Year 7 Monitoring Report

UT Millers Creek
Duplin County, NC

DMS Project ID No. 95719 Contract No. 5000

DWR Project No. 13-0187

USACE Action ID No. SAW-2013-00386

Construction Completed: February 2015
Morphology Data Collected: March 17, 2021
Vegetation Data Collected: October 19, 2021
Submitted: January 2022

Prepared for:

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

Prepared by:

HDR Engineering Inc. (HDR)
of the Carolinas
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Mitigation Services
ENVIRONMENTAL QUALITY

ROY COOPER
Governor

ELIZABETH BISER
Secretary

December 16, 2021

Via email: Jessica.Tisdale@hdrinc.com

Jessica Tisdale
HDR

Subject: DMS Comments
UT to Millers Creek, Project ID #95719, DMS Contract #5000

Jessica,

After receiving the MY7 draft report, DMS offers the following comments:

1. Page 4, discussion of Southern site boundary should be revised to reflect outcome of landowner discussion and project history. During the Stewardship and property site visit 10/2021, it was discovered that a small portion of the gravel road was installed during project construction, impacting the southeastern property corner. This went unnoticed during monitoring. Property staff added this road to the infrastructure layer to ensure it does not expand or migrate as the project moves into Stewardship.
2. Revise shapefile on CCPV to show label as "gravel road" rather than "vegetation encroachment."
3. Provide picture of gravel road for report.
4. Provide vegetation plot height data (table) for IRT consideration.

Digital:

1. Please review the CVS mdb and ensure that the data supports the creation of Table 7 in the report. The Table 7 export from the mdb does not currently match Table 7 in the report.
2. Certain BHR values do not appear to correspond with calculated BHR values. For example, the current BHRs for XS-1 and XS-7 should be 0.8 and 0.9, respectively. Note that to validate reported BHR's the current low bank height was used to determine the low bank height elevation since a low bank height elevation wasn't explicitly identified.
3. Please review reported values in Table 12. As an example, it does not appear that there were 222 consecutive days where the water level was above -12 in. for gauge 6.
4. Please include the photos used in the report as JPEGs.

Please call if you have any questions about these comments and insert the responses after your cover page to the report. Thanks for your work,

LHCrocker.

Lindsay Crocker, DMS

January 10, 2022

Dear Lindsay Crocker
DMS

DMS provided the following comments and HDR has replied with the below responses in italics:

1. DMS: Page 4, discussion of Southern site boundary should be revised to reflect outcome of landowner discussion and project history. During the Stewardship and property site visit 10/2021, it was discovered that a small portion of the gravel road was installed during project construction, impacting the southeastern property corner. This went unnoticed during monitoring. Property staff added this road to the infrastructure layer to ensure it does not expand or migrate as the project moves into Stewardship.

   HDR: *The paragraph amended to: During the stewardship site visit in October 2021 by DMS staff, it was discovered that a small portion of the gravel road was installed during project construction, impacting the southeastern property corner. This went unnoticed during monitoring. DMS property staff added this road to the infrastructure layer to ensure it does not expand or migrate as the project moves into the stewardship phase. The southeastern easement boundary (witness post #14) was removed from its original location. Table 6 notes the acreage of the encroachment and Figure 2.1 illustrates the area.*

2. DMS: Revise shapefile on CCPV to show label as “gravel road” rather than “vegetation encroachment.”
   HDR: *“Gravel Road (in Easement)” is depicted on the legend and as a call out CCPV.*

3. DMS: Provide picture of gravel road for report.
   HDR: *The gravel road is depicted on page 19 as Figure 3.10.*

4. DMS: Provide vegetation plot height data (table) for IRT consideration.
   HDR: *Vegetation plot height data has been added as Table 8. Planted Tree/Shrub Height Data.*

Digital:

1. DMS: Please review the CVS mdb and ensure that the data supports the creation of Table 7 in the report. The Table 7 export from the mdb does not currently match Table 7 in the report.

hdrinc.com

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T 919.232.6654 **F** 919.785.1187

HDR: *A few minor changes in the CVS mdb were made to match the created Table 7. Due to 128-bit computer systems, the CVS tool is not compatible with current computers and is not able to be exported. Lindsay exported Table 7 out from CVS for comparison and changes were made to the original Table 7.*

2. DMS: Certain BHR values do not appear to correspond with calculated BHR values. For example, the current BHRs for XS-1 and XS-7 should be 0.8 and 0.9, respectively. Note that to validate
   reported BHR's the current low bank height was used to determine the low bank height elevation since a low bank height elevation wasn't explicitly identified.
   HDR: *BHR values as well as other Y7 cross section values have been updated per our discussions following review. These affected the riffle cross section plots as well as tables 10 and 11. Figures and tables have been revised.*
3. DMS: Please review reported values in Table 12. As an example, it does not appear that there were 222 consecutive days where the water level was above -12 in. for gauge 6.
   HDR: *For gauges 1, 5 & 6, consecutive days where the water level was above -12 inches were changed/corrected in Table 12 (now Table 13).*

4. DMS: Please include the photos used in the report as JPEGs.
   HDR: *All photos in the report have been included as JPEGs in the electronic folder.*

Sincerely,
HDR Engineering (HDR) of the Carolinas

Jessica Tisdale
Sr. Environmental Scientist

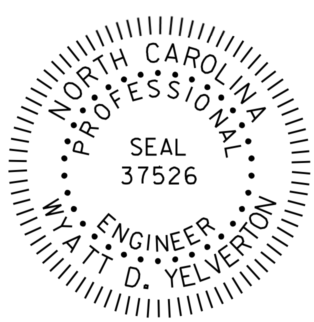
Prepared by:

HDR Engineering
555 Fayetteville Street, Suite 900
Raleigh, North Carolina 27601
919.232.6600
919.232.6642 (fax)

I HEREBY CERTIFY THAT THE DOCUMENT CONTAINED HEREIN, UT MILLERS CREEK YEAR 7 MONITORING REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED AND DATED THIS ____10____ DAY OF____January____ 2022.

Wyatt D. Yelverton, PE



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1.0 PROJECT SUMMARY

The following report summarizes the vegetation establishment, stream stability, and wetland hydrology for Year 7 monitoring for the UT Millers Creek Site (hereafter referred to as the "Site") in Duplin County, North Carolina.

1.1 Goals and Objectives

The primary goals of the UT Millers Creek stream and wetland mitigation project focus on:

- Reducing stressors to water quality
- Providing and enhancing flood attenuation
- Restoring and enhancing aquatic, semi-aquatic and riparian habitat, and
- Restoring and enhancing habitat connectivity with adjacent natural habitats.

The following objectives accomplish the goals listed above:

1. Removing stressors to water quality and increasing attenuation is directly tied to:
    a. Restoration of the formerly deeply incised and entrenched UT as a Priority I (PI) restoration where bankfull and larger flows access the historic floodplain allowing nutrients, sedimentation, trash, and debris from upstream urban runoff to settle from floodwaters.
    b. Restoration of the UT as PI restoration allows the Site to mitigate flood flows by reconnecting bankfull and higher flows to its historic floodplain.
    c. Restoration of the riparian buffers and wetlands adjacent to the UT (i.e. restoration of an existing pond and ditch back to riparian wetlands) allows floodwaters to attenuate, in turn reducing stressors from upstream impacts.
    d. Restoration of wetland hydrology within the riparian buffer supports hydrophytic vegetation, which assists in the uptake, storage and fixation of nutrients and sedimentation from overbank flows. Adjacent low quality pine plantations were removed and planted with native hydrophytic vegetation.
2. Restoring and enhancing aquatic, semi-aquatic and terrestrial habitat is directly tied to:
    a. Introduction of woody materials such as planted vegetation, log sills, soil lifts and toe wood to the restored channel. Woody materials will promote shading, bed form diversity and foraging opportunities for aquatic organisms, benthic macroinvertebrates, and fish.
    b. Restoration of native vegetation to the stream channel banks and the adjacent riparian corridor has diversified flora and provides an abundance of available foraging and cover habitat for amphibians, reptiles, mammals, and birds.
    c. Restoration of wetland hydrology and introducing floodwaters back to the historic floodplain provides a diversity of habitats for semi-aquatic flora and fauna that may have not been seen on the Site since before anthropogenic disturbances.
3. Habitat restoration and connectivity can be directly tied to:
    a. The removal of existing pine plantations and replanting of native vegetation.
    b. The restored community ensures a protected habitat corridor between the Site and the downstream mature riparian buffers and upland habitats.

1.2 Success Criteria

Monitoring of restoration efforts will be performed until success criteria are fulfilled. Monitoring includes stream channel/hydraulics, wetland hydrology, and vegetation. Year 7 Monitoring consists of hydrology monitoring, stream morphology data collection, and vegetation monitoring. In general, the restoration success criteria, and required remediation actions, are based on the Stream Mitigation Guidelines (USACE et al. 2003) and the Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation (NCEEP 2011). Project success criteria are further detailed in the Baseline Monitoring Document & As-Built Baseline Report (ICA 2015).

1.3 Background Summary

The North Carolina Department of Environmental and Natural Resources Department of Mitigation Services (DMS) contracted ICA Engineering, Inc. (ICA) to restore 2,625 linear feet of the Unnamed Tributary to Millers Creek (UT) and 4.5 acres of riparian wetlands within the Site to assist in fulfilling stream mitigation goals in the watershed (Table 1 and Table 4). The Site is located approximately one-half (0.5) mile west of Magnolia in Duplin County, North Carolina and contains an unnamed tributary to Millers Creek and associated restored riparian wetlands (Figure 1). The Site is located within DMS Targeted Local Watershed Catalogue Unit (CU) 03030006. The Site is comprised of one property owned by William Jeffrey Hatcher and wife Susan King Hatcher (PIN # 247100987405). Additional information concerning project history is presented in Table 2.

1.4 Vegetation Assessment

Vegetation is meeting stem per acre success criteria across the Site following the seventh year of monitoring. Overall, the Site is averaging 499 planted stems per acre; exceeding the success criteria of 210 stems per acre after Year 7 Monitoring. Noted in past reports, the Year 7 requirement of a 10-foot average tree height is not expected to be met. Plots 1 and 4 have met the height requirement and have average heights of 17 and 14.7 feet, respectively. Average height across all plots is 8.9 feet and values across plots range from a low in plot 3 with 3.1 feet to a high of 17 feet in plot 1. Successional vegetation dynamics are occurring on the Site with the typically establishment of red maple, pine and sweetgum species. These pioneer seedlings, saplings and trees are most prevalent in plots 2, 5, and 6. Table 7 and Figure 3.12 exhibit species plot data and average tree height in each plot, respectively.

Areas of low stem density between Sta. 33+60 – 36+00 have seen an increase in volunteers and steady growth of planted stems. These soils are most likely less productive due to soil nutrient limitations and will vegetate slightly slower than the surrounding soils.

During the stewardship site visit in October 2021 by DMS staff, it was discovered that a small portion of the gravel road was installed during project construction, impacting the southeastern property corner. This went unnoticed during monitoring. DMS property staff added this road to the infrastructure layer to ensure it does not expand or migrate as the project moves into the stewardship phase. The southeastern easement boundary (witness post #14) was removed from its original location. Table 6 notes the acreage of the gravel road encroachment, Figure 2.1 illustrates the area and Figure 3.10 shows a photo of the area.

1.5 Stream Stability

UT to Millers Creek remains stable and functioning as designed. Bank erosion noted from previous years have stabilized. No new areas of bank erosion were noted during the monitoring period.

Two locations were noted as problem areas. The first location, approximately 5 ft upstream of cross section 9, was a stream block caused by a length of lumber. The lumber was approximately 4 inches by 6 inches in cross section and between 4 and 5 feet in length. It was lodged perpendicular to stream flow. There were no apparent adverse effects to channel banks or stream channel due to the blockage. The monitoring crew removed the piece of lumber while on Site.

The second location noted as a problem area was at Sta. 36+75 on the left overbank area. Large woody vegetation on the floodplain had been removed by beaver activity. Although it was apparent that beavers removed the vegetation, no beaver activity was noted within any part of the stream channel.

All riffle cross sections retained similar parameters when compared to previous years. The one minor exception was to cross section 9 where a slight uptick in bankfull width and bankfull maximum depth were documented. Subsequently, values for cross sectional area and bankfull width/depth ratio were slightly elevated. The presence of the stream block immediately upstream, as noted above, likely is the cause for these minor variations. No notable changes were seen in pool cross section locations.

The Site has experienced several bankfull flows throughout the monitoring period. During Year 7 monitoring, bankfull events were confirmed by moisture content and no obvious signs nearby that floodplains were not getting accessed frequently. Due to the age of the crest gauge devices and insect activity, reliable measurement readings were unattainable. Site bankfull event documentation can be found in Appendix E.

Bank pins, at locations noted on the as-built survey, were not seen during visual inspection and stream data collection. Therefore, no signs of bank erosion at these locations were present during the monitoring period.

1.6 Wetlands

Based upon the Final Mitigation Plan, the hydrologic criteria for restored wetlands at the Site are as follows (based upon the corresponding landscape position and wetland community type):

a. For the **riparian bottomland hardwood forest community**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of 12.5 percent of the growing season, equivalent to 38 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.
b. For the **headwater riparian community (zero-order geomorphic position)**, the hydrologic criterion will be the establishment of a static water table at, or within, 12 inches of the soil surface for a minimum of 10 percent of the growing season,

equivalent to 30 days based upon hydrologic monitoring undertaken from Feb 1st through Nov 30th of each monitoring year.

The UT Millers Site exhibits a range of hydrologic conditions characteristic of small stream swamp wetland community types of the inner Coastal Plain of North Carolina. The majority of the groundwater gauges documented elevated groundwater levels at or near the soil surface for extended periods of time during the growing season. In addition, portions of the Site exhibited intermittent to prolonged periods of surface inundation. It is worth noting that the Site exceeded the 70th percentile for monthly precipitation totals during the months of February, June and July. Refer to the attached gauge hydrographs depicting recorded groundwater and surface water levels from January 1 through October 20.

All of the groundwater gauges located on the mitigation site exhibit hydrology indicative of jurisdictional wetlands (i.e. hydroperiods greater than 5% of the growing season), and all six gauges exceeded the minimum success criteria as outlined above. While the specific durations of wetland hydrology at each gauge varied across the Site, each gauge displayed prolonged wetland hydroperiods throughout the growing season.

The summary of hydroperiods for each gauge is presented in Table 8 and gauge locations are depicted in Figure 2.1.

2.0 METHODOLOGY

Groundwater hydrology was monitored using six automated gauges (RDS, Inc. WM-20s) located within the riparian wetland restoration areas. Two reference gauges were installed: one in a Headwater Riparian Wetland and one in a Bottomland Hardwood Wetland. Gauges were installed in accordance with installation methods outlined in the Wetlands Regulatory Assistance Program (WRAP) Technical Note 00-02 (Sprecher, 2000). Water levels were recorded once daily, and the data was downloaded every two-three months.

Year 7 monitoring surveys were completed using a GNSS VRS Rover. Each cross section was marked with a rebar monument at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83-State Plane. Surveying these monuments throughout the Site ensured proper orientation. The survey data was imported into MicroStation for verification. The Ohio Department of Natural Resources' "The Reference Reach Spreadsheet Version 4.3L" were used to analyze cross section data (Mecklenburg 2006). Tables and figures were created using Microsoft Excel. The channel is entirely a sand bed system; therefore, a pebble count was not conducted. Bank pins were not exposed (i.e. no erosion occurred at bank pin locations) and therefore were not surveyed.

Vegetation monitoring was completed using CVS level II methods, for nine, 100 square meter vegetation plots (Lee et al. 2006). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

3.0 REFERENCES

ICA Engineering, Inc. As-Built Monitoring Document & As-Built Baseline Report for UT Millers Creek Full Delivery Site. 2015.

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm).

Mecklenburg, Dan. 2006. The Reference Reach Spreadsheet Version 4.3L. 2006. Ohio Department of Natural Resources. Division of Soil and Water. (http://www.dnr.state.oh.us/tabid/9188/default.aspx)

NCEEP. Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for stream and/or Wetland Mitigation. 2011.

Sprecher, S. W. (2000). "Installing Monitoring Wells/Piezometers in Wetlands," ERDC TN-WRAP-00-02, U.S. Army Research and Development Center, Vicksburg, MS.

