

Annual Monitoring Report

Monitoring Year 3 of 7

FINAL

Cochran Stream and Wetland Restoration Site

NCDMS Contract No.: 004947

NCDMS Project No.: 95720

USACE Permit Action ID: SAW-2013-00280

DWR Project No.: 13-0188

Macon County, NC

Data Collected: April 2017 – October 2017



Prepared for:

Division of Mitigation Services

North Carolina Department of Environment and Natural Resources
1652 Mail Service Center
Raleigh, NC 27699-1652

January 2018



302 Jefferson Street, Suite 110
Raleigh, NC 27605

Corporate Headquarters
5020 Montrose Blvd. Suite 650
Houston, TX 77006
Main: 713.520.5400

January 31, 2018

Paul Wiesner
NC DEQ Division of Mitigation Services
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

RE: Cochran Branch Stream and Wetland Restoration Site: MY3 Monitoring Report
(NCDMS ID 95720)

Listed below are comments provided by DMS on January 10, 2018 regarding the Cochran Branch Stream and Wetland Restoration Site: Year 3 Monitoring Report and RES' responses.

Cover: Please include the USACE Permit Action ID and the DWR Project Number on the report cover page.

[Done.](#)

General: As noted in the report text; Cochran Branch is one of the projects that the IRT has requested be reverted to the Mitigation Plan asset totals prior to the 2018 credit release. Wetland assets have remained consistent since the approve mitigation plan so those will not be updated. Total stream assets will be reduced to 1,783 SMUs (1,387 SMUs on Cochran Branch & 396 SMUs on Parrish Branch) per the approved mitigation plan.

Contract 004947 stipulates a total of 1,756 SMUs so this update will not affect the current invoicing pay schedule.

General: At the April 3, 2017 IRT Credit Release Meeting, the IRT took issue with RES not collecting stream data in MY2. RES agreed to collect stream data in MY4 (2018) to compensate for this IRT concern. This has been reported in the MY3 text and RES plans to collect stream data in MY4 (2018) accordingly.

General: As a project objective is to eradicate invasive, exotic or undesirable plant species, please be sure to closely monitor and treat invasive species along the entire conservation easement through project closeout. At project closeout, the regulatory agencies may expect no living exotic invasive species within the project conservation easement based on the objective.

Section 1.1 - Goals and Objectives: Objectives – Update 1,882 feet to 1,783 feet per the approved mitigation plan.

[Done.](#)



Section 1.4.1 - Vegetation: Invasive species were noted in the report verbiage and the CCPV mapping. Please note if any invasive treatment was conducted in MY3 (2017). In the report verbiage, please indicate if an invasive treatment is planned for the site in MY4 (2018).

No invasive treatment was conducted in MY3. The invasives are limited to the edge of the easement boundary and will be treated in MY4. This has been added to the report.

As reported in Table 7, please report the estimated average planted stem tree height observed in MY3 (2017) in the report verbiage.

Done.

Table 1: Please revert Table 1 back to the totals found in the Mitigation Plan. Add a note at bottom of table to acknowledge communications with IRT regarding the change. Suggested table note: “* Stream credit calculations were originally calculated along the as-built thalweg. Based on the April 3, 2017 IRT Credit Release Meeting, these stream credits have been reverted back to the amounts in the IRT approved mitigation plan.”

Done.

Table 2: Please list all invasive-exotic treatments in Table 2. The report text indicates MY2-2016 invasive treatments within the conservation easement but none are shown in the table.

Done.

Cross Sections / Cross Section Tables – A couple of methods are currently being utilized to calculate the BHR from year to year. To compare subsequent monitoring years to the As-built condition one can hold the bankfull depth static (denominator) while allowing the Low TOB max depth (numerator) to vary. Another method that has been proposed and is being evaluated is to hold the As-built cross sectional area static within each year’s new cross section and allow that to determine the max bankfull depth for each year. However; if there are large changes in the W/D ratio either method can make for somewhat distorted BHR values depending upon the direction and magnitude of the change in the W/D ratio. Please update the calculations to reflect changes observed in the overlays and explain in detail as a table footnote how the calculations were made. Be prepared to defend the method used for the 2018 credit release and justify through context whether or not any changes observed in a cross section represent an issue.

BHR was calculated on riffles using the baseline bankfull elevation. This method was used because the dimension of the channels has not changed enough to alter the bankfull elevation. None of the riffle cross sections exceeded a 1.2 BHR. This has been added to the text and as a footnote to Table 11a.

Table 14: Please provide estimated dates for the bankfull events reported in the table. Please also note that three bankfull events were reported on Parrish Branch.

Done.

Wetland Reference Gauge: A Macon County wetland reference gauge is noted in the report text on the Cat Creek site but the data is not included in the appendices or the support files. Please provide the wetland reference gauge data in the FINAL revised report and updated support files.

The reference gauge located at the Cat Creek site failed to collect data in 2017. The gauge will be replaced and data will be reported in 2018. This has been added to the text.

**Cochran Branch
Macon County, North Carolina
DMS Project ID 95720**

**Little Tennessee River Basin
HUC 06010202040020**

Prepared by:



**Resource Environmental Solutions, LLC
302 Jefferson Street, Suite 110
Raleigh, NC 27605
919-209-1061**

Contents

1.0 Project Summary.....	3
1.1. Goals and Objectives	3
1.2. Success Criteria.....	3
1.3. Project Setting and Background.....	5
1.4. Project Performance.....	5
2.0 Methods.....	7
3.0 References.....	7

Appendix A. General Tables and Figures

Table 1. Project Components and Mitigation Credits
Table 2. Project Activity and Reporting History
Table 3. Project Contacts
Table 4. Project Information
Figure 1. Project Vicinity Map

Appendix B. Visual Assessment Data

Figure 2. Current Conditions Plan View Map (CCPV)
Table 5. Visual Stream Morphology Stability Assessment
Table 6. Vegetation Condition Assessment
Stream Photos
Vegetation Plot Photos

Appendix C. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Summary
Table 8. CVS Vegetation Plot Metadata
Table 9. Planted and Total Stem Counts (Species by Plot)

Appendix D. Stream Geomorphology Data

Table 10. Morphological Parameters Summary Data
Table 11a. Dimensional Morphology Summary
Table 11b. Stream Reach Data Summary
Cross Section Plots
Pebble Count Data
Table 12. Pebble Count Data Summary
Charts 1-3. MY3 Stream Reach Substrate Composition
Table 13. Bank Pin Array Summary Data

Appendix E. Hydrology Data

Table 14. Documentation of Geomorphological Significant Flow Events
Table 15. Rainfall Summary
Chart 4. 2017 Precipitation Data for Cedar Creek Site
Table 16. Wetland Hydrology Attainment Data
Charts 5-12. 2017 Groundwater Monitoring Gauge Hydrographs

1.0 PROJECT SUMMARY

1.1. 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 impacts

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

- Implement Priority I and II restoration of 1,783 feet of stream and rehabilitation/re-establishment of 4.35 acres of wetlands
- Implement appropriate changes in 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 within 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

1.2. Success Criteria

1.2.1. Morphological Parameters and Channel Stability

Restored and enhanced streams are 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.

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.

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.

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

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.

1.2.2. 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.

1.2.3. 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 that 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 reference wetland groundwater data. The reference wetland site will be the NCDMS Cat Creek Stream and Wetland Restoration Site – NCDMS Project # 71 – 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 (<http://agacis.rcc-acis.org/37113/wets>). The Macon County dataset 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 187 days. Based on this, wetland hydrology success will be achieved if the water table is within 12 inches of the soil surface for one or more periods of at least 15 consecutive days during the growing season.

1.2.4. 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). 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).

1.3. Project Setting and Background

The Cochran Branch Mitigation Project (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 streams, Cochran Branch and Parrish Branch, along with 4.35 acres of wetlands on the Cochran Branch floodplain. The Site lies within the Little Tennessee River Watershed N.C. Division of Water Resources (DWR) sub-basin 04-04-01 and local HUC 06010202040020. The project is located within the NCDMS Iotla Creek targeted local watershed (TLW) and within the Franklin to Fontana local watershed plant (LWP). Cochran Branch drains to Burningtown Creek approximately 0.5 miles downstream of the project. Burningtown Creek is classified as B;Tr by NCDEQ.

Following 2016 monitoring the NCIRT requested a review of the differential between the Approved Mitigation Plan and Baseline Monitoring Report. The table below details the discrepancies by reach. The cause of increased baseline SMUs is survey methodology (thalweg vs. centerline) as well as construction field adjustments. The Mitigation Plan lengths were based on centerline. Wetland credits are unchanged from Mitigation Plan to Baseline Monitoring Report.

Reach	Mitigation Type*	Proposed Length (LF)	Mitigation Ratio	Proposed SMUs	Baseline SMUs
Cochran Branch	P1 Restoration	1,387	1:1	1,387	1,418
Parrish Branch	P1 Restoration	396	1:1	396	402
Total		1,783		1,783	1,820

*P1=Priority 1

**The contracted amount of credits for this Site was 1,756 SMUs

1.4. Project Performance

Monitoring Year 3 (MY3) data was collected from April through October 2017. Monitoring activities included visual assessment of all reaches and the surrounding easement, collection of images at eight permanent photo stations, and inventory of eight permanent vegetation monitoring plots. Monitoring activities also included stream monitoring consisting of nine cross-sections, five pebble counts, and three bank pin arrays. Stream monitoring was not performed in MY2 and will be completed in MY4 as a replacement for the lack of data collection.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found

in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly Restoration Plan) documents available on the NCDMS website (<http://portal.NCDEQ.org/web/eep>). All raw data supporting the tables and figures in the appendices is available from DMS upon request.

1.4.1. Vegetation

Visual assessment of vegetation outside of the monitoring plots (**Appendix B – Table 6**) indicates that the herbaceous vegetation is becoming well established throughout the project. Populations of Chinese privet (*Ligustrum sinense*) and multiflora rose (*Rosa multiflora*) were treated in 2016 but the invasive species are still present along the easement boundary in lower densities. Follow-up treatments will be performed in MY4 and as needed in future monitoring years.

Monitoring of the eight permanent vegetation plots was completed during October 2017. Summary tables and photographs associated with MY3 monitoring are located in Appendix C. MY3 monitoring data indicates that all plots met interim success criteria of 320 planted stems per acre. Planted stem densities among plots ranged from 324 to 647 planted stems per acre with an annual mean of 470 planted stems per acre across all plots. A total of 12 species were documented within the plots. When volunteer stems are included, the mean annual total stems per acre rose to 516 and ranged between 324 and 769 stems per acre. The estimated average tree height observed was 89 cm (2.9 ft). Missing stems from the failing Vegetation Plot 6 were located in MY3 and the plot is now exceeding success criteria.

1.4.2. Stream Geomorphology

Visual assessment of the stream channel was performed to document signs of instability, such as eroding banks, structural instability, or excessive sedimentation. No indication of instability was observed during visual assessment and all structures are functioning as designed (**Appendix A Figure 2 and Appendix B Table 5**).

Geomorphic data for MY3 was collected during October 2017. Summary tables and cross-section plots related to stream morphology are located in Appendix D. Cross-sectional overlays showed minimal dimensional change between MY2 and MY3 data collection efforts (**Appendix B; Table 11a**). Starting in MY3, BHR was calculated on riffles using the baseline bankfull elevation. This method was used because the dimension of the channels has not changed enough to alter the bankfull elevation. None of the riffle cross sections exceeded a 1.2 BHR.

Substrate monitoring was performed during MY3. Pebble count D50 was coarse gravel for Reach 1, and very coarse gravel for Reach 2. The channel substrate will be monitored in future years for shifts in particle size distributions.

The bank pin arrays indicate that no erosion is taking place in the meanders during MY3 (**Appendix D; Table 12**).

1.4.3. Groundwater and Stream Hydrology

During MY3, seven of the eight groundwater monitoring wells met the 8 percent hydroperiod success criteria (**Appendix E; Table 16**). Groundwater Monitoring Well 1, located outside of the wetland re-establishment area, was the only well not to meet success criteria. Hydroperiods among the monitoring wells ranged from 1 to 92 percent of the growing season. Total number of consecutive days within 12 inches of the soil surface ranged from 2 to 171. The reference gauge located at the Cat Creek Site failed to collect any data in 2017. It will be replaced and reference data will be included in the next monitoring report.

One bankfull event occurred on Cochran Branch (mainstem) and three events occurred on Parrish Branch during MY3. The highest events measured 0.92 and 0.79 respectively (**Appendix E; Table 14**). This is the fourth bankfull event recorded on Cochran Branch and the first three recorded on Parrish Branch since project completion.

2.0 METHODS

This report presents the results of the Monitoring Year 3 (MY3) visual, hydrologic, morphological, and vegetation data. Permanent photo station photos were collected during the initial visual assessment; during leaf-off conditions. Additional photos of vegetation or stream problem areas were taken as needed.

Geomorphic measurements were taken during low flow conditions using a Topcon GTS-312 Total Station. Three-dimensional coordinates associated with cross-section data was collected in the field and geo-referenced (NAD83 State Plane feet FIPS 3200). Morphological data was collected at 9 cross-sections. Survey data was imported into CAD, ArcGIS®, and Microsoft Excel® for data processing and analysis. Channel substrate was characterized using a Wolman Pebble Count as outlined in Harrelson et al. (1994) and processed using Microsoft Excel.

Vegetation success is being monitored at eight permanent monitoring plots. Vegetation monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition and density of planted species. Data is processed using the CVS data entry tool. In the field, the four corners of each plot were permanently marked with rebar and photos of each plot taken from the origin each monitoring year.

Precipitation data was collected using an Onset HOBO Data Logging Rain Gauge. Groundwater for hydrologic success of restored wetlands was monitored using eight HOBO U20 Water Level Loggers. An additional logger was installed on site, above ground, for use as a barometric reference. Data loggers collected depth to groundwater daily and all data were processed using HOBOWare and analyzed using Microsoft Excel. Bankfull events were documented with two crest gauges, one each being located on Cochran Branch and Parrish Branch. During quarterly visits to the site, the height of the corkline was recorded.

