MONITORING YEAR 1 ANNUAL REPORT
FINAL

December 2021

SANDY BRANCH MITIGATION SITE
Chatham County, NC
Cape Fear River Basin
HUC 03030003

DMS Project No. 100060
NCDEQ Contract No. 7527
USACE Action ID No. SAW-2018-01167
NCDWR Project No. 2018-0786

Data Collection Period: May-November 2021

DMS RFP No. 16-007331

PREPARED FOR:

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

December 19, 2021

Jeremiah Dow
N.C. Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

RE: Monitoring Year 1 Report Sandy Branch Mitigation Site, DMS ID# 100060
Cape Fear River Basin – CU# 03030003
Chatham County, North Carolina
Contract No. 7527

Dear Mr. Dow,

We have reviewed the comments on the Monitoring Year 1 Report for the above referenced project dated December 15, 2021 and have revised the report based on these comments. The revised documents are submitted with this letter. Below are responses to each of your comments. For your convenience, the comments are reprinted with our response in italics.

MY1 Report – Stream Mitigation

1. The soil temperature figure should be included in the report and if budburst photos are available these should also be included in the report and digital submittal.

The soil temperature figure was added to Appendix D and included in the digital submittal. No budburst photos are available.

2. A figure should be included in the report illustrating a time series for the crest gauge data and indicating the occurrence of the bankfull events listed in Table 10. Please also collate these raw data and submit them as a single workbook with the figure included.

A figure illustrating a time series for the crest gauge data and indicating the occurrence of bankfull events was added to Appendix D and included in the digital submittal.

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

Sincerely,

Jason Lorch, *Monitoring Coordinator*

SANDY BRANCH MITIGATION SITE

Monitoring Year 1 Annual Report

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Section 1: PROJECT OVERVIEW

The Sandy Branch Mitigation Site (Site) is located in Chatham County, approximately seven miles southeast of Siler City, NC in the Cape Fear River Basin 8-Digit Hydrologic Unit Code (HUC) 03030003. The Site involves re-establishing a stream and wetland complex utilizing stream restoration, wetland re-establishment, and wetland rehabilitation approaches. The Site is located within the DMS Targeted Local Watershed (TLW) for the Cape Fear River Basin HUC 03030003070050 (Bear Creek TLW) and the NC DWR Subbasin 03-06-12. The Sandy Branch Mitigation Site is one of the projects identified in the Upper Rocky River Local Watershed Plan (Table 3-1 in the report identifies it as Site No. 5) as a priority for stream and wetland restoration. The Site was selected by DMS to provide stream and wetland credits in the Cape Fear River Basin 03030003 (Cape Fear 03).

1.1 Project Quantities and Credits

A conservation easement was recorded on 18.10 acres and was fenced prior to construction (Figure 1). Mitigation work within the Site included 3,286 linear feet of perennial stream channel restoration and 8.540 acres of wetland re-establishment and rehabilitation. The project is expected to provide 3,286.000 stream credits and 7.267 wetland credits at closeout.

Table 1. Project Mitigation Quantities and Credits

Project Components							
Project Segment	**Mitigation Plan Footage/Acreage**	**As-Built Footage/Acreage**	**Mitigation Category**	**Restoration Level**	**Mitigation Ratio (X:1)**	**Credits**	**Comments**
Stream							
Sandy Branch R1	861	849	Warm	R	1	861.000	Full Channel Restoration, Planted Buffer, Fencing Out Livestock
	40	40	Warm	N/A	N/A	N/A	External Crossing, Culvert
	110	104	Warm	R	1	110.000	Full Channel Restoration, Planted Buffer, Fencing Out Livestock
Sandy Branch R2	1,929	1,919	Warm	R	1	1,929.000	
UT1	131	125	Warm	R	1	131.000	
UT2	255	254	Warm	R	1	255.000	
					Total:	**3,286.000**	
Wetland							
Re-establishment	N/A	4.721	Riparian	R	1.000	4.721	
Rehabilitation	3.819	3.819	Riparian	RE	1.500	2.546	
					Total:	**7.267**	

Project Credits		
Restoration Level	**Stream - Warm**	**Riparian Wetland - Riverine**
Restoration	3,286.000	
Re-establishment		4.721
Rehabilitation		2.546
Totals	**3,826.000**	**7.267**

1.2 Project Goals and Objectives

The project is intended to provide numerous ecological benefits within the Cape Fear River Basin. While benefits such as habitat improvement and geomorphic stability are limited to the Site, reduced nutrient and sediment loading have farther reaching effects. Table 2 below describes expected outcomes to water quality and ecological processes associated with the project goals and objectives. These goals were established and completed with careful consideration of goals and objectives described in the River Basin Restoration Priorities and to meet the DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed.

Table 2: Goals, Performance Criteria, and Functional Improvements

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Monitoring Results
Improve the stability of stream channels	Reconstruct stream channels that will maintain stable pattern and profile considering hydrologic and sediment inputs to the system, landscape setting, and the watershed conditions.	Reduce sediment inputs from bank erosion. Contribute to protection of, or improvement to, a Nutrient-Sensitive Water.	Entrenchment ratios remaining above 2.2 and bank height ratios remaining below 1.2, coarser material in riffles and finer material in pools, and progression towards stability shown in visual inspections.	Cross-section monitoring will be assessed during MY1, MY2, MY3, MY5, and MY7 and visual inspections will be assessed annually.	No deviations from design.
Reconnect channels with floodplains and riparian wetlands	Reconstruct stream channels with appropriate bankfull dimensions and depth relative to the existing floodplain.	Reduce shear stress on channels, hydrate adjacent wetland areas, and filter pollutants from overbank flows.	Four bankfull events in separate years within monitoring period.	Crest gauges and/or pressure transducers recording flow elevations.	Several bankfull events were recorded during MY1.
Improve instream habitat	Install habitat features such as constructed riffles, lunker logs, and brush toe into restored streams. Add woody material to channel beds. Construct pools of varying depth.	Improve aquatic communities in project streams.	There is no required performance standard for this metric.	N/A	N/A

Goal	Objective/ Treatment	Likely Functional Uplift	Performance Criteria	Measurement	Monitoring Results
Restore wetland hydrology, soils, and plant communities	Re-establish and rehabilitate riparian wetlands by raising stream beds and planting native wetland species.	Improve terrestrial habitat. Contribute to protection of, or improvement to, a Nutrient-Sensitive Water.	Free groundwater surface within 12 inches of the ground surface for 10% (27 days) of the growing season under normal precipitation conditions.	12 groundwater gauges equipped with pressure transducers are located in representative wetland areas and monitored annually.	9 out of 12 groundwater gauges had groundwater within 12 inches of the ground surface for 10.0% (27 days) of the growing season consecutively.
Restore and enhance native floodplain vegetation	Plant native tree species in riparian zones where currently insufficient.	Reduce/control sediment inputs, reduce/ manage nutrient inputs, provide canopy to shade streams and reduce thermal loadings, contribute to protection of, or improvement to, a Nutrient-Sensitive Water.	Survival rate of 320 stems per acre at MY3, 260 planted stems per acre at MY5, and 210 stems per acre at MY7. Planted stems must average at least seven feet in height in each plot at the end of MY5 and 10 feet in height in each plot by the end of 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.	All 13 vegetation plots have a planted stem density greater than 320 stems per acre.
Permanently protect the project site from harmful uses	Establish conservation easements and fence the Site.	Prevent development and agricultural uses that would damage the Site or reduce the benefits of the project.	Prevent easement encroachment.	Visually inspect the perimeter of the Site to ensure no easement encroachment is occurring.	No easement encroachments.

1.3 Project Attributes

The Site is located on a single parcel bounded by Elmer Moore Road on the northern edge and other agricultural parcels to the east, south, and west. Prior to restoration the Site was an active livestock operation characterized by extensively grazed pasture, minimal riparian vegetation, and project streams functioning as the primary water source for livestock. The streams and riparian buffers onsite were in the same approximate configurations since before 1965, according to aerial photographs. In general, the area maintained its rural, agricultural character for more than 50 years with only minor changes in land use and land cover. Table 3 below and Table 8 in Appendix C present additional information on pre-restoration conditions.

Table 3. Project Attributes

Project Information				
Project Name	Sandy Branch Mitigation Site			
County	Chatham			
Project Area (acres)	18.10			
Project Coordinates (latitude and longitude decimal)	35°38’35"N 79°23'14"W			
Project Watershed Summary Information				
Physiographic Province	Piedmont			
River Basin	Cape Fear			
USGS Hydrologic Unit 8-digit	3030003			
DWR Sub-basin	03-06-12			
Project Drainage Area (acres)	463			
Project Drainage Area Percentage of Impervious Area	2%			
Land Use Classification	49% Cultivated Crops/Hay, 36% Forested, 13% Developed, 2% Other			
Reach Summary Information				
Parameters	**Sandy Branch R1**	**Sandy Branch R2**	**UT1**	**UT2**
Pre-project length (feet)	964	1,931	102	257
Post-project length (feet)	953	1,919	125	254
Valley confinement (Confined, moderately confined, unconfined)	Unconfined			
Drainage area (acres)	323	388-463	35	73
Perennial, Intermittent, Ephemeral	Perennial			
NCDWR Water Quality Classification	C, NSW			
Dominant Stream Classification (existing)	E4/F4	F4	E4/F4	F4
Dominant Stream Classification (proposed)	C4			
Dominant Evolutionary Classification (Simon) if applicable	Stage III: Degradation			
Wetland Summary Information				
Parameters	**Re-establishment**		**Rehabilitation**	
Pre-project area (acres)	N/A		3.819	
Post-project area (acres)	4.721		3.819	
Wetland Type (non-riparian, riparian)	Riparian		Riparian	
Mapped Soil Series	CmB - Cid-Lignum complex, 2-6% slopes			
Soil Hydric Status	Predominatly Non-Hydric			
Regulatory Considerations				
Regulation	**Applicable?**	**Resolved?**	**Supporting Docs?**	
Waters of the United States - Section 404	Yes	Yes	USACE Nationwide Permit No. 27 and DWQ 401 Water Quality Certification No. 4134.	
Waters 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			
Essential Fisheries Habitat	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 2: Goals, Performance Criteria, and Functional Improvements.

2.1 Vegetative Assessment

The MY1 vegetative survey was completed in August 2021. Vegetation monitoring resulted in a stem density range of 445 to 769 planted stems per acre which is well above the interim requirement of 320 stems per acre required at MY3. Average stem density was 598 planted stems per acre. All 13 vegetation plots met the interim success criteria and are on track to meet the final success criteria required for MY7. Refer to Appendix A for Vegetation Plot Photographs and the Vegetation Condition Assessment Table and Appendix B for Vegetation Plot Data.

2.2 Vegetation Areas of Concern

No vegetative areas of concern were identified during MY1.

2.3 Stream Assessment

Morphological surveys for MY1 were conducted in May 2021. All streams within the Site are stable and functioning as designed. All 8 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. Substrate measurements indicate the maintenance of coarser materials in the riffle reaches and finer particles in the pools. 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

No Stream areas of concern were identified during MY1.

2.5 Hydrology Assessment

At the end of MY7, four or more bankfull events must have occurred in separate years within the restoration reaches. Sandy Branch had multiple bankfull events in MY1 resulting in partial attainment of the stream hydrology assessment criteria. Refer to Appendix D for hydrologic data.

2.6 Wetland Assessment

The performance criteria for wetland hydrology is groundwater within 12 inches of the ground surface for 10.0% (27 days) of the growing season consecutively. The estimated growing season is March 1st-November 17th. These dates were determined using the NRCS WETS tables, soil temperature data from the on-site soil temperature probe, and bud burst observations of *Salix nigra* on February 23, 2021. Of the twelve groundwater monitoring wells on the Site, 9 wells met the success criteria during MY1. The nine wells that met were all well above the success criteria of 27 days, all meeting with 37-62 days consecutively. Wells 2 and 6 missed with a hydroperiod of 7.6% (20 days) and Groundwater Well 3 missed with a hydroperiod of 7.3% (19 days). After construction of the stream channel it is anticipated that the groundwater table will take some time to recharge. Refer to Figure 1 for the groundwater gauge locations and Appendix D for groundwater hydrology data and plots.

2.7 Adaptive Management Plan

No adaptive management plans are needed at this time.

2.8 Monitoring Year 1 Summary

All vegetation plots are on track to exceed the MY3 interim requirement of 320 planted stems per acre. Vegetative cover has become well established and planted tree species are showing positive trends in both density and vigor. Herbaceous growth is flourishing across the site and is providing effective ground coverage to filter incoming runoff and nutrients. All project streams are stable and functioning as designed. The nine groundwater gauges that met were well above the success criteria and showed groundwater within the upper twelve inches for 14.1 to 23.7% (37-62 days) of the growing season consecutively.

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 Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 4: REFERENCES

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North Carolina Interagency Review Team. 2016. Wilmington District Stream and Wetland Compensatory

Mitigation Update. Accessed at: https://saw-reg.usace.army.mil/PN/2016/Wilmington-District-Mitigation-Update.pdf

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Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

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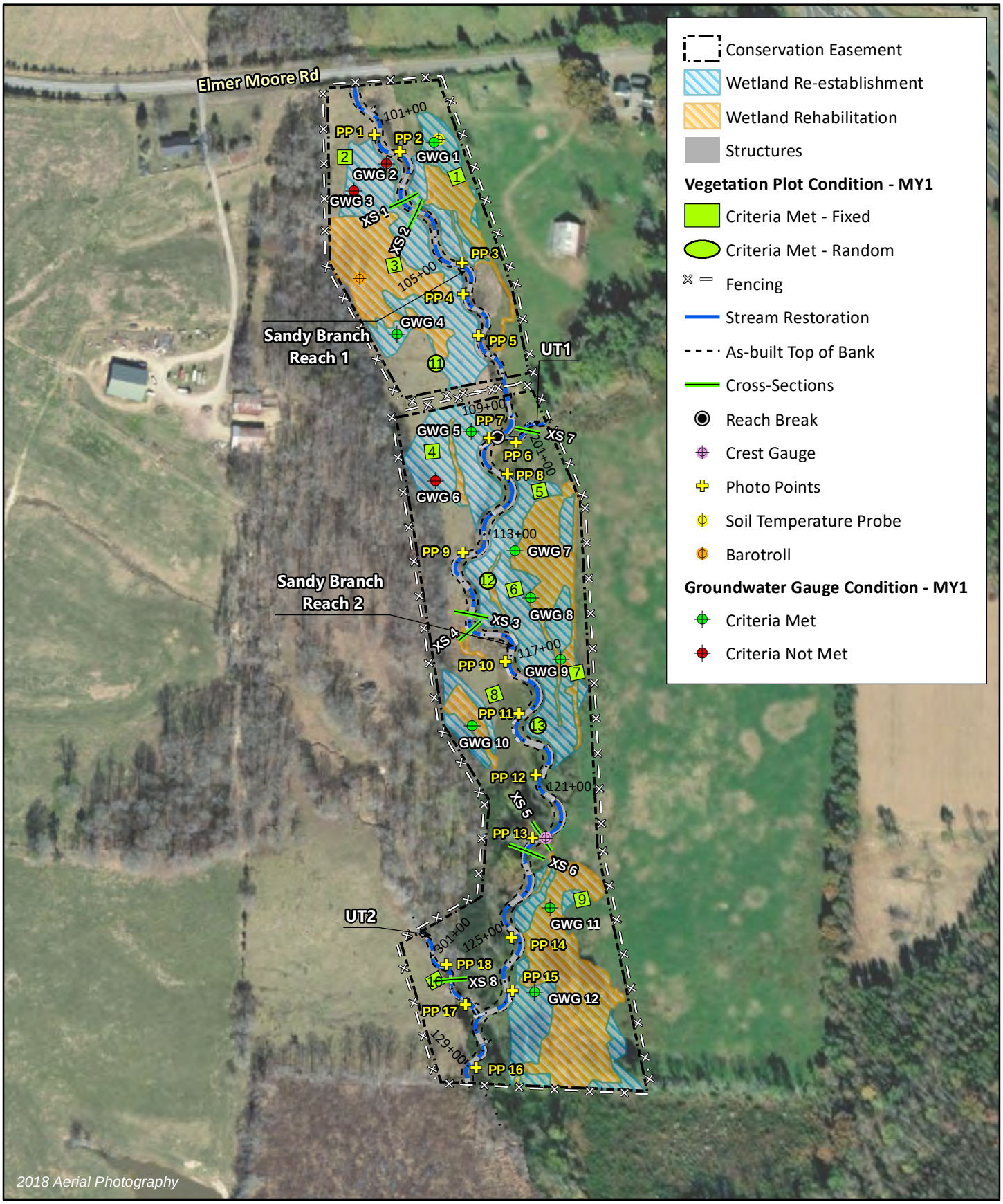

