Blockhouse Creek Restoration Project

Year 1 Monitoring Report

Polk County, North Carolina

Monitoring Firm: Michael Baker Engineering, Inc. (Baker)

Monitoring Firm POC: Micky Clemmons

Prepared for: North Carolina Ecosystem Enhancement Program (NCEEP)

NCEEP Project Manager: Guy Pearce

Report Prepared By: Michael Baker Engineering, Inc.
797 Haywood Road, Suite 201
Asheville, NC 28806

Contract Number: D06027-A

Date Submitted: November 2009

FINAL

Table of Contents

Tables

Figures

Appendices

EXECUTIVE SUMMARY

This Annual Report details the monitoring activities during the 2009 growing season (Monitoring Year 1) on the Blockhouse Creek Restoration Site ("Site"). This Annual Monitoring Report presents data on stream geometry, stem count data from vegetation monitoring stations, and discusses any observed tendencies relating to stream stability and vegetation survival success. The Site is currently on track to meet the hydrologic, vegetative, and stream success criteria specified in the Blockhouse Creek Restoration Plan.

The Blockhouse Creek Site ("Site") was restored through a full delivery contract with the North Carolina Ecosystem Enhancement Program (NCEEP). Prior to restoration, stream and riparian functions on the Site were impaired as a result of historic agricultural land use practices as well as culvert installations that took place during the construction of the adjacent equestrian and nature center and Interstate 26. The streams on the Site were channelized and riparian vegetation had been cleared. Blockhouse Creek also exhibited instability as a result of improperly installed culverts. As-built surveys conducted in the Summer of 2008 indicate that 5,875 linear feet of stream were restored on Blockhouse Creek and two unnamed tributaries (UT1 and UT2), to Blockhouse Creek.

A total of ten vegetation monitoring plots 100 square meters (m^2) (10m x 10m) in size were used to predict survivability of the woody vegetation planted on-site. The Year 1 vegetation monitoring indicated an average survivability of 620 stems per acre. The data shows that the Site is on track for meeting the minimum success interim criteria of 320 trees per acre by the end of Year 3 and the final success criteria of 260 trees per acre by the end of Year 5.

With the exception of slight aggradation in isolated reaches, cross-section surveys indicate the stream dimension of Blockhouse Creek and its tributaries remained stable during Year 1. Overall, in-stream structures also remained stable during Year 1. However, the longitudinal profile for Reach 2 of Blockhouse Creek above I-26 reflects the presence of a sandbag weir at station 14+31which has backed up water for most of this reach. Baker has contacted FENCE regarding the removal of this weir. The lower reach of Blockhouse Creek immediately downstream of the Interstate 26 and downstream of the confluence with UT2 exhibited some aggradation, most likely from sand and gravel coming out of the I-26 box culverts. UT1 did not exhibit any significant profile changes. As noted in the previous monitoring report, UT2 did not contain flow during the As-built survey. However, UT2 did contain water during Year 1 monitoring; the longitudinal profile survey reflects generally stable conditions along the channel. Compared with the as-built survey, UT2 appears to have degraded slightly above and below a wetland complex adjacent to the project area. However, it is likely that the "downcutting" is attributable to the small tributary experiencing periodic flow sufficient to flush the tributary of excess siltation present at the time of the as-built survey. The channel slope on UT2 was designed to be gradual in the vicinity of the wetland as compared to other sections of UT2 to avoid impacts to the hydrology of the site. As a consequence, there is little change in the profile in the vicinity of the wetland when compared to the As-built survey. Visual observations and cross-sections confirm channel overflow in areas, although flow was not sufficient to be recorded on a crest gauge located on UT2. Based on the overall stability of the channel, no maintenance or repair work of channel profile is required beyond the removal of a downed tree at cross-section 14.

Bank repair work was performed on one isolated section in Reach 4 of Blockhouse Creek where soil subsidence had created a "sink hole" behind rootwads near cross-section 8. The unstable area, was approximately 5 feet in length, and was the result of soil erosion beneath a rootwad that was previously installed. Bank repairs were minor and consisted of placing rock in the base of the hole, covering this with a geotextile, backfilling, re-seeding and matting the area.

The on-site crest gauges did not record any bankfull flow events across the project area during Year 1 of the post construction monitoring period. The site will continue to be periodically monitored for the occurrence of bankfull events which will be included in future monitoring reports.

Table 1 summarizes site conditions before and after restoration as well as what was predicted in the restoration plan. The stream mitigation units developed on the project exceed the number of units that Baker contracted with the North Carolina Ecosystem Enhancement Program (NCEEP) to provide. The monitoring plan and Year 1 monitoring data are discussed in Sections 2.1 through 2.5 of this report. The 2009 stream cross section data presented in this Report were collected during April and May 2009. Vegetation monitoring plots were assessed in June 2009.

1.0 PROJECT BACKGROUND

The Blockhouse Creek restoration project involved restoration, enhancement or preservation of 6,305 linear feet (LF) of four on-site streams: Blockhouse Creek and three smaller unnamed tributaries (UTs) identified in the project as UT1, UT2, and UT3. Blockhouse Creek is a "blue-line" stream, as shown on the USGS topographic quadrangle for the site, and is considered to be perennial based on field evaluations using NCDWQ stream assessment protocols. The three tributaries were all identified as perennial during initial project scoping, although UT2 and UT3 have little or no flow during extreme drought conditions as observed during previous summers. A total of 8.6 acres of stream and riparian buffer are protected through a conservation easement.

1.1 Project Goals and Objectives

The goals for the restoration project are as follows:

- Create geomorphically stable conditions on Blockhouse Creek.
- Restore hydrologic connections between creek and floodplain.
- Improve the water quality of Blockhouse Creek.
- Improve aquatic and terrestrial habitat along the project corridor.

To achieve these goals, design objectives of the project included:

- Restoration or enhancement of channel dimension, pattern and profile;
- Improvements to water quality in the Blockhouse Creek watershed through nutrient removal, sediment removal, improved recreational opportunities, streambank stability, and erosion control;
- Improved water quantity/flood attenuation through water storage and flood control, reduction in downstream flooding due to the reconnection of stream and floodplain, improved ground water recharge, and improved and restored hydrologic connections;
- Enhancement of aquatic and terrestrial habitats through improved substrate and instream cover, addition of woody debris, reduction in water temperature due to shading, restoration of terrestrial habitat, increase of spatial extent of natural area, and improved aesthetics.

1.2 Project Structure

Restoration of site hydrology involved the restoration of natural stream functions to impaired reaches on the site. The streams in their pre-project condition were channelized and, as a result, were highly incised. Because of the extent of the incision, a Rosgen Priority I restoration, which would connect the stream to the abandoned floodplain (terrace), would not have been feasible without extending the project reach several thousand feet upstream and significantly altering the channel profile. However, there was sufficient space in areas within the project boundaries to implement a Rosgen Priority II restoration by excavating the floodplain and creating a new meandering channel. With the exception of a small section of UT2, the restored streams were designed as Rosgen "E" channels with design dimensions based on those of reference parameters. The upper project reach on UT2 was designed as an "E" channel while the lower section of the project reach (approximately 200 feet) was designed as a "B" channel. The preserved reach on UT3 was determined to be a "B" channel that transitions to an "E" channel.

The design for restored sections of the streams involved the construction of new, meandering channels across excavated floodplains. This new channel system was constructed through grassed fields. The

streams through the site were restored to a stable dimension, pattern, and profile. Total stream length across the project was increased from approximately 6,191 LF to 6,305 LF. The design allows stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing streambank stress. Instream structures were used to control streambed grade, reduce streambank stress, and promote bedform sequences and habitat diversity. Rootwad and log vane structures will protect streambanks and promote habitat diversity in pool sections. Constructed riffles were used to promote both hydraulic and habitat heterogeneity to the channel. Where grade control was a design consideration, constructed riffles were installed to provide long-term stability. Streambanks were stabilized using a combination of erosion control matting, bare-root planting, transplants, and geolifts. Transplants provided immediate living root mass to increase streambank stability and create shaded holding areas for fish and other aquatic biota. Native vegetation was planted across the site, and the entire restoration site is protected through a permanent conservation easement. Table 1 summarizes project data for each reach and restoration approaches used.

Table 1. Project Restoration Components

Blockhouse Creek Restoration Project-#D06027-A

Project Segment or Reach ID	Existing Feet/ Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Blockhouse Cr. Reach 1	887 LF	R	P2	1070 LF	1.0	1,070	0+00-10+70	Meandering channel construction; excavation of floodplain
Blockhouse Cr. Reach 2	340 LF	R	P2	340 LF	1.0	340	10+70-14+14	Meandering channel construction; excavation of floodplain
Blockhouse Cr. Reach 3	950 LF	E	I	950 LF	1.5	633	14+34-25+44	Constraints prevented restoration; bankfull benches established, structures installed, pattern stabilized.
Blockhouse Cr. Reach 4	1,821 LF	R	P2	1,780 LF	1.0	1,780	28+37-46+15	Meandering channel construction; floodplain excavation
UT 1	523 LF	R	P2	580 LF	1.0	580	0+00-5+80	Meandering channel construction; floodplain excavation
UT 2	1,240 LF	R	P2	1,155 LF	1.0	1,155	0+00-11+74	Was incised at lower end, upper 1000 LF realigned to a more stable pattern with only minor floodplain grading
UT 3	430 LF	P	-	430 LF	5.0	86	0+00-4+30	No channel alteration (preservation)

Mitigation Unit Summations

Stream (LF)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment
5,644	NA	NA	NA	8.6	

1.3 Project Location

The Blockhouse Creek mitigation site is located on the Foothills Equestrian Nature Center (FENCE) property approximately three miles east of Tryon, in Polk County, North Carolina. From Asheville take I-26 South to South Carolina Exit #1 and turn right toward Landrum, S.C. Go 1.5 miles, and turn right onto Bomar Road (look for the Land Mart on the corner). Go one short block and turn right onto Prince Road. After 1.7 miles, turn left onto Hunting Country Road, just before the I-26 bridge. Go .5 mile to the FENCE entrance on the left or another .1 miles (going under I-26) to the second entrance on the right. The Blockhouse Creek site starts at near the horse stables accessed through the first entrance and below the first culvert under the steeplechase course. Figure 1 illustrates the physical location of the project site.

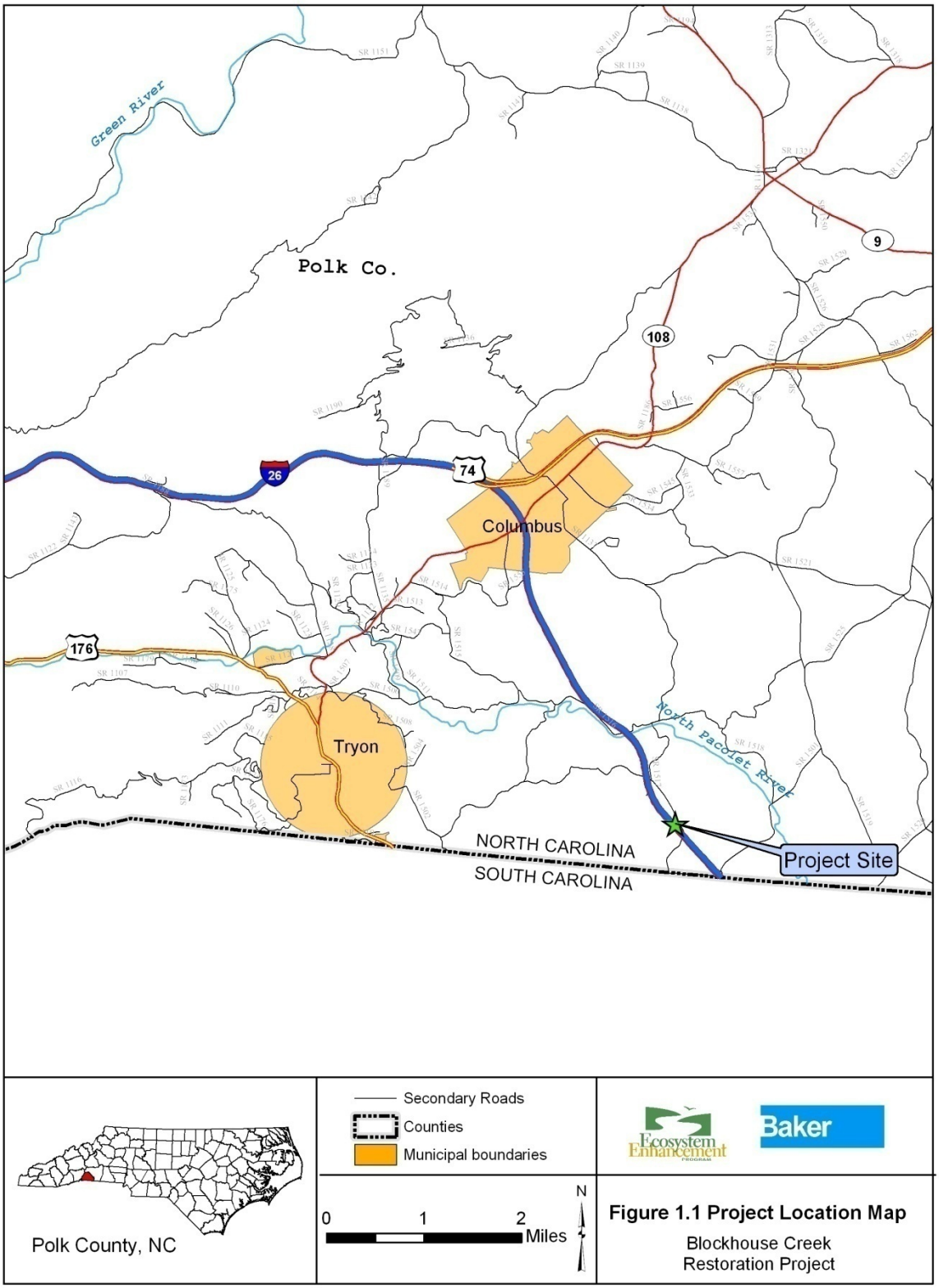


Figure 1.1 Project Location Map
Blockhouse Creek
Restoration Project

1.4 History and Background

The Blockhouse Creek Restoration site is located within the Foothills Equestrian Nature Center (FENCE), approximately three miles east of Tryon, in Polk County, North Carolina. The project site is situated in the Broad River Basin, within North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-06 and United States Geologic Survey (USGS) hydrologic unit 03050105150020.

Since the late 1980s, the project area has been used as an equestrian/recreational complex. Surrounding lands are currently used for pasture land, hay production and residential use. Prior to the establishment of an equestrian and nature center, the FENCE property was used for agriculture activities and timber production. At that time, riparian buffers were removed and streams were channelized which was a common practice. There is also evidence on some tributaries of ephemeral gullies which most likely resulted from clear cutting. More recent development in the watershed has resulted in additional changes to Blockhouse Creek and its tributaries. Construction of the equestrian facility, nature trails and Interstate 26 required the installation of bridged and culverted stream crossings that have been detrimental to stream stability. These structures have also impacted the flow pattern and velocity of the project streams, resulting in changes to the cross-sectional area, and often facilitating the deepening of the channel. This deepening of the channel resulted in the streams becoming incised and losing their connection to the adjacent floodplain.

In accordance with the approved restoration plan for the site, construction activities began in January 2008. Project activity on Blockhouse Creek and UT1 and UT2 consisted of making adjustments to channel dimension, pattern, and profile. A primary design consideration for this project was to allow stream flows larger than bankfull to spread onto a floodplain, dissipating flow energies and reducing streambank stress. The design for most of the restoration reaches involved a priority II approach with the construction of new, meandering channels across a floodplain that was excavated to the bankfull elevation of the creek. The lower part of reach 4 was not incised and did not require this approach. Along this section the overly sinuous channel was realigned in a more stable pattern at the existing elevation. Total stream length across the project increased from approximately 6,191 LF to 6,305 LF.

Rootwads, rock and log vanes and other structures were used to protect streambanks and promote habitat diversity in pool sections. Streambanks were stabilized using a combination of erosion control matting, bare-root planting, transplants, and geolifts. Transplants provided living root mass quickly to increase streambank stability and create shaded holding areas for fish and aquatic biota. Native vegetation was planted across the site, and the entire restoration site is protected through a permanent conservation easement.

The chronology of the Blockhouse Creek restoration project is presented in Table 2. The contact information for designers, contractors and plant material suppliers is presented in Table 3. Relevant project background information is presented in Table 4. The total stream length on restoration and enhancement reaches, surveyed during Year 1 monitoring was 5,875 LF.

Table 2. Project Activity and Reporting History
Blockhouse Creek Restoration Project-#D06027-A

Activity or Report	Data Collection Complete	Completion or Delivery
Categorical Exclusion Approved	---	January 2007
Conservation Easement Signed	---	September 2007
Restoration Plan Approved	---	October 2007
Project Permit Approval	---	December 2007/ January 2008
Final Design-90%	---	October 2007
Construction		
`Upstream of Interstate-26	January 2008	March 2008
Downstream of Interstate-26	March 2008	May 2008
Permanent seed mix and riparian vegetation applied to project site		
Upstream of Interstate-26	January 2008	March 2008
Downstream of Interstate-26	March 2008	June 2008
Vegetation Plots , Crest Gauges and Photo Stations Established	July 2008	September 2008
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	July 2008	December 2008
Year 1 Monitoring	June 2009	November 2009
Year 2 Monitoring	June 2010	December 2010
Year 3 Monitoring	June 2011	December 2011
Year 4 Monitoring	June 2012	December 2012
Year 5 Monitoring	June 2013	December 2013

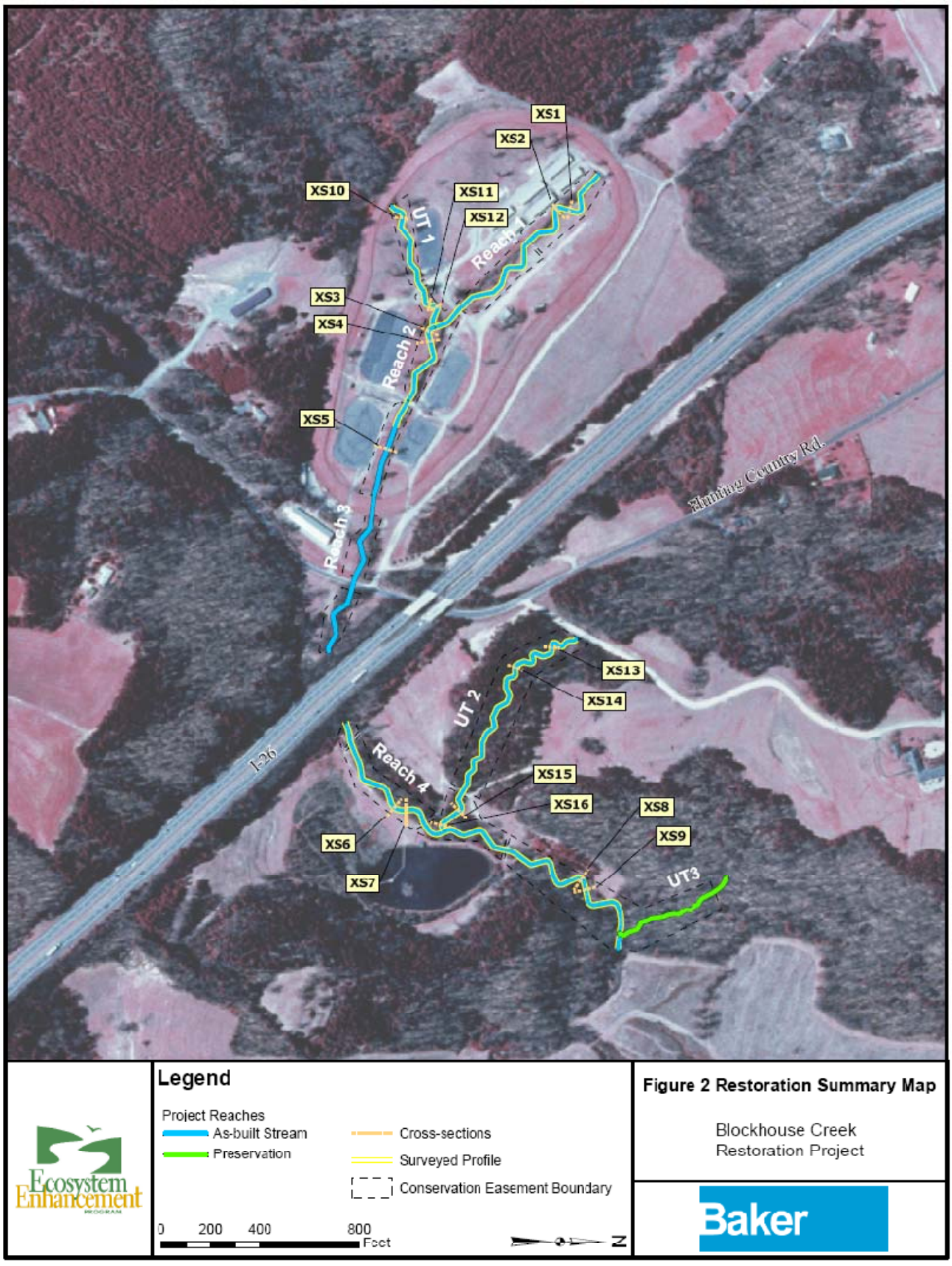
Table 3. Project Contacts Table Blockhouse Creek Restoration Project-#D06027-A	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact: Micky Clemmons, Tel. 828.350.1408 x2002
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27511 Contact: Will Pedersen, Tel. 919.459.9001
Planting & Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27511 Contact: George Morris, Tel. 919.459.9001
Seed Mix Sources	Green Resources
Nursery Stock Suppliers	Arborgen and Hillis Nursery
Monitoring	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201 Asheville, NC 28806 Contact: Carmen McIntyre, Tel. 828.350.1408 x2010

Table 4. Project Background Table Blockhouse Creek Restoration Project-#D06027-A	
Project County	Polk County, NC
Drainage Area (Square Miles or Acres)	
Blockhouse Creek Reach 1	1.63 mi^2
Blockhouse Creek Reach 2	1.97 mi^2
Blockhouse Creek Reach 3	2.21 mi^2
Blockhouse Creek Reach 4	2.44 mi^2
UT 1	211.2 Ac.
UT 2	57.6 Ac.
UT 3	38.4 Ac.
Drainage impervious cover estimate (%)	<1%
Stream Order	Second Order
Physiographic Region	Piedmont Province. Borders Blue Ridge Escarpment

Ecoregion	Southern Inner Piedmont
Rosgen Classification of As-built	
Blockhouse Creek Reach 1	C4
Blockhouse Creek Reach 2	C4
Blockhouse Creek Reach 3	E4/Bc4
Blockhouse Creek Reach 4	E4
UT 1	C4
UT 2	Bc5 (upper)/Cb (lower)
UT 3	B-E (lower)
Cowardin Classification	Riverine
Dominant Soil Types	
Blockhouse Creek Reach 1	Chewacla Loam, Pacolet Sandy Clay Loam
Blockhouse Creek Reach 2	Chewacla Loam, Pacolet Sandy Clay Loam
Blockhouse Creek Reach 3	Chewacla Loam, Pacolet Sandy Clay Loam
Blockhouse Creek Reach 4	Chewacla Loam, Pacolet Sandy Clay Loam, Rion Sandy Loam
UT 1	Chewacla Loam, Pacolet Sandy Clay Loam
UT 2	Pacolet Sandy Clay Loam,
UT 3	Chewacla Loam, Pacolet Sandy Clay Loam
Reference Site ID	Reference reach used for upper portion of project area located 350 LF upstream of project. Big Branch, Surry County was also identified in the NCDOT reference reach database as a suitable reference for design ratios
USGS HUC for Project and Reference Sites	Blockhouse Creek HUC#: 03050105 Big Branch HUC#: 03040101
Any portion of project segment(s) on NC 303d List?	No
Any portion of project upstream of a 303d Listed Segment?	No
Reasons for 303d Listing or Stressor	N/A
% of Project Easement Fenced	0, area demarcated with rope and posts but not a livestock fence.

