MONITORING YEAR 1 ANNUAL REPORT

Final

December 2021

SASSARIXA SWAMP MITIGATION SITE

Johnston County, NC
Neuse River Basin
HUC 03020201

DMS Project No. 100040
DMS Contract No. 7425
DMS RFP No. 16-007279
USACE Action ID No. 2018-00432
DWR Project No. 2018-0198

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PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

PREPARED BY:

312 West Millbrook Road, Suite 225
Raleigh, NC 27609

Jason Lorch
jlorch@wildlandseng.com
Phone: 919.851.9986

SASSARIXA SWAMP MITIGATION SITE

Monitoring Year 1 Annual Report

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Section 1: PROJECT OVERVIEW

The Sassarixa Swamp Mitigation Site (Site) is located in Johnston County, approximately six miles southwest of Smithfield and five miles north of Four Oaks. The Site drains to Holts Lake, which drains to the Neuse River. Holts Lake is a recreational lake classified as a Nutrient Sensitive Water (NSW) and the Neuse River is a water supply for the City of Goldsboro. Table 3 presents information related to the project attributes.

1.1 Project Quantities and Credits

The Site is located on 10 parcels under 7 different landowners and a conservation easement was recorded on 65.06 acres. Mitigation work within the Site included restoration, enhancement II, and preservation of perennial and intermittent stream channels. Table 1 below shows stream credits by reach and the total amount of stream credits expected at closeout.

Table 1: Project Quantities and Credits

PROJECT MITIGATION QUANTITIES							
Project Segment	**Mitigation Plan Footage**	**As-Built Footage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Credits**	**Comments**
Stream							
Sassarixa Creek R1-R3	2,631	2,631	Warm	EII	2.5	1,052.400	Ford Crossing, Fencing Out Livestock
T1 R1	570	570	Warm	EII	2.5	228.000	Bank Stabilization, Fencing Out Livestock
T1 R2	824	810	Warm	R	1.0	824.000	Full Channel Restoration, Fencing Out Livestock
T1 R3	509	507	Warm	R	1.0	509.000	Full Channel Restoration, Fencing Out Livestock
T1 R4	252	252	Warm	EII	2.5	100.800	Fencing Out Livestock
T1A	358	356	Warm	EII	2.5	143.200	Fencing Out Livestock
T1B	275	276	Warm	EII	2.5	110.000	Fencing Out Livestock
T1C	307	307	Warm	EII	2.5	122.800	Fencing Out Livestock
T2	1,010	1,006	Warm	R	1.0	1,010.000	Pond Removal, Fencing Out Livestock
T3 R1	1,053	1,041	Warm	R	1.0	1,053.000	Full Channel Restoration, Fencing Out Livestock
T3 R2	61	61	Warm	P	10.0	6.100	Conservation Easement
T4 R1	206	206	Warm	EII	2.5	82.400	Ford Crossing, Fencing Out Livestock
T4 R2	398	399	Warm	EII	2.5	159.200	Bank Stabilization, Fencing Out Livestock
T4 R3	1,509	1,510	Warm	P	10.0	150.900	Culvert Crossing, Conservation Easement
T5 R1	670	642	Warm	EII	2.5	268.000	Bank Stabilization

T5 R2	885	874	Warm	R	1.0	885.000	Full Channel Restoration, Fencing Out Livestock
T5 R3	965	961	Warm	EII	4.0	241.250	Culvert Crossing, Bank Stabilization
T5A	1,026	1,018	Warm	EII	2.5	410.400	Bank Stabilization, Fencing Out Livestock
T5B	580	580	Warm	EII	2.5	232.000	Fencing Out Livestock
T5C[1]	588	588	Warm	EII	2.5	235.200	Fencing Out Livestock
T6 R1	381	383	Warm	R	1.0	381.000	Full Channel Restoration, Fencing Out Livestock
T6 R2	1,035	1,037	Warm	EII	2.5	414.000	Culvert Crossing, Bank Stabilization. Fencing Out Livestock
					Total:	**8,618.650**	

1. T5C Credited using the Headwater Stream guidance method of the valley length.

Restoration Level	Stream		
	Warm	Cool	Cold
Restoration	4,662.000		
Enhancement I	--		
Enhancement II	3,799.650		
Preservation	157.000		
Totals	**8,618.650**		
Total Stream Credit	**8,618.650**		

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits. Table 2 below describes expected outcomes to water quality and ecological processes and provides project goals and objectives.

Table 2: Goals, Performance Criteria, and Functional Improvements

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve the stability of stream channels.	Construct stream channels that will maintain stable cross-sections, patterns, and profiles over time.	Reduce sediment inputs from bank erosion. Reduce shear stress on channel boundary.	ER stays over 2.2 and BHR below 1.2 with visual assessments showing progression towards stability.	Cross-section monitoring will be assessed during MY1, MY2, MY3, MY5, and MY7 and visual inspections will be assessed annually.	No deviations from design. In-stream vegetation was treated Site wide in September 2021.

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Cumulative Monitoring Results
Improve instream habitat.	Install habitat features such as constructed riffles, lunker logs, and brush toes into restored/enhanced streams. Add woody materials to channel beds. Construct pools of varying depth.	Increase and diversify available habitats for macroinvertebrates, fish, and amphibians leading to colonization and increase in biodiversity over time.	There is no required performance standard for this metric.	N/A	N/A
Reconnect channels with floodplains to allow a natural flooding regime.	Reconstruct stream channels with designed bankfull dimensions and depth based on reference reach data. Remove pond above T2.	Allow more frequent flood flows to disperse on the floodplain.	Four bankfull events in separate years within monitoring period. 30 consecutive days of flow for intermittent channels.	Crest gauges and/or pressure transducers recording flow elevations.	Bankfull events documented on all reaches during MY1. Greater than 30 consecutive days of flow recorded on all intermittent streams during MY1.
Restore and enhance native floodplain and streambank vegetation.	Plant native tree and understory species in riparian zones and plant native shrub and herbaceous species on streambanks.	Reduce sediment inputs from bank erosion and runoff. Increase nutrient cycling and storage in floodplain. Provide riparian habitat. Add a source of LWD and organic material to stream.	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7. Height requirement is 7 feet at MY5 and 10 feet at MY7.	One hundred square meter vegetation plots are placed on 2% of the planted area of the Site and monitored during MY1, MY2, MY3, MY5, and MY7.	10 out of 11 vegetation plots have a planted stem density greater than 320 stems per acre. Veg plot 2 has a stem density of 243 planted stems per acre.
Permanently protect the project Site from harmful uses.	Establish conservation easements on the Site.	Protect the Site from encroachment on the riparian corridor and direct impact to streams and wetlands.	Prevent easement encroachment.	Visually inspect the perimeter of the Site to ensure no easement encroachment is occurring.	Cattle encroachment occurred in July 2021. No cattle have been seen on Site since.

1.3 Project Attributes

The project includes several adjacent properties that have been owned and operated as a livestock farm by a single family since 1850, where livestock were continually rotated through all fields with access to the project streams. Based on aerial photos from 1950 to 2012 onsite streams have existed in their approximate locations with very little change to riparian buffer extents since 1950. Two alterations to the Site visible from historical aerial photography were the addition of the pond on T2 between 1964 and 1973, and the addition of the large pond below T5A, T5B, and T5C between 1950 and 1961. According to the landowners, in the 1960's and early 1970's a hog yard was located at the upstream end of T4 and T5, where the streams were diverted to make a hog wallow area. The hogs were moved to a hog house in the early 1970's, however goats, horses, and cattle had continuous access to this portion of the site until Hurricane Matthew struck in September 2016. The floods from the storm destroyed much

of the fencing around T4 and T5 and livestock have been rotated in other fields since that time while fencing was being repaired. Other portions of the site had not seen significant changes in land use with livestock or crop rotations from existing activities. Table 3 below and Table 9 in Appendix C present additional information on pre-restoration conditions.

Table 3: Project Attributes

PROJECT INFORMATION					
Project Name	Sassarixa Swamp Mitigation Site	County		Johnston County	
Project Area (acres)	65.06	Project Coordinates		35.472153, -78.436000	
PROJECT WATERSHED SUMMARY INFORMATION					
Physiographic Province	Rolling Coastal Plain	River Basin		Neuse River	
USGS HUC 8-digit	03020201	USGS HUC 14-digit		03020201130030	
DWR Sub-basin	03-04-04	Land Use Classification		66% agriculture, 27% forested, 7% developed	
Project Drainage Area (acres)	5,024	Percentage of Impervious Area		0.9%	
RESTORATION TRIBUTARY SUMMARY INFORMATION					
Parameters	**T1**	**T2**	**T3**	**T5**	**T6**
Pre-project length (feet)	2,202	348	1,098	2,544	1,342
Post-project (feet)	2,155	1,010	1,114	2,553	1,451
Valley confinement (Confined, moderately confined, unconfined)	Unconfined	Moderately Confined to Unconfined			
Drainage area (acres)	45	25	26	41.25	38.25
Perennial, Intermittent, Ephemeral	Intermittent		Perennial		
DWR Water Quality Classification	C, NSW			B, NSW	
Dominant Stream Classification (existing)	G5	G5	B5/G5	E5	G5/E5
Dominant Stream Classification (proposed)	C5b/E5b	C5b/E5b	C5b/E5b	C5/E5	C5/E5
Dominant Evolutionary class (Simon) if applicable	Stage III	Stage IV		Stage III	Stage IV
REGULATORY CONSIDERATIONS					
Parameters	**Applicable?**	**Resolved?**	**Supporting Documentation**		
Water of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.		
Water of the United States - Section 401	Yes	Yes			
Endangered Species Act	Yes	Yes	Categorical Exclusion in Mitigation Plan (Wildlands, 2019)		
Historic Preservation Act	Yes	Yes			
Coastal Zone Management Act (CZMA or CAMA)	N/A	N/A	N/A		
Essential Fisheries Habitat	N/A	N/A	N/A		

Section 2: Monitoring Year 1 Data Assessment

Annual monitoring and site visits were conducted during MY1 to assess the condition of the project. The vegetation and stream success criteria for the Site follow the approved success criteria presented in the Mitigation Plan (Wildlands, 2019). Performance criteria for vegetation, stream, and hydrologic assessment are located in Section 1.2 Table 3: Goals, Performance Criteria, and Functional Improvements.

2.1 Vegetative Assessment

The MY1 vegetative survey was completed in September 2021. Vegetation monitoring resulted in a stem density range of 243 to 607 planted stems per acre and average stem density was 504 planted stems per acre. Out of the eleven vegetation plots, ten met the interim success criteria of 320 stems per acres, while Vegetation Plot 2 has 243 stems per acres and is on track to meet the final success criteria of 210 stems per acre. A more thorough visual assessment will take place in the area near Vegetation Plot 2 in Spring 2022 to assess the survivability of the planted trees and resprouts. Refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table and Appendix B for Vegetation Plot Data.

There were a significant number of mature hardwood trees that were left untouched from construction. A visual site assessment in November 2021 indicated that mature hardwood trees in construction areas have survived. Planted trees and volunteer species are growing throughout the Site and starting to fill in an understory that will eventually become a mature hardwood forest.

2.2 Vegetation Areas of Concern

Before construction, Chinese privet (*Ligustrum sinense*) was treated along Sasssarixa Creek during the winter of 2020/2021 using a combination of methods including foliar and cut stump applications. Out of the 27.00 acres that was originally treated, resprouts did emerge along the lower half of Sassarixa Creek totaling 11.99 acres (Figure 1a). A follow up treatment will occur during MY2 to treat the resprouts.

Several cattle were observed within the Site throughout July 2021. Cattle had access to 11.39 acres of the Site between the Sassarixa Creek ford crossing to the top of T1 (Figure 1a). The cattle were entering the Site through the high tensile fence along the Sassarixa Creek ford crossing. The landowner has agreed to keep the outside gates closed unless supervising the cattle crossing Sassarixa Creek. No cattle have been seen in the easement since July 2021, indicating the easement encroachment has been resolved. No major damage occurred to the Site due to cattle encroachment, except for several dented easement signs.

2.3 Stream Assessment

Morphological surveys for MY1 were conducted in July 2021. All streams within the Site are stable and functioning as designed. All 10 cross-sections at the Site show little to no change in the bankfull area and width-to-depth ratio, and bank height ratios are less than 1.2. Refer to Appendix A for the Visual Stream Morphology Stability Assessment Table and Stream Photographs. Refer to Appendix C for Stream Geomorphology Data.

2.4 Stream Areas of Concern

The spring and summer of 2021 had below average rainfall. Due to dry conditions and lack of shade before woody vegetation has become established, *Murdanina* (Figure 1a-b) was observed in most tributaries. Wildlands was proactive with in-stream vegetation management and treated T1 Reach 1-3,

T2, T3 Reach 1, T5 Reach 2, and T6 Reach 1 and 2 in September 2021. The treatment was effective and follow up treatments will occur in MY2 to ensure the in-stream vegetation is eradicated.

2.5 Hydrology Assessment

By the end of MY7, four bankfull events must have occurred in separate years within the restoration reaches. At least one bankfull event was recorded on all stream restoration reaches. Therefore, the hydrologic success criterion for bankfull events has been partially met in MY1.

In addition, the presence of baseflow must be documented on restored intermittent reaches (T1 Reach 2, T2 and T3 Reach 1) for a minimum of 30 consecutive days during a normal precipitation year. In-stream flow gauges equipped with pressure transducers were installed to monitor continuity of baseflow. All intermittent reaches in MY1 exceeded baseflow success criteria. The maximum consecutive days ranged from 44 days to 108 days. Refer to Appendix 5 for hydrologic data.

