Monitoring Report MY03

Sandy Bridge Restoration Site
DMS Contract 6400
DMS Project Number 96920

DWR #: 15-0414
USACE Action ID: 201500827
Rutherford County, North Carolina

Prepared for:
NCDMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

Monitoring Data Collected: 2019
Date Submitted: December 2019

Mitigation Project Name	**Sandy Bridge Farm**	**County**	**Rutherford**	**USACE Action ID**	**2015-00827**
DMS ID	**96920**	**Date Project Instituted**	**4/10/2015**	**NCDWR Permit No**	**2015-0414**
River Basin	**Broad**	**Date Prepared**	**6/13/2019**		
Cataloging Unit	**03050105**				

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)			**1,626.000**						**6.740**					
Potential Credits (As-Built Survey)			**1,626.000**						**6.653**					
1 (Site Establishment)	**N/A**				N/A	N/A	**N/A**				**N/A**		N/A	N/A
2 (Year 0 / As-Built)	**30%**		487.800		2017	5/19/2017	**30%**		1.996		**N/A**		2017	5/19/2017
3 (Year 1 Monitoring)	**10%**		162.600		2018	4/25/2018	**10%**		0.665		**N/A**		2018	4/25/2018
4 (Year 2 Monitoring)	**10%**		162.600		2019	4/26/2019	**10%**		0.665		**N/A**		2019	4/26/2019
5 (Year 3 Monitoring)	**10%**				2020		**15%**				**N/A**		2020	
6 (Year 4 Monitoring)	**5%**				2021		**5%**				**N/A**		2021	
7 (Year 5 Monitoring)	**10%**				2022		**15%**				**N/A**		2022	
8 (Year 6 Monitoring)	**5%**				2023		**5%**				**N/A**		2023	
9 (Year 7 Monitoring)	**10%**				2024		**10%**				**N/A**		2024	
Stream Bankfull Standard	**10%**		162.600		2019	4/26/2019	**N/A**				**N/A**			
Total Credits Released to Date			**975.600**						**3.327**					

NOTES:

CONTINGENCIES:

Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

1 - For NCDMS, no credits are released during the first milestone

2 - For NCDMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCDMS Portal, provided the following criteria have been met:

1) Approval of the final Mitigation Plan
2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
4) Reciept of necessary DA permit authorization or written DA approval for porjects where DA permit issuance is not required

3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met

Mitigation Project Name	**Sandy Bridge Farm**		**County**	**Rutherford**	**USACE Action ID**	**2015-00827**
DMS ID	**96920**		**Date Project Instituted**	**4/10/2015**	**NCDWR Permit No**	**2015-0414**
River Basin	**Broad**		**Date Prepared**	**6/13/2019**		
Cataloging Unit	**03050105**					

DEBITS (released credits only)

			Ratios	1	1.5	2.5	5	**1.02961**	3	2	5	1	3	2	5	1	3	2	5
				Stream Restoration	Stream Enhancment I	Stream Enhancement II	Stream Preservation	Riparian Restoration	Riparian Creation	Riparian Enhancement	Riparian Preservation	Nonriparian Restoration	Nonriparian Creation	Nonriparian Enhancement	Nonriparian Preservation	Coastal Marsh Restoration	Coastal Marsh Creation	Coastal Marsh Enhancement	Coastal Marsh Preservation
As-Built Amounts (feet and acres)				**1,626.000**				**6.850**											
As-Built Amounts (mitigation credits)				**1,626.000**				**6.653**											
Percentage Released				**60.000%**				**50.000%**											
Released Amounts (feet / acres)				**975.600**				**3.425**											
Released Amounts (credits)				**975.600**				**3.327**											
NCDWR Permit	USACE Action ID	Project Name																	
2009-1301		Kings Mountain Quarry Expansion						2.055											
2009-1301		Kings Mountain Quarry Expansion						0.685											
2009-1301		Kings Mountain Quarry Expansion						0.685											
Remaining Amounts (feet / acres)				**975.600**				**0.000**											
Remaining Amounts (credits)				**975.600**				**0.000**											

Monitoring and Design Firm

Prepared by:

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

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

December 2019

KCI ASSOCIATES OF NORTH CAROLINA, PA

ENGINEERS • SCIENTISTS • SURVEYORS • CONSTRUCTION MANAGERS

4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 (919) 783-9214 (919) 783-9266 Fax

February 6, 2020

Mr. Harry Tsomides
North Carolina Division of Mitigation Services
5 Ravenscroft Dr. #102
Asheville, NC 28801

Re: Response to Sandy Bridge Farm MY03 Report Comments

Dear Mr. Tsomides,

KCI has reviewed the comments prepared by the DMS for the Sandy Bridge Farm MY03 Report and has prepared the following responses:

1. The addition of gauges (3) and vegetation plots (2) in 2018 are noted; please clarify in the report why these features were added to the project during MY2.
   KCI Response: These additional monitoring components were installed in response to a request from the IRT made after a site visit on December 6, 2017. A note stating this has been added to the report.

2. Cross section 4 shows repeated values on the vertical scale. Please correct.
   KCI Response: This issue has been corrected.

3. Please indicate whether KCI (during downstream repairs) removed the multiple loose tubular steel gates around the relict beaver dam near the upstream end of the project (see MY02 report comment).
   KCI Response: These were removed during the repair of the non-project stream in November 2019.

4. Wetland Reestablishment feature shape does not match the creditable acreage reported in the asset table. Please provide DMS with a feature for the Wetland Reestablishment that accurately characterizes the creditable assets, or provide further clarification.
   KCI Response: It appears that the shape provided did not exclude the open water area of the BMP. An updated shapefile that accurately characterizes the assets on site has been provided.

5. The digital data provided does not include a CVS tool submission.
   KCI Response: Because neither the RFP or the Mitigation Plan stipulate the use of CVS protocol for vegetation data collection, KCI does not use it for this project. All vegetation data collected is included in the Excel sheet named "Sandy Bridge Vegetation MY-03" that is included with the digital deliverables.

6. Visual data folder did not include excel sheets for visual assessment tables.
   KCI Response: These have been added to the digital deliverable.

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

Sincerely,

Adam Spiller
Project Manager

TABLE OF CONTENTS

Appendix A – Background Tables

Appendix B – Visual Assessment Data

Appendix C – Vegetation Plot Data

Appendix D – Stream Measurement and Geomorphology Data

Appendix E – Hydrologic Data

PROJECT SUMMARY

The Sandy Bridge Farm Restoration Site (SBFRS) was completed in March 2017 and restored a total of 6.85 acres of riparian wetland (1.29 acres of wetland rehabilitation and 5.56 acres of wetland reestablishment) and 1,626 linear feet of stream. The SBFRS is a riparian system located in the Broad River Basin (03050105 8-digit cataloging unit) in Rutherford County, North Carolina that had been substantially modified to maximize the use of the area for grazing. The completed project will restore impacted agricultural lands to a functioning stream and wetland ecosystem with enhanced water quality, restored hydrology, and improved fish and wildlife habitat.

The SBFRS is protected by a 9.5 acre permanent conservation easement, held by the State of North Carolina. The site is located off of Rock Road, approximately 3 miles north of Rutherfordton, North Carolina. The project site is bounded by interspersed pastureland and forested land to the east, agricultural land and Rock Road to the north-northwest, and Catheys Creek to the southwest.

The North Carolina Ecosystem Enhancement Program's (NCEEP) publication in 2009 identified HUC 03050105070020 (Catheys Creek) as a Targeted Local Watershed (TLW). The goals and priorities for SBRFS are based on the information presented in the Broad River Basin Restoration Priorities: to restore wetland and stream functions, to maintain and enhance water quality, to restore hydrology, and to improve fish and wildlife habitat (NCEEP 2009). The project goals, which reflect those from the approved Mitigation Plan, are in line with the following basin priorities:

- Reduce sources of sediment and nutrients by restoring riparian buffer vegetation, excluding livestock, and restoring natural geomorphology.
- Prioritize project implementation in the Catheys Creek local watershed planning area.

The goals for the project are to:

- Restore a channelized stream to a meandering C-type channel with a floodplain.
- Buffer and reduce sediment impacts to the project stream.
- Restore a Piedmont Alluvial Forest Community.
- Restore a wetland hydroperiod to drained and livestock-impacted land.

The project goals will be addressed through the following objectives:

- Relocate a channelized stream to its historic landscape position.
- Install an appropriately-sized channel cross-section.
- Install bedform diversity with pools, riffles, and habitat structures.
- Demarcate the project easement boundaries and fence out livestock.
- Plant the site with native trees and shrubs and an herbaceous seed mix that supports the development of a Piedmont Alluvial Forest.
- Fill field ditches and redevelop wetland microtopography to slow the flow of surface and subsurface drainage.

To restore the site, select ditches across the site were modified or filled and incoming surface inputs and seeps were integrated to create a stream/wetland complex. Additionally, Tributary 1 to Catheys Creek was improved with Priority 1 stream restoration to re-meander the stream and elevate the groundwater table. The entire site was planted as a Piedmont Alluvial Forest community (Schafale 2012). The site was constructed as designed with no modification from the design plan.

The majority of monitoring components were installed in March 2017. Nine groundwater monitoring wells were installed to evaluate the attainment of jurisdictional wetland hydrology. A stream gauge was installed on Tributary 1 to Catheys Creek to record the occurrence of bankfull events. To determine the success of the planted mitigation areas, eight 10 m x 10 m permanent vegetation monitoring plots were established. The location of the planted stems relative to the origin within these plots, as well as the species, was recorded and planted stems were grouped into size categories (0-10 cm, 10-50 cm, 50-100 cm, >137 cm). Any volunteers found within the plots were also grouped into size categories by species, but separate from the planted stems. Six permanent photo reference points were established and will be taken annually. Four permanent cross-sections (two sets of coupled riffles and pools) were also established and a detailed longitudinal profile of the stream was taken. Wolman pebble counts were performed at both of the riffle cross-sections. The cross-section measurements will be repeated in future monitoring years, but the longitudinal profile will only be repeated if there are concerns about bed elevation adjustments. Reports will be submitted to DMS by the end of each monitoring year. During a site visit with the IRT on December 6, 2017, it was requested that KCI install three additional groundwater monitoring wells and two additional vegetation plots. On March 30, 2018 the three additional groundwater monitoring wells were installed along the area of the filled, pre-construction stream channel. On September 10, 2018, the two additional vegetation plots were installed near the southern end of the site.

Vegetative success criteria for the site is 320 woody stems/acre after three years, 260 woody stems/acre after five years, and 210 woody stems/acre after seven years. The baseline monitoring counted an average of 647 woody stems/acre. To meet the hydrologic success criteria, the upper 12 inches of the soil profile must have continuously saturated or inundated conditions for at least 10% of the growing season during normal weather conditions. The soil survey for Rutherford County estimates the growing season begins April 4 and ends November 6 (217 days), meaning the water table must be within 12 inches of the surface for at least 22 consecutive days during the growing season. A minimum of two bankfull events must also be recorded during the monitoring period. Bank height ratios should not exceed 1.2 and the entrenchment ratios should be 2.2 or greater. Visual assessments will also be used to identify problem areas.

MONITORING RESULTS

The site was planted in March 2017 with tree tube protection installed around many of the planted stems. The third-year monitoring was conducted July 11, 2019. The site averaged 526 planted stems/acre across all 10 plots. Six of the 10 plots had greater than 320 planted stems/acre, with Plots 1, 6, 7, and 8 not achieving the success criteria. Including volunteers, the site averaged 703 total stems/acre. The vegetation on the site was significantly impacted by beavers during the second monitoring year. Although there is still a good quantity of woody stems, many of the previously large and healthy stems have been chewed down to a smaller size or killed by beaver activity. Even with the beaver impacts, in general, the site is well vegetated, with widespread herbaceous coverage and many healthy planted stems. KCI is planning a supplemental planting before the beginning of the next growing season in areas where the herbaceous vegetation is outcompeting the planted woody stems and where beaver damage is most severe.

Daily rainfall data were obtained from the NC State Climate Office for a local weather station in Rutherfordton, NC. In 2019 the months of February, April, June, July, September, and October experienced above average rainfall, while January, May, and August experienced average rainfall. The months of March and November experienced below average rainfall for the site. Overall, the area experienced above average rainfall during the 2019 growing season. During the site's third growing season, all 12 of the groundwater monitoring wells had continuous saturation

within 12 inches of the ground surface for 10% (22 days) or more of the 217 day growing season (April 4 to November 6).

The stream gauge has recorded multiple bankfull events in each year since construction, including 10 bankfull events in 2019. This large number of bankfull events is the desired outcome for this project. A component of the stream design was to provide regular recharging of the riparian wetlands from overbank stream flows. In June 2018, several large beaver dams were discovered towards the lower half of the stream. These dams were removed in early August 2018. KCI has been continuously monitoring for further signs of beaver activity, trapping beavers on-site and removing dams when they are found. Additional dams were removed in November 2018, June 2019, August 2019, and October 2019. See Appendix B and Appendix E for more information.

The third-year cross-section survey showed aggradation in the pool cross-sections (XS2 and 4) as well as aggradation on the banks of Cross-section 1. The cross-section survey took place only a few days after several large beaver dams had been removed. The backwater from these dams had deposited sediment throughout the project, especially in the pools. At the time the cross-sections were surveyed, this sediment had not had a chance to wash through the system. A visual inspection of the site in November 2019 revealed that almost all of this sediment had washed through and it is anticipated that next year's cross-section survey will show the cross-sections closer to their baseline conditions. A mid-channel bar reported in Cross-section 2 last year is no longer present. This bar had formed as a result of backwater from beaver activity and it was anticipated that once the dams were removed, it would wash out, which is what happened.

The monitored cross-section data have been calculated by adjusting the bankfull elevation to maintain the baseline bankfull area for each cross-section. A total cross-sectional metric has been added to the cross-section data to indicate the cross-sectional area below the baseline bankfull elevation. In instances where there has been some lateral aggradation and narrowing (XS1) the data show the cross-section having a significantly higher bankfull width and higher width/depth ratio as compared to previous years. The comparison of cross-section plots between monitoring events illustrates that this change does not indicate a problematic change in cross-section condition. Future monitoring will show how the channel has adjusted to the varying backwater conditions and how the stream has processed the sediment from these events.

The right bank of the stream that flows along the easement's southern boundary has been experiencing significant erosion due to several areas of obstruction in the center of this channel that are diverting water into the banks. Although this stream is not part of the project, and is located outside of the easement bounds, the erosion on the right bank has encroached into the easement. In November 2019, KCI repaired and stabilize this area. This work involved removing the mid-channel obstructions and sloping back the eroding bank. This area will receive live-stake planting in early 2020. During this work, several farm gates that had become buried in the stream bank were removed and a small swale was dug to direct water into the site that had been ponding in fields adjacent to the eastern boundary of the site. This swale was designed to drain inundated areas that had formed off site and dissipate the water throughout the wetlands on-site. See Appendix B for more information.

