Hip Bone Creek Baseline Monitoring Report

Hip Bone Creek Restoration Site
Cape Fear River Basin - 03030003
Monitoring Year 00
DMS Contract 7528
DMS Project Number 100059

DWR #: 2018-0785
USACE AID #: SAW-2018-01160
Chatham County, North Carolina

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

Baseline Data Collected: May 2021
Date Submitted: August 2021

Monitoring and Design Firm

Prepared by:

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KCI ASSOCIATES OF NORTH CAROLINA, PA

ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS

4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 (919) 783-9214 (919) 783-9266 Fax

MEMORANDUM

Date: August 27, 2021

To: Jeremiah Dow, DMS Project Manager

From: Tim Morris, Project Manager
KCI Associates of North Carolina, PA

Subject: Hip Bone Creek Mitigation Site
MY-00 Baseline Monitoring Report Comments
Cape Fear River Basin CU 03030003
NCDMS Project # 100059
Contract # 7528

Please find below our responses in italics to the MY-00 Baseline Monitoring Report comments from NCDMS received on August 13, 2021, for the Hip Bone Creek Mitigation Site.

- Title Page – Please correct the river basin and HUC.
  KCI Response: This error has been corrected.

- We highly recommend following the most recent DMS monitoring template released in October 2020. The new template is designed to shorten reports and simplify many of the tables.
  KCI Response: The morphology tables have been updated to conform to the October 2020 template. Future monitoring reports will use the October 2020 template.

- Table 1 – Please add the surveyed as-built stream lengths to this table. The existing footage/acreage column can be replaced with the as-built lengths. Also, adjust wetland areas, if necessary, based on the response to comment 9.f.
  KCI Response: The Existing Footage/Acreage column has been replaced with the As-Built Lengths.

- Table 4 – Please update the Regulatory Considerations on this Table since the Section 401 and 404 permits were issued.
  KCI Response: Table 4 has been updated to reflect that these permits have been issued.

- CCPV – The photo points should be labeled so they can be matched with the photo log.
  KCI Response: The missing labels have been added to the CCPV.

Table 7a – We highly recommend using new template tables. T1 geomorphology data needs a separate table foreach reach so that as-built condition and design parameters can be compared.
KCI Response: Both Table 7 and Table 8 have been updated to match the October 2020 template.

- The Visual Stream Stability Assessment and Visual Vegetation Assessment tables were not included. Please ensure these are included in the MY1 report.
  KCI Response: These tables were not included since there are not usually concerns about stream stability and vegetative cover in the baseline report. These tables will be included in all future monitoring reports.

- Record Drawing / As-built Sheets
  - The Title Sheet should include the DMS Project Number (100059), DWR # (20180785), and USACE #(SAW-2017-0016160). The asset table should be updated based on the response to Comment 3 above.
    KCI Response: These changes have been made.
  - All plan sheets should show Limits of Disturbance, and typically we would see monitoring devices such as cross sections, monitoring wells, crest/flow gauges, and veg plots.
    KCI Response: Monitoring devices and the LOD have been added to the plan sheets.
  - Recommend removing callouts for in-channel structures that are not a deviation from design. For example, on Sheet 3 the "Installed 'Step Pool' (TYP.)" can be removed along with the other stream structure callouts.
    KCI Response: This change has been made.
  - Sheet 8 – River Birch, Southern Red Oak, and Persimmon species did not change from the amount proposed in the mitigation plan and should be colored black.
    KCI Response: This change has been made.
  - Sheet 10 & 11 – Please update the Boundary Marking Plan sheets to show that fencing was not constructed at numerous crossings. These changes should be called out in red as deviations from design.
    KCI Response: The interiors of the crossings were not fenced during DMS's site visit on August 13 because KCI's fencing subcontractor is waiting for the necessary material to arrive. Once this material arrives, the fencing will be installed as soon as possible. In the meantime the landowner has agreed not to move cattle through these crossings.

- Digital Files
  - The submitted stream and wetland features appear to be from the mitigation plan. Please include as-built features that accurately represent the Restoration Footage and Acreage column in the asset table.
    KCI Response: Because there was no change in alignment between design and construction of the site, the figures from the mitigation plan accurately represent the Restoration Footage and Acreage column in the asset table. A shapefile of the center line surveyed during the as-built survey has been included in the digital deliverables, but because of limitations in the precision of this survey, particularly around bends in the stream, the lengths of the reaches as represented in this shapefile do not perfectly align with those in the Restoration Footage and Acreage column in the asset table.
  - Please include unique ID's for the stream gauges that will relate to the ID's used for any supporting data.
    KCI Response: This change has been made.
  - Please submit the existing stream features (displayed in Fig. 7 of mitigation plan).
    KCI Response: This shapefile has been included in the digital deliverables.

  - Note that in order to meet the 2 year in the ground requirement to apply volunteers towards performance standards, height and x, y coordinates would need to be reported for

volunteers rather than stem counts binned by height.
KCI Response: This has been noted.

- Veg Plot 3's stems per acre value reported in Table 6 does not match the value included in the Plot 3 tab in the Hipbone Veg MY00 excel file. Please review these data and correct any outstanding mismatches.
  KCI Response: Plot 3's tab has been updated to display the correct totals.
- Two wetland polygons overlap with stream features that represent no-credit segments on T2 and T3 (e.g. the TOB was not excised from the polygon). Please clarify and remove the stream footprint from the wetland areas if necessary based on USACE JD.
  KCI Response: The area within the TOB of T2 and T3 has been removed from the wetland area. This resulted in a loss of 0.017 acres of wetland rehabilitation, 0.022 acres of wetland enhancement and 0.020 WMC's.

Please contact me if you have any questions or would like clarification concerning these responses.

Sincerely,

Tim Morris
Project Manager

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PROJECT SUMMARY

The Hip Bone Creek Restoration Site (HBCRS) is a full delivery project for the North Carolina Division of Mitigation Services (DMS). The site was completed in 2021 and restored and enhanced a total of 4,026 linear feet of stream and 6.023 acres of riparian wetland. The HBCRS is a riparian system in the Cape Fear River Basin (03030003 8-digit cataloging unit) in Chatham County, North Carolina. The site's natural hydrologic regime had been substantially modified by relocation and straightening, impacts from cattle, installation of field ditches, and other anthropogenic impacts. This site offers the chance to restore impacted agricultural lands to a stable stream and wetland ecosystem with a functional riparian buffer, floodplain access, and riparian wetlands.

The HBCRS is protected by an 18.68 acre permanent conservation easement, held by the State of North Carolina. The site is located approximately 3.3 miles southeast of Siler City, North Carolina. Specifically, the site is on Carter Brooks Road just east of US-421. The center of the site is at approximately 35.6804N and -79.4018 W in the Siler City USGS Quadrangle.

The North Carolina Ecosystem Enhancement Program (NCEEP) published the Cape Fear River Basin Restoration Priorities (RBRP) in 2009. The project's 14 digit CU (03030003070020, Tick Creek/Rocky River) was identified as a Targeted Local Watershed (TLW) in the RBRP and is one of three 14 digit hydrologic units in the DMS Upper and Middle Rocky River Local Watershed Plan (LWP). The goals and priorities for the HBCRS are based on the information presented in the RBRP and LWP: maintaining and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat (NCEEP, 2009). The project will support the following TLW goals:

- Reduce and control sediment inputs.
- Reduce and manage nutrient inputs.

The project will also address the following stressors and sources listed in the LWP:

- Stream bank erosion
- Lack of adequate forested buffer
- Livestock access to streams
- Fecal coliform bacteria
- Nutrient inputs
- Floodplain alteration

The project goals will be addressed through the following objectives:

- Relocate channelized streams to historic landscape positions
- Install a bankfull-sized channel cross-section
- Install bedform diversity with pools, riffles, and habitat structures
- Demarcate the project easement boundaries and fence out livestock
- Plant the site with native trees and shrubs and a herbaceous seed mix
- Reconnect streams to a floodplain
- Redevelop wetland microtopography to slow the flow of surface and subsurface drainage

Project planting and construction were completed in April 2021. The site was constructed as designed with only a few minor modifications from the design plan. Invasive species on site were treated and removed during construction. A step pool was added at STA 10+00 on T1. There were multiple small headcuts on T3 that were stabilized throughout the reach with stone RIFFLE enhancements. Riffle enhancements were added to the beginning EII section of T3. See Appendix E – As-Built Plan Sheets for details concerning these changes.

The monitoring components were installed in May 2021. Two automatically recording pressure transducer stream gauges that take a reading every 10 minutes were installed: one each in the upper third of T1-1 and T3-1 to monitor the number of consecutive days of flow in these streams. An additional automatically recording pressure transducer stream gauge was installed along T1-5 to record the occurrence of bankfull events. Cameras were installed in the vicinity of each of the flow gauges and set to record a short video once a day to provide additional verification of flow. Eight automatically recording pressure transducer groundwater monitoring gauges were installed within the wetlands on site. Seven of these gauges were installed within the re-establishment riparian wetlands on site and one of these gauges was installed within the rehabilitation wetland on site. To determine the success of the planted mitigation areas, ten 10 m x 10 m permanent vegetation monitoring plots were established. An additional eight 10 m x 10 m random vegetation monitoring plots were sampled throughout the site as well. The locations of the planted stems relative to the origin were recorded within the permanent plots and the species and height of each planted stem were recorded for all plots. Any volunteers found within the plots were also grouped into size categories by species, but separate from the planted stems. Eight permanent photo reference points were established and will be taken annually. Sixteen permanent cross-sections (8 riffle cross-sections and 8 pool cross-sections) were also established and a detailed longitudinal profile of the stream was taken. Wolman pebble counts were performed at all of the riffle cross-sections. The cross-section measurements will be repeated in future monitoring years, but the longitudinal profile will only be repeated if there are concerns about bed elevation adjustments. Reports will be submitted to DMS each year and the first year of monitoring will take place in 2021. First year monitoring data is scheduled to be collected in November 2021, six months after baseline data collection.

Vegetative success criteria for the stream mitigation is 260 woody stems/acre after five years, and 210 woody stems/acre after seven years. Trees in each plot must average seven feet in height at Year 5 and ten feet in height at Year 7. Volunteer species must be present for a minimum of two growing seasons and must be a species from the approved planting list to count toward vegetative success. A single species may not account for more than 50% of the required number of stems within any plot. A minimum of four bankfull events must also be recorded during the monitoring period. All project streams must show a minimum of 30 continuous days of flow within a calendar year (assuming normal precipitation). A “normal” year is based on NRCS climatological data for Chatham County with the 30th and 70th percentile thresholds as the range of normal, as documented in the USACE Technical Report “Accessing and Using Meteorological Data to Evaluate Wetland Hydrology, April 2000.” Wetlands on the site must present continuous saturation or inundation within 12” of the soil surface for 12% of the growing season. Bank height ratios (BHR) should not exceed 1.2 and the entrenchment ratios (ER) should be 2.2 or greater. BHR and ER at any measured riffle cross-section should not change more than 10% from the baseline condition during any given monitoring interval (e.g. no more than 10% between years 1 and 2, 2 and 3, 3 and 5, or 5 and 7). Visual assessments will also be used to identify problem areas.

BASELINE CONDITIONS

The site was planted in April 2021. The baseline vegetation monitoring was conducted May 13 and May 14, 2021. The average plot stem density from the eighteen surveyed plots is 1,005 planted stems/acre. Baseline monitoring was conducted during dormancy, so many of the stems were not identified to species. During MY01, these trees will be identified to species.

The baseline longitudinal profile was surveyed in May 2021. The baseline cross-sections were surveyed between May 18 and May 19, 2021. The baseline survey found that the stream was constructed as designed and all structures were installed as planned with small variations, as called out in the as-built plans. The profile and cross-section surveys found that the dimension and profile of the stream were built as designed, with some small variation as is typical for stream restoration projects. A post construction drone video of the site can be found at the following link: https://youtu.be/4xzm5mH9IgY

REFERENCES

NCDENR, Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009. Raleigh, NC. https://files.nc.gov/ncdeq/Mitigation%20Services/Watershed_Planning/Cape_Fear_River_Basin/RBRP%20CapeFear%202009%20Revised%20032013.pdf

NCDEQ, Division of Mitigation Services. June 2017. "As-built Baseline Monitoring Report Format, Data and Content Requirement." https://files.nc.gov/ncdeq/Mitigation%20Services/Document%20Management%20Library/Guidance%20and%20Template%20Documents/6_AB_Baseline__Rep_Templ_June%202017.pdf

NCIRT. October 24, 2016. "Wilmington District Stream and Wetland Compensatory Mitigation Update." https://saw-reg.usace.army.mil/PN/2016/Wilmington-District-Mitigation-Update.pdf

USACE, Sprecher, S. W.; Warne, A. G. 2000. "Accessing and Using Meteorological Data to Evaluate Wetland Hydrology." https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/ADA378910.xhtml

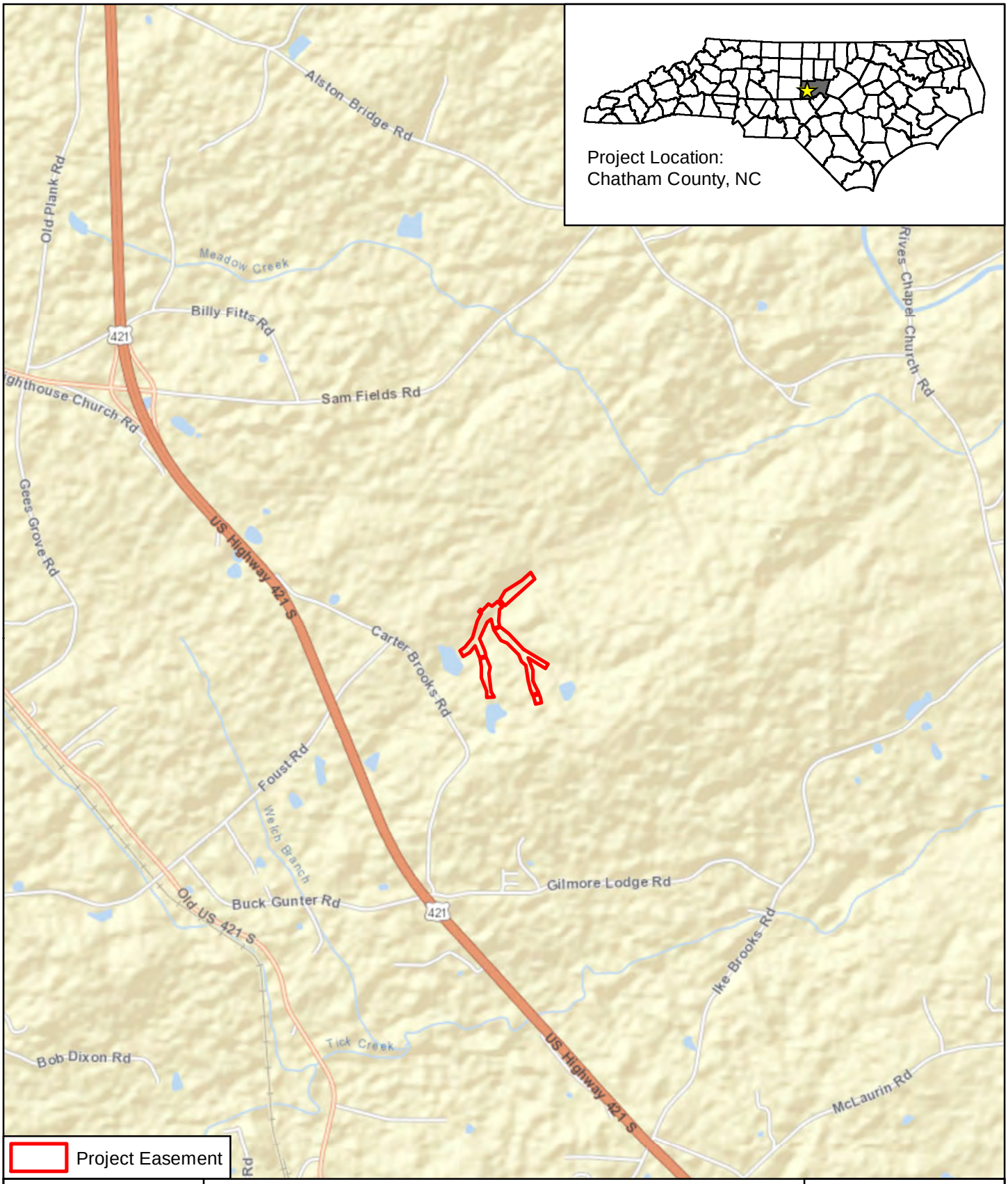


FIGURE 1. PROJECT SITE VICINITY MAP
HIP BONE CREEK RESTORATION SITE
CHATHAM COUNTY, NC

APPENDIX A

Background Tables

Table 1. Project Components and Mitigation Credits
Hip Bone Creek Restoration Site, DMS Project #100059

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	
Type	R	RE	R	RE	R	RE	R	RE
Linear Feet/Acres	2,860	1,166	4.528	1.495				
Credits	2,860.000	466.400	4.032	0.598				
TOTAL CREDITS	**3,326.400**		**4.630**					

Project Components

Project Component -or- Reach ID	Stationing/ Location	As-built Footage/ Acreage	Restoration Footage or Acreage	Creditable Footage or Acreage	Restoration Level	Approach (PI, PII etc.)	Mitigation Ratio (X:1)	Mitigation Credits	Notes/Comments
T1 Reach 1	10+00 to 17+80	745	780	750	R	I	1:1	750.000	30’ exception STA 13+12 TO 13+42
T1 Reach 2	17+80 to 26+86	890	906	906	R	I	1:1	906.000	
T1 Reach 3	26+86 to 29+54	208	269	209	R	I	1:1	209.000	60’ exception STA 27+77 to 28+37
T1 Reach 4	29+54 to 32+49	295	295	295	EII	N/A	2.5:1	118.000	
T1 Reach 5	32+49 to 37+01	447	452	452	R	I/II	1:1	452.000	
T3 Reach 1	300+00 to 303+10	280	310	280	EII	N/A	2.5:1	112.000	30’ exception STA 301+57 to 301+87
T3 Reach 2	311+10 to 317+00	590	591	591	EII	N/A	2.5:1	236.400	
T3 Reach 3	317+00 to 322+73	545	573	543	R	I	1:1	543.000	30’ exception STA 317+98 to 318+28
Riparian Enhancement	N/A	1.473	1.495	1.495	E	N/A	2.5:1	0.598	30’ exception STA 13+12 to 13+42
Riparian Wetland Re-establishment	N/A	3.040	3.040	3.040	R (Re-est.)	N/A	1:1	3.040	
Riparian Wetland Rehabilitation	N/A	1.471	1.488	1.488	R (Rehab.)	N/A	1.5:1	0.992	

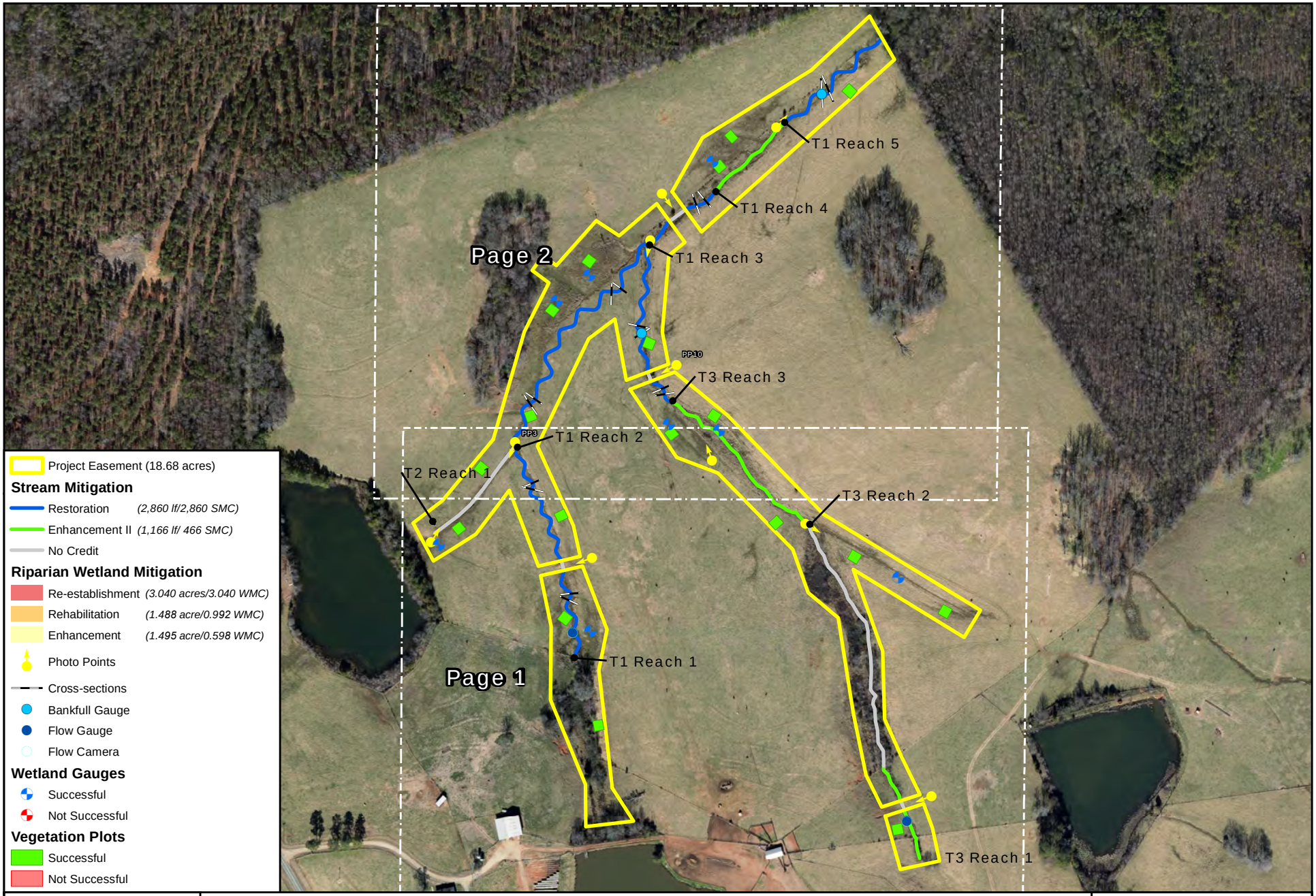
Table 2. Project Activity & Reporting History Hipbone Creek Restoration Site, DMS Project #100059		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		March 17, 2020
Final Design - Construction Plans		March 17, 2020
Construction Grading Completed		April 16, 2021
Planting Completed		April 30, 2021
Baseline Monitoring/Report	May 2021	July 2021
Vegetation Monitoring	May 14, 2021	
Stream Survey	May 21,2021	

