

**Meadowbranch Swamp Wetland Restoration
2015 Monitoring Report
Monitoring Year Four**

**DMS Project Number 92351
DMS Contract Number 004800**



Submitted to:

NC Department of Environment and Natural Resources
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

Submitted: March 14, 2016

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2015 Monitoring Report
Monitoring Year Four**

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Submitted: March 14, 2016

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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 aka Saddletree Swamp) 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 (Schafale and Weakley, 1990). 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) (Schafale and Weakley, 1990). 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 4 (MY4) field investigations took place on November 3rd, 2015 and January 15th, 2016. All three vegetation plots are in good condition and all are meeting vegetative success criteria with a project average of 513 stems per acre. Large numbers of volunteer stems, primarily river birch are present in all three plots. Some insect damage was observed on green ash 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.

Two randomly selected transects were inventoried within the Chinese privet removal areas. Both transects contained large numbers of Chinese privet and very few other species. Native species were all larger naturally occurring trees and no planted native stems were observed. 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. The percentage of Chinese privet in the two random transects was 78 percent and 94 percent, respectively. These results are presented in Table 9 of Appendix C.

The presence of Chinese privet continues to be a problem at the site, especially along the canal access road and in the cut lines leading to the groundwater gauges between the former logging road and the canal access road. Treatment areas are notable in that there are large patches of stems that appear dead; however, upon closer observation, new growth is present on some of these stems. Treatment was successful in some areas, but not all. Chinese privet is still present in very dense patches along the canal access road in the northern portions of the site. Areas identified as invasive areas of concern during previous monitoring years remain on the Current Condition Plan View.

Overall, the site is in good condition, with the exception to the presence of Chinese privet. 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.

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 consecutive days. Seven of the 12 groundwater gauges installed on-site met the hydrologic success criteria described above during the timeframe between April 1 and September 25 of 2015. The reference wetland gauge also met the wetland criteria.

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 and during MY4 on January 15, 2016. 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 52.99 inches, indicating that the past year has been above normal.

On-site stream gauge data and USGS stream gauge data indicate up to three bankfull events over the past year (September 2014 to January 1 2016). A single-day bankfull event on February 27, 2015, a three-day event from November 9 to November 11, 2015, and a multi-day event that began on December 24, 2015 and continued into 2016.

1.3 OTHER ISSUES

Erosion was first 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 has been 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. During the annual site assessment (May 2015) a washout area was observed along the bank of the canal between stations 25+00 and 30+00, which appears to be due to water movement over the canal access road. Bank erosion was observed behind the matting of Berm Cut 2 and Road Cut 2. The roadway cuts and bank condition will continue to 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

DMS's website. All raw data supporting the tables and figures in the appendices is available from DMS 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 whose data 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 the data gathered by those devices was downloaded using the same equipment stated above.

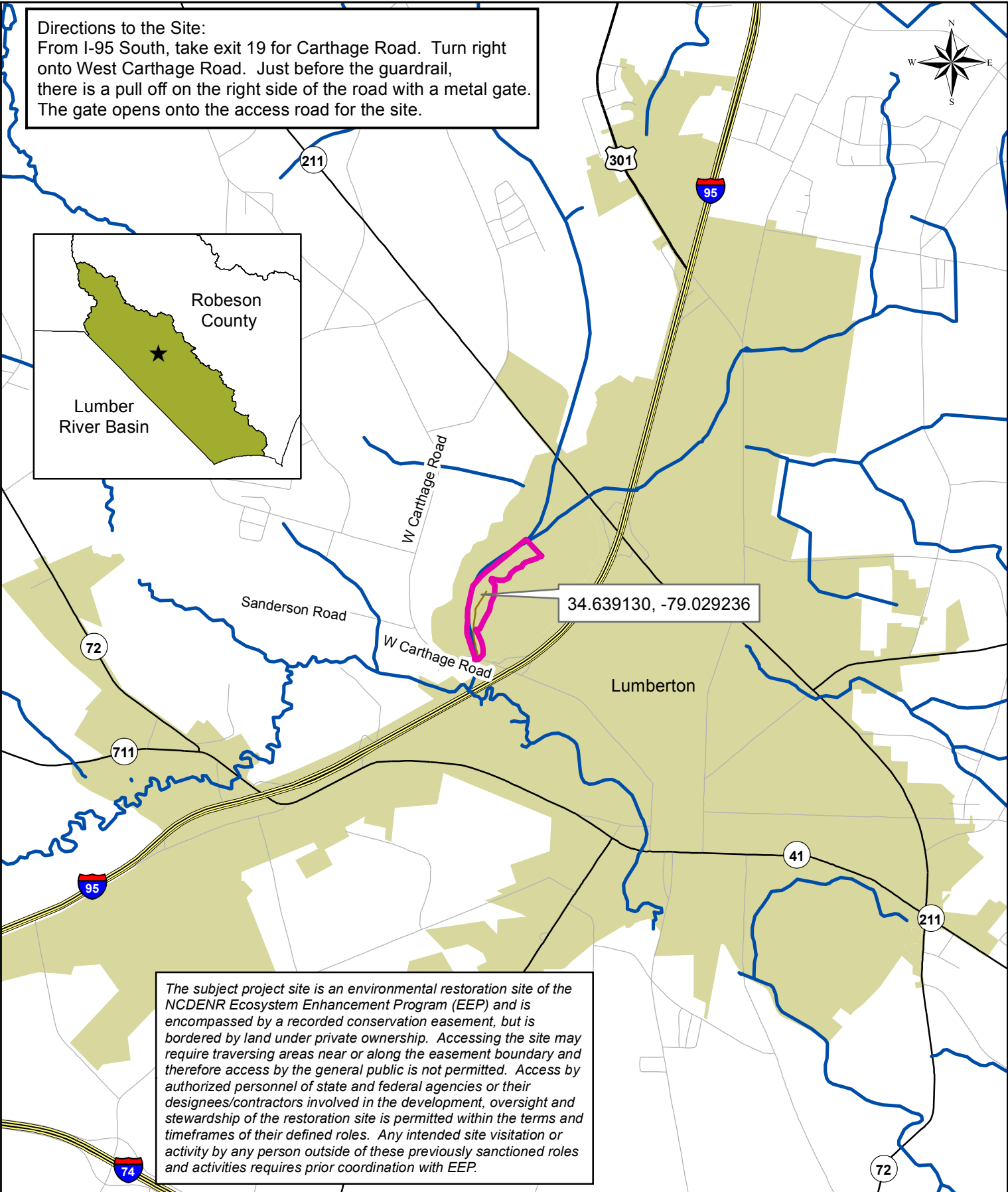
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- The John R. McAdams Company, Inc. 2007. Meadowbranch Swamp Wetland Restoration Restoration Plan. USGS HUC 03040203, Robeson County, North Carolina. Prepared for NC Ecosystem Enhancement Program. June 18, 2007.
- USGS. 2014. Lumber River at Lumberton, 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

Directions to the Site:
 From I-95 South, take exit 19 for Carthage Road. Turn right onto West Carthage Road. Just before the guardrail, there is a pull off on the right side of the road with a metal gate. The gate opens onto the access road for the site.



The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.

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 Division of Mitigation Services

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

Project Number: 92351
Date: February 2016

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 DMS Project Number 92351									
Project Component	Existing Acres	Restoration Level	Approach	Acreege	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 = R1 = Restoration; E = Enhancement; P = Preservation; Not Applicable =

Table 1b: Project Restoration Components

Meadowbranch Swamp Wetland Restoration DMS 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: 4 yr 9 months

Elapsed Time Since Planting Complete: 4 yr 3 months

Number of Reporting Years: 4

Meadowbranch Swamp Wetland Restoration DMS 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	Jan-16	March-16
Year 5 Monitoring		

