Baseline Monitoring Document and As Built Baseline Report

FINAL

Jacob's Landing Stream Restoration Site
Rowan County, North Carolina
EEP Contract 003984
EEP Project Number 95024

Submitted to:

Ecosystem Enhancement PROGRAM

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

Monitoring Data Collected: February 2014
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Monitoring and Design Firm

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September 2014

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EXECUTIVE SUMMARY

The Jacob's Landing Stream Restoration Site, completed in November 2013, restored 4,484 linear feet and implemented 109 linear feet of enhancement on four tributaries to Irish Buffalo Creek in the Yadkin-Pee Dee River Basin. The completed project will return these tributaries to a stable stream ecosystem, lower the sediment supply entering Irish Buffalo Creek, and reduce incoming nutrients from livestock. This project also looks to expand aquatic and terrestrial habitat in the Rocky River Watershed (03040105). The project is located in the Irish Buffalo Creek Drainage (03040105020040), which the EEP has identified as a Targeted Local Watershed (TLW).

The site's 0.72-square mile watershed is mostly pasture and mixed hardwoods with small pockets of rural residential development. Prior to construction the site was actively used for timber and cattle production for over five generations. The project streams had been degraded primarily through a long history of logging, grazing, and channelization.

The project streams consist of four tributaries to Irish Buffalo Creek: Tributary 1 (T1), Tributary 1A (T1A), Tributary 2 (T2), and Tributary T2A (T2A). The pre-existing T1 began with isolated bank erosion and thick invasive vegetation (primarily Chinese privet) on the banks. Downstream, T1 entered a more heavily wooded section with a steeper slope along the left bank before flowing through a pasture as it reached the southern project boundary. The stream had been straightened and consequently lacked the appropriate stream planform. The riparian zone had sparse to no vegetation with actively widening and eroding banks. The pre-existing T1A channel was overly sinuous with eroding banks that joined T1 near the top of the Site. T2 began as a low width-to-depth ratio channel with high vertical banks. The eroding slopes within the valley contributed additional sediment to the system, which resulted in unstable bed morphology. Shortly after the confluence of T2A, the cattle had severely impacted the channel, leaving no riparian vegetation and actively eroding banks. T2A began as a deeply entrenched channel with vertical valley walls. The riparian vegetation had been removed, which allowed the steep banks to erode and obscured the riffle and pool features in the tributary.

The project goals and objectives are listed below.

Project Goals

- Restore a diverse riparian corridor that connects forested stream systems upstream and downstream of the project.
- Reduce the sediment supply entering Irish Buffalo Creek.

Project Objectives

- Restore stable channel planforms to streams that have been straightened and modified.
- Reshape and stabilize eroding stream banks.
- Plant the site with native trees to help reestablish a diverse riparian corridor.
- Install exclusion fencing and alternative watering options to keep livestock out of the project streams.

Project construction was completed in November 2013. The project restored 4,484 linear feet of stream and implemented 109 linear feet of Enhancement II. The overall approach to the design of Jacob's Landing Stream Restoration Site was a combination of Priority 1 and 2 approaches, with Priority 2 being used in more constrained areas and Priority 1 employed where the streams could be brought back up to connect with the floodplain. The streams at Jacob's Landing Stream Restoration Site were restored to C4 and B4c/C4 Rosgen stream types. In addition to the channel work, there were three water quality structures and multiple areas of slope stabilization outside of the easement that were completed as a part of the project to reduce sediment inputs from the surrounding property. The riparian buffer was planted to achieve Piedmont Alluvial Forest and Mesic Mixed Hardwood Forest Communities (Schafale and Weakley 1990). Site activities provide 4,528 Stream Mitigation Units. The site is protected by a permanent conservation easement to be held by the State of North Carolina.

Limited modifications were made to the design plan during construction. Two step pools were removed and five boulder step pools were replaced with log step pools on T2A. Due to the extra structures and additional work required to define the pattern on T2A, the mitigation type has been changed from Enhancement I as described in the mitigation plan to restoration. For photos of restored T2A, see Photo Point 8 in Appendix B. On T2, one additional log drop was installed near STA 65+00.

The monitoring components were installed in February/March 2014. The monitoring plan includes two longitudinal profiles (approximately 1,500 linear feet each along T1 and T2), eleven cross-sections, eight in riffles and three in pools. Ten permanent photo reference points have been established with a total of twenty-two photos to be taken annually. To determine the success of the planted buffer, thirteen permanent vegetation monitoring plots were established according to the CVS-EEP protocol. The site will be monitored for at least five 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 riparian buffer must meet the success criteria of a site average of 320 planted stems/acre at the end of the monitoring period based on the vegetation monitoring plots. The baseline monitoring counted an average of 766 stems/acre in the 13 stream vegetation monitoring plots. Stream success will be assessed utilizing measurements of stream dimension, pattern, and profile as well as through site photographs. Two bankfull events also must occur on the restored streams over the monitoring period in separate monitoring years.

1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

1.1 Location and Setting

The North Carolina Ecosystem Enhancement Program (NCEEP) has completed restoration and enhancement of 4,593 linear feet of stream at the Jacob's Landing Stream Restoration Site (hereafter referred to as the "Site") to assist in fulfilling stream mitigation goals in the area. The Site is located west of China Grove and north of Kannapolis off of Saw Road (see Figure 1, Appendix A). The Site is within the 03040105 Rocky River Watershed Cataloging Unit (8-digit HUC) and the 03040105020040 Irish Buffalo Creek Local Watershed Unit (14-digit HUC). In the North Carolina Ecosystem Enhancement Program's (EEP) most recent publication of excluded and Targeted Local Watersheds/Hydrologic Units, the 03040105020040 14-digit HUC has been identified as a Targeted Local Watershed. The Site is located in the Piedmont Physiographic Province and the project streams initiate as headwater systems out of moderately-sloped, forested hills. The site's 0.72-square mile project watershed is comprised predominantly of pasture and mixed hardwoods, with small pockets of rural residential development. Prior to construction, the site was actively used for timber and cattle production for over five generations.

1.2 Project Goals and Objectives

The project goals and objectives are listed below.

Project Goals

- Restore a diverse riparian corridor that connects forested stream systems upstream and downstream of the project.
- Reduce the sediment supply entering Irish Buffalo Creek.

Project Objectives

- Restore stable channel planforms to streams that have been straightened and modified.
- Reshape and stabilize eroding stream banks.
- Plant the site with native trees to help reestablish a diverse riparian corridor.
- Install exclusion fencing and alternative watering options to keep livestock out of the project streams.

1.3 Project Structure, Restoration Type and Approach

1.3.1 Project Structure

The Site consists of four tributaries to Irish Buffalo Creek: Tributary 1 (T1), Tributary 1A (T1A), Tributary 2 (T2), and Tributary T2A (T2A). The project restored 4,484 linear feet of stream and also included 109 linear feet of Enhancement II. The tributaries make up the four project reaches at the site. T1 was restored along its entire length expect for a 109 linear foot section of Enhancement II. T1A, T2, and T2A were all restored (see Figure 2 in Appendix A for an overview of the site layout).

The project's mitigation activities will provide 4,528 Stream Mitigation Units (Table 1, Appendix A). Planting occurred within 12.83 acres of the 13.9-acre conservation easement including stream banks and floodplain. Target natural communities consist of Piedmont Alluvial Forest for the riparian areas along T1, T1A, and T2, and Mesic Mixed Hardwood Forest along T2A (Schafale and Weakley 1990).

1.3.2 Project Restoration Type and Approach

Prior to construction, the project streams had become degraded through a long history of logging, grazing, and channelization. The pre-restoration conditions of the streams showed evidence of bank erosion and undercutting along with channelization in portions of each reach and channel incisions as indicated by bank height ratios ranging from 1.6 to 6.3.

The overall approach to the design of Jacob's Landing Stream Restoration Site was a combination of Priority 1 and 2 approaches, with Priority 2 being used in more constrained areas and Priority 1 employed where the streams could be brought back up to connect with the floodplain. All of the streams at Jacob's Landing Stream Restoration Site were restored to C4 and B4c/C4 Rosgen stream types. The pre-existing T1 began with isolated bank erosion and thick invasive vegetation (primarily Chinese privet) on the banks. Downstream, T1 entered a more heavily wooded section with a steeper slope along the left bank before flowing through a pasture as it reached the southern project boundary. The stream had been straightened and lacked the appropriate stream planform. The riparian zone had sparse to no vegetation with actively widening and eroding banks. The heavily wooded section of T1 was designed and implemented as Enhancement II, but the rest of T1 was restored using mostly a Priority 2 approach. The pre-existing T1A channel was overly sinuous with eroding banks that joined T1 near the top of the Site, and the entire reach was restored. T2 began as a low width-to-depth ratio channel with high vertical banks. The eroding slopes within the valley contributed additional sediment to the system, which resulted in unstable bed morphology. Shortly after the confluence of T2A, the cattle had severely impacted the channel, leaving no riparian vegetation and actively eroding banks. The entire length of T2 was restored with mainly a Priority 2 approach. T2A began as a deeply entrenched channel with vertical valley walls. The riparian vegetation had been removed, which allowed the steep banks to erode and obscured the riffle and pool features in the tributary. While originally designed as an Enhancement I reach, T2A was constructed as restoration due to the extra structures and additional work required to define the pattern on T2A. Two step pools were removed and five boulder step pools were replaced with log step pools instead. In addition to the channel work, there were three water quality structures and multiple areas of slope stabilization outside of the easement that were completed as a part of the project to reduce sediment inputs from the surrounding property.

1.4 Project History, Contacts and Attribute and 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 September 2012. Construction began in early 2013. The project construction was completed in November 2013 and the Site was planted in January 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

2.1 Morphologic Parameters and Channel Stability

Monitoring of the Site shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data to support the evaluation of the project in meeting established restoration objectives. Specifically, project success will be assessed utilizing measurements of stream dimension and profile, site photographs, and vegetation sampling.

The purpose of monitoring is to evaluate the stability of the restored stream. Following the procedures established in the USDA Forest Service Manual, *Stream Channel Reference Sites* (Harrelson *et al*. 1994) and the methodologies utilized in the Rosgen stream assessment and classification system (Rosgen D.L. 1994 and 1996), data collected will consist of detailed dimension measurements, longitudinal profiles, and bed materials sampling.

2.1.1 Dimension

The cross-section surveys shall provide a detailed measurement of the stream and banks and will include points on the adjacent floodplain or valley, at the top of bank, bankfull, at all breaks in slope, the edge of water, and thalweg. Width/depth and entrenchment ratios will be calculated for each cross-section based on the survey data. Cross-section measurements should show little or no change from the as-built cross-sections. However, some change is natural and expected, indicating that the site is settling post-construction. Changes that may indicate destabilizing conditions include significant widening or deepening of the riffle section or a consistent trend of change over the course of the monitoring. For a pool cross-section, deepening is frequently a positive change while consistent filling of the pool may indicate destabilization. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increased stability or whether they indicate movement toward an unstable condition.

