water oak	c
2	Liriodendron tulipifera	tuliptree	d
2	Quercus alba	white oak	e
2	Quercus phellos	willow oak	f
2	Liriodendron tulipifera	tuliptree	g
2	Quercus nigra	water oak	h
2	Liriodendron tulipifera	tuliptree	i
2	Liriodendron tulipifera	tuliptree	j
2	Fraxinus pennsylvanica	green ash	k
2	Fraxinus pennsylvanica	green ash	l
2	Fraxinus pennsylvanica	green ash	m
2	Carpinus caroliniana	American hornbeam	n
2	Quercus bicolor	swamp white oak	o

Plot 3

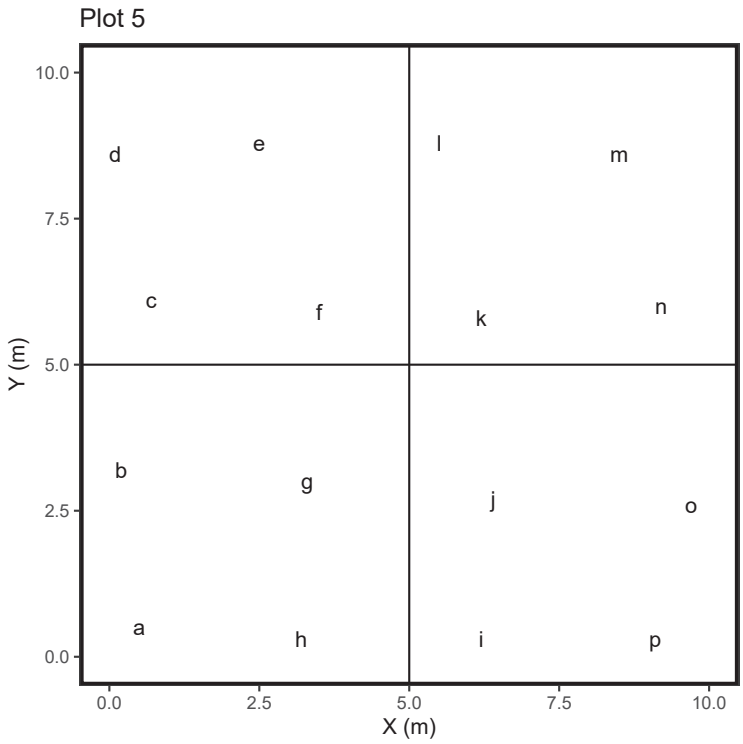


Plot ID	Scientific Name	Common Name	Map ID
3	Quercus phellos	willow oak	a
3	Liriodendron tulipifera	tuliptree	b
3	Quercus bicolor	swamp white oak	c
3	Fraxinus pennsylvanica	green ash	d
3	Carpinus caroliniana	American hornbeam	e
3	Carpinus caroliniana	American hornbeam	f
3	Liriodendron tulipifera	tuliptree	g
3	Liriodendron tulipifera	tuliptree	h
3	Liriodendron tulipifera	tuliptree	i
3	Quercus bicolor	swamp white oak	j
3	Fraxinus pennsylvanica	green ash	k
3	Quercus bicolor	swamp white oak	l
3	Ilex verticillata	common winterberry	m
3	Quercus michauxii	swamp chestnut oak	n
3	Carpinus caroliniana	American hornbeam	o
3	Quercus phellos	willow oak	p
3	Betula nigra	river birch	q
3	Betula nigra	river birch	r
3	Platanus occidentalis	American sycamore	s
3	Liriodendron tulipifera	tuliptree	t
3	Betula nigra	river birch	u
3	Nyssa biflora	swamp tupelo	v

Plot 4



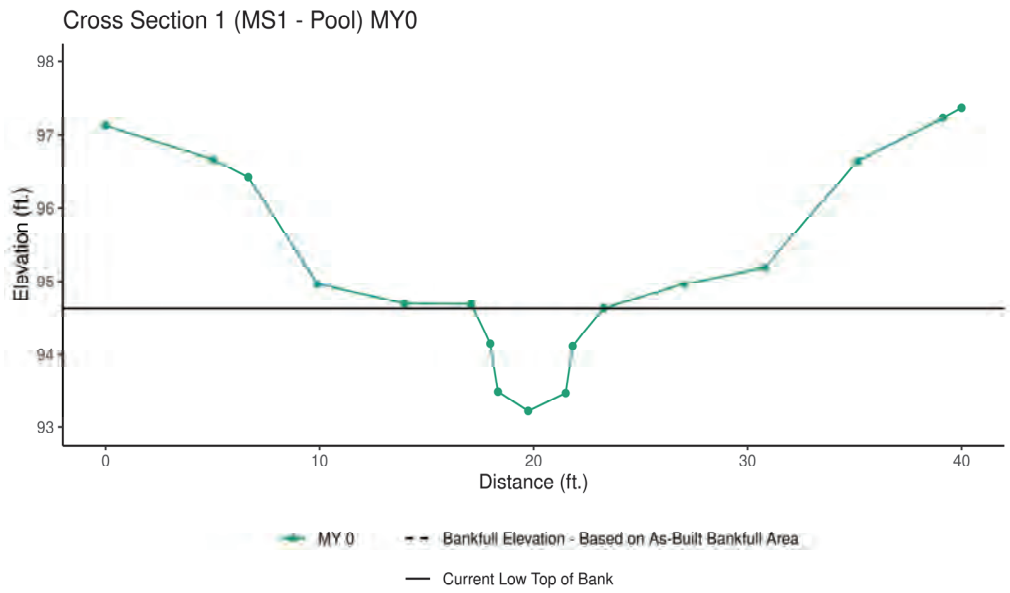
PLOT ID	Scientific Name	Common Name	Map ID
4	Carpinus caroliniana	American hornbeam	a
4	Quercus phellos	willow oak	b
4	Platanus occidentalis	American sycamore	c
4	Persea palustris	swamp bay	d
4	Nyssa biflora	swamp tupelo	e
4	Quercus alba	white oak	f
4	Quercus michauxii	swamp chestnut oak	g
4	Platanus occidentalis	American sycamore	h
4	Fraxinus pennsylvanica	green ash	i
4	Betula nigra	river birch	j
4	Quercus michauxii	swamp chestnut oak	k
4	Quercus michauxii	swamp chestnut oak	l
4	Carpinus caroliniana	American hornbeam	m
4	Carpinus caroliniana	American hornbeam	n
4	Quercus alba	white oak	o
4	Quercus phellos	willow oak	p
4	Persea palustris	swamp bay	q
4	Quercus bicolor	swamp white oak	r
4	Betula nigra	river birch	s
4	Carpinus caroliniana	American hornbeam	t
4	Quercus michauxii	swamp chestnut oak	u



PLOT ID	Scientific Name	Common Name	Map ID
5	Betula nigra	river birch	a
5	Quercus bicolor	swamp white oak	b
5	Carpinus caroliniana	American hornbeam	c
5	Liriodendron tulipifera	tuliptree	d
5	Platanus occidentalis	American sycamore	e
5	Nyssa biflora	swamp tupelo	f
5	Nyssa biflora	swamp tupelo	g
5	Persea palustris	swamp bay	h
5	Nyssa biflora	swamp tupelo	i
5	Fraxinus pennsylvanica	green ash	j
5	Persea palustris	swamp bay	k
5	Platanus occidentalis	American sycamore	l
5	Quercus alba	white oak	m
5	Nyssa biflora	swamp tupelo	n
5	Quercus nigra	water oak	o
5	Carpinus caroliniana	American hornbeam	p

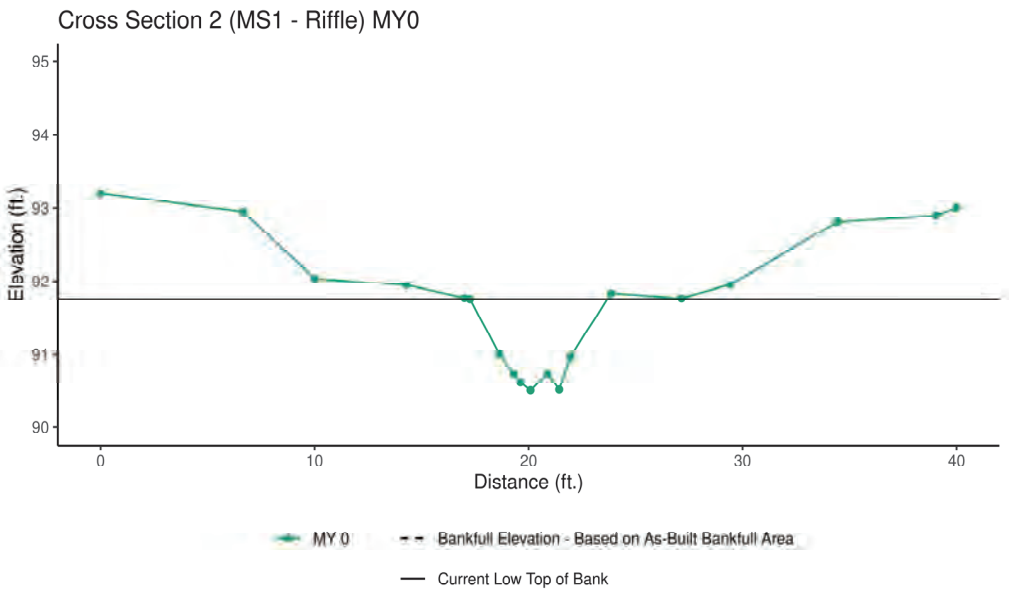
Appendix C:
Stream Geomorphology Data

Cross-Sections with Annual Overlays
Baseline Longitudinal Profile
Baseline Stream Data Summary Tables
Cross-Section Morphology Data



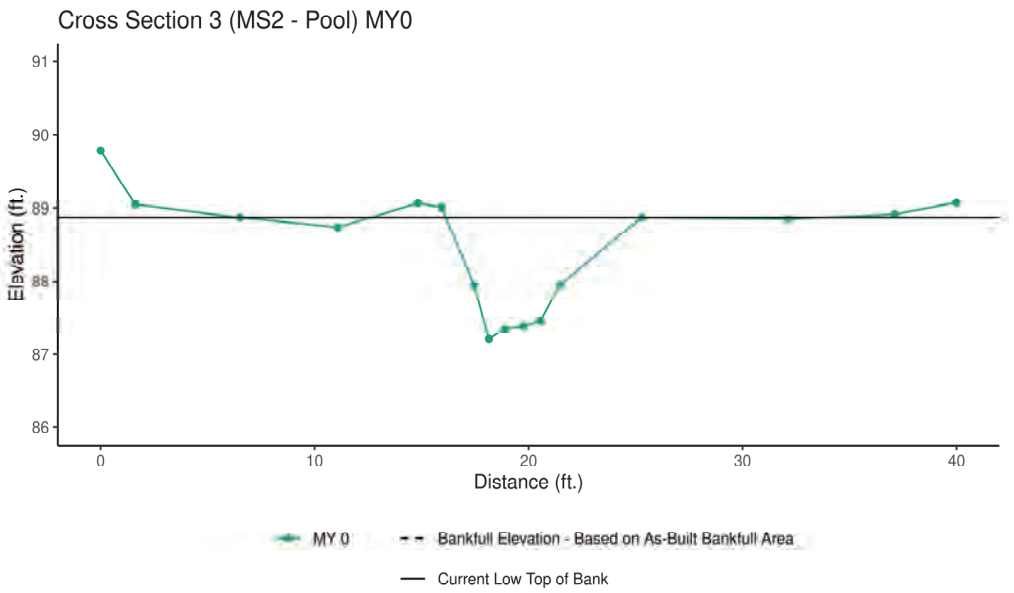
Distance	Elevation	Features
0	97.13	TLP
5.01505743	96.661	
6.66701267	96.423	
9.9181043	94.958	
13.9797212	94.694	
17.0828066	94.688	TLB
17.9752035	94.141	LEW
18.3368543	93.483	
19.7476893	93.23	THW
21.5006209	93.465	
21.8267096	94.109	REW
23.2847916	94.631	TRB, BKF
27.0044459	94.957	
30.7931633	95.186	
35.1278405	96.637	
39.1282577	97.231	
40	97.363	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	94.63							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	93.23							
LTOB Elevation	94.63							
LTOB Max Depth	1.401							
LTOB Cross Sectional Area	5.20							



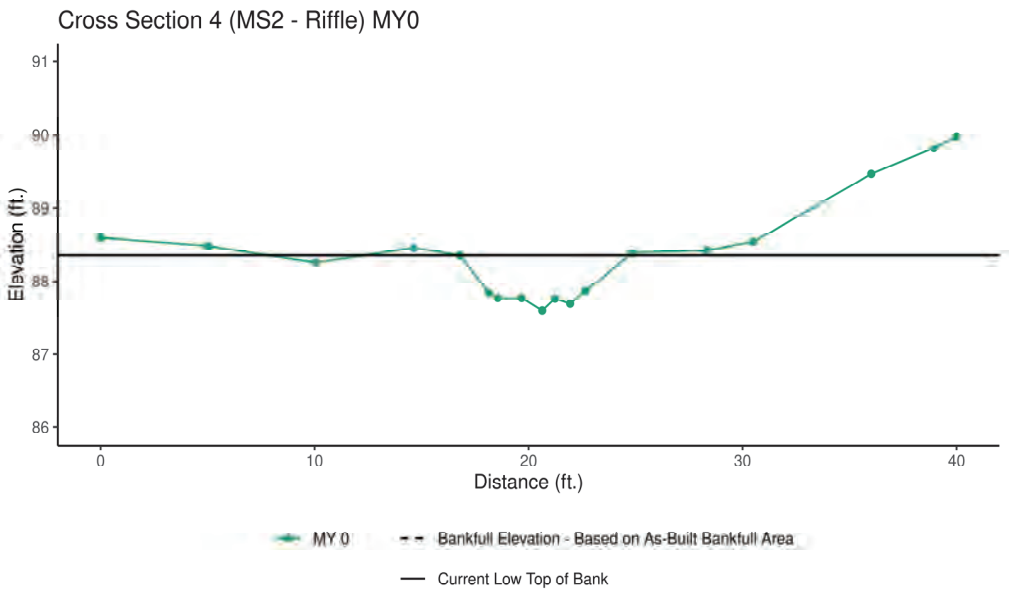
Distance	Elevation	Features
0	93.2	TLP
6.65511833	92.949	
10.0094058	92.035	
14.283247	91.946	
17	91.766	
17.26	91.75	TLB, BKF
18.6330314	91.005	LEW
19.3158898	90.729	
19.6169731	90.613	
20.0902015	90.505	THW
20.8923498	90.733	
21.4303707	90.515	
21.9574117	90.968	REW
23.856714	91.829	TRB
27.1474987	91.761	
29.4165101	91.951	
34.4277528	92.812	
39.0641429	92.898	
40	93.002	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	91.75							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	90.51							
LTOB Elevation	91.75							
LTOB Max Depth	1.245							
LTOB Cross Sectional Area	4.72							



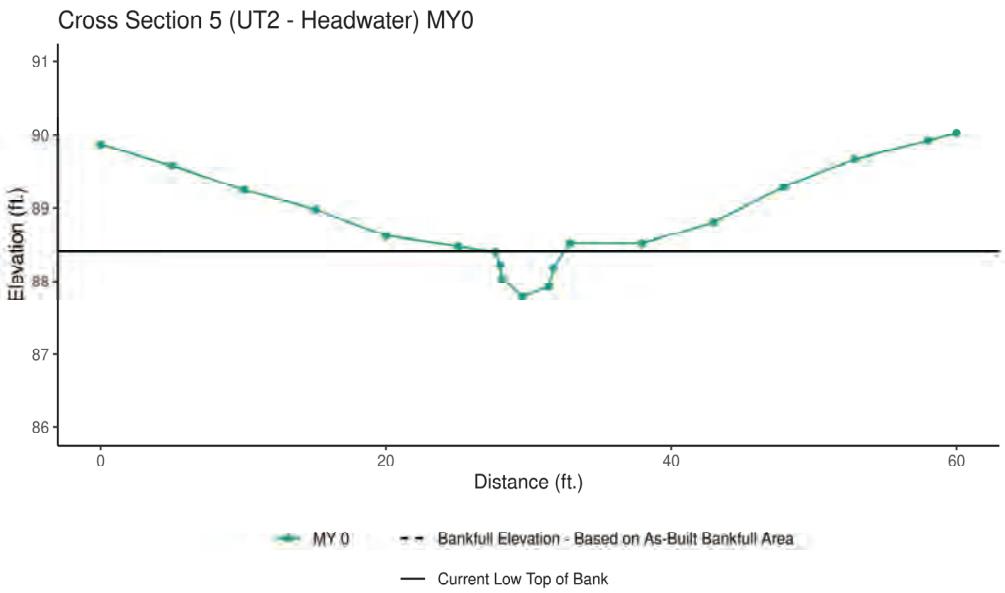
Distance	Elevation	Features
0	89.78	TLP
1.62463288	89.048	
6.49046786	88.872	
11.0923588	88.739	
14.8303026	89.066	
15.9362521	89.005	TLB
17.4536087	87.947	LEW
18.1479565	87.204	
18.8920674	87.343	THW
19.7721091	87.386	
20.5489516	87.459	
21.4891533	87.954	REW
25.2912664	88.872	TRB, BKF
32.165449	88.852	
37.1117513	88.917	
40	89.073	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.87							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	87.34							
LTOB Elevation	88.87							
LTOB Max Depth	1.529							
LTOB Cross Sectional Area	7.68							



