FINAL

ANNUAL MONITORING REPORT
YEAR 5 (2016)
GREENBRIER CREEK STREAM/WETLAND/BUFFER RESTORATION SITE
ALAMANCE AND CHATHAM COUNTIES, NORTH CAROLINA
(DMS Project No. 671, Contract No. 004801)
Construction Completed January 2011

Submitted to:
North Carolina Department of Environmental Quality
Division of Mitigation Services
Raleigh, North Carolina

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November 2016

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1.0 EXECUTIVE SUMMARY

The Greenbrier Stream Restoration Site (Site) is situated within the United States Geological Society (USGS) hydrologic unit 03030003 and North Carolina Division of Water Resources (NCDWR) Priority Sub-basin 03-06-12. The Site is located approximately 8 miles north of Siler City at the crossing of Staley-Snow Camp/Pleasant Hill Church Road over Greenbrier Creek. The Site is encompassed within a 50.48 acre easement located in three parcels, individually owned by Jerrold Murchison (32.94 acres), Charles Cheek (0.52 acres), and Larry Matthews (17.02 acres). Primary land uses were active row crop production on the Murchison parcel and active pasture on the Matthews/Cheek parcels. Project streams, Greenbrier Creek and an Unnamed Tributary (UT) to Greenbrier Creek, became impaired from poor land management, stream dredging, upstream disturbances, and human impacts. This report (compiled based on North Carolina Division of Mitigation Services' (NCDMS)'s *Procedural Guidance and Content Requirements for DMS Monitoring Reports* Version 1.4 dated 11/7/11) summarizes data for Year 5 (2016) annual monitoring.

The project goals are to:

- Improve water quality by reducing nutrient loading from a livestock operation in a water supply watershed.
- Reduce the high level of sediment loading to the stream from steep, eroding banks.
- Improve both aquatic and terrestrial riparian buffer habitat.

These goals will be accomplished through the implementation of the following objectives:

- Preservation and protection of important wetlands and stream channel reaches upstream of the Matthews property.
- Improvement of water quality (reduction of nutrient and sediment inputs) by creating a vegetated riparian buffer filter strip between the stream and livestock operations currently on the property.
- Reduction of high sediment loads in the stream through stabilization of eroding channel banks.
- Improvement of deteriorated aquatic habitat by reduction of nutrient and sediment loads in the streams, providing more variable stream channel geometry and creating more opportunities for carbon inputs from trees in the restored buffer zone.
- Improvement of terrestrial habitat through restoration of diverse native woody vegetation in the riparian buffer zone and control of invasive Chinese privet (*Ligustrum sinense*).

Vegetation success criteria dictate that an average density of 320 stems per acre must be surviving in the first three monitoring years. Subsequently, 290 stems per acre must be surviving in year 4 and 260 stems per acre in year 5. Stem counts will be based on an average of the evaluated vegetation plots. Based on the number of stems counted, average densities were measured at 482 planted stems per acre (excluding livestakes) surviving in year 5 (2016). In addition, each individual plot met success criteria based on planted stems with the exception of plots 5 and 7, which were 2 stems and 1 stem shy of success with 202 planted stems per acre and 242 planted stems per acre, respectively. However, when including naturally recruited stems of black walnut (*Juglans nigra*) and black locust (*Robinia pseudoacacia*) both plots 5 and 7 met success criteria.

Plot 5 is adjacent to the unnamed tributary, which is characterized by dense fescue that may have outcompeted some of the planted bare root seedlings shortly after construction. Plot 7 is characterized by a dense herbaceous layer as well as several mature trees that may have contributed to planted stem mortality in this area. Supplemental planting at the Site occurred on February 13 and 14, 2012, in response to the contractor's vegetation warranty assessment (Appendix F). During this effort, 1952 bare root and 1-gallon trees were planted at the Site. Supplemental planting appears to have resulted in vegetative success across the majority of the Site.

Chinese privet (*Ligustrum sinense*) and Japanese privet (*Ligustrum japonicum*) were observed scattered throughout the Site; however, these dense areas have been treated several times over the course of the monitoring period. Invasive treatments appear successful, with several small privet populations remaining onsite (Figure 2A, Appendix B). In addition, scattered stems of Bradford pear (*Pyrus calleryana*) and multiflora rose (*Rosa multiflora*) are present in minimal numbers within the Site. Herbaceous species including Japanese stiltgrass (*Microstegium vimineum*) and fescue (*Festuca* sp.) are found across the entire Site. Japanese stiltgrass is found in portions of the Site covered by mature canopy along the upstream reach of the unnamed tributary, downstream reach of Greenbrier Creek, and throughout the preservation reach. Fescue is found in open areas previously maintained as pasture.

With the exception of the impounded and previously impounded areas, vegetation within the preservation reach is well-established with scattered occurrences of invasive species. Three small but dense populations of tree-of-heaven (*Ailanthus altissima*) were observed on the eastern edge of the preservation reach (Figure 2B, Appendix B). Additionally, Japanese honeysuckle (*Lonicera japonica*), Chinese privet (*Ligustrum sinense*), and Japanese stiltgrass (*Microstegium vimineum*) were observed scattered throughout the reach.

A visual assessment and geomorphic survey were completed for the Site, and indicate that project reaches are performing within established success criteria ranges as shown below. Due to contracting issues, no baseline data was collected for this project. Although there are no baseline cross-sections to compare with Year 5 (2016) measurements, the Year 1 (2012) cross-sections should serve as an adequate baseline. No significant bank erosion was recorded. In addition, no significant aggradation or degradation of the bed was noted.

A total of 10 bankfull events have occurred within 5 different monitoring years.

Stream Success Criteria (from approved Restoration Plan 2008):

- Success is defined as the documentation of no substantial aggradation or degradation of the channel or banks.
- Downcutting, deposition, bank erosion, and an increase in sands or finer substrate material must be documented for assessment by the regulatory agencies.
- Comparison of existing condition BEHI values with BEHI values computed after vegetation is established will indicate bank stabilization trajectories.
- A minimum of two bankfull events must occur in separate years within the five-year monitoring.

Beaver have been an ongoing issue within the Site and are being closely monitored and trapped when necessary. Currently, one large, well-established impoundment is located on the preservation reach consisting of three major beaver dams (Dams 1, 2, and 3, Figure 2B, Appendix B). This impoundment is characterized by standing water and a lack of living woody stems. The beaver remain active in this area, and few woody stems are surviving in the previously impounded footprint. It does not appear that natural recruits are becoming established in these areas at this time. The currently impounded and previously impounded areas are depicted on the Current Conditions Plan View Map (Figure 2B, Appendix B).

Fencing along the downstream ford has been heavily damaged by debris during high flow events. Additionally, a small section of fencing has failed in the ford on the unnamed tributary, though it appears that the pasture adjacent to this portion of the easement is no longer used for livestock grazing (Figure 2A, Appendix B).

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in tables and figures within this report's appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the DMS website. All raw data supporting the tables and figures in the appendices is available from DMS upon request.

2.0 METHODOLOGY

2.1 Vegetation Assessment

Twelve vegetation plots were established and marked after construction with four-foot metal U-bar post demarking the corners with a ten foot, three-quarter inch PVC at the origin. The plots are 10 meters square and are located randomly within the Site. These plots were surveyed in July for the Year 5 (2016) monitoring season using the *CVS-DMS Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008) (http://cvs.bio.unc.edu/methods.htm); results are included in Appendix C. The taxonomic standard for vegetation used for this document was *Flora of the Southern and Mid-Atlantic States* (Weakley 2012).

2.2 Stream Assessment

Annual stream monitoring was conducted in February 2016. Fourteen permanent cross-sections, eight riffle and six pool, were established and will be used to evaluate stream dimension; locations are depicted on Figure 2A (Appendix B). Cross-sections are permanently monumented with 4-foot metal garden posts at each end point. Cross-sections will be surveyed to provide a detailed measurement of the stream and banks including points on the adjacent floodplain, top of bank, bankfull, breaks in slope, edge of water, and thalweg. Data will be used to calculate width-depth ratios, entrenchment ratios, and bank-height ratios for each cross-section. In addition, photographs will be taken and pebble counts will be conducted at each permanent cross-section location annually.

Two monitoring reaches were established (the unnamed tributary and Greenbrier Creek) and will be used to evaluate longitudinal profile; locations are depicted on Figure 2A (Appendix B). Longitudinal profile measurements will include average water surface slopes, facet slopes, and pool-to-pool spacing. Measurements of channel pattern (belt-width, meander length, and radius of curvature) were proposed for Year 1 (2012); however, the design channel was developed at a sinuosity of 1.0-1.1, resulting in no measurable meander bends, belt-widths, or radius of curvatures. Two crest gauges were installed onsite; one on the unnamed tributary and one on Greenbrier Creek, upstream of the confluence. These were used to document bankfull events throughout the monitoring period. Additionally, thirty-one permanent photo points were established throughout the restoration reach (14 cross-sections, 12 vegetation plots, and 5 fixed station photos). Photographs are included in the Appendices.

3.0 REFERENCES

Lee, Michael T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-DMS Protocol for Recording Vegetation, Version 4.2. (online). Available: http://cvs.bio.unc.edu/methods.htm.

Weakley, Alan S. 2012. Flora of the Southern and Mid-Atlantic States. Available online at: http://www.herbarium.unc.edu/WeakleysFlora.pdf [September 28, 2012]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

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APPENDIX A

PROJECT VICINITY MAP AND BACKGROUND TABLES

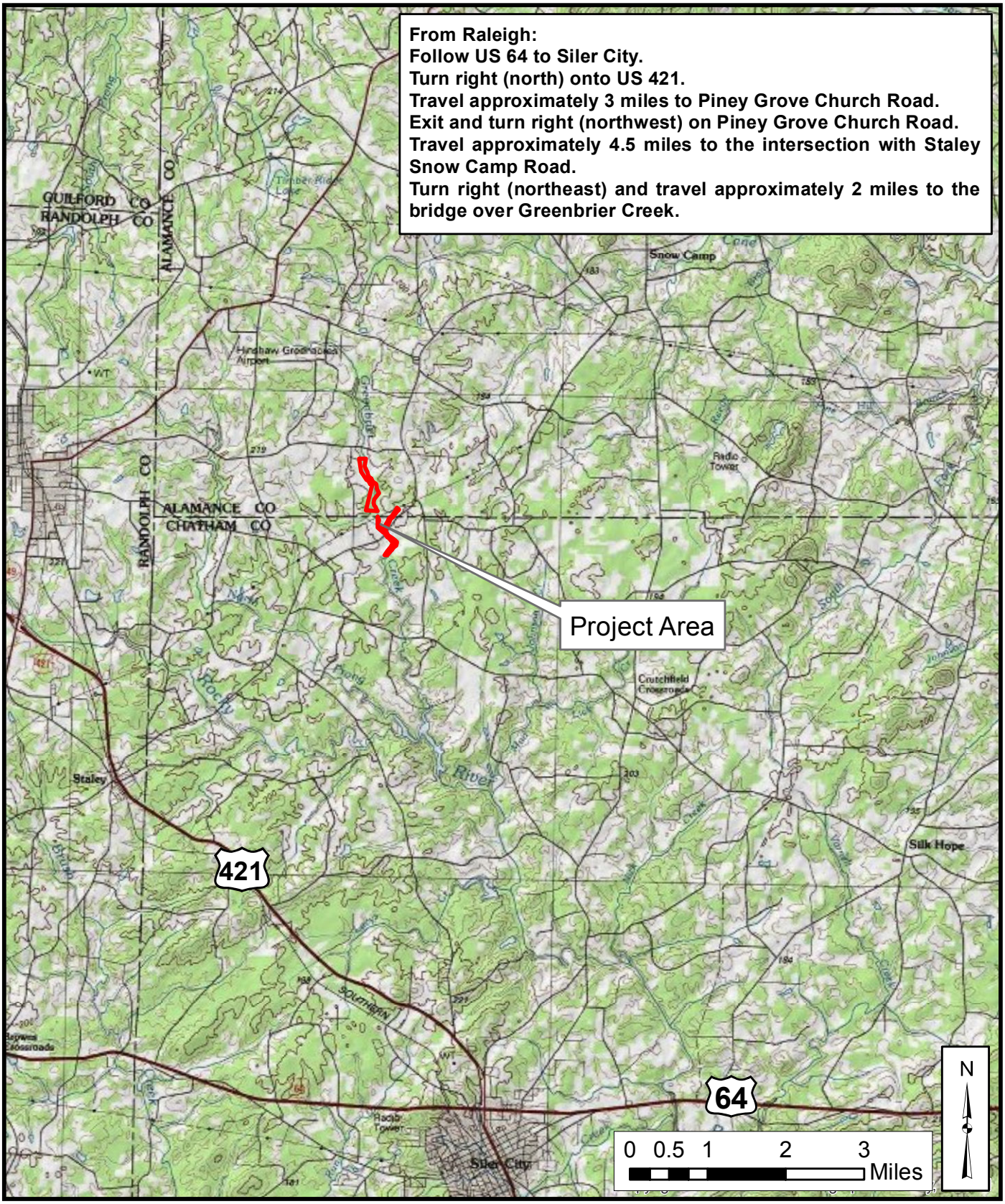
Figure 1. Vicinity Map

Table 1. Project Restoration Components

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attributes Table



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SITE LOCATION MAP
GREENBRIER SITE
DMS PROJECT NUMBER 671
Alamance and Chatham Counties, North Carolina

Dwn. by.	KRJ
Date:	Sept. 2015
Project:	12-004.09

FIGURE
1

Table 1. Project Components and Mitigation Credits
Greenbrier Creek Stream Restoration Site (DMS Project Number 671)

Mitigation Credits							
	Stream		Riparian Wetland		Buffer		
Type	Restoration	Restoration Equivalent	Restoration	Restoration Equivalent			
Totals	2974	891	--	1.4 WMU			171,838.080

Projects Components							
Project Component/ Reach ID	Station Range	Existing Linear Footage/ Acreage	Priority Approach	Restoration/ Restoration Equivalent	Restoration Linear Footage/ Acreage	Mitigation Ratio	Comment
Greenbrier Mainstem Upstream of Bridge		659	PIII	R	670	1:1.5	
Greenbrier Mainstem Downstream of Bridge		1966	PIII	R	1945	1:1.5	
UT Upstream of Culvert		1180	PIII	R	1129	1:1.5	
UT Downstream of Culvert		749	PIII	R	717	1:1.5	
Greenbrier Mainstem		4455	Preservation	RE	4455	5:1	

Component Summation			
Restoration Level	Stream (linear footage)	Riparian Wetland (acres)	Buffer (square footage)
Restoration	--	--	171,838.080
Enhancement (Level I)	4461	--	--
Preservation	4455	6.93	
Totals	**8916**	6.93	--
Mitigation Units	**3865 SMUs**	**1.4 WMU**	**--**

Table 2. Project Activity and Reporting History
Greenbrier Stream Restoration Site (DMS Project Number 671)

Elapsed Time Since Grading Complete: 5 years 10 months
Elapsed Time Since Planting Complete: 5 years 10 months
Number of Reporting Years: 5

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan		October 2008
Final Design – Construction Plans		April 28, 2010
Construction		January 25, 2011
Temporary S&E mix applied to entire project area		February 1, 2011
Permanent seed mix applied to entire project area		February 1, 2011
Containerized and bare root plantings for entire reach		February 8, 2011
As-built construction drawings		April 2011
Supplemental Planting of bare root and 1 gallon trees		February 14, 2012
Year 1 Monitoring (2012)	September 2012	February 2013
Year 2 Monitoring (2013)	July 2013	September 2013
Year 3 Monitoring (2014)	September 2014	October 2014
Year 4 Monitoring (2015)	September 2015	October 2015
Year 5 Monitoring (2016)	September 2016	November 2016

Table 3. Project Contacts Table
Greenbrier Stream Restoration Site (DMS Project Number 671)

Designer	Biohabitats, Inc. 8218 Creedmoor Road, Suite 200 Raleigh, NC 27613 Kevin Nunnery 919-518-0311
Construction, Planting, and Seeding Contractor	Carolina Environmental Contracting, Inc. Mount Airy, NC Stephen James 919-921-1116
Seed Mix Source	Green Source Colfax, NC Rodney Montgomery
As-Built Construction Drawings	Biohabitats, Inc. 8218 Creedmoor Road, Suite 200 Raleigh, NC 27613 Kevin Nunnery 919-518-0311
Years 1-5 Monitoring Performers	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

Table 4. Project Baseline Information and Attributes
Greenbrier Stream Restoration Site (DMS Project Number 671)

Project Information				
Project Name	Greenbrier Stream Restoration Site			
Project County	Alamance and Chatham			
Project Area (Acres)	50.48			
Project Coordinates (Lat/Long – NAD83)	-79.48 89 50N, 35.84 01 17E			
Project Watershed Summary Information				
Physiographic Region	Piedmont			
Ecoregion	Carolina Slate Belt			
Project River Basin	Cape Fear			
USGS 8-digit HUC	03030003			
USGS 14-digit HUC	03030003070010			
NCDWQ Subbasin	03-06-12			
Project Drainage Area (Sq. Mi.)	5.01			
Project Drainage Area Impervious Surface	<5%			
Watershed Type	Rural			
Reach Summary Information				
Parameters	**Reach 1**	**Reach 2**	**Reach 3**	**Reach 4**
Restored/Enhanced Length (Linear Feet)	670	1945	1129	717
Drainage Area (Square Miles)	5.0	5.0	0.3	0.3
NCDWQ Index Number	17-43-5			
NCDWQ Classification	WS-III			
Valley Type/Morphological Description	VIII/C4			
Dominant Soil Series	Chewacla			
Drainage Class	Somewhat poorly drained			
Soil Hydric Status	Nonhydric, may contain hydric Wehadkee inclusions			
Slope	0.0017		0.0099	
FEMA Classification	AE floodplain		AE floodplain	
Native Vegetation Community	Hardwoods		Hardwoods	
Percent Composition of Exotic Invasives	~20		~20	
Regulatory Considerations				
Regulation	**Applicable**			
Waters of the U.S. –Sections 404 and 401	Yes-Received Appropriate Permits			
Endangered Species Act	No			
Historic Preservation Act	No			
CZMA/CAMA	No			
FEMA Floodplain Compliance	Yes			
Essential Fisheries Habitat	No			

APPENDIX B

VISUAL ASSESSMENT DATA

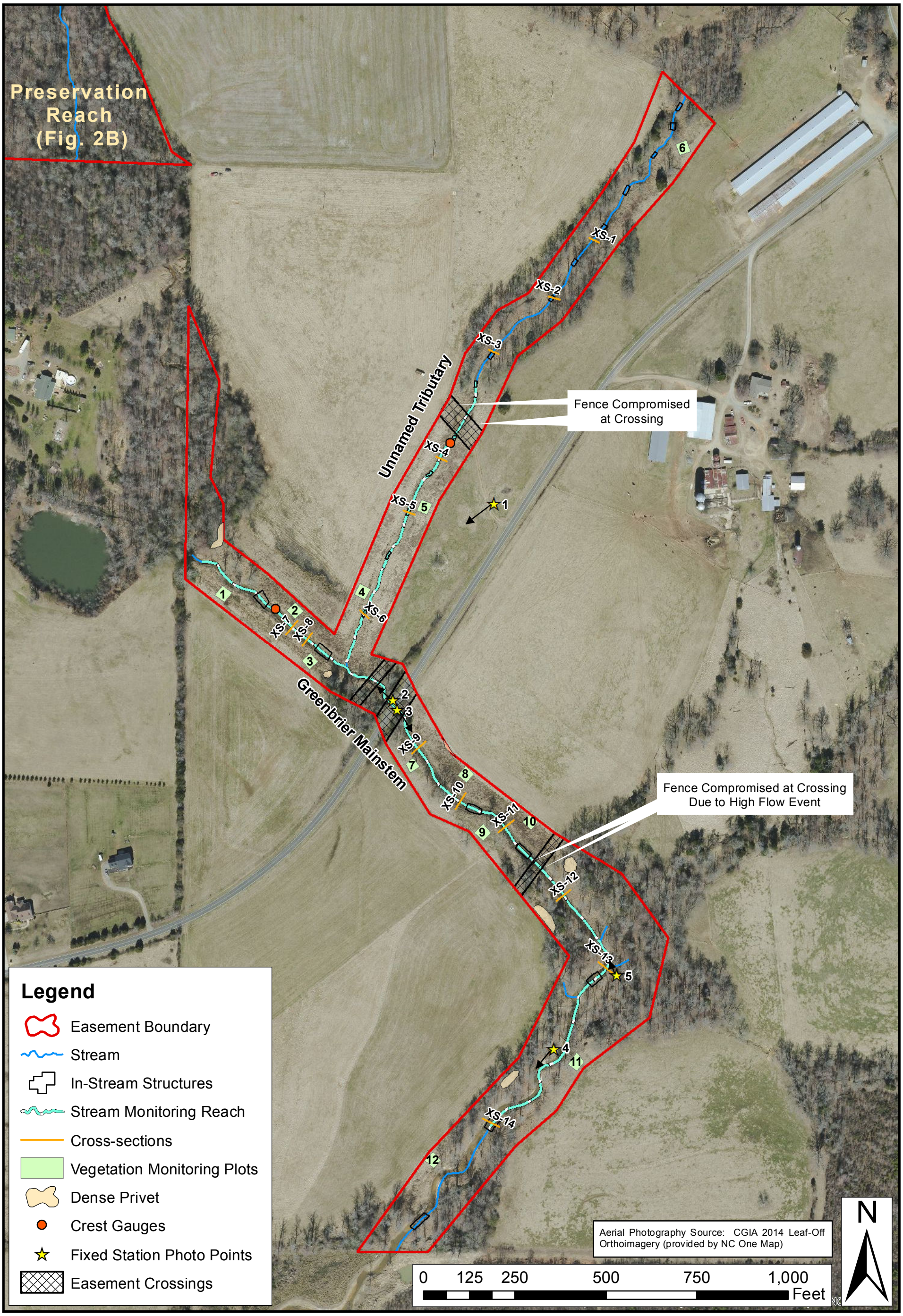
Figures 2A-2B. Current Conditions Plan View