1.5 Monitoring Plan View

The monitoring plan view for Blockhouse Creek and its tributaries is included in Appendix C. The plan set provides a view of channel pattern as well as the location of structures designed to aid in dimension and profile stability. Other features shown on the plan view include the location of crest gauges, vegetation monitoring plots, cross-sections and reference photo stations. Figure 2 depicts the project streams, easement boundaries and monitoring reference data.


XS1
XS2
XS10
XS11
XS12
UT 1
Reach 1
XS3
XS4
Reach 2
XS5
Reach 3
Hunting Country Rd.
XS13
XS14
UT 2
I-26
Reach 4
XS15
XS16
XS8
XS9
XS6
XS7
UT3
Legend
Project Reaches
As-built Stream
Preservation
Cross-sections
Surveyed Profile
Conservation Easement Boundary
0 200 400 800
Feet
N
Ecosystem Enhancement Program
Figure 2 Restoration Summary Map
Blockhouse Creek
Restoration Project
Baker

2.0 YEAR 1 PROJECT CONDITION AND MONITORING RESULTS

The five-year monitoring plan for the Blockhouse Creek Site includes criteria to evaluate the success of the vegetative and geomorphic components of the project. The specific locations of vegetation plots, permanent cross-sections, and crest gauges are shown on the Year 1 monitoring plan sheets (Appendix C). Photo points, located along the stream restoration project, are also shown.

2.1 Vegetation Assessment

2.1.1 Description of Vegetative Monitoring

As a final stage of construction, the stream margins and riparian area of the Site were planted with bare root trees, live stakes, and an herbaceous seed mixture of temporary and permanent ground cover vegetation. The woody vegetation was planted randomly ten to thirteen feet apart from the top of the stream banks to the outer edge of the project's easement limits. Bare-root trees were planted at a target density of 680 stems per acre and planting was completed in May 2008. Species planted and as-built densities are summarized in Table 5.

The permanent seed mix of herbaceous species applied to the project's riparian area included soft rush (*Juncus effuses),* creeping bentgrass (*Agrostis stolenifera),* virginia wild rye (*Elymus virginicus),wild bergamot* (*Monarda fistulosa),* smartweed (*Polygonum pennsylvanicum), beggars* tick seed (*Bidens frondosa), indian grass* (*Sorgastrum nutans*), fox sedge (*Carex vulpinoidea*), deer tongue (*Dichanthelium clandestinum*), *big bluestem (Andropogon gerardii)* and black eyed susan *(Rudbeckia hirta).*

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, 10 vegetation monitoring quadrants were installed across the restoration site to predict the survival rate of the bare-rooted trees. On a designated corner within each of the ten vegetation quadrants, one herbaceous plot was also delineated. Mortality will be determined from the difference between the previous year's living, planted trees and the current year's living, planted trees. The size of individual quadrants is 100 square meters for woody tree species. The herbaceous plots measure 1 square meter in size and are located within the larger vegetation quadrants established. Individual seedlings within each plot were flagged to facilitate locating them during future monitoring events. Each seedling was also marked with aluminum tags to ensure that the correct identification is made during future monitoring of the vegetation plots. The plots were randomly located to represent the different areas within the project. The locations of the ten vegetation plots are presented in Appendix C.

2.1.2 Vegetative Success Criteria

The interim measure of vegetative success for the site will be the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. The final vegetative success criteria will be the survival of 260, 5-year old, planted trees per acre at the end of year five of the monitoring period. Herbaceous cover is photographed annually during the growing season to provide a record of the density of ground cover derived from the riparian seed mix applied. If the measurement of vegetative density proves to be inadequate for assessing plant community health, additional plant community indices may be incorporated into the vegetation monitoring plan as requested by the NCEEP.

Table 5. Rooted trees, live stakes and seeding planted in the riparian zone of Blockhouse Creek Blockhouse Creek Restoration Project-#D06027-A		
The species composition for two different areas is shown; with one area being upstream of I-26 and the second area being downstream of I-26.		
Planting Plan		
Scientific name	Common name	Percent Planted by Species
Blockhouse Creek upstream of I-26 and UT1 (40% trees/ 60% shrubs) planted at 680 stems/A		
Trees - Planted 13'x13'		
Acer rubrum	Red maple	13
Fraxinus pennsylvanica	Green ash	13
Juglans nigra	Black walnut	13
Liriodendron tulipfera	Tulip poplar	0.5
Platanus occidentalis	Sycamore	0.5
Understory Trees/Shrubs- Planted 10'x10'		
Alnus serrulata	Tag alder	9
Calicanthus floridus	Sweet shrub	10
Cornus florida	Flowering dogwood	12
Cercis Canadensis	Redbud	10
Carpinus caroliniana	Ironwood	9
Asimina triloba	Paw paw	9
Blockhouse Creek downstream of I-26 and UT2 (60% Trees/ 40% shrubs) planted at 680 stems/A		
Trees - Planted 10'x10'		
Acer rubrum	Red maple	4
Diospyros virginiana	Persimmon	6
Juglans nigra	Black walnut	12
Liriodendron tulipfera	Tulip poplar	10
Platanus occidentalis	Sycamore	10
Prunus serotina	Black cherry	6
Quercus phellos	Willow oak	6
Quercus rubra	Red oak	6
Understory Trees/Shrubs- Planted 13'x13'		
Alnus serrulata	Tag alder	6
Calicanthus floridus	Sweet shrub	6
Cornus florida	Flowering dogwood	9
Cercis Canadensis	Redbud	8
Carpinus caroliniana	Ironwood	6
Asimina triloba	Paw paw	5
Woody Vegetation for Live Stakes - Planted 3’ x 3’ on center		
Salix sericea	Silky willow	30
Physocarpus opulifolius	Ninebark	25

Sambucus Canadensis	Elderberry	15
Cornus amomum	Silky dogwood	30
Note: Species selection may change due to availability at the time of planting.		

2.1.3 Vegetation Observations and Results

Temporary seeding applied to streambanks beneath the erosion matting sprouted within two weeks of application and has generally provided good ground coverage. Live stake, bare root trees, and live brush in the geolift structures have also flourished and are contributing to streambank stability. Bare-root trees were planted throughout the conservation easement with the exception of the preservation reach. A 30-foot buffer was established along of the majority of the restored stream and the width exceeds this minimum in most places. However at crossings the easement "pinches" in to meet the crossing structure and along one section of Reach 3 the easement on the left bank is less than 30 feet due to existing constraints; however, the total width is greater than 60 feet.

Tables A.1. through A.6. in Appendix A present vegetation metadata, vegetation vigor, vegetation damage and stem count data of the monitoring stations at the end of the Year 1 monitoring period. Data from the Year 1 monitoring event of the ten vegetation plots showed a range of 480 to 840 stems per acre. The data showed that the plots had an average of 620 stems per acre. Based on these results, this site is on track to meet the success criteria of 320 stems per acre at the end of monitoring Year 3.

Trees within each monitoring plot are flagged regularly to prevent planted trees from losing their identifying marks due to flag degradation. It is important for trees within the monitoring plots to remain marked to ensure they are all accounted for during the annual stem counts and calculation of tree survival. No significant volunteer woody species were observed in any of the vegetation plots. The plots will also be assessed during Year 2 monitoring for volunteer species.

2.1.4 Vegetation Problem Areas

No woody vegetation problem areas were identified during Year 1 monitoring. The project area was at the end of a number of drought years at the time planting initially occurred. Mortality rates for woody vegetation planted appear to be low though some sections of the project have experienced higher rates of mortality as evidenced by the vegetative plot data listed in Appendix A. Although the density of herbaceous cover varies across the site, conditions observed on-site during the Year 1 monitoring surveys indicate an improvement in vegetative cover. Drought conditions almost certainly contributed to some of the mortality observed among the woody vegetation planted. However, survival rates of the established plots indicate that plantings across the easement area are of sufficient density to meet regulatory requirements, as well as the site stabilization and habitat enhancement goals originally set forth in the restoration plan. It is expected that site vegetation will continue to improve given that we continue to experience good weather conditions as the buffer matures during the next several years.

2.1.5 Vegetation Photographs

Photographs are used to visually document vegetation success in sample plots. A total of ten sample sites were established to document tree conditions and herbaceous coverage at each vegetation plot across the Site. Reference photos of tree and herbaceous condition within plots are taken at least once per year. Photos of the plots are included in Appendix A of this report.

2.2 Stream Assessment

2.2.1 Description of Geomorphic Monitoring

Geomorphic monitoring of restored stream reaches is being conducted over a five year period to evaluate the effectiveness of the restoration. Monitored stream parameters include channel dimension (cross-sections), profile (longitudinal survey), bed composition, bank stability, bankfull flows and stability of reference sites documented by photographs. Crest gauges, as well as high flow marks, will be used to document the occurrence of bankfull events. The methods used and any related success criteria are described below for each parameter. The location of permanent cross-sections and crest gauges is shown on the Year 1 monitoring plan sheets in Appendix C.

2.2.2 Morphometric Success Criteria

2.2.2.1 Cross-Sections

Sixteen permanent cross-sections selected for monitoring were located in representative riffle and pool reaches on Blockhouse Creek, UT1 and UT2. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. A common benchmark is used for cross-sections and consistently referenced to facilitate comparison of year-to-year data. The cross-sectional surveys includes 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 are classified using the Rosgen Stream Classification System.

There should be little change in the Year 1 monitoring cross-sections between years. If changes do take place, they will be evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio).

2.2.2.2 Longitudinal Profile

A longitudinal profile was completed for the restored streams to provide a baseline for evaluating changes in channel bed condition over time. A longitudinal profile was conducted for the entire project length of UT1 and UT2. An additional 3,396 linear feet of stream channel was surveyed on Blockhouse Creek, including the upper 1,500 feet above I-26 and the entire length below I-26. Longitudinal profiles will be replicated annually during the five year monitoring period.

Measurements taken during longitudinal profiles include thalweg, water surface, inner berm, bankfull, and top of low bank, if the features were present. Each of these measurements was taken at the head of each feature (e.g., riffle, or pool) and the maximum pool depth. Elevations of grade control structures will also be included in longitudinal profiles surveyed. All surveys were tied to a permanent benchmark of know elevation. Cross-section and longitudinal profile data are provided in Appendix B.

The longitudinal profiles should show that the bed features are remaining stable and are not aggrading or degrading. The pools should remain deep with flat water surface slopes, and the riffles should remain steeper and shallower than the pools. Bed form observations should be consistent with those observed for channels of the stream type that the design was based on.

2.2.2.3 Bed Material Analyses

Bed material analyses will include pebble counts taken during each geomorphic survey. Pebble counts will provide data on the particle size distribution of the stream bed. These samples may reveal changes in sediment gradation that can occur over time as the stream

adjusts to the constructed channel and to its sediment load. Significant changes in the particle size distribution will be evaluated with respect to stream stability and watershed changes.

2.2.3 Morphometric Results

2.2.3.1 Cross-Sections

Year 1 cross-section monitoring data for stream stability was collected during May and June 2008.
The sixteen permanent cross-sections along the restored channels were re-surveyed to document stream dimension at the end of monitoring Year 1. Cross-sectional data is presented in Appendix B and the location of cross-sections is shown on the plan sheets in Appendix C.

The cross-sections show that there has been little to no adjustment to stream dimension since construction. Cross-sections 1, 7, and 8 on Blockhouse Creek and cross-sections 12 and 14 on UT1 and UT2 respectively, exhibited slight signs of aggradation and adjustment of channel dimension, but are otherwise stable. Cross-sections 1 and 7 were both located at riffles which were originally slightly steeper than what was surveyed in 2009. Cross-sections 8, 12 and 14 were taken at pools which have experienced slight aggradation since the As-built survey was completed. A tree was down at cross-section 14 as well, contributing to local aggradation along this subreach of UT2. Changes at cross-section 8 and 5 may in part be attributable to the fact that the cross-section pin was disturbed and had to be relocated. At cross-section 5, the original right bank pin could not be found. The left bank pin of cross-section 8 was lost as a result of minor repairs made to the left bank behind a rootwad.

As noted in the vegetation monitoring section, the Blockhouse Creek restoration site experienced drought conditions for several years leading up to the construction of the project. However, 2009 has been a wetter year; some cross-section and profile data collected reflect the development of low bankfull benches as well the development of point bar features on the inside bank of meander bends. The remaining cross-sections did not indicate any changes in dimension compared to as-built conditions and appeared to be stable with the help of in-stream structures, adequate bank sloping and developing vegetation.

2.2.3.2 Longitudinal Profile

Longitudinal profiles for Year 1 were surveyed in May and June 2009 and are compared to the data collected during the as-built condition survey. Profiles of the various project reaches are presented in Appendix B.

The longitudinal profile for Blockhouse Creek upstream of Interstate 26 remains stable and has not changed significantly since the as-built survey was completed in 2008. The longitudinal profile for Reach 2 of Blockhouse Creek reflects the presence of a sandbag weir at station 14+31which has backed up water within the channel. This was done temporarily by the landowner in order to pump water from the creek to wet down equestrian riding rings. The lower reach of Blockhouse Creek immediately downstream of the Interstate 26 culvert and downstream of the confluence with UT2 exhibited some aggradation. UT1 did not exhibit any considerable profile changes. UT2 did not contain flow during the As-built survey but at the time of the Year 1 survey had a bold flow. Compared with the as-built survey, UT2 appears to have degraded slightly above and below a wetland complex adjacent to the project area. However, it is likely that the “downcutting” is attributable to the small tributary experiencing periodic flow sufficient to flush the tributary of excess siltation. Visual observations and cross-sections confirm channel overflow in areas, although flow was

not sufficient to be recorded on a crest gauge located on UT2. Channel slope on UT2 was designed to be gradual in the vicinity of the wetland as compared to other sections of UT2 to avoid impacts to the hydrology of the site. As a consequence, there is little change in the profile in this area when compared to the As-built survey.

In-stream structures installed within the restored stream included constructed riffles, log vanes, boulder steps, and root wads. Visual observations of these structures through the first year indicate that structures are functioning as designed and holding their elevation and grade. Log vanes placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Boulder steps maintained step-pool spacing and facilitated transitions in channel slope at the confluence of UT2 to Blockhouse Creek. In addition to providing grade control, the boulder steps also provided bedform diversity, improving in-stream habitat. Rootwads placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms.

2.2.3.3 Bed Material Analyses

Pebble count data collected in several project reaches indicate Blockhouse Creek and its tributaries continue to transport particles roughly the same size or larger as those found during as-built surveys (Table B2., Appendix B). A pebble count was not performed on UT2 due to the dominance of silt and sand as the bed material in this channel. Visual observation of Blockhouse Creek and its tributaries and a review of pebble count data collected did not yield any signs that sediment transport functions have been hampered by the restoration project.

2.2.4 Hydrologic Criteria

The occurrence of bankfull events within the monitoring period will be documented by the use of crest gauges and photographs of high flow lines. Three crest gauges were installed on the floodplain within 10 feet of the restored channels and with the bottom of the gage at approximately bankfull. One crest gauge was placed on UT 2, while 2 gauges were set up on Blockhouse Creek (upstream and downstream of I-26). The first gauge on the main channel was set up on the right bank below the confluence of UT 1 and Blockhouse Creek. The second crest gauge was set up, at the downstream end of the project, just upstream of the confluence of UT3 and Blockhouse Creek on the right bank. The crest gauge on UT2 was placed above the vehicle crossing at the lower end of the tributary. The crest gauges will record the highest watermark between site visits and will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during site visits.

Two bankfull flow events must be documented within the 5-year monitoring period. The two bankfull events must occur in separate years; otherwise, the stream monitoring may have to be continued until two bankfull events have been documented in separate years.

2.2.5 Hydrologic Monitoring Results

No bankfull events were recorded during the Year 1 monitoring period. We will be evaluating the site selection of these gages and may be lowering them. At present the bottom of the gage is approximately at the bankfull elevation, so flows at bankfull may not register. If we place them at a position lower than bankfull we should be better able to detect a stage that is at bankfull.

2.2.6 Stream Problem Areas

A few areas of concern were noted at the project site, some of which are not related to a specific point on the channel. The rate of overland flow that the site experiences above Interstate 26

continues to be somewhat of a concern. Due to the buildings on this site and the high compaction of the soil from heavy use by horse show participants, the runoff from the land adjoining the stream is high. This has not affected the channel proper but is the source of some minor rutting along terrace slopes leading down to the floodplain. In October 2008, Baker and FENCE submitted a grant funding application to the N.C. Clean Water Management Trust Fund for a project that would address this issue, but the grant was not funded. Although the threat overland flow poses to stream quality will be mitigated as the riparian buffer matures, the implementation of additional measures that would reduce the rate and intensity of stormwater would provide many benefits to FENCE and this project stream.

The second concern is that two of the three box culverts under Interstate 26 are two thirds full of sand. As noted in the As-built Report, during high flow events this sand mobilizes into the channel downstream of the interstate. This is causing some pools to fill with sand and the loss of pool depth. The channel is moving this material and it will eventually correct the problem but it will affect the lower end of the project over the next several years. The NCDOT has been contacted about this issue but they do not appear able to address the problem.

A concern that was located at a specific point is at cross-section 8 in Reach 4 of Blockhouse Creek. The bank behind a rootwad located in one of the last meanders of the project area required some minor repair work due to soil subsidence. The loss of bank occurred due to stream flow under the rootwad eroding soil from around the trunk of the rootwad creating a "sinkhole" in an area of approximately 5 feet by 5 feet. Loss of soil at the base of the rootwad and overland flow resulted in a small "sinkhole" being created behind the rootwad. To remedy the problem, 10 to 14 inch rock was placed at the base of the hole and this was covered with a geotextile, backfilled, re-seeded and the area was mated.

Lastly, the small sandbag weir located at Station 14+31 has resulted in an alteration of riffle-pool dimensions and sequencing in Reach 2 of Blockhouse Creek. While no structures have been adversely impacted by the dam, much of Reach 2 is now a pool. If a breach were to occur, it is possible that high flow could damage some of the woody vegetation present on both downstream banks. Although this weir is located within an easement break, Baker has been in communication with the U.S. Army Corps of Engineers regarding the weir. Please see Appendix D for comments received by the U.S. Army Corps of Engineers from a site visit conducted in October 2009. We have submitted a letter to the Director of FENCE requesting that the dam be removed and will continue to monitor the situation. It is possible that we will need to modify a cross-vane just above this location to provide greater convergence and greater pool scour. This will provide the depth needed for the landowner to do their temporary irrigation pumping during horse shows.