REFERENCES

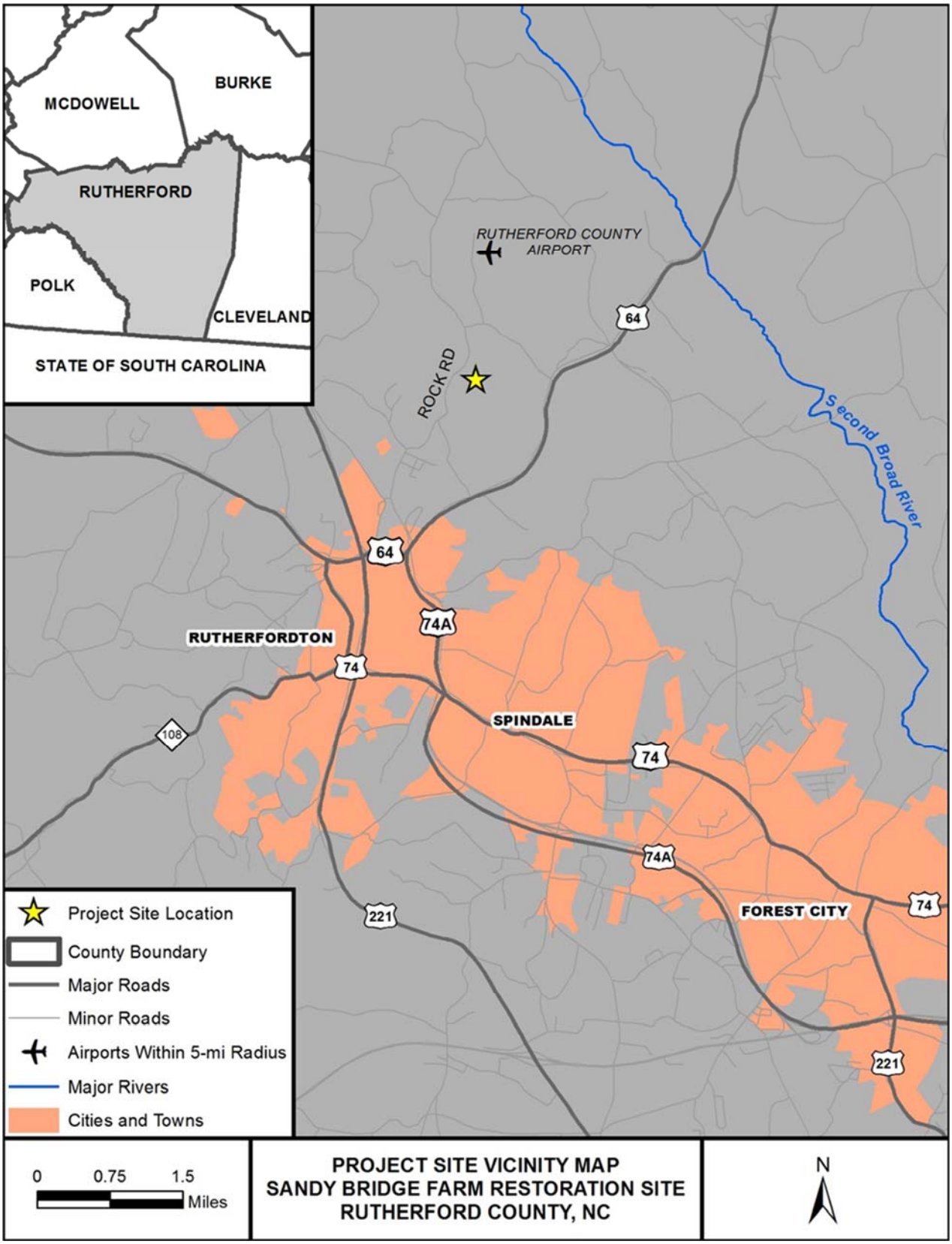
NCDENR, Ecosystem Enhancement Program. 2009. Broad River Basin Restoration Priorities 2009. Raleigh, NC. Last accessed 1/2016 at: http://portal.ncdenr.org/c/document_library/get_file?uuid=705d1b58-cb91-451e-aa58-4ef128b1e5ab&groupId=60329

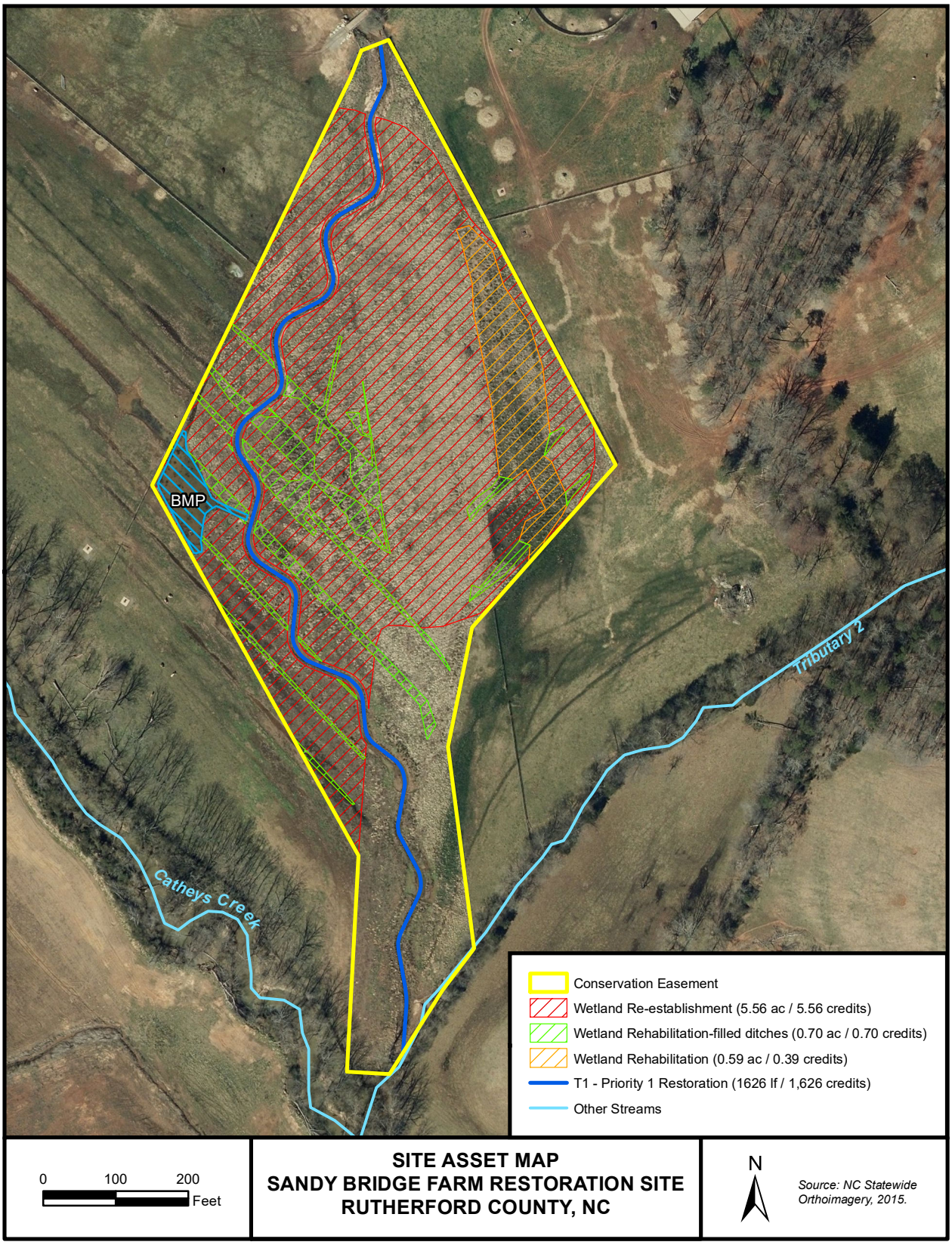
NCDENR, Ecosystem Enhancement Program. 2014. NCDENR, Ecosystem Enhancement Program. 2014. Stream and Wetland Mitigation Monitoring Guidelines. Last accessed1/2016 at: http://portal.ncdenr.org/c/document_library/get_file?p_l_id=60409&folderId=18877169&name=DLFE-86604.pdf

NCDENR, Ecosystem Enhancement Program. 2014. Stream and Wetland Mitigation Monitoring
Guidelines. Last accessed 6/2015 at: http://portal.ncdenr.org/c/document_library/get_file?p_l_id=60409&folderId=18877169&name=DLFE-86606.pdf

NC Wetland Functional Assessment Team. 2010. NC Wetland Assessment Method (NC WAM)
User Manual, version 4.1. Last accessed 11/2012 at: http://portal.ncdenr.org/c/document_library/get_file?uuid=76f3c58b-dab8-4960-ba43-45b7faf06f4c&groupId=38364

Schafale, M.P. and A.S. Weakley. 2012. Guide to the Natural Communities of North Carolina:
Fourth Approximation. Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment and Natural Resources. Raleigh, NC.


MCDOWELL
BURKE
RUTHERFORD
POLK
CLEVELAND
STATE OF SOUTH CAROLINA
RUTHERFORD COUNTY AIRPORT
ROCK RD
64
Second Broad River
RUTHERFORDTON
74A
74
SPINDALE
108
FOREST CITY
221
Project Site Location
County Boundary
Major Roads
Minor Roads
Airports Within 5-mi Radius
Major Rivers
Cities and Towns
0 0.75 1.5
Miles
PROJECT SITE VICINITY MAP
SANDY BRIDGE FARM RESTORATION SITE
RUTHERFORD COUNTY, NC
N



SITE ASSET MAP
SANDY BRIDGE FARM RESTORATION SITE
RUTHERFORD COUNTY, NC

Source: NC Statewide Orthoimagery, 2015.

APPENDIX A

Background Tables

Table 1. Project Components and Mitigation Credits
Sandy Bridge Farm Restoration Site, DMS Project #96920

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Credits	1,626		6.65						

Project Components

Project Component -or- Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach (PI, PII etc.)	Restoration -or- Restoration Equivalent	Restoration Footage/ Acreage	Mitigation Ratio	Credits
Tributary 1	10+00 to 26+26	1,470 lf	PI	Restoration	1,626 lf	1:1	1,626
Wetland Reestablishment				Restoration	5.56 ac	1:1	5.56
Wetland Rehabilitation*		0.79 ac		Restoration	0.70 ac	1:1	0.70
Wetland Rehabilitation		0.59 ac		Restoration	0.59 ac	1.5:1	0.39

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetlands (Acres)		Non-Riparian Wetlands (Acres)	Buffer (square feet)	Upland (Acres)
		Riverine	Non-Riverine			
Restoration	1,626 lf					
Reestablishment		5.56 ac				
Rehabilitation		1.29 ac				
Enhancement						
Creation						
Preservation						
High Quality Preservation						

R= Restoration RE= Restoration Equivalent of Creation or Enhancement
*=wetland rehabilitation associated with filled ditches

Table 2. Project Activity & Reporting History Sandy Bridge Farm Restoration Sites, DMS Project #96920		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		June 2016
Final Design - Construction Plans		June 2016
Construction Grading Completed		Aug 29, 2016
Planting Completed		March 11, 2017
Baseline Monitoring/Report	March 2017	April 2017
Vegetation Monitoring	*March 21, 2017*	
Stream Survey	*March 20, 2017*	
Year 1 Monitoring	November 2017	December 2017
Vegetation Monitoring	*October 26, 2017*	
Stream Survey	*November 6, 2017*	
Additional Groundwater Gauges Installed		March 30, 2018
Beaver Dam Removal		August 20, 2018
Additional Vegetation Plots Installed		September 10, 2018
Beaver Dam Removal		November 6, 2018
Year 2 Monitoring	November 2018	December 2018
Vegetation Monitoring	*September 10, 2018*	
Stream Survey	*XS1 and 2: June 28, 2018* *XS3 and 4: September 11, 2018*	
Beaver Dam Removal		June 14, 2019
Beaver Dam Removal		August 8, 2019
Beaver Dam Removal		October 17, 2019
Non-project Reach Repair		November 21, 2019
Year 3 Monitoring	November 2019	December 2019
Vegetation Monitoring	*July 11, 2019*	
Stream Survey	*June 19, 2019*	

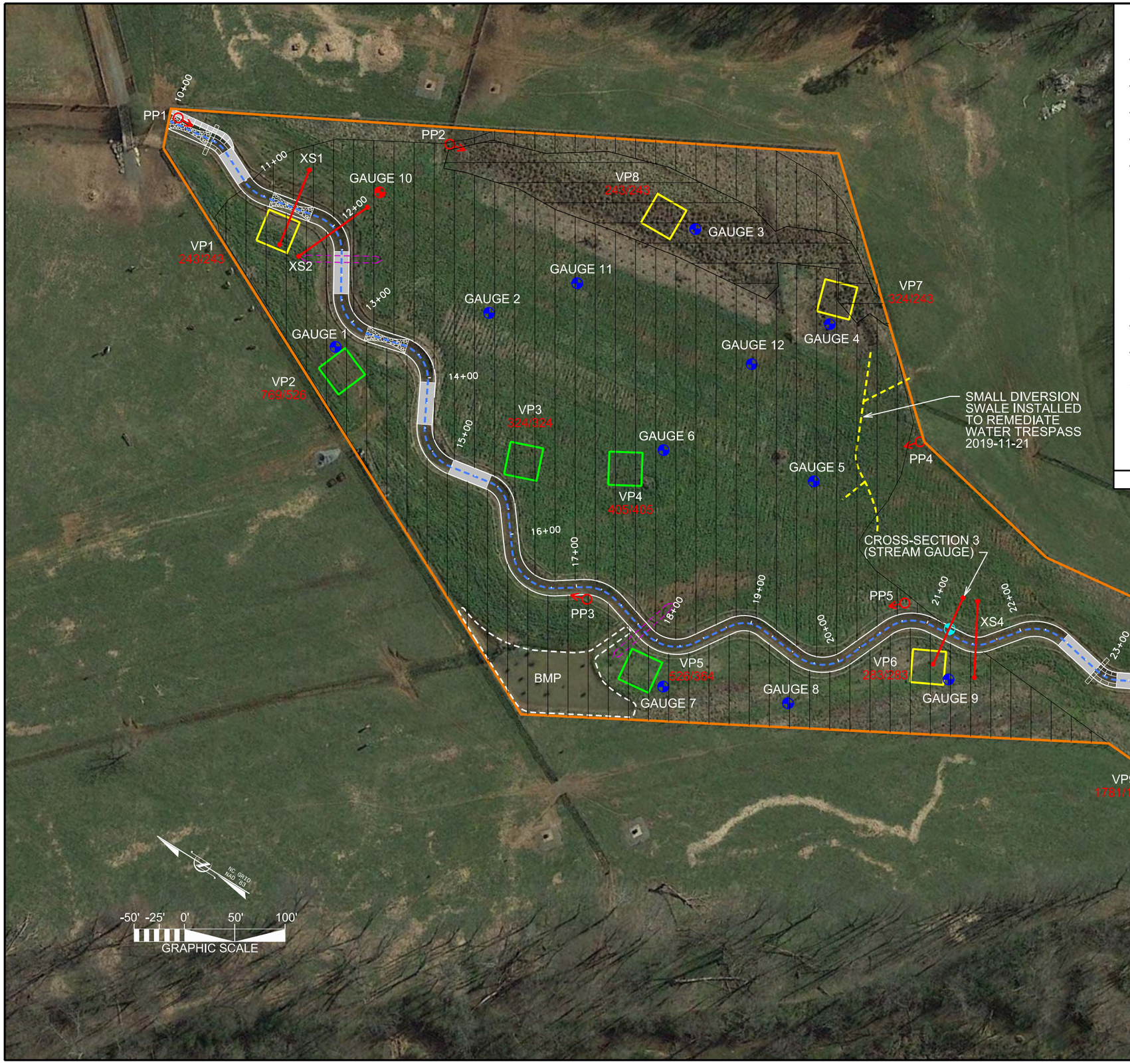
Table 3. Project Contacts **Sandy Bridge Farm Restoration Sites, DMS Project #96920**	
Design Firm	KCI Associates of North Carolina, PC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	KCI Environmental Technologies and Construction 4505 Falls of Neuse Road, Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512
Planting Contractor	Conservation Services Inc. 1620 N. Delphine Ave. Waynesboro, VA 22980 Contact: Mr. David Coleman Phone: (540) 941-0067
Monitoring Performers	KCI Associates of North Carolina, PC 4505 Falls of Neuse Road Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Information Sandy Bridge Farm Restoration Site, DMS Project #96920			
Project Name	Sandy Bridge Farm Restoration Site		
County	Rutherford County		
Project Area (acres)	9.45 acres		
Project Coordinates (lat. and long.)	35.407997° N, -81.937000° W		
Project Watershed Summary Information			
Physiographic Province	Piedmont		
River Basin	Broad		
USGS Hydrologic Unit 8-digit	03050105	**USGS Hydrologic Unit 14-digit**	03050105070020
DWQ Sub-basin	9-41-13-(0.5)		
Project Drainage Area (acres)	837 acres		
Project Drainage Area Percentage of Impervious Area	8%		
CGIA Land Use Classification	Mixed Hardwoods/Conifers 42% (350.0 ac), Managed Herbaceous Cover 39% (329.3 ac), Mountain Conifers 12% (99.5 ac), Mixed Shrubland 5% (43.5 ac), Low Intensity Developed 1% (11.0 ac)		
Existing Reach Summary Information			
Parameters	**T1**		
Length of reach (linear feet)	1,470 lf		
Valley classification	Valley Type VIII		
Drainage area (acres)	837 acres		
NCDWQ Water Quality Classification	WS-V (Water Supply – upstream)		
Morphological Description (stream type)	Ditched channel		
Evolutionary trend	Channelized		
Mapped Soil Series	Wehadkee-Chewacla Association		
Drainage class	Poorly drained; Somewhat poorly drained		
Soil Hydric status	Drained hydric		
Slope	0-1%		
FEMA classification	Zone AE		
Existing vegetation community	N/A (Pasture)		
Percent composition of exotic invasive vegetation	5%		
Existing Wetland Summary Information			
Parameters			
Size of Wetland (acres)	0.59 acres (Wetland Rehabilitation Area)		
Wetland Type	Headwater Seep		
Mapped Soil Series	Wehadkee-Chewacla Association		
Drainage class	Poorly drained; Somewhat poorly drained		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Seepage/ Precipitation		
Hydrologic Impairment	Ditching and Grazing		
Existing vegetation community	Emergent Wetland		
Percent composition of exotic invasive vegetation	5%		

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	DWR# 15-0414 USACE Action ID# 201500827	Jurisdictional Determination
Waters of the United States – Section 401	Yes	DWR# 15-0414 USACE Action ID# 201500827	Jurisdictional Determination
Endangered Species Act	No	N/A	N/A
Historic Preservation Act	No	N/A	N/A
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	N/A
FEMA Floodplain Compliance	No	N/A	N/A
Essential Fisheries Habitat	No	N/A	N/A