Site Fixed-Station Photographs

Vegetation Monitoring Plot Photographs

Tables 5a-5b. Visual Stream Morphology Stability Assessment

Table 6. Vegetation Condition Assessment



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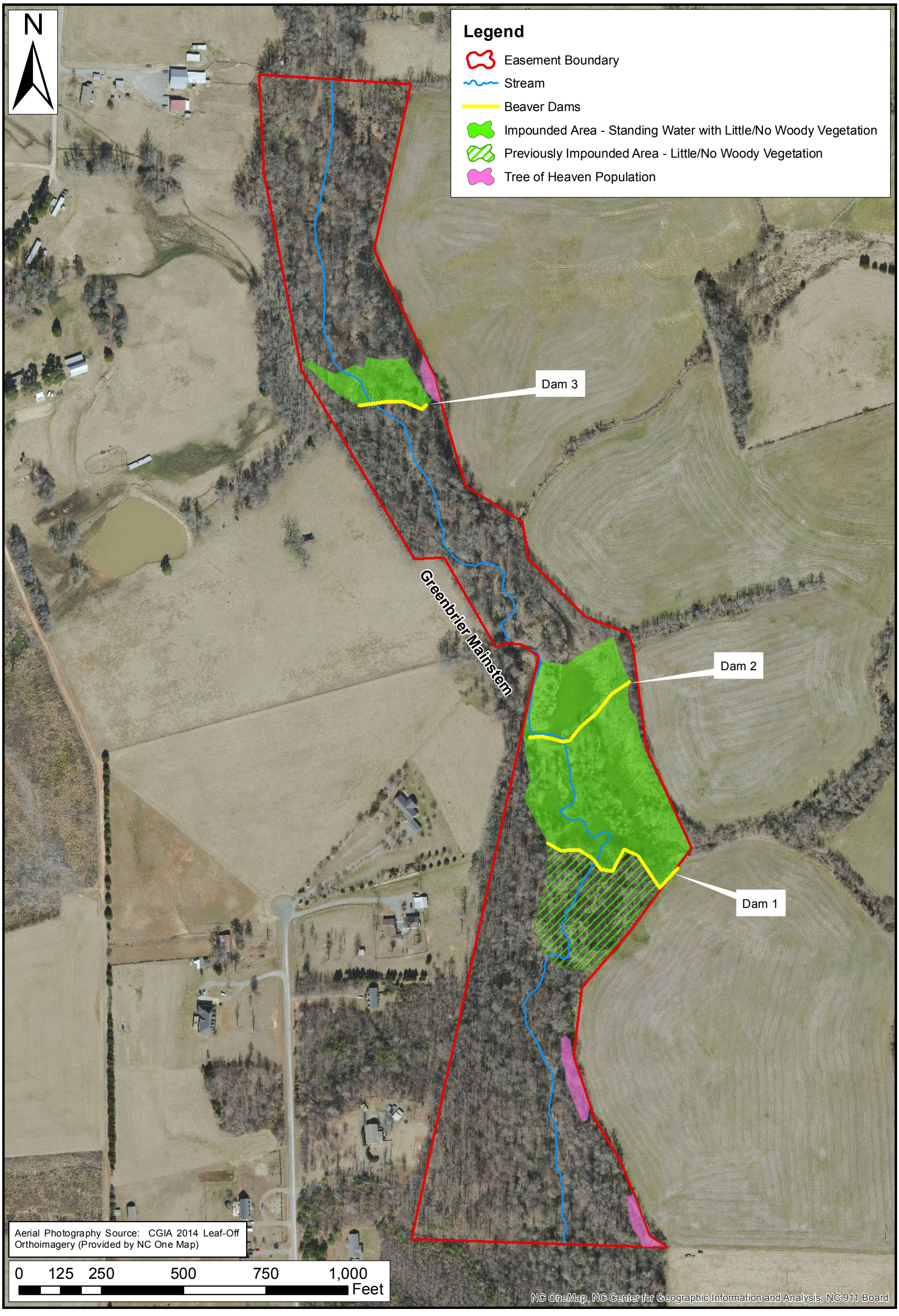
CURRENT CONDITIONS PLAN VIEW
GREENBRIER CREEK STREAM RESTORATION SITE
DMS PROJECT NUMBER 671
Alamance and Chatham Counties, North Carolina

Dwn. by. KRJ/CLF	FIGURE 2A
Date: Sept. 2016	
Project: 12-004.09	



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CURRENT CONDITIONS PLAN VIEW
GREENBRIER CREEK STREAM RESTORATION SITE
DMS PROJECT NUMBER 671
Alamance and Chatham Counties, North Carolina

Dwn. by. KRJ/CLF	FIGURE 2B
Date: Sept. 2016	
Project: 12-004.09	

Greenbrier Creek
Site Fixed-Station Photographs
Taken July 2016

Greenbrier Creek
Vegetation Monitoring Photographs
Taken July 2016

Greenbrier Creek
Vegetation Monitoring Photographs
Taken July 2016
(continued)

Table 5a **Visual Stream Morphology Stability Assessment**
Reach ID **Greenbrier**
Assessed Length **2235**

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. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	23	23			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	24	24			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	100	100			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	100	100			100%			
		2. Thalweg centering at downstream of meander (Glide)	100	100			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	0	0			0%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			0%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			0%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			0%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			0%			

Table 5b **Visual Stream Morphology Stability Assessment**
Reach ID **Greenbrier UT1**
Assessed Length **867**

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. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	35	35			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	36	36			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	100	100			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	100	100			100%			
		2. Thalweg centering at downstream of meander (Glide)	100	100			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	1	1			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			100%			

Greenbrier

Table 6 Vegetation Condition Assessment

Planted Acreage[1] **16.5**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of planted woody and herbaceous material on stream banks	0.1 acres	N/A	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on visual observations and MY4 stem count criteria.	0.1 acres	N/A	0	0.00	0.0%
			Total		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%
			Cumulative Total	0	0.00	0.0%

Easement Acreage[2] **50.48**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern[4]	Chinese privet and Tree of Heaven	1000 SF	Tan and Pink Polygons	9	0.59	1.2%
5. Easement Encroachment Areas[3]	Encroachment	none	N/A	0	0.00	0.0%

1 = 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.

2 = The acreage within the easement boundaries.

3 = 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.

4 = 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 spcies 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 DMS 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 likley 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 ealry 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 symbolzing invasives polygons, particulalry for situations where the conditon 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.

APPENDIX C

VEGETATION PLOT DATA

Table 7. Vegetation Plot Criteria Attainment

Table 8. CVS Vegetation Plot Metadata

Table 9. Planted Stems by Plot and Species

Table 7. Vegetation Plot Criteria Attainment Based on Planted Stems
Greenbrier Creek Restoration Site (DMS Project Number 671)

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1*	Yes	83%
2*	Yes	
3*	Yes	
4*	Yes	
5*	No**	
6	Yes	
7*	No**	
8	Yes	
9*	Yes	
10	Yes	
11*	Yes	
12*	Yes	

*These vegetation plots (Plots 1-5, 7, 9, and 11-12) are located entirely within riparian buffer credit areas and will be used to document stream mitigation as well as riparian buffer success. Remaining vegetation plots (Plots 6, 8, and 10) are located partially within the riparian buffer credit areas.
**Plots 5 and 7 don't make success criteria based on planted stems alone; however, when including naturally recruited stems of black walnut (*Juglans nigra*) and black locust (*Robinia pseudoacacia*), both plots 5 and 7 meet success criteria.

Table 8. CVS Vegetation Plot Metadata
Greenbrier Creek Restoration Site (DMS Project Number 671)

Report Prepared By	Corri Faquin
Date Prepared	9/21/2016 9:58
database name	Axiom-Greenbrier-2016-CVSDatabase-v2.3.1.mdb
database location	S:\Business\Projects\12\12-004 EEP Monitoring\12-004.09 Greenbrier Stream\2016\CVS
computer name	KEENAN-PC
file size	44769280
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	671
project Name	Greenbrier Stream
Sampled Plots	12

Table 9. Total and Planted Stems by Plot and Species
DMS Project Code 671. Project Name: Greenbrier Stream

			Current Plot Data (MY5 2016)																									
			671-01-0001			671-01-0002			671-01-0003			671-01-0004			671-01-0005			671-01-0006			671-01-0007			671-01-0008			671-01-0009		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree	3	3	3	2	2	2										1	1	1				2	2	2	2	2	8
Acer rubrum	red maple	Tree																											
Baccharis halimifolia	eastern baccharis	Shrub																											
Betula nigra	river birch	Tree																						3	3	3			
Carpinus caroliniana	American hornbeam	Tree																											
Carya	hickory	Tree													1	1	1												
Celtis laevigata	sugarberry	Tree																											
Celtis occidentalis	common hackberry	Tree																			2	2	2						
Cornus amomum	silky dogwood	Shrub																											
Diospyros virginiana	common persimmon	Tree	1	1	1																			1	1	1			
Fraxinus americana	white ash	Tree				1	1	1																					
Fraxinus pennsylvanica	green ash	Tree	3	3	3	4	4	4	11	11	11	5	5	5				1	1	1	3	3	3	3	3	3	5	5	5
Juglans nigra	black walnut	Tree									1						2			1			29			1			8
Liquidambar styraciflua	sweetgum	Tree						4						1						2									
Liriodendron tulipifera	tuliptree	Tree																			1	1	1						
Nyssa	tupelo	Tree				1	1	1																					
Platanus occidentalis	American sycamore	Tree	3	3	3				2	2	2				1	1	1												
Prunus serotina	black cherry	Tree																1	1	3							1	1	1
Pyrus calleryana	Callery pear	Exotic															2												
Quercus phellos	willow oak	Tree							1	1	1									2									
Robinia pseudoacacia	black locust	Tree			1						1						1									1			
Salix nigra	black willow	Tree						1						1															
Salix sericea	silky willow	Shrub										2	2	2															
Ulmus americana	American elm	Tree				2	2	2			1	2	2	2	2	2	2	4	4	4				3	3	4	1	1	1
Viburnum dentatum	southern arrowwood	Shrub	1	1	1							1	1	1	1	1	1	2	2	2									
		Stem count	11	11	11	10	10	15	14	14	16	10	10	12	5	5	8	9	9	16	6	6	35	12	12	15	9	9	23
		size (ares)	1			1			1			1			1			1			1			1			1		
		size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
		Species count	5	5	6	5	5	7	3	3	6	4	4	6	4	4	7	5	5	8	3	3	4	5	5	7	4	4	5
		Stems per ACRE	445.2	445.2	445.2	404.7	404.7	607	566.6	566.6	647.5	404.7	404.7	485.6	202.3	202.3	323.7	364.2	364.2	647.5	242.8	242.8	1416	485.6	485.6	607	364.2	364.2	930.8

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

Table 9. Total and Planted Stems by Plot and Species (continued)
DMS Project Code 671. Project Name: Greenbrier Stream

			Current Plot Data (MY5 2016)									Annual Means													
			671-01-0010			671-01-0011			671-01-0012			MY5 (2016)			MY4 (2015)			MY3 (2014)			MY2 (2013)			MY1 (2012)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer negundo	boxelder	Tree	2	2	2				5	5	5	17	17	23	17	17	17	18	18	18	18	18	18	18	18	18
Acer rubrum	red maple	Tree																					2			1
Baccharis halimifolia	eastern baccharis	Shrub																		2			1			1
Betula nigra	river birch	Tree										3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
Carpinus caroliniana	American hornbeam	Tree													2	2	2	3	3	3	3	3	3	3	3	3
Carya	hickory	Tree										1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Celtis laevigata	sugarberry	Tree						1						1			1									
Celtis occidentalis	common hackberry	Tree										2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Cornus amomum	silky dogwood	Shrub																1	1	1	2	2	2			
Diospyros virginiana	common persimmon	Tree	1	1	1	1	1	1				4	4	4	4	4	5	4	4	4	4	4	4	4	4	4
Fraxinus americana	white ash	Tree										1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Fraxinus pennsylvanica	green ash	Tree	11	11	11	9	9	9	13	13	14	68	68	69	72	72	78	76	76	86	74	74	74	65	65	68
Juglans nigra	black walnut	Tree												42			24			32			36			30
Liquidambar styraciflua	sweetgum	Tree			1						1			9			6			6			15			9
Liriodendron tulipifera	tuliptree	Tree				4	4	4	1	1	1	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5
Nyssa	tupelo	Tree										1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Platanus occidentalis	American sycamore	Tree				2	2	2	2	2	2	10	10	10	10	10	10	10	10	10	9	9	9	8	8	8
Prunus serotina	black cherry	Tree				2	2	2				4	4	6	4	4	5	6	6	8	8	8	8	8	8	8
Pyrus calleryana	Callery pear	Exotic												2			1						1			
Quercus phellos	willow oak	Tree										1	1	3	1	1	3	1	1	2	1	1	1	1	1	1
Robinia pseudoacacia	black locust	Tree												4			4			3			3			1
Salix nigra	black willow	Tree												2									1			
Salix sericea	silky willow	Shrub										2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ulmus americana	American elm	Tree	2	2	3				1	1	1	17	17	20	15	15	15	14	14	14	13	13	13	12	12	12
Viburnum dentatum	southern arrowwood	Shrub	1	1	1							6	6	6	7	7	7	4	4	4	3	3	3	4	4	4
		Stem count	17	17	19	18	18	19	22	22	24	143	143	215	148	148	193	153	153	209	151	151	209	138	138	183
		size (ares)	1			1			1			12			12			12			12			12		
		size (ACRES)	0.02			0.02			0.02			0.30			0.30			0.30			0.30			0.30		
		Species count	5	5	6	5	5	6	5	5	6	15	15	21	16	16	21	17	17	21	17	17	24	16	16	21
		Stems per ACRE	688	688	768.9	728.4	728.4	768.9	890.3	890.3	971.2	482.3	482.3	725.1	499.1	499.1	650.9	516	516	704.8	509.2	509.2	704.8	465.4	465.4	617.1

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

APPENDIX D

STREAM SURVEY DATA

Cross-section Plots

Longitudinal Profile Plots

Substrate Plots

Tables 10a-b. Baseline Stream Data Summary

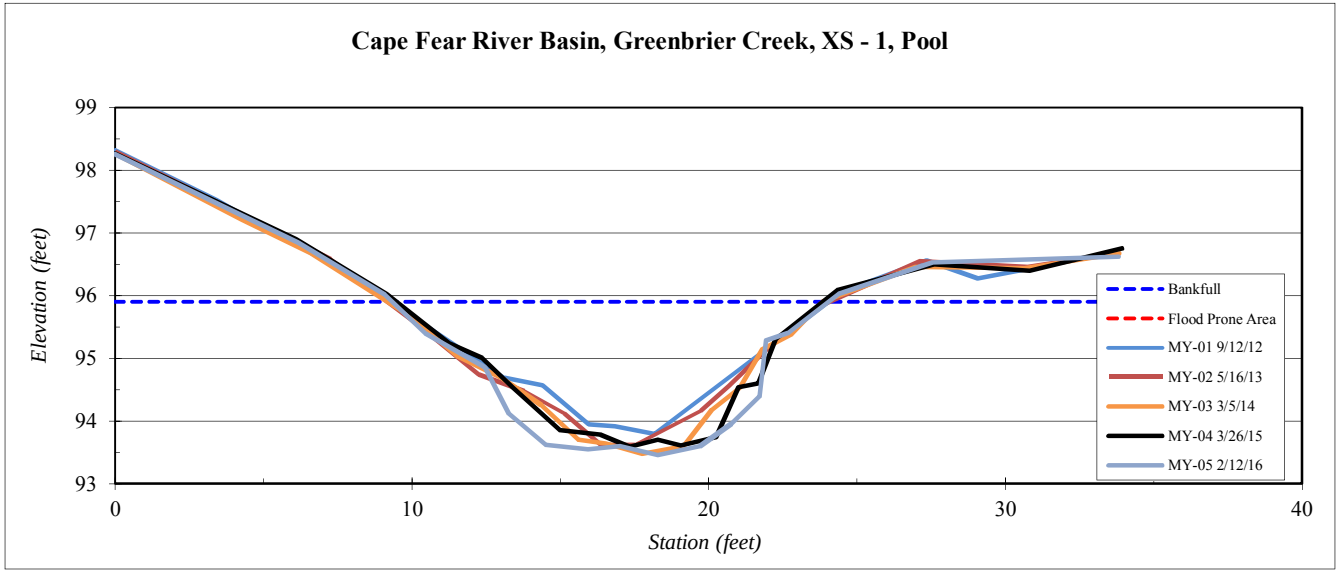
Tables 11a-b. Monitoring Data

River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 1, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.0	98.26
6.2	96.85
9.1	96.02
10.5	95.39
12.5	94.86
13.3	94.12
14.5	93.62
15.9	93.55
17.0	93.59
18.3	93.46
19.7	93.60
20.8	93.95
21.7	94.39
21.9	95.28
22.7	95.41
24.4	96.03
27.5	96.53
33.8	96.62

SUMMARY DATA	
Bankfull Elevation:	95.9
Bankfull Cross-Sectional Area:	22.6
Bankfull Width:	14.7
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.5
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	E

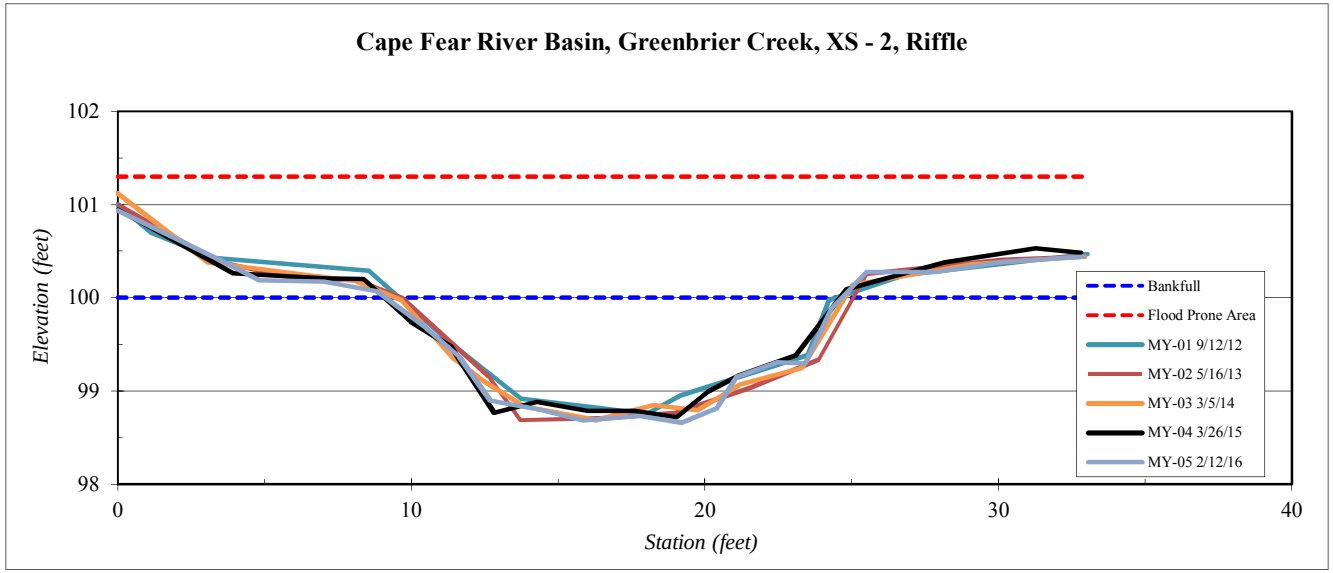


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 2, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	100.94
3.57	100.40
4.82	100.19
7.02	100.17
8.82	100.07
10.43	99.69
11.62	99.37
12.68	98.90
14.38	98.80
15.84	98.68
17.78	98.73
19.24	98.66
20.41	98.81
21.09	99.15
22.49	99.31
23.4	99.29
24.3	99.88
25.5	100.27
27.9	100.28
30.2	100.38
32.9	100.44

SUMMARY DATA	
Bankfull Elevation:	100.0
Bankfull Cross-Sectional Area:	14.1
Bankfull Width:	15.5
Flood Prone Area Elevation:	101.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	17.0
Entrenchment Ratio:	6.5
Bank Height Ratio:	1.0

Stream Type	E

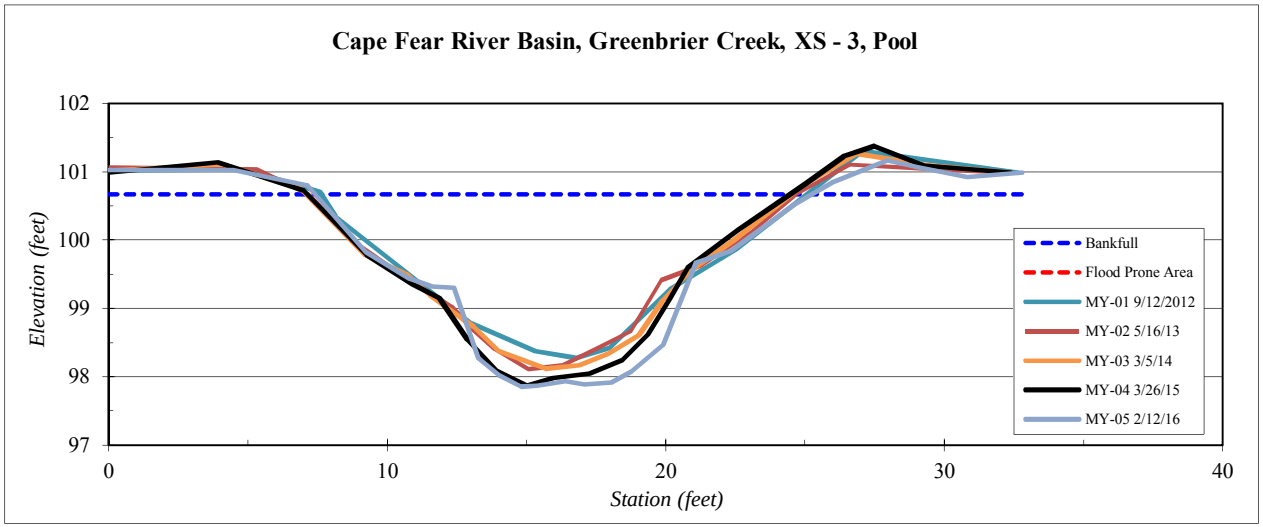


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 3, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	101.03
4.47	101.02
7.13	100.80
9.23	99.83
10.76	99.44
11.62	99.32
12.41	99.30
13.27	98.27
14.04	98.01
14.81	97.86
15.39	97.87
16.39	97.93
17.09	97.89
18.04	97.91
18.76	98.07
19.90	98.47
21.09	99.66
22.37	99.84
24.67	100.53
26.01	100.84
27.95	101.16
28.98	101.08
30.83	100.92
32.80	100.98

SUMMARY DATA	
Bankfull Elevation:	100.7
Bankfull Cross-Sectional Area:	28.1
Bankfull Width:	17.9
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	E

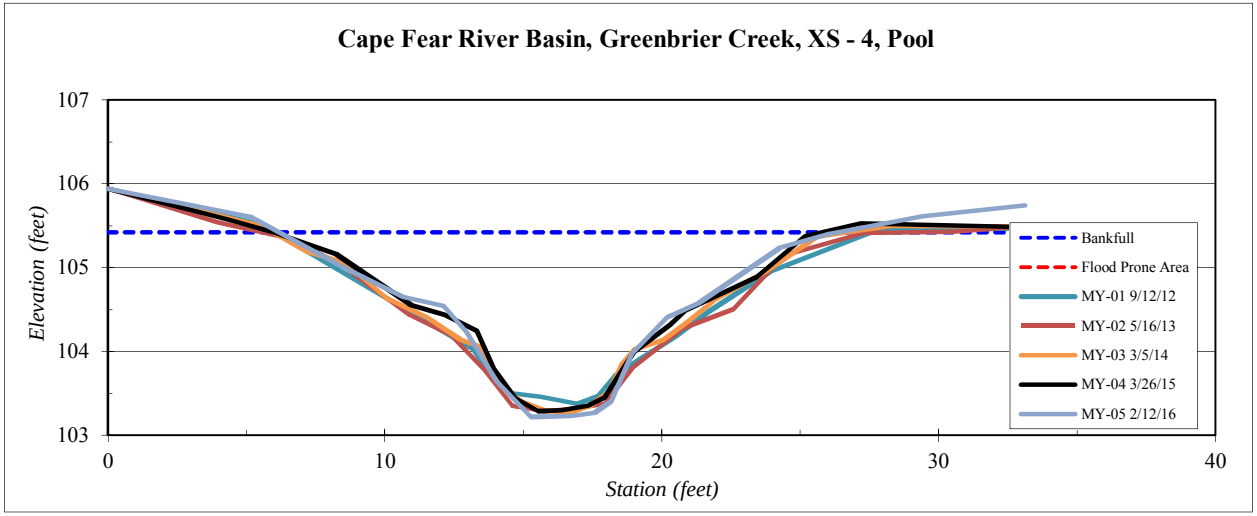


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 4, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	105.94
5.15	105.61
8.51	105.00
10.66	104.65
12.11	104.54
12.95	104.23
14.03	103.64
15.28	103.22
16.73	103.23
17.57	103.27
18.18	103.41
18.91	103.97
20.18	104.40
21.31	104.58
24.27	105.24
26.02	105.40
29.40	105.61
33.12	105.74

