

Whittier Creek Mitigation Project

Year 1 (2022) Monitoring Report

Surry County, North Carolina

DMS Project ID No. 100020

DEQ Contract No. 7182

DWR# 17-1044

Yadkin River Basin: 03040101-110040

DMS RFP #16-006993 (Issued: 9/16/16)

USACE Action ID No. SAW-2017-01503

Year 1 Collection Period: Survey November 2022, Vegetation November 2022



Submitted to/Prepared for:

NC Department of Environmental Quality
Division of Mitigation Services (DMS)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Michael Baker

I N T E R N A T I O N A L

Submission Date: February 2023

 *This document was printed using 30% recycled paper.*

February 9, 2023

Matthew Reid, PM
NCDEQ, Division of Mitigation Services (DMS)
2090 U.S. 70 Highway
Swannanoa, NC 28778

Subject: Response to DMS Comments for Draft MY1 Report Review
Whittier Creek Mitigation Project, Surry County
Yadkin River Basin: 03040101
DMS Project #100020, DEQ Contract #7182

Mr. Reid:

Please find enclosed our responses to the NC Division of Mitigation Services' review comments dated December 16, 2022 in reference to the Whittier Creek Mitigation Project's Draft MY1 Report. We have revised the Draft document in response to the referenced review comments as outlined below.

General Report Comments

- Supplemental planting is planned for bare areas along R7 this winter. Please use species from the approved Mitigation Plan planting list and update the MY2 report with species list, quantities, and type (bare root, gallon, etc.).

Response: Michael Baker will include the information above in the MY2 report.

- Encroachments were identified on UT4a. DMS observed the small encroachment on a monitoring site visit and the solution proposed by Baker should rectify the problem. Please provide photos in the MY2 report of the additional posts and horse tape used to correct mowing encroachment.

Response: Michael Baker plans to address the situation and document the solution in the MY2 report.

- 1.4 Monitoring Result and Project Performance: Flow gauge (WCFL1) is discussed in the section. This gauge is labeled differently throughout the report. CCPV and photo on page 26 refers to gage as CSR1, Figure 6 refers to gauge as in-channel flow gauge 1 and Table 11 uses WCFL1. Please update report for consistency. Is this gage different than the two other continuous stage recorders installed on the site?

Response: To be consistent throughout the report, Michael Baker has renamed all gauges to continuous stage recorder (CSR) 1,2, and 3. All revisions have been made to table 10 and figure 5.

- Table 2: The lines for 404 Permit Date and Final Design Construction Plans can be removed from the table. Please include the Invasive Treatment activity from 2022.

Response: Table revised as requested. Invasive have been included.

- Table 5: A separate Table 5: Visual Stream Morphology Stability Assessment should be completed for all Reach IDs shown in Table 10. At the top of each table, please include the date that field assessment occurred.

Response: Table revised to include reaches: 4A, 4B, 5, and 7.

- Current Table 5 has several problems. Reach ID and assess length does not correspond to project. When determining the number of riffles, meanders, and engineered structure for each reach, please refer to the asbuilt. The current numbers shown for riffle condition, meander pool condition and structures does not match the CCPV or asbuilt. Please review and revise for all reaches.

Response: Table 5 has been revised to include all the information as stated above.

- Table 7: Thank you for utilizing the current vegetation monitoring table. Please include the MYO mobile plot information. 10 species, 931 stems/acre was reported in MYO.

Response: Table 7 was revised to include MYO.

- Cross Sections: Please only show markers for current year of monitoring. Previous years can be turned off.

Response: Revisions made as requested.

- Cross Section 3: Please add note regarding bank height ratio calculation as shown on other riffle cross section graphs.

Response: Revision made as requested.

- Figure 5: Please refer to “surface water gage template” (attached) for required graph information. Graph is missing several key pieces of information: bankfull elevation, thalweg elevation, etc.

Response: Additional information have been added to the graph as requested.

- Figure 5: Please update graph titles and refer to the reach and gage names how they occur within tables, CCPV and text for consistency. For example, one graph currently shows Whittier Creek Reach 4b Automatic Crest Gauge (Continuous Stage Recorder), but on the graph it is labeled as WCCG1. This should be UT4b – CSR1 or something similar.

Response: Revisions made as requested.

- Figure 5: Please print all Figure 5 graphs in landscape for final.

Response: All Figure 5 graphs have been changed to landscape as requested.

- Table 11: Flow gauge is referred to as WCFL1. Please review and revise.

Response: Table 11 has been removed and CSR1 is added to Table 10 to be consistent through the entire report.

- Figure 7: Please use bars to represent the Observed Project Rainfall for each month. Alternatively, a table can be used instead of graph as shown on sheet labeled “Rainfall Summary” in attached template.

Response: Figure 7 has been removed and made into Table 11 Rainfall Summary.

- Appendix F: Please include Baker’s comment response email to the IRT MYO review. Micky responded to Kim in an Email dated June 24, 2022.

Response: IRT MYO review email has been added to Appendix F as requested.

Digital Deliverable Comments

- No comments were generated for the draft digital deliverables submitted; however, please update the final digital deliverables with any changes made to the revised MY1 report and submit on USB drive with final deliverables.

Response: All revised documents in the report have been added to the digital deliverables to be submitted via USB drive.

As requested, two hardcopies of the final revised MY1 report has been included with this response along with a full electronic copy on a USB drive. Please do not hesitate to contact me further should have any additional questions regarding our response submittal.

Sincerely,



Andrew Powers
Project Manager

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1.0 PROJECT SUMMARY

1.1 Project Description

Michael Baker Engineering, Inc. (Michael Baker) restored approximately 2,844 linear feet of existing jurisdictional stream and enhanced 328 linear feet of stream along both the main stem of, and unnamed tributaries to Whittier Creek. The project also reestablished roughly 5.5 acres of riparian buffer, though not for buffer credit. The project is located in the Yadkin River Basin, within the Hydrologic Unit Code (HUC) 03040101-110040 (the Bull Creek – Ararat River Watershed), which is identified as a Targeted Local Watershed (TLW) in DMS’s 2009 *Upper Yadkin Pee-Dee River Basin Restoration Priorities* (RBRP) report.

The Whittier Creek Mitigation Project is located on an active cattle farm in Surry County, North Carolina, approximately 7 miles west of the Town of Pilot Mountain (Figure 1). Historic agriculture uses on the project site have been predominantly cattle pasture and crop production (tobacco and hay). These activities had negatively impacted both water quality and streambank stability along the project streams and their tributaries (Table 4). The project is being conducted as part of the NCDMS Full Delivery In-Lieu Fee Program and is anticipated to generate at close-out a total of 3,059.667 cool stream mitigation credits (Table 1) and is protected by a 6.9-acre permanent conservation easement.

1.2 Goals and Objectives

The goals of this project are identified below:

- Reconnect stream reaches to their floodplains
- Improve stream stability
- Improve aquatic habitat
- Reestablish forested riparian buffers
- Permanently protect the project

To accomplish these goals, the following objectives were identified:

- To raise channel beds or excavate bankfull floodplains by utilizing either a Priority I or Priority II Restoration approach, or through an Enhancement Level I approach.
- To construct streams of appropriate dimensions, pattern, and profile in restored reaches, slope stream banks and provide bankfull benches on enhanced streams, and utilize bio-engineering to provide long-term stability.
- Construct an appropriate channel morphology for all streams, increasing the number and depths of pools, increasing the amount of woody debris with structures including geo-lifts, brush-toe, log vanes/weirs, root wads, woody riffles, and/or log J-hooks.
- Establish riparian buffers at a 30-foot minimum width along all stream reaches, planted with native tree and shrub species.
- Establish a permanent conservation easement restricting land use in perpetuity. This will prevent site disturbance and allow the project to mature and stabilize.

1.3 Project Success Criteria

The success criteria and performance standards for the project will follow the North Carolina Interagency Review Team (NCIRT) guidance document *Wilmington District Stream and Wetland Compensatory Mitigation Update* dated October 24, 2016 and as described in Section 7 of the approved Mitigation Plan. All specific monitoring activities will follow those outlined in detail in Section 8 of the approved Mitigation Plan and will be conducted for a period of 7 years unless otherwise noted. Annual monitoring reports will follow the DMS document *Annual Monitoring Report Format, Data Requirements, and Content Guidance* from June 2017.

1.4 Monitoring Results and Project Performance

The Year 1 monitoring survey data of the eleven permanent cross-sections indicates that these stream sections are geomorphically stable and are within the lateral/vertical stability and in-stream structure performance categories. Certain cross-sections (as shown in Figure 3 and Table 9 in Appendix D) have shown very minor fluctuations in their geometry from last year, but these fluctuations do not represent a trend towards instability based off visual field evaluations. These fluctuations are the result of vegetation stabilizing the banks. All reaches are stable and performing as designed and are rated at 100 percent for all the parameters evaluated (Table 5 in Appendix B). There were no Stream Problem Areas (SPAs) identified.

During Year 1 monitoring, the planted acreage performance categories were functioning well overall. The planted stems endured fairly harsh growing conditions in their first year, with dryer than usual conditions in the summer and fall. However, the average density of total planted stems, based on data collected from the four permanent and one random monitoring plots for the Year 1 monitoring conducted in November 2022, was 729 stems per acre (Table 7 in Appendix C). Thus, the Year 1 vegetation data demonstrate that the Site is on track to meet the minimum success interim criteria of 320 trees per acre by the end of Year 3. During baseline MY0 Michael Baker reported all vegetation plot data using the CVS data tool. However, due to early stage in the project Michael Baker will report all data using the DMS Vegetation Table Production Tool from here on through the remaining years. Data from baseline MY0 has been included in year 1 Table 7.

There were however, three Vegetation Problem Areas (VPAs) identified during the Year 1 monitoring (Table 6 in Appendix B). The first VPA consists of low stem density and low vigor totaling 0.22 acres observed along the left and right bank of R7 close to station 20+75. These are areas that are impacted by compacted soils and overbank events after the confluence of UT5 and R7. Michael Baker plans to supplementally plant these areas and put out soil amendments this winter. The second VPA is a minor boundary encroachment on the left and right bank easement line on UT4a. These were areas accidentally mowed by the landowner before it was clear to delineate the easement boundary in the pasture. Michael Baker plans to install horse tape to ensure the boundary line until buffer vegetation establishes a clear line. Finally, the third VPA consists of a small area of observed privet (*Ligustrum sinense*) totaling about 0.05 acres. These areas have been treated during monitoring year 1 but will be treated again in 2023. The exact locations of each of these VPAs is shown in the Current Condition Plan View (CCPV) found in Appendix B.

During Year 1 monitoring, one post-construction bankfull event were observed at 0.43” along Reach 7 (see Table 10 in Appendix E and Figure 5 in Appendix E). The event occurred on 7/9/22 as documented through continuous stage recorders along with photographs found in the additional photolog in Appendix B.

As the observed monthly rainfall data for the project presented in Table 11 in Appendix E demonstrates, the past 12 months have varied dramatically as compared to historic average precipitation. A total of 44.5 inches of rainfall was observed for the project, while Surry County averages 49.0 inches of annual rainfall, an excess of just 4.5 inches. However, while the winter of 2021-2022 saw much greater than average rainfall totals, several months in the summer and fall saw much less than average rainfall totals.

Summary information/data related to the Site and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report Appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan available on the DMS website. Any raw data supporting the tables and figures in the Appendices is available from DMS upon request.

This report documents the successful completion of the Year 1 monitoring activities for the post-construction monitoring period.

1.5 Technical and Methodological Descriptions

Stream survey data was collected using a differential laser level, which was derived and compared to the As-built Survey. The survey data from the permanent project cross-sections were collected and classified using the Rosgen Stream Classification System to confirm design stream type (Rosgen 1994 and 1996).

The five vegetation-monitoring quadrants (plots) were installed across the site in accordance with the CVS-DMS Protocol for Recording Vegetation, Version 4.1 (Lee 2007) and the data collected from each was input into the DMS Vegetation Table Production Tool.

Three in-stream continuous stage recorders were installed along Reach UT5, UT4b, and Reach 7. The gauges themselves are all Van Essen brand Diver Mate data loggers.

