As-Built Baseline Monitoring Report
FINAL VERSION
Horne Creek Tributaries Mitigation Project
Monitoring Year 0
Calendar Year of Data Collection: 2020

NCDEQ DMS Project Identification # 100026
NCDEQ DMS Contract # 7181
Yadkin River Basin (Cataloging Unit 03040101)
USACE Action ID Number: SAW-2017-01510
NCDEQ DWR Project # 2017-1156
Surry County, NC
Contracted Under RFP # 16-006993
Data Collection Period: May 2020
Submission Date: August 2020

Prepared for:

North Carolina Department of Environmental Quality
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August 3, 2020

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Matthew Reid, Project Manager
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

RE: WLS Responses to NCDEQ DMS Review Comments for Task 6 Submittal, Draft Baseline Monitoring Report for the Horne Creek Tributaries Mitigation Project, DMS Full-Delivery Project ID #100026, Contract #7181, Yadkin River Basin, Cataloging Unit 03040101, Surry County, NC

Dear Mr. Reid:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Baseline Monitoring Report (including record drawings) for the Horne Creek 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 a CD. The electronic deliverables are organized under the following folder structure as required under the digital submission requirements:

1. Report PDF
2. Support Files
    1_ Background Tables
    2_Visual
    3_Veg Plot
    4_Geomorph
    5_Hydro
    6_As-Built Plans

We are providing our written responses to DMS' review comments on the Draft 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:

• **List of Appendices: Photos are listed as "Stream Station Photographs", but in the report the photos are of the cross-sections. Are these photos intended to take the place of stream photo points?** WLS Response: Yes, the stream station photo points are located at each cross section. Per DMS comment #2 below, WLS has also renamed this Appendix section to Stream Photo Points (Cross-Sections, Culvert Crossings, EII Reaches). The MY0 report will not include any photos points at the culvert crossings or EII reaches.

• **DMS recommends adding photo points in MY1. Please include photos at culvert crossings and EII reaches. Include photo points on the CCPV.** WLS Response: WLS will add photo points to all culvert

crossings and EII reaches for MY1. The data will be included in the MY1 CCPV and appropriate appendices. These symbols have been added to the MY0 CCPV, but there will not be any photos in the appendices.

• **List of Appendices: Table 5 Baseline Vegetation is incorrectly labeled as Table 6 in the report. Please update.** WLS Response: "Table 5 Baseline Vegetation" has been updated with the correct number.

• **List of Appendices: Appendix D has "Baseline Cross-Sections" listed. Consider updating to "Baseline Cross-Sections and Profiles".** WLS Response: Baseline Cross-Sections was updated to read Baseline Cross-Sections and Profiles.

• **The approved Mitigation Plan indicated 12 vegetation plots would be installed at the site; however, there are only 10 permanent plots installed. Also, there are no random plots used as described in the Mitigation Plan. Please explain the deviation from the IRT approved Mitigation Plan.** WLS Response: The mitigation plan was an estimate at the time and before the easement was finalized. The final planted acreage is 10.2, which equates to 9 vegetation plots. Even if the entire easement area of 11.87 acres was planted that equates to 10 vegetation plots. The Mitigation Plan stated that we "may" utilize random plots. After construction we determined that the established permanent vegetation plots were capturing the newly planted areas adequately and random plots were not necessary.

• **Section 3.3.11 indicates that two structures are piping. Please provide additional information about these structures. What type of structure, reach, and stationing? Please call out structures on CCPV and update status in the MY1 report.** WLS Response: Only one structure is piping, and the reference to two structures was a typo. Section 3.3.1.1 has been updated to include the information on the structure, which is on R4 at approximate station 19+55 (grade log j-hook vane). The MY0 CCPV has been updated with a callout on the structure and WLS will update the status of the structure in the MY1 report.

• **The R5 profile shows numerous occasions where the water surface cuts through the thalweg elevation. Are these survey error, piping, dry channel, or other?** WLS Response: There are eight locations on R5 where the water surface profile cuts underneath the thalweg due to missed survey points (no water surface shots at the structure inverts). There are no locations on R5 where piping is occurring, nor is the channel dry. WLS has included call outs for the locations along R5 that have the water surface elevation clipped through the thalweg due to survey error.

• **There is only one crest gauge/transducer installed on R5. Is FG-1 installed at XS1 on Reach 1 capable of capturing bankfull events? If FG-1 is unable to document bankfull events, DMS recommends installing a second crest gauge/transducer on R1.** WLS Response: Correct, there is one crest gauge/transducer on R5, which follows the IRT guidance of one gauge per 5,000 LF of reach. There are 2 symbols on the CCPV because we have installed a cork gauge and pressure transducer in the same area. The flow gauge on Reach 1 is capable of capturing bankfull events, but WLS will install a crest gauge on the lower section of R1 and will include the data in the MY1 report.

• **Table 2: Please change "Restoration Plan" to "Mitigation Plan".** WLS Response: Table 2 has been updated accordingly.

• **Table 2: Please remove "Mitigation Plan" from the "Asbuilt / Year 0 Monitoring" activity.** WLS Response: WLS has updated Table 2 accordingly.

• **CCPV: Please add an overview map that shows both project streams in relation to one another.** WLS Response: An overview map displaying all project reaches was created and added to the CCPV.

• **CCPV: Please include stationing. When photo points are added in MY1, please include these locations on the CCPV.** WLS Response: Stream stationing and photo points have been added to the CCPV.

• **XS4: Is the shot near the 10' mark a rod height error? The photographs of the cross section do not seem to indicate an approximate 1.5' height difference on the left bank. Please verify.** WLS Response: The shot at the 10' mark for XS-4 was an error due to incorrectly inputting the data into the Mecklenburg spreadsheet. WLS has corrected the reading and updated the data and Appendix D accordingly.

• **X13: Is the right bank shot a survey error or was an offset shot used to capture an undercut bank? The right bank photos for XS13 do not seem to correlate to the surveyed section. Please verify and correct as necessary.** WLS Response: XS-13 was shot using an offset to capture an undercut bank in the channel. The pool undercuts a large leftover root (under the matting) from a cut down tree in this pool at the cross-section location.

• **As-built Plan sheets: Stationing and elevations are not shown on the profiles. Please revise for final.** WLS Response: The stationing and elevations have been added to the profiles.

• **As-built Sheet 5: R4 Asbuilt Bankfull line does not appear correctly in profile downstream of culvert crossing. Revise as necessary.** WLS Response: The as-built bankfull line has been revised on Sheet 5.

• **Electronic Deliverables: Please include features characterizing the EII portions of R4a (10+98-11+54) and R4b (10+72-10+99). Currently the only features included in the digital submission were for the R portions of R4a and R4b. Please include the EII features in the CCPV as well.** WLS Response: Reaches R4a and R4b are now included in the electronic deliverables and are included on the CCPV.

Please contact me if you have any questions or comments.

Sincerely,

Water & Land Solutions, LLC

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LIST OF APPENDICES

1 Project Summary

1.1 Project Location and Description

The Horne Creek Tributaries Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery mitigation project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-006993. The Project will provide stream mitigation credits in the Yadkin River Basin (Cataloging Unit 03040101). The Project is located in Surry County approximately seven miles southwest of the Town of Pilot Mountain at 36.2851950° and -80.5032100°. The project site is in NCDEQ Sub-basin 03-07-02, in the 8-digit Hydrologic Unit Code (HUC) 03040101, in the Ararat River & Upper Yadkin River Local Watershed Plan Study Area (Local Watershed Plan ID: LWP-2008-51), and in the Targeted Local Watershed 03040101110070 (Warm Water Thermal Regime), all within the Yadkin River Basin.

The Project involved the restoration, enhancement, and permanent protection of seven stream reaches (R1, R2, R3, R4, R4a, R4b, and R5) and their riparian buffers, totaling approximately 5,428 linear feet of streams. The Project will provide significant ecological improvements and functional uplift through stream and aquatic habitat restoration and through decreasing nutrient and sediment loads within the watershed. The mitigation plan provides a detailed project summary and Table 1 provides a summary of project assets. Figure 1 illustrates the project mitigation components.

1.2 Monitoring Schedule and Reporting

The Project will be monitored on a regular basis with physical inspections to occur a minimum of twice per year throughout the seven-year post-construction monitoring period, or until performance standards are met. The measure of stream restoration success will be documented by bankfull flows and no change in stream channel classification. The measure of vegetative success for the Project will be the survival of at least 210 trees per acre with an average height of eight feet at the end of year seven of the monitoring period. Site inspections and monitoring reports will also identify components and features that require routine maintenance or adaptive management.

1.3 Project Goals and Objectives

The Project will meet the goals and objectives described in the Horne Creek Tributaries Final Approved Mitigation Plan and will address general restoration goals and opportunities outlined in the North Carolina Division of Mitigation Services (DMS) Upper Yadkin River Basin Restoration Priority Plan (RBRP) (DEQ 2009). More specifically, watershed goals and management strategies described in the Upper Yadkin Local Watershed Plan (LWP) will be met by:

- Reducing sediment, soil erosion, turbidity, and nutrient inputs such as fecal coliform bacteria, nitrogen, and phosphorus to the Horne Creek Watershed.
- Restoring, enhancing, and protecting headwater streams, wetlands, riparian buffers, and aquatic habitat functions.
- Improving riparian corridor management and targeting restoration of impacted streams and riparian buffer areas.
- Promoting agronomic farm management techniques and implementing agricultural BMPs and water quality features such as livestock exclusion fencing, alternative watering systems, and nutrient management devices.

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

- Provide a floodplain connection to the incised Project stream reaches by lowering bank height ratios (BHRs) to less than 1.2, thereby promoting more natural or overbank flood flows,
- Improve bedform diversity by increasing scour pool spacing and depth variability,
- Increase native species riparian buffer and vegetation density/composition along streambank and floodplain areas that meet requirements of a minimum 30-foot-wide and 210 stems/acre after the monitoring period,
- Improve aquatic habitat and fish species diversity and migration through the addition of in-stream cover and native woody debris,
- Site protection through an 11.87-acre conservation easement in excess of 30 feet from the top of the restored streambanks, that will protect all streams, wetlands and aquatic resources in perpetuity.

1.4 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.

1.4.1 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. In addition to the pressure transducers, traditional cork gauges will be installed at bankfull elevation and will be used to document bankfull events with photographs.

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.

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: Representative streambed material samples will be collected in monitoring years 5 and 7 at locations where riffles are installed in restoration reaches. The post-construction riffle substrate samples will be compared to the existing riffle substrate data collected during the design phase. 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 exhibit surface flow for a minimum of 30 consecutive days throughout some portion of the year during a year with normal or below 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. 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.

1.4.2 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.

1.4.3 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, cattle exclusion fence damage, and general streambed conditions. Permanent photo points will be at the cross-sections, culvert crossings, and Enhancement II reaches.

2 Project Mitigation Components

2.1 Project Components

The Project mitigation components include a combination of Stream Restoration and Enhancement activities, as summarized in the table below.

Table 1. Mitigation Plan Stream Mitigation Credits (SMCs)

Project Component	Existing Footage or Acreage	Proposed Reach Stationing	Restored Footage, Acreage, or SF	Creditable Footage, Acreage or SF	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Credits
R1	1,397	10+00 – 23+40	1,320	1,320	R	PI/PII	1	1,320
R2	286	10+17 – 13+13	296	296	R	PII	1	296
R3	75	11+80 – 12+55	76	76	R	PII	1	76
R4	1,191	13+13 – 25+19	1,167	1,167	R	PI/PII	1	1,167
R4a	124	10+98 – 11+54	57	57	EII	-	2.5	23
R4a	-	11+55 – 12+65	111	111	R	PI	1	111
R4b	89	10+72 – 10+99	27	27	EII	-	2.5	11
R4b	-	10+99 – 12+24	125	125	R	PI	1	125
R5	2,519	25+19 – 48+12	2,249	2,249	R	PI	1	2,249
Totals	**5,681**		**5,428**	**5,428**				**5,378**
							Credit Loss in Required Buffer	-300
							Credit Gain for Additional Buffer	325
							Net Change in Credit from Buffers	+25
							Total Credits per Buffer Calculator	5,403
							Total Adjusted SMCs	**5,389**

Note 1: No mitigation credits were calculated outside the conservation easement boundaries.
Note 2: The difference in Proposed Reach Stationing length and Restored Footage is the result of permanent crossings.
Note 3: The Wilmington District Stream Buffer Calculator was used to determine credit losses/gains due to 11% of the total project lengths buffer widths being less than 30'. Based on the stream buffer credit calculator the total net increase in stream credits is 25 credits. This is due in part to many areas within the buffer being greater than 30'. WLS is proposing the adjusted SMCs totaling 5,389 credits.
Note 4: Values in table were rounded to the nearest whole number.

2.2 Design Approach

2.2.1 Stream

The Project stream design approach included a combination of Stream Restoration and Enhancement activities. Priority Level I Restoration reaches incorporated the design of a single-thread meandering channel, with parameters based on data taken from reference site comparison, published empirical

relationships, NC Piedmont Regional Curves, and hydrologic and hydraulic analyses. The restoration of planform and dimension, frequent overbank flows and a restored riparian buffer will provide the appropriate hydrology and sediment transport throughout the project catchments. All non-vegetated areas within the easement were planted with native vegetation and any areas of invasive species were removed and/ or treated.

- **Reach R1 –** R1 begins at the upstream western boundary of the Project immediately downstream of an existing stream crossing. The majority of the reach was restored as a Rosgen B4 stream type within its current location and tied into the downstream channel. Work along R1 involved relocating the channel towards the center of the valley and implementing a Priority Level I/II Restoration by raising the bed elevation and reconnecting the stream with its abandoned floodplain. Fencing was installed outside of the easement boundary to permanently exclude livestock and reduce sediment and nutrient inputs. A permanent 20-foot wide culverted crossing was installed to allow for landowner access between pastures. Additionally, one water quality treatment feature was installed inside of the conservation easement to reduce sediment and nutrient inputs that would otherwise enter the riparian buffer as untreated water.

- **Reach R2 –** R2 begins downstream of a roadway culvert under Caudle Road. Work along R2 involved Priority Level II restoration by slightly raising the bed elevation and reconnecting the stream with a constructed floodplain. The reach was restored as a Rosgen B4 stream type using appropriate step-pool morphology with minimal meander planform geometry that accommodated the valley slope and width. One water quality treatment feature was constructed inside of the conservation easement at the beginning of R2 to capture, attenuate, and treat overland flow that would otherwise enter the riparian buffer as untreated water.

- **Reach R3 –** R3 begins at the confluence of R2 and R4. Work along R3 involved Priority Level II restoration by slightly raising the bed elevation and reconnecting the stream with a constructed floodplain. The reach was restored as a Rosgen B4a stream type using appropriate step-pool morphology with minimal meander planform geometry to accommodate the valley slope and width. Two water quality treatment features were constructed in series along R3 to capture, attenuate, and treat overland flow.

- **Reach R4 –** R4 begins at the confluence of R2 and R3. Work along R4 involved a combination of Priority Level I and II Restoration by gradually raising the bed elevation and reconnecting the stream with its adjacent floodplain or a constructed floodplain. A majority of the channel was restored in its current location while the lower 200 feet was relocated to its historic position to meander across the left floodplain before connecting with R5. Two permanent 20-foot wide culverted crossings were installed to allow for landowner access between pastures.

- **Reach R4a –** R4a is a small perennial headwater tributary that begins at a spring head within the upper catchment. R4a consisted of Enhancement Level II practices in the upper 57 linear feet by removing cattle and planting native vegetation to maintain and improve the stability of the channel. The lower 111 feet was restored as a Rosgen B4 stream type using appropriate riffle-pool and step-pool morphology with minimal meander planform geometry. This approach

allowed restoration of a stable channel form with appropriate bedform diversity and allowed the channel to be tied into Reach R4.

- **Reach R4b –** R4b is a small perennial headwater tributary that begins at a spring head within the upper catchment. A majority of this reach was stable except for the downstream end where an active headcut had propagated upstream from R5. Work along R4b involved Enhancement Level II practices in upper 27 linear feet to maintain and improve the stability of the channel. The lower 125 linear feet was restored as a Rosgen B4 stream type using appropriate riffle-pool and step-pool morphology with minimal meander planform geometry. This approach allowed restoration of a stable channel form with appropriate bedform diversity and allowed the channel to be tied into Reach R4.

- **Reach R5 –** R5 begins at the confluence of R4 and R4b. Work along R5 involved Priority Level I Restoration by raising the bed elevation and reconnecting the stream with its historic floodplain. A majority of the channel was constructed offline and the existing degraded channel was partially to completely filled. A permanent 20-foot culverted crossing was installed to allow for landowner access between pastures.

3 As-Built (Baseline) Condition

3.1 As-built Survey

An as-built survey conducted under the responsible charge of a North Carolina Professional Land Surveyor (Chris Cole, PLS with Ascension Land Surveying), was utilized to document the as-built or baseline condition of the Project post-construction. The Project construction and planting were completed in April 2020 and the as-built survey was completed in June 2020 due to surveyor availability and adverse weather conditions. Cattle were excluded with temporary fencing prior to construction and permanent fencing was completed in June 2020. Baseline monitoring activities occurred in May 2020. The as-built survey included a topographic surface survey, locating the constructed stream channels, in-stream structures, monitoring device locations, a longitudinal profile survey for each project reach, and cross-section surveys for each reach.

3.2 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 are located in Appendix E.

3.3 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. Minor piping was noted at one in-stream structure on R4 but is expected to resolve naturally as minor adjustments occur in the streambed at this location. Along R5, some of the rock riffles that were constructed using on-site alluvium showed signs of sediment migration into pools after multiple rain

events. These facet slope adjustments are expected as sediment is transported through the system and demonstrates the channels ability to establish and maintain dynamic equilibrium given the new flow regime and catchment conditions. Several log riffles were removed from the project reaches and replaced with rock riffles due to material availability. Establishment of temporary vegetation was sparse on reaches R4 and R5 immediately following construction. Subsequently, additional temporary seeding and mulching was applied post-construction to establish ground cover and help stabilize the site. No other major issues or mitigating factors were observed immediately after construction which require consideration or remedial action.

3.3.1 Morphological Assessment

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

3.3.1.1 Stream Horizontal Pattern & Longitudinal Profile

The MY0 stream channel pattern and longitudinal profiles closely match the profile design parameters. On the design profiles, riffles were depicted as straight lines with consistent slopes. Various locations for the riffle profiles shown on the as-built survey illustrate multiple slope breaks due to the installation of log and rock structures and woody debris within the streambed. The constructed riffle slopes and pool depths vary slightly from design parameters due to field adjustments and fine sediment migration during construction. The MY0 plan form geometry or pattern fell within acceptable ranges of the design parameters for all restored reaches. These 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. Minor piping was noted on R4 at one of the in-stream structures at approximate station 19+55 (grade log j-hook vane) and is expected to resolve naturally as natural adjustments occur in the streambed at this location.

3.3.1.2 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.

3.3.1.3 Substrate

Representative streambed material samples will be collected in years 5 and 7 at the locations where riffles are installed in reaches that were proposed for restoration as part of the Project.

3.3.2 Stream Hydrology

3.3.2.1 Stream Flow

Two pressure transducers (flow gauges) were installed in May 2020 in the restoration sections on reaches R1 and R2 to document baseflow conditions. The flow gauge locations are within the upper one-third of the project reaches as shown on Figure 1 and data will be included in the Monitoring Year 1 Report.

3.3.2.2 Bankfull Events

Two crest gauges were installed to document bankfull events on R1 and R5. WLS installed a conventional cork crest gauge, along with a pressure transducer to validate flood stations on both reaches. 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.

3.3.3 Vegetation

Monitoring of the 10 permanent vegetation plots was completed during the first week of May 2020. Vegetation data can be found in Appendix C with the associated photos located in Appendix B. The MY0 average planted density is 696 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. 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.

No areas of with significant invasive plant species were observed post-construction. The site will be monitored closely, and any invasive plant species will be treated as needed.

4 Methods

Stream cross-section monitoring was conducted using a Topcon RL-H5 Laser Level. Three-dimensional coordinates associated with cross-section data were collected in the field (NAD83 State Plane feet PIPS 3200). Morphological data were collected at 16 cross-sections. Survey data were imported into Microsoft Excel® for data processing and analysis. 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 was 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.

Vegetation success is being monitored at a total of 10 permanent vegetation plots. 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 CVS data entry tool. In the field, the four corners of each plot were permanently marked with PVC at the origin and rebar at the other corners. 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.

5 References

Lee Michael T., Peet Robert K., Roberts Steven D., and Wentworth Thomas R., 2008. CVS-EEP Protocol for Recording Vegetation Level. Version 4.2

(RBRP) North Carolina Ecosystem Enhancement Program (EEP), 2009. Yadkin Pee-Dee River Basin Watershed Restoration Priorities (RBRP). February 2009.

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

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

Water and Land Solutions, LLC (2019). Horne Creek Tributaries Mitigation Plan. NCDMS, Raleigh, NC.

Appendix A:
Background Tables

Table 1. Horne Creek Tributaries (ID-100026) - Mitigation Assets and Components

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
R1	1,397	1,320	Warm	R	PI/PII	1.00000			1,342	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
R2	286	296	Warm	R	PII	1.00000			289	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
R3	75	76	Warm	R	PII	1.00000			73	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
R4	1,191	1,167	Warm	R	PI/PII	1.00000			1,181	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
R4A	124	57	Warm	EII	PI	2.50000			57	Supplemental Planting of Buffer, Livestock Exclusion, Permananent Easement
R4A	-	111	Warm	R	PI	1.00000			105	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
R4B	89	27	Warm	EII	PI	2.50000			27	Supplemental Planting of Buffer, Livestock Exclusion, Permananent Easement
R4B	-	125	Warm	R	PI	1.00000			123	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement
R5	2,519	2,249	Warm	R	PI	1.00000			2,270	Full Channel Restoration, Planted Buffer, Permanent Conservation Easement.

Project Credits

Restoration Level	Stream			Riparian Wetland		Non-Rip Wetland	Coastal Marsh
	Warm	Cool	Cold	Riverine	Non-Riv		
Restoration	**5344.000**						
Re-establishment							
Rehabilitation							
Enhancement							
Enhancement I							
Enhancement II	**33.600**						
Creation							
Preservation							
Totals	**5377.600**			**0.000**	**0.000**	**0.000**	

Overall Assets Summary

Asset Category	Overall Credits
Stream	**5,378**
RP Wetland	**NA**
NR Wetland	**NA**
Buffer	**NA**
Buffer Loss SMC	**-300**
Buffer Gain SMC	**325**
Total SMU	**5,403**
Total Adjusted SMCs	**5,389**

Table 2. Project Activity and Reporting History Horne Creek Tributaries #100026		
Elapsed Time Since grading complete:	**2 months**	
Elapsed Time Since planting complete:	**2 months**	
Number of reporting Years[1]:	**0**	
	Data Collection	**Completion or**
Activity or Deliverable	**Complete**	**Delivery**
Institution Date	N/A	05/22/17
404 permit date	N/A	01/15/20
Mitigation Plan	N/A	07/29/19
Final Design – Construction Plans	N/A	07/29/19
Construction	N/A	04/30/20
Containerized, bare root and B&B plantings for reach/segments 1&2	N/A	04/30/20
As-built (Year 0 Monitoring – baseline)	May-20	07/01/20
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring/ Close Out		

Table 3. Project Contacts Table Horne Creek Tirbutaries Mitigation Project	
Designer	Water & Land Solutions, LLC
	7721 Six Forks Rd, Ste. 130, Raleigh, NC 27615
Primary project design POC	Christopher Tomsic - (828) 493-3287
Construction Contractor	North State Environmental, Inc.
	2889 Lowery Street, Winston-Salem, NC 27101
Construction contractor POC	Andrew Roten - (336) 406-9078
Survey Contractor	Ascension Land Surveying
	116 Williams Road, Mocksville, NC 27028
Survey contractor POC	Christopher Cole - (704) 579-7197
Planting Contractor	Ripple EcoSolutions, LLC
	215 Moonridge Rd, Chapel Hill, NC 27516
Planting contractor POC	George Morris - (919) 818-3984
Seeding Contractor	North State Environmental, Inc.
	2889 Lowery Street, Winston-Salem, NC 27101
Contractor point of contact	Andrew Roten - (336) 406-9078
Seed Mix Sources	Green Resource
	(336) 588-6363
Nursery Stock Suppliers (Bare Roots)	Native Forest Nursery
	(704) 483-3397
Nursery Stock Suppliers (Bare Roots/plugs)	Mellow Marsh Farm
	(919) 742-1200
Nursery Stock Suppliers (Live Stakes)	Foggy Mountain Nursery
	(336) 384-5323
Monitoring Performers	Water & Land Solutions, LLC
	7721 Six Forks Rd, Ste. 130, Raleigh, NC 27615
Stream Monitoring POC	Kyle Obermiller - (828) 808-2240
Vegetation Monitoring POC	Kyle Obermiller - (828) 808-2240
Wetland Monitoring POC	Kyle Obermiller - (828) 808-2240

Table 4. Project Background Information			
Project Name	Horne Creek Tributaries		
County	Surry		
Project Area (acres)	11.9		
Project Coordinates (latitude and longitude)	36.2851950º N, -80.5032100º W		
Planted Acreage (Acres of Woody Stems Planted)	10.2		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Yadkin		
USGS Hydrologic Unit 8-digit	03040101	USGS Hydrologic Unit 14-digit	030401011110070
DWR Sub-basin	03-07-02		
Project Drainage Area (Acres and Square Miles)	0.06 (R1) and 0.26 (R5)		
Project Drainage Area Percentage of Impervious Area	<1%		
CGIA Land Use Classification	2.01.03, 2.01.01, 3.02 (46% pasture/hay, 24% row crop, 16% mixed forest)		