US Army Corps of Engineers Wilmington District. Stream Mitigation Guidelines. 2003

Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDICES

Appendix A. Project Vicinity Map and Background Tables

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Vicinity Map

UT to Millers Creek Mitigation Site, Duplin County, NC

0 750 1,500 3,000 4,500 6,000 Feet

1 inch = 2,000 feet

Figure

1

Table 1. Project Components and Mitigation Credits UT to the Millers Creek, Duplin County DMS Project ID No. 95719									
Mitigation Credits									
	Stream (SMU)		Riparian Wetland (WMU)		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE	--	--	--
Totals	2,709		8.00						

Project Components							
Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach (PI, PII, etc.)	Restoration or Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio	SMU or WMU
UT Millers Creek	10+13 – 37+22	2,100	PI	Restoration	2,709	1:1	2,709
Drained Wetland (Headwater)	NA	1.22	NA	Restoration	1.22	1:1	1.22
Drained Wetland (Pines)	NA	3.78	NA	Restoration	3.78	1:1	3.78
Drained Wetland (Mature Woods)	NA	2.55	NA	Restoration	2.55	1.25:1	2.04
Drained Wetland (Berm/Spoil Along UT)	NA	0.45	NA	Restoration	0.45	1:1	0.45
Pond	NA	0.77	NA	Restoration	0.77	1.5:1	0.51
TOTAL	NA	2,100/8.77	PI/NA	Restoration	2,709/8.77	1 – 1.5:1	2,709/8.00

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	2,709	8.77				

BMP Elements			
Element	Location	Purpose/Function	Notes
Forested Buffer	UT Millers buffer	Buffer to protect stream	Filter nutrients and provide cover, foraging areas, habitat, woody debris, and wildlife

Table 2. Project Activity and Reporting History UT to Millers Creek (DMS Project ID No. 95719)		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	Aug-13	Sep-14
Final Design – Construction Plans	Sep-14	Sep-14
Construction	3-Nov-14	23-Jan-15
Temporary S&E Mix Applied to Entire Project Area	---	23-Jan-15
Permanent Seed Mix Applied to Entire Project Area	---	23-Jan-15
Bare Root, Containerized, and B&B plantings for Entire Project Area	---	10-Mar-15
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	Mar-15	Apr-15
Year 1 Monitoring	Oct-15	Dec-15
Year 2 Monitoring	Nov-16	Feb-17
Year 3 Monitoring	Nov-17	Jan-18
Year 4 Monitoring	Dec-18	Jan-19
Year 5 Monitoring	Oct-19	Jan-20
Year 6 Monitoring	May-20	Dec-20
Year 7 Monitoring	21-Oct	Dec-21

Table 3. Project Contacts Table UT to Millers Creek (DMS Project ID No. 95719)	
Designer Primary project design POC	Land Management Group, Inc 3101 Poplarwood Court, Suite 120 Raleigh, North Carolina 27604 Kevin Williams (919) 810-6525
Construction Contractor Construction Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Planting Contractor Planting Contractor POC	River Works, Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Phillip Todd (919) 582-3574
Seeding Contractor Seeding Contractor POC	Land Mechanic Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592 Lloyd Glover (919) 639-6132
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) ArborGen 2) Mellow Marsh Farm, Inc. 3) Foggy Mountain Nursery (live stakes)
Monitoring Performers	HDR|ICA 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Vickie Miller (HDR) (919) 232-6637
Stream Monitoring POC	HDR|ICA 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Wyatt Yelverton, PE (HDR) (919) 232-6623
Vegetation Monitoring POC	HDR|ICA 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Jessica Tisdale (HDR) (919) 232-6654

Table 4. Project Information
UT to Millers Creek (DMS Project ID No. 95719)

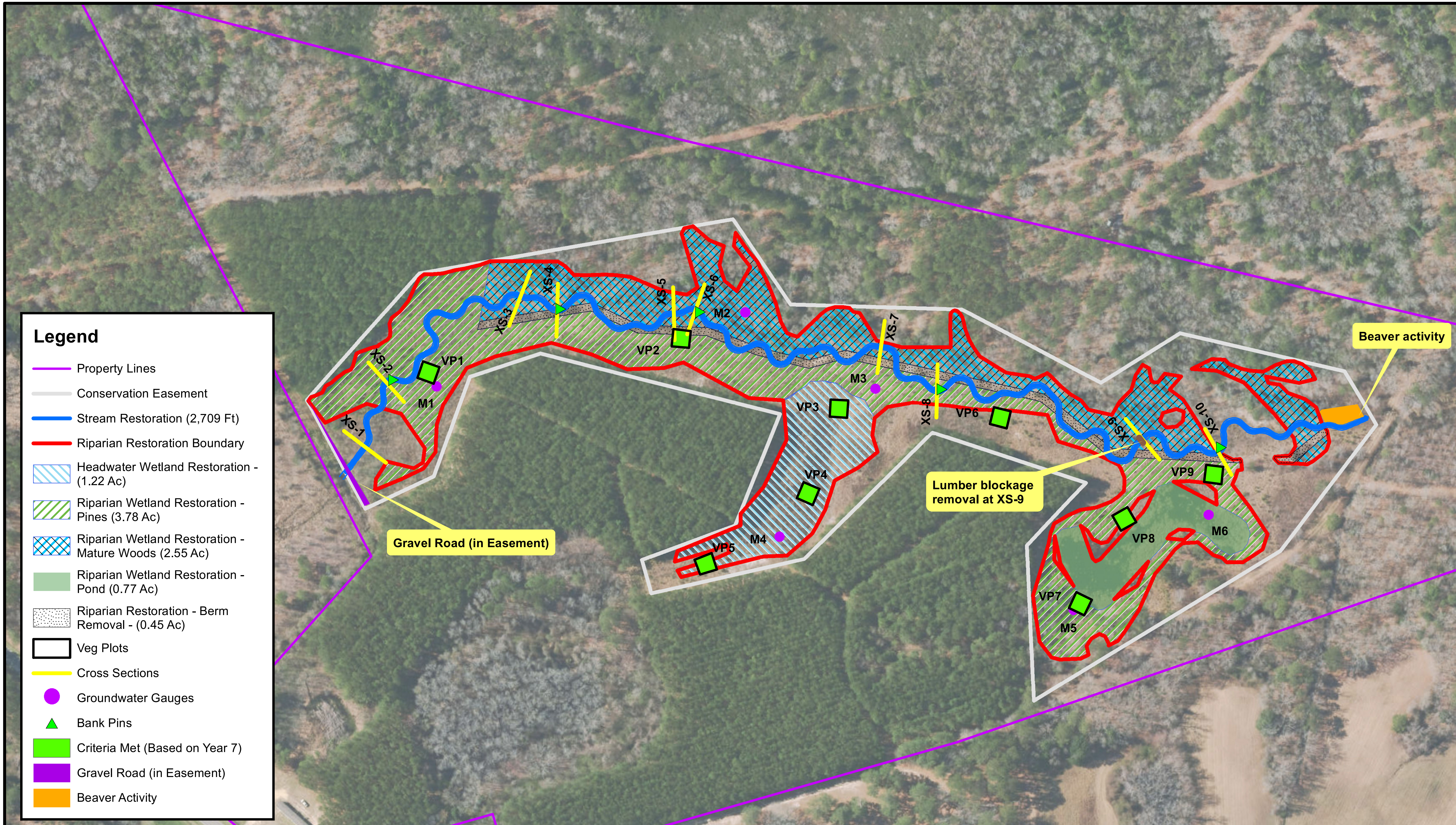
Project Information	
Project Name	UT to Millers Creek Stream and Wetland Mitigation Site
Project County	Duplin
Project Area (acres)	15.944 AC
Project Coordinates	34.894467,-78.067625
Project Watershed Summary Information	
Physiographic Region	Coastal Plain
Ecoregion	Southeastern Plains
Project River Basin	Cape Fear
USGS 8-digit HUC	3030006
USGS 14-digit HUC	3030006110040
NCDWQ Subbasin	03-06-19
Project Drainage Area	250 AC
Watershed Land Use	Cultivated, Southern Yellow Pine, Bottomland Forest / Hardwood Swamps

Reach Summary Information	
Parameters	**UT to Millers Creek**
Restored length	2,709 linear feet
Drainage Area	250 AC.
NCDWQ Index Number	36
NCDWQ Classification	C, Sw
Valley Type/Morphological Description	X/Existing G/5/Restored E5
Dominant Soil Series	Bibb sandy loam and Torhunta fine sandy loam (USDA/NRCS records). Cape Fear, Rains, Plummer, Rutlege and Lynn Haven Soil series (additional series mapped by LMG)
Drainage Class	Poorly and very poorly
Soil Hydric Status	Bibb sandy loam (hydric) Torhunta mucky fine sandy loam (hydric)
Slope	0.0016
FEMA Classification	Zone X
Native Vegetation Community	Mixed stand of hardwoods and pine
Percent Composition of Exotic Invasives	<5%

Wetland Summary Information			
Parameters	**Wetland 1**	**Wetland 2**	**Wetland 3**
Size of Wetland (acres)	0.21	0.12	0.59
Wetland Type (non-riparian riverine or riparian non-riverine	Riparian Non-Riverine	Riparian Non-Riverine	Riparian Non-Riverine
Mapped Soil Series	BbA	ToA	BnB
Drainage class	Poorly Drained	Very Poorly Drained	Moderately Well Drained
Soil Hydric Status	Hydric	Hydric	Partially Hydric
Source of Hydrology	Groundwater	Groundwater	Groundwater
Hydrologic Impairment	Stream Incision	Stream Incision	Stream Incision/Beavers
Native vegetation community	Forested	Forested	Emergent
Percent composition of exotic invasion vegetation	0	0	0

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan/NW 27
Endangered Species Act	No	Yes	NCNHP/USFWS
Historic Preservation Act	No	Yes	NCSHPO
CZMA/CAMA	No	Yes	--
FEMA Floodplain Compliance	Yes	Yes	HECRAS
Essential Fisheries Habitat	No	N/A	--

Appendix B. Visual Assessment Data



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Current Condition Plan View - Year 7

UT Millers Creek, Duplin County, North Carolina

Figure 3.1

Table 5: Visual Stream Morphology Stability Assessment

Reach ID: UT Millers Creek

Assessed Length: 2,709 FT

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	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	N/A	N/A			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	5	5			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	61	61			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	57	57			100%			
		2. Thalweg centering at downstream of meander (Glide)	57	57			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100.0%	N/A	N/A	N/A
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	N/A	N/A	N/A
				Totals	0	0	100.0%	N/A	N/A	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	12	12			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	12	12			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	12	12			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	12	12			100%			

Table 6 Vegetation Condition Assessment

Planted Acreage 12.35

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.05 acre	NA	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, 5 or 7 stem count criteria.	0.1 acre	NA	0	0.0	0.0%
			Total			
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.1 acre	NA	0	0.0	0.0%
			Cumulative Total			

Easement Acreage 15.94

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	NA	N/A	N/A	N/A
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Solid Purple	1	0.03	0.18%

Figures 3.1 - 3.11. Vegetation Plots and Problem Area Photos

3.1 Vegetation Plot 1

3.2 Vegetation Plot 2

3.3 Vegetation Plot 3

3.4 Vegetation Plot 4

3.5 Vegetation Plot 5

3.6 Vegetation Plot 6

3.7 Vegetation Plot 7

3.8 Vegetation Plot 8

3.9 Vegetation Plot 9

3.10 Gravel road at southeastern boundary (facing west)

3.11 Large lumber debris at XS 9

3.12 Beaver activity at STA 36+75

Appendix C. Vegetation Plot Data

Table 7. DMS Project Code 95719. Project Name: UT Millers Creek

			Current Plot Data (MY7 2021)																										
			95719-01-0001			95719-01-0002			95719-01-0003			95719-01-0004			95719-01-0005			95719-01-0006			95719-01-0007			95719-01-0008			95719-01-0009		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree						25			34						16						63			16			22
Alnus serrulata	tag alder	Shrub				1	1	1																			1	1	3
Baccharis halimifolia	silverling	Shrub									1																		
Betula nigra	river birch	Tree				1	1	1																					
Clethra alnifolia	sweet pepperbush	Shrub																											3
Fraxinus pennsylvanica	green ash	Tree				1	1	1										3	3	3	9	9	9	5	5	5	4	4	4
Ilex opaca	American holly	Tree																		1									
Juglans nigra	black walnut	Tree			1																								
Laurus nobilis	sweet bay	Shrub																											
Liquidambar styraciflua	sweetgum	Tree			7			52			9						10			59			7			14			15
Liriodendron tulipifera	tuliptree	Tree							1	1	1							1	1	1				1	1	1	2	2	2
Magnolia virginiana	sweetbay	Tree				1	1	1																					
Morella cerifera	wax myrtle	Shrub									1				2	2	9						1						
Myrica sp.	sweetgale	Shrub																											
Nyssa sylvatica	blackgum	Tree				1	1	1																					
Persea borbonia	redbay	tree																											
Pinus	pine	Tree									14																		
Pinus taeda	loblolly pine	Tree						1									62			3			3			6			1
Platanus occidentalis	American sycamore	Tree													8	8	8												
Prunus serotina	black cherry	Tree																											
Quercus	oak	Tree																											
Quercus michauxii	swamp chestnut oak	Tree	3	3	3	3	3	3	2	2	2							4	4	4				2	2	2	4	4	4
Quercus nigra	water oak	Tree						1												6									
Quercus phellos	willow oak	Tree				2	2	2	4	4	4							9	9	9							2	2	2
Salix nigra	black willow	Tree															26						1						
Rhus copallinum	winged sumac	Shrub																											
Taxodium distichum	bald cypress	Tree	9	9	9	5	5	5	4	4	4	12	12	12	8	8	8				10	10	10	10	10	10	5	5	5
Ulmus alata	winged elm	Tree																		9									
Vaccinium corymbosum	high-bush blueberry	Shrub																		7									
		Stem count	12	12	20	15	15	94	11	11	70	12	12	12	18	18	139	17	17	102	19	19	94	18	18	54	18	18	61
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	2	2	4	8	8	12	4	4	9	1	1	1	3	3	7	4	4	10	2	2	7	4	4	7	6	6	10
		Stems per ACRE	485.6	485.6	809.4	607.1	607.1	3804	445.2	445.2	2833	485.6	485.6	485.6	728.5	728.5	5625	688	688	4128	768.9	768.9	3804	728.5	728.5	2185	728.5	728.5	2469

	Annual Means																	
	MY7 (2021)			MY5 (2019)			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2015)		
Scientific Name	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum			176			24			3									
Alnus serrulata	2	2	4															
Baccharis halimifolia			1															
Betula nigra	1	1	1	4	4	4	4	4	4	3	3	4	8	8	8	13	13	13
Clethra alnifolia			3															
Fraxinus pennsylvanica	22	22	22	25	25	25	27	27	27	27	27	27	27	27	27	28	28	28
Ilex opaca																		
Juglans nigra			1															
Laurus nobilis						1												
Liquidambar styraciflua			114			89			35			23			5			
Liriodendron tulipifera	5	5	5	8	8	8	14	14	14	13	13	13	15	15	15	19	19	19
Magnolia virginiana	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Morella cerifera	2	2	11	2	2	2	2	2	4	2	2	2	2	2	2	3	3	3
Myrica sp.						3												
Nyssa sylvatica	1	1	1	1	1	1			3									
Persea borbonia									1									
Pinus			14									3						
Pinus taeda			73			42			12									
Platanus occidentalis	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Prunus serotina												1						
Quercus												2						
Quercus michauxii	18	18	18	20	20	20	19	19	19	20	20	20	21	21	21	22	22	22
Quercus nigra			1			6												
Quercus phellos	17	17	17	18	18	18	19	19	19	21	21	21	25	25	25	28	28	28
Salix nigra			27			8			6			1						
Rhus copallinum																		
Taxodium distichum	63	63	63	63	63	63	65	65	65	64	64	64	64	64	64	67	67	67
Ulmus alata																		
Vaccinium corymbosum																		
Stem count	140	140	561	150	150	323	159	159	221	159	159	190	171	171	176	189	189	189
size (ares)	9			9			9			9			9			9		
size (ACRES)	0.22			0.22			0.22			0.22			0.22			0.22		
Species count	11	11	20	10	10	17	9	9	15	9	9	14	9	9	10	9	9	9
Stems per ACRE	629.5	629.5	2523	674.5	674.5	1452	714.9	714.9	994	714.9	714.9	854	768.9	768.9	791	849.8	849.8	850

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

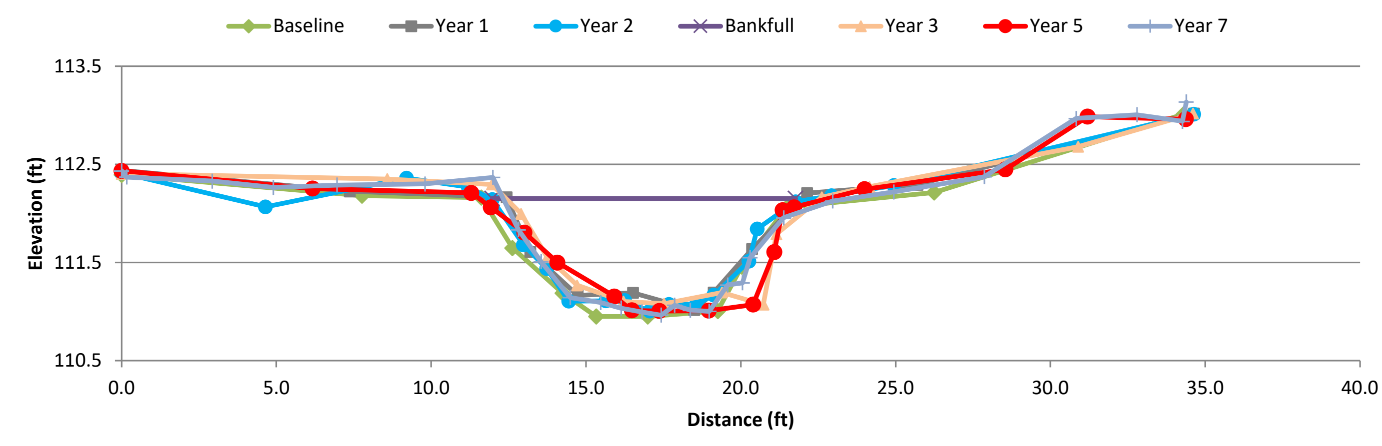
Fails to meet requirements by more than 10%