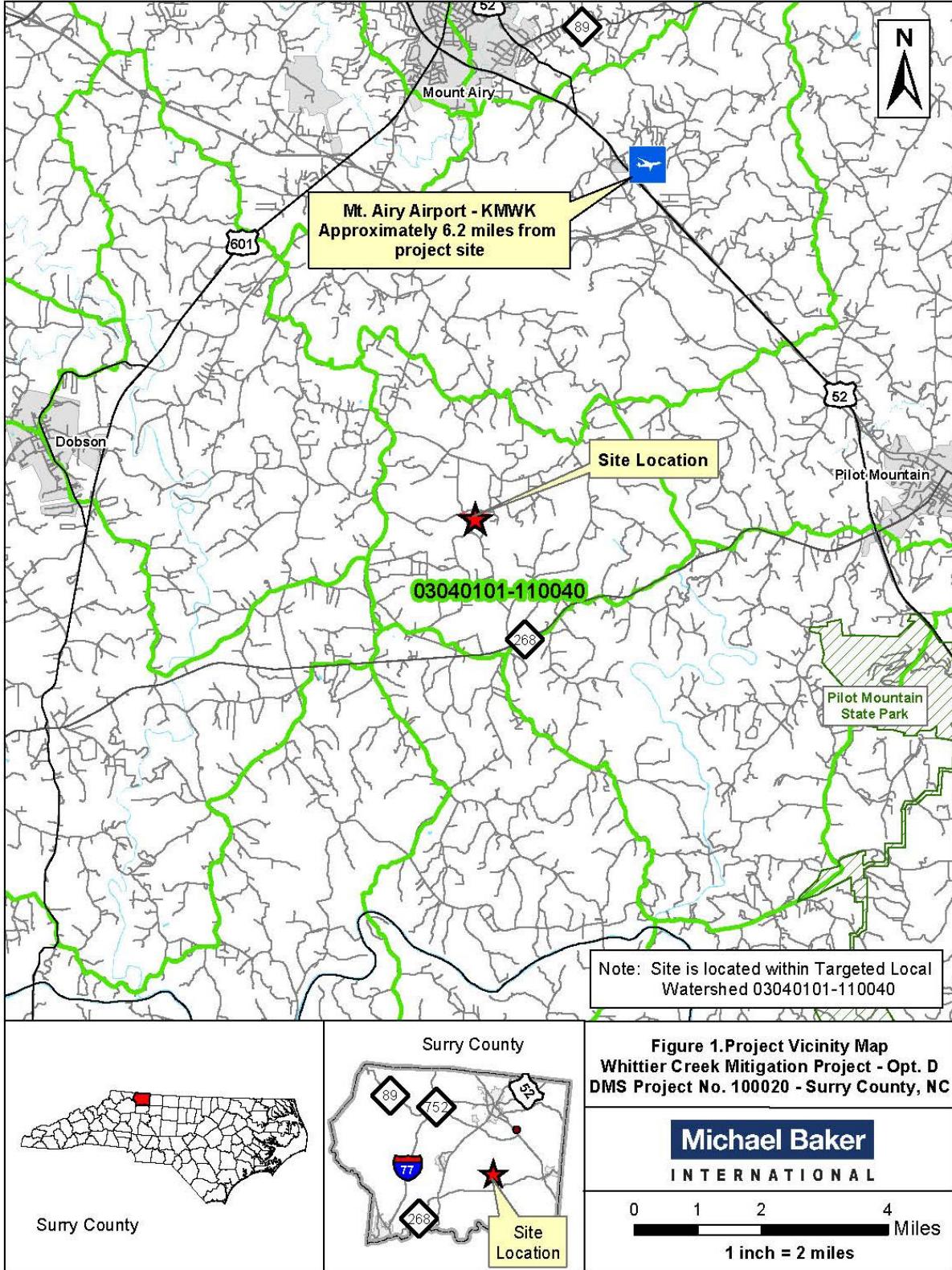
The specific locations of monitoring features, such as vegetation plots, permanent cross-sections, reference photograph stations, and crest gauges, are shown on the CCPV map found in Appendix B.

1.6 References

- Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-DMS Protocol for Recording Vegetation, Version 4.1.
- NC Division of Mitigation Services (DMS). DMS Vegetation Table Production Tool. North Carolina, Raleigh, NC. 2012.
- North Carolina Division of Mitigation Services. 2009. Upper Yadkin Pee-Dee River Basin Restoration Priorities. NC Department of Environmental Quality. Raleigh, NC.
- North Carolina Division of Mitigation Services. 2017. *Annual Monitoring Report Format, Data Requirements, and Content Guidance June 2017*. NC Department of Environmental Quality. Raleigh, NC.
- North Carolina Interagency Review Team (NCIRT). 2016. Guidance document “*Wilmington District Stream and Wetland Compensatory Mitigation Update*”. October 24, 2016
- Rosgen, D.L. 1994. A Classification of Natural Rivers. *Catena* 22:169-199.
- Rosgen, D.L. 1996. *Applied River Morphology*. Wildlands Hydrology. Pagosa Springs, CO.

1.7 Vicinity Map

Project Coordinates: 36.3779 N, -80.5999 W



APPENDIX A

Background Tables and Figures

Table 1.0 Project Components and Mitigation Credits
Whittier Creek Mitigation Project - NCDMS Project No. 100020

Project Component (reach ID, etc.)	Wetland Position and HydroType	Existing Footage or Acreage	Stationing	As-Built Restored Footage ¹	Mitigation Plan Designed Footage	Restoration Level	Approach Priority Level	Mitigation Ratio (X:1)	Mitigation Plan Credits ²
Reach R7 (Whittier Creek)		1,462	11+36 - 15+50, 15+62 - 24+91	1,343	1,332	R	P2	1	1,332.000
Reach UT4a		338	10+00 -13+27	328	328	E	L1	1.5	218.667
Reach UT4b		764	13+76 - 21+30	754	761	R	P1	1	761.000
Reach UT5		765	10+00 - 12+46, 12+91 - 17+92	747	748	R	P1	1	748.000
Wetland Group 1									
Buffer Group 1 (BG1)									

¹ All stream stationing and restored footage numbers reported here and shown in the as-built plan sheets use *thalweg* survey values and have had easement breaks removed.

² Credits reported here are derived from the design lengths as taken from the approved mitigation plan Table 11.1

Table 1.1
As-Built Centerline Length and Area Summations by Mitigation Category

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Credited Buffer (ft ²)
		Riverine	Non-Riverine		
Restoration	2,844				
Enhancement					
Enhancement I	328				
Enhancement II					
Creation					
Preservation					
High Quality Pres					

Table 1.2
Overall Assets Summary

Asset Category	Overall Credits
Stream (cool)	3,059.667
RP Wetland	
NR Wetland	
Buffer	

Conservation Easement

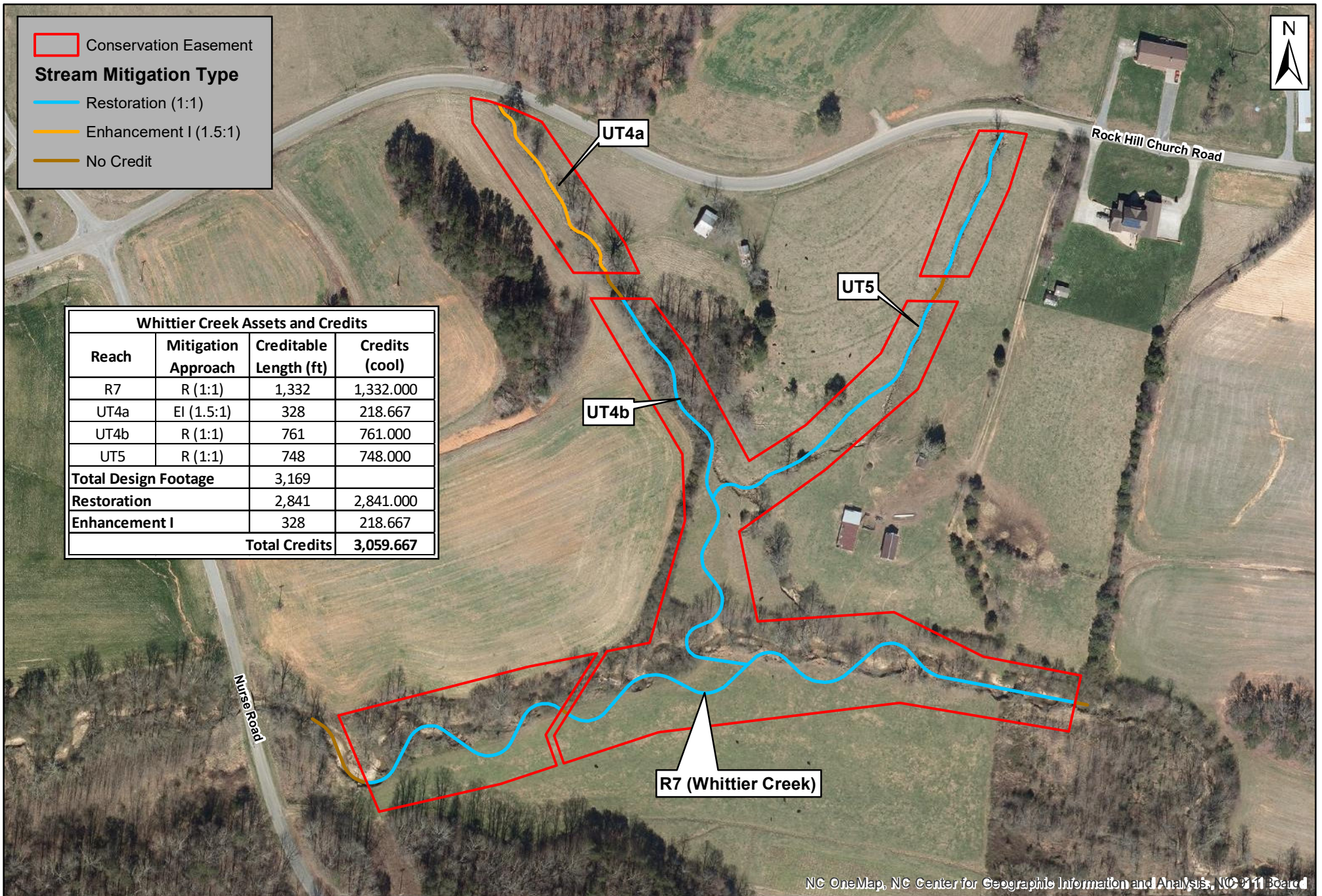
Stream Mitigation Type

Restoration (1:1)

Enhancement I (1.5:1)

No Credit

Whittier Creek Assets and Credits			
Reach	Mitigation Approach	Creditable Length (ft)	Credits (cool)
R7	R (1:1)	1,332	1,332.000
UT4a	EI (1.5:1)	328	218.667
UT4b	R (1:1)	761	761.000
UT5	R (1:1)	748	748.000
Total Design Footage		3,169	
Restoration		2,841	2,841.000
Enhancement I		328	218.667
Total Credits			3,059.667



NC OneMap, NC Center for Geographic Information and Analysis, NC 11 Board

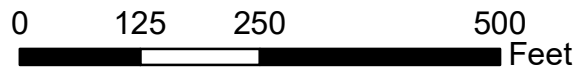


Figure 2. Project Asset and Credit Map
Whittier Creek Mitigation Project
DMS Project No. 100020

Table 2. Project Activity and Reporting History
Whittier Creek Mitigation Project - NCDMS Project No. 100020

Grading Completed in June 2021		
Elapsed Time Since grading complete:	1 year and 5 months	
All Planting Completed in January 2022		
Elapsed Time Since planting complete:	11 months	
Number of Reporting Years¹:	1	
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Institution date	N/A	May-2017
Mitigation Plan	N/A	Mar-2020
Construction Grading Completed	N/A	Jun-2021
As-Built Survey	Aug-2021	Aug-2021
Livestake and Bareroot Planting Completed	N/A	Jan-2022
As-Built Stream Survey	Aug-2021	N/A
As-Built Vegetation Monitoring	Jan-2022	N/A
As-Built Baseline Monitoring Report (MY0)	Jan-2022	Feb-2022
Year 1 Stream Survey	Nov-2022	N/A
Year 1 Vegetation Monitoring	Nov-2022	N/A
Year 1 Invasive Treatment		Apr-2022
Year 1 Monitoring	Nov-2022	Dec-2022
Year 2 Monitoring (anticipated)	Oct-2023	Dec-2023
Year 3 Monitoring (anticipated)	Oct-2024	Dec-2024
Year 4 Monitoring (anticipated)	Oct-2025	Dec-2025
Year 5 Monitoring (anticipated)	Oct-2026	Dec-2026
Year 6 Monitoring (anticipoated)	Oct-2027	Dec-2027
Year 7 Monitoring (anticipated)	Oct-2028	Dec-2028

¹ = The number of monitoring reports excluding the as-built/baseline report

Table 3. Project Contacts
Whittier Creek Mitigation Project - NCDMS Project No. 100020

Designer	8000 Regency Parkway, Suite 600
Michael Baker Engineering, Inc.	Cary, NC 27518 Contact: Katie McKeithan, Tel. 919-418-5703
Construction Contractor	5616 Coble Church Rd
KBS Earthworks, Inc.	Julian, NC 27283 Contact: Kory Strader, Tel. 336-362-0289
Survey Contractor	88 Central Avenue
Kee Mapping and Surveying	Asheville, NC 28801 Contact: Brad Kee, Tel. 828-575-9021
Planting Contractor	5616 Coble Church Rd
KBS Earthworks, Inc.	Julian, NC 27283 Contact: Kory Strader, Tel. 336-362-0289
Seeding Contractor	5616 Coble Church Rd
KBS Earthworks, Inc.	Julian, NC 27283 Contact: Kory Strader, Tel. 336-362-0289
Seed Mix Sources	
Green Resources	Telephone: 336-855-6363
Nursery Stock Suppliers	
Mellow Marsh Farm	Telephone: 919-742-1200
Bruton Natural Systems	Telephone: 919-242-6555
Monitoring Performers	
Michael Baker Engineering, Inc.	8000 Regency Parkway, Suite 600 Cary, NC 27518
Stream Monitoring POC	Drew Powers, Tel. 919-418-5732
Vegetation Monitoring POC	Drew Powers, Tel. 919-418-5732

