Briles Stream Restoration
Mitigation Plan / As-Built Report
EEP Project # 47
2008

Submitted to:

Ecosystem Enhancement PROGRAM

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June 2008

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EXECUTIVE SUMMARY

The Briles Site Stream Restoration restored, enhanced, and preserved a total of 3,112 feet of stream in the Yadkin River Basin. The goals of the project included restoring stable channel morphology, improving water quality, and enhancing aquatic and terrestrial habitat. In order to reach these goals, the project objectives included building an appropriate C4/B4c channel with stable dimensions; excluding livestock from the stream and riparian buffer; installing in-stream structures to promote bed feature diversity and prevent vertical instability, and planting a riparian buffer of native trees and shrubs.

The project site is situated within the Yadkin 03 watershed cataloging unit (8-digit HUC 03040103050030) and is in a portion of the NCDWQ Priority Sub-basin 03-07-09. The North Carolina Ecosystem Enhancement Program (EEP) identifies this HUC as a Targeted Local Watershed. The site is located on a 87-acre parcel owned by Mr. and Mrs. Kenneth Briles. It is located southeast of the intersection of Ross Wood Road and Pleasant Grove Road in Trinity, Randolph County, North Carolina. The primary land uses on the property include rangeland (pasture), a chicken egg farm, and forest. The Unnamed Tributary to Jackson Creek is a first order (becomes second order at the confluence with another Unnamed Tributary) perennial stream that flows south/southeast through the subject property before joining Jackson Creek. The mainstem and tributary are separated into four reaches.

The project includes 1,787 linear feet of restoration based on Priority Level 2 and 3 approaches (Reaches 1 and 2). There are also 817 linear feet of Enhancement I (Reach 3) and 508 linear feet of preservation (Reach 4). In a modification to the plans, two in-stream structures were not installed at Stations 12+90 and 27+50 due to bedrock outcrops. There was also a slight alignment adjustment to the stream near Stations 11+20 and 15+90, which was done to preserve mature trees along the banks. Reaches 1 and 2 were restored to Rosgen stream type C4 and Reach 3 was restored to Rosgen stream type B4c. Riparian buffers associated with the stream restoration extend fifty feet on both sides of the stream. The as-built condition of the buffer follows the planting plan with the exception of approved substitutions for three of the tree species that were unavailable at the time of planting.

The site will be monitored beginning in 2008 through 2012 or until the success criteria are achieved. Reports will be submitted to the EEP each year. Monitoring shall consist of the collection and analysis of stream stability and riparian/stream bank vegetation survivability data. Specifically, project success will be assessed utilizing measurements of stream dimension, pattern, profile, site photographs, and vegetation sampling. Cross-section and profile measurements should show little or no change from the as-built conditions. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increased stability or whether they indicate movement toward an unstable condition. Baseline monitoring of the as-built conditions was conducted in December 2007 and January 2008. This monitoring revealed that sedimentation has occurred in several pools post-construction following several storm events. Future monitoring will determine whether these pools will be capable of maintaining their design depth. Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, corrective actions will be taken. Further baseline monitoring conditions are described in this report.

1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Briles Stream Restoration site is located on an 87-acre parcel owned by Mr. and Mrs. Kenneth Briles that is located southeast of the intersection of Ross Wood Road and Old US 64 in Trinity, Randolph County, North Carolina. From Raleigh, take US 64 west. In Randolph County, about 12 miles after passing through Asheboro, make a left onto Old US 64. After about 2 miles, take a left onto Ross Wood Rd. The Briles site is located at a chicken egg farm on the right (Figure 1).

1.2 Project Goals and Objectives

The goals and objectives of the Briles Stream Restoration project are as follows:

Project Goals:

- Restore a stable channel morphology that is capable of moving the flows and sediment provided by its watershed.
- Restore riparian buffer habitat and functions.
- Improve water quality and reduce land and riparian vegetation loss resulting from lateral erosion and bed degradation.
- Improve aquatic and terrestrial habitat.

Project Objectives:

- Build appropriate C4 and B4c channels with stable channel dimensions.
- Plant a functional Bottomland Hardwood Forest community to create an effective riparian buffer.
- Exclude livestock from the riparian areas.
- Preserve portions of the site that currently function as a stable riverine environment.

1.3 Project Structure, Restoration Type and Approach

The project stream, UT to Jackson Creek, became impaired from poor grazing management and anthropogenic disturbances. Sedimentation from bank erosion and stream bed degradation were widespread throughout the site. Restoration of the first 1,425 linear feet of the main stem (Reach 1) was accomplished utilizing a Priority Level 2 approach (Table 1). Reach 1 was restored to a C4 stream type. The restoration of the remaining 362 linear feet of the main stem below the confluence with the tributary (Reach 2) was based on Priority Level 3. Reach 2 was designed to be a B4c. However, Reach 2 became a C4 channel during construction when the floodplain was built wider than designed. Enhancement I of 817 linear feet of the tributary (Reach 3) was based on a Priority Level 3 approach. All three reaches contain cross vanes to help maintain the stream profile and pattern. The stream dimension, pattern, and profile are based on the morphological criteria and hydraulic geometry relationships developed from the reference streams. The project also includes the preservation of 508 linear feet of stream (Reach 4) immediately downstream of Reach 2. This stable portion of stream has high quality aquatic habitat and is bordered by a mature riparian buffer.

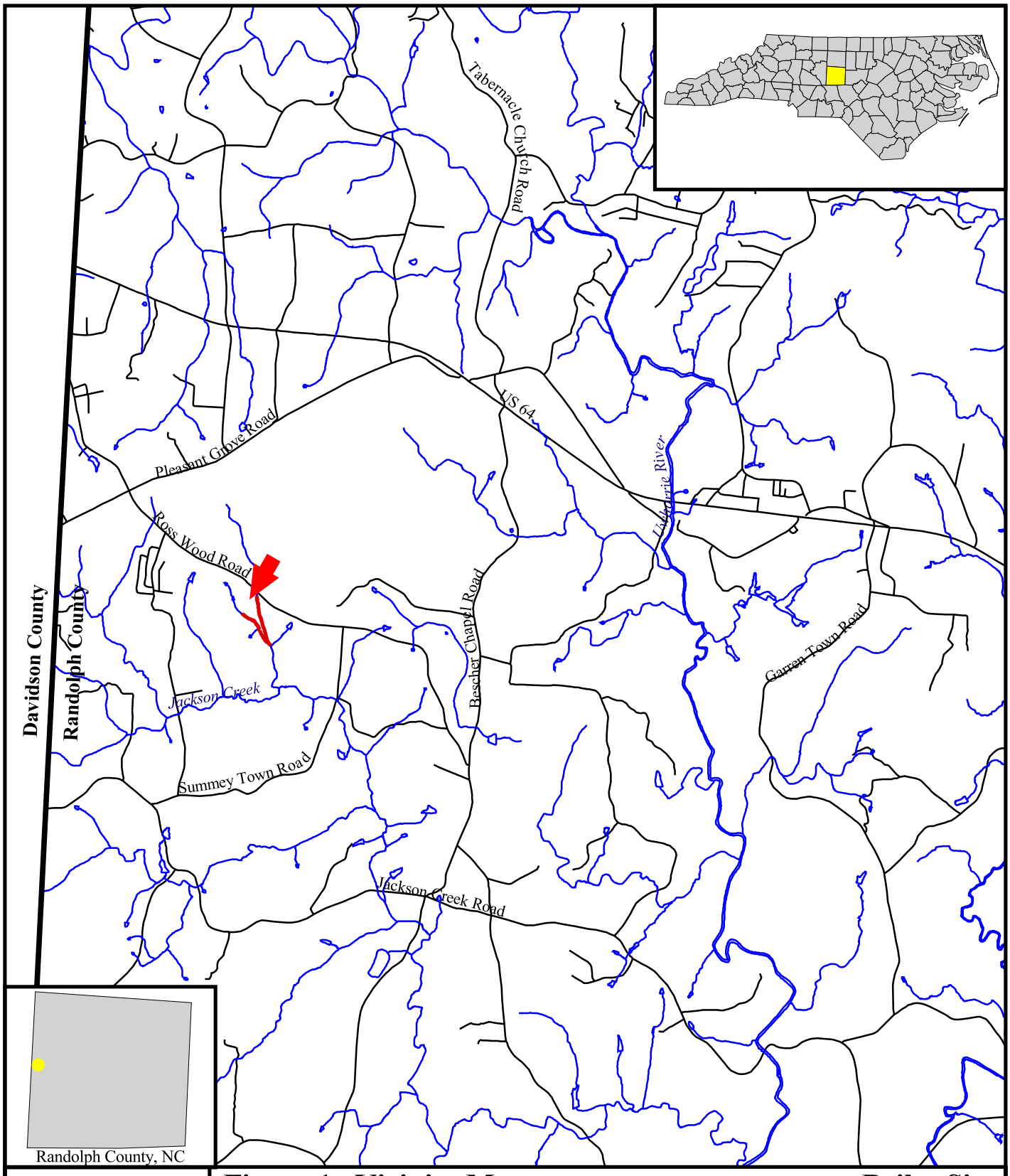

Figure 1. Vicinity Map **Briles Site**

Project Reach
Streams
Roads

N

4000 0 4000 Feet

Ecosystem Enhancement PROGRAM

Table I. Project Restoration Components Project Name and Number: Briles Site - 47						
Project Segment / Reach ID	**Existing Footage**	**Type**	**Approach**	**Project Footage**	**Stationing**	**Comment**
Reach 1	1,375 lf	R	P2	1,425 lf	10+00 - 24+25	Project length includes a 17-foot wide ford crossing easement exception
Reach 2	355 lf	R	P3	362 lf	24+25 - 27+87	
Reach 3	820 lf	EI	P3	817 lf	50+00 - 58+17	Project length includes a 36-foot wide ford crossing easement exception
Reach 4	508 lf	P	-	508 lf	28+88 - 33+96	

Mitigation Unit Summations					
Stream (lf)	**Riparian Wetland (Ac)**	**Nonriparian Wetland (Ac)**	**Total Wetland (Ac)**	**Buffer (Ac)**	**Comment**
2,393	0	0	0	0	

R = Restoration P = Preservation EI = Enhancement I

P2 = Priority 2 P3 = Priority 3

1.4 Project History, Contacts and Data

The project was initiated by the North Carolina Department of Transportation in 2003. In that same year, a feasibility study was conducted for the site. After the feasibility study was completed, the site was transferred to the EEP and the restoration plan was produced. Construction was completed at the site in November 2007 and planting took place in January 2008.