Based on the data collected, riffles, pools and other constructed features along the restored channel are stable and are functioning as designed. Structures installed to enhance pool habitat are stable and functioning. However, the full functioning of some structures is being impaired by slight aggradation, particularly downstream of the box culvert under Interstate 26 and areas of UT2 where channel slope modification was limited due to the presence of a nearby wetland. Beyond the issues noted above, no areas of concern have been identified during the first year following completion of the project. Overall, the site is on track to achieve the stream morphology success criteria specified in the Restoration Plan for the Site.

2.2.7 Stream Photographs

Photographs are used to document restoration success qualitatively. Reference stations were photographed during the as-built survey and will be monitored for five years following construction. Reference photos are taken once a year, from a height of approximately five to six feet. Permanent markers installed will ensure that the same locations (and view directions) are

utilized during each monitoring period. Reference photographs of the project streams are shown in Appendix B.

2.2.7.1 Lateral Reference Photos

Reference photo transects were taken of the right and left banks at each permanent cross-section. For each stream bank photograph, a survey tape was centered in the frame which represents the cross-section line located perpendicular to the channel flow. The water line was located in the lower edge of the frame in order to document bank and riparian conditions. Photographers will make an effort to consistently maintain the same area in each photo over time.

2.2.7.2 Structure Photos

Photographs of primary grade control structures (i.e. vanes and weirs), along the restored stream are included within the photographs taken at reference photo stations. Photographers will make every effort to consistently maintain the same area in each photo over time.

Lateral and structure photographs are used to evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, structure function and stability, and effectiveness of erosion control measures. Lateral photos should not indicate excessive erosion or degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation and consistent structure function.

Photographs of the restoration project were taken in May and June 2009. The photographs illustrate generally stable conditions across the project site. Vegetative growth along the streambanks and riparian buffers has improved since construction was completed in 2008. Structures are functioning as designed; to date, no structures have had to be repaired.

2.2.8 Stream Stability Assessment

To aid the NCEEP in evaluating the risk of erosion from changes in channel and bank stability and subsequent sediment yield from the project area, Baker will assign numeric values to streambank and channel features. This will occur during Year 5 of the monitoring period. These numeric scores will be derived using the Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) evaluation methods. The scores will then be used to evaluate channel stability and project sediment export. Results from an annual visual stability assessment are provided in Appendix B.

2.2.9 Quantitative Measures Summary Tables

The quantitative pre-construction, reference reach, and design data used to determine restoration approach, as well as the As-built baseline data used during the project's post-construction monitoring period are summarized in Appendix B.

APPENDIX A. Vegetation Data

Table A1. Vegetation Metadata

Blockhouse Creek Restoration Project-#D06027-A

Report Prepared By	Carmen Horne-McIntyre
Date Prepared	9/24/2009 13:33

database name	cvs-eep-entrytool-v2.2.7.mdb
database location	L:\Monitoring\Monitoring Guidance
computer name	ASHECMCINTYR
file size	63639552

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.

PROJECT SUMMARY----------

Project Code	109276
project Name	Blockhouse Creek Restoration Project: D06027-A
Description	Restoration of 4,830 linear feet (LF), enhancement of 972LF and preservation of 393LF of stream along Blockhouse Creek and its tributaries, approximately three miles east of Tryon in Polk County, North Carolina.
River Basin	Broad
length(ft)	6000
stream-to-edge width (ft)	30
area (sq m)	33441.71
Required Plots (calculated)	10
Sampled Plots	10

Table A2. Vegetation Vigor by Species

Blockhouse Creek Restoration Project-#D06027-A

	Species	CommonName	4	3	2	1	0	Missing	Unknown
	Alnus serrulata	hazel alder	6						
	Asimina triloba	pawpaw	1				1		
	Betula nigra	river birch	5	4	1		1		
	Cornus amomum	silky dogwood	5	1	1		1		
	Cornus florida	flowering dogwood		1			1		
	Diospyros virginiana	common persimmon	10	6			1	1	
	Fraxinus pennsylvanica	green ash	26						
	Halesia carolina	Carolina silverbell	2						
	Juglans nigra	black walnut	4	1		1	3		
	Quercus phellos	willow oak	6				4		
	Calycanthus floridus	eastern sweetshrub	2	1			3		
	Cercis canadensis	eastern redbud	2				3		
	Quercus rubra	northern red oak	8	2		1	4		
	Liriodendron tulipifera	tuliptree	10				9		
	Platanus occidentalis	American sycamore	25	15			4		
	Acer rubrum	red maple	6	1	1		2	1	
TOT:	**16**	**16**	**118**	**32**	**3**	**2**	**37**	**2**	

Table A3. Vegetation Damage by Species

Blockhouse Creek Restoration Project-#D06027-A

	Species	CommonName	Count of Damage Categories	(no damage)	Site Too Dry	Unknown
	Acer rubrum	red maple	4	7	1	3
	Alnus serrulata	hazel alder	0	6		
	Asimina triloba	pawpaw	1	1		1
	Betula nigra	river birch	1	10		1
	Calycanthus floridus	eastern sweetshrub	3	3		3
	Cercis canadensis	eastern redbud	3	2		3
	Cornus amomum	silky dogwood	0	8		
	Cornus florida	flowering dogwood	1	1		1
	Diospyros virginiana	common persimmon	1	17		1
	Fraxinus pennsylvanica	green ash	0	26		
	Halesia carolina	Carolina silverbell	0	2		
	Juglans nigra	black walnut	3	6		3
	Liriodendron tulipifera	tuliptree	7	12		7
	Platanus occidentalis	American sycamore	3	41		3
	Quercus phellos	willow oak	4	6		4
	Quercus rubra	northern red oak	4	11		4
TOT:	**16**	**16**	**35**	**159**	**1**	**34**

Table A4. Vegetation Damage by Plot

Blockhouse Creek Restoration Project-#D06027-A

	plot	Count of Damage Categories	(no damage)	Site Too Dry	Unknown
	109276-CHM-0001-year:1	3	14		3
	109276-CHM-0002-year:1	4	15	1	3
	109276-CHM-0003-year:1	3	16		3
	109276-CHM-0004-year:1	6	19		6
	109276-CHM-0005-year:1	6	16		6
	109276-CHM-0006-year:1	0	21		
	109276-CHM-0007-year:1	0	12		
	109276-CHM-0008-year:1	13	16		13
	109276-CHM-0009-year:1	0	14		
	109276-CHM-0010-year:1	0	16		
TOT:	**10**	**35**	**159**	**1**	**34**

Table A5. Stem Count by Plot and Species

Blockhouse Creek Restoration Project-#D06027-A

	Species	CommonName	Total Planted Stems	# plots	avg# stems	plot 109276-CHM-0001-year:1	plot 109276-CHM-0002-year:1	plot 109276-CHM-0003-year:1	plot 109276-CHM-0004-year:1	plot 109276-CHM-0005-year:1	plot 109276-CHM-0006-year:1	plot 109276-CHM-0007-year:1	plot 109276-CHM-0008-year:1	plot 109276-CHM-0009-year:1	plot 109276-CHM-0010-year:1
	Acer rubrum	red maple	8	3	2.67	3	3		2						
	Alnus serrulata	hazel alder	6	3	2	1	2		3						
	Asimina triloba	pawpaw	1	1	1						1				
	Betula nigra	river birch	10	4	2.5				1	3		2			4
	Calycanthus floridus	eastern sweetshrub	3	3	1		1	1	1						
	Cercis canadensis	eastern redbud	2	2	1		1	1							
	Cornus amomum	silky dogwood	7	3	2.33	3							3		1
	Cornus florida	flowering dogwood	1	1	1							1			
	Diospyros virginiana	common persimmon	16	5	3.2			1	1	4	8	2			
	Fraxinus pennsylvanica	green ash	26	7	3.71	2	3			4	8	2		4	3
	Halesia carolina	Carolina silverbell	2	1	2				2						
	Juglans nigra	black walnut	6	4	1.5	2	2		1			1			
	Liriodendron tulipifera	tuliptree	10	4	2.5			2			1		2		5
	Platanus occidentalis	American sycamore	40	8	5	3	4	7	7	4		3	3	9	
	Quercus phellos	willow oak	6	2	3							1	5		
	Quercus rubra	northern red oak	11	4	2.75			4	1		3		3		
TOT:	**16**	**16**	**155**	**16**		**14**	**16**	**16**	**19**	**15**	**21**	**12**	**16**	**13**	**13**

Table A6. Stem Count Arranged by Plot (Year 1)
Blockhouse Creek Restoration Project D06027-A

	Plots										As-built	Year 1	Year 2	Year 3	Year 4	Year 5	Site Average
Tree Species	1	2	3	4	5	6	7	8	9	10	**Totals**	**Totals**	**Totals**	**Totals**	**Totals**	**Totals**	**Stems/acre**
Betula nigra				1	3		2			4	14	10					
Acer rubrum	3	3		2							10	8					
Fraxinus pennsylvanica	2	3			4	8	2		4	3	26	26					
Juglans nigra	2	2		1			1				15	6					
Platanus occidentalis	3	4	7	7	4		3	3	9		44	40					
Liriodendron tulipfera			2			1		2		5	15	10					
Quercus phellos							1	5			9	6					
Quercus rubra			4	1		3		3			14	11					
Diospyros virginiana			1	1	4	8	2				16	16					
Shrub Species																	
Alnus serrulata	1	1		3							2	5					
Calicanthus floridus		1	1	1							9	3					
Halesia carolina				2								2					
Cercis canadensis		1	1								5	2					
Asimina triloba						1					2	1					
Cornus florida		1					1				2	2					
Cornus amomum	3							3		1	5	7					
Stems/plot	14	16	16	19	15	21	12	16	13	13							
Stems/acre Year 1	560	640	640	760	600	840	480	640	520	520							620
Stems/acre Initial	680	760	760	880	880	840	480	1160	560	640							764

Blockhouse Creek Restoration Project
Photo Log - Vegetation Plot Photo Points

Notes:

1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All points are marked with a wooden stake and pink flagging tape.
3. Herbaceous plot located in foreground of each photo.

6/26/2009
Photo Point 1: Veg Plot 1

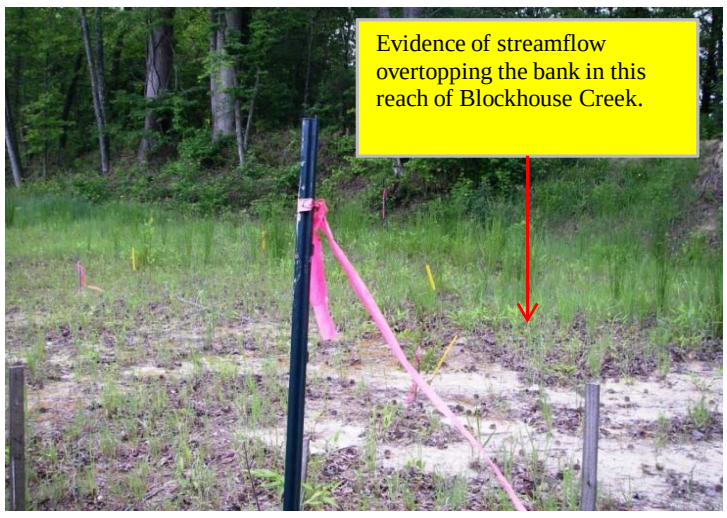
6/26/2009
Photo Point 2: Veg Plot 2

6/26/2009
Photo Point 3: Veg Plot 3

6/26/2009
Photo Point 4: Veg Plot 4

6/26/2009
Photo Point 5: Veg Plot 5

6/26/2009
Photo Point 6: Veg Plot 6



6/26/2009

Photo Point 7: Veg Plot 7

6/26/2009

Photo Point 8: Veg Plot 8

6/26/2009

Photo Point 9: Veg Plot 9

6/26/2009

Photo Point 10: Veg Plot 10

APPENDIX B. Geomorphic Data

Table B1. Categorical Stream Feature Visual Stability Assessment
Blockhouse Creek Restoration Project-#D06027-A

Features	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	100%	100%				
B. Pools	100%	95%				
C. Thalweg	100%	95%				
D. Meanders	100%	100%				
E. Bed General	100%	100%				
F. Bank Stability	100%	95%				
G. Vanes	100%	100%				
H. Rootwads, Boulders, Geolifts	100%	100%				

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
Blockhouse Creek: Reach 1

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			(As-Built)			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	16.48	-----	16.92	-----	18.50	20.00	21.50	18.50	20.00	21.50	----	21.69	----	----	21.24	----
Floodprone Width (ft)	-----	-----	33.00	-----	-----	-----	-----	-----	70+	-----	----	53.90	----	----	53.91	----
Bankfull Mean Depth (ft)	1.82	-----	1.80	-----	1.80	2.30	2.80	-----	1.9	-----	----	1.34	----	----	1.29	----
Bankfull Max Depth (ft)	-----	-----	3.00	-----	2.50	3.30	4.10	-----	2.5	-----	----	2.29	----	----	2.33	----
Bankfull Cross Sectional Area (ft2)	29.88	-----	30.60	-----	39.60	47.05	54.50	-----	29.4	-----	----	29.00	----	----	27.40	----
Width/Depth Ratio	-----	-----	9.40	-----	9.19	10.57	11.94	-----	8.2	-----	----	16.20	----	----	16.45	----
Entrenchment Ratio	-----	-----	1.90	-----	6.05	6.40	6.74	-----	>2.2	-----	----	2.50	----	----	2.50	----
Bank Height Ratio	-----	-----	2.80	-----	1.00	1.05	1.10	-----	1.05	-----	----	1.60	----	----	0.90	----
Bankfull Velocity (fps)	-----	-----	2.94	-----	3.50	4.25	5.00	-----	3.06	-----	----	3.10	----	----	3.28	----
Pattern																
Channel Beltwidth (ft)	-----	6.31	10.16	14.00	30.50	37.25	44.00	55.00	89.50	124.00	59.00	80.50	102.00	59.00	80.50	102.00
Radius of Curvature (ft)	-----	-----	----	-----	42.30	52.70	63.10	16.00	23.50	31.00	15.50	23.25	31.00	15.50	23.25	31.00
Meander Wavelength (ft)	-----	-----	----	-----	185.00	222.50	260.00	109.00	147.50	186.00	108.50	150.15	191.80	108.50	150.15	191.80
Meander Width Ratio	-----	-----	0.60	-----	1.50	1.83	2.16	2.97	4.37	5.77	----	3.71	----	----	3.79	----
Profile																
Riffle Length (ft)	-----	-----	----	-----	-----	-----	-----	25.00	70.00	115.00	18.76	36.50	73.00	20.01	45.20	131.46
Riffle Slope (ft/ft)	-----	-----	----	-----	0.0150	0.0170	0.0190	0.0081	0.0096	0.0110	0.0030	0.0085	0.0140	0.0041	0.0085	0.0195
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	8.00	21.50	35.00	13.00	17.00	21.00	5.63	28.04	44.96
Pool Spacing (ft)	-----	-----	----	-----	97.50	138.65	179.80	62.00	85.50	109.00	65.00	77.50	90.00	64.79	73.52	106.68
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	0.3 / 0.58 /1.0/5.7/12.4			----			0.3 / 0.58 /1.0/5.7/12.4			NA/5.01/10.75/22.6/31.09			.84/7.32/10.07/32/95.44		
Reach Shear Stress (competency) lb/f2	-----	-----	0.38	-----	-----	-----	-----	-----	0.33	-----	-----	0.32	-----	-----	0.32	-----
Stream Power (transport capacity) W/m2	-----	-----	1.13	-----	-----	-----	-----	-----	1.02	-----	-----	0.99	-----	-----	1.04	-----
Additional Reach Parameters																
Channel length (ft)	-----	-----	887.00	-----	-----	330.00	-----	-----	1070.00	-----	-----	1070.00	-----	-----	1070.00	-----
Drainage Area (SM)	-----	-----	1.63	-----	0.20	1.90	2.30	-----	1.63	-----	-----	1.63	-----	-----	1.63	-----
Rosgen Classification	-----	-----	E4	-----	-----	C/E4	-----	-----	E4	-----	-----	C4	-----	-----	C4	-----
Bankfull Discharge (cfs)	126.72	-----	90.00	-----	-----	----	-----	-----	90.00	-----	-----	90.00	-----	-----	90.00	-----
Sinuosity	-----	-----	1.01	-----	-----	1.10	-----	-----	1.10	-----	-----	1.18	-----	-----	1.18	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0067	-----	-----	0.0054	-----	-----	0.0054	-----

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
Blockhouse Creek: Reach 2

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			(As-Built)			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	17.71	----	25.6	----	18.50	20.00	21.50	18.50	20.00	21.50	----	22.57	----	----	19.69	----
Floodprone Width (ft)	-----	----	37.5	----	----	----	----	-----	70+	-----	----	57.30	----	----	57.10	----
Bankfull Mean Depth (ft)	1.92	----	1.94	----	1.80	2.30	2.80	-----	2.25	-----	----	1.54	----	----	1.64	----
Bankfull Max Depth (ft)	-----	----	3.3	----	2.50	3.30	4.10	-----	3.00	-----	----	2.92	----	----	2.85	----
Bankfull Cross Sectional Area (ft2)	33.98	----	49.7	----	39.60	47.05	54.50	-----	35.6	-----	----	34.90	----	----	32.20	----
Width/Depth Ratio	-----	----	13.2	----	9.19	10.57	11.94	-----	8.00	-----	----	14.62	----	----	12.03	----
Entrenchment Ratio	-----	----	1.5	----	6.05	6.40	6.74	-----	>2.2	-----	----	2.50	----	----	2.90	----
Bank Height Ratio	-----	----	2.0	----	1.00	1.05	1.10	-----	1.00	-----	----	0.90	----	----	1.00	----
Bankfull Velocity (fps)	-----	----	2.41	----	3.50	4.25	5.00	-----	3.37	-----	----	3.44	----	----	3.73	----
Pattern																
Channel Beltwidth (ft)	-----	5.09	8.70	12.30	30.50	37.25	44.00	63.00	103.50	144.00	57.30	81.92	100.10	57.30	81.92	100.10
Radius of Curvature (ft)	-----	----	----	----	42.30	52.70	63.10	18.00	27.00	36.00	30.79	34.06	37.32	30.79	34.06	37.32
Meander Wavelength (ft)	-----	----	----	----	185.00	63.60	260.00	126.00	171.00	216.00	145.67	165.94	186.21	145.67	165.94	186.21
Meander Width Ratio	-----	----	0.34	----	1.50	1.83	2.16	3.41	5.05	6.70	----	3.63	----	----	4.16	----
Profile																
Riffle Length (ft)	-----	----	----	----	-----	-----	-----	25.00	55.00	85.00	35.00	55.50	76.00	15.42	43.77	72.12
Riffle Slope (ft/ft)	-----	----	----	----	0.0150	0.0170	0.0190	0.0081	0.0046	0.0011	0.0109	0.0230	0.0350	0.0008	0.0088	0.0167
Pool Length (ft)	-----	----	----	----	-----	-----	-----	8.00	21.5000	35.00	15.00	20.00	25.00	17.59	21.20	25.73
Pool Spacing (ft)	-----	----	----	----	97.50	138.65	179.80	72.00	99.00	126.00	58.00	89.00	120.00	44.75	84.82	118.59
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	.87/2.99/7.6/19/21.8			-----			.87/2.99/7.6/19/21.8			NA/5.01/10.75/22.6/31.09			.84/7.32/10.07/32/95.44		
Reach Shear Stress (competency) lb/f2	-----	-----	0.45	-----	-----	-----	-----	-----	0.54	-----	-----	0.50	-----	-----	0.50	-----
Stream Power (transport capacity) W/m2	-----	-----	1.09	-----	-----	-----	-----	-----	1.83	-----	-----	1.73	-----	-----	1.87	-----
Additional Reach Parameters																
Channel length (ft)	-----	-----	340.00	-----	-----	330.00	-----	-----	340.00	-----	-----	340.00	-----	-----	340.00	-----
Drainage Area (SM)	-----	-----	1.97	-----	0.20	1.90	2.30	-----	1.97	-----	-----	1.97	-----	-----	1.97	-----
Rosgen Classification	-----	-----	E4	-----	-----	C/E4	-----	-----	E4	-----	-----	C4	-----	-----	Bc/C4	-----
Bankfull Discharge (cfs)	145.30	-----	120.00	-----	----	----	----	----	120.00	----	-----	120.00	-----	-----	120.00	-----
Sinuosity	-----	-----	1.02	-----	-----	1.10	----	-----	1.10	-----	-----	0.38	-----	-----	0.38	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0121	-----	-----	0.0183	-----	-----	0.0183	-----