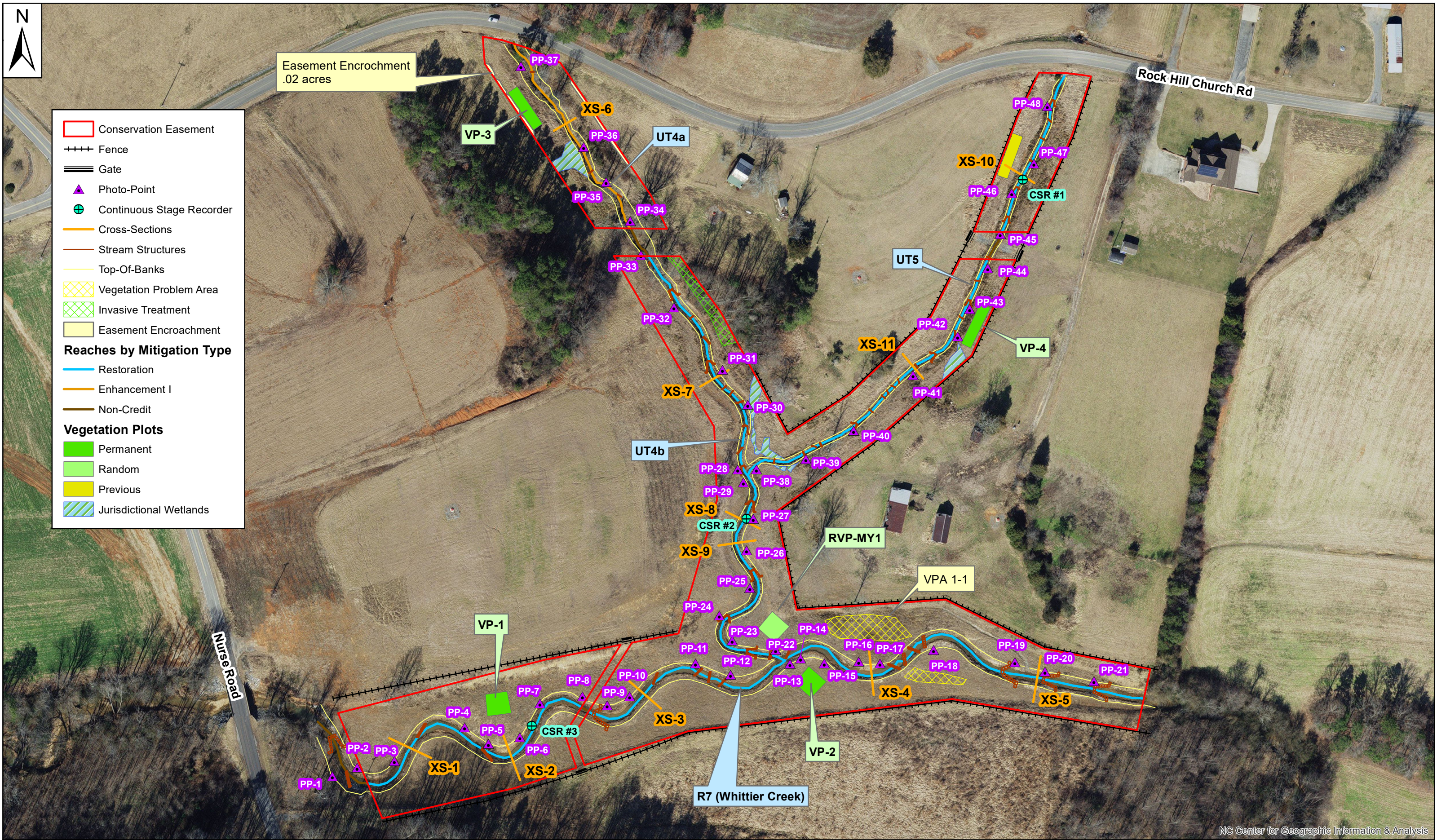
Table 4. Project Attributes for Existing Conditions

Whittier Creek Mitigation Project – NCDMS Project No. 100020

Project Information				
Project Name		Whittier Creek Site – Option D Mitigation Project		
County		Surry		
Project Area (acres)		6.97		
Project Coordinates (lat. and long.)		36.3779 N, -80.5999 W		
Project Watershed Summary Information				
Physiographic Province		Northern Inner Piedmont		
River Basin		Yadkin Pee-Dee		
USGS Hydrologic Unit 8-digit	3040101	USGS Hydrologic Unit 14-digit	03040101-110040	
DWR Sub-basin		03-07-03		
Project Drainage Area (acres)		1,722 acres / 2.69 square miles (at downstream end of R7)		
Stream Temperature Regime		cool		
Project Drainage Area Percentage of Impervious Area		0.95% impervious area		
USGS National Land Cover Database (NLCD) for 2011		8.2% developed (predominantly rural residential), 41.6% cultivated crops and hay, 6.9% grass/pasture, 4.8% shrub/scrub, and 38.3% forested.		
Reach Summary Information				
Parameters	Reach R7	UT4a	UT4b	UT5
Existing length of reach (linear feet)	1,462	338	764	765
Valley confinement (Confined, moderately confined, unconfined)	Unconfined	Moderately Confined	Unconfined	Moderately Confined
Drainage area (acres)	1,722	225	305	72
Perennial, Intermittent, Ephemeral	Perennial	Perennial	Perennial	Perennial
NCDWR Water Quality Classification	C	C	C	C
Stream Classification (existing / proposed)	G4&F4/C4	E4&B4/B4b	E4&G4c/C4	B4/B4
Evolutionary trend (Simon)	IV – Degradation and Widening	III – Degradation	IV – Degradation and Widening	III – Degrading
FEMA classification	Zone X	Zone X	Zone X	Zone X
Regulatory Considerations				
Parameters	Applicable?	Resolved?	Supporting Docs?	
Water of the United States - Section 404	Yes	Yes	PCN	
Water of the United States - Section 401	Yes	Yes	PCN	
Endangered Species Act	Yes	Yes	Categorical Exclusion	
Historic Preservation Act	Yes	Yes	Categorical Exclusion	
Coastal Zone Management Act (CAMA)	No	N/A	N/A	
FEMA Floodplain Compliance	No	N/A	N/A	
Essential Fisheries Habitat	No	N/A	N/A	

APPENDIX B

Visual Assessment Data



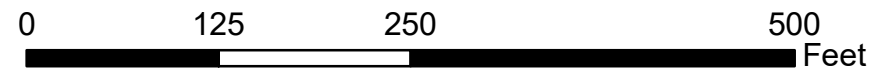
- Conservation Easement
 - Fence
 - Gate
 - ▲ Photo-Point
 - ⊕ Continuous Stage Recorder
 - Cross-Sections
 - Stream Structures
 - Top-Of-Banks
 - Vegetation Problem Area
 - Invasive Treatment
 - Easement Encroachment
- Reaches by Mitigation Type**
- Restoration
 - Enhancement I
 - Non-Credit
- Vegetation Plots**
- Permanent
 - Random
 - Previous
 - Jurisdictional Wetlands

Easement Encroachment
.02 acres

Rock Hill Church Rd

Nurse Road

R7 (Whittier Creek)



NC Center for Geographic Information & Analysis

**Figure 3. Current Conditions Plan View
Monitoring Year 1
Whittier Creek Mitigation Project (#100020)
Surry County, NC**

Table 5. Visual Stream Morphology Stability Assessment
Whittier Creek Mitigation Project – NCDMS Project No. 100020

Reach ID: Reach UT4A							
Assessed Length (LF): 328							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	0	0			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth \geq 1.5)	0	0			100%
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
		2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected		0	0	100%
		3. Mass Wasting	Banks slumping, caving or collapse		0	0	100%
	Totals					0	0
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	4	4			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	4	4			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	4	4			100%
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	4	4			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio \geq 1.5. Rootwads/logs providing some cover at low flow	3	3			100%
Reach ID: Reach UT4b							
Assessed Length (LF): 754							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	4	4			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth \geq 1.5)	7	7			100%
		2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	7	7			100%
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	4	4			100%
		2. Thalweg centering at downstream of meander bend (Glide)	7	7			100%
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
		2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected		0	0	100%
		3. Mass Wasting	Banks slumping, caving or collapse		0	0	100%
	Totals					0	0
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	16	16			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	16	16			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	16	16			100%
	3. Bank Position	Bank erosion within the structures extent of influence does not exceed 15%	16	16			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio \geq 1.5. Rootwads/logs providing some cover at low flow	8	8			100%

Reach ID: Reach UT5							
Assessed Length (LF): 747							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	19	19			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth \geq 1.5)	5	5			100%
		2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	5	5			100%
4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	19	19			100%	
	2. Thalweg centering at downstream of meander bend (Glide)	5	5			100%	
Totals							
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected			0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%
Totals							
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	22	22			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	22	22			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	22	22			100%
		Bank erosion within the structures extent of influence does not exceed 15%	22	22			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio \geq 1.5. Rootwads/logs providing some cover at low flow	16	16			100%
Reach ID: Reach 7							
Assessed Length (LF): 1,343							
Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number per As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended
1. Bed	1. Vertical Stability	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%
		2. Degradation - Evidence of downcutting			0	0	100%
	2. Riffle Condition	1. Texture Substrate - Riffle maintains coarser substrate	12	12			100%
	3. Meander Pool Condition	1. Depth - Sufficient (Max Pool Depth/Mean Bkf Depth \geq 1.5)	11	11			100%
		2. Length - Sufficient (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	11	11			100%
4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	12	12			100%	
	2. Thalweg centering at downstream of meander bend (Glide)	11	11			100%	
Totals							
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover due to active scour and erosion			0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting is expected			0	0	100%
	3. Mass Wasting	Banks slumping, caving or collapse			0	0	100%
Totals							
3. Engineering Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	21	21			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill	21	21			100%
	2a. Piping	Structures lacking any substantial flow underneath or around sills or arms	21	21			100%
		Bank erosion within the structures extent of influence does not exceed 15%	21	21			100%
	4. Habitat	Pool forming structures maintaining - Max Pool Depth/Mean Bankfull Depth ratio \geq 1.5. Rootwads/logs providing some cover at low flow	17	17			100%

Table 6. Vegetation Conditions Assessment
Whittier Creek Mitigation Project - NCDMS Project No. 100020

Planted Acreage: 5.49						
Vegetation Category	Definitions	Mapping Threshold (acres)	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas *	Very limited cover both woody and herbaceous material.	0.1 acres	Yellow Hatching	2	0.22	4.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	N/A	0	0.00	0.0%
Total						
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems or a size class that are obviously small given the monitoring year.	0.25 acres	Yellow Hatching	2	0.22	4.0%
Cumulative Total						
Easement Acreage: 6.9						
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Points	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	1000 ft ²	Green Hatching	1	0.05	0.7%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	577 ft ²	Yellow Polygon	2	0.02	0.3%

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-1: Reach 7, looking down valley from top of project



PP-2: Reach 7, downstream, Station 11+00



PP-3: Reach 7, downstream, Station 12+00



PP-4: Reach 7, downstream, Station 13+25



PP-5: Reach 7, downstream, Station 13+75



PP-6: Reach 7, downstream, Station 14+25

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-7: Reach 7, downstream, Station 14+75



PP-8: Reach 7, downstream, Station 15+50



PP-9: Reach 7, downstream, Station 16+00



PP-10: Reach 7, downstream, Station 16+50



PP-11: Reach 7, downstream, Station 17+50



PP-12: Reach 7, downstream, Station 18+00

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-13: Reach 7, upstream, Station 19+00 at confluence with Reach UT4B



PP-14: Reach 7, downstream, Station 19+25



PP-15: Reach 7, downstream, Station 19+75



PP-16: Reach 7, downstream, Station 20+25



PP-17: Reach 7, downstream, Station 20+75



PP-18: Reach 7, downstream, Station 21+50

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-19: Reach 7, upstream, Station 22+75



PP-20: Reach 7, downstream, Station 23+25



PP-21: Reach 7, downstream, Station 24+00



PP-22: Reach UT4B, upstream, Station 21+10



PP-23: Reach UT4B, upstream, Station 20+50



PP-24: Reach UT4B, upstream, Station 20+00

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-25: Reach UT4B, upstream, Station 19+25



PP-26: Reach UT4B, upstream, Station 18+75



PP-27: Reach UT4B, upstream, Station 18+00



PP-28: Reach UT4B, Station 17+50 at confluence with Reach UT5



PP-29: Reach UT4B, upstream, Station 17+25



PP-30: Reach UT4B, upstream, Station 16+50

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-31: Reach UT4B, upstream, Station 15+75



PP-32: Reach UT4B, upstream, Station 15+50



PP-33: Reach UT4B, upstream, Station 13+75



PP-34: Reach UT4A, upstream, Station 13+25



PP-35: Reach UT4A, upstream, Station 12+50



PP-36: Reach UT4A, upstream, Station 11+75

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-37: Reach UT4A, upstream, Station 10+25



PP-38: Reach UT5, upstream, Station 17+75



PP-39: Reach UT5, upstream, Station 17+00



PP-40: Reach UT5, upstream, Station 16+15



PP-41: Reach UT5, upstream, Station 15+00



PP-42: Reach UT5, upstream, Station 14+00

Whittier Creek: MY1 Stream Station Photo-Points (taken 11/16/22)



PP-43: Reach UT5, upstream, Station 13+60



PP-44: Reach UT5, upstream, Station 13+00 at ford crossing



PP-45: Reach UT5, upstream, Station 12+50



PP-46: Reach UT5, upstream, Station 11+75



PP-47: Reach UT5, upstream, Station 11+25



PP-48: Reach UT5, upstream, Station 10+50

Whittier Creek: MY1 Vegetation Plot Photos (taken 11/16/2022)



Vegetation Plot 1



Vegetation Plot 2



Vegetation Plot 3



Vegetation Plot 4



Random Vegetation Plot – MY1

Whittier Creek: MY1 Additional Project Photos



Continuous Stage Recorder #1 on UT5 (11/19/22)



Continuous Stage Recorder #2 on UT4b (11/19/22)



Continuous Stage Recorder #3 on R7 (11/19/22)



R7 Overbank Event Evidence (7/27/22)



Encroachment to the CE on UT4a (11/16/22)



Invasive treatment along UT4a (11/19/2022)

Whittier Creek: MY1 Additional Project Photos



Invasive treatment along UT4a (11/19/2022)



Vegetation Problem Area – R7 left bank (11/16/22)



Vegetation Problem Area – R7 left bank (11/16/22)



Site Camera Located to Capture Storm Events. Due to Installing in June the Early Year Storm Events were not Captured. 6/29/2022

