

FINAL
YEAR 1 (2014) ANNUAL MONITORING REPORT
BEAR CREEK (PHILLIPS SITE) RESTORATION PROJECT

Chatham County, North Carolina
EEP Project No. 26 (Contract No. 5715)
DWR Project No. 0713-94
SCO No. 09-07726-01A

Data Collection – May-October 2014

Cape Fear River Basin
Cataloging Unit 03030003



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1.0 PROJECT SUMMARY

The North Carolina Ecosystem Enhancement Program (EEP) has established the Bear Creek (Phillips Site) Restoration Project (Site) located off of Siler City-Glendon Road (SR 1006) in the southwest portion of Chatham County. The Site is encompassed within 14-digit Cataloging Unit 03030003070050 of the Cape Fear River Basin (Figure 1 and Table 4, Appendix A). Land use at the Site, prior to mitigation activities, was composed of agricultural uses including livestock grazing and was primarily comprised of open pasture with a few small areas of mixed hardwood forest. Site streams had been impaired by historical and current land management practices, which include timber harvesting, pasture conversion, channelization, and livestock grazing. The easement boundary currently has no signage or marking. Completed project activities, reporting history, completion dates, project contacts, and project attributes are summarized in Tables 1-4 (Appendix A). This report (compiled based on the NC Ecosystem Enhancement Program (NCEEP) *Procedural Guidance and Content Requirements for EEP Monitoring Reports* Version 1.5 dated 6/8/12) summarizes data for Year 1 (2014) monitoring.

The Site is located in the *Upper and Middle Rocky River Local Watershed Plan* (LWP) area (http://www.nceep.net/services/lwps/Rocky_Cape_Fear/Summary_of_Findings_and_RecommendationsUpperRocky_CapeFear_.pdf). The LWP identified the following major stressors in the watershed: excess nutrient loading from farming and urban runoff, a lack of riparian vegetation, channel modifications, bacterial contamination, and sediment loading from overland runoff and stream bank erosion. Specifically, cattle access to streams and insufficient bank vegetation were identified as prime causes of streambank erosion in the watershed. The LWP identified the Bear Creek Project as a stream restoration opportunity with the potential to improve water quality and habitat within the Upper Rocky River watershed.

The Site's watershed includes Hydrologic Unit Code (HUC) 03030003070050 which was identified as a Targeted Local Watershed in NCEEP's *Cape Fear River Basin Restoration Priorities (RBRP) 2009* (http://www.nceep.net/services/lwps/cape_fear/RBRP%20Cape%20Fear%202008.pdf) and is identified in the *Upper Rocky River Local Watershed Plan Detailed Assessment and Targeting of Management Report* (http://www.nceep.net/services/lwps/Rocky_Cape_Fear/Rocky_River_DATMR_Final_6-27-05.pdf).

Site construction resulted in a stable riparian system that will reduce sediment and nutrient loading to Bear Creek while contributing to water quality conditions that support terrestrial and aquatic species identified in the basin. The goals of the Bear Creek Restoration Project address stressors identified in the LWP and include the following.

- Remove harmful nutrients from creek flow,
- Reduce pollution of creeks by removing excess sediment,
- Improve stream bank stability,
- Increase dissolved oxygen concentrations,
- Improve in-stream habitat,
- Restore terrestrial habitat, and
- Improve aesthetics.

The project goals were addressed through the following project objectives.

- Cattle were removed from streams and runoff will be filtered through buffer zones. Flood flows will be filtered through restored floodplain areas, where flood flow will spread through native vegetation, which will uptake excess nutrients.
- Stream bank erosion, which contributes sediment loads to the creek, will be greatly reduced, if not eliminated in the Site. Eroding stream banks were stabilized by increasing woody root mass on banks and reducing channel incision. Storm flow containing grit and fine sediments will be filtered through restored floodplain areas where flow will spread through native vegetation. The spreading flood flows will reduce velocity, allowing sediment to settle out.
- Eroding stream banks were stabilized using bioengineering, natural channel design techniques, and grading to reduce bank angles and bank height.
- In-stream structures will promote aeration of water.
- In-stream structures were constructed to improve habitat diversity and trap detritus. Wood structures were incorporated into the stream as part of the restoration design including log drops and rock structures that incorporate woody debris.
- Adjacent buffer and riparian habitats were restored with native vegetation as part of the project. Native vegetation will provide cover and food for terrestrial creatures.
- Native plant species were planted, invasive species were treated, and eroding and unstable areas were stabilized as part of this project.

The Site mitigation plan was completed in June 2011 with the final design and construction plans completed in June 2012 (Table 2, Appendix A). Project construction was completed between April and October 2013. The implemented mitigation is as follows (Figure 2, Appendix B and Table 1, Appendix A).

- 4061 Stream Mitigation Units by:
 - Restoring approximately 4061 linear feet of stream channel through construction of stable channel at the historic floodplain elevation.
- Planting a native woody riparian buffer (at least 50 feet in width) adjacent to restored channels within the Site.
- Protecting the Site in perpetuity with a conservation easement.

Stream Success Criteria

Stream restoration success criteria for the Site are based on the *Stream Mitigation Guidelines* issued in April 2003 by the USACE and NCDWQ. Success criteria for stream restoration will include 1) documentation of two bankfull events, 2) little change in the channel cross-section from as-built conditions, 3) stable longitudinal profile, 4) substrate consistency, and 5) photographic evidence of stability.

Bankfull Events

Two bankfull flow events in separate years must be documented within the 5-year monitoring period. Otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

Cross-sections

Riffle cross-sections located on the restoration and enhancement reaches should be stable and should show little change in bankfull area, maximum depth ratio, and width-to-depth ratio. Riffle cross-sections should

generally fall within the parameters defined for channels of the appropriate Rosgen stream type. If any changes do occur, these changes will be evaluated to assess whether the stream channel is showing signs of instability. Indicators of instability include a vertically incising thalweg or eroding channel banks. Changes in the channel that indicate a movement toward stability or enhanced habitat include a decrease in the width-to-depth ratio in meandering channels or an increase in pool depth.

Longitudinal Profile

Longitudinal profile data for the stream reach should show that bedform features are remaining stable. The riffles should be steeper and shallower than the pools, while the pools should be deep with flat water surface slopes. The relative percentage of riffles and pools should not change significantly from the design parameters.

Bed Material Analysis

Substrate materials in restoration reaches should indicate a progression towards or the maintenance of coarser materials in the riffle features and smaller particles in the pool features.

Photo Reference Sites

Photographs will be used to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures subjectively. Lateral photos should not indicate excessive erosion or continuing degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation.

Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria for this project includes an average density of 320 planted stems per acre must be surviving in the first three monitoring years. Subsequently, 290 planted stems per acre must be surviving in year 4, and 260 planted stems per acre in year 5.

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 NC Ecosystem Enhancement Program (NCEEP) website. All raw data supporting the tables and figures in the appendices are available from NCEEP upon request.

2.0 METHODOLOGY

2.1 Streams

Post-restoration monitoring will be conducted for five years following the completion of construction to evaluate the effectiveness of Site restoration activities. Monitored stream parameters include stream dimension (cross-sections), pattern (longitudinal survey), profile (profile survey), and photographic documentation. Stream survey data can be found in Appendix D.

Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented using a crest gauge and visual observations. The crest gauge was installed along the streambank to record the highest watermark

between site visits, and the gauge will be checked each time the Site is visited to determine if a bankfull event has occurred (Figures 2A-2B, Appendix B). Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring Site visits.

Cross-sections

Ten permanent cross-sections, six riffle and four pool, were established and will be used to evaluate stream dimension; locations are depicted on Figures 2, 2A, and 2B (Appendix B). Because riffle cross-sections are critical in determining bankfull design parameters, the number of riffle cross-sections established outnumber pool cross-sections. Each cross-section is marked on both banks with permanent pins to establish the exact transect location. A common benchmark will be used for cross-section comparisons from year-to-year data. The annual cross-section survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System.

Longitudinal Profile

After Site construction, approximately 4100 linear feet of longitudinal profile was completed to document baseline conditions. Longitudinal profile will be resurveyed annually for the duration of the five-year monitoring period. Measurements include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each channel unit (e.g., riffle, pool) and at the maximum pool depth. The survey will be tied to a permanent benchmark.

Bed Material Analysis

Pebble counts will be conducted for six permanent riffle cross-sections (100-counts per cross-section) across the Site. Pebble counts will be completed annually during the five year monitoring period to reveal any changes in sediment gradation over time as the stream adjusts to upstream sediment loads.

Photo Reference Sites

Photographs will be used to visually document restoration success for at least five years following construction. Lateral reference photos should show a stable cross-section with no excessive erosion or degradation of the banks. Reference photographs will show both banks at each permanent cross-section. A survey tape pulled across the cross-section will be centered in the bank photographs. The photographer will make every effort to maintain the same area in each photo over time.

Stream Areas of Concern

During monitoring year 1 (2014), two stream areas of concern were observed. An outer bend on the Unnamed Tributary to Bear Creek has been severely scoured (Area of Concern #1). The bank appears unstable and is void of all vegetation. One additional area of concern is the upstream culverted crossing on Bear Creek (Area of Concern #2). Rain events since construction have caused a significant amount of debris to block the culverts. Efforts to remove debris manually have been unsuccessful. During storm events the stream is bypassing the culvert and scouring the crossing. These areas of concern are depicted on Figures 2A-2B in Appendix B.

2.2 Vegetation

After planting was completed, an initial evaluation was performed to verify planting methods were successful and to determine initial species composition and density. Twelve sample vegetation plots (10-meter by 10-meter) were installed and measured within the Site as per guidelines established in *CVS-EEP Protocol for Recording Vegetation, Version 4.2* (Lee et al. 2008). Vegetation plots are permanently monumented with 6-foot metal t-posts at each corner. In each sample plot, vegetation parameters to be

monitored include species composition and species density. Visual observations of the percent cover of shrub and herbaceous species will also be documented by photograph. Vegetation plot information can be found in Appendix C. MY1 (2014) stem count measurements indicate an average of 314 planted stems per acre (excluding livestock) across the Site, which is slightly below success criteria for monitoring year 1 (2014). Additionally, six of the twelve vegetation monitoring plots met success criteria. The lack of vegetation survival can be attributed to poor soils in the graded floodplain throughout the site. Also, just after construction was complete, several large rain events caused flooding that scoured the floodplain, leaving it bare. Vegetation is slowly establishing, but there are still many bare areas. These scoured areas have been depicted on Figures 2A-2B in Appendix B.

3.0 REFERENCES

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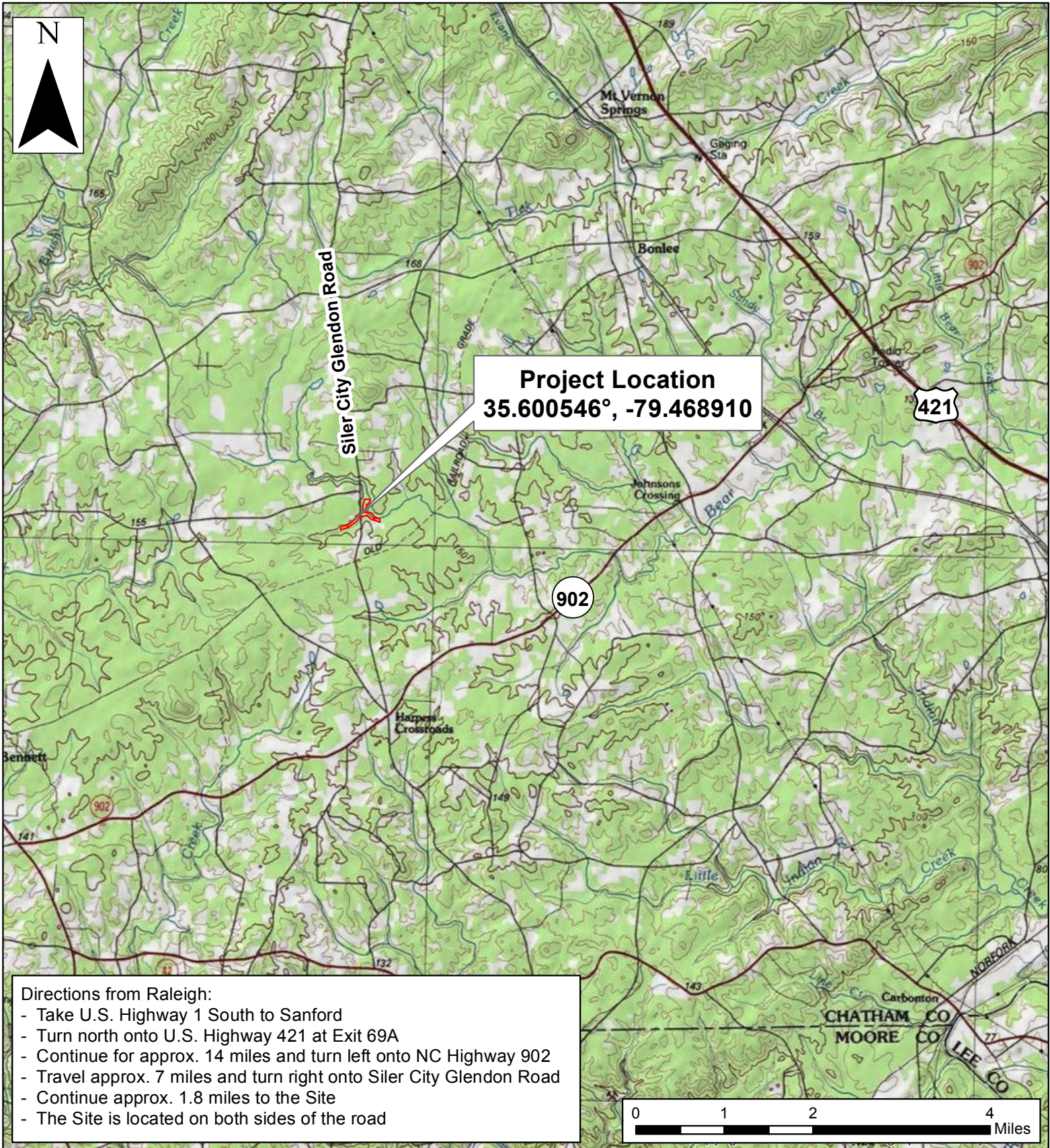
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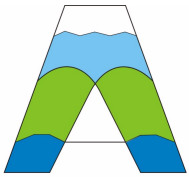

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APPENDIX A
PROJECT VICINITY MAP AND BACKGROUND TABLES

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



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 Axiom Environmental, Inc.	 Ecosystem Enhancement PROGRAM

VICINITY MAP
BEAR CREEK (PHILLIPS)
EEP PROJECT NUMBER 26
Chatham County, North Carolina

