

Monitoring Report

Twin Bays Wetland Restoration Site

DMS Contract 004739

DMS Project Number 95363

Monitoring Year 03



Prepared for:

NCDMS, 1652 Mail Service Center, Raleigh, NC 27699-1652

Construction Completed: March 2014

Data Collection: 2015

Submitted: December 2016

Design and Monitoring Firm



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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

The Twin Bays Wetland Restoration Site, (TBWRS) completed in March 2014, restored 10.6 acres of non-riparian wetland along with 0.4 acre of upland preservation. The TBWRS is a non-riparian wetland system in the Cape Fear Basin (03030007 8-digit HUC) in southern Duplin County, North Carolina. The project is located in the 14-digit HUC 03030007090040 (Rock Fish Creek), which DMS has identified as a Targeted Local Watershed (TLW) (NCDENR, EEP 2009).

The project site is protected by an 11.72-acre permanent conservation easement held by the State of North Carolina. TBWRS is located on a single parcel located off of Cornwallis Road approximately two miles northwest of Wallace, North Carolina. The project site is bounded by Cornwallis Road to the west, a ditch along the property line to the south, and agricultural land to the east and north. Prior to construction, the site was actively used for row crop farming. The site had a long history of hydrologic modification in order to allow for farming to take place on the property.

The Cape Fear River Basin Restoration Priorities state the goals for the TBWRS's 14-digit HUC are to expand restoration opportunities and repair riparian buffers (NCDENR EEP, 2009). The project goals for TBWRS are in line with the basin priorities and include the following:

- Slow and treat the runoff of upslope agricultural drainage.
- Restore a Hardwood Flats Community.
- Develop valuable wetland habitat niches within a drained agricultural landscape.

The project goals will be addressed through the following objectives:

- Fill field ditches to restore surface flow retention and elevate local groundwater levels.
- Redevelop longer wetland flow patterns to increase surface flow retention time.
- Modify an existing pond to its natural seep condition to feed the downslope wetland.
- Restore a native forested hardwood wetland community using natives trees and seed mixes.

There are three non-credit generating areas on the site. There is 0.4-acre of uplands located in the forested northeastern corner of the project boundary. This area remained undisturbed and is included in the TBWRS conservation easement. There is a 0.2 acre utility easement on the west side of the site along Cornwallis Road that remained undisturbed. Additionally, the southernmost ditch, located adjacent to the project easement, was left open and not filled. It is anticipated that leaving this ditch open will have minimal impacts to the overall hydrologic performance of the site. The hydrologic influence of this ditch was modeled using Lateral Effect, a software program that determines the lateral effect of a drainage ditch or borrow pit on adjacent wetland hydrology (NCSU BAE, 2011). This analysis determined that the potential horizontal drainage influence averages 76'. Due to the fact that the southern ditch cannot be filled because of the potential for hydrologic trespass, the area immediately adjacent to the ditch will not be a credit generating part of the site. It is assumed that with the onsite modifications, such as filling ditches and surface roughening, the entire site will have more surface and groundwater, which may decrease the effect of the ditch. For this reason, the non-credit generating portion of the site is assumed to be half of the zone of influence for the ditch.

The TBWRS provided mitigation for wetland impacts within Hydrologic Unit 03030007 by restoring 10.6 acres of wetland and preserving 0.4-acre of uplands, generating 10.6 riparian wetland mitigation units (WMU's). The TBWRS will be monitored to determine if the project is on-track to meeting jurisdictional wetland status. The wetland site will be deemed successful once hydrology is established and vegetation success criteria are met. During the site's third growing season, all ten vegetation monitoring plots met the success criteria. Thirteen of the seventeen groundwater monitoring gauges also met the success criteria, with only gauges 1 (gauge malfunction), 3 (non-credit bearing), 12, and 14 not achieving success.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan documents available on the DMSs website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

2.0 MONITORING RESULTS

The TBWRS will be monitored to determine if the project is on-track to meeting jurisdictional wetland status. The wetland restoration area will be deemed successful once hydrology is established and vegetation success criteria are met. The site will be monitored for at least seven years or until the success criteria are achieved.

2.1 VEGETATION MONITORING

The success criteria for the planted species in the mitigation area will be based on the vegetative density estimated as woody stems/acre based on monitoring plot data. The site will demonstrate the re-establishment of targeted vegetative communities through the survival and growth of planted species and volunteer colonization, with an average stem density of 320 stems/acre after three years, 288 stems/acre after four years, 260 stems/acre after five years, and 210 stems/acre after seven years to be considered successful. To determine the success of the planted mitigation area, ten permanent vegetation monitoring plots (10 by 10 meters) have been established in the wetland restoration area at a density that represents the total mitigation acreage. The average density of these plots will determine whether the site meets the success criterion.

The third-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 987 planted stems/acre. All ten plots had greater than 320 planted stems/acre. Including volunteers, the site averaged 1,137 total stems/acre. In general the site is well vegetated, with widespread herbaceous coverage and healthy planted stems.

2.2 HYDROLOGY MONITORING

Wetland hydrology will be monitored with a series of automatic gauges that record water table depth. The site must present continuous saturated or inundated hydrologic conditions for at least 8% of the growing season with a 50% probability of reoccurrence during normal weather conditions. A "normal" year is based on NRCS climatological data for Duplin County using the 30th to 70th percentile thresholds as the range of normal as documented in the USACE Technical Report "Assessing and Using Meteorological Data to Evaluate Wetland Hydrology, April 2000." The soil survey for Duplin County does not contain growing season data; therefore, due to its close proximity, the Sampson County soil survey was used. The estimated growing season begins March 18 and ends November 11 (239 days). The water table of the restored wetlands must be within 12" of the soils surface continuously for at least 8% (19 days) of the 239-day growing season. Wetland hydrology will be monitored with sixteen automatic gauges that record water table depth. Daily data will be collected from the automatic gauges over the 7-year monitoring period.

Due to the inherent variability in the site's soils and associated drainage characteristics, it is unlikely that the project will exhibit uniform hydrologic conditions across the site, making a single hydrologic performance criterion unrepresentative of the site's performance. As such, the gauge data can be evaluated and presented as a spatial average with each gauge representing the area half the distance to adjacent gauges. The spatial average will be the calculated value for comparison with the performance

standard for credit validation. Gauges representing areas not achieving a minimum of 6.5% saturation will be considered non-attaining even if the spatial average exceeds the credit validation performance standard.

To monitor the effect of the unfilled ditch described in Section 1.0, four sets of coupled gauges were installed perpendicular to the unfilled ditch. Each set includes a gauge that is 40' from the open ditch and another that is 75' from the ditch. An additional two gauges were installed between the coupled gauges to monitor hydrology less than 40' from the open ditch in the non-credit bearing zone.

The daily rainfall data were obtained from the NC State Climate Office for a local weather station in Jacksonville, NC. In 2016, the months of February, May, September, and October experienced above average rainfall, while January, June, and August experienced average rainfall. The months of March, April, July, and November recorded below average rainfall for the site. Overall, the area experienced average rainfall during the 2016 growing season.

During the site's third growing season, all but four of the seventeen total gauges met the hydrologic success criteria. Of those four, one was in a non-credit bearing area (close to an open ditch). Another of those gauges malfunctioned, but since the gauge adjacent to it, which is closer to the open ditch met the hydrology criteria, it is likely that without the malfunction this gauge also would have met the criteria, like in the previous monitoring years. The other two gauges that did not meet the criteria all achieved hydrology last year, and one of those gauges was only one day from meeting it this year. Three gauges were below 6.5% continuous saturation and so were not used in the analysis to determine the spatial average for the hydrology of the entire site. This analysis is based off percent saturation contours for the restoration area calculated from the gauge data. Following the method described above and as illustrated in the figure in Appendix D, it is determined that based on the spatial average, the site was continuously saturated for 19.6% of the growing season and met the hydrology success criteria of 8% for the third year of monitoring.

3.0 METHODOLOGY

The CVS-EEP protocol, Level 2 (<http://cvs.bio.unc.edu/methods.htm>) was used to collect vegetation data from the site. The vegetation monitoring was completed on July 6, 2016.

4.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2 (<http://cvs.bio.unc.edu/methods.htm>)

NCDENR, Ecosystem Enhancement Program. 2009. Lower Yadkin Pee-Dee River Basin Priorities 2009. Raleigh, NC.
http://www.nceep.net/services/restplans/Yadkin_Pee_De_RBRP_2009_Final.pdf

NCSU BAE. North Carolina State University, Biological and Agricultural Engineering. 2011. Method to Determine Lateral Effect of a Drainage Ditch on Adjacent Wetland Hydrology. Last accessed 11/2012 at:
http://www.bae.ncsu.edu/soil_water/projects/lateral_effect.html

USACE. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

Appendix A

Project Vicinity Map and Background Tables

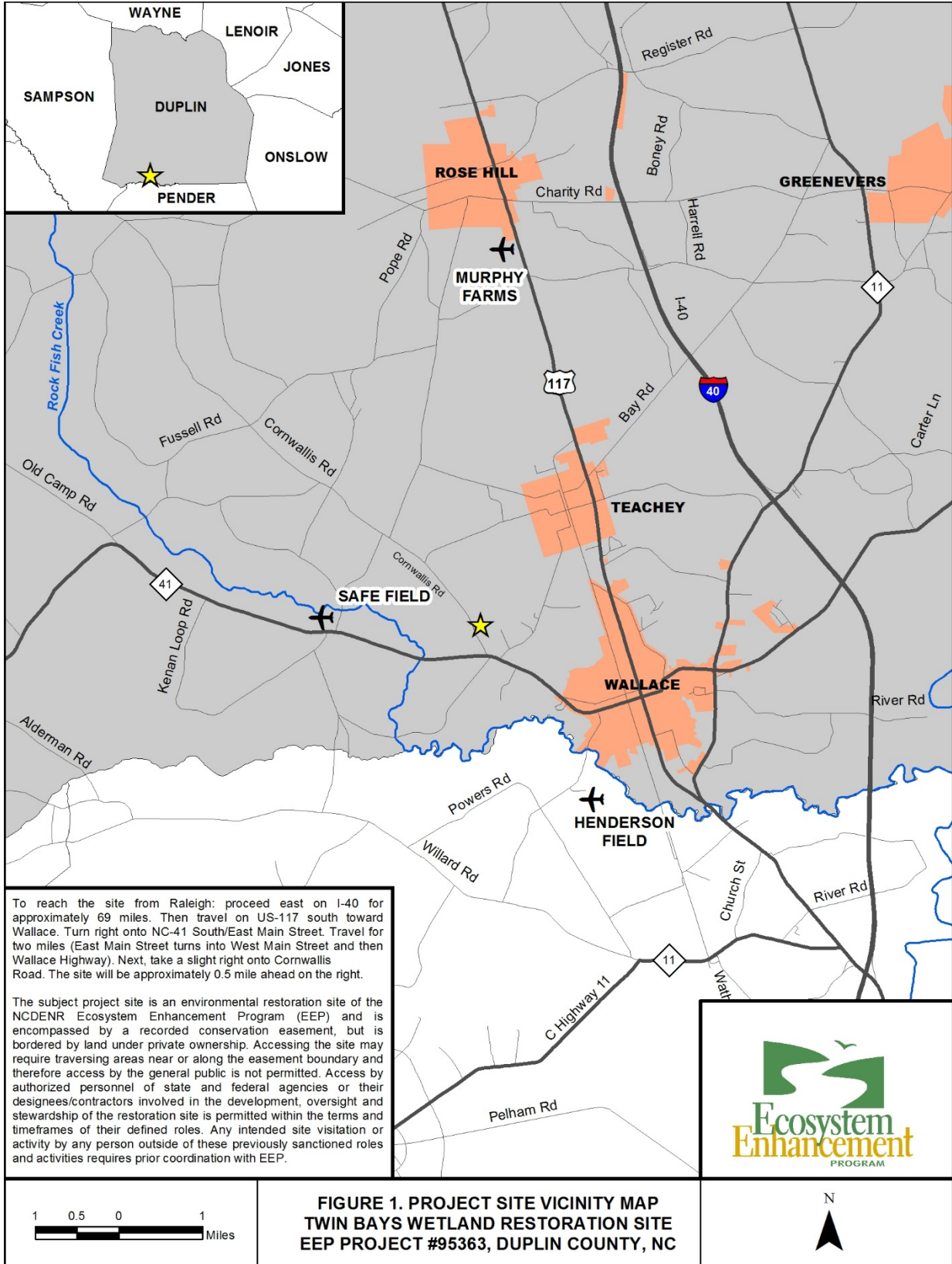


Table 1. Project Components and Mitigation Credits									
Twin Bays Wetland Restoration Site, DMS Project # 95363									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Acres					10.6				
Credits					10.6				
TOTAL CREDITS					10.6				
Project Components									
Project Component -or- Reach ID	Stationing/ Location		Existing Footage/ Acreage		Approach (PI, PII etc.)		Restoration -or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
Wetland Area	Central and Southern portion of project easement		10.6 acres		-		Restoration	10.6 acres	1:1
Component Summation									
Restoration Level	Stream (linear feet)		Riparian Wetland (acres)		Non-riparian Wetland (acres)		Buffer (square feet)	Upland (acres)	
			Riverine	Non-Riverine					
Restoration					10.6 acres				
Enhancement									
Enhancement I									
Enhancement II									
Creation									
Preservation									0.4 acre
High Quality Preservation									
TOTAL	-	-	-	-	10.6 acres		-		0.4 acre
TOTAL WMU	-	-	-	-	10.6		-		-