Table 3. Project Contacts **Stony Fork Restoration Site, DMS Project #97085**	
Design Firm	KCI Associates of North Carolina, PC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	Chatham Civil Contracting 811 Archie Johnson Road Siler City, NC 27344 Contact: Mr. Stephen James Phone: (919)704-4442
Planting Contractor	Shenandoah Habitats 1983 Jefferson Highway Waynesboro, VA 22980 Contact: Mr. David Coleman Phone: (540) 941-0067
Monitoring Performers	
	KCI Associates of North Carolina, PC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Information **Hip Bone Creek Restoration Site, DMS Project #100059**			
Project Name	Hip Bone Creek Restoration Site		
County	Chatham County		
Project Area	18.68 ac		
Project Coordinates (lat. and long.)	35.6804 N, -79.4018		
Planted Acreage (acres of woody stems planted)	17.40		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Cape Fear		
USGS Hydrologic Unit 8-digit	03030003	**USGS Hydrologic Unit 14-digit**	03030003070020
DWQ Sub-basin	03-06-12		
Project Drainage Area (acres)	158 acres		
Project Drainage Area Percentage of Impervious Area	1%		
CGIA Land Use Classification	Pasture/Farmland (85%), Forest (9%), Open Water (5%), and Rural Development (1%)		
Existing Reach Summary Information			
Parameters	**T1**	**T3**	
Length of reach (linear feet)	2,439	2,202	
Valley confinement	Unconfined	Unconfined	
Drainage area (acres)	158 acres	43 acres	
Perennial, Intermittent, Ephemeral	Intermittent	Intermittent	
NCDWQ Water Quality Classification	C	C	
Rosgen Stream Classification (Existing / Proposed)	G4/C4 and C4b	G4/C4	
Evolutionary trend (Simon)	Channelized, Stage III	Channelized, Stage IIII	
FEMA classification	None	None	
Existing Wetland Summary Information			
Parameters	**T1**	**T3**	
Size of Wetland (acres)	2.52 ac (WA and WE)	0.99 ac (WB, WC, WD, WF, and WG)	
Wetland Type	Headwater Forest	Headwater Forest	
Mapped Soil Series	Georgeville	Chewacla/Wehadkee	
Drainage class	Well Drained	Poorly Drained	
Soil Hydric Status	Non-Hydric	Hydric	
Source of Hydrology	Stream Floodplain	Stream Floodplain	
Restoration or Enhancement Method	Enhancement	Re-establishment, Rehabilitation, and Enhancement	
Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	NWP 27 issued	SAW-2018-01160
Waters of the United States – Section 401	Yes	NWP 27 issued	DWR # 18-0785
Endangered Species Act	Yes	Yes	USFWS
Historic Preservation Act	No	Yes	NCSHIPO
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	Yes	N/A
Essential Fisheries Habitat	No	N/A	N/A

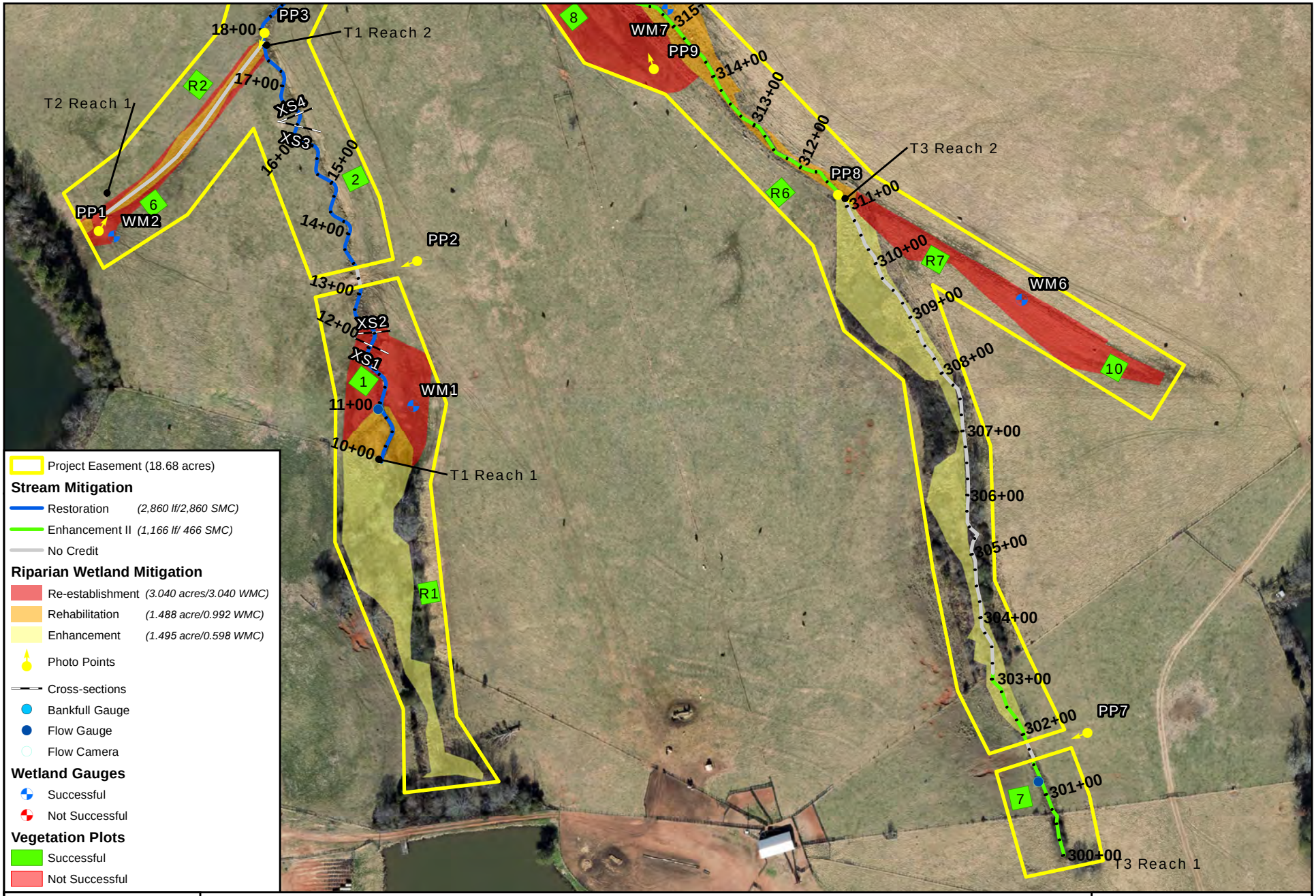
APPENDIX B

Visual Assessment Data



CURRENT CONDITIONS PLANVIEW PAGE
HIP BONE CREEK RESTORATION SITE
CHATHAM COUNTY, NC

Image Source: NC OneMap
2017 Orthoimagery.



CURRENT CONDITIONS PLANVIEW PAGE
HIP BONE CREEK RESTORATION SITE
CHATHAM COUNTY, NC

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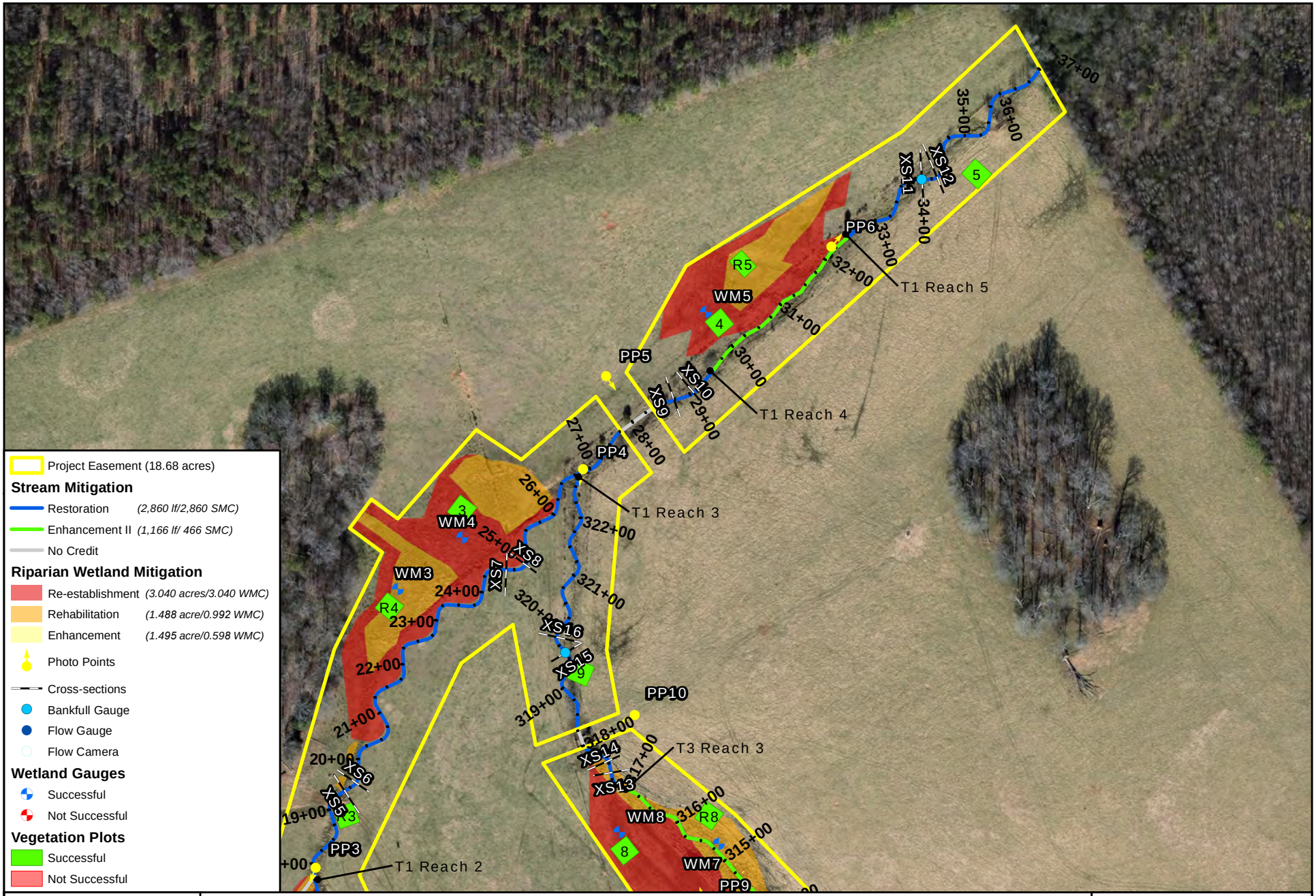
2017 Orthoimagery.



CURRENT CONDITIONS PLANVIEW PAGE
HIP BONE CREEK RESTORATION SITE
CHATHAM COUNTY, NC

Image Source: NC OneMap 2017 Orthoimagery.

Photo Reference Photos

PP1 – MY-00 – 5/24/21

PP2 – MY-00 – 5/24/21

PP3 – MY-00 – 5/24/21

PP4 – MY-00 – 5/24/21

PP5 – MY-00 – 5/24/21

PP6 – MY-00 – 5/24/21

PP7 – MY-00 – 5/24/21

PP8 – MY-00 – 5/24/21

PP9 – MY-00 – 5/24/21

PP10 – MY-00 – 5/24/21

Vegetation Monitoring Plot Photos

Vegetation Plot 1 – MY-00 – 5/14/21

Vegetation Plot 2 – MY-00 – 5/14/21

Vegetation Plot 3 – MY-00 – 5/13/21

Vegetation Plot 4 – MY-00 – 5/13/21

Vegetation Plot 5 – MY-00 – 5/13/21

Vegetation Plot 6 – MY-00 - 5/14/21

Vegetation Plot 7 – MY-00 – 5/13/21

Vegetation Plot 8 – MY-00 – 5/13/21

Vegetation Plot 9 – MY-00 – 5/13/21

Vegetation Plot 10 – MY-00 – 5/13/21

Vegetation Plot R1 – MY-00 – 5/14/21

Vegetation Plot R2 – MY-00 – 5/14/21

Vegetation Plot R3 – MY00 – 5/14/21

Vegetation Plot R4 – MY00 – 5/14/21

Vegetation Plot R5 – MY00 – 5/13/21

Vegetation Plot R6 – MY00 – 5/13/21

Vegetation Plot R7 – MY-00 – 5/13/21

Vegetation Plot R8 – MY-00 – 5/13/21

APPENDIX C

Vegetation Plot Data

Table 5. Species and Quantity of Planted Stems Hip Bone Creek Restoration Site, DMS Project #100059			
Common Name	Scientific Name	Bare Root	Live Stakes
Sycamore	*Platanus occidentalis*	4,380	
Swamp Chestnut Oak	*Quercus michauxii*	380	
River Birch	*Betula nigra*	4,225	
Willow Oak	*Quercus phellos*	3,535	
Pin Oak	*Quercus palustris*	1,845	
Southern Red Oak	*Quercus falcata*	1,690	
Persimmon	*Diospyros virginiana*	845	
Black Willow	*Salix nigra*		800
Silky Willow	*Salix sericea*		1,000
Silky Dogwood	*Cornus ammomum*		1,000

Table 6. Stem Count by Plot and Species
Hip Bone Creek Restoration Site, DMS Project #100059

	Current Plot Data (MY00 2020)													
	Plot 01		Plot 02		Plot 03		Plot 04		Plot 05		Plot 06		Plot 07	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)	7	7	12	12	3	3	6	6	8	8	14	14	3	3
Black Willow (*Salix nigra*)	1	1												
Buttonbush (*Cephalanthus occidentalis*)														
Honey Locust (*Gleditsia triacanthos*)														
Loblolly Pine (*Pinus taeda*)						1								
Oak (*Quercus sp.*)	1	1	5	5					3	3	1	1	10	10
Persimmon (*Diospyros virginiana*)	1	1	1	1										
Pin Oak (*Quercus palustris*)	2	2			6	6	2	2			1	1		
Red Maple (*Acer rubrum*)						7								
River Birch (*Betula nigra*)	12	12	8	8	2	2	5	5	13	13	6	6	1	1
Swamp Chestnut Oak (*Quercus michauxii*)	2	2												
Sweetgum (*Liquidambar styraciflua*)														
Willow Oak (*Quercus phellos*)	1	1	3	3	2	2	4	4	1	1			6	6
Winged Elm (*Ulmus alata*)						5								
Unknown					4	4	2	2	1	1	1	1	10	10
Stem count	27	27	29	29	17	30	19	19	26	26	23	23	30	30
size (ares)	1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	8	8	5	5	5	8	5	5	5	5	5	5	5	5
Stems per ACRE	1,093	1,093	1,174	1,174	688	1,214	769	769	1,052	1,052	931	931	1,214	1,214

Table 6. Stem Count by Plot and Species
Hip Bone Creek Restoration Site, DMS Project #100059

	Current Plot Data (MY00 2020)													
	Plot 08		Plot 09		Plot 10		Plot R1		Plot R2		Plot R3		Plot R4	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)	2	2			10	10	2	2	8	8	11	11	3	3
Black Willow (*Salix nigra*)														
Buttonbush (*Cephalanthus occidentalis*)														
Honey Locust (*Gleditsia triacanthos*)														
Loblolly Pine (*Pinus taeda*)														
Oak (*Quercus sp.*)			1	1	12	12	7	7	3	3	2	2		
Persimmon (*Diospyros virginiana*)					2	2					1	1		
Pin Oak (*Quercus palustris*)	3	3			1	1	4	4			1	1		
Red Maple (*Acer rubrum*)														10
River Birch (*Betula nigra*)	22	22	18	18			11	11	10	10	10	10	4	4
Swamp Chestnut Oak (*Quercus michauxii*)	1	1			2	2	2	2					1	1
Sweetgum (*Liquidambar styraciflua*)														3
Willow Oak (*Quercus phellos*)	1	1	6	6	7	7			4	4	1	1	1	1
Winged Elm (*Ulmus alata*)														7
Unknown			6	6	3	3			1	1				
Stem count	29	29	31	31	37	37	26	26	26	26	26	26	9	29
size (ares)	1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	5	5	4	4	7	7	5	5	5	5	6	6	4	7
Stems per ACRE	1,174	1,174	1,255	1,255	1,497	1,497	1,052	1,052	1,052	1,052	1,052	1,052	364	1,174

Table 6. Stem Count by Plot and Species
Hip Bone Creek Restoration Site, DMS Project #100059

	Current Plot Data (MY00 2020)								Annual Means	
	Plot R5		Plot R6		Plot R7		Plot R8		MY00 (2021)	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Sycamore (*Platanus occidentalis*)	2	2	1	1	7	7	5	5	104	104
Black Willow (*Salix nigra*)									1	1
Buttonbush (*Cephalanthus occidentalis*)		2								2
Honey Locust (*Gleditsia triacanthos*)				1						1
Loblolly Pine (*Pinus taeda*)										1
Oak (*Quercus sp.*)	8	8	12	12	1	1	9	9	75	75
Persimmon (*Diospyros virginiana*)					1	1			6	6
Pin Oak (*Quercus palustris*)	1	1			3	3	3	3	27	27
Red Maple (*Acer rubrum*)										17
River Birch (*Betula nigra*)	6	6	8	8					136	136
Swamp Chestnut Oak (*Quercus michauxii*)	3	3	1	1					12	12
Sweetgum (*Liquidambar styraciflua*)										3
Willow Oak (*Quercus phellos*)	1	1	5	5	7	7	7	7	57	57
Winged Elm (*Ulmus alata*)										12
Unknown					1	1			29	29
Stem count	21	23	27	28	20	20	24	24	447	483
size (ares)	1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.445	
Species count	6	7	5	6	6	6	4	4	9	15
Stems per ACRE	850	931	1,093	1,133	809	809	971	971	1,005	1,086

APPENDIX D

Stream Measurement and Geomorphology Data

Table 7a. Baseline Stream Data Summary, Hip Bone Creek, Reach T1-1										
Parameter	**Pre-Existing Condition**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	5.2	6.3	6.3	7.3	2	5.4		5.5	6.4	2
Floodprone Width (ft)	12.0	13.4	13.4	14.8	2	35	42	54.8	54.9	2
Bankfull Mean Depth (ft)	0.3	0.4	0.4	0.5	2	0.4		0.4	0.6	2
Bankfull Max Depth (ft)	0.9	1.1	1.1	1.3	2	0.7		0.8	1.1	2
Bankfull Cross Sectional Area (ft^2)	2.4	2.5	2.5	2.5	2	2.2		2.1	3.9	2
Width/Depth Ratio	11.0	16.4	16.4	21.8	2	13.0		10.7	14.5	2
Entrenchment Ratio	1.6	2.3	2.3	2.9	2	6.5	7.8	8.5	9.9	2
Bank Height Ratio	1.0	1.1	1.1	1.2	2	1.0		1.0	1.0	2
Max part size (mm) mobilized at bankfull	30					29		42		
Rosgen Classification	G4c/G4					C4b		C4b		
Bankfull Discharge (cfs)	8.1 – 8.6					8.0		5.6 – 13.5		
Sinuosity (ft)	1.0					1.2		1.2		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.024		0.0249		
Other										

Table 7b. Baseline Stream Data Summary, Hip Bone Creek, Reach T1-2										
Parameter	**Pre-Existing Condition**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	4.4	7.3	7.3	10.2	2	7.0		6.5	7.9	1
Floodprone Width (ft)	12.6	20.4	20.4	28.2	2	42	56	56.7	57.2	1
Bankfull Mean Depth (ft)	0.4	0.7	0.7	1.0	2	0.6		0.7	0.7	1
Bankfull Max Depth (ft)	1.4	1.4	1.4	1.5	2	0.9		1.1	1.1	1
Bankfull Cross Sectional Area (ft^2)	4.2	4.2	4.2	4.2	2	4.0		4.6	5.4	1
Width/Depth Ratio	4.5	14.7	14.7	24.8	2	12.2		9.3	11.7	1
Entrenchment Ratio	2.8	2.8	2.8	2.9	2	6.0	8.0	7.1	8.7	1
Bank Height Ratio	1.0	1.0	1.0	1.0	2	1.0		1.0	1.0	1
Max part size (mm) mobilized at bankfull	33					25		29		
Rosgen Classification	G4c/G4					C4		C4		
Bankfull Discharge (cfs)	14.1 – 14.6					13.6		13.7 – 15.6		
Sinuosity (ft)	1.0					1.2		1.2		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.015		0.014		
Other										

Table 7c. Baseline Stream Data Summary, Hip Bone Creek, Reach T1-3 and 5										
Parameter	**Pre-Existing Condition**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	4.6	11.8	11.6	19.3	4	8.6		9.3	9.4	1
Floodprone Width (ft)	12.5	28.3	25.4	49.9	4	30	58	47.8	77.5	1
Bankfull Mean Depth (ft)	0.4	0.7	0.6	1.3	4	0.7		0.8	0.8	1
Bankfull Max Depth (ft)	1.1	1.7	1.8	1.9	4	1.1		1.2	1.4	1
Bankfull Cross Sectional Area (ft^2)	5.8	6.6	6.0	8.8	4	6.0		7.2	7.3	1
Width/Depth Ratio	3.6	24.2	25.6	42.1	4	12.4		11.8	12.3	1
Entrenchment Ratio	2.0	2.5	2.6	2.7	4	3.5	6.7	5.1	8.3	1
Bank Height Ratio	1.0	1.1	1.0	1.5	4	1.0		1.0	1.0	1
Max part size (mm) mobilized at bankfull	18					17		23		
Rosgen Classification	G4c/G4					C4		C4		
Bankfull Discharge (cfs)	15.3 – 22.7					19.8		19.3 – 20.0		
Sinuosity (ft)	1.0					1.14		1.14		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.0082		0.0101		
Other										

Table 7d. Baseline Stream Data Summary, Hip Bone Creek, Reach T3										
Parameter	**Pre-Existing Condition**					**Design**		**Monitoring Baseline (MY0)**		
Riffle Only	Min	Mean	Med	Max	n	Min	Max	Min	Max	n
Bankfull Width (ft)	4.6	11.8	11.6	19.3	3	5.8		6.5	7.2	2
Floodprone Width (ft)	12.5	28.3	25.4	49.9	3	30	40	45.2	50.3	2
Bankfull Mean Depth (ft)	0.4	0.7	0.6	1.3	3	0.5		0.5	0.5	2
Bankfull Max Depth (ft)	1.1	1.7	1.8	1.9	3	0.7		0.8	0.9	2
Bankfull Cross Sectional Area (ft^2)	5.8	6.6	6.0	8.8	3	2.7		3.4	3.9	2
Width/Depth Ratio	3.6	24.2	25.6	42.1	3	12.7		12.3	13.3	2
Entrenchment Ratio	2.0	2.5	2.6	2.7	3	5.2	6.9	7.0	7.0	2
Bank Height Ratio	1.0	1.1	1.0	1.5	3	1.0		1.0	1.0	2
Max part size (mm) mobilized at bankfull	39					23		29		
Rosgen Classification	G4					C4		C4		
Bankfull Discharge (cfs)	2.7 – 9.0					8.7		9.7 – 11.1		
Sinuosity (ft)	1.0					1.13		1.13		
Water Surface Slope (Channel) (ft/ft)	0.02 – 0.039					0.017		0.0183		
Other										

Table 8. Cross Section Dimensional Morphology Summary
Hip Bone Creek Restoration Site, DMS Project #100059