Reach Summary Information

Parameters	Reach 1	Reach 2	Reach 3	Reach 4	Reach 4A	Reach 4B	Reach 5
Length of reach (linear feet)	1,320	296	76	1,167	168	152	2,249
Valley confinement (Confined, moderately confined, unconfined)	mod confined	mod confined	mod confined	unconfined	unconfined	unconfined	unconfined
Drainage area (Acres and Square Miles)	38 and 0.06	41 and 0.06	29 and 0.05	83 and 0.13	29 and 0.05	2 and 0.003	166 and 0.26
Perennial, Intermittent, Ephemeral	Perennial	Intermittent	Intermittent	Perennial	Perennial/Intermittent	Perennial/Intermittent	Perennial
NCDWR Water Quality Classification	C	C, WS-IV	C	C, WS-IV	C	C	C, WS-IV
Stream Classification (existing)	E5b/F5b (incised)	G4 (incised)	E6b (incised)	B4 (incised)	B4c (incised)	G5	B4c/G4c (incised)
Stream Classification (proposed)	B4	B4	B4a	B4/C4b	B4	B4	C4
Evolutionary trend (Simon)	III/IV	III	III	IV/V	I	I	IV/V
FEMA classification	N/A	N/A	N/A	N/A	N/A	N/A	N/A

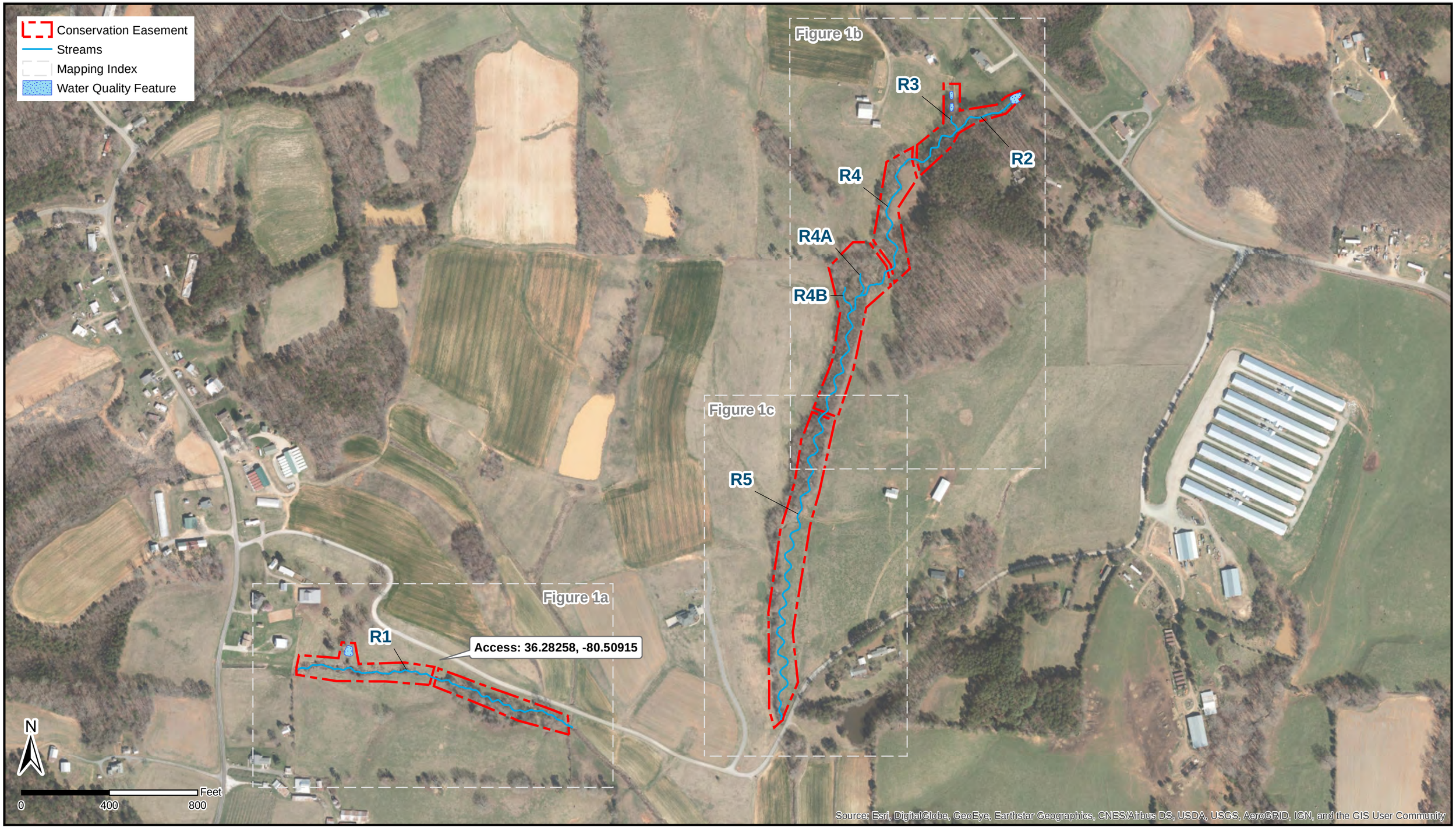
Regulatory Considerations

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

Appendix B:

Visual Assessment Data

Figure 1: Current Condition Plan View (CCPV)
Stream Photo Points (Cross-Sections, Culvert Crossings, EII Reaches)
Vegetation Plot Photographs
Monitoring Device Photographs



WATER & LAND™ SOLUTIONS

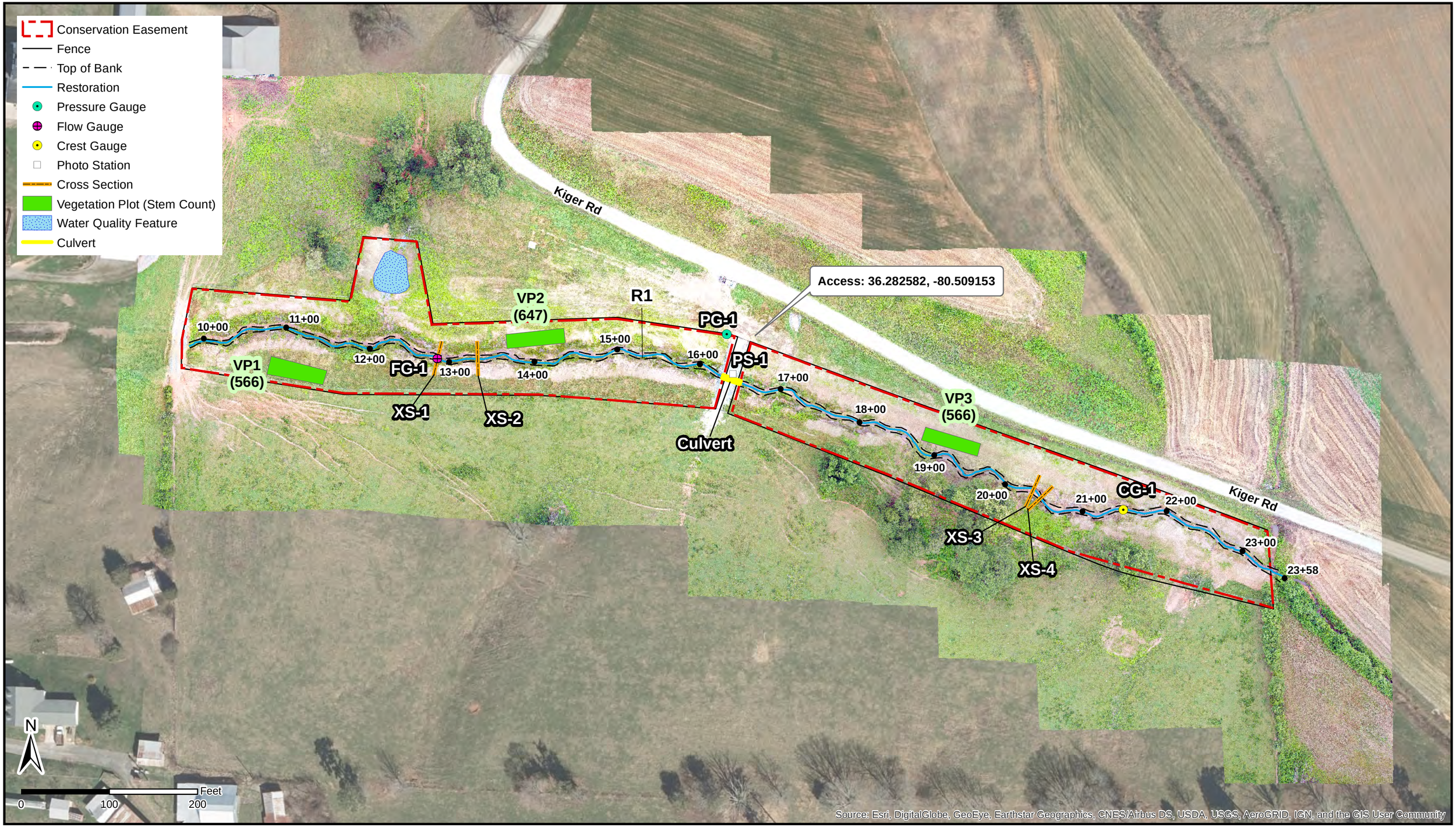
Horne Creek Tributaries Mitigation Project
Surry County, North Carolina

USACE Action ID Number: SAW-2017-01510
DMS project number: 100026
May 2020
MY0

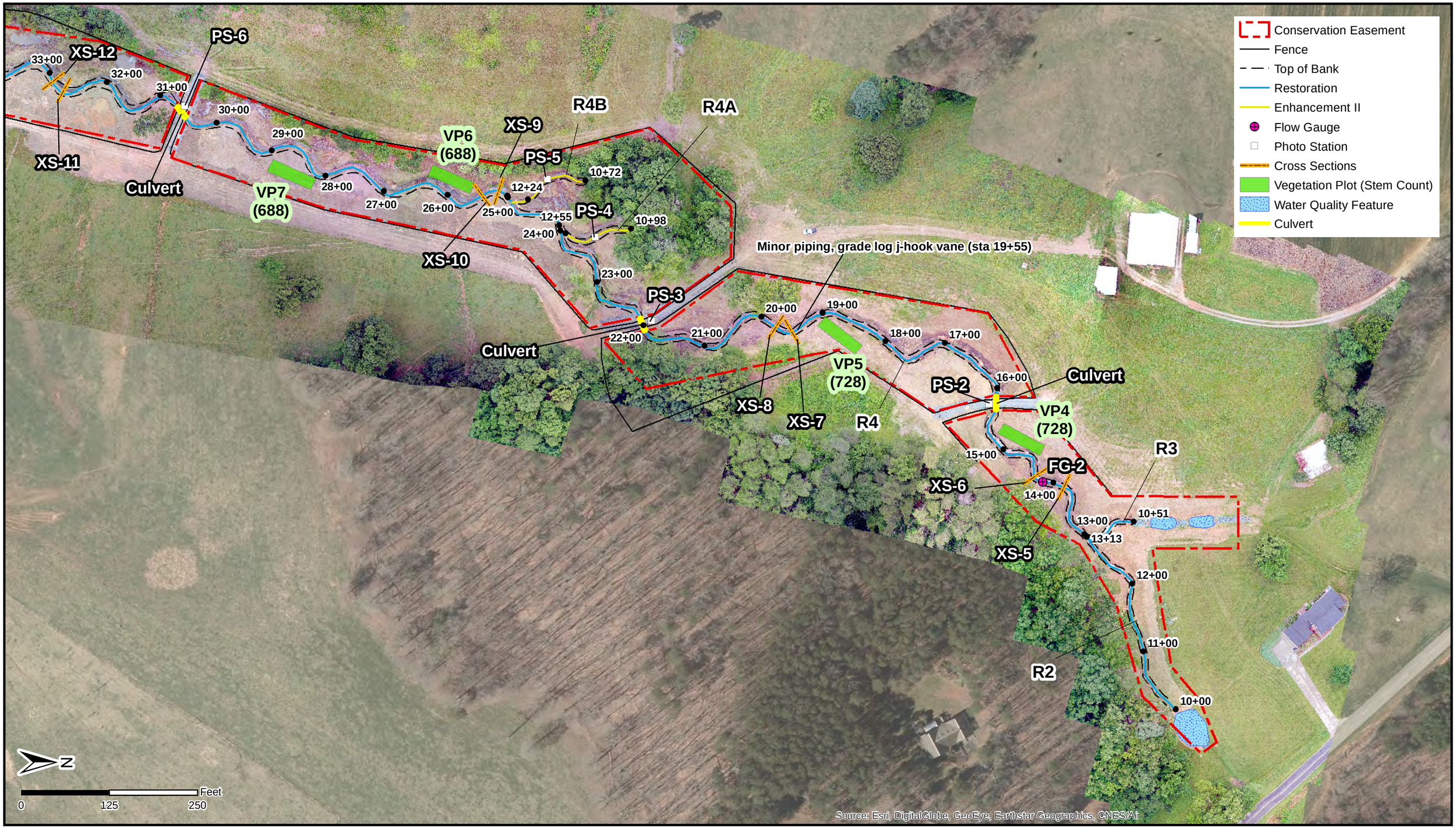
Current Conditions
Plan View
Monitoring Year 0

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1



WATER & LAND™ SOLUTIONS	**Horne Creek Tributaries Mitigation Project** **Surry County, North Carolina**	USACE Action ID Number: SAW-2017-01510 DMS project number: 100026 May 2020 MY0	Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1a



WATER & LAND™ SOLUTIONS

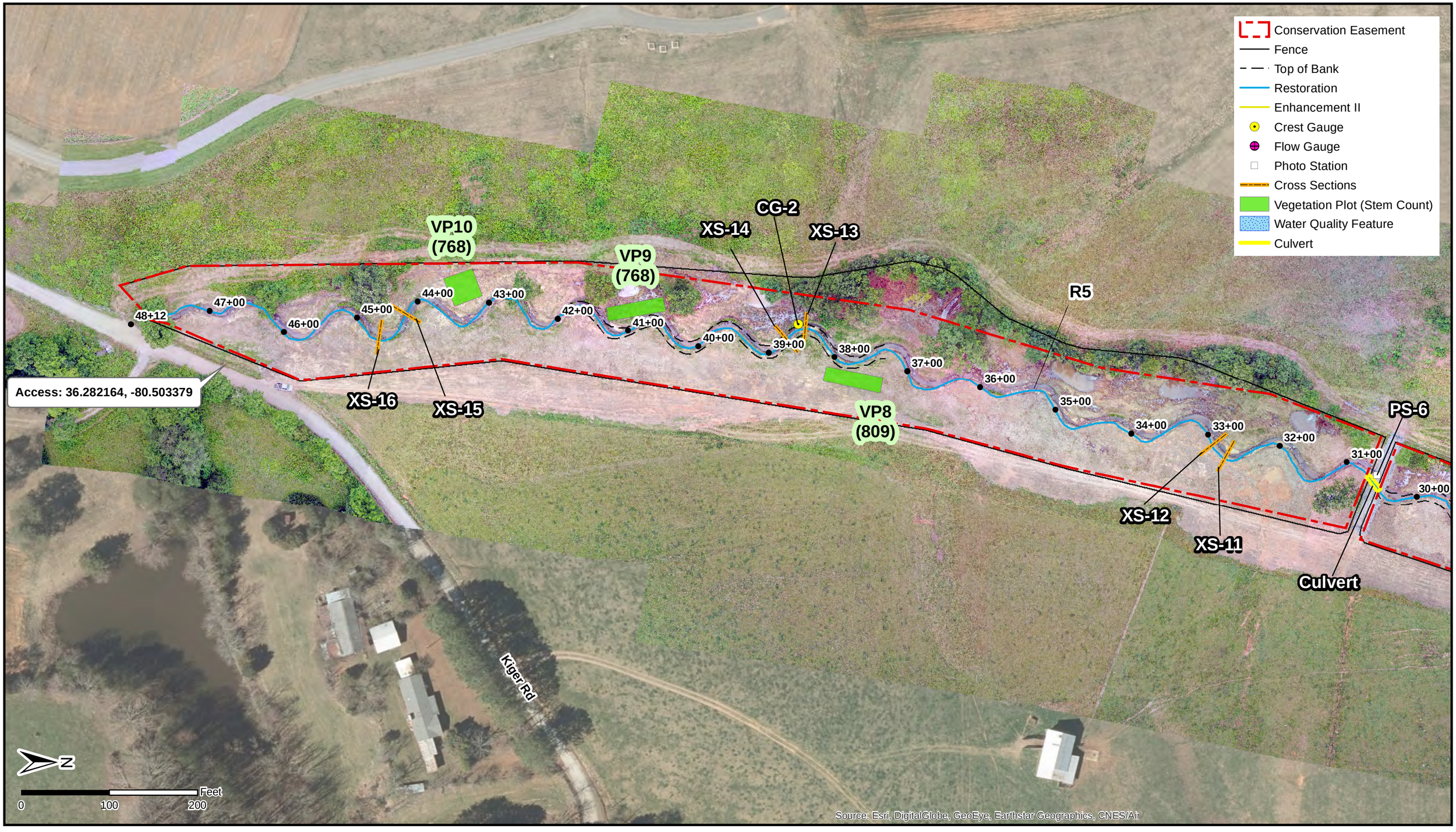
Horne Creek Tributaries Mitigation Project
Surry County, North Carolina

USACE Action ID Number: SAW-2017-01510
DMS project number: 100026
May 2020
MY0

Current Conditions
Plan View
Monitoring Year 0

NAD 1983 2011 State Plane
North Carolina FIPS 3200 FT US

FIGURE
1b



WATER & LAND™ SOLUTIONS	**Horne Creek Tributaries Mitigation Project** **Surry County, North Carolina**	USACE Action ID Number: SAW-2017-01510 DMS project number: 100026 May 2020 MY0	Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1 c

R1, XS1, Upstream (MY-00)

R1, XS1, Left Bank (MY-00)

R1, XS1, Downstream (MY-00)

R1, XS1, Right Bank (MY-00)

R1, XS2, Upstream (MY-00)

R1, XS2, Left Bank (MY-00)

R1, XS2, Downstream (MY-00)

R1, XS2, Right Bank (MY-00)

R1, XS3, Upstream (MY-00)

R1, XS3, Left Bank (MY-00)

R1, XS3, Downstream (MY-00)

R1, XS3, Right Bank (MY-00)

R1, XS4, Upstream (MY-00)

R1, XS4, Left Bank (MY-00)

R1, XS4, Downstream (MY-00)

R1, XS4, Right Bank (MY-00)

R4, XS5, Upstream (MY-00)

R4, XS5, Left Bank (MY-00)

R4, XS5, Downstream (MY-00)

R4, XS5, Right Bank (MY-00)

R4, XS6, Upstream (MY-00)

R4, XS6, Left Bank (MY-00)

R4, XS6, Downstream (MY-00)

R4, XS6, Right Bank (MY-00)

R4, XS7, Upstream (MY-00)

R4, XS7, Left Bank (MY-00)

R4, XS7, Downstream (MY-00)

R4, XS7, Right Bank (MY-00)

R4, XS8, Upstream (MY-00)

R4, XS8, Left Bank (MY-00)

R4, XS8, Downstream (MY-00)

R4, XS8, Right Bank (MY-00)

R5, XS9, Upstream (MY-00)

R5, XS9, Left Bank (MY-00)

R5, XS9, Downstream (MY-00)

R5, XS9, Right Bank (MY-00)

R5, XS10, Upstream (MY-00)

R5, XS10, Left Bank (MY-00)

R5, XS10, Downstream (MY-00)

R5, XS10, Right Bank (MY-00)

R5, XS11, Upstream (MY-00)

R5, XS11, Left Bank (MY-00)

R5, XS11, Downstream (MY-00)

R5, XS11, Right Bank (MY-00)

R5, XS12, Upstream (MY-00)

R5, XS12, Left Bank (MY-00)

R5, XS12, Downstream (MY-00)

R5, XS12, Right Bank (MY-00)

R5, XS13, Upstream (MY-00)

R5, XS13, Left Bank (MY-00)

R5, XS13, Downstream (MY-00)

R5, XS13, Right Bank (MY-00)

R5, XS14, Upstream (MY-00)

R5, XS14, Left Bank (MY-00)

R5, XS14, Downstream (MY-00)

R5, XS14, Right Bank (MY-00)

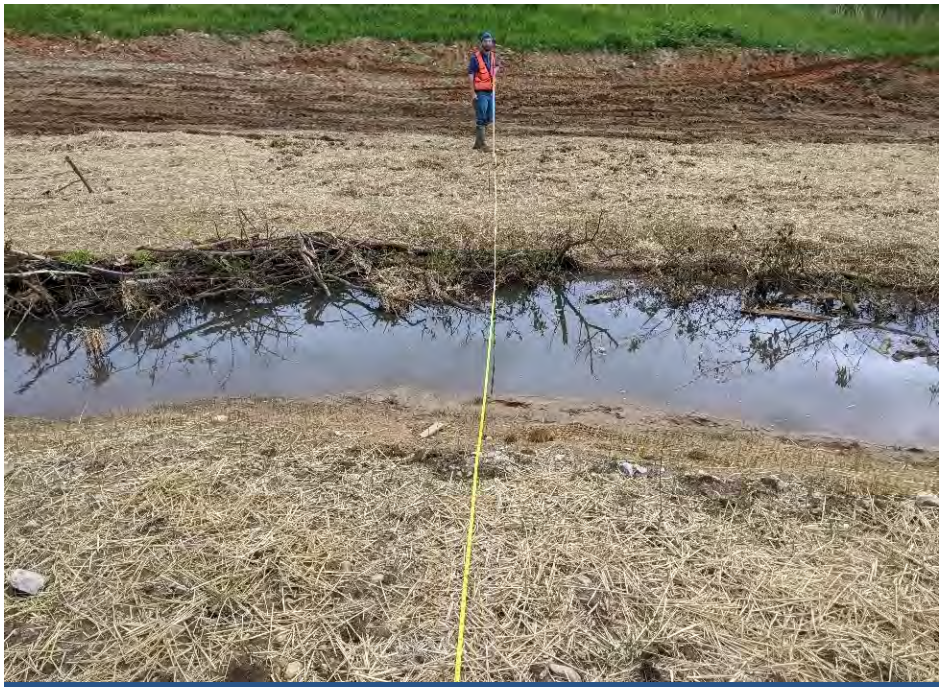
R5, XS15, Upstream (MY-00)

R5, XS15, Left Bank (MY-00)

R5, XS15, Downstream (MY-00)

R5, XS15, Right Bank (MY-00)

R5, XS16, Upstream (MY-00)



R5, XS16, Left Bank (MY-00)

R5, XS16, Downstream (MY-00)

R5, XS16, Right Bank (MY-00)

Veg Plot 1 (MY-00)

Veg Plot 3 (MY-00)

Veg Plot 2 (MY-00)

Veg Plot 4 (MY-00)

Veg Plot 5 (MY-00)

Veg Plot 7 (MY-00)

Veg Plot 6 (MY-00)

Veg Plot 8 (MY-00)

Veg Plot 9 (MY-00)

Veg Plot 10 (MY-00)

Flow Gauge – R1

Flow Gauge – R2

Crest Gauge (Pressure Transducer) – R5

Crest Gauge (Cork) – R5

Appendix C:
Vegetation Monitoring Plot Data

CVS Project Code 6. Project Name: Horne Creek

Table 5: Baseline Vegetation

			Current Plot Data (MY0 2020)																											Annual Means		
			006-01-0001			006-01-0002			006-01-0003			006-01-0004			006-01-0005			006-01-0006			006-01-0007			006-01-0008			006-01-0009			006-01-0010			MY0 (2020)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Alnus serrulata	hazel alder	Shrub	1	1	1							3	3	3	1	1	1	2	2	2	1	1	1	2	2	2	2	2	2	2	2	2	14	14	14
Asimina triloba	pawpaw	Tree	4	4	4				2	2	2	1	1	1	2	2	2	1	1	1				2	2	2	4	4	4	2	2	2	18	18	18
Betula nigra	river birch	Tree																						2	2	2	2	2	2				4	4	4
Carpinus caroliniana	American hornbeam	Tree				1	1	1				3	3	3	2	2	2	1	1	1	2	2	2				1	1	1	3	3	3	13	13	13
Cercis canadensis	eastern redbud	Tree				1	1	1	2	2	2	1	1	1	3	3	3	2	2	2										1	1	1	10	10	10
Corylus americana	American hazelnut	Shrub	1	1	1	1	1	1				1	1	1	2	2	2	1	1	1	2	2	2	1	1	1	2	2	2	1	1	1	12	12	12
Diospyros virginiana	common persimmon	Tree	1	1	1							1	1	1	2	2	2	4	4	4							2	2	2	2	2	2	12	12	12
Fraxinus pennsylvanica	green ash	Tree							1	1	1	2	2	2							1	1	1										4	4	4
Hamamelis virginiana	American witchhazel	Tree				1	1	1				1	1	1							3	3	3	1	1	1							6	6	6
Lindera benzoin	northern spicebush	Shrub	2	2	2	2	2	2							2	2	2	1	1	1	1	1	1	5	5	5				2	2	2	15	15	15
Liriodendron tulipifera	tuliptree	Tree	3	3	3	7	7	7	5	5	5				1	1	1	1	1	1	4	4	4	1	1	1	3	3	3	4	4	4	29	29	29
Nyssa biflora	swamp tupelo	Tree																			1	1	1	3	3	3							4	4	4
Nyssa sylvatica	blackgum	Tree	2	2	2	1	1	1	1	1	1	1	1	1				2	2	2							1	1	1				8	8	8
Platanus occidentalis	American sycamore	Tree							1	1	1	2	2	2							1	1	1	2	2	2	1	1	1				7	7	7
Quercus alba	white oak	Tree							1	1	1							1	1	1	1	1	1							1	1	1	4	4	4
Quercus rubra	northern red oak	Tree				2	2	2	1	1	1	1	1	1	2	2	2							1	1	1							7	7	7
Tilia americana	American basswood	Tree										1	1	1	1	1	1	1	1	1							1	1	1	1	1	1	5	5	5
		Stem count	14	14	14	16	16	16	14	14	14	18	18	18	18	18	18	17	17	17	17	17	17	20	20	20	19	19	19	19	19	19	172	172	172
		size (ares)	1			1			1			1			1			1			1			1			1			1			10		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.25		
		Species count	7	7	7	8	8	8	8	8	8	12	12	12	10	10	10	11	11	11	10	10	10	10	10	10	10	10	10	10	10	10	17	17	17
		Stems per ACRE	566.6	566.6	566.6	647.5	647.5	647.5	566.6	566.6	566.6	728.4	728.4	728.4	728.4	728.4	728.4	688	688	688	688	688	688	809.4	809.4	809.4	768.9	768.9	768.9	768.9	768.9	768.9	696.1	696.1	696.1

Table 5a: Vegetation Plot Mitigation Success Summary Table

Plot #	Planted Stems/Acre	Volunteers/ Acre	Total Stems/Acre	Success Criteria Met	Average Stem Height (ft)
1	566.6	0	566.6	Yes	1.4
2	647.5	0	647.5	Yes	1.6
3	566.6	0	566.6	Yes	1.7
4	728.4	0	728.4	Yes	1.5
5	728.4	0	728.4	Yes	1.2
6	688	0	688	Yes	1
7	688	0	688	Yes	1.6
8	809.4	0	809.4	Yes	1
9	768.9	0	768.9	Yes	1.1
10	768.9	0	768.9	Yes	1.2
Project Average	696.07	0	696.07	Yes	1.33

Cara Conder

From: Kayne Van Stell
Sent: Monday, March 16, 2020 3:49 PM
To: Cara Conder; Catherine Manner; Christopher Tomsic; Adam McIntyre; Daniel Ingram; Kyle Obermiller; Emily Dunnigan; Nick Childs
Cc: George Morris
Subject: FW: Horne Creek Tribs Planting

Follow Up Flag: Follow up
Flag Status: Flagged

-----Original Message-----
From: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>
Sent: Monday, March 16, 2020 3:41 PM
To: Kayne Van Stell <kayne@waterlandsolutions.com>; Haupt, Mac <mac.haupt@ncdenr.gov>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>
Subject: RE: Horne Creek Tribs Planting

Kayne,
I understand that there have been delays due to weather, and we have been notified by several providers that planting has been delayed. As we have told the other providers, I don't have any problem with planting extending into April provided that you can still meet the 180 timeframe for monitoring. For the upcoming guidance, I believe we will also state that if planting is not complete by April 30th, the growing season cannot count toward the required years of monitoring, so just make sure you get all the plants in by that deadline.
Thank you,

Todd Tugwell
Mitigation Project Manager
Wilmington District, US Army Corps of Engineers
3331 Heritage Trade Drive, Suite 105
Wake Forest, North Carolina 27587
(919) 554-4884 ext. 58

-----Original Message-----
From: Kayne Van Stell [mailto:kayne@waterlandsolutions.com]
Sent: Monday, March 16, 2020 12:29 PM
To: Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Haupt, Mac <mac.haupt@ncdenr.gov>; Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>

Subject: [Non-DoD Source] Horne Creek Tribs Planting

Hi All,

This email is to notify the IRT that we are currently constructing the Horne Creek Tributaries mitigation project (USACE #SAW-2017-01510, DWR #17-1156). We are requesting approval for vegetation planting to be completed by mid to late April. We understand the standard/guidance is to finish site planting by March 15th as stated in the mitigation plan. As of today, the contractor and subs/vendors are continuing all construction activities, including planting, and we plan to install veg plots at least 180 days prior to the initiation of the first year of monitoring (MY1). This may of course change depending on state/federal restrictions and we'll have to manage accordingly. Hope you and yours stay safe and healthy during this unprecedented situation.

