

**Baseline Monitoring Report
FINAL**

**Twin Bays Wetland Restoration Site
Duplin County, North Carolina
EEP Contract 004739
EEP Project Number 95363**



Submitted to:



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

**Monitoring Data Collected: April 2014
Date Submitted: June 2014**

Monitoring and Design Firm

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EXECUTIVE SUMMARY

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 non-riparian wetland system in the Cape Fear Basin (03030007 8-digit HUC) in southern Duplin County, North Carolina that had substantially modified to maximize agricultural production. The completed 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 site's 25.4-acre watershed is characterized by 93% agriculture, 2% forest, and 5% low-intensity development. 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 agriculture 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.

Project construction was completed in March 2014. TBWRS involved the restoration of approximately 10.6 acre of non-riparian wetlands and 0.4 acre of upland preservation. The primary restoration action involved filling the existing ditches. The pond located in the north-central portion of the site was restored to an ephemeral pond. The wetland was constructed as designed with only one modification made to the design plan during construction: below the restored ephemeral pond, the area was graded to disperse pond overflow throughout the wetland.

The monitoring components were installed in March and April 2014. Sixteen groundwater monitoring gauges were installed to evaluate the attainment of jurisdictional wetland hydrology. To determine the success of the planted mitigation area, ten permanent vegetation monitoring plots were established according to the CVS-EEP Level 2 protocol. Six permanent photo points have been established with a total of eleven photos to be taken annually. The site will be monitored for at least seven years or until the success criteria are achieved. Reports will be submitted to the EEP each year. The first year of monitoring will take place in 2014.

The planted wetland must meet the success criteria of a site average 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. The baseline monitoring counted an average of 1,052 stems/acre in the 10 vegetation monitoring plots.

Wetland hydrology will be monitored with a series of automatic gauges that record water table depth. To meet the success criterion, the upper 12 inches of the soil profile must have continuously saturated or inundated conditions for at least 8% of the growing season with a 50% probability of reoccurrence during normal weather conditions. Due to the inherent variability in the sites soil's 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.

1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

1.1 Location and Setting

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed restoration of 10.6 acres of non-riparian wetlands at the Twin Bays Wetland Restoration Site (TBWRS) to assist in fulfilling wetland mitigation goals in the area. The project site, which is protected by an 11.72-acre permanent conservation easement held by the State of North Carolina, is situated in Duplin County in the Carolina Flatwoods (Level IV 63h) ecoregion of the Coastal Plain physiographic province. The site is located on a single parcel located off of Cornwallis Road, approximately two miles northwest of Wallace, North Carolina (Figure 1, Appendix A). The Site is within the 03030007 Cape Fear River Watershed Cataloging Unit (8-digit HUC) and the 03030007090040 Rock Fish Creek Local Watershed Unit (14-digit HUC) which has been identified as a Targeted Local Watershed (NCDENR, EEP 2009). The Cape Fear River Basin as a whole is experiencing a large amount of habitat alteration due to population growth from Wilmington and its surrounding metropolitan area. The TBWRS Project was identified as a wetland opportunity to improve habitat within the TLW.

1.2 Project Goals and Objectives

The project goals address stressors identified in the TLW 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 project 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 forested hardwood wetland community using native trees and seed mixes.

1.3 Project Structure, Restoration Type and Approach

1.3.1 Project Structure

The mitigation work included approximately 10.6 acres of non-riparian wetland restoration and 0.4 acres of upland preservation for a total of 10.6 Wetland Mitigation Units as shown in Figure 2 and described in Table 1 in Appendix A. Planting occurred within 11.7 acres of the 11.72-acre conservation easement. The target natural community consists of Hardwood Flats Community (NCWAM, v. 4.1 2010).

1.3.2 Project Restoration Type and Approach

Prior to construction, the site had a long history of hydrologic modification in order to allow for farming to take place on the property. The site is located within a flat interstream divide that spans two unnamed tributaries to Rock Fish Creek. Three primary ditches existed on the TBWRS that carried water from the northern edge of the site toward the center of the site and discharged into a main ditch that ran west to east across the extent of the site. The central ditch then discharges into another ditch running north to south. This southeastern ditch flowed into an off-site ditch running west to east along the southern property line, which then flowed into an unnamed tributary to Rock Fish Creek. The ditch networks were originally installed at the site to quickly remove surface inputs and to lower the water table during the growing season. In addition to the modifications made to the site with ditching, the TBWRS also contained a small pond in the north-central wooded portion of the site. A past landowner created the pond berm to capture flow from two seeps to the north. This pond was hindering the dispersal of seepage flow across the site to the south.

The modifications at the TBWRS focused on restoring hydrology to the wetland mitigation area. This was achieved by removing the anthropogenic modifications that were previously implemented across the site. The primary restoration action involved filling the existing ditches. A detailed topographic survey was used to design slight grading modifications to redirect and lengthen overland flow paths in order to retain and treat surface hydrology longer. Surface roughness variations were installed throughout the TBWRS to alleviate soil compaction and to enhance surface water storage.

The pond located in the north-central portion of the site was restored to an ephemeral pond, as requested by NC WRC. The pond was partially filled at an appropriate elevation to allow the area to be only seasonally inundated. Select pond berms were breached to encourage flow dispersal into the downslope wetlands. Below the ephemeral pond, the area was graded to disperse pond overflow throughout the wetland. This area will yield restoration credit as part of the overall forested system, but it is expected that a mix of emergent and forested conditions will result from the restoration approach. Due to the small area involved, current performance standards for this area will not be applicable.

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. 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.

A suitable reference wetland was found approximately 0.5 mile north of the TBWRS. The reference wetland is comprised of deciduous hardwoods over a shrub layer with broad-leaved evergreens and is consistent with the Hardwood Flats Community that will be the primary wetland type at the project site. A groundwater monitoring well has been installed to document the reference wetland hydrology during the course of monitoring.

1.4 Project History, Contacts and Attribute Data

The project was first identified as a full-delivery mitigation project developed for the North Carolina Ecosystem Enhancement Program (EEP) restoration by KCI Associates of NC, PA. This project began in the planning phase in 2011 with the final mitigation plan completed in October 2013. Construction began in January 2014. Site construction was completed in March 2014 and TBWRS was planted in late March 2014. Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4 (Appendix A).

2.0 SUCCESS CRITERIA

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.