2.6 Wetland Assessment

One groundwater gauge was installed and monitored within an existing wetland zone along T3 at a location requested by North Carolina Division of Water Resources. The purpose of the gauge is to assess potential effects to wetland hydrology from the construction of the restored stream channel through this area. The results of this monitoring are not tied to a success criteria. Results from the groundwater gauge, during MY1, show that the existing wetland maintained free groundwater within 12 inches of the ground surface for 47.5% of the defined growing season (March 1 to November 16).

2.7 Adaptive Management Plan

As indicated in Section 2.2, 11.99 acres of Chinese privet resprouts will be treated throughout MY2. The management plan will integrate multiple treatment options of cut stump and foliar spray depending on plant height.

A follow up in-stream vegetation treatment will occur in the spring of 2022 to treat the remaining vegetation that survived the September 2021 treatment.

2.8 Monitoring Year 1 Summary

Overall, the Site has met the success criteria for MY1. Ten out of eleven veg plots are on track to meet the MY3 interim success criteria. The area surrounding veg plot 2 will be assessed during MY2 to check for planted tree resprouts and survivability. Mature trees that were avoided during construction are healthy with a new understory layer coming in. Follow up treatments of 11.99 acres of Chinese privet resprouts and in-stream vegetation will occur during MY2. The landowner will keep the outside gates closed along the Sassarixa Creek ford crossing, resolving the July 2021 cattle encroachment. Bankfull events were documented on all stream restoration reaches partially fulfilling the final bankfull hydrologic success requirement. Greater than 30 days of consecutive flow were recorded on monitored intermittent stream reaches T1 Reach 2, T2, and T3 Reach 1 fulfilling MY1 success requirement. Overall, the Site is meeting its goals of preventing excess nutrients and sediment from entering the Neuse River tributaries and is on track to meet final success criteria.

Summary information and data related to the performance of various project and monitoring elements can be found in the tables and figures in the report appendices. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 3: METHODOLOGY

Geomorphic data was collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Crest gauges and pressure transducers were installed in riffle cross-sections and monitored throughout the year. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers standards (USACE, 2003). Vegetation monitoring protocols followed the Wilmington District Stream and Wetland Compensatory Mitigation Update (NCIRT, 2016).

Section 4: REFERENCES

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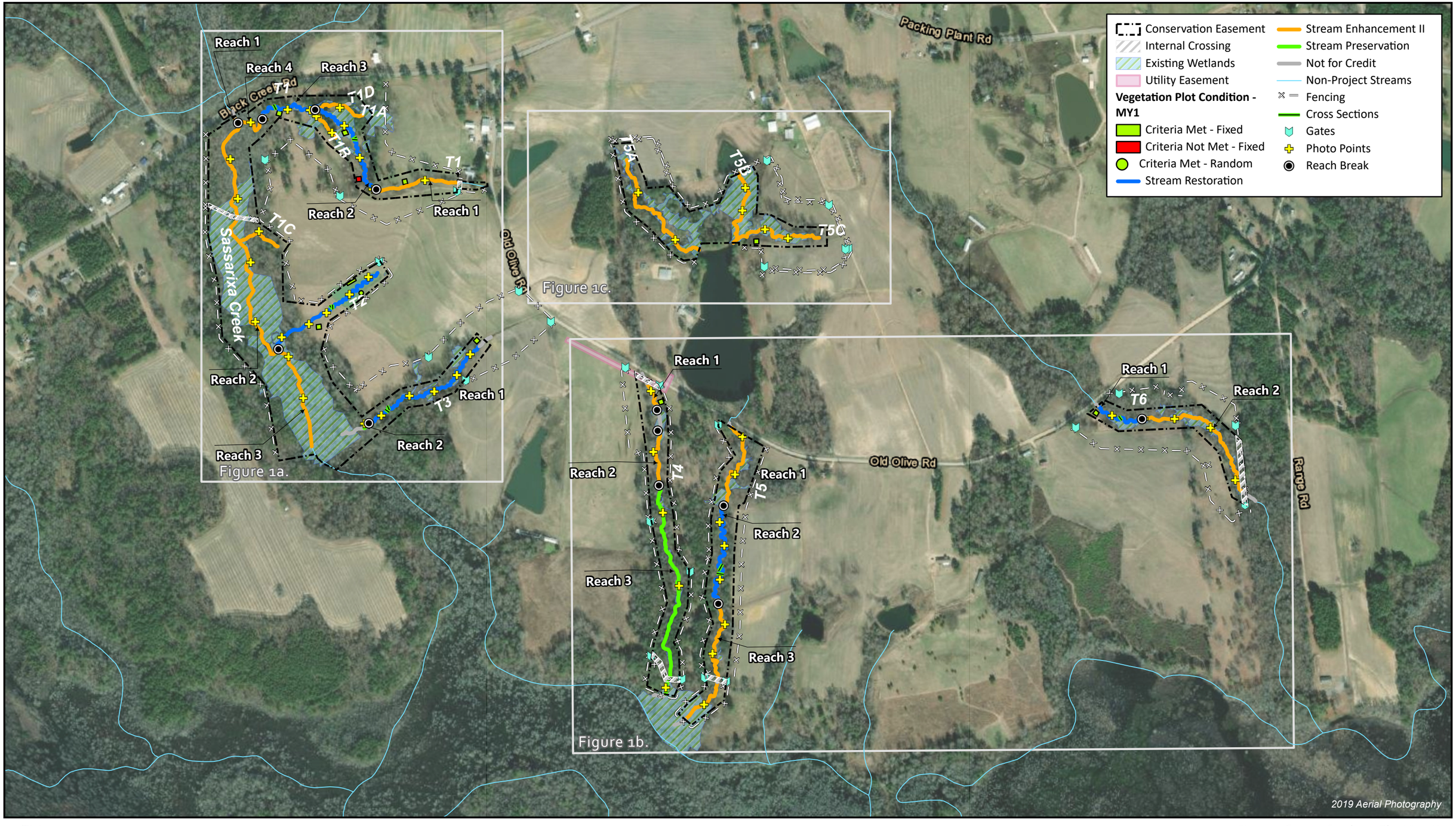


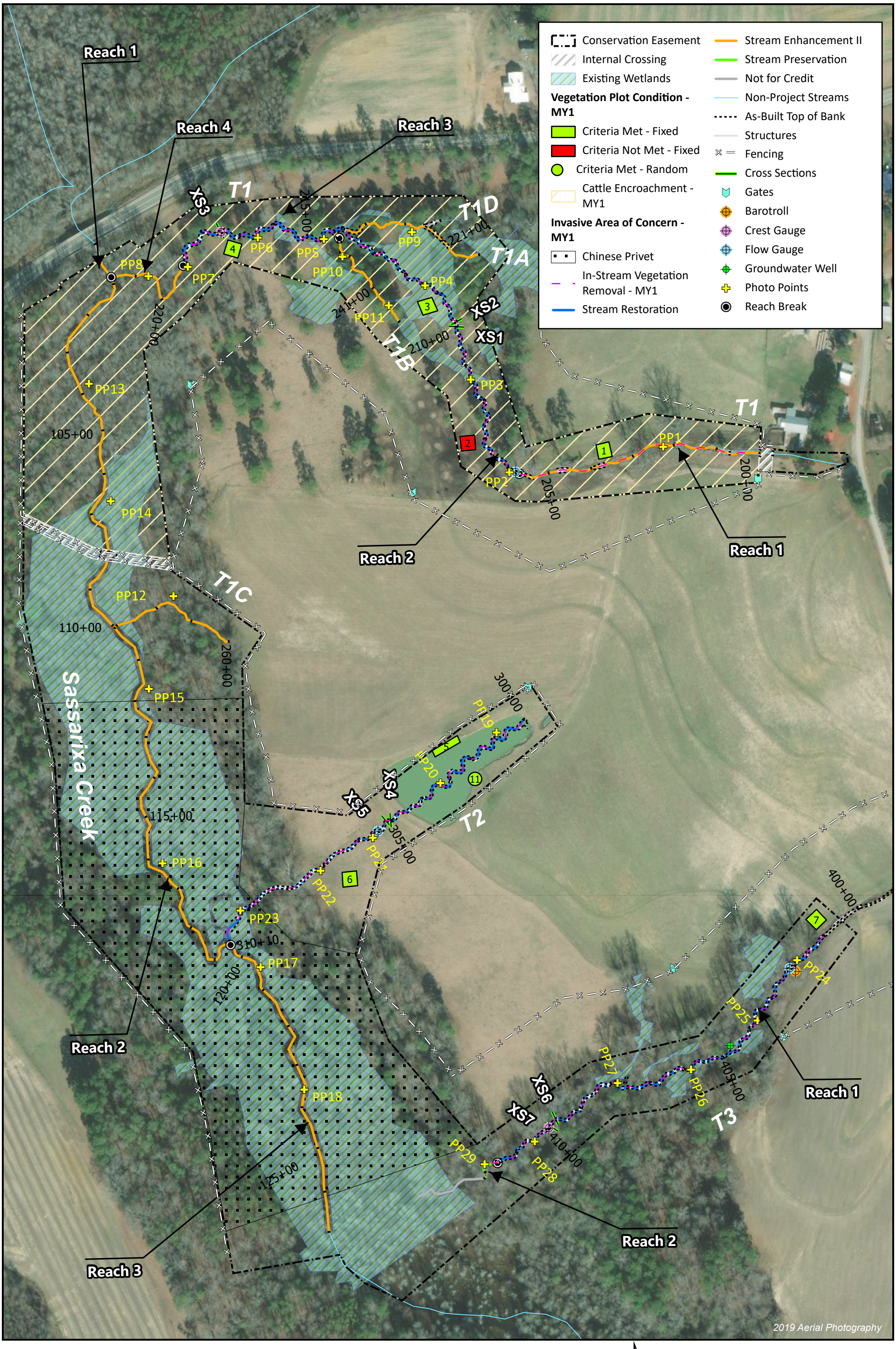
WILDLANDS ENGINEERING

0 600 1,200 Feet

N

Figure 1. Current Condition Plan View Key
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

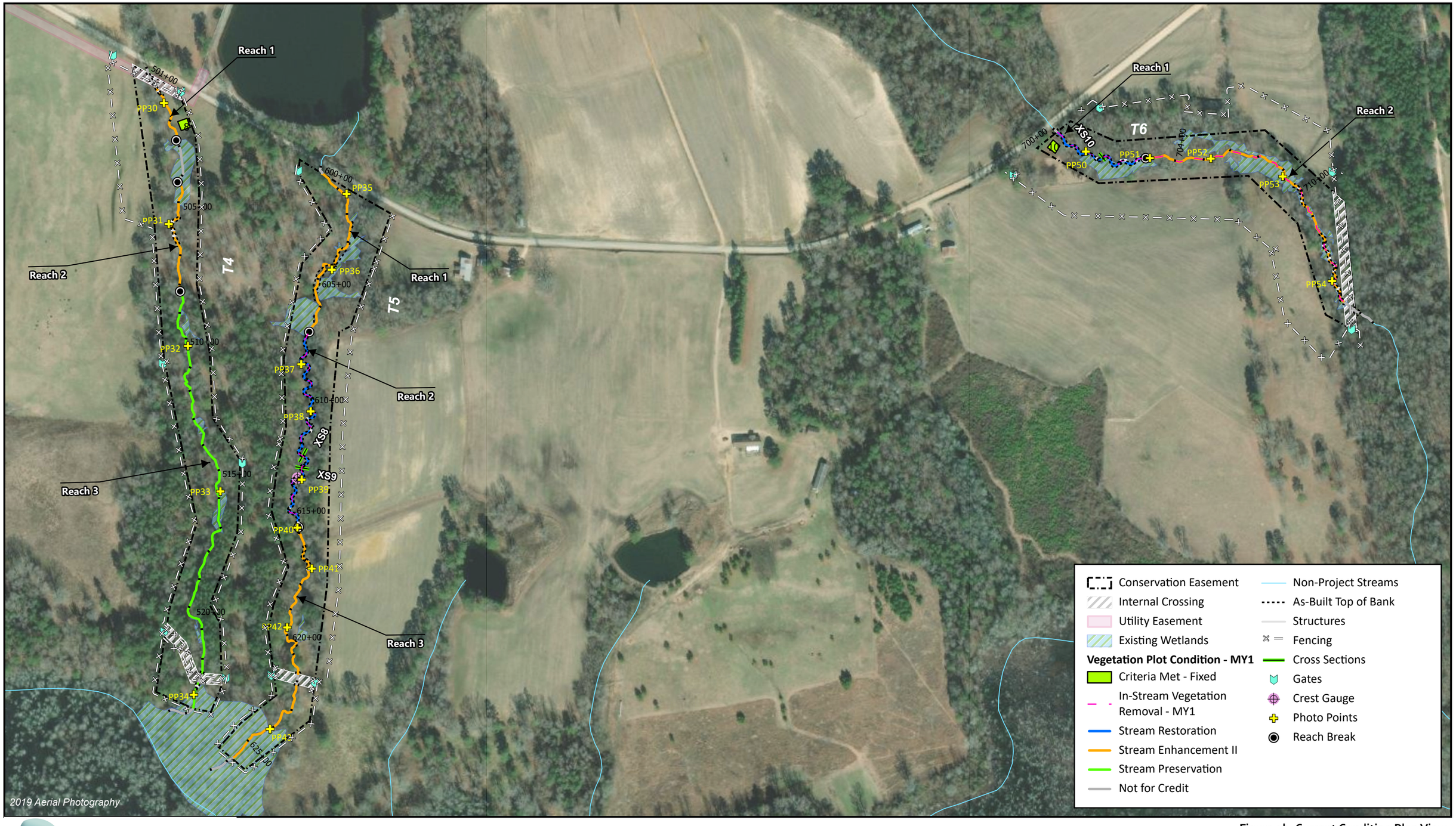
Johnston County, NC



WILDLANDS ENGINEERING

Figure 1a. Current Condition Plan View
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Johnston County, NC