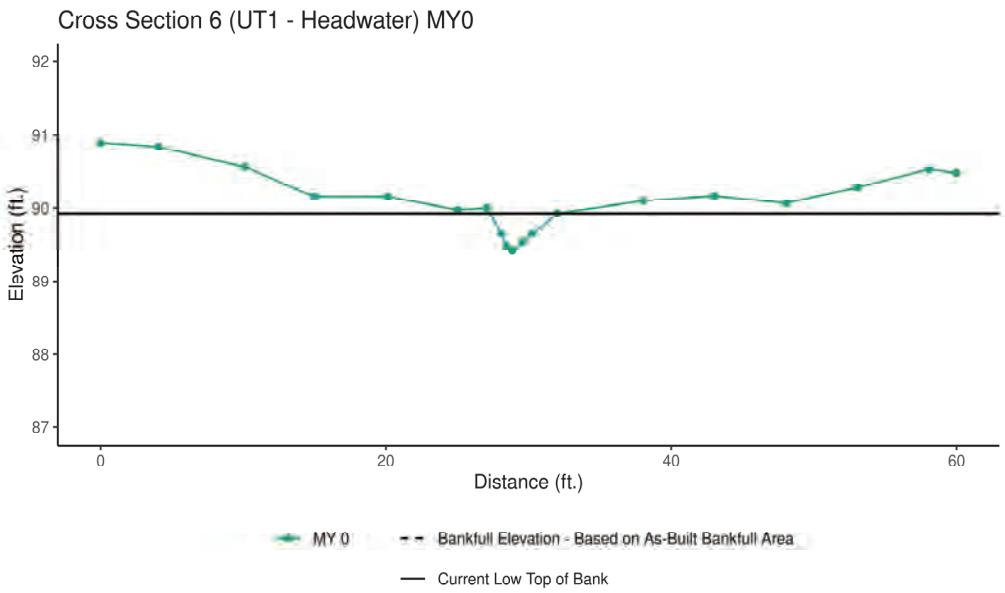
Distance	Elevation	Features
0	88.59	TLP
5.01021926	88.476	
10.0501809	88.259	
14.63502	88.452	
16.8046359	88.354	TLB, BKF
18.1458448	87.838	LEW
18.5589461	87.767	
19.6789918	87.766	
20.6376962	87.599	THW
21.2361238	87.758	
21.9420406	87.69	
22.6508962	87.862	REW
24.8321935	88.388	TRB
28.3520593	88.42	
30.5012521	88.533	
36.0147357	89.467	
38.9410423	89.813	
40	89.98	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.35							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	87.60							
LTOB Elevation	88.35							
LTOB Max Depth	0.755							
LTOB Cross Sectional Area	3.64							



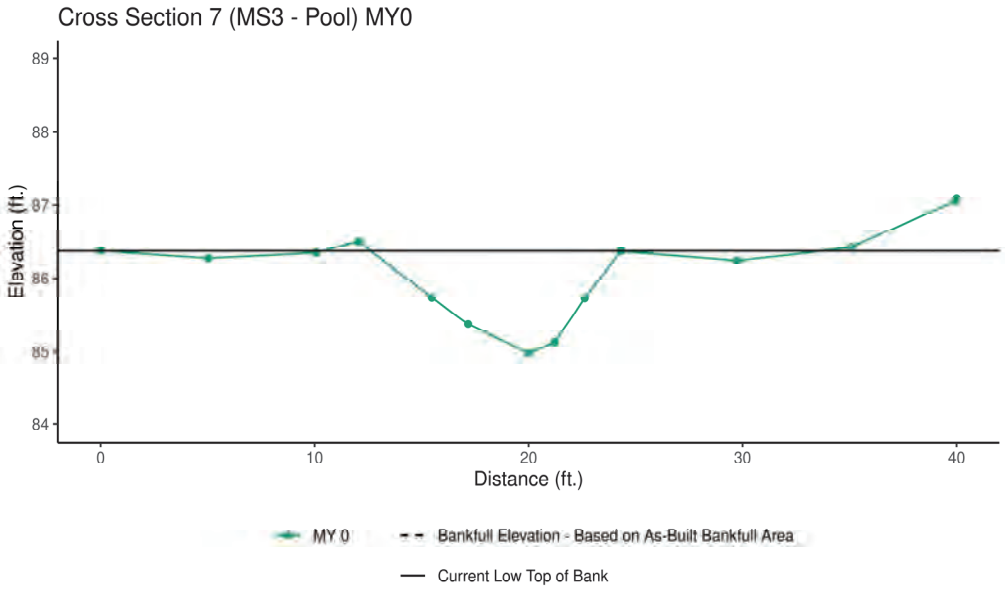
Distance	Elevation	Features
0	89.87	TLP
4.99681839	89.576	
10.0422701	89.254	
15.054868	88.979	
20.0136102	88.621	
25.0539083	88.474	
27.6613688	88.401	TLB, BKF
28.008209	88.219	LEW
28.1304146	88.03	
29.576	87.792	THW
31.4148037	87.926	
31.7340032	88.184	REW
32.9060611	88.517	TRB
37.9493216	88.515	
42.9695099	88.806	
47.8935198	89.295	
52.8793027	89.666	
57.9840358	89.921	
60	90.026	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	88.40							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	87.79							
LTOB Elevation	88.40							
LTOB Max Depth	0.609							
LTOB Cross Sectional Area	1.96							



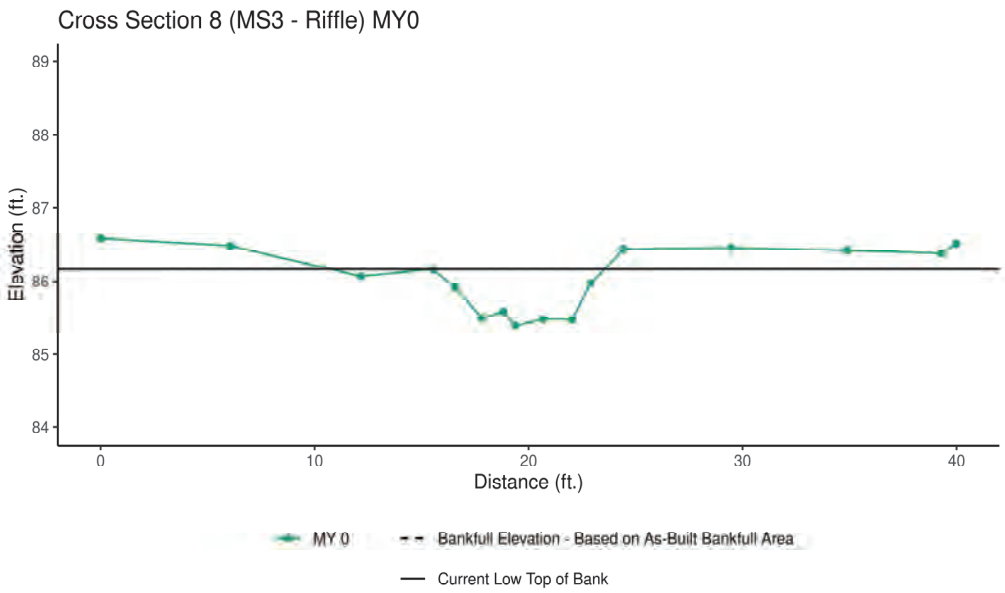
Distance	Elevation	Features
0	90.89	TLP
4.05488015	90.834	
10.0863871	90.565	
14.978272	90.158	
20.0907095	90.155	
25.0268367	89.975	
27.0905358	89.998	TLB
28.1194524	89.649	LEW
28.4591595	89.47	
28.8569726	89.416	THW
29.5836805	89.532	
30.2437927	89.651	REW
32.0308517	89.927	TRB, BKF
38.0183527	90.097	
42.9864599	90.164	
48.0364995	90.065	
53.0600698	90.284	
58.0444326	90.532	
60	90.48	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	89.93							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	89.42							
LTOB Elevation	89.93							
LTOB Max Depth	0.511							
LTOB Cross Sectional Area	1.23							



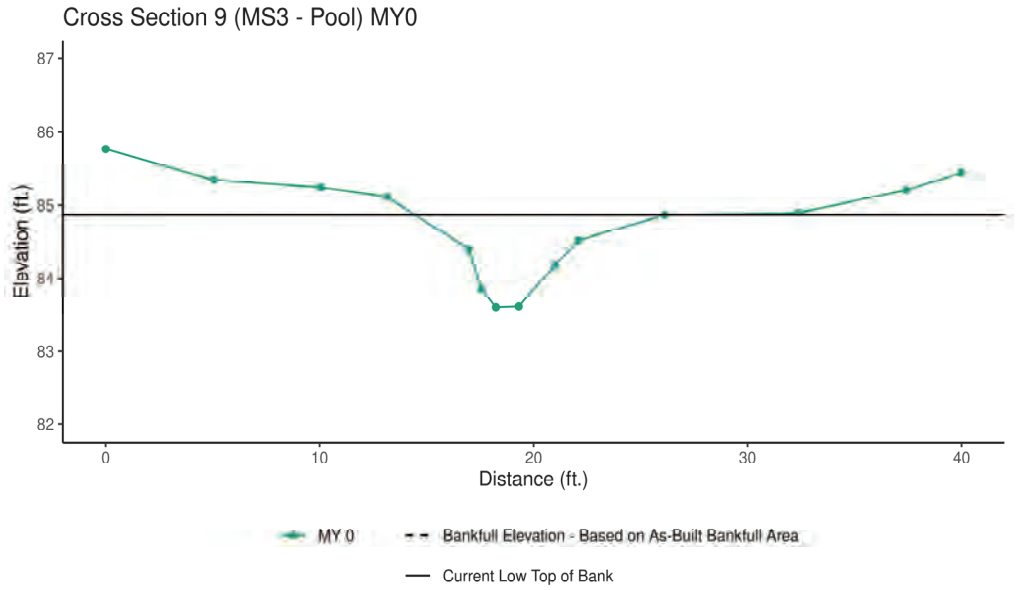
Distance	Elevation	Features
0	86.38	TLP
5.01725513	86.274	
10.0583679	86.352	
12.0781135	86.5	TLB
15.4792508	85.73	LEW
17.1727645	85.37	
19.9995377	84.975	THW
21.2249179	85.125	
22.6226437	85.723	REW
24.318421	86.373	TRB, BKF
29.7561931	86.24	
35.0867662	86.423	
39.9534139	87.054	
40	87.088	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	86.37							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	84.98							
LTOB Elevation	86.37							
LTOB Max Depth	1.398							
LTOB Cross Sectional Area	9.20							



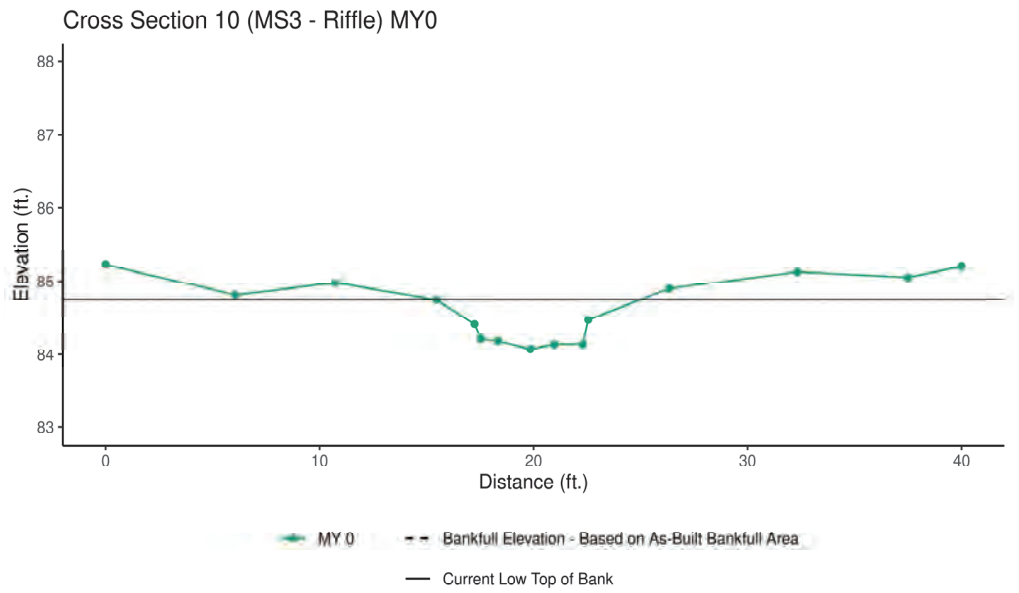
Distance	Elevation	Features
0	86.58	TLP
6.08795245	86.477	
12.1605003	86.074	
15.5296503	86.168	TLB, BKF
16.5797362	85.908	LEW
17.8344209	85.496	
18.8247548	85.584	
19.375555	85.395	THW
20.6936236	85.486	
22.0373112	85.479	
22.9072941	85.974	REW
24.429714	86.436	TRB
29.4742495	86.452	
34.8900509	86.419	
39.2997121	86.381	
40	86.509	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	86.17							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	85.40							
LTOB Elevation	86.17							
LTOB Max Depth	0.773							
LTOB Cross Sectional Area	4.04							



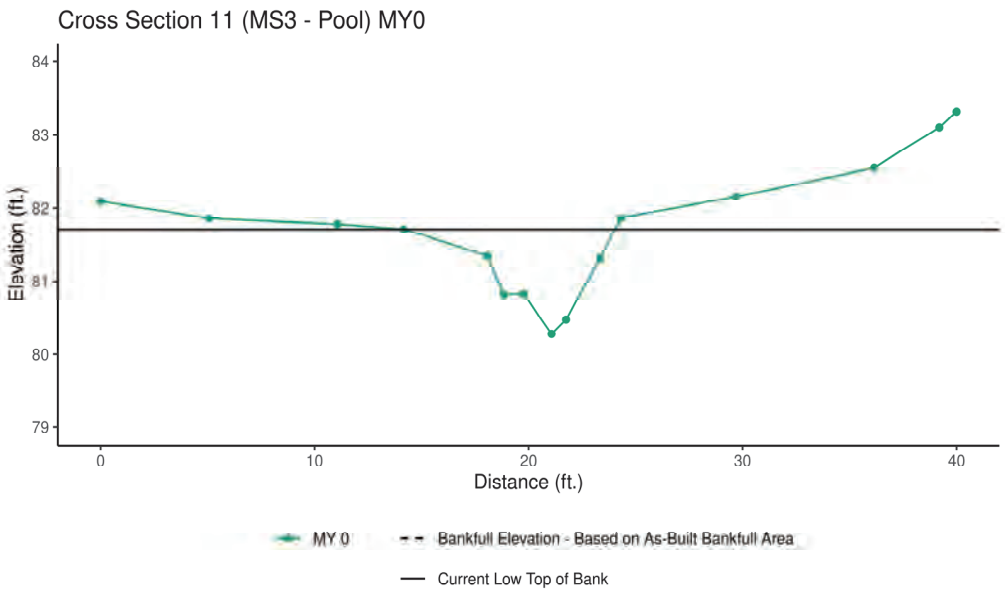
Distance	Elevation	Features
0	85.76	TLP
5.04804091	85.348	
10.0351177	85.244	
13.1288539	85.115	TLB
16.9745582	84.396	LEW
17.5614877	83.848	
18.240083	83.603	THW
19.3037771	83.614	
21.0094351	84.181	
22.102319	84.515	REW
26.1443797	84.868	TRB, BKF
32.4201518	84.897	
37.4201815	85.206	
40	85.444	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	84.87							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	83.60							
LTOB Elevation	84.87							
LTOB Max Depth	1.265							
LTOB Cross Sectional Area	6.09							



