MY0 FINAL MONITORING REPORT
Banner Branch Mitigation Project
Stokes County
Roanoke River Basin
CU 03010103

DMS Project # 100080
DMS Contract # 7610 and 7701
DMS RFP # 16-007405
USACE Action ID Number SAW-2018-01760
DWR Project # 18-1154
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

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July 30, 2021

NC Department of Environmental Quality
Division of Mitigation Services
Attn: Jeremiah Dow, Project Manager
217 W. Jones Street, Suite 3000
Raleigh, NC 27603

RE: WLS Responses to NCDEQ DMS Review Comments for Task 6 Submittal, Draft Baseline Monitoring Report for the Banner Branch Mitigation Project, DMS Full-Delivery Project ID #100080, Contract #s 7610 & 7701, Roanoke River Basin, Cataloging Unit 03010103, Stokes County, NC

Dear Mr. Dow:

Water & Land Solutions, LLC (WLS) is pleased to present the Final Baseline Monitoring Report (including record drawings) for the Banner Branch 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 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:

1. Table 2 – The changes recommended below are intended to allow for the removal of Section 2.2 in future monitoring reports. Response: WLS will remove Section 2.2 in future monitoring reports and present all information in Table 2.

a. Recommend adding which monitoring years that assessments will occur in the Measurement column, i.e., indicate that vegetation plots and cross sections will be evaluated in years 1, 2, 3, 5, & 7. For vegetation, please indicate that there are 20 fixed veg plots and 2 random plots in the Measurement column. Response: Measurement frequency and monitoring years has been added to the Measurement column. For veg plot and cross-sections, data will be collected in years 1, 2, 3, 5, & 7. Flow gauge, wetland gauge, and bankfull

gauge data will be provided for all 7 years of monitoring. In the vegetation row, it has been revised to have 20 fixed veg plots and 2 random transects.

b. Please change the cross section Measurement to read: "20 cross section surveys and visual assessment." Response: This has been revised.

c. Recommend adding rows for any additional monitoring such as pebble counts and putting "N/A" in the Performance Criteria column. Response: Columns for pebble counts and macrobenthic sampling have been added.

2. Section 3 – In future reports this section only needs to be Table 3. All text under Section 3.1 – Design Approach can be removed. Response: Section 3.1/Design Approach will be removed in future reports.

3. Record Drawing

a. Some of the profile callouts throughout the Plan and Profile sheets are pointing to the wrong features, i.e., on Sheet 3 the arrow for As-built Water Surface is pointing at the Design Thalweg line and As-built Bankfull is pointing at the Design Bankfull line. Response: All profile callouts throughout the plan and profile sheets have been corrected.

b. Please label the wetlands. Response: the wetlands have been labeled on the Monitoring Sheets per DMS email on 7/19.

c. The below were noted during the July 15 site visit:

- **Sheet 5 – J-hook called out was not installed, or was installed in a different location.** Response: The J-hook shown in the design along UT4-R1 at station 26+50 was moved to station 25+20. The drawing has been corrected.
- **Sheet 11 – Recommend removing red coloring for thalweg and top of bank in areas outside of conservation easement where work was not done (see area starting around station 72+20).** Response: The thalweg and top of banks in these locations has been greyed out to indicate that no work was performed in these areas.
- **Sheet 14 – callout geolift to indicate what change occurred.** Response: The geolift has been called out.
- **Sheet 18 – Show fence line in red along the right bank.** Response: The short stretch of new fence that ties into existing fence is now shown in red. Most of the existing fence is outside the plan view in this area.
- **Sheet 21 – Geolift called out was actually added to upstream meander at XS-12. Also, like the Sheet 11 comment above, please remove the red coloring for the channel outside the CE where no work was done.** Response: The thalweg and top of banks in these locations has been greyed out to indicate that no work was performed in these areas. Also, the geolift has been moved to the appropriate location and labeled accordingly.
- **Sheet 24 – Recommend callout for stone and log riffles added to reach.** Response: The stone and log riffles have been called out as requested.
- **Sheet 26 – Remove text that says "Tie to Existing Fence" and color the fence line red since a fence was constructed.** Response: The callout has been removed and as-built fence has been added to the sheet.

4. Digital Files

a. Please review the "ASB_TWG" shapefile, and ensure that the individual segments in the attribute table reflect the individual entries in the asset table. Currently, multiple segments in the shapefile have lengths that do not match the reported asset table as-built lengths. Response: The attribute table stream lengths now mirror the asset table.

b. Please include cross section unique ID's in the "ASB_XS" shapefile. Response: The unique cross section IDs in the attribute table are under the column "Name".

c. If available, please submit features that characterize existing streams and wetlands. Response: The existing stream and wetlands shapefiles are included in the e-data as Pre-existing_Stream.shp and Pre-existing_Wetlands.shp.

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 Banner Branch Mitigation Project ("Project") is a North Carolina Department of Environmental Quality (NCDEQ), Division of Mitigation Services (DMS) full-delivery stream and wetland mitigation project contracted with Water & Land Solutions, LLC (WLS) in response to RFP 16-007405. The Project provides stream and wetland mitigation credits in the Roanoke River Basin (Cataloging Unit 03010103). The project site is located in Stokes County approximately five miles northeast of Lawsonville. The project site is in NCDEQ sub-basin 03-02-01, Roanoke River Basin Priority Plan (RBRP, amended 2015), and Targeted Local Watershed 03010103180010 (Warm Water Thermal Regime), all within the Roanoke River Basin.

The Project involved the restoration, enhancement, preservation and permanent protection of 14 stream reaches (UT1-R1, UT1-R2, UT1-R3, UT1A, UT1B, UT1C, UT2, UT2A, UT3, BB-R1, BB-R2, BB-R3, UT4-R1, and UT4-R2) and their riparian buffers, totaling approximately 15,707 linear feet of designed streams and 6.183 acres of riparian wetlands. The Project will provide significant ecological improvements and functional uplift through stream and aquatic habitat restoration and through decreasing nutrient and sediment loads within the watershed. The mitigation plan provides a detailed project summary and Table 1 provides a summary of project assets. The CCPV's illustrate the project mitigation components.

Prior to construction, landowners historically cleared large portions of mature forest and manipulated, and/or straightened streams and ditched riparian wetland systems to provide areas for crop production and cattle grazing. Many of the Project reaches had been heavily impacted from these historic and current land use practices, including livestock production, agriculture, and silviculture. Continuous livestock intrusion and associated hoof shear had severely impacted the streambanks along many of the Project stream reaches. The stream channels were actively incising in these areas and the floodplain connection had been lost in many locations. The lack of adequate and high-quality buffer vegetation, past land use disturbances, active channel degradation, minimal impervious cover, and current agricultural and livestock practices presented a significant opportunity for water quality and ecosystem improvements through the implementation of this Project.

1.2 Project Quantities and Credits

The Project mitigation components include a combination of Stream Restoration, Enhancement and Preservation activities, as well as Riparian Wetland Restoration (Re-establishment & Rehabilitation) and Enhancement, as summarized in Table 1.

Table 1. Banner Branch Mitigation Site (ID-100080) 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							
UT1-R1 (upper)	373	402	Warm	EI	1.50000	248.667	Floodplain Bench, In-Stream Structures, Supplemental Planting, Exclusion of Livestock, Permanent Conservation Easement
UT1-R1 (lower)	136	136	Warm	P	10.00000	13.600	Supplemental Planting, Exclusion of Livestock, Permanent Conservation Easement
UT1-R2	1,783	1,822	Warm	EII	2.50000	713.200	Riparian Planting, Livestock Exclusion
UT1-R3	822	851	Warm	P	10.00000	82.200	Conservation Easement
UT1A	410	410	Warm	EII	2.50000	164.000	Riparian Planting, Livestock Exclusion
UT1B (upper)	391	428	Warm	EII	2.50000	156.400	Riparian Planting, Livestock Exclusion
UT1B (lower)	97	103	Warm	EI	1.50000	64.667	Bank grading, Stabilization, Supplemental planting, Conservation Easement
UT1C (upper)	69	69	Warm	P	10.00000	6.900	Conservation Easement
UT1C (lower)	151	146	Warm	R	1.00000	151.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
UT2	1,287	1,270	Warm	R	1.00000	1,287.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
UT2A	289	287	Warm	EI	1.50000	192.667	Bank grading, Stabilization, Supplemental planting,. Conservation Easement
UT3	589	551	Warm	R	1.00000	589.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
BB-R1	808	865	Warm	R	1.00000	808.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
BB-R2	1,835	1,746	Warm	R	1.00000	1,835.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
BB-R3	636	678	Warm	R	1.00000	636.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
UT4-R1 (upper)	2,346	2,346	Warm	R	1.00000	2,346.000	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement
UT4-R1 (lower)	1,730/233	1,589/265	Warm	R	1.00/1.25	1,916.400	Full Channel Restoration, Planted Buffer, Exclusion of Livestock, Permanent Conservation Easement. 233 LF adjacent to pond credited at 1.25:1.
UT4-R2	1,722	1,760	Warm	EI	1.50000	1,148.000	Bank Grading, Stabilization, Supplemental Planting, Conservation Easement
					Total:	**12,358.701**	
Wetland							
W1	0.825	0.783	R	REE	2.00000	0.413	Planted, excluded livestock, remediated compaction and encompasses section of Priority 1 reaches
W1A	1.240	1.227	R	E	1.00000	1.240	Planted, excluded livestock, remediated compaction, soil manipulation, and encompasses section of Priority 1 reach
W2	0.524	0.511	R	E	2.00000	0.262	Planted, excluded livestock, remediated compaction
W3	0.888	0.886	R	RH	1.50000	0.592	Planted, excluded livestock, remediated compaction and encompasses section of Priority 1 reach
W4	0.321	0.319	R	E	2.00000	0.161	Planted, excluded livestock, remediated compaction
W4A	0.808	0.807	R	REE	1.00000	0.808	Planted, excluded livestock, remediated compaction, soil manipulation, and encompasses section of EI reach
W5	0.203	0.203	R	E	2.00000	0.102	Planted, excluded livestock, remediated compaction and encompasses section of EII reach
W5A	0.097	0.097	R	E	2.00000	0.049	Planted, excluded livestock, remediated compaction, and encompasses section of EII reach
W5B	0.010	0.007	R	E	2.00000	0.005	Planted, excluded livestock, remediated compaction
W6A	0.251	0.251	R	RH	1.50000	0.167	Planted, excluded livestock, remediated compaction and encompasses section of Priority 1 reach
W6B	0.045	0.045	R	E	2.00000	0.023	Planted, excluded livestock, remediated compaction
W7	0.041	0.041	R	E	2.00000	0.021	Planted, excluded livestock, remediated compaction
W8A	0.107	0.107	R	REE	1.00000	0.107	Planted, remediated compaction, soil manipulation, and encompasses section of Priority 1 reach of BB-R1
W9	0.823	0.817	R	REE	1.00000	0.823	Planted, excluded livestock, remediated compaction, soil manipulation, and encompasses section of P1 reach of BB-R2
					Total:	**4.773**	

Project Credits

	Stream			Riparian	Non-Rip	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	9,568.400					
Re-establishment				2.151		
Rehabilitation				0.759		
Enhancement				1.863		
Enhancement I	1,654.000					
Enhancement II	1,033.600					
Creation						
Preservation	102.700					
Totals	**12,358.701**			**4.773**		

Total Stream Credit	**12,358.701**
Total Wetland Credit	**4.773**

Wetland Mitigation Category

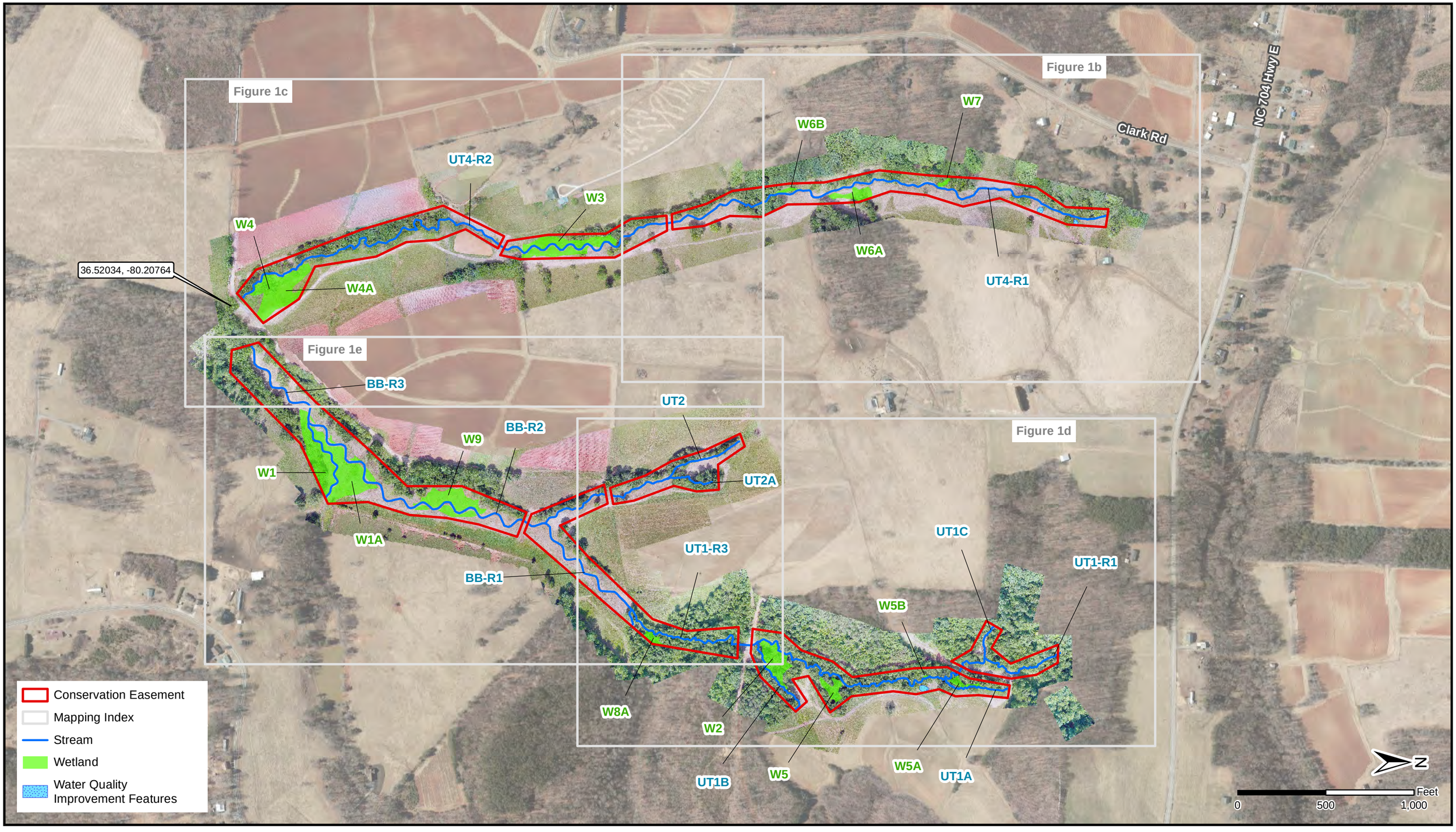
CM	Coastal Marsh
R	Riparian
NR	Non-Riparian

Restoration Level

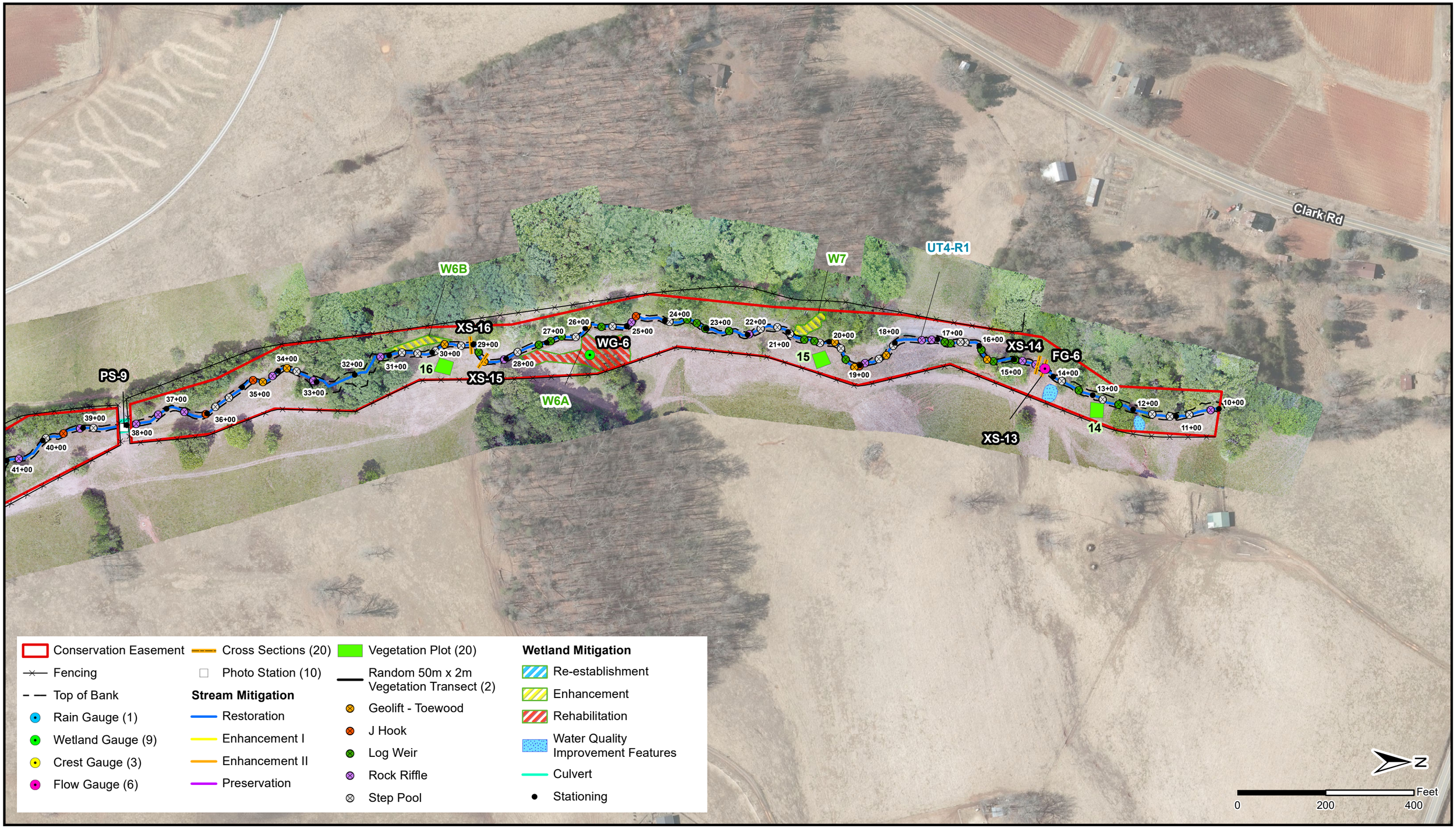
HQP	High Quality Preservation
P	Preservation
E	Wetland Enhancement - Veg and Hydro
EII	Stream Enhancement II
EI	Stream Enhancement I
C	Wetland Creation
RH	Wetland Rehabilitation - Veg and Hydro
REE	Wetland Re-establishment Veg and Hydro
R	Restoration

1.3 Current Condition Plan View

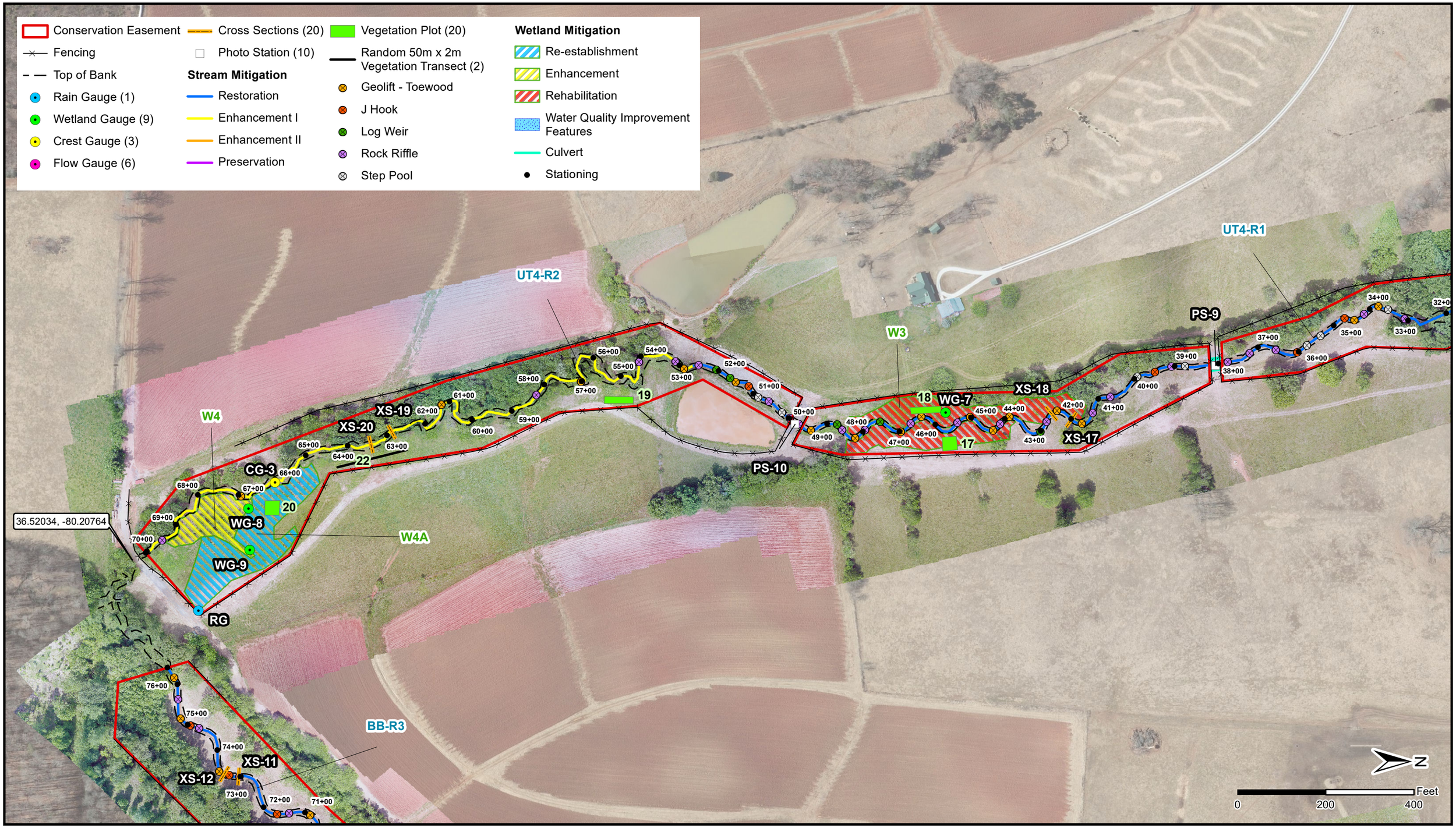
The following pages present the Current Condition Plan View (CCPV).



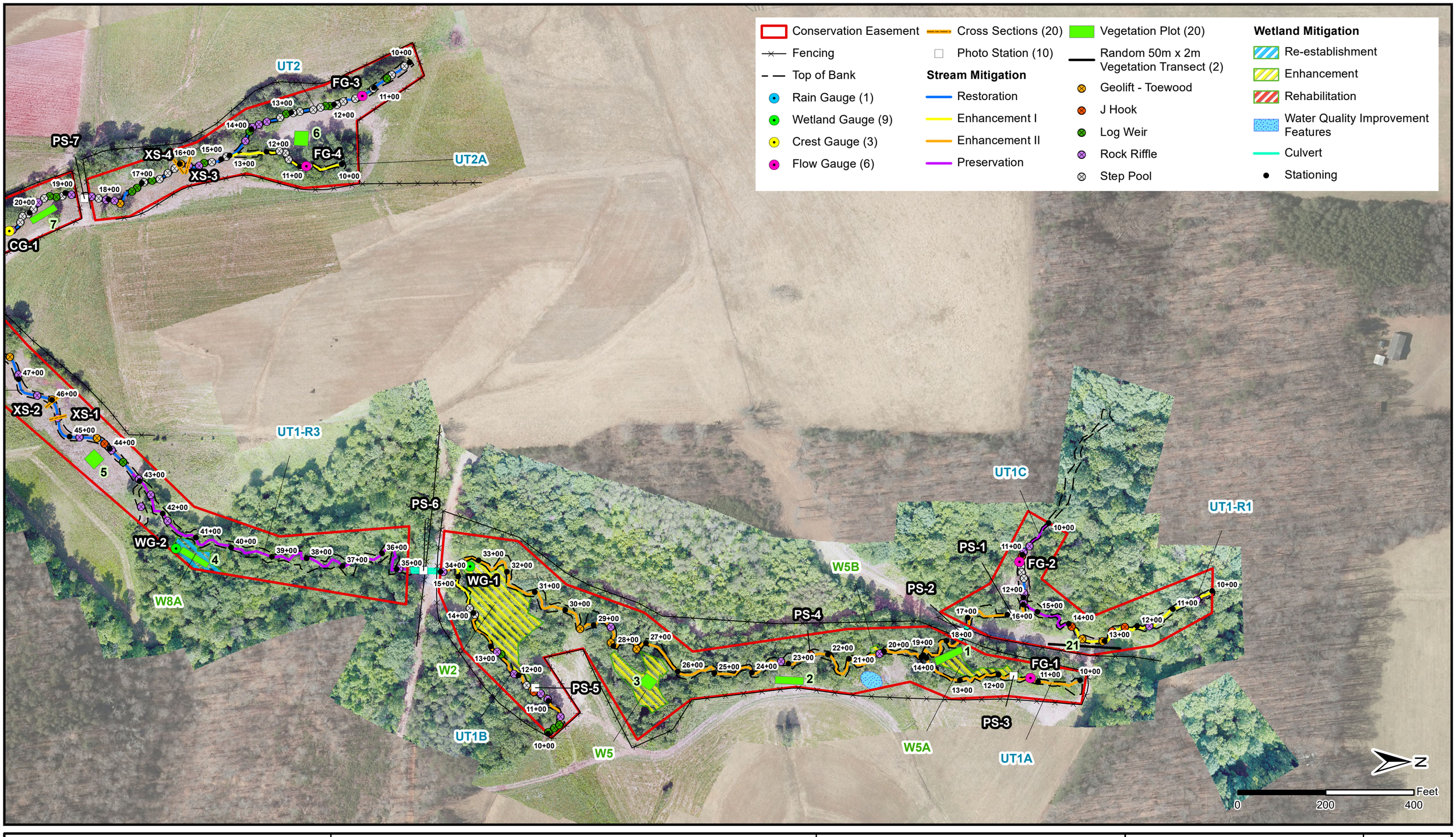
WATER & LAND™ SOLUTIONS	**Banner Branch Mitigation Project** **Stokes County, North Carolina**	USACE Action ID Number: SAW-2018-01760 June 2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE 1a



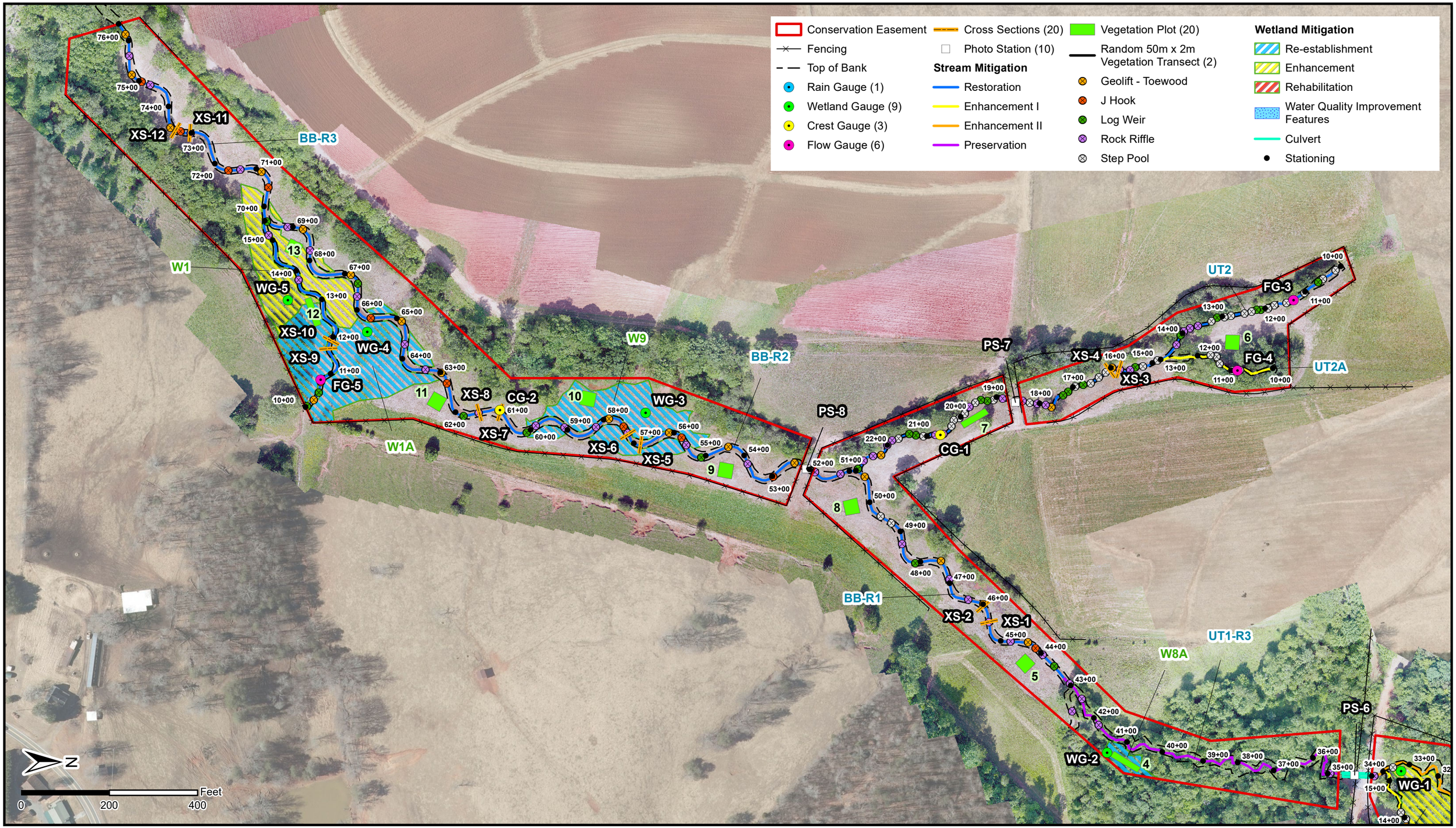
WATER & LAND™ SOLUTIONS	**Banner Branch Mitigation Project** **Stokes County, North Carolina**	USACE Action ID Number: SAW-2018-01760 June 2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE **1b**



WATER & LAND™ SOLUTIONS	**Banner Branch Mitigation Project** **Stokes County, North Carolina**	USACE Action ID Number: SAW-2018-01760 June 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	**Banner Branch Mitigation Project** **Stokes County, North Carolina**	USACE Action ID Number: SAW-2018-01760 June 2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE **1d**



WATER & LAND™ SOLUTIONS	**Banner Branch Mitigation Project** **Stokes County, North Carolina**	USACE Action ID Number: SAW-2018-01760 June 2021 MY0	USACE Current Conditions Plan View Monitoring Year 0 NAD 1983 2011 State Plane North Carolina FIPS 3200 FT US	FIGURE **1e**

2 Goals, Performance Criteria, and Functional Improvements

2.1 Project Goals and Objectives

The Project will meet the goals and objectives described in the Banner Branch Final Approved Mitigation Plan and will address general restoration goals and opportunities outlined in the DMS Roanoke River Basin RBRP. More specifically, watershed goals and management strategies described in the RBRP will be met by:

- Reducing sediment, soil erosion, turbidity, and nutrient inputs such as fecal coliform bacteria, nitrogen, and phosphorus to the Banner Branch Watershed.
- Restoring, enhancing, preserving, and protecting headwater streams, wetlands, riparian buffers, and aquatic habitat functions.
- Improving riparian corridor management and targeting restoration of impacted streams, wetlands, 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, and wetlands restoration.