2.1 Wetland Vegetation

The site must demonstrate the re-establishment of targeted vegetative community based on the survival and growth of planted species and volunteer colonization, with an average stem density of 320 stems/acre required after three years, 288 stems/acre after four years, 260 stems/acre after five years, and 210 stems/acre after 7 years. Permanent 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.

2.2 Wetland Hydrology

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

3.0 MONITORING PLAN

Annual monitoring will be conducted during the first full growing season following project completion. Monitoring of TBWRS efforts will be performed for vegetation and wetland hydrology components of the site until the success criteria are fulfilled. The establishment, collection, and summarization of monitoring data shall be conducted in accordance with the most current version of the EEP document entitled *Procedural Guidance and Content Requirements for EEP Monitoring Reports (version 1.5)*. Permanent monuments, marking monitoring feature locations, were established on-site in March/April 2014. The locations of these monitoring features are marked in Figure 3 (See Appendix A).

3.1 Wetland Hydrology

Sixteen groundwater monitoring gauges were set up and assessed for the baseline monitoring to evaluate the attainment of jurisdictional wetland hydrology. Verification of wetland hydrology will be determined by automatic recording well data collected within the project area and reference wetland. 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 following wetland construction. The nearby reference wetland will also be monitored using the same procedures for comparative analysis (See Figure 4 in Appendix A).

To monitor the effect of the unfilled ditch described in Section 1.3.2, four sets of coupled gauges were installed perpendicular to the unfilled ditch. Each set includes a well that is 40' from the open ditch and one 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 (See GA1-GA10 on Figure 3 in Appendix A).

3.2 Wetland Vegetation

Ten vegetation plots were set up and assessed for the baseline vegetation monitoring. The plots were installed with flagged metal conduit at each corner and a flagged PVC pipe was installed at the photo corner. Vegetation data collection must follow the CVS-EEP Protocol for Recording Vegetation (Lee et al. 2008). The baseline vegetation monitoring was conducted as Level 1: Inventory of Planted Stems, as will the first-year monitoring. Beginning in Year Two and continuing throughout the rest of the monitoring period, the TBWRS will be monitored using the Level 2 protocol. Baseline vegetation plot information can be found in Appendix B.

3.3 Digital Photos

Six photograph reference points (PRPs) with a total of eleven photos have been established as part of the baseline monitoring to assist in characterizing the TBWRS and to allow qualitative evaluation of the TBWRS conditions. Starting in the first monitoring year, these photos will be taken in late summer, so that vegetative conditions are similar between monitoring years.

3.4 Watershed Conditions

Yearly monitoring will document any evident changes in the watershed. Any large hydrologic events in the watershed, such as tropical storms or hurricanes, will also be documented in the yearly monitoring reports.

3.5 Monitoring Guidelines

The first scheduled monitoring will be conducted during the first full growing season following project completion. Monitoring shall subsequently be conducted annually for a total period of seven years or until the project meets its success criteria. Annual monitoring reports will be prepared and submitted after all monitoring tasks for each year are completed. The report will document the monitored components and include all collected data, analyses, and photographs. Each report will provide the new monitoring data and compare the most recent results against previous findings. The monitoring report format will be similar to that set out in the most recent EEP monitoring protocol.

3.6 Maintenance and Contingency

KCI will monitor the TBWRS on a regular basis and conduct a physical inspection of the site a minimum of once per year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance should be expected most often in the first two years following site construction and may include repairing constructed outlets and flow dispersment from seepage areas. Any maintenance activities will be documented in the yearly monitoring reports.

4.0 BASELINE CONDITIONS

Baseline monitoring data were collected in April 2014. The wetland was constructed as designed with only one modification made to the design plan during construction: below the restored ephemeral pond, the area was graded to disperse pond overflow throughout the wetland. Any changes made to the design during construction are documented in the As-Built Plan Sheets in Appendix C.

TBWRS was planted with a total of twelve different species of bare root trees in March 2014. Baseline vegetation monitoring data were collected in April 2014. The Level 1 CVS-EEP protocol was used to collect vegetation data. Plot photos from all the vegetation plots can be found in Appendix B.

The results of the vegetation baseline monitoring show an average of 1,052 stems per acre in the planted restoration area (Table 5, Appendix B). Additionally, stem counts within each individual plot were well-above the required 320 stems per acre. An attempt to identify all trees was made, but since monitoring was conducted while the trees were dormant, many were unidentifiable. All trees will be positively identified during the first year of monitoring.

5.0 REFERENCES

- Lee, Michael 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. 6/8/2012. Procedural Guidance and Content Requirements for EEP Monitoring Reports. NCEEP Monitoring Report Template, Version 1.5.
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- NCDENR, Ecosystem Enhancement Program. 2009. Cape Fear River Basin Restoration Priorities 2009. Raleigh, NC. Last accessed 10/2012 at:
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- 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
- NC Wetland Functional Assessment Team. 2010. NC Wetland Assessment Method (NC WAM) User Manual, version 4.1. Last accessed 11/2012 at: http://portal.ncdenr.org/c/document_library/get_file?uuid=76f3c58b-dab8-4960-ba43-45b7faf06f4c&groupId=38364

