

**YEAR 5 of 5 Monitoring Report  
Tributaries of Wicker Branch Stream Restoration  
Union County, North Carolina  
DMS Project Number: 95022  
Contract No: 003982  
USACE Action Id No: SAW 2013-01680**

**Yadkin River  
03040105**



**Prepared for:**

**NC Department of Environmental Quality  
Division of Mitigation Services  
1652 Mail Service Center  
Raleigh, NC 27699-1652**

**Data Collection Period November 2019  
Submitted: February 2020**

Mitigation Project Name Tributaries of Wicker Branch Stream Restoration Site  
 DMS ID 95022  
 River Basin Yadkin  
 Cataloging Unit 03040105

County  
 Date Project Instituted 7/13/2011  
 Date Prepared 6/14/2019

USACE Action ID 2013-01680  
 NCDWR Permit No 2013-0957

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riparian	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Year (Wetland)
Potential Credits (Mitigation Plan)	2,539.670													
Potential Credits (As-Built Survey)	2,539.667													
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A		N/A	N/A
2 (Year 0 / As-Built)	30%	761.900			2016	2/1/2016	N/A				N/A		N/A	N/A
3 (Year 1 Monitoring)	10%	253.967			2016	4/25/2016	N/A				N/A		N/A	N/A
4 (Year 2 Monitoring)	10%	253.967			2017	10/20/2017	N/A				N/A		N/A	N/A
5 (Year 3 Monitoring) - Resubmitted	10%	253.967			2018	4/26/2019	N/A				N/A		N/A	N/A
6 (Year 4 Monitoring)	10%	253.967			2019	4/26/2019	N/A				N/A		N/A	N/A
7 (Year 5 Monitoring)	15%				2020		N/A				N/A		N/A	N/A
Stream Bankfull Standard	15%	380.950			2019	4/26/2019	N/A				N/A		N/A	N/A
Total Credits Released to Date		1,904.750												

NOTES:

CONTINGENCIES:



Signature of Wilmington District Official Approving Credit Release

27 Sept 2019

Date

- 1 - For DMS, no credits are released during the first milestone
- 2 - For DMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the DMS (NCEEP) Portal, provided the following criteria have been met:
  - 1) Approval of the final Mitigation Plan
  - 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
  - 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
  - 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required
- 3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met



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**03040105**

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**Raleigh, NC 27699-1652**

**Prepared by:**

**AECOM**

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**February 2020**



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February 11, 2020

Harry Tsomides  
North Carolina Department of Environmental Quality  
Division of Mitigation Services  
5 Ravenscroft Dr., Suite 102  
Asheville, NC 28801

**RE: Year 5 (2019) Monitoring Report the Tributaries of Wicker Branch Project (DMS Project # 95022)**

Dear Mr. Tsomides,

Please find enclosed two copies of the Year 5 Monitoring Report for the Tributaries of Wicker Branch Project. Also included is a disc containing the Digital Data submission files. This report has been finalized following your review comments dated January 9, 2020. The following changes have been made to the draft report based on your comments (in italics).

*Please include copies of both the 2017 IRT site meeting minutes, and the AECOM January 2019 memo to DMS (addressing site concerns) in an Appendix, and reference them in the Project Summary.*

A short paragraph has been added to the Project Summary and the memos have been included as Appendix F. Also included was my memo dated May 3, 2018 that was a response to the IRT site meeting.

*If possible, please add a photo of the recently repaired structure on Tributary 1b.*

A photo of the repair was added to the end of Appendix B.

*Digital support file comments*

*DMS does not have spatial features for the creditable assets for the site. Please provide features that characterize the creditable assets that have been reported, ensuring that features are segmented and attributed as they are in the asset table and that feature lengths match the linear feet reported.*

The shapefiles in Figure 2 Assets were modified to match the asset table. A map package of Figure 2 as well as the asset shapefile can be found in the digital submittal under 6.0 Other.

*- There is no MY5 CVS file within the given data.*

The MY5 cvs (raw survey data) has been placed in the digital submittal under 4. Geomorphological Data.



*- Please provide DMS with stream gage data and precipitation data used to create streamflow figures.*

The stream gauge data and precipitation data has been placed in the digital submittal under 5. Hydro. The precipitation data is included on the same spreadsheet as the flow as well as in a separate spreadsheet.

If you have any questions regarding this Monitoring Report, please feel free to give me a call.

Regards,

A handwritten signature in blue ink, appearing to read 'Ron Johnson', written in a cursive style.

Ron Johnson

Project Manger

AECOM Technical Services of North Carolina, Inc.

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## 1.0 PROJECT SUMMARY

The Tributaries of Wicker Branch Stream Restoration Project is located in Union County, North Carolina in the Yadkin River Basin, (HUC 03040105081010), and within a North Carolina Department of Environmental Quality, Division of Mitigation Services (DMS) Targeted Local Watershed (TLW). It is also located within the watershed of Lanes Creek, a 303d-listed stream and Water Supply Watershed.

The project site consists of four headwater stream channels that flow through agricultural land and prior to restoration efforts were devoid of riparian vegetation. Past and present agricultural use of the land had severely impacted and degraded the channels. The project goals address stressors identified in the TLW and include the following:

- Improved water quality in Wicker Branch.
- Improve aquatic habitat in the tributary channels.
- Provide aesthetic value, wildlife habitat, and bank stability through the creation of a riparian zone.
- Create a contiguous wildlife corridor, with connection of some isolated adjacent natural habitats to larger downstream forested tracts.
- Provide shading and biomass input to the stream and mast for wildlife when vegetation is mature.

These objectives were achieved through restoring, enhancing, and preserving 4020 feet of perennial and intermittent stream channel. The riparian areas were also planted with native vegetation to improve habitat and protect water quality. The project reaches consist of Tributary 1A (Priority 1 Restoration), Tributary 1B (Enhancement Level II including invasive species control), Tributary 2 (Preservation), Tributary 3 (Enhancement Levels I and II), and Tributary 4 (Enhancement Level II)(See **Table 1** in **Appendix A** and **Figure 2** in **Appendix A**).

Tributary 2 was determined to be unsuitable for mitigation credits during a site visit with the USACE in August, 2011. It was requested by the USACE that a 30 foot buffer and conservation easement be acquired to provide riparian habitat connectivity between the restored segments of Tributary 1A and upstream wooded areas.

An Interagency Review Team (IRT) visit to the site was performed in April 25 that identified several issues that included:

- Areas of low stem density
- Lack of channel formation on Tributary 3 between wetlands
- Bankfull data event collection and verification
- Presence of invasive privet along Tributary 1b
- Easement encroachments at several equipment crossings

A memorandum documenting the meeting and the actions taken is included in **Appendix F**. A site visit was also performed by DMS Property and NCDEQ Stewardship personnel on October 5, 2018. A memorandum documenting their concerns and the actions taken is also included in **Appendix F**.

Project success will be determined by monitoring channel stability and vegetation within the easement. Success criteria have been outlined in the 2013 Mitigation Plan and include a stable dimension, pattern, and profile documented through the surveying of cross-sections and longitudinal profiles. Vegetation monitoring plots will have a minimum of 260 stems per acre after 5 years.

Project design was completed in December 2013 and the project constructed in September and October 2014. Planting was complete in March 2015 (See **Table 2** in **Appendix A**).

Herbaceous vegetation is well established though out the easement. The vegetation monitoring plots show an average density of 445 stems per acre down from baseline planting of 684 stems per acre but still well above the 320 stems per acre at end of year 3 and 260 stems per acre at year 5. Two plots do not meet the vegetation success criteria. Plots 6 and 10 are at 243 stems per acre, just under the success criteria. A number of volunteer woody stems are present throughout the easement. Volunteer species included black locust, elm, box elder, persimmon, oaks, sweetgum, pine, willows, elderberry, and redbud.

Work on controlling or removing invasive species occurred throughout the summer. Chinese privet (*Ligustrum sinense*) that was present in the buffer along Tributary 1B responded well to treatment in 2018 contained isolated stems which were cut and treated in 2019. Isolated privet that has started to appear in the buffer along Tributary 1A, and Tributary 4 were also treated. Several areas of dense honeysuckle (*Lonicera japonica*) that developed in isolated areas on Tributary 1 and 3 were treated in 2019. Scattered chinaberry (*Melia azedarach*) trees along the edges of Tributary 1 and 3 were cut as well. A small area of cat-tails (*Typha* sp.) was also treated but did not seem to respond to the herbicide. The cat-tails will be treated again in the spring once growth begins.

The restored stream channels appear to be stable with no areas of bank erosion observed. During construction in 2014 a headcut at the bottom of Tributary 1B was stabilized with a log sill and stone. Floodplain flows during bankfull events started to erode the bank around the left bank side of the sill in 2018. This was repaired in 2019 by filling the eroding area with soil and rock and placing a log sill in the floodplain to direct flow away from the end of the instream sill (see photograph at the end of **Appendix B**).

The adjacent fields were planted in corn in 2019. The only encroachment that has occurred this year is at the top of Tributary 2. The encroachment has occurred because the equipment crossing is not wide enough to accommodate the farmers equipment. AECOM is working with the landowner and the farmer that leases the property to develop a temporary exception to the easement that will allow access. The buffer present in this area is along an ephemeral drainage that does not generate any credits and not along the main stream channel (Tributary 1). The area of encroachment is shown on **Figure 3** in **Appendix B**.

## Hydrology

AECOM is currently monitoring the stream flow on Tributaries 1 and 3 using Onset HOB0 pressure transducers. Transducers are installed in two separate pools on each of the tributaries for a total of 4 locations. On Tributary 1A a transducer is located on the downstream end of the project and a second is located above the confluence with Tributary 2. On Tributary 3 one

transducer is located on the downstream end and a second is located in a pool just below the wetland at the beginning of the Enhancement I reach. The locations of the transducers are shown on Figure 3 Current Condition Plan View in Appendix B.

The transducers are suspended in the pool at a set elevation and use pressure to measure the depth of water over (above) the transducer. The elevation of the transducer is known, as is the elevation of the head of the riffle and the top of the bank (for bankfull flow). When the elevation of the water level in the pool above the transducer exceeds the elevation of the head of the riffle, then it is assumed that flow is occurring. The data for the transducers (which monitor flow) is presented in graphs that can be found in Appendix E.

A large rain event in early October 2018 (1.2 inches on October 10 and 1.9 inches on October 11) recharged flow in the site tributaries so that flow was typically present through April. Tributary 1 had continuous flow in the lower portion from October 21, 2018 through April 22, 2019. The upper portion of Tributary 1 fluctuated a bit more but had continuous flow from January 23 through April 22, 2019. Tributary 3 had flow in both the upper and lower reaches from October through April 22, 2019.

A bankfull event was recorded by the transducers on April 8, 2019 and confirmed through visual observation of rack lines and debris in the floodplain during an April 22, 2019 site visit. Bankfull events were also recorded on February 22, and March 1, 2019 by the transducers.

### **Tributary 3 Stream Mitigation Units**

The project as described in the Mitigation Plan is projected to generate 2539.65 SMUs through a mixture of Restoration, Enhancement I, and Enhancement II. During the Interagency Review Team (IRT) site visit in April 2017 it was noted that the upper reach located between two wetland areas was silted in and lacked a distinct channel. This reach is 264 feet in length and has been proposed as Enhancement II at a Mitigation Ratio of 2.5:1. This length was projected to generate 105.6 SMUs.

During the October 2018 monitoring it was observed that a channel was starting to reform in this reach. The channel will continued to be monitored to see if a channel continues to reform and to what extent (length).

## **2.0 METHODOLOGY**

Vegetation survival, channel stability, and wetland hydrology were monitored on the project site. Post restoration monitoring will occur for a minimum of five years or until success criteria are met.

### **2.1 VEGETATION**

Eleven vegetation plots were established and assess for the baseline vegetation monitoring. The Carolina Vegetative Survey-EEP Protocol Level 2 methodology was used to sample vegetation on October 14 and 15, 2015 (Lee et al. 2006, <http://cvs.bio.unc.edu/methods.htm>).

## **2.2 STREAM ASSESSMENT**

Twelve permanent monitoring cross-sections have been established on the site as follows:

- Tributary 1A (1,390 feet) – 4 riffle and 3 pool cross-sections
- Tributary 3 (640 feet) – 2 riffle and 1 pool cross-sections
- Tributary 4 (631 feet) – 2 riffle cross-sections

Wolman pebble counts were conducted on each cross-section. Particle sizes less than 2.0 millimeters (mm) were determined by touch using the following guidelines:

- Silt – Smooth feeling (not gritty)
- Fine sand – Slightly gritty texture
- Coarse sand – Very gritty texture

Multiple parameters were located including top of bank, thalweg, and water surface. Pool and riffle features were called out to calculate feature slopes and lengths. The survey was performed with a survey grade GPS (Trimble TCS3 with an R8 Model 3 GNSS receiver).

## **2.3 VISUAL ASSESSMENT**

A visual assessment of the stream was performed to assess the bank (lateral stability), bed (vertical stability), the easement boundary, and site vegetation.

## **2.4 DIGITAL PHOTOS**

Digital photos of each of the vegetation plots and each cross-section were also taken as seen in **Appendix B**.

## **3.0 REFERENCES**

Lee, M.T., R.K. Peet, S.D. Roberts, T.R. Wentworth. 2006. *CVS-EEP Protocol for Recording Vegetation Version 4.0*.

## **APPENDIX A – General Figures and Tables**

Figure 1: Vicinity Map

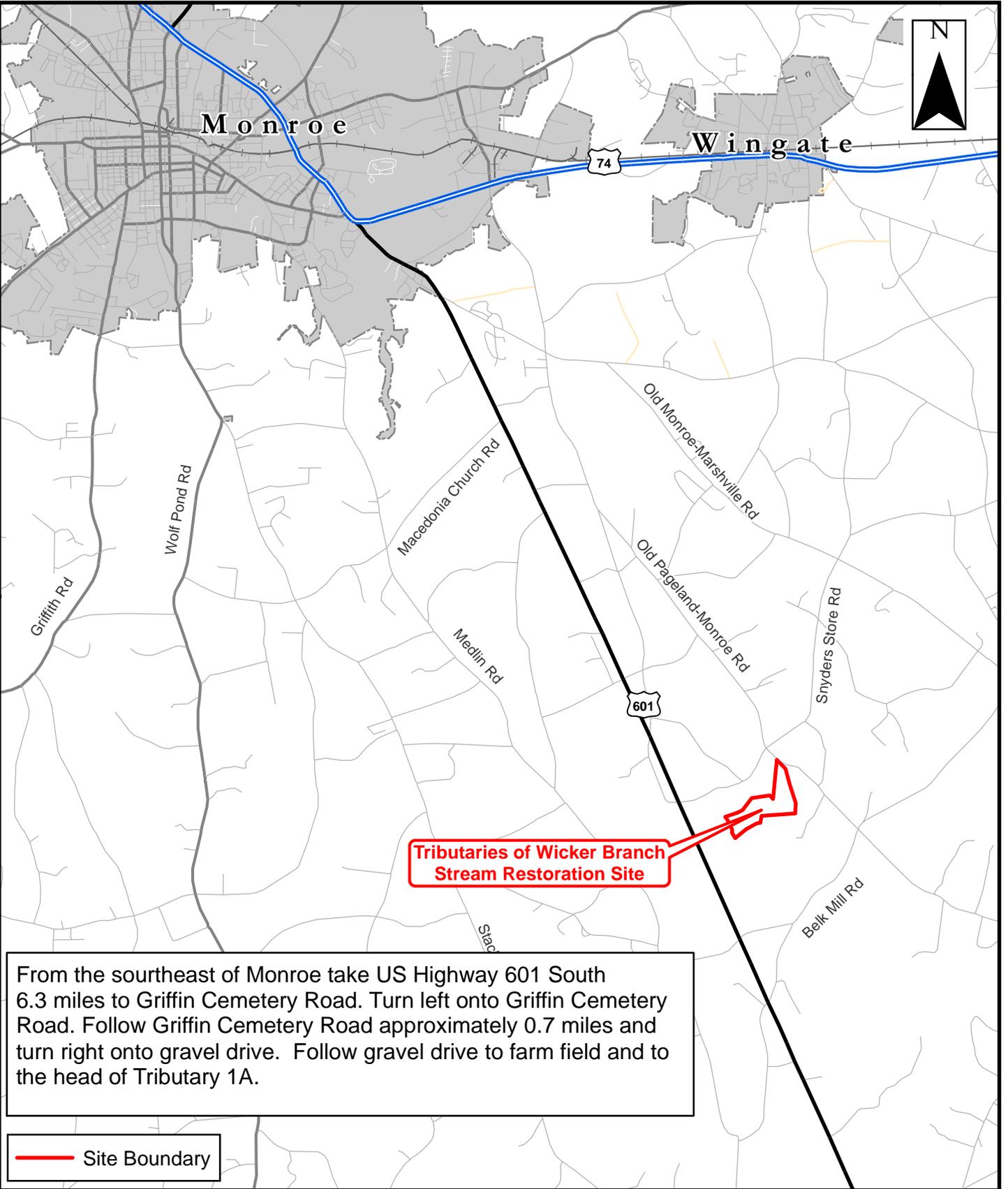
Figure 2: Stream Assets Map

Table 1: Project Components and Mitigation Credits

Table 2: Project Activity and Reporting History

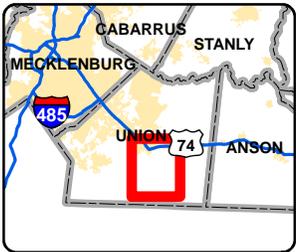
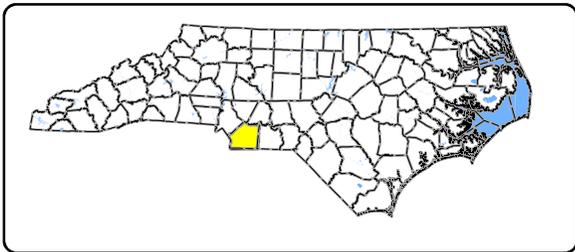
Table 3: Project Contacts

Table 4: Project Baseline Information and Attribute

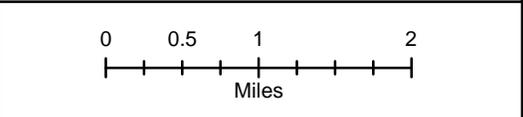


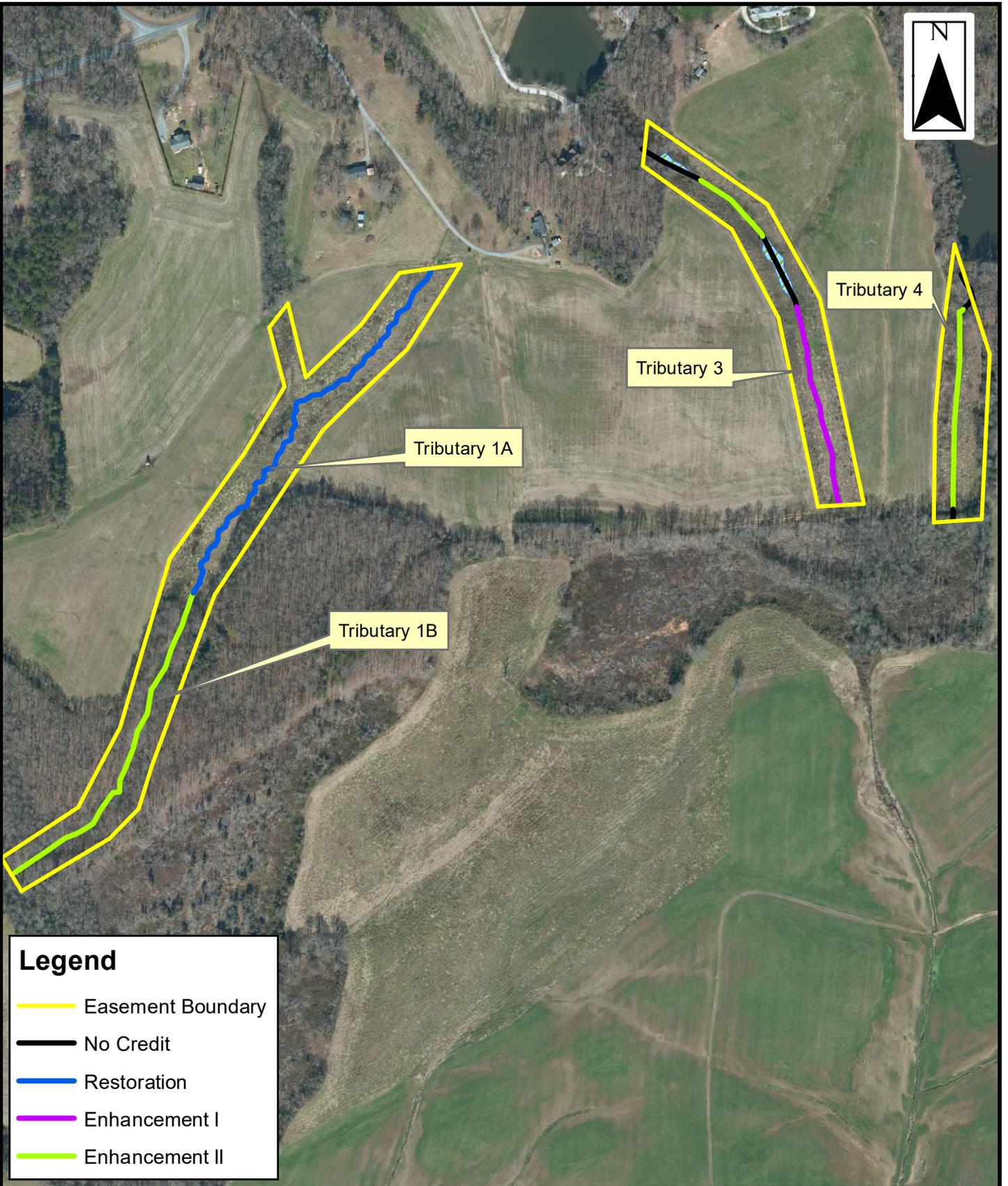
From the southeast of Monroe take US Highway 601 South 6.3 miles to Griffin Cemetery Road. Turn left onto Griffin Cemetery Road. Follow Griffin Cemetery Road approximately 0.7 miles and turn right onto gravel drive. Follow gravel drive to farm field and to the head of Tributary 1A.