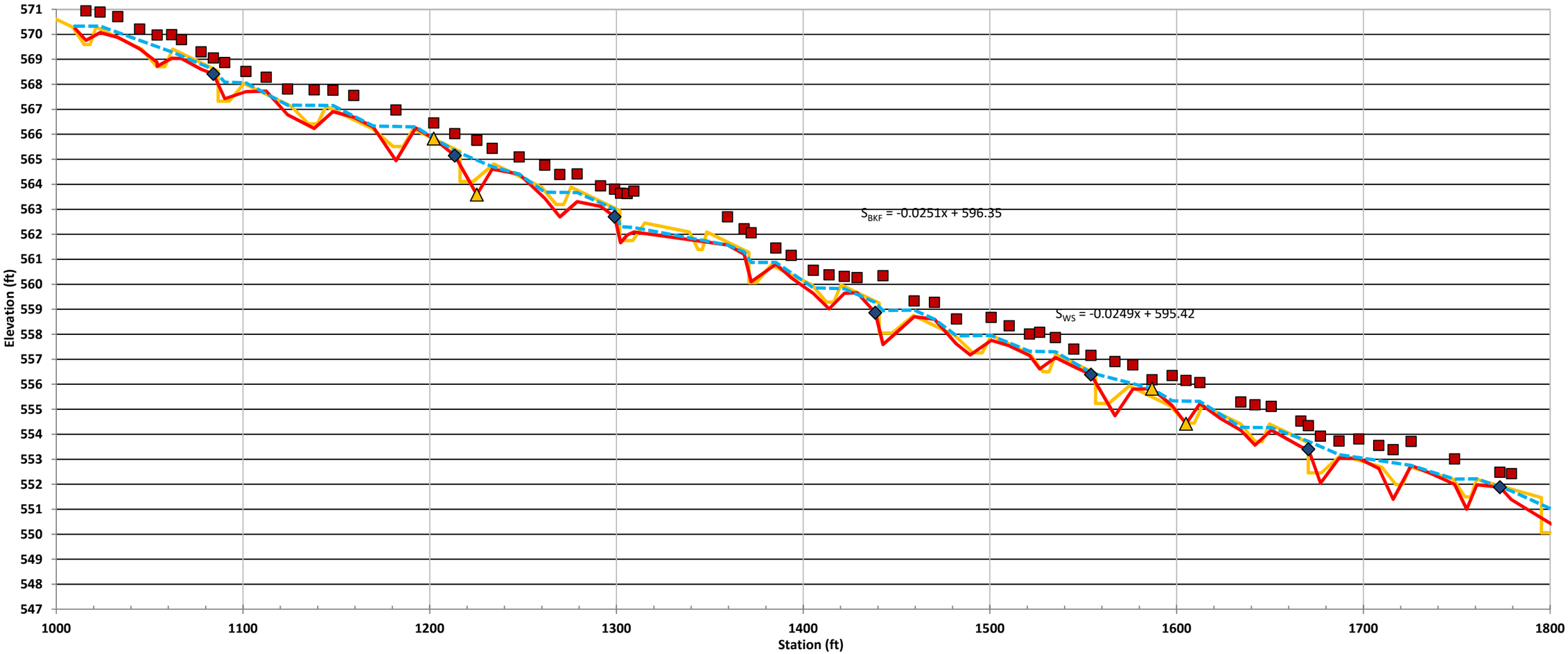
Dimension and Substrate	Cross-Section 1 (Riffle) Station 12+00, T1-1							Cross-Section 2 (Pool) Station 12+25, T1-1							Cross-Section 3 (Riffle) Station 16+25, T1-1						
	MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	566.3							565.6							555.7						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0							1.0							1.0						
Thalweg Elevation	566							563.7							555						
LTOB2 Elevation	566.3							565.6							555.7						
LTOB2 Max Depth (ft)	0.8							1.9							1.1						
LTOB2 Cross Sectional Area (ft2)	2.1							10.9							3.9						
	Cross-Section 4 (Pool) Station 16+37, T1-1							Cross-Section 5 (Riffle) 19+37 Station, T1-2							Cross-Section 6 (Pool) Station 19+62, T1-2						
	MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	555.0							550.3							549.7						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0							1.0							1.0						
Thalweg Elevation	553.5							549							547.6						
LTOB2 Elevation	555.0							550.3							549.7						
LTOB2 Max Depth (ft)	1.5							1.1							2.1						
LTOB2 Cross Sectional Area (ft2)	8.1							5.4							14.0						
	Cross-Section 7 (Riffle) Station 24+62, T1-2							Cross-Section 8 (Pool) Sation 25+00, T1-2							Cross-Section 9 Riffle) Station 28+75, T1-4						
	MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	542.6							542.5							536.6						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0							1.0							1.0						
Thalweg Elevation	542							540.2							535						
LTOB2 Elevation	542.6							542.5							536.6						
LTOB2 Max Depth (ft)	1.1							2.2							1.4						
LTOB2 Cross Sectional Area (ft2)	4.6							16.7							7.2						
	Cross-Section 10 (Pool) Station 29+00, T1-4							Cross-Section 11 (Riffle) Station 34+00, T1-4							Cross-Section 12 (Pool) Station 34+37, T1-4						
	MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	536.3							531.5							531.3						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0							1.0							1.0						
Thalweg Elevation	534							530.2							529						
LTOB2 Elevation	536.3							531.5							531.3						
LTOB2 Max Depth (ft)	2.6							1.2							2.4						
LTOB2 Cross Sectional Area (ft2)	20.0							7.3							20.8						

Table 8. Cross Section Dimensional Morphology Summary
Hip Bone Creek Restoration Site, DMS Project #100059

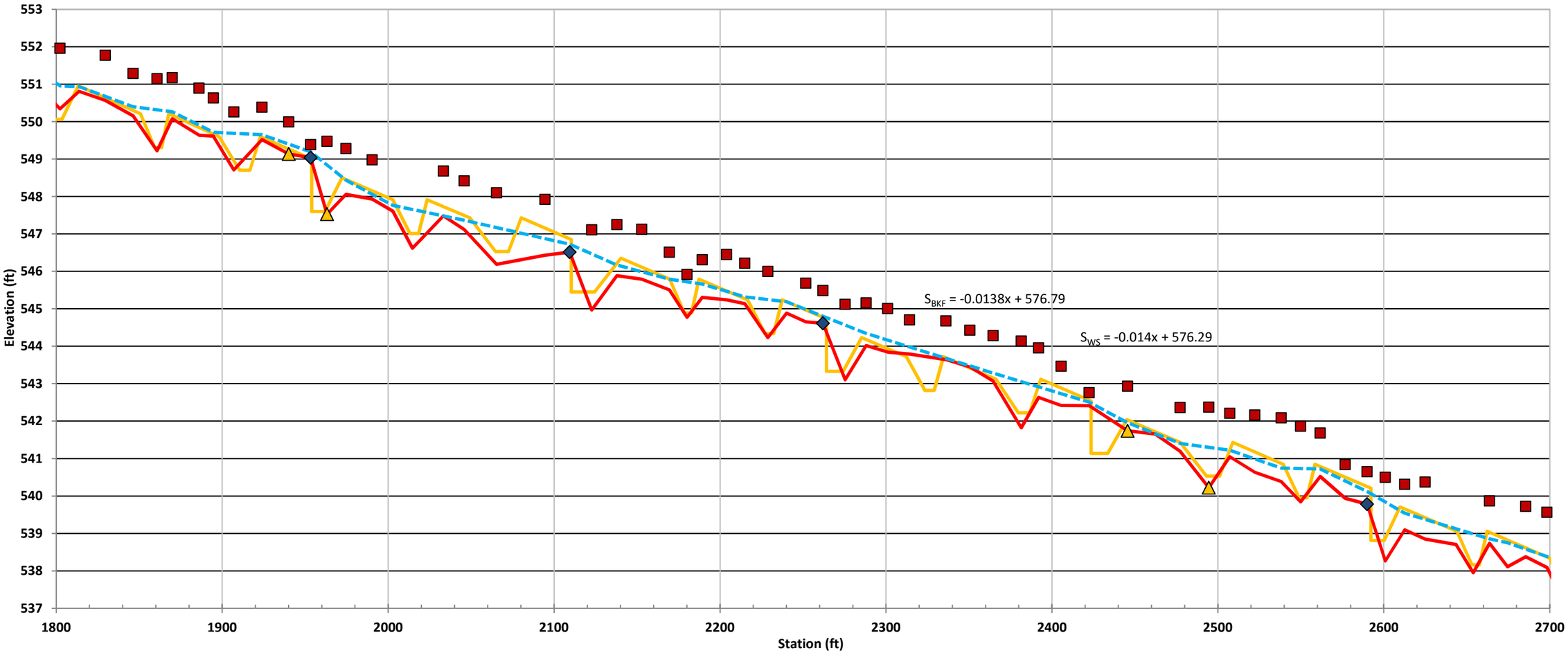
Dimension and Substrate	Cross-Section 13 (Riffle) Station 317+37, T3-3							Cross-Section 14 (Pool) Station 317+50, T3-3							Cross-Section 15 (Riffle) Station 319+62, T3-3						
	MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07		MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	548.8							548.3							544.7						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0							1.0							1.0						
Thalweg Elevation	548							547.2							544						
LTOB2 Elevation	548.8							548.3							544.7						
LTOB2 Max Depth (ft)	0.8							1.1							0.9						
LTOB2 Cross Sectional Area (ft2)	3.4							4.3							3.9						

	Cross-Section 16 (Pool) Station 319+87, T3-3						
	MY00	MY01	MY02	MY03	MY05	MY07	
Bankfull Elevation (ft) - Based on AB-Bankfull1 Area	544.2						
Bank Height Ratio_Based on AB Bankfull1 Area	1.0						
Thalweg Elevation	542.7						
LTOB2 Elevation	544.2						
LTOB2 Max Depth (ft)	1.4						
LTOB2 Cross Sectional Area (ft2)	8.6						

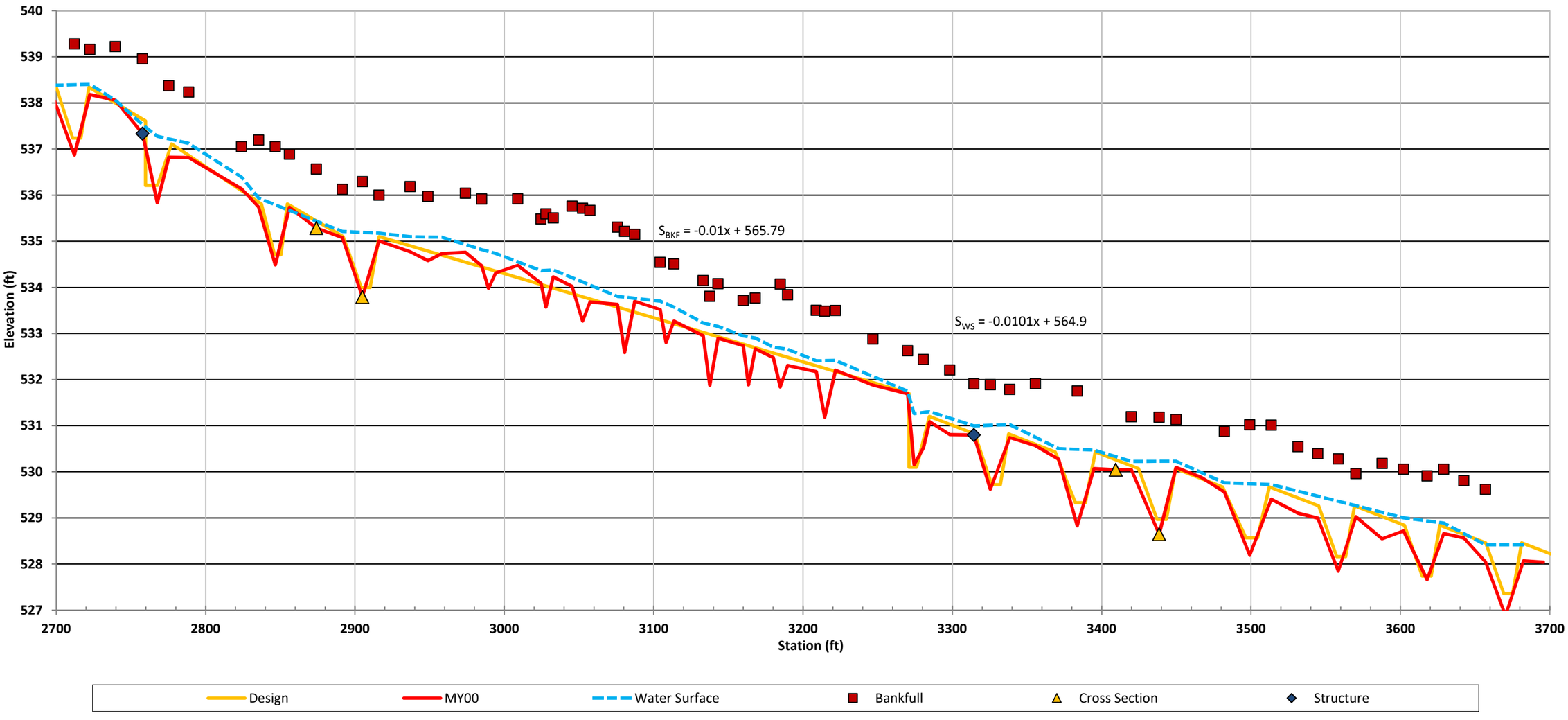
Longitudinal Profile
Hip Bone Creek - T1-1
Monitoring Year 00, 2021



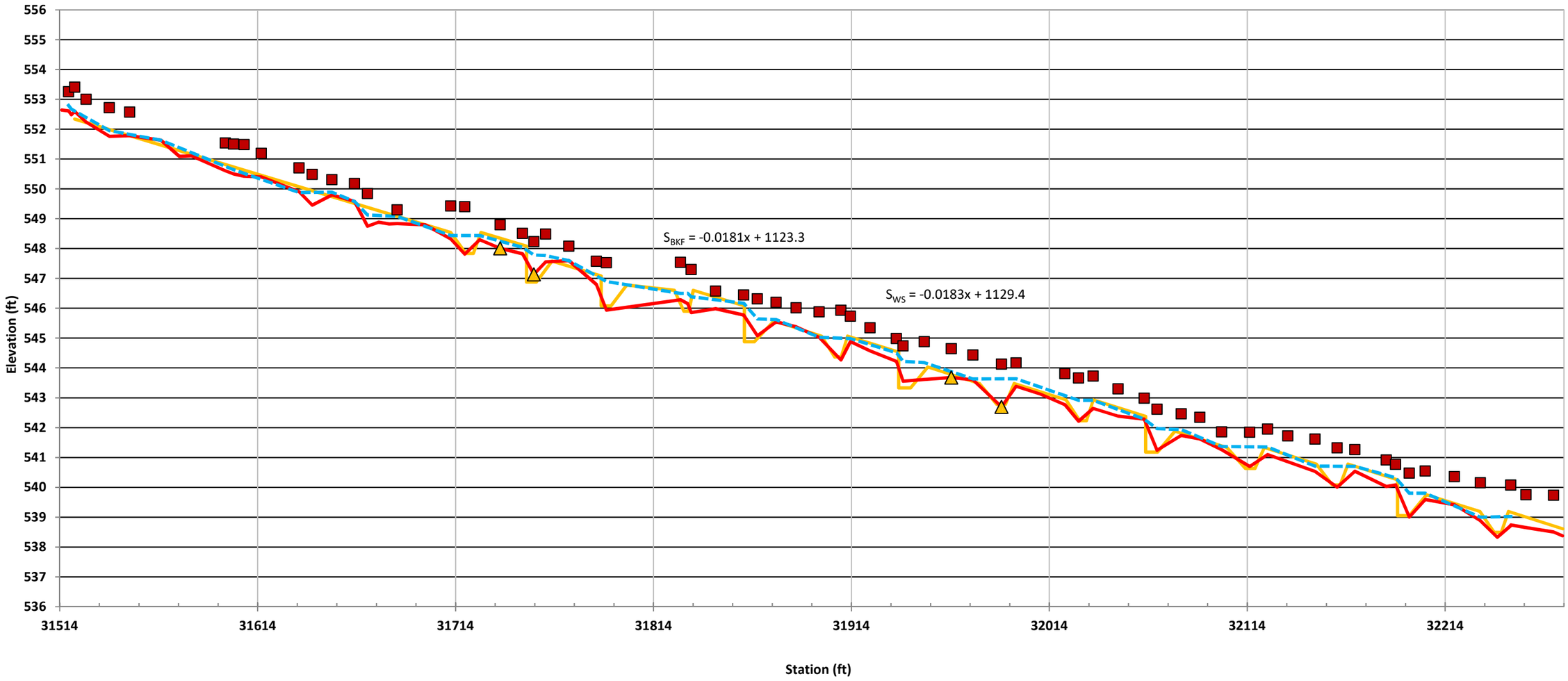
Longitudinal Profile
Hip Bone Creek - T1-2
Monitoring Year 00, 2021



Longitudinal Profile
Hip Bone Creek - T1-3 and T1-5
Monitoring Year 00, 2021



Longitudinal Profile
Hip Bone Creek T3
Monitoring Year 00, 2021

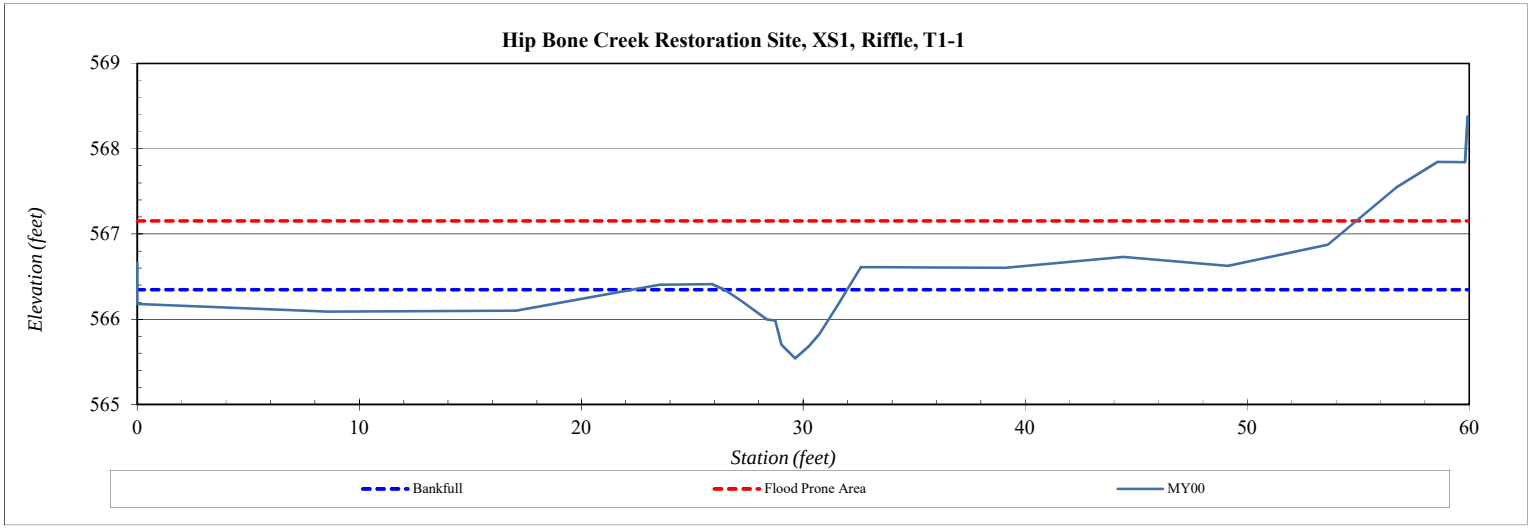


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS1
Drainage Area (sq mi):	0.06
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	566.70
0.0	566.22
8.6	566.13
17.1	566.14
23.5	566.44
25.9	566.45
26.4	566.38
27.2	566.26
28.3	566.04
28.7	566.02
29.0	565.74
29.6	565.58
30.3	565.72
30.7	565.86
31.6	566.21
32.6	566.65
33.6	566.65
35.7	566.65
39.1	566.64
44.4	566.77
49.1	566.66
53.6	566.91
56.7	567.58
58.6	567.88
59.8	567.88
59.9	568.41

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	566.35
Bankfull Cross-Sectional Area (sq ft):	2.1
LTOB Cross-Sectional Area (sq ft):	2.1
Bankfull Width (ft):	5.5
Flood Prone Area Elevation (ft):	567.15
Flood Prone Width (ft):	55
Max Depth at Bankfull (ft):	0.8
Mean Depth at Bankfull (ft):	0.4
W / D Ratio (ft/ft):	14.5
Entrenchment Ratio (ft/ft):	9.9
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	565.54

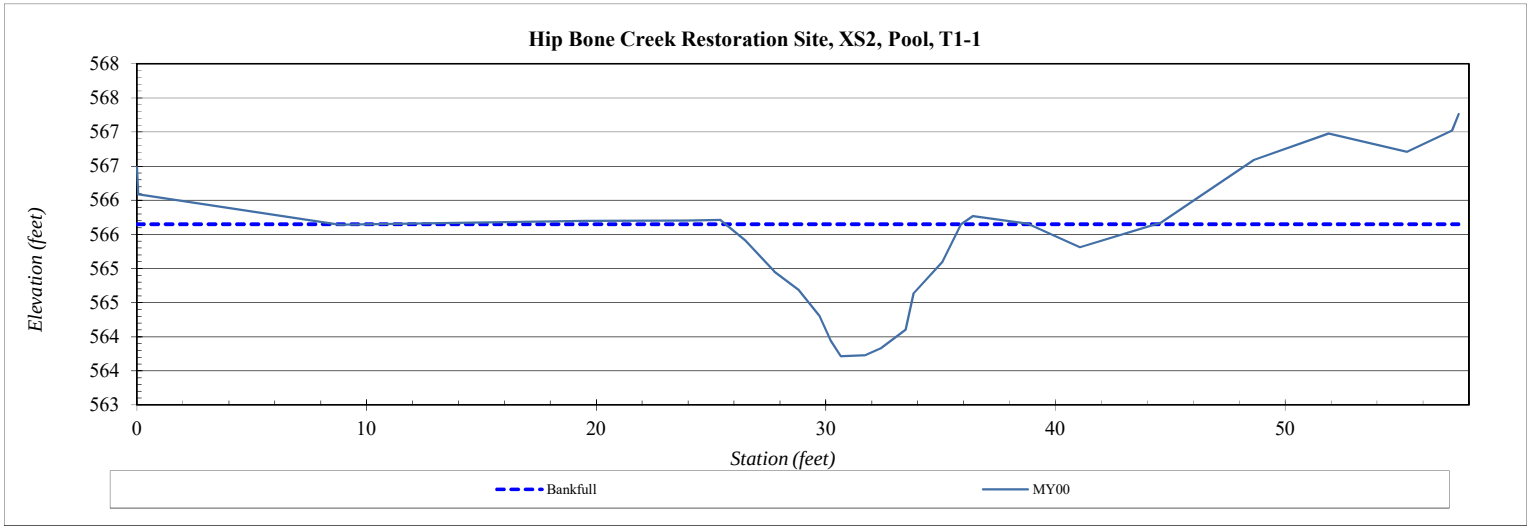


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS2
Drainage Area (sq mi):	0.06
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	566.46
0.1	566.06
8.8	565.61
19.5	565.67
24.0	565.67
25.4	565.68
26.5	565.39
27.8	564.93
28.8	564.66
29.7	564.28
30.2	563.92
30.7	563.68
31.7	563.70
32.4	563.81
33.5	564.07
33.8	564.61
35.1	565.07
35.9	565.62
36.4	565.74
38.8	565.62
41.1	565.28
44.6	565.64
46.0	565.97
48.6	566.56
51.9	566.95
55.3	566.68
57.3	567.00
57.6	567.23