APPENDIX C

Vegetation Plot Data

Table 7. Vegetation Plot Data
Whittier Creek Mitigation Project - NCDMS Project No. 100020

	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 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC			2	2					1
	Betula nigra	river birch	Tree	FACW	3	3	3	3					
	Carpinus caroliniana	American hornbeam	Tree	FAC	1	1							1
	Celtis laevigata	sugarberry	Tree	FACW							1	1	
	Diospyros virginiana	common persimmon	Tree	FAC	4	4			2	2	1	1	
	Fraxinus pennsylvanica	green ash	Tree	FACW							2	2	
	Hamamelis virginiana	American witchhazel	Tree	FACU			2	2			3	3	3
	Juglans nigra	black walnut	Tree	UPL			1	1					2
	Lindera benzoin	northern spicebush	Tree	FACW					1	1			1
	Liriodendron tulipifera	tuliptree	Tree	FACU	6	6	5	5	1	1			1
	Nyssa sylvatica	blackgum	Tree	FAC							1	1	
	Platanus occidentalis	American sycamore	Tree	FACW	1	1			2	2	1	1	1
	Quercus alba	white oak	Tree	FACU					2	2			
	Quercus lyrata	overcup oak	Tree	OBL	1	1	4	4	4	4	4	4	
	Quercus phellos	willow oak	Tree	FACW	4	4	1	1	6	6	8	8	2
Ulmus americana	American elm	Tree	FAC	1	1								
Sum	Performance Standard				21	21	18	18	18	18	21	21	12
Mitigation Plan Performance Standard	Current Year Stem Count					21		18		18		21	12
	Stems/Acre					850		729		729		850	486
	Species Count					8		7		7		8	8
	Dominant Species Composition (%)					29		28		33		38	25
	Average Plot Height (ft.)					158		209		224		210	194
% Invasives					0		0		0		0	0	
Post Mitigation Plan Performance Standard	Current Year Stem Count					21		18		18		21	12
	Stems/Acre					850		729		729		850	486
	Species Count					8		7		7		8	8
	Dominant Species Composition (%)					29		28		33		38	25
	Average Plot Height (ft.)					158		209		224		210	194
% 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.

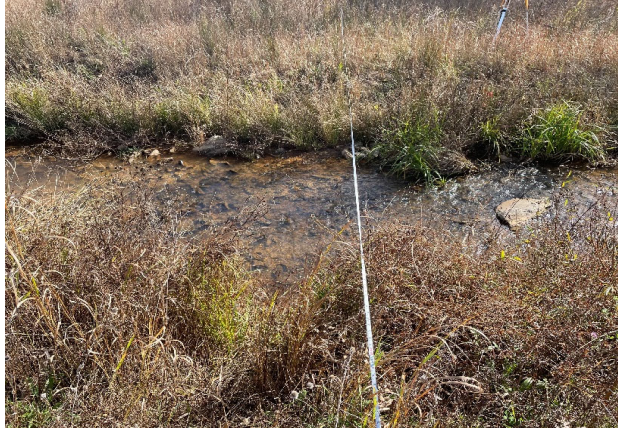
	Veg Plot 1 F				Veg Plot 2 F				Veg Plot 3 F			
	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives	Stems/Ac.	Av. Ht. (ft)	# Species	% Invasives
Monitoring Year 7												
Monitoring Year 5												
Monitoring Year 3												
Monitoring Year 2												
Monitoring Year 1	850	158	8	0	729	209	7	0	729	224	7	0
Monitoring Year 0	1052	194	8	0	1255	216	7	0	810	227	7	0
	Veg Plot 4 F				Veg Plot Group 1 R							
	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	210	8	0	486	194	8	0				
Monitoring Year 0	1052	201	10	0	931		10	0				

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

APPENDIX D

Stream Measurement and Geomorphology Data

Permanent Cross-Section 1
Year 1 Survey Collected: November 2022

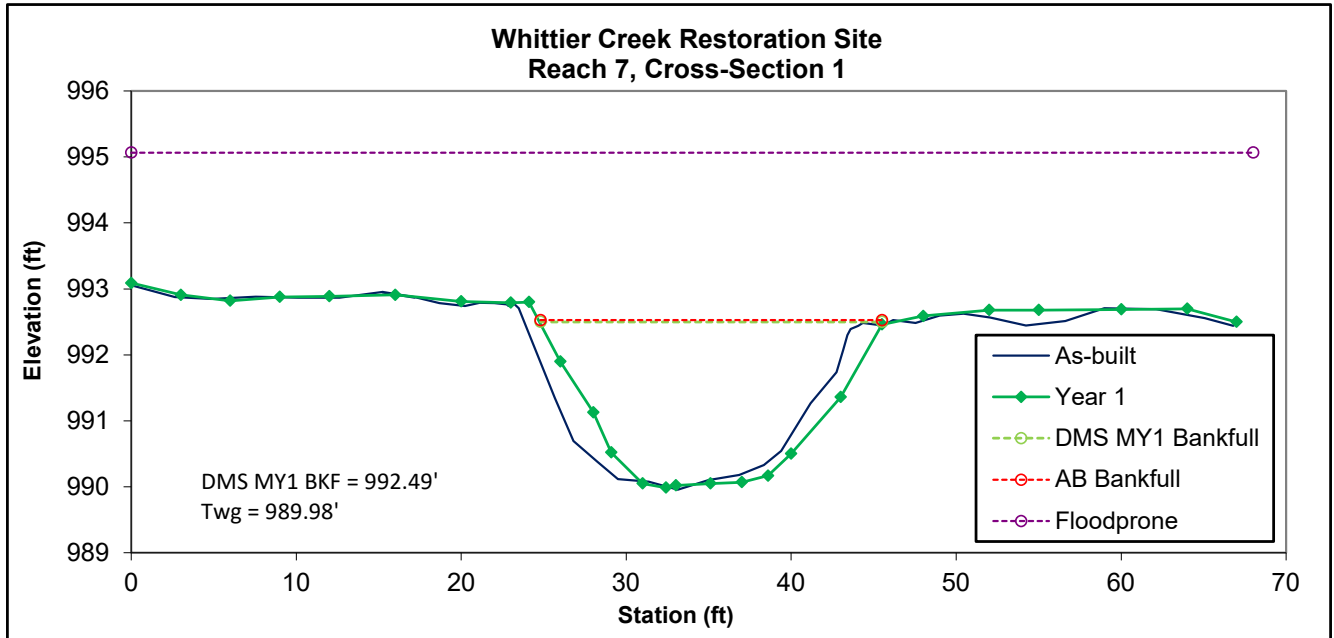


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Riffle	C	36.8	22.5	1.6	2.5	13.8	1.0	3.0	992.48	992.46



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 2
Year 1 Survey Collected: November 2022

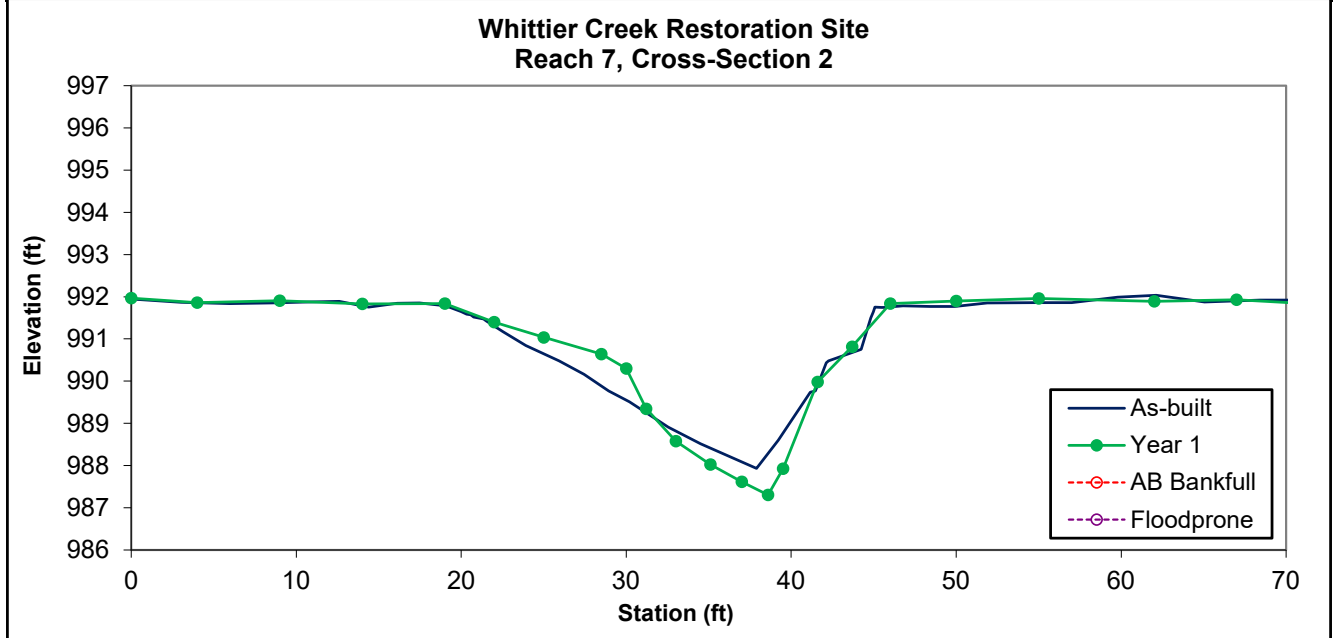


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Pool	-	49.4	26.2	1.9	4.4	13.9	-	-	991.75	991.84



Permanent Cross-Section 3
Year 1 Survey Collected: November 2022

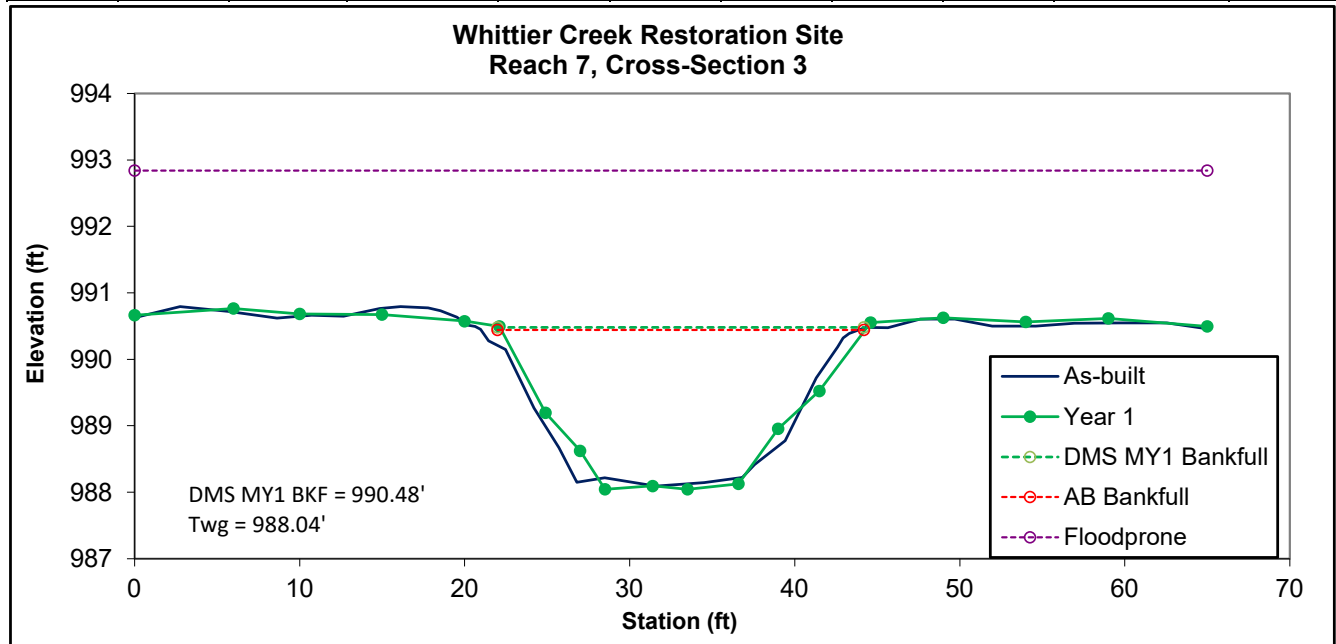


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Riffle	C	36.1	22.1	1.6	2.4	13.5	1.0	2.9	990.44	990.49



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 4
 Year 1 Survey Collected: November 2022

