Baseline Monitoring Document and As-Built Baseline Report

FINAL

Cochran Stream and Wetland Restoration Site
NCDMS Contract No. 004947
NCDMS Project No. 95720
Macon, North Carolina
Data Collected: 6/12/2015 - 6/25/2015
Date Submitted: 8/4/2015

Submitted to:

NCDENR-Division of Mitigation Services
1652 Mail Service Center Raleigh NC 27699-1652

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Prepared for:

Resource Environmental Solutions

302 Jefferson Street, Suite 110
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balance through proper planning

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Executive Summary

The Cochran Stream and Wetland Restoration Site (Site) is located in the Little Tennessee River Watershed (NSCDWQ sub-basin 04-04-01 and HUC 06010202040020) approximately 6 miles northwest of Franklin, North Carolina, in Macon County at latitude 35°12'52" N and longitude 83°29'20" W. The site encompasses approximately 10 acres of agricultural land and consisted of two unstable streams, Cochran Branch and Parrish Branch, along with degraded former wetlands on the Cochran Branch floodplain.

Through the North Carolina Division of Mitigation Services full-delivery process, Environmental Banc & Exchange, LLC, an entity of Resource Environmental Solutions, LLC, generated a total of 1,820 stream mitigation units through Priority I and II Restoration and 4.30 wetland mitigation units through Restoration and Rehabilitation. The goal of the project was to address the stressors identified in the Targeted Local Watershed Plan such as improving water quality, wetland function, aquatic and terrestrial habitat, and flood flow attenuation. The goals were addressed by restoring stable channel morphology and sediment transport capacity, improving stream bed form and habitat, re-grading the floodplain to remove drainage ditches, spoil berms, and overburdened soils, improving stream bank stabilization, and providing riparian buffer restoration by re-establishing a native plant community within the easement.

Historic land use at the Site has consisted primarily of agriculture and livestock grazing. Additional land use practices, including the excavation of drainage ditches, maintenance and removal of riparian vegetation, and the relocating, dredging, and straightening of on-site streams have contributed to unstable channel characteristics, degraded water quality, and degradation of prior wetlands.

The project site was delineated into two components totaling 1,882 linear feet. The Site was then delineated into three separate reaches, Cochran Branch 1a (379 feet), Cochran Branch 1b (1,101 feet), and Parrish Branch (402 feet). A Duke Energy Right-of-Way at the upstream end of Cochran Branch 1a accounts for the difference between the mitigation units and total footage. Cochran Branch 1a and 1b received Priority I Restoration while Parrish Branch received Priority II Restoration. The installation of brush, rock, and wood structures were utilized throughout the restored reaches to provide bed and bank stability as well as aquatic habitat. The Cochran Branch stream profile was raised to reconnect it with the floodplain while Parrish Branch, due to topographic constraints, was repositioned to connect the channel to the low point in the valley and the new floodplain of Cochran Branch.

Three separate wetland areas were identified within the project site. The project wetland components include approximately 4.24 acres of wetland restoration and 0.11 acres of wetland enhancement, totaling 4.35 acres of wetlands. 3.42 acres of the total restoration acres are considered re-establishment, while the remaining 0.82 acres are rehabilitation. Re-establishment of the wetlands on the Cochran Branch floodplain involved the removal of overburden material to expose the underlying buried A-horizon and hydric soils. Wetland hydrology was restored by raising the bed elevation of Cochran Branch and filling the floodplain drainage ditches. Additional grading activities included harvesting usable topsoil material for re-use on the re-graded floodplain, removal of spoil berms, and grading the micro-topography to provide for additional retention of surface water and increased habitat diversity. Rehabilitation of existing wetland on the Cochran Branch floodplain involved elimination of drainage features that are impacting wetland hydrology and improving micro-topography to improve surface water retention. Aggressive re-grading was limited to areas where there was more than 4 inches of overburden on a well-defined buried A-horizon. Where re-grading was determined feasible, the topsoil and vegetation was removed first and stockpiled for redistribution on the new floodplain surface. Re-establishment of wetlands adjacent to Parrish Branch were re-graded to the outfall of the middle ditch to form a subdued alluvial fan feature, typical of wetland features found on small mountain streams. The graded fan feature

will be saturated with flow from the persistent seep emanating from this ditch. All Re-establishment, Rehabilitation, and Enhancement areas were ripped to remove effects of past compaction and planted with native wetland vegetation.

A baseline stream and topographic survey was performed between 6/12 and 6/25/2015 to document baseline conditions at the Site. The stream pattern, profile, and dimension very closely reflected those values outlined in the design.

A vegetation survey at the Site was conducted on May 29, 2015. Results from the initial survey indicate that the planted stem density ranged between 647 and 850 with the mean density of 789 though all plots in MY0. A total of nine species were documented across all plots with species diversity in the plots ranging from three and six.

Annual monitoring will begin during in 2015 and will include stream, wetland, and vegetation monitoring components as established in this document. Annual monitoring will occur for seven years.

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1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTE

1.1. Location and Setting

The Cochran Branch Mitigation Site (the Site) is located approximately 6 miles northwest of Franklin, North Carolina at latitude 35°12'52" N and longitude 83°29'20" W. The Site encompasses approximately 10 acres of agricultural land and consists of two unstable streams, Cochran Branch and Parrish Branch, along with degraded former wetlands on the Cochran Branch floodplain. The Site lies within the Little Tennessee River Watershed NC Division of Water Quality (DWQ) sub-basin 04-04-01 and local HUC 06010202040020 and is within an NCDMS targeted local watershed. Cochran Branch drains to Burningtown Creek approximately 0.5 miles downstream of the project. Burningtown Creek is classified as B;Tr by DWQ (2012). The site is located within the Franklin to Fontana NC-DMS Local Watershed Plan (LWP).

The Cochran Branch Mitigation Site lies within the Southern Crystalline Ridges and Mountains Level IV ecoregion of the Blue Ridge Level III ecoregion (USGS 2002). This ecoregion occurs primarily on Precambrian-age igneous and high-grade metamorphic rocks, which are mostly gneiss and schist, covered by well-drained, acidic, loamy soils. The site is located within a Type II colluvial valley (Rosgen) that presents a structurally influenced morphology with valley cross slopes averaging 25% and longitudinal slopes averaging 4%. The valley bottom adjacent to Cochran Branch transitions from a confined colluvial form at the upstream end to a locally broader alluvial form that is present throughout the majority of the site. Historic land use at the Site has consisted primarily of agriculture and livestock grazing. Additional land use practices, including the maintenance and removal of riparian vegetation and the relocating, dredging, and straightening of on-site streams have contributed to unstable channel characteristics and degraded water quality.

1.2. Project Goals and Objectives

The overall goals address the stressors identified in the TLW and include the following:

- Improve water quality within the restored channel reaches and downstream watercourses by reducing sediment and nutrient inputs and increasing dissolved oxygen levels
- Improve local aquatic and terrestrial ecological function through increased stream shading, habitat complexity, and availability of organic/woody material
- Improve aquatic and benthic habitat and associated streambed form
- Improve site hydrology, wetland functions, and attenuation of flood flows
- Provide riparian area and wetland restoration with a native plant community
- Protect the site from future land use impacts

The specific project objectives that are intended to target the above goals include the following:

- Implement Priority I and II restoration of 1,882 feet of stream and rehabilitation/re-establishment of 4.35 acres of wetlands
- Implement appropriate changes in the dimension, pattern and/or profile to establish geomorphically stable conditions within the project reaches
- Modify degraded stream channels to enable proper sediment transport capacity and improved streambed form

- Integrate in-stream structures and native bank vegetation
- Re-grade the floodplain to remove drainage ditches, spoil berms, and overburden soil
- Plant native woody and herbaceous riparian vegetation with a minimum width of 30 feet from the edge of the restored channels and throughout the restored wetland area
- Eradicate invasive, exotic or undesirable plant species
- Install livestock exclusion fencing
- Establish a permanent conservation easement

1.3. Project Structure, Restoration Type and Approach

1.3.1. Project Structure

Construction of the Cochran Branch Stream and Wetland Restoration Project produced a total of 1,820 stream mitigation units and 4.30 acres of wetland mitigation units, as outline in Table 1 and depicted in Figure 2. The project site was delineated into three components totaling 1,882 feet; Cochran Branch 1a (379 feet), Cochran Branch 1b (1,101 feet), and Parrish Branch (402 feet). Sixty-two feet of Cochran Branch 1a is located underneath a Duke Energy Transmission Line Right-of-Way and is not considered creditable footage. This accounts for the difference between restored footage and stream mitigation units.

1.3.2. Restoration Type and Approach

Cochran Branch

Cochran Branch is divided into two sub-reaches; Reach 1A is the steeper upstream reach and Reach 1B is downstream from the steeper reach and flows through the majority of the site. Reach 1A was constructed as a Priority I restoration of a type B4 stream with moderate sinuosity and an average slope of 3.5%. Reach 1B was constructed as a Priority I restoration of a type C4 stream with moderate sinuosity and an average slope of 0.85%. Due to the extent of degradation, the reach was completely reconstructed. The stream profile has been raised to reconnect it with the floodplain, which is integral to the success and function of the proposed wetland restoration. Reconstruction of the channel provided for the configuration of proper cross sectional geometry that reduces stress on the banks and eliminates bank scour. Additionally, reconstruction provided the opportunity to harvest the gravel bed material in the existing channel and utilize it to construct proper, functional riffles. Riffles constructed from native gravel material along with in-stream structures provide immediate habitat features and a dramatic functional lift.

Parrish Branch

Parrish Branch was constructed for restoration of a type B4 stream with moderate sinuosity and an average channel slope of 3.3%. Full restoration addressed the degraded conditions of severe channel incision, unstable banks and improper channel dimensions which are negatively affecting the stream functions. A Priority II approach was required for the majority of the reach due to topographic constraints. The downstream end of Parrish Branch was repositioned to connect the channel to the low point in the valley and the new floodplain of Cochran Branch which was constructed as Priority I restoration.

Wetland Rehabilitation and Re-establishment

Wetland re-establishment was integrated throughout the entire area of the Cochran floodplain that contains hydric soils and that is not presently considered jurisdictional wetlands. Wetland rehabilitation was completed for the extant wetlands located within the Cochran floodplain. Using the NCWAM designations, the rehabilitation converted the existing *Non-tidal Freshwater Marsh* to a *Bottomland Hardwood Forrest*. The re-establishment and rehabilitation of the Cochran floodplain as a *Bottomland*

Hardwood Forrest corresponds with the *Montane Alluvial Forrest* community (NCWFAT 2010). Two additional wetland features were also addressed that are not directly connected to the Cochran floodplain. Wetland enhancement was completed for the existing pocket wetland located on the terrace adjacent to the floodplain. Additionally, the restoration of Parrish Branch and adjacent field indicators of buried hydric soils provided the opportunity to re-establish wetlands at the outfall of the middle ditch.

1.4. Project History, Contacts and Attribute Data

The project was first identified as a full-delivery mitigation project for the North Carolina Department of Mitigation Services by Environmental Banc and Exchange, LLC, an entity of Resource Environmental Solutions, LLC (RES). Project planning began in 2012 with the final mitigation plan completed in September 2014 and the final design and construction plans completed in October 2014. Construction and planting of the site was completed in May 2015. Project activities, reporting dates, project contacts, and background information are outlined in Tables 2-4 (Appendix A).

2.0 SUCCESS CRITERIA

2.1. Morphological Parameters and Channel Stability

Restored and enhanced streams shall be in compliance with the standards set forth in the USACE 2003 Stream Mitigation Guidelines and the "Ecosystem Enhancement Program Monitoring Requirements and Performance Standards for Stream and Wetland Mitigation" dated November 7, 2011. Restored and enhanced streams should demonstrate morphologic stability to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the several months that follow construction and some change/variation subsequent to that is also to be expected. However, the observed change should not be unidirectional such that it represents a robust trend. If some trend is evident, it should be very modest or indicate migration to a stable form.

2.1.1. Dimension

Cross-section measurements should indicate little change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether the adjustments are associated with increased stability or whether they indicate movement towards an unstable condition.

2.1.2. Pattern and Profile

Visual inspection of the pattern and profile should indicate stability with little deviation from as-built conditions for the restored stream. Pool depths may vary from year to year, but the majority should maintain depths sufficient to be observed as distinct features. The pools should maintain their depth with flatter water surface slopes, while the riffles should remain shallower and steeper. Pattern and profile measurements will not be collected unless conditions seem to indicate that a detectable and detrimental change appears to have occurred.

2.1.3. Substrate

Calculated D_{50} and D_{84} values should indicate coarser size class distribution of bed materials in riffles and finer size class distribution in pools. The majority of riffle pebble counts should indicate maintenance or coarsening of substrate distributions. Generally, it is anticipated that the bed material will coarsen over time.

2.1.4. Sediment Transport

Depositional features should be consistent with a stable stream that is effectively managing its sediment load. Point bar and inner berm features, if present, should develop without excessive encroachment of the channel. Isolated development of robust (i.e. comprised of coarse material and/or vegetated actively diverting flow) mid-channel or lateral bars will be acceptable. Likewise, development of a higher number of mid-channel or lateral bars that are minor in terms of their permanency such that profile measurements do not indicate systemic aggradation will be acceptable, but trends in the development of robust mid-channel or alternating bar features will be considered a destabilizing condition and may require intervention or have success implications.

2.2. Surface Water Hydrology

Monitoring of stream surface water stages should indicate recurrence of bankfull flow on average every 1 to 2 years. At a minimum, throughout the monitoring period, the surface water stage should achieve bankfull or greater elevations at least twice. The bankfull events must occur during separate monitoring years.

2.3. Groundwater Hydrology

The USACE defines minimum hydrology for jurisdictional wetlands to be saturation within 12 inches of the surface for at least 5% of the growing season if soils and vegetation meet jurisdictional criteria. Given the hydric soils are present throughout the restoration area but that wetland vegetation will be newly established, it is reasonable to set the minimum hydrology threshold slightly above the jurisdictional minimum threshold. As such the minimum performance standard is set to provide saturated soils within 12 inches of the surface for at least eight percent (8%) of the growing season under average climatic conditions. In the event of non-typical years of climatic conditions, groundwater monitoring data should demonstrate similar hydro-periods when compared to the reference wetland groundwater data. The reference wetland site will be the NCDMS Cat Creek Stream and Wetland Restoration Site located east of Franklin in Macon County, NC. The growing season for the site was based on the Natural Resource Conservation Service (NRCS) WETS dataset for Macon County. The Macon County data set is based on a site with elevations roughly the same as the project site. According to NRCS, the growing season for Macon County is defined to be the period with a 50% probability that the daily minimum temperature is higher than 28°F. At the project site, this period extends from April 16th to October 19th for a total of 185 days. Based on this, wetland hydrology success will be achieved if the water table is within 12 inches of the soil surface for 15 consecutive days or more during the growing season.

2.4. Vegetation

Riparian vegetation monitoring shall be conducted for a minimum of seven years to ensure that success criteria are met per USACE guidelines. Accordingly, success criteria will consist of a minimum survival of 260 planted stems per acre by the end of the Year 5 monitoring period and a minimum of 210 planted stems per acre at the end of Year 7. If monitoring indicates either that the specified survival rate is not being met or the development of detrimental conditions (i.e., invasive species, diseased vegetation), appropriate corrective actions will be developed and implemented. Additionally, planted vegetation must average 8 feet in height in each plot at year 7 (as defined in the USACE 2003 SMGs). If this performance standard is met by year 5 and stem density is trending toward success (i.e., no less than 260 five year-old stems/acre) monitoring of vegetation on the site may be terminated provided written approval is given by the USACE in consultation with the North Carolina Interagency Review Team (NCIRT).

