

# Monitoring Report

**Twin Bays Wetland Restoration Site**

**EEP Contract 004739**

**EEP Project Number 95363**

**Monitoring Year 01**



Prepared for:



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

**Construction Completed: March 2014**

**Data Collection: 2014**

**Submitted: December 2014**

## **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. Historically, the project area has been substantially modified to maximize row crop production. The project offers the chance to restore impacted agricultural lands to non-riparian wetland habitat. The project is located in the 14-digit HUC 03030007090040 (Rock Fish Creek), which the EEP 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 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.

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 EEPs website. All raw data supporting the tables and figures in the appendices are available from EEP 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 survival and growth. The site will demonstrate the re-establishment of targeted vegetative communities based on 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 statistically represents the total mitigation acreage. The average density of these plots will determine whether the site meets success criterion.

The first-year vegetation monitoring was based on the Level 2 CVS-EEP vegetation monitoring protocol. The site's average density for this monitoring period was 894 planted stems/acre. All ten plots had greater than 320 planted stems/acre. Including volunteers, the site averaged 955 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 an average of 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. KCI will monitor soil temperature to verify that the local growing season is consistent with the NRCS published data and reserves the right to present this information as a modifier to the number of days of saturation that is required to achieve jurisdictional status. Wetland hydrology will be monitored with sixteen automatic gauges that record water table depth.

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.

The wetland gauges will be checked and/or downloaded every other month. Daily data will be collected from the automatic gauges over the 7-year monitoring period.

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. This data was collected for informational/research purposes only.

The daily rainfall data were obtained from the NC State Climate Office for a local weather station in Wallace, NC. In 2014, the months of April and June experienced above average rainfall, while March and May experienced average rainfall. The months of July, August, September, October, and November recorded below average rainfall for the site. Overall, the area experienced below average rainfall during the 2014 growing season.

During the site's first growing season, all four of the gauges located 75' from the ditch had continuous saturation within 12 inches of the ground surface for 8% (19 days) of the 239 day growing season (March 18 to November 11). Two of the four gauges located 40' from the ditch also met this metric while neither of the two gauges located less than 40' from the ditch achieved 8% continuous saturation. In the restoration area, only two gauges were below 8% saturation. These two gauges, Gauges 12 and 13, both had continuous saturation for approximately 6% of the growing season, only 5 days less than the 8% metric. It is expected that with more establishment time, all of the gauges within the credit bearing area will be above 8% in future monitoring years. Since gauges 12 and 13 were below 6.5% continuous saturation, these gauges were excluded from the analysis to determine the spatial average for the hydrology of the entire site. The exclusion of these two gauges lead to 2.43 acres of the 10.6 acre wetland restoration area being excluded, for a total of 8.17 acres. This analysis is based off percent saturation contours for the restoration area calculated from the gauge data. Because there was not a gauge installed in the central northern portion of the site, an estimated data point was used to create the contours. The percent saturation for this data point is based on comparing observations in this location to the conditions at the other gauges. Since this portion of the site has an active seep, it has more standing water and is the most frequently saturated part of the site. For this reason, the percent saturation for this data point was made to match the highest of all of the established gauges. Before the 2015 growing season begins, an additional gauge will be installed within this part of the site. Following the method described above and as illustrated in the figure in Appendix D, it is determined that based on the spatial average, the attaining portion of the site was continuously saturated for 10.8% of the growing season and met the hydrology success criteria of 8% for the first year of monitoring. As mentioned above, it is expected that the entire site will attain the hydrology success criteria in future years.

### **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 November 3, 2014.

#### 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](http://www.nceep.net/services/restplans/Yadkin_Pee_De_RBRP_2009_Final.pdf)

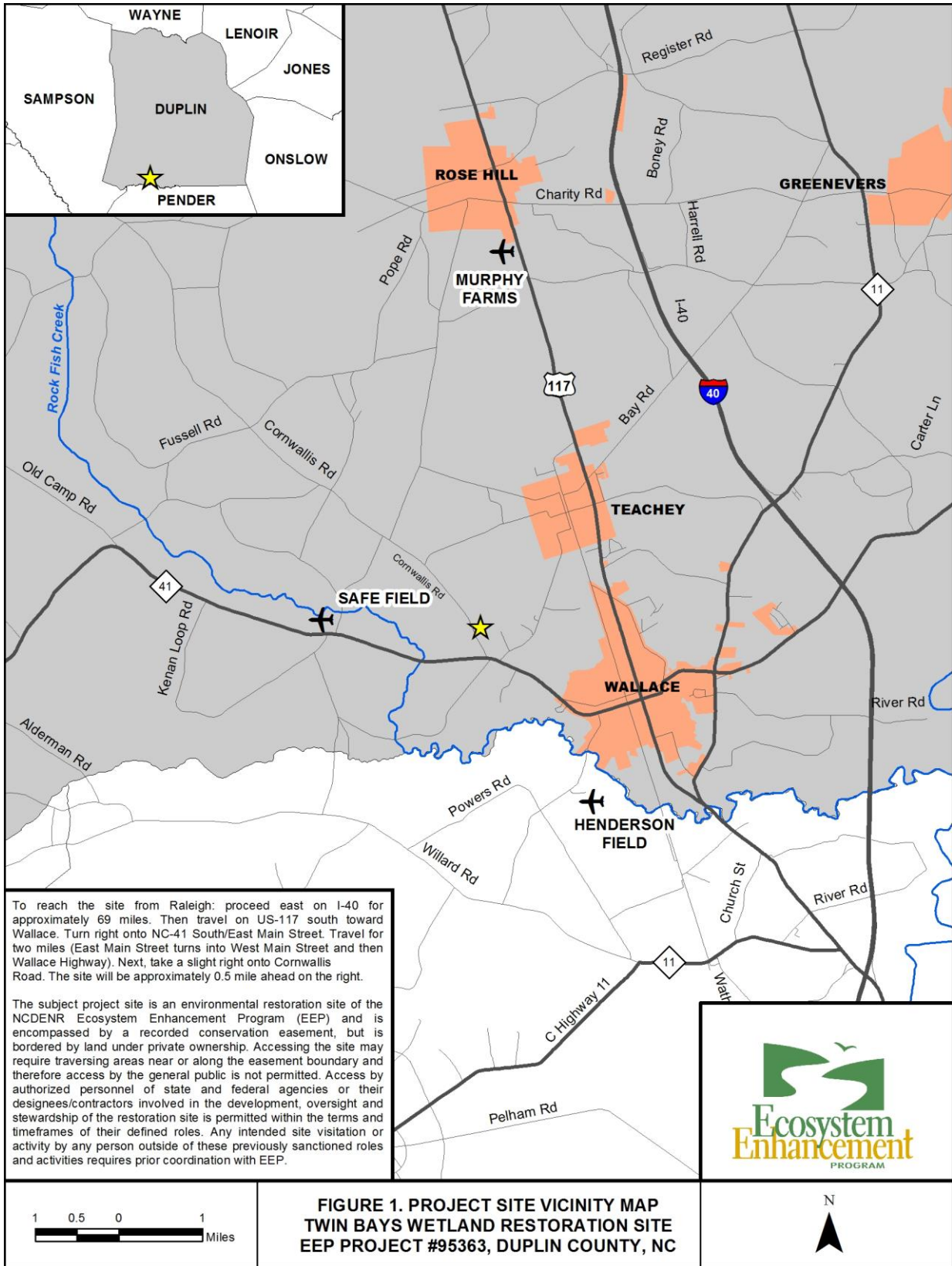
NCSU BAE. North Carolina State University, Biological and Agricultural Engineering. 2011. Method to Determine Lateral Effect of a Drainage Ditch on Adjacent Wetland Hydrology. Last accessed 11/2012 at:  
[http://www.bae.ncsu.edu/soil\\_water/projects/lateral\\_effect.html](http://www.bae.ncsu.edu/soil_water/projects/lateral_effect.html)

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

# **Appendix A**

## **Project Vicinity Map and Background Tables**





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

<b>Table 2. Project Activity &amp; Reporting History Twin Bays Wetland Restoration Site, EEP Project # 95363</b>		
<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
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

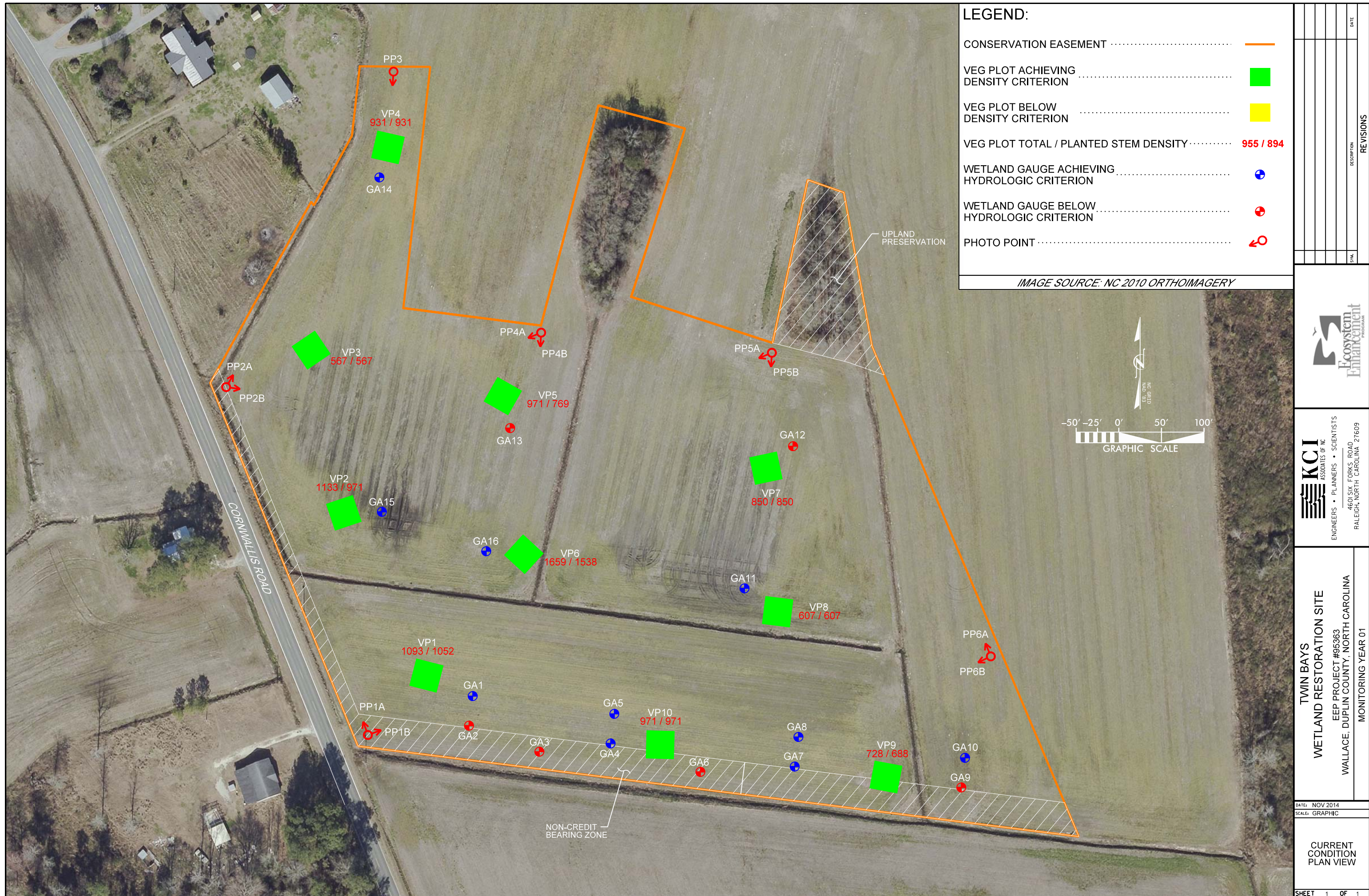
<b>Table 3. Project Contacts Twin Bays Wetland Restoration Site, EEP Project # 95363</b>	
<b>Design Firm</b>	KCI Associates of North Carolina, PC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
<b>Construction Contractor</b>	KCI Environmental Technologies and Construction, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
<b>Planting Contractor</b>	Forestree Management Co. 1280 Maudis Road Bailey, NC 27807 Contact: Mr. Tony Cortez Phone: (252) 243-2513
<b>Monitoring Performers</b>	
<b>MY-00-01</b>	KCI Associates of North Carolina, PC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