Dwn. by: PHP/KRJ	FIGURE 1
Date: April 2014	
Project: 12.004.17	

**Table 1. Project Components and Mitigation Credits
Bear Creek (Phillips Site) Restoration Project**

Mitigation Credits							
Stream		Riparian Wetland			Nonriparian Wetland		
Restoration		Restoration			Restoration		
4061		--			--		
Projects Components							
Station Range	Existing Linear Footage/Acreage	Priority Approach	Restoration/Restoration Equivalent	Restoration Linear Footage/Acreage	Mitigation Ratio	Mitigation Credits	Comment
Bear Creek Reach 1 Station 200+60 to 210+63	859	PII	Restoration	1003-25=978	1:1	978	Stream crossing (25 linear feet) removed from credit.
Bear Creek Reach 2 Station 210+63 to 222+52	1050	PII	Restoration	1189-35=1154	1:1	1154	Stream crossing (35 linear feet) removed from credit.
UT to Bear Creek Station 100+00 to 120+11	1857	PI	Restoration	2011-62-20 =1929	1:1	1929	Stream Crossing and forded crossing (62 linear feet and 20 linear feet) removed from credit.
Component Summation							
Restoration Level	Stream (linear footage)	Riparian Wetland (acreage)			Nonriparian Wetland (acreage)		
Restoration	4061	--			--		
Enhancement (Level 1)	--	--			--		
Enhancement (Level II)	--	--			--		
Totals	4061	--			--		
Mitigation Units	4061 SMUs	0.00 Riparian WMUs			0.00 Nonriparian WMUs		

**Table 2. Project Activity and Reporting History
Bear Creek (Phillips Site) Restoration Project**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Mitigation Plan	--	June 2011
Final Design – Construction Plans	--	June 2012
Construction	--	April 2013-October 2013
Temporary S&E Mix applied to Entire Project Site	--	April 2013-October 2013
Permanent Seed Mix applied to the Entire Project Site	--	April 2013-October 2013
Bare Root; Containerized; and B&B Plantings for the Entire Project Site	--	March 2014
Mitigation Plan/ As-Built (Year 0 Monitoring Baseline)	March-April 2014	May 2014
Year 1 Monitoring	September 2014	November 2014
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

**Table 3. Project Contacts Table
Bear Creek (Phillips Site) Restoration Project**

Designer	Wildlands Engineering 1430 South Mint Street, Suite 104 Charlotte, NC 28203 Emily Reinicker 704-332-7754
Construction Plans and Sediment and Erosion Control Plans	Wildlands Engineering 1430 South Mint Street, Suite 104 Charlotte, NC 28203 Emily Reinicker 704-332-7754
Construction Contractor	Land Mechanic Designs, Inc 126 Circle G Lane Willow Spring, NC 27592 Charles Hill 919-639-6132
Planting Contractor	Carolina Silvics, Inc. 908 Indian Trail Road Edenton, NC 27932 Mary-Margaret S. McKinney 252-482-8491
As-built Surveyor	Stewart-Proctor Engineering and Surveying Chapanoke Road Raleigh, NC 27603 Herb Proctor 919-779-1855
Baseline Data Collection and Annual Monitoring	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis 919-215-1693

**Table 4. Project Attribute Table
Bear Creek (Phillips Site) Restoration Project**

Project County	Chatham County, North Carolina		
Physiographic Region	Carolina Slate Belt		
Ecoregion	Piedmont		
Project River Basin	Cape Fear		
USGS HUC for Project (14 digit)	03030003070050		
NCDWQ Sub-basin for Project	06-06-12		
Planning Area	Upper and Middle Rocky River LWP		
WRC Class (Warm, Cool, Cold)	Warm		
% of project easement fenced or demarcated	100% fenced to exclude livestock		
Beaver activity observed during design phase?	unknown		
	Restoration Component Attribute Table		
	Bear Cr Reach 1	Bear Cr Reach 2	UT to Bear Cr
Drainage Area (acres)	2610	3196	565
Stream Order (USGS topo)	3rd	3rd	2nd
Restored Length (feet)	966	1179	1937
Perennial or Intermittent	P	P	P
Watershed Type	Rural		
Watershed impervious cover	<5%		
NCDWQ AU/Index number	17-43-16		
NCDWQ Classification	C	C	C
303d listed?	No		
Upstream of a 303d listed	No		
Reasons for 303d listed segment	NA		
Total acreage of easement	14.42		
Total existing vegetated acreage of easement	---		
Total planted restoration acreage	~14.42		
Rosgen Classification of preexisting	C4	G4	E/C5
Rosgen Classification of As-built	C4	C4	C5
Valley type	VIII	VIII	VIII
Valley slope	0.0031	0.0018	0.0054
Cowardin classification of proposed	NA	NA	NA
Trout waters designation	No		
Species of concern, endangered etc.	No		
Dominant Soil Series	Callison-Lignum complex 2-6% slopes (CaB)	Riverview silt loam 0-3% slopes (RvA)	Callison - misenheimer complex 6-10% slopes (CbC)

APPENDIX B

VISUAL ASSESSMENT DATA

Figures 2 and 2A-2B. Current Conditions Plan View (CCPV)
Tables 5A-5C. Visual Stream Morphology Stability Assessment
Table 6. Vegetation Condition Assessment
Vegetation Plot Photographs



Figure 2A





Figure 2B



Siler City Glendon Road

Legend

-  Easement Boundary
-  Stream Channel



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CURRENT CONDITIONS PLAN VIEW
BEAR CREEK (PHILLIPS)
EEP PROJECT NUMBER 26
Chatham County, North Carolina

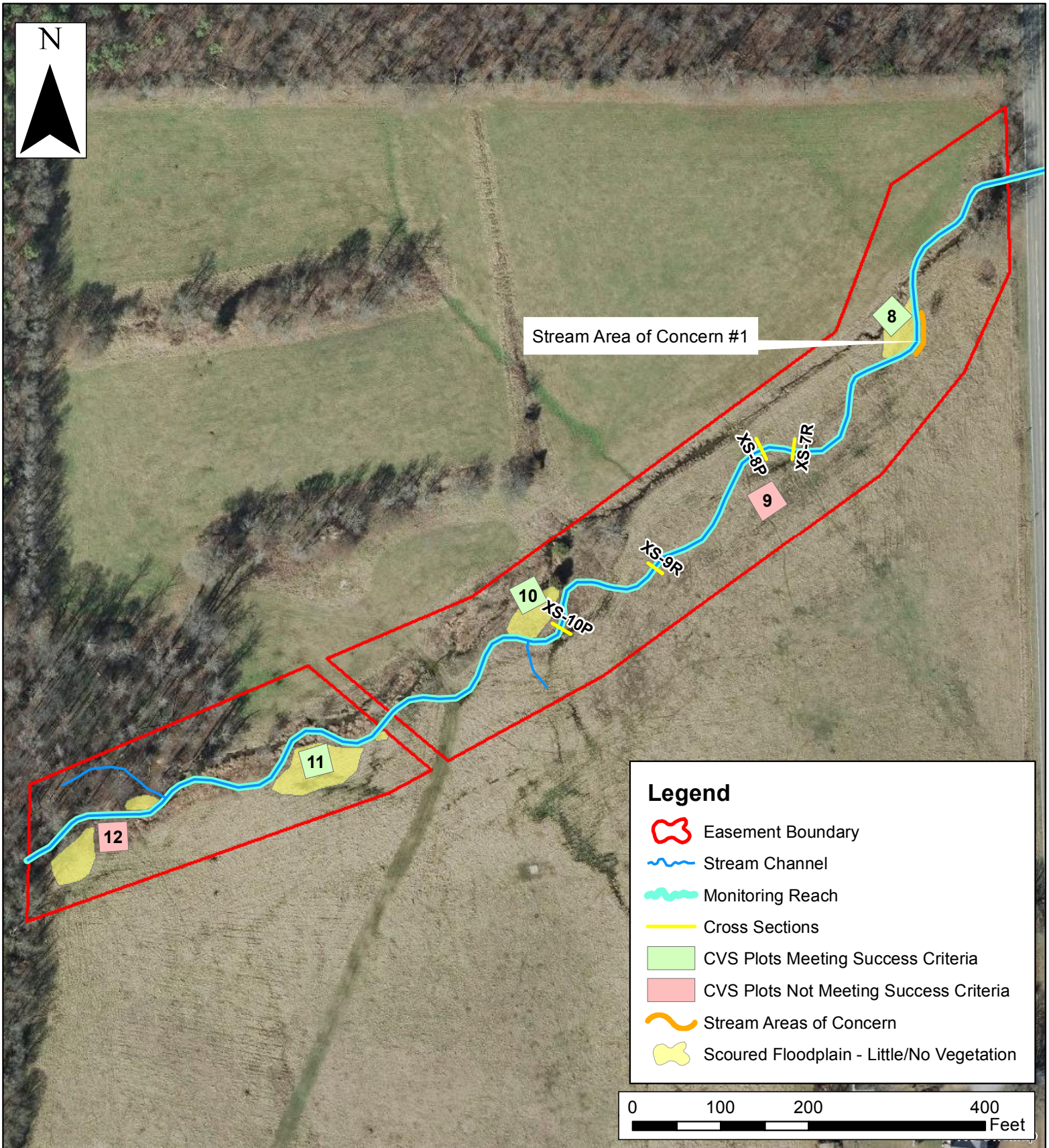
Dwn. by.
PHP/KRJ

Date:
October 2014

Project:
12.004.17

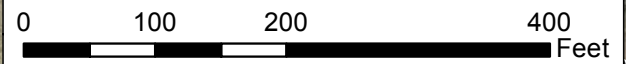
FIGURE

2




Legend

- Easement Boundary
- Stream Channel
- Monitoring Reach
- Cross Sections
- CVS Plots Meeting Success Criteria
- CVS Plots Not Meeting Success Criteria
- Stream Areas of Concern
- Scoured Floodplain - Little/No Vegetation




Prepared by:



Axiom Environmental, Inc.

Prepared for:



Ecosystem Enhancement PROGRAM

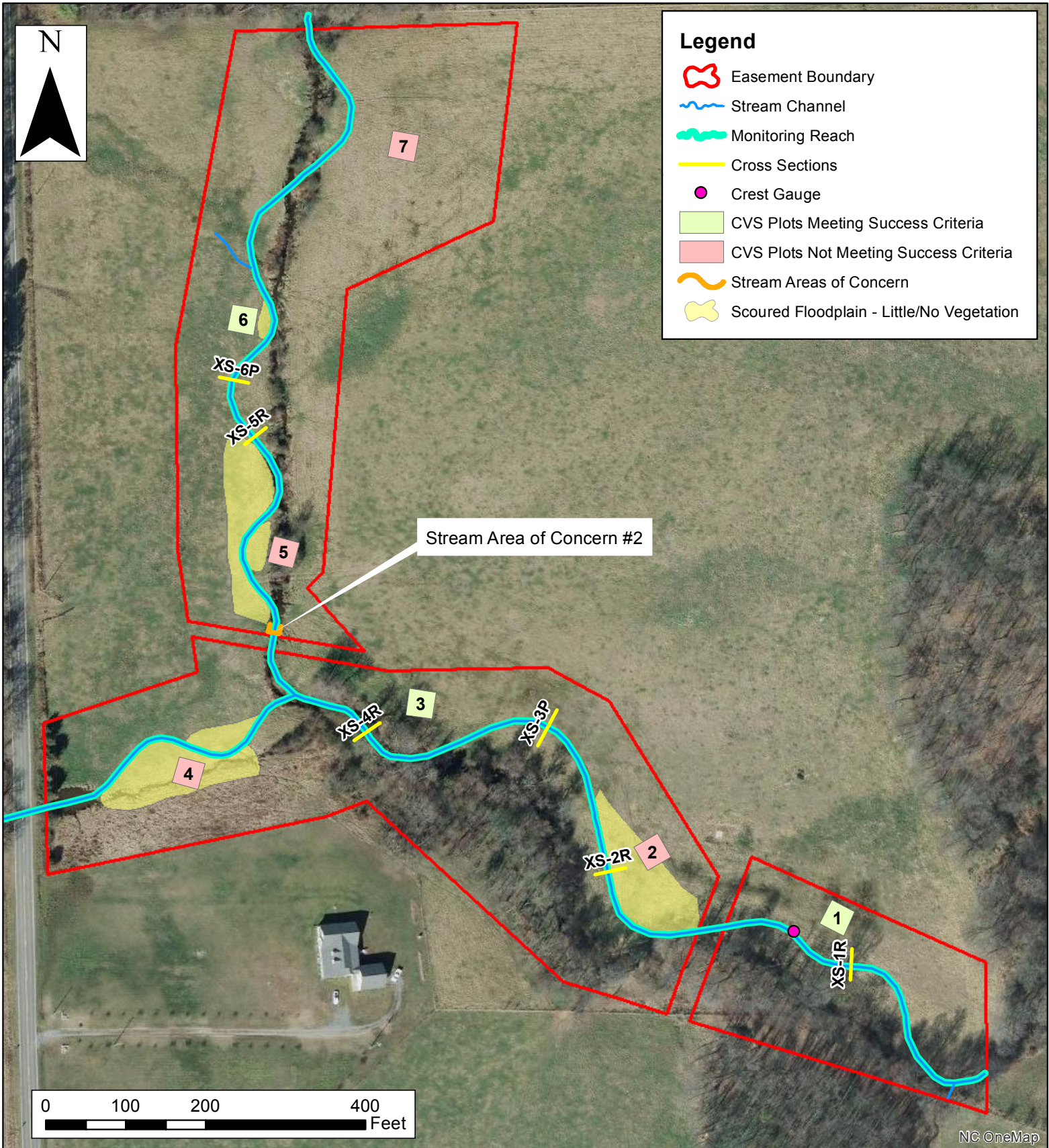
CURRENT CONDITIONS PLAN VIEW
BEAR CREEK (PHILLIPS)
EEP PROJECT NUMBER 26
Chatham County, North Carolina



Dwn. by:
PHP/KRJ

Date:
October 2014

Project:
12.004.17

FIGURE
2A



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CURRENT CONDITIONS PLAN VIEW
 BEAR CREEK (PHILLIPS)
 EEP PROJECT NUMBER 26
 Chatham County, North Carolina

Dwn. by: PHP/KRJ
Date: October 2014
Project: 12.004.17

FIGURE
2B

Table 5A
 Reach ID
 Assessed Length

Visual Stream Morphology Stability Assessment
 Bear Creek - Reach 1 (Upstream)
 966

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	7	7			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	8	8			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	8	8			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	7	7			100%			
		2. Thalweg centering at downstream of meander (Glide)	8	8			100%			
	Totals									
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 <u>NOT</u> 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										
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	15	15			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	15	15			100%			