Table II. Project Activity and Reporting History Project Name and Number: Briles - 47		
Activity or Report	**Data Collection**	**Completion or Delivery**
Feasibility Study	2003	May 03
Restoration Plan	2003/2004	Dec 05
Final Design - Construction Plans	N/A	Sep 06
Construction	N/A	Nov 07
Temporary seed mix applied to entire project area	N/A	Nov 07
Planting	N/A	Jan 08
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	Dec 07	Feb 08

Table III. Project Contact Table Project Name and Number: Briles Site - 47	
Design Firm	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 783-9214 Fax: (919) 783-9266
Construction Contractor	L-J, Inc. 220 Stoneridge Dr., Ste. 405 Columbia, SC 29210 Contact: Mr. Richard Goodwin Phone: (803) 929-1181 Fax: (803) 929-7625
Planting Contractor	Habitat Assessment and Restoration Program, Inc. 9305-D Monroe Road Charlotte, NC 28270 Contact: Alan Peoples Phone: (704) 975-0881 Fax: (704) 841-2447
Seed Mix Sources	Evergreen Seed Company 6125 NC HWY 55 Fuquay Varina, NC 27526 Phone: (919) 567-1333
Nursery Stock Suppliers	Foggy Mountain Nursery 13213 HWY 88 W. Creston, NC 28615 Phone: (919) 524-5304
Monitoring Performers	
MY-00	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 783-9214 Fax: (919) 783-9266

Table IV. Project Data Table Project Name and Number: Briles - 47	
Project County	Randolph County
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Project River Basin	Yadkin
USGS HUC for Project	03040103050030
NCDWQ Sub-basin for Project and Reference	03-07-09
Drainage Area	0.6 sq. mi.
Stream Order	First/Second Order
Watershed Type (Rural, Urban, Developing, etc.)	Rural
Watershed LULC Distribution Urban	2%
Ag-Row Crop	12%
Ag-Livestock	13%
Forested	72%
Water/Wetlands	<1%
Watershed impervious cover (%)	1%
Rosgen Classification of As-built	C4 (Reach 1 and Reach 2)
	B4c (Reach 3)
Reference Site ID	Richland Creek
	UT Back Creek
	UT Fisher River
NCDWQ AU/Index Number	13-2-2 (Jackson Creek)
NCDWQ Classification for Project	C
Within EEP Watershed Plan?	No
Any portion of the project segment upstream of a 303d listed segment?	Yes, Uwharrie River
Reasons for 303d Listing or Stressor	Low dissolved oxygen
Total project acreage of easement	13.3 Acres
Total vegetated acreage within easement	11.3 Acres
Total planted acreage	8.5 Acres
WRC Class (Warm, Cool, Cold)	Warm
Trout Designation	No
Species of concern, endangered etc.	N/A
Pre-construction Beaver activity?	No
Dominant Soil Types	Georgeville Silty Clay Loam
% of Project Easement Fenced	0%

2.0 PROJECT MONITORING / AS-BUILT CONDITIONS

2.1 Monitoring Features

Permanent monuments, marking monitoring feature locations, were established on-site. The beginning and end of each permanent cross-section was marked with rebar set in concrete monuments. Vegetation plots were installed with flagged metal conduit at each corner and flagged PVC pipe at the photo corner. The locations of the permanent photo points are marked in the Monitoring Plan View (Appendix A).

2.2 Monitoring Guidelines

Five permanent cross-sections, three riffle and two pool, were established and will be used to evaluate stream dimension. Pebble counts will be performed at each cross-section. Cross-sections will be surveyed each year using a total station and data such as area and width to depth ratio will be calculated. Longitudinal profile will be conducted on Reaches 1 and 2. The profile will be surveyed with a total station and will record feature changes, water surface levels, and bankfull elevations. These data will be used to obtain feature lengths and slopes, pool-to-pool spacing and other longitudinal measurements. Reach 3 will be visually monitored each year. Stem counts of planted trees and shrubs will be conducted in the eight vegetation monitoring plots, which were established following the latest EEP vegetation monitoring protocol. Visual monitoring of the entire site will be conducted with annual site walks and site photos taken from ten permanent photo points located throughout the site.

2.3 As-Built Conditions

2.3.1 Stream

Baseline stream monitoring data were collected in December 2007. These data are included in Tables V and VI and Appendices C, D and E.

Within the restoration reaches the final design plans for the project stream called for 27 riffles and 27 pools. The baseline monitoring counted 21 riffles and 19 pools. The discrepancy between the number of pools and riffles stems from sedimentation post-construction that occurred before ground cover had stabilized the soils. Future monitoring will determine whether these pools will be capable of maintaining their designed depth.

There were minimal changes to the design during construction. Bedrock was encountered in various locations throughout the site. Most of this bedrock was hammered to accommodate the designed channel. However, there are isolated portions of the stream where the bedrock is slightly above the designed stream grade. Due to the presence of the bedrock already serving as grade control, two cross vanes were not installed (STA. 12+95 and 27+40). Reach 2 was designed to be a B4c. However, Reach 2 became a C4 channel during construction when the floodplain was built wider than designed. The changes from the design do not pose a serious threat to the long-term stability of the restored channel. The bedrock also caused the contractor to make an adjustment to the alignment of the ford crossing. The new alignment is perpendicular to the restored channel, which is important for stream stability, but it is not fully within the easement exception and encroaches upon the conservation easement. The easement may need to be adjusted to reflect this change and maintain compliance with the easement guidelines. Since the completion of construction, the landowner has installed easement fencing throughout the project.

Table V illustrates that some of the design pattern ratios are different from the as-built pattern ratios. These differences do not represent a deviation from the design; they are due to the fact that site constraints prevented the design ratios, obtained from the reference reach, from being applied uniformly to the final design.

Table V(a). Baseline Stream Summary: Reach 1
Project Name and Number: Briles - 47

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built				
Dimension -Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Med	Max	n
Bankfull Width (ft)	8.5	15.2	11.7	28.8	4	9.0	13.1	12.6	18.0	6	15.4		13.4	13.8		14.2	2
Floodprone Width (ft)	20	42	44	60	4	13	114	150	200	6	>35		38	43		>48	2
Bankfull Mean Depth (ft)	0.6	1.4	1.4	2.2	4	0.9	1.2	1.2	1.5	6	1.1		1.1	1.2		1.2	2
Bankfull Max Depth (ft)	1.5	2.0	1.8	2.8	4	1.3	1.6	1.6	2	6	2.0		1.9	2.0		2.0	2
Bankfull Cross-Sectional Area (ft^2)	15.1	17.6	18.2	18.8	4	10.4	15.3	13.5	22.3	6	17.0		15.9	16.1		16.2	2
Width/Depth Ratio	3.8	16.3	8.2	44.9	4	7.6	11.5	9.7	18	6	14.0		11.3	11.9		12.4	2
Entrenchment Ratio	1.8	3.5	3.7	4.7	4	1.3	7.5	8.4	14.4	6	>2.2		2.7	3.1		>3.5	2
Bank Height Ratio	1.0	1.7	1.9	1.8	4	1.0	1.0	1.0	1.0	6	1.0		1.0	1.0		1.0	2
Bankfull Velocity (fps)	1.8	3.0	3.2	3.6	4	4	5.1	4.7	6.8	6	3.0	3.8					
Pattern																	
Channel Beltwidth (ft)	50					75			135		77		31	51	56	60	5
Radius of Curvature (ft)	25			57		14.5			26.8		20	50	28	41	42	55	14
Rc:Bankfull width (ft/ft)	0.9			6.7		1			1.6		1.5	3.2	2.0	3.0	3.0	4.0	
Meander Wavelength (ft)	50			100		70			148		105	170	78	92	91	110	6
Meander Width Ratio	1.7			5.9		3.6			13		5		2.2	3.7	4.1	4.3	
Profile																	
Riffle Length (ft)													20	46	44	115	19
Riffle Slope (ft/ft)	0.0040			0.0120		0.0030			0.0760		0.0050	0.0120	0.0014	0.0095	0.0102	0.0163	19
Pool Length (ft)						28			108		15	30	7	12	10	27	17
Pool Spacing (ft)						38			181		46	154	50	82	78	157	17
Substrate and Transport Parameters																	
SC% / Sa% / G% / C% / B% / Be%	14% / 27% / 47% / 7% / - / 5%												47% / 30% / 19% / 1% / - / 3%				
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)	0.3 / 1.2 / 6.1 / 10.6 / 61.9 / - / -												0.062 / 0.062 / 0.101 / 4.6 / 25 / - / -				
Reach Shear Stress (competency) lb/ft^2											0.34		0.44				
Additional Reach Parameters																	
Channel length (ft)	1,375										1,446		1,425				
Drainage Area (SM)	0.51					0.9 - 0.63					0.51		0.51				
Rosgen Classification	G4c/E4/C4/5					C4					C4		C4				
Bankfull Discharge (cfs)	50 - 65					60 - 140					50		50				
Sinuosity	1.0					1.5					1.2		1.1				
Water Surface Slope (ft/ft)	0.004 - 0.012					0.007 - 0.012					0.005		0.0063				
BF slope (ft/ft)											0.005		0.0057				

Table V(b). Baseline Stream Summary: Reach 2
Project Name and Number: Briles - 47