SUMMARY DATA	
Bankfull Elevation:	105.4
Bankfull Cross-Sectional Area:	19.8
Bankfull Width:	20.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

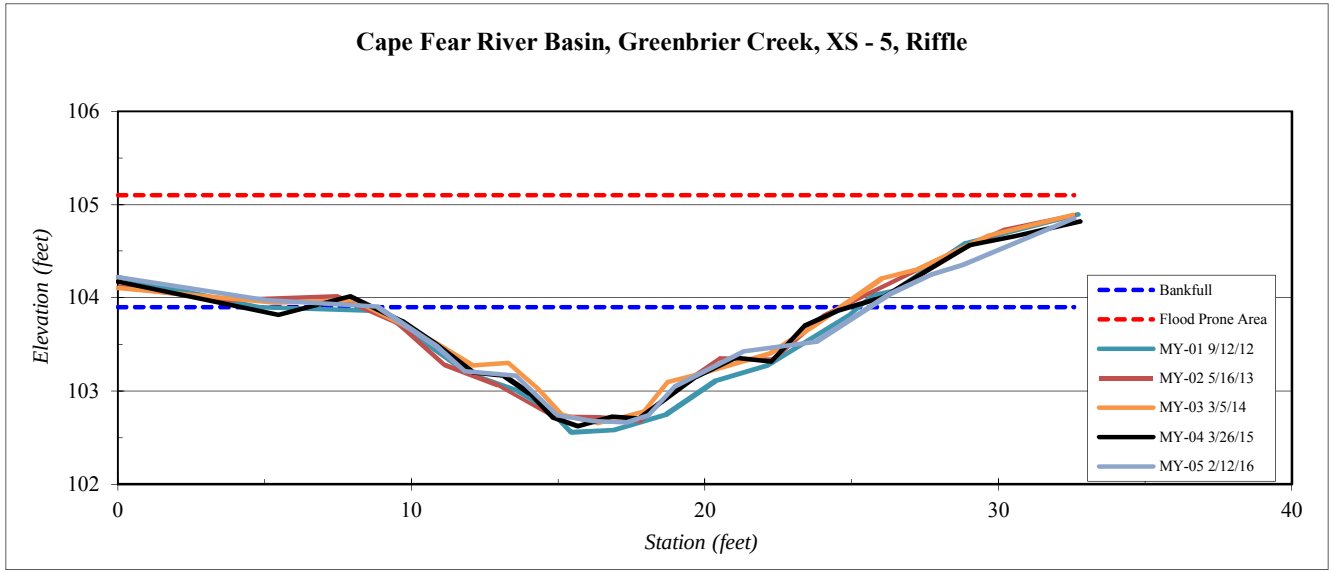


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 5, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	104.22
5.07	103.97
8.83	103.90
10.87	103.48
11.82	103.21
13.56	103.17
14.97	102.74
16.21	102.67
17.33	102.66
18.08	102.74
18.97	103.05
21.34	103.42
23.79	103.53
26.32	104.05
27.71	104.25
28.78	104.35
32.59	104.85

SUMMARY DATA	
Bankfull Elevation:	103.9
Bankfull Cross-Sectional Area:	11.1
Bankfull Width:	16.8
Flood Prone Area Elevation:	105.1
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	25.4
Entrenchment Ratio:	6.0
Bank Height Ratio:	1.0

Stream Type	E

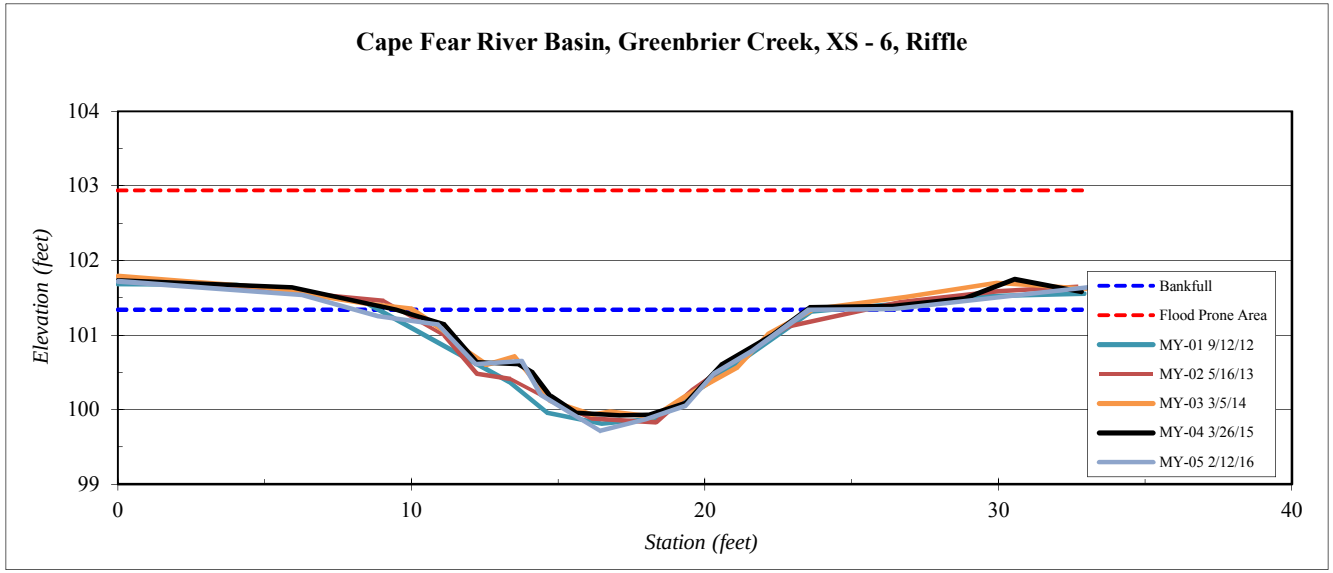


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 6, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	101.72
6.31	101.54
8.87	101.25
10.91	101.14
12.20	100.61
13.76	100.65
14.41	100.19
16.43	99.72
18.00	99.87
19.34	100.05
20.30	100.48
21.59	100.78
23.56	101.34
26.40	101.35
33.04	101.64

SUMMARY DATA	
Bankfull Elevation:	101.3
Bankfull Cross-Sectional Area:	12.2
Bankfull Width:	15.5
Flood Prone Area Elevation:	102.9
Flood Prone Width:	100.0
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	0.8
W / D Ratio:	19.7
Entrenchment Ratio:	6.5
Bank Height Ratio:	1.0

Stream Type	E

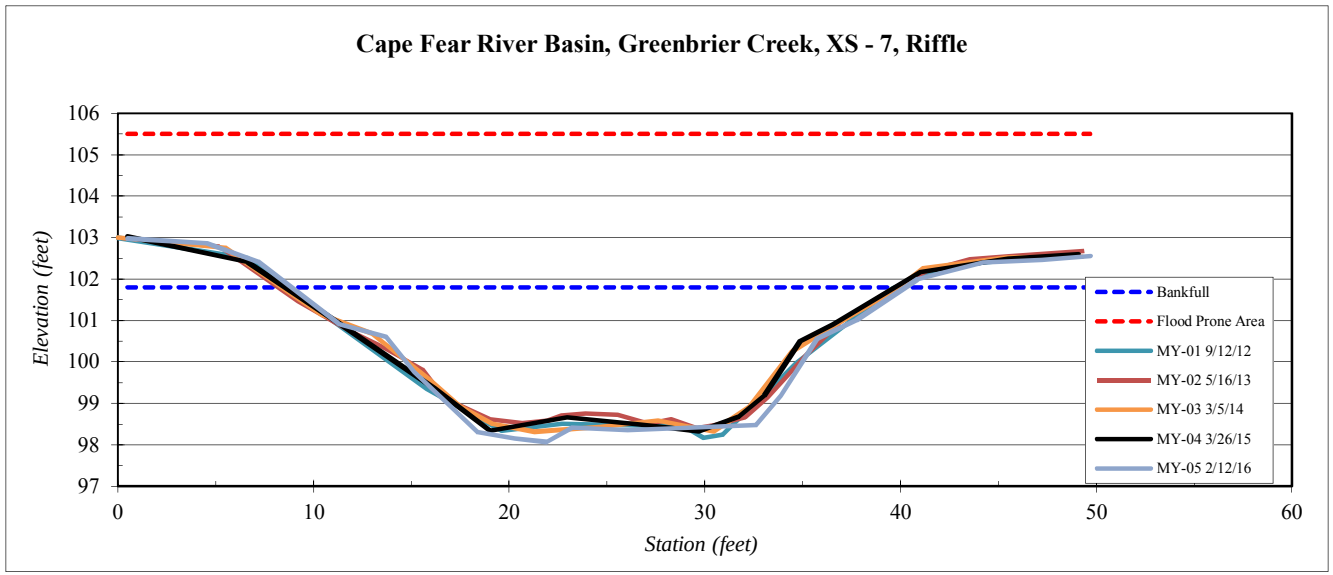


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 7, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.50	102.98
4.56	102.87
5.64	102.68
7.18	102.42
11.30	100.91
13.72	100.61
15.14	99.77
17.00	98.93
18.40	98.31
20.28	98.15
21.91	98.07
23.21	98.42
26.09	98.35
32.63	98.47
33.87	99.19
35.7	100.56
37.7	101.01
40.9	102.00
44.2	102.39
47.2	102.46
49.7	102.55

SUMMARY DATA	
Bankfull Elevation:	101.8
Bankfull Cross-Sectional Area:	74.5
Bankfull Width:	31.4
Flood Prone Area Elevation:	105.5
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	2.4
W / D Ratio:	13.2
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.0

Stream Type	E

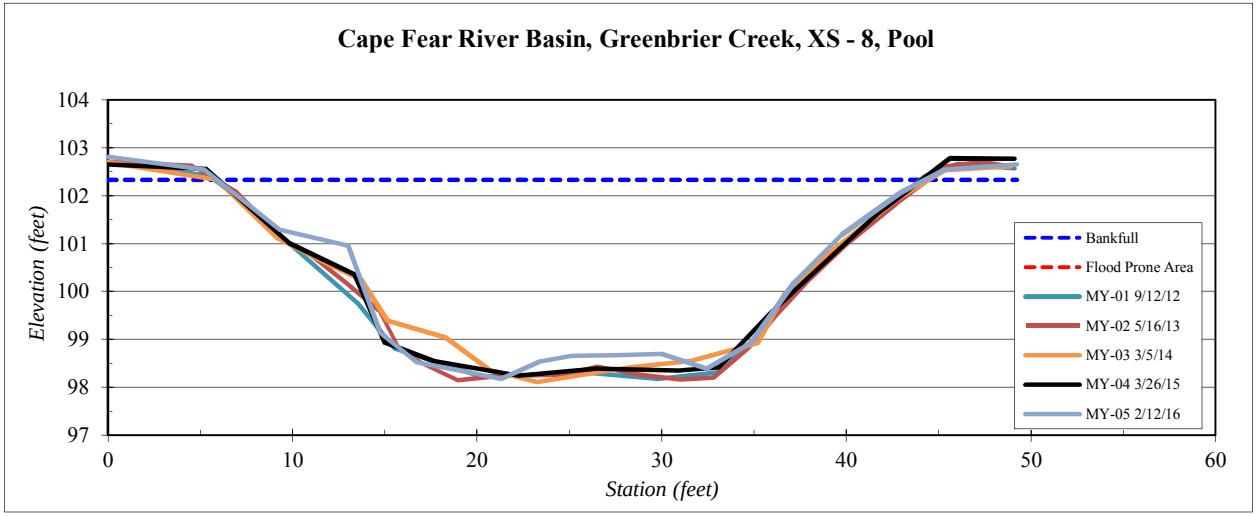


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 8, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	102.81
5.22	102.54
9.30	101.29
13.00	100.96
14.74	99.13
16.74	98.53
18.49	98.39
21.31	98.18
23.39	98.54
25.11	98.66
27.52	98.67
29.99	98.70
32.44	98.39
34.82	98.92
37.19	100.19
39.75	101.19
42.95	102.07
45.34	102.54
49.24	102.66

SUMMARY DATA	
Bankfull Elevation:	102.3
Bankfull Cross-Sectional Area:	99.1
Bankfull Width:	38.4
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	4.2
Mean Depth at Bankfull:	2.6
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

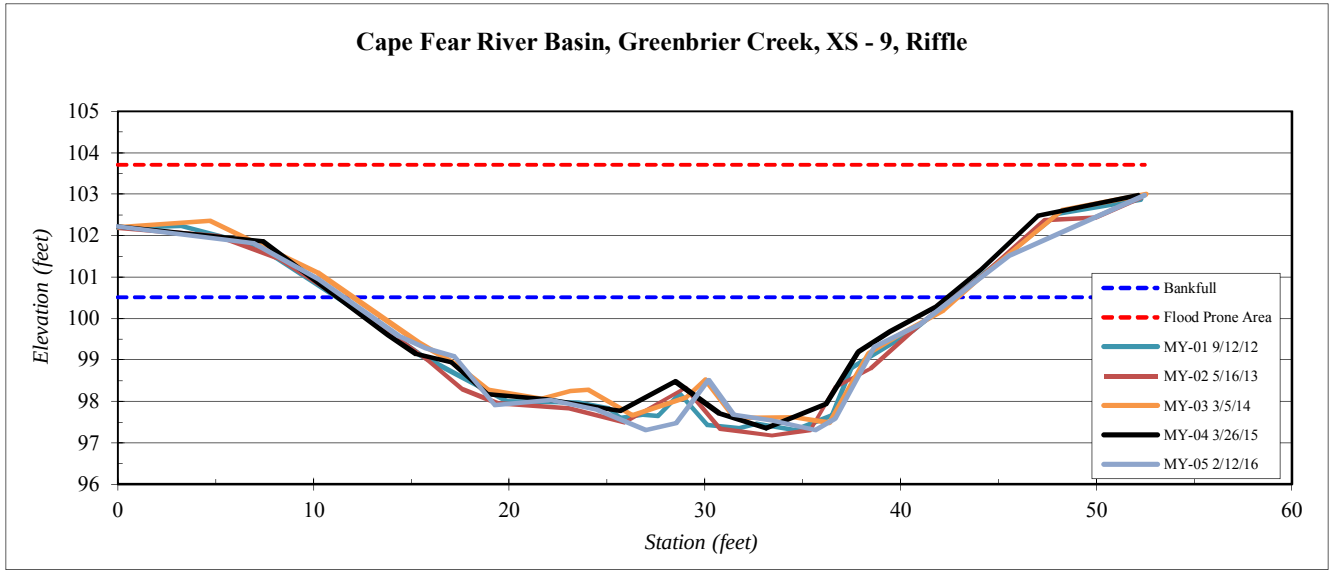


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 9, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	102.22
6.94	101.82
10.24	100.96
14.36	99.58
15.74	99.29
17.20	99.08
19.27	97.92
22.11	98.04
24.46	97.81
27.00	97.30
28.55	97.48
30.19	98.50
31.48	97.68
33.44	97.53
35.65	97.31
36.68	97.59
38.65	99.32
41.05	99.86
45.58	101.52
52.48	102.98

SUMMARY DATA	
Bankfull Elevation:	100.5
Bankfull Cross-Sectional Area:	64.2
Bankfull Width:	31.2
Flood Prone Area Elevation:	103.7
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	2.1
W / D Ratio:	15.2
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.4

Stream Type	E

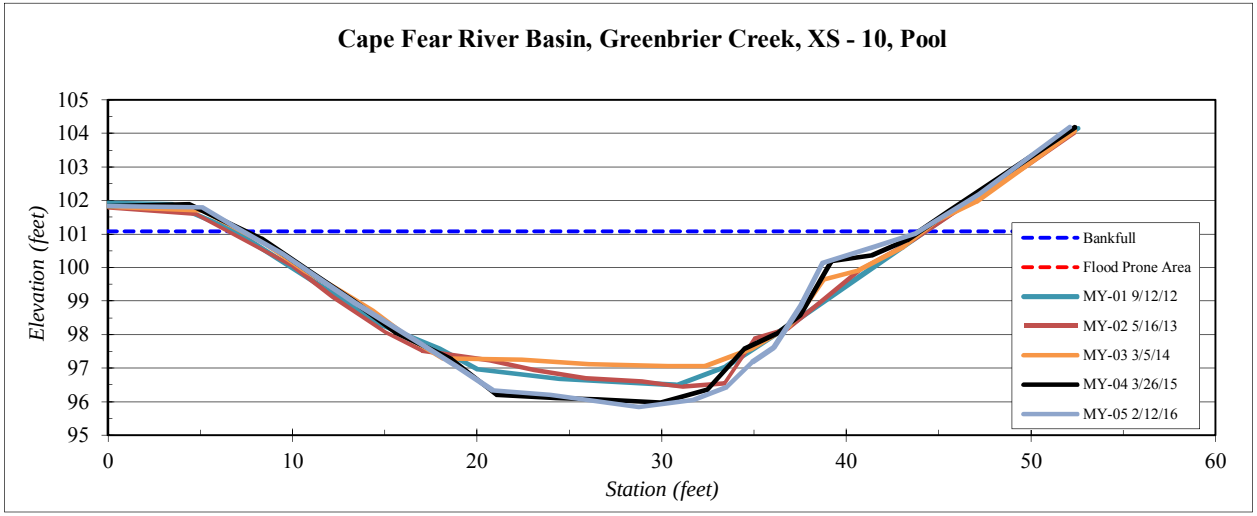


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 10, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	101.83
5.12	101.79
6.90	101.20
9.49	100.40
13.34	98.94
16.91	97.75
18.88	97.07
20.84	96.34
23.97	96.21
28.74	95.85
31.69	96.04
33.52	96.43
34.89	97.17
36.08	97.62
37.54	98.86
38.72	100.13
41.60	100.63
43.74	101.01
47.16	102.18
52.11	104.18

SUMMARY DATA	
Bankfull Elevation:	101.1
Bankfull Cross-Sectional Area:	113.8
Bankfull Width:	36.7
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	5.2
Mean Depth at Bankfull:	3.1
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

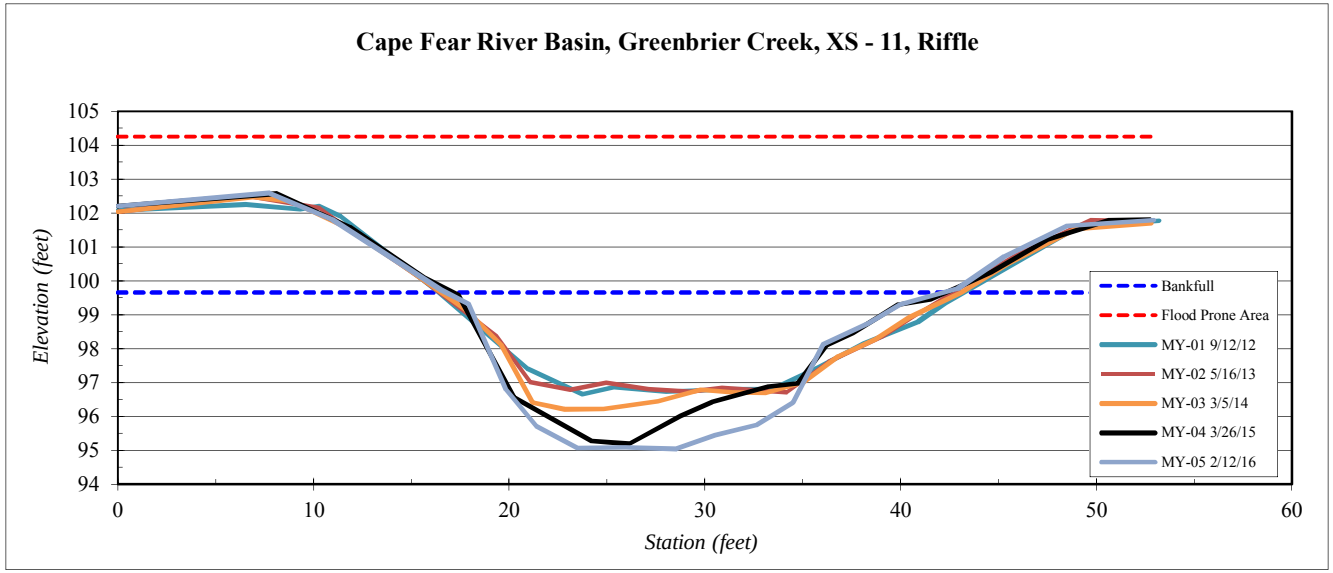


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 11, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	102.20
7.75	102.59
10.96	101.80
16.51	99.73
17.91	99.31
19.84	96.80
21.40	95.70
23.48	95.07
25.94	95.10
28.55	95.04
30.52	95.45
32.66	95.75
34.49	96.41
36.03	98.13
38.36	98.75
39.99	99.30
42.91	99.77
45.31	100.71
48.50	101.62
52.93	101.79

SUMMARY DATA	
Bankfull Elevation:	99.7
Bankfull Cross-Sectional Area:	72.4
Bankfull Width:	25.4
Flood Prone Area Elevation:	104.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	4.6
Mean Depth at Bankfull:	2.9
W / D Ratio:	8.9
Entrenchment Ratio:	3.9
Bank Height Ratio:	1.4

Stream Type	E

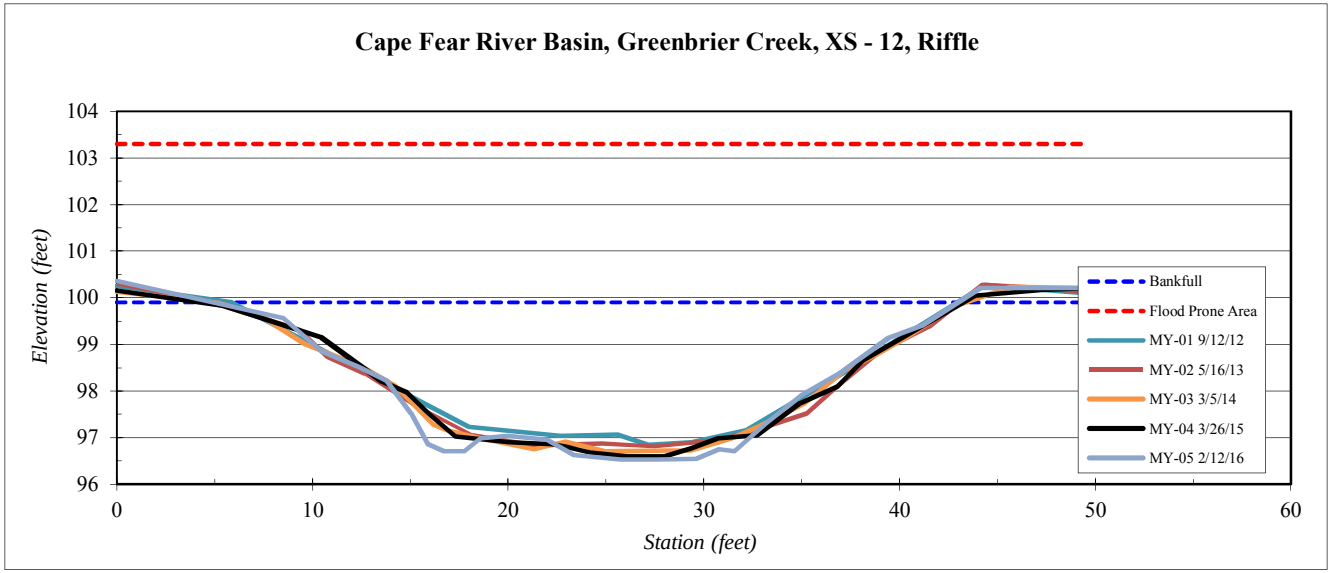


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 12, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	100.36
8.49	99.56
10.47	98.85
12.32	98.52
13.80	98.22
15.04	97.52
15.91	96.86
16.72	96.71
17.76	96.71
18.59	96.98
19.96	97.04
21.99	96.96
23.35	96.63
25.74	96.53
27.68	96.53
29.61	96.54
30.79	96.76
31.57	96.71
33.20	97.32
34.96	97.91
36.91	98.37
39.44	99.13
41.20	99.41
44.17	100.21
49.57	100.21