Table 8. Planted Tree/Shrub Height Data

Plot Trees/Shrubs	Planted Tree/Shrub Height (cm)								
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9
1	250	64	90	440	165	184	210	285	330
2	470	320	33	300	180	97	97	95	310
3	630	190	145	440	175	38	145	49	190
4	310	155	88	490	109	360	330	54	130
5	630	50	45	510	104	66	250	340	400
6	680	390	140	380	77	75	220	310	480
7	580	75	85	430	340	155	110	300	480
8	570	90	117	440	480	87	110	55	360
9	610	480	182	520	130	330	200	77	110
10	670	410	9.2	480	240	76	102	270	220
11	370	550	118	530	290	130	330	320	95
12	450	560		440	130	125	390	290	450
13		350			137	70	200	300	100
14		435			530	117	330	240	77
15		80			480	90	210	390	110
16					560	128	210	210	95
17					450	188	220	235	290
18					410		210	270	340
19							184		
Av. height by plot (cm)	518.3	279.9	95.7	450.0	277.1	136.2	213.6	227.2	253.7
Av. height by plot (ft)	17.0	9.2	3.1	14.8	9.1	4.5	7.0	7.5	8.3
Av. height across plots (ft)	8.9								

Appendix D. Stream Survey Data

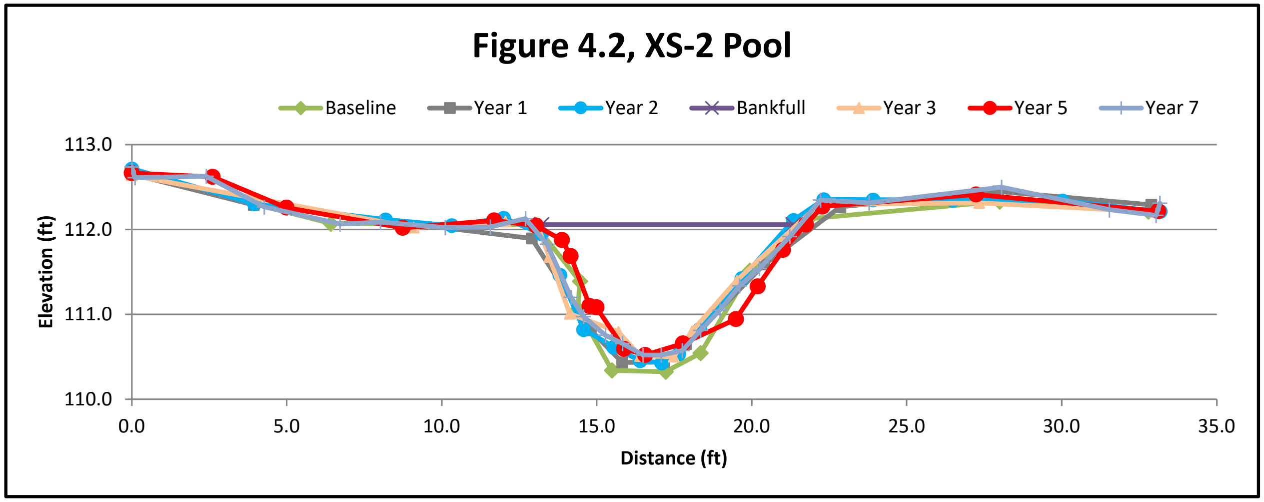
Figure 4.1, XS-1 Riffle



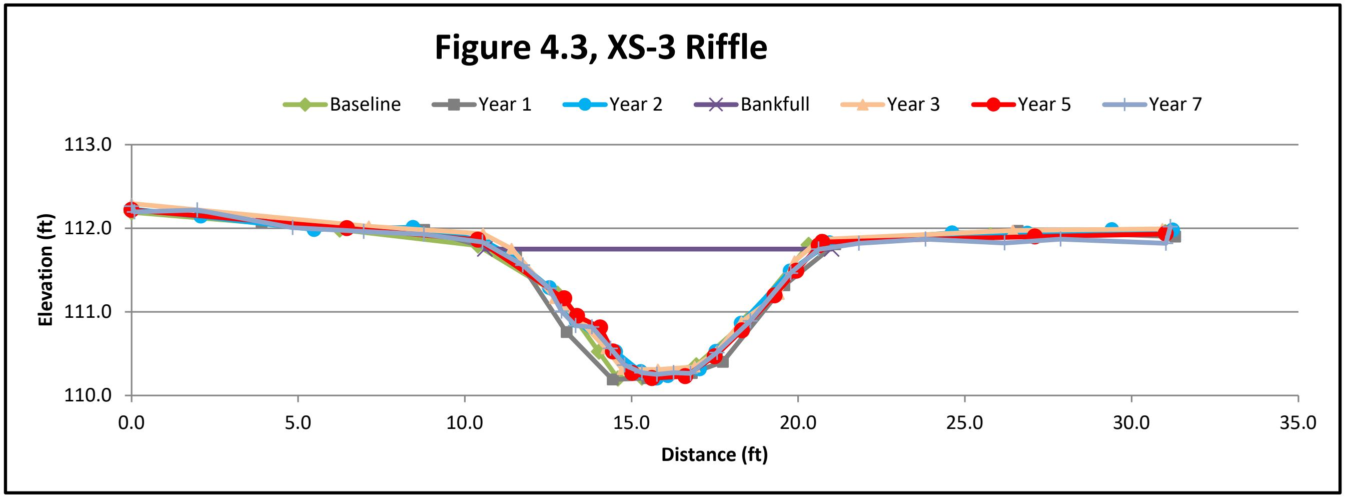
	Cross Section 1 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.7	9.1	9.4	9.5	9.8	8.6
Floodprone Width (ft)	195.2	195.2	195.2	195.2	195.2	195.2
Bankfull Mean Depth (ft)	0.8	0.7	0.7	0.7	0.7	0.9
Bankfull Max Depth (ft)	1.1	1.0	1.1	1.0	1.1	1.2
Bankfull Cross Sectional Area (ft^2)	7.7	6.3	6.7	6.8	7.1	7.7
Bankfull Width/Depth Ratio	12.2	13.2	13.2	13.2	13.4	9.5
Bankfull Entrenchment Ratio	20.2	21.4	20.8	20.5	20.0	22.7
Low Bank Height (ft)	---	---	---	---	1.0	1.0
Bankfull Bank Height Ratio*	1.0	1.1	1.1	1.1	>1	0.8

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

**Updated bankfull elevation used in MY7. Also updated method used for bank height ratio (BHR) in MY7.



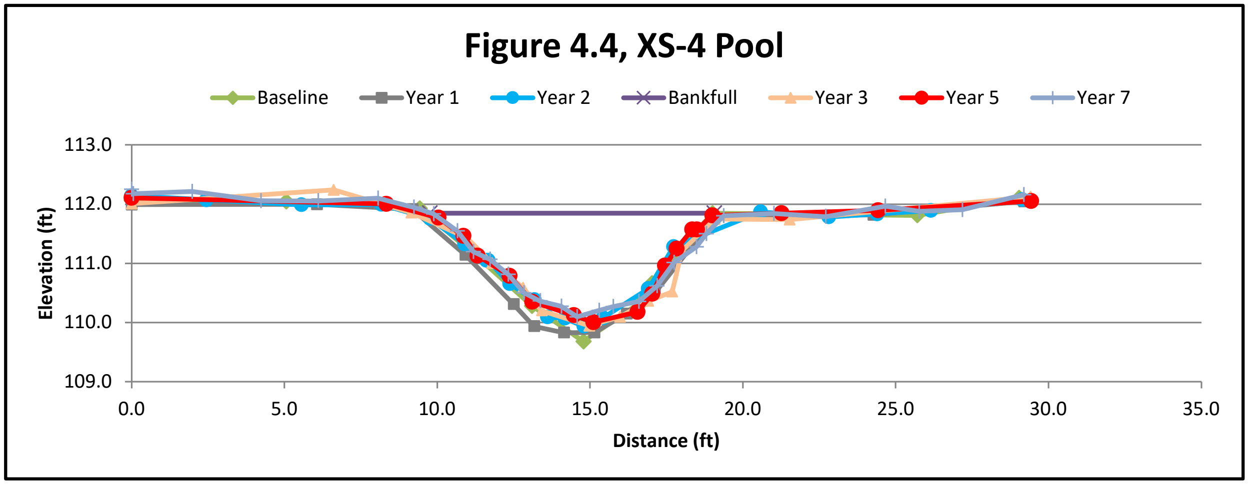
	Cross Section 2 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	8.6	8.6	7.8	8.0	9.1	8.7
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.0	0.9	1.0	0.9	0.9	0.9
Bankfull Max Depth (ft)	1.7	1.5	1.5	1.5	1.5	1.5
Bankfull Cross Sectional Area (ft^2)	8.8	7.3	7.3	7.0	8.0	8.2
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						



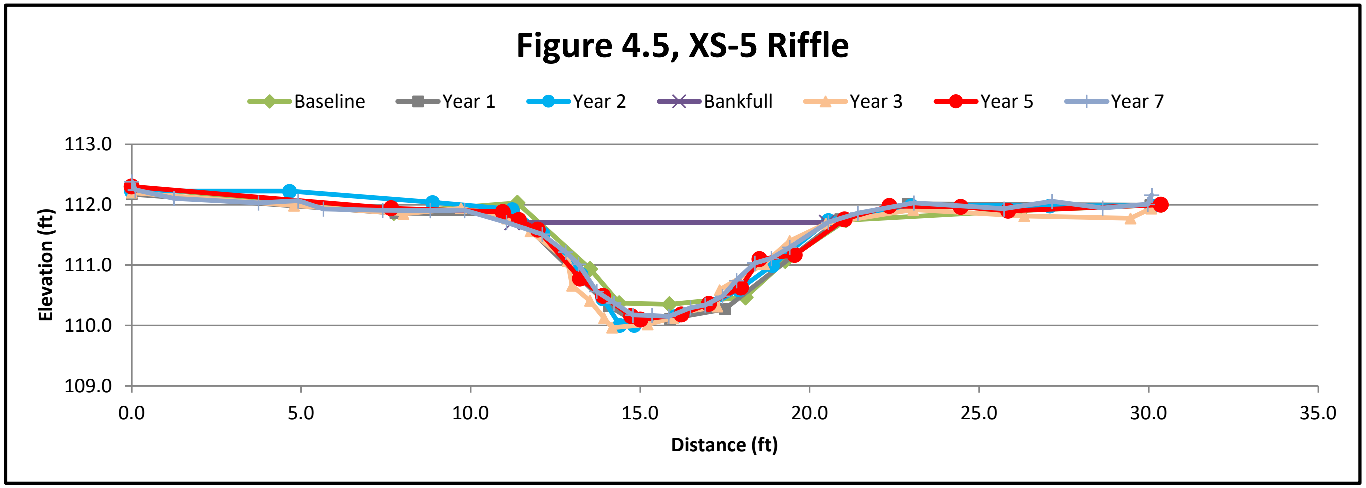
Dimension	Cross Section 3 (Riffle)					
	Base	MY1	MY2	MY3	MY5	MY7**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.9	10.6	10.0	9.2	10.0	8.9
Floodprone Width (ft)	126.3	126.3	126.3	126.3	126.3	126.3
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9	0.9	1
Bankfull Max Depth (ft)	1.6	1.6	1.6	1.5	1.6	1.6
Bankfull Cross Sectional Area (ft^2)	8.8	9.9	8.5	8.5	8.8	9.0
Bankfull Width/Depth Ratio	11.1	11.4	11.6	10.0	11.3	8.7
Bankfull Entrenchment Ratio	12.8	11.9	12.7	13.8	12.7	14.2
Low Bank Height (ft)	---	---	---	---	1.6	1.5
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.1	1.1	0.9

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

**Updated bankfull elevation used in MY7. Also updated method used for bank height ratio (BHR) in MY7.



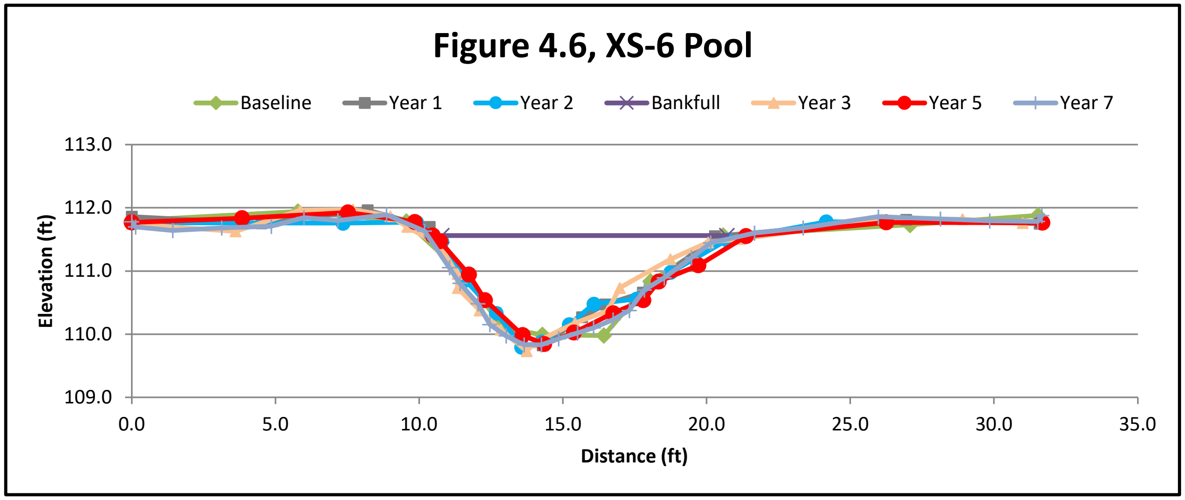
	Cross Section 4 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.4	9.8	10.2	12.2	9.5	9.5
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.2	0.9	0.8	1.1	1.0
Bankfull Max Depth (ft)	2.2	1.9	1.8	1.8	1.8	1.7
Bankfull Cross Sectional Area (ft^2)	10.9	11.4	9.4	9.8	10.0	10.0
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						



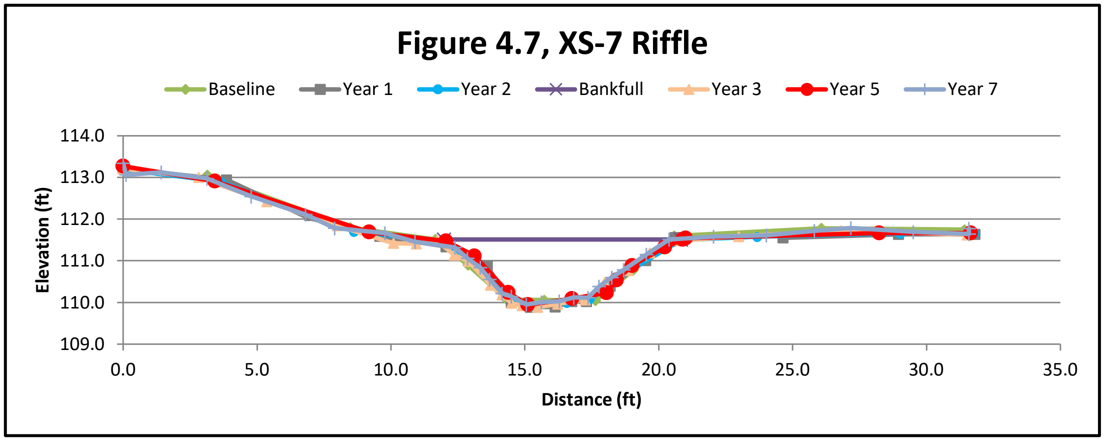
	Cross Section 5 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.1	9.4	8.9	9.9	9.5	8.4
Floodprone Width (ft)	182.9	182.9	182.9	182.9	182.9	182.9
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.9	0.9	1.1
Bankfull Max Depth (ft)	1.4	1.6	1.7	1.8	1.6	1.8
Bankfull Cross Sectional Area (ft^2)	8.4	9.7	9.1	9.3	8.9	9.5
Bankfull Width/Depth Ratio	10.0	9.1	8.7	10.5	10.2	7.4
Bankfull Entrenchment Ratio	20.0	19.5	20.5	18.5	19.2	21.8
Low Bank Height (ft)	---	---	---	---	1.8	1.6
Bankfull Bank Height Ratio*	1.0	1.1	1.0	1.0	1.1	0.9

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

**Updated bankfull elevation used in MY7. Also updated method used for bank height ratio (BHR) in MY7.



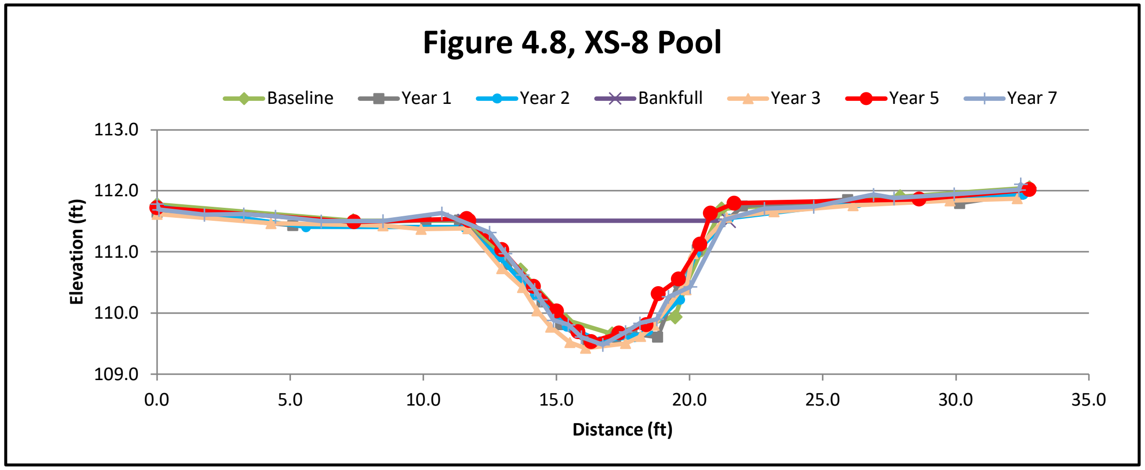
	Cross Section 6 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	10.5	9.7	9.8	9.5	11.1	10.9
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.0	1.0	0.9	0.9	0.9	1.0
Bankfull Max Depth (ft)	1.6	1.7	1.7	1.7	1.7	1.7
Bankfull Cross Sectional Area (ft^2)	10.1	9.3	8.7	8.4	10.2	10.7
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio*						