3.0 MONITORING PLAN

3.1. Stream Channel Stability and Geomorphology

A total of 9 cross-sections, including 5 riffles and 4 pools, were installed upon completion of construction and will be monitored during MY 1, 3, 5, and 7. The total number of cross-sections include six on Cochran Branch and three on Parrish Branch. Data collected from annual monitoring will be compared with the as-built conditions to document the current state of the channel and any trends in the stream profile occurring throughout the monitoring period.

3.2. Stream Hydrology

A total of two crest gauges were installed on site. Crest gauges will be monitored quarterly to document highest stage for the monitoring interval and verify occurrences of bankfull events. In addition, observations of wrack and depositional features in the floodplain will be documented with photos.

3.3. Groundwater Hydrology

A total of eight groundwater monitoring gauges have been installed upon completion of construction and will be monitored quarterly. Data collected from the quarterly monitoring will be compared to the success criteria stated in Section 2.3 to determine if groundwater hydrology was met by each groundwater monitoring gauge each monitoring year.

3.4. Vegetation

Eight vegetation monitoring plots, approximately 0.025 acres individually, were established based on guidance given in the *CVS-EEP Protocol for Recording Vegetation Version 4.2* (Lee et al. 2008). Data was collected using the Level I protocol during initial baseline monitoring to document baseline conditions immediately after construction and planting. Subsequent annual vegetation will use the Level II protocol. Annual monitoring will determine planted vegetative success and the overall trajectory of woody plant restoration and regeneration at the site. Vegetation monitoring plot corners were marked with t-posts and PVC conduit.

3.5. Permanent Photo Stations

Permanent photo stations were established at each cross-section to digitally document annual conditions of the left and right banks. Each vegetation monitoring plot includes a photo station taken diagonally from the origin towards the opposite plot corner. Additionally, 16 permanent photo stations were established throughout the project area to provide representative digital documentation of stream features and vegetation conditions. Permanent photo stations were marked with labeled wooden stakes and red flagging tape.

3.6. Maintenance and Contingency

RES and Equinox will monitor the site on a regular basis and shall 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 the following:

- *Stream*- Routine channel maintenance and repair activities may include chinking of in-stream structures to prevent piping, securing of loose coir matting, and supplemental installations of live stakes and other target vegetation along the channel. Areas where storm water and floodplain flows intercept the channel may also require maintenance to prevent bank failures and head-

cutting. Management of beaver activity will include removal of nuisance beavers and beaver dams that affect the stream.

- *Wetland*- Routine wetland maintenance and repair activities may include securing of loose coir matting and supplemental installations of live stakes and other target vegetation within the wetland. Areas where storm water and floodplain flows intercept the wetland may also require maintenance to prevent scour.
- *Vegetation*- Vegetation shall be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, mulching, and fertilizing. Exotic invasive plant species shall be controlled by mechanical and/or chemical methods. Any vegetation control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
- *Site Boundary*- Site boundaries shall be identified in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, tree-blazing, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis. Boundary markings will comply with requirements of the RFP Addendum titled "Full Delivery Requirement for Completion of Survey for Conservations Easements" dated 7/21/11.
- *Utility Right of Way*- Utility rights-of-way within the site may be maintained only as allowed by Conservation Easement or existing easement, deed restrictions, rights of way, or corridor agreements.

4.0 BASELINE CONDITIONS

A baseline survey was performed between June 15 and June 25, 2015 to document baseline conditions at the site. A vegetation survey was conducted on May 29, 2015 to document planted vegetation after construction for future comparison.

Reach summary tables, cross-section summary tables, and cross-section plots related to stream morphology can be found in Appendix B. Generally, the pattern, profile, and dimension were relatively similar to those values outlined in the design. The Cochran 1b as-built slope (0.0076 ft/ft) was slightly lower than the design slope of 0.0085; however, the slope falls within the design slope range of 0.0073 – 0.0089. Likewise, the Parrish Branch as-built water surface slope of 0.025 was slightly lower than the design value of 0.033. However, the as-built value fell within the design slope range of 0.018 – 0.033 listed in the mitigation plan.

Vegetation data, summary tables, and plot photos are located in Appendix C. Results from the initial survey indicate that planted stem density ranged between 647 and 850 stems per acre with a mean density of 789 stems per acre across all plots for MY0. A total of nine species were documented across all plots with species diversity within the plots ranging between three and six. At the time of vegetation data collection, herbaceous vegetation had begun to establish.

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)

North Carolina Wetland Functional Assessment Team. 2010. *North Carolina Wetland Assessment Method User Manual*, version 4.1.

Natural Resources Conservation Service. 2015. Field Office Technical Guide for Macon County, North Carolina- WETS Climate Data Retrieval. Accessed July 24, 2015.

Appendix A
General Tables and Figures

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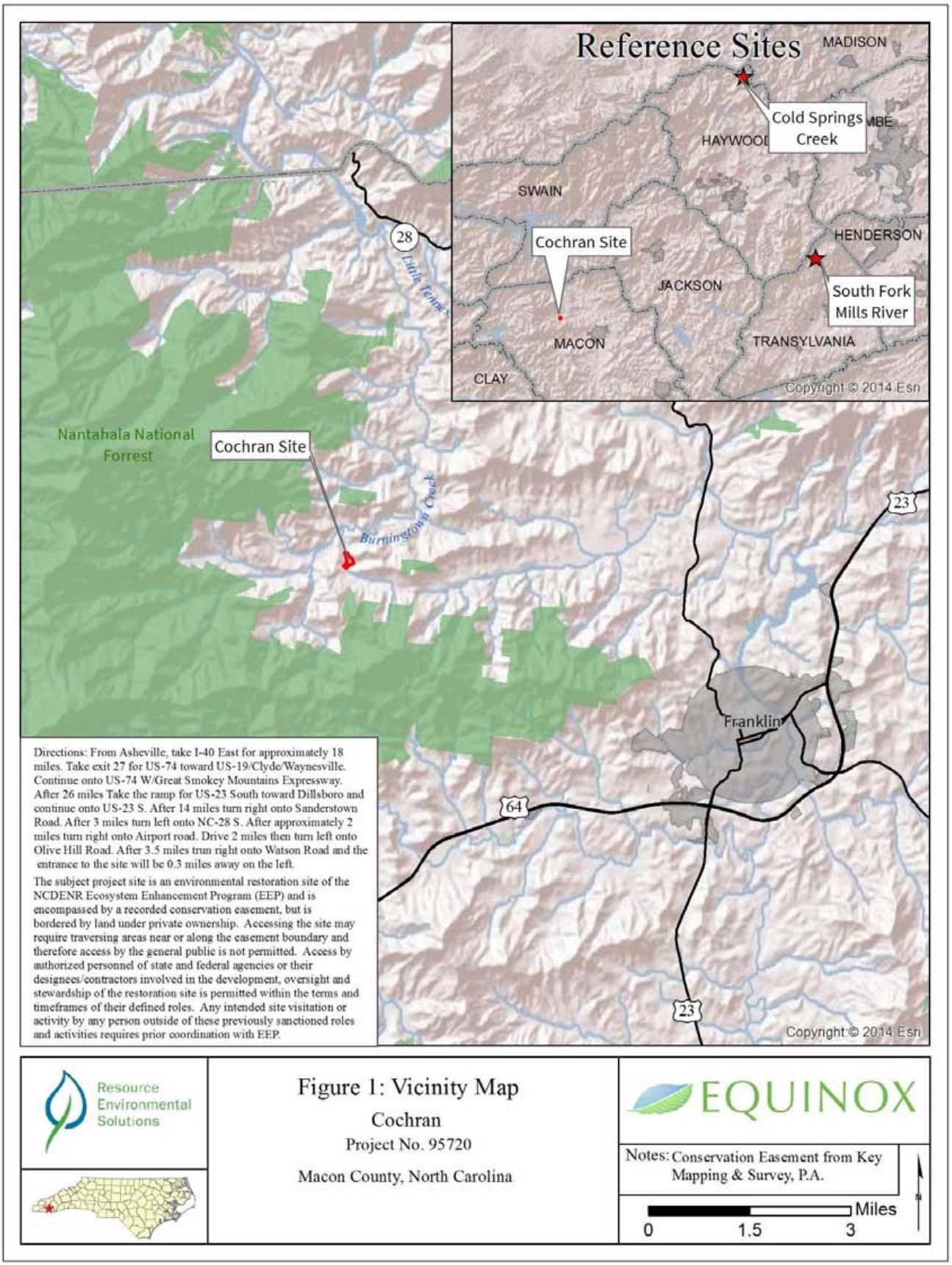
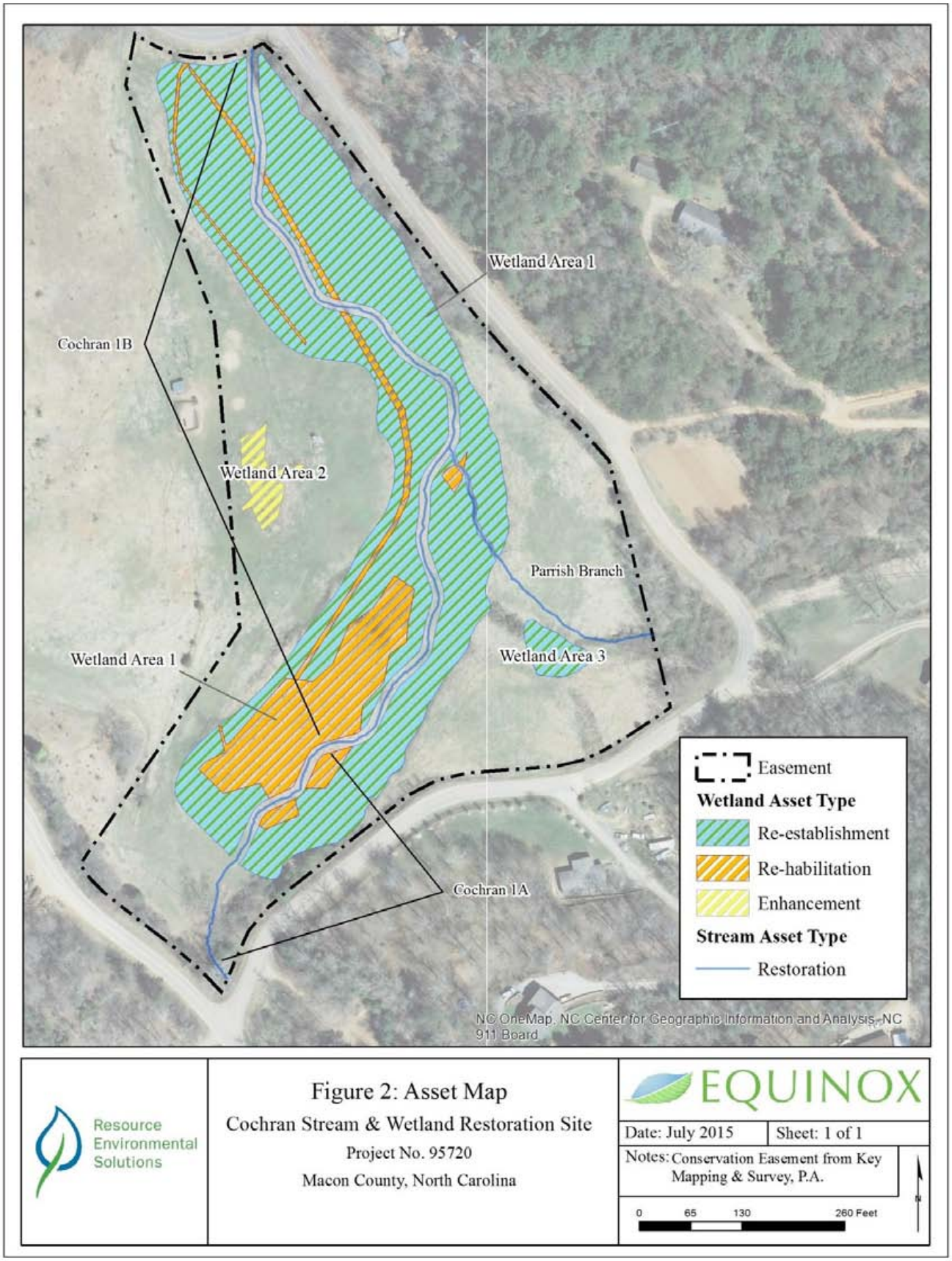

Reference Sites
MADISON
Cold Springs Creek
HAYWOOD
SWAIN
Cochran Site
HENDERSON
JACKSON
South Fork Mills River
MACON
TRANSYLVANIA
CLAY
Copyright © 2014 Esri
Nantahala National Forrest
Cochran Site
Burningtown Creek
Little Tenn
28
23
64
Franklin
Directions: From Asheville, take I-40 East for approximately 18 miles. Take exit 27 for US-74 toward US-19/Clyde/Waynesville. Continue onto US-74 W/Great Smokey Mountains Expressway. After 26 miles Take the ramp for US-23 South toward Dillsboro and continue onto US-23 S. After 14 miles turn right onto Sanderstown Road. After 3 miles turn left onto NC-28 S. After approximately 2 miles turn right onto Airport road. Drive 2 miles then turn left onto Olive Hill Road. After 3.5 miles trun right onto Watson Road and the entrance to the site will be 0.3 miles away on the left.
The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.
Resource Environmental Solutions
Figure 1: Vicinity Map
Cochran
Project No. 95720
Macon County, North Carolina
EQUINOX
Notes: Conservation Easement from Key Mapping & Survey, P.A.
Miles
0
1.5
3


Wetland Area 1
Cochran 1B
Wetland Area 2
Parrish Branch
Wetland Area 1
Wetland Area 3
Cochran 1A
Easement
Wetland Asset Type
Re-establishment
Re-habilitation
Enhancement
Stream Asset Type
Restoration
NC OneMap, NC Center for Geographic Information and Analysis, NC 911 Board
Resource Environmental Solutions
Figure 2: Asset Map
Cochran Stream & Wetland Restoration Site
Project No. 95720
Macon County, North Carolina
EQUINOX
Date: July 2015
Sheet: 1 of 1
Notes: Conservation Easement from Key Mapping & Survey, P.A.
0 65 130 260 Feet
N