APPENDIX A

General Tables and Figures

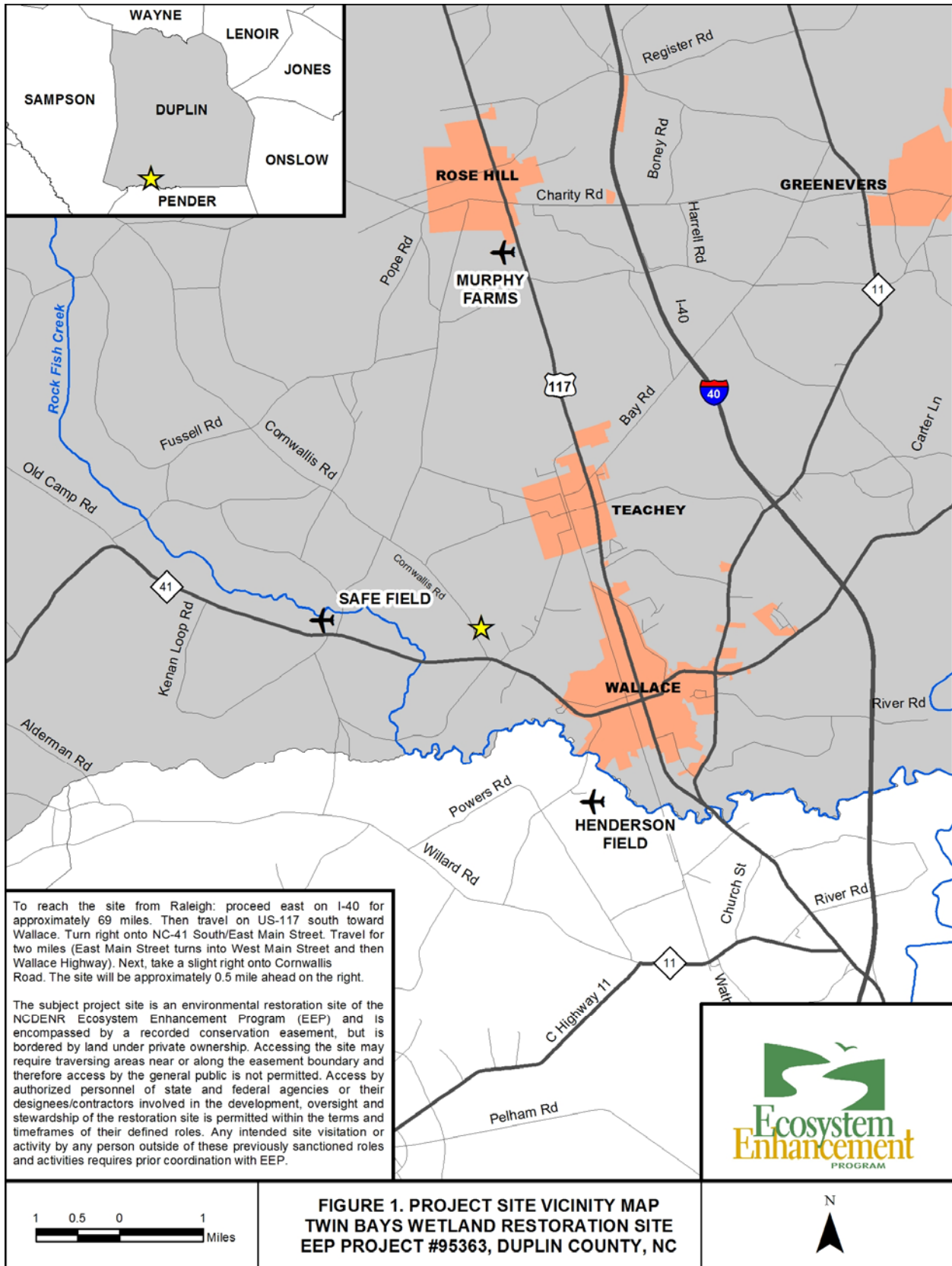




Table 1. Project Components and Mitigation Credits									
Twin Bays Wetland Restoration Site, EEP Project # 95363									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Acres					10.6	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

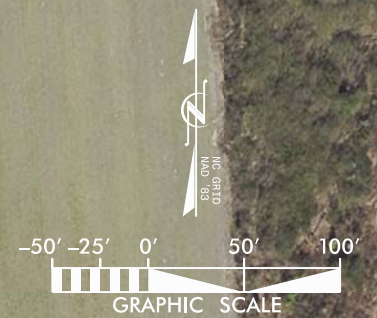
*Additional 0.2 acre is under the utility easement and not included in the determination of credits. There were no BMP elements included in this project.



LEGEND

- CONSERVATION EASEMENT
- VEGETATION PLOT (VP)
- ⊙ PHOTO POINT (PP)
- ⊙ GAUGE LOCATION (GA)

IMAGE SOURCE: NC 2010 ORTHOIMAGERY



SYL	DESCRIPTION	DATE



KCI
ASSOCIATES OF NC
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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

