Meadowbranch Swamp Wetland Restoration
2014 Final Monitoring Report
Monitoring Year Three

Ecosystem Enhancement Program Project Number 92351
Ecosystem Enhancement Program Contract Number 004800

Submitted to:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Project Designed by:

EcoEngineering – A Division of the John R. McAdams Co.
2905 Meridian Parkway
Durham, NC 27713
Construction Complete: February 2011

Submitted: November 6, 2014

Ecosystem Enhancement PROGRAM

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Submitted: November 6, 2014

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1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

The goal of this project was to restore, enhance, and preserve the project area. The project created low areas in an access road adjacent to the Meadowbranch Canal based on flood elevations, removed a former logging road, and planted native wetland vegetation in select areas. According to the Restoration Plan (The John R. McAdams Company, Inc, 2007) and the Baseline Monitoring Report (EcoEngineering, 2011), the intent of this project was to return the site to a more natural hydrologic state to accomplish the following objectives:

- Store and treat runoff from 1.8 square miles of developed land, nearly half the land area of Lumberton, which drains to the project site.
- Allow for retention and treatment of sediment, nutrients, and toxins to improve water quality of the Lumber River, an impaired stream located approximately six miles downstream of the project site.
- Support the goals outlined in the 2003 Lumber River Basinwide Water Quality Plan by implementing a project within a watershed that has been identified by the NC Wetlands Restoration Program (NCWRP) as having the greatest need.
- Assist in the improvement of water quality; the Basinwide Water Quality Plan indicates 406 miles of waters within Subbasin 03-07-51 are impaired.
- Provide a more natural flood regime and flood storage for waters in Meadowbranch Swamp.
- Connect to surrounding wetland areas and enhance the wildlife habitat present in the wetland.

The project site is approximately one-half mile west-northwest of Lumberton, in Robeson County, North Carolina. The site consists of a wooded parcel owned by the Lumber River Conservancy which encompasses approximately 55.4 acres (Figure 1). The site is located along Carthage Road which bounds the site to the south. Located immediately adjacent to the west of the site is a channelized water feature known as Meadowbranch Swamp Canal. There is an access road, which is maintained by the City of Lumberton, along Meadowbranch Swamp Canal which extends north from Carthage Road to NC 211. In addition, there was a former logging road located within the interior of the site which began approximately 100 feet from Meadowbranch Swamp Canal. The former logging road began at Carthage Road and extended north, roughly paralleling Meadowbranch Swamp Canal for a distance of approximately 2,000 feet. Along the eastern edge of the former logging road was a ditch feature.

The site is located in the Inner Coastal Plain Physiographic Region of North Carolina and lies within US Geological Survey (USGS) Hydrologic Unit Code 03040203 080010 (NCDENR, 2003), which falls within the Lumber River Basin. The NC Division of Water Resources (NCDWR) River Subbasin for the project area is listed as the Lumber 03-07-51 (NCDENR, 2003). The current state classification (NCDENR, 2012) for Meadowbranch Swamp (Stream Index # 14-12) from its source to the Lumber River, is C; Sw (swamp waters). Class C waters support aquatic life, wildlife, and they can also be used for secondary recreation and agriculture. The Sw classification is intended for waters which have low velocities and other natural characteristics different from adjacent streams.

The project site is almost entirely forested primarily with young hardwoods and some areas of young pine. This is due to the fact that the site was logged approximately 15 years ago. Due to the timing of the logging, the site is currently at a stage of succession where the vegetation is very dense. Currently, there are a few small areas near the access road along Meadowbranch Swamp that still have stands of relatively older growth bald cypress (*Taxodium distichum*) and would be designated as Cypress-Gum Swamp. Other larger areas have some young bald cypress, but are more dominated by red maple (*Acer rubrum*) and river birch (*Betula nigra*). Aside from the few areas of Cypress-Gum Swamp on the site, the remainder of the area could best be described as a disturbed site undergoing succession to a Coastal Plain Bottomland Hardwood forest (based on reference wetland conditions). In general, the majority of the site appears to have characteristics of a Coastal Plain Bottomland Hardwood forest. However, some portions of the site contained large concentrations of Chinese privet (*Ligustrum sinense*) which have been removed and treated. These areas have been replanted with native vegetation.

1.1 VEGETATION

Monitoring Year 3 (MY3) field investigations took place on September 25, 2014. All three vegetation plots are in fair condition and all are meeting vegetative success criteria. Vegetation plots 1 and 3 are doing especially well and supporting large populations of volunteer stems. Some insect damage was observed on river birch seedlings within vegetation plot 3. Insect activity has been noted and will be monitored for changes in severity over subsequent monitoring events. Damage has not caused visible mortality at the time of observation. Vegetation plot 2 has not been as successful as vegetation plots 1 and 3 in that many of the stems have died, or are unable to be located. Vegetation plot 2 contains a large population of bush clover (*Lespedeza sp.*) which may be contributing to stem mortality due to the nature of the dense thickets of bush clover.

Two random transects were inventoried within the Chinese privet removal areas. Both transects contained large amounts of Chinese privet and very little amounts of other species. It was difficult to distinguish between naturally regenerating native stems and planted native stems; however, the dominant shrub stratum in both transects was Chinese privet. There are some larger native canopy trees in the area, but native species were observed in very small numbers in the shrub and sapling stratum. It appears that some spraying/treatment of Chinese privet had taken place on-site since the site assessment in May of 2014; however, the treatment areas seemed to be concentrated along paths to monitoring wells and the edge of the canal access road. Widespread treatment within the Chinese privet removal areas was not observed. In areas where treatment had taken place, re-sprouting was observed. The percentage of Chinese privet in the two random transects was 80 percent and 56 percent, respectively. These results are presented in Table 9 of Appendix C.

Overall, the site is in good condition, with the exception of the presence of Chinese privet. Chinese privet was observed scattered along the entirety of the canal road, and is still present in these areas. While the Chinese privet is still present, the limits do not appear to be expanding. The northern portions of the site continue to support the largest populations. The Chinese privet is particularly abundant between berm cuts 8 and 9 and along the canal road and removal areas. Very large specimens (20-30 feet) were observed in these areas.

1.2 HYDROLOGY

The growing season is 213 days, and has been set from April 1 to October 30. Criteria established for the site state that groundwater levels must be at or above 12 inches of the ground surface for 10 percent of the growing season, or 21 days. Eight of the 13 groundwater gauges installed on-site met the hydrologic success criteria described above during the timeframe between April 1 and September 25 of 2014.

A rain gauge was installed on the site in October of 2006. During MY1, it was discovered that the gauge was not functioning properly. Data were downloaded on November 16, 2012 and resulted in readings for two days only. A replacement gauge was installed on April 24, 2013. A data download was attempted during MY2 (on September 17, 2013). The unit connected, but had not been recording data accurately. The unit was repaired and replaced in January of 2014. URS attempted to download data from the rain gauge on May 6, 2014. The unit connected, but had not been recording data. URS reset the unit and attempted to download again during MY3 on September 25, 2014. The unit would not connect to the data logger. To date, rainfall estimates have been provided through the NC Climate Retrieval and Observations Network of the Southeast (NC CRONOS) Lumberton station (315177), which is in close proximity (less than 0.6 miles) to the site. Due to persistent problems with the gauge, NC CRONOS data will be relied upon to provide reasonable estimates for site rainfall totals. Normal annual precipitation for the station is 47.9 inches. Rainfall over the past 12 months totaled 44.4 inches, indicating that the past year has been slightly below normal.

On-site stream gauge data and USGS stream gauge data indicate one major bankfull event over the past 12 months (September 2012 to September 2013). A smaller event is indicated by on-site stream gauge data on May 16, 2014. Evidence of the bankfull events is present on-site and observed during MY3. There are drainage patterns from the canal into the wetlands on the back side of the access road and vegetation has been matted down in these areas.

1.3 OTHER ISSUES

Erosion was noted behind the matting at Roadway Cuts 1 and 2 during MY1. The erosion in these areas is still present, but has not changed since MY1. More recent erosion was noted along the banks of Meadowbranch Canal in the vicinity of Roadway Cuts 3 and 4 during MY2. Erosion is still evident behind the matting at both of these areas. A new area of bank erosion was noted during the annual site assessment in May of 2014. This area is located just downstream of the stream gauge and was present during MY3 monitoring. Photographs have been included with electronic files, but these areas were not identified as a problem at this time. The roadway cuts and bank condition will be monitored for changes during future monitoring events.

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 (formerly Mitigation Plan) and in the Mitigation Plan (formerly Restoration Plan) documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

2.0 METHODOLOGY

Three vegetation plots have been established along the former logging road within the project site. These plots were established according to CVS-EEP Protocol for Recording Vegetation (Lee et al., v.4.2, 2008) and are 20 meters by five meters in size. During MY1, the corners of each plot were marked with three-foot PVC piping and flagged. The southwest corner of each plot, or plot origin, was flagged with orange and the remaining three corners were flagged with blue. Planted stems were flagged with white.

Version 4.2 of the CVS-EEP Protocol for Recording Vegetation was used to inventory these plots (Level 1-2). Natural regeneration stems were recorded but not flagged. A reference photograph was taken from the origin of each plot, facing across the plot.

Additionally, two random transects, 50 meters by two meters in size were established within the Chinese privet areas and inventoried for stems greater than one meter high. Stem counts included planted stems, volunteers, and invasive species (Chinese privet). Stem species and count were recorded. No stems were flagged within the transects.

Ten automated groundwater gauges, a stream gauge, and a rainfall gauge were installed at the site in October 2006. These gauges were installed in order to monitor the water table at the site during the initial project investigation and design. One of the 10 gauges was placed on the west side of Meadowbranch Swamp Canal in the reference wetland area in order to monitor reference wetland hydrology. Following the completion of construction, three additional automated groundwater gauges (gauges 11 through 13) were placed within the limits of the restored area of the former logging road to measure the groundwater table. All 13 gauges were located and marked with blue and white striped flagging. All 13 gauges are *Ecotone* brand water level monitors that were downloaded using a handheld *Meazura* MEZ1000 data logger. For the gauges where transects were used to locate them away from the former logging road or maintenance road, pink flagging was used to mark transect lines.

The stream gauge and rainfall gauge are also *Ecotone* brand monitors and were downloaded using the same equipment stated above.

3.0 REFERENCES

EcoEngineering. 2011. Meadowbranch Swamp Wetland Restoration Baseline Monitoring Report. SCO# 06-06731-01, EEP ID# 92351, Robeson County. EcoEngineering, A division of the John R. McAdams Company, Inc. Prepared for NC Ecosystem Enhancement Program. November 14, 2011.

EEP. 2011. Procedural Guidance and Content Requirements for EEP Monitoring Reports. Version 1.4 (11/07/11). NCDENR, NCEEP. 46pp.

Lee, Michael T., Peek, Robert K., Roberts, Steven D., Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation. All Levels of Plot Sampling. Version 4.2. (http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf).

NC CRONOS. 2014. NC Climate Retrieval and Observations Network of the Southeast. State Climate Office of North Carolina. Station 315177 – Lumberton. http://www.nc-climate.ncsu.edu/cronos.