<b>Table 4. Project Information</b>			
<b>Twin Bays Wetland Restoration Site, EEP Project # 95363</b>			
<b>Project Name</b>	Twin Bays Wetland Restoration Site		
<b>County</b>	Duplin County		
<b>Project Area (acres)</b>	11.72 acres		
<b>Project Coordinates (lat. and long.)</b>	34.748418 N , -78.027129 W		
<b>Project Watershed Summary Information</b>			
<b>Physiographic Province</b>	Coastal Plain		
<b>River Basin</b>	Cape Fear		
<b>USGS Hydrologic Unit 8-digit</b>	03030007	<b>USGS Hydrologic Unit 14-digit</b>	03030007090040
<b>DWQ Sub-basin</b>	18-74-29b		
<b>Project Drainage Area (acres)</b>	25.4 acres		
<b>Project Drainage Area Percentage of Impervious Area</b>	2%		
<b>CGIA Land Use Classification</b>	93% Cultivated, 2% Mixed Shrubland, and 5% Low-Intensity Development		
<b>Wetland Summary Information (Post-Restoration)</b>			
<b>Parameters</b>	<b>Wetland Area</b>		
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%		
<b>Regulatory Considerations</b>			
<b>Regulation</b>	<b>Applicable?</b>	<b>Resolved?</b>	<b>Supporting Documentation</b>
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**

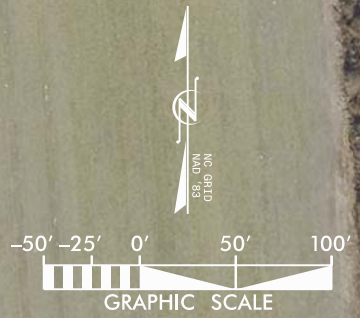




**LEGEND:**

- CONSERVATION EASEMENT ..... ————
- VEG PLOT ACHIEVING DENSITY CRITERION ..... ■
- VEG PLOT BELOW DENSITY CRITERION ..... ■
- VEG PLOT TOTAL / PLANTED STEM DENSITY ..... 955 / 894
- WETLAND GAUGE ACHIEVING HYDROLOGIC CRITERION ..... ⊕
- WETLAND GAUGE BELOW HYDROLOGIC CRITERION ..... ⊕
- PHOTO POINT ..... ↻

IMAGE SOURCE: NC 2010 ORTHOIMAGERY



NO.	DATE	REVISIONS



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**TWIN BAYS**  
WETLAND RESTORATION SITE  
EEP PROJECT #95363  
WALLACE, DUPLIN COUNTY, NORTH CAROLINA  
MONITORING YEAR 01

DATE: NOV 2014  
SCALE: GRAPHIC  
**CURRENT CONDITION PLAN VIEW**  
SHEET 1 OF 1



<b>Table 5. Vegetation Condition Assessment</b>						
<b>Twin Bays Restoration Site, EEP Project #95363</b>						
<b>Planted Acreage 10.6</b>			<b>Easement Acreage 11.7</b>			
<b>Vegetation Category</b>	<b>Definitions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
<b>1. Bare Areas</b>	Very limited cover of both woody and herbaceous material.	0.1 acre	Pattern and Color	0	0.00	0.0%
<b>2. Low Stem Density Areas</b>	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%
<b>Total</b>				0	0.00	0.0%
<b>3. Areas of Poor Growth Rates or Vigor</b>	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%
<b>Cumulative Total</b>				0	0.00	0.0%
<b>4. Invasive Areas of Concern</b>	Areas or points (if too small to render as polygons at map scale).	1,000 SF	Pattern and Color	0	0.00	0.0%
<b>5. Easement Encroachment Areas</b>	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 – MY01 – 11/3/14



PP1b– MY-00 – 4/10/14



PP1b – MY01 – 11/3/14



PP2a – MY-00 – 4/10/14



PP2a – MY01 – 11/3/14





PP2b – MY-00 – 4/10/14



PP2b – MY01 – 11/3/14



PP3 – MY-00 – 4/10/14



PP3 – MY01 – 11/3/14



PP4a – MY-00 – 4/10/14



PP4a – MY01 – 11/3/14





PP4b – MY-00 – 4/10/14



PP4b – MY01 – 11/3/14



PP5a – MY-00 – 4/10/14



PP5a – MY01 – 11/3/14



PP5b – MY-00 – 4/10/14



PP5b – MY01 – 11/3/14





PP6a – MY-00 – 4/10/14



PP6a – MY01 – 11/3/14



PP6b– MY-00 – 4/10/14



PP6b – MY01 – 11/3/14



## Vegetation Plot Photos



Veg Plot #1 – MY-01 – 11/3/14



Veg Plot #2 – MY-01 – 11/3/14



Veg Plot #3 – MY-01 – 11/3/14



Veg Plot #4 – MY-01 – 11/3/14



Veg Plot #5 – MY-01 – 11/3/14



Veg Plot #6 – MY-01 – 11/3/14





Veg Plot #7 – MY-01 – 11/3/14



Veg Plot #8 – MY-01 – 11/3/14



Veg Plot #9 – MY-01 – 11/3/14



Veg Plot #10 – MY-01 – 11/3/14

# **Appendix C**

## **Vegetation Plot Data**

<b>Table 6. Vegetation Plot Criteria Attainment</b>			
<b>Twin Bays Restoration Site EEP Project #95363</b>			
<b>Vegetation Plot ID</b>	<b>Vegetation Survival Threshold Met?</b>	<b>Monitoring Year 01 Planted Stem Density (stems/acre)</b>	<b>Monitoring Year 01 Total Stem Density (stems/acre)</b>
1	Yes	1052	1093
2	Yes	971	1133
3	Yes	567	607
4	Yes	931	931
5	Yes	769	971
6	Yes	1538	1659
7	Yes	850	850
8	Yes	607	607
9	Yes	688	728
10	Yes	971	971

<b>Table 7. CVS Vegetation Plot Metadata Twin Bays Restoration Site EEP Project #95363</b>	
<b>Report Prepared By</b>	Dale Prihoda
<b>Date Prepared</b>	11/14/2014 13:44
<b>database name</b>	KCI-2014-T.mdb
<b>database location</b>	M:\2012\20122265 TwinBays\Monitoring\Vegetation CVS Database
<b>computer name</b>	12-3ZV4FP1
<b>file size</b>	61734912
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	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.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>ALL Stems by Plot and spp</b>	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.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	95363
<b>project Name</b>	Twin Bays Restoration Site
<b>Description</b>	Wetland restoration site
<b>River Basin</b>	Cape Fear
<b>area (sq m)</b>	24523.92
<b>Required Plots (calculated)</b>	10
<b>Sampled Plots</b>	10

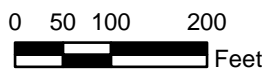


**Table 8. CVS Stem Count Total and Planted by Plot and Species**  
**EEP Project Code 95363. Project Name: Twin Bays Restoration Site**

Scientific Name	Common Name	Species Type	Current Plot Data (MY1 2014)																											Annual Means											
			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			MY1 (2014)			MY0 (2014)					
			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	PnoLS	P-all	T	PnoLS	P-all	T			
Acer rubrum	red maple	Tree			1				1	1	1																									3	3	7	5	5	5
Aronia arbutifolia	Red Chokeberry	Shrub				5	5	5							3	3	3																8	8	8	11	11	11			
Baccharis halimifolia	eastern baccharis	Shrub						3			1						2									1						7									
Betula nigra	river birch	Tree	5	5	5				1	1	1	3	3	3	6	6	6	16	16	16				1	1	1	5	5	5	11	11	11	48	48	48	47	47	47			
Fraxinus pennsylvanica	green ash	Tree				11	11	11	1	1	1	1	1	1				9	9	9	2	2	2										24	24	24	5	5	5			
Liquidambar styraciflua	sweetgum	Tree						1																								1									
Liriodendron tulipifera	tuliptree	Tree							1	1	1																			1	1	1	18	18	18						
Magnolia virginiana	sweetbay	Tree							1	1	1				4	4	4	1	1	1	6	6	6	1	1	1				13	13	13	17	17	17						
Platanus occidentalis	American sycamore	Tree															3	3	3	3										3	3	3									
Quercus michauxii	swamp chestnut oak	Tree	11	11	11	4	4	4	2	2	2	6	6	6				7	7	7	12	12	12	10	10	10	2	2	2				54	54	54						
Quercus pagoda	cherrybark oak	Tree										11	11	11	2	2	2										3	3	3	7	7	7	23	23	23	22	22	22			
Quercus phellos	willow oak	Tree																						6	6	6	3	3	3	9	9	9									
Salix nigra	black willow	Tree															3															3									
Taxodium distichum	bald cypress	Tree	5	5	5																						1	1	1	6	6	6	1	1	1						
Ulmus americana	American elm	Tree																															8	8	8						
Unknown		Shrub or Tree							3	3	3	1	1	1	3	3	3				1	1	1				1	1	1	1	1	1	10	10	10	104	104	104			
Vaccinium corymbosum	highbush blueberry	Shrub	5	5	5	4	4	4	4	4	4	1	1	1	1	1	1	2	2	2				1	1	1				1	1	1	19	19	19	22	22	22			
	<b>Stem count</b>		26	26	27	24	24	28	14	14	15	23	23	23	19	19	24	38	38	41	21	21	21	15	15	15	17	17	18	24	24	24	221	221	236	260	260	260			
	<b>size (ares)</b>		1			1			1			1			1			1			1			1			1			10			10								
	<b>size (ACRES)</b>		0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.25			0.25								
	<b>Species count</b>		4	4	5	4	4	6	8	8	9	6	6	6	6	6	8	6	6	7	4	4	4	5	5	5	5	5	6	6	6	6	13	13	16	11	11	11			
	<b>Stems per ACRE</b>		1052	1052	1093	971	971	1133	567	567	607	931	931	931	769	769	971	1538	1538	1659	850	850	850	607	607	607	688	688	728	971	971	971	894	894	955	1052	1052	1052			