**TWIN BAYS
WETLAND RESTORATION SITE**
WALLACE, DUPLIN COUNTY, NORTH CAROLINA

DATE: JUNE 2014
SCALE: GRAPHIC

**MONITORING
PLAN VIEW**

SHEET 1 OF 1
FIGURE 3

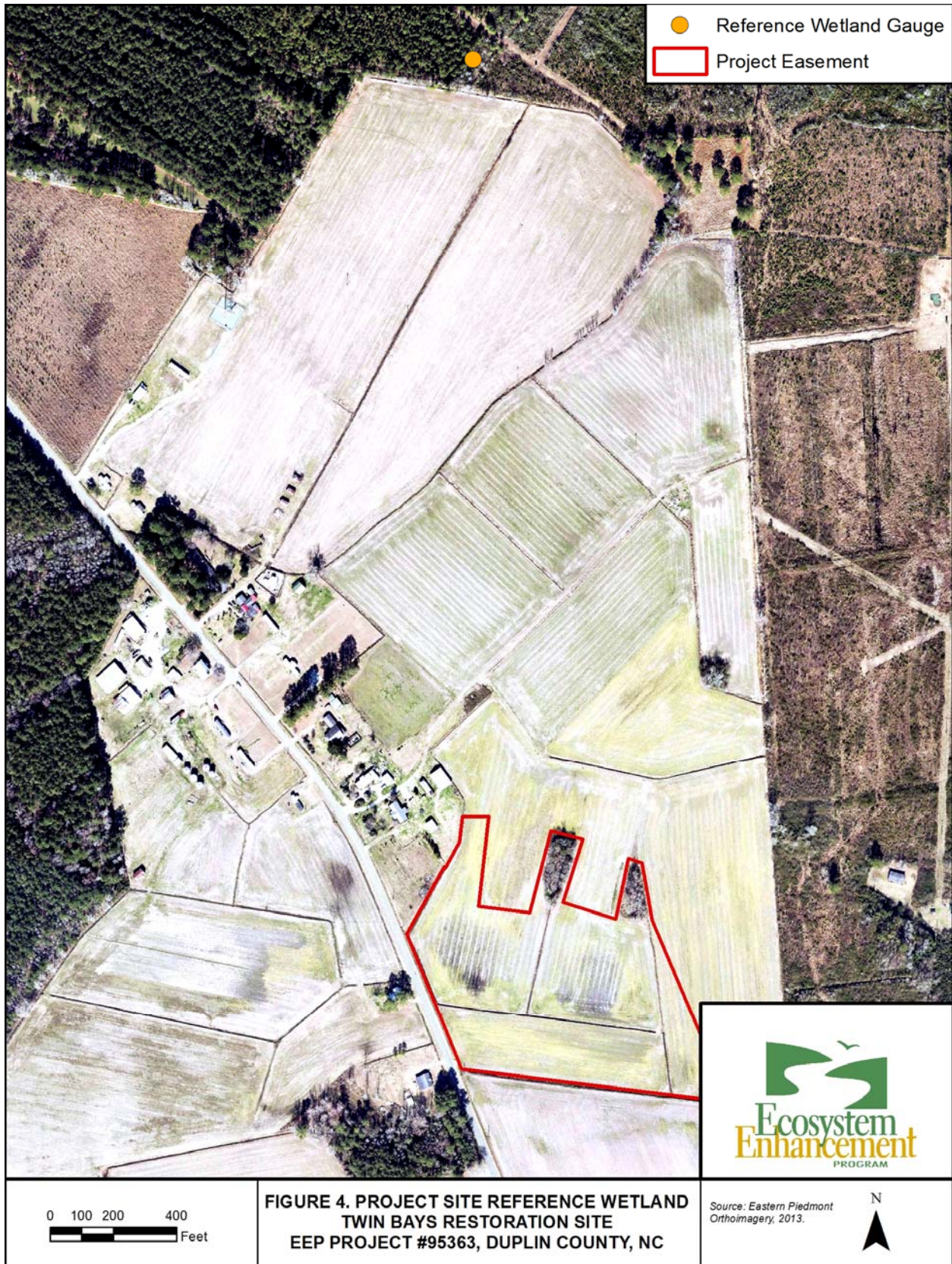


Table 2. Project Activity & Reporting History Twin Bays Wetland Restoration Site, EEP Project # 95363		
Activity or Report	Data Collection Complete	Actual Completion or Delivery
Mitigation Plan		Oct 13
Final Design - Construction Plans		Dec 13
Construction		Feb/March 14
Planting		March 14
Baseline Monitoring/Report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

Table 3. Project Contacts Twin Bays Wetland Restoration Site, EEP Project # 95363	
Design Firm	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
Construction Contractor	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
Planting Contractor	Forestree Management Co. 1280 Maudis Road Bailey, NC 27807 Contact: Mr. Tony Cortez Phone: (252) 243-2513
Monitoring Performers	
MY-00	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

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

APPENDIX B

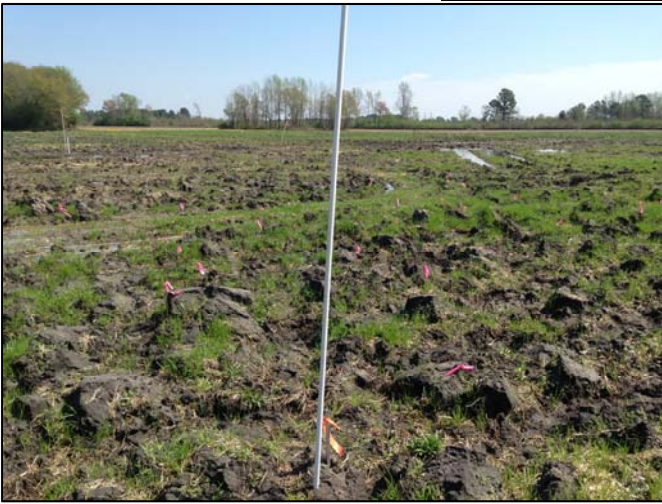
Baseline Data

Table 5. CVS Stem Count Total and Planted by Plot and Species

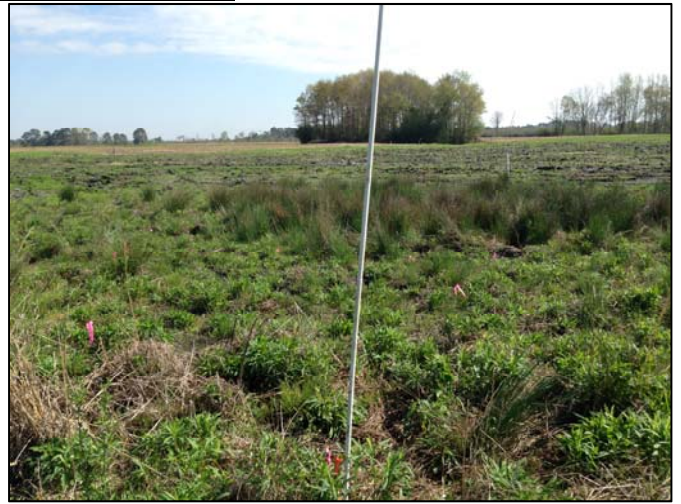
Twin Bays Wetland Restoration Site (EEP Project Code 95363)			Current Plot Data (MY00 2014)																										
Scientific Name	Common Name	Species Type	95363-01-0001			95363-01-0002			95363-01-0003			95363-01-0004			95363-01-0005			95363-01-0006			95363-01-0007			95363-01-0008			95363-01-0009		
			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
<i>Acer rubrum</i>	Red maple	Tree	2	2	2				1	1	1	1	1	1										1	1	1			
<i>Aronia arbutifolia</i>	Red chokeberry	Tree				6	6	6							3	3	3	1	1	1	1	1	1						
<i>Betula nigra</i>	River birch	Tree	5	5	5				1	1	1	5	5	5	6	6	6	13	13	13				1	1	1	5	5	5
<i>Fraxinus pennsylvanica</i>	Green ash	Tree				1	1	1				1	1	1							3	3	3						
<i>Liriodendron tulipifera</i>	Yellow poplar	Tree				3	3	3	7	7	7	1	1	1										4	4	4	3	3	3
<i>Magnolia virginiana</i>	Sweetbay magnolia	Tree													4	4	4	4	4	4	7	7	7	2	2	2			
<i>Quercus pagoda</i>	Cherry bark oak	Tree										8	8	8	2	2	2	2	2	2							4	4	4
<i>Taxodium distichum</i>	Bald cypress	Tree																											
<i>Ulmus americana</i>	American Elm	Tree																6	6	6				2	2	2			
Unknown		Shrub or Tree	16	16	16	11	11	11	6	6	6	10	10	10	3	3	3	14	14	14	14	14	14	12	12	12	13	13	13
<i>Vaccinium corymbosum</i>	Highbush blueberry	Shrub or Tree	5	5	5	4	4	4	4	4	4				3	3	3	2	2	2				1	1	1	2	2	2
Stem count			28	28	28	25	25	25	19	19	19	26	26	26	21	21	21	42	42	42	25	25	25	23	23	23	27	27	27
size (acres)			1			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	4	4	4	7	7	7	5	5	5
Stems per ACRE			1133	1133	1133	1012	1012	1012	769	769	769	1052	1052	1052	850	850	850	1700	1700	1700	1012	1012	1012	931	931	931	1093	1093	1093