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
Blockhouse Creek: Reach 3

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			(As-Built)			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	18.50	----	21.2	----	18.50	20.00	21.50	18.50	20.00	21.50	----	21.50	----	----	18.16	----
Floodprone Width (ft)	-----	----	>150	----	----	----	----	-----	45+	-----	----	44.20	----	----	30.59	----
Bankfull Mean Depth (ft)	1.99	----	2.31	----	1.80	2.30	2.80	-----	2.25	-----	----	1.54	----	----	1.75	----
Bankfull Max Depth (ft)	-----	----	3.3	----	2.50	3.30	4.10	-----	3.00	-----	----	3.20	----	----	3.13	----
Bankfull Cross Sectional Area (ft2)	36.75	----	49.1	----	39.60	47.05	54.50	-----	35.6	-----	----	33.00	----	----	31.70	----
Width/Depth Ratio	-----	----	9.2	----	9.19	10.57	11.94	-----	8.00	-----	----	13.99	----	----	10.40	----
Entrenchment Ratio	-----	----	>7	----	6.05	6.40	6.74	-----	>2.2	-----	----	2.10	----	----	1.70	----
Bank Height Ratio	-----	----	1.1	----	1.00	1.05	1.10	-----	1.00	-----	----	0.80	----	----	0.90	----
Bankfull Velocity (fps)	-----	----	2.44	----	3.50	4.25	5.00	-----	3.37	-----	-----	3.64	-----	-----	3.79	-----
Pattern																
Channel Beltwidth (ft)	-----	8.69	33.02	57.34	30.50	37.25	44.00	63.00	103.50	144.00	54.70	60.85	67.00	54.70	60.85	67.00
Radius of Curvature (ft)	-----	----	----	----	42.30	52.70	63.10	18.00	27.00	36.00	26.49	34.25	42.00	26.49	34.25	42.00
Meander Wavelength (ft)	-----	----	----	----	185.00	63.60	260.00	126.00	171.00	216.00	125.06	160.07	195.07	125.06	160.07	195.07
Meander Width Ratio	-----	----	1.56	----	1.50	1.83	2.16	3.15	5.18	7.20	-----	2.83	-----	-----	3.35	-----
Profile																
Riffle Length (ft)	-----	----	----	----	-----	-----	-----	25.00	60.00	95.00	35.00	52.50	70.00	35.00	52.50	70.00
Riffle Slope (ft/ft)	-----	----	----	----	0.0150	0.0170	0.0190	0.0038	0.0038	0.0038	0.0120	0.0270	0.0420	0.0120	0.0270	0.0420
Pool Length (ft)	-----	----	----	----	-----	-----	-----	10.00	22.50	35.00	10.00	17.00	24.00	----	29.09	----
Pool Spacing (ft)	-----	----	----	----	97.50	138.65	179.80	72.00	99.00	126.00	30.00	76.00	122.00	----	75.39	----
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	.5/2.12/6.1/18.1/21.1			-----			.5/2.12/6.1/18.1/21.1			NA/.31/2.24/26.23/55.59			NA/.31/2.24/26.23/55.59		
Reach Shear Stress (competency) lb/f2	-----	-----	0.54	-----	-----	-----	-----	-----	0.50	-----	-----	0.50	-----	-----	0.50	-----
Stream Power (transport capacity) W/m2	-----	-----	1.33	-----	-----	-----	-----	-----	1.69	-----	-----	1.82	-----	-----	1.90	-----
Additional Reach Parameters																
Channel length (ft)	-----	-----	950.00	-----	-----	330.00	-----	-----	950.00	-----	-----	950.00	-----	-----	950.00	-----
Drainage Area (SM)	-----	-----	2.21	-----	0.20	1.90	2.30	-----	2.21	-----	-----	2.21	-----	-----	2.21	-----
Rosgen Classification	-----	-----	C4	-----	-----	C/E4	-----	-----	E4	-----	-----	E4/Bc4	-----	-----	Bc/C4	-----
Bankfull Discharge (cfs)	157.88	-----	120.00	-----	----	----	----	----	120.00	----	-----	120.00	-----	-----	120.00	-----
Sinuosity	-----	-----	1.06	-----	-----	1.10	----	-----	1.10	-----	-----	1.03	-----	-----	1.03	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0004	-----	-----	0.0032	-----	-----	0.0032	-----

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
Blockhouse Creek: Reach 4

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			(As-Built)			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	19.21	18.2	18.85	19.5	18.50	20.00	21.50	18.50	20.00	21.50	19.01	19.32	19.62	20.37	21.05	21.72
Floodprone Width (ft)	-----	23.2	41.60	60	----	----	----	----	50+	-----	52.80	56.10	59.40	53.54	56.37	59.20
Bankfull Mean Depth (ft)	2.05	1.83	1.92	2.0	1.80	2.30	2.80	-----	2.25	-----	1.77	1.81	1.84	1.83	1.89	1.94
Bankfull Max Depth (ft)	-----	3.0	3.10	3.2	2.50	3.30	4.10	-----	3.00	-----	2.98	3.07	3.15	3.28	3.42	3.55
Bankfull Cross Sectional Area (ft2)	39.30	35.6	35.95	36.3	39.60	47.05	54.50	-----	35.6	-----	34.80	34.95	35.10	37.24	39.66	42.07
Width/Depth Ratio	-----	9.1	9.90	10.7	9.19	10.57	11.94	-----	8.00	-----	10.30	10.69	11.08	11.14	11.18	11.21
Entrenchment Ratio	-----	1.3	2.15	3	6.05	6.40	6.74	-----	>2.2	-----	2.70	2.90	3.10	2.63	2.68	2.51
Bank Height Ratio	-----	1.7	2.80	3.9	1.00	1.05	1.10	-----	1.00	-----	1.10	1.15	1.20	1.00	1.00	1.00
Bankfull Velocity (fps)	-----	-----	3.34	-----	3.50	4.25	5.00	-----	3.37	-----	3.42	3.43	3.45	2.85	3.03	3.22
Pattern																
Channel Beltwidth (ft)	-----	5.47	44.56	83.65	30.50	37.25	44.00	63.00	103.50	144.00	47.00	72.80	98.60	47.00	72.80	98.60
Radius of Curvature (ft)	-----	-----	-----	-----	42.30	52.70	63.10	18.00	27.00	36.00	16.00	27.30	33.80	16.00	27.30	33.80
Meander Wavelength (ft)	-----	-----	-----	-----	185.00	63.60	260.00	126.00	171.00	216.00	81.40	106.20	131.00	134.80	155.30	202.28
Meander Width Ratio	-----	-----	2.36	-----	1.50	1.83	2.16	3.15	5.18	7.20	2.43	3.77	5.10	2.23	3.46	4.69
Profile																
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	25.00	65.00	105.00	27.00	53.50	80.00	27.27	63.28	138.03
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.0150	0.0170	0.0190	0.0075	0.0088	0.0100	0.0110	0.0135	0.0160	0.0035	0.0122	0.0199
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	10.00	22.50	35.00	10.00	15.50	21.00	11.51	29.31	55.77
Pool Spacing (ft)	-----	-----	-----	-----	97.50	138.65	179.80	72.00	99.00	126.00	12.00	63.00	114.00	53.94	96.53	135.92
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	.3/.58/1.0/5.7/12.4			-----			.3/.58/1.0/5.7/12.4			NA/.31/2.24/26.23/55.59			.25/3.35/8.66/101.21/125.52		
Reach Shear Stress (competency) lb/f2	-----	-----	0.49	-----	-----	-----	-----	-----	0.54	-----	-----	0.56	-----	-----	0.56	-----
Stream Power (transport capacity) W/m2	-----	-----	1.64	-----	-----	-----	-----	-----	1.83	-----	-----	1.90	-----	-----	1.90	-----
Additional Reach Parameters																
Channel length (ft)	-----	-----	1821.00	-----	-----	330.00	-----	-----	1780.00	-----	-----	1780.00	-----	-----	1780.00	-----
Drainage Area (SM)	-----	-----	2.44	-----	0.20	1.90	2.30	-----	2.44	-----	-----	2.44	-----	-----	2.44	-----
Rosgen Classification	-----	-----	E4	-----	-----	C/E4	-----	-----	E4	-----	-----	E4	-----	-----	E4	-----
Bankfull Discharge (cfs)	169.59	-----	120.00	-----	----	----	----	----	120.00	----	-----	120.00	-----	-----	120.00	-----
Sinuosity	-----	-----	1.29	-----	-----	1.10	----	-----	1.10	-----	-----	1.19	-----	-----	1.19	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0047	-----	-----	0.0043	-----	-----	0.0043	-----

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
UT1

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			As-Built			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	8.98	----	9.3	-----	18.50	20.00	21.50	-----	10.00	-----	11.42	11.93	12.43	11.72	11.74	11.76
Floodprone Width (ft)	-----	----	23.6	-----	----	----	----	30+	32.5+	35+	38.90	39.75	40.60	38.90	39.73	40.55
Bankfull Mean Depth (ft)	1.13	-----	.91	-----	1.80	2.30	2.80	-----	1.05	-----	0.86	0.88	0.90	0.93	0.94	0.94
Bankfull Max Depth (ft)	-----	-----	1.5	-----	2.50	3.30	4.10	-----	1.50	-----	1.66	1.71	1.76	1.76	1.79	1.81
Bankfull Cross Sectional Area (ft2)	10.08	-----	8.4	-----	39.60	47.05	54.50	-----	10.50	-----	10.30	10.50	10.70	10.90	10.95	11.00
Width/Depth Ratio	-----	-----	10.2	-----	9.19	10.57	11.94	-----	9.50	-----	12.66	13.57	14.48	12.53	12.58	12.63
Entrenchment Ratio	-----	-----	2.6	-----	6.05	6.40	6.74	-----	>2.2	-----	3.10	3.35	3.60	3.30	3.35	3.40
Bank Height Ratio	-----	-----	3.2	-----	1.00	1.05	1.10	-----	1.00	-----	0.90	0.95	1.00	1.00	1.00	1.00
Bankfull Velocity (fps)	-----	-----	3.57	-----	3.50	4.25	5.00	-----	2.86	-----	2.80	2.86	2.91	2.73	2.74	2.75
Pattern																
Channel Beltwidth (ft)	-----	5.30	9.47	13.63	30.50	37.25	44.00	35.00	57.50	80.00	32.86	40.08	44.68	32.86	40.08	44.68
Radius of Curvature (ft)	-----	-----	-----	-----	42.30	52.70	63.10	10.00	15.00	20.00	10.78	16.82	19.62	10.78	16.82	19.62
Meander Wavelength (ft)	-----	-----	-----	-----	185.00	63.60	260.00	70.00	95.00	120.00	32.86	38.77	44.68	71.79	99.94	121.21
Meander Width Ratio	-----	-----	1.02	-----	1.50	1.83	2.16	3.50	5.75	8.00	2.88	3.36	3.59	2.80	3.41	3.80
Profile																
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	25.00	50.00	75.00	19.00	46.50	74.00	33.27	51.10	75.42
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.0150	0.0170	0.0190	0.0200	0.0235	0.0270	0.0250	0.0310	0.0370	0.0171	0.0218	0.0264
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	8.00	14.00	20.00	7.00	11.00	15.00	8.94	13.43	27.91
Pool Spacing (ft)	-----	-----	-----	-----	97.50	138.65	179.80	40.00	55.00	70.00	13.00	36.50	60.00	35.15	54.54	65.49
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	3/13.27/16.00/25.97/3			----			.68/13.27/16.00/25.97/31.4			1.68/11.71/16/26.89/34.85			.16/14.57/20.93/58.61/117.21		
Reach Shear Stress (competency) lb/f2	-----	-----	0.94	-----	-----	-----	-----	-----	0.92	-----	-----	0.80	-----	-----	0.80	-----
Stream Power (transport capacity) W/m2	-----	-----	3.37	-----	-----	-----	-----	-----	2.62	-----	-----	3.40	-----	-----	3.40	-----
Additional Reach Parameters																
Channel length (ft)	-----	-----	523.00	-----	-----	330.00	-----	-----	580.00	-----	-----	580.00	-----	-----	580.00	-----
Drainage Area (SM)	-----	-----	0.33	-----	0.20	1.90	2.30	-----	0.33	-----	-----	0.33	-----	-----	0.33	-----
Rosgen Classification	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	C4	-----	-----	C4	-----
Bankfull Discharge (cfs)	39.98	-----	30.00	-----	----	----	----	----	30.00	----	-----	30.00	-----	-----	30.00	-----
Sinuosity	-----	-----	1.05	-----	-----	1.10	----	1.15	1.10	1.18	-----	1.12	-----	-----	1.12	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0142	-----	-----	0.0176	-----	-----	0.0176	-----

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
UT2 (Upper Reach)

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			As-Built			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Med	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	5.48	-----	6.30	-----	18.50	20.00	21.50	-----	7.00	-----	----	8.55	----	----	8.24	----
Floodprone Width (ft)	-----	-----	22.60	-----	----	----	----	----	35+	----	----	29.50	----	----	34.30	----
Bankfull Mean Depth (ft)	0.76	-----	0.61	-----	1.80	2.30	2.80	-----	0.70	-----	----	0.61	----	----	0.65	----
Bankfull Max Depth (ft)	-----	-----	0.90	-----	2.50	3.30	4.10	-----	1.00	-----	----	1.00	----	----	1.36	----
Bankfull Cross Sectional Area (ft2)	4.17	-----	3.80	-----	39.60	47.05	54.50	-----	5.00	-----	----	5.20	----	----	5.37	----
Width/Depth Ratio	-----	-----	10.30	-----	9.19	10.57	11.94	-----	10.00	-----	----	14.00	----	----	12.64	----
Entrenchment Ratio	-----	-----	3.60	-----	6.05	6.40	6.74	----	>2.2	----	----	3.40	----	----	4.16	----
Bank Height Ratio	-----	-----	2.80	-----	1.00	1.05	1.10	-----	1.00	-----	----	1.00	----	----	1.20	----
Bankfull Velocity (fps)	-----	-----	3.42	-----	3.50	4.25	5.00	-----	2.60	-----	----	2.50	----	----	2.42	----
Pattern																
Channel Beltwidth (ft)	-----	6.80	29.55	52.30	30.50	37.25	44.00	25.00	40.50	56.00	20.34	33.50	43.00	20.34	33.50	43.00
Radius of Curvature (ft)	-----	-----	-----	-----	42.30	52.70	63.10	7.00	10.50	14.00	11.60	17.54	32.69	11.60	17.54	32.69
Meander Wavelength (ft)	-----	-----	-----	-----	185.00	222.50	260.00	49.00	66.50	84.00	46.87	74.30	101.72	46.87	74.30	101.72
Meander Width Ratio	-----	-----	4.69	-----	1.50	1.83	2.16	3.50	5.75	8.00	----	3.92	----	----	4.07	----
Profile																
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	18.00	34.00	50.00	7.00	24.00	41.00	7.16	9.92	12.93
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.0150	0.0170	0.0190	0.0270	0.03	0.0360	0.0270	0.03	0.0360	0.0456	0.06	0.0774
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	3.50	9.25	15.00	4.00	9.50	15.00	4.16	5.94	7.10
Pool Spacing (ft)	----	-----	-----	-----	97.50	138.65	179.80	28.00	38.50	49.00	22.00	30.00	38.00	15.40	20.45	29.22
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	.25 /.41 / .6 /1.7 /2.4			-----			.25 /.41 / .6 /1.7 /2.4			.13/.43/.73/1.9/2.97			.13/.43/.73/1.9/2.97		
Reach Shear Stress (competency) lb/f2	-----	-----	0.40	-----	-----	-----	-----	-----	0.30	-----	-----*	-----*	-----*	-----*	-----*	-----*
Stream Power (transport capacity) W/m2	-----	-----	1.36	-----	-----	-----	-----	-----	0.78	-----	-----*	-----*	-----*	-----*	-----*	-----*
Additional Reach Parameters																
Channel length (ft)	-----	-----	1616.00	-----	-----	330.00	-----	-----	950.00	-----	-----	950.00	-----	-----	950.00	-----
Drainage Area (SM)	-----	-----	0.09	-----	0.20	1.90	2.30	-----	0.09	-----	-----	0.09	-----	-----	0.09	-----
Rosgen Classification	-----	-----	E5	-----	-----	B	-----	-----	E4	-----	-----	Bc5	-----	-----	Bc5/E5	-----
Bankfull Discharge (cfs)	15.64	-----	13.00	-----	----	-----	----	-----	13.00	-----	-----	13.00	-----	-----	13.00	-----
Sinuosity	-----	-----	1.34	-----	-----	1.10	----	-----	1.28	-----	-----	0.82	-----	-----	0.82	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0164	-----	-----	0.0292	-----	-----	0.0292	-----

Notes: UT 2 continues to transport a considerable volume of fine and coarse sediments. Therefore, a substrate sample was not collected.

Table B2. Baseline Stream Summary - Year 1 Monitoring

Blockhouse Creek Restoration Project #D06027-A

Baseline Stream Summary
UT2 (Lower Reach)

Parameter	Regional Curve Equation	Pre-Existing Condition			Reference Reach(es) Data			Design			As-Built			Monitoring Year 1		
Dimension - Riffle	Eq.	Min	Mean	Max	Min	Mean	Max				Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	5.48	-----	6.30	-----	-----	7.00	-----	-----	7.00	-----	----	10.93	----	----	5.03	----
Floodprone Width (ft)	-----	-----	22.60	-----	-----	-----	-----	-----	35+	-----	----	24.10	----	----	27.20	----
Bankfull Mean Depth (ft)	0.76	-----	0.61	-----	-----	0.71	-----	-----	0.70	-----	----	0.53	----	----	0.61	----
Bankfull Max Depth (ft)	-----	-----	0.90	-----	-----	1.00	-----	-----	1.00	-----	----	1.04	----	----	0.93	----
Bankfull Cross Sectional Area (ft2)	4.17	-----	3.80	-----	-----	5.00	-----	-----	5.00	-----	----	4.90	----	----	2.83	----
Width/Depth Ratio	-----	-----	10.30	-----	12.00	15.00	18.00	-----	10.00	-----	----	24.52	----	----	8.94	----
Entrenchment Ratio	-----	-----	3.60	-----	-----	>2.2	-----	-----	>2.2	-----	----	2.20	----	----	4.00	----
Bank Height Ratio	-----	-----	2.80	-----	1.00	1.05	1.10	-----	1.00	-----	----	0.70	----	----	1.00	----
Bankfull Velocity (fps)	-----	-----	3.42	-----	4.00	5.00	6.00	-----	2.60	-----	----	2.65	----	----	4.59	----
Pattern																
Channel Beltwidth (ft)	-----	5.69	11.85	18.00	-----	-----	-----	25.00	40.50	56.00	34.28	43.54	52.80	34.28	43.54	52.80
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	23.72	25.92	28.12	23.72	25.92	28.12
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	120.46	-----	-----	120.46	-----
Meander Width Ratio	-----	-----	1.88	-----	-----	-----	-----	-----	5.79	-----	----	3.98	----	----	8.66	----
Profile																
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	5.00	10.00	15.00	5.00	9.50	14.00	7.16	9.92	12.93
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.0320	0.0420	0.0520	0.0320	0.04	0.0520	0.0320	0.04	0.0520	0.0456	0.06	0.0774
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	4.00	6.50	9.00	3.00	4.00	5.00	4.16	5.94	7.10
Pool Spacing (ft)	-----	-----	-----	-----	10.50	22.75	35.00	10.50	22.75	35.00	12.00	15.50	19.00	15.40	20.45	29.22
Substrate and Transport Parameters																
d16 / d35 / d50 / d84 / d95	-----	.25 /.41 / .6 /1.7 /2.4			-----			.25 /.41 / .6 /1.7 /2.4			.11/.68/1.23/4.47/67.74			.11/.68/1.23/4.47/67.74		
Reach Shear Stress (competency) lb/f2	-----	-----	1.36	-----	-----	-----	-----	-----	1.15	-----	-----*	-----*	-----*	-----*	-----*	-----*
Stream Power (transport capacity) W/m2	-----	-----	4.66	-----	-----	-----	-----	-----	3.00	-----	-----*	-----*	-----*	-----*	-----*	-----*
Additional Reach Parameters																
Channel length (ft)	-----	-----	205.00	-----	-----	-----	-----	-----	205.00	-----	-----	205.00	-----	-----	205.00	-----
Drainage Area (SM)	-----	-----	0.09	-----	-----	-----	-----	-----	0.09	-----	-----	0.09	-----	-----	0.09	-----
Rosgen Classification	-----	-----	E5	-----	-----	B	-----	-----	B4	-----	-----	Cb	-----	-----	Cb5	-----
Bankfull Discharge (cfs)	15.64	-----	13.00	-----	-----	-----	-----	-----	13.00	-----	-----	13.00	-----	-----	13.00	-----
Sinuosity	-----	-----	1.34	-----	1.10	1.15	1.20	-----	1.14	-----	-----	1.11	-----	-----	1.11	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.0232	-----	-----	0.0173	-----	-----	0.0173	-----

Notes: UT 2 continues to transport a considerable volume of fine and coarse sediments. Therefore, a substrate sample was not collected.