SUMMARY DATA	
Bankfull Elevation:	99.9
Bankfull Cross-Sectional Area:	77.8
Bankfull Width:	38.1
Flood Prone Area Elevation:	103.3
Flood Prone Width:	100.0
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.0
W / D Ratio:	18.7
Entrenchment Ratio:	2.6
Bank Height Ratio:	1.0

Stream Type	E

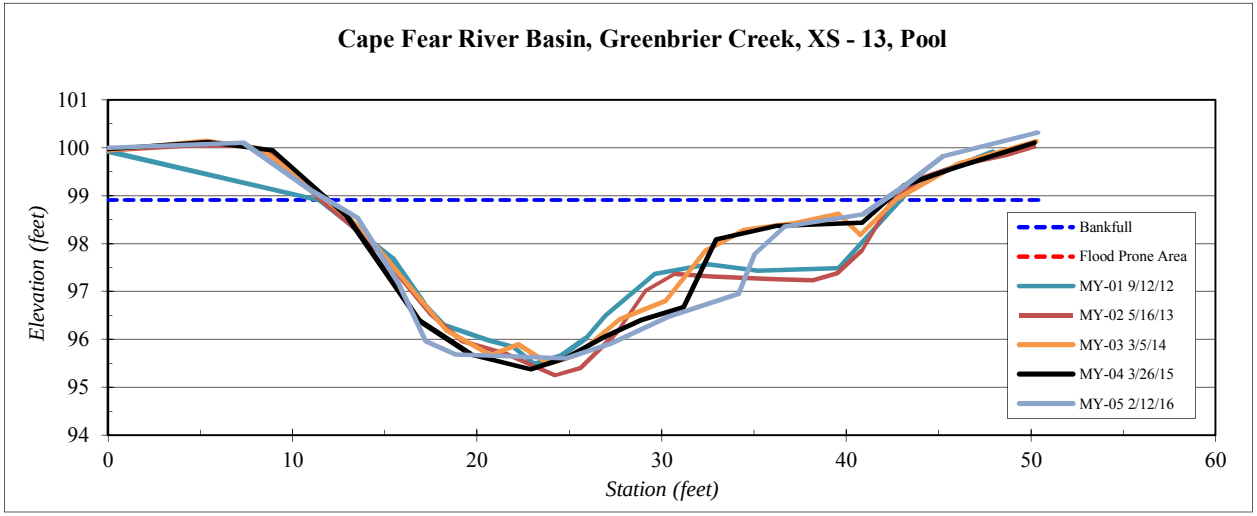


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 13, Pool
Feature	Pool
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	99.99
7.34	100.10
10.98	99.11
13.51	98.55
15.75	97.15
17.22	95.97
18.83	95.68
21.20	95.66
24.79	95.60
27.22	95.91
30.36	96.47
32.16	96.69
34.17	96.95
35.03	97.78
36.66	98.36
40.89	98.60
43.18	99.21
45.25	99.82
50.38	100.32

SUMMARY DATA	
Bankfull Elevation:	98.9
Bankfull Cross-Sectional Area:	59.8
Bankfull Width:	30.2
Flood Prone Area Elevation:	NA
Flood Prone Width:	NA
Max Depth at Bankfull:	3.3
Mean Depth at Bankfull:	2.0
W / D Ratio:	NA
Entrenchment Ratio:	NA
Bank Height Ratio:	1.0

Stream Type	C/E

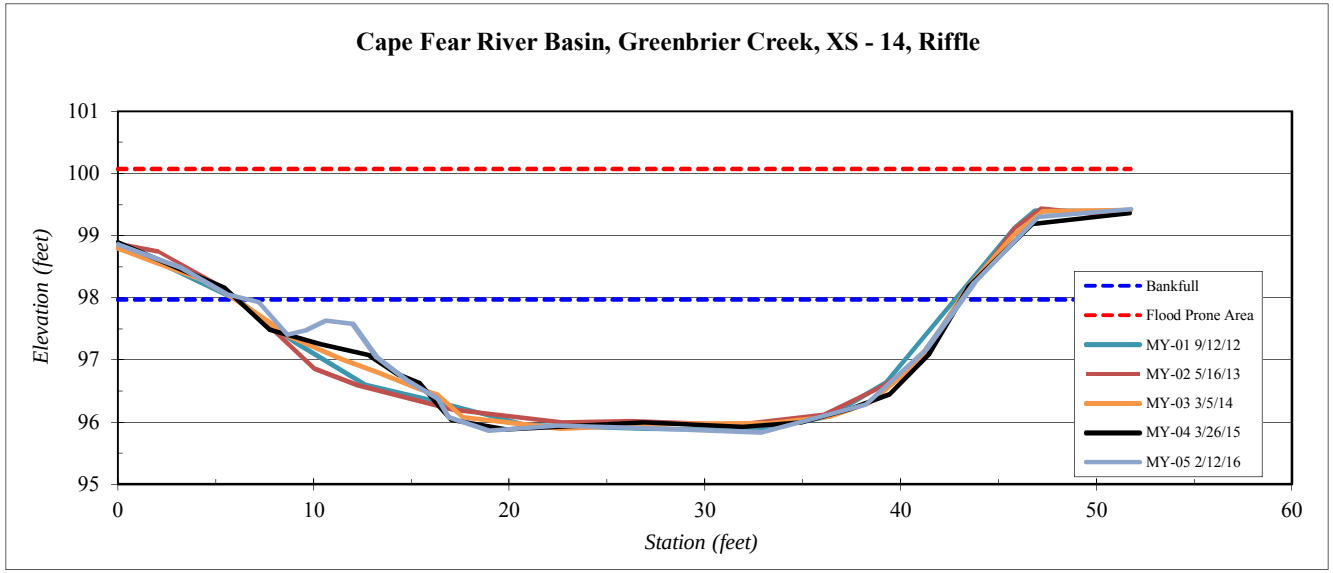


River Basin:	Cape Fear
Watershed:	Greenbrier Creek
XS ID	XS - 14, Riffle
Feature	Riffle
Date:	2/12/2016
Field Crew:	Perkinson, Keith

Station	Elevation
0.00	98.85
3.21	98.49
5.61	98.06
7.19	97.93
8.66	97.41
9.63	97.47
10.64	97.64
12.01	97.58
13.24	97.03
14.78	96.66
16.35	96.38
16.92	96.08
18.97	95.86
22.49	95.94
26.96	95.90
32.86	95.83
38.23	96.28
41.31	97.17
43.79	98.25
47.03	99.30
51.76	99.42

SUMMARY DATA	
Bankfull Elevation:	98.0
Bankfull Cross-Sectional Area:	55.5
Bankfull Width:	36.4
Flood Prone Area Elevation:	100.1
Flood Prone Width:	100.0
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.5
W / D Ratio:	23.9
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

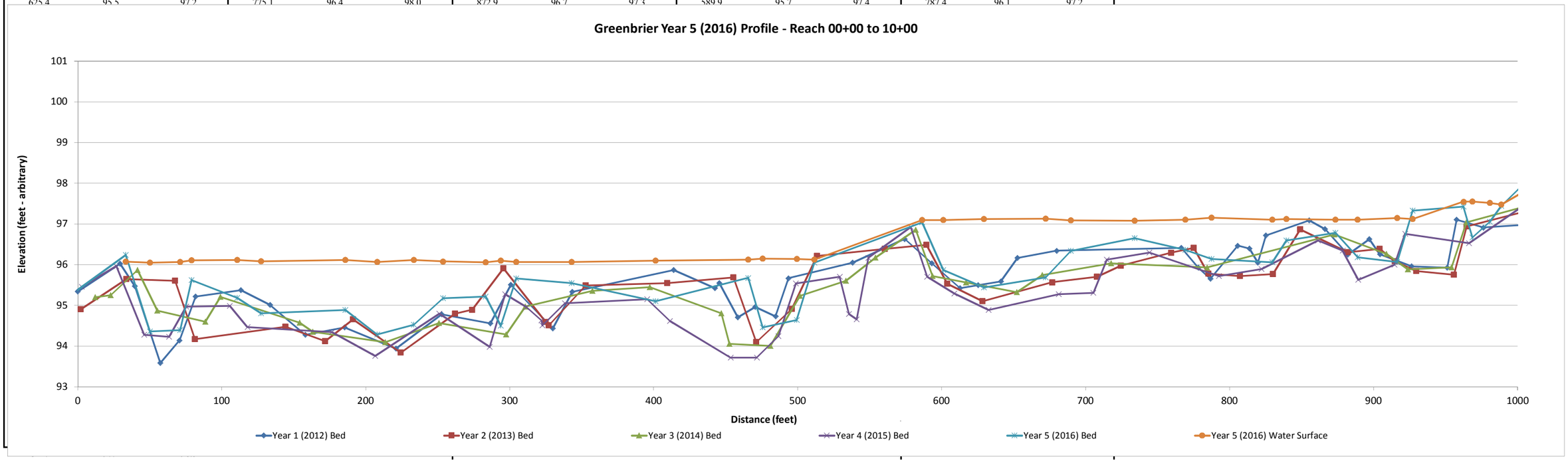
Stream Type	E



Project Name	Greenbrier - Year 5 (2016) Profile
Reach	Main Reach (00+00 - 10+00)
Feature	Profile
Date	2/12/16
Crew	Perkinson, Keith

2012 Year 1 Monitoring \Survey			2013 Year 2 Monitoring \Survey			2014 Year 3 Monitoring \Survey			2015 Year 4 Monitoring \Survey			2016 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	95.3	96.7	2.0	94.9	97.7	12.0	95.2	95.9	2.8	95.5	95.9	-2.0	95.3	
29.2	96.0	96.7	33.8	95.6	97.7	22.8	95.3	95.9	26.8	96.0	96.3	33.3	96.2	96.1
39.5	95.5	96.7	67.7	95.6	97.7	41.4	95.9	96.2	46.1	94.3	96.4	50.2	94.4	96.0
57.2	93.6	96.7	81.4	94.2	97.7	55.2	94.9	96.2	63.5	94.2	96.4	71.0	94.4	96.1
70.6	94.1	96.7	144.4	94.5	97.7	88.6	94.6	96.2	75.3	95.0	96.4	79.1	95.6	96.1
81.8	95.2	96.7	171.8	94.1	97.7	99.1	95.2	96.3	105.5	95.0	96.3	110.7	95.2	96.1
113.4	95.4	96.7	191.1	94.7	97.7	154.1	94.6	96.3	117.9	94.5	96.4	127.3	94.8	96.1
133.5	95.0	96.7	224.3	93.8	97.7	163.2	94.3	96.3	176.5	94.3	96.3	185.7	94.9	96.1
158.1	94.3	96.7	262.0	94.8	97.6	213.5	94.1	96.3	206.7	93.8	96.3	207.9	94.3	96.1
185.3	94.5	96.7	274.0	94.9	97.7	250.8	94.6	96.3	251.2	94.8	96.3	233.5	94.5	96.1
220.9	93.9	96.7	295.6	95.9	97.7	297.6	94.3	96.3	286.2	94.0	96.4	253.6	95.2	96.1
252.8	94.8	96.8	325.1	94.6	97.7	310.8	95.0	96.3	296.9	95.3	96.4	283.3	95.2	96.1
286.5	94.6	96.7	327.1	94.5	97.7	357.4	95.4	96.3	311.5	95.0	96.4	293.8	94.5	96.1
300.7	95.5	96.7	352.8	95.5	97.7	397.3	95.4	96.3	322.0	94.6	96.4	304.6	95.7	96.1
330.0	94.4	96.7	409.4	95.5	97.7	447.1	94.8	96.4	322.7	94.5	96.4	343.0	95.5	96.1
343.4	95.3	96.7	455.4	95.7	97.7	452.6	94.1	96.3	338.3	95.1	96.3	401.4	95.1	96.1
413.8	95.9	96.7	471.1	94.1	97.7	481.0	94.0	96.3	395.5	95.2	96.4	465.7	95.7	96.1
442.5	95.4	96.6	496.0	94.9	97.7	501.6	95.2	96.3	411.2	94.6	96.4	475.6	94.5	96.1
445.7	95.5	96.7	513.5	96.2	97.7	533.4	95.6	96.4	453.5	93.7	96.4	499.3	94.6	96.1
458.4	94.7	96.6	560.5	96.4	97.7	554.0	96.2	96.7	471.6	93.7	96.4	511.7	96.0	96.1
470.5	95.0	96.7	589.4	96.5	98.0	582.1	96.9	97.3	486.7	94.2	96.4	586.5	97.0	97.1
484.7	94.7	96.7	603.9	95.5	98.0	593.7	95.7	97.2	498.9	95.5	96.4	601.2	95.9	97.1
493.7	95.7	96.7	628.4	95.1	98.0	617.0	95.6	97.3	529.2	95.7	96.4	629.4	95.4	97.1
538.1	96.0	96.7	676.8	95.6	98.0	652.1	95.3	97.3	535.6	94.8	96.5	672.2	95.7	97.1
574.4	96.6	97.1	708.0	95.7	98.0	670.0	95.7	97.3	540.9	94.7	96.5	689.7	96.3	97.1
593.1	96.0	97.2	724.4	96.0	97.9	717.8	96.0	97.2	549.2	96.2	96.7	734.0	96.7	97.1
612.9	95.4	97.1	759.4	96.3	98.0	784.4	95.9	97.3	578.5	96.9	97.3	769.2	96.4	97.1
625.4	95.5	97.2	775.1	96.4	98.0	872.9	96.7	97.3	589.9	95.7	97.4	787.4	96.1	97.2

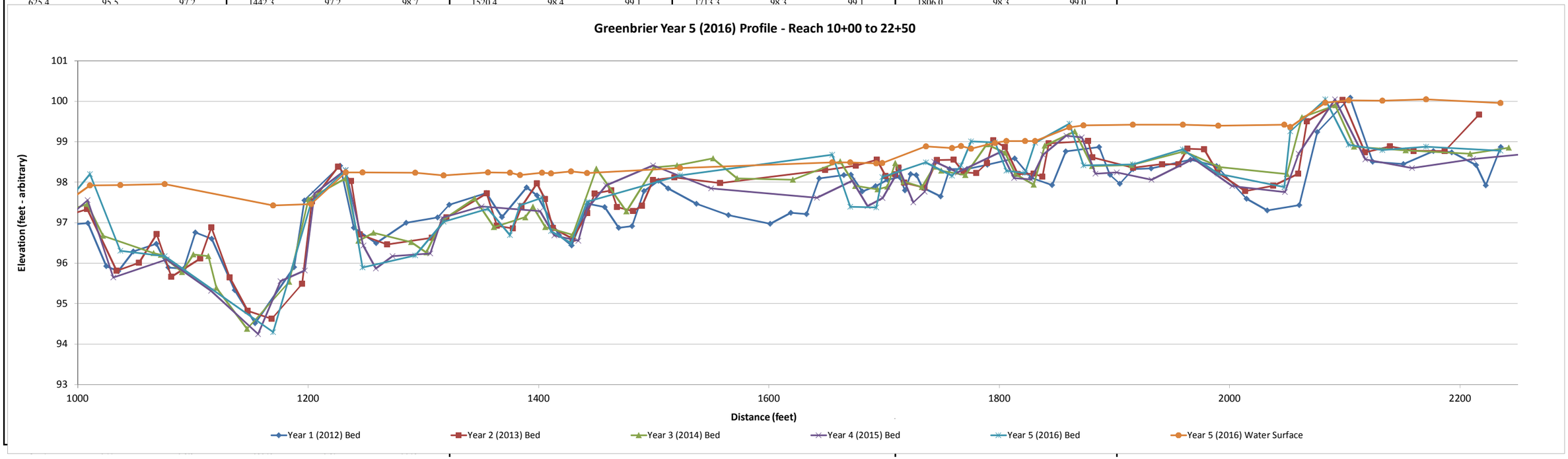
	2012	2013	2014	2015	2016
Avg. Water Surface Slope	0.0017	0.0010	0.0020	0.0019	0.0019
Riffle Length	29	34	72	64	54
Avg. Riffle Slope	0.0050	0.0006	0.0074	0.0087	0.0080
Pool Length	18	27	52	58	48
Avg. Pool Slope	0.0000	0.0000	0.0004	0.0006	0.0006



Project Name	Greenbrier - Year 5 (2016) Profile
Reach	Main Reach (10+00 - 22+50)
Feature	Profile
Date	2/12/16
Crew	Perkinson, Keith

2012 Year 1 Monitoring \Survey			2013 Year 2 Monitoring \Survey			2014 Year 3 Monitoring \Survey			2015 Year 4 Monitoring \Survey			2016 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	95.3	96.7	964.7	96.9	98.0	964.4	97.0	97.4	966.3	96.5	97.5	988.7	97.4	97.5
29.2	96.0	96.7	1008.3	97.3	98.0	1008.2	97.5	98.0	1008.6	97.6	98.2	1010.6	98.2	97.9
39.5	95.5	96.7	1033.6	95.8	98.0	1022.0	96.7	98.1	1030.9	95.6	98.2	1037.0	96.3	97.9
57.2	93.6	96.7	1053.2	96.0	98.0	1065.9	96.2	98.1	1077.1	96.1	98.2	1075.5	96.2	98.0
70.6	94.1	96.7	1068.6	96.7	98.0	1072.3	96.2	98.1	1115.8	95.3	98.2	1169.7	94.3	97.4
81.8	95.2	96.7	1081.4	95.7	98.0	1090.5	95.8	98.1	1156.6	94.2	98.2	1202.6	97.5	97.5
113.4	95.4	96.7	1106.3	96.1	98.0	1100.5	96.2	98.1	1176.0	95.6	98.2	1232.6	98.3	98.2
133.5	95.0	96.7	1116.1	96.9	98.0	1113.5	96.2	98.1	1197.1	95.8	98.1	1247.3	95.9	98.2
158.1	94.3	96.7	1131.9	95.6	98.0	1120.5	95.4	98.1	1205.6	97.7	98.1	1293.1	96.2	98.2
185.3	94.5	96.7	1147.6	94.8	98.0	1146.9	94.4	98.1	1232.4	98.3	99.0	1317.5	97.0	98.2
220.9	93.9	96.7	1168.5	94.6	97.9	1183.4	95.5	98.1	1247.9	96.4	99.0	1356.0	97.3	98.2
252.8	94.8	96.8	1194.7	95.5	98.0	1200.3	97.6	98.1	1258.9	95.9	99.0	1375.1	96.7	98.2
286.5	94.6	96.7	1203.3	97.5	98.0	1232.4	98.1	98.8	1273.2	96.2	99.0	1384.0	97.4	98.2
300.7	95.5	96.7	1226.0	98.4	98.7	1243.9	96.6	98.9	1306.1	96.2	99.0	1403.0	97.6	98.2
330.0	94.4	96.7	1237.4	98.0	98.7	1256.6	96.8	98.9	1316.5	97.1	98.9	1410.9	96.8	98.2
343.4	95.3	96.7	1245.0	96.7	98.7	1289.4	96.5	98.9	1350.7	97.4	98.9	1428.1	96.5	98.3
413.8	95.9	96.7	1268.7	96.5	98.7	1302.7	96.3	98.9	1401.4	97.3	99.0	1442.1	97.5	98.2
442.5	95.4	96.6	1307.3	96.6	98.7	1316.3	97.1	98.9	1413.8	96.7	99.0	1522.8	98.2	98.4
445.7	95.5	96.7	1320.1	97.1	98.7	1344.6	97.6	98.9	1434.7	96.6	98.9	1655.0	98.7	98.5
458.4	94.7	96.6	1355.1	97.7	98.7	1361.2	96.9	98.8	1442.0	97.3	98.9	1670.6	97.4	98.5
470.5	95.0	96.7	1364.0	96.9	98.7	1388.5	97.1	98.9	1458.7	97.9	98.9	1693.2	97.4	98.5
484.7	94.7	96.7	1377.9	96.9	98.7	1395.3	97.4	98.9	1499.5	98.4	99.0	1698.4	98.1	98.5
493.7	95.7	96.7	1385.3	97.4	98.7	1406.0	96.9	98.9	1549.8	97.8	99.0	1736.2	98.5	98.9
538.1	96.0	96.7	1398.7	98.0	98.7	1429.8	96.7	98.9	1641.6	97.6	99.0	1758.8	98.2	98.8
574.4	96.6	97.1	1405.5	97.6	98.7	1450.2	98.3	98.9	1672.5	98.0	99.0	1766.8	98.4	98.9
593.1	96.0	97.2	1412.5	96.9	98.7	1476.3	97.3	98.9	1685.7	97.4	99.0	1775.4	99.0	98.8
612.9	95.4	97.1	1429.7	96.6	98.7	1500.2	98.4	98.9	1698.8	97.6	99.0	1796.2	99.0	99.0
625.4	95.5	97.2	1442.3	97.2	98.7	1520.4	98.4	99.1	1713.3	98.3	99.1	1806.0	98.3	99.0

	2012	2013	2014	2015	2016
Avg. Water Surface Slope	0.0017	0.0010	0.0020	0.0019	0.0019
Riffle Length	29	34	72	64	54
Avg. Riffle Slope	0.0050	0.0006	0.0074	0.0087	0.0080
Pool Length	18	27	52	58	48
Avg. Pool Slope	0.0000	0.0000	0.0004	0.0006	0.0006

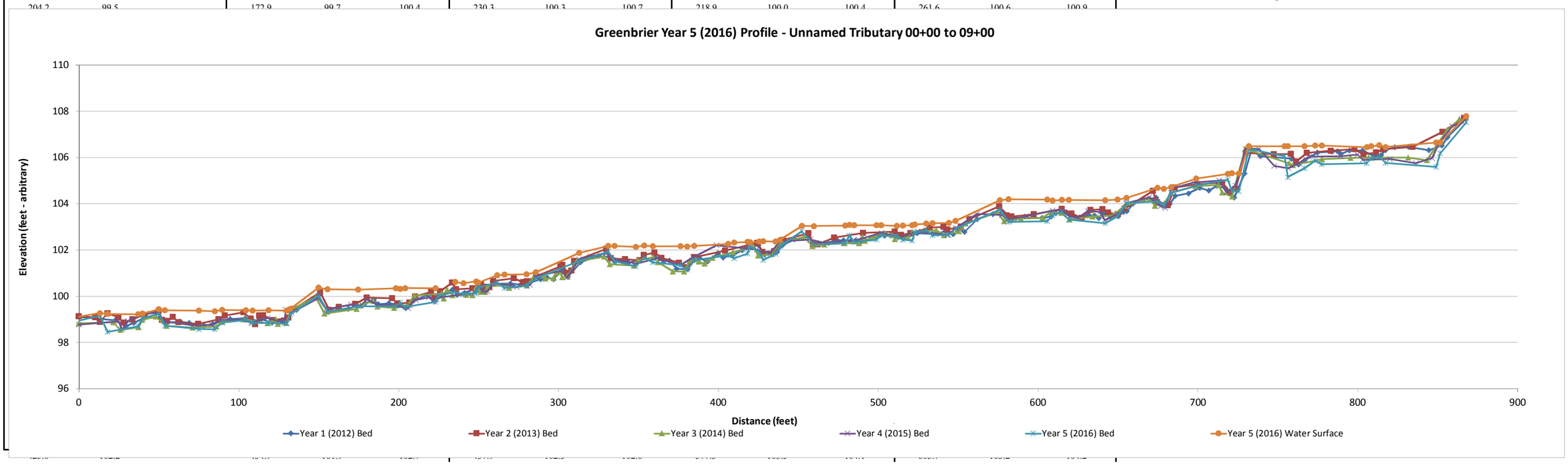


Project Name	Greenbrier - Year 5 (2016) Profile
Reach	Unnamed Tributary (00+00 - 09+00)
Feature	Profile
Date	2/12/16
Crew	Perkinson, Keith