Table 3: Project Contacts Table

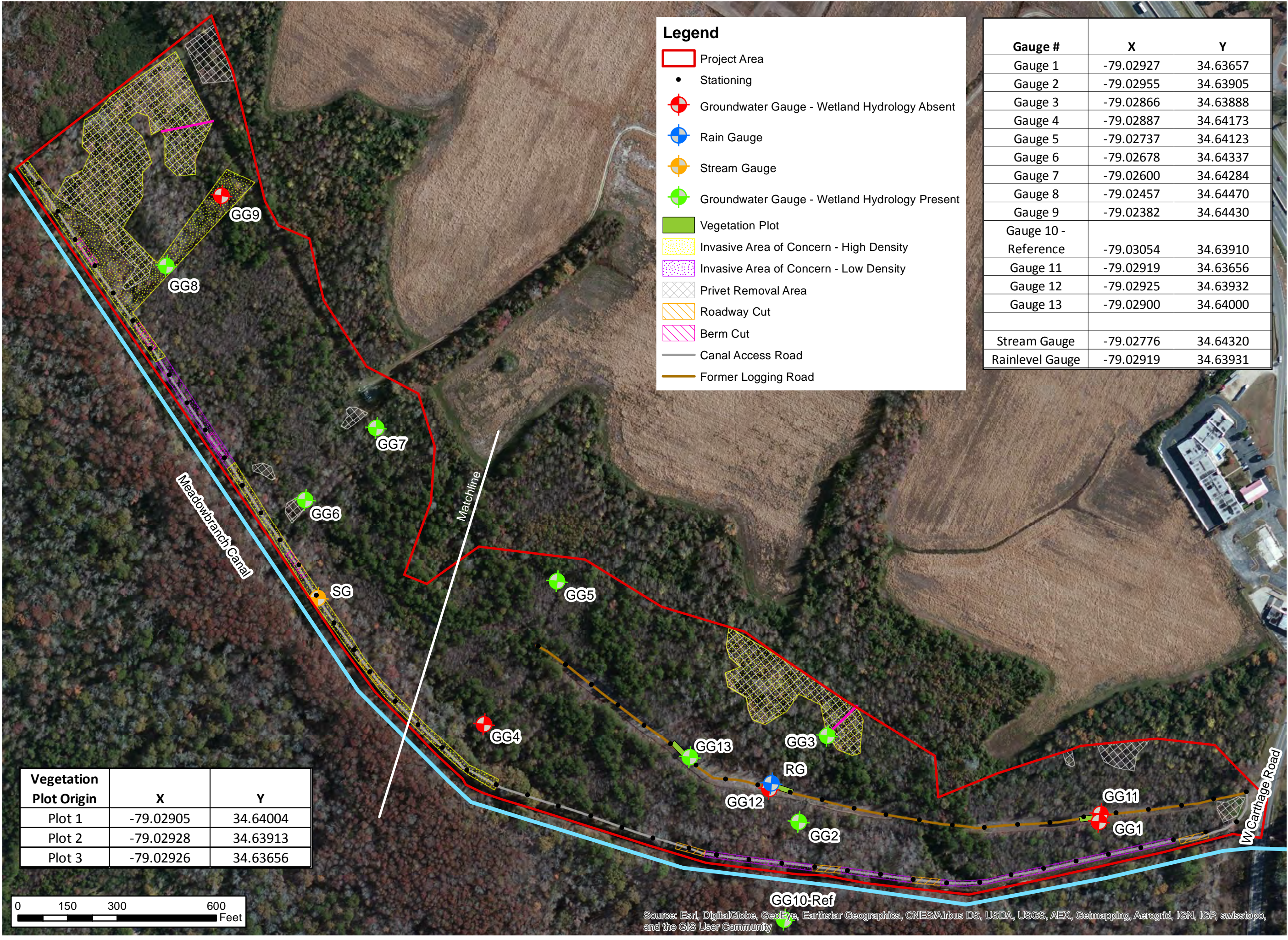
Meadowbranch Swamp Wetland Restoration DMS Project Number 92351	
Designer Primary project design POC	EcoEngineering – A Division of The John R. McAdams Co. 2905 Meridian Parkway Durham, NC 27713 George Buchholz 919-287-4262
Construction Contractor Construction contractor POC	EQR, LLC 1405 Benson Court, 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 and 3 Monitoring POC	URS Corporation – North Carolina 201 N Front Street, Suite 509 Wilmington, NC 28401 Susan Westberry 910-343-5994
Monitoring Performers – Year 4 Monitoring POC	URS Corporation – North Carolina 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 Ron Johnson, 919-854-6200

Table 4: Project Baseline Information and Attributes

Meadowbranch Swamp Wetland Restoration DMS 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
NCDWR Sub-basin for Project	03-07-51
Within extent of DMS Watershed Plan?	N/A
WRC Hab Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100%; by canal & by DMS markers
Beaver activity observed during design phase?	Yes
Restoration Component Attribute Table	
	PROJECT SITE
Meadowbranch Canal Drainage Area	34.4 ac
Stream order	3 rd
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
NCDWRAU/Index number	14-12
NCDWR 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

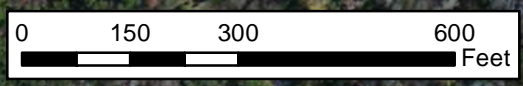


Legend

- Project Area
- Stationing
- ⊕ Groundwater Gauge - Wetland Hydrology Absent
- ⊕ Rain Gauge
- ⊕ Stream Gauge
- ⊕ Groundwater Gauge - Wetland Hydrology Present
- 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



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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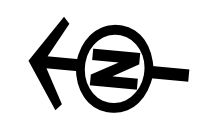
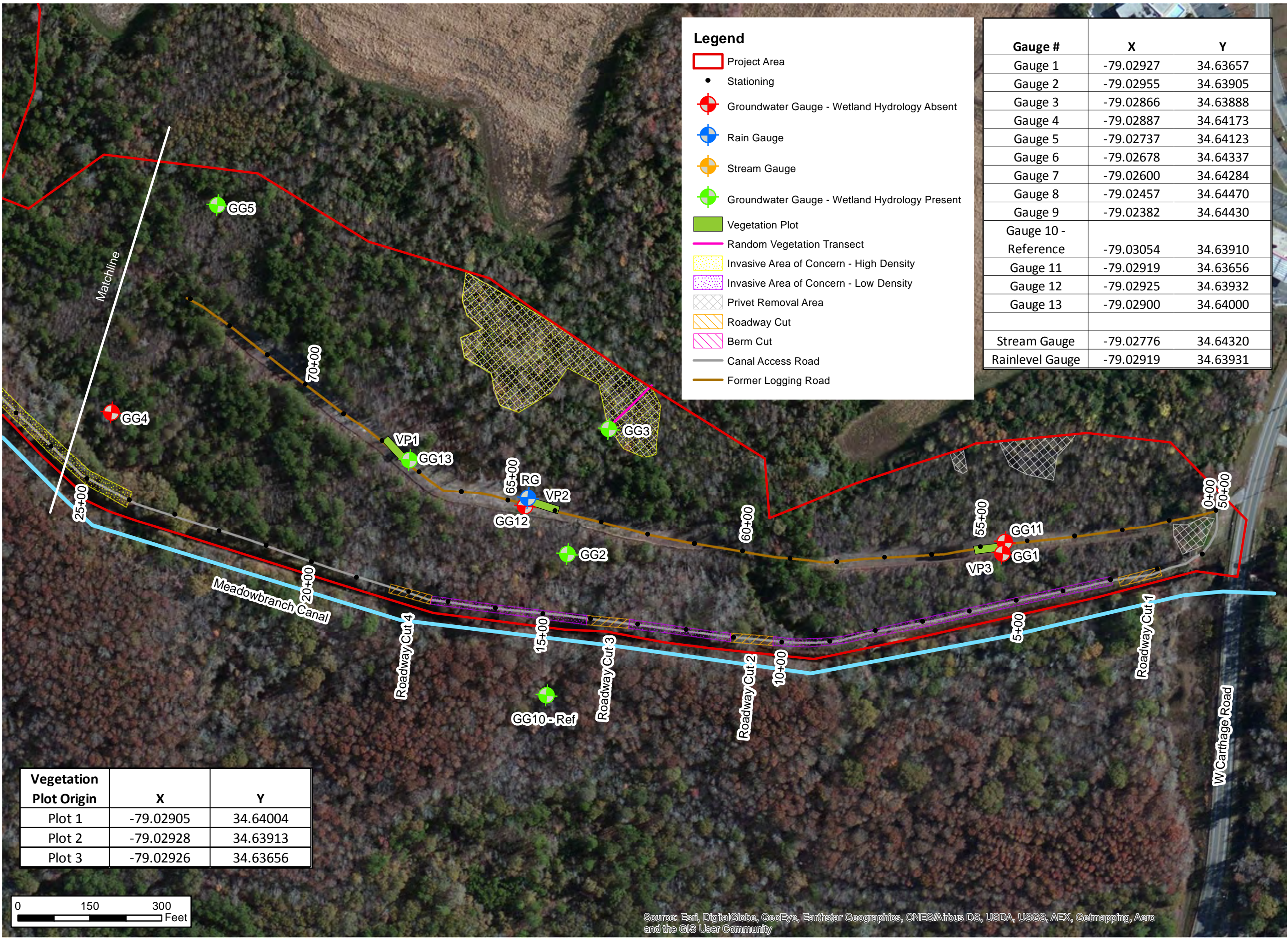


Figure 2
 Current Condition
 Plan View
 Project Overview

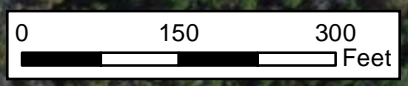


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- ⊕ Rain Gauge
- ⊕ Stream Gauge
- ⊕ Groundwater Gauge - Wetland Hydrology Present
- Vegetation Plot
- Random Vegetation Transect
- Invasive Area of Concern - High Density
- Invasive Area of Concern - Low Density
- Privet Removal Area
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- Berm Cut
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- 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



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerco and the GIS User Community

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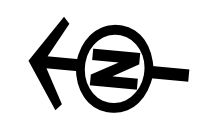


Project:
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 CU 03040203

Monitoring Year:
 4 (2015)