WILDLANDS ENGINEERING

0 150 300 Feet

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Figure 1 - Current Condition Plan View
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021
Chatham County, NC

APPENDIX A. Visual Assessment Data

Table 4. Visual Stream Morphology Stability Assessment Table

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Sandy Branch Reach 1

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	953
					Assessed Bank Length	1,906
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.	13	13		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	8	8		0%

Sandy Branch Reach 2

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	1,919
					Assessed Bank Length	3,838
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.	24	24		100%
	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

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

UT1

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	125
					Assessed Bank Length	250
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.	4	4		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	2	2		100%

UT2

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	254
					Assessed Bank Length	508
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.	6	6		100%
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	1	1		100%

Table 5. Vegetation Condition Assessment Table
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Planted Acreage **15.87**

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 **20.72**

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	0	0%
Easement Encroachment Areas	Encroachment may be point, line, or polygon. Encroachment to be mapped consists of any violation of restrictions specified in the conservation easement. Common encroachments are mowing, cattle access, vehicular access. Encroachment has no threshold value as will need to be addressed regardless of impact area.	none	0 Encroachments Noted / 0 ac	

STREAM AND CULVERT CROSSING PHOTOGRAPHS

PHOTO POINT 1 Sandy Branch R1 – upstream *(5/20/2021)*

PHOTO POINT 1 Sandy Branch R1 – downstream *(5/20/2021)*

PHOTO POINT 2 Sandy Branch R1 – upstream *(5/20/2021)*

PHOTO POINT 2 Sandy Branch R1 – downstream *(5/20/2021)*

PHOTO POINT 3 Sandy Branch R1 – upstream *(5/20/2021)*

PHOTO POINT 3 Sandy Branch R1 – downstream *(5/20/2021)*

PHOTO POINT 4 Sandy Branch R1 – upstream *(5/20/2021)*

PHOTO POINT 4 Sandy Branch R1 – downstream *(5/20/2021)*

PHOTO POINT 5 Sandy Branch R1 – upstream *(5/20/2021)*

PHOTO POINT 5 Sandy Branch R1 – downstream *(5/20/2021)*

PHOTO POINT 6 UT1 – upstream *(5/20/2021)*

PHOTO POINT 6 UT1 – downstream *(5/20/2021)*

	
PHOTO POINT 7 Sandy Branch R2 – upstream *(5/20/2021)*	**PHOTO POINT 7 Sandy Branch R2 –** downstream *(5/20/2021)*
	
PHOTO POINT 8 Sandy Branch R2 – upstream *(5/20/2021)*	**PHOTO POINT 8 Sandy Branch R2 –** downstream *(5/20/2021)*
	
PHOTO POINT 9 Sandy Branch R2 – upstream *(5/20/2021)*	**PHOTO POINT 9 Sandy Branch R2 –** downstream *(5/20/2021)*

PHOTO POINT 10 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 10 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 11 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 11 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 12 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 12 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 13 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 13 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 14 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 14 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 15 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 15 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 16 Sandy Branch R2 – upstream *(5/20/2021)*

PHOTO POINT 16 Sandy Branch R2 – downstream *(5/20/2021)*

PHOTO POINT 17 UT2 – upstream *(5/20/2021)*

PHOTO POINT 17 UT2 – downstream *(5/20/2021)*

PHOTO POINT 18 UT2 – upstream *(5/20/2021)*

PHOTO POINT 18 UT2 – downstream *(5/20/2021)*

	
CULVERT CROSSING Sandy Branch R1 – upstream *(11/19/2021)*	**CULVERT CROSSING Sandy Branch R1 –** downstream *(11/19/2021)*

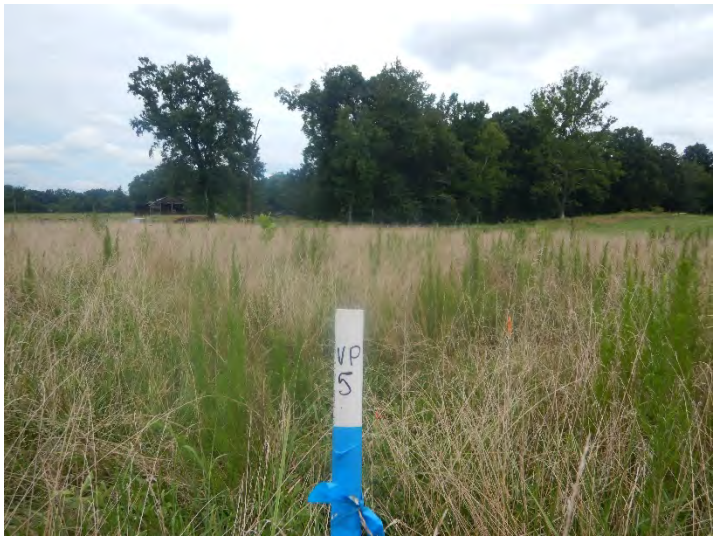
VEGETATION PLOT PHOTOGRAPHS

FIXED VEG PLOT 1 *(08/06/2021)*

FIXED VEG PLOT 2 *(08/06/2021)*

FIXED VEG PLOT 3 *(08/06/2021)*

FIXED VEG PLOT 4 *(08/06/2021)*

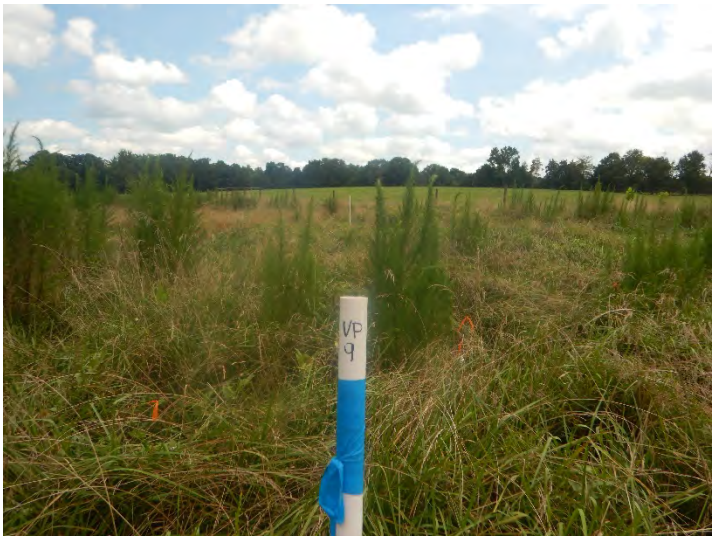


FIXED VEG PLOT 5 *(08/06/2021)*

FIXED VEG PLOT 6 *(08/06/2021)*

FIXED VEG PLOT 7 *(08/06/2021)*

FIXED VEG PLOT 8 *(08/06/2021)*



FIXED VEG PLOT 9 *(08/06/2021)*

FIXED VEG PLOT 10 *(08/06/2021)*

RANDOM VEG PLOT 11 *(08/06/2021)*

RANDOM VEG PLOT 12 *(08/06/2021)*

RANDOM VEG PLOT 13 *(08/06/2021)*

GROUNDWATER WELL PHOTOGRAPHS

GROUNDWATER WELL 1 ***(11/19/2021)***

GROUNDWATER WELL 2 ***(11/19/2021)***

GROUNDWATER WELL 3 ***(11/19/2021)***

GROUNDWATER WELL 4 ***(11/19/2021)***

GROUNDWATER WELL 5 ***(11/19/2021)***

GROUNDWATER WELL 6 ***(11/19/2021)***

GROUNDWATER WELL 7 *(11/19/2021)*

GROUNDWATER WELL 8 *(11/19/2021)*

GROUNDWATER WELL 9 *(11/19/2021)*

GROUNDWATER WELL 10 *(11/19/2021)*

GROUNDWATER WELL 11 *(11/19/2021)*

GROUNDWATER WELL 12 *(11/19/2021)*

APPENDIX B. Vegetation Plot Data

Table 6. Vegetation Performace Standards Summary Table

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

Plot	Success Criteria Met *	Tract Mean
Fixed Vegetation Plot 1	Yes	100%
Fixed Vegetation Plot 2	Yes	
Fixed Vegetation Plot 3	Yes	
Fixed Vegetation Plot 4	Yes	
Fixed Vegetation Plot 5	Yes	
Fixed Vegetation Plot 6	Yes	
Fixed Vegetation Plot 7	Yes	
Fixed Vegetation Plot 8	Yes	
Fixed Vegetation Plot 9	Yes	
Fixed Vegetation Plot 10	Yes	
Random Vegetation Plot 11	Yes	
Random Vegetation Plot 12	Yes	
Random Vegetation Plot 13	Yes	

*Success Criteria Met is based on the interim success criteria for MY3 of 320 planted stems per acre.

Table 7a. Fixed Plots: Planted and Total Stem Counts
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

			Current Plot Data (MY1 2021)																	
			VP 1			VP 2			VP 3			VP 4			VP 5			VP 6		
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**
Acer negundo	Boxelder	Tree	1	1	1				1	1	1				1	1	1	1	1	1
Betula nigra	River Birch	Tree	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4
Celtis laevigata	Sugarberry	Shrub Tree	1	1	1										1	1	1	1	1	1
Diospyros virginiana	Persimmon	Tree	1	1	1							2	2	2				1	1	1
Platanus occidentalis	Sycamore	Tree	2	2	2	4	4	4	1	1	1	3	3	3	2	2	2	3	3	3
Quercus michauxii	Swamp Chestnut Oak	Tree	2	2	2	4	4	4	3	3	3	1	1	1	4	4	4	3	3	3
Quercus nigra	Water Oak	Tree	1	1	1	1	1	1							1	1	1	2	2	2
Quercus pagoda	Cherrybark Oak	Tree	2	2	2				2	2	2				1	1	1			
Quercus phellos	Willow Oak	Tree				3	3	3	2	2	2				4	4	4			
Quercus shumardii	Shumard Oak	Tree																		
Salix nigra	Black Willow	Tree	1	1	1				1	1	1	1	1	1						
Ulmus rubra	Slippery Elm	Tree				1	1	1				2	2	2						
		Stem count	14	14	14	15	15	15	12	12	12	11	11	11	16	16	16	15	15	15
		size (ares)	1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	9	9	9	6	6	6	7	7	7	6	6	6	8	8	8	7	7	7
		Stems per ACRE	567	567	567	607	607	607	486	486	486	445	445	445	647	647	647	607	607	607

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%

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems

Table 7a. Fixed Plots: Planted and Total Stem Counts

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

			Current Plot Data (MY1 2021)												Annual Means					
			VP 7			VP 8			VP 9			VP 10			MY1 (2021)			MY0 (2021)		
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**
Acer negundo	Boxelder	Tree				1	1	1	1	1	1	1	1	1	7	7	7	7	7	7
Betula nigra	River Birch	Tree	2	2	2	3	3	3	3	3	3	3	3	3	26	26	26	26	26	26
Celtis laevigata	Sugarberry	Shrub Tree	1	1	1										4	4	4	5	5	5
Diospyros virginiana	Persimmon	Tree							2	2	2				6	6	6	6	6	6
Platanus occidentalis	Sycamore	Tree	2	2	2	2	2	2	3	3	3	2	2	2	24	24	24	24	24	24
Quercus michauxii	Swamp Chestnut Oak	Tree	1	1	1	2	2	2	2	2	2	1	1	1	23	23	23	23	23	23
Quercus nigra	Water Oak	Tree	2	2	2	1	1	1							8	8	8	9	9	9
Quercus pagoda	Cherrybark Oak	Tree	1	1	1				2	2	2				8	8	8	8	8	8
Quercus phellos	Willow Oak	Tree	4	4	4	2	2	2	1	1	1	4	4	4	20	20	20	21	21	21
Quercus shumardii	Shumard Oak	Tree										2	2	2	2	2	2	3	3	3
Salix nigra	Black Willow	Tree													3	3	3	3	3	3
Ulmus rubra	Slippery Elm	Tree	1	1	1	3	3	3	1	1	1	2	2	2	10	10	10	11	11	11
		Stem count	14	14	14	14	14	14	15	15	15	15	15	15	141	141	141	146	146	146
		size (ares)	1			1			1			1			10			10		
		size (ACRES)	0.02			0.02			0.02			0.02			0.25			0.25		
		Species count	8	8	8	7	7	7	8	8	8	7	7	7	12	12	12	12	12	12
		Stems per ACRE	567	567	567	567	567	567	607	607	607	607	607	607	571	571	571	591	591	591

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%

PnoLS - Planted Stems Excluding Live Stakes

P-all - All Planted Stems

T - All Woody Stems

Table 7b. Random Plots: Planted and Total Stem Counts
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

			Current Plot Data (MY1 2021)						Annual Means			
			VP 11		VP 12		VP 13		MY1 (2021)		MY0 (2021)	
Scientific Name	**Common Name**	**Species Type**	**Te**	**Total**	**Te**	**Total**	**Te**	**Total**	**Te**	**Total**	**Te**	**Total**
Acer negundo	Boxelder	Tree									2	2
Betula nigra	River Birch	Tree	2	2	2	2	2	2	6	6	12	12
Celtis laegivata	Sugarberry	Shrub Tree					1	1	1	1		
Diospyros virginiana	Common Persimmon	Tree			7	7			7	7		
Platanus occidentalis	Sycamore	Tree	6	6	3	3	3	3	12	12	8	8
Quercus michauxii	Swamp Chestnut Oak	Tree	4	4	2	2	2	2	8	8	6	6
Quercus nigra	Water Oak	Tree	3	3			1	1	4	4	2	2
Quercus pagoda	Cherrybark Oak	Tree					6	6	6	6		
Quercus phellos	Willow Oak	Tree	1	1			1	1	2	2	6	6
Quercus shumardii	Shumard Oak	Tree									1	1
Salix nigra	Black Willow	Tree	1	1					1	1		
Ulmus rubra	Slippery Elm	Tree	2	2			1	1	3	3	1	1
		Stem count	19	19	14	14	17	17	50	50	38	38
		size (ares)	1		1		1		3		3	
		size (ACRES)	0.02		0.02		0.02		0.07		0.07	
		Species count	7	7	4	4	8	8	10	10	8	8
		Stems per ACRE	769	769	567	567	688	688	674	674	513	513

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%

Te - Number of stems including exotic species

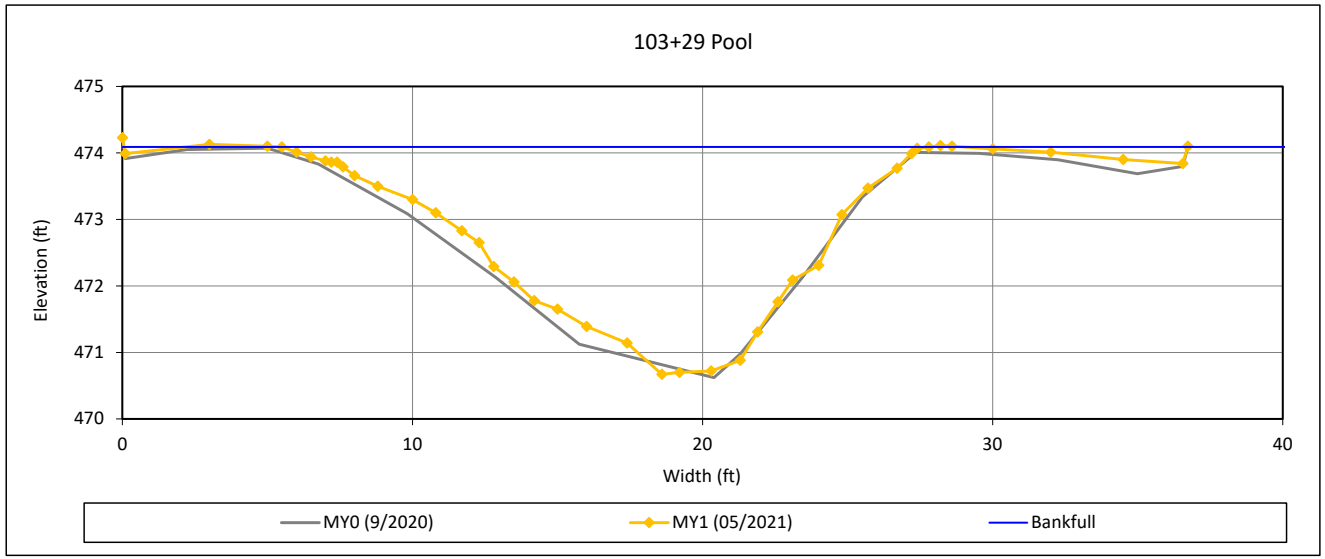
Total - Number of stems excluding exotic species