Twin Bays Wetland Restoration Site (EEP Project Code 95363)			Current Plot Data (MY00 2014)			Annual Means		
Scientific Name	Common Name	Species Type	95363-01-0010			MY00 (2014)		
			PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer rubrum</i>	Red maple	Tree				5	5	5
<i>Aronia arbutifolia</i>	Red chokeberry	Tree				11	11	11
<i>Betula nigra</i>	River birch	Tree	11	11	11	47	47	47
<i>Fraxinus pennsylvanica</i>	Green ash	Tree				5	5	5
<i>Liriodendron tulipifera</i>	Yellow poplar	Tree				18	18	18
<i>Magnolia virginiana</i>	Sweetbay magnolia	Tree				17	17	17
<i>Quercus pagoda</i>	Cherry bark oak	Tree	6	6	6	22	22	22
<i>Taxodium distichum</i>	Bald cypress	Tree	1	1	1	1	1	1
<i>Ulmus americana</i>	American Elm	Tree				8	8	8
Unknown		Shrub or Tree	5	5	5	104	104	104
<i>Vaccinium corymbosum</i>	Highbush blueberry	Shrub or Tree	1	1	1	22	22	22
Stem count			24	24	24	260	260	260
size (acres)			1			10		
size (ACRES)			0.02			0.25		
Species count			5	5	5	11	11	11
Stems per ACRE			971	971	971	1052	1052	1052