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

- Restore stream, wetland and floodplain hydrology by reconnecting historic flow paths and promoting geomorphically stable conditions and more natural flood processes;
- Improve and protect water quality by reducing streambank erosion, nutrient and sediment inputs;
- Restore and protect stream, wetland, and riparian buffer functions and habitat connectivity in perpetuity by recording a permanent conservation easement; and
- Implement agricultural BMPs 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	6 Flow Gauges (UT1A, UT1C, UT2, UT2A, UT3, UT4-R1). Devices record 2x/day and inspected quarterly.	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 for 8% of growing season.	3 Crest gauges/pressure transducers (UT2, BB-R2, UT4-R2); Devices record hourly & inspected quarterly. 9 Wetland gauges (W1,W1A, W2, W3, W4, W4A, W6A, W8A, W9); inspected quarterly.	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.	20 Cross sections surveys and visual assessment; Cross-sections in Years 1, 2, 3, 5, and 7.	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 with average height of six feet; and a minimum of 210 stems per acre and average eight foot tree heights must be present at year seven.	CVS Level I & II Protocol Tree for 20 fixed veg plots (Strata Composition, Vigor, and Density), 2 random transects/plots, and visual assessment. Years 1, 2, 3, 5, and 7 for veg plots.	22/22 Veg Plots met in 2021
Improve streambed material and stability	Improve bedform diversity and increase lateral stability.	Reduce embeddedness to allow for interstitial flow habitat.	N/A	Pebble Counts (riffles) in years 5 and 7 in restoration reaches.	Data in MY5 and MY7
Improve Benthic Macroinverebrate Communities and Aquatic Habitat	Increase native woody debris and structures in channel.	Increase leaf litter and organic matter critical to provide in-stream cover/shade, wood recruitment, and carbon sourcing.	N/A	Evaluate BMI Communities at two sites (BB-R3 and UT4-R2) in MY3 and MY7	Data in MY3 and MY7

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 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 (see Appendix D for installation diagrams). 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.

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 FIPS 3200). Morphological data will be collected at 20 cross-sections. Survey data will be imported into Microsoft Excel® and the 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: 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 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.

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.

2.2.2 Wetlands

Wetland Hydrology: The performance standard for wetland hydrology will be eight percent based on the suggested wetland saturation thresholds for soils taxonomic subgroups. The proposed success criteria for wetland hydrology will be when the soils are saturated within 12 inches of the soil surface for eight percent (14 days) of the 177-day growing season (April 21st through October 16th) based on WETS data table for Stokes County, NC. The saturated conditions should occur during a period when antecedent precipitation has been normal or drier than normal for a minimum frequency of 5 years in 10 (USACE, 2005 and 2010b). Precipitation data will be obtained from an on-site rain gauge and the Danbury WETS Station, approximately 11 miles south of the Project site. If a normal year of precipitation does not occur during the first seven years of monitoring, WLS will continue to monitor the Project hydrology until the Project site has been saturated for the appropriate hydroperiod. If rainfall amounts for any given year during the monitoring period are abnormally low, reference wetland hydrology data will be compared to determine if there is a correlation with the weather conditions and site variability.

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 20 permanent/fixed vegetation plots and two random 5m x 20m 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, height, and density of planted species. Data are processed using the DMS ShinyApp 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.

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, cattle exclusion fence damage, and general streambed conditions.

3 Project Attributes

3.1 Design Approach

3.1.1 Stream

The Project stream design approach included a combination of Stream Restoration, Enhancement, and Preservation activities. Priority Level I and Level II Restoration approaches incorporated the design of both single-thread meandering channels and step-pool channels. All non-vegetated areas within the easement were planted with native vegetation and any areas of invasive species were removed and/ or treated.

Restoration: UT1C (lower), UT2, UT3, BB-R1, BB-R2, BB-R3, UT4-R1

- **UT1C (lower) –** Due to the previously severe headcut along lower UT1C, a Priority Level I/II Restoration approach was utilized to restore headwater stream functions. The lower reach was restored as a Rosgen 'B4' stream type using appropriate step-pool morphology with limited meander geometry. The upper reach is currently stable and the restoration activities reconnected the new channel within the natural valley by raising the vertical profile, providing bankfull benches near the confluence with UT1-R1 further downstream. In-stream structures, including log and rock riffles, log weirs and constructed riffles/cascades were used to dissipate flow energy, protect streambanks, and eliminate potential for future incision.

- **UT2 –** Due to the past manipulation and degraded nature of UT2, a Priority Level I/II Restoration approach was proposed to restore headwater stream functions and improve water quality. This headwater stream had been a watering source and shade area for cattle over many decades, and this ongoing degradation left the riparian areas devoid of understory woody vegetation. The reach was restored as a Rosgen 'B4' stream type using appropriate step-pool morphology with limited meander geometry. A new channel was constructed within the natural valley by raising the vertical profile, providing bankfull benches and reconnecting with the BB-R2 channel alignment further downstream. In-stream structures, such as constructed riffles/cascades, log and rock step-pools were used to control grade in the steeper sections, as well as dissipate flow energy, protect

streambanks, and eliminate potential for future incision. Restored streambanks were graded to stable side slopes and the floodplain was reconnected to further promote stability and hydrological function.

As part of the restoration activities, the existing channel was filled to an elevation sufficient to connect the new bankfull channel to floodprone areas using suitable fill material excavated from the newly restored channel, spoil piles and borrow areas. Additionally, permanent fencing and a 30-foot ford stream crossing was installed to exclude livestock and reduce sediment and nutrient inputs.

- **UT3 –** UT3 previously exhibited ditched conditions due to past manipulation and channelization. Therefore, a Priority Level I Restoration approach was proposed to improve stream functions and wetland hydrology in areas with hydric soils. The reach was restored as a Rosgen 'C4' stream type using appropriate riffle-pool morphology with appropriate meander geometry. Work along this reach involved filling in the ditches, raising the bed elevation, and reconnecting the existing stream with its relic floodplain. A new channel was constructed offline before reconnecting with BB-R2 channel alignment further downstream. In-stream structures, including log and rock riffles, log weirs and log vanes were used to dissipate flow energy, protect streambanks, and eliminate potential for future incision. Restored streambanks were graded to stable side slopes and the floodplain was reconnected to further promote stability and hydrological function across the stream and wetland complex.

- **BB-R1, BB-R2, and BB-R3 –** The Banner Branch mainstem tributary (BB-R1) begins at the confluence with Banner Branch and UT1-R3. The Banner Branch mainstem reaches were moderately to severely incised with BHRs often exceeding 1.5. Work along these reaches involved a Priority Level I Restoration by raising the bed elevation upstream of UT1-R3 confluence and reconnecting the existing stream with its relic floodplain in the low point of the valley. BB-R2 begins at the confluence with UT2 and upstream of a 30-foot ford stream crossing. The ford crossing was improved and BB-R2 was relocated to the low point in the valley and constructed entirely offline. The lower section of BB-R3 transitions into a Priority Level II restoration to create a floodplain bench and tie into the existing bed elevation near the bottom of the project boundary. This approach promotes more frequent over bank flooding in areas with hydric soils, thereby creating favorable conditions for wetland restoration (both rehabilitation and re-establishment).

  These reaches were restored as Rosgen 'C4' stream types using appropriate riffle-pool morphology with a conservative meander planform geometry that accommodates the flatter valley slope and widths. In-stream structures were incorporated to control grade, dissipate flow energies, protect streambanks, and eliminate the potential for future channel incision. In-stream structures included constructed riffles for grade control and aquatic habitat and log j-hook vanes, and log and rock weirs for encouraging pool formation, bank stability, and bedform diversity. In addition to in-stream channel features, shallow depressions were created in the floodplain to provide habitat diversity, nutrient cycling, and improved treatment of overland flows.

- **UT4-R1 (upper) and UT4-R1 (lower) –** The restoration of upper UT4-R1 began near the top of the headwater catchment. Due to the past manipulation and severely degraded nature of UT4-R1, a Priority Level I/II Restoration approach was proposed to restore headwater stream functions and improve water quality. This stream system had been a primary watering source and shade area for cattle over many decades, and this ongoing degradation had left the riparian areas devoid of understory woody vegetation. Given the valley confinement and steeper slopes, the upper reach was restored as a Rosgen 'B4' stream type using appropriate step-pool morphology with limited meander geometry. Within portions of the deeper channel segments, a shallow Priority Level II Restoration approach was utilized to create bankfull benches. Additionally, a 30-foot culvert stream crossing was installed.

  The lower reach was restored as a Rosgen 'C4b' stream type using a Priority Level I Restoration approach to restore stream functions and improve water quality. The design approach included riffle-pool morphology with a conservative meander planform geometry that accommodates flatter valley slope and widths. In-stream structures, such as constructed riffles/cascades, log and rock step-pools were used to control grade in the steeper sections, as well as dissipate flow energy, protect streambanks, and eliminate potential for future incision. Restored streambanks were graded to stable side slopes and the floodplain was reconnected to further promote stability and hydrological function.

  In the lower section of UT4-R1, the existing 30-foot ford stream crossing was improved before reconnecting with the UT4-R2 channel alignment further downstream. Channel and floodplain excavation in this reach segment included the removal of shallow legacy sediments to accommodate the new design channel and in-stream structures, as well as a more natural step-pool morphology using grade control structures in the steeper transitional areas. Areas of invasive species (i.e. Chinese privet) were removed and treated along the existing farm pond to improve riparian buffer vegetation and maintain stable side slopes. Additionally, permanent fencing and a water quality improvement feature was installed to exclude cattle and capture, attenuate, and treat concentrated flow from existing ephemeral drainages that would otherwise enter the riparian buffer as untreated surface runoff.

Enhancement Level I: UT1-R1 (upper), UT2A, UT4-R2, UT1B (lower)

- **UT1-R1 (upper) –** Due to the past manipulation, channelization and degraded nature of the upper project reach, an Enhancement Level I approach was employed to improve stream functions and improve water quality. The left streambank was sloped back and stabilized in the upper section and a meander bend was relocated partially offline within the abandoned floodplain area before reconnecting with the stable channel alignment further downstream. Riparian buffers in excess of 30 feet were supplementally planted and now protected along the entire reach. Mature trees and significant native vegetation was protected and incorporated into the design. Bioengineering techniques, such as geolifts, toe wood, and live stakes, were used to protect streambanks and promote woody vegetation growth. Exotic species vegetation was removed/treated, and native riparian species vegetation was planted in the resulting disturbed areas. Permanent fencing was installed and/or relocated along with alternative watering systems to exclude livestock and reduce direct sediment and nutrient inputs.

- **UT2A –** UT2A begins at a small spring adjacent to Reach UT2. The channel had been experiencing bank erosion from hoof shear but was vertically stable throughout most of its length. An Enhancement Level I approach was proposed along this reach to address localized bank erosion, an active headcut and lateral instability. In-stream structures, such as constructed riffles/cascades, log and rock step-pools, were used to control grade in the steeper sections, as well as dissipate flow energy, protect streambanks, and eliminate potential for future incision. Construction activities consisted of regrading the streambanks back to the existing stable dimension, installing erosion control matting, and supplemental riparian buffer planting and live stakes. The reach in this section was proposed as a Rosgen 'B4' stream type.

- **UT4-R2 –** Work activities along UT4-R2 included channel and floodplain excavation in the upper reach segment to accommodate a new design channel and in-stream structures, as well as a more natural step-pool morphology using grade control structures in the steeper transitional areas. The lower section of the channel was vertically stable and enhancement work consisted of bank stabilization, removal and treatment of invasive species, minimal channel relocation and in-stream structure installation. Bioengineering techniques, such as toe wood and live stakes, were used to protect streambanks and promote native woody vegetation growth. A majority of the right buffer area, including streamside vegetation, contained large clusters of Chinese privet. Any exotic species vegetation was removed in these areas from approximate station 55+00 to 71+53. The buffer and stream banks were replanted with native riparian species vegetation in the resulting disturbed areas. Riparian buffers in excess of 30 feet were restored and protected along the entire length of UT4-R2, and permanent fencing was installed to exclude livestock and reduce direct sediment and nutrient inputs.

- **UT1B (lower) –** UT1B lower begins immediately downstream of UT1B. Previously this area was experiencing a higher water table and aggradation due to a partially blocked culvert. A pilot channel was constructed to establish a natural tie-in connection with UT1B (upper) and UT1-R2. Enhancement Level I practices consisted of new channel construction, in-stream structure installation, and invasive species treatment. Bioengineering techniques, such as live stakes, were used to protect streambanks and promote native woody vegetation growth. Any invasive species vegetation was removed in these areas. The buffer and stream banks were replanted with native riparian species vegetation in the resulting disturbed areas in excess of 30 feet. Permanent fencing was installed to exclude livestock and reduce direct sediment and nutrient inputs.

Enhancement Level II: UT1A, UT1B (upper), UT1-R2

Work along project reaches UT1A, UT1B (upper), and UT1-R2 involved Enhancement Level II practices to improve the channel condition and aquatic function. These areas had been historically disturbed through cattle intrusion, pasture use and agricultural practices, and the channel exhibited poor channel definition and/or degraded conditions in some sections. However, many segments of the existing channel had limited bank erosion and/or channel incision. Consequently, WLS planted and restored the riparian buffer widths to more than 30 feet, stabilized localized bank erosion and permanently excluded livestock. The existing culvert crossing on UT1-R2 was replaced with a 48" diameter pipe and the existing culvert between UT1-R2 and UT1-R3 was also replaced with a 60" diameter pipe and 24" diameter bankfull pipe.

Mature trees or significant native vegetation was protected and incorporated into the design. Where necessary, bioengineering techniques, such as geolifts, toe wood, brush layers, and live stakes, were also used to protect streambanks and promote woody vegetation growth along the streambanks. Additionally, permanent fencing was installed to exclude livestock and reduce sediment and nutrient inputs. Exotic species vegetation was removed in these areas and native riparian species vegetation was planted in disturbed areas. Finally, a water quality improvement feature was installed near UT1-R2 to capture, attenuate, and treat concentrated flow from existing ephemeral draws that would otherwise enter the riparian buffer as untreated water. The BMP was constructed inside of the conservation easement and will require no maintenance.

Preservation: UT1C (upper), UT1-R3, UT1-R1 (lower)

Preservation was proposed along these reaches since the stream systems are mostly stable with a mature riparian buffer due to minimal historic impacts. An existing headcut was stabilized along lower UT1C before the confluence with UT1-R2 and all areas are protected in perpetuity through a conservation easement. Any exotic species vegetation was treated in these areas and riparian buffers in excess of 30 feet are now permanently protected along the entire reach length. This approach extends the wildlife corridor throughout a majority of the riparian corridor, while providing a natural hydrologic connection and critical habitat linkage within the catchment area.

3.1.2 Wetland

Riparian Wetland Re-establishment: W1A, W4A, W8A, W9

These areas contain hydric soil conditions that are favorable for re-establishing historic wetlands. It is anticipated that as a direct result of implementing Priority Level I stream restoration, limited soil manipulation, removal of livestock, revegetation, and restoration of groundwater hydrology, historic wetlands will regain their lost functions. An overbank flooding regime was restored throughout these areas by raising the stream bed elevation to reconnect the channels to their active floodplain. For W8A, the vertical profile of Banner Branch was gradually raised and tied into BB-R1/UT1-R3 confluence at station 43+11 thereby increasing the frequency of overbank flows and restoring hydrology necessary for wetland re-establishment. WLS is not proposing stream credit on Banner Branch proper upstream of this confluence.

Riparian Wetland Rehabilitation: W3 and W6A

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

Riparian Wetland Enhancement: W1, W2, W4, W5, W5A, W5B, W6B, W7

As described above, the restoration activities provide significant functional uplift across the project area. The restoration activities also improve and enhance the hyporheic zone interaction and hydrology to existing wetland areas. Wetland enhancement areas were planted with native wet tolerant species. Restoration of a natural stream system required that the new channel be relocated to the lowest part of the valley, which resulted in a temporary disturbance of existing marginal or lower functioning wetlands.

In some areas, disturbance of the existing wetlands was unavoidable to restore a stable and fully functioning wetland and riparian system. However, restoration of the stream channels will also improve areas of adjacent wetlands through higher water table conditions (elevated stream profile) and a more frequent over-bank flooding regime.

3.2 Project Attributes

See Table 3 for Project Attributes.

Table 3. Project Attribute Table	
Project Name	Banner Branch Mitigation Project
County	Stokes
Project Area (acres)	40.87
Project Coordinates (latitude and longitude decimal degrees)	36.525421° N, -80.203265° W
Project Watershed Summary Information	
Physiographic Province	Piedmont
River Basin	Roanoke
USGS Hydrologic Unit 8-digit	03010103
DWR Sub-basin	03-02-01
Project Drainage Area (acres)	563 (BB-R3) and 224 (UT4-R2); 0.88 (BB-R3) and 0.35 (UT4-R2)
Project Drainage Area Percentage of Impervious Area	<2
Land Use Classification	2.01.03, 3.02 (50% pasture/hay, 48% mixed forest)

Reach Summary Information														
Parameters	**UT1-R1**	**UT1-R2**	**UT1-R3**	**UT1A**	**UT1B**	**UT1C**	**UT2**	**UT2A**	**UT3**	**BB-R1**	**BB-R2**	**BB-R3**	**UT4-R1**	**UT4-R2**
Pre-project length (feet)	535	1,827	822	410	391	227	1,315	289	338	986	2,080	478	4,624	1,722
Post-project (feet)	538	1,822	851	410	531	215	1,270	287	551	865	1,746	678	4,200	1,760
Valley confinement (Confined, moderately confined, unconfined)	mod confined	mod confined	mod confined	mod confined	mod confined	mod confined	confined	mod confined	unconfined	unconfined	unconfined	unconfined	unconfined	unconfined
Drainage area (acres)	41.2	135	166.4	4.6	41.6	15.8	28.3	3.1	76.8	409.6	480	563.2	153.6	224
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Intermittent	Intermittent	Intermittent	Perennial/Int	Intermittent	Perennial/Int	Perennial	Perennial	Perennial	Perennial/Int	Perennial
NCDWR Water Quality Classification	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Dominant Stream Classification (existing)	G4c/B4c	F4	E4	G5	E5	F4	F4	B4a	E5 (incised)	B4c	E4 (incised)	E4 (incised)	B4c/F4	E5
Dominant Stream Classification (proposed)	B4	F4	E4	G5	E5	B4	B4	B4a	C4	C4	C4	C4	B4/C4b	E5
Dominant Evolutionary class (Simon) if applicable	II/III	V/VI	V/VI	VI	III	I	III/IV	III	II/III	IV	IV/V	IV	IV/V	III/IV

Wetland Summary Information														
Parameters	**W1**	**W1A**	**W2**	**W3**	**W4**	**W4A**	**W5**	**W5A**	**W5B**	**W6A**	**W6B**	**W7**	**W8A**	**W9**
Pre-project (acres)	0.859	0.000	0.524	0.906	0.321	0.000	0.203	0.097	0.010	0.251	0.045	0.041	0.000	0.000
Post-project (acres)	0.783	1.227	0.511	0.886	0.319	0.807	0.203	0.097	0.007	0.251	0.045	0.041	0.107	0.817
Wetland Type (non-riparian, riparian)	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine	riparian riverine
Mapped Soil Series	Codorus loam	Codorus loam & Dan River & Comus	Fairview-Poplar Forest Complex	Fairview-Poplar Forest Complex	Codorus loam	Codorus loam	Clifford sandy clay loam	Clifford sandy clay loam	Fairview-Poplar Forest Complex	Fairview-Poplar Forest Complex	Fairview-Poplar Forest Complex	Fairview-Poplar Forest Complex	Dan River & Comus	Dan River & Comus
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric	Hydric

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
Essential Fisheries Habitat	No	N/A	N/A

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 (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 2021 and the as-built survey was completed in June 2021. Cattle were excluded with temporary fencing prior to construction and permanent fencing was completed in May 2021. Baseline monitoring activities occurred in April 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, wetland areas, or changes in vegetation species planted. No major issues or mitigating factors were observed immediately after construction which require consideration or remedial action. Along UT3, the channel alignment was adjusted from approximate design station 10+00 to 10+78 due to an upstream flow path alteration and tie in location near the property line. Lower UT1B was also slightly adjusted from approximate design station 14+25 to 14+88 at the UT1-R2 confluence to protect existing vegetation and prevent root damage within the dripline. The in-stream structure installation generally followed the proposed design in these locations. Additional log steps were installed along upper UT3 and a constructed riffle was omitted along lower UT1B.

4.4 Morphological Assessment

Morphological data for the as-built profile was collected in April 2021. 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. 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. Overall 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.

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.

4.4.3 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.

4.5 Stream Hydrology

4.5.1 Stream Flow

Six pressure transducers (flow gauges) were installed in April 2021 on reaches UT1A, UT1C, UT2, UT2A, UT3, and UT4-R1 to document baseflow conditions. The flow gauge locations are within the upper one-third of the project reaches as shown on the CCPVs and data will be included in the Monitoring Year 1 Report.

4.5.2 Bankfull Events

Three crest gauges were installed in April 2021 to document bankfull events. WLS installed a conventional cork crest gauge, along with a pressure transducer to validate flood status on UT2, BB-R2, UT4-R2. Stream hydrology data will be included in the Monitoring Year 1 Report in this section and in the appendices. Recorder locations are shown on the CCPV's.

4.6 Wetlands

Nine groundwater wells were installed in April 2021 to monitor wetland hydrology. Groundwater well locations are shown on the CCPV's, and the data will be included subsequent monitoring reports.

4.7 Vegetation

Monitoring of the 20 permanent vegetation plots and two random transects was completed during April 2021. Vegetation data photos can be found in Appendix B. The MY0 average planted density is 850 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 also meeting the interim measure requirements and has 648 – 1,133 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.

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

Appendix A:
Visual Assessment Data

Visual Stream Morphology Stability Assessment Table Vegetation Condition Assessment Table
Photos: Cross Section Photos
Photos: Stream Photo Stations (EII Reaches and Culvert & Ford Crossings)

Visual Stream Stability Assessment						
Reach		UT1-R1, UT1-R2, UT1-R3, UT1A, UT1B, UT1C, UT2, UT2A, UT3, BB-R1, BB-R2, BB-R3, UT4-R1, UT4-R2				
Assessed Stream Length		15,724				
Assessed Bank Length		31,021				
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.	303	303		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)	85	85		100%

Visual Vegetation Assessment				
Planted acreage	**30**			
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	**41**			
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	

BB-R1, XS1, Upstream (MY-00)

BB-R1, XS1, Left Bank (MY-00)

BB-R1, XS1, Downstream (MY-00)

BB-R1, XS1, Right Bank (MY-00)

BB-R1, XS2, Upstream (MY-00)

BB-R1, XS2, Left Bank (MY-00)

BB-R1, XS2, Downstream (MY-00)

BB-R1, XS2, Right Bank (MY-00)

UT2, XS3, Upstream (MY-00)

UT2, XS3, Left Bank (MY-00)

UT2, XS3, Downstream (MY-00)

UT2, XS3, Right Bank (MY-00)

UT2, XS4, Upstream (MY-00)

UT2, XS4, Left Bank (MY-00)

UT2, XS4, Downstream (MY-00)

UT2, XS4, Right Bank (MY-00)

BB-R2, XS5, Upstream (MY-00)

BB-R2, XS5, Left Bank (MY-00)

BB-R2, XS5, Downstream (MY-00)

BB-R2, XS5, Right Bank (MY-00)

BB-R2, XS6, Upstream (MY-00)

BB-R2, XS6, Left Bank (MY-00)

BB-R2, XS6, Downstream (MY-00)

BB-R2, XS6, Right Bank (MY-00)

BB-R2, XS7, Upstream (MY-00)

BB-R2, XS7, Left Bank (MY-00)

BB-R2, XS7, Downstream (MY-00)

BB-R2, XS7, Right Bank (MY-00)

BB-R2, XS8, Upstream (MY-00)

BB-R2, XS8, Left Bank (MY-00)

BB-R2, XS8, Downstream (MY-00)

BB-R2, XS8, Right Bank (MY-00)

UT3, XS9, Upstream (MY-00)

UT3, XS9, Left Bank (MY-00)

UT3, XS9, Downstream (MY-00)

UT3, XS9, Right Bank (MY-00)

UT3, XS10, Upstream (MY-00)

UT3, XS10, Left Bank (MY-00)

UT3, XS10, Downstream (MY-00)

UT3, XS10, Right Bank (MY-00)

BB-R3, XS11, Upstream (MY-00)

BB-R3, XS11, Left Bank (MY-00)

BB-R3, XS11, Downstream (MY-00)

BB-R3, XS11, Right Bank (MY-00)

BB-R3, XS12, Upstream (MY-00)

BB-R3, XS12, Left Bank (MY-00)

BB-R3, XS12, Downstream (MY-00)

BB-R3, XS12, Right Bank (MY-00)

UT4-R1, XS13, Upstream (MY-00)

UT4-R1, XS13, Left Bank (MY-00)

UT4-R1, XS13, Downstream (MY-00)

UT4-R1, XS13, Right Bank (MY-00)

UT4-R1, XS14, Upstream (MY-00)

UT4-R1, XS14, Left Bank (MY-00)

UT4-R1, XS14, Downstream (MY-00)

UT4-R1, XS14, Right Bank (MY-00)

UT4-R1, XS15, Upstream (MY-00)

UT4-R1, XS15, Left Bank (MY-00)

UT4-R1, XS15, Downstream (MY-00)

UT4-R1, XS15, Right Bank (MY-00)

UT4-R1, XS16, Upstream (MY-00)

UT4-R1, XS16, Left Bank (MY-00)

UT4-R1, XS16, Downstream (MY-00)

UT4-R1, XS16, Right Bank (MY-00)

UT4-R1, XS17, Upstream (MY-00)

UT4-R1, XS17, Left Bank (MY-00)

UT4-R1, XS17, Downstream (MY-00)

UT4-R1, XS17, Right Bank (MY-00)

UT4-R1, XS18, Upstream (MY-00)

UT4-R1, XS18, Left Bank (MY-00)

UT4-R1, XS18, Downstream (MY-00)

UT4-R1, XS18, Right Bank (MY-00)

UT4-R2, XS19, Upstream (MY-00)

UT4-R2, XS19, Left Bank (MY-00)

UT4-R2, XS19, Downstream (MY-00)

UT4-R2, XS19, Right Bank (MY-00)

UT4-R2, XS20, Upstream (MY-00)

UT4-R2, XS20, Left Bank (MY-00)

UT4-R2, XS20, Downstream (MY-00)

UT4-R2, XS20, Right Bank (MY-00)

PS-1 – UT1-R1, EII, Upstream (MY-00)

PS-1 – UT1-R1, EII, Downstream (MY-00)

PS-2 – UT1-R1 Culvert Crossing, Upstream (MY-00)

PS-2 – UT1-R1 Culvert Crossing, Downstream (MY-00)

PS-3 – UT1A, EII, Upstream (MY-00)

PS-3 – UT1A, EII, Downstream (MY-00)

PS-4 – UT1-R2, EII, Upstream (MY-00)

PS-4 – UT1-R2, EII, Downstream (MY-00)

PS-5 – UT1B, EII, Upstream (MY-00)

PS-5 – UT1B, EII, Downstream (MY-00)

PS-6 – UT1-R2 Culvert Crossing, Upstream (MY-00)

PS-6 – UT1-R2 Culvert Crossing, Downstream (MY-00)

PS-7 – UT2 Ford Crossing, Upstream (MY-00)

PS-7 – UT2 Ford Crossing, Downstream (MY-00)

PS-8 – BB-R2 Ford Crossing, Upstream (MY-00)

PS-8 – BB-R2 Ford Crossing, Downstream (MY-00)

PS-9 – UT4-R1 Culvert Crossing, Upstream (MY-00)

PS-9 – UT4-R1 Culvert Crossing, Downstream (MY-00)

PS-10 – UT4-R1 Ford Crossing, Upstream (MY-00)

PS-10 – UT4-R1 Ford Crossing, Downstream (MY-00)

Appendix B:
Vegetation Plot Data

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

Banner Branch Mitigation Project Red-line Planting List				
Species	**Common Name**	**Stems**	**% Planted**	**Mitigation Plan %**
Fraxinus pennsylvanica	Green ash	805	4%	4%
Betula nigra	River birch	1,409	7%	8%
Tilia americana	Basswood	1,409	7%	7%
Quercus michauxii	Swamp chestnut oak	1,409	7%	8%
Platanus occidentalis	American sycamore	2,013	10%	10%
Liriodendron tulipifera	Tulip poplar	2,013	10%	10%
Quercus phellos	Willow oak	1,409	7%	7%
Nyssa sylvatica	Black gum	1,409	7%	8%
Quercus alba	White oak	1,409	7%	7%
Quercus falcata	Southern red oak	1,409	7%	7%
Carpinus caroliniana	American hornbeam	604	3%	3%
Diospyros virginiana	Persimmon	604	3%	3%
Amelanchier arborea	Common serviceberry	604	3%	3%
Hamamelis virginiana	Witch-hazel	604	3%	3%
Asimina triloba	Pawpaw	604	3%	3%
Lindera benzoin	Spicebush	604	3%	3%
Alnus serrulata	Hazel alder	604	3%	3%
Corylus americana	Hazelnut	604	3%	3%
Magnolia tripetala	Umbrella magnolia	604	3%	0%
Total		**20,130**	**100%**	

* changes from mitigation plan in red

Banner Branch Planted Stems and Densities Table	
Planted Acreage	30
Date of Initial Plant	2021-04-07
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-04-15
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 F		Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F		Veg Plot 11 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	OBL																						
	Amelanchier arborea	common serviceberry	Tree	FAC									1	1					2	2			1	1	1	1
	Asimina triloba	pawpaw	Tree	FAC			3	3									1	1	3	3	1	1	1	1	1	1
	Betula nigra	river birch	Tree	FACW			1	1	1	1	2	2			3	3					3	3	4	4	2	2
	Carpinus caroliniana	American hornbeam	Tree	FAC	3	3	1	1	1	1	2	2	1	1	1	1			1	1	1	1	3	3	3	3
	Corylus americana	American hazelnut	Shrub	FACU			1	1			1	1					1	1	1	1					1	1
	Diospyros virginiana	common persimmon	Tree	FAC							1	1					1	1					1	1		
	Fraxinus pennsylvanica	green ash	Tree	FACW	6	6							1	1					3	3	2	2			1	1
	Hamamelis virginiana	American witchhazel	Tree	FACU	1	1	2	2							1	1	1	1			1	1				
	Lindera benzoin	northern spicebush	Tree	FAC							1	1			1	1									1	1
	Liriodendron tulipifera	tuliptree	Tree	FACU			1	1	2	2	8	8	2	2	3	3	6	6	2	2	1	1	2	2	1	1
	Nyssa sylvatica	blackgum	Tree	FAC			1	1					4	4	2	2			1	1			2	2	2	2
	Platanus occidentalis	American sycamore	Tree	FACW	7	7	2	2	8	8			2	2	3	3	4	4			2	2			3	3
	Quercus alba	white oak	Tree	FACU			1	1	1	1			2	2	5	5	3	3			1	1	1	1	1	1
	Quercus falcata	southern red oak	Tree	FACU									3	3	2	2	1	1			1	1			1	1
	Quercus michauxii	swamp chestnut oak	Tree	FACW			2	2	3	3	1	1	3	3	1	1	2	2			1	1	2	2		
	Quercus phellos	willow oak	Tree	FAC	1	1	4	4	2	2	2	2	2	2	1	1							1	1	2	2
	Tilia americana	American basswood	Tree	FACU	1	1	1	1							2	2			1	1						
Sum	Performance Standard				19	19	20	20	18	18	18	18	21	21	25	25	20	20	14	14	14	14	18	18	20	20
Post Mitigation Plan Species	Magnolia tripetala	umbrella-tree	Tree	FACU													1	1	2	2	2	2			1	1
Sum	Proposed Standard				19	19	20	20	18	18	18	18	21	21	25	25	21	21	16	16	16	16	18	18	21	21
Mitigation Plan Performance Standard	Current Year Stem Count					19		20		18		18		21		25		20		14		14		18		20
	Stems/Acre					769		810		729		729		850		1012		810		567		567		729		810
	Species Count					6		12		7		8		10		12		9		8		10		10		13
	Dominant Species Composition (%)					37		20		44		44		19		20		29		19		19		22		14
	Average Plot Height					2		2		1		1		2		2		2		2		2		2		2
	% Invasives					0		0		0		0		0		0		0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					19		20		18		18		21		25		21		16		16		18		21
	Stems/Acre					769		810		729		729		850		1012		850		648		648		729		850
	Species Count					6		12		7		8		10		12		10		9		11		10		14
	Dominant Species Composition (%)					37		20		44		44		19		20		29		19		19		22		14
	Average Plot Height					2		2		1		1		2		2		2		2		2		2		2
	% Invasives					0		0		0		0		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.