-Kayne

Kayne M. Van Stell

Vice President, Ecosystem Design Services

Water & Land Solutions

7721 Six Forks Rd, Suite 130

Raleigh, North Carolina 27615

Office (919) 614-5111 | Mobile (919) 818-8481 | Email kayne@waterlandsolutions.com
<mailto:kayne@waterlandsolutions.com>

Appendix D:

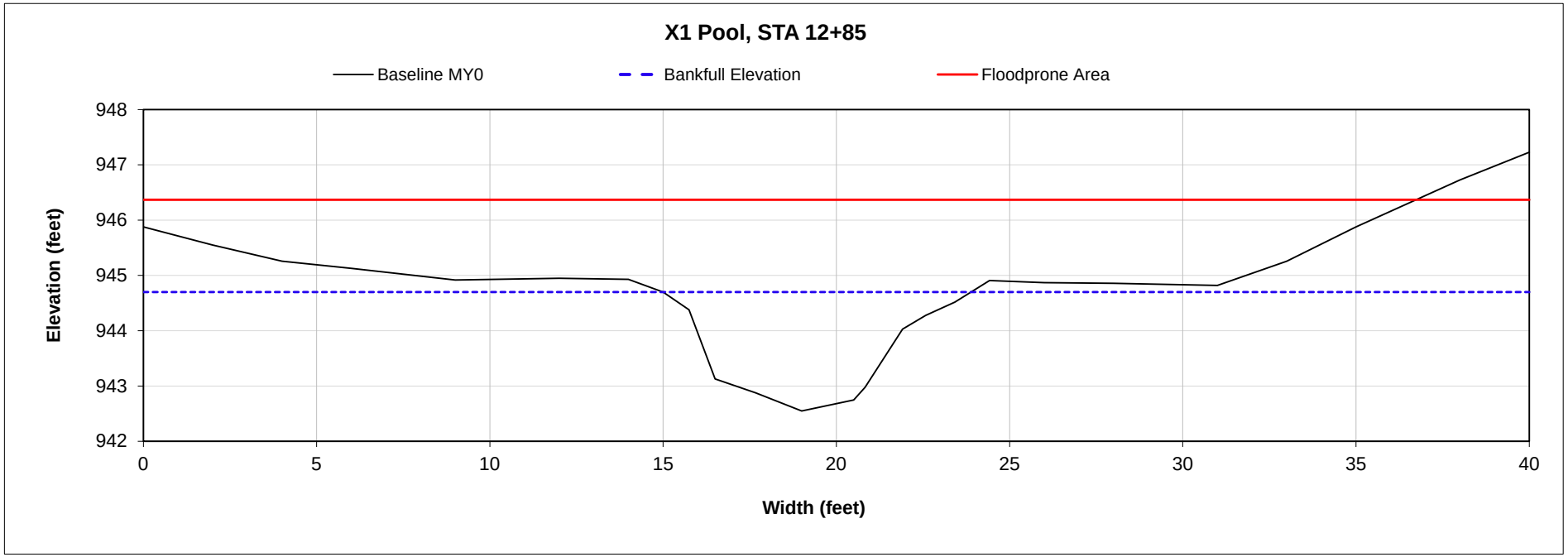
Stream Measurement and Geomorphology Data

Baseline Cross-Sections
Baseline Longitudinal Profile
Table 6a: Baseline Stream Data Summary
Table 6b: Cross-section Morphology Data
Table 6c: Stream Reach Morphology Data

Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R1
Cross Section ID	XS-1
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	944.7
Low Bank Height Elevation (ft)	944.7
Bankfull Max Depth (ft)	2.1
Low Bank Height (ft)	2.1
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	11.1
% Change Bank Height Ratio	NA

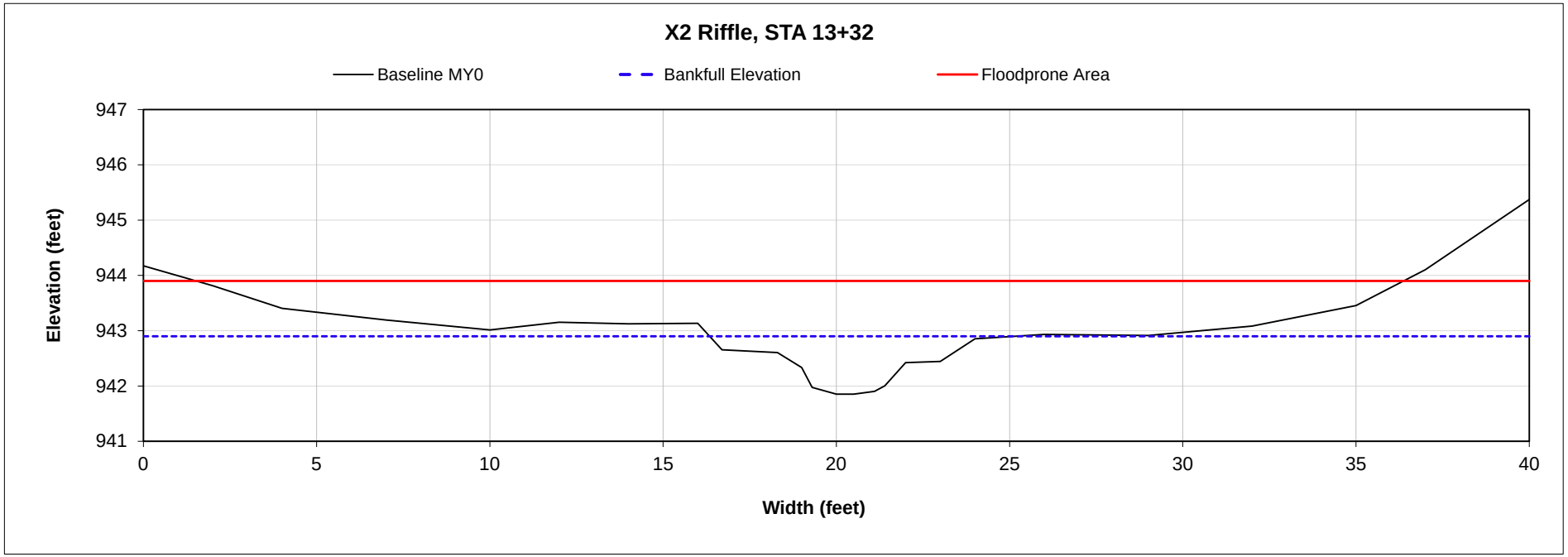
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R1
Cross Section ID	XS-2
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	942.9
Low Bank Height Elevation (ft)	942.9
Bankfull Max Depth (ft)	1.0
Low Bank Height (ft)	1.0
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	3.9
% Change Bank Height Ratio	NA

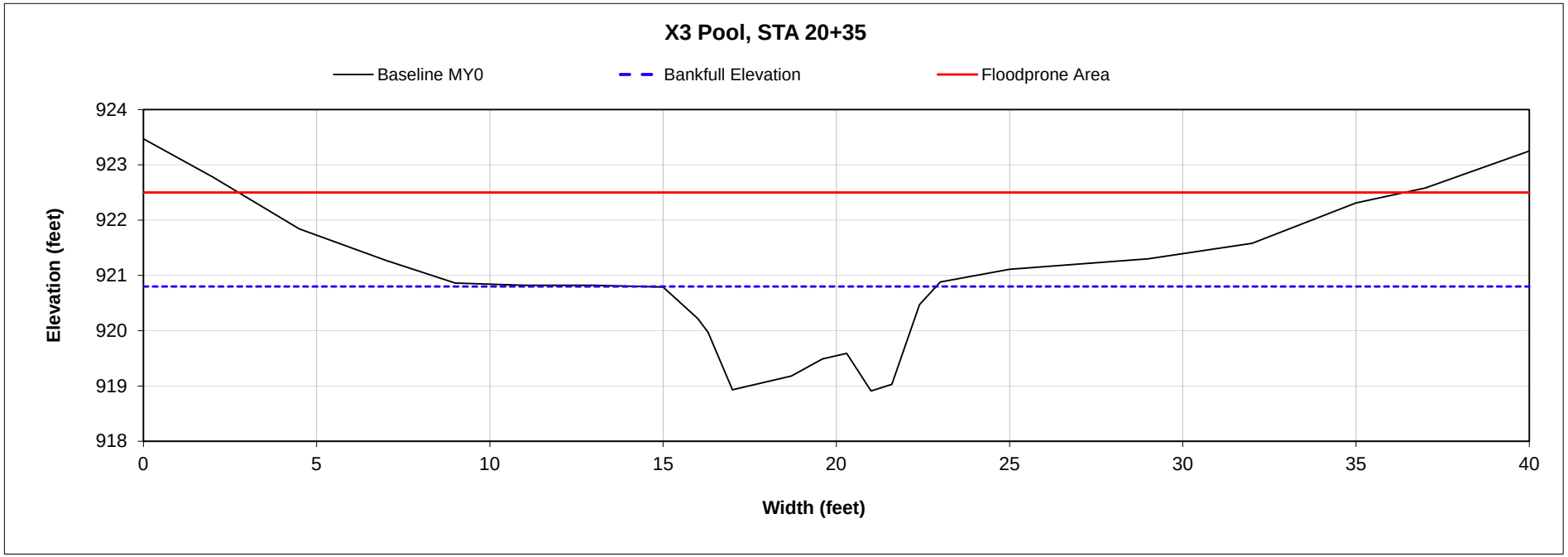
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R1
Cross Section ID	XS-3
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	920.8
Low Bank Height Elevation (ft)	920.8
Bankfull Max Depth (ft)	1.9
Low Bank Height (ft)	1.9
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	9.6
% Change Bank Height Ratio	NA

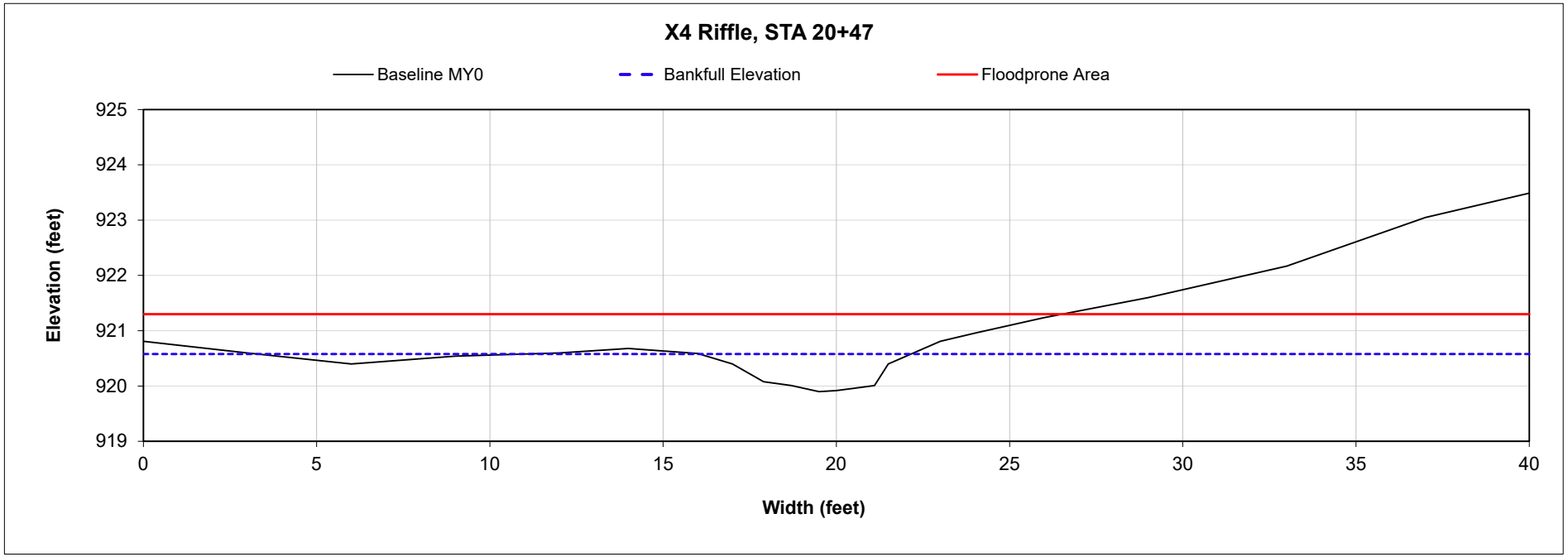
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R1
Cross Section ID	XS-4
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	920.6
Low Bank Height Elevation (ft)	920.6
Bankfull Max Depth (ft)	0.7
Low Bank Height (ft)	0.7
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	2.6
% Change Bank Height Ratio	NA

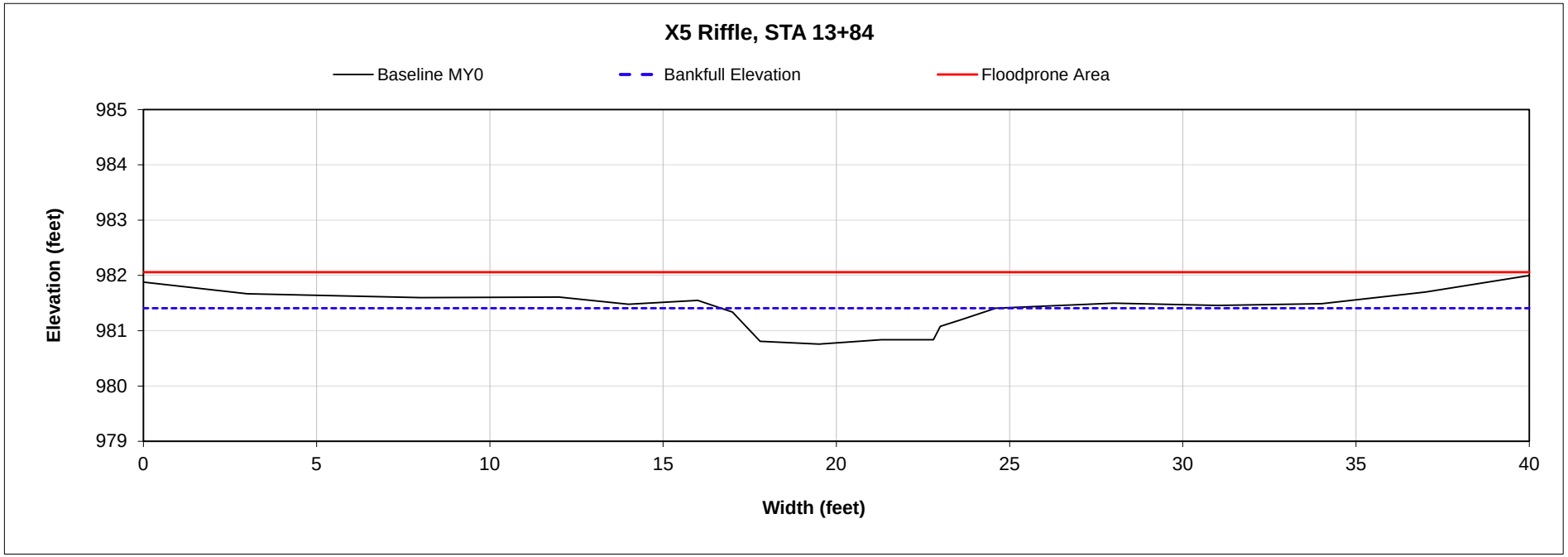
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R4
Cross Section ID	XS-5
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	981.4
Low Bank Height Elevation (ft)	981.4
Bankfull Max Depth (ft)	0.7
Low Bank Height (ft)	0.7
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	3.7
% Change Bank Height Ratio	NA

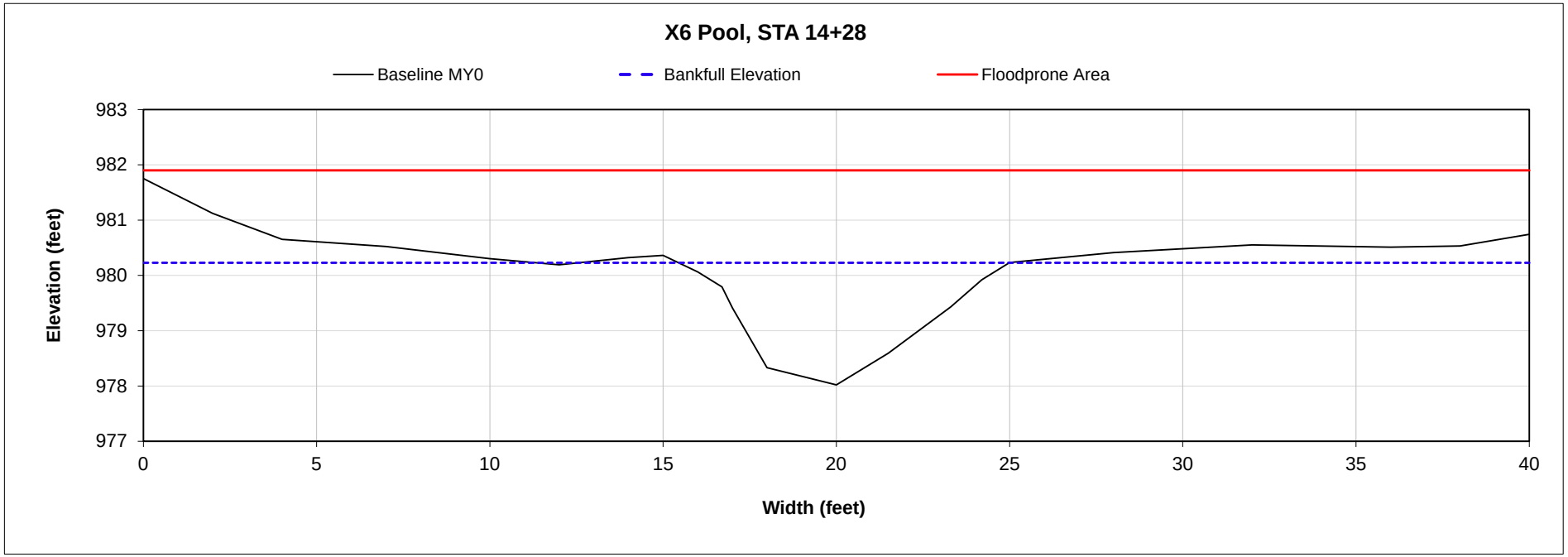
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R4
Cross Section ID	XS-6
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	980.2
Low Bank Height Elevation (ft)	980.2
Bankfull Max Depth (ft)	2.2
Low Bank Height (ft)	2.2
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	11.6
% Change Bank Height Ratio	NA

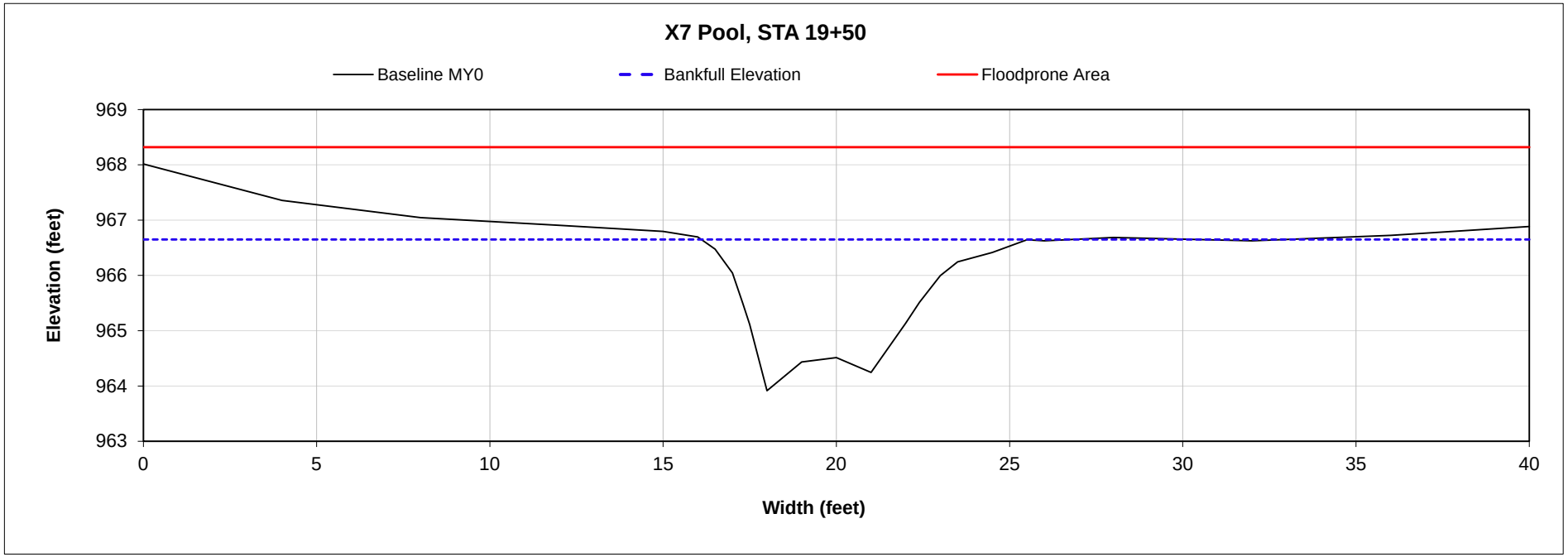
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R4
Cross Section ID	XS-7
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	966.6
Low Bank Height Elevation (ft)	966.6
Bankfull Max Depth (ft)	2.7
Low Bank Height (ft)	2.7
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	12.4
% Change Bank Height Ratio	NA