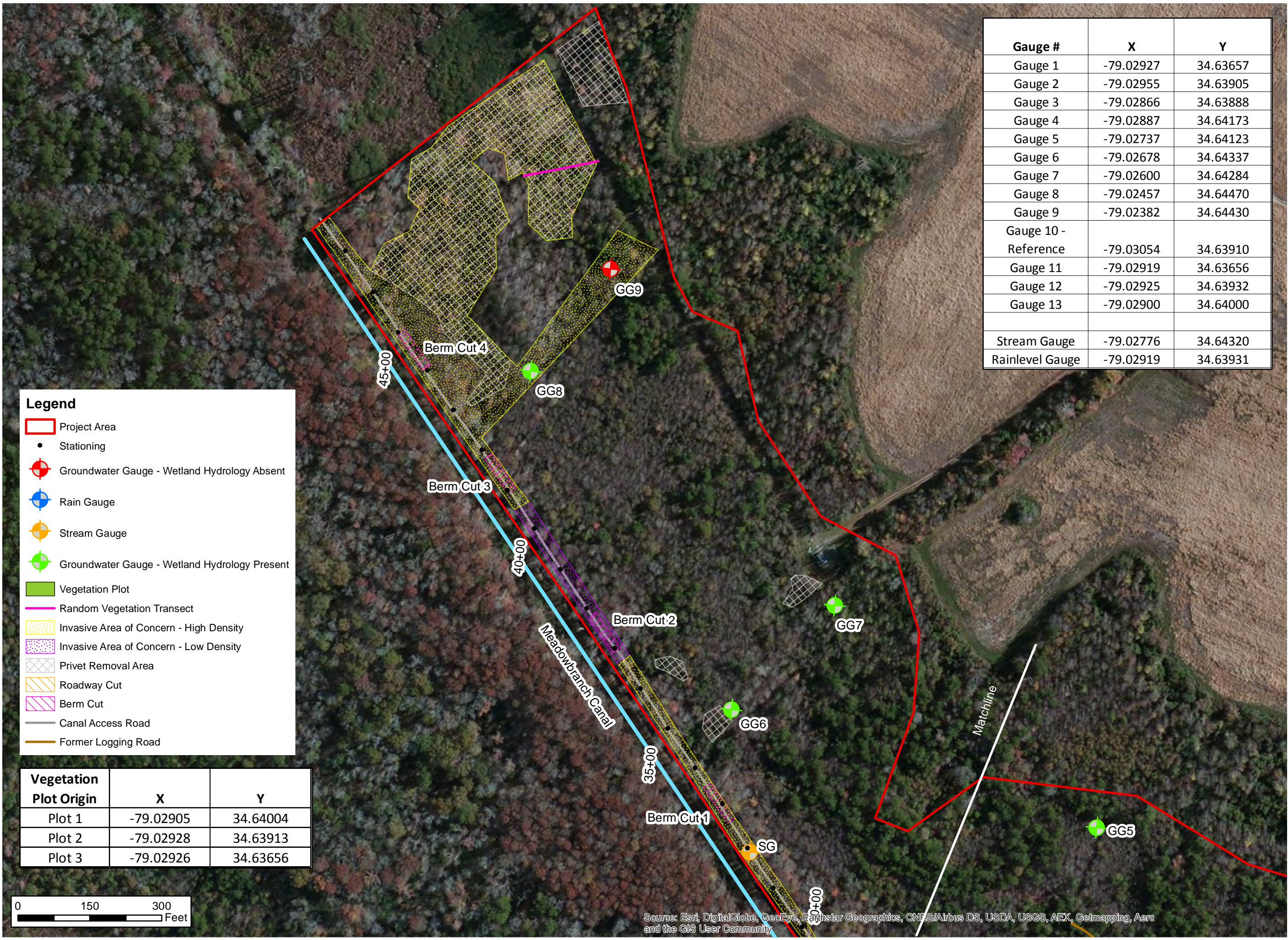
Project Number:
 92351

Date:
 February 2016



2010 Aerial
 Orthophotography
 (Source: NCOneMap)

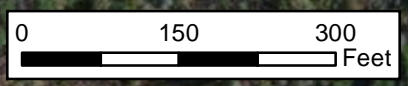
Figure 2a
 Current Condition
 Plan View



Legend

- Project Area
- Stationing
- ⊕ Groundwater Gauge - Wetland Hydrology Absent
- ⊕ Rain Gauge
- ⊕ Stream Gauge
- ⊕ Groundwater Gauge - Wetland Hydrology Present
- Vegetation Plot
- Random Vegetation Transect
- 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

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



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

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Prepared For:
 North Carolina
 Division of Mitigation Services



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

Monitoring Year:
 4 (2015)

Project Number:
 92351

Date:
 February 2016



Figure 2b
 Current Condition
 Plan View

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aero and the GIS User Community

Table 5: Vegetation Condition Assessment Table

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

**Table 7: CVS Vegetation Metadata Table
Meadowbranch Swamp Wetland Restoration
DMS Project Number 92351**

Report Prepared By	Ron Johnson
Date Prepared	2/5/2016 10:07:27 AM
database name	Meadowbranch Swamp Canal_92351_MY4_2015.mdb
database location	N:\Morrisville\Jobs3\31828749_NCEEP_Meadowbranch\2015_Year 4
computer name	
file size	60821504
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
Meadowbranch Swamp Wetland Restoration
DMS Project Number 92351

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2015)									Annual Means														
			E92351-01-0001			E92351-01-0002			E92351-01-0003			MY4 (2015)			MY3 (2014)			MY2 (2013)			MY1 (2012)			MY0 (2011)		
			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
<i>Acer rubrum</i>	red maple	Tree									1			1						4			6			
<i>Betula nigra</i>	river birch	Tree	7	7	52	5	5	44	5	5	77	17	17	173	16	16	114	16	16	91	15	15	16	16	16	16
<i>Fraxinus pennsylvanica</i>	green ash	Tree	2	2	2	1	1	1	4	4	4	7	7	7	8	8	12	7	7	7	5	5	5	7	7	7
<i>Liquidambar styraciflua</i>	sweetgum	Tree			3						25			28			6			15						
<i>Morella cerifera</i>	wax myrtle	shrub																		4						
<i>Pinus taeda</i>	loblolly pine	Tree			6			7			6			19						5			1			
<i>Quercus</i>	oak	Tree							1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	3
<i>Quercus laurifolia</i>	laurel oak	Tree				1	1	1				1	1	1	1	1	1	1	1	1	4	4	4	4	4	4
<i>Quercus lyrata</i>	overcup oak	Tree	1	1	1	2	2	2				3	3	3	2	2	2	4	4	4	3	3	4	6	6	6
<i>Quercus nigra</i>	water oak	Tree																						3	3	3
<i>Quercus pagoda</i>	cherrybark oak	Tree																						1	1	1
<i>Quercus phellos</i>	willow oak	Tree	1	1	1	2	2	2	5	5	5	8	8	8	10	10	10	8	8	8	12	12	12	15	15	15
<i>Salix nigra</i>	black willow	Tree			1						2			3						3						
<i>Taxodium distichum</i>	bald cypress	Tree	1	1	1							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Stem count			12	12	67	11	11	57	15	15	121	38	38	245	39	39	147	38	38	144	42	42	51	56	56	56
size (ares)			1			1			1			3			3			3			3			3		
size (ACRES)			0.02			0.02			0.02			0.07			0.07			0.07			0.07			0.07		
Species count			5	5	8	5	5	6	4	4	8	7	7	11	7	7	8	7	7	12	7	7	9	9	9	9
Stems per ACRE			485.6	485.6	2711	445.2	445.2	2307	607	607	4897	512.6	512.6	3305	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
Meadowbranch Swamp Wetland Restoration
DMS Project Number 92351

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2015)	
			Random Transect 1	Random Transect 2
			Total	Total
<i>Acer rubrum</i>	red maple	Tree	9	3
<i>Quercus laurifolia</i>	laurel oak	Tree	1	1
<i>Ligustrum sinense</i>	chinese privet	Shrub/Tree	53	92
<i>Quercus michauxii</i>	basket oak	Tree	1	
<i>Liriodendron tulipifera</i>	tulip tree	Tree		2
<i>Carya specs.</i>	hickory species	Tree	1	
<i>Sambucus canadensis</i>	elderberry	Shrub	1	
<i>Fraxinus pennsylvanica</i>	green ash	Tree	1	
<i>Magnolia virginiana</i>	sweet bay	Tree	1	
Total stem count			68	98
Invasive stem count			53	92
Native stem count			15	6
Size (ares)			1	
Size (ACRES)			0.02	
Species count			8	4
Native stems per acre			750	300
Percent of total stems invasive			78	94

Appendix D: Hydrologic Data

Table 10: Verification of Bankfull Events

Meadowbranch Swamp Wetland Restoration DMS Project Number 92351			
Date of Data Collection	Date of Occurrence	Method	Photo # (if available)
1/15/2016	2/27/2015 and 11/9/2015	On-site data logger (<i>Ecotone</i> water level gauge)	
1/15/2016	11/9/2015 to 11/11/2015	On-site data logger (<i>Ecotone</i> water level gauge)	
1/15/2016	12/24/2015 into January 2016	On-site data logger (<i>Ecotone</i> water level gauge)	

The data logger on-site recorded three bankfull events in 2015. A single-day bankfull event on February 27, 2015, a three-day event from November 9 to November 11, 2015, and a multi-day event that began on December 24, 2015 and continued into 2016. Proximal USGS gauge data supports these findings. Potential bankfull occurrence from September 25, 2014 to January 1, 2016 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 January 1, 2015 and December 31, 2015 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 six times during the past year:

- January 13 – 17 (5 days) peak discharge of 2440 cfs on 1/14/2015
- February 26 – March 2 (5 days) peak discharge of 2560 cfs on 2/27/2015
- October 8 – 11 (4 days), peak discharge of 2390 cfs on 10/9/2015
- November 7 – 12 (6 days), peak discharge of 2540 cfs on 11/10/2015
- November 23 – 27 (5 days), peak discharge of 2260 cfs on 11/25/2015
- December 23 into 2016 (9+ days), peak discharge of 5140 cfs on 12/26/2015

Based on a comparison of the on-site data logger and the USGS gauge data it appears that a slightly more accurate estimate of bankfull for Meadowbranch Canal is when the USGS gauge on the Lumber River is at around 2500 cfs.

