MY01 MONITORING REPORT

Hip Bone Creek Restoration Site
Chatham County
Cape Fear River Basin - 03040101

DMS Project #100059
DMS Contract #7528
DMS RFP #16-007331
USACE AID #: SAW 2017-0016160 DWR #: 2018-0785
Monitoring Data Collected: 2021

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

Mitigation Services
ENVIRONMENTAL QUALITY

Monitoring and Design Firm

Prepared by:

KCI Associates of North Carolina, PA
4505 Falls of Neuse Road
Suite 400
Raleigh, NC 27609
(919) 783-9214

Project Contact: Tim Morris
Email: tim.morris@kci.com

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: February 2, 2022
To: Jeremiah Dow, DMS Project Manager
From: Tim Morris, Project Manager
KCI Associates of North Carolina, PA
Subject: MY-01 Monitoring Report Comments
Hip Bone Creek DMS#100059, Contract 007528
Cape Fear River Basin CU 03040101
Chatham County, North Carolina

Please find below our responses in italics to the MY-01 Monitoring Report comments from NCDMS received on January 21, 2022, for the Hip Bone Creek Restoration Site.

1. CCPV maps' satellite imagery did not render.
   KCI Response: This issue has been corrected.

2. Please verify that no invasive vegetation was treated or identified.
   KCI Response: Invasive species were treated during construction but have not been treated since construction was completed. Scattered clumps of Chines privet are present in the wetland enhancement areas but below the mapping threshold. These will be treated again in future monitoring years.

3. We recommend adding a line to the cross section graphs that identifies the low top of bank (LTOB) in addition to the existing Bankfull (based on MY0 cross sectional area) line.
   KCI Response: A LTOB line has been added to the cross-section graphs.

4. You may discontinue future pebble counts if you wish on this project. Per the memo distributed on Oct. 19, 2021, "The absence of pebble count data in future monitoring reports where pebble count data was listed as part of monitoring in the mitigation plan must be documented in the monitoring report. The September 29, 2021 Technical Work Group meeting may be cited as the source of the new policy."
   KCI Response: Future pebble counts will be discontinued.

5. Table 9 – All LTOB Cross Sectional Areas are identical between MY0 and MY1 yet there are changes in BHR and LTOB Max Depth which would imply a change in cross sectional area. Please clarify.
   KCI Response: The value for the bankfull cross-sectional area was accidentally used in this table. This error has been corrected.

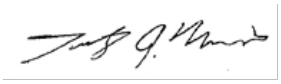
6. Please address the IRT's MY0 comments and do a comment response letter. Please include the letter in an Appendix of the MY1 report.
   KCI Response: A response to comments letter has been prepared and included in Appendix F – Other Data.

7. Please do not alter the output of the veg table tool. The color coding is intended to communicate performance and the date of current survey, planted acreage, etc. is required information. In the resubmittal, please include the input and output from the tool and update the tables in the report.
   KCI Response: Initially we were unable to get the veg table tool to output any tables for any of our projects and so an attempt was made to copy the formatting of the example tables provided. Since submitting the draft version of this report, whatever was causing the error appears to have been corrected and the tool is generating the output tables. The tables in the report have been updated and the input and output files have been added to the digital deliverable.

8. Note that the submitted vegetation data includes conflicting performance standard approval designations. For example, Betula nigra is listed as "Approved Post Mit Plan" in the Random Plot 2 sheet but is described as "Approved Mit Plan" in other sheets and in Table 6.
   KCI Response: This error has been corrected.

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

Sincerely,



Tim Morris
Project Manager

TABLE OF CONTENTS

Appendix A – Visual Assessment Data

Appendix B – Vegetation Plot Data

Appendix C – Stream Geomorphology Data

Appendix D – Hydrologic Data

Appendix E – Project Timeline and Contact Info

Appendix E – Project Timeline and Contact Info

PROJECT SUMMARY

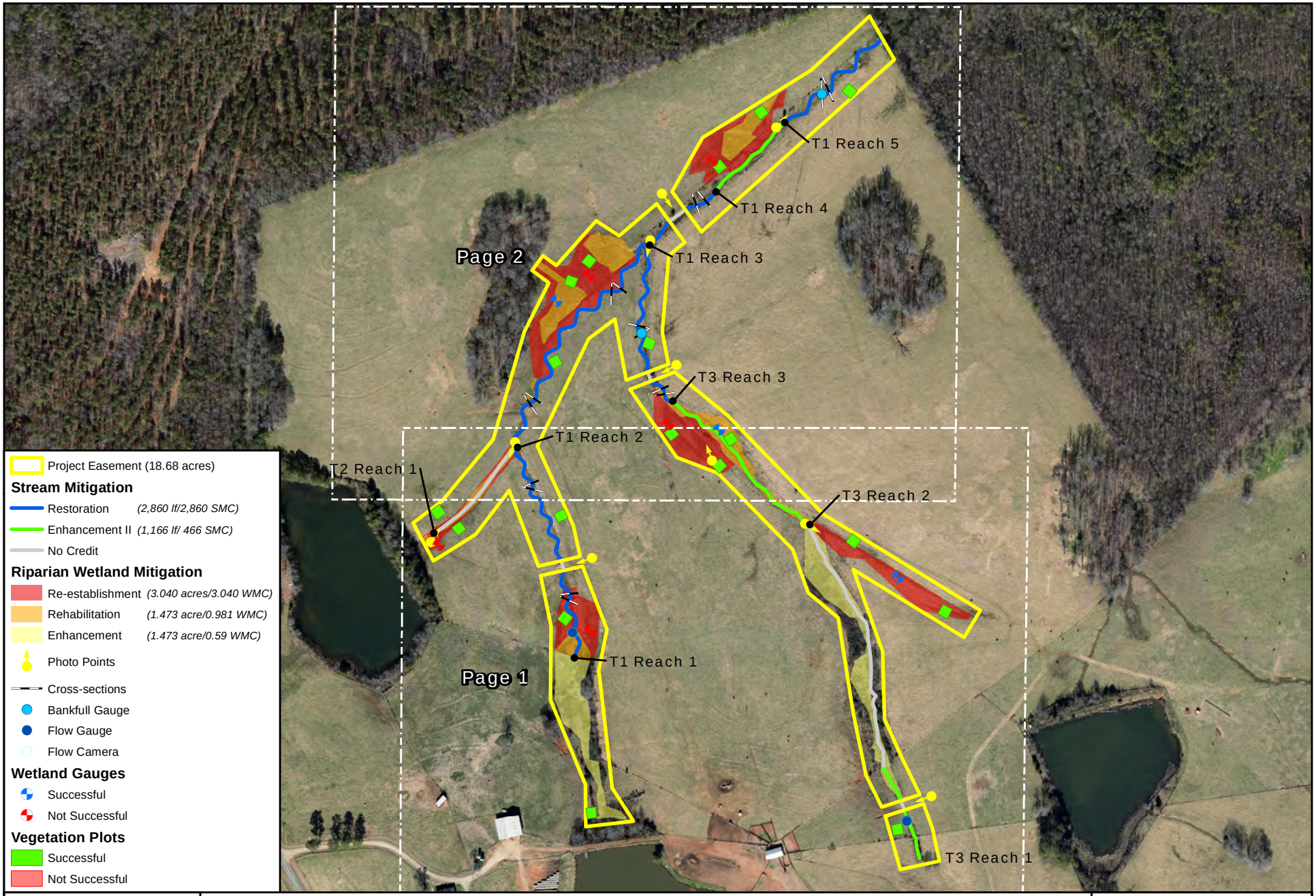
The Hip Bone Creek Restoration Site (HBCRS) is a full delivery project for the North Carolina Division of Mitigation Services (DMS). The site restored and enhanced a total of 4,026 linear feet of stream and 6.023 acres of riparian wetland. The HBCRS is a riparian system in the Cape Fear River Basin (03030003 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 restored impacted agricultural lands to a stable stream and wetland ecosystem with a functional riparian buffer, floodplain access, and riparian wetlands. Project planting and construction were completed in April 2021 and the monitoring components were installed in May 2021.

Table 1. Hip Bone Creek Restoration Site (ID-100059) Project Mitigation Quantities and Credits

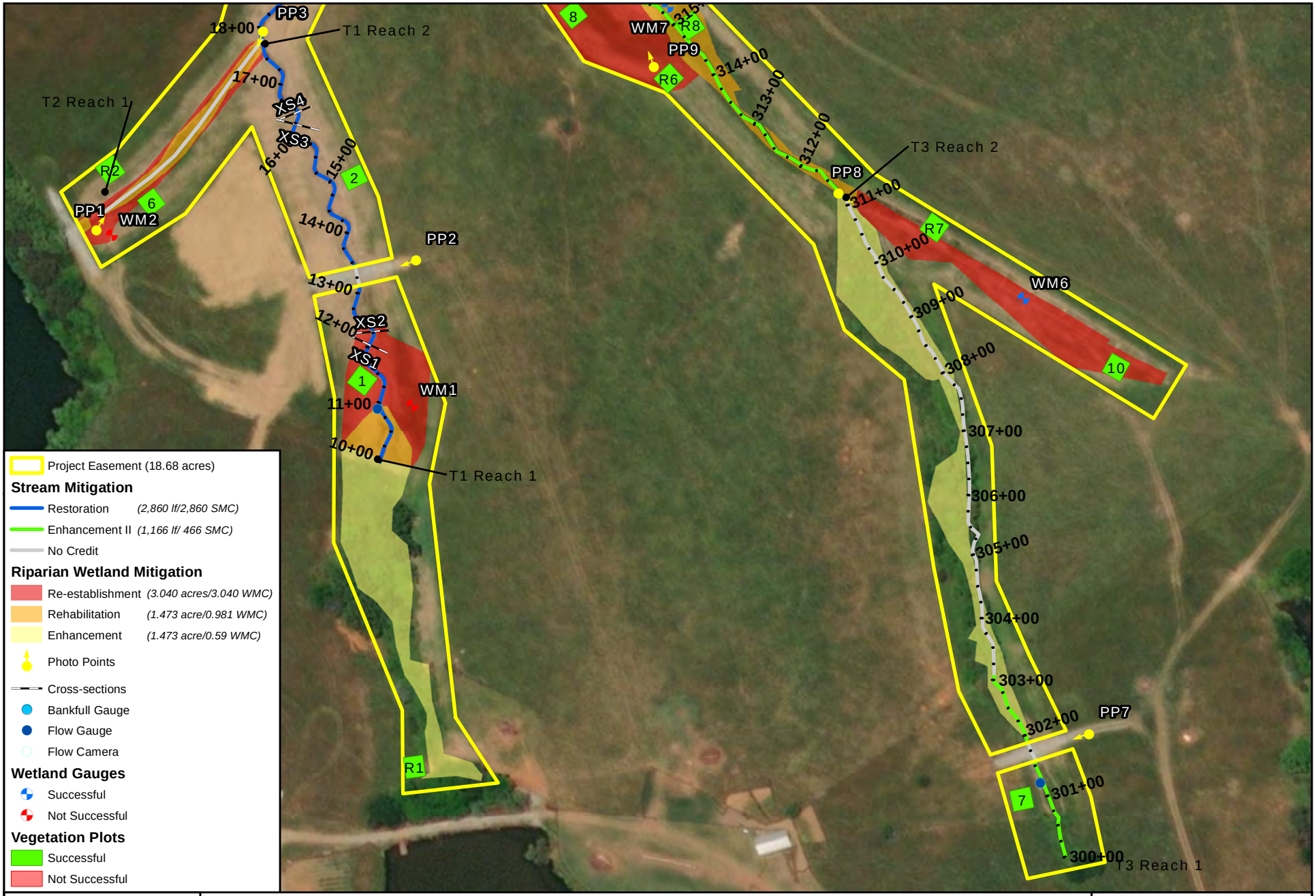
Project Segment	Original Mitigation Plan Ft/Ac	As-Built Ft/ Ac	Original Mitigation Category	Original Restoration Level	Original Mitigation Ratio (X:1)	Credits		Comments
Stream								
T1 Reach 1	780	745	Warm	R	1.00000	750.000		30' exception STA 13+12 to 13+42
T1 Reach 2	906	890	Warm	R	1.00000	906.000		
T1 Reach 3	269	208	Warm	R	1.00000	209.000		60' exception STA 27+77 to 28+37
T1 Reach 4	295	295	Warm	EII	2.50000	118.000		
T1 Reach 5	452	447	Warm	R	1.00000	452.000		
T3 Reach 1	310	280	Warm	EII	2.50000	112.000		30' exception STA 301+57 to 301+87
T3 Reach 2	591	590	Warm	EII	2.50000	236.400		
T3 Reach 3	573	545	Warm	R	1.00000	543.000		30' exception STA 317+98 to 318+28
					Total:	**3,326.400**		
Wetland								
Riparian Enhancement	1.495	1.473	R	E	2.50000	0.598		
Riparian Re-establishment	3.040	3.04	R	REE	1.00000	3.040		
Riparian Rehabilitation	1.488	1.471	R	RH	1.50000	0.992		
					Total:	**4.630**		

Project Credits

	Stream			Riparian	Non-Riparian	Coastal
Restoration Level	Warm	Cool	Cold	Wetland	Wetland	Marsh
Restoration	2,860.000					
Re-establishment				3.040		
Rehabilitation				0.992		
Enhancement				0.598		
Enhancement I						
Enhancement II	466.400					
Creation						
Preservation						
Total	**3,326.400**			**4.630**		



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



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

Image Source: Esri, Maxar, Earthstar Geographics, USDA FSA, USGS, Aerogrid, IGN, IGP, and the GIS User Community

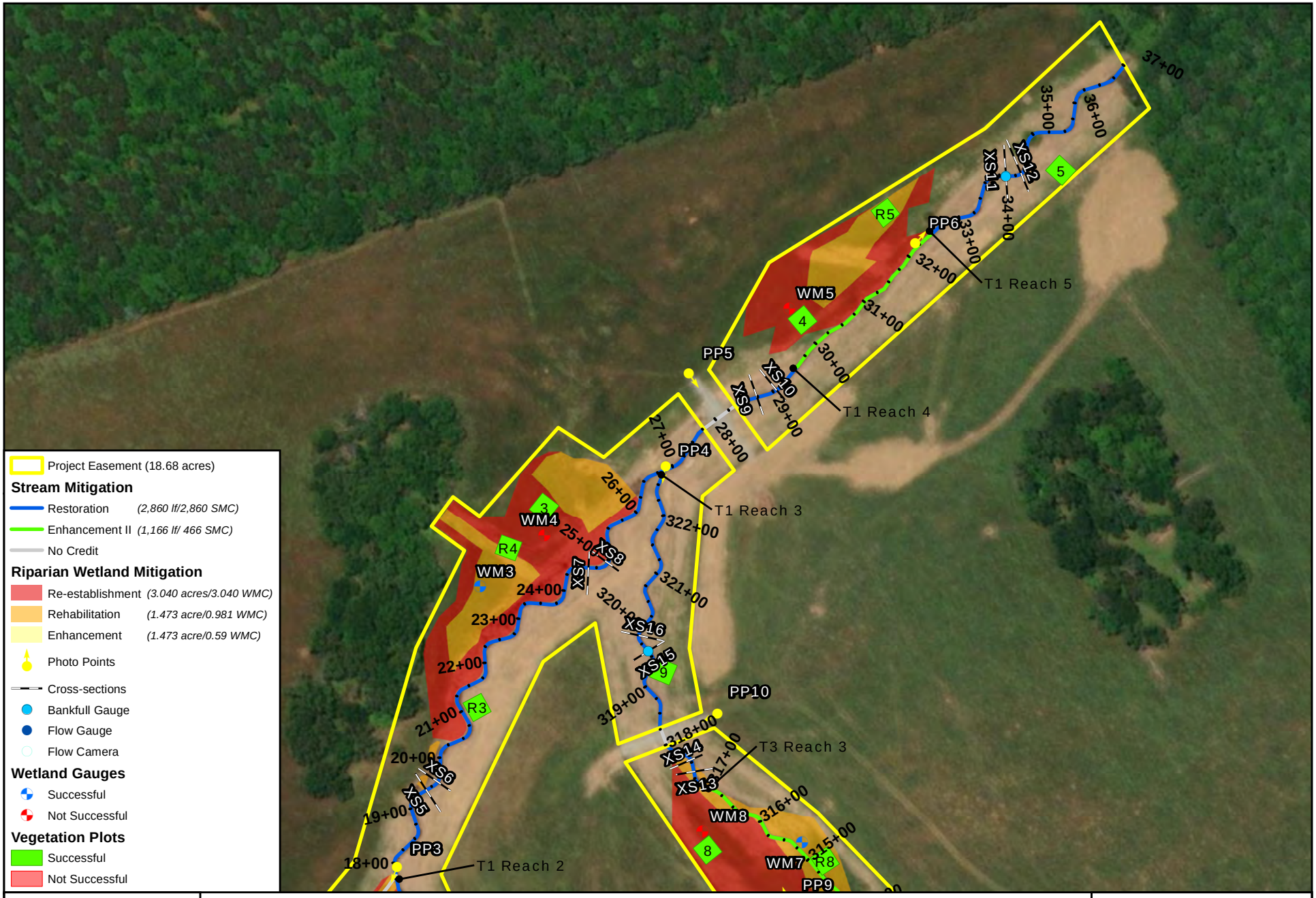

Project Easement (18.68 acres)
Stream Mitigation
Restoration (2,860 lf/2,860 SMC)
Enhancement II (1,166 lf/ 466 SMC)
No Credit
Riparian Wetland Mitigation
Re-establishment (3.040 acres/3.040 WMC)
Rehabilitation (1.473 acre/0.981 WMC)
Enhancement (1.473 acre/0.59 WMC)
Photo Points
Cross-sections
Bankfull Gauge
Flow Gauge
Flow Camera
Wetland Gauges
Successful
Not Successful
Vegetation Plots
Successful
Not Successful
PP3
PP4
PP5
PP6
PP9
PP10
T1 Reach 2
T1 Reach 3
T1 Reach 4
T1 Reach 5
T3 Reach 3
WM3
WM4
WM5
WM7
WM8
R3
R4
R5
R8
XS5
XS6
XS7
XS8
XS9
XS10
XS11
XS12
XS13
XS14
XS15
XS16
18+00
19+00
20+00
21+00
22+00
23+00
24+00
25+00
26+00
27+00
28+00
29+00
30+00
31+00
32+00
33+00
34+00
35+00
36+00
37+00
317+00
318+00
319+00
320+00
321+00
322+00
315+00
316+00
0
100
200
Feet
CURRENT CONDITIONS PLANVIEW PAGE
HIP BONE CREEK RESTORATION SITE
CHATHAM COUNTY, NC
N
Image Source: Esri, Maxar, Earthstar Geographics, USDA FSA, USGS, Aerogrid, IGN, IGP, and the GIS User Community

Table 2. Hip Bone Creek Restoration Site (ID-100059) Goals, Performance and Results

Goal	Objective/Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Restore a channelized stream to a meandering C-type channel with a floodplain	-Relocate channelized streams to historic landscape positions -Install a bankfull-sized channel cross-section - Install bedform diversity with pools, riffles, and habitat strucures	Dispersion of high flows on the floodplain, increase in biogeochemical cycling within the system, and recharging of riparian wetlands.	BHR<1.2, ER>2.2, and no change >10% in BHR or ER between monitoring events; 4 bankfull events; continuous flow for at least 30 days each year	16 cross-section surveys, 4 pressure transducer stream gauges (measuring bankfull events on T1-5 and T3-3 and stream flow on T1-1 and T3-1), annual visual inspection	All 16 XS have BHR<1.2 and ER>2.2; no BKF events in 2021; T1-1 flow for 105 consecutive days, T3-1 flow for 205 consecutive days
Buffer and reduce sediment impacts to the project stream	Demarcate the project easement boundaries and fence out livestock	Reduction in sediment, nutrient, and fecal coliform inputs to.	Fence intact around entire easement, adequate signage present around easement boundary	Annual visual inspection	Fenceing installation completed 10/4/21, fence and signs are in good condition
Restorea forested riparian community	Plant the site with native trees and shrubs and a herbaceous seed mix	Reduction in floodplain sediment inputs from runoff, increased bank stability, increased LWD and organic material in streams.	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7.	18 vegetation plots	All veg plots >320 stems/acre
Restore a wetland hydroperiod to drained and/or livestock-impacted land	Reconnect streams to floodplain; redevelop wetland microtopography to slow the flow of surface and subsurface drainage	Increase in wetland hydroperiod and biogeochemical cycling within the system, decrease in sediment and nutrient inputs to streams.	Continuous saturation within 12" of the soil surface for 12% of the growing season (26 days)	8 pressure transducer gauges	3/8 gauges >12% continuous saturation in 2021

Table 3. Hip Bone Creek Restoration Site (ID-100059) Project Attribute Table

Project Name	Hip Bone Creek Restoration Site		
County	Chatham County		
Project Area (acres)	18.68		
Project Coordinates (latitude and longitude decimal degrees)	35.6804 N, -79.4018 W		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Cape Fear		
USGS Hydrologic Unit 8-digit	3030003		
DWR Sub-basin	3/6/2012		
Project Drainage Area (acres)	158		
Project Drainage Area Percentage of Impervious Area	1%		
Land Use Classification	Pasture/Farmland (85%), Forest (9%), Open Water (5%), and Rural Development (1%)		
Reach Summary Information			
Parameters	**Reach 1**	**Reach 3**	
Pre-project length (feet)	2,439	1,403	
Post-project (feet)	2,702	1,474	
Valley confinement (Confined, moderately confined, unconfined)	Unconfined	Unconfined	
Drainage area (acres)	158	43	
Perennial, Intermittent, Ephemeral	Intermittent	Intermittent	
NCDWR Water Quality Classification	C	C	
Dominant Stream Classification (existing)	G4	G4	
Dominant Stream Classification (proposed)	C4/C4b	C4	
Dominant Evolutionary class (Simon) if applicable	Channelized, Stage III	Channelized, Stage III	
Wetland Summary Information			
Parameters	**WA and WE**	**WB, WC, WD, WF, and WG**	
Pre-project (acres)	2.52	0.99	
Post-project (acres)	2.78	2.67	
Wetland Type (non-riparian, riparian)	Riparian	Riparian	
Mapped Soil Series	Georgeville	Chewacla/Wehadkee	
Soil Hydric Status	Non-hydric	Hydric	
Regulatory Considerations			
Parameters	**Applicable?**	**Resolved?**	**Supporting Docs?**
Water of the United States - Section 404	Yes	Yes	SAW-2018-01160
Water of the United States - Section 401	Yes	Yes	DWR# 18-0785
Endangered Species Act	Yes	Yes	USFWS
Historic Preservation Act	No	N/A	NCSHPO
Coastal Zone Management Act (CZMA or CAMA)	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

MONITORING RESULTS

The first year of vegetation monitoring was conducted November 15 and November 17, 2021. During the site's first growing season all 18 vegetation monitoring plots achieved the success criteria of 320 stems/acre. Across all of the plots the site averaged 933 planted stems/acre. Including volunteers the site averaged 1,021 stems/acre. Overall the site is well vegetated with many planted and volunteer woody stems throughout the whole project and a robust and diverse herbaceous layer.

The MY01 cross-section survey was completed on December 13, 2021. The MY01 survey found that the stream was functioning as designed with no problem areas identified. All 16 cross-sections had bank height ratios less than 1.2 and entrenchment ratios greater than 2.2.

The daily rainfall data was obtained from a local weather station in Siler City, NC, provided by the NC State Climate Office. In 2021, the months of January, June, August, September, and October experienced average rainfall. March, April, May, November, and December experienced below average rainfall while February and July recorded above average rainfall. Overall the site experienced average rainfall during 2021. Although the overall rainfall total for the site was average for the year, the months of March, April, and May were extremely dry. The water table is typically at its peak for the growing season during these months since evapotranspiration rates are not yet as high as they are later in the growing season, and the water table is still recharged from the typically wetter winter months. Because of this period of drought, the water table was not able to recharge to its typical level by the time that the growing season and evapotranspiration rates were at their peak.

During the site's first growing season, 3 of the 8 gauges achieved the success criteria of 12% continuous saturation (26 days). This low rate of success is likely due to the extremely dry beginning of the growing season mentioned above, and KCI does not believe that it is reflective of the typical hydrology of the site. Both of the stream flow gauges recorded greater than 30 consecutive day of flow. This data was further backed up by the flow cameras which also both showed greater than 30 consecutive days of flow despite being obscured by vegetation for a large portion of the summer. No bankfull events were recorded in 2021.