NCDENR. 2014. 2014 Draft Category 5 Water Quality Assessments – 303(d) List. http://portal.ncdenr.org/c/document_library/get_file?uuid=d61a8974-6af6-4edb-829f-e658935e3341&groupId=38364

NCDENR. 2012. Surface Water Classifications. http://portal.ncdenr.org/web/wq/ps/csu/classifications.

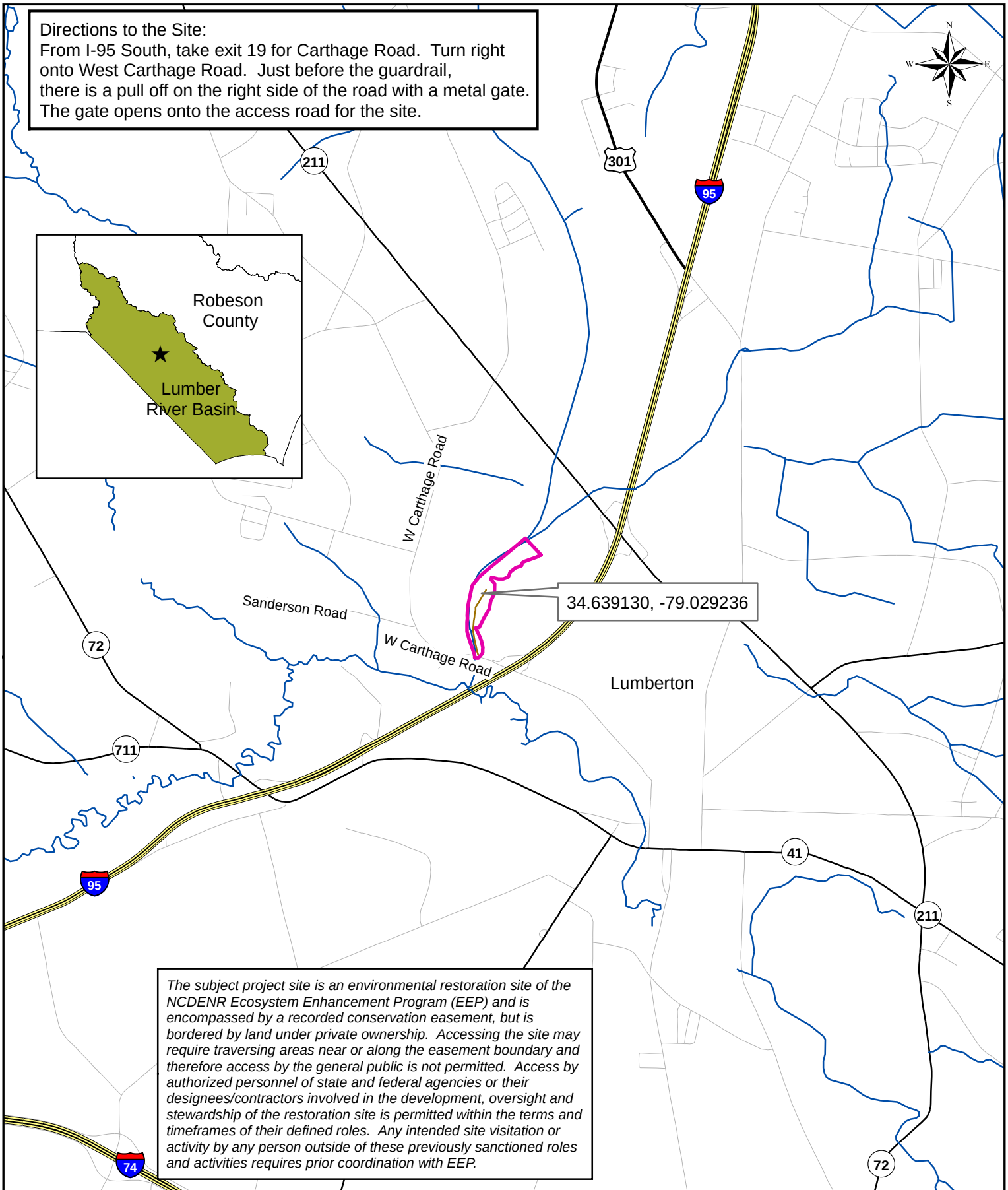
NCDENR. 2003. 2003 Lumber River Basinwide Water Quality Plan. Division of Water Quality.

The John R. McAdams Company, Inc. 2007. Meadowbranch Swamp Wetland Restoration Restoration Plan. USGS HUC 03040203, Robeson County, North Carolina. Prepared for NC Ecosystem Enhancement Program. June 18, 2007.

USGS. 2014. Lumber River at Lumberton, NC streamflow gauge. USGS Real-Time Water Data. Gauge 02134170. http://waterdata.usgs.gov.

Appendices for Project Background, Condition and Performance Data

Appendix A: Project Vicinity Map and Background Tables



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NC Ecosystem Enhancement Program
Ecosystem Enhancement Program

Project: Meadowbranch Swamp Wetland Restoration
Robeson County, NC
CU 03040203

Project Number: 92351

Date: November 2014

Legend
- Project Area
- Former Logging Road
- Streams
- Interstate
- US Hwy
- NC Hwy
- Local Road
- Municipal Boundary

Figure 1
Vicinity Map and Directions

0 0.25 0.5 1 Miles

Table 1a: Project Restoration Components

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351									
Project Component	**Existing Acres**	**Restoration Level**	**Approach**	**Acreage**	**Stationing**	**Mitigation Ratio**	**Mitigation Units**	**BMP Elements**	**Comments**
Former Logging Road	2.88	R1	Grading of Road, Removal of Ditch Feature, & Replanting	2.88	50+00 – 72+50	1:1	2.88		
Enhancement of Wetlands (Hydrological)	39.5	E	Improved Hydrologic Connections from Berm Cuts & Road Crossings	39.5		2:1	19.75		
Enhancement of Wetlands (Hydrological & Vegetative)	4.93	E	Improved Hydrologic Connections from Berm Cuts & Road Crossings, Privet Removal, Herbicide Treatment, & Replanting	4.93		2:1	2.47		
Enhancement of Wetlands (Vegetative)	0.35	E	Privet Removal, Herbicide Treatment, & Replanting	0.35		2:1	0.18		
Preservation (Wetlands)	0.87	P	Preservation of Existing Wetlands	0.87		10:1	0.09		

1 = BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI – Natural Infiltration Area; O = Other
CF = Cattle Fencing; WS = Watering System; CH = Livestock Housing; Not Applicable =

Table 1b: Project Restoration Components

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351							
Restoration Level	**Stream (lf)**	**Riparian Wetland (Ac)**		**Non-Riparian (Ac)**	**Upland (Ac)**	**Buffer (Ac)**	**BMP**
		Riverine	Non-Riverine				
Restoration		2.88					
Enhancement (Hydrological)		39.5					
Enhancement (Hydrological & Vegetative)		4.93					
Enhancement (Vegetative)		0.35					
Preservation (Wetlands)		0.87					
		47.75					
Totals (Acres)	0	47.75		0	0	0	0
MU Totals	0	25.36		0	0	0	0

Not Applicable =

Table 2: Project Activity and Reporting History

Elapsed Time Since Grading Complete: 3 yr 9 months
Elapsed Time Since Planting Complete: 3 yr 3 months
Number of Reporting Years: 3

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351		
Activity or Deliverable	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	Apr-07	Jun-07
Final Design – Construction Plans	Oct-10	Dec-10
Construction	N/A	Feb-11
Containerized, bare root and B&B plantings for reach/segments 1&2	N/A	Feb-11
Mitigation Plan/As-Built (Year 0 Monitoring – baseline)	Sep-11	Oct-11
Year 1 Monitoring	Nov-12	Jan-13
Year 2 Monitoring	Sep-13	Nov-13
Year 3 Monitoring	Sep-14	Oct-14
Year 4 Monitoring		
Year 5 Monitoring		

Table 3: Project Contacts Table

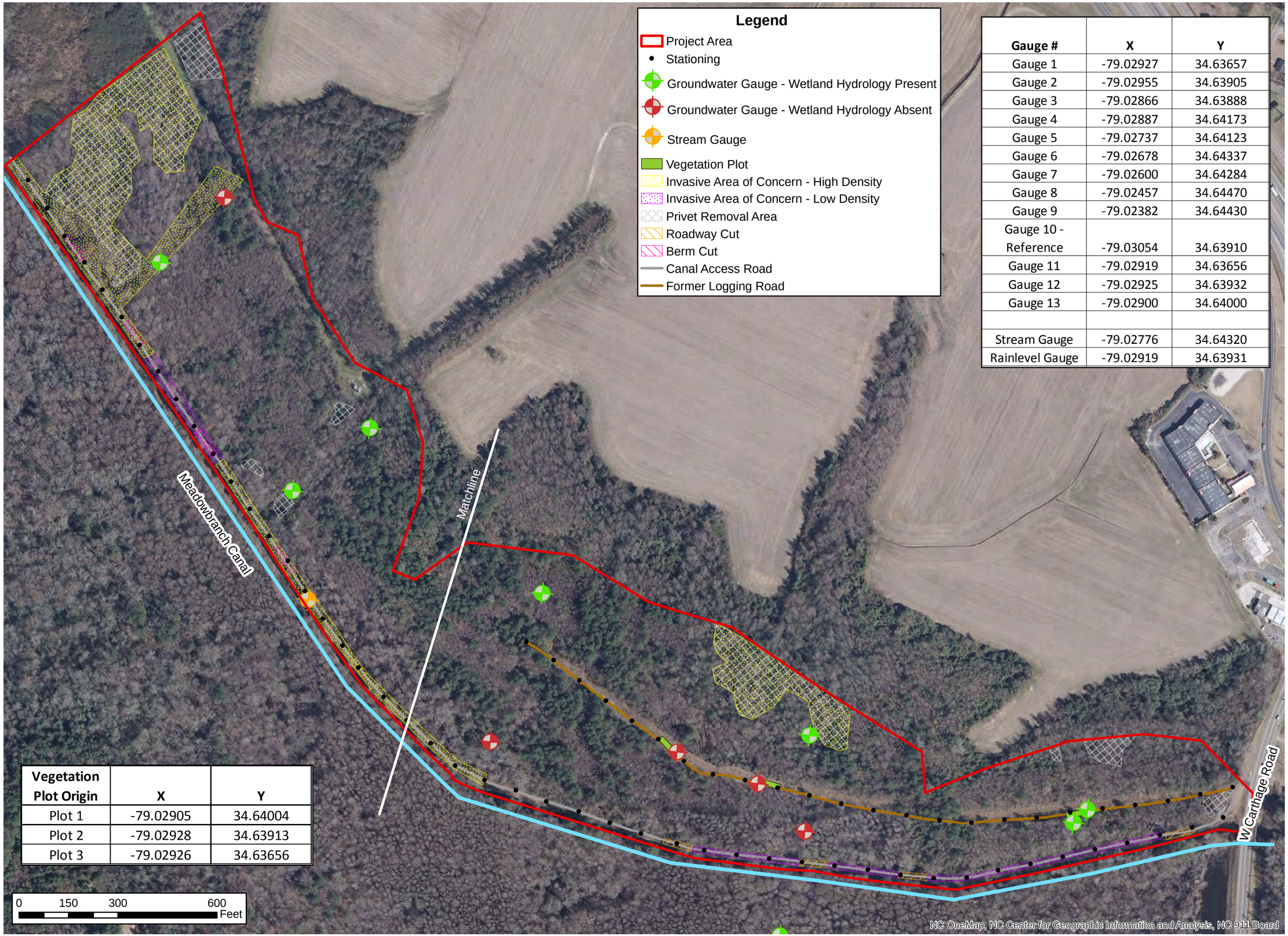
Meadowbranch Swamp Wetland Restoration EEP Project Number 92351	
Designer Primary project design POC	EcoEngineering – A Division of The John R. McAdams Co. 2905 Meridian Parkway Durham, NC 27713 George Buchholz 919-287-4262
Construction Contractor Construction contractor POC	EQR, LLC 1405 Benson Court, Suite C Arbutus, MD 21227 James Walker 443-304-3314
Survey Contractor Survey contractor POC	Turner Land Surveying PO Box 41023 Raleigh, NC 27629 David Turner 919-623-5095
Planting Contractor Planting contractor POC	Natives, Inc. 550 East Westinghouse Boulevard Charlotte, NC 28273 Gregg Antemann 866-527-1177
Seeding Contractor Seeding contractor POC	EQR, LLC 1405 Benson Court, Suite C Arbutus, MD 21227 James Walker 443-304-3314
Seed Mix Sources	ERNST Seeds 9066 Mercer Pike Meadville, PA 16335 800-873-3321
Nursery Stock Suppliers	NC Division of Forest Resources 1616 Mail Service Center Raleigh, NC 27699 919-733-2162
Monitoring Performers – Year 0 Monitoring POC	EcoEngineering – A Division of The John R. McAdams Co. 2905 Meridian Parkway Durham, NC 27713 George Buchholz 919-287-4262
Monitoring Performers – Year 1 Monitoring POC	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 Kathleen McKeithan 919-461-1597
Monitoring Performers – Year 2 Monitoring POC	URS Corporation – North Carolina 201 N Front Street, Suite 509 Wilmington, NC 28401 Susan Westberry 910-343-5994
Monitoring Performers – Year 3 Monitoring POC	URS Corporation – North Carolina 201 N Front Street, Suite 509 Wilmington, NC 28401 Susan Westberry 910-343-5994