Banner Branch Planted Stems and Densities Table	
Planted Acreage	30
Date of Initial Plant	2021-04-07
Date(s) of Supplemental Plant(s)	#N/A
Date(s) Mowing	#N/A
Date of Current Survey	2021-04-15
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 12 F		Veg Plot 13 F		Veg Plot 14 F		Veg Plot 15 F		Veg Plot 16 F		Veg Plot 17 F		Veg Plot 18 F		Veg Plot 19 F		Veg Plot 20 F		Veg Plot 21 R	Veg Plot 22 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total	Total
Species Included in Approved Mitigation Plan	Alnus serrulata	hazel alder	Tree	OBL	1	1							1	1	1	1	2	2			1	1	3	
	Amelanchier arborea	common serviceberry	Tree	FAC			4	4	1	1					3	3	1	1			2	2		
	Asimina triloba	pawpaw	Tree	FAC			2	2			2	2	2	2	3	3	1	1			2	2	1	1
	Betula nigra	river birch	Tree	FACW							3	3			2	2			3	3				
	Carpinus caroliniana	American hornbeam	Tree	FAC			1	1			5	5	1	1			1	1	1	1	1	1	1	
	Corylus americana	American hazelnut	Shrub	FACU	2	2	1	1			2	2	1	1	1	1	2	2	1	1			1	3
	Diospyros virginiana	common persimmon	Tree	FAC	1	1	1	1	2	2	1	1	1	1	1	1			3	3	1	1	1	
	Fraxinus pennsylvanica	green ash	Tree	FACW	4	4	3	3					3	3	1	1			2	2			3	
	Hamamelis virginiana	American witchhazel	Tree	FACU	1	1			3	3	1	1					2	2	1	1	2	2		
	Lindera benzoin	northern spicebush	Tree	FAC	1	1					1	1	2	2	2	2			2	2				
	Liriodendron tulipifera	tuliptree	Tree	FACU			1	1	1	1	1	1	2	2	5	5	1	1	3	3	2	2		2
	Nyssa sylvatica	blackgum	Tree	FAC	1	1	1	1	2	2			4	4			4	4			2	2		1
	Platanus occidentalis	American sycamore	Tree	FACW	2	2					2	2	1	1	1	1			3	3			2	1
	Quercus alba	white oak	Tree	FACU	2	2	1	1	3	3	3	3	1	1	1	1					2	2	2	3
	Quercus falcata	southern red oak	Tree	FACU	1	1	1	1	5	5	2	2	1	1	2	2	3	3			4	4	1	4
	Quercus michauxii	swamp chestnut oak	Tree	FACW	2	2	3	3	1	1	1	1	1	1	2	2	2	2						1
	Quercus phellos	willow oak	Tree	FAC	3	3	1	1	1	1			1	1			1	1	1	1			2	3
	Tilia americana	American basswood	Tree	FACU	2	2	1	1	2	2			4	4	2	2	2	2	1	1	1	1	1	
Sum	Performance Standard				23	23	21	21	21	21	24	24	26	26	27	27	22	22	21	21	20	20	18	19
Post Mitigation Plan Species	Magnolia tripetala	umbrella-tree	Tree	FACU			1	1	1	1	1	1	1	1	1	1			1	1				
Sum	Proposed Standard				23	23	22	22	22	22	25	25	27	27	28	28	22	22	22	22	20	20	18	19
Mitigation Plan Performance Standard	Current Year Stem Count					23		21		21		24		26		27		22		21		20	18	19
	Stems/Acre					931		850		850		972		1052		1093		891		850		810	729	769
	Species Count					13		13		10		12		15		14		12		11		11	11	9
	Dominant Species Composition (%)					17		19		23		20		15		18		18		14		20	17	21
	Average Plot Height					2		2		2		2		2		2		2		2		2	1	2
	% Invasives					0		0		0		0		0		0		0		0		0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count					23		22		22		25		27		28		22		22		20	18	19
	Stems/Acre					931		891		891		1012		1093		1133		891		891		810	729	769
	Species Count					13		14		11		13		16		15		12		12		11	11	9
	Dominant Species Composition (%)					17		18		23		20		15		18		18		14		20	17	21
	Average Plot Height					2		2		2		2		2		2		2		2		2	1	2
	% Invasives					0		0		0		0		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.

Vegetation Performance Standards Summary Table

	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	769		6	0	810		12	0	729		7	0
	Veg Plot 4 F				Veg Plot 5 F				Veg Plot 6 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	729		8	0	850		10	0	1012		12	0
	Veg Plot 7 F				Veg Plot 8 F				Veg Plot 9 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	810		10	0	567		9	0	567		11	0
	Veg Plot 10 F				Veg Plot 11 F				Veg Plot 12 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	729		10	0	810		14	0	931		13	0
	Veg Plot 13 F				Veg Plot 14 F				Veg Plot 15 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	891		14	0	850		11	0	972		13	0
	Veg Plot 16 F				Veg Plot 17 F				Veg Plot 18 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	1052		16	0	1093		15	0	891		12	0
	Veg Plot 19 F				Veg Plot 20 F				Veg Plot Group 1 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		12	0	810		11	0	729		11	0
	Veg Plot Group 2 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.

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)

Fixed Veg Plot 7 (MY-00)

Fixed Veg Plot 6 (MY-00)

Fixed Veg Plot 8 (MY-00)

Fixed Veg Plot 9 (MY-00)

Fixed Veg Plot 11 (MY-00)

Fixed Veg Plot 10 (MY-00)

Fixed Veg Plot 12 (MY-00)

Fixed Veg Plot 13 (MY-00)

Fixed Veg Plot 15 (MY-00)

Fixed Veg Plot 14 (MY-00)

Fixed Veg Plot 16 (MY-00)

Fixed Veg Plot 17 (MY-00)

Fixed Veg Plot 19 (MY-00)

Fixed Veg Plot 18 (MY-00)

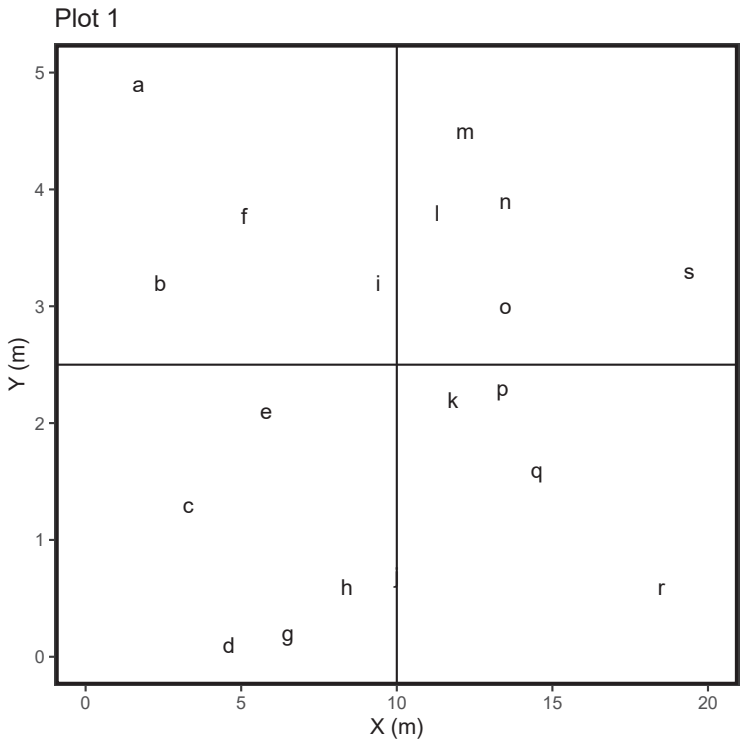
Fixed Veg Plot 20 (MY-00)

Random Veg Plot 21 (View South) (MY-00)

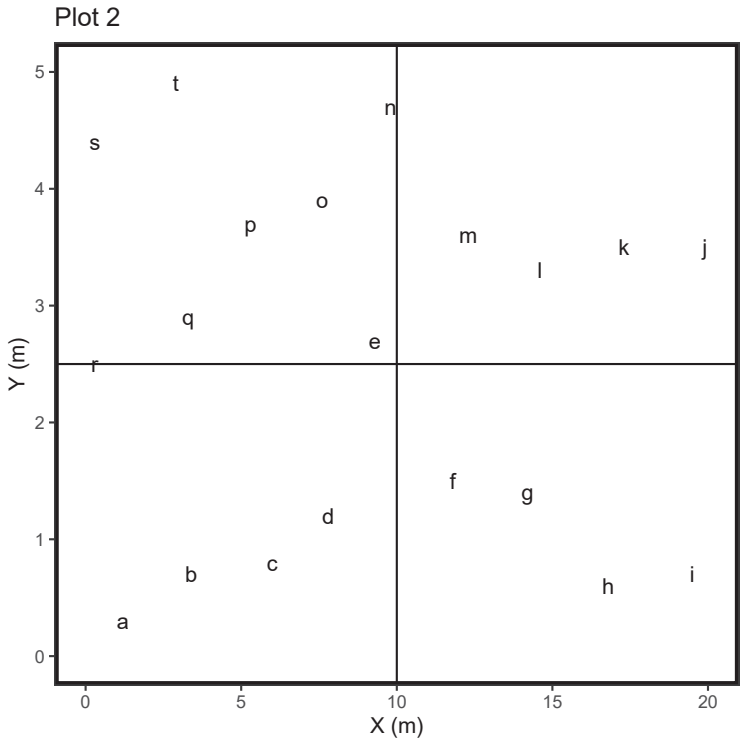
Random Veg Plot 21 (View North) (MY-00)

Random Veg Plot 22 (View North) (MY-00)

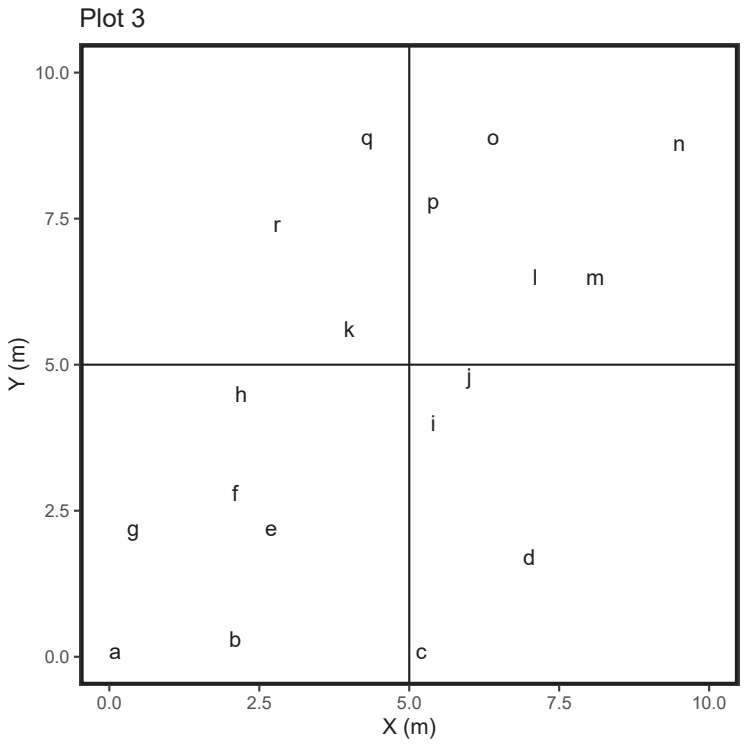
Random Veg Plot 22 (View South) (MY-00)



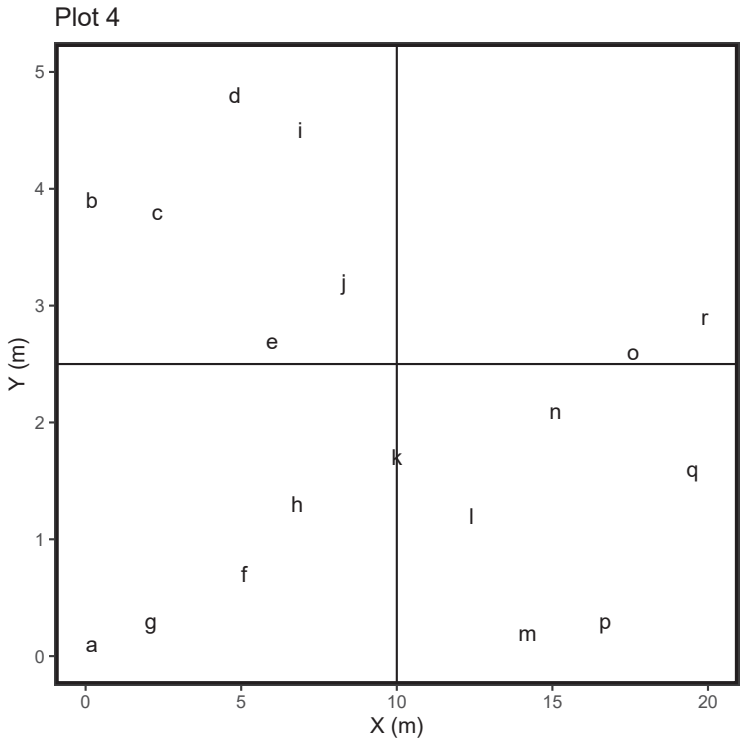
Plot #	Scientific Name	Common Name	Mapped Stem Label
1	Tilia americana	American basswood	a
1	Fraxinus pennsylvanica	green ash	b
1	Platanus occidentalis	American sycamore	c
1	Platanus occidentalis	American sycamore	d
1	Fraxinus pennsylvanica	green ash	e
1	Fraxinus pennsylvanica	green ash	f
1	Fraxinus pennsylvanica	green ash	g
1	Hamamelis virginiana	American witchhazel	h
1	Carpinus caroliniana	American hornbeam	i
1	Carpinus caroliniana	American hornbeam	j
1	Platanus occidentalis	American sycamore	k
1	Carpinus caroliniana	American hornbeam	l
1	Platanus occidentalis	American sycamore	m
1	Fraxinus pennsylvanica	green ash	n
1	Fraxinus pennsylvanica	green ash	o
1	Quercus phellos	willow oak	p
1	Platanus occidentalis	American sycamore	q
1	Platanus occidentalis	American sycamore	r
1	Platanus occidentalis	American sycamore	s



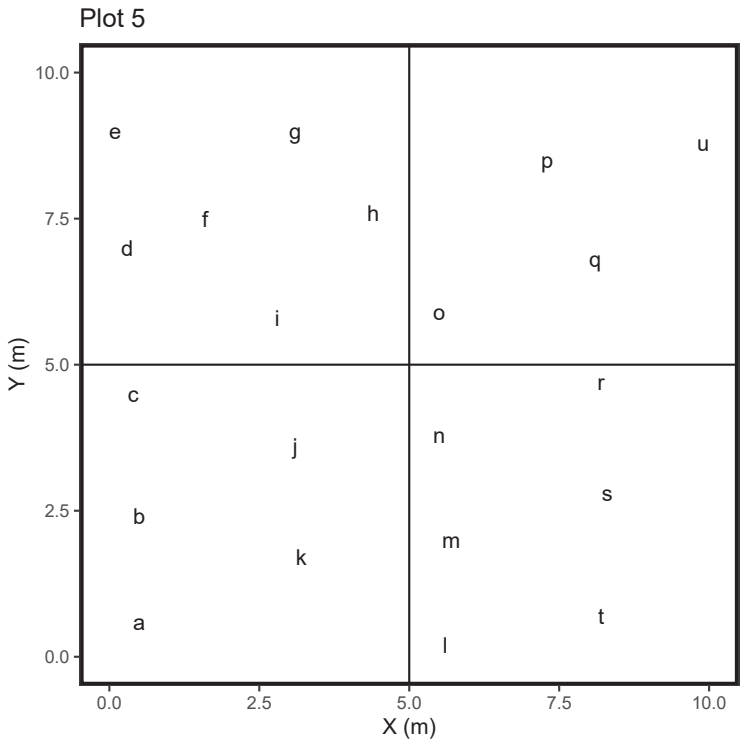
Plot #	Scientific Name	Common Name	Mapped Stem Label
2	Quercus phellos	willow oak	a
2	Tilia americana	American basswood	b
2	Hamamelis virginiana	American witchhazel	c
2	Hamamelis virginiana	American witchhazel	d
2	Asimina triloba	pawpaw	e
2	Quercus michauxii	swamp chestnut oak	f
2	Asimina triloba	pawpaw	g
2	Asimina triloba	pawpaw	h
2	Platanus occidentalis	American sycamore	i
2	Platanus occidentalis	American sycamore	j
2	Quercus phellos	willow oak	k
2	Quercus michauxii	swamp chestnut oak	l
2	Carpinus caroliniana	American hornbeam	m
2	Liriodendron tulipifera	tuliptree	n
2	Corylus americana	American hazelnut	o
2	Nyssa sylvatica	blackgum	p
2	Quercus phellos	willow oak	q
2	Quercus alba	white oak	r
2	Betula nigra	river birch	s
2	Quercus phellos	willow oak	t



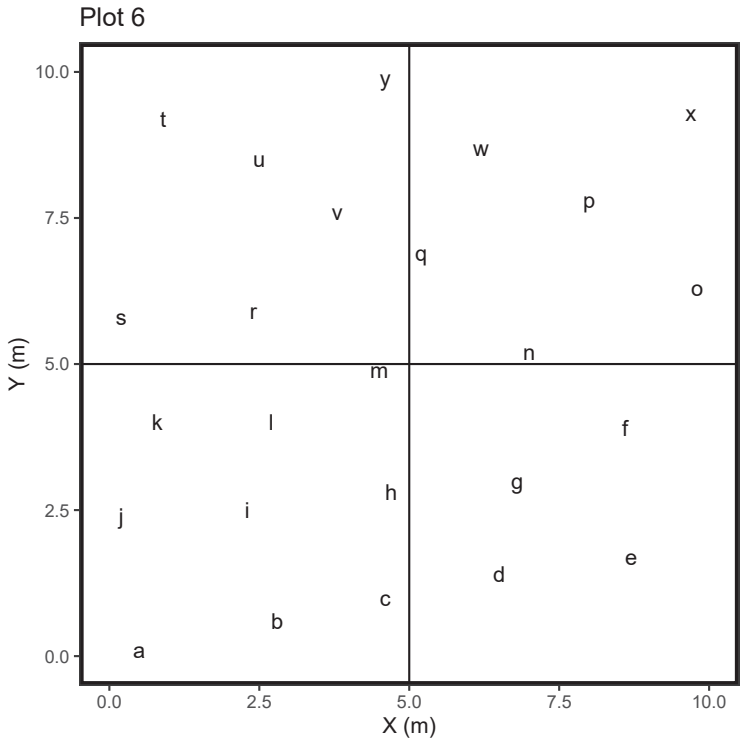
Plot #	Scientific Name	Common Name	Mapped Stem Label
3	Platanus occidentalis	American sycamore	a
3	Liriodendron tulipifera	tuliptree	b
3	Platanus occidentalis	American sycamore	c
3	Platanus occidentalis	American sycamore	d
3	Quercus michauxii	swamp chestnut oak	e
3	Platanus occidentalis	American sycamore	f
3	Platanus occidentalis	American sycamore	g
3	Liriodendron tulipifera	tuliptree	h
3	Quercus phellos	willow oak	i
3	Quercus phellos	willow oak	j
3	Quercus alba	white oak	k
3	Carpinus caroliniana	American hornbeam	l
3	Quercus michauxii	swamp chestnut oak	m
3	Betula nigra	river birch	n
3	Platanus occidentalis	American sycamore	o
3	Quercus michauxii	swamp chestnut oak	p
3	Platanus occidentalis	American sycamore	q
3	Platanus occidentalis	American sycamore	r



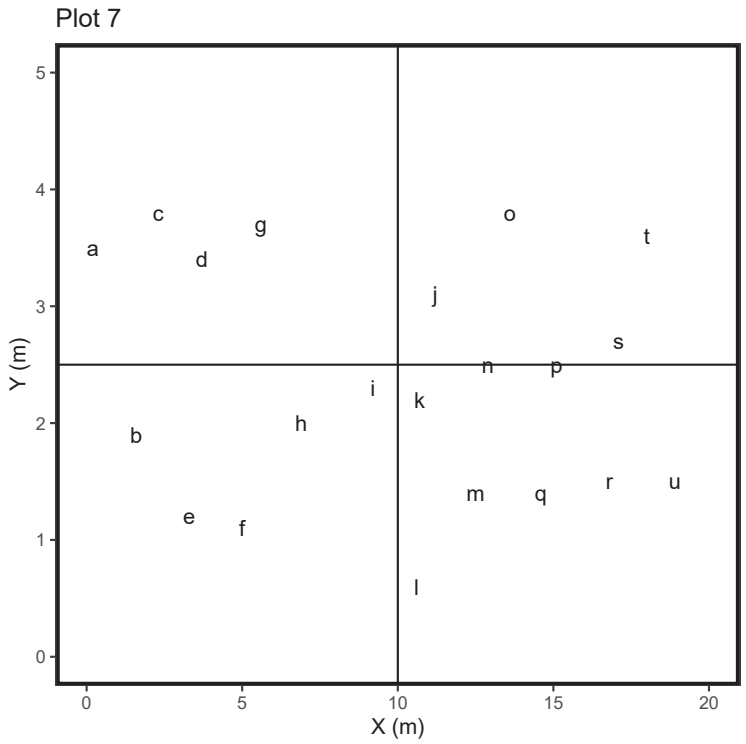
Plot #	Scientific Name	Common Name	Mapped Stem Label
4	Carpinus caroliniana	American hornbeam	a
4	Liriodendron tulipifera	tuliptree	b
4	Quercus phellos	willow oak	c
4	Liriodendron tulipifera	tuliptree	d
4	Liriodendron tulipifera	tuliptree	e
4	Liriodendron tulipifera	tuliptree	f
4	Liriodendron tulipifera	tuliptree	g
4	Corylus americana	American hazelnut	h
4	Carpinus caroliniana	American hornbeam	i
4	Lindera benzoin	northern spicebush	j
4	Diospyros virginiana	common persimmon	k
4	Quercus phellos	willow oak	l
4	Liriodendron tulipifera	tuliptree	m
4	Liriodendron tulipifera	tuliptree	n
4	Quercus michauxii	swamp chestnut oak	o
4	Liriodendron tulipifera	tuliptree	p
4	Betula nigra	river birch	q
4	Betula nigra	river birch	r



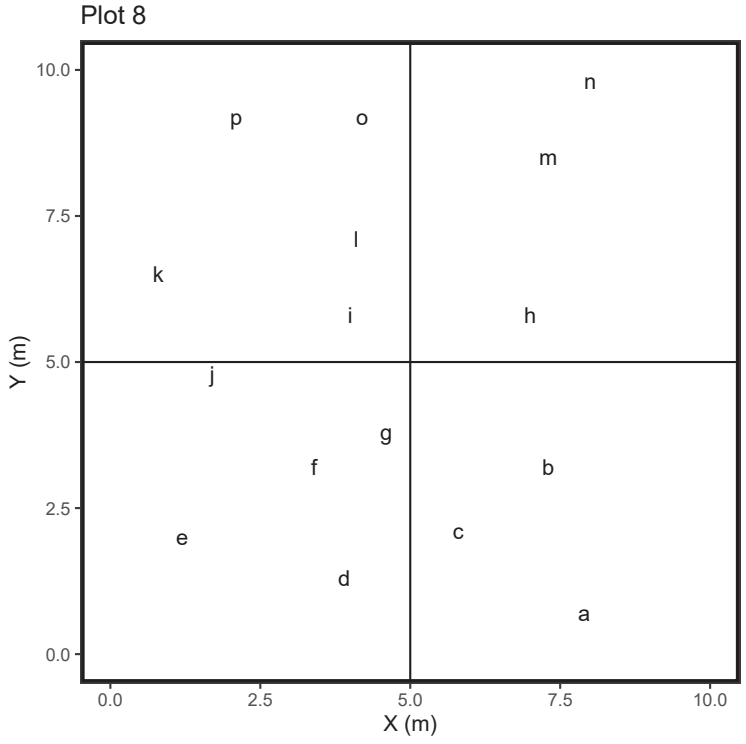
Plot #	Scientific Name	Common Name	Mapped Stem Label
5	Platanus occidentalis	American sycamore	a
5	Nyssa sylvatica	blackgum	b
5	Liriodendron tulipifera	tuliptree	c
5	Quercus falcata	southern red oak	d
5	Fraxinus pennsylvanica	green ash	e
5	Amelanchier arborea	common serviceberry	f
5	Quercus phellos	willow oak	g
5	Platanus occidentalis	American sycamore	h
5	Quercus phellos	willow oak	i
5	Quercus michauxii	swamp chestnut oak	j
5	Quercus alba	white oak	k
5	Liriodendron tulipifera	tuliptree	l
5	Quercus michauxii	swamp chestnut oak	m
5	Quercus falcata	southern red oak	n
5	Nyssa sylvatica	blackgum	o
5	Quercus alba	white oak	p
5	Quercus falcata	southern red oak	q
5	Quercus michauxii	swamp chestnut oak	r
5	Nyssa sylvatica	blackgum	s
5	Nyssa sylvatica	blackgum	t
5	Carpinus caroliniana	American hornbeam	u



Plot #	Scientific Name	Common Name	Mapped Stem Label
6	Tilia americana	American basswood	a
6	Quercus alba	white oak	b
6	Quercus phellos	willow oak	c
6	Quercus michauxii	swamp chestnut oak	d
6	Quercus alba	white oak	e
6	Liriodendron tulipifera	tuliptree	f
6	Betula nigra	river birch	g
6	Platanus occidentalis	American sycamore	h
6	Nyssa sylvatica	blackgum	i
6	Betula nigra	river birch	j
6	Quercus falcata	southern red oak	k
6	Quercus alba	white oak	l
6	Nyssa sylvatica	blackgum	m
6	Quercus alba	white oak	n
6	Hamamelis virginiana	American witchhazel	o
6	Platanus occidentalis	American sycamore	p
6	Quercus falcata	southern red oak	q
6	Quercus alba	white oak	r
6	Liriodendron tulipifera	tuliptree	s
6	Carpinus caroliniana	American hornbeam	t
6	Betula nigra	river birch	u
6	Platanus occidentalis	American sycamore	v
6	Liriodendron tulipifera	tuliptree	w
6	Lindera benzoin	northern spicebush	x
6	Tilia americana	American basswood	y

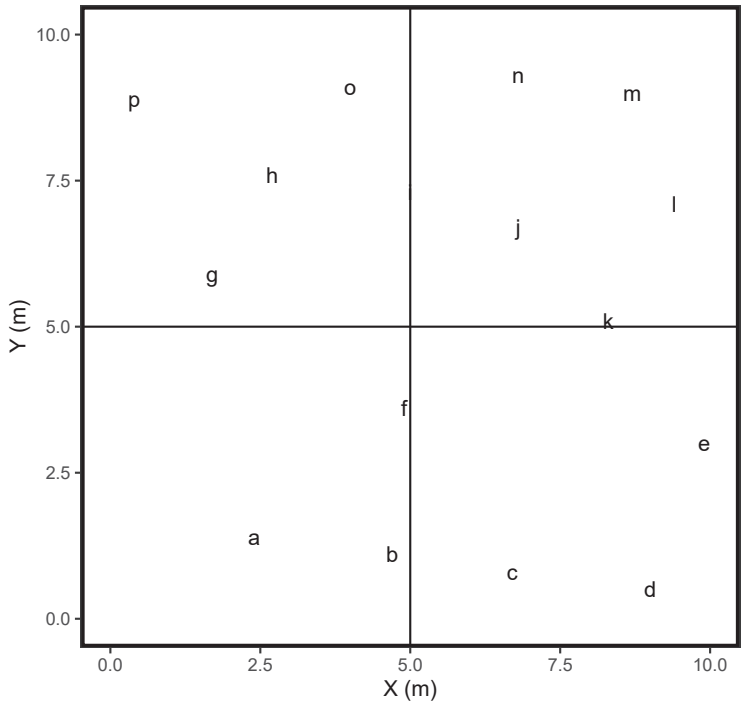


Plot #	Scientific Name	Common Name	Mapped Stem Label
7	Magnolia tripetala	umbrella-tree	a
7	Corylus americana	American hazelnut	b
7	Quercus alba	white oak	c
7	Quercus alba	white oak	d
7	Quercus michauxii	swamp chestnut oak	e
7	Quercus michauxii	swamp chestnut oak	f
7	Asimina triloba	pawpaw	g
7	Liriodendron tulipifera	tuliptree	h
7	Liriodendron tulipifera	tuliptree	i
7	Liriodendron tulipifera	tuliptree	j
7	Liriodendron tulipifera	tuliptree	k
7	Platanus occidentalis	American sycamore	l
7	Quercus falcata	southern red oak	m
7	Liriodendron tulipifera	tuliptree	n
7	Liriodendron tulipifera	tuliptree	o
7	Diospyros virginiana	common persimmon	p
7	Platanus occidentalis	American sycamore	q
7	Hamamelis virginiana	American witchhazel	r
7	Quercus alba	white oak	s
7	Platanus occidentalis	American sycamore	t
7	Platanus occidentalis	American sycamore	u



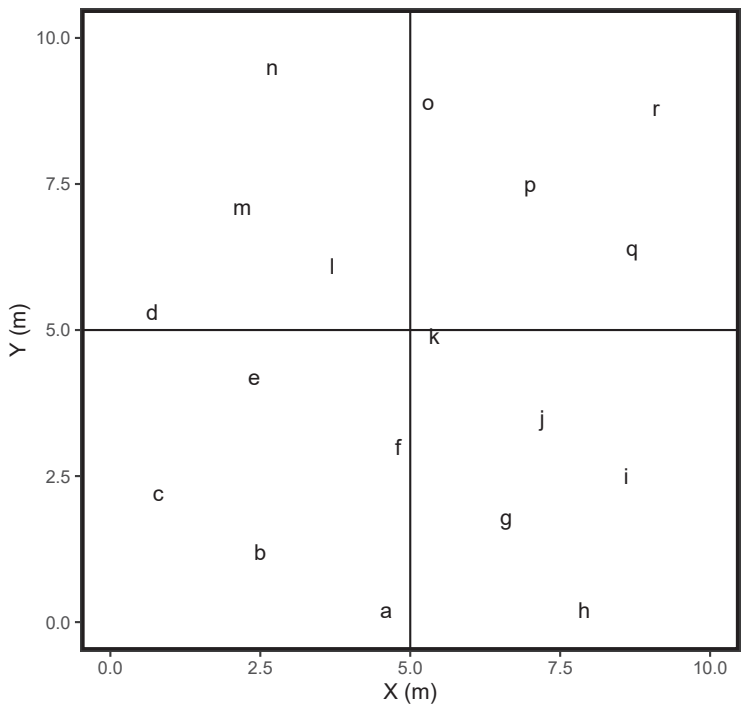
Plot #	Scientific Name	Common Name	Mapped Stem Label
8	Nyssa sylvatica	blackgum	a
8	Fraxinus pennsylvanica	green ash	b
8	Magnolia tripetala	umbrella-tree	c
8	Liriodendron tulipifera	tuliptree	d
8	Magnolia tripetala	umbrella-tree	e
8	Asimina triloba	pawpaw	f
8	Asimina triloba	pawpaw	g
8	Amelanchier arborea	common serviceberry	h
8	Amelanchier arborea	common serviceberry	i
8	Liriodendron tulipifera	tuliptree	j
8	Asimina triloba	pawpaw	k
8	Corylus americana	American hazelnut	l
8	Carpinus caroliniana	American hornbeam	m
8	Fraxinus pennsylvanica	green ash	n
8	Fraxinus pennsylvanica	green ash	o
8	Tilia americana	American basswood	p

Plot 9

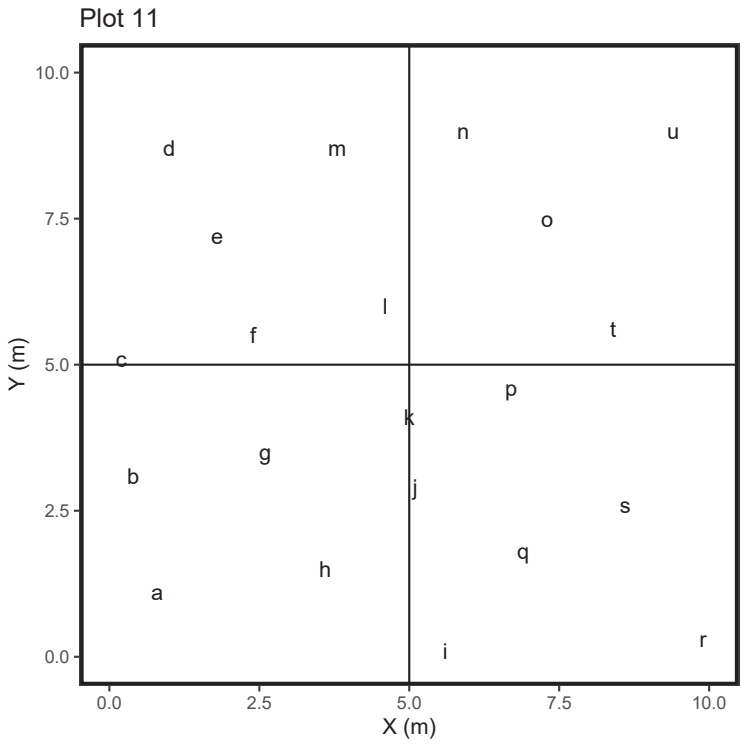


Plot #	Scientific Name	Common Name	Mapped Stem Label
9	Fraxinus pennsylvanica	green ash	a
9	Betula nigra	river birch	b
9	Quercus alba	white oak	c
9	Asimina triloba	pawpaw	d
9	Quercus falcata	southern red oak	e
9	Platanus occidentalis	American sycamore	f
9	Hamamelis virginiana	American witchhazel	g
9	Carpinus caroliniana	American hornbeam	h
9	Liriodendron tulipifera	tuliptree	i
9	Platanus occidentalis	American sycamore	j
9	Betula nigra	river birch	k
9	Magnolia tripetala	umbrella-tree	l
9	Fraxinus pennsylvanica	green ash	m
9	Quercus michauxii	swamp chestnut oak	n
9	Betula nigra	river birch	o
9	Magnolia tripetala	umbrella-tree	p