Table 5B
 Reach ID
 Assessed Length

Visual Stream Morphology Stability Assessment
 Bear Creek - Reach 2 (Downstream)
 1179

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	10	10			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	10	10			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	10	10			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	10	10			100%			
		2. Thalweg centering at downstream of meander (Glide)	9	9			100%			
Totals					0	0	100%	0	0	100%
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%			100%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	15	15			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	15	15			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	15	15			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	15	15			100%			

Table 5C
 Reach ID
 Assessed Length

Visual Stream Morphology Stability Assessment
 UT to Bear Creek
 1937

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Riffle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	24	24			100%			
	3. Meander Pool Condition	1. <u>Depth Sufficient</u> (Max Pool Depth : Mean Bankfull Depth \geq 1.6)	24	24			100%			
		2. <u>Length</u> appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	24	24			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	24	24			100%			
		2. Thalweg centering at downstream of meander (Glide)	24	24			100%			
	Totals					1	25			
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	25	99%			99%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%			100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%			100%
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	30	30			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	30	30			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	30	30			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	30	30			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio \geq 1.6 Rootwads/logs providing some cover at base-flow.	30	30			100%			

BEAR CREEK (PHILLIPS)

Table 6 Vegetation Condition Assessment

Planted Acreage¹ **14.42**

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 floodplain	0.1 acres	Pink Polygon	12	1.06	7.4%	
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on visual observations and MY1 stem count criteria.	0.1 acres	N/A	0	0.00	0.0%	
Total					1.06	7.4%	
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	1.06	7.4%

Easement Acreage² **14.42**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern⁴	N/A	1000 SF	N/A	1	0.00	0.0%
5. Easement Encroachment Areas³	N/A	none	N/A	0	0.00	0.0%

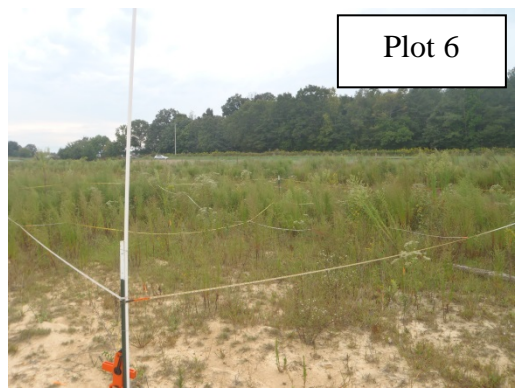
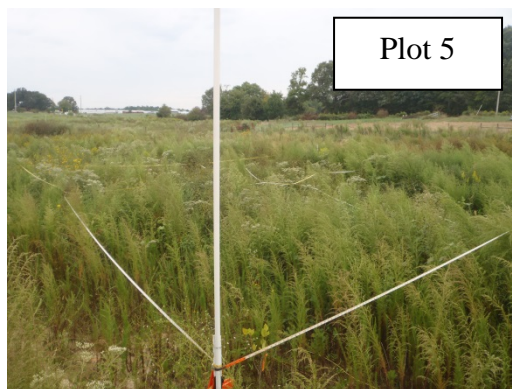
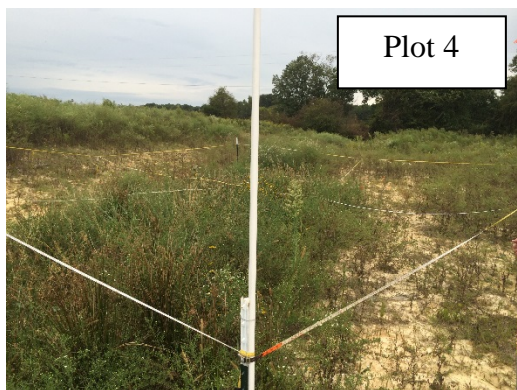
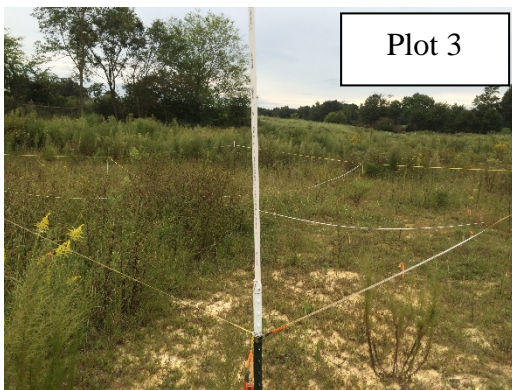
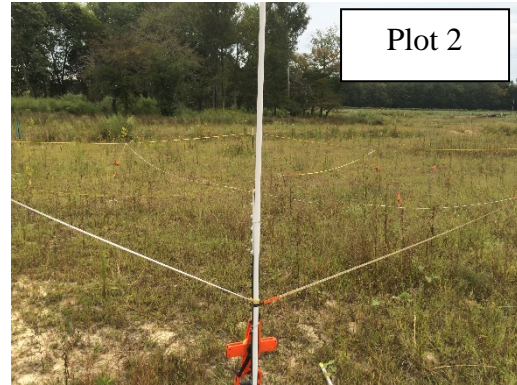
1 = Enter the planted acreage within the easement. This number is calculated as the easement acreage minus any existing mature tree stands that were not subject to supplemental planting of the understory, the channel acreage, crossings or any other elements not directly planted as part of the project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

2 = The acreage within the easement boundaries.

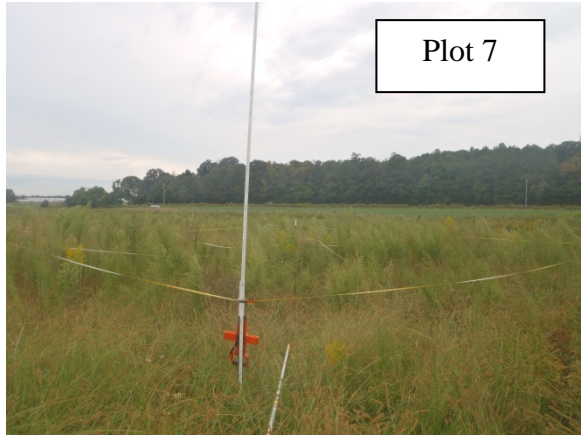
3 = Encroachment may occur within or outside of planted areas and will therefore be calculated against the overall easement acreage. In the event a polygon is cataloged into items 1, 2 or 3 in the table and is the result of encroachment, the associated acreage should be tallied in the relevant item (i.e., 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 species are those with the potential to directly outcompete native, young, woody stems in the short-term (e.g. monitoring period or shortly thereafter) or affect the community structure for existing, more established tree/shrub stands over timeframes that are slightly longer (e.g. 1-2 decades). The low/moderate concern group are those species that generally do not have this capacity over the timeframes discussed and therefore are not expected to be mapped with regularity, but can be mapped, if in the judgement of the observer their coverage, density or distribution is suppressing the viability, density, or growth of planted woody stems. Decisions as to whether remediation will be needed are based on the integration of risk factors by EEP such as species present, their coverage, distribution relative to native biomass, and the practicality of treatment. For example, even modest amounts of Kudzu or Japanese Knotweed early in the projects history will warrant control, but potentially large coverages of Microstegium in the herb layer will not likely trigger control because of the limited capacities to impact tree/shrub layers within the timeframes discussed and the potential impacts of treating extensive amounts of ground cover. Those species with the "watch list" designator in gray shade are of interest as well, but have yet to be observed across the state with any frequency. Those in *red italics* are of particular interest given their extreme risk/threat level for mapping as points where isolated specimens are found, particularly early in a projects monitoring history. However, areas of discrete, dense patches will of course be mapped as polygons. The symbology scheme below was one that was found to be helpful for symbolizing invasives polygons, particularly for situations where the condition for an area is somewhere between isolated specimens and dense, discrete 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.

**Bear Creek (Phillips Site)
Vegetation Monitoring Photographs
Taken September 2014**



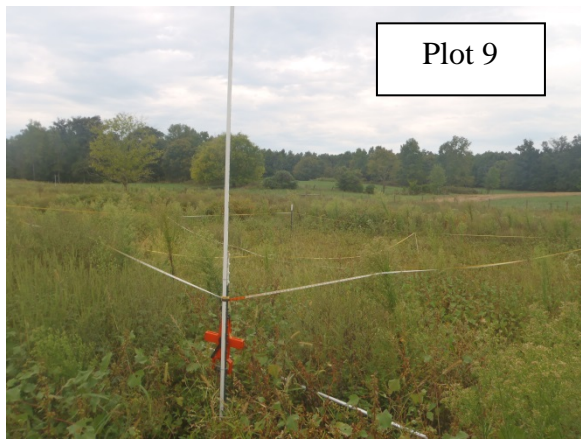
**Bear Creek (Phillips Site)
Vegetation Monitoring Photographs
Taken September 2014
(continued)**



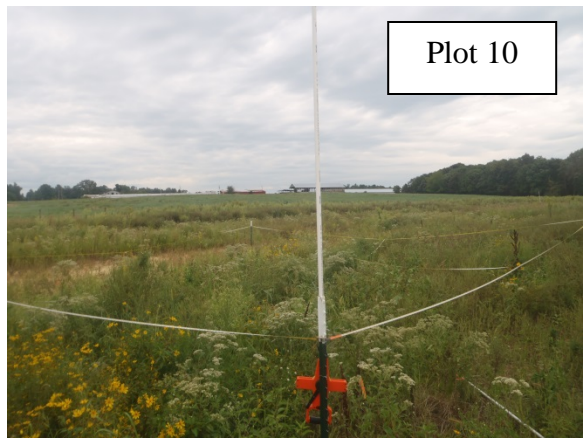
Plot 7



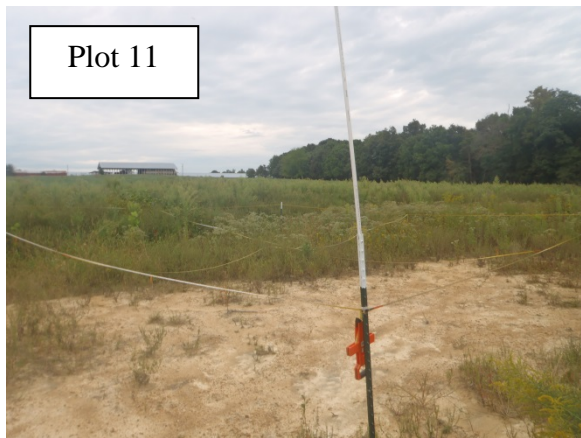
Plot 8



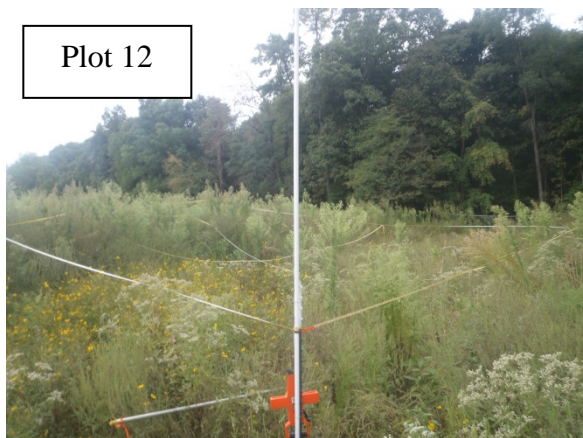
Plot 9



Plot 10



Plot 11



Plot 12

APPENDIX C

VEGETATION PLOT DATA

Table 7. Planted Woody Vegetation

Table 8. Vegetation Plot Success by Project Asset Type

Table 9. Total and Planted Stems by Plot and Species

**Table 7. Planted Woody Vegetation
Bear Creek (Phillips Site) Restoration Project**

SPECIES	QUANTITY
Bare Root Seedlings	
River birch (<i>Betula nigra</i>)	300
Green ash (<i>Fraxinus pennsylvanica</i>)	600
Sweetgum (<i>Liquidambar styraciflua</i>)	200
Tulip poplar (<i>Liriodendron tulipifera</i>)	200
Red chokeberry (<i>Photinia pyrifolia</i>)	280
American sycamore (<i>Platanus occidentalis</i>)	900
Scarlet oak (<i>Quercus coccinea</i>)	300
Swamp chestnutoak (<i>Quercus michauxii</i>)	800
Willow oak (<i>Quercus phellos</i>)	800
Southern arrowwood (<i>Viburnum dentatum</i>)	670
Rusty blackhaw (<i>Viburnum rifidulum</i>)	150
TOTAL	5200
Livestakes	
Silky dogwood (<i>Cornus amomum</i>)	2940
Black willow (<i>Salix nigra</i>)	1260
TOTAL	4200

**Table 8. Vegetation Plot Success by Plot Type
Bear Creek (Phillips Site) (#26)**

Plot #	Riparian Buffer Stems ¹	Stream/Wetland Stems ²	Live Stakes	Invasives	Volunteers ³	Total ⁴	Unknown Growth Form
1	n/a	8	0	0	0	8	0
2	n/a	5	0	0	0	8	3
3	n/a	12	0	0	1	13	0
4	n/a	2	0	0	0	2	0
5	n/a	6	0	0	0	7	1
6	n/a	10	0	0	0	11	1
7	n/a	2	0	0	0	2	0
8	n/a	11	0	0	0	13	2
9	n/a	2	0	0	0	2	0
10	n/a	10	0	0	0	10	0
11	n/a	12	0	0	0	12	0
12	n/a	6	0	0	3	9	0

Stem Class

¹Buffer Stems

²Stream/ Wetland Stems

³Volunteers

⁴Total

characteristics

Native planted hardwood trees. Does NOT include shrubs. No pines. No vines.

Native planted woody stems. Includes shrubs, does NOT include live stakes. No vines

Native woody stems. Not planted. No vines.

Planted + volunteer native woody stems. Includes live stakes. Excl. exotics. Excl. vines.