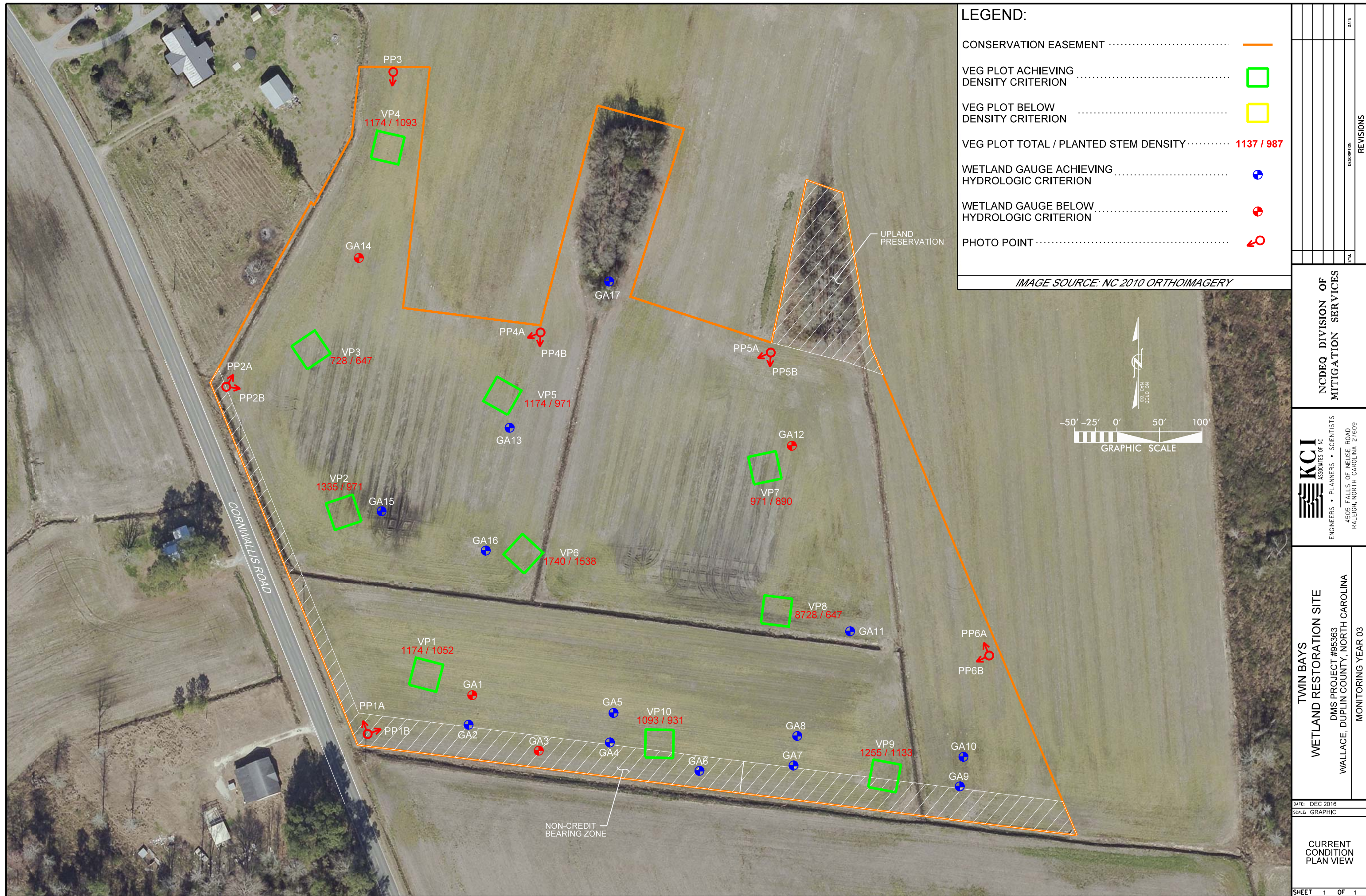
Table 2. Project Activity & Reporting History Twin Bays Wetland Restoration Site, DMS Project # 95363		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Mitigation Plan		Oct 13
Final Design - Construction Plans		Dec 13
Construction		Feb/March 14
Planting		March 14
Baseline Monitoring/Report	April 14	May 14
Year 1 Monitoring	Nov 14	Dec 14
Supplemental Planting		March 15
Year 2 Monitoring	Nov 15	Jan 16
Year 3 Monitoring	Nov 16	Dec 16

Table 3. Project Contacts Twin Bays Wetland Restoration Site, DMS Project # 95363	
Design Firm	KCI Associates of North Carolina, PA 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	KCI Environmental Technologies and Construction, Inc. 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Planting Contractor	Forestry Management Co. 1280 Maudis Road Bailey, NC 27807 Contact: Mr. Tony Cortez Phone: (252) 243-2513
Monitoring Performers	
MY-00-03	KCI Associates of North Carolina, PA 4505 Falls of Neuse Rd. Suite 400 Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Information			
Twin Bays Wetland Restoration Site, DMS Project # 95363			
Project Name	Twin Bays Wetland Restoration Site		
County	Duplin County		
Project Area (acres)	11.72 acres		
Project Coordinates (lat. and long.)	34.748418 N , -78.027129 W		
Project Watershed Summary Information			
Physiographic Province	Coastal Plain		
River Basin	Cape Fear		
USGS Hydrologic Unit 8-digit	03030007	USGS Hydrologic Unit 14-digit	03030007090040
DWQ Sub-basin	18-74-29b		
Project Drainage Area (acres)	25.4 acres		
Project Drainage Area Percentage of Impervious Area	2%		
CGIA Land Use Classification	93% Cultivated, 2% Mixed Shrubland, and 5% Low-Intensity Development		
Wetland Summary Information (Post-Restoration)			
Parameters	Wetland Area		
Size of Wetland (acres)	10.6 acres		
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Non-riparian		
Mapped Soil Series	Rains (Torhunta, Murville/Leon and Udorthents by detailed soil investigation)		
Drainage class	Poorly drained		
Soil Hydric Status	Drained Hydric		
Source of Hydrology	Hillside seepage / precipitation		
Hydrologic Impairment	Ditching and Crops		
Native vegetation community	Hardwood Flats Community		
Percent composition of exotic invasive vegetation	0%		
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States – Section 404	Yes	Yes, received 404 permit	N/A
Waters of the United States – Section 401	Yes	Yes, received 401 permit	N/A
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	FEMA Floodplain Checklist
Essential Fisheries Habitat*	No	N/A	N/A

Appendix B

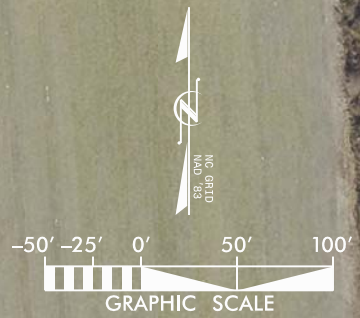
Visual Assessment Data



LEGEND:

CONSERVATION EASEMENT	
VEG PLOT ACHIEVING DENSITY CRITERION	
VEG PLOT BELOW DENSITY CRITERION	
VEG PLOT TOTAL / PLANTED STEM DENSITY	1137 / 987
WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION	
WETLAND GAUGE BELOW HYDROLOGIC CRITERION	
PHOTO POINT	

IMAGE SOURCE: NC 2010 ORTHOIMAGERY



NO.	DATE	REVISIONS

NCDEQ DIVISION OF
MITIGATION SERVICES

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

TWIN BAYS
WETLAND RESTORATION SITE
DMS PROJECT #95363
WALLACE, DUPLIN COUNTY, NORTH CAROLINA
MONITORING YEAR 03

DATE: DEC 2016
SCALE: GRAPHIC
CURRENT CONDITION
PLAN VIEW
SHEET 1 OF 1

Table 5. Vegetation Condition Assessment						
Twin Bays Restoration Site, DMS Project #95363						
Planted Acreage 10.6			Easement Acreage 11.7			
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 acre	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 acre	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 acre	Pattern and Color	0	0.00	0.0%
Cumulative Total				0	0.00	0.0%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1,000 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 Points



PP1a – MY-00 – 4/10/14



PP1a – MY03 – 8/23/16



PP1b – MY-00 – 4/10/14



PP1b – MY03 – 8/23/16



PP2a – MY-00 – 4/10/14



PP2a – MY03 – 8/23/16



PP2b – MY-00 – 4/10/14



PP2b – MY03 – 8/23/16



PP3 – MY-00 – 4/10/14



PP3 – MY03 – 8/23/16



PP4a – MY-00 – 4/10/14



PP4a – MY03 – 8/23/16



PP4b – MY-00 – 4/10/14



PP4b – MY03 – 8/23/16



PP5a – MY-00 – 4/10/14



PP5a – MY03 – 8/23/16



PP5b – MY-00 – 4/10/14



PP5b – MY03 – 8/23/16



PP6a – MY-00 – 4/10/14



PP6a – MY03 – 8/23/16



PP6b– MY-00 – 4/10/14



PP6b – MY03 – 8/23/16

Vegetation Plot Photos



Veg Plot #1 – MY03 – 7/6/16



Veg Plot #2 – MY03 – 7/6/16



Veg Plot #3 – MY03 – 7/6/16



Veg Plot #4 – MY03 – 7/6/16



Veg Plot #5 – MY03 – 7/6/16



Veg Plot #6 – MY03 – 7/6/16



Veg Plot #7 – MY03 – 7/6/16



Veg Plot #8 – MY03 – 7/6/16



Veg Plot #9 – MY03 – 7/6/16



Veg Plot #10 – MY03 – 7/6/16

Appendix C

Vegetation Plot Data

Table 6. Vegetation Plot Criteria Attainment			
Twin Bays Restoration Site DMS Project #95363			
Vegetation Plot ID	Vegetation Survival Threshold Met?	Monitoring Year 03 Planted Stem Density (stems/acre)	Monitoring Year 03 Total Stem Density (stems/acre)
1	Yes	1,052	1,174
2	Yes	971	1,335
3	Yes	647	728
4	Yes	1,093	1,174
5	Yes	971	1,174
6	Yes	1,538	1,740
7	Yes	890	971
8	Yes	647	728
9	Yes	1,133	1,255
10	Yes	931	1,093

Table 7. CVS Vegetation Plot Metadata	
Twin Bays Restoration Site DMS Project #95363	
Report Prepared By	Randall Jones
Date Prepared	7/31/2016 11:32
database name	KCI-2015-95363_Twin Bays.mdb
database location	M:\2012\20122265 TwinBays\Monitoring\Vegetation CVS Database
computer name	12-3ZV4FP1
file size	62296064
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	95363
project Name	Twin Bays Restoration Site
Description	Wetland restoration site
River Basin	Cape Fear
area (sq m)	24523.92
Required Plots (calculated)	10
Sampled Plots	10

Table 8. CVS Stem Count Total and Planted by Plot and Species
DMS Project Code 95363. Project Name: Twin Bays Restoration Site

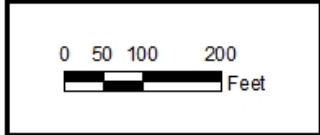
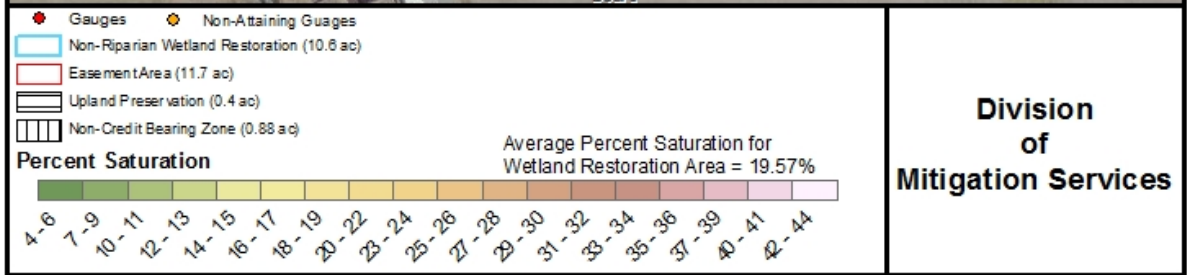
Scientific Name	Common Name	Species Type	Current Plot Data (MY3 2016)																																
			95363-01-0001			95363-01-0002			95363-01-0003			95363-01-0004			95363-01-0005			95363-01-0006			95363-01-0007			95363-01-0008			95363-01-0009			95363-01-0010					
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T			
Acer rubrum	red maple	Tree			2			1	1	1	3													2	2	2						1			
Aronia arbutifolia	Red Chokeberry	Shrub				5	5	5							2	2	5													1	1	1			
Baccharis halimifolia	eastern baccharis	Shrub			1			7									2						2						1			1			
Betula nigra	river birch	Tree	5	5	5				1	1	1	4	4	4	6	6	6	16	16	16				1	1	1	5	5	5	11	11	11			
Diospyros virginiana	common persimmon	Tree																								1									
Fraxinus pennsylvanica	green ash	Tree				11	11	11	1	1	1	2	2	2				9	9	9	2	2	2												
Liquidambar styraciflua	sweetgum	Tree						1																											
Liriodendron tulipifera	tuliptree	Tree							2	2	2																			1	1	1			
Magnolia virginiana	sweetbay	Tree							1	1	1				6	6	6	2	2	2	6	6	6												
Nyssa biflora	swamp tupelo	Tree																																	
Pinus taeda	loblolly pine	Tree												2																					
Platanus occidentalis	American sycamore	Tree																3	3	3						1									
Quercus michauxii	swamp chestnut oak	Tree	7	7	7	4	4	4	6	6	6	8	8	8	3	3	3	6	6	6	14	14	14	10	10	10	1	1	1						
Quercus pagoda	cherrybark oak	Tree										11	11	11	1	1	1							1	1	1	3	3	5	5	5	5	5	5	5
Quercus palustris	pin oak	Tree																									1	1	1						
Quercus phellos	willow oak	Tree	4	4	4							2	2	2	2	2	2										9	9	9	3	3	3			
Salix nigra	black willow	Tree																		5															2
Sambucus canadensis	Common Elderberry	Shrub																																	
Taxodium distichum	bald cypress	Tree	6	6	6																			1	1	1	9	9	9	2	2	2			
Ulmus americana	American elm	Tree																																	
Unknown		Shrub or Tree																																	
Vaccinium corymbosum	highbush blueberry	Shrub	4	4	4	4	4	4	4	4	4				4	4	4	2	2	2				1	1	1									
Stem count			26	26	29	24	24	33	16	16	18	27	27	29	24	24	29	38	38	43	22	22	24	16	16	18	28	28	31	23	23	27			
size (ares)			1			1			1			1			1			1			1			1			1								
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02								
Species count			5	5	7	4	4	7	7	7	7	5	5	6	7	7	8	6	6	7	3	3	4	6	6	8	6	6	7	6	6	9			
Stems per ACRE			1052	1052	1174	971	971	1335	647	647	728	1093	1093	1174	971	971	1174	1538	1538	1740	890	890	971	647	647	728	1133	1133	1255	931	931	1093			