— Site Boundary



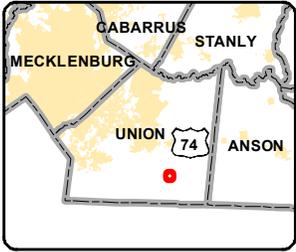
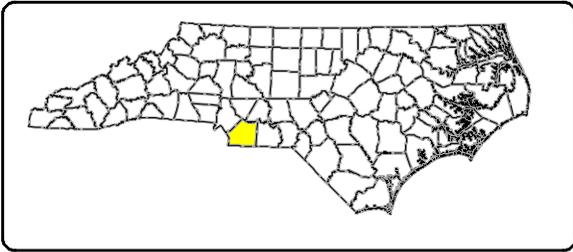
**1. Vicinity Map**  
 Tributaries of Wicker Branch  
 Stream Restoration Site (DMS No. 95022)  
 Union County, NC





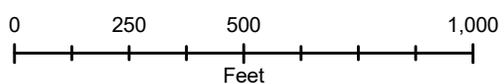
**Legend**

-  Easement Boundary
-  No Credit
-  Restoration
-  Enhancement I
-  Enhancement II



## 2. Stream Assets Map

Tributaries of Wicker Branch  
Stream Restoration Site (DMS No. 95022)  
Union County, NC





**Table 2. Project Activity and Reporting History  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Restoration Plan	Dec-13	Dec-13
Final Design – Construction Plans	Mar-14	Mar-14
Construction	Nov-14	Nov-14
Permanent seed applied to entire site	Nov-14	Nov-14
Plantings for entire site	Mar-15	Mar-15
Mitigation Plan (Year 0 Monitoring – baseline)	May-15	Jan-16
Year 1 Monitoring - Vegetation and Stream Channel	Oct-15	Mar-16
Year 2 Monitoring - Vegetation and Stream Channel	Oct-16	Dec-16
Invasives Control	Oct-17	Oct-17
Year 3 Monitoring -Vegetation and Stream Channel	Oct-17	Feb-18
Invasives Control	July/Spt-18	July/Spt-18
Year 4 Monitoring Vegetation and Stream Channel	Oct-18	Jan-19
Invasives Control	May-19	May, July -19
Year 5 Monitoring -Vegetation and Stream Channel	Nov-19	Feb-20

**Table 3. Project Contact Table**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

<p><b>Owner</b></p> <p>NCDEQ - Division of Mitigation Services</p>	<p>Harry Tsomides  NCDEQ - Division of Mitigation Services  5 Ravenscroft Drive, Suite 102  Asheville, NC 28801</p> <p>(828) 545-7057</p>
<p><b>Designer</b></p> <p>AECOM of North Carolina, Inc.</p>	<p>Ron Johnson, Project Manager  701 Corporate Center Drive, Suite 475  Raleigh, NC 27607  (919) 854-6210</p>
<p><b>Landowner</b></p> <p>Richard Simpson</p>	<p>3308 Old Pageland Monroe Rd.  Monroe, NC 28112  704-506-5184</p>
<p><b>Construction Contractor</b></p>	<p>Riverworks  6105 Chapel Hill Road  Raleigh, NC 27607</p>
<p><b>Planting Contractor</b></p>	<p>Efird's Landscaping  42759 Greenview Drive  Albemarle, NC 38001  (704) 985-6559</p>
<p><b>Seeding Contractor</b></p>	<p>Riverworks</p>
<p><b>Invasives Contractor</b></p>	<p>Habitat Assessment &amp; Restoration Professionals  Charlotte, North Carolina</p>
<p><b>Monitoring Performer</b></p> <p>AECOM of North Carolina, Inc.</p>	<p>701 Corporate Center Drive, Suite 475  Raleigh, NC 27607  919-760-4000</p>

**Table 4. Project Baseline Information and Attributes  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

<b>Project Information</b>					
Project Name	Tributaries of Wicker Branch				
Project County	Union				
Project Area (acres)	15.49				
Project Coordinates (lat/long)	34.8946849, -80.4472082				
<b>Project Watershed Summary</b>					
Physiographic Province	Carolina Slate Belt - Piedmont				
Project River Basin	Yadkin-Pee Dee				
USGS HUC for Project	3040105081010				
NCDWQ Sub-basin for Project	3/7/2014				
Project Drainage Area (acres)	173				
Project Drainage Area Percentage of Impervious Area	2% to 3%				
CGIA Land Use Classification	Cultivated/Managed Herbaceous Cover				
<b>Reach Summary Information (Pre-restoration)</b>					
Parameters	Trib 1A	Trib 1B	Trib 2	Trib 3	Trib 4
Length of Reach (feet)	1293	1095	330	1184	631
Valley Classification	Type II	Type II	Type II	Type II	Type II
Drainage area (acres)	71.5	94.5	17.6	32.7	29.8
NCDWQ Stream ID Score	38.5	38.5	27	43	31.5
NCDWQ Water Quality Classification	WS-V	WS-V	WS-V	WS-V	WS-V
Morphological Description	B4c, G4c, F4	C4/F4	N/A	F/B6c/F6	N/A*
Evolutionary Trend	G→F→C	N/A	N/A	G→F→C	N/A
Underlying Mapped Soils	Cid channery silt loam	Chewacla silt loam	Cid channery silt loam, Badin channery silt loam	Cid channery silt loam	Cid channery silt loam, Goldston-Badin complex
Drainage Class	Moderately well drained/ somewhat poorly drained	Somewhat poorly drained	Moderately well drained/ somewhat poorly drained, well drained	Moderately well drained/ somewhat poorly drained	Somewhat poorly drained to excessively drained
Soil Hydric Status	No	Yes	No	No	No
Slope	1.30%	1.00%	1.70%	1.40%	1.00%
FEMA Classification	Zone X	Zone X	Zone X	Zone X	Zone X
Native Vegetation	None	Mesic Mixed Hardwoods	None	None	None
Percent Composition of Exotic Invasive Vegetation	0	50 % Understory	0	0	0
<b>Regulatory Considerations</b>					
Regulation	Applicable			Resolved	
Waters of the US – Section 404	Yes			Yes	
Waters of the US – Section 401	Yes			Yes	
Endangered Species Act	Yes			Yes	
Historic Preservation Act	No			N/A	
CZMA/CAMA	No			N/A	
FEMA Floodplain Compliance	No			N/A	
Essential Fisheries Habitat	No			N/A	

## **APPENDIX B – VISUAL ASSESSMENT DATA**

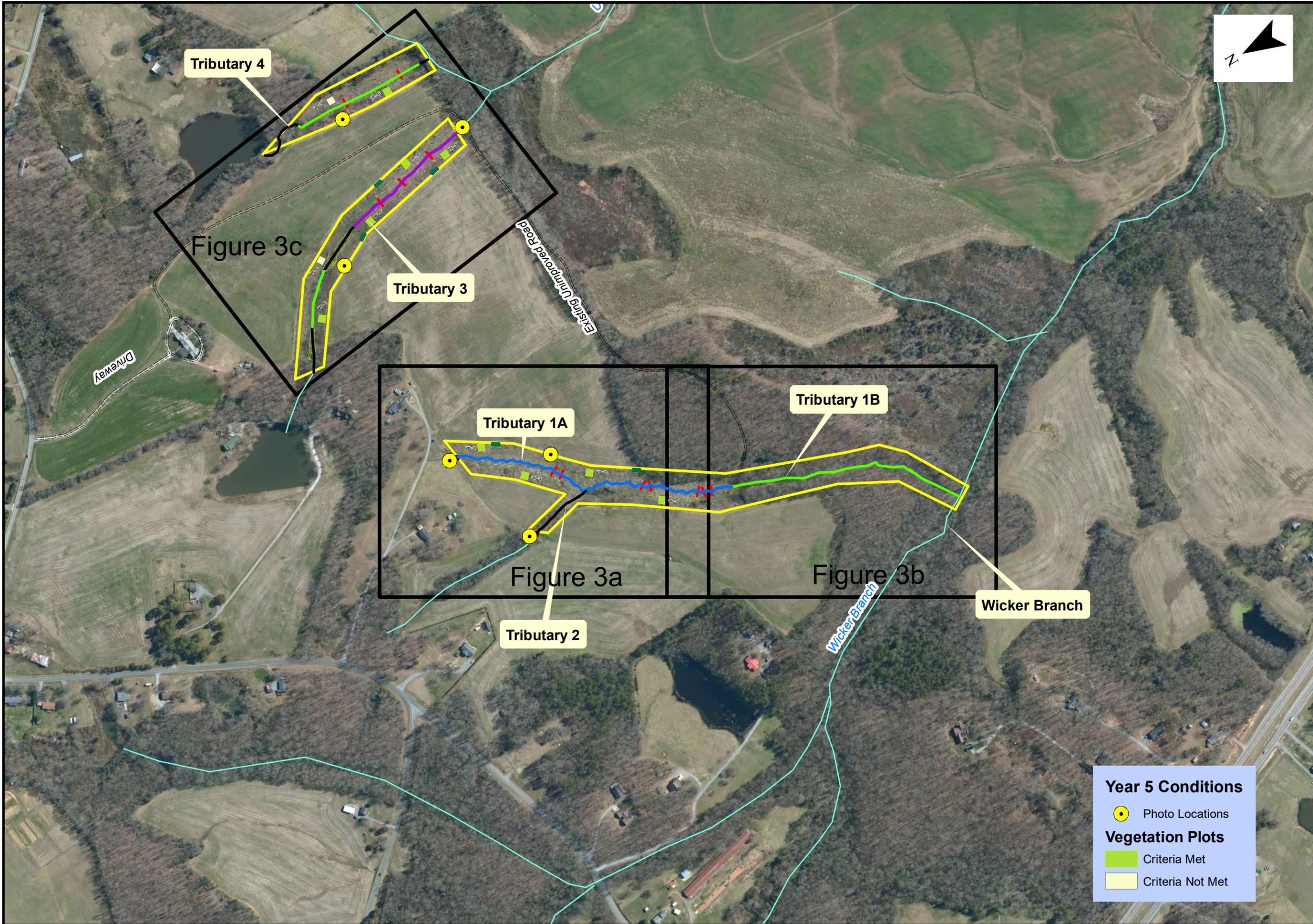
Figure 3: Current Condition Plan View

Table 5: Visual Stream Morphology Stability Assessment

Table 6: Vegetation Condition Assessment

Photos: Stream Stations

Photos: Vegetation Plots



Tributary 4

Figure 3c

Tributary 3

Tributary 1A

Tributary 1B

Figure 3a

Figure 3b

Tributary 2

Wicker Branch

Driveway

Existing Unimproved Road

Wicker Branch

**Year 5 Conditions**

- Photo Locations

**Vegetation Plots**

- Criteria Met
- Criteria Not Met

**Legend**

- Cross Sections
- Equipment Crossing
- Log Sill
- Level Spreader
- Stream
- Easement Boundary

Scale in Feet

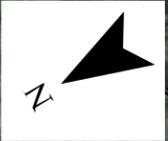
0 50 100

**Existing Condition Plan View**  
 Tributaries of Wicker Branch Stream Restoration  
 Union County, NC  
 DMS Project No. 95022



**Assets**

- No Credit
- Restoration
- Enhancement I
- Enhancement II



**Legend**

- Existing Wetlands
- Level Spreader
- Cross Sections
- Equipment Crossing
- Log Sill
- Culvert
- Stream
- Easement Boundary
- Unimproved Road

**Existing Condition Plan View**  
 Tributaries of Wicker Branch Stream Restoration  
 Union County, NC  
 DMS Project No. 95022

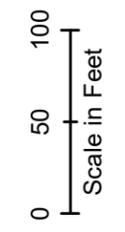
**FIGURE 3a**

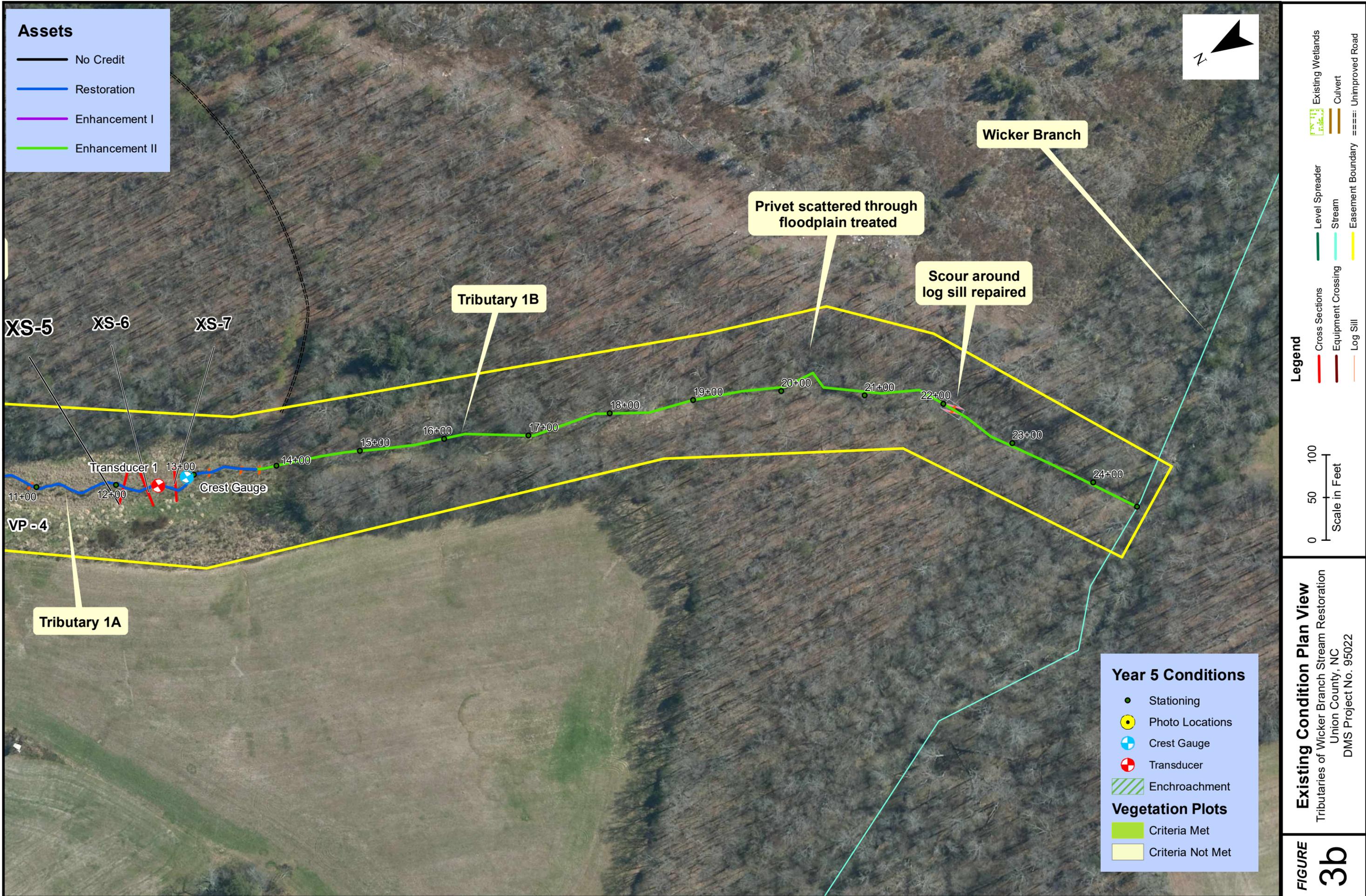
**Year 5 Conditions**

- Stationing
- Photo Locations
- Crest Gauge
- Transducer
- Enchroachment

**Vegetation Plots**

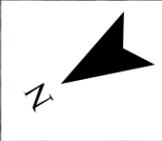
- Criteria Met
- Criteria Not Met





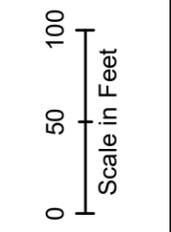
**Assets**

- No Credit
- Restoration
- Enhancement I
- Enhancement II



**Legend**

- Cross Sections
- Equipment Crossing
- Log Sill
- Existing Wetlands
- Level Spreader
- Stream
- Easement Boundary
- Culvert
- Unimproved Road



**Existing Condition Plan View**  
 Tributaries of Wicker Branch Stream Restoration  
 Union County, NC  
 DMS Project No. 95022

**Year 5 Conditions**

- Stationing
- Photo Locations
- Crest Gauge
- Transducer
- Enchroachment

**Vegetation Plots**

- Criteria Met
- Criteria Not Met

**FIGURE 3b**



**Assets**

- No Credit
- Restoration
- Enhancement I
- Enhancement II

**Legend**

- Cross Sections
- Equipment Crossing
- Log Sill
- Existing Wetlands
- Level Spreader
- Stream
- Easement Boundary
- Culvert
- Unimproved Road

Scale in Feet  
0 50 100

**Year 5 Conditions**

- Stationing
- Photo Locations
- Crest Gauge
- Transducer
- Enchroachment

**Vegetation Plots**

- Criteria Met
- Criteria Not Met

**FIGURE 3C**  
**Existing Condition Plan View**  
 Tributaries of Wicker Branch Stream Restoration  
 Union County, NC  
 DMS Project No. 95022

**Table 5. Visual Stream Morphology Stability Assessment  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Reach ID		Tributary 1								
Assessed Length		2485								
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	50	50			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth $\geq$ 1.6)	49	49			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	49	49			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	50	50			100%			
2. Thalweg centering at downstream of meander (Glide)		50	50			100%				
<b>Totals</b>										
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 <b>NOT</b> 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%
<b>Totals</b>										
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	32	33			97%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	33	33			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	33	33			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	33	33			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio $\geq$ 1.6 Rootwads/logs providing some cover at base-flow.	33	33			100%			

**Table 5. Visual Stream Morphology Stability Assessment  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Reach ID		Tributary 3								
Assessed Length		904								
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	12	12			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth $\geq$ 1.6)	12	12			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	12	12			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	12	12			100%			
		2. Thalweg centering at downstream of meander (Glide)	12	12			100%			
	<b>Totals</b>					0	0			
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%
<b>Totals</b>					0	0	100%	0	0	100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	13	13			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	13	13			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	13	13			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	13	13			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio $\geq$ 1.6 Rootwads/logs providing some cover at base-flow.	13	13			100%			

**Table 5. Visual Stream Morphology Stability Assessment  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Reach ID		Tributary 4								
Assessed Length		630								
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)	4	4	0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting					100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	4	4	0	0	100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth $\geq$ 1.6)	4	4	0	0	100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	4	4			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	4	4	0	0	100%			
2. Thalweg centering at downstream of meander (Glide)		4	4	100%						
<b>Totals</b>					0	0	100%	0	0	100%
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion	4	4	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.					100%			
	3. Mass Wasting	Bank slumping, calving, or collapse					100%			
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	4	4	0	0	100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	4	4			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio $\geq$ 1.6 Rootwads/logs providing some cover at base-flow.	4	4			100%			

**Table 6. Vegetation Condition Assessment  
Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Planted Acreage		11.57				
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Area
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Beige dot pattern	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Red Hatch	0	0.00	0.0%
<b>Total</b>				0	0.00	0.0%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	N/A	0	0.00	0.0%
<b>Cumulative Total</b>				0	0.00	0.0%

**Easement Acreage<sup>2</sup>**                      **15.49**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern <sup>4</sup>	Presence of Chinese privet and honeysuckle	1000 SF	Yellow Hatch	0	0.00	0.0%
5. Easement Encroachment Areas <sup>3</sup>	Areas or points (if too small to render as polygons at map scale).	none	Green Hatch	1	0.03	0.2%

<sup>1</sup> = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project effort.

<sup>2</sup> = The acreage within the easement boundaries.

<sup>3</sup> = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., item 1, 2 or 3) as well as a parallel tally in item 5.

<sup>4</sup> = Invasives may occur in or out of planted areas, but still within the easement and will therefore be calculated against the overall easement acreage. Invasives of concern/interest are listed below. The list of high concern species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discreet, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discreet patches. In any case, the point or polygon/area feature can be symbolized to describe things like high or low concern and species can be listed as a map inset, in legend items if the number of species are limited or in the narrative section of the executive summary.



Vegetation Monitoring Plot 1 – 11/14/2019



Vegetation Monitoring Plot 4 – 11/14/2019



Vegetation Monitoring Plot 2 – 11/14/2019



Vegetation Monitoring Plot 5 – 11/13/2019



Vegetation Monitoring Plot 3 – 11/14/2019



Vegetation Monitoring Plot 6 – 11/14/2019



Vegetation Monitoring Plot 7 – 11/13/2019



Vegetation Monitoring Plot 10 – 11/14/2019



Vegetation Monitoring Plot 8 – 11/14/2019



Vegetation Monitoring Plot 11 – 11/14/2019



Vegetation Monitoring Plot 9 – 11/14/2019



Cross Section 1 (looking upstream) – 11/13/19



Cross Section 4 (looking upstream) – 11/13/19



Cross Section 2 (looking upstream) – 11/13/19



Cross Section 5 (looking upstream) – 11/13/19



Cross Section 3 (looking upstream) – 11/13/19



Cross Section 6 (looking upstream) – 11/13/19



Cross Section 7 (looking upstream) – 11/14/19



Cross Section 10 (looking upstream) – 11/14/19



Cross Section 8 (looking upstream) – 11/14/19



Cross Section 11 (looking upstream) – 11/14/19



Cross Section 9 (looking upstream) – 11/14/19



Cross Section 12 (looking upstream) – 11/14/19



Photo Monitoring Point 1 – 11/14/19



Photo Monitoring Point 2 – 11/14/19



Photo Monitoring Point 3 – 11/14/19



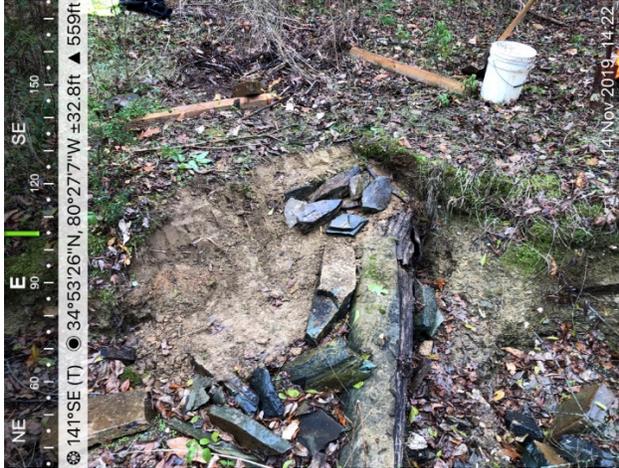
Photo Monitoring Point 4 – 11/13/19



Photo Monitoring Point 5 – 11/14/19



Photo Monitoring Point 6 – 11/14/19



Repair of log sill erosion on lower portion of  
Tributary 1B

## **APPENDIX C: VEGETATION PLOT DATA**

Table 7: Vegetation Plot Counts and Densities



## **APPENDIX D: STREAM GEOMORPHOLOGY DATA**

Cross-Sections

Longitudinal Profiles

Pebble Counts

Table 8: Baseline Stream Data Summary

Table 9a: Cross-Section Morphology Data

Table 9b: Stream Reach Morphology Data

## Cross-section Plot Exhibit

River Basin	Yadkin-Pee Dee
Watershed	Wicker Branch
X-Sec ID	XS-1, Sta. 4+65
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	11/13/2019
Field Crew	Ron Johnson

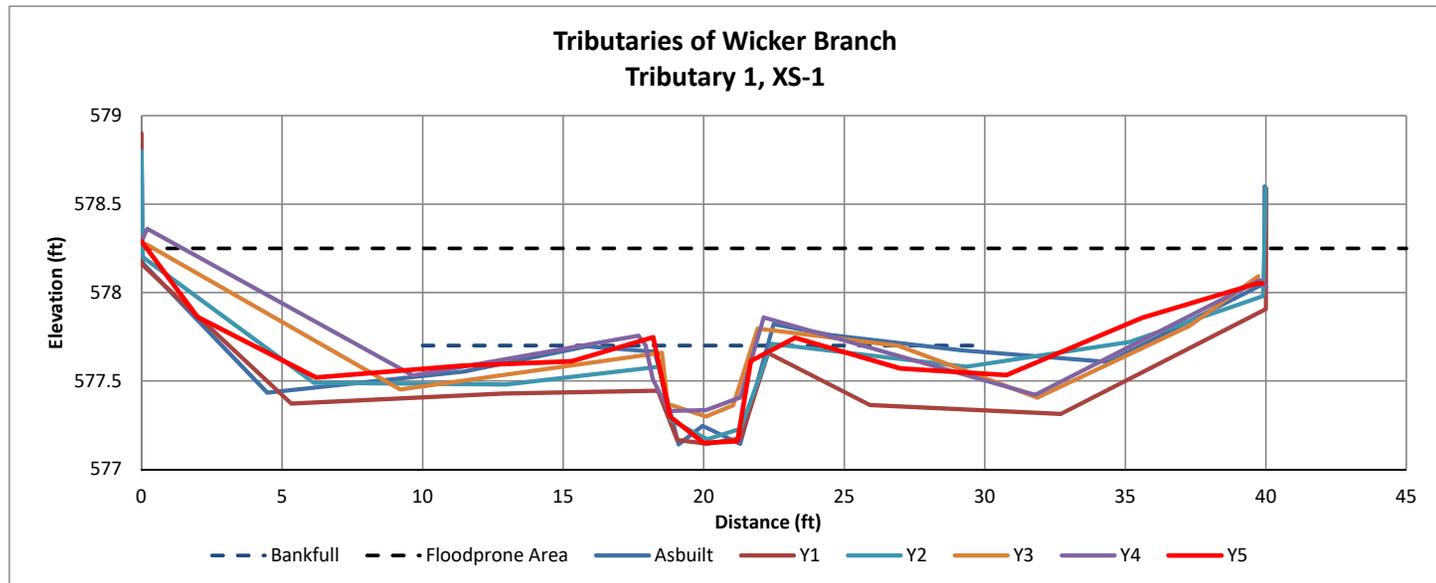
Station	Elevation	
0	578.29	LBPIN
1.99	577.86	GR
6.21	577.52	GR
11.4	577.59	GR
15.3	577.61	GR
18.2	577.75	TOB
18.81	577.30	TOE
20	577.15	TW
21.2	577.16	TOE
21.68	577.61	TOB
23.25	577.74	GR
26.99	577.57	GR
30.77	577.53	GR
35.6	577.86	GR
39.69	578.05	GR
39.88	578.05	RBPIN

### Summary Data

Bankfull Elevation	577.7
Bankfull Width (ft)	4.33
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.35
Bankfull Max Depth (ft)	0.55
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.51
Bankfull Width/Depth Ratio	12.37
Bankfull Entrenchment Ratio	11.5
Low Top of Bank Depth (ft)	0.46
Bankfull Bank Height Ratio	0.83



Photo: Cross-section 1 looking upstream





## Cross-section Plot Exhibit

River Basin	Yadkin-Pee Dee
Watershed	Wicker Branch
X-Sec ID	XS-3, Sta. 9+34
Feature	Riffle
Drainage Area (sq mi)	0.15
Date	11/13/2019
Field Crew	Ron Johnson