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

APPENDIX A

Visual Assessment Data

Table 4. Hip Bone Creek Resotration Site (ID-100059) Visual Stream Stability Assessment

Reach T1
Assessed Stream Length 2702
Assessed Bank Length 5404

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.	16	16		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)	16	16		100%

Reach T3
Assessed Stream Length 1,474
Assessed Bank Length 2,948

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.	7	7		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)	7	7		100%

Table 5. Hip Bone Creek Restoration Site (ID-100059) Visual Vegetation Assessment

Planted acreage **17.4**

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 **18.7**

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	

Photo Reference Photos

PP1 – MY-00 – 5/24/21

PP1 – MY-01 – 9/29/21

PP2 – MY-00 – 5/24/21

PP2 – MY-01 – 9/29/21

PP3 – MY-00 – 5/24/21

PP3 – MY-01 – 9/29/21

PP4 – MY-00 – 5/24/21

PP4 – MY-01 – 9/29/21

PP5 – MY-00 – 5/24/21

PP5 – MY-01 – 9/29/21

PP6 – MY-00 – 5/24/21

PP6 – MY-01 – 9/29/21

PP7 – MY-00 – 5/24/21

PP7 – MY-01 – 9/29/21

PP8 – MY-00 – 5/24/21

PP8 – MY-01 – 9/29/21

PP9 – MY-00 – 5/24/21

PP9 – MY-01 – 9/29/21

PP10 – MY-00 – 5/24/21

PP10 – MY-01 – 9/29/21

Vegetation Monitoring Plot Photos

Vegetation Plot 1 – MY-00 – 5/14/21

Vegetation Plot 1 – MY-01 – 11/17/21

Vegetation Plot 2 – MY-00 – 5/13/21

Vegetation Plot 2 – MY-01 – 11/17/21

Vegetation Plot 3 – MY-00 – 5/13/21

Vegetation Plot 3 – MY-01 - 11/17/21

Vegetation Plot 4 – MY-00 – 5/13/21

Vegetation Plot 4 – MY-01 – 11/17/21

Vegetation Plot 5 – MY-00 – 5/13/21

Vegetation Plot 5 – MY-01 – 11/17/21

Vegetation Plot 6 – MY-00 – 5/14/21

Vegetation Plot 6 – MY-01 – 11/17/21

Vegetation Plot 7 – MY-00 – 5/13/21

Vegetation Plot 7 – MY-01 – 11/17/21

Vegetation Plot 8 – MY-00 – 5/13/21

Vegetation Plot 8 – MY-01 – 11/17/21

Vegetation Plot 9 – MY-00 – 5/13/21

Vegetation Plot 9 – MY-01 - 11/17/21

Vegetation Plot 10 – MY-00 – 5/13/21

Vegetation Plot 10 – MY-01 – 11/15/21

Vegetation Plot R1 – MY-01 – 11/15/21

Vegetation Plot R2 – MY-01 – 11/15/21

Vegetation Plot R3 – MY-01 – 11/15/21

Vegetation Plot R4 – MY-01 – 11/15/21

Vegetation Plot R5 – MY-01 – 11/15/21

Vegetation Plot R6 – MY-01 – 11/15/21

Vegetation Plot R7 – MY-01 – 11/15/21

Vegetation Plot R8 – MY-01 – 11/15/21

APPENDIX B

Vegetation Plot Data

Table 6. Vegetation Performance Standards Summary Table

Hip Bone Creek Restoration Site (ID-100059)

	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	1093	2	7	0	972	2	5	0	729	2	6	0
Monitoring Year 0	1093	1	7	0	1174	2	6	0	688	2	6	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	850	2	5	0	972	2	5	0	972	2	5	0
Monitoring Year 0	769	1	4	0	1052	1	5	0	931	2	5	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	1133	1	3	0	1174	2	5	0	1174	2	5	0
Monitoring Year 0	1214	2	3	0	1174	1	5	0	1255	1	6	0
	Veg Plot 10 F				**Veg Plot Group 1 R**				**Veg Plot Group 2 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	1255	2	8	0	324	2	4	0	1052	2	5	0
Monitoring Year 0	1498	2	8	0	1052	1	5	0	1052	2	5	0
	Veg Plot Group 3 R				**Veg Plot Group 4 R**				**Veg Plot Group 5 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	1052	2	4	0	688	3	4	0	1093	2	5	0
Monitoring Year 0	1052	2	6	0	364	2	4	0	850	1	6	0
	Veg Plot Group 6 R				**Veg Plot Group 7 R**				**Veg Plot Group 8 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	1174	2	6	0	1336	2	7	0	688	2	6	0
Monitoring Year 0	1093	1	5	0	810	1	6	0	972	1	4	0

Planted Acreage	17.4
Date of Initial Plant	2021-04-30
Date(s) of Supplemental Plant(s)	
Date(s) Mowing	
Date of Current Survey	2021-11-17
Plot size (ACRES)	0.0247

Table 6. Vegetation Plot Data
Hip Bone Creek Restoration Site (ID-100059)

	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	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW	11	11	6	6	3	3	5	5	14	14
	Cornus amomum	silky dogwood	Shrub	FACW										
	Diospyros virginiana	common persimmon	Tree	FAC	1	1			2	2				
	other													
	Platanus occidentalis	American sycamore	Tree	FACW	7	7	12	12	4	4	7	7	6	6
	Quercus falcata	southern red oak	Tree	FACU			2	2	2	2			1	1
	Quercus michauxii	swamp chestnut oak	Tree	FACW	2	2					1	1		
	Quercus palustris	pin oak	Tree	FACW	3	3	1	1	5	5	3	3	1	1
	Quercus phellos	willow oak	Tree	FAC	1	1	3	3	2	2	5	5	2	2
	Quercus sp.													
	Salix nigra	black willow	Tree	OBL	1	2								
Sum	Performance Standard				26	27	24	24	18	18	21	21	24	24
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*						*2*				
	Baccharis halimifolia	*eastern baccharis*	*Tree*	*FACW*										
	Callicarpa americana	*American beautyberry*	*Shrub*	*FACU*										
	Juglans nigra	*black walnut*	*Tree*	*FACU*										
	Liquidambar styraciflua	*sweetgum*	*Tree*	*FAC*						*13*		*2*		
	Pinus taeda	*loblolly pine*	*Tree*	*FAC*						*1*				
	Prunus serotina	*black cherry*	*Tree*	*FACU*										
	Ulmus alata	*winged elm*	*Tree*	*FACU*						*6*		*1*		
	Ulmus americana	*American elm*	*Tree*	*FACW*										
Sum	Proposed Standard				26	27	24	24	18	18	21	21	24	24
Mitigation Plan Performance Standard	*Current Year Stem Count*					*27*		*24*		*18*		*21*		*24*
	Stems/Acre					1093		972		729		850		972
	Species Count					7		5		6		5		5
	Dominant Species Composition (%)					41		50		32		29		58
	Average Plot Height (ft.)					2		2		2		2		2
	% Invasives					0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					27		24		18		21		24
	Stems/Acre					1093		972		729		850		972
	Species Count					7		5		6		5		5
	Dominant Species Composition (%)					41		50		32		29		58
	Average Plot Height (ft.)					2		2		2		2		2
	% Invasives					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.

Table 6. Vegetation Plot Data
Hip Bone Creek Restoration Site (ID-100059)

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 6 F		Veg Plot 7 F		Veg Plot 8 F		Veg Plot 9 F		Veg Plot 10 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW	6	6	1	1	22	22	17	17		
	Cornus amomum	silky dogwood	Shrub	FACW										
	Diospyros virginiana	common persimmon	Tree	FAC	1	1					1	1	1	1
	other												1	1
	Platanus occidentalis	American sycamore	Tree	FACW	14	15	11	11	2	2	4	4	10	10
	Quercus falcata	southern red oak	Tree	FACU									4	4
	Quercus michauxii	swamp chestnut oak	Tree	FACW					1	1			1	1
	Quercus palustris	pin oak	Tree	FACW	1	1			3	3	1	1	1	1
	Quercus phellos	willow oak	Tree	FAC	1	1	16	16	1	1	6	6	12	12
	Quercus sp.												1	1
	Salix nigra	black willow	Tree	OBL										
Sum	Performance Standard				23	24	28	28	29	29	29	29	31	31
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*										
	Baccharis halimifolia	*eastern baccharis*	*Tree*	*FACW*										
	Callicarpa americana	*American beautyberry*	*Shrub*	*FACU*										
	Juglans nigra	*black walnut*	*Tree*	*FACU*										
	Liquidambar styraciflua	*sweetgum*	*Tree*	*FAC*										
	Pinus taeda	*loblolly pine*	*Tree*	*FAC*										
	Prunus serotina	*black cherry*	*Tree*	*FACU*										
	Ulmus alata	*winged elm*	*Tree*	*FACU*										
	Ulmus americana	*American elm*	*Tree*	*FACW*										
Sum	Proposed Standard				23	24	28	28	29	29	29	29	31	31
Mitigation Plan Performance Standard	*Current Year Stem Count*					*24*		*28*		*29*		*29*		*31*
	Stems/Acre					972		1133		1174		1174		1255
	Species Count					5		3		5		5		8
	Dominant Species Composition (%)					62		57		76		59		39
	Average Plot Height (ft.)					2		1		2		2		2
	% Invasives					0		0		0		0		0
Post Mitigation Plan Performance Standard	Current Year Stem Count					24		28		29		29		31
	Stems/Acre					972		1133		1174		1174		1255
	Species Count					5		3		5		5		8
	Dominant Species Composition (%)					62		57		76		59		39
	Average Plot Height (ft.)					2		1		2		2		2
	% Invasives					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.

Table 6. Vegetation Plot Data
Hip Bone Creek Restoration Site (ID-100059)

	Scientific Name	Common Name	Tree/Shrub	Indicator Status	Veg Plot 1 R Total	Veg Plot 2 R Total	Veg Plot 3 R Total	Veg Plot 4 R Total	Veg Plot 5 R Total	Veg Plot 6 R Total	Veg Plot 7 R Total	Veg Plot 8 R Total
Species Included in Approved Mitigation Plan	Betula nigra	river birch	Tree	FACW	1	4	12	2	18	8	2	4
	Cornus amomum	silky dogwood	Shrub	FACW							3	
	Diospyros virginiana	common persimmon	Tree	FAC						2	1	
	other											
	Platanus occidentalis	American sycamore	Tree	FACW	3	12	7	8	5	6	10	8
	Quercus falcata	southern red oak	Tree	FACU		1				5	1	2
	Quercus michauxii	swamp chestnut oak	Tree	FACW					1			
	Quercus palustris	pin oak	Tree	FACW	2	1	2	3	1	2	4	1
	Quercus phellos	willow oak	Tree	FAC	2	8	5		2	6		1
	Quercus sp.											
	Salix nigra	black willow	Tree	OBL				4			12	1
Sum	Performance Standard				8	26	26	17	27	29	33	17
Post Mitigation Plan Species	*Acer rubrum*	*red maple*	*Tree*	*FAC*								
	Baccharis halimifolia	*eastern baccharis*	*Tree*	*FACW*								*1*
	Callicarpa americana	*American beautyberry*	*Shrub*	*FACU*	*1*							
	Juglans nigra	*black walnut*	*Tree*	*FACU*	*1*							*1*
	Liquidambar styraciflua	*sweetgum*	*Tree*	*FAC*								
	Pinus taeda	*loblolly pine*	*Tree*	*FAC*								
	Prunus serotina	*black cherry*	*Tree*	*FACU*	*1*							
	Ulmus alata	*winged elm*	*Tree*	*FACU*			*11*					*1*
	Ulmus americana	*American elm*	*Tree*	*FACW*	*1*							
Sum	Proposed Standard				8	26	26	17	27	29	33	17
Mitigation Plan Performance Standard	*Current Year Stem Count*				*8*	*26*	*26*	*17*	*27*	*29*	*33*	*17*
	Stems/Acre				324	1052	1052	688	1093	1174	1336	688
	Species Count				4	5	4	4	5	6	7	6
	Dominant Species Composition (%)				25	46	32	47	67	28	36	40
	Average Plot Height (ft.)				2	2	2	3	2	2	2	2
	% Invasives				0	0	0	0	0	0	0	0
Post Mitigation Plan Performance Standard	Current Year Stem Count				8	26	26	17	27	29	33	17
	Stems/Acre				324	1052	1052	688	1093	1174	1336	688
	Species Count				4	5	4	4	5	6	7	6
	Dominant Species Composition (%)				25	46	32	47	67	28	36	40
	Average Plot Height (ft.)				2	2	2	3	2	2	2	2
	% Invasives				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.

APPENDIX C

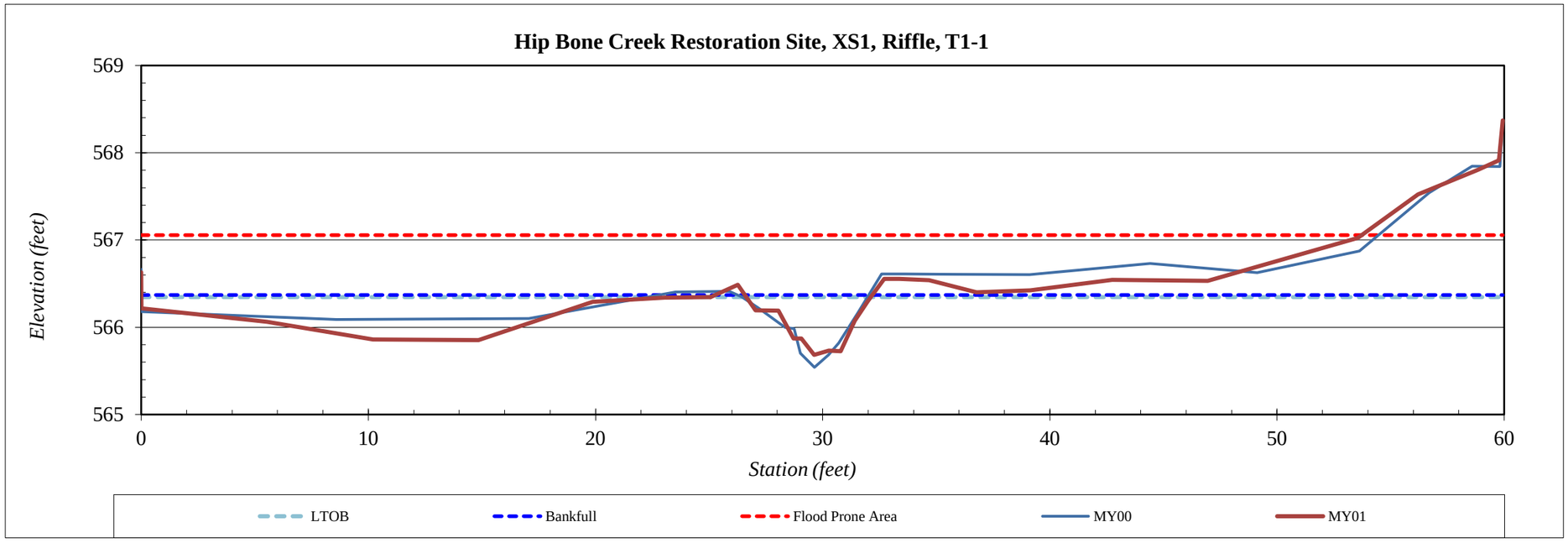
Stream Geomorphology Data

Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS1
Drainage Area (sq mi):	0.06
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	566.63
0.0	566.22
5.5	566.06
10.2	565.86
14.9	565.85
19.9	566.29
23.1	566.34
25.1	566.35
26.3	566.49
27.0	566.20
28.0	566.19
28.7	565.87
29.1	565.87
29.6	565.68
30.3	565.73
30.8	565.73
31.4	566.08
32.0	566.30
32.7	566.55
33.4	566.55
34.7	566.54
36.8	566.40
39.1	566.43
42.7	566.54
47.0	566.53
53.6	567.03
56.2	567.52
58.8	567.81
59.8	567.91
59.9	568.37

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	566.37
Bankfull Cross-Sectional Area (sq ft):	2.1
LTOB Cross-Sectional Area (sq ft):	2.0
Bankfull Width (ft):	5.6
Flood Prone Area Elevation (ft):	567.06
Flood Prone Width (ft):	54
Max Depth at Bankfull (ft):	0.7
Mean Depth at Bankfull (ft):	0.4
W / D Ratio (ft/ft):	14.9
Entrenchment Ratio (ft/ft):	9.6
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	565.68

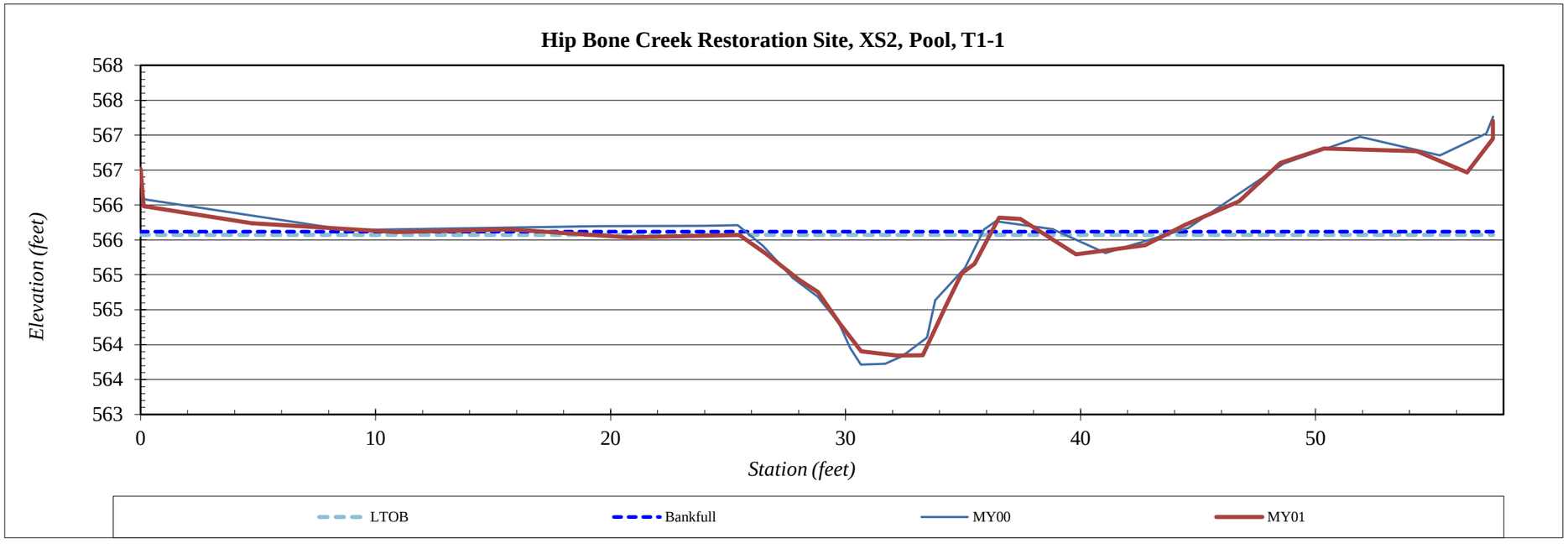


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS2
Drainage Area (sq mi):	0.06
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	566.52
0.1	565.98
4.7	565.74
10.9	565.61
15.7	565.65
20.7	565.54
23.4	565.56
25.5	565.57
26.6	565.30
28.0	564.93
28.8	564.76
29.7	564.31
30.7	563.91
32.2	563.84
33.3	563.85
33.8	564.25
34.3	564.57
34.9	565.02
35.5	565.16
36.5	565.82
37.4	565.80
39.8	565.29
42.8	565.43
44.5	565.72
46.8	566.05
48.5	566.60
50.4	566.81
54.3	566.77
56.4	566.46
57.5	566.95
57.5	567.20

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	565.62
Bankfull Cross-Sectional Area (sq ft):	10.9
LTOB Cross-Sectional Area (sq ft):	10.5
Bankfull Width (ft):	10.7
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.8
Mean Depth at Bankfull (ft):	1.0
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	563.84

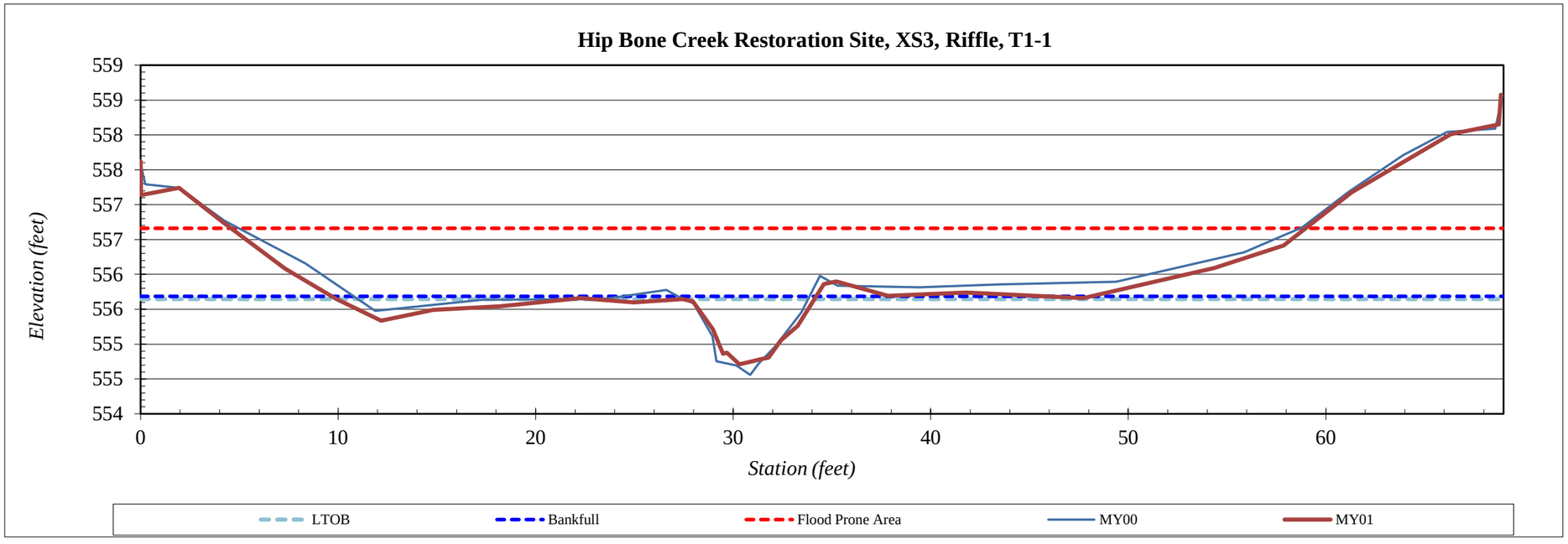


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS3
Drainage Area (sq mi):	0.08
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	557.63
0.0	557.14
1.9	557.24
4.2	556.73
7.3	556.08
9.9	555.65
12.2	555.34
14.8	555.49
18.2	555.54
22.3	555.66
25.0	555.60
27.4	555.65
28.0	555.61
29.0	555.21
29.5	554.86
29.7	554.88
30.3	554.71
30.9	554.75
31.4	554.78
31.8	554.80
32.4	555.06
33.3	555.26
34.6	555.86
35.2	555.90
37.8	555.69
41.8	555.74
47.7	555.66
54.4	556.09
57.9	556.41
61.3	557.18
66.3	558.01
68.8	558.15
68.9	558.58

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	555.69
Bankfull Cross-Sectional Area (sq ft):	3.9
LTOB Cross-Sectional Area (sq ft):	3.6
Bankfull Width (ft):	6.8
Flood Prone Area Elevation (ft):	556.66
Flood Prone Width (ft):	54
Max Depth at Bankfull (ft):	1.0
Mean Depth at Bankfull (ft):	0.6
W / D Ratio (ft/ft):	11.9
Entrenchment Ratio (ft/ft):	8.0
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	554.71