Rainfall data are presented in Figure 4.

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

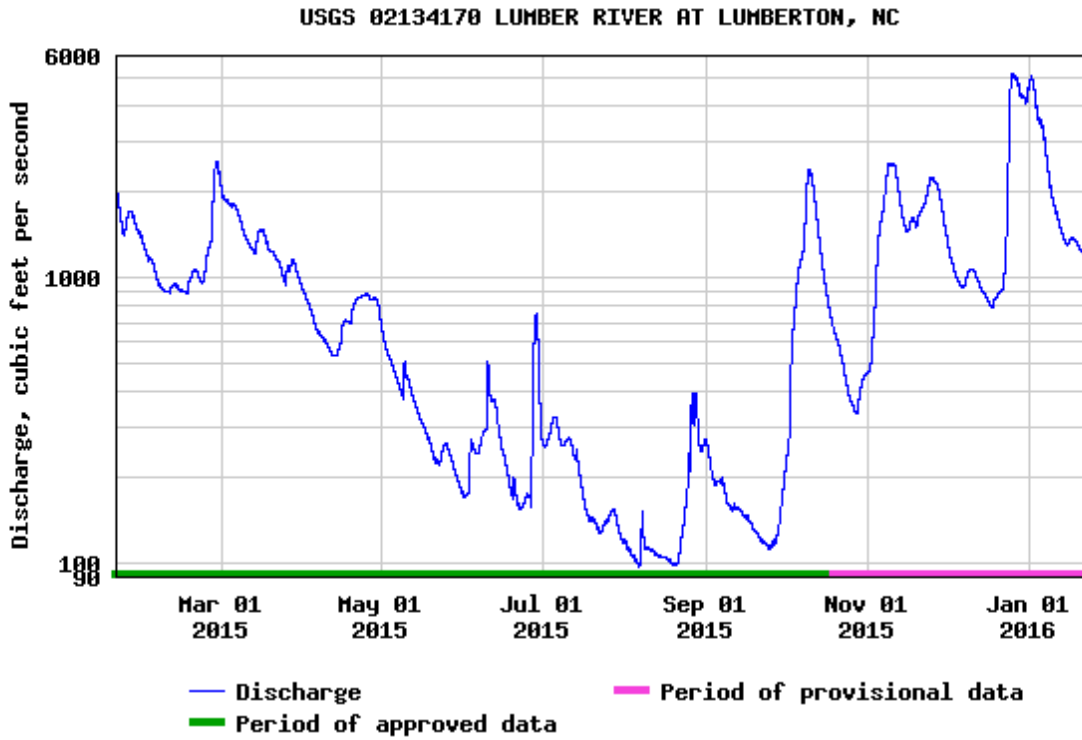


Figure 4: Meadowbranch Swamp Canal 30-70 Percentile Graph for Rainfall in 2015, Lumberton, NC