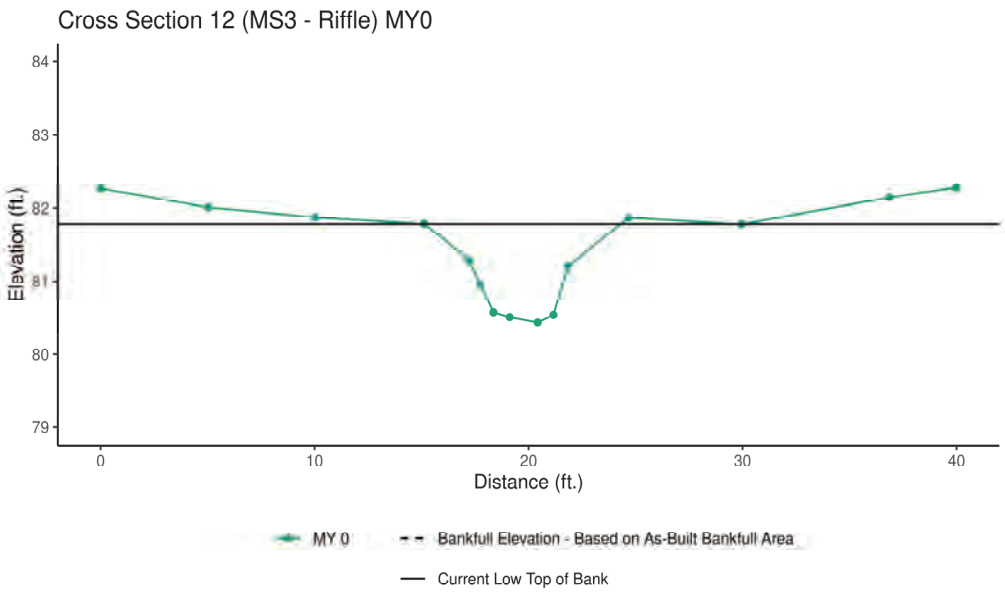
Distance	Elevation	Features
0	85.23	TLP
6.07838811	84.81	
10.7389927	84.976	
15.4658309	84.744	TLB, BKF
17.2399256	84.412	LEW
17.533969	84.209	
18.3365342	84.179	
19.8453158	84.07	THW
20.9766648	84.136	
22.2982012	84.135	
22.5541639	84.472	REW
26.3319657	84.897	TRB
32.3412602	85.13	
37.486728	85.054	
40	85.205	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	84.74							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	84.07							
LTOB Elevation	84.74							
LTOB Max Depth	0.674							
LTOB Cross Sectional Area	3.77							



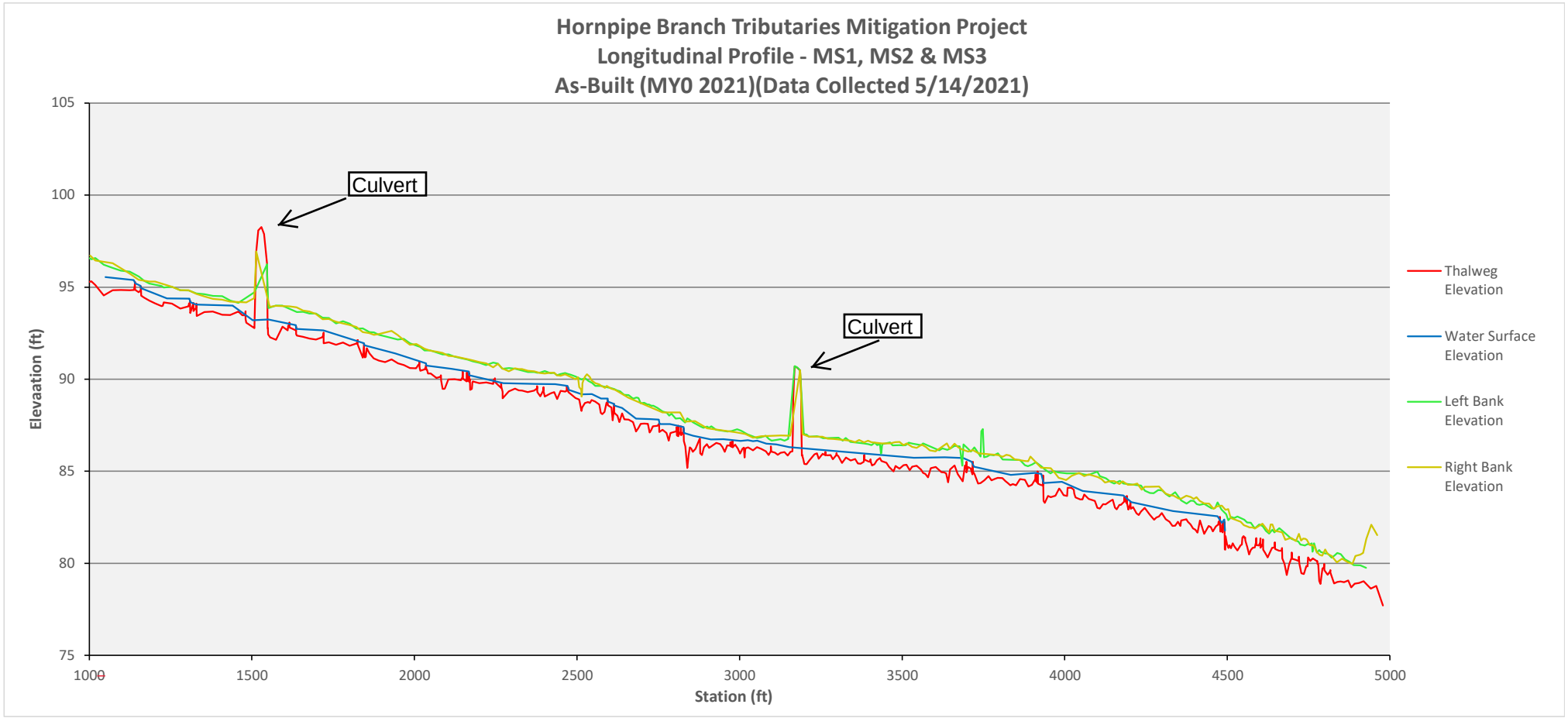
Distance	Elevation	Features
0	82.09	TLP
5.0561428	81.86	
11.0788814	81.782	
14.1614238	81.71	TLB, BKF
18.0779614	81.343	LEW
18.8451597	80.814	
19.7703604	80.826	
21.0737386	80.273	THW
21.7509537	80.473	
23.334964	81.312	REW
24.3212148	81.868	TRB
29.6982312	82.154	
36.1520446	82.55	
39.1949599	83.101	
40	83.312	TRP

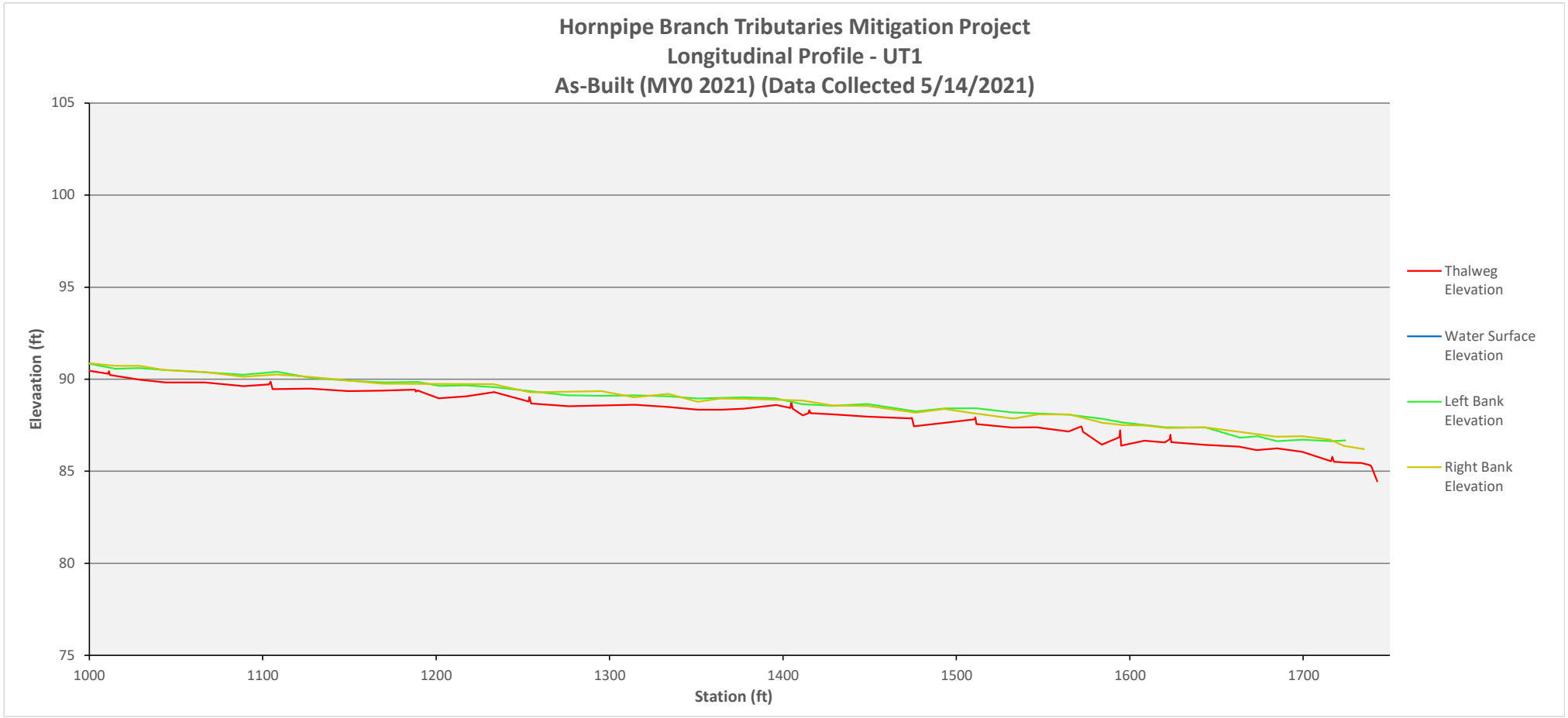
	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	81.71							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	80.27							
LTOB Elevation	81.71							
LTOB Max Depth	1.437							
LTOB Cross Sectional Area	5.88							



Distance	Elevation	Features
0	82.27	TLP
5.01530428	82.008	
10.0190084	81.873	
15.1246918	81.787	TLB, BKF
17.2145553	81.287	LEW
17.7437045	80.958	
18.3575924	80.575	
19.1156855	80.508	
20.426516	80.433	THW
21.1614517	80.539	
21.8405546	81.202	REW
24.6678845	81.869	TRB
29.9717948	81.781	
36.8623834	82.143	
40	82.284	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	81.79							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	80.43							
LTOB Elevation	81.79							
LTOB Max Depth	1.354							
LTOB Cross Sectional Area	6.47							


Hornpipe Branch Tributaries Mitigation Project
Longitudinal Profile - MS1, MS2 & MS3
As-Built (MY0 2021)(Data Collected 5/14/2021)
Culvert
Culvert
Elevation (ft)
105
100
95
90
85
80
75
1000
1500
2000
2500
3000
3500
4000
4500
5000
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Hornpipe Branch Tributaries Mitigation Project
Longitudinal Profile - UT1
As-Built (MY0 2021) (Data Collected 5/14/2021)
105
100
95
90
85
80
75
Elevation (ft)
1000
1100
1200
1300
1400
1500
1600
1700
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation

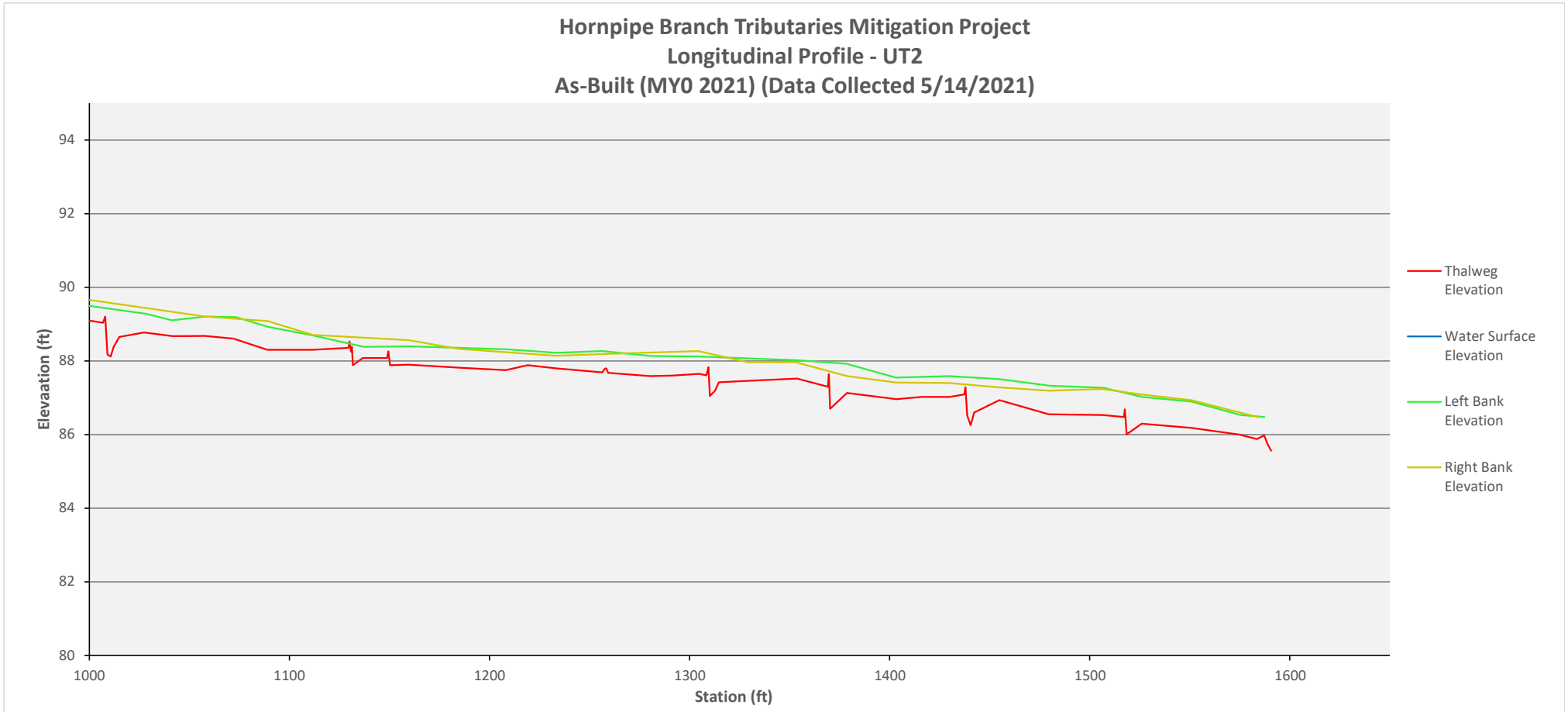

Hornpipe Branch Tributaries Mitigation Project
Longitudinal Profile - UT2
As-Built (MY0 2021) (Data Collected 5/14/2021)
Elevation (ft)
94
92
90
88
86
84
82
80
1000
1100
1200
1300
1400
1500
1600
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation

Table7a: Baseline Stream Data Summary Hornpipe, MS1											Hornpipe, MS2										Hornpipe, MS3									
Parameter	Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)			Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)			Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		4.2			1		6.9		6.4	1		4.5			1		7.5		7.9	1		8.4			1		8.4	8.0	9.5	3
Floodprone Width (ft)		9.0			1	15.0	30.0		34.5	1		8.7			1	29.0	47.0		33.9	1		8.8			1	19.0	30.0	40.0	40.0	3
Bankfull Mean Depth (ft)		0.9			1		0.5		0.7	1		1.0			1		0.6		0.5	1		0.7			1		0.6	0.4	0.7	3
Bankfull Max Depth (ft)		1.2			1		0.7		1.2	1		1.3			1		0.8		0.8	1		0.8			1		0.9	0.7	1.3	3
Bankfull Cross Sectional Area (ft^2)		3.8			1		3.7		4.7	1		4.4			1		4.3		3.6	1		5.5			1		5.4	3.8	6.5	3
Width/Depth Ratio		4.7			1		13.0		8.8	1		4.5			1		13.0		17.1	1		12.7			1		13.0	13.0	24.0	3
Entrenchment Ratio		2.1			1	2.2	4.3		5.4	1		2.0			1	3.9	6.3		4.3	1		1.1			1	2.3	3.6	4.2	5.0	3
Bank Height Ratio		2.6			1	1.0	1.1		1.0	1		2.2			1	1.0	1.1		1.0	1		4.8			1	1.0	1.1	1.0	1.0	3
Max part size (mm) mobilized at Bankfull	14.0					10.0		12.0			13.0					8.0		6.0			10.0					9.0		8.0		
Rosgen Classification	Channelized					DA/E5		E5			Channelized					E5/C5		C5			F5					E5/C5		C5		
Bankfull Discharge (cfs)	4.0					4.0		4.0			4.5					4.5		4.5			6.6					6.6		6.6		
Sinuosity (ft)	1.01					1.02		1.02			1.01					1.11		1.10			1.02					1.18		1.16		
Water Surface Slope (Channel) (ft/ft)	0.005					0.0049		0.0044			0.0041					0.0037		0.0033			0.004					0.0044		0.0042		
Other																														