Table B3. Morphology and Hydraulic Monitoring Summary - Year 1 Monitoring
Blockhouse Creek Restoration Project #D06027-A

	Blockhouse Creek Reach 1 (1,070 ft)												Blockhouse Creek Reach 2 (340ft)											
Parameter	Cross Section 1 Riffle						Cross Section 2 Pool						Cross Section 3 Pool						Cross Section 4 Riffle					
	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	21.69	21.24					23.48	23.72					23.01	22.05					22.57	19.69				
Floodprone Width (ft)	>54	53.91					>54	55.24					>48	47.49					>57	57.10				
BF Cross Sectional Area (ft2)	29.00	27.40					30.80	31.20					34.20	35.00					34.90	32.20				
BF Mean Depth (ft)	1.34	1.29					1.31	1.32					1.49	1.59					1.54	1.64				
BF Max Depth (ft)	2.29	2.33					2.81	3.16					3.45	3.66					2.92	2.85				
Width/Depth Ratio	16.20	16.45					17.89	18.01					15.49	13.89					14.62	12.03				
Entrenchment Ratio	2.50	2.50					2.30	2.30					2.10	2.20					2.50	2.90				
Wetted Perimeter (ft)	24.37	23.82					26.10	26.36					25.99	25.23					25.65	22.97				
Hydraulic Radius (ft)	1.19	1.15					1.18	1.18					1.32	1.39					1.36	1.40				
Substrate																								
d50 (mm)	2.24	10.07																						
d84 (mm)	26.23	32.00																						

	Blockhouse Creek Reach 3 (950ft)						Blockhouse Creek Reach 4 (1,780 ft)																	
Parameter	Cross Section 5 Riffle						Cross Section 6 Pool						Cross Section 7 Riffle						Cross Section 8 Pool					
	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	21.50	18.16					24.40	19.83					19.62	20.37					18.35	24.39				
Floodprone Width (ft)	>44	30.59					>36	35.26					>53	53.54					>61	61.16				
BF Cross Sectional Area (ft2)	33.00	31.70					35.40	28.10					34.80	37.24					35.80	35.30				
BF Mean Depth (ft)	1.54	1.75					1.45	1.42					1.77	1.83					1.95	1.45				
BF Max Depth (ft)	3.20	3.13					2.88	2.72					3.15	3.55					4.50	3.06				
Width/Depth Ratio	13.99	10.40					16.83	13.99					11.08	11.14					9.41	16.85				
Entrenchment Ratio	2.10	1.70					1.50	1.78					2.70	2.63					3.30	2.51				
Wetted Perimeter (ft)	24.58	21.66					27.30	22.67					23.16	24.03					22.25	27.29				
Hydraulic Radius (ft)	1.34	1.46					1.30	1.24					1.50	1.55					1.61	1.29				

Blockhouse Creek Reach 4 (1,780 ft)																				
Parameter	Cross Section 9 Riffle																			
	AB	MY1	MY2	MY3	MY4	MY5														
Dimension																				
BF Width (ft)	19.01	21.72																		
Floodprone Width (ft)	>59	59.20																		
BF Cross Sectional Area (ft2)	35.10	42.07																		
BF Mean Depth (ft)	1.84	1.94																		
BF Max Depth (ft)	2.98	3.28																		
Width/Depth Ratio	10.30	11.21																		
Entrenchment Ratio	3.10	2.73																		
Wetted Perimeter (ft)	22.69	25.60																		
Hydraulic Radius (ft)	1.55	1.64																		
Substrate																				
d50 (mm)	2.24	8.66																		
d84 (mm)	26.23	101.21																		

Parameter	AB (2008)			MY-1 (2009)			MY-2 (2010)			MY-3 (2011)			MY-4 (2012)			MY-5 (2013)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	54.70	102.00	63.00	54.70	102.00	63.00												
Radius of Curvature (ft)	15.50	42.00	30.90	15.50	42.00	30.90												
Meander Wavelength (ft)	81.40	195.07	138.30	81.40	195.07	138.30												
Meander Width Ratio	2.98	4.18	3.58	2.98	4.18	3.58												
Profile																		
Riffle length (ft)	15.00	80.00	47.50	15.41	138.03	47.83												
Riffle Slope (ft/ft)	0.00	0.04	0.02	0.00	0.02	0.01												
Pool Length (ft)	10.00	25.00	17.50	5.63	55.77	27.78												
Pool Spacing (ft)	30.00	122.00	76.00	44.75	135.92	83.56												
Substrate																		
d50 (mm)	2.24			8.66														
d84 (mm)	26.23			101.21														
Additional Reach Parameters																		
Valley Length (ft)	2939.00			2939.00														
Channel Length (ft)	4140.00			4140.00														
Sinuosity	1.12	1.19	1.16	1.12	1.19	1.16												
Water Surface Slope (ft/ft)	0.00	0.01	0.01	0.00	0.01	0.00												
BF Slope (ft/ft)	0.00	0.02	0.01	0.00	0.02	0.01												
Rosgen Classification	C4/Bc4/E4			C4/Bc/E4														

UT1 Reach (580 ft)																		
Parameter	Cross Section 10 Riffle						Cross Section 11 Riffle						Cross Section 12 Pool					
	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
Dimension																		
BF Width (ft)	12.43	11.72					11.42	11.76					12.95	13.30				
Floodprone Width (ft)	>39	38.90					>41	40.55					>30	30.20				
BF Cross Sectional Area (ft2)	10.70	10.90					10.30	11.00					10.40	8.30				
BF Mean Depth (ft)	0.86	0.93					0.90	0.94					0.80	0.63				
BF Max Depth (ft)	1.76	1.76					1.66	1.81					1.58	1.72				
Width/Depth Ratio	14.48	12.63					12.66	12.53					16.16	21.23				
Entrenchment Ratio	3.10	3.30					3.60	3.40					2.30	2.30				
Wetted Perimeter (ft)	14.15	13.58					13.22	13.64					14.55	14.56				
Hydraulic Radius (ft)	0.76	0.80					0.78	0.81					0.71	0.57				
Substrate																		
d50 (mm)	----	20.93																
d84 (mm)	----	58.61																

Parameter	AB (2008)			MY-1 (2009)			MY-2 (2010)			MY-3 (2011)			MY-4 (2012)			MY-5 (2013)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	32.86	44.68	42.70	32.86	44.68	42.70												
Radius of Curvature (ft)	10.78	19.62	18.43	10.78	19.62	18.43												
Meander Wavelength (ft)	32.86	116.72	44.68	32.86	116.72	44.68												
Meander Width Ratio	2.88	3.45	3.16	2.80	3.36	3.08												
Profile																		
Riffle length (ft)	19.00	74.00	46.50	33.27	75.42	40.08												
Riffle Slope (ft/ft)	0.03	0.04	0.03	0.02	0.04	0.02												
Pool Length (ft)	7.00	15.00	11.00	8.90	27.90	10.63												
Pool Spacing (ft)	13.00	60.00	36.50	13.00	65.50	49.01												
Substrate																		
d50 (mm)	----			20.93														
d84 (mm)	----			58.61														
Additional Reach Parameters																		
Valley Length (ft)	525.00			525.00														
Channel Length (ft)	580.00			580.00														
Sinuosity	1.12	1.13	1.12	1.12	1.13	1.12												
Water Surface Slope (ft/ft)	----	----	0.02	----	----	0.02												
BF Slope (ft/ft)	----	----	0.02	----	----	0.02												
Rosgen Classification	C4			C4														

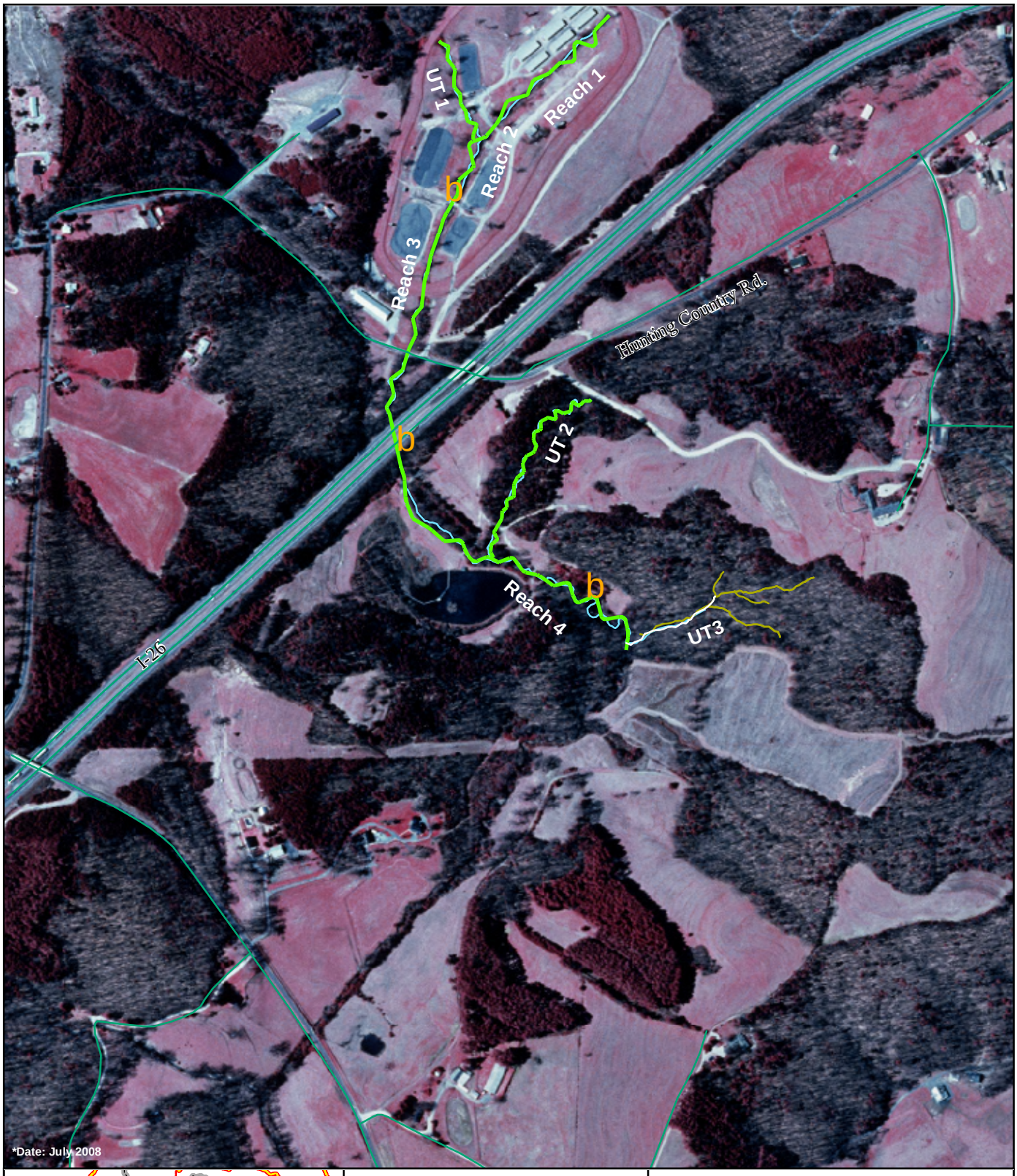
UT2 Reach (1,155 ft)																							
Parameter	Cross Section 13 Riffle						Cross Section 14 Pool						Cross Section 15 Riffle						Cross Section 16 Riffle					
	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	6.72	5.34					6.21	5.03					8.55	8.24					6.87	5.02				
Floodprone Width (ft)	19.06	23.21					>21	20.10					>29	34.30					>27	27.10				
BF Cross Sectional Area (ft2)	2.56	3.45					4.50	2.83					5.20	5.37					4.90	4.31				
BF Mean Depth (ft)	0.38	0.65					0.72	0.56					0.61	0.65					0.71	0.86				
BF Max Depth (ft)	0.81	1.21					1.24	0.93					1.00	1.36					1.05	1.30				
Width/Depth Ratio	17.60	8.27					8.59	8.94					14.00	12.64					9.63	5.85				
Entrenchment Ratio	2.80	4.34					3.40	4.00					3.40	4.16					3.90	2.80				
Wetted Perimeter (ft)	7.48	6.64					7.65	6.15					9.77	9.54					8.29	6.74				
Hydraulic Radius (ft)	0.34	0.52					0.59	0.46					0.53	0.56					0.59	0.64				
Substrate																								
d50 (mm)	----	---																						
d84 (mm)	----	---																						

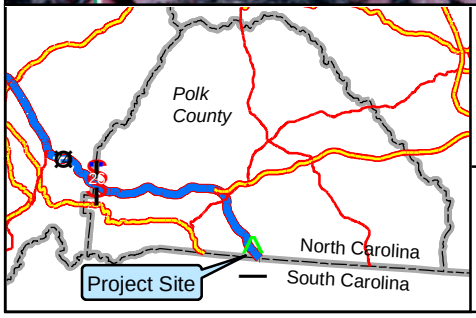
Parameter	AB (2008)			MY-1 (2009)			MY-2 (2010)			MY-3 (2011)			MY-4 (2012)			MY-5 (2013)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	20.34	52.80	35.30	20.34	52.80	35.30												
Radius of Curvature (ft)	11.60	32.69	18.70	11.60	32.69	18.70												
Meander Wavelength (ft)	46.87	120.46	81.27	46.87	120.46	81.27												
Meander Width Ratio	3.28	6.18	4.73	4.05	6.41	5.23												
Profile																		
Riffle length (ft)	5.00	41.00	23.00	7.16	50.72	11.31												
Riffle Slope (ft/ft)	0.03	0.05	0.04	0.01	0.08	0.03												
Pool Length (ft)	3.00	15.00	9.00	4.16	16.57	6.54												
Pool Spacing (ft)	12.00	38.00	25.00	15.40	42.37	21.57												
Substrate																		
d50 (mm)	----			----														
d84 (mm)	----			----														
Additional Reach Parameters																		
Valley Length (ft)	946.00			946.00														
Channel Length (ft)	1155.00			1155.00														
Sinuosity	1.14	1.28	1.21	1.14	1.28	1.21												
Water Surface Slope (ft/ft)	0.01	0.03	0.02	0.01	0.04	0.03												
BF Slope (ft/ft)	0.02	0.03	0.02	0.02	0.03	0.02												
Rosgen Classification	Bc5/Cb			Bc/Cb5/E5														

Notes: Any discrepancy between As-built data presented in this report in Tables B2 and B3 and the original report are based on corrections for calculating median instead of mean in some locations.

Table B4. Stream Problem Areas- Year 1 Monitoring
Blockhouse Creek Restoration Project #D06027-A

Feature Issue	Station Number	Suspected Cause
Minor rutting from overland flow	n/a	Exposed earth from equestrian activities, runoff from buildings
Aggradation	28+21	Sediment laden triple box culvert under I-26
Sandbag Weir	14+31	Irrigated water used for dust control and green/landscaped areas
Bank erosion/soil subsidence	42+07	Toeslope erosion