3.0 REFERENCES

- Environmental Banc & Exchange, LLC. 2014. Cochran Branch, Final Mitigation Plan, Macon County, North Carolina. NCEEP Project No. 95720
- Harrelson, Cheryl, C. Rawlins and J. Potyondy. 1994. Stream Channel Reference Sites: An Illustrated Guide to Field Technique. Gen. Tech. Rep. RM-245. Rocky Mountain Forest and Range Experiment Station. USDA Forest Service. Fort Collins, Colorado
- Lee, M.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>; accessed November 2008.
- USACE (U.S. Army Corps of Engineers). 2003. Stream Mitigation Guidelines. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, North Carolina Wildlife Resources Commission, North Carolina Department of Environment and Natural Resources-Division of Water Quality. Wilmington District.

Appendix A
General Tables and Figures

Table 1. Project Components and Mitigation Credits									
Cochran Stream and Wetland Restoration Project									
Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen	Phosphorous
	R	RE	R	RE	R	RE		Nutrient Offset	
Totals	1,783		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		1,332		PI	R	1,387	1:1	
Parrish Branch	200+15 - 204+11		232		PII	R	396	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	Riparian Wetland		Non-riparian Wetland	Buffer	Upland			
	(linear feet)	(acres)		(acres)	(square feet)	(acres)			
		Riverine	Non-Riverine						
Restoration	1,783	-	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							

¹Restoration footage accounts for no credits in crossings, exclusions, and powerline ROWs.

²BR = 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

Note: Stream credit calculations were originally calculated along the as-built thalweg. Based on the April 3, 2017 IRT Credit Release Meeting, these stream credits have been reverted back to the amounts in the IRT approved mitigation plan.

**Table 2. Project Activity and Reporting History
Cochran Stream and Wetland Restoration Project**

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)	Jun - 2015	Aug - 2015
Invasive-Exotic Vegetation Treatment	-	Jun - 2015
Year 1 Monitoring	Dec - 2015	Jan - 2016
Invasive-Exotic Vegetation Treatment	-	Feb - 2016
Invasive-Exotic Vegetation Treatment	-	Jun - 2016
Year 2 Monitoring	Mar - 2016	Nov - 2016
Year 3 Monitoring	Stream: Oct - 2017	Jan - 2018
	Vegetation: Oct - 2017	
Year 4 Monitoring		
Year 5 Monitoring		
Year 6 Monitoring		
Year 7 Monitoring		

Table 3. Project Contacts	
Cochran Stream and Wetland Restoration Project	
Prime Contractor	Resource Environmental Solutions, LLC 302 Jefferson Street; Suite 110 Raleigh, North Carolina 27605 Daniel Ingram (919) 209-1056
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 Highway 38 South Blenheim, SC 29516 (843)528-9669
	North Carolina Forestry 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-MY2) 2015 - 2016	Equinox Environmental 37 Haywood St. Asheville, North Carolina 28802 Drew Alderman (828) 253-6856
Monitoring Performers (MY3) 2017	Resource Environmental Solutions, LLC 302 Jefferson Street; Suite 110 Raleigh, North Carolina 27605 Ryan Medric (919) 741-6268

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	Very 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
Area (Acres)	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	Very Poorly Drained	Very 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			

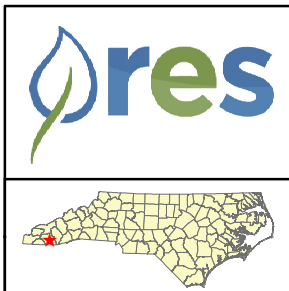
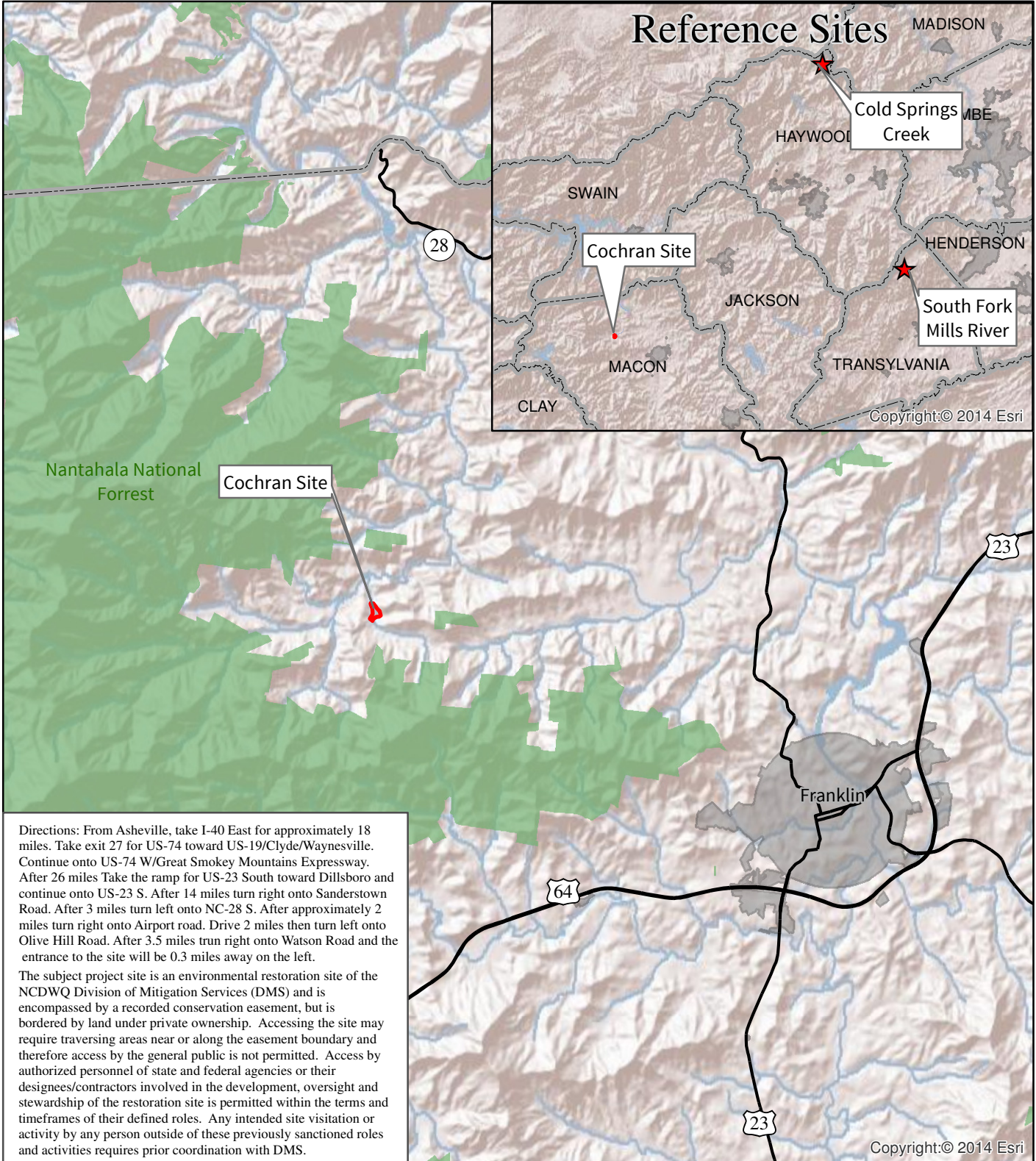
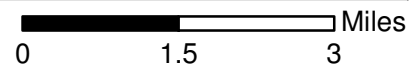
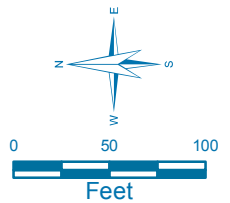


Figure 1: Vicinity Map
 Cochran
 Project No. 95720
 Macon County, North Carolina

Notes: Conservation Easement from Key Mapping & Survey, P.A.



Appendix B
Visual Assessment Data



1 inch = 100 feet

Figure 2
Cochran Branch Stream Restoration Project
MY3 2017
Current Conditions
Plan View

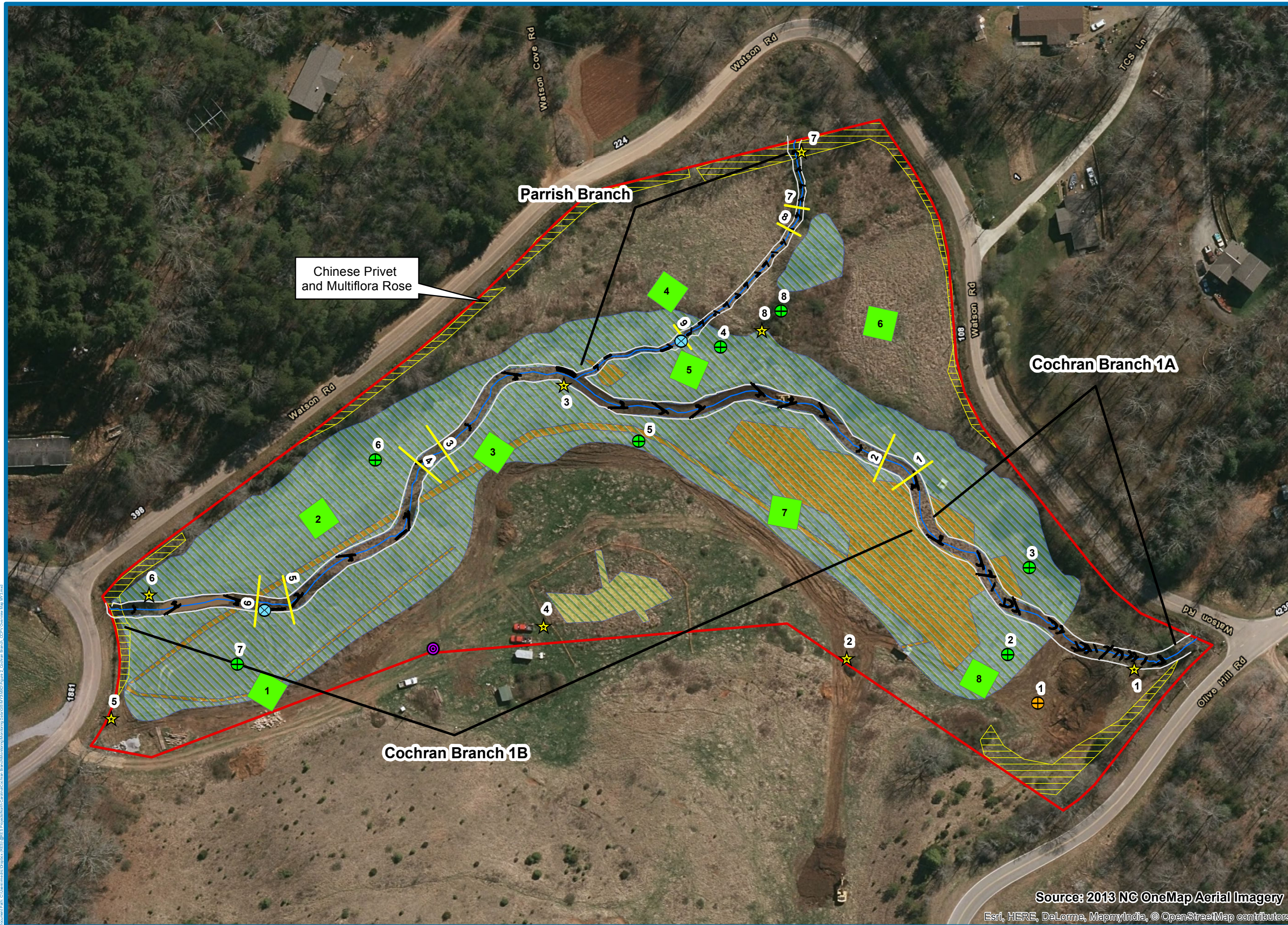
Date: 11/10/2017 | Drawn by: RTM

LEGEND

- Conservation Easement
- Photo Station
- Rain Gauge
- Crest Gauge
- Cross Section
- Restoration
- Structure
- Top of Bank
- Wetland**
 - Enhancement
 - Re-establishment
 - Re-habilitation
- Wetland Gauge**
 - Successful
 - Unsuccessful
- Vegetation Plot**
 - Successful

Riparian Buffer Conditions

Invasive Species	Target Community		
	Present	Marginal	Absent
Absent	No Fill	[Green/Yellow]	[Red/Yellow]
Present	[Green/Yellow]	[Green/Yellow]	[Red/Yellow]
Common	[Green/Yellow]	[Green/Yellow]	[Red/Yellow]



Chinese Privet
and Multiflora Rose

Parrish Branch

Cochran Branch 1A

Cochran Branch 1B

Source: 2013 NC OneMap Aerial Imagery

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

**Table 5 Cont'd. Visual Stream Morphology Stability Assessment
Cochran Stream and Wetland Restoration Project - Parrish Branch
Assessed Length 402 feet**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run Units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars).			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting.			0	0	100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate.	22	22			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6).	22	22			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle).	22	22			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run).	22	22			100%			
		2. Thalweg centering at downstream of meander bend (Glide).	22	22			100%			
2. Bank	1. Scoured / Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	0	0	100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse.			0	0	100%	0	0	100%
	Totals					0	0	100%	0	0
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	19	19			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	19	19			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	19	19			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>NOT</u> exceed 15%.	19	19			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth Ratio ≥ 1.6. Rootwads/logs providing some cover at base-flow.	19	19			100%			

**Table 6. Vegetation Condition Assessment
Cochran Stream and Wetland Restoration Project**

Planted Acreage : 10.05					
Vegetation Category	Definitions	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	N/A	0	0.00	0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	N/A	0	0.00	0%
Totals			0	0.00	0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	N/A	0	0.00	0%
Cumulative Totals			0	0.00	0%
Easement Acreage : 10.05					
Vegetation Category	Definitions	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	Vertical Lines (Red - Dense/ Yellow - Present)	5	0.40	3%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	N/A	0	0.00	0%

N/A - Item does not apply.