# **Appendix D**

## **Hydrologic Data**

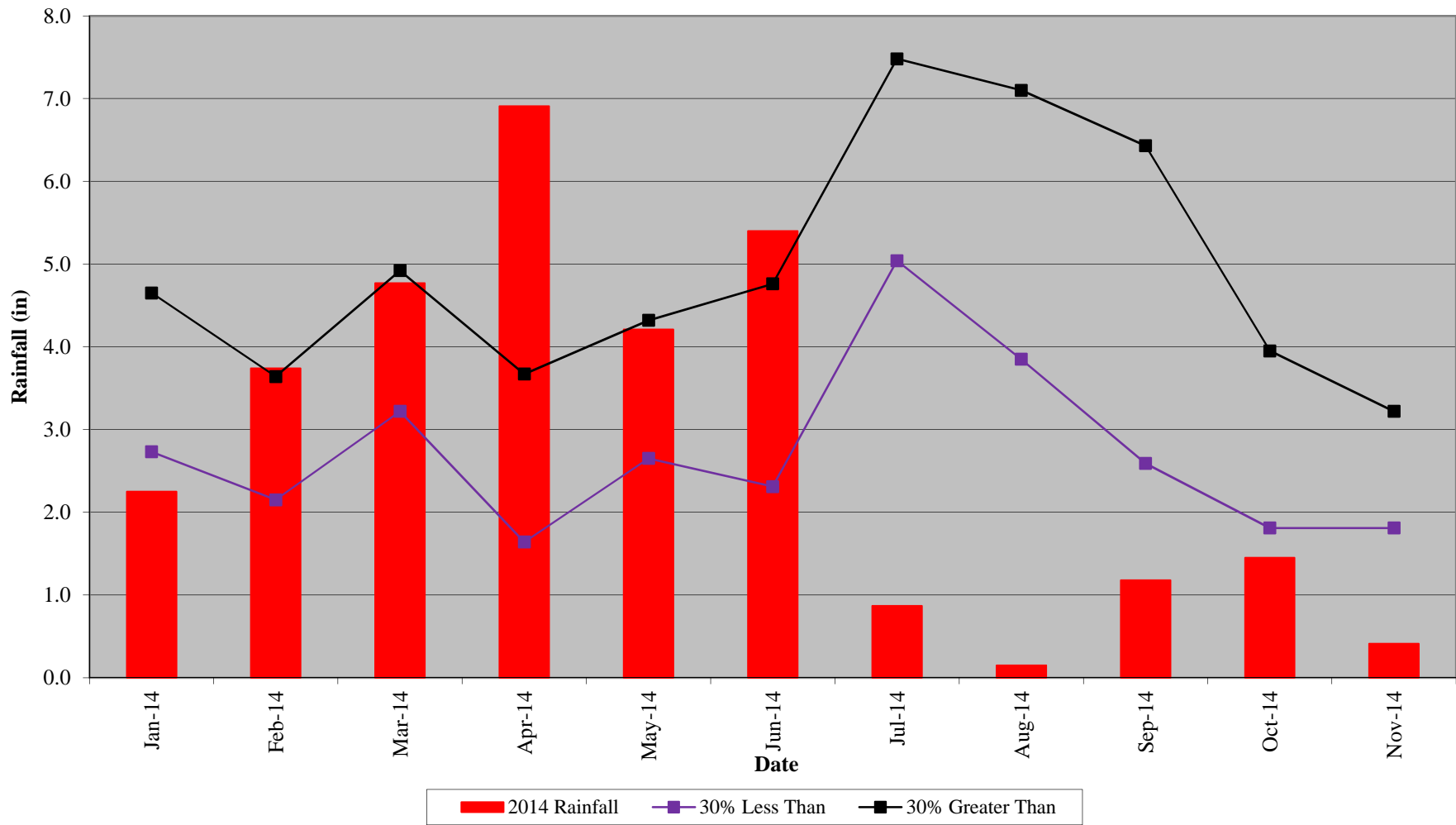


**TWIN BAYS PERCENT SATURATION  
TWIN BAYS RESTORATION SITE  
EEP PROJECT #95363, DUPLIN COUNTY, NC**

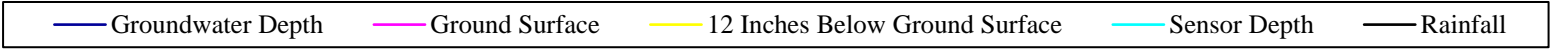
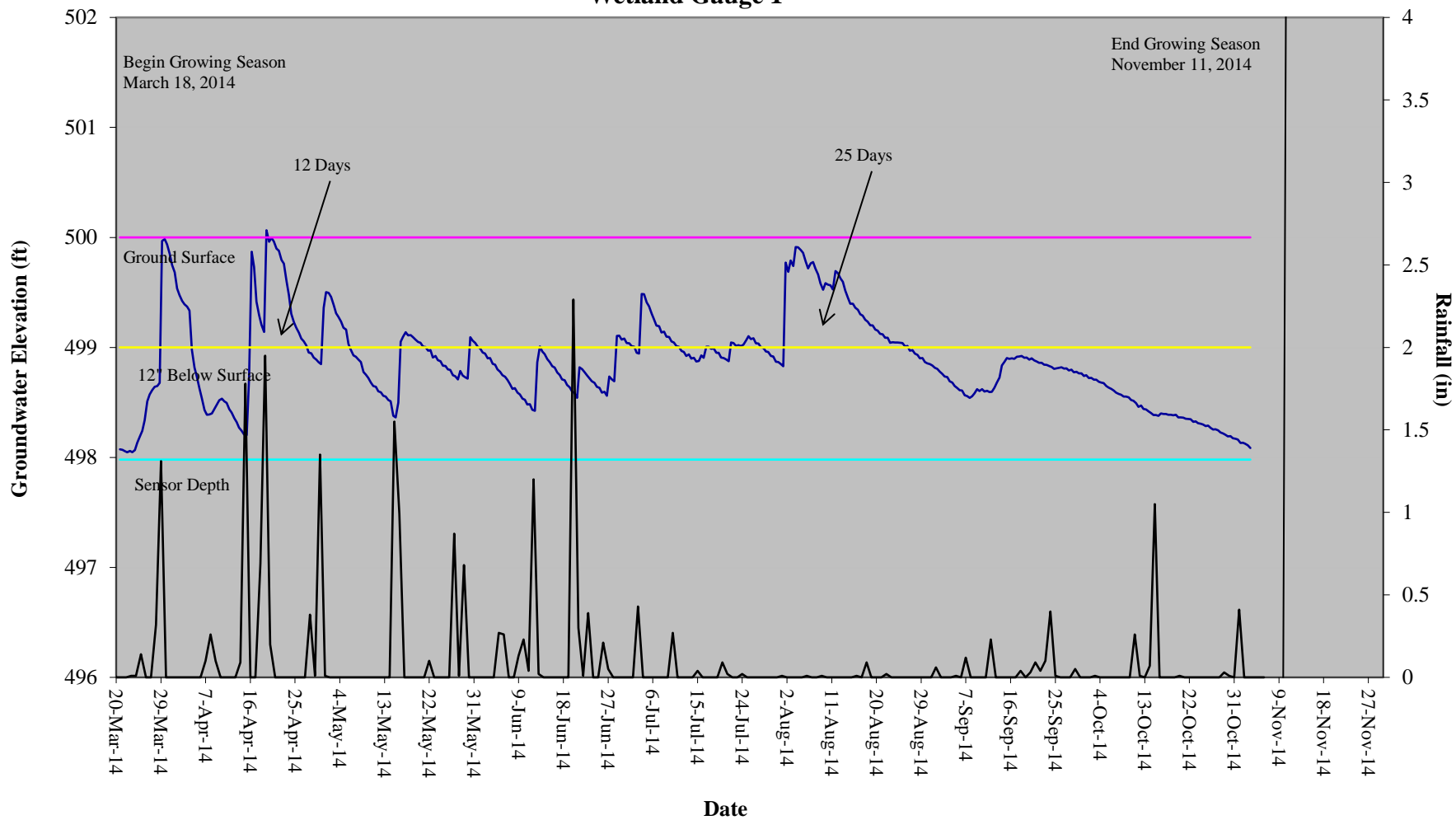
Source: Eastern Piedmont  
Orthoimagery, 2013.



**Twin Bays Wetland Restoration Site  
30-70 Percentile Graph  
WETS Station Name: Warsaw, NC**

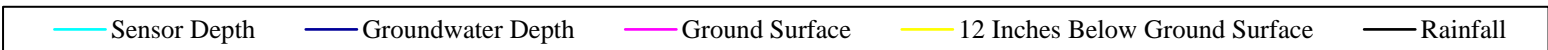
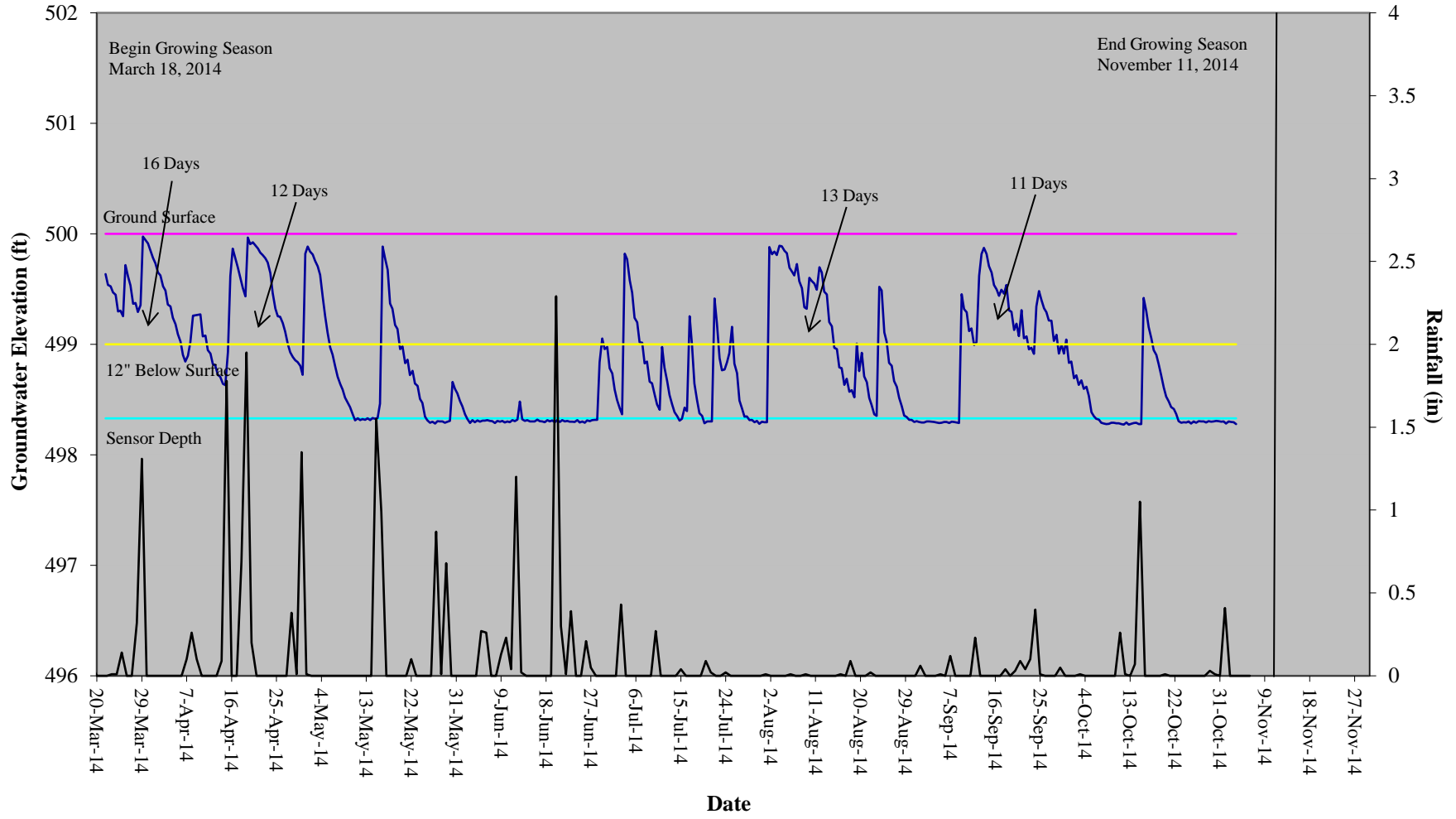