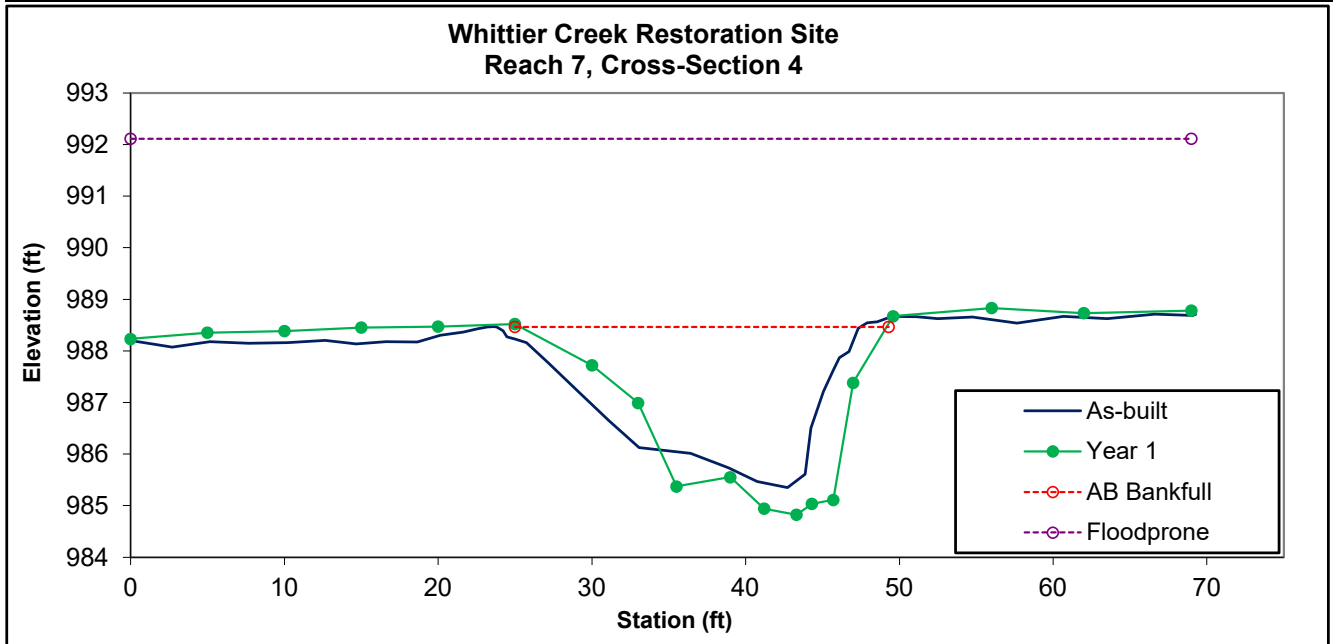


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Pool	-	48.2	23.8	2	3.6	11.8	-	-	988.47	988.67



Permanent Cross-Section 5
Year 1 Survey Collected: November 2022

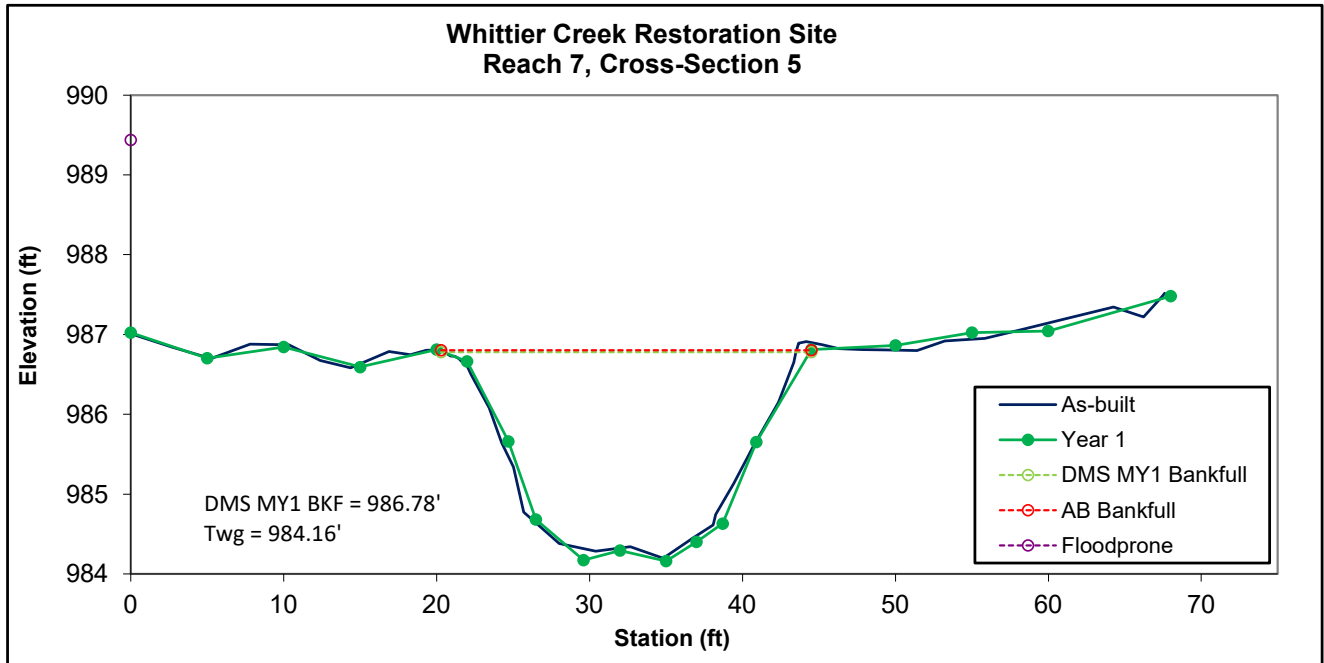


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Rifle	C	40.7	24.3	1.7	2.6	14.6	1.0	2.8	986.80	984.81



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 6
Year 1 Survey Collected: November 2022

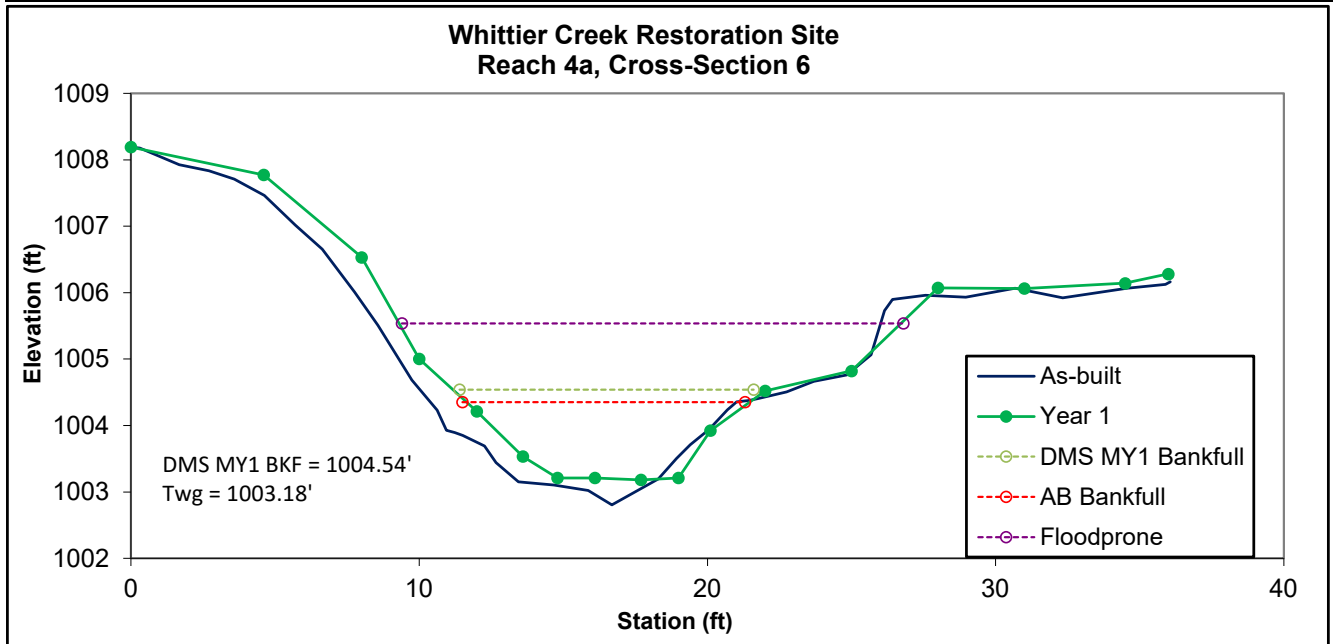


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Riffle	C	8.0	9.9	0.8	1.2	12.1	1	1.8	1004.36	1004.50



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 7
Year 1 Survey Collected: November 2022

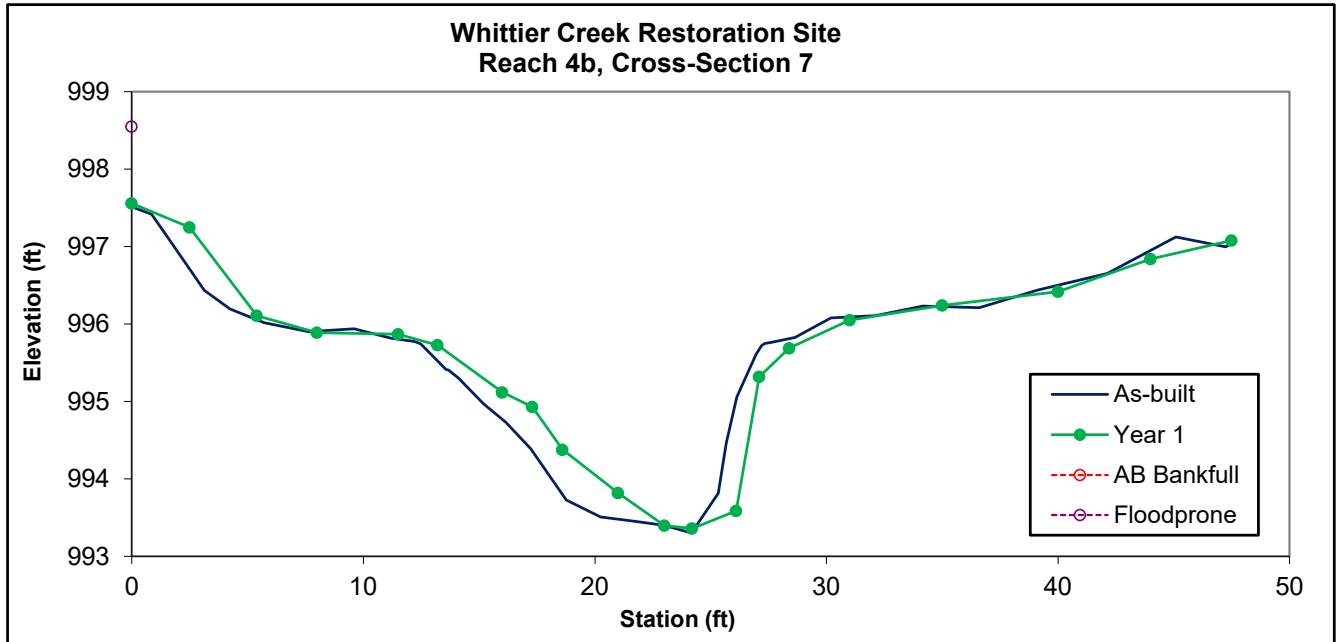


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Pool	-	19.8	15.4	1.3	2.4	11.9	-	-	995.72	995.69



Permanent Cross-Section 8
Year 1 Survey Collected: November 2022

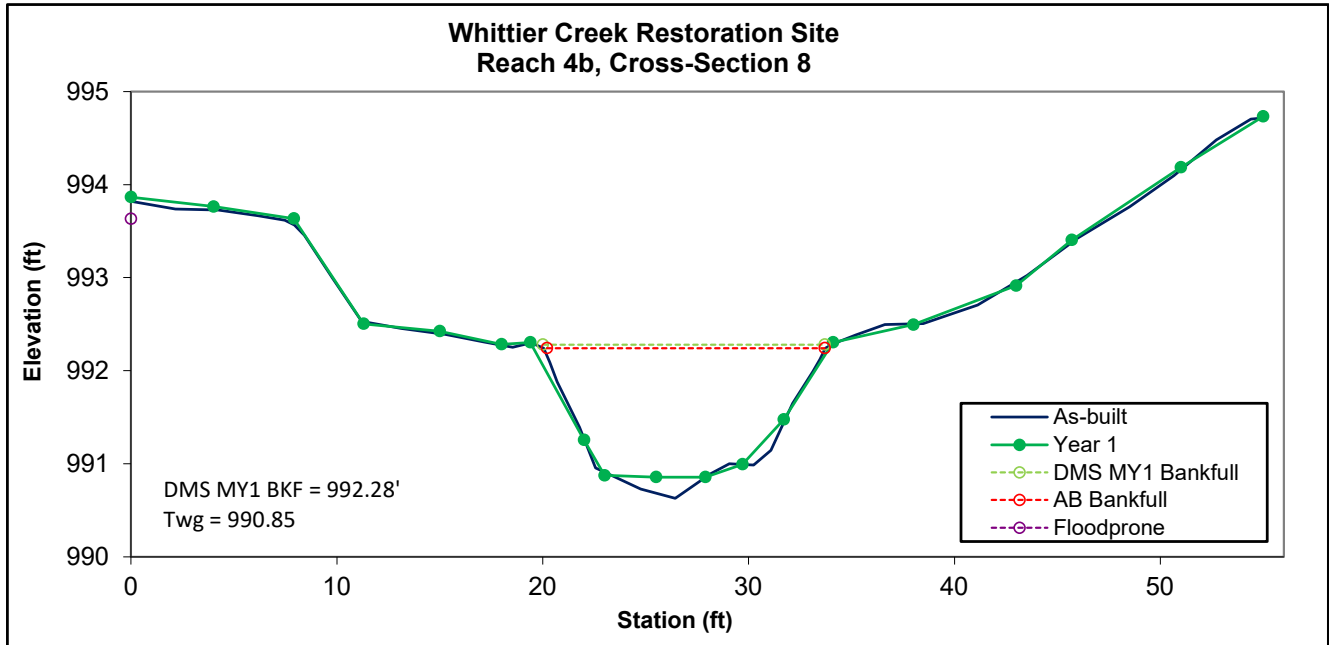


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Riffle	C	14.4	14.4	1	1.4	14.3	1.0	2.7	992.24	992.30



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 9
Year 1 Survey Collected: November 2022