APPENDIX B

Visual Assessment Data



LEGEND:

- VEG PLOT ACHIEVING DENSITY CRITERION
- VEG PLOT BELOW DENSITY CRITERION
- VEG PLOT TOTAL / PLANTED STEM DENSITY — 703/526
- WETLAND GAUGE ACHIEVING HYDRO. CRITERION
- WETLAND GAUGE BELOW HYDRO. CRITERION
- PHOTO POINT
- CROSS-SECTION
- CONSERVATION EASEMENT
- STREAM RESTORATION
- REMOVED BEAVER DAMS
- WETLAND REESTABLISHMENT
- WETLAND REHABILITATION
- STEP POOL
- RIFFLE GRADE CONTROL
- RIFFLE ENHANCEMENT

IMAGE SOURCE: GOOGLE EARTH 2017

REVISIONS			
SYM.	DESCRIPTION	DATE	

NCDEQ DIVISION OF MITIGATION SERVICES

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4505 FALLS OF NEUSE RD, SUITE 400
RALEIGH, NORTH CAROLINA 27609

SANDY BRIDGE FARM
STREAM AND RIPARIAN WETLAND SITE

DMS PROJECT #96920
RUTHERFORD COUNTY, NORTH CAROLINA

MONITORING YEAR 03

DATE: DEC 2019
SCALE: GRAPHIC

CURRENT CONDITION PLAN VIEW

Table 5 **Visual Stream Morphology Stability Assessment**
Sandy Bridge Farm Stream Restoration Site, DMS Project#96920
Reach ID **Reach 1**
Assessed Length **1626**

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
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	20	20			100%
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	20	20			100%
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	20	20			100%
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	20	20			100%
		2. Thalweg centering at downstream of meander (Glide)	20	20			100%
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%
	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%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%
				Totals	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	8	8			100%
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	8	8			100%
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			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)	6	6			100%
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	5	5			100%

Table 6 **Vegetation Condition Assessment**

Sandy Bridge Farm Stream Restoration Site, DMS Project# 96920

Planted Acreage **9.5**

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.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	0	0.00	0.0%
			Total	0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.00	0.0%
Easement Acreage	**9.5**					
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	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Photo Reference Photos

PP1 – MY-00 – 3/21/17

PP1 – MY-03 – 11/16/19

PP2 – MY-00 – 3/21/17

PP2 – MY-03 – 11/16/19

PP3 – MY-00 – 3/21/17

PP3 – MY-03 – 11/16/19

PP4 – MY-00 – 3/21/17

PP4 – MY-03 – 11/16/19

PP5– MY-00 – 3/21/17

PP5– MY-03 – 11/16/19

PP6– MY-00 – 3/21/17

PP6– MY-03 – 11/16/19

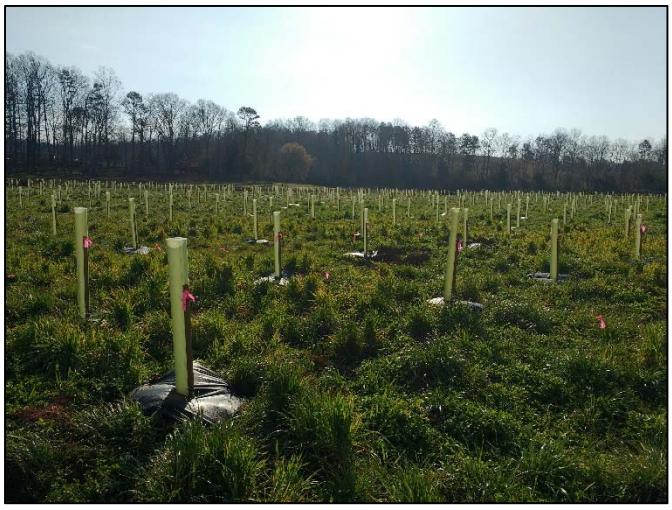
Vegetation Monitoring Plot Photos

Vegetation Plot 1 – MY-00 – 3/21/17

Vegetation Plot 1 – MY-03 – 7/11/19

Vegetation Plot 2 – MY-00 – 3/21/17

Vegetation Plot 2 – MY-03 – 7/11/19

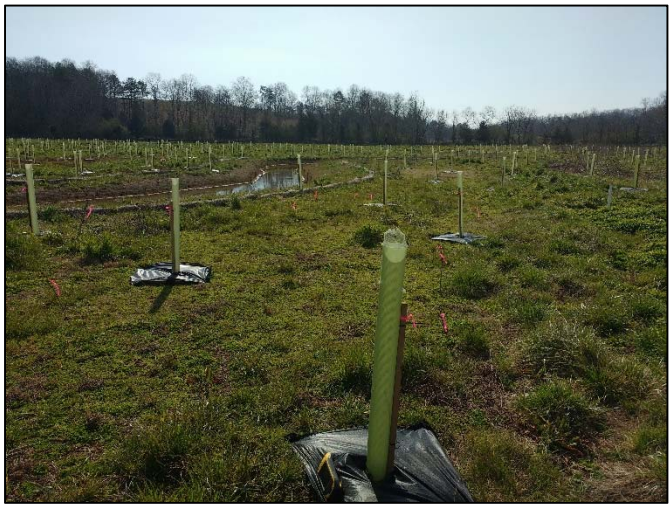


Vegetation Plot 3 – MY-00 – 3/21/17

Vegetation Plot 3 – MY-03 – 7/11/19

Vegetation Plot 4 – MY-00 – 3/21/17

Vegetation Plot 4 – MY-03 – 7/11/19



Vegetation Plot 5 – MY-00 – 3/21/17

Vegetation Plot 5 – MY-03 – 7/11/19

Vegetation Plot 6 – MY-00 – 3/21/17

Vegetation Plot 6 – MY-03 – 7/11/19

Vegetation Plot 7 – MY-00 – 3/21/17

Vegetation Plot 7 – MY-03 – 7/11/19

Vegetation Plot 8 – MY-00 – 3/21/17

Vegetation Plot 8 - MY-03 – 7/11/19

Vegetation Plot 9– MY-02 – 9/10/18

Vegetation Plot 9 - MY-03 – 7/11/19

Vegetation Plot 10– MY-02 – 9/10/18

Vegetation Plot 10 - MY-03 – 7/11/19

Repair Area Photos

Photo 1. Eroding stream bank that was encroaching into easement before repair, 8/29/2018

Photo 2. Stream bank after repair, 11/21/2019

APPENDIX C

Vegetation Plot Data

Table 7. Stem Count by Plot and Species																
Sandy Bridge Farm Restoration Site, DMS Project #96920																
	Current Plot Data (MY03 2018)															
	Plot 01		Plot 02		Plot 03		Plot 04		Plot 05		Plot 06		Plot 07		Plot 08	
Species	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total	Planted	Total
American Elm (Ulmus americana)							2	2		1	2	2				
Black Walnut (Juglans nigra)																
Black Willow (Salix nigra)				2												
Box Elder (Acer negundo)																
Buttonbush (Cephalanthus occidentalis)	3	3	1	1									4	6		
Eastern Cottonwood (Populus deltoides)					2	2			2	3	1	1	1	1	1	1
Green Ash (Fraxinus pennsylvanica)															2	2
Oak (Quercus sp.)																
Persimmon (Diospyros virginiana)			1	1												
Pin Oak (Quercus palustris)																
Red Chokeberry (Aronia arbutifolia)																
Red Maple (Acer rubrum)			1	1			4	4							1	1
River Birch (Betula nigra)	1	1	2	5	4	4	3	3					1	1		
Silky Dogwood (Cornus amomum)	2	2	7	7					5	7	1	1				
Smooth Sumac (Rhus glabra)																
Sugarberry (Celtis laevigata)									1	1	2	2				
Swamp Chestnut Oak (Quercus michauxii)							1	1								
Sycamore (Platanus occidentalis)			1	2					1	1						
Tulip Poplar (Liriodendron tulipifera)																
Willow Oak (Quercus phellos)					2	2					1	1			2	2
Witch Hazel (Hamamelis virginiana)																
Unknown																
Stem count	6	6	13	19	8	8	10	10	9	13	7	7	6	8	6	6
size (ares)	1		1		1		1		1		1		1		1	
size (ACRES)	0.025		0.025		0.025		0.025		0.025		0.025		0.025		0.025	
Species count	3	3	6	7	3	3	4	4	4	5	5	5	3	3	4	4
Stems per ACRE	243	243	526	769	324	324	405	405	364	526	283	283	243	324	243	243

Table 7. Stem Count by Plot and Species												
Sandy Bridge Farm Restoration Site, DMS Project #96920												
	Current Plot Data (MY03 2019)				**Annual Means**							
	Plot 09		**Plot 10**		**MY03 (2019)**		**MY02 (2018)**		**MY01 (2017)**		**MY00 (2016)**	
Species	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**	**Planted**	**Total**
American Elm (Ulmus americana)			2	2	6	7	6	6	7	7		
Black Walnut (Juglans nigra)									1	1		
Black Willow (Salix nigra)						2		1				
Box Elder (Acer negundo)		10		5		15		8		1		
Buttonbush (Cephalanthus occidentalis)					8	10	8	8	9	9		
Eastern Cottonwood (Populus deltoides)					7	8	9	9	16	16		
Green Ash (Fraxinus pennsylvanica)	11	11	1	1	14	14	13	13				
Oak (Quercus sp.)											4	4
Persimmon (Diospyros virginiana)					1	1	1	1				
Pin Oak (Quercus palustris)							2	2	2	2		
Red Chokeberry (Aronia arbutifolia)	6	6			6	6	6	6	2	2		
Red Maple (Acer rubrum)		2			6	8	6	6	9	9		
River Birch (Betula nigra)					11	14	11	12	11	11		
Silky Dogwood (Cornus amomum)	4	6	1	1	20	24	21	22	13	13		
Smooth Sumac (Rhus glabra)									1	2		
Sugarberry (Celtis laevigata)					3	3	3	4	4	4		
Swamp Chestnut Oak (Quercus michauxii)	3	3	6	6	10	10	10	10	3	3		
Sycamore (Platanus occidentalis)	1	5	2	2	5	10	5	12	3	5		
Tulip Poplar (Liriodendron tulipifera)			1	1	1	1	1	1	6	6	1	1
Willow Oak (Quercus phellos)	1	1			6	6	7	7	6	6		
Witch Hazel (Hamamelis virginiana)									1	1		
Unknown									3	3	139	139
Stem count	26	44	13	18	104	139	109	128	97	101	144	144
size (ares)	1		1		8		8		8		8	
size (ACRES)	0.025		0.025		0.20		0.197684		0.20		0.20	
Species count	6	8	6	7	0	0	15	17	17	18	3	3
Stems per ACRE	1052	1781	526	728	526	703	551	647	491	511	728	728

APPENDIX D

Stream Measurement and Geomorphology Data

Table 8. Baseline Stream Data Summary
Sandy Bridge Farm Stream Restoration Site, DMS Project #96920

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design	As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Proposed	Min	Mean	Max	n
Bankfull Width (ft)	31.5	32.9	330	34.0	4	14.8	16.7		18.6	2	15.0	15.4	17.2	18.9	2
Floodprone Width (ft)	60.9	72.9	69.3	92.0	4	>40	>47		>55	2	>38	>60	>68	>70	2
Bankfull Mean Depth (ft)	2.1	2.2	2.2	2.5	4	1.3	1.5		1.7	2	0.9	0.7	0.8	0.9	2
Bankfull Max Depth (ft)	3.1	3.4	3.4	3.7	4	1.9	2.2		2.4	2	1.3	1.5	1.5	1.5	2
Bankfull Cross-Sectional Area (ft^2)	66.6	73.2	71.2	84.0	4	25.0	25.1		25.1	2	12.7	13.2	13.5	13.8	2
Width/Depth Ratio	13.5	14.8	14.9	16.0	4	8.8	11.3		13.8	2	17.7	17.3	22.1	27.0	2
Entrenchment Ratio	1.9	2.2	2.2	2.7	4	>2.5	>2.5		>2.5	2	>2.5	3.8	4.0	4.1	2
Bank Height Ratio	1.1	1.4	1.3	1.7	4	1.2	1.4		1.5	2	1.0	1.0	1.0	1.0	2
Pattern															
Channel Beltwidth (ft)	*					60				1	35-60	35		60	2
Radius of Curvature (ft)	*					16			87	1	30-50	30		50	2
Rc:Bankfull width (ft/ft)	*					0.9			5.9	1	2.0-3.3	2.0		3.3	2
Meander Wavelength (ft)	*					66			191	1	134-160	134		160	2
Meander Width Ratio	*					4.1				1	8.9-10.7	8.9		10.7	2
Riffle Length (ft)												23	40	56	20
Riffle Slope (ft/ft)	0.000			0.010	2	0.013			0.035	2	0.002-0.008	0.000	0.006	0.014	20
Pool Length (ft)	*					14			33	2	17-55	11	22	39	20
Pool Spacing (ft)	*					50			105	2	55-90	25.9	78.3	102.2	19
Substrate and Transport Parameters															
SC% / Sa% / G% / C% / B% / Be%	18%/39%/43%/1%/0%/0%											66%/2%/22%/10%/1%/0%			
d16 / d35 / d50 / d84 / d95 (mm)	0.076/1.2/3.3/5.2/9.4/18											0.062/0.5/17.5/25.5/40/90			
Channel length (ft)	1,470										1,626	1,626			
Drainage Area (SM)	1.31					1.49					1.31	1.31			
Rosgen Classification	E4-G4					C4					C4	C4			
Sinuosity	1.0					1.3					1.2	1.2			
Water Surface Slope (ft/ft)	0.0043					0.0050					0.0038	0.0027			

*No data shown due to channelization/lack of bed diversity

Table 9. Cross-Section Morphology Data Tables
Sandy Bridge Farm Stream Restoration Site, DMS Project #96920

Dimension and Substrate	Cross-Section 1 (Riffle) Station 14+75							Cross-Section 2 (Pool) Station 16+40						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation	866.7	866.9	867.3	867.4				866.7	866.7	867.5	867.7			
Bankfull Width (ft)	15.4	15.7	18.1	13.8				18.8	19.6	18.6	21.0			
Floodprone Width (ft)	>80	>80	>80	>80				-	-	-	-			
Bankfull Mean Depth (ft)	0.9	0.9	0.8	1.0				1.4	1.4	1.4	1.3			
Bankfull Max Depth (ft)	1.5	1.7	2.0	2.1				2.7	2.7	2.2	2.7			
Bankfull Cross-Sectional Area (ft^2)	13.8	13.8	13.8	13.8				26.8	26.8	26.8	26.8			
Total Cross-Sectional Area (ft^2)	13.8	10.9	7.2	7.1				26.8	26.2	12.9	10.9			
Bankfull Width/Depth Ratio	17.3	17.9	23.6	13.4				-	-	-	-			
Bankfull Entrenchment Ratio	4.1	5.1	4.4	5.9				-	-	-	-			
Bankfull Bank Height Ratio	1.0	1.0	0.8	0.8				-	-	-	-			
d50 (mm)	35	26	0.7	0.6				-	-	-	-			

	Cross-Section 3 (Riffle) Station 101+73							Cross-Section 4 (Pool) Station 105+67						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Elevation	865.3	865.3	865.2	865.2				865.3	865.16	865.1	865.4			
Bankfull Width (ft)	15.7	17.3	15.4	16.7				18.7	18.1	17.1	20.4			
Floodprone Width (ft)	>70	>70	>70	>70				-	-	-	-			
Bankfull Mean Depth (ft)	0.8	0.8	0.9	0.8				1.5	1.6	1.7	1.4			
Bankfull Max Depth (ft)	1.5	1.6	1.6	1.7				3.0	3.1	3.0	1.9			
Bankfull Cross-Sectional Area (ft^2)	13.1	13.1	13.1	13.1				28.8	28.8	28.8	28.8			
Total Cross-Sectional Area (ft^2)	13.1	12.4	15.1	15.1				28.8	30.7	32.1	20.7			
Bankfull Width/Depth Ratio	18.8	22.8	18.0	19.7				-	-	-	-			
Bankfull Entrenchment Ratio	4.6	4.2	4.7	4.5				-	-	-	-			
Bankfull Bank Height Ratio	1.0	1.0	1.0	0.9				-	-	-	-			
d50 (mm)	0.062	0.062	0.062	0.062				-	-	-	-			