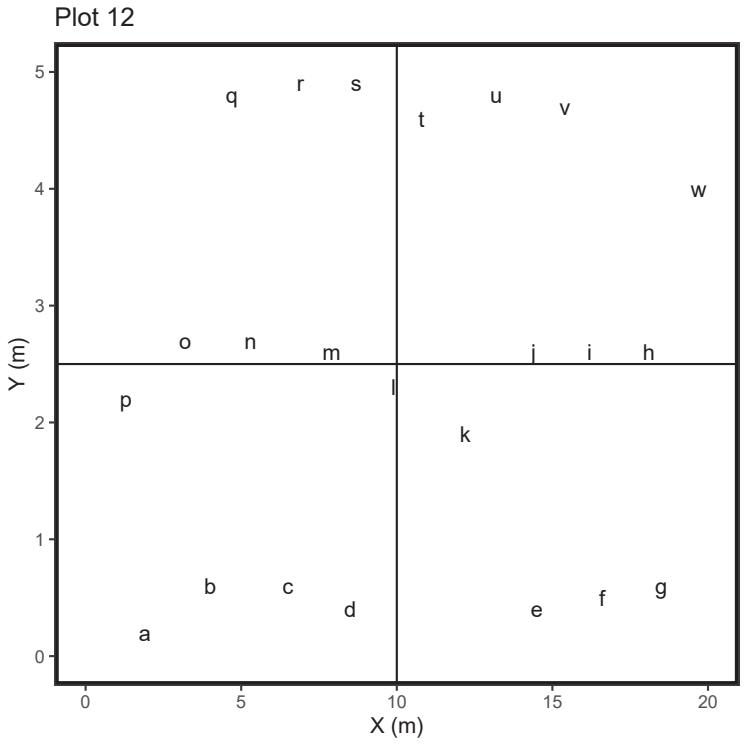
Plot 10



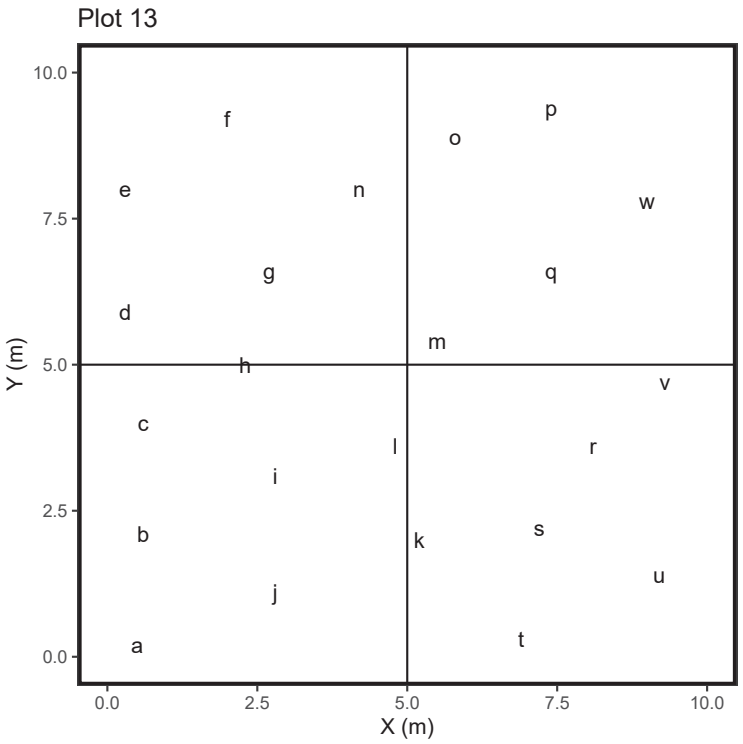
Plot #	Scientific Name	Common Name	Mapped Stem Label
10	Quercus phellos	willow oak	a
10	Nyssa sylvatica	blackgum	b
10	Nyssa sylvatica	blackgum	c
10	Diospyros virginiana	common persimmon	d
10	Amelanchier arborea	common serviceberry	e
10	Liriodendron tulipifera	tuliptree	f
10	Quercus alba	white oak	g
10	Liriodendron tulipifera	tuliptree	h
10	Carpinus caroliniana	American hornbeam	i
10	Quercus michauxii	swamp chestnut oak	j
10	Carpinus caroliniana	American hornbeam	k
10	Quercus michauxii	swamp chestnut oak	l
10	Asimina triloba	pawpaw	m
10	Betula nigra	river birch	n
10	Betula nigra	river birch	o
10	Carpinus caroliniana	American hornbeam	p
10	Betula nigra	river birch	q
10	Betula nigra	river birch	r



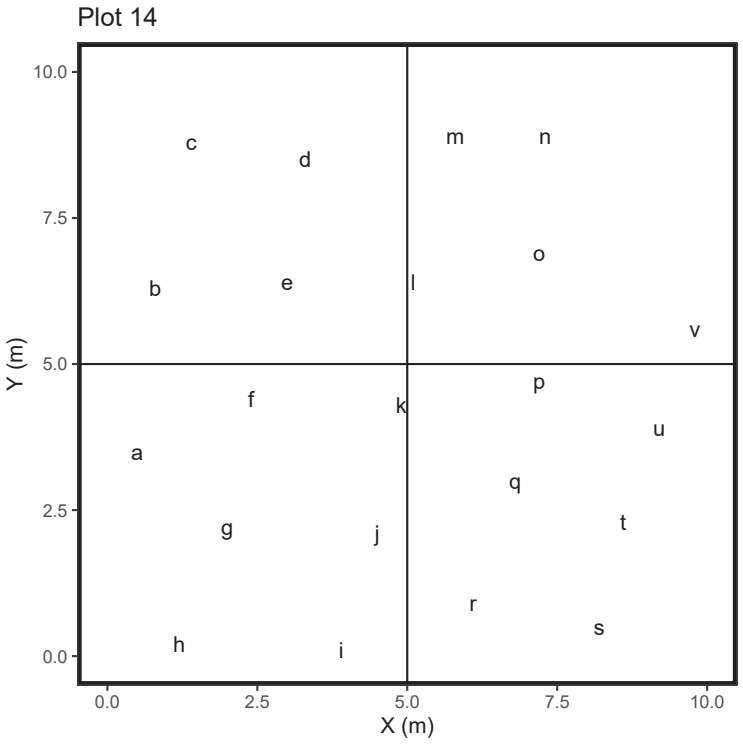
Plot #	Scientific Name	Common Name	Mapped Stem Label
11	Quercus phellos	willow oak	a
11	Quercus phellos	willow oak	b
11	Quercus falcata	southern red oak	c
11	Platanus occidentalis	American sycamore	d
11	Fraxinus pennsylvanica	green ash	e
11	Asimina triloba	pawpaw	f
11	Corylus americana	American hazelnut	g
11	Liriodendron tulipifera	tuliptree	h
11	Platanus occidentalis	American sycamore	i
11	Carpinus caroliniana	American hornbeam	j
11	Carpinus caroliniana	American hornbeam	k
11	Betula nigra	river birch	l
11	Lindera benzoin	northern spicebush	m
11	Amelanchier arborea	common serviceberry	n
11	Quercus alba	white oak	o
11	Magnolia tripetala	umbrella-tree	p
11	Platanus occidentalis	American sycamore	q
11	Nyssa sylvatica	blackgum	r
11	Nyssa sylvatica	blackgum	s
11	Carpinus caroliniana	American hornbeam	t
11	Betula nigra	river birch	u



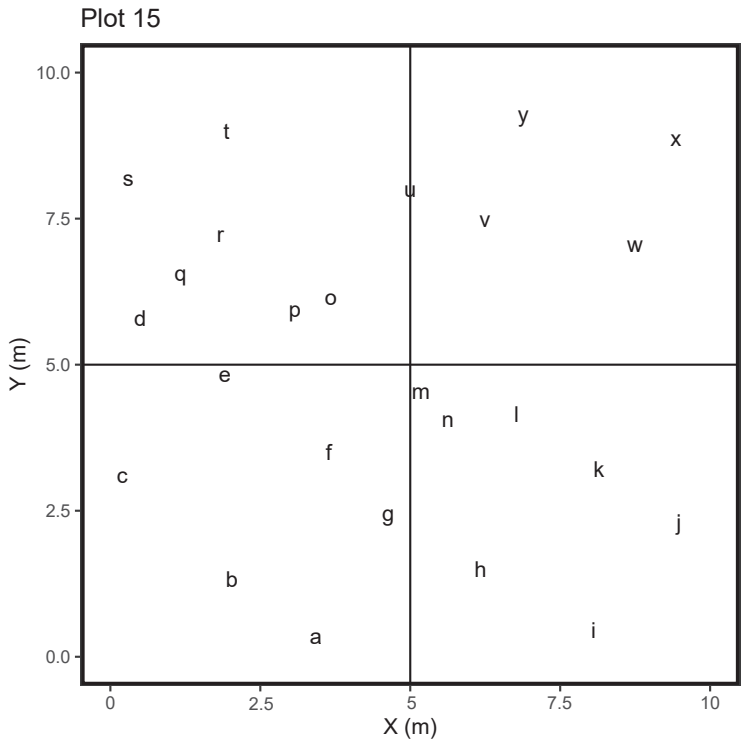
Plot #	Scientific Name	Common Name	Mapped Stem Label
12	Quercus michauxii	swamp chestnut oak	a
12	Lindera benzoin	northern spicebush	b
12	Quercus michauxii	swamp chestnut oak	c
12	Tilia americana	American basswood	d
12	Platanus occidentalis	American sycamore	e
12	Platanus occidentalis	American sycamore	f
12	Corylus americana	American hazelnut	g
12	Fraxinus pennsylvanica	green ash	h
12	Tilia americana	American basswood	i
12	Nyssa sylvatica	blackgum	j
12	Fraxinus pennsylvanica	green ash	k
12	Corylus americana	American hazelnut	l
12	Quercus falcata	southern red oak	m
12	Hamamelis virginiana	American witchhazel	n
12	Fraxinus pennsylvanica	green ash	o
12	Fraxinus pennsylvanica	green ash	p
12	Alnus serrulata	hazel alder	q
12	Quercus phellos	willow oak	r
12	Quercus phellos	willow oak	s
12	Quercus phellos	willow oak	t
12	Quercus alba	white oak	u
12	Quercus alba	white oak	v
12	Diospyros virginiana	common persimmon	w



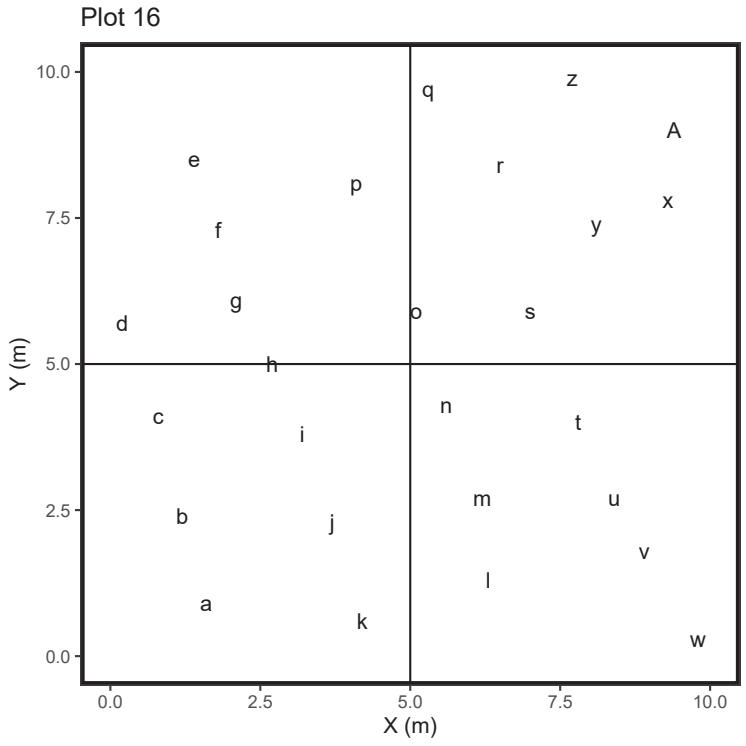
Plot #	Scientific Name	Common Name	Mapped Stem Label
13	Asimina triloba	pawpaw	a
13	Nyssa sylvatica	blackgum	b
13	Fraxinus pennsylvanica	green ash	c
13	Tilia americana	American basswood	d
13	Liriodendron tulipifera	tuliptree	e
13	Fraxinus pennsylvanica	green ash	f
13	Diospyros virginiana	common persimmon	g
13	Quercus michauxii	swamp chestnut oak	h
13	Quercus falcata	southern red oak	i
13	Liriodendron tulipifera	tuliptree	j
13	Quercus alba	white oak	k
13	Amelanchier arborea	common serviceberry	l
13	Carpinus caroliniana	American hornbeam	m
13	Quercus phellos	willow oak	n
13	Corylus americana	American hazelnut	o
13	Asimina triloba	pawpaw	p
13	Quercus michauxii	swamp chestnut oak	q
13	Amelanchier arborea	common serviceberry	r
13	Fraxinus pennsylvanica	green ash	s
13	Amelanchier arborea	common serviceberry	t
13	Amelanchier arborea	common serviceberry	u
13	Magnolia tripetala	umbrella-tree	v
13	Quercus michauxii	swamp chestnut oak	w



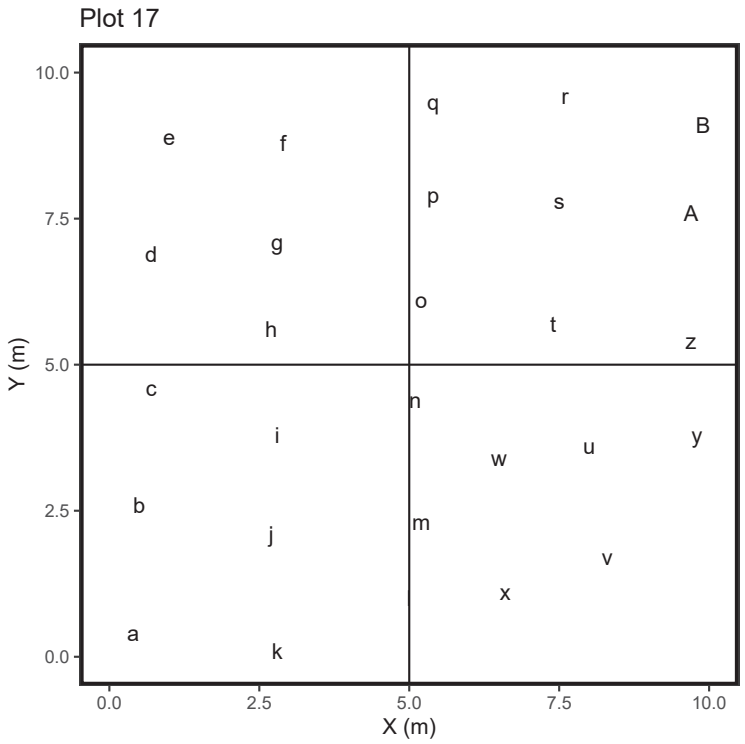
Plot #	Scientific Name	Common Name	Mapped Stem Label
14	Quercus falcata	southern red oak	a
14	Quercus falcata	southern red oak	b
14	Quercus falcata	southern red oak	c
14	Quercus michauxii	swamp chestnut oak	d
14	Diospyros virginiana	common persimmon	e
14	Nyssa sylvatica	blackgum	f
14	Nyssa sylvatica	blackgum	g
14	Amelanchier arborea	common serviceberry	h
14	Quercus falcata	southern red oak	i
14	Quercus alba	white oak	j
14	Quercus phellos	willow oak	k
14	Quercus falcata	southern red oak	l
14	Quercus alba	white oak	m
14	Hamamelis virginiana	American witchhazel	n
14	Hamamelis virginiana	American witchhazel	o
14	Liriodendron tulipifera	tuliptree	p
14	Tilia americana	American basswood	q
14	Tilia americana	American basswood	r
14	Magnolia tripetala	umbrella-tree	s
14	Hamamelis virginiana	American witchhazel	t
14	Diospyros virginiana	common persimmon	u
14	Quercus alba	white oak	v



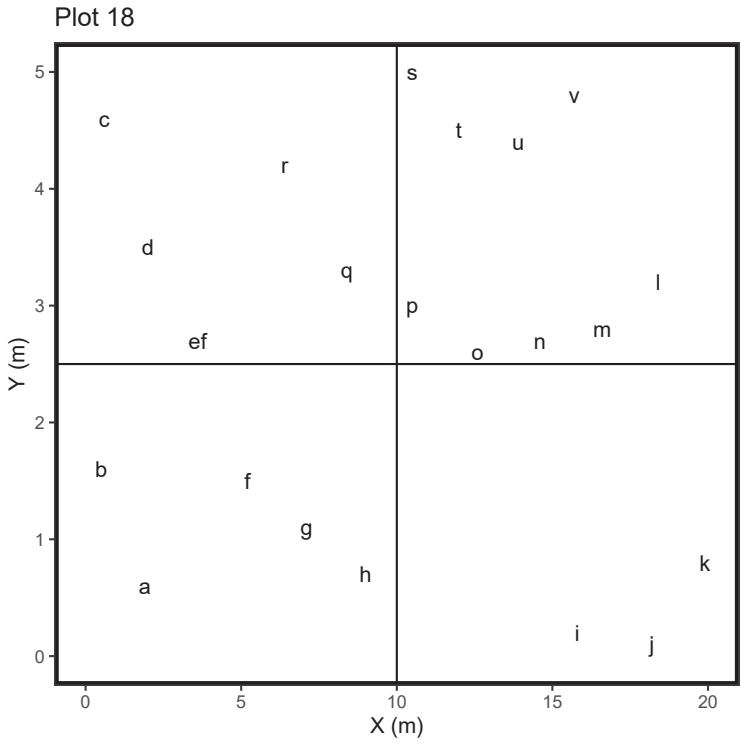
Plot #	Scientific Name	Common Name	Mapped Stem Label
15	Betula nigra	river birch	a
15	Betula nigra	river birch	b
15	Platanus occidentalis	American sycamore	c
15	Platanus occidentalis	American sycamore	d
15	Betula nigra	river birch	e
15	Lindera benzoin	northern spicebush	f
15	Corylus americana	American hazelnut	g
15	Corylus americana	American hazelnut	h
15	Carpinus caroliniana	American hornbeam	i
15	Carpinus caroliniana	American hornbeam	j
15	Carpinus caroliniana	American hornbeam	k
15	Carpinus caroliniana	American hornbeam	l
15	Quercus alba	white oak	m
15	Quercus michauxii	swamp chestnut oak	n
15	Magnolia tripetala	umbrella-tree	o
15	Quercus falcata	southern red oak	p
15	Quercus falcata	southern red oak	q
15	Quercus alba	white oak	r
15	Quercus alba	white oak	s
15	Asimina triloba	pawpaw	t
15	Carpinus caroliniana	American hornbeam	u
15	Hamamelis virginiana	American witchhazel	v
15	Diospyros virginiana	common persimmon	w
15	Asimina triloba	pawpaw	x
15	Liriodendron tulipifera	tuliptree	y



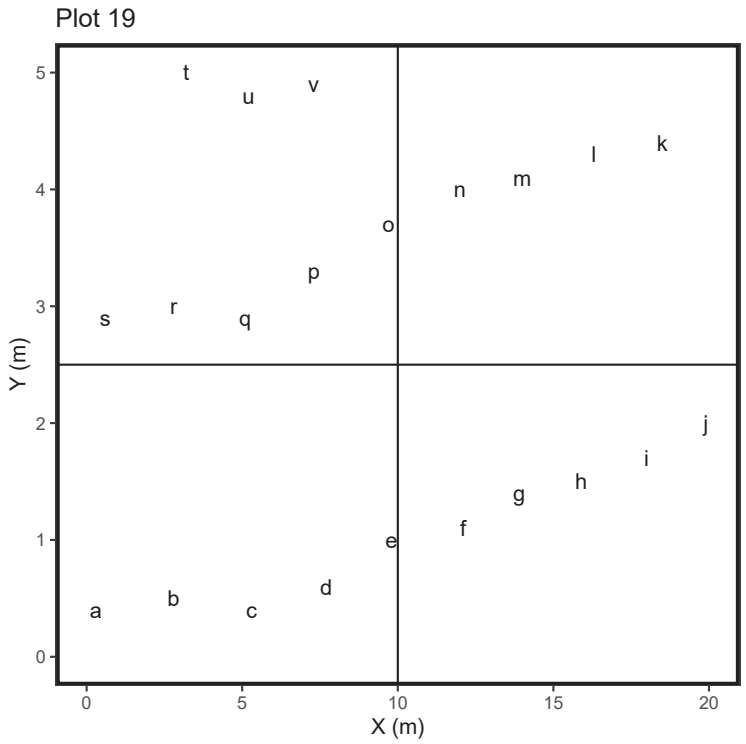
Plot #	Scientific Name	Common Name	Mapped Stem Label
16	Tilia americana	American basswood	a
16	Liriodendron tulipifera	tuliptree	b
16	Liriodendron tulipifera	tuliptree	c
16	Nyssa sylvatica	blackgum	d
16	Asimina triloba	pawpaw	e
16	Lindera benzoin	northern spicebush	f
16	Quercus falcata	southern red oak	g
16	Fraxinus pennsylvanica	green ash	h
16	Fraxinus pennsylvanica	green ash	i
16	Fraxinus pennsylvanica	green ash	j
16	Quercus phellos	willow oak	k
16	Asimina triloba	pawpaw	l
16	Nyssa sylvatica	blackgum	m
16	Nyssa sylvatica	blackgum	n
16	Nyssa sylvatica	blackgum	o
16	Lindera benzoin	northern spicebush	p
16	Tilia americana	American basswood	q
16	Tilia americana	American basswood	r
16	Alnus serrulata	hazel alder	s
16	Diospyros virginiana	common persimmon	t
16	Quercus michauxii	swamp chestnut oak	u
16	Corylus americana	American hazelnut	v
16	Carpinus caroliniana	American hornbeam	w
16	Tilia americana	American basswood	x
16	Quercus alba	white oak	y
16	Magnolia tripetala	umbrella-tree	z
16	Platanus occidentalis	American sycamore	A



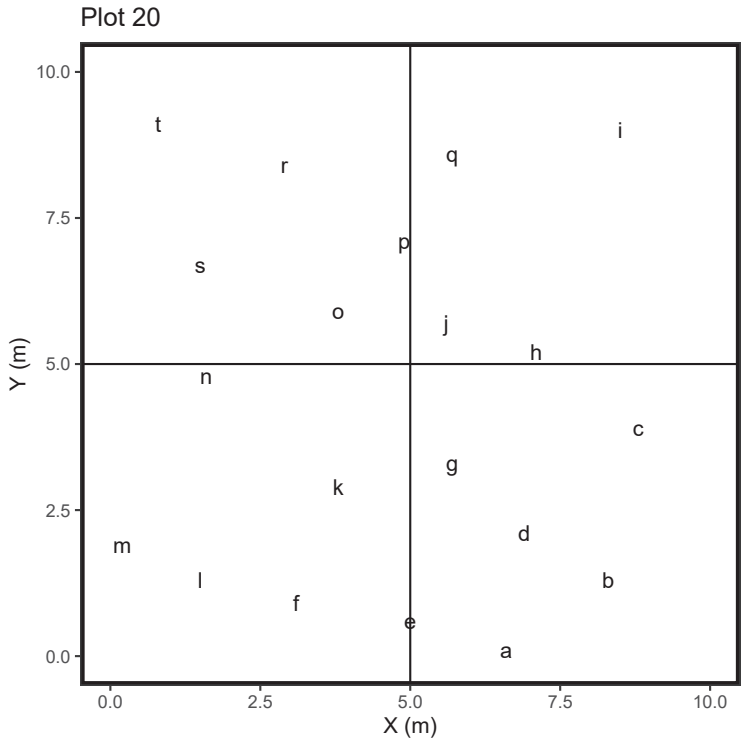
Plot #	Scientific Name	Common Name	Mapped Stem Label
17	Diospyros virginiana	common persimmon	a
17	Betula nigra	river birch	b
17	Amelanchier arborea	common serviceberry	c
17	Amelanchier arborea	common serviceberry	d
17	Quercus michauxii	swamp chestnut oak	e
17	Platanus occidentalis	American sycamore	f
17	Liriodendron tulipifera	tuliptree	g
17	Liriodendron tulipifera	tuliptree	h
17	Liriodendron tulipifera	tuliptree	i
17	Tilia americana	American basswood	j
17	Liriodendron tulipifera	tuliptree	k
17	Tilia americana	American basswood	l
17	Magnolia tripetala	umbrella-tree	m
17	Quercus alba	white oak	n
17	Quercus falcata	southern red oak	o
17	Asimina triloba	pawpaw	p
17	Corylus americana	American hazelnut	q
17	Lindera benzoin	northern spicebush	r
17	Fraxinus pennsylvanica	green ash	s
17	Asimina triloba	pawpaw	t
17	Amelanchier arborea	common serviceberry	u
17	Asimina triloba	pawpaw	v
17	Liriodendron tulipifera	tuliptree	w
17	Betula nigra	river birch	x
17	Quercus falcata	southern red oak	y
17	Lindera benzoin	northern spicebush	z
17	Alnus serrulata	hazel alder	A
17	Quercus michauxii	swamp chestnut oak	B



Plot #	Scientific Name	Common Name	Mapped Stem Label
18	Hamamelis virginiana	American witchhazel	a
18	Hamamelis virginiana	American witchhazel	b
18	Quercus falcata	southern red oak	c
18	Quercus falcata	southern red oak	d
18	Corylus americana	American hazelnut	e
18	Corylus americana	American hazelnut	f
18	Tilia americana	American basswood	g
18	Quercus phellos	willow oak	h
18	Quercus falcata	southern red oak	i
18	Carpinus caroliniana	American hornbeam	j
18	Tilia americana	American basswood	k
18	Nyssa sylvatica	blackgum	l
18	Nyssa sylvatica	blackgum	m
18	Nyssa sylvatica	blackgum	n
18	Nyssa sylvatica	blackgum	o
18	Alnus serrulata	hazel alder	p
18	Alnus serrulata	hazel alder	q
18	Liriodendron tulipifera	tuliptree	r
18	Asimina triloba	pawpaw	s
18	Amelanchier arborea	common serviceberry	t
18	Quercus michauxii	swamp chestnut oak	u
18	Quercus michauxii	swamp chestnut oak	v



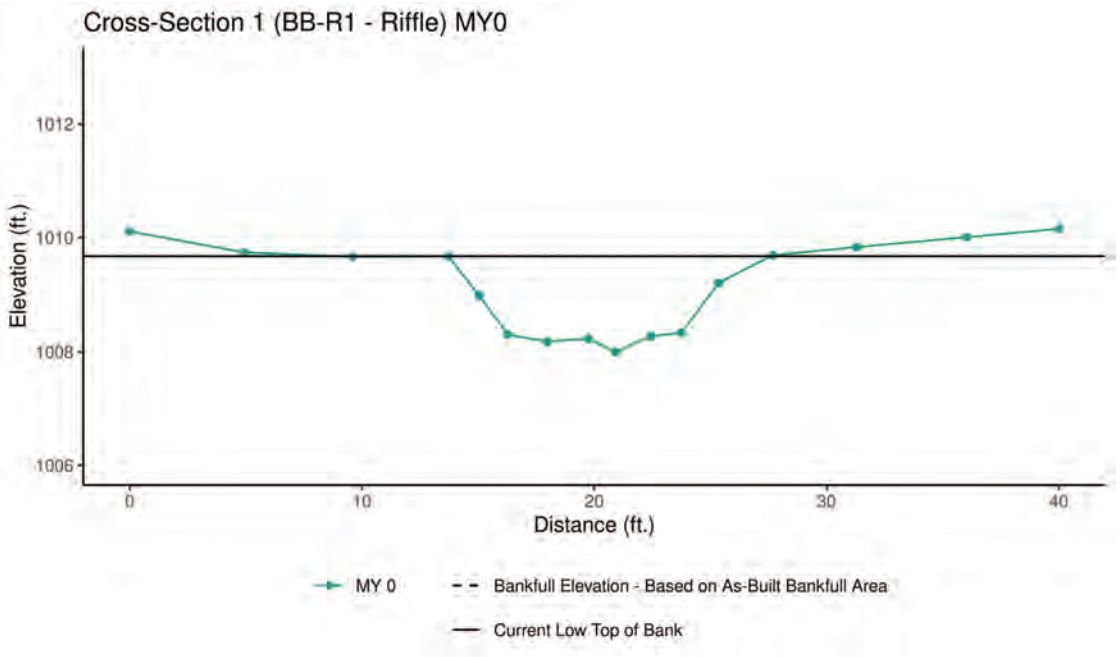
Plot #	Scientific Name	Common Name	Mapped Stem Label
19	Platanus occidentalis	American sycamore	a
19	Corylus americana	American hazelnut	b
19	Lindera benzoin	northern spicebush	c
19	Lindera benzoin	northern spicebush	d
19	Carpinus caroliniana	American hornbeam	e
19	Magnolia tripetala	umbrella-tree	f
19	Tilia americana	American basswood	g
19	Liriodendron tulipifera	tuliptree	h
19	Liriodendron tulipifera	tuliptree	i
19	Liriodendron tulipifera	tuliptree	j
19	Diospyros virginiana	common persimmon	k
19	Diospyros virginiana	common persimmon	l
19	Diospyros virginiana	common persimmon	m
19	Platanus occidentalis	American sycamore	n
19	Betula nigra	river birch	o
19	Quercus phellos	willow oak	p
19	Platanus occidentalis	American sycamore	q
19	Betula nigra	river birch	r
19	Betula nigra	river birch	s
19	Fraxinus pennsylvanica	green ash	t
19	Hamamelis virginiana	American witchhazel	u
19	Fraxinus pennsylvanica	green ash	v



Plot #	Scientific Name	Common Name	Mapped Stem Label
20	Amelanchier arborea	common serviceberry	a
20	Quercus alba	white oak	b
20	Amelanchier arborea	common serviceberry	c
20	Quercus alba	white oak	d
20	Diospyros virginiana	common persimmon	e
20	Quercus falcata	southern red oak	f
20	Asimina triloba	pawpaw	g
20	Liriodendron tulipifera	tuliptree	h
20	Quercus falcata	southern red oak	i
20	Nyssa sylvatica	blackgum	j
20	Nyssa sylvatica	blackgum	k
20	Hamamelis virginiana	American witchhazel	l
20	Hamamelis virginiana	American witchhazel	m
20	Carpinus caroliniana	American hornbeam	n
20	Asimina triloba	pawpaw	o
20	Liriodendron tulipifera	tuliptree	p
20	Alnus serrulata	hazel alder	q
20	Quercus falcata	southern red oak	r
20	Tilia americana	American basswood	s
20	Quercus falcata	southern red oak	t

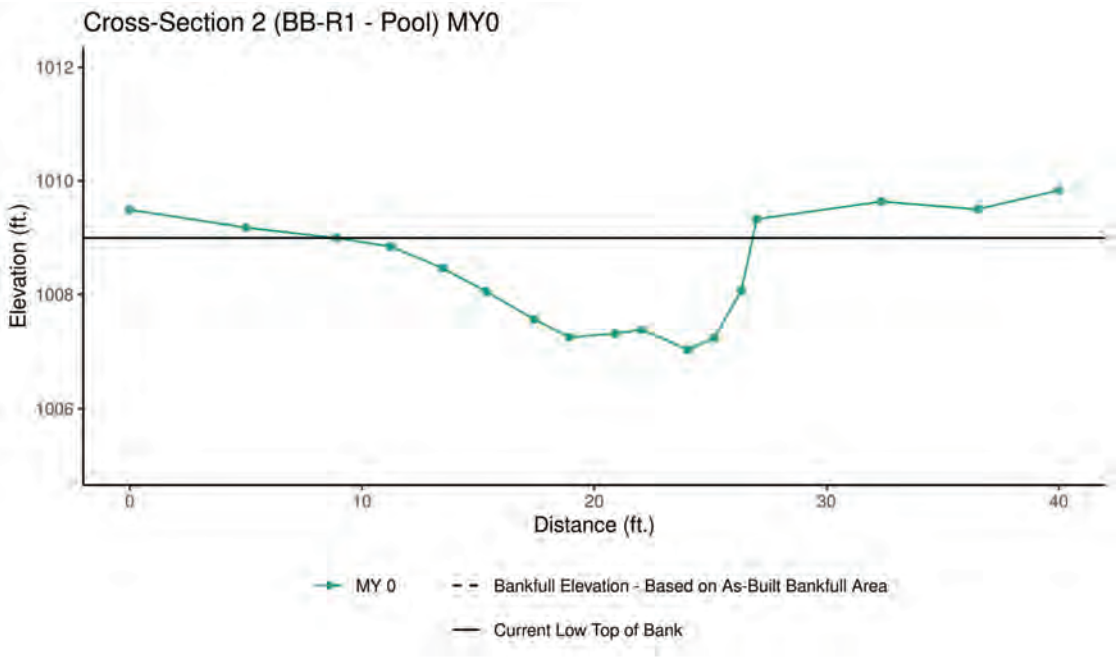
Appendix C:
Stream Geomorphology Data

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



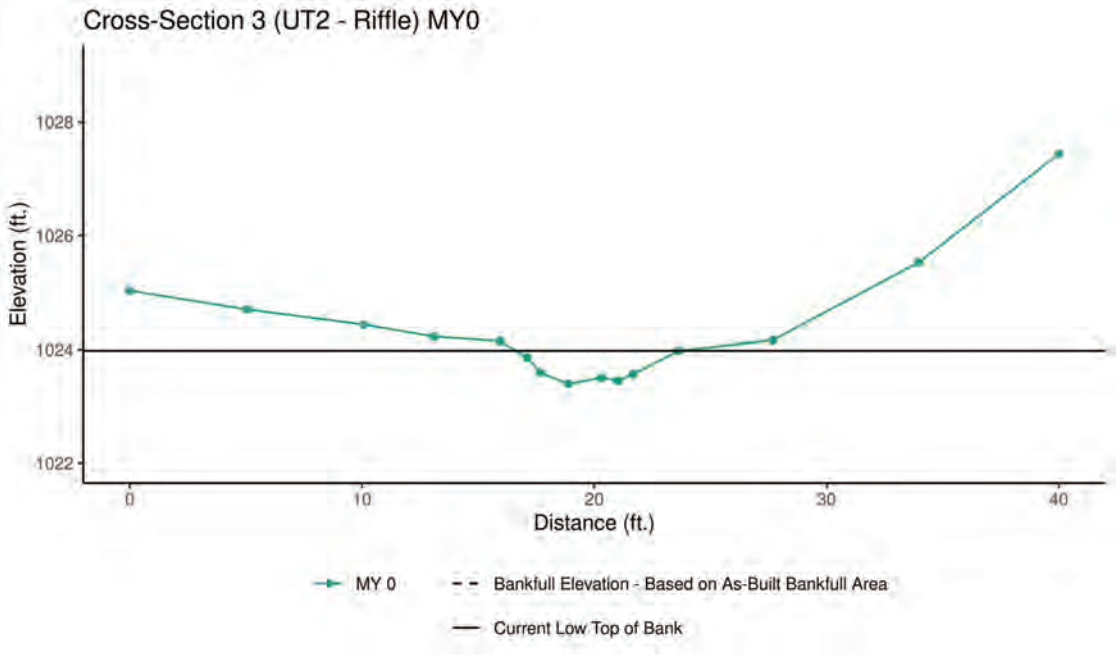
Distance	Elevation	Features
0	1010.108	TLP
4.90983472	1009.739	
9.59873747	1009.66	
13.7178814	1009.67	TLB, BKF
15.0480104	1008.976	
16.2762905	1008.29	LEW
17.9666881	1008.166	
19.7337784	1008.22	
20.9138739	1007.995	THW
22.4306703	1008.258	
23.7651894	1008.326	REW
25.3423828	1009.197	
27.6726082	1009.688	TRB
31.3189171	1009.833	
36.0225084	1010.006	
40	1010.152	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1009.67							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1008.00							
LTOB Elevation	1009.67							
LTOB Max Depth	1.675							
LTOB Cross Sectional Area	14.77							