Cochran Branch Reach 1a – Permanent Photo Station 1
Station 101+33 – Downstream
October 4, 2017



Cochran Branch Reach 1a – Permanent Photo Station 1
Station 101+33 – Upstream
October 4, 2017



Cochran Branch – Permanent Photo Station 2
East 95°
October 4, 2017



Cochran Branch – Permanent Photo Station 2
South 186°
October 4, 2017



Cochran Branch – Permanent Photo Station 3
Station 108+87 – Upstream
October 4, 2017



Parrish Branch – Permanent Photo Station 3
Station 108+87 – Upstream
October 4, 2017



Cochran Branch – Permanent Photo Station 4
South Southeast 160°
October 4, 2017



Cochran Branch – Permanent Photo Station 5
Southeast 150°
October 4, 2017



Cochran Branch – Permanent Photo Station 6
Station 114+62 – Upstream 186°
October 4, 2017



Parrish Branch – Permanent Photo Station 7
Station 200+25 – Upstream 276°
October 4, 2017



Parrish Branch – Permanent Photo Station 8
Southeast 135°
October 4, 2017



Parrish Branch – Permanent Photo Station 8
Southwest 225°
October 4, 2017



Cochran - Vegetation Monitoring Plot 1
October 4, 2017



Cochran - Vegetation Monitoring Plot 2
October 4, 2017



Cochran - Vegetation Monitoring Plot 3
October 4, 2017



Cochran - Vegetation Monitoring Plot 4
October 4, 2017



Cochran - Vegetation Monitoring Plot 5
October 4, 2017



Cochran - Vegetation Monitoring Plot 6
October 4, 2017



Cochran - Vegetation Monitoring Plot 7
October 4, 2017



Cochran - Vegetation Monitoring Plot 8
October 4, 2017

Appendix C
Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Summary

Plot #	Planted Stems/Acre	Volunteer Stems/Acre	Total Stems/Acre	Success Criteria Met?	Average Tree Height (cm)*
1	324	162	486	Yes	96
2	647	121	769	Yes	116
3	324	0	324	Yes	76
4	486	0	486	Yes	99
5	567	0	567	Yes	138
6	405	81	486	Yes	61
7	486	0	486	Yes	70
8	526	0	526	Yes	58
Project Avg	470	46	516	Yes	89

*The tallest eight tree heights were averaged as this represents 320 stems/acre

**Table 8: CVS Vegetation Plot Metadata
Cochran Branch Stream and Wetland Restoration Site**

Report Prepared By	Eric Teitsworth
Date Prepared	10/23/2017 13:38
database name	Cochran_MY3_2017.mdb
database location	C:\Users\eteitsworth\Dropbox (RES)\@RES Projects\North Carolina\Cochran Branch\Monitoring\Monitoring Data\MY3_2017\Vegetation Data
computer name	D4V0KGH2
file size	61775872
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	95720
project Name	Cochran Branch Stream and Wetland
Description	
River Basin	Little Tennessee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	8

**Table 9. Planted Total Stem Counts (Species by Plot)
Cochran Stream Restoration Site**

		Current Plot Data (MY3 2017)																								
Scientific Name	Common Name	Species Type	95720-01-0001			95720-01-0002			95720-01-0003			95720-01-0004			95720-01-0005			95720-01-0006			95720-01-0007			95720-01-0008		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer rubrum</i>	Red Maple	Tree																								
<i>Acer rubrum var. rubrum</i>	Red Maple	Tree	1	1	1																					
<i>Alnus serrulata</i>	Hazel Alder	Shrub																								
<i>Betula nigra</i>	River Birch	Tree	1	1	1	4	4	4																		
<i>Cephalanthus occidentalis</i>	Common Buttonbush	Shrub																								
<i>Diospyros virginiana</i>	Common Persimmon	Tree																								
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree																								
<i>Liriodendron tulipifera var.</i>	Tulip-tree, Yellow Pop	Tree																								
<i>Nyssa sylvatica</i>	Blackgum	Tree																								
<i>Platanus occidentalis var. o.</i>	Sycamore, Plane-tree	Tree	2	2	2	10	10	10	4	4	4	6	6	6	10	10	10									
<i>Quercus</i>	Oak	Tree				1	1	1																		
<i>Quercus alba</i>	White Oak	Tree							2	2	2															
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	2	2	2				2	2	2															
<i>Quercus nigra</i>	Water Oak	Tree										1	1	1												
<i>Quercus phellos</i>	Willow Oak	Tree	2	2	2	1	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1	1	
<i>Quercus rubra var. rubra</i>	Northern Red Oak	Tree																								
<i>Salix nigra</i>	Black Willow	Tree																								
<i>Sambucus canadensis</i>	Common Elderberry	Shrub																								
<i>Unknown</i>		Shrub or Tree																								
Stem count			8	8	12	16	16	19	8	8	8	12	12	12	14	14	14	10	10	12	12	12	12	13	13	13
size (ares)			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			5	5	6	4	4	5	3	3	3	4	4	4	4	4	4	2	2	3	5	5	5	4	4	4
Stems per ACRE			324	324	486	647	647	769	324	324	324	486	486	486	567	567	567	405	405	486	486	486	486	526	526	526

¹PnoLS: No livestakes included in tally; P-all: All planted stems included in tally; T: Total stems including recruitment.

Color Key

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%
Recruit Stems

**Table 9 Con't. Planted Total Stem Counts (Annual Means)
Cochran Stream Restoration Site**

Scientific Name	Common Name	Species Type	Annual Means											
			MY3 (2017)			MY2 (2016)			MY1 (2015)			MY0 (2015)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer rubrum</i>	Red Maple	Tree			2									
<i>Acer rubrum var. rubrum</i>	Red Maple	Tree	1	1	1	1	1	7	1	1	1	4	4	4
<i>Alnus serrulata</i>	Hazel Alder	Shrub			3			4						
<i>Betula nigra</i>	River Birch	Tree	8	8	8	12	12	12	14	14	14	16	16	16
<i>Cephalanthus occidentalis</i>	Common Buttonbush	Shrub				1	1	1						
<i>Diospyros virginiana</i>	Common Persimmon	Tree	7	7	7	8	8	8						
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree							1	1	1	2	2	2
<i>Liriodendron tulipifera var.</i>	Tulip-tree, Yellow Pop	Tree	13	13	13	6	6	6	10	10	10	27	27	27
<i>Nyssa sylvatica</i>	Blackgum	Tree				1	1	1						
<i>Platanus occidentalis var. o.</i>	Sycamore, Plane-tree	Tree	36	36	36	39	39	39	45	45	45	48	48	48
<i>Quercus</i>	Oak	Tree	1	1	1	2	2	2	23	23	23	38	38	38
<i>Quercus alba</i>	White Oak	Tree	4	4	4	4	4	4						
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	9	9	9	13	13	13	9	9	9	11	11	11
<i>Quercus nigra</i>	Water Oak	Tree	1	1	1	1	1	1	3	3	3			
<i>Quercus phellos</i>	Willow Oak	Tree	13	13	13	19	19	19	9	9	9	8	8	8
<i>Quercus rubra var. rubra</i>	Northern Red Oak	Tree										1	1	1
<i>Salix nigra</i>	Black Willow	Tree			4			7			4			
<i>Sambucus canadensis</i>	Common Elderberry	Shrub						2						
<i>Unknown</i>		Shrub or Tree										1	1	1
Stem count			93	93	102	107	107	126	115	115	119	156	156	156
size (ares)			8			8			8			8		
size (ACRES)			0.20			0.20			0.20			0.20		
Species count			10	10	13	12	12	15	9	9	10	10	10	10
Stems per ACRE			470	470	516	541	541	637	582	582	602	789	789	789

¹PnoLS: No livestock included in tally; P-all: All planted stems included in tally; T: Total stems including recruitment.

Color Key

- 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%
- Recruit Stems

Appendix D
Stream Geomorphology Data

Table 10. Baseline Stream Data Summary
Cochran Stream and Wetland Restoration Project - 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%																									
d16 / d35 / d50 / d84 / d95 / d ^p / d ^{sp} (mm)																									
Reach Shear Stress (Competency) lb/ft ²																									
Max Part Size (mm) Mobilized at Bankfull																									
Stream Power (Transport Capacity) W/m ²																									
Additional Reach Parameters																									
Drainage Area (mi ²)																									
Impervious Cover Estimate (%)																									
Rosgen Classification																									
Bankfull Velocity (fps)																									
Bankfull Discharge (cfs)																									
Valley Length (ft)																									
Channel Thalweg Length (ft)																									
Sinuosity																									
Water Surface Slope (ft/ft)																									
Bankfull Slope (ft/ft)																									
Bankfull Floodplain Area (acres)																									
Proportion Over Wide (%)																									
Entrenchment Class (ER Range)																									
Incision Class (BHR Range)																									
BEHI																									
Channel Stability or Habitat Metric																									
Biological or Other																									

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

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Cochran Stream and Wetland Restoration Project - 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%																									
d16 / d35 / d50 / d84 / d95 / d _p / d _p ⁹⁰ (mm)																									
Reach Shear Stress (Competency) lb/ft ²																								-	
Max Part Size (mm) Mobilized at Bankfull																								-	
Stream Power (Transport Capacity) W/m ²																								1.3	
Additional Reach Parameters																									
Drainage Area (mi ²)																								1.20	
Impervious Cover Estimate (%)																								0.72	
Rosgen Classification																								E4	
Bankfull Velocity (fps)																								C4	
Bankfull Discharge (cfs)																								66.0	
Valley Length (ft)																								989	
Channel Thalweg Length (ft)																								416.7	
Sinuosity																								1,088	
Water Surface Slope (ft/ft)																								1,101	
Bankfull Slope (ft/ft)																								1.1	
Bankfull Floodplain Area (acres)																								0.0085	
Proportion Over Wide (%)																								0.0076	
Entrenchment Class (ER Range)																								0.0068	
Incision Class (BHR Range)																								-	
BEHI																								-	
Channel Stability or Habitat Metric																								25.7	
Biological or Other																								-	

- Information unavailable.

Non-Applicable.

Table 10 Cont'd. Baseline Stream Data Summary
Cochran Stream and Wetland Restoration Project - 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 ^m (mm)																									5.2 / 22 / 45 / 130 / 190 / - / -
Reach Shear Stress (Competency) lb/ft ²																									1.947
Max Part Size (mm) Mobilized at Bankfull																									91
Stream Power (Transport Capacity) W/m ²																									45
Additional Reach Parameters																									
Drainage Area (mi ²)																									0.10
Impervious Cover Estimate (%)																									-
Rosgen Classification																									G
Bankfull Velocity (fps)																									4.5
Bankfull Discharge (cfs)																									123.0
Valley Length (ft)																									380.0
Channel Thalweg Length (ft)																									375
Sinuosity																									1.1
Water Surface Slope (ft/ft)																									1.05
Bankfull Slope (ft/ft)																									0.033
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 11a. Baseline Morphology & Hydraulic Monitoring Summary
Cochran Stream and Wetland Restoration Project**

	Cross-Section 1 (Pool) Cochran Branch						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	2,156.1	-	2,156.1			2,155.8	2,155.8	-	2,155.8			2,152.1	2,152.1	-	2,152.1			2,151.9	2,151.9	-	2,151.9			2,149.9	2,149.9	-	2,149.9		
Bankfull Width (ft)	16.7	16.8	-	20.6			17.3	17.1	-	16.9			14.6	15.4	-	15.3			16.2	17.4	-	16.8			17.0	17.3	-	16.8		
Floodprone Width (ft)	>217.0	>217.0	-	>52.5			>173.5	>173.5	-	>54.7			>135.0	>135	-	>59.7			>217.5	>217.5	-	>59.0			>236.5	>236.5	-	>52.9		
Bankfull Mean Depth (ft)	1.6	1.1	-	0.9			1.0	0.9	-	0.8			0.8	0.7	-	0.7			1.9	1.8	-	1.9			1.5	1.5	-	1.5		
Bankfull Max Depth (ft)	3.1	2.6	-	2.3			1.5	1.4	-	1.4			1.0	1.1	-	1.1			3.5	4.3	-	4.2			3.3	3.4	-	3.1		
Bankfull Cross Sectional Area (ft ²)	27.5	19.2	-	19.5			16.6	15.2	-	14.0			11.0	11.3	-	10.8			31.0	31.3	-	32.7			25.4	26.4	-	25.2		
Bankfull Width/Depth Ratio	10.2	14.7	-	21.8			18.1	19.2	-	20.4			19.2	20.8	-	21.6			8.5	9.7	-	8.6			11.4	11.4	-	11.2		
Bankfull Entrenchment Ratio	>13	>12.9	-	N/A			>10	>10.2	-	>3.2			>9.3	>8.8	-	>3.9			>13.4	>12.5	-	N/A			>13.9	>13.7	-	N/A		
Bankfull Bank Height Ratio	1.0	1.0	-	N/A			1.0	1.0	-	0.9			1.0	1.0	-	1.1			1.0	1.0	-	N/A			1.0	1.0	-	N/A		
d50 (mm)	-	N/A	-	N/A			-	1.4	-	26			-	28.0	-	28			-	N/A	-	N/A			-	N/A	-	N/A		
	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	2149.7	-	2149.7			2160.2	2160.2	-	2160.2			2159.8	2159.8	-	2159.8			2154.6	2154.6	-	2154.6								
Bankfull Width (ft)	17.8	17.9	-	15.6			4.4	4.5	-	3.7			6.8	7.2	-	8.0			5.9	6.6	-	5.8								
Floodprone Width (ft)	>197.0	>197.0	-	>54.5			>14.2	>14.2	-	11.9			>93.7	>93.7	-	>28.2			>24.0	>24.0	-	>29.3								
Bankfull Mean Depth (ft)	0.8	0.8	-	0.8			0.4	0.4	-	0.2			0.8	0.8	-	0.6			0.4	0.3	-	0.3								
Bankfull Max Depth (ft)	1.1	1.2	-	1.2			0.6	0.7	-	0.4			1.8	2.0	-	1.9			0.6	0.6	-	0.6								
Bankfull Cross Sectional Area (ft ²)	13.6	13.6	-	12.1			1.8	2.0	-	0.6			5.2	5.5	-	5.0			2.1	2.0	-	2.0								
Bankfull Width/Depth Ratio	23.4	23.4	-	20.2			10.9	10.4	-	23.6			9.0	9.6	-	12.7			16.6	21.7	-	17.0								
Bankfull Entrenchment Ratio	>11.0	>11.0	-	>3.5			>3.2	>3.1	-	3.2			>13.7	>12.9	-	N/A			>4.0	>3.7	-	>5.1								
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			1.0	1.0	-	1.0			1.0	1.0	-	N/A			1.0	1.0	-	0.9								
d50 (mm)	-	11.0	-	24			-	4.3	-	1.6			-	N/A	-	N/A			-	3.9	-	3.2								

N/A - Item does not apply.