Legend

New Channel Alignment

Previous Channel Alignment

b Stream Problem Areas

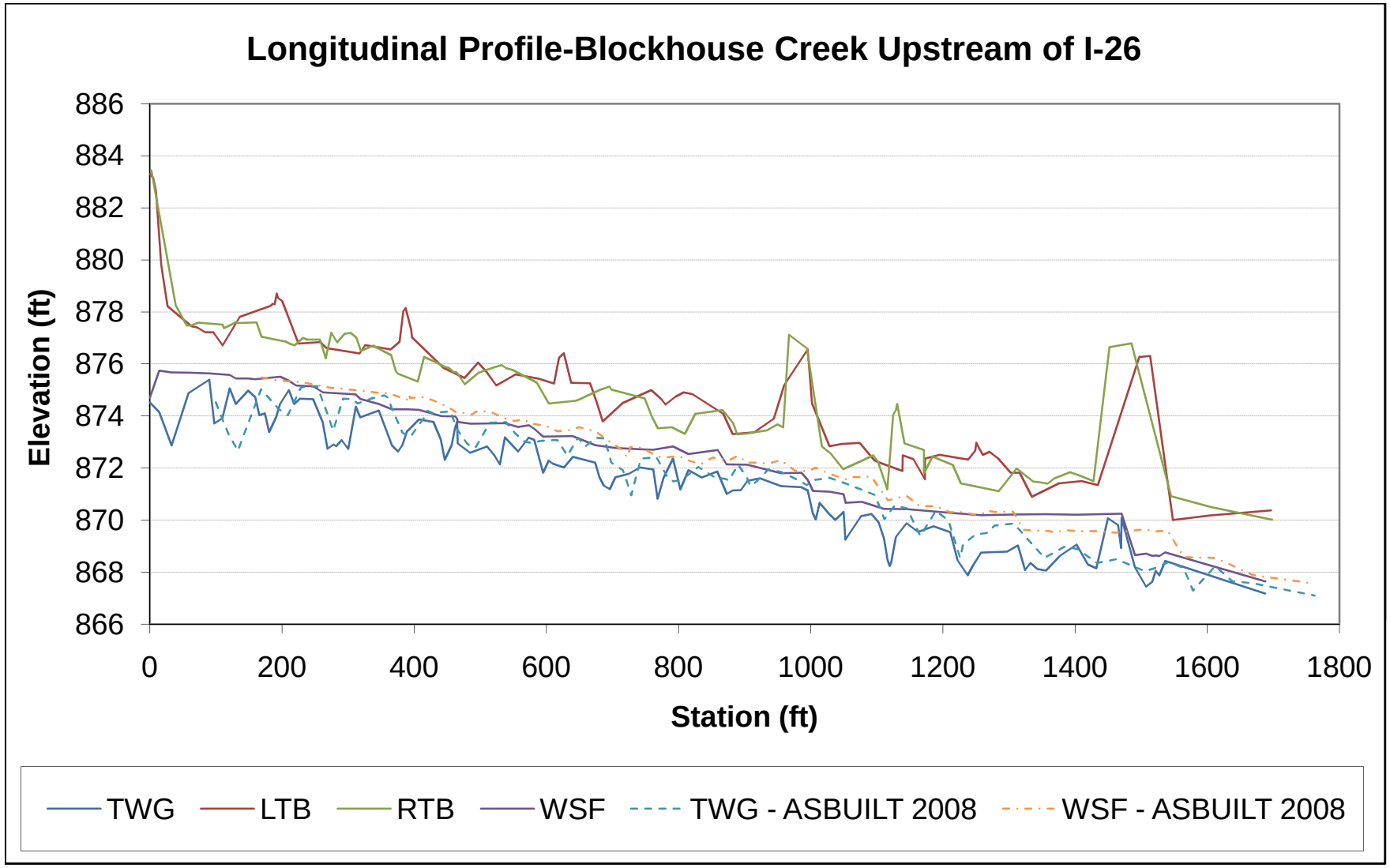
0 200 400 800

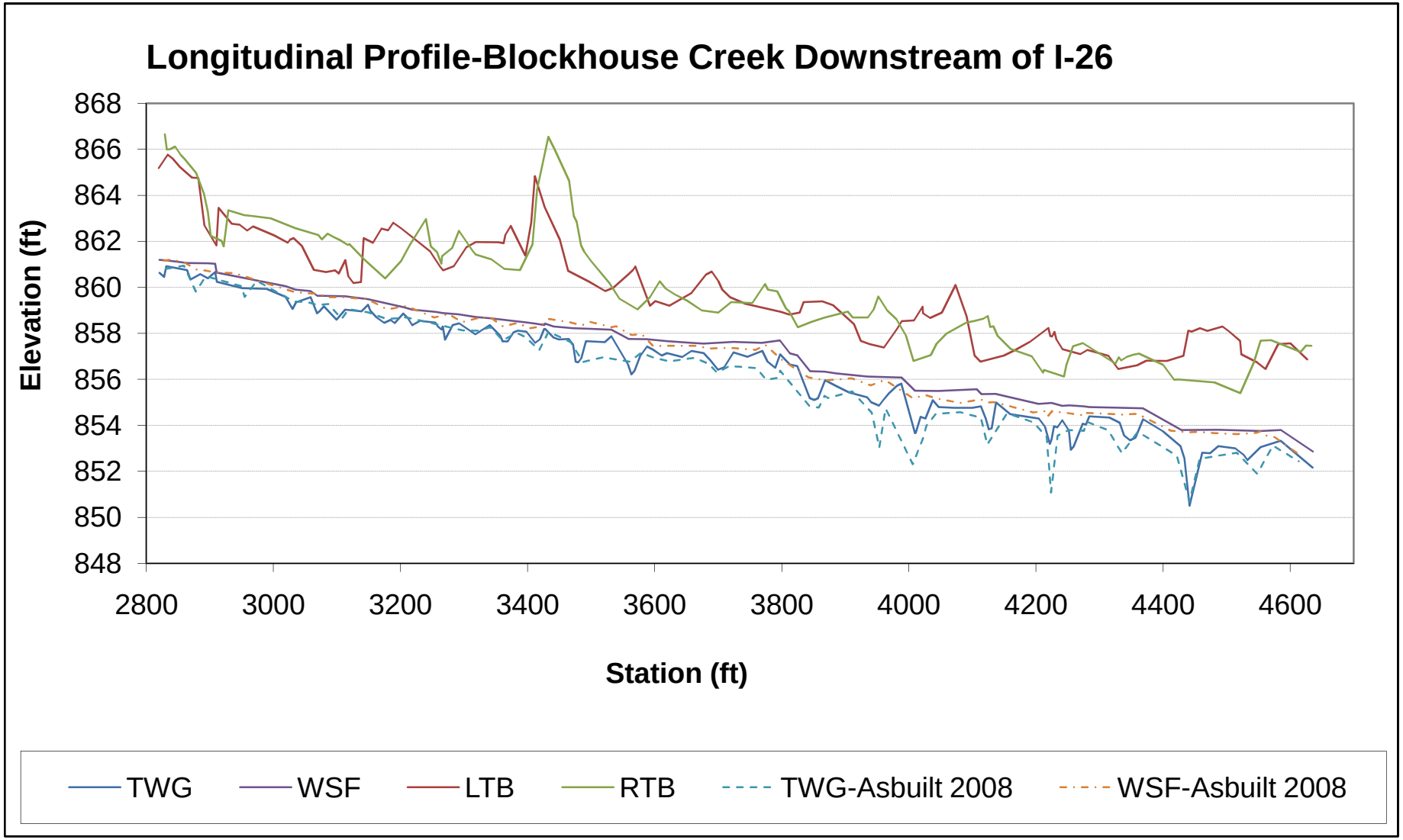
Feet

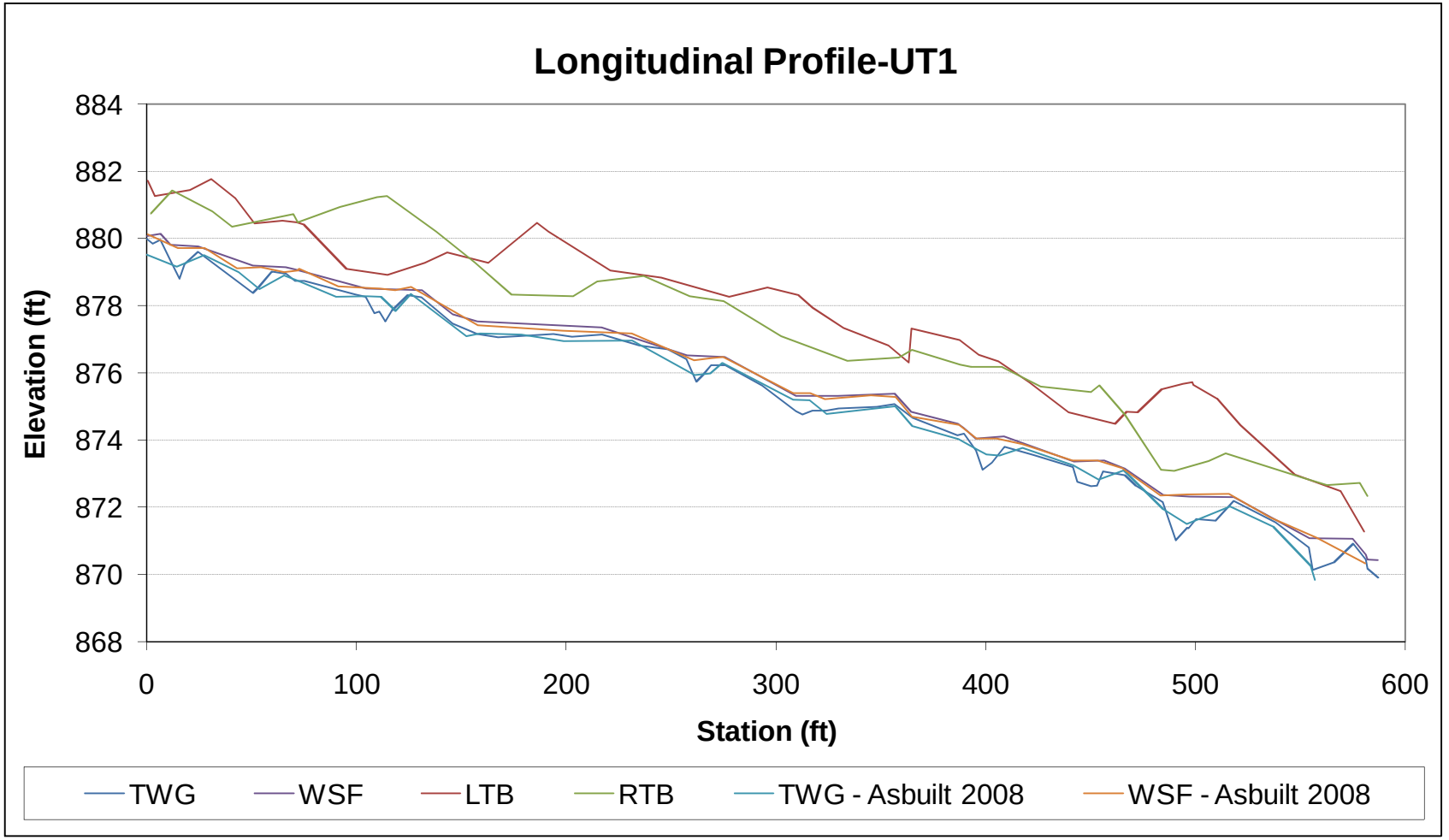
Figure B1. Stream Problem Areas

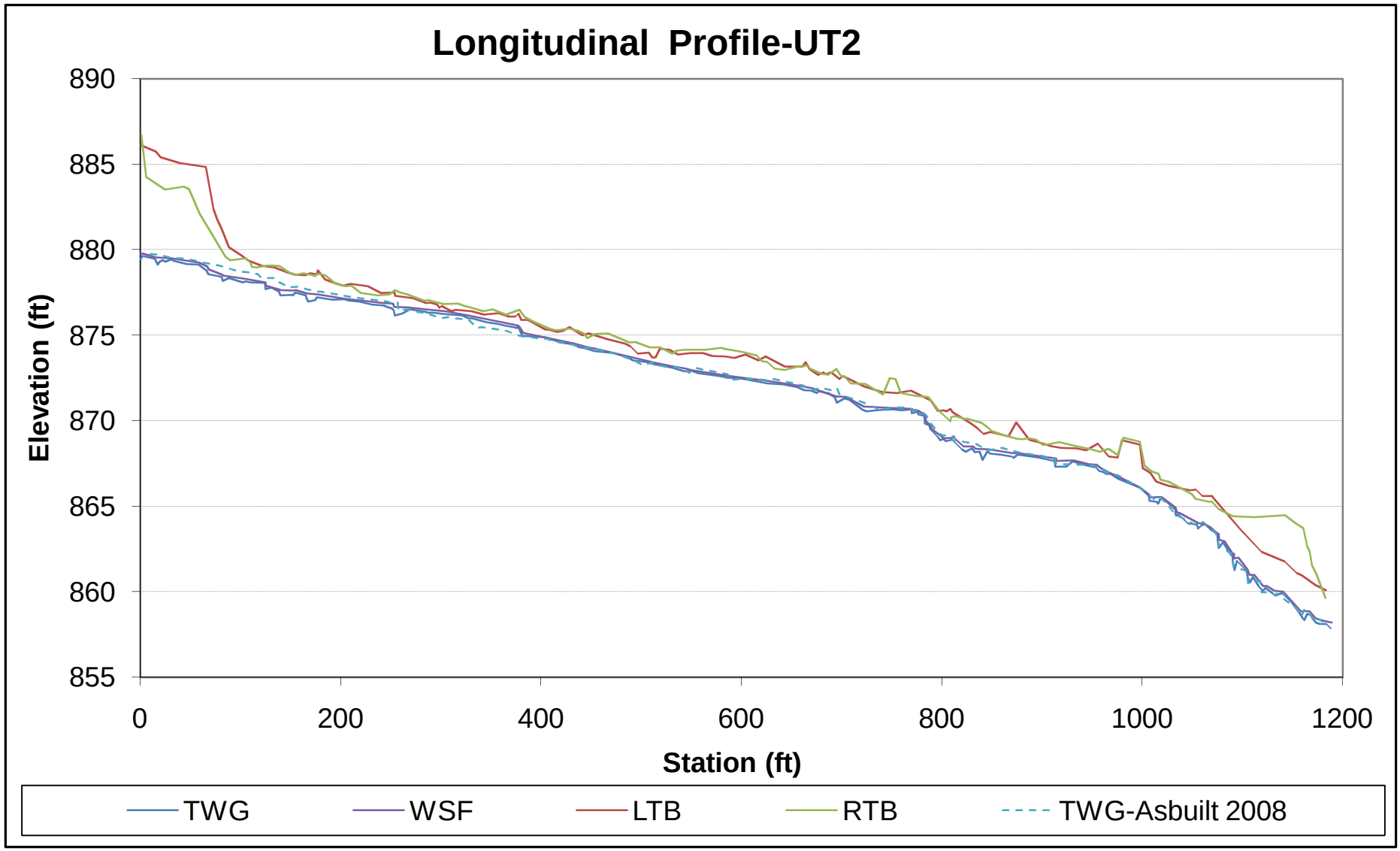
Blockhouse Creek Restoration Project

Baker


Longitudinal Profile-Blockhouse Creek Upstream of I-26
Elevation (ft)
886
884
882
880
878
876
874
872
870
868
866
0
200
400
600
800
1000
1200
1400
1600
1800
Station (ft)
TWG
LTB
RTB
WSF
TWG - ASBUILT 2008
WSF - ASBUILT 2008


Longitudinal Profile-Blockhouse Creek Downstream of I-26
Elevation (ft)
868
866
864
862
860
858
856
854
852
850
848
2800
3000
3200
3400
3600
3800
4000
4200
4400
4600
Station (ft)
TWG
WSF
LTB
RTB
TWG-Asbuilt 2008
WSF-Asbuilt 2008


Longitudinal Profile-UT1
Elevation (ft)
884
882
880
878
876
874
872
870
868
0
100
200
300
400
500
600
Station (ft)
TWG
WSF
LTB
RTB
TWG - Asbuilt 2008
WSF - Asbuilt 2008


Longitudinal Profile-UT2
890
885
880
875
870
865
860
855
Elevation (ft)
0
200
400
600
800
1000
1200
Station (ft)
TWG
WSF
LTB
RTB
TWG-Asbuilt 2008

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4	27.4	21.24	1.29	2.33	16.45	0.9	2.5	876.97	876.81

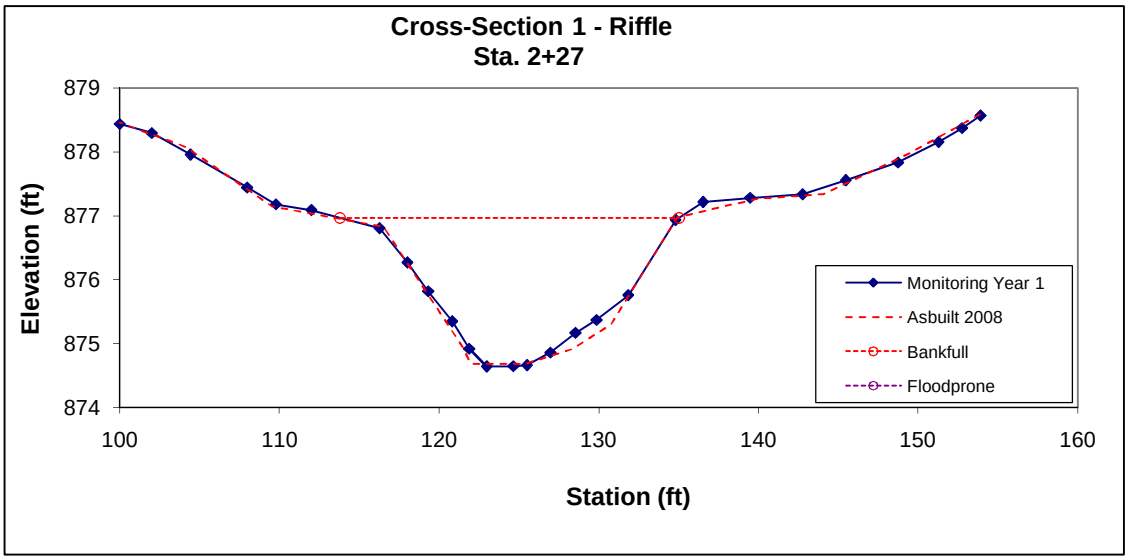


Photo 1: XS-1 facing right bank

Photo 2: XS-1 facing left bank

Photo 3: XS-1 facing left bank

Photo 4: XS-1 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4	31.2	23.72	1.32	3.16	18.01	1.1	2.3	876	876.41

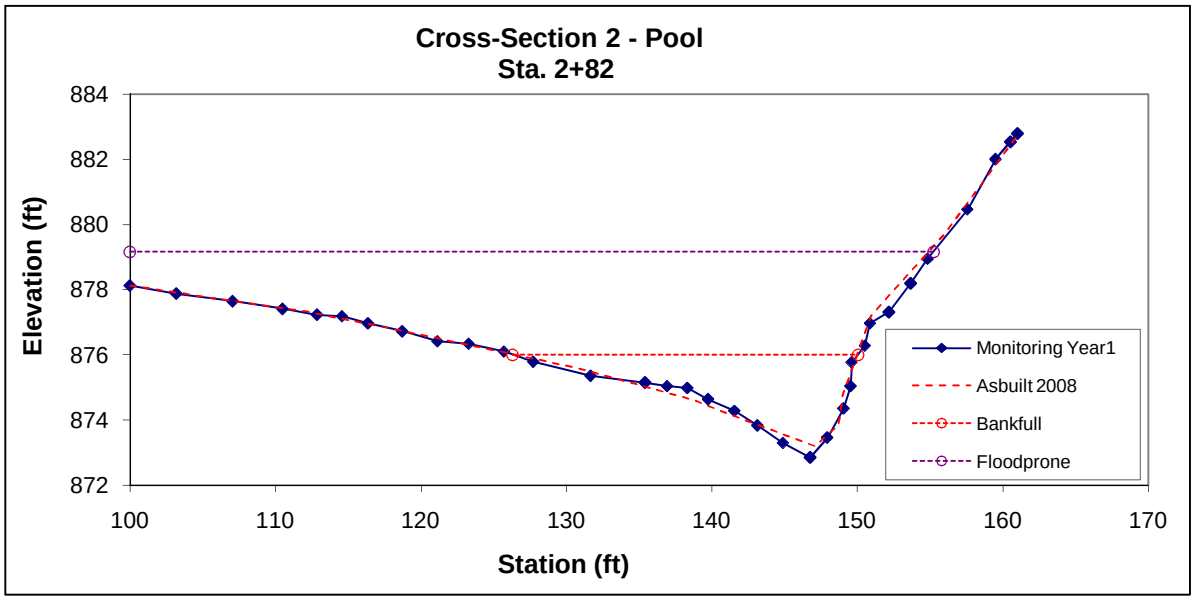


Photo 5: XS-2 facing right bank

Photo 6: XS-2 facing left bank

Photo 7: XS-2 facing right bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	Bc	35	22.05	1.59	3.66	13.89	1	2.2	871.9	871.89

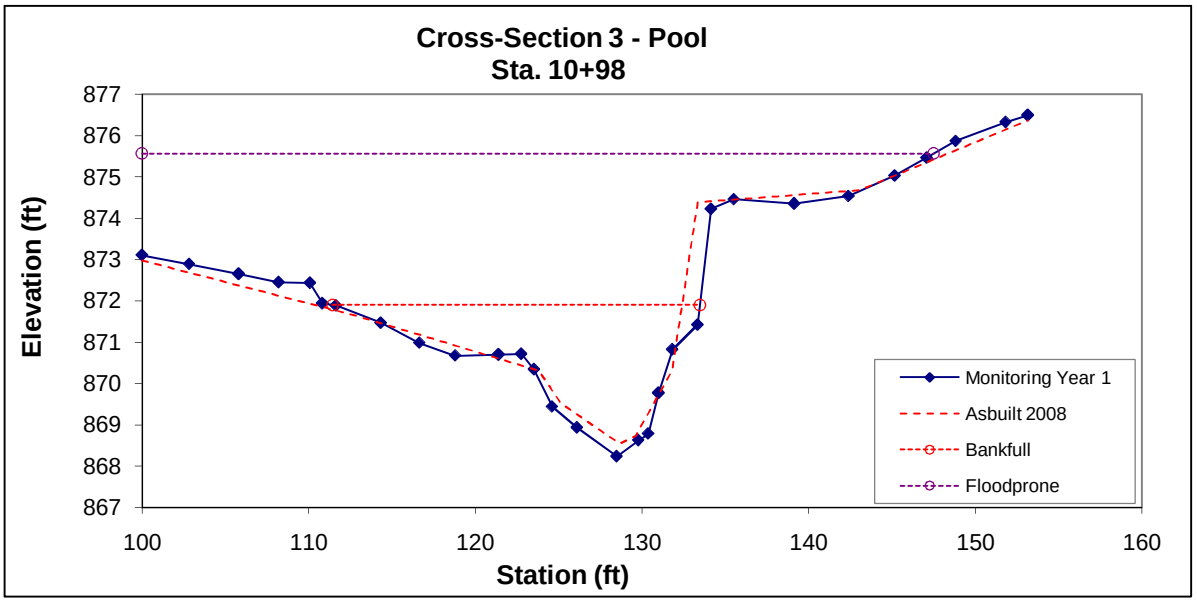


Photo 8: XS-3 facing right bank

Photo 9: XS-3 facing left bank

Photo 10: XS-3 upstream view of right bank

Photo 11: XS-3 facing left bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4	32.2	19.69	1.64	2.85	12.03	1	2.9	872.4	872.37

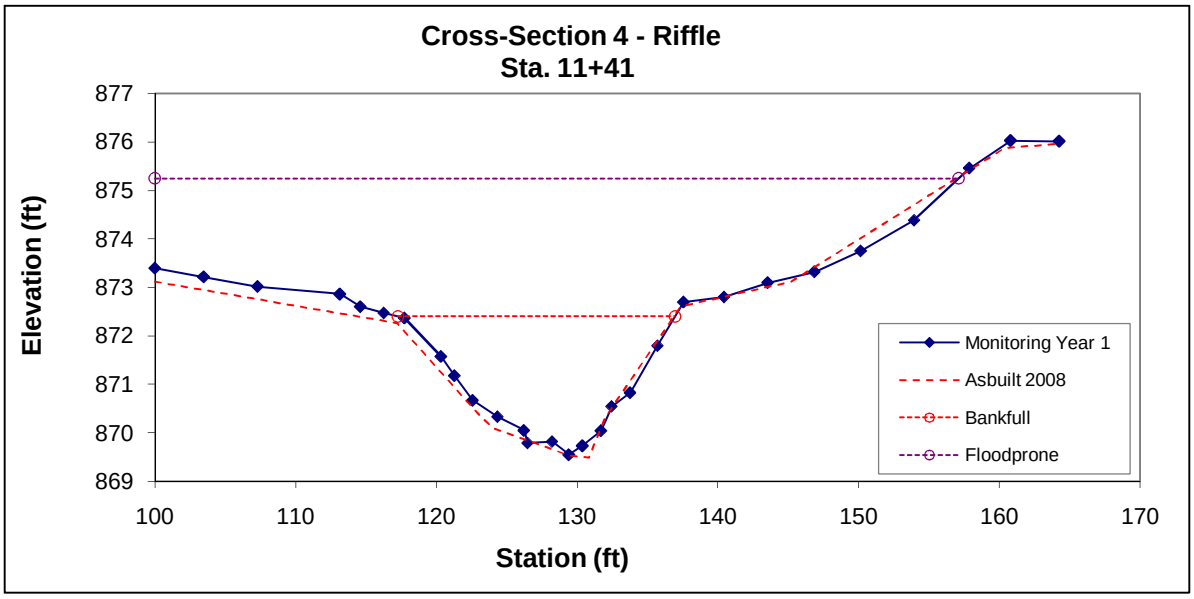


Photo 12: XS-4 facing right bank

Photo 13: XS-4 facing left bank

Photo 14: XS-4 facing right bank

Photo 15: XS-4 facing left bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	31.7	18.16	1.75	3.13	10.4	0.9	1.7	870.3	870.01

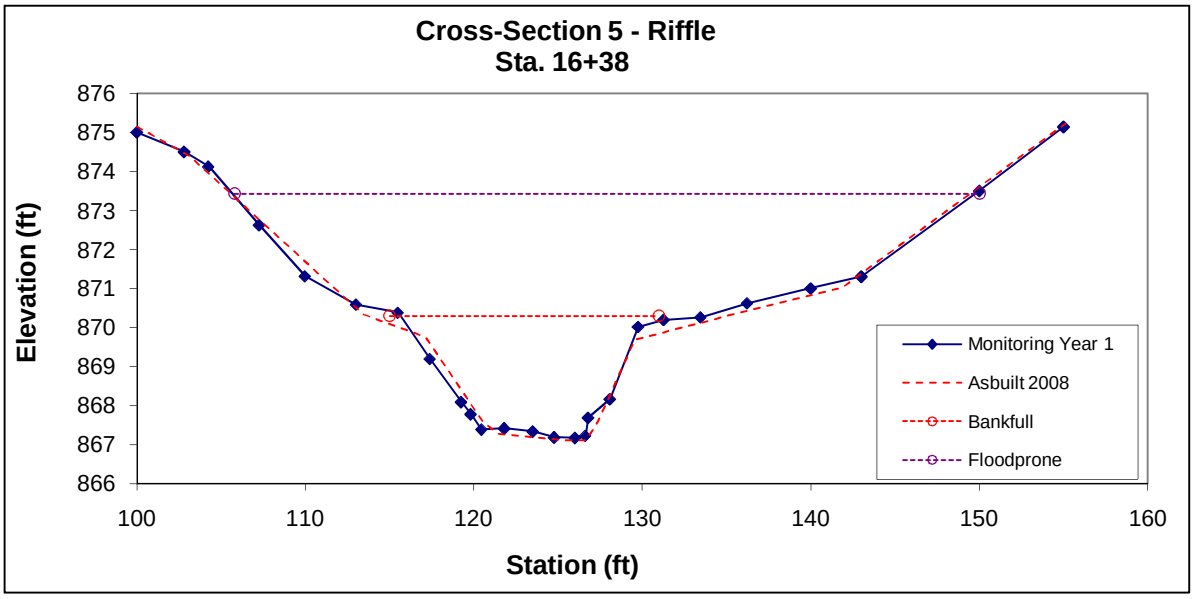


Photo 16: XS-5 facing right bank

Photo 17: XS-5 facing left bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4	28.1	19.83	1.42	2.72	13.99	0.9	1.8	860.9	860.73