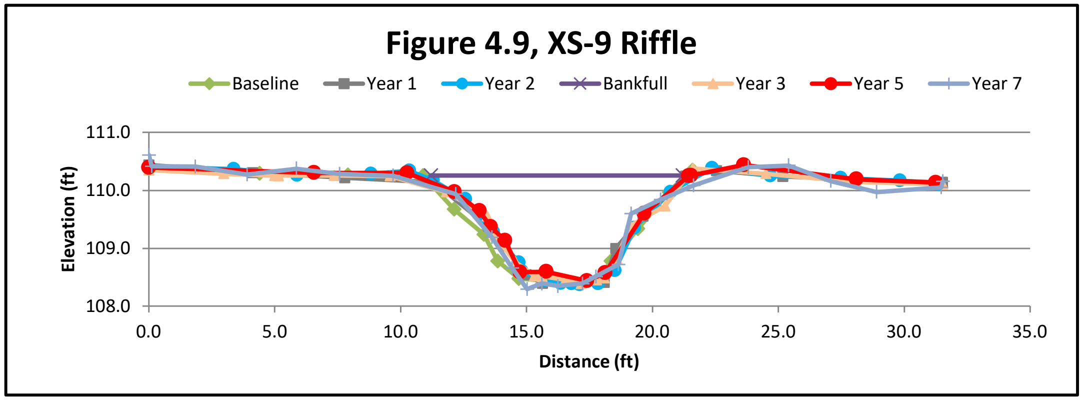
*Baseline cross-section was not started on left pin

	Cross Section 7 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	8.8	10.2	9.6	9.7	9.4	7.2
Floodprone Width (ft)	162.2	162.2	162.2	162.2	162.2	162.2
Bankfull Mean Depth (ft)	1.0	0.9	0.9	0.9	0.9	1.1
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.6	1.6	1.6
Bankfull Cross Sectional Area (ft^2)	8.7	8.6	8.5	8.7	8.0	7.7
Bankfull Width/Depth Ratio	8.8	12.0	10.9	10.9	11.0	6.6
Bankfull Entrenchment Ratio	18.5	16.0	16.8	16.7	17.3	22.5
Low Bank Height (ft)	---	---	---	---	1.6	1.4
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.0	1.0	0.9

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.
**Updated bankfull elevation used in MY7. Also updated method used for bank height ratio (BHR) in MY7.



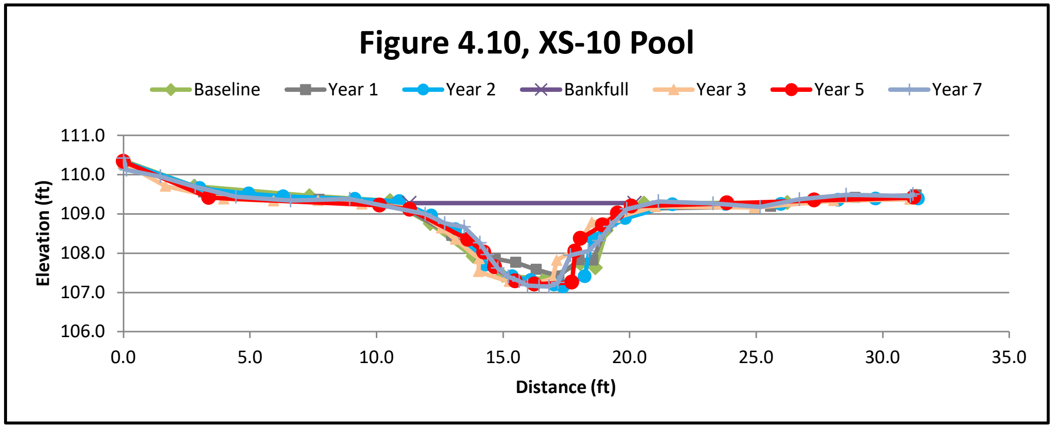
	Cross Section 8 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.5	10.0	9.6	9.3	9.0	9.9
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.2	1.1	1.2	1.2	1.2
Bankfull Max Depth (ft)	1.9	2.0	1.9	2.0	2.0	2.0
Bankfull Cross Sectional Area (ft^2)	11.1	11.9	10.8	11.4	10.5	11.5
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						



	Cross Section 9 (Riffle)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7**
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	10.5	10.2	11.1	11.7	11.1	8.1
Floodprone Width (ft)	219.0	219.0	219.0	219.0	219.0	219.0
Bankfull Mean Depth (ft)	1.1	1.1	1.0	1.0	1.0	1.3
Bankfull Max Depth (ft)	1.8	1.9	1.9	1.9	1.8	2.0
Bankfull Cross Sectional Area (ft^2)	12.0	11.1	11.3	11.2	10.7	10.9
Bankfull Width/Depth Ratio	9.1	9.4	10.9	12.2	11.5	6.1
Bankfull Entrenchment Ratio	20.9	21.5	19.8	18.8	19.8	27.0
Low Bank Height (ft)	---	---	---	---	1.9	1.6
Bankfull Bank Height Ratio*	1.0	0.9	1.0	1.1	1.0	0.8

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

**Updated bankfull elevation used in MY7. Also updated method used for bank height ratio (BHR) in MY7.



	Cross Section 10 (Pool)					
Dimension	Base	MY1	MY2	MY3	MY5	MY7
Based on fixed baseline bankfull elevation						
Bankfull Width (ft)	9.8	9.2	10.5	9.6	9.9	11.0
Floodprone Width (ft)						
Bankfull Mean Depth (ft)	1.2	1.0	1.0	1.0	1.0	0.9
Bankfull Max Depth (ft)	1.9	1.7	2.1	2.1	2.1	2.1
Bankfull Cross Sectional Area (ft^2)	11.4	8.7	10.7	10.2	10.1	10.1
Bankfull Width/Depth Ratio						
Bankfull Entrenchment Ratio						
Low Bank Height (ft)						
Bankfull Bank Height Ratio						

Table 9. Baseline Stream Data Summary UT to Millers Creek, DMS Project ID No. 95719 UT to Millers Creek: 2,709 LF											
Parameter	**Regional Curve**	**Pre-Existing Condition**	**Reference - Wildcat Branch**	**Referece - UT Brick Bound Swamp**	**Design**	**As-built/Baseline**					
Dimension and Substrate - Riffle	Eq.	Mean	Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)		9.7	8.2	6.1	8.8	8.8	9.6	9.7	10.5	0.7	5
Floodprone Width (ft)		12.3	130.0	24.5	125.0	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)		0.75	1.03	0.50	0.92	0.8	0.9	0.9	1.1	0.1	5
Bankfull Max Depth (ft)		1.1	1.6	1.0	1.4	1.1	1.5	1.5	1.8	0.3	5
Bankfull Cross Sectional Area (ft^2)		7.2	8.5	3.1	8.3	7.7	9.1	8.7	12.0	1.7	5
Width/Depth Ratio		12.9	8.0	12.2	9.5	8.8	10.2	10.0	12.2	1.4	5
Entrenchment Ratio		1.3	15.9	4.0	14.3	11.9	13.1	12.9	14.3	0.9	5
Bank Height Ratio		4.83	1.09	1.00	1.00	1.0	1.0	1.0	1.0	0.0	5
d50 (mm)		sand	sand	sand	sand						
Profile											
Riffle Length (ft)						8.6	21.9	22.8	33.6	9.0	7
Riffle Slope (ft/ft)		Channelized	0.0022	0.0012	0.0007	0.0039	0.0069	0.0075	0.0096	0.0019	7
Pool Length (ft)						9.1	27.0	25.7	53.9	11.6	61
Pool Max depth (ft)		Channelized	1.75	1.25	1.75	1.60	1.86	1.90	2.20	0.23	5
Pool Spacing (ft)		Channelized	14.0 - 16.6	15.29 - 27.81	20.1 - 84.9	12.5	41.8	40.3	96.3	18.4	63
Pool Cross Sectional Area (ft^2)						8.80	10.46	10.90	11.40	1.05	5
Pattern											
Channel Beltwidth (ft)		Channelized	13.8 - 19.4	13.8 - 19.4	17.5 - 52.5						
Radius of Curvature (ft)		Channelized	10.9 - 15.3	5.0 - 9.0	20.1 - 22.8						
Rc: Bankfull Width (ft/ft)		Channelized	1.3 - 1.9	0.9 - 1.5	2.3 - 2.6						
Meander Wavelength (ft)		Channelized	22.5 - 29.0	23.0 - 29.0	14.0 - 56.0						
Meander Width Ratio		Channelized	1.7 - 2.4	2.3 - 3.2	2.0 - 6.0						
Substrate, bed and transport parameters											
Ri% / P%						33/67					
SC% / Sa% / G% / C% / B% / Be%											
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)											
Reach Shear Stress (competency) lb/ft^2											
Max part size (mm) mobilized at bankfull											
Unit Stream Power (transport capacity) lbs/ft.s		0.01			0.01	0.02					
Additional Reach Parameters											
Drainage Area (SM)		0.37	0.44	0.11	0.37						
Impervious cover estimate (%)											
Rosgen Classification		G-F/5	E5	E5	E5	E5					
Bankfull Velocity (fps)			1.00	0.97	0.80						
Bankfull Discharge (cfs)		8.4	8.5	3.0	8.4						
Valley length (ft)		2126			2126	2126					
Channel Thalweg length (ft)		2339			2679	2709					
Sinuosity (ft)		1.10	1.15	1.35	1.26	1.27					
Water Surface Slope (Channel) (ft/ft)		0.0011	0.0024	0.0016	0.0005	0.0005					
BF slope (ft/ft)					0.0005	0.0005					
Bankfull Floodplain Area (acres)											
Proportion over wide (%)											
Entrenchment Class (ER Range)											
Incision Class (BHR Range)											
BEHI VL% / L% / M% / H% / VH% / E%											
Channel Stability or Habitat Metric											
Biological or Other											

Table 10. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters - Cross Section)
UT to Millers Creek (DMS Project No. 95719)
UT to Millers Creek: 2,709 LF

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.7	9.1	9.4	9.5	9.8	8.6		8.6	8.6	7.8	8.0	9.1	8.7	
Floodprone Width (ft)	195.2	195.2	195.2	195.2	195.2	195.2								
Bankfull Mean Depth (ft)	0.8	0.7	0.7	0.7	0.7	0.9		1.0	0.9	1.0	0.9	0.9	0.9	
Bankfull Max Depth (ft)	1.1	1.0	1.1	1.0	1.1	1.2		1.7	1.5	1.5	1.5	1.5	1.5	
Bankfull Cross Sectional Area (ft^2)	7.7	6.3	6.7	6.8	7.1	7.7		8.8	7.3	7.3	7.0	8.0	8.2	
Bankfull Width/Depth Ratio	12.2	13.2	13.2	13.2	13.4	9.5								
Bankfull Entrenchment Ratio	20.2	21.4	20.8	20.5	20.0	22.7								
Low Bank Height (ft)	---	---	---	---	1.0	1.0								
Bankfull Bank Height Ratio*	1.0	1.1	1.1	1.1	<1	0.8								
	Cross Section 3 (Riffle)							**Cross Section 4 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	9.9	10.6	10.0	9.2	10.0	8.9		9.4	9.8	10.2	12.2	9.5	9.5	
Floodprone Width (ft)	126.3	126.3	126.3	126.3	126.3	126.3								
Bankfull Mean Depth (ft)	0.9	0.9	0.9	0.9	0.9	1.0		1.2	1.2	0.9	0.8	1.1	1.0	
Bankfull Max Depth (ft)	1.6	1.6	1.6	1.5	1.6	1.6		2.2	1.9	1.8	1.8	1.8	1.7	
Bankfull Cross Sectional Area (ft^2)	8.8	9.9	8.5	8.5	8.8	9.0		10.9	11.4	9.4	9.8	10.0	10.0	
Bankfull Width/Depth Ratio	11.1	11.4	11.6	10.0	11.3	8.7								
Bankfull Entrenchment Ratio	12.8	11.9	12.7	13.8	12.7	14.2								
Low Bank Height (ft)	---	---	---	---	1.6	1.5								
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.1	1.1	0.9								
	Cross Section 5 (Riffle)							**Cross Section 6 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation[1]														
Bankfull Width (ft)	9.1	9.4	8.9	9.9	9.5	8.4		10.5	9.7	9.8	9.5	11.1	10.9	
Floodprone Width (ft)	182.9	182.9	182.9	182.9	182.9	182.9								
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.9	0.9	1.1		1.0	1.0	0.9	0.9	0.9	1.0	
Bankfull Max Depth (ft)	1.4	1.6	1.7	1.8	1.6	1.8		1.6	1.7	1.7	1.7	1.7	1.7	
Bankfull Cross Sectional Area (ft^2)	8.4	9.7	9.1	9.3	8.9	9.5		10.1	9.3	8.7	8.4	10.2	10.7	
Bankfull Width/Depth Ratio	10.0	9.1	8.7	10.5	10.2	7.4								
Bankfull Entrenchment Ratio	20.0	19.5	20.5	18.5	19.2	21.8								
Low Bank Height (ft)	---	---	---	---	1.8	1.6								
Bankfull Bank Height Ratio*	1.0	1.1	1.0	1.0	1.1	0.9								
	Cross Section 7 (Riffle)							**Cross Section 8 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	8.8	10.2	9.6	9.7	9.4	7.2		9.5	10.0	9.6	9.3	9.0	9.9	
Floodprone Width (ft)	162.2	162.2	162.2	162.2	162.2	162.2								
Bankfull Mean Depth (ft)	1.0	0.9	0.9	0.9	0.9	1.1		1.2	1.2	1.1	1.2	1.2	1.2	
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.6	1.6	1.6		1.9	2.0	1.9	2.0	2.0	2.0	
Bankfull Cross Sectional Area (ft^2)	8.7	8.6	8.5	8.7	8.0	7.7		11.1	11.9	10.8	11.4	10.5	11.5	
Bankfull Width/Depth Ratio	8.8	12.0	10.9	10.9	11.0	6.6								
Bankfull Entrenchment Ratio	18.5	16.0	16.8	16.7	17.3	22.5								
Low Bank Height (ft)	---	---	---	---	1.6	1.4								
Bankfull Bank Height Ratio*	1.0	1.0	1.0	1.0	1.0	0.9								
	Cross Section 9 (Riffle)							**Cross Section 10 (Pool)**						
Dimension	Base	MY1	MY2	MY3	MY5	MY7	MY+	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation														
Bankfull Width (ft)	10.5	10.2	11.1	11.7	11.1	8.1		9.8	9.2	10.5	9.6	9.9	11.0	
Floodprone Width (ft)	219.0	219.0	219.0	219.0	219.0	219.0								
Bankfull Mean Depth (ft)	1.1	1.1	1.0	1.0	1.0	1.3		1.2	1.0	1.0	1.0	1.0	0.9	
Bankfull Max Depth (ft)	1.8	1.9	1.9	1.9	1.8	2.0		1.9	1.7	2.1	2.1	2.1	2.1	
Bankfull Cross Sectional Area (ft^2)	12.0	11.1	11.3	11.2	10.7	10.9		11.4	8.7	10.7	10.2	10.1	10.1	
Bankfull Width/Depth Ratio	9.1	9.4	10.9	12.2	11.5	6.1								
Bankfull Entrenchment Ratio	20.9	21.5	19.8	18.8	19.8	27.0								
Low Bank Height (ft)	---	---	---	---	1.9	1.6								
Bankfull Bank Height Ratio*	1.0	0.9	1.0	1.1	1.0	0.8								

*Base through MY3 BHR calculated by holding bankfull elevation constant. MY5 data calculated by fitting as-built bankfull cross section area to monitoring year channel.