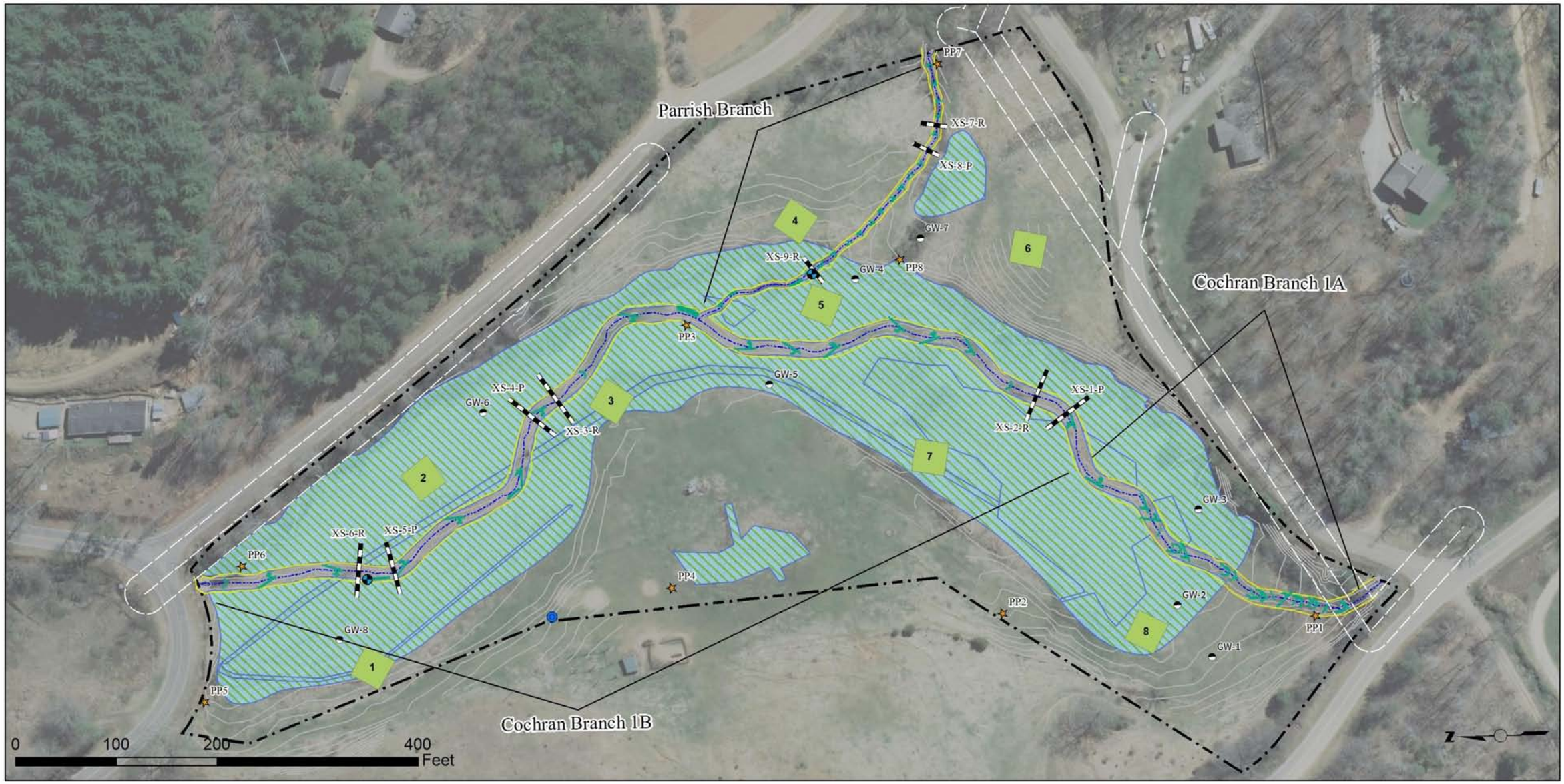


Figure 3. Baseline Monitoring Features
Map Overview
Cochran Stream and Wetland Restoration Project
Macon County, NC
NCDMS Contract No. 004370
NCDMS Project No.: 95720
July 2015

- Crest Gauge
- Gauge
- Monitoring Well
- Photo Points
- Cross-Section
- Thalweg (As-Built)
- Top of Bank
- Duke ROW
- Contour
- Wetland
- Easement
- Hook-Log Run
- Hook Run
- Log Vane with Hook
- Log Sill
- Boulder Shelf
- Brush Toe
- Armored Riffle

Notes:
1) This is not a survey and should not be construed as such.
2) Baseline Data Provided by Kee Mapping
3) Orthoimagery provided by NCOneMap (2010)

Prepared by:
Resource Environmental Solutions
EQUINOX

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Table 1. Project Components and Mitigation Credits

Cochran Branch Stream and Wetland Restoration Site / Project Number 95720

Mitigation Credits

	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	**1,820**		**4.24**	**0.06**			-	-	-

Project Components

Project Component -or- Reach ID	Stationing/Location	Existing Footage/Acreage	Approach (PI, PII etc.)	Restoration -or- Restoration Equivalent	Restoration Footage or Acreage[1]	Mitigation Ratio
Cochran Branch	100+60 - 115+05	1332	PI	R	1,418	1:1
Parrish Branch	200+15 - 204+11	232	PII	R	402	1:1
Wetland Area 1		-	Re-Est.	R	3.33	1:1
Wetland Area 1		0.88	Re-Hab.	R	0.82	1:1
Wetland Area 2		0.11	Enh.	RE	0.11	2:1
Wetland Area 3		-	Re-Est.	R	0.09	1:1

Component Summation

Restoration Level	Stream[1] (linear feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	1,820	-	4.24	-	-	-
Enhancement	-	-	0.11	-	-	-
Enhancement I	-		-	-	-	-
Enhancement II	-	-	-	-	-	-
Creation	-	-	-	-	-	-
Preservation	-	-	-	-	-	-
Preservation	-	-	-	-	-	-

BMP Elements

Element[2]	Location	Purpose/Function	Notes
FB	Entire Site	Protect Stream	

[1]Restoration footage accounts for crossings and exclusions.

[2]BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

Table 2. Project Activity and Reporting History Cochran Branch Stream and Wetland Restoration Site / Project No 95720		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Mitigation Plan	Aug - 2014	Sept - 2014
Final Design - Construction Plans	Oct - 2014	Oct - 2014
Construction	N/A	May - 2015
Permanent Seed Mix Applied	May - 2015	May - 2015
Live Stake and Bare Root Plantings	May - 2015	May - 2015
Baseline Monitoring Document (Year 0 Monitoring - Baseline)	June - 2015	August - 2015
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts	
Cochran Branch Stream and Wetland Restoration Site – Project No 95720	
Prime Contractor	Resource Environmental Solutions, LLC 302 Jefferson Street; Suite 110 Raleigh, North Carolina 27605 David Godley (919) 209-1053
Designer	Wolf Creek Engineering 12 1/2 Wall Street Suite C Asheville, North Carolina 28801 S. Grant Ginn (828) 449-1930
Construction Contractor	Northstate Environmental 2889 Lowery Street Winston Salem, North Carolina 27101 Darrell Westmoreland (336) 725-2010
Seeding Contractor	Northstate Environmental 2889 Lowery Street Winston Salem, North Carolina 27101 Darrell Westmoreland (336) 725-2010
Planting Contractor	Resource Environmental Solutions, LLC 302 Jefferson Street; Suite 110 Raleigh, North Carolina 27605 David Godley (919) 209-1053
As-built Surveys	Kee Mapping and Surveying PO Box 2566 Asheville, North Carolina 28802 Phillip B. Key (828) 575-9021
Seeding Mix Source	Northstate Environmental 2889 Lowery Street Winston Salem, North Carolina 27101 Darrell Westmoreland (336) 725-2010
Bare Root Seedlings	Arborgen 5594 Higway 38 South Blenheim, SC 29516 (843)528-9669
	North Carolina Foresty Claridge Nursery 762 Claridge Nursery Road Goldsboro, North Carolina 27530 (919) 731-7988
Live Stakes	Foggy Mountain Nursery 2251 Ed Little Road Creston, North Carolina 28643 (336) 384-5323
Monitoring Performers (MY0)-2015	Equinox Environmental 37 Haywood St. Asheville, North Carolina 28802 Hunter Terrell (828) 253-6856

Table 4. Project Baseline Information and Attributes					
Project Information					
Project Name	Cochran Branch				
County	Macon County				
Project Area (acres)	10.06				
Project Coordinates (latitude and longitude)	35°12'52.03" N, 83°29'20.10" W				
Project Watershed Summary Information					
Physiographic Province	Blue Ridge				
River Basin	Little Tennessee				
USGS Hydrologic Unit 8-digit: 06010203		USGS Hydrologic Unit 14-Digit: 6010202040020			
DWQ Sub-basin	40-04-01				
Project Drainage Area (acres)	811				
Project Drainage Area Percentage of Impervious Area	<5%				
CGIA Land Use Classification	2.01.03 Hay and Pasture Land				
Reach Summary Information					
Parameters	**Cochran Branch**	**Parrish Branch**			
Length of reach (linear feet)	1332	232			
Valley classification (Rosgen)	II	II			
Drainage area	1.25	0.11			
NCDWQ stream identification score	48	40			
NCDWQ Water Quality Classification	B, Tr	B, Tr			
Morphological Description (stream type) (Rosgen)	G4	G4			
Evolutionary trend (Rosgen)	G→ F → C → E	G→ F → B			
Underlying mapped soils	NkA	NkA, ScC			
Drainage class	Verry Poorly Drained	Very Poorly Drained, Mod Well Drained			
Soil Hydric status	Hydric	Hydric, Non-Hydric			
Slope	0.7%	4.2%			
FEMA classification	N/A	N/A			
Native vegetation community	Agricultural	Agricultural			
Percent composition of exotic invasive vegetation	6%	0%			
Wetland Summary Information					
Parameters	**A**	**B**	**C**	**D**	**E**
	4.24	0.11			
Wetland Type (non-riparian, riparian riverine or riparian non-riverine)	Riparian Non-Riverine	Riparian Non-Riverine			
Mapped Soil Series	NkA	NkA			
Drainage class	Verry Poorly Drained	Verry Poorly Drained			
Soil Hydric Status	Hydric	Hydric			
Source of Hydrology	Groundwater	Groundwater			
Previous Hydrologic Impairment	Dredging/Ditching	Dredging/Ditching			
Native vegetation community	Montane Alluvial Forest	Montane Alluvial Forest			
Percent composition of exotic invasive vegetation	0%	0%			

Regulatory Considerations			
Regulation	**Applicable?**	**Resolved?**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	PCN 27 (SAW -2013-00280)
Waters of the United States – Section 401	Yes	Yes	401 Certification DWR# 13-0188
Endangered Species Act	No	Yes	ERTR
Historic Preservation Act	No	Yes	ERTR
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	No	N/A	
FEMA Floodplain Compliance	N/A	N/A	
Essential Fisheries Habitat	N/A	N./A	

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Appendix B
Morphological Summary Data and Plots

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Table 5. Baseline Stream Data Summary
Cochran Branch / Project No. 95720 - Cochran Branch 1a (379 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline[1]					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	-	18.9	9.0	10.0	10.0	11.0	1.4	2	23.4	24.7	-	24.7	-	-	-	14.7	-	-	-	-	-	-	-
Floodprone Width (ft)				12.0	18.5	18.5	25.0	9.2	2	43.0	48.0	-	52.0	-	-	-	-	-	-	-	-	-	-	-
Bankfull Mean Depth (ft)	-	-	1.3	0.9	1.0	1.0	1.1	0.1	2	1.3	1.4	-	1.5	-	-	-	0.9	-	-	-	-	-	-	-
Bankfull Max Depth (ft)				1.2	1.3	1.3	1.5	0.2	2	1.8	1.8	-	2.2	-	-	-	1.13	-	-	-	-	-	-	-
Bankfull Cross Sectional Area (ft^2)		21.5		9.6	9.8	9.8	10.0	0.3	2	33.4	33.4	-	34.6	-	-	-	12.7	-	-	-	-	-	-	-
Width/Depth Ratio				8.4	10.3	10.3	12.1	2.6	2	15.8	18.3	-	18.4	-	-	-	17.0	-	-	-	-	-	-	-
Entrenchment Ratio				1.3	1.8	1.8	2.3	0.7	2	1.7	1.9	-	2.1	-	-	-	5.4	-	-	-	-	-	-	-
Bank Height Ratio				0.9	1.5	1.5	2.0	0.8	2	1.0	1.2	-	1.3	-	-	-	-	-	-	-	-	-	-	-
d50 (mm)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	29.0	-	40.0	-	-	-	-	-	10.9	20.4	18.8	31.7	8.6	7
Riffle Slope (ft/ft)				-	-	-	-	-	-	0.015	0.023	-	0.028	-	-	0.009	0.017	0.025	0.007	0.017	0.021	0.025	0.007	7
Pool Length (ft)				-	-	-	-	-	-	6.0	18.0	-	42.0	-	-	-	-	-	5.3	10.7	8.7	21.6	5.5	7
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	2.3	-	2.3	-	-	-	-	-	2.0	2.4	2.4	3.1	0.4	6
Pool Spacing (ft)				-	-	-	-	-	-	51.0	87.0	-	113.0	-	-	34.1	45.4	56.8	36.2	48.6	47.6	62.2	9.6	6
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-	18.7	24.9	31.2	17.1	27	28.7	33.4	7.4	4
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	75.0	-	103.0	-	-	25.0	31.0	37.0	24.0	37.6	43.9	44.8	11.8	3
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6	2.6	3.0	3.0	0.8	3
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	73.9	92.8	92.4	116	19.2	5
Meander Width Ratio				-	-	-	-	-	-	-	1.7	-	-	-	-	-	1.5	-	1.2	1.8	2.0	2.3	0.5	4
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%					-						-									42%/ 28%/ 22%/ 7%/ 0%				
SC% / Sa% / G% / C% / B% / Be%					- / 56% / - / - / - / -						1% / 10% / 48% / 41% / 0% / 1%													
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)					3 / 4 / 6 / 11 / 14 / - / -						5.2 / 22 / 45 / 130 / 190 / - / -													
Reach Shear Stress (Competency) lb/ft^2					-						1.947						0.47			-				
Max Part Size (mm) Mobilized at Bankfull					-						91						45			-				
Stream Power (Transport Capacity) W/m^2					-						-						1.6							
Additional Reach Parameters																								
Drainage Area (mi^2)					1.11						2.77													
Impervious Cover Estimate (%)					-						-													
Rosgen Classification					G						B4						B4			B				
Bankfull Velocity (fps)		-			-						4.5						3.5							
Bankfull Discharge (cfs)		-			-						123.0						66.0							
Valley Length (ft)					-						380						321							
Channel Thalweg Length (ft)					-						400						337			379				
Sinuosity					-						1.10						1.05			1.18				
Water Surface Slope (ft/ft)					-						-						0.035			0.033				
Bankfull Slope (ft/ft)					-						-						0.035			0.033				
Bankfull Floodplain Area (acres)					-						-						-							
Proportion Over Wide (%)					-						-													
Entrenchment Class (ER Range)					-						-													
Incision Class (BHR Range)					-						-													
BEHI					20.6						-													
Channel Stability or Habitat Metric					-						-													
Biological or Other					-						-													

[1]Reach less than 500 feet and restricted to visual assessment; no cross-sections located in this reach

- Information unavailable.

Non-Applicable.