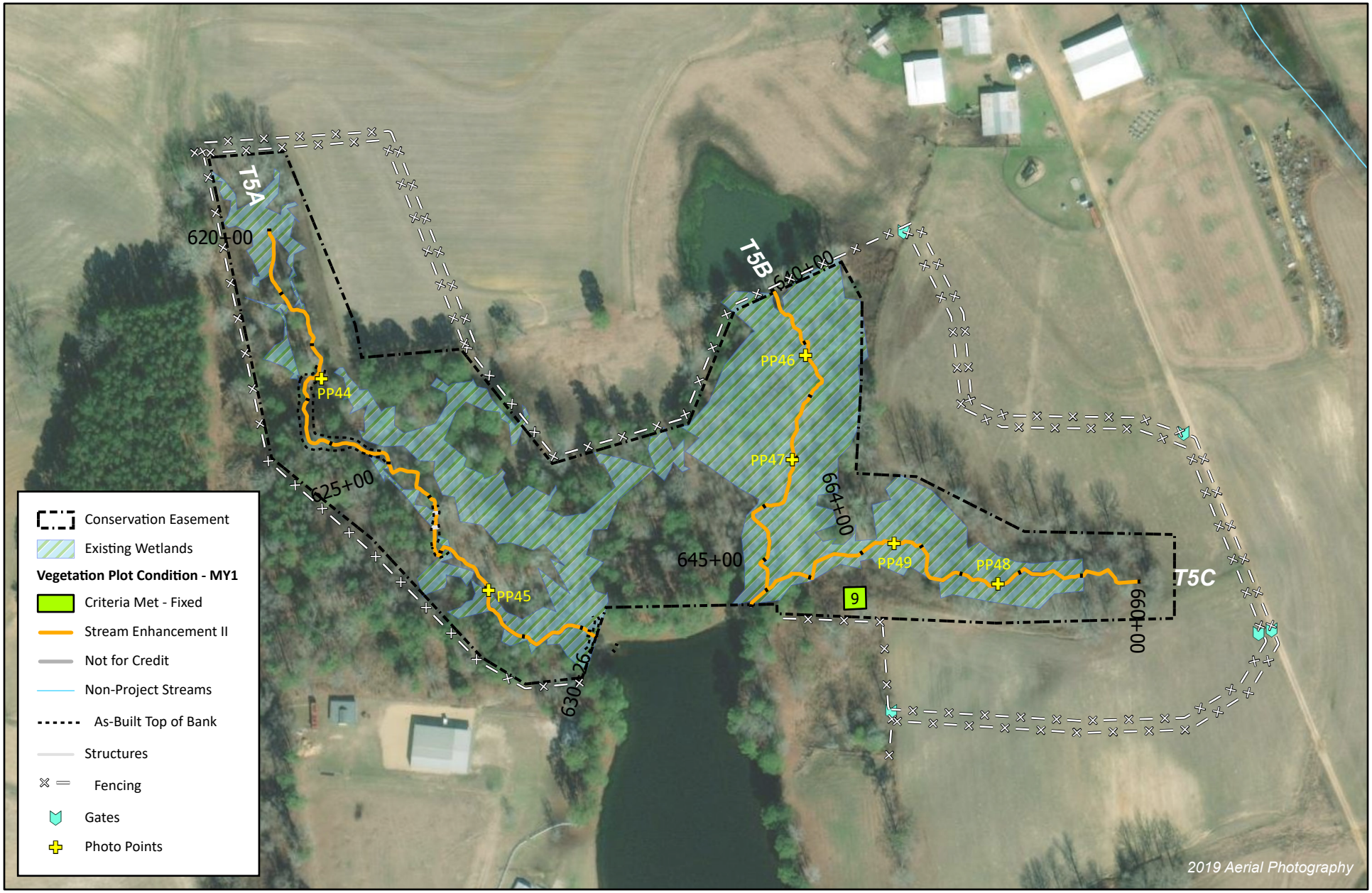
WILDLANDS ENGINEERING

0 300 600 Feet

N

Figure 1b. Current Condition Plan View
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Johnston County, NC



WILDLANDS ENGINEERING

0 100 200 Feet

N

Figure 1c. Current Condition Plan View
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Johnston County, NC

APPENDIX A. VISUAL ASSESSMENT DATA

Table 4. Visual Stream Morphology Stability Assessment Table

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

T1 R2

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	810
					Assessed Bank Length	1,620
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	27	27		100%

T1 R3

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	507
					Assessed Bank Length	1,014
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	14	14		100%

Table 4. Visual Stream Morphology Stability Assessment Table

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

T2

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	1,006
					Assessed Bank Length	2,012
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.	34	34		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	18	18		100%

T3 R1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	1,041
					Assessed Bank Length	2,082
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	30	30		100%

Table 4. Visual Stream Morphology Stability Assessment Table

Sassarixa Swamp Mitigation Site
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Monitoring Year 1 - 2021

T5 R2

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	874
					Assessed Bank Length	1,748
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	20	20		100%

T6 R1

Major Channel Category		Metric	Number Stable, Performing as Intended	Total Number in As-built	Amount of Unstable Footage	% Stable, Performing as Intended
					Assessed Stream Length	383
					Assessed Bank Length	766
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.	0	0		N/A
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	5	5		100%

Table 5. Vegetation Condition Assessment Table
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Planted Acreage **13.03**

Vegetation Category	Definitions	Mapping Threshold (ac)	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material.	0.10	0	0%
Low Stem Density Areas	Woody stem densities clearly below target levels based on current MY stem count criteria.	0.10	0	0%
		Total	**0**	**0%**
Areas of Poor Growth Rates	Planted areas where average height is not meeting current MY Performance Standard.	0.10	0	0%
		Cumulative Total	**0.0**	**0%**

Easement Acreage **65.06**

Vegetation Category	Definitions	Mapping Threshold (ac)	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. Invasive species included in summation above should be identified in report summary.	0.10	11.99*	18%
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	1 Encroachments Noted / 11.39 ac**	

*Chinese privet (*Ligustrum sinense*) resprouted throughout an existing mautre canopy forest along Sassarixa Creek.
**Cattle accessed the Site in July but minimal impacts were made and the encroachment has been resolved.

STREAM PHOTOGRAPHS

	
PHOTO POINT 1 T1 R1 – upstream *(11/9/2021)*	**PHOTO POINT 1 T1 R1 – downstream *(11/9/2021)***
	
PHOTO POINT 2 T1 R2 – upstream *(11/9/2021)*	**PHOTO POINT 2 T1 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 3 T1 R2 – upstream *(11/9/2021)*	**PHOTO POINT 3 T1 R2 – downstream *(11/9/2021)***

PHOTO POINT 4 T1 R2 – upstream *(11/9/2021)*

PHOTO POINT 4 T1 R2 – downstream *(11/9/2021)*

PHOTO POINT 5 T1 R3 – upstream *(11/9/2021)*

PHOTO POINT 5 T1 R3 – downstream *(11/9/2021)*

PHOTO POINT 6 T1 R3 – upstream *(11/9/2021)*

PHOTO POINT 6 T1 R3 – downstream *(11/9/2021)*

	
PHOTO POINT 7 T1 R3 – upstream *(11/9/2021)*	**PHOTO POINT 7 T1 R4 – downstream *(11/9/2021)***
	
PHOTO POINT 8 T1 R4 – upstream *(11/9/2021)*	**PHOTO POINT 8 T1 R4 – downstream *(11/9/2021)***
	
PHOTO POINT 9 T1A – upstream *(11/9/2021)*	**PHOTO POINT 9 T1A – downstream *(11/9/2021)***

	
PHOTO POINT 10 T1B – upstream *(11/9/2021)*	**PHOTO POINT 10 T1B – downstream *(11/9/2021)***
	
PHOTO POINT 11 T1B – upstream *(11/9/2021)*	**PHOTO POINT 11 T1B – downstream *(11/9/2021)***
	
PHOTO POINT 12 T1C – upstream *(11/9/2021)*	**PHOTO POINT 12 T1C – downstream *(11/9/2021)***

PHOTO POINT 13 Sassarixa Creek R2 – upstream *(11/9/2021)*

PHOTO POINT 13 Sassarixa Creek R2 – downstream *(11/9/2021)*

PHOTO POINT 14 Sassarixa Creek R2 – upstream *(11/9/2021)*

PHOTO POINT 14 Sassarixa Creek R2 – downstream *(11/9/2021)*

PHOTO POINT 15 Sassarixa Creek R2 – upstream *(11/9/2021)*

PHOTO POINT 15 Sassarixa Creek R2 – downstream *(11/9/2021)*

	
PHOTO POINT 16 Sassarixa Creek R2 – upstream *(11/9/2021)*	**PHOTO POINT 16 Sassarixa Creek R2 – downstream *(11/9/2021)***
	
PHOTO POINT 17 Sassarixa Creek R3 – upstream *(11/9/2021)*	**PHOTO POINT 17 Sassarixa Creek R3 – downstream *(11/9/2021)***
	
PHOTO POINT 18 Sassarixa Creek R3 – upstream *(11/9/2021)*	**PHOTO POINT 18 Sassarixa Creek R3 – downstream *(11/9/2021)***

	
PHOTO POINT 19 T2 – upstream *(11/9/2021)*	**PHOTO POINT 19 T2 – downstream *(11/9/2021)***
	
PHOTO POINT 20 T2 – upstream *(11/9/2021)*	**PHOTO POINT 20 T2 – downstream *(11/9/2021)***
	
PHOTO POINT 21 T2 – upstream *(11/9/2021)*	**PHOTO POINT 21 T2 – downstream *(11/9/2021)***

PHOTO POINT 22 T2 – upstream *(11/9/2021)*

PHOTO POINT 22 T2 – downstream *(11/9/2021)*

PHOTO POINT 23 T2 – upstream *(11/9/2021)*

PHOTO POINT 23 T2 – downstream *(11/9/2021)*

PHOTO POINT 24 T3 R1 – upstream *(11/9/2021)*

PHOTO POINT 24 T3 R1 – downstream *(11/9/2021)*

	
PHOTO POINT 25 T3 R1 – upstream *(11/9/2021)*	**PHOTO POINT 25 T3 R1 – downstream *(11/9/2021)***
	
PHOTO POINT 26 T3 R1 – upstream *(11/9/2021)*	**PHOTO POINT 26 T3 R1 – downstream *(11/9/2021)***
	
PHOTO POINT 27 T3 R1 – upstream *(11/9/2021)*	**PHOTO POINT 27 T3 R1 – downstream *(11/9/2021)***

	
PHOTO POINT 28 T3 R1 – upstream *(11/9/2021)*	**PHOTO POINT 28 T3 R1 – downstream *(11/9/2021)***
	
PHOTO POINT 29 T3 R2 – upstream *(11/9/2021)*	**PHOTO POINT 29 T3 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 30 T4 R1 – upstream *(11/9/2021)*	**PHOTO POINT 30 T4 R1 – downstream *(11/9/2021)***

	
PHOTO POINT 31 T4 R2 – upstream *(11/9/2021)*	**PHOTO POINT 31 T4 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 32 T4 R3 – upstream *(11/9/2021)*	**PHOTO POINT 32 T4 R3 – downstream *(11/9/2021)***
	
PHOTO POINT 33 T4 R3 – upstream *(11/9/2021)*	**PHOTO POINT 33 T4 R3 – downstream *(11/9/2021)***

PHOTO POINT 34 T4 R3 – upstream *(11/9/2021)*

PHOTO POINT 34 T4 R3 – downstream *(11/9/2021)*

PHOTO POINT 35 T5 R1 – upstream *(11/9/2021)*

PHOTO POINT 35 T5 R1 – downstream *(11/9/2021)*

PHOTO POINT 36 T5 R1 – upstream *(11/9/2021)*

PHOTO POINT 36 T5 R1 – downstream *(11/9/2021)*

	
PHOTO POINT 37 T5 R2 – upstream *(11/9/2021)*	**PHOTO POINT 37 T5 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 38 T5 R2 – upstream *(11/9/2021)*	**PHOTO POINT 38 T5 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 39 T5 R2 – upstream *(11/9/2021)*	**PHOTO POINT 39 T5 R2 – downstream *(11/9/2021)***

	
PHOTO POINT 40 T5 R2 – upstream *(11/9/2021)*	**PHOTO POINT 40 T5 R3 – downstream *(11/9/2021)***
	
PHOTO POINT 41 T5 R3 – upstream *(11/9/2021)*	**PHOTO POINT 41 T5 R3 – downstream *(11/9/2021)***
	
PHOTO POINT 42 T5 R3 – upstream *(11/9/2021)*	**PHOTO POINT 42 T5 R3 – downstream *(11/9/2021)***

	
PHOTO POINT 43 T5 R3 – upstream *(11/9/2021)*	**PHOTO POINT 43 T5 R3 – downstream *(11/9/2021)***
	
PHOTO POINT 44 T5A – upstream *(11/9/2021)*	**PHOTO POINT 44 T5A – downstream *(11/9/2021)***
	
PHOTO POINT 45 T5A – upstream *(11/9/2021)*	**PHOTO POINT 45 T5A – downstream *(11/9/2021)***

	
PHOTO POINT 46 T5B – upstream *(11/9/2021)*	**PHOTO POINT 46 T5B – downstream *(11/9/2021)***
	
PHOTO POINT 47 T5B – upstream *(11/9/2021)*	**PHOTO POINT 47 T5B – downstream *(11/9/2021)***
	