Table 4: Project Baseline Information and Attributes

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351	
Project County	Robeson
Physiographic Region	Inner Coastal Plain
Ecoregion	Southeastern Floodplains and Low Terrace
Project River Basin	Lumber
USGS HUC for Project (14 digit)	03040203 080010
NCDWQ Sub-basin for Project	03-07-51
Within extent of EEP Watershed Plan?	N/A
WRC Hab Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100%; by canal & by EEP markers
Beaver activity observed during design phase?	Yes
Restoration Component Attribute Table	
	PROJECT SITE
Meadowbranch Canal Drainage Area	34.4 ac
Stream order	3rd
Restored length	N/A
Perennial or Intermittent	N/A
Watershed type (rural, urban, developing, etc.)	Developing
Watershed LULC Distribution	N/A
Watershed impervious cover	N/A
NCDWQ AU/Index number	14-12
NCDWQ classification	C; Sw
303(d) listed?	No*
Upstream of a 303(d) listed segment?	No*
Reasons for 303(d) listing or stressor	N/A
Total acreage of easement	55.4
Total vegetated acreage within the easement (wetland & privet areas)	50.61
Total planted acreage as part of the restoration (former logging road & privet areas)	8.16
Dominant soil series and characteristics	
Series	Bibb
Depth	N/A
Clay %	N/A
K	N/A
T	N/A

* The Lumber River is not listed as impaired on the 2014 Draft 303(d) list, but was listed at the time of the project inception and construction.

Appendix B: Visual Assessment Data



Legend

- Project Area
- Stationing
- Groundwater Gauge - Wetland Hydrology Present
- Groundwater Gauge - Wetland Hydrology Absent
- Stream Gauge
- Vegetation Plot
- Invasive Area of Concern - High Density
- Invasive Area of Concern - Low Density
- Privet Removal Area
- Roadway Cut
- Berm Cut
- Canal Access Road
- Former Logging Road

Gauge #	X	Y
Gauge 1	-79.02927	34.63657
Gauge 2	-79.02955	34.63905
Gauge 3	-79.02866	34.63888
Gauge 4	-79.02887	34.64173
Gauge 5	-79.02737	34.64123
Gauge 6	-79.02678	34.64337
Gauge 7	-79.02600	34.64284
Gauge 8	-79.02457	34.64470
Gauge 9	-79.02382	34.64430
Gauge 10 - Reference	-79.03054	34.63910
Gauge 11	-79.02919	34.63656
Gauge 12	-79.02925	34.63932
Gauge 13	-79.02900	34.64000
Stream Gauge	-79.02776	34.64320
Rainlevel Gauge	-79.02919	34.63931

Vegetation Plot Origin	X	Y
Plot 1	-79.02905	34.64004
Plot 2	-79.02928	34.63913
Plot 3	-79.02926	34.63656

0 150 300 600 Feet

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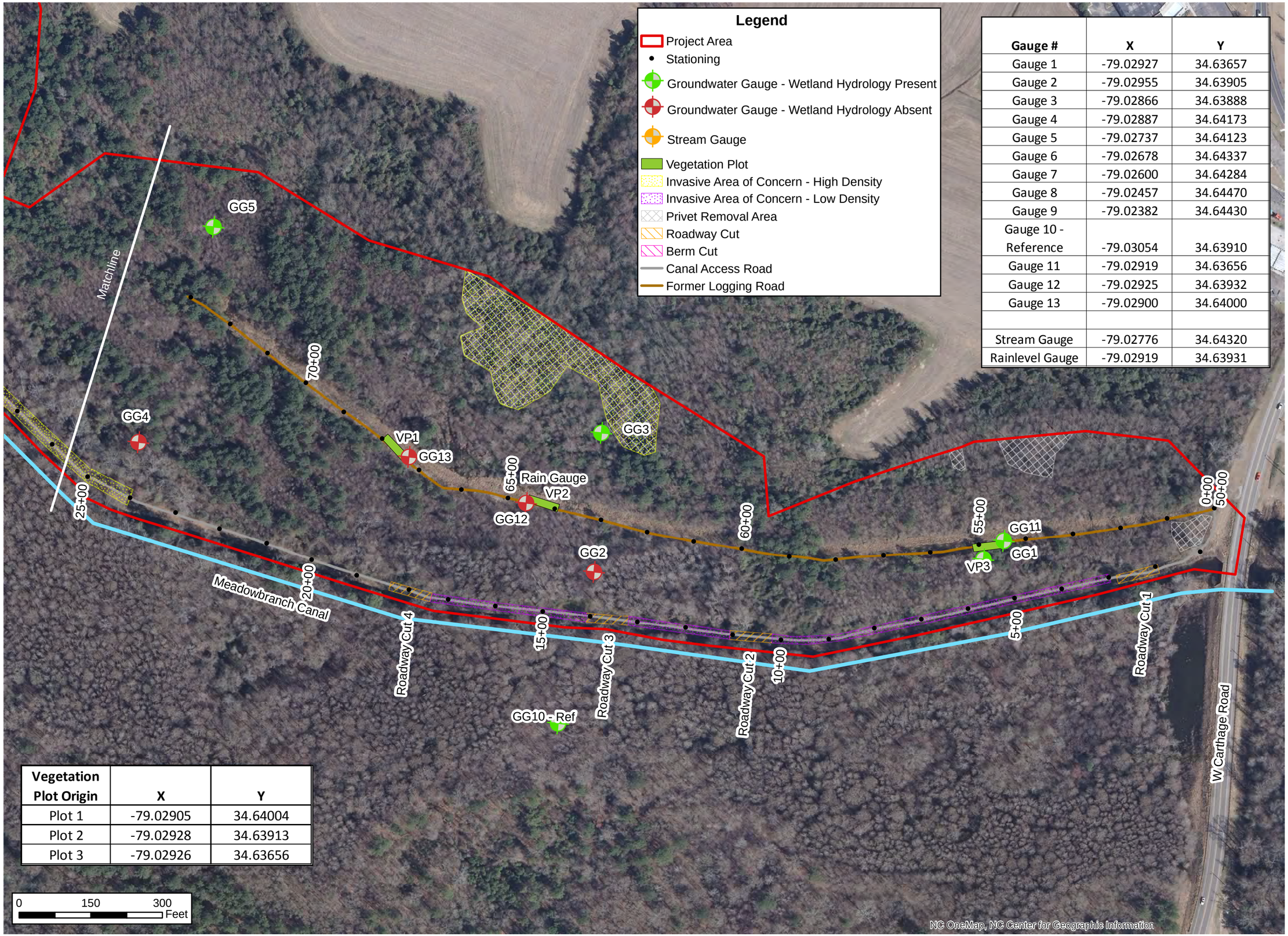
2013 Aerial Orthophotography (Source: NCOneMap)