Table 5. Baseline Stream Data Summary
Cochran Branch / Project No. 95720 - Cochran Branch 1b (1,101 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)			18.9	7.0	7.9	7.5	9.5	1.2	4	12.0	14.4	-	16.5	-	-	-	14.7	-	14.6	16.6	17.3	17.8	1.77	3
Floodprone Width (ft)				15.0	16.8	16.0	20.0	2.2	4	60.0	72.5	-	72.5	-	-	-	-	-	135.0	168.5	173.5	197.0	31.3	3
Bankfull Mean Depth (ft)	-	-	1.3	1.2	1.3	1.3	1.5	0.2	4	-	-	-	-	-	-	-	0.9	-	0.8	0.8	0.8	1.0	0.11	3
Bankfull Max Depth (ft)				1.5	1.7	1.7	1.8	0.2	4	19	2.3	-	3.3	-	-	-	1.13	-	1.0	1.2	1.1	1.5	0.24	3
Bankfull Cross Sectional Area (ft^2)	21.5			8.3	10.5	10.9	12.1	1.6	4	18.2	25.9	-	35.9	-	-	-	12.7	-	11.0	13.7	13.6	16.6	2.78	3
Width/Depth Ratio				4.7	6.0	5.6	8.1	1.5	4	7.1	8.2	-	10.0	-	-	-	17.0	-	18.1	20.3	19.2	23.4	2.8	3
Entrenchment Ratio				1.7	2.2	2.2	2.5	0.3	4	4.3	4.9	-	5.5	-	-	-	11.5	-	9.3	10.1	10.0	11.0	0.85	3
Bank Height Ratio				1.5	1.9	2.0	2.2	0.3	4	0.7	1.1	-	1.6	-	-	-	-	-	1.0	1.0	1.0	1.0	0	3
d50 (mm)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	62.6	82.0	-	101.4	-	-	-	-	-	12.4	29.5	33.6	47.0	11.6	17
Riffle Slope (ft/ft)				-	-	-	-	-	-	0.006	0.006	-	0.007	-	-	0.006	0.008	0.009	0.001	0.006	0.006	0.017	0.004	17
Pool Length (ft)				-	-	-	-	-	-	13.4	45.1	-	80.3	-	-	-	-	-	16.2	24.1	24.2	31.0	4.6	17
Pool Max Depth (ft)				-	-	-	-	-	-	0.4	0.5	-	0.6	-	-	-	-	-	2.3	3.1	3.0	4.2	0.5	17
Pool Spacing (ft)				-	-	-	-	-	-	67.9	84.9	-	101.9	-	-	62.3	74.8	87.3	38.0	60.2	59.5	86.8	15.6	17
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	24.9	49.9	62.3	17.2	33.9	29.0	64.0	13.9	11
Radius of Curvature (ft)				-	-	-	-	-	-	-	-	-	-	-	-	19.0	25.0	31.0	22.5	29.1	27.4	36.6	5.2	7
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	1.8	1.7	2.2	0.3	7
Meander Wavelength (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.1	130.8	136.9	249.7	58.2	12
Meander Width Ratio				-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	-	1.0	2.0	1.7	3.9	0.8	11
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%				-						-									50% / 3%/ 39%/ 8%/ 0%					
SC% / Sa% / G% / C% / B% / Be%				- / 30% / - / - / - / -						- / 9% / - / - / - / - / -														
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)				4 / 8 / 11 / 22 / 29 / - / -						7 / 26 / 54 / 68 / 70 / - / -														
Reach Shear Stress (Competency) lb/ft^2				-						-						0.42			-					
Max Part Size (mm) Mobilized at Bankfull				-						-						45			-					
Stream Power (Transport Capacity) W/m^2				-						-						1.3								
Additional Reach Parameters																								
Drainage Area (mi^2)				1.20						0.72														
Impervious Cover Estimate (%)				-						-														
Rosgen Classification				G						E4						C4			C					
Bankfull Velocity (fps)	-			-						-						-								
Bankfull Discharge (cfs)	-			-						-						66.0								
Valley Length (ft)				-						-						989								
Channel Thalweg Length (ft)				-						416.7						1,088			1,101					
Sinuosity				-						-						1.1			1.12					
Water Surface Slope (ft/ft)				-						-						0.0085			0.0076					
Bankfull Slope (ft/ft)				-						-						-			0.0068					
Bankfull Floodplain Area (acres)				-						-						-								
Proportion Over Wide (%)				-						-														
Entrenchment Class (ER Range)				-						-														
Incision Class (BHR Range)				-						-														
BEHI				25.7						-														
Channel Stability or Habitat Metric				-						-														
Biological or Other				-						-														

- Information unavailable.

Non-Applicable.

Table 5. Baseline Stream Data Summary
Cochran Branch / Project No. 95720 - Parrish Branch (402 feet)

Parameter	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			As-Built / Baseline					
Dimension & Substrate - Riffle	**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**	**Min**	**Mean**	**Max**	**Min**	**Mean**	**Med**	**Max**	**SD**	**N**
Bankfull Width (ft)	-	-	7.4	3.5	4.1	4.1	4.7	0.8	2	23.4	24.7	-	24.7	-	-	-	5.4	-	4.4	5.2	5.2	5.9	1.06	2
Floodprone Width (ft)				8.0	8.0	8.0	8.0	0.0	2	43.0	48	-	52.0	-	-	-	-	-	14.2	19.1	19.1	24.0	6.93	2
Bankfull Mean Depth (ft)	-	-	0.6	0.4	0.5	0.5	0.5	0.1	2	1.3	1.35	-	1.5	-	-	-	0.4	-	0.4	0.4	0.4	0.4	0.03	2
Bankfull Max Depth (ft)				0.6	0.7	0.7	0.8	0.1	2	1.8	1.8	-	2.2	-	-	-	0.57	-	0.6	0.6	0.6	0.6	0.01	2
Bankfull Cross Sectional Area (ft^2)		4.0		1.4	1.9	1.9	2.3	0.6	2	33.4	33.4	-	34.6	-	-	-	2.2	-	1.8	2.0	2.0	2.1	0.23	2
Width/Depth Ratio				8.5	9.0	9.0	9.5	0.7	2	15.8	18.3	-	18.4	-	-	-	13.4	-	10.9	13.8	13.8	16.6	3.99	2
Entrenchment Ratio				1.6	2.0	2.0	2.3	0.5	2	1.7	1.9	-	2.1	-	-	-	5.6	-	3.2	3.6	3.6	4.0	0.57	2
Bank Height Ratio				2.3	6.2	6.2	10.0	5.4	2	1.0	1.2	-	1.3	-	-	-	-	-	1.0	1.0	1.0	1.0	0	2
d50 (mm)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Profile																								
Riffle Length (ft)				-	-	-	-	-	-	20.0	29.0	-	40.0	-	-	-	-	-	6.1	10.0	9.8	15.5	2.3	22
Riffle Slope (ft/ft)				-	-	-	-	-	-	0.015	0.023	-	0.028	-	-	0.017	0.026	0.035	0.001	0.025	0.023	0.047	0.013	22
Pool Length (ft)				-	-	-	-	-	-	6.0	18.0	-	42.0	-	-	-	-	-	1.7	5.0	4.5	10.2	2.0	22
Pool Max Depth (ft)				-	-	-	-	-	-	2.3	2.3	-	2.3	-	-	-	-	-	1.1	1.5	1.5	1.9	0.2	22
Pool Spacing (ft)				-	-	-	-	-	-	51.0	87.0	-	113.0	-	-	12.4	16.5	20.7	13.5	17.2	15.5	25.2	3.4	21
Pattern																								
Channel Belt Width (ft)				-	-	-	-	-	-	-	43.0	-	-	-	-	6.4	8.5	10.6	6.9	9.9	9.8	12.6	1.4	14
Radius of Curvature (ft)				-	-	-	-	-	-	44.0	75.0	-	103.0	-	-	9.0	11.0	13.0	5.8	9.5	8.9	15.3	3.2	8
Rc: Bankfull Width (ft)				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.8	1.7	2.9	0.6	8
Meander Wavelength (ft)				-	-	-	-	-	-	-	100.0	-	-	-	-	-	-	-	29.1	32.1	31.4	39.7	2.7	15
Meander Width Ratio				-	-	-	-	-	-	-	1.7	-	-	-	-	-	2.8	-	1.3	1.9	1.9	2.4	0.3	14
Substrate, Bed and Transport Parameters																								
Ri% / Ru% / P% / G% / S%						-						-									59%/ 0%/ 29%/ 5%/ 7%			
SC% / Sa% / G% / C% / B% / Be%						-						1% / 10% / 48% / 41% / 0% / 1%												
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)						-						5.2 / 22 / 45 / 130 / 190 / - / -												
Reach Shear Stress (Competency) lb/ft^2						-						1.947					0.47				-			
Max Part Size (mm) Mobilized at Bankfull						-						91					45				-			
Stream Power (Transport Capacity) W/m^2						-						-					-							
Additional Reach Parameters																								
Drainage Area (mi^2)						0.10						2.77												
Impervious Cover Estimate (%)						-						-												
Rosgen Classification						G						B4					B4				B			
Bankfull Velocity (fps)		-				-						4.5					-							
Bankfull Discharge (cfs)		-				-						123.0					9.0							
Valley Length (ft)						-						380.0					375							
Channel Thalweg Length (ft)						-						400.0					394				402			
Sinuosity						-						1.1					1.05				1.07			
Water Surface Slope (ft/ft)						-						-					0.033				0.025			
Bankfull Slope (ft/ft)						-						-					-				0.029			
Bankfull Floodplain Area (acres)						-						-					-							
Proportion Over Wide (%)						-						-												
Entrenchment Class (ER Range)						-						-												
Incision Class (BHR Range)						-						-												
BEHI						26.6						-												
Channel Stability or Habitat Metric						-						-												
Biological or Other						-						-												

- Information unavailable.

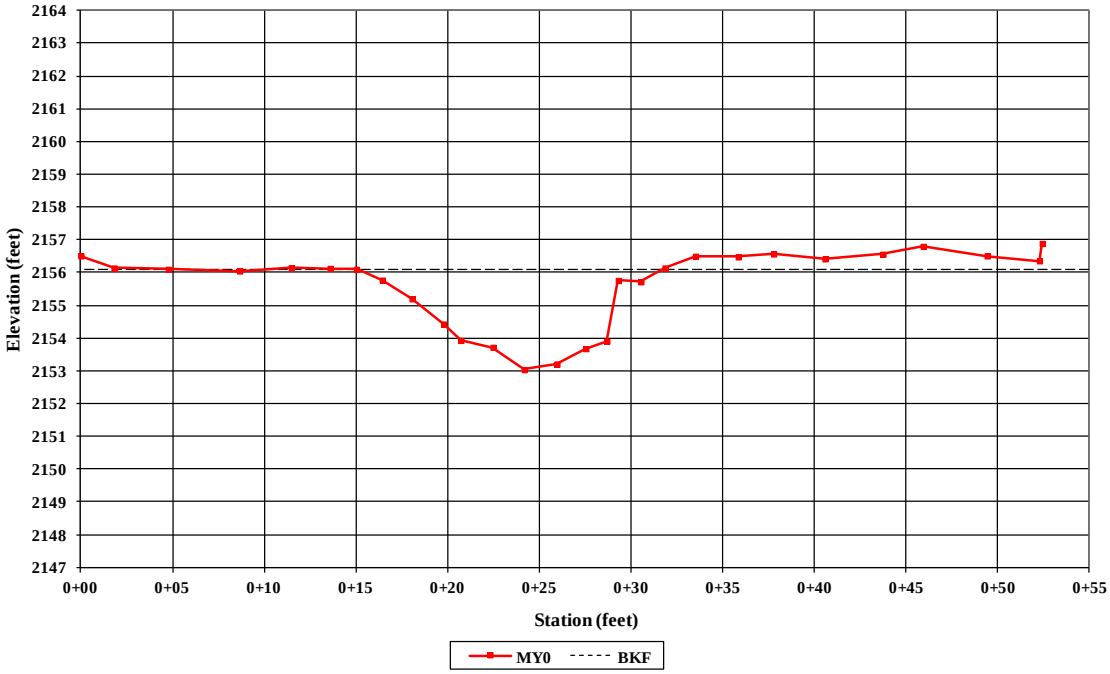
Non-Applicable.

Table 6. Baseline Morphology & Hydraulic Monitoring Summary Cochran Branch / Project No. 95720																												
	Cross-Section 1 (Pool) Cochran Banch						Cross-Section 2 (Riffle) Cochran Branch						Cross-Section 3 (Riffle) Cochran Branch						Cross-Section 4 (Pool) Cochran Branch						Cross-Section 5 (Pool) Cochran Branch					
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
Record Elevation (datum) Used	2,156.1						2,155.8						2,152.1						2,151.9						2,149.9					
Bankfull Width (ft)	16.7						17.3						14.6						16.2						17.0					
Floodprone Width (ft)	>217						>173.5						>135						>217.5						>236.5					
Bankfull Mean Depth (ft)	1.6						1.0						0.8						1.9						1.5					
Bankfull Max Depth (ft)	3.1						1.5						1.0						3.5						3.3					
Bankfull Cross Sectional Area (ft^2)	27.5						16.6						11.0						31.0						25.4					
Bankfull Width/Depth Ratio	10.2						18.1						19.2						8.5						11.4					
Bankfull Entrenchment Ratio	>13						>10						>9.3						>13.4						>13.9					
Bankfull Bank Height Ratio	1.0						1.0						1.0						1.0						1.0					
Cross Sectional Area between End Pins (ft^2)	40.8						45.8						25.4						49.7						54.2					
d50 (mm)	-						-						-						-						-					
	Cross-Section 6 (Riffle) Cochran Branch						Cross-Section 7 (Riffle) Parrish Branch						Cross-Section 8 (Pool) Parrish Branch						Cross-Section 9 (Riffle) Parrish Branch											
Dimension	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**						
Record Elevation (datum) Used	2149.7						2160.2						2159.8						2154.6											
Bankfull Width (ft)	17.8						4.4						6.8						5.9											
Floodprone Width (ft)	>197						>14.2						>93.7						>24.0											
Bankfull Mean Depth (ft)	0.8						0.4						0.8						0.4											
Bankfull Max Depth (ft)	1.1						0.6						1.8						0.6											
Bankfull Cross Sectional Area (ft^2)	13.6						1.8						5.2						2.1											
Bankfull Width/Depth Ratio	23.4						10.9						9.0						16.6											
Bankfull Entrenchment Ratio	>11						>3.2						>13.7						>4											
Bankfull Bank Height Ratio	1.0						1.0						1.0						1.0											
Cross Sectional Area between End Pins (ft^2)	37.9						40.6						31.6						29.4											
d50 (mm)	-						-						-						-											

N/A - Item does not apply.