Table7a: Baseline Stream Data Summary Hornpipe, UT1 (HW)											Hornpipe, UT2 (HW)									
Parameter	Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)			Pre-Existing Condition (3/14/2018)					Design		MY0 (3/24/2021)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		4.3			1		4.4		4.7	1		2.7			1		4.4		4.8	1
Floodprone Width (ft)		6.9			1	15.0	30.0		44.5	1		4.4			1	15.0	30.0		30.5	1
Bankfull Mean Depth (ft)		0.4			1		0.3		0.3	1		0.4			1		0.3		0.4	1
Bankfull Max Depth (ft)		1.0			1		0.3		0.5	1		0.6			1		0.3		0.6	1
Bankfull Cross Sectional Area (ft^2)		1.6			1		1.2		1.2	1		1.1			1		1.2		2.0	1
Width/Depth Ratio		11.5			1		16.0		18.2	1		6.8			1		16.0		11.9	1
Entrenchment Ratio		1.6			1	3.4	6.8		9.4	1		1.6			1	3.4	6.8		6.3	1
Bank Height Ratio		3.3			1	1.0	1.1		1.0	1		4.7			1	1.0	1.1		1.0	1
Max part size (mm) mobilized at Bankfull	9.0					6.0		6.0			9.0					7.0		10.0		
Rosgen Classification	Channelized					DA		DA			Channelized					DA		DA		
Bankfull Discharge (cfs)	1.4					1.4		1.4			1.2					1.2		1.2		
Sinuosity (ft)	1.06					1.09		1.09			1.06					1.07		1.05		
Water Surface Slope (Channel) (ft/ft)	0.0065					0.0062		0.0063			0.0067					0.0065		0.0062		
Other																				

Monitoring Data - Cross Section Morphology Monitoring Summary

Hornpipe Branch Tributaries/DMS:100076 Segment/Reach: MS1, MS2, MS3, UT1, UT2 (Data Collected 3/24/2021)

	Cross Section 1 (Pool - MS1)							Cross Section 2 (Riffle - MS1)							Cross Section 3 (Pool - MS2)							Cross Section 4 (Riffle - MS2)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	94.63							91.75							88.87							88.35						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	93.23							90.51							87.34							87.60						
LTOB[2] Elevation	94.63							91.75							88.87							88.35						
LTOB[2] Max Depth (ft)	1.40							1.25							1.53							0.75						
LTOB[2] Cross Sectional Area (ft^2)	5.20							4.72							7.68							3.64						
	Cross Section 5 (Headwater - UT2)							Cross Section 6 (Headwater UT1)							Cross Section 7 (Pool - MS3)							Cross Section 8 (Riffle - MS3)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	88.40							89.93							86.37							86.17						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	87.79							89.42							84.98							85.40						
LTOB[2] Elevation	88.40							89.93							86.37							86.17						
LTOB[2] Max Depth (ft)	0.61							0.51							1.40							0.77						
LTOB[2] Cross Sectional Area (ft^2)	1.96							1.23							9.20							4.04						
	Cross Section 9 (Pool - MS3)							Cross Section 10 (Riffle - MS3)							Cross Section 11 (Pool - MS3)							Cross Section 12 (Riffle - MS3)						
	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+	MY0	MY1	MY2	MY3	MY5	MY7	MY+
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	84.87							84.74							81.71							81.79						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	83.60							84.07							80.27							80.43						
LTOB[2] Elevation	84.87							84.74							81.71							81.79						
LTOB[2] Max Depth (ft)	1.27							0.67							1.44							1.35						
LTOB[2] Cross Sectional Area (ft^2)	6.09							3.77							5.88							6.47						

The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking channel change moving forward. They are the bank height ratio using a constant As-built bankfull area and the cross sectional area and max depth based on each years low top of bank. These are calculated as follows:

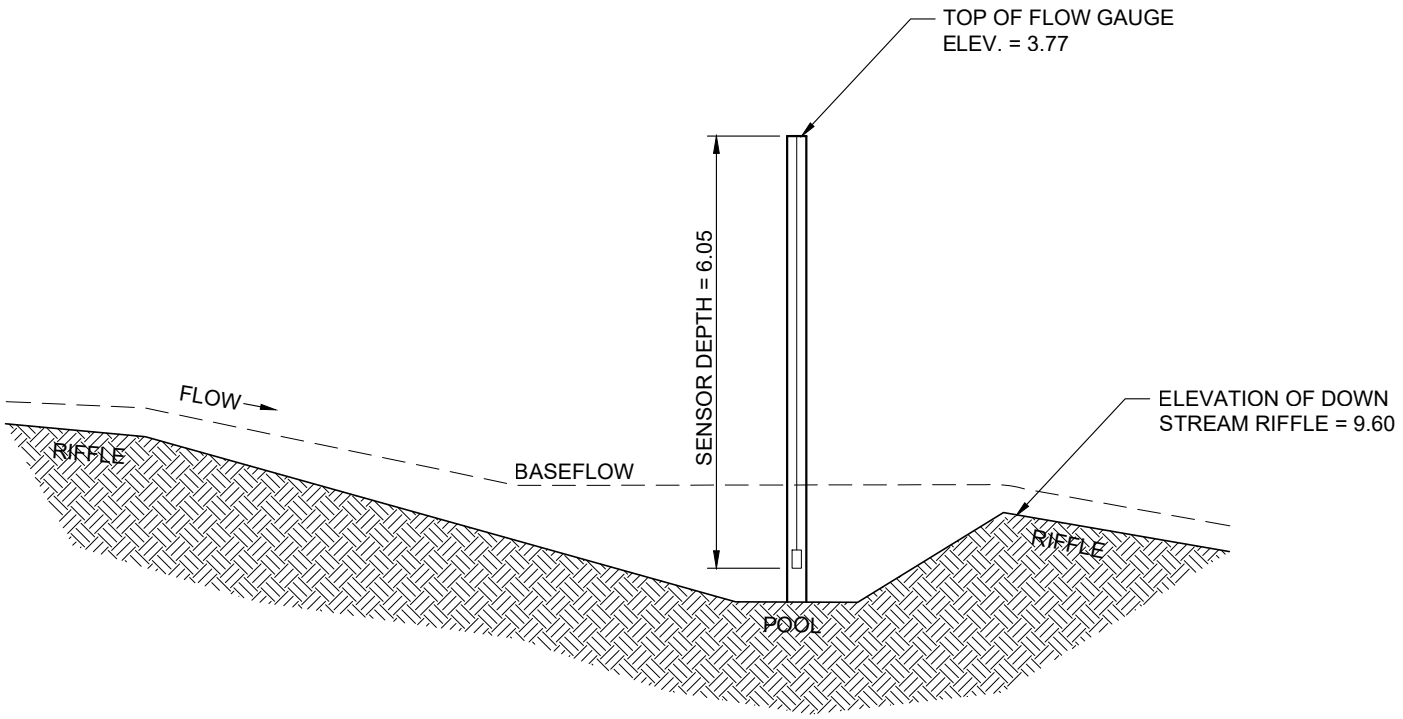
1 - **Bank Height Ratio (BHR)** takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation. For example if the As-built bankfull area was 10 ft2, then the MY1 bankfull elevation would be adjusted until the calculated bankfull area within the MY1 cross section survey = 10 ft2. The BHR would then be calculated with the difference between the low top of bank (LTOB) elevation for MY1 and the thalweg elevation for MY1 in the numerator with the difference between the MY1 bankfull elevation and the MY1 thalweg elevation in the denominator. This same process is then carried out in each successive year.

2 - **LTOB Area and Max depth -** These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference

Note: The smaller the channel the closer the survey measurements are to their limit of reliable detection, therefore inter-annual variation in morphological measurement (as a percentage) is by default magnified as channel size decereases. Some of the variability above is the result of this factor and some is due to the large amount of depositional sediments observed.

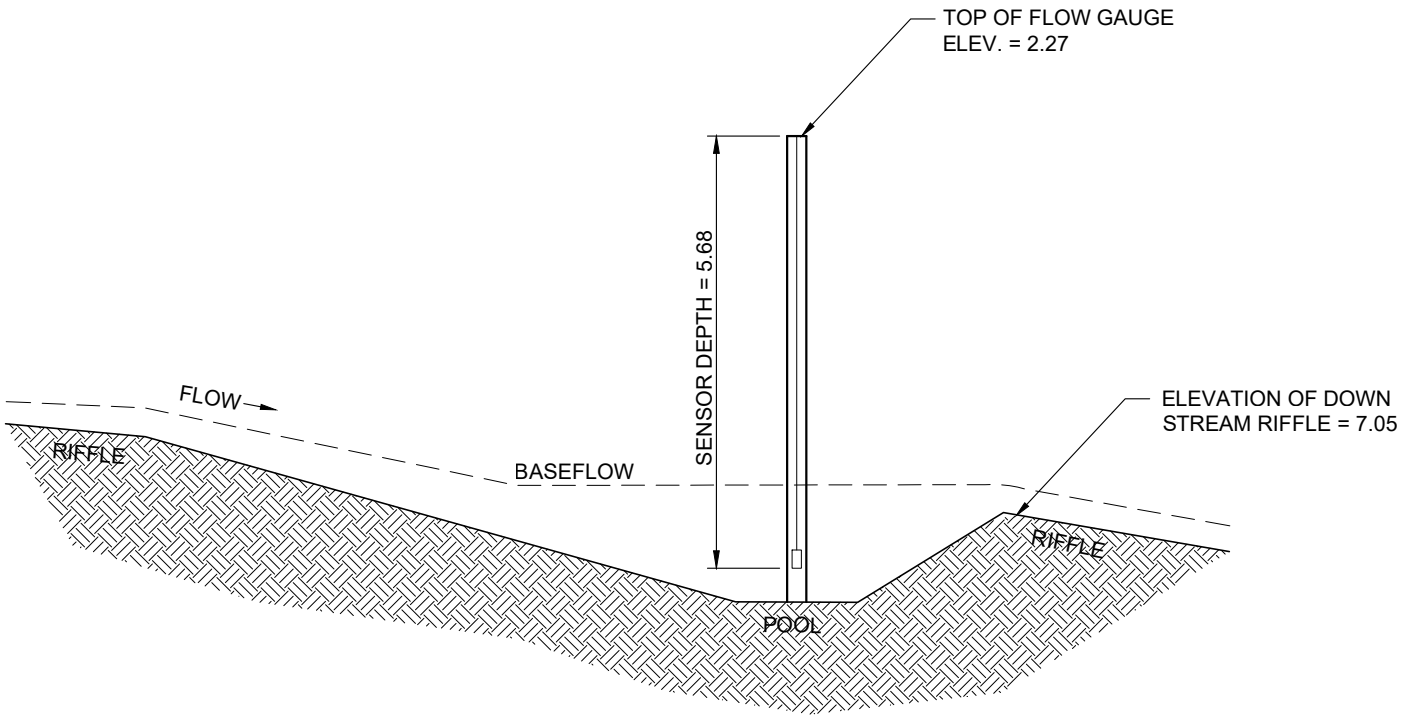
Appendix D:
Hydrologic Data

Flow Gauge Installation Diagrams
Crest Gauge Installation Diagram
Photos: Groundwater and Surface Water Gauges



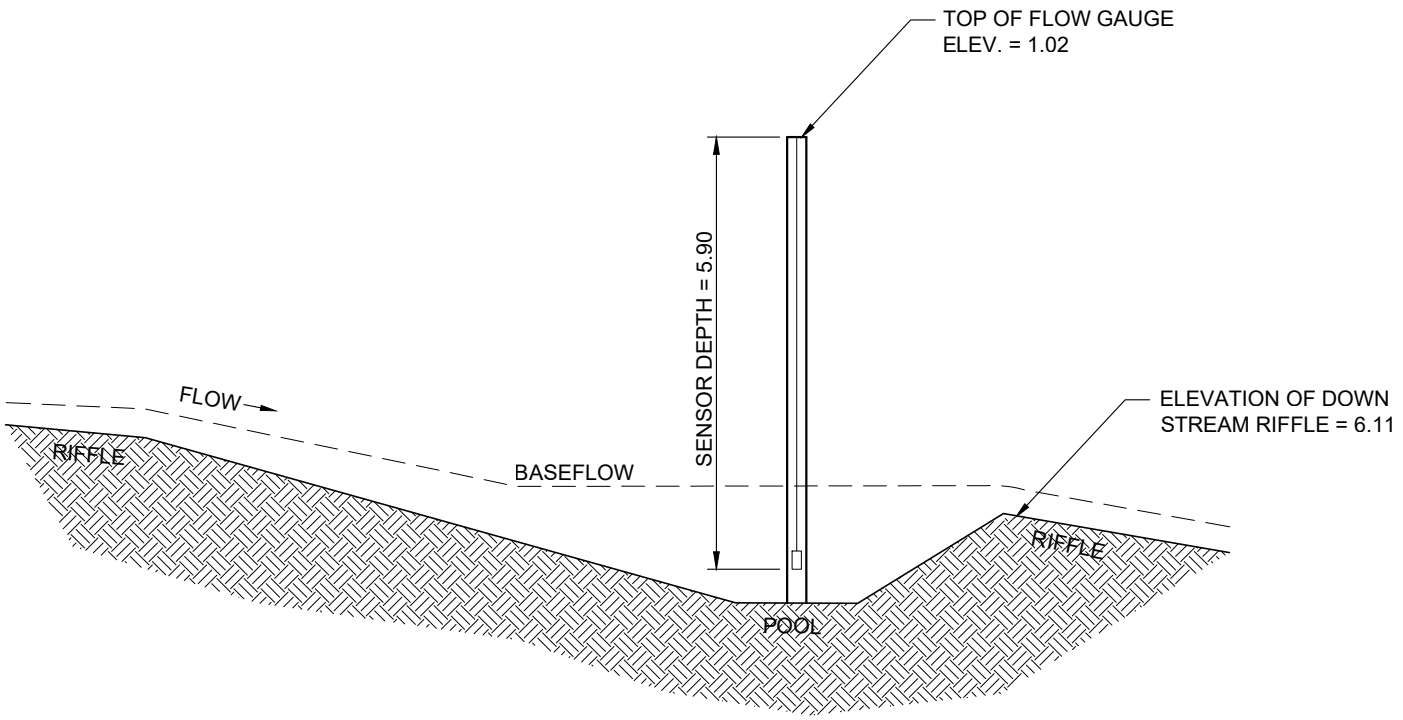
FLOW GAUGE #1 - MS1

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 6.05 - (9.60 - 3.77)
Flow Depth = 0.22 feet



FLOW GAUGE #2 - UT1

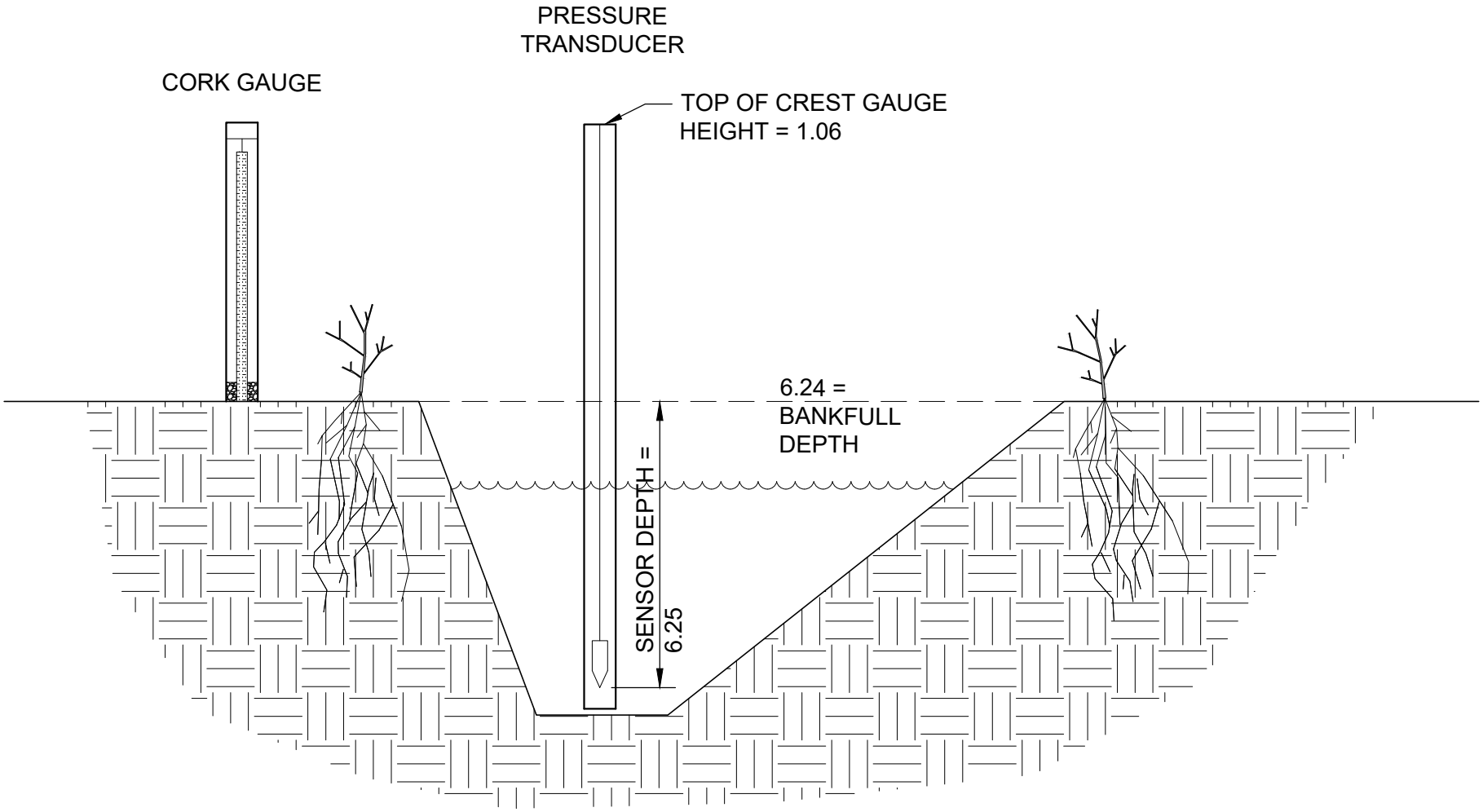
Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.68 - (7.05 - 2.27)
Flow Depth = 0.90 feet