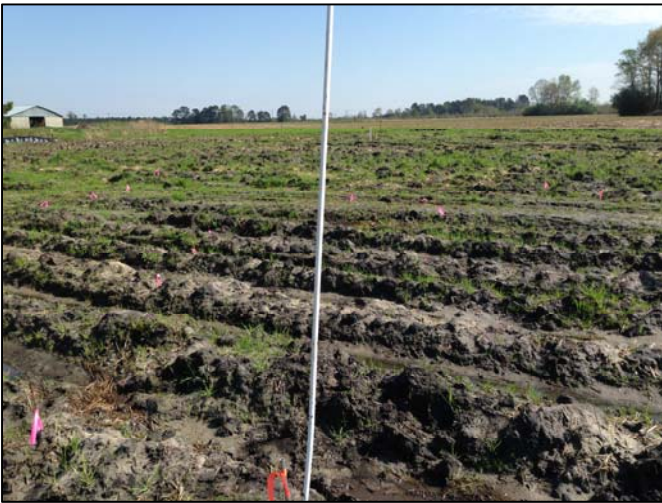
Vegetation Monitoring Plot Photos



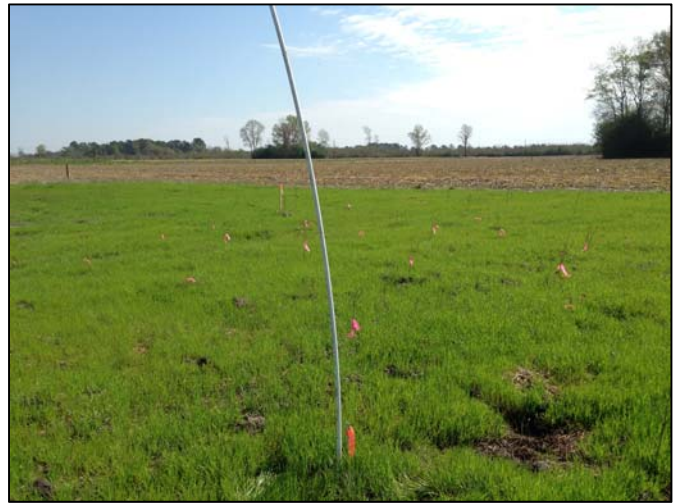
Vegetation Plot 1 – MY-00 – 4/9/14



Vegetation Plot 2 – MY-00 – 4/9/14



Vegetation Plot 3 – MY-00 – 4/9/14



Vegetation Plot 4 – MY-00 – 4/9/14



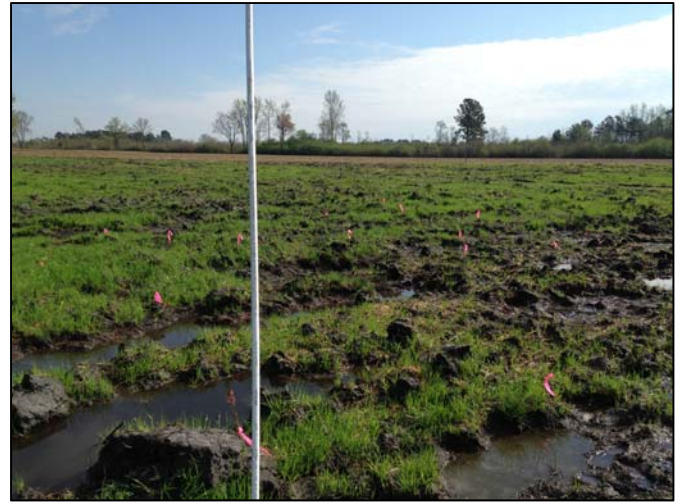
Vegetation Plot 5 – MY-00 – 4/9/14



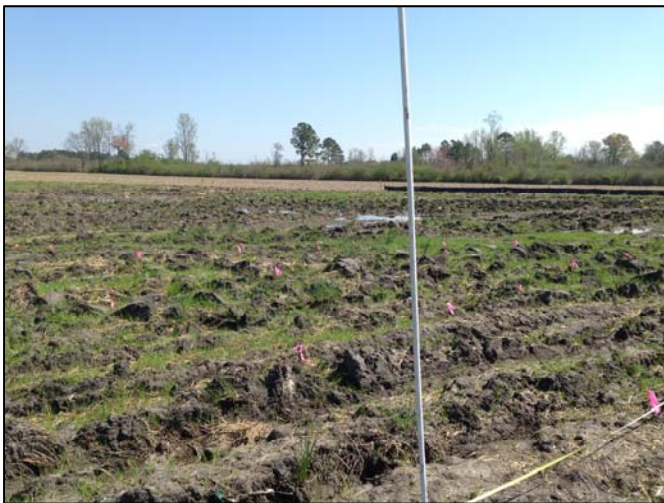
Vegetation Plot 6 – MY-00 – 4/9/14



Vegetation Plot 7 – MY-00 – 4/9/14



Vegetation Plot 8 – MY-00 – 4/9/14



Vegetation Plot 9 – MY-00 – 4/9/14



Vegetation Plot 10 – MY-00 – 4/9/14

Photo Reference Points



PP1a – MY-00 – 4/10/14



PP1b – MY-00 – 4/10/14



PP2a – MY-00 – 4/10/14



PP2b – MY-00 – 4/10/14



PP3 – MY-00 – 4/10/14



PP4a – MY-00 – 4/10/14



PP4b – MY-00 – 4/10/14



PP5a – MY-00 – 4/10/14



PP5b – MY-00 – 4/10/14



PP6a – MY-00 – 4/10/14



PP6b – MY-00 – 4/10/14

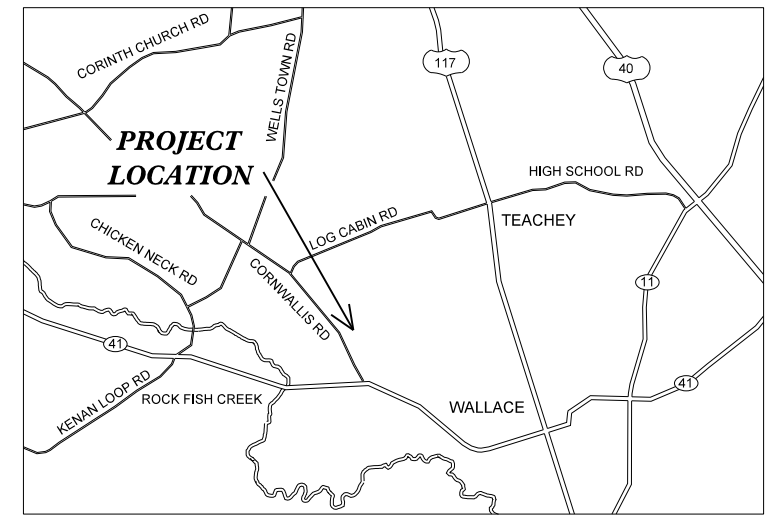
APPENDIX C

As-Built Plan Sheet

STATE	EEP PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	95363	1	3

NO.	DESCRIPTION	DATE

KCI JOB# : 20122265



VICINITY MAP
NOT TO SCALE

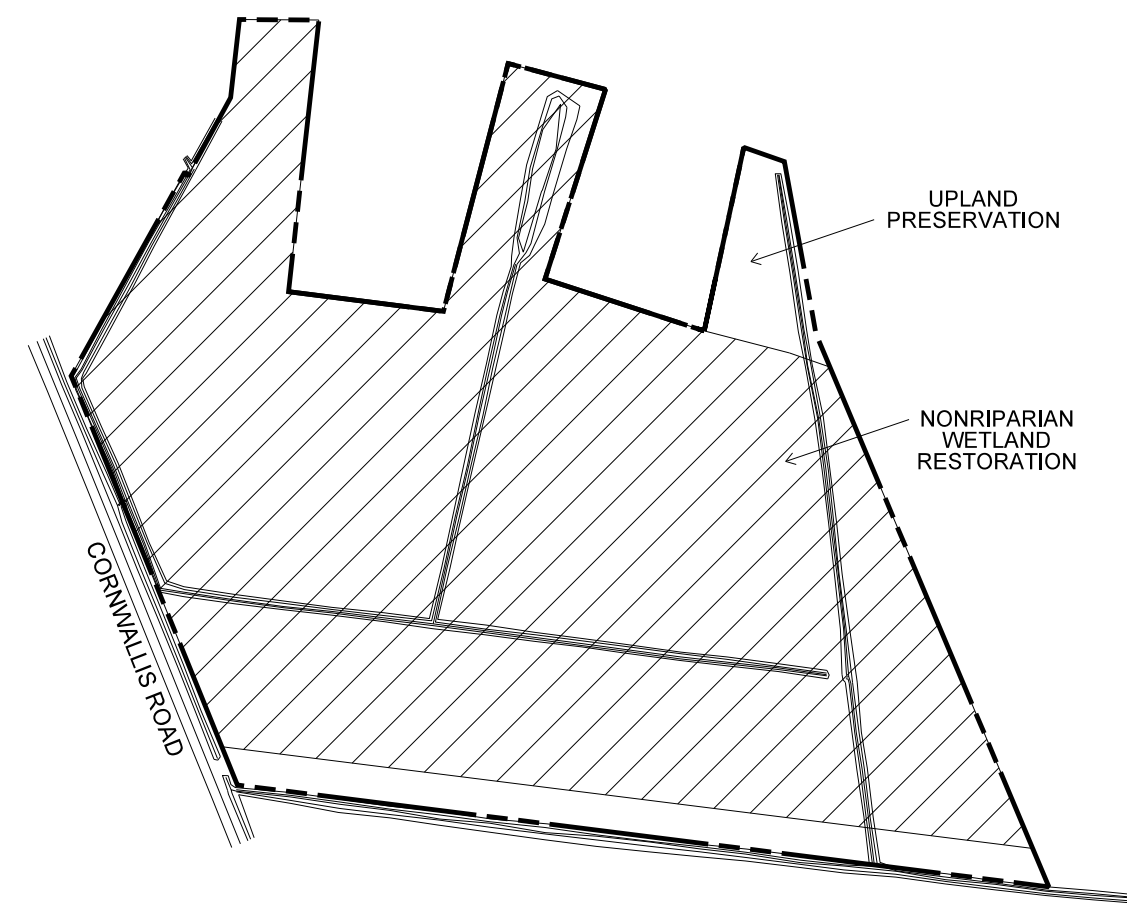
DIRECTIONS FROM RALEIGH:
PROCEED EAST ON I-40 FOR APPROXIMATELY 70 MILES. TAKE EXIT 369, US-117 S. TAKE A LEFT ONTO US-117 S. TRAVEL APPROXIMATELY 15 MILES AND THEN TAKE A RIGHT ONTO E MAIN ST IN WALLACE, NC. TRAVEL 2 MILES AND TURN RIGHT ONTO CORNWALLIS RD. THE SITE WILL BE ON THE RIGHT APPROXIMATELY 0.4 MILES AHEAD.