APPENDIX C. Stream Geomorphology Data

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 1 - Sandy Branch R1



Bankfull Dimensions	
38.0	x-section area (ft.sq.)
21.8	width (ft)
1.7	mean depth (ft)
3.4	max depth (ft)
23.2	wetted perimeter (ft)
1.6	hydraulic radius (ft)
12.5	width-depth ratio

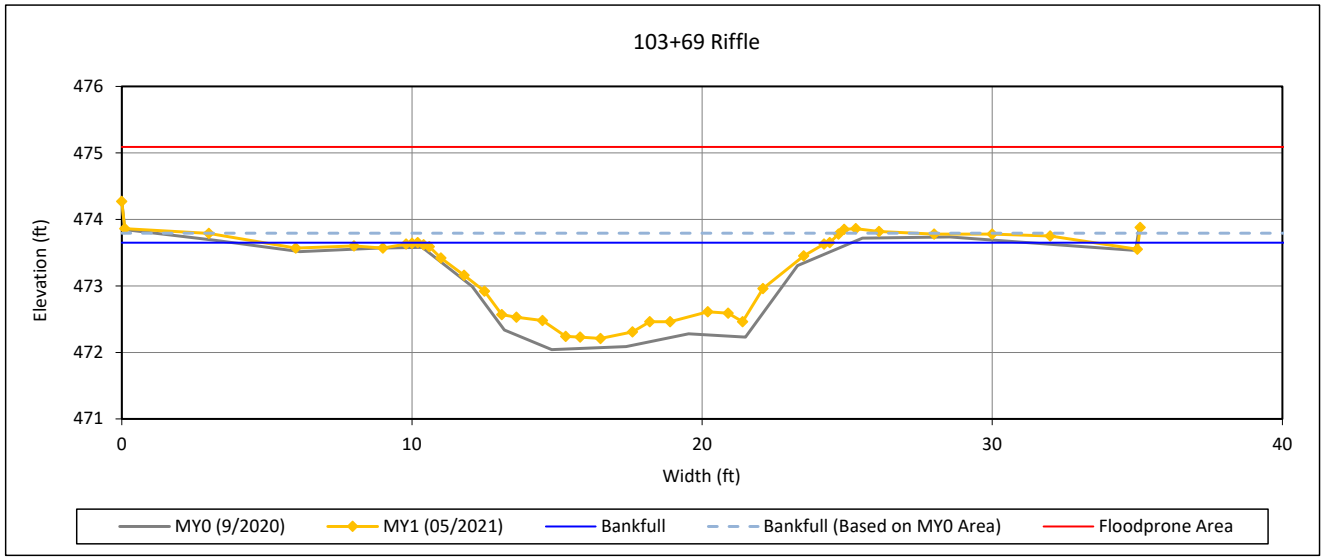
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 2 - Sandy Branch R1



Bankfull Dimensions	
12.9	x-section area (ft.sq.)
14.2	width (ft)
0.9	mean depth (ft)
1.4	max depth (ft)
14.8	wetted perimeter (ft)
0.9	hydraulic radius (ft)
15.7	width-depth ratio
100.0	W flood prone area (ft)
7.0	entrenchment ratio
< 1.0	low bank height ratio

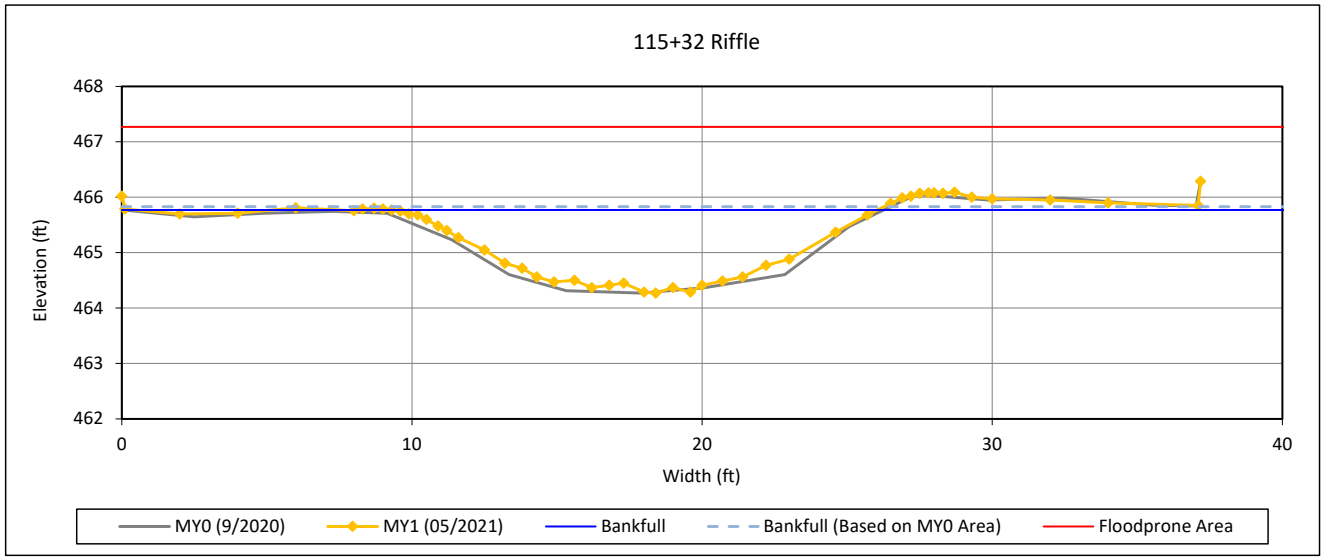
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 3 - Sandy Branch R2



Bankfull Dimensions	
15.3	x-section area (ft.sq.)
16.7	width (ft)
0.9	mean depth (ft)
1.5	max depth (ft)
17.2	wetted perimeter (ft)
0.9	hydraulic radius (ft)
18.3	width-depth ratio
70.0	W flood prone area (ft)
4.2	entrenchment ratio
1.0	low bank height ratio

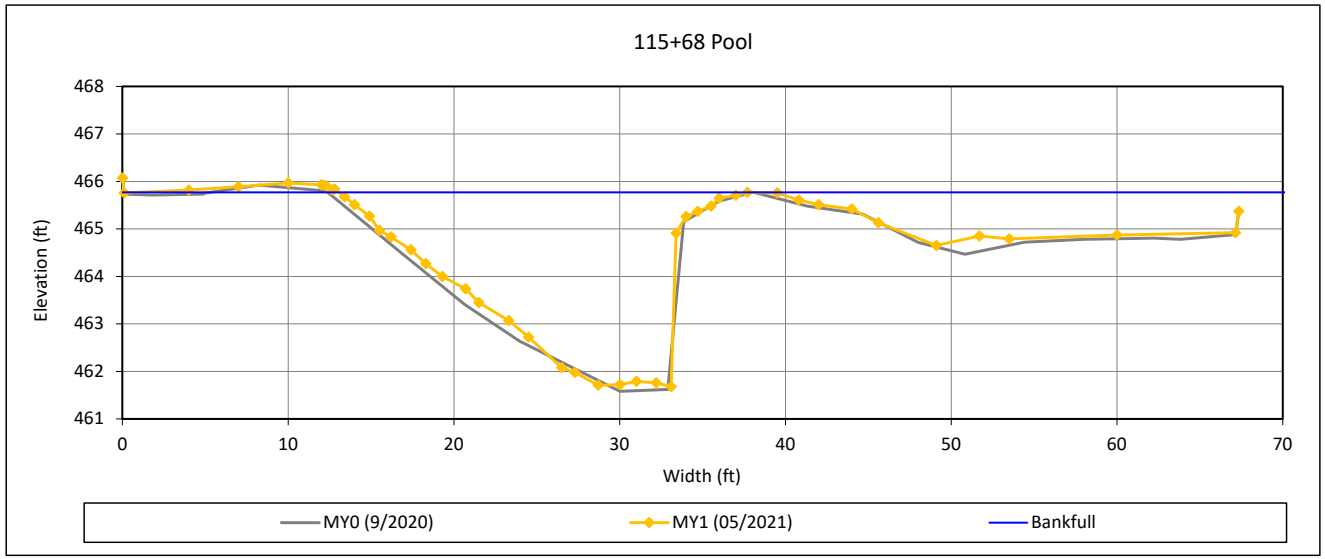
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 4 - Sandy Branch R2



Bankfull Dimensions	
52.9	x-section area (ft.sq.)
24.6	width (ft)
2.1	mean depth (ft)
4.1	max depth (ft)
28.3	wetted perimeter (ft)
1.9	hydraulic radius (ft)
11.5	width-depth ratio

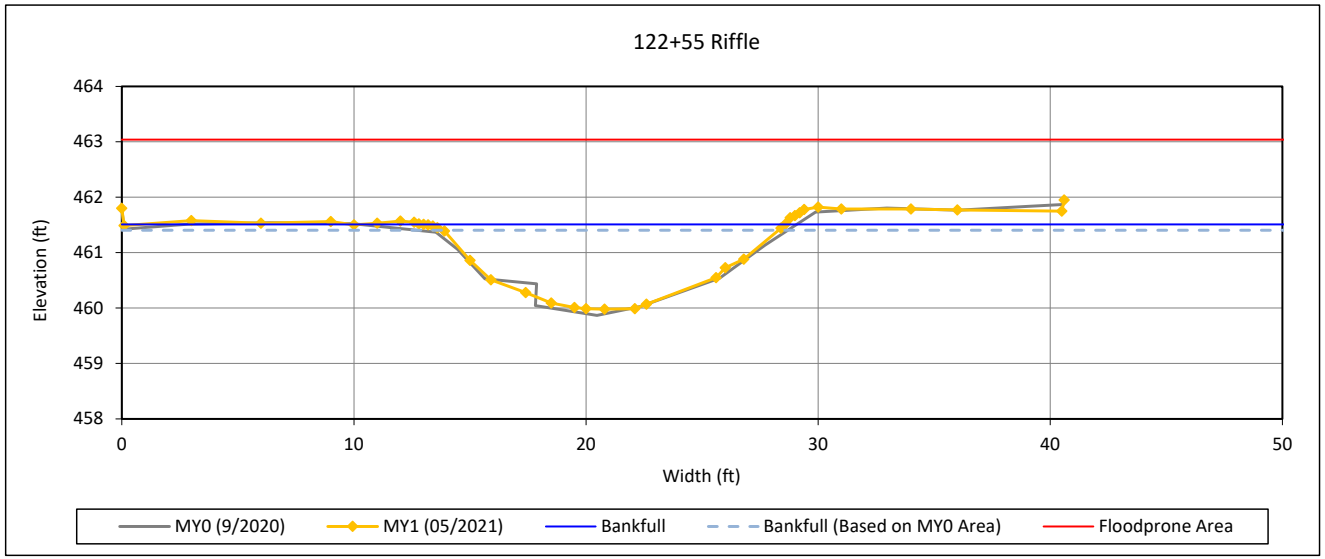
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 5 - Sandy Branch R2



Bankfull Dimensions	
15.6	x-section area (ft.sq.)
15.6	width (ft)
1.0	mean depth (ft)
1.5	max depth (ft)
16.0	wetted perimeter (ft)
1.0	hydraulic radius (ft)
15.6	width-depth ratio
80.0	W flood prone area (ft)
5.1	entrenchment ratio
1.1	low bank height ratio

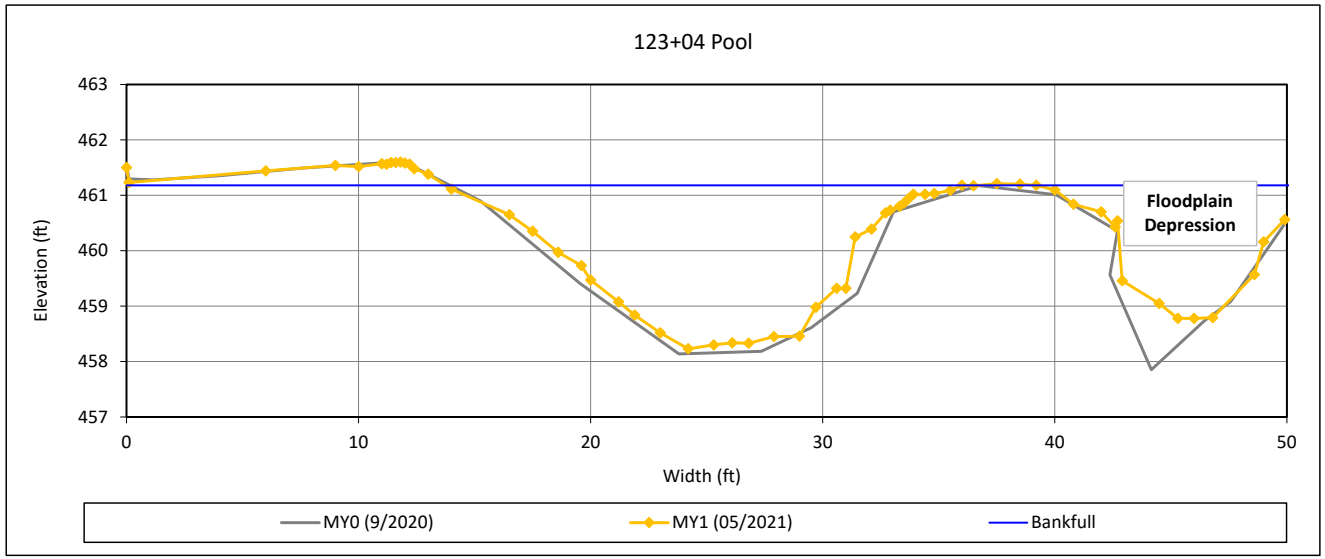
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 6 - Sandy Branch R2



Bankfull Dimensions	
34.5	x-section area (ft.sq.)
22.3	width (ft)
1.6	mean depth (ft)
3.0	max depth (ft)
23.7	wetted perimeter (ft)
1.5	hydraulic radius (ft)
14.3	width-depth ratio

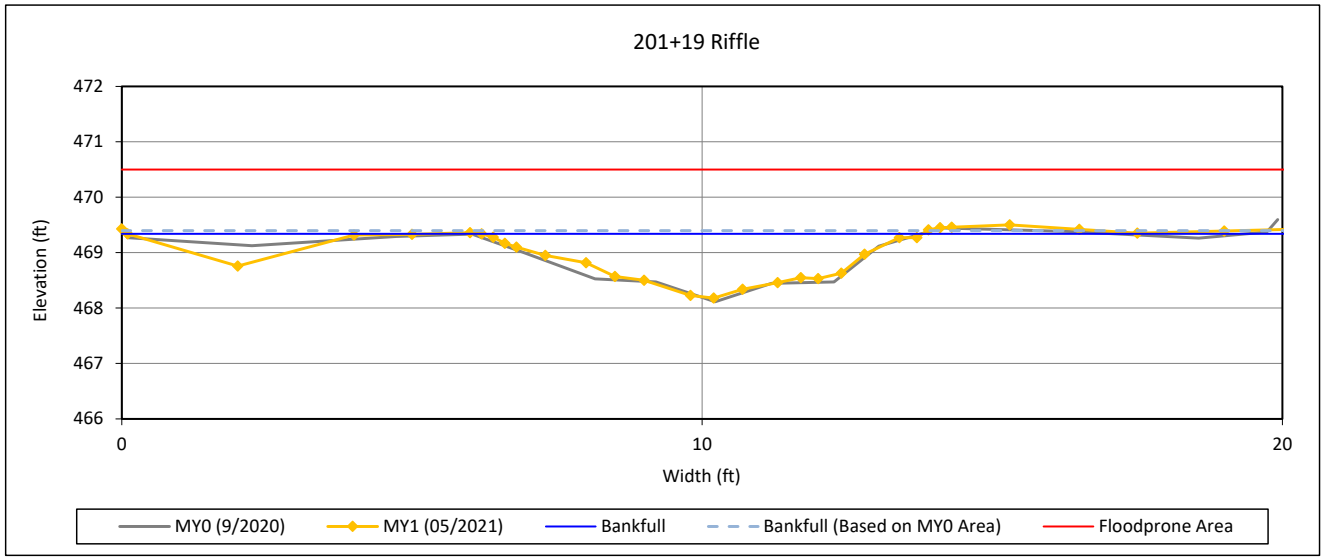
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 7 - UT1