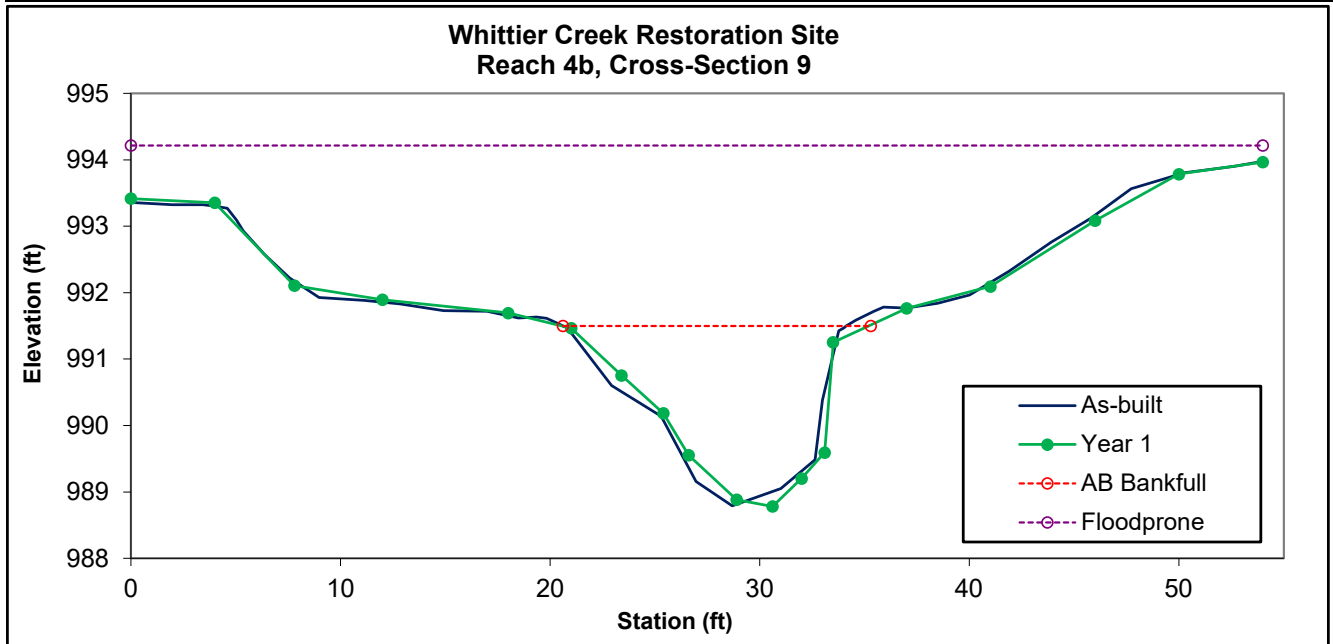


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Pool	-	21.2	14.7	1.4	2.7	10.1	-	-	991.50	991.25



Permanent Cross-Section 10
Year 1 Survey Collected: November 2022

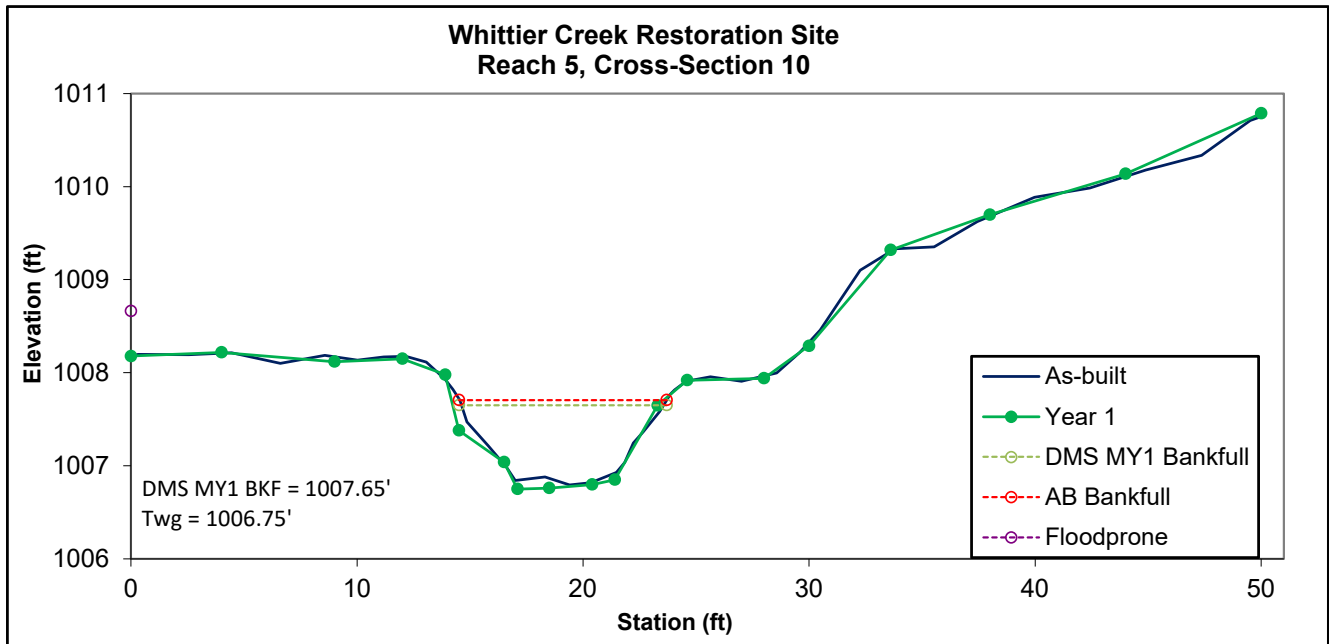


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Riffle	C	6.4	9.4	0.7	1.0	13.8	1.4	3.3	1007.70	1008.00



Note: Per DMS/IRT request, bank height ratio for MY1 has been calculated using the bankfull elevation as determined from the as-built bankfull area. All other values were calculated using the as-built bankfull elevation.

Permanent Cross-Section 11
 Year 1 Survey Collected: November 2022



Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	LTOB Elev
Pool	-	11.3	9.4	1.2	1.9	7.7	-	-	998.87	999.16

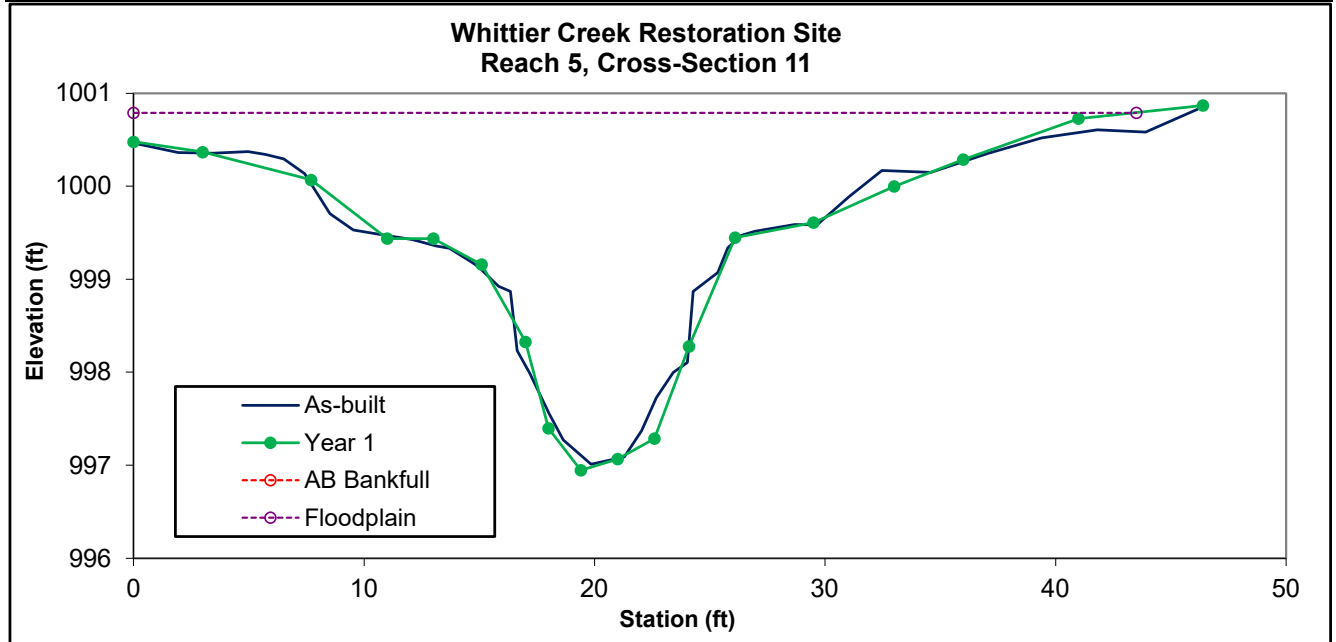


Table 8. Baseline Stream Data Summary
Whittier Creek Restoration Project: DMS Project No ID. 100020

Reach 7 (Whittier Creek)

Parameter	Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
				Composite								
Dimension and Substrate - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
BF Width (ft)	18.5	20.1	21.7	-----	-----	-----	-----	22.2	-----	20.5	22.0	22.9
Floodprone Width (ft)	22	23.0	24	-----	-----	-----	50	100	150	75	130	155
BF Mean Depth (ft)	1.8	1.8	1.8	-----	-----	-----	-----	1.8	-----	1.6	1.7	1.8
BF Max Depth (ft)	2.2	2.3	2.3	-----	-----	-----	-----	2.3	-----	2.4	2.5	2.6
BF Cross-sectional Area (ft ²)	33.5	36.2	38.8	-----	-----	-----	-----	41.0	-----	36.2	37.7	40.0
Width/Depth Ratio	10.2	11.2	12.1	12.0	13.5	15.0	-----	12.3	-----	11.6	12.9	14.2
Entrenchment Ratio	1.1	1.2	1.2	-----	-----	-----	2.3	4.6	6.8	3.3	5.4	7.1
Bank Height Ratio	2.8	3.0	3.2	1.0	1.0	1.0	-----	1.0	-----	1.0	1.0	1.0
d50 (mm)	6.4	16	26	-----	-----	-----	-----	-----	-----	44	48	50
Pattern												
Channel Beltwidth (ft)	45	55	65	-----	-----	-----	80	100	120	70	97	120
Radius of Curvature (ft)	25	39	53	-----	-----	-----	36	48	60	41	46	59
Rc/Bankfull width (ft/ft)	1.2	1.8	2.3	2.0	2.5	3.0	1.6	2.4	3.1	1.7	2.1	2.7
Meander Wavelength (ft)	61	125	188	-----	-----	-----	160	180	200	165	183	200
Meander Width Ratio	2.1	2.5	2.8	3.5	5.8	8.0	3.6	4.5	5.4	3.2	4.2	6.2
Profile												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	21	37	55
Riffle Slope (ft/ft)	0.0030	0.0075	0.0120	-----	-----	-----	0.0057	0.0073	0.0089	0.0028	0.0072	0.0116
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	37	65	91
Pool to Pool Spacing (ft)	36	104	172	-----	-----	-----	78	117	155	45	91	144
Pool Max Depth (ft)	3.3	4.15	5	-----	-----	-----	-----	4.0	-----	3.3	4.2	5.3
Substrate and Transport Parameters												
SC% / Sa% / G% / C% / Bo%	0% / 9% / 86% / 5% / 0%			-----	-----	-----	-----	-----	-----	0% / 2% / 63% / 33% / 2%		
d16 / d35 / d50 / d84 / d95	11 / 19 / 26 / 51 / 64			-----	-----	-----	-----	-----	-----	21 / 34 / 48 / 103 / 151		
Additional Reach Parameters												
Drainage Area (SM)	-----	2.69	-----	-----	-----	-----	-----	2.69	---	-----	2.69	-----
Impervious cover estimate (%)	-----	0.95%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	G4/F4	-----	-----	C4	-----	-----	C4	-----	-----	C4	-----
BF Velocity (fps)	4.9	5.3	5.7	3.5	4.3	5.0	-----	4.6	-----	-----	-----	-----
BF Discharge (cfs)	-----	190	-----	-----	-----	-----	-----	190	-----	-----	190	-----
Valley Length	-----	1,153	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Length (ft)	-----	1,488	-----	-----	-----	-----	-----	1,484	-----	-----	1,495	-----
Sinuosity	-----	1.29	-----	-----	-----	-----	-----	1.21	-----	-----	1.22	-----
Water Surface Slope (Channel) (ft/ft)	-----	0.0051	-----	-----	-----	-----	-----	0.0056	-----	-----	0.0053	-----

Table 8. Baseline Stream Data Summary
Whittier Creek Restoration Project: DMS Project No ID. 100020