Figure 2
Current Condition Plan View
Project Overview



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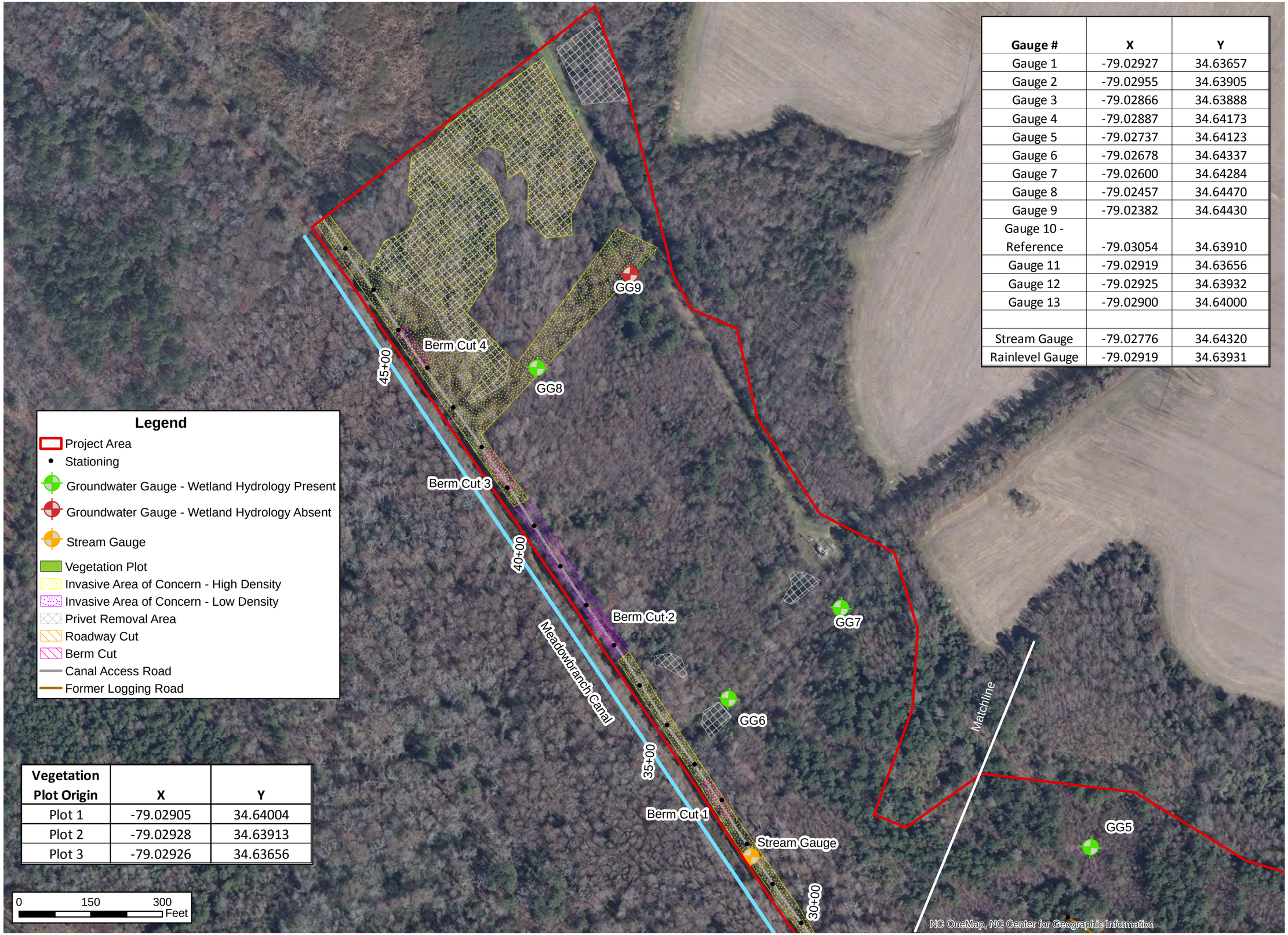
2013 Aerial Orthophotography (Source: NCOneMap)

Figure 2a
Current Condition Plan View
South



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2013 Aerial Orthophotography (Source: NCOneMap)

Figure 2b
Current Condition Plan View
North

Table 5: Vegetation Condition Assessment Table

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351						
Planted Acreage	**8.16 ac**					
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	N/A	0	0	0
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on 3, 4, or 5 stem count criteria	0.1 acres	N/A	0	0	0
			Total	**0**	**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	N/A	0	0	0
			Cumulative Total	**0**	**0**	**0**
Easement Acreage	**55.4 ac**					
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
4. Invasive Areas of Concern – High Density	Areas of presence and/or re-growth of Chinese privet with high density	1000 SF	Yellow dot pattern	3	6.81	12.3
5. Invasive Areas of Concern – Low Density	Areas of presence and/or re-growth of Chinese privet with low density, or spotty growth	1000 SF	Purple dot pattern	4	9.39	16.9
6. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	none	N/A	0	0	0

Vegetation Monitoring Plot Photos

VP1

VP2

VP3

Appendix C: Vegetation Plot Data

Table 6: Vegetation Plot Mitigation Success Summary Table

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351		
Tract	**Vegetation Plot ID**	**Vegetation Survival Threshold Met?**
Meadowbranch	VP1	Yes
	VP2	Yes
	VP3	Yes

Table 7: CVS Vegetation Metadata Table

Report Prepared By	Susan Westberry
Date Prepared	10/3/2014 11:25
database name	Meadowbranch Swamp Canal_92351_MY3_2014.mdb
database location	Z:\Share\SW\Meadowbranch Monitoring\2014_Year 3
computer name	1612LP-W70005
file size	60002304
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	92351
project Name	Meadowbranch Swamp Wetland Restoration
Description	Restore surface flow and groundwater elevations within the site area by removing the former logging road and modifying the canal access road.
River Basin	Lumber
length(ft)	4788
stream-to-edge width (ft)	7
area (sq m)	6226.85
Required Plots (calculated)	3
Sampled Plots	3

Table 8: CVS Stem Count Total and Planted by Plot and Species

			Current Plot Data (MY3 2014)									Annual Means											
			E92351-01-0001			E92351-01-0002			E92351-01-0003			MY3 (2014)			MY2 (2013)			MY1 (2012)			MY0 (2011)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree															4			6			
Betula nigra	river birch	Tree	7	7	18	4	4	34	5	5	62	16	16	114	16	16	91	15	15	16	16	16	16
Fraxinus pennsylvanica	green ash	Tree	2	2	6	2	2	2	4	4	4	8	8	12	7	7	7	5	5	5	7	7	7
Liquidambar styraciflua	sweetgum	Tree			6									6			15						
Morella cerifera	wax myrtle	shrub															4						
Pinus taeda	loblolly pine	Tree															5			1			
Quercus	oak	Tree							1	1	1	1	1	1	1	1	1	2	2	2	3	3	3
Quercus laurifolia	laurel oak	Tree				1	1	1				1	1	1	1	1	1	4	4	4	4	4	4
Quercus lyrata	overcup oak	Tree	1	1	1	1	1	1				2	2	2	4	4	4	3	3	4	6	6	6
Quercus nigra	water oak	Tree																			3	3	3
Quercus pagoda	cherrybark oak	Tree																			1	1	1
Quercus phellos	willow oak	Tree	1	1	1	4	4	4	5	5	5	10	10	10	8	8	8	12	12	12	15	15	15
Salix nigra	black willow	Tree															3						
Taxodium distichum	bald cypress	Tree	1	1	1							1	1	1	1	1	1	1	1	1	1	1	1
		Stem count	12	12	33	12	12	42	15	15	72	39	39	147	38	38	144	42	42	51	56	56	56
		Size (ares)	1			1			1			3			3			3			3		
		Size (ACRES)	0.02			0.02			0.02			0.07			0.07			0.07			0.07		
		Species count	5	5	6	5	5	5	4	4	4	7	7	8	7	7	12	7	7	9	9	9	9
		Stems per ACRE	485.6	485.6	1335	485.6	485.6	1700	607	607	2914	526.1	526.1	1983	512.6	512.6	1942	566.6	566.6	688	755.4	755.4	755.4

Color for Density

- Exceeds requirements by 10%
- Exceeds requirements, but by less than 10%
- Fails to meet requirements, by less than 10%
- Fails to meet requirements by more than 10%

Table 9: Stem Count Total by Random Transect Plot

			Current Plot Data (MY3 2014)	
			Random Transect 1	Random Transect 2
Scientific Name	**Common Name**	**Species Type**	**Total**	**Total**
Acer rubrum	red maple	Tree	14	5
Betula nigra	river birch	Tree		8
Ligustrum sinense	Chinese privet	Shrub/Tree	126	30
Liquidambar styraciflua	sweetgum	Tree	6	
Liriodendron tulipifera	tulip tree	Tree	2	
Nyssa sylvatica	black gum	Tree		3
Sambucus canadensis	elderberry	Shrub		6
Fraxinus pennsylvanica	green ash	Tree	8	
Quercus falcata	Southern red oak	Tree	1	
Morella cerifera	wax myrtle	Shrub/Tree		2
Total stem count			157	54
Invasive stem count			126	30
Native stem count			31	24
Size (ares)			1	
Size (ACRES)			0.02	
Species count			6	6
Native stems per acre			1550	1,200
Percent of total stems invasive			80.3	55.6

Appendix D: Hydrologic Data

Table 10: Verification of Bankfull Events

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351			
Date of Data Collection	Date of Occurrence	Method	Photo # (if available)
5/6/14	Unknown	Site photographs (evidence of overwash onto canal road)	13, 14
9/25/14	1/13/14 to 1/15/14	On-site data logger (*Ecotone* water level gauge)	
9/25/14	5/16/14	On-site data logger (*Ecotone* water level gauge)	
9/25/14	Unknown	Site photographs (water marks and sediment within reference wetland indicating water above bankfull)	2, 4
10/3/14	One between 9/25/13 and 9/25/14	Proximal USGS gauge resource (supports findings of on-site data logger)	

The data logger on-site recorded one extended bankfull event (January 13, 2014 to January 15, 2014) and one single-day bankfull event (May 16, 2014) between September 25, 2013 and September 25, 2014. Proximal USGS gauge data support this finding. Potential bankfull occurrence for the entire year (September 25, 2013 to September 25, 2014) was extrapolated based on USGS stream gauge discharge data for the Lumber River at Lumberton, NC. The USGS gauge plot is shown on (Figure 3). The gauge is located less than two miles downstream from the project site and has a drainage area of 708 square miles.

An estimate of the number of bankfull events between September 25, 2013 and September 25, 2014 was made by comparing the stream discharges from the USGS data in cubic feet per second (cfs) against the bankfull discharge estimated from the drainage area on the Coastal Plain Regional Curve. According to the regional curve, a bankfull event occurs on a stream with a 708-square mile drainage area when the discharge is about 2,000 cfs. This discharge was exceeded once during the past year, and coincides the results from the on-site data logger. On January 13, 2014, the USGS gauge reached 2,050 cfs, it peaked during this event at 2,370 cfs on January 14, 2014 and receded below 2,000 cfs on January 16, 2014. Rainfall data are presented in Figure 4.

Photos 13 and 14. Evidence of overwash from canal and drainage pattern from wetland to canal

Photos 2 and 3. Water marks and sediment in reference wetland

Figure 3: USGS Proximal Gauge: Lumber River at Lumberton, NC

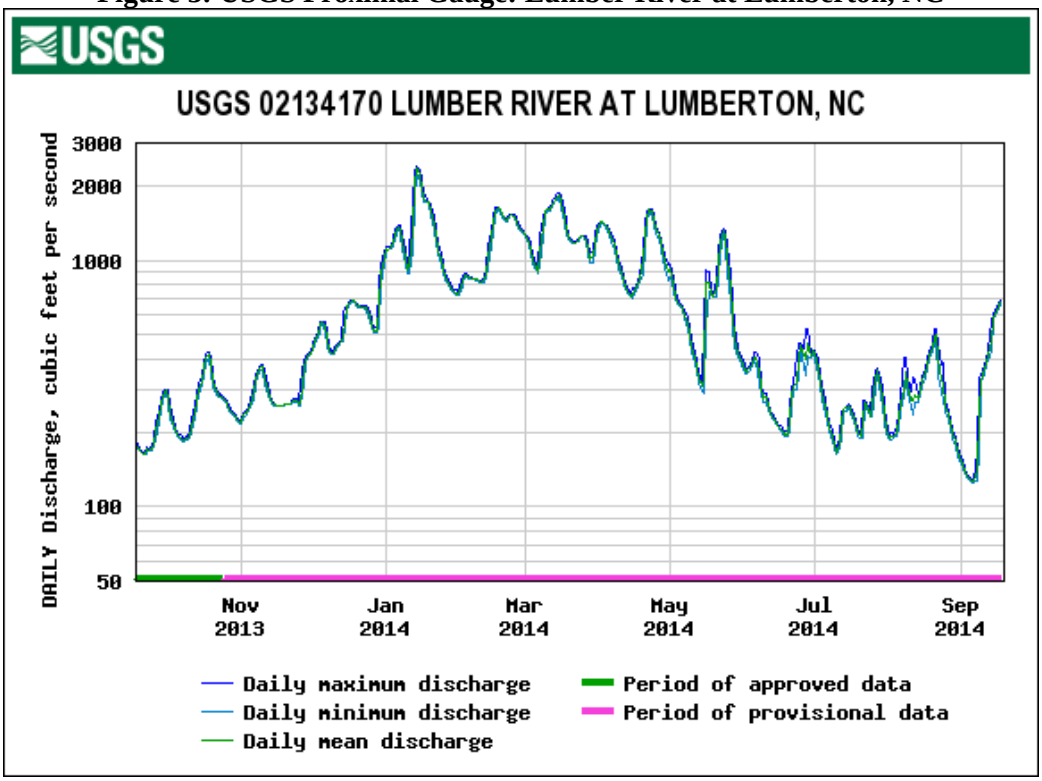


Figure 4: Meadowbranch Swamp Canal 30-70 Percentile Graph for Rainfall in 2014, Lumberton, NC