2.1.2 Pattern and Profile

For the profile, the reach under assessment should not demonstrate any trends in thalweg aggradation or degradation over any significant continuous portion of its length. The profile should also demonstrate contrasting bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so around design distributions. The majority of pools should be maintained at greater depths with lower water surface slopes while riffles should be shallow with greater water surface slopes. Pattern features should show little adjustment over the monitoring period

2.1.3 Substrate

Substrate measurements, from annual pebble count data, should indicate the progression towards, or the maintenance of, the anticipated distributions from the design phase. While stream projects are designed to transport bedload in equilibrium and carry overall sediment loads at bankfull, fines can be transported even at low discharges and upstream instability beyond design projections can also lead to deposition as storm events recede in areas of energy dissipation such as restoration reaches. This can have the effect of obscuring bedform and fining of riffles especially in the first few years after the implementation of a stream project. In many cases subsequent narrowing and reduction of width/depth ratios as a project develops/stabilizes can then increase transport efficiency and return bedform to intended distributions, but some fining can persist due to upstream disturbance.

2.1.4 Sediment Transport

Maintenance of sediment transport will be evident by stable features in the monitored cross-sections and profile. From these two indicators, there should be no evidence of any significant trend in aggradation or degradation throughout the channel.

2.2 Vegetation

Vegetation success is based on the criteria established in the USACE Stream Mitigation Guidelines (2003). This document states that vegetation monitoring results indicate the following planted stem density minimums in the corresponding monitoring years: 320 stems/acre through Year Three, 288 stems/acre in Year Four, and 260 stems/acre in Year Five. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will be developed to include invasive species control, the removal of dead/dying plants, and replanting.

2.3 Hydrology

Success criteria include documentation of a minimum of two bankfull events during the monitoring period. In addition, bankfull events must occur during separate monitoring years.

3.0 MONITORING PLAN

Annual monitoring will be conducted during the first full growing season following project completion. Monitoring of the Site restoration efforts will be performed for stream, vegetation, and hydrology components of the Site until 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)* (NCEEP 2012). Permanent monuments, marking monitoring feature locations, were established on-site in February 2014. The locations of these monitoring features are marked in Figure 3 in Appendix A.

3.1 Stream Hydrology

Two automatic recording gauges have been installed along T1 and T2 to record water levels indicating when bankfull events occur.

3.2 Stream Channel Stability and Geomorphology

Data to be collected consists of detailed dimension and pattern measurements, longitudinal profiles, and bed materials sampling. Stream data will be calculated from the monitored longitudinal profiles and cross-sections (Appendix B). Various morphological parameters will be calculated from this information such as bankfull slopes, pool-to-pool spacing, and feature lengths

3.2.1 Dimension

Eleven total permanent monitoring cross-sections have been established on the Site. Six riffle cross-sections and four pool cross-sections have been installed on the tributaries; locations are depicted on Figure 2 (Appendix A). Permanent monuments of rebar have been established at each end of these cross-sections. These cross-sections will be surveyed each year, with measurements occurring at bankfull, top of bank, edge of water, and other significant breaks in slope. Data will be used to calculate width-depth ratios, entrenchment ratios, and bank height ratios for each cross-section. Photographs will also be taken at each permanent cross-section annually.

3.2.2 Profile

Two longitudinal profiles have been established on T1 and T2 for a total of approximately 3,000 linear feet. These profiles will be used to evaluate stream pattern and longitudinal profile each monitoring year (see Figure 3, Appendix A for locations). The profile will be surveyed in detail, documenting the elevations of the thalweg, water surface, and bankfull. Pool and riffle features will be called out to calculate feature slopes and lengths.

3.2.3 Pattern

Pattern measurements have been taken for the as-built condition and are documented in this report. Future pattern measurements will not be taken unless there is evidence that significant geomorphological adjustments have occurred.

3.2.4 Visual Assessment

A visual assessment of the stream to include an assessment of the bank (lateral stability), bed (vertical stability), the easement boundary, and site vegetation will be completed each year to document the necessary parameters required for the EEP monitoring report.

3.2.5 Vegetation

Thirteen 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, http://cvs.bio.unc.edu/methods.htm). 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 site will be monitored using the Level 2 protocol. Baseline vegetation plot information can be found in Appendix C.

3.2.6 Digital Photos

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

3.2.7 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.

3.3 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 five 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.

3.4 Maintenance and Contingency

KCI will monitor the site 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 reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to in-stream structures. Any maintenance activities will be documented in the yearly monitoring reports.

4.0 BASELINE CONDITIONS

Baseline stream monitoring data were collected in February 2014. Any changes made to the design during construction are shown on the As-Built Site Plan in Appendix D. Limited modifications were made to the design plan during construction. Two step pools were removed and five boulder step pools were replaced with log step pools on T2A. Due to the extra structures and additional work required to define the pattern on T2A, the mitigation type has been changed from Enhancement I as described in the mitigation plan to restoration. For photos of restored T2A, see Photo Point 8 on page in Appendix B. On T2, one additional log drop was installed near STA 65+00. In addition to the channel work, there were multiple areas of slope stabilization outside of the easement that were completed as a part of the project to reduce sediment inputs from the surrounding property.

Table 5 compares the designed morphological values and ratios to the as-built values and ratios of the restored streams (Appendix B). Overall, the Site was built as designed. The differences between the designed and as-built channels are minor. T1A and T2A are being monitored visually, and as a result, there are no as-built data included for these two reaches in Table 5.

The site was planted with a total of nine different species of bare root trees in January 2014. Baseline monitoring data were collected in February 2014. The Level 1 CVS-EEP protocol (http://cvs.bio.unc.edu/methods.htm) was used to collect vegetation data. Plot photos from all the vegetation plots can be found in Appendix C.

The results of the baseline monitoring show an average of 766 stems per acre in the planted stream zone (Table 7. Appendix C). 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