FLOW GAUGE #3 - UT2

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.90 - (6.11 - 1.02)
Flow Depth = 0.81 feet

CROSS SECTIONAL VIEW OF STREAM



Crest Gauge CG-1 (MS-3)

Bankfull Event Depth (for transducer) = (Top of Gauge + Sensor Depth) - Bankfull

Bankfull Event Depth = (1.06 + 6.25) - 6.24

Bankfull Event Depth = 1.07 feet

Flow Gauge (FG-1) – MS1

Flow Gauge (FG-2) – UT1

Flow Gauge (FG-3) – UT2

Crest Gauge (CG-1, Pressure Transducer) – MS3

Crest Gauge (CG-1, Cork) – MS3

Rain Gauge and Ambient Pressure Gauge

Groundwater Well (GW-1) – Right floodplain of MS2

Groundwater Well (GW-2) – Left floodplain of UT2

Appendix E:

Project Timeline and Contact Info

Project Timeline and Contacts

Activity or Deliverable	Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted	NA	6/14/2018
Mitigation Plan Approved	NA	7/6/2020
Construction (Grading) Completed	NA	3/26/2021
Planting Completed	NA	4/3/2021
As-built Survey Completed	NA	5/14/2021
MY-0 Baseline Report	4/29/2021	6/18/2021
MY1+ Monitoring Reports		
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

Hornpipe Branch Tributaries	
Provider	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Mitigation Provider POC: Emily Dunnigan	(269) 908-6306
Designer	7721 Six Forks Road, Suite 130
Water & Land Solutions, LLC	Raleigh, NC 27615
Primary project design POC: Kayne Van Stell	(919) 818-8481
Construction Contractor	453 Silk Hope Liberty Road
Wright Contracting, LLC	Siler City, NC 27344
Primary contractor POC: Ben Johnson	(336) 402-8312

DEPARTMENT OF ENVIRONMENTAL QUALITY - DIVISION OF MITIGATION SERVICES

HORNPIPE BRANCH TRIBUTARIES MITIGATION PROJECT

LENOIR COUNTY, NORTH CAROLINA

NCDEQ - DMS PROJECT ID # 100076
NCDEQ - DMS CONTRACT #7605 UNDER RFP 16-007401
NEUSE RIVER BASIN (CU 03020202)
USACE ACTION ID # SAW-2018-01762
TYPE OF WORK : STREAM MITIGATION

I, JAMES R. WATSON, CERTIFY THAT THIS PROJECT WAS COMPLETED UNDER MY DIRECT AND RESPONSIBLE CHARGE FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION; THAT THIS GROUND SURVEY WAS PERFORMED AT THE 95 PERCENT CONFIDENCE LEVEL (2 SIGMA) TO MEET FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THE HORIZONTAL ACCURACY IS 0.10', THAT THE VERTICAL ACCURACY IS 0.15', AND THAT THE ORIGINAL DATA WAS OBTAINED ON 4/13/2021; THAT THE SURVEY WAS COMPLETED ON 5/13/2021; THAT CONTOURS SHOWN HEREON MAY NOT MEET THE STATED STANDARD; AND ALL COORDINATES ARE BASED ON NAD 83(2011); AND ALL ELEVATIONS ARE BASED ON NAVD 88.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS 13TH DAY OF MAY, A.D., 2021.

James R. Watson
L-4712

NORTH CAROLINA PROFESSIONAL LAND SURVEYOR
SEAL L-4712
JAMES R. WATSON

THE FOLLOWING INFORMATION WAS USED TO PERFORM THIS GNSS SURVEY:

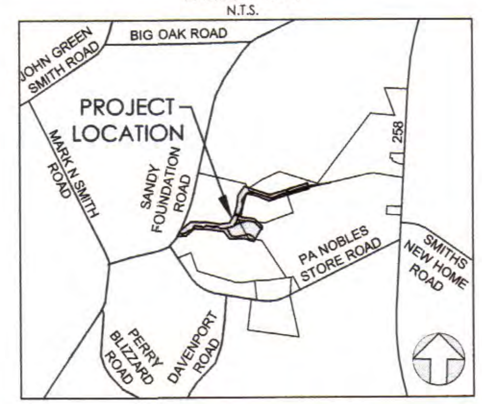
CLASS OF SURVEY: A
POSITIONAL ACCURACY: 0.10'
TYPE OF GPS FIELD PROCEDURE: RTK
DATES OF SURVEY: 4/13/2021 - 5/13/2021
DATUM / EPOCH: NAD 83(2011)
PUBLISHED / FIXED CONTROL USED: OPUS SOLUTION
GEOID MODEL: GEOID12
COMBINED GRID FACTOR: 0.99987576
UNITS: U.S. SURVEY FEET

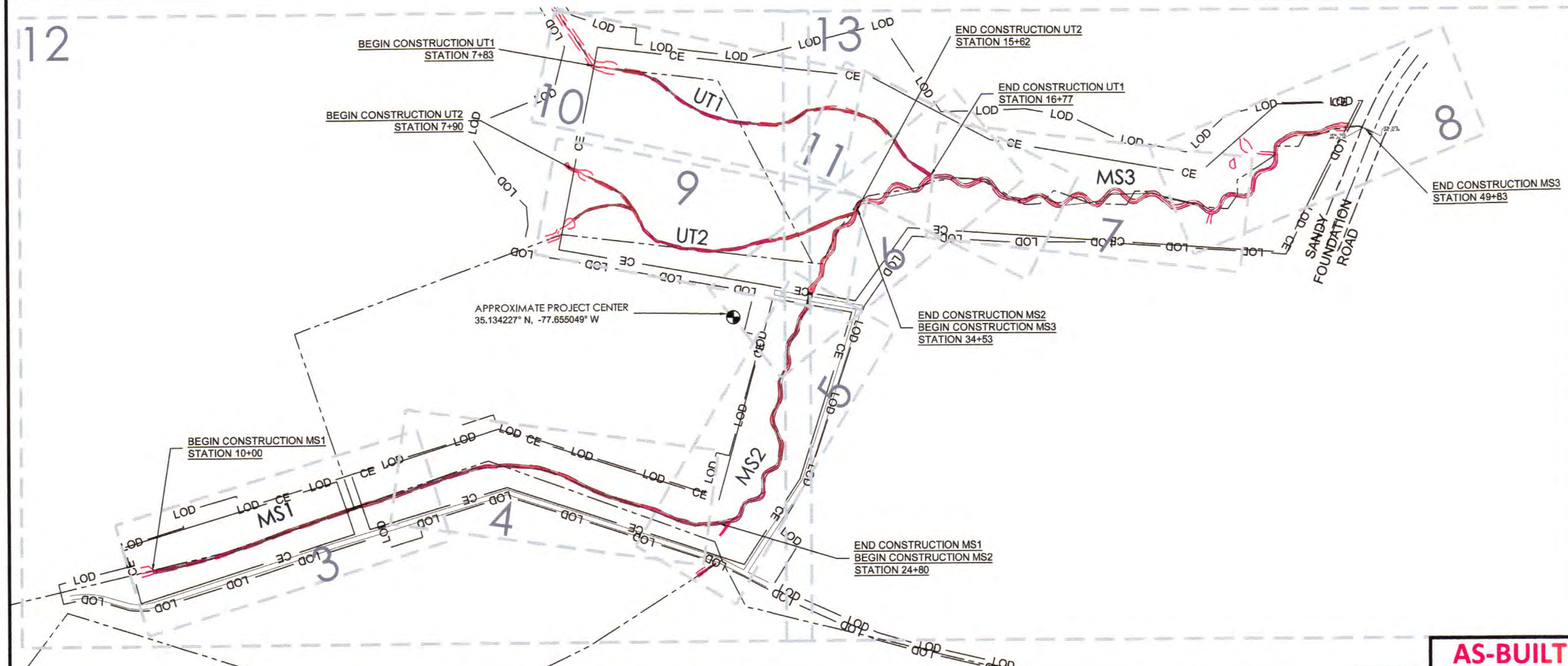
PROJECT SUMMARY

Project Reach Designation	Type of Mitigation	Proposed Stream Length (LF)	Mitigation Ratio (X:1)	Proposed Stream Mitigation Credits (SMCs)
MS1	Stream Restoration (PI/PII)	1,440	1	1,440.000
MS2	Stream Restoration (PI)	943	1	943.000
MS3	Stream Restoration (PI/PII)	1,529	1	1,529.000
UT1	Stream Restoration (HW/PI)	677	1	677.000
UT2	Stream Restoration (HW/PI)	562	1	562.000
Total		**5,151**		**5,151.000**

SHEET INDEX

VICINITY MAP
N.T.S.





AS-BUILT

WATER & LAND SOLUTIONS
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Raleigh, NC 27615
(919)614-5111
waterlandsolutions.com

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 36916 CHRISTOPHER A. TOMSIC
5/27/2021
DocuSigned by: Chris 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	2-21-20
B	FINAL DRAFT MIT PLAN	4-8-20
C	FINAL MIT PLAN	8-24-20
D	ISSUED FOR CONSTRUCTION	10-19-20
E	ASBUILT	5-27-21

PROJECT NAME

HORNPIPE BRANCH TRIBUTARIES MITIGATION PROJECT

LENOIR COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-006
FILENAME	ASB_01_HORNPIPE_COVER.DWG
DESIGNED BY	KMV
DRAWN BY	APL
DATE	5-27-21
HORIZ. SCALE	1" = 300'
VERT. SCALE	N/A

NORTH

150 75 0 150 300
GRAPHIC SCALE

SHEET NAME

COVER SHEET

SHEET NUMBER

1

LEGEND

- ROOTWAD
- LOG VANE
- LOG WEIR
- LOG STEP-POOL
- CONSTRUCTED STONE RIFFLE
- CONSTRUCTED LOG RIFFLE
- GEOLIFT W/ TOEWOOD
- RIP RAP
- PROPOSED OUTLET CHANNEL
- CE ——— CE — PROPOSED CONSERVATION EASEMENT BOUNDARY
- 100 — EXISTING MAJOR CONTOUR
- 101 — EXISTING MINOR CONTOUR
- LOD ——— LOD — LIMITS OF DISTURBANCE
- WLB ——— WLB — EXISTING WETLAND BOUNDARY
- EXISTING WOODLINE
- PROPOSED TOP OF STREAM BANK
- EXISTING PROPERTY BOUNDARY
- EXISTING FENCE
- 15+00 — PROPOSED CENTERLINE (THALWEG)
- EXISTING FARM PATH
- PROPOSED FARM PATH
- EXISTING TREE
- FLOODPLAIN DEPRESSION
- WATER QUALITY TREATMENT FEATURE
- x — PROPOSED GATE
- EXISTING WETLAND AREA

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LENOIR COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-006
FILENAME	ASB_02_HORNPIPE_LEGEND.DWG
DESIGNED BY	KMV
DRAWN BY	APL
DATE	5-27-21
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SHEET NAME

LEGEND

SHEET NUMBER

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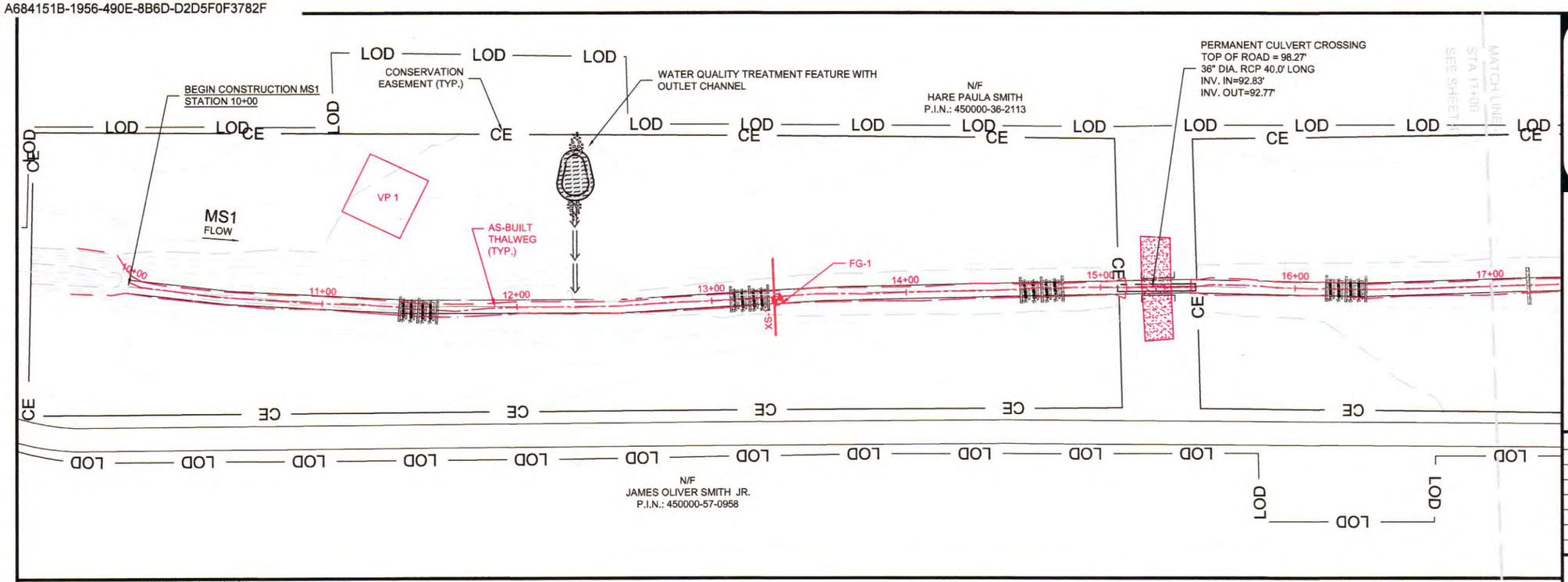

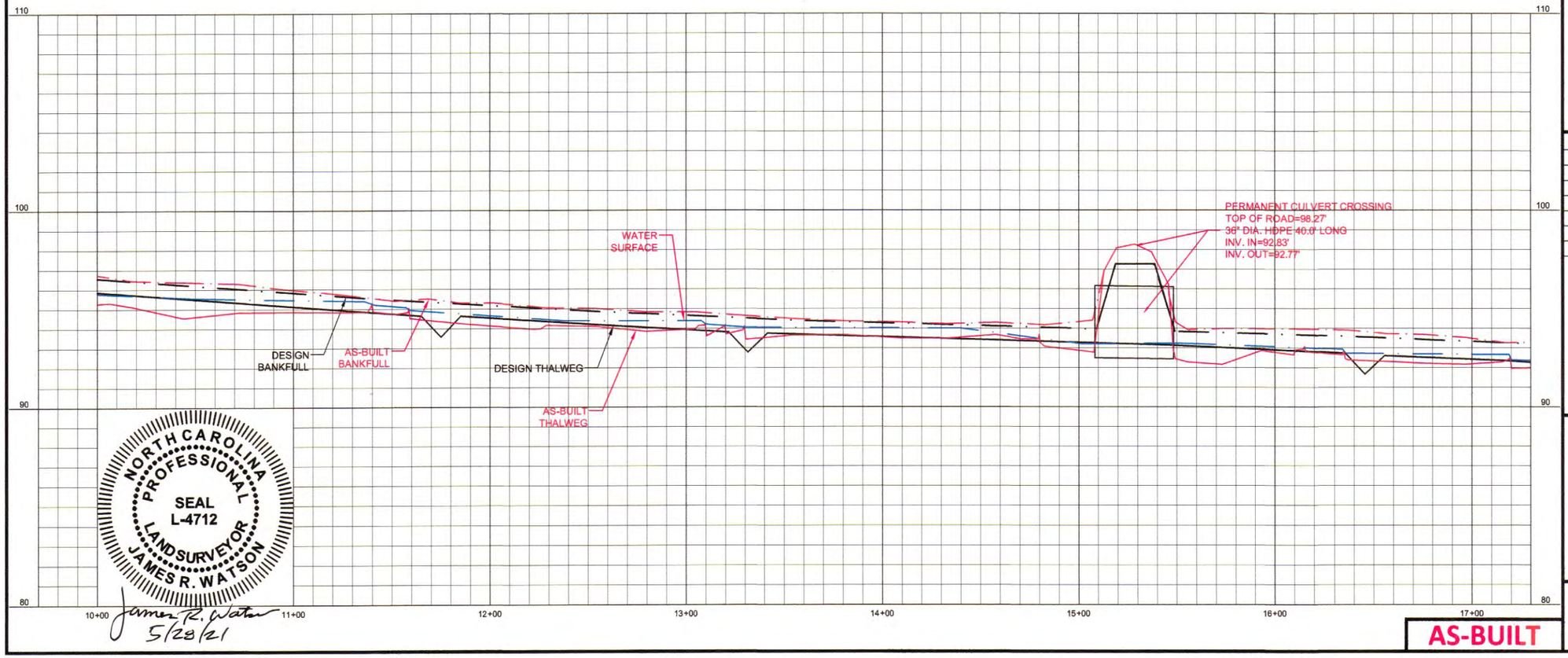

NORTH CAROLINA PROFESSIONAL SEAL L-4712 LAND SURVEYOR JAMES R. WATSON

James R. Watson 5/28/21

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5/27/2021
DocuSigned by: Chris Tomsic
Date: 5/28/2021