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	565.65
Bankfull Cross-Sectional Area (sq ft):	10.9
LTOB Cross-Sectional Area (sq ft):	10.9
Bankfull Width (ft):	10.3
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.9
Mean Depth at Bankfull (ft):	1.1
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	563.71

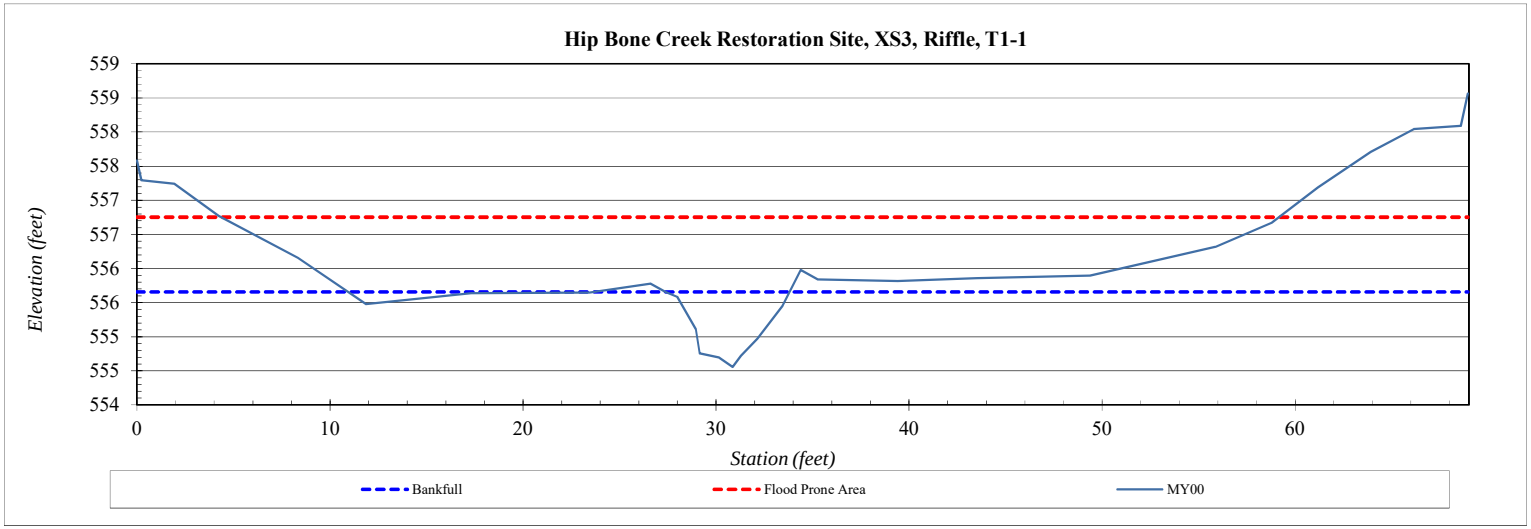


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS3
Drainage Area (sq mi):	0.08
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	557.59
0.2	557.29
2.0	557.24
4.2	556.77
8.3	556.16
11.9	555.48
17.3	555.64
23.5	555.64
26.6	555.78
27.4	555.66
28.0	555.59
29.0	555.11
29.2	554.75
30.2	554.69
30.9	554.56
31.3	554.72
32.1	554.97
33.4	555.45
34.4	555.98
35.3	555.84
39.4	555.81
43.5	555.86
49.4	555.90
55.9	556.32
58.8	556.67
61.2	557.19
63.9	557.71
66.1	558.04
68.6	558.09
68.9	558.57

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	555.66
Bankfull Cross-Sectional Area (sq ft):	3.9
LTOB Cross-Sectional Area (sq ft):	3.9
Bankfull Width (ft):	6.4
Flood Prone Area Elevation (ft):	556.75
Flood Prone Width (ft):	55
Max Depth at Bankfull (ft):	1.1
Mean Depth at Bankfull (ft):	0.6
W / D Ratio (ft/ft):	10.7
Entrenchment Ratio (ft/ft):	8.5
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	554.56

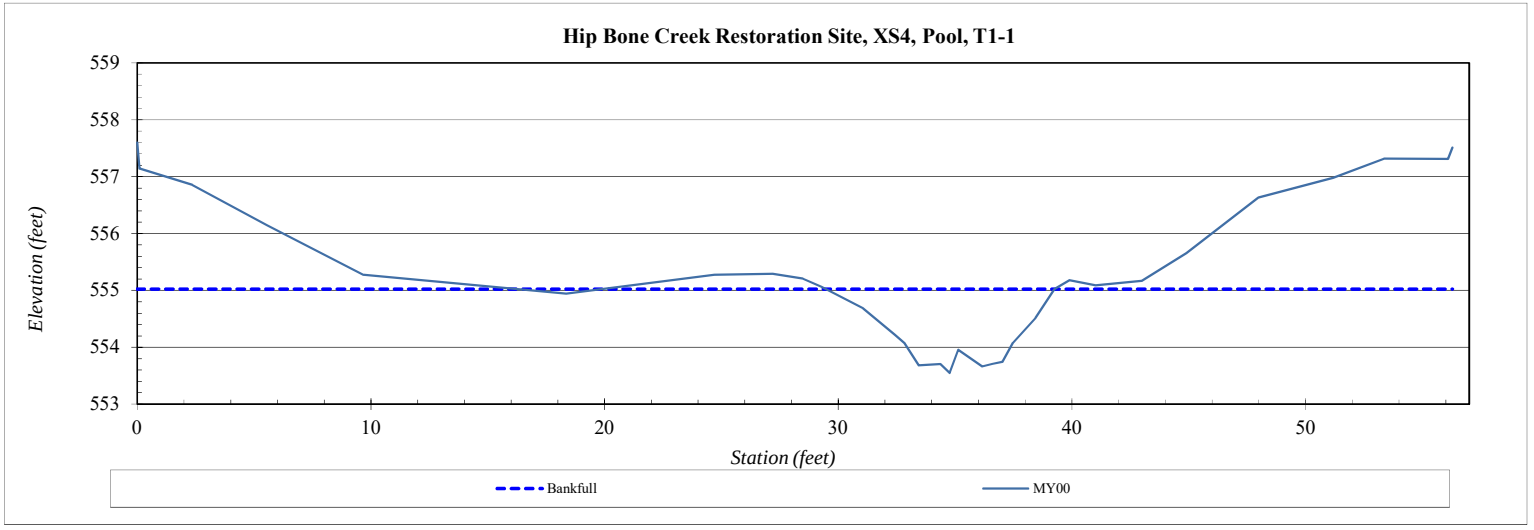


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS4
Drainage Area (sq mi):	0.08
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	557.60
0.1	557.14
2.4	556.85
5.6	556.15
9.7	555.28
18.4	554.94
24.7	555.27
27.2	555.29
28.5	555.21
29.3	555.07
31.1	554.69
32.4	554.22
32.8	554.07
33.4	553.68
34.4	553.71
34.8	553.55
35.1	553.96
36.2	553.67
36.6	553.71
37.0	553.74
37.5	554.08
38.4	554.51
39.3	555.02
39.9	555.18
41.0	555.09
43.0	555.17
44.9	555.66
48.0	556.63
51.2	556.98
53.4	557.32
56.1	557.31
56.3	557.52

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	555.02
Bankfull Cross-Sectional Area (sq ft):	8.1
LTOB Cross-Sectional Area (sq ft):	8.1
Bankfull Width (ft):	9.8
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.5
Mean Depth at Bankfull (ft):	0.8
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	553.55

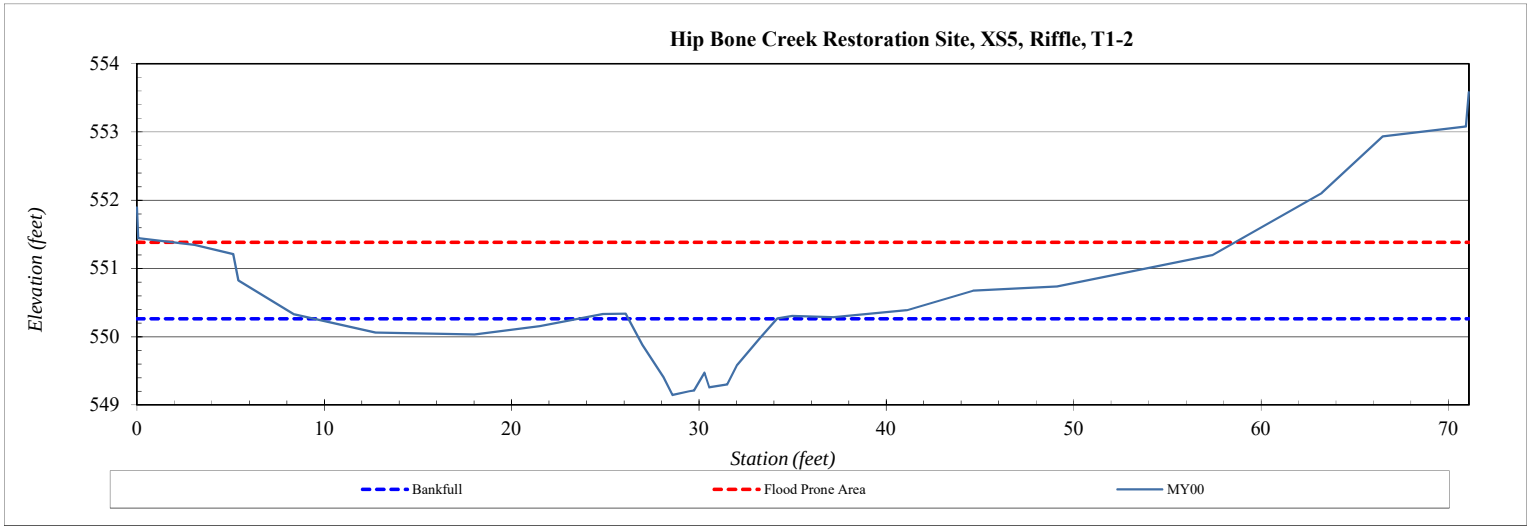


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS5
Drainage Area (sq mi):	0.13
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	551.89
0.1	551.45
3.1	551.34
5.2	551.21
5.4	550.82
8.4	550.33
12.7	550.06
18.0	550.03
21.5	550.15
24.9	550.33
26.1	550.34
27.0	549.88
28.1	549.41
28.6	549.15
29.5	549.20
29.7	549.21
30.3	549.47
30.6	549.26
31.5	549.30
32.0	549.59
33.3	549.98
34.2	550.26
35.0	550.30
37.2	550.28
41.1	550.39
44.6	550.68
49.1	550.73
57.4	551.20
63.2	552.10
66.5	552.94
70.9	553.08
71.1	553.58

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	550.26
Bankfull Cross-Sectional Area (sq ft):	5.4
LTOB Cross-Sectional Area (sq ft):	5.4
Bankfull Width (ft):	7.9
Flood Prone Area Elevation (ft):	551.38
Flood Prone Width (ft):	57
Max Depth at Bankfull (ft):	1.1
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	11.7
Entrenchment Ratio (ft/ft):	7.1
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	549.15

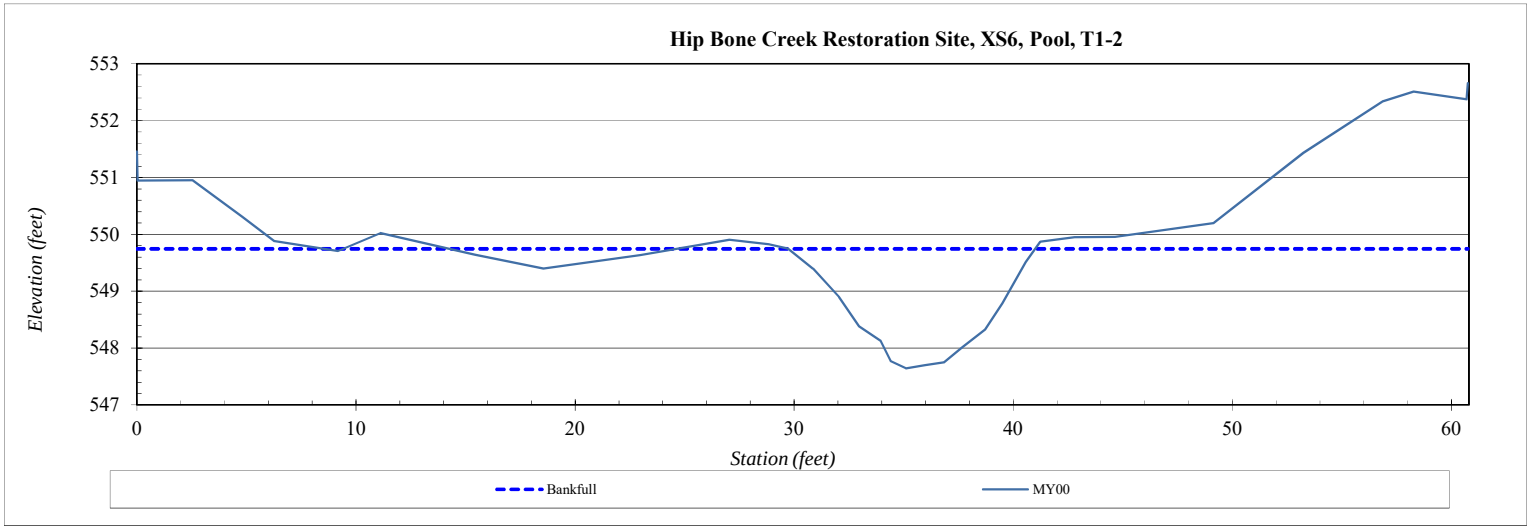


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS6
Drainage Area (sq mi):	0.13
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	551.46
0.0	550.95
2.5	550.95
4.8	550.31
6.3	549.88
9.2	549.71
11.1	550.02
15.4	549.64
18.6	549.40
23.0	549.63
27.0	549.90
28.8	549.83
29.7	549.75
30.9	549.40
32.0	548.90
33.0	548.38
33.9	548.13
34.4	547.77
35.1	547.64
36.0	547.70
36.8	547.75
37.7	548.01
38.7	548.33
39.5	548.79
40.6	549.52
41.2	549.87
42.8	549.95
44.6	549.96
49.1	550.19
53.2	551.44
56.8	552.34
58.3	552.51
60.7	552.37
60.8	552.66

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	549.75
Bankfull Cross-Sectional Area (sq ft):	14.0
LTOB Cross-Sectional Area (sq ft):	14.0
Bankfull Width (ft):	11.3
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.1
Mean Depth at Bankfull (ft):	1.2
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	547.64

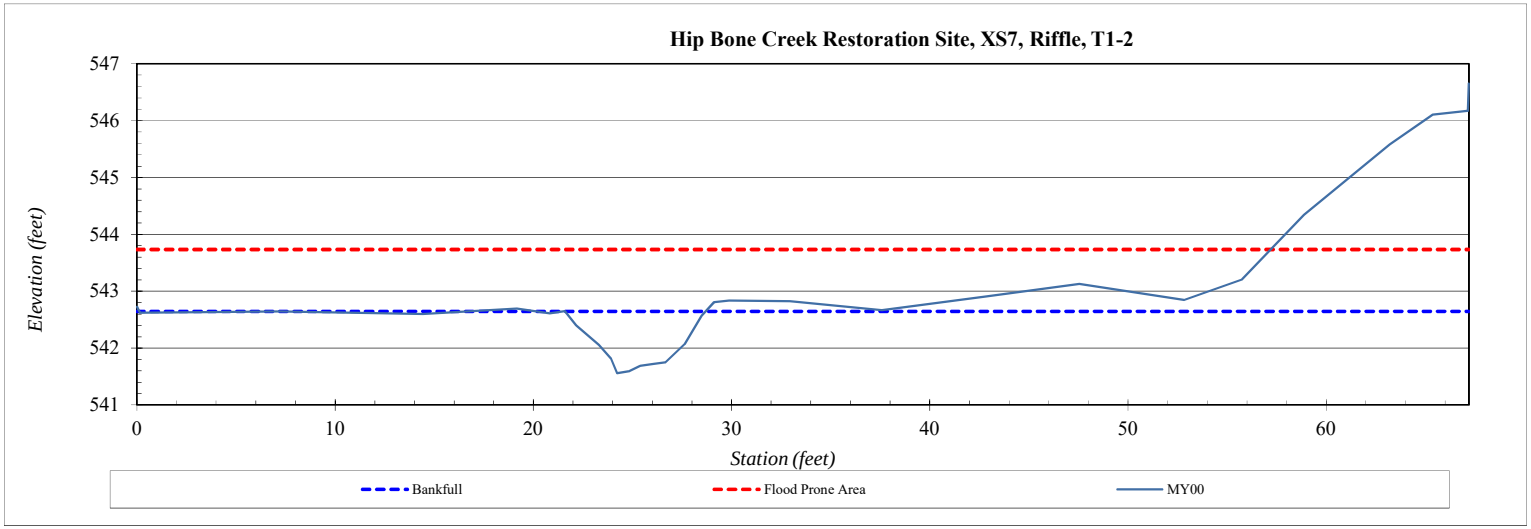


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS7
Drainage Area (sq mi):	0.14
Date:	5/21/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	542.73
0.1	542.62
7.2	542.64
14.4	542.60
19.2	542.69
20.8	542.61
21.6	542.65
22.2	542.40
23.3	542.06
23.9	541.81
24.2	541.56
24.8	541.59
25.4	541.69
26.0	541.72
26.7	541.75
27.6	542.07
28.5	542.57
29.1	542.81
29.9	542.84
32.9	542.82
37.6	542.67
42.9	542.91
47.5	543.13
52.8	542.84
55.8	543.21
58.9	544.35
63.2	545.58
65.4	546.11
67.1	546.17
67.2	546.65

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	542.65
Bankfull Cross-Sectional Area (sq ft):	4.6
LTOB Cross-Sectional Area (sq ft):	4.6
Bankfull Width (ft):	6.5
Flood Prone Area Elevation (ft):	543.73
Flood Prone Width (ft):	57
Max Depth at Bankfull (ft):	1.1
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	9.3
Entrenchment Ratio (ft/ft):	8.7
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	541.56

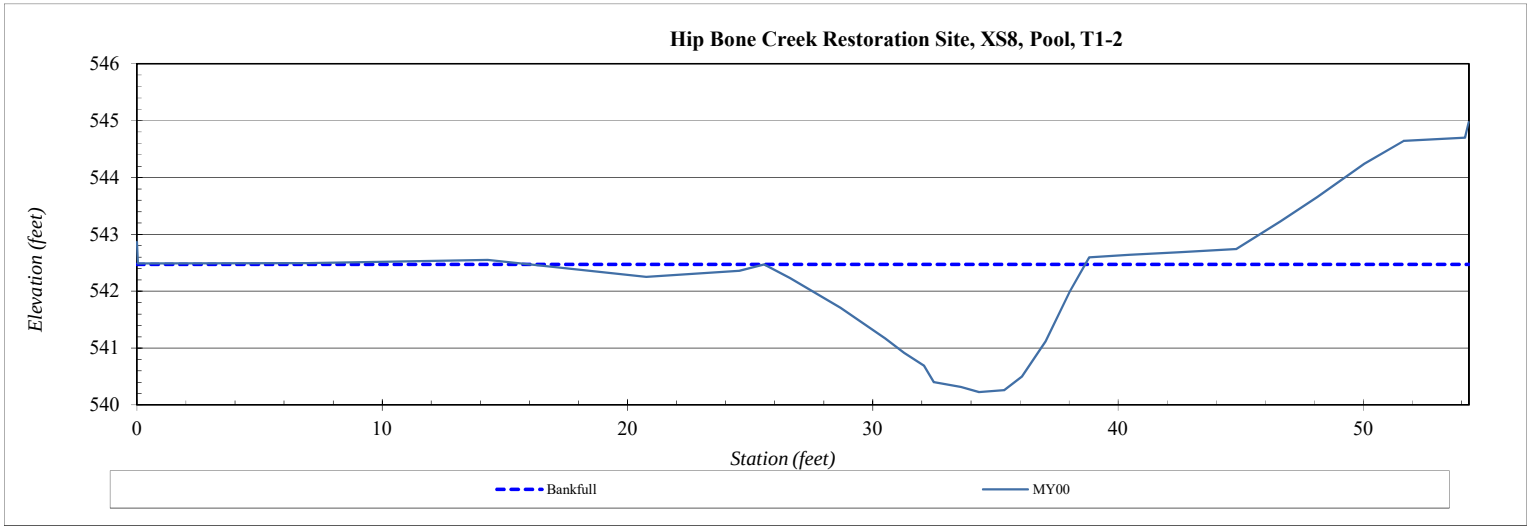


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS8
Drainage Area (sq mi):	0.14
Date:	5/21/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	542.86
0.0	542.49
7.0	542.49
14.3	542.55
20.8	542.25
24.6	542.36
25.6	542.47
26.6	542.23
28.7	541.71
30.5	541.17
31.3	540.92
32.1	540.69
32.5	540.40
33.6	540.31
34.3	540.23
35.3	540.26
36.1	540.50
37.0	541.12
38.0	542.00
38.8	542.59
40.5	542.64
42.5	542.69
44.8	542.74
46.6	543.23
48.1	543.66
50.0	544.25
51.6	544.65
54.1	544.70
54.3	544.97

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	542.47
Bankfull Cross-Sectional Area (sq ft):	16.7
LTOB Cross-Sectional Area (sq ft):	16.7
Bankfull Width (ft):	13.1
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.2
Mean Depth at Bankfull (ft):	1.3
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	540.23