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APPENDIX A

General Tables and Figures

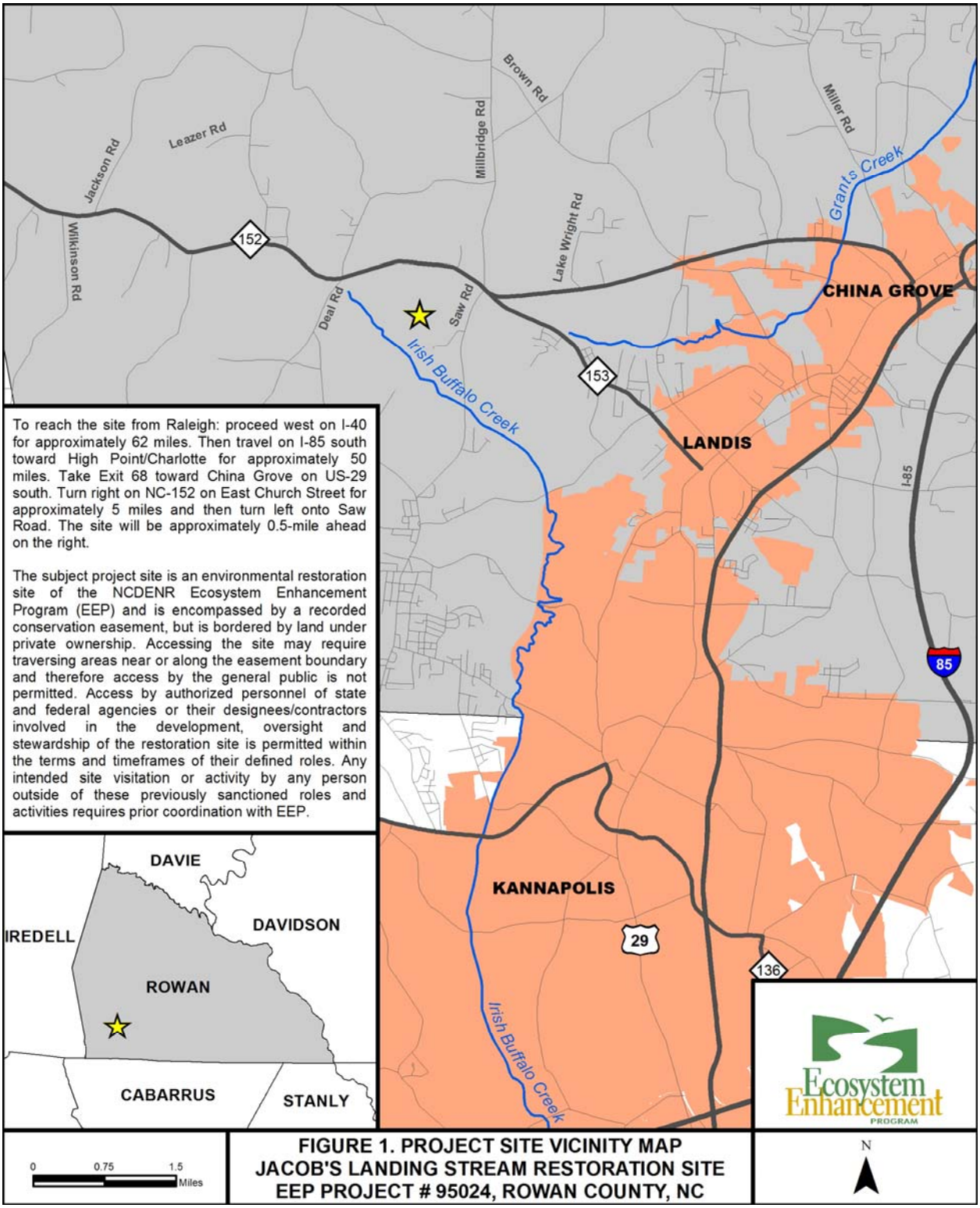


FIGURE 1. PROJECT SITE VICINITY MAP
JACOB'S LANDING STREAM RESTORATION SITE
EEP PROJECT # 95024, ROWAN COUNTY, NC

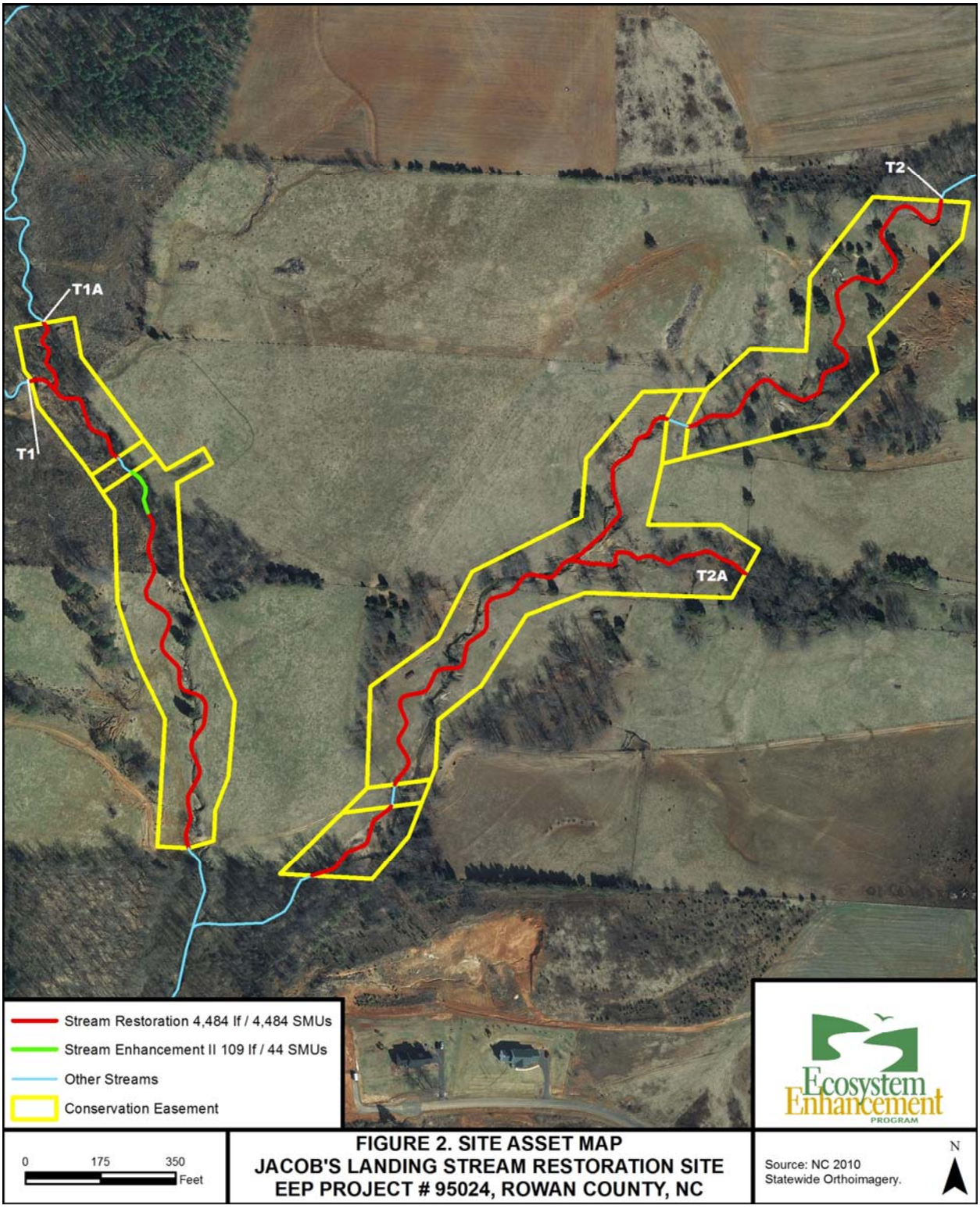

T1A
T1
T2
T2A
Stream Restoration 4,484 lf / 4,484 SMUs
Stream Enhancement II 109 lf / 44 SMUs
Other Streams
Conservation Easement
Ecosystem Enhancement PROGRAM
0 175 350 Feet
FIGURE 2. SITE ASSET MAP
JACOB'S LANDING STREAM RESTORATION SITE
EEP PROJECT # 95024, ROWAN COUNTY, NC
Source: NC 2010 Statewide Orthoimagery.
N

Table 1. Project Components and Mitigation Credits
Jacob's Landing Stream Restoration Site / EEP Project # 95024

Mitigation Credits

	Stream		Riparian Wetland	Non-riparian Wetland	Buffer	Nitrogen Nutrient Offset
Type	R	EII				
Length	4,484	109				
Credits	4,484	44				
TOTAL CREDITS	4,528					

Project Components

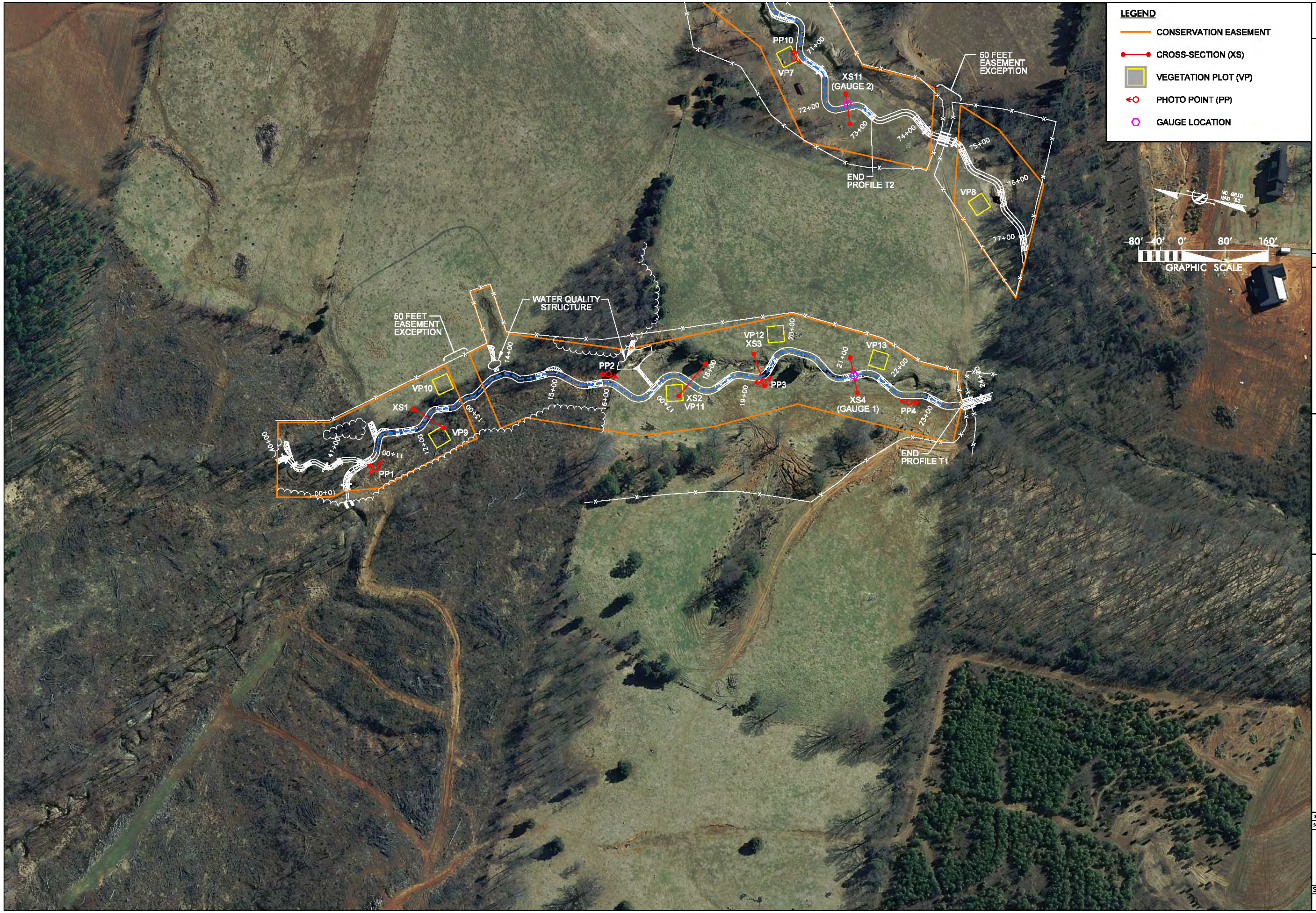
Project Component -or- Reach ID	Design Stationing/ Location	Existing Footage	Approach (PI, PII etc.)	Restoration -or- Restoration Equivalent	Restoration Footage	Mitigation Ratio
T1	10+00 – 13+03	326	P2	Restoration	303	1:1
T1	13+52 – 14+61	158	-	Enhancement II	109*	1:2.5
T1	14+61 – 23+54	846	P2	Restoration	893	1:1
T1A	40+00 – 41+78	294	P2	Restoration	178	1:1
T2	50+00 – 77+45	2,935	P2	Restoration	2,645*	1:1
T2A	100+00 – 104+65	465	P2	Restoration	465	1:1

Component Summation

Restoration Level	Stream (linear feet)	Mitigation Units (SMU)
Total Restoration	4,484	4,484
Total Enhancement II	109	44
TOTAL SMU		**4,528**

*Mitigation units have been calculated to exclude the easement exceptions and water utility easements.

Though not formal BMPs, several small water quality detention structures were installed throughout the project to improve water quality from the surrounding drainage area.



REVISIONS

STAL	DESCRIPTION	DATE
		SEPT 2012

Ecosystem Enhancement Program

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

JACOB'S LANDING
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA
REACH T1

DATE: FEB 2014
SCALE: GRAPHIC

MONITORING
PLAN VIEW

SHEET 1 OF 2
FIGURE 3

REVISIONS

DESCRIPTION	DATE	STAL
	SEPT 2012	

Ecosystem Enhancement Program

KCI
ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
460 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

JACOB'S LANDING STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2

DATE: FEB 2014

SCALE: GRAPHIC

MONITORING PLAN VIEW

SHEET 2 OF 2

FIGURE 3

Table 2. Project Activity & Reporting History Jacob's Landing Stream Restoration Site		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Mitigation Plan		Sept 12
Final Design - Construction Plans		Dec 12
Construction		Nov 13
Planting		Jan 14
Baseline Monitoring/Report	Feb/March 14	April 14

Table 3. Project Contacts Jacob's Landing Stream Restoration Site	
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	Wright Contracting, LLC 160 Walker Road Lawndale, NC 28090 Contact: Mr. Stephen James Phone: (704) 692-4633
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 **Jacob's Landing Stream Restoration Site**				
Project Name	Jacob's Landing Stream Restoration Site			
County	Rowan County			
Project Area (acres)	13.9 acres			
Project Coordinates (lat. and long.)	35.552956 N, 80.653116 W			
Project Watershed Summary Information				
Physiographic Province	Piedmont			
River Basin	Yadkin-Pee Dee			
USGS Hydrologic Unit 8-digit	03040105	USGS Hydrologic Unit 14-digit	03040105020040	
DWQ Sub-basin	13-17-09			
Project Drainage Area	459 acres/0.72 square miles			
Project Drainage Area Percentage of Impervious Area	2.3% / 6 acres			
CGIA Land Use Classification	4.8% Cultivated, 60.1% Managed Herbaceous Cover, and 35.1% Mixed Upland Hardwoods.			
Reach Summary Information (Post-Restoration)				
Parameters	**T1**	**T1A**	**T2**	**T2A**
Length of reach (linear feet)	1,305	178	2,645	465
Valley classification	VIII	VIII	VIII	VIII
Drainage area (acres)	258.6 acres	136.9 acres	200.6 acres	35.7 acres
NCDWQ Water Quality Classification	Class C, WSIII	Class C, WSIII	Class C, WSIII	Class C, WSIII
Morphological Description (stream type)	C4	B4c/C4	C4	B4c/C4
Evolutionary trend	Stage II (Constructed)	Stage II (Constructed)	Stage II (Constructed)	Stage II (Constructed)
Mapped Soil Series	Chewacla loam	Chewacla loam	Pacolet sandy loam and Chewacla loam	Pacolet sandy loam
Drainage class	Poorly drained	Well drained	Poor to Well drained	Well drained
Soil Hydric status	Non hydric	Non hydric	Non hydric	Non hydric
Slope	0-2%	0-2%	0-2%	0-2%
FEMA classification	N/A	N/A	N/A	N/A
Native vegetation community	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Mesic Mixed Hardwood Forest
Percent composition of exotic invasive vegetation	0%	0%	0%	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	Yes	Floodplain development permit obtained through Rowan County		N/A
Essential Fisheries Habitat*	No	N/A		N/A

APPENDIX B

Morphological Summary Data and Plots

Table 5a. T1 Baseline Stream Data Summary
Jacob's Landing Stream Restoration Site