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LENOIR COUNTY, NC

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DESIGNED BY	KMV
DRAWN BY	APL
DATE	5-27-21
HORIZ. SCALE	1" = 60'
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NORTH

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GRAPHIC SCALE

SHEET NAME

MS1

PLAN AND PROFILE

SHEET NUMBER

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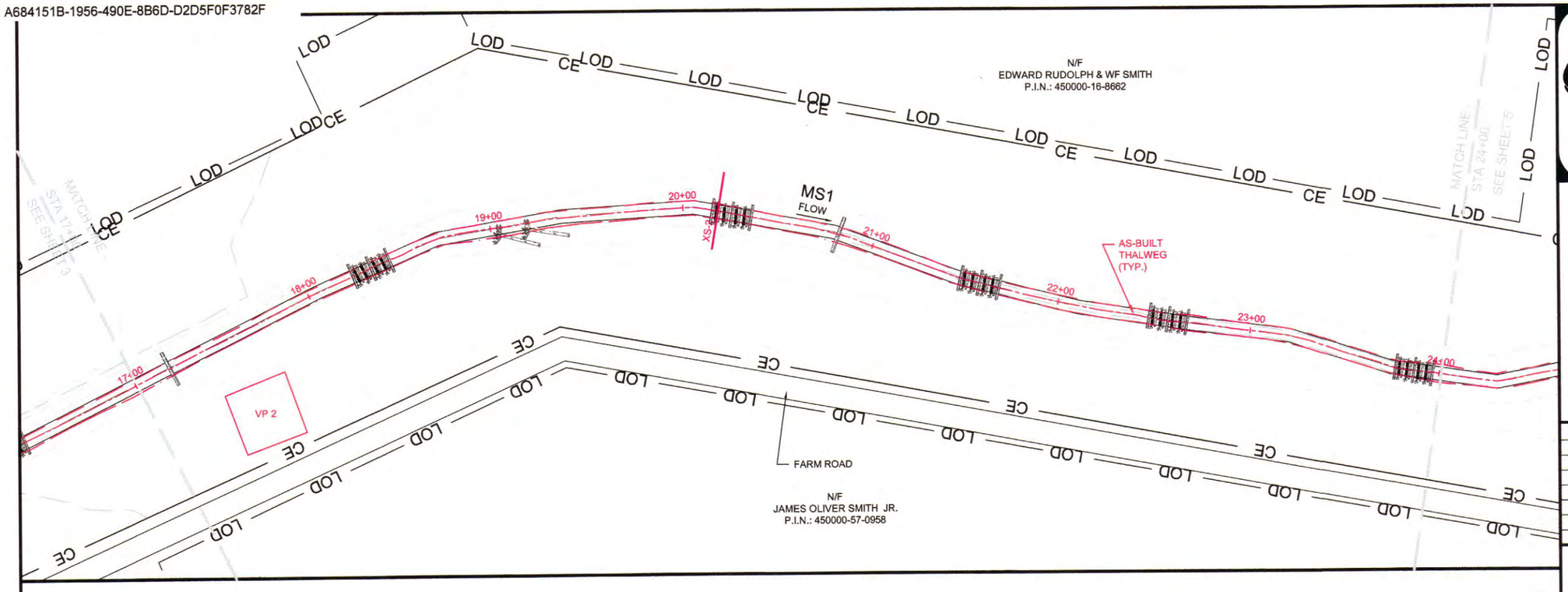

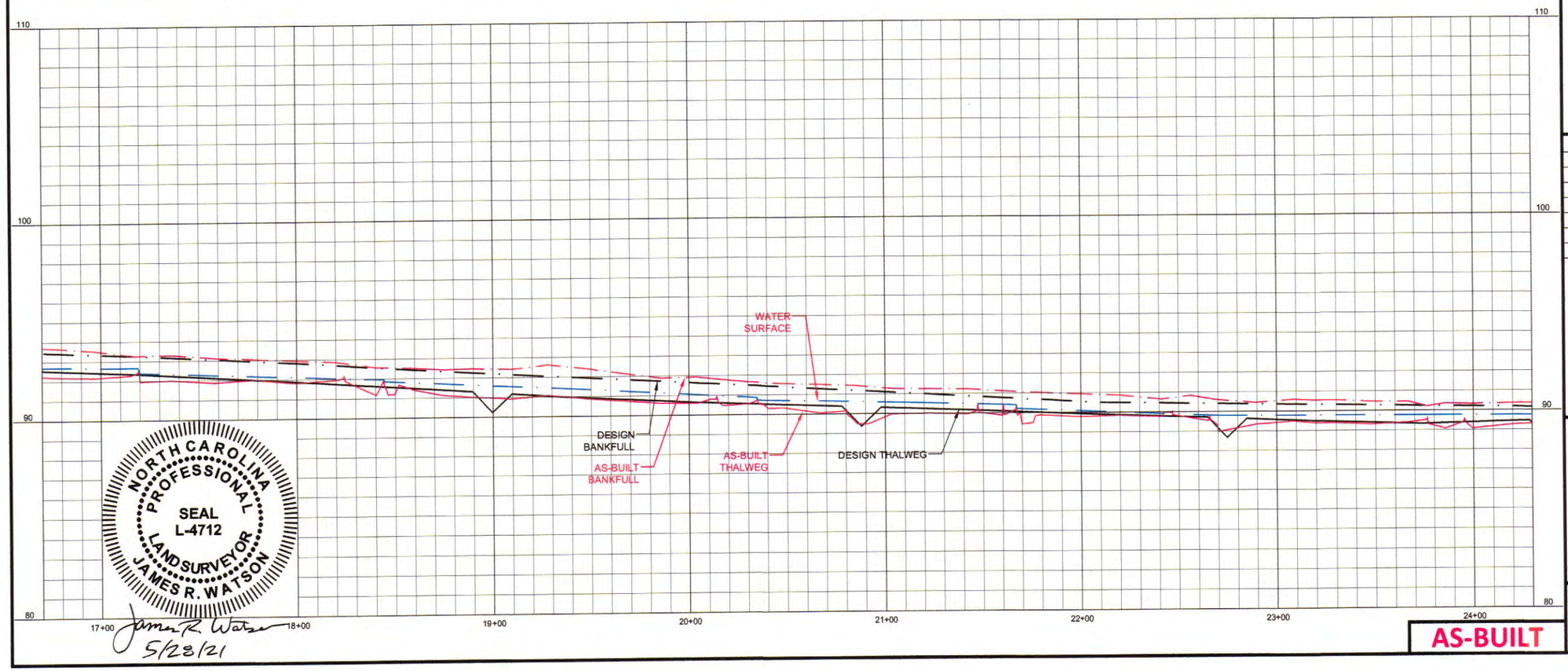

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HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

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GRAPHIC SCALE

SHEET NAME

MS1

PLAN AND PROFILE

SHEET NUMBER

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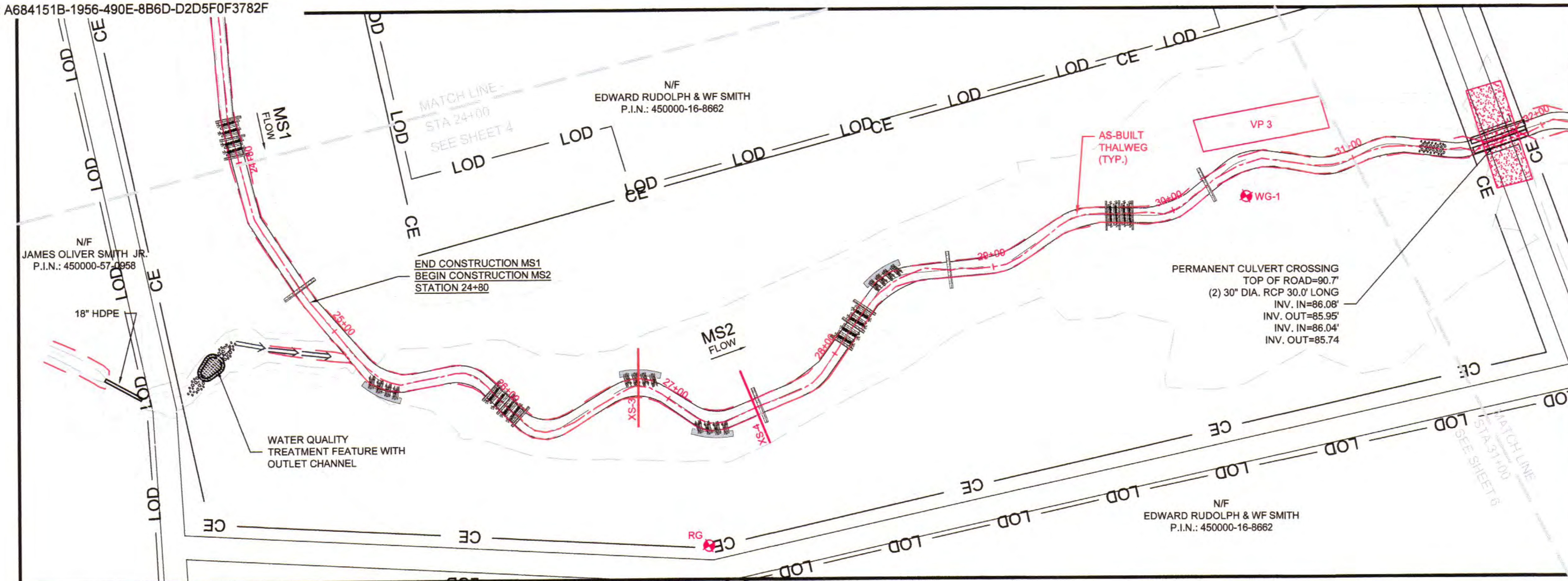

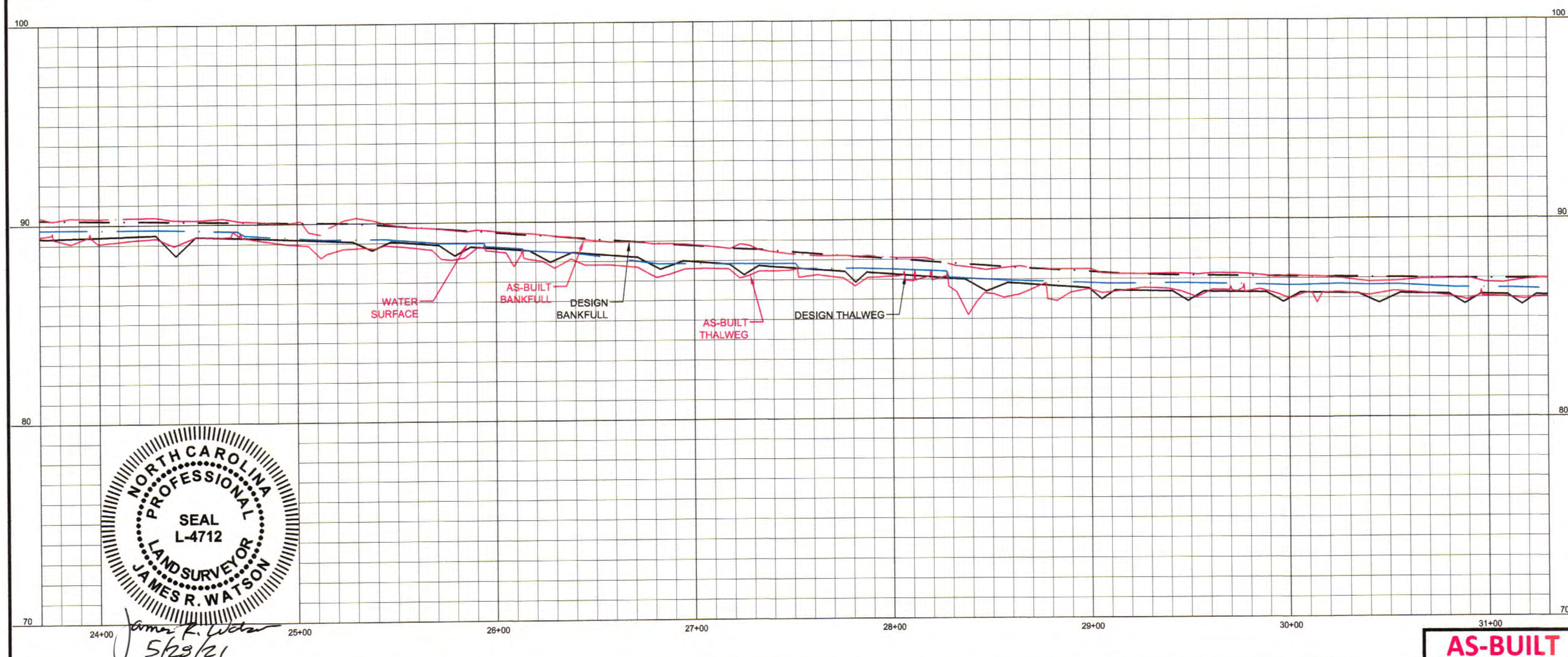

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DATE	5-27-21
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

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GRAPHIC SCALE

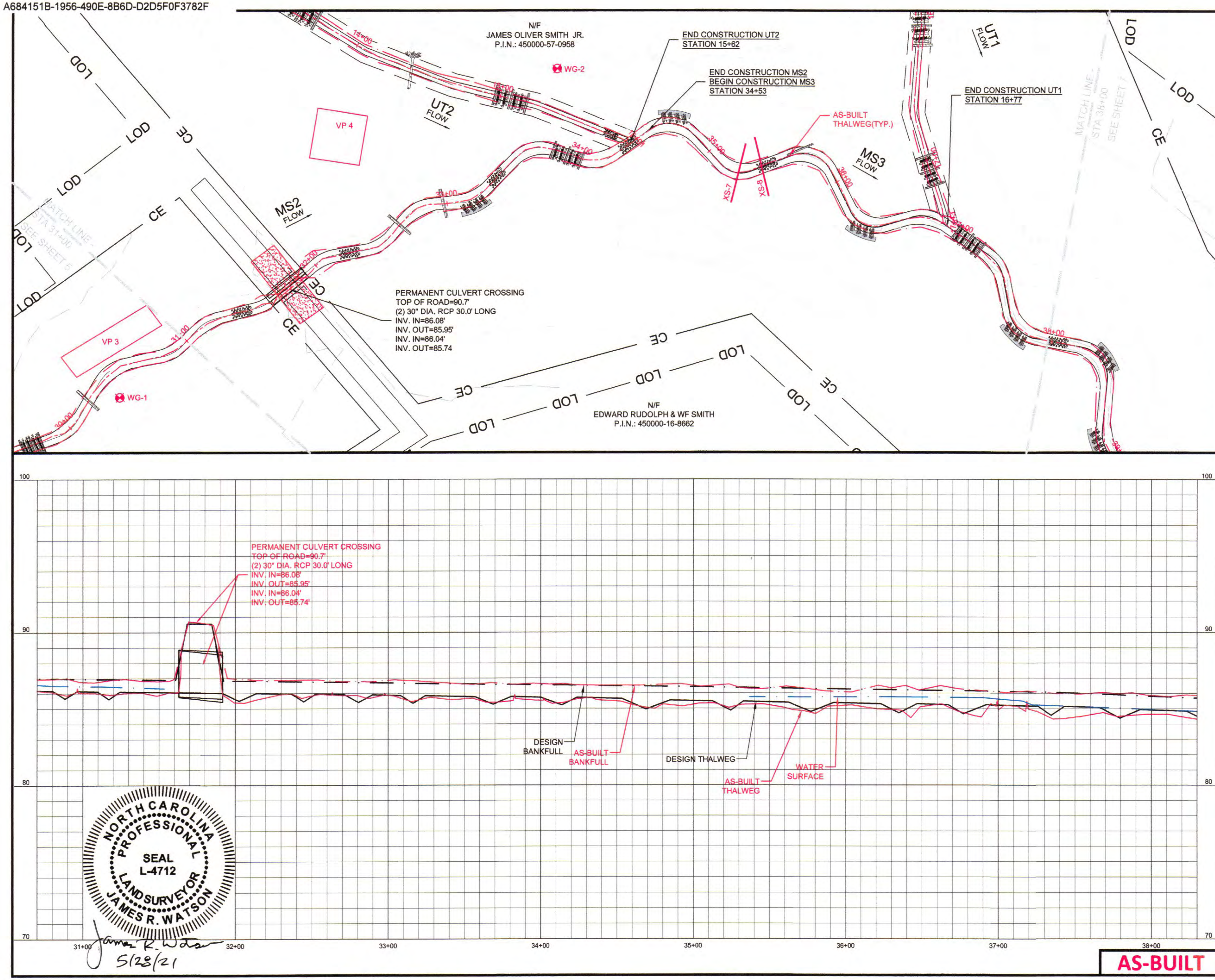
SHEET NAME

MS1 & MS2

PLAN AND PROFILE

SHEET NUMBER

5



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HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