PHOTO POINT 48 T5C – upstream *(11/9/2021)*	**PHOTO POINT 48 T5C – downstream *(11/9/2021)***

	
PHOTO POINT 49 T5C – upstream *(11/9/2021)*	**PHOTO POINT 49 T5C – downstream *(11/9/2021)***
	
PHOTO POINT 50 T6 R1 – upstream *(11/9/2021)*	**PHOTO POINT 50 T6 R1 – downstream *(11/9/2021)***
	
PHOTO POINT 51 T6 R2 – upstream *(11/9/2021)*	**PHOTO POINT 51 T6 R2 – downstream *(11/9/2021)***

	
PHOTO POINT 52 T6 R2 – upstream *(11/9/2021)*	**PHOTO POINT 52 T6 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 53 T6 R2 – upstream *(11/9/2021)*	**PHOTO POINT 53 T6 R2 – downstream *(11/9/2021)***
	
PHOTO POINT 54 T6 R2 – upstream *(11/9/2021)*	**PHOTO POINT 54 T6 R2 – downstream *(11/9/2021)***

STREAM CROSSING PHOTOGRAPHS

Sassarixa Creek Reach 2 – Looking Upstream *(11/9/2021)*

Sassarixa Creek Reach 1 – Looking Downstream *(11/9/2021)*

T1 Reach 1 – Looking Upstream *(11/9/2021)*

T1 Reach 1 – Looking Downstream *(11/9/2021)*

T4 Reach 3 – Looking Upstream *(11/9/2021)*

T4 Reach 3 – Looking Downstream *(11/9/2021)*

	
T5 Reach 3 – Looking Upstream *(11/9/2021)*	**T5 Reach 3 – Looking Downstream** *(11/17/2021)*
	
T6 Reach 2 – Looking Upstream *(11/9/2021)*	**T6 Reach 2 – Looking Downstream** *(11/9/2021)*

VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(9/2/2021)*

FIXED VEG PLOT 2 *(9/2/2021)*

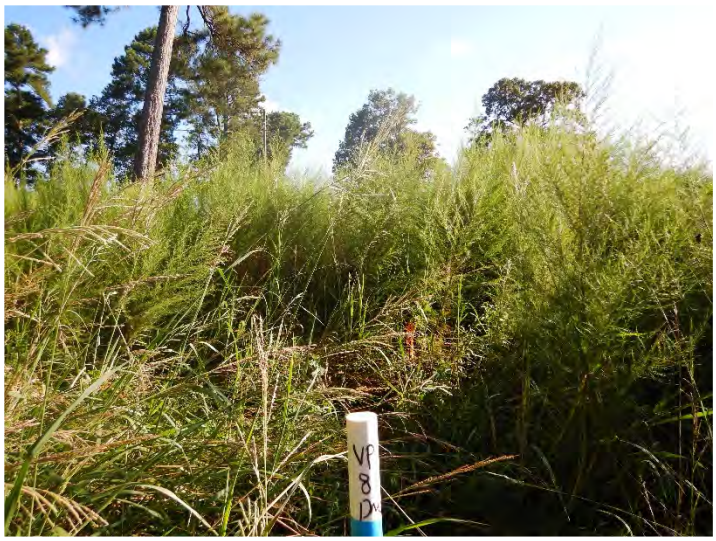
FIXED VEG PLOT 3 *(9/2/2021)*

FIXED VEG PLOT 4 *(9/2/2021)*

FIXED VEG PLOT 5 *(9/2/2021)*

FIXED VEG PLOT 6 *(9/2/2021)*

FIXED VEG PLOT 7 *(9/2/2021)*



FIXED VEG PLOT 8 *(9/2/2021)*

FIXED VEG PLOT 9 *(9/2/2021)*

FIXED VEG PLOT 10 *(9/2/2021)*

RANDOM VEG PLOT 11 *(9/2/2021)*

APPENDIX B. VEGETATION PLOT DATA

Table 6. Vegetation Plot Data
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Planted Acreage	13.03
Date of Initial Plant	2021-03-05
Date of Current Survey	2021-09-06
Plot size (ACRES)	0.0247

	Scientific Name	Common Name	Tree/ Shrub	Indicator Status	Veg Plot 1 F		Veg Plot 2 F		Veg Plot 3 F		Veg Plot 4 F		Veg Plot 5 F	
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC	1	1			1	1	1	1	1	1
	Betula nigra	river birch	Tree	FACW	2	2			4	4	1	1	2	2
	Liquidambar styraciflua	sweetgum	Tree	FAC										
	Magnolia virginiana	sweetbay	Tree	FACW	1	1	2	2	1	1	1	1	1	1
	Platanus occidentalis	American sycamore	Tree	FACW			1	1	4	4	2	2	4	4
	Populus deltoides	eastern cottonwood	Tree	FAC			3	3			1	1	1	1
	Quercus michauxii	swamp chestnut oak	Tree	FACW	2	2			2	2	4	4	1	1
	Quercus nigra	water oak	Tree	FAC	2	2					1	1		
	Quercus phellos	willow oak	Tree	FACW	1	1			3	3	3	3	2	2
Sum				Performance Standard	9	9	6	6	15	15	14	14	12	12
Mitigation Plan Performance Standard				Current Year Stem Count		9		6		15		14		12
				Stems/Acre		364		243		607		567		486
				Species Count		6		3		6		8		7
				Dominant Species Composition (%)		22		50		27		29		33
				Average Plot Height		2		2		3		2		3
				% Invasives		0		0		0		0		0
Post Mitigation Plan Performance Standard				Current Year Stem Count		9		6		15		14		12
				Stems/Acre		364		243		607		567		486
				Species Count		6		3		6		8		7
				Dominant Species Composition (%)		22		50		27		29		33
				Average Plot Height		2		2		3		2		3
				% 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
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Planted Acreage	13.03
Date of Initial Plant	2021-03-05
Date of Current Survey	2021-09-06
Plot size (ACRES)	0.0247

	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		Veg Plot 11 R
					Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Total
Species Included in Approved Mitigation Plan	Acer negundo	boxelder	Tree	FAC	2	2	1	1	2	2	2	2			1
	Betula nigra	river birch	Tree	FACW	2	2	2	2	1	1	3	3	1	1	4
	Liquidambar styraciflua	sweetgum	Tree	FAC											1
	Magnolia virginiana	sweetbay	Tree	FACW	1	1	1	1	1	1	1	1	2	2	1
	Platanus occidentalis	American sycamore	Tree	FACW	2	2	3	3	3	3	5	5	3	3	1
	Populus deltoides	eastern cottonwood	Tree	FAC			1	1	1	1	2	2	2	2	1
	Quercus michauxii	swamp chestnut oak	Tree	FACW	3	3	3	3	4	4	1	1	2	2	1
	Quercus nigra	water oak	Tree	FAC			1	1					1	1	
	Quercus phellos	willow oak	Tree	FACW	3	3	2	2	2	2	1	1	2	2	2
Sum				Performance Standard	13	13	14	14	14	14	15	15	13	13	12
Mitigation Plan Performance Standard				Current Year Stem Count		13		14		14		15		13	12
				Stems/Acre		526		567		567		607		526	486
				Species Count		6		8		7		7		7	8
				Dominant Species Composition (%)		23		21		29		33		23	33
				Average Plot Height		2		3		3		3		2	3
				% Invasives		0		0		0		0		0	0
Post Mitigation Plan Performance Standard				Current Year Stem Count		13		14		14		15		13	12
				Stems/Acre		526		567		567		607		526	486
				Species Count		6		8		7		7		7	8
				Dominant Species Composition (%)		23		21		29		33		23	33
				Average Plot Height		2		3		3		3		2	3
				% Invasives		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.

Table 7. Vegetation Performance Standards Summary Table

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

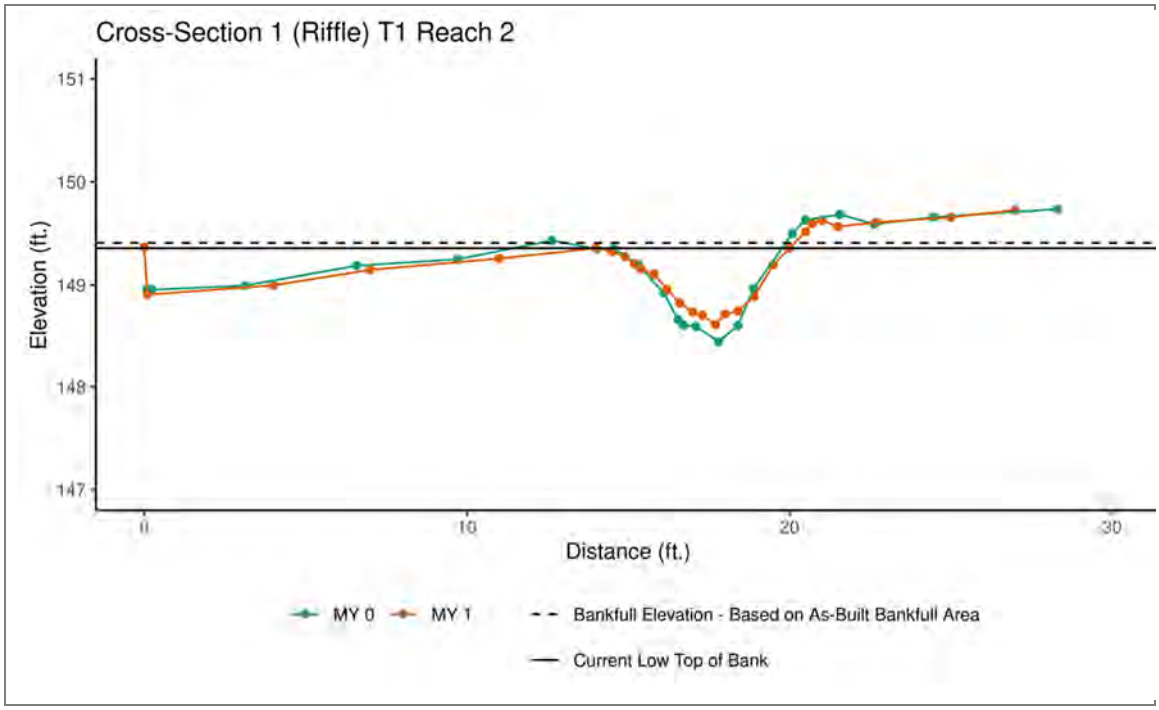
Monitoring Year 1 - 2021

	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	364	2	6	0	243	2	3	0	607	3	6	0
Monitoring Year 0	567	3	8	0	445	2	5	0	607	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	567	2	8	0	486	3	7	0	526	2	6	0
Monitoring Year 0	607	2	8	0	486	3	7	0	567	3	6	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	567	3	8	0	567	3	7	0	607	3	7	0
Monitoring Year 0	567	2	8	0	567	3	7	0	648	2	7	0
	Veg Plot 10 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	526	2	7	0	486	3	8	0				
Monitoring Year 0	607	2	8	0	648	2	8	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.