Table 9. Total and Planted Stems by Plot and Species
EEP Project Code 26. Project Name: Bear Creek (Phillips Site)

			Current Plot Data (MY1 2014)																							
Scientific Name	Common Name	Species Type	026-01-0001			026-01-0002			026-01-0003			026-01-0004			026-01-0005			026-01-0006			026-01-0007			026-01-0008		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree	1	1	1																					
Fraxinus pennsylvanica	green ash	Tree	3	3	3	2	2	2	3	3	3				1	1	1	2	2	2				6	6	6
Liquidambar styraciflua	sweetgum	Tree																								
Liriodendron tulipifera	tuliptree	Tree																								
Photinia pyrifolia	red chokeberry					3	3	3						1	1	1	1	1	1				2	2	2	
Platanus occidentalis	American sycamore	Tree	1	1	1	1	1	1	1	1	1			3	3	3	4	4	4	1	1	1	2	2	2	
Quercus	oak	Tree	2	2	2	2	2	2	1	1	1															
Quercus michauxii	swamp chestnut oak	Tree							4	4	4			1	1	1							1	1	1	
Quercus phellos	willow oak	Tree	1	1	1				1	1	1	1	1	1			1	1	1	1	1	1	2	2	2	
Ulmus americana	American elm	Tree							1	1	2			1	1	1	3	3	3							
Viburnum	viburnum	shrub										1	1	1												
Viburnum dentatum	southern arrowwood	Shrub							1	1	1															
Stem count			8	8	8	8	8	8	12	12	13	2	2	2	7	7	7	11	11	11	2	2	2	13	13	13
size (ares)			1			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			5	5	5	4	4	4	7	7	7	2	2	2	5	5	5	5	5	5	2	2	2	5	5	5
Stems per ACRE			323.7	323.7	323.7	323.7	323.7	323.7	485.6	485.6	526.1	80.94	80.94	80.94	283.3	283.3	283.3	445.2	445.2	445.2	80.94	80.94	80.94	526.1	526.1	526.1

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

P-all = Planting including livestakes
 T = All planted and natural recruits including livestakes
 T includes natural recruits

Table 9. Total and Planted Stems by Plot and Species (cont'd)
EEP Project Code 26. Project Name: Bear Creek (Phillips Site)

			Current Plot Data (MY1 2014)												Annual Means					
Scientific Name	Common Name	Species Type	026-01-0009			026-01-0010			026-01-0011			026-01-0012			MY1 (2014)			MY0 (2014)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Betula nigra	river birch	Tree				4	4	4	7	7	7	2	2	2	14	14	14	26	26	26
Fraxinus pennsylvanica	green ash	Tree	1	1	1										18	18	18	18	18	18
Liquidambar styraciflua	sweetgum	Tree												3			3			
Liriodendron tulipifera	tuliptree	Tree																1	1	1
Photinia pyrifolia	red chokeberry														7	7	7	8	8	8
Platanus occidentalis	American sycamore	Tree				2	2	2	2	2	2	2	2	2	19	19	19	22	22	22
Quercus	oak	Tree													5	5	5	56	56	56
Quercus michauxii	swamp chestnut oak	Tree	1	1	1										7	7	7	3	3	3
Quercus phellos	willow oak	Tree				3	3	3	3	3	3	2	2	2	15	15	15	2	2	2
Ulmus americana	American elm	Tree													5	5	6			
Viburnum	viburnum	shrub													1	1	1	4	4	4
Viburnum dentatum	southern arrowwood	Shrub				1	1	1							2	2	2	1	1	1
Stem count			2	2	2	10	10	10	12	12	12	6	6	9	93	93	97	141	141	141
size (ares)			1			1			1			1			12			12		
size (ACRES)			0.02			0.02			0.02			0.02			0.30			0.30		
Species count			2	2	2	4	4	4	3	3	3	3	3	4	10	10	11	10	10	10
Stems per ACRE			80.94	80.94	80.94	404.7	404.7	404.7	485.6	485.6	485.6	242.8	242.8	364.2	313.6	313.6	327.1	475.5	475.5	475.5

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

P-all = Planting including livestakes
 T = All planted and natural recruits including livestakes
 T includes natural recruits

Appendix D.
Stream Geomorphology Data

Tables 10a-10f. Baseline Stream Data Summary
Tables 11a-11f. Monitoring Data-Dimensional Data Summary
Cross-section Plots
Longitudinal Profile Plots
Substrate Plots

Table 10a. Baseline Stream Data Summary (Bear Creek Reach 1)
Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Gauge	Regional Curve			Pre-Existing Condition (Reach 1)					Reference Reach(es) Data					Design (Reach 1)			Monitoring Baseline									
		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD					
Dimension and Substrate - Riffle Only																											
BF Width (ft)							24.4			10.7			11.2				24.5			23.8							
Floodprone Width (ft)							310.0			60			114+		126	394				250							
BF Mean Depth (ft)							2.1			1.6			1.8				1.9			1.8							
BF Max Depth (ft)							3.2			2.1			2.6				2.8			2.8							
BF Cross Sectional Area (ft ²)							50.8			17.8			19.7				47.1			42.3							
Width/Depth Ratio							11.7			5.8			7.1				12.7			13.3							
Entrenchment Ratio							12.7			5.5			10.2+		5.1	16.1				10.5							
Bank Height Ratio							1.1						1.0				1.0			1.0							
Profile																											
Riffle length (ft)					The existing reach had little, measurable patten or profile features																						
Riffle slope (ft/ft)																		0.0130			0.0040	0.0060					
Pool length (ft)																											
Pool Max depth (ft)																					2.5	6.0					
Pool spacing (ft)																					71.0		91.0	147.0			
Pattern																											
Channel Beltwidth (ft)					The existing reach had little, measurable patten or profile features					38			41				144			144							
Radius of Curvature (ft)															11			15		44	70			44		70	
Rc:Bankfull width (ft/ft)															1.3			1.4		1.8	2.9			1.8		2.9	
Meander Wavelength (ft)															46			48		154	286			154		286	
Meander Width ratio															4.1			4.4		6.3	11.7			6.3		11.7	
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							C4						E4				C4										
Bankfull Velocity (fps)							4.5										4.9										
Bankfull Discharge (cfs)							230																				
Valley Length (ft)							781						----														
Channel Thalweg Length (ft)							859						----				----										
Sinuosity							1.1						2.3														
Water Surface Slope (ft/ft)							0.0034						0.0047														
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)
Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					Monitoring Baseline									
Ri%/RU%P%G%/S%																									
SC%/SA%/G%/C%/B%BE%																									
d16/d35/d50/d84/d95	NA	11.5	14.1	27.3	57.7																				
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 10c. Baseline Stream Data Summary (Bear Creek Reach 2)
Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Gauge	Regional Curve			Pre-Existing Condition (Reach 2)					Reference Reach(es) Data					Design (Reach 2)			Monitoring Baseline				
		LL	UL	Eq.	Min	Mean	Med	Max	SD	Min	Mean	Med	Max	SD	Min	Max	Med	Min	Mean	Med	Max	SD
Dimension and Substrate - Riffle Only																						
BF Width (ft)							26.0			10.7			11.2				28.5	27.2	28.5	29.0	29.3	1.1
Floodprone Width (ft)							250.0			60			114+		233	256			250			
BF Mean Depth (ft)							2.4			1.6			1.8				2.0	1.8	1.9	1.8	2.1	0.2
BF Max Depth (ft)							4.1			2.1			2.6				2.8	2.7	2.9	2.7	3.4	0.4
BF Cross Sectional Area (ft ²)							70.8			17.8			19.7				57.6	48.8	54.3	52.9	61.1	6.3
Width/Depth Ratio							9.7			5.8			7.1				14.1	14.0	15.1	15.0	16.1	1.1
Entrenchment Ratio							9.4			5.5			10.2+		8.2	9.0		8.5	8.8	8.6	9.2	0.4
Bank Height Ratio							1.1						1.0				1.0		1.0			
Profile																						
Riffle length (ft)																						
Riffle slope (ft/ft)													0.0130				0.0017	0.0028				
Pool length (ft)																						
Pool Max depth (ft)							4.7						3.3				2.5	6.0				
Pool spacing (ft)						100.0			250.0				71.0				82.0	203.0				
Pattern																						
Channel Beltwidth (ft)					100			180		38			41				176			176		
Radius of Curvature (ft)					80			200		11			15				55	85		55		85
Rc:Bankfull width (ft/ft)					3.1			7.7		1.3			1.4				1.9	3		1.9		3
Meander Wavelength (ft)					300			480		46			48				158	374		158		374
Meander Width ratio					4.2			6.9		4.1			4.4							6.2		62
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							G4					E4					C4					
Bankfull Velocity (fps)							3.8										4.7					
Bankfull Discharge (cfs)							270															
Valley Length (ft)							955															
Channel Thalweg Length (ft)							1050															
Sinuosity							1.1						2.3				1.2					
Water Surface Slope (ft/ft)							0.0016						0.0047				0.0041					
BF slope (ft/ft)							----						----				----					
Bankfull Floodplain Area (acres)							----						----				----					
% of Reach with Eroding Banks							----						----				----					
Channel Stability or Habitat Metric							----						----				----					
Biological or Other							----						----				----					

Table 10d. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					Monitoring Baseline									
Ri%/RU%P%G%/S%																									
SC%/SA%/G%/C%/B%BE%																									
d16/d35/d50/d84/d95																									
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 11e. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Sections)

Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Cross Section 7 (Unnamed Tributary)							Cross Section 8 (Unnamed Tributary)							Cross Section 9 (Unnamed Tributary)							Cross Section 10 (Unnamed Tributary)							
	Riffle							Pool							Riffle							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)	12.5	11.7						16.3	15.2						11.4	11.4							14.2	16.3					
Floodprone Width (ft) (approx)	80.0	80.0						NA	NA						80.0	80.0							NA	NA					
BF Mean Depth (ft)	0.9	0.9						1.4	1.5						0.9	0.9							1.3	1.2					
BF Max Depth (ft)	1.6	1.6						2.8	3.0						1.4	1.4							2.3	2.3					
BF Cross Sectional Area (ft ²)	11.8	11.1						22.2	23.0						10.0	9.9							18.4	19.0					
Width/Depth Ratio	13.2	12.3						NA	NA						13.0	13.1							NA	NA					
Entrenchment Ratio	6.4	6.8						NA	NA						7.0	7.0							NA	NA					
Bank Height Ratio	1.0	1.0						1.0	1.0						1.0	1.0							1.0	1.0					
d50 (mm)	4.3	9.4						----	----						25.7	24.2							----	----					

Table 11f. Monitoring Data - Stream Reach Data Summary

Bear Creek (Phillips Site) Restoration Project - EEP Project Number 26

Parameter	Baseline					MY-1					MY-2					MY-3					MY-4					MY-5				
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)	11.4	12.0	12.0	12.5	0.8	11.4	11.6	11.6	11.7	0.2																				
Floodprone Width (ft)		80					80																							
BF Mean Depth (ft)	0.9	1.0	1.0	1.0	0.1	0.9	1.0	1.0	1.0	0.1																				
BF Max Depth (ft)	1.4	1.5	1.5	1.6	0.1	1.4	1.5	1.5	1.6	0.1																				
BF Cross Sectional Area (ft ²)	10.0	10.9	10.9	11.8	1.3	9.9	10.5	10.5	11.1	0.8																				
Width/Depth Ratio	12.5	12.6	12.6	12.7	0.1	11.7	12.2	12.2	12.7	0.7																				
Entrenchment Ratio	6.4	6.7	6.7	7.0	0.4	6.8	6.9	6.9	7.0	0.1																				
Bank Height Ratio		1.0					1.0																							
Profile - Unnamed Tributary																														
Riffle length (ft)	9	35	29	92	21	9	32	27	99	21																				
Riffle slope (ft/ft)	0.0006	0.0081	0.0063	0.0189	0.0059	NA*	NA*	NA*	NA*	NA*																				
Pool length (ft)	4	23	19	73	15	4	21	17	47	12																				
Pool Max depth (ft)	2.3	2.6	2.3	2.8		2.3	2.7	2.7	3.0																					
Pool spacing (ft)	13	69	74	121	30	16	68	72	127	26																				
Pattern																														
Channel Beltwidth (ft)	68			77																										
Radius of Curvature (ft)	27			47																										
Rc:Bankfull width (ft/ft)	2			3.5																										
Meander Wavelength (ft)	79			165																										
Meander Width ratio	5			5.7																										
Additional Reach Parameters																														
Rosgen Classification		C-Type					C-Type																							
Channel Thalweg Length (ft)		1971					1999																							
Sinuosity		1.2					1.2																							
Water Surface Slope (Channel) (ft/ft)		0.0041					NA*																							
BF slope (ft/ft)		----					----																							
Ri%/RU%P%G%/S%	44	13	33	10		46	12	30	12																					
SC%/SA%/G%/C%/B%BE%																														
d16/d35/d50/d84/d95																														
% of Reach with Eroding Banks																														
Channel Stability or Habitat Metric																														
Biological or Other																														

NA* No water in channel during field surveys.

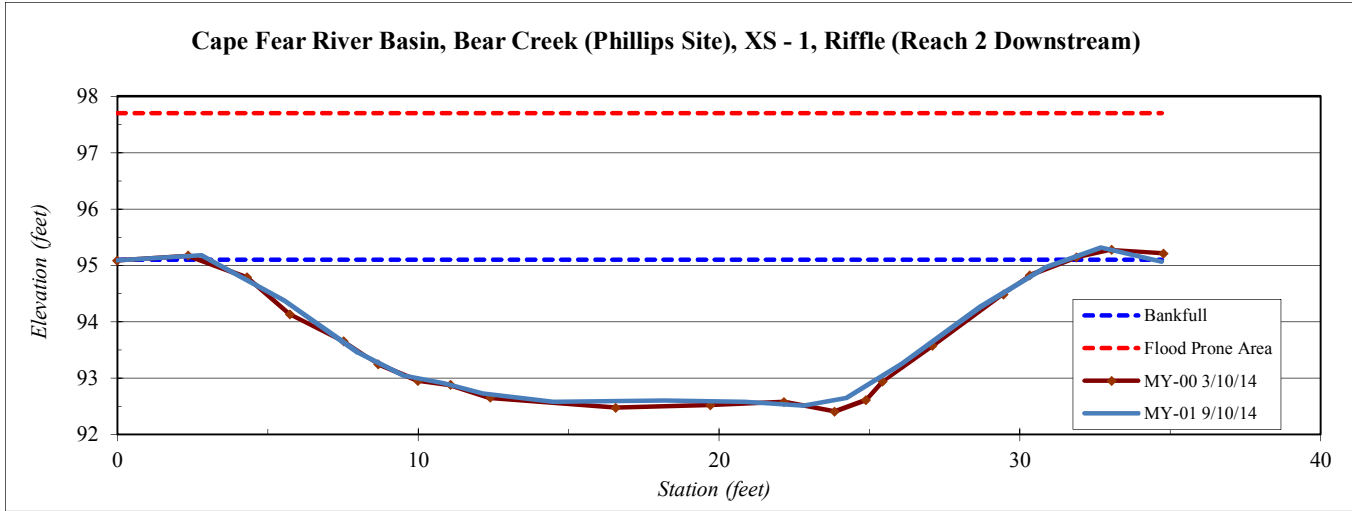
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 1, Riffle (Reach 2 Downstream)
Drainage Area (sq mi):	4.99
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.00	95.09
2.79	95.18
5.57	94.37
8.01	93.45
9.52	93.04
10.87	92.91
12.15	92.73
14.49	92.58
18.20	92.60
20.85	92.57
22.81	92.51
24.24	92.64
26.07	93.25
28.69	94.25
30.85	94.97
32.70	95.31
34.72	95.07