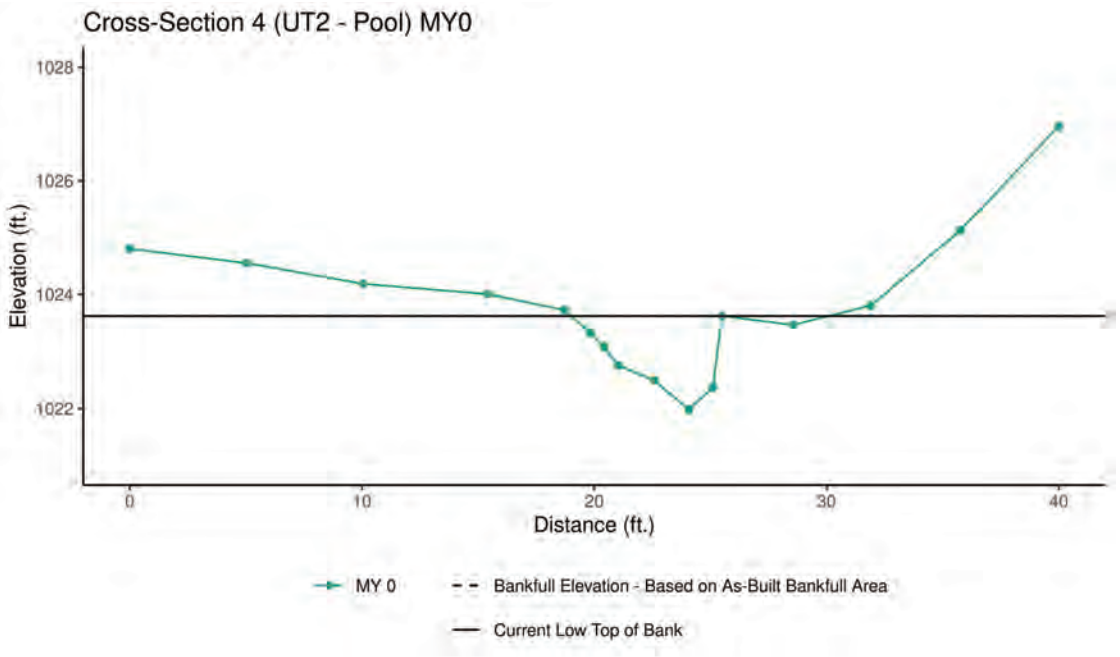
Distance	Elevation	Features
0	1009.489	TLP
5.01644147	1009.174	
8.88400929	1008.992	TLB, BKF
11.2403356	1008.841	
13.4818262	1008.459	
15.3450954	1008.049	LEW
17.4253219	1007.557	
18.9356147	1007.245	
20.9113635	1007.308	
22.0430492	1007.376	
24.0379344	1007.031	THW
25.1597509	1007.232	
26.3328701	1008.066	REW
26.9941468	1009.325	TRB
32.3655091	1009.633	
36.4935192	1009.497	
40	1009.832	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1008.99							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1007.03							
LTOB Elevation	1008.99							
LTOB Max Depth	1.961							
LTOB Cross Sectional Area	19.91							



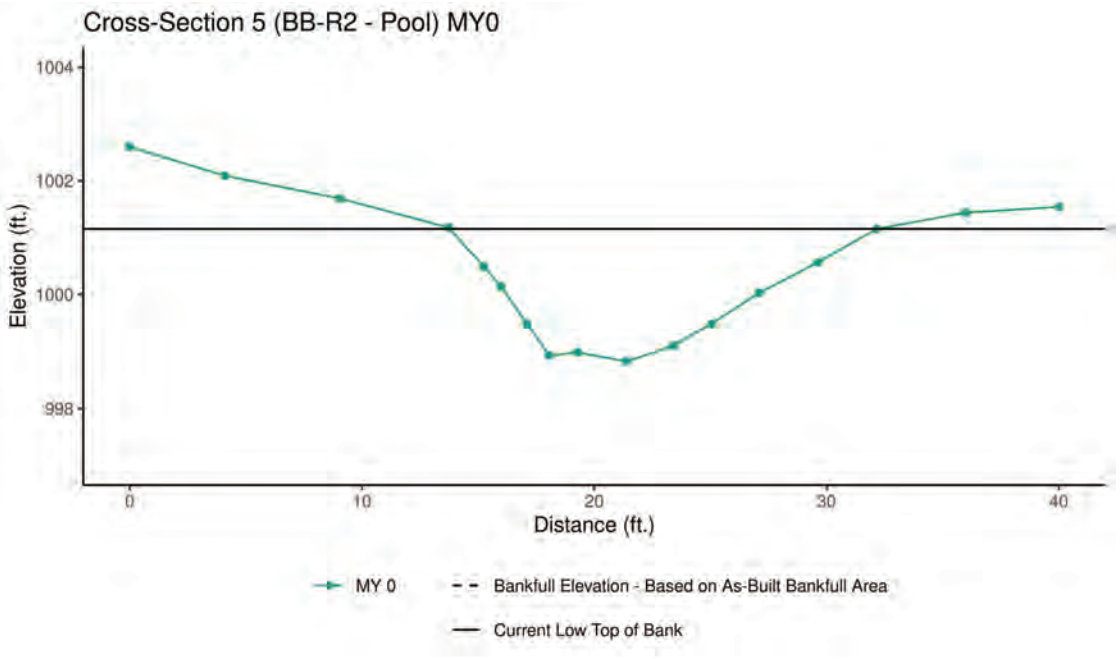
Distance	Elevation	Features
0	1025.028	TLP
5.07326561	1024.697	
10.0939947	1024.432	
13.0881252	1024.224	
15.932916	1024.143	TLB
17.1153092	1023.862	
17.6758762	1023.596	LEW
18.8867336	1023.397	
20.3176348	1023.506	
21.0207044	1023.452	THW
21.667741	1023.569	REW
23.6232306	1023.979	TRB, BKF
27.6862335	1024.16	
33.9683707	1025.527	
40	1027.437	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1023.98							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1023.45							
LTOB Elevation	1023.98							
LTOB Max Depth	0.527							
LTOB Cross Sectional Area	2.36							



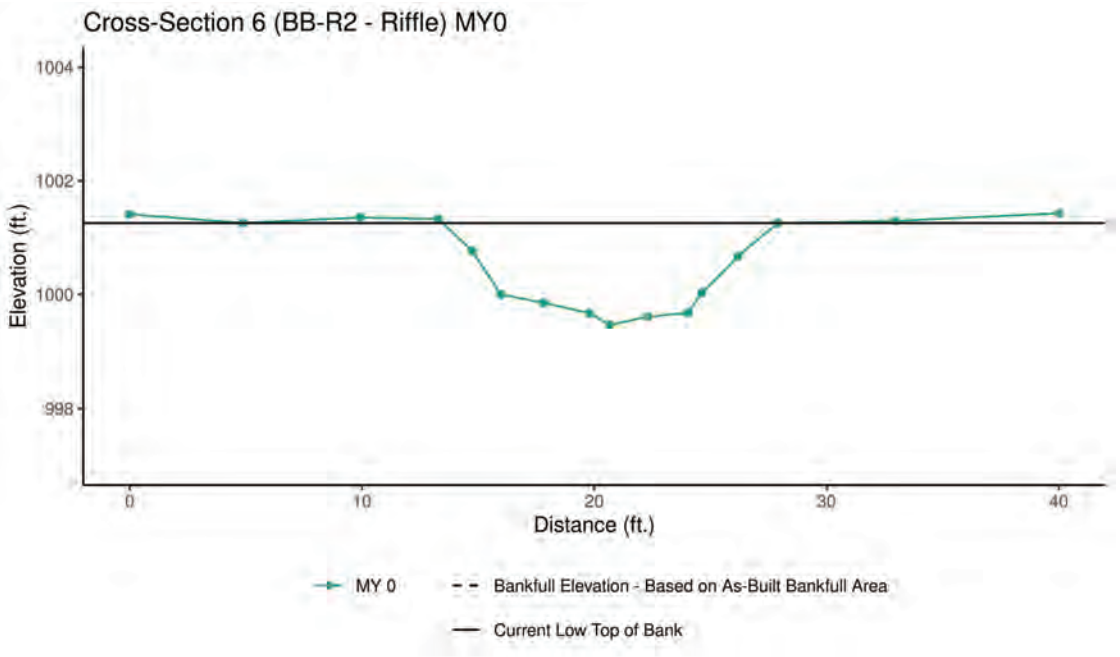
Distance	Elevation	Features
0	1024.802	TLP
5.06048071	1024.548	
10.0479354	1024.184	
15.4232277	1024.003	
18.7208112	1023.722	TLB
19.8307763	1023.316	
20.4242493	1023.079	LEW
21.0369744	1022.757	
22.589326	1022.493	
24.0702027	1021.983	THW
25.1036107	1022.366	REW
25.4892295	1023.618	TRB, BKF
28.543546	1023.46	
31.906978	1023.802	
35.7595695	1025.127	
40	1026.96	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1023.62							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1021.98							
LTOB Elevation	1023.62							
LTOB Max Depth	1.635							
LTOB Cross Sectional Area	6.12							



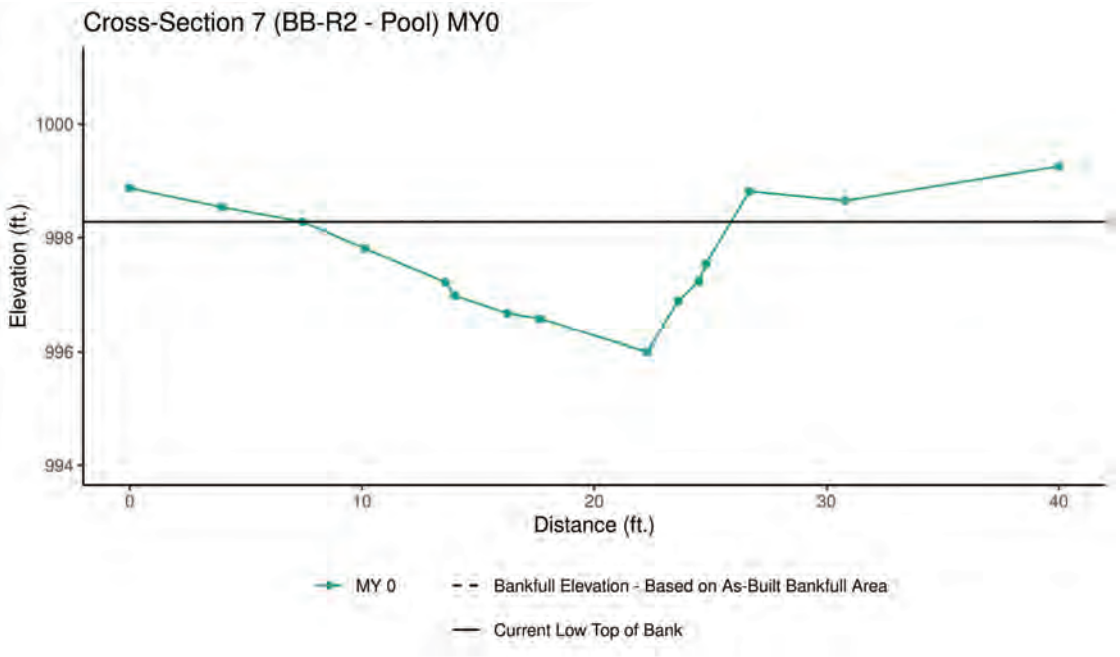
Distance	Elevation	Features
0	1002.598	TLP
4.10745493	1002.088	
9.06125803	1001.686	
13.7269088	1001.177	TLB
15.2511193	1000.487	
15.9775854	1000.138	LEW
17.1041698	999.482	
18.0595722	998.935	THW
19.2732697	998.987	
21.3956388	998.83	
23.4132913	999.101	
25.0512359	999.482	
27.0942938	1000.026	REW
29.6272674	1000.565	
32.1651022	1001.152	TRB, BKF
35.9921246	1001.439	
40	1001.538	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1001.15							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	998.94							
LTOB Elevation	1001.15							
LTOB Max Depth	2.217							
LTOB Cross Sectional Area	24.67							



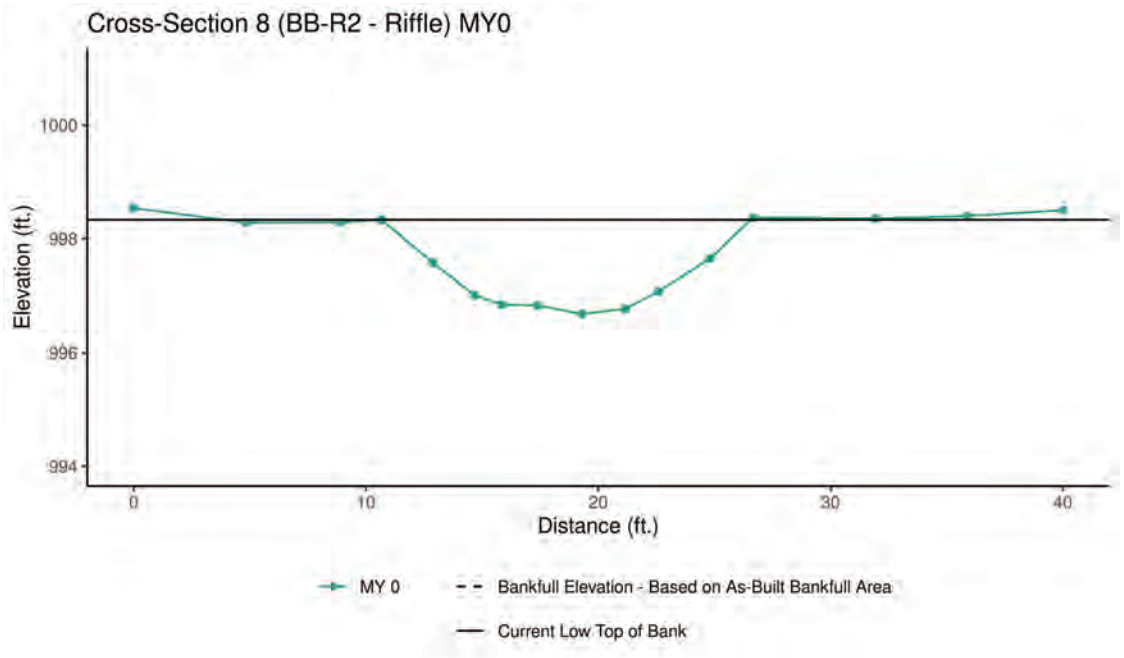
Distance	Elevation	Features
0	1001.408	TLP
4.88070702	1001.256	
9.92858364	1001.352	
13.2737253	1001.328	TLB
14.7468134	1000.763	
15.9807157	999.997	LEW
17.821715	999.85	
19.7873925	999.668	
20.6758853	999.462	THW
22.31125	999.604	
24.0392941	999.675	
24.6421251	1000.032	REW
26.1840908	1000.668	
27.8938102	1001.254	TRB, BKF
32.9441489	1001.292	
40	1001.427	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1001.25							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	999.46							
LTOB Elevation	1001.25							
LTOB Max Depth	1.792							
LTOB Cross Sectional Area	16.63							



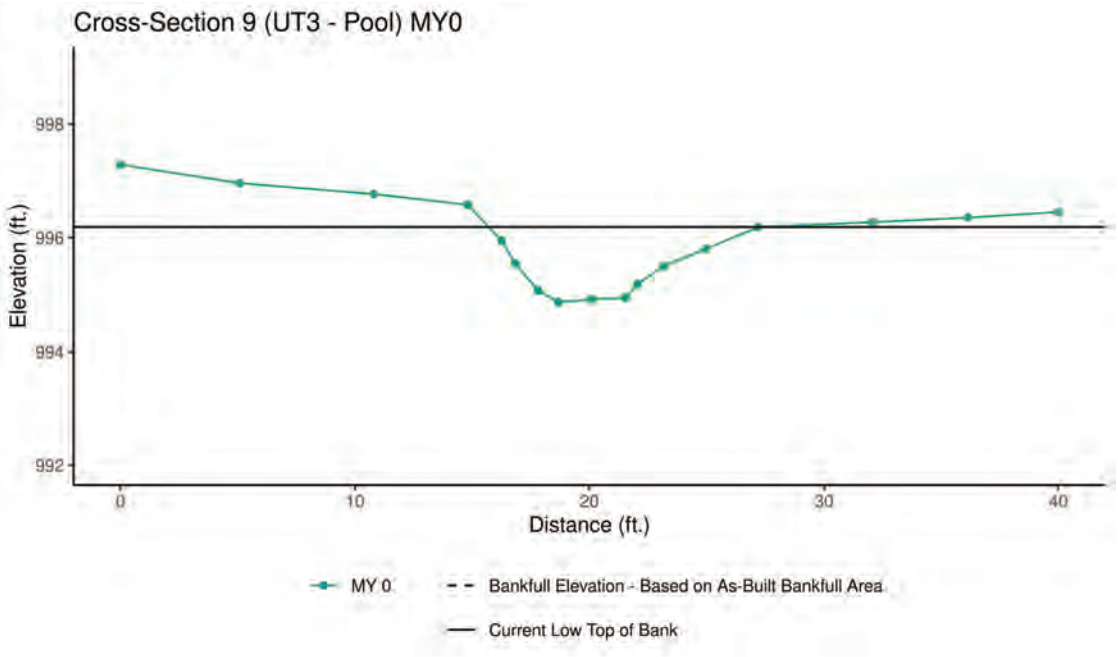
Distance	Elevation	Features
0	998.871	TLP
3.98251303	998.534	
7.45830074	998.276	TLB, BKF
10.1371461	997.803	
13.5977319	997.214	LEW
13.9905649	996.977	
16.2708029	996.662	
17.6678313	996.568	
22.2716642	995.993	THW
23.6187828	996.883	
24.5042224	997.225	
24.8010943	997.532	
26.6799918	998.813	TRB
30.8194251	998.65	
40	999.254	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	998.28							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	995.99							
LTOB Elevation	998.28							
LTOB Max Depth	2.283							
LTOB Cross Sectional Area	22.81							



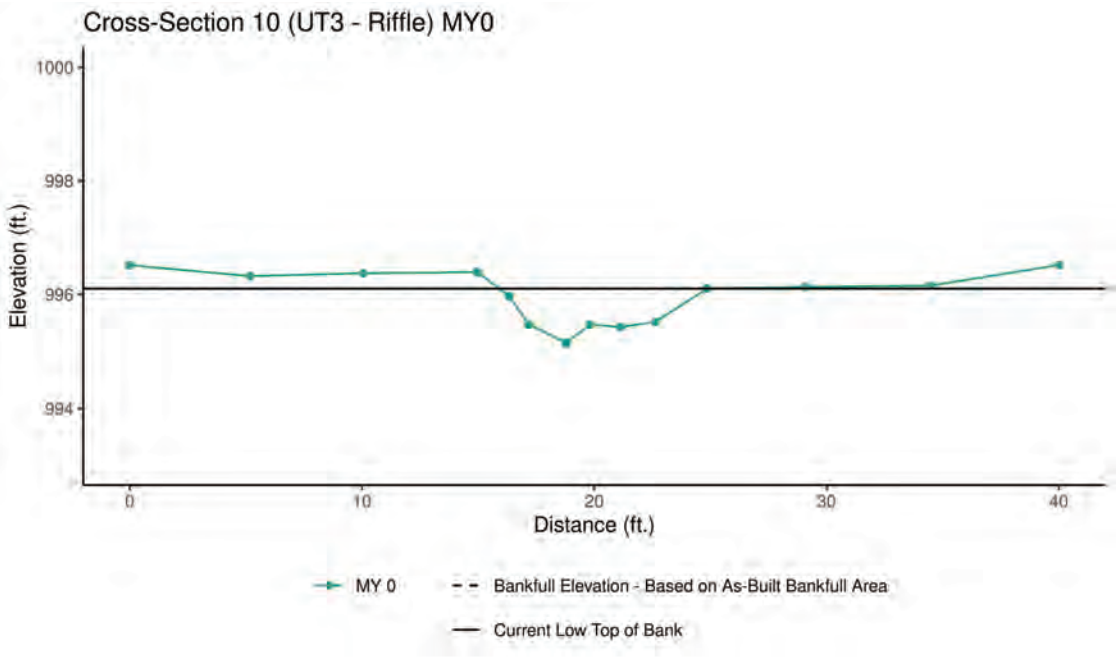
Distance	Elevation	Features
0	998.535	TLP
4.83688671	998.281	
8.87194257	998.287	
10.6703337	998.329	TLB, BKF
12.887357	997.572	
14.6816867	996.999	LEW
15.8630046	996.833	
17.4153993	996.819	
19.2937213	996.67	THW
21.173342	996.762	
22.5825182	997.066	REW
24.8136996	997.649	
26.6843597	998.369	TRB
31.9566747	998.352	
35.8889218	998.397	
40	998.498	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	998.33							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	996.67							
LTOB Elevation	998.33							
LTOB Max Depth	1.659							
LTOB Cross Sectional Area	17.48							



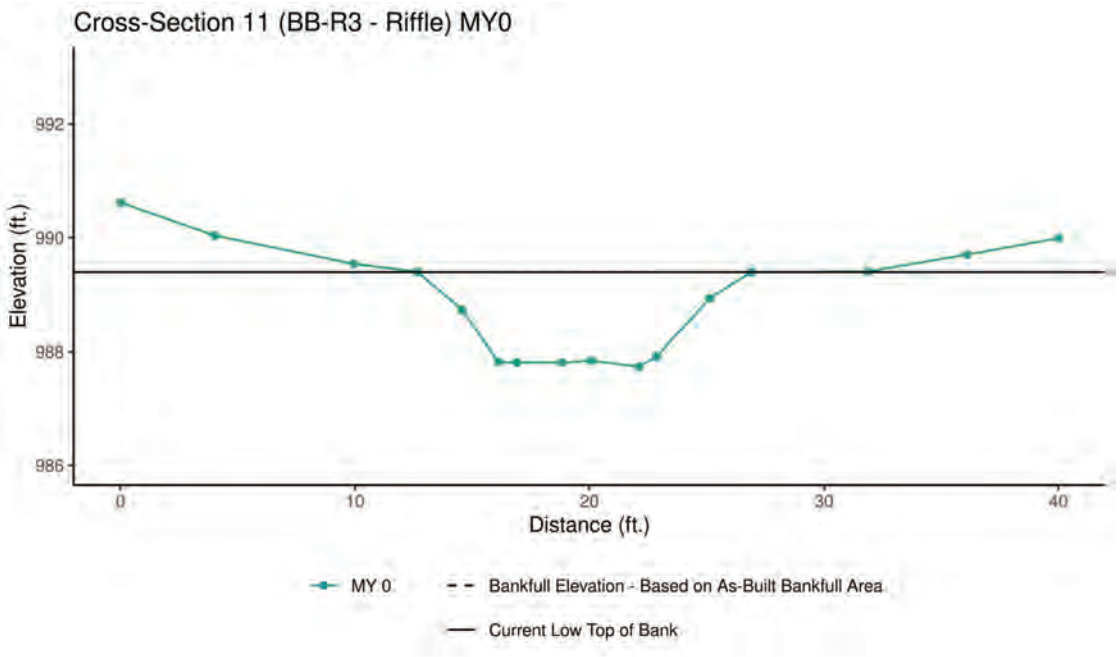
Distance	Elevation	Features
0	997.283	TLP
5.07118458	996.958	
10.8046726	996.765	
14.8084097	996.577	TLB
16.2561953	995.945	
16.8357945	995.541	LEW
17.8033526	995.068	
18.6793923	994.862	THW
20.0903471	994.909	
21.5459941	994.939	
22.0449075	995.18	
23.1624221	995.493	REW
24.9639844	995.802	
27.2075446	996.185	TRB, BKF
32.0902287	996.27	
36.1217047	996.35	
40	996.449	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	996.19							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	994.86							
LTOB Elevation	996.19							
LTOB Max Depth	1.323							
LTOB Cross Sectional Area	8.82							



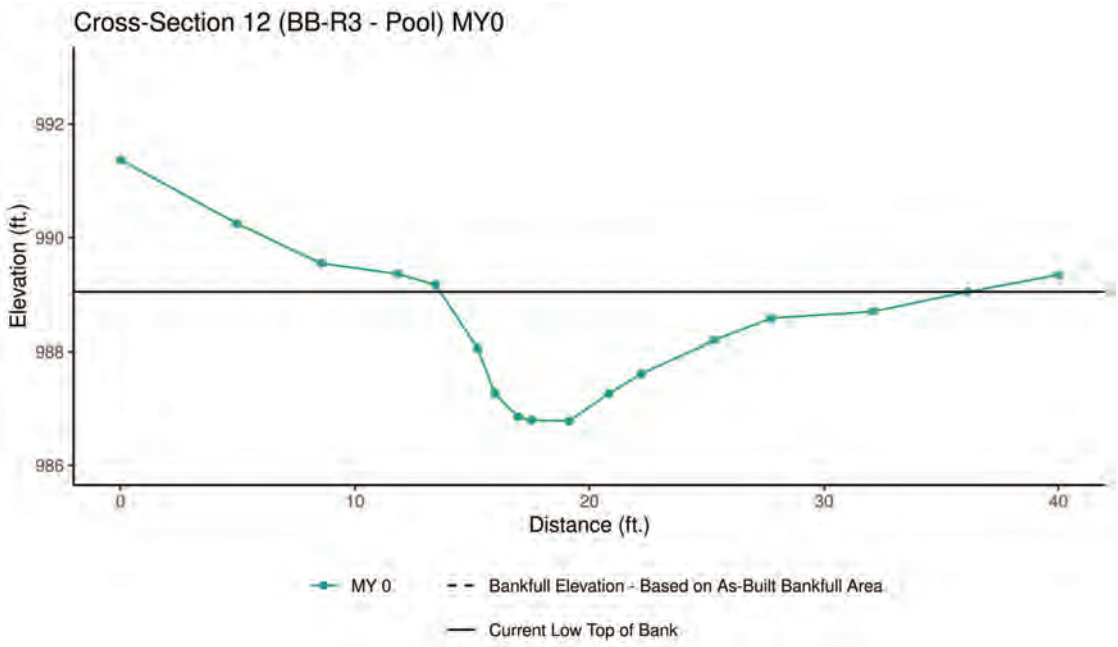
Distance	Elevation	Features
0	996.512	TLP
5.17140842	996.321	
10.0501027	996.37	
14.9676217	996.391	TLB
16.3354305	995.969	
17.1823283	995.471	LEW
18.7881846	995.146	THW
19.8190857	995.466	
21.1481378	995.423	
22.6229549	995.514	REW
24.865052	996.101	TRB, BKF
29.1054871	996.131	
34.446228	996.151	
40	996.515	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	996.10							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	995.15							
LTOB Elevation	996.10							
LTOB Max Depth	0.955							
LTOB Cross Sectional Area	4.91							



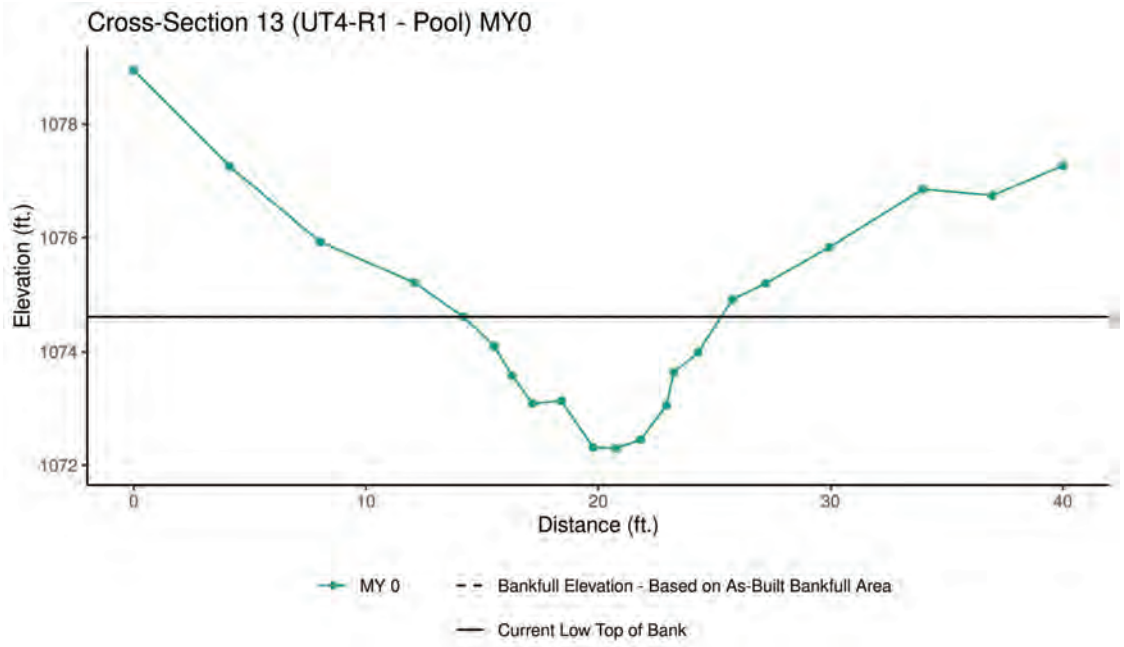
Distance	Elevation	Features
0	990.615	TLP
4.01495816	990.035	
9.9539665	989.536	
12.6582692	989.398	TLB
14.5633087	988.726	
16.114564	987.821	LEW
16.9090731	987.809	
18.8024372	987.81	
20.0858298	987.839	
22.102105	987.737	THW
22.8605312	987.911	REW
25.1263755	988.93	
26.9041701	989.391	TRB, BKF
31.8817837	989.403	
36.0926773	989.699	
40	989.987	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	989.39							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	987.74							
LTOB Elevation	989.39							
LTOB Max Depth	1.654							
LTOB Cross Sectional Area	15.65							