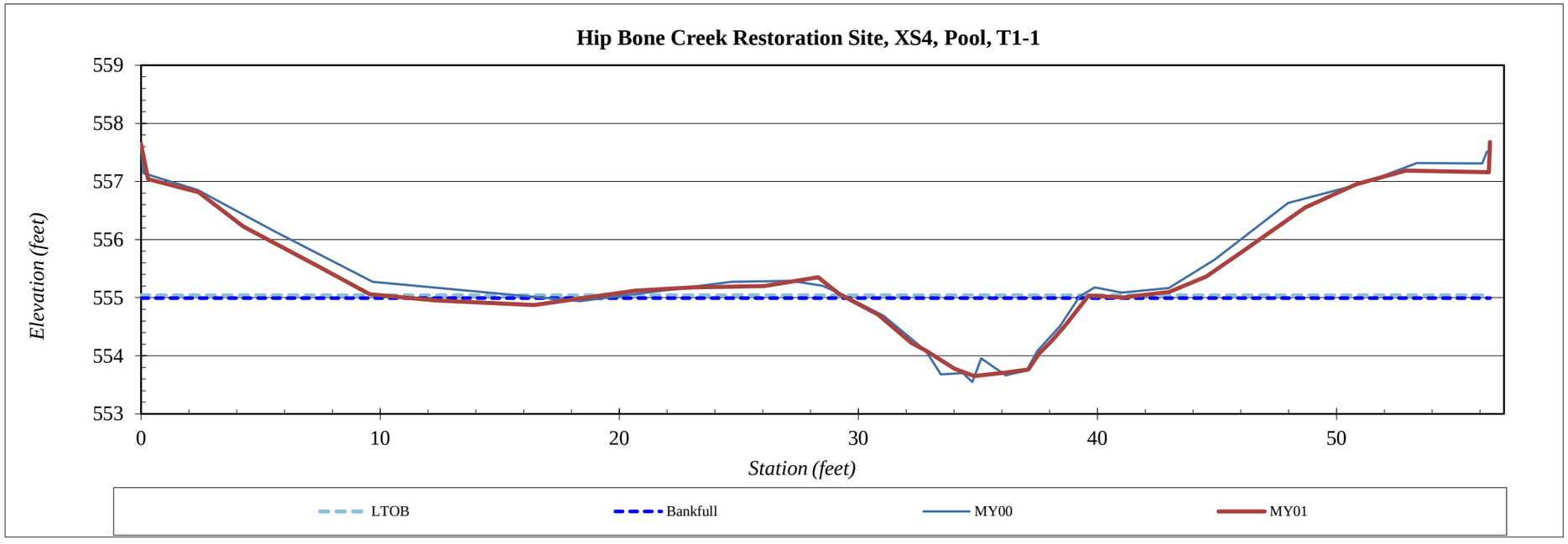


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS4
Drainage Area (sq mi):	0.08
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	557.64
0.3	557.04
2.4	556.82
4.3	556.23
7.5	555.53
9.6	555.06
12.3	554.95
16.4	554.87
20.7	555.12
23.1	555.18
26.0	555.20
28.3	555.35
29.2	555.07
30.8	554.71
32.2	554.22
32.9	554.08
34.0	553.78
34.9	553.65
36.2	553.71
37.1	553.76
37.6	554.04
38.1	554.25
38.6	554.52
39.6	555.04
41.1	555.00
43.0	555.10
44.5	555.36
46.0	555.78
48.7	556.55
50.8	556.96
52.9	557.19
56.4	557.16
56.4	557.68

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	554.99
Bankfull Cross-Sectional Area (sq ft):	8.1
LTOB Cross-Sectional Area (sq ft):	8.7
Bankfull Width (ft):	10.0
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.3
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):	553.65

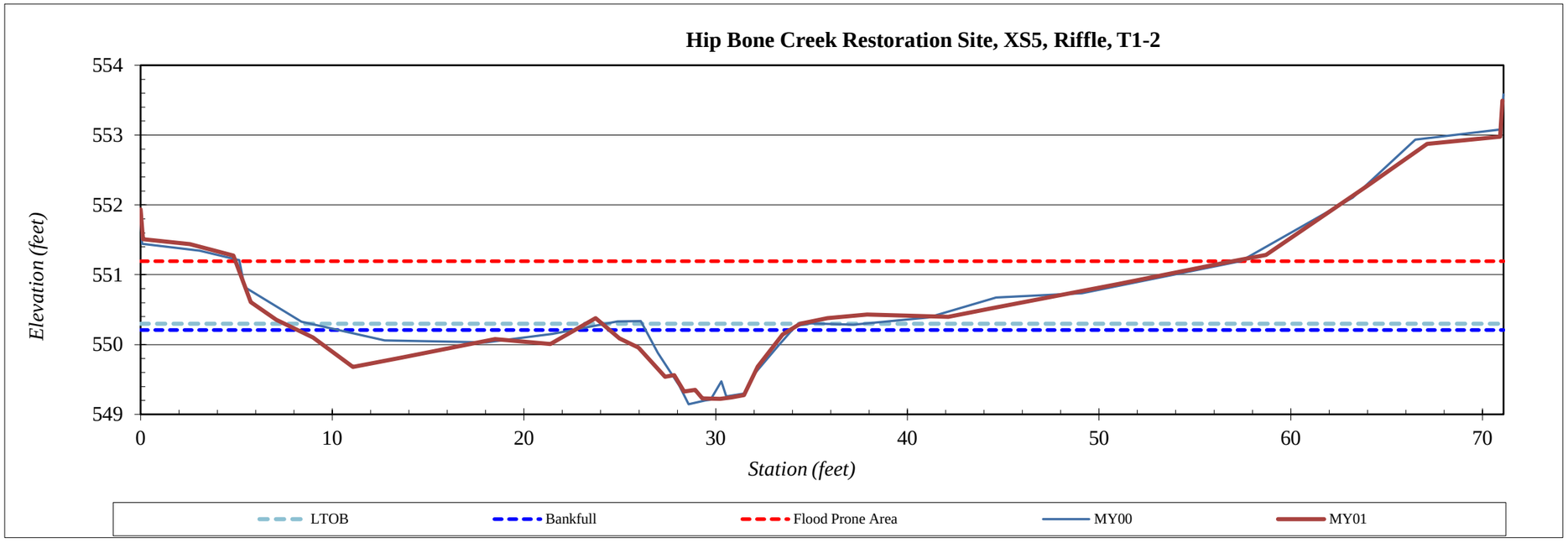


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS5
Drainage Area (sq mi):	0.13
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	551.94
0.1	551.51
2.6	551.44
4.8	551.28
5.7	550.61
7.1	550.36
9.0	550.10
11.1	549.68
13.7	549.82
18.5	550.08
21.4	550.01
23.7	550.38
25.0	550.09
26.0	549.95
27.4	549.54
27.8	549.56
28.3	549.33
28.9	549.35
29.3	549.23
30.2	549.22
30.8	549.24
31.5	549.28
32.2	549.69
33.5	550.14
34.4	550.30
35.8	550.38
37.9	550.43
42.1	550.40
44.4	550.52
51.0	550.86
56.4	551.17
58.7	551.29
64.0	552.28
67.1	552.87
70.9	552.98
71.0	553.49

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	550.21
Bankfull Cross-Sectional Area (sq ft):	5.4
LTOB Cross-Sectional Area (sq ft):	6.2
Bankfull Width (ft):	8.9
Flood Prone Area Elevation (ft):	551.19
Flood Prone Width (ft):	52
Max Depth at Bankfull (ft):	1.0
Mean Depth at Bankfull (ft):	0.6
W / D Ratio (ft/ft):	14.7
Entrenchment Ratio (ft/ft):	5.8
Bank Height Ratio (ft/ft):	1.1
Thalweg Elevation (ft):	549.22

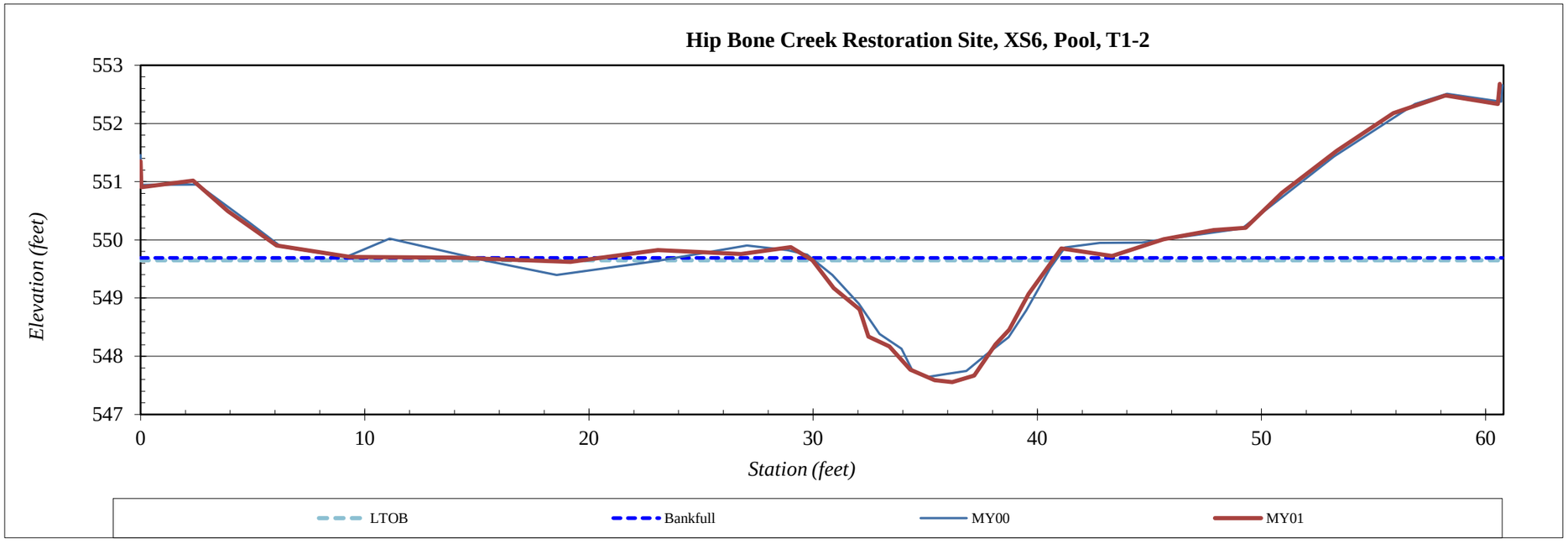


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS6
Drainage Area (sq mi):	0.13
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	551.35
0.0	550.91
2.3	551.02
3.9	550.49
6.1	549.90
9.4	549.71
14.0	549.70
19.2	549.62
23.1	549.82
26.8	549.76
29.0	549.88
30.0	549.65
30.9	549.17
32.1	548.80
32.5	548.34
33.4	548.17
34.3	547.77
35.4	547.59
36.2	547.56
37.2	547.67
38.1	548.21
38.7	548.46
39.6	549.07
41.1	549.85
43.3	549.72
45.6	550.01
47.9	550.17
49.3	550.21
50.9	550.81
53.4	551.53
55.9	552.18
58.2	552.48
60.5	552.34
60.6	552.68

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	549.69
Bankfull Cross-Sectional Area (sq ft):	14.0
LTOB Cross-Sectional Area (sq ft):	13.6
Bankfull Width (ft):	10.8
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.1
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):	547.56

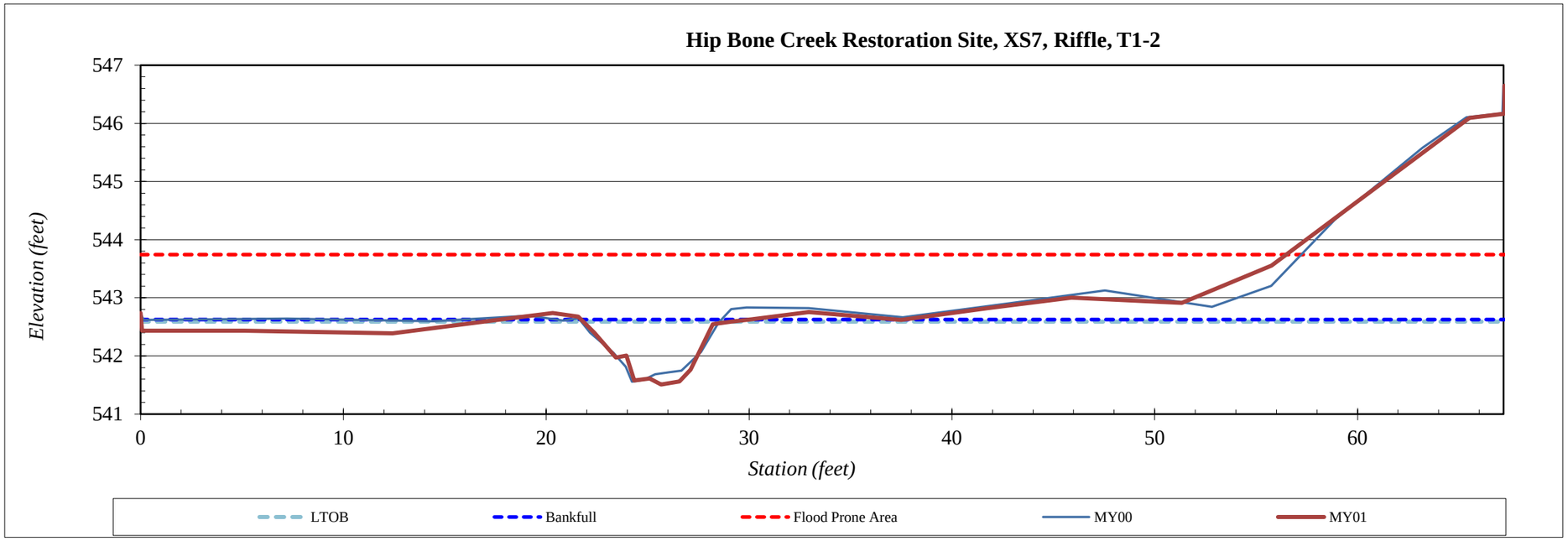


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS7
Drainage Area (sq mi):	0.14
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	542.74
0.1	542.44
5.1	542.44
12.4	542.39
17.5	542.61
20.3	542.74
21.6	542.68
22.4	542.40
23.4	541.97
24.0	542.00
24.3	541.58
25.1	541.61
25.7	541.51
26.6	541.56
27.1	541.77
28.2	542.54
29.2	542.59
30.2	542.63
33.0	542.76
37.5	542.62
41.8	542.82
45.9	543.00
51.3	542.91
55.8	543.55
59.9	544.64
65.5	546.09
67.2	546.17
67.2	546.65

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	542.63
Bankfull Cross-Sectional Area (sq ft):	4.6
LTOB Cross-Sectional Area (sq ft):	4.4
Bankfull Width (ft):	6.5
Flood Prone Area Elevation (ft):	543.74
Flood Prone Width (ft):	56
Max Depth at Bankfull (ft):	1.1
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	9.1
Entrenchment Ratio (ft/ft):	8.7
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	541.51

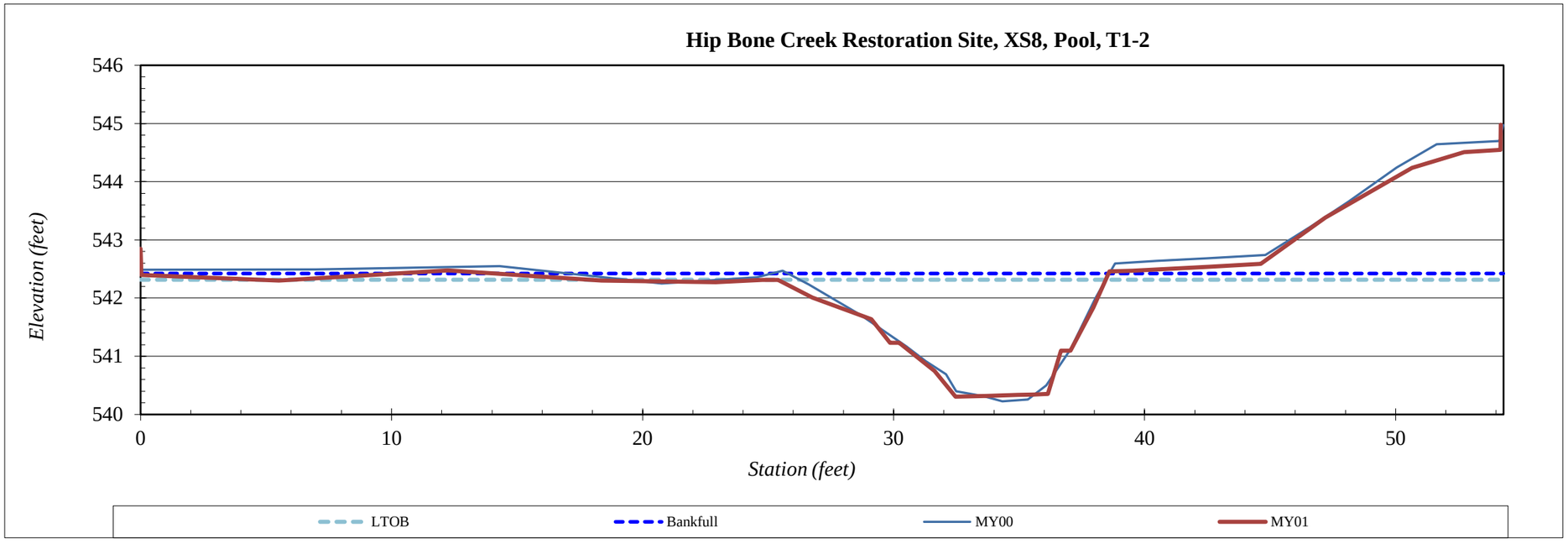


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS8
Drainage Area (sq mi):	0.14
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	542.85
0.0	542.40
5.5	542.30
12.2	542.47
18.4	542.30
22.9	542.27
24.8	542.31
25.4	542.32
26.8	542.01
29.1	541.64
29.9	541.23
30.2	541.23
31.6	540.75
32.5	540.31
33.8	540.32
34.9	540.34
35.6	540.34
36.2	540.35
36.7	541.10
37.0	541.10
38.0	541.84
38.6	542.46
39.5	542.47
42.5	542.54
44.6	542.59
47.2	543.38
50.7	544.24
52.7	544.51
54.2	544.55
54.2	544.98

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	542.42
Bankfull Cross-Sectional Area (sq ft):	16.7
LTOB Cross-Sectional Area (sq ft):	15.3
Bankfull Width (ft):	13.2
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.1
Mean Depth at Bankfull (ft):	1.3
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	0.9
Thalweg Elevation (ft):	540.31

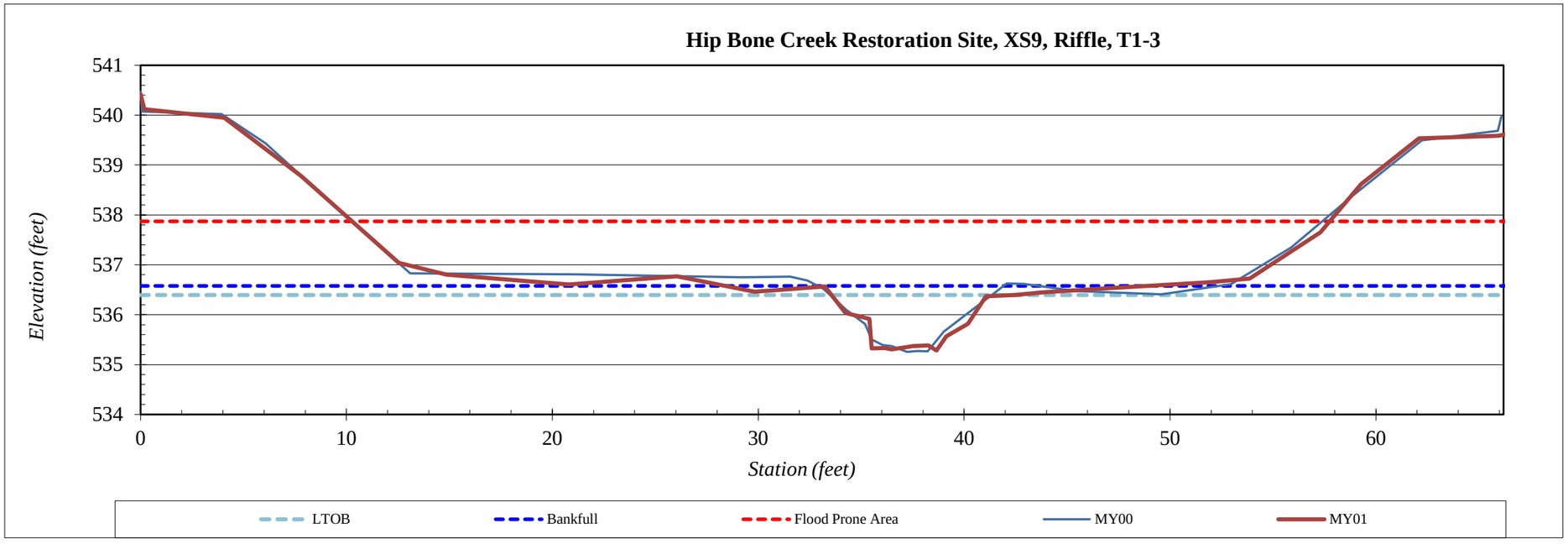


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS9
Drainage Area (sq mi):	0.19
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	540.42
0.2	540.12
4.1	539.95
7.8	538.78
12.5	537.04
14.9	536.80
20.8	536.61
26.1	536.77
29.8	536.46
31.6	536.51
32.2	536.53
33.2	536.57
34.2	536.03
35.4	535.92
35.5	535.33
36.1	535.33
36.5	535.31
37.1	535.34
37.5	535.37
38.3	535.38
38.7	535.28
39.1	535.57
40.2	535.82
41.1	536.37
42.5	536.39
43.8	536.45
46.8	536.53
52.0	536.65
53.9	536.72
57.3	537.65
59.3	538.62
62.1	539.53
66.0	539.59
66.3	539.62

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	536.58
Bankfull Cross-Sectional Area (sq ft):	7.2
LTOB Cross-Sectional Area (sq ft):	5.5
Bankfull Width (ft):	10.3
Flood Prone Area Elevation (ft):	537.87
Flood Prone Width (ft):	47
Max Depth at Bankfull (ft):	1.3
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	14.7
Entrenchment Ratio (ft/ft):	4.6
Bank Height Ratio (ft/ft):	0.9
Thalweg Elevation (ft):	535.28

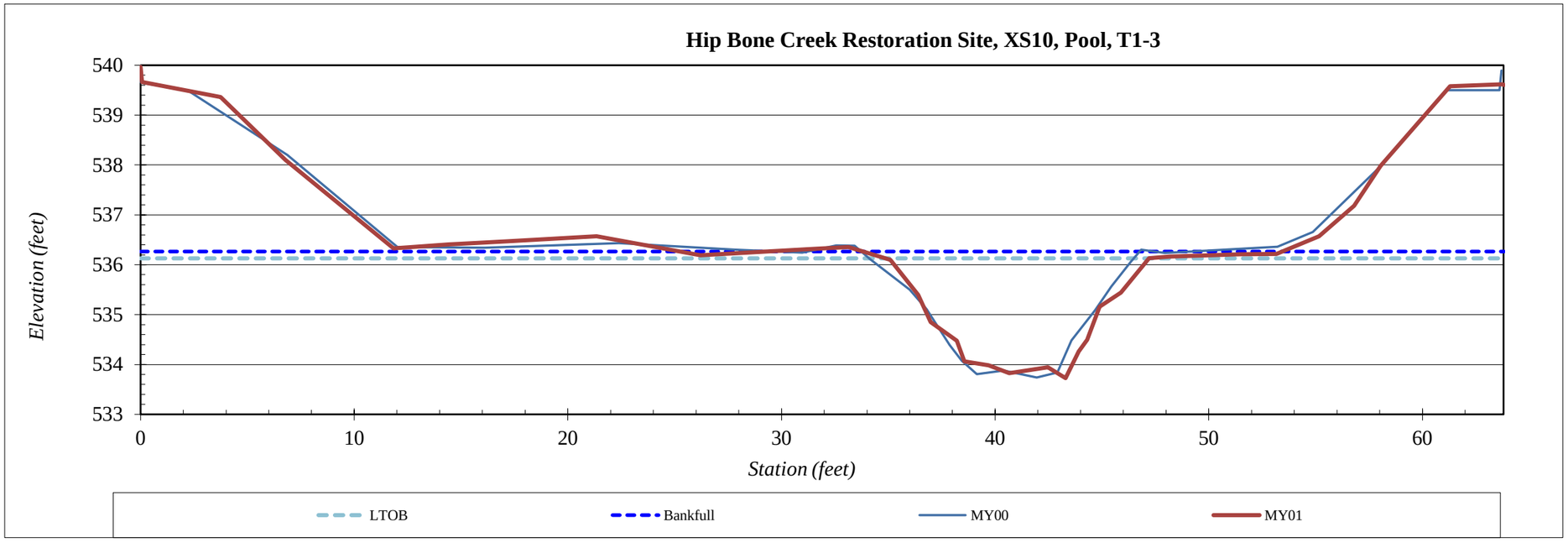


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS10
Drainage Area (sq mi):	0.19
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	539.97
0.1	539.67
3.7	539.36
6.8	538.10
11.8	536.33
14.4	536.41
17.3	536.47
21.3	536.57
26.2	536.19
31.4	536.32
33.1	536.36
35.1	536.10
36.4	535.40
37.0	534.85
38.2	534.48
38.6	534.06
39.7	533.98
40.7	533.83
42.5	533.94
43.3	533.73
43.9	534.26
44.3	534.49
44.9	535.16
45.9	535.44
47.2	536.13
48.2	536.16
51.5	536.21
53.2	536.22
55.2	536.57
56.8	537.19
58.0	537.98
61.3	539.58
63.7	539.62
63.8	539.61