2012 Year 1 Monitoring \Survey			2013 Year 2 Monitoring \Survey			2014 Year 3 Monitoring \Survey			2015 Year 4 Monitoring \Survey			2016 Year 5 Monitoring \Survey		
Station	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**	**Station**	**Bed Elevation**	**Water Elevation**
0.0	99.1		0.0	99.1	99.4	0.0	98.8		0.0	98.8	99.1	-1.0	98.9	99.1
22.6	99.0		10.3	99.1	99.4	21.4	98.9	99.3	24.6	98.9	99.3	13.1	99.2	99.3
29.3	98.7		13.0	98.9	99.4	26.0	98.5	99.4	27.0	98.6	99.3	17.8	98.5	99.2
34.3	98.8		17.9	99.3	99.4	37.2	98.7	99.3	28.5	98.7	99.4	37.1	98.7	99.2
41.7	99.1		24.6	99.1	99.5	39.5	99.0	99.3	30.6	98.9	99.3	39.8	99.0	99.2
50.4	99.1		27.9	98.9	99.5	48.1	99.1	99.4	41.5	99.2	99.4	49.9	99.2	99.4
55.2	98.8		33.5	99.0	99.5	54.7	98.7	99.4	48.6	99.3	99.3	53.7	98.7	99.4
63.4	98.9		40.9	99.2		71.0	98.6	99.4	53.2	98.9	99.6	75.0	98.6	99.4
68.8	98.8		49.9	99.4		85.9	98.7	99.4	70.9	98.7	99.5	85.1	98.6	99.4
78.3	98.7		52.0	99.0	99.6	89.6	98.9	99.4	83.0	98.8	99.5	89.5	98.9	99.4
83.7	98.8		55.1	98.9	99.6	103.6	99.0	99.5	88.0	99.0	99.4	104.4	99.0	99.4
94.5	99.0		58.7	99.1	99.7	118.0	98.8	99.5	102.8	99.0	99.5	108.5	98.8	99.4
104.0	99.0		62.3	98.9	99.7	123.2	99.0	99.5	107.7	98.8	99.5	118.6	98.8	99.4
109.8	98.9		74.6	98.8	99.7	124.5	98.8	99.5	117.9	99.1	99.5	130.0	98.8	99.4
114.0	99.0		87.2	99.0	99.6	129.6	98.8	99.5	128.6	98.8	99.4	132.2	99.2	99.4
120.8	98.9		91.3	99.2	99.4	132.5	99.4	99.6	129.2	99.4		149.8	100.0	100.4
127.2	99.0		102.8	99.3	99.7	148.2	99.9	100.3	132.8	99.3	99.4	155.5	99.3	100.3
136.1	99.4		107.4	99.0	99.7	153.6	99.2	100.3	149.8	99.9	100.4	174.6	99.6	100.3
149.6	100.0		110.3	98.8	99.6	173.6	99.4	100.3	154.6	99.4	100.4	198.3	99.6	100.3
156.0	99.3		112.7	99.2	99.7	176.2	99.6	100.3	170.1	99.6	100.3	200.9	99.7	100.3
168.5	99.5		115.2	99.2	99.7	184.0	99.8	100.3	175.9	99.6	100.4	204.0	99.5	100.3
178.9	99.7		121.0	99.0	99.7	186.8	99.6	100.3	180.0	99.9	100.3	223.0	99.8	100.3
184.5	99.8		131.2	99.1	99.7	197.2	99.5	100.4	186.4	99.6	100.3	224.8	100.0	
187.1	99.6		134.7	99.4	99.6	205.7	99.6	100.4	195.6	99.6	100.3	235.2	100.2	100.6
193.7	99.7		150.9	100.2	100.4	209.7	100.0	100.4	206.0	99.5	100.3	240.4	100.1	100.6
198.3	99.7		156.4	99.4	100.4	226.8	100.1	100.5	207.0	99.6	100.3	248.4	100.1	100.6
200.1	99.6		162.6	99.5	100.4	228.2	99.9	100.5	210.7	99.8	100.3	249.8	100.4	100.6
204.2	99.5		172.9	99.7	100.4	230.3	100.3	100.7	218.9	100.0	100.4	261.6	100.6	100.9

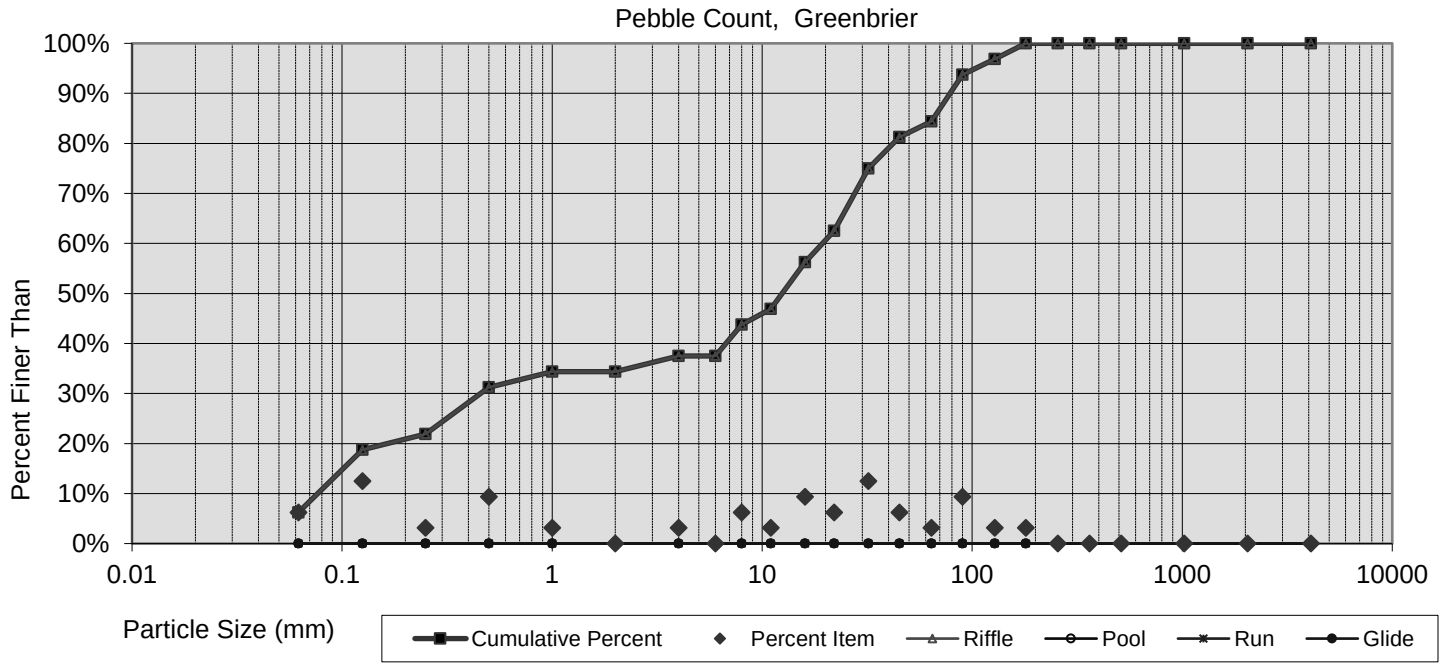
	2012*	2013	2014	2015	2016
Avg. Water Surface Slope	----	0.0092	0.0102	0.0103	0.0100
Riffle Length	10	16	14	19	17
Avg. Riffle Slope	----	0.0124	0.0206	0.0188	0.0200
Pool Length	9	6	15	15	18
Avg. Pool Slope	----	0.0008	0.0038	0.0071	0.0014

* No water in channel during field measurments.



	Pebble Count,
	Greenbrier

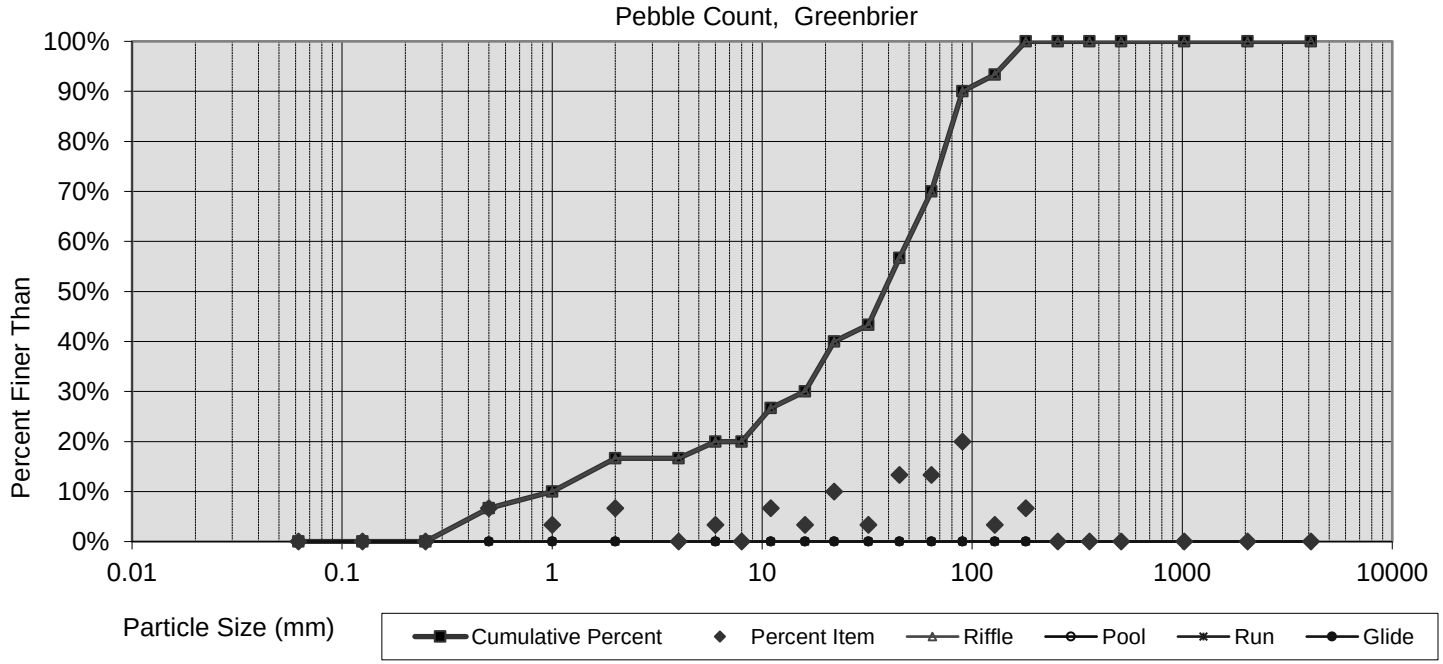
Note:	**Cross Section 2**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.107	2.30	12.5	61	104	6%	28%	50%	16%	0%	0%

	Pebble Count,
	Greenbrier

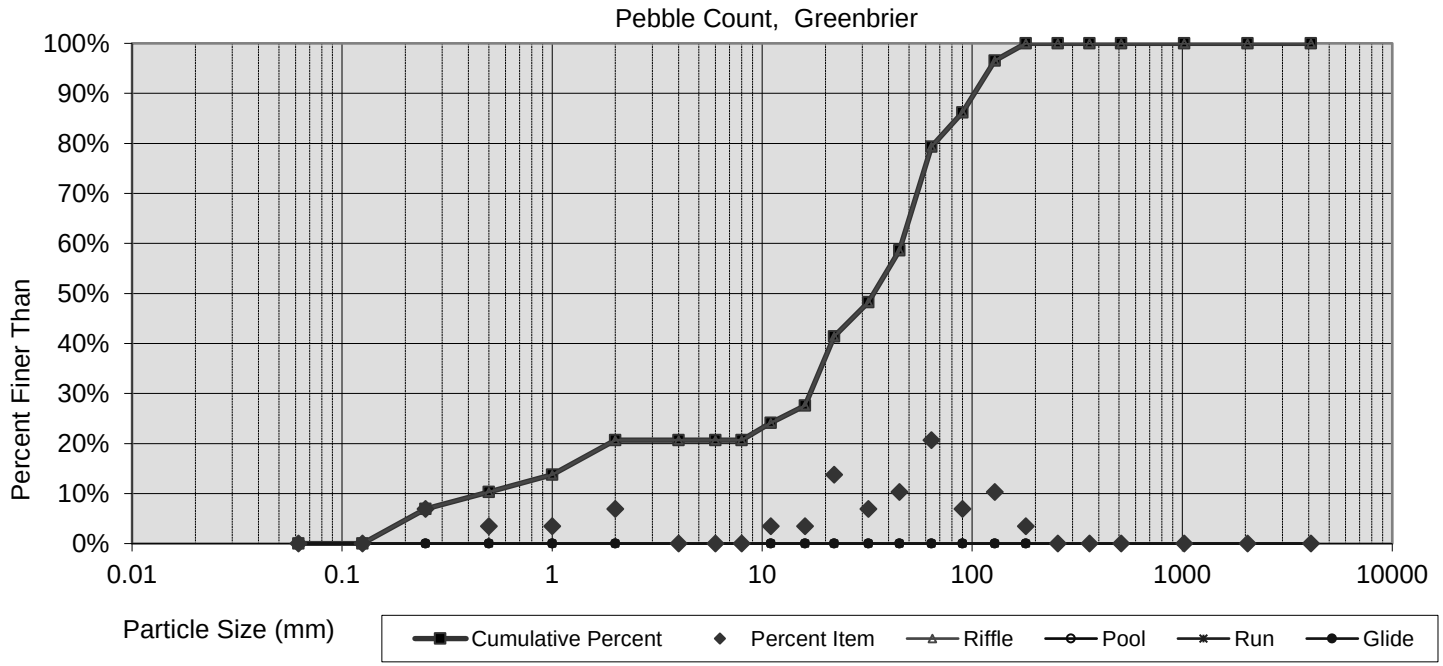
Note:	**Cross Section 5**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.866	18.76	37.9	81	139	0%	17%	53%	30%	0%	0%

	Pebble Count,
	Greenbrier

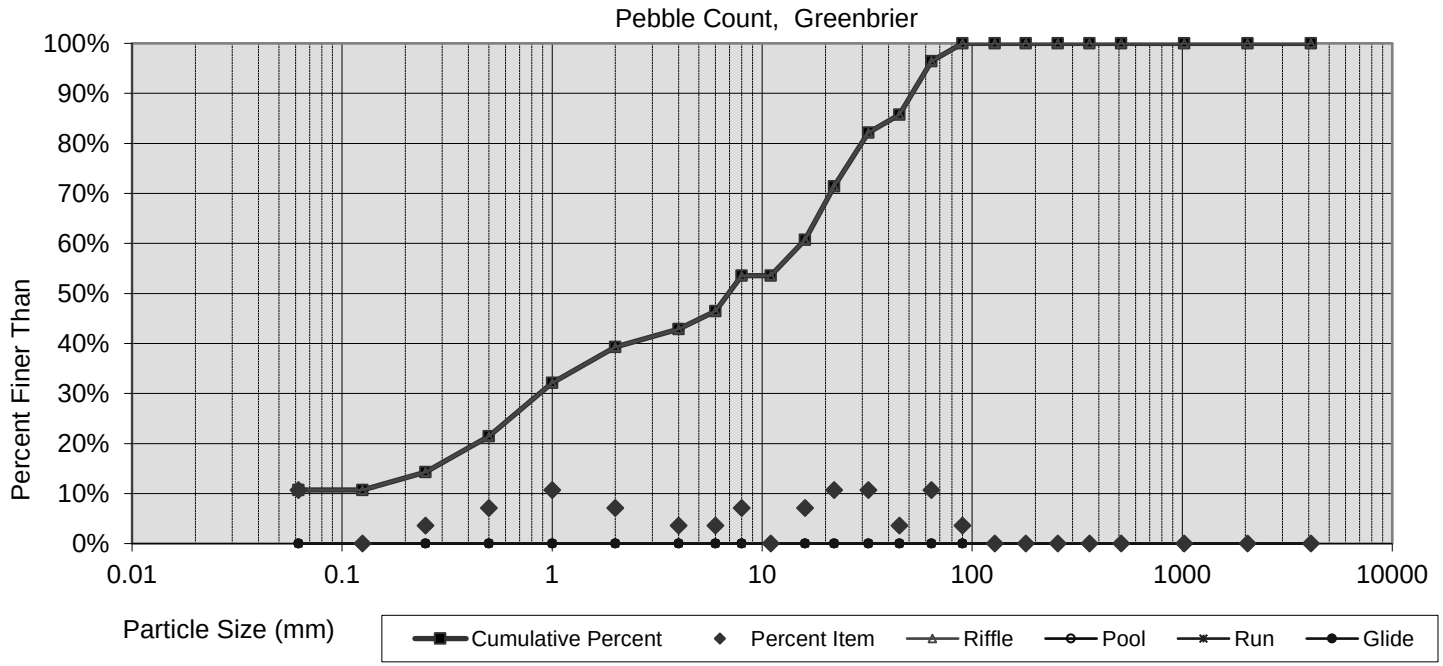
Note:	**Cross Section 6**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.248	18.99	33.9	81	121	0%	21%	59%	21%	0%	0%

	Pebble Count,
	Greenbrier

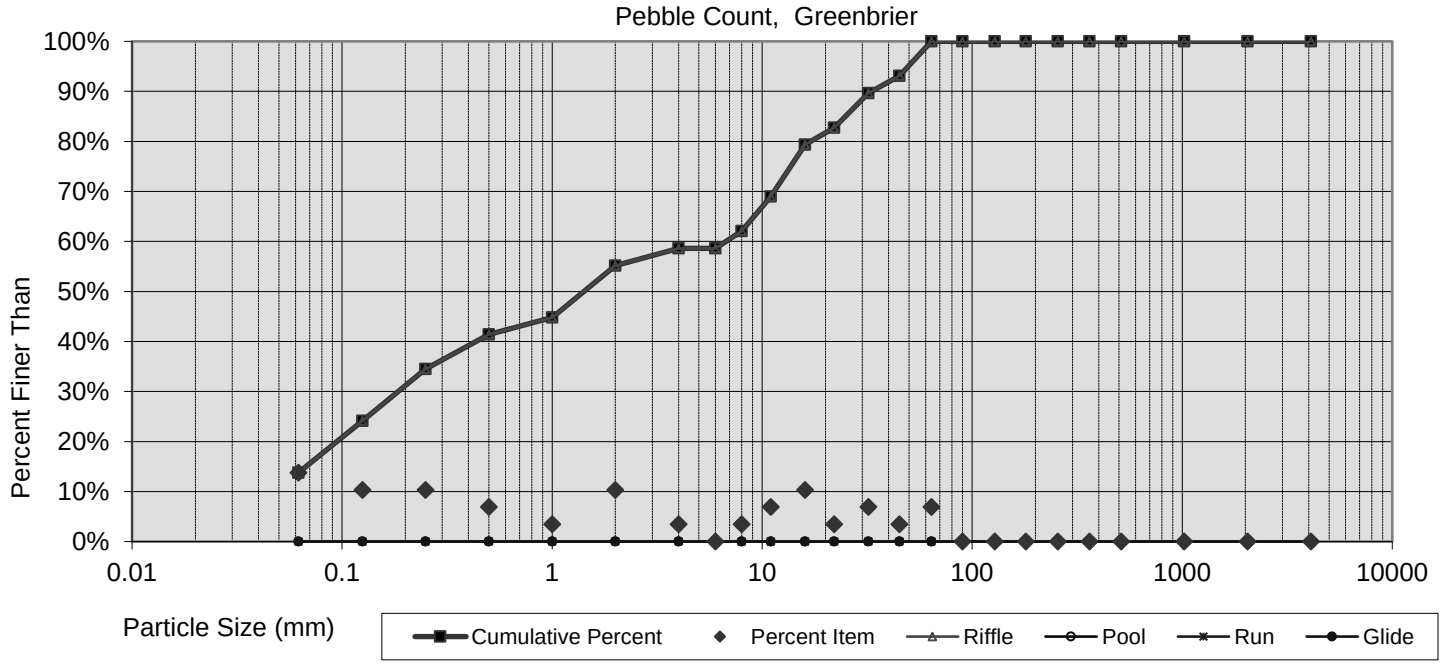
Note:	**Cross Section 7**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.295	1.32	6.9	38	61	11%	29%	57%	4%	0%	0%

	Pebble Count,
	Greenbrier

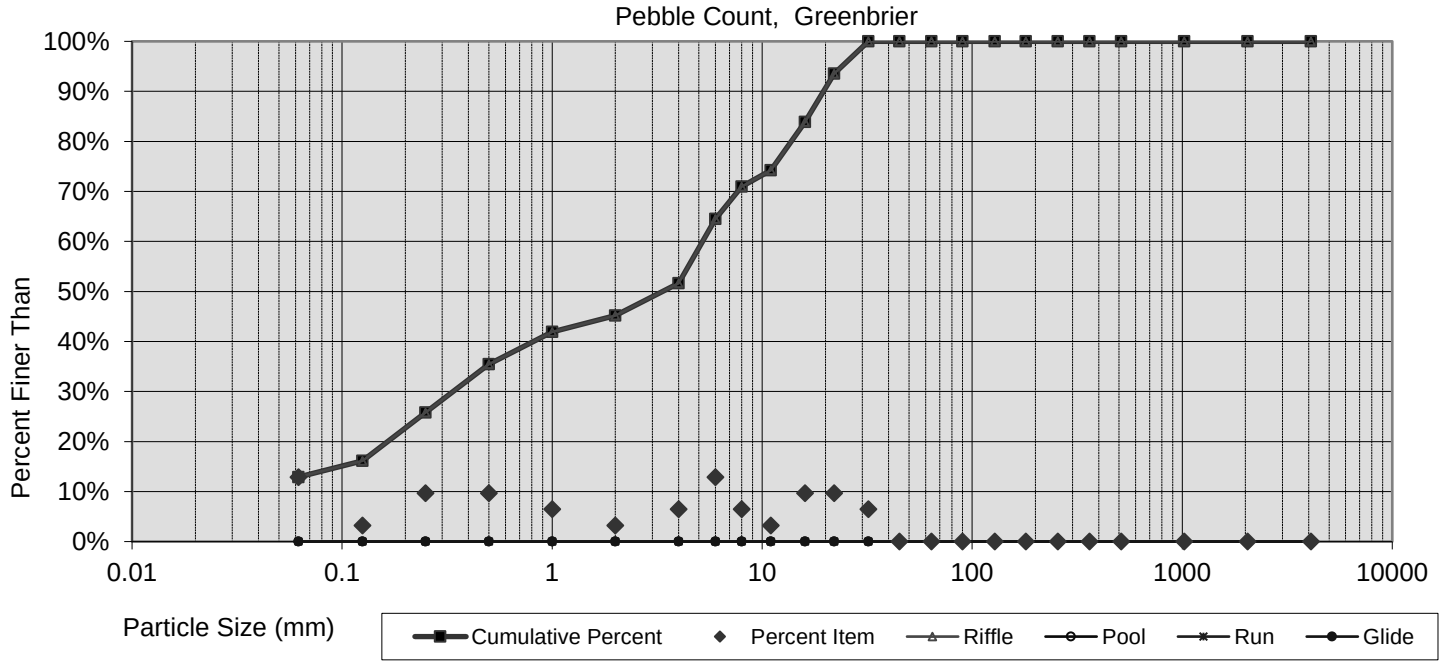
Note:	**Cross Section 9**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.072	0.26	1.4	24	50	14%	41%	45%	0%	0%	0%