Bankfull Dimensions	
4.9	x-section area (ft.sq.)
7.6	width (ft)
0.6	mean depth (ft)
1.2	max depth (ft)
8.1	wetted perimeter (ft)
0.6	hydraulic radius (ft)
11.9	width-depth ratio
55.0	W flood prone area (ft)
7.2	entrenchment ratio
1.0	low bank height ratio

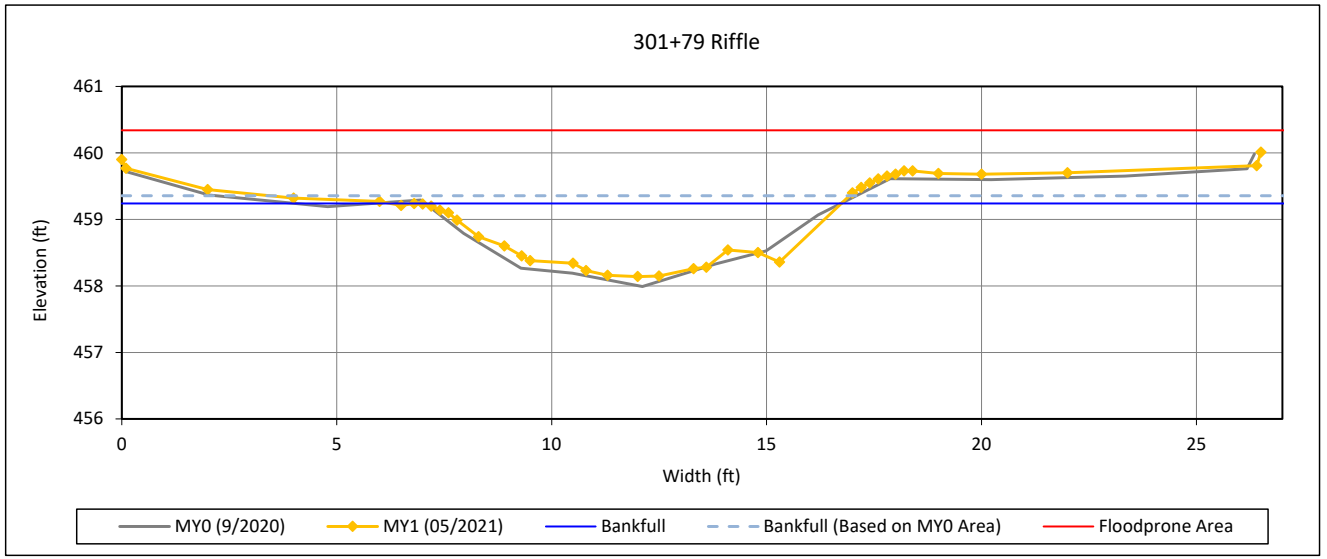
Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Cross-Section Plots

Sandy Branch Mitigation Site
DMS Project No. 100061
Monitoring Year 1 - 2021

Cross-Section 8 - UT2



Bankfull Dimensions	
7.1	x-section area (ft.sq.)
9.9	width (ft)
0.7	mean depth (ft)
1.1	max depth (ft)
10.5	wetted perimeter (ft)
0.7	hydraulic radius (ft)
13.8	width-depth ratio
80.0	W flood prone area (ft)
8.0	entrenchment ratio
< 1.0	low bank height ratio

Survey Date: 05/2021
Field Crew: Wildlands Engineering

View Downstream

Table 8. Baseline Stream Data Summary

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**Sandy Branch R1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	6.6		1	14.0		14.4		1
Floodprone Width (ft)	>60		1	>30.8		100		1
Bankfull Mean Depth	1		1	0.9		1		1
Bankfull Max Depth	1.6		1	1.3		1.5		1
Bankfull Cross Sectional Area (ft^2)	6.6		1	13.2		14.9		1
Width/Depth Ratio	6.5		1	14.8		13.9		1
Entrenchment Ratio	>9.1		1	>2.20		6.9		1
Bank Height Ratio	1.0		1	1.00	1.20	1.0		1
Max part size (mm) mobilized at bankfull	87			88		82.7		
Rosgen Classification	E4/F4			C4		C4		
Bankfull Discharge (cfs)	22			44.0		51		
Sinuosity	1.10			1.16		1.16		
Water Surface Slope ($ft/ft)^2$	0.0100	0.0140	---	0.002	0.011	0.007		
Other	---			---		---		
Parameter	**Sandy Branch R2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	7.3	11	3	16.0		15.0	16.9	2
Floodprone Width (ft)	11.0	40	3	>35.2		70	80	2
Bankfull Mean Depth	1.2	1.6	3	1.1		0.9	1.0	2
Bankfull Max Depth	1.7	2.1	3	1.5		1.4	1.5	2
Bankfull Cross Sectional Area (ft^2)	9.1	14.0	3	17.5		14.0	16.3	2
Width/Depth Ratio	4.7	8.4	3	14.6		16.2	17.5	2
Entrenchment Ratio	1.5	3.7	3	>2.20		4.1	5.3	2
Bank Height Ratio	1.8	2.4	3	1.0	1.2	1.0	1.0	2
Max part size (mm) mobilized at bankfull	---			---		68.3		
Rosgen Classification	F4			C4		C4		
Bankfull Discharge (cfs)	29	39	---	51.0	58.0	53	57	2
Sinuosity	1.20			1.27		1.27		
Water Surface Slope ($ft/ft)^2$	0.0041	0.0090	---	0.004	0.024	0.006		
Other	---			---		---		

Table 8. Baseline Stream Data Summary

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

	PRE-EXISTING CONDITIONS			DESIGN		MONITORING BASELINE (MY0)		
Parameter	**UT1**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	3.3		1	7.0		7.7		1
Floodprone Width (ft)	12		1	>15.4		55.0		1
Bankfull Mean Depth	0.63		1	0.6		0.7		1
Bankfull Max Depth	1.2		1	0.8		1.2		1
Bankfull Cross Sectional Area (ft^2)	2.1		1	4.0		5.3		1
Width/Depth Ratio	5.2		1	12.3		11.3		1
Entrenchment Ratio	3.7		1	>2.20		7.1		1
Bank Height Ratio	2.9		1	1.0	1.2	1.0		
Max part size (mm) mobilized at bankfull	---			---		62.6		
Rosgen Classification	E4/F4			C4		C4		
Bankfull Discharge (cfs)	7.7			9.0		13		
Sinuosity	1.10			1.14		1.14		
Water Surface Slope ($ft/ft)^2$	0.0270		---	0.003	0.020	0.008		
Other	---			---		---		
Parameter	**UT2**							
Riffle Only	**Min**	**Max**	**n**	**Min**	**Max**	**Min**	**Max**	**n**
Bankfull Width (ft)	2.9		1	9.0		9.9		1
Floodprone Width (ft)	6		1	>19.8		80.0		1
Bankfull Mean Depth	1.4		1	0.7		0.8		1
Bankfull Max Depth	1.7		1	1.0		1.3		1
Bankfull Cross Sectional Area (ft^2)	4.1		1	6.5		8.1		1
Width/Depth Ratio	2.1		1	12.5		12.2		1
Entrenchment Ratio	2.2		1	>2.20		8.1		1
Bank Height Ratio	2.5		1	1.0	1.2	1.0		
Max part size (mm) mobilized at bankfull	---			---		77.4		
Rosgen Classification	F4			C4		C4		
Bankfull Discharge (cfs)	15			16.0		27		
Sinuosity	1.10			1.09		1.09		
Water Surface Slope ($ft/ft)^2$	0.0084	0.0140	---	0.004	0.025	0.008		
Other	---			---		---		

Table 9. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

	Sandy Branch Reach 1												Sandy Branch Reach 2											
	Cross-Section 1 (Pool)						Cross-Section 2 (Riffle)						Cross-Section 3 (Riffle)						Cross-Section 4 (Pool)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	N/A	N/A					473.58	473.79					465.71	465.83					N/A	N/A				
Bank Height Ratio - Based on AB Bankfull[1] Area	N/A	N/A					1.00	0.91					1.00	0.96					N/A	N/A				
Thalweg Elevation	470.62	470.67					472.04	472.21					464.27	464.29					461.58	461.68				
LTOB[2] Elevation	474.01	474.09					473.58	473.65					465.71	465.77					465.78	465.77				
LTOB[2] Max Depth (ft)	3.4	3.4					1.5	1.4					1.4	1.5					4.2	4.1				
LTOB[2] Cross Sectional Area (ft^2)	38.9	38.0					14.9	12.9					16.3	15.3					56.7	52.9				
	Sandy Branch Reach 2												UT1						UT2					
	Cross-Section 5 (Riffle)						Cross-Section 6 (Pool)						Cross-Section 7 (Riffle)						Cross-Section 8 (Riffle)					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY5**	**MY7**
Bankfull Elevation (ft) - Based on AB-Bankfull[1] Area	461.37	461.40					N/A	N/A					469.34	469.40					459.29	459.36				
Bank Height Ratio - Based on AB Bankfull[1] Area	1.00	1.07					N/A	N/A					1.00	0.95					1.00	0.90				
Thalweg Elevation	459.87	459.99					458.14	458.23					468.11	468.18					457.99	458.14				
LTOB[2] Elevation	461.37	461.51					461.17	461.18					469.34	469.34					459.29	459.24				
LTOB[2] Max Depth (ft)	1.5	1.5					3.3	3.0					1.2	1.2					1.3	1.1				
LTOB[2] Cross Sectional Area (ft^2)	14.0	15.6					38.6	34.5					5.3	4.9					8.1	7.1				

[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.

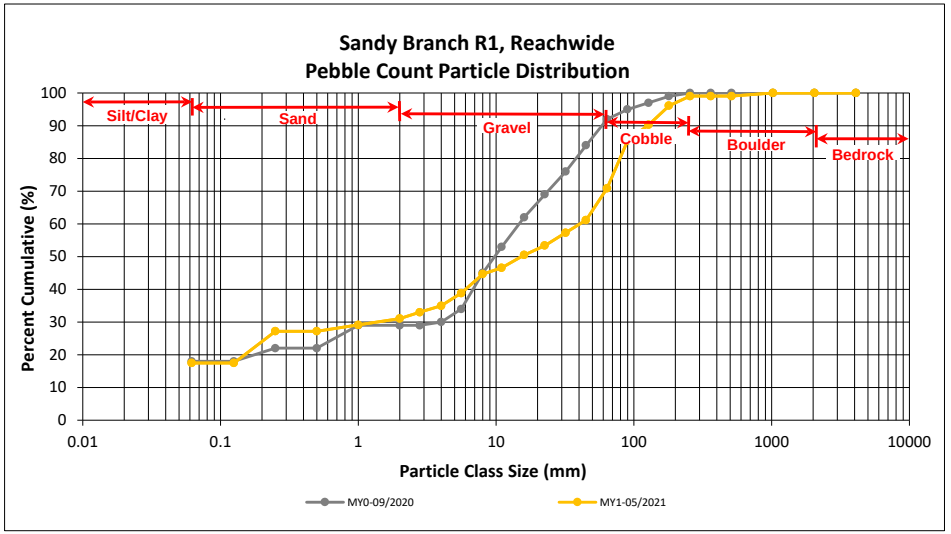
Reachwide Pebble Count Plots

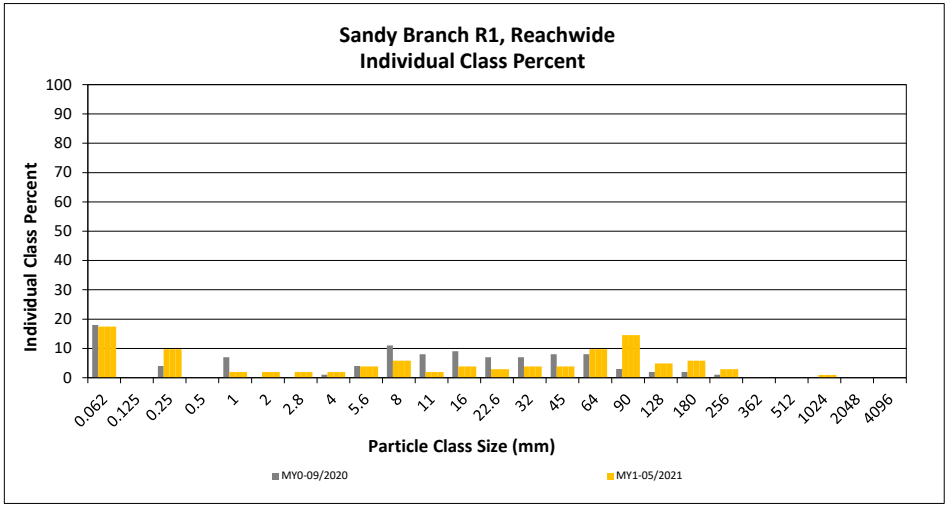
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Sandy Branch R1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	2	16	18	17	17
SAND	Very fine	0.062	0.125					17
	Fine	0.125	0.250		10	10	10	27
	Medium	0.25	0.50					27
	Coarse	0.5	1.0		2	2	2	29
	Very Coarse	1.0	2.0		2	2	2	31
GRAVEL	Very Fine	2.0	2.8		2	2	2	33
	Very Fine	2.8	4.0		2	2	2	35
	Fine	4.0	5.6		4	4	4	39
	Fine	5.6	8.0		6	6	6	45
	Medium	8.0	11.0	1	1	2	2	47
	Medium	11.0	16.0		3	3	4	50
	Coarse	16.0	22.6	2	1	3	3	53
	Coarse	22.6	32	4		4	4	57
	Very Coarse	32	45	3	1	4	4	61
	Very Coarse	45	64	8		8	10	71
COBBLE	Small	64	90	15		15	15	85
	Small	90	128	5		5	5	90
	Large	128	180	6		6	6	96
	Large	180	256	3		3	3	99
BOULDER	Small	256	362					99
	Small	362	512					99
	Medium	512	1024	1		1	1	100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	4.02
D_{50} =	15.3
D_{84} =	87.0
D_{95} =	168.6
D_{100} =	1024.0