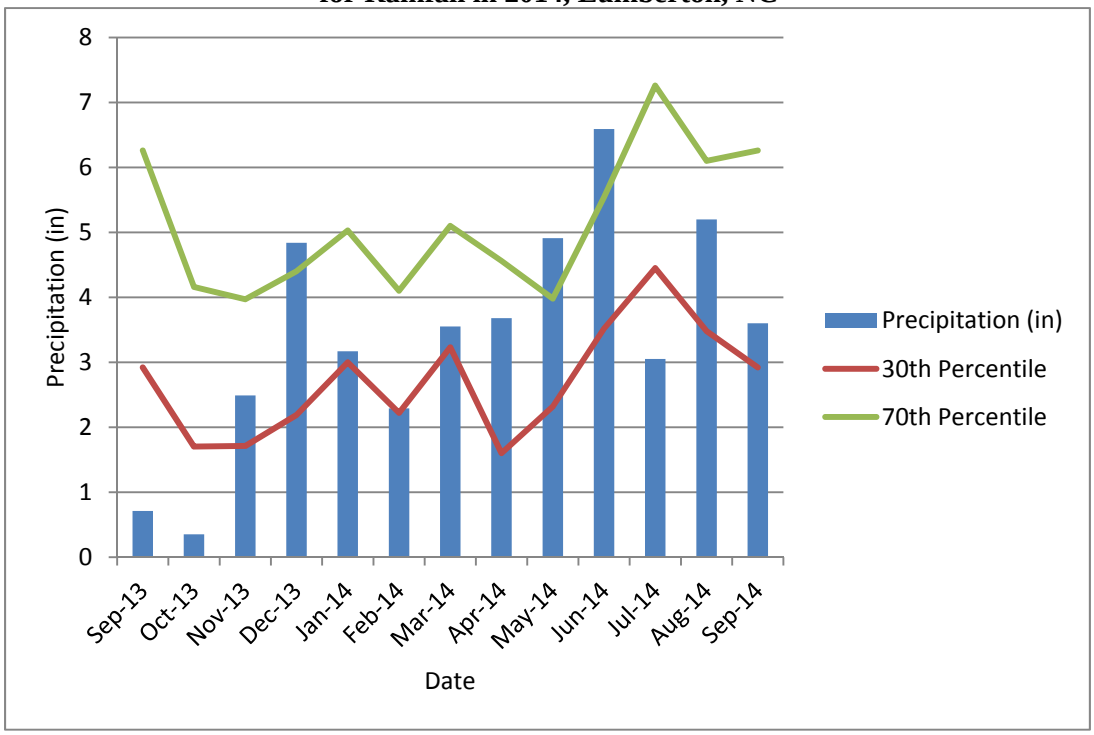


Figure 5: Monitoring Gauge 1

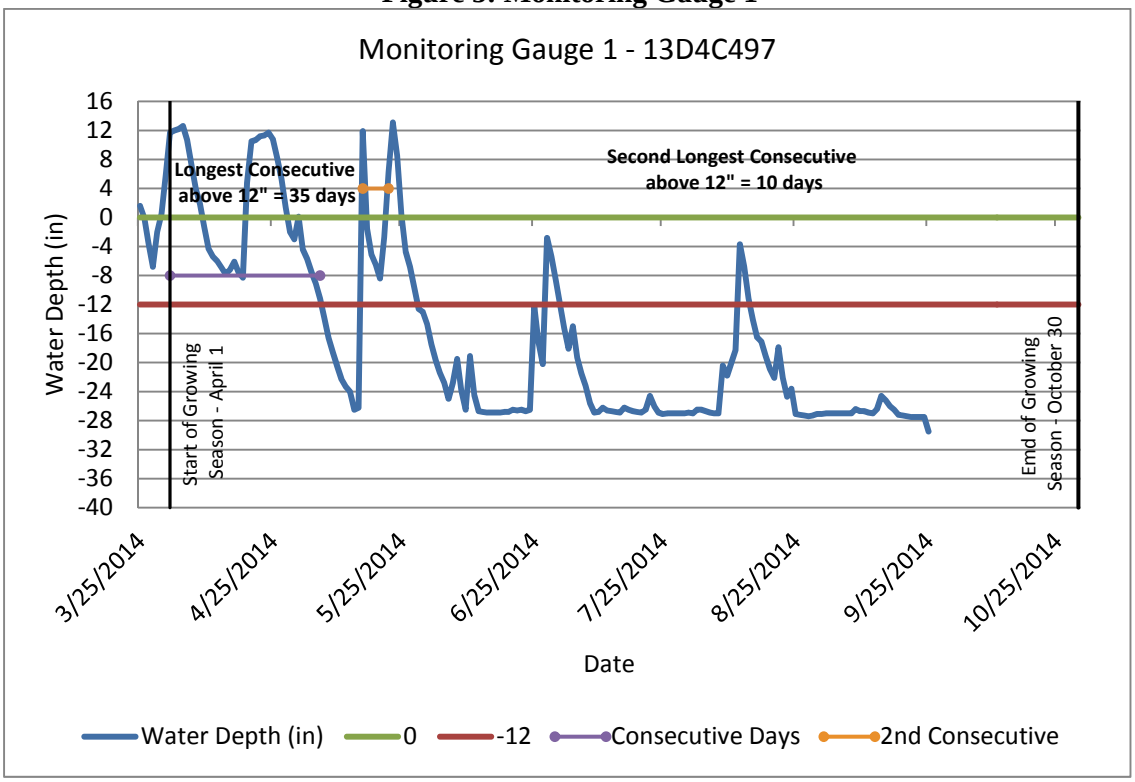


Figure 6: Monitoring Gauge 2

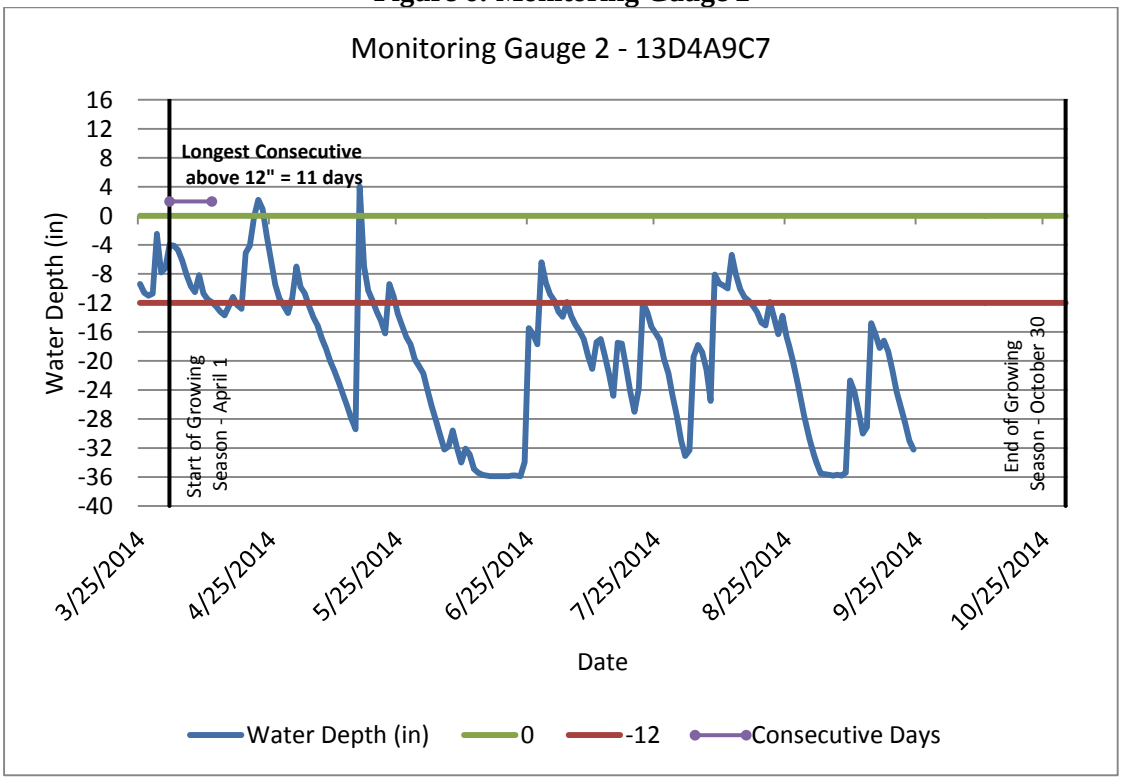


Figure 7: Monitoring Gauge 3

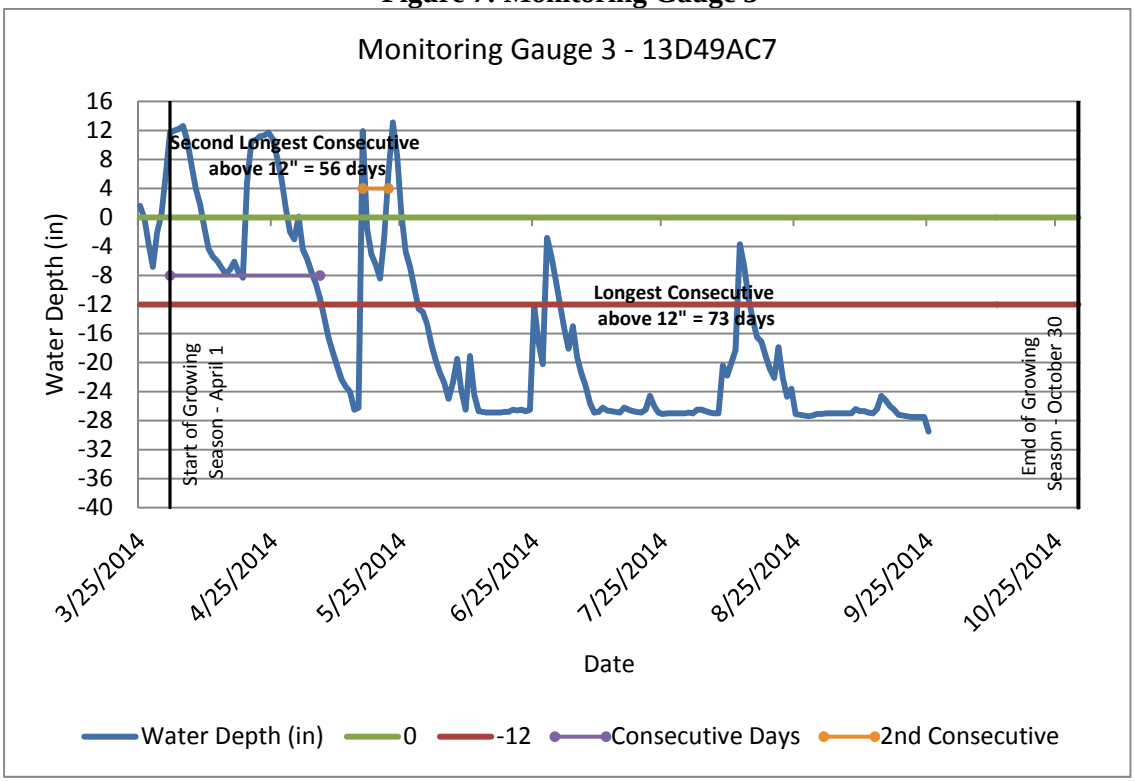


Figure 8: Monitoring Gauge 4