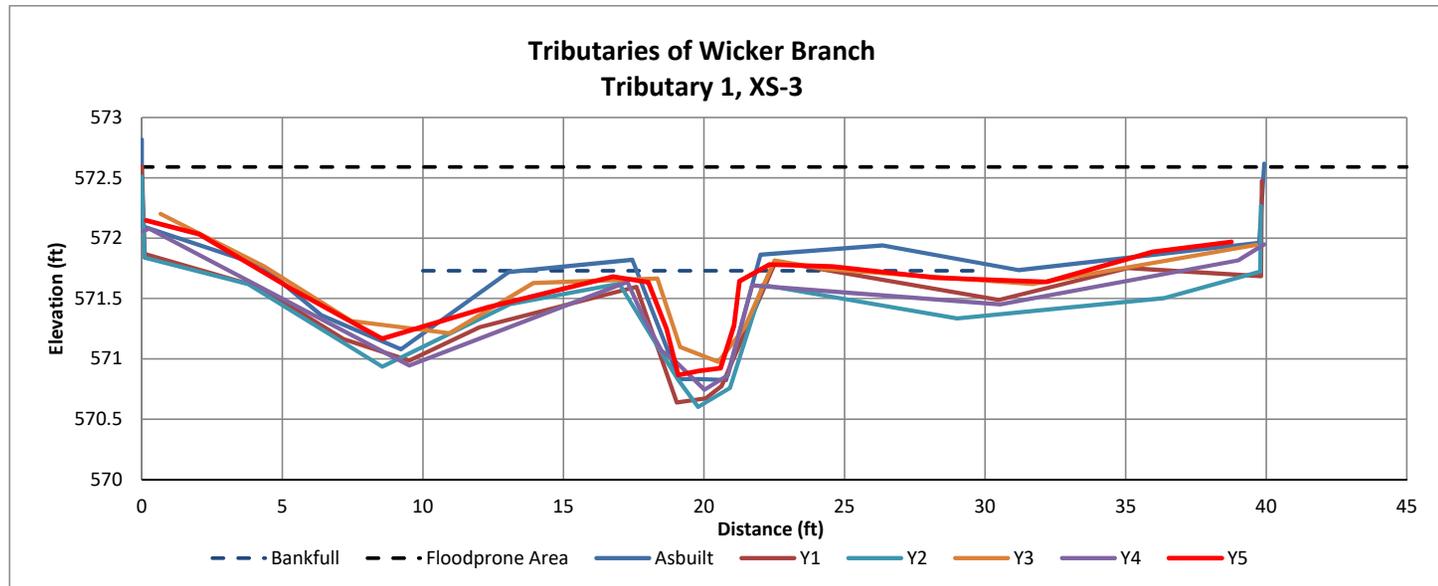
Station	Elevation
0.16	572.15 LBPIN
2.04	572.03 GR
5.31	571.58 GR
8.55	571.17 GR
12.3	571.43 GR
16.76	571.68 GR
18.02	571.64 TOB
18.67	571.25
19.08	570.87 TW
19.83	570.90
20.59	570.92
21.07	571.28 TOE
21.26	571.64 TOB
22.34	571.78 GR
24.57	571.77 GR
28.24	571.67 GR
32.19	571.64 GR
35.97	571.89 GR
38.76	571.97 RBPIN

### Summary Data

Bankfull Elevation	571.73
Bankfull Width (ft)	9.9
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.31
Bankfull Max Depth (ft)	0.86
Bankfull Cross Sectional Area (ft <sup>2</sup> )	3.08
Bankfull Width/Depth Ratio	32.03
Bankfull Entrenchment Ratio	5
Low Top of Bank Depth (ft)	0.82
Bankfull Bank Height Ratio	0.95



Photo: Cross-section 3 looking upstream



## Cross-section Plot Exhibit

River Basin	Yadkin-Pee Dee
Watershed	Wicker Branch
X-Sec ID	XS-4, Sta. 9+72
Feature	Pool
Drainage Area (sq mi)	0.15
Date	11/13/2019
Field Crew	Ron Johnson

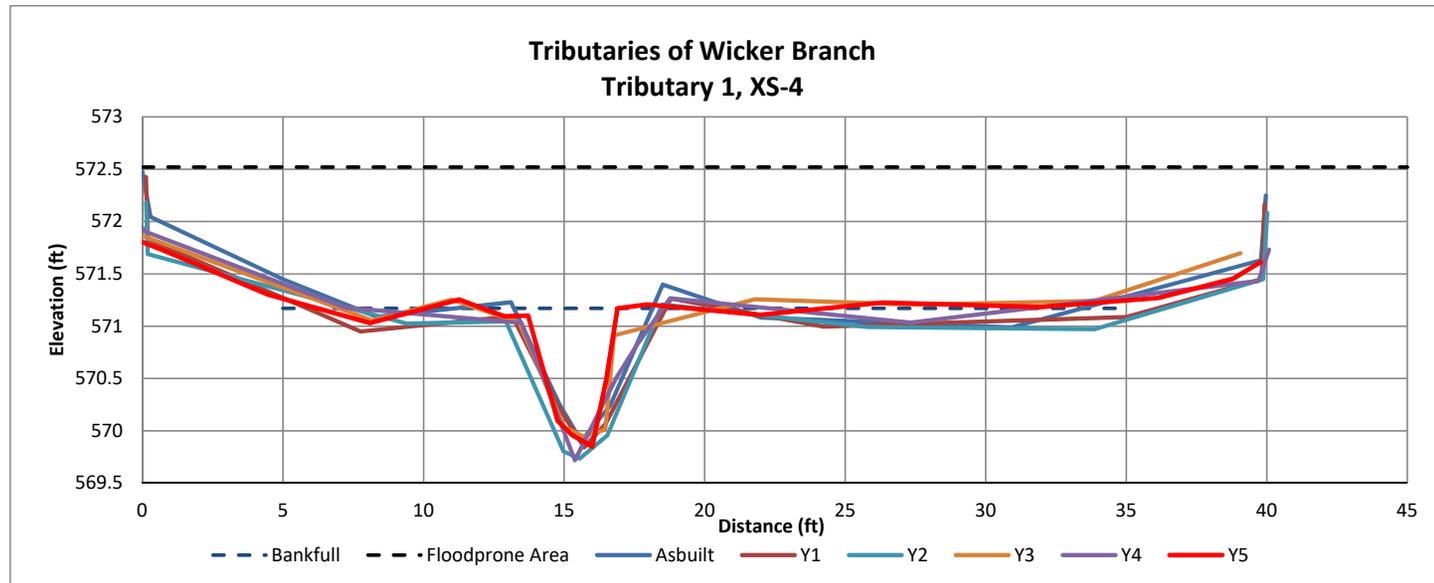
Station	Elevation	
0.04	571.80	LBPIN
0.68	571.73	GR
4.46	571.30	GR
8.1	571.03	GR
11.27	571.25	GR
12.88	571.10	GR
13.72	571.10	TOB
14.77	570.10	TOE
15.26	569.97	
16	569.85	TW
16.5	570.49	TOE
16.9	571.17	TOB
17.97	571.21	GR
21.98	571.11	GR
26.33	571.23	GR
31.96	571.18	GR
36.13	571.27	GR
38.79	571.45	GR
39.78	571.61	RBPIN

### Summary Data

Bankfull Elevation	571.17
Bankfull Width (ft)	9.6
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.35
Bankfull Max Depth (ft)	1.35
Bankfull Cross Sectional Area (ft <sup>2</sup> )	3.72
Bankfull Width/Depth Ratio	27.4
Bankfull Entrenchment Ratio	5.2
Low Top of Bank Depth (ft)	1.25
Bankfull Bank Height Ratio	0.92



Photo: Cross-section 4 looking upstream





## Cross-section Plot Exhibit

<b>River Basin</b>	Yadkin-Pee Dee
<b>Watershed</b>	Wicker Branch
<b>X-Sec ID</b>	XS-6, Sta. 12+37
<b>Feature</b>	Riffle
<b>Drainage Area (sq mi)</b>	0.15
<b>Date</b>	11/13/2019
<b>Field Crew</b>	Ron Johnson

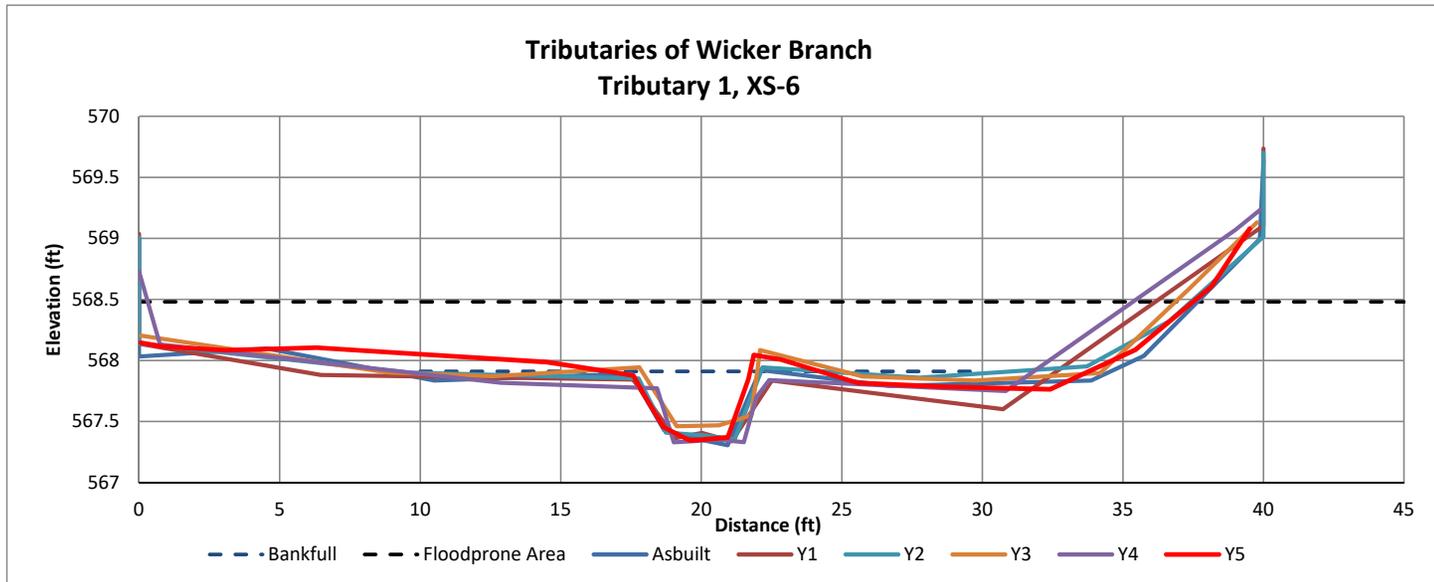
Station	Elevation	
0.05	568.15	LBPIN
0.85	568.11	GR
3.06	568.08	GR
6.31	568.10	GR
10.43	568.04	GR
14.5	567.99	GR
17	567.90	GR
17.59	567.88	TOB
17.92	567.74	TOE
18.65	567.45	
19.6	567.34	TW
20.95	567.37	
21.68	567.85	TOE
21.87	568.04	TOB
22.82	568.01	GR
25.57	567.82	GR
28.61	567.78	GR
32.42	567.76	GR
35.45	568.09	GR
38.16	568.61	GR
39.51	569.08	RBPIN

### Summary Data

Bankfull Elevation	567.91
Bankfull Width (ft)	5.09
Floodprone Width (ft)	50
Bankfull Mean Depth (ft)	0.34
Bankfull Max Depth (ft)	0.57
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.72
Bankfull Width/Depth Ratio	14.97
Bankfull Entrenchment Ratio	7.85
Low Top of Bank Depth (ft)	0.53
Bankfull Bank Height Ratio	0.92



Photo: Cross-section 6 looking upstream





## Cross-section Plot Exhibit

<b>River Basin</b>	Yadkin-Pee Dee
<b>Watershed</b>	Wicker Branch
<b>X-Sec ID</b>	XS-8, Sta. 1+83
<b>Feature</b>	Riffle
<b>Drainage Area (sq mi)</b>	0.05
<b>Date</b>	11/14/2019
<b>Field Crew</b>	Ron Johnson

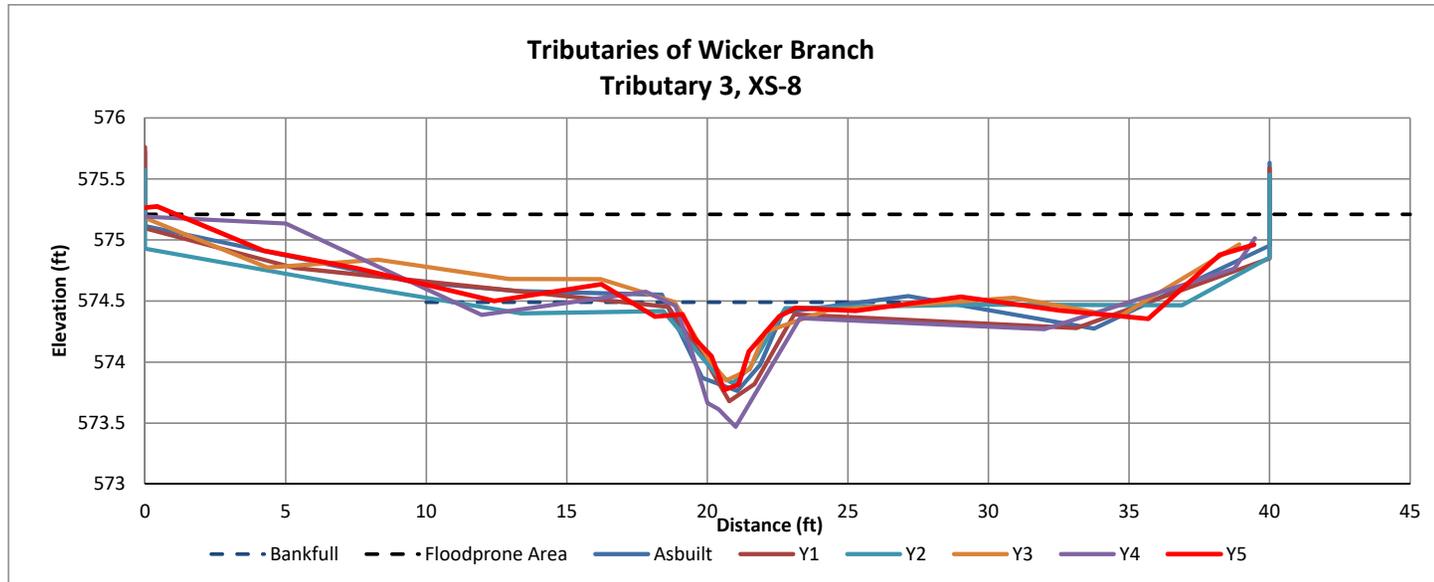
Station	Elevation
0	575.27
0.43	575.28 GR
4.21	574.91 GR
7.51	574.77 GR
12.42	574.50 GR
16.23	574.64 GR
18.13	574.37 GR
19.11	574.39 TOB
19.56	574.19 TOE
20.15	574.05 TW
20.6	573.77 TOE
21.11	573.82 TOB
21.48	574.09 GR
22.56	574.37 GR
23.13	574.44 GR
25.27	574.42 GR
29.02	574.54 GR
32.55	574.42 GR
35.68	574.35 GR
38.23	574.88 GR
39.45	574.96 RBPIN

### Summary Data

Bankfull Elevation	574.49
Bankfull Width (ft)	6.7
Floodprone Width (ft)	40
Bankfull Mean Depth (ft)	0.25
Bankfull Max Depth (ft)	0.72
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.66
Bankfull Width/Depth Ratio	26.8
Bankfull Entrenchment Ratio	5.97
Low Top of Bank Depth (ft)	0.67
Bankfull Bank Height Ratio	0.93



Photo: Cross-section 8 looking downstream





## Cross-section Plot Exhibit

<b>River Basin</b>	Yadkin-Pee Dee
<b>Watershed</b>	Wicker Branch
<b>X-Sec ID</b>	XS-10, Sta. 4+95
<b>Feature</b>	Pool
<b>Drainage Area (sq mi)</b>	0.05
<b>Date</b>	11/14/2019
<b>Field Crew</b>	Ron Johnson

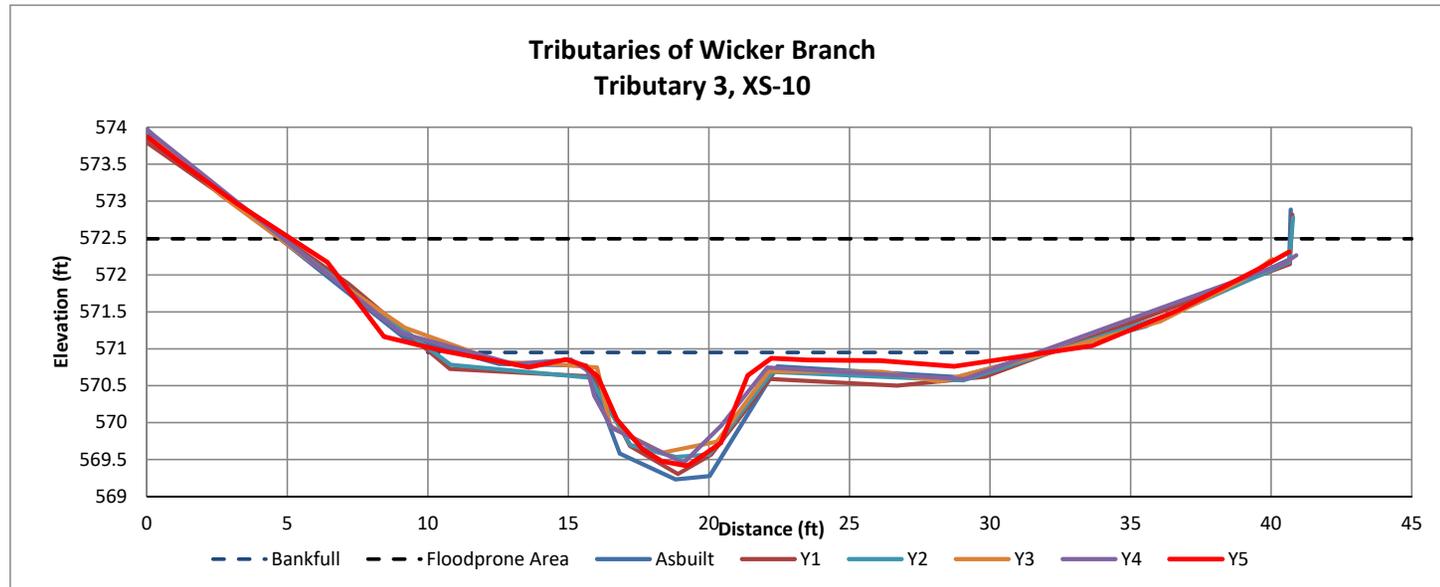
Station	Elevation	
0	573.87	LBPIN
1.17	573.53	GR
3.21	572.97	GR
6.42	572.17	GR
8.44	571.16	GR
10.58	570.97	GR
13.6	570.75	GR
14.92	570.86	GR
15.56	570.78	GR
16.04	570.63	TOB
16.72	570.04	
17.65	569.63	TOE
18.32	569.48	
19.23	569.41	TW
20.42	569.72	TOE
21.38	570.64	
22.22	570.87	TOB
23.5	570.85	GR
26.08	570.84	GR
28.74	570.76	GR
33.64	571.04	GR
36.74	571.53	GR
39.54	572.08	GR
40.64	572.31	RBPIN

### Summary Data

Bankfull Elevation	570.95
Bankfull Width (ft)	11
Floodprone Width (ft)	35
Bankfull Mean Depth (ft)	0.63
Bankfull Max Depth (ft)	1.54
Bankfull Cross Sectional Area (ft <sup>2</sup> )	6.98
Bankfull Width/Depth Ratio	17.5
Bankfull Entrenchment Ratio	3.2
Low Top of Bank Depth (ft)	1.45
Bankfull Bank Height Ratio	0.94



Photo: Cross-section 10 looking upstream





## Cross-section Plot Exhibit

River Basin	Yadkin-Pee Dee
Watershed	Wicker Branch
X-Sec ID	XS-12, Sta. 6+42
Feature	Riffle
Drainage Area (sq mi)	0.05
Date	11/14/2019
Field Crew	Ron Johnson

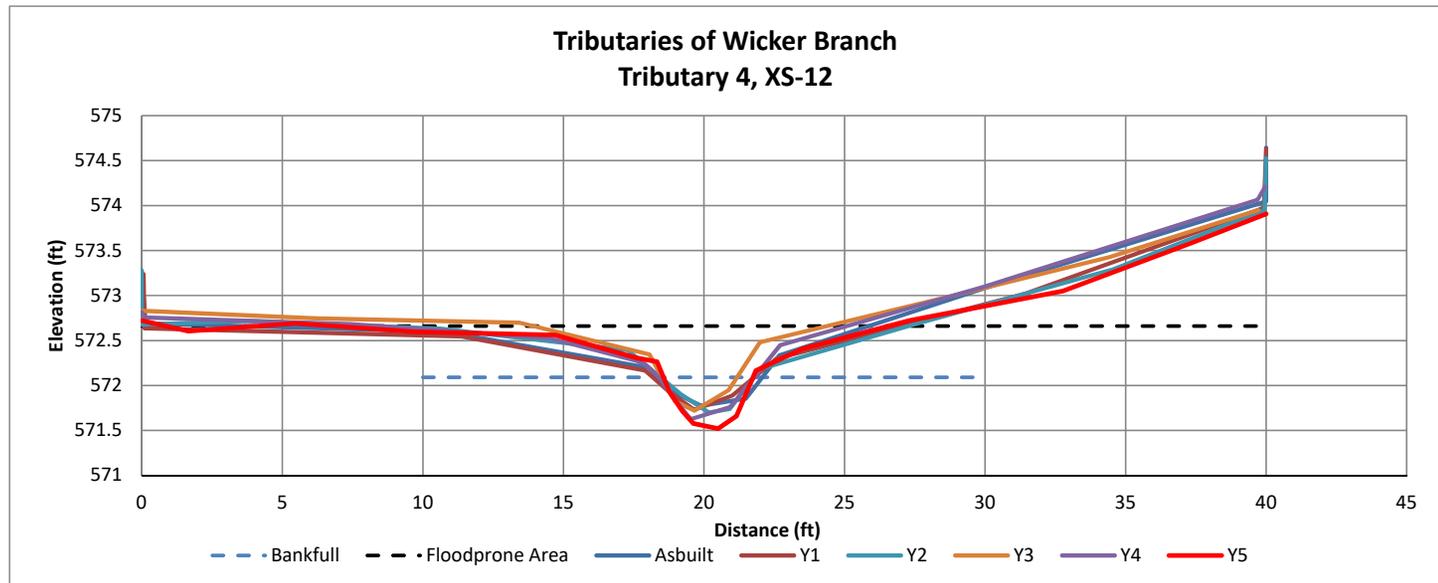
Station	Elevation	
0	572.72	LBPIN
1.66	572.60	GR
5.45	572.69	GR
9.71	572.60	GR
14.7	572.56	GR
17.6	572.31	GR
18.33	572.26	TOB
18.78	571.93	
19.24	571.71	
19.63	571.58	
20.5	571.52	TW
21.16	571.66	
21.85	572.17	TOB
23.53	572.41	GR
27.3	572.72	GR
32.77	573.05	GR
37.3	573.58	GR
40	573.91	RBPIN

### Summary Data

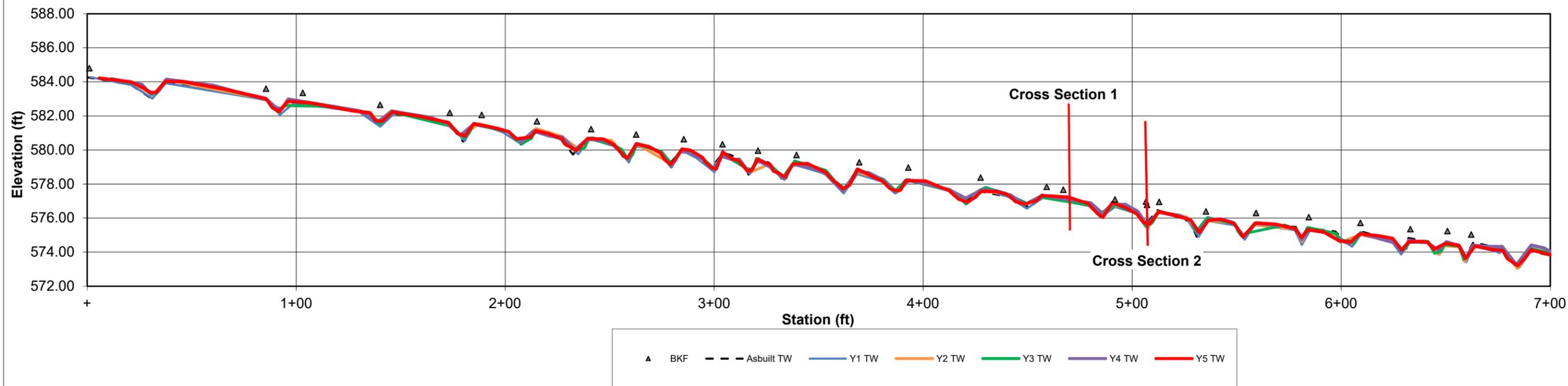
Bankfull Elevation	572.09
Bankfull Width (ft)	3.18
Floodprone Width (ft)	23
Bankfull Mean Depth (ft)	0.39
Bankfull Max Depth (ft)	0.57
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.23
Bankfull Width/Depth Ratio	8.15
Bankfull Entrenchment Ratio	7.2
Low Top of Bank Depth (ft)	0.64
Bankfull Bank Height Ratio	1.1