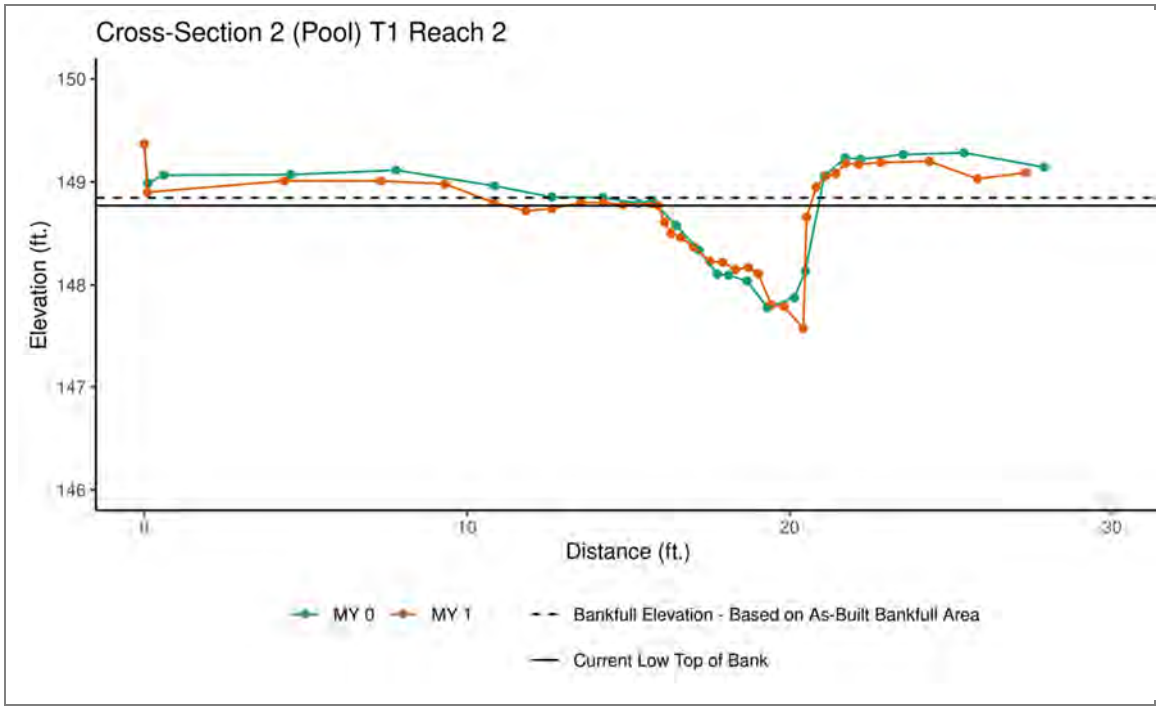
APPENDIX C. STREAM GEOMORPHOLOGY DATA

Cross-Section Plots



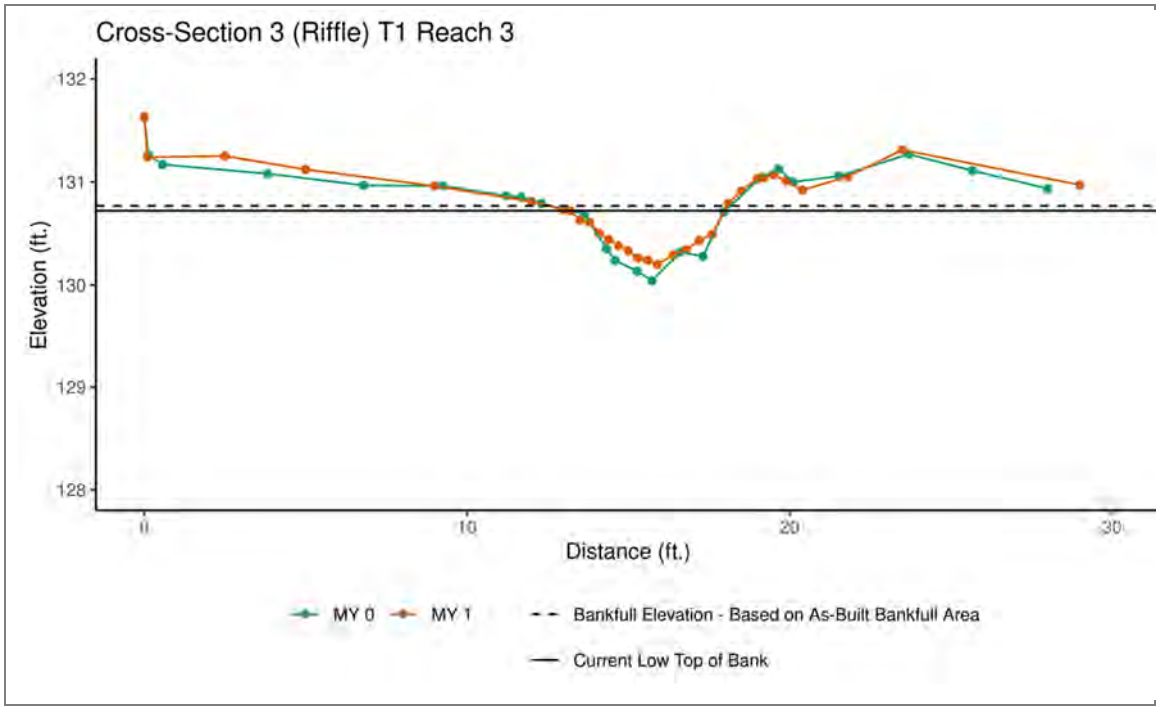
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	149.35	149.41				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.93				
Thalweg Elevation	148.45	148.62				
LTOB Elevation	149.35	149.36				
LTOB Max Depth	0.90	0.74				
LTOB Cross-Sectional Area	2.47	2.16				

Downstream *(07/27/2021)*



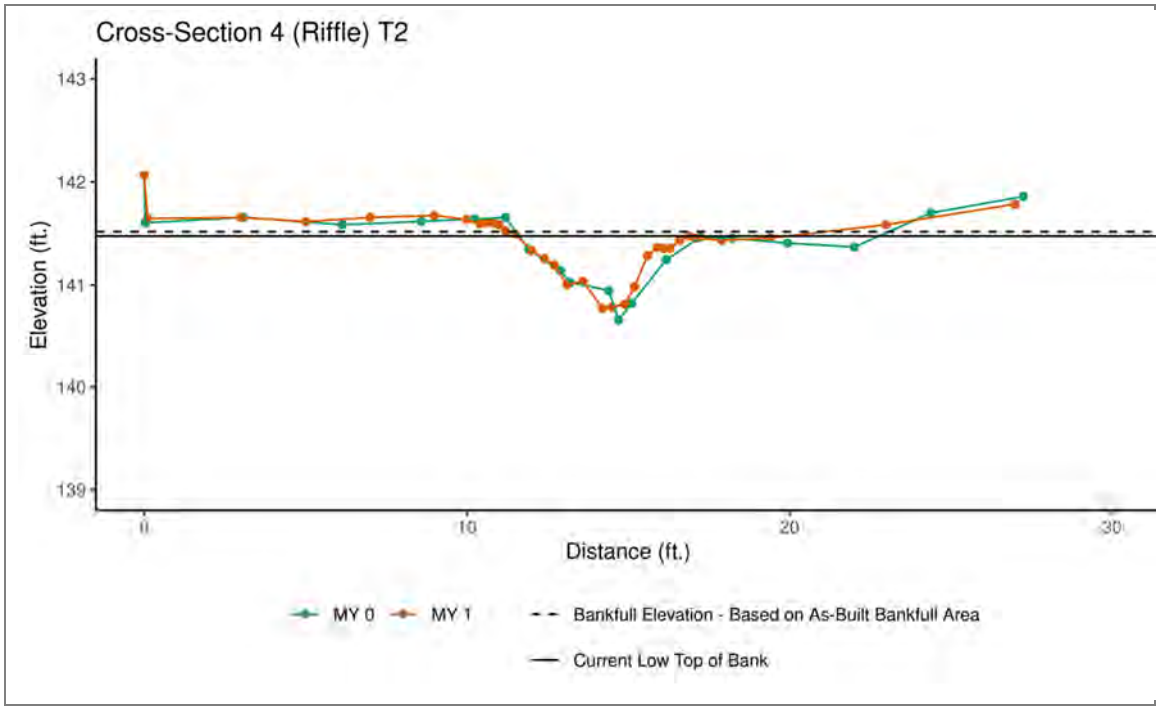
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A				
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A				
Thalweg Elevation	147.78	147.58				
LTOB Elevation	148.82	148.77				
LTOB Max Depth	1.04	1.19				
LTOB Cross-Sectional Area	3.20	2.84				

Downstream *(07/27/2021)*



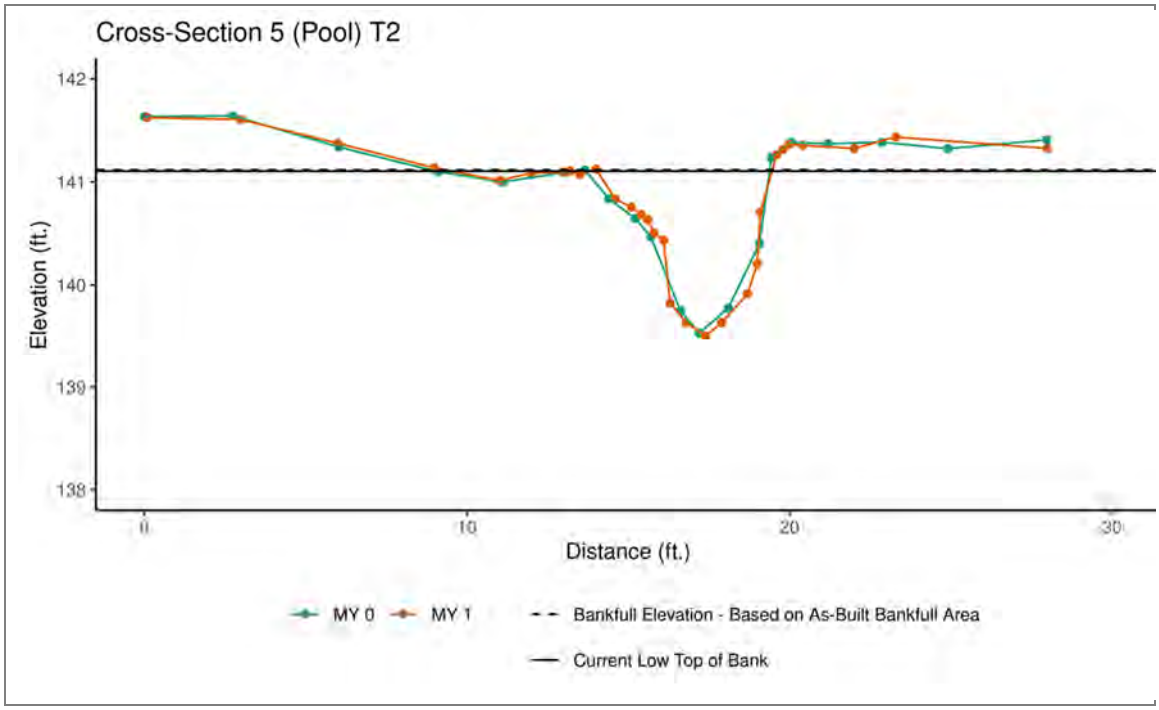
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	130.69	130.77				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.91				
Thalweg Elevation	130.04	130.24				
LTOB Elevation	130.69	130.72				
LTOB Max Depth	0.64	0.48				
LTOB Cross-Sectional Area	1.67	1.45				

Downstream *(07/27/2021)*



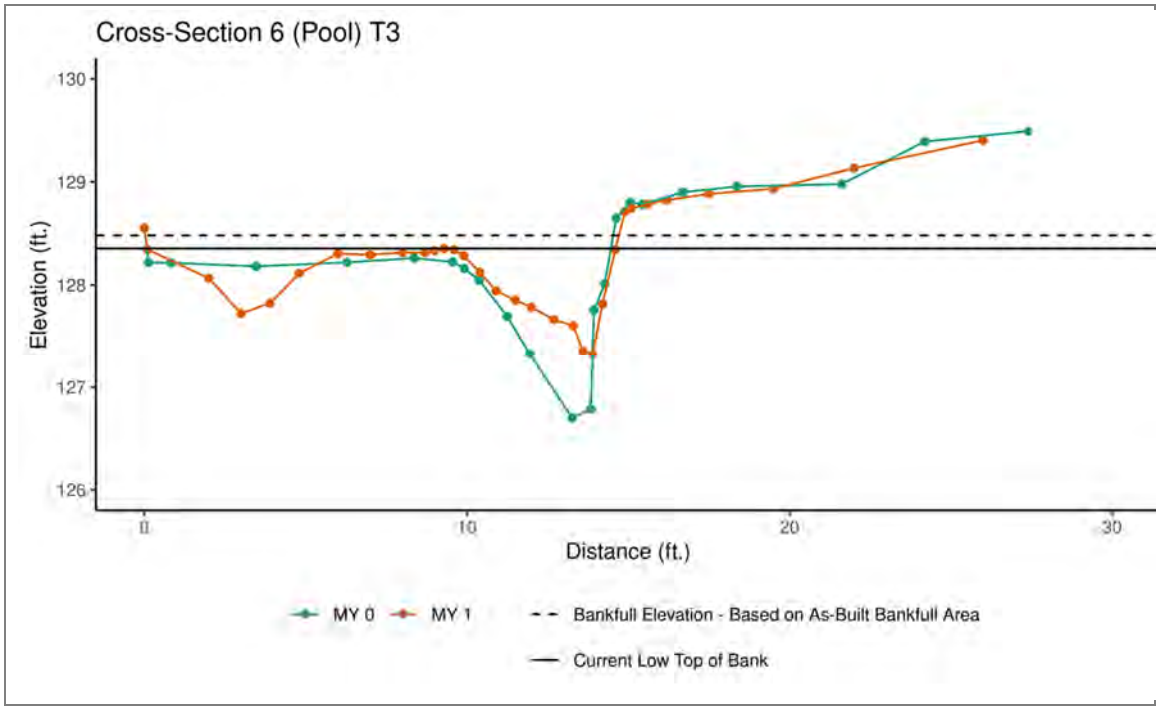
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	141.46	141.52				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.94				
Thalweg Elevation	140.66	140.78				
LTOB Elevation	141.46	141.47				
LTOB Max Depth	0.80	0.69				
LTOB Cross-Sectional Area	1.99	1.76				

Downstream *(07/27/2021)*



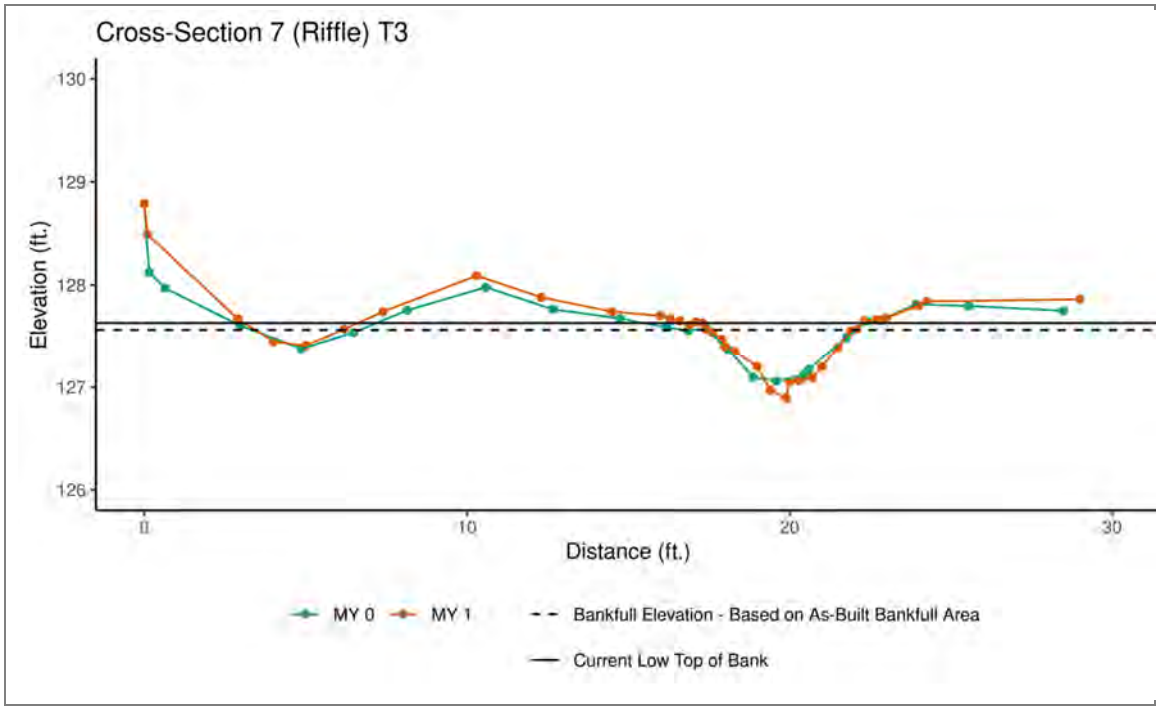
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A				
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A				
Thalweg Elevation	139.53	139.50				
LTOB Elevation	141.12	141.10				
LTOB Max Depth	1.58	1.60				
LTOB Cross-Sectional Area	4.88	4.82				