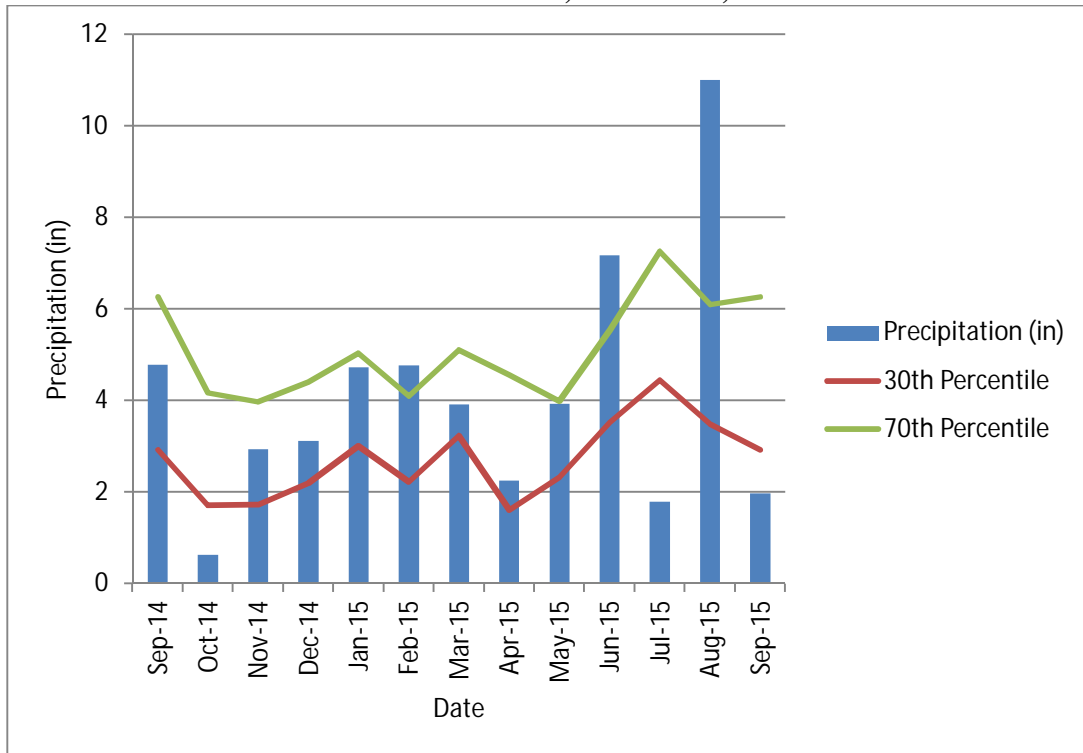


Figure 5: Monitoring Gauge 1

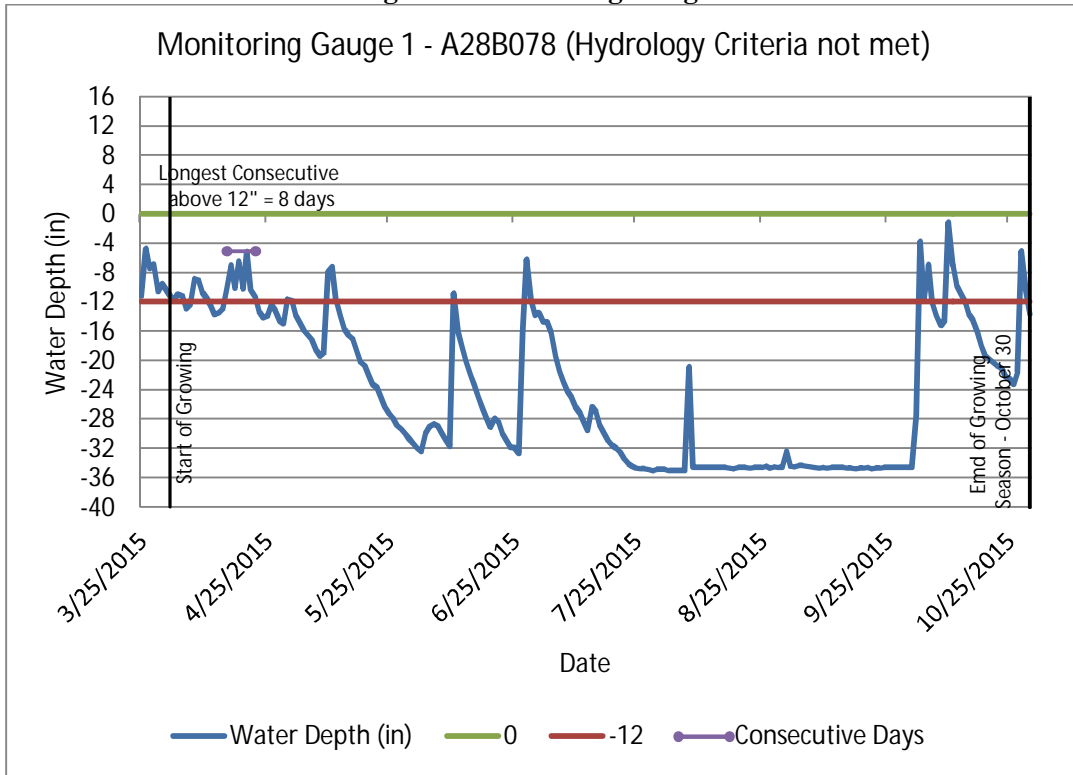


Figure 6: Monitoring Gauge 2

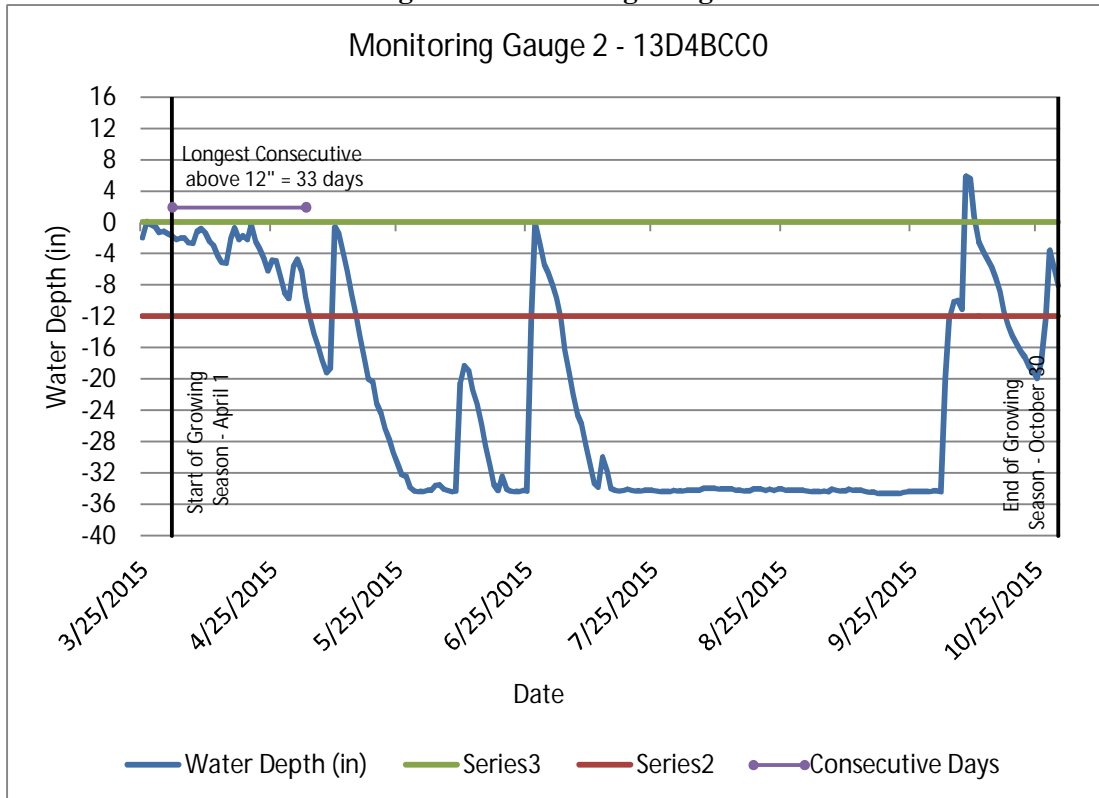


Figure 7: Monitoring Gauge 3