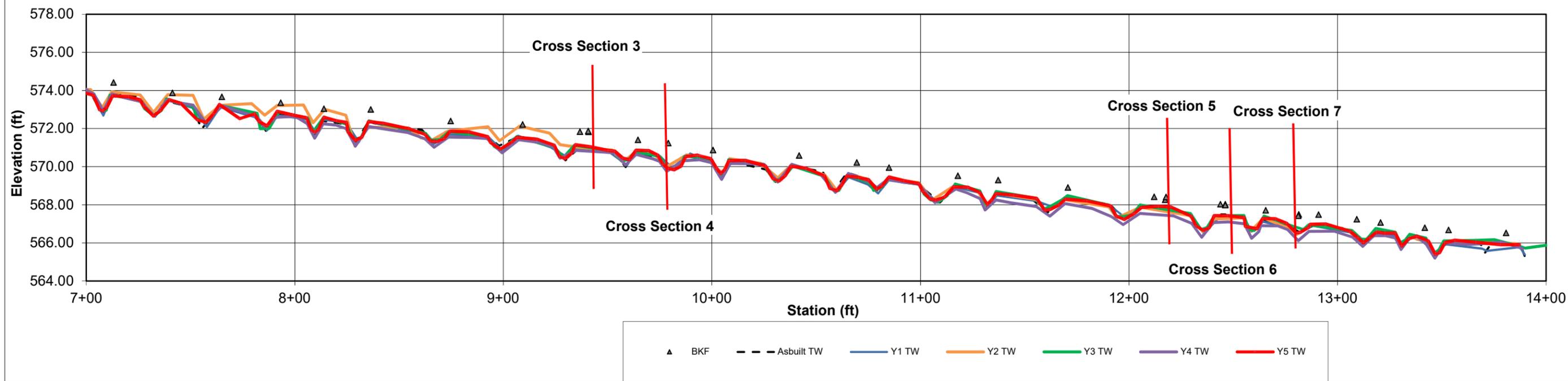
Photo: Cross-section 12 looking upstream



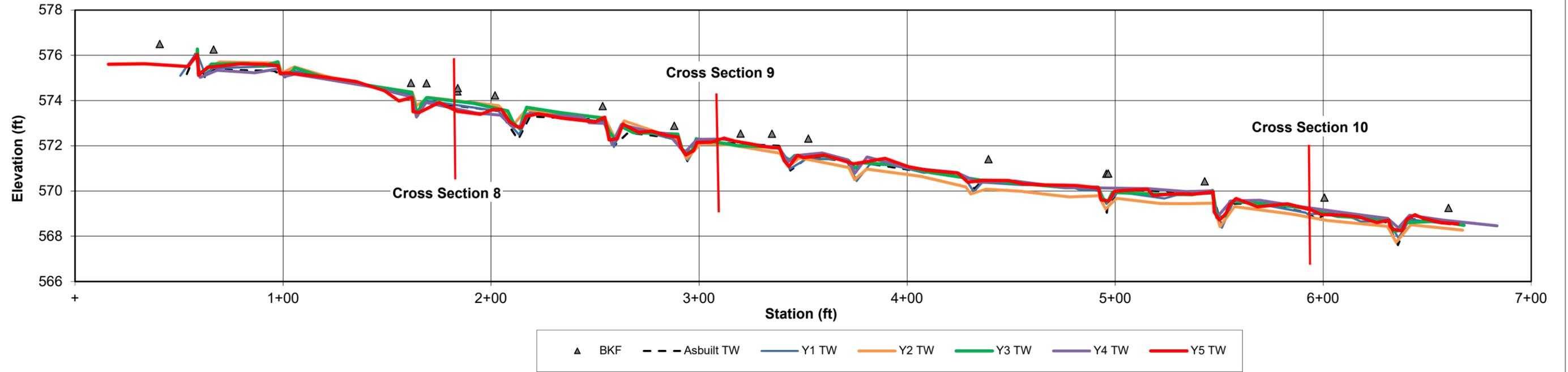
Tributaries of Wicker Branch - Tributary 1A Longitudinal Profile



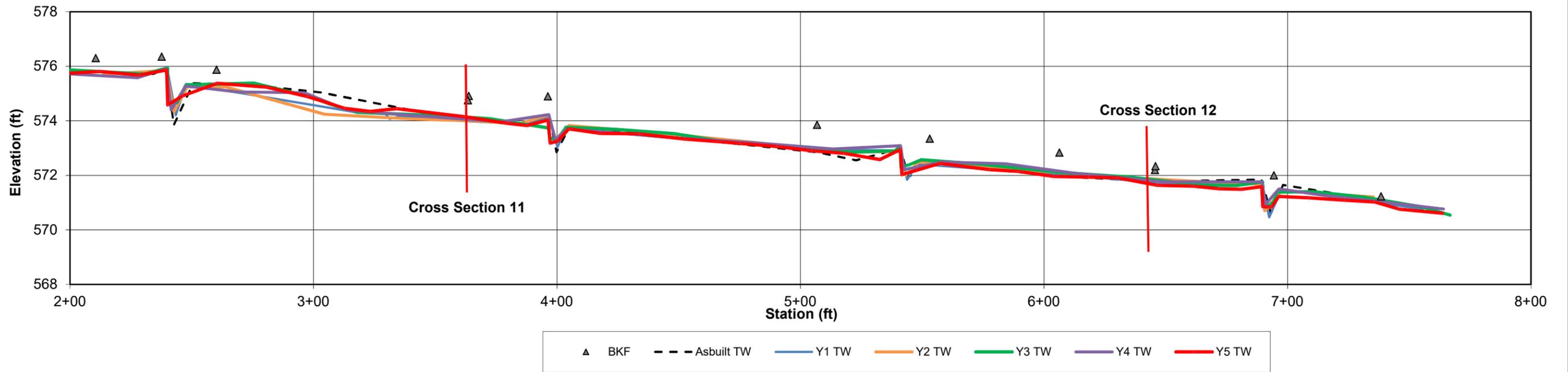
Tributaries of Wicker Branch - Tributary 1A Longitudinal Profile



Tributaries of Wicker Branch - Tributary 3 Longitudinal Profile



Tributaries of Wicker Branch - Tributary 4 Longitudinal Profile

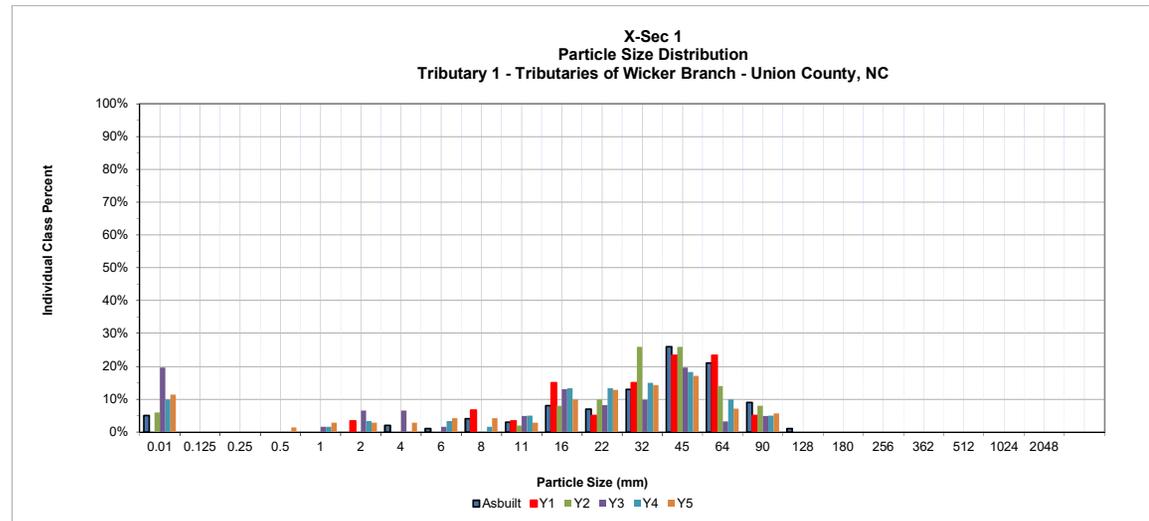
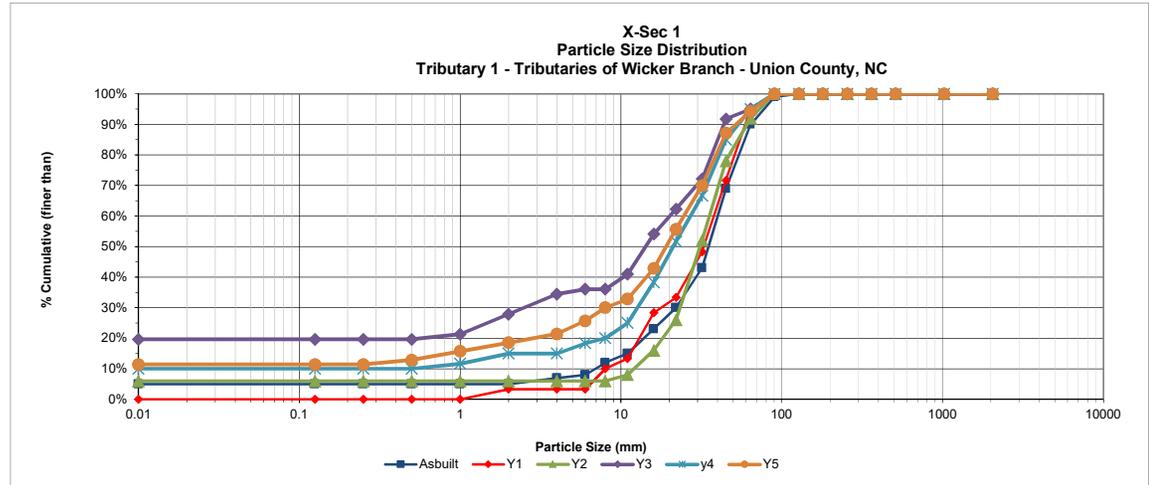


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 1  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	8	11%	11%
S	Very Fine	.062 - .125	0	0%	11%
	Fine	.125 - .25	0	0%	11%
N	Medium	.25 - .50	1	1%	13%
D	Coarse	.50 - 1.0	2	3%	16%
S	Very Coarse	1.0 - 2.0	2	3%	19%
G	Very Fine	2.0 - 4.0	2	3%	21%
	Fine	4.0 - 5.7	3	4%	26%
R	Fine	5.7 - 8.0	3	4%	30%
A	Medium	8.0 - 11.3	2	3%	33%
V	Medium	11.3 - 16.0	7	10%	43%
E	Coarse	16.0 - 22.6	9	13%	56%
L	Coarse	22.6 - 32.0	10	14%	70%
S	Very Coarse	32.0 - 45.0	12	17%	87%
C	Very Coarse	45.0 - 64.0	5	7%	94%
	Small	64 - 90	4	6%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	19.7
D84	43
D95	67

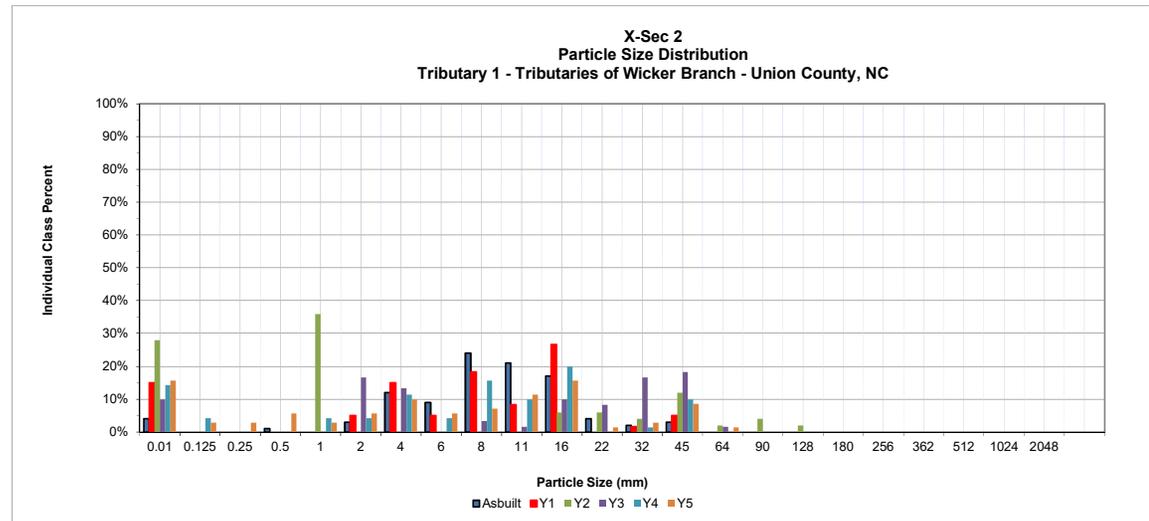
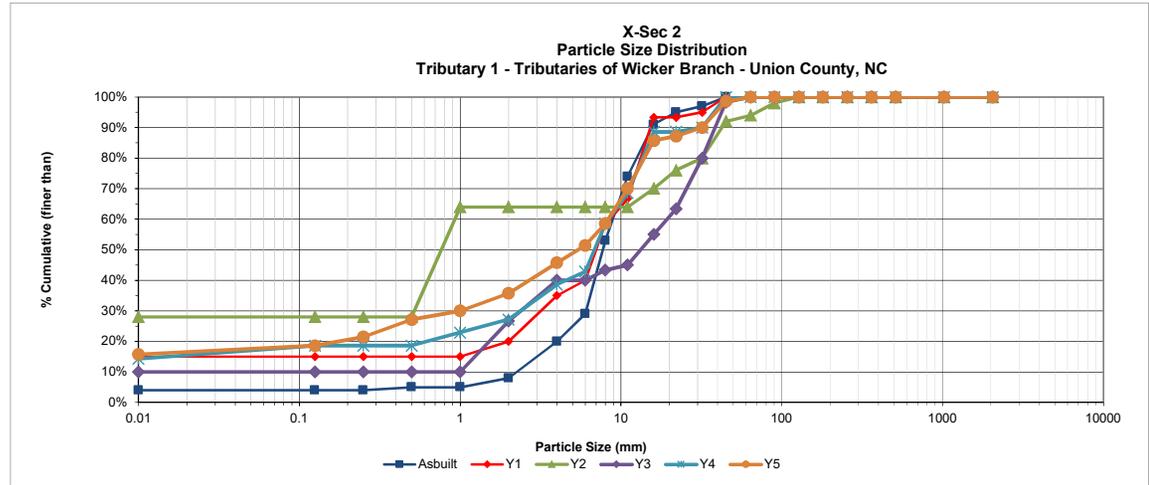


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 2  
 Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	10	14%	14%
S	Very Fine	.062 - .125	3	4%	19%
	Fine	.125 - .25	0	0%	19%
N	Medium	.25 - .50	0	0%	19%
D	Coarse	.50 - 1.0	3	4%	23%
S	Very Coarse	1.0 - 2.0	3	4%	27%
G	Very Fine	2.0 - 4.0	8	11%	39%
	Fine	4.0 - 5.7	3	4%	43%
R	Fine	5.7 - 8.0	11	16%	59%
A	Medium	8.0 - 11.3	7	10%	69%
V	Medium	11.3 - 16.0	14	20%	89%
E	Coarse	16.0 - 22.6	0	0%	89%
L	Coarse	22.6 - 32.0	1	1%	90%
S	Very Coarse	32.0 - 45.0	7	10%	100%
C	Very Coarse	45.0 - 64.0	0	0%	100%
	Small	64 - 90	0	0%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	6.75
D84	15
D95	39

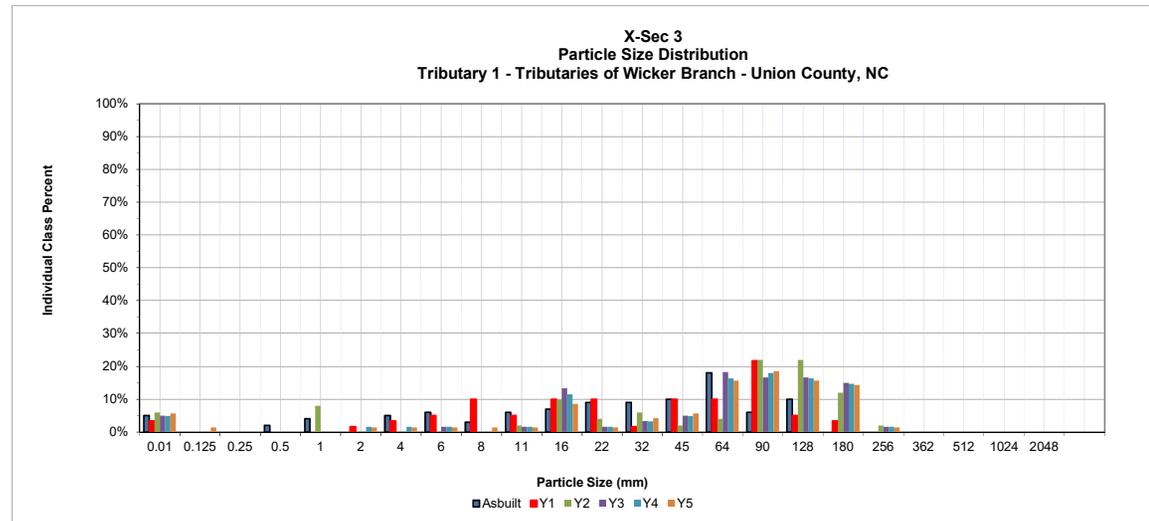
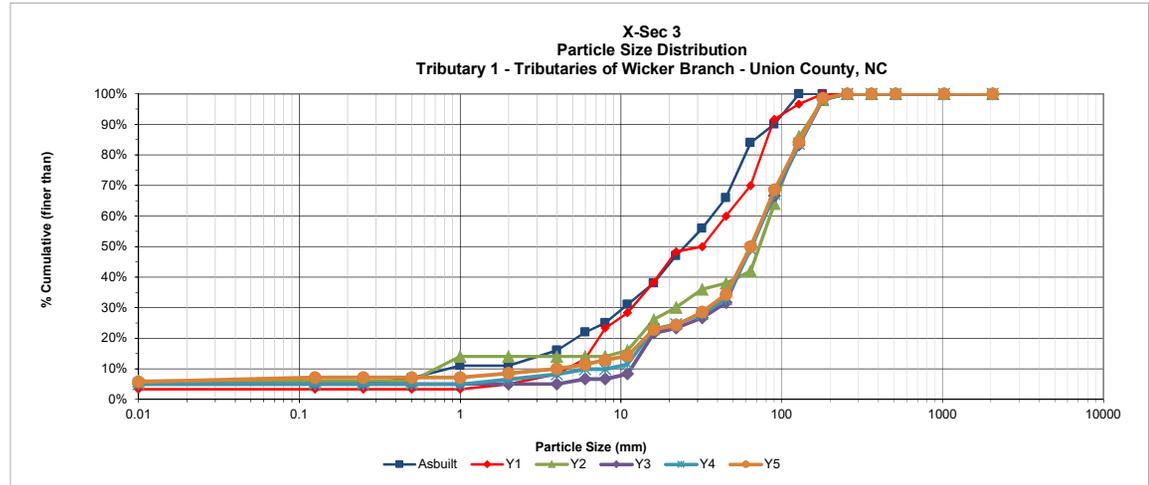


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 3  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	4	6%	6%
S A N D	Very Fine	.062 - .125	1	1%	7%
	Fine	.125 - .25	0	0%	7%
	Medium	.25 - .50	0	0%	7%
	Coarse	.50 - 1.0	0	0%	7%
S	Very Coarse	1.0 - 2.0	1	1%	9%
G R A V E L S	Very Fine	2.0 - 4.0	1	1%	10%
	Fine	4.0 - 5.7	1	1%	11%
	Fine	5.7 - 8.0	1	1%	13%
	Medium	8.0 - 11.3	1	1%	14%
	Medium	11.3 - 16.0	6	9%	23%
	Coarse	16.0 - 22.6	1	1%	24%
	Coarse	22.6 - 32.0	3	4%	29%
	Very Coarse	32.0 - 45.0	4	6%	34%
C O B B L E	Very Coarse	45.0 - 64.0	11	16%	50%
	Small	64 - 90	13	19%	69%
	Small	90 - 128	11	16%	84%
B L O C K	Large	128 - 180	10	14%	99%
	Large	180 - 256	1	1%	100%
B L O C K	Small	256 - 362	0	0%	100%
	Small	362 - 512	0	0%	100%
D R Y	Medium	512 - 1024	0	0%	100%
	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	64
D84	127
D95	167

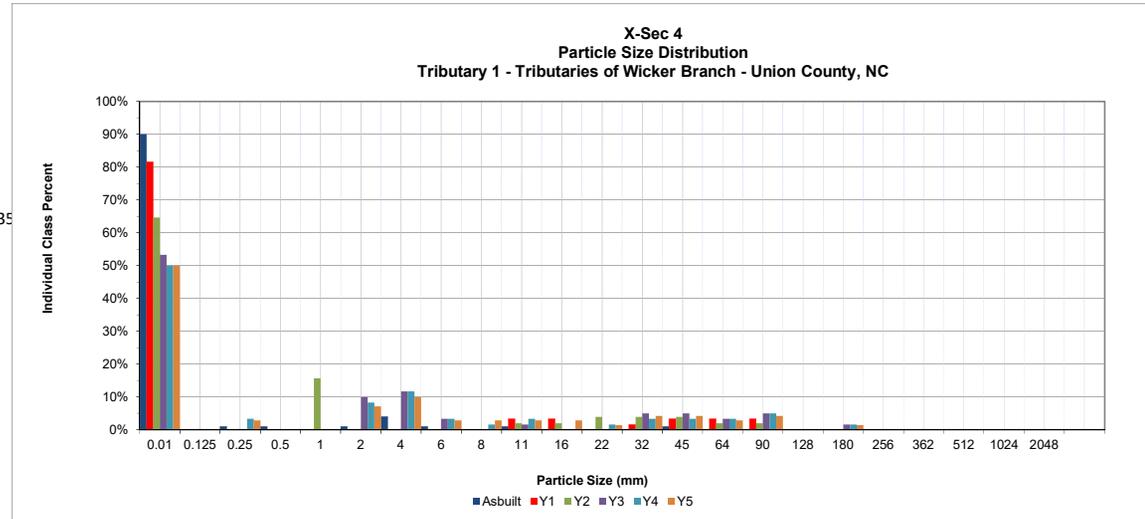
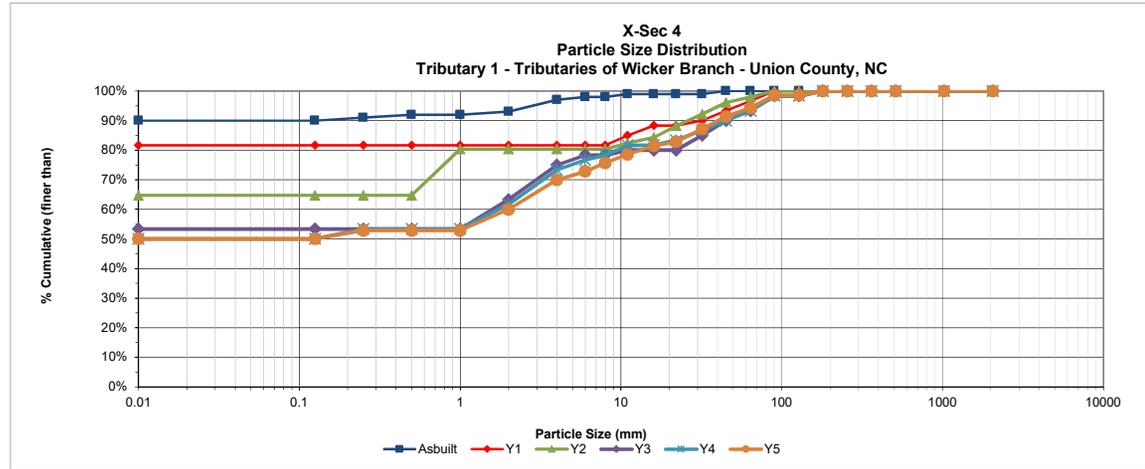