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	536.27
Bankfull Cross-Sectional Area (sq ft):	20.0
LTOB Cross-Sectional Area (sq ft):	18.1
Bankfull Width (ft):	14.4
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.5
Mean Depth at Bankfull (ft):	1.4
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	0.9
Thalweg Elevation (ft):	533.73

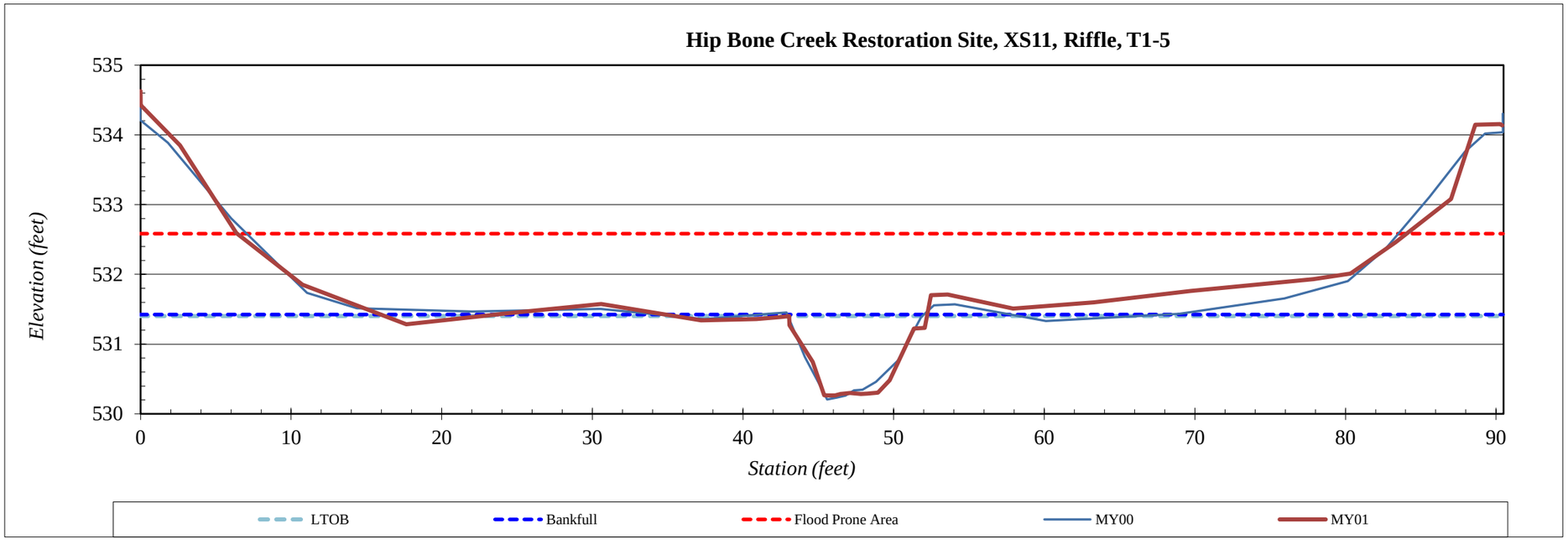


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS11
Drainage Area (sq mi):	0.25
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	534.85
0.0	534.65
2.6	534.07
6.4	532.81
10.7	532.07
17.6	531.51
24.5	531.66
30.6	531.79
37.2	531.56
40.9	531.58
42.5	531.61
43.1	531.62
43.1	531.49
44.6	530.96
45.4	530.49
45.6	530.48
46.1	530.48
46.5	530.50
47.1	530.52
47.8	530.50
48.2	530.51
49.0	530.52
49.7	530.70
51.3	531.44
52.1	531.45
52.5	531.92
53.6	531.93
57.9	531.73
63.3	531.82
69.7	531.98
77.9	532.15
80.3	532.23
83.3	532.68
87.0	533.30
88.6	534.37
90.4	534.38

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	531.42
Bankfull Cross-Sectional Area (sq ft):	7.3
LTOB Cross-Sectional Area (sq ft):	7.1
Bankfull Width (ft):	9.2
Flood Prone Area Elevation (ft):	532.58
Flood Prone Width (ft):	78
Max Depth at Bankfull (ft):	1.2
Mean Depth at Bankfull (ft):	0.8
W / D Ratio (ft/ft):	11.5
Entrenchment Ratio (ft/ft):	8.5
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	530.26

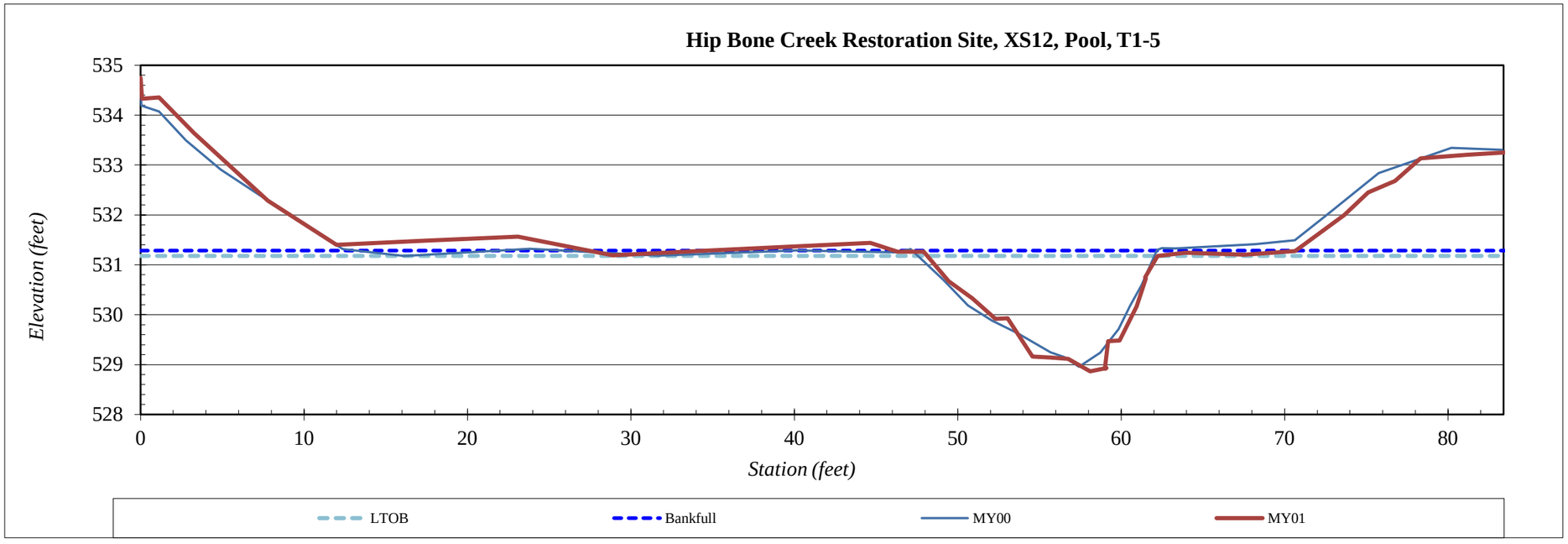


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS12
Drainage Area (sq mi):	0.25
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	534.97
0.1	534.55
1.1	534.57
3.3	533.86
7.8	532.51
12.0	531.62
17.5	531.71
23.1	531.79
28.9	531.41
34.5	531.51
40.4	531.60
44.7	531.66
46.3	531.48
47.9	531.48
49.5	530.89
50.9	530.55
52.3	530.13
53.1	530.15
54.6	529.38
55.7	529.36
56.8	529.33
58.1	529.09
59.1	529.15
59.0	529.14
59.0	529.14
59.2	529.69
59.9	529.71
60.9	530.38
61.5	530.94
61.5	530.97
62.2	531.40
63.9	531.46
67.6	531.42
70.6	531.50
87.1	532.22
87.1	532.67

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	531.29
Bankfull Cross-Sectional Area (sq ft):	20.8
LTOB Cross-Sectional Area (sq ft):	19.3
Bankfull Width (ft):	14.3
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	2.4
Mean Depth at Bankfull (ft):	1.5
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	528.87

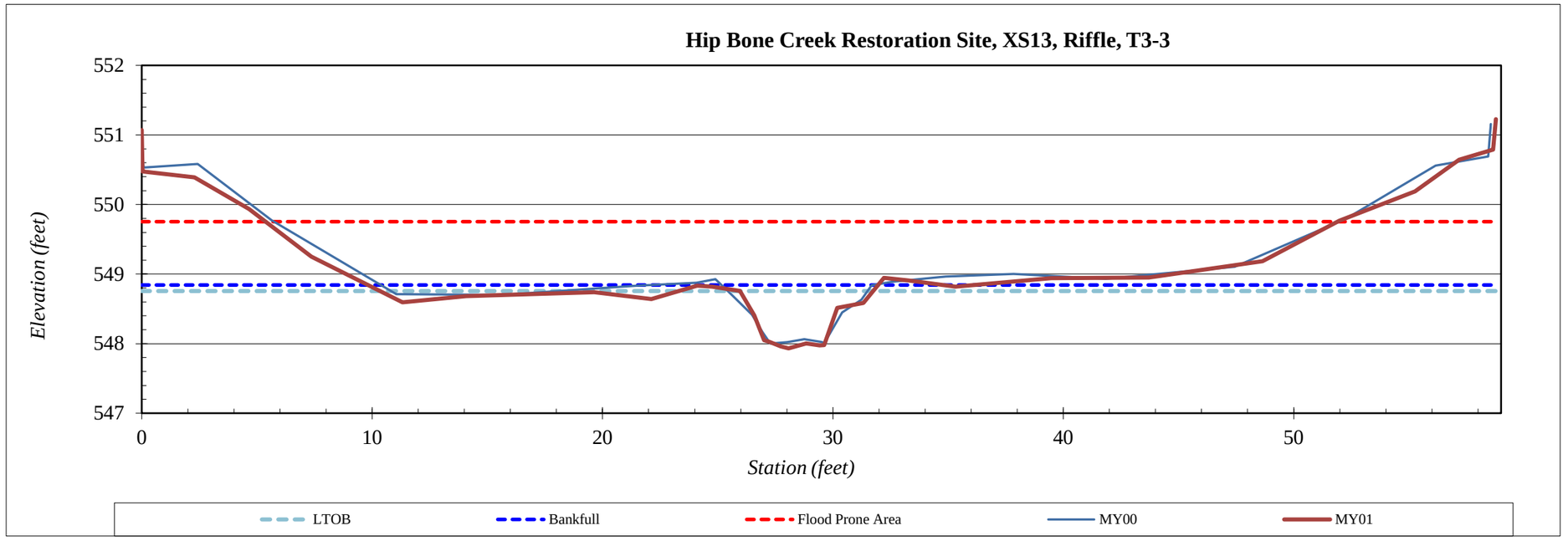


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS13
Drainage Area (sq mi):	0.05
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	551.07
0.0	550.48
2.3	550.39
4.7	549.94
7.4	549.25
11.3	548.60
14.1	548.69
19.6	548.74
22.1	548.64
24.1	548.83
24.8	548.82
26.0	548.76
26.6	548.40
27.0	548.05
27.2	548.02
27.7	547.96
28.1	547.93
28.8	548.00
29.4	547.98
29.6	547.98
30.2	548.51
31.3	548.59
32.2	548.95
33.3	548.91
35.3	548.82
39.5	548.94
43.7	548.95
48.6	549.19
52.0	549.77
55.3	550.19
57.2	550.65
58.7	550.79
58.8	551.23

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):	2.9
Bankfull Width (ft):	6.0
Flood Prone Area Elevation (ft):	549.75
Flood Prone Width (ft):	47
Max Depth at Bankfull (ft):	0.9
Mean Depth at Bankfull (ft):	0.6
W / D Ratio (ft/ft):	10.5
Entrenchment Ratio (ft/ft):	7.8
Bank Height Ratio (ft/ft):	0.9
Thalweg Elevation (ft):	547.93

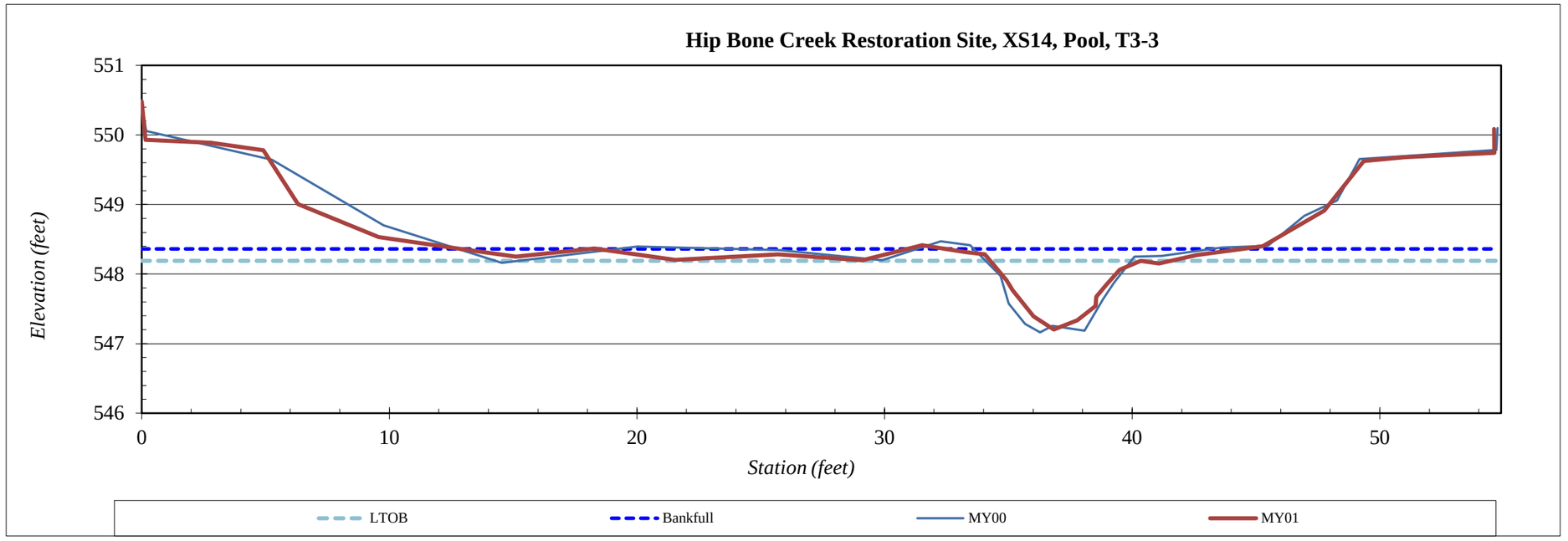


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS14
Drainage Area (sq mi):	0.05
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	550.48
0.2	549.93
2.8	549.89
4.9	549.78
6.3	549.01
9.6	548.53
12.7	548.37
15.1	548.25
18.3	548.37
21.5	548.20
25.7	548.28
29.1	548.20
31.5	548.42
33.3	548.32
34.1	548.28
34.9	547.91
35.2	547.77
36.0	547.39
36.8	547.20
37.8	547.34
38.5	547.54
38.6	547.68
39.0	547.85
39.5	548.06
40.3	548.19
41.1	548.15
42.6	548.27
45.3	548.40
47.8	548.91
49.4	549.63
51.1	549.68
54.6	549.74
54.6	550.08

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	548.36
Bankfull Cross-Sectional Area (sq ft):	4.3
LTOB Cross-Sectional Area (sq ft):	3.2
Bankfull Width (ft):	6.3
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.2
Mean Depth at Bankfull (ft):	0.7
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	0.9
Thalweg Elevation (ft):	547.20

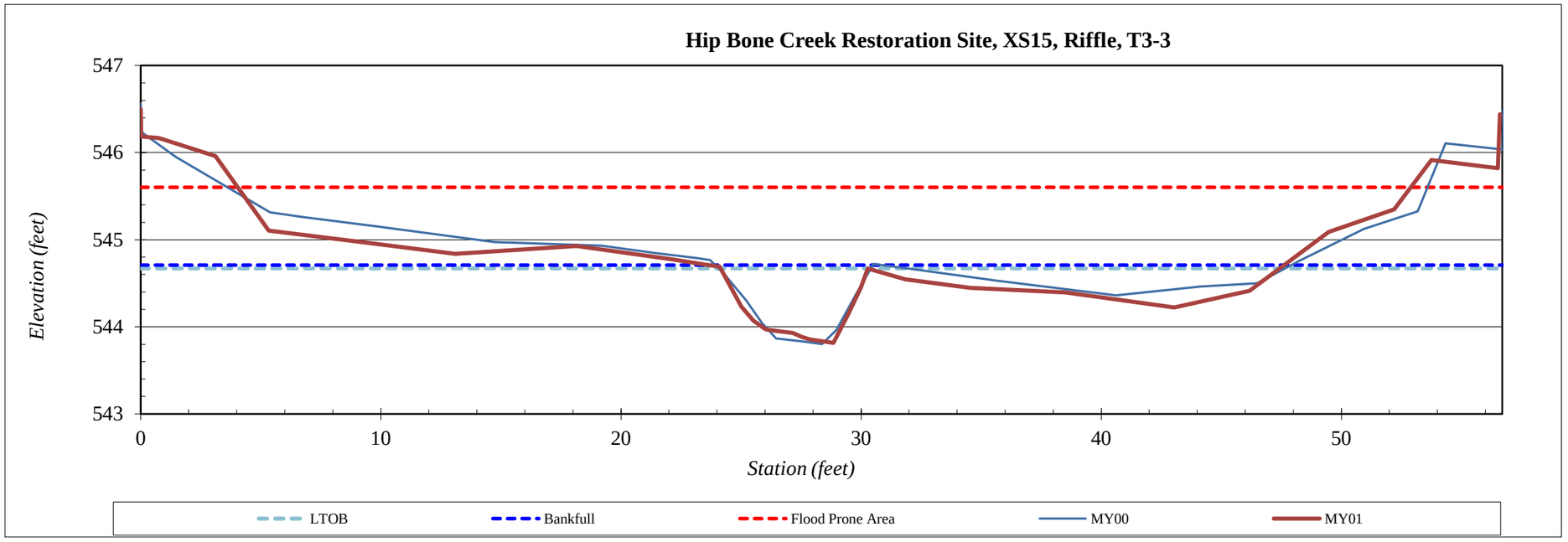


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS15
Drainage Area (sq mi):	0.06
Date:	12/13/2021
Field Crew:	TS, KB

Station	Elevation
0.0	546.50
0.0	546.18
0.8	546.17
3.1	545.96
5.3	545.11
9.3	544.97
13.1	544.84
18.1	544.93
22.1	544.78
23.5	544.71
24.1	544.69
25.0	544.23
25.5	544.07
26.0	543.97
26.5	543.95
27.2	543.93
27.5	543.88
27.9	543.86
28.9	543.82
29.5	544.15
30.0	544.45
30.3	544.67
31.8	544.54
34.5	544.45
38.5	544.40
43.0	544.22
46.2	544.41
49.5	545.09
52.2	545.35
53.8	545.92
56.5	545.82
56.6	546.44

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	544.71
Bankfull Cross-Sectional Area (sq ft):	3.9
LTOB Cross-Sectional Area (sq ft):	3.6
Bankfull Width (ft):	6.6
Flood Prone Area Elevation (ft):	545.60
Flood Prone Width (ft):	49
Max Depth at Bankfull (ft):	0.9
Mean Depth at Bankfull (ft):	0.6
W / D Ratio (ft/ft):	11.4
Entrenchment Ratio (ft/ft):	7.4
Bank Height Ratio (ft/ft):	1.0
Thalweg Elevation (ft):	543.82

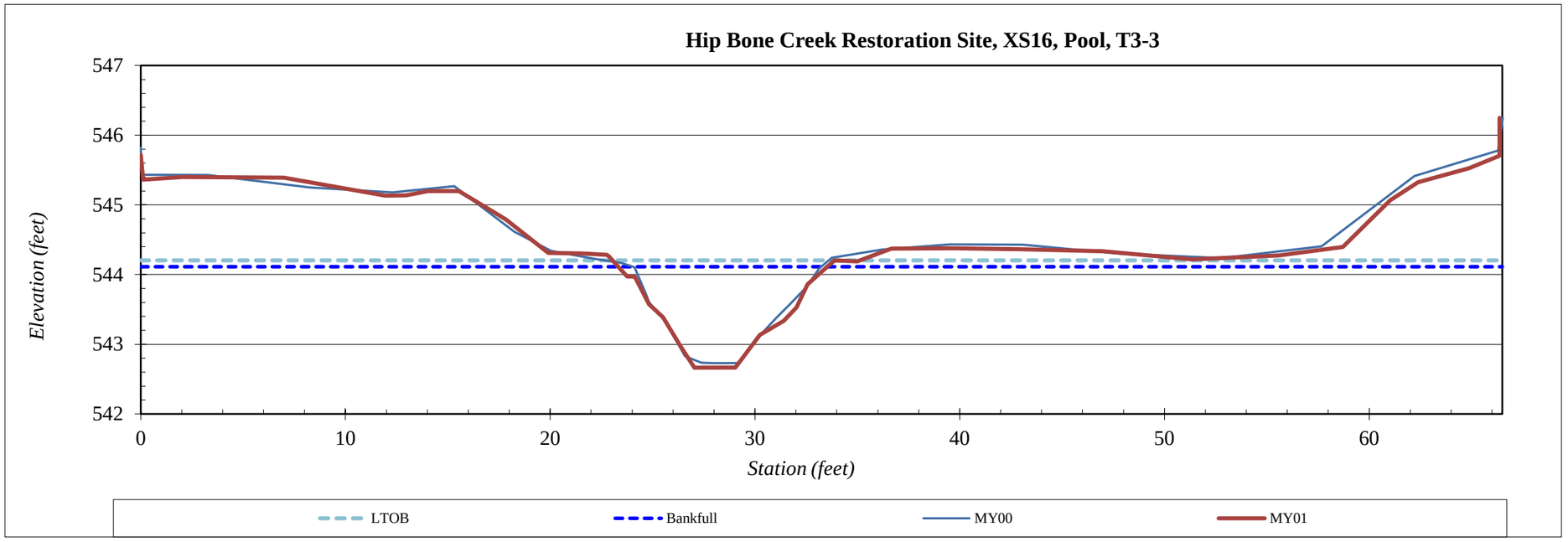


Cross-Section Plots

River Basin:	Cape Fear River
Site:	Hip Bone Creek Restoration Site
XS ID	XS16
Drainage Area (sq mi):	0.06
Date:	12/13/2021
Field Crew:	TS, KB

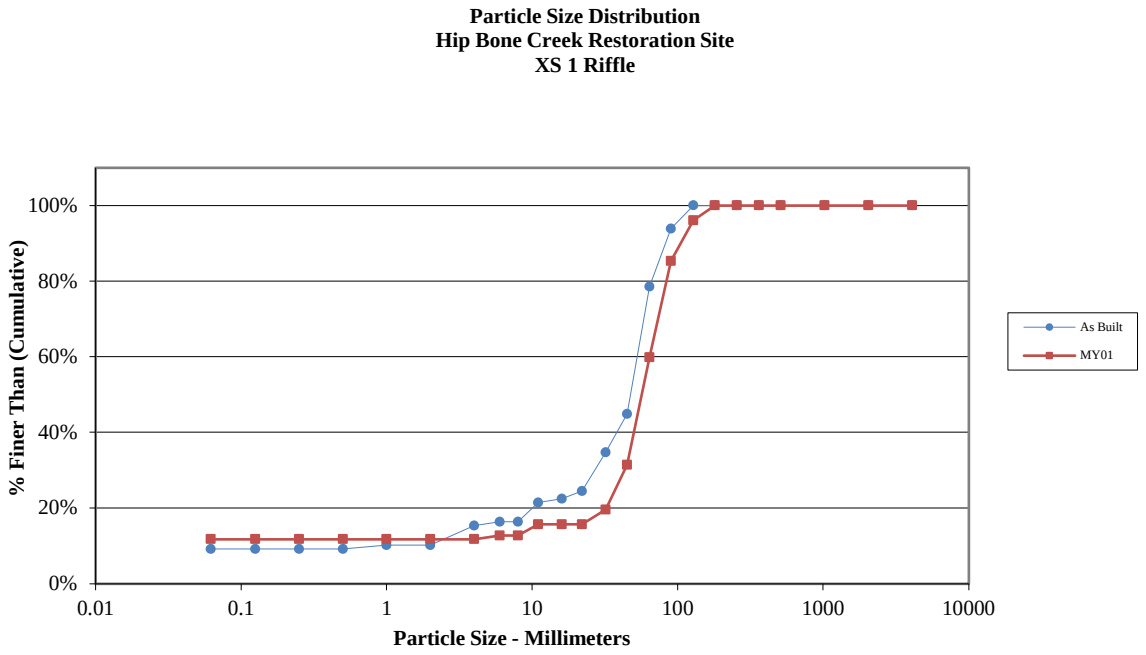
Station	Elevation
0.0	545.72
0.1	545.36
2.1	545.40
7.0	545.39
11.9	545.13
13.0	545.14
14.0	545.20
15.5	545.20
17.8	544.79
19.9	544.31
21.6	544.30
22.8	544.28
22.9	544.27
23.8	543.98
24.1	543.97
24.8	543.57
25.5	543.39
26.4	542.96
27.0	542.66
28.3	542.67
29.0	542.67
30.2	543.13
31.4	543.34
32.0	543.53
32.6	543.86
33.9	544.20
35.0	544.19
36.7	544.37
39.7	544.38
43.0	544.36
47.0	544.34
51.3	544.22
55.6	544.27
64.9	545.53
66.4	545.71
66.4	546.25