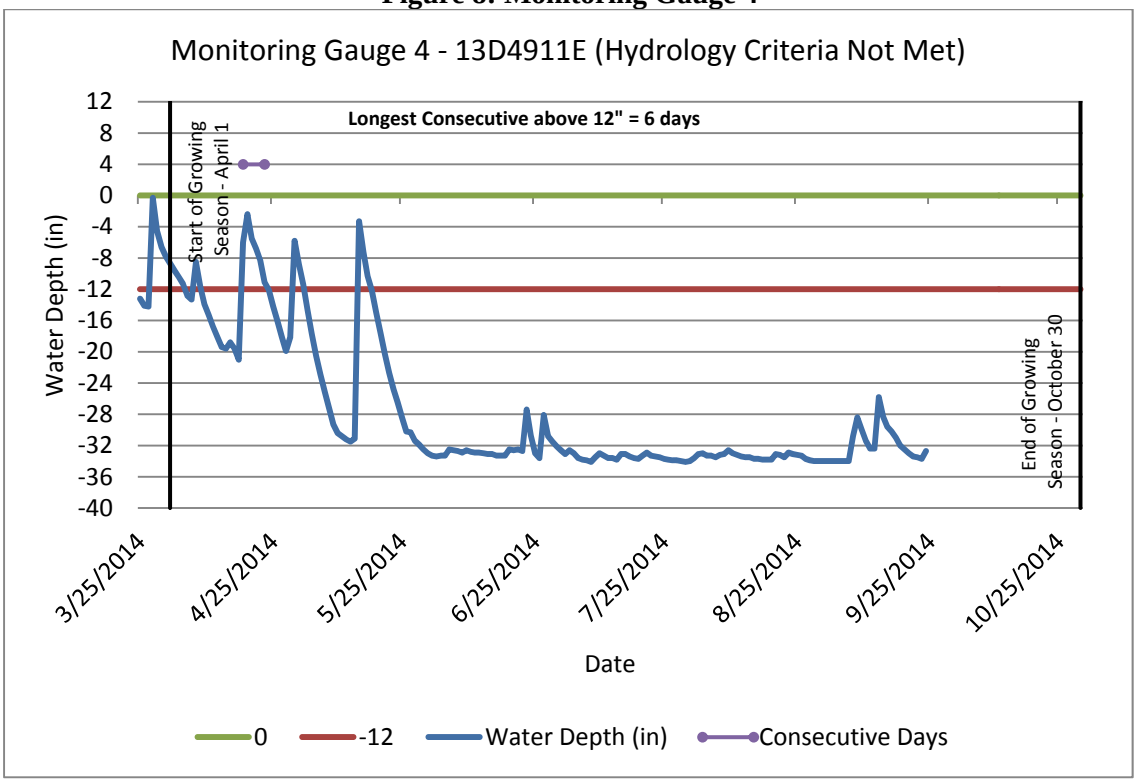


Figure 9: Monitoring Gauge 5

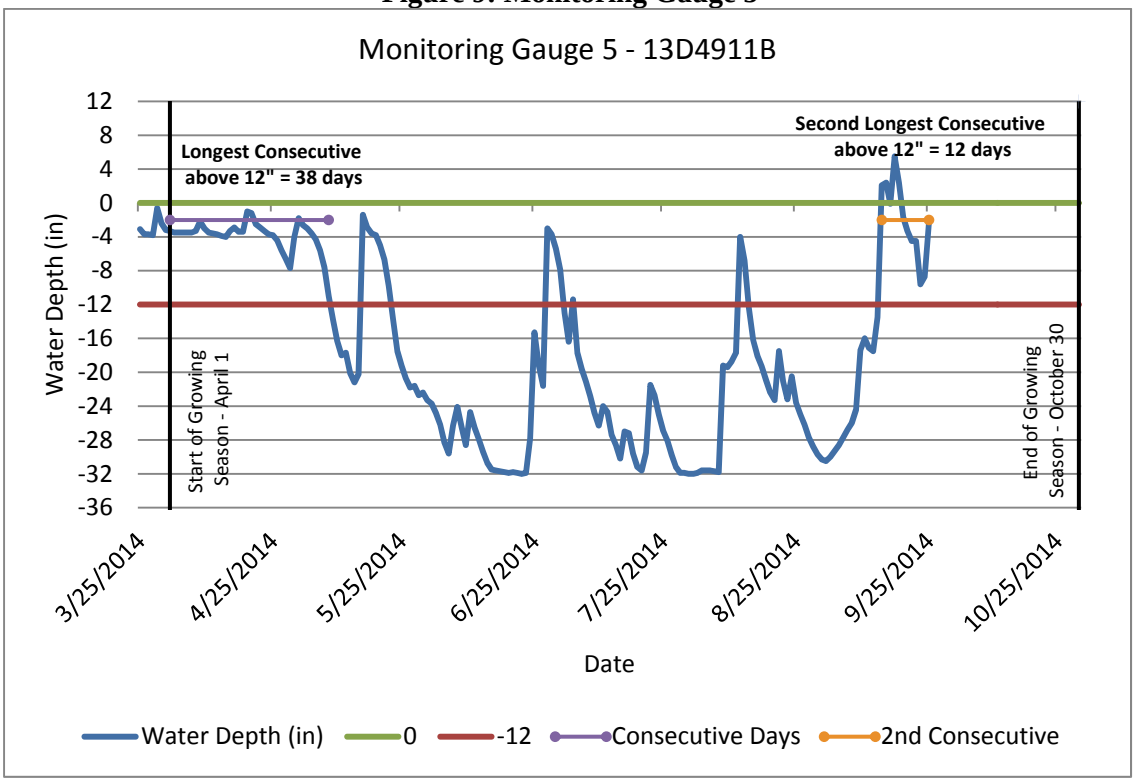
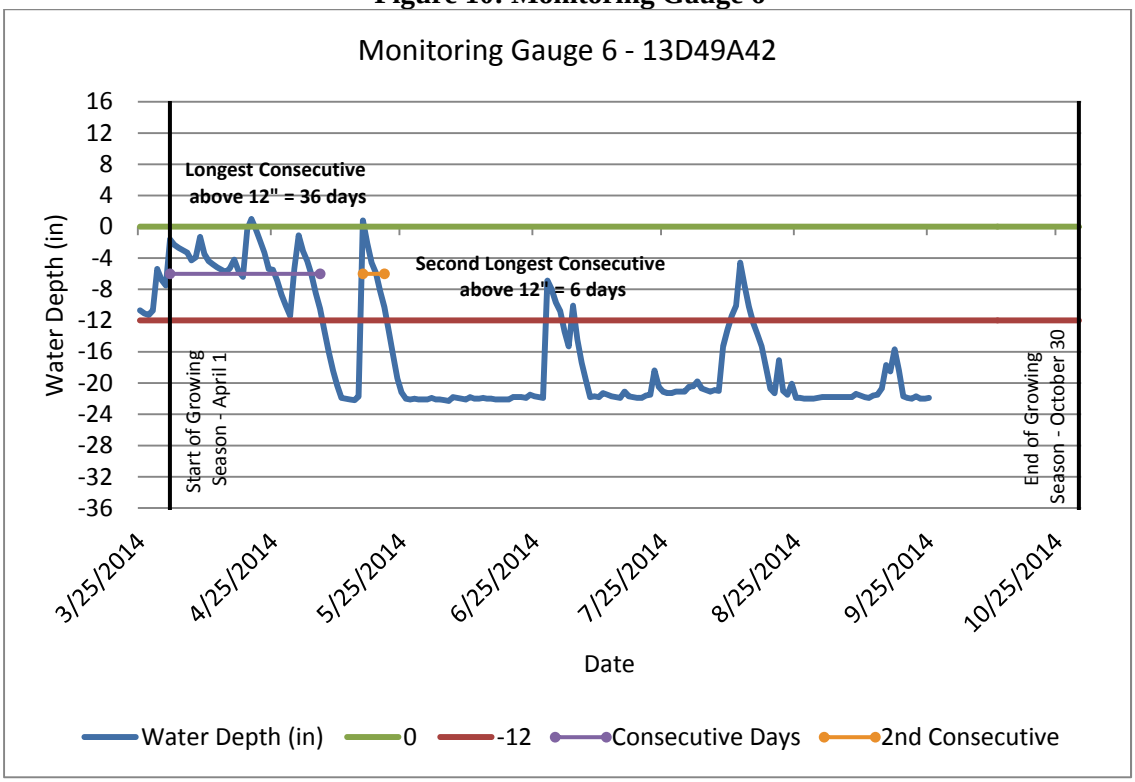


Figure 10: Monitoring Gauge 6



*Note: Water depths were adjusted seven inches, calibration point was seven inches above ground surface.