### Twin Bays Restoration Site Hydrograph Wetland Gauge 1

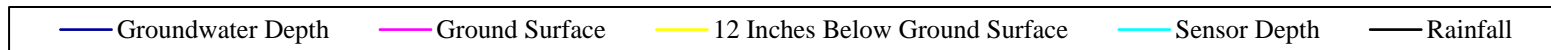
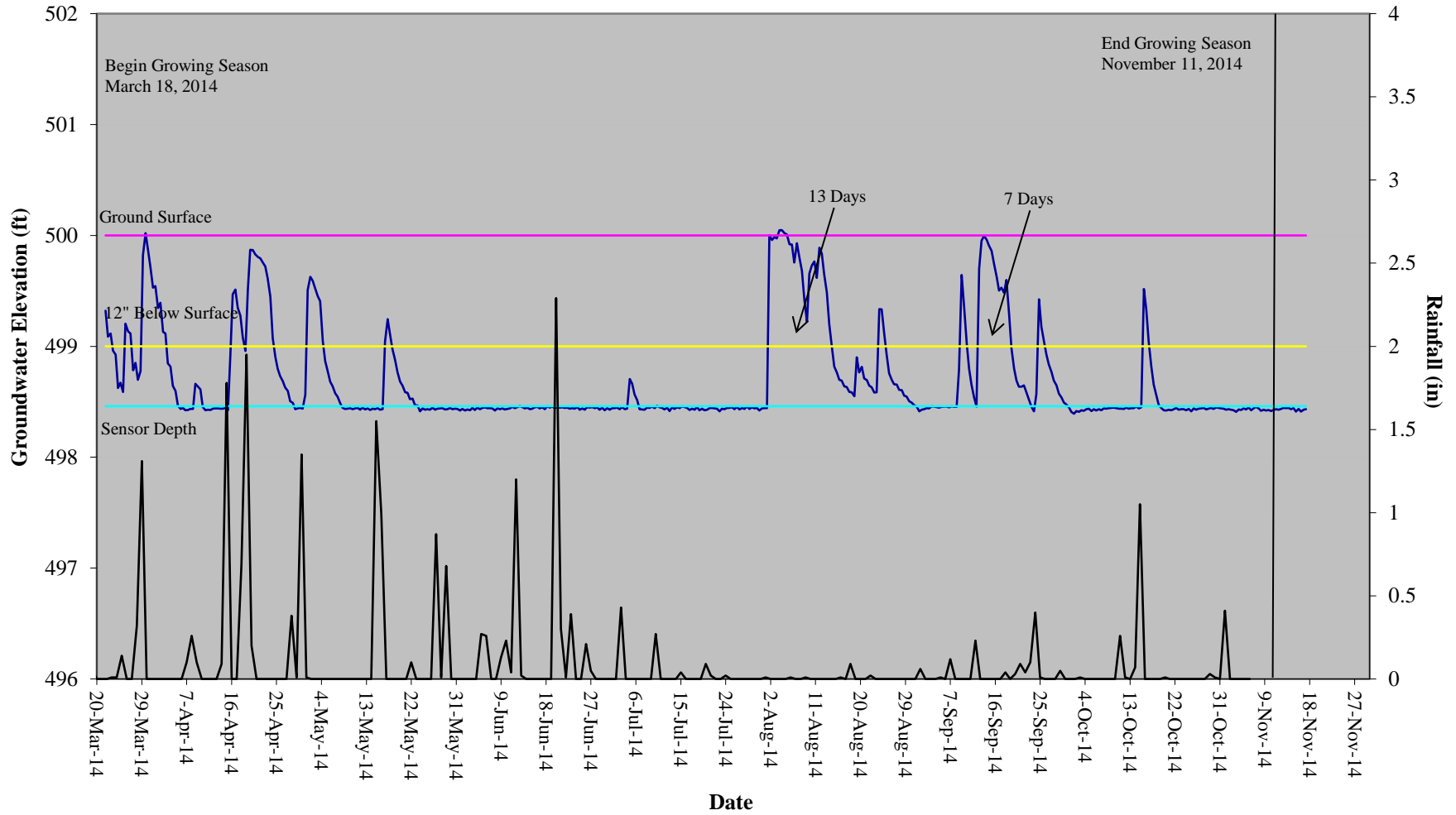




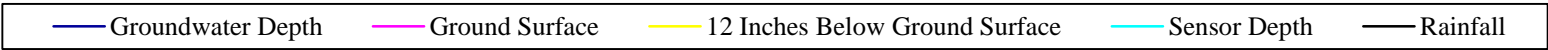
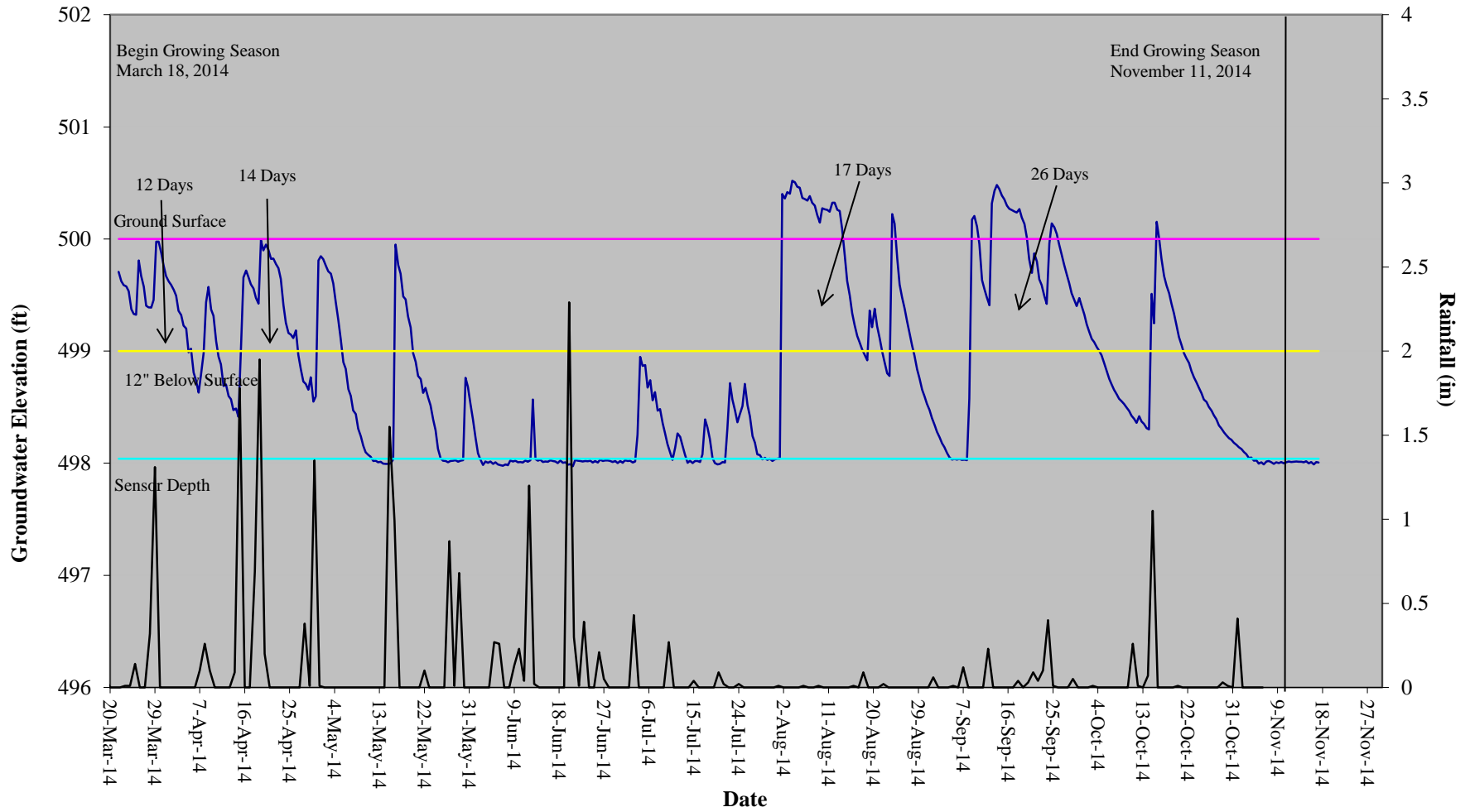
## Twin Bays Restoration Site Hydrograph Wetland Gauge 2