SUMMARY DATA	
Bankfull Elevation:	95.1
Bankfull Cross-Sectional Area:	51.3
Bankfull Width:	28.5
Flood Prone Area Elevation:	97.7
Flood Prone Width:	250.0
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.8
W / D Ratio:	15.8
Entrenchment Ratio:	8.8
Bank Height Ratio:	1.0



Stream Type	C
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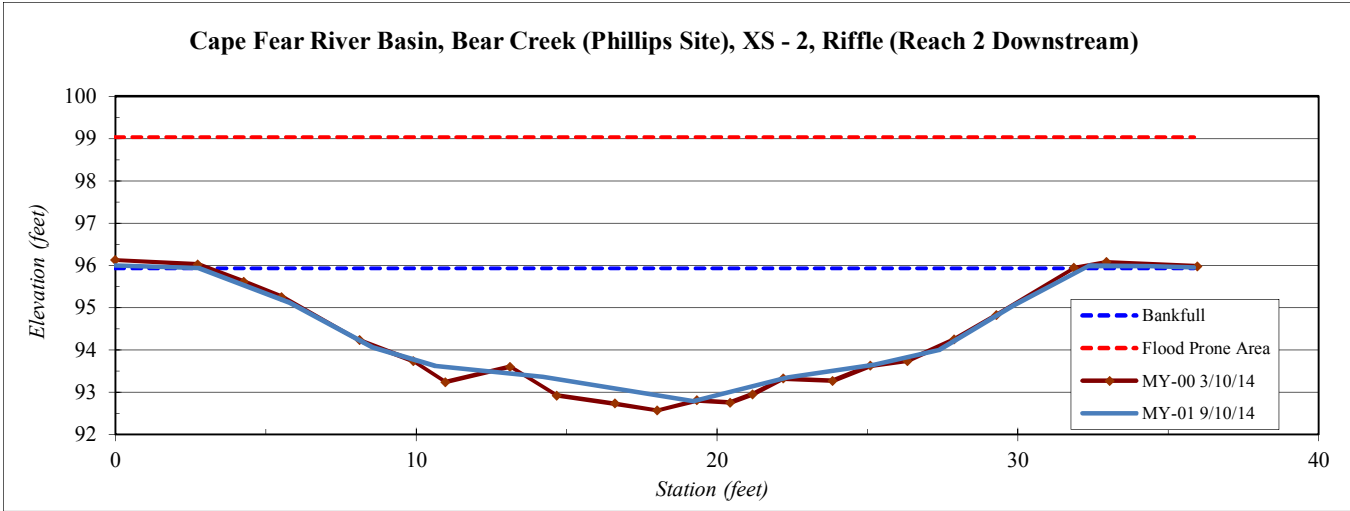
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 2, Riffle (Reach 2 Downstream)
Drainage Area (sq mi):	4.99
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan



Stream Type	C
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Station	Elevation
0.00	95.99
2.77	95.93
5.79	95.12
8.57	94.06
10.65	93.62
14.22	93.37
19.22	92.79
22.35	93.34
25.25	93.65
27.39	93.99
29.87	95.07
32.38	95.99
34.37	95.99
35.85	95.95

SUMMARY DATA	
Bankfull Elevation:	95.9
Bankfull Cross-Sectional Area:	57.3
Bankfull Width:	29.4
Flood Prone Area Elevation:	99.0
Flood Prone Width:	250.0
Max Depth at Bankfull:	3.1
Mean Depth at Bankfull:	1.9
W / D Ratio:	15.1
Entrenchment Ratio:	8.5
Bank Height Ratio:	1.0



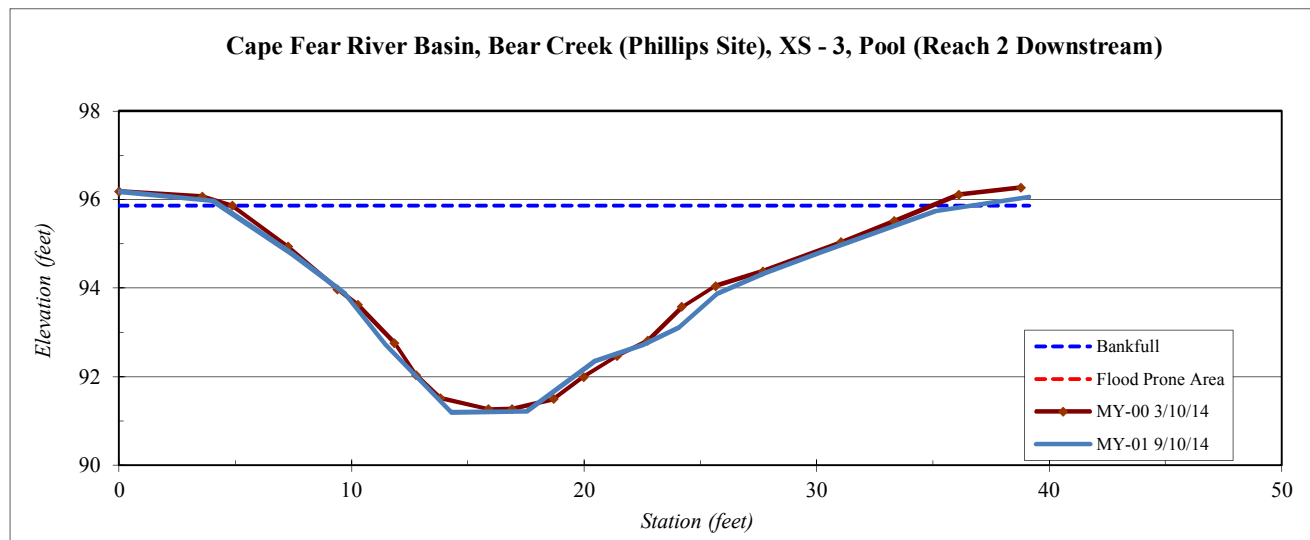
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 3, Pool (Reach 2 Downstream)
Drainage Area (sq mi):	4.99
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.0	96.2
4.0	96.0
7.4	94.8
9.7	93.9
11.5	92.7
14.3	91.2
17.6	91.2
20.5	92.4
22.5	92.7
24.1	93.1
25.7	93.9
27.8	94.3
30.1	94.8
35.1	95.74
39.1	96.06

SUMMARY DATA	
Bankfull Elevation:	95.9
Bankfull Cross-Sectional Area:	72.7
Bankfull Width:	32.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	4.7
Mean Depth at Bankfull:	2.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0



Stream Type



River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 4, Riffle (Reach 2 Downstream)
Drainage Area (sq mi):	4.99
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

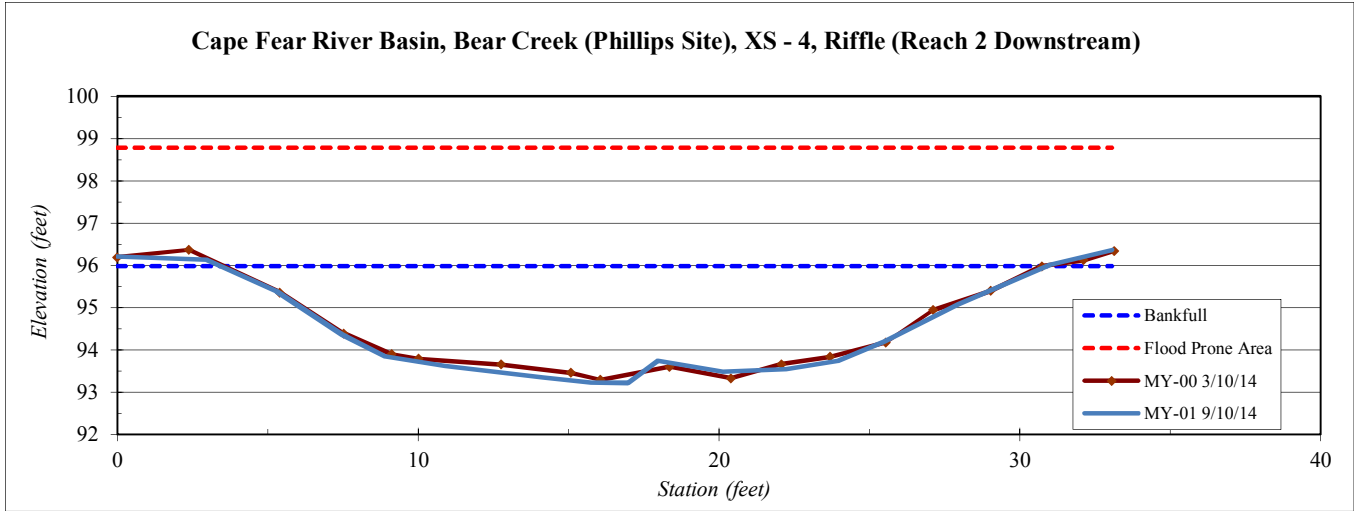
Station	Elevation
0.00	96.21
2.97	96.14
5.28	95.39
7.47	94.36
8.91	93.85
10.89	93.63
14.15	93.35
15.75	93.23
16.99	93.22
17.99	93.74
20.12	93.48
22.24	93.54
23.97	93.74
25.50	94.20
27.93	95.08
31.01	96.01
33.07	96.36

SUMMARY DATA	
Bankfull Elevation:	96.0
Bankfull Cross-Sectional Area:	50.4
Bankfull Width:	27.4
Flood Prone Area Elevation:	98.8
Flood Prone Width:	250.0
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.8
W / D Ratio:	14.9
Entrenchment Ratio:	9.1
Bank Height Ratio:	1.0



Stream Type	C
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Cape Fear River Basin, Bear Creek (Phillips Site), XS - 4, Riffle (Reach 2 Downstream)



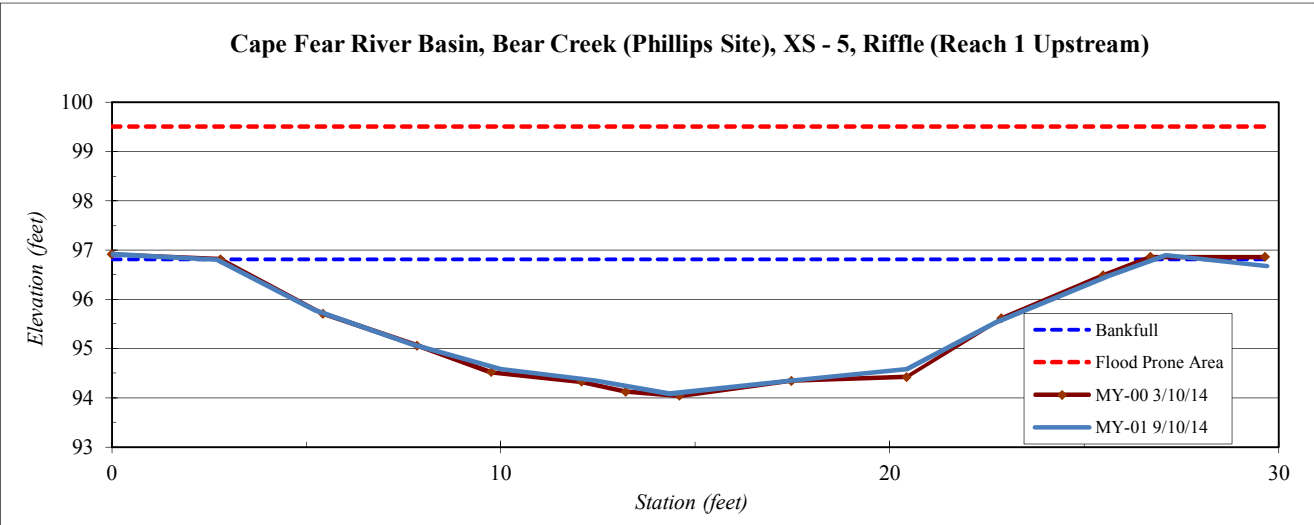
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 5, Riffle (Reach 1 Upstream)
Drainage Area (sq mi):	4.08
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.00	96.92
2.70	96.80
5.22	95.78
7.71	95.08
10.01	94.58
12.44	94.35
14.34	94.08
17.46	94.35
20.45	94.58
22.74	95.53
25.65	96.48
27.10	96.90
29.70	96.67

SUMMARY DATA	
Bankfull Elevation:	96.8
Bankfull Cross-Sectional Area:	41.5
Bankfull Width:	24.1
Flood Prone Area Elevation:	99.5
Flood Prone Width:	250.0
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.7
W / D Ratio:	14.0
Entrenchment Ratio:	10.4
Bank Height Ratio:	1.0



Stream Type C



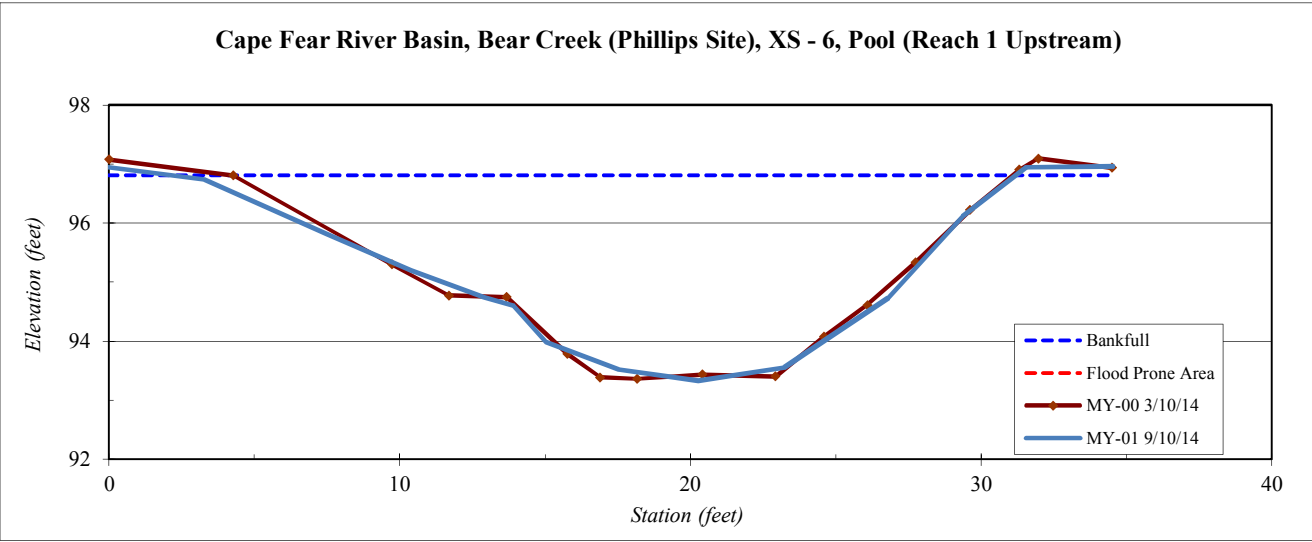
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 6, Pool (Reach 1 Upstream)
Drainage Area (sq mi):	4.08
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.0	96.9
3.3	96.7
7.5	95.8
10.4	95.2
12.9	94.7
13.9	94.6
15.0	94.0
17.5	93.5
20.3	93.3
23.2	93.6
24.8	94.1
26.8	94.7
29.4	96.1
31.6	96.95
34.5	96.96