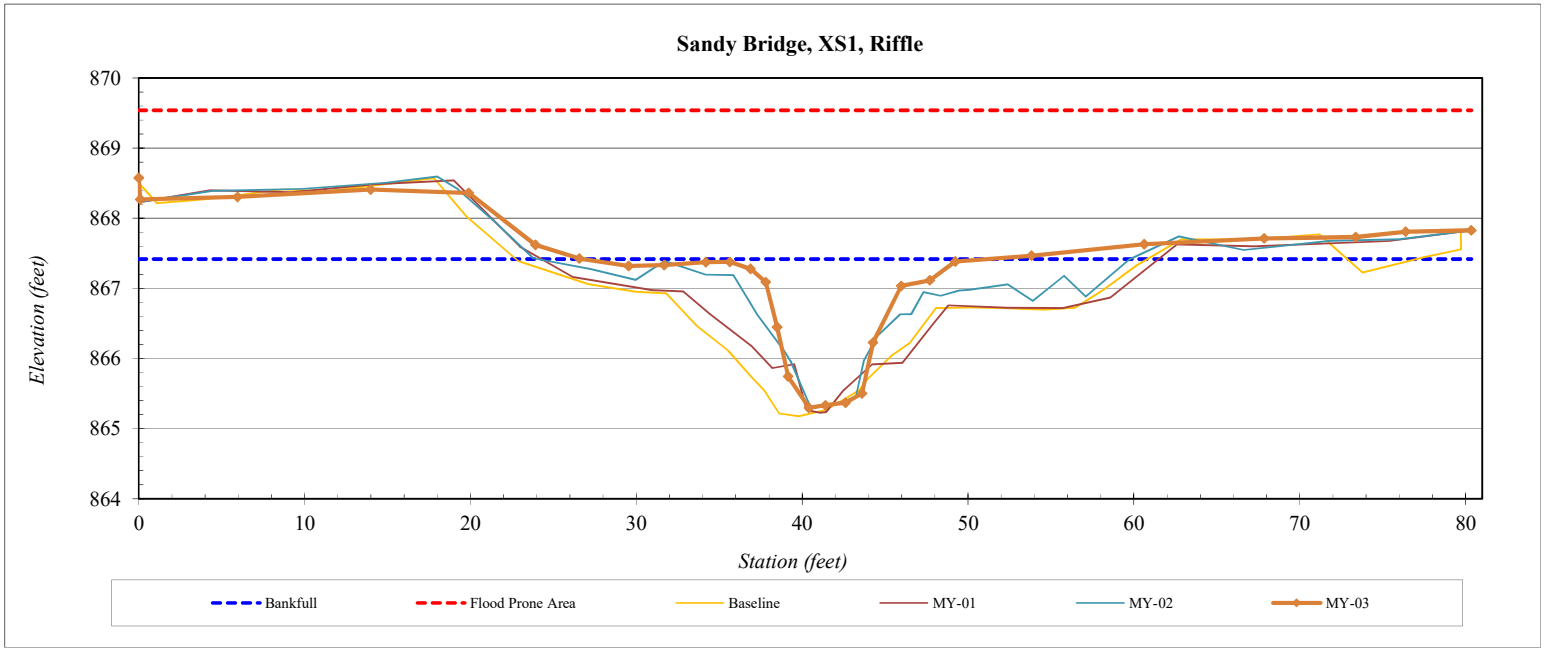
Calculations are based on a fixed bankfull area established during the baseline survey, and the resulting bankfull elevation. Total Cross-Sectional Area represents the cross-sectional area measured from the baseline bankfull elevation.

Cross-Section Plots

River Basin:	Broad
Site:	Sandy Bridge
XS ID	XS1
Drainage Area:	837 acres
Date:	6/19/2019
Field Crew:	T. Seelinger, A. Gutierrez

Station	Elevation
0.0	868.58
0.1	868.27
6.0	868.31
14.0	868.41
19.9	868.36
23.9	867.62
26.6	867.42
29.5	867.32
31.7	867.33
34.2	867.37
35.6	867.38
36.9	867.28
37.8	867.09
38.5	866.45
39.2	865.74
40.4	865.30
41.4	865.33
42.6	865.37
43.6	865.50
44.3	866.23
46.0	867.04
47.7	867.12
49.2	867.39
53.8	867.47
60.6	867.63
67.8	867.71
73.4	867.73
76.4	867.81
80.4	867.83

SUMMARY DATA	
Current Bankfull Elevation:	867.42
Bankfull Cross-Sectional Area:	13.8
Total Cross-Sectional Area:	7.1
Bankfull Width:	13.6
Flood Prone Area Elevation:	869.5
Flood Prone Width:	80.4
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.0
W / D Ratio:	13.4
Entrenchment Ratio:	5.9
Bank Height Ratio:	0.8

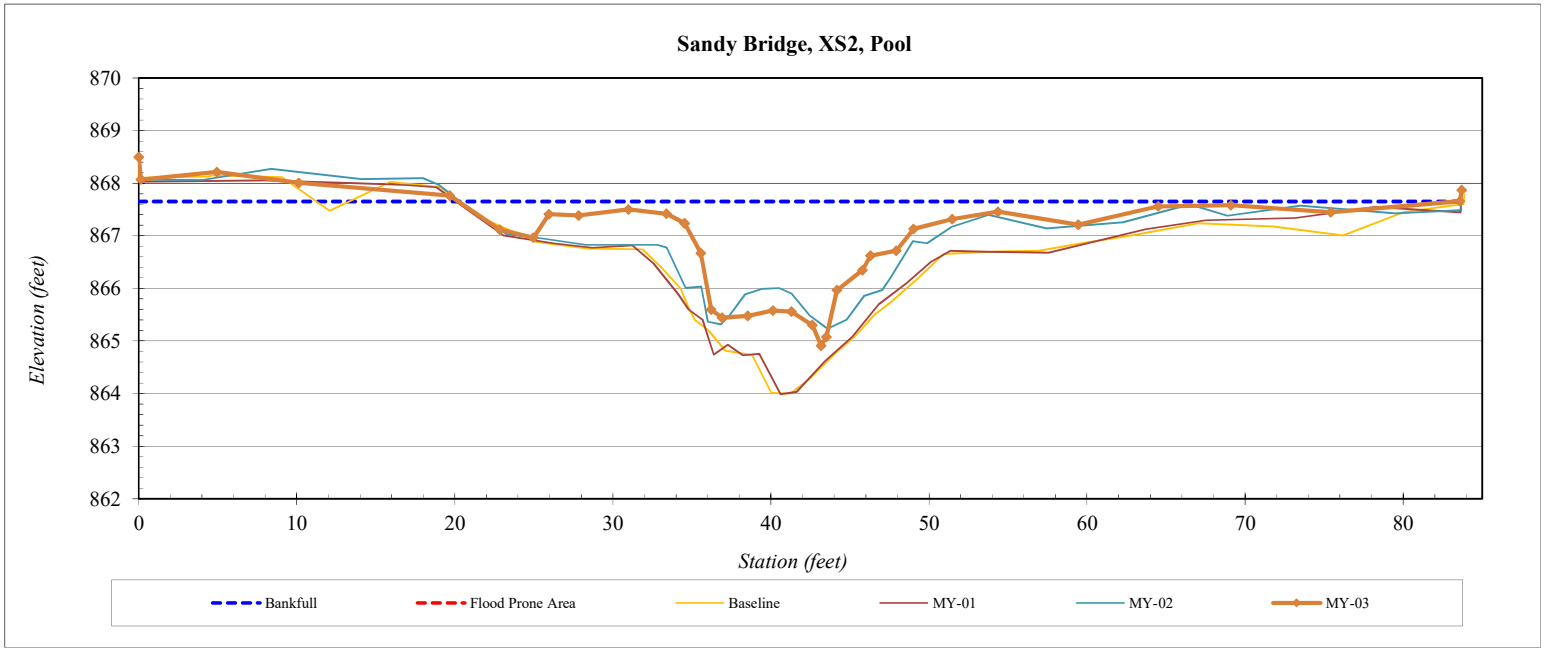


Cross-Section Plots

River Basin:	Broad
Site:	Sandy Bridge
XS ID	XS2
Drainage Area:	837 acres
Date:	6/19/2019
Field Crew:	T. Seelinger, A. Gutierrez

Station	Elevation
0.0	868.50
0.1	868.07
5.0	868.21
10.1	868.01
19.7	867.76
22.8	867.12
25.0	866.96
26.0	867.41
27.8	867.39
31.0	867.50
33.4	867.42
34.5	867.24
35.6	866.67
36.2	865.60
36.9	865.45
38.5	865.48
40.1	865.58
41.3	865.56
42.6	865.30
43.2	864.91
43.5	865.08
44.2	865.97
45.8	866.34
46.3	866.62
47.9	866.72
49.0	867.13
51.5	867.32
54.4	867.46
59.4	867.21
64.5	867.56
69.1	867.58
75.4	867.45
83.6	867.66
83.7	867.87

SUMMARY DATA	
Current Bankfull Elevation:	867.65
Bankfull Cross-Sectional Area:	26.8
Total Cross-Sectional Area:	10.9
Bankfull Width:	21.0
Flood Prone Area Elevation:	---
Flood Prone Width:	---
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.3
W / D Ratio:	---
Entrenchment Ratio:	---
Bank Height Ratio:	---

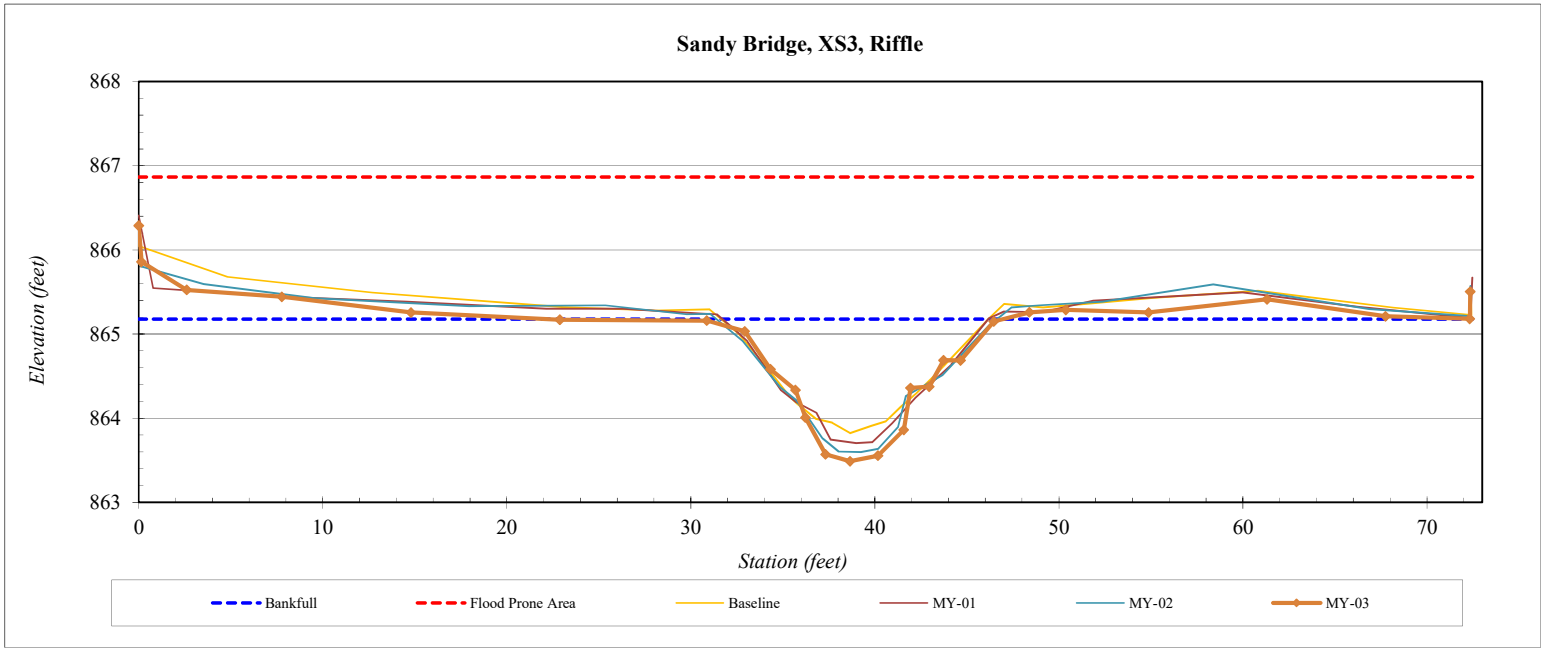


Cross-Section Plots

River Basin:	Broad
Site:	Sandy Bridge
XS ID	XS3
Drainage Area:	837 acres
Date:	6/19/2019
Field Crew:	T. Seelinger, A. Gutierrez

Station	Elevation
0.0	866.29
0.1	865.86
2.6	865.53
7.8	865.44
14.8	865.26
22.9	865.17
30.9	865.16
32.9	865.03
34.3	864.58
35.7	864.34
36.2	864.01
37.3	863.57
38.6	863.49
40.2	863.56
41.6	863.86
41.9	864.36
43.0	864.38
43.7	864.69
44.7	864.69
46.5	865.15
48.4	865.26
50.4	865.29
54.9	865.26
61.3	865.41
67.7	865.21
72.3	865.18
72.3	865.50

SUMMARY DATA	
Current Bankfull Elevation:	865.18
Bankfull Cross-Sectional Area:	13.1
Total Cross-Sectional Area:	15.1
Bankfull Width:	16.1
Flood Prone Area Elevation:	866.9
Flood Prone Width:	72.3
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.8
W / D Ratio:	19.7
Entrenchment Ratio:	4.5
Bank Height Ratio:	0.9

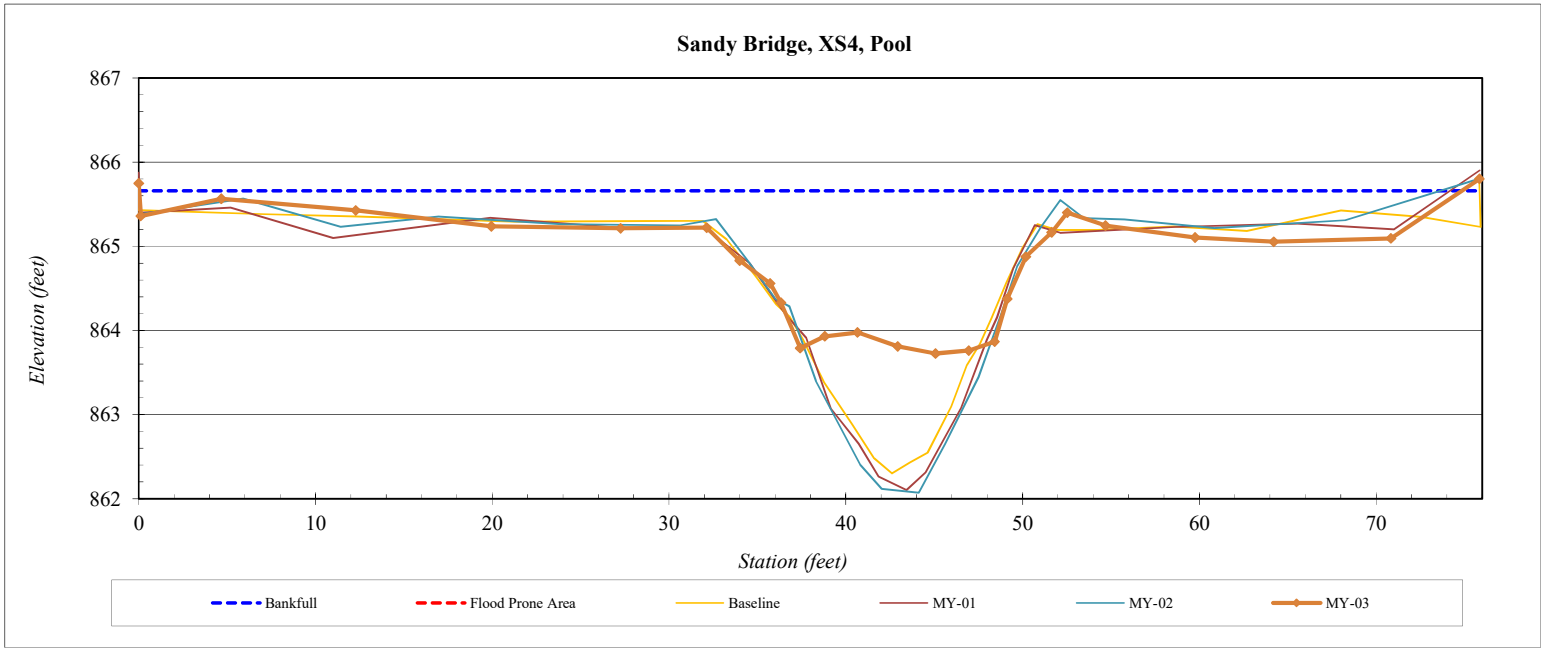


Cross-Section Plots

River Basin:	Broad
Site:	Sandy Bridge
XS ID	XS4
Drainage Area:	837 acres
Date:	6/19/2019
Field Crew:	T. Seelinger, A. Gutierrez