Parameter	Pre-Existing Condition*					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	6.5			9.1	4	6.9				1	11.5	12.2	10.1	11.0	12.1	3
Floodprone Width (ft)	1			26	4	23				1	25	70	40	56	71	3
Bankfull Mean Depth (ft)	0.9			1.8	4	1.1				1	1.0	1.0	0.8	0.8	0.8	3
Bankfull Max Depth (ft)	1.1			2.8	4	1.6				1	1.5	1.6	1.2	1.3	1.4	3
Bankfull Cross-Sectional Area (ft^2)	8.6			12.1	4	7.4				1	11.2	12.6	7.9	8.8	10.0	3
Width/Depth Ratio	3.7			9.6	4	6.4				1	12.0	12.0	12.9	13.8	14.6	3
Entrenchment Ratio	1.5			3.3	4	3.4				1	2.2	4.9	3.7	5.1	5.9	3
Bank Height Ratio	1.6			2.2	4	1.0				1	1.0	1.0	1.0	1.0	1.0	3
Pattern																
Channel Beltwidth (ft)	13			26	2	14	26		38	2	25	50	25	38	50	
Radius of Curvature (ft)	6			30	2	12	19		25	2	20	45	20	33	45	
Rc:Bankfull width (ft/ft)	0.7			4.6	2	1.7	2.7		3.6	2	2.0	4.0	2.0	3.0	4.0	
Meander Wavelength (ft)	75			110	2	43	73		102	2	65	125	65	95	125	
Meander Width Ratio	1.4			4.0	2	2	3.8		5.5	2	1.9	3.5	1.9	3.0	3.5	
Profile																
Riffle Length (ft)													11	22	32	21
Riffle Slope (ft/ft)	0.007			0.043	2	0.011			0.025	2	0.007	0.012	0.001	0.013	0.026	21
Pool Length (ft)						16			23		12	30	6	18	38	23
Pool Spacing (ft)						28			57		20	75	30	56	79	23
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 24% / 76% / 0% / 0% / 0%												0% / 25% / 52% / 23% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1 / 5 / 7 / 10 / 17 / 25												5 / 15 / 22 / 38 / 94 / 143			
Additional Reach Parameters																
Channel length (ft)	1,330										1,305		1,305			
Drainage Area (SM)	0.40					0.16					0.40		0.40			
Rosgen Classification	G4					E4					C4		C4			
Sinuosity	1.07-1.15					1.18					1.09-1.12		1.09-1.12			
Water Surface Slope (ft/ft)	0.009-0.014					0.0070					0.007-0.010		0.007			

Table 5b. T1A Baseline Stream Data Summary																
Jacob's Landing Stream Restoration Site																
Parameter	Pre-Existing Condition*					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	7.7				1	6.9				1	8.5					
Floodprone Width (ft)	15				1	23				1	19					
Bankfull Mean Depth (ft)	0.8				1	1.1				1	0.7					
Bankfull Max Depth (ft)	1.2				1	1.6				1	1.2					
Bankfull Cross-Sectional Area (ft^2)	6.4				1	7.4				1	6.2					
Width/Depth Ratio	9.3				1	6.4				1	12.0					
Entrenchment Ratio	1.9				1	3.4				1	2.2					
Bank Height Ratio	2.2				1	1.0				1	1.0					
Pattern																
Channel Beltwidth (ft)	20			75	1	14	26		38	2	19	24				
Radius of Curvature (ft)	8			24	1	12	19		25	2	10	25				
Rc:Bankfull width (ft/ft)	1			3.1	1	1.7	2.7		3.6	2	1.2	2.9				
Meander Wavelength (ft)	25			50	1	43	73		102	2	50	55				
Meander Width Ratio	2.6			9.7	1	2	3.8		5.5	2	2.2	2.8				
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.013			0.019	1	0.011			0.025	2	0.010	0.012				
Pool Length (ft)						16			23		7	14				
Pool Spacing (ft)						28			57		22	34				
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%																
d16 / d35 / d50 / d84 / d95 (mm)																
Additional Reach Parameters																
Channel length (ft)	294										178		178			
Drainage Area (SM)	0.21					0.40					0.21		0.21			
Rosgen Classification	E4					B4c					B4c/C4		B4c/C4			
Sinuosity	2.10					1.20					1.11					
Water Surface Slope (ft/ft)	0.023					0.013					0.017					

Table 5c. T2 Baseline Stream Summary																
Jacob's Landing Stream Restoration Site																
Parameter	Pre-Existing Condition*					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	8.8			12.3	4	6.9				1	10.4	11.6	10.4	10.9	12.0	5
Floodprone Width (ft)	17			20	4	23				1	23	50	27	32	42	5
Bankfull Mean Depth (ft)	1.0			1.0	4	1.1				1	0.9	1.0	0.8	0.8	0.9	5
Bankfull Max Depth (ft)	1.3			1.8	4	1.6				1	1.4	1.5	1.2	1.3	1.4	5
Bankfull Cross-Sectional Area (ft^2)	9.2			11.7	4	7.4				1	9.1	11.1	8.8	9.2	9.7	5
Width/Depth Ratio	8.4			12.9	4	6.4				1	12.0	12.0	11.8	12.9	15.2	5
Entrenchment Ratio	1.4			2.3	4	3.4				1	2.2	4.3	2.6	3.2	4.2	5
Bank Height Ratio	1.5			4.7	4	1.0				1	1.0	1.0	1.0	1.0	1.0	5
Pattern																
Channel Beltwidth (ft)	10			60	2	14	26		38	2	25	50	25	38	50	
Radius of Curvature (ft)	8			35	2	12	19		25	2	20	45	20	33	45	
Rc:Bankfull width (ft/ft)	0.9			3.9	2	1.7	2.7		3.6	2	2.0	4.0	2.0	3.0	4.0	
Meander Wavelength (ft)	65			130	2	43	73		102	2	60	130	60	95	130	
Meander Width Ratio	1.1			6.8	2	2	3.8		5.5	2	2.2	4.8	2.2	4.0	4.8	
Profile																
Riffle Length (ft)													14	22	36	33
Riffle Slope (ft/ft)	0.003			0.011	2	0.011			0.025	2	0.006	0.017	0.004	0.016	0.041	33
Pool Length (ft)						16			23	2	8	35	7	18	35	31
Pool Spacing (ft)						28			57	2	30	95	42	59	107	31
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	6% / 25% / 68% / 1% / 0% / 0%												0% / 6% / 58% / 32% / 3% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1 / 2 / 3 / 6 / 12 / 24												16 / 30 / 44 / 65 / 109 / 144			
Additional Reach Parameters																
Channel length (ft)	2,935										2,641		2,641			
Drainage Area (SM)	0.31					0.16					0.31		0.31			
Rosgen Classification	E4, F4					E4					C4		C4			
Sinuosity	1.09-1.45					1.18					1.16-1.31		1.16-1.31			
Water Surface Slope (ft/ft)	0.007-0.010					0.0007					0.009-0.0100		0.009			

Table 5d. T2A Baseline Stream Data Summary																
Jacob's Landing Stream Restoration Site																
Parameter	Pre-Existing Condition*					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	6.6				1	6.9				1	6.5					
Floodprone Width (ft)	11				1	23				1	14					
Bankfull Mean Depth (ft)	0.5				1	1.1				1	0.5					
Bankfull Max Depth (ft)	1.1				1	1.6				1	0.9					
Bankfull Cross-Sectional Area (ft^2)	3.4				1	7.4				1	3.5					
Width/Depth Ratio	12.8				1	6.4				1	12.0					
Entrenchment Ratio	1.7				1	3.4				1	2.2					
Bank Height Ratio	6.3				1	1.0				1	1.0					
Pattern																
Channel Beltwidth (ft)	8			15	1	14	26		38	2	8	15				
Radius of Curvature (ft)	10			12	1	12	19		25	2	10	25				
Rc:Bankfull width (ft/ft)	1.5			1.8	1	1.7	2.7		3.6	2	1.5	3.8				
Meander Wavelength (ft)	50			63	1	43	73		102	2	50	63				
Meander Width Ratio	1.2			2.3	1	2	3.8		5.5	2	1.2	2.3				
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.010			0.017	1	0.011			0.025	2	0.010	0.012				
Pool Length (ft)						16			23	2	4	15				
Pool Spacing (ft)						28			57	2	22	42				
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%																
d16 / d35 / d50 / d84 / d95 (mm)																
Additional Reach Parameters																
Channel length (ft)	465										465		465			
Drainage Area (SM)	0.06					0.40					0.06		0.06			
Rosgen Classification	G4					B4c					B4c/C4		B4c/C4			
Sinuosity	1.16					1.20					1.13					
Water Surface Slope (ft/ft)	0.019					0.013					0.014					

Table 6. Cross-Section Morphology Data Tables
Jacob's Landing Stream Restoration Site

Dimension and Substrate	Cross-Section 1 (T1-Riffle) Station 12+29							Cross-Section 2 (T1-Riffle) Station 17+79							Cross-Section 3 (T1-Pool) Station 19+25							Cross-Section 4 (T1-Riffle) Station 21+36							Cross-Section 5 (T2-Riffle) Station 52+53						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	10.8							12.1							15.5							10.1							10.4						
Floodprone Width (ft)	40.0							71.0							-							58.0							27.0						
Bankfull Mean Depth (ft)	0.8							0.8							1.2							0.8							0.9						
Bankfull Max Depth (ft)	1.3							1.4							2.8							1.2							1.3						
Bankfull Cross-Sectional Area (ft^2)	8.5							10.0							18.1							7.9							9.0						
Bankfull Width/Depth Ratio	13.7							14.6							-							12.9							12.0						
Bankfull Entrenchment Ratio	3.7							5.9							-							5.7							2.6						
Bankfull Bank Height Ratio	1.0							1.0							-							1.0							1.0						
d50 (mm)	2							28							-							35							47						

	Cross-Section 6 (T2-Riffle) Station 56+18							Cross-Section 7 (T2-Pool) Station 60+09							Cross-Section 8 (T2-Riffle) Station 63+84							Cross-Section 9 (T2-Riffle) Station 66+63							Cross-Section 10 (T2-Pool) Station 68+61						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	10.6							13.3							10.7							10.8							12.5						
Floodprone Width (ft)	29.0							-							30.0							42.0							-						
Bankfull Mean Depth (ft)	0.8							1.0							0.9							0.9							1.2						
Bankfull Max Depth (ft)	1.3							1.9							1.3							1.2							1.8						
Bankfull Cross-Sectional Area (ft^2)	8.8							13.8							9.7							9.2							14.5						
Bankfull Width/Depth Ratio	12.8							-							11.8							12.7							-						
Bankfull Entrenchment Ratio	2.7							-							2.8							3.9							-						
Bankfull Bank Height Ratio	1.0							-							1.0							1.0							-						
d50 (mm)	49							-							66							41							-						

	Cross-Section 11 (T2-Riffle) Station 72+48						
Based on fixed baseline elevation	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	12.0						
Floodprone Width (ft)	>50						
Bankfull Mean Depth (ft)	0.8						
Bankfull Max Depth (ft)	1.4						
Bankfull Cross-Sectional Area (ft^2)	9.5						
Bankfull Width/Depth Ratio	15.2						
Bankfull Entrenchment Ratio	4.2						
Bankfull Bank Height Ratio	1.0						
d50 (mm)	16						