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TWIN BAYS
WETLAND RESTORATION SITE

DUPLIN COUNTY, NORTH CAROLINA
CAPE FEAR RIVER BASIN

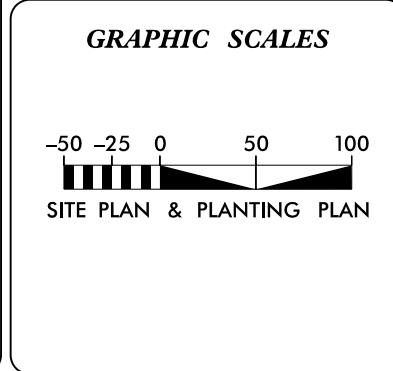
ROCK FISH CREEK WATERSHED
03030007090040



AS-BUILT PLAN

- INDEX OF SHEETS**
- 1 AS-BUILT: TITLE SHEET
 - 2 AS-BUILT: SITE PLAN
 - 3 AS-BUILT: PLANTING PLAN

CONTRACT #: 004739



PROJECT DATA

NONRIPARIAN WETLAND RESTORATION = 10.6 ACRES

UPLAND PRESERVATION = 0.4 ACRE

Prepared in the Office of:

KCI Associates
of North Carolina, P.A.
SUITE 220 LANDMARK CENTER II, 4601 SIX FORKS RD., RALEIGH, NC 27609
ENGINEERS • PLANNERS • ECOLOGISTS

GARY M. MRYNCZA, P.E.
PROJECT ENGINEER

JOE PFEIFFER
WETLAND DESIGN








PROJECT ENGINEER

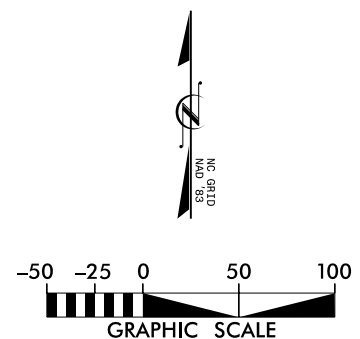
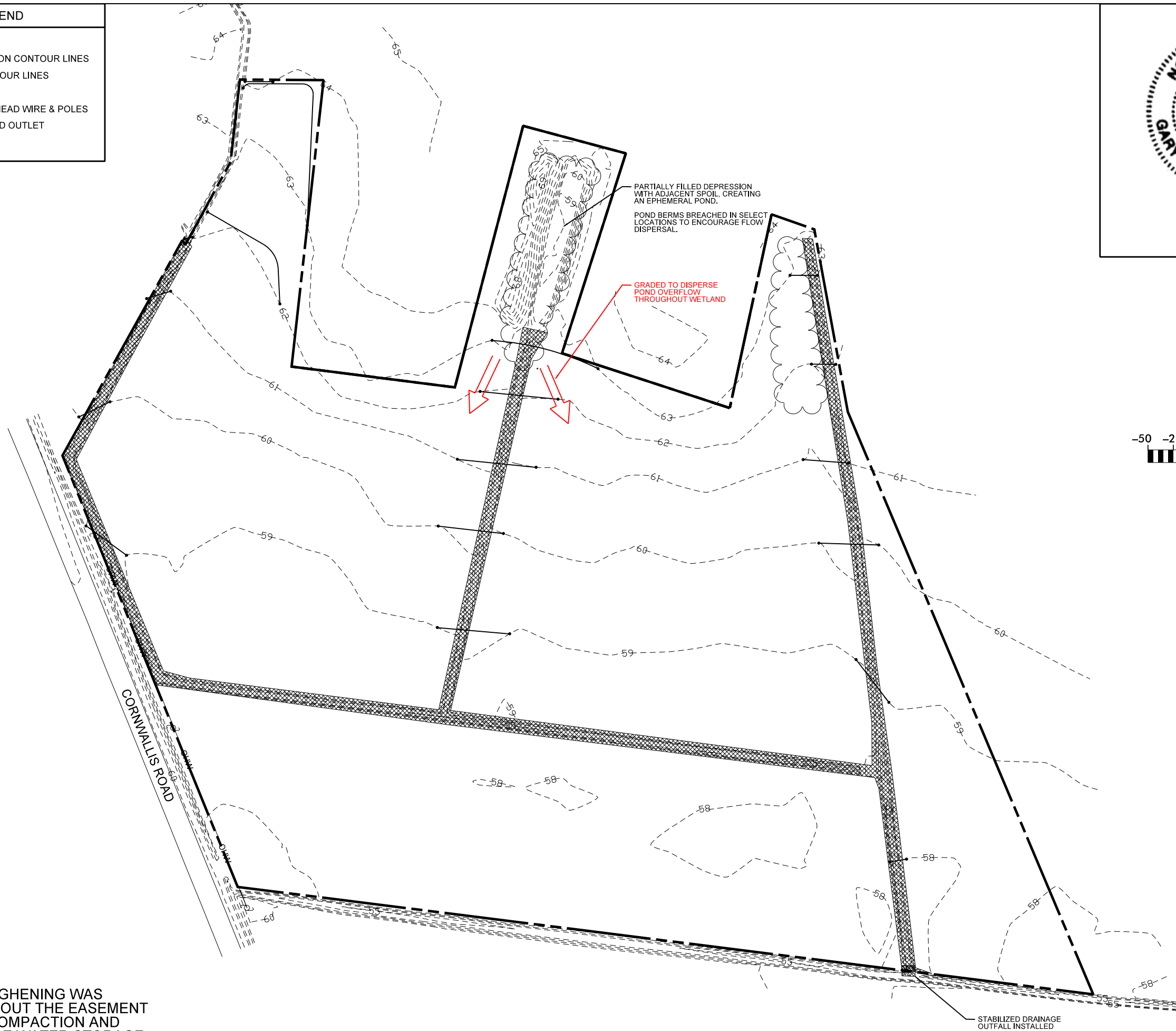
SIGNATURE: _____ P.E.

Prepared for:

JEFF JUREK
CONTRACT ADMINISTRATOR

SITE PLAN LEGEND

-  EASEMENT LINE
-  PRE-RESTORATION CONTOUR LINES
-  DESIGNED CONTOUR LINES
-  TREE LINE
-  EXISTING OVERHEAD WIRE & POLES
-  ROCK STABILIZED OUTLET
-  FILLED DITCH



NOTE: SURFACE ROUGHENING WAS INSTALLED THROUGHOUT THE EASEMENT TO ALLEVIATE SOIL COMPACTION AND TO ENHANCE SURFACE WATER STORAGE.