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built				
Dimension -Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Med	Max	n
Bankfull Width (ft)		22.9			1	9.0	9.5		10.0	2	14.3			15.8			1
Floodprone Width (ft)		37			1	13	17		21	2	19	32		>60			1
Bankfull Mean Depth (ft)		0.8			1	1.1	1.2		1.2	2	1.2			1.3			1
Bankfull Max Depth (ft)		2.2			1	1.3	1.4		1.5	2	1.5	2.5		2.3			1
Bankfull Cross-Sectional Area (ft^2)		18.8			1	10.4	10.6		10.7	2	17.0			19.8			1
Width/Depth Ratio		27.9			1	8.0	10.0		12.0	2	12.0			12.6			1
Entrenchment Ratio		1.6			1	1.3	1.8		2.3	2	1.3	2.3		>3			1
Bank Height Ratio		2			1	1.0	1.0		1.0	2	1.0			1.0			1
Bankfull Velocity (fps)		2.1			1	4.1	4.3		4.5	2	3.0	3.8					
Pattern																	
Channel Beltwidth (ft)	50					45					70		28	29		30	2
Radius of Curvature (ft)	25			57		13			42		28	100	44	53	48	66	3
Rc:Bankfull width (ft/ft)	0.9			6.7		1.3			4.4		2.0	7.0	2.8	3.4	3.0	4.2	3
Meander Wavelength (ft)	50			100		96			136		72	215	45	63		81	2
Meander Width Ratio	1.7			5.9		4.5			5.0		5.0		1.7	1.8		1.9	3
Profile																	
Riffle Length (ft)													17	150		232	2
Riffle Slope (ft/ft)	0.0040			0.0120		0.0100			0.0200		0.0050	0.0120	0.0054	0.0056		0.0057	2
Pool Length (ft)						3			25		15	30	8	11		14	2
Pool Spacing (ft)						30			59		28	86		256			1
Substrate and Transport Parameters																	
SC% / Sa% / G% / C% / B% / Be%	14% / 27% / 47% / 7% / - / 5%												34% / 40% / 26% / - / - / -				
d16 / d35 / d50 / d84 / d95 / di^p / di^{sp} (mm)	0.3 / 1.2 / 6.1 / 10.6 / 61.9 / - /-												0.062 / 0.067 / 0.17 / 5.5 / 18 / - /-				
Reach Shear Stress (competency) lb/ft^2											0.45		0.38				
Additional Reach Parameters																	
Channel length (ft)	365										362		362				
Drainage Area (SM)	0.51					0.38					0.62		0.62				
Rosgen Classification	G4c/E4/C4/5					B4c					B4c		C4				
Bankfull Discharge (cfs)	50 - 65					42-46					65		65				
Sinuosity	1					1.2					1.1		1.06				
Water Surface Slope (ft/ft)	0.004 - 0.012					0.013					0.006		0.0047				
BF slope (ft/ft)											0.006		0.0043				

Table VI. Morphology and Hydraulic Monitoring Summary Project Name and Number: Briles - 47															
Parameter	Cross-Section 1 Riffle			Cross-Section 2 Pool			Cross-Section 3 Riffle			Cross-Section 4 Riffle			Cross-Section 5 Pool		
Dimension	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2	MY0	MY1	MY2
Current Bankfull Width (ft)	13.4			15.9			14.2			15.8			14.0		
Current Floodprone Width (ft)	>48			>60			38			>60			>80		
Current Bankfull Mean Depth (ft)	1.2			1.2			1.1			1.3			1.5		
Current Bankfull Max Depth (ft)	1.9			2.2			2.0			2.3			3.2		
Current Bankfull Cross-Sectional Area (ft^2)	15.9			18.9			16.2			19.8			21.4		
Current Bankfull Width/Depth Ratio	11.3			13.3			12.4			12.6			9.2		
Current Bankfull Entrenchment Ratio	>3.6			>3.8			2.6			>3.8			>3.7		
Current Bankfull Bank Height Ratio	1.0			1.0			1.0			1.0			1.0		
As-built Bkf Elevation Width (ft)	13.4			15.9			14.2			15.8			14		
As-built Bkf Elevation Floodprone Width (ft)	>48			>60			38			>60			>80		
As-built Bkf Elevation Mean Depth (ft)	1.2			1.2			1.1			1.3			1.5		
As-built Bkf Elevation Max Depth (ft)	1.9			2.2			2.0			2.3			3.2		
As-built Bkf Elevation Cross-Sectional Area (ft^2)	15.9			18.9			16.2			19.8			21.4		
As-built Bkf Elevation Width/Depth Ratio	11.3			13.3			12.4			12.6			9.2		
As-built Bkf Elevation Entrenchment Ratio	>3.6			>3.8			2.6			>3.8			9.2		
As-built Bkf Elevation Bank Height Ratio	1.0			1.0			1.0			1.0			1.0		
Cross-Sectional Area between cross-section end pins	67			84			146			86			82		
Substrate															
d50 (mm)	0.14			0.27			0.06			0.17			0.06		
d84 (mm)	7.1			5.6			2.1			5.5			0.7		
Channel Length (ft)	1,425									362					
Sinuosity	1.1									1.05					
Water Surface Slope (ft/ft)	0.0063									0.0047					
BF Slope (ft/ft)	0.0057									0.0043					
Rosgen Classification	C4									C4					

*Area taken from lowest pin elevation

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2.3.2 Vegetation

Baseline vegetation monitoring data were collected in January 2008. A total of eight vegetation monitoring plots were established. Five of the eight plots include live stakes. Plot photos can be found in Appendix B.

Baseline monitoring calculated an average of 675 trees per acre (Table VII). The planting plan was followed with the exception of approved substitutions for three of the tree species that were unavailable at the time of planting. The substitutions replaced *Ulmus rubra* with *Quercus phellos* and more *Fraxinus pennsylvanica*, *Lindera benzoin* with *Callicarpa americana*, and *Hamamelis virginiana* with *Corylus americana*.

Table VII: Stem counts for each species arranged by plot.
Project Name and Number: Briles - 47

Species	Plots								Initial Totals	Year 1 Totals	Survival %
	1	2	3	4	5	6	7	8			
Trees											
Betula nigra	2	5	5		1			2	15	-	-
Cornus amomum	6	3		7	14	2	6	6	44	-	-
Fraxinus pennsylvanica	2	2	3	3	5	7	2	3	27	-	-
Liriodendron tulipifera	1	5		1	1				8	-	-
Platanus occidentalis			1	2					3	-	-
Quercus pagoda	2		2	1	1	3		2	11	-	-
Quercus phellos						1	1		2	-	-
Salix nigra		3		1					4	-	-
Salix sericea		2		5	1			3	11	-	-
Sambucus canadensis	1	6						3	10	-	-

3.0 SUCCESS CRITERIA

3.1 Channel Stability

Cross-section measurements should show little or no change from the as-built cross-sections. If changes do occur, they will be evaluated to determine whether they are minor adjustments associated with settling and increasing stability or whether they indicate movement toward an unstable condition. Annual measurements of the longitudinal profile should indicate stable bedform features with little change from the as-built survey. The pools should maintain their depth with lower water surface slopes, while the riffles should remain shallower with steeper water surface slopes. Sediment transport should remain relatively unchanged with respect to aggradation and deposition of sediments. Visual monitoring of Reach 3 should indicate minimal changes between monitoring years and should not show any visual indicators of instability.

3.2 Vegetation

Riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will be developed, which could include invasive species control, the removal of dead/dying plants, and replanting.

3.3 Hydrology

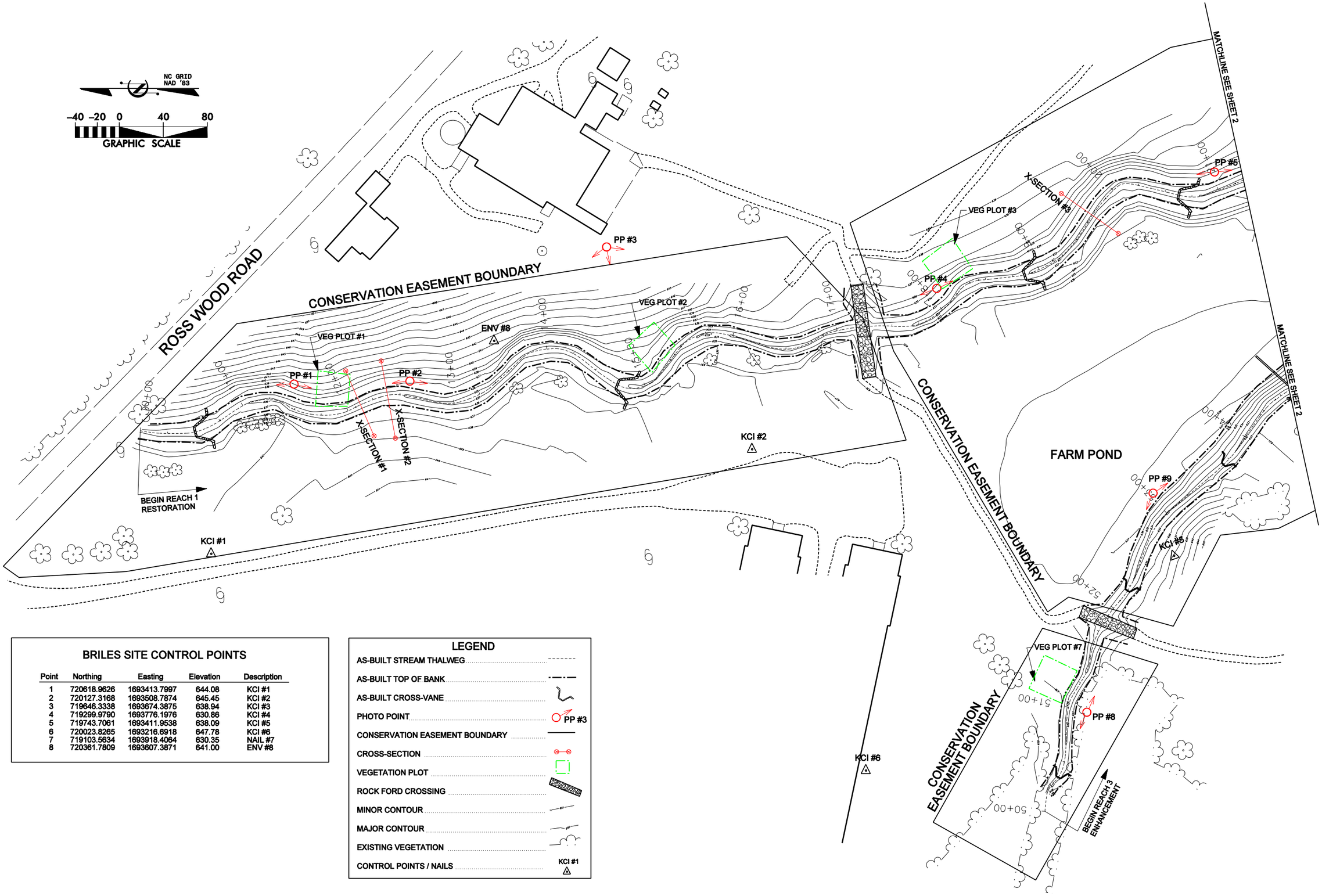
A minimum of two bankfull events must occur in separate years within the five-year monitoring period. If stream gauge data reveals that this criterion is not met, probable causes for this will be determined.