Photo Reference Points

PP1U – MY-00 – 3/11/14

PP1D – MY-00 – 3/11/14

PP1 Tributary – MY-00 – 3/11/14

PP2U – MY-00 – 3/11/14

PP2D – MY-00 – 3/11/14

PP3U – MY-00 – 3/11/14

PP3D – MY-00 – 3/11/14

PP4U – MY-00 – 3/11/14

PP4D – MY-00 – 3/11/14

PP5U – MY-00 – 3/11/14

PP5D – MY-00 – 3/11/14

PP6U – MY-00 – 3/11/14

PP6D – MY-00 – 3/11/14

PP7U – MY-00 – 3/11/14

PP7D – MY-00 – 3/11/14

PP8U – MY-00 – 3/11/14

PP8D – MY-00 – 3/11/14

PP9U – MY-00 – 3/11/14

PP9D – MY-00 – 3/11/14

PP9 Tributary – MY-00 – 3/11/14

PP10U – MY-00 – 3/11/14

PP10D – MY-00 – 3/11/14

APPENDIX C

Vegetation Data

Table 7. CVS Stem Count Total and Planted by Plot and Species

Jacobs Landing Stream Restoration Site (EEP Project Code 95024)			Current Plot Data (MY00-2014)																				
			95024-01-0001			95024-01-0002			95024-01-0003			95024-01-0004			95024-01-0005			95024-01-0006			95024-01-0007		
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**
Betula nigra	river birch	Tree	7	7	7	9	9	9	5	5	5	2	2	2				8	8	8	4	4	4
Platanus occidentalis	American sycamore	Tree										3	3	3									
Quercus	oak	Tree				2	2	2							8	8	8						
Quercus alba	white oak	Tree																					
Quercus phellos	willow oak	Tree																					
Unknown		Shrub or Tree	14	14	14	8	8	8	14	14	14	15	15	15	7	7	7	13	13	13	10	10	10
Stem count			21	21	21	19	19	19	19	19	19	20	20	20	15	15	15	21	21	21	14	14	14
size (ares)			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			2	2	2	3	3	3	2	2	2	3	3	3	2	2	2	2	2	2	2	2	2
Stems per ACRE			850	850	850	769	769	769	769	769	769	809	809	809	607	607	607	850	850	850	567	567	567

Jacobs Landing Stream Restoration Site (EEP Project Code 95024)			Current Plot Data (MY00-2014)																	Annual Means		
			95024-01-0008			95024-01-0009			95024-01-0010			95024-01-0011			95024-01-0012			95024-01-0013			MY0 (2014)		
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**
Betula nigra	river birch	Tree							2	2	2	4	4	4	3	3	3				44	44	44
Platanus occidentalis	American sycamore	Tree																			3	3	3
Quercus	oak	Tree													1	1	1				11	11	11
Quercus alba	white oak	Tree										1	1	1							1	1	1
Quercus phellos	willow oak	Tree	10	10	10	6	6	6	9	9	9	2	2	2	13	13	13	14	14	14	54	54	54
Unknown		Shrub or Tree	10	10	10	12	12	12	7	7	7	8	8	8	7	7	7	8	8	8	133	133	133
Stem count			20	20	20	18	18	18	18	18	18	15	15	15	24	24	24	22	22	22	246	246	246
size (ares)			1			1			1			1			1			1			13		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.32		
Species count			2	2	2	2	2	2	3	3	3	4	4	4	4	4	4	2	2	2	6	6	6
Stems per ACRE			809	809	809	728	728	728	728	728	728	607	607	607	971	971	971	890	890	890	766	766	766

Vegetation Monitoring Plot Photos

Vegetation Plot 1 – MY-00 – 2/20/14

Vegetation Plot 2 – MY-00 – 2/20/14

Vegetation Plot 3 – MY-00 – 2/20/14

Vegetation Plot 4 – MY-00 – 2/20/14

Vegetation Plot 5 – MY-00 – 2/20/14

Vegetation Plot 6 – MY-00 – 2/20/14

Vegetation Plot 7 – MY-00 – 2/20/14

Vegetation Plot 8 – MY-00 – 2/20/14

Vegetation Plot 9 – MY-00 – 2/25/14

Vegetation Plot 10 – MY-00 – 2/25/14

Vegetation Plot 11 – MY-00 – 2/25/14

Vegetation Plot 12 – MY-00 – 2/25/14

Vegetation Plot 13 – MY-00 – 2/25/14

APPENDIX D

As-Built Plan Sheets

KCI JOB# : 20110675

CONTRACT #: 003984

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

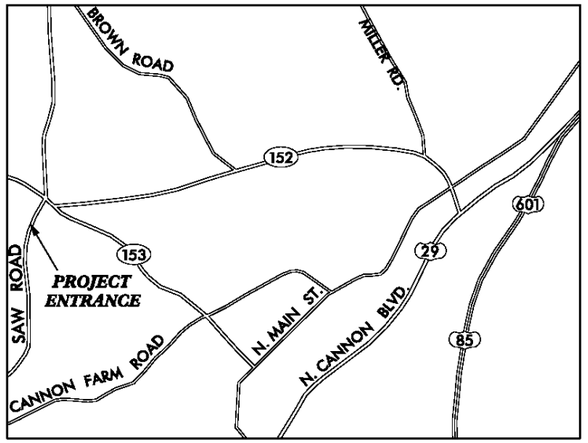
STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	003984	1	9

SYM.	DESCRIPTION	DATE
	REVISIONS	

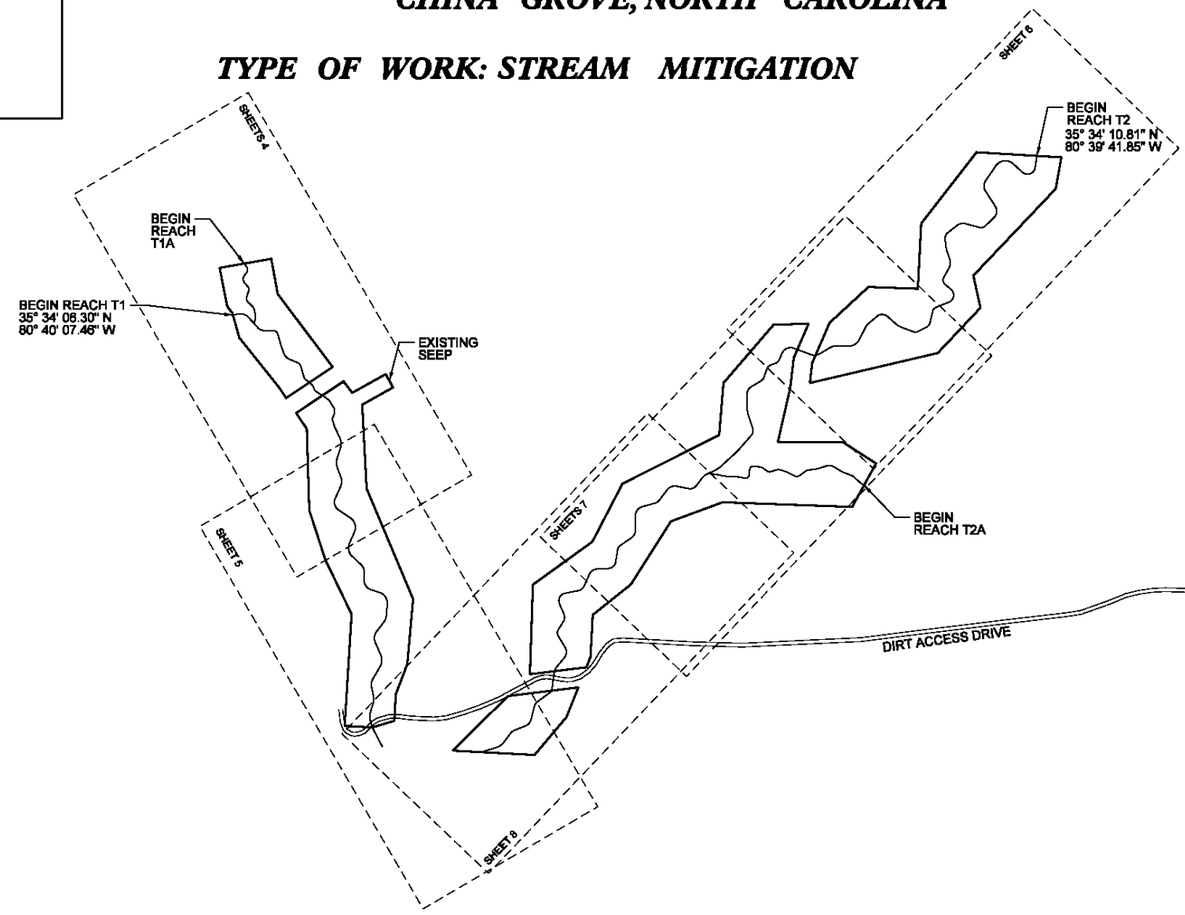
ROWAN COUNTY

LOCATION: JACOB'S LANDING
CHINA GROVE, NORTH CAROLINA

TYPE OF WORK: STREAM MITIGATION



VICINITY MAP
NOT TO SCALE



DIRECTIONS TO SITE

FROM RALEIGH, TAKE I-40 WEST. SLIGHT LEFT ONTO I-85 BUS S/US-29 S/US-70 W (signs for High Point/Charlotte). FOLLOW I-85 SOUTH TO EXIT 68. MERGE ONTO US-29 CONNECTOR SOUTH. TURN RIGHT ONTO NORTH CAROLINA 152 W/CHURCH STREET. TURN LEFT ONTO SAW ROAD. TAKE A RIGHT AT THE TWO STORY HOUSE AT 350 SAW ROAD. FOLLOW THE DIRT DRIVE THROUGH THE CATTLE FIELDS TO THE SITE.

INDEX OF SHEETS

AS-BUILT PLANS

GRAPHIC SCALES

–150′ –75′ 0′ 150′ 300′
AS-BUILT SITE PLAN (OVERVIEW)

–40′ –20′ 0′ 40′ 80′
AS-BUILT SITE PLAN

–100′ –50′ 0′ 100′ 200′
PLANTING PLAN

PROJECT DATA

STREAM RESTORATION LENGTH = 4,484 FEET

STREAM ENHANCEMENT II LENGTH = 109 FEET

Prepared in the Office of:

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

ALEX FRENCH
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

GARY M. MRYNCZA, P.E.