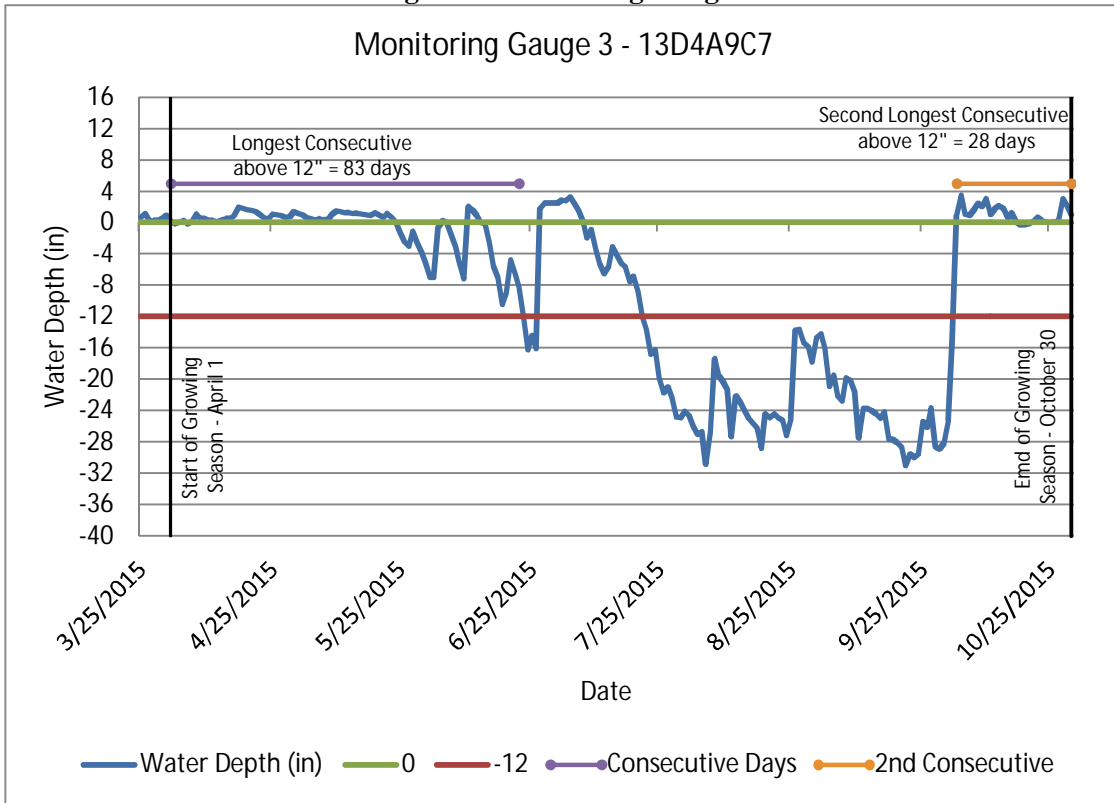


Figure 8: Monitoring Gauge 4

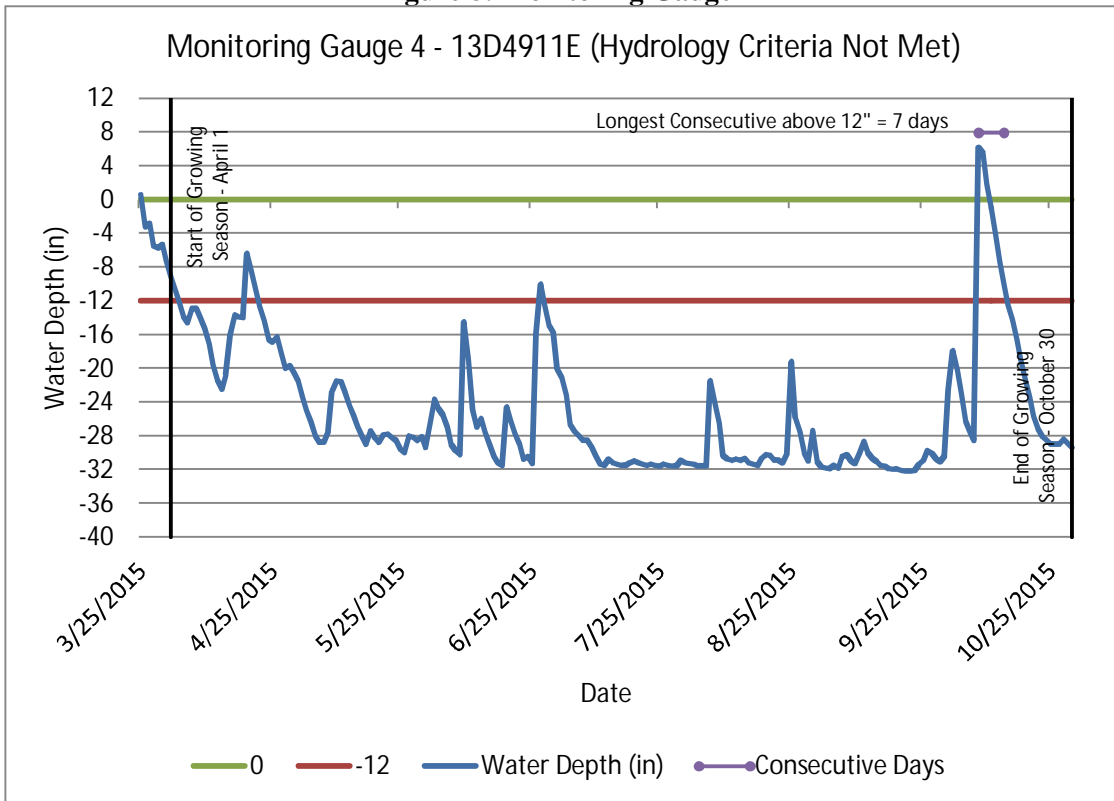


Figure 9: Monitoring Gauge 5

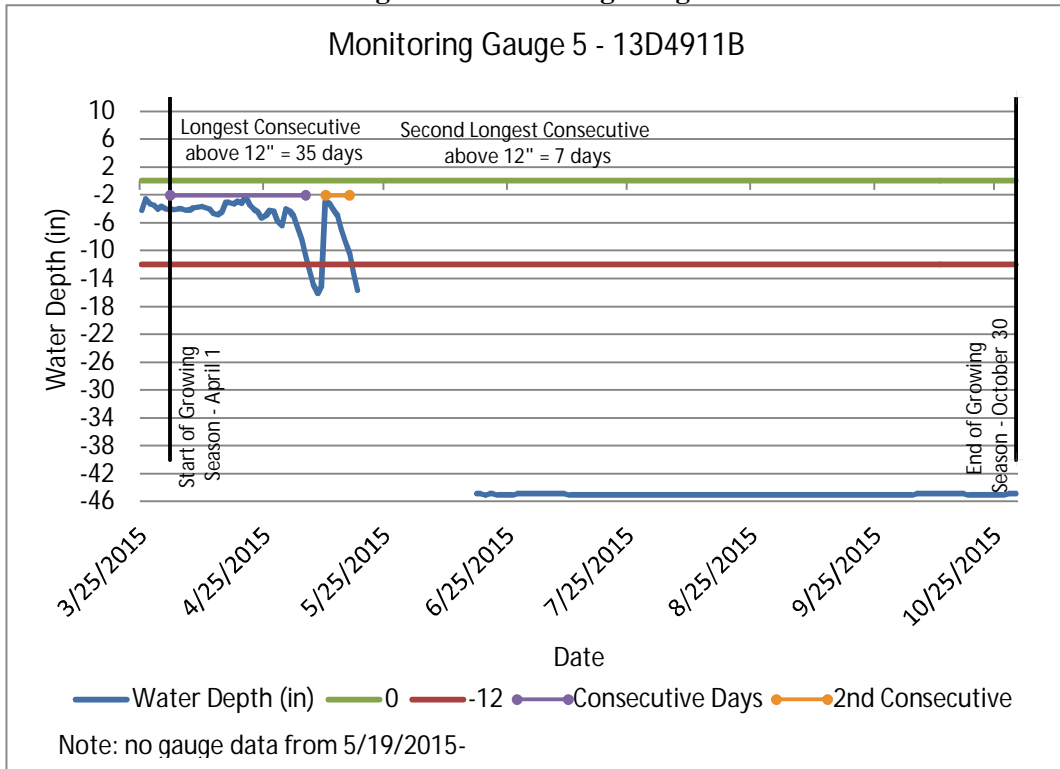
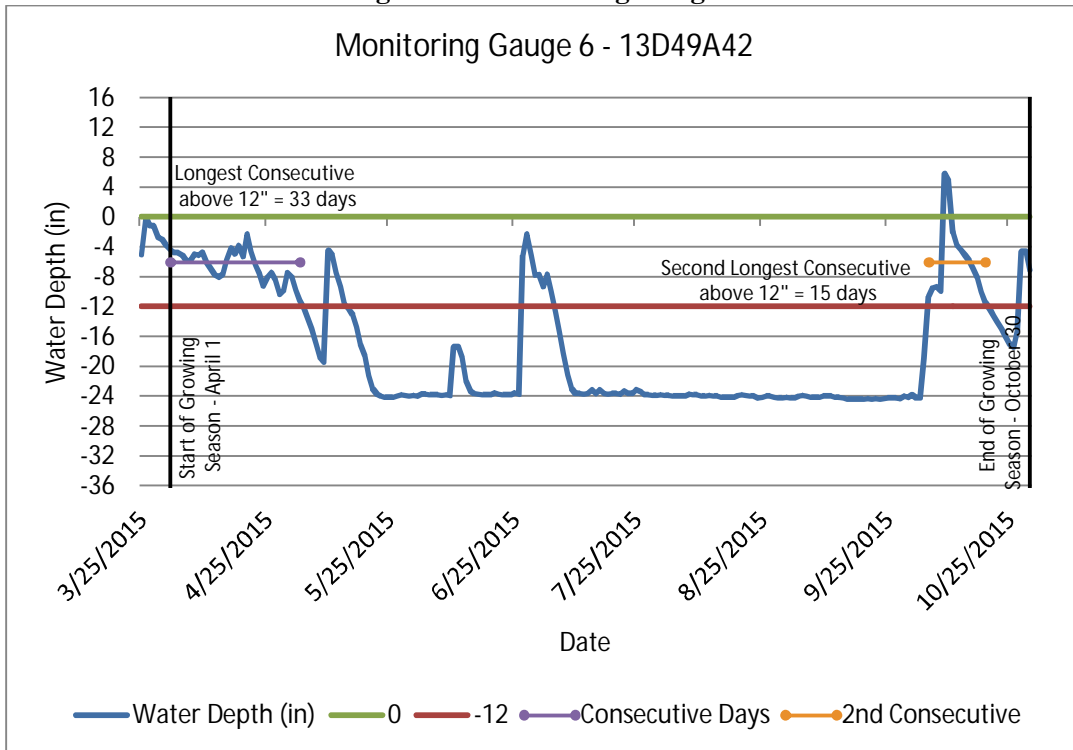