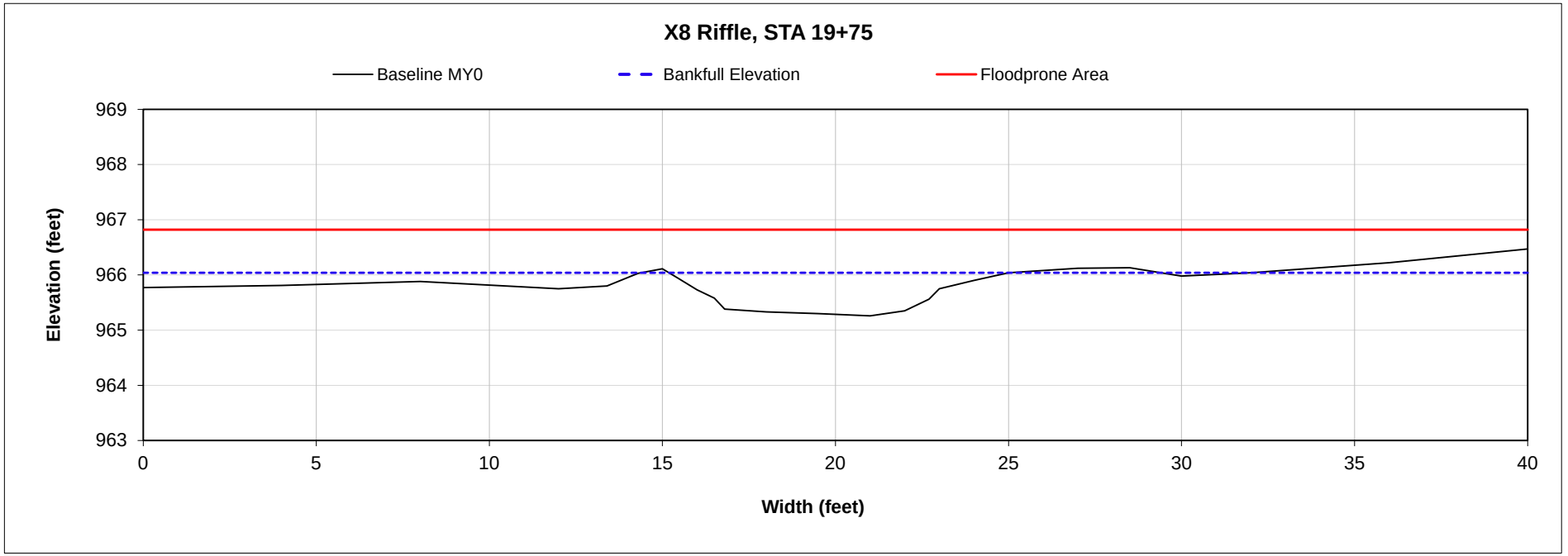
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R4
Cross Section ID	XS-8
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	966.0
Low Bank Height Elevation (ft)	966.0
Bankfull Max Depth (ft)	0.8
Low Bank Height (ft)	0.8
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	5.1
% Change Bank Height Ratio	NA

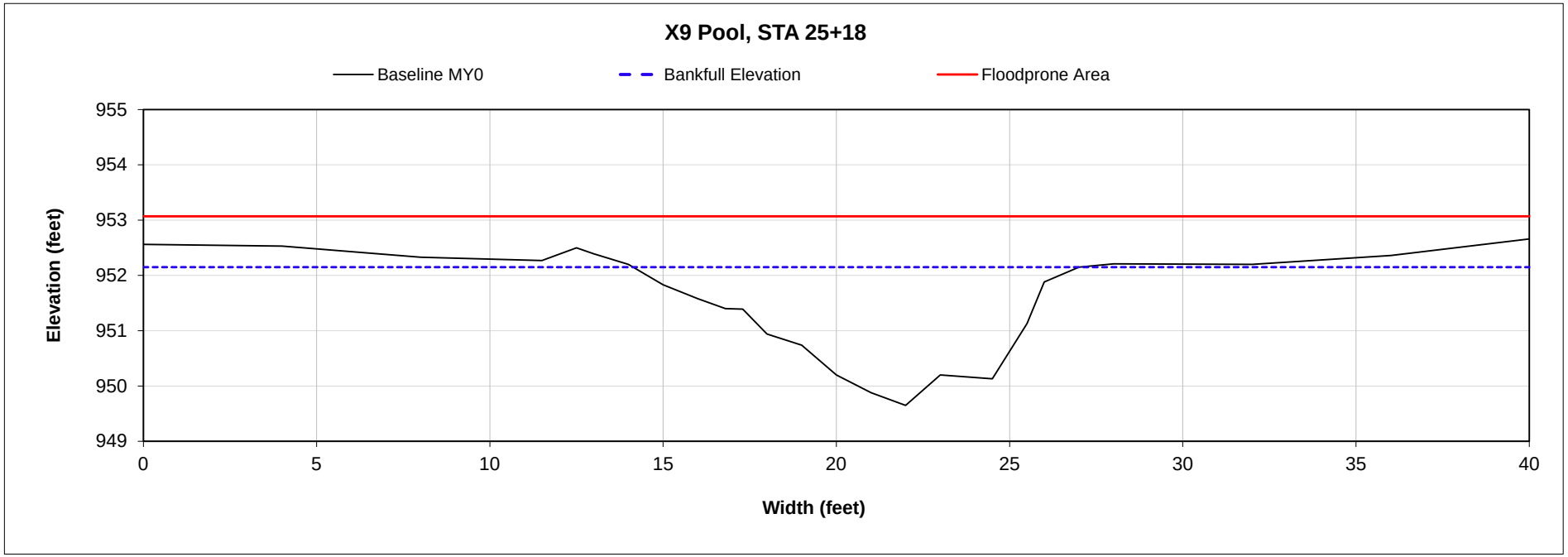
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-9
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	952.2
Low Bank Height Elevation (ft)	952.2
Bankfull Max Depth (ft)	2.5
Low Bank Height (ft)	2.5
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	16.8
% Change Bank Height Ratio	NA

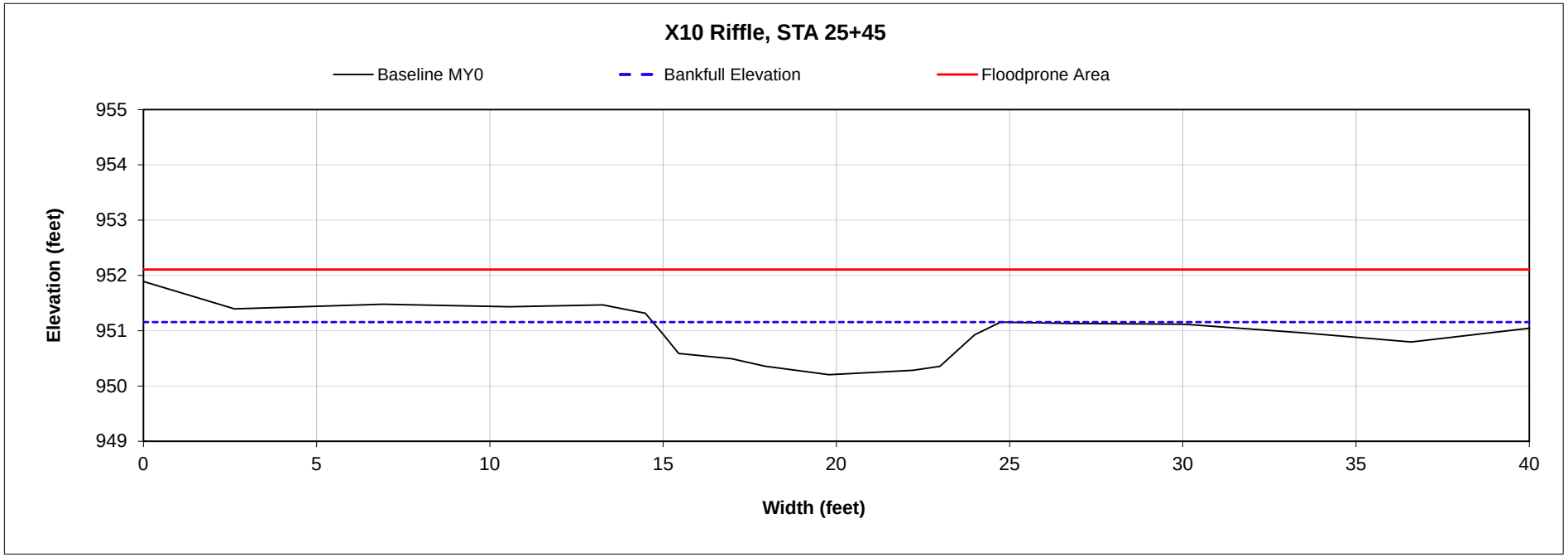
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-10
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	951.2
Low Bank Height Elevation (ft)	951.2
Bankfull Max Depth (ft)	1.0
Low Bank Height (ft)	1.0
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	6.9
% Change Bank Height Ratio	NA

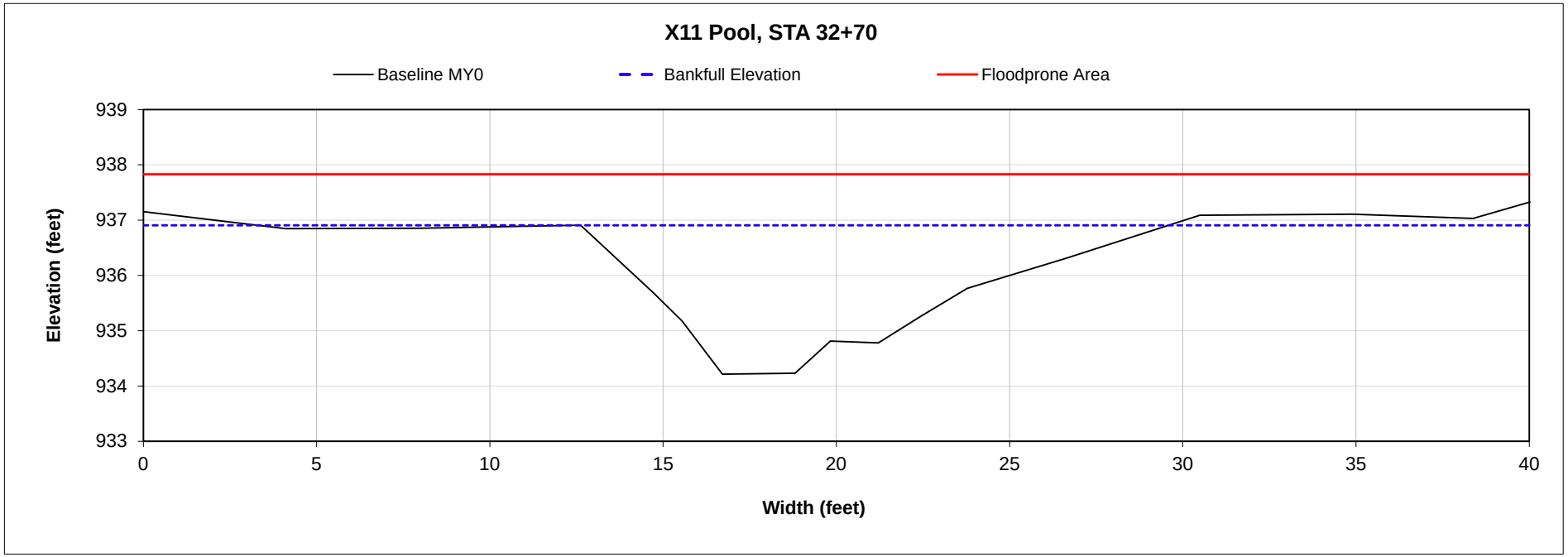
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-11
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	936.9
Low Bank Height Elevation (ft)	936.9
Bankfull Max Depth (ft)	2.7
Low Bank Height (ft)	2.7
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	23.6
% Change Bank Height Ratio	NA

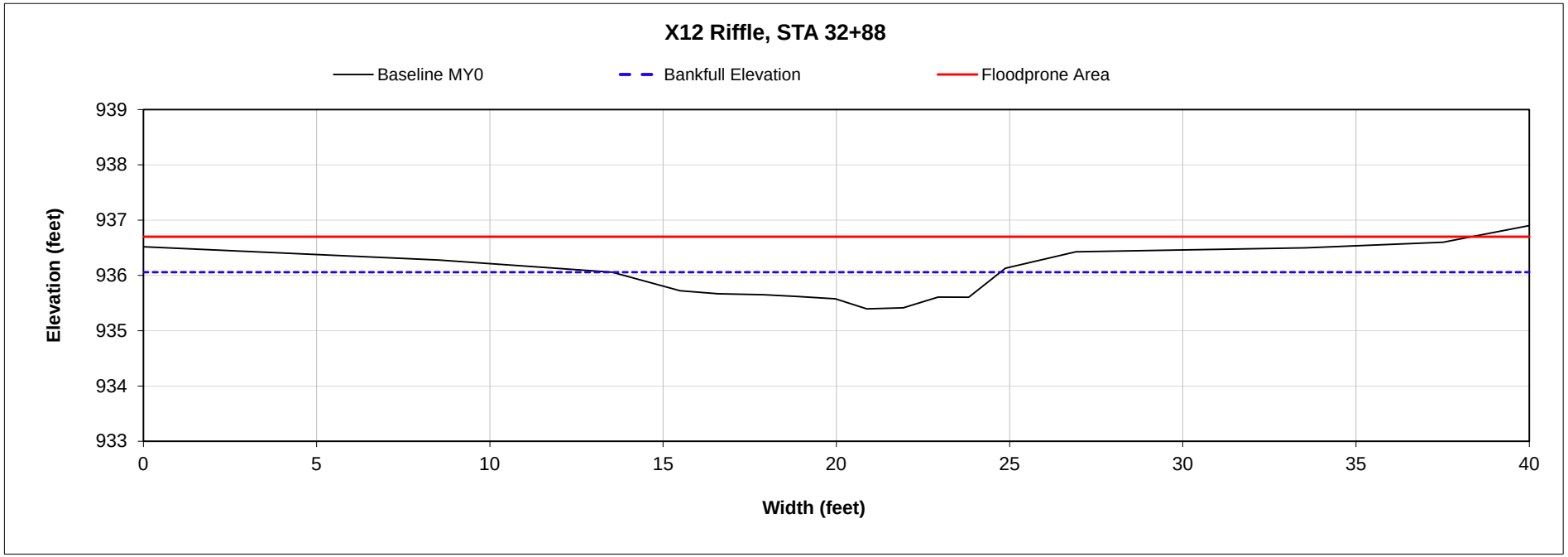
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-12
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	936.1
Low Bank Height Elevation (ft)	936.1
Bankfull Max Depth (ft)	0.7
Low Bank Height (ft)	0.7
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	4.5
% Change Bank Height Ratio	NA

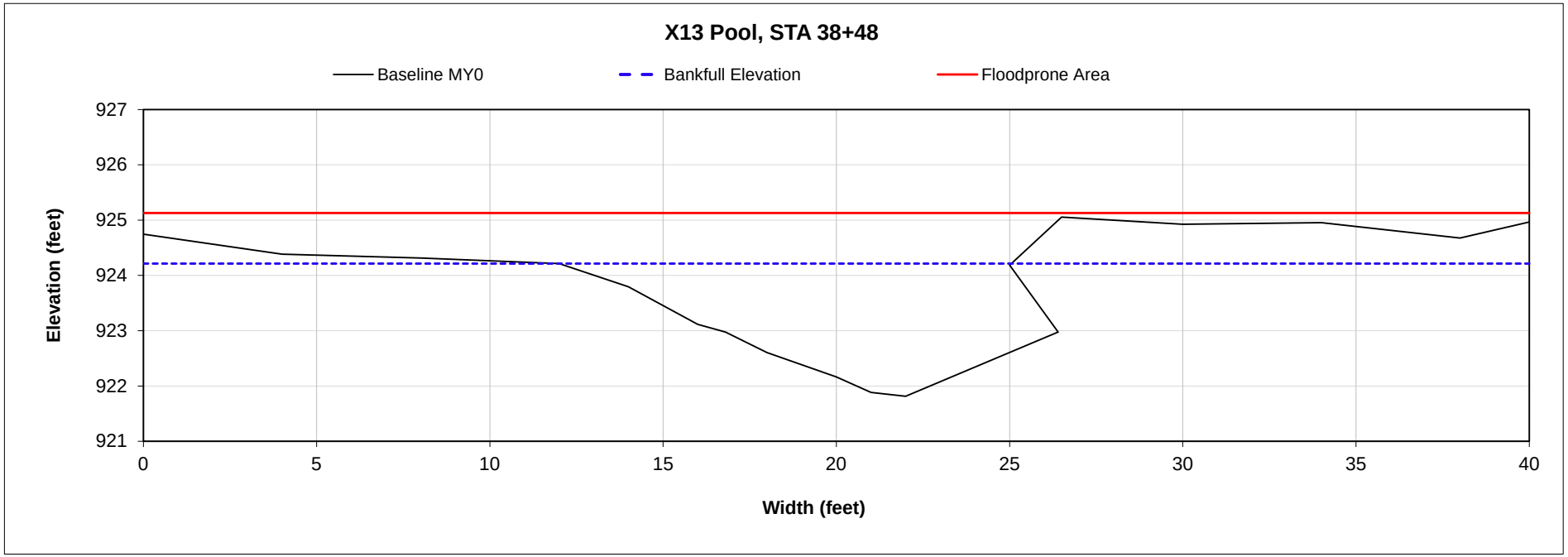
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-13
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	924.2
Low Bank Height Elevation (ft)	924.2
Bankfull Max Depth (ft)	2.4
Low Bank Height (ft)	2.4
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	19.9
% Change Bank Height Ratio	NA

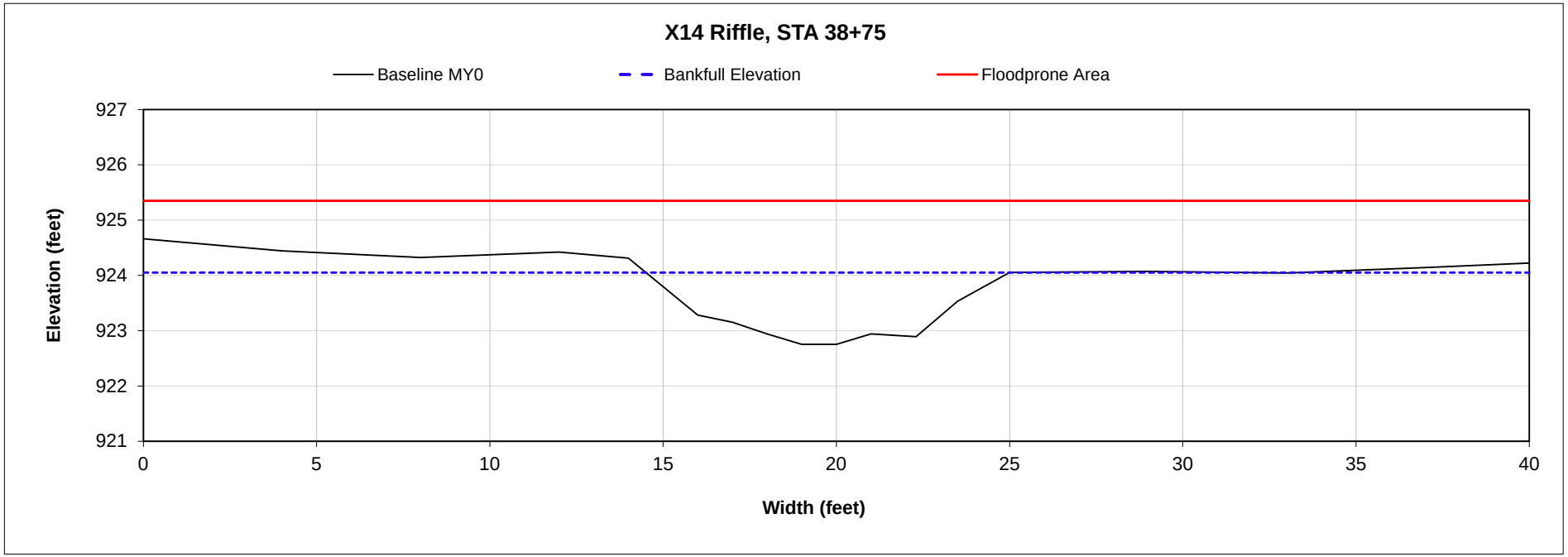
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-14
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	924.0
Low Bank Height Elevation (ft)	924.0
Bankfull Max Depth (ft)	1.2
Low Bank Height (ft)	1.2
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	8.4
% Change Bank Height Ratio	NA

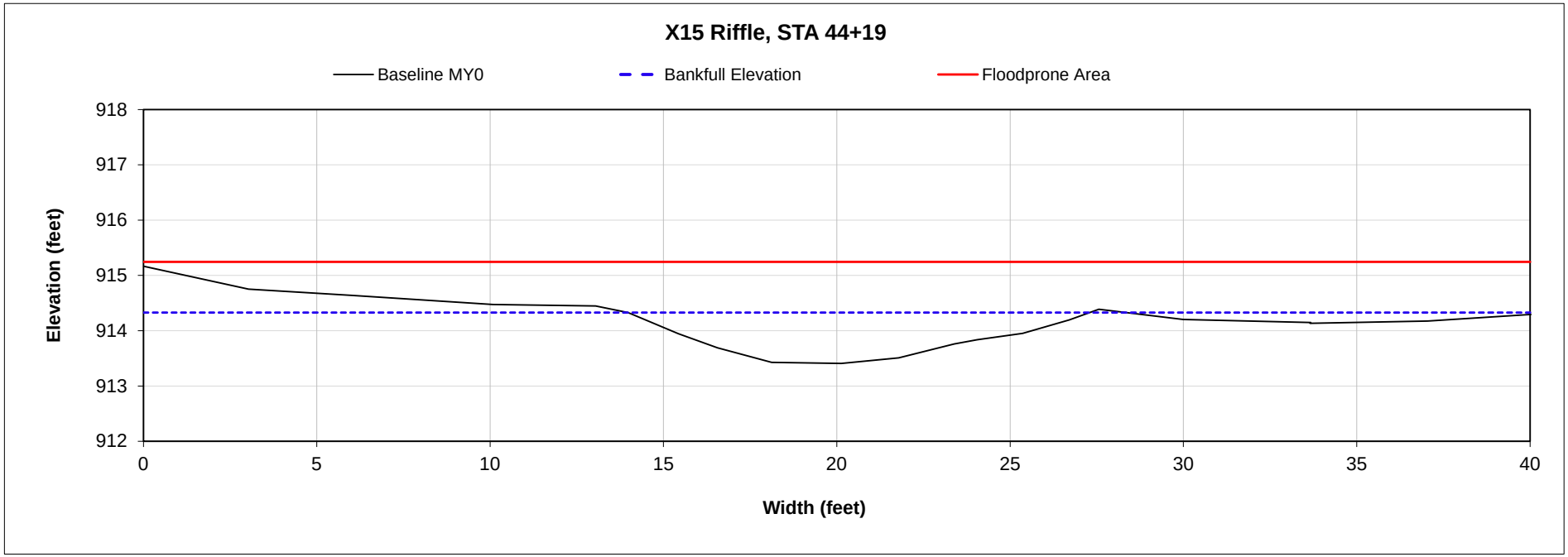
Looking Downstream



Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-15
Field Crew	K. Obermiller, E. Dunnigan

Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	914.3
Low Bank Height Elevation (ft)	914.3
Bankfull Max Depth (ft)	0.9
Low Bank Height (ft)	0.9
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	7.7
% Change Bank Height Ratio	NA