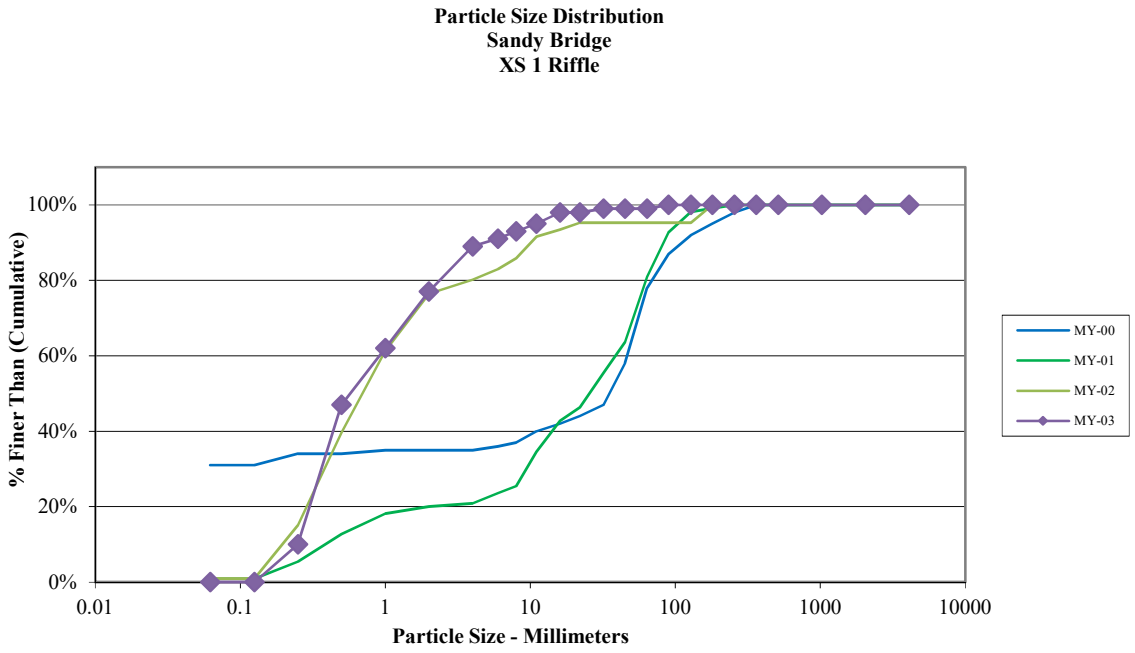
Station	Elevation
0.0	865.75
0.1	865.36
4.7	865.56
12.3	865.43
19.9	865.24
27.3	865.22
32.1	865.22
34.0	864.83
35.7	864.56
36.3	864.33
37.4	863.79
38.8	863.93
40.7	863.98
42.9	863.81
45.1	863.73
47.0	863.76
48.4	863.87
49.1	864.38
50.2	864.88
51.6	865.17
52.5	865.40
54.7	865.25
59.8	865.11
64.2	865.05
70.8	865.09
75.8	865.80

SUMMARY DATA	
Current Bankfull Elevation:	865.66
Bankfull Cross-Sectional Area:	28.8
Total Cross-Sectional Area:	20.7
Bankfull Width:	20.4
Flood Prone Area Elevation:	---
Flood Prone Width:	---
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.4
W / D Ratio:	---
Entrenchment Ratio:	---
Bank Height Ratio:	---



Cross-Section 1 Riffle - MY-03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	10
Medium	.25 - .50	N	37
Coarse	.50 - 1	D	15
Very Coarse	1 - 2	S	15
Very Fine	2 - 4		12
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	1
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



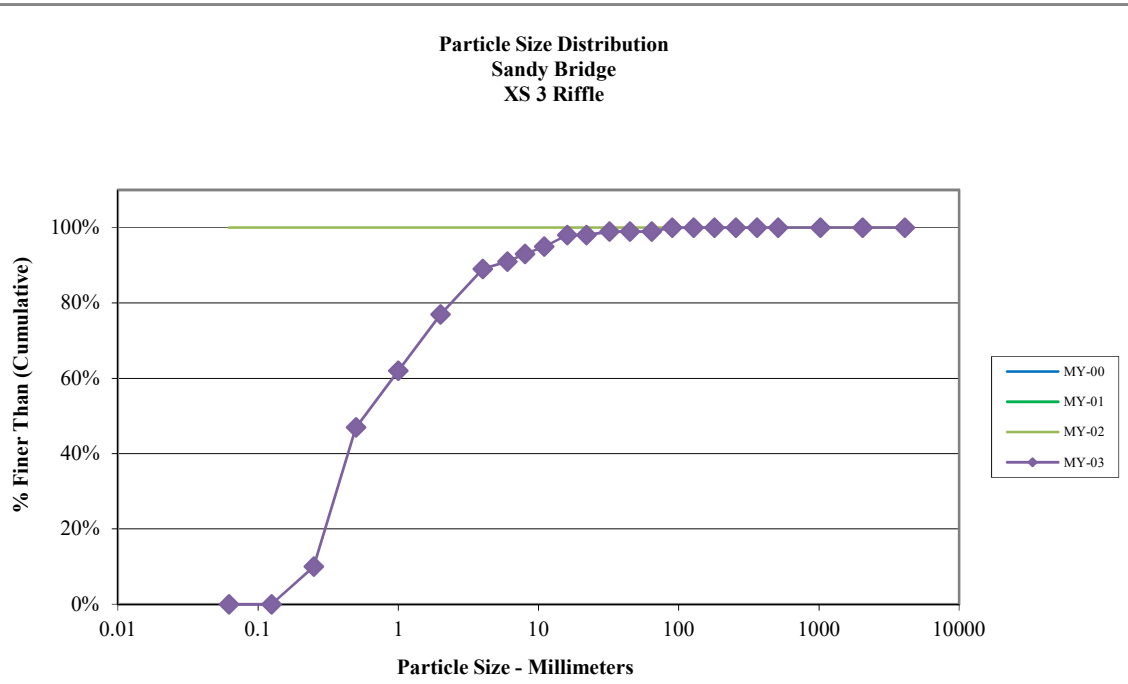
Size (mm)	
D16	0.28
D35	0.4
D50	0.57
D65	1.1
D84	3
D95	11

Size Distribution	
mean	0.9
dispersion	3.6
skewness	0.20

Type	
silt/clay	0%
sand	77%
gravel	22%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Riffle - MY-03			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	75
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	5
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	10
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.29
D95	0.81

Size Distribution	
mean	0.1
dispersion	2.8
skewness	0.41

Type	
silt/clay	75%
sand	25%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

APPENDIX E

Hydrologic Data

Sandy Bridge Farm Restoration Site
30-70 Percentile Graph
WETS Station Name: Lake Lure 2, NC

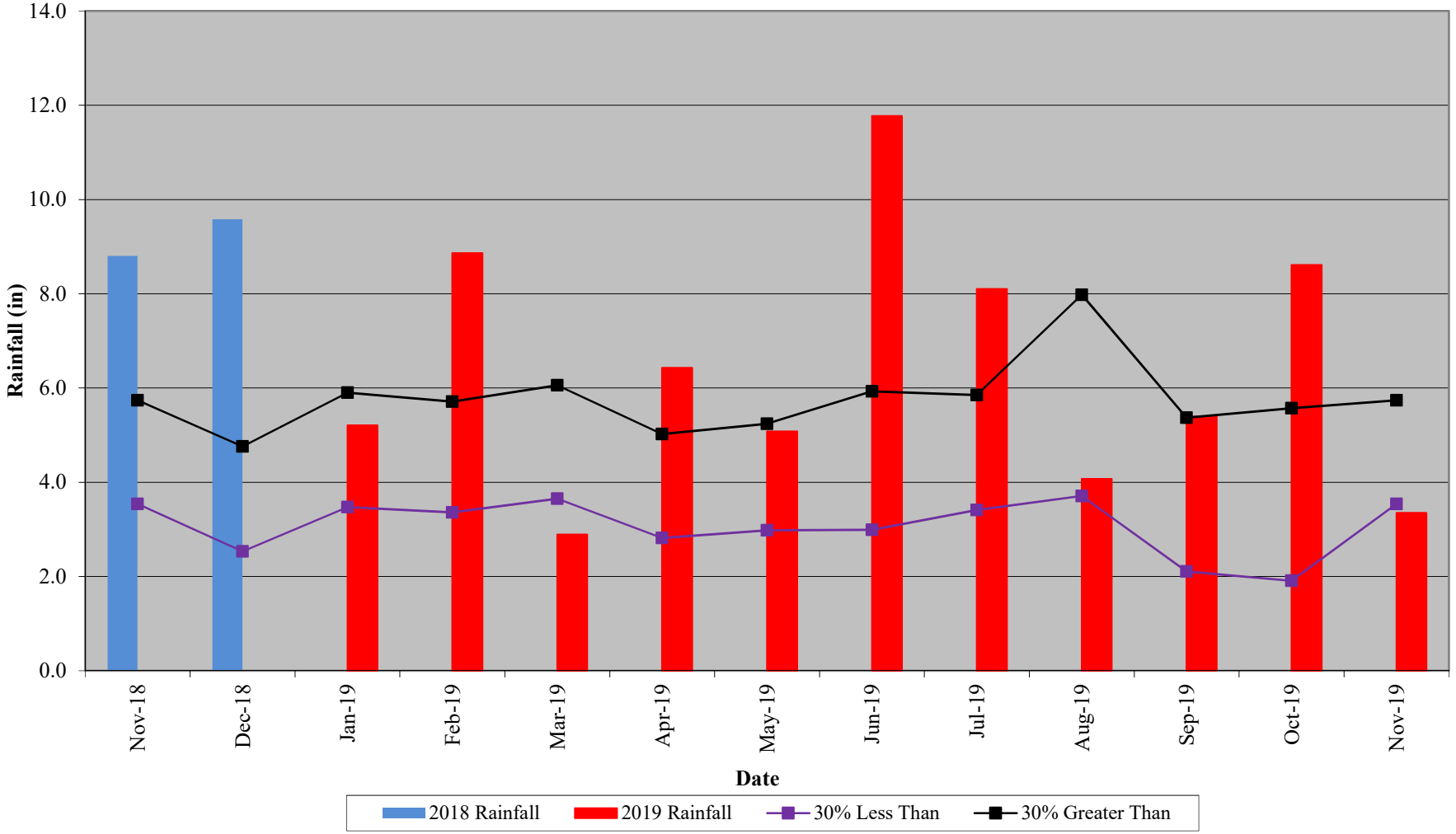


Table 10. Verification of Bankfull Events Sandy Bridge Farm Restoration Site, DMS Project #96920		
Date of Occurrence	**Method**	**Photo Number**
April 6, 2017	Onsite stream gauge	
April 24, 2017	Onsite stream gauge	
May 29, 2017	Onsite stream gauge	
August 3, 2017	Onsite stream gauge	
August 14, 2017	Onsite stream gauge	
August 15, 2017	Onsite stream gauge	
September 5, 2017	Onsite stream gauge	
October 23, 2017	Onsite stream gauge, photos taken on site	1
February 7, 2018	Onsite stream gauge, photos taken on site	2
February 11, 2018	Onsite stream gauge	
April 15, 2018	Onsite stream gauge	
April 24, 2018	Onsite stream gauge	
May 19, 2018	Onsite stream gauge	
May 30, 2018	Onsite stream gauge	
September 16, 2018	Onsite stream gauge	
October 11, 2018	Onsite stream gauge	3
January 4, 2019	Onsite stream gauge	
January 20, 2019	Onsite stream gauge	
January 24, 2019	Onsite stream gauge	
February 18, 2019	Onsite stream gauge	
February 21, 2019	Onsite stream gauge	
February 22, 2019	Onsite stream gauge	
April 8, 2019	Onsite stream gauge	
May 11, 2019	Onsite stream gauge	
June 18, 2019	Onsite stream gauge	
October 31, 2019	Onsite stream gauge	

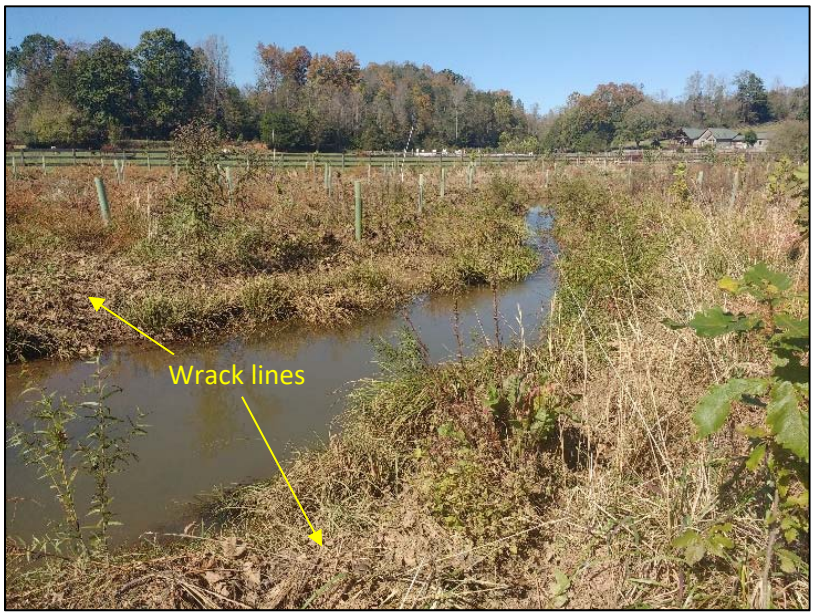
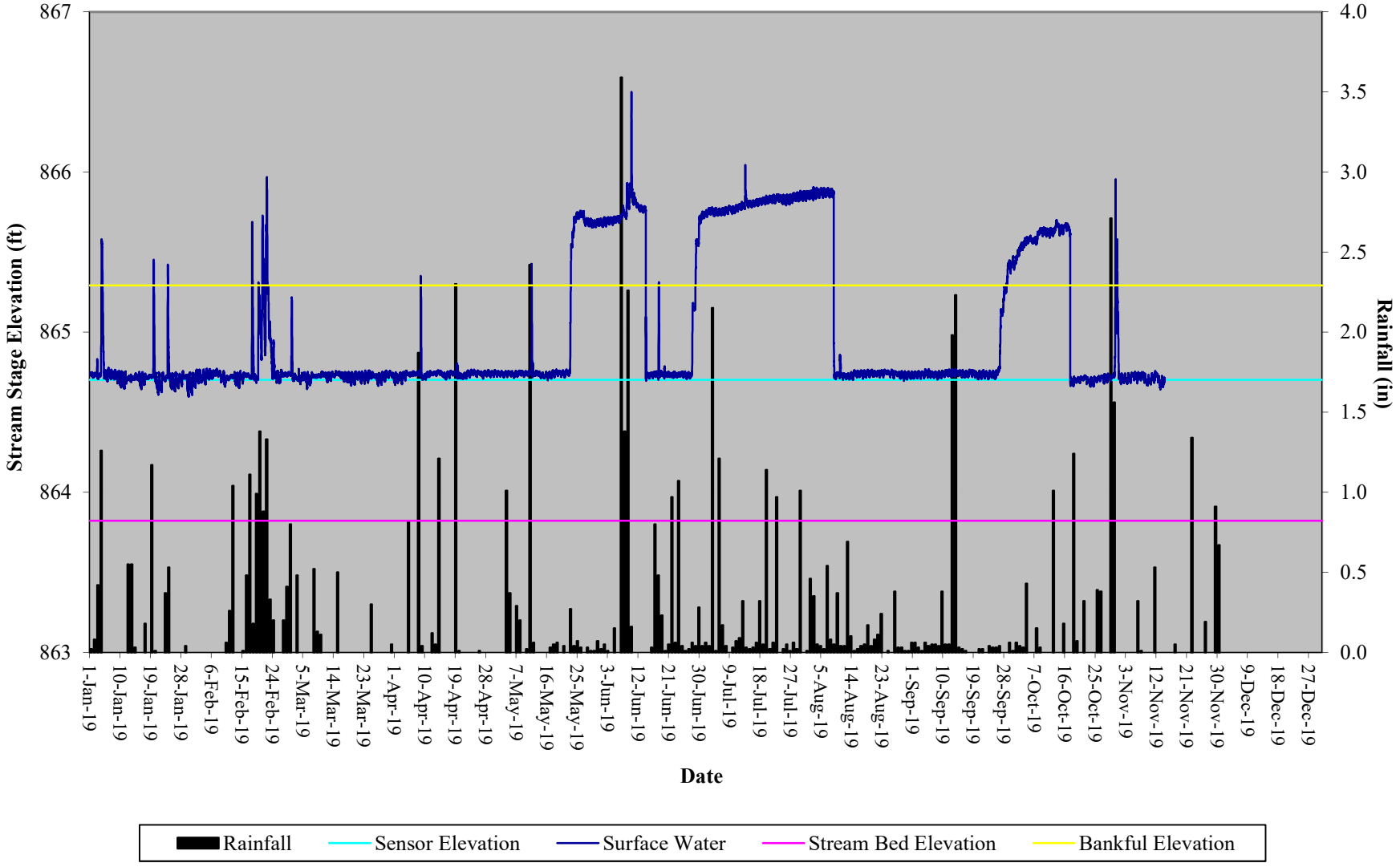