- Information Unavailable

Note: Starting in MY3, Bankfull Bank Height Ratio was calculated on riffles using the baseline bankfull elevation. This method was used because the dimension of the channels has not changed enough to alter the bankfull elevation.

Table 11b. Monitoring Data - Stream Reach Data Summary
Cochran Stream and Wetland Restoration Project - Cochran 1a (379 feet)

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5						MY - 6						MY - 7					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension & Substrate - Riffle																																																
Bankfull Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Floodprone Width (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Mean Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Max Depth (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bankfull Cross-Sectional Area (ft ²)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Width/Depth Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Entrenchment Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bank Height Ratio	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Profile																																																
Riffle Length (ft)	10.9	20.4	18.8	31.7	8.6	7																																										
Riffle Slope (ft/ft)	0.007	0.017	0.021	0.025	0.0	7																																										
Pool Length (ft)	5.3	10.7	8.7	21.6	5.5	7																																										
Pool Max Depth (ft)	2.0	2.4	2.4	3.1	0.4	6																																										
Pool Spacing (ft)	36.2	48.6	47.6	62.2	9.6	6																																										
Pattern																																																
Channel Belt Width (ft)	17.1	27.0	28.7	33.4	7.40	4																																										
Radius of Curvature (ft)	24.0	37.6	43.9	44.8	11.76	3																																										
Rc: Bankfull Width (ft/ft)	1.63	2.6	2.98	3.05	0.80	3																																										
Meander Wavelength (ft)	73.9	92.8	92.4	116.0	19.16	5																																										
Meander Width Ratio	1.2	1.8	2.0	2.3	0.50	4																																										
Additional Reach Parameters																																																
Rosgen Classification	B																																															
Channel Thalweg Length (ft)	379																																															
Sinuosity (ft)	1.18																																															
Water Surface Slope (Channel) (ft/ft)	0.033																																															
Bankfull Slope (ft/ft)	0.033																																															
Ri% / Ru% / P% / G% / S%	42%	28%	22%	7%	0%																																											

- Information Unavailable

N/A - Information does not apply.

Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

**Table 11b. Monitoring Data - Stream Reach Data Summary
Cochran Stream and Wetland Restoration Project - Cochran 1b (1,101 feet)**

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5						MY - 6						MY - 7					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension & Substrate - Riffle																																																
Bankfull Width (ft)	14.6	16.6	17.3	17.8	1.8	3	15.4	16.8	17.1	17.9	1.3	3	-	-	-	-	-	-	15.3	15.9	15.6	16.9	0.9	3																								
Floodprone Width (ft)	135.0	168.5	173.5	197.0	31.3	3	135.0	168.5	173.5	197.0	31.3	3	-	-	-	-	-	-	54.5	56.3	54.7	59.7	2.9	3																								
Bankfull Mean Depth (ft)	0.8	0.8	0.8	1.0	0.1	3	0.7	0.8	0.8	0.9	0.1	3	-	-	-	-	-	-	0.7	0.8	0.8	0.8	0.1	3																								
Bankfull Max Depth (ft)	1.0	1.2	1.1	1.5	0.2	3	1.1	1.2	1.2	1.4	0.2	3	-	-	-	-	-	-	1.1	1.2	1.2	1.4	0.2	3																								
Bankfull Cross-Sectional Area (ft ²)	11.0	13.7	13.6	16.6	2.8	3	11.3	13.4	13.6	15.2	2.0	3	-	-	-	-	-	-	10.8	12.3	12.1	14.0	1.6	3																								
Width/Depth Ratio	18.1	20.3	19.2	23.4	2.8	3	19.2	21.1	20.8	23.4	2.1	3	-	-	-	-	-	-	20.2	20.7	20.4	21.6	0.8	3																								
Entrenchment Ratio	9.3	10.1	10.0	11.0	0.9	3	8.8	10.0	10.2	11.0	1.1	3	-	-	-	-	-	-	3.2	3.5	3.5	3.9	0.4	3																								
Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	3	1.0	1.0	1.0	1.0	0.0	3	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	3																								
Profile																																																
Riffle Length (ft)	12.4	29.5	33.6	47.0	11.6	17																																										
Riffle Slope (ft/ft)	0.001	0.006	0.006	0.017	0.004	17																																										
Pool Length (ft)	16.2	24.1	24.2	31.0	4.6	17																																										
Pool Max Depth (ft)	2.3	3.1	3.0	4.2	0.5	17																																										
Pool Spacing (ft)	38.0	60.2	59.5	86.8	15.6	17																																										
Pattern																																																
Channel Belt Width (ft)	17.2	33.9	29.0	64.0	13.9	11																																										
Radius of Curvature (ft)	22.5	29.1	27.4	36.6	5.2	7																																										
Rc: Bankfull Width (ft/ft)	1.36	1.8	1.65	2.20	0.3	7																																										
Meander Wavelength (ft)	38.1	130.8	136.9	249.7	58.2	12																																										
Meander Width Ratio	1.0	2.0	1.7	3.9	0.8	11																																										
Additional Reach Parameters																																																
Rosgen Classification	C																																															
Channel Thalweg Length (ft)	1,101																																															
Sinuosity (ft)	1.12																																															
Water Surface Slope (Channel) (ft/ft)	0.0076																																															
Bankfull Slope (ft/ft)	0.0068																																															
Ri% / Ru% / P% / G% / S%	50%	3%	39%	8%	0%																																											

- Information Unavailable
N/A - Information does not apply.
Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step

**Table 11b cont'd. Monitoring Data - Stream Reach Data Summary
Cochran Stream and Wetland Restoration Project - Parrish Branch (402 feet)**

Parameter	Baseline						MY - 1						MY - 2						MY - 3						MY - 4						MY - 5						MY - 6						MY - 7											
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n						
Bankfull Width (ft)	4.4	5.2	5.2	5.9	1.1	2	4.5	5.6	5.6	6.6	1.5	2	-	-	-	-	-	-	3.7	4.8	4.8	5.8	1.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Floodprone Width (ft)	14.2	19.1	19.1	24.0	6.9	2	14.2	19.1	19.1	24.0	6.9	2	-	-	-	-	-	-	11.9	20.6	20.6	29.3	12.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Bankfull Mean Depth (ft)	0.4	0.4	0.4	0.4	0.0	2	0.3	0.4	0.4	0.4	0.1	2	-	-	-	-	-	-	0.2	0.3	0.3	0.3	0.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Bankfull Max Depth (ft)	0.6	0.6	0.6	0.6	0.0	2	0.6	0.7	0.7	0.7	0.1	2	-	-	-	-	-	-	0.4	0.5	0.5	0.6	0.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Bankfull Cross-Sectional Area (ft ²)	1.8	2.0	2.0	2.1	0.2	2	2.0	2.0	2.0	2.0	0.0	2	-	-	-	-	-	-	0.6	1.3	1.3	2.0	1.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Width/Depth Ratio	10.9	13.8	13.8	16.6	4.0	2	10.4	16.1	16.1	21.7	8.0	2	-	-	-	-	-	-	17.0	20.3	20.3	23.6	4.7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Entrenchment Ratio	3.2	3.6	3.6	4.0	0.6	2	3.1	3.4	3.4	3.7	0.4	2	-	-	-	-	-	-	3.2	4.2	4.2	5.1	1.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Bank Height Ratio	1.0	1.0	1.0	1.0	0.0	2	1.0	1.0	1.0	1.0	0.0	2	-	-	-	-	-	-	1.0	1.0	1.0	1.0	0.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
Profile																																																						
Riffle Length (ft)	6.1	10.0	9.8	15.5	2.3	22																																																
Riffle Slope (ft/ft)	0.00	0.025	0.023	0.047	0.013	22																																																
Pool Length (ft)	1.7	5.0	4.5	10.2	2.0	22																																																
Pool Max Depth (ft)	1.1	1.5	1.5	1.9	0.2	22																																																
Pool Spacing (ft)	13.5	17.2	15.5	25.2	3.4	21																																																
Pattern																																																						
Channel Belt Width (ft)	6.9	9.9	9.8	12.6	1.4	14																																																
Radius of Curvature (ft)	5.8	9.5	8.9	15.3	3.2	8																																																
Re: Bankfull Width (ft/ft)	1.1	1.8	1.7	2.9	0.6	8																																																
Meander Wavelength (ft)	29.1	32.1	31.4	39.7	2.7	15																																																
Meander Width Ratio	1.3	1.9	1.9	2.4	0.3	14																																																
Additional Reach Parameters																																																						
Rosgen Classification	B																																																					
Channel Thalweg Length (ft)	402																																																					
Sinuosity (ft)	1.07																																																					
Water Surface Slope (Channel) (ft/ft)	0.025																																																					
Bankfull Slope (ft/ft)	0.029																																																					
Ri% / Ru% / P% / G% / S%	59%	0%	29%	5%	7%																																																	

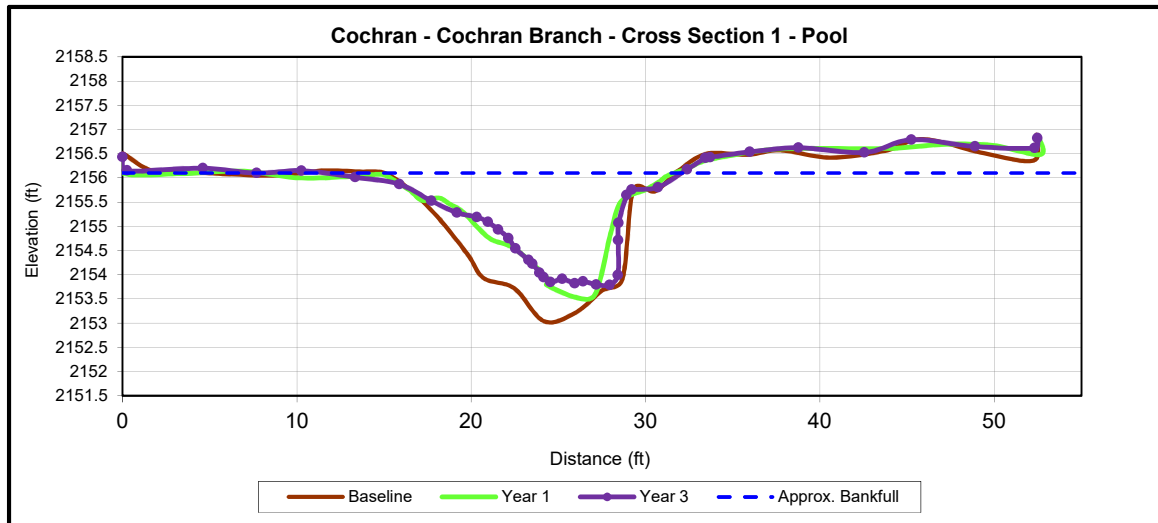
- Information Unavailable
N/A - Information does not apply.
Ri = Riffle / Ru = Run / P = Pool / G = Glide / S = Step



Upstream



Downstream



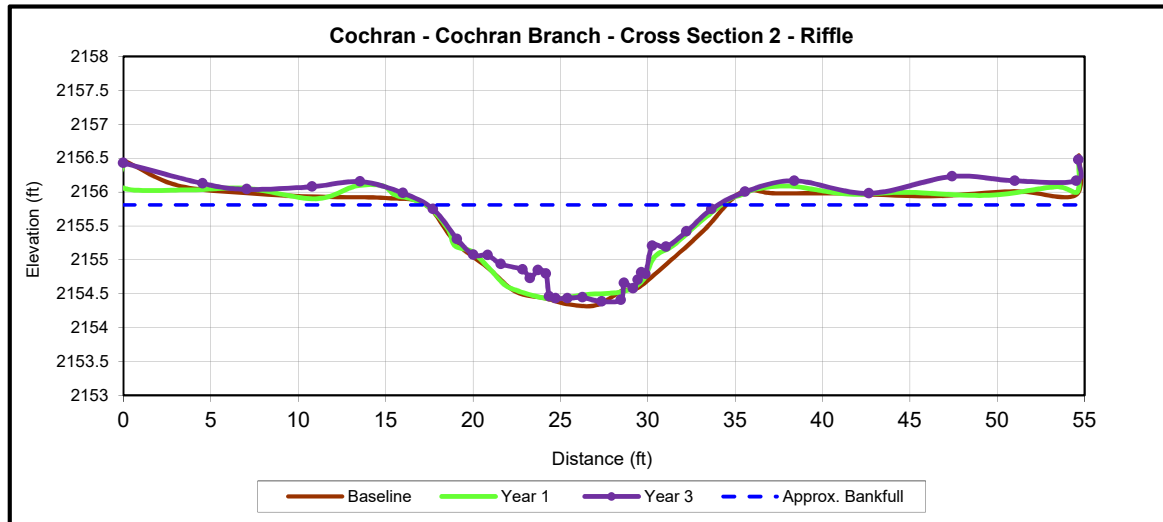
Based on fixed baseline bankfull elevation	Cross Section 1 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Record elevation (datum) used	2156.1	2156.1	-	2156.1			
Bankfull Width (ft)	16.7	16.8	-	20.6			
Floodprone Width (ft)	>217.0	>217.0	-	>52.5			
Bankfull Mean Depth (ft)	1.6	1.1	-	0.9			
Bankfull Max Depth (ft)	3.1	2.6	-	2.3			
Bankfull Cross Sectional Area (ft ²)	27.5	19.2	-	19.5			
Bankfull Width/Depth Ratio	10.2	14.7	-	21.8			
Bankfull Entrenchment Ratio	>13.0	>12.9	-	>2.5			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