Figure 11: Monitoring Gauge 7

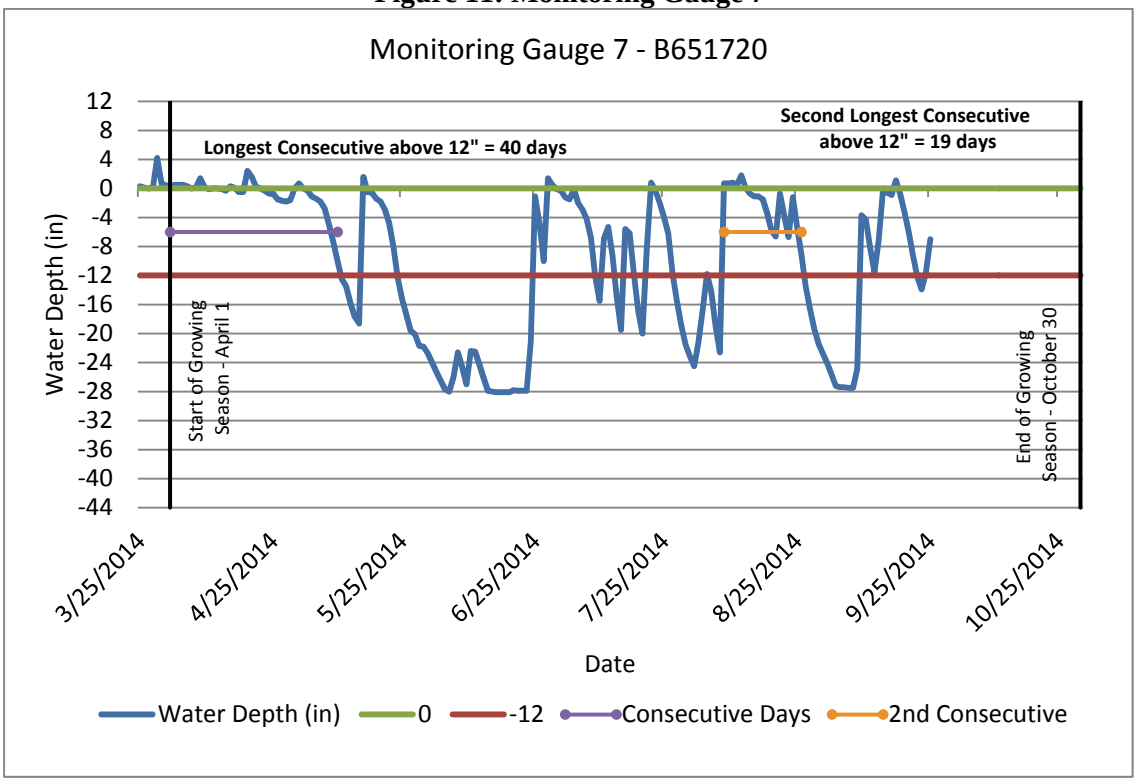


Figure 12: Monitoring Gauge 8

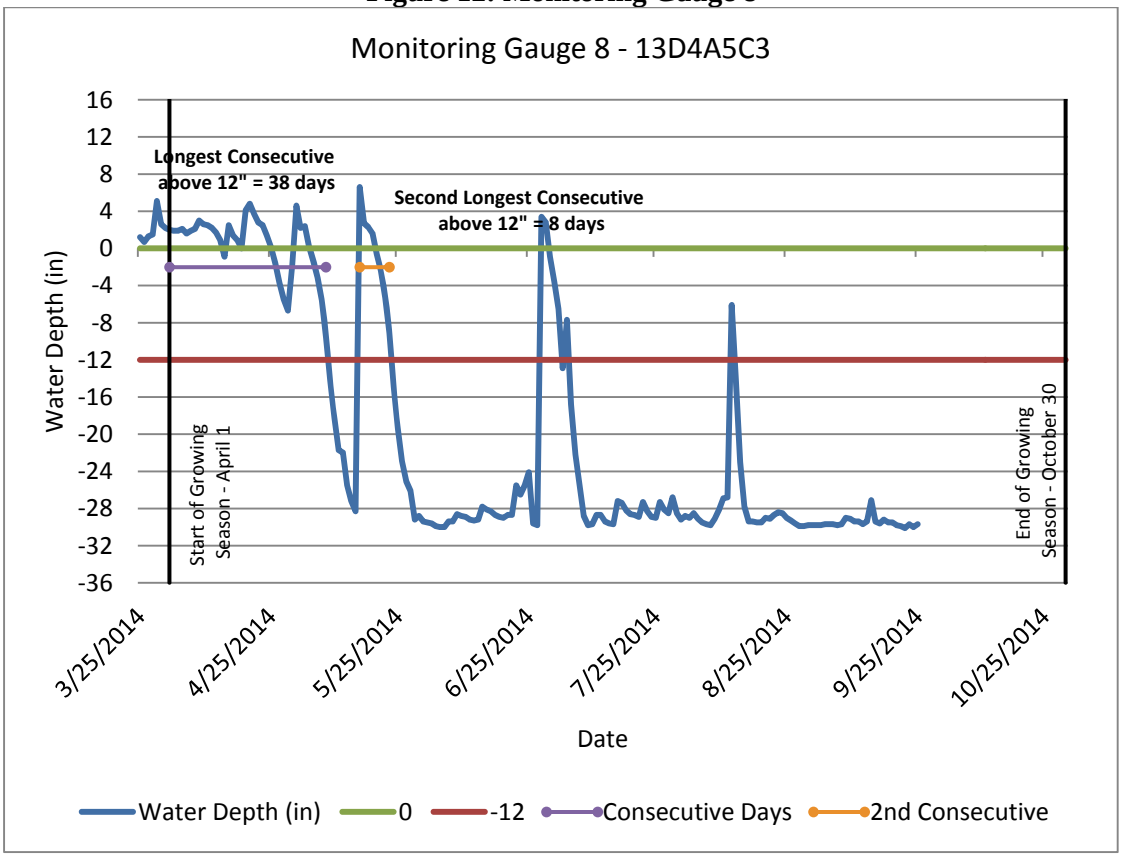


Figure 13: Monitoring Gauge 9

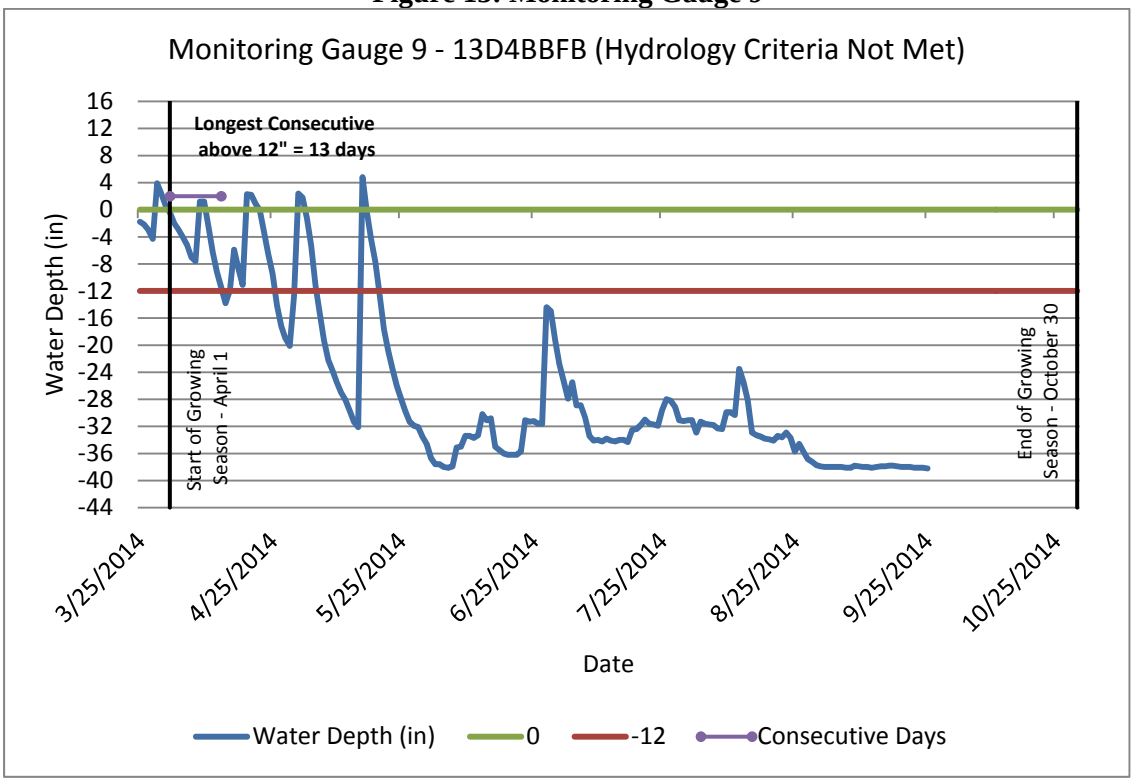
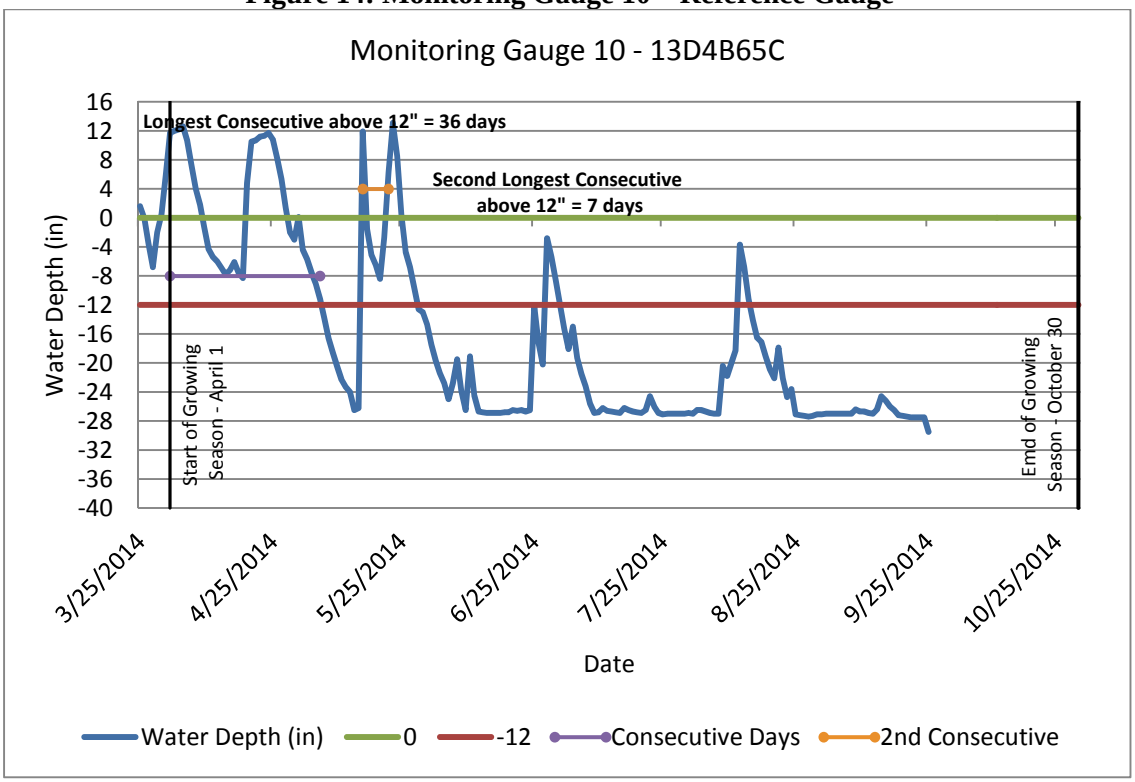
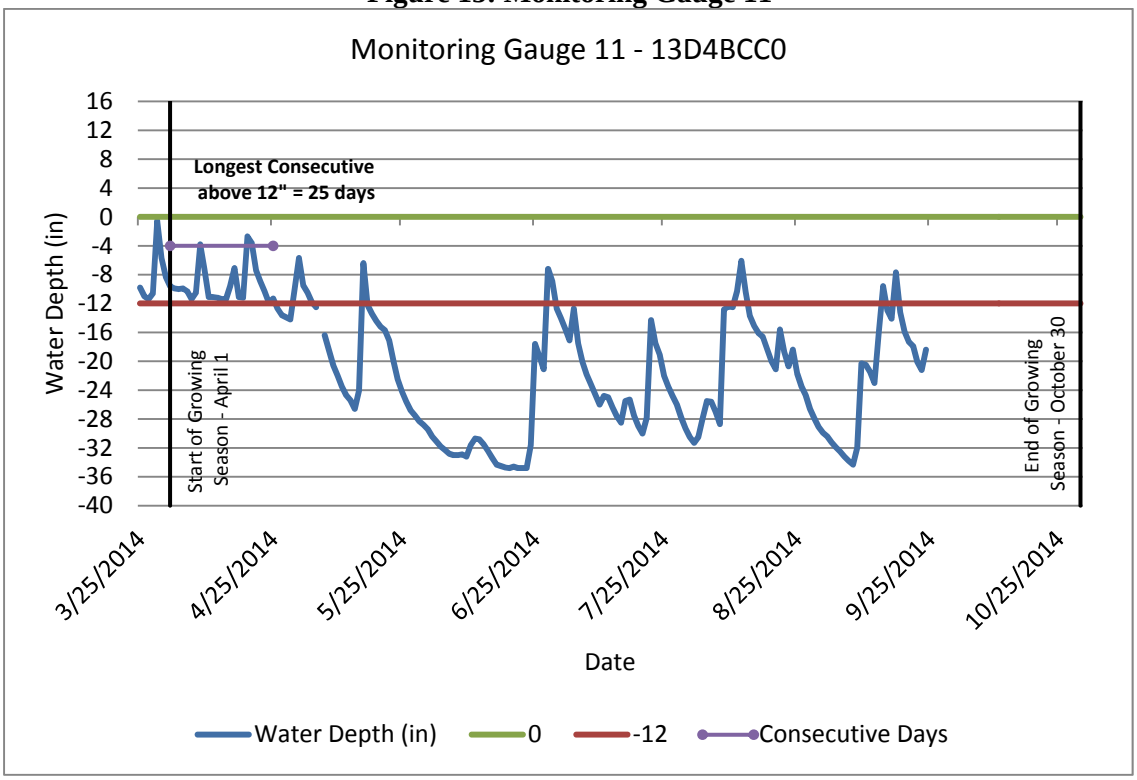