	Pebble Count,
	Greenbrier

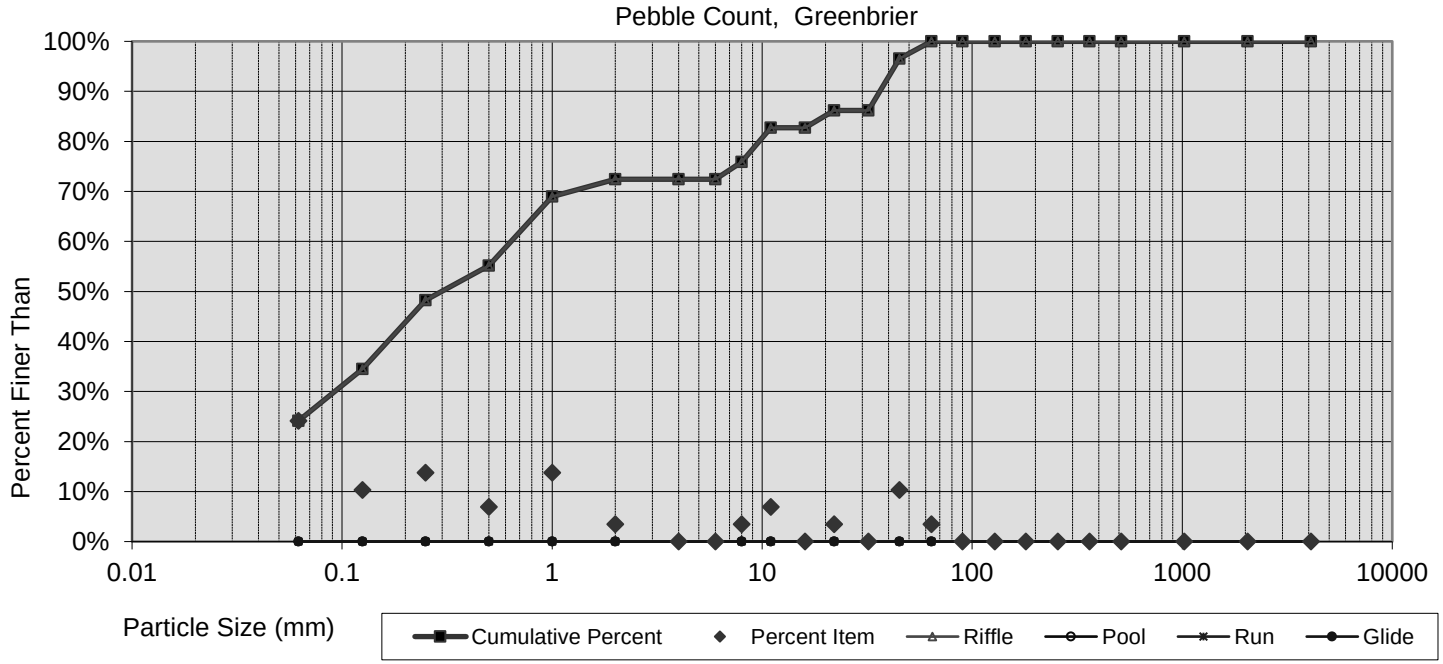
Note:	**Cross Section 11**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.122	0.48	3.4	16	24	13%	32%	55%	0%	0%	0%

	Pebble Count,
	Greenbrier

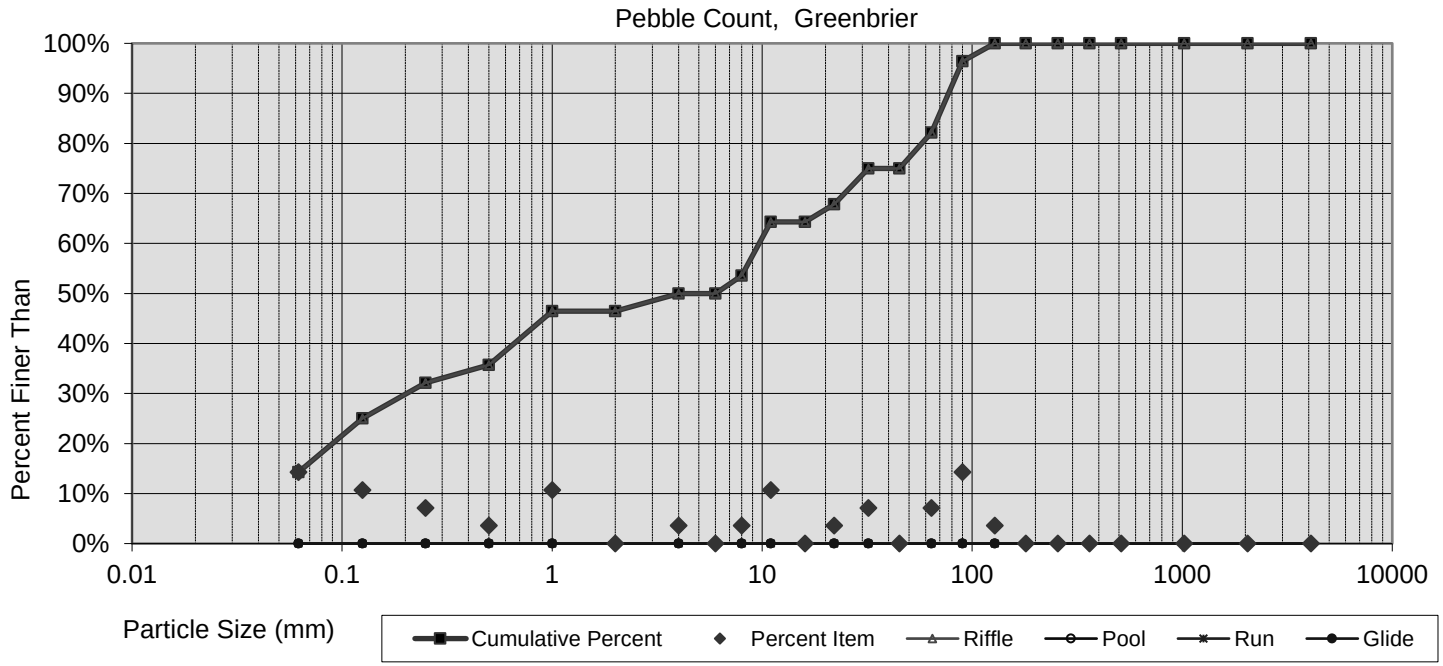
Note:	**Cross Section 12**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.13	0.3	18	43	24%	48%	28%	0%	0%	0%

	Pebble Count,
	Greenbrier

Note:	**Cross Section 14**

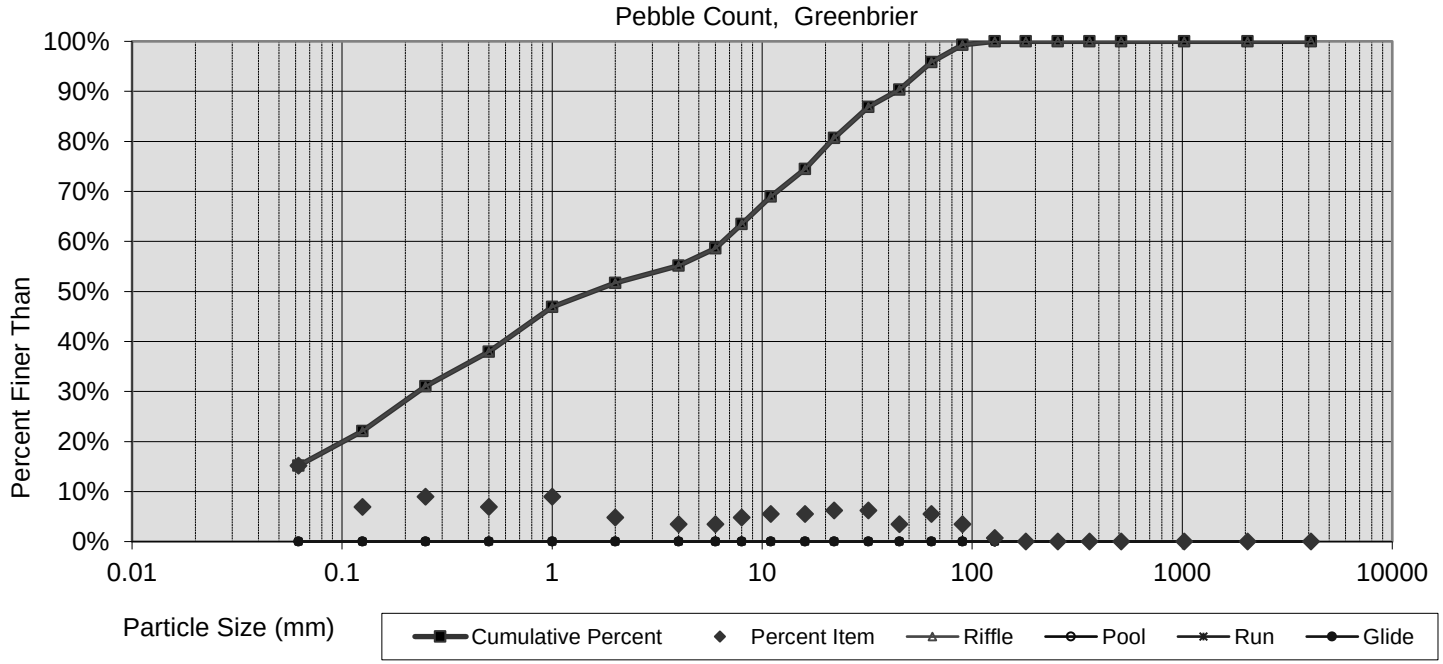


Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.069	0.44	6.0	67	87	14%	32%	36%	18%	0%	0%

Pebble Count,

	Greenbrier

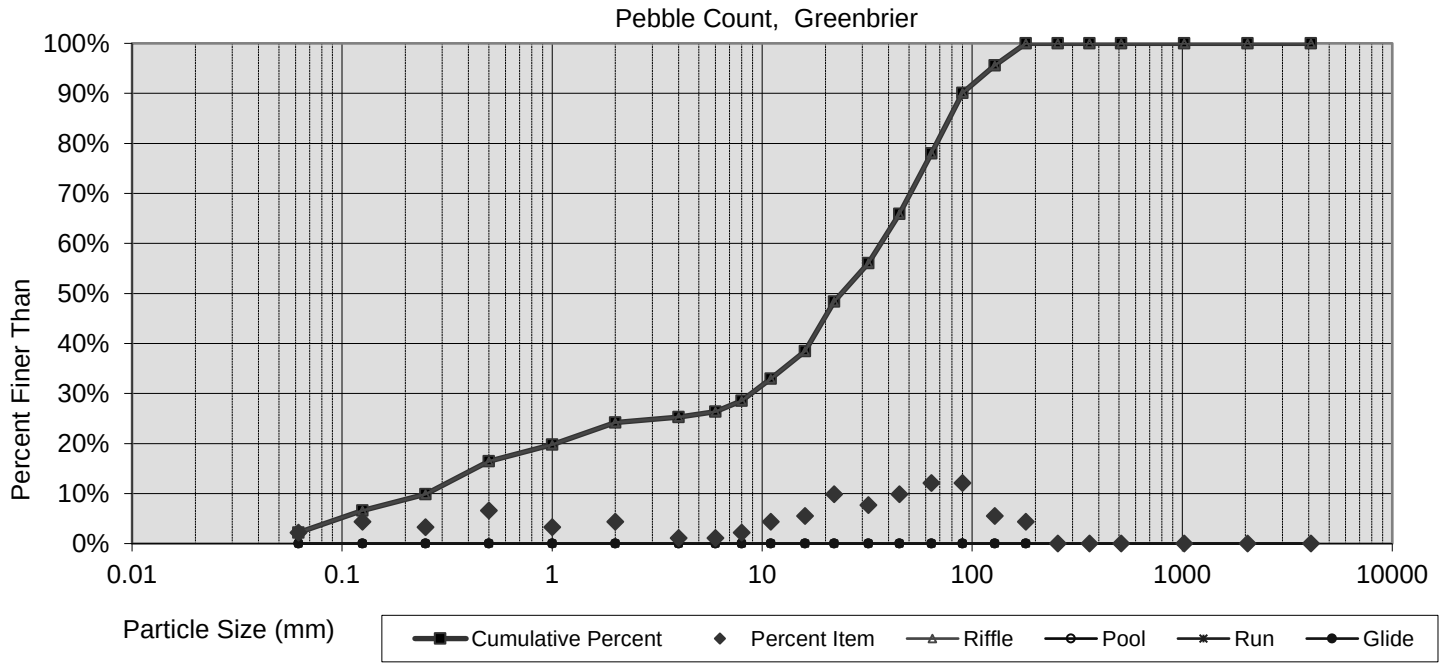
Note:	**Total Main Channel**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.067	0.37	1.6	27	61	15%	37%	44%	4%	0%	0%

	Pebble Count,
	Greenbrier

Note:	**Total UT**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.475	12.64	23.8	76	123	2%	22%	54%	22%	0%	0%

Table 10a. Baseline Stream Data Summary - Unnamed Tributary
Greenbrier Creek (DMS Project Number 671)

Parameter	Gauge	Regional Curve			Pre-Existing Condition - UT					Reference Reach(es) Data					Design			Year 1 (2012) Monitoring - UT				
Dimension and Substrate - Riffle Only		**LL**	**UL**	**Eq.**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Max**	**Med**	**Min**	**Mean**	**Med**	**Max**	**SD**
BF Width (ft)					3.2			6.6			27.6						12.0	14.5		14.7	16.5	
Floodprone Width (ft)					8			50			140						40			100		
BF Mean Depth (ft)							0.9				1.2						0.7	0.7		0.8	0.9	
BF Max Depth (ft)					1.2			1.4			2.0						1.0	1.2		1.3	1.5	
BF Cross Sectional Area (ft^2)					2.7			5.8			33.5						7.8	11.9		12.0	12.7	
Width/Depth Ratio					3.7			7.4			23.0						18.0	16.3		18.1	23.6	
Entrenchment Ratio					1.2			>2.2			5.1						>2.2	6.1		6.6	6.9	
Bank Height Ratio					1.0			~1.3			1.0						1.0			1.0		
Profile																						
Riffle length (ft)							----				----						----	2	12	10	32	35
Riffle slope (ft/ft)							----				----						----	No Water in Channel During Survey				
Pool length (ft)							----				----						----	4.0	10.0	8.9	25.0	36.0
Pool Max depth (ft)							----				2.8						----	1.2		1.3	1.5	
Pool spacing (ft)							----			25			104				----	8	23	22	42	9
Pattern																						
Channel Beltwidth (ft)							----				77						----	Channel Sinuosity 1.0 to 1.1; therefore, no pattern variables are able to be calculated.				
Radius of Curvature (ft)							----				----						----					
Rc:Bankfull width (ft/ft)							----				----						----					
Meander Wavelength (ft)							----			94			100				----					
Meander Width ratio							----				2.8						----					
Transport parameters																						
Reach Shear Stress (competency) lbs/ft^2																						
Max part size (mm) mobilized at bankfull																						
Stream Power (transport capacity) W/m^2																						
Additional Reach Parameters																						
Rosgen Classification					G4c-type					C4-type					C4-type			C-type				
Bankfull Velocity (fps)																						
Bankfull Discharge (cfs)																						
Valley Length (ft)					-----					----												
Channel Thalweg Length (ft)					-----					----					868			868				
Sinuosity					1.0					1.1					1.0			1.0				
Water Surface Slope (ft/ft)					0.0030 - 0.0038					0.0077					0.0038			----				
BF slope (ft/ft)					-----					-----					-----			----				
Bankfull Floodplain Area (acres)					-----					----					-----			----				
% of Reach with Eroding Banks					-----					-----												
Channel Stability or Habitat Metric					----					-----												
Biological or Other					-----					-----												

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Greenbrier Creek (DMS Project Number 671)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							Monitoring Baseline						
Ri%/RU%P%G%/S%																						36	17	32	15			
SC%/SA%/G%/C%/B%BE%																												
d16/d35/d50/d84/d95								0.09	1.5	9.5	65.0	120.0																
Entrainment Class <1.5/1.5-1.99/2.0-4.9/5.0-																												
Incision Class <1.2/1.2-1.49/1.5-1.99/>2.0																												

Table 10a. Baseline Stream Data Summary - Main Channel (continued)
Greenbrier Creek (DMS Project Number 671)

Parameter	Gauge	Regional Curve			Pre-Existing Condition - Main Channel					Reference Reach(es) Data					Design			Year 1 (2012) Monitoring - Main Channel				
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD
BF Width (ft)							20.0				27.6						35.0	27.0		31.0	37.1	
Floodprone Width (ft)					160			200			140				160	200				100		
BF Mean Depth (ft)							2.5				1.2						1.8	1.6		2.0	2.3	
BF Max Depth (ft)							3.2				2.0						2.5	2.1		3.1	3.6	
BF Cross Sectional Area (ft^2)							50.4				33.5						61.0	56.0		62.3	71.8	
Width/Depth Ratio							8.1				23.0						20.0	12.9		15.5	22.9	
Entrenchment Ratio							>2.2				5.1						>2.2	2.7		3.2	3.7	
Bank Height Ratio							1.0				1.0						1.0	1.0		1.0	1.7	
Profile																						
Riffle length (ft)							----				----						----	5	38	29	114	29.9
Riffle slope (ft/ft)							----				----						----	0.0000	0.0050	0.0024	0.0263	0.0070
Pool length (ft)							----				----						----	8	33	17	172	37.0
Pool Max depth (ft)							4.5				2.8						----	2.1		3.1	3.6	
Pool spacing (ft)							----			25			104				----	26	93	72	260	56
Pattern																						
Channel Beltwidth (ft)							----				77						----	Channel Sinuosity 1.0 to 1.1; therefore, no pattern variables are able to be calculated.				
Radius of Curvature (ft)							----				----						----					
Rc:Bankfull width (ft/ft)							----				----						----					
Meander Wavelength (ft)							----			94			100				----					
Meander Width ratio							----				2.8						----					
Transport parameters																						
Reach Shear Stress (competency) lbs/ft^2																						
Max part size (mm) mobilized at bankfull																						
Stream Power (transport capacity) W/m^2																						
Additional Reach Parameters																						
Rosgen Classification					E5-type					C4-type					C5-type			C-type				
Bankfull Velocity (fps)																						
Bankfull Discharge (cfs)																						
Valley Length (ft)					-----					----												
Channel Thalweg Length (ft)					-----					----					2235			2235				
Sinuosity					1.0					1.1					1.0			1.0				
Water Surface Slope (ft/ft)					0.0009					0.0077					0.0009			0.0017				
BF slope (ft/ft)					-----					-----					-----			----				
Bankfull Floodplain Area (acres)					-----					----					-----			----				
% of Reach with Eroding Banks					-----					-----												
Channel Stability or Habitat Metric					----					-----												
Biological or Other					-----					-----												

Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Greenbrier Creek (DMS Project Number 671)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							Monitoring Baseline						
Ri%/RU%P%G%/S%																						38	13	35	15			
SC%/SA%/G%/C%/B%BE%																												
d16/d35/d50/d84/d95								0.09	1.5	9.5	65.0	120.0																
Entrainment Class <1.5/1.5-1.99/2.0-4.9/5.0-																												
Incision Class <1.2/1.2-1.49/1.5-1.99/>2.0																												

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)
Greenbrier Creek (DMS Project Number 671)

Parameter	Cross Section 1 - UT Pool							Cross Section 2 - UT Riffle							Cross Section 3 - UT Pool							Cross Section 4 - UT Pool						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)		15.7	16.1	14.7	14.4	14.7			14.5	14.2	15.3	15.5	15.5			17.6	17.5	17.5	17.4	17.9			23.1	21.7	20.8	19.8	20.2	
Floodprone Width (ft) (approx)		NA	NA	NA	NA	NA			100.0	100.0	100.0	100.0	100.0			NA	NA	NA	NA	NA			NA	NA	NA	NA	NA	
BF Mean Depth (ft)		1.2	1.2	1.4	1.4	1.5			0.8	1.0	0.9	0.9	0.9			1.4	1.4	1.4	1.5	1.6			1.0	1.0	1.0	1.0	1.0	
BF Max Depth (ft)		2.3	2.4	2.4	2.3	2.4			1.2	1.3	1.3	1.3	1.3			2.4	2.6	2.6	2.8	2.8			2.1	2.1	2.2	2.1	2.2	
BF Cross Sectional Area (ft^2)		19.6	19.6	20.1	20.1	22.6			12.0	14.2	13.9	13.4	14.1			24.8	24.6	25.3	26.6	28.1			22.3	22.1	20.8	19.6	19.8	
Width/Depth Ratio		NA	NA	NA	NA	NA			17.5	14.2	16.8	17.9	17.0			NA	NA	NA	NA	NA			NA	NA	NA	NA	NA	
Entrenchment Ratio		NA	NA	NA	NA	NA			6.9	7.0	6.5	6.5	6.5			NA	NA	NA	NA	NA			NA	NA	NA	NA	NA	
Bank Height Ratio		NA	NA	NA	NA	NA			1.0	1.0	1.0	1.0	1.0			NA	NA	NA	NA	NA			NA	NA	NA	NA	NA	
d50 (mm)		----	----	----	----	----			60.4	41.3	25.3	18.8	12.5			----	----	----	----	----			----	----	----	----	----	

Table 11b. Monitoring Data - Stream Reach Data Summary
Greenbrier Creek (DMS Project Number 671)