SUMMARY DATA	
Bankfull Elevation:	96.8
Bankfull Cross-Sectional Area:	56.3
Bankfull Width:	29.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.5
Mean Depth at Bankfull:	1.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0



Stream Type C



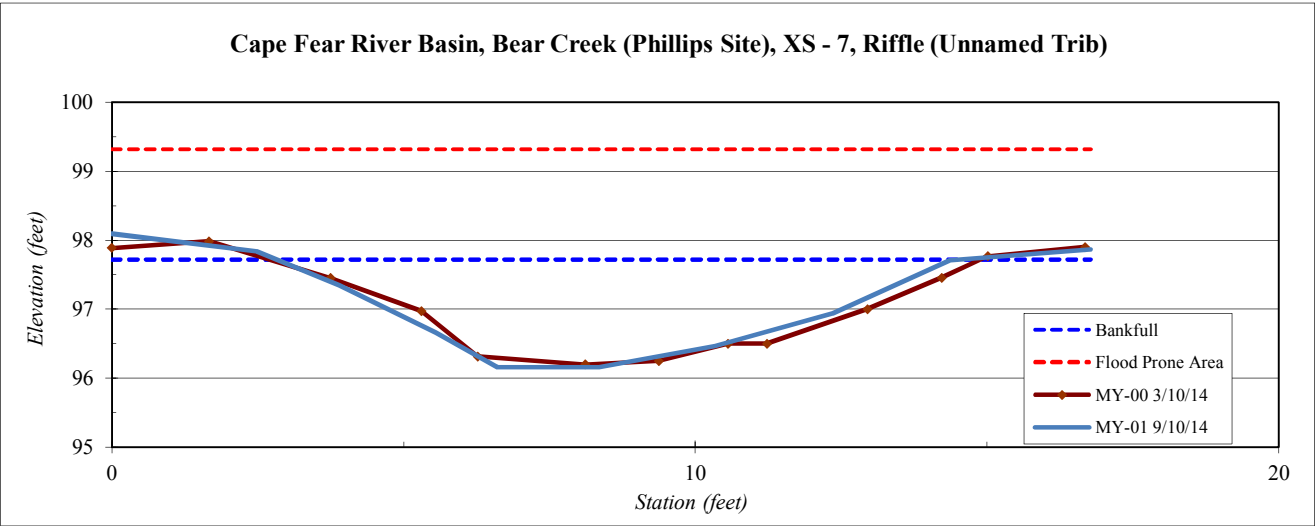
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 7, Riffle (Unnamed Trib)
Drainage Area (sq mi):	0.88
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan



Station	Elevation
0.00	98.09
2.48	97.84
3.90	97.35
5.55	96.66
6.61	96.16
8.35	96.16
10.33	96.47
12.35	96.94
14.37	97.71
16.77	97.87

SUMMARY DATA	
Bankfull Elevation:	97.7
Bankfull Cross-Sectional Area:	11.1
Bankfull Width:	11.7
Flood Prone Area Elevation:	99.3
Flood Prone Width:	80.0
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	0.9
W / D Ratio:	12.3
Entrenchment Ratio:	6.8
Bank Height Ratio:	1.0

Stream Type	C
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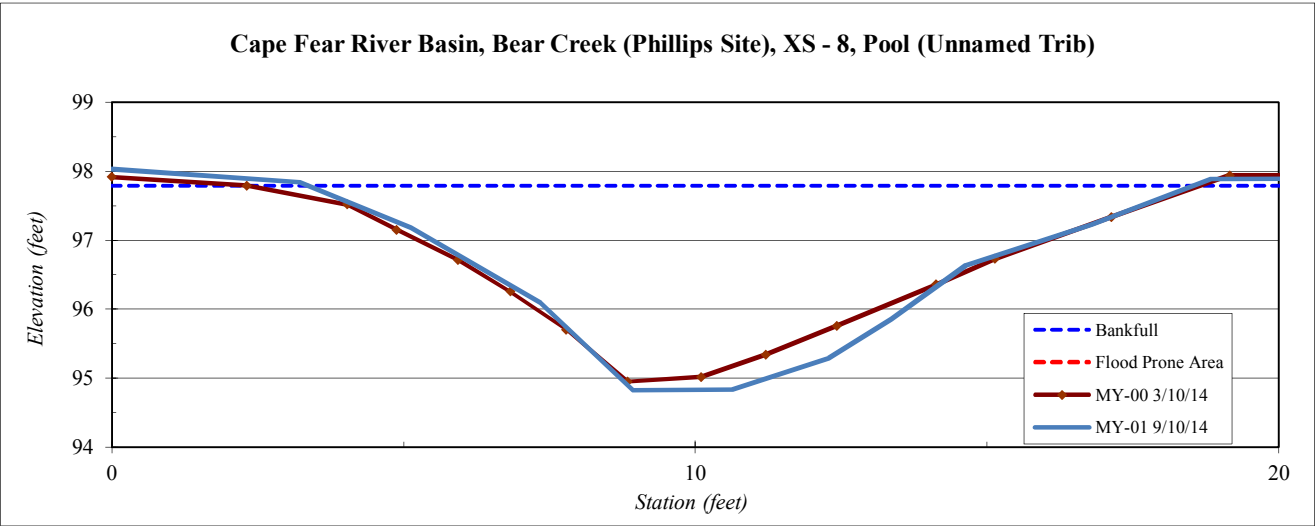
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 8, Pool (Unnamed Trib)
Drainage Area (sq mi):	0.88
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.00	98.03
3.22	97.84
5.13	97.18
7.34	96.10
8.93	94.82
10.63	94.83
12.29	95.29
13.36	95.85
14.63	96.64
16.80	97.23
18.84	97.88
21.82	97.89

SUMMARY DATA	
Bankfull Elevation:	97.8
Bankfull Cross-Sectional Area:	23.0
Bankfull Width:	15.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.5
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0



Stream Type C



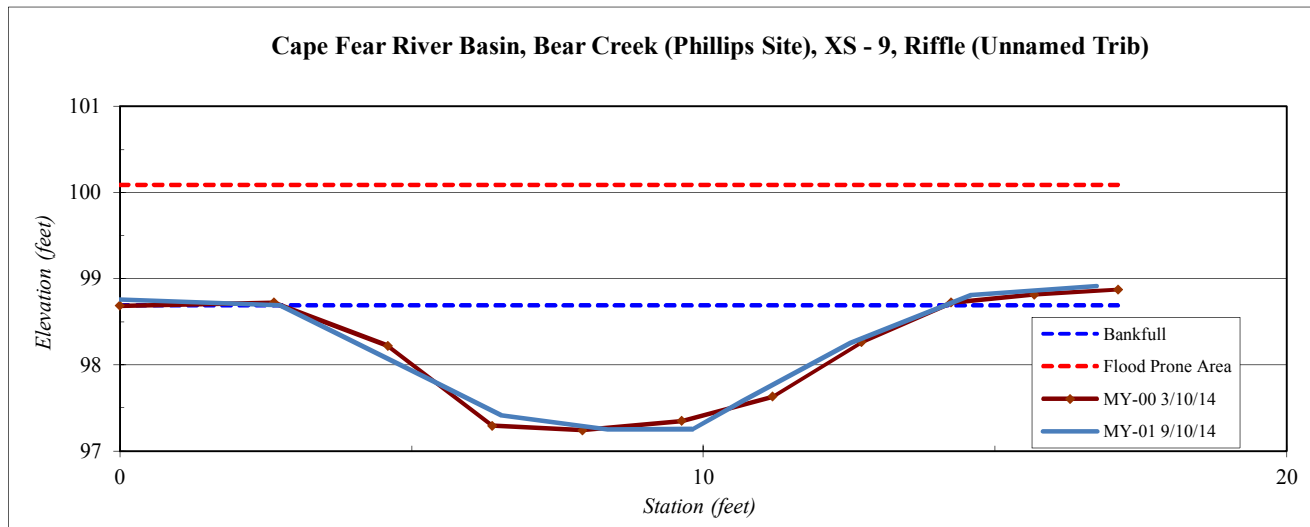
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 9, Riffle (Unnamed Trib)
Drainage Area (sq mi):	0.88
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan



Stream Type C

Station	Elevation
0.00	98.76
2.74	98.69
5.38	97.80
6.54	97.41
8.36	97.25
9.82	97.25
10.67	97.58
12.52	98.25
14.59	98.81
16.74	98.91

SUMMARY DATA	
Bankfull Elevation:	98.7
Bankfull Cross-Sectional Area:	9.9
Bankfull Width:	11.4
Flood Prone Area Elevation:	100.1
Flood Prone Width:	80.0
Max Depth at Bankfull:	1.4
Mean Depth at Bankfull:	0.9
W / D Ratio:	13.1
Entrenchment Ratio:	7.0
Bank Height Ratio:	1.0



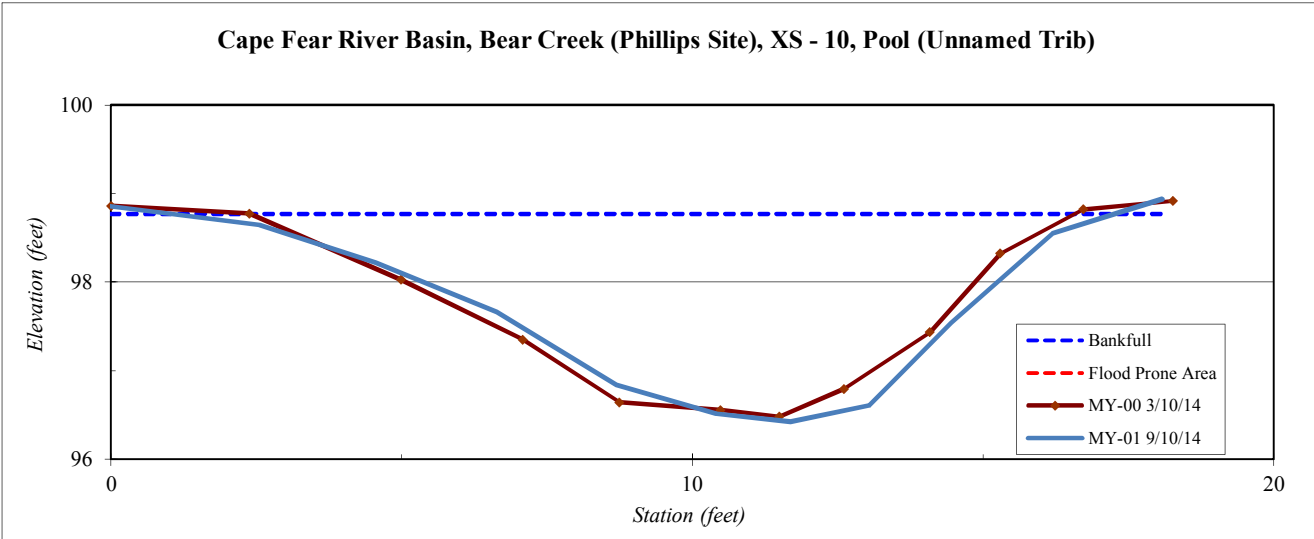
River Basin:	Cape Fear
Site Name	Bear Creek (Phillips Site)
XS ID	XS - 10, Pool (Unnamed Trib)
Drainage Area (sq mi):	0.88
Date:	9/10/2014
Field Crew:	Perkinson, Jernigan

Station	Elevation
0.0	98.9
2.5	98.6
4.6	98.2
6.6	97.7
8.7	96.8
10.4	96.5
11.7	96.4
13.0	96.6
14.5	97.5
16.2	98.6
18.1	98.9

SUMMARY DATA	
Bankfull Elevation:	98.8
Bankfull Cross-Sectional Area:	19.0
Bankfull Width:	16.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	1.0



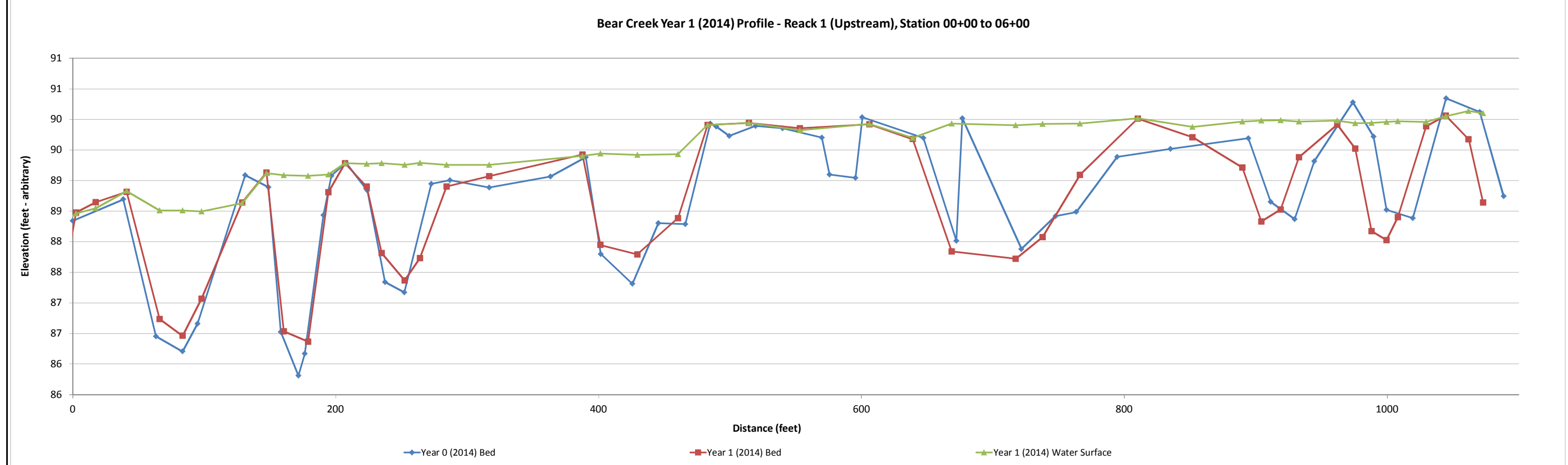
Stream Type



Project Name	Bear Creek - Profile
Reach	Reach 1 (Upstream) Station 00+00 - 11+00
Feature	Profile
Date	9/10/14
Crew	Perkinson, Jernigan