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

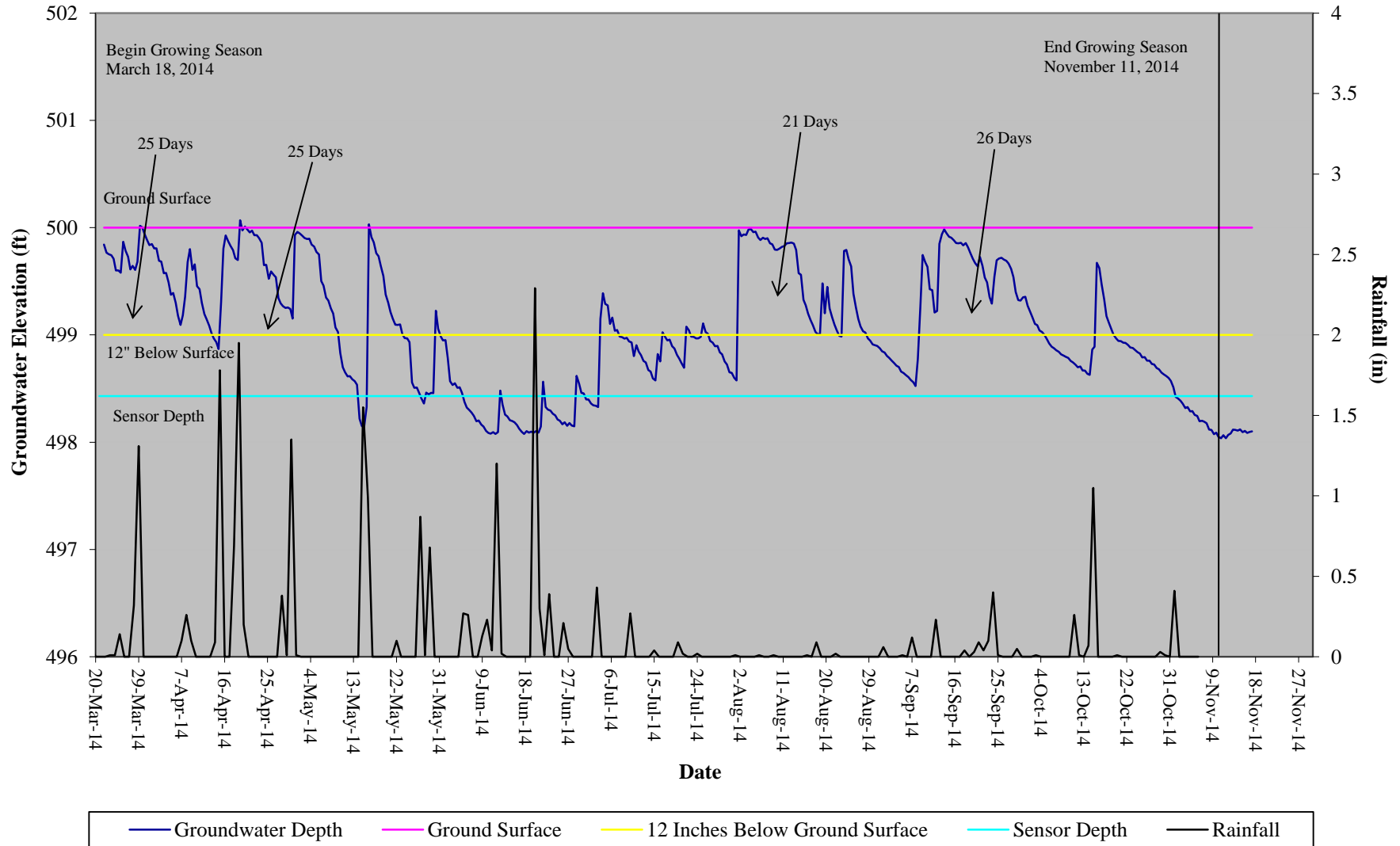


## Twin Bays Restoration Site Hydrograph Wetland Gauge 4

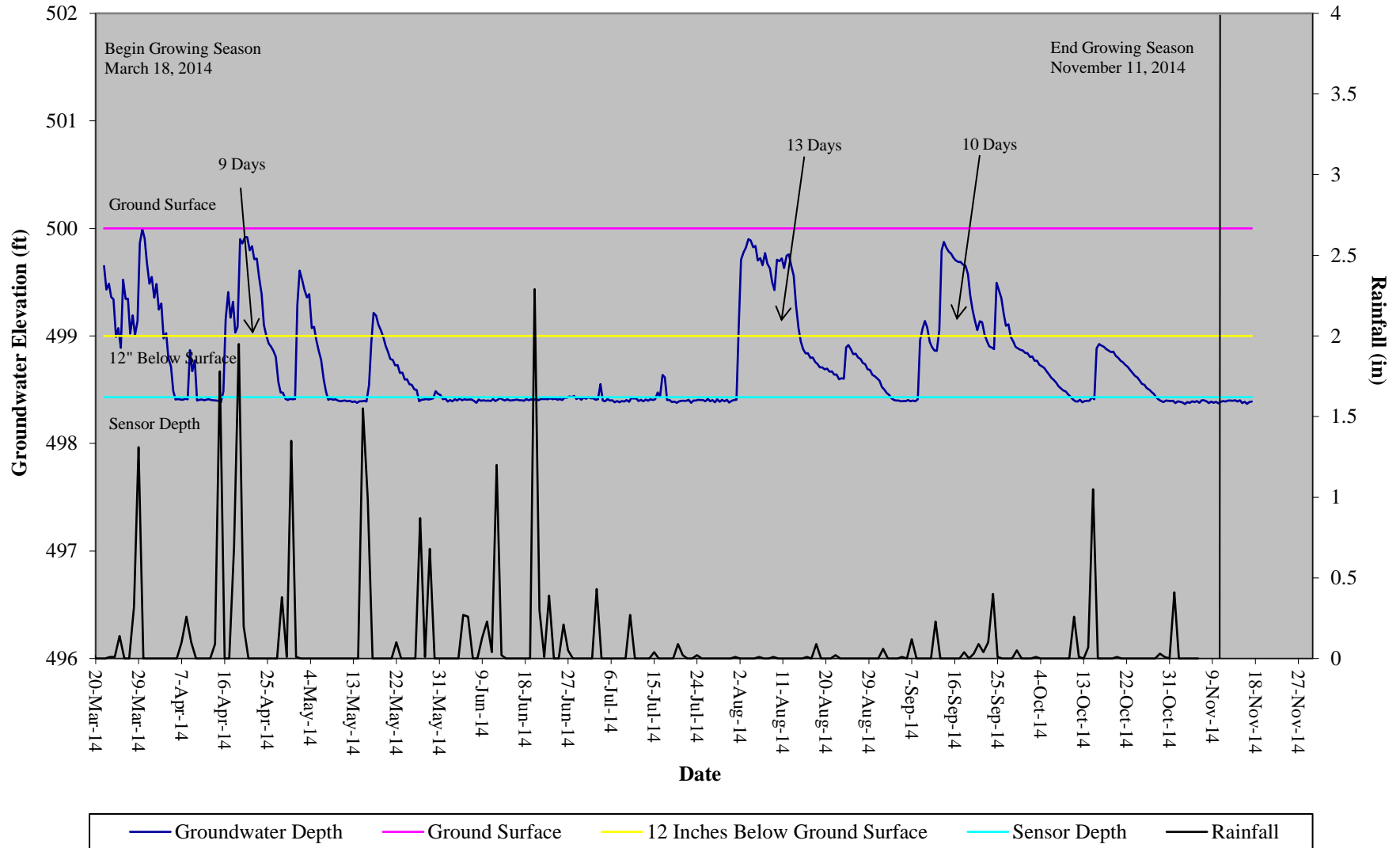




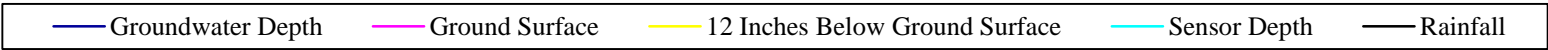
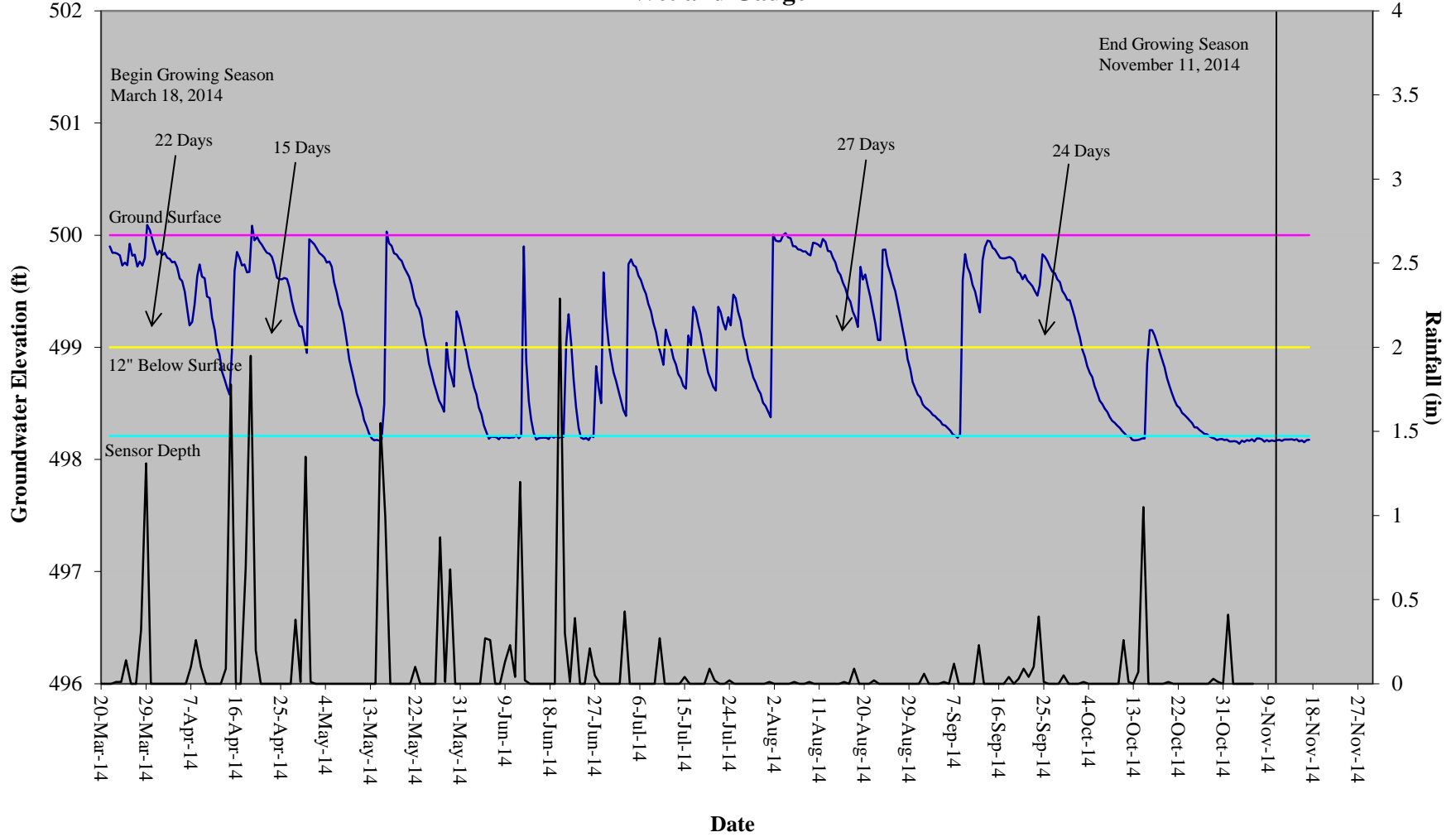
## Twin Bays Restoration Site Hydrograph Wetland Gauge 5



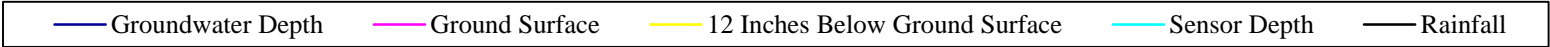
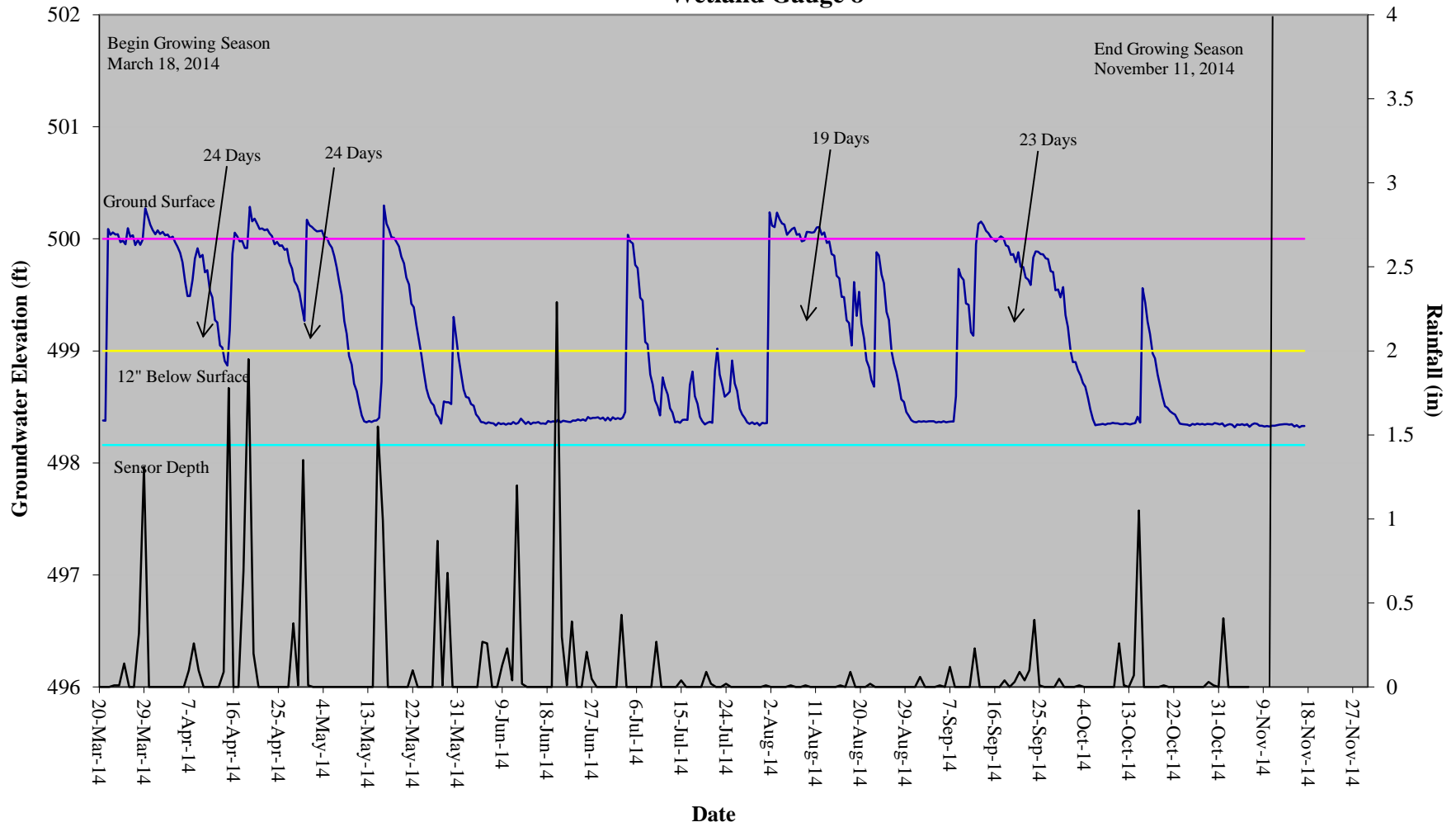
## Twin Bays Restoration Site Hydrograph Wetland Gauge 6 - non-credit bearing