Parameter	Baseline					MY-1 (UT)					MY-2 (UT)					MY-3 (UT)					MY-4 (UT)					MY-5 (UT)				
Dimension and Substrate - Riffle Only	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**	**Min**	**Mean**	**Med**	**Max**	**SD**
BF Width (ft)						14.5		14.7	16.5		15.3		15.6	17.3		13.7		15.3	16.9		14.1		17.5	15.5		15.5		15.5	16.8	
Floodprone Width (ft)								100					100					100					100					100		
BF Mean Depth (ft)						0.7		0.8	0.9		0.7		0.8	0.9		0.7		0.8	0.9		0.7		0.8	0.9		0.7		0.8	0.9	
BF Max Depth (ft)						1.2		1.3	1.5		1.3		1.3	1.5		1.3		1.3	1.4		1.3		1.3	1.4		1.2		1.3	1.6	
BF Cross Sectional Area (ft^2)						11.9		12.0	12.7		12.2		12.6	14.2		11.5		11.6	13.9		11.4		12.2	13.4		11.1		12.2	14.1	
Width/Depth Ratio						16.3		18.1	23.6		17.0		19.5	24.7		17.0		17.1	24.1		17.2		17.6	25.0		17.2		19.4	24.0	
Entrenchment Ratio						6.1		6.6	6.9		5.8		6.2	6.5		5.9		6.6	7.3		5.7		6.4	7.1		6.0		6.3	6.5	
Bank Height Ratio								1.0					1.0					1.0					1.0					1.0		
Profile - Main Channel																														
Riffle length (ft)						5	38	29	114	30	10	48	34	194	45	13	72	32	239	76	15	64	33	231	62	19	54	34	213	53
Riffle slope (ft/ft)						0.0000	0.0049	0.0024	0.0263	0.0071	0.0000	0.0039	0.0006	0.0199	0.0067	0.0000	0.0074	0.0017	0.0217	0.0084	0.0000	0.0087	0.0025	0.0325	0.0105	0.0000	0.0080	0.0050	0.0261	0.0086
Pool length (ft)						8	33	17	172	37	2	47	27	181	43	16	52	30	169	45	5	58	25	168	64	8	48	26	174	49
Pool Max depth (ft)						3.4		4.2	4.6		2.0		3.1	4.0		3.4		3.5	4.0		3.5		3.5	5.1		3.3		3.7	5.2	
Pool spacing (ft)						26	93	72	260	56	25	101	98	220	54	34	137	116	295	84	30	147	143	284	85	51	128	101	256	70
Profile - Unnamed Tributary (* No Water in Channel During Field Surveys)																														
Riffle length (ft)						2	12	10	32	7	3	17	16	51	12	2	14	14	30	8	6	19	17	40	9	5	17	14	45	11
Riffle slope (ft/ft)						NA*	NA*	NA*	NA*	NA*	0.0000	0.0164	0.0124	0.0481	0.0147	0.0007	0.0206	0.0124	0.0820	0.0211	0.0000	0.0188	0.0141	0.0785	0.0207	0.0000	0.0200	0.0155	0.0701	0.0200
Pool length (ft)						4	10	9	25	36	2	7	6	25	6	3	15	11	84	17	2	15	14	43	11	4	18	16	43	10
Pool Max depth (ft)						2.1		2.3	2.4		1.3		1.3	1.5		2.2		2.4	2.6		2.1		2.3	2.8		2.2		2.4	2.8	
Pool spacing (ft)						8	23	22	42	9	14	32	31	58	12	7	34	33	120	23	9	39	35	81	18	19	39	38	69	15
Pattern																														
Channel Beltwidth (ft)						Channel Sinuosity 1.0 to 1.1; therefore, no pattern variables are able to be calculated.																										
Radius of Curvature (ft)																														
Rc:Bankfull width (ft/ft)																														
Meander Wavelength (ft)																														
Meander Width ratio																														
Additional Reach Parameters																														
Rosgen Classification						C-Type					C-Type					C-Type					C-Type					C-Type				
Channel Thalweg Length (ft)						868					866					864					866					869				
Sinuosity						1.1					1.1					1.1					1.1					1.1				
Water Surface Slope (Channel) (ft/ft)						----					0.0092					0.0102					0.0103					0.0100				
BF slope (ft/ft)						----					----					----					----					----				
Ri%/RU%P%G%/S%						36	17	32	15		51	17	21	11		36	11	43	10		36	15	35	14		36	9	45	10	
SC%/SA%/G%/C%/B%BE%											4	7	60	29	0	7	15	52	26	0	4	23	48	25	0	2	22	54	22	0
d16/d35/d50/d84/d95											14.1	29.8	43	85	112	0.79	25.8	41.8	80	111	0.5	15.1	32.6	72	120	0.5	12.6	23.8	76	123
% of Reach with Eroding Banks						0					0					0					0					0				
Channel Stability or Habitat Metric																														
Biological or Other																														

* No Water in UT During Field Measurements.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections) (continued)
Greenbrier Creek (DMS Project Number 671)

Parameter	Cross Section 5 - UT Riffle							Cross Section 6 - UT Riffle							Cross Section 7 - Main Tributary Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)		16.5	17.3	16.9	17.5	16.8			14.7	15.6	13.7	11.4	15.5			30.8	31.6	31.5	31.2	31.4	
Floodprone Width (ft) (approx)		100.0	100.0	100.0	100.0	100.0			100.0	100.0	100.0	100.0	100.0			100.0	100.0	100.0	100.0	100.0	
BF Mean Depth (ft)		0.7	0.7	0.7	0.7	0.7			0.9	0.8	0.8	1.0	0.8			2.3	2.2	2.2	2.3	2.4	
BF Max Depth (ft)		1.3	1.3	1.3	1.3	1.2			1.5	1.5	1.4	1.4	1.6			3.6	3.4	3.5	3.5	3.7	
BF Cross Sectional Area (ft^2)		11.9	12.6	11.5	12.2	11.1			12.7	12.2	11.6	11.4	12.2			71.8	69.7	69.7	70.2	74.5	
Width/Depth Ratio		22.9	23.8	24.8	25.1	25.4			17.0	19.9	16.2	11.4	19.7			13.4	14.3	14.2	13.9	13.2	
Entrenchment Ratio		6.1	5.8	5.9	5.7	6.0			6.8	6.4	7.3	8.8	6.5			3.2	3.2	3.2	3.2	3.2	
Bank Height Ratio		1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0	1.0	
d50 (mm)		58.6	46.1	47.7	43.1	37.9			50.0	39.6	51.4	33.9	33.9			8.3	7.4	11.7	9.4	6.9	

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections) (continued)
Greenbrier Creek (DMS Project Number 671)

Parameter	Cross Section 8 - Main Channel							Cross Section 9 - Main Channel							Cross Section 10 - Main Channel							Cross Section 11 - Main Channel						
	Pool							Riffle							Pool							Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)		38.7	36.8	38.6	38.1	38.4			31.0	30.8	30.9	31.2	31.2			37.4	37.9	36.9	36.5	36.7			27.0	26.5	26.5	25.1	25.4	
Floodprone Width (ft) (approx)		NA	NA	NA	NA	NA			100.0	100.0	100.0	100.0	100.0			NA	NA	NA	NA	NA			100.0	100.0	100.0	100.0	100.0	
BF Mean Depth (ft)		2.8	2.7	2.6	2.7	2.6			2.0	2.1	1.9	1.9	2.1			2.9	2.9	2.7	3.1	3.1			2.1	2.1	2.2	2.5	2.9	
BF Max Depth (ft)		4.2	4.0	4.2	4.1	4.2			3.1	3.2	3.0	3.2	3.2			4.6	4.6	4.0	5.1	5.2			3.0	3.0	3.4	4.5	4.6	
BF Cross Sectional Area (ft^2)		109.8	98.3	101.1	103.8	99.1			62.3	63.8	60.0	60.0	64.2			109.7	109.5	100.4	112.6	113.8			56.0	55.8	59.2	64.0	72.4	
Width/Depth Ratio		NA	NA	NA	NA	NA			15.4	14.9	15.9	16.2	15.2			NA	NA	NA	NA	NA			13.0	12.6	11.9	9.8	8.9	
Entrenchment Ratio		NA	NA	NA	NA	NA			3.2	3.2	3.2	3.2	3.2			NA	NA	NA	NA	NA			3.7	3.8	3.8	4.0	3.9	
Bank Height Ratio		NA	NA	NA	NA	NA			1.4	1.4	1.7	1.4	1.4			NA	NA	NA	NA	NA			1.7	1.6	1.6	1.6	1.6	
d50 (mm)		----	----	----	----	----			4.0	2.8	0.7	0.7	1.4			----	----	----	----	----			1.0	2..8	4.3	2.0	3.4	

Table 11b. Monitoring Data - Stream Reach Data Summary (continued)
Greenbrier Creek (DMS Project Number 671)

Parameter	Baseline					MY-1 (Main Channel)					MY-2 (Main Channel)					MY-3 (Main Channel)					MY-4 (Main Channel)					MY-5 (Main Channel)				
Dimension and Substrate - Riffle Only	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD
BF Width (ft)						27.0		31.0	37.1		26.5		32.1	37.1		26.5		37.0	38.6		25.1		37.0	39		25.4		36.4	38.4	
Floodprone Width (ft)								100					100					100					100					100		
BF Mean Depth (ft)						1.6		2.0	2.3		1.6		2.1	2.7		1.5		2.0	2.6		1.5		2.0	2.7		1.5		2.1	2.9	
BF Max Depth (ft)						2.1		3.1	3.6		2.0		3.1	4.0		2.1		3.2	4.2		2.1		3.3	4.5		2.1		3.4	4.6	
BF Cross Sectional Area (ft^2)						56.0		62.3	71..8		55.8		57.6	98.3		56.6		60.0	101.1		56.8		64.0	103.8		55.5		72.4	99.1	
Width/Depth Ratio						12.9		15.5	22.9		12.6		14.7	23.2		12.0		16.3	24.7		10.0		16.4	24.7		8.8		14.9	24.3	
Entrenchment Ratio						2.7		3.2	3.7		2.7		3.1	3.8		2.6		2.7	3.8		2.6		2.7	4.0		2.6		2.7	3.9	
Bank Height Ratio						1.0		1.0	1.7		1.0		1.0	1.7		1.0		1.0	1.6		1.0		1.0	1.5		1.0		1.0	1.4	
Profile - Main Channel																														
Riffle length (ft)						5	38	29	114	30	10	48	34	194	45	13	72	32	239	76	15	64	33	231	62	19	54	34	213	53
Riffle slope (ft/ft)						0.0000	0.0049	0.0024	0.0263	0.0071	0.0000	0.0039	0.0006	0.0199	0.0067	0.0000	0.0074	0.0017	0.0217	0.0084	0.0000	0.0087	0.0025	0.0325	0.0105	0.0000	0.0080	0.0050	0.0261	0.0086
Pool length (ft)						8	33	17	172	37	2	47	27	181	43	16	52	30	169	45	5	58	25	168	64	8	48	26	174	49
Pool Max depth (ft)						3.4		4.2	4.6		2.0		3.1	4.0		3.4		3.5	4.0		3.5		3.5	5.1		3.3		3.7	5.2	
Pool spacing (ft)						26	93	72	260	56	25	101	98	220	54	34	137	116	295	84	30	147	143	284	85	51	128	101	256	70
Profile - Unnamed Tributary (* No Water in Channel During Field Surveys)																														
Riffle length (ft)						2	12	10	32	7	3	17	16	51	12	2	14	14	30	8	6	19	17	40	9	5	17	14	45	11
Riffle slope (ft/ft)						NA*	NA*	NA*	NA*	NA*	0.0000	0.0164	0.0124	0.0481	0.0147	0.0007	0.0206	0.0124	0.0820	0.0211	0.0000	0.0188	0.0141	0.0785	0.0207	0.0000	0.0200	0.0155	0.0701	0.0200
Pool length (ft)						4	10	9	25	36	2	7	6	25	6	3	15	11	84	17	2	15	14	43	11	4	18	16	43	10
Pool Max depth (ft)						2.1		2.3	2.4		1.3		1.3	1.5		2.2		2.4	2.6		2.1		2.3	2.8		2.2		2.4	2.8	
Pool spacing (ft)						8	23	22	42	9	14	32	31	58	12	7	34	33	120	23	9	39	35	81	18	19	39	38	69	15
Pattern																														
Channel Beltwidth (ft)						Channel Sinuosity 1.0 to 1.1; therefore, no pattern variables are able to be calculated.																										
Radius of Curvature (ft)																														
Rc:Bankfull width (ft/ft)																														
Meander Wavelength (ft)																														
Meander Width ratio																														
Additional Reach Parameters																														
Rosgen Classification						C-Type					C-Type					C-Type					C-Type					C-Type				
Channel Thalweg Length (ft)						2235					2216					2230					2247					2237				
Sinuosity						1.1					1.1					1.1					1.1					1.1				
Water Surface Slope (Channel) (ft/ft)						0.0017					0.001					0.002					0.0019					0.0019				
BF slope (ft/ft)						----					----					----					----					----				
Ri%/RU%P%G%/S%						38	13	35	15		37	9	43	11		36	11	43	10		43	9	36	12		43	10	36	12	
SC%/SA%/G%/C%/B%BE%											11	47	34	8	0	15	38	44	3	0	13	39	46	2	0	15	37	44	4	0
d16/d35/d50/d84/d95											0.09	0.23	0.8	45	76	0.07	0.35	1.3	25	53	0.077	0.32	1.4	20	52	0.067	0.37	1.6	27	61
% of Reach with Eroding Banks						0					0					0					0					0				
Channel Stability or Habitat Metric																														
Biological or Other																														

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections) (continued)
Greenbrier Creek (DMS Project Number 671)

Parameter	Cross Section 12 - Main Channel Riffle							Cross Section 13 - Main Channel Pool							Cross Section 14 - Main Channel Riffle						
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+	MY0	MY1	MY2	MY3	MY4	MY5	MY5+
BF Width (ft)		37.1	32.1	38.3	39.0	38.1			31.5	31.1	30.8	30.3	30.2			36.7	37.1	37.0	37.0	36.4	
Floodprone Width (ft) (approx)		100.0	100.0	100.0	100.0	100.0			NA	NA	NA	NA	NA			100.0	100.0	100.0	100.0	100.0	
BF Mean Depth (ft)		1.9	1.8	2.0	2.0	2.0			1.8	2.0	1.7	1.9	2.0			1.6	1.5	1.5	1.5	1.5	
BF Max Depth (ft)		3.1	3.1	3.2	3.3	3.4			3.4	3.7	3.4	3.5	3.3			2.1	2.0	2.1	2.1	2.1	
BF Cross Sectional Area (ft^2)		71.8	57.6	76.2	76.2	77.8			56.0	61.9	51.6	56.1	59.8			57.3	57.5	56.6	56.8	55.5	
Width/Depth Ratio		19.2	17.9	19.3	20.0	18.7			NA	NA	NA	NA	NA			23.5	23.9	24.2	24.1	23.9	
Entrenchment Ratio		2.7	3.1	2.6	2.6	2.6			NA	NA	NA	NA	NA			2.7	2.7	2.7	2.7	2.7	
Bank Height Ratio		1.0	1.0	1.0	1.0	1.0			NA	NA	NA	NA	NA			1.0	1.0	1.0	1.0	1.0	
d50 (mm)		0.2	0.2	0.3	0.3	0.3				----	----	----	----			46.6	14.6	1.7	1.4	6.0	

APPENDIX E

HYDROLOGY DATA

Table 12. Verification of Bankfull Events

Table 12: Verification of Bankfull Events

Greenbrier Stream Restoration Site (DMS Project Number 671)

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
9/21/2012	9/18/2012	Visual observations of overbank event including wrack lines and sediment deposition resulting from a 1.78 inch* rainfall event on September 18, 2012 that occurred after numerous rainfall events, within the 3 weeks prior, that totaled 2.34 inches*.	1
7/16/2013	7/4/2013	Visual observations of overbank event including wrack lines and sediment deposition resulting from 5.87 inches** of rainfall between 6/26/2013 and 7/4/2013.	2
7/17/2014	5/15/2014	Visual observations of wrack and sediment deposition as well as crest gauge data indicate an overbank event resulting from 3.46 inches** of rainfall on 5/15/2014.	---
9/16/2014	8/9/2014	Crest gauge data indicates an overbank event resulting from 2.34 inches** of rainfall on 8/9/2014.	---
9/16/2014	9/4/2014	Visual observations of wrack and sediment deposition as well as crest gauge data indicate an overbank event resulting from 2.15 inches** of rainfall on 9/4/2014.	3-4
4/2/2015	12/24/2014	Visual observations of wrack on the floodplain as well as crest gauge data indicates an overbank event resulting from 2.24 inches** of rainfall between 12/22/2014 and 12/24/2014.	5
4/20/2016	10/3/2015	Crest gauge data indicates an overbank event resulting from 2.71 inches*** of rainfall between 10/2/2015 and 10/3/2015.	---
4/20/2016	12/23/2015	Visual observations of wrack on the floodplain as well as crest gauge data indicates an overbank event resulting from 3.30 inches*** of rainfall between 12/22/2015 and 12/23/2015.	6
7/28/2016	7/4/2016	Visual observations of wrack on the floodplain as well as crest gauge data indicates an overbank event resulting from 2.02 inches*** of rainfall between 7/3/2016 and 7/4/2016.	7
9/22/2016	9/19/2016	Visual observations of laid back vegetation in the floodplain as well as crest gauge data indicates an overbank event resulting from 2.53 inches*** of rainfall on 9/19/2016.	8

* Reported at the Mount Vernon Springs, Siler City, NC weather station (Weather Underground 2012)
**Reported at the KNCCHAPE13, Chapel Hill, NC weather station (Weather Underground 2014, Weather Underground 2015)
*** Reported at the KBUY, Burlington, NC weather station (Weather Underground 2016)

Bankfull Event Photo 1 showing evidence of a 2012 overbank event

Bankfull Event Photo 2 showing evidence of a 2013 overbank event

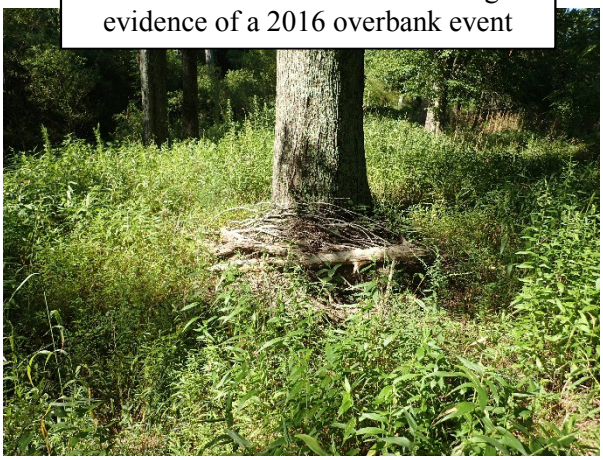
Bankfull Event Photo 3 showing evidence of a 2014 overbank event

Bankfull Event Photo 4 showing evidence of a 2014 overbank event

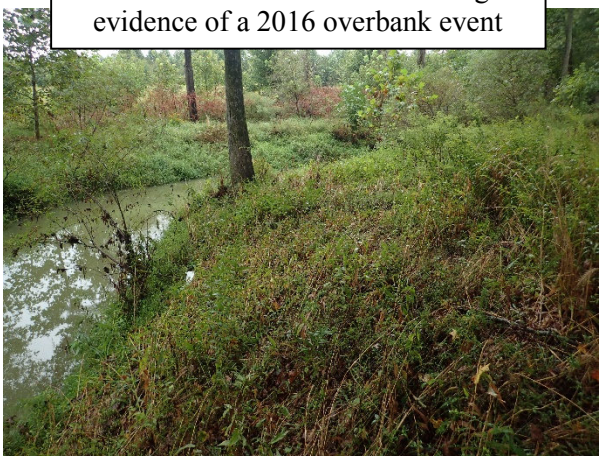
Bankfull Event Photo 5 showing evidence of a 2015 overbank event

Bankfull Event Photo 6 showing evidence of a 2015 overbank event

Bankfull Event Photo 7 showing evidence of a 2016 overbank event



Bankfull Event Photo 8 showing evidence of a 2016 overbank event



APPENDIX F. SUPPLEMENTAL PLANTING

DMS Warranty Letter
Nursery Plant List-Supplemental Planting
Contractor Completion Notification

Ecosystem Enhancement PROGRAM

November 8, 2011

Joanne Cheatham
Carolina Environmental Contracting, Inc.
PO Box 1905
Mount Airy, NC 27030

Kitara A. Smith
Great American Insurance Company
580 Walnut Street
Cincinnati, OH 45202

Re: Greenbrier Creek Stream Restoration Site
SCO # 0406210-02
Vegetation Warranty Items

Dear Ms. Cheatham:

As stated in the November 8, 2011 letter addressed to you from Ed Hajnos, portions the Greenbrier Creek project site did not meet the vegetation warranty as stated in contract documents. As per SCO contract 0406210-02 Special Provision Section 6.0, bare roots were to be planted at 680 stems per acre, and containerized seedlings at 435 per acre, of those 80% minimum were to survive for one year from Project Acceptance. The warranty period began 2/28/2011 and will expire 2/28/2012.

Field data is summarized below and supplemental information about replant requirements is attached.

Vegetation assessment methodology

Planted vegetation at the Greenbrier Creek site has been assessed once since February 2011 project planting; on September 28, 2011 by the Owner. Data collected during the sampling effort report higher plant mortality than contractually permissible. Warranty replant numbers are based on the data collected. Field methodology and data are described below.

September 28, 2011 sampling

Fourteen (14) vegetation plots were established, each 1,076 sq ft (25m x 4m) in Zone 4 of the original planting plan. All planted bare root and shrubs present within the plot were counted towards the warranty criteria, including those that were top-dead but were re-sprouting at their base. Given 680 stems were planted per acre, 544 per acre were required to survive 1 year, or 13

per plot to meet the 100% warranty. Fourteen (14) sample plots did not meet the survival criteria (Vegetation Warranty Data Map attached).

Zone 4 Data Results

Plot	Living bare roots and shrubs	Required stems per plot	Warranty meet	Supplemental planting density/acre needed to meet warranty
1	4	13	No	364
2	6	13	No	283
3	6	13	No	283
4	2	13	No	445
5	10	13	No	121
6	3	13	No	405
7	10	13	No	121
8	1	13	No	486
9	1	13	No	486
10	12	13	No	40
11	4	13	No	364
12	3	13	No	405
13	3	13	No	405
14	4	13	No	364

Two vegetation plots were established, each 1,076 sq ft (25m x 4m) in Zone 5 of the original planting plan. All containerized seedlings present within the plot were counted towards the warranty criteria, including those that were top-dead but were re-sprouting at their base. Given 435 stems were planted per acre, 348 per acre were required to survive 1-year, or 9 per plot to meet the 100% warranty. Two (2) sample plots did not meet the survival criteria (Vegetation Warranty Data Map attached).

Zone 5 Data Results

Plot	Living bare roots and shrubs	Required stems per plot	Warranty meet	Supplemental planting density/acre needed to meet warranty
1	4	9	No	202
2	7	9	No	81

Supplemental planting

In general, some of plant survival in the Zone 4 and Zone 5 planting zones did not meet the warranty requirement. The table below outlines necessary replanting areas. Surviving stems were subtracted from the warranty criteria (544/acre for Zone 4 and 348 per acre for Zone 5) so that the "Total plants needed" column is the number of remaining stems needed get warranty criteria (544/348) stems per acre in areas with deficient vegetation. Planting densities were averaged into planting zones and are identified on the attached Supplemental Planting Map.

Supplemental Planting Plan

Location (looking downstream)	Planting Zone	Average # stems/ac needed to meet warranty	Acres	Total plants needed
Zone 5 (Unnamed Tributary)	Zone 5	142	0.8	114
Unnamed Tributary (St 400+00 - 407+00) & mainstem (St 106+50 - 100+00)	Zone 4	418	3.0	1,254
Right, mainstem (St 200+00 - 205+50)	Zone 4	263	0.6	158
Left, mainstem (St 200+00 - 206+00)	Zone 4	310	0.7	217
Left, mainstem (St 212+50 - 214+00)	Zone 4	445	0.2	89
Right, mainstem (St 210+50 - 219+00)	Zone 4	121	1	121
		Total	**6.3**	**1,952**

Instructions

- The Supplemental Planting effort needs to be coordinated with EEP so we can arrange with the landowner to be on site.
- All replant materials must conform to the original project specification (dormant season planting, species composition, size, vigor, etc.)
- The Supplemental Planting effort must take place in the dormant season for Alamance County; (December 1 –April 1).
- No planting shall be done when the temperature is below 32^0 F, when the soil to be excavated for the plant hole is frozen, when the sides or bottom o the plant hole are frozen, or when the soil is too wet.

Although the warranty for this project doesn't expire until February 28, 2012, EEP does not intend to reassess the site again for additional warranty compliance. Plants installed during the warranty replant will not have a warranty place on them. Once Carolina Environmental Contracting, Inc. complies with this replanting, a Satisfaction Letter will be awarded.

If you disagree with this finding or have any questions, please contact me directly.