4.0 MAINTENANCE AND CONTINGENCY PLAN

Aspects of the restoration deemed problem areas will be dealt with accordingly based on the severity of the problem. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to in-stream structures. All maintenance activities will be documented in the yearly monitoring reports and any major repairs will be completed after consultation with the EEP.

Appendix A

Monitoring Plan View



BRILES SITE CONTROL POINTS

Point	Northing	Easting	Elevation	Description
1	720618.9626	1693413.7997	644.08	KCI #1
2	720127.3168	1693508.7874	645.45	KCI #2
3	719646.3338	1693674.3875	638.94	KCI #3
4	719299.9790	1693776.1976	630.86	KCI #4
5	719743.7061	1693411.9538	638.09	KCI #5
6	720023.8265	1693216.6918	647.78	KCI #6
7	719103.5634	1693918.4064	630.35	NAIL #7
8	720361.7809	1693607.3871	641.00	ENV #8

LEGEND

- AS-BUILT STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT CROSS-VANE
- PHOTO POINT — PP #3
- CONSERVATION EASEMENT BOUNDARY
- CROSS-SECTION
- VEGETATION PLOT
- ROCK FORD CROSSING
- MINOR CONTOUR
- MAJOR CONTOUR
- EXISTING VEGETATION
- CONTROL POINTS / NAILS — KCI #1

NO.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement Program

KCI
ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

BRILES SITE - UT TO JACKSON CREEK STREAM RESTORATION PROJECT

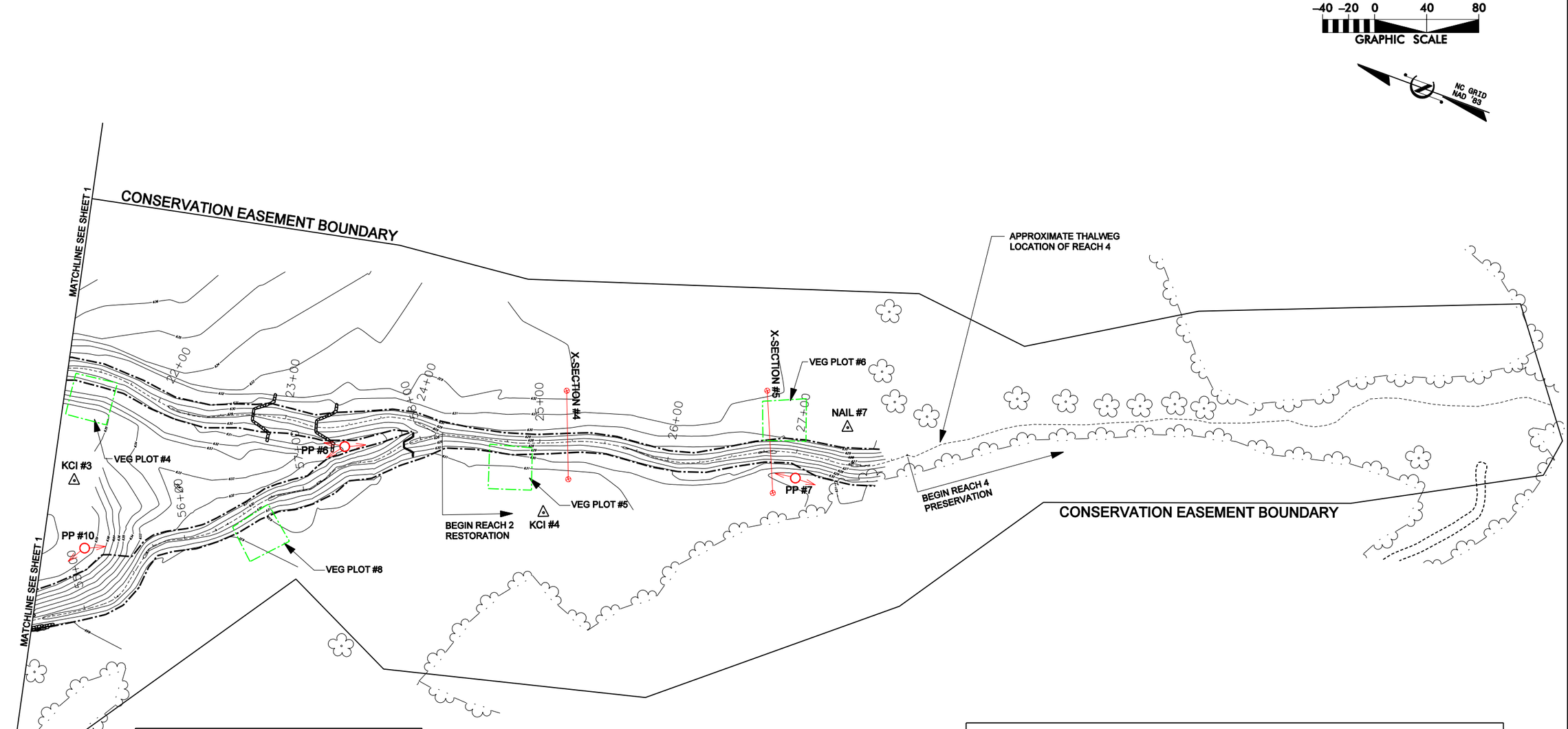
TRINITY, RANDOLPH COUNTY, NORTH CAROLINA

STATIONS 10+00 TO 21+25 AND 50+00 TO 54+59

DATE: FEBRUARY 2008
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 1 OF 2



LEGEND

- AS-BUILT STREAM THALWEG
- AS-BUILT TOP OF BANK
- AS-BUILT CROSS VANE
- PHOTO POINT — PP #3
- CONSERVATION EASEMENT BOUNDARY
- CROSS-SECTION
- VEGETATION PLOT
- ROCK FORD CROSSING
- MINOR CONTOUR
- MAJOR CONTOUR
- EXISTING VEGETATION
- CONTROL POINTS / NAILS — KCI #4

MONITORING FEATURE COORDINATES
(NC STATE PLANE, NAD 83 FT DATUM)

		NORTHING	EASTING	ELEVATION
CROSS-SECTION #1	LB	720498.79	1693580.07	641.75
	RB	720470.99	1693520.93	638.83
CROSS-SECTION #2	LB	720464.53	1693589.12	642.13
	RB	720451.60	1693518.86	638.69
CROSS-SECTION #3	LB	719846.29	1693741.32	637.81
	RB	719794.59	1693705.08	636.42
CROSS-SECTION #4	LB	719315.73	1693870.15	632.61
	RB	719291.05	1693806.79	631.74
CROSS-SECTION #5	LB	719171.34	1693923.56	631.76
	RB	719140.12	1693851.37	631.17

MONITORING FEATURE COORDINATES
(NC STATE PLANE, NAD 83 FT DATUM)

	NORTHING	EASTING
VEGETATION PLOT #1	720524.20	1693547.80
	720494.87	1693547.92
	720492.58	1693576.67
	720521.84	1693580.12
VEGETATION PLOT #2	720237.16	1693605.89
	720216.28	1693581.31
	720195.26	1693606.07
	720214.52	1693627.10
VEGETATION PLOT #3	719945.39	1693700.55
	719926.97	1693672.93
	719954.29	1693654.75
	719972.60	1693679.73
VEGETATION PLOT #4	719670.38	1693719.91
	719638.20	1693722.93
	719673.83	1693751.98
	719641.29	1693756.06
VEGETATION PLOT #5	719346.24	1693778.78
	719314.87	1693789.20
	719325.35	1693819.87
	719356.93	1693811.13
VEGETATION PLOT #6	719171.97	1693914.70
	719161.18	1693886.71
	719129.98	1693897.43
	719140.91	1693928.32
VEGETATION PLOT #7	719846.25	1693277.97
	719831.92	1693307.43
	719861.71	1693321.73
	719875.69	1693291.30
VEGETATION PLOT #8	719498.34	1693662.81
	719475.38	1693 687.92
	719500.49	1693709.05
	719520.05	1693683.06