- Information Unavailable

Cochran Branch
Cross Section 1 - Pool
Station 104+73



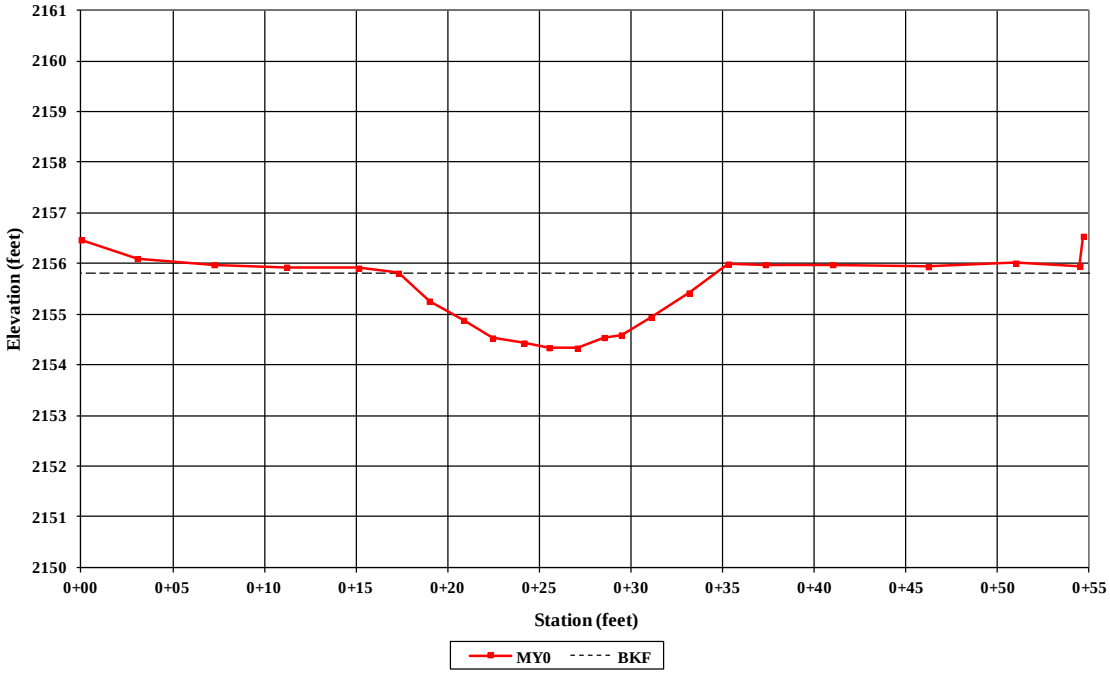
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Cochran Branch
Cross Section 2 - Riffle
Station 105+08



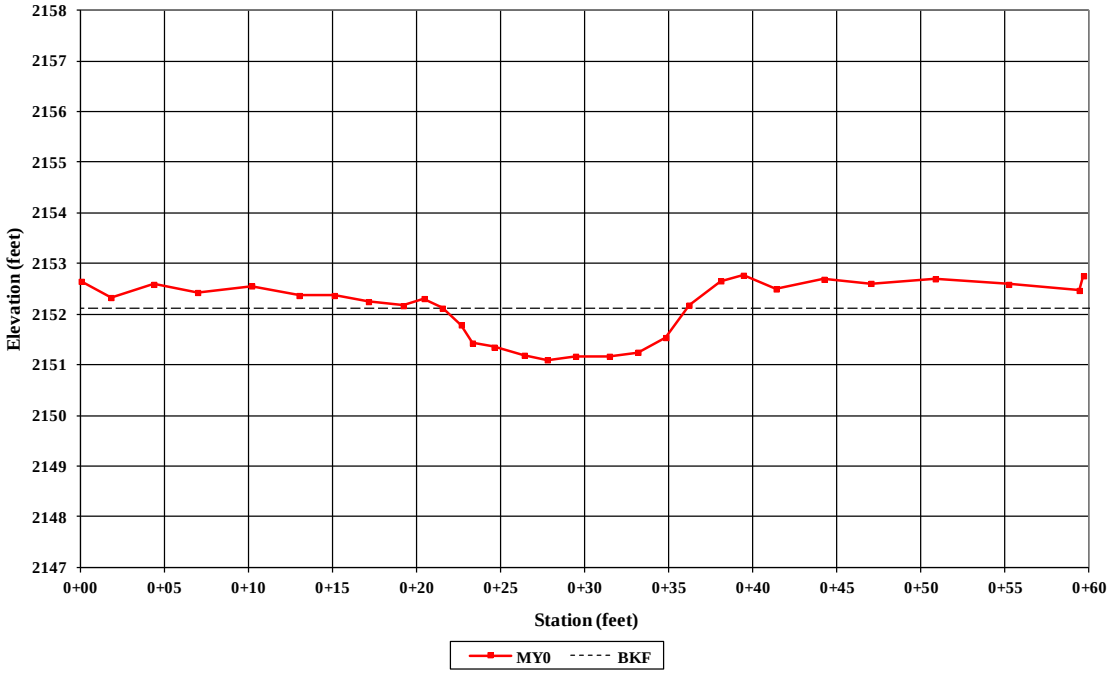
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Cochran Branch
Cross Section 3 - Riffle
Station 110+60



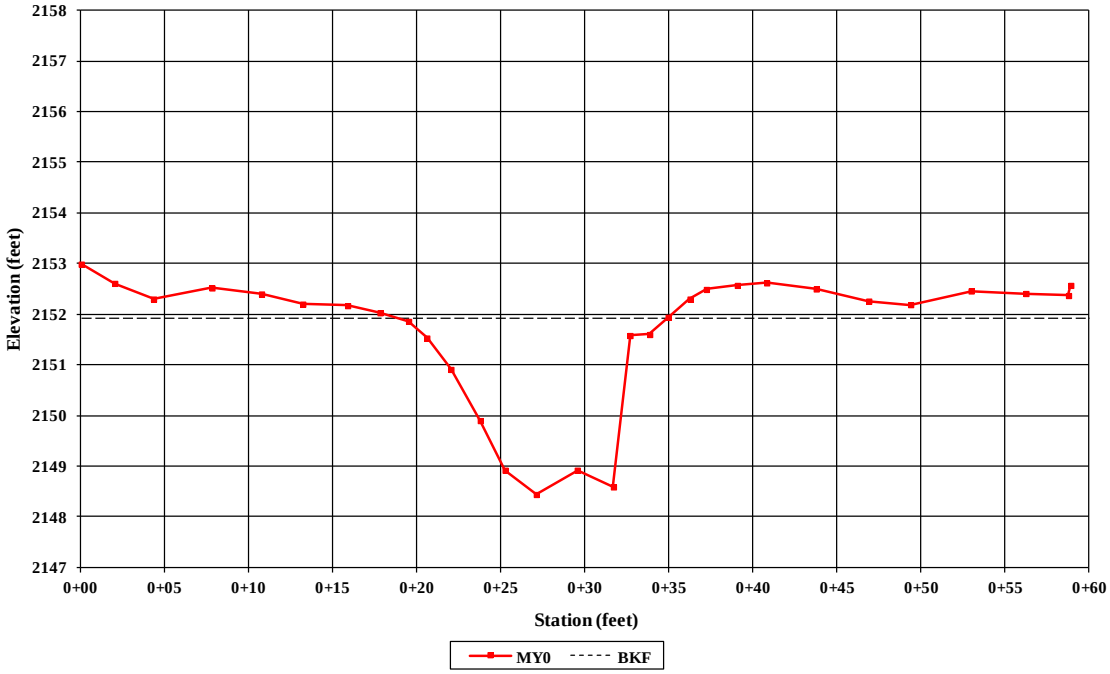
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Cochran Branch
Cross Section 4 - Pool
Station 110+90



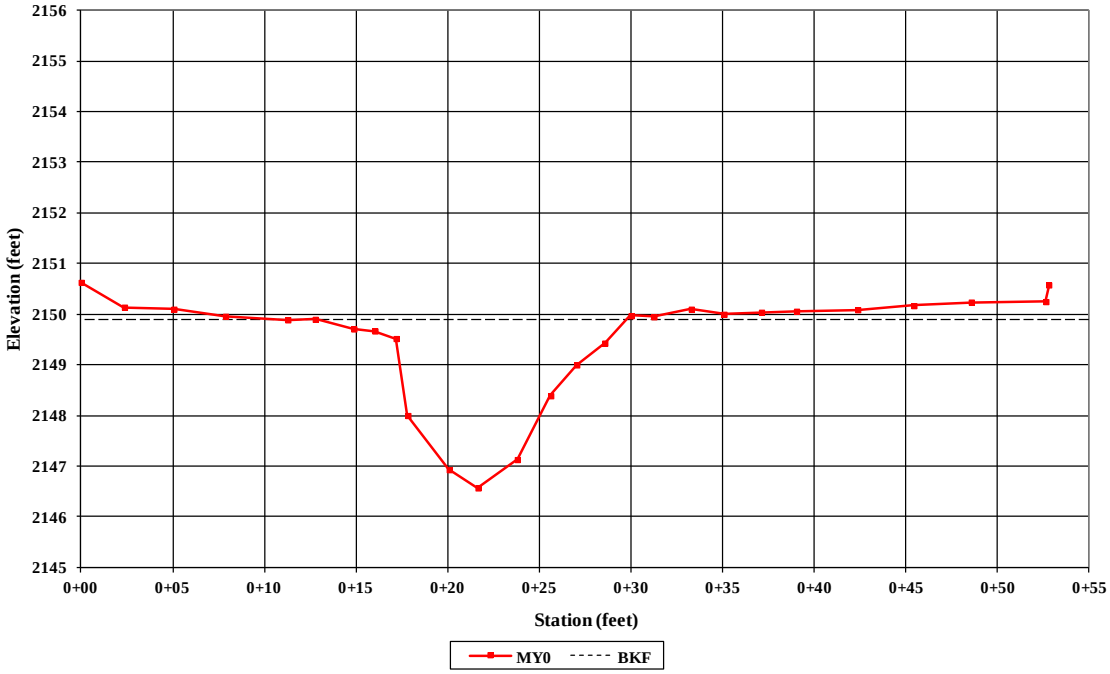
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Cochran Branch
Cross Section 5 - Pool
Station 113+08



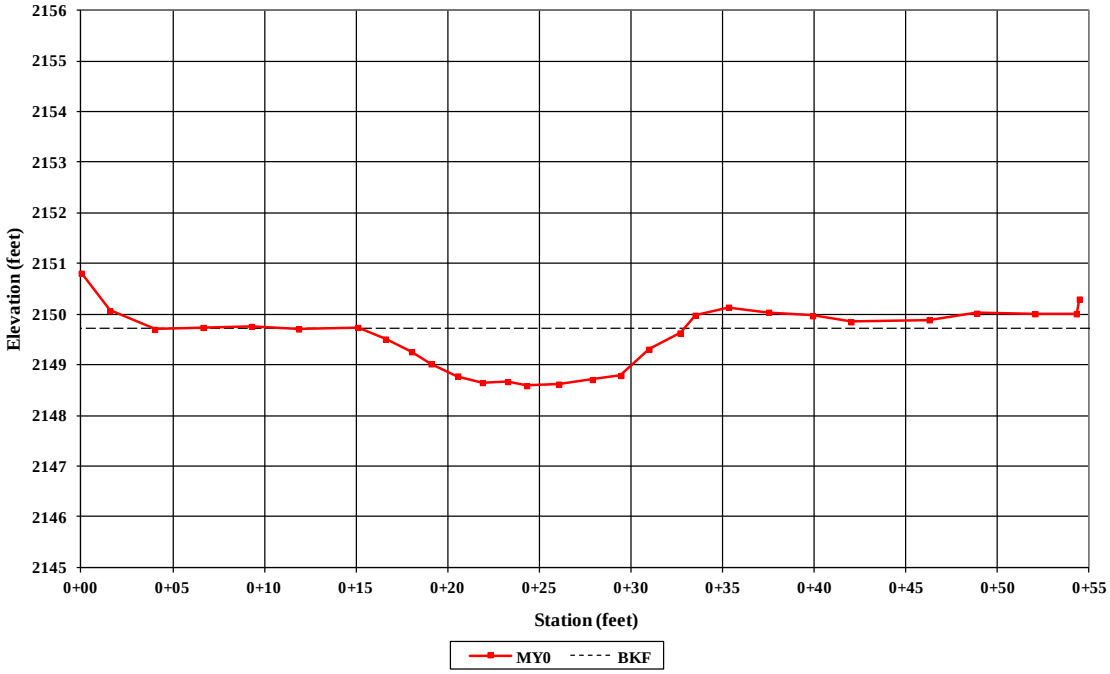
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Cochran Branch
Cross Section 6 - Riffle
Station 113+44



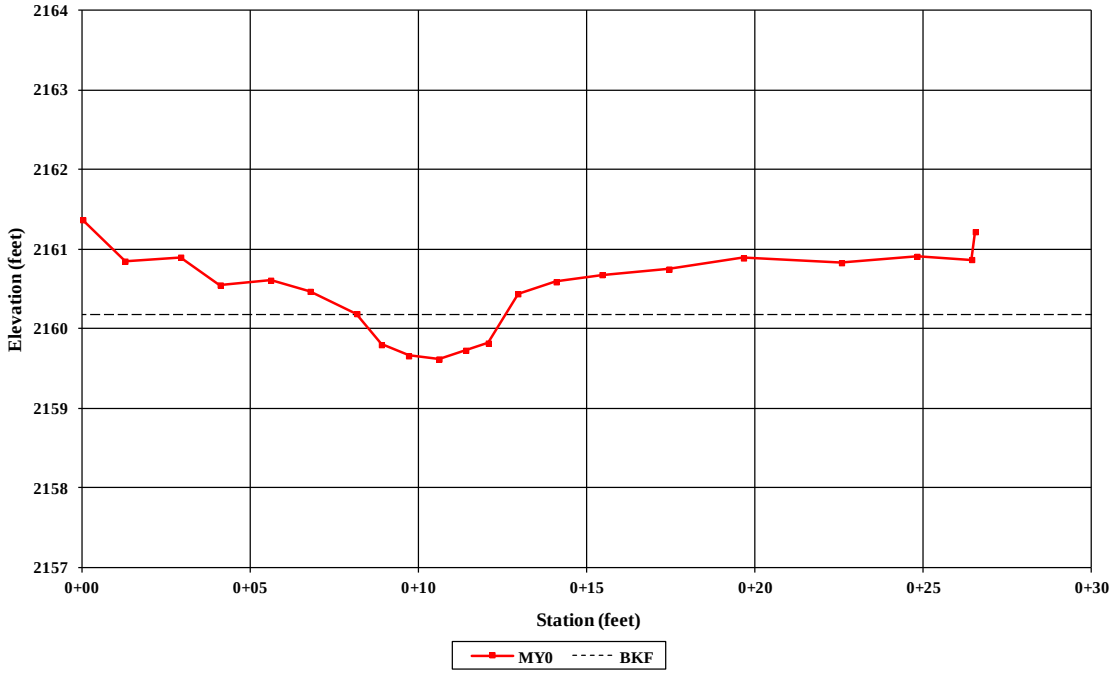
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Parrish Branch
Cross Section 7 - Riffle
Station 200+88