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GRAPHIC SCALE

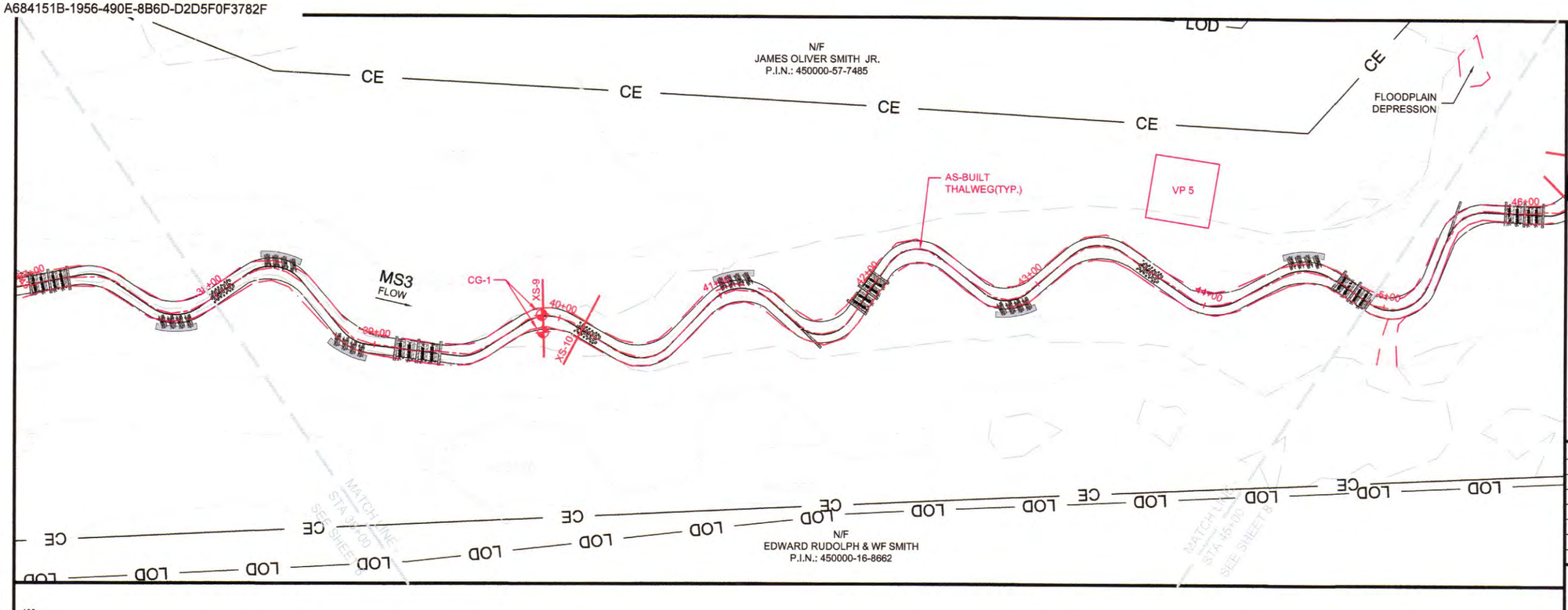
SHEET NAME

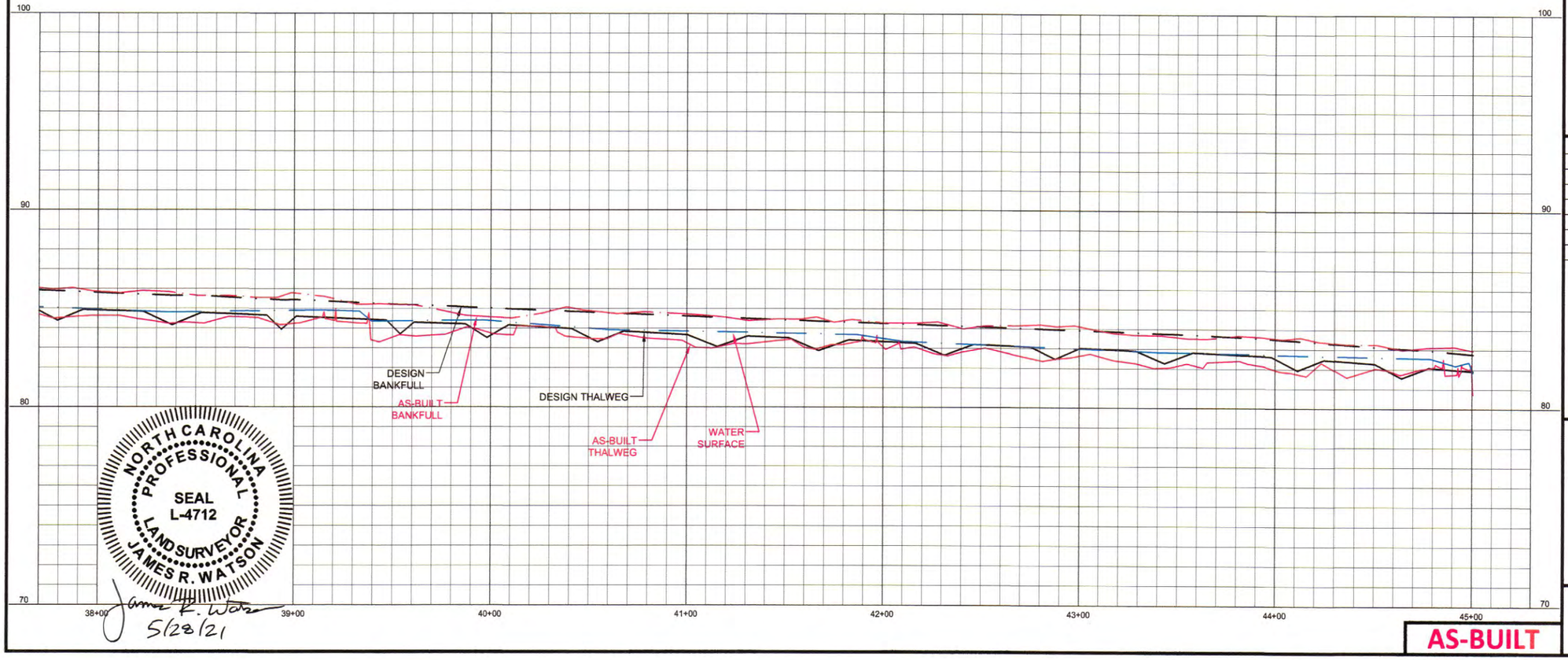
MS2 & MS3

PLAN AND PROFILE

SHEET NUMBER

6





NORTH CAROLINA PROFESSIONAL SEAL L-4712 LAND SURVEYOR JAMES R. WATSON
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8/27/2021
DocuSigned by: Chris Tomsic
Email: ctomsic@wlsengineering.com

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FIRM LICENSE NO. P-1480

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DATE	5-27-21
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

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GRAPHIC SCALE

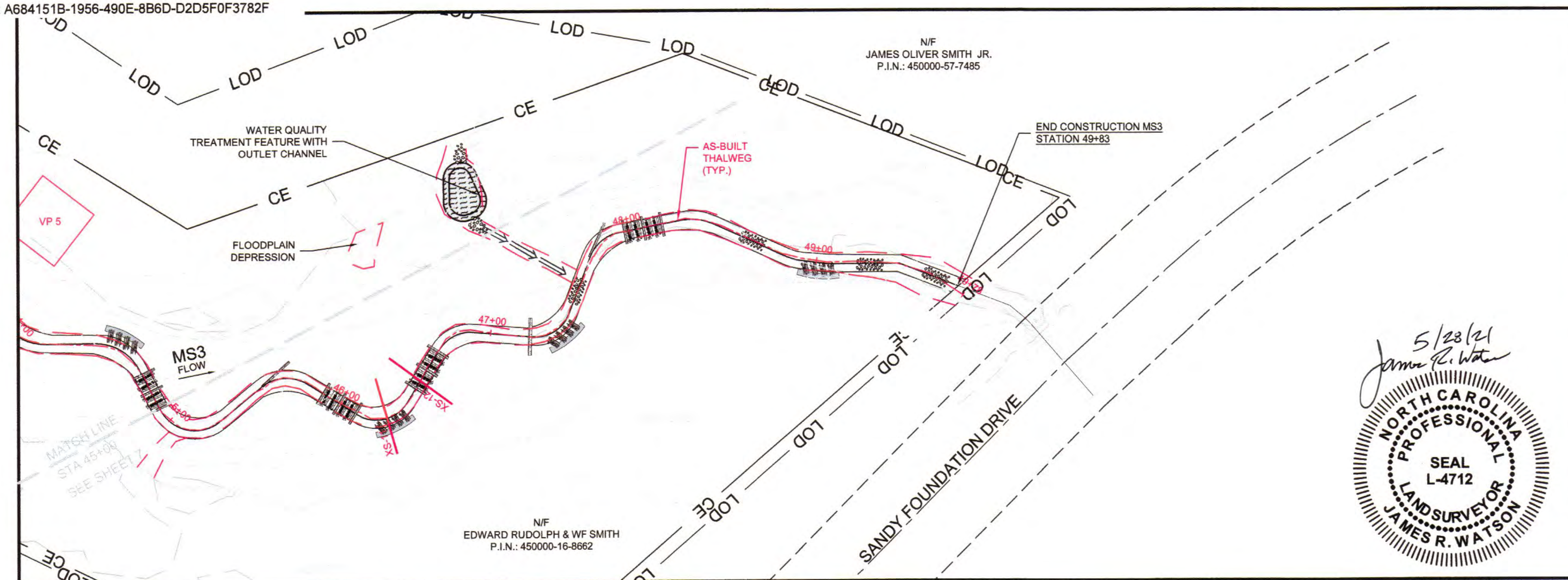
SHEET NAME

MS3

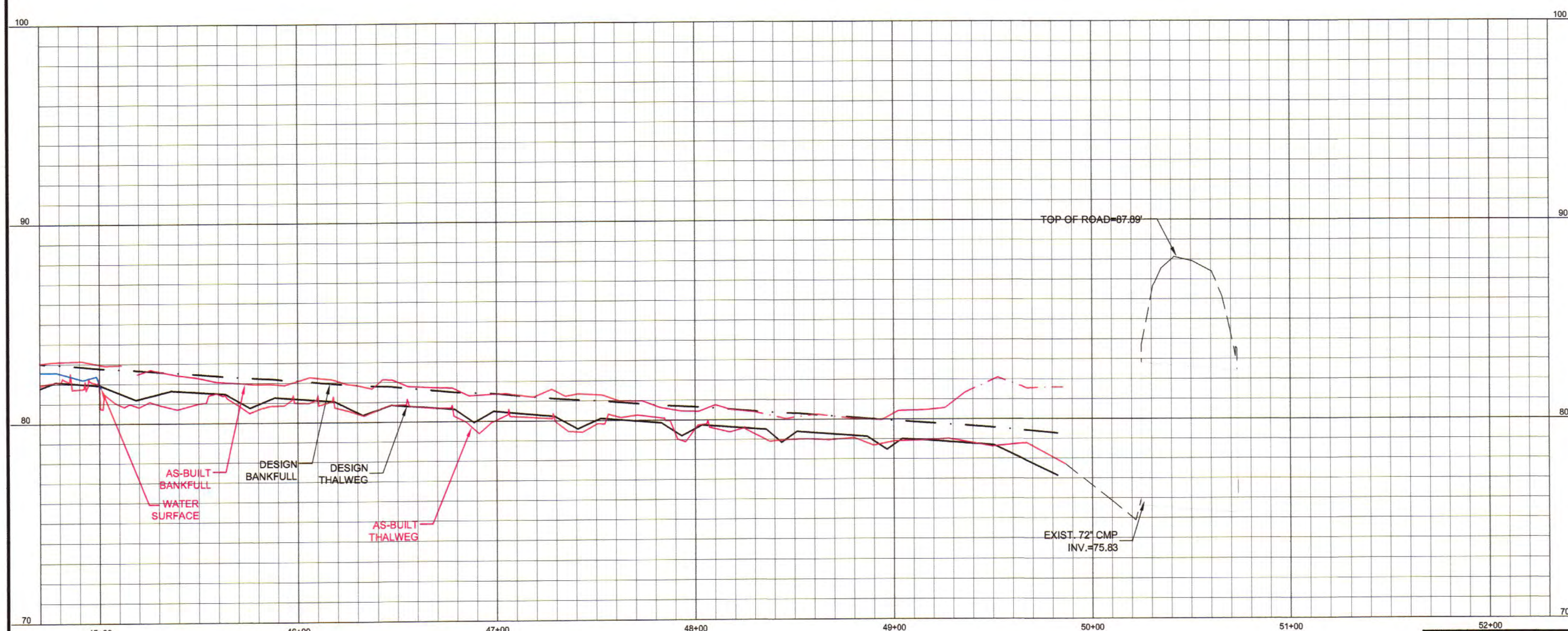
PLAN AND PROFILE

SHEET NUMBER

7



5/28/21
James R. Watson
NORTH CAROLINA PROFESSIONAL LAND SURVEYOR SEAL L-4712 JAMES R. WATSON



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waterlandsolutions.com

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 36916 ENGINEER CHRISTOPHER A. TOMSIC
5/27/2021
DocuSigned by: Chris 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	2-21-20
B	FINAL DRAFT MIT PLAN	4-8-20
C	FINAL MIT PLAN	8-24-20
D	ISSUED FOR CONSTRUCTION	10-19-20
E	ASBUILT	5-27-21

PROJECT NAME

HORNPIPE BRANCH TRIBUTARIES MITIGATION PROJECT

LENOIR COUNTY, NC

DRAWING INFORMATION

PROJECT NO.	18-006
FILENAME	ASB_03-11_HORNPIPE_PLAN AND PROFILES.DWG
DESIGNED BY	KMV
DRAWN BY	APL
DATE	5-27-21
HORIZ. SCALE	1" = 60'
VERT. SCALE	1" = 6'

NORTH

30 15 0 30 60
GRAPHIC SCALE

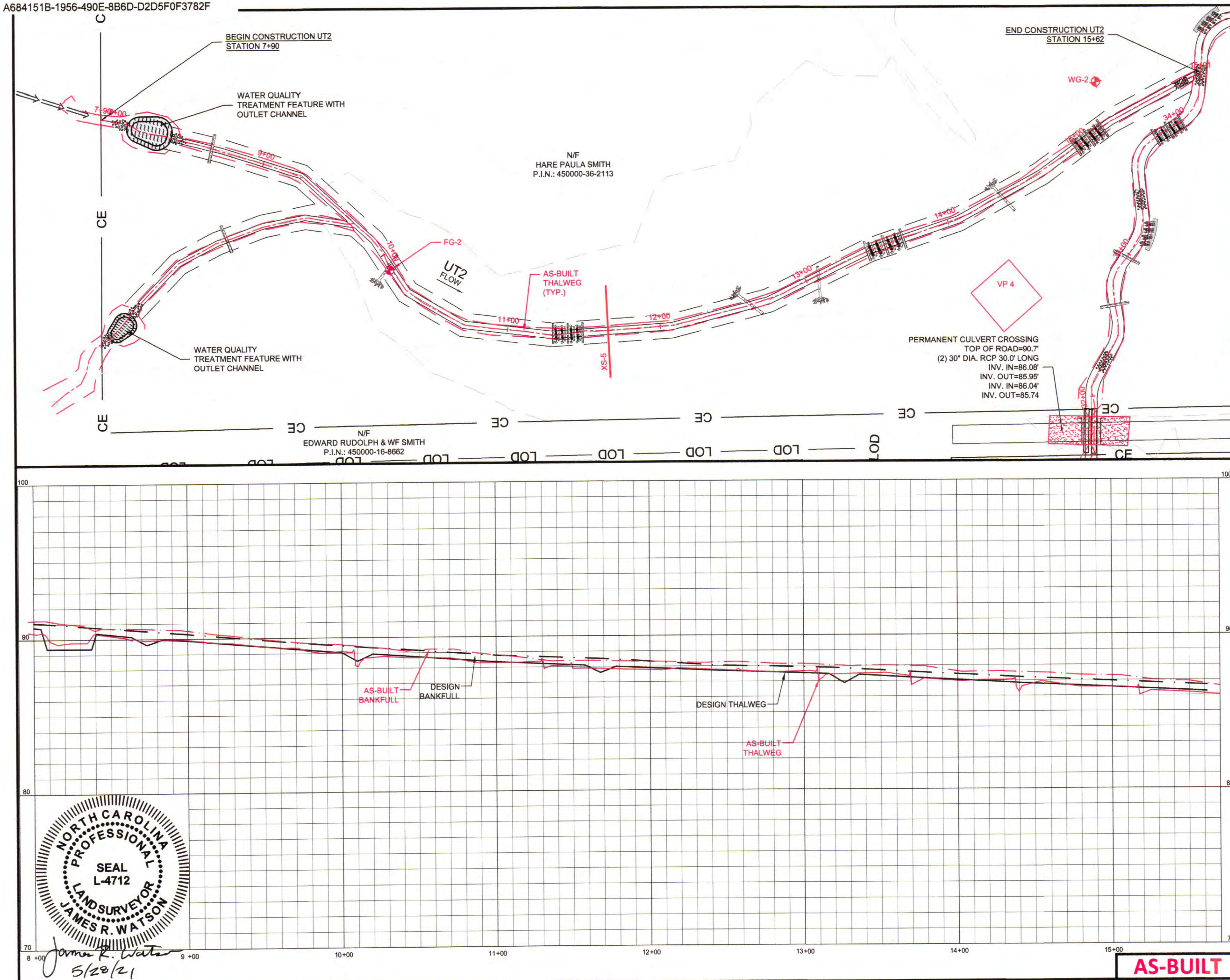
SHEET NAME

MS3

PLAN AND PROFILE

SHEET NUMBER

8



AS-BUILT

WATER & LAND SOLUTIONS

7721 Six Forks Rd., Suite 130
Raleigh, NC 27615
(919)614-5111
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VERT. SCALE	1" = 6'