Table 11. Monitoring Data - Stream Reach Data Summary
UT to Millers Creek (DMS Project No. 95719)

Parameter	Baseline						MY-1					
Dimension and Substrate	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	8.8	9.6	9.7	10.5	0.7	5	9.1	9.9	10.2	10.6	0.6	5
Floodprone Width (ft)	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)	0.8	0.9	0.9	1.1	0.1	5	0.7	0.9	0.9	1.1	0.2	5
[1]Bankfull Max Depth (ft)	1.1	1.5	1.5	1.8	0.3	5	1.0	1.6	1.6	1.9	0.3	5
Bankfull Cross Sectional Area (ft^2)	7.7	9.1	8.7	12.0	1.7	5	6.3	9.1	9.7	11.1	1.8	5
Width/Depth Ratio	8.8	10.2	10.0	12.2	1.4	5	9.1	11.0	11.4	13.2	1.7	5
Entrenchment Ratio	11.9	13.1	12.9	14.3	0.9	5	11.9	18.1	19.5	21.5	4.1	5
Low Bank Height (ft)	---	---	---	---	---	---	---	---	---	---	---	---
[1]Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	5	0.9	1.0	1.0	1.1	0.1	5
Profile												
Riffle Length (ft)	8.6	21.9	22.8	33.6	9.0	7						
Riffle Slope (ft/ft)	0.0039	0.0069	0.0075	0.0096	0.0019	7						
Pool Length (ft)	9.1	27.0	25.7	53.9	11.6	61						
Pool Max depth (ft)	1.60	1.86	1.90	2.20	0.23	5						
Pool Spacing (ft)	12.5	41.8	40.3	96.3	18.4	63						
Pattern*												
Channel Beltwidth (ft)		17.5 - 52.5										
Radius of Curvature (ft)		20.1 - 22.8										
Rc:Bankfull width (ft/ft)		2.3 - 2.6										
Meander Wavelength (ft)		14.0 - 56.0										
Meander Width Ratio		2.0 - 6.0										
Additional Reach Parameters												
Rosgen Classification	E5											
Channel Thalweg length (ft)	2709											
Sinuosity (ft)	1.27											
Water Surface Slope (Channel) (ft/ft)	0.0011											
BF slope (ft/ft)	0.0005											
[3]Ri% / Ru% / P% / G% / S%	33		67									
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Parameter	MY-2						MY- 3					
Dimension and Substrate	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	8.9	9.8	9.6	11.1	0.8	5	9.2	10.0	9.7	11.7	1.0	5
Floodprone Width (ft)	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)	0.7	0.9	0.9	1.0	0.1	5	0.7	0.9	0.9	1.0	0.1	5
[1]Bankfull Max Depth (ft)	1.1	1.6	1.6	1.9	0.3	5	1.0	1.5	1.6	1.9	0.3	5
Bankfull Cross Sectional Area (ft^2)	6.7	8.8	8.5	11.3	1.6	5	6.8	8.9	8.7	11.2	1.6	5
Width/Depth Ratio	8.7	11.1	10.9	13.2	1.6	5	10.0	11.4	10.9	13.2	1.3	5
Entrenchment Ratio	12.7	18.1	19.8	20.8	3.4	5	13.8	17.6	18.5	20.5	2.6	5
Low Bank Height (ft)	---	---	---	---	---	---	---	---	---	---	---	---
[1]Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	5	1.0	1.0	1.1	1.1	0.1	5
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)												
Pool Length (ft)												
Pool Max depth (ft)												
Pool Spacing (ft)												
Pattern*												
Channel Beltwidth (ft)												
Radius of Curvature (ft)												
Rc:Bankfull width (ft/ft)												
Meander Wavelength (ft)												
Meander Width Ratio												
Additional Reach Parameters												
Rosgen Classification												
Channel Thalweg length (ft)												
Sinuosity (ft)												
Water Surface Slope (Channel) (ft/ft)												
BF slope (ft/ft)												
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Parameter	MY- 5						MY- 7					
Dimension and Substrate	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	9.4	9.9	9.8	11.1	0.7	5	7.2	8.2	8.4	8.9	0.7	5
Floodprone Width (ft)	126.3	177.1	182.9	219.0	35.1	5	126.3	177.1	182.9	219.0	35.1	5
Bankfull Mean Depth (ft)	0.7	0.9	0.9	1.0	0.1	5	0.9	1.1	1.1	1.3	0.1	5
[1]Bankfull Max Depth (ft)	1.1	1.5	1.6	1.8	0.3	5	1.2	1.6	1.6	2.0	0.3	5
Bankfull Cross Sectional Area (ft^2)	7.1	8.7	8.8	10.7	1.3	5	7.7	9.0	9.0	10.9	1.3	5
Width/Depth Ratio	10.2	11.5	11.3	13.4	1.2	5	6.1	7.7	7.4	9.5	1.4	5
Entrenchment Ratio	12.7	17.8	19.2	20.0	3.0	5	14.2	21.6	22.5	27.0	4.7	5
Low Bank Height (ft)	1.0	1.6	1.6	1.9	0.3	5	1.0	1.4	1.5	1.6	0.2	5
[1]Bank Height Ratio	1.0	1.0	1.0	1.1	0.0	5	0.8	0.9	0.9	0.9	0.0	5
Profile												
Riffle Length (ft)												
Riffle Slope (ft/ft)												
Pool Length (ft)												
Pool Max depth (ft)												
Pool Spacing (ft)												
Pattern*												
Channel Beltwidth (ft)												
Radius of Curvature (ft)												
Rc:Bankfull width (ft/ft)												
Meander Wavelength (ft)												
Meander Width Ratio												
Additional Reach Parameters												
Rosgen Classification												
Channel Thalweg length (ft)												
Sinuosity (ft)												
Water Surface Slope (Channel) (ft/ft)												
BF slope (ft/ft)												
[3]Ri% / Ru% / P% / G% / S%												
[3]SC% / Sa% / G% / C% / B% / Be%												
[3]d16 / d35 / d50 / d84 / d95 /												
[2]% of Reach with Eroding Banks												
Channel Stability or Habitat Metric												
Biological or Other												

Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section measurements and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3
*Pattern data taken from design calculations as stream was built according to design plans per As-Built drawings

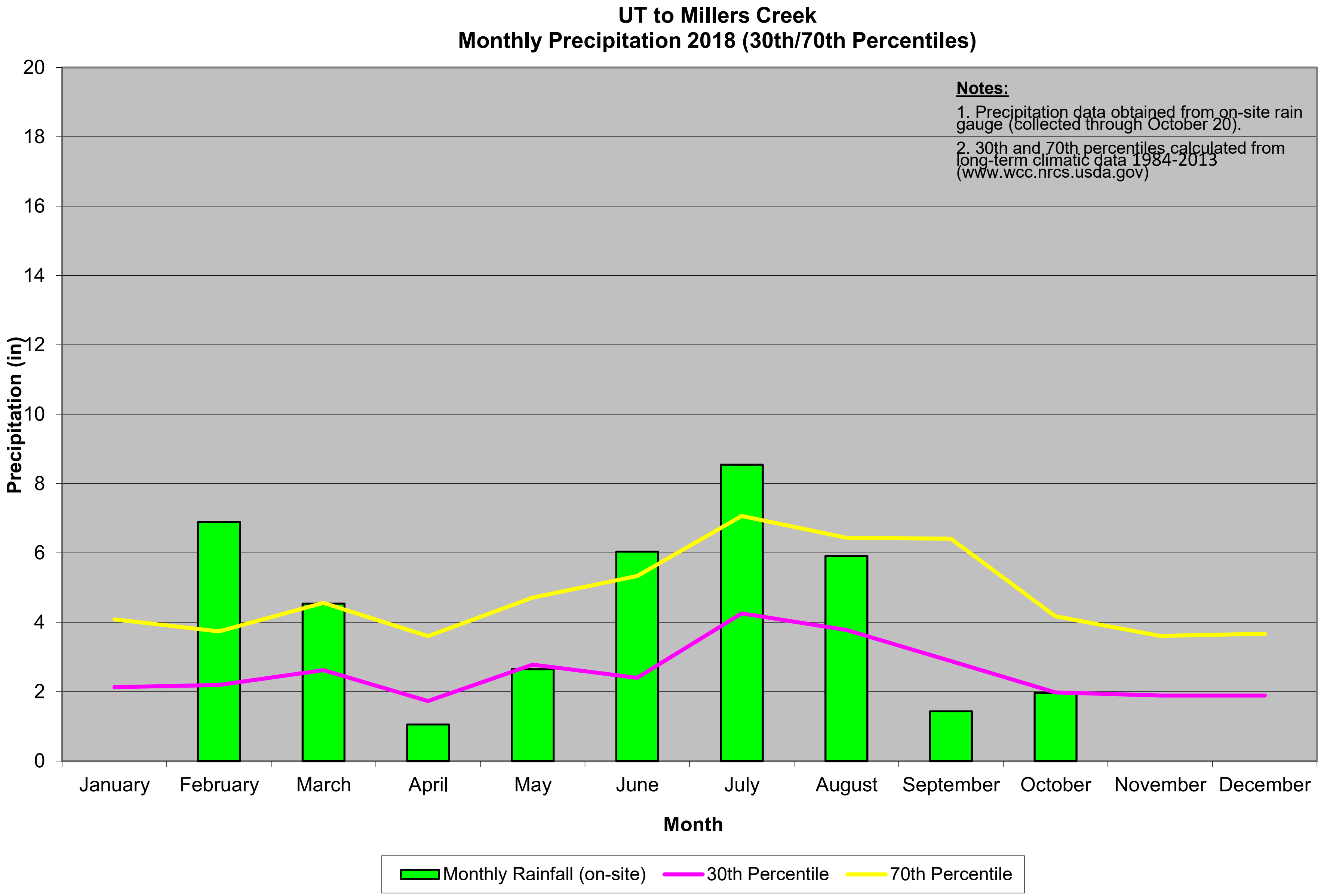
Appendix E. Hydrologic Data

Table 12. Verification of Bankfull Events

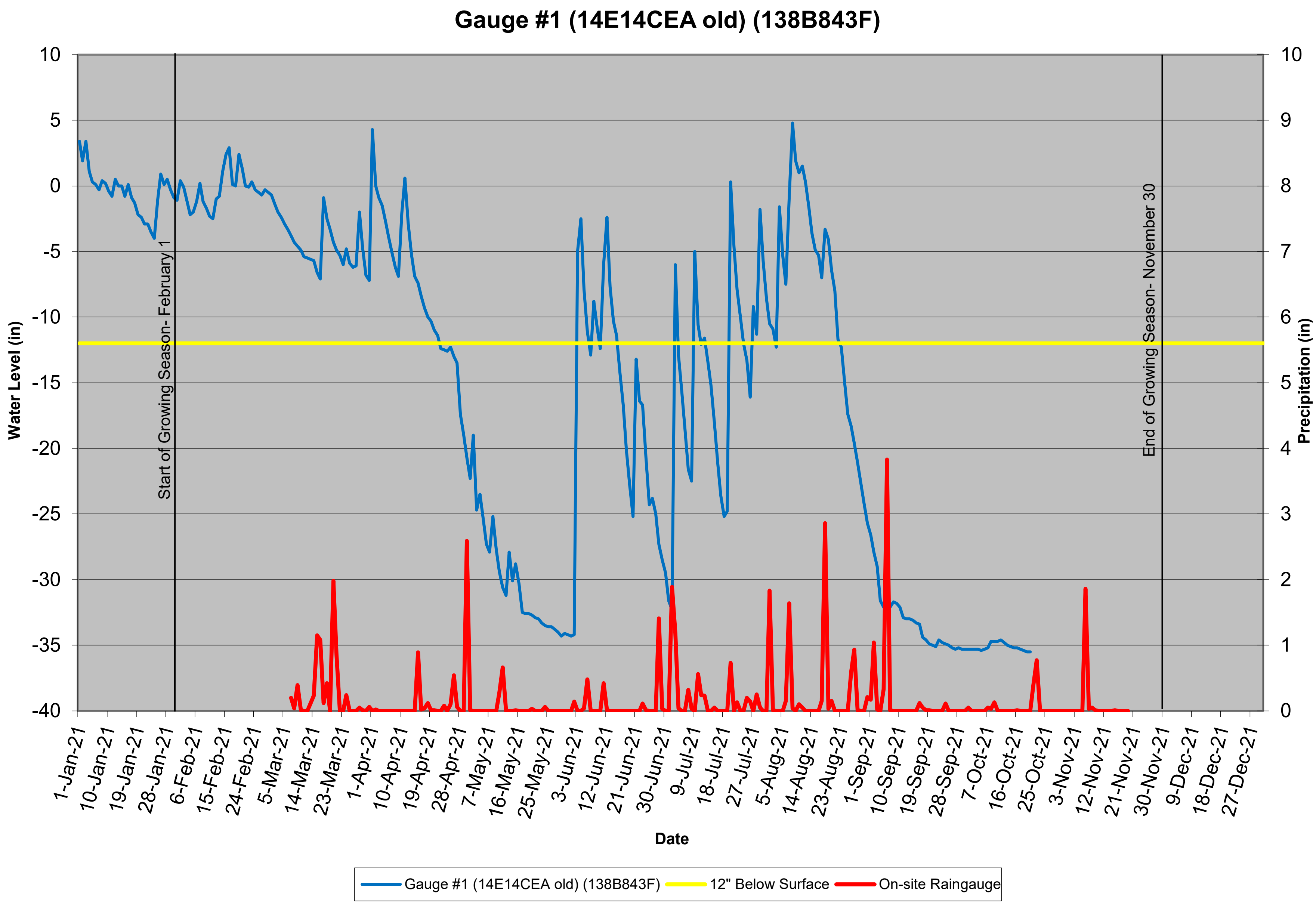
Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)
	Site	Sta.					
7/14/2015	2	37+03	2.29	107.16	109.45	107.71	1.74
7/14/2015	2	37+03	2.29	107.16	109.45	107.71	1.74
10/19/2015	1	10+62	1.50	111.46	112.96	112.07	0.89
4/27/2016	1	10+62	1.88	111.46	113.34	112.07	1.26
4/27/2016	2	37+03	3.70	107.16	110.87	107.71	3.15
10/10/2016	1	10+62	2.79	111.46	114.25	112.07	2.18
10/10/2016	2	37+03	3.43	107.16	110.59	107.71	2.88
10/10/2016	N/A	Approx 20+00	Visual	Visual	Visual	Visual	Visual
1/17/2017	1	10+62	2.29	111.46	113.75	112.07	1.68
1/17/2017	2	37+03	3.13	107.16	110.29	107.71	2.58
4/26/2017	1	10+62	2.00	111.46	113.46	112.07	1.39
4/26/2017	2	37+03	4.06	107.16	111.22	107.71	3.51
3/13/2018	1	10+62	3.58	111.46	115.04	112.07	2.97
3/13/2018	2	37+03	3.58	107.16	110.74	107.71	3.03
9/12/2018	1	10+62	4.5	111.46	115.96	112.07	3.89
9/12/2018	2	37+03	4.0	107.16	111.16	107.71	3.45
3/29/2019	1	10+62	2.42	111.46	113.88	112.07	1.81
3/29/2019	2	37+03	1.50	107.16	108.66	107.71	0.95
10/17/2019	1	10+62	2.25	111.46	113.71	112.07	1.64
10/17/2019	2	37+03	1.42	107.16	108.58	107.71	0.87
5/12/2020	1	10+62	Insect Damage	111.46	N/A	112.07	N/A
5/12/2020	2	37+03	2.31	107.16	109.47	107.71	1.76
3/17/2021	1	10+62	Insect Damage	111.46	N/A	112.07	N/A
3/17/2021	2	37+03	Insect Damage	107.16	N/A	107.71	N/A

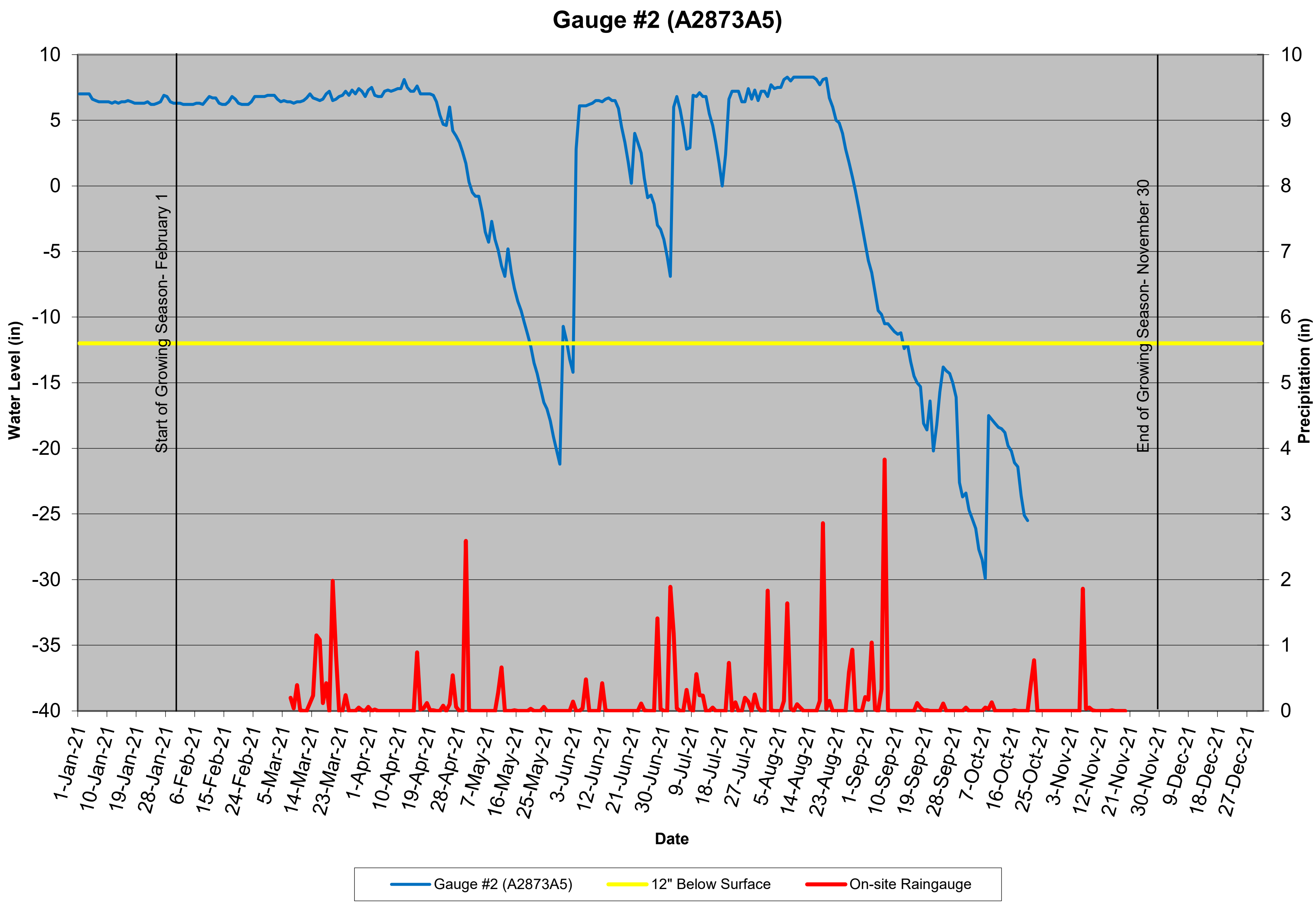
Table 13. Summary of Gauge Hydrologic Data