Avg. Water Surface Slope	2014	2014	2015	2016	2017
Riffle Length	0.0017	0.0014			
Avg. Riffle Slope	57	68			
Pool Length	0.0053	0.0061			
Pool to Pool Spacing	26	35			
	115	147			

2014 Year 0 Monitoring \Survey			2014 Year 1 Monitoring \Survey			2015 Year 2 Monitoring \Survey			2016 Year 3 Monitoring \Survey			2017 Year 4 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

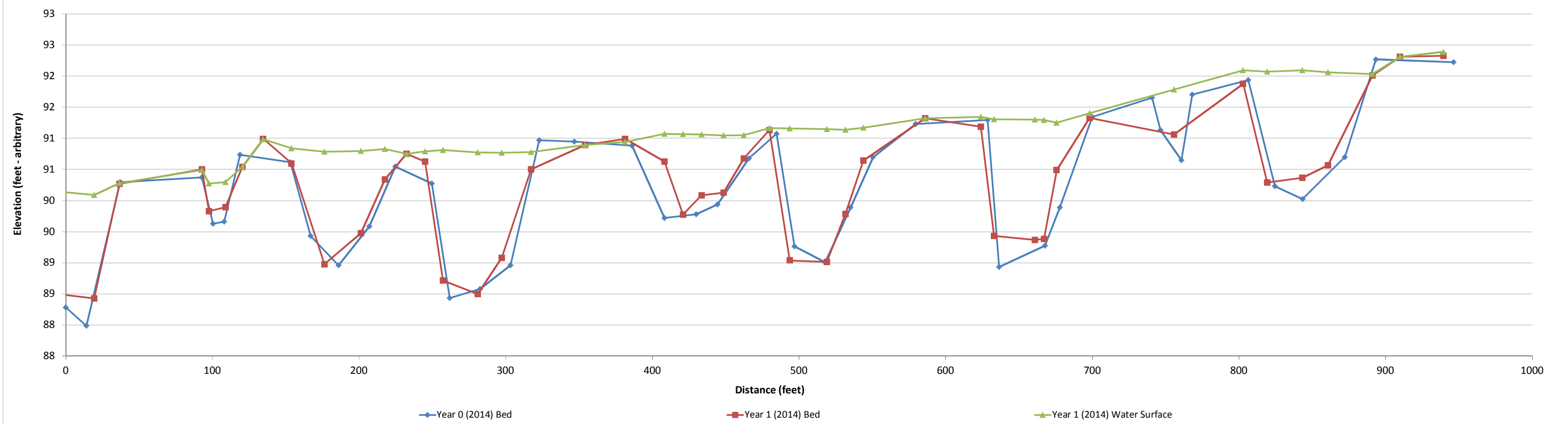


Project Name Bear Creek - Profile
Reach Reach 2 (Downstream) Station 00+00 - 10+00
Feature Profile
Date 9/10/14
Crew Perkinson, Jernigan

	2014	2014	2015	2016	2017
Avg. Water Surface Slope	0.0019	0.0020			
Riffle Length	45	60			
Avg. Riffle Slope	0.0052	0.0048			
Pool Length	33	32			
Pool to Pool Spacing	107	122			

2014 Year 0 Monitoring \Survey			2014 Year 1 Monitoring \Survey			2015 Year 2 Monitoring \Survey			2016 Year 3 Monitoring \Survey			2017 Year 4 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

Bear Creek Year 1 (2014) Profile - Reach 2 (Downstream), Station 00+00 to 10+00

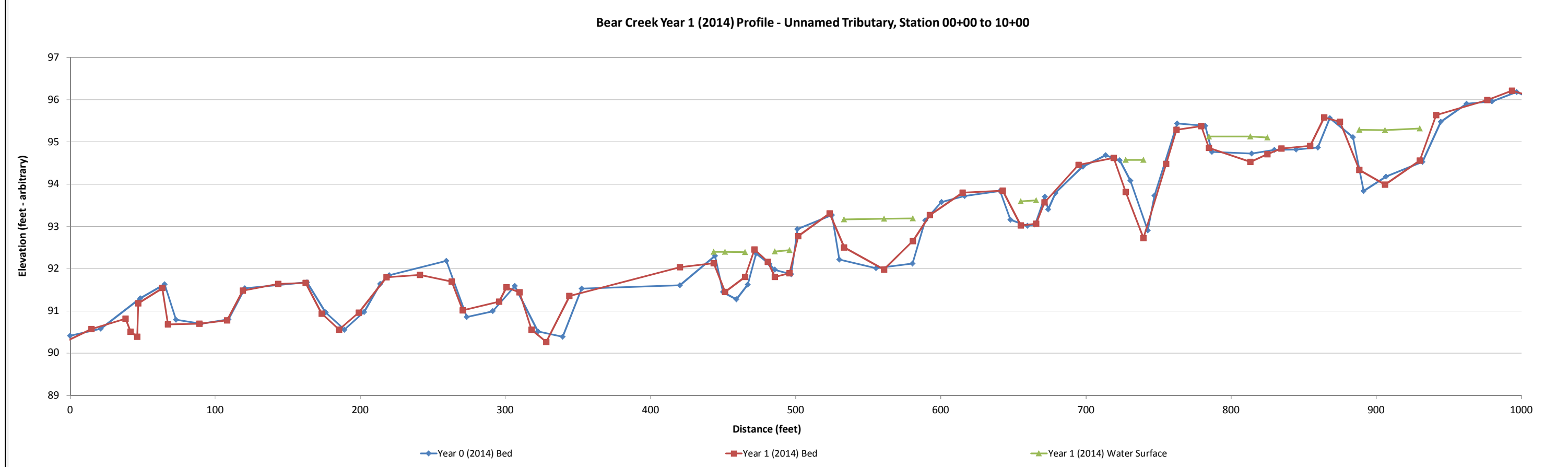


Project Name	Bear Creek - Profile
Reach	UT to Bear Creek Station 00+00 - 10+00
Feature	Profile
Date	9/10/14
Crew	Perkinson, Jernigan

	2014	2014	2015	2016	2017
Avg. Water Surface Slope	0.0041	NA*			
Riffle Length	35	32			
Avg. Riffle Slope	0.0081	NA*			
Pool Length	23	21			
Pool to Pool Spacing	69	68			

NA* No water in channel during field surveys.

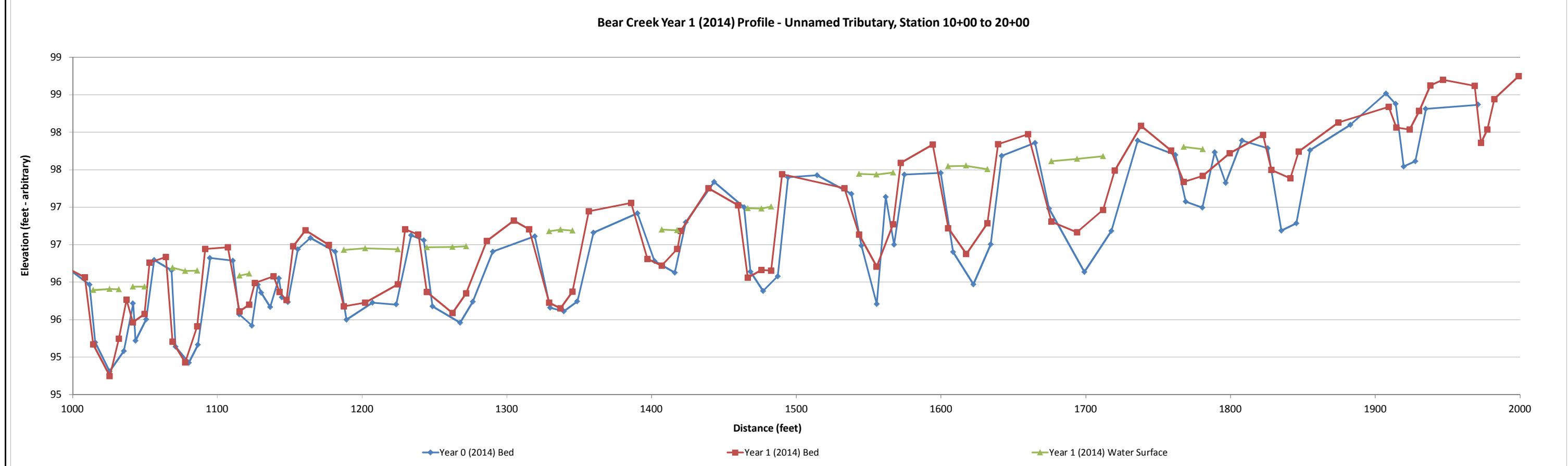
2014 Year 0 Monitoring \Survey			2014 Year 1 Monitoring \Survey			2015 Year 2 Monitoring \Survey			2016 Year 3 Monitoring \Survey			2017 Year 4 Monitoring \Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation



Project Name	Bear Creek - Profile
Reach	UT to Bear Creek Station 10+00 - 20+00
Feature	Profile
Date	9/10/14
Crew	Perkinson, Jernigan

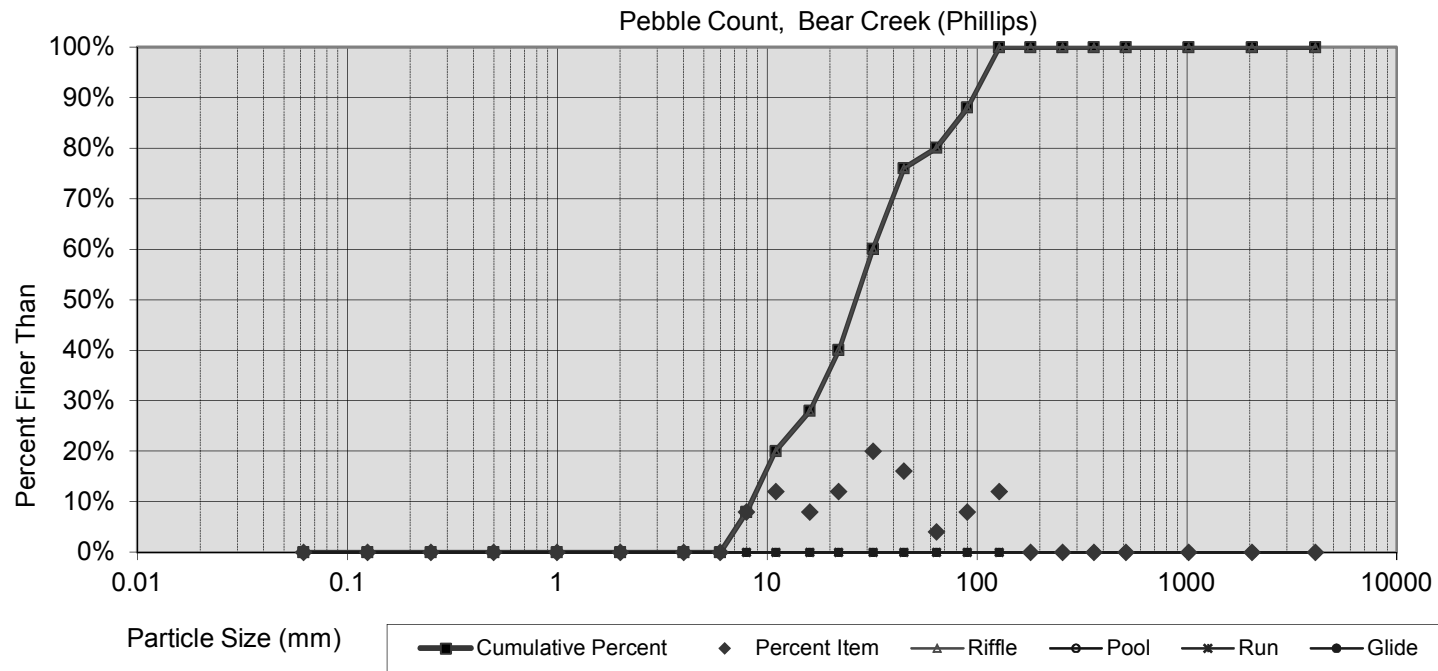
	2014	2014	2015	2016	2017
Avg. Water Surface Slope	0.0041				
Riffle Length	35				
Avg. Riffle Slope	0.0081				
Pool Length	23				
Pool to Pool Spacing	69				

2014 Year 0 Monitoring \Survey			2014 Year 1 Monitoring \Survey			2015 Year 2 Monitoring \Survey			2016 Year 3 Monitoring \Survey			2017 Year 4 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



Bear Creek (Phillips)
Cape Fear

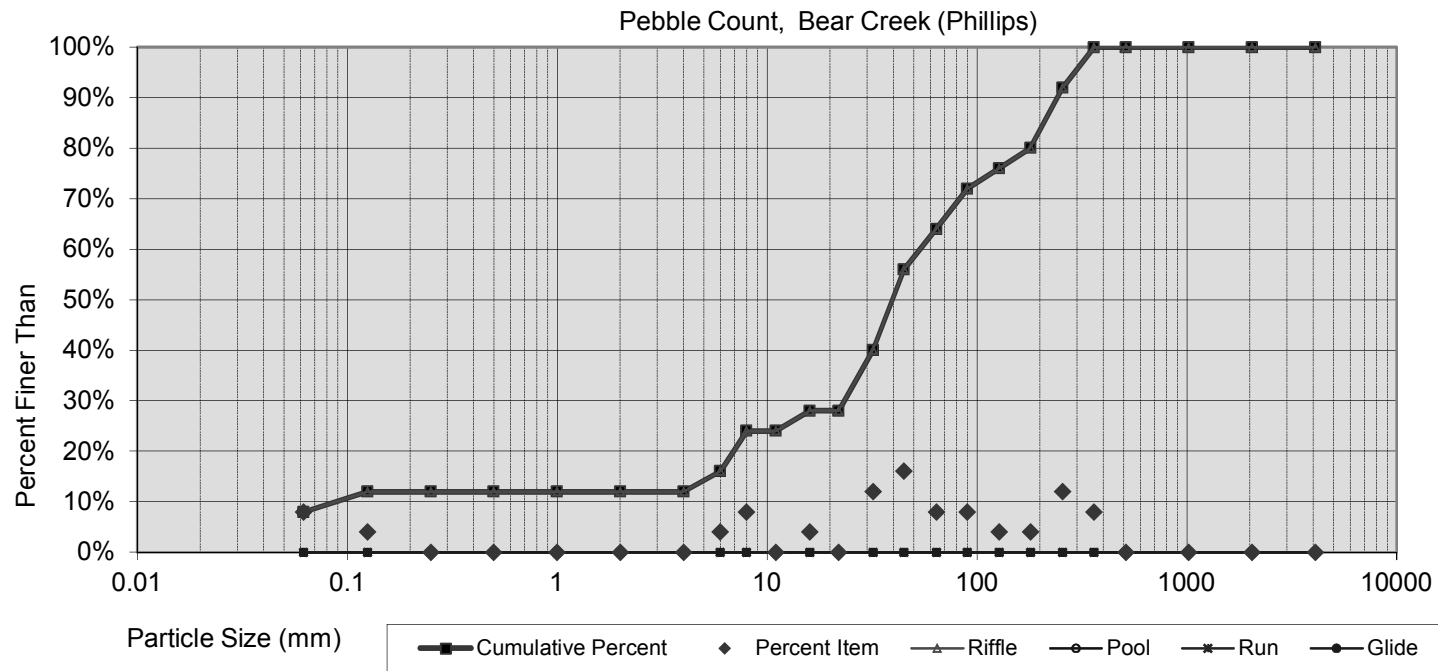
Note: Cross Section 1 - Mainstem



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
9.892	19.27	26.5	76	111	0%	0%	80%	20%	0%	0%