SUMMARY DATA	
Bankfull Elevation (ft) - Based on AB-Bankfull Area	544.11
Bankfull Cross-Sectional Area (sq ft):	8.6
LTOB Cross-Sectional Area (sq ft):	9.5
Bankfull Width (ft):	10.2
Flood Prone Area Elevation (ft):	---
Flood Prone Width (ft):	---
Max Depth at Bankfull (ft):	1.4
Mean Depth at Bankfull (ft):	0.8
W / D Ratio (ft/ft):	---
Entrenchment Ratio (ft/ft):	---
Bank Height Ratio (ft/ft):	1.1
Thalweg Elevation (ft):	542.66



Cross-Section 1 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	12
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	4
Very Coarse	32 - 45	S	12
Very Coarse	45 - 64		29
Small	64 - 90	C	26
Small	90 - 128	O	11
Large	128 - 180	B	4
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	102

Note:



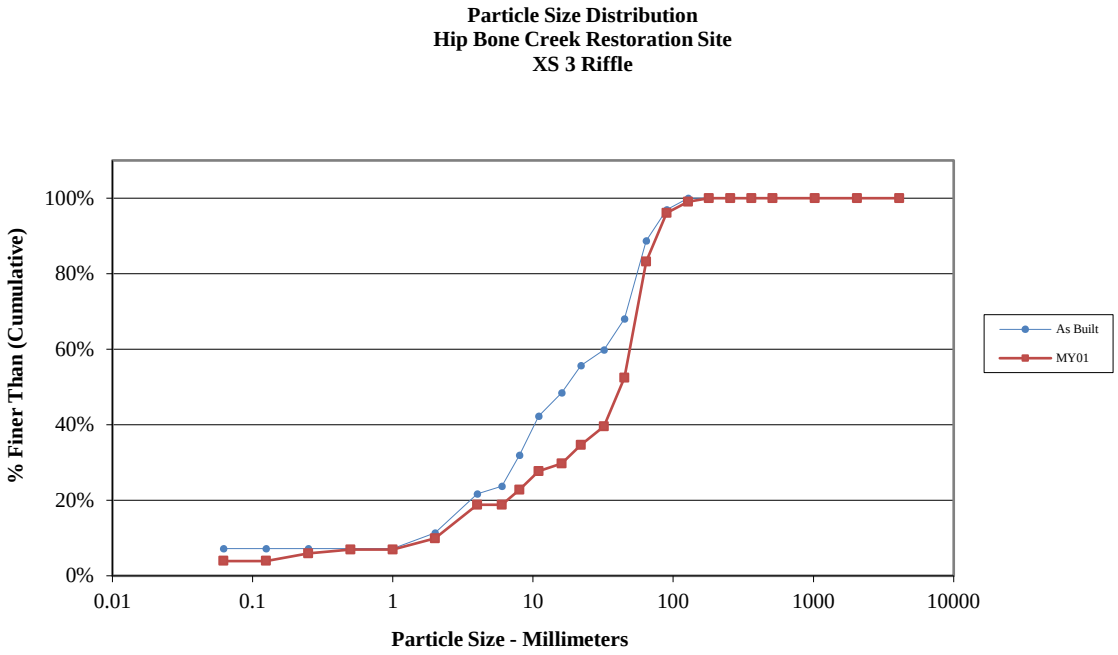
Size (mm)	
D16	23
D35	47
D50	57
D65	69
D84	88
D95	120

Size Distribution	
mean	45.0
dispersion	2.0
skewness	-0.13

Type	
silt/clay	12%
sand	0%
gravel	48%
cobble	40%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	4
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	2
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		9
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	13
Very Coarse	45 - 64		31
Small	64 - 90	C	13
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	101

Note:



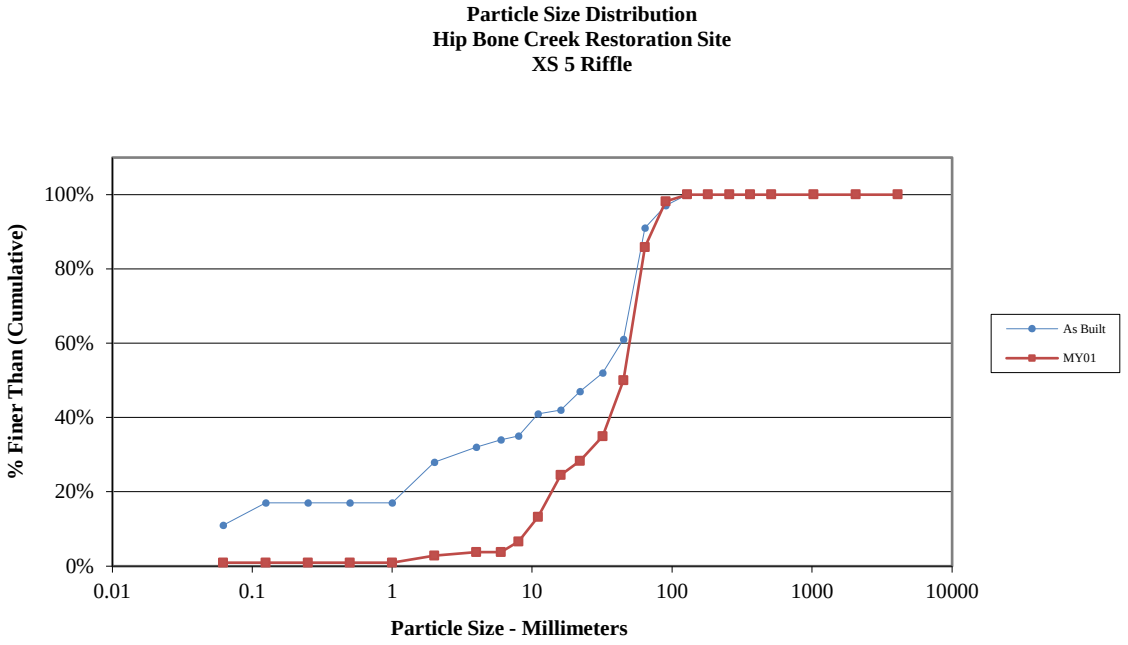
Size (mm)	
D16	3.2
D35	23
D50	42
D65	52
D84	65
D95	88

Size Distribution	
mean	14.4
dispersion	7.3
skewness	-0.41

Type	
silt/clay	4%
sand	6%
gravel	73%
cobble	17%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		1
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	12
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	16
Very Coarse	45 - 64		38
Small	64 - 90	C	13
Small	90 - 128	O	2
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	106

Note:



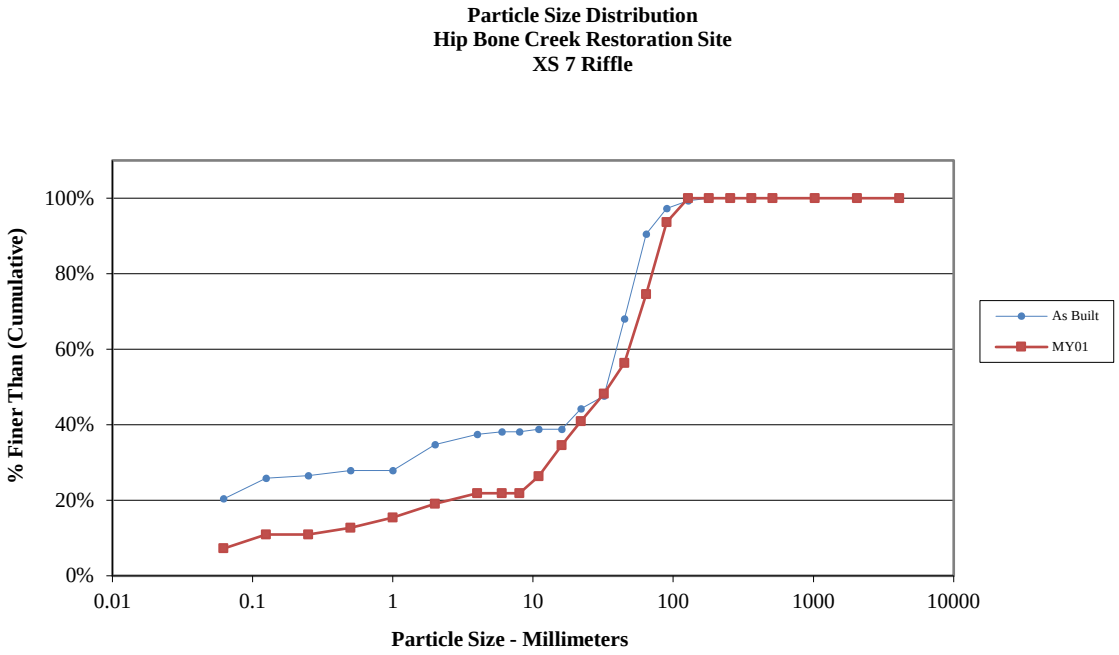
Size (mm)	
D16	12
D35	32
D50	45
D65	52
D84	63
D95	83

Size Distribution	
mean	27.5
dispersion	2.6
skewness	-0.25

Type	
silt/clay	1%
sand	2%
gravel	83%
cobble	14%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Riffle -MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	8
Very Fine	.062 - .125	S	4
Fine	.125 - .25	A	
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	3
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		3
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	9
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	8
Very Coarse	32 - 45	S	9
Very Coarse	45 - 64		20
Small	64 - 90	C	21
Small	90 - 128	O	7
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	110

Note:



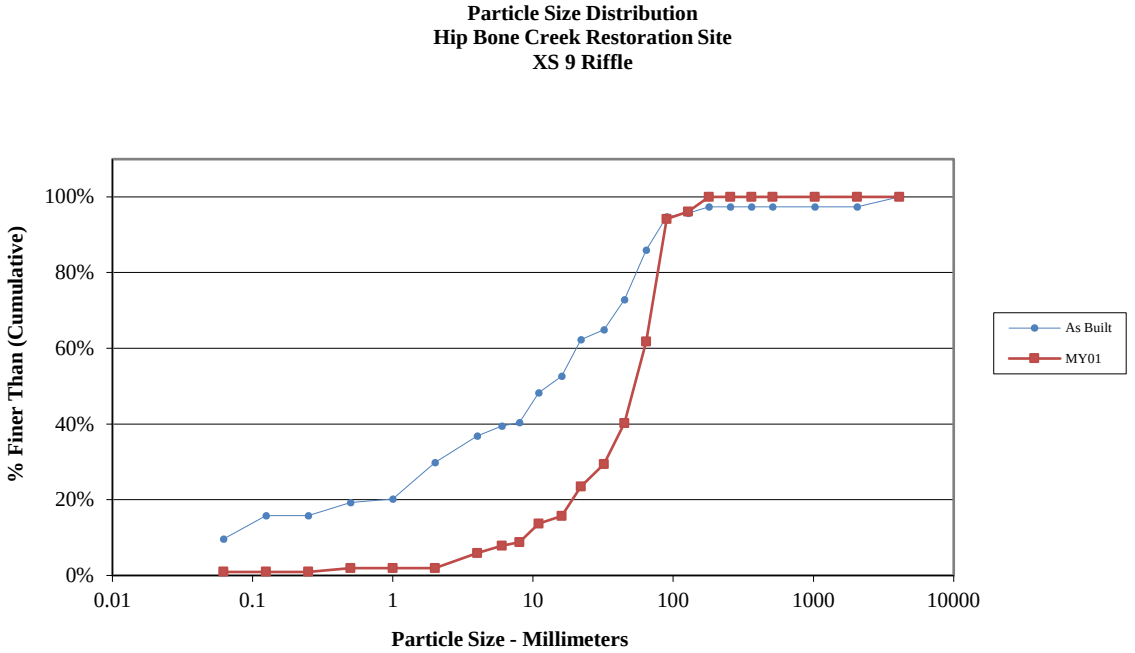
Size (mm)	
D16	1.1
D35	16
D50	35
D65	53
D84	76
D95	97

Size Distribution	
mean	9.1
dispersion	17.0
skewness	-0.43

Type	
silt/clay	7%
sand	12%
gravel	55%
cobble	25%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		4
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	8
Coarse	22.6 - 32	L	6
Very Coarse	32 - 45	S	11
Very Coarse	45 - 64		22
Small	64 - 90	C	33
Small	90 - 128	O	2
Large	128 - 180	B	4
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	102

Note:



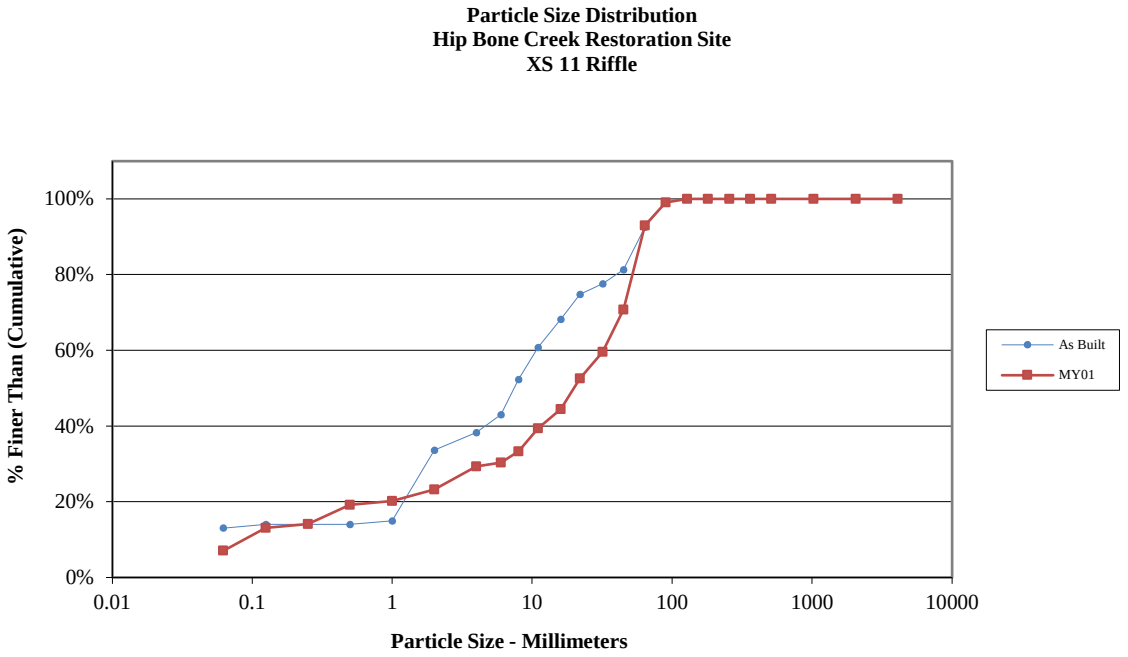
Size (mm)	
D16	16
D35	38
D50	53
D65	66
D84	81
D95	110

Size Distribution	
mean	36.0
dispersion	2.4
skewness	-0.20

Type	
silt/clay	1%
sand	1%
gravel	60%
cobble	38%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 11 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	7
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	1
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		6
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	6
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	8
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	11
Very Coarse	45 - 64		22
Small	64 - 90	C	6
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	99

Note:



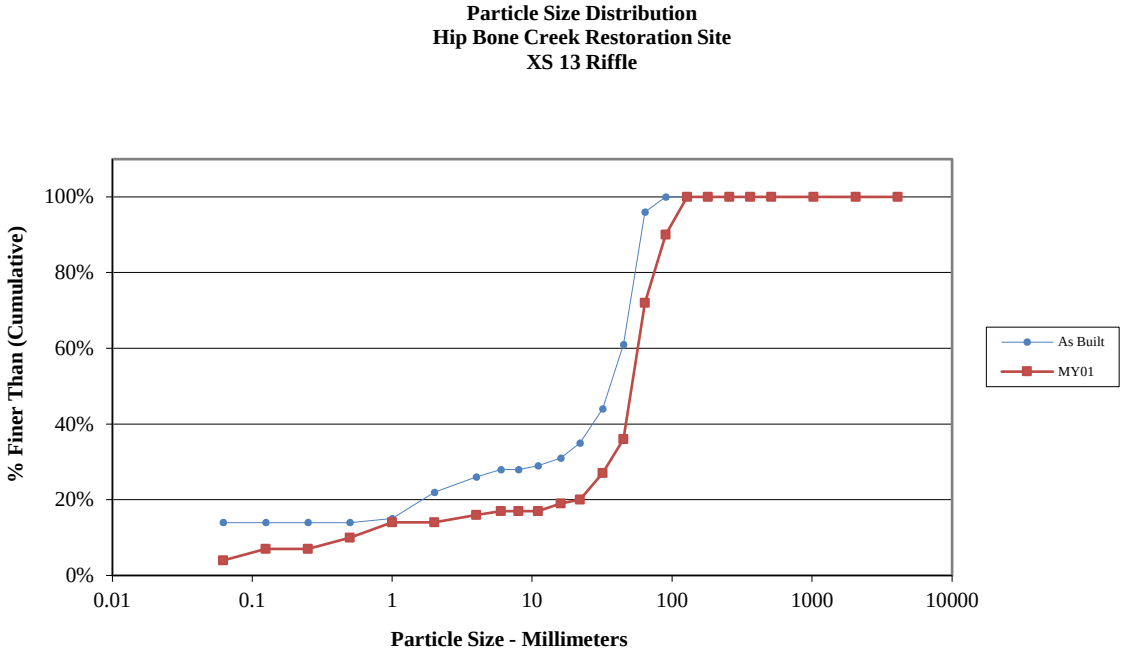
Size (mm)	
D16	0.32
D35	8.7
D50	20
D65	38
D84	56
D95	72

Size Distribution	
mean	4.2
dispersion	32.7
skewness	-0.45

Type	
silt/clay	7%
sand	16%
gravel	70%
cobble	7%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 13 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	4
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	
Very Fine	2 - 4		2
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	9
Very Coarse	45 - 64		36
Small	64 - 90	C	18
Small	90 - 128	O	10
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:



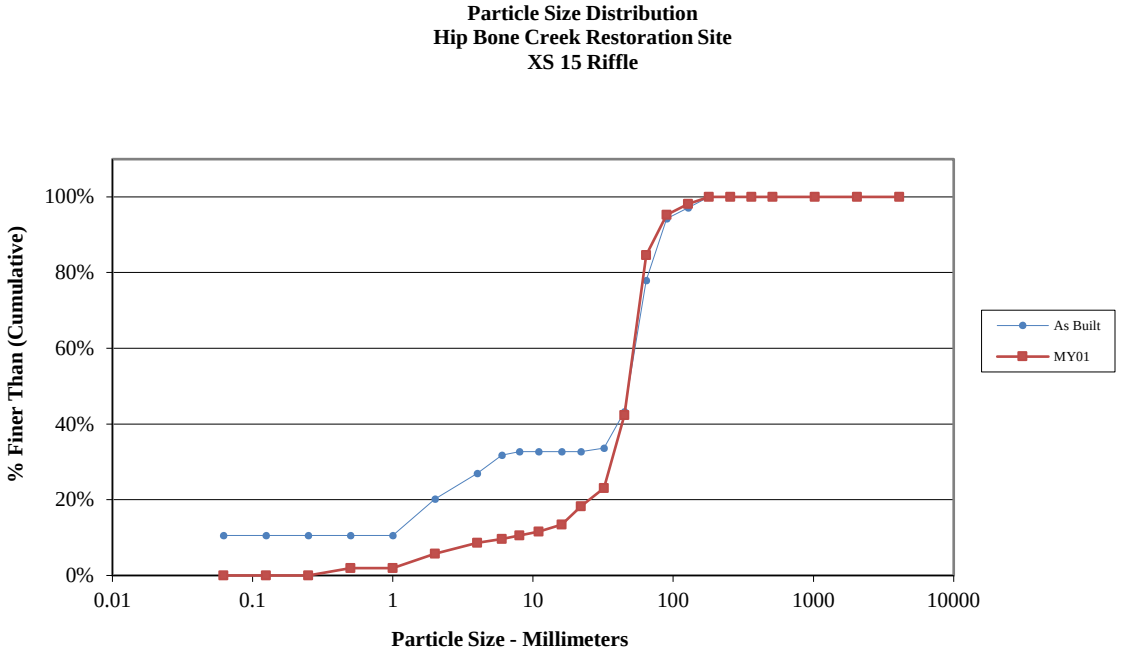
Size (mm)	
D16	4
D35	43
D50	52
D65	60
D84	80
D95	110

Size Distribution	
mean	17.9
dispersion	7.3
skewness	-0.41

Type	
silt/clay	4%
sand	10%
gravel	58%
cobble	28%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 15 Riffle - MY-01			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		3
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	20
Very Coarse	45 - 64		44
Small	64 - 90	C	11
Small	90 - 128	O	3
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	
		Total	104

Note:



Size (mm)	
D16	19
D35	40
D50	48
D65	54
D84	64
D95	89

Size Distribution	
mean	34.9
dispersion	1.9
skewness	-0.19

Type	
silt/clay	0%
sand	6%
gravel	79%
cobble	15%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Table 8a. Baseline Stream Data Summary, Hip Bone Creek (ID-100059), 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	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	16.4	16.4	21.8	2	13		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	1.1	1.1	1.2	2	1		1	1	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		5.6 – 13.5		
Sinuosity (ft)	1					1.2		1.2		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.024		0.0249		
Other										

Table 8b. Baseline Stream Data Summary, Hip Bone Creek (ID-100059), 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		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	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		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	8	7.1	8.7	1
Bank Height Ratio	1	1	1	1	2	1		1	1	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					1.2		1.2		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.015		0.014		
Other										

Table 8c. Baseline Stream Data Summary, Hip Bone Creek (ID-100059), 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	8.8	4	6		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	2.5	2.6	2.7	4	3.5	6.7	5.1	8.3	1
Bank Height Ratio	1	1.1	1	1.5	4	1		1	1	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					1.14		1.14		
Water Surface Slope (Channel) (ft/ft)	0.003 – 0.025					0.0082		0.0101		
Other										

Table 8d. Baseline Stream Data Summary, Hip Bone Creek (ID-100059), 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	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	2.5	2.6	2.7	3	5.2	6.9	7	7	2
Bank Height Ratio	1	1.1	1	1.5	3	1		1	1	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					1.13		1.13		
Water Surface Slope (Channel) (ft/ft)	0.02 – 0.039					0.017		0.0183		
Other										

Table 9. Cross Section Dimensional Morphology Summary
Hip Bone Creek Restoration Site (ID-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	566.4						565.6	565.6						555.7	555.7					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	1.0						1.0	1.0						1.0	1.0					
Thalweg Elevation	565.5	565.7						563.7	563.8						554.6	554.7					
LTOB Elevation	566.3	566.3						565.6	565.6						555.7	555.6					
LTOB Max Depth (ft)	0.8	0.7						1.9	1.7						1.1	0.9					
LTOB Cross Sectional Area (ft2)	2.1	2.0						10.9	10.5						3.9	3.6					
	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	555.0						550.3	550.2						549.7	549.7					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	1.0						1.0	1.1						1.0	1.0					
Thalweg Elevation	553.5	553.7						549.1	549.2						547.6	547.6					
LTOB Elevation	555.0	555.0						550.3	550.3						549.7	549.6					
LTOB Max Depth (ft)	1.5	1.4						1.1	1.1						2.1	2.1					
LTOB Cross Sectional Area (ft2)	8.1	8.7						5.4	6.2						14.0	13.6					
	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	542.6						542.5	542.4						536.6	536.6					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	1.0						1.0	0.9						1.0	0.9					
Thalweg Elevation	541.6	541.5						540.2	540.3						535.3	535.3					
LTOB Elevation	542.6	542.6						542.5	542.3						536.6	536.4					
LTOB Max Depth (ft)	1.1	1.1						2.2	2.0						1.4	1.1					
LTOB Cross Sectional Area (ft2)	4.6	4.4						16.7	15.3						7.2	5.5					
	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	536.3						531.5	531.4						531.3	531.3					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	0.9						1.0	1.0						1.0	1.0					
Thalweg Elevation	533.7	533.7						530.2	530.3						529.0	528.9					
LTOB Elevation	536.3	536.1						531.5	531.4						531.3	531.2					
LTOB Max Depth (ft)	2.6	2.4						1.2	1.1						2.4	2.3					
LTOB Cross Sectional Area (ft2)	20.0	18.1						7.3	7.1						20.8	19.3					