Downstream *(07/27/2021)*



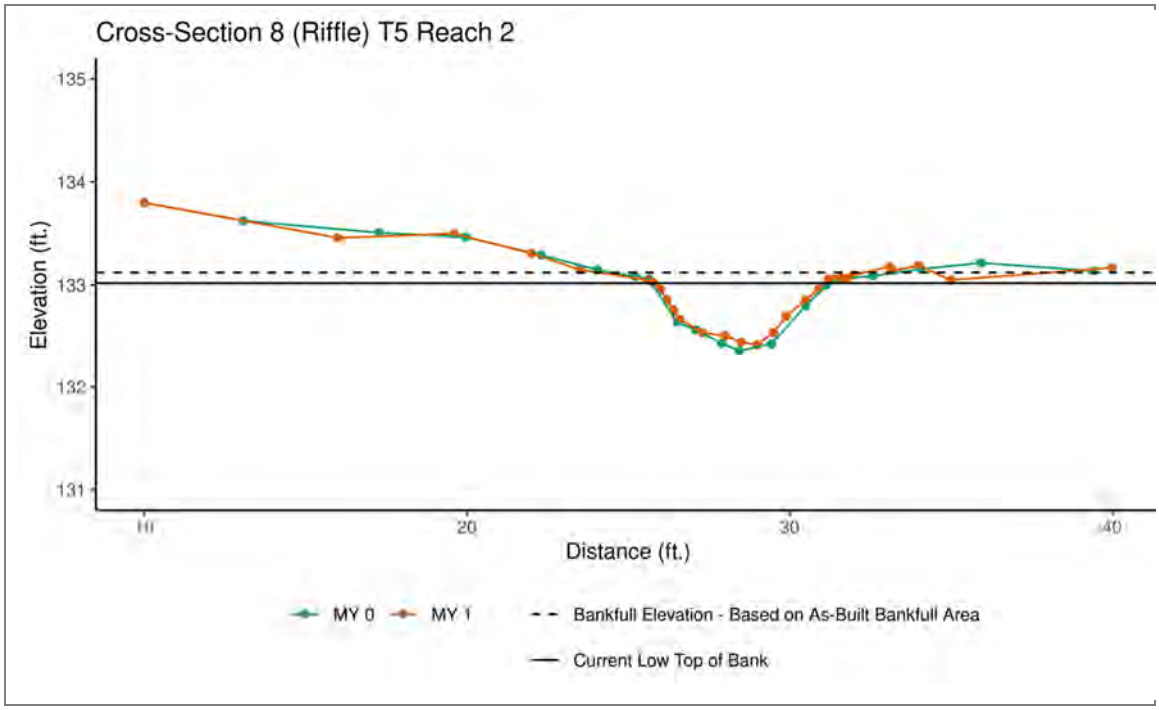
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A				
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A				
Thalweg Elevation	126.70	127.32				
LTOB Elevation	128.16	128.35				
LTOB Max Depth	1.46	1.03				
LTOB Cross-Sectional Area	3.25	2.57				

Downstream *(07/27/2021)*



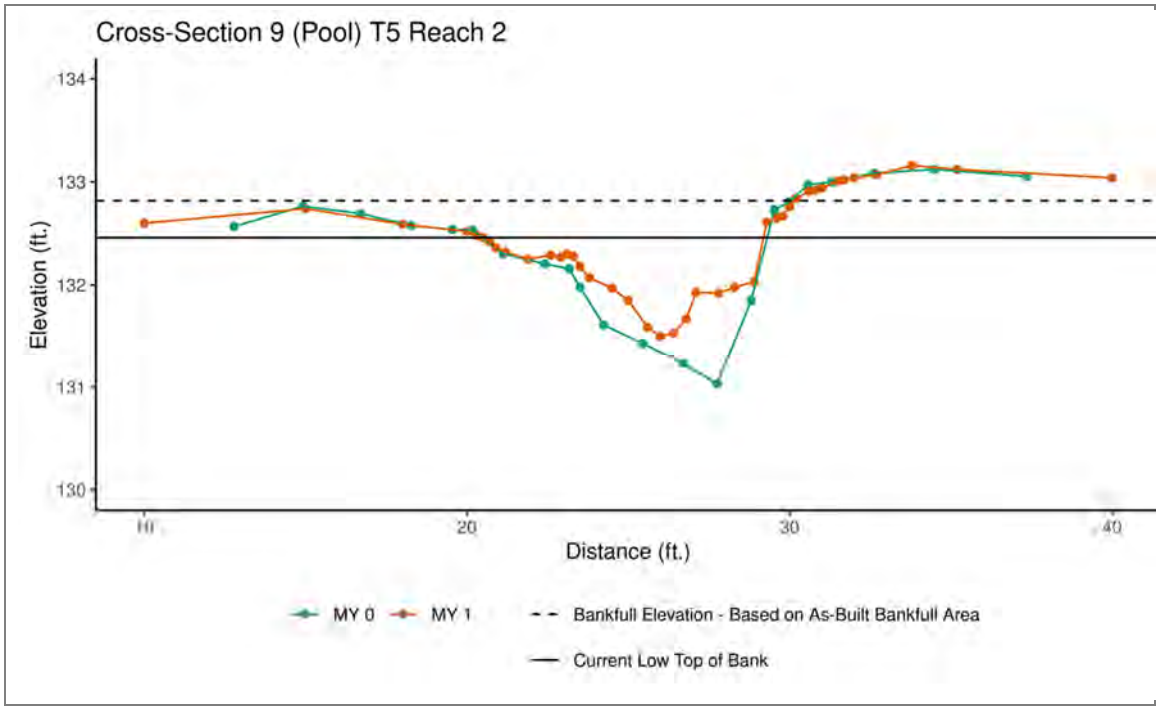
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	127.58	127.56				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	1.10				
Thalweg Elevation	127.06	126.89				
LTOB Elevation	127.58	127.63				
LTOB Max Depth	0.52	0.74				
LTOB Cross-Sectional Area	1.50	1.82				

Downstream *(07/27/2021)*



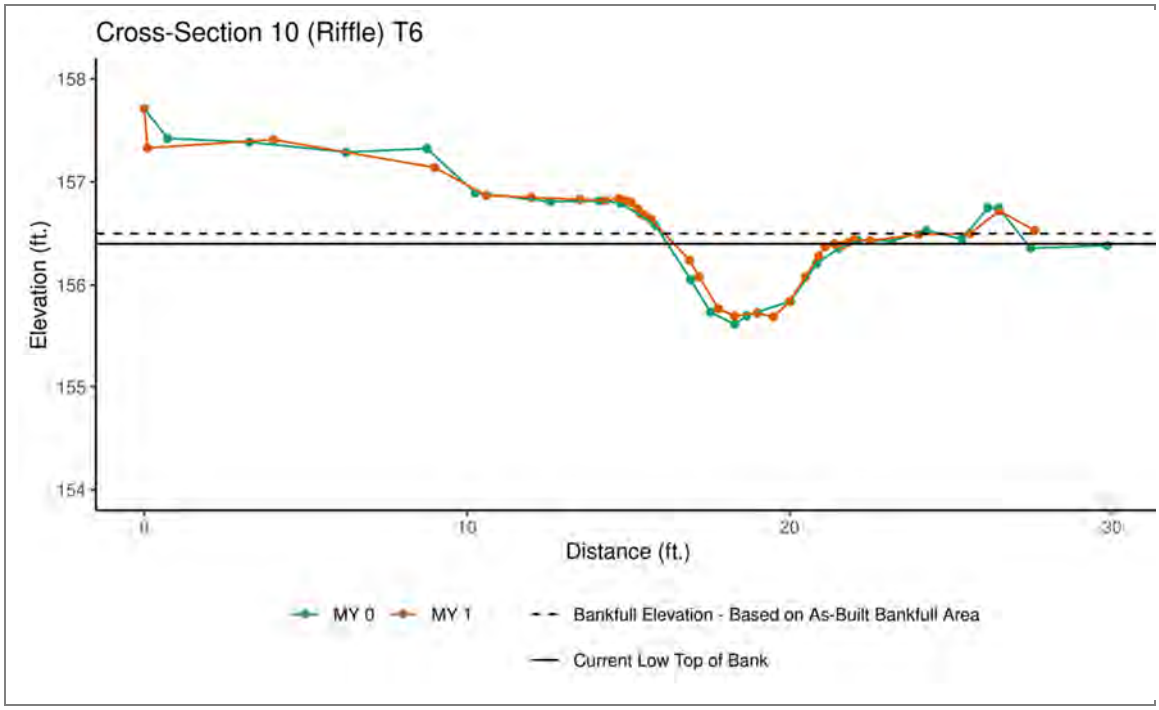
	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	133.06	133.12				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.85				
Thalweg Elevation	132.36	132.42				
LTOB Elevation	133.06	133.02				
LTOB Max Depth	0.70	0.60				
LTOB Cross-Sectional Area	2.49	1.95				

Downstream *(07/27/2021)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	N/A	N/A				
Bank Height Ratio - Based on AB-Bankfull Area	N/A	N/A				
Thalweg Elevation	131.03	131.50				
LTOB Elevation	132.53	132.46				
LTOB Max Depth	1.50	0.96				
LTOB Cross-Sectional Area	6.97	3.86				

Downstream *(07/27/2021)*



	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation - Based on AB-Bankfull Area	156.43	156.50				
Bank Height Ratio - Based on AB-Bankfull Area	1.00	0.88				
Thalweg Elevation	155.62	155.69				
LTOB Elevation	156.43	156.40				
LTOB Max Depth	0.81	0.71				
LTOB Cross-Sectional Area	2.69	2.20				

Downstream *(07/27/2021)*

Table 8. Baseline Stream Data Summary

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**T1 R2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3.4		1	3.6		5.2		1
Floodprone Width (ft)	8		1	>7.9		200		1
Bankfull Mean Depth	1		1	0.3		0.4		1
Bankfull Max Depth	0.7		1	0.4	0.5	0.9		1
Bankfull Cross Sectional Area (ft^2)	2.5		1	1.2		2.5		1
Width/Depth Ratio	4.9		1	11.0		11.0		1
Entrenchment Ratio	2.2		1	>2.2		34.6		1
Bank Height Ratio	3.0		1	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	G5			C5b/E5b		C5b/E5b		
Bankfull Discharge (cfs)	8.8			3.0		9.0		
Sinuosity	1.20			1.20		1.20		
Water Surface Slope ($ft/ft)^2$	0.0190	0.0300	2	0.0250	0.0410	0.0322		
Other	---			---		---		
Parameter	**T1 R3**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3.4		1	4.2		4.3		1
Floodprone Width (ft)	8		1	>9.2		90		1
Bankfull Mean Depth	1		1	0.4		0.4		1
Bankfull Max Depth	0.7		1	0.4	0.6	0.6		1
Bankfull Cross Sectional Area (ft^2)	2.5		1	1.5		1.7		1
Width/Depth Ratio	4.9		1	12.0		11.1		1
Entrenchment Ratio	2.2		1	>2.2		21.9		1
Bank Height Ratio	3.0		1	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	G5			C5/E5		C5/E5		
Bankfull Discharge (cfs)	8.8			3.5		4.3		
Sinuosity	1.20			1.20		1.20		
Water Surface Slope ($ft/ft)^2$	0.0190	0.0300	2	0.0092	0.0250	0.0181		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**T2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3		1	4.2		5.6		1
Floodprone Width (ft)	4		1	>9.2		75		1
Bankfull Mean Depth	0.5		1	0.4		0.4		1
Bankfull Max Depth	0.6		1	0.5		0.8		1
Bankfull Cross Sectional Area (ft^2)	1.5		1	1.5		2.0		1
Width/Depth Ratio	6		1	12.0		15.7		1
Entrenchment Ratio	1.2		1	>2.2		13.4		1
Bank Height Ratio	6.5		1	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	G5			C5b/E5b		C5b/E5b		
Bankfull Discharge (cfs)	5.4			2.0		4.3		
Sinuosity	1.14			1.40		1.40		
Water Surface Slope ($ft/ft)^2$	0.0290		1	0.0051	0.0064	0.0147		
Other	---			---		---		
Parameter	**T3 R1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3.2	4.2	2	3.6		4.7		1
Floodprone Width (ft)	5	24	2	>7.9		35		1
Bankfull Mean Depth	0.42	0.5	2	0.3		0.3		1
Bankfull Max Depth	0.7	0.56	2	0.4	0.5	0.5		1
Bankfull Cross Sectional Area (ft^2)	1.7		2	1.0		1.5		1
Width/Depth Ratio	6.4	10	2	12.0		14.8		1
Entrenchment Ratio	1.1	7.1	2	>2.2		7.4		1
Bank Height Ratio	2.7	7.0	2	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	B5/G5			C5/E5b		C5/E5b		
Bankfull Discharge (cfs)	6.2	6.9	2	2.5		4.5		
Sinuosity	1.16			1.20		1.20		
Water Surface Slope ($ft/ft)^2$	0.0340		1	0.0280	0.0330	0.0312		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**T5 R2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3.1		1	5.6		5.9		1
Floodprone Width (ft)	27		1	>11		170		1
Bankfull Mean Depth	1.1		1	0.5		0.4		1
Bankfull Max Depth	1.4		1	0.6	0.8	0.7		1
Bankfull Cross Sectional Area (ft^2)	3.5		1	2.7		2.5		1
Width/Depth Ratio	2.8		1	12.0		14.0		1
Entrenchment Ratio	8.7		1	>2.2		16.9		1
Bank Height Ratio	1.6		1	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	E5			C5/E5		C5/E5		
Bankfull Discharge (cfs)	10.9			6.0		5.4		
Sinuosity	1.20			1.40		1.40		
Water Surface Slope ($ft/ft)^2$	0.0120		1	0.0086	0.0170	0.0111		
Other	---			---		---		
Parameter	**T6 R1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	4.1		1	6.4		6.0		1
Floodprone Width (ft)	7		1	>14		90		1
Bankfull Mean Depth	1.1		1	0.41		0.4		1
Bankfull Max Depth	1.5		1	0.5	0.7	0.8		1
Bankfull Cross Sectional Area (ft^2)	4.4		1	3.3		2.7		1
Width/Depth Ratio	3.7		1	12.0		13.3		1
Entrenchment Ratio	1.7		1	>2.2		15.1		1
Bank Height Ratio	2.0		1	1.0	1.2	1.0		1
Max part size (mm) mobilized at bankfull	---			---		---		
Rosgen Classification	G5			C5/E5		C5/E5		
Bankfull Discharge (cfs)	12.8			5.5		5.9		
Sinuosity	1.10			1.20		1.20		
Water Surface Slope ($ft/ft)^2$	0.0086		1	0.0049	0.0150	0.0107		
Other	---			---		---		