Photo 1. Sediment on plants and wrack lines above bankfull, 10/26/2017

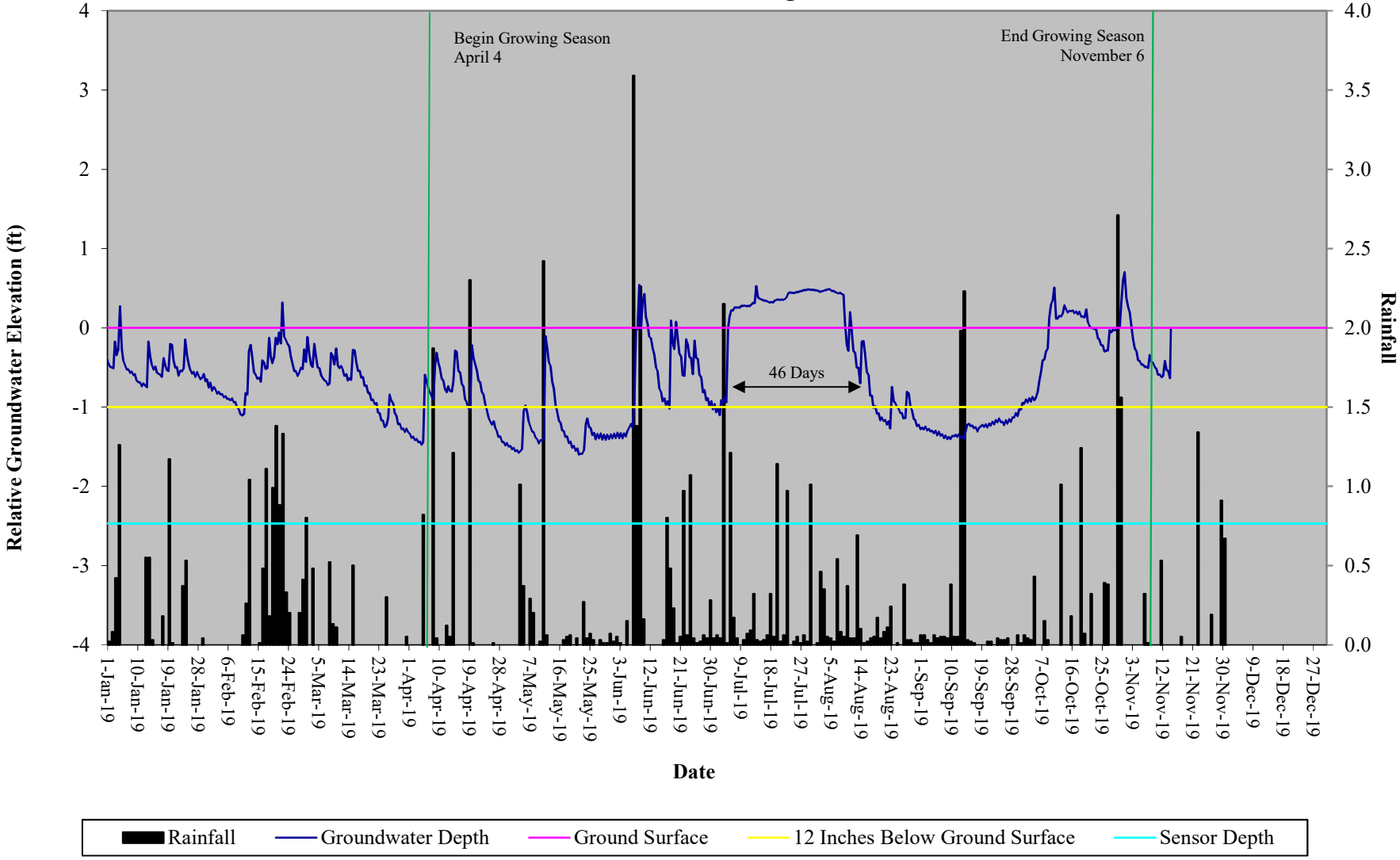
Photo 2. Bankfull event on site, 2/7/2018

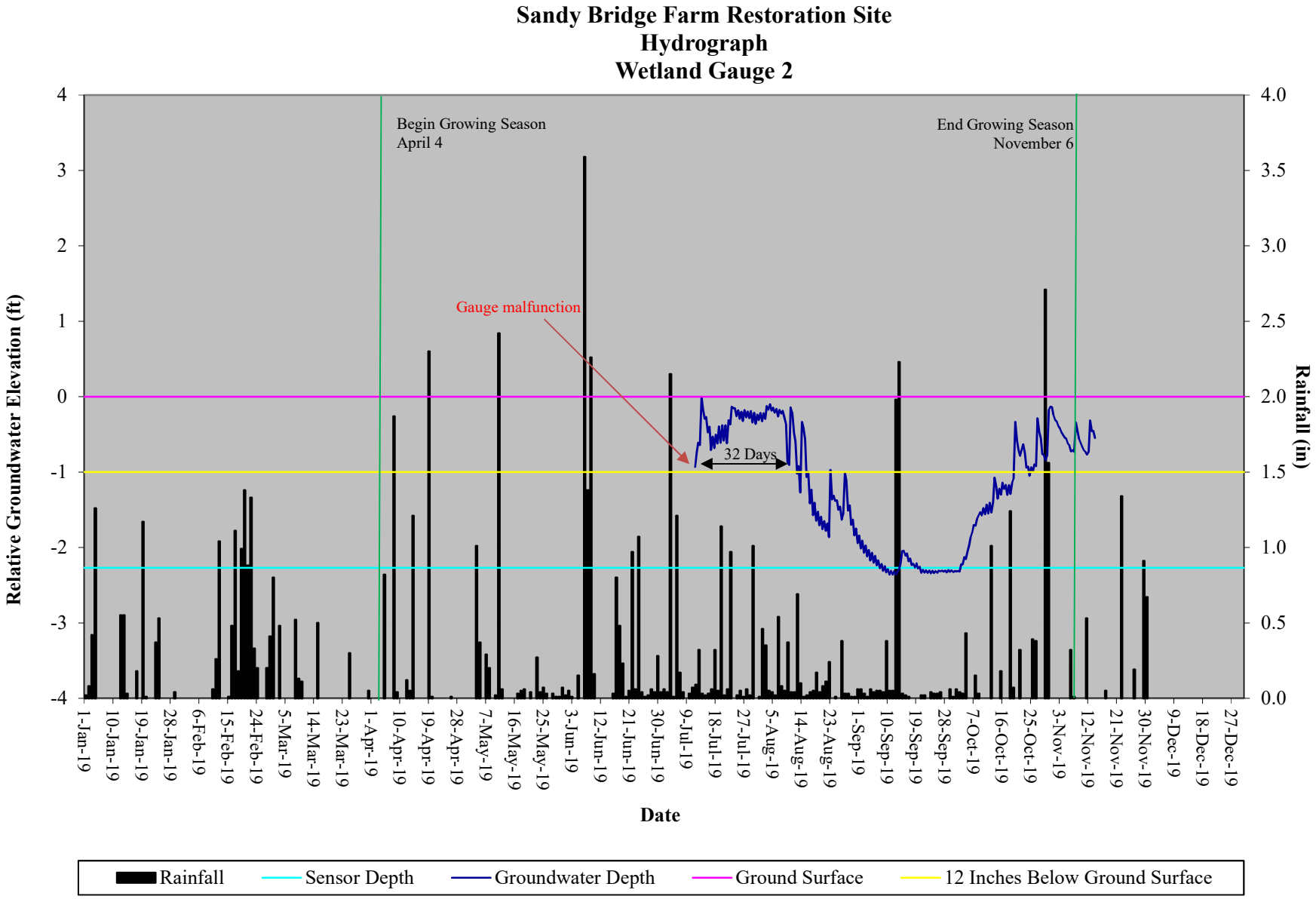
Photo 3. Wrack lines above bankfull, 11/7/2018

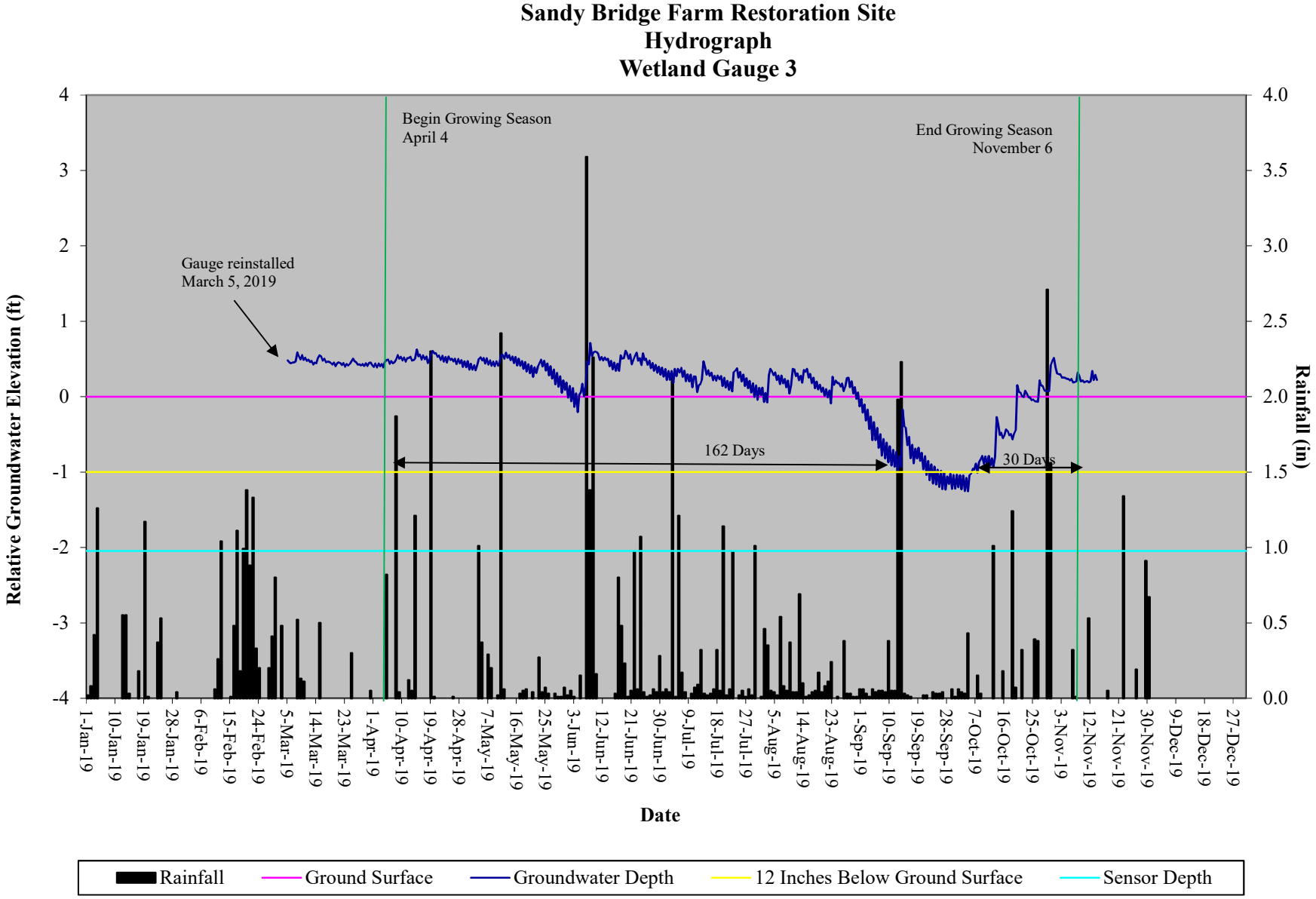
Sandy Bridge Farm Restoration Site
Hydrograph
Stream Gauge



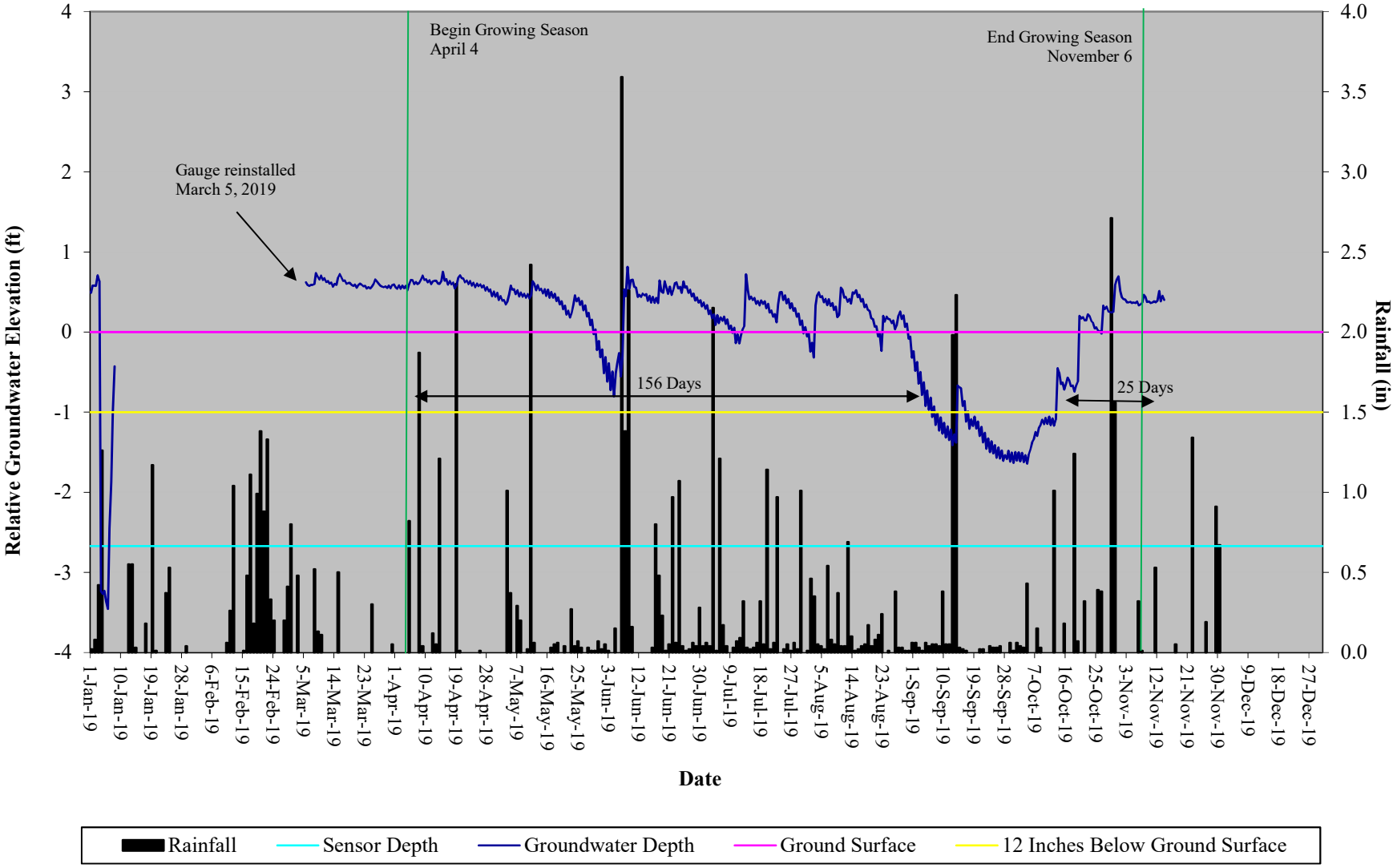
Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 1