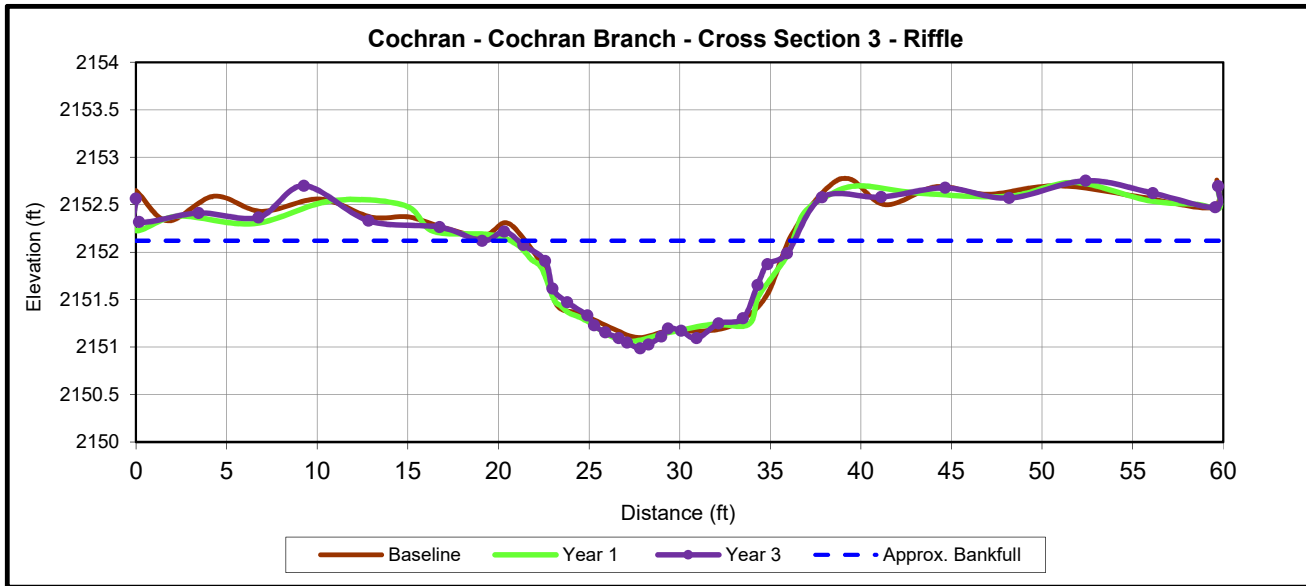
Cross Section 2 (Riffle)							
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY5	MY7	MY+
Record elevation (datum) used	2155.8	2155.8	-	2155.8			
Bankfull Width (ft)	17.3	17.1	-	16.9			
Floodprone Width (ft)	>173.5	>173.5	-	>54.7			
Bankfull Mean Depth (ft)	1.0	0.9	-	0.8			
Bankfull Max Depth (ft)	1.5	1.4	-	1.4			
Bankfull Cross Sectional Area (ft ²)	16.6	15.2	-	14.0			
Bankfull Width/Depth Ratio	18.1	19.2	-	20.4			
Bankfull Entrenchment Ratio	>10.0	>10.2	-	>3.2			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



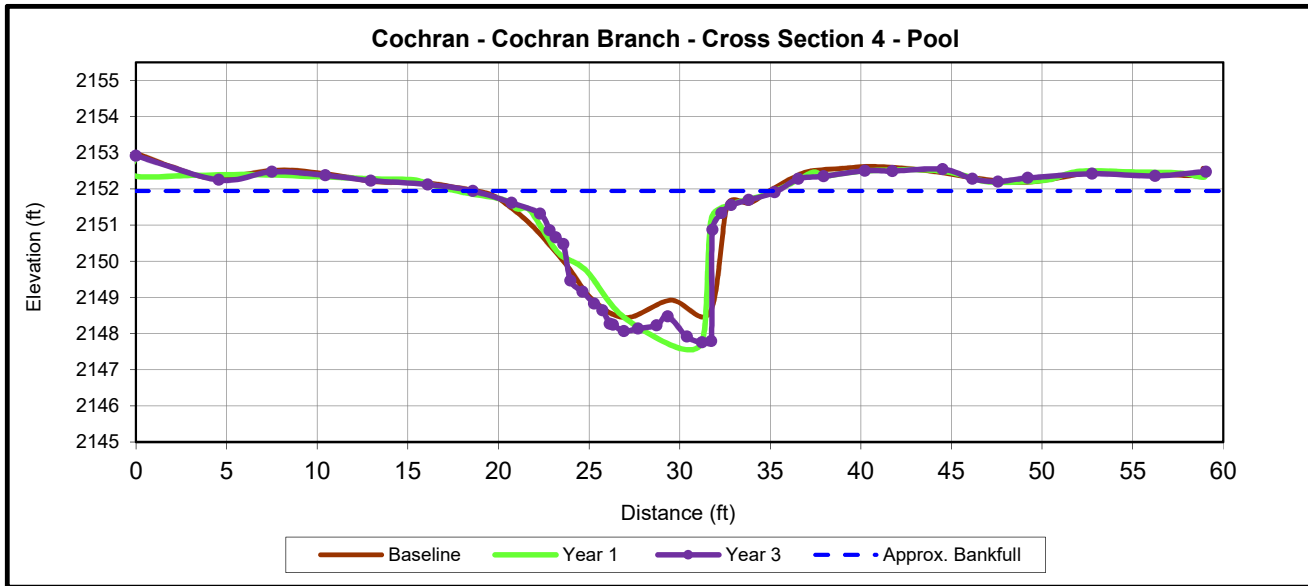
	Cross Section 3 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation							
Record elevation (datum) used	2152.1	2152.1	-	2152.1			
Bankfull Width (ft)	14.6	15.4	-	15.3			
Floodprone Width (ft)	>135.0	>135	-	>59.7			
Bankfull Mean Depth (ft)	0.8	0.7	-	0.7			
Bankfull Max Depth (ft)	1.0	1.1	-	1.1			
Bankfull Cross Sectional Area (ft ²)	11.0	11.3	-	10.8			
Bankfull Width/Depth Ratio	19.2	20.8	-	21.6			
Bankfull Entrenchment Ratio	>9.3	>8.8	-	>3.9			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



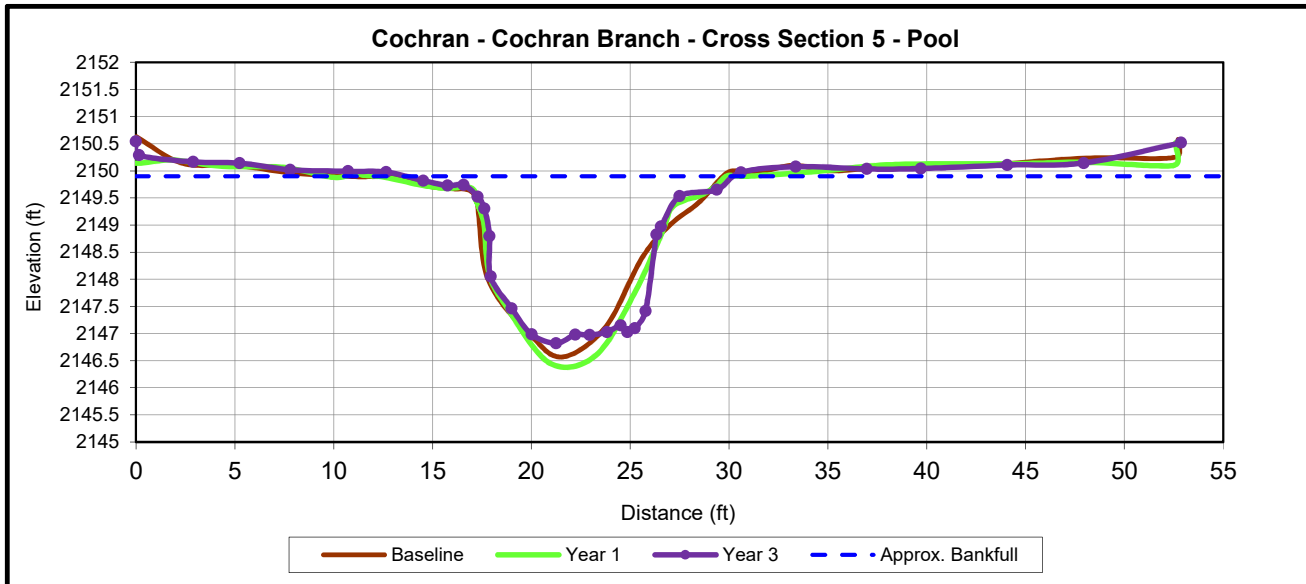
	Cross Section 4 (Pool)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY5	MY7	MY+
Record elevation (datum) used	2151.9	2151.9	-	2151.9			
Bankfull Width (ft)	16.2	17.4	-	16.8			
Floodprone Width (ft)	>217.5	>217.5	-	>59.0			
Bankfull Mean Depth (ft)	1.9	1.8	-	1.9			
Bankfull Max Depth (ft)	3.5	4.3	-	4.2			
Bankfull Cross Sectional Area (ft ²)	31.0	31.3	-	32.7			
Bankfull Width/Depth Ratio	8.5	9.7	-	8.6			
Bankfull Entrenchment Ratio	>13.4	>12.5	-	>3.5			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



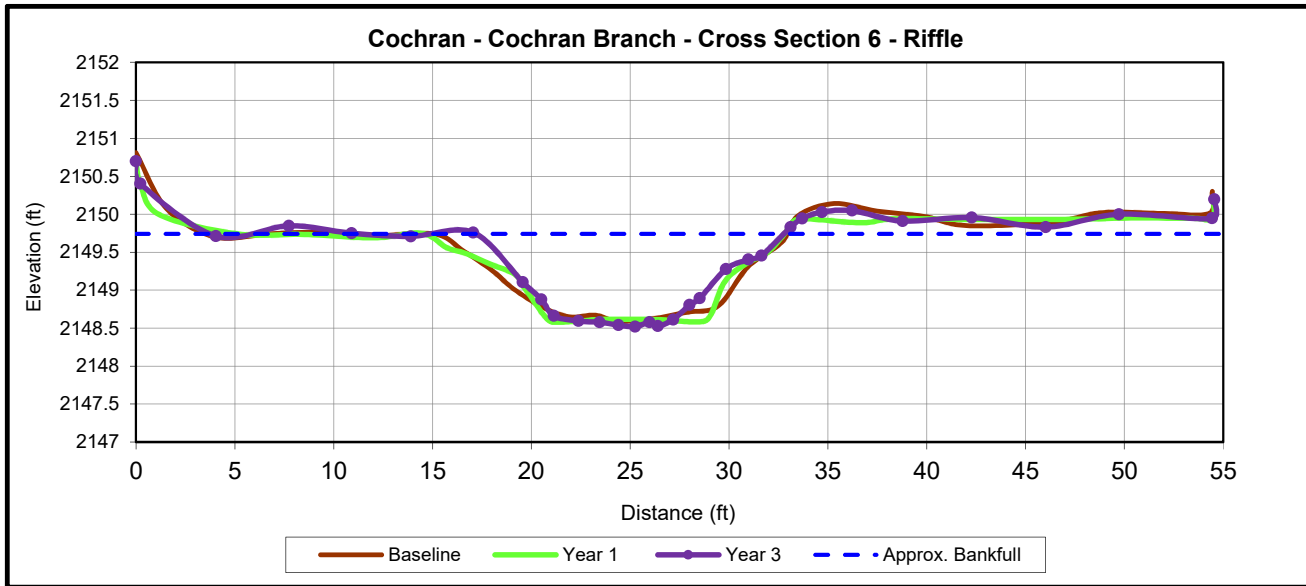
	Cross Section 5 (Pool)						
Based on fixed baseline bankfull elevation	Base	MY1	MY2	MY3	MY5	MY7	MY+
Record elevation (datum) used	2149.9	2149.9	-	2149.9			
Bankfull Width (ft)	17.0	17.3	-	16.8			
Floodprone Width (ft)	>236.5	>236.5	-	>52.9			
Bankfull Mean Depth (ft)	1.5	1.5	-	1.5			
Bankfull Max Depth (ft)	3.3	3.4	-	3.1			
Bankfull Cross Sectional Area (ft ²)	25.4	26.4	-	25.2			
Bankfull Width/Depth Ratio	11.4	11.4	-	11.2			
Bankfull Entrenchment Ratio	>13.9	>13.7	-	>3.2			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