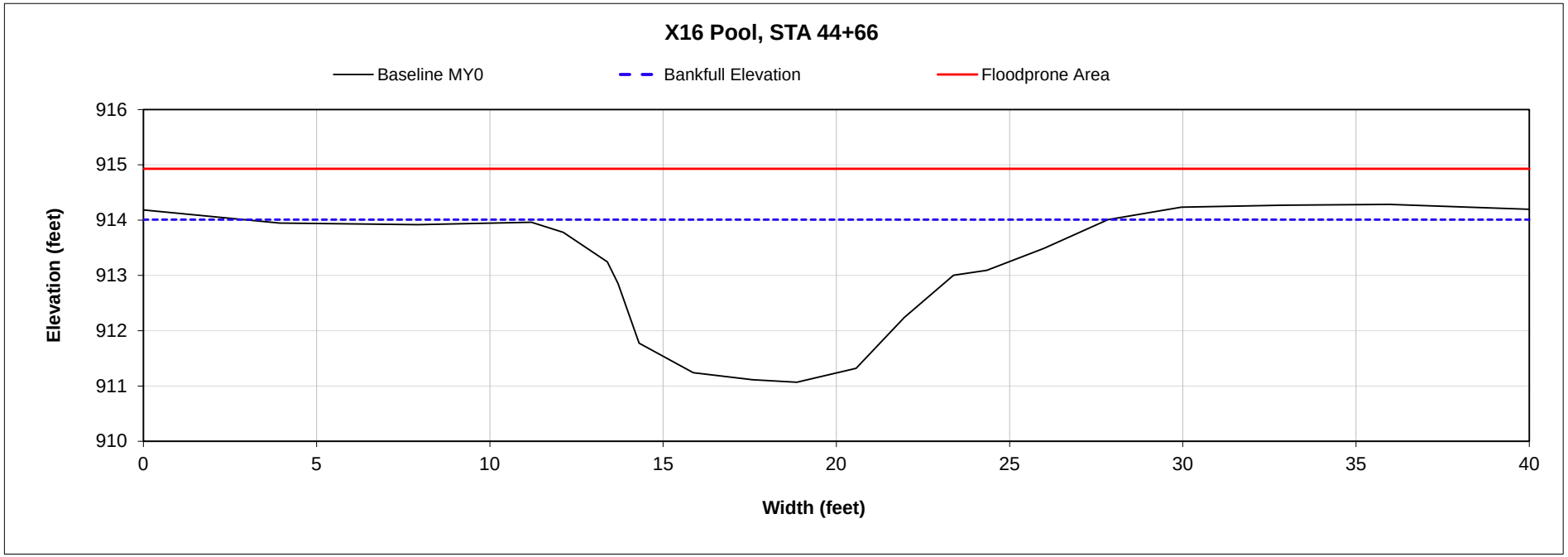
Looking Downstream

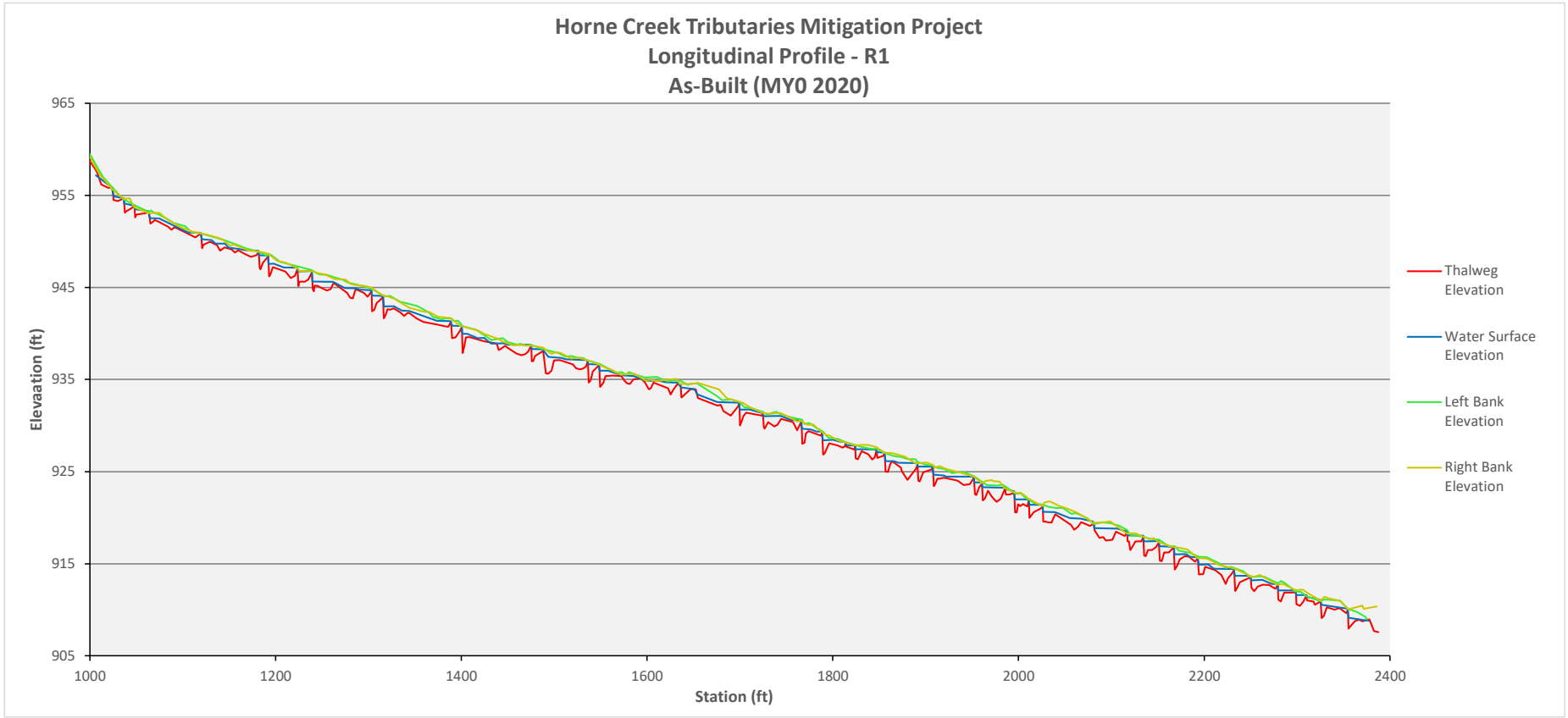


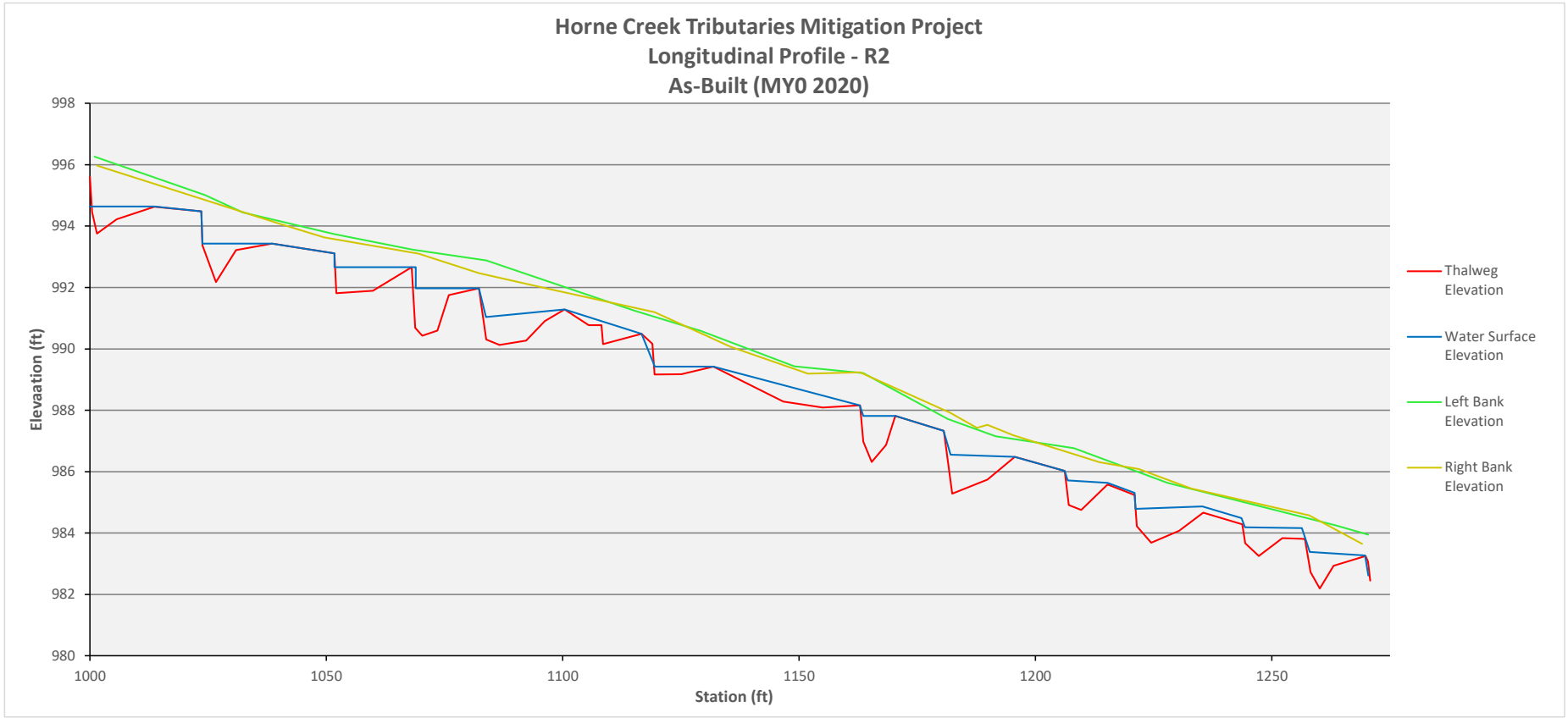
Project Name	Horne Creek Tributaries Mitigation Project
Project ID	100026
Reach ID	R5
Cross Section ID	XS-16
Field Crew	K. Obermiller, E. Dunnigan

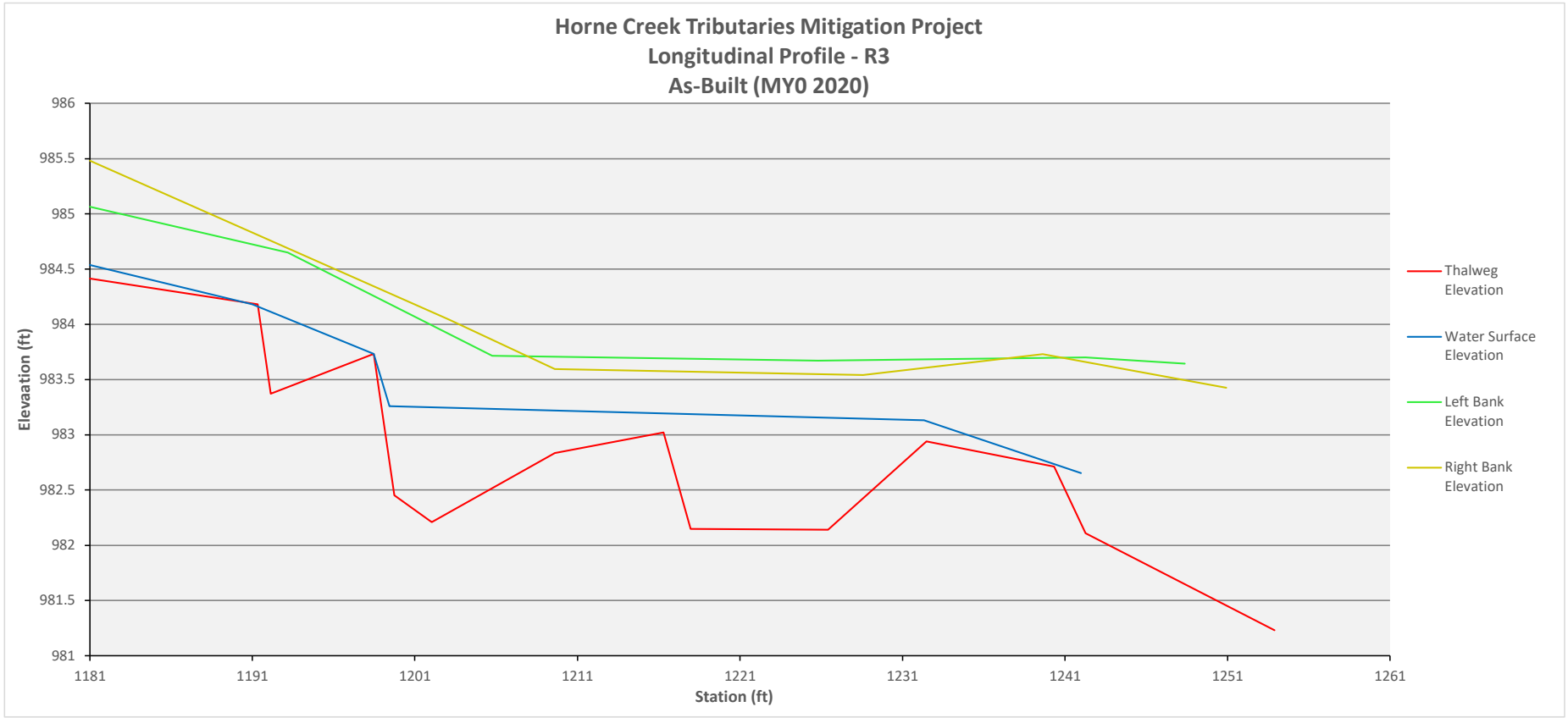
Dimension Data Summary: MY0 2020	
Bankfull Elevation (ft)	914.0
Low Bank Height Elevation (ft)	914.0
Bankfull Max Depth (ft)	2.9
Low Bank Height (ft)	2.9
Bank Height Ratio	1.0
Bankfull X-section Area (ft²)	27.1
% Change Bank Height Ratio	NA

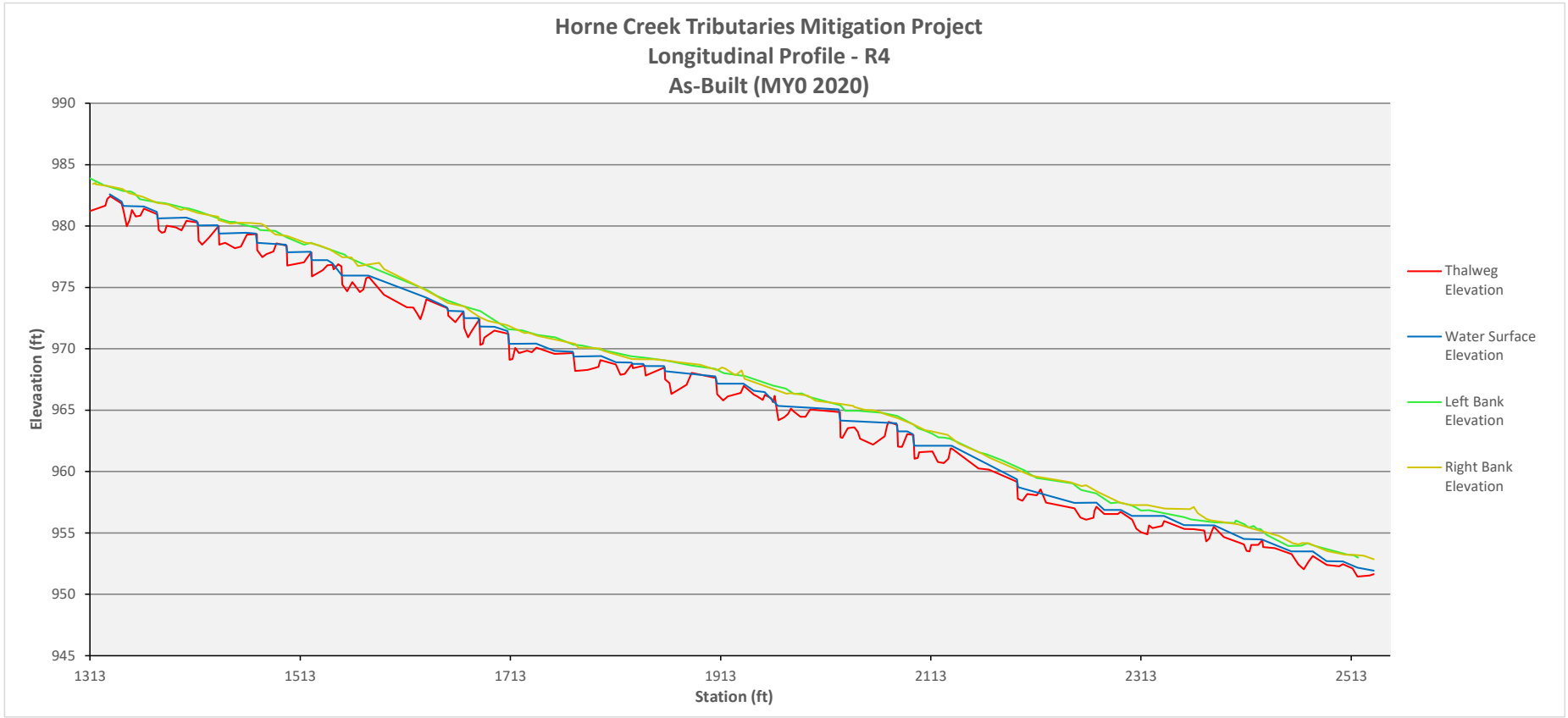
Looking Downstream

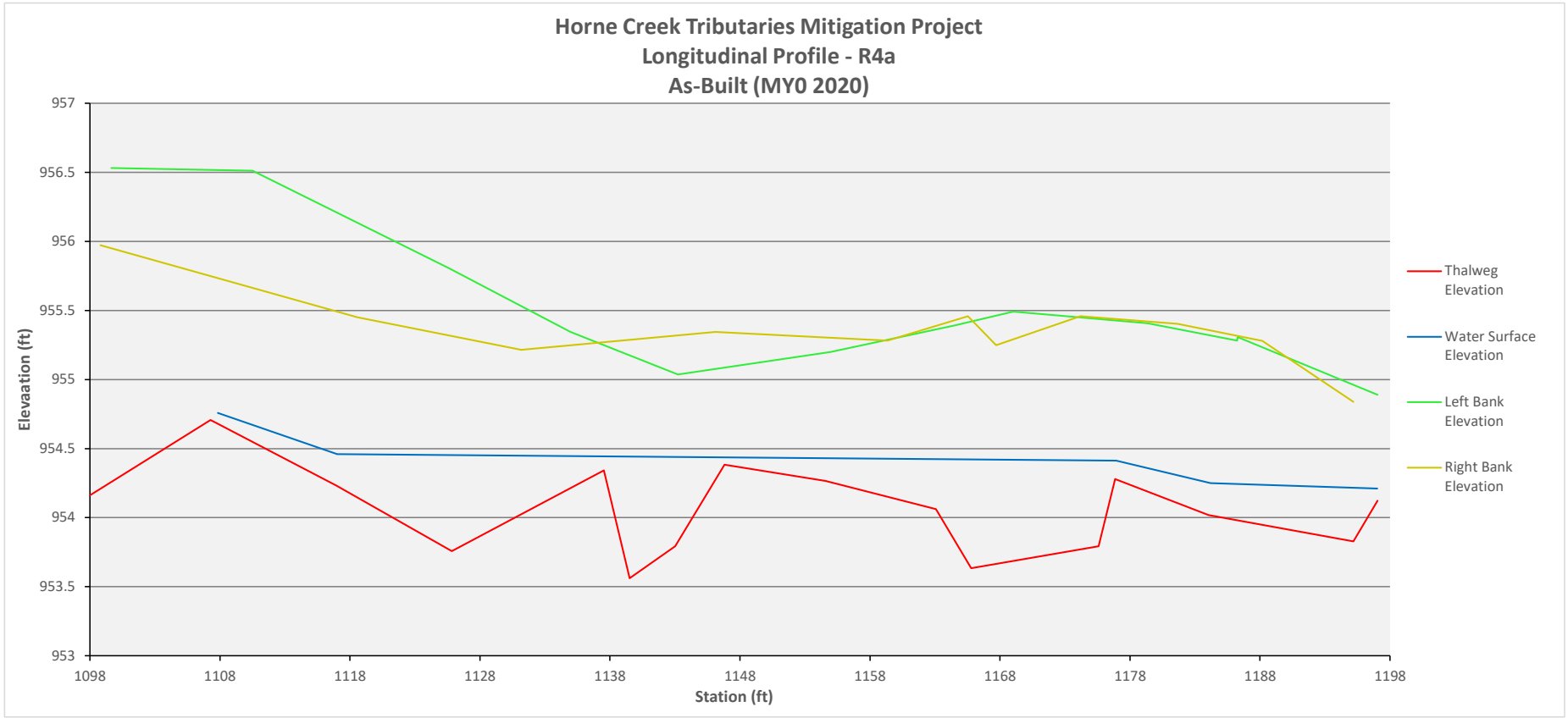


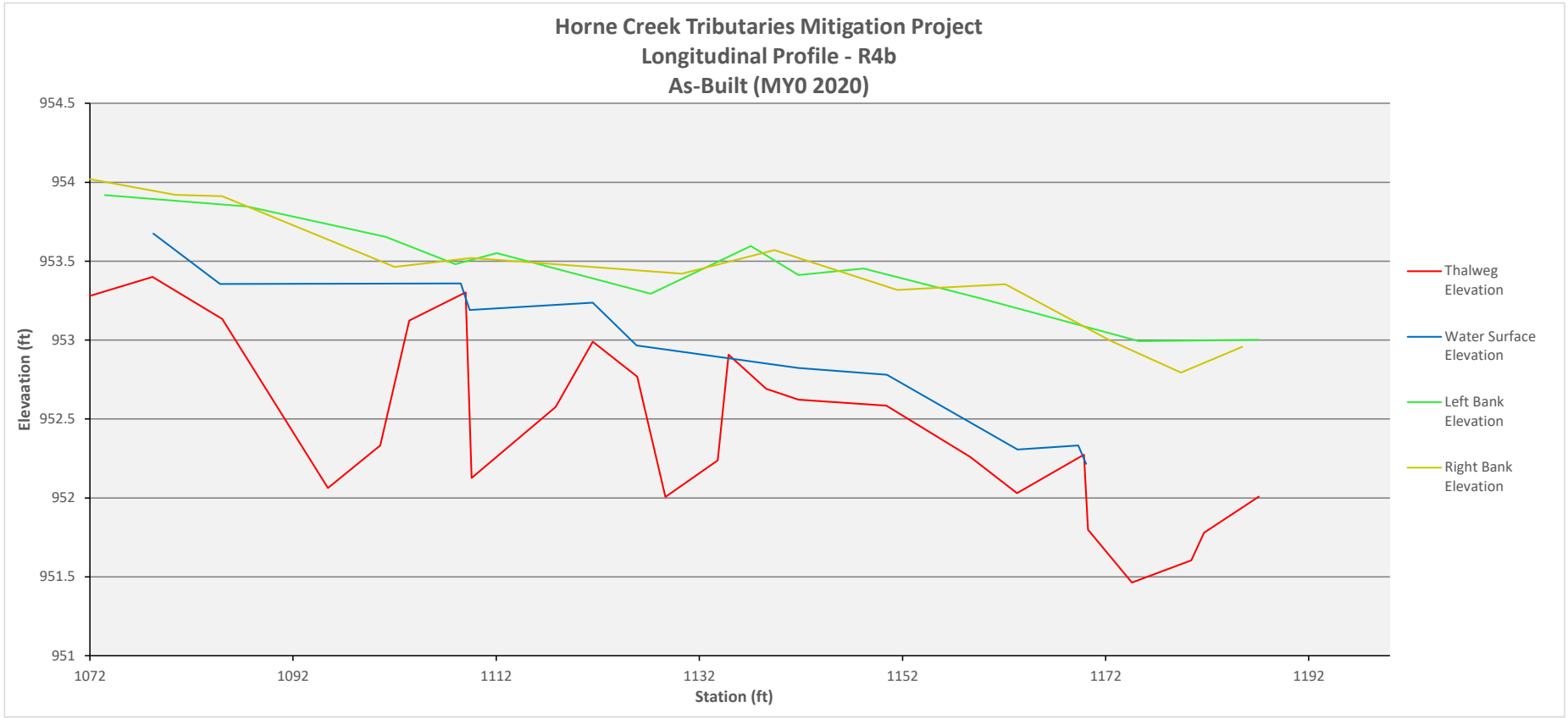

Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R1
As-Built (MY0 2020)
Elevation (ft)
965
955
945
935
925
915
905
1000
1200
1400
1600
1800
2000
2200
2400
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R2
As-Built (MY0 2020)
Elevation (ft)
998
996
994
992
990
988
986
984
982
980
1000
1050
1100
1150
1200
1250
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R3
As-Built (MY0 2020)
Elevation (ft)
986
985.5
985
984.5
984
983.5
983
982.5
982
981.5
981
1181
1191
1201
1211
1221
1231
1241
1251
1261
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R4
As-Built (MY0 2020)
990
985
980
975
970
965
960
955
950
945
Elevation (ft)
1313
1513
1713
1913
2113
2313
2513
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R4a
As-Built (MY0 2020)
Elevation (ft)
957
956.5
956
955.5
955
954.5
954
953.5
953
1098
1108
1118
1128
1138
1148
1158
1168
1178
1188
1198
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation


Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R4b
As-Built (MY0 2020)
954.5
954
953.5
953
952.5
952
951.5
951
Elevation (ft)
1072
1092
1112
1132
1152
1172
1192
Station (ft)
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation

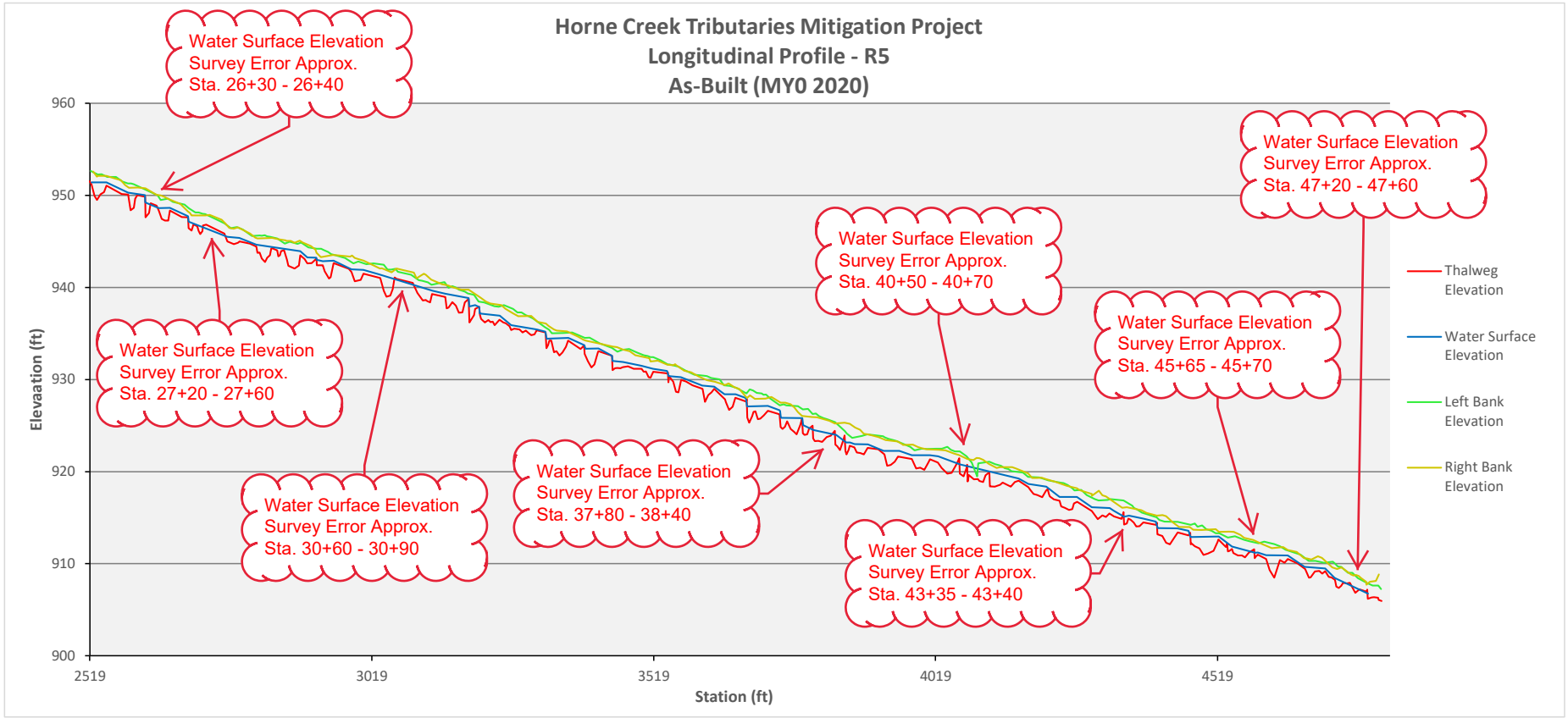

Horne Creek Tributaries Mitigation Project
Longitudinal Profile - R5
As-Built (MY0 2020)
Water Surface Elevation Survey Error Approx. Sta. 26+30 - 26+40
Water Surface Elevation Survey Error Approx. Sta. 27+20 - 27+60
Water Surface Elevation Survey Error Approx. Sta. 30+60 - 30+90
Water Surface Elevation Survey Error Approx. Sta. 37+80 - 38+40
Water Surface Elevation Survey Error Approx. Sta. 40+50 - 40+70
Water Surface Elevation Survey Error Approx. Sta. 43+35 - 43+40
Water Surface Elevation Survey Error Approx. Sta. 45+65 - 45+70
Water Surface Elevation Survey Error Approx. Sta. 47+20 - 47+60
Thalweg Elevation
Water Surface Elevation
Left Bank Elevation
Right Bank Elevation
Elevation (ft)
960
950
940
930
920
910
900
2519
3019
3519
4019
4519
Station (ft)