Figure 10: Monitoring Gauge 6



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

Figure 11: Monitoring Gauge 7

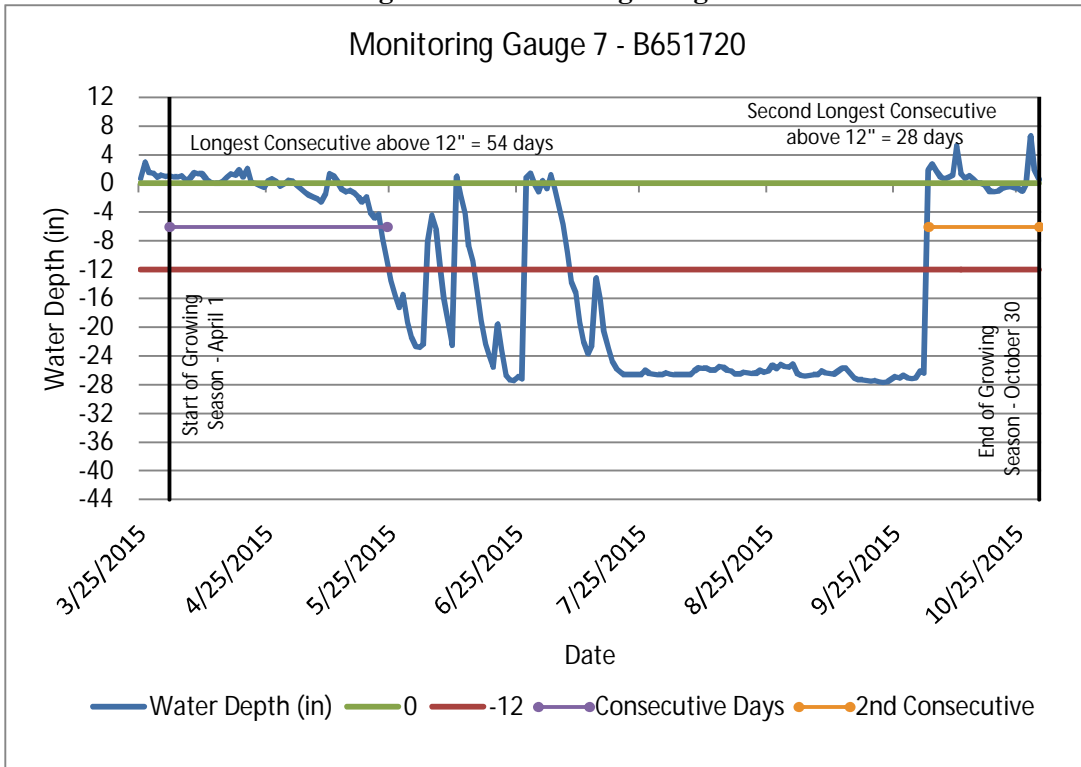


Figure 12: Monitoring Gauge 8

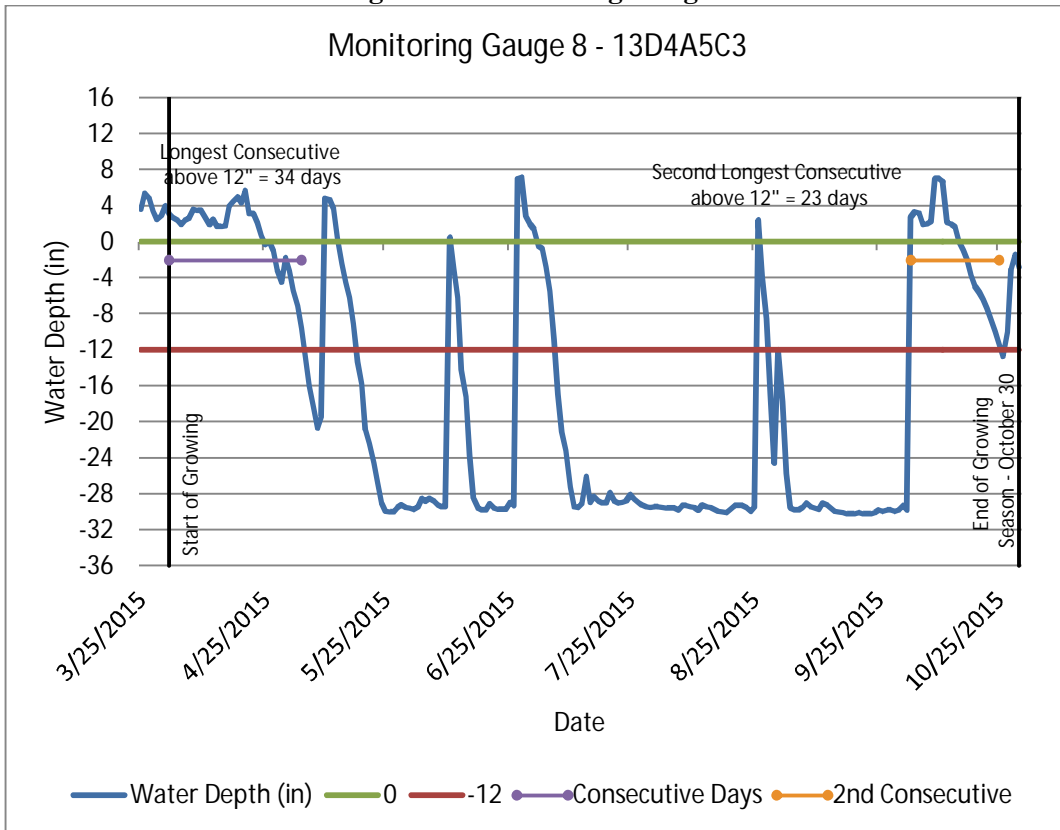


Figure 13: Monitoring Gauge 9

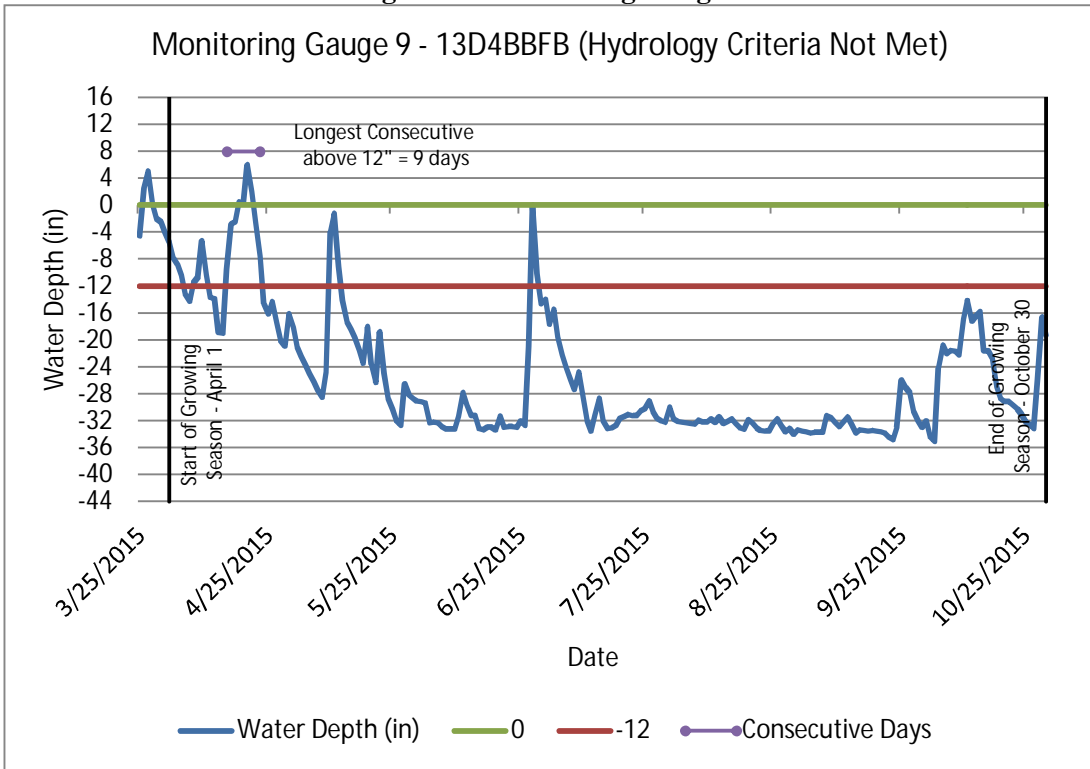
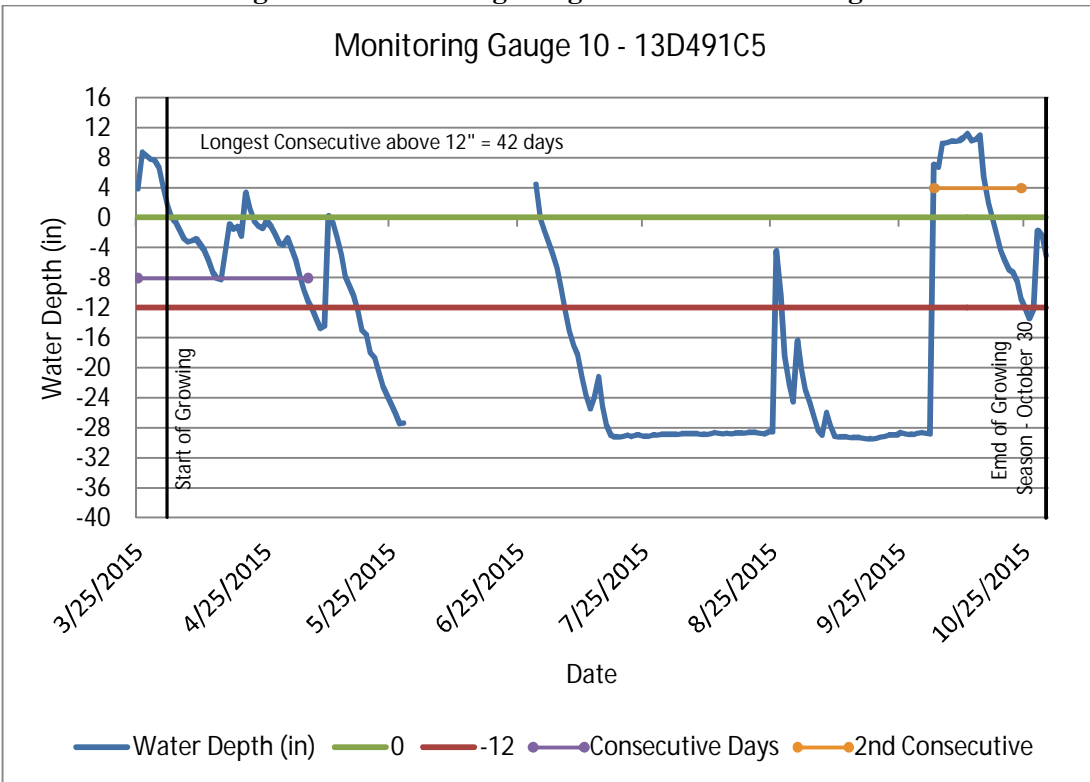
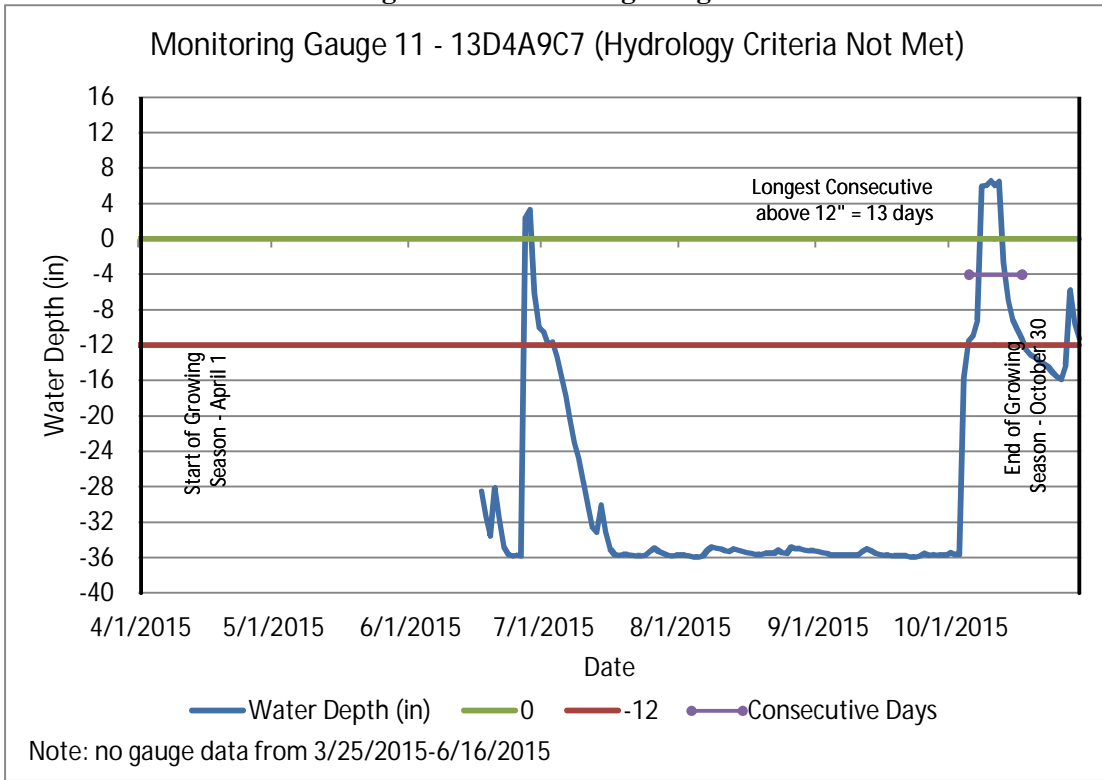


Figure 14: Monitoring Gauge 10 – Reference Gauge



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

Figure 15: Monitoring Gauge 11



*Note: Gauge was replaced on June 16, 2015.