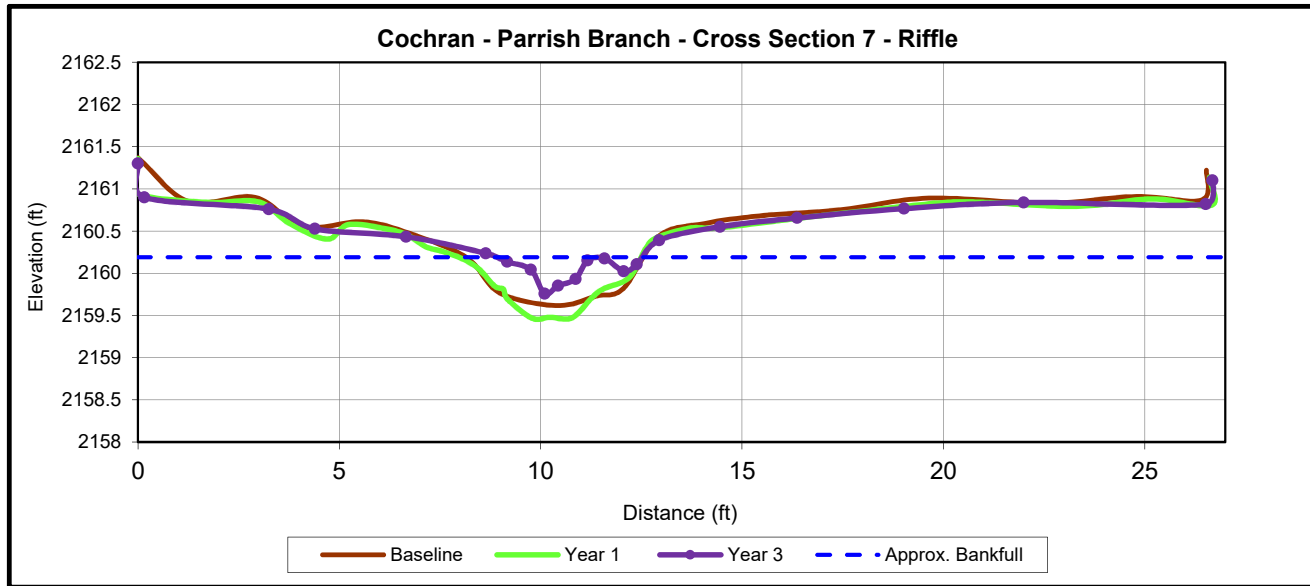
	Cross Section 6 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation							
Record elevation (datum) used	2149.7	2149.7	-	2149.7			
Bankfull Width (ft)	17.8	17.9	-	15.6			
Floodprone Width (ft)	>197.0	>197.0	-	>54.5			
Bankfull Mean Depth (ft)	0.8	0.8	-	0.8			
Bankfull Max Depth (ft)	1.1	1.2	-	1.2			
Bankfull Cross Sectional Area (ft ²)	13.6	13.6	-	12.1			
Bankfull Width/Depth Ratio	23.4	23.4	-	20.2			
Bankfull Entrenchment Ratio	>11.0	>11.0	-	>3.5			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



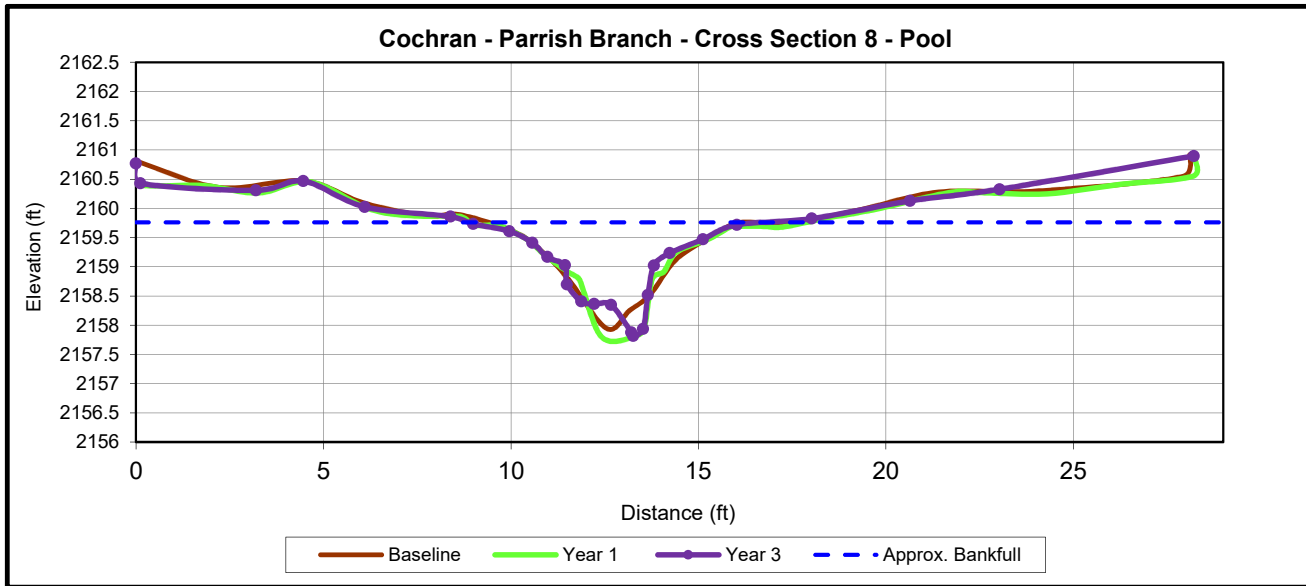
	Cross Section 7 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation							
Record elevation (datum) used	2160.2	2160.2	-	2160.2			
Bankfull Width (ft)	4.4	4.5	-	3.7			
Floodprone Width (ft)	>14.2	>14.2	-	11.9			
Bankfull Mean Depth (ft)	0.4	0.4	-	0.2			
Bankfull Max Depth (ft)	0.6	0.7	-	0.4			
Bankfull Cross Sectional Area (ft ²)	1.8	2.0	-	0.6			
Bankfull Width/Depth Ratio	10.9	10.4	-	23.6			
Bankfull Entrenchment Ratio	>3.2	>3.1	-	3.2			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream



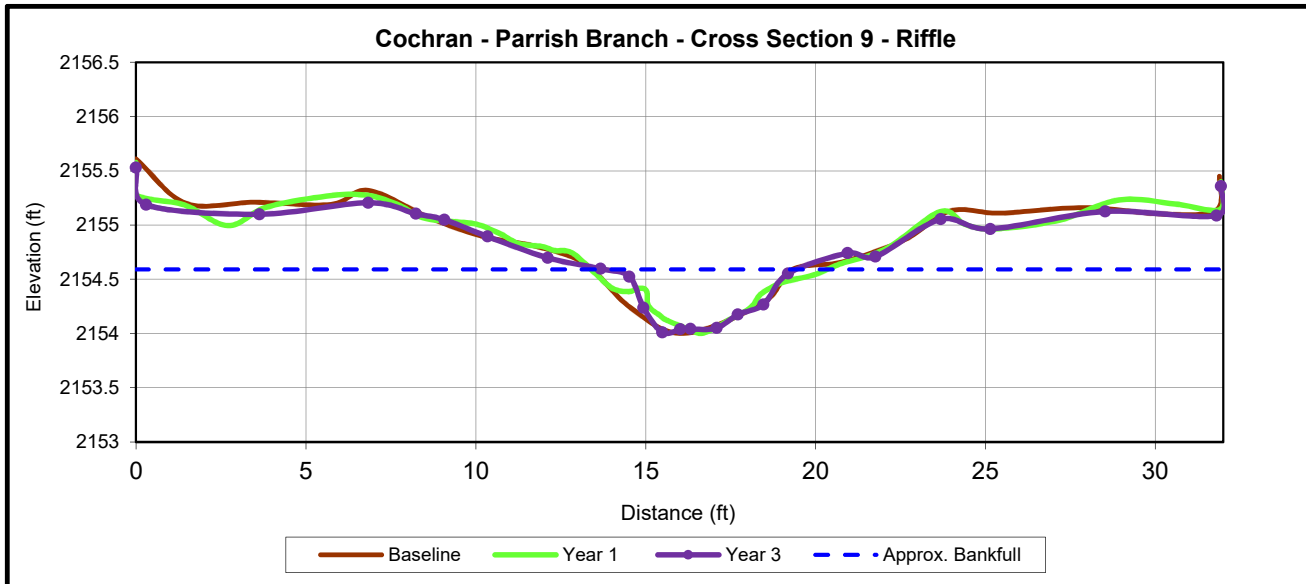
	Cross Section 8 (Pool)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation							
Record elevation (datum) used	2159.8	2159.8	-	2159.8			
Bankfull Width (ft)	6.8	7.2	-	8.0			
Floodprone Width (ft)	>93.7	>93.7	-	>28.2			
Bankfull Mean Depth (ft)	0.8	0.8	-	0.6			
Bankfull Max Depth (ft)	1.8	2.0	-	1.9			
Bankfull Cross Sectional Area (ft ²)	5.2	5.5	-	5.0			
Bankfull Width/Depth Ratio	9.0	9.6	-	12.7			
Bankfull Entrenchment Ratio	>13.7	>12.9	-	>3.5			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			



Upstream



Downstream

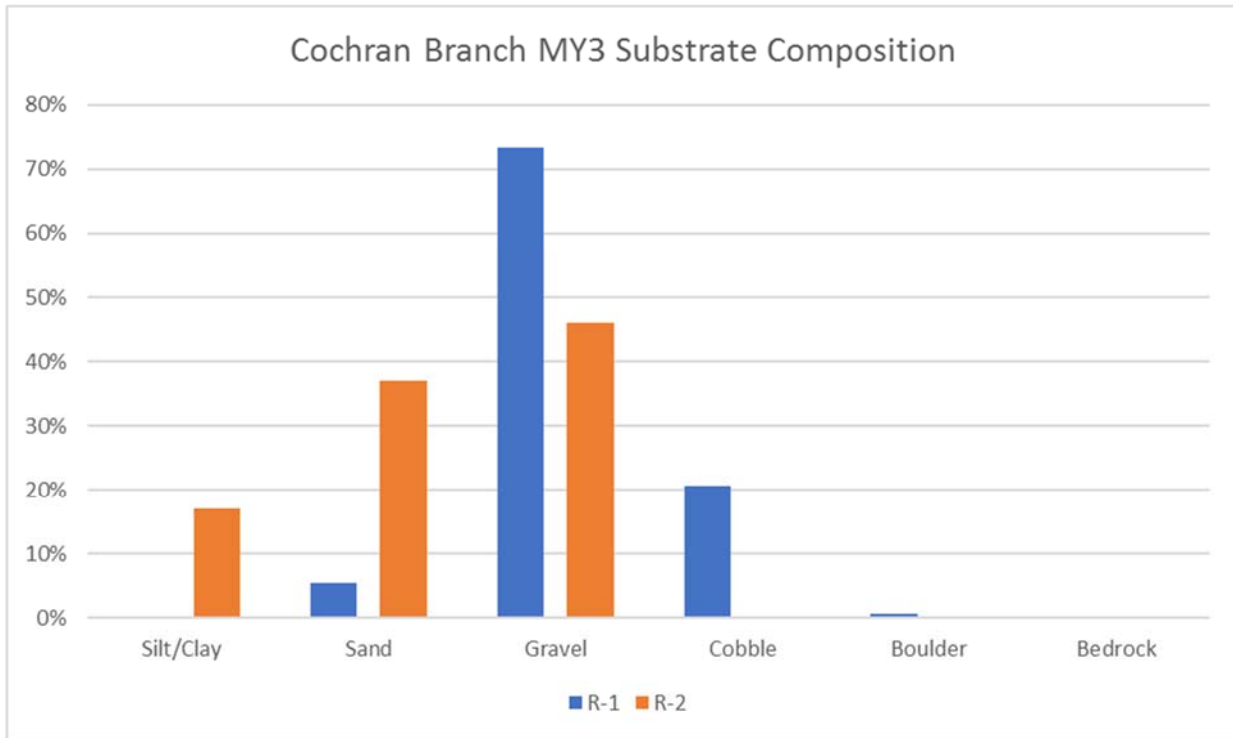


	Cross Section 9 (Riffle)						
	Base	MY1	MY2	MY3	MY5	MY7	MY+
Based on fixed baseline bankfull elevation							
Record elevation (datum) used	2154.6	2154.6	-	2154.6			
Bankfull Width (ft)	5.9	6.6	-	5.8			
Floodprone Width (ft)	>24.0	>24.0	-	>29.3			
Bankfull Mean Depth (ft)	0.4	0.3	-	0.3			
Bankfull Max Depth (ft)	0.6	0.6	-	0.6			
Bankfull Cross Sectional Area (ft ²)	2.1	2.0	-	2.0			
Bankfull Width/Depth Ratio	16.6	21.7	-	17.0			
Bankfull Entrenchment Ratio	>4.0	>3.7	-	>5.1			
Bankfull Bank Height Ratio	1.0	1.0	-	1.0			

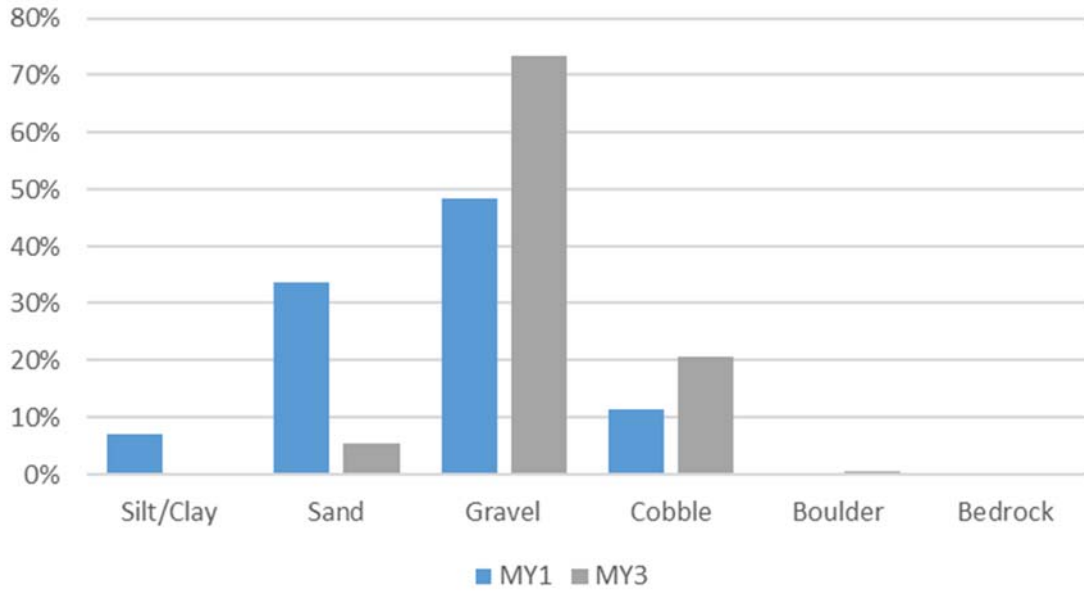
Table 12. Pebble Count Data Summary

Stream Reach	MY1 - 2015		MY3 - 2017	
	Pebble Count		Pebble Count	
	D ₅₀ (mm)	D ₈₄ (mm)	D ₅₀ (mm)	D ₈₄ (mm)
R-1	13.5	4.1	26.0	2.4
R-2	46.3	22.5	64.7	10.0