Gauge Number	Wetland Community Type	Target Hydroperiod	Percentage of Growing Season Year 1	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 1 Growing Season	Percentage of Growing Season Year 2	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 2 Growing Season	Percentage of Growing Season Year 3	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 3 Growing Season	Percentage of Growing Season Year 4	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 4 Growing Season	Percentage of Growing Season Year 5	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 5 Growing Season	Percentage of Growing Season Year 6	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 6 Growing Season	Percentage of Growing Season Year 7	Longest Number Of Consecutive Days Meeting Wetland Hydrology Criteria During Year 7 Growing Season
1	Riparian Bottomland Hardwood	12.5%	43	130	23	69	7.6	23	13	40	30	90	21	64	26	80
2	Riparian Bottomland Hardwood	12.5%	53	161	49	149	43.6	132	52	155	36	109	60	181	36	108
3	Riparian Bottomland Hardwood	12.5%	10	30	21	65	5.6	17	12.5	38	28	86	21	65	26	80
4	Headwater Riparian (Zero Order)	10%	70	212	100	304	52.5	159	54	162	45	137	100	304	77	232
5	Riparian Bottomland Hardwood	12.5%	32	97	49	149	49.2	149	52	155	37	112	100	304	35	106
6	Riparian Bottomland Hardwood	12.5%	52	158	48	146	51.5	156	54	162	39	117	100	304	37	115

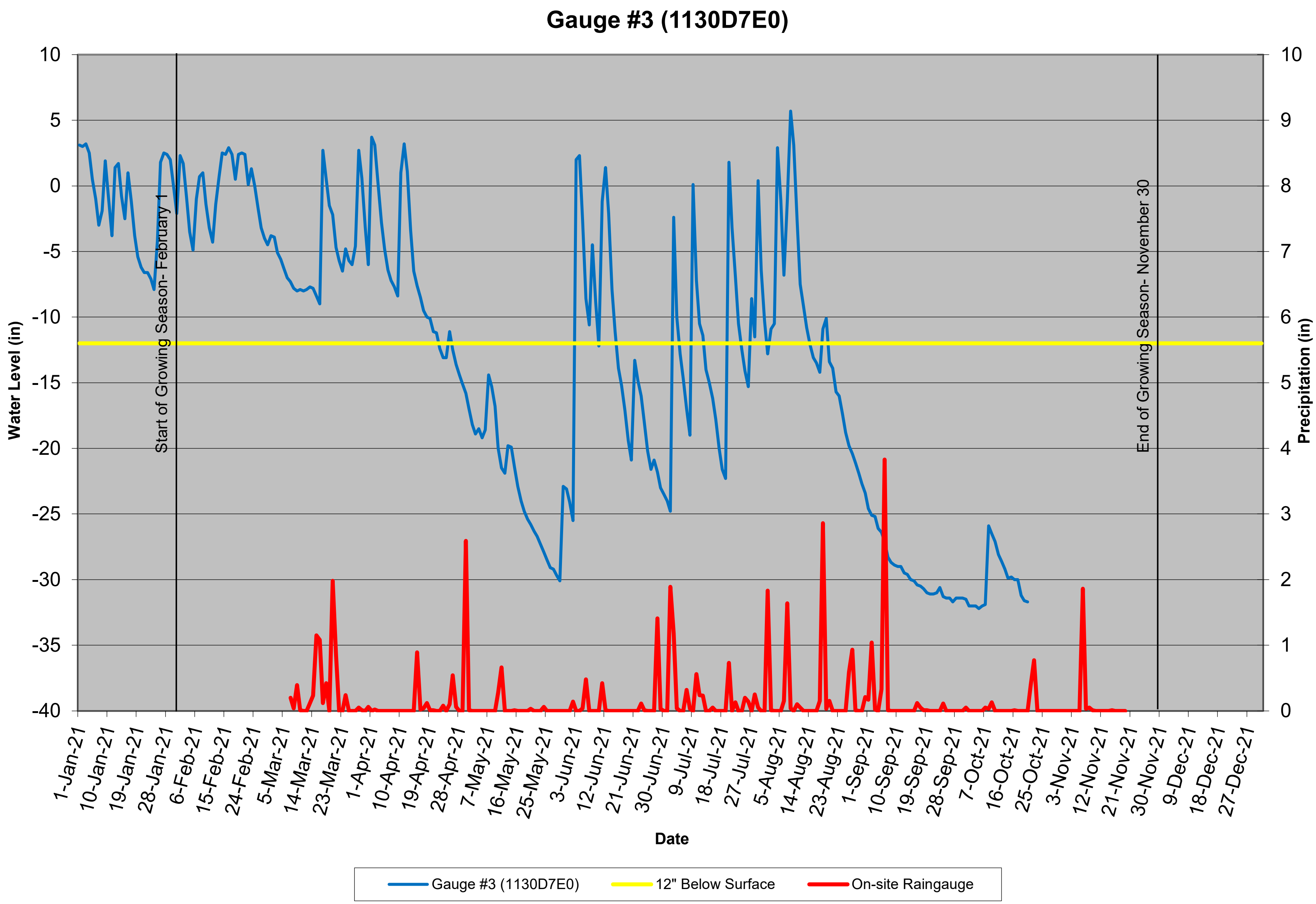


UT to Millers Creek
Monthly Precipitation 2018 (30th/70th Percentiles)
Notes:
1. Precipitation data obtained from on-site rain gauge (collected through October 20).
2. 30th and 70th percentiles calculated from long-term climatic data 1984-2013 (www.wcc.nrcs.usda.gov)
Precipitation (in)
0
2
4
6
8
10
12
14
16
18
20
January
February
March
April
May
June
July
August
September
October
November
December
Month
Monthly Rainfall (on-site)
30th Percentile
70th Percentile

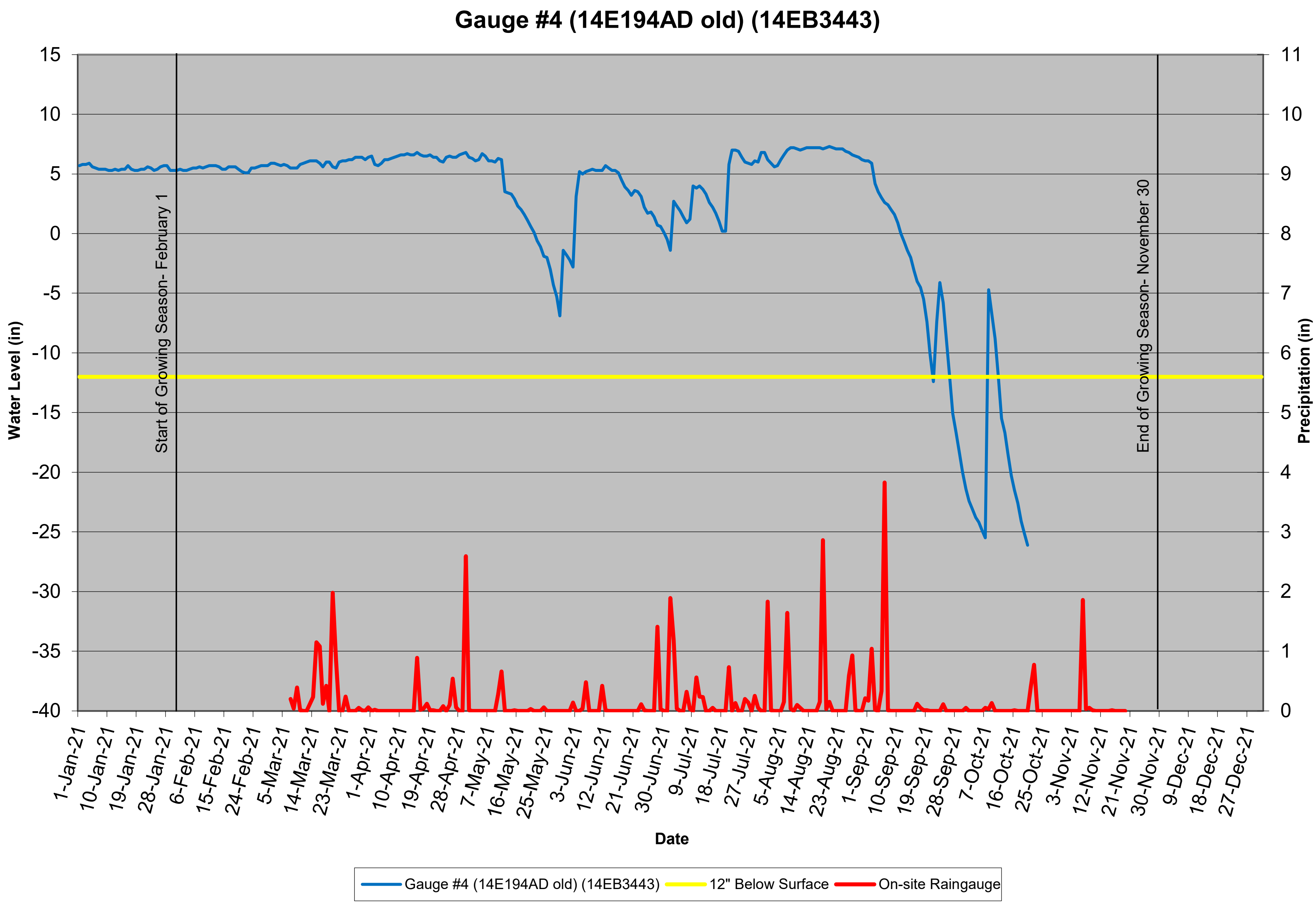

Gauge #1 (14E14CEA old) (138B843F)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge #1 (14E14CEA old) (138B843F)
12" Below Surface
On-site Raingauge

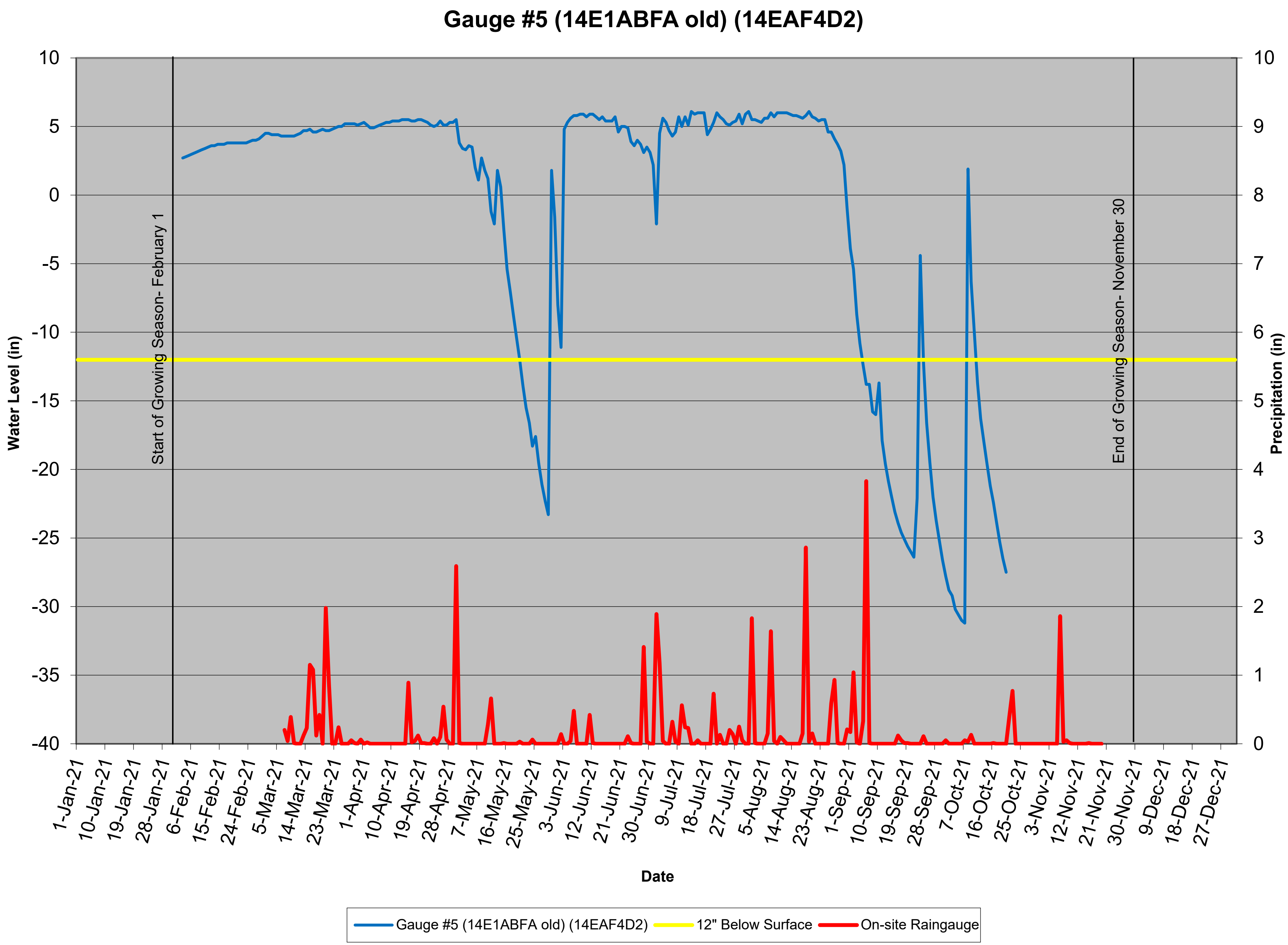


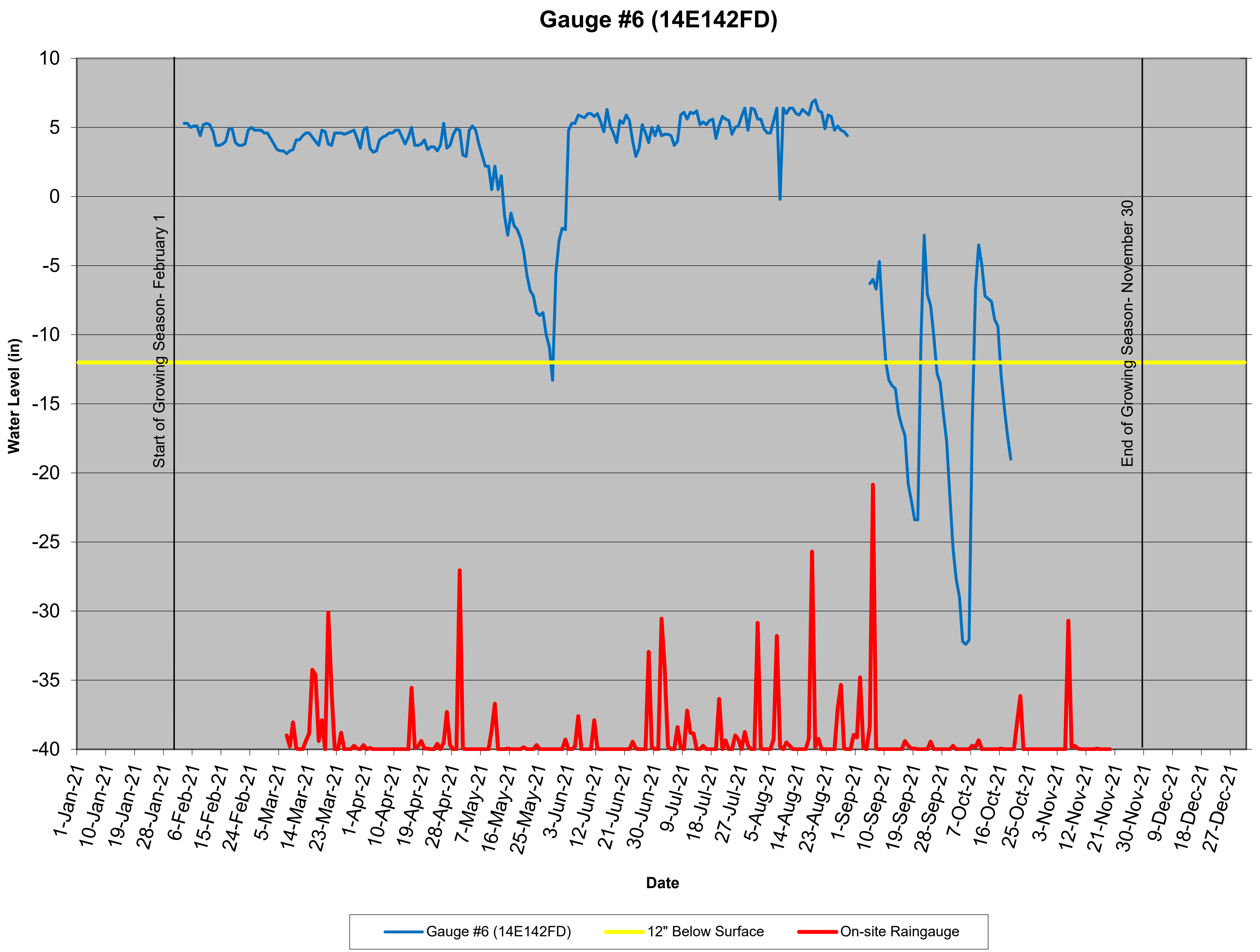
Gauge #2 (A2873A5)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
Gauge #2 (A2873A5)
12" Below Surface
On-site Raingauge