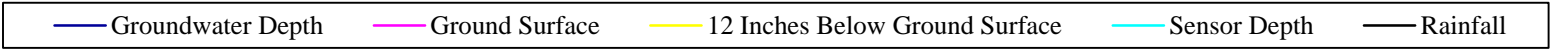
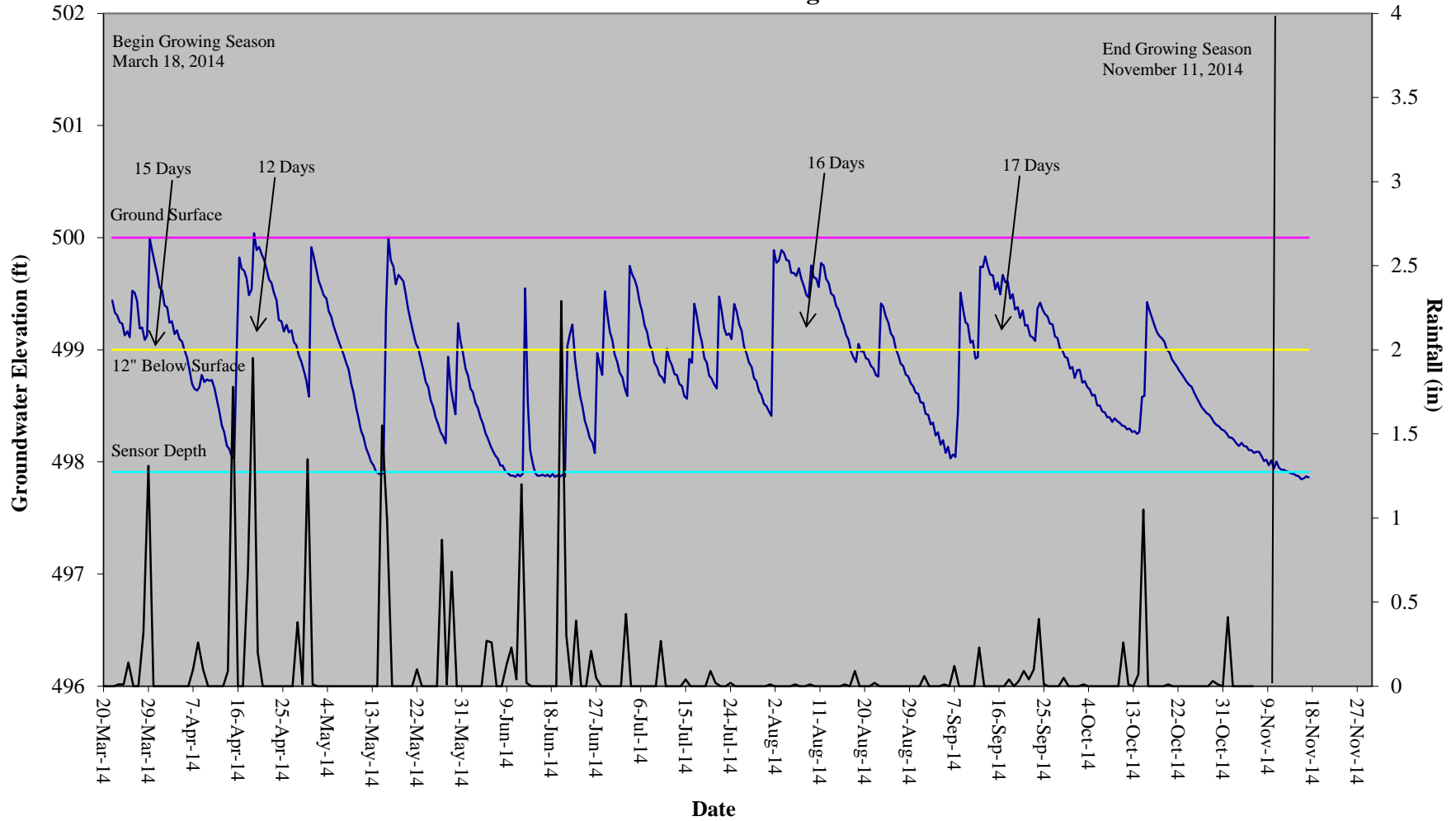
## Twin Bays Restoration Site Hydrograph Wetland Gauge 7



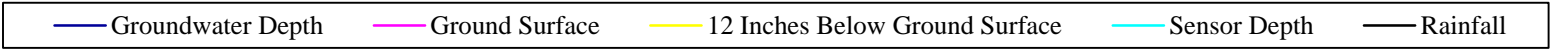
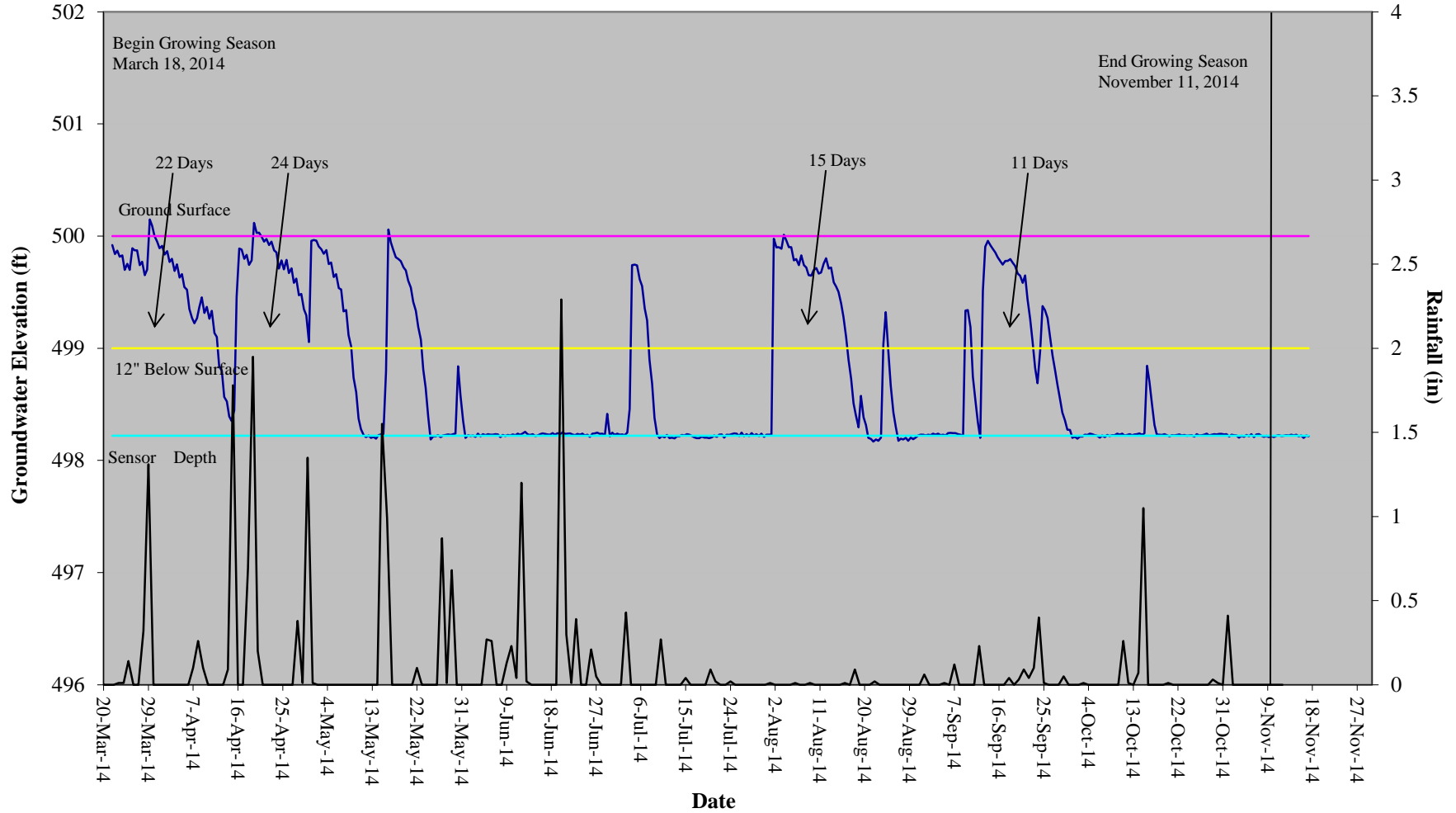
## Twin Bays Restoration Site Hydrograph Wetland Gauge 8



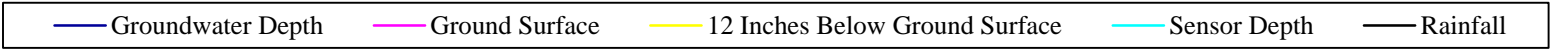
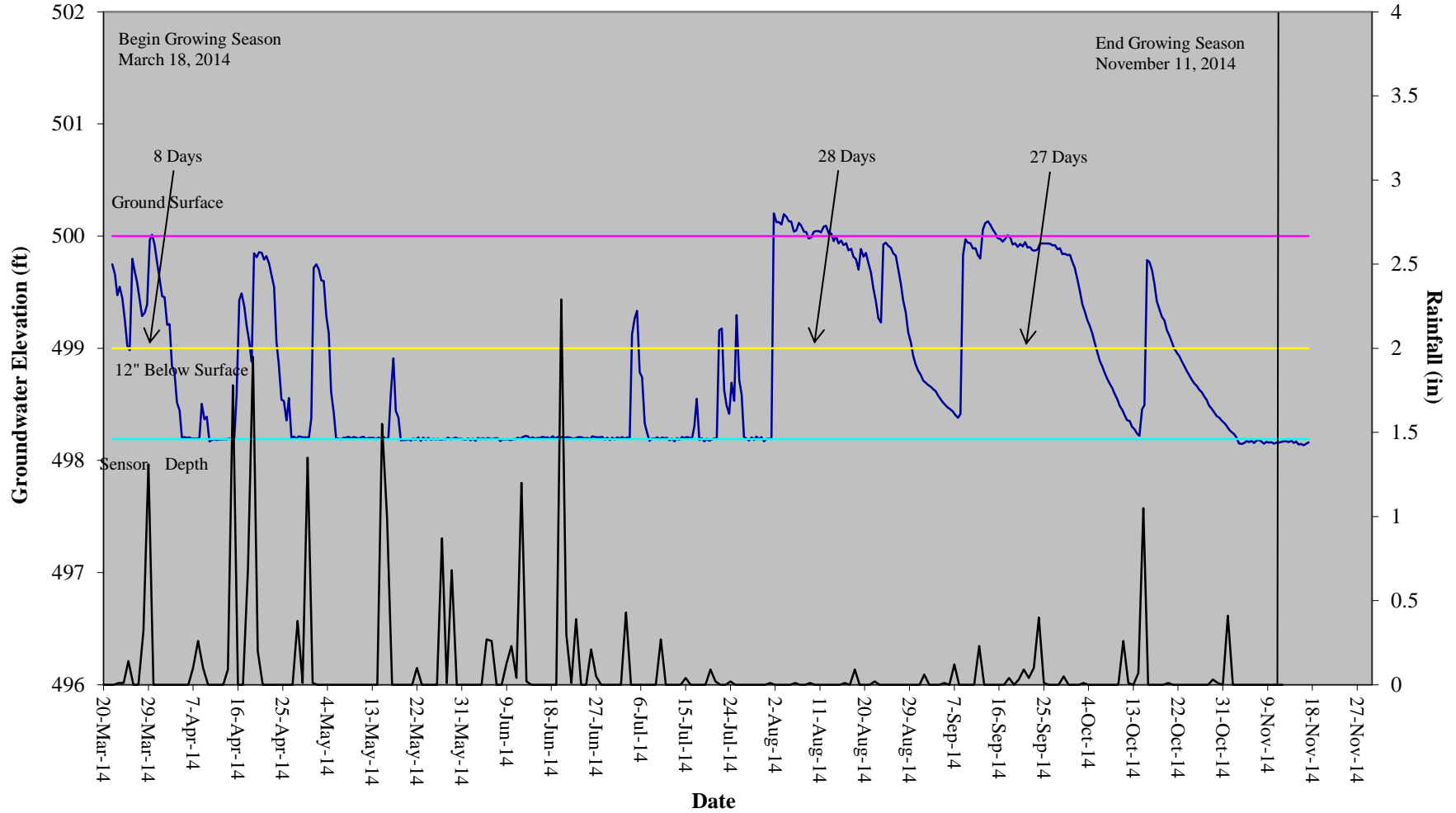
## Twin Bays Restoration Site Hydrograph Wetland Gauge 9