Bear Creek (Phillips)
Cape Fear

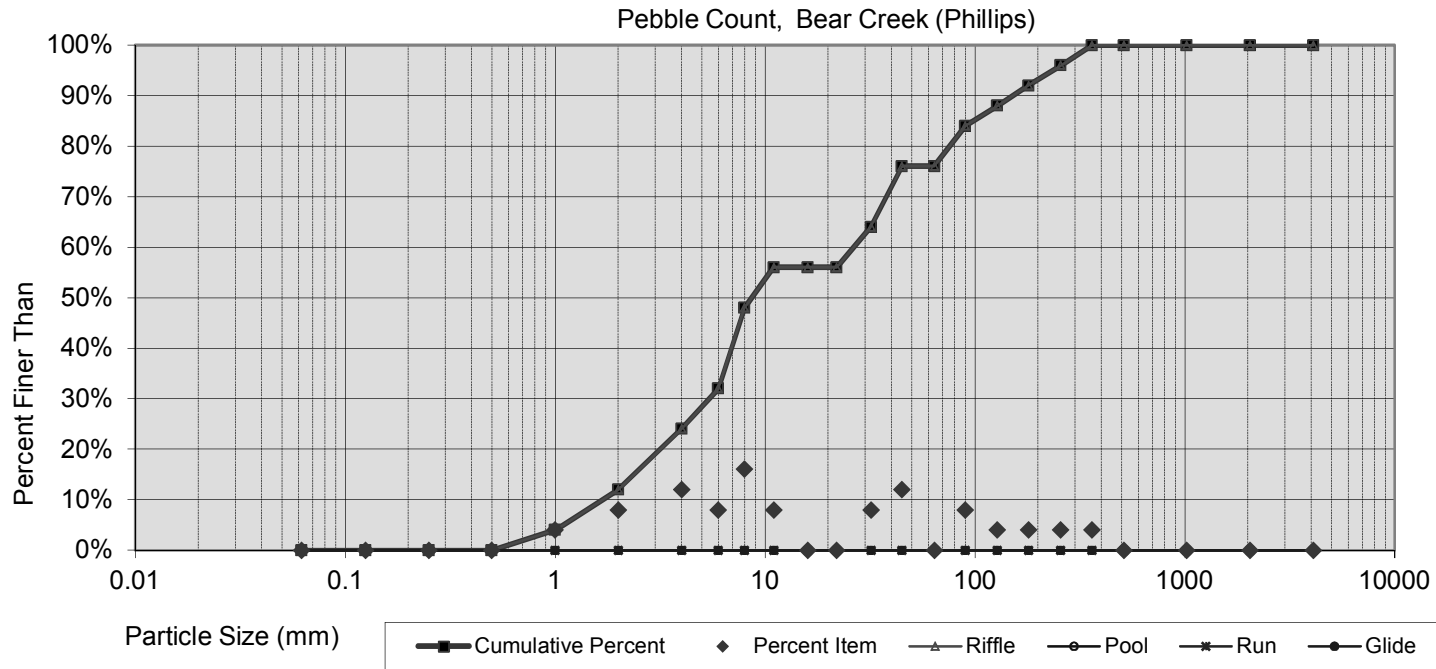
Note: Cross Section 2 - Mainstem



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
6.000	27.37	39.6	202	292	8%	4%	52%	28%	8%	0%

Bear Creek (Phillips)
Cape Fear

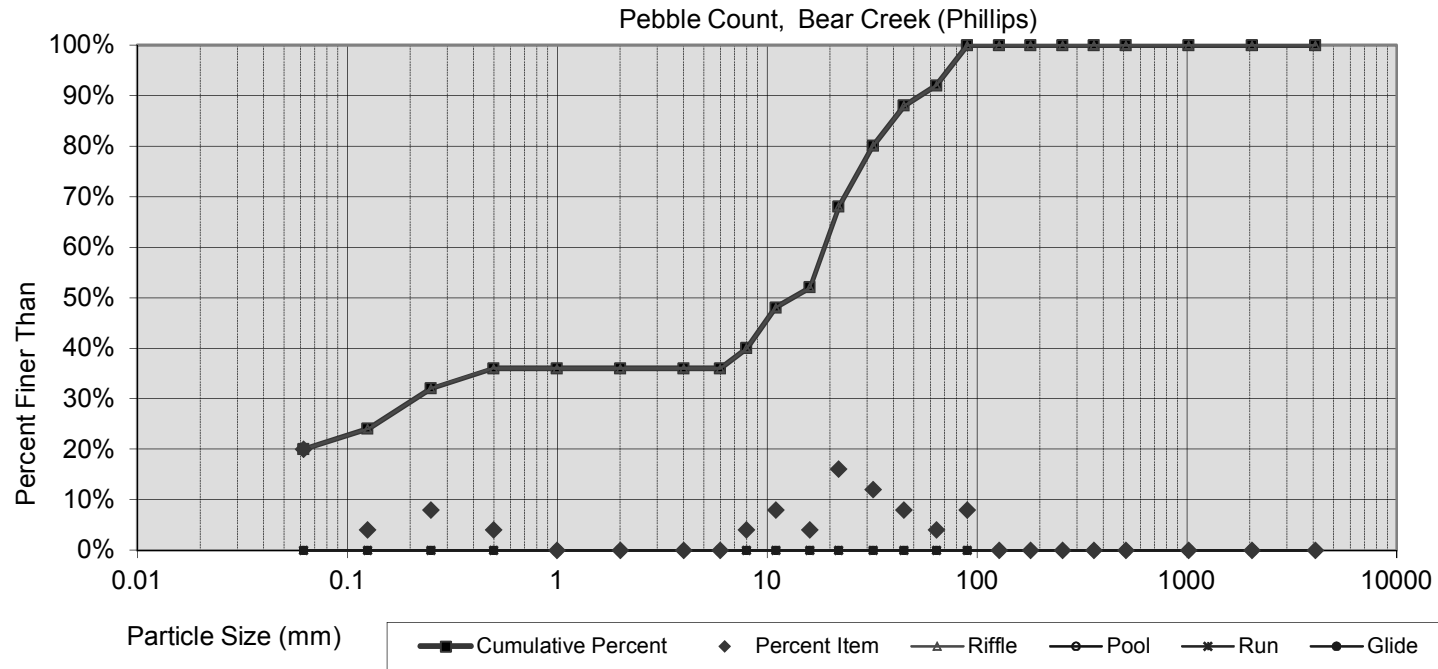
Note: Cross Section 4 - Mainstem



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
2.520	6.33	8.7	90	234	0%	12%	64%	20%	4%	0%

Bear Creek (Phillips)
Cape Fear

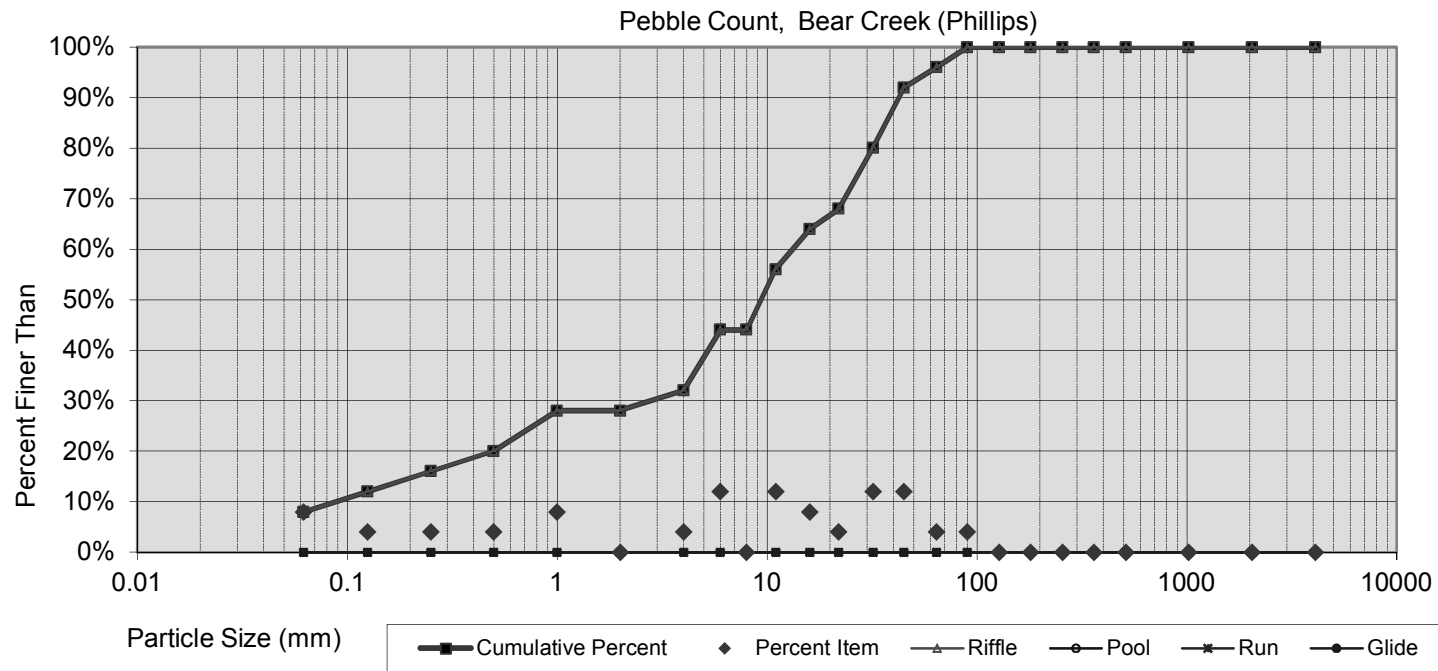
Note: Cross Section 5 - Mainstem



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.42	13.3	38	73	20%	16%	56%	8%	0%	0%

Bear Creek (Phillips)
Cape Fear

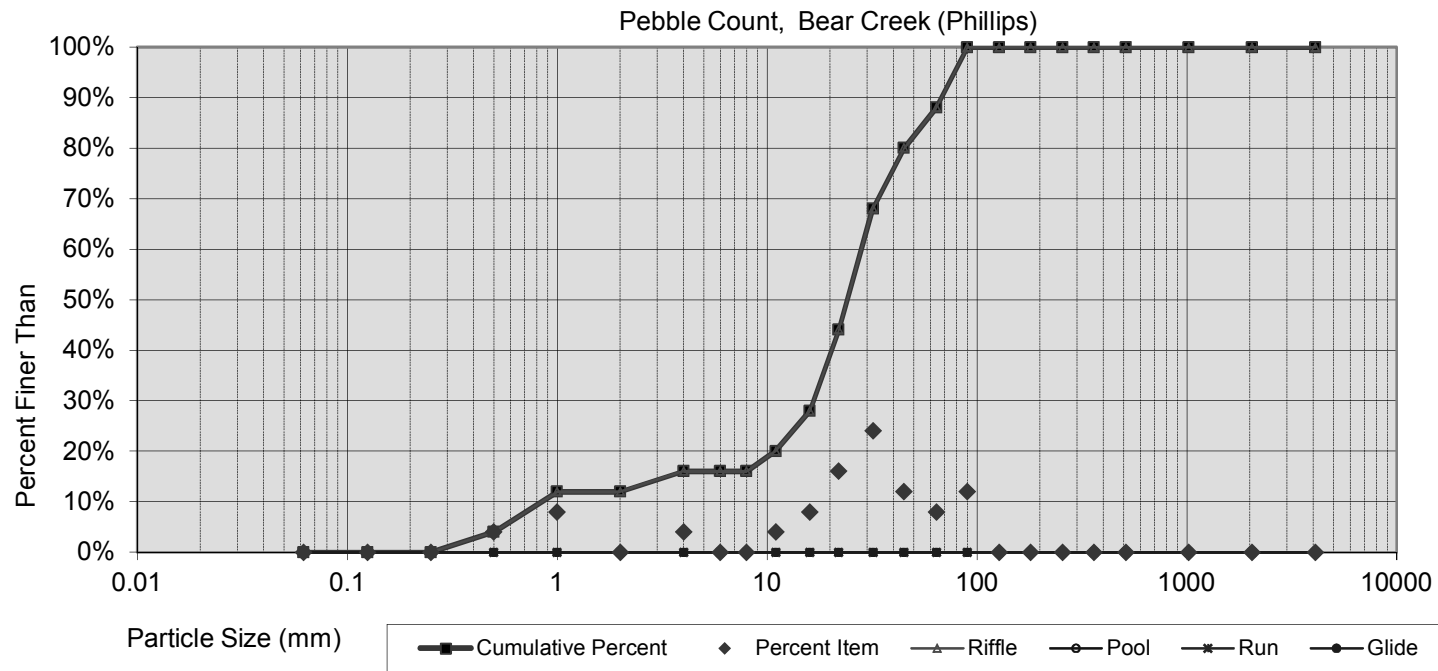
Note: Cross Section 7 - Tributary 1



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.250	4.43	9.4	36	59	8%	20%	68%	4%	0%	0%

Bear Creek (Phillips)
Cape Fear

Note: Cross Section 9 - Tributary 1



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
8.000	18.39	24.2	54	78	0%	12%	76%	12%	0%	0%

Appendix E.
Hydrology Data

Table 12. Verification of Bankfull Events

**Table 12. Verification of Bankfull Events
Bear Creek (Phillips) Restoration Site (EEP Project Number 26)**

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
March 13, 2014	March 7, 2014	Wrack on floodplain and crest gauge data indicate a bankfull event after 1.59 inches* of rain in one day.	1
August 22, 2014	May 15, 2014	Crest gauge data indicate a bankfull event after 2.08 inches* of rain in one day.	--
September 23, 2014	September 4, 2014	Wrack on floodplain and crest gauge data indicate bankfull event after 1.95 inches rain* in three days.	2

*Weather Underground 2014