Table 6a. Baseline Stream Data Summary
Horne Creek Tributaries Mitigation Project

Parameter	Design		Baseline	
Reach ID: R1				
Dimension (Riffle)	Min	Max	Min	Max
Bankfull Width (ft)	-	7.0	6.2	7.6
Floodprone Width (ft)	28.0	65.0	23.9	34.5
Bankfull Mean Depth (ft)	-	0.4	0.4	0.5
Bankfull Max Depth (ft)	-	0.6	0.7	1.0
Bankfull Cross Sectional Area (ft^2)	-	2.9	2.6	3.9
Width/Depth Ratio	-	17.0	14.7	14.8
Entrenchment Ratio	4.0	9.3	3.9	4.5
Bank Height Ratio	-	1.0	1.0	1.0
Profile				
Riffle Length (ft)	10.0	20.0	10.7	26.1
Riffle Slope (ft/ft)	0.038	0.062	0.040	0.058
Pool Length (ft)	5.0	20.0	6.8	19.8
Pool Max Depth (ft)	0.8	1.4	0.9	1.9
Pool Spacing (ft)	10.5	35.0	10.8	35.5
Pattern				
Channel Beltwidth (ft)	24.5	56.0	12.4	24.3
Radius of Curvature (ft)	14.0	21.0	12.6	20.3
Rc:Bankfull Width (ft/ft)	2.0	3.0	2.0	2.7
Meander Wavelength (ft)	49.0	84.0	49.2	57.2
Meander Width Ratio	3.5	8.0	1.7	7.9
Transport Parameters				
Boundary Shear Stress (lb/ft^2)	0.79		0.84	
Max part size (mm) mobilized at bankfull	127.00		135.00	
Stream Power (W/m^2)	47.60		56.93	
Additional Reach Parameters				
Rosgen Classification	B4		B4	
Bankfull Velocity (fps)	4.2		4.6	
Bankfull Discharge (cfs)	12.0		12.0	
Sinuosity	1.07		1.12	
Water Surface Slope (Channel) (ft/ft)	0.037		0.037	
Bankfull Slope (ft/ft)	0.037		0.038	

Parameter	Design		Baseline	
Reach ID: R2				
Dimension (Riffle)	Min	Max	Min	Max
Bankfull Width (ft)	-	6.0	-	-
Floodprone Width (ft)	15.0	19.0	-	-
Bankfull Mean Depth (ft)	-	0.5	-	-
Bankfull Max Depth (ft)	-	0.6	-	-
Bankfull Cross Sectional Area (ft^2)	-	2.8	-	-
Width/Depth Ratio	-	13.1	-	-
Entrenchment Ratio	2.5	3.2	-	-
Bank Height Ratio	-	1.0	-	-
Profile				
Riffle Length (ft)	5.0	15.0	5.6	13.1
Riffle Slope (ft/ft)	0.033	0.054	0.047	0.073
Pool Length (ft)	5.0	15.0	8.6	15.3
Pool Max Depth (ft)	0.9	1.6	1.4	2.7
Pool Spacing (ft)	9.0	30.0	11.0	27.1
Pattern				
Channel Beltwidth (ft)	-	-	-	-
Radius of Curvature (ft)	-	-	-	-
Rc:Bankfull Width (ft/ft)	-	-	-	-
Meander Wavelength (ft)	-	-	-	-
Meander Width Ratio	-	-	-	-
Transport Parameters				
Boundary Shear Stress (lb/ft^2)	0.75		-	
Max part size (mm) mobilized at bankfull	123.00		-	
Stream Power (W/m^2)	43.31		-	
Additional Reach Parameters				
Rosgen Classification	B4		B4	
Bankfull Velocity (fps)	4.4		4.4	
Bankfull Discharge (cfs)	12.0		12.0	
Sinuosity	1.08		1.11	
Water Surface Slope (Channel) (ft/ft)	0.030		0.042	
Bankfull Slope (ft/ft)	0.030		0.046	

Parameter	Design		Baseline	
Reach ID: R4				
Dimension (Riffle)	Min	Max	Min	Max
Bankfull Width (ft)	-	9.0	7.9	9.6
Floodprone Width (ft)	38.0	79.0	59.0	70.0
Bankfull Mean Depth (ft)	-	0.6	0.5	0.5
Bankfull Max Depth (ft)	-	0.8	0.7	0.8
Bankfull Cross Sectional Area (ft^2)	-	5.2	3.7	5.1
Width/Depth Ratio	-	15.6	17.2	18.2
Entrenchment Ratio	4.2	8.8	4.2	5.0
Bank Height Ratio	-	1.0	1.0	1.0
Profile				
Riffle Length (ft)	10.0	30.0	11.5	33.2
Riffle Slope (ft/ft)	0.032	0.052	0.027	0.063
Pool Length (ft)	10.0	30.0	8.5	25.3
Pool Max Depth (ft)	1.2	2.0	1.4	2.6
Pool Spacing (ft)	13.5	45.0	20.6	57.9
Pattern				
Channel Beltwidth (ft)	31.5	72.0	31.7	48.2
Radius of Curvature (ft)	18.0	27.0	13.4	24.3
Rc:Bankfull Width (ft/ft)	2.0	3.0	1.7	2.5
Meander Wavelength (ft)	63.0	108.0	71.9	111.1
Meander Width Ratio	3.5	8.0	9.1	11.6
Transport Parameters				
Boundary Shear Stress (lb/ft^2)	0.93		0.75	
Max part size (mm) mobilized at bankfull	144.00		123.00	
Stream Power (W/m^2)	57.07		46.87	
Additional Reach Parameters				
Rosgen Classification	B4/C4b		B4/C4b	
Bankfull Velocity (fps)	4.2		4.3	
Bankfull Discharge (cfs)	22.00		22.0	
Sinuosity	1.31		1.32	
Water Surface Slope (Channel) (ft/ft)	0.029		0.025	
Bankfull Slope (ft/ft)	0.029		0.025	

Parameter	Design		Baseline	
Reach ID: R5				
Dimension (Riffle)	Min	Max	Min	Max
Bankfull Width (ft)	-	10.0	10.0	13.3
Floodprone Width (ft)	54.0	134.0	95.0	140.0
Bankfull Mean Depth (ft)	-	0.7	0.5	0.8
Bankfull Max Depth (ft)	-	0.9	0.7	1.2
Bankfull Cross Sectional Area (ft^2)	-	7.2	4.5	8.4
Width/Depth Ratio	-	13.9	14.5	27.7
Entrenchment Ratio	5.4	13.4	3.4	4.0
Bank Height Ratio	-	1.0	1.0	1.0
Profile				
Riffle Length (ft)	15.0	30.0	14.8	39.0
Riffle Slope (ft/ft)	0.030	0.040	0.015	0.043
Pool Length (ft)	15.0	35.0	16.1	41.9
Pool Max Depth (ft)	1.4	2.5	2.0	3.1
Pool Spacing (ft)	15.0	70.0	37.8	59.7
Pattern				
Channel Beltwidth (ft)	35.0	80.0	41.6	56.8
Radius of Curvature (ft)	20.0	30.0	19.3	29.9
Rc:Bankfull Width (ft/ft)	2.0	3.0	1.9	2.2
Meander Wavelength (ft)	70.0	120.0	81.8	107.6
Meander Width Ratio	3.5	8.0	7.6	10.5
Transport Parameters				
Boundary Shear Stress (lb/ft^2)	0.79		0.75	
Max part size (mm) mobilized at bankfull	128.00		123.00	
Stream Power (W/m^2)	43.10		42.77	
Additional Reach Parameters				
Rosgen Classification	C4		C4	
Bankfull Velocity (fps)	3.8		3.9	
Bankfull Discharge (cfs)	27.0		27.0	
Sinuosity	1.21		1.23	
Water Surface Slope (Channel) (ft/ft)	0.020		0.020	
Bankfull Slope (ft/ft)	0.020		0.020	

Table 6b. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)
Horne Creek Tributaries #100026

	Cross Section 1 (Pool)							Cross Section 2 (Riffle)							Cross Section 3 (Pool)							Cross Section 4 (Riffle)						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	8.9							7.6							7.9							6.2						
Floodprone Width (ft)	36.7							34.5							33.3							23.9						
Bankfull Mean Depth (ft)	1.2							0.5							1.2							0.4						
Bankfull Max Depth (ft)	2.1							1.0							1.9							0.7						
Bankfull Cross Sectional Area (ft^2)	11.1							3.9							9.6							2.6						
Bankfull Width/Depth Ratio	7.1							14.8							6.4							14.7						
Bankfull Entrenchment Ratio	4.1							4.5							4.2							3.9						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	N/a							N/a							N/a							N/a						
	Cross Section 5 (Riffle)							**Cross Section 6 (Pool)**							**Cross Section 7 (Pool)**							**Cross Section 8 (Riffle)**						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	7.9							9.6							9.4							9.6						
Floodprone Width (ft)	40.0							40.0							40.0							40.0						
Bankfull Mean Depth (ft)	0.5							1.2							1.3							0.5						
Bankfull Max Depth (ft)	0.7							2.2							2.7							0.8						
Bankfull Cross Sectional Area (ft^2)	3.7							11.6							12.4							5.1						
Bankfull Width/Depth Ratio	17.2							7.9							7.1							18.2						
Bankfull Entrenchment Ratio	5.0							4.2							4.3							4.2						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	N/a							N/a							N/a							N/a						
	Cross Section 9 (Pool)							**Cross Section 10 (Riffle)**							**Cross Section 11 (Pool)**							**Cross Section 12 (Riffle)**						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	12.9							10.0							17.0							11.2						
Floodprone Width (ft)	40.0							40.0							40.0							38.5						
Bankfull Mean Depth (ft)	1.3							0.7							1.4							0.5						
Bankfull Max Depth (ft)	2.5							1.0							2.7							0.7						
Bankfull Cross Sectional Area (ft^2)	16.8							6.9							23.6							4.5						
Bankfull Width/Depth Ratio	9.8							14.5							12.2							27.7						
Bankfull Entrenchment Ratio	3.1							4.0							2.4							3.4						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	N/a							N/a							N/a							N/a						
	Cross Section 13 (Pool)							**Cross Section 14 (Riffle)**							**Cross Section 15 (Riffle)**							**Cross Section 16 (Pool)**						
Parameters	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	13.0							10.2							13.3							16.6						
Floodprone Width (ft)	40.0							40.0							40.0							40.0						
Bankfull Mean Depth (ft)	1.5							0.8							0.6							1.6						
Bankfull Max Depth (ft)	2.4							1.2							0.9							2.9						
Bankfull Cross Sectional Area (ft^2)	19.9							8.4							7.7							27.1						
Bankfull Width/Depth Ratio	8.5							2.4							22.9							10.2						
Bankfull Entrenchment Ratio	3.1							3.9							3.0							2.4						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
d50 (mm)	N/a							N/a							N/a							N/a						

Table 6c. Monitoring Data - Stream Reach Summary
Horne Creek Tributaries Mitigation Project

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5+	
Reach ID: R1												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	10.7	26.1										
Riffle Slope (ft/ft)	0.0395	0.0582										
Pool Length (ft)	6.8	19.8										
Pool Max depth (ft)	0.9	1.9										
Pool Spacing (ft)	10.8	35.5										
Pattern												
Channel Beltwidth (ft)	12.4	24.3										
Radius of Curvature (ft)	12.6	20.3										
Rc:Bankfull width (ft/ft)	2.0	2.7										
Meander Wavelength (ft)	49.2	57.2										
Meander Width Ratio	1.7	7.9										
Additional Reach Parameters												
Rosgen Classification	B4											
Sinuosity (ft)	1.12											
Water Surface Slope (Channel) (ft/ft)	0.0368											
BF slope (ft/ft)	0.038											
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations from baseline conditions

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5+	
Reach ID: R2												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	5.6	13.1										
Riffle Slope (ft/ft)	0.0473	0.0725										
Pool Length (ft)	8.6	15.3										
Pool Max depth (ft)	1.4	2.7										
Pool Spacing (ft)	11.0	27.1										
Pattern												
Channel Beltwidth (ft)	-	-										
Radius of Curvature (ft)	-	-										
Rc:Bankfull width (ft/ft)	-	-										
Meander Wavelength (ft)	-	-										
Meander Width Ratio	-	-										
Additional Reach Parameters												
Rosgen Classification	B4											
Sinuosity (ft)	1.11											
Water Surface Slope (Channel) (ft/ft)	0.0423											
BF slope (ft/ft)	0.0457											
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5+	
Reach ID: R4												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	11.5	33.2										
Riffle Slope (ft/ft)	0.0273	0.0628										
Pool Length (ft)	8.5	25.3										
Pool Max depth (ft)	1.4	2.6										
Pool Spacing (ft)	20.6	57.9										
Pattern												
Channel Beltwidth (ft)	31.7	48.2										
Radius of Curvature (ft)	13.4	24.3										
Rc:Bankfull width (ft/ft)	1.7	2.5										
Meander Wavelength (ft)	71.9	111.1										
Meander Width Ratio	9.1	11.6										
Additional Reach Parameters												
Rosgen Classification	B4/C4b											
Sinuosity (ft)	1.32											
Water Surface Slope (Channel) (ft/ft)	0.0250											
BF slope (ft/ft)	0.0254											
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile

Parameter	Baseline		MY1		MY2		MY3		MY4		MY5+	
Reach ID: R5												
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Profile												
Riffle Length (ft)	14.8	39.0										
Riffle Slope (ft/ft)	0.01547	0.04344										
Pool Length (ft)	16.1	41.9										
Pool Max depth (ft)	2.0	3.1										
Pool Spacing (ft)	37.8	59.7										
Pattern												
Channel Beltwidth (ft)	41.6	56.8										
Radius of Curvature (ft)	19.3	29.9										
Rc:Bankfull width (ft/ft)	1.9	2.2										
Meander Wavelength (ft)	81.8	107.6										
Meander Width Ratio	7.6	10.5										
Additional Reach Parameters												
Rosgen Classification	C4											
Sinuosity (ft)	1.23											
Water Surface Slope (Channel) (ft/ft)	0.0198											
BF slope (ft/ft)	0.01984											
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Pattern and Profile data will not typically be collected unless visual data, dimensional data or profile data indicate significant deviations

Appendix E: As-Built Survey/Record Drawings

DEPARTMENT OF ENVIRONMENTAL QUALITY - DIVISION OF MITIGATION SERVICES

HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NORTH CAROLINA

NCDEQ - DMS PROJECT ID # 100026
NCDEQ - DMS CONTRACT #7181 UNDER RFP 16-006993
YADKIN RIVER BASIN (CU 03040101)
USACE ACTION ID # SAW-2017-01510
TYPE OF WORK : STREAM MITIGATION

CERTIFICATE OF AS-BUILT SURVEY AND ACCURACY

I, CHRISTOPHER L. COLE, CERTIFY THAT THIS MAP WAS DRAWN UNDER MY SUPERVISION AND THAT THIS GROUND SURVEY WAS PERFORMED AT THE 90% CONFIDENCE LEVEL TO MEET FEDERAL GEOGRAPHIC DATA COMMITTEE STANDARDS; THAT THIS SURVEY WAS PERFORMED TO MEET THE REQUIREMENTS FOR A TOPOGRAPHIC/PLANIMETRIC SURVEY TO THE ACCURACY OF CLASS "A" AND VERTICAL ACCURACY WHEN APPLICABLE TO THE CLASS "A" STANDARD, AND THAT THE ORIGINAL DATA WAS OBTAINED BEFORE 6/27/2020; THAT THE SURVEY WAS COMPLETED BEFORE 6/27/2020; THAT CONTOURS SHOWN AS [BROKEN LINES] MAY NOT MEET THE STATED STANDARD; AND ALL COORDINATES ARE BASED ON 'NAD 83/2011 AND ELEVATIONS ARE BASED ON NAVD88/GEOID I 2A.

(1) CLASS OF SURVEY: A
(2) POSITIONAL ACCURACY: 0.07'
(3) TYPE OF GPS FIELD PROCEDURE: RTK/VRS
(4) DATES OF SURVEY: 6/27/2020
(5) DATUM/EPOCH: NAD83/2011
(6) GEOID: 12A
(7) COMBINED GRID FACTOR: 0.99999453
(8) UNITS: US SURVEY FEET
(9) CORS STATION: NCNW NCST DOBS

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS THE 4th DAY OF August

OFFICIAL SEAL

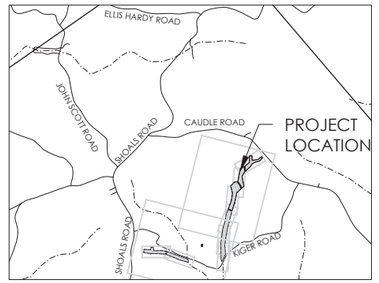
NORTH CAROLINA PROFESSIONAL SEAL L-5008 LAND SURVEYOR CHRISTOPHER L. COLE

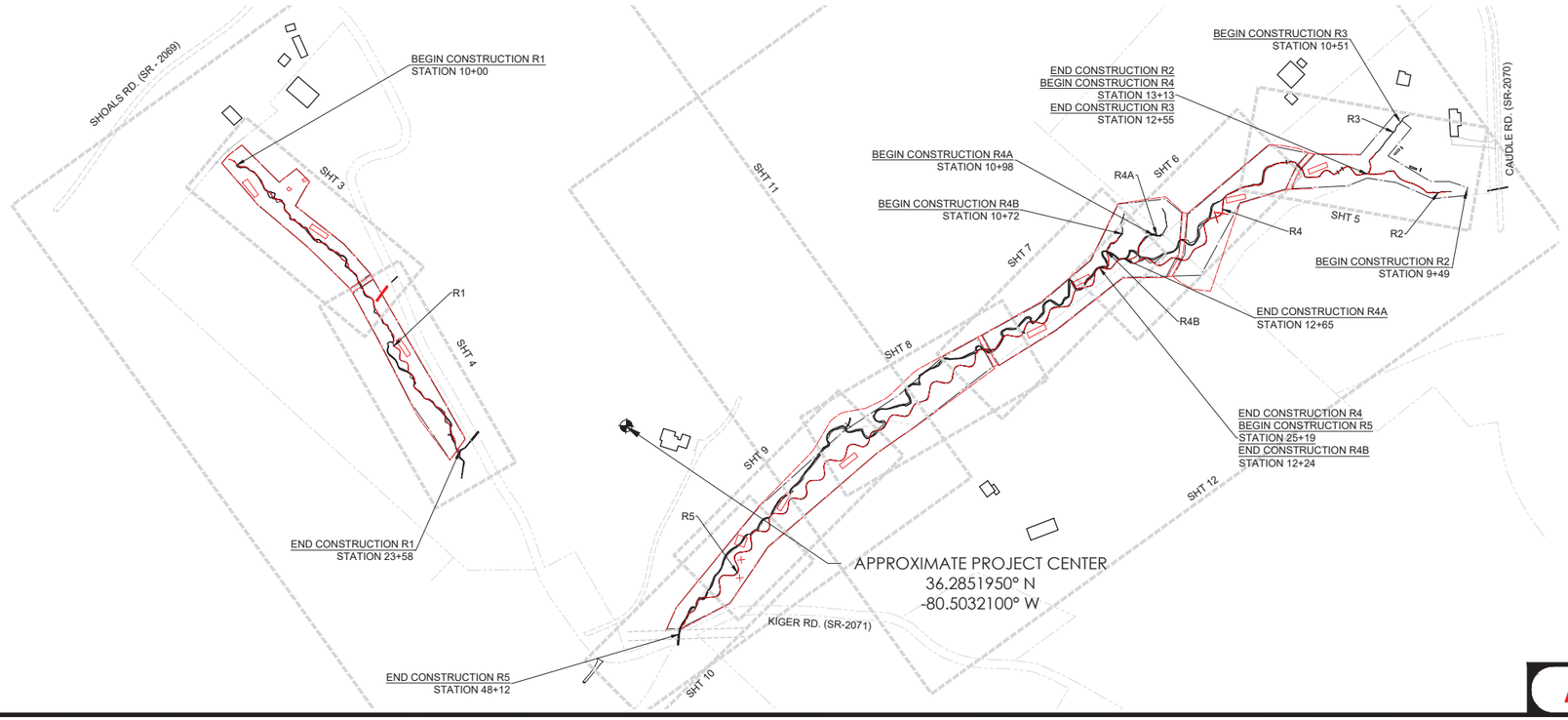
Christopher L. Cole
CHRISTOPHER L. COLE, NCPLS L-5008

SHEET INDEX

VICINITY MAP

N.T.S.





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REVISIONS

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A	DRAFT MIT PLAN	12-13-18
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E	AS-BUILT PLANS(FOR REVIEW ONLY)	7-2-20
F	FINAL AS-BUILT PLAN	8-3-20

PROJECT NAME

HORNE CREEK TRIBUTARIES MITIGATION PROJECT
SURRY COUNTY, NC

DRAWING INFORMATION

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DRAWN BY :	APL
DATE :	8-3-20
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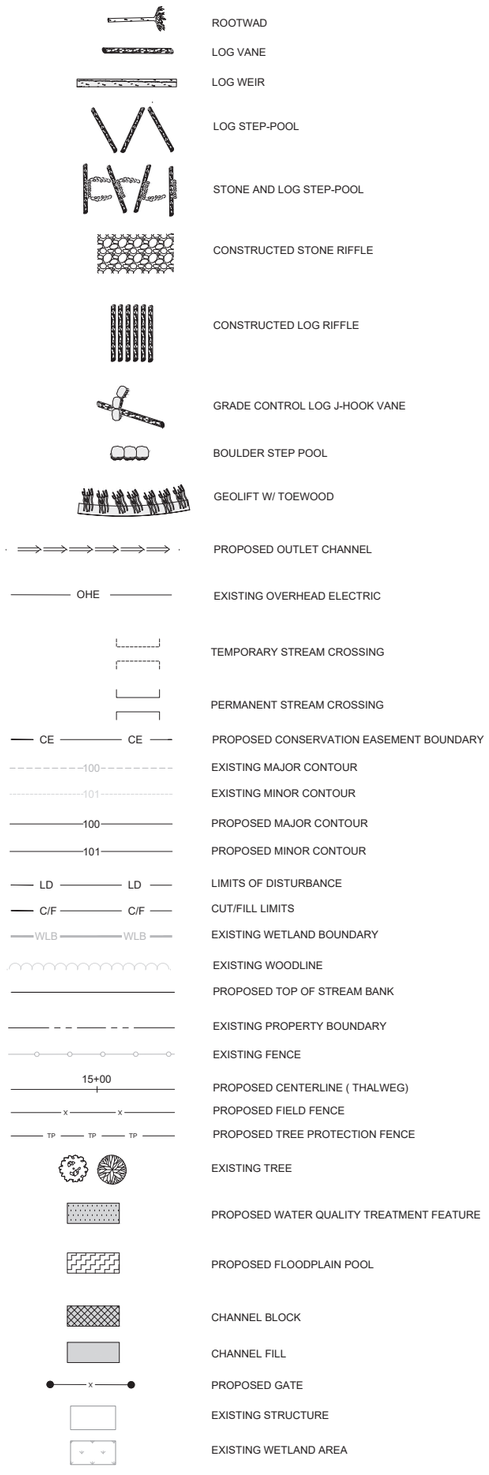

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PROJECT NAME

HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

DRAWING INFORMATION

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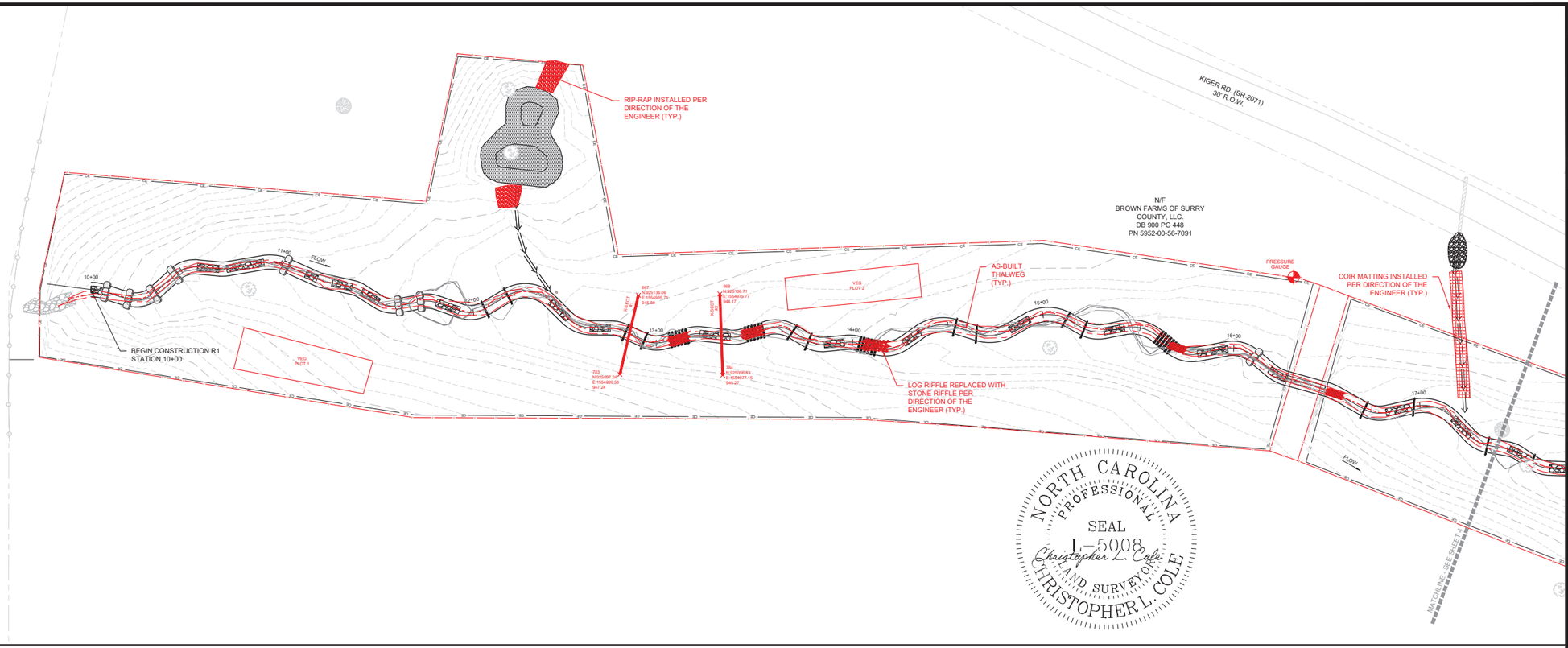