P.E.
SIGNATURE:

Prepared for:

Ecosystem PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

GENERAL NOTES:

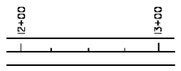
1. THIS PLAT DOES NOT REPRESENT A BOUNDARY SURVEY OF THE PARENT TRACTS. THE PARENT TRACT BOUNDARIES ADJACENT TO THIS EASEMENT ARE NOT CHANGED BY THIS PLAT. BOUNDARY INFORMATION SHOWN HEREON WAS DERIVED FROM DEEDS AND MAPS OF THE ROWAN COUNTY AND MONUMENTATION FOUND IN THE FIELD.
2. DISTANCES SHOWN ARE HORIZONTAL GROUND DISTANCES IN U.S. SURVEY FEET UNLESS OTHERWISE NOTED.
3. THE BASIS OF THE MERIDIANS AND COORDINATES FOR THIS PLAT IS THE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM 1983 (NAD 83), BASED ON DIFFERENTIAL GPS OBSERVATIONS PERFORMED IN SEPTEMBER 2013.
4. VERTICAL DATA SHOWN HEREON BASED ON NAVD '88.
5. DEED REFERENCES:
   - DB 915 PG 687
   - DB 875 PG 742
   - DB 1122 PG 670
   - DB 756 PG 923
6. SUBJECT PROPERTIES KNOWN AS TAX NUMBER:
   - #234 023
   - #234 024
   - #234 025
7. SUBJECT PROPERTIES PARTIALLY LIE WITHIN THE AREA DESIGNATED AS ZONE "X", BASED ON FEDERAL FLOOD INSURANCE RATE MAP 3710560600J EFFECTIVE JUNE 16, 2009.
8. NO UNDERGROUND UTILITIES LOCATED DURING THE COURSE OF THIS SURVEY.

CONTROL POINTS

POINT	NORTHING	EASTING	ELEV
KCI#300	664903.87	1504085.22	793.15
KCI#301	665233.49	1504239.55	793.59
KCI#302	665473.30	1504002.98	795.81
KCI#303	665697.94	1504191.77	814.90
KCI#304	665937.34	1503951.47	802.99
KCI#305	664916.39	1504449.19	794.00
KCI#306	665228.78	1504766.13	799.81
KCI#307	665600.75	1504938.38	806.02
KCI#308	665792.33	1505240.51	812.50
KCI#309	666042.52	1505553.70	816.94
KCI#310	666304.60	1505937.21	830.19
KCI#311	665620.22	1505198.16	816.10
KCI#312	665466.78	1505394.29	831.29

PROJECT LEGEND:

Thalweg with Approximate Bankfull Limits



Step Pool

Riffle Grade Control

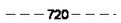
Soil Lift

Riffle Enhancement

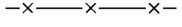
Existing Woods Line

Minor Contour Line

Major Contour Line



New Woven Wire Fence



Overhead Power Line

REVISIONS

STA	DESCRIPTION	DATE

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

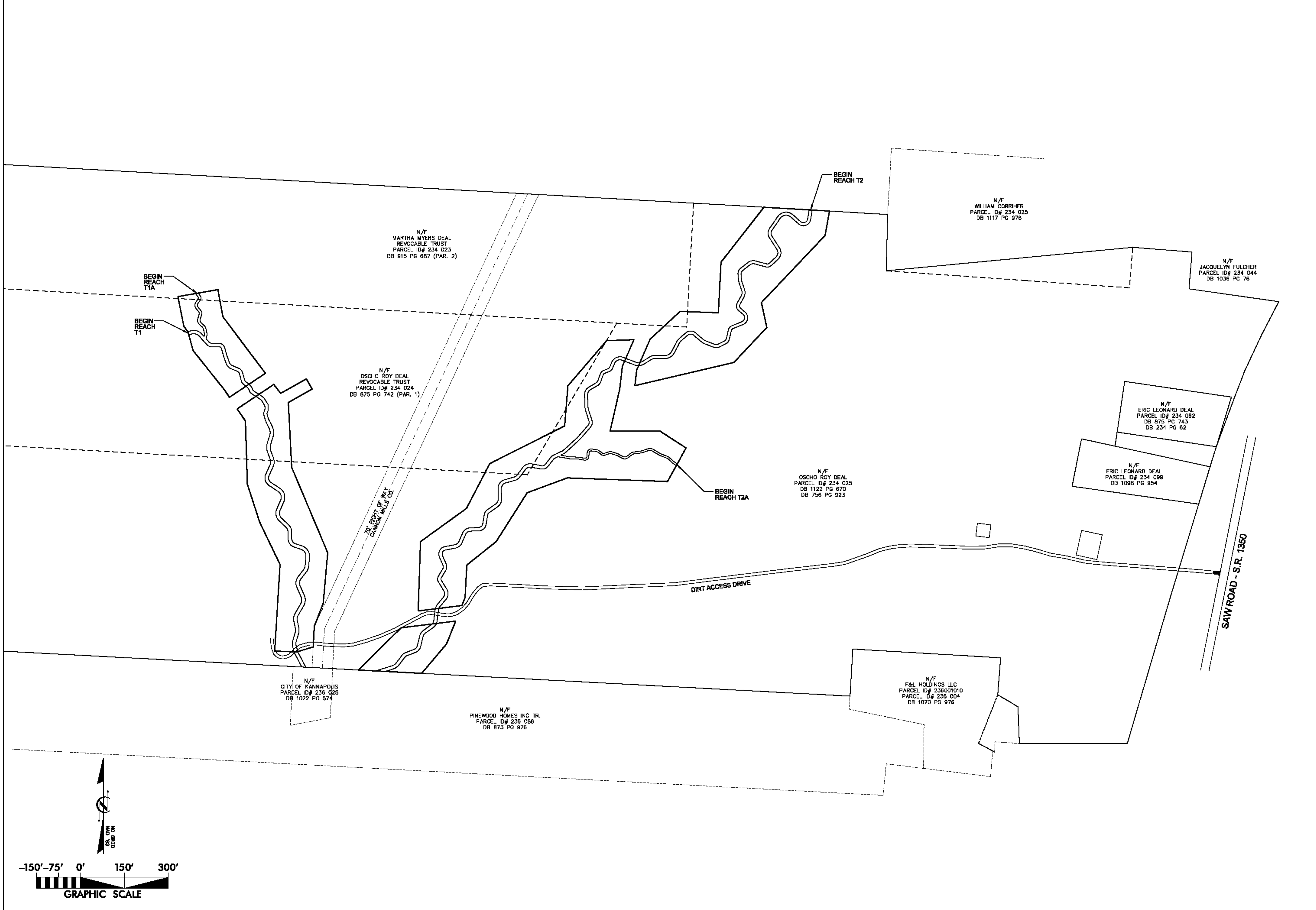
Ecosystem

JACOB'S LANDING
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MARCH 2013
SCALE: N.T.S.

PROJECT LEGEND & NOTES

SHEET 2 OF 9



DESCRIPTION	DATE

REVISIONS

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JACOB'S LANDING
STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

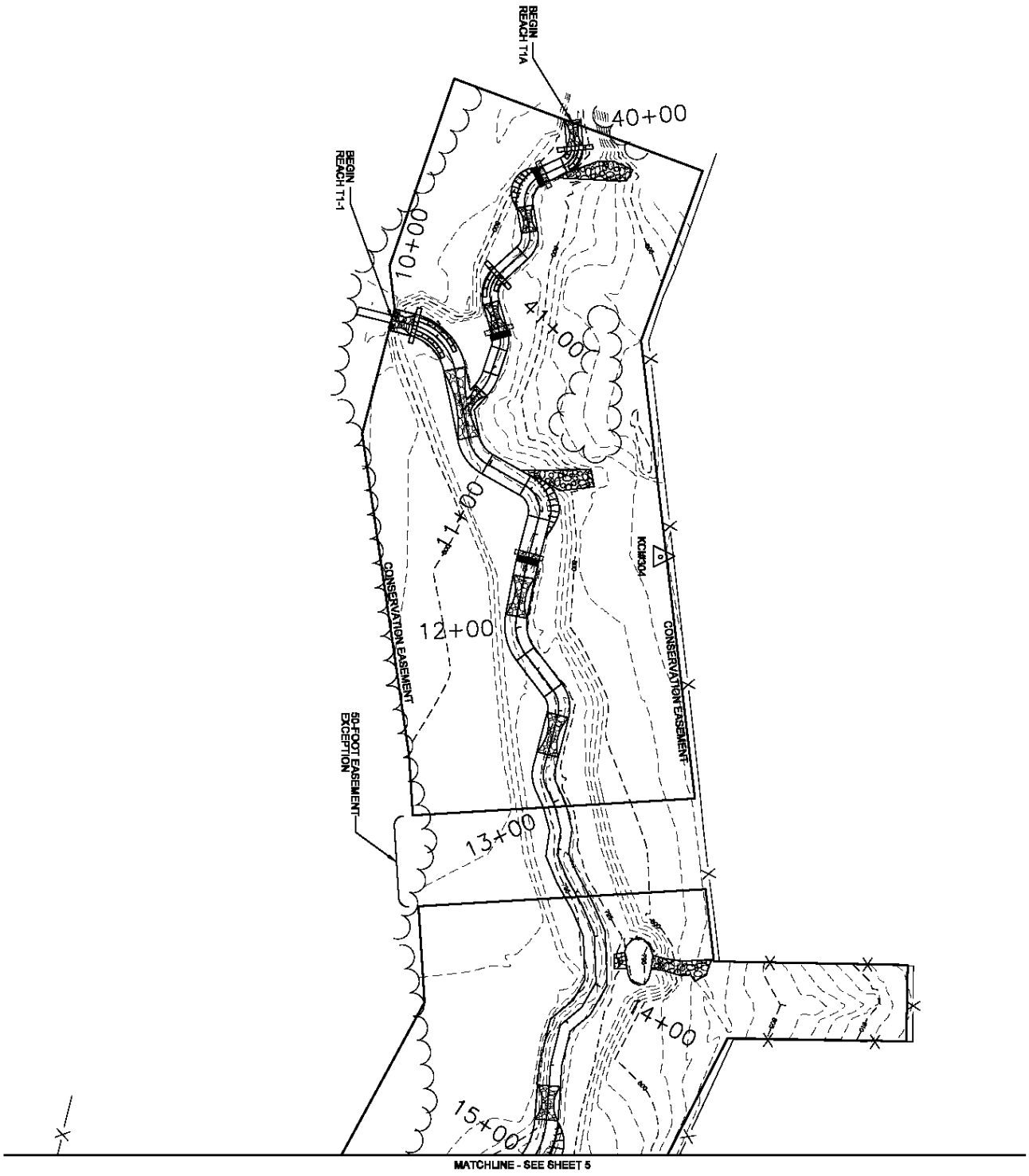
REACHES T1, T1A, T2 AND T2A

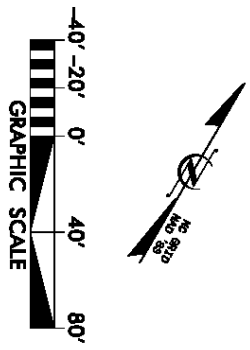
DATE: MARCH 2013

SCALE: 1"=150'

AS-BUILT SITE PLAN (OVERVIEW)

SHEET 3 OF 9





AS-BUILT SITE PLAN

SHEET 4 OF 9

DATE: MARCH 2013

SCALE: 1"=40'

JACOB'S LANDING STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACHES T1 AND T1A