Table 9. Cross Section Dimensional Morphology Summary
Hip Bone Creek Restoration Site (ID-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	548.8						548.3	548.4						544.7	544.7					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	0.9						1.0	0.9						1.0	1.0					
Thalweg Elevation	548	547.9						547.2	547.2						544	543.8					
LTOB Elevation	548.8	548.8						548.3	548.2						544.7	544.7					
LTOB Max Depth (ft)	0.8	0.8						1.1	1.0						0.9	0.9					
LTOB Cross Sectional Area (ft2)	3.4	2.9						4.3	3.2						3.9	3.6					

	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	544.1					
Bank Height Ratio_Based on AB Bankfull1 Area	1.0	1.1					
Thalweg Elevation	542.7	542.7					
LTOB Elevation	544.2	544.2					
LTOB Max Depth (ft)	1.4	1.5					
LTOB Cross Sectional Area (ft2)	8.6	9.5					

APPENDIX D

Hydrologic Data

Hip Bone Creek Restoration Site
30-70 Percentile Graph
WETS Station Name: Siler City 2N

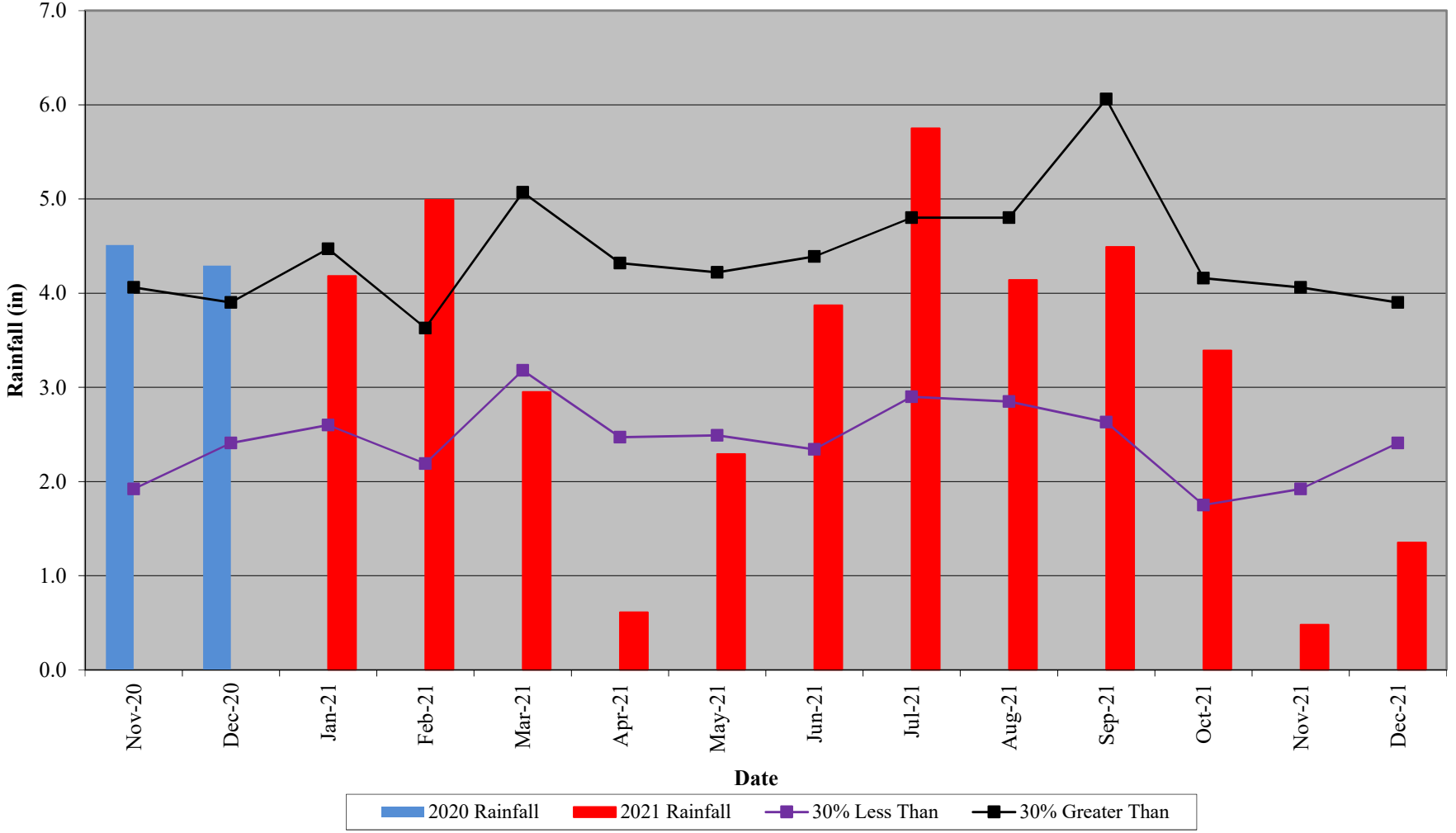


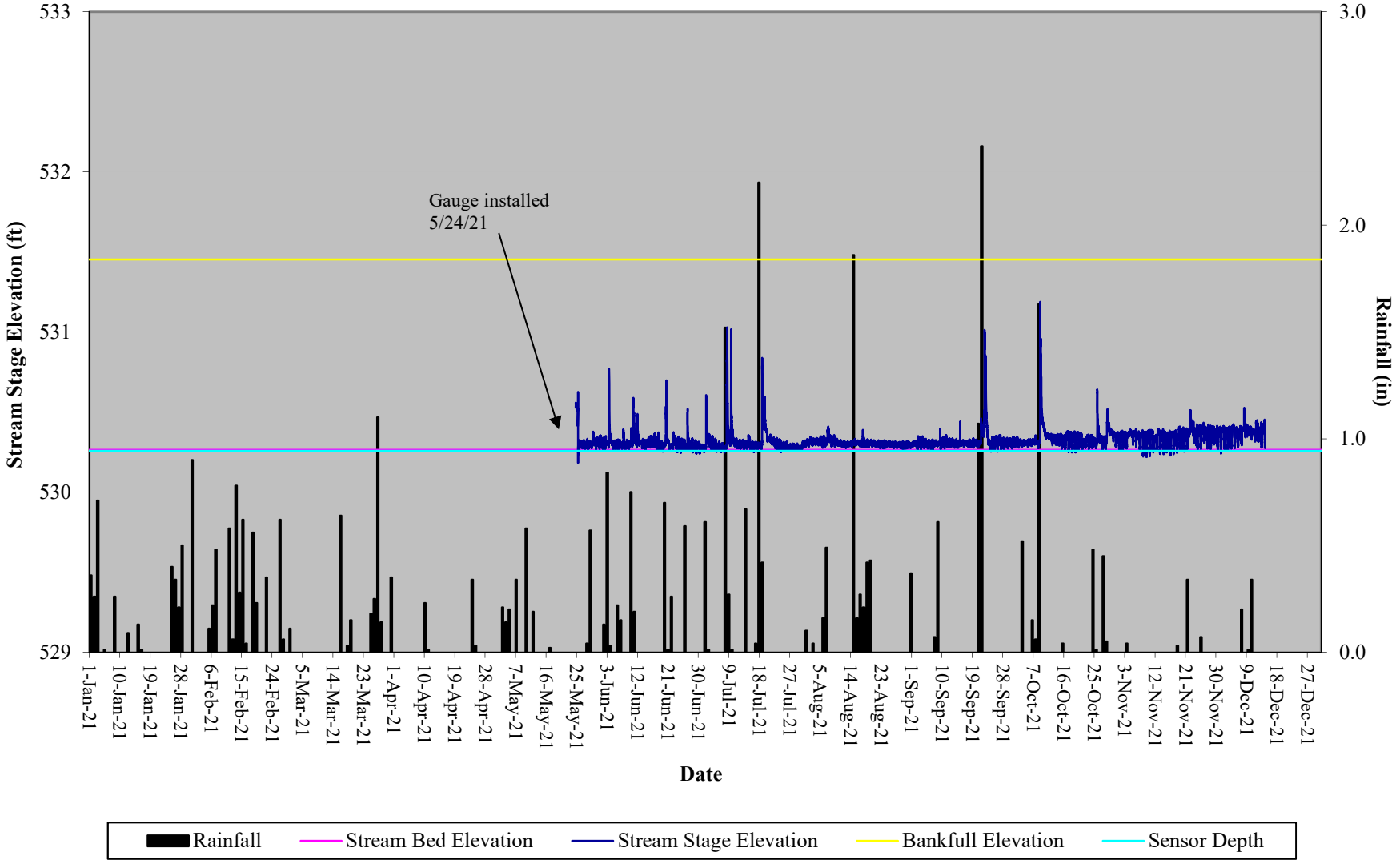
Table 10. Rainfall Summary, Hip Bone Creek Restoration Site (ID-100059)							
	MY1 2021	MY2 2022	MY3 2023	MY4 2024	MY5 2025	MY6 2026	MY7 2027
Annual Precip Total	38.49						
WETS 30th Percentile	29.73						
WETS 70th Percentile	53.88						
Normal	Y						

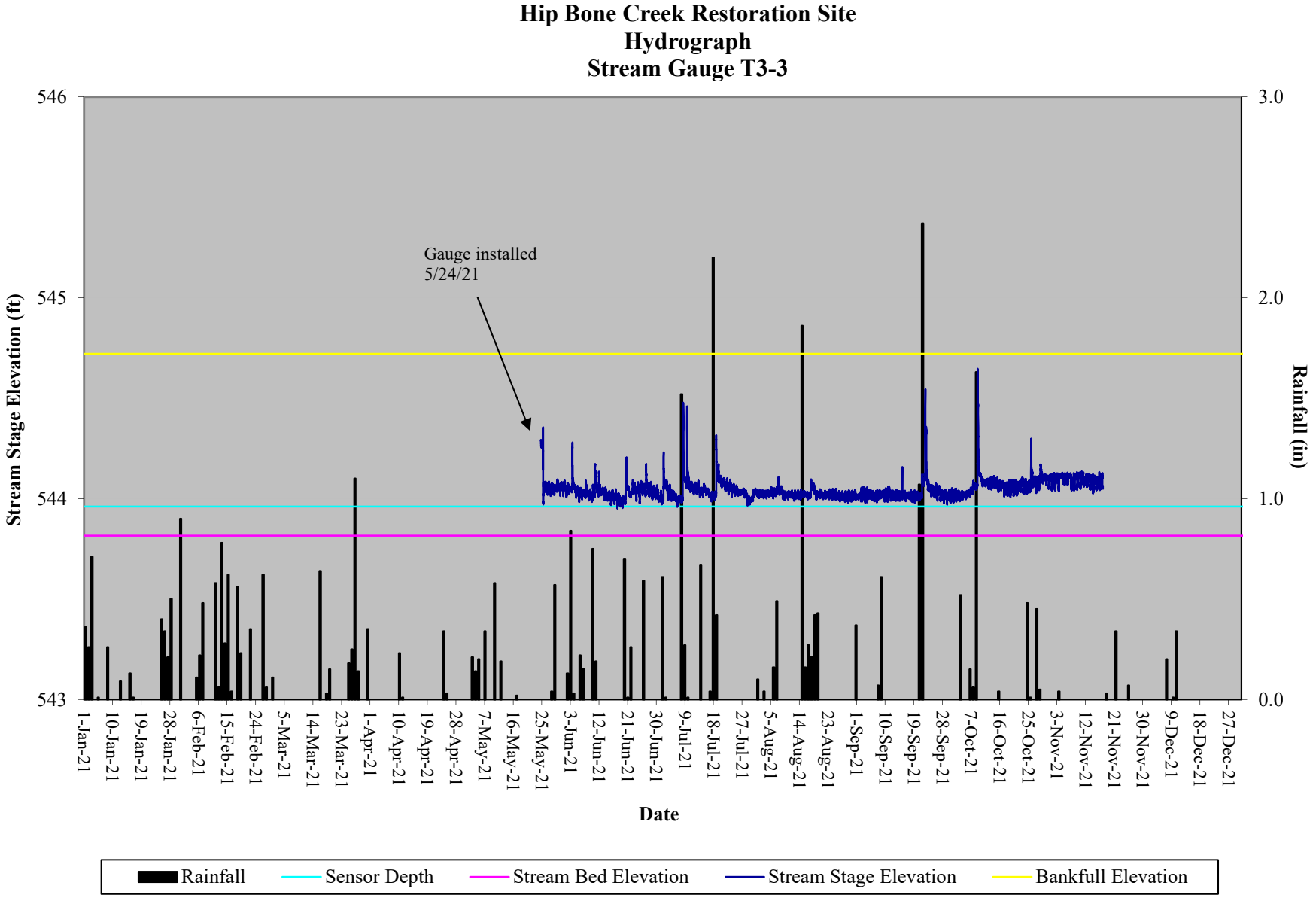
Table 11. Overbank Events , Hip Bone Creek Restoration Site (ID-100059)							
Gage ID	MY1 2021	MY2 2022	MY3 2023	MY4 2024	MY5 2025	MY6 2026	MY7 2027
T1-5	none						
T3-3	none						

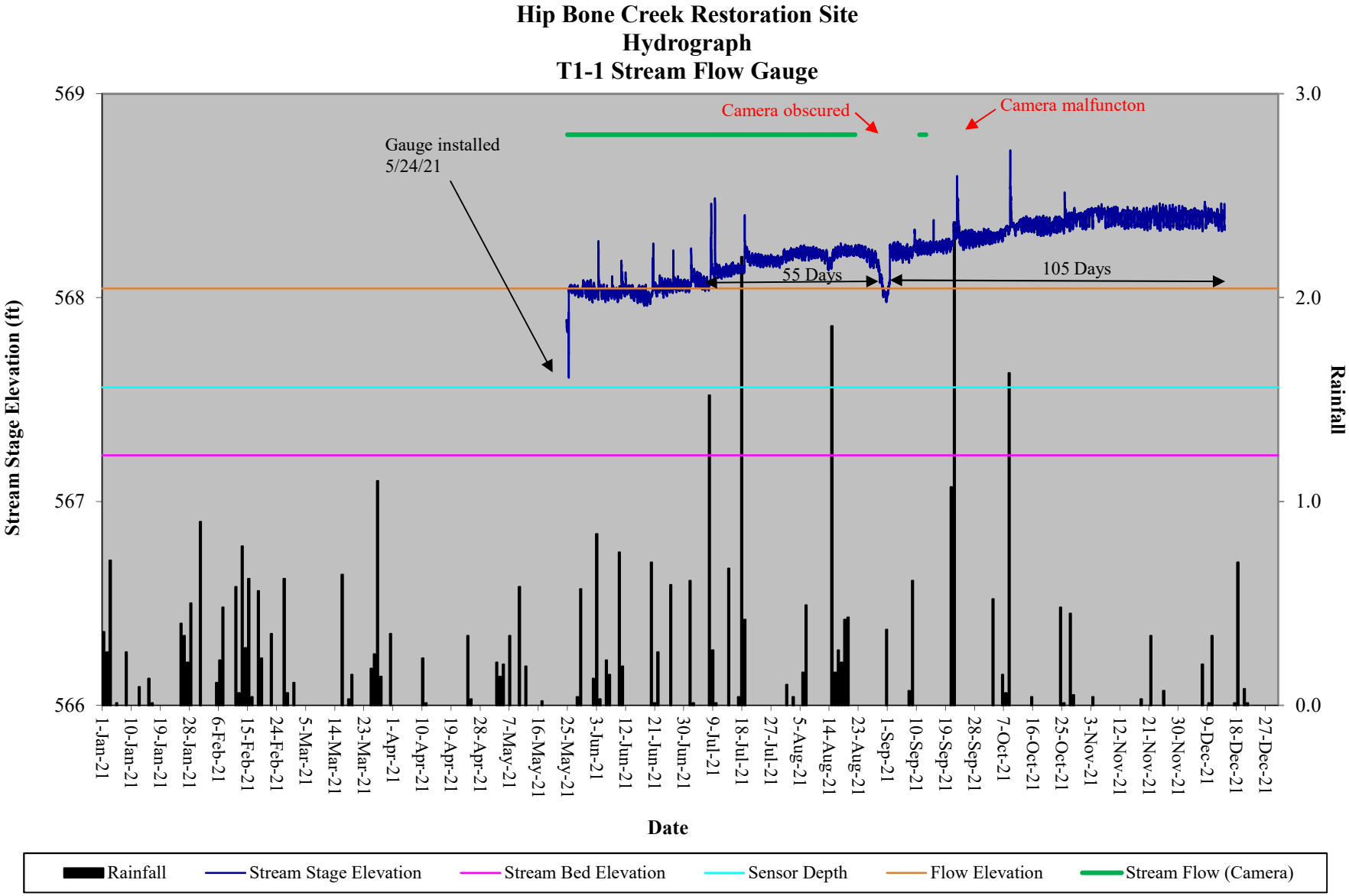
Table 12. Stream Flow Criteria Attainment, Hip Bone Creek Restoration Site (ID-100059)							
	Greater than 30 Days of Flow/Max Consecutive Days						
Reach	MY1 2021	MY2 2022	MY3 2023	MY4 2024	MY5 2025	MY6 2026	MY7 2027
T1-1 (Gauge)	Yes/105						
T1-1 (Camera)	Yes/90						
T3-1 (Gauge)	Yes/205						
T3-1 (Camera)	Yes/39						

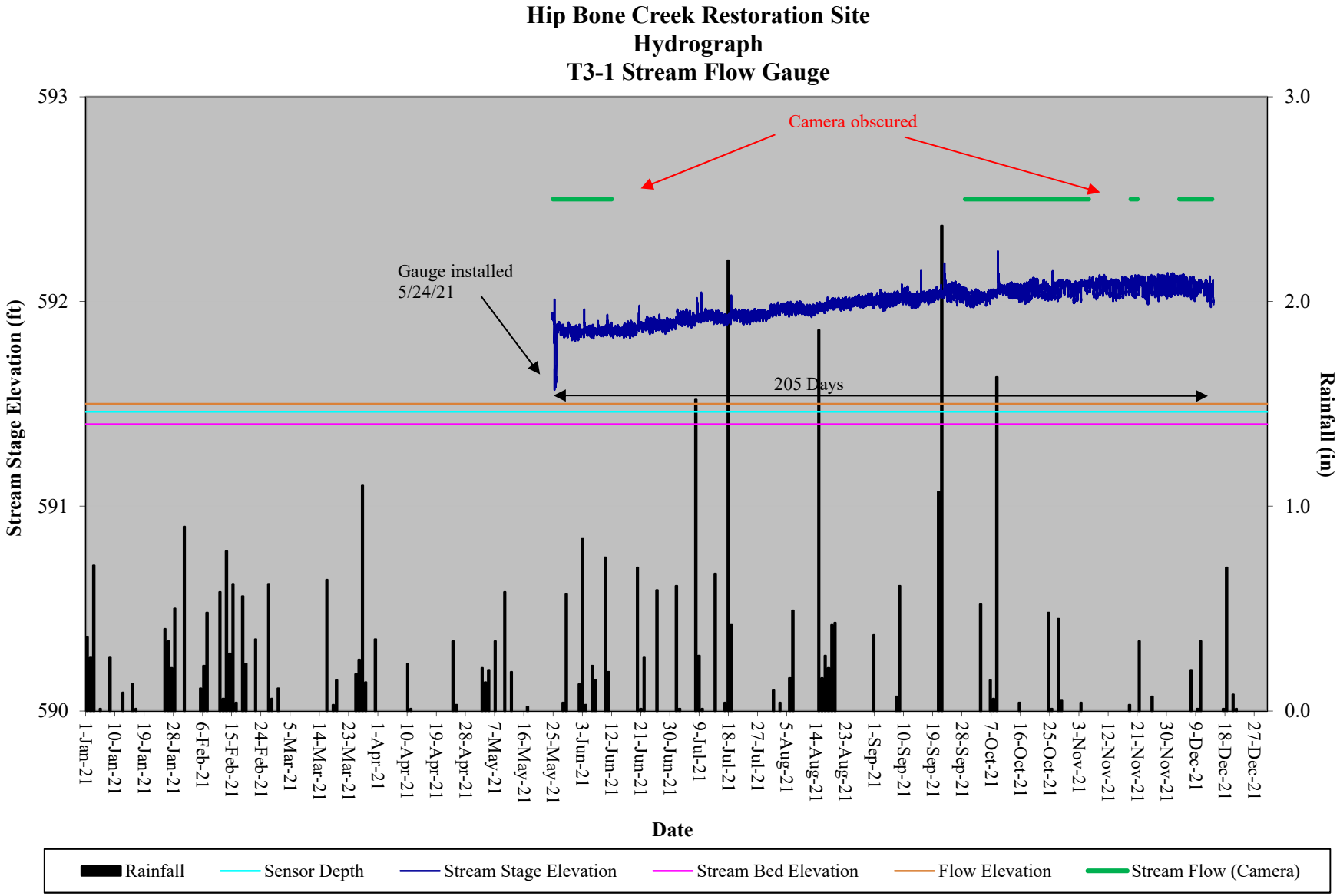
Table 12. Stream Flow Criteria Attainment, Hip Bone Creek Restoration Site (ID-100059)							
	Performance Standard: **12 %** WETS Station: **Siler City 2N** Growing Season: **4/2 to 11/5 (217 days)**						
	Max. Consecutive Hydroperiod (%)						
Monitoring Gauge	MY1 2021	MY2 2022	MY3 2023	MY4 2024	MY5 2025	MY6 2026	MY7 2027
WM-1	5.5%						
WM-2	6.0%						
WM-3	30.9%						
WM-4	5.1%						
WM-5	3.2%						
WM-6	19.8%						
WM-7	28.1%						
WM-8	2.3%						

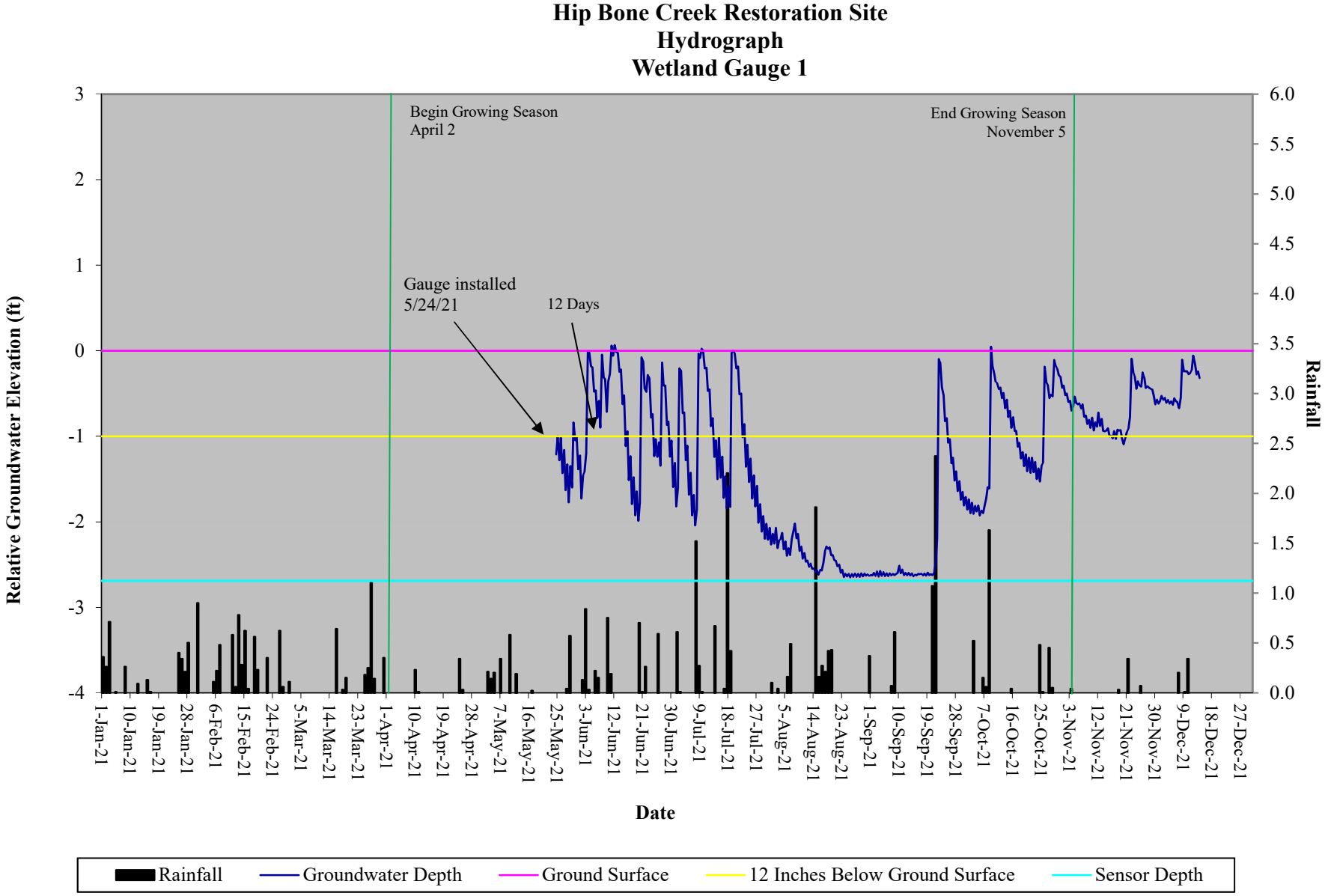
Hip Bone Creek Restoration Site
Hydrograph
Stream Gauge T1-5