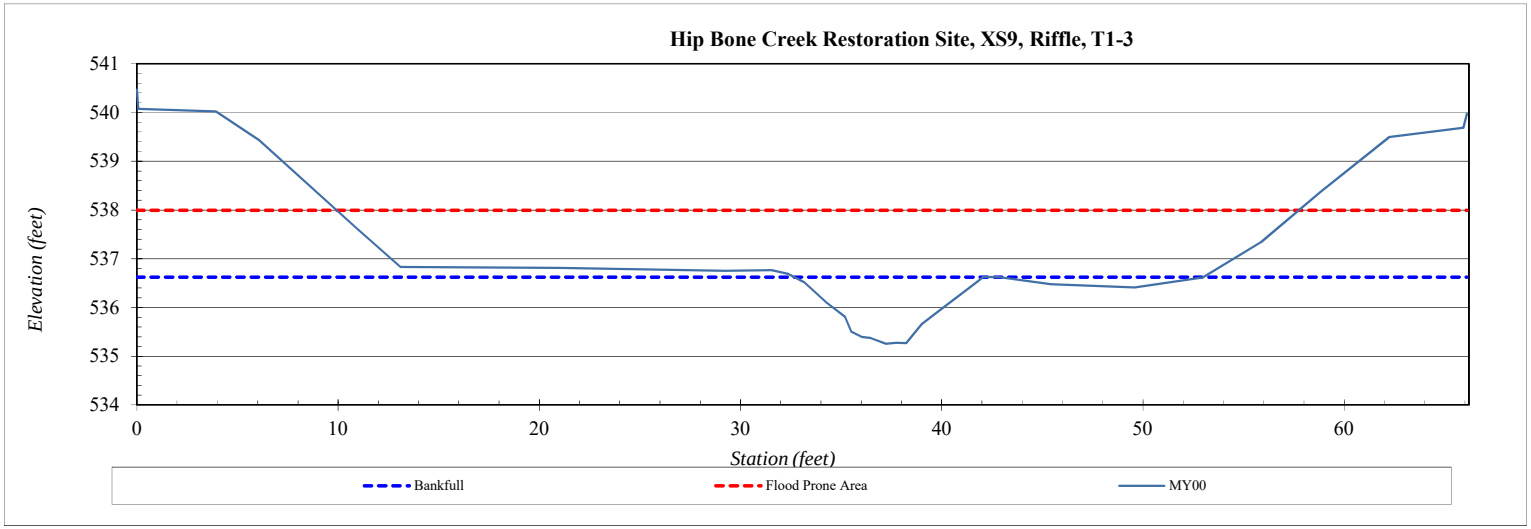


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS9
Drainage Area (sq mi):	0.19
Date:	5/21/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	540.47
0.1	540.07
3.9	540.02
6.1	539.44
10.9	537.62
13.1	536.83
21.1	536.81
29.2	536.75
31.5	536.76
32.4	536.69
33.2	536.52
34.3	536.10
35.2	535.81
35.5	535.51
36.0	535.39
36.5	535.37
37.2	535.26
37.7	535.27
38.2	535.27
39.0	535.66
40.2	536.03
41.6	536.46
42.1	536.62
42.9	536.62
45.4	536.48
49.6	536.41
53.0	536.61
55.9	537.35
58.8	538.37
62.2	539.49
65.9	539.68
66.1	539.98

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	536.62
Bankfull Cross-Sectional Area (sq ft):	7.2
LTOB Cross-Sectional Area (sq ft):	7.2
Bankfull Width (ft):	9.4
Flood Prone Area Elevation (ft):	537.99
Flood Prone Width (ft):	48
Max Depth at Bankfull (ft):	1.4
Mean Depth at Bankfull (ft):	0.8
W / D Ratio (ft/ft):	12.3
Entrenchment Ratio (ft/ft):	5.1
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	535.26

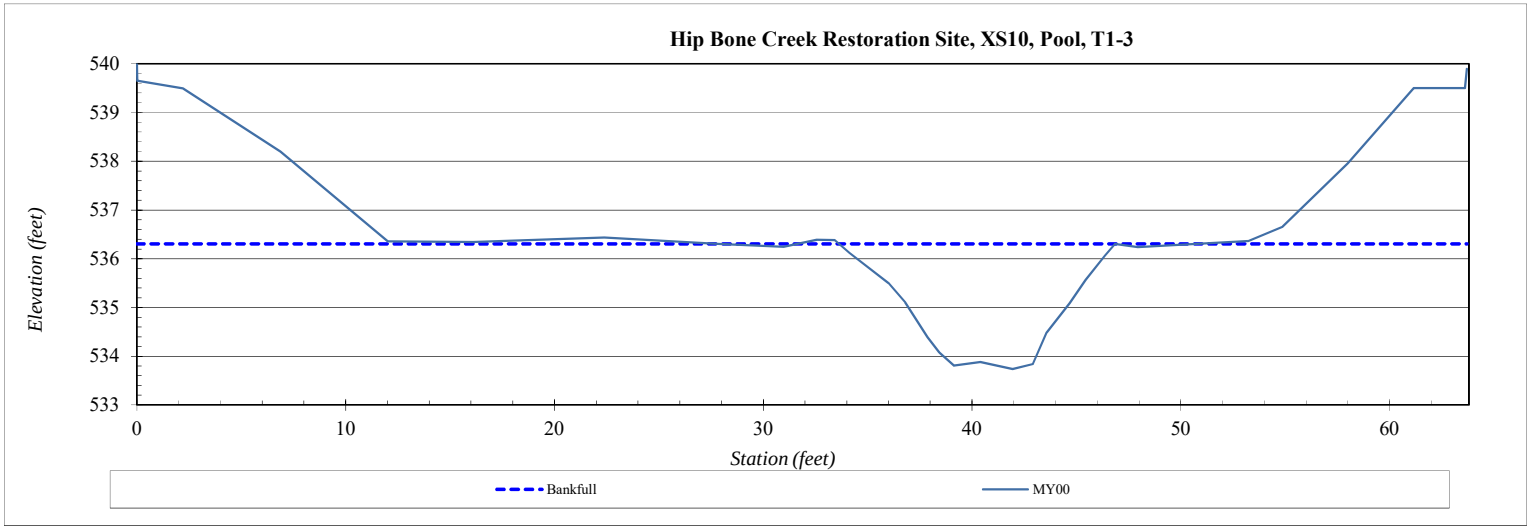


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS10
Drainage Area (sq mi):	0.19
Date:	5/21/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	539.99
0.0	539.65
2.2	539.50
6.9	538.20
12.0	536.36
16.1	536.34
22.4	536.43
27.9	536.31
31.0	536.24
32.6	536.39
33.4	536.38
34.1	536.12
36.0	535.50
36.8	535.10
37.9	534.39
38.4	534.08
39.1	533.81
40.4	533.88
41.9	533.74
42.9	533.84
43.6	534.49
44.7	535.09
45.4	535.56
46.4	536.07
46.8	536.31
47.9	536.24
53.2	536.36
54.9	536.66
58.0	537.96
61.2	539.50
63.6	539.50
63.7	539.90

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	536.31
Bankfull Cross-Sectional Area (sq ft):	20.0
LTOB Cross-Sectional Area (sq ft):	20.0
Bankfull Width (ft):	12.7
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.6
Mean Depth at Bankfull (ft):	1.6
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	533.74

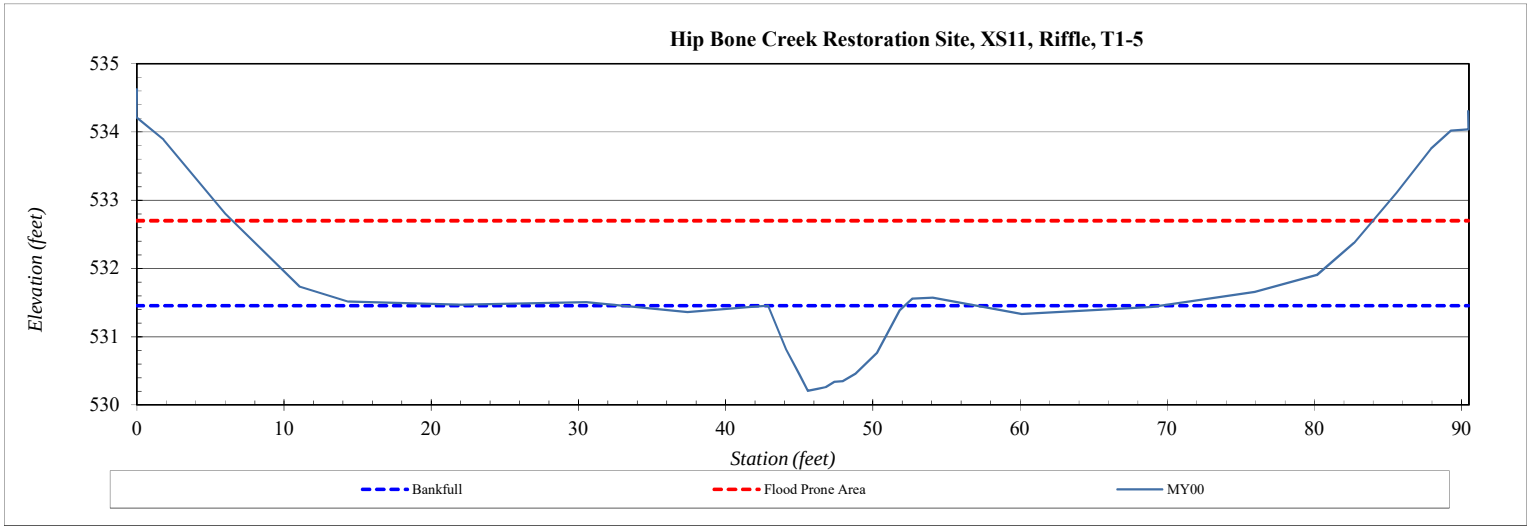


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS11
Drainage Area (sq mi):	0.25
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	534.63
0.0	534.22
1.8	533.89
6.0	532.80
11.1	531.74
14.4	531.52
22.0	531.47
30.5	531.50
37.4	531.36
41.7	531.44
42.9	531.45
44.1	530.82
45.0	530.45
45.6	530.21
46.2	530.24
46.8	530.26
47.4	530.34
47.9	530.35
48.8	530.46
50.3	530.76
51.8	531.39
52.7	531.56
54.1	531.57
60.1	531.33
69.0	531.43
76.0	531.66
80.2	531.91
82.7	532.38
85.6	533.11
87.9	533.76
89.3	534.02
90.5	534.04
90.4	534.30

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	531.45
Bankfull Cross-Sectional Area (sq ft):	7.3
LTOB Cross-Sectional Area (sq ft):	7.3
Bankfull Width (ft):	9.3
Flood Prone Area Elevation (ft):	532.70
Flood Prone Width (ft):	77
Max Depth at Bankfull (ft):	1.2
Mean Depth at Bankfull (ft):	0.8
W / D Ratio (ft/ft):	11.8
Entrenchment Ratio (ft/ft):	8.3
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	530.21

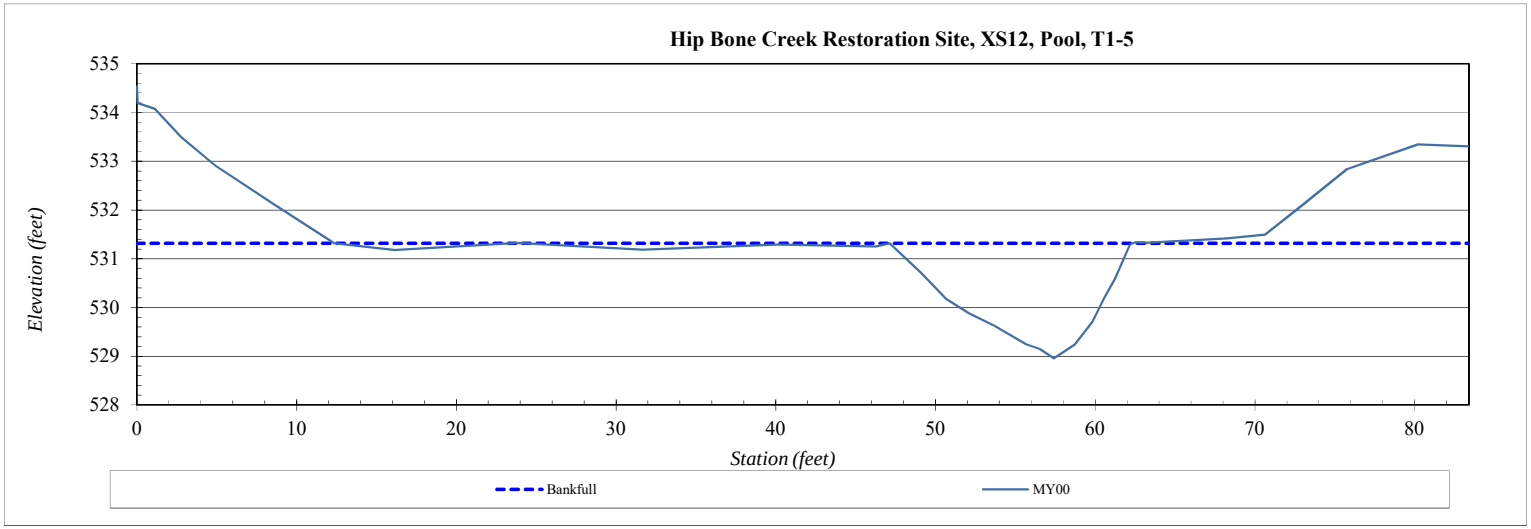


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS12
Drainage Area (sq mi):	0.25
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	534.53
0.1	534.19
1.1	534.08
2.8	533.50
4.9	532.91
8.7	532.10
12.4	531.31
16.1	531.17
23.8	531.32
31.7	531.18
40.1	531.29
46.3	531.25
47.1	531.32
47.8	531.12
49.1	530.69
50.6	530.19
52.1	529.88
53.7	529.63
55.7	529.25
56.5	529.15
57.4	528.96
58.7	529.24
59.8	529.71
60.5	530.18
61.3	530.59
62.2	531.30
62.5	531.34
63.3	531.33
68.2	531.41
70.6	531.49
72.7	532.02
75.8	532.84
80.2	533.34
83.3	533.30

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	531.32
Bankfull Cross-Sectional Area (sq ft):	20.8
LTOB Cross-Sectional Area (sq ft):	20.8
Bankfull Width (ft):	15.1
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.4
Mean Depth at Bankfull (ft):	1.4
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	528.96

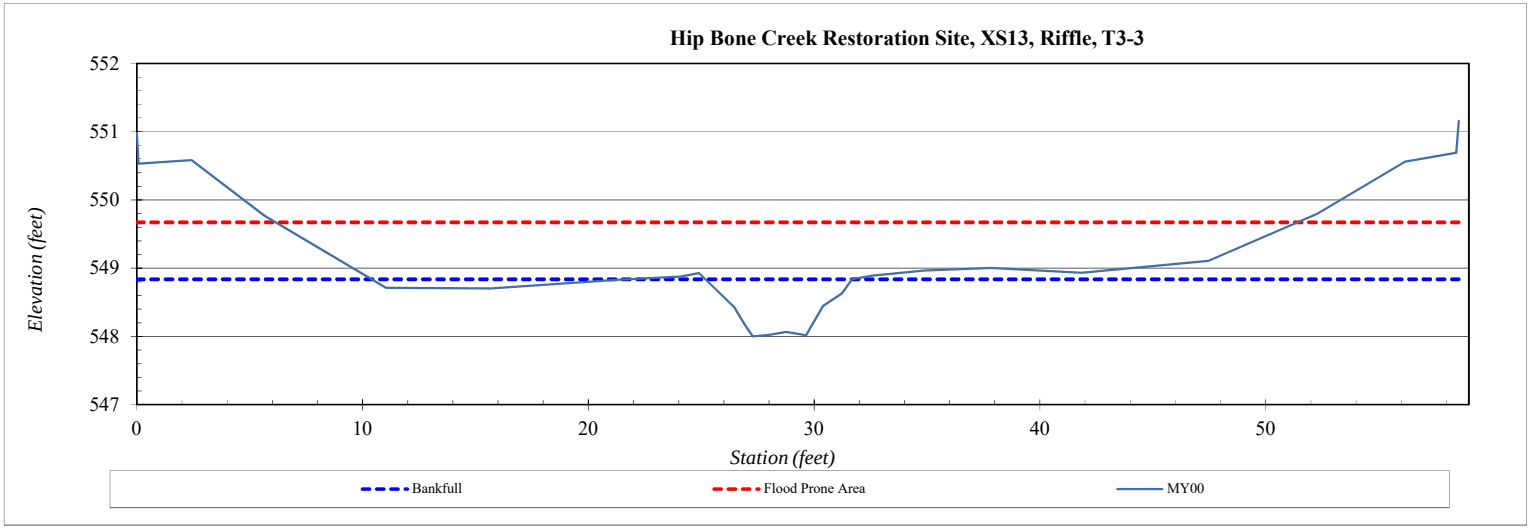


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS13
Drainage Area (sq mi):	0.05
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	550.98
0.1	550.53
2.4	550.58
5.6	549.77
11.0	548.71
15.7	548.70
21.5	548.83
24.1	548.88
24.9	548.93
25.7	548.69
26.5	548.42
26.9	548.17
27.3	548.00
28.0	548.02
28.8	548.07
29.5	548.03
29.6	548.01
30.4	548.45
31.2	548.63
31.7	548.84
32.6	548.89
34.9	548.96
37.8	549.00
41.8	548.93
47.4	549.10
52.3	549.80
56.2	550.56
58.4	550.69
58.6	551.16

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	548.84
Bankfull Cross-Sectional Area (sq ft):	3.4
LTOB Cross-Sectional Area (sq ft):	3.4
Bankfull Width (ft):	6.5
Flood Prone Area Elevation (ft):	549.67
Flood Prone Width (ft):	45
Max Depth at Bankfull (ft):	0.8
Mean Depth at Bankfull (ft):	0.5
W / D Ratio (ft/ft):	12.3
Entrenchment Ratio (ft/ft):	7.0
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	548.00

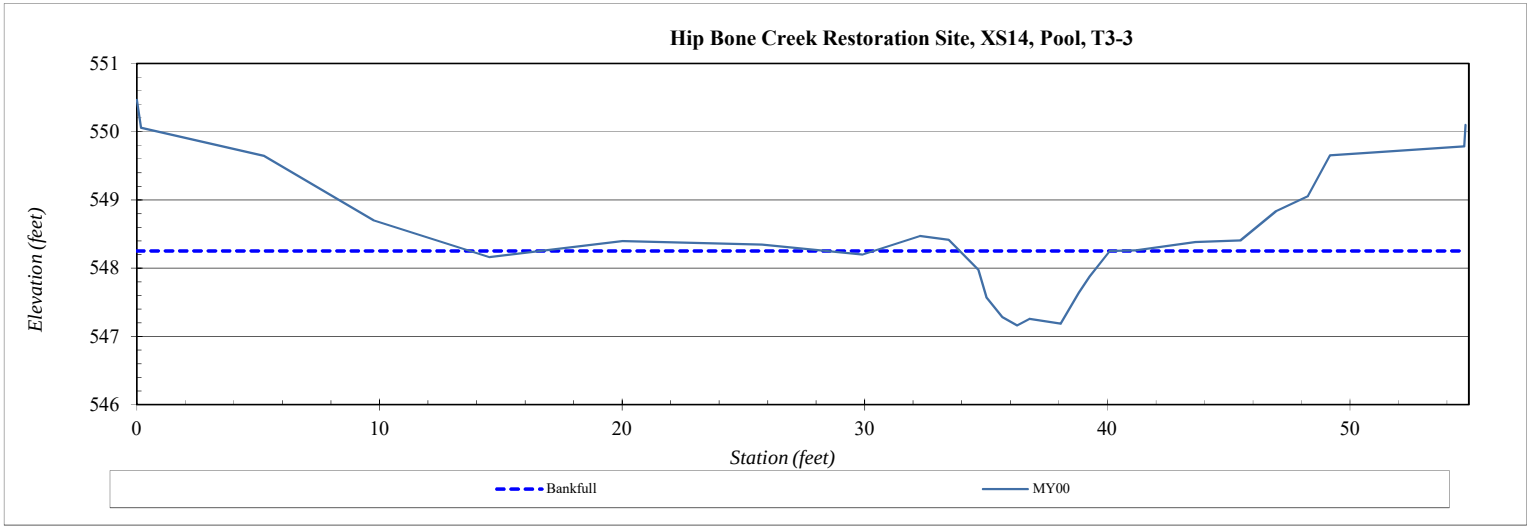


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS14
Drainage Area (sq mi):	0.05
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	550.47
0.2	550.06
5.3	549.64
9.8	548.70
14.5	548.16
20.0	548.40
25.8	548.35
29.9	548.20
32.3	548.47
33.5	548.41
34.7	547.98
35.0	547.58
35.7	547.28
36.3	547.16
36.8	547.26
38.1	547.19
38.8	547.64
39.3	547.88
40.1	548.25
41.2	548.26
43.6	548.38
45.5	548.41
46.9	548.84
48.3	549.06
49.2	549.65
51.0	549.70
54.7	549.78
54.8	550.10

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	548.25
Bankfull Cross-Sectional Area (sq ft):	4.3
LTOB Cross-Sectional Area (sq ft):	4.3
Bankfull Width (ft):	6.2
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.1
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	547.16

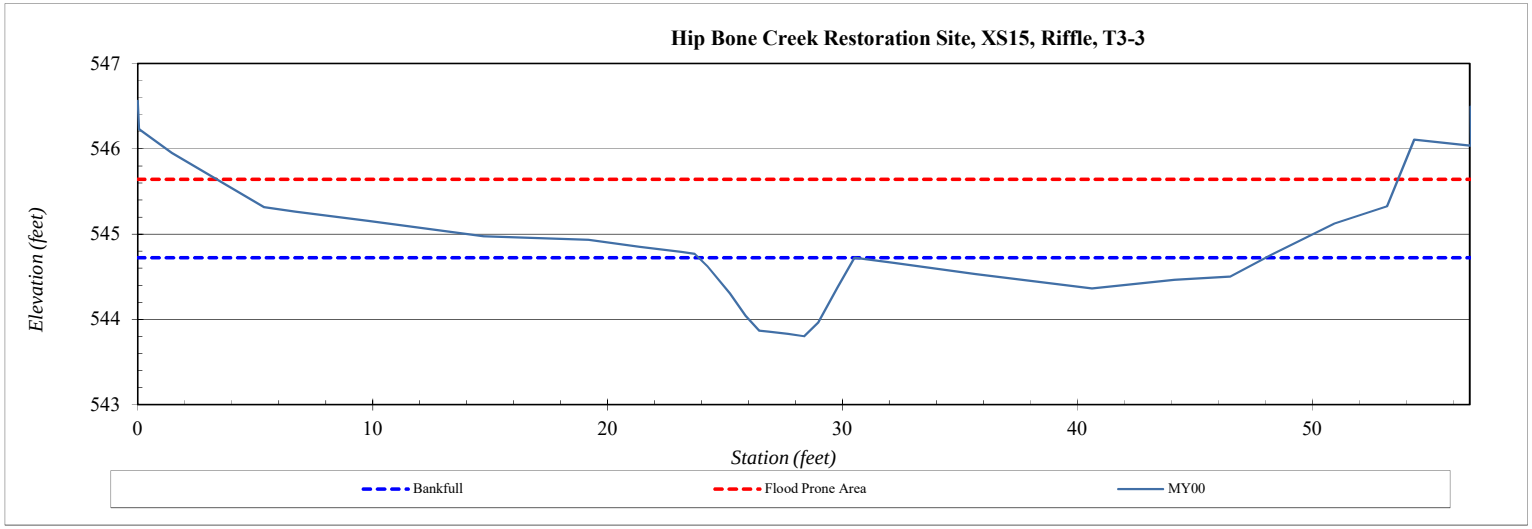


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS15
Drainage Area (sq mi):	0.06
Date:	5/20/2021
Field Crew:	TS, KB, CP