Table 8. CVS Stem Count Total and Planted by Plot and Species
DMS Project Code 95363. Project Name: Twin Bays Restoration Site

Scientific Name	Common Name	Species Type	Annual Means											
			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
			P-noLS	P-all	T	P-noLS	P-all	T	P-noLS	P-all	T	P-noLS	P-all	T
Acer rubrum	red maple	Tree	3	3	9	3	3	9	3	3	7	5	5	5
Aronia arbutifolia	Red Chokeberry	Shrub	8	8	11	7	7	7	8	8	8	11	11	11
Baccharis halimifolia	eastern baccharis	Shrub			14			11			7			
Betula nigra	river birch	Tree	49	49	49	48	48	48	48	48	48	47	47	47
Diospyros virginiana	common persimmon	Tree			1									
Fraxinus pennsylvanica	green ash	Tree	25	25	25	26	26	26	24	24	24	5	5	5
Liquidambar styraciflua	sweetgum	Tree			1			1			1			
Liriodendron tulipifera	tuliptree	Tree	3	3	3	3	3	3	1	1	1	18	18	18
Magnolia virginiana	sweetbay	Tree	15	15	15	15	15	15	13	13	13	17	17	17
Nyssa biflora	swamp tupelo	Tree						5						
Pinus taeda	loblolly pine	Tree			2									
Platanus occidentalis	American sycamore	Tree	3	3	4	3	3	7	3	3	3			
Quercus michauxii	swamp chestnut oak	Tree	59	59	59	59	59	59	54	54	54			
Quercus pagoda	cherrybark oak	Tree	21	21	23	21	21	22	23	23	23	22	22	22
Quercus palustris	pin oak	Tree	1	1	1									
Quercus phellos	willow oak	Tree	20	20	20	20	20	20	9	9	9			
Salix nigra	black willow	Tree			7			2			3			
Sambucus canadensis	Common Elderberry	Shrub						3						
Taxodium distichum	bald cypress	Tree	18	18	18	16	16	16	6	6	6	1	1	1
Ulmus americana	American elm	Tree										8	8	8
Unknown		Shrub or Tree							10	10	10	104	104	104
Vaccinium corymbosum	highbush blueberry	Shrub	19	19	19	22	22	22	20	20	20	22	22	22
Stem count			244	244	281	243	243	276	222	222	237	260	260	260
size (ares)			10			10			10			10		
size (ACRES)			0.25			0.25			0.25			0.25		
Species count			13	13	18	12	12	17	13	13	16	11	11	11
Stems per ACRE			987	987	1137	983	983	1117	898	898	959	1052	1052	1052

Appendix D

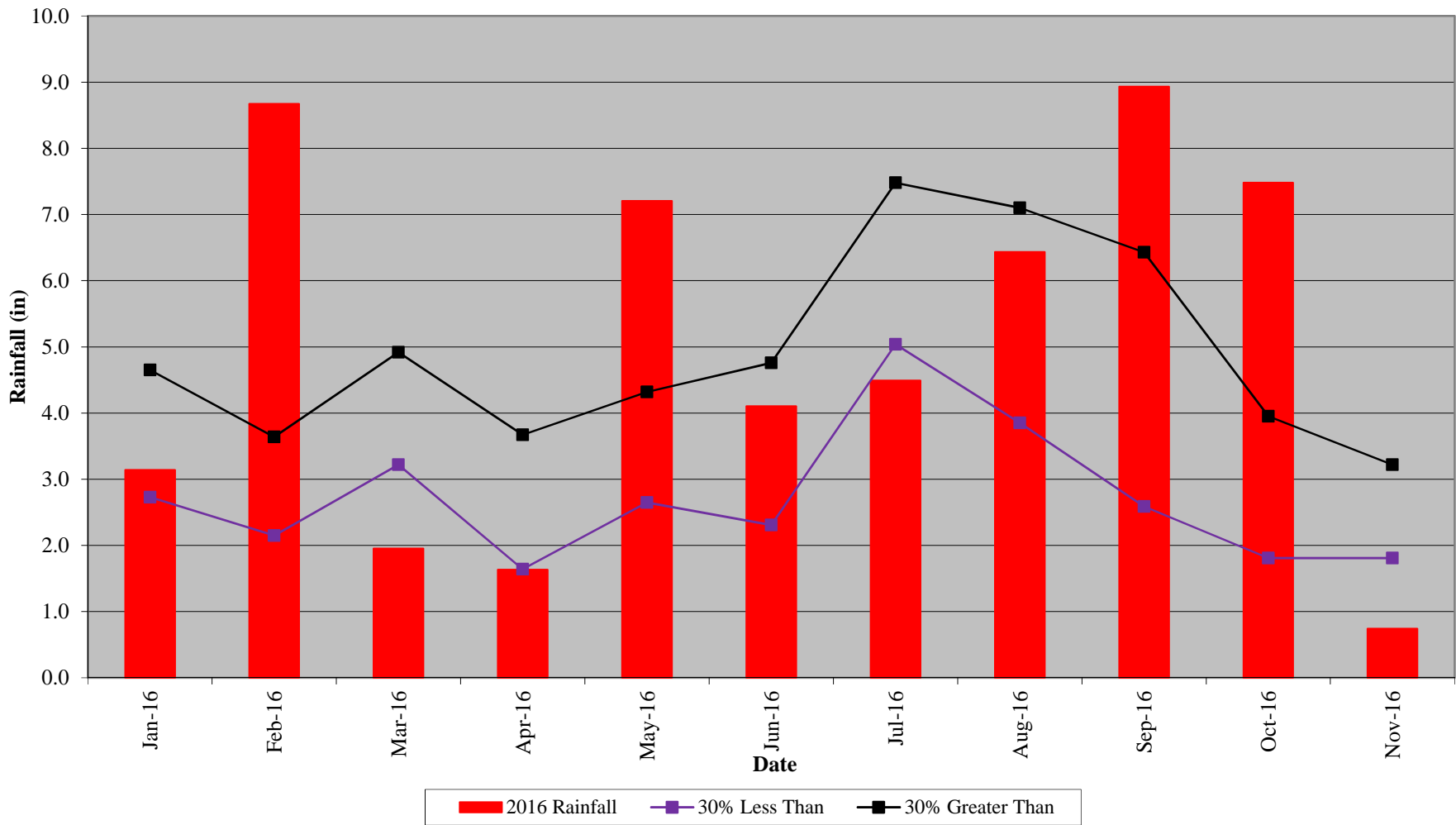
Hydrologic Data



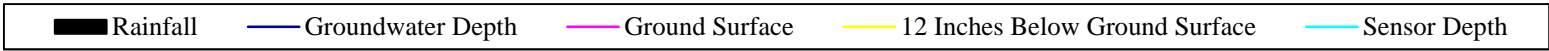
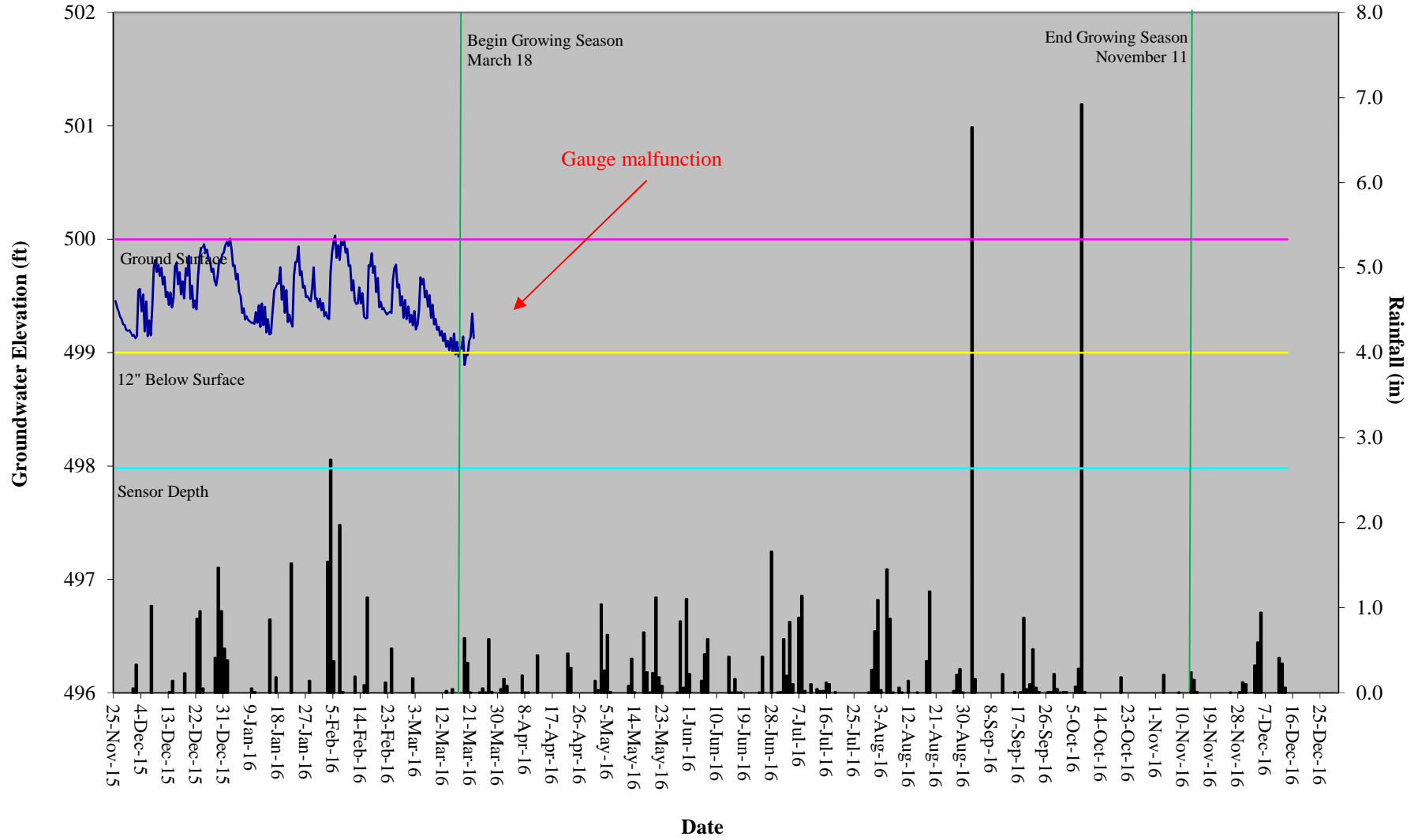
**TWIN BAYS PERCENT SATURATION
TWIN BAYS RESTORATION SITE
DMS PROJECT #95363, DUPLIN COUNTY, NC**

Source: Eastern Piedmont Orthoimagery, 2013.