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement Program

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BRILES SITE - UT TO JACKSON CREEK STREAM RESTORATION PROJECT

TRINITY, RANDOLPH COUNTY, NORTH CAROLINA

STATIONS 21+25 TO 27+87 AND 54+59 TO 58+17

DATE: FEBRUARY 2008
SCALE: SEE SHEET

MONITORING PLAN VIEW

SHEET 2 OF 2

Appendix B

Vegetation Plot Photos

Vegetation Plot 1: 1/9/08 – As-Built

Vegetation Plot 2: 1/9/08 – As-Built

Vegetation Plot 3: 1/9/08 – As-Built

Vegetation Plot 4: 1/9/08 – As-Built

Vegetation Plot 5: 1/9/08 – As-Built

Vegetation Plot 6: 1/9/08 – As-Built

Vegetation Plot 7: 1/9/08 – As-Built

Vegetation Plot 8: 1/9/08 – As-Built

Appendix C

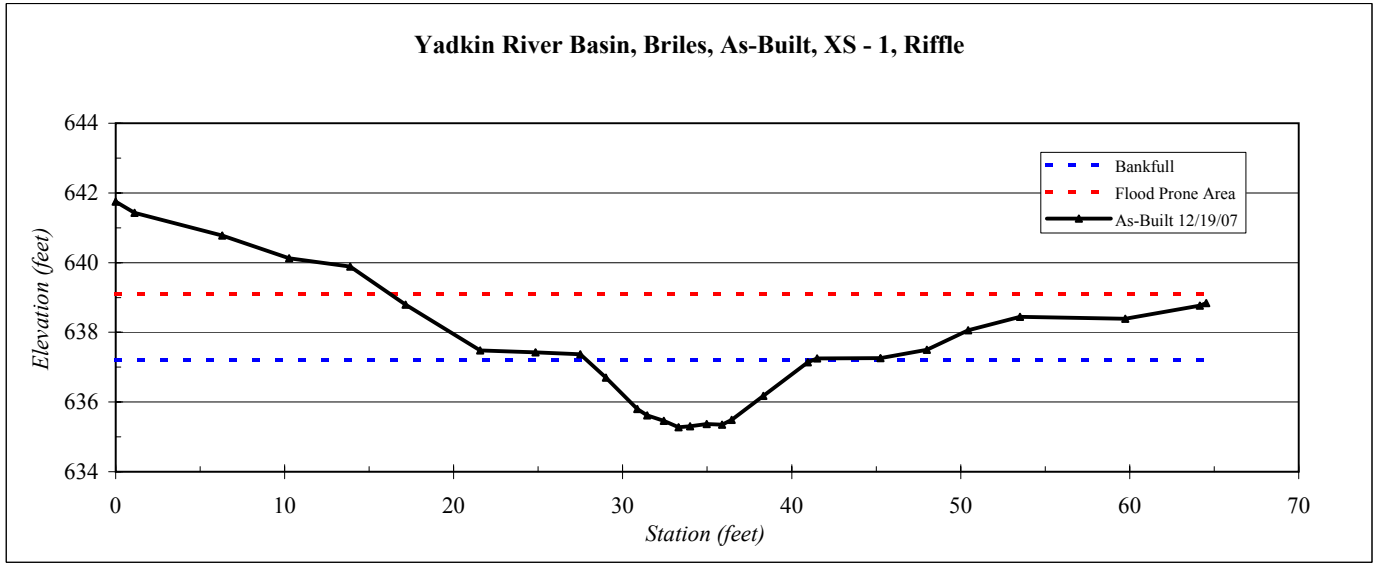
Cross-Section Plots and Pebble Counts

River Basin:	Yadkin
Watershed:	Briles, As-Built
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	0.51
Date:	12/19/2007
Field Crew:	B. Roberts, K. O'Briant

Station	Elevation
0.0	641.75
1.1	641.43
6.3	640.78
10.3	640.12
13.9	639.89
17.2	638.79
21.6	637.48
24.8	637.43
27.5	637.37
29.0	636.70
30.9	635.80
31.5	635.62
32.4	635.46
33.3	635.27
34.0	635.30
35.0	635.37
35.9	635.35
36.4	635.49
38.3	636.18
41.0	637.14
41.5	637.25
45.3	637.26
48.0	637.50
50.4	638.06
53.5	638.44
59.7	638.39
64.1	638.77
64.5	638.84

SUMMARY DATA	
Bankfull Elevation:	637.2
Bankfull Cross-Sectional Area:	15.9
Bankfull Width:	13.4
Flood Prone Area Elevation:	639.1
Flood Prone Width:	>48
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	11.3
Entrenchment Ratio:	>3.6
Bank Height Ratio:	1.0

Stream Type	C4

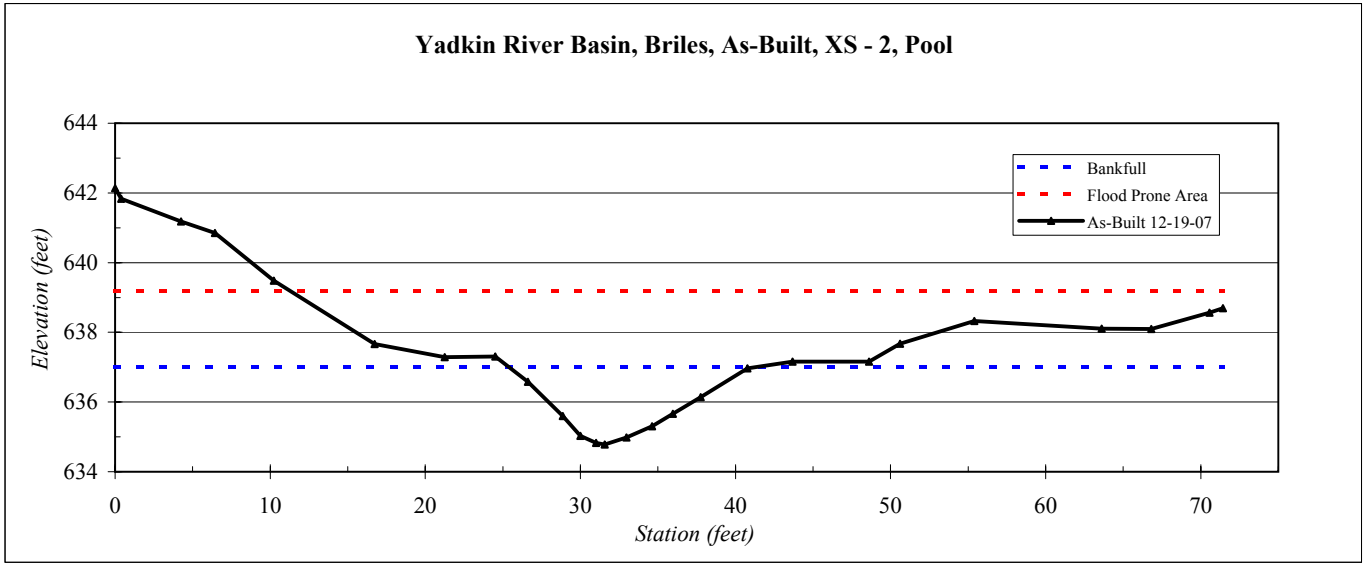


River Basin:	Yadkin
Watershed:	Briles, As-Built
XS ID	XS - 2, Pool
Drainage Area (sq mi):	0.51
Date:	12/19/2007
Field Crew:	B. Roberts, K. O'Briant

Station	Elevation
0.0	642.14
0.4	641.83
4.2	641.18
6.4	640.85
10.2	639.48
16.7	637.67
21.2	637.29
24.5	637.31
26.6	636.58
28.9	635.59
30.0	635.02
31.0	634.83
31.6	634.78
33.0	634.99
34.6	635.31
36.0	635.66
37.8	636.14
40.8	636.97
43.7	637.16
48.6	637.16
50.6	637.67
55.4	638.32
63.6	638.10
66.8	638.09
70.6	638.56
71.4	638.70

SUMMARY DATA	
Bankfull Elevation:	637.0
Bankfull Cross-Sectional Area:	18.9
Bankfull Width:	15.9
Flood Prone Area Elevation:	639.2
Flood Prone Width:	>60
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.2
W / D Ratio:	13.3
Entrenchment Ratio:	>3.8
Bank Height Ratio:	1.0

Stream Type	C4

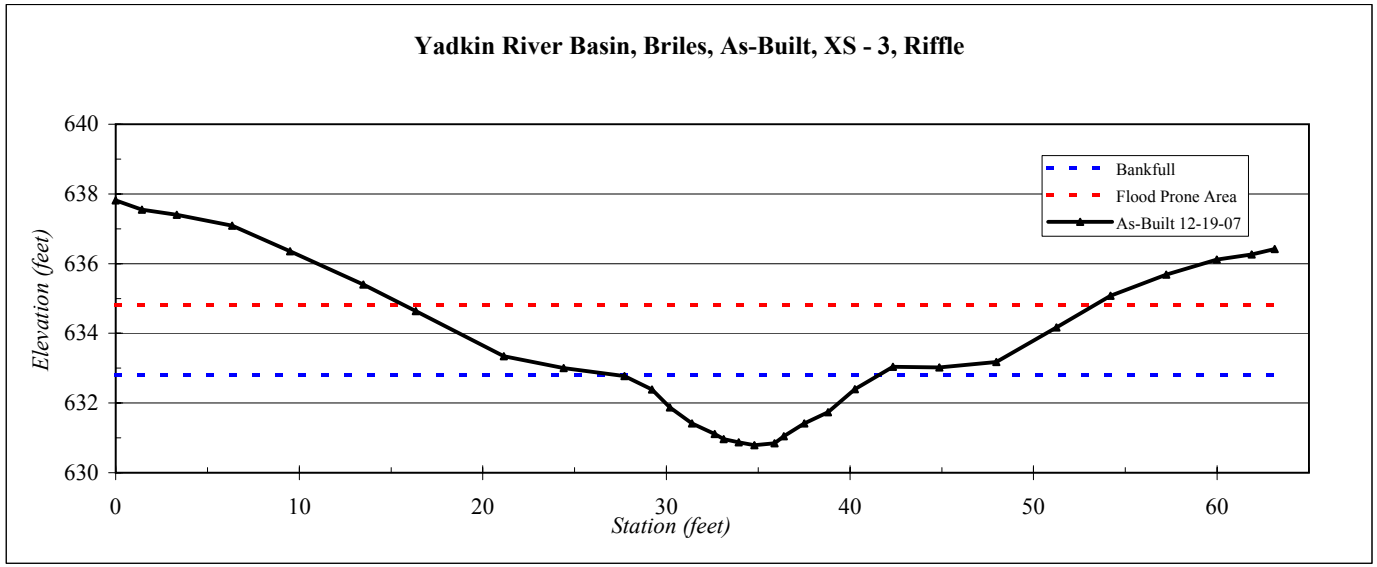


River Basin:	Yadkin
Watershed:	Briles, As-Built
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	0.51
Date:	12/19/2007
Field Crew:	B. Roberts, K. O'Briant