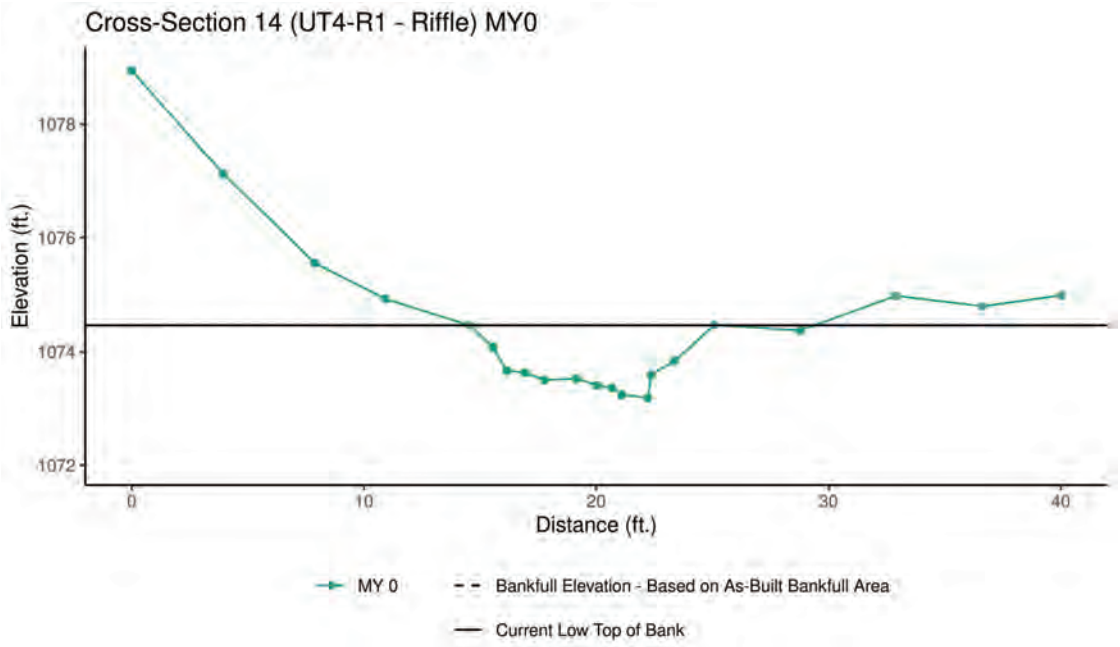
Distance	Elevation	Features
0	991.368	TLP
4.98631086	990.242	
8.56423739	989.545	
11.8038545	989.361	
13.4294901	989.169	TLB
15.2299899	988.052	
15.964887	987.268	LEW
16.9569475	986.855	
17.517646	986.794	THW
19.1355628	986.78	
20.8296407	987.264	
22.2122115	987.611	
25.3185284	988.193	
27.7549392	988.58	
32.10374	988.697	
36.1074409	989.043	TRB, BKF
40	989.342	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	989.04							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	986.79							
LTOB Elevation	989.04							
LTOB Max Depth	2.249							
LTOB Cross Sectional Area	21.50							



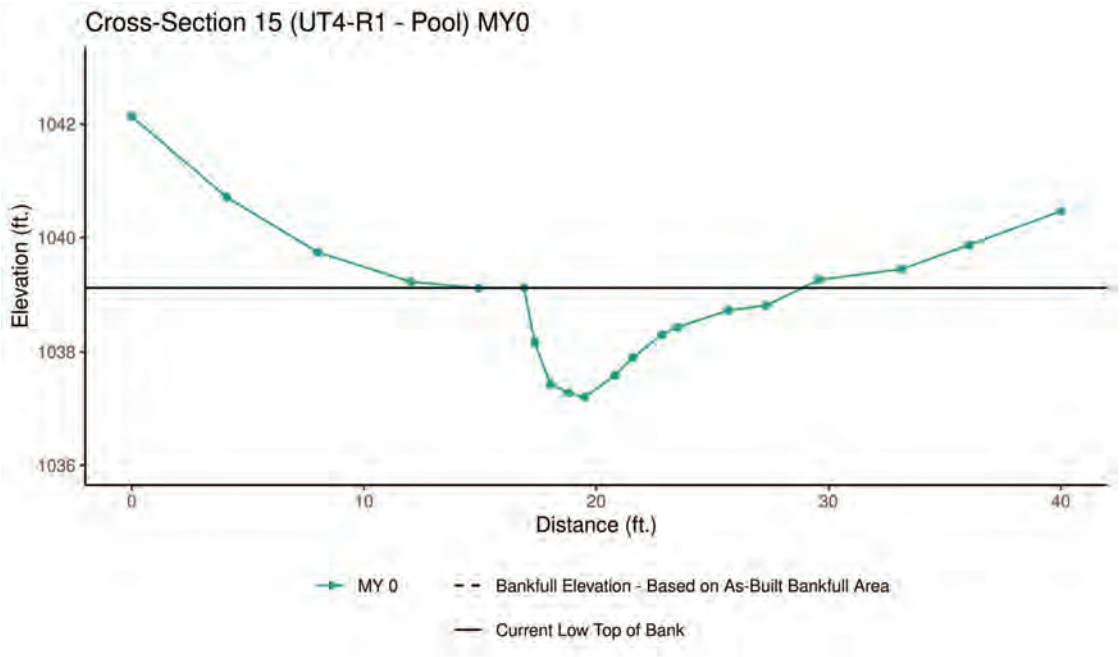
Distance	Elevation	Features
0	1078.946	TLP
4.1252503	1077.256	
8.02955864	1075.923	
12.087842	1075.208	
14.191189	1074.603	TLB, BKF
15.5285865	1074.09	
16.2903663	1073.577	
17.1811909	1073.088	
18.4040958	1073.133	
19.7867382	1072.314	THW
20.7528052	1072.298	
21.8272876	1072.451	
22.9411163	1073.058	
23.2454487	1073.636	REW
24.3072682	1073.99	
25.7745905	1074.909	TRB
27.2020343	1075.191	
29.9395977	1075.826	
33.9772542	1076.852	
36.9672522	1076.742	
40	1077.263	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1074.60							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1072.31							
LTOB Elevation	1074.60							
LTOB Max Depth	2.289							
LTOB Cross Sectional Area	14.60							



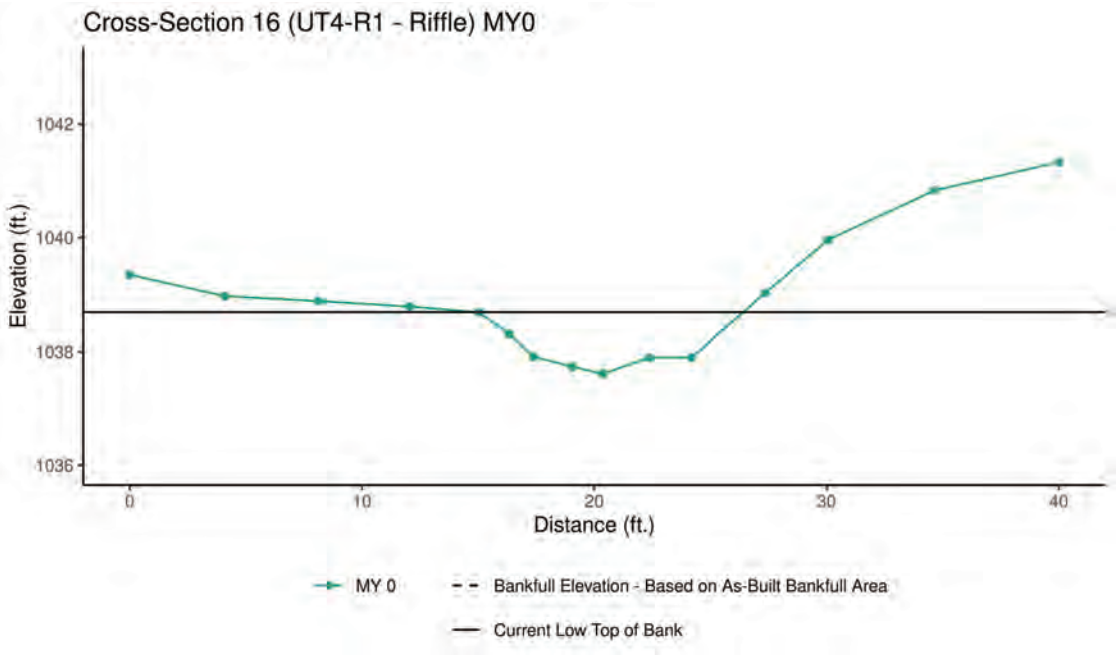
Distance	Elevation	Features
0	1078.941	TLP
3.94059336	1077.123	
7.88150271	1075.549	
10.9120173	1074.92	
14.5435893	1074.453	TLB, BKF
15.551174	1074.074	
16.152085	1073.663	
16.9374776	1073.632	LEW
17.7602267	1073.503	
19.159353	1073.525	
20.0459838	1073.405	
20.6763844	1073.364	
21.1048543	1073.242	THW
22.2202108	1073.186	
22.3689421	1073.596	REW
23.3578715	1073.835	
25.101274	1074.46	TRB
28.7799813	1074.361	
32.8922693	1074.972	
36.641991	1074.789	
40	1074.981	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1074.45							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1073.24							
LTOB Elevation	1074.45							
LTOB Max Depth	1.211							
LTOB Cross Sectional Area	7.83							



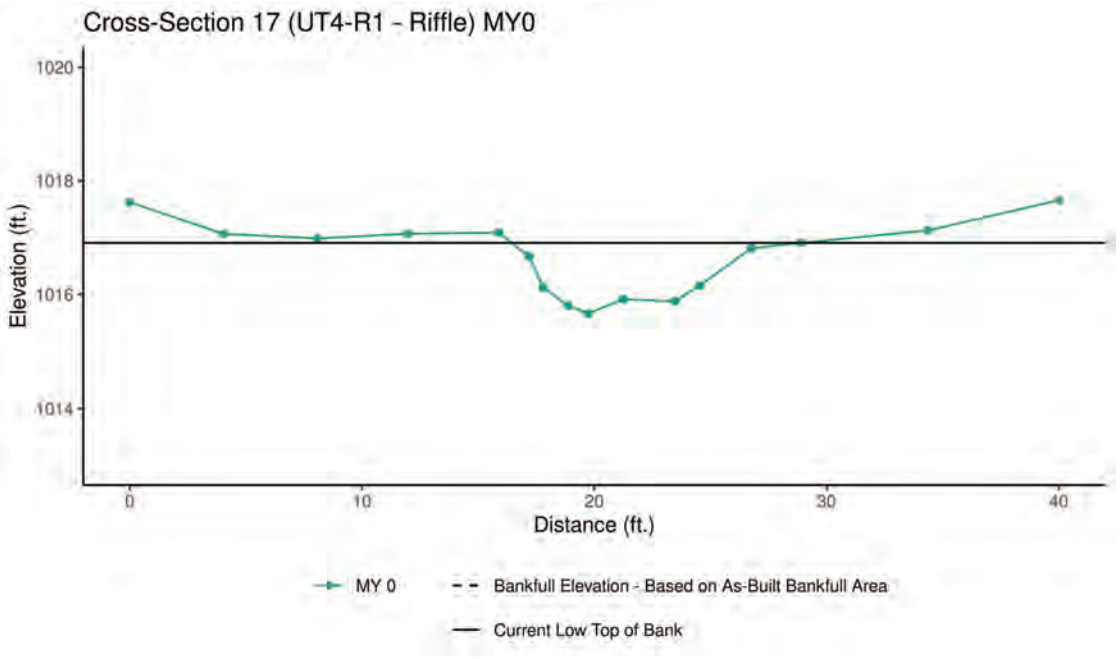
Distance	Elevation	Features
0	1042.135	TLP
4.08823336	1040.711	
8.0071189	1039.742	
12.0026599	1039.221	
14.9498277	1039.107	
16.8830112	1039.113	TLB, BKF
17.3564271	1038.156	LEW
18.0272044	1037.427	
18.8128473	1037.273	THW
19.5012022	1037.202	
20.8069354	1037.583	
21.5746186	1037.9	
22.8299094	1038.284	
23.4890426	1038.419	REW
25.66211	1038.714	
27.3112426	1038.803	
29.586692	1039.255	TRB
33.129166	1039.442	
36.0471298	1039.87	
40	1040.465	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1039.11							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1037.27							
LTOB Elevation	1039.11							
LTOB Max Depth	1.84							
LTOB Cross Sectional Area	10.71							



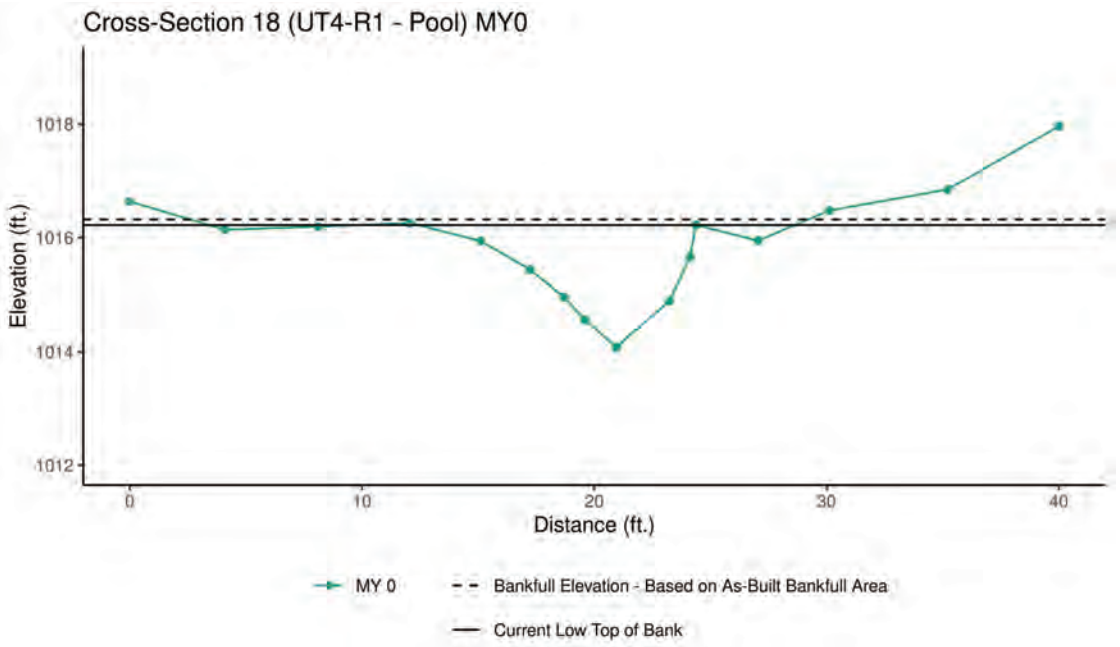
Distance	Elevation	Features
0	1039.344	TLP
4.09636925	1038.967	
8.14322848	1038.88	
12.0608007	1038.784	
15.0239762	1038.684	TLB, BKF
16.3380665	1038.302	
17.384313	1037.911	LEW
19.0360939	1037.738	
20.3634704	1037.61	THW
22.3650811	1037.893	
24.1923481	1037.896	REW
27.355876	1039.023	
30.062947	1039.96	TRB
34.6599094	1040.832	
40	1041.325	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1038.68							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1037.61							
LTOB Elevation	1038.68							
LTOB Max Depth	1.074							
LTOB Cross Sectional Area	7.80							



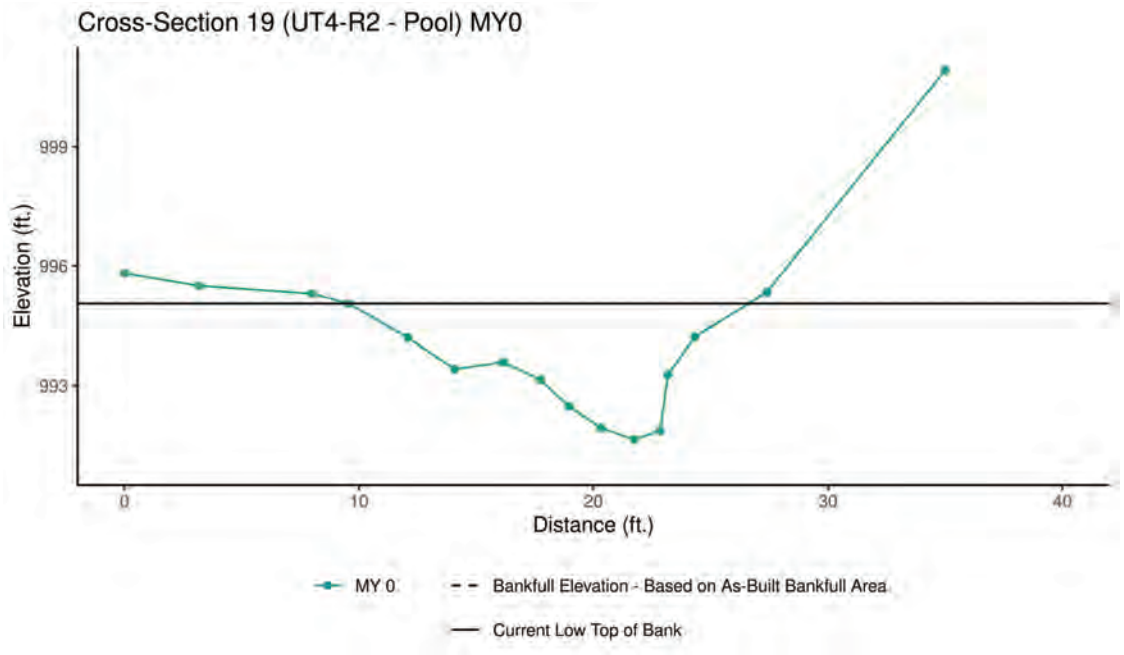
Distance	Elevation	Features
0	1017.622	TLP
4.03347245	1017.066	
8.08476654	1016.983	
11.9650371	1017.067	
15.8975899	1017.086	TLB
17.1939361	1016.666	
17.7972726	1016.122	LEW
18.873478	1015.801	
19.7443659	1015.661	THW
21.2328893	1015.91	
23.4785115	1015.881	
24.5403785	1016.153	REW
26.760558	1016.812	
28.9063532	1016.906	TRB, BKF
34.3784386	1017.126	
40	1017.657	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1016.91							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	1015.66							
LTOB Elevation	1016.91							
LTOB Max Depth	1.245							
LTOB Cross Sectional Area	8.36							



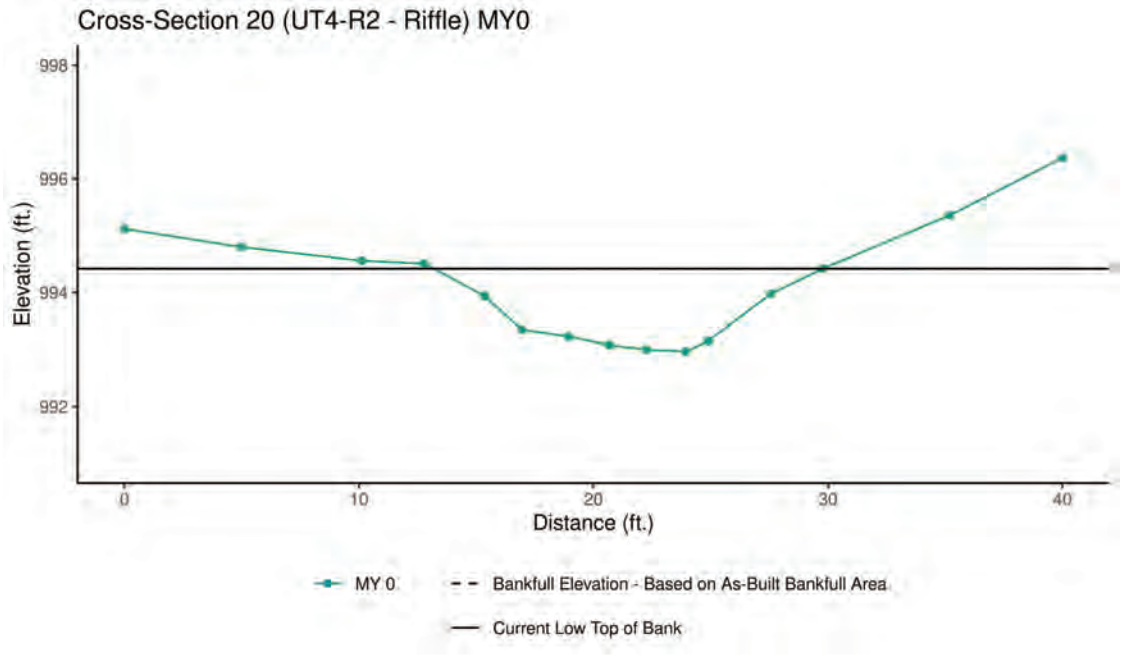
Distance	Elevation	Features
0	1016.635	TLP
4.0991182	1016.138	
8.13729316	1016.191	
12.0679008	1016.256	TLB, BKF
15.1099991	1015.939	
17.2340986	1015.436	
18.7061642	1014.947	LEW
19.6039385	1014.549	
20.9508113	1014.072	THW
23.233454	1014.881	REW
24.1290612	1015.66	
24.3769703	1016.219	TRB
27.0512237	1015.946	
30.1229236	1016.475	
35.2136633	1016.847	
40	1017.959	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	1016.26							
Bank Height Ratio - Based on As-Built Bankfull Area	0.96							
Thalweg Elevation	1014.07							
LTOB Elevation	1016.22							
LTOB Max Depth	2.147							
LTOB Cross Sectional Area	11.81							



Distance	Elevation	Features
0	995.816	TLP
3.19804518	995.499	
8.01003595	995.301	
9.55916403	995.054	TLB, BKF
12.0849186	994.199	
14.0778867	993.418	
16.1616869	993.589	
17.7392438	993.15	LEW
18.9641559	992.482	
20.3185083	991.935	
21.7359301	991.648	THW
22.8442261	991.866	
23.1756176	993.279	REW
24.3161885	994.215	
27.3882808	995.335	TRB
35	1000.924	TRP

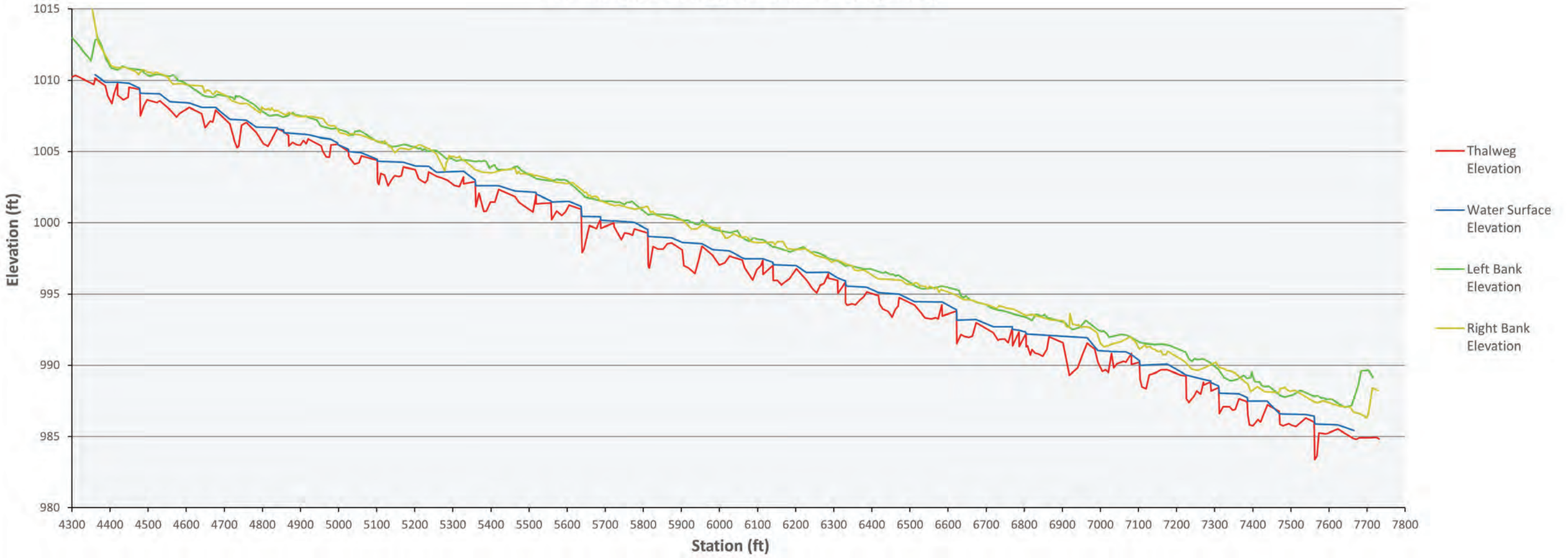
	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	995.05							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	991.65							
LTOB Elevation	995.05							
LTOB Max Depth	3.406							
LTOB Cross Sectional Area	27.60							



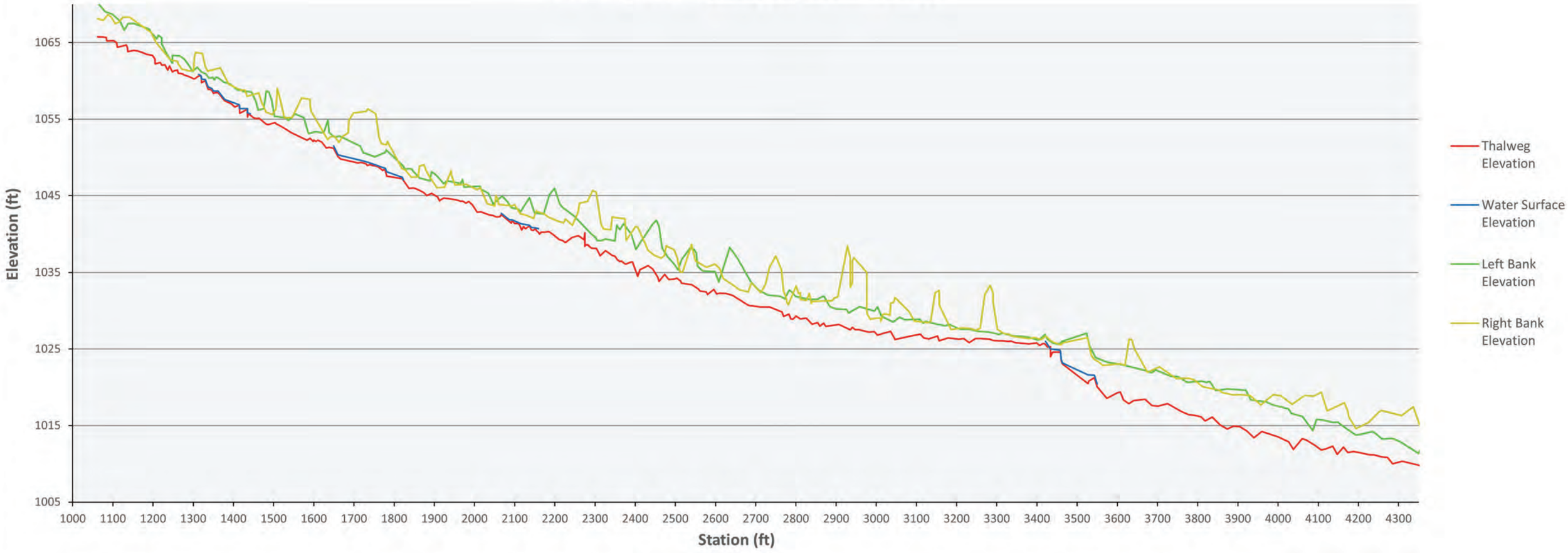
Distance	Elevation	Features
0	995.117	TLP
4.9942548	994.796	
10.118796	994.555	
12.7801602	994.505	TLB
15.3565314	993.936	
16.9470601	993.339	LEW
18.9572832	993.22	
20.6946777	993.074	THW
22.2609967	992.999	
23.9251715	992.965	
24.9027512	993.148	REW
27.564364	993.973	
29.7783278	994.416	TRB, BKF
35.1803845	995.354	
40	996.369	TRP

	MY0	MY1	MY2	MY3	MY4	MY5	MY6	MY7
Bankfull Elevation - Based on As-Built Bankfull Area	994.42							
Bank Height Ratio - Based on As-Built Bankfull Area	1.00							
Thalweg Elevation	993.07							
LTOB Elevation	994.42							
LTOB Max Depth	1.342							
LTOB Cross Sectional Area	14.51							

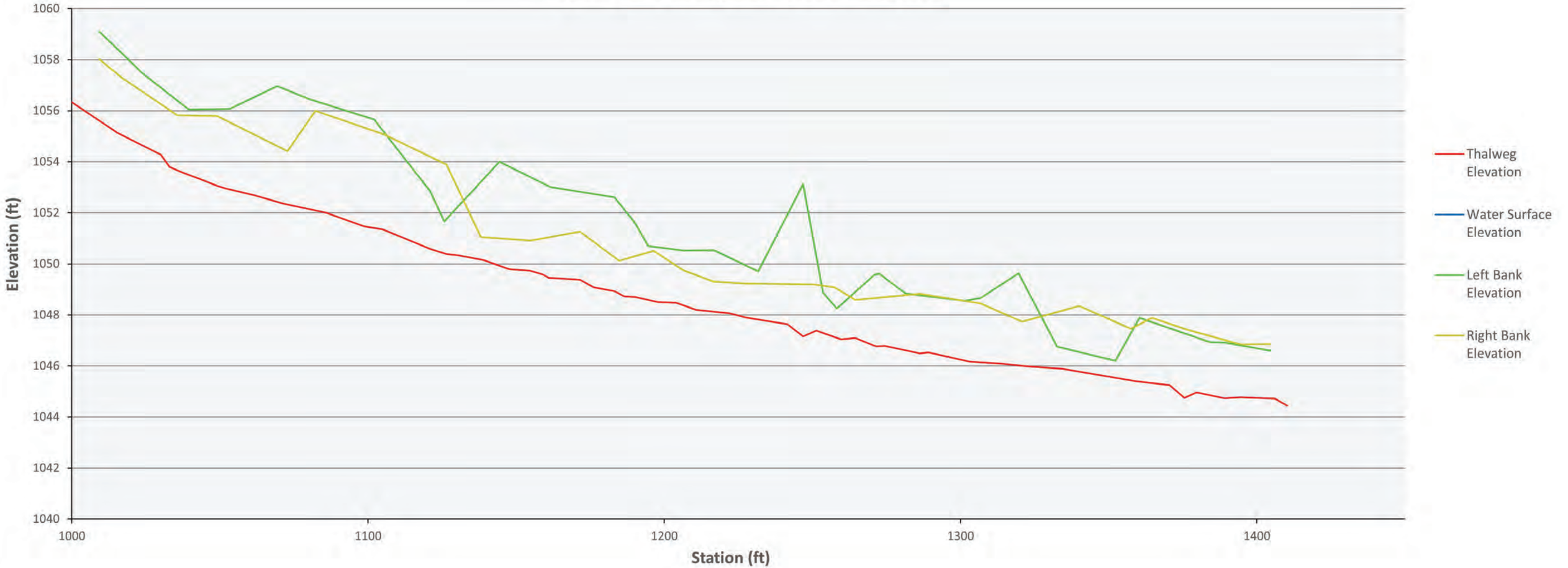
Banner Branch Mitigation Project
Longitudinal Profile - BB-R1, BB-R2, BB-R3
As-Built (MY0 2021)(Data Collected May 2021)



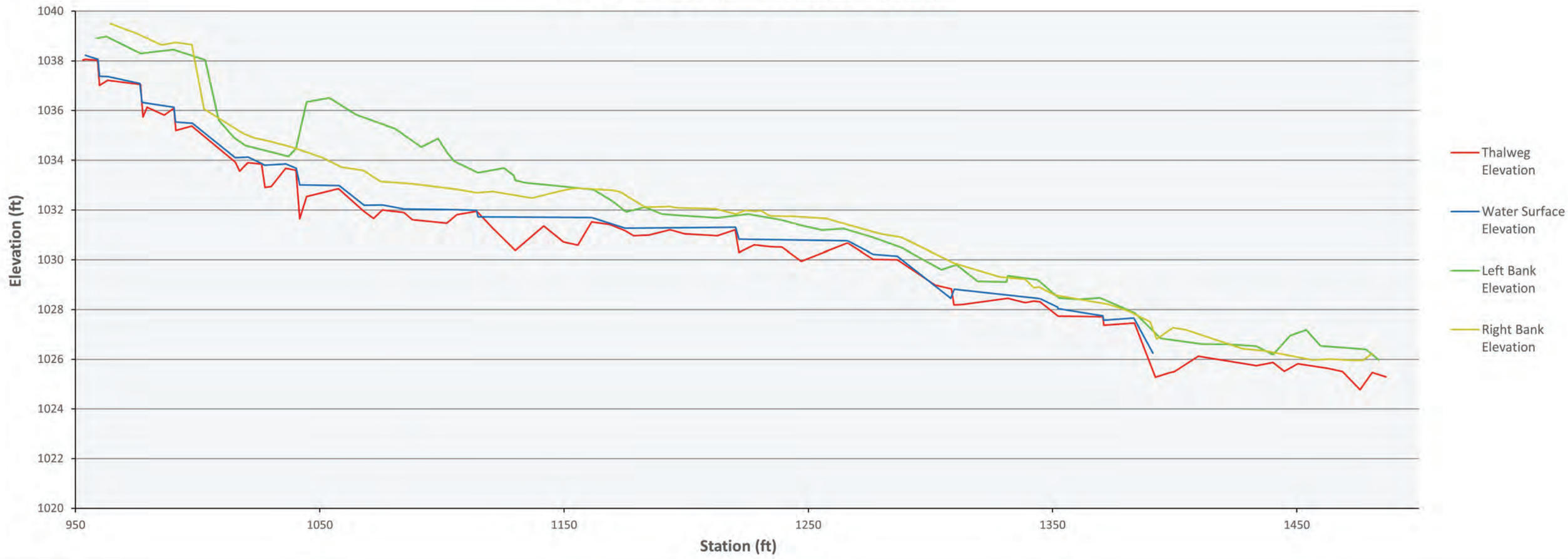
Banner Branch Mitigation Project
Longitudinal Profile - UT1-R1, UT1-R2, UT1-R3
As-Built (MY0 2021)(Data Collected May 2021)