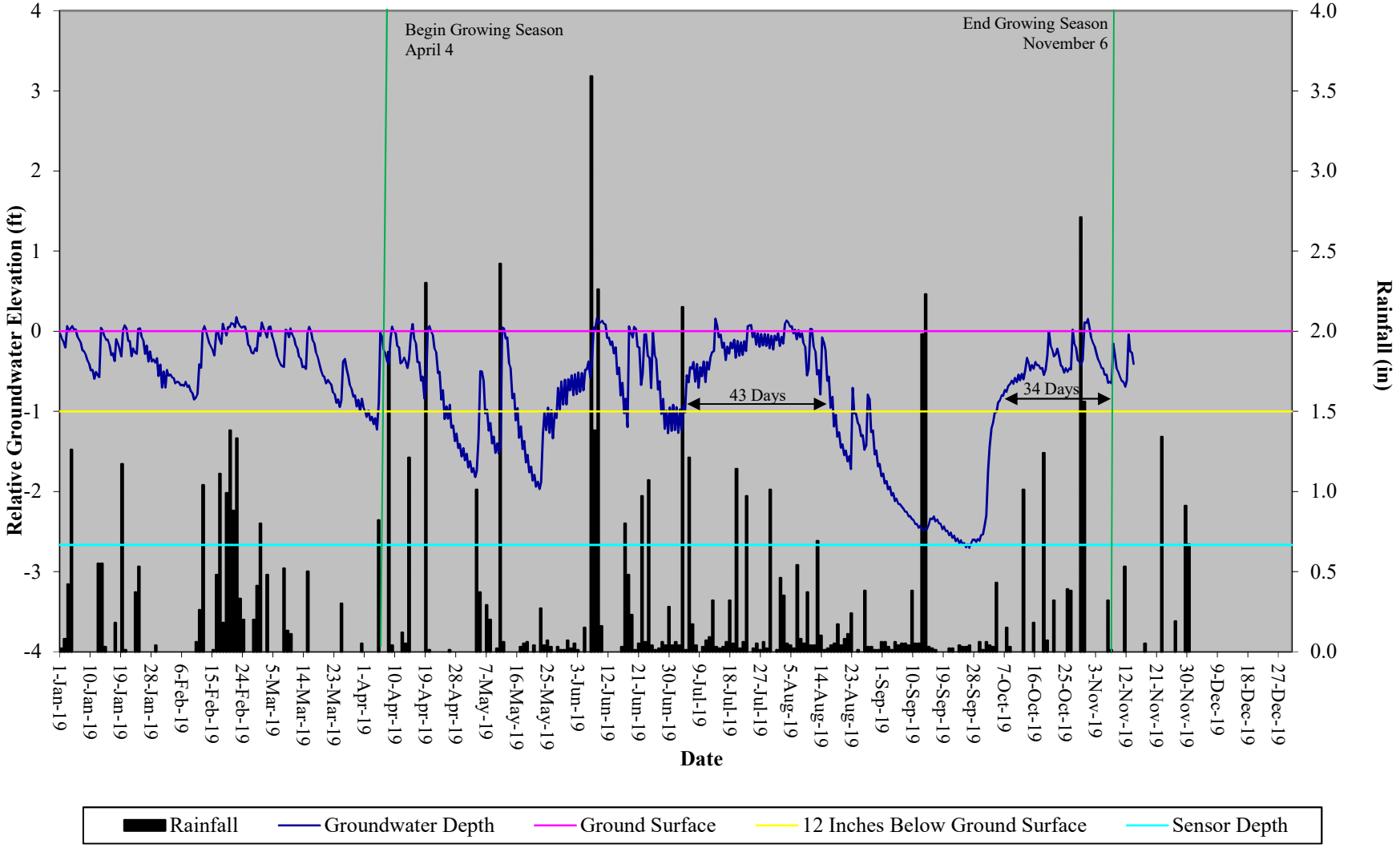

Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 2
Begin Growing Season
April 4
End Growing Season
November 6
Gauge malfunction
32 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

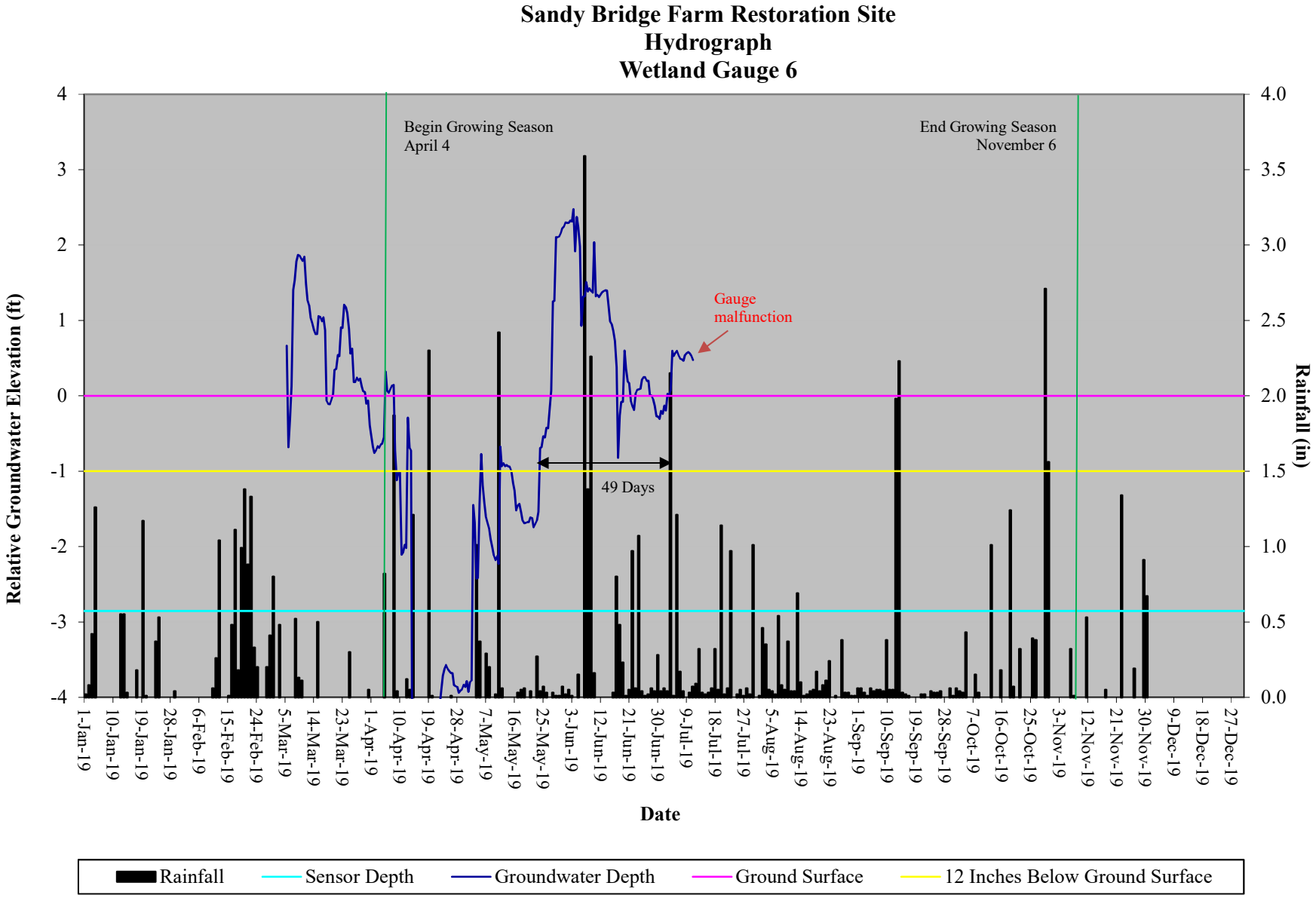

Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 3
Begin Growing Season
April 4
End Growing Season
November 6
Gauge reinstalled
March 5, 2019
162 Days
30 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Ground Surface
Groundwater Depth
12 Inches Below Ground Surface
Sensor Depth

Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 4

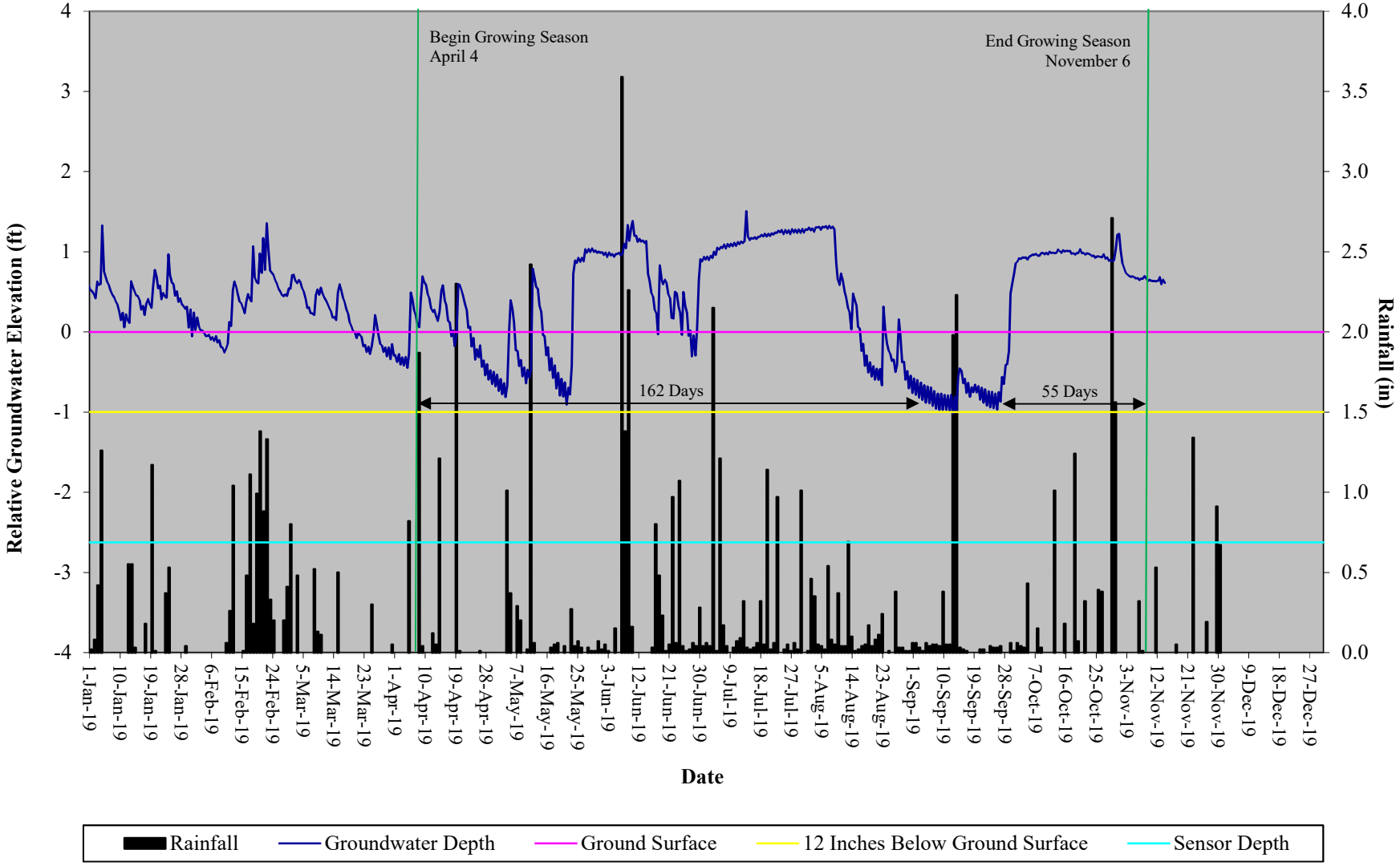


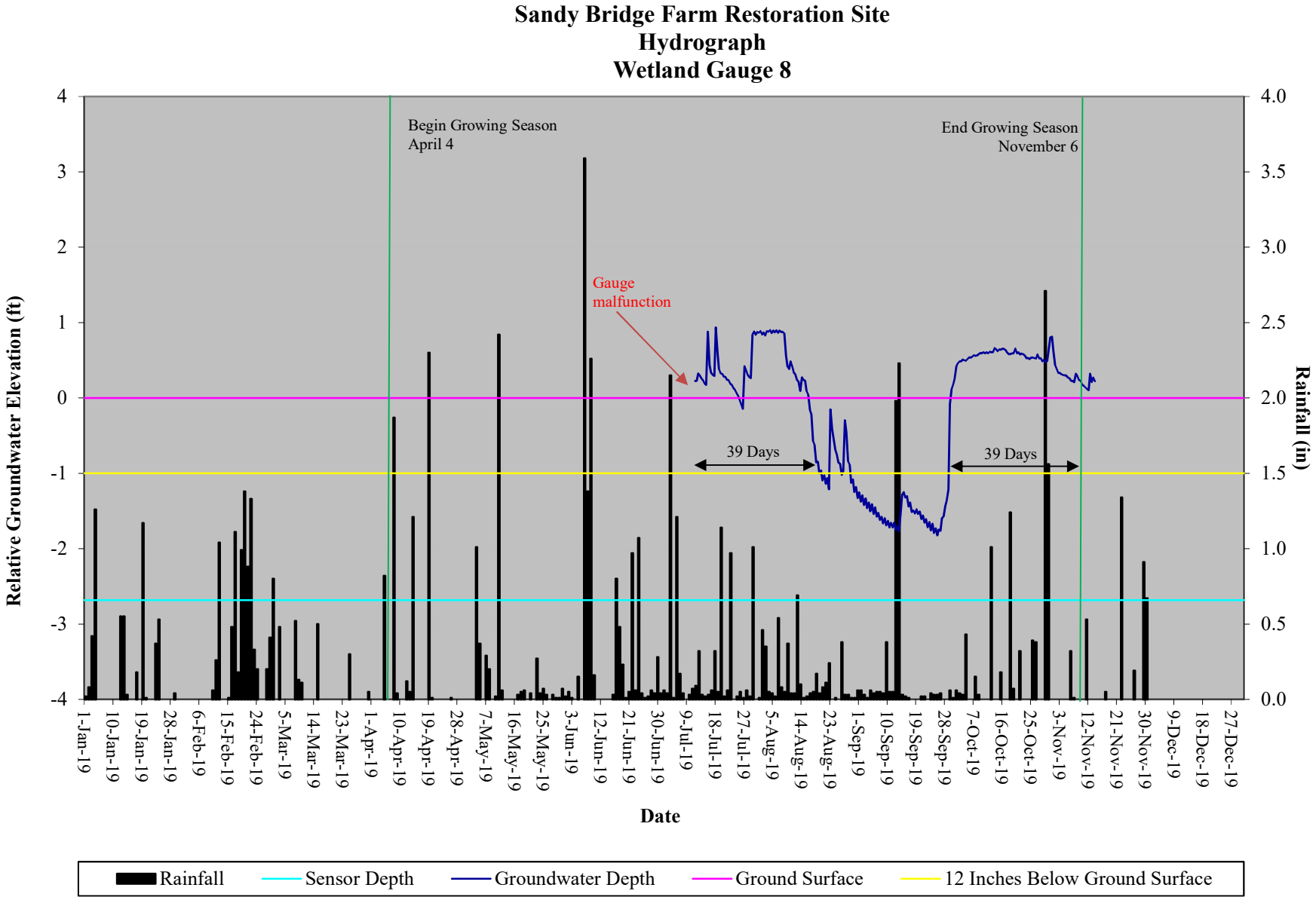
Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 5

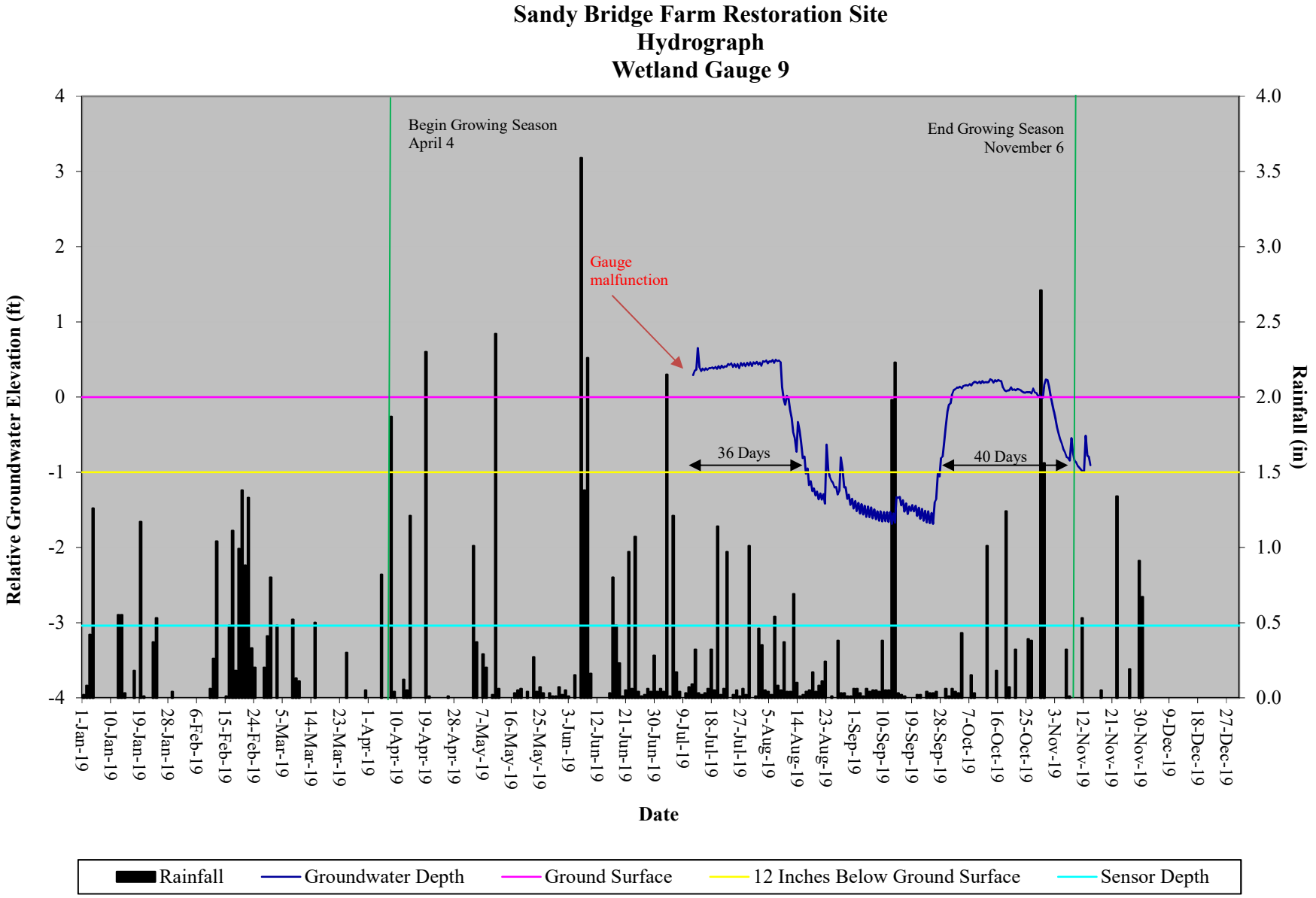



Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 6
Begin Growing Season
April 4
End Growing Season
November 6
Gauge
malfunction
49 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