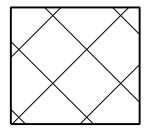
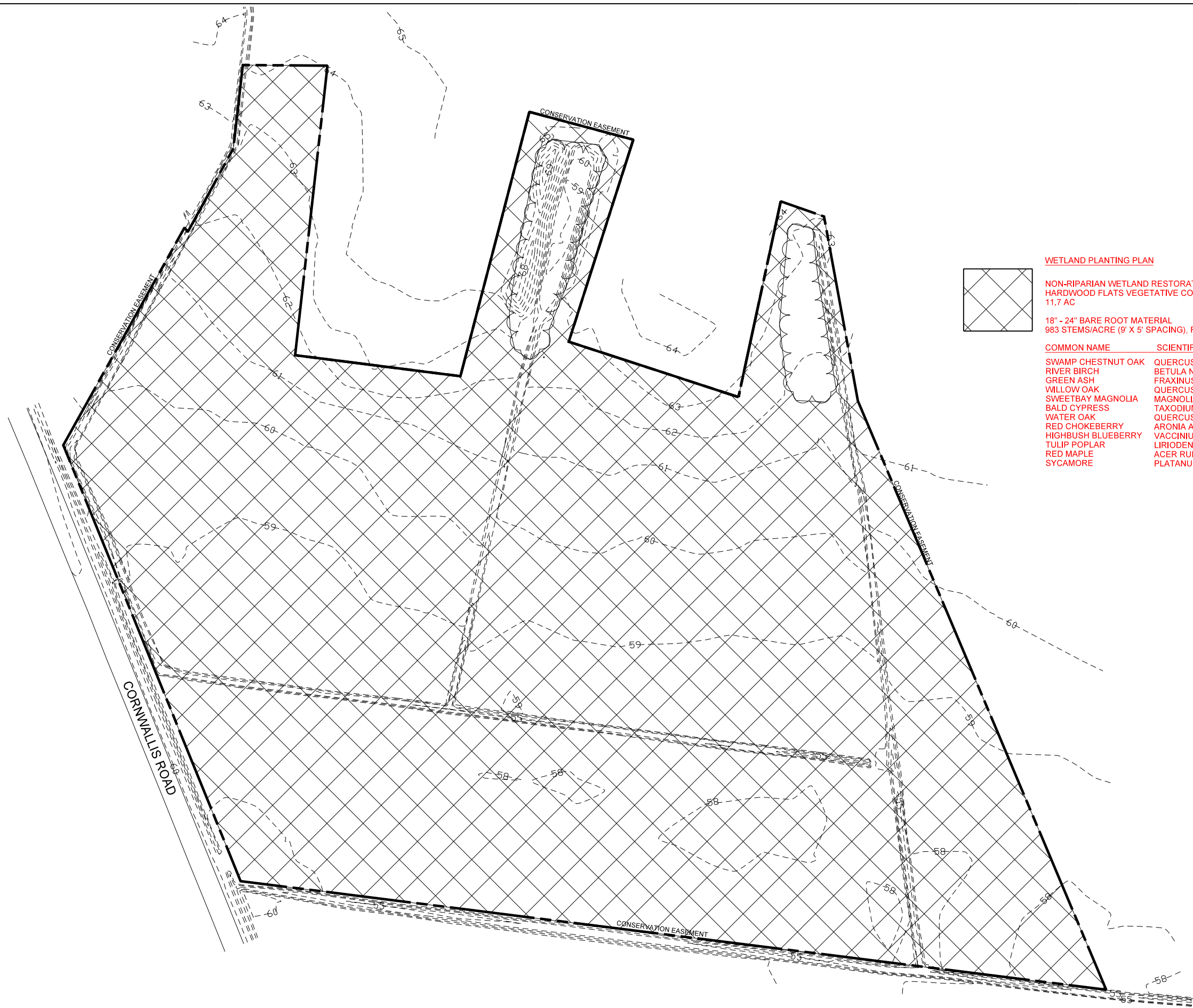
NO.	SYMBOL	DESCRIPTION	REVISIONS



KCI
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ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD, SUITE 220
RALEIGH, NORTH CAROLINA 27609

TWIN BAYS
WETLAND RESTORATION SITE
WALLACE, DUPLIN COUNTY, NORTH CAROLINA

DATE: APRIL 2014
SCALE: GRAPHIC
AS-BUILT: SITE PLAN
SHEET 2 OF 3

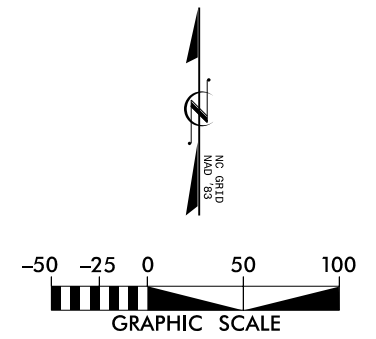


WETLAND PLANTING PLAN

NON-RIPARIAN WETLAND RESTORATION
HARDWOOD FLATS VEGETATIVE COMMUNITY
11.7 AC

18" - 24" BARE ROOT MATERIAL
983 STEMS/ACRE (9' X 5' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	WETLAND INDICATOR	% OF TOTAL	# OF PLANTS
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	FACW	16	1800
RIVER BIRCH	BETULA NIGRA	FACW	16	1800
GREEN ASH	FRAXINUS PENNSYLVANICA	FACW	11	1300
WILLOW OAK	QUERCUS PHELLOS	FACW	11	1300
SWEETBAY MAGNOLIA	MAGNOLIA VIRGINIANA	FACW	9	1000
BALD CYPRESS	TAXODIUM DISTICHUM	OBL	9	1000
WATER OAK	QUERCUS NIGRA	FAC	9	1000
RED CHOKEBERRY	ARONIA ARBUTIFOLIA	FACW	4	500
HIGHBUSH BLUEBERRY	VACCINIUM CORYMBOSUM	FACW	4	500
TULIP POPLAR	LIRIODENDRON TULIPIFERA	FACW	4	500
RED MAPLE	ACER RUBRUM	FACW	3	400
SYCAMORE	PLATANUS OCCIDENTALIS	FACW	3	400
			100	11,500



NO.	SYMBOL	DESCRIPTION	REVISIONS



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TWIN BAYS
WETLAND RESTORATION SITE
WALLACE, DUPLIN COUNTY, NORTH CAROLINA

DATE: APRIL 2014
SCALE: GRAPHIC
AS-BUILT:
PLANTING
PLAN
SHEET 3 OF 3