Reach UT4a												
Parameter	Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
				Composite								
Dimension and Substrate - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
BF Width (ft)	----	7.3	----	----	----	----	----	11.0	----	----	10.6	----
Floodprone Width (ft)	----	20	----	----	----	----	----	30	----	----	18	----
BF Mean Depth (ft)	----	1.4	----	----	----	----	----	0.9	----	----	0.9	----
BF Max Depth (ft)	----	1.6	----	----	----	----	----	1.2	----	----	1.5	----
BF Cross-sectional Area (ft ²)	----	9.9	----	----	----	----	----	10.0	----	----	9.9	----
Width/Depth Ratio	----	5.4	----	10.0	12.5	15.0	----	12.2	----	----	12.0	----
Entrenchment Ratio	----	2.7	----	----	----	----	----	2.7	----	----	1.7	----
Bank Height Ratio	----	1.3	----	----	1.0	----	----	1.0	----	----	1.0	----
d50 (mm)	----	27	----	----	----	----	----	----	----	----	42	----
Pattern												
Channel Beltwidth (ft)	----	----	----	----	----	----	----	----	----	----	----	----
Radius of Curvature (ft)	----	----	----	----	----	----	----	----	----	----	----	----
Rc/Bankfull width (ft/ft)	----	----	----	----	----	----	----	----	----	----	----	----
Meander Wavelength (ft)	----	----	----	----	----	----	----	----	----	----	----	----
Meander Width Ratio	----	----	----	----	----	----	----	----	----	----	----	----
Profile												
Riffle Length (ft)	----	----	----	----	----	----	----	----	----	6	13	18
Riffle Slope (ft/ft)	0.026	0.035	0.043	----	----	----	0.026	0.035	0.043	----	0.031	----
Pool Length (ft)	----	----	----	----	----	----	----	----	----	17	33	48
Pool to Pool Spacing (ft)	35	58	80	35	53	70	38	58	77	30	33	35
Pool Max Depth (ft)	1.1	1.9	2.7	----	----	----	----	2.0	----	---	1.6	---
Substrate and Transport Parameters												
SC% / Sa% / G% / C% / B%	0% / 1% / 77% / 22% / 0%			----	----	----	----	----	----	0% / 1% / 69% / 29% / 1%		
d16 / d35 / d50 / d84 / d95	12 / 18 / 27 / 80 / 128			----	----	----	----	----	----	16 / 32 / 42 / 97 / 141		
Additional Reach Parameters												
Drainage Area (SM)	----	0.35	----	----	----	----	----	0.35	----	----	0.35	----
Impervious cover estimate (%)	----	1.28%	----	----	----	----	----	----	----	----	----	----
Rosgen Classification	----	E4/B4	----	----	C4/B4	----	----	B4	----	----	B4	----
BF Velocity (fps)	----	5.0	----	4.0	5.0	6.0	----	5.0	----	----	----	----
BF Discharge (cfs)	----	50	----	----	----	----	----	50	----	----	50	----
Valley Length	----	316	----	----	----	----	----	----	----	----	----	----
Channel Length (ft)	----	338	----	----	----	----	----	328	----	----	334	----
Sinuosity	----	1.1	----	1.1	1.2	1.2	----	1.1	----	----	1.1	----
Water Surface Slope (Channel) (ft/ft)	----	0.024	----	----	----	----	----	0.024	----	----	0.021	----

* The As-Built parameters shown here apply only to those surveyed sections of Reach UT4a where the channel was improved in its cross-section, profile, and in-stream structures.

Table 8. Baseline Stream Data Summary
Whittier Creek Restoration Project: DMS Project No ID. 100020

Reach UT4b												
Parameter	Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension and Substrate - Riffle												
BF Width (ft)	9.5	9.8	10.1	-----	-----	-----	-----	12.7	-----	-----	13.7	-----
Floodprone Width (ft)	13	18.0	23	-----	-----	-----	30	45	60	-----	49	-----
BF Mean Depth (ft)	1.0	1.2	1.4	-----	-----	-----	-----	1.0	-----	-----	1.1	-----
BF Max Depth (ft)	1.2	1.7	2.2	-----	-----	-----	-----	1.2	-----	-----	1.6	-----
BF Cross-sectional Area (ft ²)	9.5	11.8	14.0	-----	-----	-----	-----	13.0	-----	-----	14.9	-----
Width/Depth Ratio	7.3	8.5	9.6	12.0	13.5	15.0	-----	12.7	-----	-----	12.6	-----
Entrenchment Ratio	1.3	1.8	2.3	-----	-----	-----	2.4	3.6	4.7	-----	3.6	-----
Bank Height Ratio	2.0	2.1	2.1	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----
d50 (mm)	----	26	----	-----	-----	-----	-----	-----	-----	-----	46	-----
Pattern												
Channel Beltwidth (ft)	----	----	----	-----	-----	-----	45	48	50	36	46	53
Radius of Curvature (ft)	----	----	----	-----	-----	-----	25	51	77	26	33	54
Rc/Bankfull width (ft/ft)	----	----	----	2.0	2.5	3.0	2.0	4.1	6.1	2.0	3.1	4.1
Meander Wavelength (ft)	----	----	----	-----	-----	-----	119	142	165	120	126	145
Meander Width Ratio	----	----	----	3.5	5.8	8.0	3.5	3.7	3.9	2.8	3.6	4.1
Profile												
Riffle Length (ft)	----	----	----	-----	-----	-----	-----	-----	-----	19	24	36
Riffle Slope (ft/ft)	0.015	0.028	0.040	-----	-----	-----	0.011	0.018	0.025	0.007	0.016	0.022
Pool Length (ft)	----	----	----	-----	-----	-----	-----	-----	-----	13	39	62
Pool to Pool Spacing (ft)	30	60	90	-----	-----	-----	45	67	89	28	60	94
Pool Max Depth (ft)	2.4	3.4	4.3	-----	-----	-----	-----	2.5	-----	2.4	2.8	3.7
Substrate and Transport Parameters												
SC% / Sa% / G% / C% / B%	0% / 9% / 83% / 8% / 0%			-----	-----	-----	-----	-----	-----	0% / 3% / 66% / 27% / 4%		
d16 / d35 / d50 / d84 / d95	8.4 / 16 / 26 / 52 / 76			-----	-----	-----	-----	-----	-----	22 / 36 / 46 / 101 / 179		
Additional Reach Parameters												
Drainage Area (SM)	----	0.48	----	-----	-----	-----	-----	0.48	-----	-----	0.48	-----
Impervious cover estimate (%)	----	1.30%	----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	----	E4/G4	----	-----	C4	-----	-----	C4	-----	-----	C4	-----
BF Velocity (fps)	4.7	5.8	6.9	3.5	4.3	5.0	-----	5.0	-----	-----	-----	-----
BF Discharge (cfs)	----	65	----	-----	-----	-----	-----	65	-----	-----	65	-----
Valley Length	----	675	----	-----	-----	-----	-----	622	-----	-----	622	-----
Channel Length (ft)	----	764	----	-----	-----	-----	-----	801	-----	-----	803	-----
Sinuosity	----	1.13	----	-----	-----	-----	-----	1.29	-----	-----	1.29	-----
Water Surface Slope (Channel) (ft/ft)	----	0.0165	----	-----	-----	-----	-----	0.0141	-----	-----	0.0136	-----

Table 8. Baseline Stream Data Summary
Whittier Creek Restoration Project: DMS Project No ID. 100020

Reach UT5												
Parameter	Pre-Existing Condition			Reference Reach(es) Data			Design			As-built		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension and Substrate - Riffle												
BF Width (ft)	7.8	7.9	8.0	-----	-----	-----	-----	8.1	-----	-----	9.1	-----
Floodprone Width (ft)	15	17.0	19	-----	-----	-----	14	17	20	-----	31	-----
BF Mean Depth (ft)	0.7	0.7	0.7	-----	-----	-----	-----	0.6	-----	-----	0.6	-----
BF Max Depth (ft)	2.3	2.6	2.8	1.2	1.4	1.5	-----	1.2	-----	-----	0.9	-----
BF Cross-sectional Area (ft ²)	5.1	5.3	5.5	-----	-----	-----	-----	5.0	-----	-----	5.9	-----
Width/Depth Ratio	11.1	11.3	11.4	12	15	18	-----	13.0	-----	-----	14.3	-----
Entrenchment Ratio	2.0	2.2	2.4	-----	-----	-----	1.7	2.1	2.5	-----	3.3	-----
Bank Height Ratio	1.4	1.8	2.2	-----	1.0	-----	-----	1.0	-----	-----	1.0	-----
d50 (mm)	----	21	----	-----	-----	-----	-----	-----	-----	-----	44	-----
Pattern												
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	15	16	20
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rc/Bankfull width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	90	124	150
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Profile												
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	7	24	57
Riffle Slope (ft/ft)	0.026	0.034	0.041	-----	-----	-----	0.013	0.025	0.037	0.011	0.020	0.039
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	7	13	33
Pool to Pool Spacing (ft)	22	81	139	-----	-----	-----	15	28	40	24	33	44
Pool Max Depth (ft)	1.6	2.0	2.3	----	-----	----	-----	1.5	----	0.8	1.7	2.7
Substrate and Transport Parameters												
SC% / Sa% / G% / C% / B%	3% / 11% / 72% / 14% / 0%			-----	-----	-----	-----	-----	-----	0% / 0% / 65% / 34% / 1%		
d16 / d35 / d50 / d84 / d95	5.6 / 12 / 21 / 57 / 104			-----	-----	-----	-----	-----	-----	23 / 33 / 44 / 109 / 169		
Additional Reach Parameters												
Drainage Area (SM)	-----	0.11	-----	-----	-----	-----	-----	0.11	-----	-----	0.11	-----
Impervious cover estimate (%)	-----	1.47%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	B4	-----	-----	B4	-----	-----	B4	-----	-----	B4	-----
BF Velocity (fps)	3.6	3.8	3.9	4.0	5.0	6.0	-----	4.0	-----	-----	-----	-----
BF Discharge (cfs)	-----	20	-----	-----	-----	-----	-----	20	-----	-----	20	-----
Valley Length	-----	740	-----	-----	-----	-----	-----	740	-----	-----	740	-----
Channel Length (ft)	-----	765	-----	-----	-----	-----	-----	787	-----	-----	792	-----
Sinuosity	-----	1.03	-----	1.10	1.15	1.20	-----	1.06	-----	-----	1.07	-----
Water Surface Slope (Channel) (ft/ft)	-----	0.0250	-----	0.020	0.025	0.030	-----	0.024	-----	-----	0.024	-----

APPENDIX E

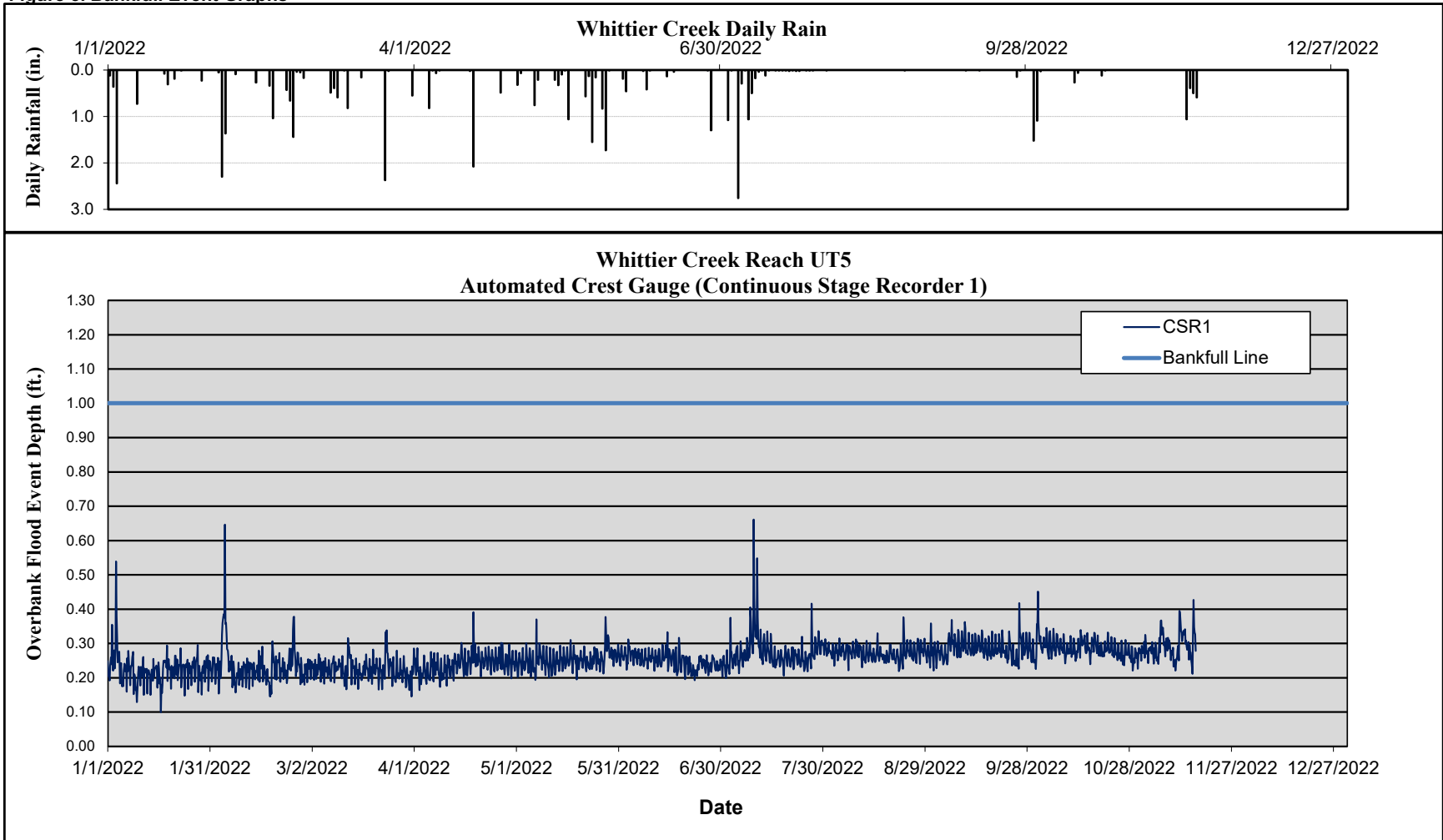
Hydrologic Data

Table 10. Verification of Bankfull Events
Whittier Creek Mitigation Project - NCDMS Project No. 100020

Date of Data Collection	UT5 Continuous Stage recorder (CSR1)	UT4 Continuous Stage recorder (CSR2)	R7 Continuous Stage recorder (CSR3)	Date of Bankfull Event Occurrence	Method of Data Collection
Year 1 Monitoring (2022)					
11/16/2022	N/A	N/A	.43"	7/9/2022	Continuous Stage Recorder

Note: Crest gauge readings were corroborated with associated spikes in the automated Continuous Stage Recorder (see graph in Appendix E) and/or with photographs (Appendix B).