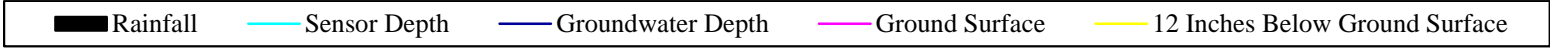
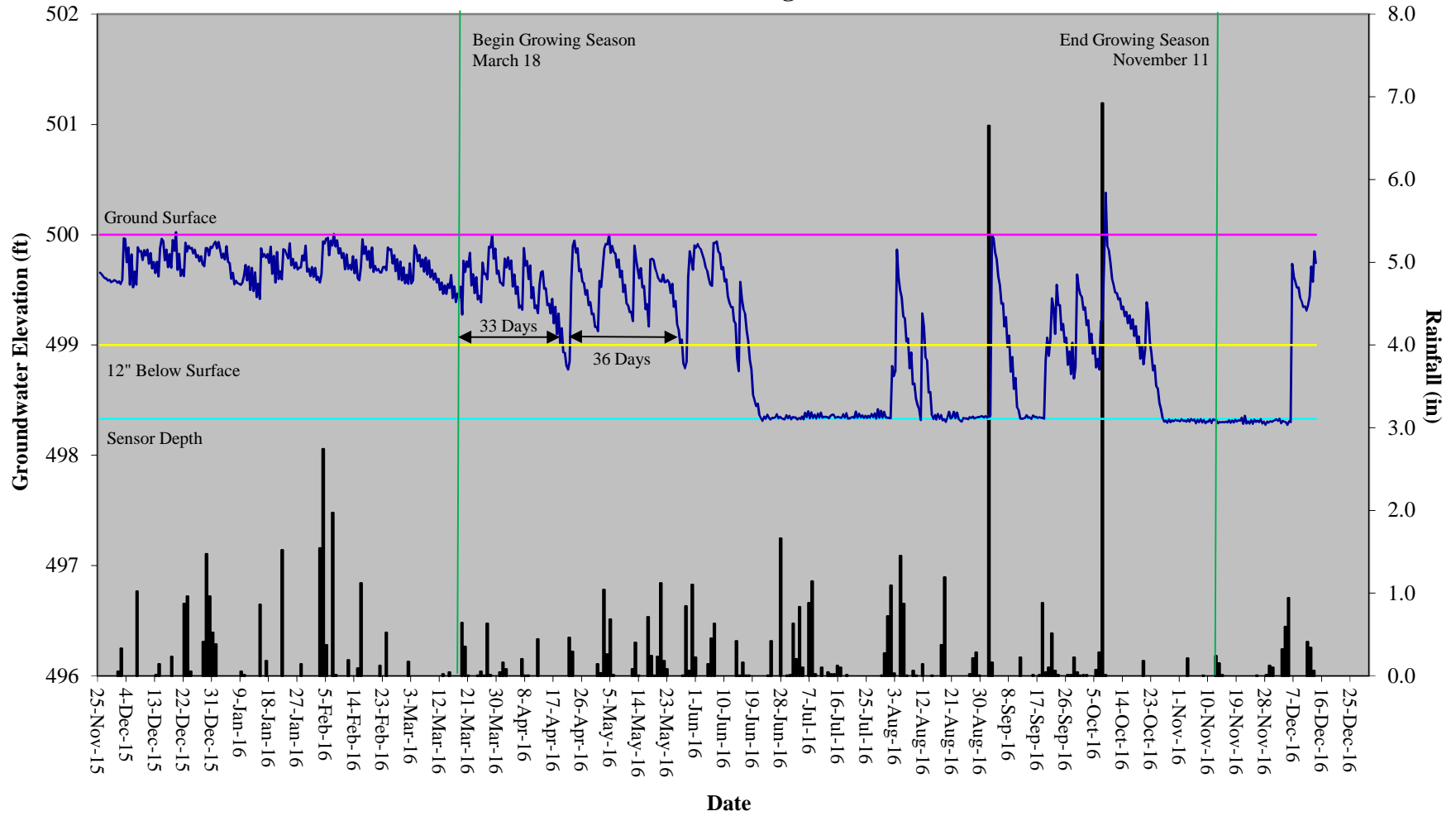
**Twin Bays Wetland Restoration Site
30-70 Percentile Graph
WETS Station Name: KOAJ - Albert Ellis Airport**



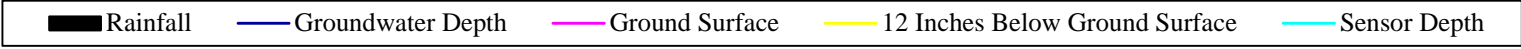
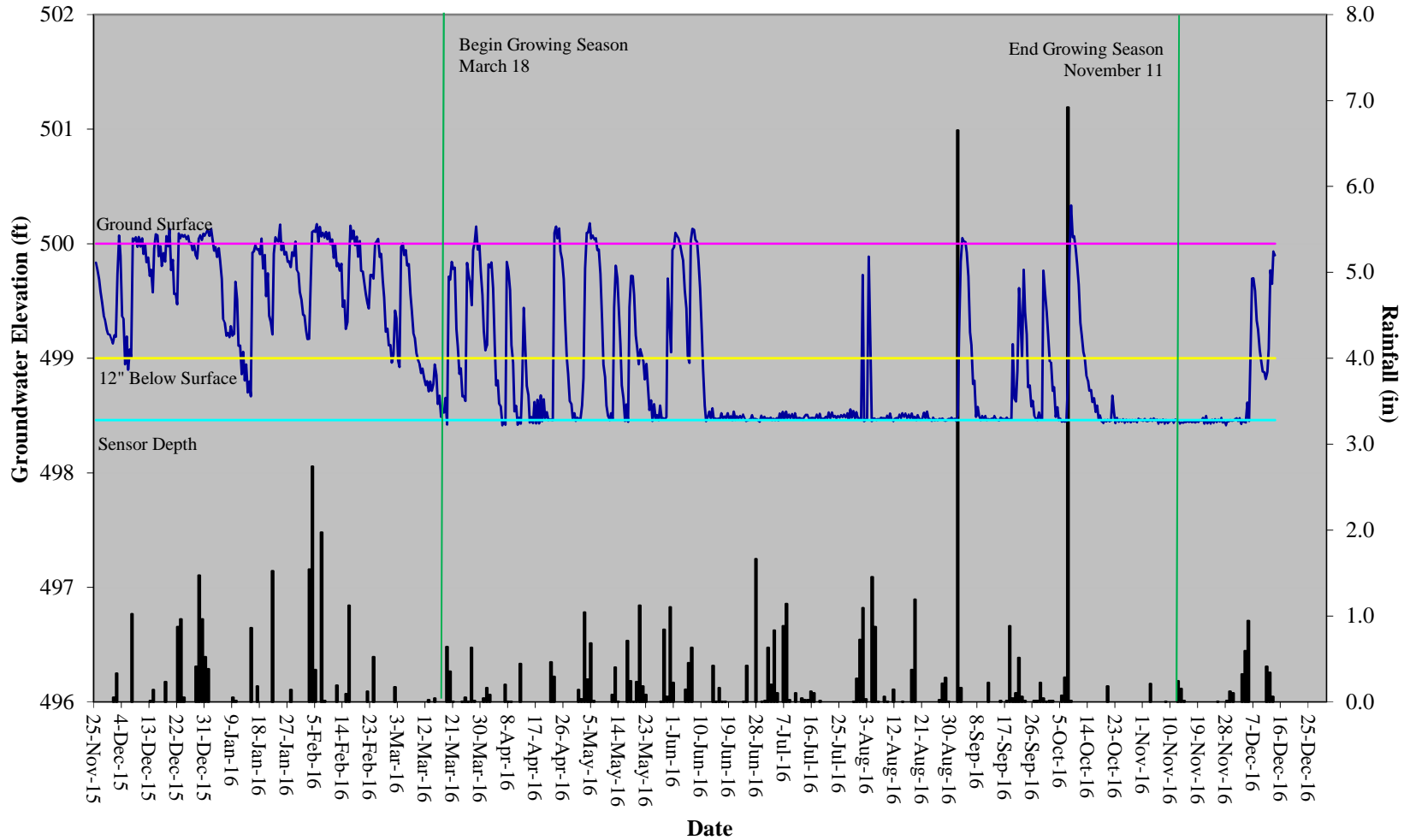
Twin Bays Restoration Site Hydrograph Wetland Gauge 1



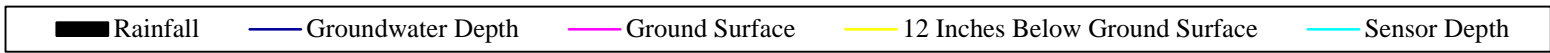
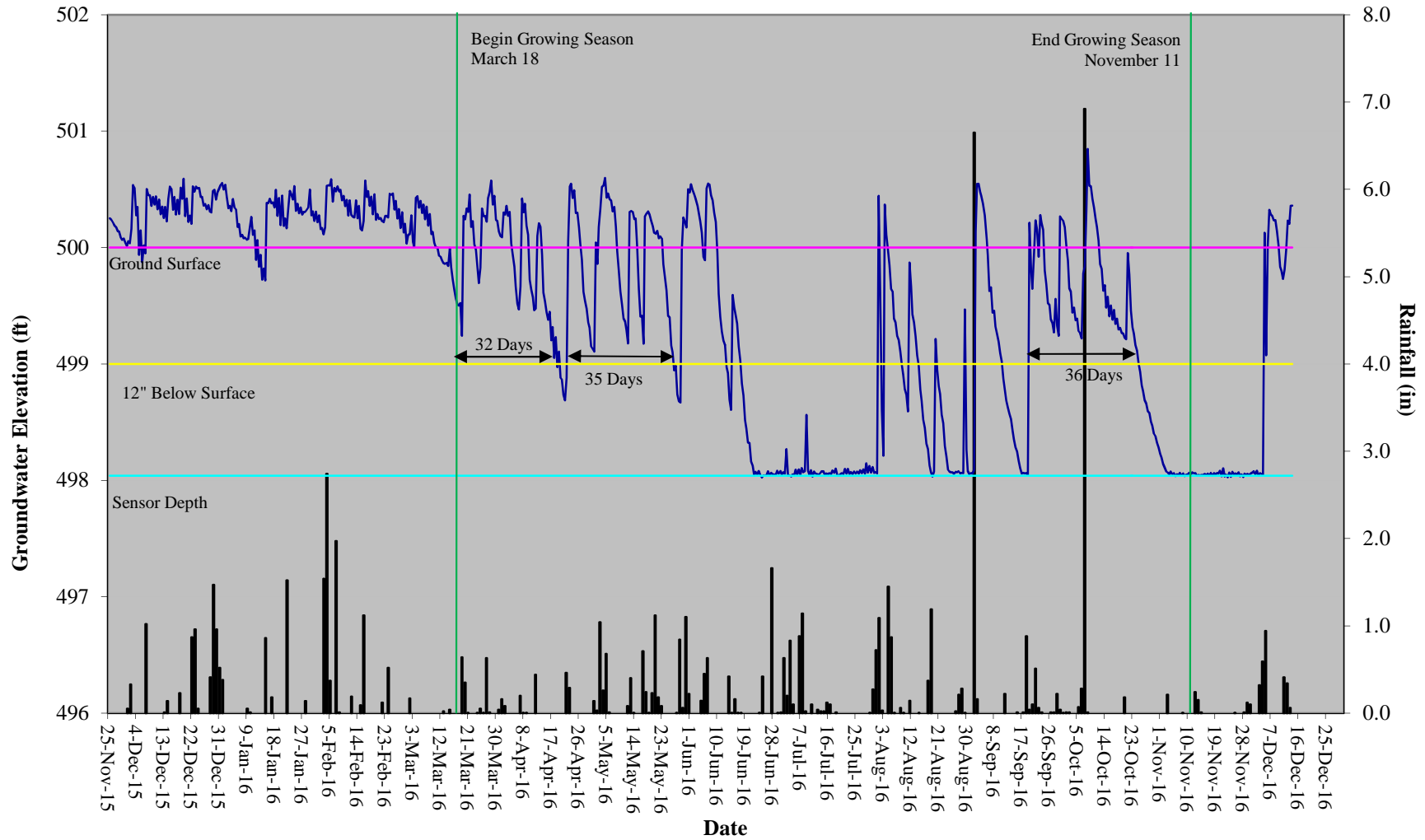
Twin Bays Restoration Site Hydrograph Wetland Gauge 2



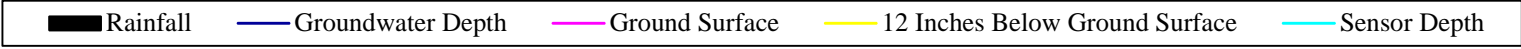
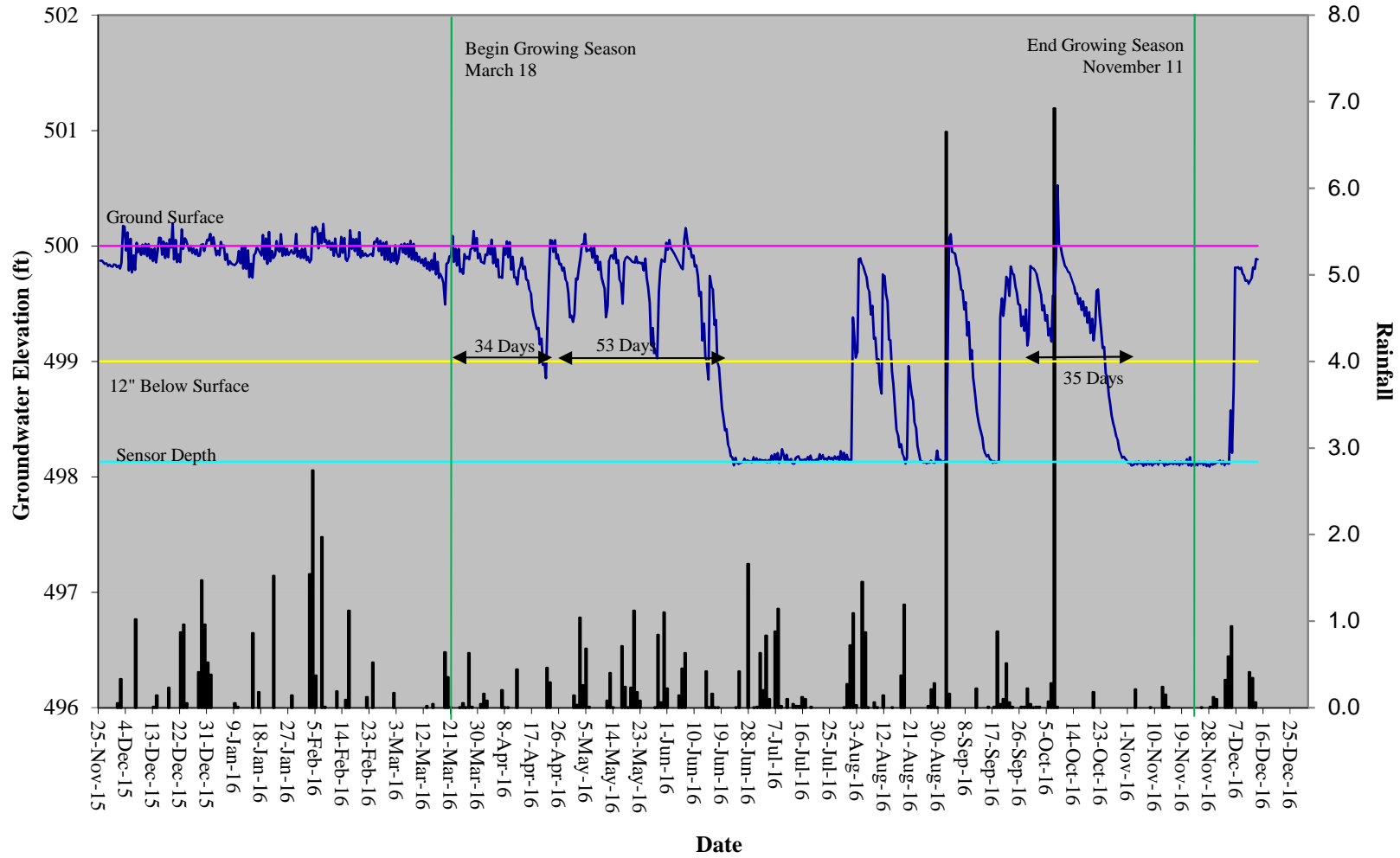
Twin Bays Restoration Site Hydrograph Wetland Gauge 3 - non-credit bearing