NORTH

30 15 0 30 60
GRAPHIC SCALE

SHEET NAME

UT2

PLAN AND PROFILE

SHEET NUMBER

9

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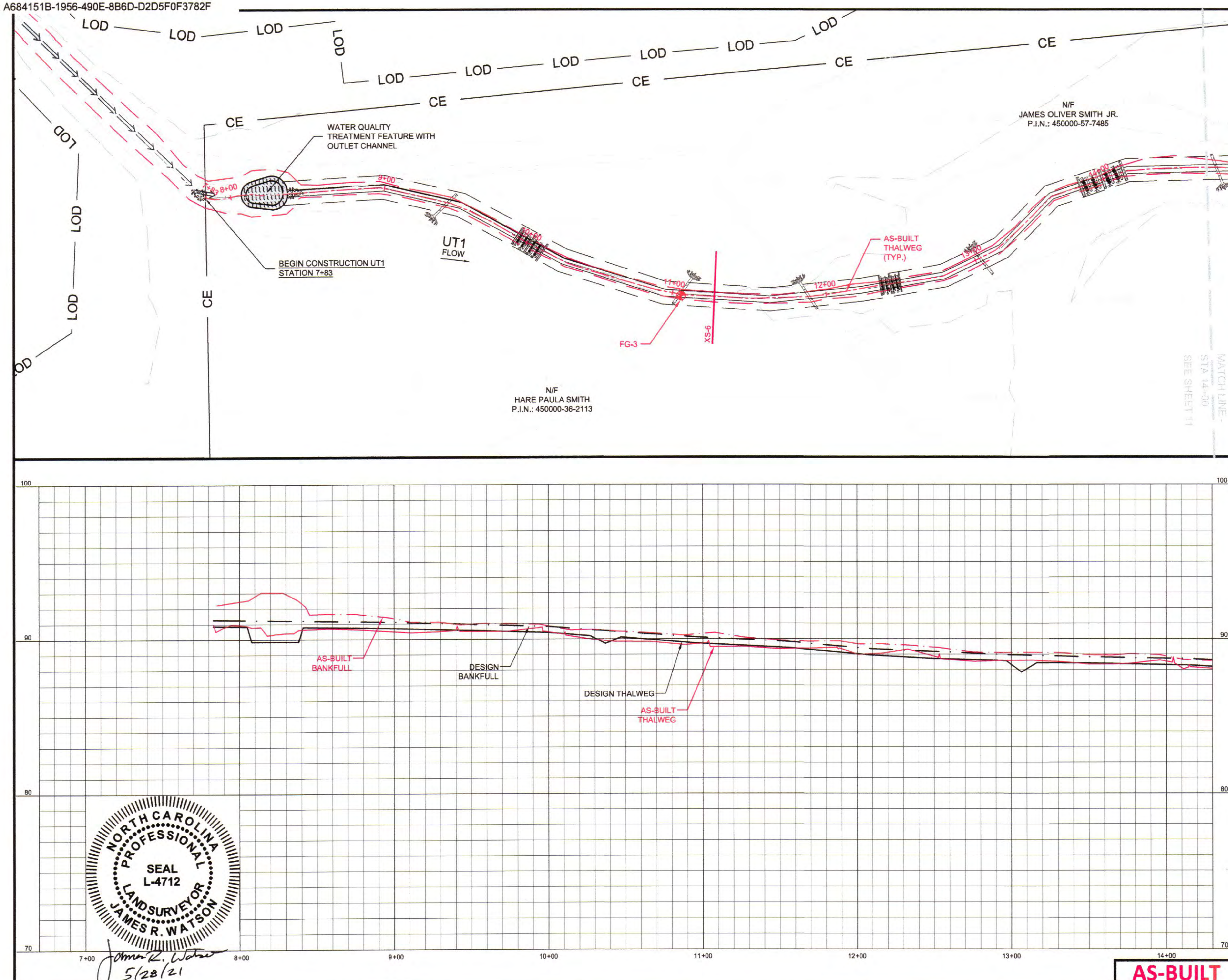

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NORTH

GRAPHIC SCALE 30 15 0 30 60

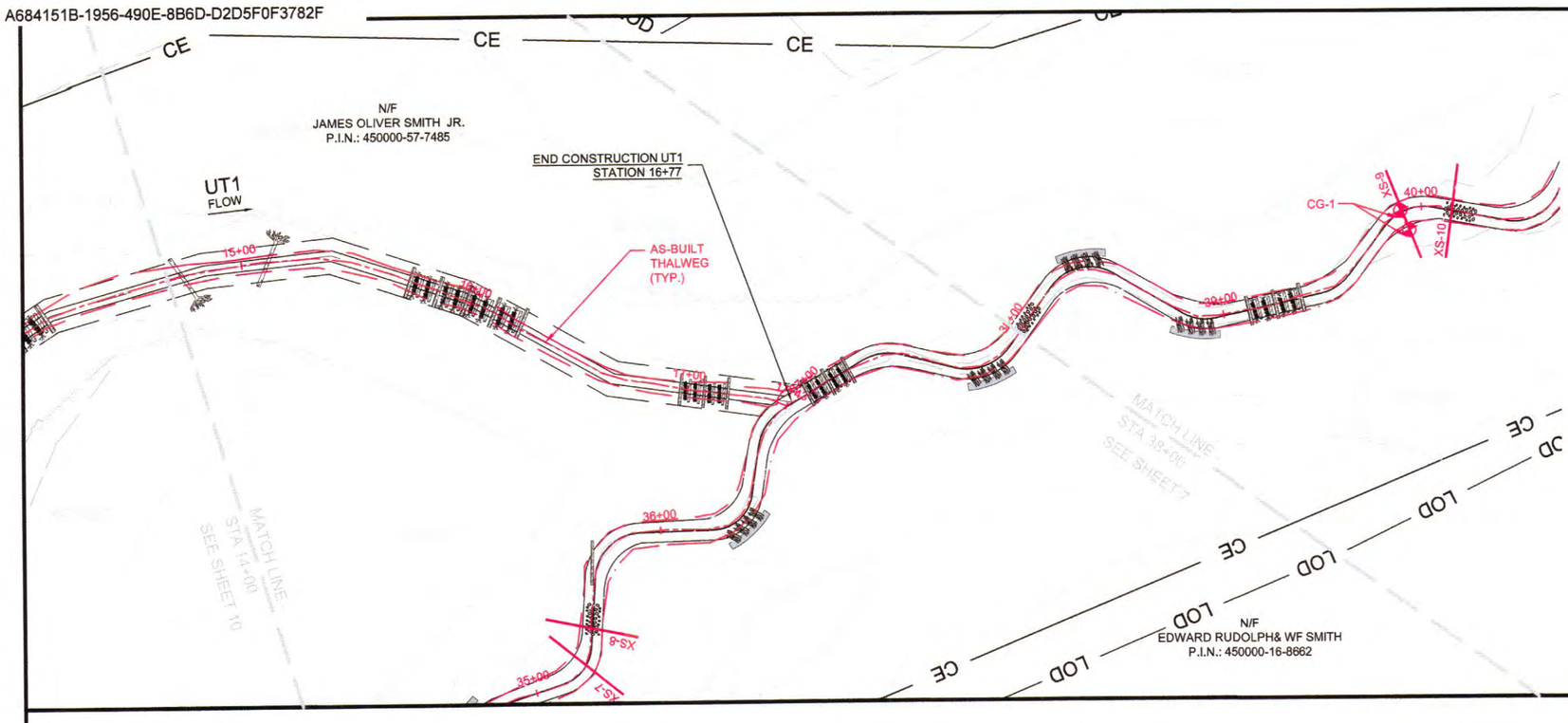
SHEET NAME

UT2 & UT1

PLAN AND PROFILE

SHEET NUMBER

10



NORTH CAROLINA PROFESSIONAL SEAL L-4712 LAND SURVEYOR JAMES R. WATSON
5/28/21

AS-BUILT

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NORTH

30 15 0 30 60
GRAPHIC SCALE

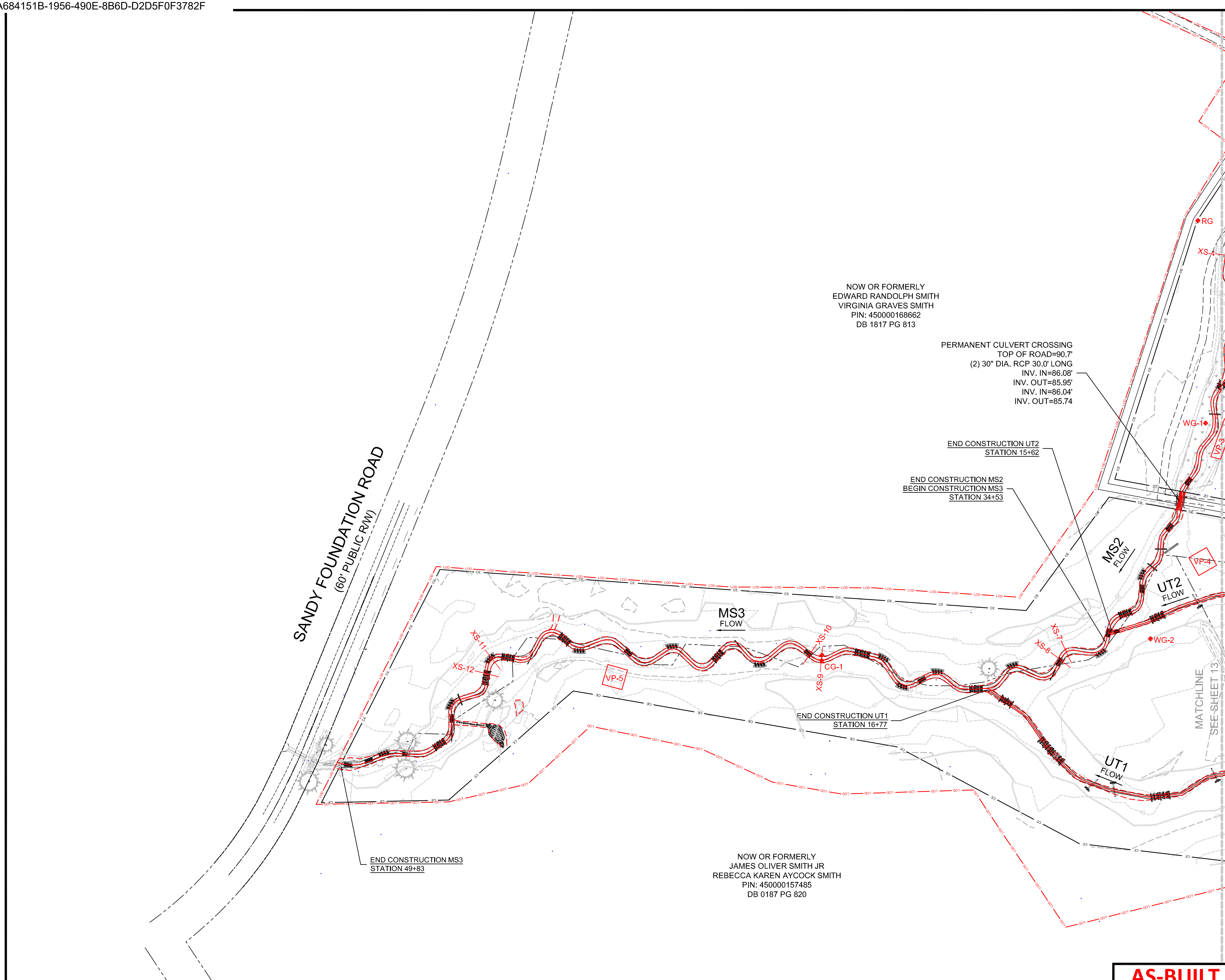
SHEET NAME

UT1

PLAN AND PROFILE

SHEET NUMBER

11



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LENOIR COUNTY, NC

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PROJECT NO.	18-006
FILENAME	ASB_12-13_HORNPIPE MONITORING PLAN.DWG
DESIGNED BY	KMV
DRAWN BY	APL
DATE	5-27-21
HORIZ. SCALE	1" = 150'
VERT. SCALE	

NORTH

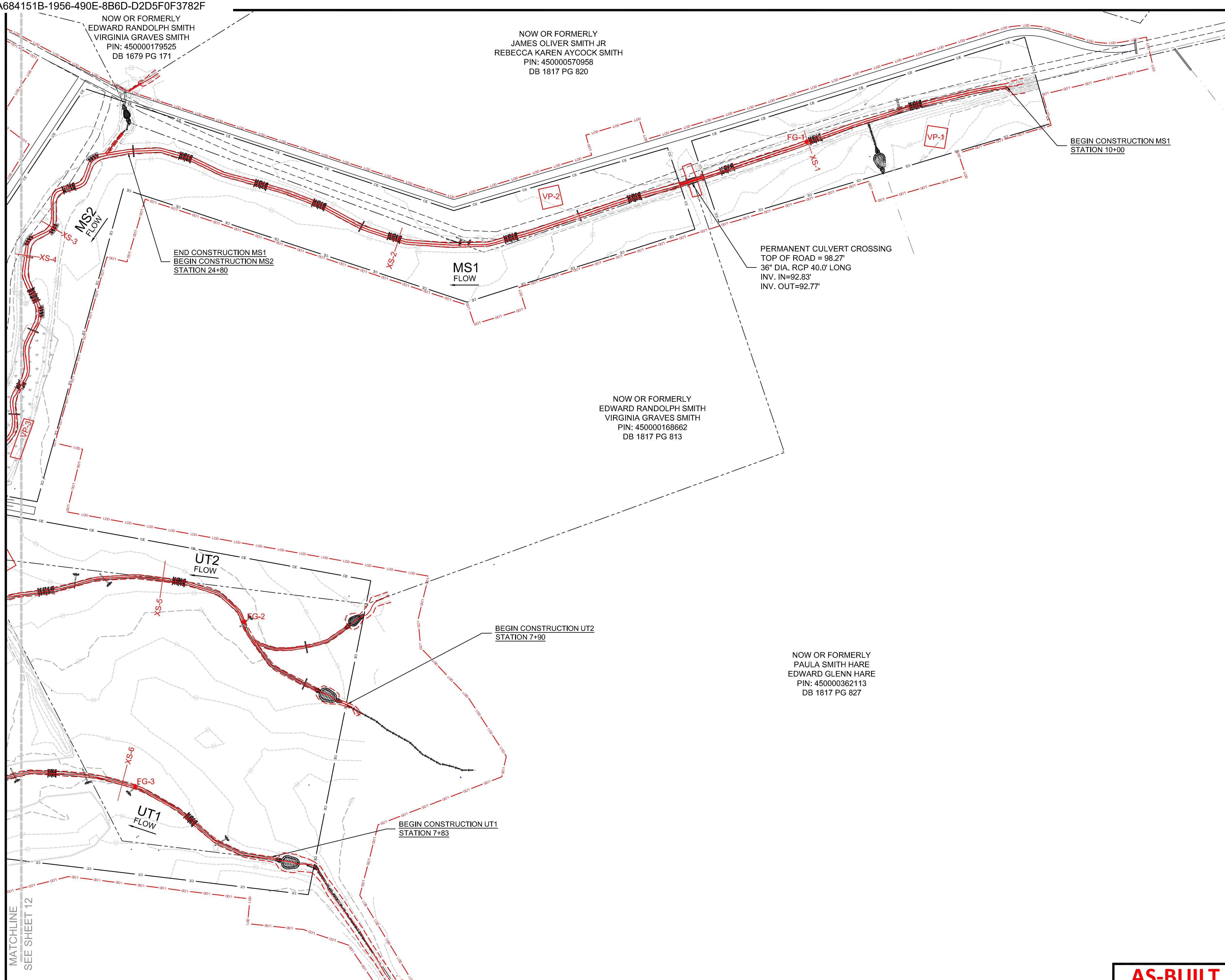
75 37.5 0 75 150
GRAPHIC SCALE

SHEET NAME

MONITORING PLAN

SHEET NUMBER

12



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VERT. SCALE	

NORTH

75 37.5 0 75 150
GRAPHIC SCALE

SHEET NAME

MONITORING PLAN

SHEET NUMBER

13