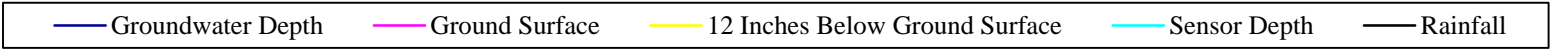
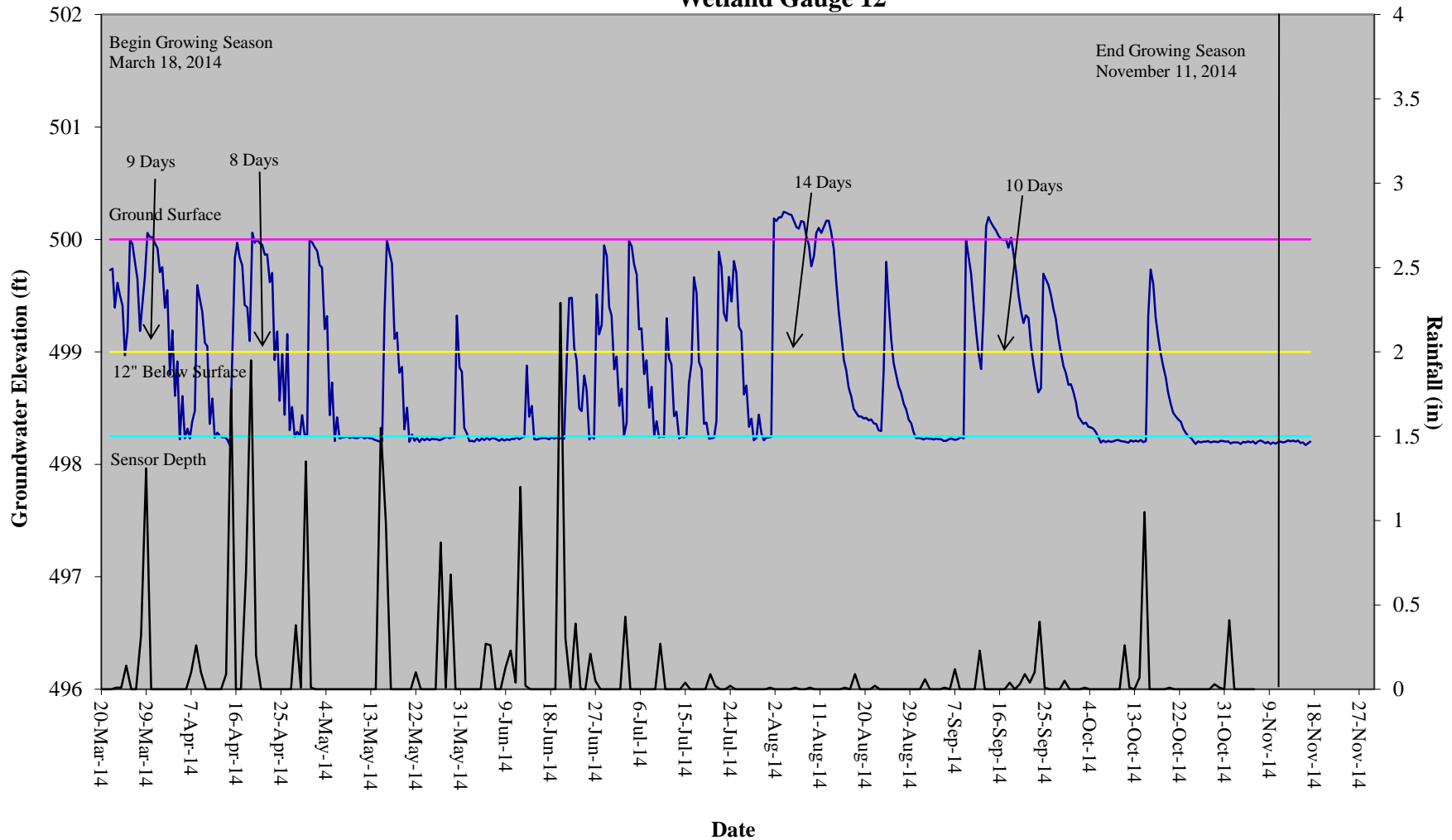
## Twin Bays Restoration Site Hydrograph Wetland Gauge 10



## Twin Bays Restoration Site Hydrograph Wetland Gauge 11

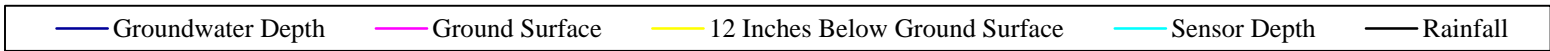
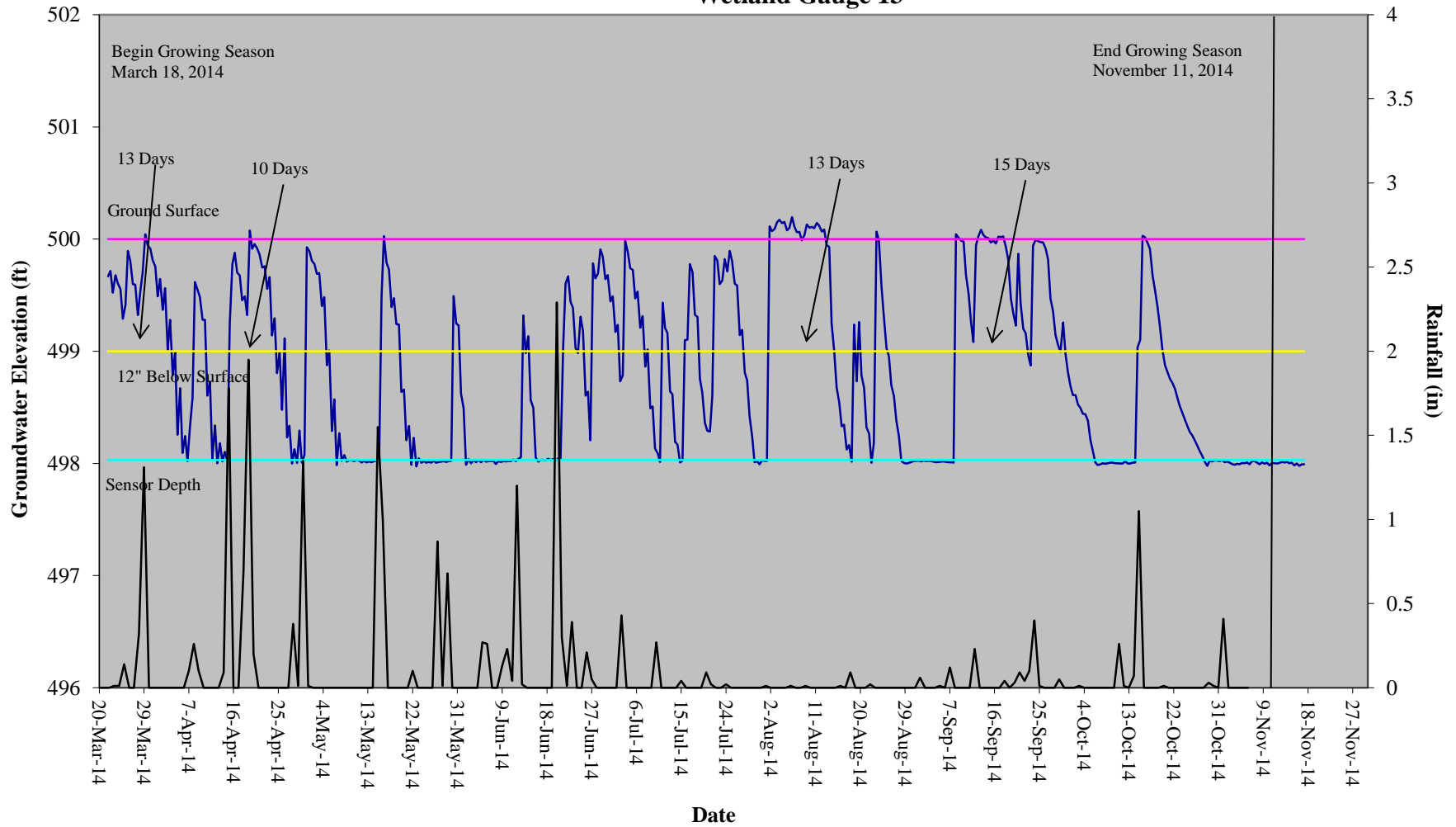