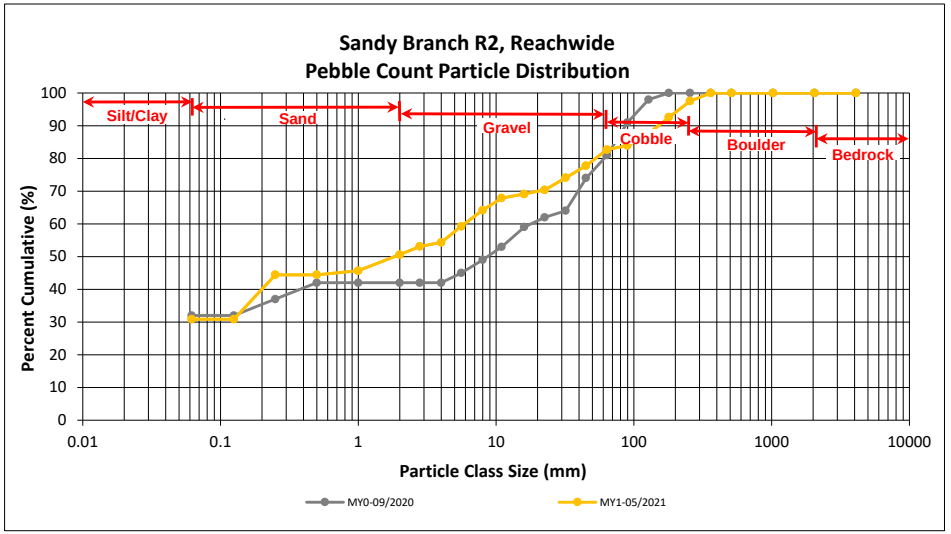
Reachwide Pebble Count Plots

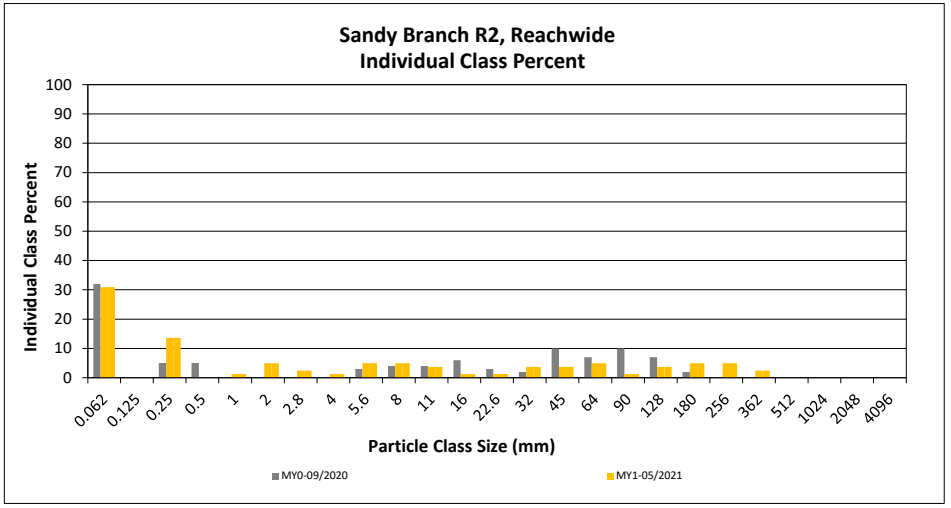
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Sandy Branch R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	24	28	31	31
SAND	Very fine	0.062	0.125					31
	Fine	0.125	0.250	4	8	12	14	44
	Medium	0.25	0.50					44
	Coarse	0.5	1.0	1		1	1	46
	Very Coarse	1.0	2.0		6	6	5	51
GRAVEL	Very Fine	2.0	2.8		4	4	2	53
	Very Fine	2.8	4.0		2	2	1	54
	Fine	4.0	5.6	1	3	4	5	59
	Fine	5.6	8.0	3	2	5	5	64
	Medium	8.0	11.0	2	1	3	4	68
	Medium	11.0	16.0	1		1	1	69
	Coarse	16.0	22.6	5		5	1	70
	Coarse	22.6	32	3		3	4	74
	Very Coarse	32	45	3		3	4	78
	Very Coarse	45	64	5		5	5	83
COBBLE	Small	64	90	4		4	1	84
	Small	90	128	3		3	4	88
	Large	128	180	4		4	5	93
	Large	180	256	4		4	5	98
BOULDER	Small	256	362	3		3	2	100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.15
D_{50} =	1.8
D_{84} =	90.4
D_{95} =	213.7
D_{100} =	362.0





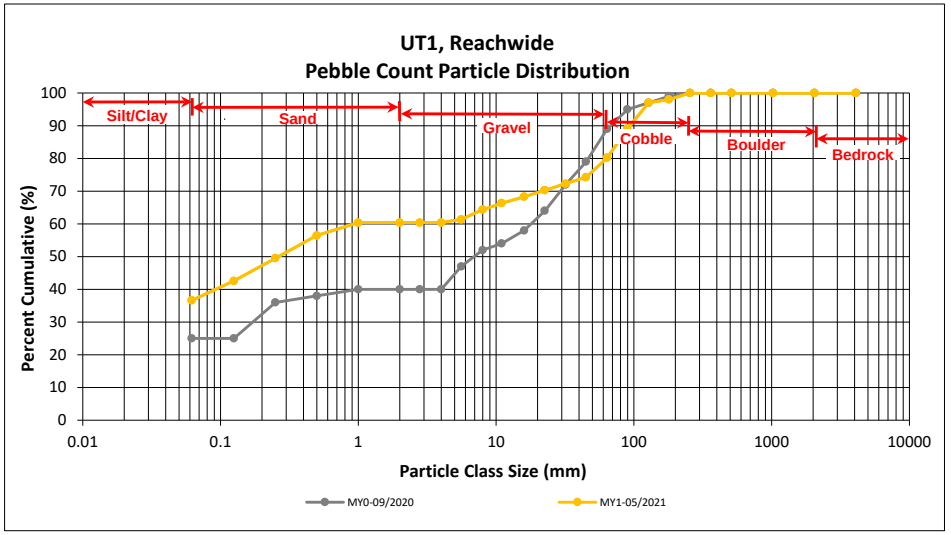
Reachwide Pebble Count Plots

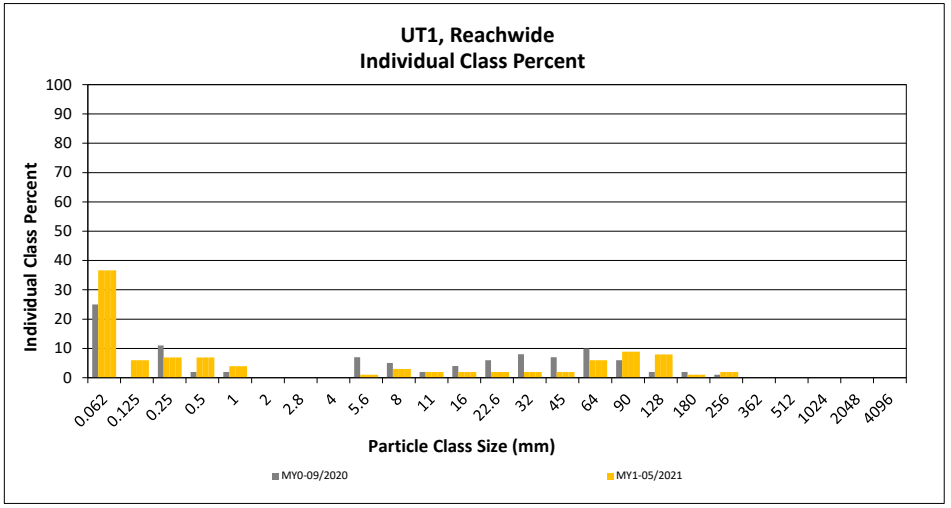
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

UT1, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	7	30	37	37	37
SAND	Very fine	0.062	0.125	3	3	6	6	43
	Fine	0.125	0.250	2	5	7	7	50
	Medium	0.25	0.50		8	8	7	56
	Coarse	0.5	1.0		4	4	4	60
	Very Coarse	1.0	2.0					60
GRAVEL	Very Fine	2.0	2.8					60
	Very Fine	2.8	4.0					60
	Fine	4.0	5.6	1		1	1	61
	Fine	5.6	8.0	3		3	3	64
	Medium	8.0	11.0	2		2	2	66
	Medium	11.0	16.0	2		2	2	68
	Coarse	16.0	22.6	2		2	2	70
	Coarse	22.6	32	2		2	2	72
	Very Coarse	32	45	2		2	2	74
	Very Coarse	45	64	4		4	6	80
COBBLE	Small	64	90	9		9	9	89
	Small	90	128	8		8	8	97
	Large	128	180	1		1	1	98
	Large	180	256	2		2	2	100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	50	50	100	100	100

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	0.3
D_{84} =	74.0
D_{95} =	117.0
D_{100} =	256.0





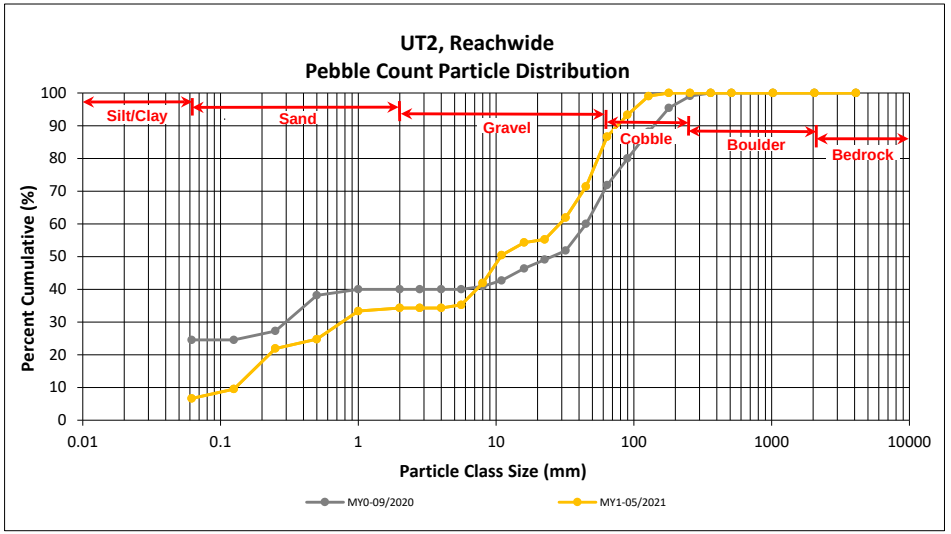
Reachwide Pebble Count Plots

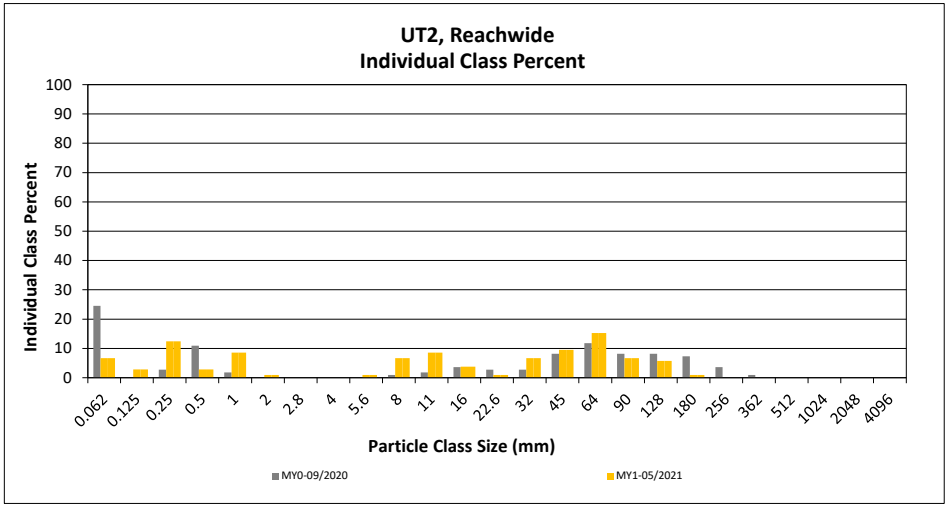
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

UT2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062		7	7	7	7
SAND	Very fine	0.062	0.125		3	3	3	10
	Fine	0.125	0.250	2	11	13	12	22
	Medium	0.25	0.50		3	3	3	25
	Coarse	0.5	1.0	3	6	9	9	33
	Very Coarse	1.0	2.0		1	1	1	34
GRAVEL	Very Fine	2.0	2.8					34
	Very Fine	2.8	4.0					34
	Fine	4.0	5.6		1	1	1	35
	Fine	5.6	8.0	2	4	6	7	42
	Medium	8.0	11.0	4	4	8	9	50
	Medium	11.0	16.0	3	1	4	4	54
	Coarse	16.0	22.6		1	1	1	55
	Coarse	22.6	32	4	3	7	7	62
	Very Coarse	32	45	8	1	9	10	71
	Very Coarse	45	64	14	1	15	15	87
COBBLE	Small	64	90	4	2	6	7	93
	Small	90	128	6		6	6	99
	Large	128	180		1	1	1	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.18
D_{35} =	5.15
D_{50} =	10.8
D_{84} =	60.2
D_{95} =	99.7
D_{100} =	180.0





APPENDIX D. Hydrology Data

Table 10. Bankfull Events

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Reach	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Sandy Branch	2/4/2021 10/9/2021						

Table 11. Rainfall Summary

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
Annual Precip Total	44.67*						
WETS 30th Percentile	29.58						
WETS 70th Percentile	54.08						
Normal	*						

*Annual precipitation total was collected up until 11/19/2021. Data will be updated in MY2.

Recorded Bankfull Events
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

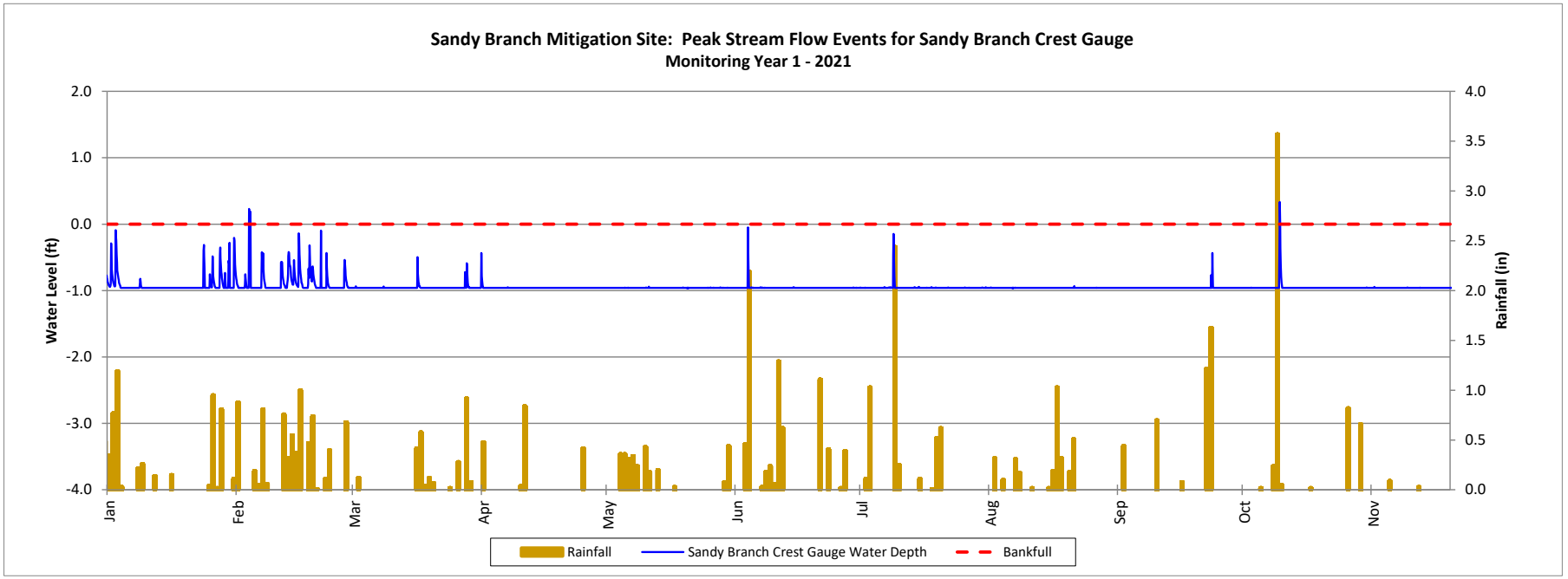


Table 12. Groundwater Gauge Summary

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Gauge	Max. Consecutive Hydroperiod (Percentage)						
	MY1 (2021)	MY2 (2022)	MY3 (2023)	MY4 (2024)	MY5 (2025)	MY6 (2026)	MY7 (2027)
1	50 days (19.1%)						
2	20 days (7.6%)						
3	19 days (7.3%)						
4	51 days (19.5%)						
5	55 days (21%)						
6	20 days (7.6%)						
7	61 days (23.3%)						
8	62 days (23.7%)						
9	51 days (19.5%)						
10	37 days (14.1%)						
11	40 days (15.3%)						
12	51 days (19.5%)						