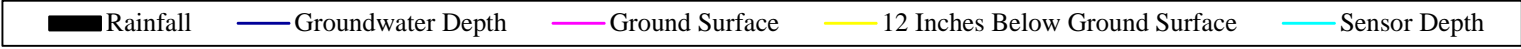
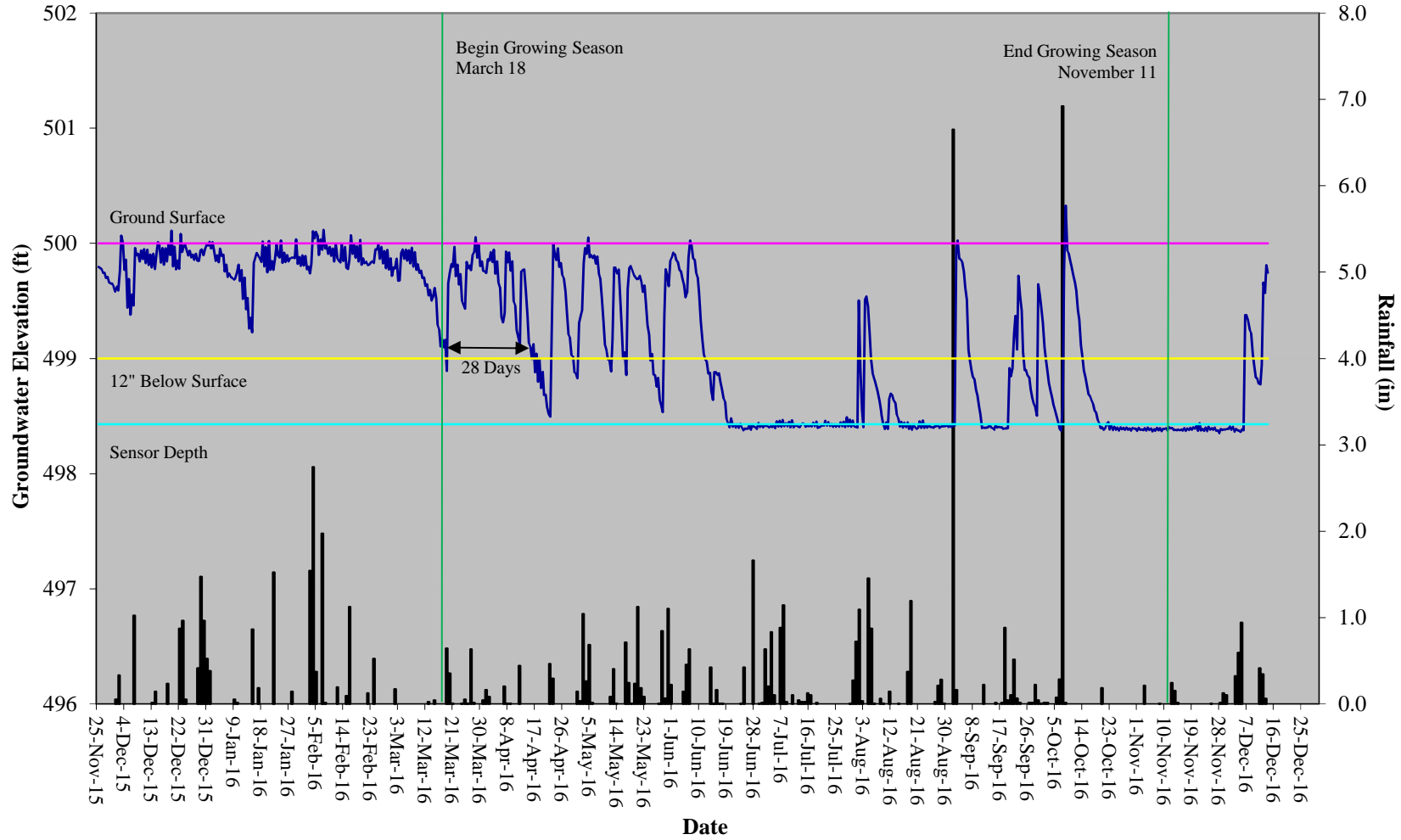
Twin Bays Restoration Site Hydrograph Wetland Gauge 4



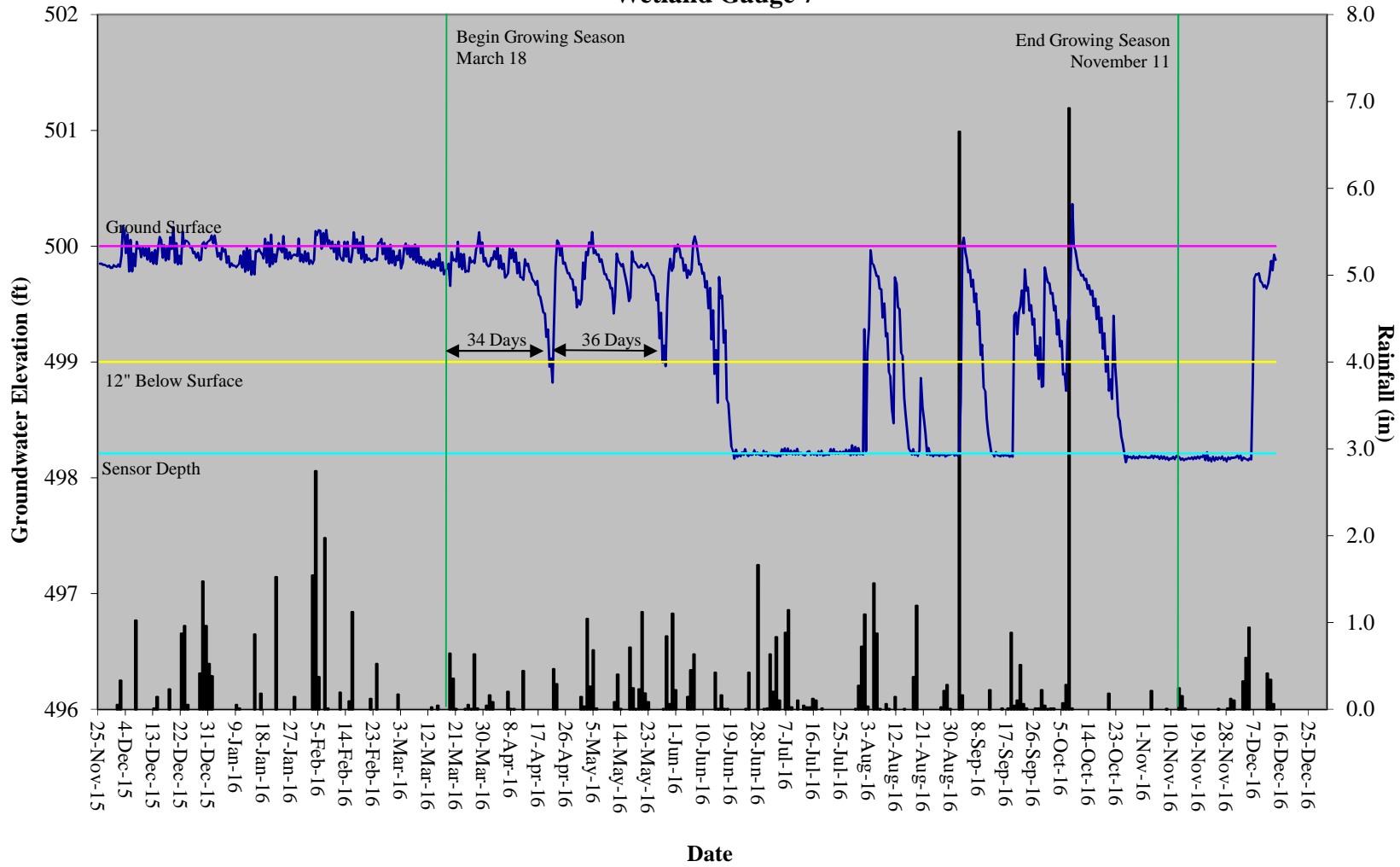
Twin Bays Restoration Site Hydrograph Wetland Gauge 5



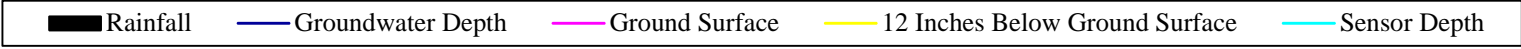
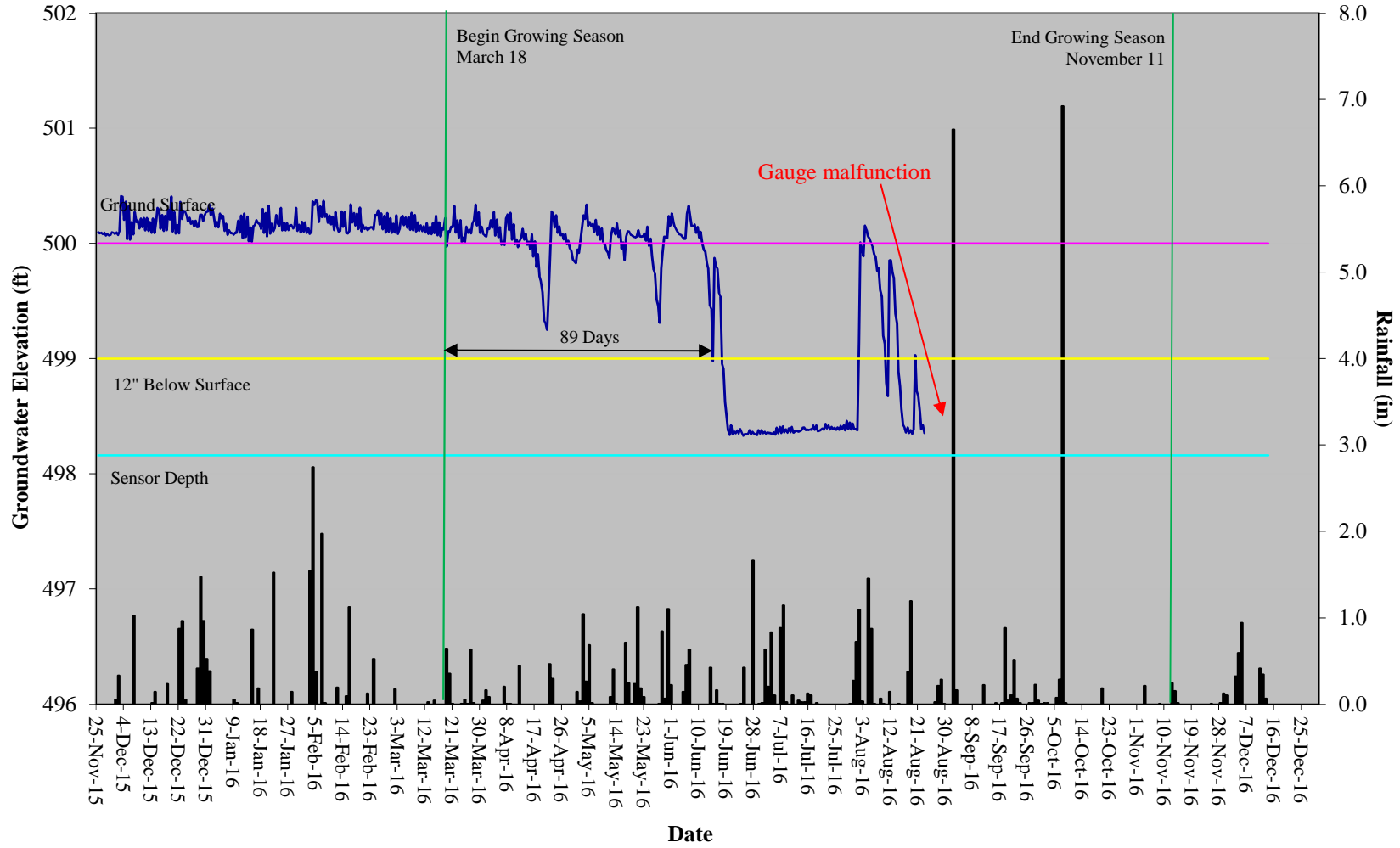
Twin Bays Restoration Site Hydrograph Wetland Gauge 6 - non-credit bearing