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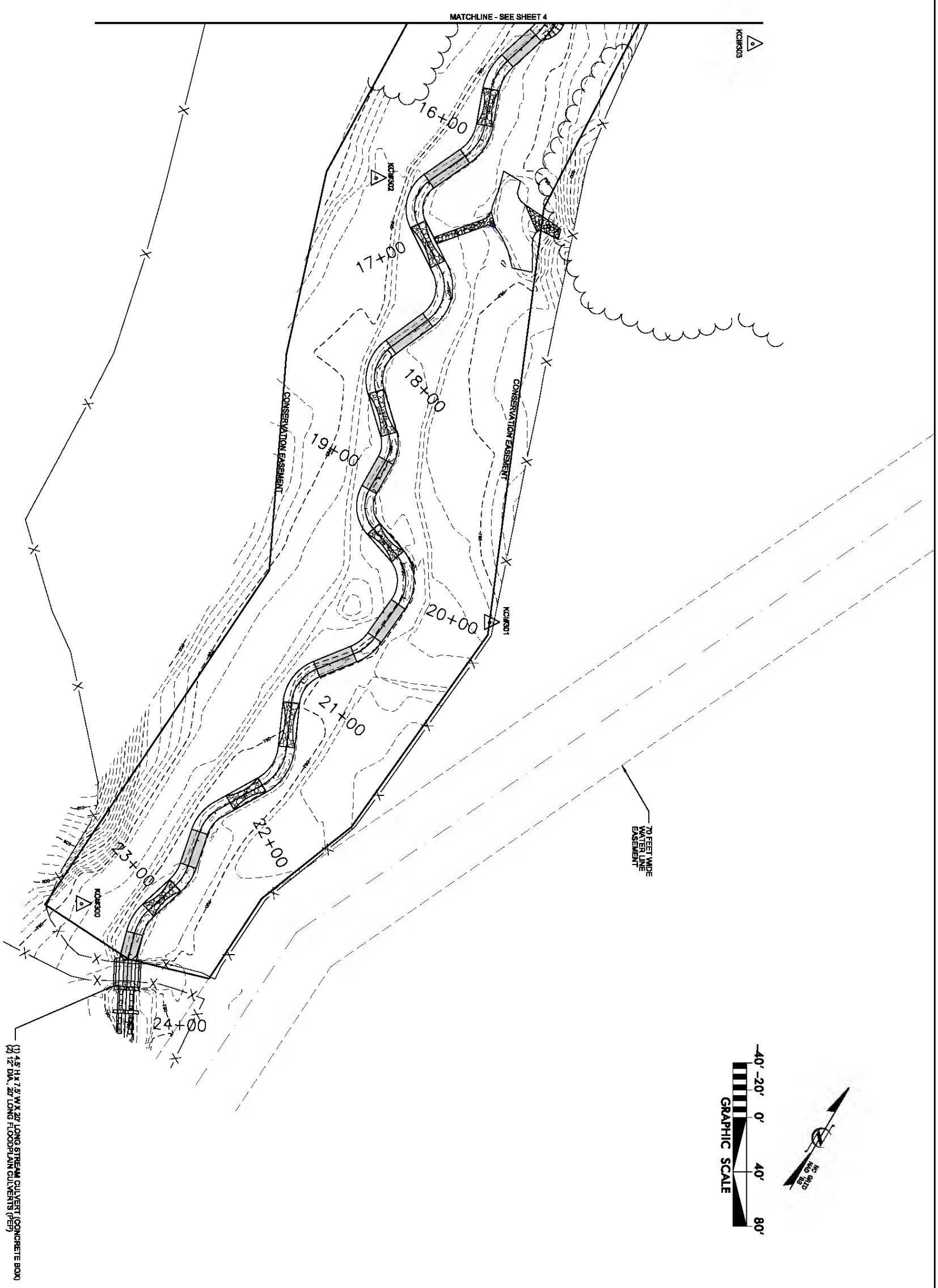
Ecosystem

SYM.	DESCRIPTION	DATE

REVISIONS



AS-BUILT
SITE PLAN

SHEET 5 OF 9

DATE: MARCH 2013
SCALE: 1"=40'

JACOB'S LANDING
STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T1

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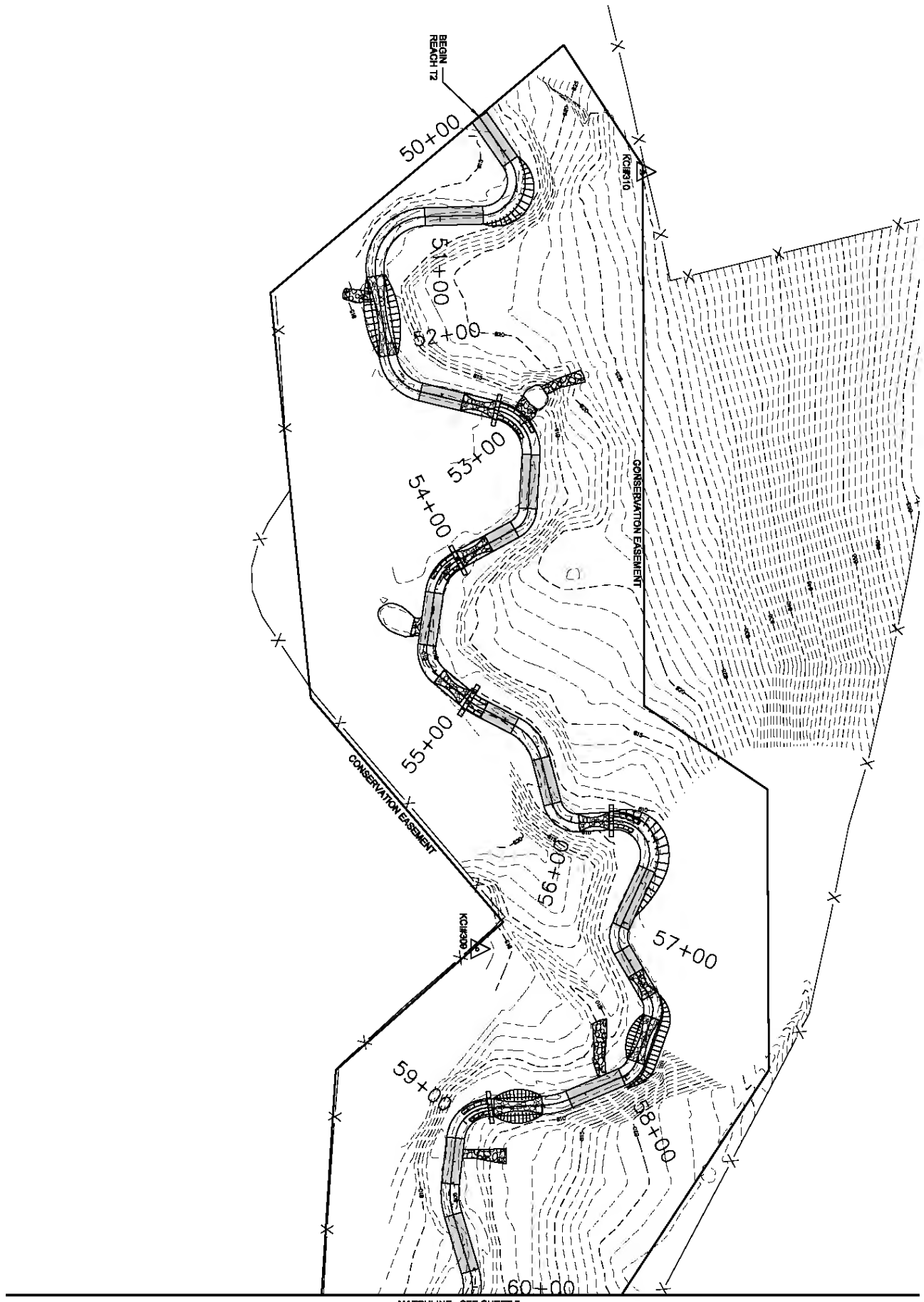
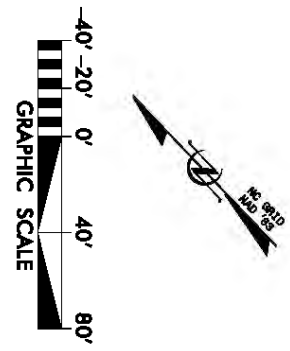
Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE

REVISIONS





SHEET 6 OF 9

AS-BUILT SITE PLAN

DATE: MARCH 2013

SCALE: 1"=40'

JACOB'S LANDING STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2

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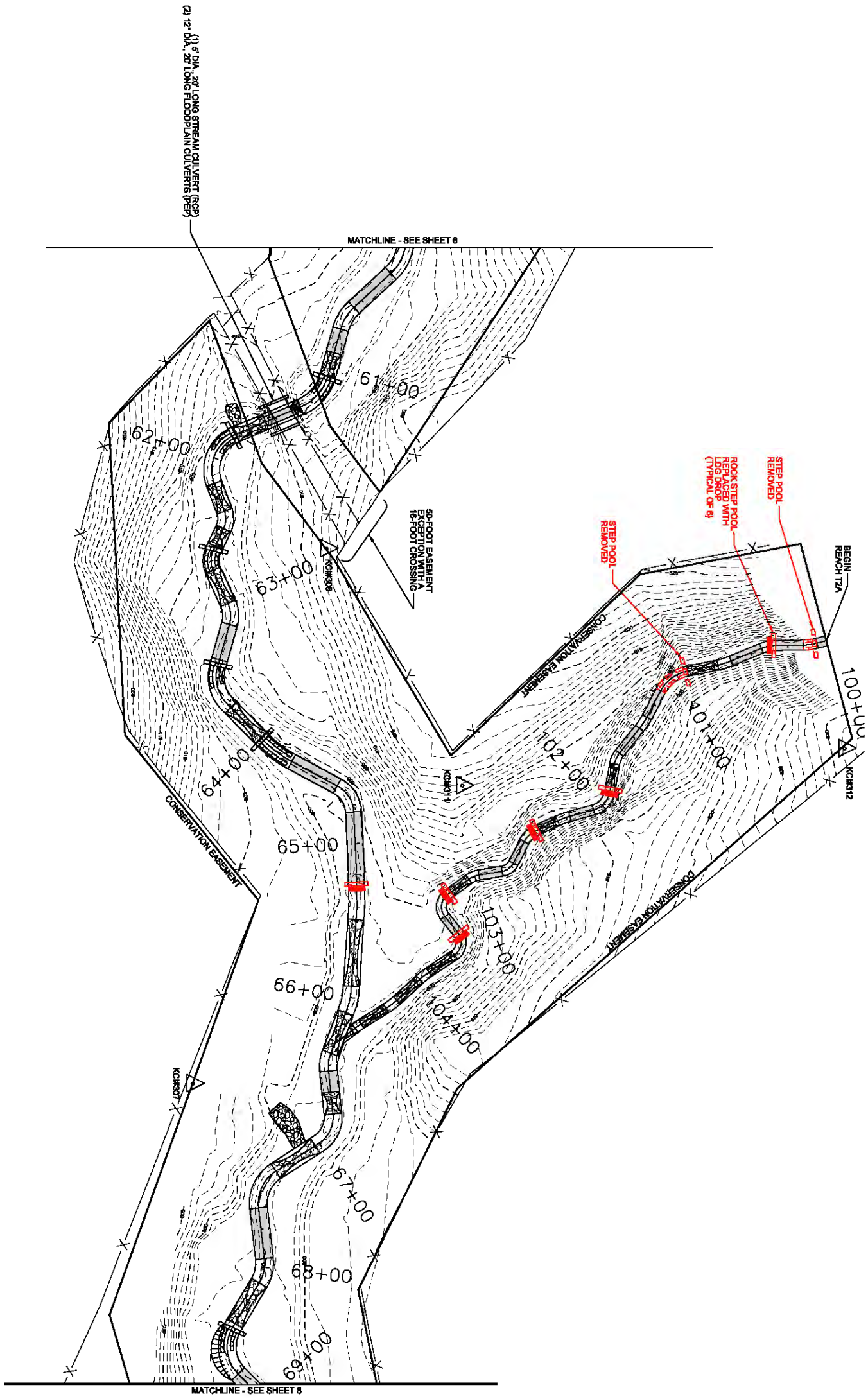
Ecosystem Enhancement