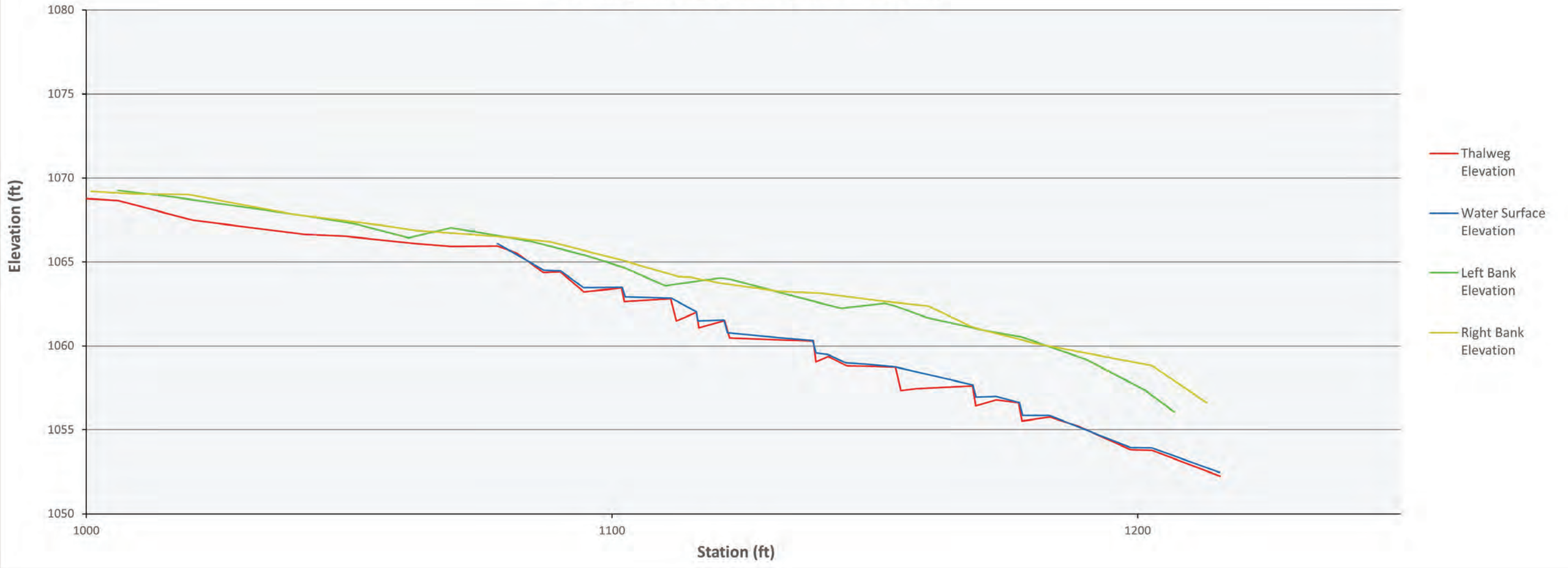
Banner Branch Mitigation Project
Longitudinal Profile - UT1A
As-Built (MY0 2021)(Data Collected May 2021)



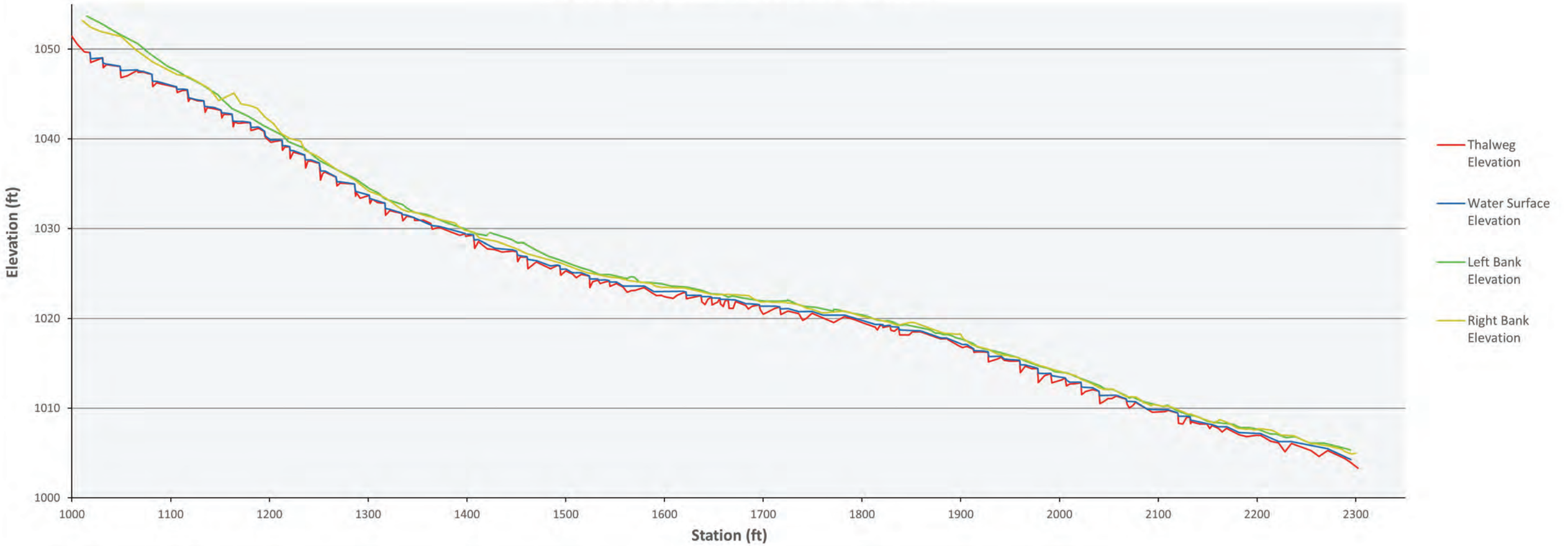
Banner Branch Mitigation Project
Longitudinal Profile - UT1B
As-Built (MY0 2021)(Data Collected May 2021)



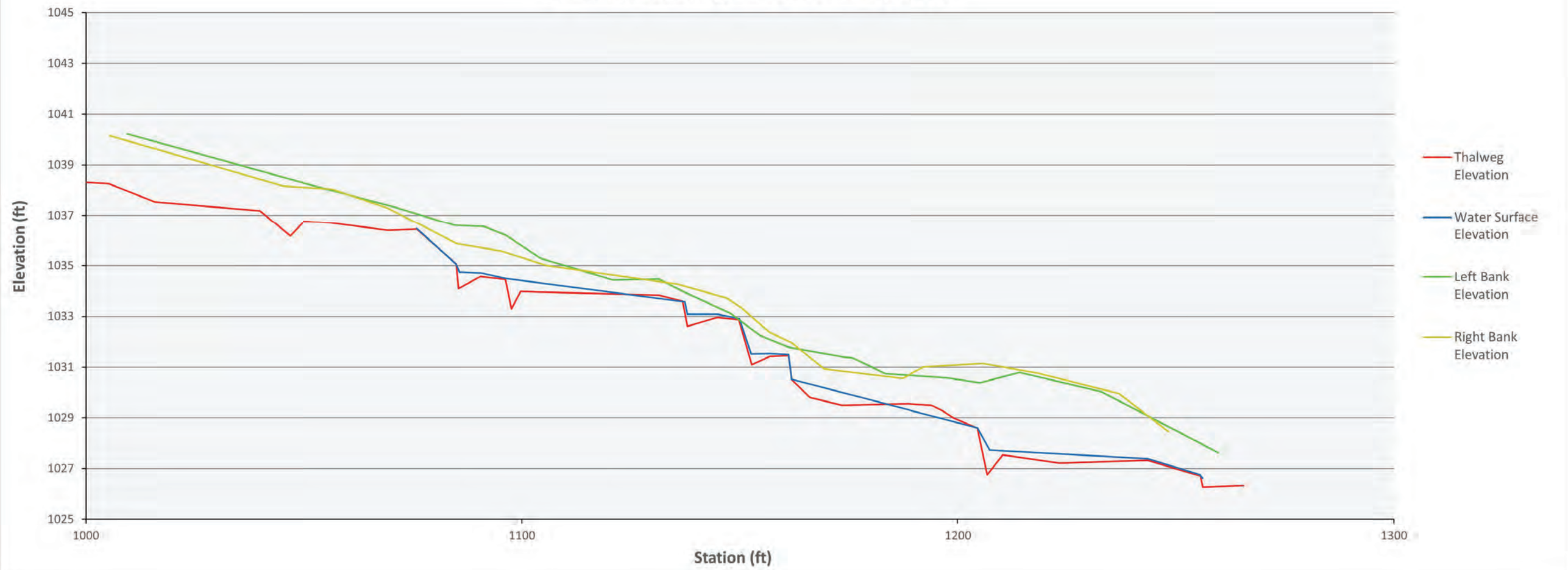
Banner Branch Mitigation Project
Longitudinal Profile - UT1C (lower)
As-Built (MY0 2021)(Data Collected May 2021)



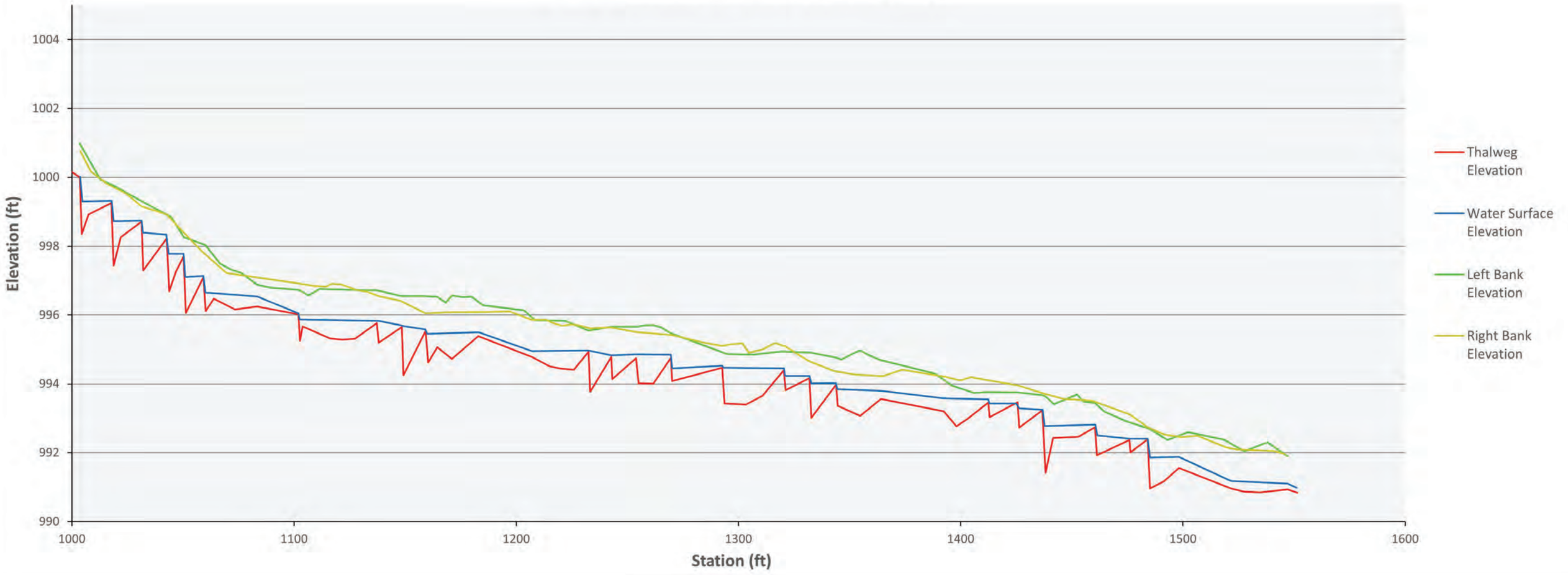
Banner Branch Mitigation Project
Longitudinal Profile - UT2
As-Built (MY0 2021)(Data Collected May 2021)



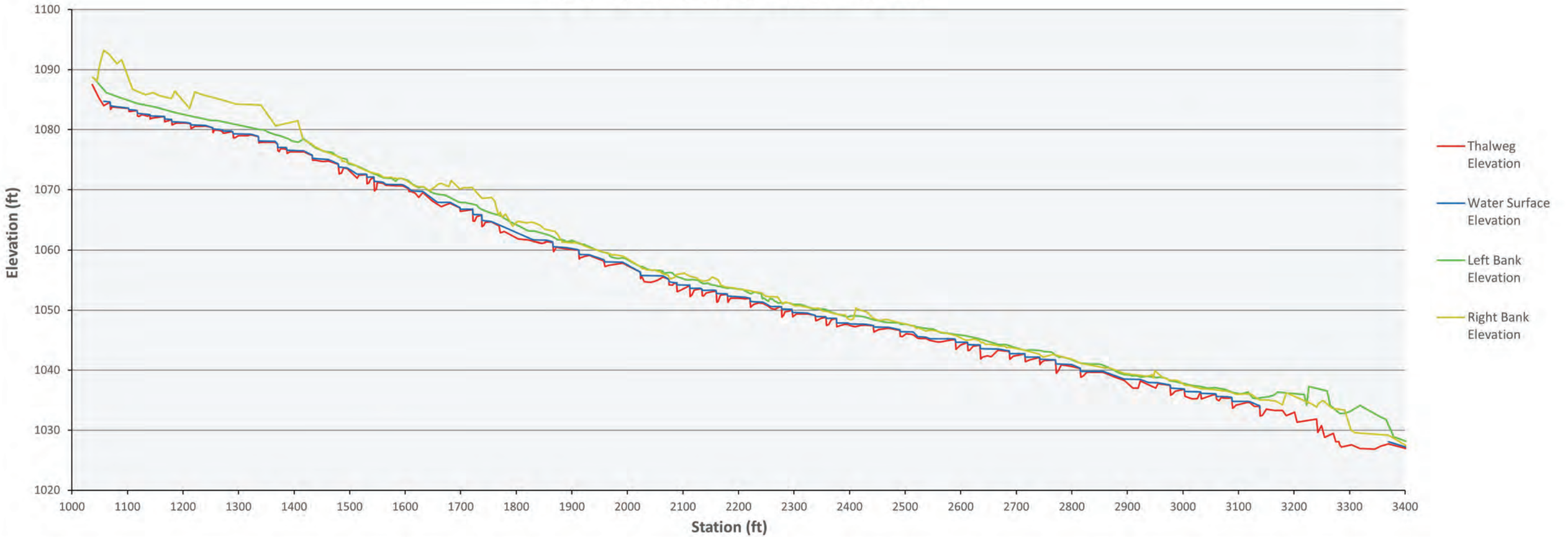
Banner Branch Mitigation Project
Longitudinal Profile - UT2A
As-Built (MY0 2021)(Data Collected May 2021)



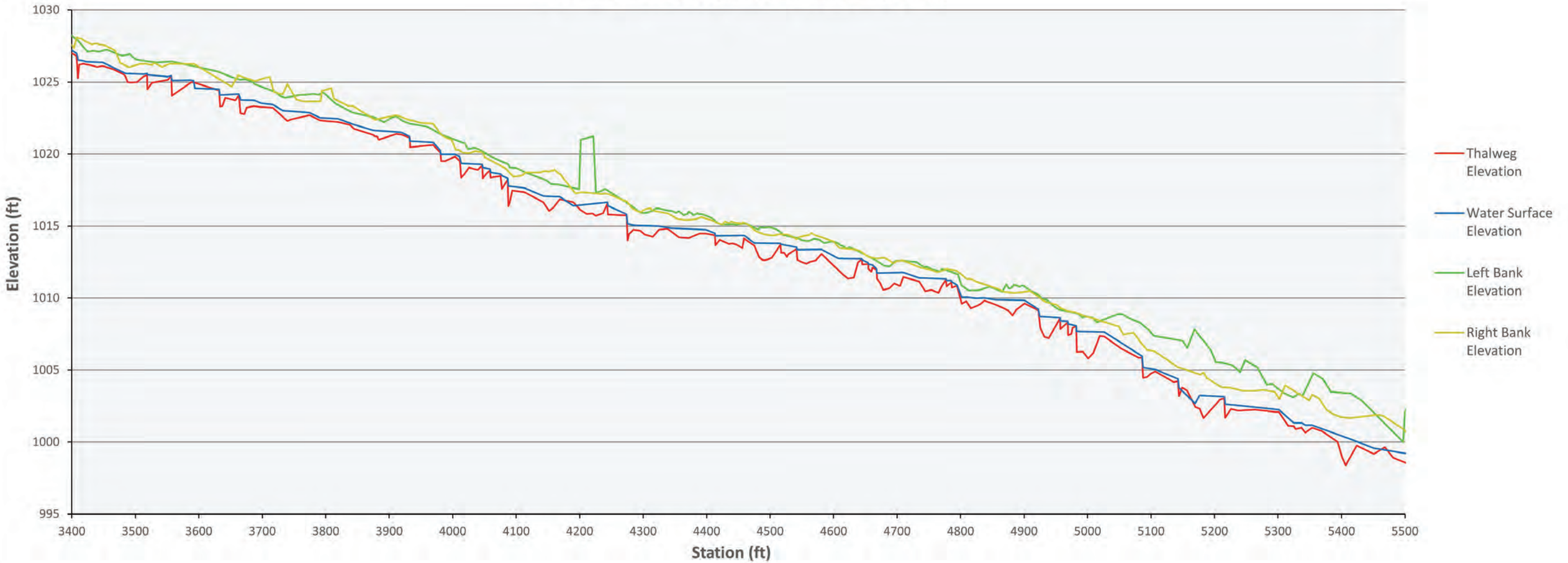
Banner Branch Mitigation Project
Longitudinal Profile - UT3
As-Built (MY0 2021)(Data Collected May 2021)



Banner Branch Mitigation Project
Longitudinal Profile - UT4-R1 (upper)
As-Built (MY0 2021)(Data Collected May 2021)



Banner Branch Mitigation Project
Longitudinal Profile - UT4-R1 (lower)
As-Built (MY0 2021)(Data Collected May 2021)



Banner Branch Mitigation Project
Longitudinal Profile - UT4-R2
As-Built (MY0 2021)(Data Collected May 2021)

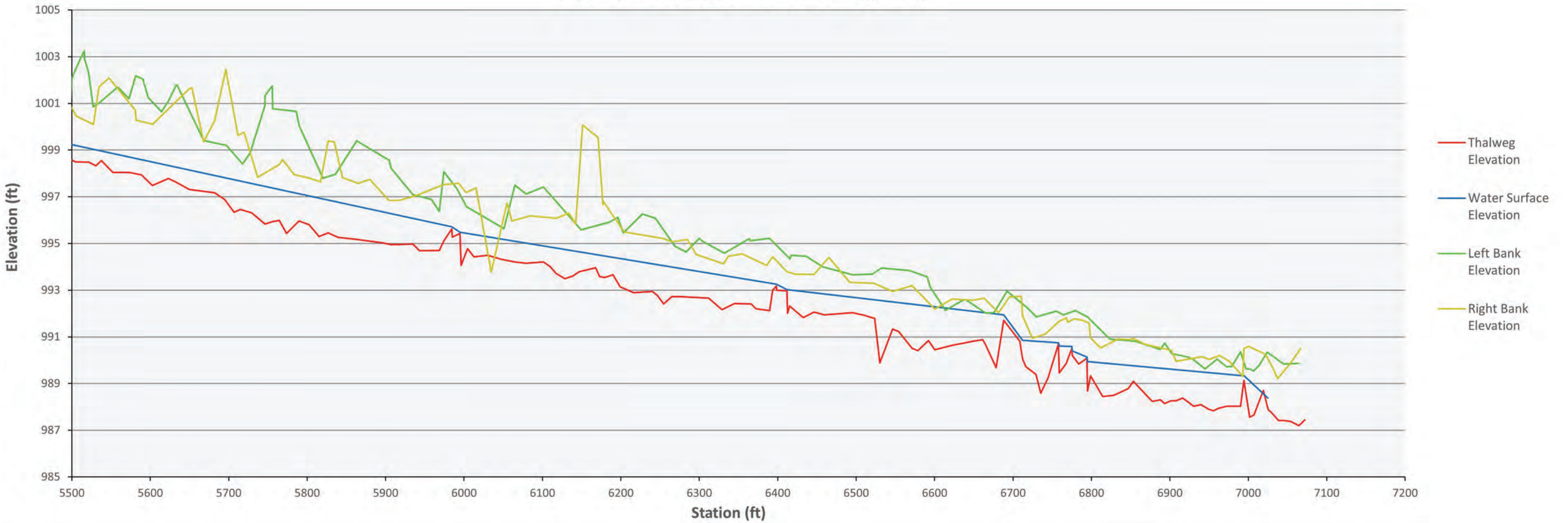


Table 7a: Baseline Stream Data Summary

Banner Branch, UT2

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		11.8					6.0		7.0	
Floodprone Width (ft)		14.0				9.0	15.0		21.9	
Bankfull Mean Depth (ft)		0.4					0.4		0.4	
Bankfull Max Depth (ft)		0.8					0.5		0.6	
Bankfull Cross Sectional Area (ft^2)		4.5					2.3		2.6	
Width/Depth Ratio		30.9					16.0		19.1	
Entrenchment Ratio		1.2				1.5	2.5		3.1	
Bank Height Ratio		1.0					1.0		1.0	
Max part size (mm) mobilized at bankfull	125.0					121.0		123.0		
Rosgen Classification	F4					B4		B4		
Bankfull Discharge (cfs)	10.00					10.00		10.00		
Sinuosity (ft)	1.14					1.10		1.10		
Water Surface Slope (Channel) (ft/ft)	0.0341					0.0352		0.0358		
Other										

Banner Branch, UT1C (lower)

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		4.4			5		4.5		3.1	
Floodprone Width (ft)		6.4			9	12.0	20.0		4.6	
Bankfull Mean Depth (ft)		0.6			5		0.4		0.1	
Bankfull Max Depth (ft)		0.9			5		0.5		0.2	
Bankfull Cross Sectional Area (ft^2)		2.6			5		1.6		0.4	
Width/Depth Ratio		7.5			9		12.5		24.0	
Entrenchment Ratio		1.5			9	2.7	4.4		1.5	
Bank Height Ratio		5.3			5		1.0		1.0	
Max part size (mm) mobilized at bankfull	199.0					149.0		184.0		
Rosgen Classification	B4a					B4		B4		
Bankfull Discharge (cfs)	6.00					6.00		6.00		
Sinuosity (ft)	1.10					1.08		1.06		
Water Surface Slope (Channel) (ft/ft)	0.0497					0.0506		0.0779		
Other										

Banner Branch, UT3

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		5.6			7		8.0		9.0	
Floodprone Width (ft)		32.0			12	20.0	40.0		40.0	
Bankfull Mean Depth (ft)		1.1			7		0.6		0.5	
Bankfull Max Depth (ft)		1.7			7		0.7		1.0	
Bankfull Cross Sectional Area (ft^2)		6.2			7		4.6		4.9	
Width/Depth Ratio		5.1			12		14.1		16.4	
Entrenchment Ratio		5.7			12	2.5	5.0		4.5	
Bank Height Ratio		1.4			7		1.0		1.0	
Max part size (mm) mobilized at bankfull	93.0					59.0		88.0		
Rosgen Classification	E5					C4		C4		
Bankfull Discharge (cfs)	24.00					24.00		24.00		
Sinuosity (ft)	1.03					1.22		1.21		
Water Surface Slope (Channel) (ft/ft)	0.0104					0.0099		0.0157		
Other										

Baseline Stream Data Summary

Banner Branch, BB-R1

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		14.8			8		13.0		13.9	
Floodprone Width (ft)		26.4			12	35.0	75.0	35.0	75.0	
Bankfull Mean Depth (ft)		1.1			8		1.1		1.1	
Bankfull Max Depth (ft)		1.6			8		1.4		1.7	
Bankfull Cross Sectional Area (ft^2)		16.1			8		14.0		14.8	
Width/Depth Ratio		13.6			12		12.1		13.0	
Entrenchment Ratio		1.8			12	2.7	5.8		>5	
Bank Height Ratio		1.2			8		1.0		1.0	
Max part size (mm) mobilized at bankfull	88.0					96.0		87.0		
Rosgen Classification	B4c					C4		C4		
Bankfull Discharge (cfs)	55.0					55.0		55.0		
Sinuosity (ft)	1.34					1.15		1.14		
Water Surface Slope (Channel) (ft/ft)	0.0082					0.0093		0.0089		
Other										

Banner Branch, BB-R2

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		13.7			8		14.0		14.4	
Floodprone Width (ft)		93.1			17	65.0	155.0	65.0	140.0	
Bankfull Mean Depth (ft)		1.5			8		1.1		1.2	
Bankfull Max Depth (ft)		2.1			8		1.5		1.8	
Bankfull Cross Sectional Area (ft^2)		21.0			8		16.0		16.6	
Width/Depth Ratio		9.0			17		12.3		12.5	
Entrenchment Ratio		6.8			17	4.6	11.1		>5	
Bank Height Ratio		1.5			8		1.0		1.0	
Max part size (mm) mobilized at bankfull	98.0					86.0		82.0		
Rosgen Classification	E4					C4		C4		
Bankfull Discharge (cfs)	60.0					60.0		60.0		
Sinuosity (ft)	1.31					1.24		1.24		
Water Surface Slope (Channel) (ft/ft)	0.0071					0.0074		0.0073		
Other										

Banner Branch, BB-R3

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)		14.6			8		15.0	17.5		
Floodprone Width (ft)		51.0			14	50.0	120.0	50.0	120.0	
Bankfull Mean Depth (ft)		1.5			8		1.2	1.1		
Bankfull Max Depth (ft)		2.7			8		1.6	1.7		
Bankfull Cross Sectional Area (ft^2)		21.9			8		17.8	17.5		
Width/Depth Ratio		9.7			14		12.6	14.5		
Entrenchment Ratio		3.5			14	3.3	8.0	>5		
Bank Height Ratio		1.4			8		1.0	1.0		
Max part size (mm) mobilized at bankfull	79.0					65.0		78.0		
Rosgen Classification	E4					C4		C4		
Bankfull Discharge (cfs)	70.0					70.0		70.0		
Sinuosity (ft)	1.15					1.20		1.18		
Water Surface Slope (Channel) (ft/ft)	0.0053					0.0061		0.0075		
Other										

Table 7a: Baseline Stream Data Summary

Banner Branch, UT4-R1 (upper)

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	9.9	11.0		12.2	5		11.0	10.5	11.4	
Floodprone Width (ft)	14.7	15.0		15.3	11	25.0	40.0	29.5	32.5	
Bankfull Mean Depth (ft)	0.7	0.7		0.8	5		0.7	0.7	0.8	
Bankfull Max Depth (ft)	1.0	1.1		1.2	5		0.9	1.1	1.3	
Bankfull Cross Sectional Area (ft^2)	8.2	8.3		8.3	5		7.7	7.8	8.1	
Width/Depth Ratio	11.8	14.8		17.8	11		15.8	13.8	16.6	
Entrenchment Ratio	1.3	1.4		1.5	11	2.3	3.6	2.6	3.1	
Bank Height Ratio	1.5	1.9		2.3	5		1.0		1.0	
Max part size (mm) mobilized at bankfull	132.0					147.0		142.0		
Rosgen Classification	B4c/F4					B4c		B4c		
Bankfull Discharge (cfs)	30.0					30.0		30.0		
Sinuosity (ft)	1.23					1.14		1.11		
Water Surface Slope (Channel) (ft/ft)	0.0185					0.0248		0.0235		
Other										

Banner Branch, UT4-R1 (lower)

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)				12.2	7		11.0		12.5	
Floodprone Width (ft)				15.3	11	37.0	70.0		40.0	
Bankfull Mean Depth (ft)				0.7	7		0.7		0.7	
Bankfull Max Depth (ft)				1.0	7		0.7		1.2	
Bankfull Cross Sectional Area (ft^2)				8.3	7		7.7		8.4	
Width/Depth Ratio				17.8	11		15.8		18.6	
Entrenchment Ratio				1.3	11		>2.2		3.2	
Bank Height Ratio				1.8	7		1.0		1.0	
Max part size (mm) mobilized at bankfull	132.0					147.0		96.0		
Rosgen Classification	F4					C4b		B4c		
Bankfull Discharge (cfs)	30.0					30.0		30.0		
Sinuosity (ft)	1.23					1.18		1.19		
Water Surface Slope (Channel) (ft/ft)	0.0185					0.0145		0.0141		
Other										

Banner Branch, UT4-R2

Parameter	Pre-Existing Condition (applicable)					Design		Monitoring Baseline (MY0)		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)				10.7	6		12.0		16.6	
Floodprone Width (ft)				39.0	10	43.0	126.0		37.6	
Bankfull Mean Depth (ft)				1.0	6		0.8		0.9	
Bankfull Max Depth (ft)				1.4	6		1.3		1.5	
Bankfull Cross Sectional Area (ft^2)				10.7	6		9.5		14.9	
Width/Depth Ratio				10.5	10		12.0		18.5	
Entrenchment Ratio				3.7	10	3.6	<6		2.3	
Bank Height Ratio				1.2	6		1.0		1.0	
Max part size (mm) mobilized at bankfull	132.0					103.0		81.0		
Rosgen Classification	incised E4					C5		C5		
Bankfull Discharge (cfs)	40.0					40.0		40.0		
Sinuosity (ft)	1.21					1.23		1.27		
Water Surface Slope (Channel) (ft/ft)	0.0012					0.012		0.011		
Other										

Table 7b: Monitoring Data - Cross Section Morphology Monitoring Summary

Banner Branch/DMS: 100080 Segment/Reach: BB-R1, BB-R2, BB-R3, UT2, UT3, UT4-R1, UT4-R2

	Cross-Section 1 (Riffle - BB-R1)							Cross-Section 2 (Pool - BB-R1)							Cross-Section 3 (Riffle - UT2)							Cross-Section 4 (Pool - UT2)						
	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	1009.67							1008.99							1023.98							1023.62						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	1008.00							1007.03							1023.45							1021.98						
LTOB[2] Elevation	1009.67							1008.99							1023.98							1023.62						
LTOB[2] Max Depth (ft)	1.68							1.96							0.53							1.63						
LTOB[2] Cross Sectional Area (ft^2)	14.77							19.91							2.36							6.12						
	Cross-Section 5 (Pool - BB-R2)							**Cross-Section 6 (Riffle - BB-R2)**							**Cross-Section 7 (Pool - BB-R2)**							**Cross-Section 8 (Riffle - BB-R2)**						
	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	1001.15							1001.25							998.28							998.33						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	998.94							999.46							995.99							996.67						
LTOB[2] Elevation	1001.15							1001.25							998.28							998.33						
LTOB[2] Max Depth (ft)	2.22							1.79							2.28							1.66						
LTOB[2] Cross Sectional Area (ft^2)	24.67							16.63							22.81							17.48						
	Cross-Section 9 (Pool - UT3)							**Cross-Section 10 (Riffle - UT3)**							**Cross-Section 11 (Riffle - BB-R3)**							**Cross-Section 12 (Pool - BB-R3)**						
	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	996.19							996.10							989.39							989.04						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	994.86							995.15							987.74							986.79						
LTOB[2] Elevation	996.19							996.10							989.39							989.04						
LTOB[2] Max Depth (ft)	1.32							0.96							1.65							2.25						
LTOB[2] Cross Sectional Area (ft^2)	8.82							4.91							15.65							21.50						
	Cross-Section 13 (Pool - UT4-R1)							**Cross-Section 14 (Riffle - UT4-R1)**							**Cross-Section 15 (Pool - UT4-R1)**							**Cross-Section 16 (Riffle - UT4-R1)**						
	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	1074.60							1074.45							1039.11							1038.68						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							1.00							1.00							1.00						
Thalweg Elevation	1072.31							1073.24							1037.27							1037.61						
LTOB[2] Elevation	1074.60							1074.45							1039.11							1038.68						
LTOB[2] Max Depth (ft)	2.29							1.21							1.84							1.07						
LTOB[2] Cross Sectional Area (ft^2)	14.60							7.83							10.71							7.80						
	Cross-Section 17 (Riffle - UT4-R1)							**Cross-Section 18 (Pool - UT4-R1)**							**Cross-Section 19 (Pool - UT4-R2)**							**Cross-Section 20 (Riffle - UT4-R2)**						
	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	1016.91							1016.26							995.05							994.42						
Bank Height Ratio_Based on AB Bankfull[1] Area	1.00							0.96							1.00							1.00						
Thalweg Elevation	1015.66							1014.07							991.65							993.07						
LTOB[2] Elevation	1016.91							1016.22							995.05							994.42						
LTOB[2] Max Depth (ft)	1.25							2.15							3.41							1.34						
LTOB[2] Cross Sectional Area (ft^2)	8.36							11.81							27.60							14.51						