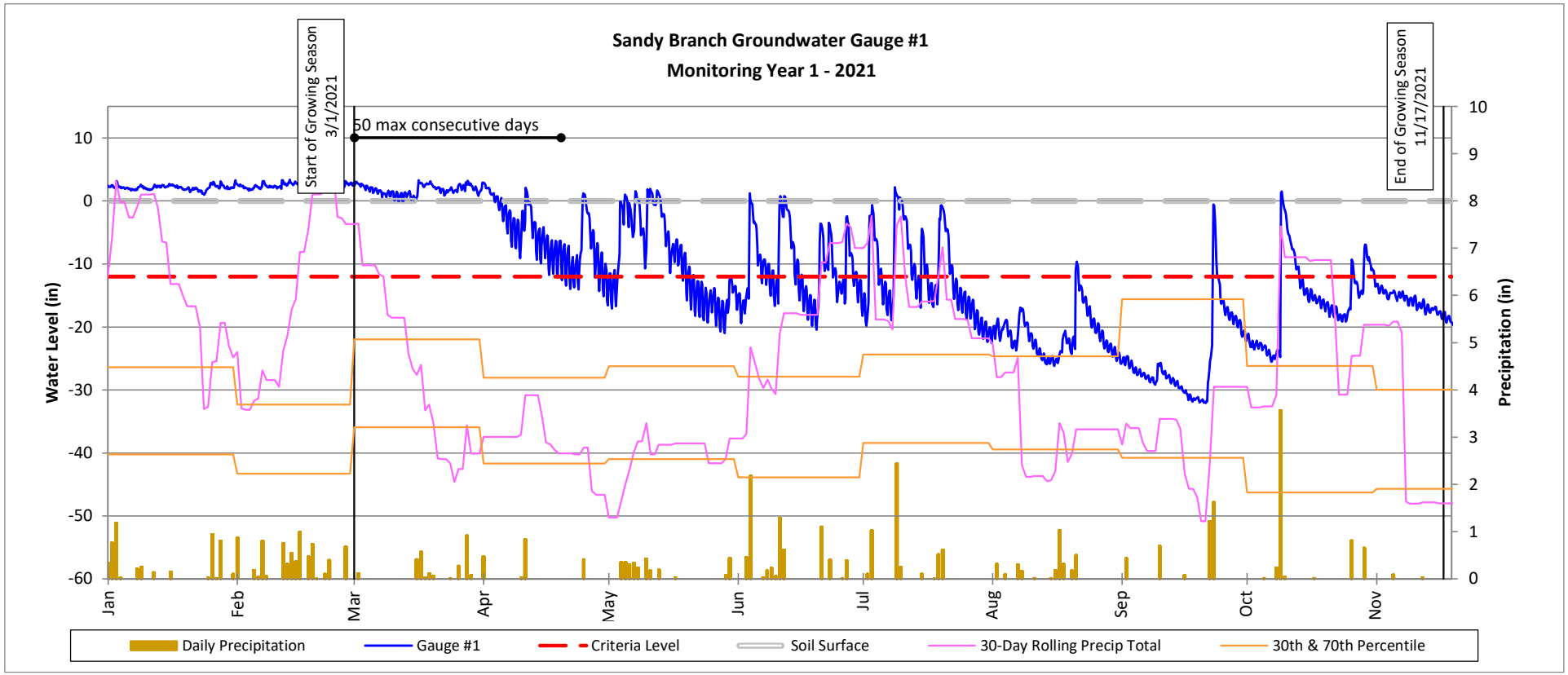
Performance Standard: **27 Days (10%)**
WETS Station (Daily Rainfall): **Goldston 3.8 N**
WETS Station (30th & 70th Percentile): **Siler City 2 N, NC**
Growing Season: **3/1/2021 to 11/17/2021 (261 Days)**

Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

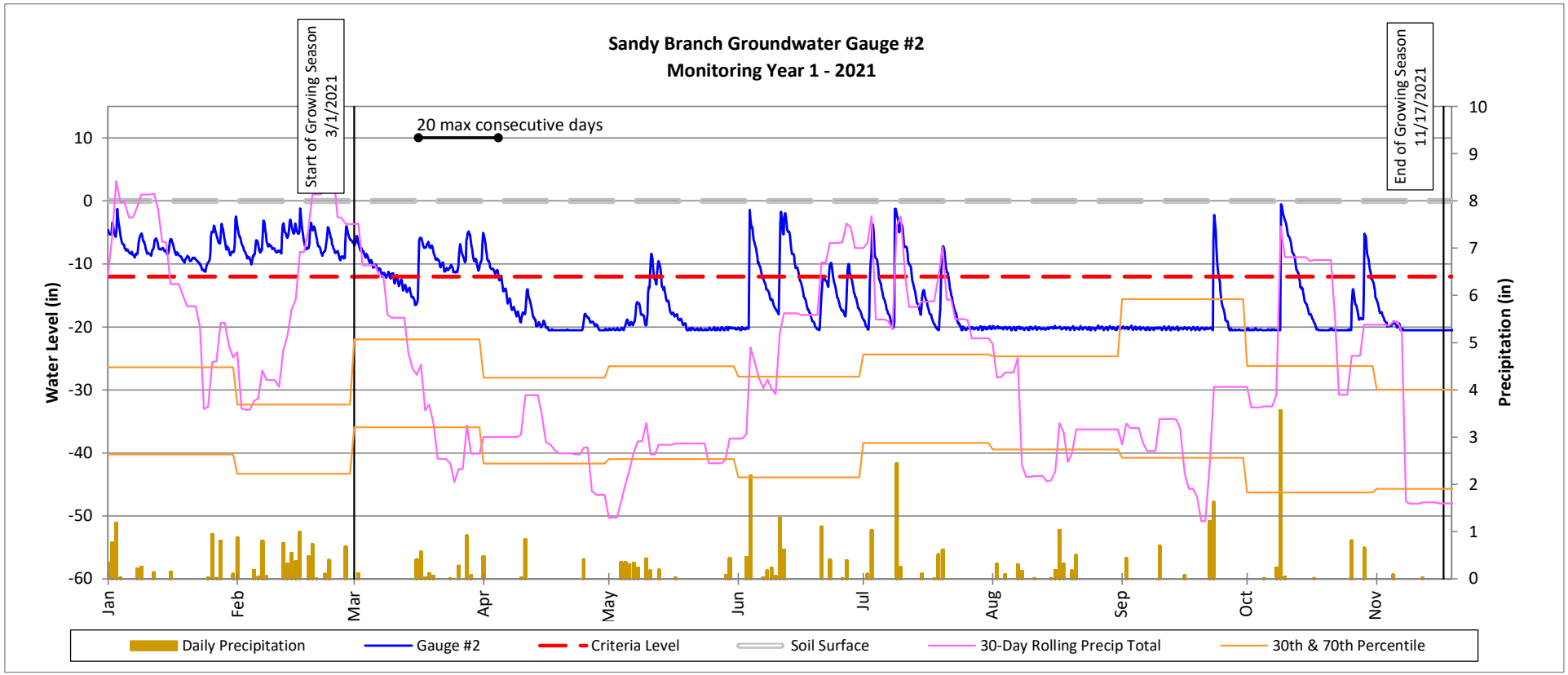


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

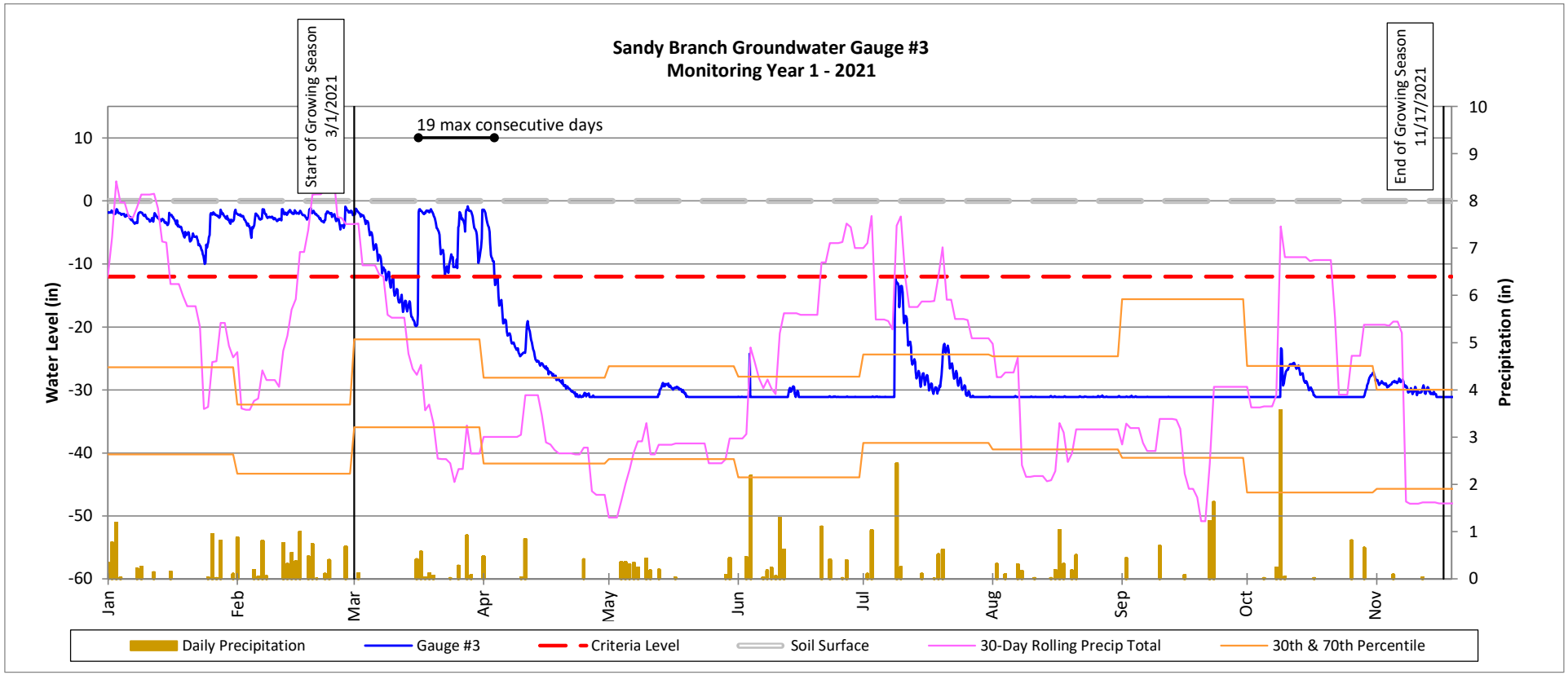


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

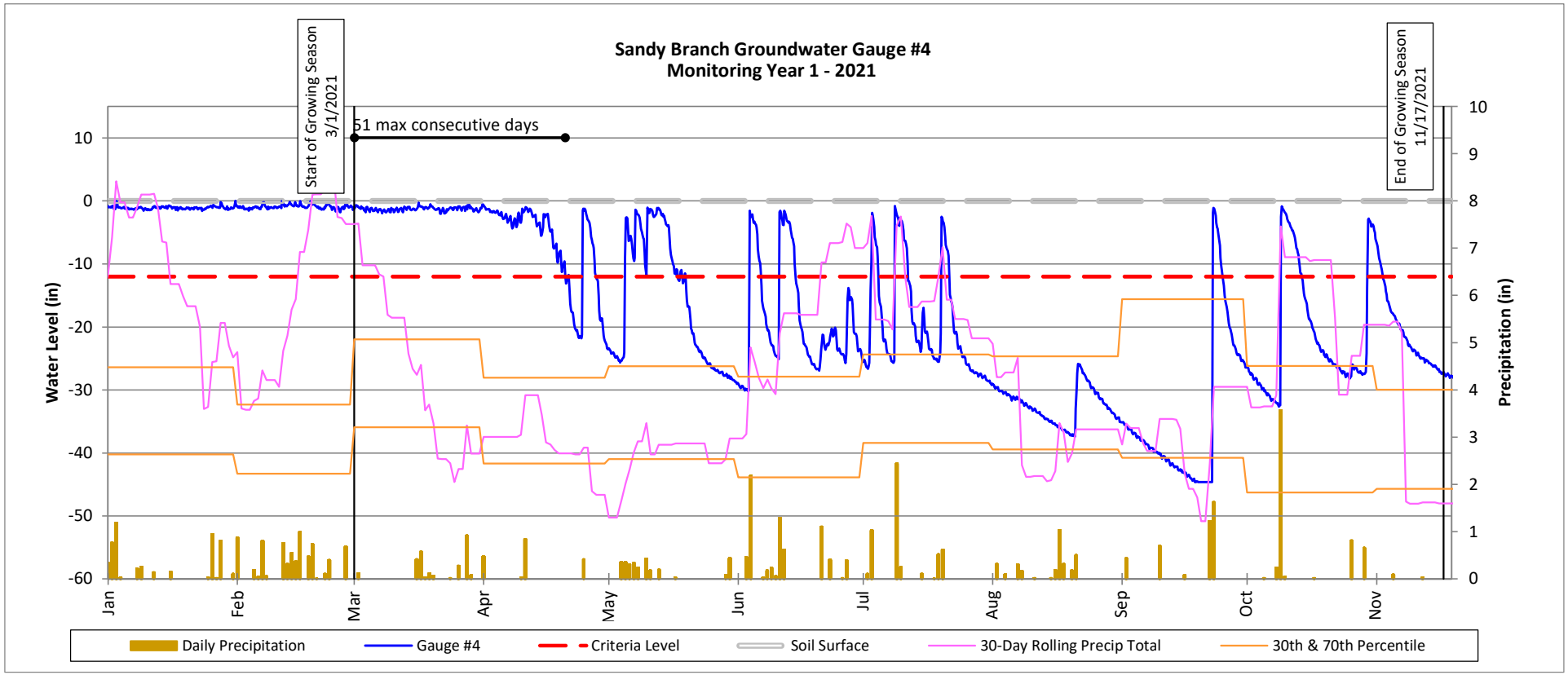


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

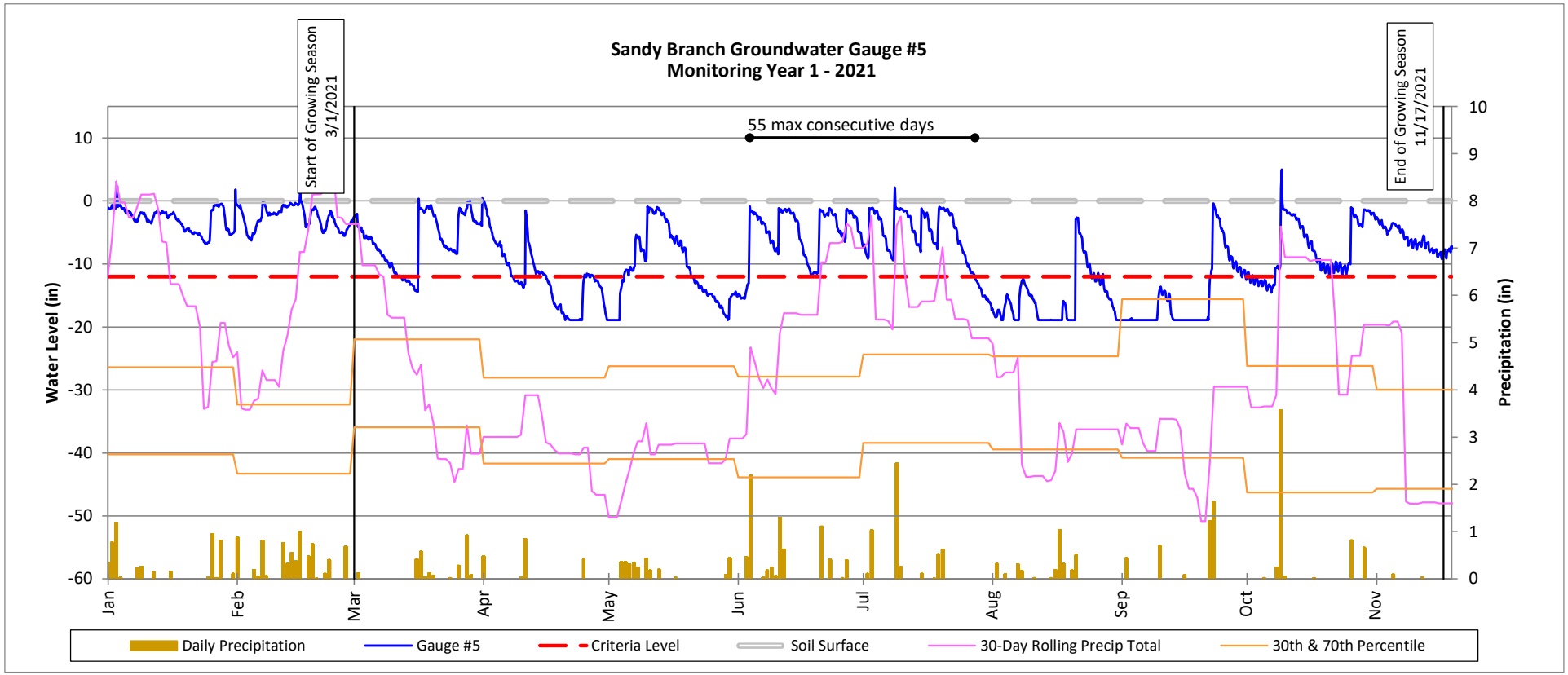


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

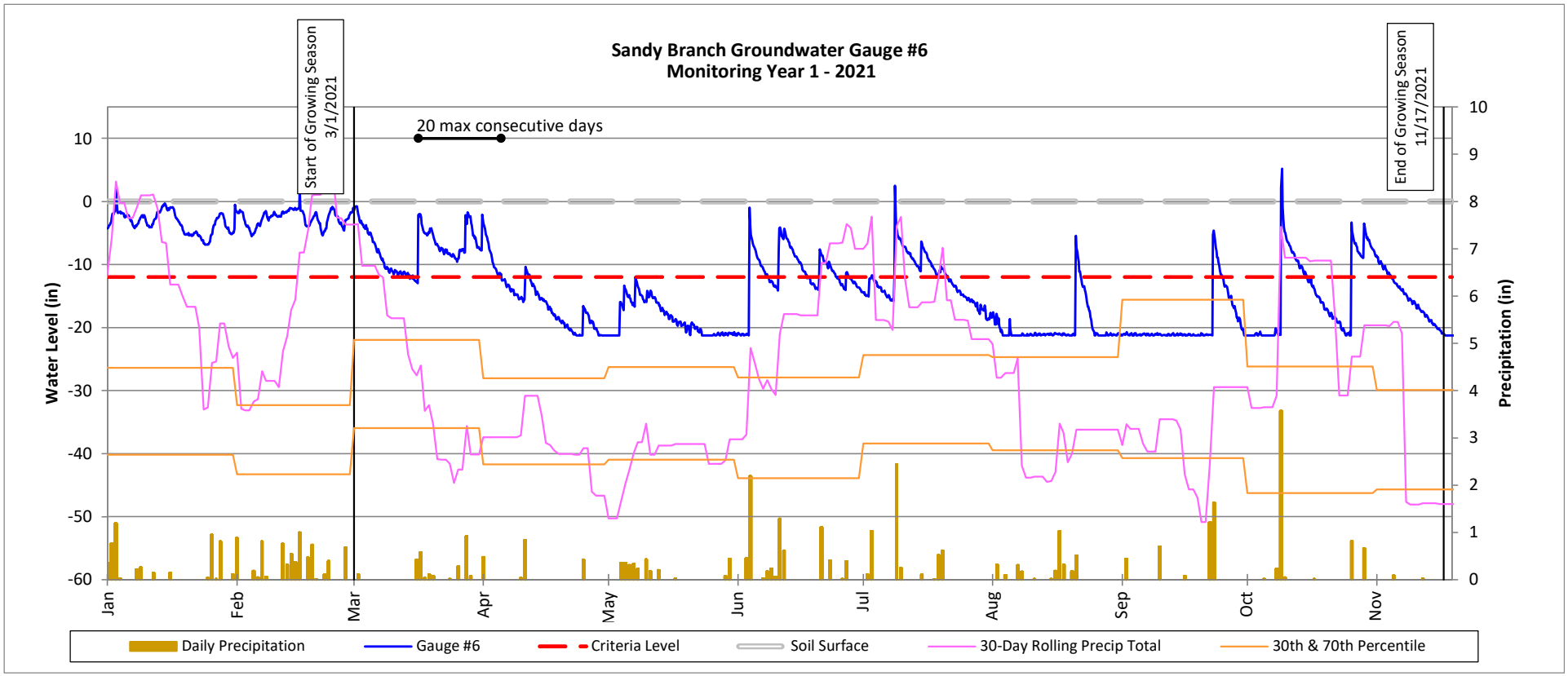


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

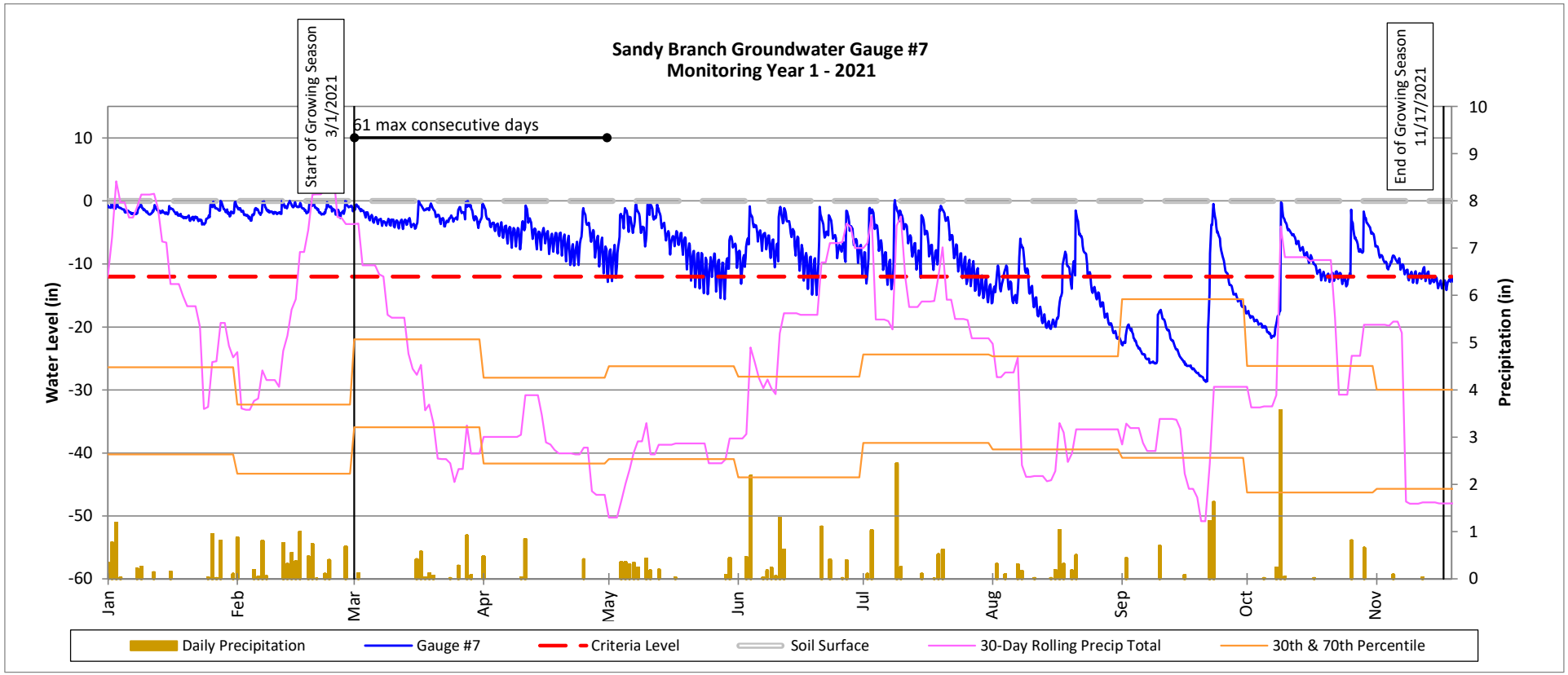


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

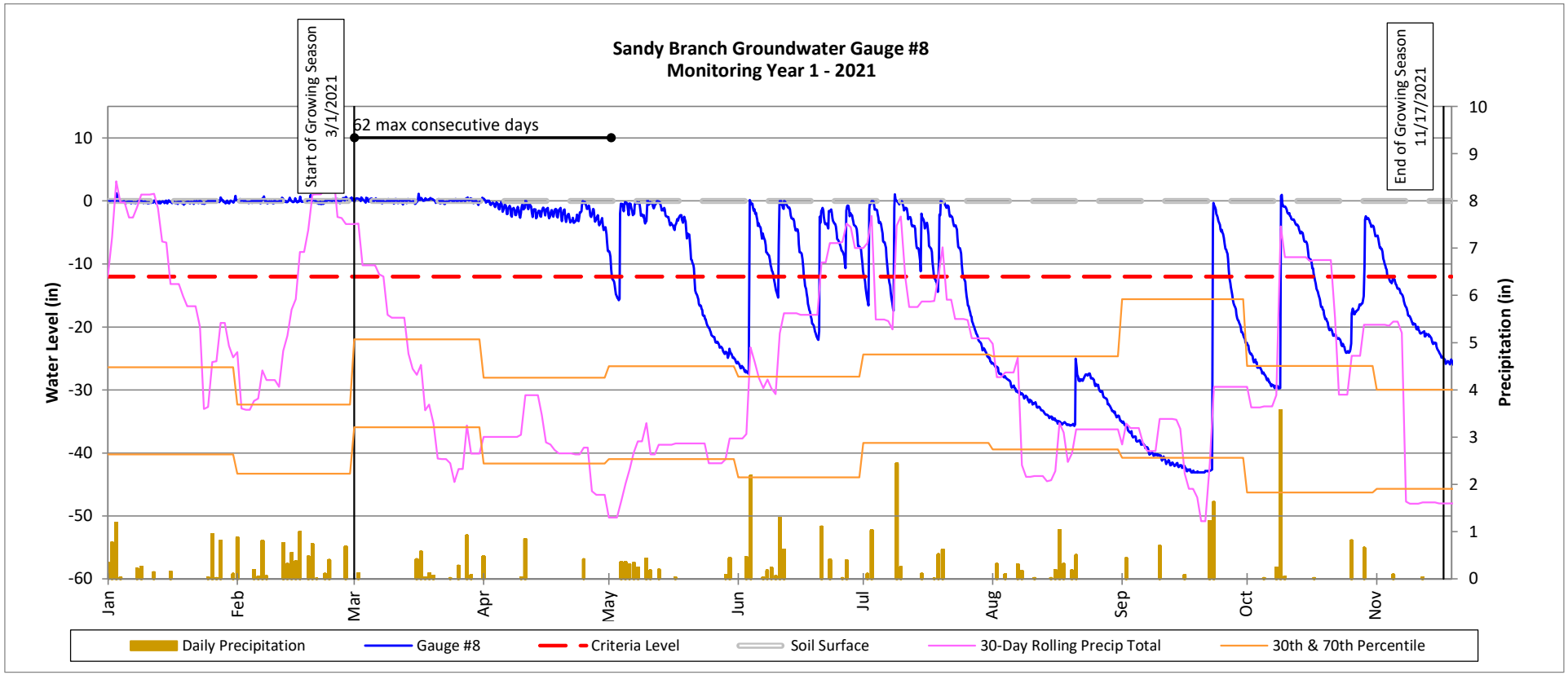


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

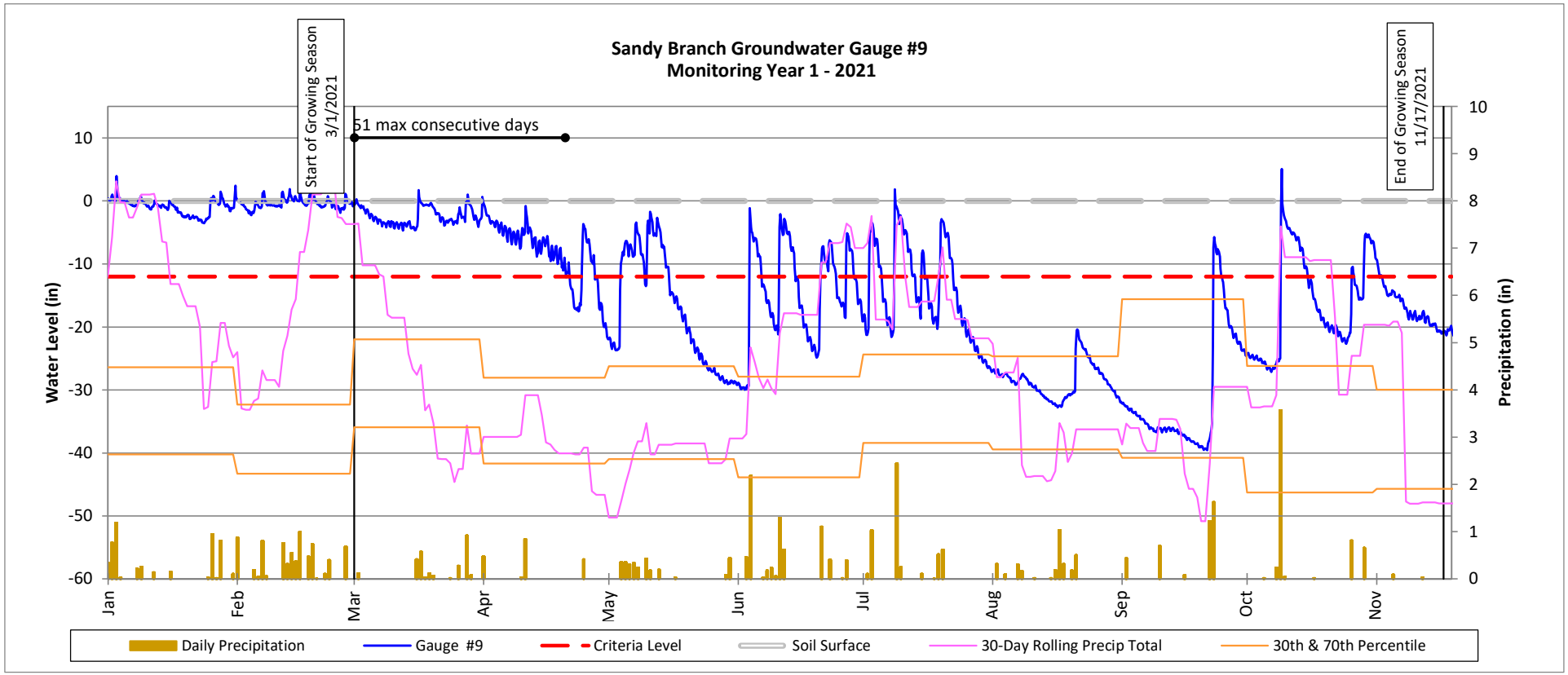


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

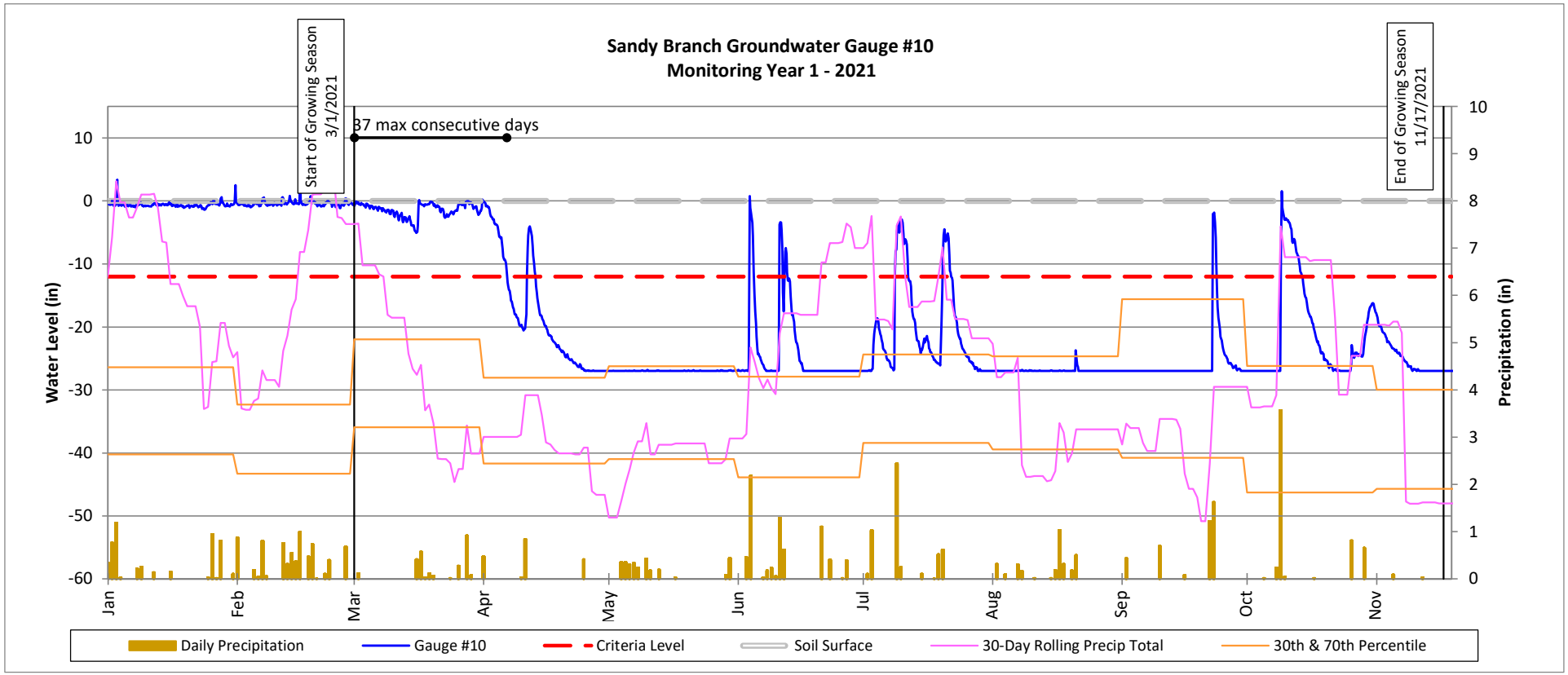


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

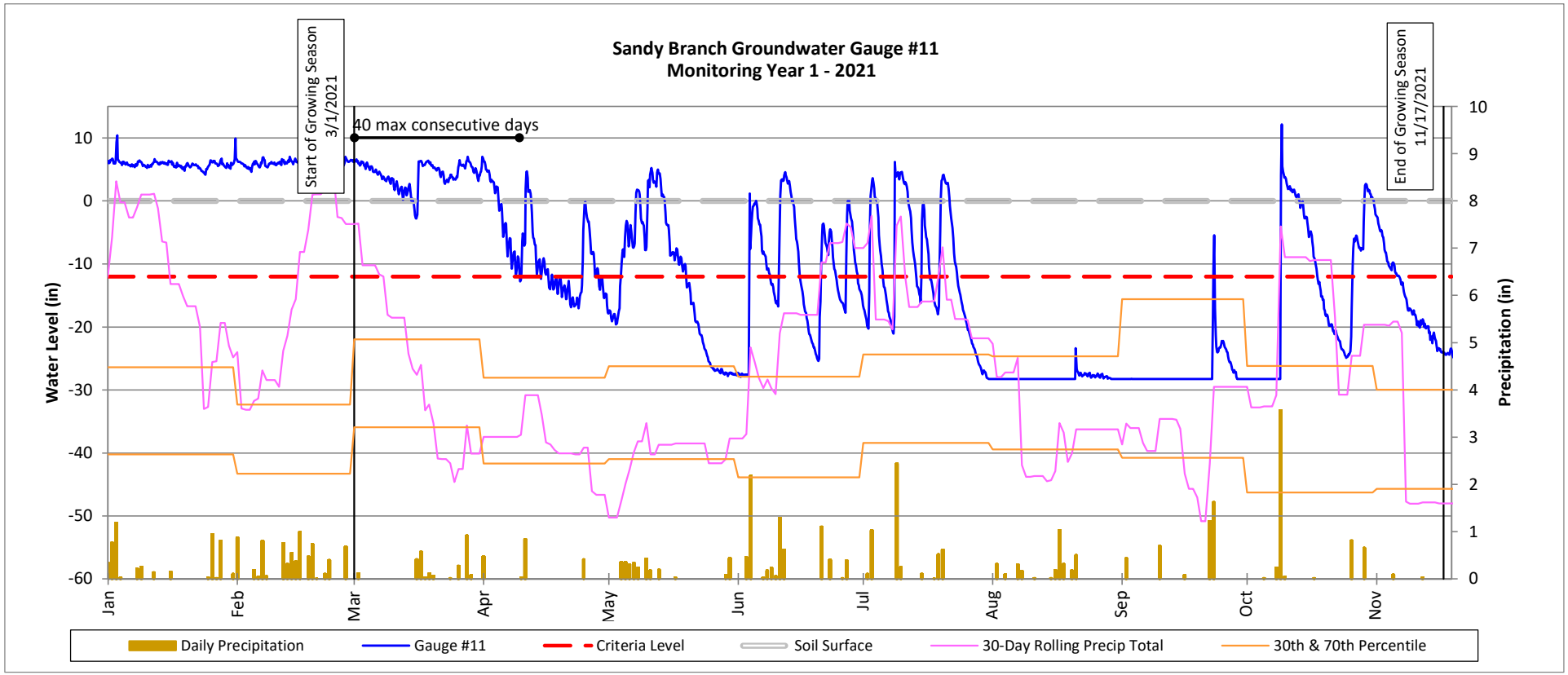


Groundwater Gauge Plots

Sandy Branch Mitigation Site

DMS Project No. 100060

Monitoring Year 1 - 2021

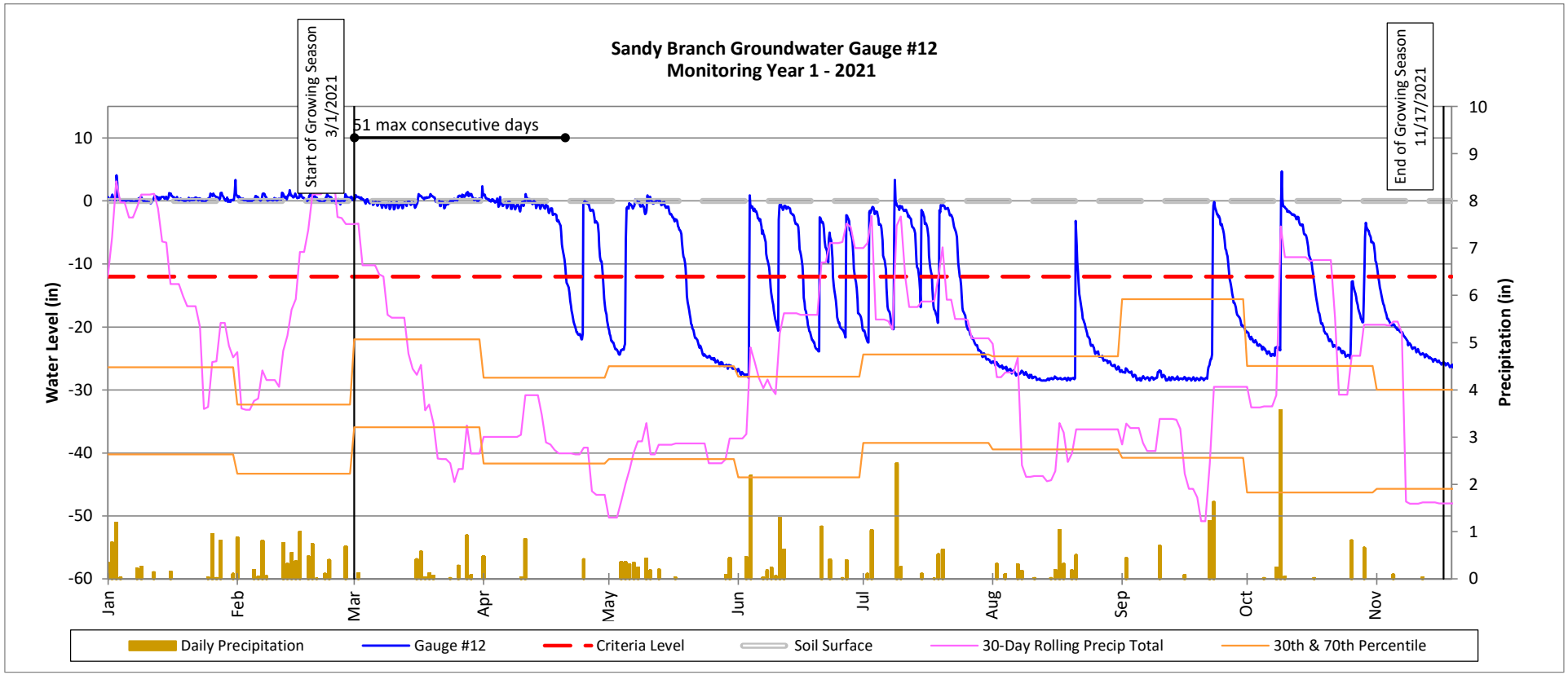


Groundwater Gauge Plots

Sandy Branch Mitigation Site

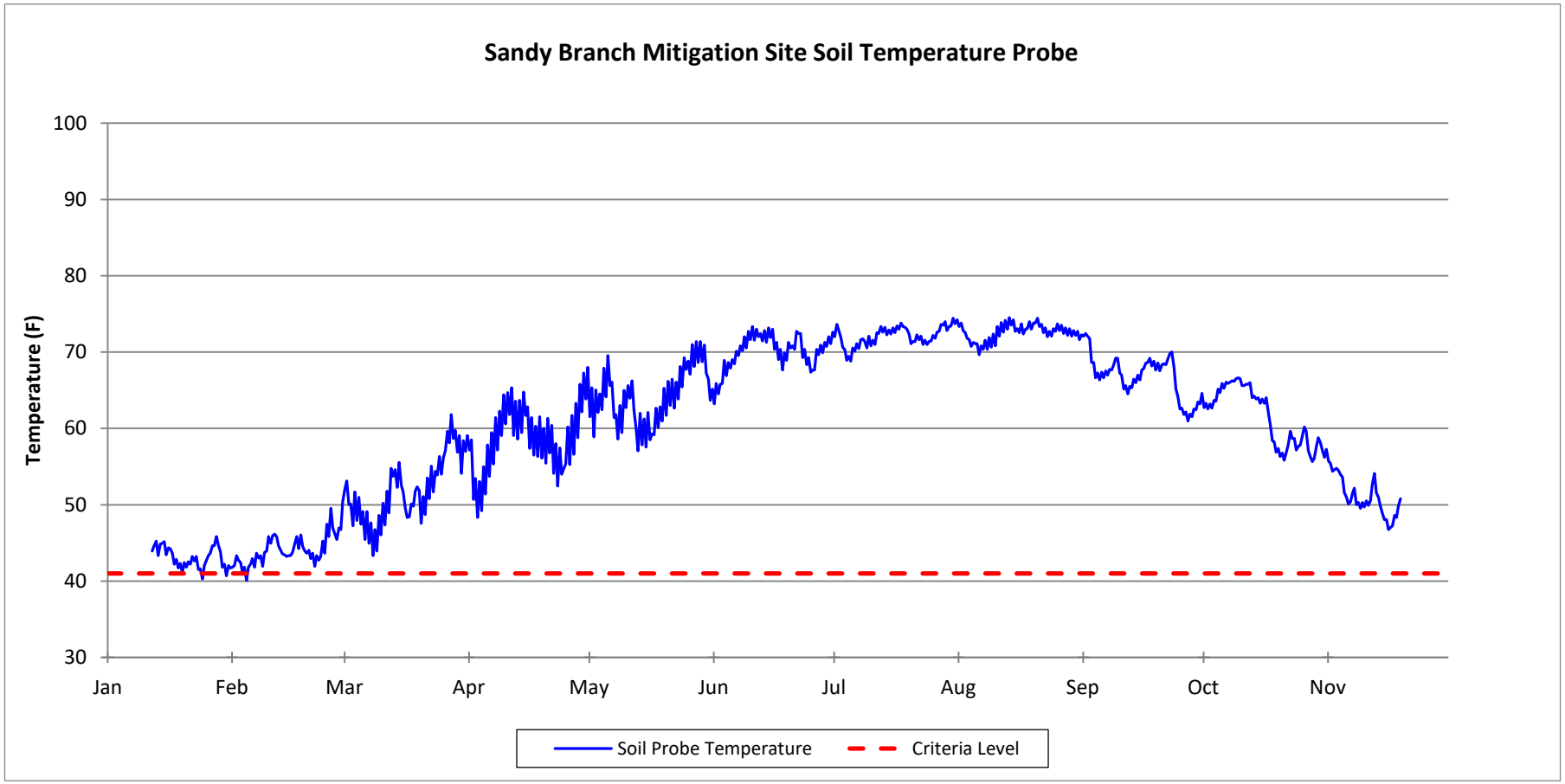
DMS Project No. 100060

Monitoring Year 1 - 2021



Soil Temperature Probe Plot

Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021



APPENDIX E. Project Timeline and Contact Info

Table 13. Project Activity and Reporting History
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Activity or Deliverable		Data Collection Complete	Task Completion or Deliverable Submission
Project Instituted		September 2017	September 2017
Mitigation Plan Approved		December 2019	December 2019
Construction (Grading) Completed		September 2020	September 2020
Planting Completed		January 2021	January 2021
As-Built Survey Completed		September 2020	September 2020
Baseline Monitoring Document (Year 0)	Stream Survey	September 2020	April 2021
	Vegetation Survey	January 2021	
Year 1 Monitoring	Stream Survey	May 2021	December 2021
	Vegetation Survey	August 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 14. Project Contact Table
Sandy Branch Mitigation Site
DMS Project No. 100060
Monitoring Year 1 - 2021

Designer Greg Turner, PE	**Wildlands Engineering, Inc.** 312 West Millbrook Road, Suite 225 Raleigh, NC 27609 919.851.9986
Construction Contractor	**Main Stream Earthwork, Inc.** 631 Camp Dan Valley Rd.
Monitoring Performers Monitoring, POC	**Wildlands Engineering, Inc.** Jason Lorch 919.851.9986

APPENDIX F. Additional Documentation

November 29, 2021

U.S. Army Corps of Engineers
Regulatory Division
Raleigh Field Office
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

Attention: Kim Browning

Subject: As-Built Report and Plans
Sandy Branch Mitigation Project, Chatham County
Cape Fear River Basin HUC 0303003
USACE Action ID No. SAW-2018-01167/DWR No. 2018-0786

Dear Ms. Browning,

We have reviewed the North Carolina Interagency Review Team's (IRT) comments on the As-Built Report for the Sandy Branch Mitigation Site. We will make necessary revisions in future monitoring documents. Below are responses to each of the IRT's comments in your letter dated May 17, 2021. Your original comments are provided below followed by our responses in bold italics.

USACE Comments, Casey Haywood:

1. Section 4.3: Please annotate in this section the plan to fence in the easement.

   Future reports will include text mentioning that the conservation easement was fenced.

2. The AB drone footage was helpful and appreciated.
3. Please mark location of the photo points to include crossings and culverts.

   Photos of the culvert crossing will be included in future monitoring reports.

USEPA Comments, Todd Bowers:

1. In Table 1, fencing is missing from the site objectives to meet the goal of permanently protecting the site from harmful uses.

   Fencing has been added to the list of site objectives in Table 1.

2. Section 2.3 Whenever percentages of a growing season are referenced it is important to clearly state the actual number of consecutive days required to meet the hydrology standard threshold.

   The number of consecutive days required to meet the hydrology standard threshold have been added whenever the percentages of a growing season are referenced.

3. Section 4.3: Fencing could be addressed again here to align with site boundary marking.

   Fencing has been addressed in future reports to align with site boundary marking.

4. Table 6b: Total area for the 3 random plots should be 3 ares instead of 2.

   The Total area for the 3 random plots will be changed from 3 ares instead of 2 in the Monitoring Year 1 Report.

5. Planting Tables on Page 85 should list the wetland indicator status for each listed species.

   Planting Tables in future as-built plan sets will include the wetland indicator status for each listed species.

6. Planting Plan on Page 85: I recommend superimposing the fixed veg plot locations on this map to illustrate that all planting zones are being monitored adequately. Figure 3 does a decent job at this so perhaps it is redundant.

   Fixed vegetation plot locations are typically shown on Figure 3. On future planting plan maps we will consider showing vegetation plots depending on the scale of the map.

7. General: I am very pleased with all the relevant photos in the document illustrating the structures, groundwater wells, cross sections and vegetation plots. The added bonus of the handheld video presented is great too as I watched it before reading the report. This allowed me to anticipate some aspects of the site (such as the lack of boulder sills) that were answered in detail by the as-built report and red-line changes from the final mitigation plan. The only request I would have with photos would be to cover the culverts in detail.

   Photos of the culverts will be included in future monitoring reports.

   DWR Comments, Erin Davis:

1. Many of the monitoring well and plot stations shifted slightly from the mitigation plan monitoring figure, which is expected to a degree. But four of wetland wells appear to have moved from being within a re-establishment area towards or within a rehabilitation area (GWG 7, 8, 10, 12). Particularly looking at GWG 7 (which was originally proposed square within a non-hydric re-establishment area) and GWG 8, will stationed well data adequately represent functional uplift and performance standards for the re-establishment credit areas as described in the approved mitigation plan?

   Monitoring wells 10 and 12 were placed as close as possible to the stations proposed in the mitigation plan and are representative of intended wetland areas. Avenza mapping service was used to determine the location of the wetland zones and assist in the placement of the monitoring wells. The accuracy of the mapping service played part in the slight shift of the groundwater well placement. Monitoring wells 7 and 8 also shifted slightly in the field to avoid placement in microtopographic high or low spots. The chosen locations for wells 7 and 8 are representative of the functional uplift and performance standards in the re-establishment zones but can be moved if deemed necessary.

2. Please confirm there were no changes from the approved mitigation plan planted species and percentages (an updated/redline as-built planting table was not included).

   No changes were made from the approved mitigation plan planted species and percentages.

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

Jason Lorch, *Monitoring Coordinator*