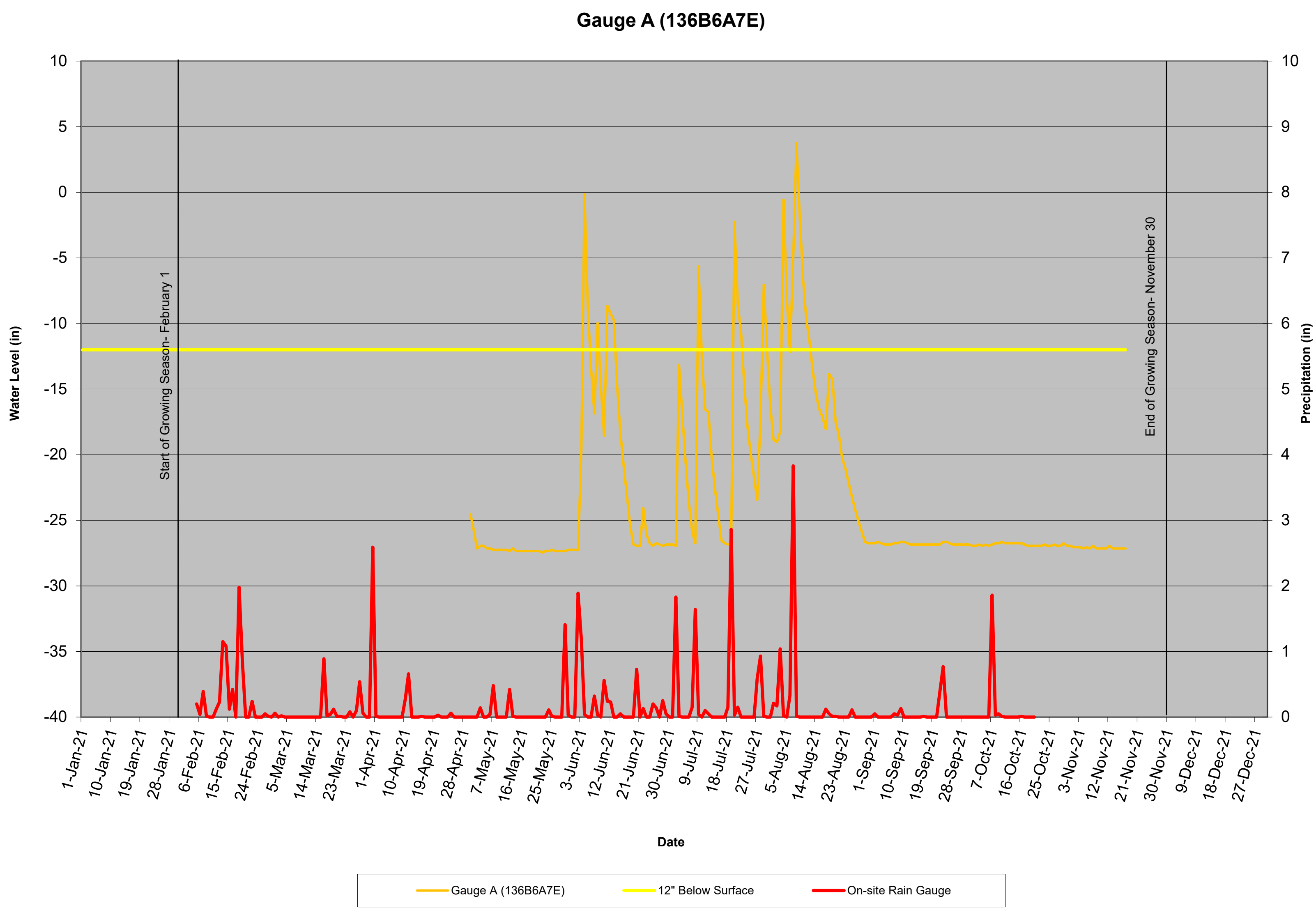
Gauge #3 (1130D7E0)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge #3 (1130D7E0)
12" Below Surface
On-site Raingauge


Gauge #4 (14E194AD old) (14EB3443)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
11
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge #4 (14E194AD old) (14EB3443)
12" Below Surface
On-site Raingauge


Gauge #5 (14E1ABFA old) (14EAF4D2)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge #5 (14E1ABFA old) (14EAF4D2)
12" Below Surface
On-site Raingauge



Gauge #6 (14E142FD)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge #6 (14E142FD)
12" Below Surface
On-site Raingauge


Gauge A (136B6A7E)
Water Level (in)
Precipitation (in)
Start of Growing Season- February 1
End of Growing Season- November 30
Date
Gauge A (136B6A7E)
12" Below Surface
On-site Rain Gauge

Credit release site visit to UT to Millers and DWR Recommendation to IRT re: credit release for Monitoring Yr. 5

Date of site visit: May 18, 2020

In attendance:

LMG- Ben Furr

DMS- Melonie, Lindsay, Jeremiah

DWR- Erin and Mac

Site Notes:

The purpose of the site visit was to visit proposed areas between gauges M1 and M3 as well as other areas that may be suspect regarding attaining wetland restoration credit. Also, DWR wanted to visit all the gauges, it appeared at several of the 6 gauges were located in depressional areas. In addition, please note that DWR has been requesting extra gauges since monitoring year 1 on this site.

The site visit started by visiting the headwater wetland restoration area and checking gauge M4. This area was dominated by bald cypress and they were between 8-10 feet tall. The area was ponded but did have adequate vegetative cover. However, gauge M4 was clearly in a depressional area. Some of the upper edges of this area of wetland credit should be verified by DMS/provider.

Next, one of the main areas DWR wanted to check was the area labeled as Area A on the attached map. DWR wanted to investigate the extent of hydric soils since there are no gauges between gauges M1 and M4. This area represents a significant portion of the riparian wetland restoration credit as labeled on Figure 2.1. DWR found that there were a number of areas where the soil cores did not show hydric indicators, or the hydric indicators where borderline. DWR recommends this area be verified as well for wetland status. In addition, DWR requires two additional gauges be installed in Area A. These gauges should be located at “upper” wetland elevations. The vegetation in Area A was better than expected (size and density). There are a number of sweet gums coming in so we made a suggestion to be aware of their increased presence on site.

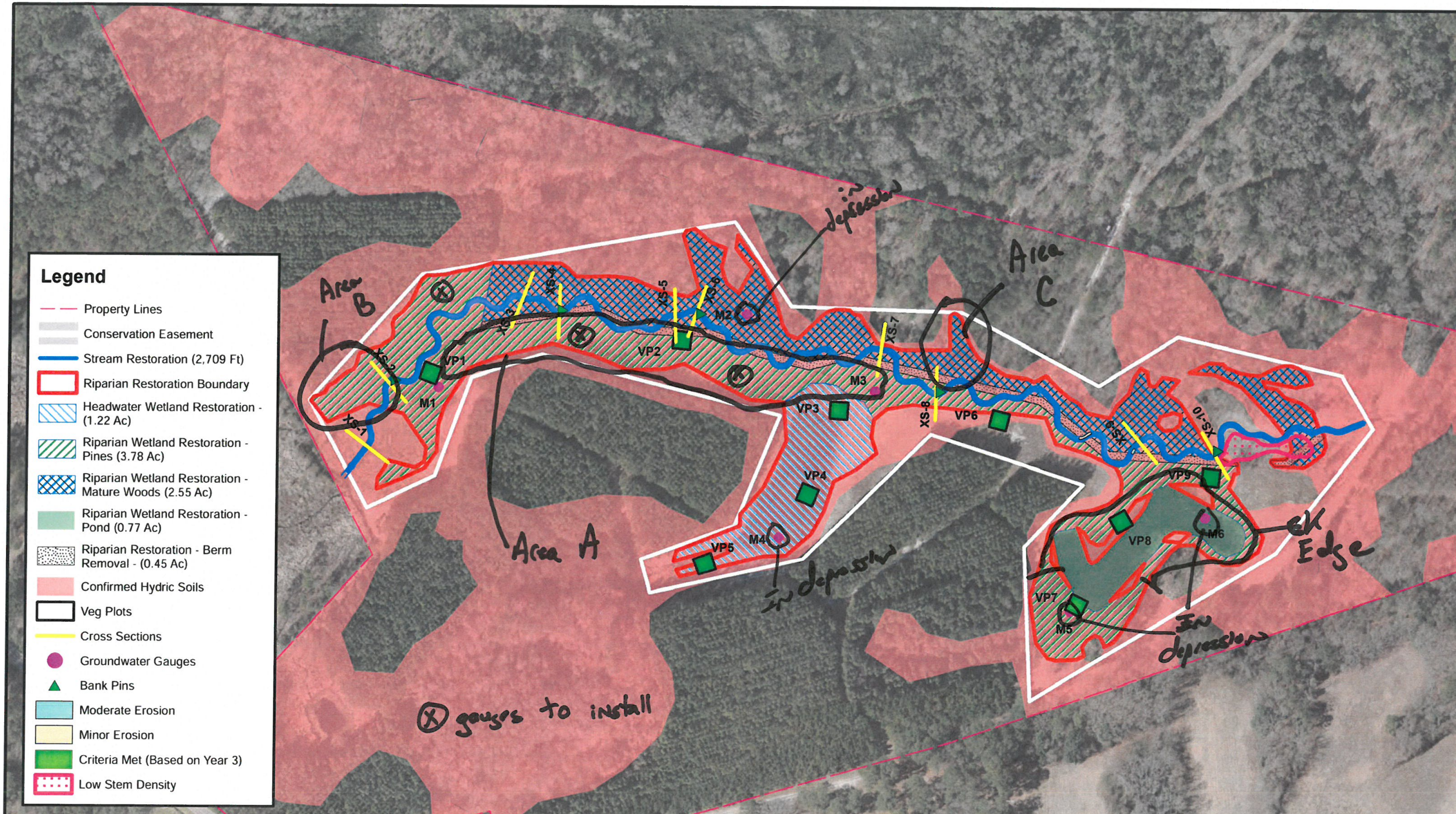
The proposed wetland area across the creek from veg plot 1 and gauge M1 was checked. The southernmost portion of this wetland polygon (labeled as Area B) did not show hydric indicators. This area will likely need to be removed from proposed wetland credit. In addition, DWR requires one gauge be installed in a location similar to what is indicated on Figure 2.1.

The group then walked the west side of the stream down to gauge M2. Gauge M2 was also in a depressional landscape position. Another area noted as Area C needs to be checked regarding extent of wetlands proposed. Finally, we visited the bottom of the project were the pond was initially. The amount of ponded water has decreased but tree growth is limited. The two gauges in this area M5 and M6 are both located in depressional areas. Moreover, the proposed wetland area around the edge of the pond needs to be checked for wetland status as indicated on Figure 2.1

The stream on site showed good bed and bank features. The channel was dry in most areas but did not have vegetation growing in the channel.

Overall the site has improved over the years, particularly from the vegetative standpoint. However, as evidenced by the site visit, some suppositions regarding the status of hydric soil and wetland extent were verified.

In summary, DWR recommends to the IRT that for any wetland credit to be released, there should be at least 3 groundwater monitoring gauges installed (now) and a wetland delineation performed to check the areas mentioned which DWR believes to be at risk. DWR is ok with releasing stream credit.



Current Condition Plan View - Year 5

UT Millers Creek, Duplin County, North Carolina

0 87.5 175 350 525 700 Feet

HDR | ICA

NC Environmental Quality

Figure 2.1

Mitigation Services
ENVIRONMENTAL QUALITY

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

January 8, 2021

MEMORANDUM FOR THE RECORD

Subject: UT to Millers Creek Hydric Soils Evaluation

1. A hydric soils evaluation was conducted January 6, 2021 by Jeremiah Dow and Lindsay Crocker, DMS. Map of the soil boring locations is attached.
2. Site soils are loamy sands and sandy loams, composed of recently formed alluvium from previous coastal plan deposition likely during Cretaceous times (USDA NRCS 2006). Site evaluation consisted of primarily Typic Fluvaqents or Typic Humaquepts, potentially matching the Rutlege or Torhunta series. These are classified as mineral-organic soils of the Coastal Plains containing umbric epipedons, very poorly drained, with loamy particle classes. Soils are masked with black organic accumulation, presenting hydric indicators that occur when aerobic microbes are not present to utilize carbon compounds and resulting in accumulation of organic carbon material. These conditions occurred here due to historic floodplain saturation (as indicated in pre-mitigation plan investigations), and current anaerobic conditions from inundation in the profile.
3. The primary indicator at this site utilized was S7 (Dark Surface), other indicators may include S8, S9, and/or A11. S7 requires a layer 4" thick, starting within the first 6" of the surface with a matrix 3 or less and chroma 1 or less. The material looks 100% masked without a hand lens, and at least 70% masked with a hand lens.
4. The areas shown with a green pin indicated masking >70%, although some areas were close to that level. Areas in red, did not qualify for that criteria, and the areas shown as orange were marginal. The soils were consistent throughout the eastern and southwest portions of the site, but there was greater clay content and some depletions on the western part of the site. Additionally, areas around the pond were mixed up, likely due to the fill removal that occurred during restoration.
5. At the time of the evaluation, the headwater wetland, pond, and other lower floodplain elevations were inundated. There were many areas outside of the credit areas that appeared inundated. The hydric soil boundary extended beyond creditable areas in numerous locations.

UT to Millers Creek

1/8/2021

Representative Soil boring 1 (Eastern floodplain)

A 0-18” 10YR 2/1 Loamy Sand, 80% coated grains, granular very friable non sticky, non-plastic

Eg 19-30” 2.5Y 5/1 Sand, granular, very friable non sticky, non-plastic

Bg 30-48”+ 2.5 Y 4/2 Loamy sand, subangular blocky, friable non sticky non-plastic

Representative Soil boring 2 (Southwestern floodplain)

A1 0-13” 10YR 2/5 Loamy sand, 70% coated grains, granular friable non-sticky, non-plastic

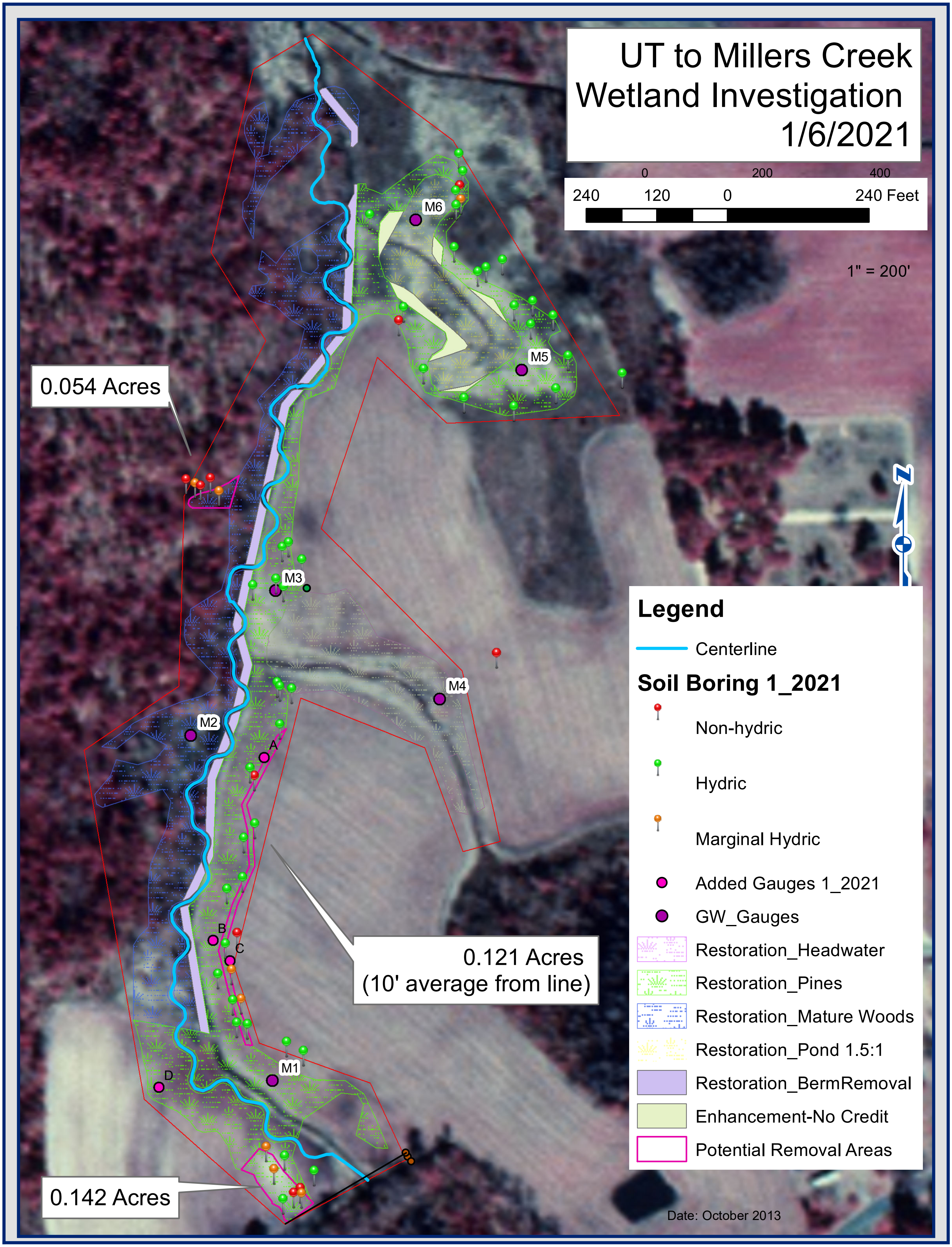
A2 13-17” 10 YR 5/2 Sandy loam, 60% coated grains, friable, non-sticky, non-plastic