Station	Elevation
0.0	546.56
0.1	546.23
1.5	545.95
5.4	545.31
6.7	545.26
9.8	545.15
14.7	544.97
19.2	544.93
21.4	544.85
23.2	544.79
23.7	544.77
24.3	544.62
25.2	544.31
25.9	544.04
26.5	543.87
26.9	543.86
27.7	543.83
28.4	543.80
29.0	543.97
29.8	544.38
30.5	544.72
31.0	544.70
32.2	544.66
35.6	544.53
40.6	544.36
44.1	544.46
46.5	544.50
48.3	544.76
50.9	545.12
53.2	545.33
54.3	546.11
56.7	546.03
56.7	546.49

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	544.72
Bankfull Cross-Sectional Area (sq ft):	3.9
LTOB Cross-Sectional Area (sq ft):	3.9
Bankfull Width (ft):	7.2
Flood Prone Area Elevation (ft):	545.64
Flood Prone Width (ft):	50
Max Depth at Bankfull (ft):	0.9
Mean Depth at Bankfull (ft):	0.5
W / D Ratio (ft/ft):	13.3
Entrenchment Ratio (ft/ft):	7.0
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	543.80

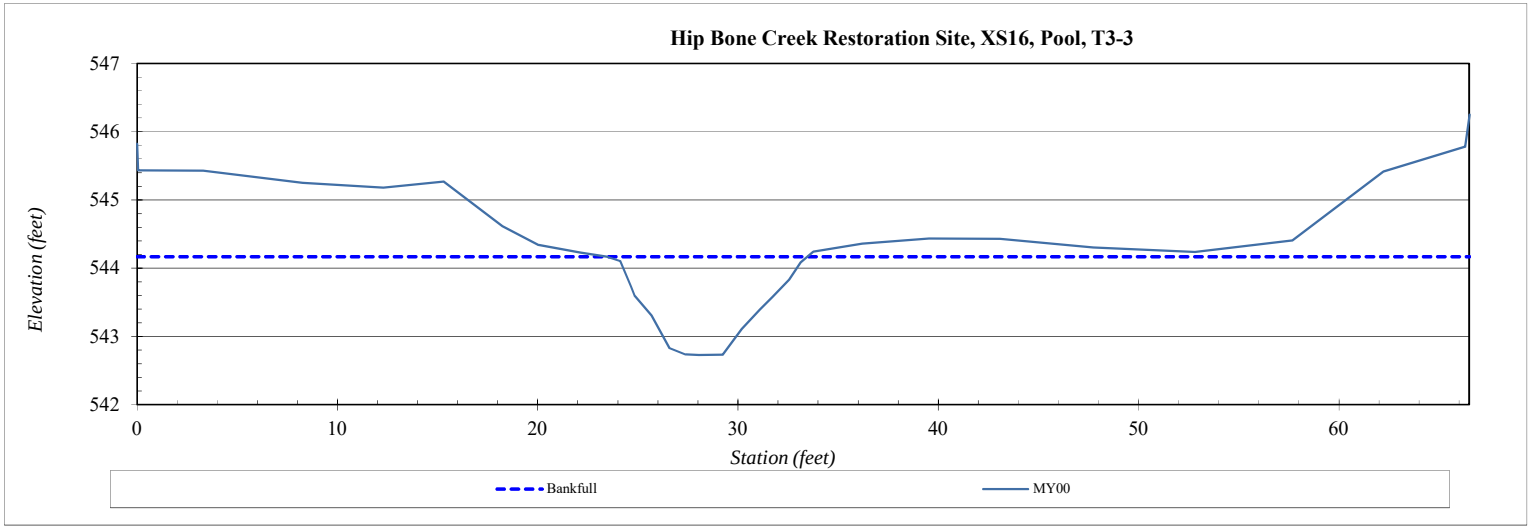


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS16
Drainage Area (sq mi):	0.06
Date:	5/20/2021
Field Crew:	TS, KB, CP

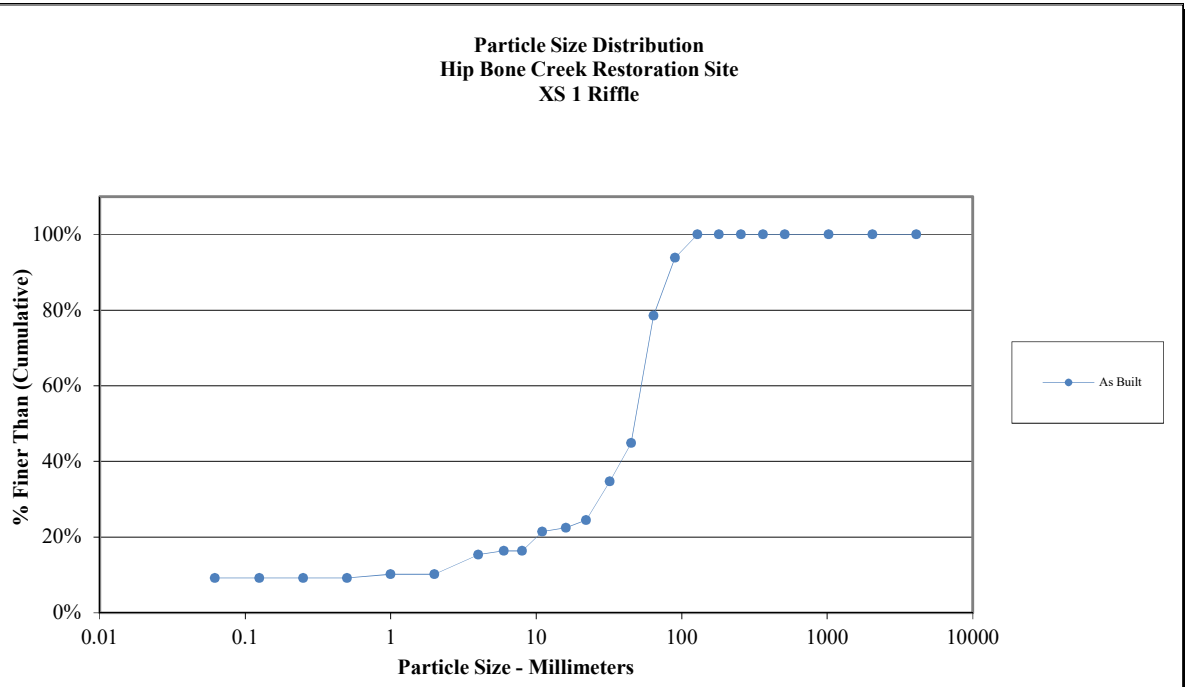
Station	Elevation
0.0	545.82
0.1	545.43
3.3	545.43
8.3	545.25
12.3	545.18
15.3	545.27
18.2	544.62
20.0	544.34
22.1	544.23
23.5	544.17
24.1	544.11
24.7	543.73
24.8	543.60
25.7	543.31
26.6	542.83
27.4	542.74
28.1	542.73
29.2	542.73
30.2	543.11
31.1	543.39
31.7	543.58
32.6	543.83
33.1	544.09
33.8	544.24
36.2	544.36
39.5	544.43
43.1	544.43
47.7	544.30
52.8	544.24
57.7	544.41
62.2	545.41
66.3	545.78
66.5	546.25

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	544.17
Bankfull Cross-Sectional Area (sq ft):	8.6
LTOB Cross-Sectional Area (sq ft):	8.6
Bankfull Width (ft):	10.0
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.4
Mean Depth at Bankfull (ft):	0.9
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	542.73



Cross-Section 1 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	9
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		5
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	10
Very Coarse	45 - 64		33
Small	64 - 90	C	15
Small	90 - 128	O	6
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	98

Note:



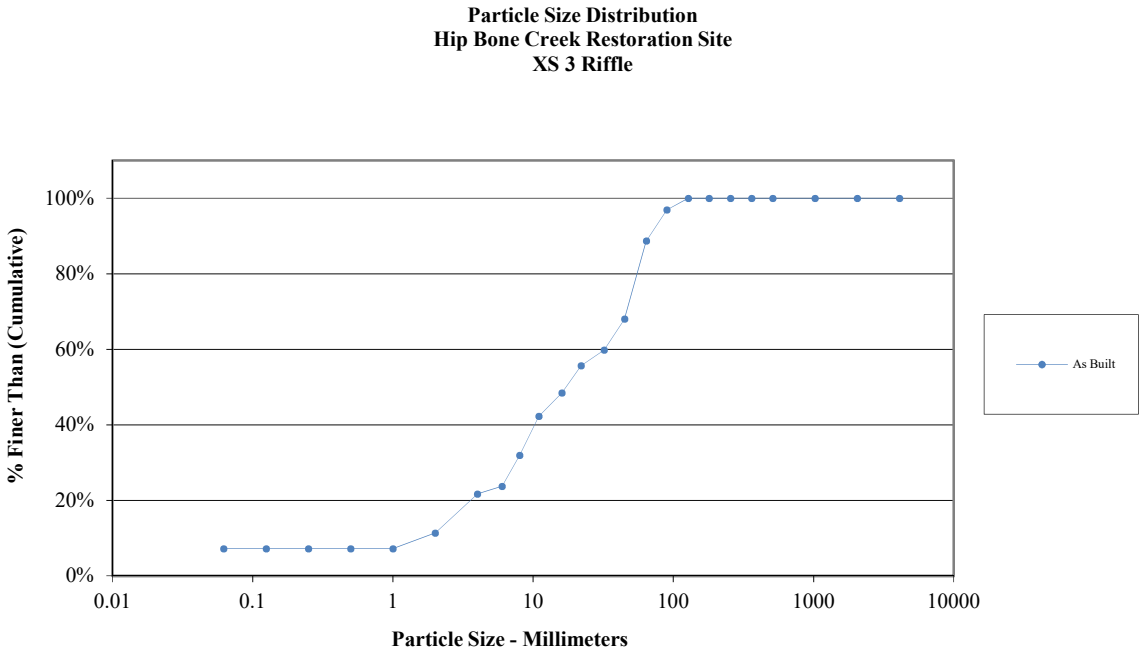
Size (mm)	
D16	5.3
D35	32
D50	47
D65	56
D84	72
D95	96

Size Distribution	
mean	19.5
dispersion	5.2
skewness	-0.36

Type	
silt/clay	9%
sand	1%
gravel	68%
cobble	24%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	7
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		10
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	8
Medium	8 - 11.3	A	10
Medium	11.3 - 16	V	6
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	4
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		20
Small	64 - 90	C	8
Small	90 - 128	O	3
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	97

Note:



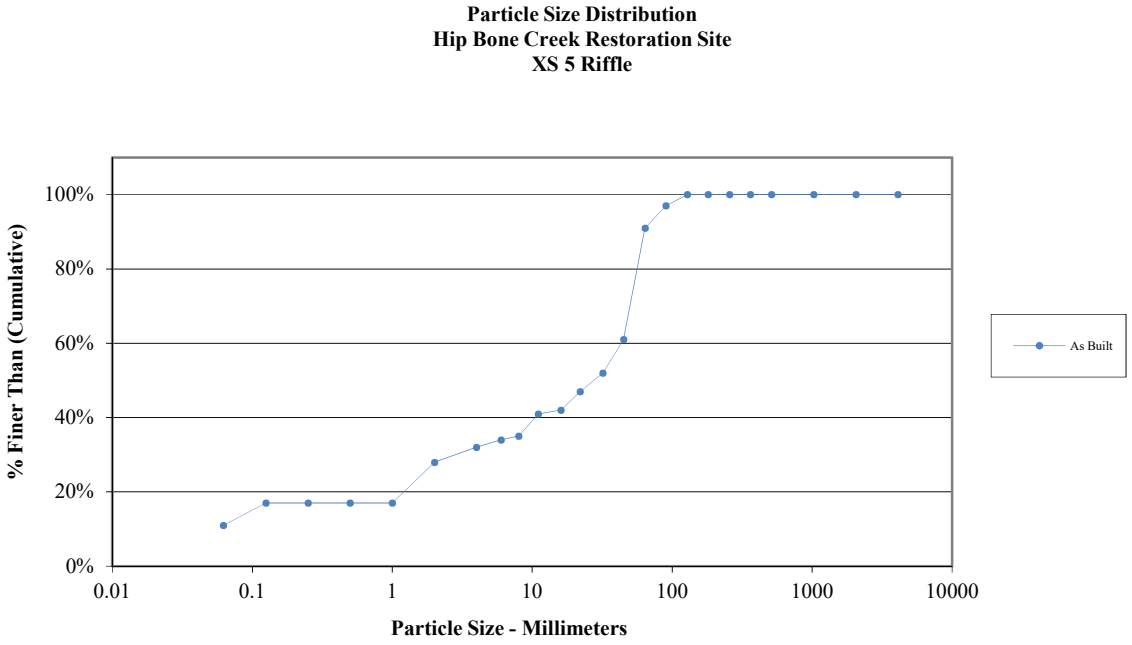
Size (mm)	
D16	2.7
D35	8.8
D50	17
D65	40
D84	59
D95	83

Size Distribution	
mean	12.6
dispersion	4.9
skewness	-0.11

Type	
silt/clay	7%
sand	4%
gravel	77%
cobble	11%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	11
Very Fine	2 - 4		4
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	6
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	9
Very Coarse	45 - 64		30
Small	64 - 90	C	6
Small	90 - 128	O	3
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



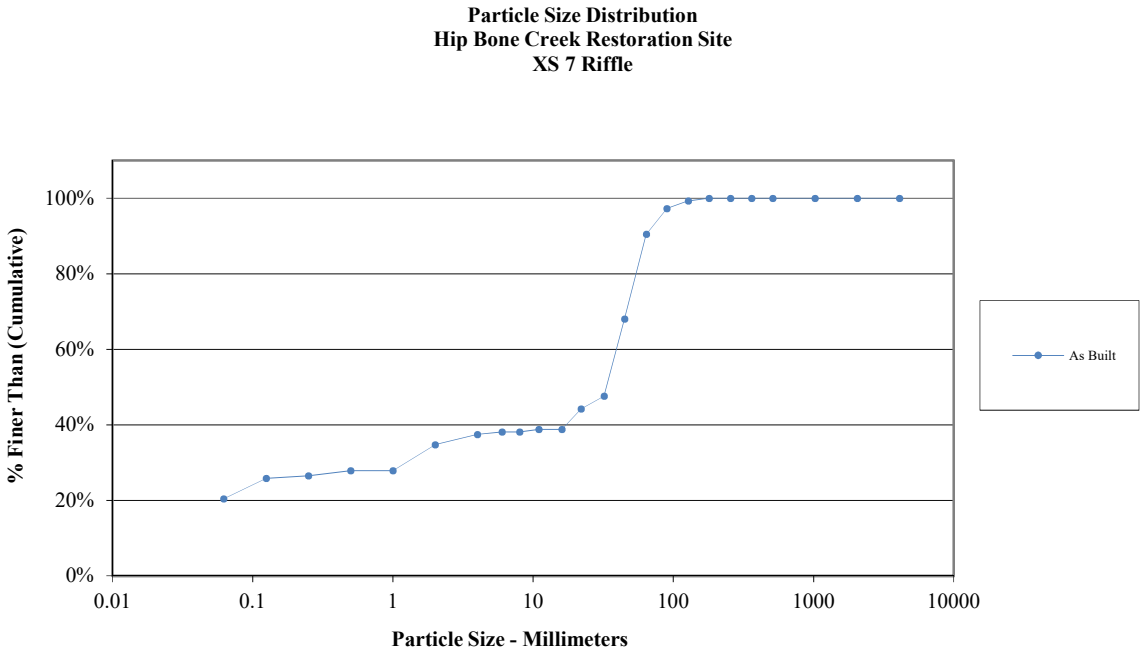
Size (mm)	
D16	0.11
D35	8
D50	28
D65	47
D84	59
D95	80

Size Distribution	
mean	2.5
dispersion	128.3
skewness	-0.63

Type	
silt/clay	11%
sand	17%
gravel	63%
cobble	9%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Riffle -MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	30
Very Fine	.062 - .125	S	8
Fine	.125 - .25	A	1
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		4
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	8
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	30
Very Coarse	45 - 64		33
Small	64 - 90	C	10
Small	90 - 128	O	3
Large	128 - 180	B	1
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	147

Note:



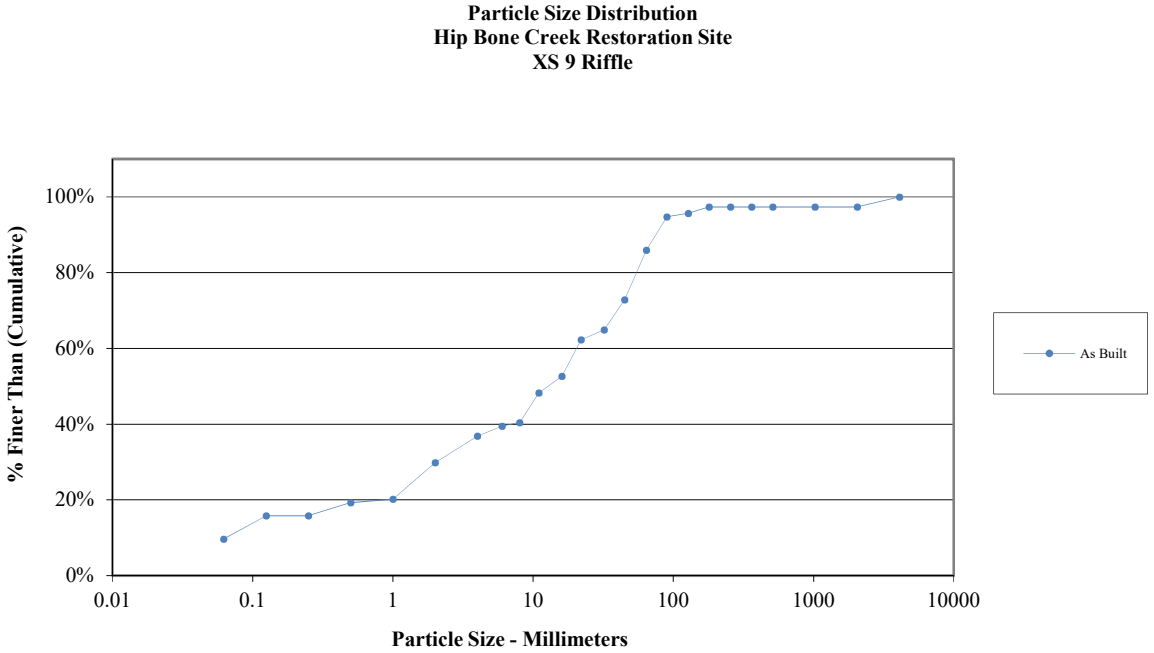
Size (mm)	
D16	0.062
D35	2.2
D50	33
D65	43
D84	58
D95	80

Size Distribution	
mean	1.9
dispersion	267.0
skewness	-0.72

Type	
silt/clay	20%
sand	14%
gravel	56%
cobble	10%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	7
Fine	.125 - .25	A	
Medium	.25 - .50	N	4
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	11
Very Fine	2 - 4		8
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	11
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	9
Very Coarse	45 - 64		15
Small	64 - 90	C	10
Small	90 - 128	O	1
Large	128 - 180	B	2
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	3
		Total	114

Note:



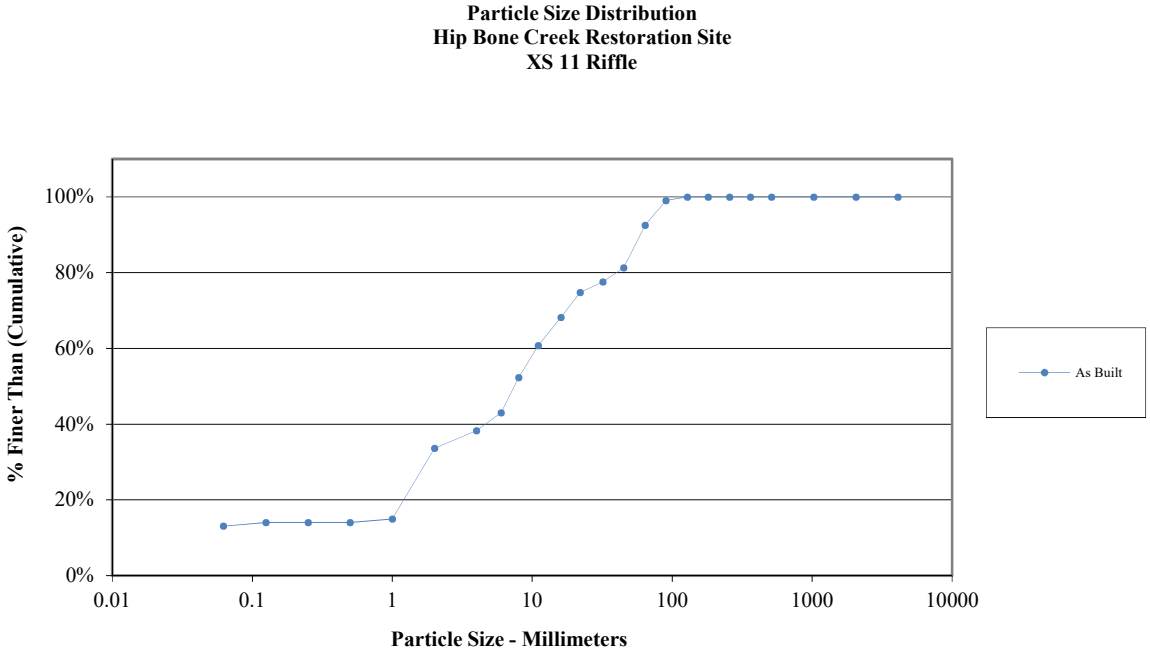
Size (mm)	
D16	0.26
D35	3.3
D50	13
D65	32
D84	61
D95	100

Size Distribution	
mean	4.0
dispersion	27.3
skewness	-0.33

Type	
silt/clay	10%
sand	20%
gravel	56%
cobble	11%
boulder	0%
bedrock	3%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 11 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	14
Very Fine	.062 - .125	S	1
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	20
Very Fine	2 - 4		5
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	10
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	8
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	4
Very Coarse	45 - 64		12
Small	64 - 90	C	7
Small	90 - 128	O	1
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	107

Note:



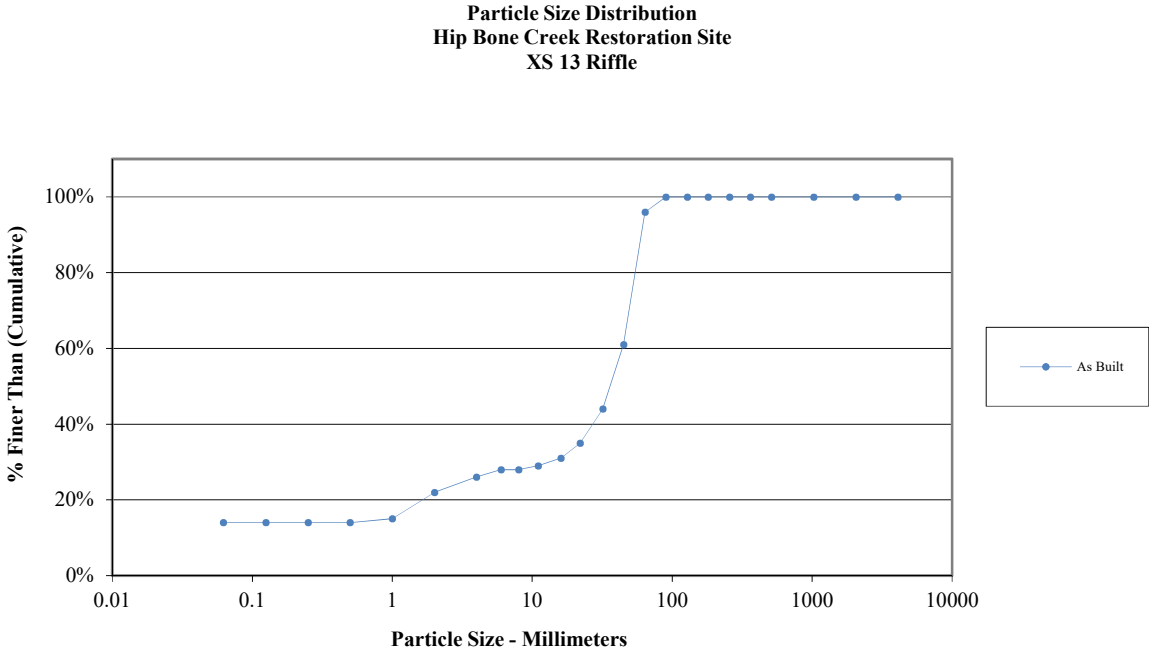
Size (mm)	
D16	1
D35	2.4
D50	7.4
D65	14
D84	49
D95	73

Size Distribution	
mean	7.0
dispersion	7.0
skewness	-0.02

Type	
silt/clay	13%
sand	21%
gravel	59%
cobble	7%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 13 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	14
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		4
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	9
Very Coarse	32 - 45	S	17
Very Coarse	45 - 64		35
Small	64 - 90	C	4
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



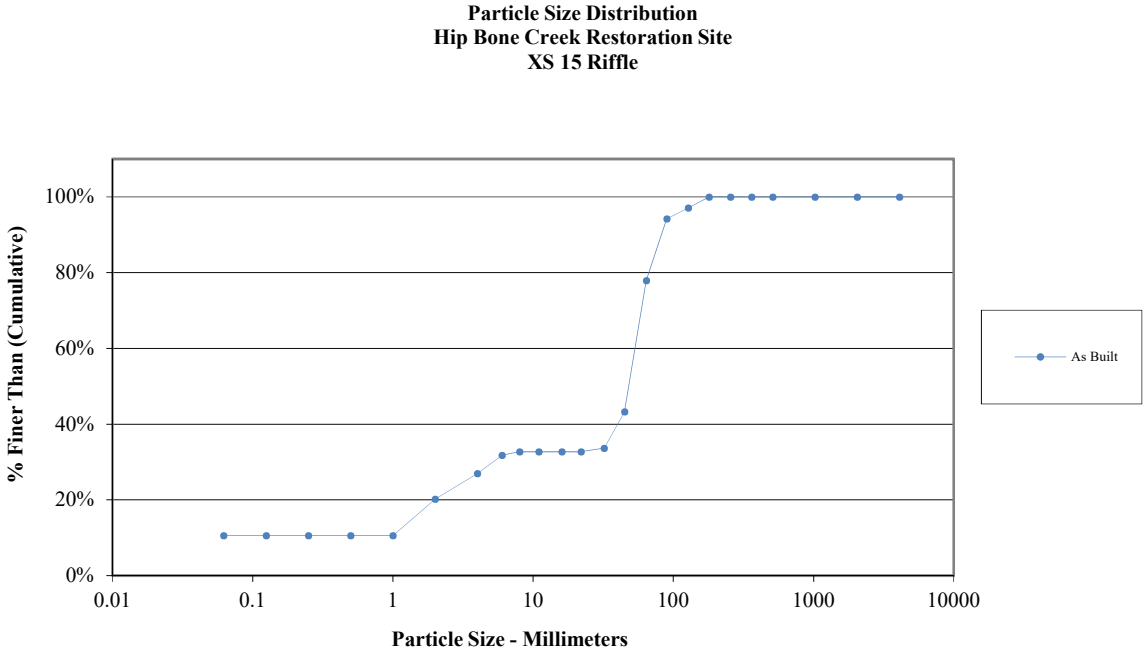
Size (mm)	
D16	1.1
D35	22
D50	36
D65	47
D84	57
D95	63

Size Distribution	
mean	7.9
dispersion	17.2
skewness	-0.50

Type	
silt/clay	14%
sand	8%
gravel	74%
cobble	4%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 15 Riffle - MY-00			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	11
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		7
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	10
Very Coarse	45 - 64		36
Small	64 - 90	C	17
Small	90 - 128	O	3
Large	128 - 180	B	3
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	104

Note:



Size (mm)	
D16	1.5
D35	34
D50	48
D65	56
D84	73
D95	99

Size Distribution	
mean	10.5
dispersion	16.8
skewness	-0.51

Type	
silt/clay	11%
sand	10%
gravel	58%
cobble	22%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

APPENDIX E

As-Built Plan Sheets

KCI JOB# : 161802913

CONTRACT #: 7528

NCDEQ DIVISION OF MITIGATION SERVICES

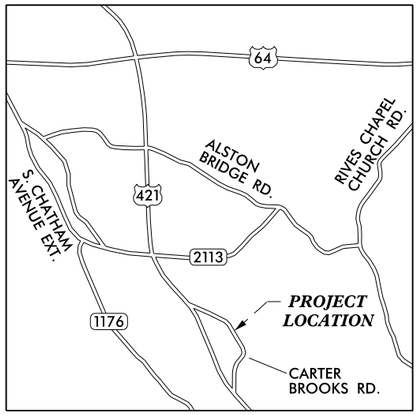
STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	7528	1	11

REVISIONS		

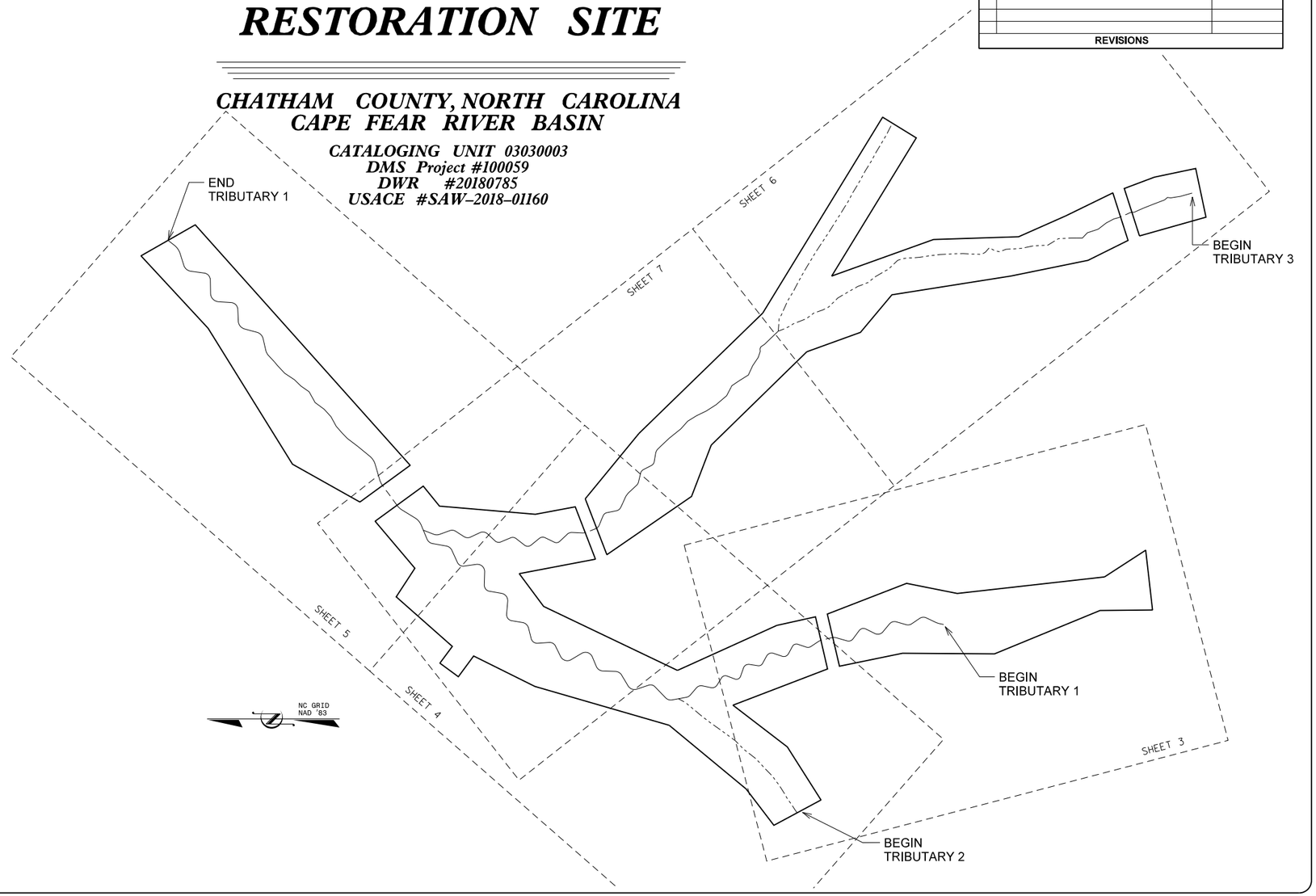
HIP BONE CREEK RESTORATION SITE

CHATHAM COUNTY, NORTH CAROLINA
CAPE FEAR RIVER BASIN

CATALOGING UNIT 03030003
DMS Project #100059
DWR #20180785
USACE #SAW–2018–01160



VICINITY MAP
NOT TO SCALE



AS–BUILT PLANS

NOTES:

NO MAJOR CHANGES WERE MADE TO THE ORIGINAL CONSTRUCTION PLANS.

DIRECTIONS TO SITE

FROM RALEIGH, TAKE US–1 SOUTH TO SANFORD. FOLLOW US–421 NORTH FOR ABOUT 17 MILES. TAKE A RIGHT ONTO GILMORE LODGE ROAD AND THEN A QUICK LEFT ONTO CARTER BROOKS ROAD. THE ENTRANCE DRIVE TO THE SITE IS ABOUT 0.8 MILE ON THE RIGHT.

INDEX OF SHEETS

Prepared in the Office of:
KCI ASSOCIATES OF NC
ENGINEERS•PLANNERS•ECOLOGISTS
4505 FALLS OF NEUSE ROAD
SUITE 400
RALEIGH, NC 27609

Prepared for:
JEREMIAH DOW
DMS PROJECT MANAGER

Prepared by:
KRISTIN E. KNIGHT, PE
PROJECT ENGINEER
ALEX FRENCH
PROJECT DESIGNER

PROJECT ENGINEER

AUGUST 17, 2021

SIGNATURE: P.E.

GENERAL NOTES:

THIS SET OF PLANS IS BASED OFF OF AN AS-BUILT SURVEY COMPLETED BY KCI ASSOCIATES OF NC IN MAY OF 2021.

THIS PLAT DOES NOT REPRESENT A BOUNDARY SURVEY OF THE PARENT TRACTS. THE PARENT TRACT BOUNDARIES ADJACENT TO THIS EASEMENT ARE NOT CHANGED BY THIS PLAT.

DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES IN U.S. SURVEY FEET UNLESS OTHERWISE NOTED.

THE BASIS OF THE MERIDIANS AND COORDINATES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS. ALL DISTANCES ARE GROUND UNLESS OTHERWISE NOTED.

NO UNDERGROUND UTILITY LOCATING PERFORMED DURING THE COURSE OF THIS SURVEY.

PROJECT LEGEND:

Designed Thalweg w/Approximate Bankfull Limits ..... 12+00 13+00

Installed Riffle Enhancement .....

Installed Riffle Grade Control .....

Installed Step Pool .....

Installed Live Lift .....

Former Channel Filled .....

Installed Buried Brush Material and Log Sill .....

Photo Point .....

Stream/Wetland Gauge .....

Vegetation Plot .....

Cross–section .....

Minor Contour Line (As–Built) .....

Major Contour Line (As–Built) 720

As–Built Thalweg w/Approximate Bankfull Limits .....

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

SYM.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA *Environmental Quality*

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

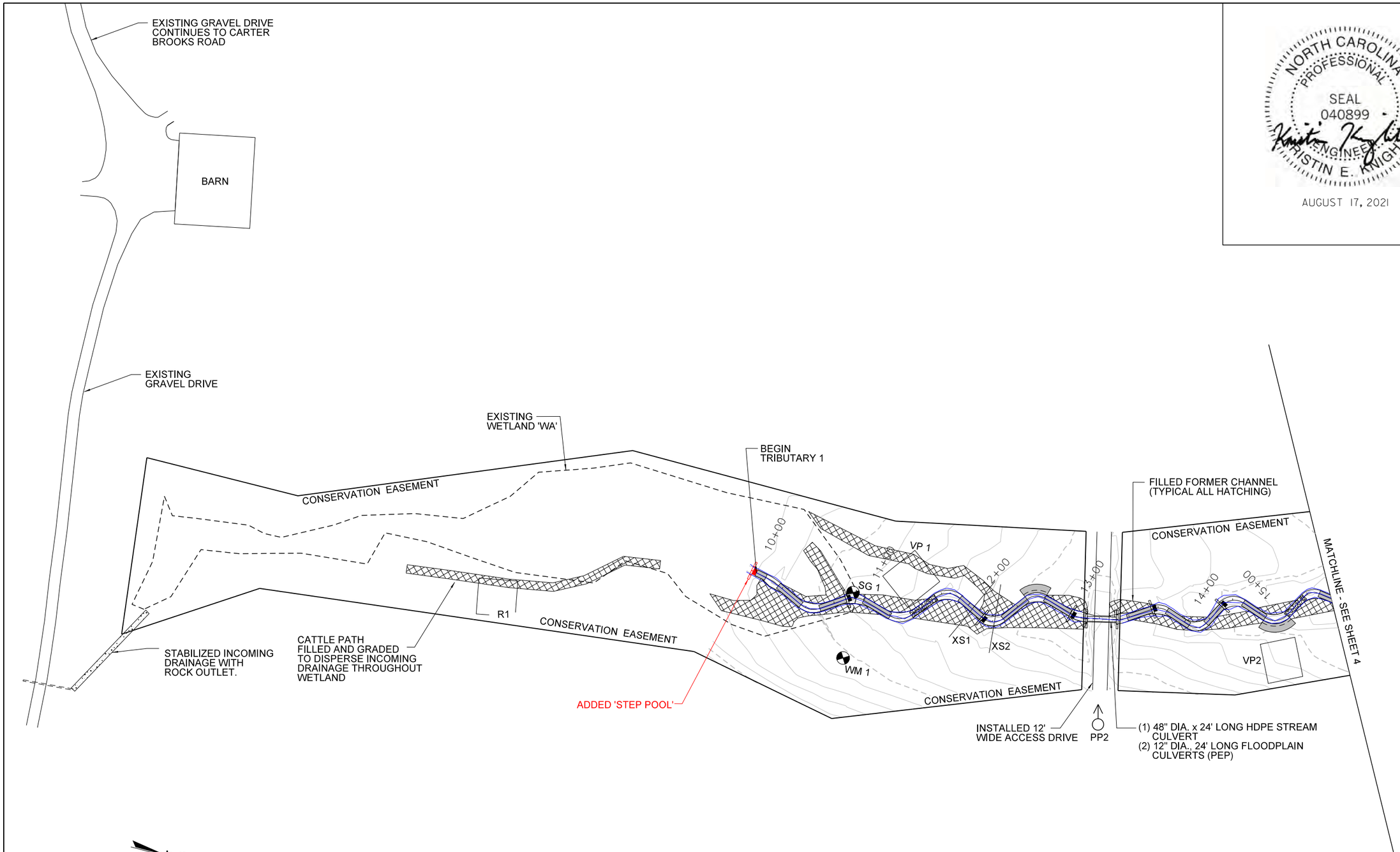
HIP BONE CREEK RESTORATION SITE

AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: N.T.S.

GENERAL NOTES & PROJECT LEGEND



NC GRID NAD '83

–40′ –20′ 0′ 40′ 80′

GRAPHIC SCALE

ALL TOPOGRAPHIC AND FEATURE DATA ARE BASED ON THE AS-BUILT SURVEY COMPLETED MAY 2021.

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

SYM.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA
Environmental Quality

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE

AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

SITE PLAN

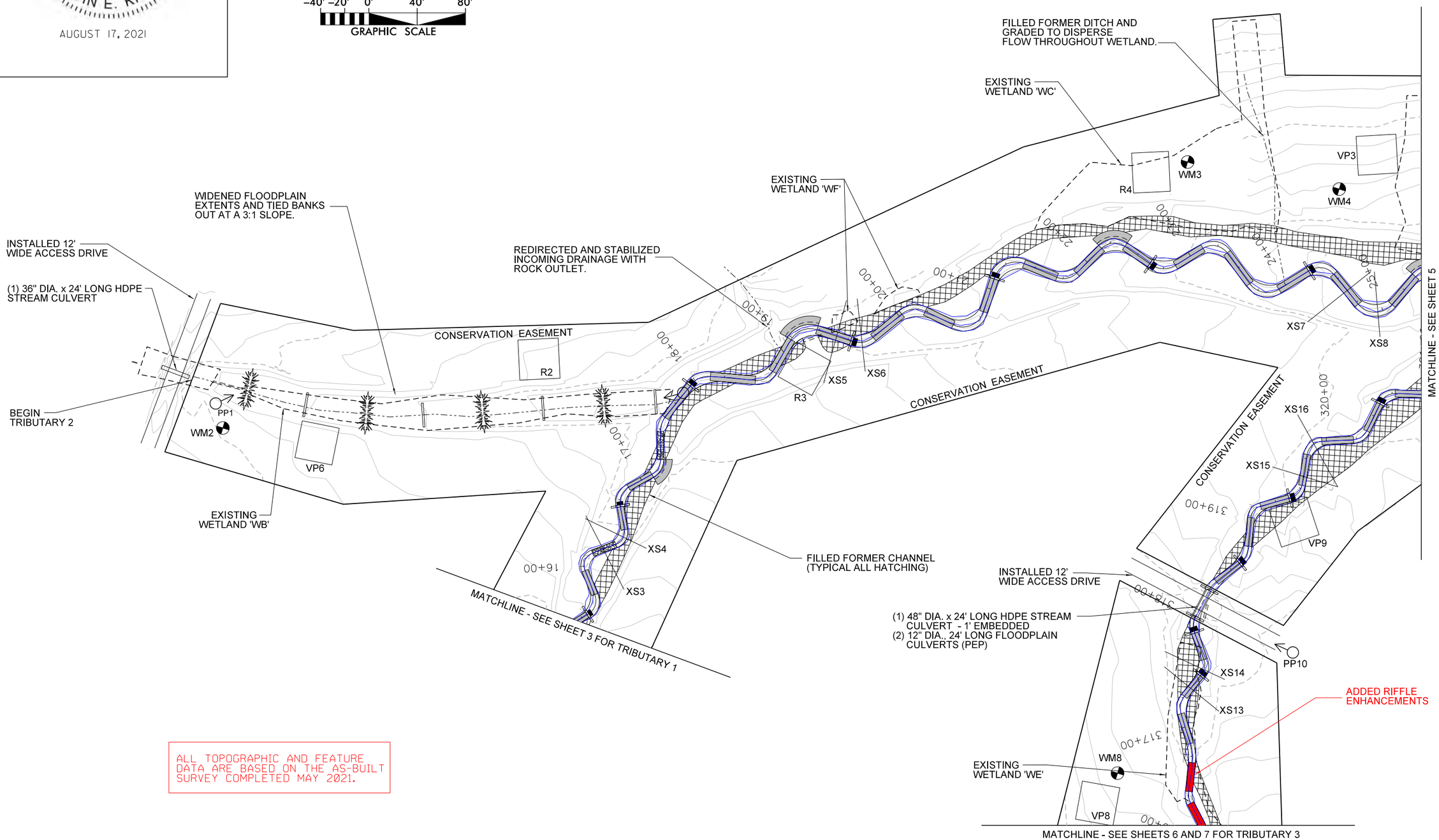
NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

NC GRID NAD '83

–40′ –20′ 0′ 40′ 80′

GRAPHIC SCALE



ALL TOPOGRAPHIC AND FEATURE DATA ARE BASED ON THE AS-BUILT SURVEY COMPLETED MAY 2021.

NO.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA *Environmental Quality*

KCI ENGINEERS • PLANNERS • SCIENTISTS ASSOCIATES OF NC

4505 FALLS OF NEUSE ROAD, SUITE 400 RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE

AS-BUILT PLANS

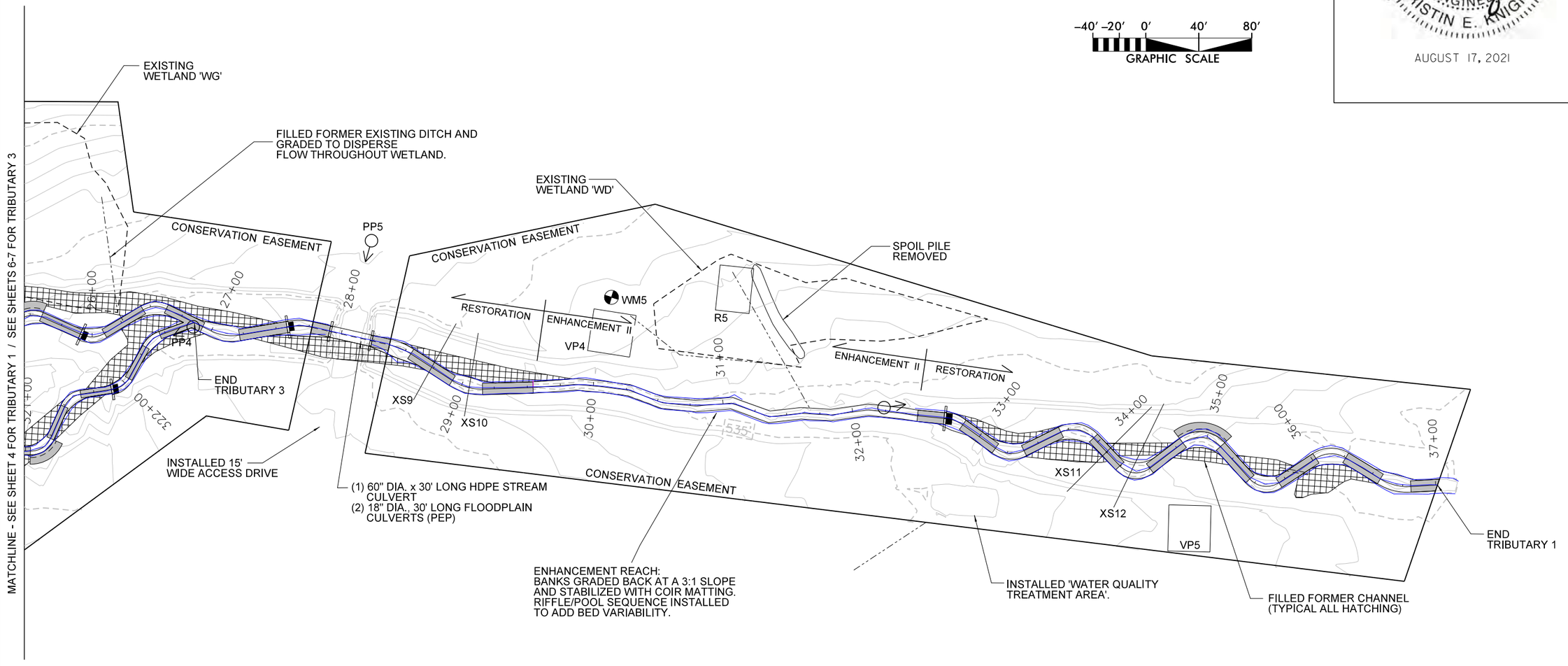
CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021

SCALE: GRAPHIC

SITE PLAN

SHEET 4 OF 11



ALL TOPOGRAPHIC AND FEATURE DATA ARE BASED ON THE AS-BUILT SURVEY COMPLETED MAY 2021.