Sincerely,

Kristie Corson

Kristie Corson
NC Department of Environment and Natural Resources
Ecosystem Enhancement Program
Office (919) 715-1954
Cell (919) 218-1373
kristie.corson@ncdenr.gov

cc:

Ed Hajnos, EEP
Jeff Jurek, EEP
Jeff Schaffer, EEP

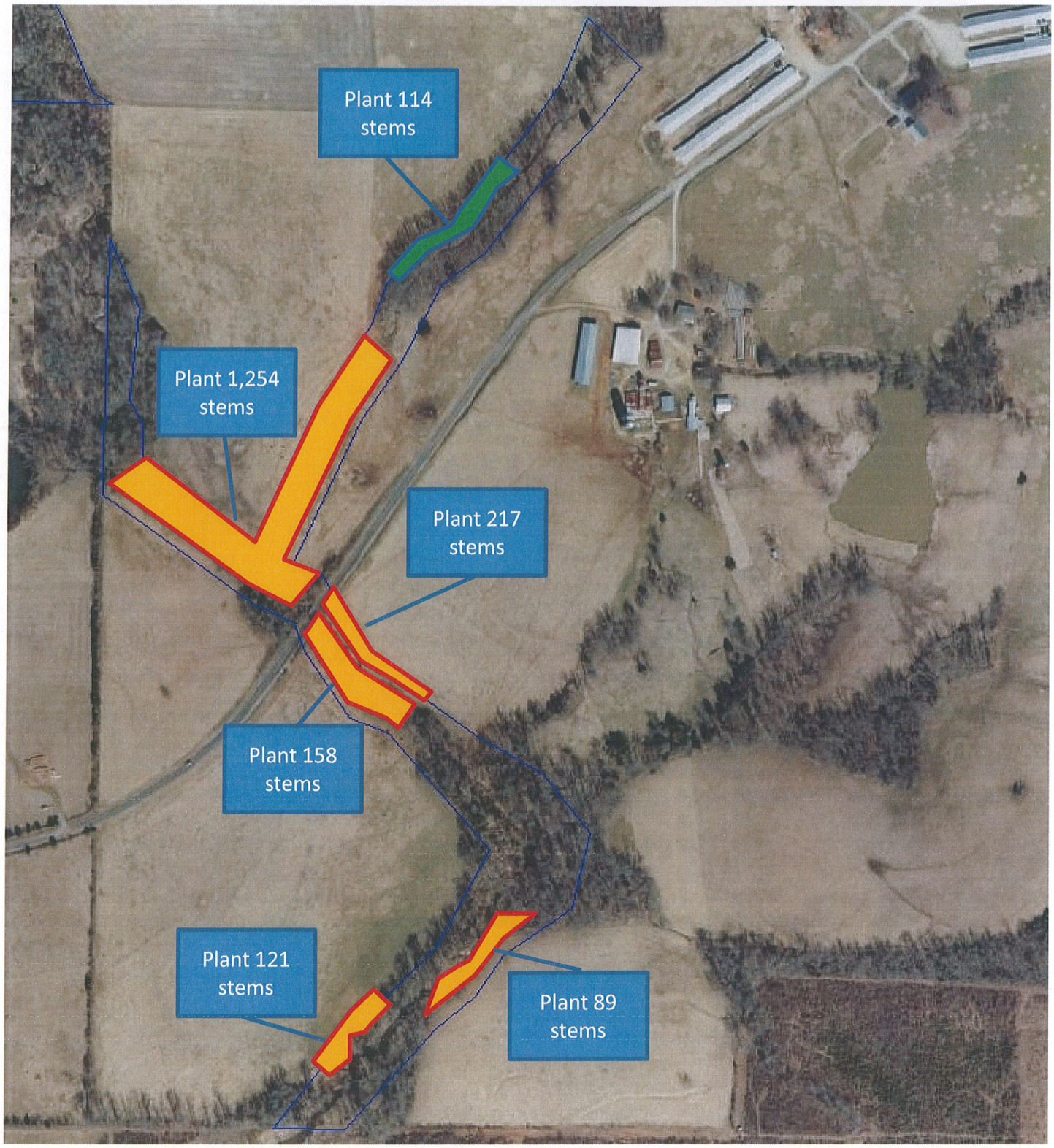
Attachments

Zone 4 plots

Zone 5 plots

conservation easement

Greenbrier Creek Stream Restoration
Alamance/Chatham Counties
Vegetation Warranty Map



Location	Planting Zone	Acres	Total plants needed
Zone 5 (Unnamed Tributary)	Zone 5	0.8	114
Unnamed Tributary (St 400+00 - 407+00) & mainstem (St 106+50 - 100+00)	Zone 4	3	1254
Right, mainstem (St 200+00 - 205+50)	Zone 4	0.6	158
Left, mainstem (St 200+00 - 206+00)	Zone 4	0.7	217
Left, mainstem (St 212+50 - 214+00)	Zone 4	0.2	89
Right, mainstem (St 210+50 - 219+00)	Zone 4	1	121
	Total	**6.3**	**1,952**

Greenbrier Creek
Vegetation Warranty Map

Zone 5 replant

Zone 4 replant

MellowMarshFarm,Inc.
Quality Wetland Plants and Seeds

Mellow Marsh Farm, Inc.
1312 Woody Store Road
Siler City, NC 27344
919.742.1200 ph
919-742-1280 fax

Invoice

DATE	INVOICE #
2/13/2012	3205

4% surcharge for payment by credit card.

BILL TO

Carolina Envirnomental Contracting, Inc.
P.O.Box 1905
Mount Airy, NC 27030
fax: 336-320-3854

SHIP TO

SHIP DATE	SHIP VIA	PROJECT	P.O. NUMBER	PAYMENT	TERMS	DUE DATE
2/13/2012	Customer	Greenbriar	Pending	check	Net 30	3/14/2012

QTY	ITEM CODE	DESCRIPTION	PRICE EACH	POT SIZE	AMOUNT
23	QURU G	Quercus rubra "Northern red oak"	5.00	gallon	115.00
23	NYSY G	Nyssa sylvatica "Black gum"	5.00	1 gallon	115.00
12	ACNE G	Acer negundo "Box elder"	5.00	gallon	60.00
3	ULAM G	Ulmus americana "American elm"	5.00	gallon	15.00
13	BENI G	Betula nigra "River birch"	5.00	1 gallon	65.00
20	QUPH G	Quercus phellos "Willow oak"	5.00	1 gallon	100.00
20	QUMI G	Quercus michauxii "Swamp chestnut oak"	5.00	1 gallon	100.00
368	FRPE BRTS	Fraxinus pennsylvanica "Green Ash"	0.80	bare root	294.40
368	PLOC BRTS	Platanus occidentalis "Sycamore"	0.80	bare root	294.40
368	NYSY BR...	Nyssa sylvatica "Black gum"	0.80	bare root	294.40
145	ACNE BR...	Acer negundo "Box elder"	0.80	bare root	116.00
368	ULAM BR...	Ulmus americana "American elm"	0.80	bare root	294.40
110	LIBE BRTS	Lindera benzoin "Spicebush"	1.25	bare root	137.50
111	VIDE BRTS	Viburnum dentatum "Arrow wood"	1.25	bare root	138.75

PO

Total	$2,139.85
Payments/Credits	$0.00
Balance Due	$2,139.85

Contract Terms & Conditions: Full payment due before delivery unless otherwise noted. If you cannot receive your order at the scheduled time, the material will require special handling and a 25% restocking or holding fee may apply. Buyer agrees to pay amount shown in 'Balance Due' according to 'Terms'. Timely payment will not be contingent on buyer's receipt of payment from his/her customer. A deposit may be required to hold plant

Carolina Environmental Contracting, Inc.
P. O. Box 1905
Mount Airy, NC 27030
Office (336) 320-3849
Fax (336) 320-3854

Certified WBE / DBE

April 24, 2012

NCEEP

Attn: Mrs. Kristie Corson

Subject: Greenbriar Stream Restoration Project.
SCO ID No.: 0406210002A

Dear Mrs. Corson,

This letter is to inform you that we were on site February 13, 2012 and February 14, 2012 to install the required plants to satisfy the requirements of the warranty for the project. CEC planted the desired plants per the drawing that was submitted to us by your office.

Sincerely,

Stephen D. James
Estimator/Project Manager

Cc. Joanne Cheatham, CEC
CEC Job File

APPENDIX G. NUTRIENT OFFSET INFORMATION

June 12, 2007 DMS Nutrient Offset Meeting Summary Letter
NCDWQ Email Response

Ecosystem Enhancement PROGRAM

August 2, 2007

Rich Gannon
North Carolina Division of Water Quality
1617 Mail Service Center
Raleigh NC 27699-1617

SUBJECT: June 12, 2007 EEP Nutrient Offset meeting summary

This correspondence is provided to summarize our June 12, 2007 meeting with you, Tom Reeder, Suzanne Klimek, Jim Stanfill and myself. The meeting was held in an attempt to clarify some issues related to EEP's use of riparian buffers to mitigate for Nitrogen and Phosphorus. It is important to come to a common understanding on these issues related to nutrient offset mitigation credit generation as we plan the implementation of mitigation projects. Below are the topics we discussed as they were presented in our May 14, 2007 letter to you. A summary of our discussions is below each topic in italics. We invite your input and response to ensure we have captured our discussions accurately.

1. Riparian Buffer N Reduction Efficiencies: With regard to the January 4, 2007 report detailing your discussions of NO_3-N reduction, we would like to clarify whether the benefits of land use change and the benefit of periodic overbank flooding have been considered in the buffer efficiency calculations. We also want to discuss EEP's buffer widths and the efficiencies that should be used for buffers 100 feet or greater. A 50% efficiency was and is used in our calculations of buffer efficiency for our offset projects. Our projects typically have 200 foot buffer widths.
   The underlying questions here were – Can EEP get more credit for buffers that are wider than 50 feet by using higher efficiency rates as shown in the NLEW paper? As a group we agreed to use an overall efficiency of 50% for riparian buffers used to offset nutrients regardless of width. Rich Gannon noted that although higher efficiencies were suggested in the "NLEW" paper for buffers wider than 50 feet, these numbers are not widely verified. It is therefore appropriate to use 50% to determine reductions. Jim Stanfill agreed noting that EEP buffers are often 200 feet wide and although using a higher efficiency would generate greater mitigation credit, the 50 % number had been used up to this point and EEP would continue to use that to calculate credits.

2. Level Spreaders: The use of level spreaders on riparian buffers not subject to concentrated flow needs to be discussed. It is our understanding that guidance on level spreaders may only be meant to apply to those riparian buffers being used as "onsite" treatment BMPs by permitees. We assume the guidance does not apply to riparian buffer restoration as typically done by EEP, but would like to discuss and get clarification on that issue.
   The standard is to provide diffuse flow through buffers. Because EEP would often need to actually clear portions of riparian buffers to install level spreaders, and also because EEP's buffers are often 200 feet wide, we do not think the use of level spreaders is necessary as long as diffuse flow is maintained. Tom Reeder and Rich Gannon agreed that level spreaders would not necessarily be needed on EEP buffers in rural areas where diffuse flow is not an issue.

3. Land Use Change: If EEP purchases agricultural land to do riparian buffer restoration we believe EEP should get credit for restoration of the entire buffer width. That is, the first 50 feet of buffer would not be excluded from our credit calculations. The argument for this is that while the act of EEP purchasing the property may have changed a property's land use and, therefore, made it subject to the buffer rules, the EEP is actually implementing an active riparian buffer restoration project on that land, not simply taking it out of agricultural use. Furthermore, if EEP does not purchase these lands, there will be no land use change.
Tom and Rich agreed with this statement- EEP should get credit for the entire width restored.

4. We also have some questions about the Jordan nutrient offset trading program, but staff are still reviewing the information that has been released.
EEP will need to provide comments on the Jordan rules to ensure the fees are set appropriately and the requirements (service area) are attainable. This area is likely to have higher implementation costs and less opportunity for lower cost buffers as nutrient offset mitigation. If EEP will accept payments in this area, we must be able to afford to implement projects.

5. EEP's Nutrient Offset Accounting Methods: *Regarding EEP's nutrient offset requirements- Jim Stanfill discussed how we measure the total pounds for 30 years when we accept a nutrient offset payment and take on a requirement. Our projects are set up to offset a total numbers of pounds and, therefore, we may have "shorter" (less than 30 years) more intense projects. Rich and Tom were in agreement with our accounting methods.*

6. Riparian Buffer Mitigation Site location – clarification of intent of rules: *In the Randleman watershed (for Cape Fear 03), EEP staff have questioned where- upstream or downstream- in the watershed the mitigation should take place. Mitigation that EEP already has downstream of the reservoir can be used, but new pursuits should be upstream in order to protect the reservoir. Likewise, in Catawba, new projects should be downstream of Lake James to be used as mitigation credit. EEP staff also clarified that the rules do not have a time requirement for EEP to provide the mitigation, but that the program uses the same time requirements as the MOU. Tom and Rich were also agreeable to this.*

7. *Rich requested that EEP allow for transparencies in its program and asked for us to provide as much data as possible in our annual report and work on information to be included on EEP's Web site. EEP agreed and is working to set up a specific web page at the program's web site devoted to the Nutrient Offset Program.*

Thank you for taking the time to discuss these issues with us. If you need additional information or want to offer corrections or clarifications to the information presented herein, please contact Kelly Williams at (919) 716-1921 or Kelly.williams@ncmail.net.

Sincerely,

Kelly Williams
In-Lieu Fee Program Coordinator

cc: Tom Reeder, NCDWQ
Jim Stanfill, NCEEP
Suzanne Klimek, NCEEP
Marc Recktenwald, NCEEP
Deborah Amaral, NCEEP

Williams, Kelly

From: Tom Reeder [tom.reeder@ncmail.net]
Sent: Wednesday, August 08, 2007 1:14 PM
To: Kelly Williams
Cc: rich.gannon@ncmail.net; suzanne Klimeck
Subject: Re: EEP Nutrient offset meeting summary

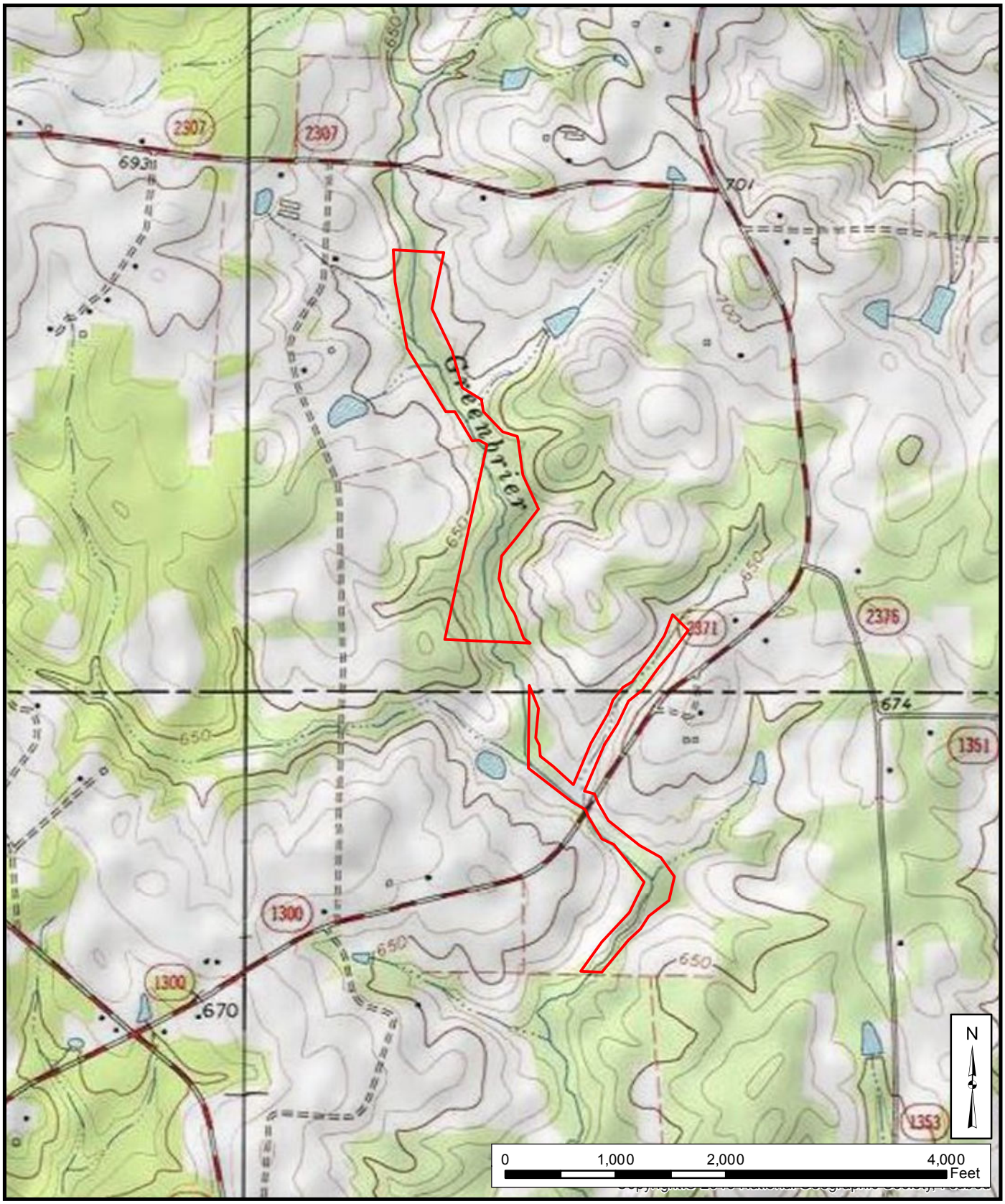
Kelly - I have read the letter and I have no problems with it. It seems to me to be an accurate record of what we discussed and agreed to. Thanks.

Kelly Williams wrote:

> Rich and Tom:
> I sent a copy of a meeting summary for your review to you last week.
> The letter is dated August 2, 2007. I have also attached it as a Word
> document. In an attempt to clarify what topics we discussed on June
> 12 when we got together in Tom's office to discuss nutrient offset and
> buffers, I simply added our understanding of our discussions beneath
> each topic as outlined in the letter sent to you prior to the meeting.
> Once you have a chance to review the summary comments (they are in
> /italics/ in the letter), I would like to hear back from you,
> especially if you have suggested changes to our summary. Feel free to
> either write back via email or add your comments or changes to the
> attached document using track changes. There are EEP staff who have
> requested a copy of the meeting summary, but I do not plan to get
> those out until I hear back from you that you are satisfied with it.
>
> Thanks for you help.
>
> Kelly Williams
> NCEEP

APPENDIX H. ADDITIONAL SITE DATA

Figure 3. USGS Topographic Map
Restoration Plan Figure 3. NRCS Soils Map
Preconstruction Photographs

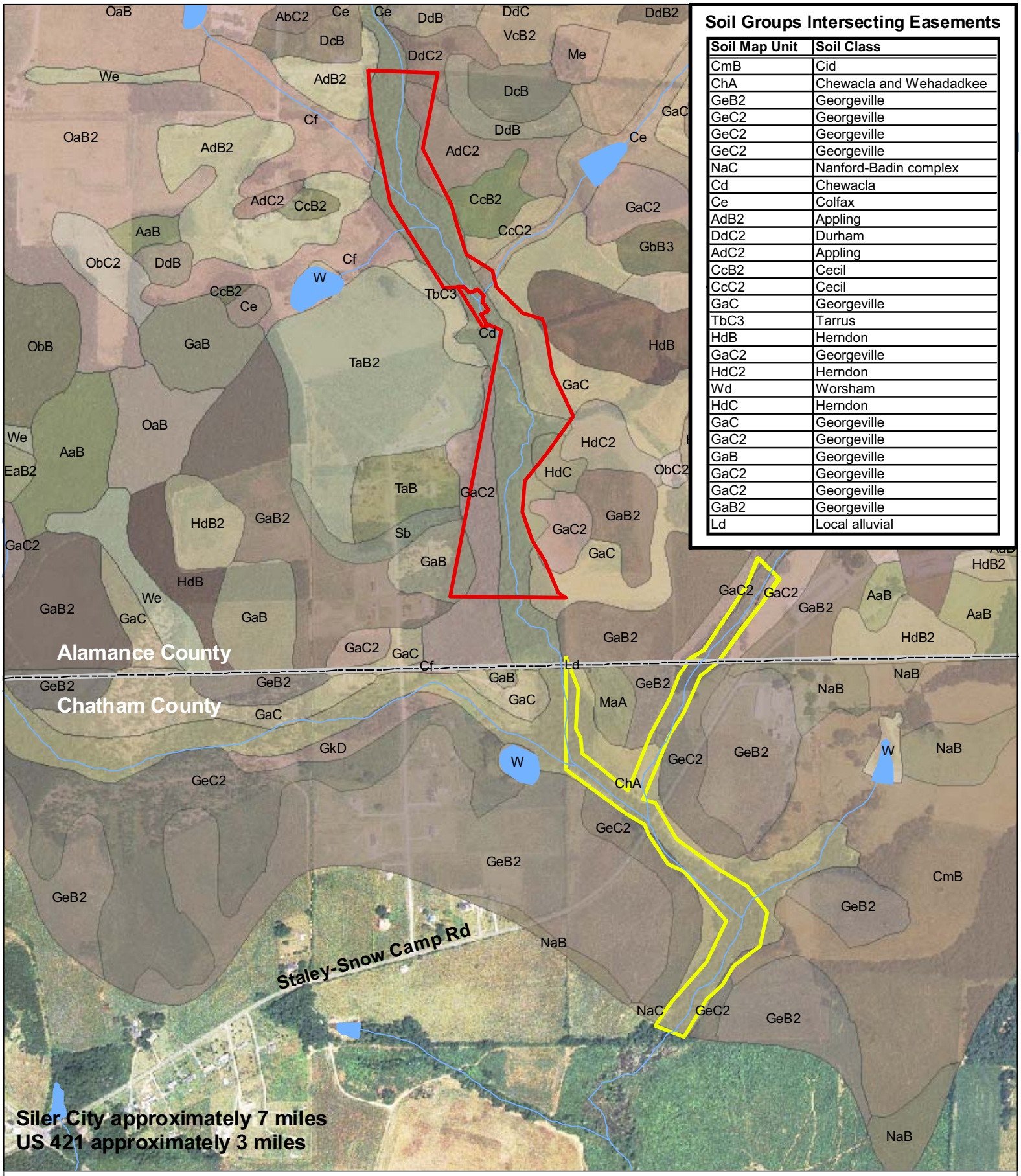


Axiom Environmental
218 Snow Ave
Raleigh, NC 27603

Axiom Environmental, Inc.

USGS TOPOGRAPHIC MAP
GREENBRIER SITE
DMS PROJECT NUMBER 671
Alamance and Chatham Counties, North Carolina

Dwn. by: KRJ	FIGURE 3
Date: Sept. 2016	
Project: 12-004.09	



Soil Groups Intersecting Easements

Soil Map Unit	Soil Class
CmB	Cid
ChA	Chewacla and Wehadadkee
GeB2	Georgeville
GeC2	Georgeville
GeC2	Georgeville
GeC2	Georgeville
NaC	Nanford-Badin complex
Cd	Chewacla
Ce	Colfax
AdB2	Appling
DdC2	Durham
AdC2	Appling
CcB2	Cecil
CcC2	Cecil
GaC	Georgeville
TbC3	Tarrus
HdB	Herndon
GaC2	Georgeville
HdC2	Herndon
Wd	Worsham
HdC	Herndon
GaC	Georgeville
GaC2	Georgeville
GaB	Georgeville
GaC2	Georgeville
GaC2	Georgeville
GaB2	Georgeville
Ld	Local alluvial

Figure 3. Project Site NRCS Soil Survey Map

Greenbrier Creek Stream Restoration

Alamance and Chatham Counties, North Carolina

May 2008

0 250 500 1,000 Feet

Legend

- Matthews Easement
- Murchison Easement
- Stream
- Lake/Pond

Ecosystem Enhancement

Biohabitats

Preconstruction Photographs