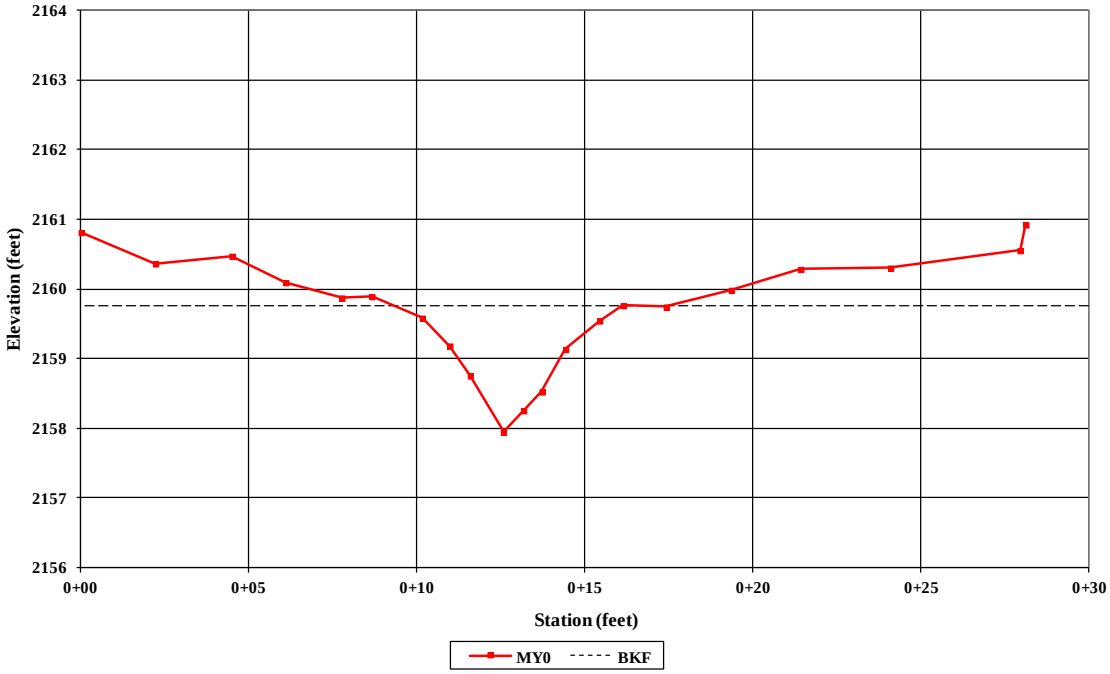
Left Descending Bank

Right Descending Bank

Upstream

Downstream

Parrish Branch
Cross Section 8 - Pool
Station 201+07

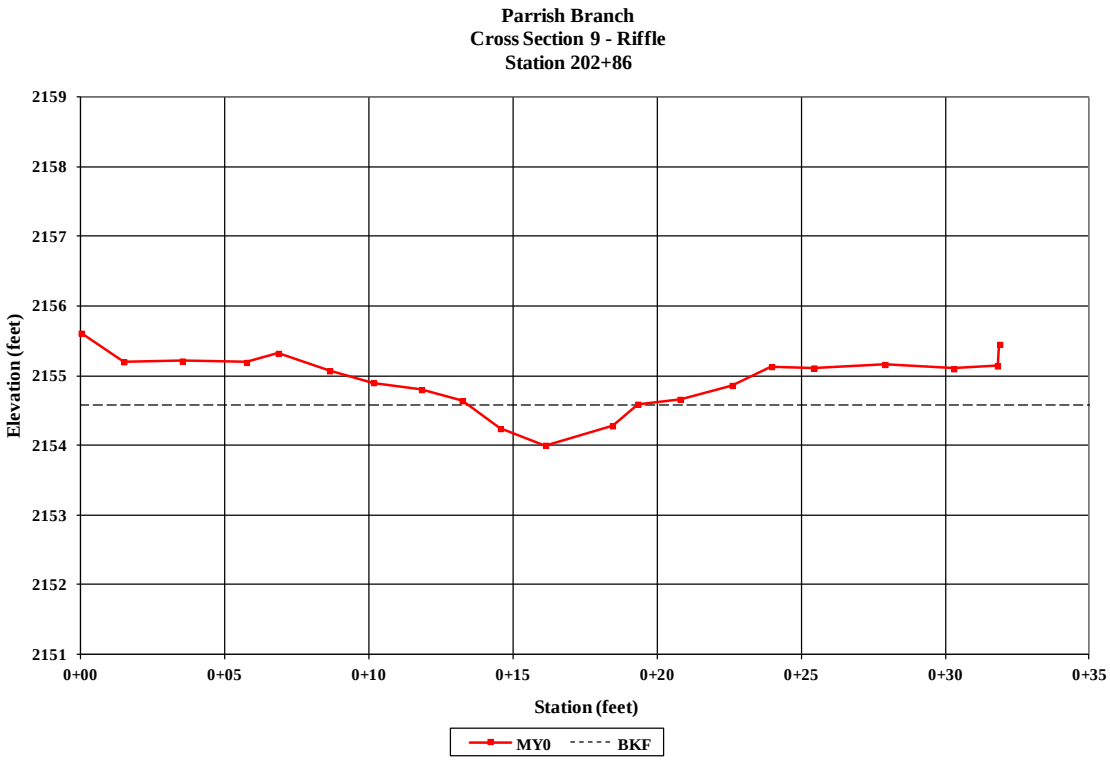


Left Descending Bank

Right Descending Bank

Upstream

Downstream



Left Descending Bank

Right Descending Bank

Upstream

Downstream

Appendix C
Vegetation Data

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Table 7. Current Plot Data (MY0 2015) Cochran Branch/ Project No. 95720																				
Scientific Name	Common Name	Species Type	Plot 01		Plot 02		Plot 03		Plot 04		Plot 05		Plot 06		Plot 07		Plot 08		MY0 (2015)	
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer rubrum var. rubrum	Red maple	Tree	4	4															4	4
Betula nigra	River birch	Tree			4	4	2	2			3	3	1	1	6	6			16	16
Fraxinus pennsylvanica	Green ash	Tree					2	2											2	2
Liriodendron tulipifera var. tulipifera	Tulip-tree, Yellow Po	Tree	2	2			6	6	6	6			6	6	2	2	5	5	27	27
Platanus occidentalis var. occidentalis	Sycamore, Plane-tree	Tree	4	4	11	11	7	7	6	6	12	12	1	1	6	6	1	1	48	48
Quercus	Oak Species	Tree	4	4	4	4	1	1	7	7	6	6	8	8	1	1	7	7	38	38
Quercus michauxii	Swamp chestnut oak	Tree	3	3			3	3							3	3	2	2	11	11
Quercus phellos	Willow oak	Tree	4	4					1	1					3	3			8	8
Quercus rubra var. rubra	Northern red oak	Tree															1	1	1	1
Unknown		Shrub or Tree															1	1	1	1
Stem count			21	21	19	19	21	21	20	20	21	21	16	16	21	21	17	17	156	156
size (ares)			1		1		1		1		1		1		1		1		8	
size (ACRES)			0.02		0.02		0.02		0.02		0.02		0.02		0.02		0.02		0.20	
Species count			6	6	3	3	6	6	4	4	3	3	4	4	6	6	6	6	10	10
Stems per ACRE			850	850	769	769	850	850	809	809	850	850	647	647	850	850	688	688	789	789

P=Planted; T=Planted & Volunteer

Color for Density

Exceeds requirements by 10%

Exceeds requirements, but by less than 10%

Fails to meet requirements, by less than 10%

Fails to meet requirements by more than 10%

Table 8. Vegetation Plot Criteria Attainment		
Cochran Branch / Project No. 95720		
Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	Yes	100%
2	Yes	
3	Yes	
4	Yes	
5	Yes	
6	Yes	
7	Yes	
8	Yes	

Vegetation Monitoring Plot 1

Vegetation Monitoring Plot 2

Vegetation Monitoring Plot 3

Vegetation Monitoring Plot 4

Vegetation Monitoring Plot 5

Vegetation Monitoring Plot 6

Vegetation Monitoring Plot 7

Vegetation Monitoring Plot 8

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Appendix D
Permanent Photo Stations

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Cochran Branch Reach 1a – Permanent Photo Station 1
Station 101+33 - Downstream

Cochran Branch Reach 1a – Permanent Photo Station 1
Station 101+33 - Upstream

Cochran Branch – Permanent Photo Station 2
East 95°

Cochran Branch – Permanent Photo Station 2
South 186°

Cochran Branch – Permanent Photo Station 3
Station 108+87 – Upstream

Parrish Branch – Permanent Photo Station 3
Station 108+87 - Upstream

Cochran Branch – Permanent Photo Station 4
South Southeast 160°

Cochran Branch – Permanent Photo Station 5
Southeast 150°

Cochran Branch – Permanent Photo Station 6
Station 114+62 – Upstream 186°

Parrish Branch – Permanent Photo Station 7
Station 200+25 – Upstream 276°

Parrish Branch – Permanent Photo Station 8
Southeast 135°

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Appendix E
Record Set

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NC DMS PROJECT #95720

RESOURCE ENVIRONMENTAL SOLUTIONS, LLC

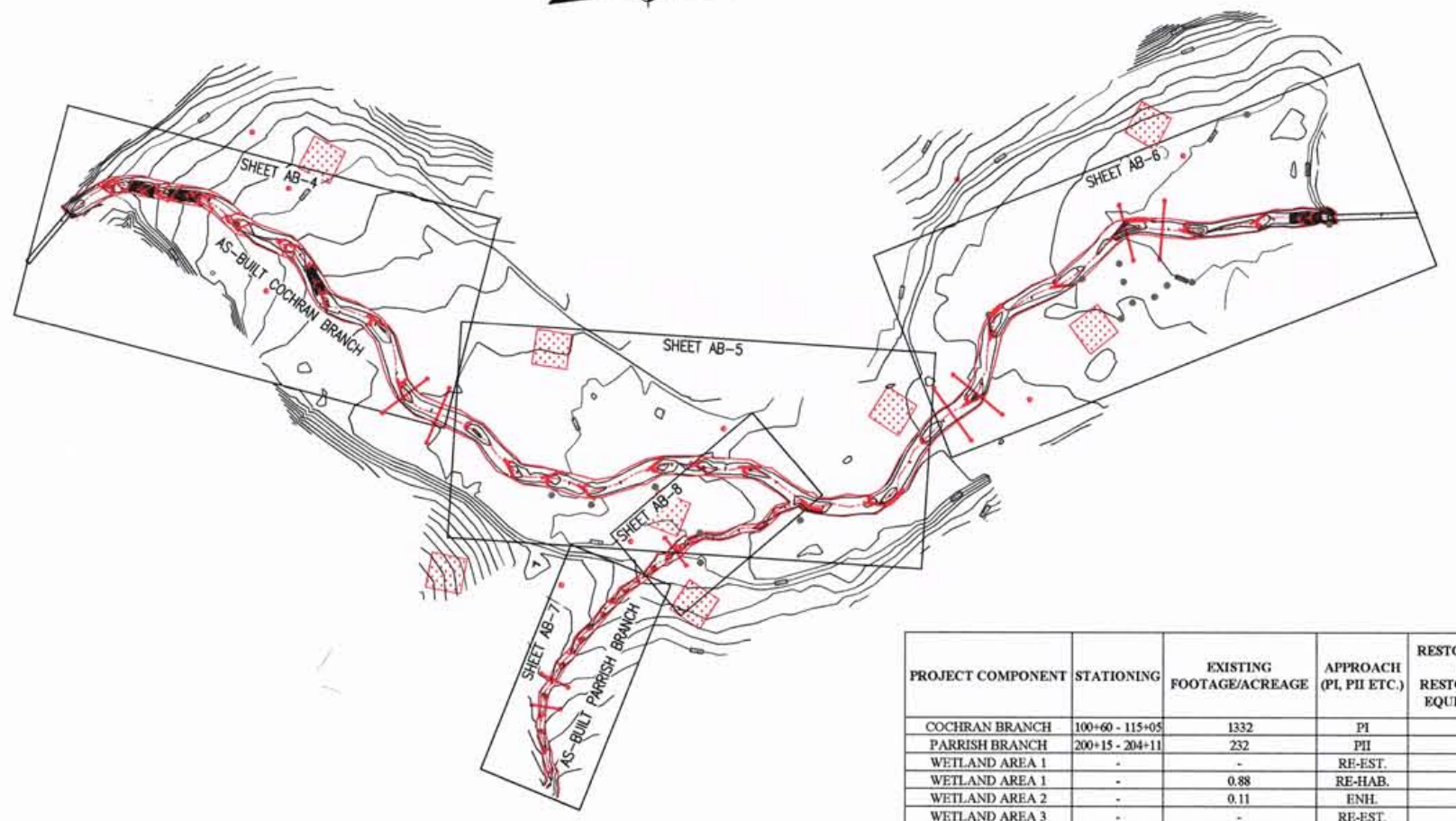
STATE	REF PROJECT NO.	SHEET NO.	TOTAL SHEETS
NC	95720	AB-1	7

	FINAL PLANS	9/11/14
R	RECORD SET	7/27/15
R1	SHEETS AB-1, AB-1A, & AB-4 - AB-8	8/3/15
SYM.	DESCRIPTION	DATE
REVISIONS		

COCHRAN BRANCH STREAM RESTORATION PROJECT

COCHRAN BRANCH
MACON COUNTY, NORTH CAROLINA

VICINITY MAP
NOT TO SCALE



SHEET INDEX

SHEET NO.	DESCRIPTION
AB- 1	TITLE SHEET
AB-1A	SITE PLAN
AB-4 - AB-8	PLAN AND PROFILE

PROJECT COMPONENT	STATIONING	EXISTING FOOTAGE/ACREAGE	APPROACH (PI, PII ETC.)	RESTORATION-OR-RESTORATION EQUIVALENT	RESTORATION FOOTAGE OR ACREAGE	MITIGATION RATIO	STREAM MITIGATION UNITS	WETLAND MITIGATION UNITS
COCHRAN BRANCH	100+60 - 115+05	1332	PI	R	1418	1	1418	-
PARRISH BRANCH	200+15 - 204+11	232	PII	R	402	1	402	-
WETLAND AREA 1	-	-	RE-EST.	R	3.33	1	-	3.33
WETLAND AREA 1	-	0.88	RE-HAB.	R	0.82	1	-	0.82
WETLAND AREA 2	-	0.11	ENH.	RE	0.11	2	-	0.06
WETLAND AREA 3	-	-	RE-EST.	R	0.09	1	-	0.09
TOTAL							1820	430

RECORD SET

GRAPHIC SCALES (SCALE IN FEET)

20 0 20 60
PLAN & HORIZONTAL PROFILE - SHEETS 4-6

10 0 10 30
PLAN & HORIZONTAL PROFILE - SHEETS 7-8

30 0 30 90
WETLAND GRADING PLAN - SHEETS 9-10

2 0 2 6
VERTICAL PROFILE - SHEETS 4-6

1 0 1 3
VERTICAL PROFILE - SHEETS 7-8

PROJECT LENGTHS

AS-BUILT RESTORATION:

COCHRAN BRANCH	= 1,418 FT
PARRISH BRANCH	= 402 FT
TOTAL LENGTH	= 1,820 FT
WETLAND RE-ESTABLISHMENT	= 3.41 AC
WETLAND REHABILITATION	= 0.82 AC
WETLAND ENHANCEMENT	= 0.11 AC

Prepared by:

Wolf Creek Engineering

Wolf Creek Engineering, Pllc
License No. P-0417
12½ Wall St., Suite C
Asheville, North Carolina 28801
Phone: 828-449-1950
www.wolfcreekeng.com

NORTH CAROLINA PROFESSIONAL SEAL 038595 ENGINEER CHRISTOPHER M. ENGLE

8/3/15

PROJECT ENGINEER

Prepared for:

Resource Environmental Solutions

Wolf Creek Engineering
ENGINEERING & ENVIRONMENTAL CONSULTING
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PHONE: (828) 449-1930 WWW.WOLFCREEKENG.COM

NORTH CAROLINA PROFESSIONAL SEAL 034195 ENGINEER CHRISTOPHER M. ENGLE
8/3/15

PROJECT: COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER: RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
TITLE: **AS-BUILT SITE PLAN**

SCALE	DRWN. BY	PROJECT NO.	SHEET NUMBER
AS NOTED	TAS	1059	AB-1A
DATE: 7/27/15	CHKD. BY SGG		

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	GROUNDWATER GAUGE LABELS

LOCATION KEY

OLIVE HILL ROAD
EXISTING 48" CMP
AS-BUILT COCHRAN BRANCH REACH 1A
AS-BUILT COCHRAN BRANCH REACH 1B
CONSERVATION EASEMENT BOUNDARY
EXISTING 60" CMP
MIDDLE BURNINGTOWN ROAD
WATSON ROAD
AS-BUILT PARRISH BRANCH REACH 1