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

SYM.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA
Environmental Quality

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE

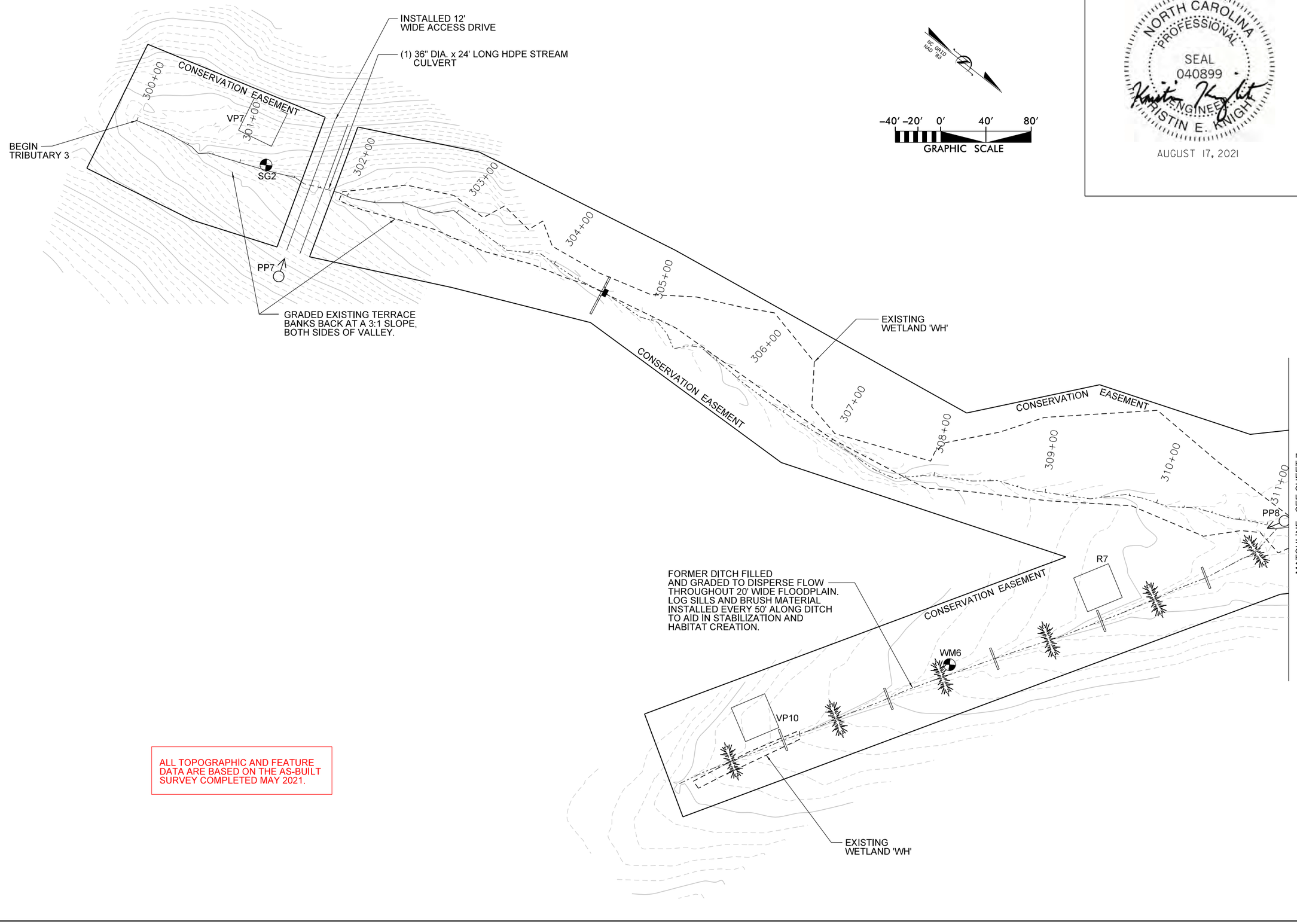
AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

SITE
PLAN

SHEET 5 OF 11



ALL TOPOGRAPHIC AND FEATURE DATA ARE BASED ON THE AS-BUILT SURVEY COMPLETED MAY 2021.

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

NO.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA
Environmental Quality

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE

AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

SITE PLAN

NC GRID
NAD 83

–40′ –20′ 0′ 40′ 80′

GRAPHIC SCALE

NORTH CAROLINA
PROFESSIONAL
SEAL
040899
ENGINEER
KRISTIN E. KNIGHT

AUGUST 17, 2021

NO.	DESCRIPTION	DATE
	REVISIONS	

MATCHLINE - SEE SHEET 6 FOR TRIBUTARY 3

MULTIPLE SMALL HEADCUTS
STABILIZED THROUGHOUT REACH
WITH STONE RIFFLE ENHANCEMENT

ADDED RIFFLE
ENHANCEMENTS

(1) 4.0' DIA. x 24' LONG HDPE
STREAM CULVERT

INSTALLED 12'
WIDE ACCESS DRIVE

MATCHLINE - SEE SHEETS 3-5 FOR TRIBUTARY 1

CONSERVATION EASEMENT

R6

312+00

313+00

314+00

315+00

316+00

317+00

318+00

319+00

320+00

321+00

322+00

PP9

VP8

ENHANCEMENT II

RESTORATION

WM8

XS13

XS14

WM7

R8

PP10

XS15

SG3

XS16

VP9

XS7

XS8

R4

WM3

WM4

VP3

24+00

25+00

26+00

27+00

28+00

PP4

PP5

EXISTING
WETLAND 'WE'

FILLED FORMER CHANNEL
(TYPICAL ALL HATCHING)

EXISTING
WETLAND 'WC'

EXISTING
WETLAND 'WG'

(1) 5.0' DIA. x 30' LONG HDPE
STREAM CULVERT

INSTALLED 15'
WIDE ACCESS DRIVE

MATCHLINE - SEE SHEETS 3-5 FOR TRIBUTARY 1

ALL TOPOGRAPHIC AND FEATURE DATA ARE BASED ON THE AS-BUILT SURVEY COMPLETED MAY 2021.

NORTH CAROLINA
Environmental Quality

KCI
ENGINEERS • PLANNERS • SCIENTISTS
ASSOCIATES OF NC

4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE

AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

SITE
PLAN

SHEET 7 OF 11

RIPARIAN FOREST PLANTING:

PLANTING ZONE 1 = 17.4 ACRES

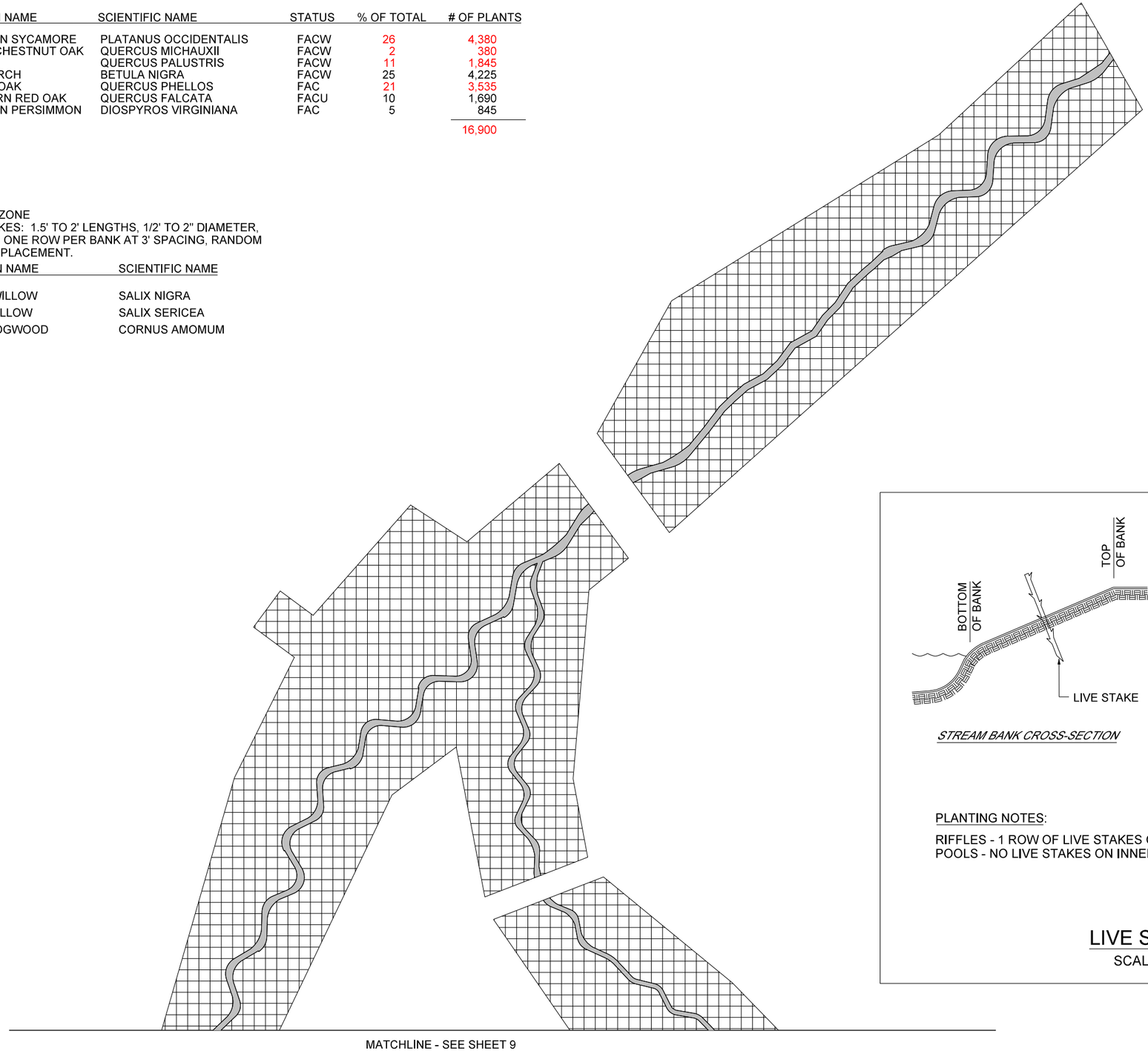
12" - 18" BARE ROOT MATERIAL
968 STEMS/ACRE (9' X 5' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	STATUS	% OF TOTAL	# OF PLANTS
AMERICAN SYCAMORE	PLATANUS OCCIDENTALIS	FACW	26	4,380
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	FACW	2	380
PIN OAK	QUERCUS PALUSTRIS	FACW	11	1,845
RIVER BIRCH	BETULA NIGRA	FACW	25	4,225
WILLOW OAK	QUERCUS PHELLOS	FAC	21	3,535
SOUTHERN RED OAK	QUERCUS FALCATA	FACU	10	1,690
AMERICAN PERSIMMON	DIOSPYROS VIRGINIANA	FAC	5	845
				16,900

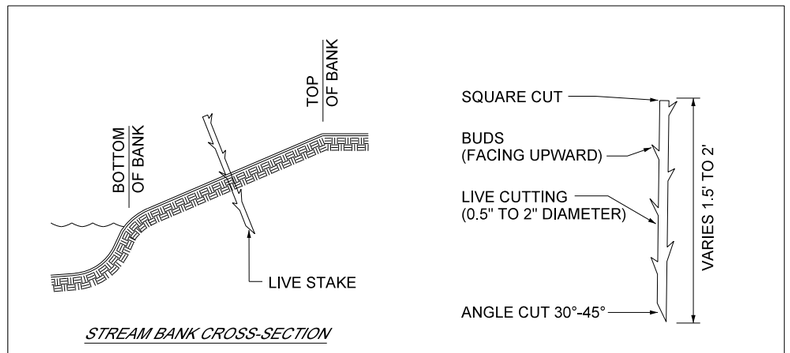
STREAM ZONE :

STREAM ZONE
LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2' TO 2" DIAMETER, PLANTED ONE ROW PER BANK AT 3' SPACING, RANDOM SPECIES PLACEMENT.

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA
SILKY DOGWOOD	CORNUS AMOMUM



MATCHLINE - SEE SHEET 9



STREAM BANK CROSS-SECTION

PLANTING NOTES:

RIFFLES - 1 ROW OF LIVE STAKES ON BOTH SIDES OF CHANNEL.
POOLS - NO LIVE STAKES ON INNER BENDS, 1 ROW ON OUTER BENDS.

LIVE STAKES

SCALE: NTS

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

NC GRID NAD 83

–70 0′ 70′ 140′

GRAPHIC SCALE

NO.	DESCRIPTION	DATE
	REVISIONS	

NORTH CAROLINA *Environmental Quality*

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE ROAD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

HIP BONE CREEK RESTORATION SITE
AS-BUILT PLANS
CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

PLANTING PLAN

SHEET 8 OF 11

MATCHLINE - SEE SHEET 8

PLANTING ZONE 1

STREAM ZONE

* NOTE: SEE SHEET 8 FOR PLANTING QUANTITIES

ANY AREAS WITHIN THE FORESTED AREA DEEMED LOW DENSITY WAS PLANTED PER DESIGN REPRESENTATIVE GUIDANCE

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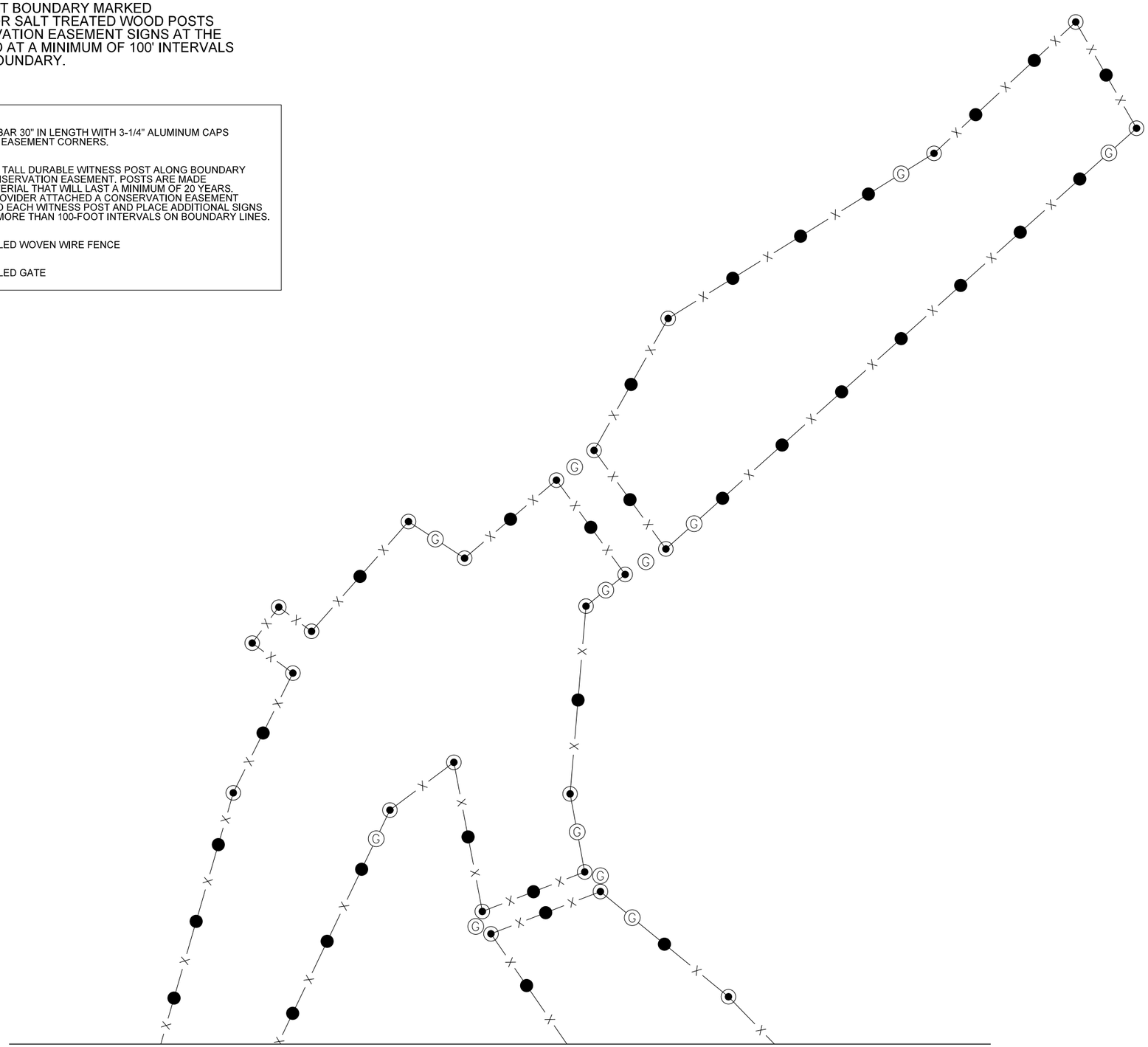
PLANTING PLAN

SHEET 9 OF 11

EASEMENT BOUNDARY MARKING

THE EASEMENT BOUNDARY MARKED WITH METAL OR SALT TREATED WOOD POSTS AND CONSERVATION EASEMENT SIGNS AT THE CORNERS AND AT A MINIMUM OF 100' INTERVALS ALONG THE BOUNDARY.

◉	5/8" REBAR 30" IN LENGTH WITH 3-1/4" ALUMINUM CAPS ON ALL EASEMENT CORNERS.
●	6-FOOT TALL DURABLE WITNESS POST ALONG BOUNDARY OF CONSERVATION EASEMENT. POSTS ARE MADE OF MATERIAL THAT WILL LAST A MINIMUM OF 20 YEARS. THE PROVIDER ATTACHED A CONSERVATION EASEMENT SIGN TO EACH WITNESS POST AND PLACE ADDITIONAL SIGNS AT NO MORE THAN 100-FOOT INTERVALS ON BOUNDARY LINES.
— X —	INSTALLED WOVEN WIRE FENCE
Ⓖ	INSTALLED GATE



NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

AUGUST 17, 2021

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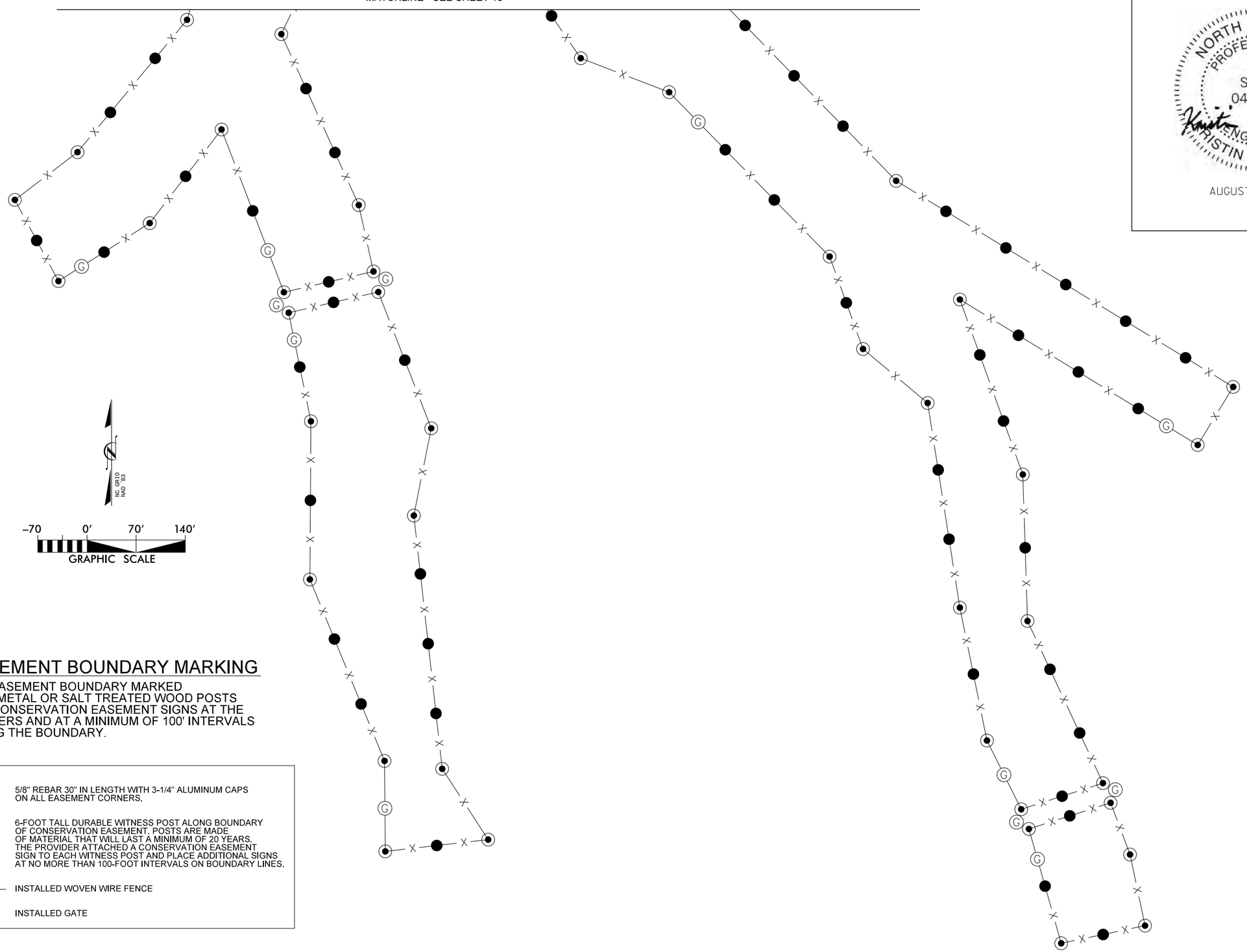
AS-BUILT PLANS

CHATHAM COUNTY, NORTH CAROLINA

DATE: AUGUST 2021
SCALE: GRAPHIC

BOUNDARY MARKING PLAN

MATCHLINE - SEE SHEET 10



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- — X — INSTALLED WOVEN WIRE FENCE
- (G) INSTALLED GATE

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

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BOUNDARY MARKING PLAN