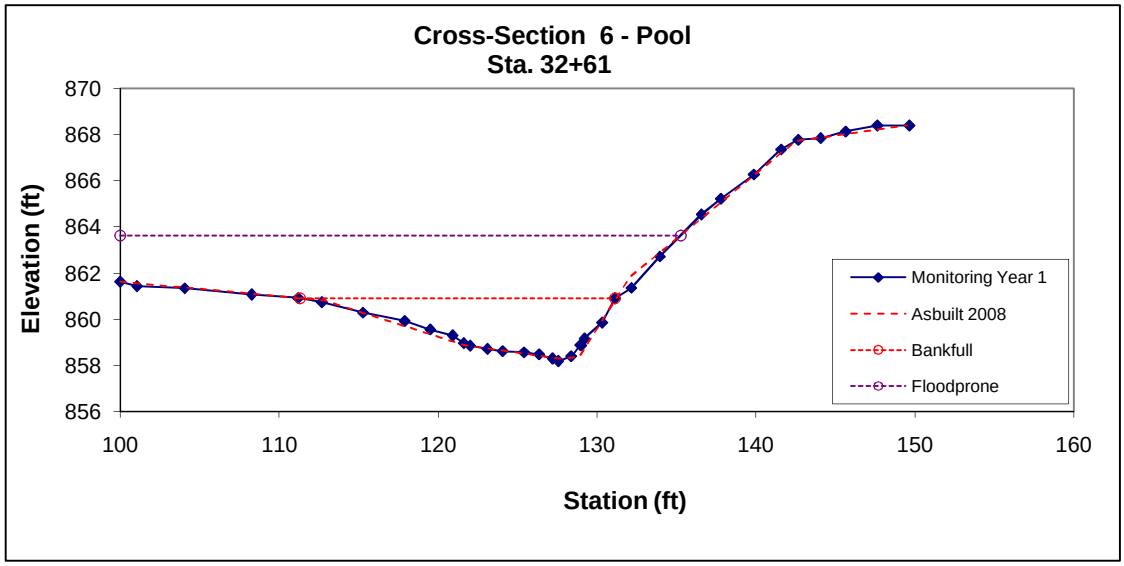


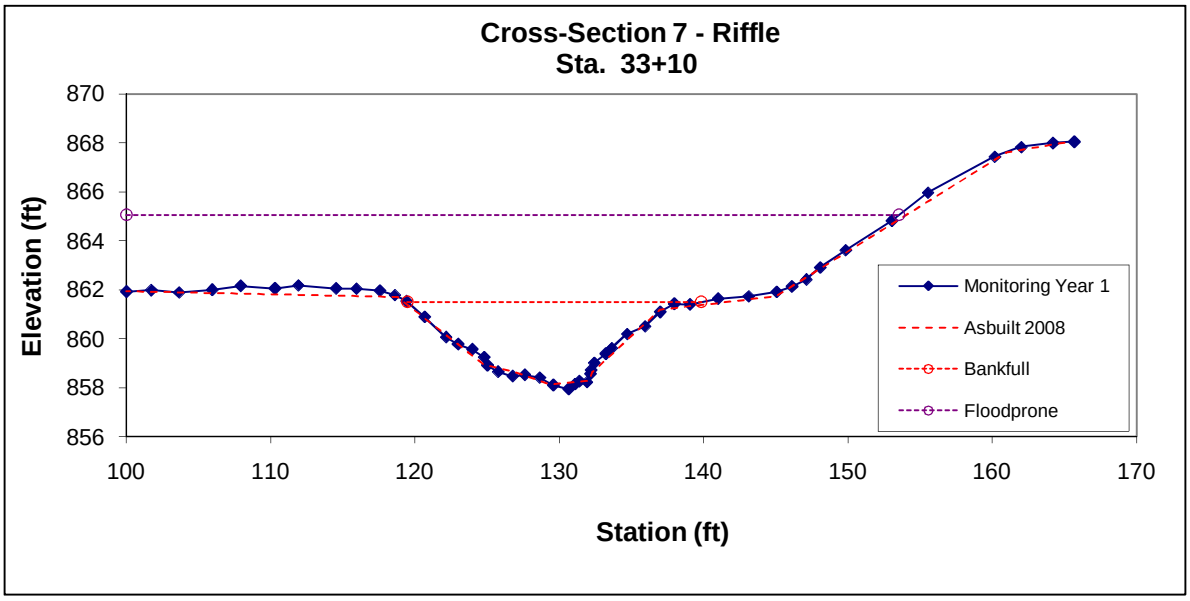
Photo 18: XS-6 facing right bank

Photo 19: XS-6 facing left bank

Photo 20: XS-6 facing upstream

Photo 21: XS-6 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E4	37.2	20.37	1.83	3.55	11.14	1	2.6	861.5	861.42



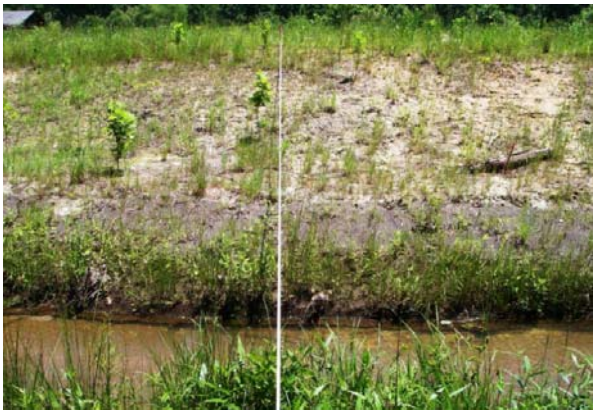


Photo 22: XS-7 facing right bank

Photo 23: XS-7 facing left bank

Photo 24: XS-7 facing upstream

Photo 25: XS-7 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E4	35.3	24.39	1.45	3.06	16.85	1	2.5	856.4	856.41

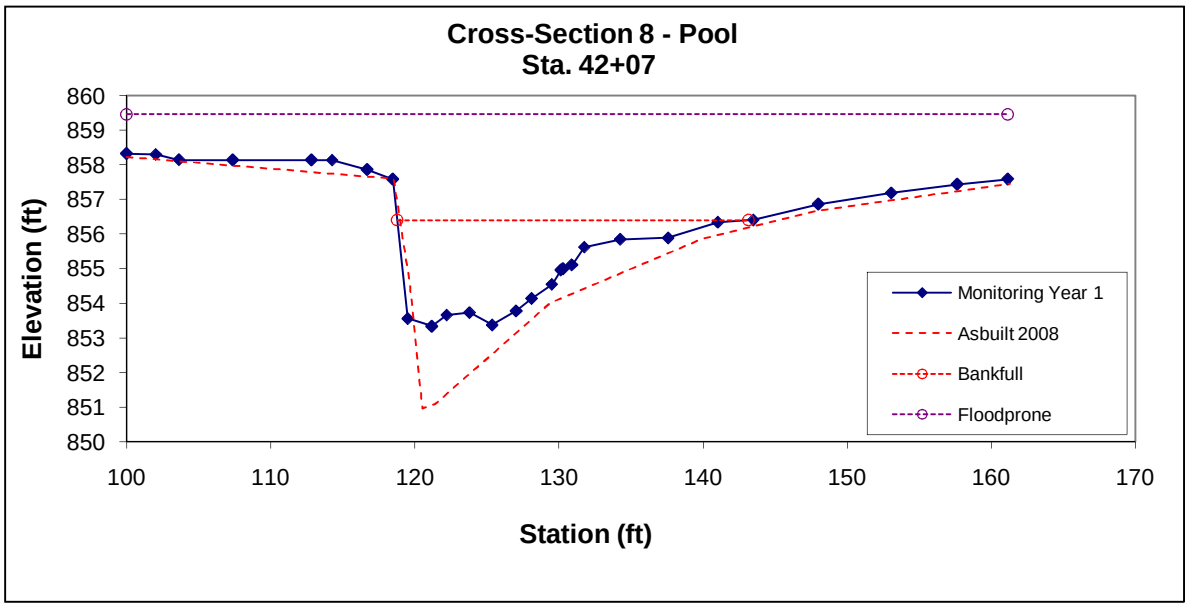


Photo 26: XS-8 facing right bank

Photo 27: XS-8 facing left bank

Photo 28: XS-8 left bank facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E4	42.1	21.72	1.94	3.28	11.21	1	2.7	857.3	857.27

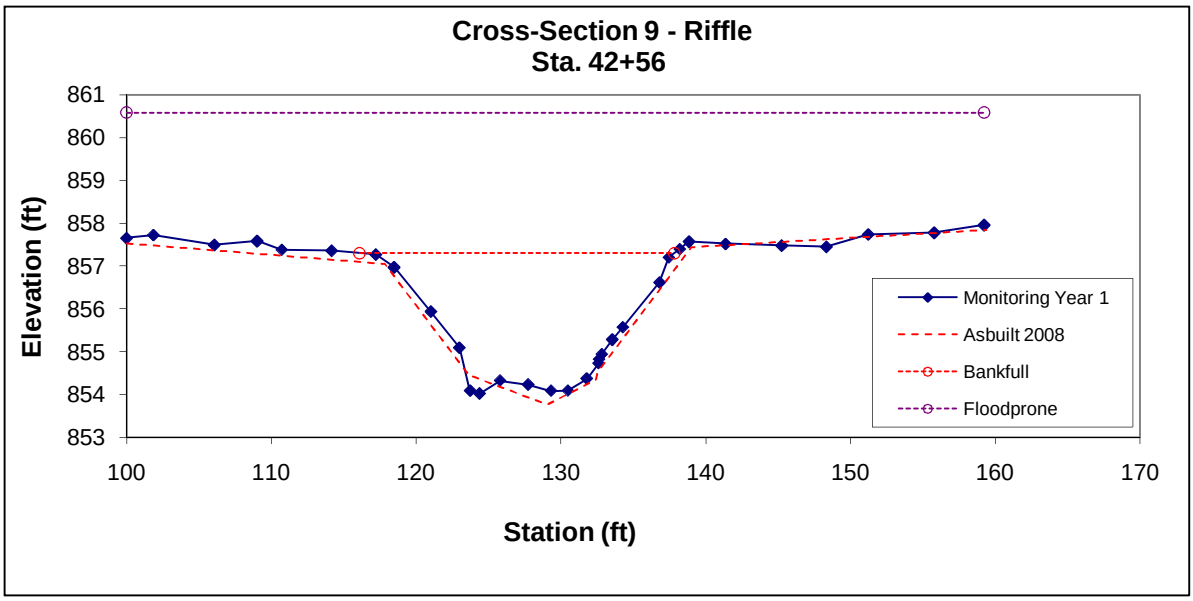


Photo 29: XS-9 facing right bank

Photo 30: XS-9 facing left bank

Photo 31: XS-9 facing upstream

Photo 32: XS-9 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4	10.9	11.72	0.93	1.76	12.63	1	3.3	880.5	880.47

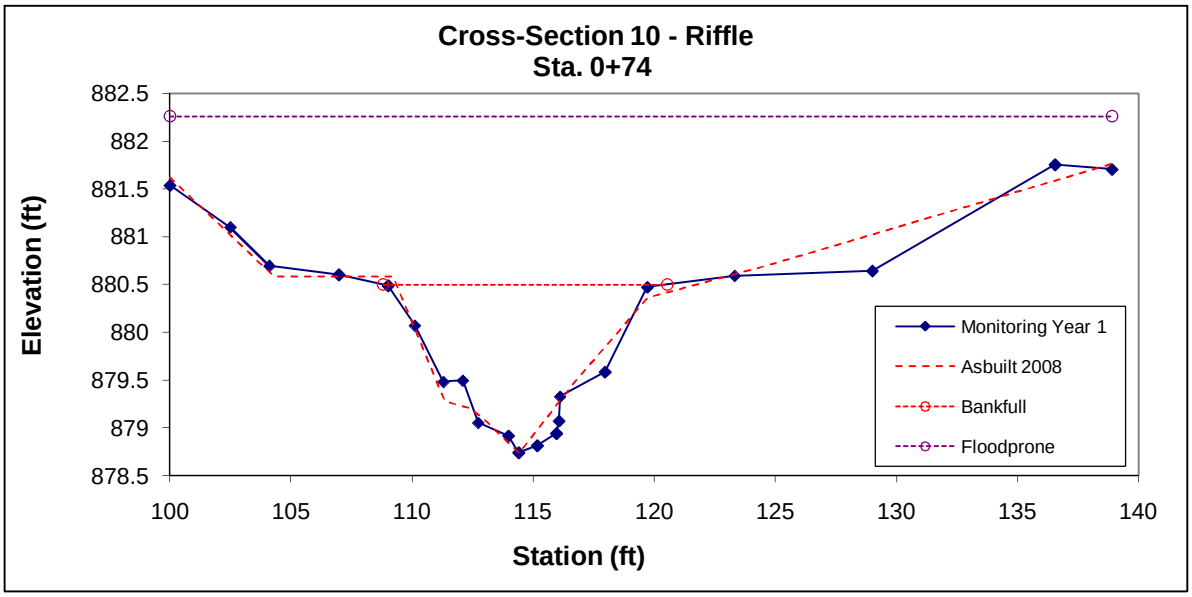


Photo 33: XS-10 facing right bank

Photo 34: XS-10 facing left bank from right bank pin

Photo 35: XS-10 facing left bank

Photo 36: XS-10 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C4	11	11.76	0.94	1.81	12.53	1	3.4	874.76	874.73

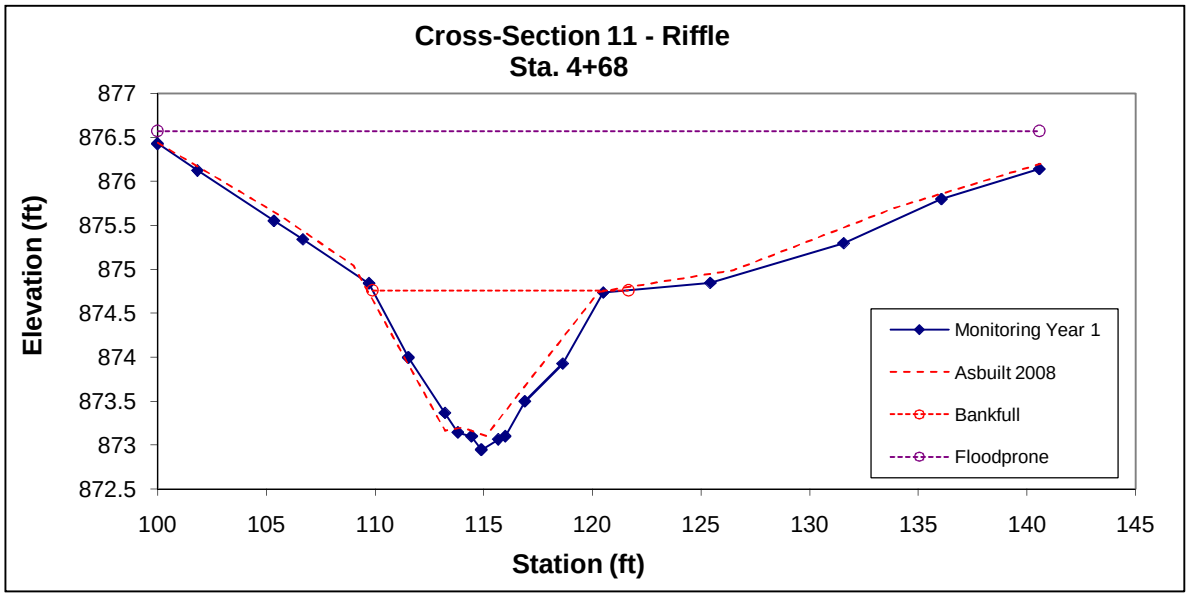


Photo 37: XS-11 facing right bank

Photo 38: XS-11 facing left bank

Photo 39: view of XS-11 from bridge, facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	C4	8.3	13.3	0.63	1.72	21.23	1	2.3	873	873.07

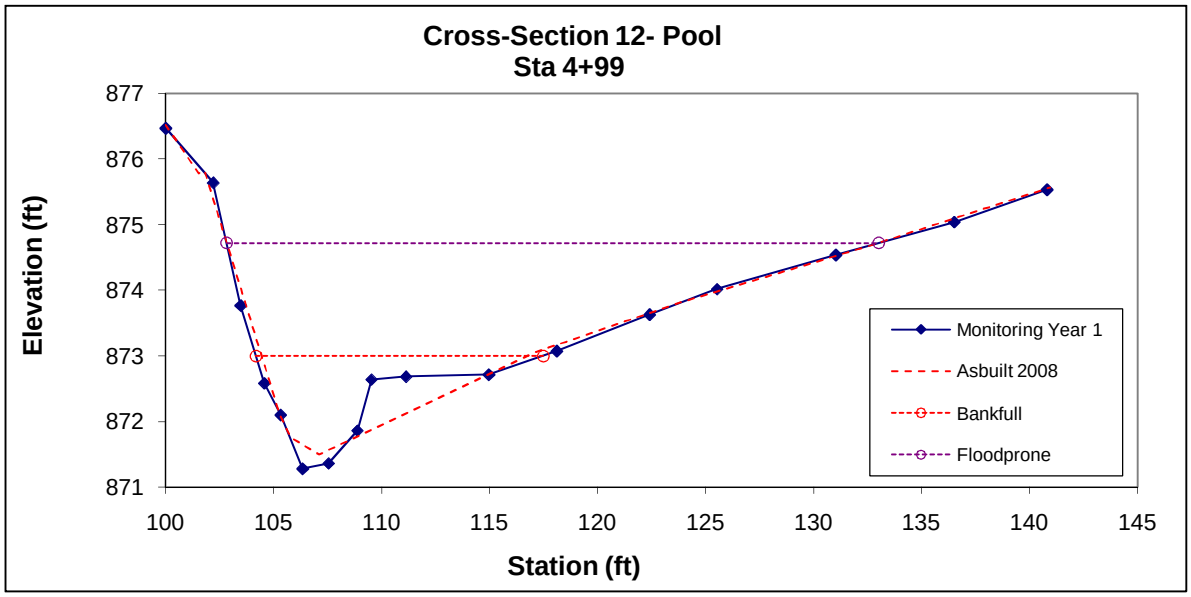


Photo 40: XS-12 facing right bank

Photo 41: XS-12 facing left bank

Photo 42: XS-12 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	3.5	5.34	0.65	1.21	8.27	1	4.3	878.54	878.53

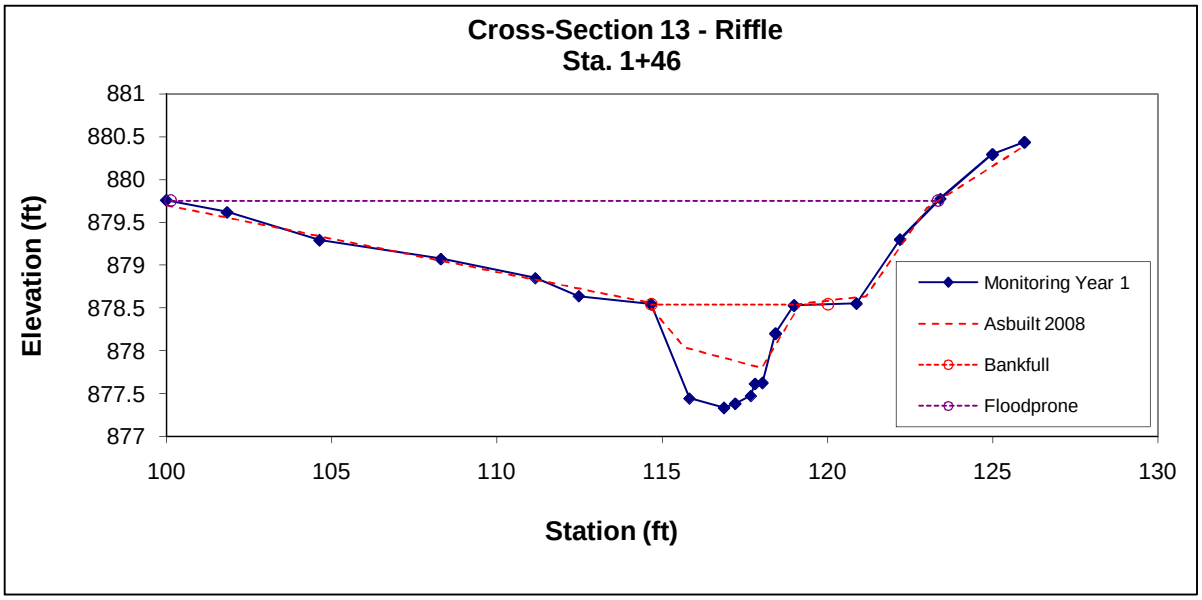


Photo 43: XS-13 facing right bank

Photo 44: XS-13 facing left bank

Photo 45: XS-13 facing upstream

Photo 46: XS-13 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	E5	2.8	5.03	0.56	0.93	8.94	1	4	876.36	876.36