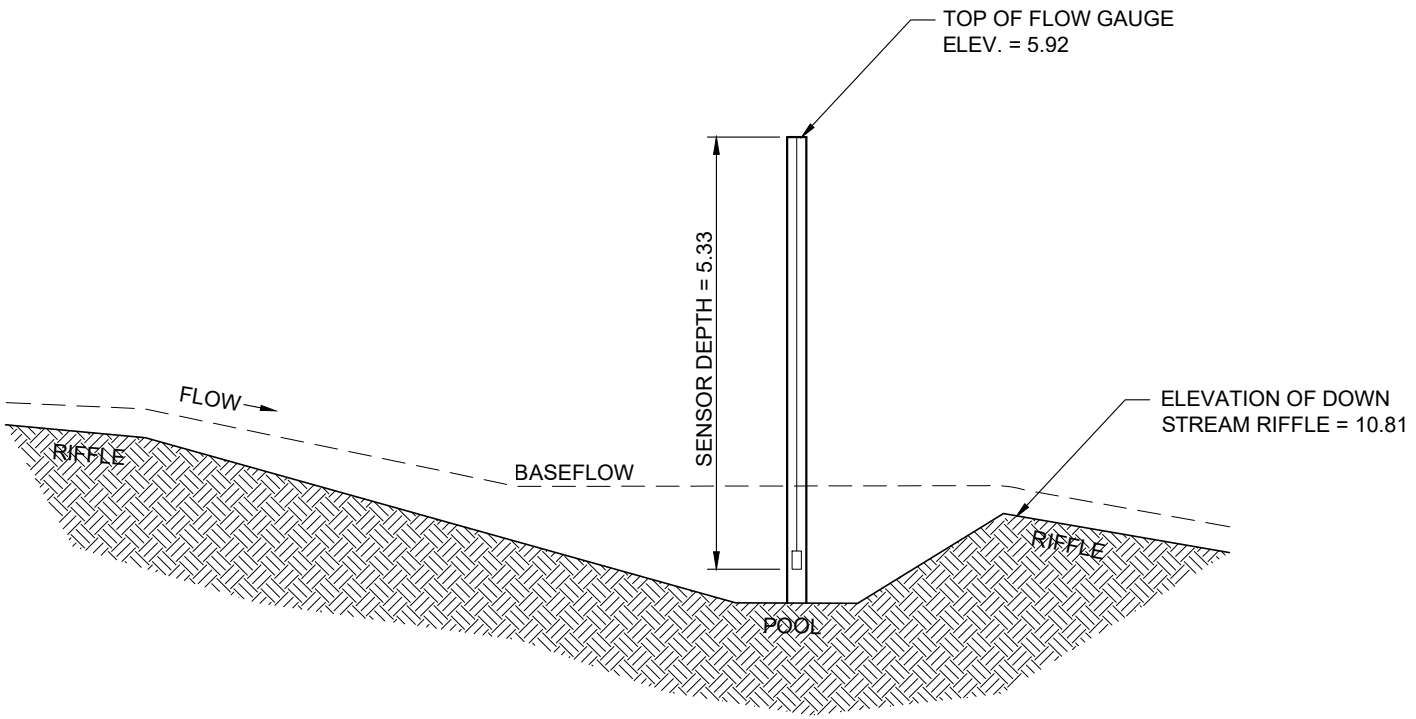
The above morphology parameters reflect the 2018 guidance that arose from the mitigation technical workgroup consisting of DMS, the IRT and industry mitigation providers/practitioners. The outcome resulted in the focus on three primary morphological parameters of interest for the purposes of tracking 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 between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

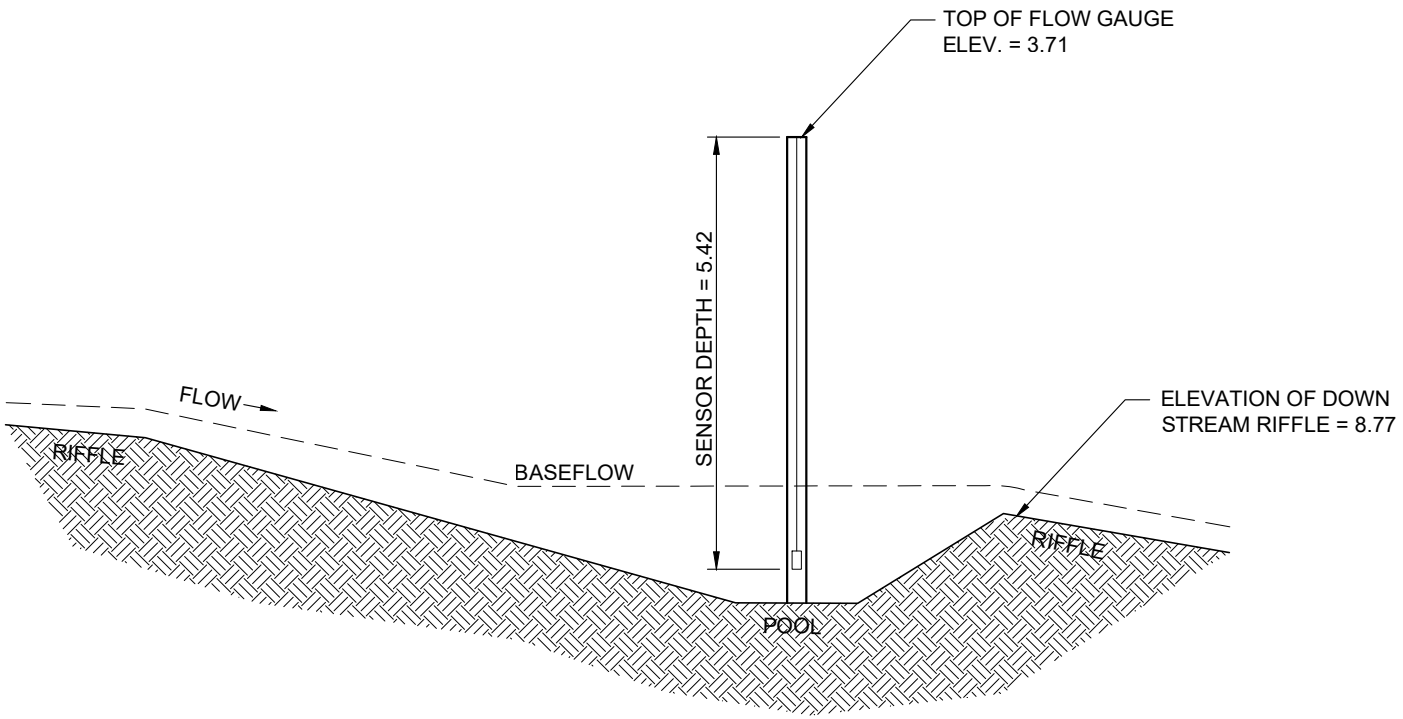
Appendix D:
Hydrologic Data

Flow Gauge and Crest Gauge Installation Diagrams
Photos: Wetland Gauge and Surface Water Gauge



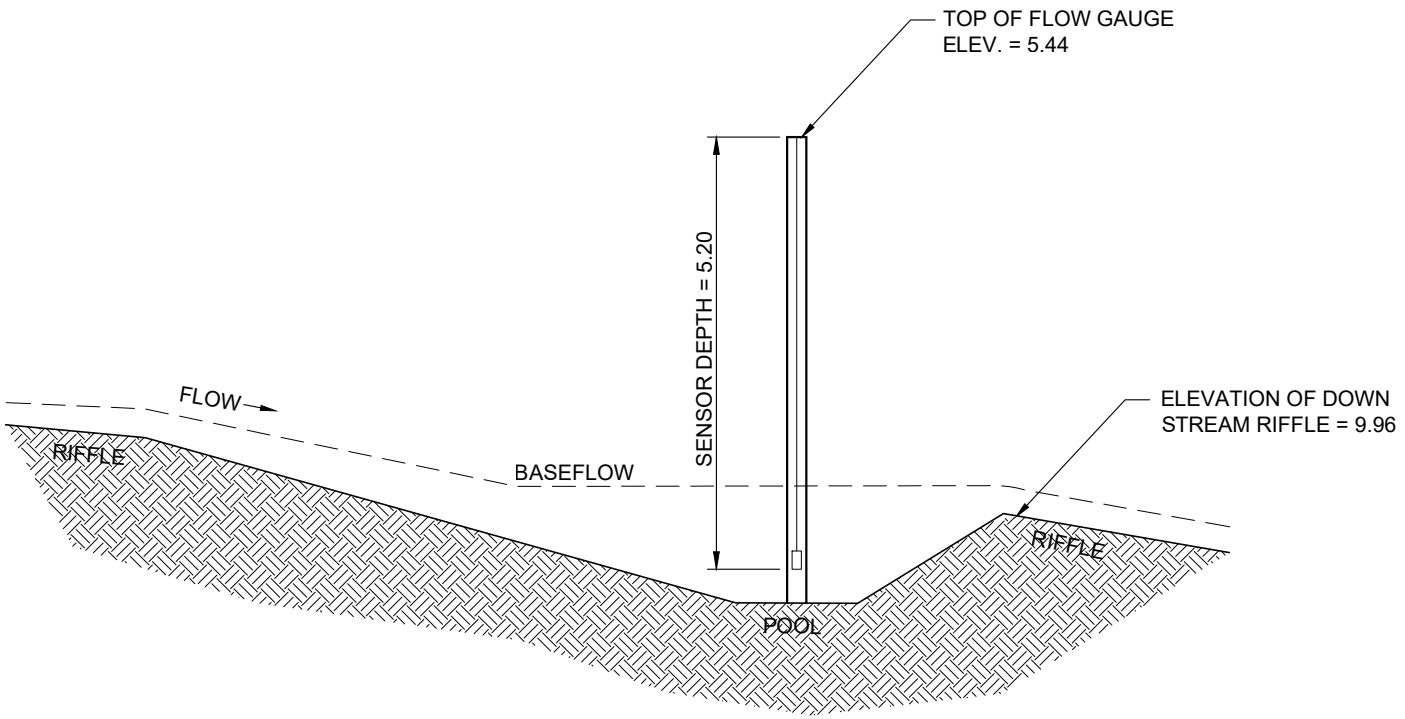
FLOW GAUGE FG-1 (UT1A)

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.33 - (10.81 - 5.92)
Flow Depth = 0.44 feet



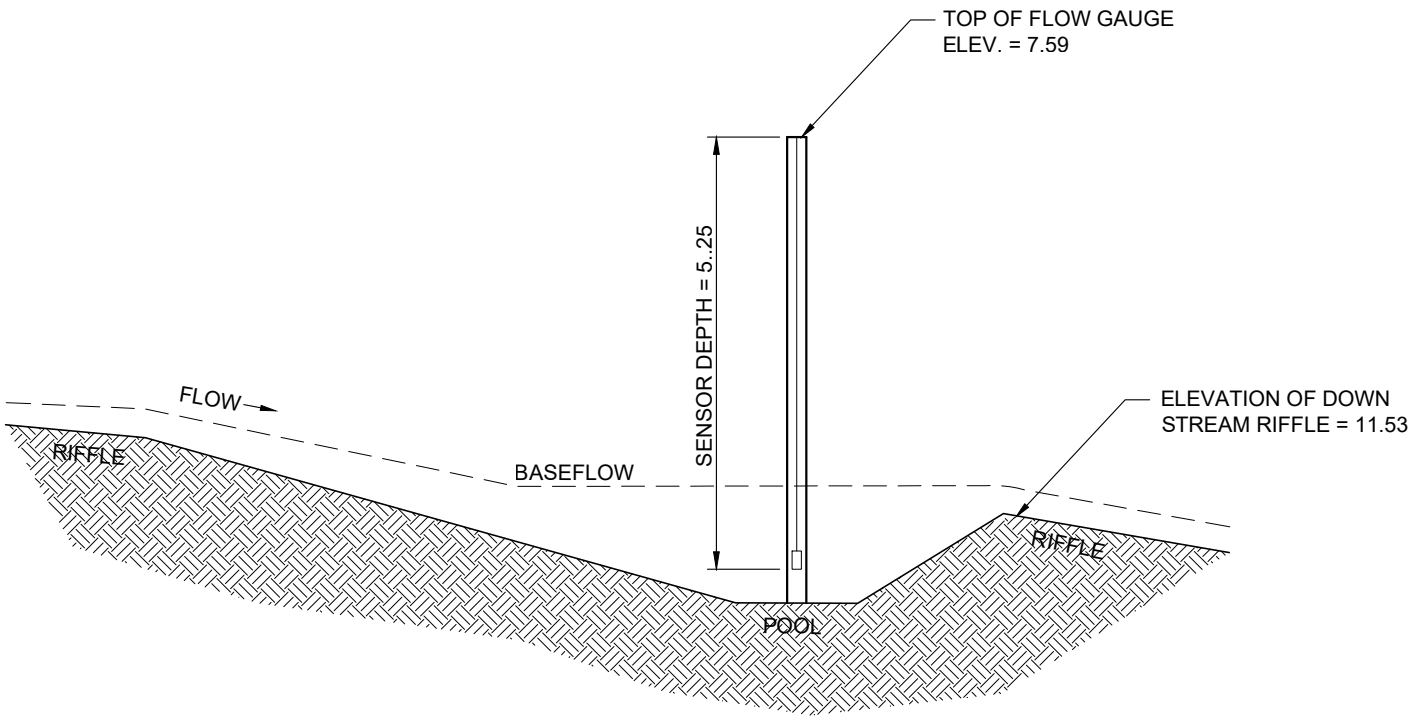
FLOW GAUGE FG-2 (UT1C)

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.42 - (8.77 - 3.71)
Flow Depth = 0.36 feet



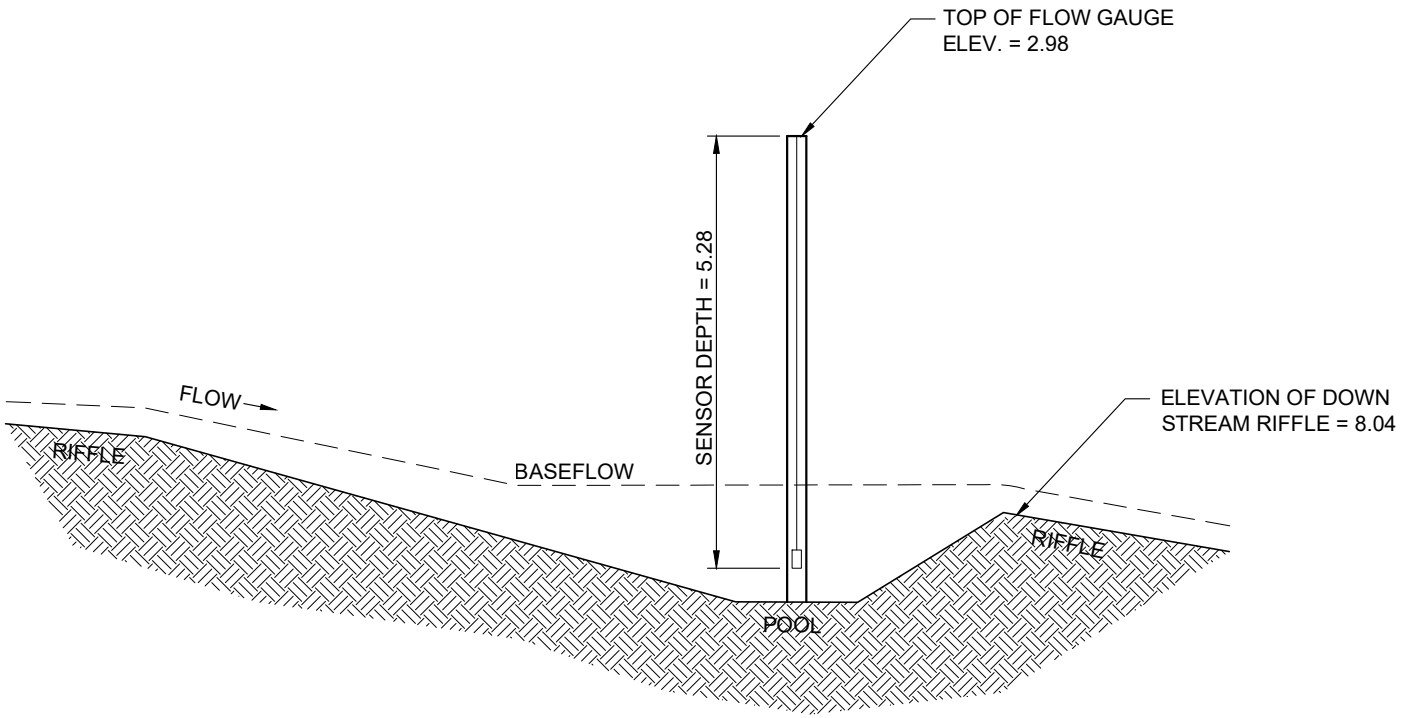
FLOW GAUGE FG-3 (UT2)

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.20 - (9.96 - 5.44)
Flow Depth = 0.68 feet



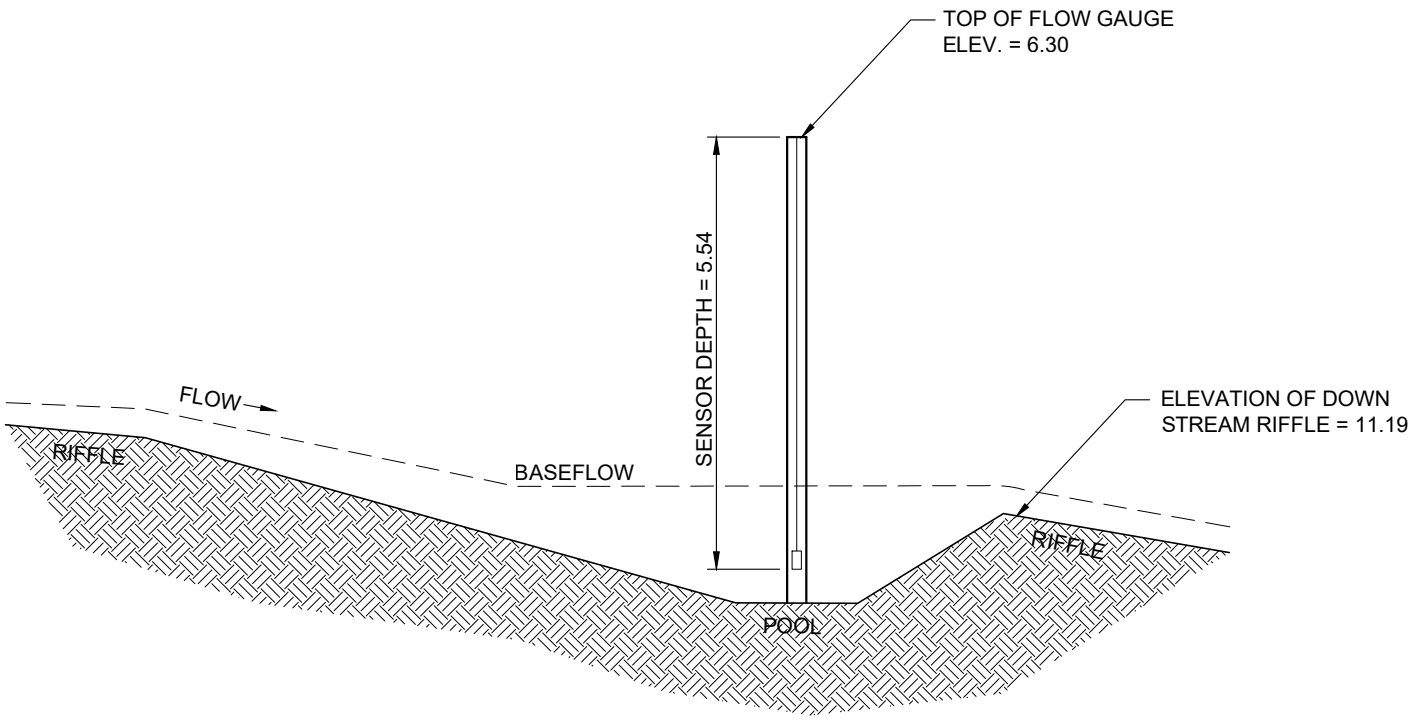
FLOW GAUGE FG-4 (UT2A)

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.25 - (11.53 - 7.59)
Flow Depth = 1.31 feet



FLOW GAUGE FG-5 (UT3)

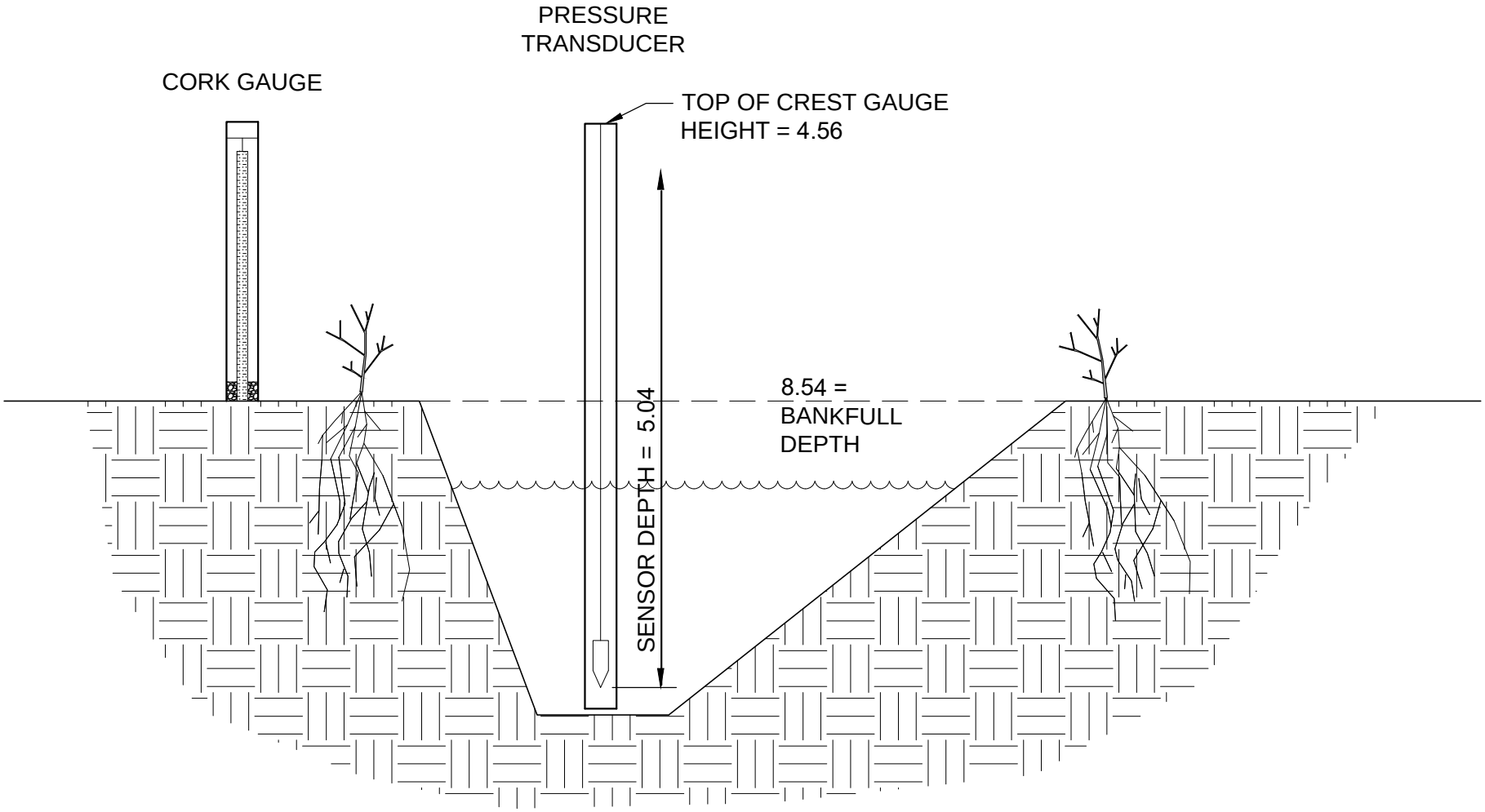
Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.28 - (8.04 - 2.98)
Flow Depth = 0.22 feet



FLOW GAUGE FG-6 (UT4-R1)

Flow Depth = Sensor Depth - (Top of Riffle - Top of Gauge)
Flow Depth = 5.54 - (11.19 - 6.30)
Flow Depth = 0.65 feet

CROSS SECTIONAL VIEW OF STREAM

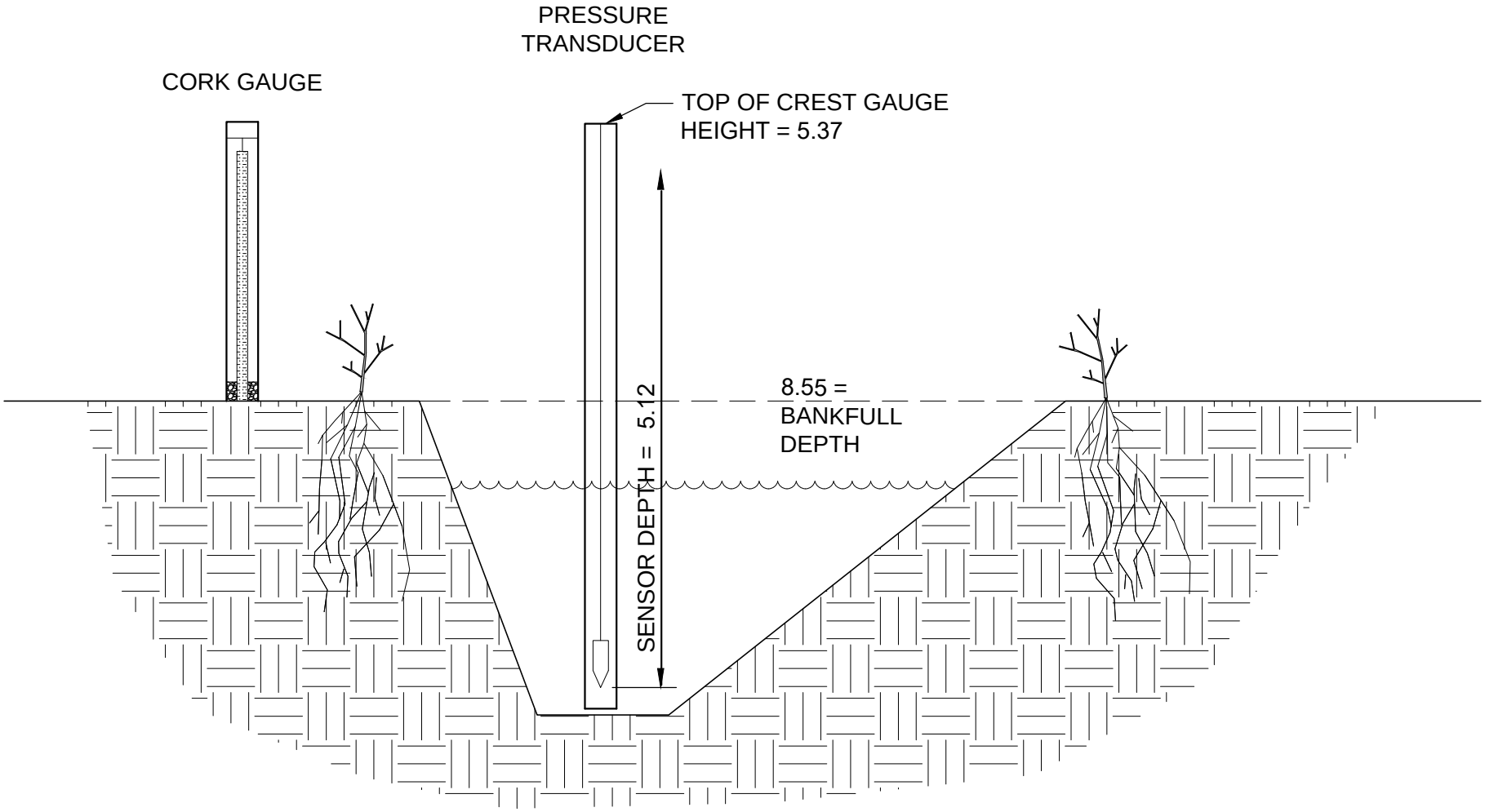


Crest Gauge CG-1 (UT2)

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

Bankfull Event Depth = 1.06

CROSS SECTIONAL VIEW OF STREAM

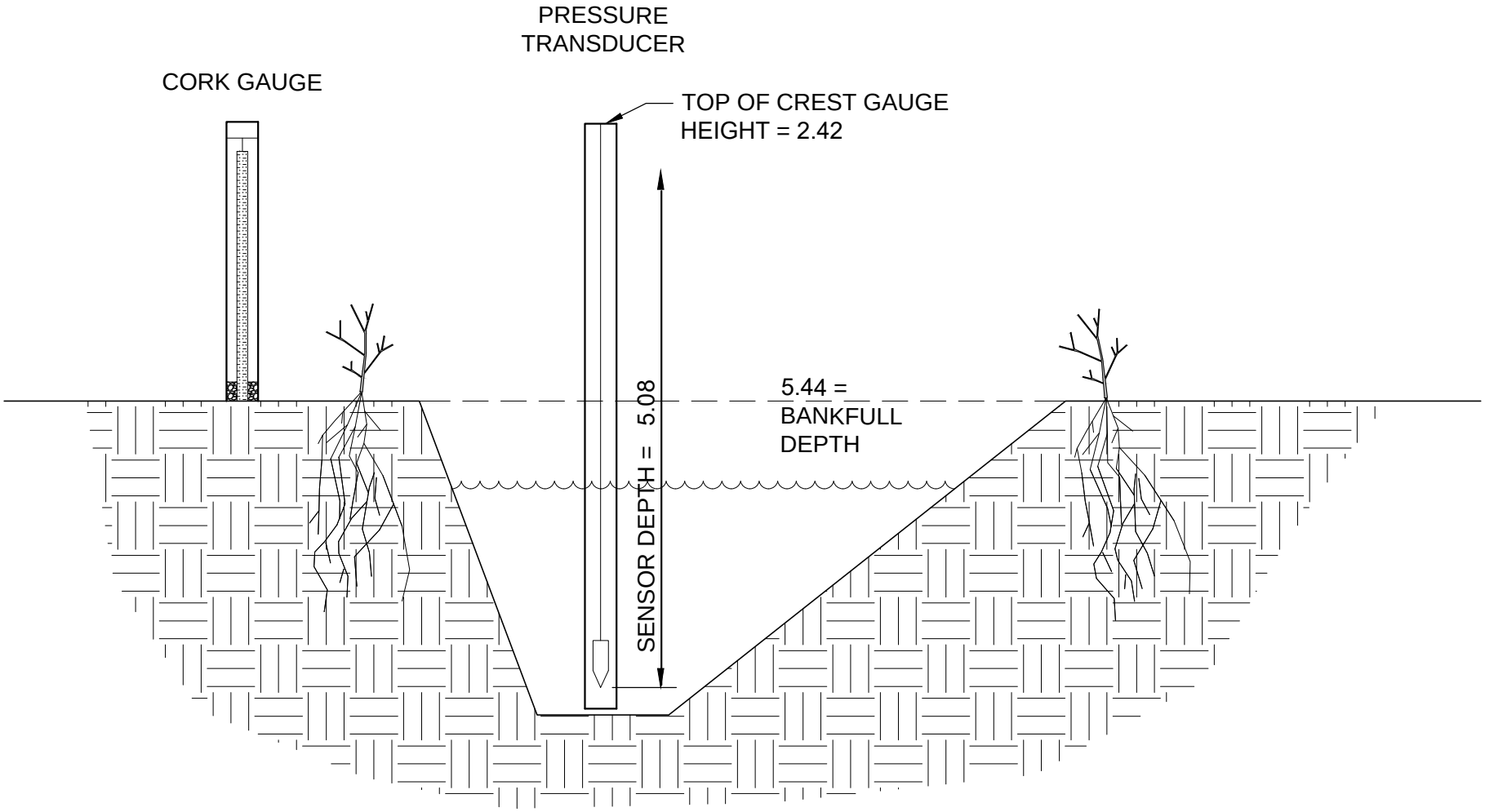


Crest Gauge CG-2 (BB-R2)

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

Bankfull Event Depth = 1.94

CROSS SECTIONAL VIEW OF STREAM



Crest Gauge CG-3 (UT4-R2)

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

Bankfull Event Depth = 2.06

Wetland Gauge WG-1 (W2)

Wetland Gauge WG-2 (W8A)

Wetland Gauge WG-3 (W9)

Wetland Gauge WG-4 (W1A)

Wetland Gauge WG-5 (W1)

Wetland Gauge WG-6 (W6A)

Wetland Gauge WG-7 (W3)

Wetland Gauge WG-8 (W4)

Wetland Gauge WG-9 (W4A)

Flow Gauge FG-1 (UT1A)

Flow Gauge FG-2 (UT1C)

Flow Gauge FG-3 (UT2)

Flow Gauge FG-4 (UT2a)

Flow Gauge FG-5 (UT3)

Flow Gauge FG-6 (UT4-R1)

Banner Branch Pressure and Rain Gauge

Crest Gauge CG-1 (UT2) Pressure Transducer

Crest Gauge CG-1 (UT2) Traditional Cork

Crest Gauge CG-2 (BB-R2) Pressure Transducer

Crest Gauge CG-2 (BB-R2) Traditional Cork

Crest Gauge CG-3 (UT4-R2) Pressure Transducer

Crest Gauge CG-3 (UT4-R2) Traditional Cork

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	6/23/2020
Construction (Grading) Completed	NA	4/21/2021
Planting Completed	NA	4/22/2021
As-built Survey Completed	NA	6/21/2021
MY-0 Baseline Report	4/22/21	6/25/2021
MY1+ Monitoring Reports		
Remediation Items (e.g. beaver removal, supplements, repairs etc.)		
Encroachment		

Banner Branch Mitigation Project/DMS: 100080	
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: Christopher Tomsic	(828) 493-3287
Construction Contractor	5616 Coble Church Road
KBS Earthworks Inc.	Julian, NC 27283
Primary contractor POC: Stephen Shore	(336) 380-2505