Station	Elevation
0.0	637.82
1.4	637.55
3.3	637.40
6.3	637.09
9.5	636.35
13.5	635.40
16.4	634.64
21.1	633.34
24.4	633.00
27.7	632.78
29.2	632.39
30.2	631.88
31.4	631.42
32.6	631.11
33.1	630.96
33.9	630.87
34.8	630.79
35.9	630.84
36.4	631.04
37.5	631.41
38.8	631.73
40.3	632.39
42.3	633.04
44.9	633.02
48.0	633.18
51.3	634.17
54.2	635.08
57.2	635.68
60.0	636.11
61.9	636.26
63.1	636.42

SUMMARY DATA	
Bankfull Elevation:	632.8
Bankfull Cross-Sectional Area:	16.2
Bankfull Width:	14.2
Flood Prone Area Elevation:	634.8
Flood Prone Width:	38
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.1
W / D Ratio:	12.4
Entrenchment Ratio:	2.6
Bank Height Ratio:	1.0

Stream Type	C4

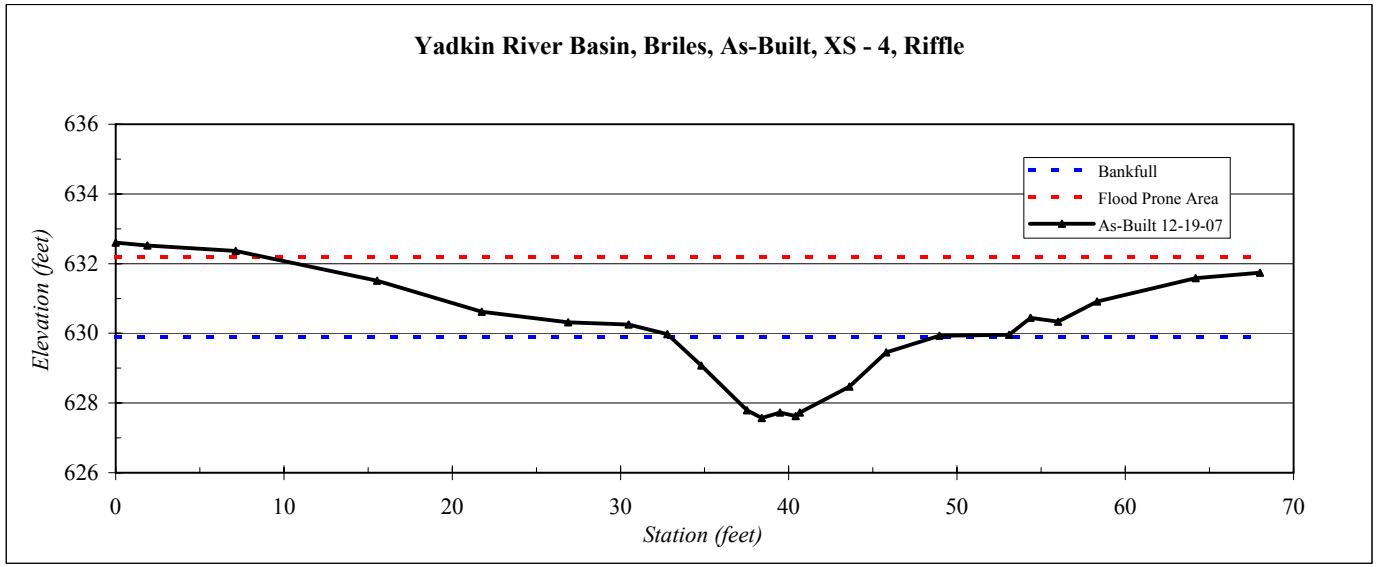


River Basin:	Yadkin
Watershed:	Briles, As-Built
XS ID	XS - 4, Riffle
Drainage Area (sq mi):	0.62
Date:	12/19/2007
Field Crew:	B. Roberts, K. O'Briant

Station	Elevation
0.0	632.60
1.9	632.52
7.1	632.37
15.5	631.51
21.8	630.62
26.9	630.31
30.5	630.25
32.8	629.98
34.8	629.07
37.5	627.79
38.4	627.57
39.5	627.72
40.4	627.63
40.7	627.73
43.6	628.47
45.8	629.45
48.9	629.93
53.1	629.96
54.4	630.45
56.0	630.33
58.3	630.92
64.2	631.59
68.0	631.74

SUMMARY DATA	
Bankfull Elevation:	629.9
Bankfull Cross-Sectional Area:	19.8
Bankfull Width:	15.8
Flood Prone Area Elevation:	632.2
Flood Prone Width:	>60
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.3
W / D Ratio:	12.6
Entrenchment Ratio:	>3.8
Bank Height Ratio:	1.0

Stream Type	C4

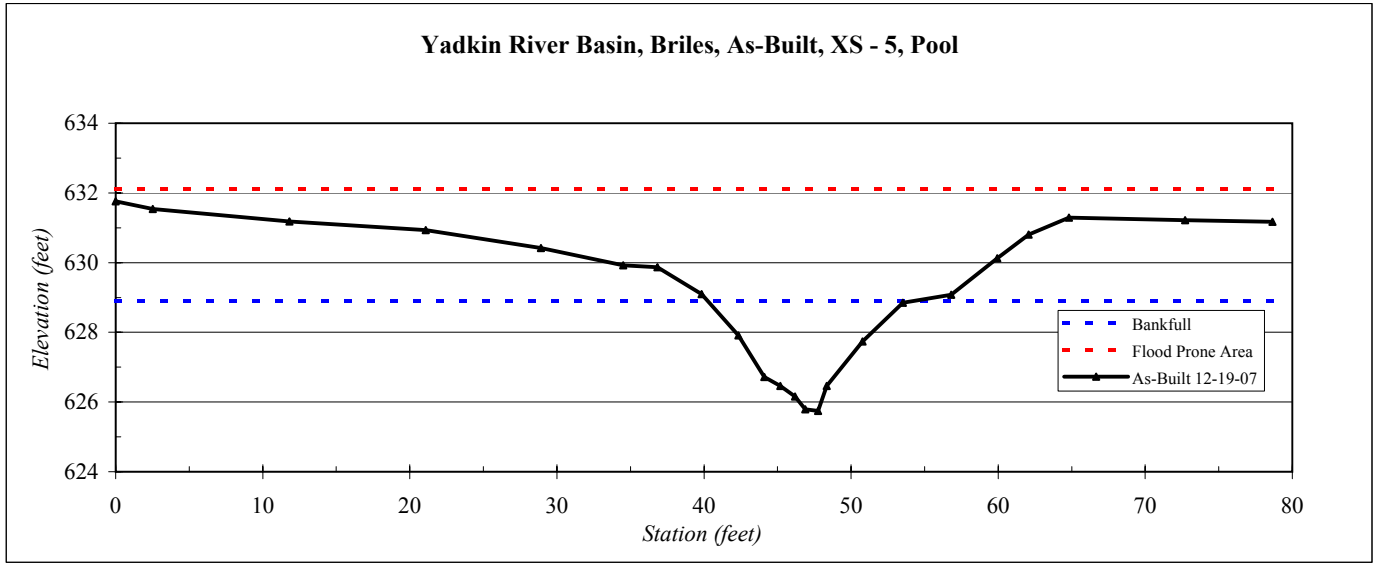


River Basin:	Yadkin
Watershed:	Briles, As-Built
XS ID	XS - 5, Pool
Drainage Area (sq mi):	0.62
Date:	12/19/2007
Field Crew:	B. Roberts, K. O'Briant

Station	Elevation
0.0	631.76
2.5	631.54
11.8	631.18
21.1	630.93
28.9	630.42
34.5	629.93
36.8	629.87
39.8	629.09
42.3	627.91
44.1	626.72
45.2	626.46
46.2	626.16
46.9	625.79
47.8	625.74
48.3	626.46
50.8	627.74
53.5	628.85
56.8	629.07
59.9	630.13
62.1	630.80
64.8	631.29
72.7	631.22
78.7	631.17

SUMMARY DATA	
Bankfull Elevation:	628.9
Bankfull Cross-Sectional Area:	21.4
Bankfull Width:	14.0
Flood Prone Area Elevation:	632.1
Flood Prone Width:	>80
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	1.5
W / D Ratio:	9.2
Entrenchment Ratio:	>3.7
Bank Height Ratio:	1.0

Stream Type	C4

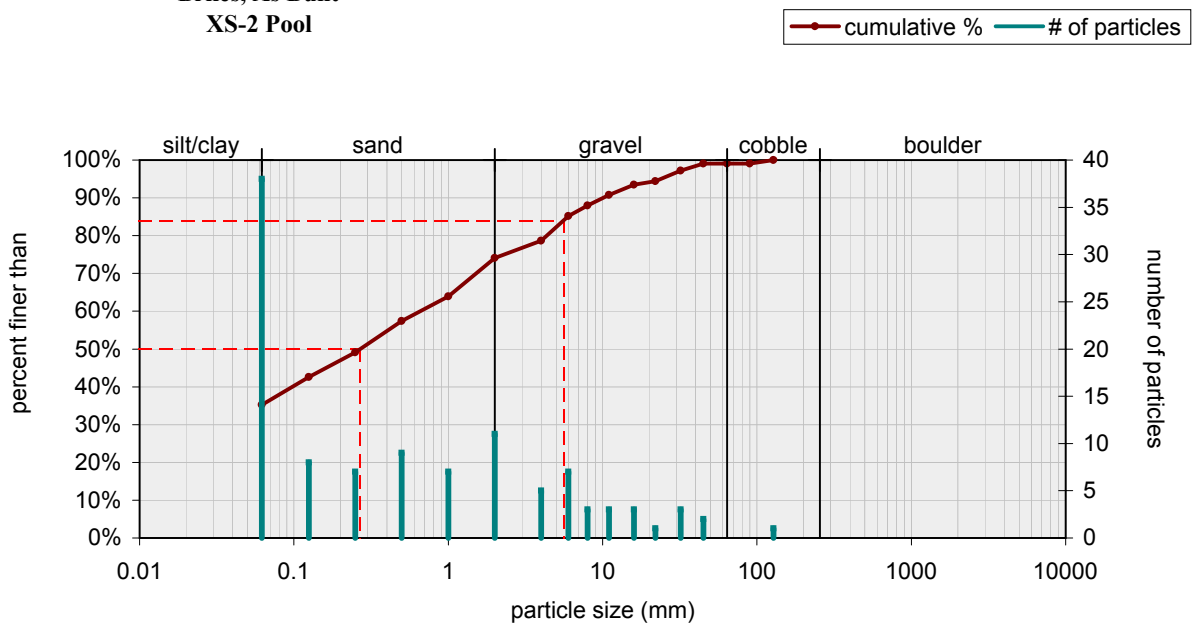


Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**38**
very fine sand	0.062 - 0.125	**8**
fine sand	0.125 - 0.25	**7**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**7**
very coarse sand	1 - 2	**11**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**7**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**3**
very coarse gravel	32 - 45	**2**
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	**1**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		108
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		108