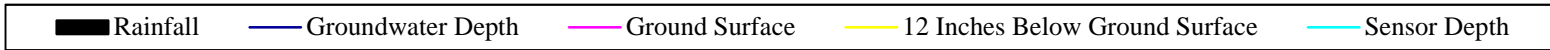
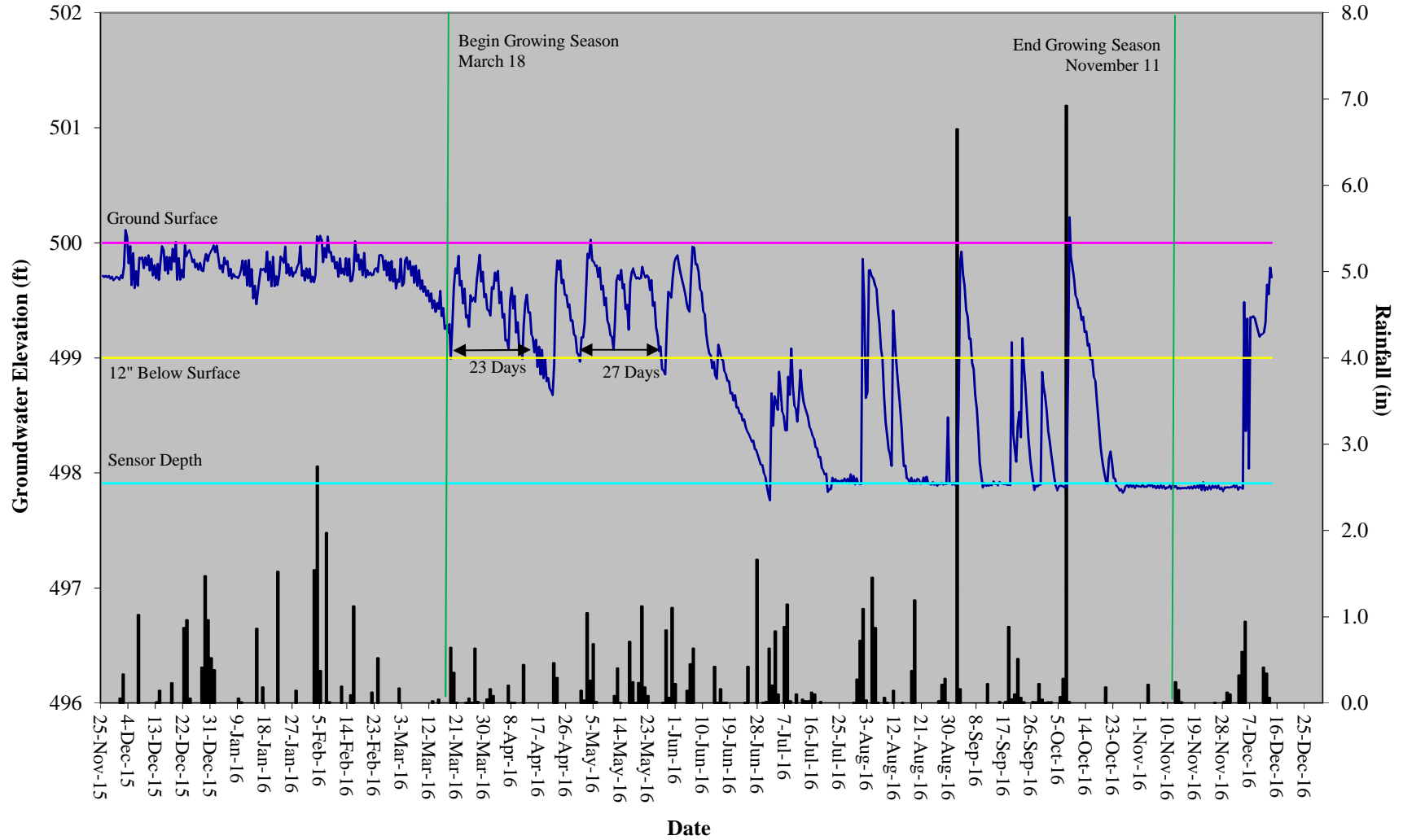
Twin Bays Restoration Site Hydrograph Wetland Gauge 7



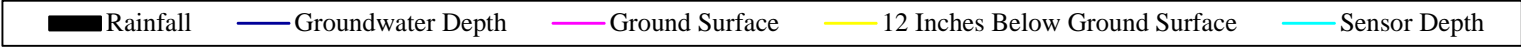
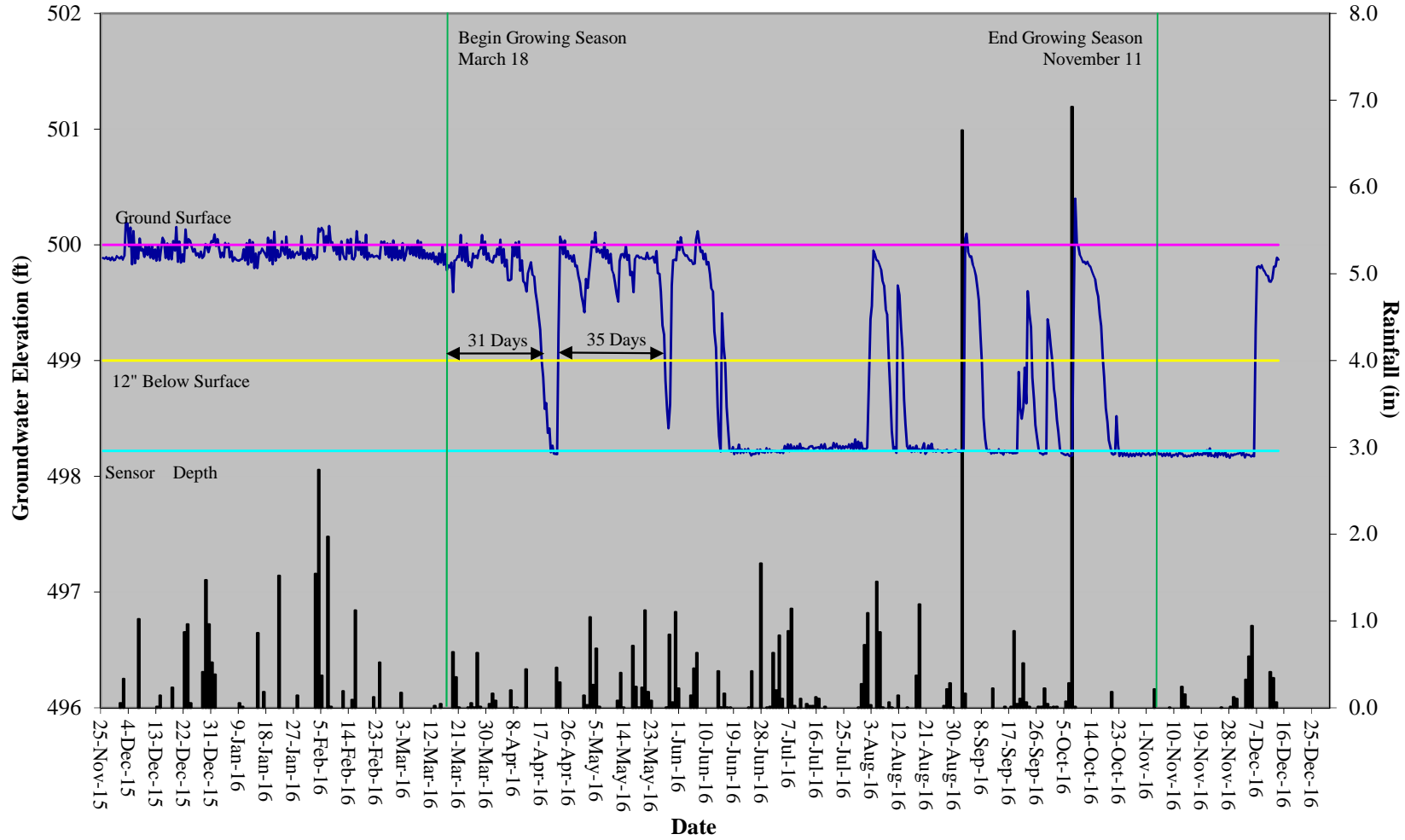
Twin Bays Restoration Site Hydrograph Wetland Gauge 8



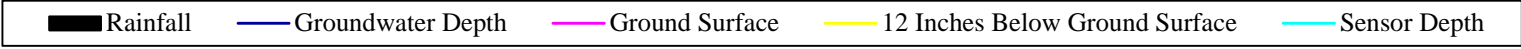
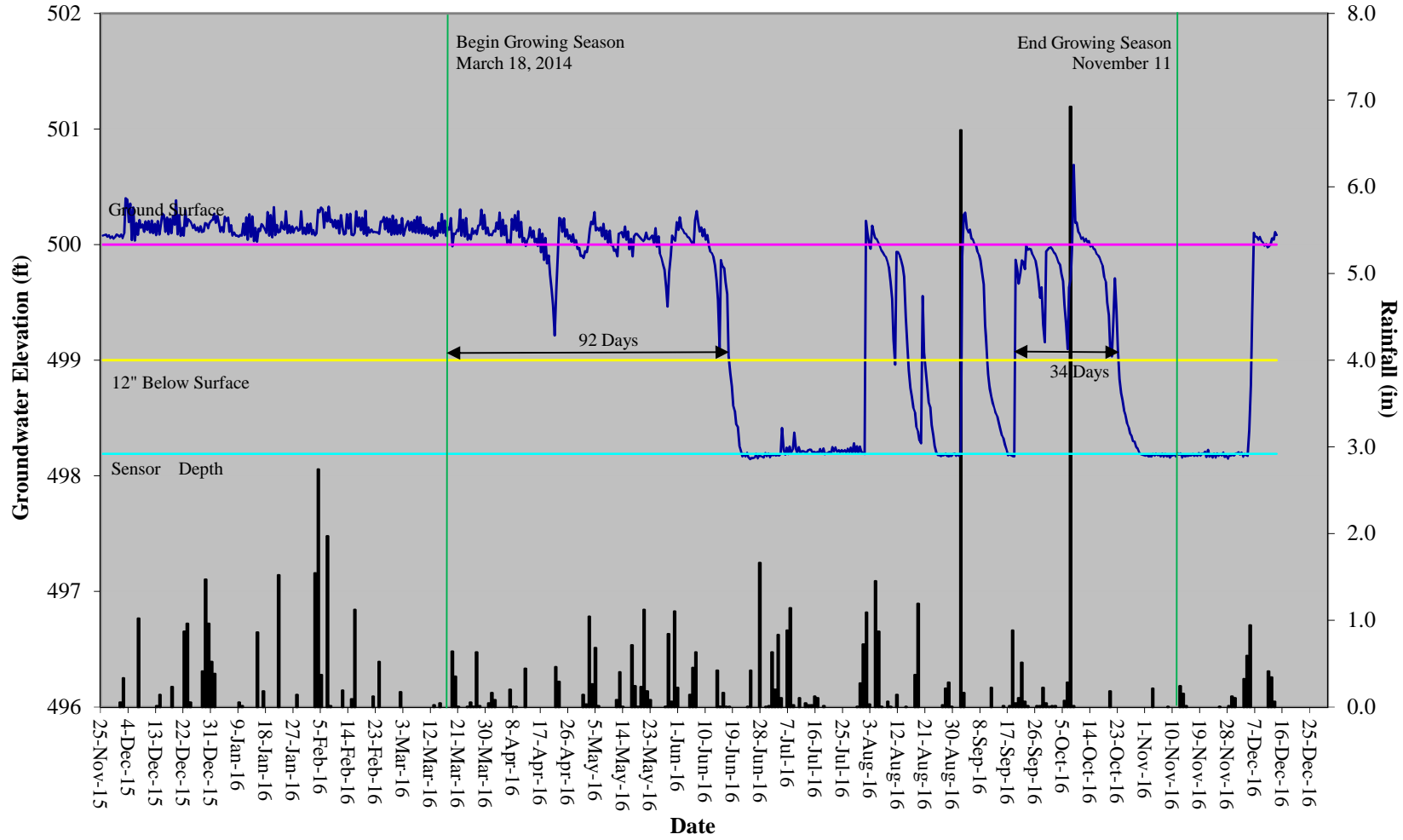
Twin Bays Restoration Site Hydrograph Wetland Gauge 9