Charts 1-3. MY3 Stream Reach Substrate Composition



Cochran Branch R-1 - Substrate Composition



Cochran Branch R-2 - Substrate Composition

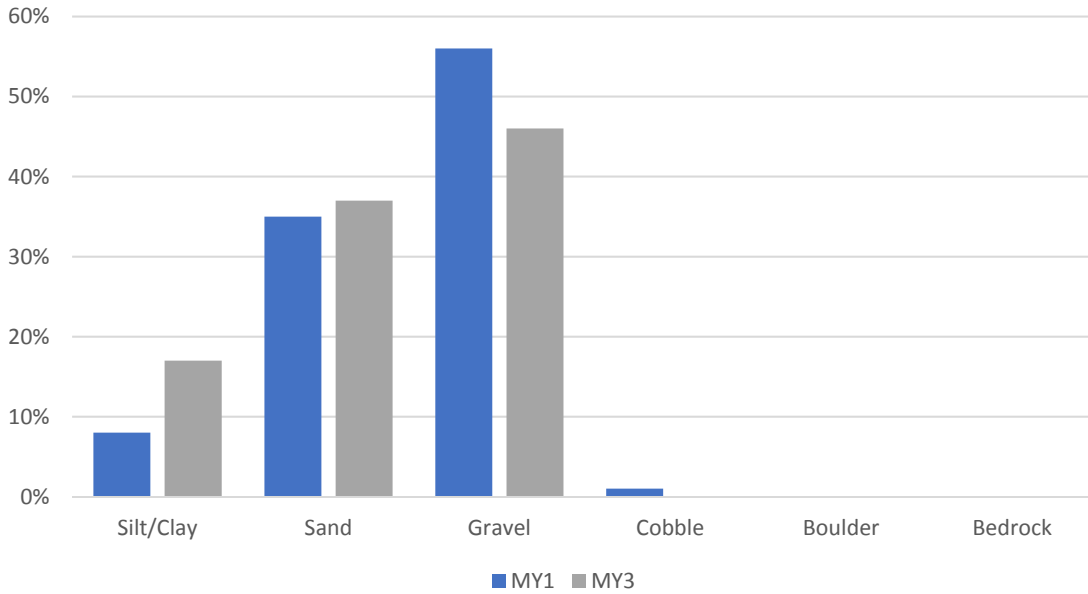


Table 13. Cochran Bank Pin Array Summary

Bank Pin Location	Position	Year 1 Reading (mm)	Year 2 Reading (mm)	Year 3 Reading (mm)
Cross Section 1	Upstream	0.0	-	0.0
	At Cross Section	0.0	-	0.0
	Downstream	0.0	-	0.0
Cross Section 4	Upstream	0.0	-	0.0
	At Cross Section	0.0	-	0.0
	Downstream	0.0	-	0.0
Cross Section 8	Upstream	0.0	-	0.0
	At Cross Section	0.0	-	0.0
	Downstream	0.0	-	0.0

- Geomorphological data was not collected in MY2

Appendix E

Hydrology Data

Table 14. Verification of Bankfull Events

Date of Data Collection	Estimated Date of Occurrence	Method	Maximum Bankfull Height (ft)	Photo #
Cochran Branch				
12/29/2015	12/24/2015	Crest Gauge	0.86	MY1
3/24/2016	2/3/2016	Crest Gauge	0.68	MY2
8/17/2016	7/15/2016	Crest Gauge	0.58	MY2
10/3/2017	5/21/2017	Crest Gauge	0.92	1
Parrish Branch				
4/17/2017	4/3/2017	Crest Gauge	0.6	3
4/17/2017	2/28/2017	Crest Gauge	0.38	3
10/3/2017	5/21/2017	Crest Gauge	0.79	2

Photo Verification of Bankfull Events



Crest Gauge @ Cochran Branch – 0.92 ft.



Crest Gauge @ Parrish Branch – 0.79 ft.



Crest Gauge @ Parrish Branch – 0.38 and 0.60 ft.

Table 15. 2017 Rainfall Summary

Month	Average	Normal Limits		Station Precipitation	On-Site Auto Rain Gauge
		30 Percent	70 Percent		
January	5.18	3.78	6.10	2.23	0.00
February	4.32	2.94	5.16	1.98	0.00
March	5.05	3.60	5.97	4.86	0.05
April	4.82	3.64	5.62	6.79	3.26
May	4.19	2.90	4.99	6.80	5.88
June	4.64	3.32	5.48	3.59	4.68
July	4.61	3.33	5.44	1.76	2.11
August	4.49	3.21	5.31	1.91	2.91
September	4.37	2.74	5.28	4.16	1.71
October	2.94	1.26	3.58	8.67	0.02*
November	4.26	2.70	5.13	1.33	---
December	5.49	4.04	6.44	---	---
Total	54.36	37.46	64.50	44.08	20.60

*On-Site rain data collected until 10/4/2017

Notes:

January - May : NWAY - Wayah, Franklin, NC - CRONOS Database

June - November 7 : Franklin 4.4 ESE - CRONOS Database

Chart 4.

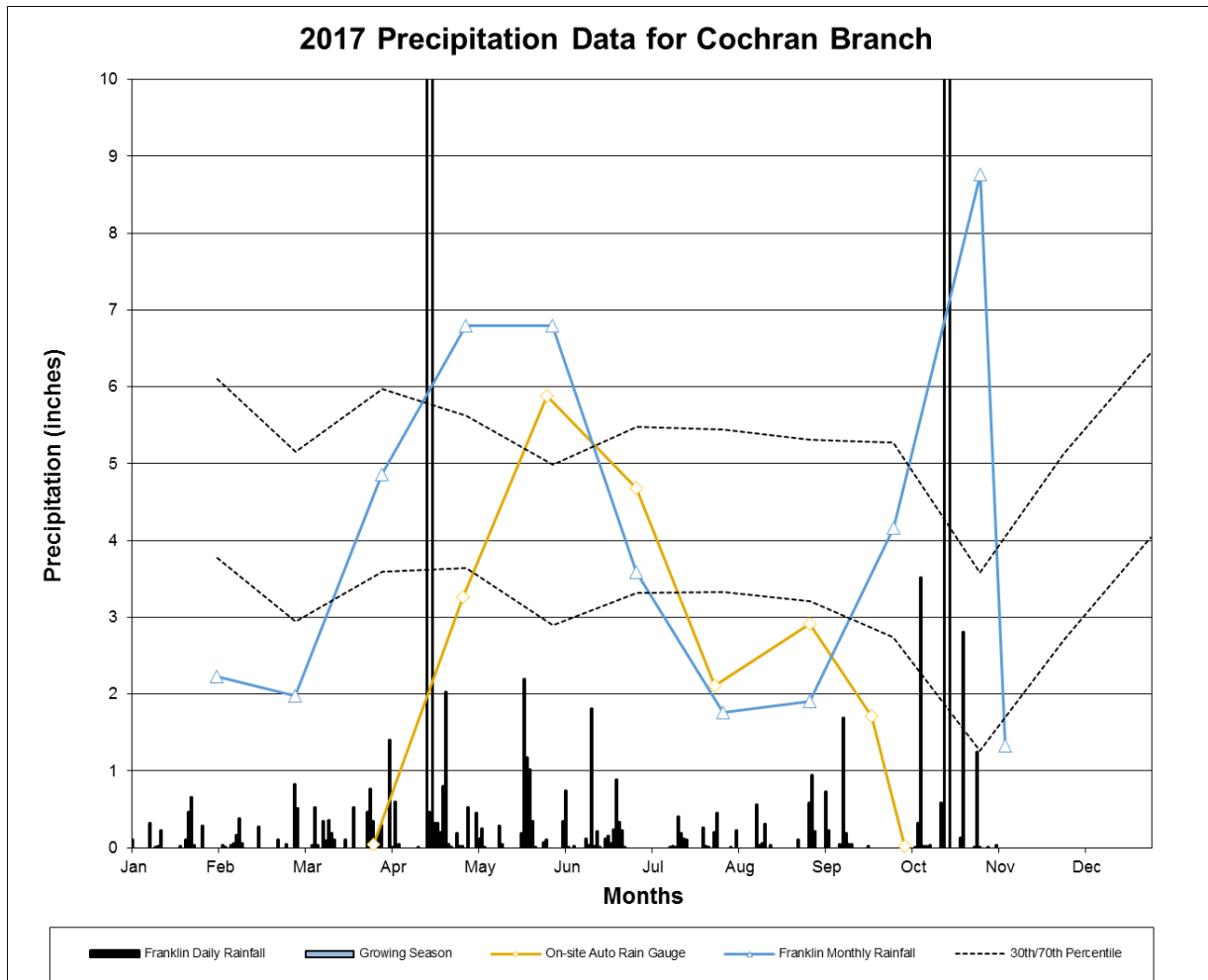


Table 16. Wetland Hydrology Attainment Data

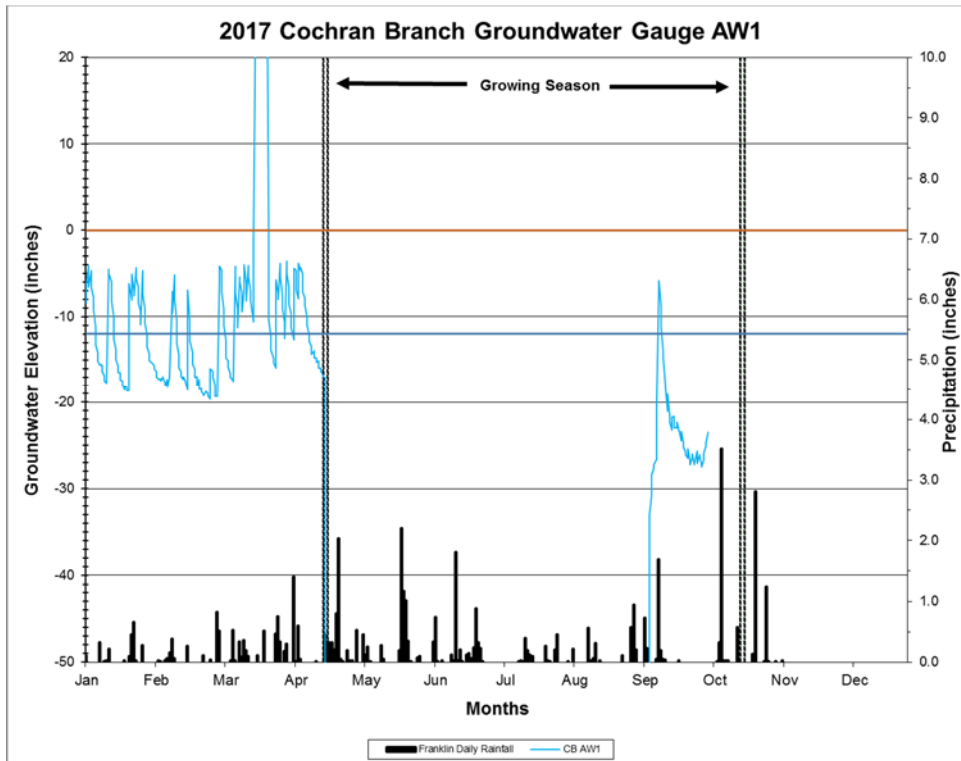
Table 16. Wetland Hydrology Attainment Data Summary of Groundwater Monitoring Results Cochran Stream & Wetland Restoration Site							
Gauge ID	Success Criteria Achieved/ Max Consecutive Days During Growing Season Percent						
	Year 1* (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)	Year 6 (2020)	Year 7 (2021)
GW-1**	Yes/ 18 13.6%	Yes/ 40 21.4%	No/2 1%				
GW-2	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				
GW-3	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171 91%				
GW-4	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				
GW-5	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				
GW-6	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				
GW-7	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				
GW-8	Yes/ 132 100%	Yes/ 187 100%	Yes/ 171.5 92%				