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 4  
 Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	35	50%	50%
S	Very Fine	.062 - .125	0	0%	50%
	Fine	.125 - .25	2	3%	53%
N	Medium	.25 - .50	0	0%	53%
	Coarse	.50 - 1.0	0	0%	53%
S	Very Coarse	1.0 - 2.0	5	7%	60%
G	Very Fine	2.0 - 4.0	7	10%	70%
	Fine	4.0 - 5.7	2	3%	73%
R	Fine	5.7 - 8.0	2	3%	76%
	Medium	8.0 - 11.3	2	3%	79%
A	Medium	11.3 - 16.0	2	3%	81%
	Coarse	16.0 - 22.6	1	1%	83%
V	Coarse	22.6 - 32.0	3	4%	87%
	Very Coarse	32.0 - 45.0	3	4%	91%
E	Very Coarse	45.0 - 64.0	2	3%	94%
	Small	64 - 90	3	4%	99%
C	Small	90 - 128	0	0%	99%
	Large	128 - 180	1	1%	100%
B	Large	180 - 256	0	0%	100%
	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
	Medium	512 - 1024	0	0%	100%
D	Lrg- Very Lrg	1024 - 2048	0	0%	100%
	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	0.06
D84	25
D95	68

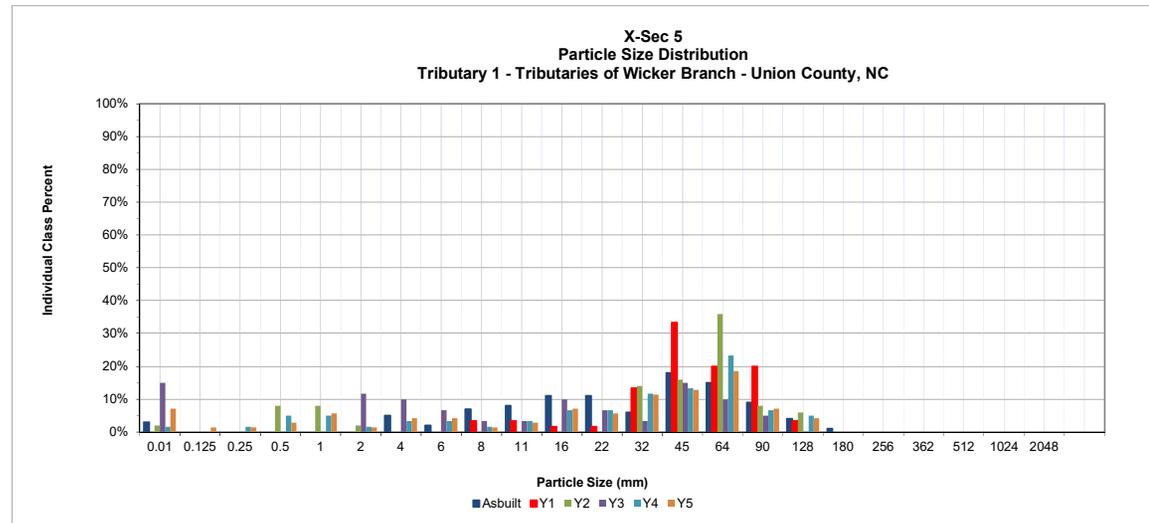
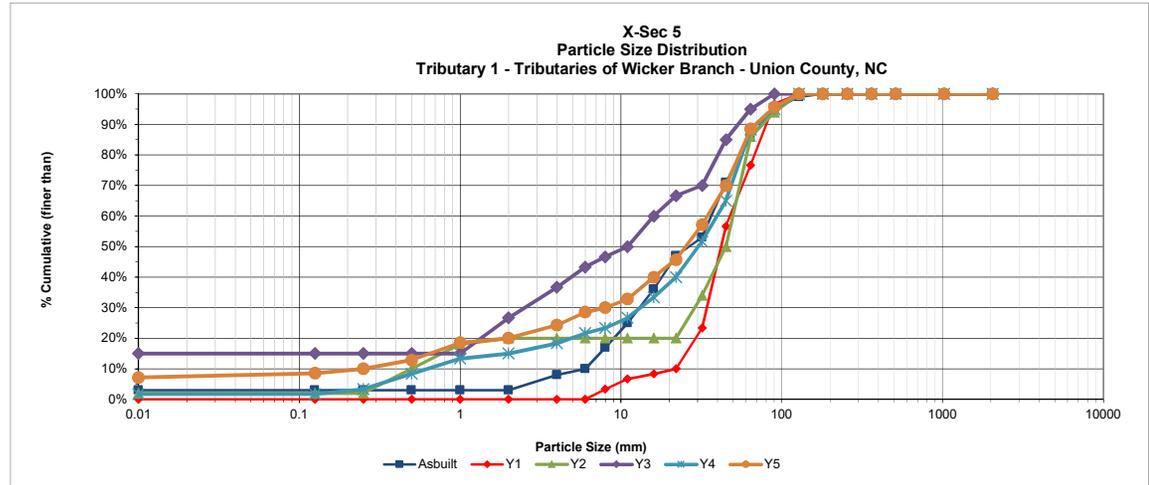


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 5  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	5	7%	7%
S A N D	Very Fine	.062 - .125	1	1%	9%
	Fine	.125 - .25	1	1%	10%
	Medium	.25 - .50	2	3%	13%
	Coarse	.50 - 1.0	4	6%	19%
S	Very Coarse	1.0 - 2.0	1	1%	20%
G R A V E L S	Very Fine	2.0 - 4.0	3	4%	24%
	Fine	4.0 - 5.7	3	4%	29%
	Fine	5.7 - 8.0	1	1%	30%
	Medium	8.0 - 11.3	2	3%	33%
	Medium	11.3 - 16.0	5	7%	40%
	Coarse	16.0 - 22.6	4	6%	46%
L S	Coarse	22.6 - 32.0	8	11%	57%
	Very Coarse	32.0 - 45.0	9	13%	70%
C O B B L E	Very Coarse	45.0 - 64.0	13	19%	89%
	Small	64 - 90	5	7%	96%
	Small	90 - 128	3	4%	100%
B L O C K	Large	128 - 180	0	0%	100%
	Large	180 - 256	0	0%	100%
B L O C K	Small	256 - 362	0	0%	100%
	Small	362 - 512	0	0%	100%
D R Y	Medium	512 - 1024	0	0%	100%
	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	16.1
D84	59
D95	87

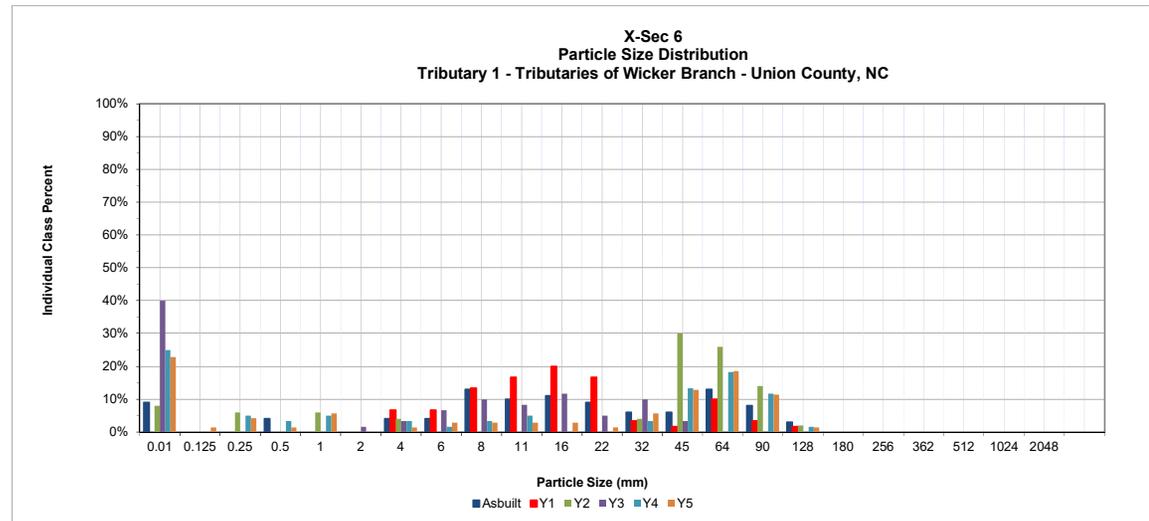
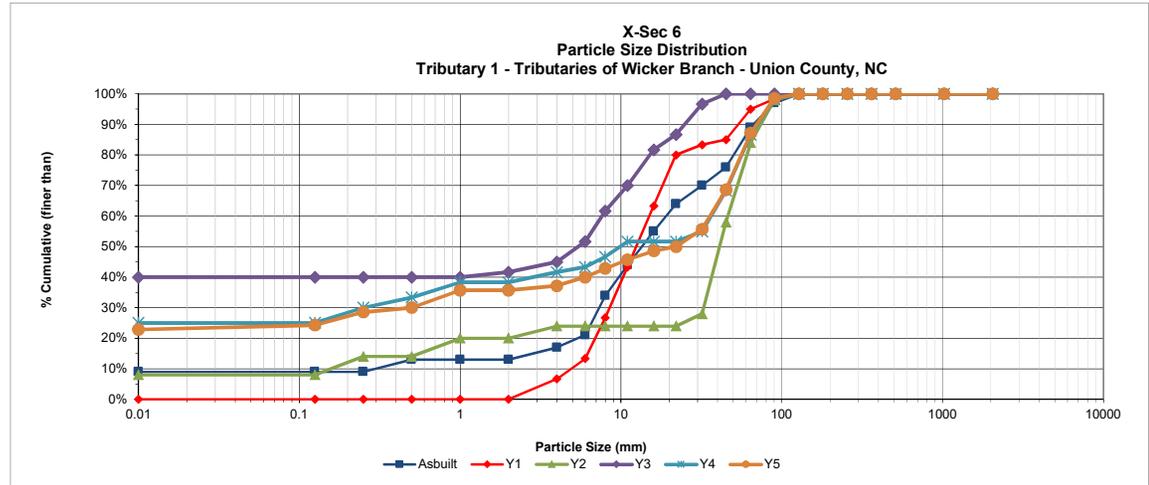


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 6  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	16	23%	23%
S	Very Fine	.062 - .125	1	1%	24%
	Fine	.125 - .25	3	4%	29%
N	Medium	.25 - .50	1	1%	30%
D	Coarse	.50 - 1.0	4	6%	36%
S	Very Coarse	1.0 - 2.0	0	0%	36%
G	Very Fine	2.0 - 4.0	1	1%	37%
	Fine	4.0 - 5.7	2	3%	40%
R	Fine	5.7 - 8.0	2	3%	43%
A	Medium	8.0 - 11.3	2	3%	46%
V	Medium	11.3 - 16.0	2	3%	49%
E	Coarse	16.0 - 22.6	1	1%	50%
L	Coarse	22.6 - 32.0	4	6%	56%
S	Very Coarse	32.0 - 45.0	9	13%	69%
C	Very Coarse	45.0 - 64.0	13	19%	87%
	Small	64 - 90	8	11%	99%
O	Small	90 - 128	1	1%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	22.6
D84	61
D95	82

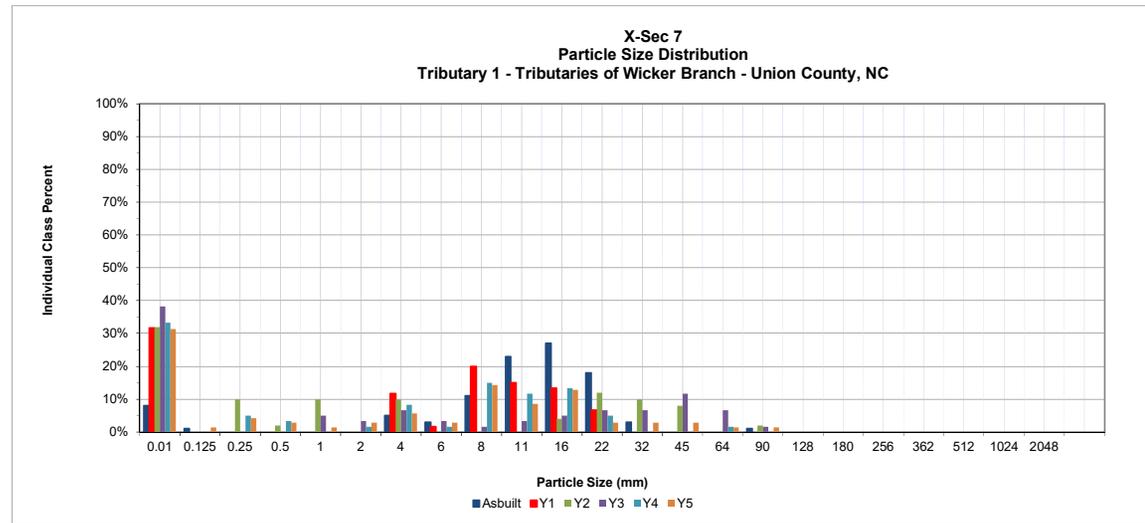
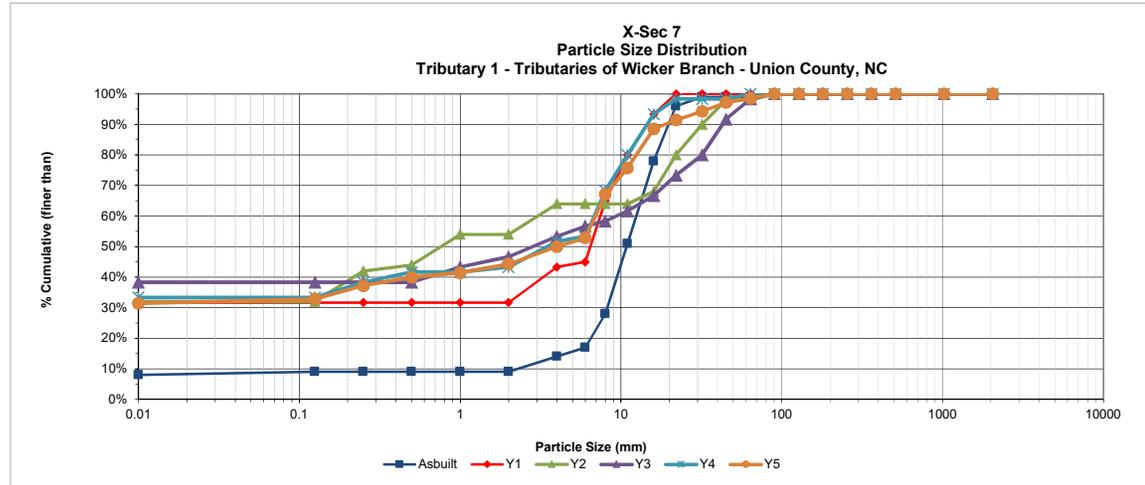


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 7  
 Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	22	31%	31%
S	Very Fine	.062 - .125	1	1%	33%
	Fine	.125 - .25	3	4%	37%
N	Medium	.25 - .50	2	3%	40%
D	Coarse	.50 - 1.0	1	1%	41%
S	Very Coarse	1.0 - 2.0	2	3%	44%
G	Very Fine	2.0 - 4.0	4	6%	50%
	Fine	4.0 - 5.7	2	3%	53%
R	Fine	5.7 - 8.0	10	14%	67%
A	Medium	8.0 - 11.3	6	9%	76%
V	Medium	11.3 - 16.0	9	13%	89%
E	Coarse	16.0 - 22.6	2	3%	91%
L	Coarse	22.6 - 32.0	2	3%	94%
S	Very Coarse	32.0 - 45.0	2	3%	97%
C	Very Coarse	45.0 - 64.0	1	1%	99%
	Small	64 - 90	1	1%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	4
D84	14
D95	35

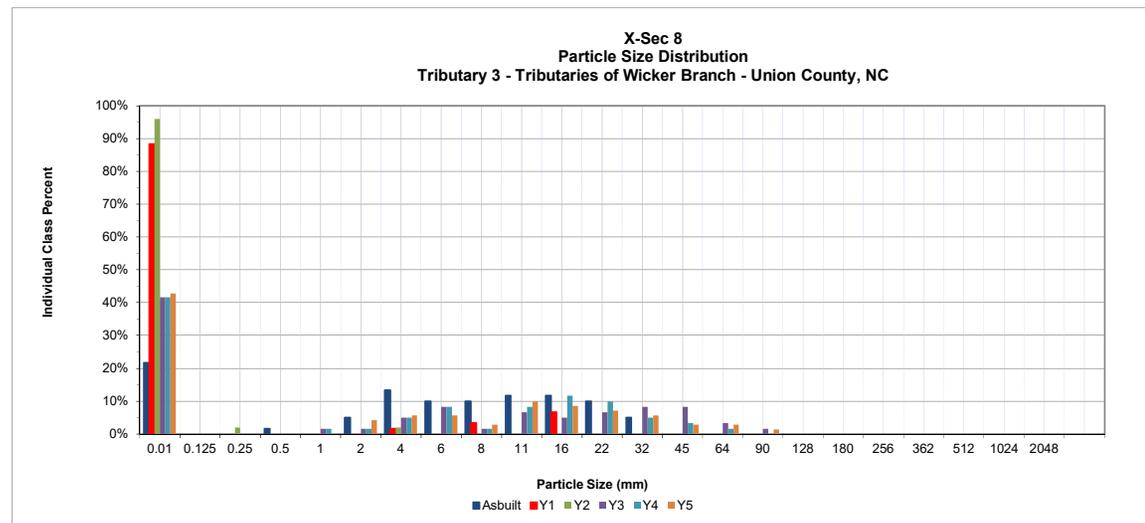
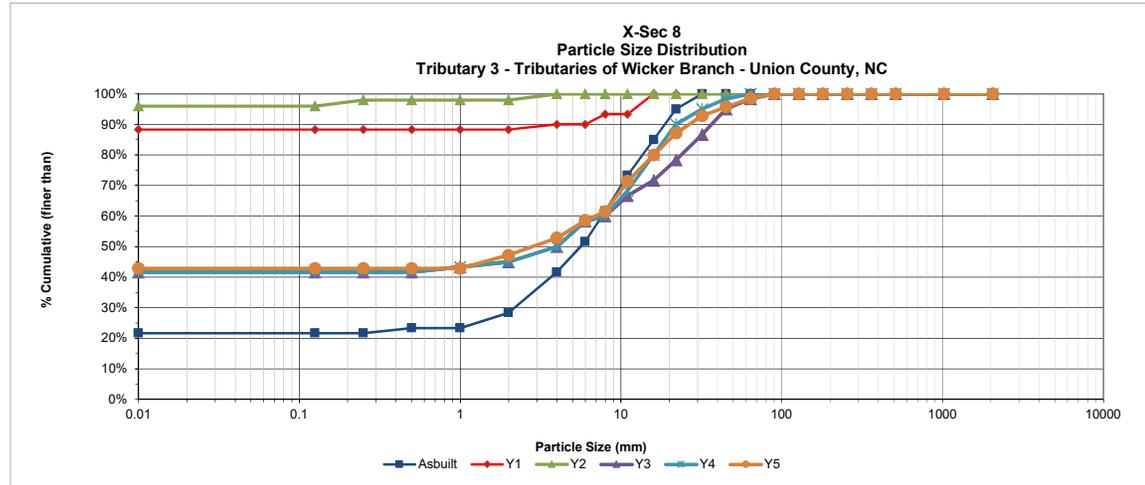


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 8  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	30	43%	43%
S	Very Fine	.062 - .125	0	0%	43%
	Fine	.125 - .25	0	0%	43%
N	Medium	.25 - .50	0	0%	43%
D	Coarse	.50 - 1.0	0	0%	43%
S	Very Coarse	1.0 - 2.0	3	4%	47%
G	Very Fine	2.0 - 4.0	4	6%	53%
	Fine	4.0 - 5.7	4	6%	59%
R	Fine	5.7 - 8.0	2	3%	61%
A	Medium	8.0 - 11.3	7	10%	71%
V	Medium	11.3 - 16.0	6	9%	80%
E	Coarse	16.0 - 22.6	5	7%	87%
L	Coarse	22.6 - 32.0	4	6%	93%
S	Very Coarse	32.0 - 45.0	2	3%	96%
C	Very Coarse	45.0 - 64.0	2	3%	99%
	Small	64 - 90	1	1%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	3
D84	20
D95	42

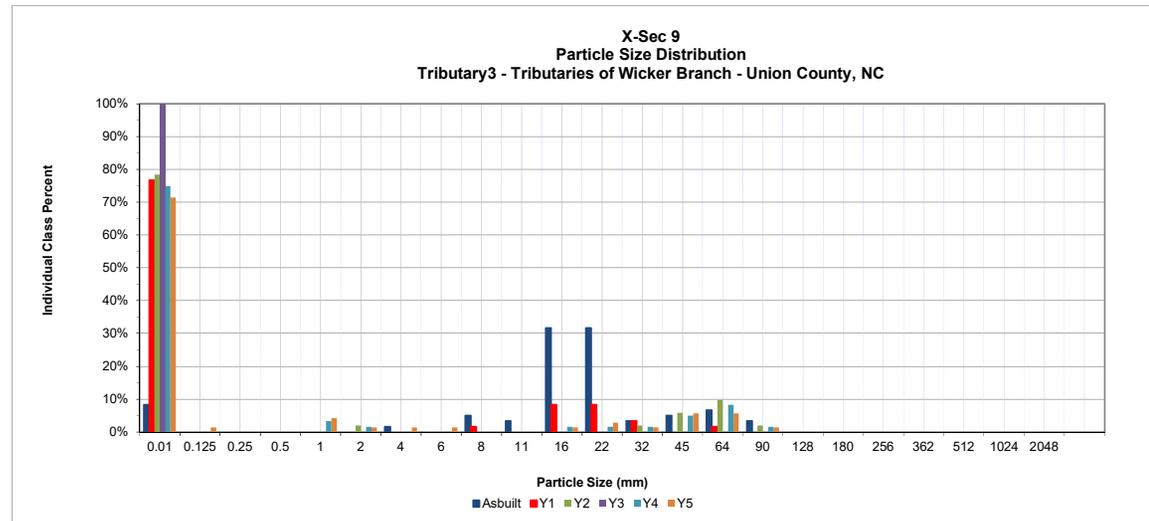
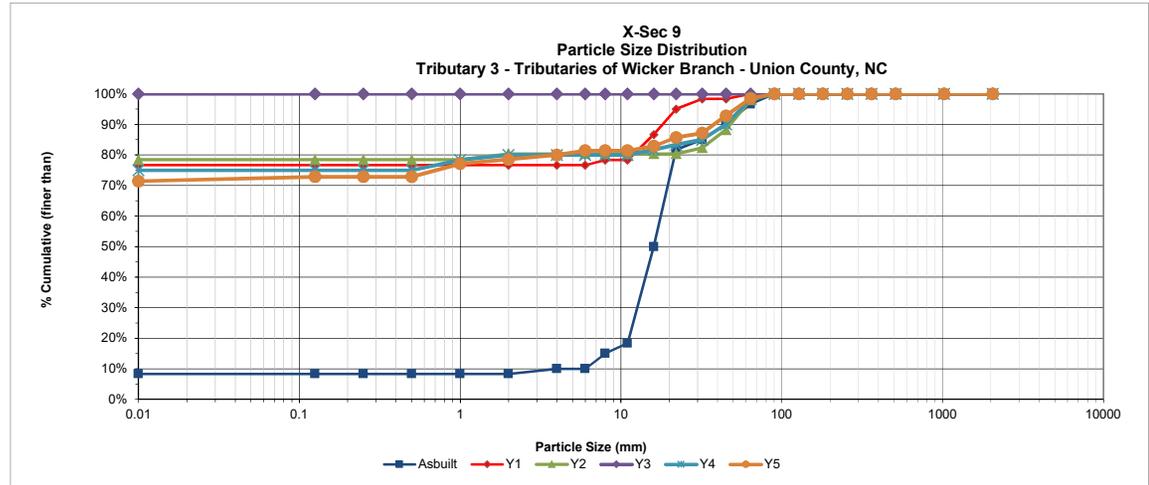


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 9  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	50	71%	71%
S	Very Fine	.062 - .125	1	1%	73%
	Fine	.125 - .25	0	0%	73%
N	Medium	.25 - .50	0	0%	73%
D	Coarse	.50 - 1.0	3	4%	77%
S	Very Coarse	1.0 - 2.0	1	1%	79%
G	Very Fine	2.0 - 4.0	1	1%	80%
	Fine	4.0 - 5.7	1	1%	81%
R	Fine	5.7 - 8.0	0	0%	81%
A	Medium	8.0 - 11.3	0	0%	81%
V	Medium	11.3 - 16.0	1	1%	83%
E	Coarse	16.0 - 22.6	2	3%	86%
L	Coarse	22.6 - 32.0	1	1%	87%
S	Very Coarse	32.0 - 45.0	4	6%	93%
C	Very Coarse	45.0 - 64.0	4	6%	99%
	Small	64 - 90	1	1%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	0.04
D84	19
D95	52