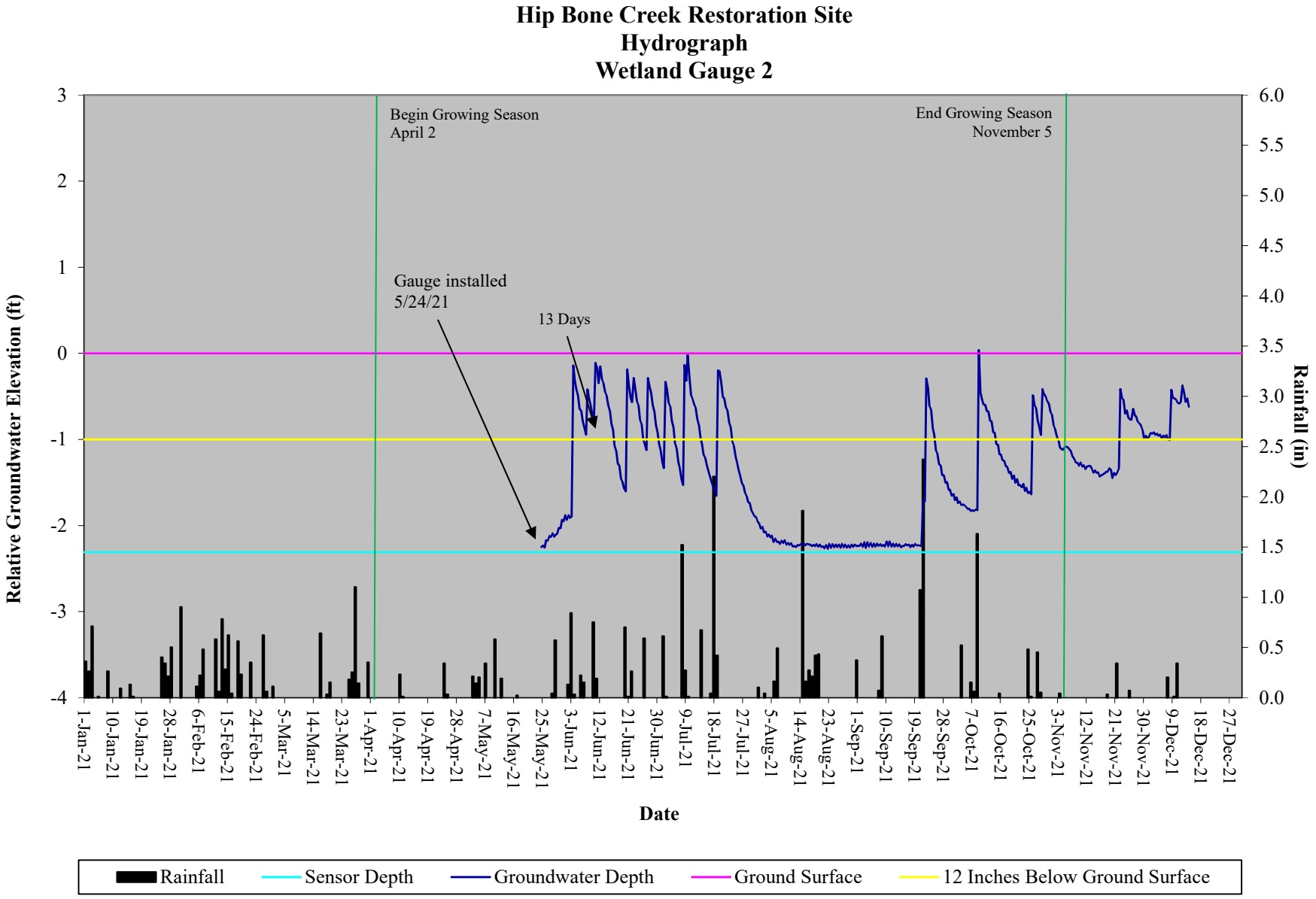



Hip Bone Creek Restoration Site
Hydrograph
Stream Gauge T3-3
Gauge installed
5/24/21
Stream Stage Elevation (ft)
Rainfall (in)
546
545
544
543
3.0
2.0
1.0
0.0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Date
Rainfall
Sensor Depth
Stream Bed Elevation
Stream Stage Elevation
Bankfull Elevation

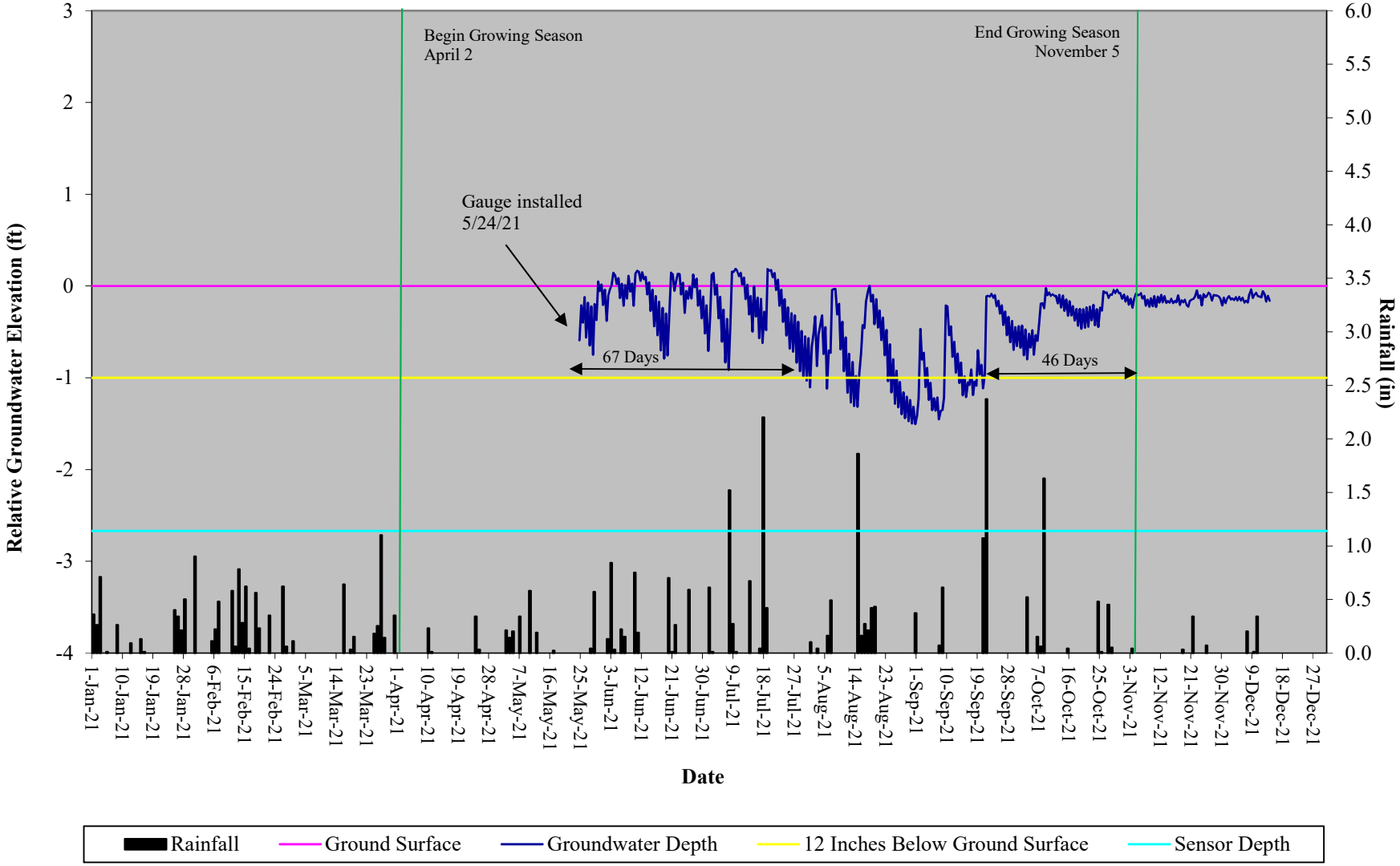

Hip Bone Creek Restoration Site
Hydrograph
T1-1 Stream Flow Gauge
Camera obscured
Camera malfunctoon
Gauge installed
5/24/21
55 Days
105 Days
Stream Stage Elevation (ft)
Rainfall
Date
569
568
567
566
3.0
2.0
1.0
0.0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Rainfall
Stream Stage Elevation
Stream Bed Elevation
Sensor Depth
Flow Elevation
Stream Flow (Camera)

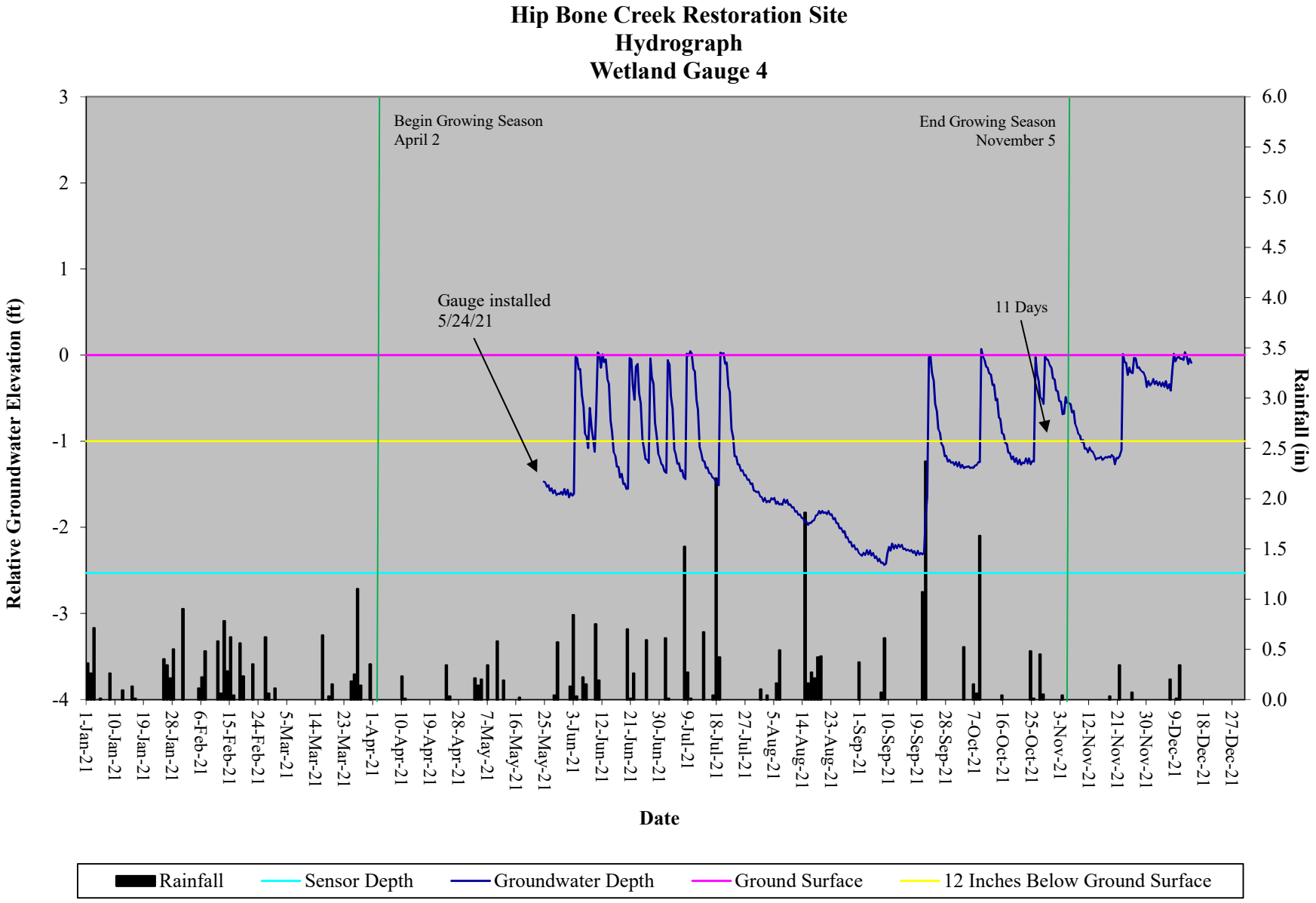

Hip Bone Creek Restoration Site
Hydrograph
T3-1 Stream Flow Gauge
Camera obscured
Gauge installed
5/24/21
205 Days
Stream Stage Elevation (ft)
Rainfall (in)
593
592
591
590
3.0
2.0
1.0
0.0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Date
Rainfall
Sensor Depth
Stream Stage Elevation
Stream Bed Elevation
Flow Elevation
Stream Flow (Camera)

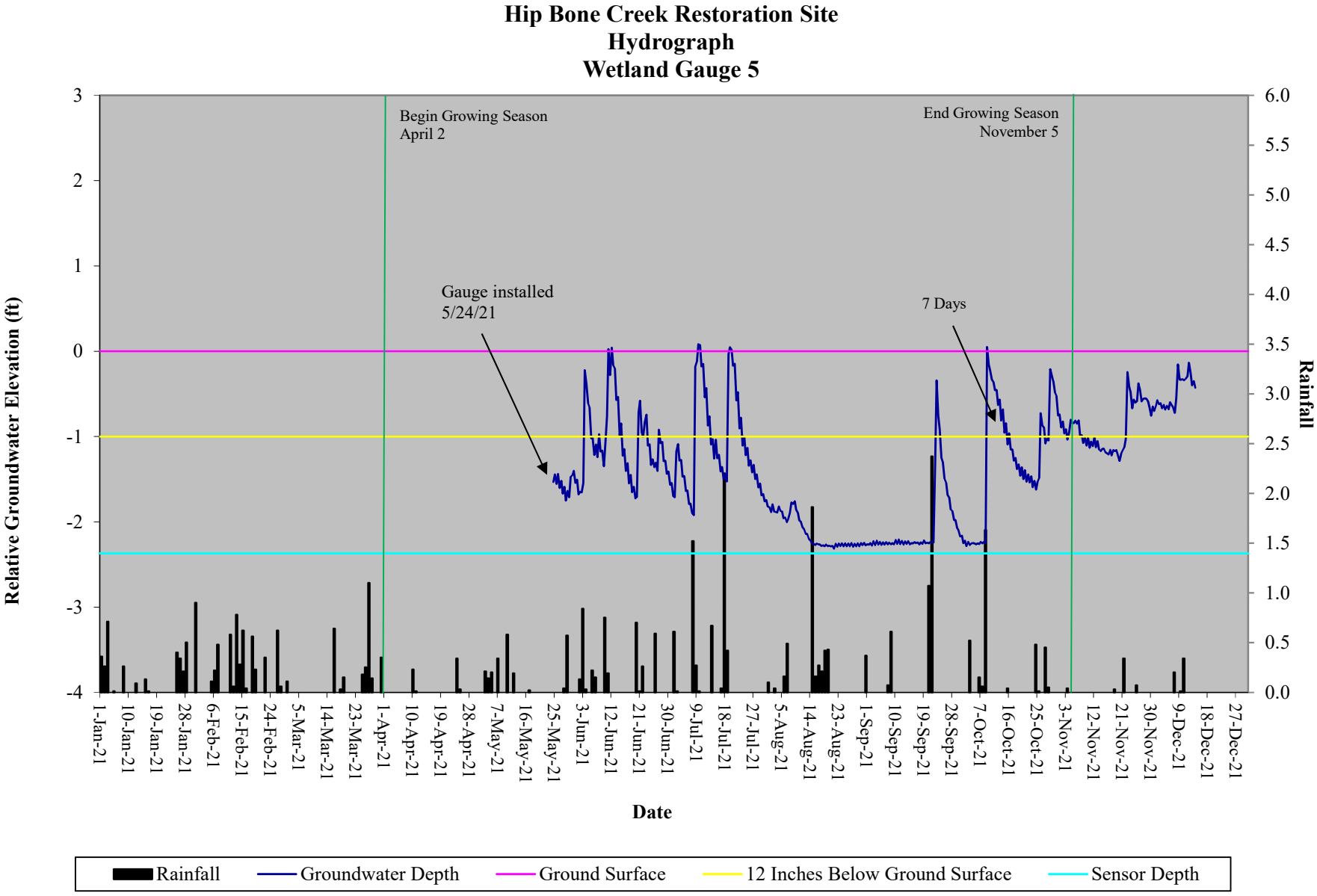

Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 1
Begin Growing Season
April 2
End Growing Season
November 5
Gauge installed
5/24/21
12 Days
Relative Groundwater Elevation (ft)
Rainfall
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth


Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
April 2
End Growing Season
November 5
Gauge installed
5/24/21
13 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

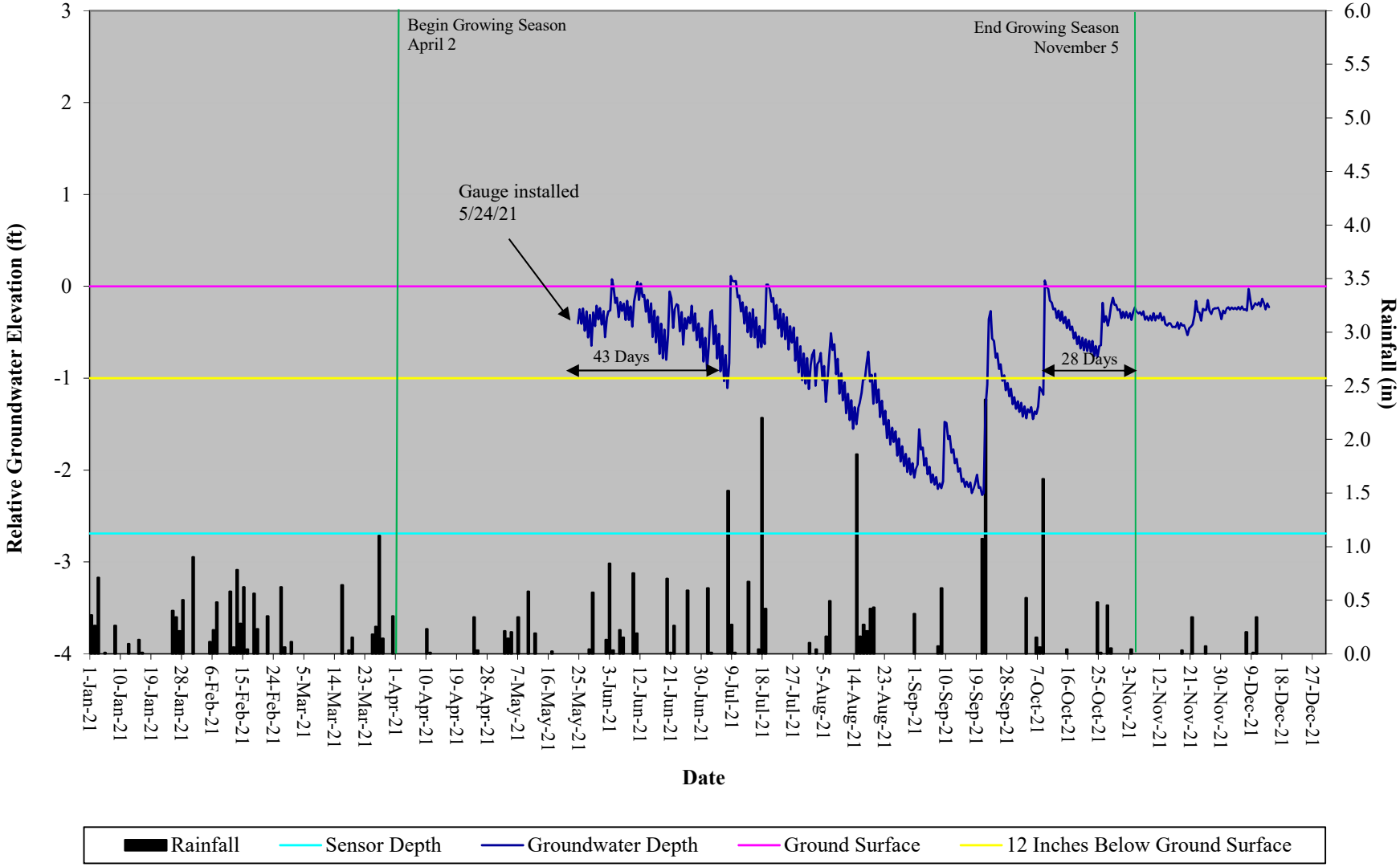
Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 3



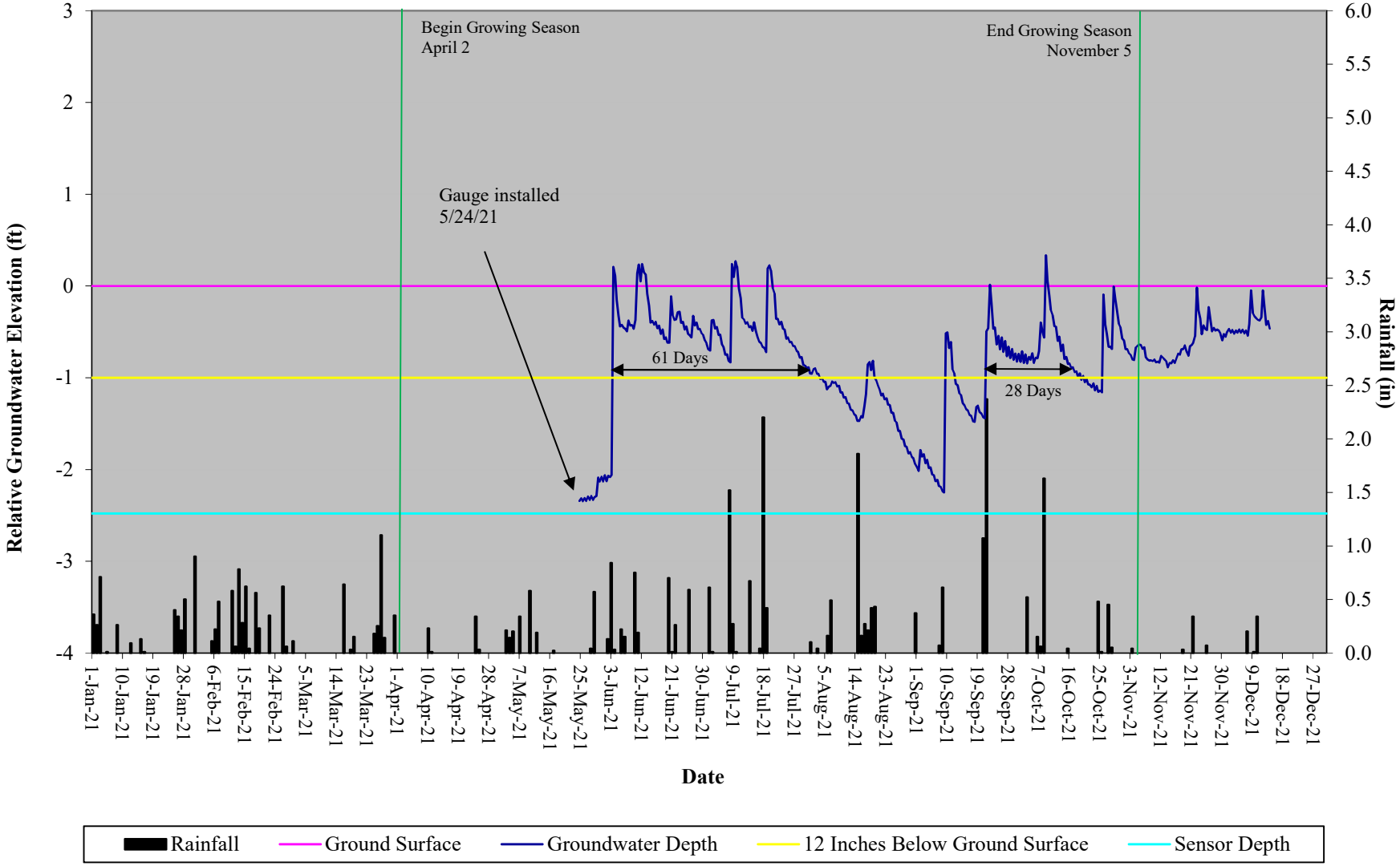

Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 4
Begin Growing Season
April 2
End Growing Season
November 5
Gauge installed
5/24/21
11 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 5
Begin Growing Season
April 2
End Growing Season
November 5
Gauge installed
5/24/21
7 Days
Relative Groundwater Elevation (ft)
Rainfall
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