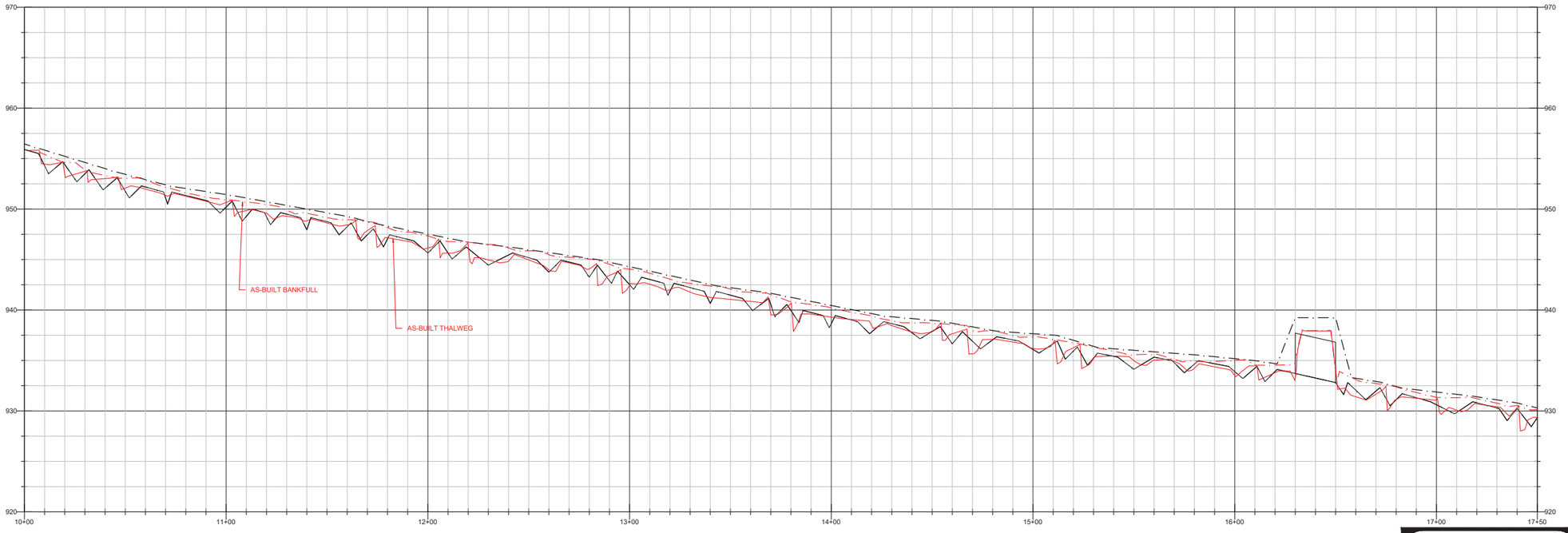

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HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

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PLAN AND PROFILE

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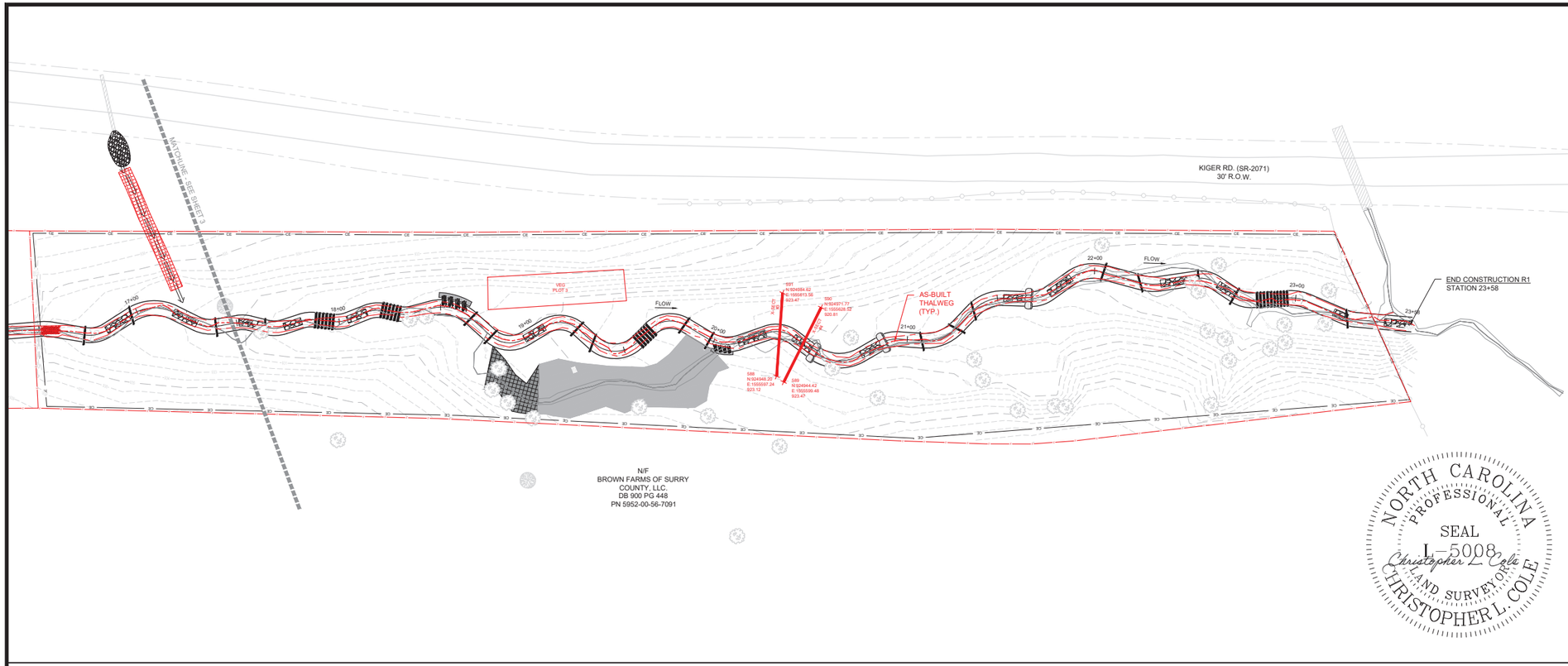

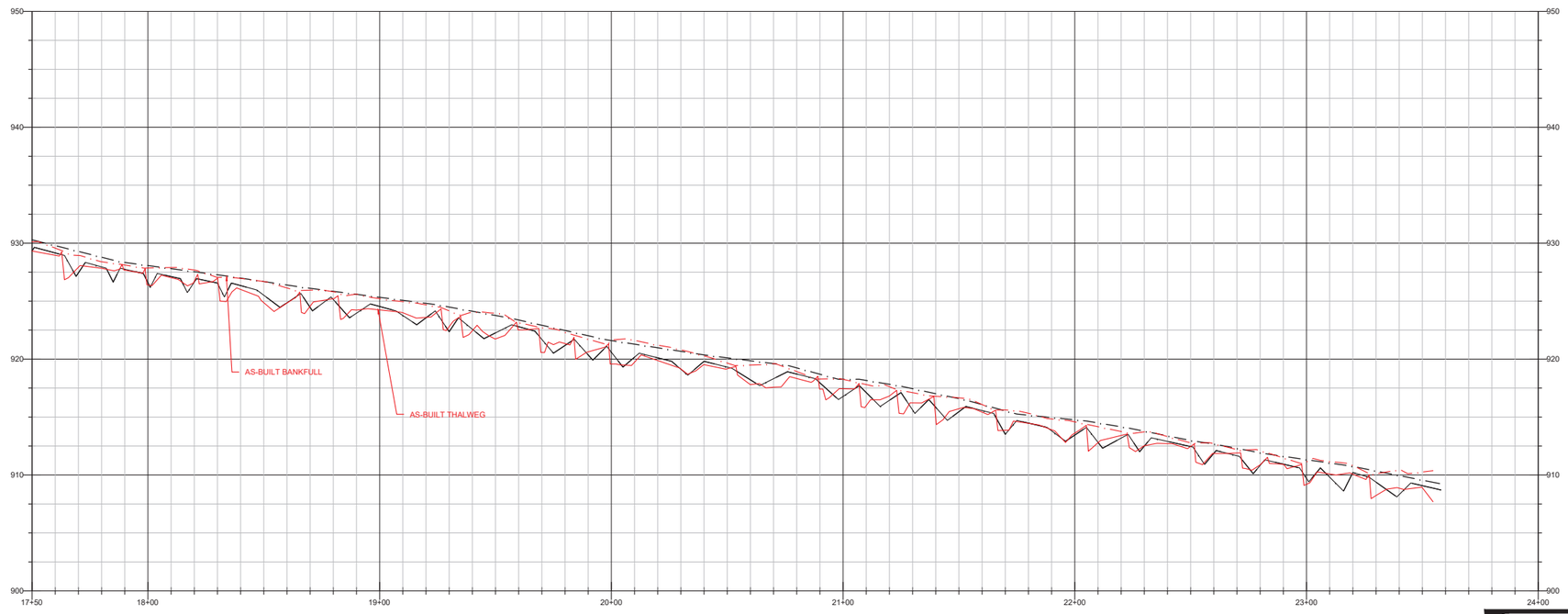

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PROJECT NAME

HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

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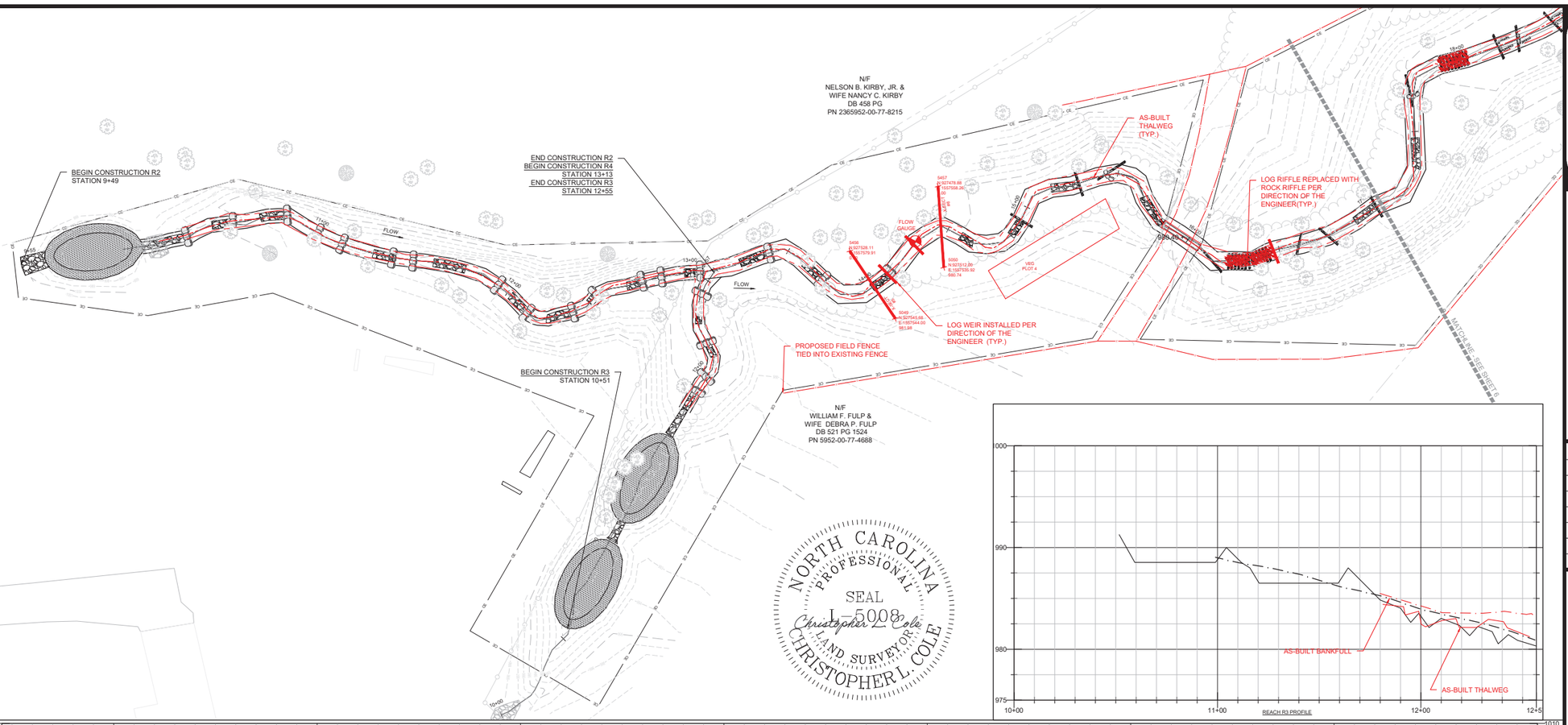

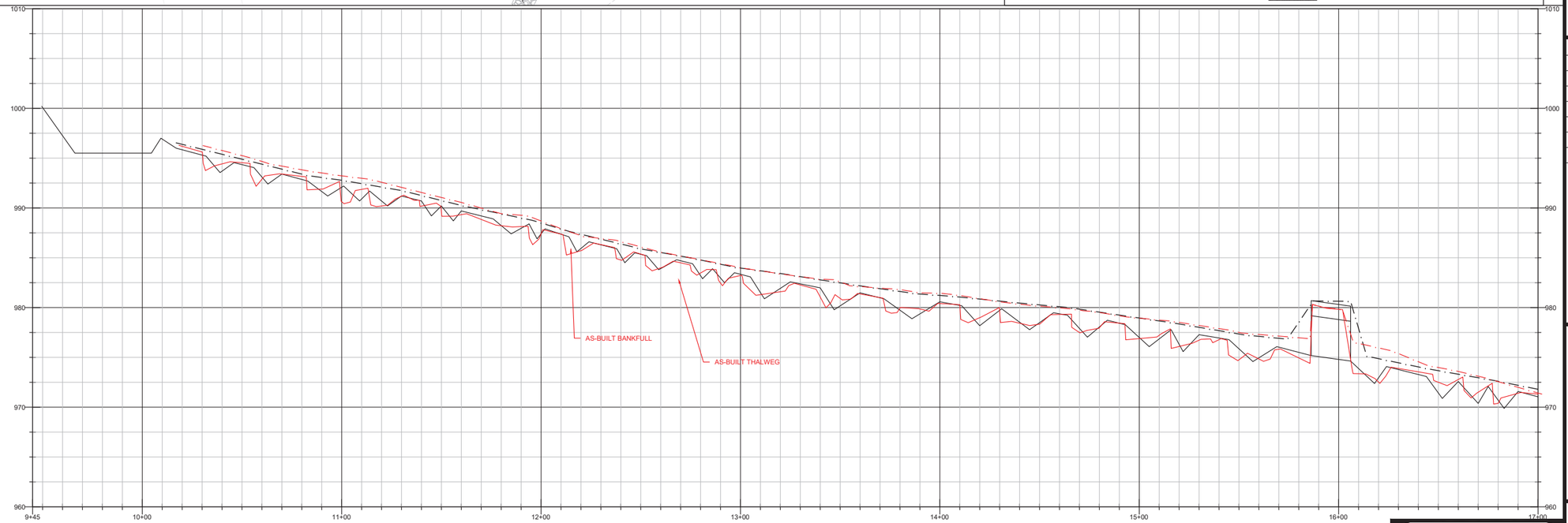

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HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

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DRAWN BY :	CAT/APL
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PLAN AND PROFILE

SHEET NUMBER

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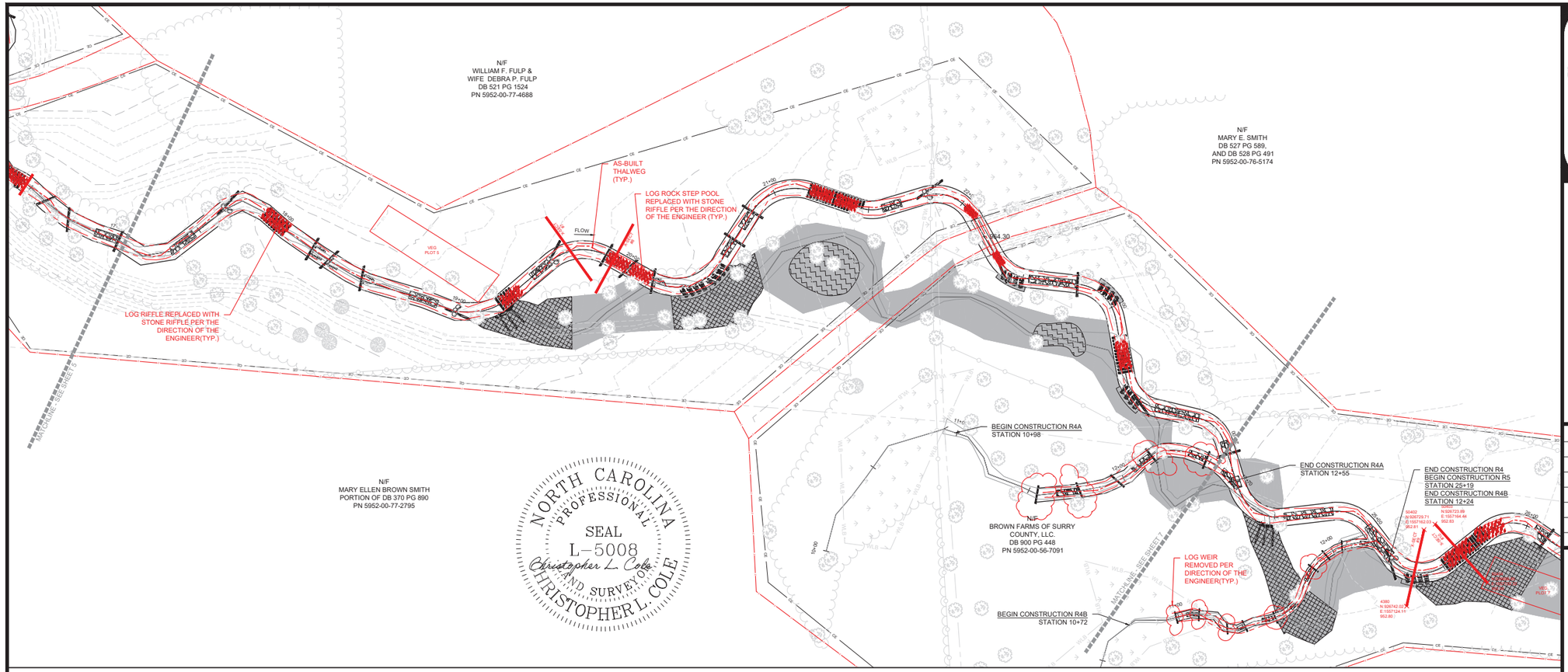

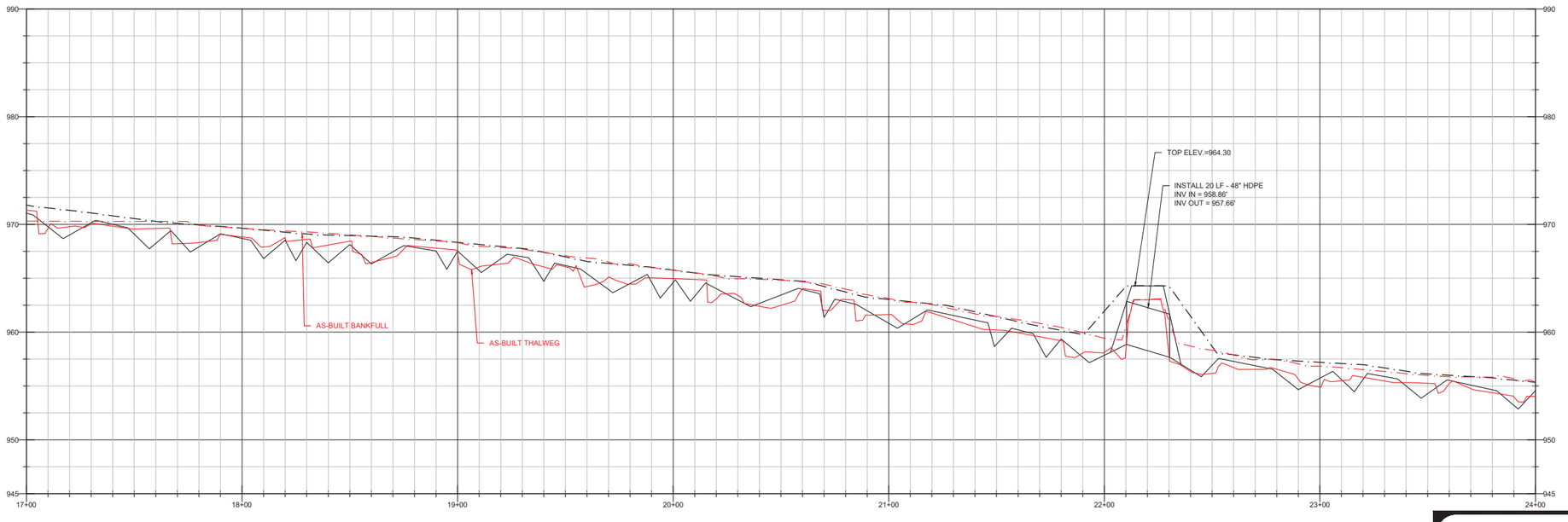

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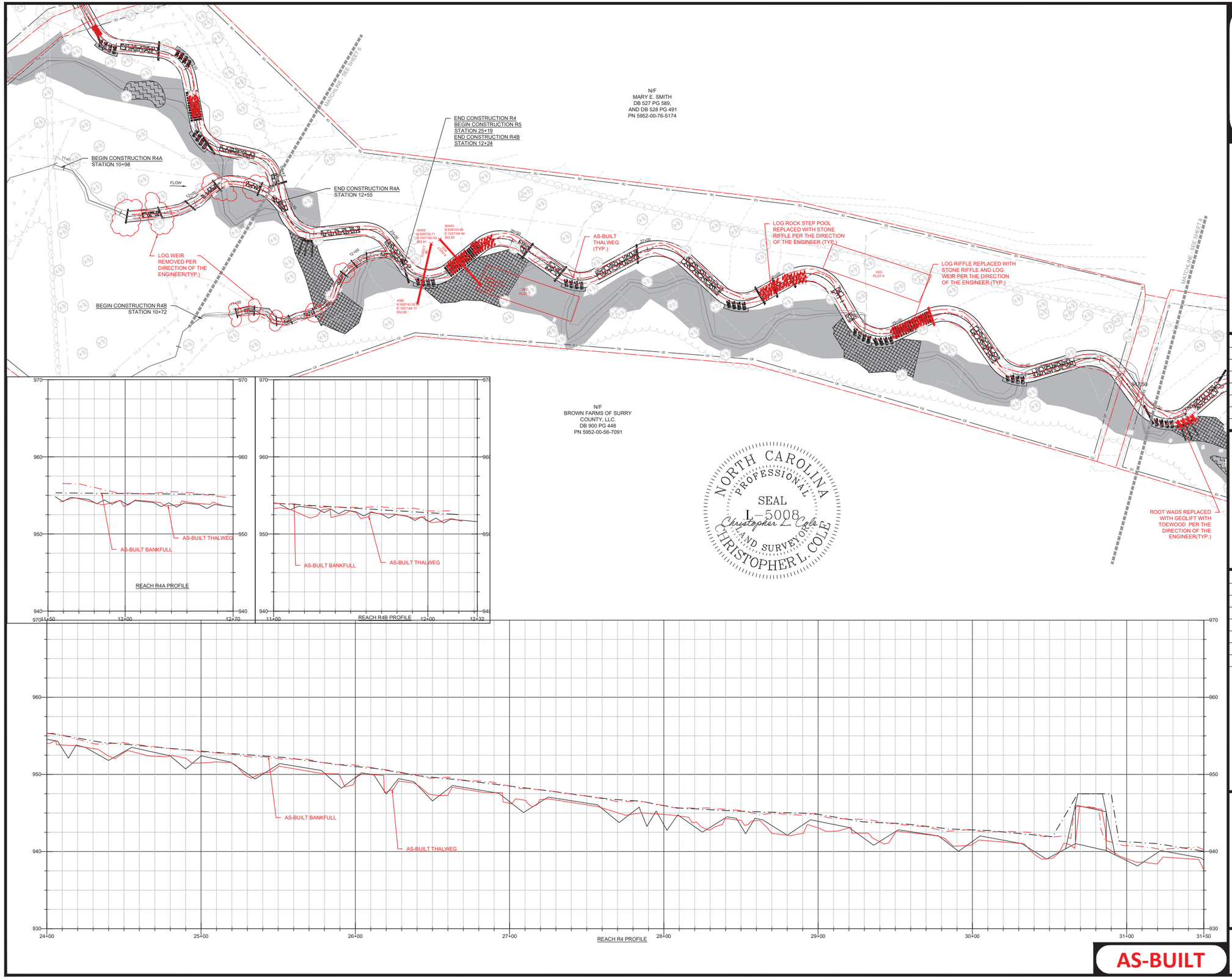

NORTH CAROLINA PROFESSIONAL SEAL L-5008 CHRISTOPHER L. COLE LAND SURVEYOR

WATER & LAND SOLUTIONS
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Raleigh, NC 27614
(919)614-5111
waterlandsolutions.com

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 8/3/2020
DocuSigned by: Chris Tomsic BA3E3C1BF67B48F...
CHRISTOPHER A. TOMSIC

ENGINEERING SERVICES BY
WLS ENGINEERING, PLLC
FIRM LICENSE NO. P-1480

REVISIONS

NO.		DATE
A	DRAFT MIT PLAN	12-13-18
B	DRAFT FINAL MIT PLAN	5-8-19
C	FINAL MIT PLAN	7-26-19
D	IFC PLANS	2-2-20
E	AS-BUILT PLANS(FOR REVIEW ONLY)	7-2-20
F	FINAL AS-BUILT PLAN	8-3-20