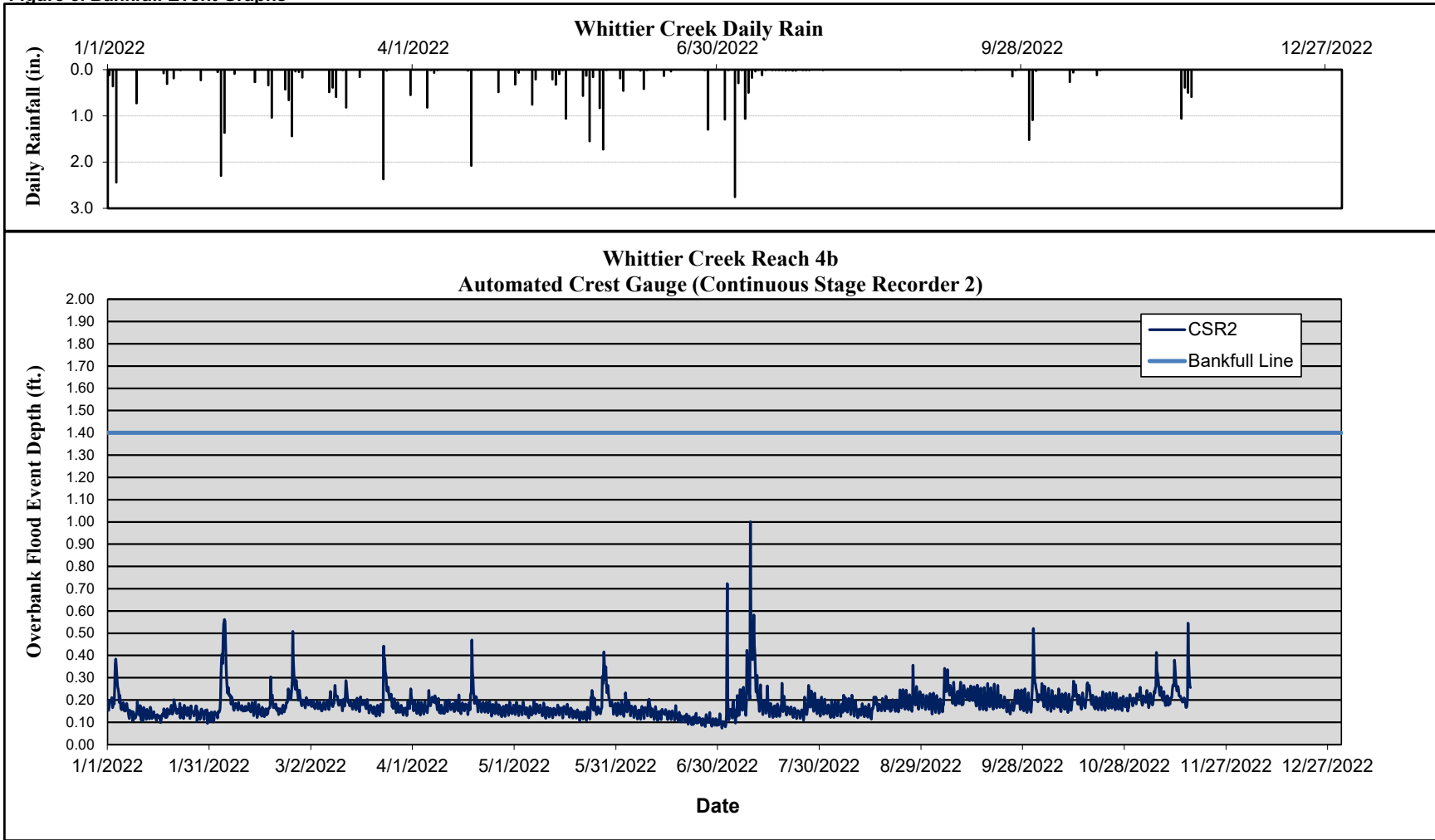
Figure 5. Bankfull Event Graphs



Note

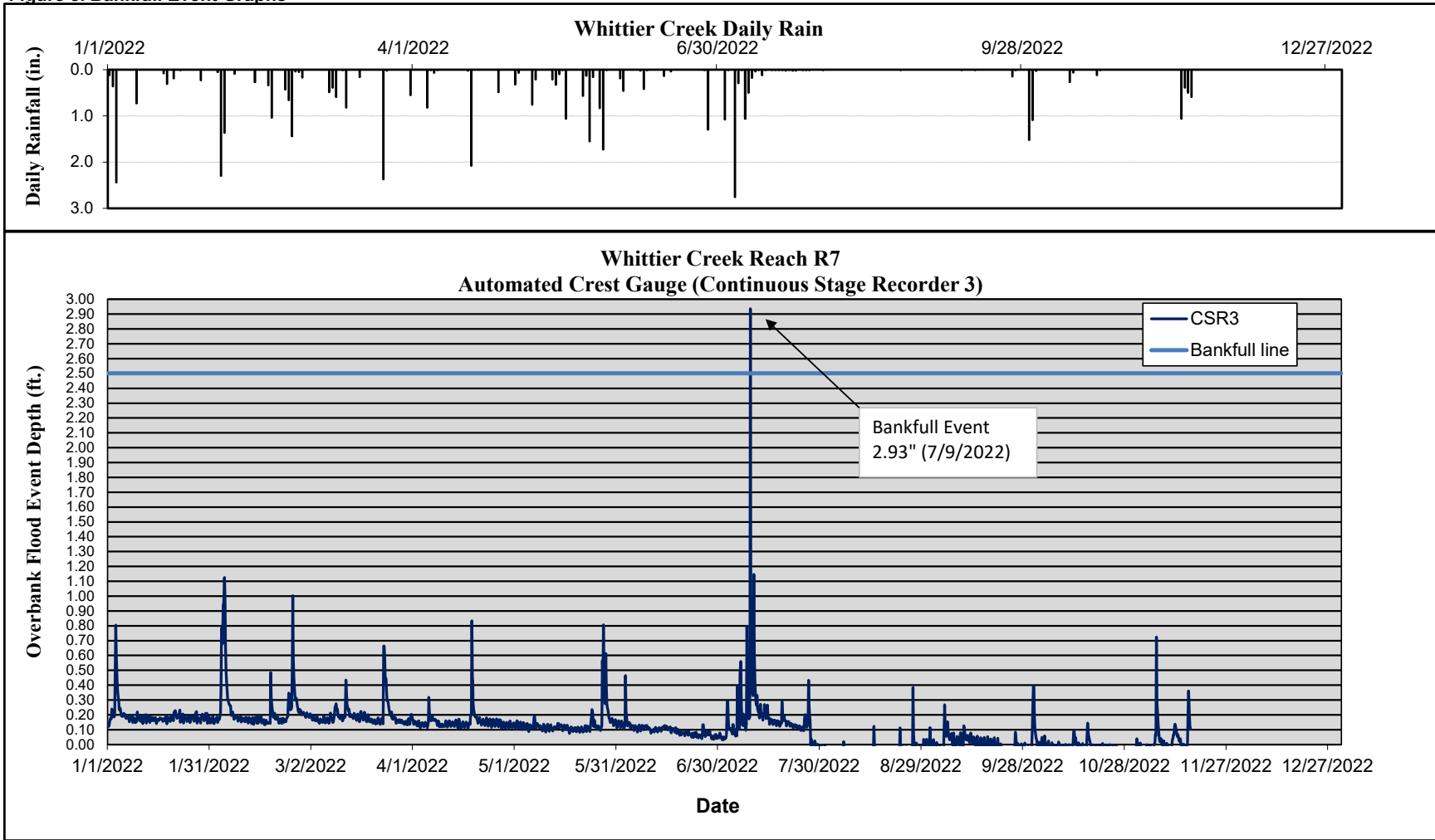
Data presented here is from 1/1/22 thru 11/16/22
Thalweg elevation 0.00'

Figure 5. Bankfull Event Graphs



Note
Data presented here is from 1/1/22 thru 11/16/22
Thalweg elevation is 0.00'

Figure 5. Bankfull Event Graphs



Note:

Data presented here is from 1/1/22 thru 11/16/22
Thalweg elevation is 0.00'

Table 11. Rainfall Summary

Rainfall Summary							
	MY1 2022	MY2 2023	MY3 2024	MY4 2025	MY5 2026	MY6 2027	MY7 2028
Annual Precip Total	49.0						
WETS 30th Percentile	32.4						
WETS 70th Percentile	58.7						
Observed Annual Rainfall	44.5						

APPENDIX F

IRT Comments

From: Clemmons, Micky
Sent: Friday, June 24, 2022 12:12 PM
To: Browning, Kimberly D CIV USARMY CESAW (USA)
Cc: Reid, Matthew; McKeithan, Katie; Allen, Melonie; Crumbley, Tyler A CIV USARMY CESAW (USA); Beth.Harmon@ncdenr.gov; jim.stanfill@ncdenr.gov; Fennel, Tommy E CIV USARMY CESAW (USA); Haywood, Casey M CIV USARMY CESAW (USA); Tugwell, Todd J CIV USARMY CESAW (USA); Davis, Erin B; Bowers, Todd; holland_youngman@fws.gov; Wilson, Travis W.; Leslie, Andrea J; Powers, Andrew; Paul Wiesner
Subject: RE: EXTERNAL: Notice of Initial Credit Release / NCDMS Whittier Creek Mitigation Site/ SAW-2017-01503 / Surry Co.

Kim,

We wanted to go ahead and respond to the question that Casey asked regarding gaps in our graph of the longitudinal profile for UT4. The gaps in the longitudinal profile for UT4 are shown because those areas were not surveyed during the as-built. These 4 sections (gaps) didn't receive any structures or bank work therefore, the survey crew did not shoot points in those areas. In the future we will include a callout box and explain in the body of the report.

Thank you for your review and comments on this project,

Micky

Micky Clemmons | Project Manager - Ecosystem Restoration

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From: Browning, Kimberly D CIV USARMY CESAW (USA) <Kimberly.D.Browning@usace.army.mil>
Sent: Tuesday, June 21, 2022 1:58 PM
To: Wiesner, Paul <paul.wiesner@ncdenr.gov>
Cc: Reid, Matthew <matthew.reid@ncdenr.gov>; McKeithan, Katie <Katie.McKeithan@mbakerintl.com>; Clemmons, Micky <Mclemmons@mbakerintl.com>; Allen, Melonie <melonie.allen@ncdenr.gov>; Crumbley, Tyler A CIV USARMY CESAW (USA) <Tyler.A.Crumbley2@usace.army.mil>; Beth.Harmon@ncdenr.gov; jim.stanfill@ncdenr.gov; Fennel, Tommy E CIV USARMY CESAW (USA) <Tommy.E.Fennel@usace.army.mil>; Haywood, Casey M CIV USARMY CESAW (USA) <Casey.M.Haywood@usace.army.mil>; Tugwell, Todd J CIV USARMY CESAW (USA) <Todd.J.Tugwell@usace.army.mil>; Davis, Erin B <erin.davis@ncdenr.gov>; Bowers, Todd <bowers.todd@epa.gov>; holland_youngman@fws.gov; Wilson, Travis W. <travis.wilson@ncwildlife.org>; Leslie, Andrea J <andrea.leslie@ncwildlife.org>
Subject: EXTERNAL: Notice of Initial Credit Release / NCDMS Whittier Creek Mitigation Site/ SAW-2017-01503 / Surry Co.

Good afternoon all,

The 15-Day As-Built/MYO review for the Whittier Creek Mitigation Site (SAW-2017-01503) ended May 13, 2022. Per Section 332.8(o)(9) of the 2008 Mitigation Rule, this review followed the streamlined review process. All comments received from the NCIRT are incorporated in the email below. The IRT is not requesting a site visit at this time. There were no objections to issuing the initial 30% credit release of 917.900 cool SMUs. Please find attached the current signed ledger.

NCDWR Comments, Erin Davis:

I reviewed the DMS Whittier Creek MYO Report and have no formal comments/questions/concerns. I'm ok with the additional species planted and the structures and crossing changes. The storm and bridge collapse photos looked severe. I'm glad they coordinated with DOT and took the time to make the proper repairs. No site visit requested. DWR is ok with the requested credit release.

USACE Comments, Casey Haywood:

I reviewed the MYO Report for NCDMS Whittier Creek and concur with DWR's statements. The bridge collapse photos were severe. I was glad to see they installed boulder-toe protection at the top of the project below Nurse road, and that they worked with DOT to address the necessary repairs after Hurricane Zeta. Regarding the Longitudinal profile for UT4, there are gaps in the graph; is this just a formatting error?

USEPA Comments, Todd Bowers:

Overall I am very pleased with the report and the work that has been completed at the site as well as efforts towards adaptive management and corrective actions for stream repairs following the flood damage incurred in late October 2020. The notes from the site visit conducted with DMS on March 24, 2022 lends evidence that the site is performing well and in excellent condition.

- Red line changes to structures (rock vanes) replaced by various other structure types in project reaches noted.
- Crossing type change from culvert to rock ford on UT5 noted.
- Armoring of Reach 7 first two meander bends noted.
- Extra stems planted during planting completed in January 2022 noted.
- Intention to treat fescue in near Veg Plot 3 and multiflora rose along left bank of UT4A in late 2022 noted.

Having not been on-site, I really appreciated the photos in the report especially those that demonstrated flooding conditions and damage caused by remnants of Hurricane Zeta. I have no other substantial comments at this point. I recommend the appropriate credit release for cool stream SMUs for this monitoring milestone MYO/Milestone 2.

Please reach out with any questions.

Thanks

Kim

Kim (Browning) Isenhour

Mitigation Project Manager, Regulatory Division | U.S. Army Corps of Engineers | 919.946.5107