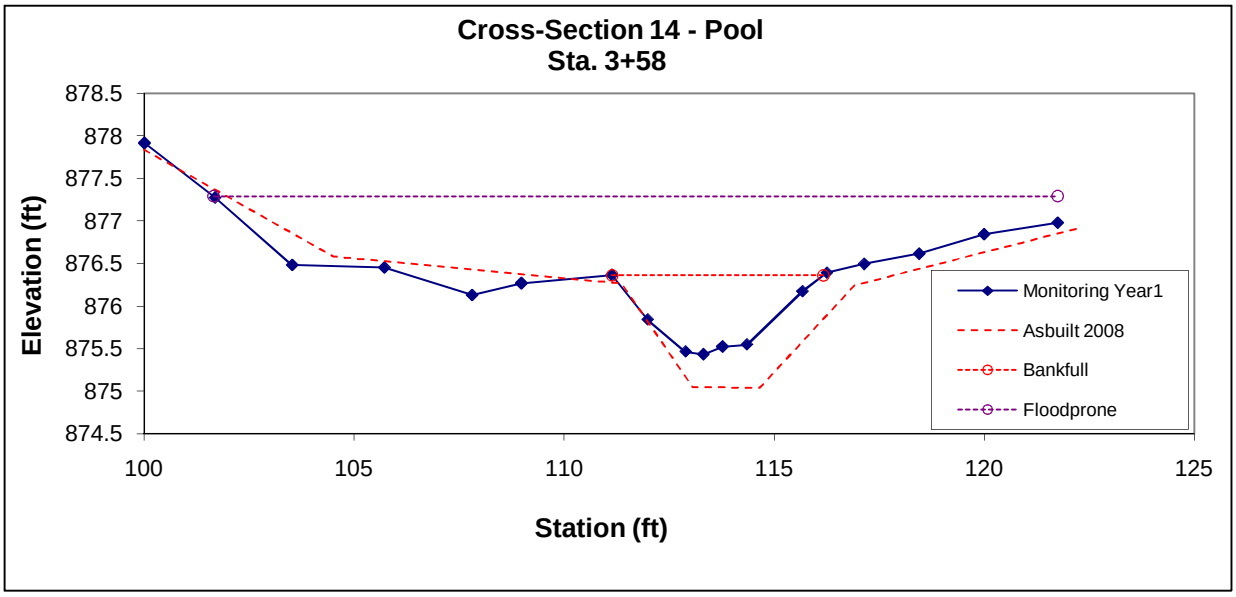


Photo 47: XS-14 facing right bank

Photo 48: XS-14 facing left bank

Photo 49: XS-14 facing upstream

Photo 50: XS-14 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cb5	5.4	8.24	0.65	1.36	12.64	1.2	4.2	865	865.29

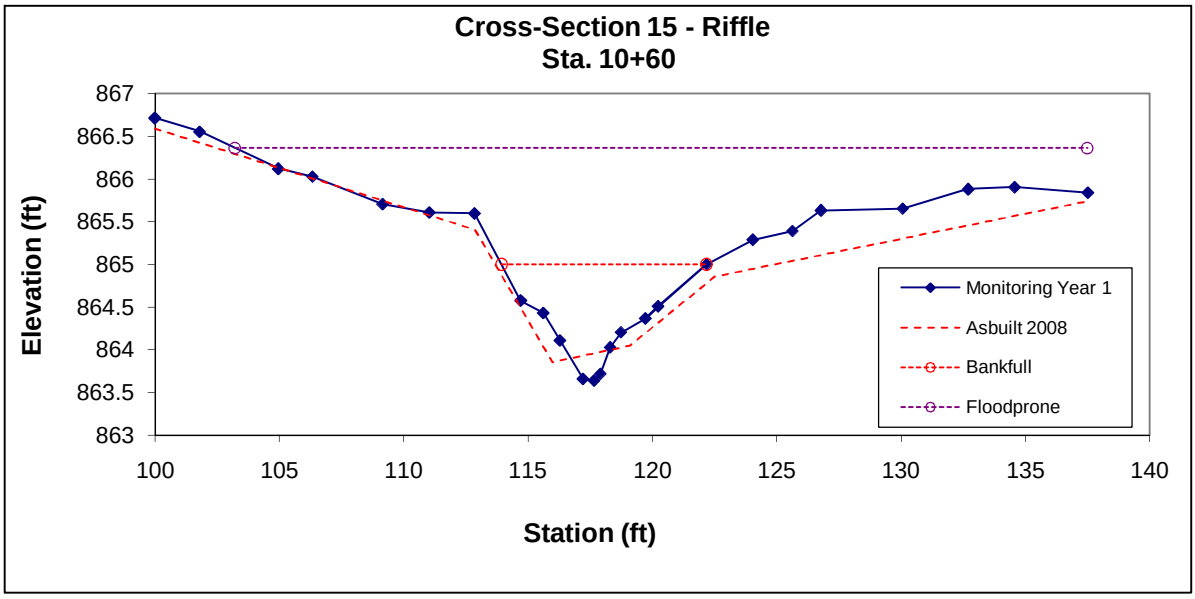


Photo 51: XS-15 facing right bank

Photo 52: XS-15 facing left bank

Photo 53: XS-15 facing upstream

Photo 54: XS-15 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	Cb5	4.3	5.02	0.86	1.3	5.85	2	2.8	859.7	860.97

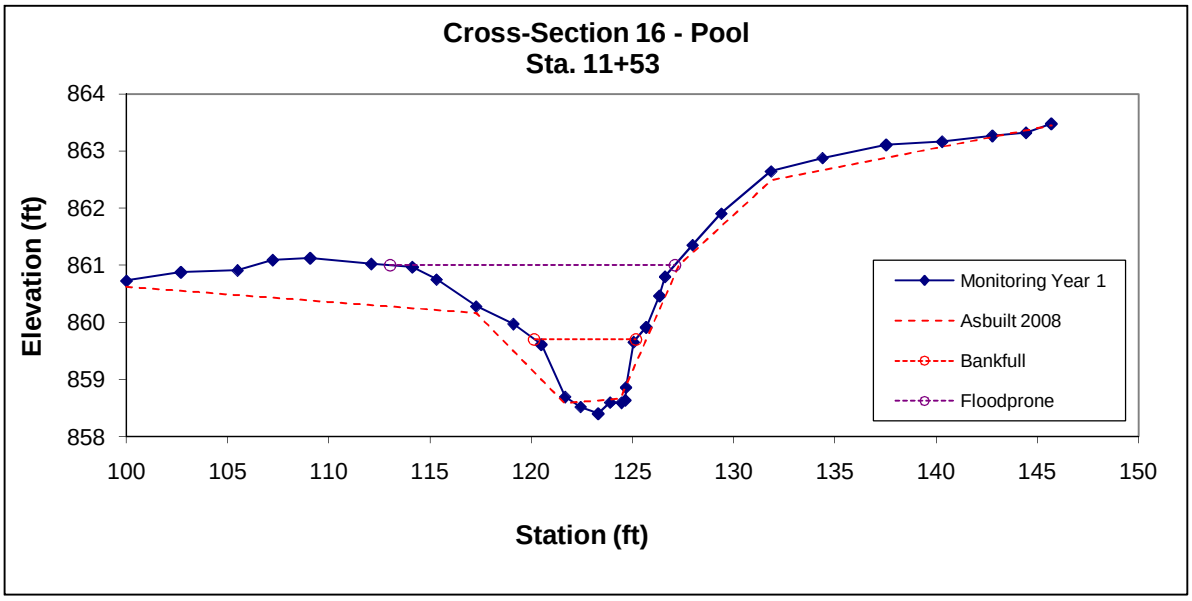
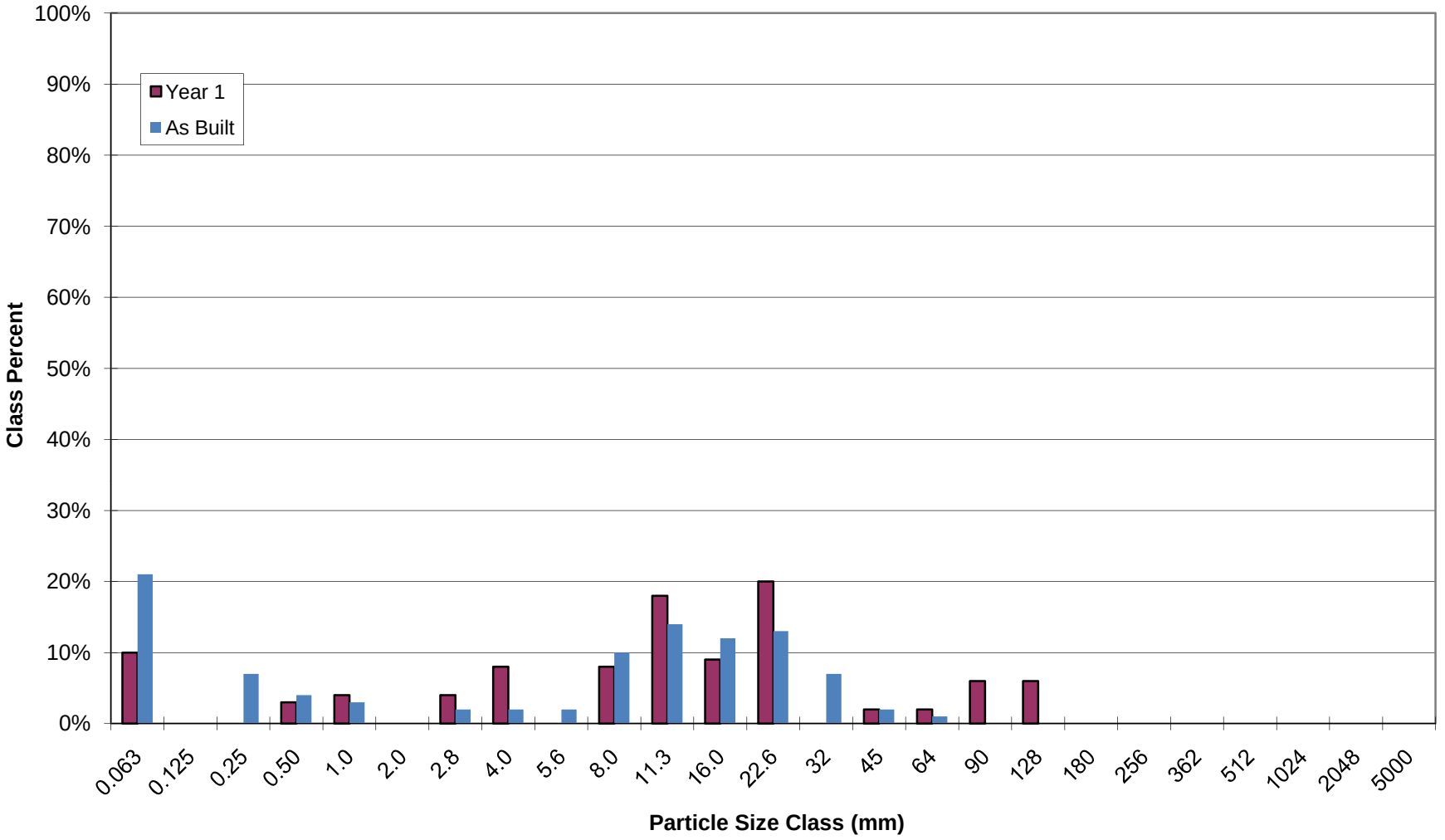


Photo 55: XS-16 facing right bank

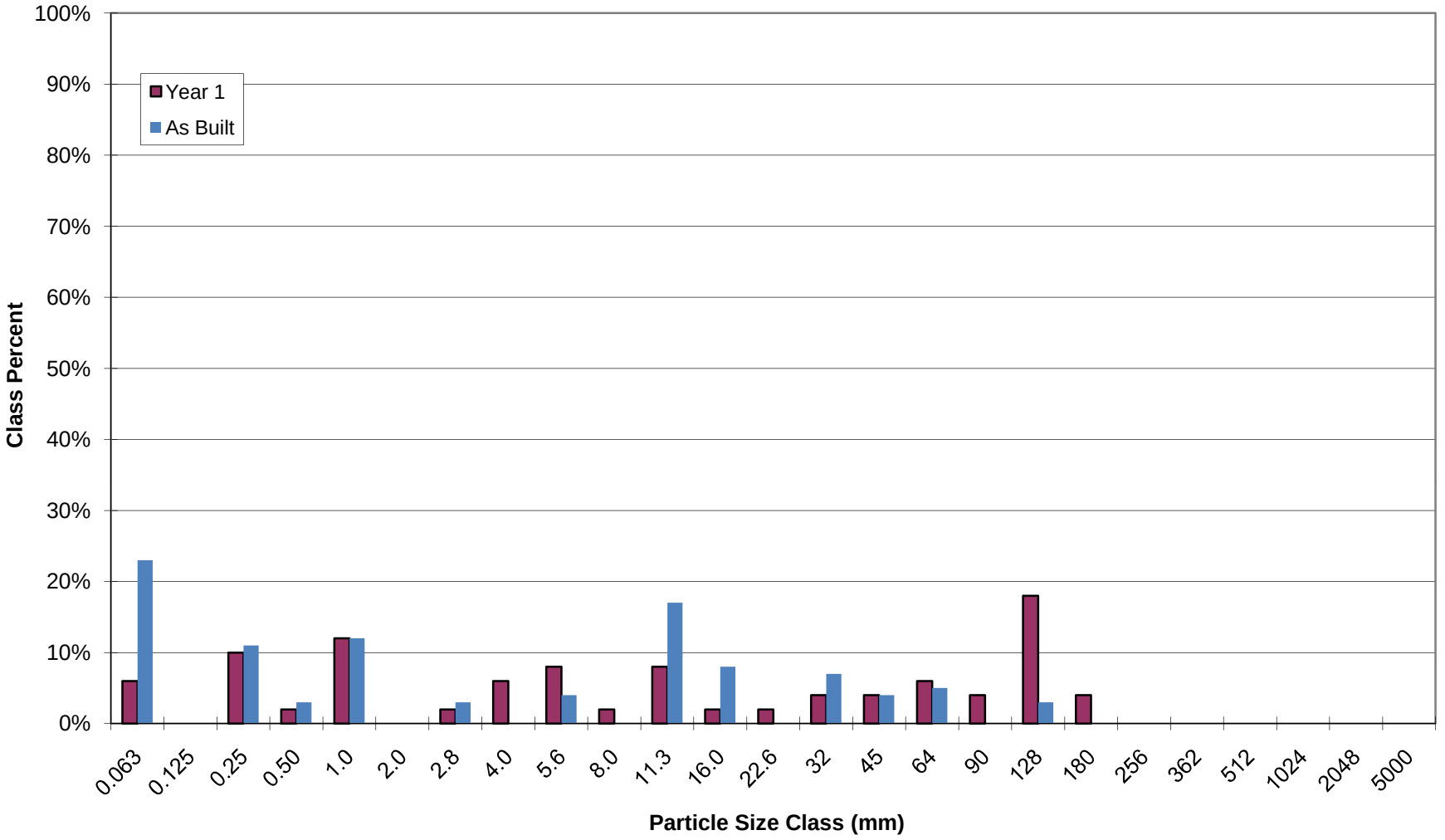
Photo 56: XS-16 facing left bank

Photo 57: XS-16 facing downstream

Blockhouse Creek
Reach 1, upstream of I-26
Riffle Pebble Count Size Class Distribution



Blockhouse Creek
Reach 4, below I-26
Riffle Pebble Count Size Class Distribution



Blockhouse Creek Restoration Project
Photo Log - Photo Points

Notes:

1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All points are marked with a wooden stake and pink flagging tape.

Photo Point 1: facing downstream

Photo Point 2: facing upstream

Photo Point 2: facing downstream

Photo Point 3: facing upstream

Photo Point 3: facing downstream

Photo Point 4: facing downstream

Photo Point 5: facing downstream

Photo Point 6: facing downstream

Photo Point 7: facing downstream

Photo Point 8: facing downstream

Photo Point 9: facing downstream

Photo Point 10: facing downstream

Photo Point 11: facing downstream

Photo Point 12: facing downstream

Photo Point 13: facing downstream

Photo Point 14: facing downstream

Photo Point 15: facing downstream

Photo Point 16: facing downstream

Photo Point 17: facing downstream

Photo Point 18: facing upstream

Photo Point 18: facing downstream

Photo Point 19: facing downstream

Photo Point 20: facing upstream

Photo Point 20: facing downstream

Photo Point 21: facing upstream

Photo Point 21: facing downstream

Photo Point 22: facing upstream

Photo Point 22: facing downstream

Photo Point 23: facing upstream

Photo Point 23: facing downstream

Photo Point 24: facing downstream

Photo Point 25: facing upstream

Photo Point 25: facing downstream

Photo Point 26: facing upstream

Photo Point 26: facing downstream

Photo Point 27: facing downstream

Photo Point 28: facing upstream

Photo Point 28: facing downstream

Photo Point 29: facing downstream

Photo Point 30: facing downstream

Photo Point 31: facing downstream

Photo Point 32: facing upstream

Photo Point 32: facing downstream

Blockhouse Creek Restoration Project: UT1
Photo Log - Photo Points

Notes:

1. Photo point locations are shown on the plan views in the actual location the picture was taken with the exception of the first photo for Point 5. Due to thick vegetation, photo taken at bridge facing downstream to provide a better view of the riffle.
2. All points are marked with a wooden stake and pink flagging tape.

Photo Point 1: facing downstream

Photo Point 2: facing upstream

Photo Point 2: facing downstream

Photo Point 3: facing upstream

Photo Point 3: facing downstream

Photo Point 4: facing downstream

Photo Point 5*: facing downstream from bridge

Photo Point 5: facing downstream

Photo Point 6: facing upstream

Photo Point 6: facing downstream

Blockhouse Creek Restoration Project: UT2
Photo Log - Photo Points

Notes:

1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All points are marked with a wooden stake and pink flagging tape.

Photo Point 1: facing downstream

Photo Point 2: facing downstream

Photo Point 3: facing downstream

Photo Point 4: facing upstream

Photo Point 4: facing downstream

Photo Point 5: facingn downstream

Photo Point 6: facing upstream

Photo Point 6: facing downstream

Photo Point 7: facing upstream

Photo Point7: facing downstream

Photo Point 8: facing upstream

Photo Point 8: facing downstream

Photo Point 9: facing upstream

Photo Point 9: facing downstream

Photo Point 10: facing upstream

Photo Point 10: facing downstream

Photo Point 11: facing downstream

Blockhouse Creek Restoration Project: UT3
Photo Log - Photo Points

Notes:

1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All points are marked with a wooden stake and pink flagging tape.

Photo Point 1: facing upstream

Photo Point 2: facing downstream

Photo Point 3: facing upstream

Photo Point 4: facing downstream

Photo Point 5: facing downstream

Photo Point 6: facing upstream

Photo Point 7: facing upstream

Photo Point 8: facing upstream

Photo Point 9: facing downstream

APPENDIX C. Monitoring Year 1 Plan Set

APPENDIX D. U.S. Army Corps of Engineers Site Review Comments-October 2009

Clemmons, Micky

From: Brown, David W SAW [David.W.Brown@usace.army.mil]
Sent: Monday, November 02, 2009 11:33 AM
To: Clemmons, Micky
Cc: Hair, Sarah E SAW
Subject: Compliance Inspection at Blockhouse Creek Stream Restoration Project Site

02-Nov-09

Baker Engineering NY, Inc.
797 Haywood Road, Suite 201
Asheville, North Carolina 28806

Micky Clemmons,

This e-mail is a follow-up to our conversation this morning pertaining to my compliance inspection on 29-Oct at the Blockhouse Creek Stream Restoration Project site in Polk County. Overall the project site & your work looks good. As mentioned during our conservation, the following items need to be addressed with the property owner (Foothills Equestrian Nature Center):

- Stall shavings & muck from the barns were noted inside the project/easement area. No placement or dumping of debris of any type inside easement area is allowed.

- Several small beaver dams were found in streams near the Barn Office to areas near Show Rings B & A2. It is advised to remove these dams & the beaver(s) during the monitoring period of this project in order to minimize adverse effects(s) this may have on the project.

- There is a small sand bag style dam in the main branch of Blockhouse Creek at the bridge to the show rings. This structure can impair the stream restoration. Though the dam may be outside the easement/project area, the USACE can consider this structure to be an unauthorized activity. The USACE request that the dam be removed.

The USACE looks forward to receiving the 1st year monitoring report in the very near future. If need any additional information or have any questions please contact Liz Hair or me.

David Brown
Regulatory Specialist
Asheville Regulatory Field Office
U.S. Army Corps of Engineers - Wilmington District
151 Patton Avenue, Room 208
Asheville, NC 28801-5006
828-271-7980 ext. 231
david.w.brown@usace.army.mil