Table 9. Cross-Section Morphology Monitoring Summary

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

	T1 Reach 2												T1 Reach 3						T2					
	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)						Cross-Section 4 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	149.35	149.41					N/A	N/A					130.69	130.77					141.46	141.52				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	0.93					N/A	N/A					1.00	0.91					1.00	0.94				
Thalweg Elevation	148.45	148.62					147.78	147.58					130.04	130.24					140.66	140.79				
LTOB[2] Elevation	149.35	149.36					148.82	148.77					130.69	130.72					141.46	141.48				
LTOB[2] Max Depth (ft)	0.90	0.74					1.04	1.19					0.64	0.48					0.80	0.69				
LTOB[2] Cross Sectional Area (ft^2)	2.47	2.16					3.20	2.84					1.67	1.45					1.99	1.76				

	T2						T3 Reach 1												T5 Reach 2					
	Cross-Section 5 (Pool)						Cross-Section 6 (Pool)						Cross-Section 7 (Riffle)						Cross-Section 8 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A					N/A	N/A					127.58	127.56					133.06	133.12				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					N/A	N/A					1.00	1.10					1.00	0.85				
Thalweg Elevation	139.53	139.51					126.70	127.32					127.06	126.89					132.36	132.42				
LTOB[2] Elevation	141.12	141.11					128.16	128.35					127.58	127.63					133.06	133.02				
LTOB[2] Max Depth (ft)	1.58	1.60					1.46	1.03					0.52	0.74					0.70	0.60				
LTOB[2] Cross Sectional Area (ft^2)	4.88	4.82					3.25	2.57					1.50	1.82					2.49	1.95				

	T5 Reach 2						T6 Reach 1					
	Cross-Section 9 (Pool)						Cross-Section 10 (Riffle)					
	MY0	MY1	MY2	MY3	MY5	MY7	MY0	MY1	MY2	MY3	MY5	MY7
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A					156.43	156.50				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.00	0.88				
Thalweg Elevation	131.03	131.50					155.62	155.69				
LTOB[2] Elevation	132.53	132.46					156.43	156.40				
LTOB[2] Max Depth (ft)	1.50	0.96					0.81	0.71				
LTOB[2] Cross Sectional Area (ft^2)	6.97	3.86					2.69	2.20				

[1]Bank Height Ratio (BHR) takes the As-built bankful area as the basis for adjusting each subsequent years bankfull elevation.

[2]LTOB Area and Max depth - These are based on the LTOB elevation for each years survey (The same elevation used for the LTOB in the BHR calculation). Area below the LTOB elevation will be used and tracked for each year as above. The difference between the LTOB elevation and the thalweg elevation (same as in the BHR calculation) will be recroded and tracked above as LTOB max depth.

APPENDIX D. HYDROLOGY DATA

Table 10. Bankfull Events

Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Reach	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
T1 Reach 3	2/16/2021 7/28/2021						
T2	7/27/2021 10/9/2021						
T3 Reach 1	7/28/2021						
T5 Reach 2	1/24/2021 7/28/2021						

Table 11. Rainfall Summary

Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Annual Precip Total	31.38*						
WETS 30th Percentile	44.35						
WETS 70th Percentile	52.31						
Normal	*						

*Annual precipitation total was collected up until 11/9/2021. Data will be updated in MY2.

Table 12. Wetland Gauge Summary

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

Gauge	Max. Consecutive Hydroperiod (Percentage)						
	MY1 (2021)*	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
1	**124 Days (47.5%)**						

Performance Standard: **None**

WETS Station: **Smithfield 2 North**

Growing Season: **3/1/2021 to 11/16/2021 (260 Days)**

*Data was collected from 3/1/2021 to 11/9/2021 (253 Days).

Wetland Gauge Plot

Sassarixa Swamp Mitigation Site

DMS Project No. 100040

Monitoring Year 1 - 2021

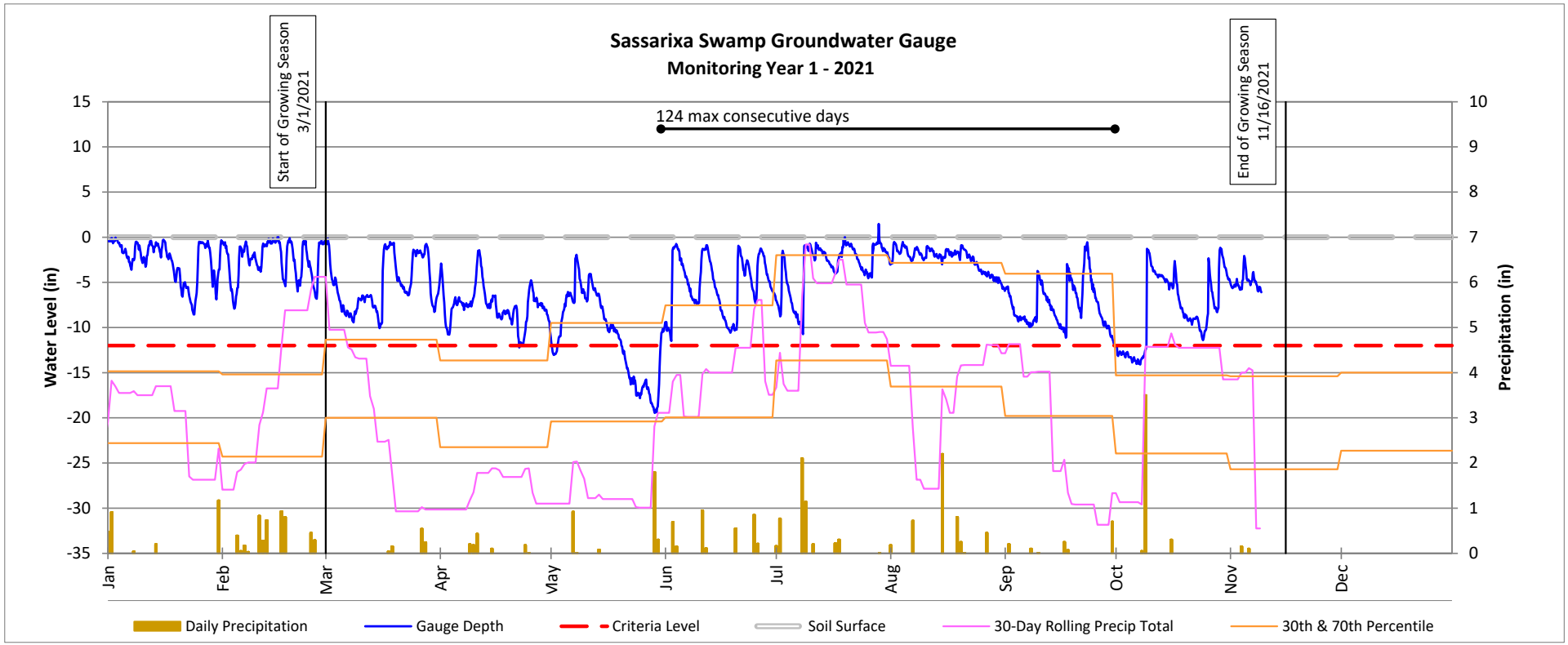


Table 13. Recorded In-Stream Flow Events Summary

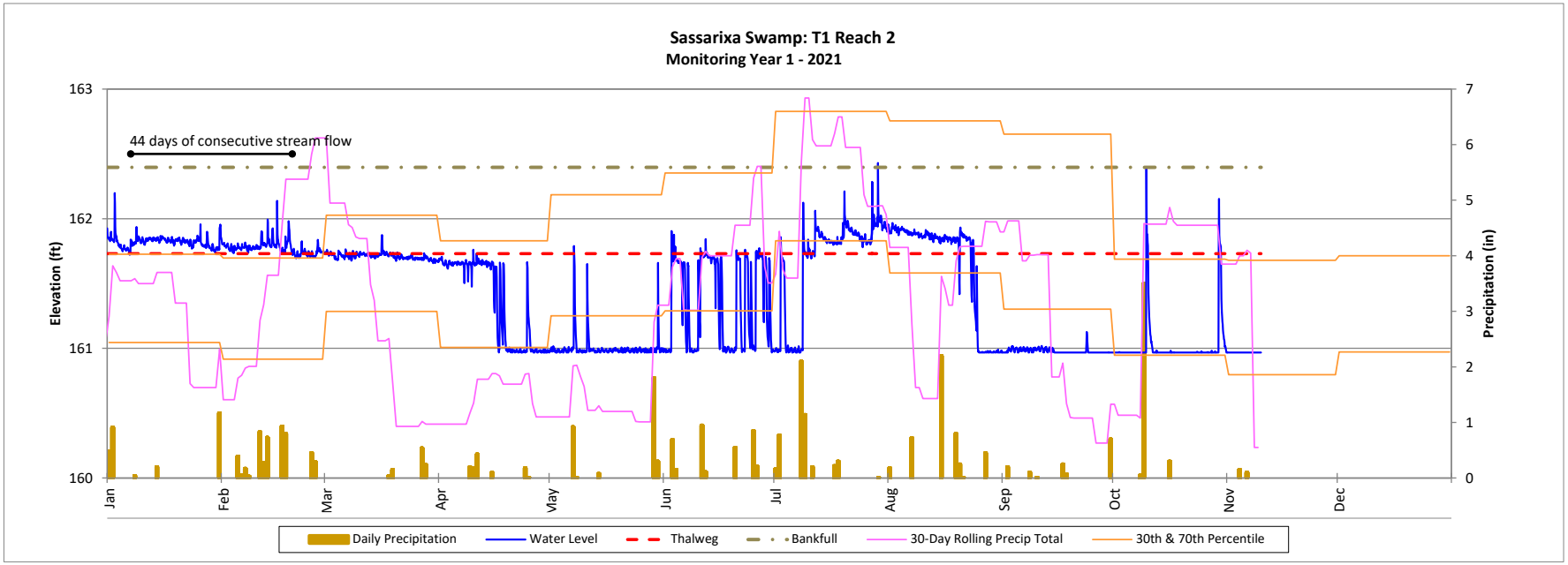
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Reach	Max Consecutive Days/Total Days Meeting Success Criteria*						
	MY1 (2021)**	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
T1 Reach 2	44 Days/ 108 Days						
T2	103 Days/ 177 Days						
T3 Reach 1	108 Days/ 190 Days						

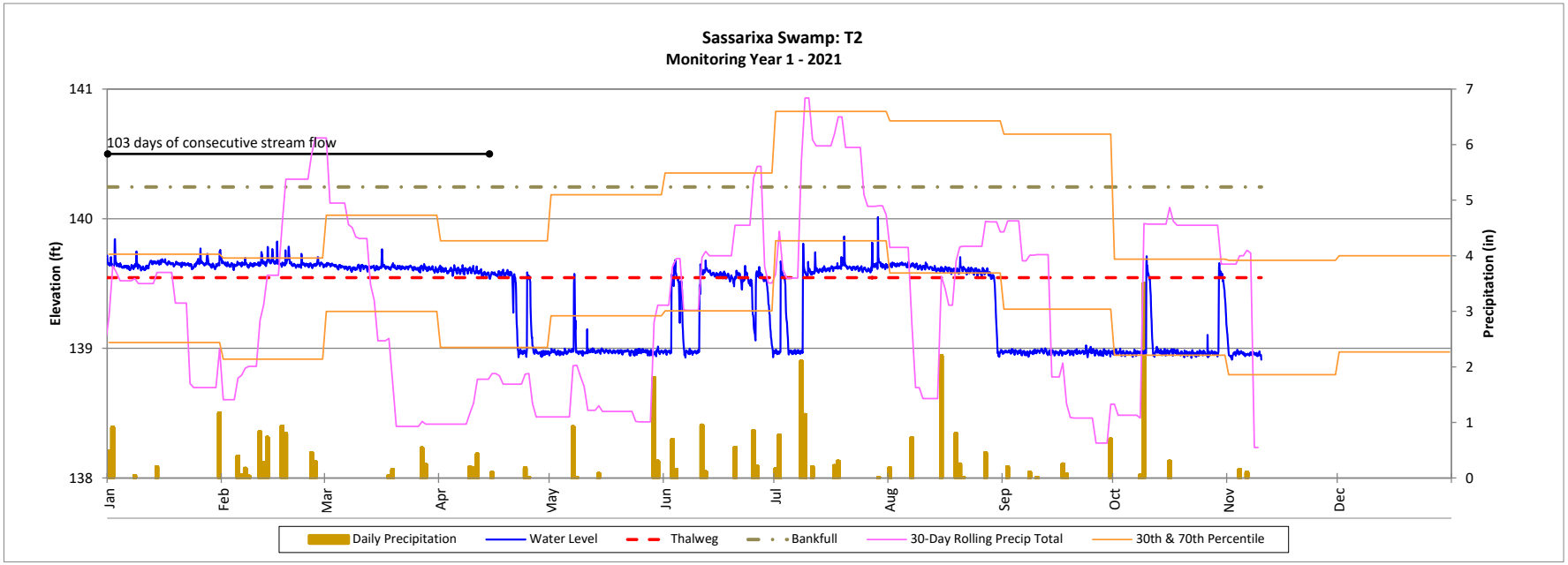
*Success criteria is 30 consecutive days of flow.