Figure 16: Monitoring Gauge 12

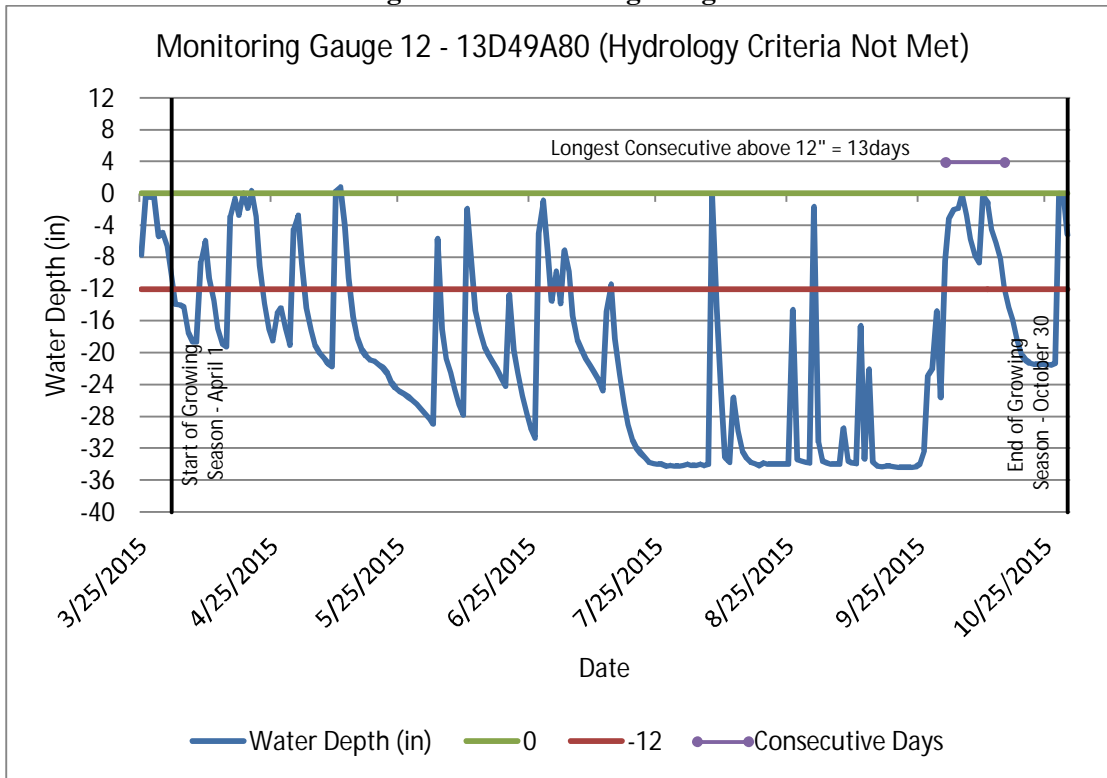


Figure 17: Monitoring Gauge 13

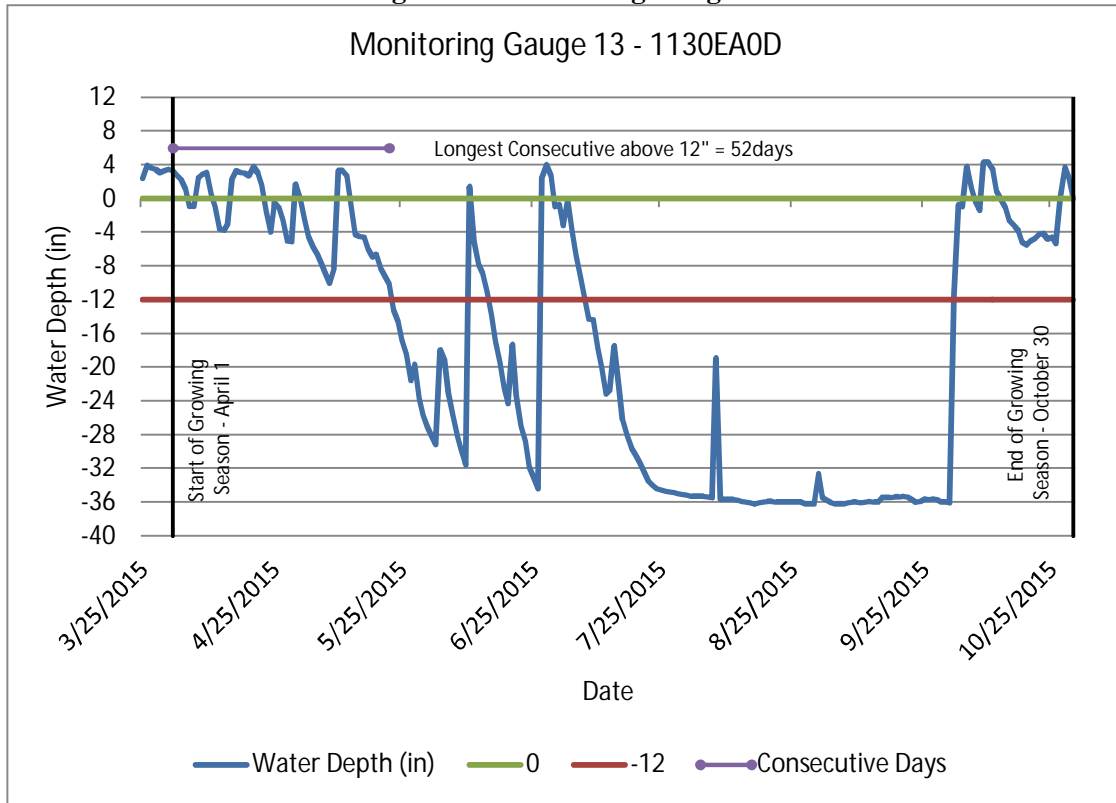


Table 11: Wetland Hydrology Criteria Attainment

Meadowbranch Swamp Wetland Restoration DMS 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%)	No/8 (3.8%)	
2	Yes/50 (23.5%)	No/11 (5.2%)	Yes/53 (24.9%)	No/11 (5.2%)	Yes/33 (15.5%)	
3	No/0 (0%)	Yes/75 (35.2%)	Yes/132 (62.0%)	Yes/73 (34.3%)	Yes/83 (39.0%)	
4	No/8 (3.8%)	No/0 (0%)	Yes/50 (23.5%)	No/6 (2.8%)	No/7 (3.3%)	
5	Yes/55 (25.8%)	No/17 (8%)	Yes/52 (24.4%)	Yes/38 (17.8%)	Yes/35 (16.4%)	
6	Yes/73 (34.3%)	No/13 (6.1%)	Yes/53** (24.9%)	Yes/36** (16.9%)	Yes/33 (15.5%)	
7	Yes/83 (39%)	No/3 (1.4%)	Yes/105 (49.3%)	Yes/40 (18.8%)	Yes/54 (25.4%)	
8	No/13 (6.1%)	No/16 (7.5%)	Yes/51 (23.9%)	Yes/38 (17.8%)	Yes/34 (16.0%)	
9	Yes/50 (23.5%)	No/5 (2.3%)	Yes/46 (21.6%)	No/13 (6.1%)	No/12 (5.6%)	
10 - Ref	Yes/21 (9.9%)	No/7 (3.3%)	Yes/30** (14.1%)	Yes/32** (15.0%)	Yes/42 (19.7%)	
11	N/A	No/4 (1.9%)	Yes/49 (23.0%)	Yes/25 (11.7%)	No/13 (6.1%)	
12	N/A	No/12 (5.6%)	Yes/27 (12.7%)	No/7 (3.3%)	No/13 (6.1%)	
13	N/A	No/15 (7%)	Yes/126 (59.2%)	No/19 (8.9%)	Yes/52 24.4%	

Notes:

* 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 both protrude from the ground. The elevations have been adjusted to compensate for the distance between the calibration level and the ground surface. Gauge 6 is 5 inches above the ground, and gauge 10 is 6 inches above the ground.

Gauges meeting wetland success criteria are highlighted in blue. Those not meeting wetland success criteria are highlighted in red.