PROJECT NAME

HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

DRAWING INFORMATION

PROJECT NO. :	100026
FILENAME :	ASB_03-10_HORNE CREEK_PP_SHEETS.DWG
DESIGNED BY :	CAT
DRAWN BY :	CAT/APL
DATE :	8-3-20
HORIZ. SCALE :	1" = 60'
VERT. SCALE :	1" = 12'

30 15 0 30 60
GRAPHIC SCALE

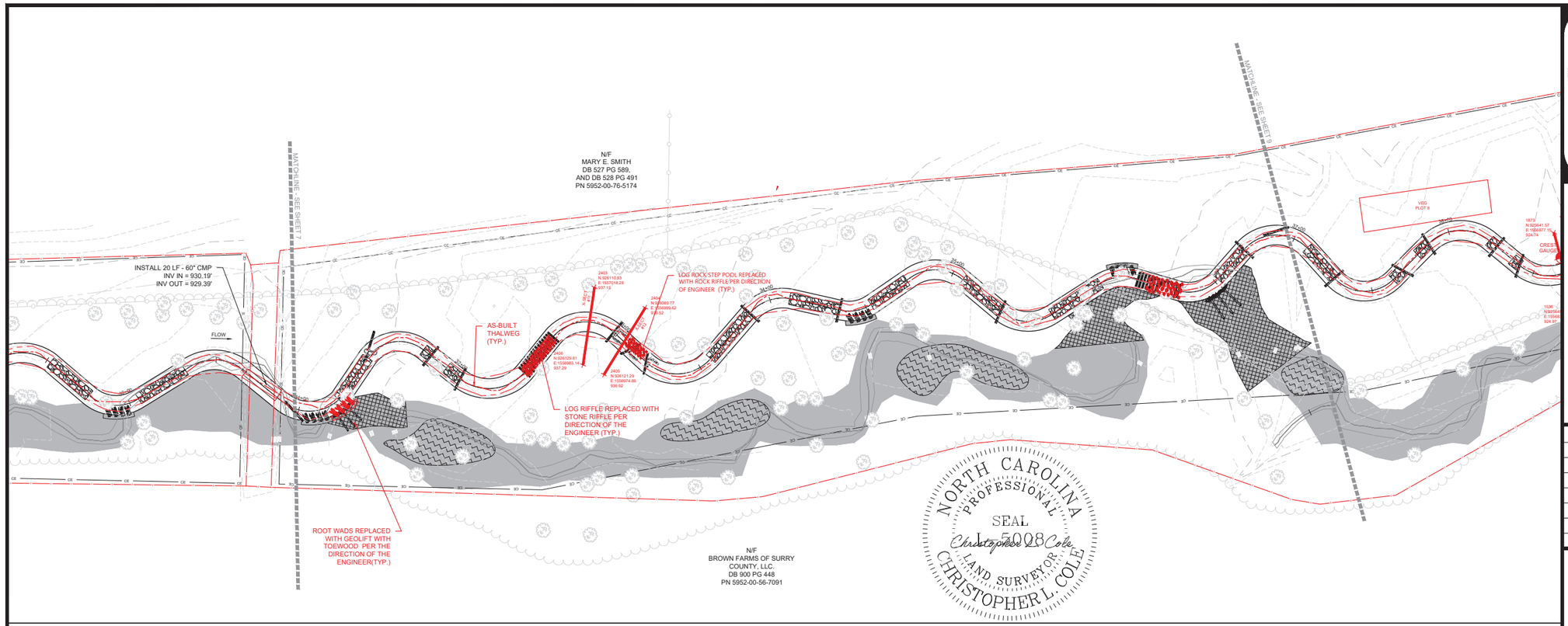
SHEET NAME

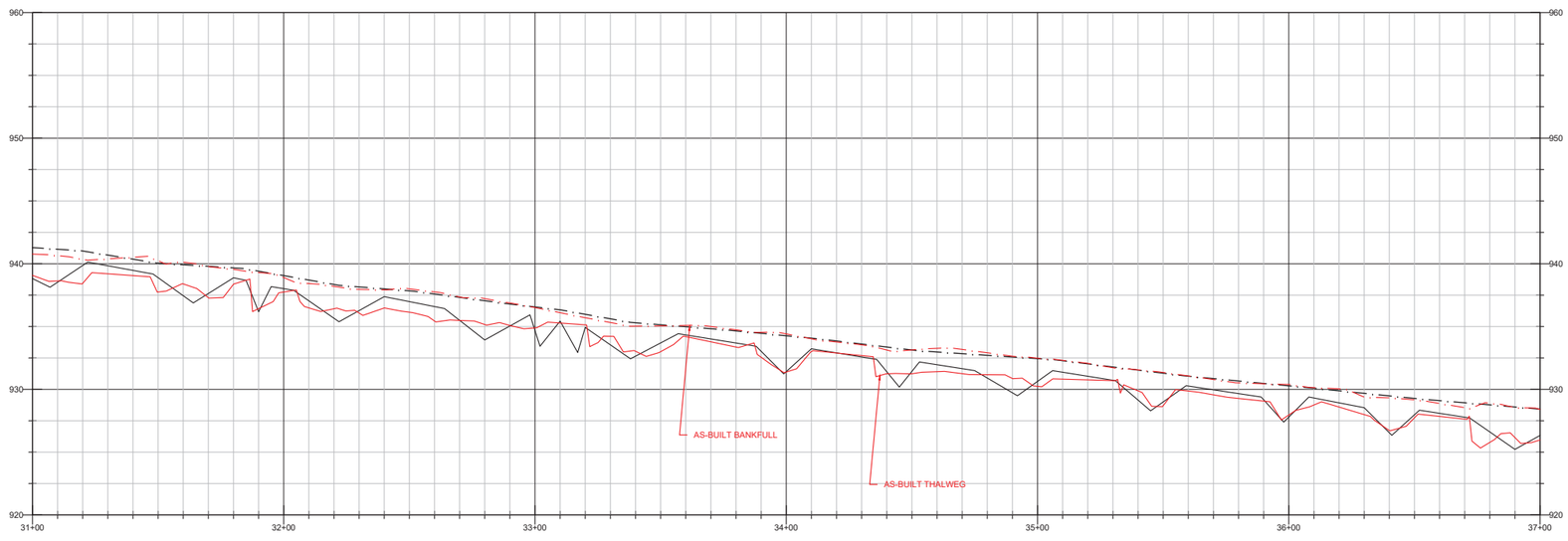
PLAN AND PROFILE

SHEET NUMBER

7

AS-BUILT





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30 15 0 30 60

GRAPHIC SCALE

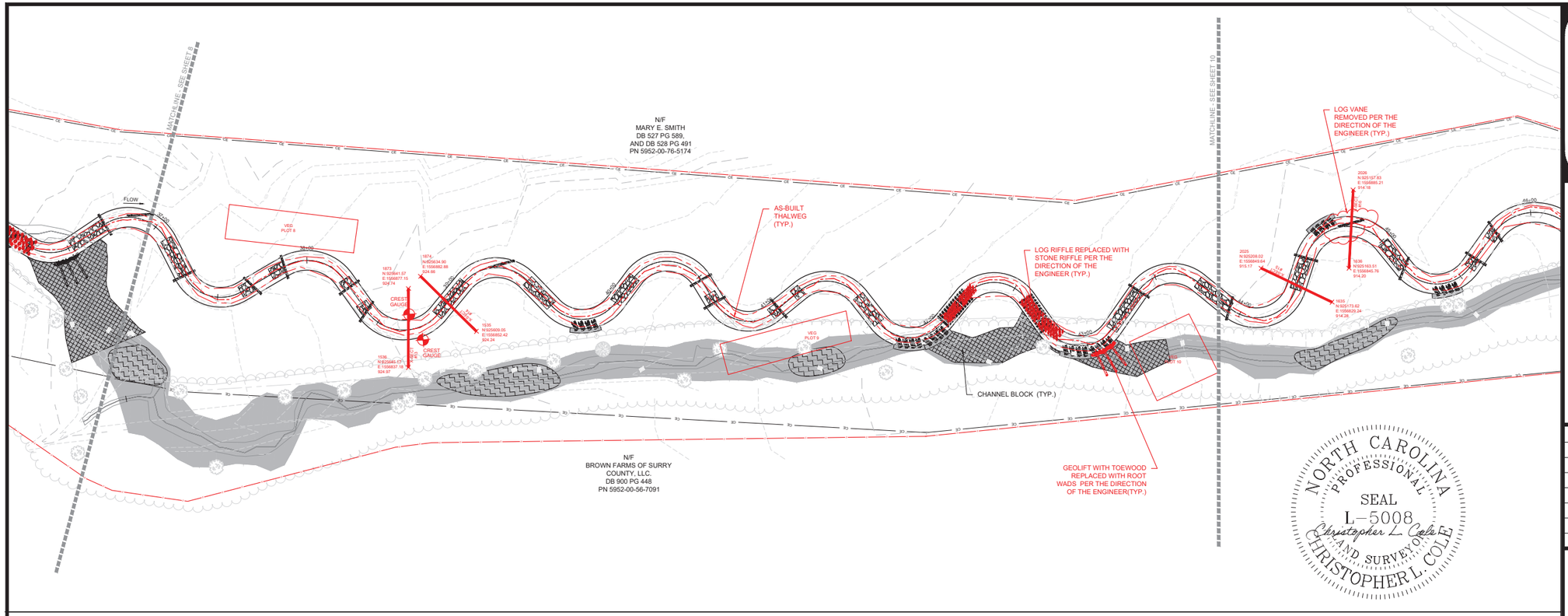
SHEET NAME

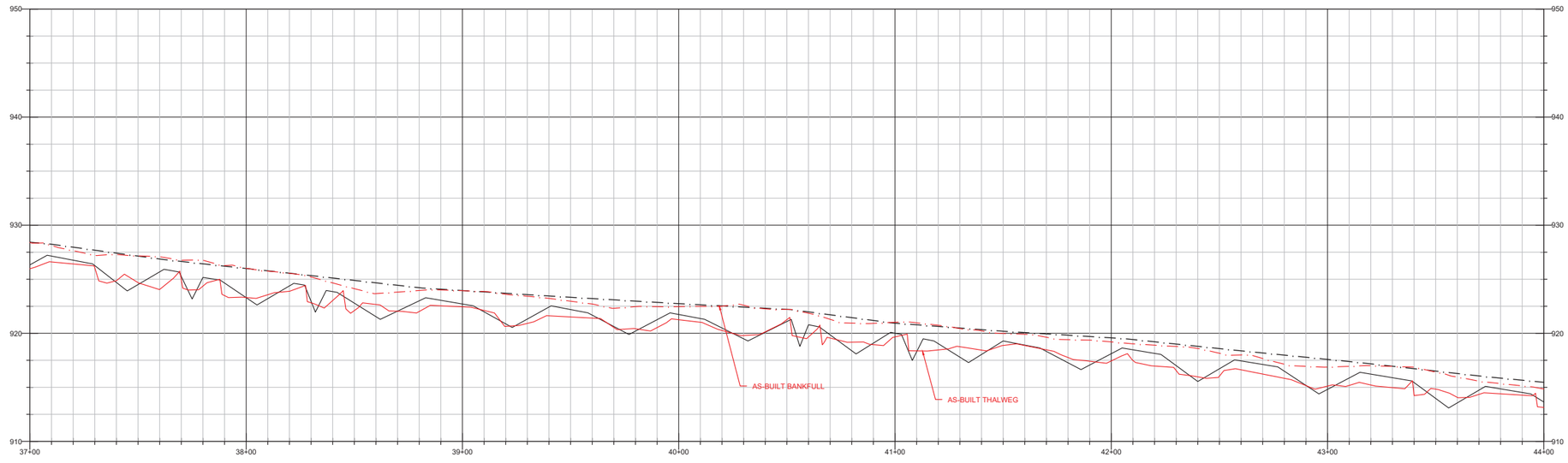
PLAN AND PROFILE

SHEET NUMBER

8

AS-BUILT





AS-BUILT

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VERT. SCALE :	1" = 12'

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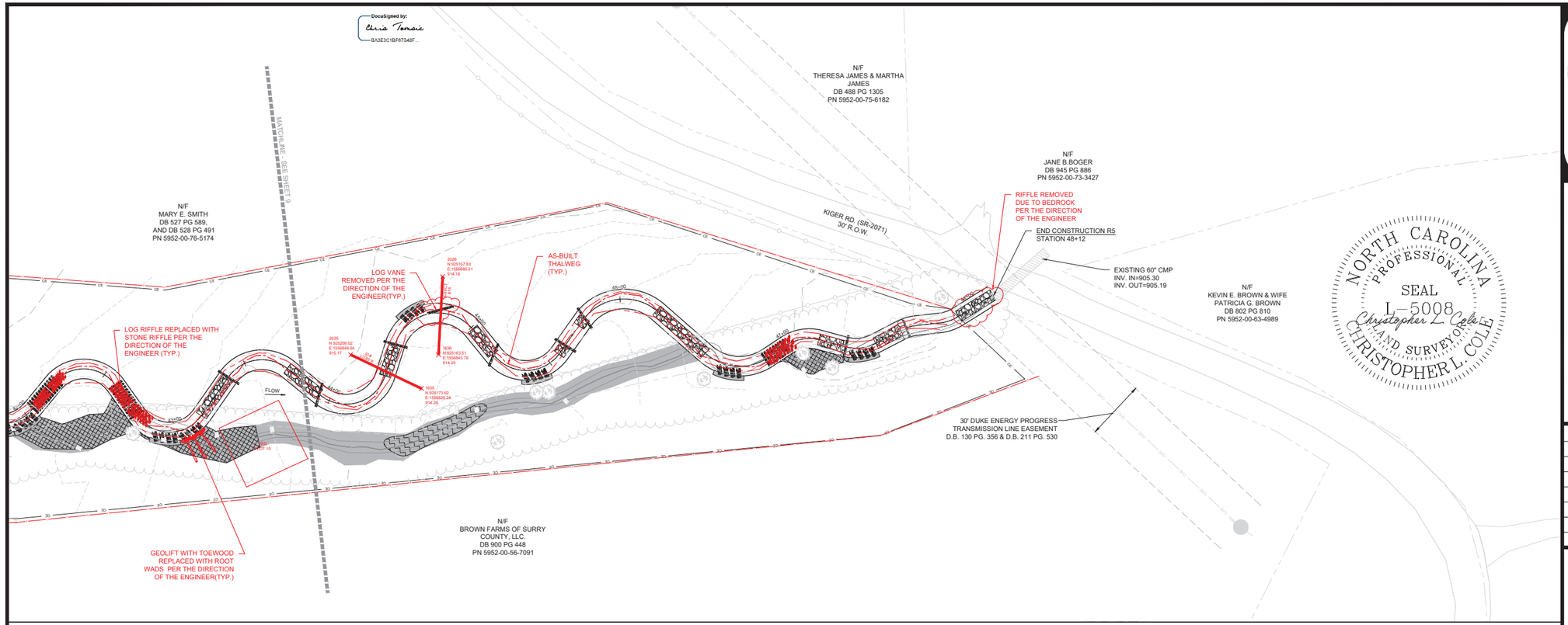
GRAPHIC SCALE

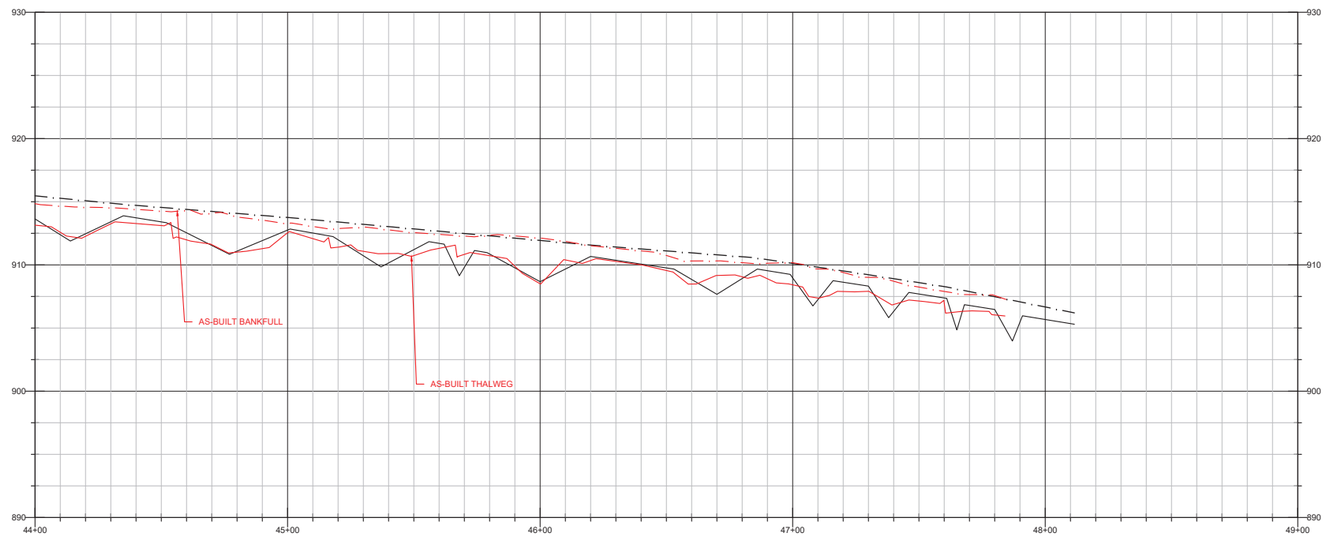
SHEET NAME

PLAN AND PROFILE

SHEET NUMBER

9





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VERT. SCALE :	1" = 12'

30 15 0 30 60

GRAPHIC SCALE

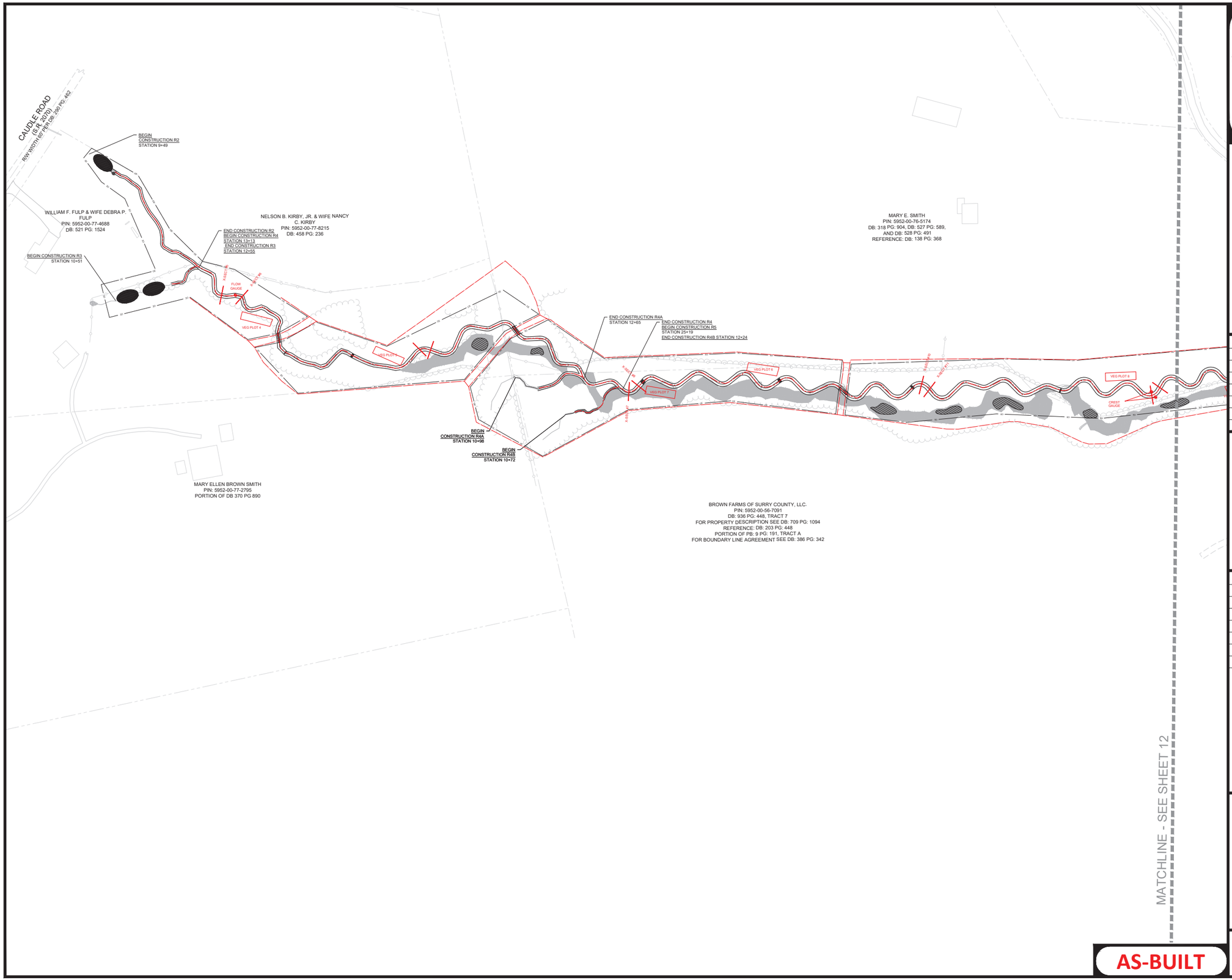
SHEET NAME

PLAN AND PROFILE

SHEET NUMBER

10

AS-BUILT



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HORNE CREEK TRIBUTARIES MITIGATION PROJECT

SURRY COUNTY, NC

DRAWING INFORMATION

PROJECT NO. :	100026
FILENAME :	ASB_11_HORNE_CREEK_MONITORING PLAN.DWG
DESIGNED BY :	CAT
DRAWN BY :	CAT/APL
DATE :	8-3-20
HORIZ. SCALE :	1" = 100'
VERT. SCALE :	N/A

50 25 0 50 100

GRAPHIC SCALE

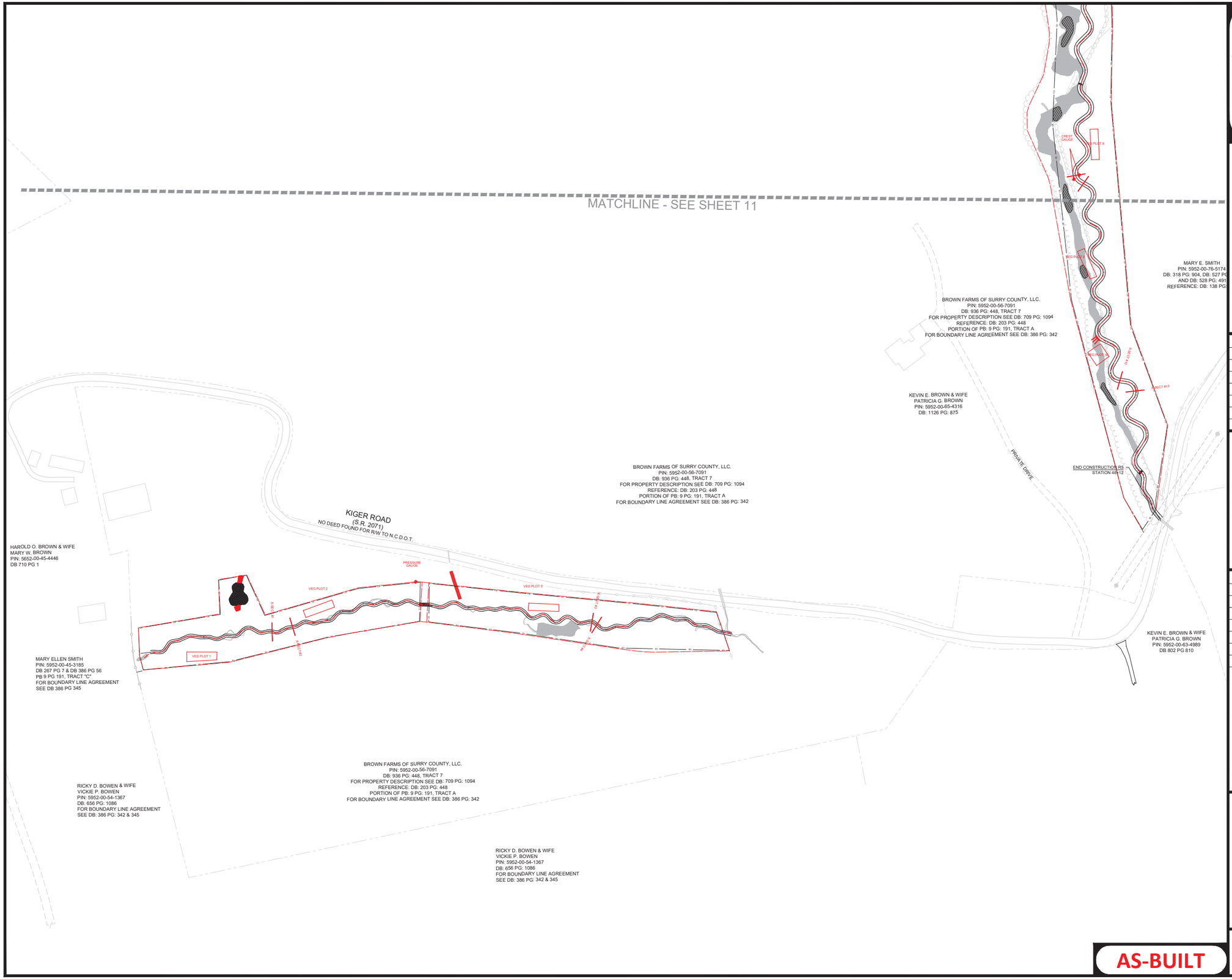
SHEET NAME

MONITORING PLAN

SHEET NUMBER

11

AS-BUILT



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HORIZ. SCALE :	1" = 150'
VERT. SCALE :	N/A

75 37.5 0 75 150

GRAPHIC SCALE

SHEET NAME

MONITORING PLAN

SHEET NUMBER

12

AS-BUILT