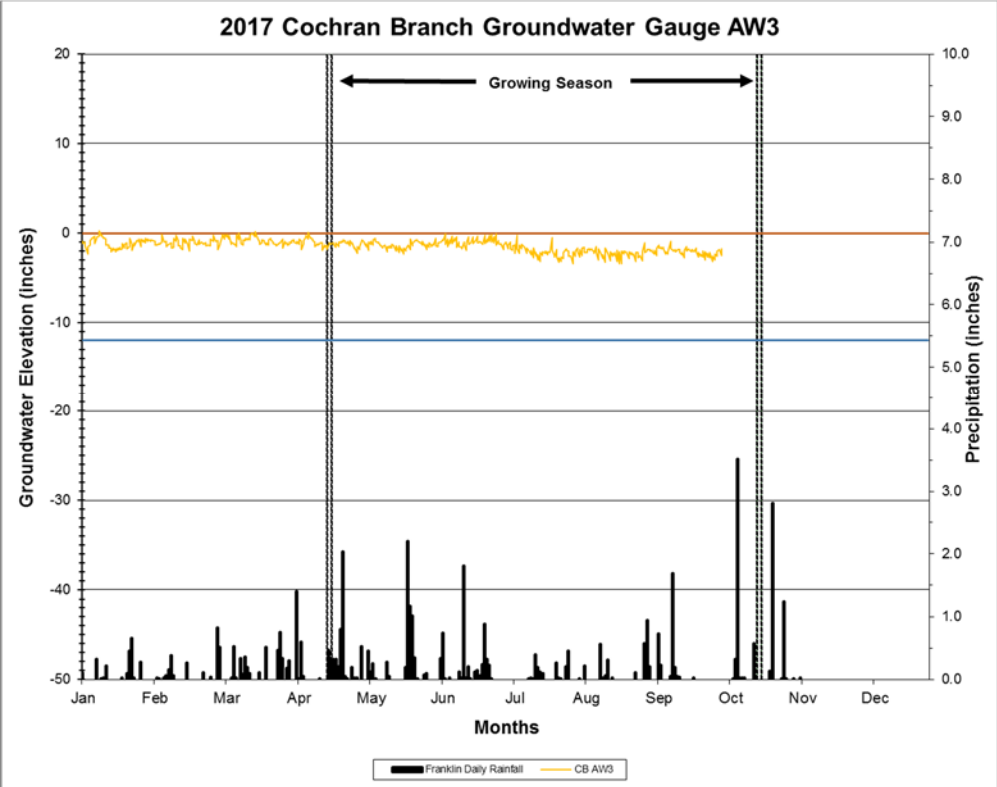
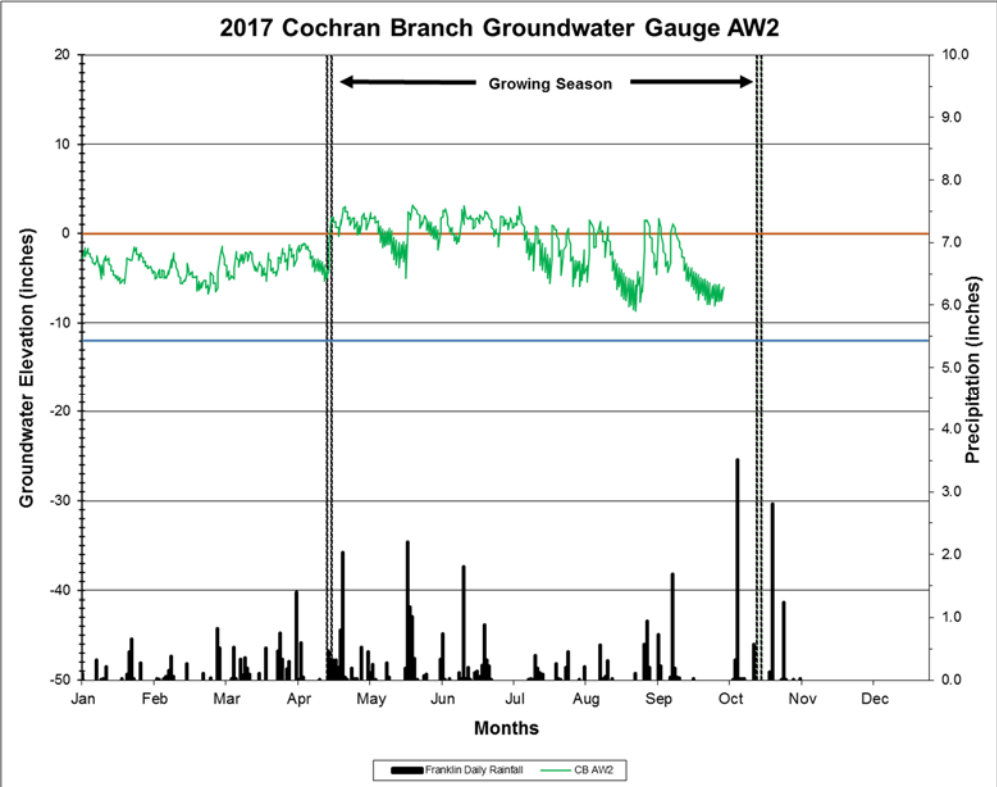
Hydrology Success Criteria = 8%; Growing season = April 16 - October 19 (187 days)

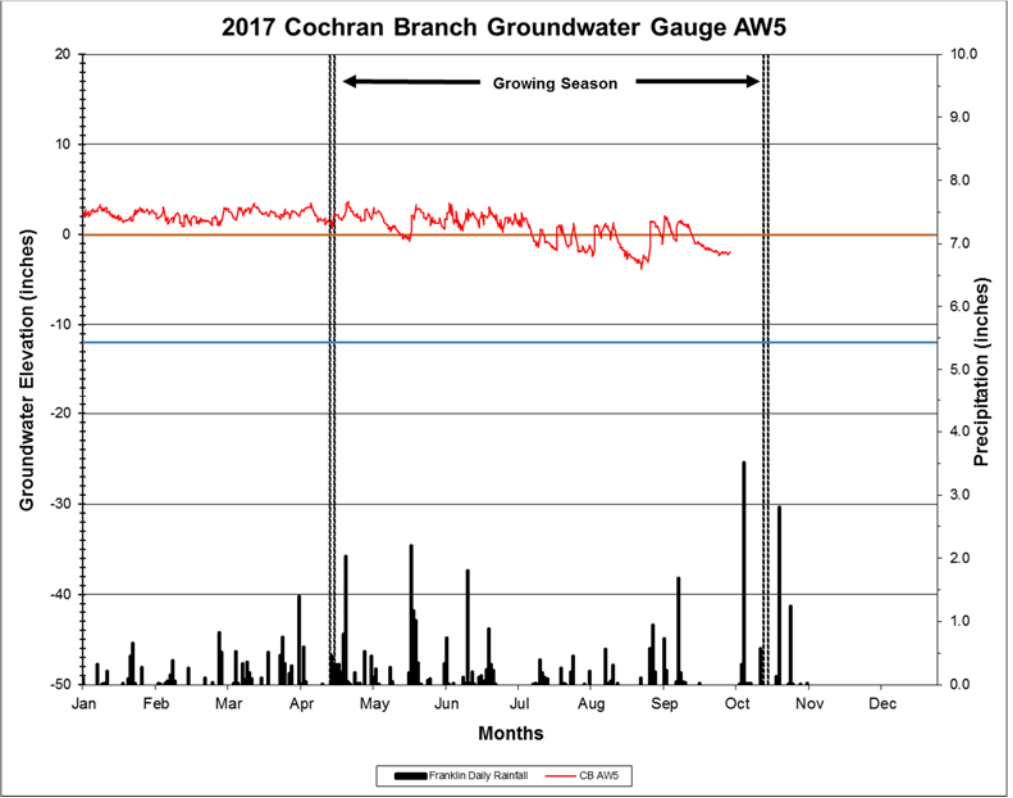
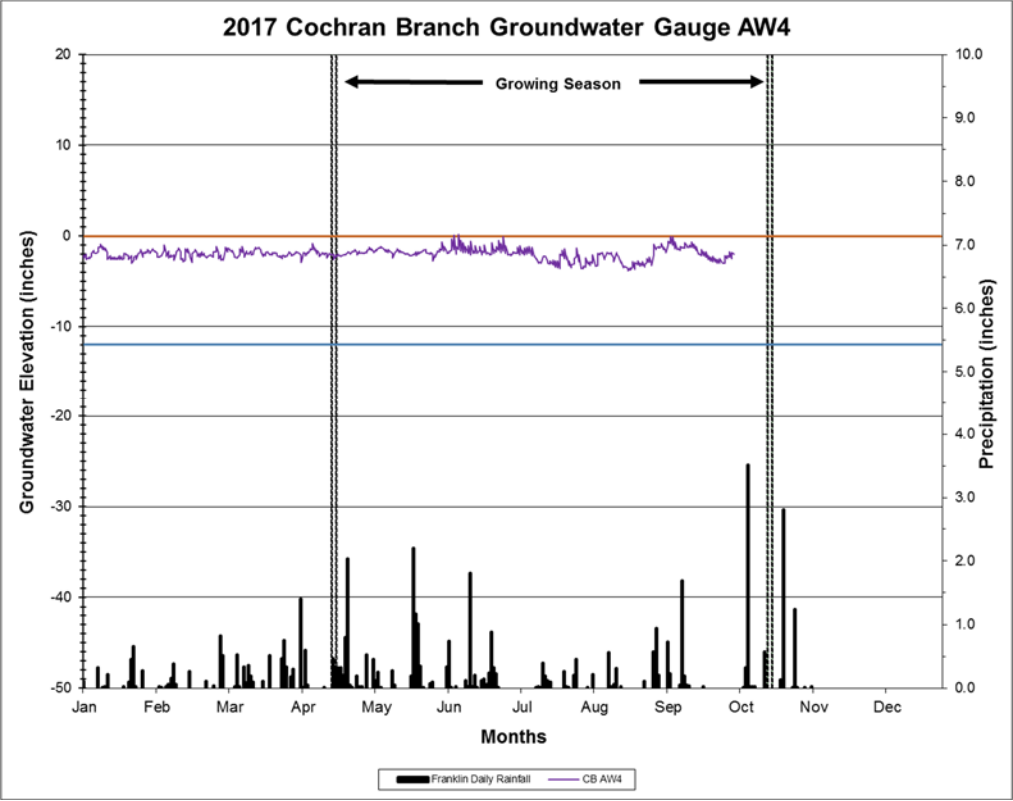
*Max consecutive days during growing season limited to 132 days due to shortened growing season. Percent based on full 187 day growing season

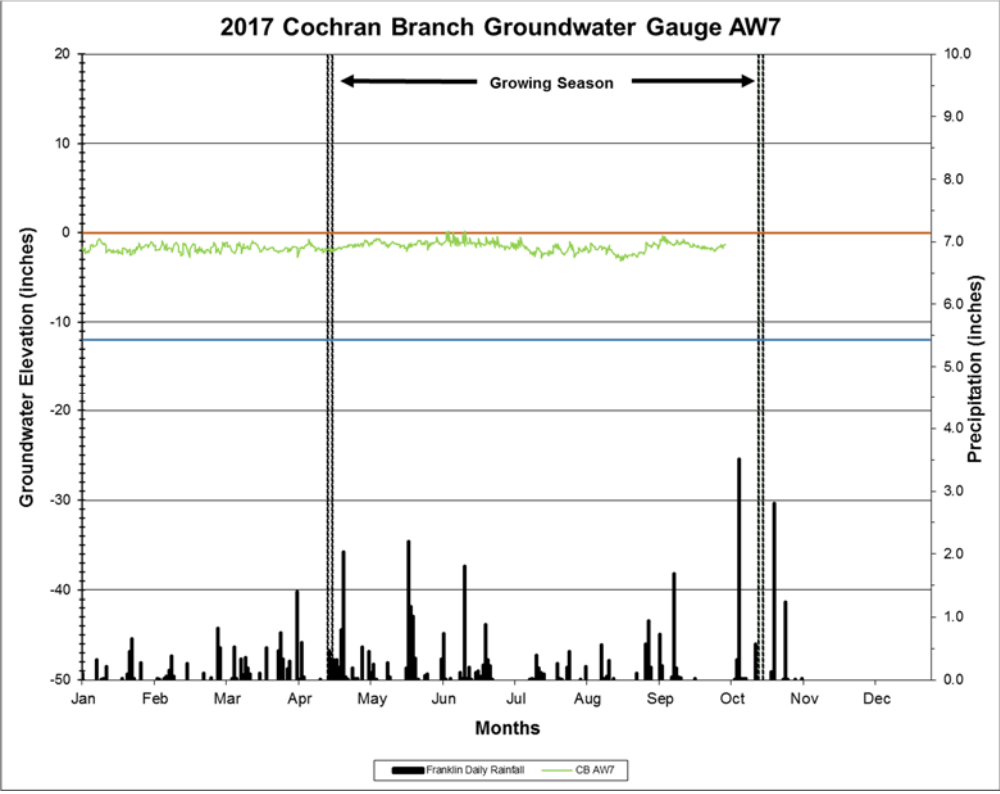
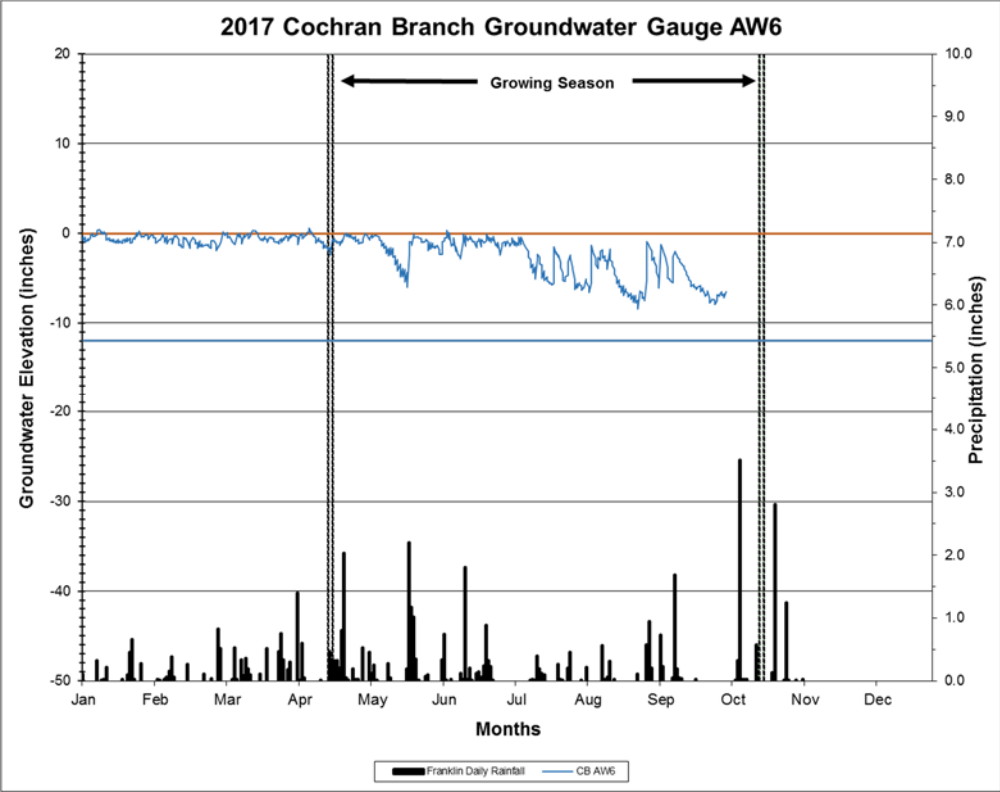
**Located just outside of wetland re-establishment area

Charts 5-12. 2017 Groundwater Monitoring Gauge Hydrographs









2017 Cochran Branch Groundwater Gauge AW8