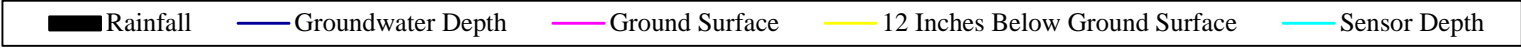
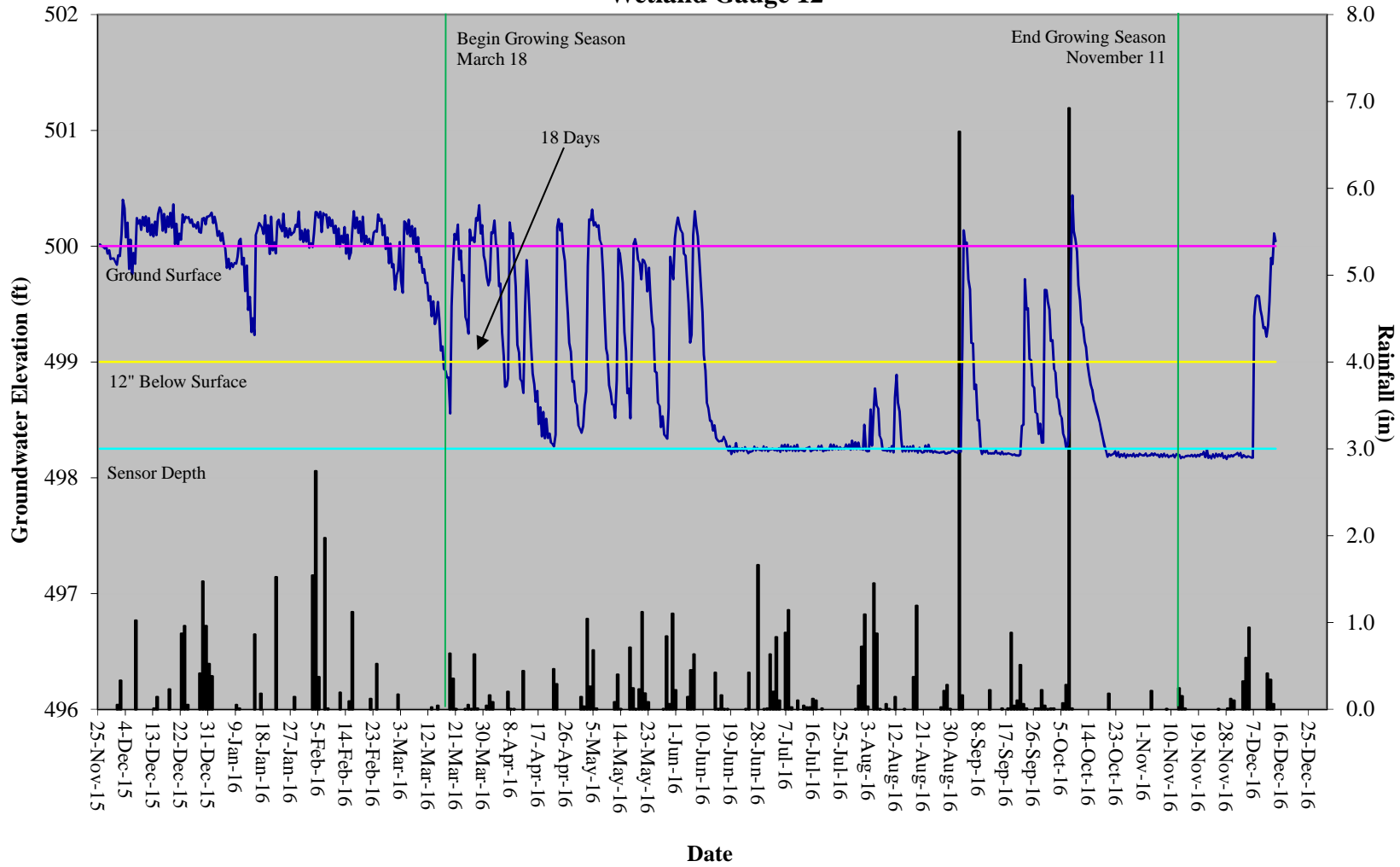
Twin Bays Restoration Site Hydrograph Wetland Gauge 10



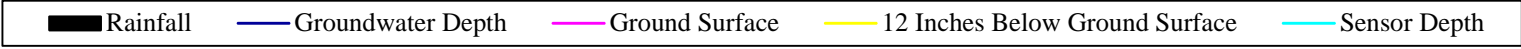
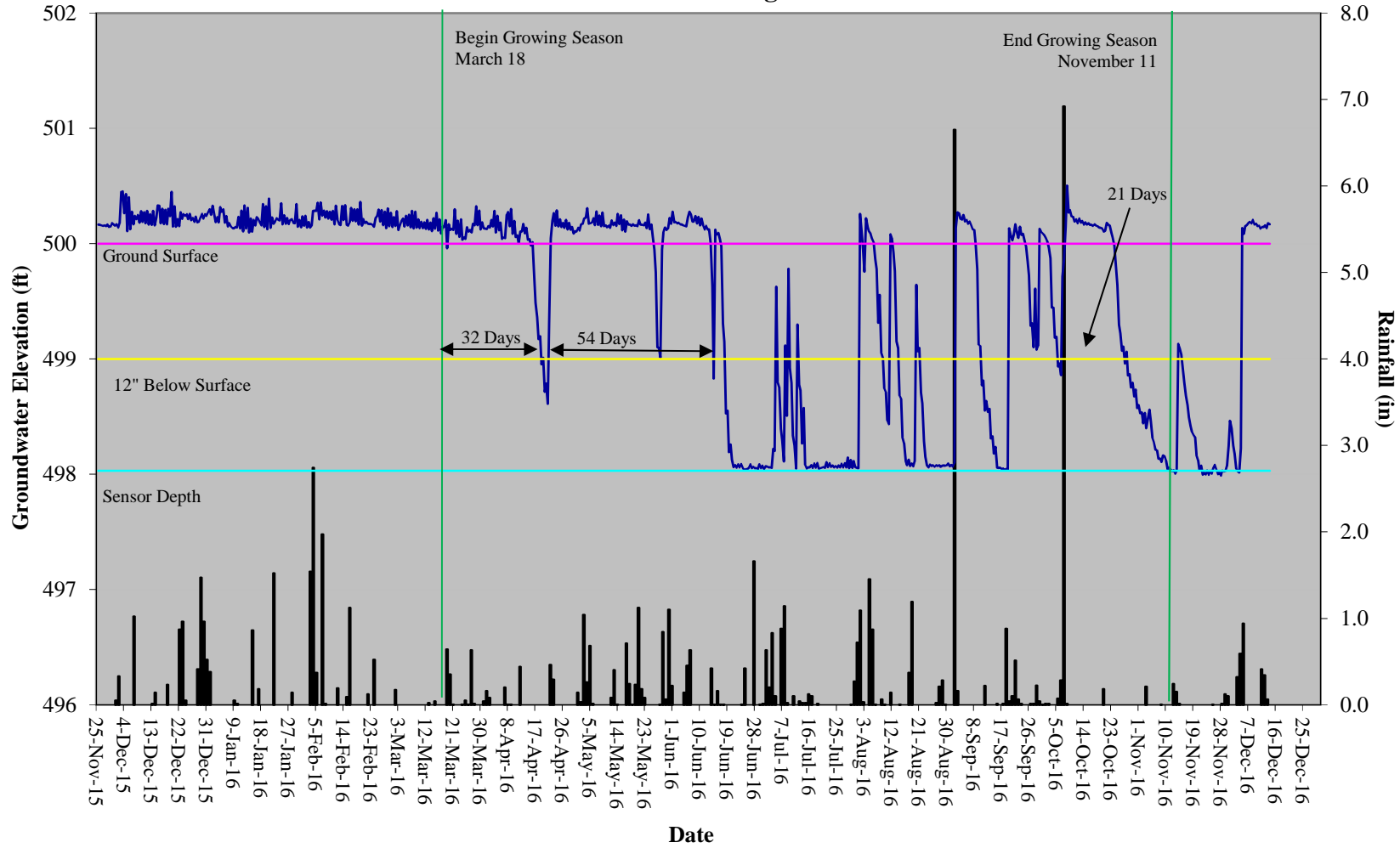
Twin Bays Restoration Site Hydrograph Wetland Gauge 11



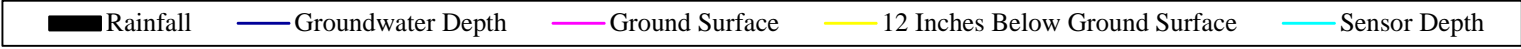
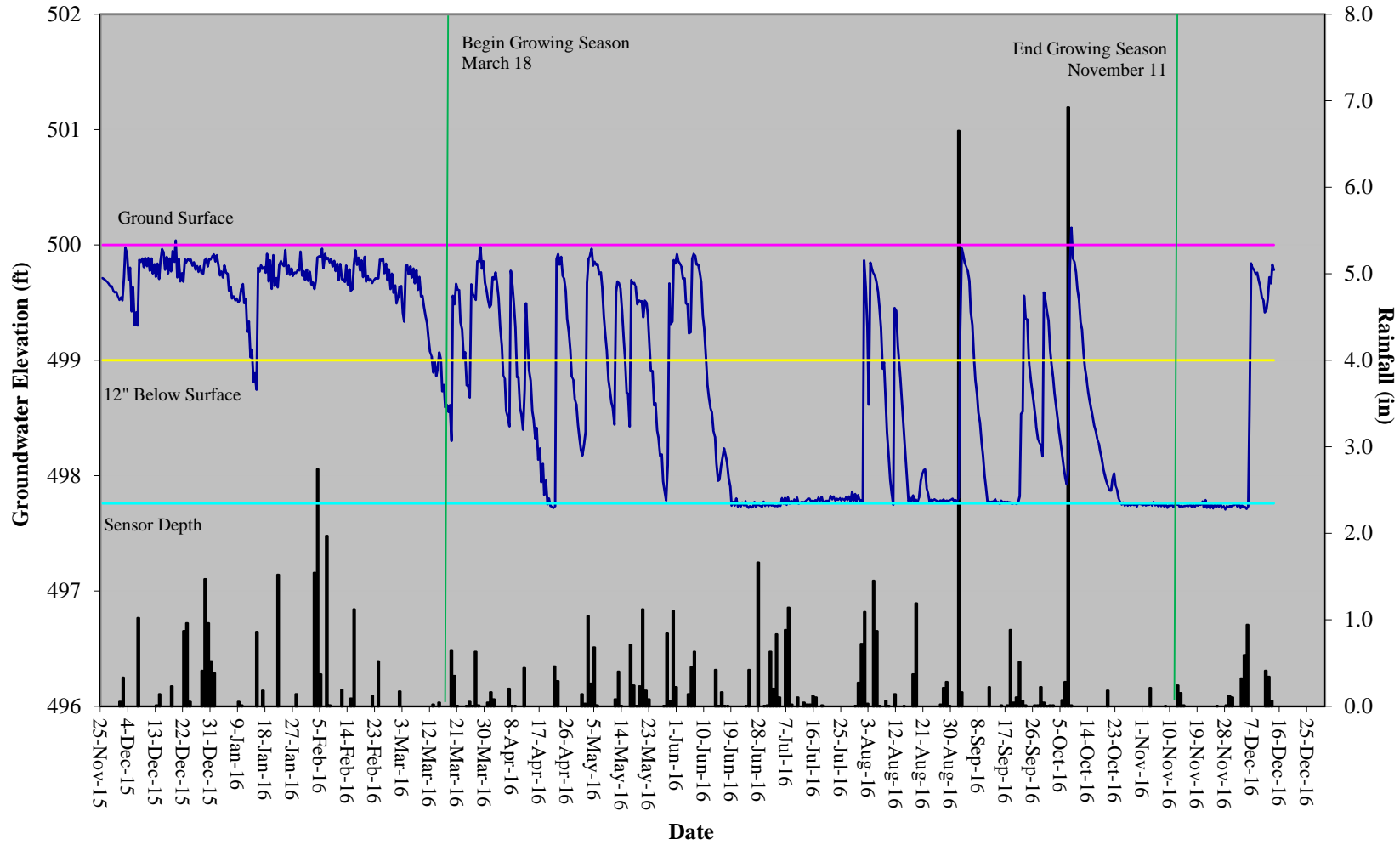
Twin Bays Restoration Site Hydrograph Wetland Gauge 12