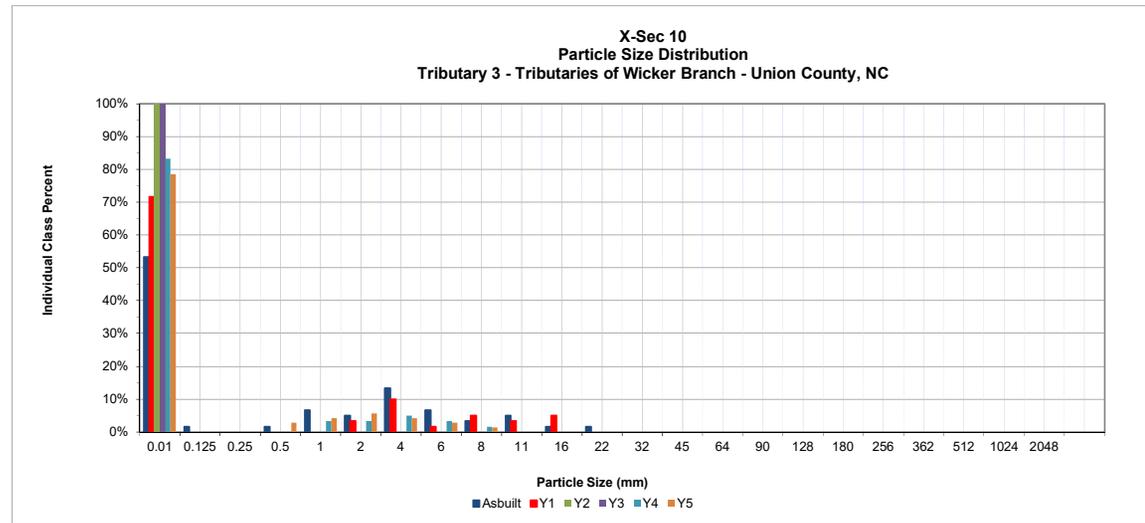
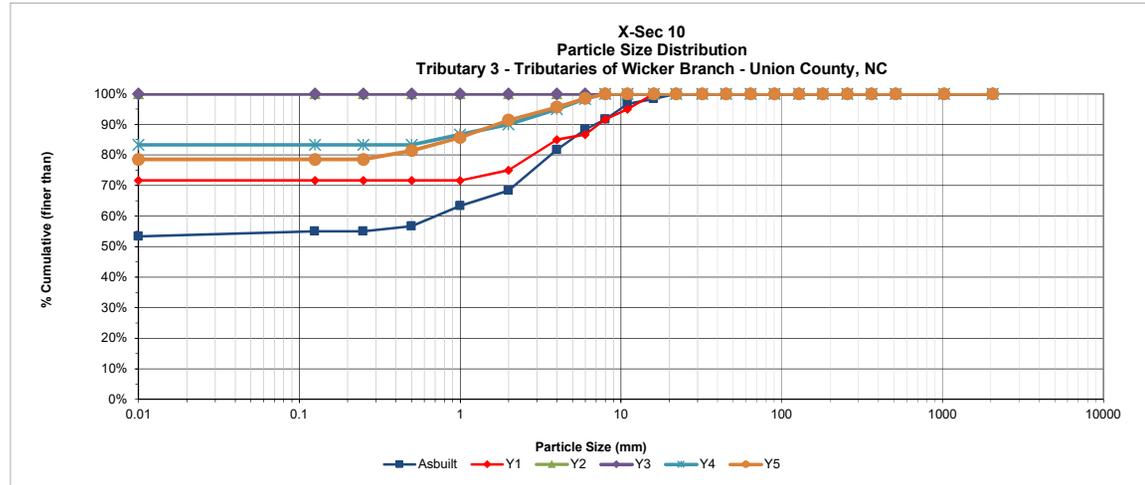


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 10  
 Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	55	79%	79%
S	Very Fine	.062 - .125	0	0%	79%
	Fine	.125 - .25	0	0%	79%
N	Medium	.25 - .50	2	3%	81%
D	Coarse	.50 - 1.0	3	4%	86%
S	Very Coarse	1.0 - 2.0	4	6%	91%
G	Very Fine	2.0 - 4.0	3	4%	96%
	Fine	4.0 - 5.7	2	3%	99%
R	Fine	5.7 - 8.0	1	1%	100%
A	Medium	8.0 - 11.3	0	0%	100%
V	Medium	11.3 - 16.0	0	0%	100%
E	Coarse	16.0 - 22.6	0	0%	100%
L	Coarse	22.6 - 32.0	0	0%	100%
S	Very Coarse	32.0 - 45.0	0	0%	100%
C	Very Coarse	45.0 - 64.0	0	0%	100%
	Small	64 - 90	0	0%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	0.03
D84	0.04
D95	0.8

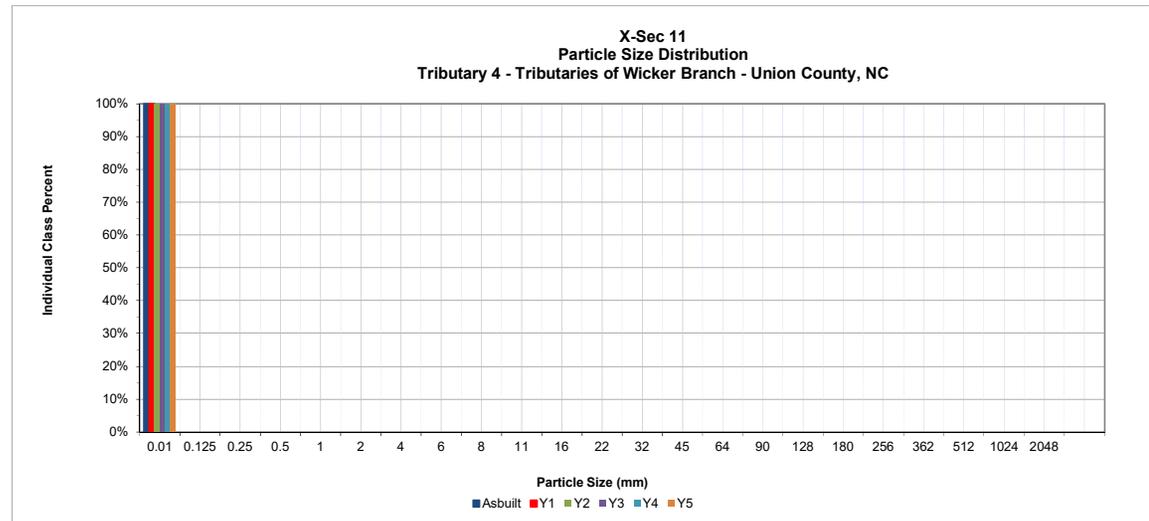
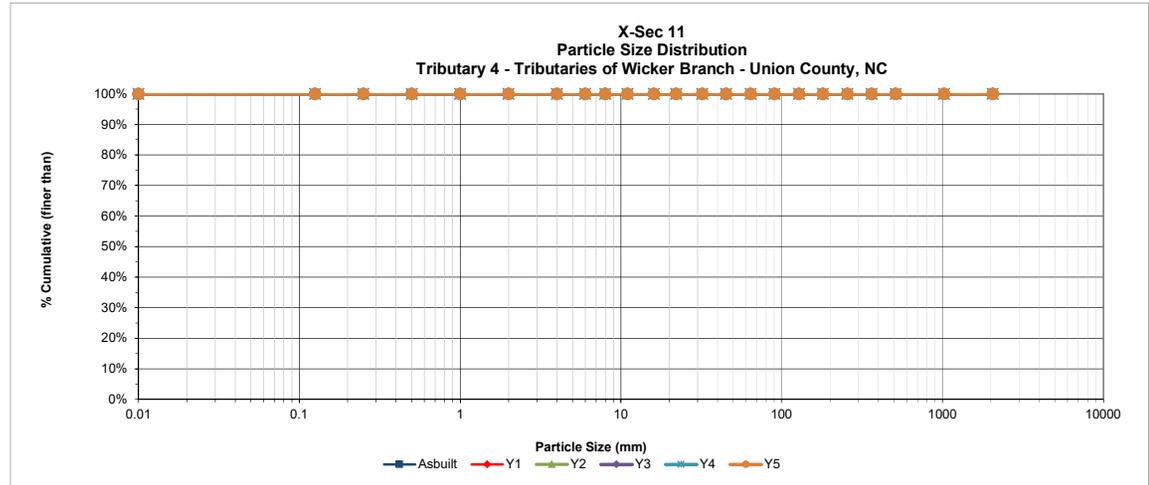


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 11  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	60	100%	100%
S	Very Fine	.062 - .125	0	0%	100%
	Fine	.125 - .25	0	0%	100%
N	Medium	.25 - .50	0	0%	100%
D	Coarse	.50 - 1.0	0	0%	100%
S	Very Coarse	1.0 - 2.0	0	0%	100%
G	Very Fine	2.0 - 4.0	0	0%	100%
	Fine	4.0 - 5.7	0	0%	100%
R	Fine	5.7 - 8.0	0	0%	100%
A	Medium	8.0 - 11.3	0	0%	100%
V	Medium	11.3 - 16.0	0	0%	100%
E	Coarse	16.0 - 22.6	0	0%	100%
L	Coarse	22.6 - 32.0	0	0%	100%
S	Very Coarse	32.0 - 45.0	0	0%	100%
	Very Coarse	45.0 - 64.0	0	0%	100%
C	Small	64 - 90	0	0%	100%
	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>60</b>	<b>100%</b>	

Summary Data	
D50	0.03
D84	0.05
D95	0.06

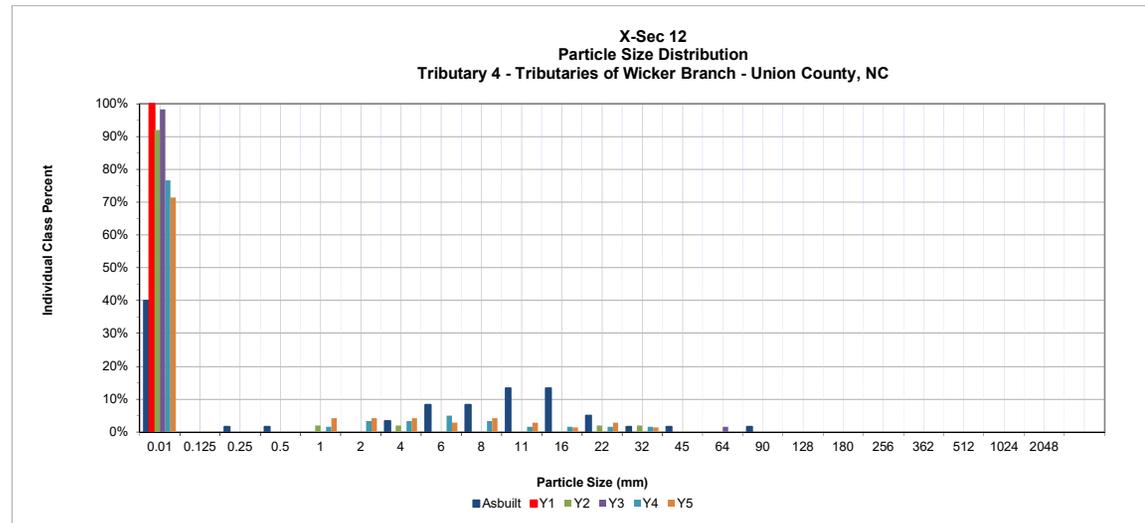
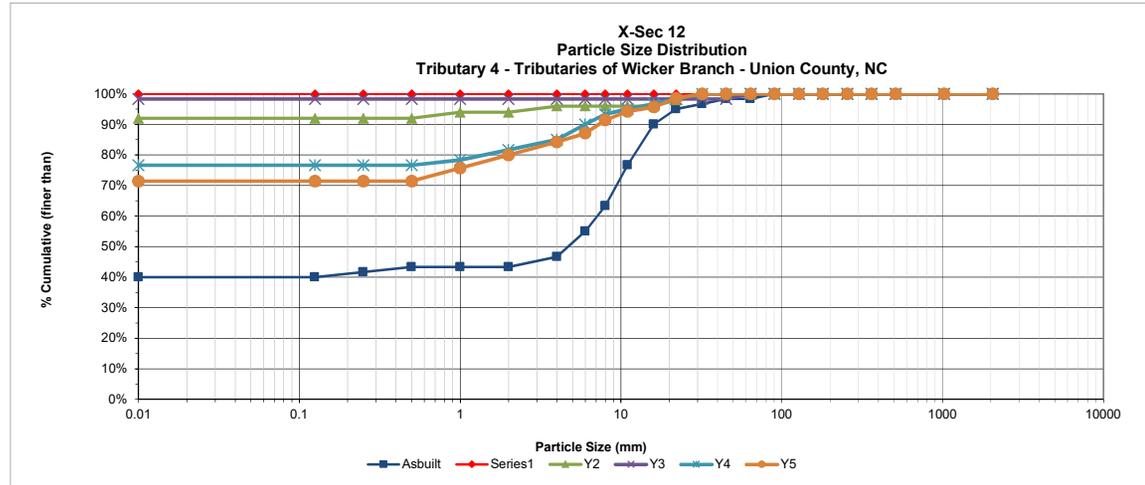


## Cross - Section Pebble Count

Project Name : Tributaries of Wickers Branch  
 Cross Section: 12  
 Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	50	71%	71%
S	Very Fine	.062 - .125	0	0%	71%
	Fine	.125 - .25	0	0%	71%
N	Medium	.25 - .50	0	0%	71%
D	Coarse	.50 - 1.0	3	4%	76%
S	Very Coarse	1.0 - 2.0	3	4%	80%
G	Very Fine	2.0 - 4.0	3	4%	84%
	Fine	4.0 - 5.7	2	3%	87%
R	Fine	5.7 - 8.0	3	4%	91%
A	Medium	8.0 - 11.3	2	3%	94%
V	Medium	11.3 - 16.0	1	1%	96%
E	Coarse	16.0 - 22.6	2	3%	99%
L	Coarse	22.6 - 32.0	1	1%	100%
S	Very Coarse	32.0 - 45.0	0	0%	100%
C	Very Coarse	45.0 - 64.0	0	0%	100%
	Small	64 - 90	0	0%	100%
O	Small	90 - 128	0	0%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
<b>Totals</b>			<b>70</b>	<b>100%</b>	

Summary Data	
D50	0.04
D84	3.9
D95	13.7



**Table 8. Baseline Stream Data Summary**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Parameter	Existing Trib 1A to Wickers Branch			Reference Reach- Spencer Creek			Reference Reach UT4 Rockwell Pastures			Proposed Trib 1 to Wickers Branch			As-built Baseline (Tributary 1A)			
	G4/B4c			C4			C4			E4						
Stream Type	0.14			0.5			0.11			0.1						
Drainage Area (sq mi)																
Dimension	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	n
BF Width (ft)	3.27	3.90	3.58			12.30			7.30			4.00	3.93	4.93	4.43	4
BF Cross Sectional Area (ft <sup>2</sup> )	1.52	1.99	1.74			10.80			4.20			1.50	1.62	2.80	1.94	4
BF Mean Depth (ft)	0.43	0.61	0.50			0.88			0.60			0.38	0.30	0.61	0.41	4
BF Max Depth (ft)	0.54	1.10	0.76			1.80			1.10			0.50	0.42	0.69	0.53	4
Width/Depth Ratio	5.36	8.48	7.37			13.98			12.60			10.52	7.49	14.94	11.56	4
Entrenchment Ratio	1.54	1.88	1.70			>2.20			2.70			>2.20	7.16	10.18	8.63	4
Wetted Perimeter (ft)	3.94	4.31	4.17			14.13			5.77			4.76	4.31	5.09	4.73	4
Hydraulic radius (ft)	0.39	0.47	0.43			0.76			0.76			0.32	0.29	0.55	0.38	4
Bank Height Ratio	2.21	2.41	2.32			1.10			1.00			1.00	1.00	1.00	1.00	4
Pool Area/Riffle Area			N/A			1.17			1.00			5.70			1.98	
Max riffle depth/mean riffle depth	1.08	1.22	1.52			2.05			1.90			1.32			1.29	
Max pool depth/mean riffle depth	1.22	2.3	1.76			2.38			2.5			6.50			2.76	
<b>Pattern</b>																
Channel Beltwidth (ft)	7	10	9	24	52	38	3.20	5.70	4.40	15	30	23	18	25	22	
Radius of Curvature (ft)	6	8	7	5	22	13	5	13	9	5	30	18	6	20	12	
Meander Wavelength	27	497	181	54	196	125	10.00	17.00	13.60	30	110	70	34	106	50	
Meander Width ratio	1.98	2.79	2.39	1.95	4.23	3.09	0.40	0.80	0.60	1.80	4.50	3.15			5.0	
Meander Length ratio	7.64	138.78	50.53	4.39	15.93	10.16	1.40	2.30	1.90	7.50	27.50	17.50			11.20	
Radius of Curvature/Riffle Width (ft)	1.68	2.23	1.96	0.44	4.23	1.05	0.70	1.70	1.20	1.00	4.20	2.60	1.35	4.06	2.71	
Pool Length/Riffle Width	3.91	7.65	5.53	0.76	1.94	1.45			N/A	1.05	3.75	2.40			2.50	
Pool to Pool Spacing/ Riffle Width	5.50	26.26	13.08	1.06	3.78	1.97	2.40	3.30	2.90	3.50	14.75	9.13	2.93	13.77	6.00	
Riffle Length/Riffle Width	1.90	20.75	8.13	0.30	1.84	1.07			N/A	2.45	11.00	6.73	1.85	10.61	3.54	
<b>Profile</b>																
Pool length (ft)	14.0	27.4	19.8	9.3	23.9	17.8			N/A	4.2	15.0	9.8	4.9	17.8	11.3	49
Pool spacing (ft)	19.7	94.0	46.8	13.0	46.5	24.2	17.6	24.1	20.8	14.0	59.0	26.5	13.0	61.0	26.6	48
Riffle length (ft)	6.8	74.3	29.1	3.7	22.6	13.1			N/A	9.8	44.0	26.9	8.2	47.0	15.7	50
Riffle slope (ft/ft)	0.014	0.027	0.02	0.020	0.036	0.026	0.006	0.049	0.028	0.018	0.029	0.02	0.01	0.48	0.03	50
Pool slope (ft/ft)	0.006	0.017	0.012	0.000	0.005	0.003	0.008	0.014	0.010	0.018	0.029	0.024	0.010	0.001	0.005	48
Run slope (ft/ft)	0.009	0.025	0.018	0.028	0.059	0.041			N/A			N/A*			N/A*	
Glide slope (ft/ft)	0.006	0.016	0.01	0.000	0.012	0.003			N/A			N/A*			N/A*	
Riffle Slope/Avg. Water Surface Slope	1.09	2.11	1.56	1.52	2.73	1.97	0.40	3.20	1.80	1.29	2.09	1.69			2.36	
Run slope/Avg. Water Surface Slope	0.73	1.95	1.41	2.12	4.47	3.11			N/A			N/A*			N/A*	
Pool Slope/Avg. Water Surface Slope	0.47	1.33	0.94	0.00	0.38	0.23	0.50	0.90	0.60	1.29	2.09	1.69			0.39	
Glide Slope/Avg. Water Surface Slope	0.50	1.25	0.78	0.00	0.91	0.23			N/A			N/A*			N/A*	
<b>Substrate</b>																
d50 (mm)	2.5	23.32	10.09			8.6			12.70				13.8	35.5	25.6	4
d84 (mm)	10.38	44.3	25.7			77.00			38.00		123		37	88	65.3	4
<b>Additional Reach Parameters</b>																
Valley Length (ft)			1285			235			N/A			1284			1285	
Channel Length (ft)			1293			266			N/A			1395			1390	
Valley Slope (ft/ft)	0.0113	0.0138	0.0132			0.0139			0.0173			0.0132			0.0129	
Water Surface Slope (ft/ft)	0.0080	0.0177	0.0128			0.0132			0.0156			0.0139			0.0127	
Sinuosity			1			1.1			1.05			1.1			1.1	

\* Runs and Glides are too short to obtain meaningful measurements

**Table 8. Baseline Stream Data Summary**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Parameter	Existing Trib 3 to Wickers Branch			Existing Trib 4 to Wickers Branch			Reference Reach- Spencer Creek			Reference Reach UT4 Rockwell Pastures			Proposed Trib 3 & 4 to Wickers Branch*			As-built Baseline (Tributary 3)				As-built Baseline (Tributary 4)			
	B6c			E6**			C4			C4			C4										
Stream Type	0.05			0.05			0.5			0.11			0.05										
Drainage Area (sq mi)																							
Dimension	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	n	Min	Max	Avg	n
BF Width (ft)	2.55	2.66	<b>2.61</b>	2.90	3.66	<b>3.28</b>			<b>12.30</b>			<b>7.30</b>			<b>3.60</b>	3.58	6.74	<b>4.70</b>	3	3.53	4.29	3.91	2
BF Cross Sectional Area (ft <sup>2</sup> )	0.40	0.63	<b>0.52</b>	0.83	1.13	<b>0.98</b>			<b>10.80</b>			<b>4.20</b>			<b>1.08</b>	1.16	6.98	<b>3.2</b>	3	1.21	1.23	<b>1.22</b>	2
BF Mean Depth (ft)	0.15	0.25	<b>0.20</b>	0.23	0.39	<b>0.31</b>			<b>0.88</b>			<b>0.60</b>			<b>0.30</b>	0.32	1.04	<b>0.59</b>	3	0.29	0.34	<b>0.32</b>	2
BF Max Depth (ft)	0.38	0.45	<b>0.42</b>	0.38	0.65	<b>0.52</b>			<b>1.80</b>			<b>1.10</b>			<b>0.60</b>	0.49	1.53	<b>0.89</b>	3	0.43	0.69	<b>0.56</b>	2
Width/Depth Ratio	10.20	17.73	<b>13.97</b>	7.44	15.91	<b>11.68</b>			<b>13.98</b>			<b>12.60</b>			<b>12.00</b>	6.48	11.19	<b>9.15</b>	3	10.38	14.79	<b>12.59</b>	2
Entrenchment Ratio	1.36	1.88	<b>1.62</b>	2.46	4.84	<b>3.65</b>			<b>&gt;2.20</b>			<b>2.70</b>			<b>&gt;2.20</b>	5.12	8.60	<b>7.20</b>	3	4.26	5.50	<b>4.88</b>	2
Wetted Perimeter (ft)	2.83	2.84	<b>2.84</b>	3.26	3.77	<b>3.52</b>			<b>14.13</b>			<b>5.77</b>			<b>4.20</b>	3.59	6.80	<b>5.20</b>	2	3.81	4.42	<b>4.12</b>	2
Hydraulic radius (ft)	0.14	0.22	<b>0.18</b>	0.22	0.35	<b>0.29</b>			<b>0.76</b>			<b>0.76</b>			<b>0.26</b>	0.24	0.72	<b>0.48</b>	2	0.28	0.32	<b>0.3</b>	2
Bank Height Ratio	2.24	3.32	<b>2.78</b>	1.00	1.60	<b>1.30</b>			<b>1.10</b>			<b>1.00</b>			<b>1.00</b>			<b>1.00</b>				<b>1.00</b>	
Pool Area/Riffle Area			N/A			N/A			1.17			1.00			8.00			0.52				N/A	
Max riffle depth/mean riffle depth	1.9	2.25	<b>2.08</b>			<b>1.68</b>			<b>2.05</b>			<b>1.90</b>			<b>2.00</b>			<b>1.51</b>				<b>1.78</b>	
Max pool depth/mean riffle depth	2.15	3.4	<b>2.78</b>	1.13	1.97	<b>1.55</b>			<b>2.38</b>			<b>2.5</b>			<b>8.30</b>			<b>2.64</b>				<b>N/A</b>	
<b>Pattern</b>																							
Channel Beltwidth (ft)	5	9	7			N/A	24	52	38	3.20	5.70	4.40			N/A*			N/A***				N/A***	
Radius of Curvature (ft)	2	8	5			N/A	5	22	13	5	13	9			N/A*			N/A***				N/A***	
Meander Wavelength	109	312	189			N/A	54	196	125	10.00	17.00	13.60			N/A*			N/A***				N/A***	
Meander Width ratio	2.00	3.31	2.65			N/A	1.95	4.23	3.09	0.40	0.80	0.60			N/A*			N/A***				N/A***	
Meander Length ratio	41.68	119.38	72.24			N/A	4.39	15.93	10.16	1.40	2.30	1.90			N/A*			N/A***				N/A***	
Radius of Curvature/Riffle Width (ft)	0.69	3.07	1.88			N/A	0.44	4.23	1.05	0.70	1.70	1.20			N/A*			N/A***				N/A***	
Pool Length/Riffle Width	6.79	14.39	9.13	3.60	10.09	6.22	0.76	1.94	1.45			N/A	1.11	1.67	N/A*			2.19				2.38	
Pool to Pool Spacing/ Riffle Width	14.80	34.66	24.86	5.46	15.70	9.91	1.06	3.78	1.97	2.40	3.30	2.90	5.56	16.11	10.83			11				37	
Riffle Length/Riffle Width	2.72	8.58	5.40	5.46	11.16	8.45	0.30	1.84	1.07			N/A	4.44	14.44	9.44			8.64				35.29	
<b>Profile</b>																							
Pool length (ft)	17.7	37.6	23.8	11.8	33.1	20.4	9.3	23.9	17.8			N/A	4.0	6.0	5.0	7.7	17.7	10.3	11	7.6	11.2	9.3	4
Pool spacing (ft)	38.6	90.5	64.9	17.9	51.5	32.5	13.0	46.5	24.2	17.6	24.1	20.8	20.0	58.0	45.3	34.7	88	52	10	140	150	145	4
Riffle length (ft)	7.1	22.4	14.1	17.9	36.62	27.7	3.7	22.6	13.1			N/A	16.0	52.0	34.0	22.2	74.9	40.6	10	133	145	138	3
Riffle slope (ft/ft)	0.011	0.027	0.019	0.008	0.014	0.0095	0.020	0.036	0.026	0.006	0.049	0.028	0.018	0.029	0.02	0.0048	0.0179	0.0115	10	0.007	0.014	0.009	3
Pool slope (ft/ft)	0.012	0.013	0.011	0.008	0.009	0.0085	0.000	0.005	0.003	0.008	0.014	0.010	0.018	0.029	0.024	0.0001	0.0048	0.0025	10	0.0001	0.0012	0.0007	4
Run slope (ft/ft)	0.013	0.034	0.023	0.008	0.030	0.0125	0.028	0.059	0.041			N/A			N/A			N/A****				N/A****	
Glide slope (ft/ft)	0.008	0.020	0.012	0.0050	0.0460	0.015	0.000	0.012	0.003			N/A			N/A			N/A****				N/A****	
Riffle Slope/Avg. Water Surface Slope	0.79	1.93	1.36	0.89	1.56	1.06	1.52	2.73	1.97	0.40	3.20	1.80	1.29	2.09	1.69			0.97				0.95	
Run slope/Avg. Water Surface Slope	0.93	2.43	1.64	0.87	3.33	1.39	2.12	4.47	3.11			N/A			N/A			N/A****				N/A****	
Pool Slope/Avg. Water Surface Slope	0.86	0.93	0.79	0.89	0.97	0.94	0.00	0.38	0.23	0.50	0.90	0.60	1.29	2.09	1.69			0.21				0.07	
Glide Slope/Avg. Water Surface Slope	0.57	1.43	0.86	0.56	5.11	1.67	0.00	0.91	0.23			N/A			N/A			N/A****				N/A****	
<b>Substrate</b>																							
d50 (mm)			0.04			0.04			8.6			12.70				0.06	16	7.1	3	0.03	4.7	2.4	2
d84 (mm)			0.06			6.16			77.00			38.00			108	5	29	17	3	0.05	14	7	2
<b>Additional Reach Parameters</b>																							
Valley Length (ft)			1184			629			235			N/A			1284			1184				629	
Channel Length (ft)			1184			631			266			N/A			1395			1184				631	
Valley Slope (ft/ft)	0.0116	0.0164	0.0135	0.0087	0.0122	0.0095			0.0139			0.0173			0.0132			0.0119				0.0097	
Water Surface Slope (ft/ft)	0.0100	0.0176	0.0140	0.0090	0.0090	0.0090			0.0132			0.0156			0.0139			0.0119				0.0095	
Sinuosity			1			1			1.1			1.05			1.1			1.0				1.0	

\* Tributary 3 and 4 - The Pattern of the channel was not altered. Tributary 4 only minimal work consisting of altering dimension was performed.