Note: XS-2

Briles, As Built
XS-2 Pool



Size (mm)		
D16	0.062	3.4
D35	0.062	12
D50	0.27	17
D65	1.1	20
D84	5.6	29
D95	24	39

Size Distribution	
mean	0.6
dispersion	12.5
skewness	0.24

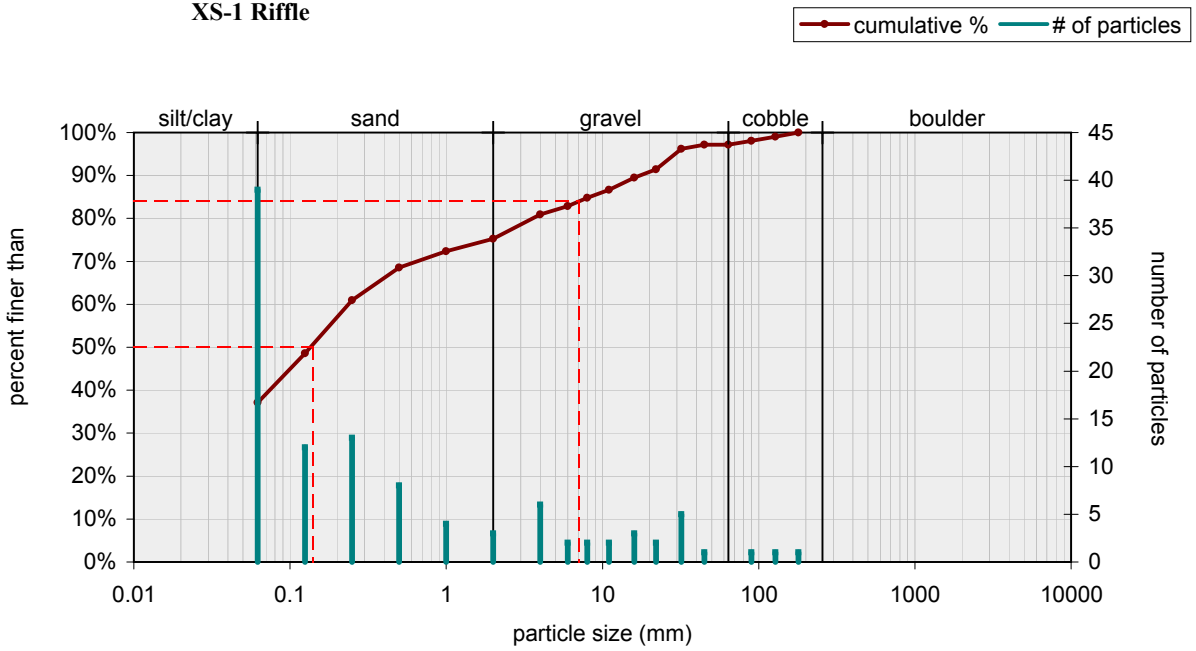
Type	
silt/clay	35%
sand	39%
gravel	25%
cobble	1%
boulder	0%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**39**
very fine sand	0.062 - 0.125	**12**
fine sand	0.125 - 0.25	**13**
medium sand	0.25 - 0.5	**8**
coarse sand	0.5 - 1	**4**
very coarse sand	1 - 2	**3**
very fine gravel	2 - 4	**6**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**2**
coarse gravel	22 - 32	**5**
very coarse gravel	32 - 45	**1**
very coarse gravel	45 - 64	
small cobble	64 - 90	**1**
medium cobble	90 - 128	**1**
large cobble	128 - 180	**1**
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		105
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		105

Note: XS-1

Briles, As Built
XS-1 Riffle



Size (mm)	
D16	0.062
D35	0.062
D50	0.14
D65	0.36
D84	7.1
D95	29

Size Distribution	
mean	0.7
dispersion	26.5
skewness	0.47

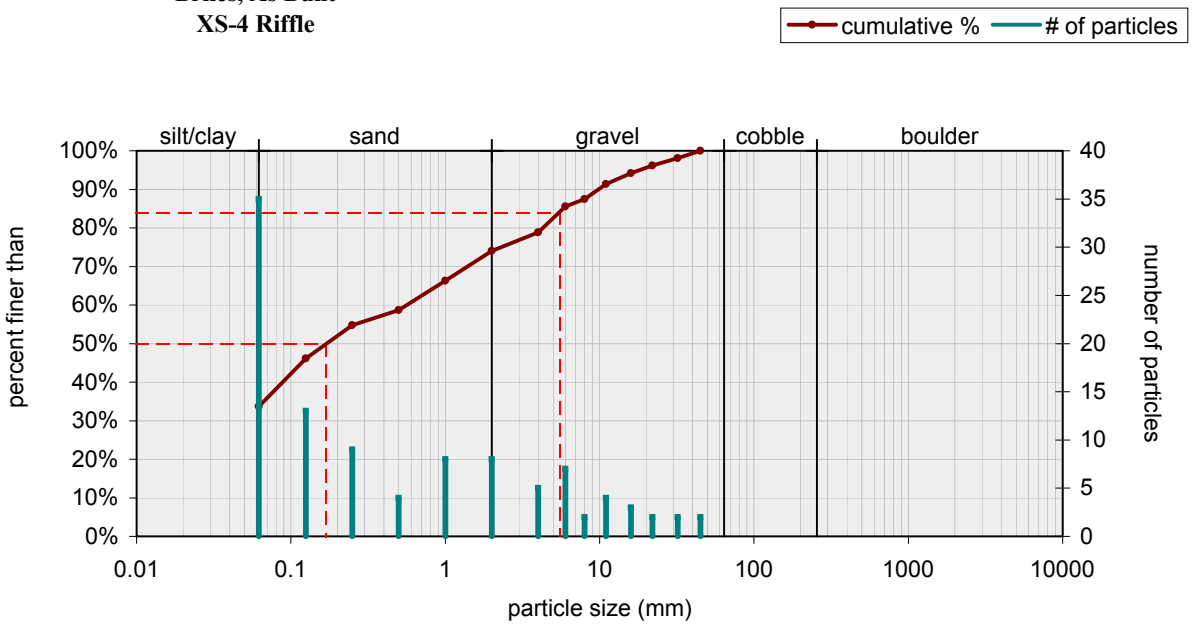
Type	
silt/clay	37%
sand	38%
gravel	22%
cobble	3%
boulder	0%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**35**
very fine sand	0.062 - 0.125	**13**
fine sand	0.125 - 0.25	**9**
medium sand	0.25 - 0.5	**4**
coarse sand	0.5 - 1	**8**
very coarse sand	1 - 2	**8**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**7**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**2**
coarse gravel	22 - 32	**2**
very coarse gravel	32 - 45	**2**
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		104
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		104

Note: XS-4

Briles, As Built
XS-4 Riffle



Size (mm)	
D16	0.062
D35	0.067
D50	0.17
D65	0.89
D84	5.5
D95	18

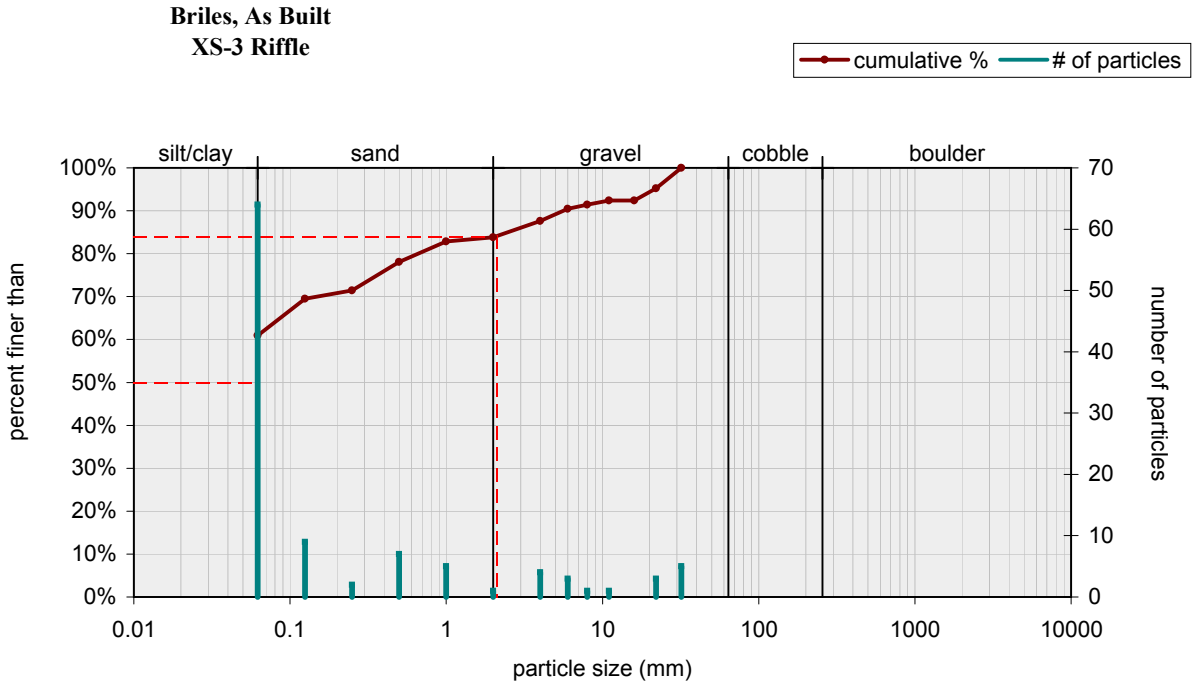
Size Distribution	
mean	0.6
dispersion	17.5
skewness	0.38