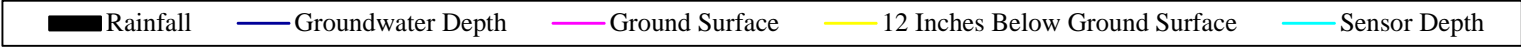
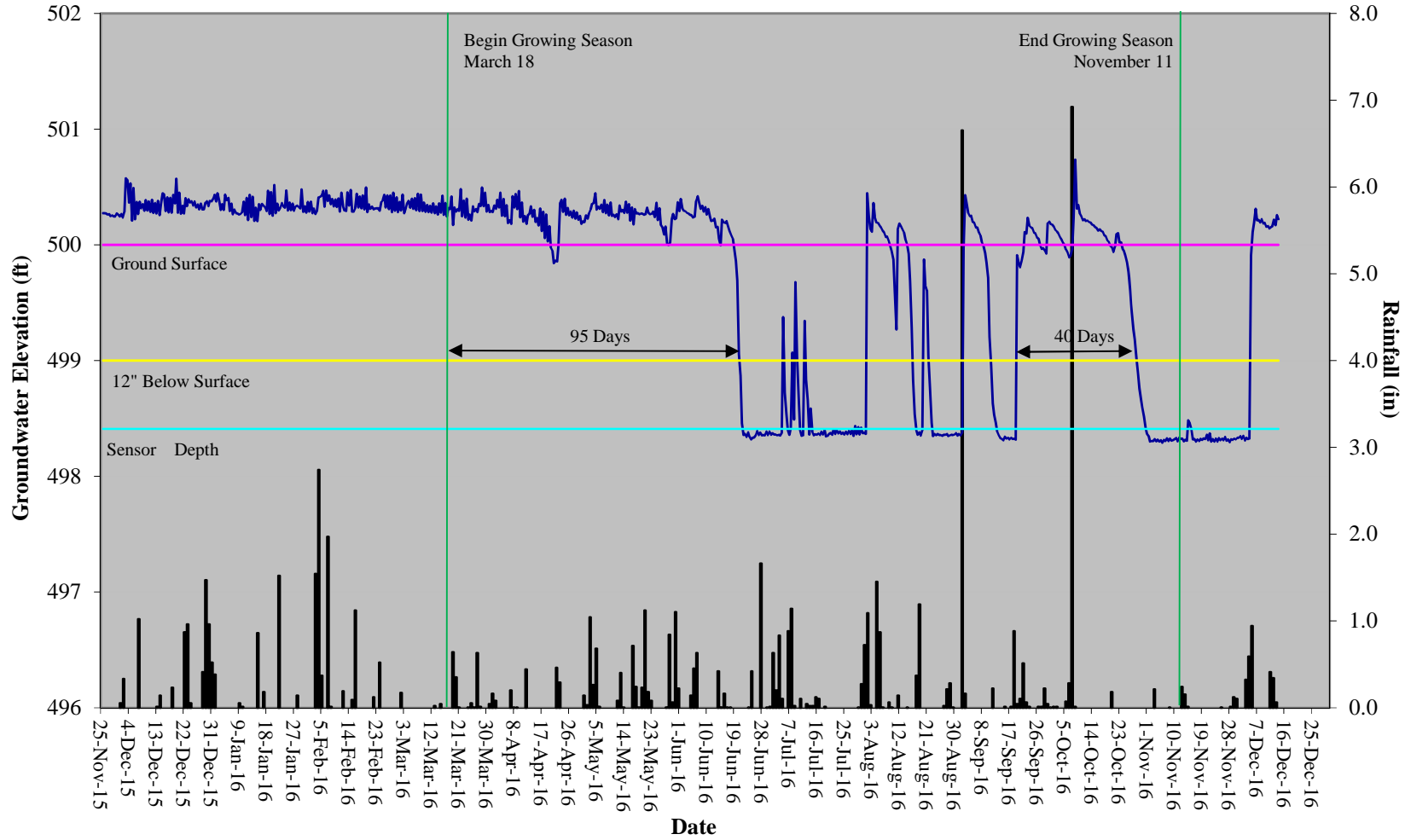
Twin Bays Restoration Site Hydrograph Wetland Gauge 13



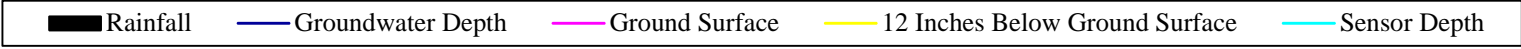
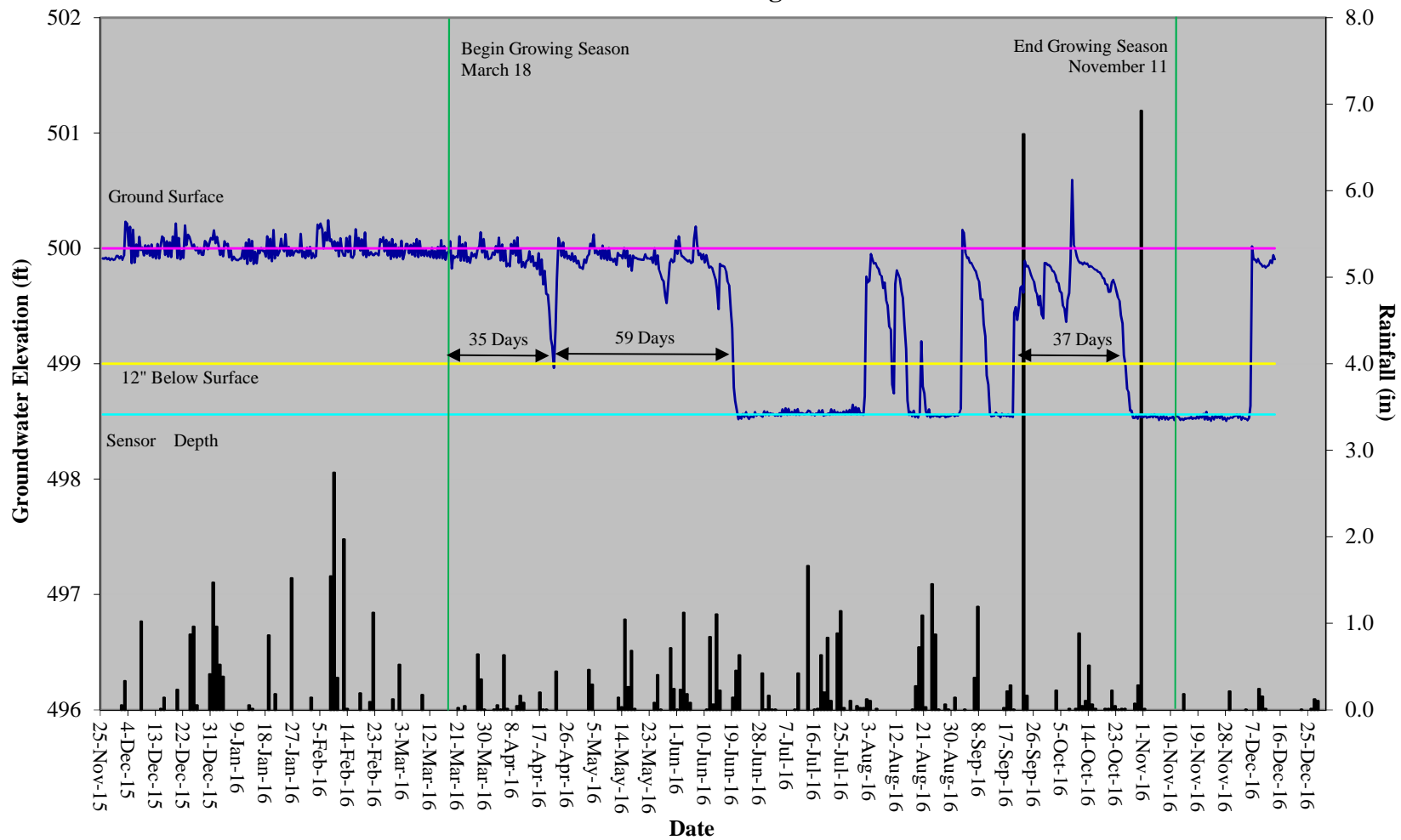
Twin Bays Restoration Site Hydrograph Wetland Gauge 14



Twin Bays Restoration Site Hydrograph Wetland Gauge 15



Twin Bays Restoration Site Hydrograph Wetland Gauge 16



Twin Bays Restoration Site Hydrograph Wetland Gauge 17

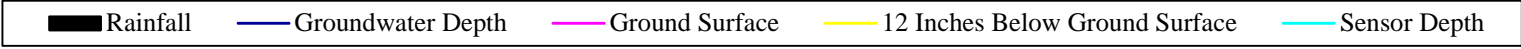
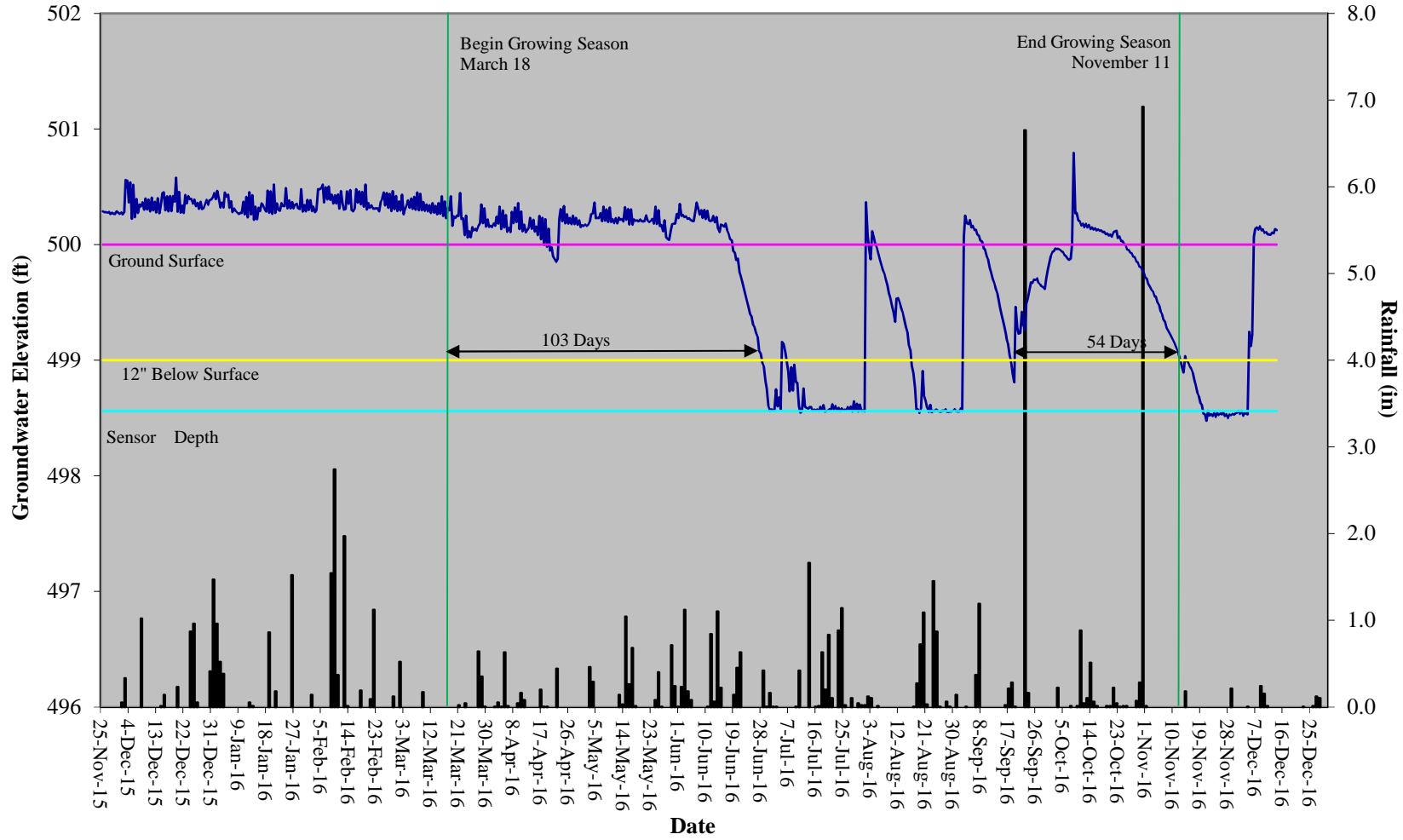


Table 9. Wetland Hydrology Attainment Table Twin Bays Restoration Site, DMS Project #95363							
	Greater than 8% Continuous Saturation/Max Consecutive Days During Growing Season (Percentage)						
Gauge #	MY-01 2014	MY-02 2015	MY-03 2016	MY-04 2017	MY-05 2018	MY-06 2019	MY-07 2020
Gauge 1	Yes/25 (10.5%)	Yes/105 (43.9%)	No/2 (0.8%)				
Gauge 2	No/16 (6.5%)	Yes/75 (31.4%)	Yes/36 (14.9%)				
Gauge 3*	No/13 (5.2%)	No/18 (7.3%)	No/10 (4.0%)				
Gauge 4	Yes/26 (10.9%)	Yes/92 (38.5%)	Yes/36 (15.1%)				
Gauge 5	Yes/27 (11.1%)	Yes/98 (41.0%)	Yes/53 (22.2%)				
Gauge 6*	No/13 (5.4%)	Yes/41 (17.2%)	Yes/28 (11.5%)				
Gauge 7	Yes/27 (11.1%)	Yes/75 (31.4%)	Yes/36 (14.9%)				
Gauge 8	Yes/24 10.0%	Yes/75 (31.4%)	Yes/89 (37.0%)				
Gauge 9	No/17 (6.9%)	Yes/92 (38.3%)	Yes/27 (11.1%)				
Gauge 10	Yes/24 (9.8%)	Yes/22 (9.2%)	Yes/49 (20.5%)				
Gauge 11	Yes/28 (11.7%)	Yes/100 (41.8%)	Yes/92 (38.5%)				
Gauge 12	No/14 (5.9%)	Yes/103 (43.1%)	No/18 (7.3%)				
Gauge 13	No/15 (6.1%)	Yes/74 (30.8%)	Yes/54 (22.6%)				
Gauge 14	Yes/22 (9.0%)	Yes/19 (8.0%)	No/13 (5.2%)				
Gauge 15	Yes/27 (11.1%)	Yes/76 (31.8%)	Yes/95 (39.7%)				
Gauge 16	Yes/49 20.3%	Yes/76 (31.8%)	Yes/59 (24.5%)				
Gauge 17**	-	Yes/104 (43.5%)	Yes/103 (42.9%)				

* = Gauge in the non-credit bearing zone ‡=Gauge malfunctioned

** = Gauge installed 3/8/2015