BEg 17-44” 2.5Y 4/2 Sandy loam, organic stains on root channels, granular, very friable, non-sticky, non-plastic

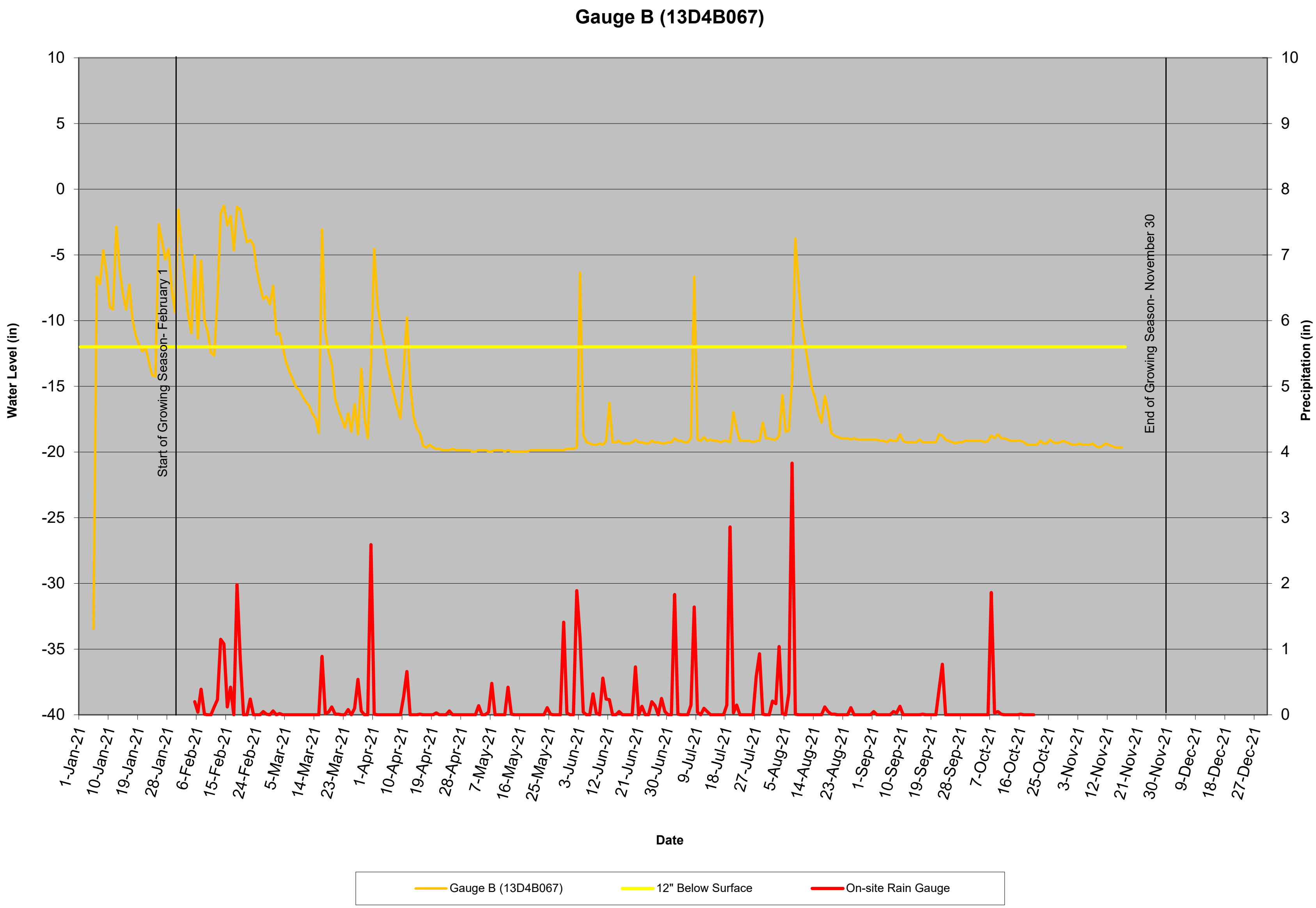
Btg 44”+ 10 YR 3/2, sandy clay loam, massive, friable, moderately sticky, slightly plastic

Spagnum moss common on-site in the inundated, and hydric soil areas.

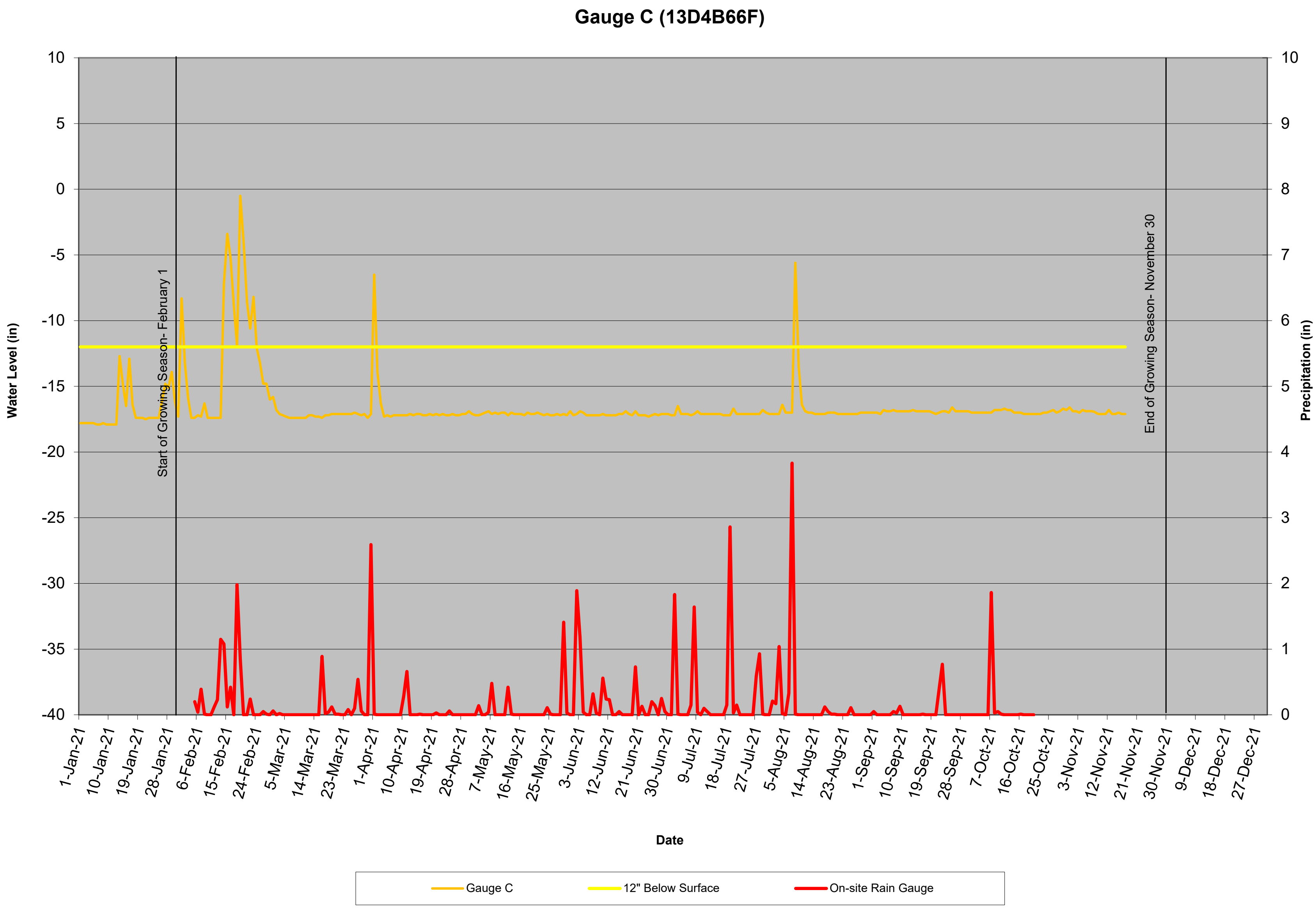
Typical example of dark surface; observe organic coating on hands.



UT to Millers Creek
Wetland Investigation
1/6/2021
0
200
400
240
120
0
240 Feet
1" = 200'
0.054 Acres
M6
M5
M3
M4
M2
A
B
C
D
M1
0.121 Acres
(10' average from line)
0.142 Acres
Legend
Centerline
Soil Boring 1_2021
Non-hydric
Hydric
Marginal Hydric
Added Gauges 1_2021
GW_Gauges
Restoration_Headwater
Restoration_Pines
Restoration_Mature Woods
Restoration_Pond 1.5:1
Restoration_BermRemoval
Enhancement-No Credit
Potential Removal Areas
Date: October 2013



Gauge B (13D4B067)
Water Level (in)
Precipitation (in)
Date
Start of Growing Season- February 1
End of Growing Season- November 30
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
10
9
8
7
6
5
4
3
2
1
0
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Gauge B (13D4B067)
12" Below Surface
On-site Rain Gauge



Gauge C (13D4B66F)
Water Level (in)
Precipitation (in)
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
9
8
7
6
4
3
2
1
Start of Growing Season- February 1
End of Growing Season- November 30
1-Jan-21
10-Jan-21
19-Jan-21
28-Jan-21
6-Feb-21
15-Feb-21
24-Feb-21
5-Mar-21
14-Mar-21
23-Mar-21
1-Apr-21
10-Apr-21
19-Apr-21
28-Apr-21
7-May-21
16-May-21
25-May-21
3-Jun-21
12-Jun-21
21-Jun-21
30-Jun-21
9-Jul-21
18-Jul-21
27-Jul-21
5-Aug-21
14-Aug-21
23-Aug-21
1-Sep-21
10-Sep-21
19-Sep-21
28-Sep-21
7-Oct-21
16-Oct-21
25-Oct-21
3-Nov-21
12-Nov-21
21-Nov-21
30-Nov-21
9-Dec-21
18-Dec-21
27-Dec-21
Date
Gauge C
12" Below Surface
On-site Rain Gauge

Supplement Hydrology Table Provided by DMS: UT to Millers Creek #95719

These tables are provided for the IRT and to illustrate differences in growing season day methods in relation to project success criteria.

Approved Mitigation Plan lists 2/1-11/30 for documenting project success.

Gauge Number	Success Hydroperiod	USED FOR MY7--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	80	26%	52	20%	33	14%
2	12.5	108	36%	100	39%	100	42%
3	12.5	80	26%	52	20%	33	14%
4	10	232	77%	204	80%	185	78%
5	12.5	106	35%	97	38%	97	41%
6	12.5	115	38%	91	36%	91	38%
A	12.5	8	3%	8	3%	8	3%
B	12.5	20	7%	4	2%	4	2%
C	12.5	10	3%	1	0%	1	0%
D	12.5	MALFUNCTION	MALFUNCTION	MALFUNCTION	MALFUNCTION	MALFUNCTION	MALFUNCTION

NOTE GAGE A ONLY STARTED FUNCTIONING ON 4/30

Gauge Number	Success Hydroperiod	USED FOR MY6--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	64	21%	36	14%	24	10%
2	12.5	181	60%	153	60%	134	57%
3	12.5	65	21%	37	15%	26	11%
4	10	304	100%	255	100%	237	100%
5	12.5	304	100%	255	100%	237	100%
6	12.5	304	100%	255	100%	237	100%

Gauge Number	Success Hydroperiod	USED FOR MY5--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	90	30%	62	24%	43	18%
2	12.5	109	36%	81	32%	62	26%
3	12.5	86	28%	58	23%	39	16%
4	10	137	45%	109	43%	90	38%
5	12.5	112	37%	84	33%	65	27%
6	12.5	117	39%	89	35%	42	18%

Gauge Number	Success Hydroperiod	USED FOR MY4--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	40	13%	40	16%	27	11%
2	12.5	155	51%	127	50%	108	46%
3	12.5	38	13%	38	15%	20	8%
4	10	162	53%	133	52%	114	48%
5	12.5	155	51%	127	50%	108	46%
6	12.5	162	53%	134	53%	115	49%

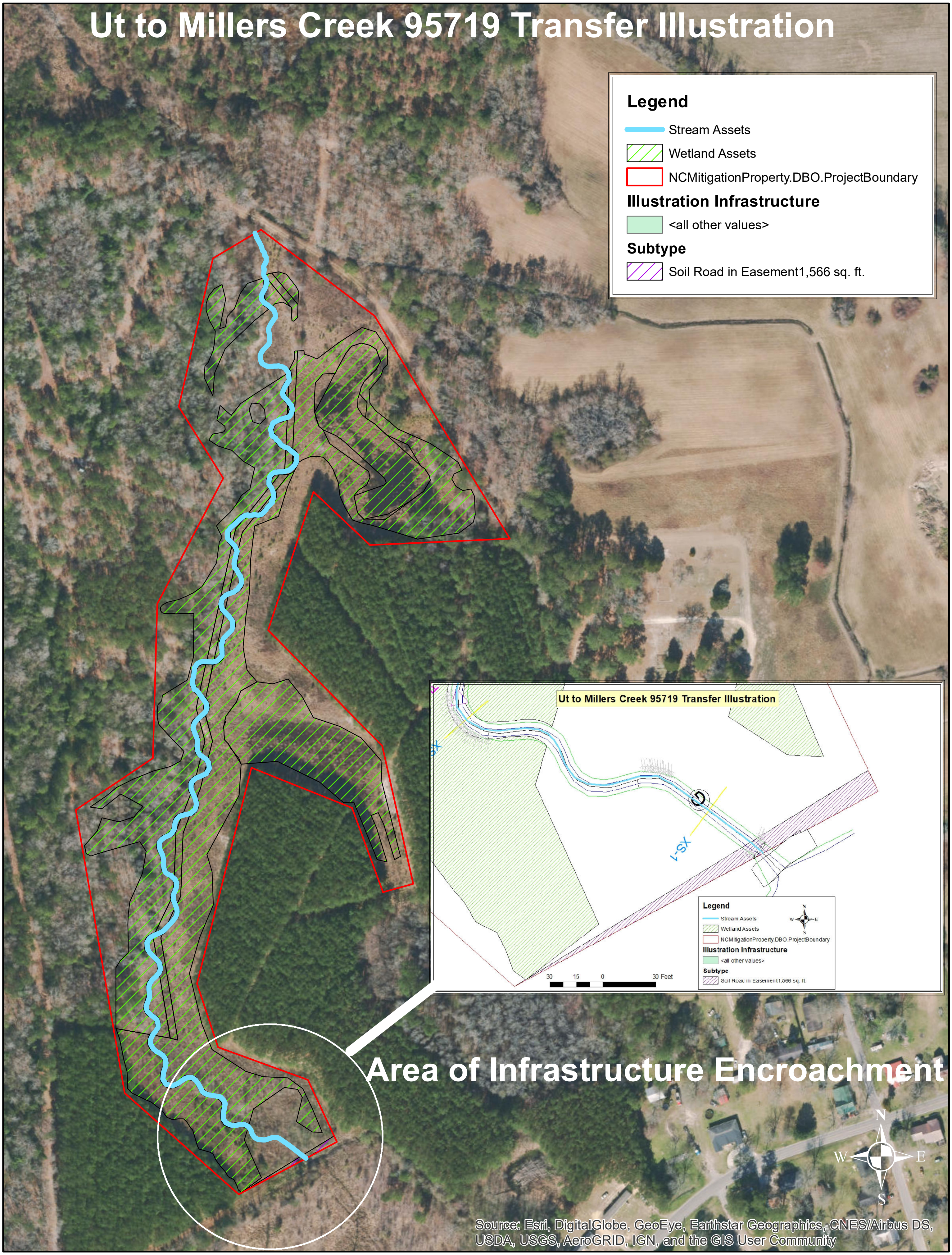
Gauge Number	Success Hydroperiod	USED FOR MY3--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	23	8%	23	9%	23	10%
2	12.5	135	45%	107	42%	88	37%
3	12.5	17	6%	17	7%	17	7%
4	10	159	52%	131	51%	112	47%
5	12.5	149	49%	121	47%	102	43%
6	12.5	156	51%	128	50%	109	46%

Gauge Number	Success Hydroperiod	USED FOR MY2--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	69	23%	50	20%	50	21%
2	12.5	149	49%	149	58%	149	63%
3	12.5	65	21%	37	15%	18	8%
4	10	304	100%	255	100%	237	100%
5	12.5	149	49%	130	51%	130	55%
6	12.5	146	48%	131	51%	131	55%

Gauge Number	Success Hydroperiod	USED FOR MY1--2/1/-11/30 303 days		3/1/-11/11 255 days		3/19/-11/11 237 days	
	%	Consecutive Days	% of growing season	Consecutive Days	% of growing season	Consecutive Days	% of growing season
1	12.5	130	43%	102	40%	83	35%
2	12.5	161	53%	133	52%	114	48%
3	12.5	30	10%	17	7%	17	7%
4	10	212	70%	184	72%	165	70%
5	12.5	97	32%	78	31%	78	33%
6	12.5	158	52%	130	51%	111	47%

Meeting success criteria

Not meeting success criteria



Ut to Millers Creek 95719 Transfer Illustration
Legend
Stream Assets
Wetland Assets
NCMitigationProperty.DBO.ProjectBoundary
Illustration Infrastructure
<all other values>
Subtype
Soil Road in Easement1,566 sq. ft.
Ut to Millers Creek 95719 Transfer Illustration
XS-1
Legend
Stream Assets
Wetland Assets
NCMitigationProperty.DBO.ProjectBoundary
Illustration Infrastructure
<all other values>
Subtype
Soil Road in Easement1,566 sq. ft.
N
W
E
S
30 15 0 30 Feet
Area of Infrastructure Encroachment
N
W
E
S
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

MBA 1_25_22