**Data was colleted through 11/9/2021. Data will be updated in MY2.

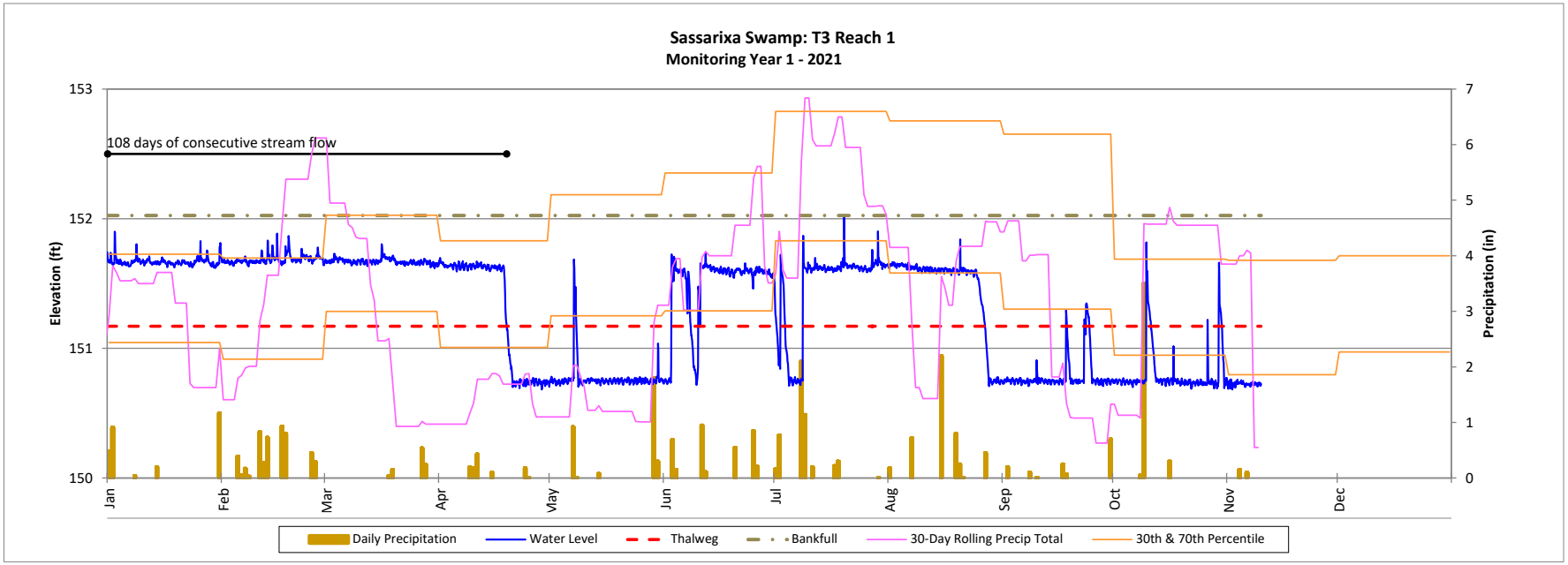
Recorded In-Stream Flow Events Plot
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021



Recorded In-Stream Flow Events Plot
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021



Recorded In-Stream Flow Events Plot
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021



APPENDIX E. PROJECT TIMELINE AND CONTACT INFO

Table 14. Project Activity and Reporting History
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		NA	January 2018
Mitigation Plan Approved		November 2019	November 2019
Construction (Grading) Completed		NA	January 2021
Planting Completed		NA	March 2021
As-Built Survey Completed		Febuary 2021	Febuary 2021
Baseline Monitoring Document (Year 0)	Stream Survey	January 2021	April 2021
	Vegetation Survey	March 2021	
Easement Encroachment			July 2021
In-Stream Vegetation Treatment			September 2021
Year 1 Monitoring	Stream Survey	July 2021	December 2021
	Vegetation Survey	September 2021	
Year 2 Monitoring	Stream Survey	2022	December 2022
	Vegetation Survey	2022	
Year 3 Monitoring	Stream Survey	2023	December 2023
	Vegetation Survey	2023	
Year 4 Monitoring			December 2024
Year 5 Monitoring	Stream Survey	2025	December 2025
	Vegetation Survey	2025	
Year 6 Monitoring			December 2026
Year 7 Monitoring	Stream Survey	2027	December 2027
	Vegetation Survey	2027	

Table 15. Project Contact Table
Sassarixa Swamp Mitigation Site
DMS Project No. 100040
Monitoring Year 1 - 2021

Designer Angela Allen, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Land Mechanic Designs, Inc.** 126 Circle G Lane Willow Spring, NC 27592
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

APPENDIX F. Additional Documentation

November 30, 2021

Kim Browning
Wilmington District, Regulatory Division
U.S. Army Corps of Engineers
11405 Falls of Neuse Road
Wake Forest, NC 27587

Subject: IRT Comments on Sassarixa Swamp Mitigation Site Baseline Report and Record Drawings
Sassarixa Swamp, SAQ 2018-00432, DMS Project Number 100040

Dear Ms. Browning,

We have reviewed the comments on the MY0 Report for the above referenced project dated August 27, 2021. Below are responses to each of your comments. For your convenience, the comments are reprinted with our response in italics.

USACE Comments, Kim Browning:

1. Table 1: T1 R4, T1A, T1B and T1C are listed as EII at 2.5:1 and part of the rationale for this ratio was livestock exclusion and understory planting. Were these areas planted? If so, with what species? The IRT agreed to a 4:1 ratio during the draft mitigation plan review but ultimately accepted 2.5:1 based on increasing understory diversity and livestock exclusion.

   The mitigation plan stated that T1A, T1B, and T1C would require planting and the exclusion of livestock to improve stream function (pg 24). However, it does not mention understory planting. We could not find mention of understory planting in any comment responses or meeting minutes.
2. The final mitigation plan planting list included 10% cherry bark oak in the floodplain and wetland planting zone. This is not listed in the MY0 report; which species were increased as a substitution?

   Cherrybark oak was only planted in the wetland areas. Of the 660 trees planted in the wetland areas, 66 were cherrybark oak so the likelihood that we would see a species in the veg plots is low.
3. In future monitoring reports it would be helpful to include planted stem percentages in Table 6.

   Table 6 is an exported excel document from a DMS template. Wildlands can discuss the possibility of including planted stem percentages in future reports.
4. Please include photo points of all crossings in future monitoring reports.

   Photo of stream crossings are now in Appendix A.

5. Sediment is observed in the channel in several sections of T2 in the photos and on the video. Do you anticipate that this will be flushed out of the system and form more defined channel features? The area where the pond was removed appears to be trending towards developing wetland features.

   Yes, sediment has already started to make its way through the system. A more defined channel can be seen on the site.

6. Please verify that a flow gauge was installed on T3. I was able to spot the gauge on T2 in the photos but photo point 24 didn't capture the gauge.

   Yes, a flow gauge was installed on T3. It is shown in Figure 1a and data is in Appendix D.

7. Is the large amount of rock observed in the video at the upper end of T2 the BMP shown on Sheet 1.25? I noted that the PCN included impacts for grading wetland GG, but the design sheets show the BMP in the wetland, which would be considered a permanent impact. Treatment features should not be placed in jurisdictional features.

   The PCN called out wetland GG as a permanent impact for grading. Wetland GG was originally a manmade wetland similar to a small retention basin that had a pipe connecting it to the pond. The original plan was to grade this into the proposed valley. However, high runoff volumes from the cattle pastures during construction began to cause erosion on the valley walls. Adding the BMP as a field adjustment was necessary to prevent future erosion by slowing the runoff from the adjacent fields.

8. In future monitoring reports please provide an estimate of how many of the mature trees that were still present after construction have died. I'm curious about the effects of construction equipment and tree survival.

   A visual assessment of mature tree mortality will be documented during every monitoring report.

9. A lot of mature pine was noted in the video that will serve as a seed source in the buffer. Please explain how this will be addressed if pine volunteers dominate the site.

   Selective pine removal will be considered if pine volunteers dominate the site.

10. Was there only one random veg plot? I'd like to request one be located along T5 near cross section 8.

    Yes, one random veg plot was approved in the Mitigation Plan. T5 is mostly mature forest with only a narrow corridor impacted during construction; therefore, only a small area was planted. A random veg plot would be very difficult to place in this small area. The random veg plot will be moved throughout the Site and can assess T5 if requested by the IRT. Attached is as-built plan sheet 3.3 showing the narrow planting zone along T5.

DWR Comments, Erin Davis:

1. DWR appreciated the discussion of the storm damage and Old Olive Road sediment source during construction. It was important to have that context given what was shown in the photos, video, and restoration profile sheets. The excess sediment is concerning. Just a reminder that any channel maintenance activities should be proposed within the next two years, since the IRT wants to see the trajectory (stream/wetland) the credit features are trending through the second half of the monitoring period.

   Excess sediment has started to make its way through the channels. Wildlands does not plan to remove excess sediment at this point.

2. It was noted that sections of T2 and Sassarixa Creek Reach 2 were stable and didn't require construction of approved design structures. Since these areas were in backwater during construction, how was stream stability assessed? Do these areas still appear stable under summer baseflow conditions?

   Stability was assessed by looking at the bed and bank features and bed slope. Summer low flow conditions show a stable system in this area. The brush toe connects the constructed channel to the confluence of Sassarixa Swamp and the bed shows no signs of scour or erosion.

3. Sheet 1.25 shows two pipes, please confirm these structures were removed.

   The field drains were not removed; however, they remain above the point of jurisdiction on the channel. Removing the drains at the easement boundary was not viable due to high elevation of the pipe outlets on steep side slopes of the floodplain and the amount of concentrated flow they produced. If the drains were removed at the easement boundary, there was a very high likelihood of significant erosion on the side slopes.

4. Sheet 5.9 has a note that an area was not fenced because of the swamp. Please confirm whether the terminal boundaries of T4 and T5 were fenced as shown.

   A site walk was completed on November 8, 2021 to verify the terminal boundaries of T4 and T5 are fenced as reported.

5. Looking at the video, it appears there are mature pines present within and/or adjacent to the site. Has a pine management strategy been developed for the monitoring period?

   A pine management strategy has not been developed at this point. Wildlands will assess the situation and treat pines as needed.

6. Just to confirm, the video segment (9:30) of T2 is showing coir logs installed at the top of slope along the terrace?

Yes, coir logs were installed at the top of slope along T2 to prevent erosion.

If you have any questions, please contact me by phone (919) 851-9986, or by email (jlorch@wildlandseng.com).

Sincerely,

Jason Lorch, *Monitoring Coordinator*

June 28, 2021

Zone 1 - Streambank Planting Zone

Zone 2 - Buffer Planting Zone

Zone 3 - Floodplain and Wetland Planting Zone

Note:-Non-hatched areas within easement are currently vegetated and were planted as needed to achieve target density. Buffer planting occured within the Limits of Disturbance

POND

OLD OLIVE ROAD

T5

T4

PLANTED WITH WOODY STEMS TO MEET VEGETATED BUFFER SUCCESS CRITERIA

PLANTED WITH WOODY STEMS TO MEET VEGETATED BUFFER SUCCESS CRITERIA

NOTES:
1. DEVIATIONS FROM THE DESIGN WILL BE SHOWN IN RED.

N

0' 100' 200' 300'
(HORIZONTAL)

WILDLANDS ENGINEERING
312 West Millbrook Road, Suite 225
Raleigh, NC 27609
Tel: 919.851.9986
Firm License No. F-0831

NORTH CAROLINA PROFESSIONAL SEAL 043290 ENGINEER GREGORY A. TUTTLE

6/28/2021

Sassarixa Swamp Mitigation Site
Johnston County, North Carolina

Planting Plan

Date:	JUNE 28, 2021
Job Number:	005-02166
Project Engineer:	GAT
Drawn By:	CAW
Checked By:	ANA

Revisions:
-

3.3
Sheet

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