Type	
silt/clay	34%
sand	40%
gravel	26%
cobble	0%
boulder	0%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**64**
very fine sand	0.062 - 0.125	**9**
fine sand	0.125 - 0.25	**2**
medium sand	0.25 - 0.5	**7**
coarse sand	0.5 - 1	**5**
very coarse sand	1 - 2	**1**
very fine gravel	2 - 4	**4**
fine gravel	4 - 6	**3**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	
coarse gravel	16 - 22	**3**
coarse gravel	22 - 32	**5**
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		105
bedrock ----------		**7**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		112

Note: XS-3



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.086
D84	2.1
D95	21

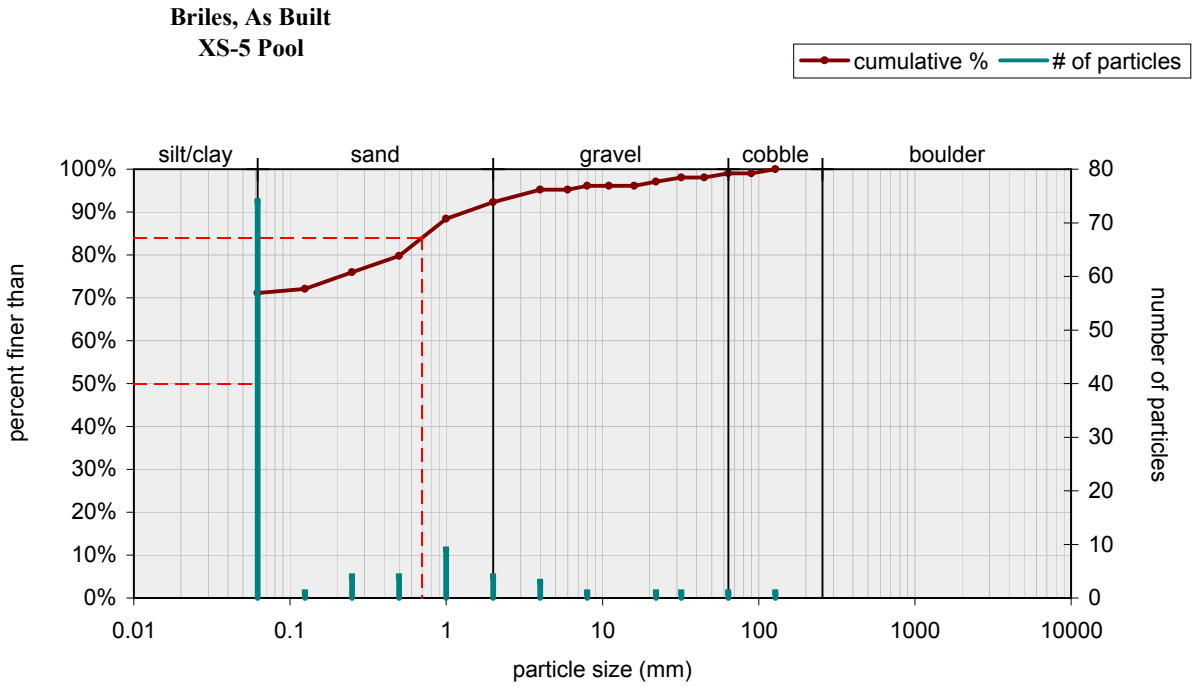
Size Distribution	
mean	0.4
dispersion	17.4
skewness	0.62

Type			
silt/clay	57%	bedrock	6%
sand	21%		
gravel	15%		
cobble	0%		
boulder	0%		

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**74**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	**4**
medium sand	0.25 - 0.5	**4**
coarse sand	0.5 - 1	**9**
very coarse sand	1 - 2	**4**
very fine gravel	2 - 4	**3**
fine gravel	4 - 6	
fine gravel	6 - 8	**1**
medium gravel	8 - 11	
medium gravel	11 - 16	
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**1**
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	**1**
small cobble	64 - 90	
medium cobble	90 - 128	**1**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		104
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		104

Note: XS-5



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.7
D95	3.8

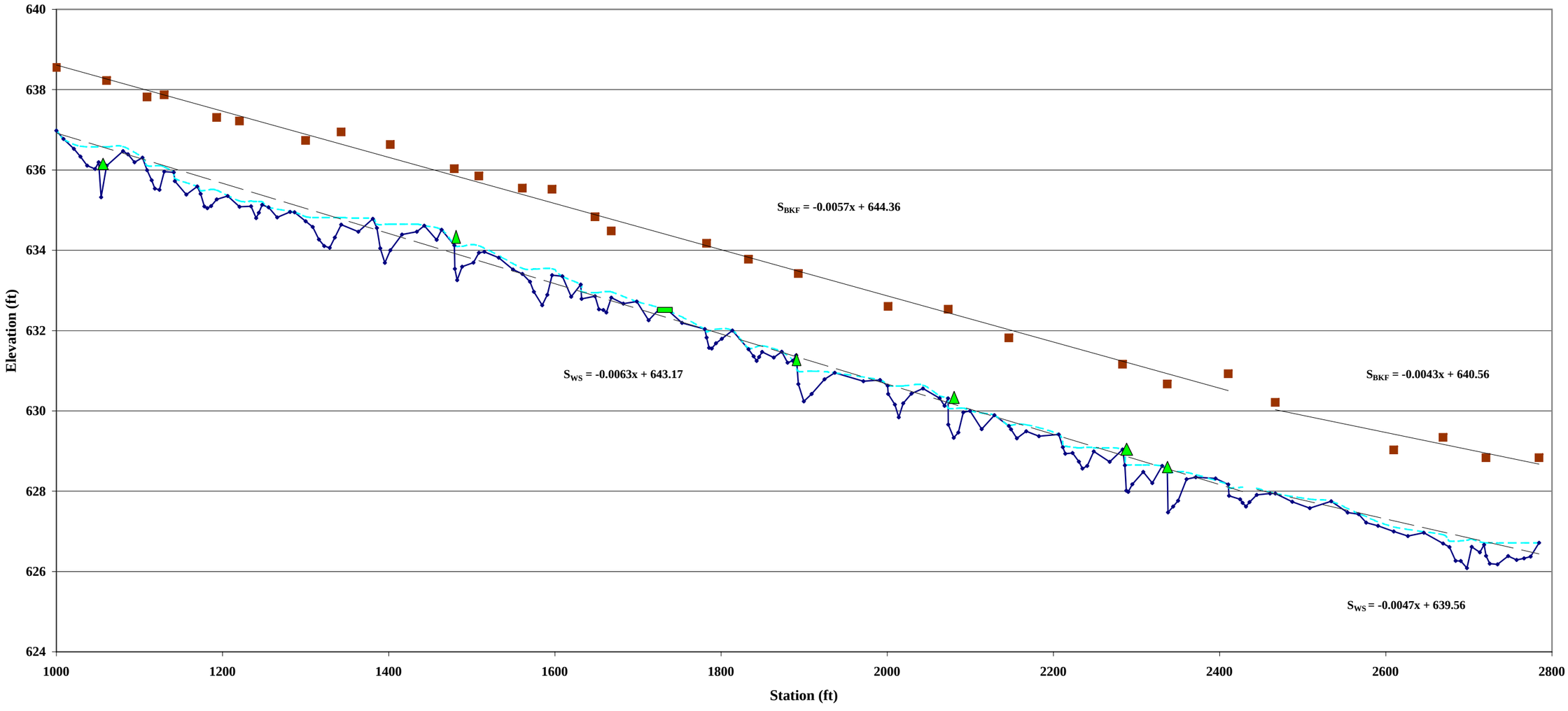
Size Distribution	
mean	0.2
dispersion	6.1
skewness	0.51

Type	
silt/clay	71%
sand	21%
gravel	7%
cobble	1%
boulder	0%

Appendix D

Longitudinal Profile

Longitudinal Profile
Briles - Unnamed Tributary to Jackson Creek
EEP Project Number - 47
Station 10+00-28+00



Appendix E

Permanent Photo Station Photos

Photo Point 1a: View looking upstream towards the beginning of the project. 12/19/07 – As-Built

Photo Point 1b: View looking downstream near Station 11+50. 12/19/07 – As-Built

Photo Point 2a: View looking upstream taken near Station 13+10. 12/19/07 – As-Built

Photo Point 2b: View looking downstream taken near Station 13+10. 12/19/07 – As-Built

Photo Point 3a: View looking upstream from eastern side slope near Station 15+00. 12/19/07 – As-Built

Photo Point 3b: View looking downstream from eastern side slope near Station 15+00. 12/19/07 – As-Built

Photo Point 4a: View looking upstream near Station 18+00. 12/19/07 – As-Built

Photo Point 4b: View looking downstream near Station 18+00. 12/19/07 – As-Built

Photo Point 5a: View looking upstream near Station 21+00. 12/19/07 – As-Built

Photo Point 5b: View looking at cross vane near Station 21+00. 12/19/07 – As-Built

Photo Point 5c: View looking downstream near Station 21+00. 12/19/07 – As-Built

Photo Point 6a: View looking upstream near confluence. 12/19/07 – As-Built

Photo Point 6b: View looking upstream the tributary near confluence. 12/19/07 – As-Built

Photo Point 6c: View looking downstream at confluence. 12/19/07 – As-Built

Photo Point 7a: View looking upstream near Station 27+25. 12/19/07 – As-Built

Photo Point 7b: View looking downstream towards end of project. 12/19/07 – As-Built

Photo Point 8a: View looking upstream towards beginning of tributary. 12/19/07 – As-Built

Photo Point 8b: View looking downstream on tributary near Station 51+00. 12/19/07 – As-Built

Photo Point 9a: View looking upstream on tributary near Station 53+15. 12/19/07 – As-Built

Photo Point 9b: View looking downstream on tributary near Station 53+15. 12/19/07 – As-Built

Photo Point 10a: View looking upstream on tributary near Station 55+25. 12/19/07 – As-Built

Photo Point 10b: View looking downstream on tributary near Station 55+25. 12/19/07 – As-Built