SYM.	DESCRIPTION	DATE

REVISIONS



SHEET 7 OF 9

AS-BUILT
SITE PLAN

DATE: MARCH 2013
SCALE: 1"=40'

JACOB'S LANDING
STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2

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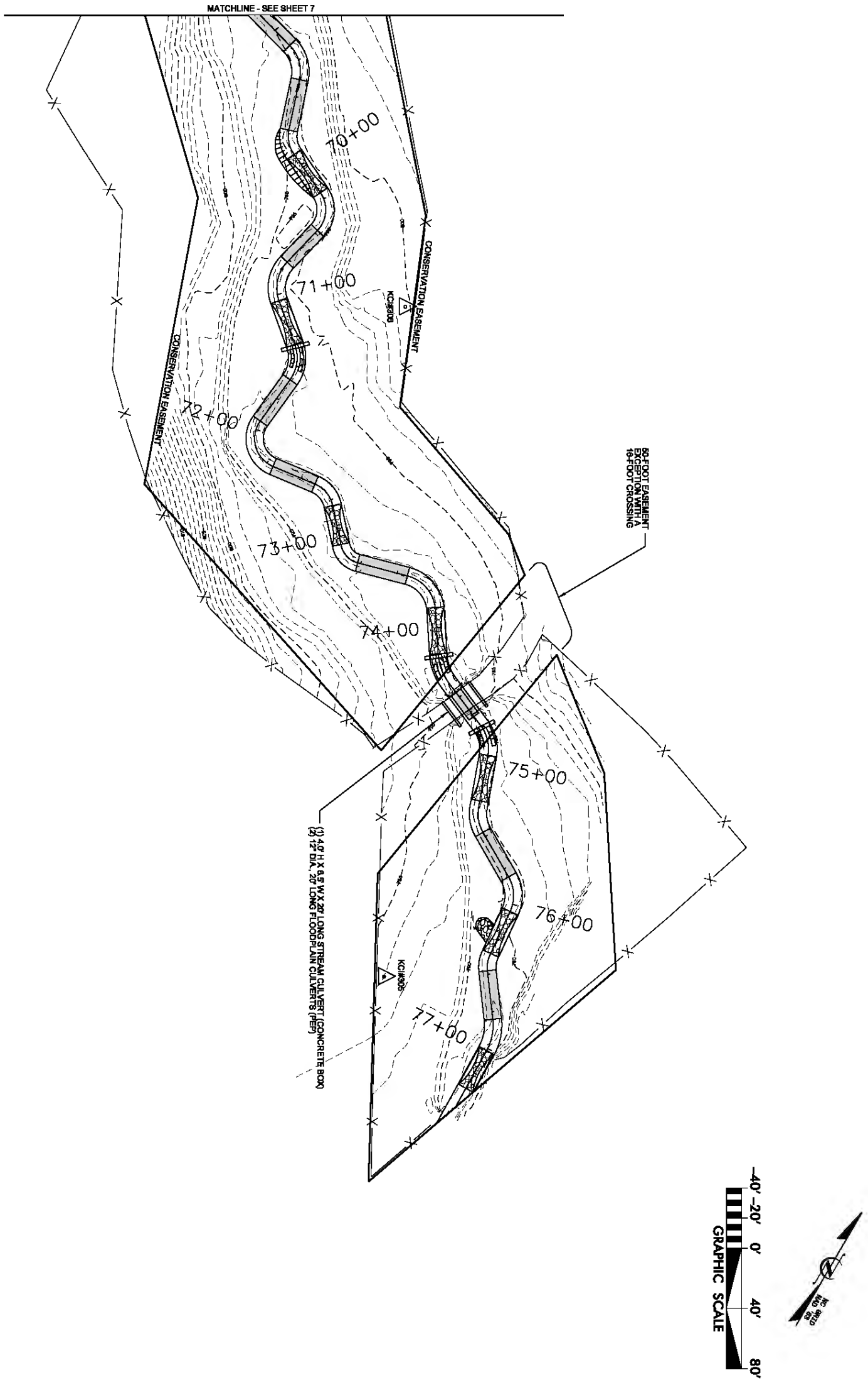
Ecosystem Enhancement

SYM.	DESCRIPTION	DATE

REVISIONS



AS-BUILT SITE PLAN

SHEET 8 OF 8

DATE: MARCH 2013

SCALE: 1"=40'

JACOB'S LANDING STREAM MITIGATION PROJECT

CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

REACH T2

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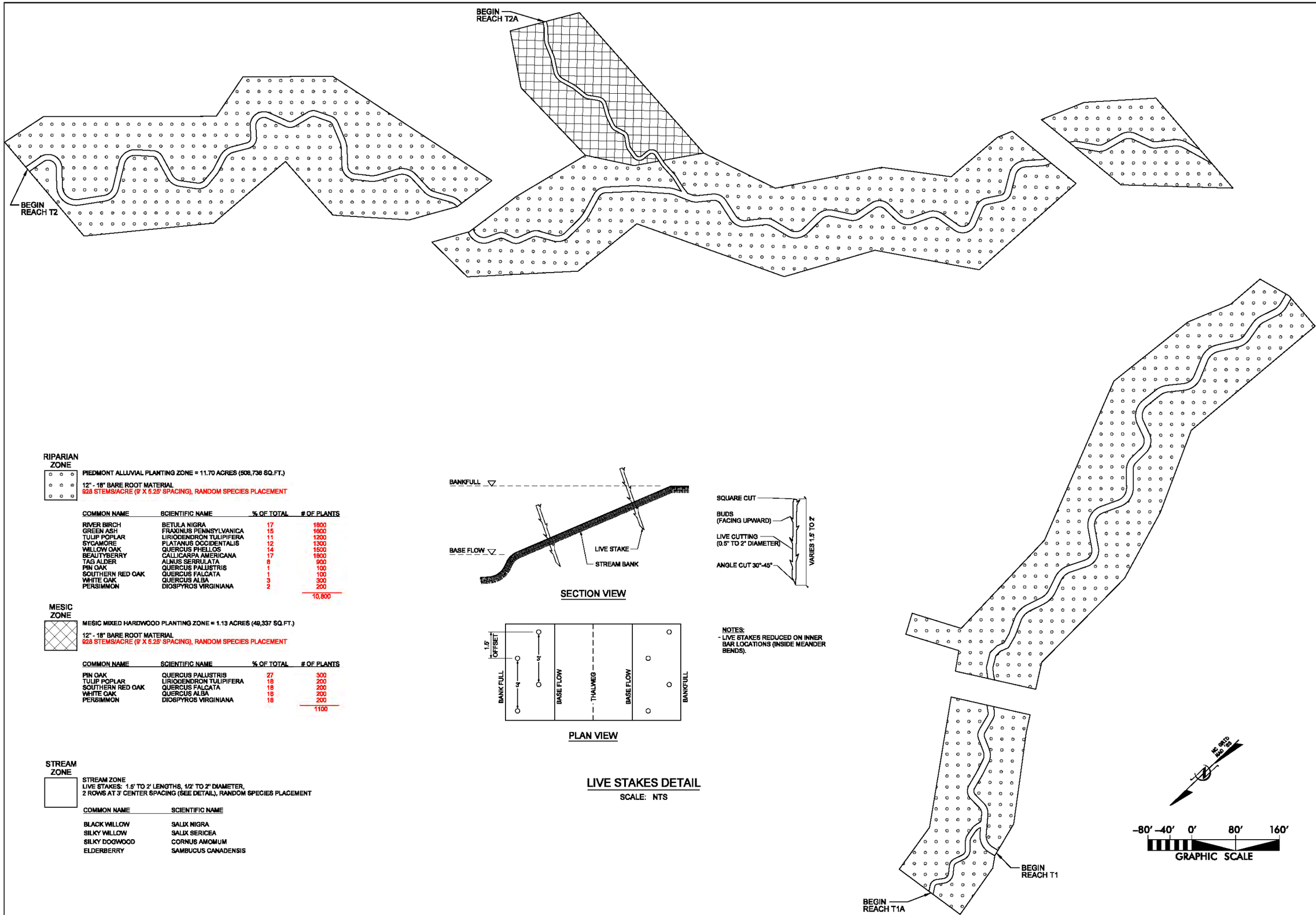
Ecosystem Enhancement

SYM.	DESCRIPTION	DATE

REVISIONS



RIPARIAN ZONE

PIEDMONT ALLUVIAL PLANTING ZONE = 11.70 ACRES (508,738 SQ.FT.)

12" - 18" BARE ROOT MATERIAL
928 STEMS/ACRE (9' X 5.25' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	17	1800
GREEN ASH	FRAXINUS PENNSYLVANICA	15	1600
TULIP POPLAR	LIRIODENDRON TULIPIFERA	11	1200
SYCAMORE	PLATANUS OCCIDENTALIS	12	1300
WILLOW OAK	QUERCUS PHELLOS	14	1500
BEAUTYBERRY	CALLICARPA AMERICANA	17	1800
TAG ALDER	ALNUS SERRULATA	8	900
PIN OAK	QUERCUS PALUSTRIS	1	100
SOUTHERN RED OAK	QUERCUS FALCATA	1	100
WHITE OAK	QUERCUS ALBA	3	300
PERSIMMON	DIOSPYROS VIRGINIANA	2	200
			10,800

MESIC ZONE

MESIC MIXED HARDWOOD PLANTING ZONE = 1.13 ACRES (49,337 SQ.FT.)

12" - 18" BARE ROOT MATERIAL
928 STEMS/ACRE (9' X 5.25' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	% OF TOTAL	# OF PLANTS
PIN OAK	QUERCUS PALUSTRIS	27	300
TULIP POPLAR	LIRIODENDRON TULIPIFERA	18	200
SOUTHERN RED OAK	QUERCUS FALCATA	18	200
WHITE OAK	QUERCUS ALBA	18	200
PERSIMMON	DIOSPYROS VIRGINIANA	18	200
			1100

STREAM ZONE

STREAM ZONE
LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2' TO 2" DIAMETER,
2 ROWS AT 3' CENTER SPACING (SEE DETAIL), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA
SILKY DOGWOOD	CORNUS AMOMUM
ELDERBERRY	SAMBUCUS CANADENSIS

LIVE STAKES DETAIL

SCALE: NTS

NOTES:
- LIVE STAKES REDUCED ON INNER BAR LOCATIONS (INSIDE MEANDER BENDS).

REVISIONS

STAL	DESCRIPTION	DATE

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JACOB'S LANDING
STREAM MITIGATION PROJECT
CHINA GROVE, ROWAN COUNTY, NORTH CAROLINA

DATE: MARCH 2013
SCALE: 1"=80'

PLANTING PLAN

SHEET 9 OF 9