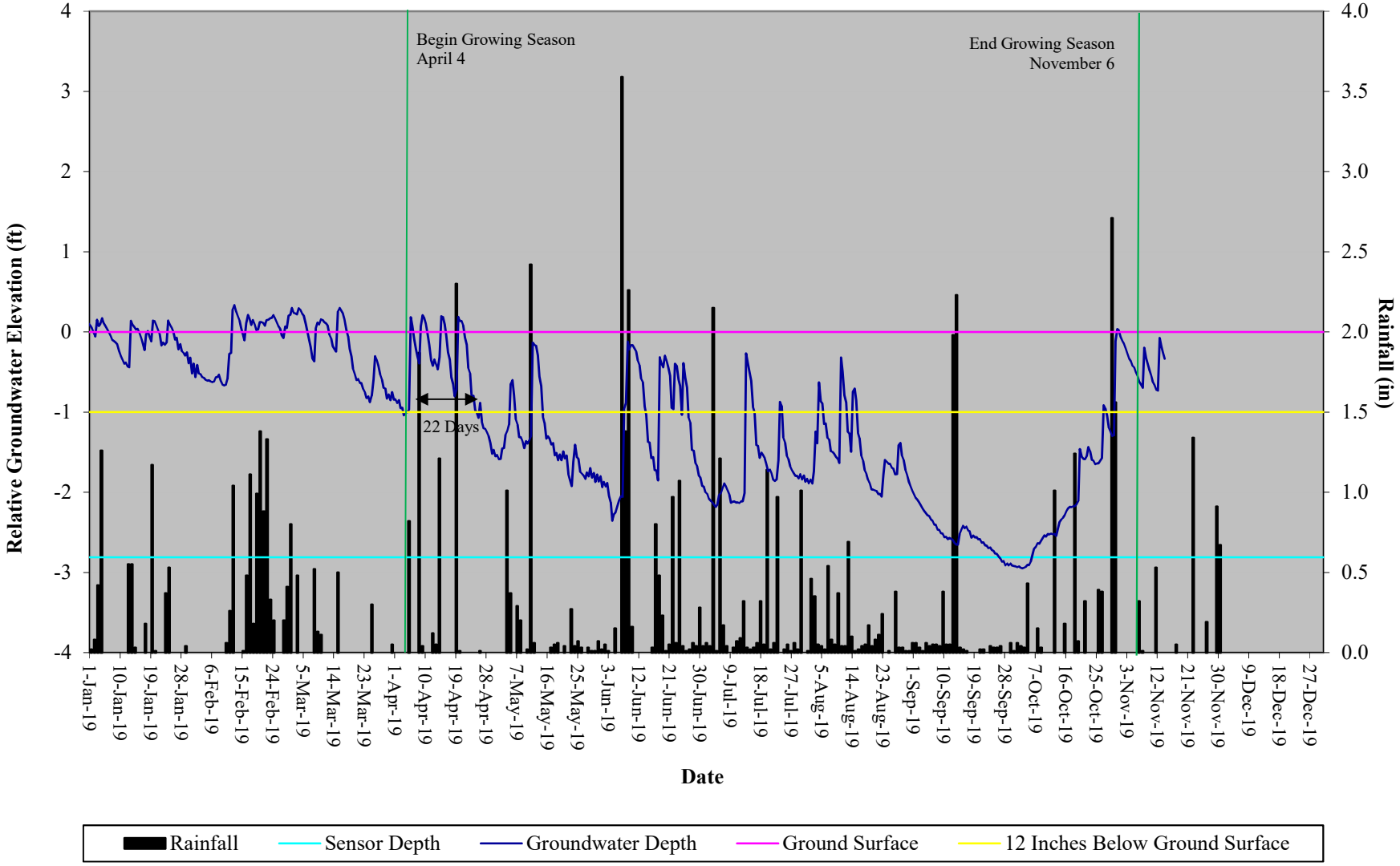
Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 7

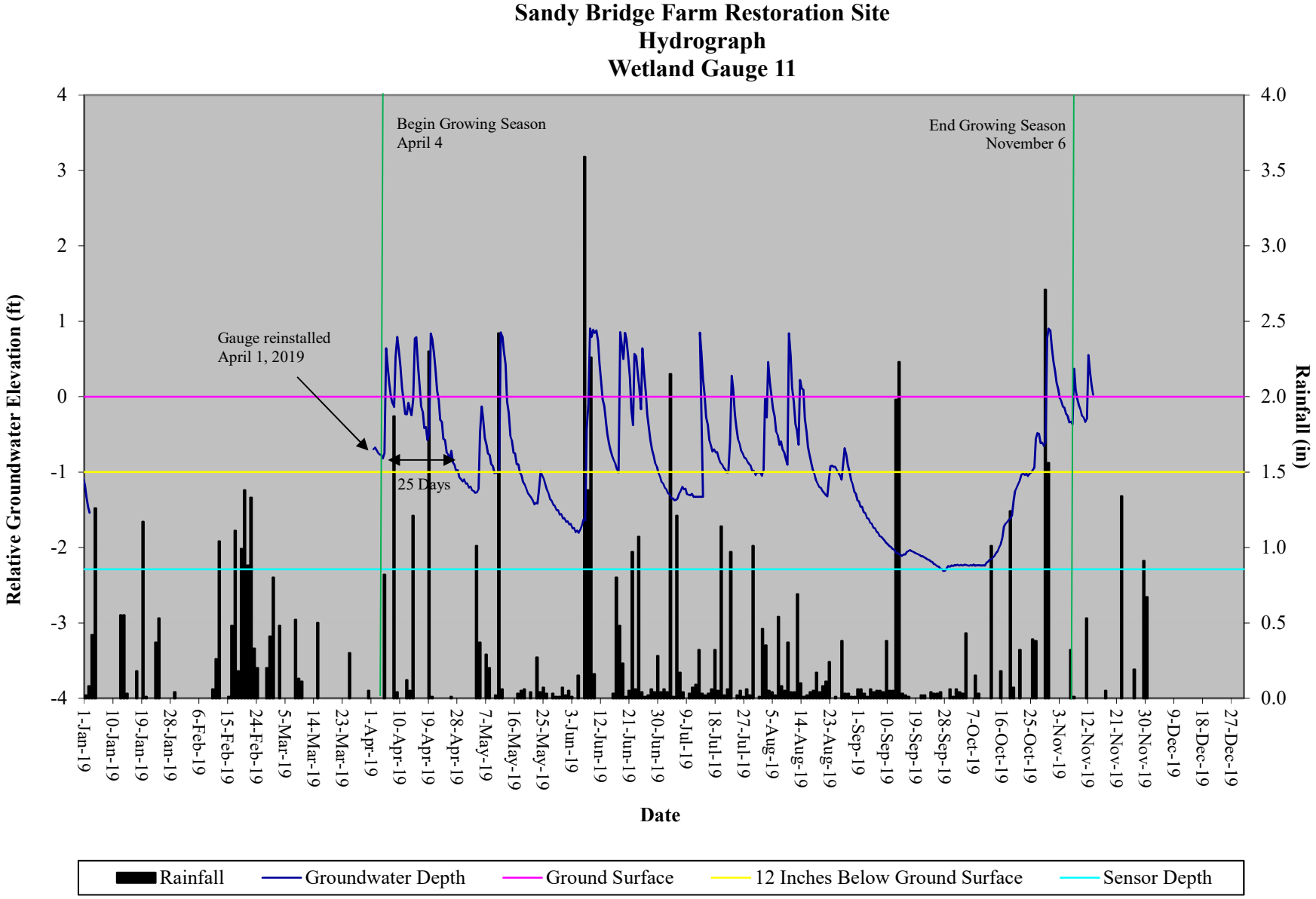



Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 8
Begin Growing Season
April 4
End Growing Season
November 6
Gauge
malfunction
39 Days
39 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-19
10-Jan-19
19-Jan-19
28-Jan-19
6-Feb-19
15-Feb-19
24-Feb-19
5-Mar-19
14-Mar-19
23-Mar-19
1-Apr-19
10-Apr-19
19-Apr-19
28-Apr-19
7-May-19
16-May-19
25-May-19
3-Jun-19
12-Jun-19
21-Jun-19
30-Jun-19
9-Jul-19
18-Jul-19
27-Jul-19
5-Aug-19
14-Aug-19
23-Aug-19
1-Sep-19
10-Sep-19
19-Sep-19
28-Sep-19
7-Oct-19
16-Oct-19
25-Oct-19
3-Nov-19
12-Nov-19
21-Nov-19
30-Nov-19
9-Dec-19
18-Dec-19
27-Dec-19
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface


Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 9
Begin Growing Season
April 4
End Growing Season
November 6
Gauge
malfunction
36 Days
40 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
4
3
2
1
0
-1
-2
-3
-4
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1-Jan-19
10-Jan-19
19-Jan-19
28-Jan-19
6-Feb-19
15-Feb-19
24-Feb-19
5-Mar-19
14-Mar-19
23-Mar-19
1-Apr-19
10-Apr-19
19-Apr-19
28-Apr-19
7-May-19
16-May-19
25-May-19
3-Jun-19
12-Jun-19
21-Jun-19
30-Jun-19
9-Jul-19
18-Jul-19
27-Jul-19
5-Aug-19
14-Aug-19
23-Aug-19
1-Sep-19
10-Sep-19
19-Sep-19
28-Sep-19
7-Oct-19
16-Oct-19
25-Oct-19
3-Nov-19
12-Nov-19
21-Nov-19
30-Nov-19
9-Dec-19
18-Dec-19
27-Dec-19
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 10




Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 11
Begin Growing Season
April 4
End Growing Season
November 6
Gauge reinstalled
April 1, 2019
25 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface
Sensor Depth

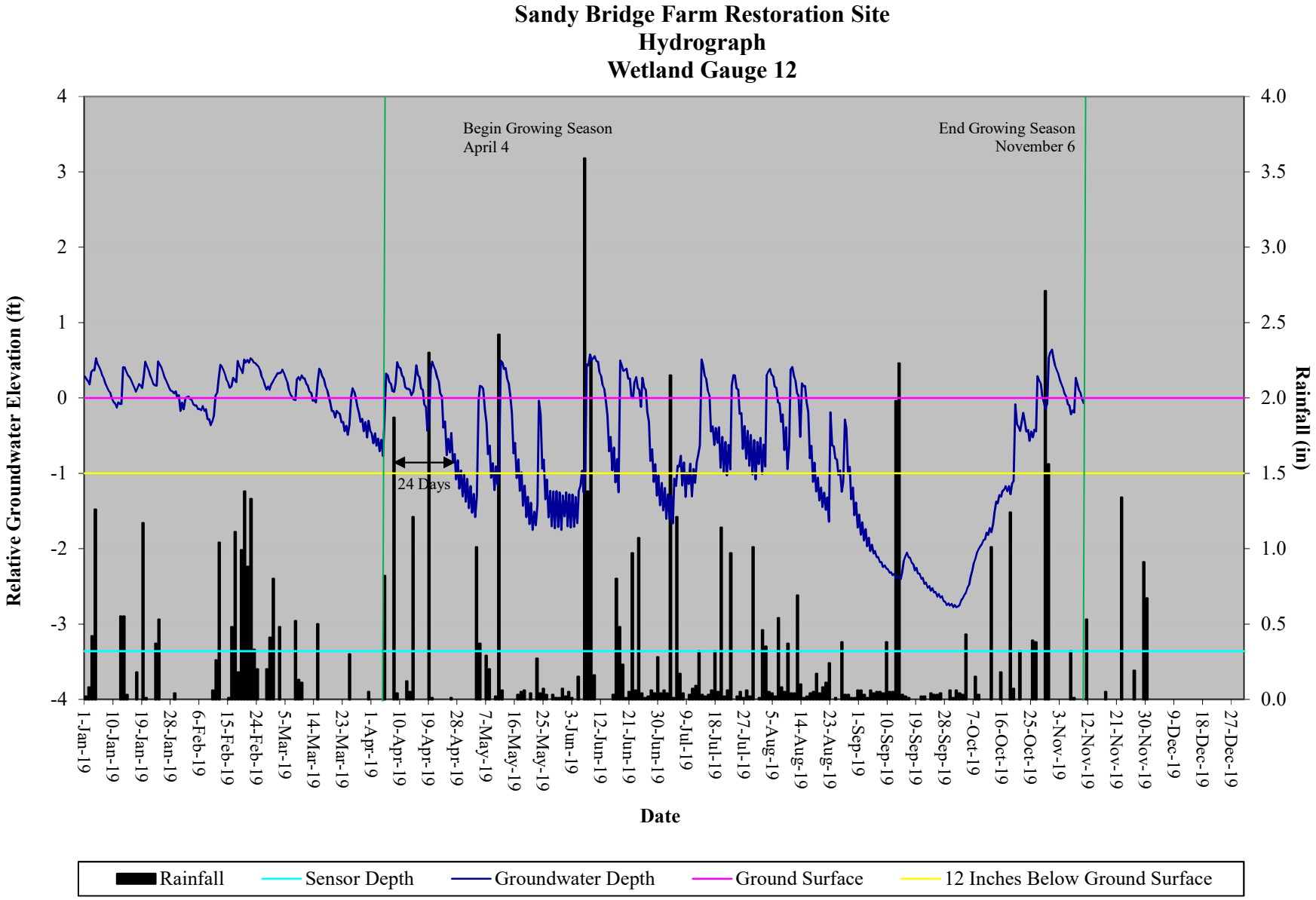

Sandy Bridge Farm Restoration Site
Hydrograph
Wetland Gauge 12
Begin Growing Season
April 4
End Growing Season
November 6
24 Days
Relative Groundwater Elevation (ft)
Rainfall (in)
Date
Rainfall
Sensor Depth
Groundwater Depth
Ground Surface
12 Inches Below Ground Surface

Table 11. Wetland Hydrology Criteria Attainment Sandy Bridge Farm Restoration Site, DMS Project #96920							
	Greater than 10% Continuous Saturation/Max Consecutive Days During Growing Season (Percentage)						
Gauge #	**MY-01 2017**	**MY-02 2018**	**MY-03 2019**	**MY-04 2020**	**MY-05 2021**	**MY-06 2022**	**MY-07 2023**
Gauge 1	Yes/30 (13.8%)	Yes/40 (18.4%)	Yes/46 (21.2%)				
Gauge 2	No/11 (5.1%)	Yes/35 (16.1%)	Yes/32 (14.7%)				
Gauge 3	Yes/110 (50.7%)	Yes/78 (35.9%)	Yes/162 (74.7%)				
Gauge 4	Yes/47 (21.7%)	Yes/105 (48.4%)	Yes/156 (71.9%)				
Gauge 5	No/11 (5.1%)	No**/6 (2.8%)	Yes/44 (20.3%)				
Gauge 6	Yes/30 (13.8%)	Yes/63 (29.0%)	Yes/49 (22.6%)				
Gauge 7	Yes/22 (10.1%)	Yes/105 (48.4%)	Yes/162 (74.7%)				
Gauge 8	Yes/29 (13.4%)	Yes/43 (19.8%)	Yes/39 (18.0%)				
Gauge 9	No/15 (6.9%)	Yes/87 (40.1%)	Yes/40 (18.4%)				
Gauge 10*		No/8 (3.7%)	Yes/22 (10.1%)				
Gauge 11*		No/8 (3.7%)	Yes/25 (11.5%)				
Gauge 12*		Yes/38 (17.5%)	Yes/24 (11.1%)				

*=Gauge installed March 30, 2018 **=Gauge malfunction, only recorded for first 35 days of growing season