## Twin Bays Restoration Site Hydrograph Wetland Gauge 12

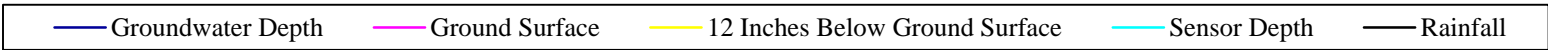
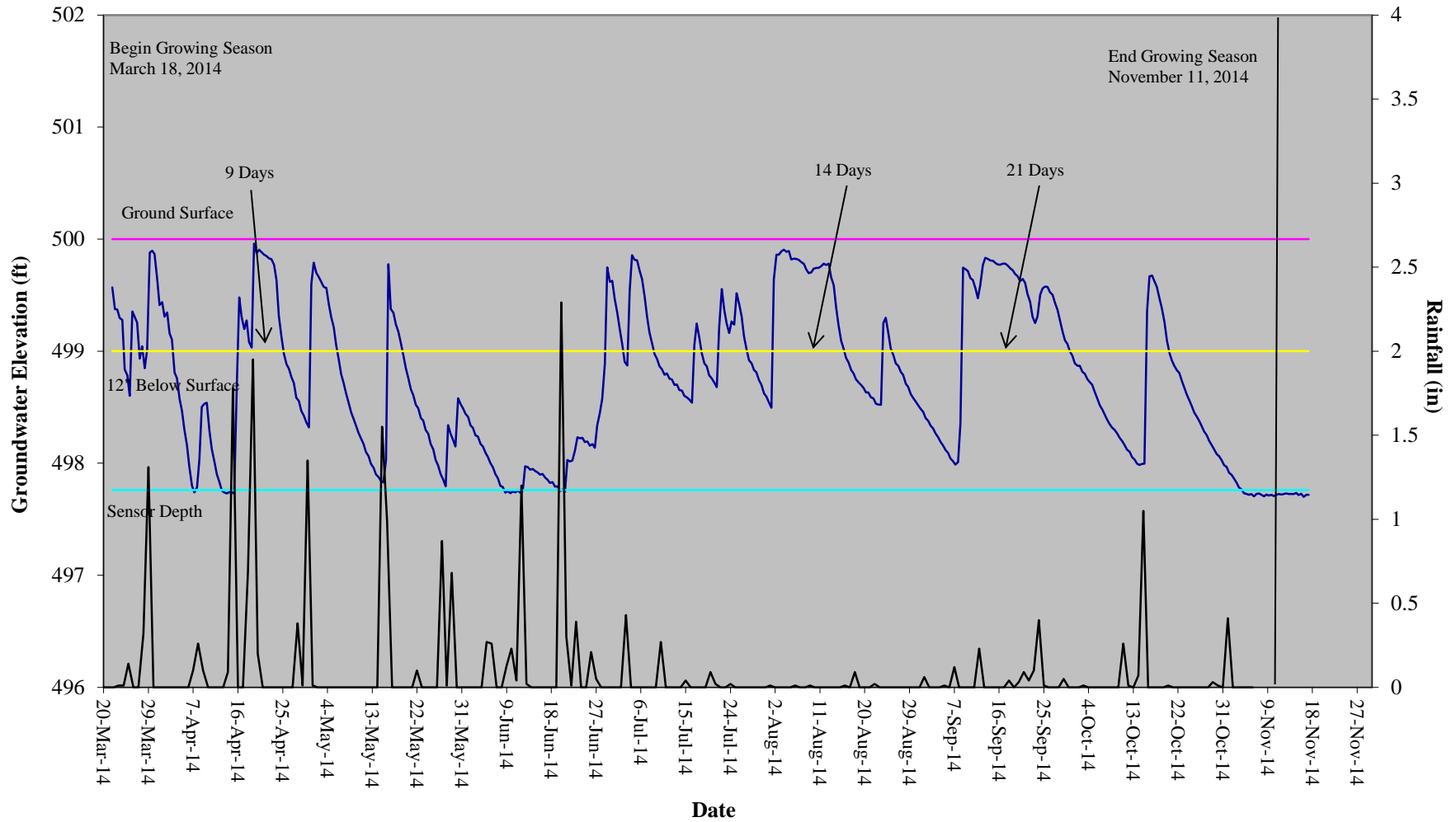




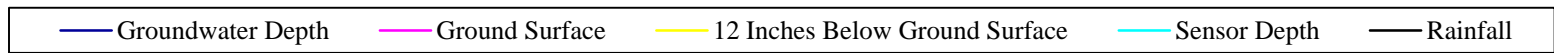
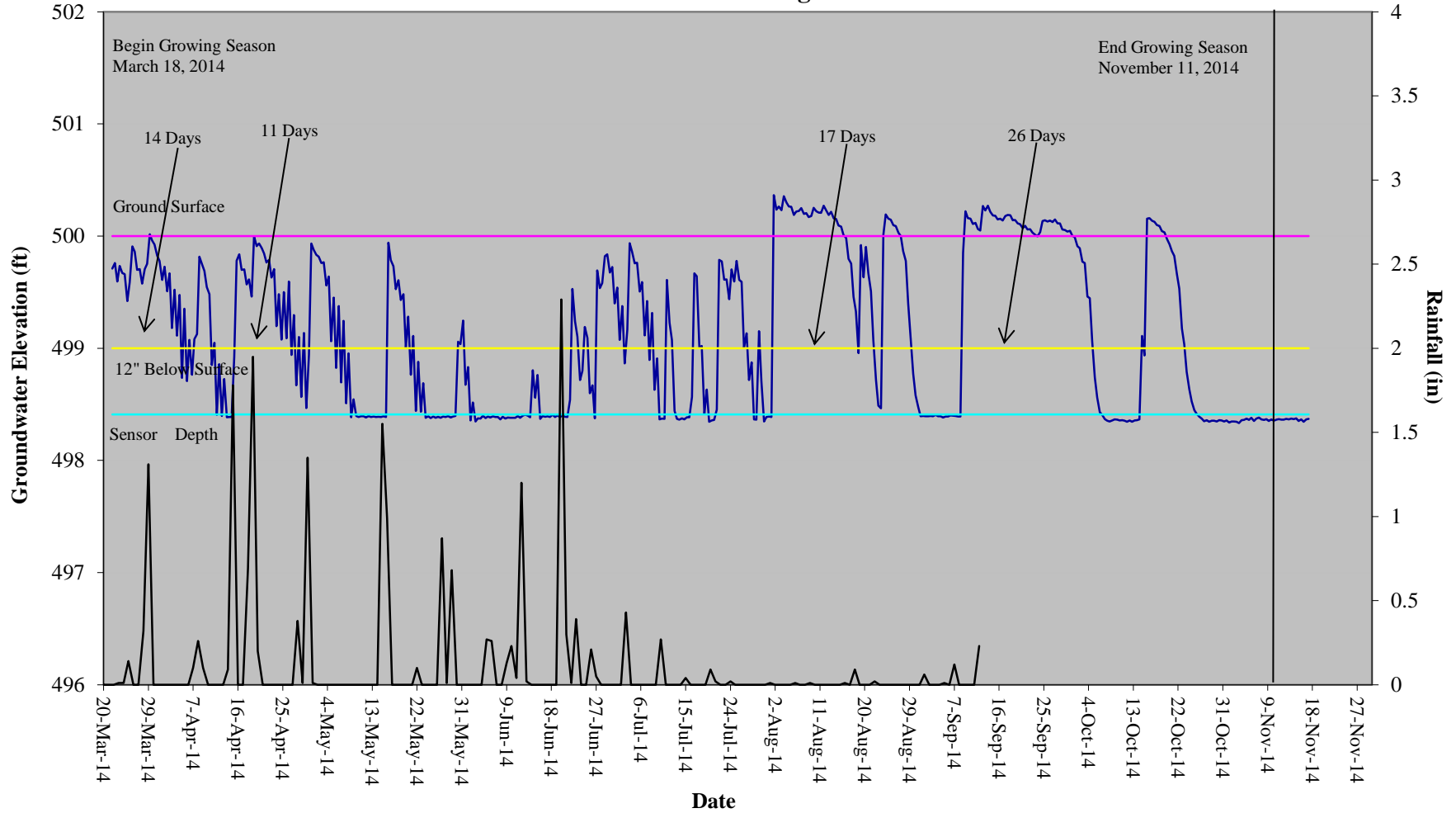
## Twin Bays Restoration Site Hydrograph Wetland Gauge 13



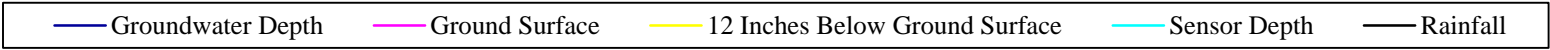
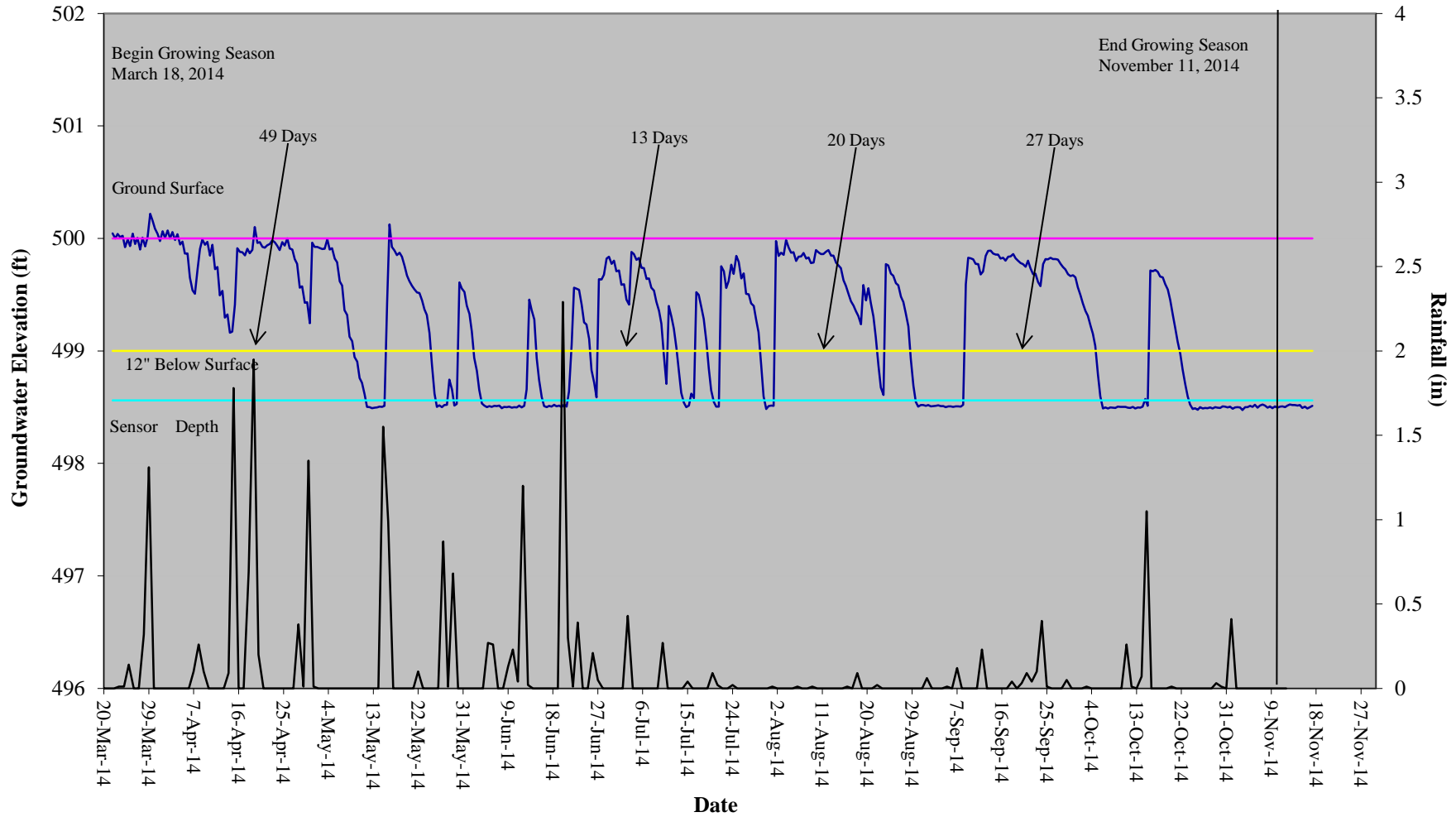
## Twin Bays Restoration Site Hydrograph Wetland Gauge 14



## Twin Bays Restoration Site Hydrograph Wetland Gauge 15



## Twin Bays Restoration Site Hydrograph Wetland Gauge 16





**Table 9. Wetland Hydrology Attainment Table  
Twin Bays Restoration Site, EEP 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%)						
Gauge 2	No/16 (6.5%)						
Gauge 3*	No/13 (5.2%)						
Gauge 4	Yes/26 (10.9%)						
Gauge 5	Yes/27 (11.1%)						
Gauge 6*	No/13 (5.4%)						
Gauge 7	Yes/27 (11.1%)						
Gauge 8	Yes/24 10.0%						
Gauge 9	No/17 (6.9%)						
Gauge 10	Yes/24 (9.8%)						
Gauge 11	Yes/28 (11.7%)						
Gauge 12	No/14 (5.9%)						
Gauge 13	No/15 (6.1%)						
Gauge 14	Yes/22 (9.0%)						
Gauge 15	Yes/27 (11.1%)						
Gauge 16	Yes/49 20.3%						

\*=Gauge in the non-credit bearing zone