PARRISH, JERRY L
PIN:6556932975
D-66/473

SAMUEL KELLY
PIN:6056621469
U-35/65

COCHRAN, RONALD R
PIN:6566021978
K-34/1966

COCHRAN, RONALD R
PIN:6566030353
W-17/239

COCHRAN, DARIAN S
PIN:6566033411
R-23/1693

SAMUEL KELLY
PIN:6566131316
U-35/1608

BAILEY, MATTHEW D
PIN:6566130548
Q-34/1064

CONSTABLE, WADE W
PIN:6566137864
D-31/2088

BENKIS, EDWIN
PIN:6566041144
P-17/242

RICHARDSON, STEVE
PIN:6556949501
R-35/1942

VEG PLOT 1
VEG PLOT 2
VEG PLOT 3
VEG PLOT 4
VEG PLOT 5
VEG PLOT 6
VEG PLOT 7
VEG PLOT 8
PHOTO STATION 1
PHOTO STATION 2
PHOTO STATION 3
PHOTO STATION 4
PHOTO STATION 5
PHOTO STATION 6
PHOTO STATION 7
PHOTO STATION 8
GROUNDWATER GAUGE 1
GROUNDWATER GAUGE 2
GROUNDWATER GAUGE 3
GROUNDWATER GAUGE 4
GROUNDWATER GAUGE 5
GROUNDWATER GAUGE 6
GROUNDWATER GAUGE 7
GROUNDWATER GAUGE 8
MONITORING XS-1
MONITORING XS-2
MONITORING XS-3
MONITORING XS-4
MONITORING XS-5
MONITORING XS-6
MONITORING XS-7
MONITORING XS-8
MONITORING XS-9
CREST GAUGE
CREST GAUGE
RAIN GAUGE

LEGEND
TOP OF BANK
THALWEG
EXISTING FENCE
PROPERTY BOUNDARY

50 0 50 150
SCALE IN FEET

NOTE: PROPERTY BOUNDARIES NOT SURVEYED PAST THE IMMEDIATE BORDER OF THE CONSERVATION EASEMENT

Wolf Creek Engineering
ENGINEERING & ENVIRONMENTAL CONSULTING
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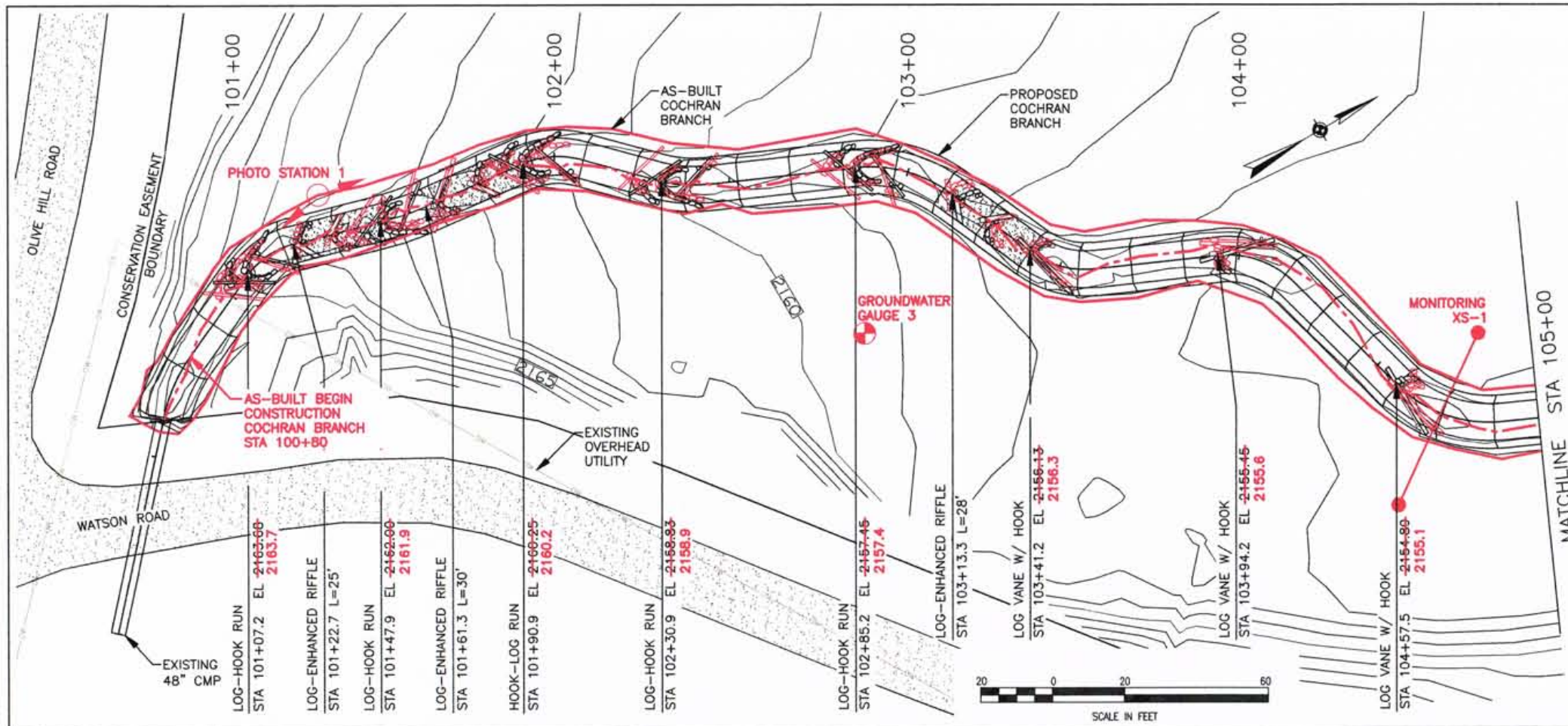
PHONE: (828) 449-1930 WWW.WOLFCREEKENG.COM

NORTH CAROLINA PROFESSIONAL SEAL 038515 ENGINEER CHRISTOPHER W. ENGLE
8/3/15

PROJECT: COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER: RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
TITLE: **AS-BUILT PLAN & PROFILE**

SCALE	DRWN. BY	PROJECT NO.	SHEET NUMBER
AS NOTED	TAS	1059	AB-4
DATE 7/27/15	CHKD. BY SGG		

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	GROUNDWATER GAUGE LABELS



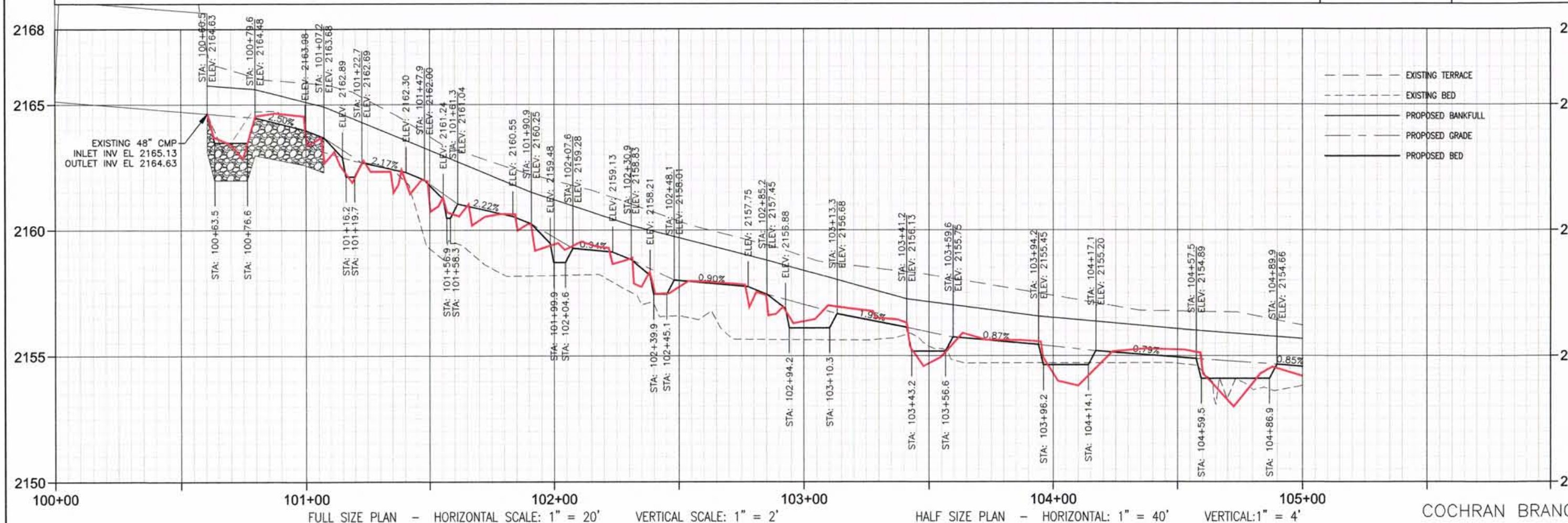
LOCATION KEY

LEGEND

PROPOSED STREAM RESTORATION
ARMORED RIFFLE
EXISTING TREE

AS BUILT LEGEND

TOP OF BANK
THALWEG



FULL SIZE PLAN – HORIZONTAL SCALE: 1" = 20' VERTICAL SCALE: 1" = 2'
HALF SIZE PLAN – HORIZONTAL: 1" = 40' VERTICAL:1" = 4'

COCHRAN BRANCH

Wolf Creek Engineering
ENGINEERING & ENVIRONMENTAL CONSULTING
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PROJECT: COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER: RESOURCE ENVIRONMENTAL SOLUTIONS, LLC

AS-BUILT PLAN & PROFILE

SCALE	AS NOTED	DRWN. BY	TAS	PROJECT NO.	SHEET NUMBER
DATE	7/27/15	CHK'D. BY	SGG	1059	AB-5

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	GROUNDWATER GAUGE LABELS

NORTH CAROLINA PROFESSIONAL SEAL 038595 ENGINEER CHRISTOPHER M. ENGLE 3/5/15

MATCHLINE STA 105+00

MATCHLINE STA 110+00

PROPOSED COCHRAN BRANCH

AS-BUILT COCHRAN BRANCH

AS-BUILT PARRISH BRANCH (SEE SHEET AB-8)

LOG VANE W/ HOOK STA 105+88.5 EL 2153.64 2154.2

VEG PLOT 7

LOG VANE W/ HOOK STA 106+27.4 EL 2153.66 2153.8

LOG VANE W/ HOOK STA 106+63.8 EL 2153.44 2153.6

LOG VANE W/ HOOK STA 107+32.2 EL 2152.98 2153.2

LOG VANE W/ HOOK STA 107+73.3 EL 2152.70 2152.8

LOG VANE W/ HOOK STA 108+09.8 EL 2152.50 2152.6

BRUSH TOE (D>2FT) STA 108+79.3 L=22' L=20'

GROUNDWATER GAUGE 5

PHOTO STATION 3

VEG PLOT 5

CREST GAUGE

GROUNDWATER GAUGE 4

MONITORING XS-9

MONITORING XS-2

BOULDER SHELF STA 105+36.3 EL 2154.23 2154.3

LOG VANE W/ HOOK STA 109+43.4 EL 2151.76 2151.9

BRUSH TOE (D>2FT) STA 109+58.1 L=13'

CONSERVATION EASEMENT BOUNDARY

2155

SCALE IN FEET 20 0 20 60

LOCATION KEY

LEGEND

PROPOSED STREAM RESTORATION

ARMORED RIFFLE

EXISTING TREE

AS BUILT LEGEND

TOP OF BANK

THALWEG

EXISTING TERRACE

EXISTING BED

PROPOSED BANKFULL

PROPOSED GRADE

PROPOSED BED

FULL SIZE PLAN – HORIZONTAL SCALE: 1" = 20' VERTICAL SCALE: 1" = 2'

HALF SIZE PLAN – HORIZONTAL: 1" = 40' VERTICAL:1" = 4'

COCHRAN BRANCH

Wolf Creek Engineering
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LICENSE NO. P-0417
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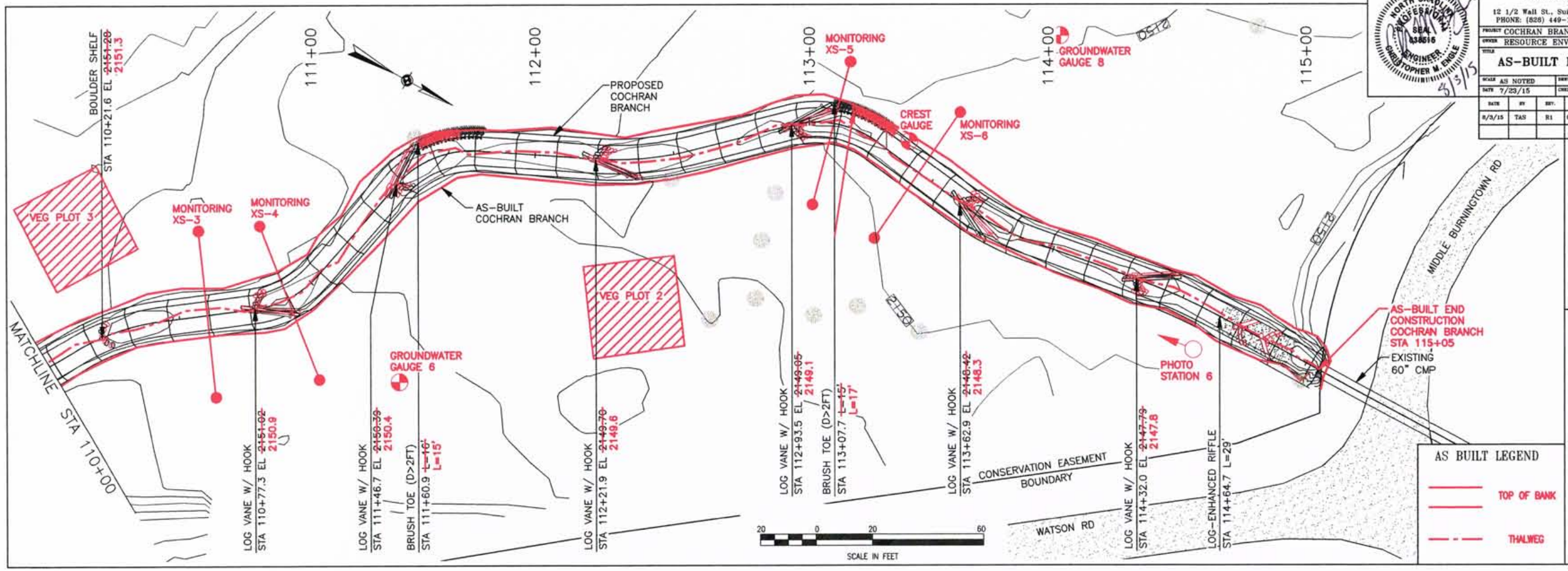
PHONE: (828) 449-1930 WWW.WOLFCREEKENG.COM

PROJECT: COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER: RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
TITLE: **AS-BUILT PLAN & PROFILE**