\*\* Tributary modified/channelized in past so application of classification of natural channels may not be applicable

\*\*\*Note on Tributaries 3 and 4 Pattern Data. These two tributaries are relatively straight channels. Beltwidth, radius of curvature, and other measurements are not applicable.

\*\*\*\* Runs and glides are too short to obtain meaningful measurements

**Table 9a. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters – Cross Sections)**

**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	3.97	3.93	3.07	3.26	4.77	4.33		5.13	6.09	5.85	4.81	8.83	6.1		4.51	4.57	5.08	4.25	11	9.9		5.14	5.31	6.2	9.9	9.6	9.6		4.76	4.27	3.8	3.9	4.5	4.2	
Floodprone Width (ft)	50	50	50	50	50	50		50	50	50	50	50	50		50	50	50	50	50	50		50	50	50	50	50	50		50	50	50	50	50	50	
Bankfull Mean Depth (ft)	0.38	0.41	0.42	0.28	0.31	0.35		0.78	0.7	0.69	0.82	0.45	0.65		0.68	0.61	0.8	0.6	0.28	0.31		0.72	0.68	0.83	0.41	0.38	0.35		0.32	0.3	0.3	0.3	0.34	0.38	
Bankfull Max Depth (ft)	0.53	0.51	0.5	0.37	0.45	0.55		1.19	1.21	1.38	1.21	1.2	1.4		1	0.69	1.22	0.9	0.89	0.86		1.33	1.26	1.5	1.28	1.42	1.35		0.79	0.42	0.45	0.42	0.47	0.55	
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.51	1.62	1.28	0.92	1.51	1.51		3.98	4.27	4.03	3.96	3.98	3.98		3.08	2.8	4.06	2.36	3.08	3.08		3.72	3.59	5.17	4.1	3.72	3.72		1.54	1.7	1.3	1.1	1.54	1.54	
Bankfull Width/Depth Ratio	10.45	9.59	7.31	11.64	15.39	12.37		6.58	8.7	8.5	4.81	19.6	9.4		6.63	7.49	6.4	7.59	39.29	32.03		7.14	7.81	7.4	24.1	25.2	27.4		14.87	14.23	11.5	13.6	13.24	10.95	
Bankfull Entrenchment Ratio	10.06	10.18	16.29	15.34	8.03	11.5		7.79	6.57	8.5	10.4	5.6	8.2		11.1	8.72	9.8	11.8	4.5	5		9.7	7.49	8.1	5	5.2	5.2		10.5	8.44	13.2	12.6	11.11	12	
Low Top of Bank Depth (ft)	NA	NA	NA	NA	0.43	0.46		NA	NA	NA	NA	1.07	1.26						0.89	0.82						1.31	1.25						0.43	0.58	
Bankfull Bank Height Ratio	1	1	1	1	0.96	0.83		1	1	1	1	0.89	0.9		1	1	0.9	0.9	1	0.95		1	1	1	1	0.92	0.92		1	1	1	1	0.9	1.05	
<b>Based on current/developing bankfull feature</b>																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft <sup>2</sup> )																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft <sup>2</sup> )																																			
d50 (mm)	35.5	32.9	31.2	14.5	21.8	19.7		7.7	6.9	0.8	13.6	6.8	6.8		25.7	32	73	64	65	64		0.03	0.04	0.05	0.06	0.06	0.06		27.3	42.4	45	11.3	30.6	26.1	
	<b>Cross Section 6 (Riffle)</b>							<b>Cross Section 7 (Pool)</b>							<b>Cross Section</b>							<b>Cross Section</b>													
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	4.39	4.93	4.37	3.98	10.02	5.09		6.59	6.21	9.94	10.5	7.1	5.53																						
Floodprone Width (ft)	50	50	50	50	50	50		40	40	40	40	40	40																						
Bankfull Mean Depth (ft)	0.39	0.33	0.4	0.34	0.17	0.34		0.49	0.59	0.4	0.4	0.45	0.58																						
Bankfull Max Depth (ft)	0.58	0.5	0.5	0.43	0.5	0.57		0.85	0.92	0.97	0.87	0.9	0.93																						
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.72	1.64	1.73	1.35	1.72	1.72		3.21	3.69	3.98	3.92	3.21	3.21																						
Bankfull Width/Depth Ratio	11.26	14.94	10.97	11.7	58.4	14.97		13.45	10.53	24.8	28.5	15.78	9.53																						
Bankfull Entrenchment Ratio	11.4	7.16	11.4	11.4	4.99	7.85		6.1	6.37	4.02	3.8	5.6	7.2																						
Low Top of Bank Depth (ft)	NA	NA	NA	NA	0.44	0.53		NA	NA	NA	NA	0.74	0.94																						
Bankfull Bank Height Ratio	1	1	1	1	0.88	0.92		1	1	1	1	0.82	1.01																						
<b>Based on current/developing bankfull feature</b>																																			
Bankfull Width (ft)																																			
Floodprone Width (ft)																																			
Bankfull Mean Depth (ft)																																			
Bankfull Max Depth (ft)																																			
Bankfull Cross Sectional Area (ft <sup>2</sup> )																																			
Bankfull Width/Depth Ratio																																			
Bankfull Entrenchment Ratio																																			
Bankfull Bank Height Ratio																																			
Cross Sectional Area between end pins (ft <sup>2</sup> )																																			
d50 (mm)	13.8	12.9	41	5.2	10	22.6		11.2	6.3	0.8	3	3.6	4																						

Note: Bankfull elevation for MY 1 - 3 based on fixed baseline bankfull elevation. Bankfull elevation for MY 4 and 5 based on Bankfull Cross-sectional area per USACE guidance.

**Table 9a. Morphology and Hydraulic Monitoring Summary (Dimensional Parameters – Cross Sections)**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

	Cross Section 8 (Pool)							Cross Section 9 (Riffle)							Cross Section 10 (Riffle)						
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	4	4.3	4.2	4.9	3.8	6.7		3.58	3.48	3.3	3.2	4.17	3.04		6.74	6.19	6.61	6.39	12.03	11	
Floodprone Width (ft)	32	32	40	40	40	40		31	31	32	33	33	34		35	35	33	32	35	35	
Bankfull Mean Depth (ft)	0.41	0.38	0.33	0.25	0.44	0.25		0.32	0.24	0.31	0.32	0.27	0.39		1.04	0.79	0.84	0.8	0.57	0.63	
Bankfull Max Depth (ft)	0.65	0.71	0.6	0.6	0.77	0.72		0.49	0.38	0.49	0.54	0.55	0.63		1.53	1.29	1.22	1.2	1.46	1.54	
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.66	1.65	1.38	1.25	1.66	1.66		1.16	0.85	1.01	1.03	1.16	1.16		6.98	4.87	5.53	5.09	6.98	6.98	
Bankfull Width/Depth Ratio	9.78	11.32	12.8	19.9	8.59	26.8		11.19	14.5	10.6	10	15.44	7.8		6.48	7.84	7.87	7.99	21.1	17.5	
Bankfull Entrenchment Ratio	7.9	9.31	9.48	8	10.57	5.97		8.6	6.89	9.77	10.35	7.89	11.5		5.12	5.1	4.96	5.02	2.96	3.2	
Low Top of Bank Depth (ft)					0.89	0.67						0.51	0.63						1.29	1.45	
Bankfull Bank Height Ratio	1	1	1	1	1.15	0.93		1	1	1	1	0.93	1		1	1	1	1	0.89	0.94	
<b>Based on current/developing bankfull feature</b>																					
Bankfull Width (ft)																					
Floodprone Width (ft)																					
Bankfull Mean Depth (ft)																					
Bankfull Max Depth (ft)																					
Bankfull Cross Sectional Area (ft <sup>2</sup> )																					
Bankfull Width/Depth Ratio																					
Bankfull Entrenchment Ratio																					
Bankfull Bank Height Ratio																					
Cross Sectional Area between end pins (ft <sup>2</sup> )																					
d50 (mm)	5.42	0.04	0.03	4	4	3		16	0.04	0.04	0.03	0.04	0.04		0.06	0.04	0.03	0.03	0.03	0.03	
	Cross Section 11 (Riffle)							Cross Section 12 (Riffle)							Cross Section						
<b>Based on fixed baseline bankfull elevation</b>	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	3.53	2.98	3.22	3.54	3.58	3.23		4.29	4.17	4.18	3.15	3.81	3.18								
Floodprone Width (ft)	19.5	19.5	18	14	14	18		18.3	18.3	24	11	19	23								
Bankfull Mean Depth (ft)	0.34	0.41	0.35	0.36	0.33	0.38		0.29	0.25	0.28	0.3	0.32	0.39								
Bankfull Max Depth (ft)	0.69	0.69	0.62	0.53	0.53	0.61		0.43	0.44	0.5	0.48	0.53	0.57								
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.21	1.22	1.12	1.27	1.21	1.21		1.23	1.05	1.19	0.94	1.23	1.23								
Bankfull Width/Depth Ratio	10.38	7.27	9.2	9.83	10.85	8.5		14.79	16.68	14.93	10.5	11.91	8.15								
Bankfull Entrenchment Ratio	5.5	6.39	5.42	3.94	3.97	5.7		4.26	5.4	5.83	3.5	5.1	7.2								
Low Top of Bank Depth (ft)					0.49	0.56						0.6	0.64								
Bankfull Bank Height Ratio	1	1	1	1	0.93	0.91		1	1	1	1.1	1.1	1.1								
<b>Based on current/developing bankfull feature</b>																					
Bankfull Width (ft)																					
Floodprone Width (ft)																					
Bankfull Mean Depth (ft)																					
Bankfull Max Depth (ft)																					
Bankfull Cross Sectional Area (ft <sup>2</sup> )																					
Bankfull Width/Depth Ratio																					
Bankfull Entrenchment Ratio																					
Bankfull Bank Height Ratio																					
Cross Sectional Area between end pins (ft <sup>2</sup> )																					
d50 (mm)	0.03	0.03	0.03	0.03	0.03	0.03		4.7	0.03	0.03	0.03	0.03	0.04								

Note: Bankfull elevation for MY 1 - 3 based on fixed baseline bankfull elevation. Bankfull elevation for MY 4 and 5 based on Bankfull Cross-sectional area per USACE guidance.



**Table 9b. Stream Reach Data Summary**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Parameter	MY 0			MY 1			MY 2			MY 3			MY 4			MY 5		
	Trib 3			Trib 3			Trib 3			Trib 3			Trib 3			Trib 3		
Dimension and Substrate - Riffle	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Bankfull Width (ft)	3.58	6.74	4.77	3.48	6.19	4.66	3.30	6.61	4.70	3.2	6.39	4.83	3.80	12.03	6.67	3.04	11	7.02
Floodprone Width (ft)	31.00	35.00	32.67	31	35	32.70	32	40	35	32	40	35.00	33	40	36	34	35	34.5
Bankfull Mean Depth (ft)	0.32	1.04	0.59	0.24	0.79	0.47	0.31	0.84	0.49	0.25	0.8	0.46	0.27	0.57	0.43	0.39	0.63	0.51
<sup>1</sup> Bankfull Max Depth (ft)	0.49	1.53	0.89	0.38	1.29	0.79	0.49	1.22	0.77	0.54	1.2	0.78	0.55	1.46	0.93	0.63	1.54	1.085
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.16	6.98	3.27	0.85	4.87	2.45	1.01	5.53	2.64	1.03	5.09	2.46	1.16	6.98	3.27	1.16	6.98	4.07
Width/Depth Ratio	6.48	11.19	9.15	7.84	14.5	11.22	7.87	12.80	10.42	7.99	19.9	12.63	8.59	21.10	15.04	7.8	17.5	12.65
Entrenchment Ratio	5.12	8.60	7.21	5.1	9.31	7.10	4.96	9.77	8.07	5.02	10.35	7.79	2.96	10.57	7.14	3.2	11.5	7.35
Low Top of Bank Depth (ft)													0.51	1.29	0.90	0.63	1.45	1.04
<sup>1</sup> Bank Height Ratio			1			1			1			1	0.89	1.15	0.99	0.94	1	0.97
Profile																		
Riffle Length (ft)	22.2	74.9	40.6	22.2	74.9	40.6	24	73	43	25	76	43	23	73	43	23	73	43
Riffle Slope (ft/ft)	0.0048	0.0179	0.0115	0.0048	0.019	0.013	0.0048	0.0179	0.0115	0.003	0.019	0.012	0.0048	0.0179	0.013	0.0048	0.0179	0.012
Pool Length (ft)	7.7	17.7	10.3	7.6	17.8	10.4	6	12	9.4	6	9	7.6	6	12	10	6	13	9
Pool Max depth (ft)	1.01	1.97	1.56	1	1.95	1.52	0.9	1.7	1.3	0.9	1.6	1.2	0.9	1.7	1.2	0.9	1.7	1.3
Pool Spacing (ft)	34.7	88	52	34.8	88.1	52	31	84	52	31	83	50	32	83	52	36	87	58
Pattern																		
Channel Beltwidth (ft)	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Radius of Curvature (ft)	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Rc/Bankfull width (ft/ft)	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Meander Wavelength (ft)	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Meander Width Ratio	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*
Transport parameters																		
Reach Shear Stress (competency) lb/ft <sup>2</sup>																		
Max part size (mm) mobilized at bankfull																		
Stream Power (transport capacity) W/m <sup>2</sup>																		
Additional Reach Parameters																		
Rosgen Classification		C4			C4			C4			C4			C4			C4	
Bankfull Velocity (fps)																		
Bankfull Discharge (cfs)																		
Valley length (ft)		1184			1184			1184			1184			1184			1184	
Channel Thalweg length (ft)		1184			1184			1184			1184			1184			1184	
Sinuosity (ft)		1.0			1.0			1.0			1.0			1.0			1.0	
Water Surface Slope (Channel) (ft/ft)		0.0119			0.0119			0.0119			0.0119			0.0119			0.0119	
BF slope (ft/ft)		0.0119			0.0119			0.0119			0.0119			0.0119			0.0119	
<sup>3</sup> Bankfull Floodplain Area (acres)																		
<sup>4</sup> Proportion over wide (%)																		
Channel Stability or Habitat Metric																		
Biological or Other																		

\*Note on Tributary 3 Pattern Data. This tributary is a relatively straight channel. Beltwidth, radius of curvature, and other pattern measurements does not provide meaningful information

**Table 9b. Stream Reach Data Summary**  
**Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022**

Parameter	MY 0			MY 1			MY 2			MY 3			MY 4			MY 5		
	Trib 4			Trib 4			Trib 4			Trib 4			Trib 4			Trib 4		
Dimension and Substrate - Riffle	Min	Max	Avg															
Bankfull Width (ft)	3.53	4.29	3.91	2.98	4.17	3.57	3.57	4.17	2.98	3.15	3.54	3.34	3.58	3.81	3.70	3.18	3.23	3.205
Floodprone Width (ft)	18.30	19.50	18.90	18.3	19.5	18.9	18.9	19.5	18.3	11	14	12.50	14.00	19.00	16.50	18	23	20.5
Bankfull Mean Depth (ft)	0.29	0.34	0.32	0.25	0.41	0.33	0.33	0.41	0.25	0.3	0.36	0.33	0.32	0.33	0.33	0.38	0.39	0.385
<sup>1</sup> Bankfull Max Depth (ft)	0.43	0.69	0.56	0.44	0.69	0.56	0.56	0.69	0.44	0.48	0.53	0.51	0.53	0.53	0.53	0.57	0.61	0.59
Bankfull Cross Sectional Area (ft <sup>2</sup> )	1.21	1.23	1.22	1.05	1.22	1.13	1.13	1.22	1.05	0.94	1.27	1.11	1.21	1.23	1.22	1.21	1.23	1.22
Width/Depth Ratio	10.38	14.79	12.59	7.27	16.68	11.97	11.97	16.68	7.27	9.83	10.5	10.17	10.85	11.91	11.38	8.15	8.5	8.325
Entrenchment Ratio	4.26	5.50	4.88	5.4	6.39	5.89	5.89	6.39	5.40	3.5	3.94	3.72	3.97	5.10	4.54	5.7	7.2	6.45
Low Top of Bank Depth (ft)													0.49	0.60	0.55	0.56	0.64	0.60
<sup>1</sup> Bank Height Ratio			1			1			1				0.93	1.10	1.02	0.91	1.1	1.005
<b>Profile</b>																		
Riffle Length (ft)	133	145	138	130	145	136	140	160	148	134	146	139	134	160	148			
Riffle Slope (ft/ft)	0.007	0.014	0.009	0.006	0.014	0.009	0.006	0.014	0.009	0.007	0.014	0.01	0.006	0.014	0.009			
Pool Length (ft)	7.6	11.2	9.3	7.4	11.1	9.2	7.1	13	10.6	5	9	7	7.4	13	10.6			
Pool Max depth (ft)	1.39	2.35	1.78	1.37	2.35	1.77	1.18	1.79	1.46	1	1.53	1.22	1.39	1.79	1.46			
Pool Spacing (ft)	140	150	145	140	150	145	140	150	145	140	150	145	140	150	145			
<b>Pattern</b>																		
Channel Beltwidth (ft)	N/A*	N/A*	N/A*															
Radius of Curvature (ft)	N/A*	N/A*	N/A*															
Rc/Bankfull width (ft/ft)	N/A*	N/A*	N/A*															
Meander Wavelength (ft)	N/A*	N/A*	N/A*															
Meander Width Ratio	N/A*	N/A*	N/A*															
<b>Transport parameters</b>																		
Reach Shear Stress (competency) lb/f <sup>2</sup>																		
Max part size (mm) mobilized at bankfull																		
Stream Power (transport capacity) W/m <sup>2</sup>																		
<b>Additional Reach Parameters</b>																		
Rosgen Classification		N/A																
Bankfull Velocity (fps)																		
Bankfull Discharge (cfs)																		
Valley length (ft)		631			631			631			631			631			631	
Channel Thalweg length (ft)		631			631			631			631			631			631	
Sinuosity (ft)		1.0			1.0			1.0			1.0			1.0			1.0	
Water Surface Slope (Channel) (ft/ft)		0.00972			0.00972			0.00972			0.00972			0.00972			0.00972	
BF slope (ft/ft)		0.0095			0.0095			0.0095			0.0095			0.0095			0.0095	
<sup>3</sup> Bankfull Floodplain Area (acres)																		
<sup>4</sup> Proportion over wide (%)																		
Channel Stability or Habitat Metric																		
Biological or Other																		

\*Note on Tributary 4 Pattern Data. This tributary is a relatively straight channel. Beltwidth, radius of curvature, and other pattern measurements does not provide meaningful information

## **APPENDIX E: HYDROLOGIC DATA**

Table 10 – Verification of Bankfull Events

Table 10. Documentation of Geomorphologically Significant Flow Events Tributaries of Wicker Branch Stream Restoration/ DMS No. 95022					
Date of Observation	Date of occurrence	Method	Greater Than Qgs=Q2*0.66 Stage	Greater than Qbkf Stage?	Notes
12/3/2014	11/23/2014	Photo on-site wrack line		Yes	See photo below
4/17/2017	Apr-17	Crest Gauge		Yes	See photos below. Most likely occurred on 1/2/2017 or 1/3/2017 when site received a total of 1.5 inches of rain
2/6/2018	1/29/2018	Photo, crest gauge, and transducer data		Yes	See photos and transducer graphs
9/16/2018	9/16/2018	Transducer data		Yes	See transducer graphs
4/8/2019	4/8/2019	Transducer data		Yes	See transducer graphs
4/22/2019	Feb or Apr-19	Crest Gauge		Yes	See Photo