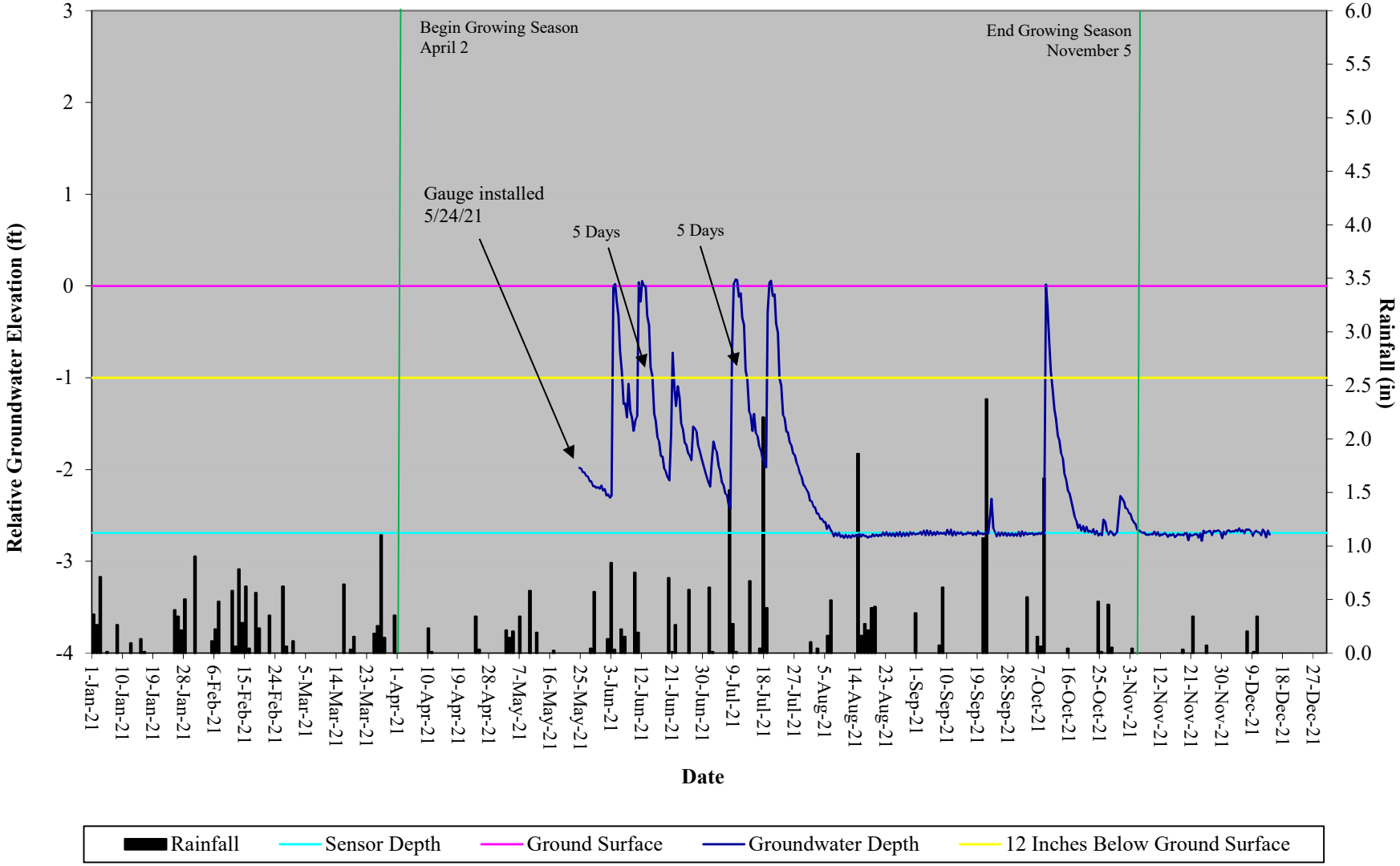
Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 6



Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 7



Hip Bone Creek Restoration Site
Hydrograph
Wetland Gauge 8



APPENDIX E

Project Timeline and Contact Info

Table 14. Project Activity & Reporting History Hipbone Creek Restoration Site (ID-100059)		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Project Instituted		April 23, 2018
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	
Year 1 Monitoring	December 2021	January 2022
Vegetation Monitoring	November 17, 2021	
Stream Survey	December 13, 2021	

Table 15. Project Contacts Stony Fork Restoration Site (ID-100059)	
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

APPENDIX F

Other Data

KCI ASSOCIATES OF NC

ISO 9001:2015 CERTIFIED

ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS

4505 Falls of Neuse Rd., Suite 400 • Raleigh, NC 27609 • Phone 919-783-9214 • Fax 919-783-9266

Date: February 8, 2022

To: Kim Browning, USACE

From: Tim Morris, Project Manager
KCI Associates of North Carolina, P.A.

Subject: Hip Bone Creek Restoration Site
Baseline Site Review – Response to IRT Comments
Cape Fear River Basin - 03030003
Chatham County, North Carolina
DEQ Contract No. #7528
DMS Project #100059
USACE AID #: SAW-2018-01160

Below are our responses to comments received on November 2, 2021 after the baseline report review for the Hip Bone Creek Restoration Site. Please contact me if you have any questions or would like clarification concerning these responses.

Kim Browning, USACE:

1. What was the minor change in wetland area due to miscalculation at the Mitigation Plan stage?
   KCI Response: KCI had originally forgotten to exclude the stream footprint from the wetland rehabilitation area around T2 and the wetland enhancement area around T3. This area consisted of 0.017 acres of wetland rehabilitation and 0.020 acres of wetland enhancement for a total of 0.020 WMC's. Because this is below the threshold of 0.1 acres, no changes have been made to the project assets from how they are presented in the mitigation plan.

2. Please notify the IRT once the fencing for the interior crossings has been installed.
   KCI Response: All fencing was completed on 10/4/2021

3. Please provide a random transect of the vegetation in the enhancement wetlands at least twice during monitoring.
   KCI Response: KCI will perform these transects sometime between MY03 and MY07.

4. I would recommend keeping an eye on the red maple in the vicinity of veg plots 3 and R4 in future monitoring years.
   KCI Response: We will keep an eye on this area but because of the extended periods of saturation that this area experiences we do not anticipate red maple being a problem in this area. Only 2 of the 7 red maple survived in VP3 and none were present in R4 during the MY01 survey.

5. Were soil borings collected near the installed wetland gauges (as per the 2016 IRT Guidance)? Please submit this data with the MY1 report. It would have been helpful to include the baseline data for the wetland gauges, if any were installed prior to construction.
   KCI Response: This data has been included in Appendix F – Other Data of the MY01 report.

Casey Haywood, USACE:

1. If supplemental planting will be needed in the future, it is recommended to avoid American sycamore and river birch due to their already high stem counts.
   KCI Response: These species will be avoided in future plantings of the site.

2. Overall, the report was thorough and well organized. Also appreciate the inclusion of drone footage.

Erin Davis, DWR:

1. DWR appreciates the inclusion of the drone video. It was very helpful for this review. And it was a bonus to see monitoring staff in action.

2. Were soil borings collected near the installed wetland gauges (as per the 2016 IRT Guidance)? Please submit this data with the MY1 report.
   KCI Response: This data has been included in Appendix F – Other Data of the MY01 report.

3. Based on the plant list and veg plot data (many starting with only 4 or 5 species), DWR recommends watching species diversity through monitoring and if any supplemental planting is needed to take advantage of the opportunity to include additional species. Since sycamore and river birch make up over 50% of planted stems, DWR requests that these species be avoided in potential supplemental plantings or included only at very low percentages.
   KCI Response: These two species will be excluded from future plantings and KCI will use any future plantings to enhance species diversity on site.

4. What were the final upstream and downstream elevations streambed/embedded structure for all culvert installations? Were there any deviations in the upstream/downstream structure station numbers from the design plan? Ideally, DWR would like to see a redline of the proposed crossing sizing table from the culvert details design plan sheet 5A.
   KCI Response: A redlined version of the proposed crossing size table (Sheet 5 of the construction plans) has been added to Appendix F – Other Data. Since the surveyors generally are instructed to survey the pipe invert, it is possible that the points that are presented in this table are for the elevation of the invert, not the elevation of the embedded material. Additionally, because the work done at the top of T3 was Enhancement II level work, this area was not surveyed as part of the as-built survey and so elevations for the culvert on T3-1 are not available. Visual inspection of the site shows that it is functioning as designed with an appropriate amount of embedded material within the pipe. Please see Appendix F – Other Data for photos of all of the culverts.

5. Redline Sheet 3 – Based on the drone video, it appears the pond drainage rock outlet was extended within the easement to approximately the first boundary bend (approximately 80-100 feet). DWR believes this change warrants a redline callout.
   KCI Response: The pond drainage outlet near the top of T1 was built as designed with no modification from the construction plans.

Todd Bower, USEPA:

1. Missing fencing and landowner agreement was noted and KCI has stated that installation will occur as soon as possible. Recommend sponsor notify the IRT when this occurs if significantly before the MY1 Report is drafted.
   KCI Response: All fencing was completed on 10/4/2021.

2. Planting followed the plan very closely with just a few minor shifts in species stem counts/percentages; all appear suitable and maintains a diverse mix of species.

3. I am concerned that the late date of planting (April 30, 2021) may incur a higher rate of mortality than desired, especially in first growing season. Recommend the sponsor and IRT pay particularly close attention to this in the upcoming MY1 report. This also pushes back the MY1 monitoring to extremely late in the season.
   KCI Response: Typically KCI tries to plant sites in late February/early March. For this site this was not an option since construction wasn't completed until April 16th, and it seemed better to plant the site late rather than to leave it unplanted for almost an entire growing season. Average stem mortality across the 10 fixed vegetation plots was 6%.

4. All the photos of the streams, veg plots, and crossings are excellent. I also really appreciated the cross section pages with data tables, charts and photo. Very well presented.

5. Thank you very much for posting the site-wide drone footage. I greatly appreciate this information as I am currently unable to make site visits. This approach also provides a level of detail that enhances the text and photos.

Sincerely,

Tim Morris
Project Manager

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** GW-1

Soil Series: Georgeville-Badin Complex

Soil Classification: Fine, kaolinitic, thermic Typic Kanhapludult/Fine, mixed, semiactive, thermic Typic Hapludults

AWT: 20" **SHWT:** 0" **Slope:** ~5% **Aspect:** Concave

Elevation: 570' **Drainage:** Well Drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 30 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Apc	0-9	10YR 5/2	7.5YR 4/6	2	PL	cL	2msbk	Mn concretions starting at 6"
Bt1	9-15	10YR 5/2	7.5YR 4/6	10	PL, M	cL	2msbk	
Bt2	15-27	10YR 5/2	2.5YR 4/8	20	PL, M	cL	2msbk	
			10YR 6/8	5	M			
Bt3	27-30+	10YR 5/2	2.5YR 4/8	2	PL	cL	2msbk	
			10YR 6/8	2	M			

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** GW-2

Soil Series: Chewacla and Wehadkee

Soil Classification: Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts/Fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts

AWT: >30" **SHWT:** >30" **Slope:** 0-1% **Aspect:** Concave

Elevation: 565' **Drainage:** Somewhat Poorly Drained, Poorly Drained and Very Poorly Drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 30 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-9	10YR 4/3	7.5YR 4/4	5	M	cL	2msbk	
Btc	9-20	10YR 5/2	5YR 3/4	2	PL, M	cL	2msbk	Mn concreations
Bt	20-30+	2.5Y 6/3	10YR 5/8	5	M	cL	2msbk	
			2.5Y 7/6	5	M			

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** GW-3

Soil Series: Chewacla and Wehadkee

Soil Classification: Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts/Fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts

AWT: 2" **SHWT:** 0" **Slope:** 0-1% **Aspect:** Concave

Elevation: 550' **Drainage:** Somewhat Poorly Drained, Poorly Drained and Very Poorly Drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-10	10YR 4/2	5YR 3/4	2	PL	cL	2msbk	
Bg1	10-12	4/10Y	7.5YR 4/4	2	M, PL	cL	2msbk	charcoal present
Bg2	12-18	4/10Y				cL	2msbk	charcoal present
Btg	18-24+	10YR 4/1	10YR 4/2	40	M	c	massive	

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** WM-4

Soil Series: Chewacla and Wehadkee

Soil Classification: Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts/Fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts

AWT: >24" **SHWT:** 10" **Slope:** 0-1% **Aspect:** Concave

Elevation: 550' **Drainage:** Somewhat Poorly Drained, Poorly Drained and Very Poorly Drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Apc	0-6	10YR 5/3	7.5YR 5/6	2	PL	cL	2msbk	Mn concreations
BAc	6-10	10YR 5/3	7.5YR 5/6	10	PL, M	cL	2msbk	Mn concreations
Btc	10-14	10YR 5/2	7.5YR 5/6	10	PL, M	cL	2msbk	Mn concreations
Bt	14-24+	10YR 6/2	10YR 5/8	20	M	c	massive	

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** WM-5

Soil Series: Chewacla and Wehadkee

Soil Classification: Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts/Fine-loamy, mixed, active, nonacid, thermic Fluvaquentic Endoaquepts

AWT: 12" **SHWT:** 17" **Slope:** 0-1% **Aspect:** Concave

Elevation: 540' **Drainage:** Somewhat Poorly Drained, Poorly Drained and Very Poorly Drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 30 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-5	10YR 5/3				cL	2msbk	
BAc	5-15	10YR 5/3	10YR 6/8	2	M	cL	2msbk	Mn concreations
			7.5YR 4/6	5	M, PL			
Btc	15-17	10YR 5/3	7.5YR 4/4	20	M	cL	2msbk	Mn concreations
Bt	17-22	10YR 5/2	7.5YR 4/4	20	M	cL	2msbk	
Btg	22-26	10YR 5/1	7.5YR 4/6	2	M	c	2msbk	
Btgc	26-30+	7/10Y	10YR 6/8	10	M	c	2msbk	Mn concreations

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** WM-6

Soil Series: Georgeville

Soil Classification: Fine, kaolinitic, thermic Typic Kanhapludult

AWT: 18" **SHWT:** 0" **Slope:** 2% **Aspect:** Concave

Elevation: 570' **Drainage:** Well drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-7	10YR 5/2	7.5YR 5/6	5	PL	cL	2msbk	
BAc	7-14	10YR 5/2	7.5YR 5/6	5	PL	c	2msbk	Mn concreations
Bt	14-16	10YR 5/2	10YR 6/8	20	M, PL	c	3msbk	
Btg	16-24+	6/10Y	10YR 6/8	20	M, PL	c	massive	

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** WM-7

Soil Series: Georgeville

Soil Classification: Fine, kaolinitic, thermic Typic Kanhapludult

AWT: >24" **SHWT:** 0" **Slope:** 2% **Aspect:** Concave

Elevation: 555' **Drainage:** Well drained **Permeability:** Moderate

Vegetation: Planted restoration site

Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-7	10YR 5/2	5YR 4/6	2	M, PL	cL	2msbk	
Btg1	7-12	10YR 6/1	10YR 6/6	10	M	c	massive	
Btg2	12-24+	7/10Y	10YR 5/6	20	M	c	massive	small gravel

COMMENTS:

DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

KCI ASSOCIATES OF NORTH CAROLINA, PA

SOIL PROFILE DESCRIPTION

Client: NC Division of Mitigation Services **Date:** December 27, 2021

Project: Hip Bone Creek Restoration Site **Project #:** DMS #100059

County: Chatham **State:** North Carolina

City/Town: Siler City **Location:** WM-8

Soil Series: Georgeville

Soil Classification: Fine, kaolinitic, thermic Typic Kanhapludult

AWT: >24" **SHWT:** 8" **Slope:** 2% **Aspect:** Concave

Elevation: 555' **Drainage:** Well drained **Permeability:** Moderate

Vegetation: Planted restoration site

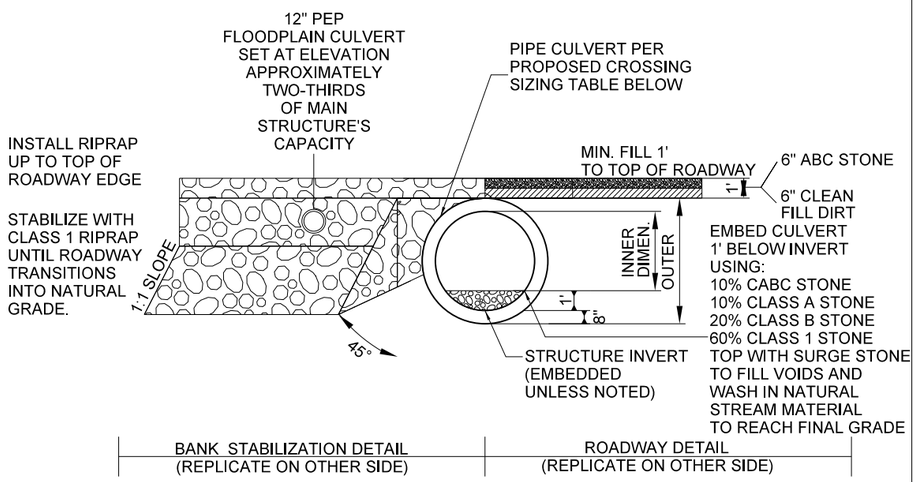
Borings terminated at 24 **Inches**

HORIZON	DEPTH (IN)	MATRIX	MOTTLES	PERCENTAGE	LOCATION	TEXTURE	STRUCTURE	NOTES
Ap	0-8	10YR 4/3	5YR 4/6	5	PL	L	1msbk	
Bt	8-10	10YR 5/2	5YR 4/6	5	PL	cL	2msbk	
Btc	10-16	10YR 5/2	5YR 4/6	10	PL, M	cL	2msbk	Mn concreations starting at 12"
Btgc	16-24+	10YR 5/1	5YR 4/6	5	PL	cL	2msbk	Mn concreations

COMMENTS:

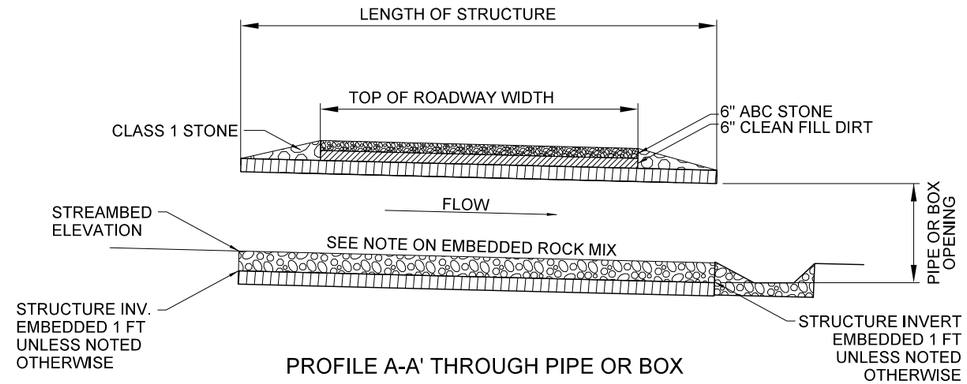
DESCRIBED BY: Tommy Seelinger DATE: 12/27/2021

TYPICAL CROSSING - CROSS-SECTIONAL VIEW



UPSTREAM SECTION

TYPICAL CROSSING - PROFILE VIEW



PROFILE A-A' THROUGH PIPE OR BOX

NORTH CAROLINA PROFESSIONAL SEAL 040899 ENGINEER KRISTIN E. KNIGHT

	DATE	REVISIONS
A	MARCH 2020	UPDATED CULVERT INFORMATION

NORTH CAROLINA
Environmental Quality

PROPOSED CROSSING SIZING								
PROJECT REACH	WIDTH OF ROADWAY (FT)	APPROX. TOP OF ROADWAY ELEVATION (FT)	STRUCTURE (ALL EMBEDDED 1 FT BELOW STREAM THALWEG UNLESS NOTED)	LENGTH OF STRUCTURE (FT)	UPSTREAM ELEVATIONS (FT) STREAM BED DESIGN / AS-BUILT	DOWNSTREAM ELEVATIONS (FT) STREAM BED DESIGN / AS-BUILT	UPSTREAM STRUCTURE STATION	DOWNSTREAM STRUCTURE STATION
T1 Upper	12	567.1	48" HDPE	24	562.45 design / 562.24 as-built	562.45 design / 562.08 as-built	13+15.04	13+39.04
T1 Lower	15	542.5	60" HDPE	30	536.78 design / 537.07 as-built	536.13 design / 536.16 as-built	27+92.26	28+22.26
T2	12	562.4	36" HDPE	24	558.71 design / 557.65 as-built	557.86 design / 556.52 as-built	N/A	N/A
T3 Upper	12	593.0	36" HDPE	24	589.30 design *	588.56 design *	301+60.49	301+84.49
T3 Lower	12	551.5	48" HDPE	24	546.78 design / 546.86 as-built	546.60 design / 546.51 as-built	318+00.49	318+24.49

ALL ELEVATIONS ARE FINISHED STREAM BED ELEVATIONS.
*Note: The upper culvert on T3 was not surveyed due to being outside the bounds of the as-built survey.

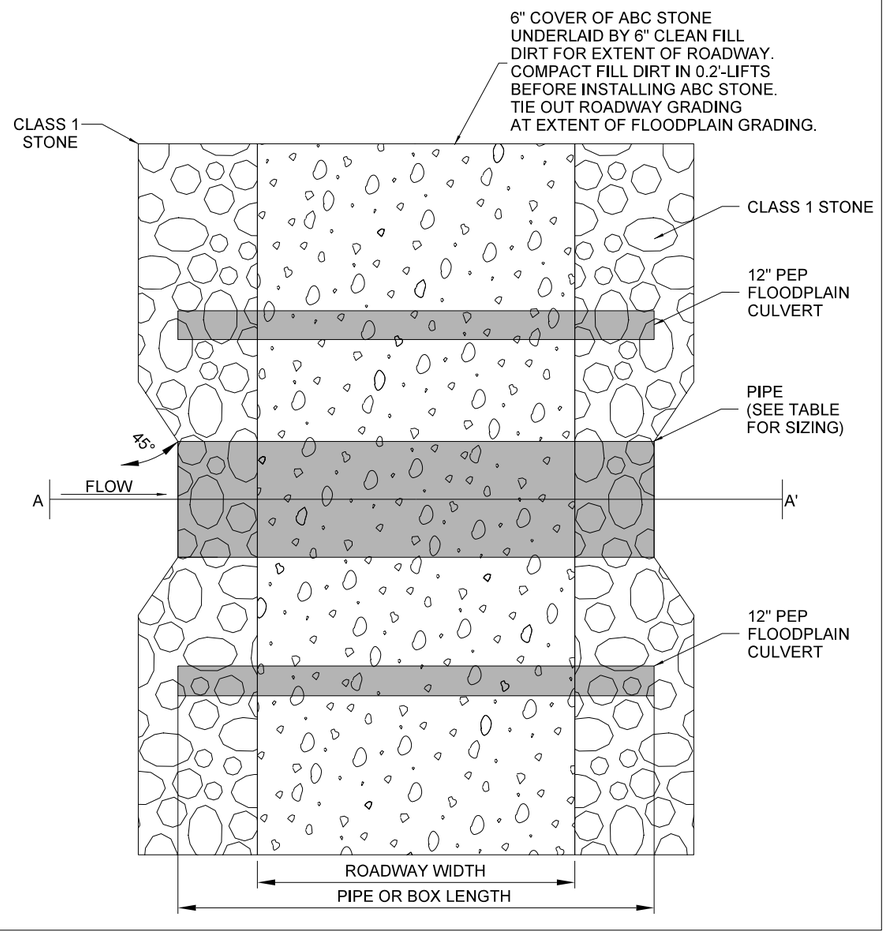
NOTES:

CULVERT THICKNESSES ASSUMED TO BE 8". ACTUAL THICKNESSES TO BE DETERMINED BY FABRICATOR.

DESIGN ROADWAY FILL IS A MINIMUM OF 1.0' AT ALL CROSSINGS.

IN LIEU OF WINGWALLS SEE RIPRAP PROTECTION/STABILIZATION.

TYPICAL CROSSING - PLANVIEW



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: FEBRUARY 2022
SCALE: NOT TO SCALE

CULVERT DETAILS

Culvert Photos

T1-1 Culvert – 4/15/2021

T1-3 Culvert – 4/15/2021

T2 Culvert – 4/15/2021

T3-1 Culvert – 1/27/2022

T3-3 Culvert – 4/15/2021