SCALE	DRWN. BY	PROJECT NO.	SHEET NUMBER
AS NOTED	TAS	1059	AB-6
DATE 7/23/15	CHKD. BY SGG		

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	GROUNDWATER GAUGE LABELS

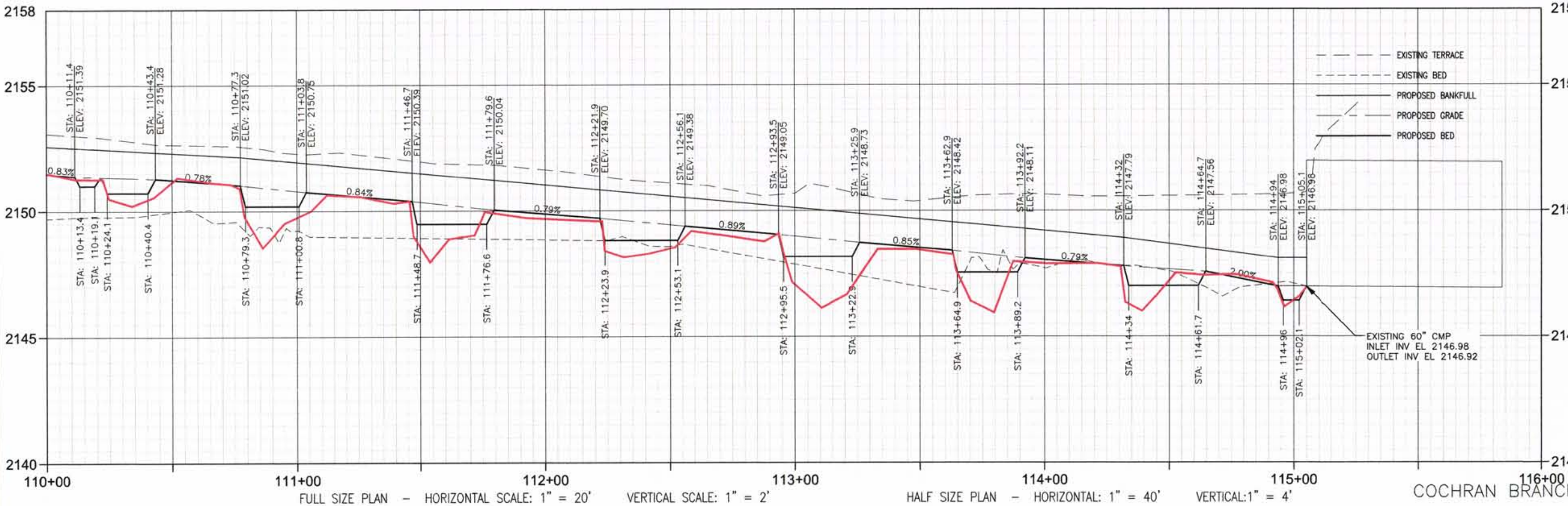
NORTH CAROLINA PROFESSIONAL SEAL 38816 ENGINEER CHRISTOPHER M. EAGLE 4/3/15



LOCATION KEY

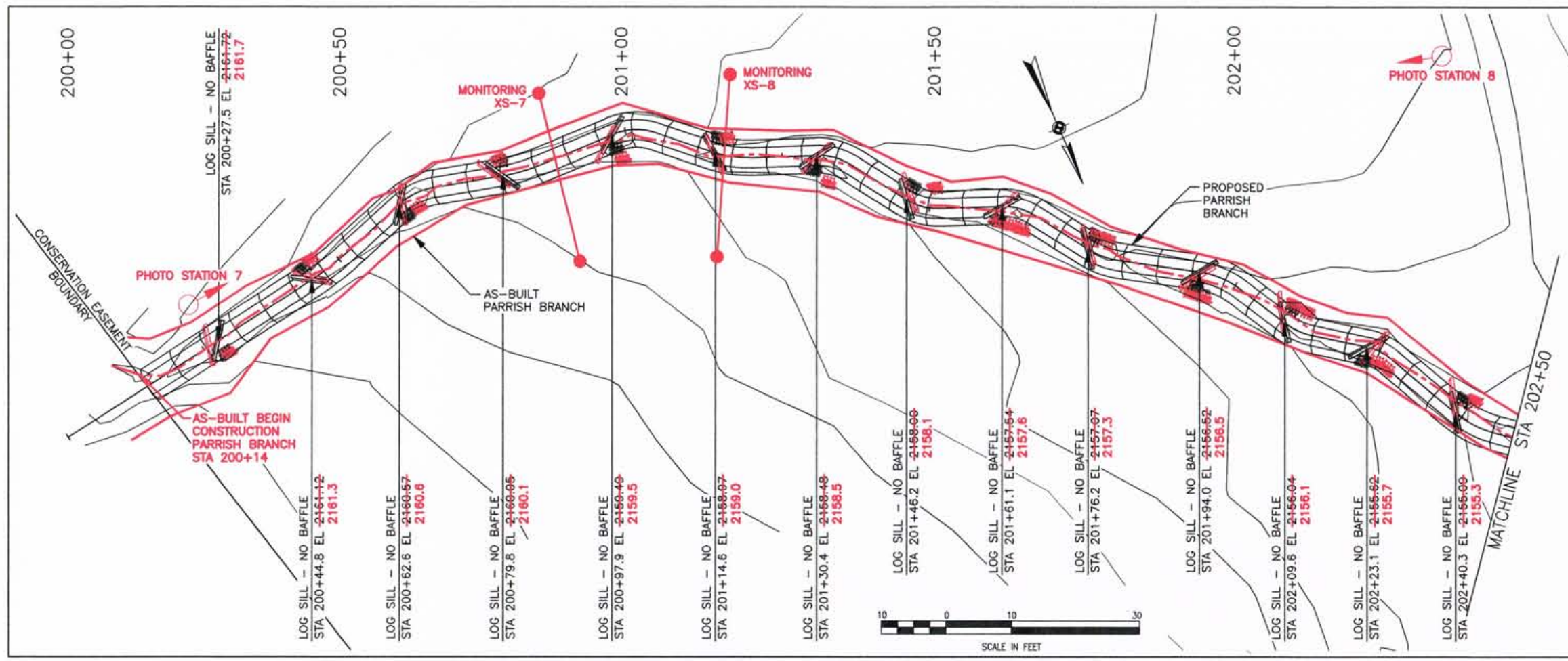
LEGEND
- PROPOSED STREAM RESTORATION
- ARMORED RIFFLE
- EXISTING TREE

AS BUILT LEGEND
- TOP OF BANK
- THALWEG



FULL SIZE PLAN – HORIZONTAL SCALE: 1" = 20' VERTICAL SCALE: 1" = 2'
HALF SIZE PLAN – HORIZONTAL: 1" = 40' VERTICAL:1" = 4'

COCHRAN BRANCH



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PHONE: (828) 449-1950 WWW.WOLFCREEKENG.COM

NORTH CAROLINA PROFESSIONAL SEAL 036595 ENGINEER CHRISTOPHER M. ENGLE

PROJECT	COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER	RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
TITLE	AS-BUILT PLAN & PROFILE
SCALE	AS NOTED
DATE	7/27/15
DRWN. BY	TAS
CHKD. BY	SGG
PROJECT NO.	1059
SHEET NUMBER	AB-7

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	TITLE BLOCK

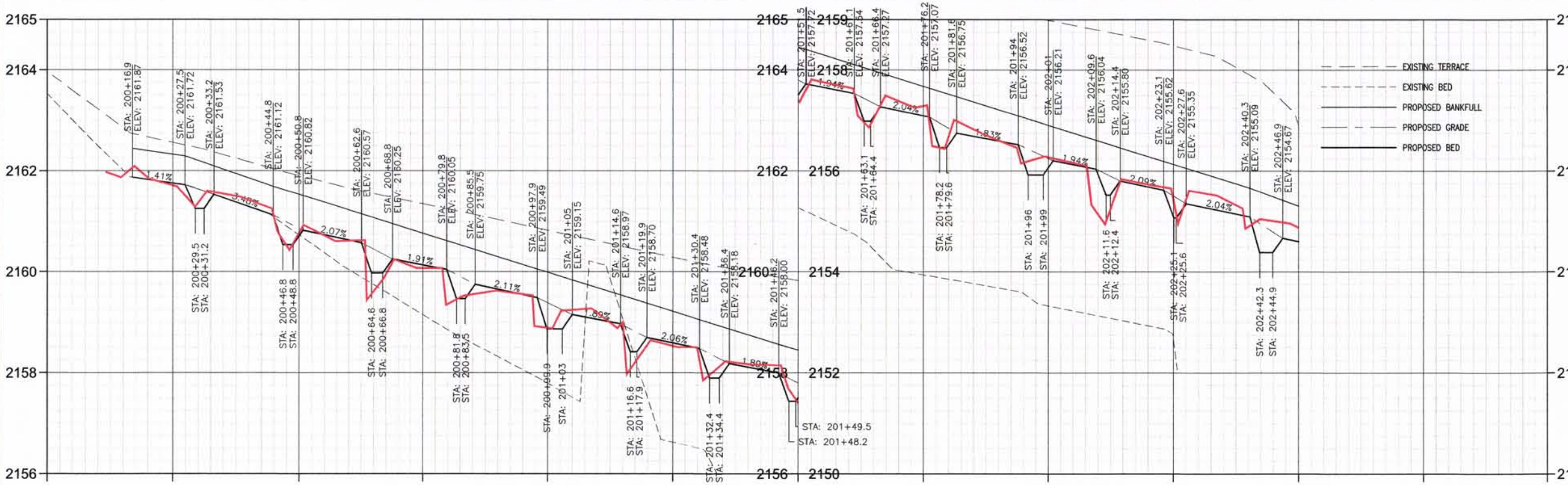
LOCATION KEY

LEGEND

- PROPOSED STREAM RESTORATION
- ARMORED RIFFLE
- EXISTING TREE

AS BUILT LEGEND

- TOP OF BANK
- THALWEG



FULL SIZE PLAN – HORIZONTAL SCALE: 1" = 10' VERTICAL SCALE: 1" = 1'

HALF SIZE PLAN – HORIZONTAL: 1" = 20' VERTICAL:1" = 2'

PARRISH BRANCH

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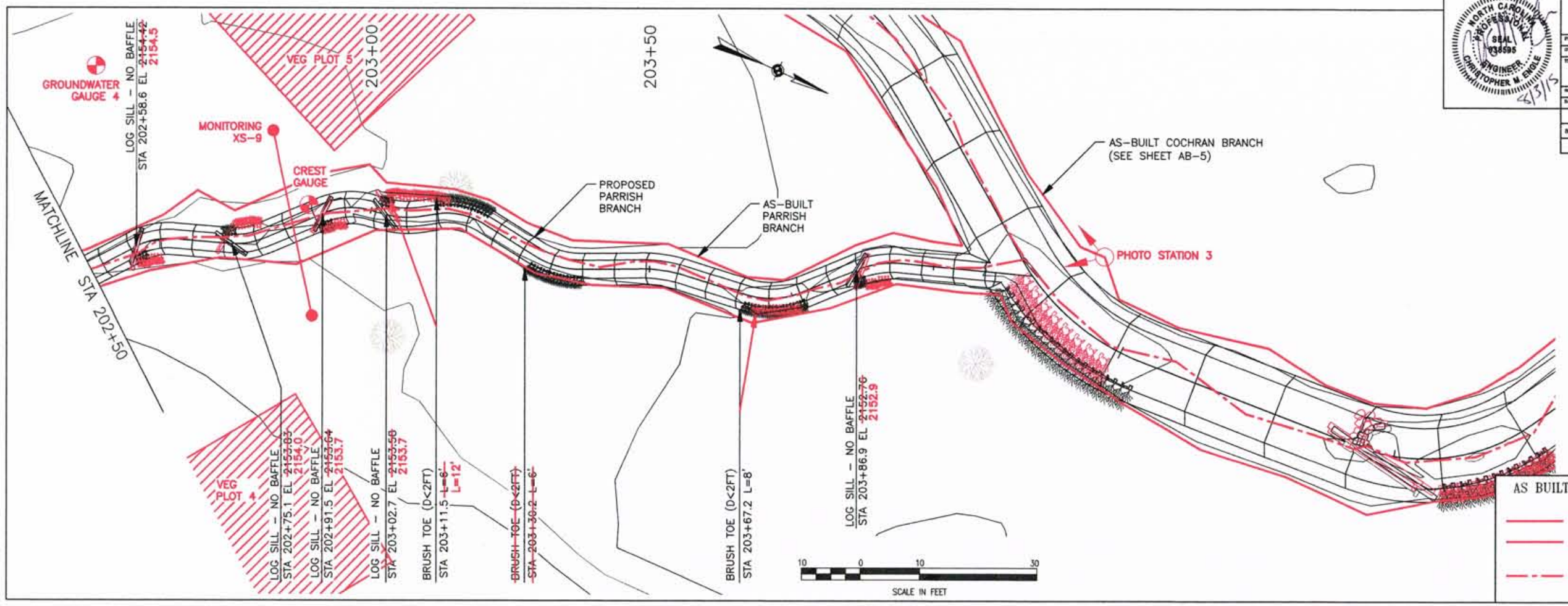
PHONE: (828) 449-1930 WWW.WOLFCREEKENG.COM

NORTH CAROLINA PROFESSIONAL SEAL 038595 ENGINEER CHRISTOPHER M. ENGLE 4/3/15

PROJECT: COCHRAN BRANCH STREAM RESTORATION PROJECT
OWNER: RESOURCE ENVIRONMENTAL SOLUTIONS, LLC
TITLE: **AS-BUILT PLAN & PROFILE**

SCALE	DRWN. BY	PROJECT NO.	SHEET NUMBER
AS NOTED	TAS	1059	AB-8
DATE 7/27/15	CHKD. BY SGG		

DATE	BY	REV.	DESCRIPTION
8/3/15	TAS	R1	GROUNDWATER GAUGE LABELS



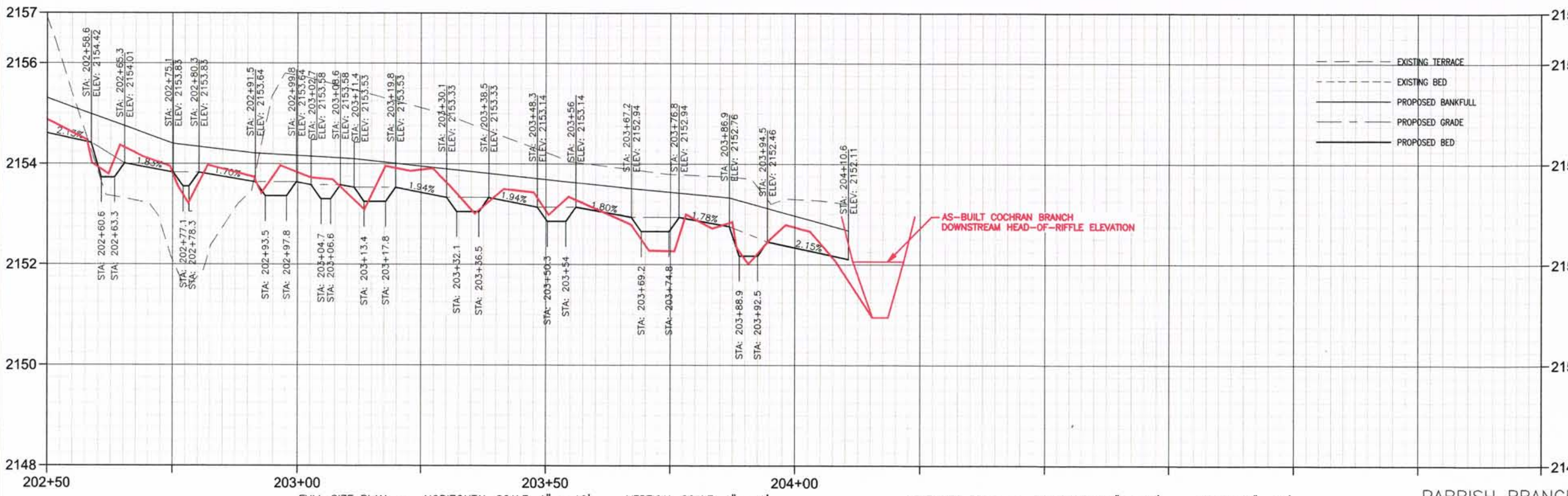
LOCATION KEY

LEGEND

- PROPOSED STREAM RESTORATION
- ARMORED RIFFLE
- EXISTING TREE

AS BUILT LEGEND

- TOP OF BANK
- THALWEG



FULL SIZE PLAN – HORIZONTAL SCALE: 1" = 10' VERTICAL SCALE: 1" = 1'
HALF SIZE PLAN – HORIZONTAL: 1" = 20' VERTICAL:1" = 2'

PARRISH BRANCH