Photo of wrack lines from 11/23/2014 bankfull event



Tributary 1 Crest Gauge 4/17/2017



Tributary 3 Crest Gauge 4/17/2017



Tributary 1 wrack lines 2/6/2018

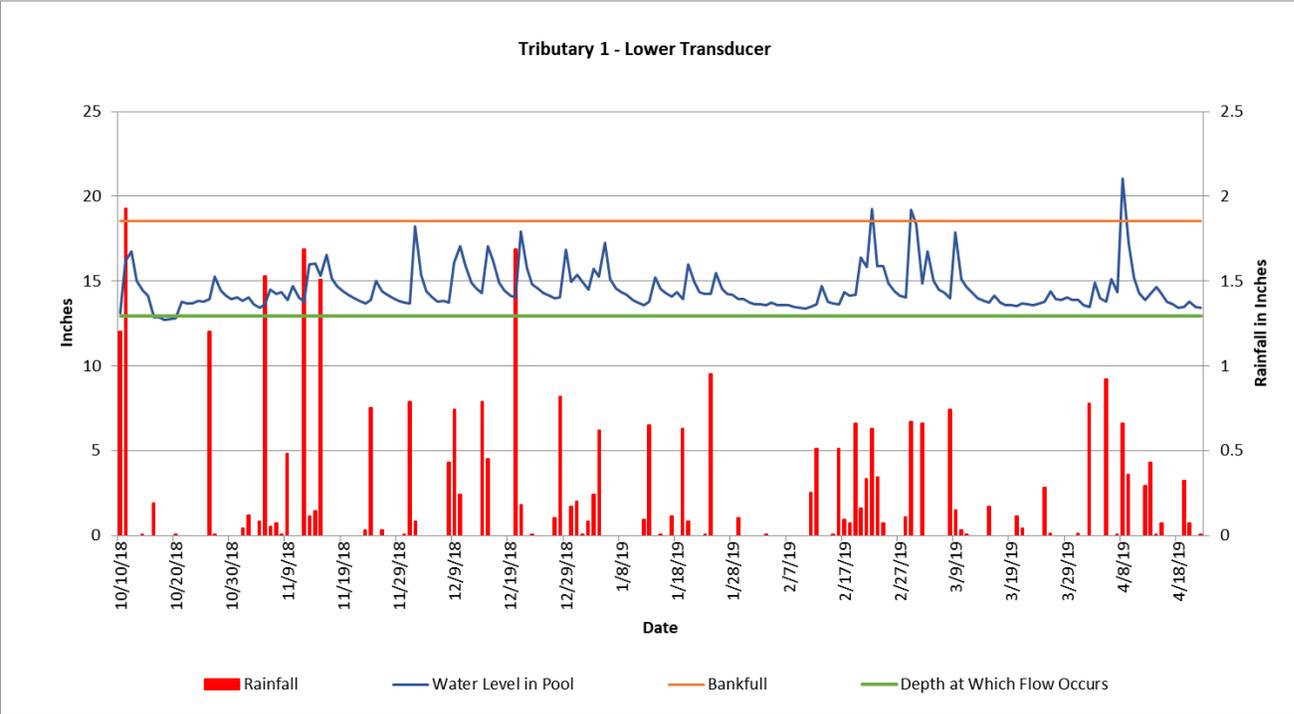
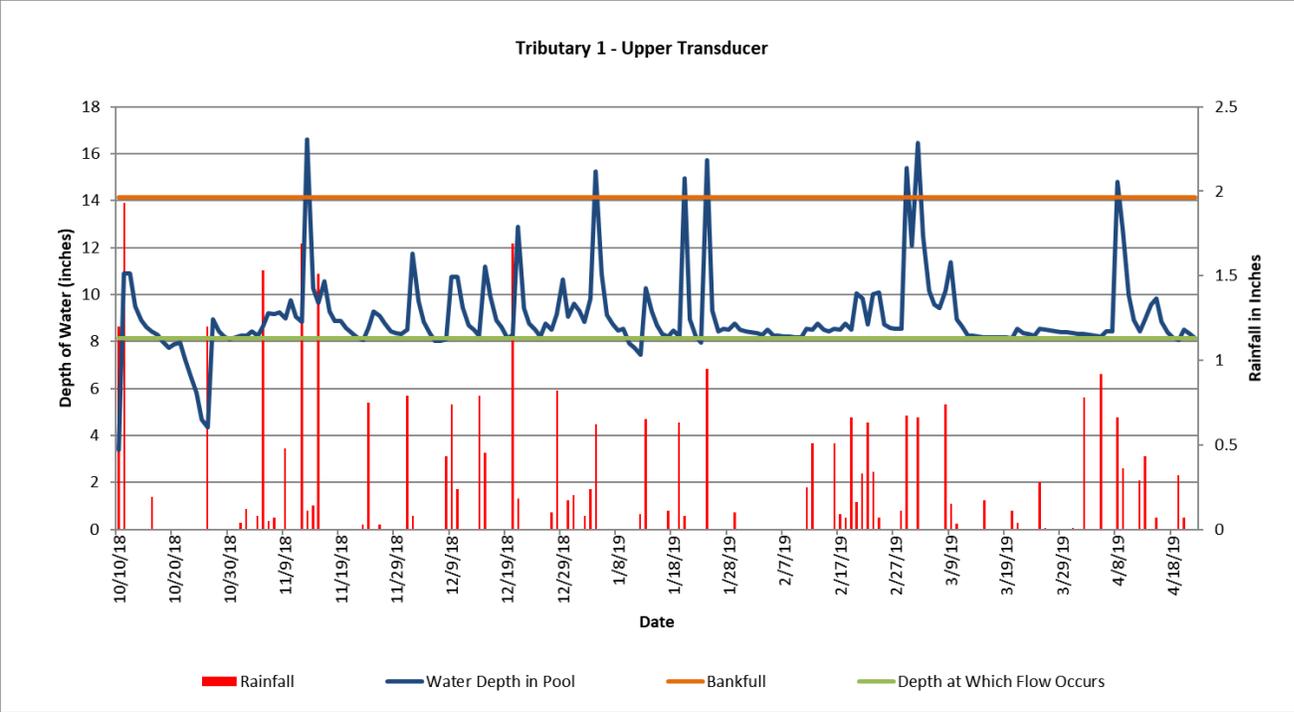


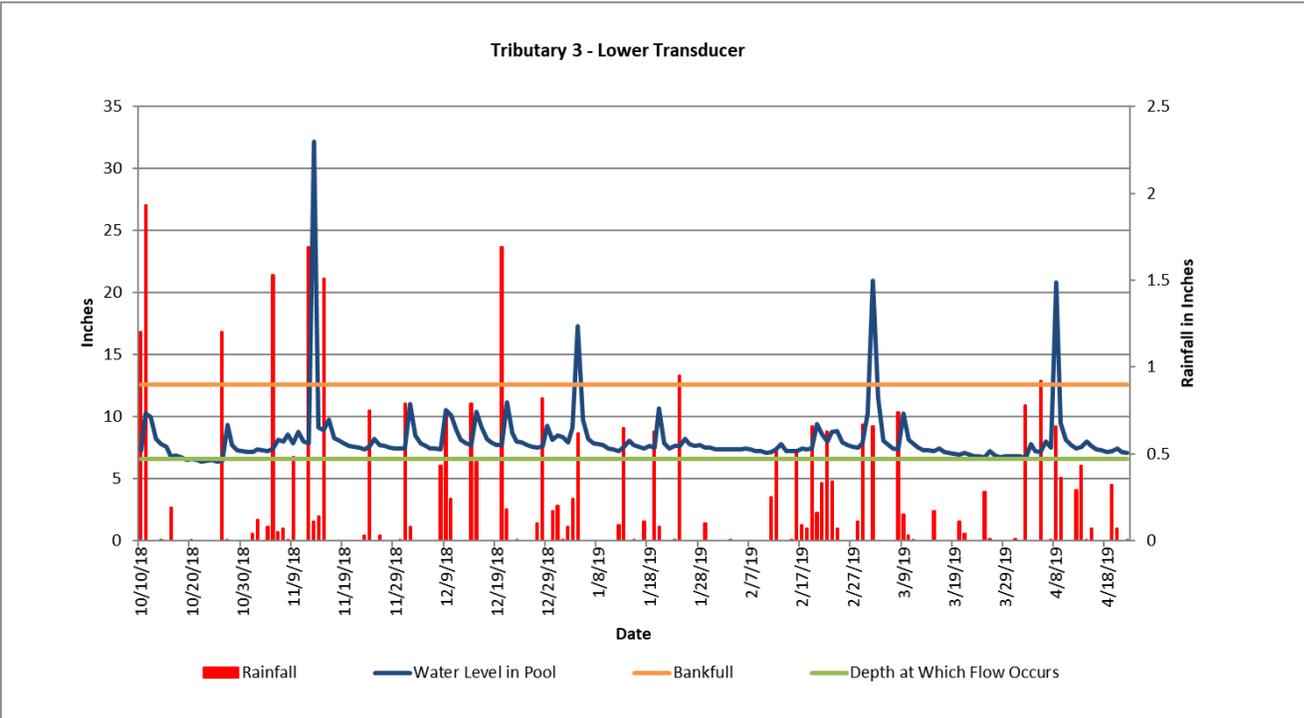
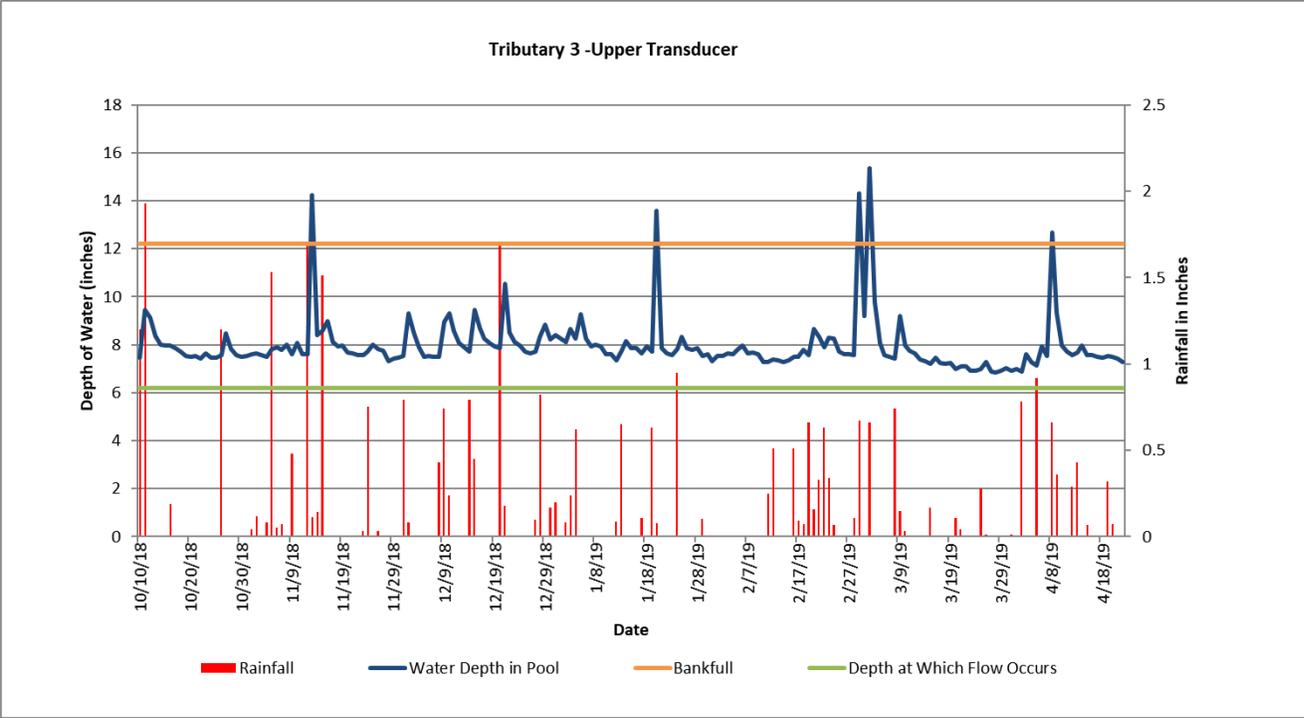
Tributary 3 wrack lines 2/6/2018



Tributary 1 Crest gauge 4/22/2019







## **APPENDIX F: 2018 IRT SITE VISIT MEMORANDUM AND RESPONSE**



## MEMORANDUM

**To:** Todd Tugwell (USACE), Kim Browning (USACE), Mac Haupt (NCDWR)

**Cc:** Paul Wiesner (NCDMS), Ron Johnson (AECOM)

**From:** Harry Tsomides (NCDMS)

**Re:** Tributaries to Wicker Branch Restoration Site, Union County -  
2017 Credit Release and IRT Site Visit

**Date:** 5/4/2017

## Meeting Summary

Below are summary points discussed during the 4/17/2017 Tributaries to Wicker Branch Credit Release on-site meeting. The meeting was held to evaluate the viability of the 2017-MY2 requested credit release. This full delivery site is currently undergoing MY3 mitigation success monitoring.

Project Name: Tributaries to Wicker Branch

DMS ID: 95022

DMS PM: Harry Tsomides

Full Delivery Provider: AECOM

FD Contract No.: 003982

Site Meeting Attendees:

Ron Johnson, AECOM

Harry Tsomides, NCDMS

Paul Wiesner, NCDMS

Mac Haupt, NCDWR

Kim Browning, USACE

Todd Tugwell, USACE

**Areas of low stem density** - While the overall stem density is showing success, there are numerous grassy expanses along the stream where planted stems are not evident. It was recommended that supplemental planting be conducted this fall/winter so that larger areas with low woody stem density more closely represent the plot location densities. Transect data collection was also discussed as a tool to provide data for non-plot areas, and if this is collected it should be included in the annual monitoring reports (locations, basic methodology, stem counts, etc).



**Stream segment between wetland areas on Trib 3 where a stream is not evident** – Keep monitoring and looking for stream channel formation; if wetland conditions persist there could be withholding of stream credits in future years.

**Bank full event data collection and verification** – Several recommendations were made by the IRT: (1) Add a continuous flow gage on Trib 1A, 50-100 feet above the confluence with Trib 2, (2) add a second continuous flow gage at least half way up Trib 3, as flow gages at the bottom end of low flow channels do not represent reach-wide average flow conditions, (3) maintain crest gages /flow gages/mounted cameras appropriately to make sure they are working and that we get good data every year since hydrology has been the main project concern so far. The subject of proper placement of flow gages came up and question asked why these were placed in pools rather than riffles. AECOM indicated they were submerged in pools but the atmospheric corrections are being made and the elevations have been set to record flow elevations at the head of the next downstream riffle. Overall, hydrology is a significant concern since the site has not had a true documented post-construction bankfull flow event.

**Invasives treatment** – Everyone agreed privet needs to be treated aggressively on lower Tributary 1B. AECOM indicated they are getting quotes from subcontractors for this work and that it will be performed soon.

**Easement violations** –AECOM needs to keep the farmer from scalloping the edges in some locations; also the crossing at lower Trib 3 has had recent encroachment along it due to equipment crossing. AECOM indicated (and the group viewed) some areas where recent boundary marking improvements had been installed by AECOM. AECOM will continue to monitor, post/repost as necessary to maintain ensure compliance.

The IRT concluded that MY2 requested credits will be released; however the above issues will be revisited during the MY3 requested credit release in early 2018.



# Memorandum

To	Harry Tsomides, DMS Project Manager	Page	1
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Subject	Tributaries of Wickers Branch – MY03 Credit Release		
From	Ron Johnson		
Date	May 3, 2018		

This memorandum is to follow up on the April 25 IRT meeting. During that meeting the IRT requested that AECOM provide an Adaptive Mitigation Plan to address invasives within the wooded area of Reach 1B and to address encroachments on the equipment crossings on Tributary 2 and 3. Additionally, they wanted information on the stream lengths and stream mitigation units (SMUs) that were being generated by Tributary 1A and the upper reach of Tributary 3.

**Invasives Treatment** – The primary invasive species on Tributary 1B is Chinese privet, which is present throughout the buffer. An initial treatment of the privet was performed in October 2014 when the project underwent construction. A second treatment was performed in the Spring of 2016 but it was not very effective. A third treatment was performed in October 2017. AECOM has contracted with Habitat Assessment & Restoration Professionals (HARP) to perform two treatments of the privet in 2018. The first treatment will occur in May with a second treatment to follow. The timing of the second treatment has not yet been determined, and will depend upon the effectiveness of the May treatment. Additional treatments in 2019 (MY05) will be performed if necessary to control any remaining privet.

**Easement Encroachment** – The farmer that leases the land is currently encroaching on the easement at the equipment crossings at Tributary 1 and Tributary 3. While additional signage was placed in these areas in 2017, a small amount of encroachment is still occurring. Longitudinal encroachments that occurred in 2015 and 2016 are no longer occurring. AECOM will reinstall signage at the easement corners where the signs have been damaged by the large farm equipment. The posts will be taller and more robust to ensure that the farmer sees and avoids the signs and the encroachments. AECOM will also have additional discussions with the farmer regarding the need to stay within the boundaries of the equipment crossings, and convey the seriousness of the easements. We will also discuss the need to communicate the need to stay out of the easements to any of the farm hands or equipment operators that farm the adjacent property.

**Stream Lengths and Stream Mitigation Units** – The project as described in the Mitigation Plan is projected to generate 2539.65 SMUs through a mixture of Restoration, Enhancement I, and Enhancement II. Tributary 1A consisted of 1390 feet of Restoration at a Mitigation Ratio of 1:1 which would generate 1390 SMUs. On Tributary 3, there is a 264 foot reach between 2 wetland areas that has been proposed as Enhancement II at a Mitigation Ratio of 2.5:1. This length was projected to generate 105.6 SMUs. The total SMUs from Tributary 1A and the upper section of Tributary 3 is 1495.6 SMUs.

## Memorandum

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CC			
Subject	Tributaries of Wickers Branch – 10/16/2018 Site Visit Comments		
From	Ron Johnson		
Date	January 23, 2019		

This memorandum is to respond to observations and comments from the October 5, 2018 site visit performed by DMS Property (Jeffery Horton) and NCDEQ Stewardship (Ed Hajnos) and provided to AECOM via an email dated December 19, 2018 as well as a your site visit on October 16, 2018 and provided in an email dated October 26, 2018 and letter dated December 17, 2018.

*Invasives – Please continue treatments, including privet which is still abundant on UT1b; other areas have honeysuckle which is choking out the planted trees. Some cattails; china berry, etc.*

AECOM will continue to treat the privet along UT-1b. Areas with extensive growth of honeysuckle will also be treated this spring. China berry trees will be physically cut. The cattails are confined to a relatively small wet area. It is not anticipated that they will spread from that area. The cattails will eventually be shaded out as the overstory develops. However, AECOM will treat the cattails with a herbicide and plant willow lvestakes to help initiate the process.

*Lack of proper easement marking (loose/crooked signage, lack of signs/posts in between distant corners, lack of corner posts altogether, poor visibility of low posts along easement edges, accuracy of some corner/line locations). The site needs to be marked to stewardship standards before the project closes out.*

AECOM will replace/update the existing easement posts and signage with a combination of wooden posts and taller t-posts to meet DMS standards.

*Erosion - recent storm-induced damage on UT1b. AECOM indicates planned repair for 2019. Please confirm.*

AECOM will be repairing the erosion that has occurred at the log sill toward the lower end of Tributary 1B. Geotextile matting will be placed in the scour area and the hole backfilled with soil and rock. A log sill will be installed in the floodplain immediately upstream of the scour hole to redirect flows during flood events to help alleviate stress on the area.

*Please confirm transducer locations are accurately mapped on the CCPV.*

Transducer locations have been confirmed and updated locations are shown on the CCPV that was submitted with the MY 4 report.

4-wheeler paths and minor access road incursions, Reach 1B.

AECOM will evaluate the areas to determine if they are still being used by 4-wheelers. The access roads were present in the wooded areas of the easement when the easements were purchased and are slowly becoming overgrown. Additional signage will be installed in the access roads to notify 4-wheelers that a restricted buffer is present. AECOM will also discuss the use of 4-wheelers in the easement with the landowner.



Stream mapping – It appears trib 4 may be migrating out of the easement before reentering it; this will need to be analyzed and rectified if necessary since any streams outside the easement will not yield assets.

This should not be an issue with asset generation. The very upper portion of Tributary 4 (shown in black) is not included in the asset calculations. As shown on the figure to the left only the lower 631 feet of Tributary 4 is generating credits (highlighted in green).

The Asset map submitted with the MY4 report was updated to more accurately reflect which portions of Tributaries 3 and 4 are generating assets.

Easement encroachment – Clipping of crossing corners. What is being done to rectify this? This was noted in the MY03 report as an issue in progress with the landowner. What is the current status?

During project development AECOM established 3 equipment crossing to allow for access to the adjacent fields by the farmer that leases the land from the landowner. These crossings were established at the top of Tributary 1A, top of Tributary 2, and at the bottom of

Tributary 3. Historically clipping has occurred at all three crossings. Following discussions with the farmer and the installation of additional signage clipping at Tributary 3 is no longer occurring.

There has been some clipping at the northeast corner of Tributary 1A. This has been due to lack of adequate signage and the farmer not knowing/aware of where the corner was. AECOM had difficulty installing adequate signage in this area due to the hardness of ground. A wooden post was installed in this area in the Fall of 2018 and should eliminate the encroachment. The post will be “updated” with

a taller post this winter/spring when other boundary markers are upgraded.



The crossing at the top of Tributary 2 remains problematic. A 35 wide easement was established at this crossing during the early stages of site development. When the easement was established AECOM assumed that the edge of the property was the edge of the treeline. The easement boundary was established in CAD prior to surveying the easement in the field. When the easement was finally surveyed and marked in the field it became apparent that there was not enough room between the edge of the easement and the treeline for the farmer to cross

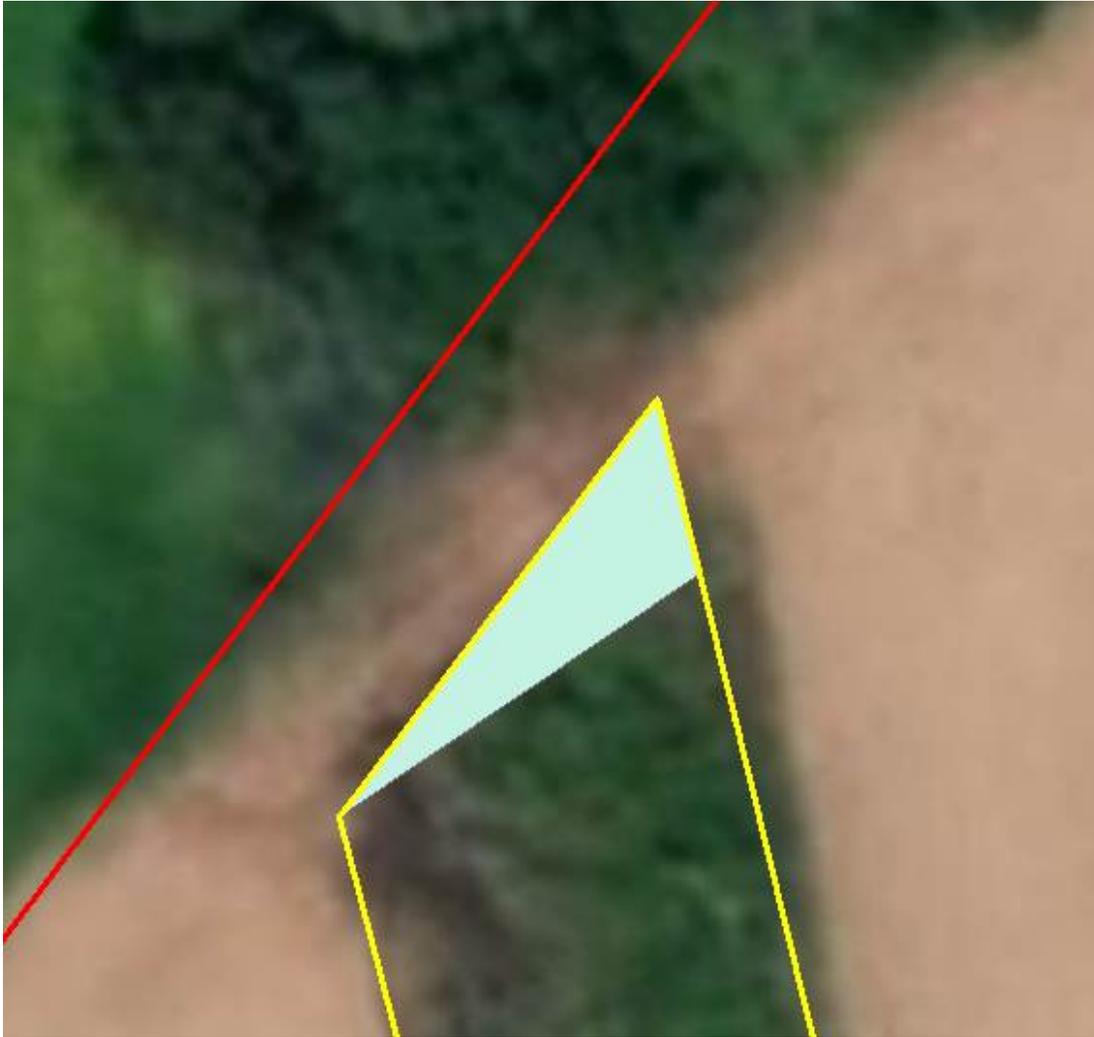
the easement with his equipment. The photo below depicts that combines that the farmer utilizes to harvest crops on the property .





The above photo depicts the location of the corner of the easement at the top of Tributary 2 in relation to the treeline. The Yellow Line is the far (northeast) corner of the easement and the wood post with the sign is the northwest corner. There is sufficient room at the northeast corner but not at the southeast corner. The photo below shows the farm equipment crossing the easement.





Expanding (or clearing) the crossing to the property line to allow for full use of the crossing would require removal of several large trees.

AECOM would like permission to modify the easement to allow adequate room for the equipment. We would work with the farmer to determine the exact distance but anticipate that it would look something like the photo above. The above photo shows reducing the length of the easement by about 35 feet on one side and maintaining it on the other. This would reduce the easement by about 1530 square feet or 0.035 acre. It should be noted that the easement in this area is not actually buffering an asset. Tributary 2 is an ephemeral feature that does not generate any stream credits.

Another option would be to not physically change the easement but just allow the area to continue to be cleared by the farmer. It would remain grassed or overgrown but no trees would end up growing on it. AECOM would like to discuss these options with DMS personnel in depth to determine a possible solution.