Figure 14: Monitoring Gauge 10 – Reference Gauge



*Note: Water depths were adjusted six inches, calibration point was six inches above ground surface. Gauge 13D4B65C was replaced with Gauge 13D491C5 on September 25, 2014.

Figure 15: Monitoring Gauge 11



*Note: Gauge was replaced on May 6, 2014. No readings were taken that day, as seen by the gap in the graph above.

Figure 16: Monitoring Gauge 12

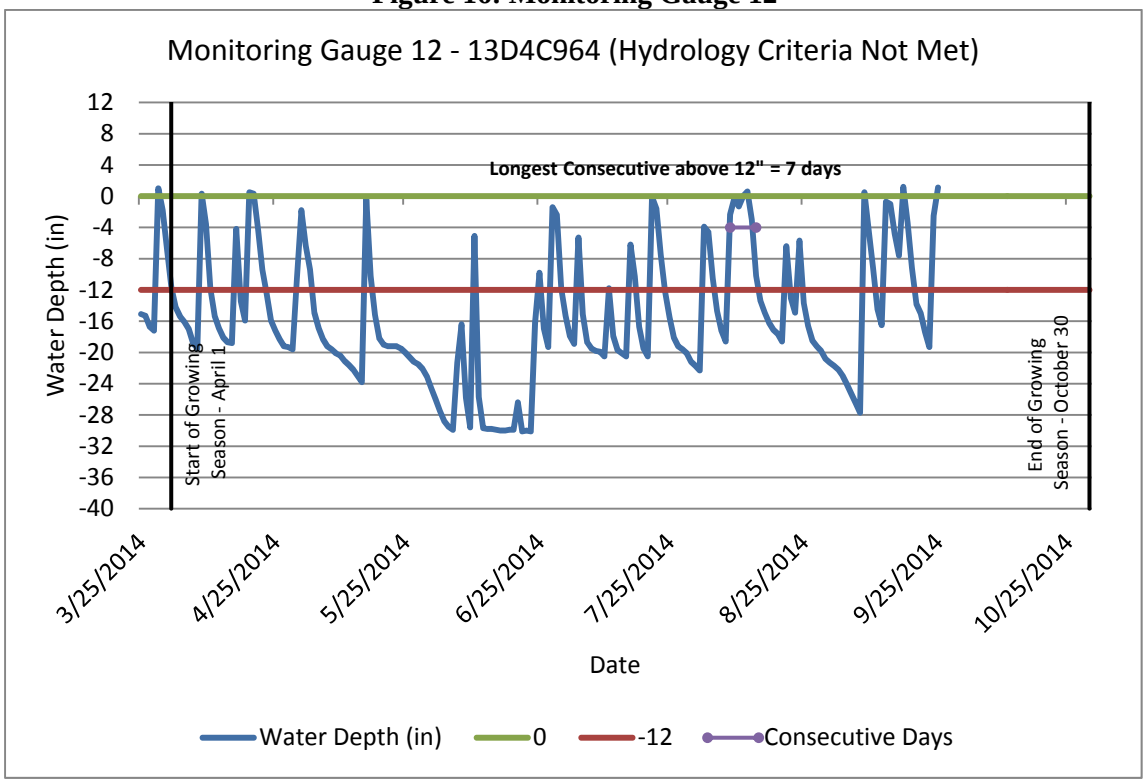
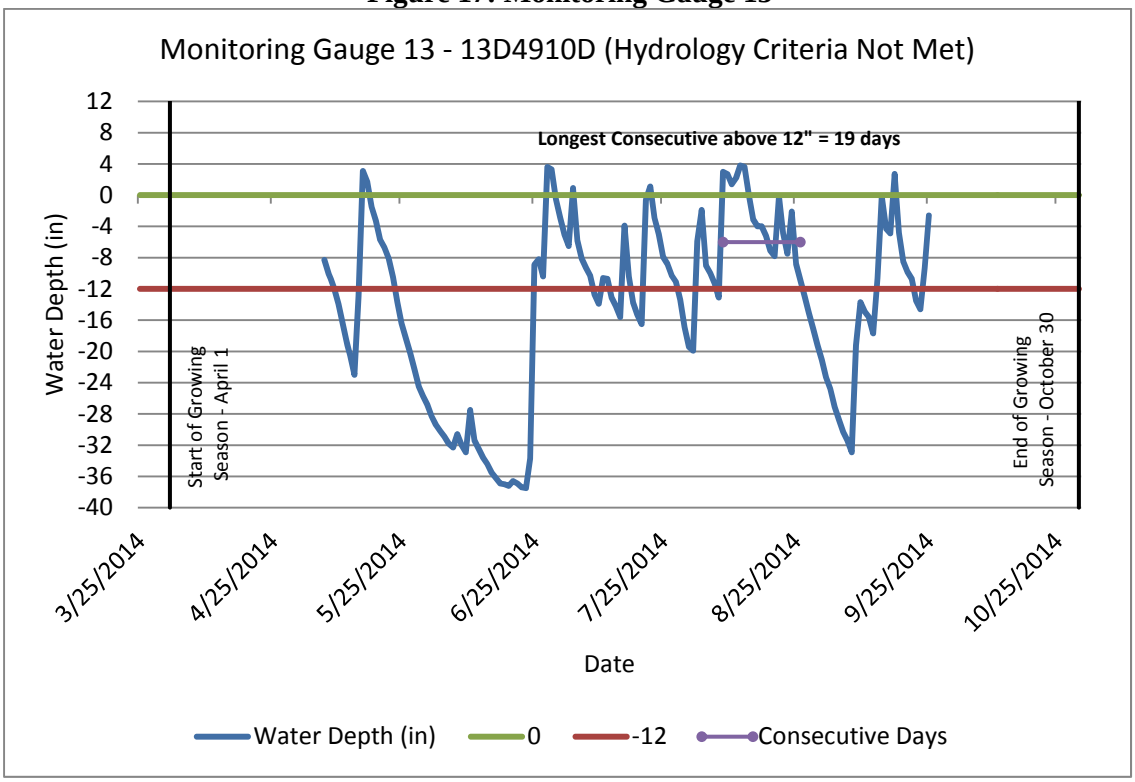


Figure 17: Monitoring Gauge 13



*Note: Gauge was replaced on May 6, 2014. The previous gauge was damaged and readings were not retrieved. Readings for the 2014 growing season begin May 7, 2014.

Table 11: Wetland Hydrology Criteria Attainment

Meadowbranch Swamp Wetland Restoration EEP Project Number 92351						
	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)*					
Gauge	**Year 0 (2011)**	**Year 1 (2012)**	**Year 2 (2013)**	**Year 3 (2014)**	**Year 4 (2015)**	**Year 5 (2016)**
1	No/0 (0%)	No/13 (6.1%)	Yes/52 (24.4%)	Yes/35 (16.4%)		
2	Yes/50 (23.5%)	No/11 (5.2%)	Yes/53 (24.9%)	No/11 (5.2%)		
3	No/0 (0%)	Yes/75 (35.2%)	Yes/132 (62.0%)	Yes/73 (34.3%)		
4	No/8 (3.8%)	No/0 (0%)	Yes/50 (23.5%)	No/6 (2.8%)		
5	Yes/55 (25.8%)	No/17 (8%)	Yes/52 (24.4%)	Yes/38 (17.8%)		
6	Yes/73 (34.3%)	No/13 (6.1%)	Yes/53** (24.9%)	Yes/36** (16.9%)		
7	Yes/83 (39%)	No/3 (1.4%)	Yes/105 (49.3%)	Yes/40 (18.8%)		
8	No/13 (6.1%)	No/16 (7.5%)	Yes/51 (23.9%)	Yes/38 (17.8%)		
9	Yes/50 (23.5%)	No/5 (2.3%)	Yes/46 (21.6%)	No/13 (6.1%)		
10 - Ref	Yes/21 (9.9%)	No/7 (3.3%)	Yes/30** (14.1%)	Yes/32** (15.0%)		
11	N/A	No/4 (1.9%)	Yes/49 (23.0%)	Yes/25 (11.7%)		
12	N/A	No/12 (5.6%)	Yes/27 (12.7%)	No/7 (3.3%)		
13	N/A	No/15 (7%)	Yes/126 (59.2%)	No/19 (8.9%)		

* Growing season is 213 days. Ten percent of growing season is equal to 21 days or more of consecutive readings above 12 inches.

** Gauges 6 and 10 were both protruding from the ground. The elevations were adjusted to compensate for the distance between the calibration level and the ground surface. Gauge 6 was 7 inches above the ground, and gauge 10 was 6 inches above the ground.